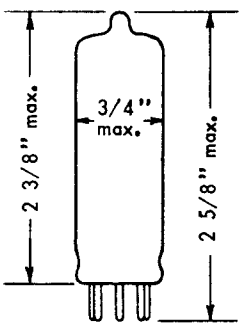
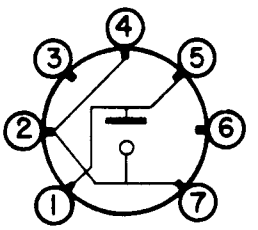
Excellence in Electronics

TYPE 0A2WA

The 0A2WA is a cold cathode, gas-filled diode of miniature construction designed for reliable service as a voltage regulator. It has an operating current range of 5 to 30 milliamperes over which it maintains a substantially constant operating voltage of 150 volts. Three cathode pins are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered.





BOTTOM VIEW

5B0

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Anode	Pin 5 Anode
Pin 2 Cathode	Pin 6 Internal Connection
Pin 3 Internal Connection	Pin 7 Cathode
Pin 4 Cathode	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test - Note 2)	900 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test - Note 3)	2.5 G
Maximum Bulb Temperature	150 °C

MOUNTING POSITION: Any

APPLICATION DATA

A warm up period of 3 minutes should be allowed each time the equipment is turned on in order to insure minimum voltage drift. After this time the bulb temperature should have reached its equilibrium level.

Attention should be given to the specified minimum supply voltage to insure operation in the darkness.

A series resistor must always be used with the 0A2WA. The resistance value must be chosen so the maximum current is not exceeded at the highest anode-supply voltage and so that the minimum current rating is always exceeded at the lowest anode-supply voltage.

When a shunt capacitor is used its maximum value should be limited to 0.1 μf. A larger value may cause the tube to oscillate and thus give unstable performance.

Special attention should be given to the bulb temperature of the tubes. Reliability will be severely impaired if the maximum bulb temperature is exceeded.

Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

ELECTRICAL DATA

Ratings:	Ebb Vdc:	Total Darkness Ionization Voltage Vdc:	Ambient Light Ionization Voltage Vdc:	Operating Voltage Vdc:	Operating Current Range mAdc (Note 4)	Bulb Temperature °C (Note 4)	Ambient Temperature °C (Note 4)
Design Maximum:	----	----	----	158	30	+150	----
Minimum:	----	165	165	140	5	----	–55

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	AVG.	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS – PART 1			**(Combined AQL = 1.0% excluding Mechanical and Inoperatives)**							
Ionization Voltage (1):	Rp/Ib = 5 – 30 mAdc Ambient Light	0.4	(1) Ez:	----	----	152	----	165	----	Vdc
Tube Voltage Drop (1):	Rp/Ib = 30 mAdc	0.4	(1) Etd:	144	----	150.6	----	153	----	Vdc
Tube Voltage Drop (2):	Rp/Ib = 5 mAdc	0.4	(2) Etd:	144	----	149	----	153	----	Vdc
Regulation:	(1) Etd – (2) Etd	0.4	Reg.:	----	----	----	----	± 5.0	----	Vdc
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope 6 – 5	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS – PART 2										
Noise:	Rp/Ib = 30 mAdc; RL = 500 ohms	1.0	Eb:	----	----	≤1.0	----	5.0	----	mVac
Oscillation:	Esig = 100 mVac; Rp/Ib = 5 – 30 mAdc; RL = 500 ohms	1.0	----	----	----	----	----	----	----	----
Voltage Jump:	Rp/Ib = 5 – 30 mAdc. (Note 6)	2.5	Jump:	----	----	<100	----	600	----	mVdc
Ionization Voltage (2):	Rp/Ib = 5 – 30 mAdc; Total Darkness (Note 5)	2.5	(2) Ez:	----	----	156	----	165	----	Vdc
Leakage:	Eb = 50 Vdc; Rp = 3000 ohms	2.5	Llb:	----	----	<1	----	5	----	μAdc
Tube Voltage Drop (3):	Rp/Ib = 20 mAdc	2.5	(3) Etd:	144	----	149.8	----	153	----	Vdc
Repeatability:	Rp/Ib = 10 mAdc; 1 min. on; 1 min off. (Note 8)	2.5	Δ Etd:	----	----	300	----	600	----	mVdc
Low Pressure Voltage Breakdown:	Pressure = 3.1 ± 0.2 mmHg; Ebb = 200 Vdc; Rp/Ib = 20 mAdc	6.5	----	----	----	----	----	----	----	----
Vibration (2):	Rp = 10,000 ohms; Ebb/Ib = 20 mAdc; F = 25 cps; G = 2.5	2.5	Ep:	----	----	<10	----	100	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle = 60°; (Note 2)	20	----	----	----	----	----	----	----	----
Fatigue:	G = 2.5; Fixed Frequency F = 25 min., 60 max. (Note 3)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F = 25 cps; G = 2.5; Ebb/Ib = 20 mAdc; Rp = 10,000 ohms	----	Ep:	----	----	----	----	100	----	mVac
Ionization Voltage (1):	Rp/Ib = 5 – 30 mAdc	----	(1) Ez:	----	----	----	----	165	----	Vdc
Tube Voltage Drop (1):	Rp/Ib = 30 mAdc	----	(1) Etd:	142	----	----	----	155	----	Vdc
Tube Voltage Drop (2):	Rp/Ib = 5 mAdc	----	(2) Etd:	142	----	----	----	155	----	Vdc
Regulation:	(1) Etd – (2) Etd	----	Reg.:	----	----	1.5	----	5.0	----	Vdc
Miniature Base Strain Test:		----	----	----	----	----	----	----	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	AVG.	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS									
1 Hour Stability Life Test:	TA= Room; Rp/Ib= 20 mAdc	1.0	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical Sample Size= 50 tubes)	----	----	----	----	----	----		
Change in Tube Voltage Drop (3) of individual tubes:	(Note 7)	----	Δ_t (3) Etd:	----	----	2.0	Vdc		
100 Hour Survival Rate Life Test:	TA= Room; Rp/Ib= 20 mAdc	----	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size = 200 tubes)	----	----	----	----	----	----		
Continuity and Shorts (Inoperatives):		0.65	----	----	----	----	----		
Change in Tube Voltage Drop (3) of individual tubes:	(Note 7)	1.0	Δ_t (3) Etd:	----	----	5.0	Vdc		
Intermittent High Temperature Life Test:	T Bulb= 150°C Rp/Ib= 20 mAdc	----	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	----	1	3
Regulations:		----	Reg.:	----	1.8	6.0	Vdc	1	3
Tube Voltage Drop (1):		----	(1) Etd:	142	150	155	Vdc	1	3
Tube Voltage Drop (2):		----	(2) Etd:	142	148	155	Vdc	1	3
Tube Voltage Drop (3):		----	(3) Etd:	142	149	155	Vdc	1	3
Change in Tube Voltage Drop (3) of individual tubes:	(Note 7)	----	Δ_t (3) Etd:	----	1.0	6.0	Vdc	1	3
Ionization Voltage (1):		----	(1) EZ:	----	151	165	Vdc	1	3
Total Defectives:		----	----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	----	2	4
Regulations:		----	Reg.:	----	2.0	8.0	Vdc	2	4
Tube Voltage Drop (1):		----	(1) Etd:	140	149.7	158	Vdc	2	4
Tube Voltage Drop (2):		----	(2) Etd:	140	147.8	158	Vdc	2	4
Tube Voltage Drop (3):		----	(3) Etd:	140	149.5	158	Vdc	2	4
Change in Tube Voltage Drop (3) of individual tubes:	(Note 7)	----	Δ_t (3) Etd:	----	1.2	8.0	Vdc	2	4
Ionization Voltage (1):		----	(1) EZ:	----	151	165	----	2	4
Total Defectives:		----	----	----	----	----	----	5	10

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test conditions and acceptance criteria per Shock test procedures of MIL-E-1 basic specifications.

ELECTRICAL DATA (Cont'd.)

NOTES (Cont'd.)

Note 3: Test Conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 4: Limits beyond which normal tube performance and tube life may be impaired.

Note 5: This test conducted in total darkness after tubes have been held in darkness for 24 hours.

Note 6: The current shall be varied from 5 to 30 mA and back to 5 mA (by adjusting R or Ebb slowly). Sudden voltage jumps registered on an oscilloscope shall not be greater than 600 millivolts.

Note 7: Δ_t Tube Voltage drop is the change in tube voltage drop from its value at the beginning of life to that at the life hour specified. This applies to individual tubes.

Note 8: Repeatability shall be defined as the maximum shift in tube voltage drop between any two firings of the tube. The test shall be made in the following manner. The tube voltage drop shall be read at 10 mA drain at the end of the specified "on" time. The tube is then turned off for the specified "off" time. The tube is restarted and operated at the same current. The voltage drop is read after the specified on time. The on-off cycle must be repeated a minimum of 5 times. The maximum difference in tube voltage drop shall be taken as the measure of repeatability.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

OB2WA

RELIABLE MINIATURE VOLTAGE REGULATOR

The OB2WA is a cold cathode, gas–filled diode of miniature construction designed for service as a voltage regulator. It has an operating current range of 5 to 30 milliamperes over which it maintains a substantially constant operating voltage of 108 volts. Three cathode pins are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration	900	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	150	°C
Altitude	120,000	Ft.

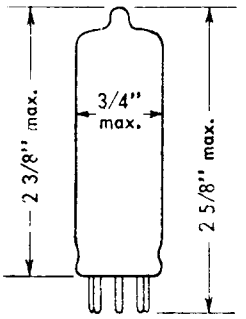
ELECTRICAL DATA

Ratings and Normal Operation	MIL–E–1 Symbol	Absolute Minimum	Normal Operation	Normal Test Conditions	Absolute Maximum	MIL–E–1 Units
Supply Voltage	---	130	---	---	---	Vdc
Ionization Voltage (Total Darkness)	Ez	---	123	---	130	Vdc
Ionization Voltage (5–50 ft. Candles)	Ez	---	118	---	130	Vdc
Current Range	I_b	5	---	---	30	mAdc
Tube Voltage Drop (30 mAdc)	E_{td}	105	109	---	111	Vdc
Tube Voltage Drop (20 mAdc)	E_{td}	105	108.5	---	111	Vdc
Tube Voltage Drop (5 mAdc)	E_{td}	105	108	---	111	Vdc
Regulation (5–30 mAdc)	---	---	±1	---	±2.5	Vdc
Noise (30 mAdc)	---	---	<1	---	5	mVac
Voltage Jump (6–10 mAdc)	---	---	<10	---	100	mVdc
Repeatability (10 mAdc)	---	---	300	---	600	mVdc
Leakage	---	---	<1	---	5	μAdc
Vibration	---	--	<10	---	100	mVac

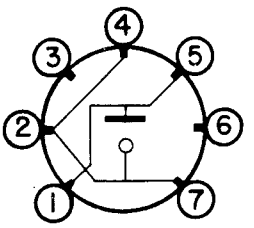
MECHANICAL DATA

ENVELOPE.....Glass T5½
OUTLINE.....JEDEC (6–5)
BASE...7 Pin Miniature (E7–1)
BASING..... 5B0
CATHODE..... Glow Discharge
MOUNTING POSITION.....Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Lead 1 Anode
Lead 2 Cathode
Lead 3 Internal Connection
Lead 4 Cathode
Lead 5 Anode
Lead 6 Internal Connection
Lead 7 Cathode

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test –	900 G. 60° hammer angle in Navy High Impact Shock Machine. Sample subjected to five impact accelerations in each of four different positions.
Fatigue Test –	2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.
Glass Strain –	A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100° C for 15 seconds and immediately immersed in water at not more than 5° C. The sample is then dried at room temperature for 48 hours.
Stability Life Test –	Sample is operated for one hour to evaluate mechanical inoperatives and initial electrical stability ($\Delta E_{td} < 2.0$ Vdc max.).
Survival Rate Life Test –	Sample is operated one hundred hours to evaluate mechanical inoperatives and early life electrical stability ($\Delta E_{td} < 3.0$ Vdc max.)
Intermittent Life Test –	1000 hours. Sample is operated with minimum Envelope Temperature of 150° C.
Altitude –	Sample is subjected to pressure of 3.1 ± 0.2 mm Hg to evaluate flashover or corona at the press of the tube.

APPLICATION NOTES

Attention should be given to the specified minimum supply voltage to insure operation in darkness.

A series resistor must always be used with the OB2WA. The resistance value must be chosen so the maximum current is not exceeded at the highest anode supply voltage and so that the minimum current rating is always exceeded at the lowest anode supply voltage.

When a shunt capacitor is used its maximum value should be limited to 0.1 μf. A large value may cause the tube to oscillate and this results in unstable performance.

Special attention should be given to the envelope temperature of the tubes. Reliability may be severely impaired if the maximum envelope temperature is exceeded.

Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperature without drawing current.

To insure minimum voltage drift, a warm–up period of 3 minutes should be allowed each time the equipment is turned on. After this time the bulb temperature should have reached equilibrium level.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS					
						Min	Lal	Typical	Ual	Max	Units
QUALIFICATION APPROVAL TESTS											
3.1	Qualification Approval:	Required for JAN Marking	---	---	---	---	---	---	---	---	---
---	Cathode	Glow Discharge	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	E7-1	---	---	---	---	---	---	---	---	---
4.9.20.3	Vibration (1):	Rp = 10,000; Ebb/Ib = 20 mAdc	---	---	Ep	---	---	< 10	---	100	mVac
MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 1											
4.13.1	x Ionization Voltage(1):	Ebb/ = 5-30 mAdc; Illumination = 5-50 ft candles	0.25	II	Ez	---	---	118	---	130	Vdc
4.13.2	Tube Voltage Drop (1)	Ebb/Ib = 30 mAdc	0.25	II	Etd	105	---	109	---	111	Vdc
4.13.2	Tube Voltage Drop (2)	Ebb/Ib = 5 mAdc	0.25	II	Etd	105	---	108	---	111	Vdc
4.13.2.1	Regulation:	(1) Etd-(2)(Etd)	0.25	II	Reg.	---	---	± 1	---	± 2.5	Vdc
4.7.5	Continuity and Shorts (Inoperatives)		0.25	II	---	---	---	---	---	---	---
4.9.1	Mechanical production tests	Envelope Outline No 6-5	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TEST, PART 2											
4.13.4.3	Noise test	Ebb/Ib = 30 mAdc	1.0	I	Eb:	---	---	< 1	---	5	mVac
4.13.4.2	Oscillation test	Esig = 100 mVac; Ebb/Ib = 5-30 mAdc	1.0	I	---	---	---	---	---	---	---
---	Voltage Jump	Ebb/Ib = 6-10 mAdc; Note 2	2.5	Code G	Jump	---	---	< 10	---	100	mVdc
4.13.1	Ionization Voltage (2):	Note 3	2.5	Code G	Ez	---	---	123	---	130	Vdc
4.13.3	Leakage Current	Eb = 50 Vdc; Rp = 3000	2.5	Code G	Llb	---	---	< 1	---	5	μAdc
4.13.2	Tube Voltage Drop (3)	Ebb/Ib = 20 mAdc	2.5	Code G	Etd	105	---	108	---	111	Vdc
---	Repeatability	Ebb/Ib = 10 mAdc; Note 4	2.5	Code G	Etd	---	---	300	---	600	mVdc
---	Low Pressure Voltage Breakdown:	Note 5	6.5	Note 6	---	---	---	---	---	---	---
4.9.19.1	Vibration (2)	Rp = 10,000; Ebb/Ib = 20 mAdc	2.5	Code G	Ep	---	---	< 10	---	100	mVac
DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7											
4.9.20.5	Shock test	Hammer Angle = 60°	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G=2.5; Fixed Freq.; F=25 min., 60 max.	2.5	Note 6	---	---	---	---	---	---	---
---	Post Shock and Fatigue Test End Points:	Vibration (2)	---	---	Ez	---	---	---	---	100	mVac
		Ionization Voltage (1)	---	---	Ez	---	---	122	---	130	Vdc
		Tube Voltage Drop (1)	---	---	Etd	103	---	109	---	113	Vdc
		Tube Voltage Drop (2)	---	---	Etd	103	---	108	---	113	Vdc
		Regulation	---	---	Reg	---	---	1	---	± 3	Vdc

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS					Units
						Min	Lal	Typical	Ual	Max	
4.9.6.1	Miniature Tube Base Strain:		---	---	---	---	---	---	---	---	---
----	Glass Strain	Note 8	2.5	I	---	---	---	---	---	---	---

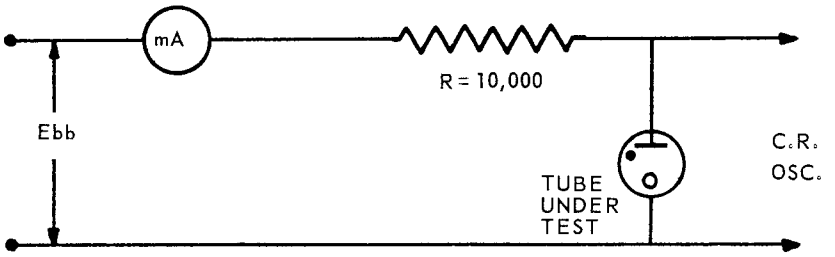
MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS		Units
					1st sample	Combined sample		Min	Max	
ACCEPTANCE LIFE TESTS, NOTE 7										
4.11.3.1	Stability Life Test (1 hour)	Ebb/Ib=20 mAdc; TA=Room; Note 9	1.0	Code I	---	---	---	---	---	---
4.11.4	Stability Life Test End Points	Change in Tube Voltage Drop (3) of individual tubes	---	---	---	---	Δ_t Etd	---	2	Vdc
4.11.3.1	Survival Rate Life Test (100 hours)	Stability Life Test Conditions or Equivalent, Note 10	---	II	---	---	---	---	---	---
4.11.4	Survival Rate Life Test End Points	Continuity and Shorts (Inoperatives)	0 65	---	---	---	---	---	---	---
		Change in Tube Voltage Drop (3) of individual tubes	1.0	---	---	---	Δ_t Etd	---	3	Vdc

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typical	Max.	
4.11.5	Intermittent Life Test	Stability Life Test Conditions or Equivalent; T Envelope=150 °C min.; Notes 11, 12	---	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points (500 hours)	Note 13 Inoperatives; Note 14	---	---	1	3	---	---	---	---	---
		Regulation	---	---	1	3	Reg	---	± 1.0	± 3	Vdc
		Tube Voltage Drop (1)	---	---	1	3	Etd	103	109	113	Vdc
		Tube Voltage Drop (2)	---	---	1	3	Etd	103	108.5	113	Vdc
		Tube Voltage Drop (3)	---	---	1	3	Etd	103	108	113	Vdc
		Change in Tube Voltage Drop (3) of individual tubes	---	---	1	3	Δ_t Etd	---	---	4.0	Vdc
		Ionization Voltage (1)	---	---	1	3	Ez	---	---	130	Vdc
		Total Defectives	---	---	4	8	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typ-ical	Max	
4.11.4	Intermittent Life Test End Points (1000 hours)	Note 13 Inoperatives; Note 14	---	---	2	5	---	---	---	---	---
		Regulation	---	---	2	5	Reg	---	±1.0	±4	Vdc
		Tube Voltage Drop (1)	---	---	2	5	Etd	103	109	116	Vdc
		Tube Voltage Drop (2)	---	---	2	5	Etd	103	108.5	116	Vdc
		Tube Voltage Drop (3)	---	---	2	5	Etd	103	108	116	Vdc
		Change in Tube Voltage Drop (3) of individual tubes	---	---	2	5	Δ_tEtd	---	---	5.0	Vdc
		Ionization Voltage (1)	---	---	2	5	Ez	---	122	130	Vdc
		Total Defectives	---	---	5	10	---	---	---	---	
	PACKAGING REQUIREMENTS										
4.9.18.1.4	Container Drop:	(d) Package Group 1; Container Size C									

Note 1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical, shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 2: Vary current from 6 mAdc to 10 mAdc and back (by adjusting Ebb slowly). Sudden voltage jumps registered on the oscilloscope shall be not greater than the specified value.



Note 3: Conditions for this test shall be those of Ionization Voltage (1) except testing shall be done in total darkness and the tube shall not have conducted or been exposed to light for at least 24 hours prior to testing. The tube shall fire within 20 seconds maximum.

Note 4: The tube shall be tested in the following manner.

a. The voltage drop shall be read at 10 mAdc drain.
b. The tube shall be turned off for one (1) minute.
c. The tube shall be re-started and operated at the same current.
d. Etd shall be read after one (1) minute of operation.
e. The on-off cycle shall be repeated a minimum of five (5) times. The maximum difference in tube voltage drop shall be taken as the measure of repeatability.

Note 5: Place tube under test in a Bell jar with pressure maintained at 3.1 ± 0.2 mm Hg. Apply a potential of 200 Vdc to the Vdc to the K and A terminals through a variable series resistor. Adjust resistor to give a current of 20.0 mAdc. There shall be no evidence of flashover or corona at the pins of the tube.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30–day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL–STD–105, sample size code letter F shall apply.

Note 7: Destructive Tests:

Tubes subject to the following destructive tests are not to be accepted under this specification.

4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.5	Intermittent Life Test

Note 8: Glass strain procedures — All tubes subjected to this test shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperatures. The entire tube shall be immersed in water at not less than 97 °C for 15 seconds and immediately thereafter immersed in water at not more than 5 °C for 5 seconds. The volume of water shall be large enough that the water temperature will not be appreciably affected by the test. The holder shall be in accordance with Drawing #245–JAN, and the tubes shall be immersed quickly. The tubes shall be so placed in the water that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5–second submersion period the tubes shall be removed and allowed to return to room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks (see 4.7.6). Electrical rejects, other than inoperatives, may be used in the performance of this test.

Note 9: *Stability life test.* See 20.2.5.1 of Appendix C.

Note 10: *Survival–rate life test.* See 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 11: *Intermittent life tests.* See 20.2.5.3 of Appendix C.

Note 12: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or small diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope.

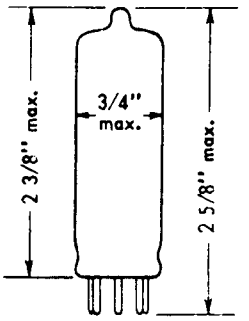
Note 13: *Order for evaluation of life–test defects.* See 4.11.3.1.2.

Note 14: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: discontinuity (see 4.7.1), shorts (see 4.7.2) air leaks (see 4.7.6).

Excellence in Electronics

TYPE OC2

The OC2 is a cold cathode, gas-filled diode of miniature construction designed for use as a voltage regulator. It has an operating current range of 5 to 30 milliamperes over which it maintains a substantially constant operating voltage of 75 volts. Three cathode pins are provided which may be used to disconnect the load when the tube is removed from the socket.



MECHANICAL DATA

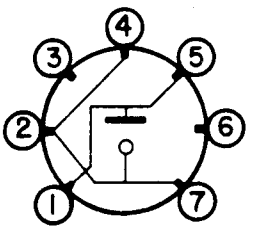
ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Anode
Pin 2 Cathode
Pin 3 Internal Connection (Do not use)
Pin 4 Cathode
Pin 5 Anode
Pin 6 Internal Connection (Do not use)
Pin 7 Cathode

MOUNTING POSITION: Any



BOTTOM VIEW
5B0

ELECTRICAL DATA

CAUTION—To Electronic Equipment Design Engineers: Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expenctancy may be reduced if conditions more severe than those specified for life test are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL OPERATION	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Total Darkness Starting Voltage:	Ez:	145	----	----	Vdc
Ambient Light Starting Voltage:	Ez:	115	----	----	Vdc
Operating Current Range:	Ib:	5	----	30	mAdc
Operating Voltage Range:	Etd:	68	75	83	Vdc
Bulb Temperature:	T-Bulb	–55	----	150	°C
Regulation:	Reg:	----	3	4.5	Vdc
Starting Current: ▲	Iz	----	----	75	ma.
Ambient Temperature:	TA	–55	----	90	°C
Anode Supply Voltage:	Ebb	115	----	----	Vdc
Series Resistor ♦	----	----	----	----	----
Shunt Capacitor:	Cs	----	----	0.1	μfd.

▲ *Averaged over starting period not exceeding 10 seconds.*

♦ *Sufficient resistance must always be used in series with the OC2, to limit the current through the tube. The value of the series resistor is dependent on the maximum anode supply voltage and the ratio of the current through the load to the operating current of the OC2, and should be chosen to limit the operating current through the tube to 30 ma. at all times after the starting period.*

Tentative Data

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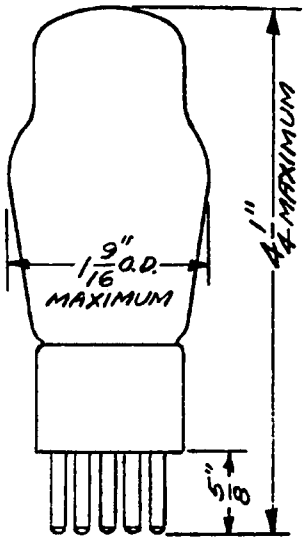
OZ3

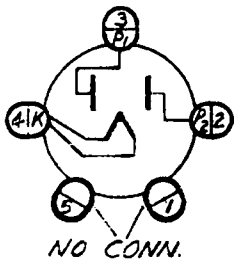
CHARACTERISTIC DATA SHEET
RAYTHEON 4-PILLAR TUBE

- - - - - - - - - - - - - - -

FULL WAVE GAS FILLED RECTIFIER
(Ionic Heated Cathode Type)

- - - - -





VIEW LOOKING ON TOP OF SOCKET

HEATER RATING

No heater supply required.

OPERATING CONDITIONS and CHARACTERISTICS

DC Voltage Output	300 max.	Volts
DC Output Current	30 min.	m.a.
	75 max.	m.a.
Peak Plate Current	200 max.	m.a.
Starting Voltage	300 min.	Volts
Voltage Drop (Dynamic)	24 avg.	Volts

The OZ3 was developed primarily for use in vibrator type B-supply units for automobile receivers. It has the typical characteristics of all gas-filled rectifiers as regards a constant drop and ability to handle peak currents and a tendency to generate rf noise. The rf noise may be eliminated by proper shielding and filtering. The shielding and filtering commonly used to eliminate vibrator noise will usually be sufficient.

The OZ3 is filled with a permanent gas rather than a vapor filling. The tube characteristics are independent of the surrounding temperature.

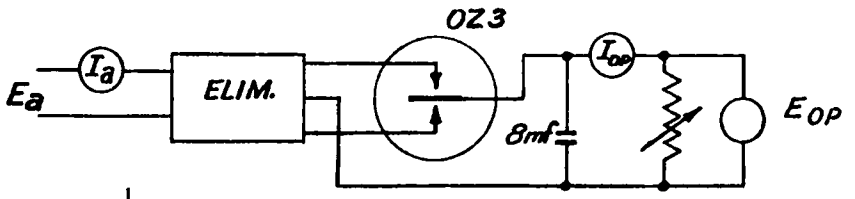
RAYTHEON ENGINEERING SERVICE

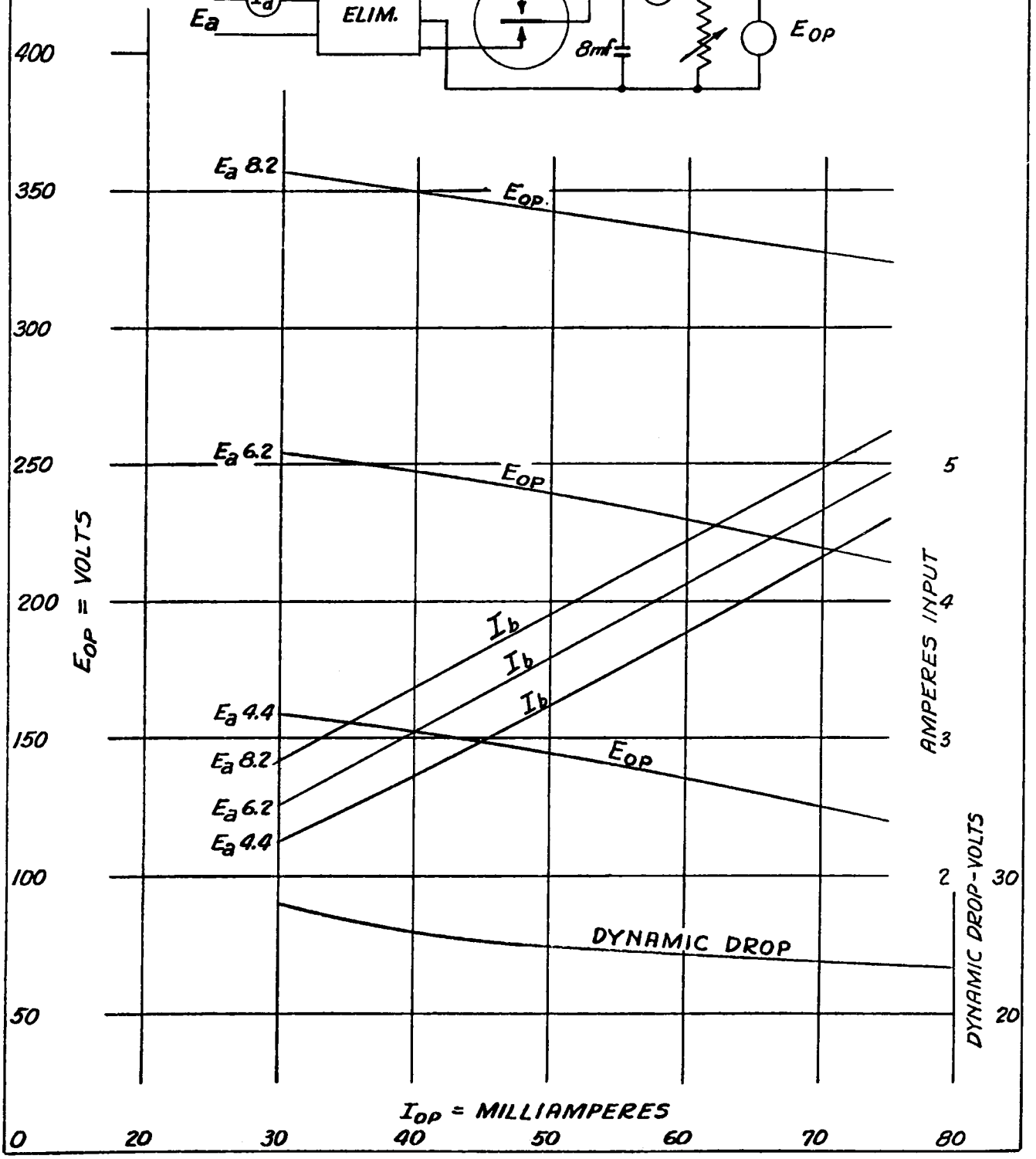
June 7, 1935 OS-1067

from RMA release #31, June 17, 1935

RAYTHEON ENGINEERING SERVICE

0Z3 OPERATING CHARACTERISTICS IN TYPICAL VIBRATOR ELIMINATOR





6-6-35

GAS-FILLED DOUBLE DIODE

TYPE 0Z4A/1003

Excellence in Electronics

The 0Z4A/1003 is a gas-filled, double diode employing an ionic-heated cathode. Its principal application is as a full-wave power rectifier in equipment with vibrator type power supplies.

MECHANICAL DATA

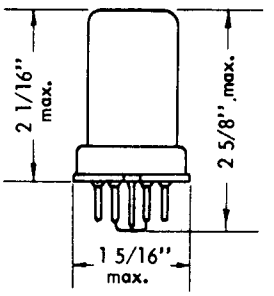
ENVELOPE: MT-8 Metal

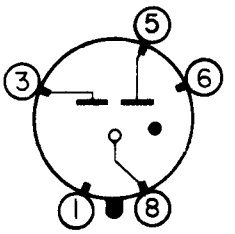
BASE: Small Wafer Octal 5-Pin

TERMINAL CONNECTIONS:

Pin 1 Shell	Pin 6 No Connection
Pin 3 Plate #2	Pin 8 Cathode
Pin 5 Plate #1	

MOUNTING POSITION: Any





BOTTOM VIEW

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Max. Peak Inverse Plate Voltage	880	volts
Max. Peak Plate Current	330	ma.
Absolute Min. Peak Starting Voltage, per Plate (Full-Wave)	300	volts
Max. DC Output Current	110	ma.
Absolute Min. DC Output Current ●	30	ma.
Min. Total Effective Plate Supply Impedance, per Plate ♦	300	ohms

CHARACTERISTICS AND TYPICAL OPERATION - VIBRATOR OPERATION - FULL-WAVE

Peak Plate Voltage, per Plate ▲	440	volts
Filter Input Condenser	8	μf
Total Effective Plate Supply Impedance, per Plate ♦	600	ohms
Average Dynamic Voltage Drop	24	volts
DC Output Current	100	ma.
DC Output Voltage	310	volts

● *Under no circumstances should the tube be operated with less than 30 ma. of cathode current.*

▲ *Open Circuit Voltage - flat portion of transformer voltage wave.*

♦ *Including vibrator, transformer and wiring.*

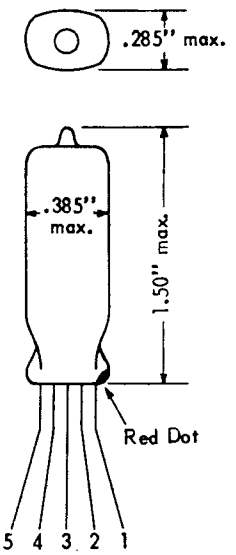
4R

Tentative Data

Excellence in Electronics

TYPE 1AD4

The 1AD4 is a filament type, fully-shielded sharp cutoff pentode of subminiature construction designed for RF and AF applications in portable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ♦

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate
Lead 2 Grid #2
Lead 3 Negative Filament, Grid #3 Shield ▲
Lead 4 Grid #1
Lead 5 Positive Filament, Grid #3▲

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)*

Grid #1 to Plate	0.01 max.
Input	4.0
Output	4.0

RATINGS-ABSOLUTE MAXIMUM VALUES: ■

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	100 volts
Grid #2 Voltage	100 volts
Plate Dissipation	0.3 watt
Grid #2 Dissipation	0.1 watt
Total Cathode Current	5.5 ma.

CHARACTERISTICS AND TYPICAL OPERATION-CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	0.10 amps.
Plate Voltage	45 volts
Grid #2 Voltage	45 volts
Grid #1 Voltage ●	0 volts
Plate Resistance (approx.)	0.5 meg.
Transconductance	2000 μmhos
Plate Current	3.0 ma.
Grid #2 Current	0.9 ma.
Grid #1 Voltage (approx.) for Gm=10 μmhos	-3.5 volts

♦ *Bulb is entirely coated with a metallic shield connected to lead 3.*

▲ *Grid #3 is composed of two deflector plates, one being connected to lead 3 and the other to lead 5.*

■ *MIL-E-1B paragraphs 3.5.1.1 and 3.5.1.2, permitting maximum plate and screen voltage ratings to be exceeded, shall not apply.*

● *Grid #1 resistor=2 megohms.*

Tentative Data

Printed in U.S.A.

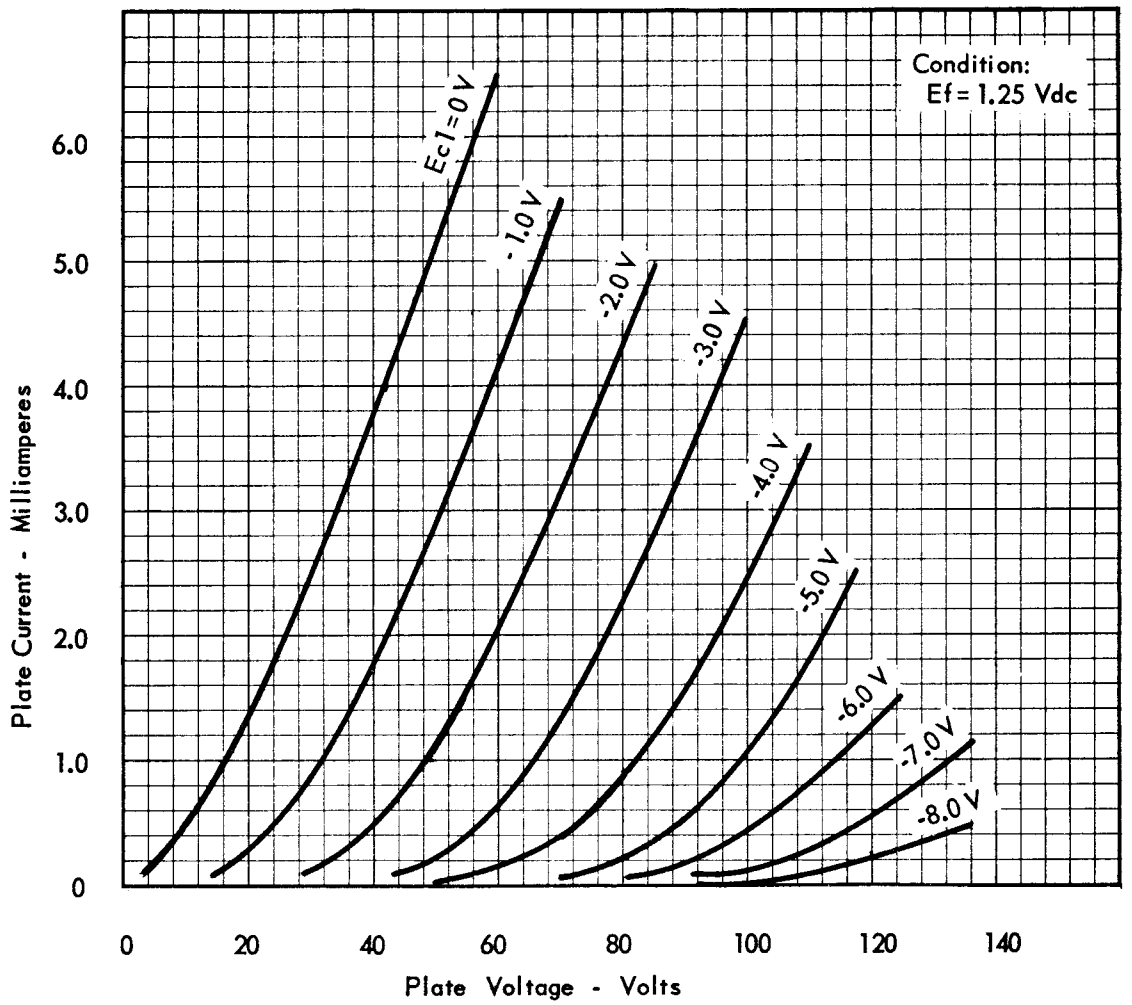
RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

November 9, 1954 NEWTON 58, MASS.

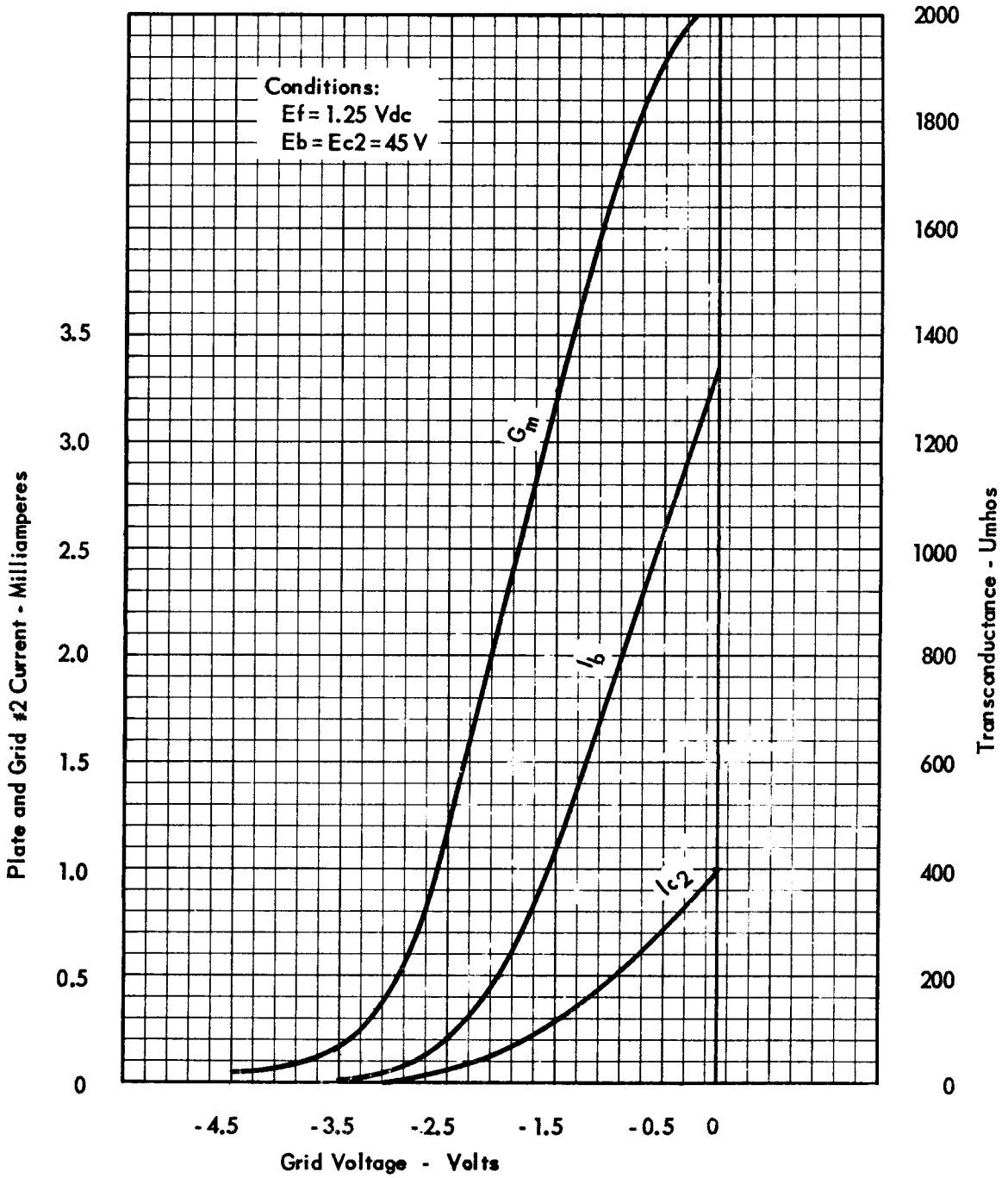
AVERAGE PLATE CHARACTERISTICS

Triode Connected



SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS

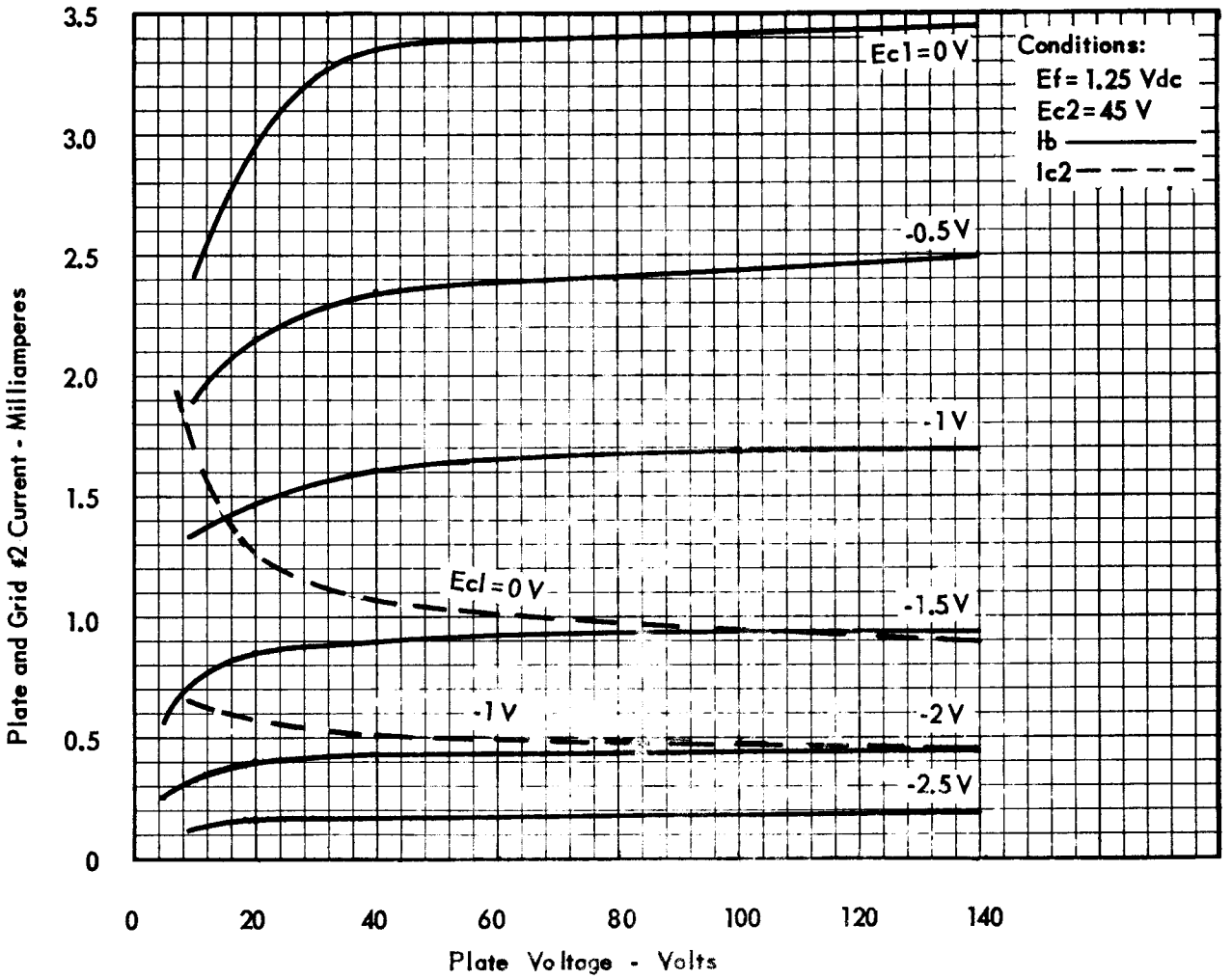


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SUBMINIATURE PENTODE

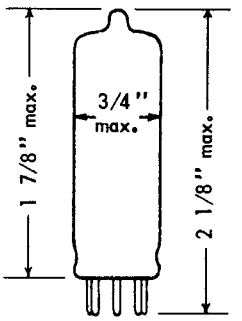
AVERAGE PLATE CHARACTERISTICS

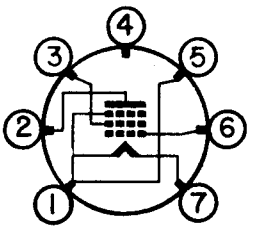


TYPE 1AE4

Excellence in Electronics

The 1AE4 is a filament type sharp cut–off pentode of miniature construction designed for RF applications in portable equipment.





BOTTOM VIEW

6AR

MECHANICAL DATA

ENVELOPE: T–5½ Glass

BASE: Miniature Button 7–Pin

TERMINAL CONNECTIONS:

Pin 1 Negative Filament and Grid #3	Pin 4 No Connection
Pin 2 Plate	Pin 5 Negative Filament, Grid #3
Pin 3 Grid #2	Pin 6 Grid #1
	Pin 7 Positive Filament

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) *

Grid #1 to Plate	0.008	max.
Input	3.6	
Output	4.4	

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.25±15%	volts
Plate Voltage	90	volts
Grid #2 Voltage	90	volts
Grid #1 Voltage		
Negative–Bias Value	50	volts
Positive–Bias Value	0	volts
Total Cathode Current	11	ma.

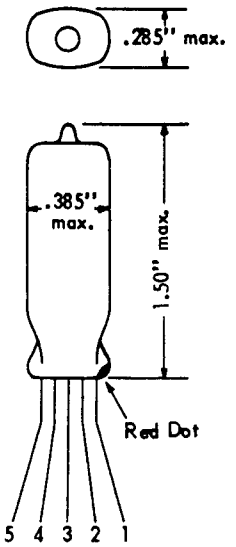
CHARACTERISTICS AND TYPICAL OPERATION–CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25±15%	volts
Filament Current	0.1	amps.
Plate Voltage	90	volts
Grid #2 Voltage	90	volts
Grid #1 Voltage	0	volts
Plate Resistance	0.5	meg.
Transconductance	1550	μmhos
Plate Current	3.5	ma.
Grid #2 Current	1.2	ma.
Grid #1 Voltage (approx. for Ib=50 μa.)	–5	volts

* *With external Shield #316.*

TYPE 1AG4

The 1AG4 is a filament type power pentode of subminiature construction designed for use in the output stage in battery operated receivers. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Negative; Grid #3 ●
Lead 3 Filament, Positive; Grid #3 ●	

MOUNTING POSITION: Any

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.25 volts
Plate Voltage	90 volts
Grid #2 Voltage	90 volts
Cathode Current (Zero Signal)	4 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

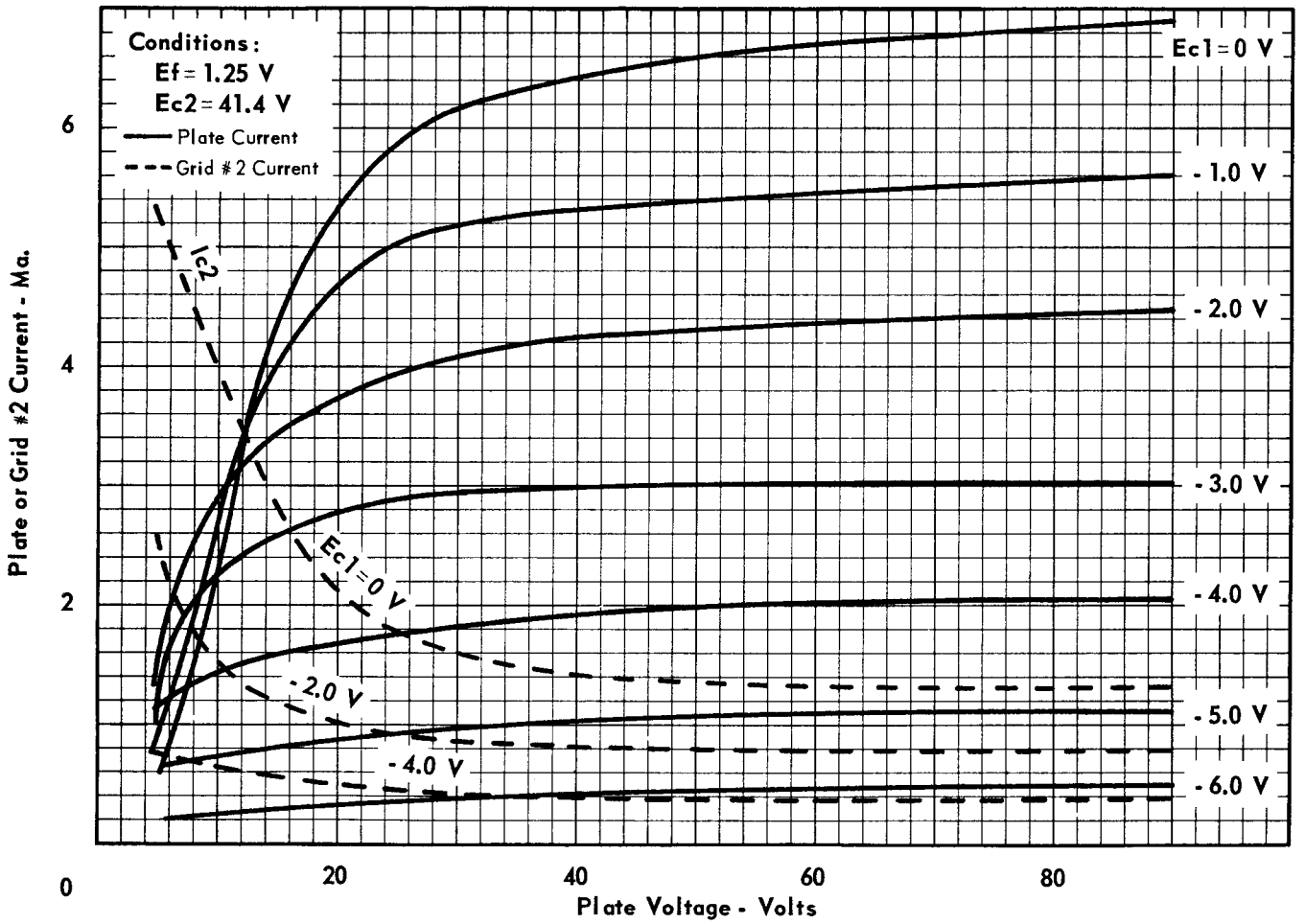
Filament Voltage (dc)	1.25 volts
Filament Current	40 ma.
Plate Voltage	41.4 volts
Grid #2 Voltage	41.4 volts
Grid #1 Voltage	-3.6 volts
Peak AF Grid #1 Voltage	3.6 volts
Plate Resistance	.18 megohms
Transconductance	1000 μmhos
Zero-Signal Plate Current	2.4 ma.
Zero-Signal Grid #2 Current	0.6 ma.
Load Resistance	12,000 ohms
Total Harmonic Distortion (approx.)	12 percent
Power Output	35 mw.

● *Grid #3 is composed of two separate deflector plates, one of which is connected to Lead 3 and the other to Lead 5.*

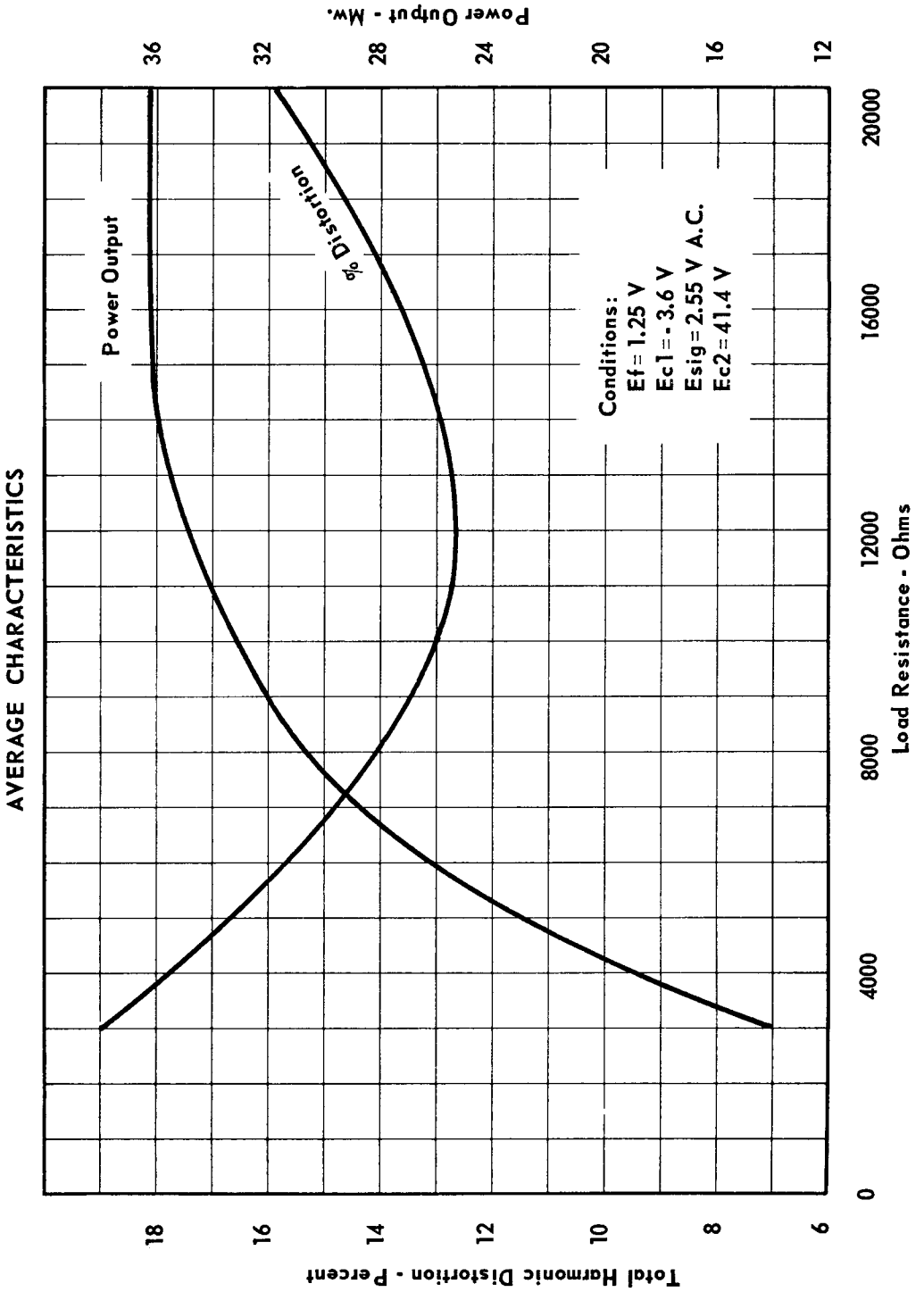
Tentative Data

Printed in U.S.A.

AVERAGE PLATE CHARACTERISTICS

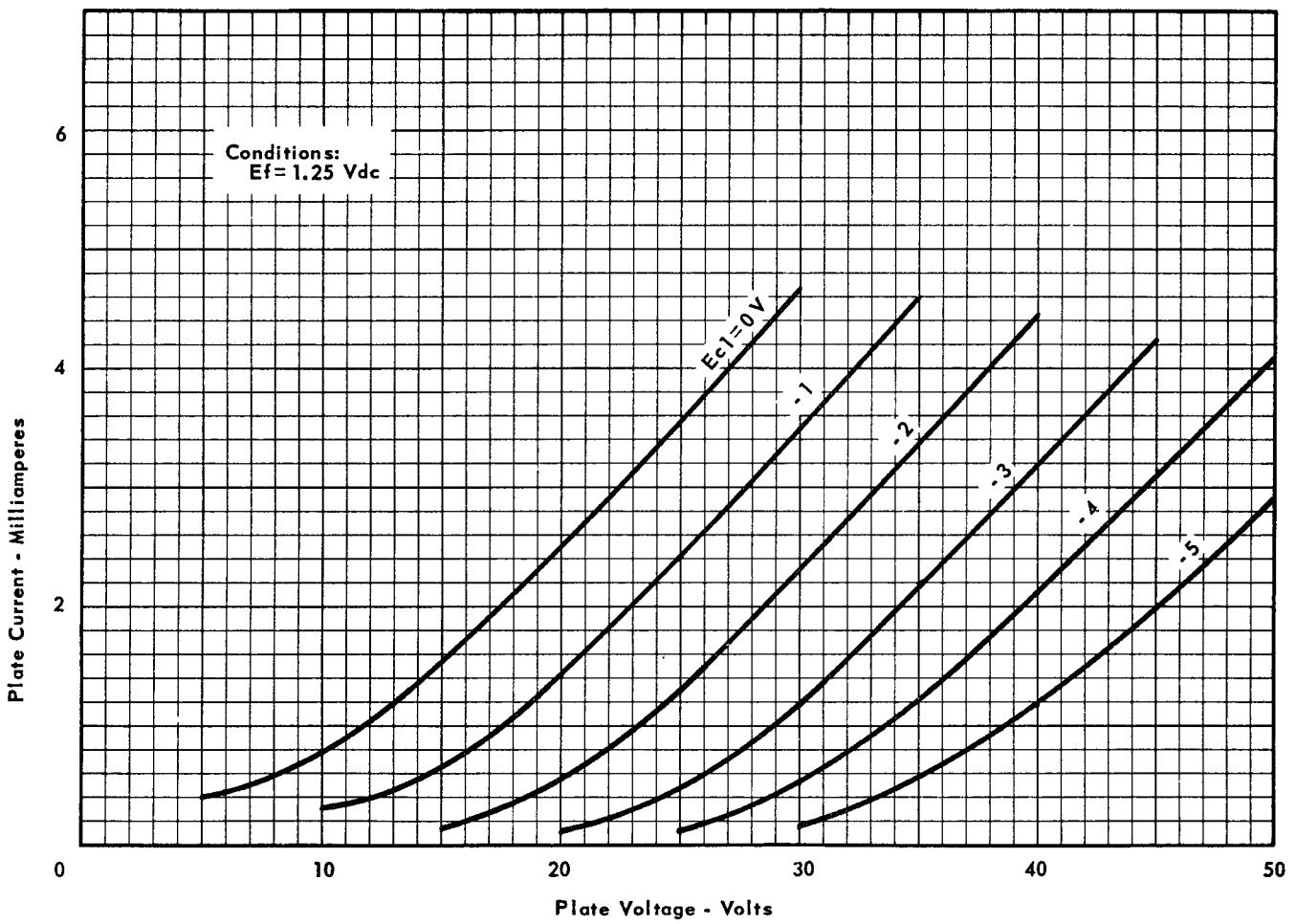


SUBMINIATURE PENTODE



SUBMINIATURE PENTODE

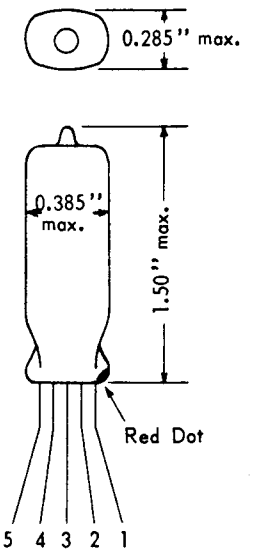
AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



Excellence in Electronics

TYPE 1AK4

The 1AK4 is a filament type, fully shielded, subminiature pentode designed for use in RF applications requiring economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive; Grid #3 ♦
Lead 3 Filament, Negative; Shield; Grid #3 ♦	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.)

Grid to Plate: (g1 to p)	0.015	max.
Input: g1 to (f+ g2+ g3)	3.5	
Output: p to (f+ g2+ g3)	5.0	

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.25	volts
Plate Voltage	90	volts
Grid #2 Voltage	90	volts
Total Cathode Current	1.0	ma.

CHARACTERISTICS AND TYPICAL OPERATION-CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	1.25	volts
Filament Current	20	20	ma.
Plate Voltage	45	67.5	volts
Grid #2 Voltage	45		volts
Grid #2 Supply Voltage		67.5	volts
Grid #2 Resistor		0.11	meg.
Grid #1 Voltage ▲	0	0	volts
Plate Resistance	1.5	2.0	meg.
Transconductance	750	750	μmhos
Plate Current	0.75	0.75	ma.
Grid #2 Current	0.2	0.2	ma.
Grid #1 Voltage (approx.) for Gm= 10 μmhos	-3	-3.5	volts

● *Bulb is entirely coated with a metallic shield connected to lead 3.*

♦ *Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5.*

▲ *Grid resistor= 5 megohms*

Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

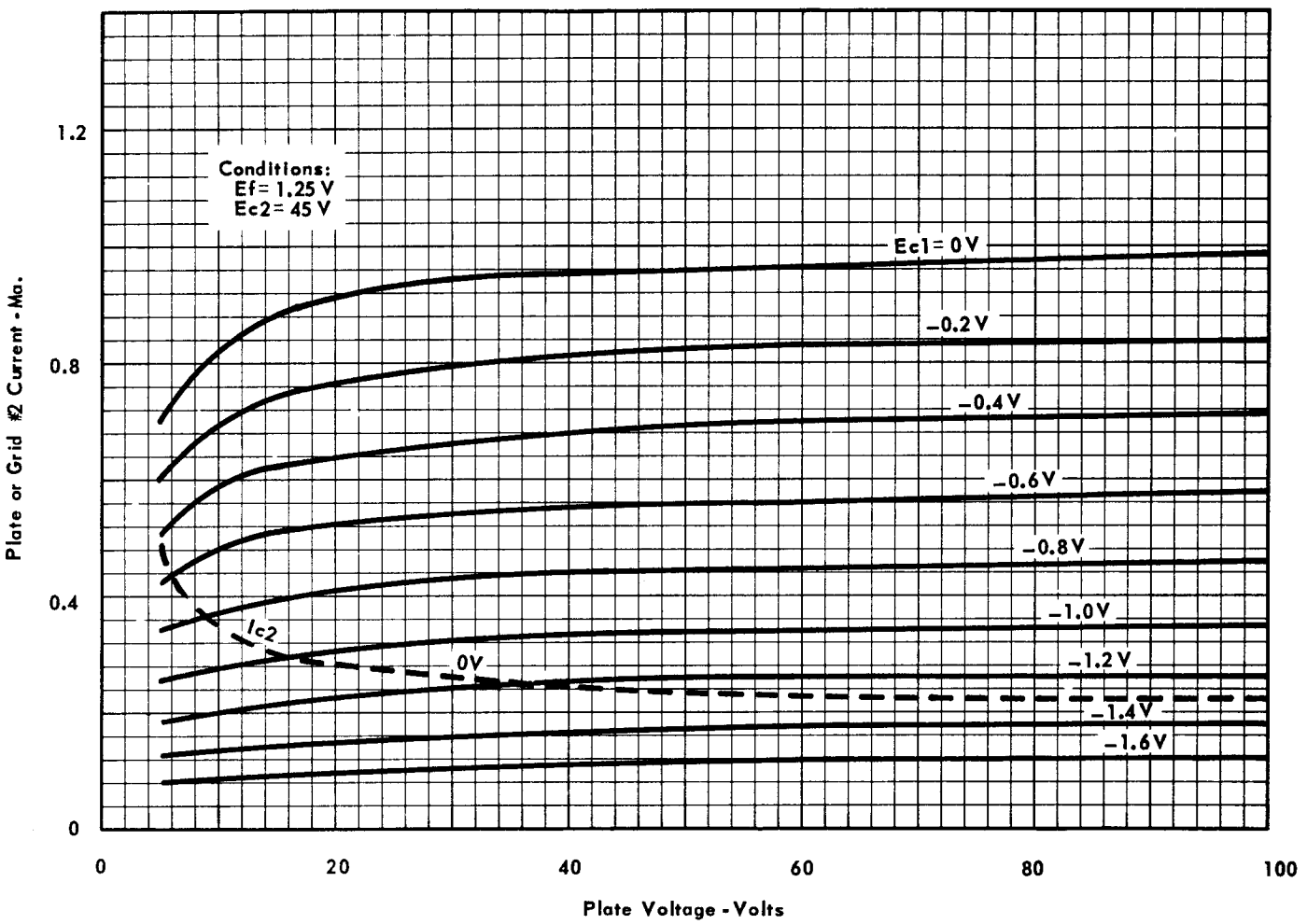
RAYTHEON MANUFACTURING COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

RAYTHEON

SUBMINIATURE PENTODE

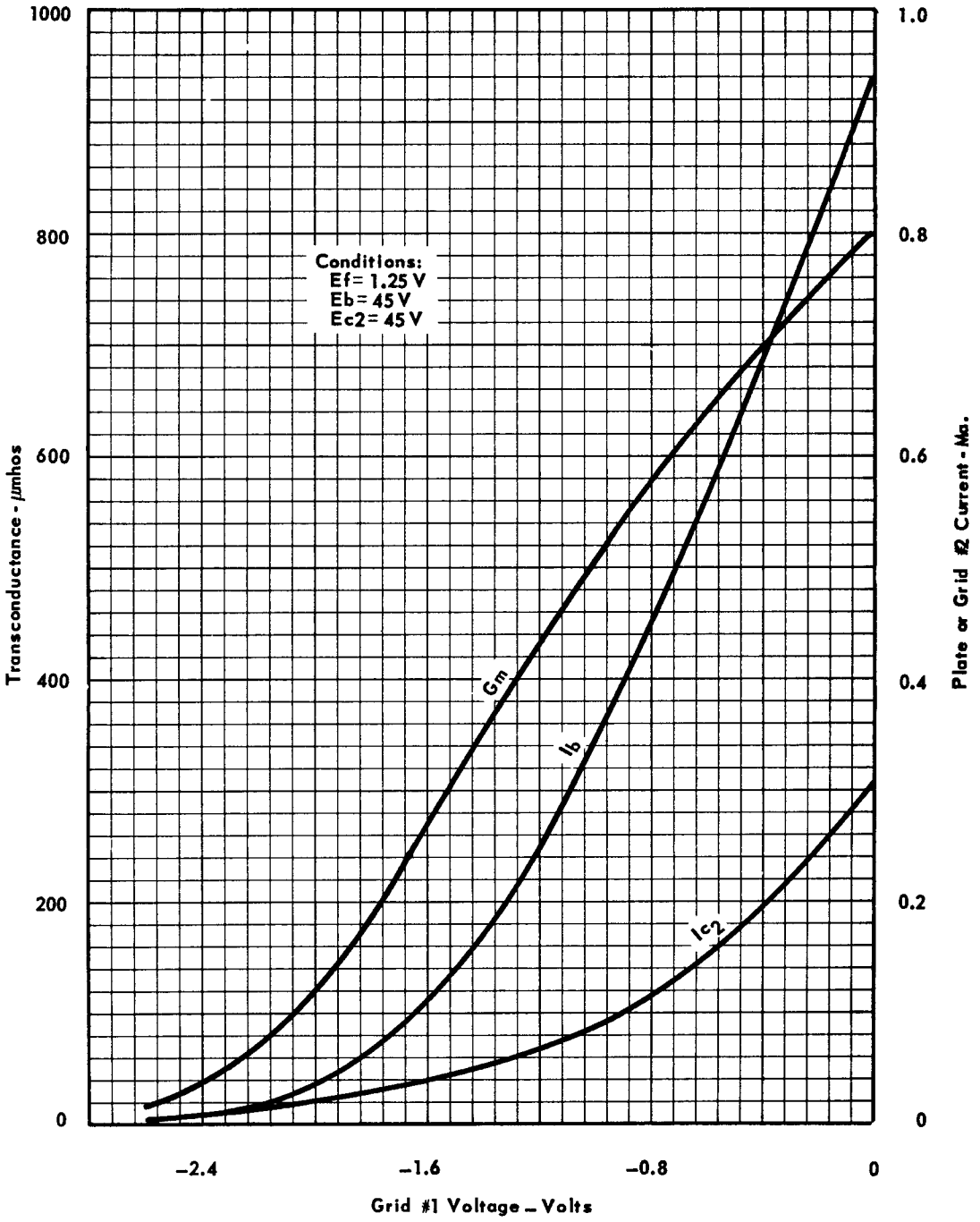
AVERAGE PLATE CHARACTERISTICS



RAYTHEON

SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



Printed in U.S.A.

from JETEC release #1432,
Aug. 16, 1954

RAYTHEON®

SUBMINIATURE DIODE-PENTODE

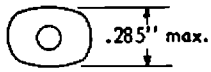
DESCRIPTION

The 1AK5 is a filament type diode-pentode of subminiature construction designed for use in applications requiring extreme economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL DATA

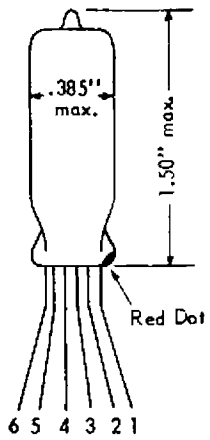
ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.048" center-to-center)



TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Pentode Plate	Lead 4 Filament, Negative; Grid #3■
Lead 2 Grid #2	Lead 5 Grid #1
Lead 3 Diode Plate	Lead 6 Filament, Positive; Grid #3■



MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)* •

Grid to Plate: (g 1 to p)	0.10 max.
Input: g 1 to (f+g 2+g 3)	2.0
Output: p to (f+g 2+g 3)	2.7

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.25 volts
Plate Voltage	90 volts
Grid #2 Voltage	90 volts
Total Cathode Current	1.0 ma.
Diode Current for Continuous Operation ♦	0.75 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A 1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	20 ma.
Plate Voltage	45 volts
Grid #2 Voltage	45 volts
Grid #1 Voltage ▲	0 volts
Plate Resistance	0.4 meg.
Transconductance	280 umhos
Plate Current	0.5 ma.
Grid #2 Current	0.2 ma.
Minimum Diode Current with 10 volts DC ♦	1.5 ma.

CHARACTERISTICS AND TYPICAL OPERATION - RESISTANCE - COUPLED AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	20 ma.
Plate Supply Voltage	45 volts
Grid #2 Supply Voltage	45 volts
Grid #1 Voltage ▲	0 volts
Load Resistance	1 meg.
Series Grid #2 Resistor	5 meg.
Grid #2 By-Pass Condenser	0.1 ufd.
Grid #1 Resistor (following tube)	10 meg.
Voltage Gain (approx.)	40

• *With close fitting shield connected to lead 4. Values are approx.*

▲ *Grid #1 Resistor = 5 megohms.*

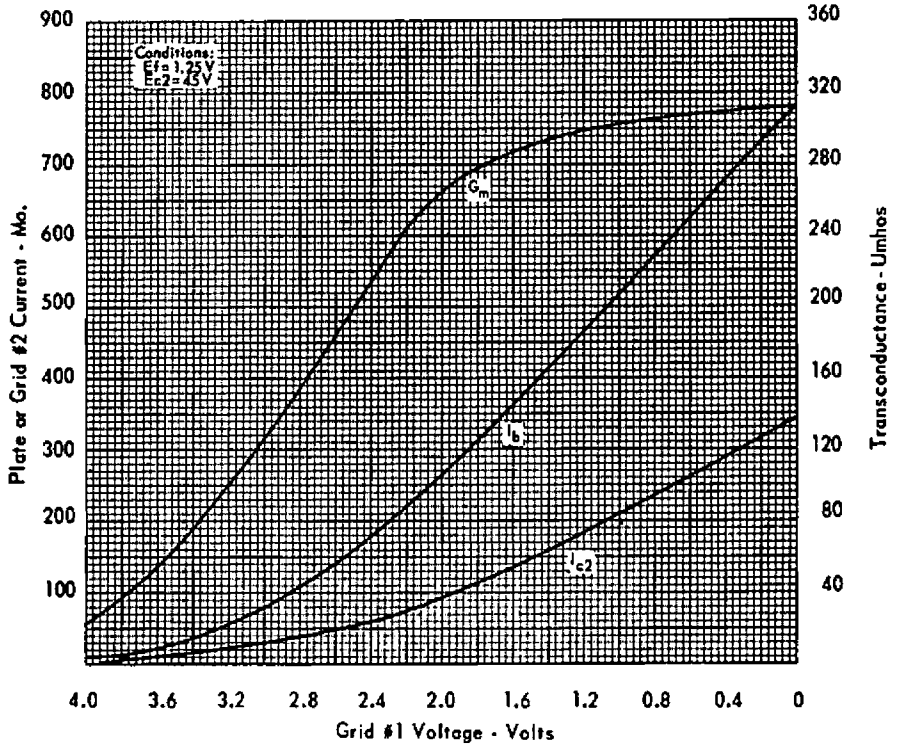
♦ *The diode is located at the negative end of the filament.*

■ *Grid #3 is comprised of two separate deflector plates, one of which is connected to Lead 4 and the other to Lead 6.*

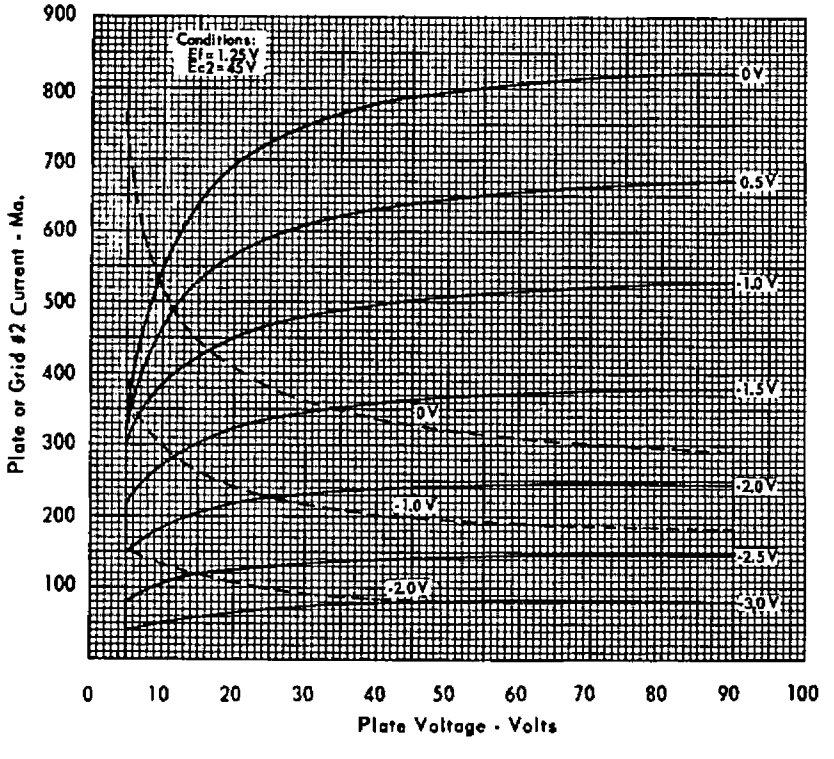
RAYTHEON®

SUBMINIATURE DIODE-PENTODE

AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



RAYTHEON TYPE 1B48

COLD CATHODE GAS RECTIFIER

The 1B48 is a small gaseous cold cathode half wave rectifier tube designed with special insulation features for use where a moderately high voltage is required. Several tubes may be operated in cascade to obtain considerably higher voltage output from less space than heretofore required.

BULB: T-5 1/2 Glass

BASE: Button 7-Pin (With Center Pin) MOUNTING POSITION: Any

DIMENSIONS

Maximum Overall Length (Excluding Center Pin)	2 1/8	inches
Maximum Seated Height	1 7/8	inches
Seated Height to Bulb Diameter of 7/16"	1 1/2 ± 3/32	inches
Maximum Diameter	3/4	inches
Center Pin Diameter	0.046	inches
Maximum Center Pin Length	11/16	inches

BASING

Pin 1 - Cathode	Pin 5 - Cathode
Pin 2 - Cathode	Pin 6 - Cathode
Pin 3 - Cathode	Pin 7 - Cathode
Pin 4 - Starter Anode	Center Pin - Anode

RATINGS

Maximum Peak Inverse Voltage	2700	volts
Maximum Peak Plate Current	50	ma
Average D.C. Voltage Drop at 6 ma	100	volts
Maximum D.C. Output Current	6	ma
Maximum Peak Plate Voltage	1600	volts
Minimum Peak A.C. Starting Voltage *	800	volts
Maximum Starter Anode Current	100	μa

* With starter anode connected to anode through a 10 megohm resistor.

from RMA release # 432, Sept. 6, 1945

RAYTHEON®

TYPE 1B90

RADIATION COUNTER TUBE

DESCRIPTION

The type 1B90 is an all glass, thin-wall, self-quenching counter tube for detecting beta and gamma radiation. It is designed for use in battery operated survey instruments and Prospector's Units for locating radioactive material.

MECHANICAL DATA

ENVELOPE: T6 Glass. Thin-wall, nominal*: 35 mg. per sq.cm.

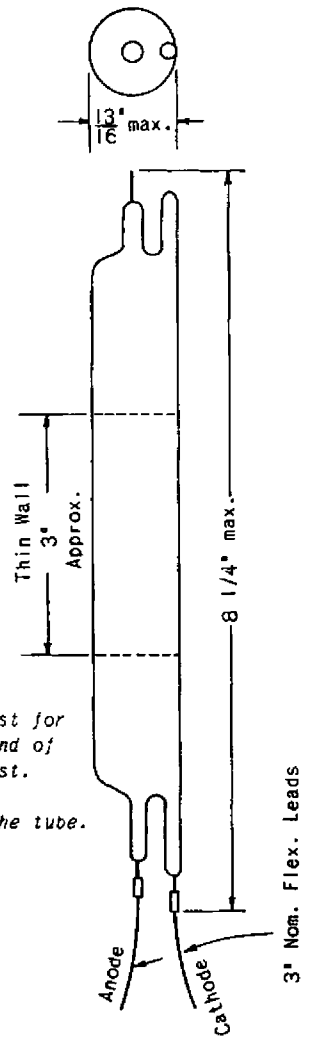
BASE: Untinned flexible stranded leads. Length: 3", nominal

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS:

Testing Voltage, max.**	Threshold ≠ 150	volts,dc
Counting Rate, max.	12000	CPM
Temperature Range	-40° to +55°	Cent.
Geiger Threshold, max.	1100	volts,dc
Plateau Length **	150	volts,dc
Relative Plateau Slope	3%	per 100 volts
Operating Voltage **	Threshold ≠ 50	volts,dc
Background ≠ (approx.)	60	CPM
Efficiency, min.	90%	
Capacity, average ≠≠	1.2	μμfds.
Life	10^8	Counts



* *Use ccution when handling thin wall of bulb.*

** *The plateau length for new tubes is longer than indicated, however, do not test for maximum length as tubes are readily damaged by very short discharges at the end of the plateau. The maximum rating test voltcge should not be exceeded during test. Operating voltage shown is for fixed voltage operation. Application of reuerse battery polarity will destroy the characteristics of the tube.*

≠ *The tube is covered with an opaque coating tc exclude light.*

≠≠ *Does not include leads.*

Tentative Data
August 23, 1949

CS-2573

RAYTHEON

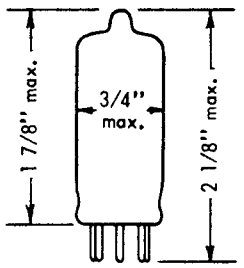
TECHNICAL INFORMATION

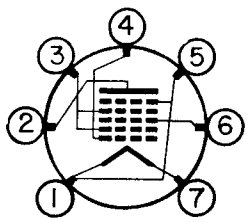
PENTAGRID CONVERTER

Excellence in Electronics

TYPE 1R5WA

The 1R5WA is a filament type heptode converter of miniature construction designed for use as a combined oscillator and mixer in battery operated equipment. Its principal application is as a mixer in oscillator sections of portable receivers. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. It is particularly useful in circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment.





BOTTOM VIEW

7AT

MECHANICAL DATA

ENVELOPE: T–5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Filament, Negative, Grid #5
Pin 2 Plate
Pin 3 Grid #2, Grid #4
Pin 4 Grid #1
Pin 5 Filament, Negative, Grid #5
Pin 6 Grid #3
Pin 7 Filament, Positive

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 3)	2.5 G

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and Performance will be jeopardized if filament voltage ratings are exceeded. Life and Reliability of Performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	1.00	1.25	1.25	1.50	Vdc
Plate Voltage (Note 7)	Eb:	----	90	90	100	Vdc
Grid Voltage	Ec1:	----	0	0	----	Vdc
Grid Voltage #2 (Note 7)	Ec2:	----	45	45	75	Vdc
Plate Dissipation	Pp:	----	----	----	0.1	Watts
Grid #2 Dissipation	Pg(2, 4):	----	----	----	0.19	Watts
Grid Resistance	Rg(1):	----	0.1	0.1	----	Meg
Conversion Transconductance	Sc:	----	----	235	----	μmhos
Plate Current	Ib1:	----	----	0.90	----	mAdc
Grid Voltage #3	Ec3:	----	0	0	0	Vdc
Cathode Current	Ik:	----	----	----	6.5	mAdc

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			Combined AQL = 1.0% excluding Mechanical and Inoperatives							
Grid Current (1):	Ec3 = −1 Vdc Eg1 = 15 Vac (Note 9)	0.65	Ic3:	0	----	----	----	−0.6	----	μAdc
Plate Current (1):	Eg1 = 15 Vac; (Note 9)	0.65	Ib:	0.55	----	----	----	1.25	----	mAdc
Cathode Current:	Eg1 = 15 Vac; (Note 9)	0.65	Ik:	2.25	----	----	----	4.75	----	mAdc
Conversion Transconductance (1):	Eg1 = 15 Vac; Ef = 1.0 Vdc (Note 9)	0.65	Sc:	130	----	----	----	340	----	μmhos
Oscillator Grid Current:	Ef = 1.0 Vdc; Plate Floating (Note 10)	0.65	Ic1:	125	----	----	----	----	----	μAdc
Noise and Microphonics:	Ebb = Ecc2 & 4 = Ecc3 = 135 Vdc; Ecal = 10.0 mVac; Rp = 2.2 Meg; Rg 2 & 4 = 4 Meg.; Cg 2 & 4 = 0.01 μf to F−; Rg3 = 8 Meg.	0.65	Eb:		----	----	----	17	----	VU
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope Outline (6−2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:	g1-all p-all g3-all	4.0	Rg-all: Rp-all: Rg3-all:	100 100 100	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	Meg. Meg. Meg.
Conversion Transconductance (2):	Eg1 = 15 Vac (Note 9)	6.5	Sc:	160	----	----	----	340	----	μmhos
Filament Current:		6.5	If:	44	----	----	----	56	----	mA
Capacitance:	Without Shield Without Shield Without Shield	6.5	Cg3-all: Cp-all: Cg3-p:	4.7 5.0 ----	---- ---- ----	---- ---- ----	---- ---- ----	6.9 7.5 0.45	---- ---- ----	μμf μμf μμf
Vibration (1):	Rp = 10,000 ohms; Ec1 = −5 Vdc; 40 cps; 15g; Rg1 = 0	6.5	Ep(1):	----	----	----	----	10	----	mVac
Vibration (2):	F = 50 cps − 3500 cps; Rp = 10,000 ohms; Ec1 = −5 Vdc; Rg1 = 0; (Note 8)	6.5	Ep(1):	----	----	----	----	25	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle = 30°	----	----	----	----	----	----	----	----	----
Fatigue:	G = 2.5; F = 25 min; 60 max; Fixed Frequency	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Conversion Transconductance (2):		----	Sc:	125	----	----	----	----	----	μmhos
Vibration (1):		----	Ep:	----	----	----	----	15	----	mVac
Miniature Tube Base Strain:		----	----	----	----	----	----	----	----	----
Glass Strain:		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL Note 1 (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	LIMITS MIN	LIMITS MAX	MIL-E-1 UNITS	Allowable Defects per Characteristics 1st Sample	Allowable Defects per Characteristics Combined Samples
ACCEPTANCE LIFE TESTS								
Intermittent Life Test:	Ef = 1.25 Vdc; or Vac with Equivalent Bias; Group A; Ecal = −16.0 Vdc; Esig = 17.5 Vac; Ec 2&4 = 67.5 Vac; (Note 12)	----	t:	500	----	Hours	----	----
Intermittent Life Test End Points:								
Conversion Transconductance (2):		----	Sc:	125	----	μmhos	----	----
Oscillator Grid Current		----	Ic1:	100	----	μAdc	----	----

NOTES:

Note 1: Characteristics, Quality Control Procedures, and Inspection Levels are made according to the appropriate paragraph of MIL-E-1, and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Plate and Screen Voltages should not exceed these values under any circumstances.

Note 8: The tube under test shall be rigidly mounted on a vibration table vibrating with simple harmonic motion. The test conditions of paragraph 4.9.19.1 of MIL-E-1 shall be applied and Ep monitored while the frequency of vibration is continuously swept from 50–3500 cps and the peak acceleration controlled constant at 2G. A low pass filter which follows the load resistor of the tube under test shall have a cut-off frequency of 3500 cps. The total time of sweep shall not be less than one (1) minute.

Note 9: For rapid testing use equipment which correlates with MIL-E-1 paragraph 4.10.12.

Note 10: With converter Oscillator Test Set (Drawing 195–Jan) having Rg1 = 50,000 ohms and with grid to filament resonant impedance adjusted to 9500 ohms.

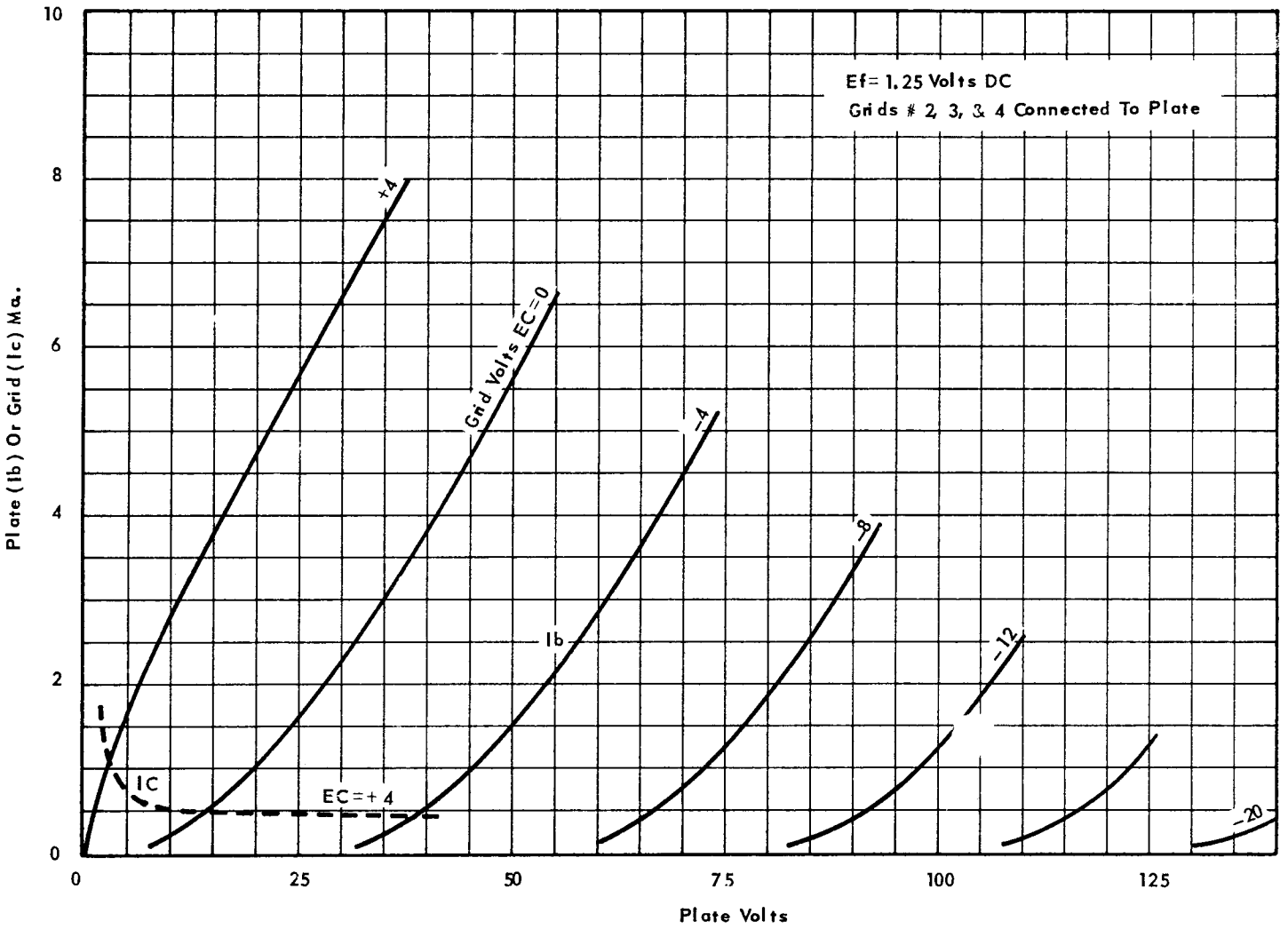
Note 11: Tubes shall be so shielded that operator proximity or movement will not affect output readings.

Note 12: Bias of grid #1 may be obtained from a dc source of self bias.

RAYTHEON

PENTAGRID CONVERTER

AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION



PENTAGRID CONVERTER

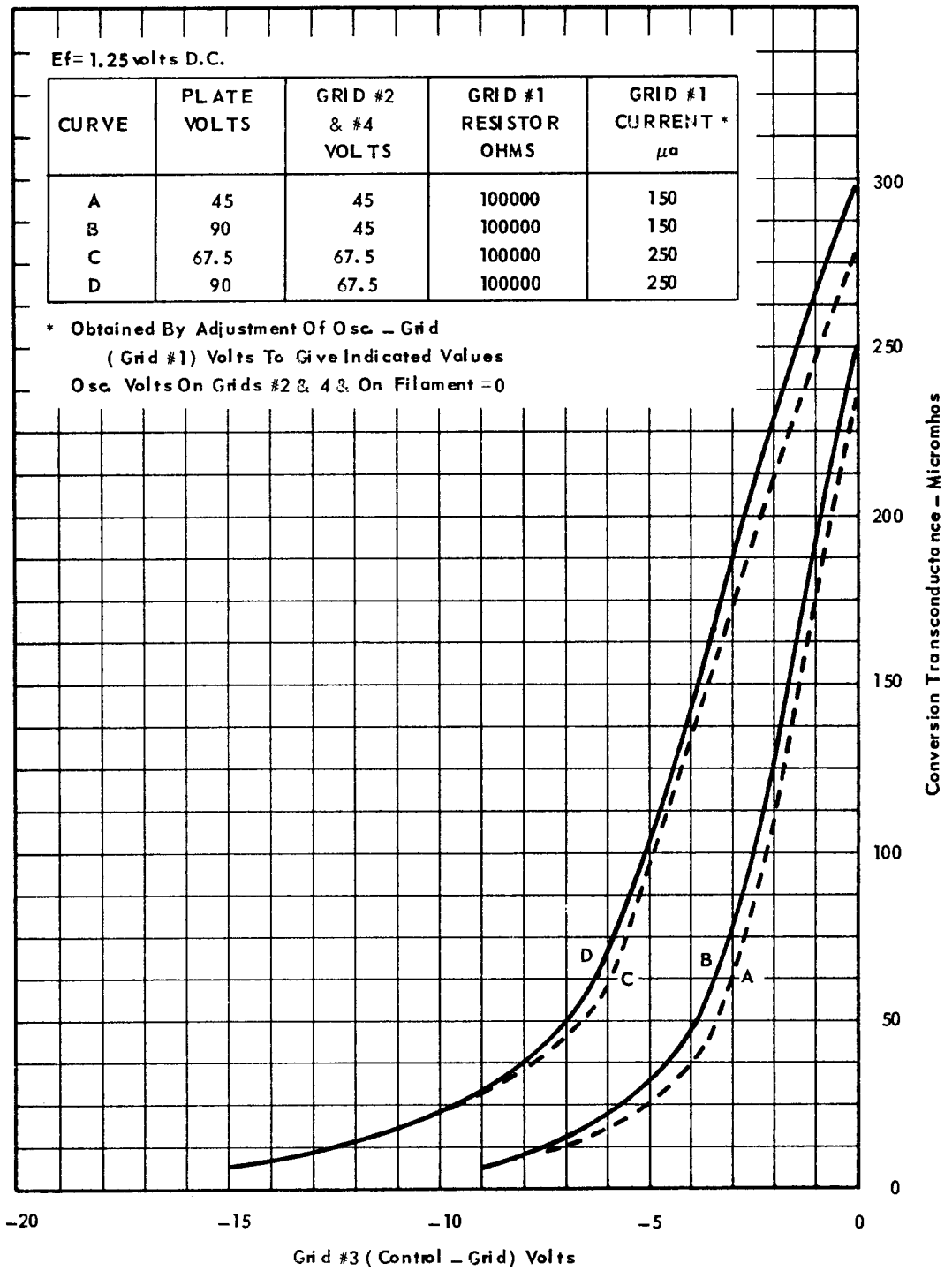
OPERATION CHARACTERISTICS

Ef = 1.25 volts D.C.

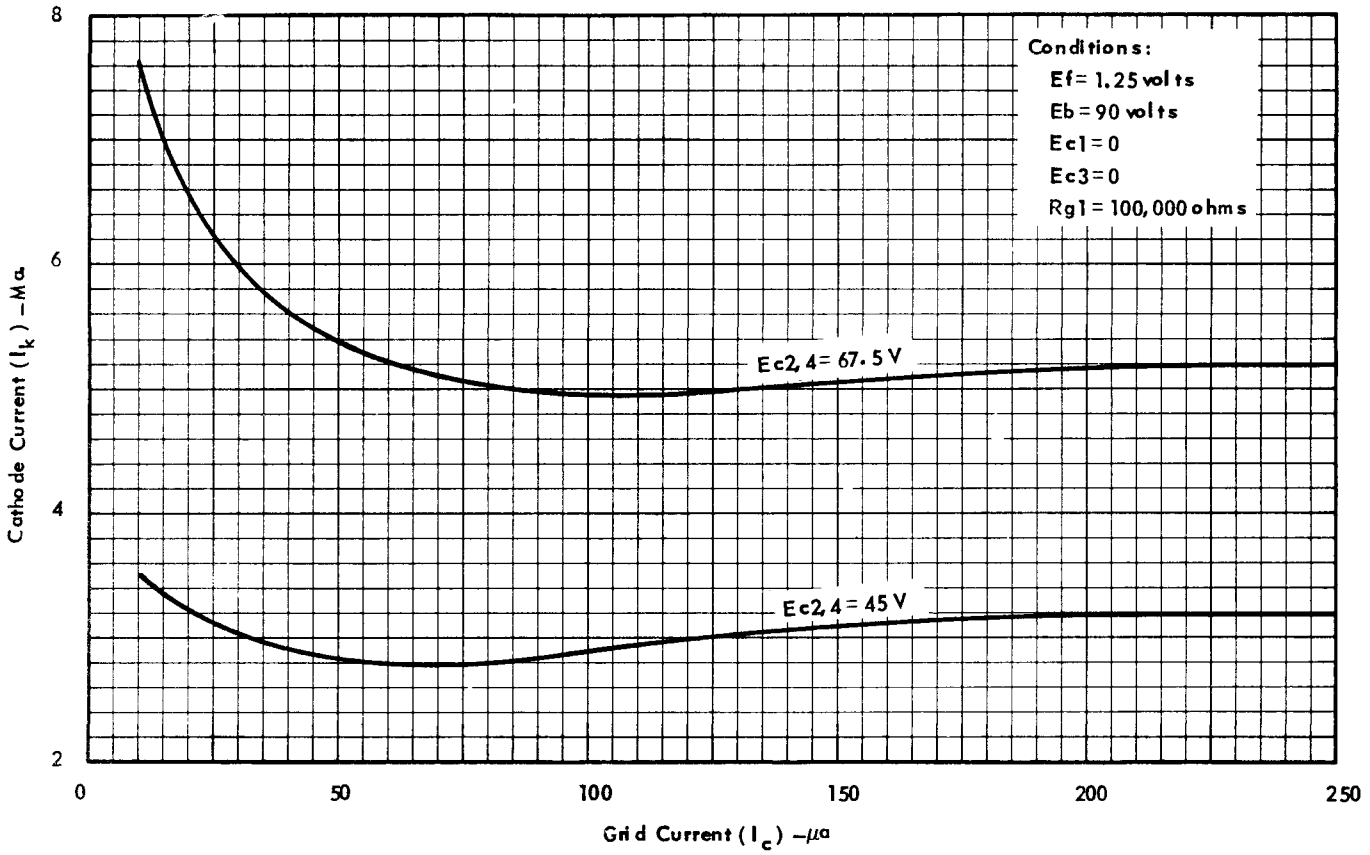
CURVE	PLATE VOLTS	GRID #2 & #4 VOLTS	GRID #1 RESISTOR OHMS	GRID #1 CURRENT * μa
A	45	45	100000	150
B	90	45	100000	150
C	67.5	67.5	100000	250
D	90	67.5	100000	250

* Obtained By Adjustment Of Osc. – Grid (Grid #1) Volts To Give Indicated Values

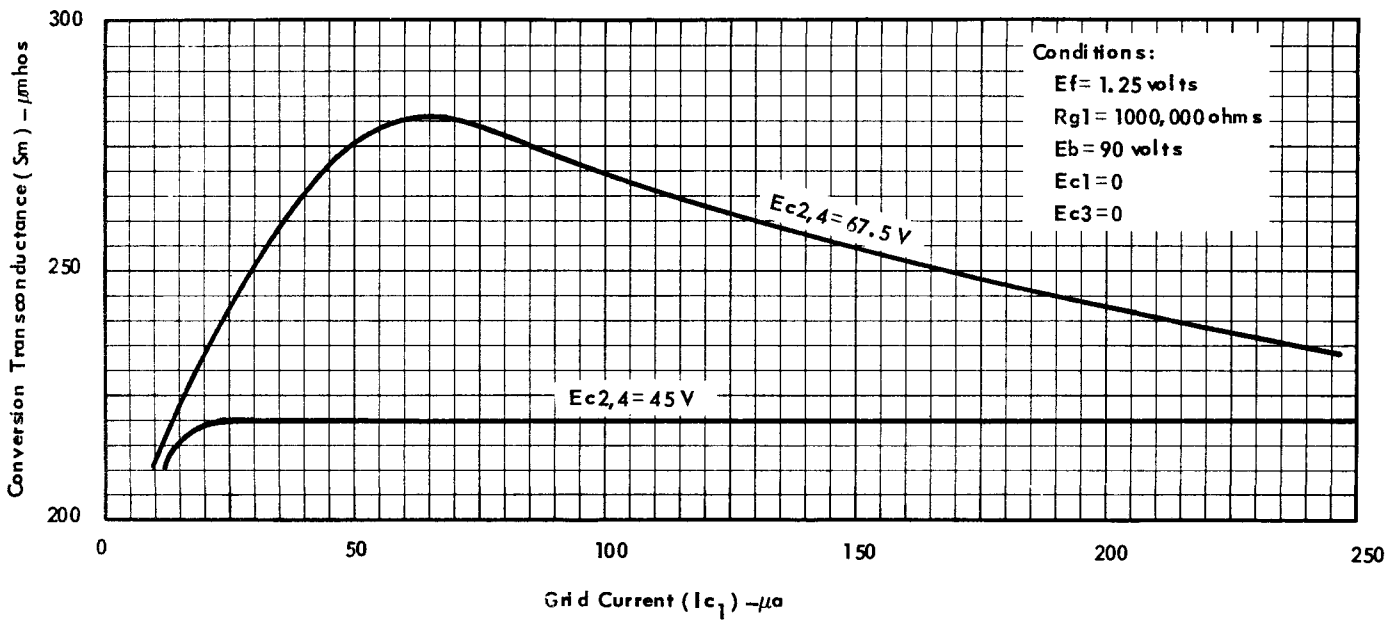
Osc. Volts On Grids #2 & 4 & On Filament = 0



OPERATION CHARACTERISTICS



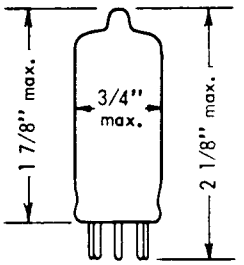
OPERATION CHARACTERISTICS

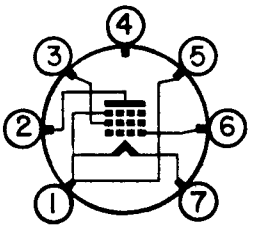


TYPE 1T4WA

Excellence in Electronics

The 1T4WA is a filament type semi-remote cutoff pentode of miniature construction. It is designed for use as a radio frequency or intermediate frequency amplifier in battery operated equipment. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. It is particularly useful in voltage amplifier circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment.





BOTTOM VIEW

6AR

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Filament, Negative, Grid #3, Shield
Pin 2 Plate
Pin 3 Grid #2
Pin 4 No Connection
Pin 5 Filament, Negative, Grid #3, Shield
Pin 6 Grid #1
Pin 7 Filament, Positive

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 3)	2.5 G

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy maybe reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	1.00	1.25	1.25	1.50	Vdc
Plate Voltage (Note 7)	Eb:	----	90	90	100	Vdc
Grid Voltage	Ec1:	----	0	0	----	Vdc
Grid Voltage #2 (Note 7)	Ec2:	----	67.5	67.5	75	Vdc
Plate Dissipation	Pp:	----	----	----	0.4	Watts
Grid #2 Dissipation	Pg2:	----	----	----	0.15	Watts
Grid Resistance	Rg(1):	----	----	----	2.0	Meg
Transconductance	Sm:	----	----	900	----	μmhos
Plate Current	Ib1:	----	----	3.5	----	mAdc
Cathode Current	Ik:	----	----	----	6.5	mAdc

Printed in U.S.A.

Tentative Data

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

8/1/59/1

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			**Combined AQL = 1.0 % excluding Mechanical and Inoperatives**							
Grid Current (1):	Eb=Ec2=90 Vdc Ec1=–2.0 Vdc	0.65	Ic1:	0	----	----	----	–1.0	----	μAdc
Plate Current (1):		0.65	Ib1:	2.3	----	----	----	4.7	----	mAdc
Screen Grid Current:		0.65	Ic2:	0.65	----	----	----	2.15	----	mAdc
Transconductance (1):		0.65	Sm(1):	660	----	----	----	1125	----	μmhos
Noise and Microphonics:	Ebb=90 Vdc; Ecc2=67.5 Vdc; Ecal=10.0 mVac; Rp=1.0Meg; Rg2=4.7Meg; Cg2=0.1μf; Rg1=0	0.65	EB:	----	----	----	----	17	----	VU
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope Outline (6–2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:	g-all=–100 Vdc p-all=–100 Vdc	4.0	Rg-all: Rp-all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Transconductance (2):	Ef=1.0 Vdc; Eb=75 Vdc; Ec2=55 Vdc	6.5	Sm(2):	500	----	----	----	1125	----	μmhos
Transconductance (3):	Ec1=–16 Vdc	6.5	Sm(3):	1	----	----	----	50	----	μmhos
Filament Current:		6.5	If:	44	----	----	----	56	----	mA
Grid Voltage:	Ec1/Ic1=0.1μAdc Ec2=45 Vdc (Note 9)	6.5	Ec(1):	----	----	----	----	2.0	----	Vdc
Plate Current (2):	Ef=1.25 Vdc; Rg=50,000 ohms; Ec1=25 Vac (Note 10)	6.5	Ib:	2.0	----	----	----	----	----	mAdc
Plate Resistance	Eb=Ec2=45 Vdc	6.5	rp:	0.17	----	----	----	----	----	Meg.
Capacitance: Capacitance: Capacitance:	Shield #316 without shield without shield	6.5	Cg1p: Cin: Cout:	---- 3.0 4.5	---- ---- ----	---- ---- ----	---- ---- ----	0.02 4.7 8.5	---- ---- ----	μμf μμf μμf
Vibration (1):	Rp=10,000 ohms; 40 cps; 15g	6.5	Ep:	----	----	----	----	10	----	mVac
Vibration (2):	F=40 cps –3500 cps; Rp=10,000 ohms (Note 8)	6.5	Ep(2):	----	----	----	----	20	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle=30° (Note 2)	----	----	----	----	----	----	----	----	----
Fatigue:	G=2.5; F=25 cps min; 60 cps max; Fixed Frequency (Note 3)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Transconductance (1):		----	Sm(1):	570	----	----	----	----	----	μmhos
Vibration (1):		----	Ep:	----	----	----	----	15	----	mVac
Miniature Tube Base Strain:		----	----	----	----	----	----	----	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS								
Intermittent Life Test:	Ef = 1.25 Vdc or Vac with equivalent bias; Group A	.----	t:	500	----	Hours	----	----
Intermittent Life Test End Points:								
Transconductance (1):			Sm(1):	540	----	μmhos	----	----
Grid Current:			Ic(1):	----	−1.0	μAdc	----	----

NOTES:

Note 1: Characteristics, Quality Control Procedures, and Inspection Levels are made according to the appropriate paragraph of MIL-E-1, and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

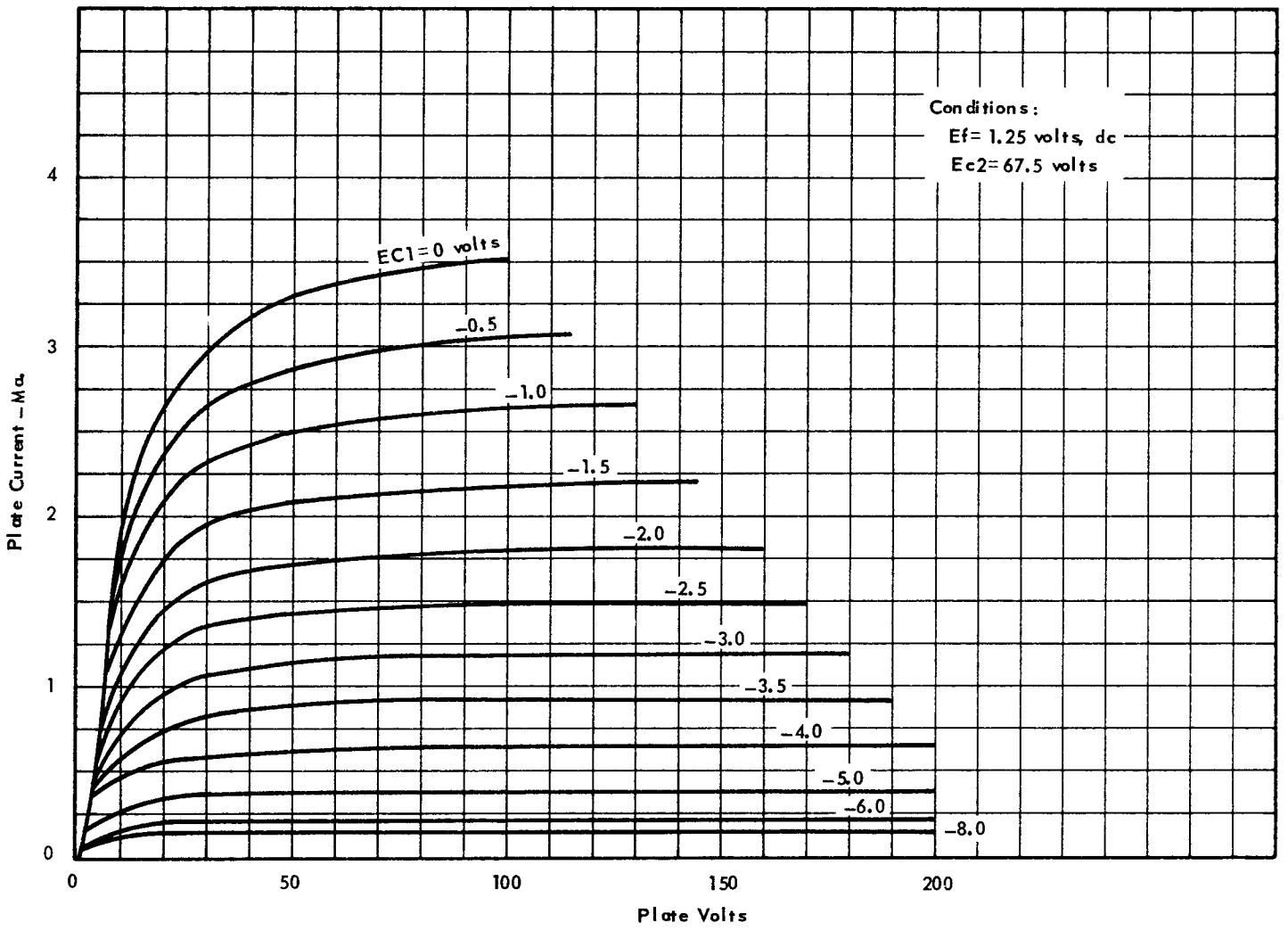
Note 7: Plate and Screen Supply Voltages should not exceed these values under any circumstances.

Note 8: The tube under test shall be rigidly mounted on a vibration table vibrating with simple harmonic motion. The test conditions of paragraph 4.9.19.1 of MIL-E-1 shall be applied and Ep monitored while the frequency of vibration is continuously swept from 50-3500 cps and the peak acceleration controlled constant at 2G. A low pass filter which follows the load resistor of the tube under test shall have a cut-off frequency of 3500 cps. The total time of sweep shall not be less than one (1) minute.

Note 9: The voltage drop in the grid current meter shall be included in the grid voltage required for the 0.1μAdc grid current.

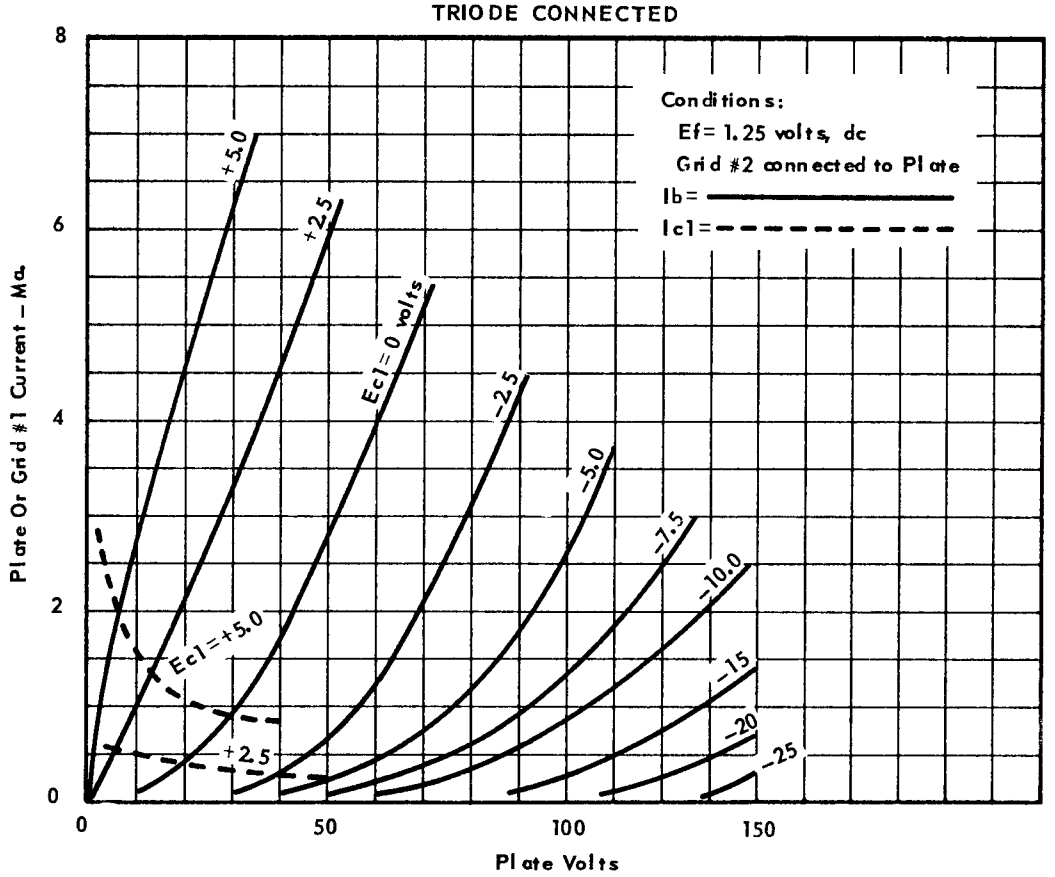
Note 10: The signal shall be coupled through a 1μf condenser and shall have a source impedance of approximately 500 ohms.

AVERAGE PLATE CHARACTERISTICS

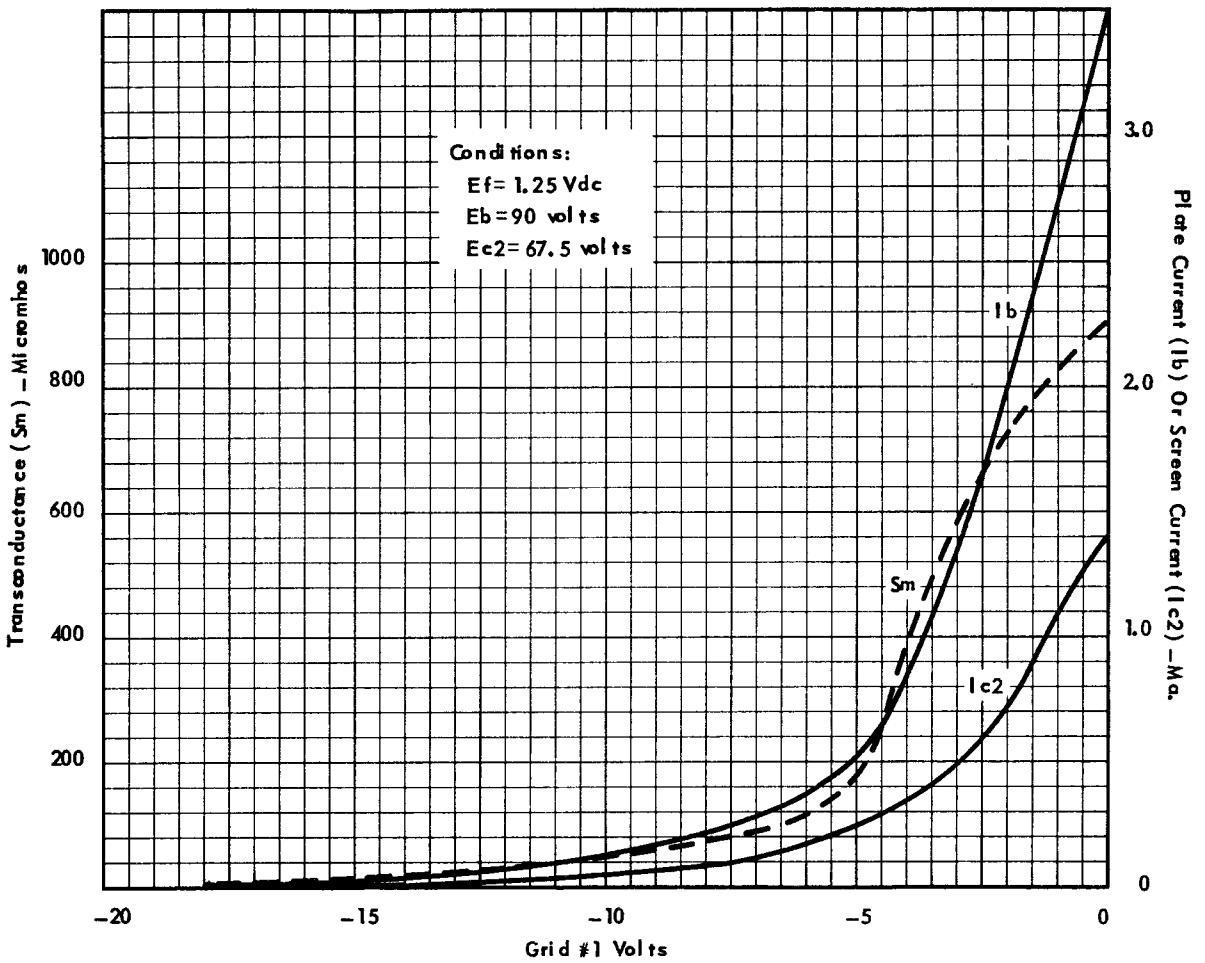


PENTODE

AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTED



AVERAGE CHARACTERISTICS



RAYTHEON

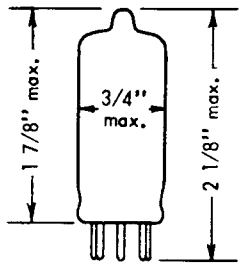
TECHNICAL INFORMATION

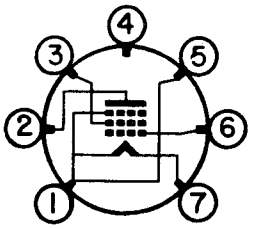
Excellence in Electronics

PENTODE

TYPE 1U4WA

The 1U4WA is a filament type sharp cut–off pentode of miniature construction designed for RF and AF applications in portable equipment. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. It is particularly useful in voltage amplifier circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment.





BOTTOM VIEW

6AR

MECHANICAL DATA

ENVELOPE: T–5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Filament, Negative, Grid #3, Shield
Pin 2 Plate
Pin 3 Grid #2
Pin 4 No Connection
Pin 5 Filament, Negative, Grid #3, Shield
Pin 6 Grid #1
Pin 7 Filament, Positive

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 3)	2.5 G

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION---To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	1.00	1.25	1.25	1.50	Vdc
Plate Voltage (Note 7)	Eb:	----	90	90	135	Vdc
Grid Voltage	Ec1:	----	0	0	----	Vdc
Grid Voltage #2 (Note 7)	Ec2:	----	90	90	135	Vdc
Plate Dissipation	Pp:	----	----	----	0.17	Watts
Grid #2 Dissipation	Pg2:	----	----	----	0.05	Watts
Grid Resistance	Rg(1):	----	----	----	2.0	Meg.
Transconductance	Sm:	----	----	900	----	μmhos
Plate Current	Ib1:	----	----	1.6	----	mAdc
Cathode Current	Ik:	----	----	----	3.0	mAdc

Tentative Data

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ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, Part 1		**Combined AQL = 1.0 % excluding Mechanical and Inoperatives**								
Grid Current (1):	Eb = Ec2 = 135 Vdc; Ec1 = −2.0 Vdc	0.65	Ic1:	0	----	----	----	−1.0	----	μAdc
Plate Current (1):		0.65	Ib1:	1.0	----	----	----	2.1	----	mAdc
Screen Grid Current:		0.65	Ic2:	0.28	----	----	----	0.62	----	mAdc
Transconductance (1):		0.65	Sm (1):	720	----	----	----	1080	----	μmhos
Noise and Microphonics:	Ebb = Ecc2 = 90 Vdc; Ecal = 10.0 mVac; Rp = 1.0 Meg.; Rg2 = 4.7 Meg.; Cg2 = 0.1μf	0.65	EB:	----	----	----	----	17	----	VU
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope Outline (6−2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, Part 2										
Insulation of Electrodes:	g-all = −100 Vdc p-all = −100 Vdc	4.0	Rg-all: Rp-all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (2):	Ec1 = −4.5 Vdc	6.5	Ib:	0	----	----	----	30	----	μAdc
Transconductance (2):	Ef = 1.0 Vdc	6.5	Sm (2):	610	----	----	----	1080	----	μmhos
Filament Current:		6.5	If:	44	----	----	----	56	----	mA
Capacitance:	Shield #316	6.5	Cg1p:	----	----	----	----	0.02	----	μμf
Capacitance:	Shield #316		Cin:	3.0	----	----	----	4.2	----	μμf
Capacitance:	Shield #316		Cout:	5.6	----	----	----	7.6	----	μμf
Vibration (1):	Rp = 10,000 ohms; 40 cps; 15 g	6.5	Ep:	----	----	----	----	10	----	mVac
Vibration (2):	f = 50 cps − 3500 cps; Rp = 10,000 ohms (Note 8)	6.5	Ep (2):	----	----	----	----	15	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle = 30° (Note 2)	----	----	----	----	----	----	----	----	----
Fatigue:	G = 2.5; F = 25 cps min; 60 cps max; Fixed Frequency (Note 3)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Transconductance (1)		----	Sm:	540	----	----	----	----	----	μmhos
Vibration		----	Ep:	----	----	----	----	15	----	mVac
Miniature Tube Base Strain:		----	----	----	----	----	----	----	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1) (Cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristics 1st Sample	Allowable Defects per Characteristics Combined Samples
ACCEPTANCE LIFE TESTS								
Intermittent Life Test:	Ef = 1.25 Vdc; or Vac with equivalent bias; Group A	----	t:	500	----	Hours	----	----
Intermittent Life Test End Points:								
Transconductance (1)		----	Sm(1):	540	----	μmhos	----	----
Grid Current		----	Ic(1):	----	-1.0	μAdc	----	----

NOTES:

Note 1: Characteristics, Quality Control Procedures, and Inspection Levels are made according to the appropriate paragraph of MIL-E-1, and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

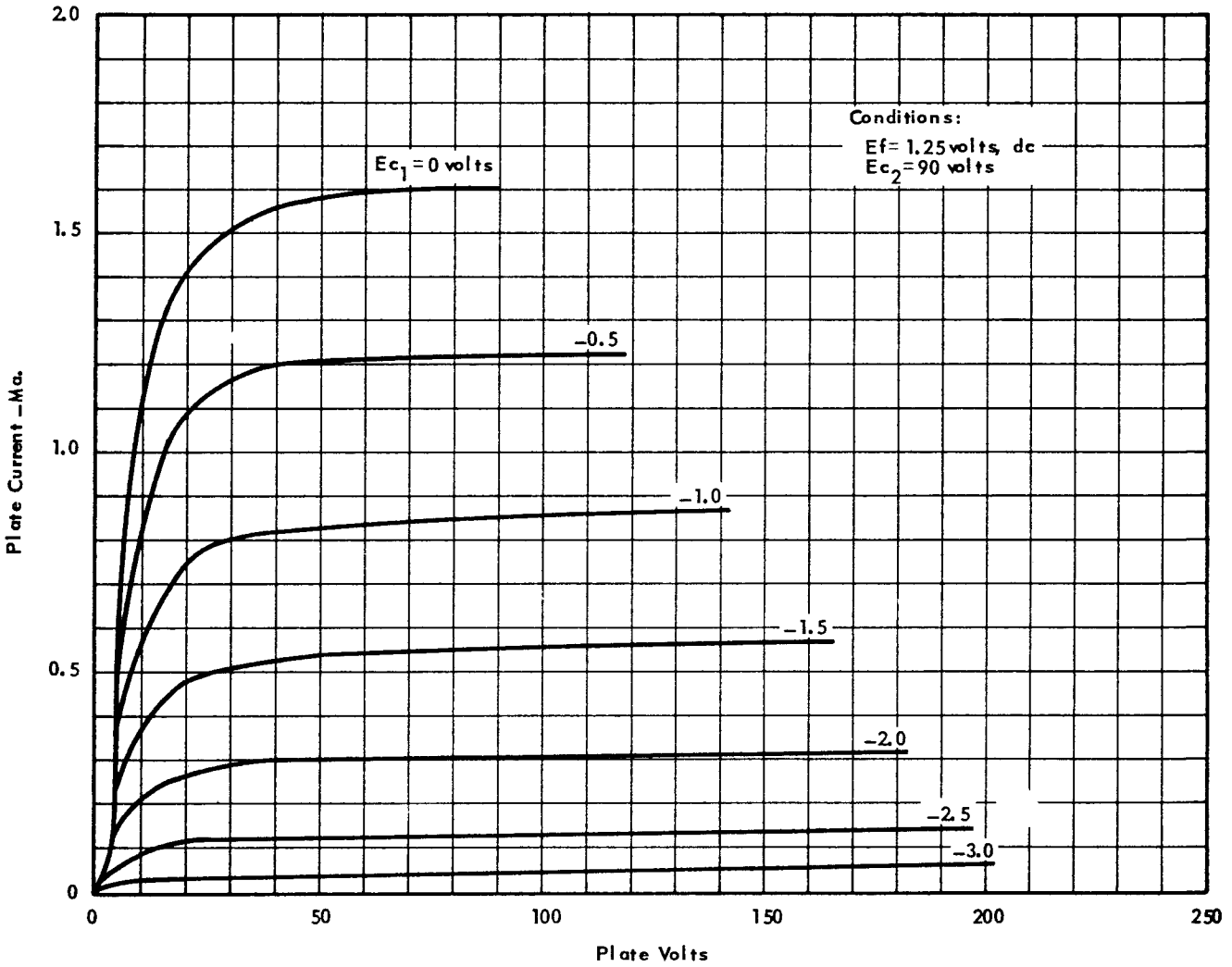
Note 5: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, and improvement in reliability will be realized.

Note 7: Plate and Screen Voltages should not exceed these values under any circumstances.

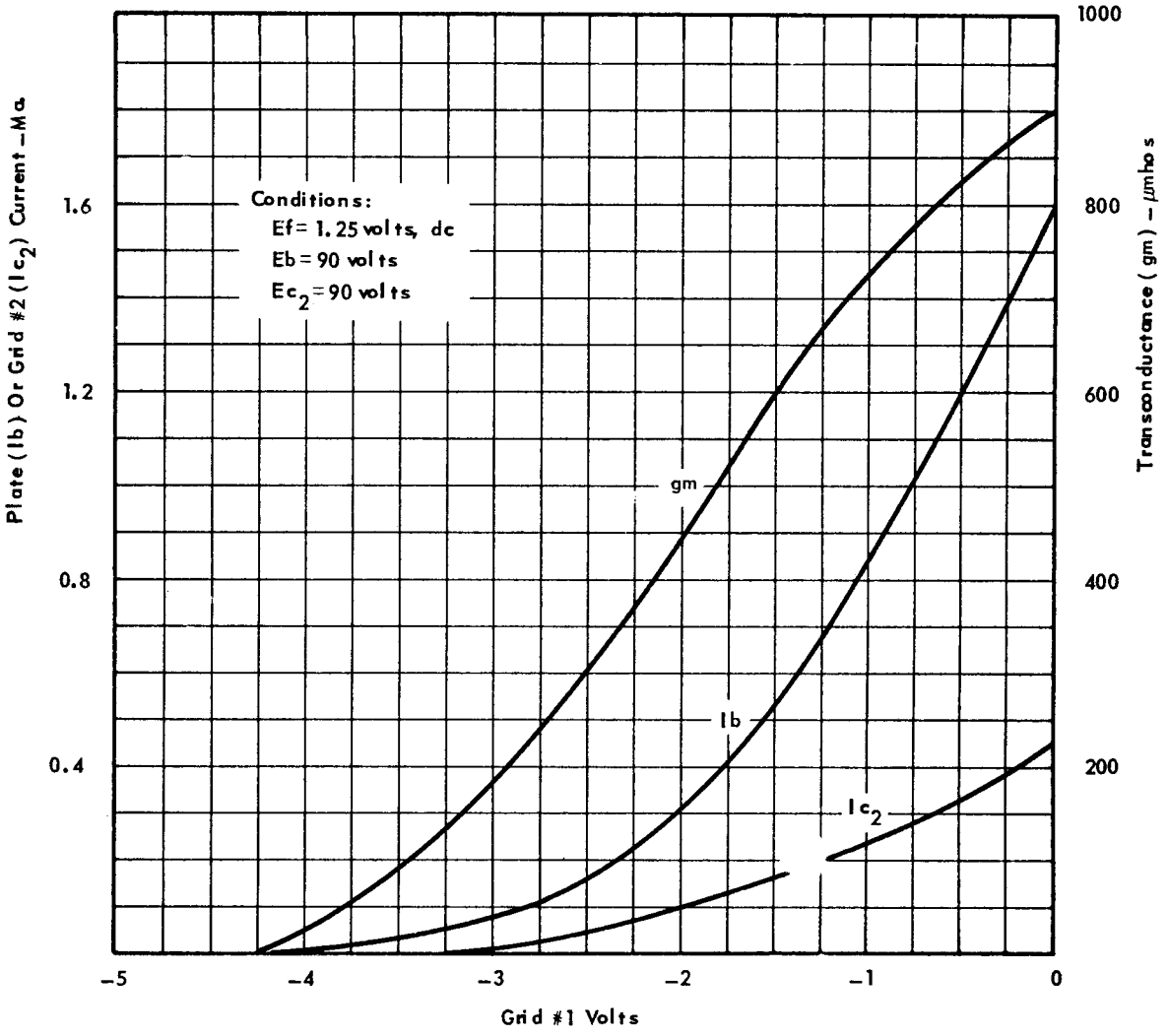
Note 8: The tube under test shall be rigidly mounted on a vibration table vibrating with simple harmonic motion. The test conditions of paragraph 4.9.19.1 of MIL-E-1 shall be applied and Ep monitored while the frequency of vibration is continuously swept from 50 – 3500 cps and the peak acceleration controlled constant at 2G. A low pass filter which follows the load resistor of the tube under test shall have a cut-off frequency of 3500 cps. The total time of sweep shall not be less than one (1) minute.

AVERAGE PLATE CHARACTERISTICS



PENTODE

AVERAGE CHARACTERISTICS



RAYTHEON

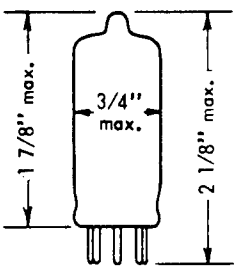
TECHNICAL INFORMATION

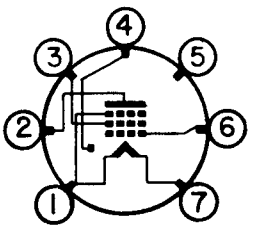
DIODE PENTODE

Excellence in Electronics

TYPE 1U5WA

The 1U5WA is a filament type, sharp cut-off, diode pentode of miniature construction. Its principal application is as a diode detector, AVC rectifier, audio frequency amplifier in portable receivers. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. It is particularly useful in detector, amplifier circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment.





BOTTOM VIEW

6BW

MECHANICAL DATA

ENVELOPE: T-5 1/2 Glass

BASE: Miniature Button 7-Pin

TERMINIAL CONNECTIONS:

Pin 1 Filament, Negative, Grid #3
Pin 2 Plate #2
Pin 3 Grid #2
Pin 4 Diode, Plate #1
Pin 5 No Connection
Pin 6 Grid #1
Pin 7 Filament, Positive

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 3)	2.5 G

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy maybe reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and Reliability of Performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	1.00	1.25	1.25	1.50	Vdc
Plate Voltage (Note 7)	Eb:	----	67.5	67.5	100	Vdc
Grid Voltage	Ec1:	----	0	0	0	Vdc
Grid Voltage #2 (Note 7)	Ec2:	----	67.5	67.5	100	Vdc
Plate Dissipation	Pp:	----	----	----	0.13	Watts
Grid #2 Dissipation	Pg2:	----	----	----	0.035	Watts
Grid Resistance	Rg(1):	----	----	----	2.0	Meg.
Transconductance	Sm:	----	----	650	----	μmhos
Plate Current	Ib1:	----	----	1.6	----	mAdc
Cathode Current	Ik:	----	----	----	5.0	mAdc
Diode Current	Iib:	----	----	----	250	μAdc

Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION
RAYTHEON COMPANY
55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, Part 1		**Combined AQL = 1.0% excluding Mechanical and Inoperatives**								
Grid Current (1):	Eb = Ec2 = 90 Vdc; Ec1 = –2.5 Vdc	0.65	Ic1:	0	----	----	----	–0.5	----	μAdc
Plate Current (1):		0.65	Ib1:	1.05	----	----	----	2.15	----	mAdc
Screen Grid Current:		0.65	Ic(2):	0.24	----	----	----	0.56	----	mAdc
Transconductance (1):	Ef = 1.0 Vdc	0.65	Sm(1):	380	----	----	----	775	----	μmhos
AC Amplification:	Ebb = Ecc2 = 45 Vdc; Rg2 = 2.0 Meg; Rg1 = 10 Meg.; Rp = 0.5 Meg.; Esig = 0.2 Vac; 0.1μf Between G2 and –F	0.65	Ep:	6.5	----	----	----	----	----	Vac
Emission (Diode):	Eib = 10 Vdc	0.65	Iis:	0.5	----	----	----	----	----	mAdc
Noise and Microphonics:	Ebb = Ecc2 = 135 Vdc; Ecal = 10.0 mVac; Rp = 1.0 Meg.; Rg2 = 4.7 Meg.; Cg2 = 0.1μf; Ec1 = 0; Rp of Diode = 2 Meg. to ground. Couple plate of diode to G1 through a 0.1μf capacitor; Rg1 = 1.5 Meg.; (Note 9, 10)	0.65	----	----	----	----	----	----	----	----
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope Outline (6–2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, Part 2										
Insulation of Electrodes:	g1-all = –100 Vdc p-all = –100 Vdc	4.0	Rg-all: Rp-all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg Meg
Transconductance (2):		6.5	Sm:	525	----	----	----	775	----	μmhos
Filament Current:		6.5	If:	44	----	----	----	56	----	mA
Vibration (1):	Rp = 10,000 ohms; F = 40 cps; G = 15	6.5	Ep(1):	----	----	----	----	10	----	mVac
Vibration (2):	F = 50 cps – 3500 cps; Rp = 10,000 ohms (Note 8)	6.5	Ep(2):	----	----	----	----	25	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle = 30° (Note 2)	----	----	----	----	----	----	----	----	----
Fatigue:	G = 2.5; F = 25 cps min., 60 cps max., Fixed Frequency (Note 3)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Transconductance (2):		----	Sm:	450	----	----	----	----	----	μmhos
Vibration (1):		----	Ep:	----	----	----	----	15	----	mVac
Diode Emission		----	Iis:	0.2	----	----	----	----	----	mAdc
Minitaure Tube Base Strain:		----	----	----	----	----	----	----	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristics 1st Sample	Allowable Defects per Characteristics Combined Samples
ACCEPTANCE LIFE TESTS								
Intermittent Life Test:	Ef = 1.25 Vdc or Vac with Equivalent Bias, Group A	----	t:	500	----	Hours	----	----
Intermittent Life Test End Points:								
Transconductance (2)		----	Sm (2):	450	----	μmhos	----	----
or AC Amplification		----	Ep:	5.0	----	Vac	----	----
Emission (Diode)		----	Iis:	0.2	----	mAdc	----	----

NOTES

Note 1: Characteristics, Quality Control Procedures, and Inspection Levels are made according to the appropriate paragraph of MIL-E-1, and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10 % heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Plate and Screen Voltages should not exceed these values under any circumstances.

Note 8: The tube under test shall be rigidly mounted on a vibration table vibrating with simple harmonic motion. The test conditions of paragraph 4.9.19.1 of MIL-E-1 shall be applied and Ep monitored while the frequency of vibration is continuously swept from 50 – 3500 cps and the peak acceleration controlled constant at 2 G. A low pass filter which follows the load resistor of the tube under test shall have a cut-off frequency of 3500 cps. The total time of swept shall not be less than one (1) minute.

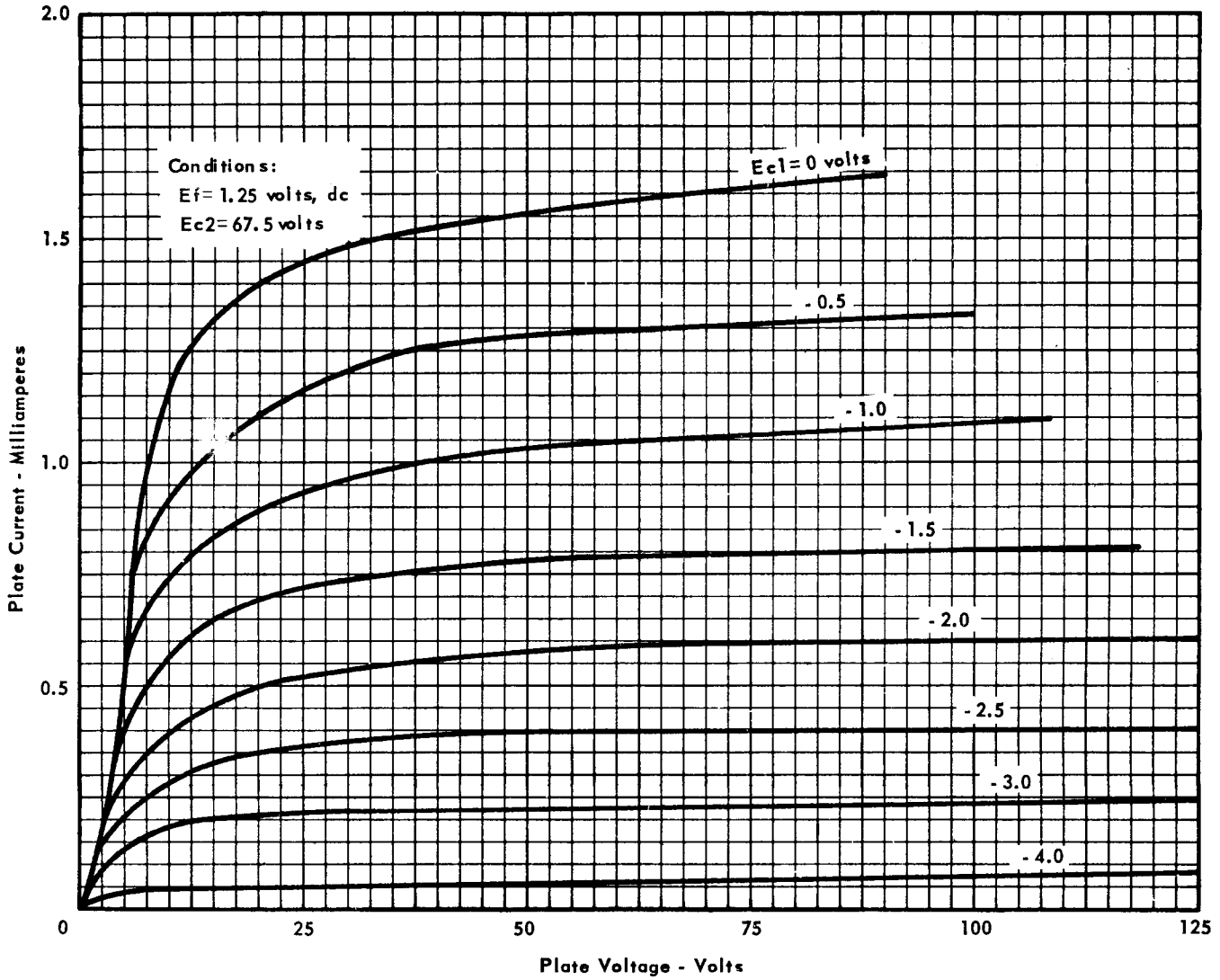
Note 9: Tubes shall be so shielded that operator proximity or movement will not affect output readings.

Note 10: The rejection level shall be set at the VU meter reading obtained during calibration.

RAYTHEON

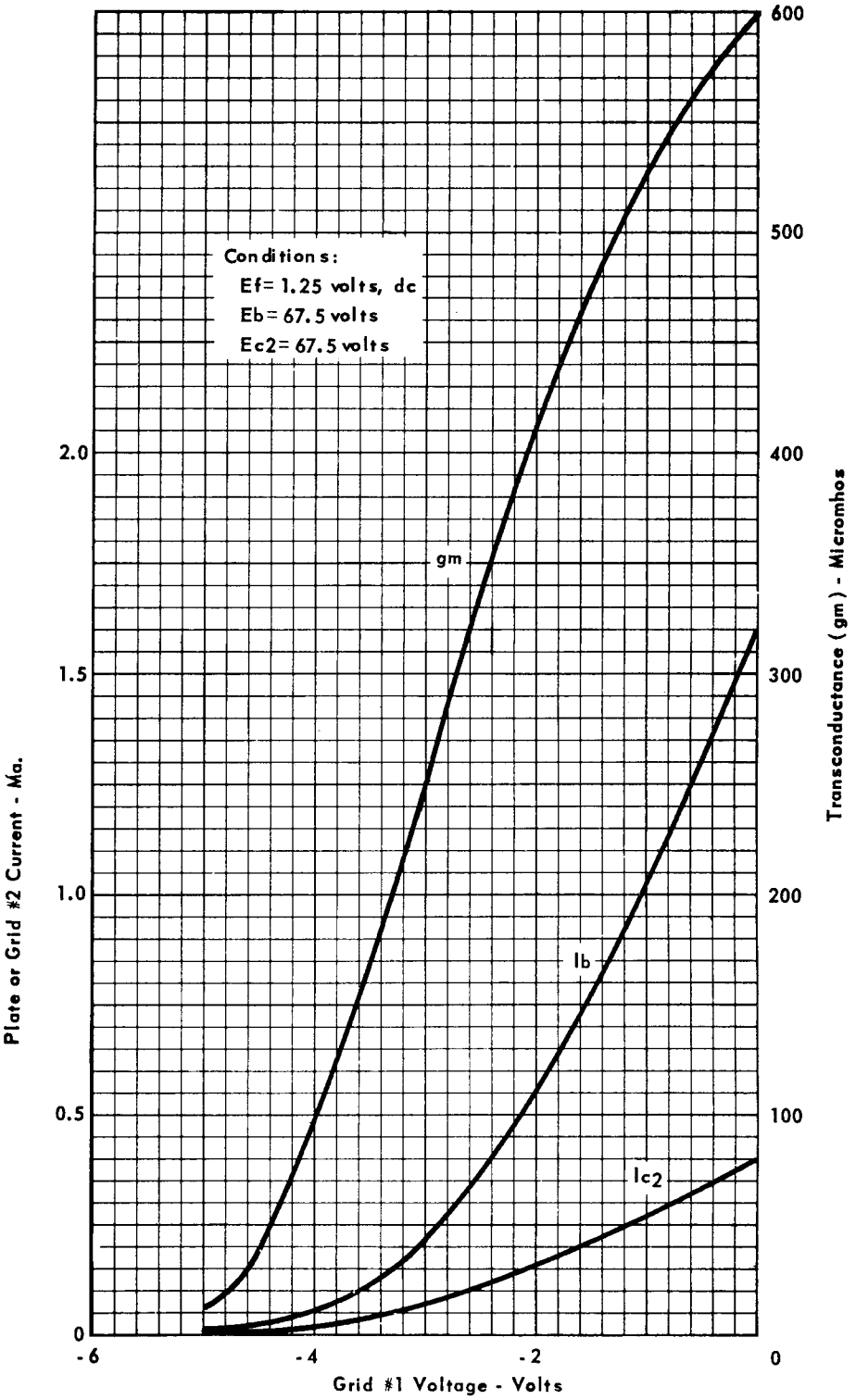
DIODE PENTODE

AVERAGE PLATE CHARACTERISTICS



DIODE PENTODE

AVERAGE CHARACTERISTICS



RADIO MANUFACTURERS ASSOCIATION
ENGINEERING DEPARTMENT

sponsor:
Raytheon Manufacturing Co.

Release No. 413

June 15, 1945

RMA TYPE

2B25

Half Wave Rectifier

Filament Type

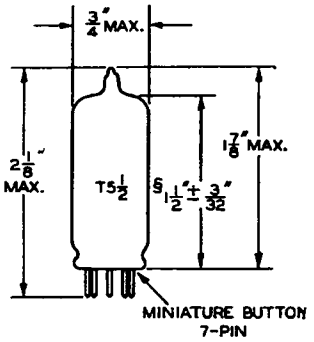
General Characteristics

Mechanical

Bulb	T-5 1/2
Base	7-Pin Button: (3/8" D. Pin Circle: 0.040" Pins)
Mounting Position	Any
Maximum Overall Length	2 1/8"
Maximum Seated Height	1 7/8"
Maximum Diameter	3/4"
Basing	3T-0-2,6,&7

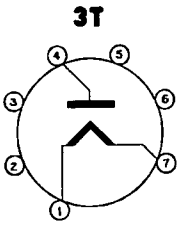
Electrical

Filament Voltage	1.4	volts
Filament Current	0.110	amp
Maximum Peak Inverse Voltage	2800	volts
Maximum A-C peak Plate Current	9.0	ma
Tube Voltage Drop: Measured with Applied D.C. at 4 ma Plate Current	60	volts
Maximum D.C. Output Current	1.5	ma
Maximum Plate Voltage (RMS)	1250	volts



5-2

§ MEASURED FROM BASE SEAT TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 7/16" I.D.



[illegible] RMA TYPE RX-233A [illegible] RX-233A

The RX-233A is a small argon filled thyratron tube with a rugged oxide coated filament, designed particularly for high voltage-low current operation in applications where constancy of characteristics is necessary with large variations in ambient temperature.

Type 2C33
RMA release # 334, April 22, 1943

BULB: T-9 Glass

BASE: Intermediate Octal 8-Pin

DIMENSIONS

Maximum Overall Length	4 5/16	inches
Maximum Seated Height	3 3/4	inches
Maximum Diameter	1 17/64	inches

BASING (RMA Designation)

Pin 1 - No Connection	Pin 5 - Grid
Pin 2 - Filament	Pin 6 - No Connection
Pin 3 - No Connection	Pin 7 - Filament
Pin 4 - No Connection	Pin 8 - No Connection

Top Cap - Plate

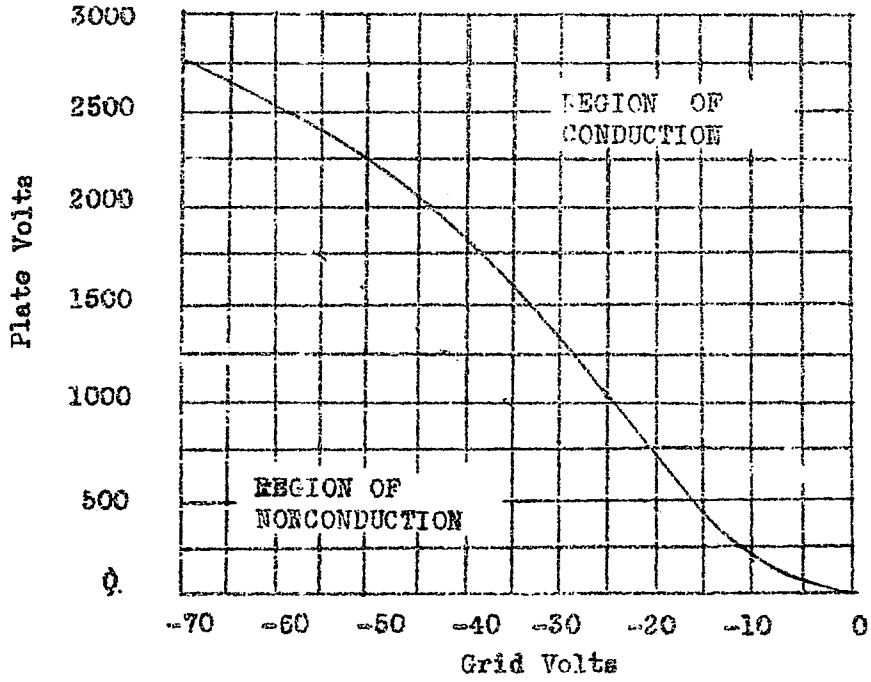
DIRECT INTERELECTRODE CAPACITANCES

G to P (Grid to Anode)	1.5	μμf

RATINGS (Grid-Controlled Rectifier)

Nominal Heater Voltage (a-c or d-c)	2.5	volts
Nominal Heater Current	2.5	amp
Minimum Heating Time	2	sec
Maximum Peak Forward Anode Voltage	1500	volts
Maximum Peak Inverse Anode Voltage	1500	volts
Maximum Peak Anode Current	1500	ma
Maximum Average Anode Current	35	ma
Tube Voltage Drop (Approx.)	15	volts
Maximum Grid Resistor	1.0	megohms
Minimum Grid Resistor	.05	megohms

AVERAGE CONTROL CHARACTERISTICS



Release 373
1/1/43

2C34 TENTATIVE RMA TYPE 2C34 2C34

TWIN TRIODE POWER AMPLIFIER OSCILIATOR

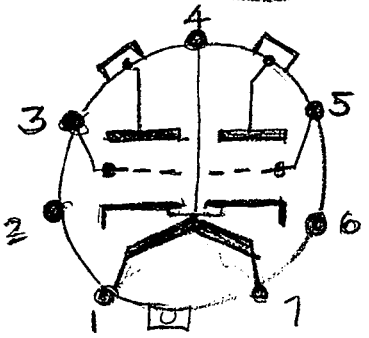
The 2C34 (RK-34) is a heater type twin triode power amplifier tube having a phenolic base. It is designed for use as a power amplifier oscillator or frequency multiplier.

BULB: ST-14 Glass MOUNTING POSITION: Any

CAPS: Small Metal

BASE: Medium Shell 7-Pin

7BL



DIMENSIONS

Maximum Overall Length	5 3/16	inches
Maximum Seated Height	4 9/16	inches
Maximum Diameter	1 13/16	inches

BASING (RMA Designation)

Pin 1 - Heater
Pin 2 - No Connection
Pin 3 - Grid-Right
Pin 4 - Cathode
Top Cap (adjacent to pin 3) - Plate-Right
Top Cap (adjacent to pin 5) - Plate-Left
Pin 5 - Grid-Left
Pin 6 - No Connection
Pin 7 - Heater

DIRECT INTERELECTRODE CAPACITANCES - Each Triode*

G to P (Grid to Plate)	2.4	μμf
G to K (Input)	3.4	μμf
P to K (Output)	0.5	μμf

RATINGS

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	0.8	amp
Maximum Plate Voltage	300	volts
Maximum Plate Dissipation (each triode)	5	watts
Maximum Peak Plate Current (each triode)	125	ma
Maximum D-C Plate Current (each triode)	40	ma

R-F POWER AMPLIFIER OR OSCILLATOR - PUSH-PULL - CLASS C

D-C Plate Voltage	300	volts
D-C Grid Voltage	-56	volts
D-C Plate Current	80	ma
D-C Grid Current	20	ma
Peak R-F Input Voltage (grid to grid)	196	volts
R-F Driving Power	1.8	watts
Power Output	16	watts

*Triode not under test connected to ground. Tube tested without shield.

A-F POWER AMPLIFIER - CLASS B
TYPICAL OPERATION

D-C Plate Voltage	180	300	volts
D-C Grid Voltage	-6	-15	volts
D-C Plate Current (no signal)	30	30	ma
D-C Plate Current (max. signal)	70	70	ma
D-C Grid Current (max. signal)	16	12	ma
Peak A-F Input Voltage (grid to grid)	100	100	volts
A-F Driving Power	0.7	0.5	watts
Load Resistance (plate to plate)	6000	10000	ohms
Power Output	7.8	15	watts

A-F POWER AMPLIFIER - CLASS A (Triodes in parallel)
TYPICAL OPERATION

D-C Plate Voltage	300	volts
D-C Grid Voltage	16	volts
D-C Plate Current	25	ma
Amplification Factor	13	
Plate Resistance	3100	ohms
Transconductance	4200	μmhos
Load Resistance	5000	ohms
Power Output	0.8	watts

FREQUENCY RANGE

The 2C34 may be operated at maximum ratings up to 60 megacycles, 75% of rated input may be used at 120 megacycles and 50% of rated input at 160 megacycles.

BIAS

At least 15 volts of fixed bias should be used with 300 volts on the plate to protect the tube in case of failure of the bias or excitation.

PLATE TEMPERATURE

The plates of the 2C34 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.

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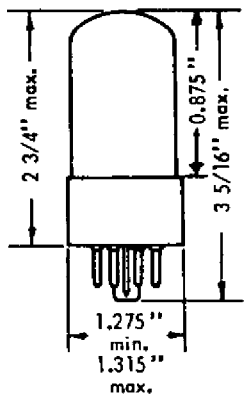
TECHNICAL INFORMATION

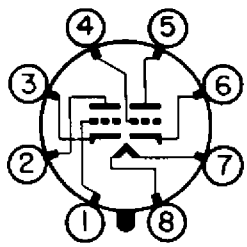
DOUBLE TRIODE

Excellence in Electronics

TYPE 2C50

The 2C50 is a heater-cathode type low power double triode designed particularly for use in "descriminator" circuits of servo amplifiers.





BOTTOM VIEW

8BD

MECHANICAL DATA

ENVELOPE: T-9 Glass

BASE: Special Shell, Octal 8-Pin B8-132, Melamine with barriers between pins inside and out (see tube outline drawing for dimensions)

TERMINAL CONNECTIONS:

Pin 1 Grid, Unit 2	Pin 5 Plate, Unit 1
Pin 2 Plate, Unit 2	Pin 6 Cathode, Unit 1
Pin 3 Cathode, Unit 2	Pin 7 Heater
Pin 4 Grid, Unit 1	Pin 8 Heater

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage (ac or dc)	12.6 volts
Heater Current	0.30 amps.
Heater-Cathode Voltage	±100 volts

RATINGS-ABSOLUTE MAXIMUM VALUES:

Peak Inverse Plate Voltage	900 volts
Peak Forward Plate Voltage	800 volts
DC Grid Voltage	-200 volts
Plate Dissipation per Plate	3.85 watts

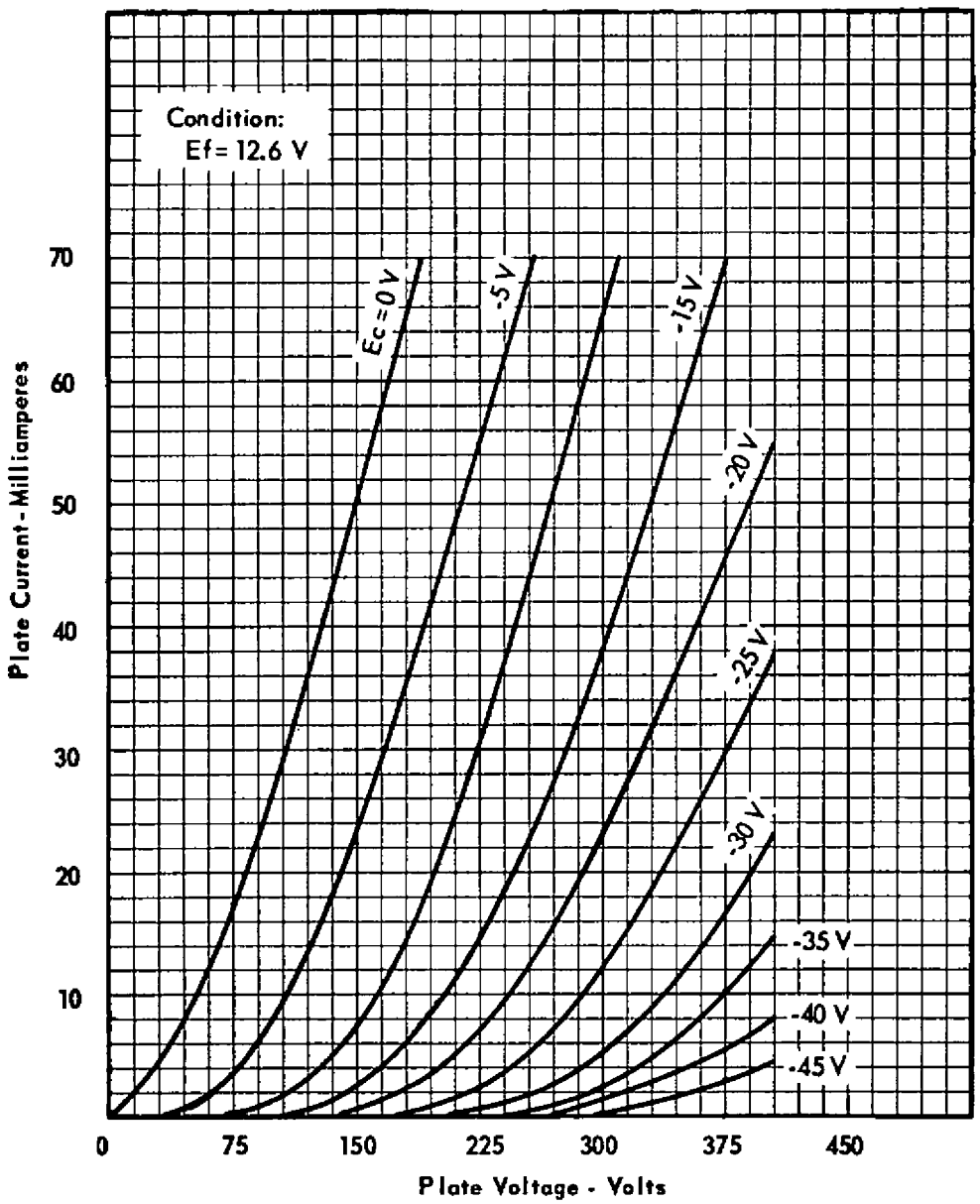
CHARACTERISTICS-CLASS A1 AMPLIFIER: (each unit)

Plate Voltage	200 volts
Grid Bias Voltage	-11 volts
Amplification Factor	10
Plate Resistance	3450 ohms
Transconductance	2900 μmhos
Plate Current	18 ma.
Plate Current at Ec1=28 V (Approx.)	0.5 ma.

from JETEC release #1419, March 28, 1955

Tentative Data

AVERAGE PLATE CHARACTERISTICS



from RMA release # 687,
Aug. 16, 1948

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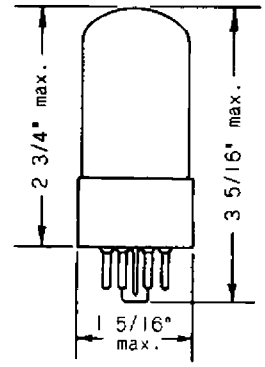
TYPE 2C52

DOUBLE TRIODE

DESCRIPTION

The 2C52 is a heater-cathode type high-mu double triode amplifier, designed for use as a voltage amplifier in critical electronic equipment requiring extreme stability and long life.

MECHANICAL DATA

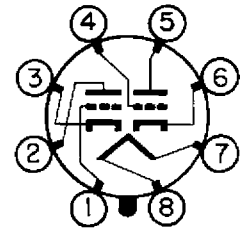


ENVELOPE: T-9 Glass

BASE: Intermediate Shell Octal 8-Pin

TERMINAL CONNECTIONS: *(JETEC Designation 8BD)*

Pin 1	Grid, Unit 2	Pin 5	Plate, Unit 1
Pin 2	Plate, Unit 2	Pin 6	Cathode, Unit 1
Pin 3	Cathode, Unit 2	Pin 7	Heater
Pin 4	Grid, Unit 1	Pin 8	Heater



BOTTOM VIEW

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(μμfds.)**

Grid to Plate	2.7
Grid to Cathode	2.3
Plate to Cathode	0.75
Grid (Unit 1) to Grid (Unit 2)	0.02
Plate (Unit 1) to Plate (Unit 2)	0.65

DESIGN CENTER MAXIMUM RATINGS - EACH UNIT:

Heater Voltage (ac or dc)**	12.6	volts
Plate Voltage	300	volts
Grid Voltage	-100	volts
DC Grid Current	2	ma.
DC Plate Current	5	ma.
Plate Dissipation	1	watt
Heater-Cathode Voltage	90	volts
Maximum Grid Circuit Resistance #	2	megohms

CHARACTERISTICS AND LIMITS - EACH UNIT:

Ef = 12.6V; Eb = 250Vdc; Ec = -2.0Vdc; Ehk = ± 100Vdc

	Min.	Rating	Max.	
Heater Current	275	300	325	ma.
Heater-Cathode Current	0	—	20	μa.
Plate Current	0.9	1.3	1.7	ma.
Plate Current at Ec = -5.0Vdc	0	—	25	ua.
Plate Current Difference between Triode Units	—	—	0.6	ma.
Grid Current	0	—	-0.5	μa.
Amplification Factor	85	100	115	
Transconductance	1400	1900	2400	μmhos
Voltage Gain ##	50	60	70	

TYPICAL OPERATION - RESISTANCE COUPLED AMPLIFIER - EACH UNIT:

Ef = 12.6V; Grid Resistor of following stage = 0.5 meg.; Adequate coupling and Cathode By-pass Condensers:

DC Plate Supply Voltage	100	100	250	volts
Plate Resistor	0.5	0.25	0.25	megohms
Grid Resistor	10	1.0	1.0	megohms
Cathode Resistor	0	15,000	6,000	ohms
Peak Output Voltage	16	13	53	volts
Voltage Gain	45	30	50	

(See reverse side for notes)

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DOUBLE TRIODE

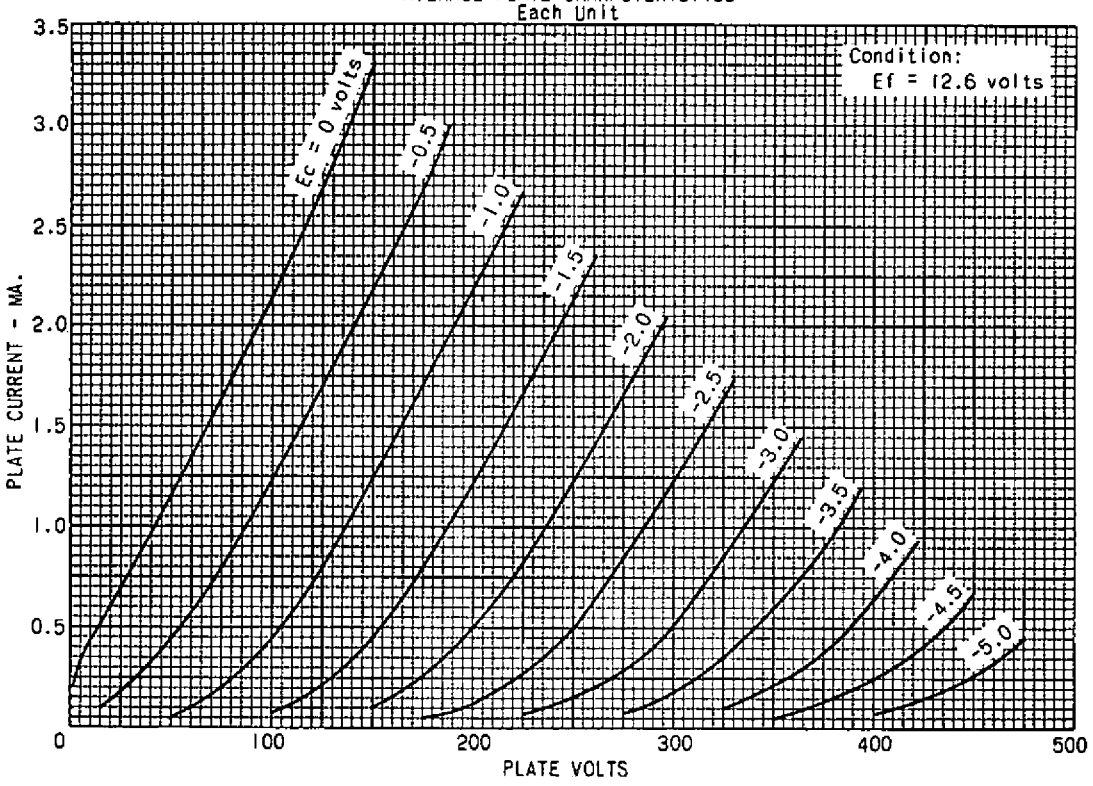
* *Without shield. Approximate values for each triode unit.*

** *To achieve long life, the heater voltage variation should not exceed ±5%; variations of ±10% are allowable providing they occur no more than 2% of the operating time.*

\# *For Grid Current bias operation, with a minimum plate resistor of 0.25 megohm, a grid resistor of 10 megohms may be used.*

\#\# *Measured with a 10 megohm grid resistor, zero external bias, 0.5 megohm plate resistor, 10 megohm impedance in following stage and a 100 volt dc plate supply.*

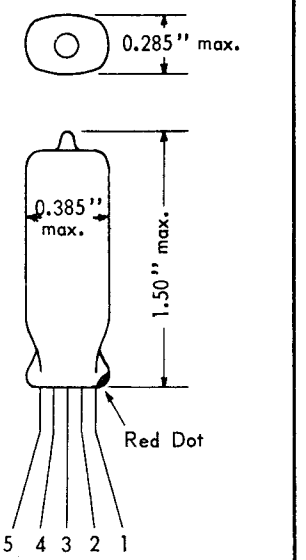
AVERAGE PLATE CHARACTERISTICS
Each Unit



Excellence in Electronics

TYPE 2E31

The 2E31 is a filament type, fully-shielded pentode of subminiature construction designed for use as an RF or IF amplifier in applications requiring economy of space, weight and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ▲

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, positive ■
Lead 3 Filament, negative; shield ■	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.)

Grid to Plate: (g1 to p)	0.08 max.
Input: g1 to (f+g2)	4.2
Output: p to (f+g2)	4.0

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc) ●	1.25 volts
Plate Voltage	45 volts
Grid #2 Voltage	45 volts
Total Cathode Current	1.0 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc) ●	1.25 volts
Filament Current	50 ma.
Plate Voltage	22.5 volts
Grid #2 Voltage	22.5 volts
Grid #1 Voltage ♦	0 volts
Plate Resistance (approx.)	0.35 megohms
Transconductance	500 μmhos
Plate Current	0.4 ma.
Grid #2 Current	0.3 ma.
Grid #1 Voltage (approx.) for plate current = 10 μa.	-2.0 volts

▲ *Bulb is entirely coated with a metallic shield connected to Lead 3.*

♦ *Grid resistor = 5 megohms.*

■ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

● *Do not use in series filament circuits. Filament voltage must never exceed 1.55 volts.*

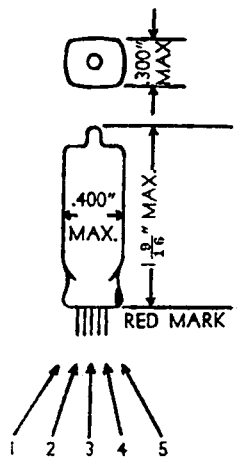
Tentative Data

RAYTHEON
Engineering Service

SUB-MINIATURE SHIELDED PENTODE SHARP CUT-OFF R-F AMPLIFIER

COATED FILAMENT

The 2E32 is a shielded pentode designed for use as an R-F amplifier in radio receivers and other portable equipment where small size, light weight and low battery drain are important. The 2E32 is designed for plug-in use with a socket.



T2x3 Glass Bulb

1—Filament Pos. and Suppressor
2—Grid #1
3—Filament Neg. and Shield†
4—Grid #2
5—Plate

0.016" dia. pins. 0.05" center to center spacing. Pins identified by red mark over plate pin. Pin length 0.200".

RATINGS

Filament Voltage	1.25	volts
Filament Current	50	ma
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts
Maximum Cathode Current	1.0	ma

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate (Maximum)	0.018	$\mu\mu f$
Input	2.1	$\mu\mu f$
Output	3.8	$\mu\mu f$

TYPICAL CLASS A_1 CHARACTERISTICS

Plate Voltage	22.5	volts
Screen Voltage	22.5	volts
Control Grid Voltage*	0	volts
Plate Current	0.35	ma
Screen Current	0.3	ma
Transconductance	500	μmhos
Plate Resistance	0.35	meg.
Grid Bias for Plate Current = 10 μa	—1.8	volts

* Grid resistance = 5 megohms.
† Bulb is entirely coated with a metallic shield.

from RMA release # 450, Nov. 10, 1945

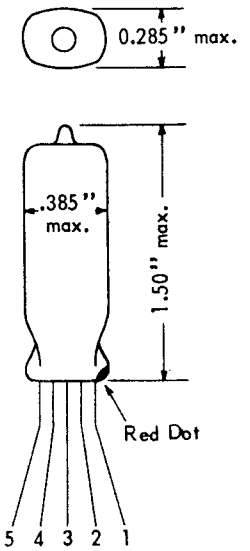
October 15, 1945 — Preliminary Data CS-2260

RADIO RECEIVING TUBE DIVISION — NEWTON, MASS.

Excellence in Electronics

TYPE 2E35

The 2E35 is a filament type pentode of subminiature construction designed for use as a power amplifier in applications requiring economy of space, weight and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.048" center-to-center

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament,
Lead 3 Filament, negative ■	positive ■

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) ▲

Grid to Plate: (g1 to p)	0.2	max.
Input: g1 to (-f+g2)	2.7	
Output: p to (-f+g2)	5.7	

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc) ●	1.25	volts
Plate Voltage	45	volts
Grid #2 Voltage	45	volts
Total Cathode Current	1.0	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc) ●	1.25	1.25	volts
Filament Current	30	30	ma.
Plate Voltage	22.5	45	volts
Grid #2 Voltage	22.5	45	volts
Grid #1 Voltage	0 ♦	-1.25	volts
Plate Resistance (approx.)	0.22	0.25	meg.
Transconductance	385	500	μmhos
Plate Current	0.27	0.45	ma.
Grid #2 Current	0.07	0.11	ma.
Load Resistance	0.15	0.10	meg.
Total Harmonic Distortion	10	10	percent
Power Output	1.2	6	mw

▲ *With shield connected to Lead 3.*

■ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

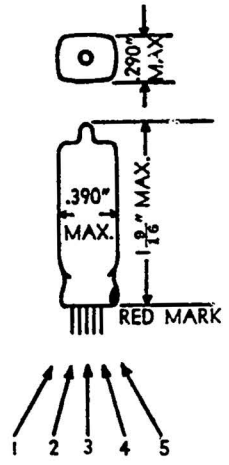
● *Do not use in series filament circuits. Filament voltage must never exceed 1.55 volts.*

♦ *Grid resistor = 5 megohms.*

RAYTHEON
Engineering Service

PENTODE SUB-MINIATURE POWER AMPLIFIER

COATED FILAMENT



T2x3 Glass Bulb

1—Filament Pos. and Suppressor
2—Grid #1
3—Filament Neg.
4—Grid #2
5—Plate

0.016" dia. pins. 0.05" center to center spacing. Pins identified by red mark over plate pin. Pin length 0.200".

The 2E36 is a pentode designed for use as a power amplifier in radio receivers and other portable equipment where small size, light weight and low battery drain are important. The 2E36 is designed for plug-in use with a socket.

RATINGS

Filament Voltage	1.25	volts
Filament Current	30	ma
Maximum Plate Voltage	45	volts
Maximum Screen Voltage	45	volts
Maximum Cathode Current	1.0	ma

DIRECT INTERELECTRODE CAPACITANCES†

Grid to Plate	0.2 max.	μμf
Input	2.7	μμf
Output	5.7	μμf

TYPICAL CLASS A_1 AMPLIFIER OPERATION AND CHARACTERISTICS

Plate Voltage	22.5	45	volts
Screen Voltage	22.5	45	volts
Control Grid Voltage	0*	—1.25	volts
Plate Current	0.27	0.45	ma
Screen Current	0.07	0.11	ma
Transconductance	385	500	μmhos
Plate Resistance	0.22	0.25	megohm
Load Resistance	0.15	0.10	megohm
Distortion	10	10	per cent
Power Output	1.2	6	mw

* Grid resistance = 5 megohms.

† With close fitting capacitance adapter shield connected to negative filament.

from RMA release # 450, Nov. 10, 1945

October 15, 1945 Preliminary Data CS-2263

RADIO RECEIVING TUBE DIVISION NEWTON, MASS.

RAYTHEON MANUFACTURING COMPANY

RAYTHEON

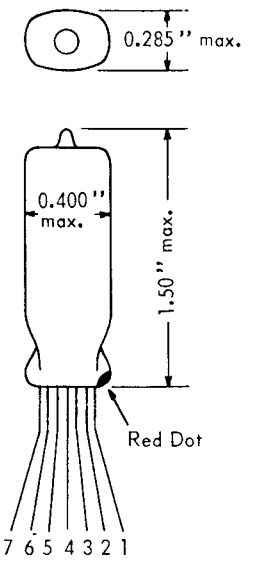
TECHNICAL INFORMATION

SUBMINIATURE
TRIODE HEPTODE

Excellence in Electronics

TYPE 2G21

The 2G21 is a filament type triode heptode of subminiature construction designed for use as a combined oscillator and mixer in radio receivers or other portable equipment requiring economy of space, weight and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.50" min. Spacing: 0.04" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate, triode
Lead 2 Plate, heptode
Lead 3 Grid #1, triode
Lead 4 Filament, negative
Lead 5 Grid #3, heptode
Lead 6 Grids #2 and #4, heptode
Lead 7 Filament, positive; Grid #5

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(μμfds.)* *

Signal Grid to Mixer Plate: (g3h to ph)	0.065
Signal Grid to Oscillator Plate: (g3h to pt)	0.022
Signal Grid to Oscillator Grid: (g3h to gt)	0.14
Oscillator Grid to Oscillator Plate: (gt to pt)	1.3
Signal Input: g3h to (f&g5h+gt+g2h&g4h+pt+ph+shd)	3.5
Oscillator Input: gt to (f&g5h+g3h+g2h&g4h+ph+shd)	3.8
Oscillator Output: gt to (f&g5h+g3h+g3h+g2h&g4h+ph+shd)	3.7
Mixer Output: ph to (f&g5h+gt+g2h&g4h+pt+g3h+shd)	3.6

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc) ●	1.25 volts
Plate Voltage, heptode	45 volts
Grids #2 and #4 Voltage	45 volts
Plate Voltage, triode	45 volts
Grid #3 Voltage	Never Positive
Total Cathode Current	2.0 ma.

CHARACTERISTICS AND TYPICAL OPERATION - FREQUENCY CONVERTER:

Filament Voltage (dc) ●	1.25 volts
Filament Current	50 ma.
Plate Voltage, heptode	22.5 volts
Grids #2 and #4 Voltage	22.5 volts
Plate Voltage, triode	22.5 volts
Grid #3 Voltage ▲	0 volts
Oscillator Grid (Grid #1) Resistor	50000 ohms
Plate Current, heptode	200 μa.
Grids #2 and #4 Current	300 μa.
Conversion Plate Resistance (approx.)	0.5 megohms
Plate Current, triode	1.0 ma.
Oscillator Grid (Grid #1) Current	30 μa.
Conversion Transconductance	60 μmhos
Grid #3 Voltage (approx.) for Conversion Transcond.= 2 μmhos	-3.5 volts

* *With shield connected to Lead 4.*

▲ *Grid #3 resistor = 5 megohms.*

● *Do not use in series filament circuits. Filament voltage must never exceed 1.55 volts.*

Tentative Data

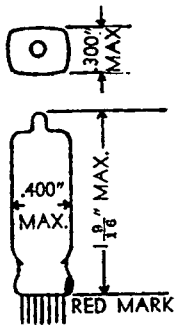
Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY
RECEIVING AND CATHODE RAY TUBE OPERATIONS
March 1, 1956 NEWTON 58, MASS.

RAYTHEON
Engineering Service

TRIODE-HEPTODE SUB-MINIATURE FREQUENCY CONVERTER

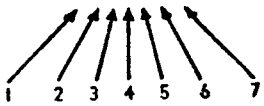
COATED FILAMENT



The 2G22 is a triode-heptode designed for use as a combined mixer and oscillator in radio receivers and other portable equipment where small size, light weight and low battery drain are important. The 2G22 is designed for plug-in use with a socket.

RATINGS

Filament Voltage	1.25	volts
Filament Current	50	ma
Maximum Heptode Plate Voltage	45	volts
Maximum Heptode Screen (G_{2H} and G_{4H}) Voltage	45	volts
Maximum Triode Plate Voltage	45	volts
Maximum Total Cathode Current	2.0	ma
Minimum External Signal Grid Bias	0	volts



T2x3 Glass Bulb

1—Filament Pos. and Heptode Grid #5
2—Heptode Grids #2 and #4
3—Heptode Grid #3
4—Filament Neg.
5—Triode Grid #1
6—Heptode Plate
7—Triode Plate

0.016" dia. pins. 0.05" center to center spacing. Pins identified by red mark over plate pin. Pin length 0.200".

DIRECT INTERELECTRODE CAPACITANCES†

G_3 to P_H (Signal Grid to Mixer Plate)	0.065	μμf
G_3 to P_T (Signal Grid to Osc. Plate)	0.022	μμf
G_3 to G_{1T} (Signal Grid to Osc. Grid)	0.14	μμf
G_{1T} to P_T (Osc. Grid to Osc. Plate)	1.3	μμf
G_3 to All (Signal Input)	3.5	μμf
P_T to All Except G_1 (Osc. Output)	3.8	μμf
G_1 to All Except P_T (Osc. Input)	3.7	μμf
P_H to All (Mixer Output)	3.6	μμf

TYPICAL FREQUENCY CONVERTER OPERATION

Plate Voltage (Heptode)	22.5	volts
Screen Voltage (Heptode Grids #2 and #4)	22.5	volts
Oscillator Plate Voltage (Triode)	22.5	volts
Signal Grid Bias (Heptode Grid #3)*	0	volts
Oscillator Grid Resistor (Triode)	50000	ohms
Plate Current (Heptode)	200	μa
Screen Current (Heptode)	300	μa
Oscillator Plate Current (Triode)	1	ma
Oscillator Grid Current (Triode)	30	μa
Conversion Transconductance	60	μmhos
Conversion Transconductance at Signal Grid Bias = −3.5	2	μmhos
Conversion Plate Resistance (Approx.)	0.5	meg.

* Grid resistance = 5 megohms.

† With close fitting capacitance adapter shield connected to negative filament.

from RMA release # 450, Nov. 10, 1945

October 15, 1945 Preliminary Data CS-2269

RADIO RECEIVING TUBE DIVISION NEWTON, MASS.

RAYTHEON MANUFACTURING COMPANY

Security Classification: Confidential

Type 2J22
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	3300 ± 33 Mc
Field Strength	2250 gauss
Peak anode voltage	20,000 volts
Power output at 30 amperes; .001 duty cycle	240 watts

Mechanical

Maximum Dimensions	- see outline drawing
Base connections	- see outline drawing
Mounting position	- any

Maximum Ratings (peak values for duty cycle specified)

Duty cycle*	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

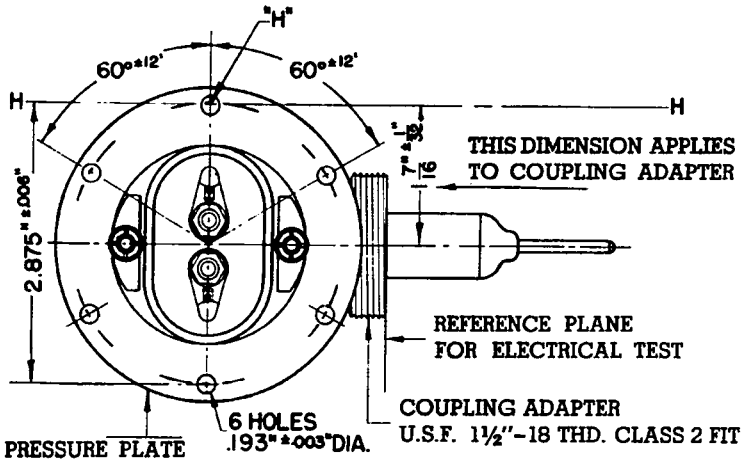
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company, Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

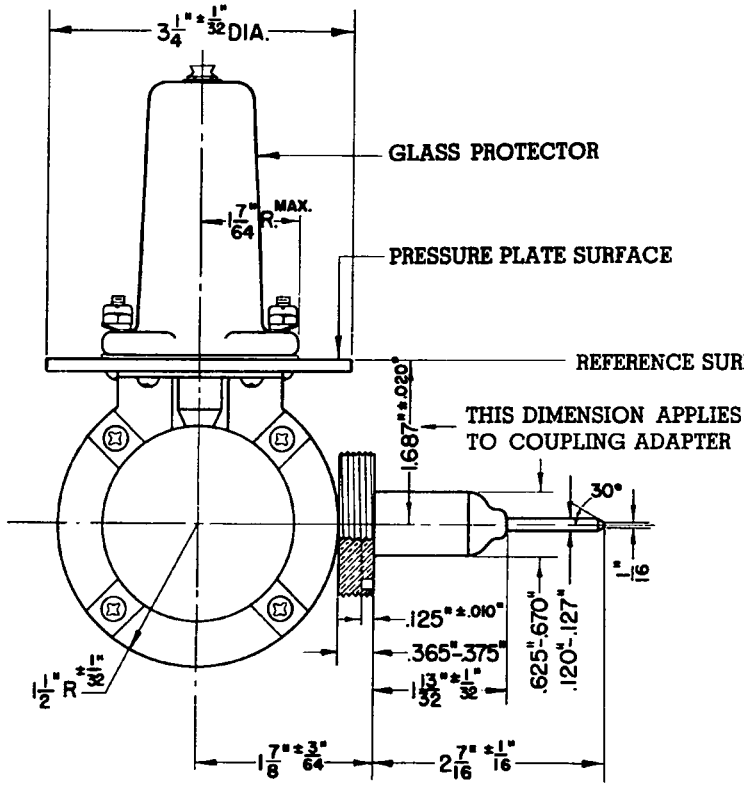


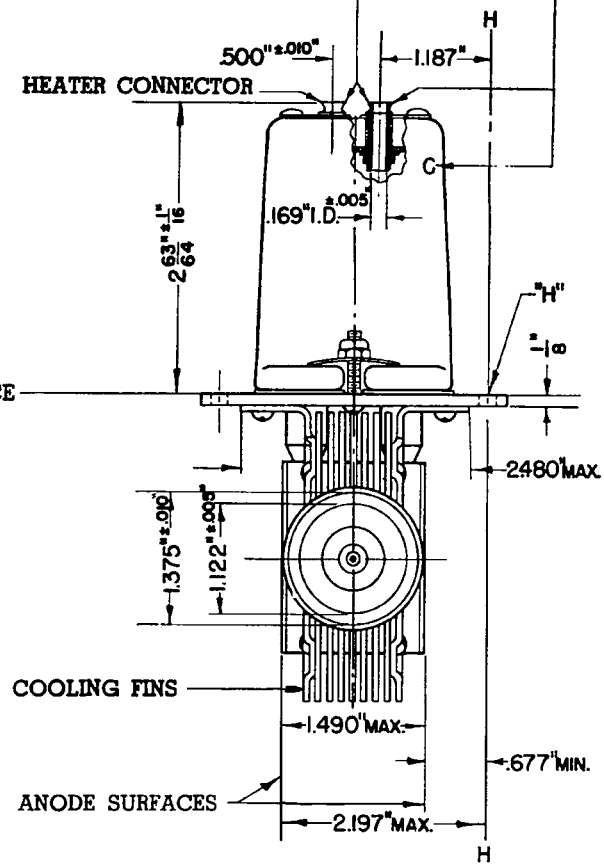
LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS





Security Classification: Confidential

Type 2J23-29
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps

Frequency	Type	Min.	Max.
	2J23	3071	3100 Mc
	2J24	3047	3071 Mc
	2J25	3019	3047 Mc
	2J26	2992	3019 Mc
	2J27	2965	2992 Mc
	2J28	2939	2965 Mc
	2J29	2914	2939 Mc

Field Strength	2400 gauss
Peak Anode Voltage	20,000 volts
Power Output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting Position - any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle *	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

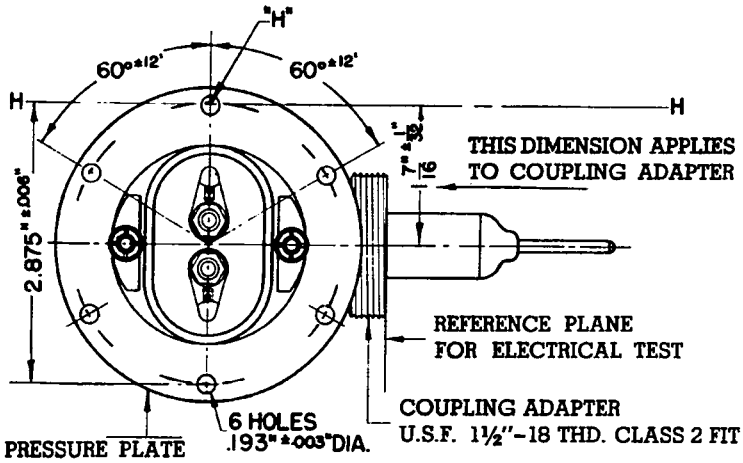
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company, Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

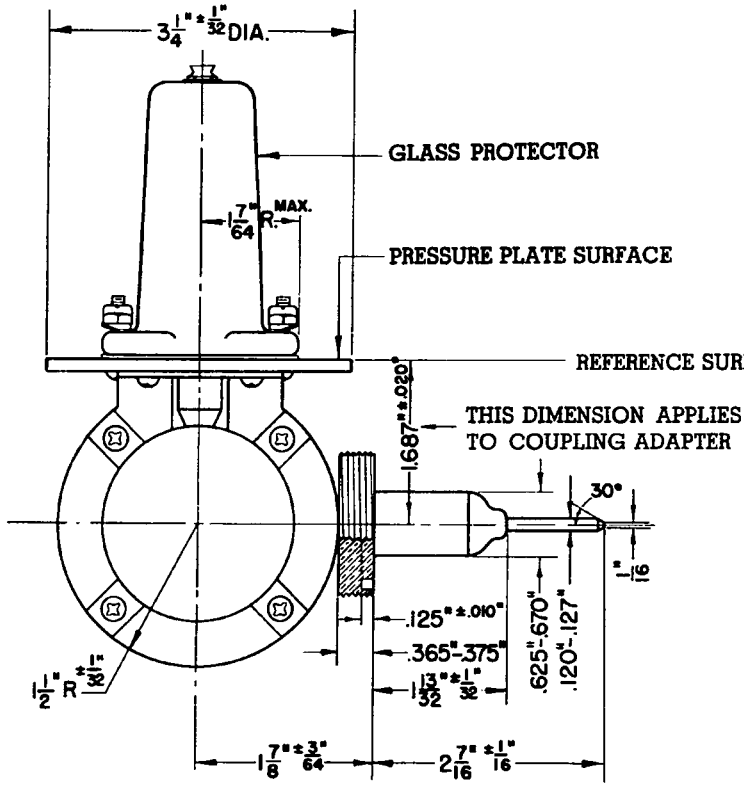


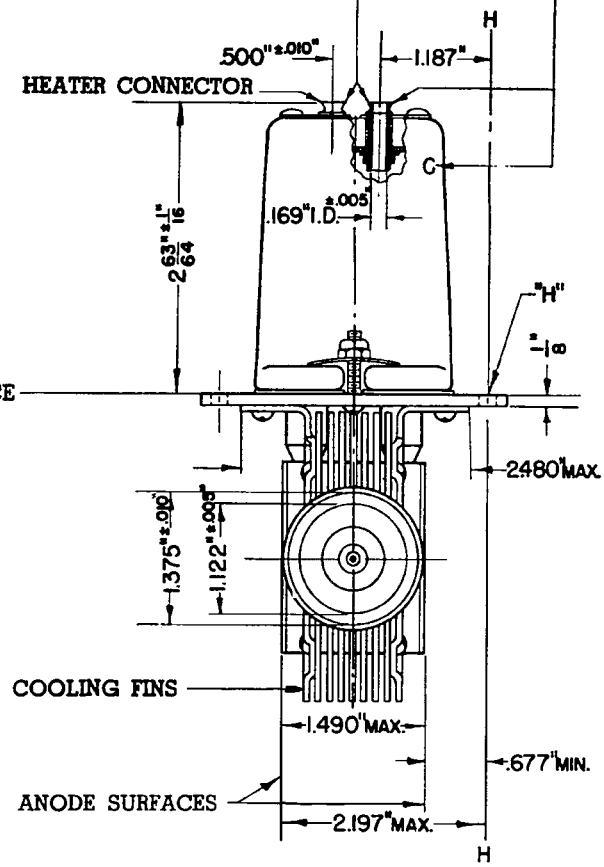
LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS





Security Classification: Confidential

Type 2J30
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	2880 ± 20 Mc
Peak Anode voltage	20,000 volts
Field strength	1900 gauss
Power output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions	- see outline drawing
Base Connections	- see outline drawing
Mounting Position	- any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle *	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

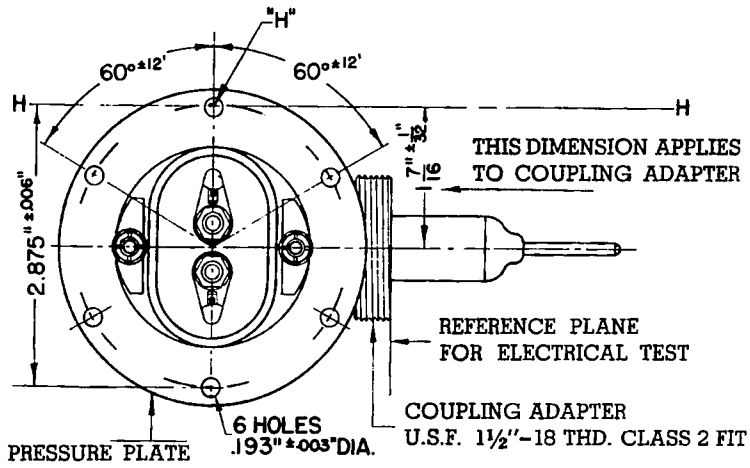
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

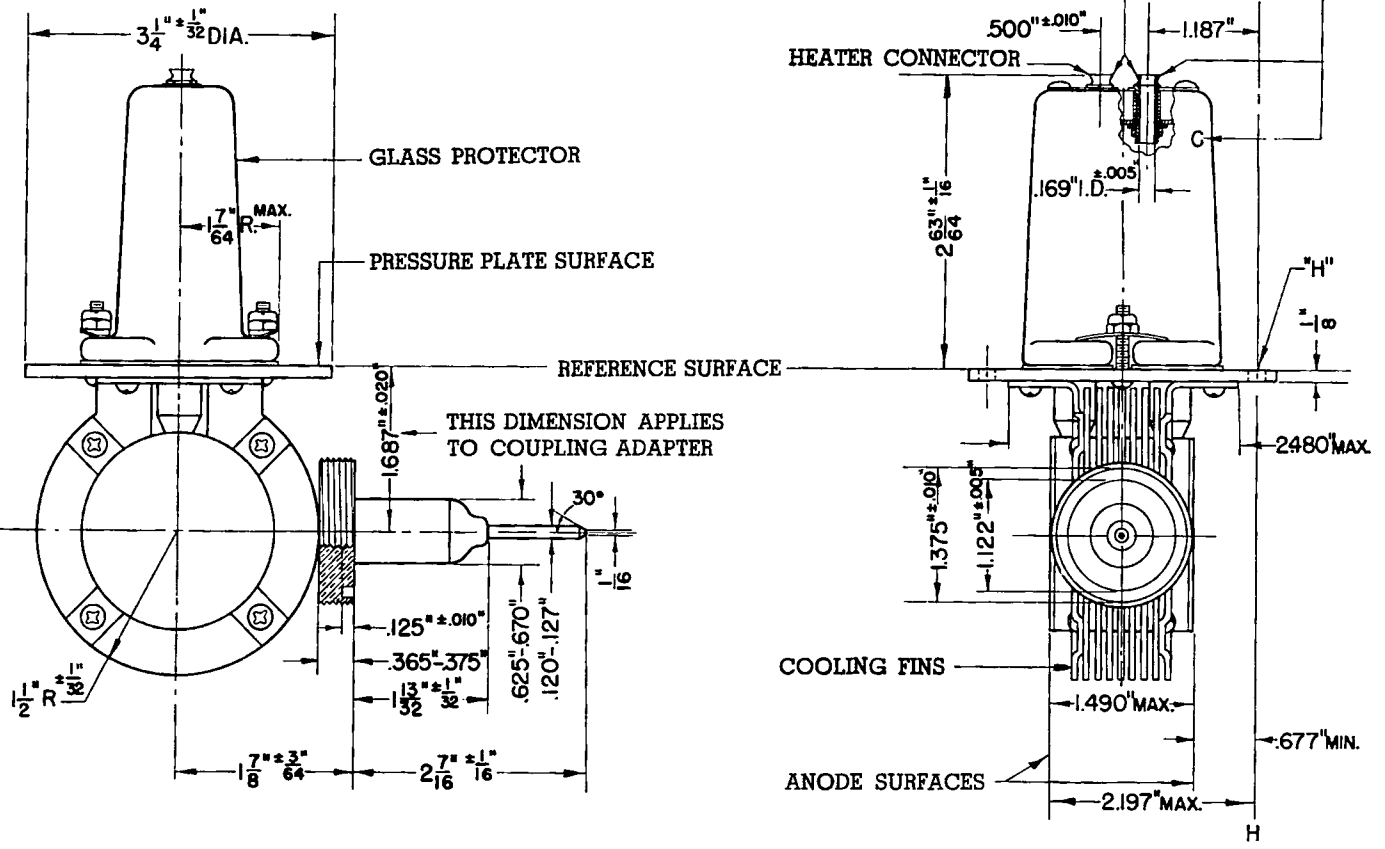


LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS



Security Classification: Confidential

Type 2J31
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	2840 ± 20 Mc
Field Strength	1900 gauss
Peak Anode voltage	20,000 volts
Power output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting position - any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle*	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

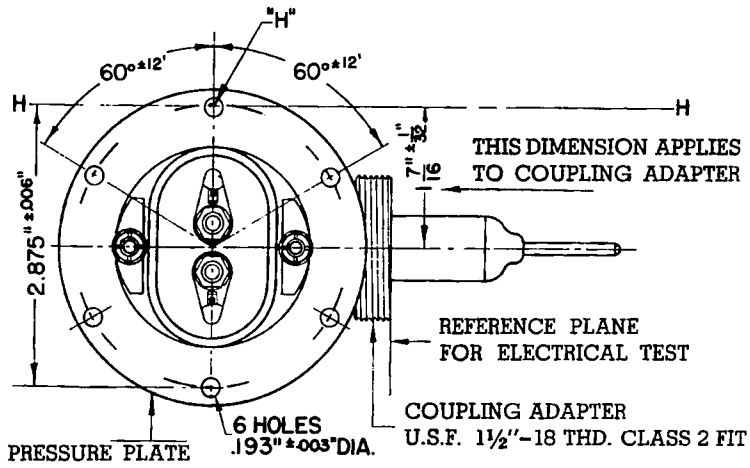
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

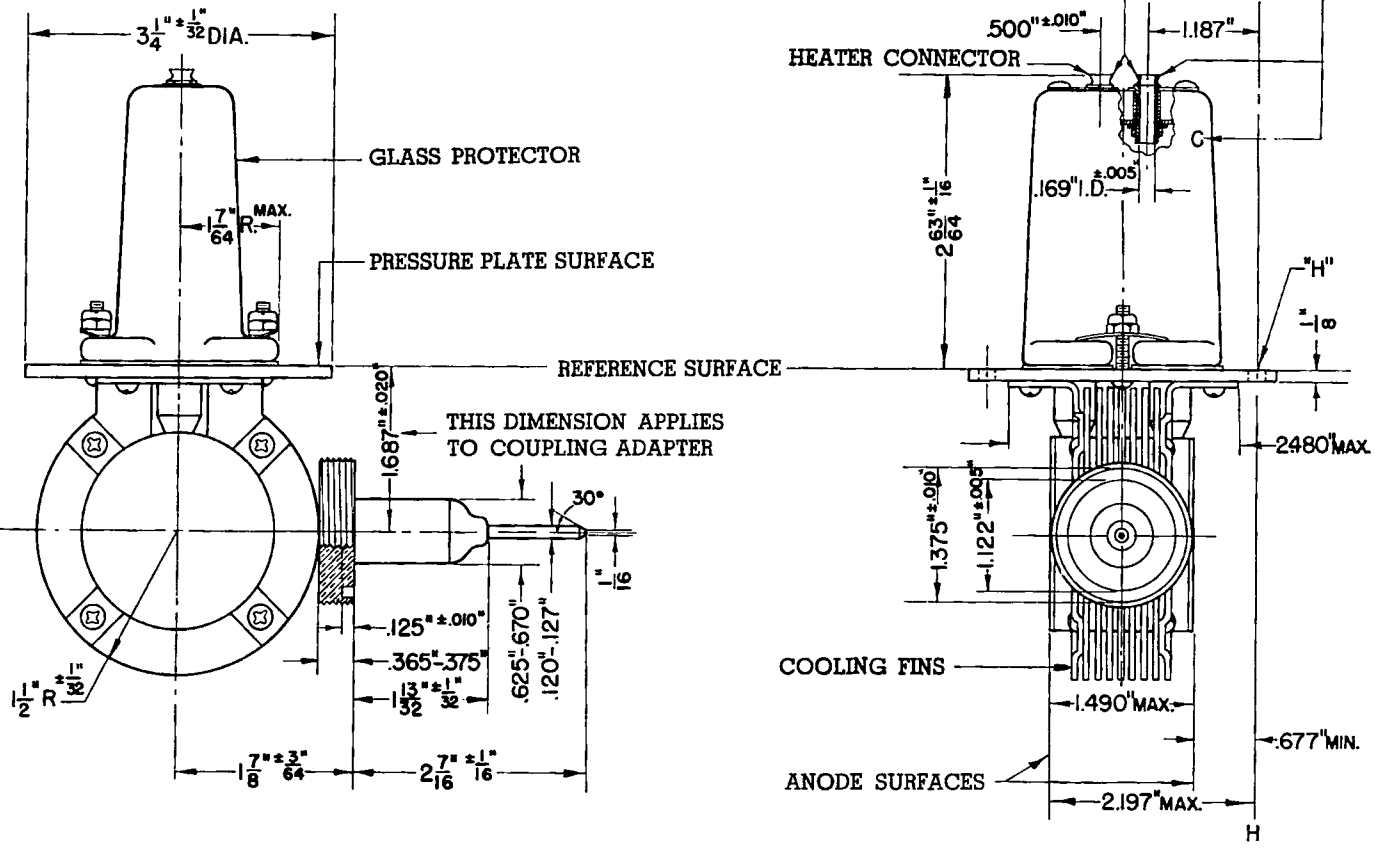


LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

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COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS



Security Classification: Confidential

Type 2J32
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	2800 ± 20 Mc
Field Strength	1900 gauss
Peak anode voltage	20,000 volts
Power output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting Positions - any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle *	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

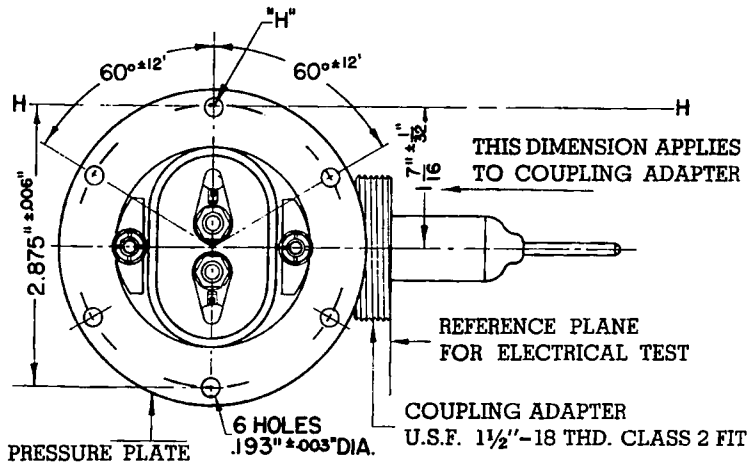
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

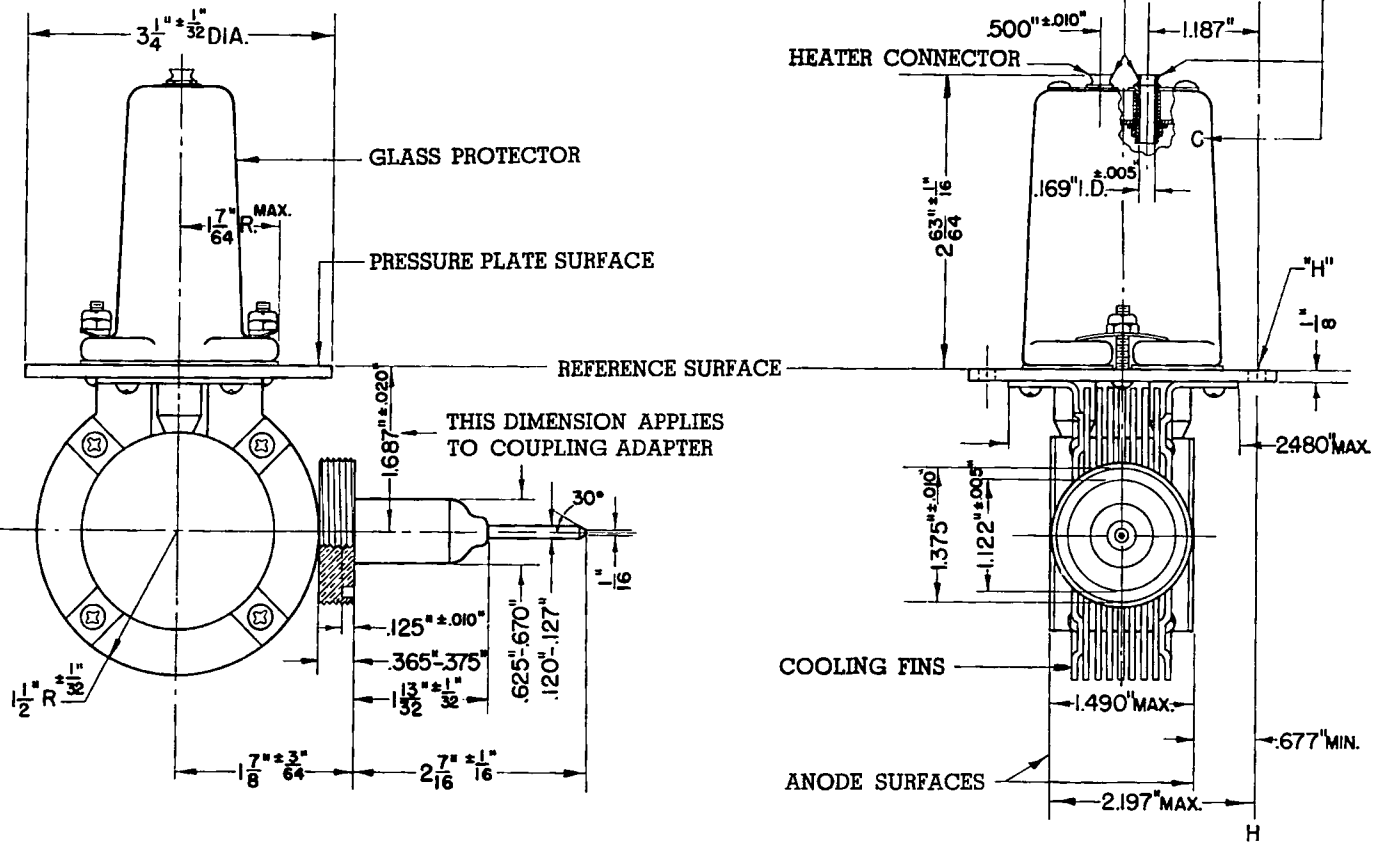


LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

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COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS



Security Classification: Confidential

Type 2J33
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	2760 ± 20 Mc
Field Strength	1900 gauss
Peak Anode Voltage	20,000 volts
Power output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting Position - any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle *	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode Dissipation	350 watts

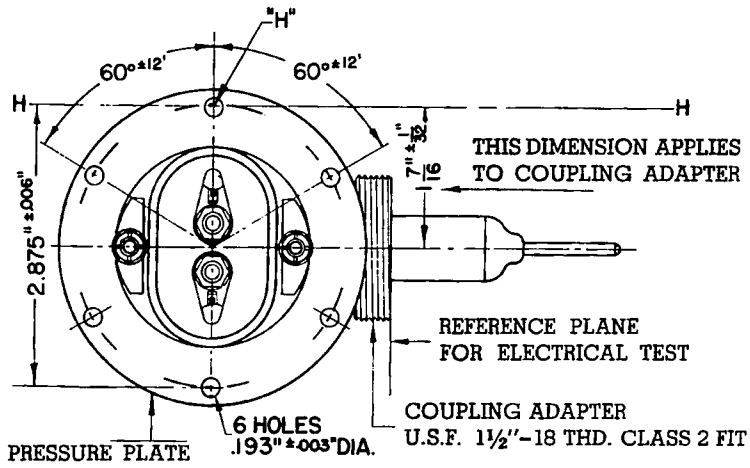
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

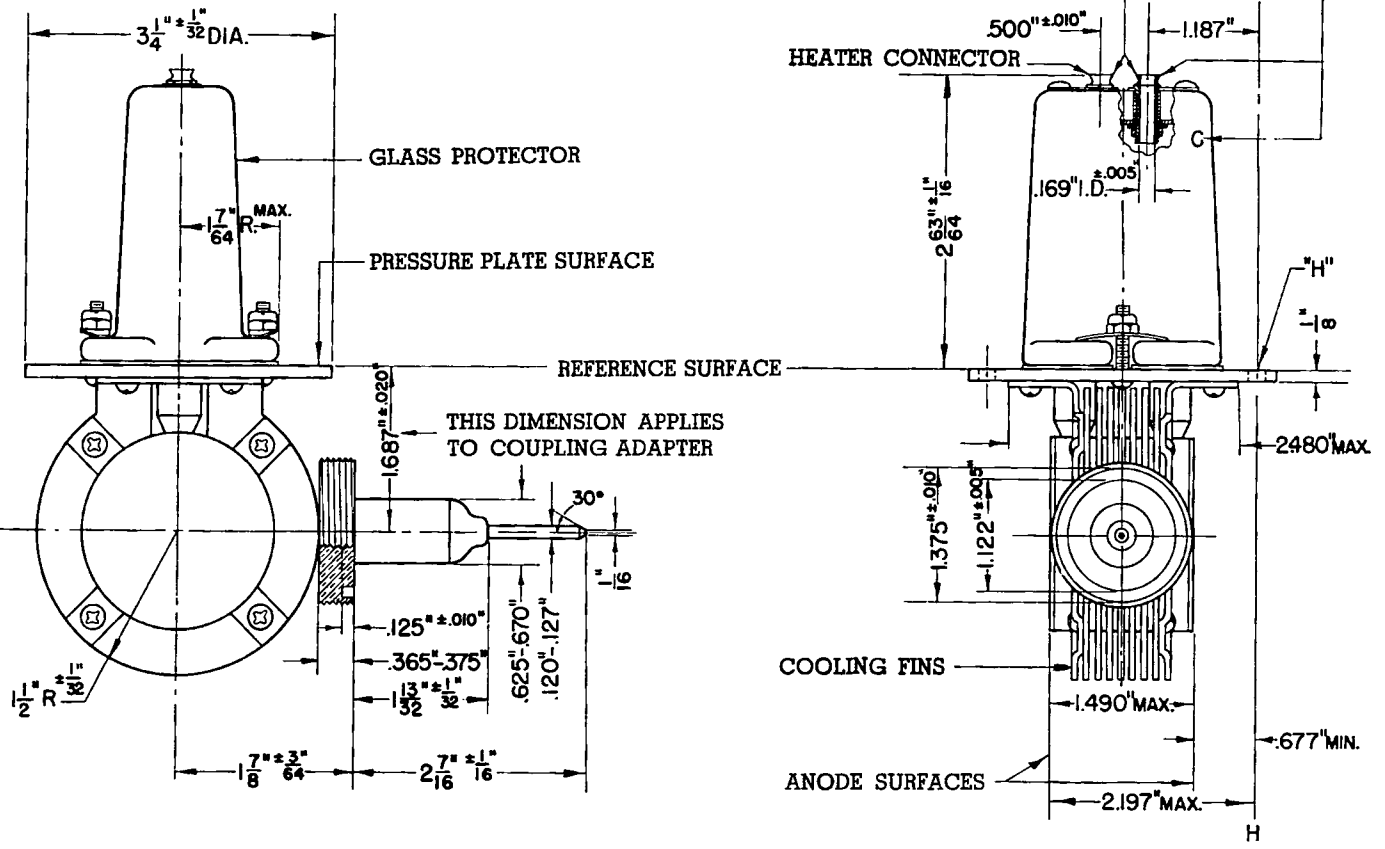


LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS



Security Classification: Confidential

Type 2J34
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency	2720 ± 20 Mc
Field Strength	1900 Gauss
Peak anode voltage	20,000 volts
Power output at 30 amperes .001 duty cycle	240 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting Position - any

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle*	.002
Anode voltage	22,000 volts
Anode current	30 amps
Anode dissipation	350 watts

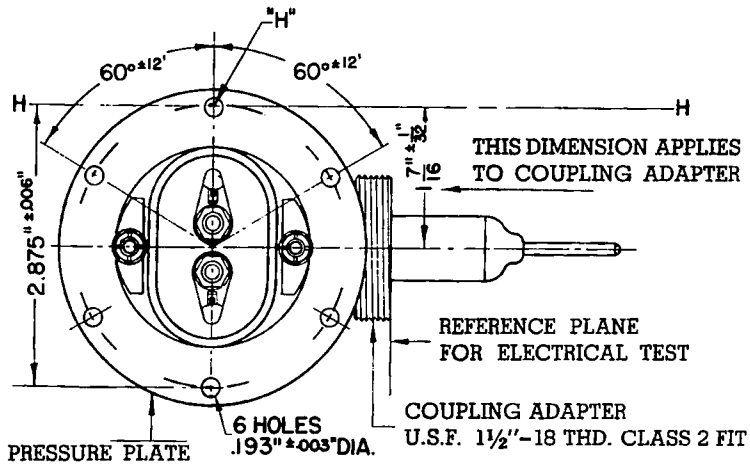
* In any 100 microsecond interval the tube shall not be operated more than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

From RMA release # 366, May 20, 1944

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING

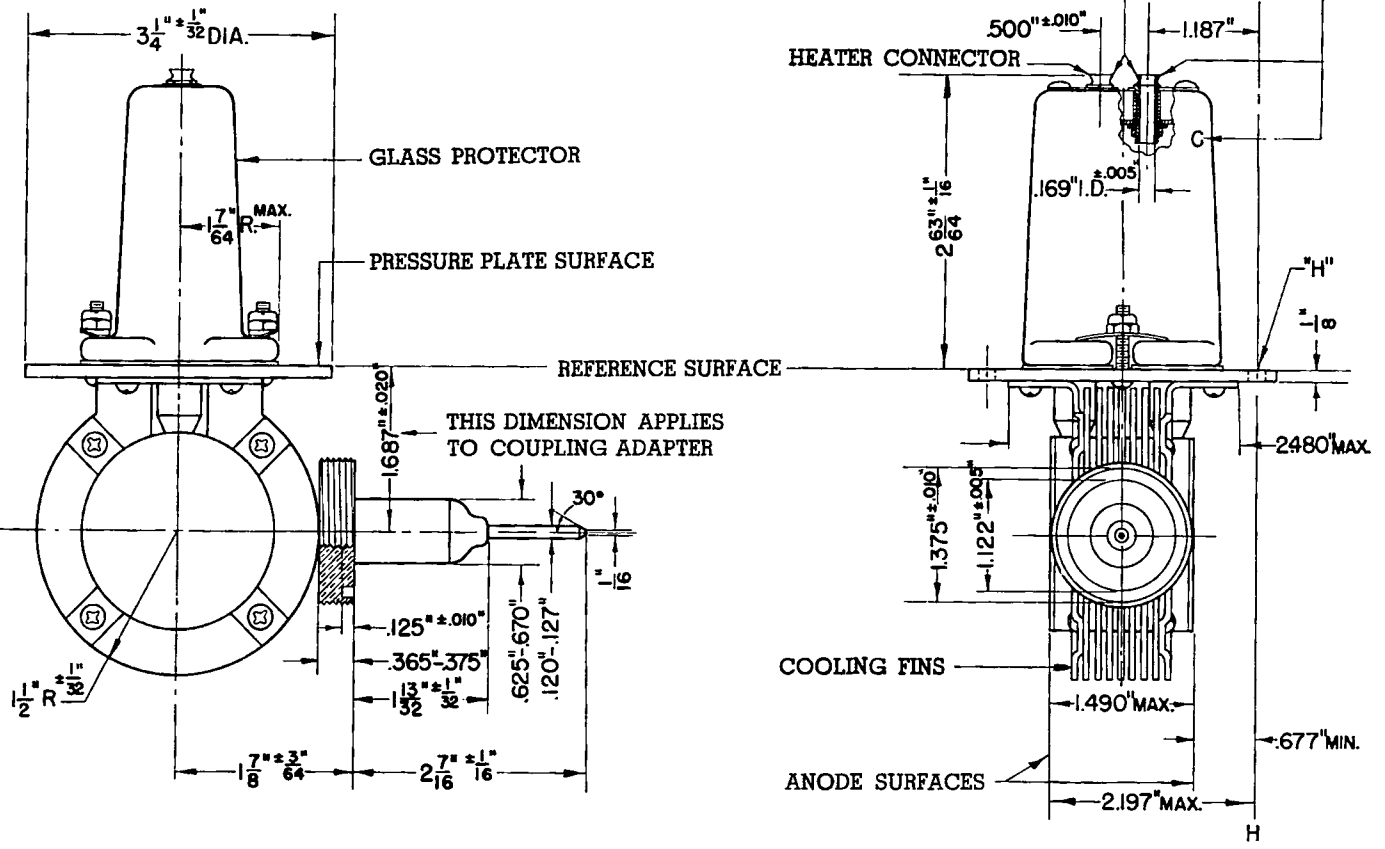


LINE H-H IS THE CENTERLINE OF REFERENCE HOLE "H."

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS



Security Classification: Confidential

Type 2J36
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament Voltage	6.3 volts
Filament Current	1.3 amps
Frequency	Min. 9003 Max. 9168 Mc
Field Strength	2500 gauss
Anode voltage	11,500 volts
Power Output at 10 amperes .001 duty cycle	12 watts

Mechanical

Maximum Dimensions - see outline
Mounting Position - any

Maximum Ratings

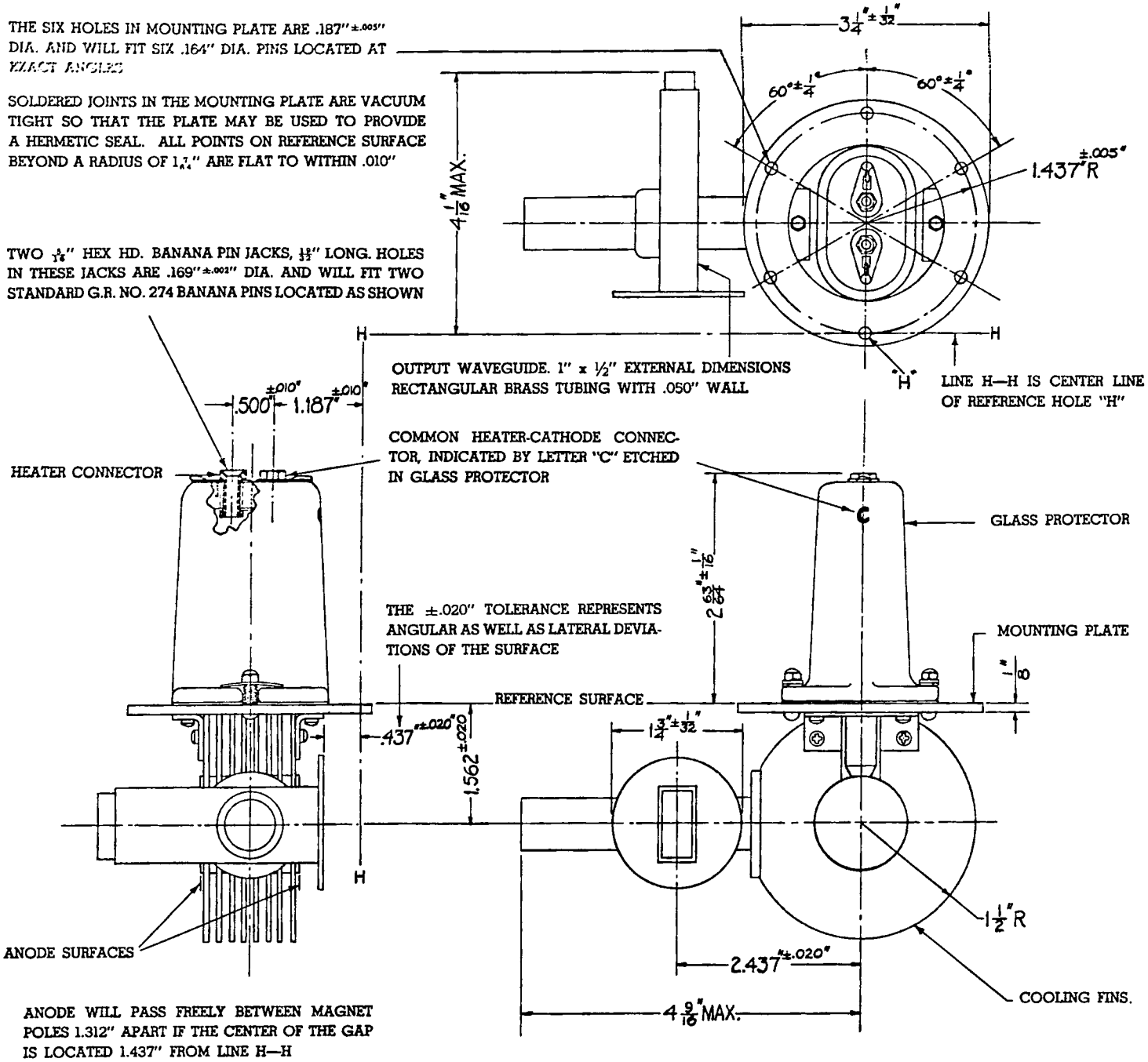
Duty Cycle*	.002
Anode voltage	13,500 volts
Anode current	12 amps
Anode dissipation	180 watts
Anode temperature	100 C degrees

* In any 100 microsecond interval the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 445, Oct. 20, 1945

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR
OUTLINE DRAWING



Security Classification: Confidential

Type 2J37 Magnetron

General Characteristics

Electrical

Cathode	Coated Unipotential	
Filament Voltage	6.3 volts	
Filament Current	1.5 amps	
Frequency	Min. 3267	Max. 3277 Mc
Magnetic Field Strength	1375 gauss	
Peak Anode voltage	10,500 volts	
Power Output at .002 duty cycle and 15 peak amperes	80 watts	

Mechanical

Maximum dimensions - see outline drawing
Base Connections - see outline drawing
Mounting Position - any

Maximum Ratings

Duty Cycle*	.006
Peak Anode voltage	12,000 volts
Peak anode current	15 amps
Anode dissipation	300 watts
Anode temperature	100 C degrees

* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company-Power Tube Division

from RMA release #445, Oct. 20, 1945

Security Classification: Confidential

Type 2J38
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.25 amps
Frequency	3249 - 3263 Mc
Peak anode voltage	4500 volts
Power output at .004 duty cycle and 3 peak amperes	10 watts

Mechanical

Maximum Dimensions - see outline drawing
Base connections - see outline drawing
Mounting position - any

Maximum Ratings

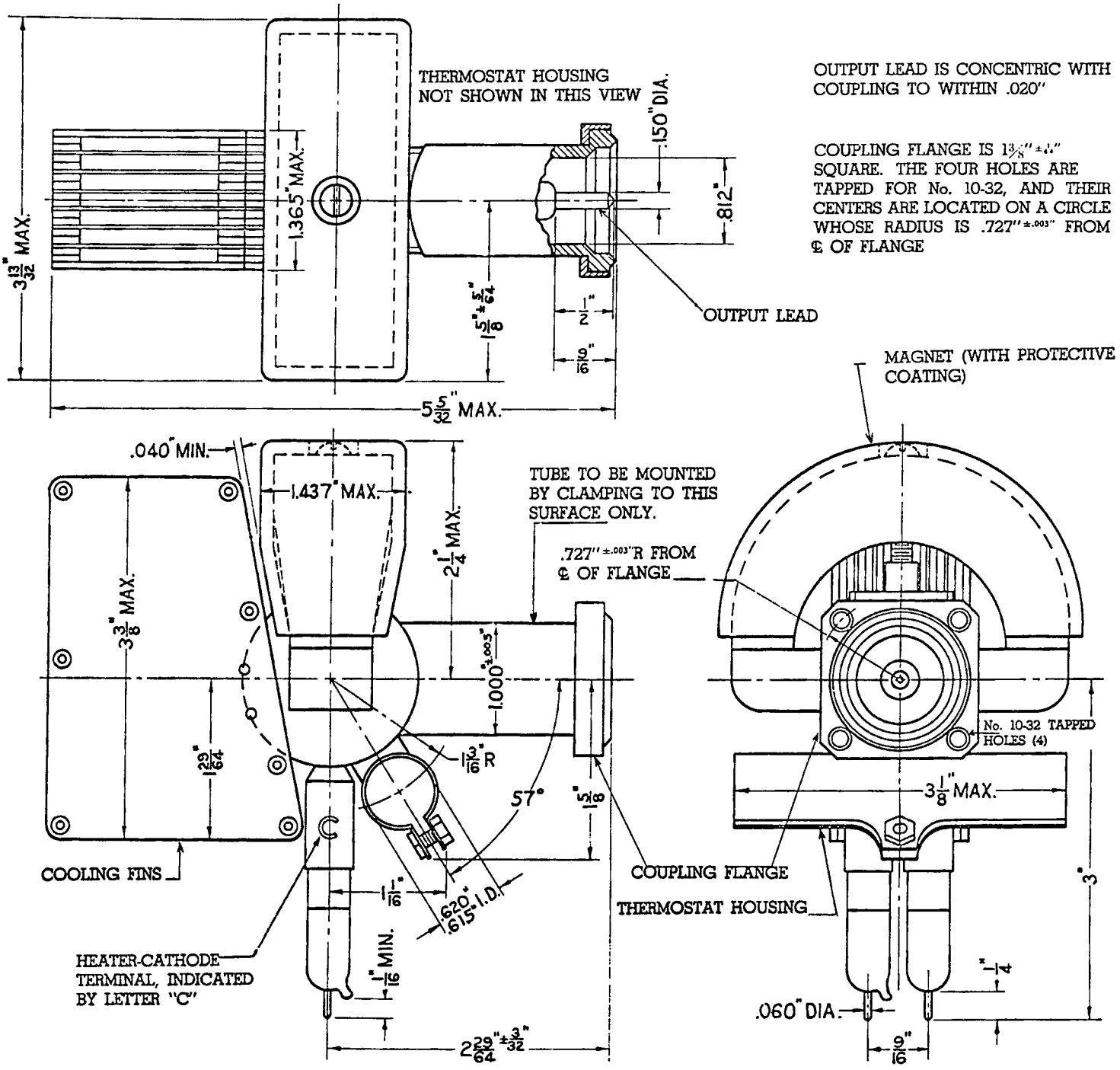
Duty Cycle*	.012
Peak anode voltage	5000 volts
Peak anode current	8 amps
Anode dissipation	160 watts
Anode temperature	100 C degrees

* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 450, Nov. 10, 1945

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR
OUTLINE DRAWING



Security Classification: Confidential

Type 2J39 Magnetron

General Characteristics

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.25 amps
Frequency	3267 - 3333 Mc.
Peak anode voltage	5000 volts
Power Output at .002 duty and 5 peak amperes	12 watts

Mechanical

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting position - any

Maximum Ratings

Duty Cycle*	.002
Peak Anode Voltage	5500 volts
Peak Anode Current	8 amps
Anode Dissipation	160 watts
Anode Temperature	100 C Degrees

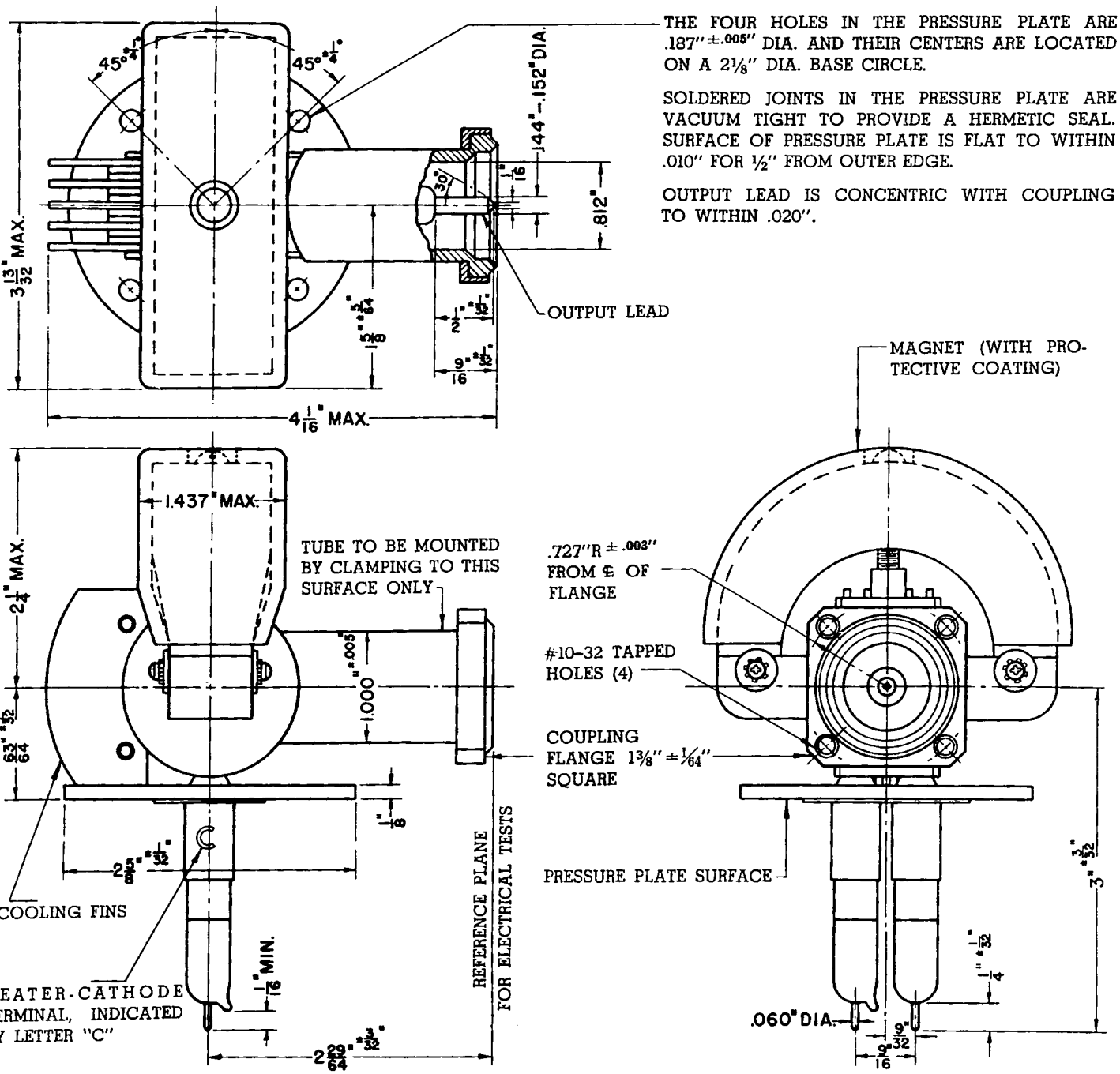
* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 456, Nov. 23, 1945

TECHNICAL INFORMATION
PACKAGE MAGNETRON OSCILLATOR

OUTLINE DRAWING



Security Classification: Confidential

Type 2J40
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.3 amps
Frequency	9305-9325 Mc
Field strength	2500 gauss
Anode voltage	11,500 volts
Power output at 10 amperes .001 duty cycle	10 watts

Mechanical

Maximum Dimensions - see outline
Mounting Position - any

Maximum Ratings

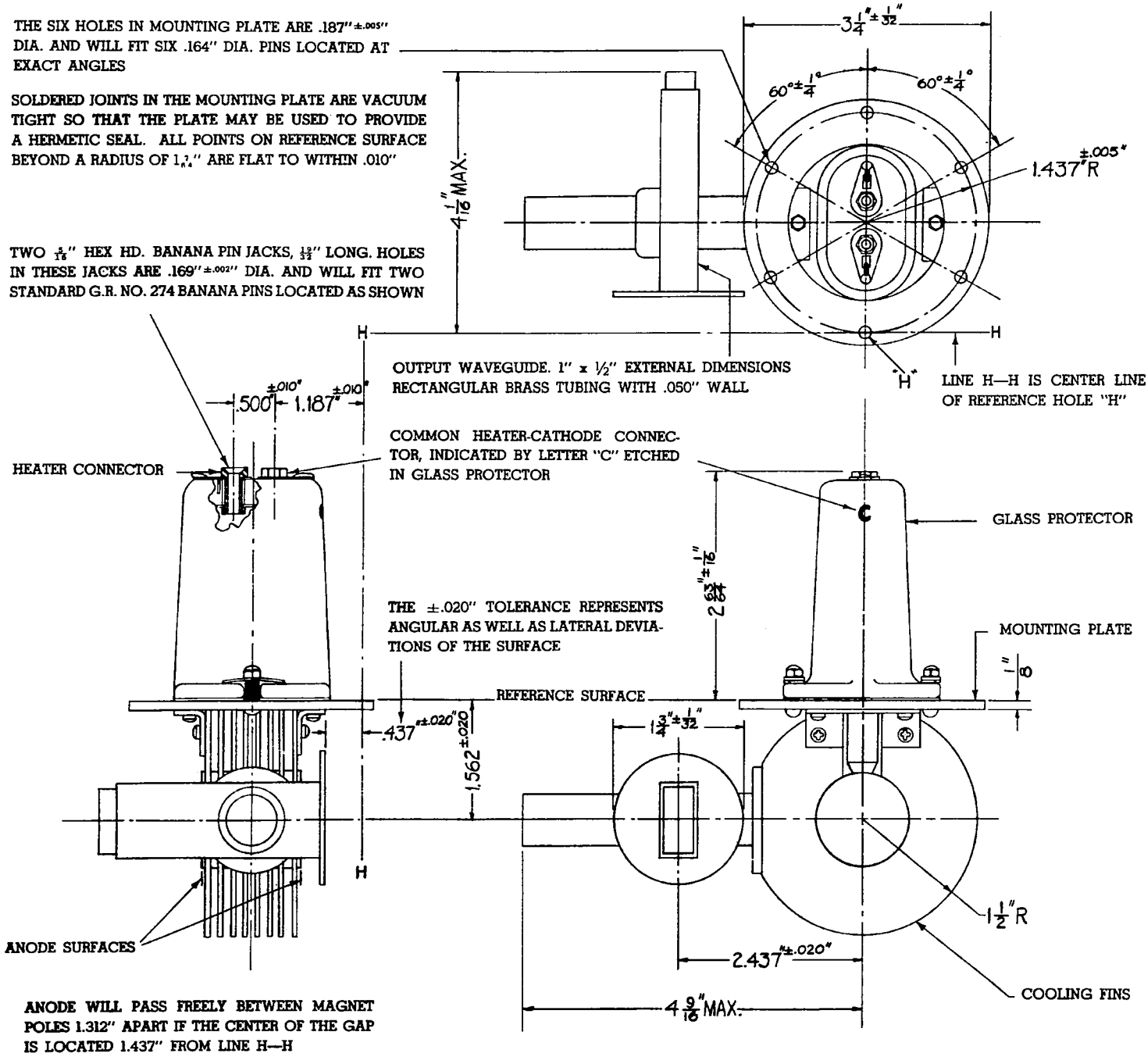
Duty Cycle *	.002
Anode voltage	13,500 volts
Anode current	10 amps
Anode dissipation	180 watts
Anode temperature	100 C degrees

* In any 100 microsecond interval the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 456, Nov. 23, 1945

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR
OUTLINE DRAWING



SECURITY CLASSIFICATION: CONFIDENTIAL

TYPE 2J54

TUNABLE MAGNETRON

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5-amps
Frequency Range	3123 - 3259 Mc
Magnetic Field Strength	1400 gauss
Peak Anode Voltage	11.6 KV
Peak Power Output	38 Kilowatts

MECHANICAL

Maximum Dimensions	- see outline drawing
Base Connections	- see outline drawing
Mounting Position	- any

MAXIMUM RATINGS

Duty Cycle *	.002
Peak anode voltage	14,000 volts
Peak anode current	15 amps
Average power input	250 watts
Anode temperature	100° C

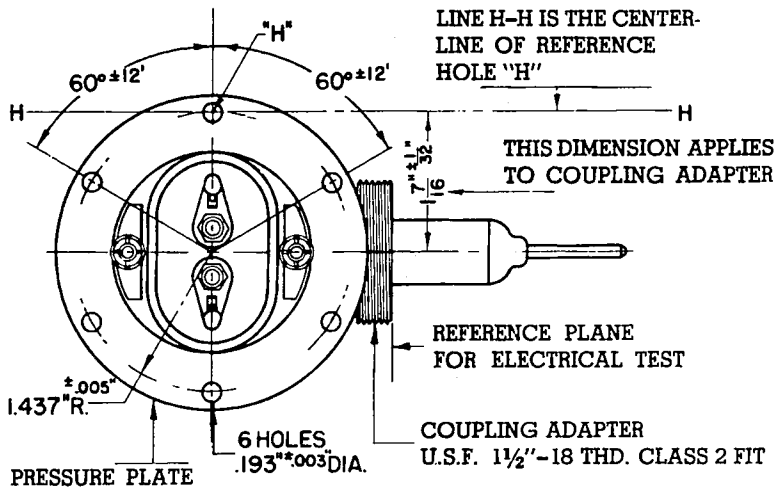
* The tube shall not be operated longer than 5 microseconds in any 100 microsecond interval.

Sponsor: Raytheon Manufacturing Company - Power Tube Division
Waltham, Massachusetts

from RMA release # 456, Nov. 23, 1945

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING

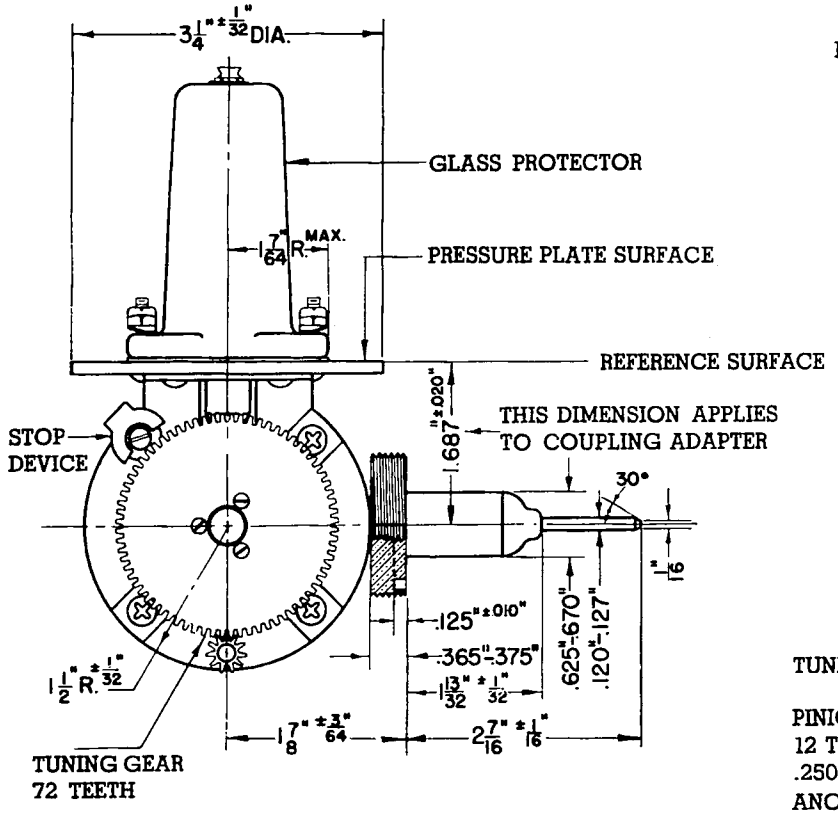


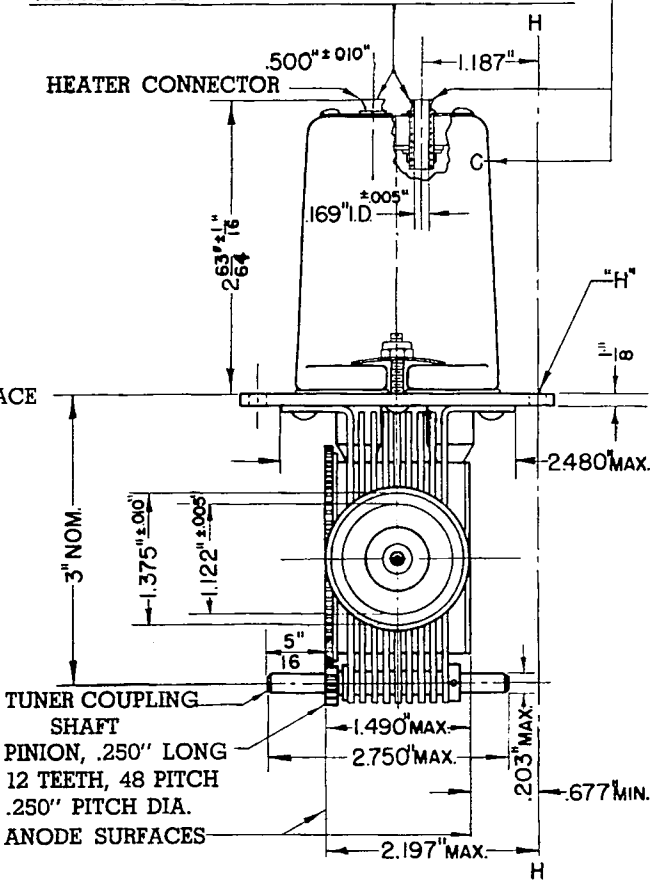
TUNING GEAR IS ASSEMBLED WITH STOP DEVICE TO PERMIT TWO TURNS (700 DEGREES) FOR TUNING

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS





Security Classification: Confidential

Type 2J58 - Tunable Magnetron

General Characteristics

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency range	2965-3019 Mc.
Magnetic Field Strength	1450 gauss
Peak anode voltage	10,500 volts
Power output at .002 duty cycle and 12.5 peak amperes	60 watts

Mechanical

Maximum Dimensions	- see outline drawing
Base Connections	- see outline drawing
Mounting position	- any

Maximum Ratings

Duty Cycle*	.002
Peak Anode Voltage	14,000 volts
Peak Anode Current	15 amps
Anode Dissipation	200 watts
Anode Temperature	100 C degrees

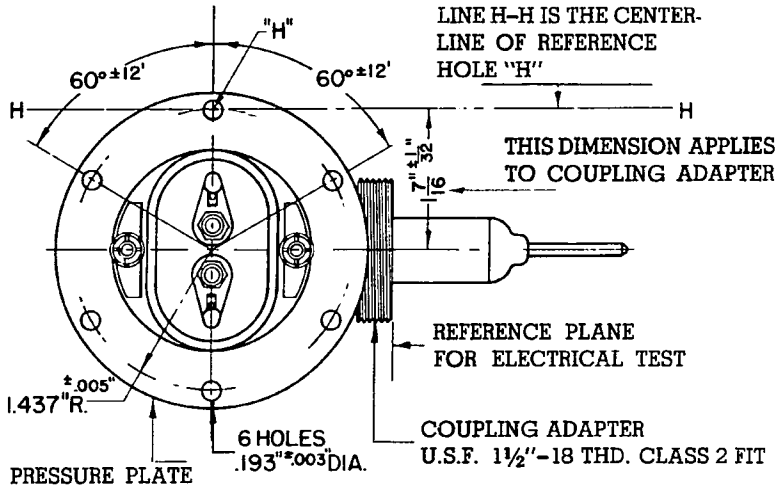
* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 456, Nov. 23, 1945

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING

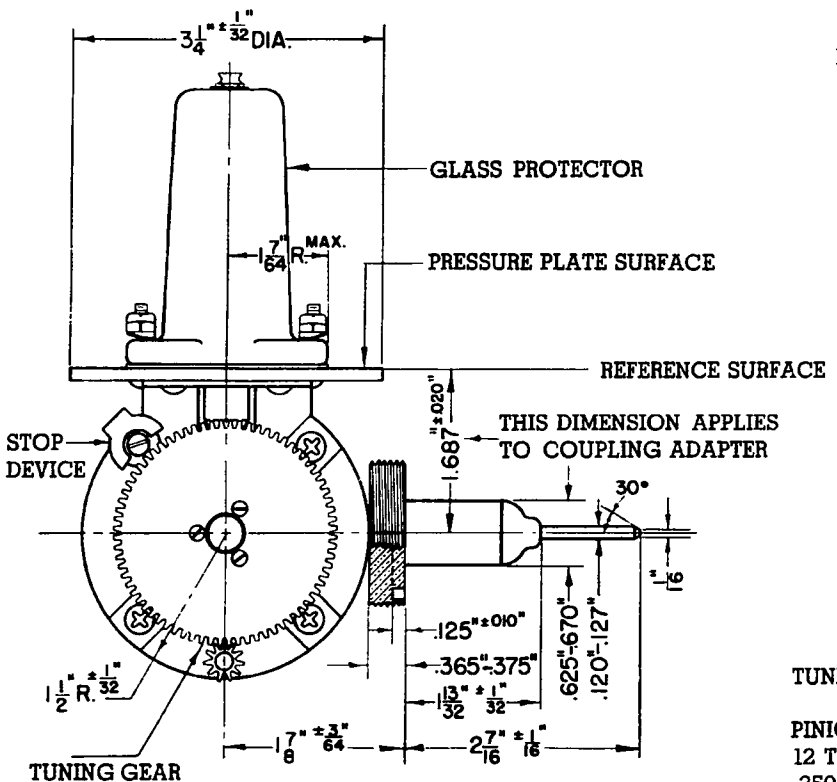


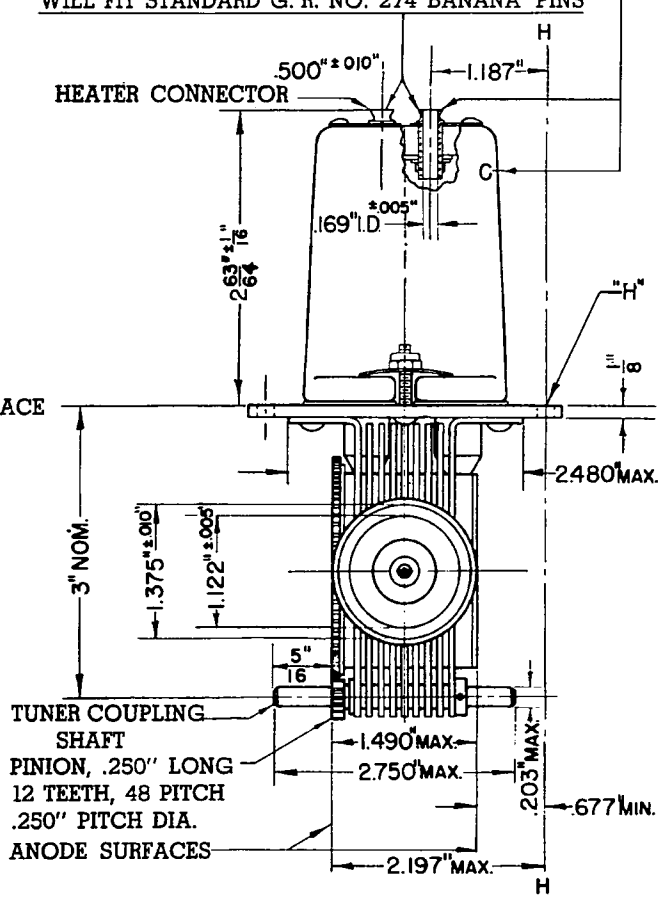
TUNING GEAR IS ASSEMBLED WITH STOP DEVICE TO PERMIT TWO TURNS (700 DEGREES) FOR TUNING

SOLDERED JOINTS IN THE PRESSURE PLATE ARE VACUUM TIGHT SO THAT IT MAY BE USED TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C"

TWO HEX. HD. PIN JACKS 19/32" LONG, LOCATED WITHIN A RADIUS OF .023" OF THE LOCATION SPECIFIED. WILL FIT STANDARD G. R. NO. 274 BANANA PINS





Security Classification: Confidential

Type 2J59 Tentative
MAGNETRON

General Characteristics

Electrical

Cathode	Coated Unipotential
Filament Voltage	6.3 volts
Filament Current-	1.5 amps
Frequency Range	3256 ± 20 Mc
Magnetic Field Strength	1300 gauss
Peak Anode Voltage	10,000 volts
Power output at .002 duty cycle and 12.5	50 watts

Mechanical

Maximum Dimensions	- see outline drawing
Base Connection	- see outline drawing
Mounting Position	- any

Maximum Ratings

Duty Cycle*	.002
Peak anode voltage	15,000 volts
Peak anode current	15 amps
Anode dissipation	200 watts
Anode temperature	100 C degrees

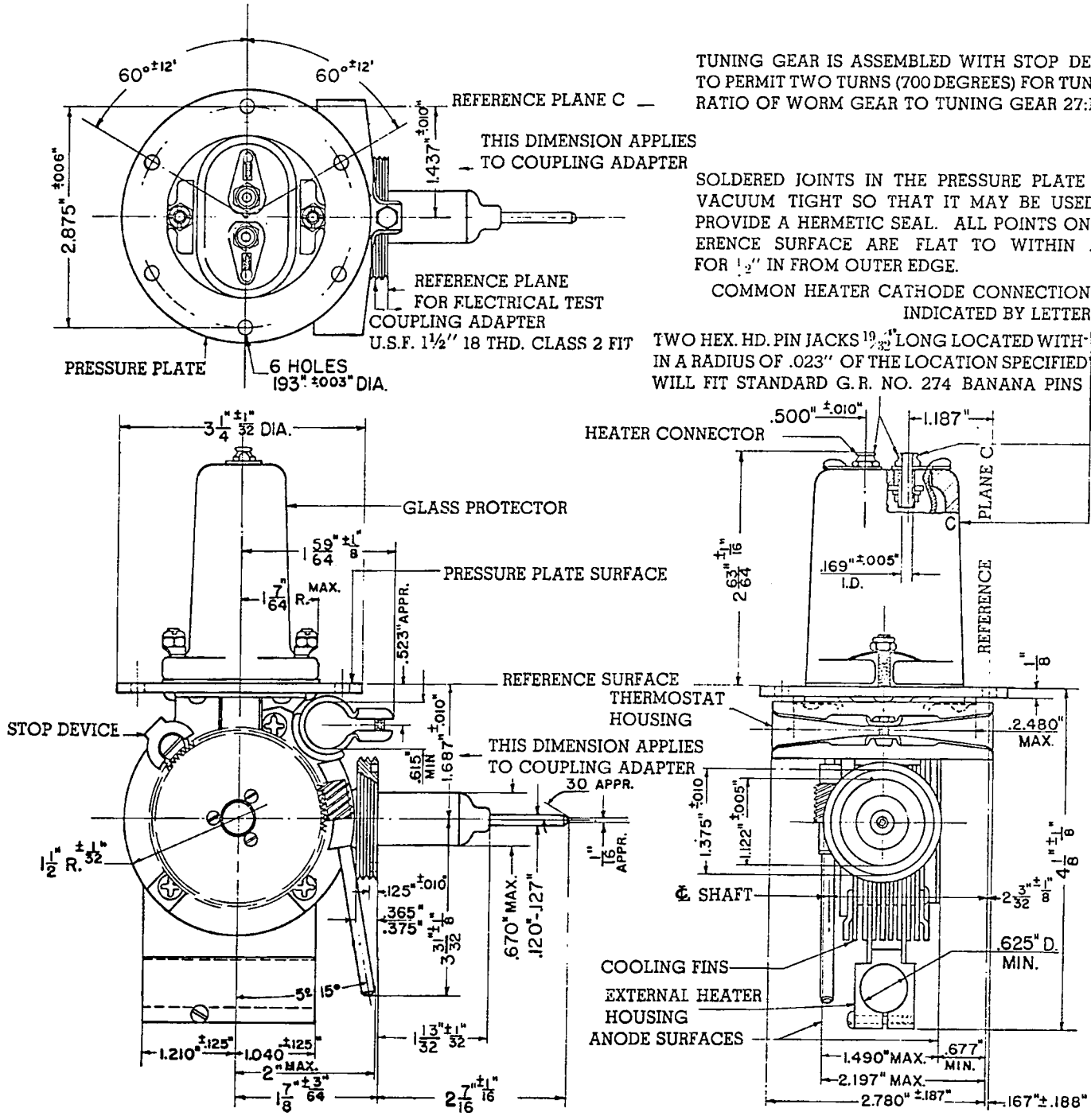
* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

Sponsor: Raytheon Manufacturing Company, Power Tube Division

from RMA release # 464, Jan. 10, 1946

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING



Security Classification: Confidential

Type 2J61-A Tentative
Tunable Magnetron

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency Range	3050 ± 55 Mc
Magnetic Field Strength	1300 gauss
Peak Anode Voltage	10,000 volts
Power output at .002 cuty cycle and 12.5	60 watts

Mechanical (Note)

Maximum Dimensions	- see outline drawing
Base Connections	- see outline drawing
Mounting Position	- any

Maximum Ratings

Duty Cycle*	.002
Peak Anode Voltage	14,000 volts
Peak Anode Current	15 amps
Anode Dissipation	200 watts
Anode Temperature	100 C degrees

* In any 100 microsecond interval the tube shall not be operated longer than 5 microseconds.

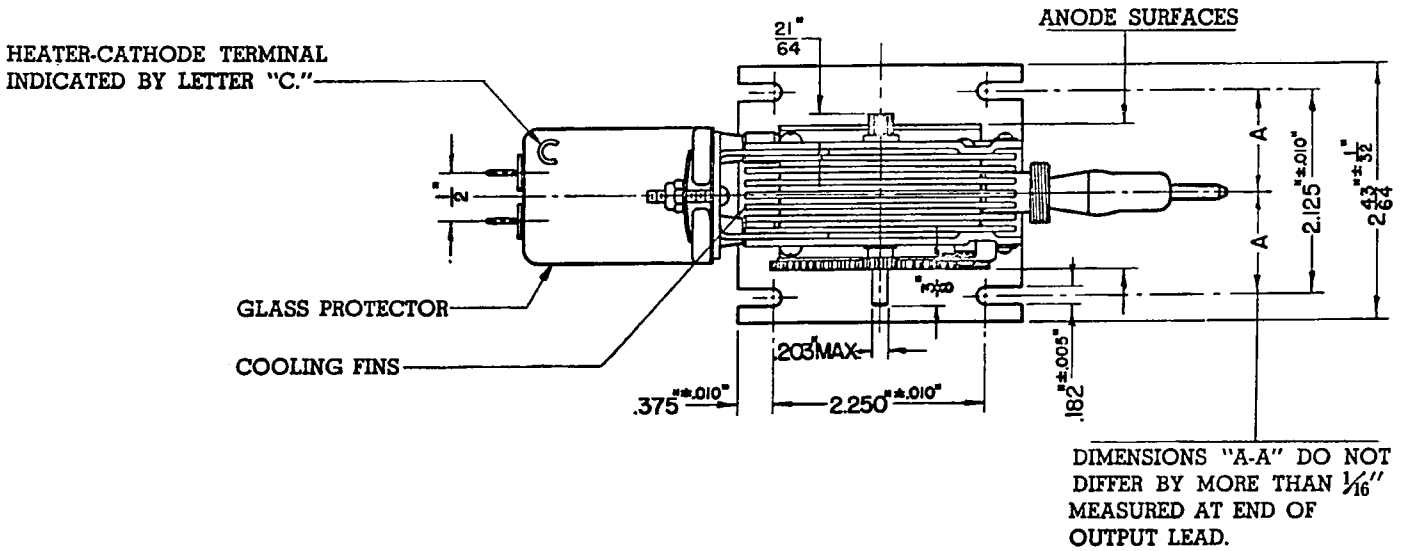
Note: Type 2J61A is ruggedized version of 2J61. The two types are completely interchangeable.

Sponsor: Raytheon Manufacturing Company-Power Tube Division

from RMA release #445, Oct. 20, 1945

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING

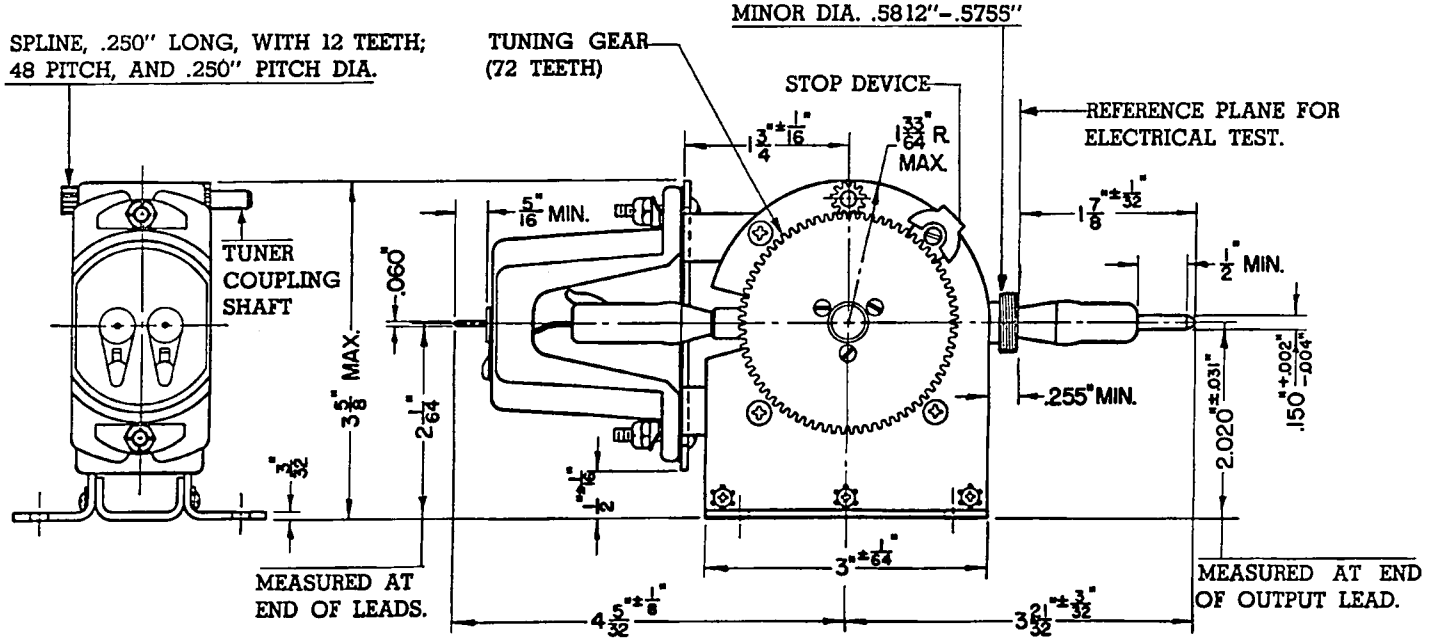


GEAR ASSEMBLED WITH STOP DEVICE TO PERMIT TWO TURNS (700 DEGREES) FOR TUNING.

ANODE AND GLASS PROTECTOR WILL PASS FREELY BETWEEN PARALLEL PLANES 1.490" APART WHEN CENTERED WITH RESPECT TO THE MOUNTING SLOTS.

OUTPUT COUPLING THREAD
.625"-27 N.S.F. THD.

MAJ. DIA. .6250"-.6168"
PITCH DIA. .6018"-.5987"
MINOR DIA. .5812"-.5755"



Security Classification: Confidential

Type 2J62-A Tentative Tunable Magnetron

GENERAL CHARACTERISTICS

Electrical

Cathode	Coated Unipotential
Filament voltage	6.3 volts
Filament current	1.5 amps
Frequency Range	2967 ± 55 Mc
Magnetic Field Strength	1300 gauss
Peak anode voltage	10,000 volts
Power output at .002 duty cycle and 12.5	60 watts

Mechanical (Note)

Maximum Dimensions - see outline drawing
Base Connections - see outline drawing
Mounting position - any

Maximum Ratings

Duty Cycle *	.002
Peak Anode Voltage	14,000 volts
Peak Anode Current	15 amps
Anode dissipation	200 watts
Anode temperature	100 C degrees

* In any 100 microsecond interval, the tube shall not be operated longer than 5 microseconds.

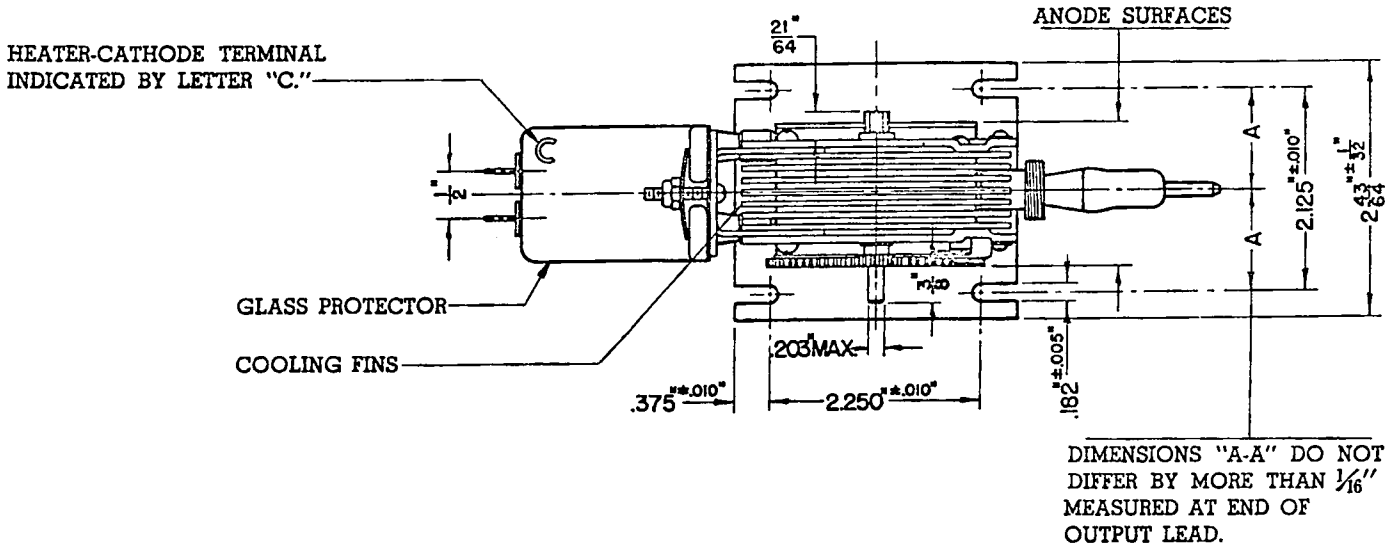
Note: Type 2J62-A is ruggedized version of 2J62. The two types are completely interchangeable.

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release #445, Oct. 20, 1945

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING

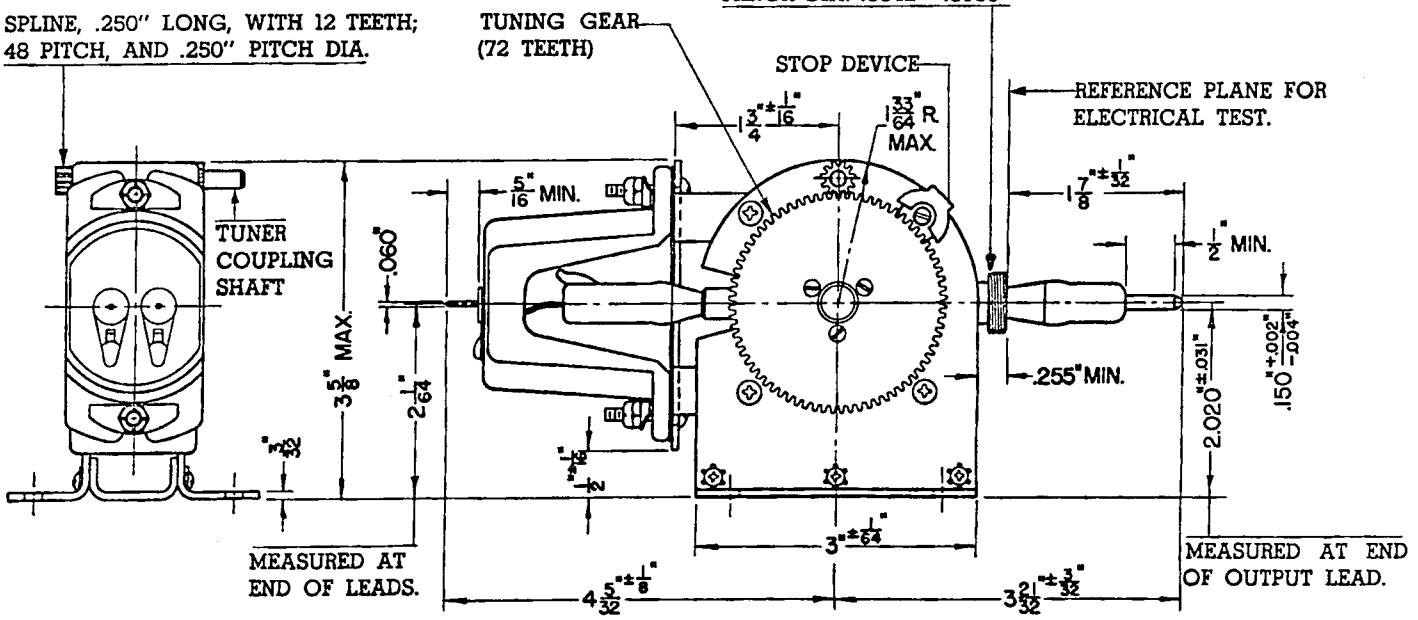


GEAR ASSEMBLED WITH STOP DEVICE TO PERMIT TWO TURNS (700 DEGREES) FOR TUNING.

ANODE AND GLASS PROTECTOR WILL PASS FREELY BETWEEN PARALLEL PLANES 1.490" APART WHEN CENTERED WITH RESPECT TO THE MOUNTING SLOTS.

OUTPUT COUPLING THREAD
.625"-27 N.S.F. THD.

MAJ. DIA. .6250"-.6168"
PITCH DIA. .6018"-.5987"
MINOR DIA. .5812"-.5755"



Security Classification: Confidential

Type 2J66 - 69
Tunable Magnetron

General Characteristics

Electrical

Cathode	uni-potential oxide coated
Voltage	6.3 volts
Current	1.50 amp

Frequency	Type	Min.	Max.
	2J66	2845	2905 Mc
	2J67	2795	2855 Mc
	2J68	2745	2805 Mc
	2J69	2695	2755 Mc

Field Strength	1700 gauss
Power Output	150 watts

Mechanical

Maximum overall height	see outline drawing
Maximum diameter	" " "
Permissable Mounting Position	any

Maximum Ratings

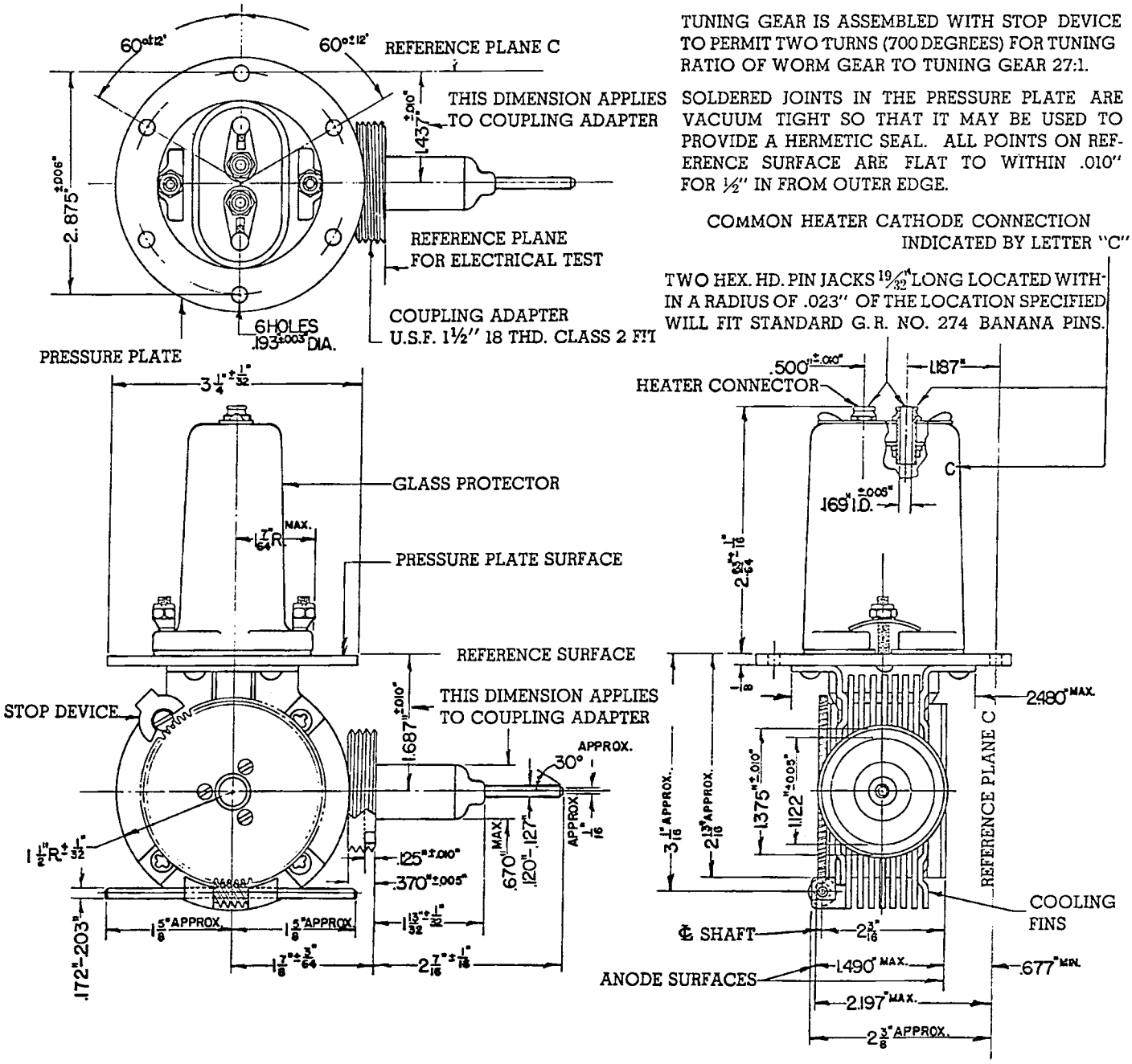
Duty Cycle (max)	.002
Anode voltage	20 KV
Anode Current	25 amp
Anode Dissipation	400 watts

Sponsor: Raytheon Manufacturing Company - Waltham, Massachusetts

from RMA release # 464, Jan. 10, 1946

TECHNICAL INFORMATION
TUNABLE MAGNETRON OSCILLATOR

OUTLINE DRAWING



from JETEC release #1551, Dec. 12, 1955

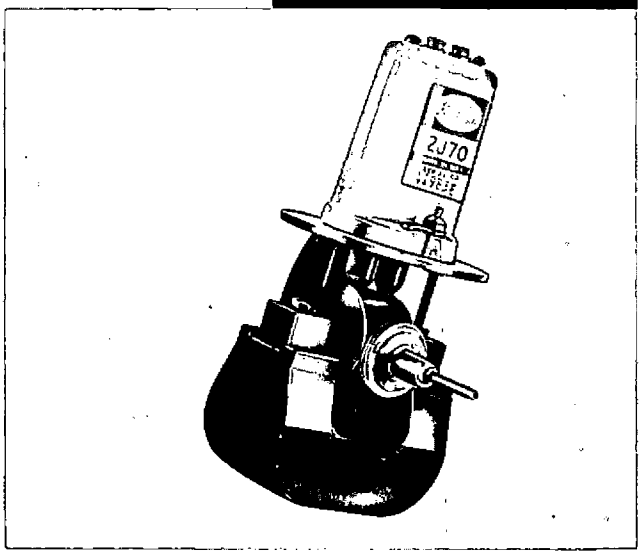
RAYTHEON

TENTATIVE DATA

Excellence in Electronics

PULSED-TYPE MAGNETRON OSCILLATOR

TYPE 2J70



The RK2J70 is a fixed-frequency, pulsed-type oscillator operating in the frequency region of 3030 to 3110 Mc with a minimum peak power output of 20 kw. It is an integral magnet, coaxial output type tube requiring forced air cooling.

GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life will be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL-E-1B purchase specifications.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK2J70 under conditions other than those recommended in this technical data sheet, the company's Magnetron Applications Engineering Group should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage — Preheat	6.3 V ± 10%
Heater Current @ 6.3V	1.10 — 1.40 A
Minimum Preheat Time	3 minutes

Maximum Ratings

The values specified below must not be exceeded under any service condition. The ratings are limiting values above which the serviceability of any tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Heater Voltage	7.0 V
Peak Anode Voltage	7.5 kv
Peak Anode Current	15 a
Peak Anode Power Input	100 kw
Average Anode Power Input	200 W
Anode Temperature	120°C
Pulse Duration	2.0 μs
Duty Cycle	.002
Frequency Change Due to Change of Steady State Temp.	.07 Mc/°C
VSWR	1.5/1
Pulling @ VSWR = 1.5/1	13 Mc

Typical Operation

Heater Voltage (operating)	6.3 V
Pulse Duration	1.0 μs
Pulse Recurrence Rate	1000 pps
Peak Anode Voltage	7.0 kv
Peak Anode Current	8.0 a
Peak Power Output	25 kw
Frequency	3030 - 3110 Mc

MECHANICAL

Mounting Position	Any
Overall Dimensions	See Outline Dwg.
Net Weight	3¾ lbs
Cooling	Forced Air
Output Coupling	See Outline Dwg.

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 6.3 V ± 10% for a period of at least 3 minutes prior to the application of anode high voltage. For operation at conditions different than those under typical operation, the manufacturer must be consulted for a heater schedule. Heater current surges in excess of 6 amps cannot be tolerated.

STARTING NEW TUBE

Aging of the RK2J70 is rarely necessary. If, however, some instability is observed in a new magnetron, it is recommended that it be seasoned under the prevailing conditions of oscillation until it stabilizes and normal operation is attained.

PULSE CHARACTERISTICS

The smooth peak of a pulse is defined as the maximum value of a smooth curve through the average of the fluctuation over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which instantaneous current is 50 percent of the smooth peak. (True only for approximately rectangular waveshapes.) The rise time is the time interval between points of 20 and 85 percent of the smooth peak. Figure 1 shows graphically the definitions mentioned.

The voltage rate of rise boundaries are currently under investigation; it is anticipated they will be published at some later date in a supplementary data sheet. Too fast a rate of rise will lead to moding. The ripple on the top of the current pulse must be kept at a minimum to avoid pushing effects which will tend to widen the spectrum. The trailing edge or decay time of the voltage pulse must be as short as possible to obtain optimum performance and high operating efficiencies. Excessive backswing may cause instability and/or noise. The backswing should not exceed 20 percent of the applied pulse.

For optimum pulse shaping, the magnetron, pulse transformer, and pulse line must be treated as a unit. Careful tailoring of the pulse line in any application is recommended.

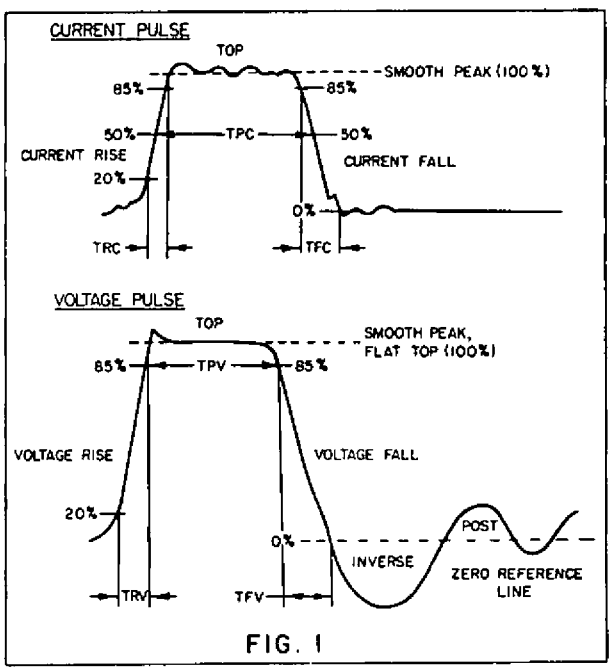


FIG. 1

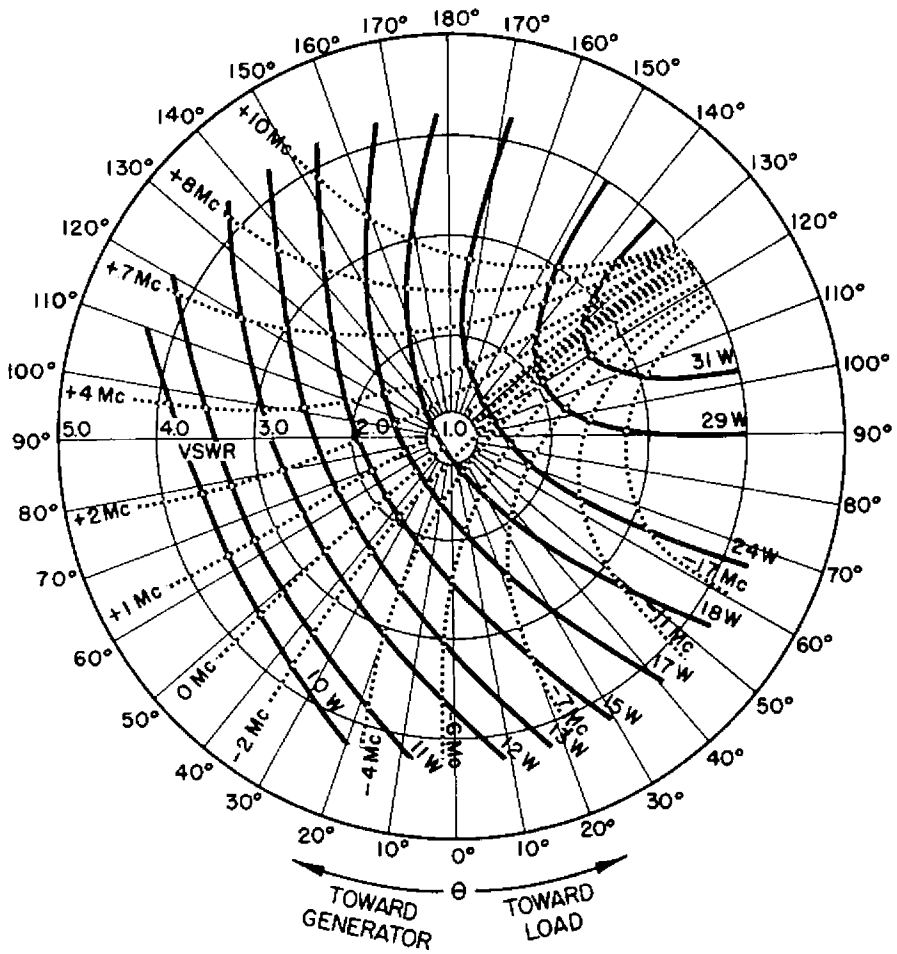
LOAD DIAGRAM

Fig. 2 is a load diagram of a typical RK2J70 magnetron. The contours of constant power output and frequency change are related to voltage standing-wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 4:1 are plotted, but operation with ratios greater than 1.5:1 is not recommended.

COOLING

Anode operating temperatures below 100°C are recommended, although temperature as high as 120°C may be tolerated at the risk of somewhat shortened tube life. The point at which the anode temperature should be monitored is indicated on the tube outline drawing.

2J70
LOAD DIAGRAM



I_b = 8 PEAK AMPS.
Prr = 1000
tpc = 1 usec.

FIG 2

FREQUENCY DRIFT

After operation of the 2J70 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period, the geometry of the tube changes slightly and is attended by a small frequency change or drift. If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes. The frequency change between two equilibrium positions will not exceed 0.07 Mc/°C.

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long-time effects." Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case, the extent to which the long-time effect is exhibited depends upon the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Figure 3 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not too serious in the RK2J70 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectra caused by this phenomena. It may, in some cases, permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Fig. 3, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although, for close control of bandwidth, the VSWR should be kept as low as possible.

More detailed information on the theories and remedies of long-line effects are available upon request.

RF RADIATION FROM CATHODE

The RK2J70 is designed to minimize the generally negligible radiation from the cathode stem. It is not possible, however, to guarantee that the radiation will be negligible; and in particularly critical environments, shielding of the stem may be necessary to avoid radiation difficulties.

OPERATING CHARACTERISTICS

Fig. 4 is a plot of peak power output and peak anode voltage, as a function of anode current.

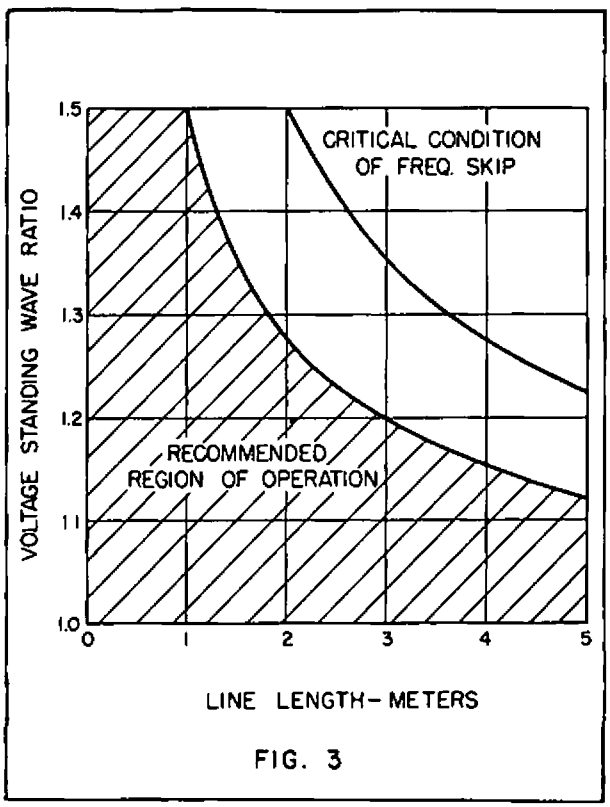


FIG. 3

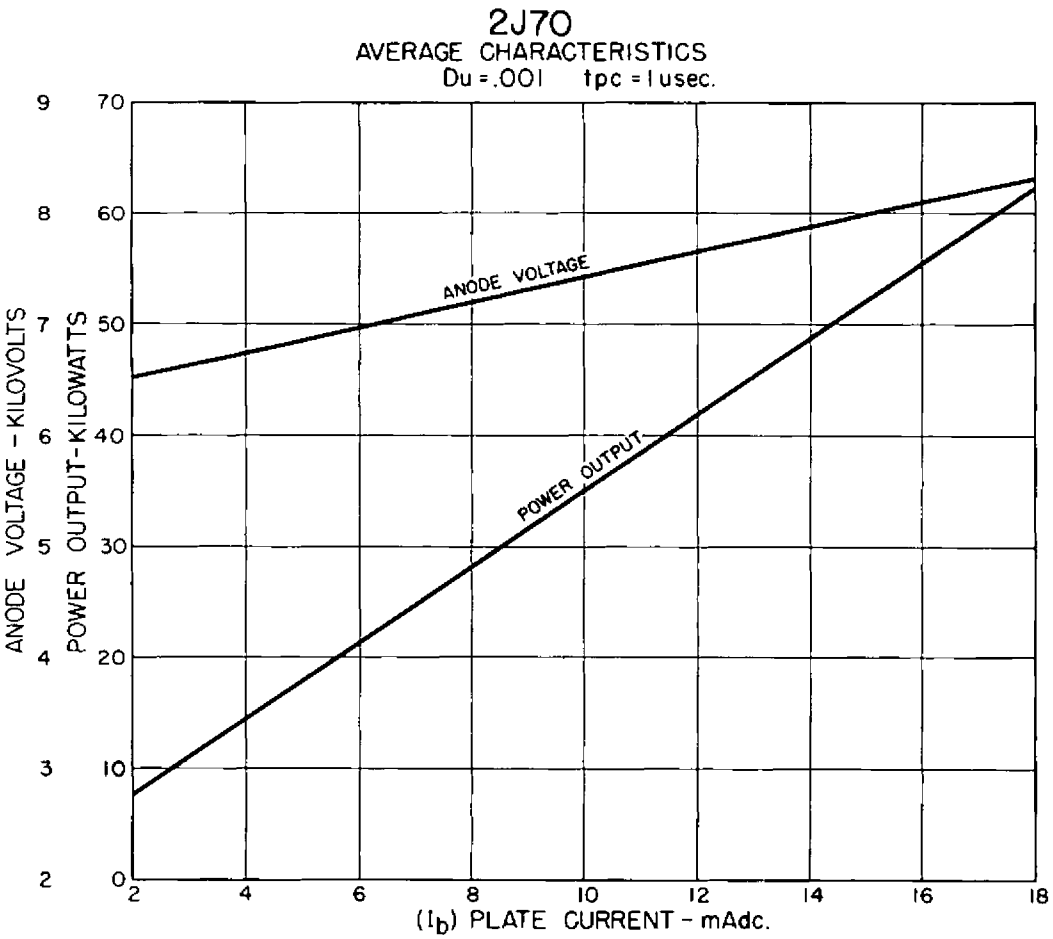


FIGURE 4

DETAILED MECHANICAL INFORMATION

OUTLINE DRAWING

The detailed mechanical dimensions are given in Fig. 5. These dimensions should be used in designing the mechanical layout rather than those of a sample tube.

INSTALLATION AND HANDLING PRECAUTIONS

Unnecessary jarring or rough handling of the tube must be avoided. Although a packaged magnetron appears to have great structural strength, the internal structure is delicate and involves critical alignment of parts. In particular, the center conductor of the coaxial output should not be subjected to sharp blows or excessive strains that may destroy its fragile metal to glass seal.

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two jacks mounted on the glass cathode bushing insulating boot. The positive high voltage should be "grounded" to the tube, preferably at the mounting plate. The two jacks serve as the heater and cathode connectors. The jack nearest the letter "C" on the insulating boot is common to heater and cathode; the other is of course, the remaining heater connector.

NOTES:

1. The jack holes shall be within a radius of .023 of the location specified but shall be spaced .500 ± .010 with respect to each other. The center line of the holes shall be perpendicular to ref. plane "A" within 3°.
2. Leads (2) shall be flexible and slack.
3. Pyrex glass, porcelain, or approved equivalent.
4. Gasket may be omitted by cementing the base to the plate.
5. Indicate common cathode connection by letter "C" on this surface.
6. Heater pipe and seal off teats shall not touch inside wall of base.
7. Any portion of the assembly extending above this surface shall be within a 1.109 R. of true center of the plate.
8. Hex-head banana locking $^{19}/_{32}$ LG. .169 ± .005 hole.
9. Common cathode connection.
10. Areas between and including these planes shall be painted with a black, heat-resistant, noncorrosive paint.
11. Protective black coating over magnet.
12. This dimension applies to adapter.
13. Center line of lead shall be concentric with adapter within .020.
14. Pressure plate surface to be flat within .010 for .500 from outer edge.
15. Output cylinder shall be noncorrosive material or painted black plated min. 20 M.S.I. silver or 10 M.S.I. gold.
16. Periphery of countersunk hole or head of #8-32 screw may extend into .191-.195 dia. holes on ref. plane "B".

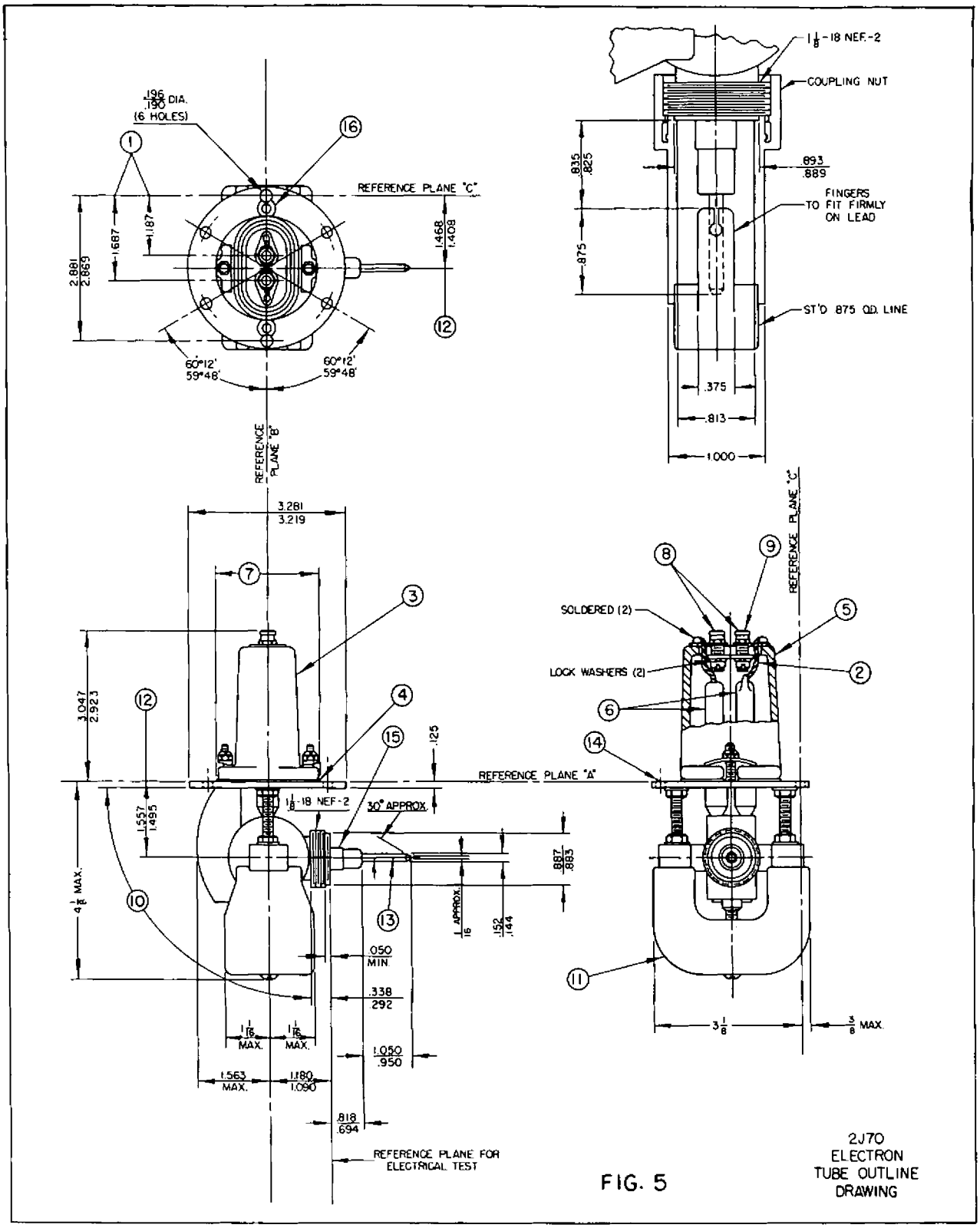


FIG. 5

2J70 ELECTRON TUBE OUTLINE DRAWING

SECURITY CLASSIFICATION: ~~CONFIDENTIAL~~

CLASSIFICATION CANCELLED, BY AUTHORITY OF THE CHIEF SIGNAL OFFICER, BY G. A. OSMUNDSEN, Captain, Signal Corps, 15/3/46

Type 2K33

Velocity Modulation Amplifier/Oscillator

GENERAL CHARACTERISTICS

ELECTRICAL

Voltage		6.3 volts
Current		.65 amps.
Frequency	Variable	1.25 ± 10% Cm
Ec1		1800 volts
Ec2		1800 volts
Ec3		1800 volts
Repeller Voltage		-200 volts
Power Output		20 milliwatts

Mechanical

Tuner Base Connection
Standard Octal Base

Pin 1 - Cathode
2 - Heater
3 - N.C.
4 - N.C.
5 - N.C.
6 - N.C.
7 - Heater
8 - Grid #1

See outline drawing for other mechanical details

Maximum Ratings

Power Input	20 watts
Dissipation	20 watts

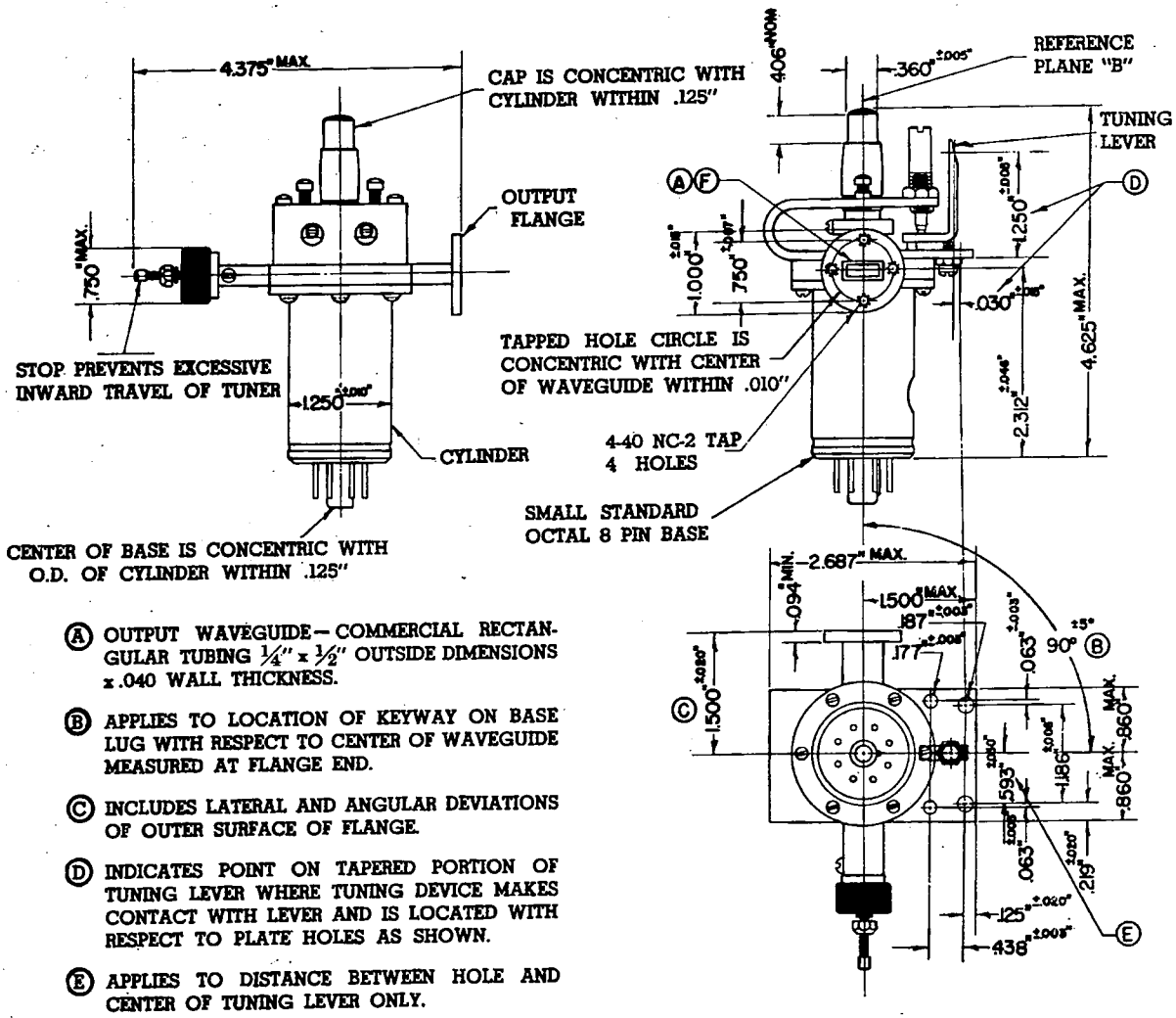
Sponsor: Raytheon Manufacturing Company, Power Tube Division

from RMA release # 478, March 20, 1946

Release No. 478

March 20, 1946

TYPE 2K33



Ⓐ OUTPUT WAVEGUIDE — COMMERCIAL RECTANGULAR TUBING ¼" x ½" OUTSIDE DIMENSIONS x .040 WALL THICKNESS.

Ⓑ APPLIES TO LOCATION OF KEYWAY ON BASE LUG WITH RESPECT TO CENTER OF WAVEGUIDE MEASURED AT FLANGE END.

Ⓒ INCLUDES LATERAL AND ANGULAR DEVIATIONS OF OUTER SURFACE OF FLANGE.

Ⓓ INDICATES POINT ON TAPERED PORTION OF TUNING LEVER WHERE TUNING DEVICE MAKES CONTACT WITH LEVER AND IS LOCATED WITH RESPECT TO PLATE HOLES AS SHOWN.

Ⓔ APPLIES TO DISTANCE BETWEEN HOLE AND CENTER OF TUNING LEVER ONLY.

Ⓕ CENTER OF WAVEGUIDE PARALLEL TO SHORT DIMENSION IS WITHIN .20" OF REFERENCE PLANE "B". .

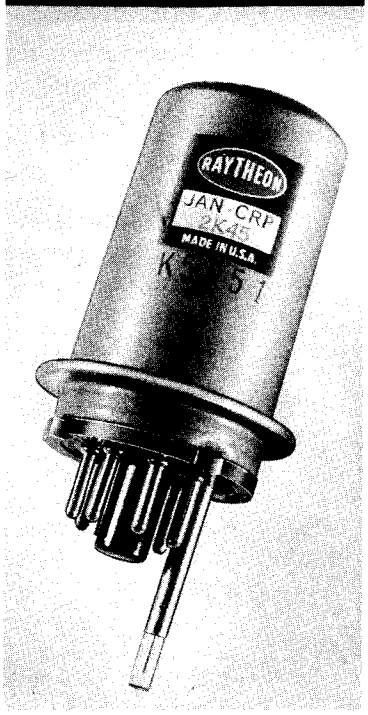
RAYTHEON

TECHNICAL INFORMATION

VELOCITY VARIATION OSCILLATOR

Excellence in Electronics

TYPE 2K45



The type 2K45 is a thermally tuned velocity variation oscillator of the single cavity (integral) reflex type designed for CW operation in the 8500 to 9660 Mc range with an average power output of 30 milliwatts. Sufficient cooling for this type is usually provided by freely circulating air. Output coupling is made by inserting the output probe directly into a standard 1" x ½" O. D. waveguide. The 2K45 is intended for local oscillator service in microwave receivers where remote frequency adjustment is desired.

GENERAL CHARACTERISTICS

Heater Characteristics:

Heater Voltage (ac or dc)	6.3 ± .5 volts
Heater Current at 6.3 volts (approx.)	.76 amperes

Maximum Ratings:

DC Resonator Voltage	350 volts
DC Resonator Current	30 ma. DC
Tuner Plate Power Dissipation	7.5 watts
DC Reflector Voltage-Positive	0 volts
DC Reflector Voltage-Negative	.350 volts
Heater Cathode Voltage	± 50 volts DC
DC Tuner Grid Voltage	.75 volts
Thermal Tuning Speed 8500-9660	9 seconds
Thermal Tuning Speed 9660-8500	9 seconds
Ambient Temperature of air around shell	110°C
Temperature of coaxial output line	70°C
VSWR Mismatch	1.5/1

Typical Operation: 8500-9660

DC Resonator Voltage	300 volts
DC Tuner Plate Voltage	300 volts
DC Resonator Current	25 ma. (average)
DC Reflector Voltage (max. Po) at 9660 Mc.	—95 to —145 volts
DC Reflector Voltage (max. Po) at 8500 Mc.	—66 to 110 volts
Power Output	26 to 34 mw.
Tuner Cathode Current	0 to 25 ma.
Tuner Grid Voltage	—35 to +15 v DC
Tuner Cathode bias resistor	750 ohms
Electronic Tuning (to halt power points)	85 to 70 mc.
Thermal Tuning Speed 8500 to 9660	6 seconds
Thermal Tuning Speed 9660 to 8500	6 seconds

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION
RAYTHEON COMPANY
FOUNDRY AVE., WALTHAM 54, MASS.

MECHANICAL:

Mounting Position	Any
Overall Dimensions	See outline drawing
Envelope	Metal
Base	Fits std. octal with #4, pin enlarged to 11/64"
Shock (maximum)	50 G
Vibration (maximum)	10 G
Altitude	50,000 feet
Humidity	100%
Tube Life	500 hours

DETAILED ELECTRICAL INFORMATION

CATHODE

In applications where the metal envelope (resonator) of the tube is operated at ground potential, the cathodes will be negative with respect to ground by the amount of resonator and tuner diode potentials respectively. The klystron cathode may be connected to one side of the heater or the center tap of the heater transformer secondary. When the klystron cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to a heater lead. When the cathode and heater are not tied together, the heater-cathode voltage should not exceed ± 100 volts. In all cases where the resonator is operated at ground potential, the heater transformers must be insulated to withstand the maximum resonator and diode voltages respectively.

In applications where the metal envelope is operated above ground potential, the tube should be surrounded by a grounded enclosure or insulating device for the protection of the operator. Adequate ventilation must be provided through this enclosure or insulating device to keep the ambient below the maximum specified values.

REFLECTOR

The reflector is connected to the #8 pin on the base of the tube. The power supply furnishing the reflector potential must be insulated to withstand the total resonator and reflecor voltage. The reflector must never be allowed to become positive with respect to the cathode. If this precaution is not observed, damage to the reflector may result. In cases where modulating potentials bring the reflector close to zero volts, or where extremely high reflector circuit impedance is required, a diode should be connected between cathode and reflector to prevent the reflector from going positive.

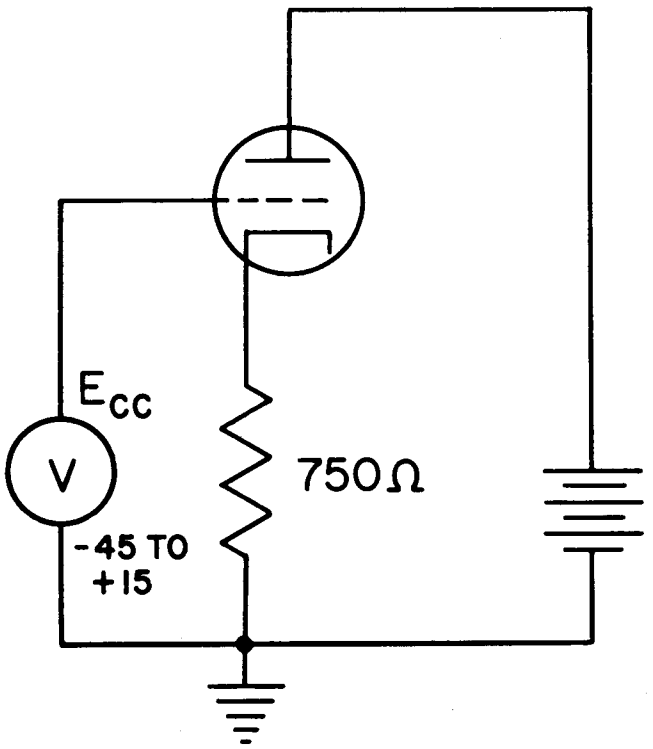
THERMAL TUNING

Thermal tuning has been accomplished in the 2K45 by coupling the thermal expansion characteristics of the plate of the integral triode to the top grid of the klystron cavity. Plate current changes in the triode (klystron tuning) are accomplished very smoothly by varying the control grid

voltage. Use of the tuner circuit in Figure 1 will avoid the possibility of drawing excessive tuner current and consequent damage to the tube.

ELECTRONIC TUNING

With the thermal tuner adjusted so that the tube is operating near the desired frequency, vernier frequency adjustment may be made by varying the reflector voltage. Maximum power output for a given thermal tuner setting, however, will be obtained at only one value of reflector voltage. If the thermal tuner and reflector voltage are mutually adjusted for maximum power output at a given frequency, and if then the reflector voltage is varied above and below the value for maximum power output, such that the power output is reduced by one half, the frequency change between the half power values is defined as the electronic tuning range. The electronic tuning range and linearity depend on the type of load and coupling used. A highly reactive load may shorten the electronic tuning range, and cause non-linear variation of frequency with reflector voltage.



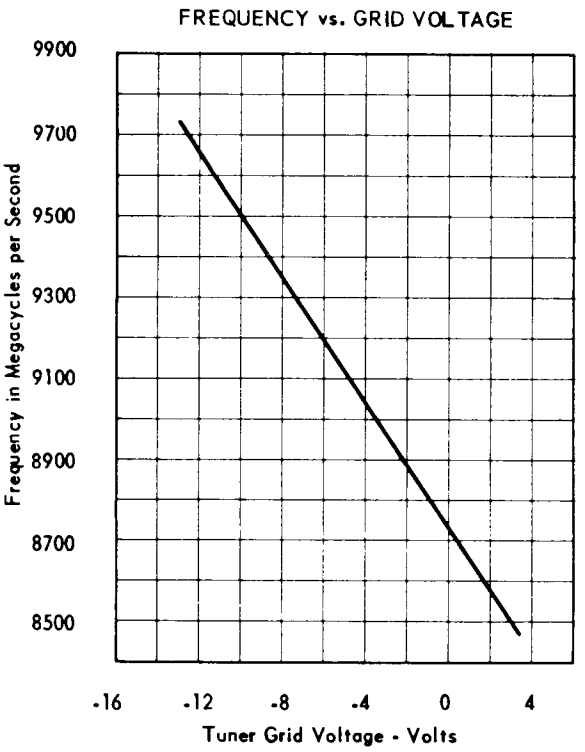


Figure 1

THE FOLLOWING DATA IS REPRESENTATIVE OF AVERAGE TUBES

TUBES DESIGNED FOR USE IN MODE A

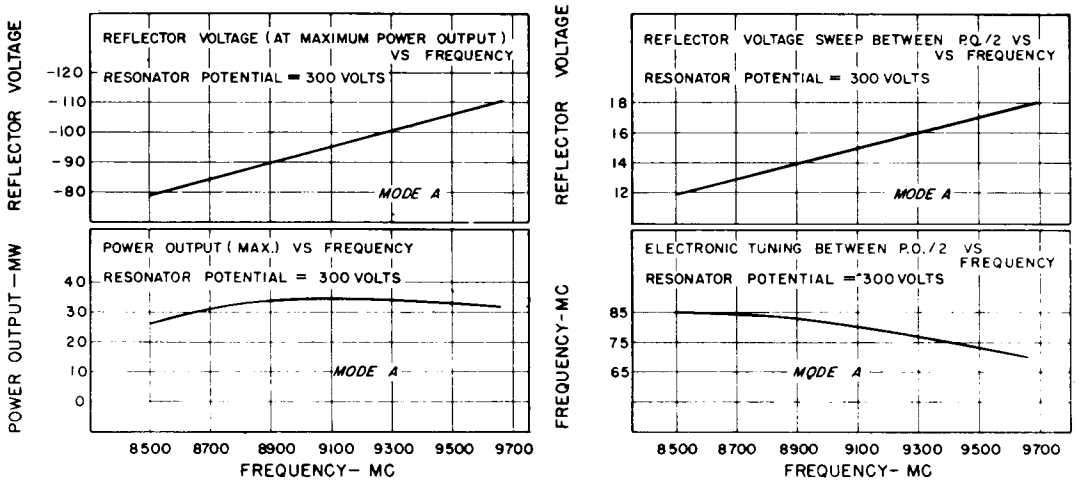


Figure 2a

MODES OF OPERATION

Oscillation may be obtained in a given tube with several combinations of resonator and reflector voltage at a particular frequency. The regions where oscillations occur, within the reflector voltage range, are referred to as voltage modes. The curves of Figure 2 show the characteristics of the 2K45 in the recommended mode. This mode has been chosen because it represents the best compromise between optimum power and wide electronic tuning range.

THE EXACT VALUE OF REFLECTOR VOLTAGE PRODUCING MAXIMUM OUTPUT AT A CERTAIN FREQUENCY, VARIES FROM TUBE TO TUBE. THE VOLTAGE FOR ALL TUBES, AT EACH MODE, WILL FALL WITHIN SHADED AREA INDICATED BELOW.

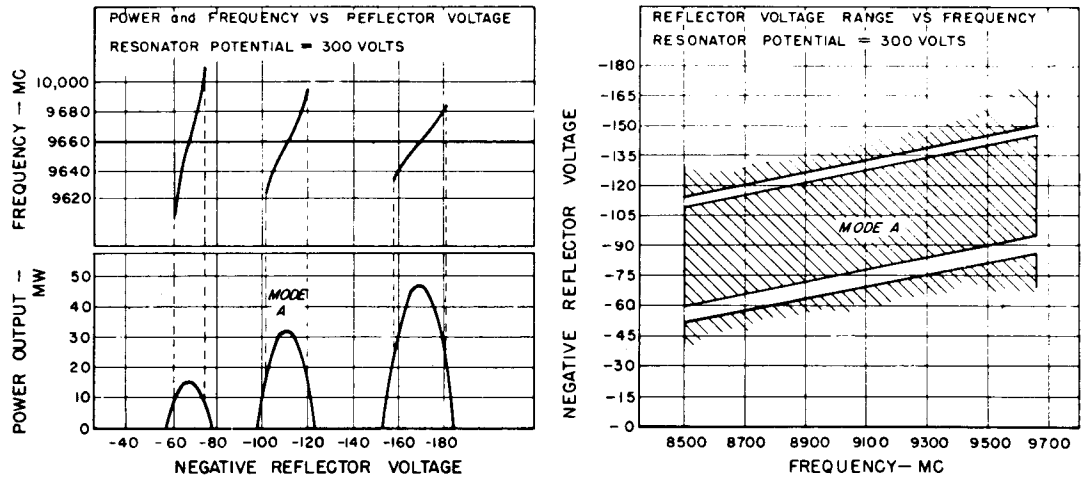


Figure 2b

DETAILED MECHANICAL INFORMATION

INSTALLATION

The 2K45 requires a modified standard octal socket with pin #4 enlarged. The tube may be mounted in any position, but should be rigidly clamped to insure the proper depth of the coaxial output line in the waveguide, and to guard against excessive strain in the coaxial output line. The tube must be clamped on or below the header skirt.

The coaxial output line is coupled into the waveguide (1" x ½") through a trap (see Figure 3 for socket details). All tabulated data in this sheet was obtained using this type of coupling. It is important that this tube coupling assembly, or its electrical equivalent, be used to insure its interchangeability. The voltage standing wave ratio at the coupling assembly should not exceed 1.1/1.

SHIELDING

Operation of the 2K45 in the presence of a strong magnetic field usually requires shielding of the resonator and reflector leads to avoid undesirable modulation of the tube output. In extremely troublesome magnetic environments, it may be necessary to place the 2K45 in a metal chamber with polyiron chokes provided to bring the voltages into the chamber.

OUTLINE DRAWING
ELECTRON TUBE 2K45

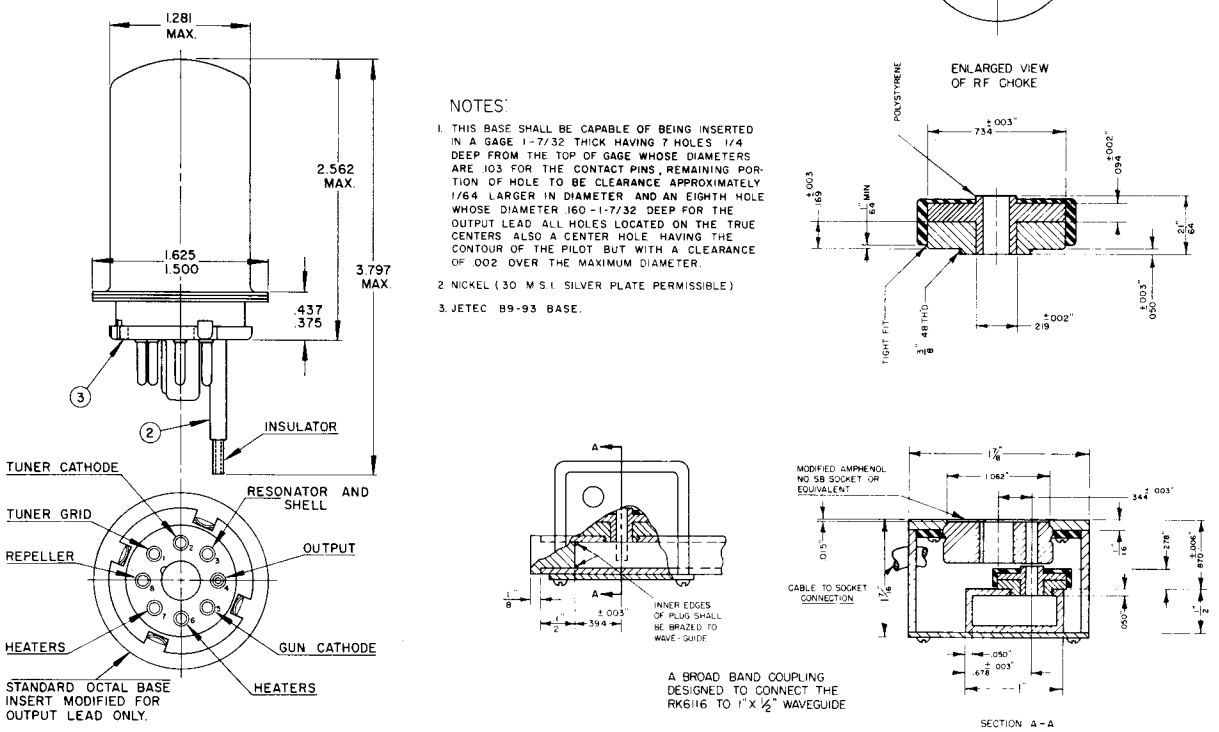


Figure 3

Excellence in Electronics

TYPE 3ACP1A 3ACP2A 3ACP7A 3ACP11A

The 3ACP—A is a 3" electrostatic focus and deflection cathode ray tube. It has a high light output, high deflection sensitivity, and a small spot size resulting from an efficient gun and post acceleration. The gun features improved deflection accuracy and electrostatic shielding to minimize interaction.

MECHANICAL DATA

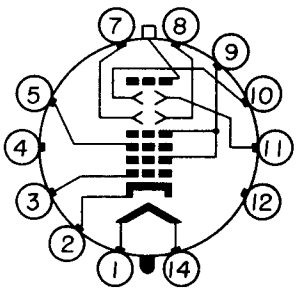
BASE: Medium Shell Diheptal 12–pin No. B12–37

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 7 Deflecting Electrode D3
Pin 2 Cathode	Pin 8 Deflecting Electrode D4
Pin 3 Grid #1	Pin 9 Accelerator
Pin 4 Internal Connection	Pin 10 Deflecting Electrode D2
Pin 5 Focusing Electrode	Pin 11 Deflecting Electrode D1
	Pin 14 Heater

MOUNTING POSITION: Any



BOTTOM VIEW

14J

GENERAL DATA

		3ACP1	3ACP2	3ACP7	3ACP11
Phosphor					
Fluorescence		Green	Green	Blue	Blue
Phosphorescence		-----	Green	Yellow	-----
Persistence		Medium	Long	Long	Short
Focusing Method	Electrostatic				
Deflection Method	Electrostatic				

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds) (approx.)

Grid #1 to all other electrodes	5.5
Cathode to all other electrodes	4.2
D1 to D2	2.1
D3 to D4	1.5
D1 to all other electrodes	5.8
D2 to all other electrodes	5.8
D3 to all other electrodes	4.5
D4 to all other electrodes	4.5

DESIGN CENTER MAXIMUM RATINGS:

Peak Heater-Cathode Voltage Max. (Note 1)	
Heater Negative with Respect to Cathode	180 volts
Heater Positive with Respect to Cathode	180 volts
Anode #2 Voltage	6000 volts DC
Anode #1 Voltage	2000 volts DC
Focusing Electrode	1500 volts DC
Grid #1 Voltage	
Negative-Bias Value	200 volts DC
Positive-Bias Value	0
Positive-Peak Value	0
Peak Voltage Between Anode #2 and any Deflecting Electrode	550 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts
Anode #2 Voltage	4000 volts DC
Anode #1 Voltage	2000 volts DC
Focusing Electrode Voltage	390 to 550 volts DC
Anode #3 Current (Note 2)	500 ma.
Grid #1 (Note 3)	–45 to –75 volts DC
Deflection Factors	
D1–D2	175 to 205 volts DC/inch
D3–D4	138 to 158 volts DC/inch
Modulation (Note 4)	21
Modulation (Note 5)	45
Line Width "A" (Note 6)	0.016

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (cont'd)

Line Width "A" (Note 5)	0.028
Spot Position (focused and undeflected) (Note 7)	3/16 inches

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg.
Resistance in any deflecting electrode circuit (Note 8)	1.0 meg.

Note 1 Cathode should be returned to one side or to the midtap of the heater transformer winding.

Note 2 Ec1 = 0 Volts DC.

Note 3 Visual extinction of undeflected focused spot.

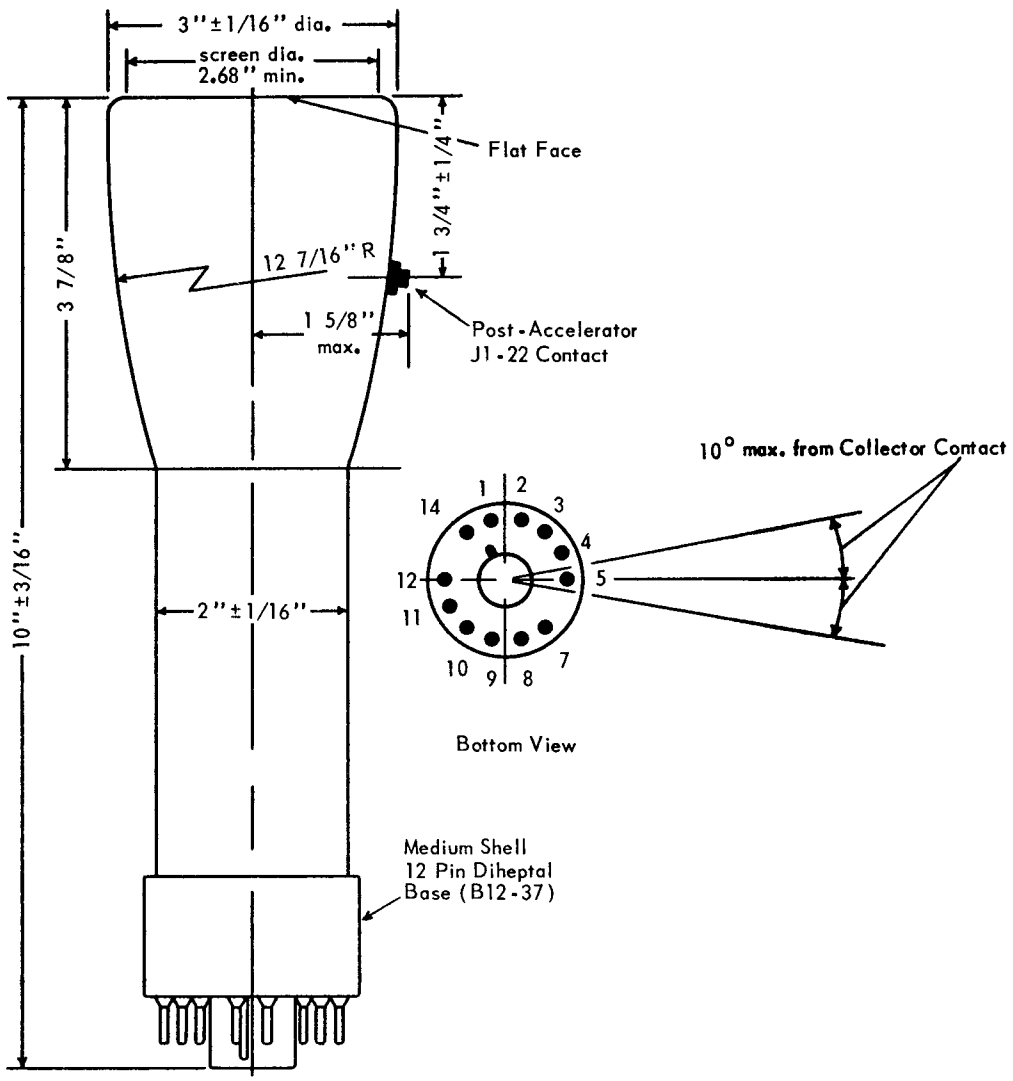
Note 4 Ib3 = 25 μA measured in accordance with MIL-E-1 specification.

Note 5 Ib3 = 200 μA measured in accordance with MIL-E-1 specification.

Note 6 Ib3 = 50 μA measured in accordance with MIL-E-1 specification.

Note 7 Centered with respect to shielded tube face. Connect free deflecting electrodes to accelerator.

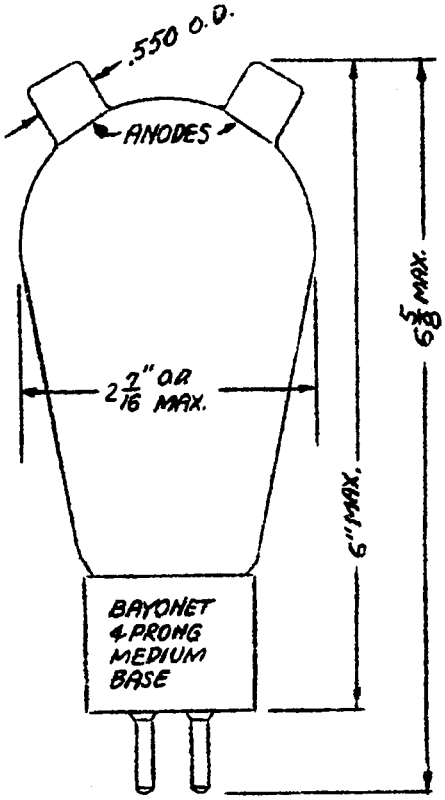
Note 8 It is recommended that the deflecting-electrode-circuit resistances be approximately equal.



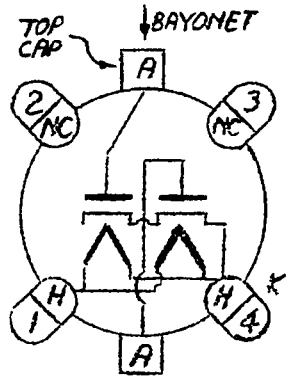
RMA Release # 309 RMA TYPE 3B23

TENTATIVE DATA
RMA TYPE 3B23
TWIN DIODE
FULL-WAVE HIGH
VACUUM RECTIFIER

E. I. A.
REGISTRATION
FILE



The 3B23 is a heater type full-wave high vacuum rectifier tube designed for use in d-c power supplies delivering approximately 1000 volts d.c. The 3B23 has a low internal voltage drop approaching that of mercury vapor type tubes and operates without generating the r-f noise common to mercury vapor tubes.



BOTTOM VIEW OF SOCKET

HEATER RATING

Heater Voltage	2.5	volts
Heater Current	8	amp

MAXIMUM RATING

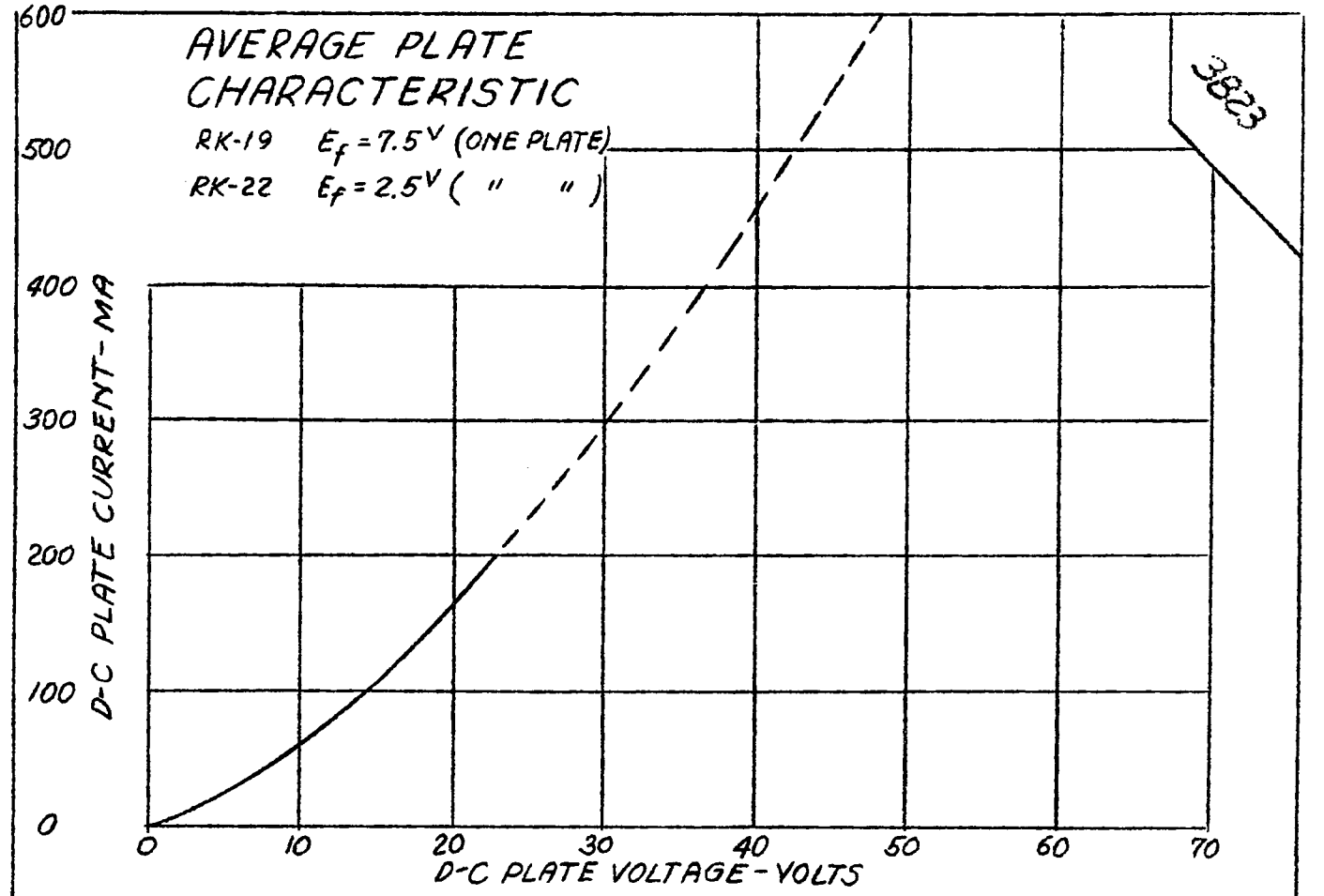
A-C Voltage per Plate	1250	volts
Peak Inverse Voltage	3500	volts
Peak Plate Current per Plate	0.6	amp
D-C Output Current (condenser input filter)	0.2	amp

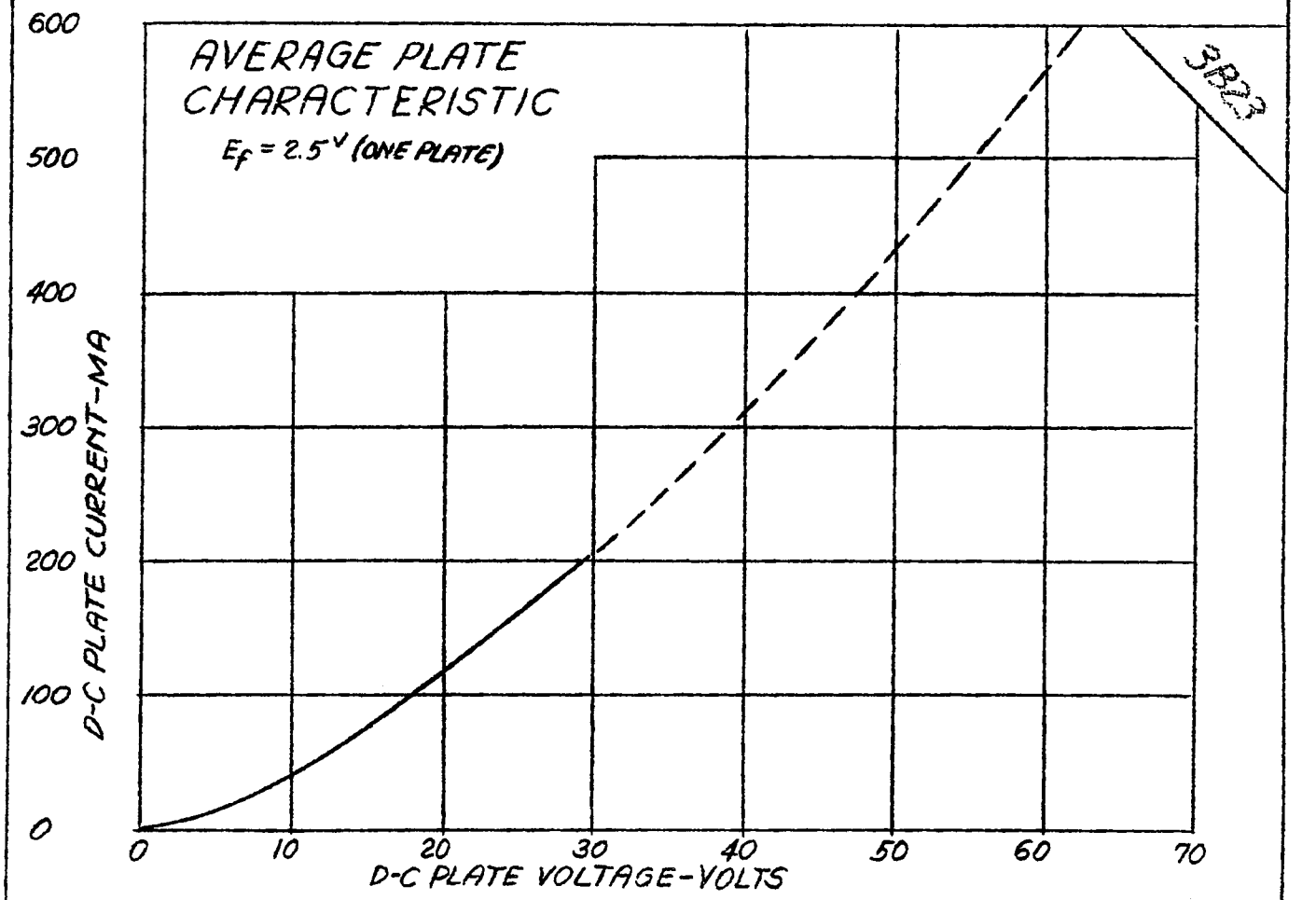
OPERATING NOTES

CAUTION The cathode should always be allowed to reach operating temperature before the plate voltage is applied. For average conditions this delay should be at least 30 seconds.

The plate leads from the power transformer should be of flexible wire to prevent strain on the top caps. Connection to the top caps should be made with a clip or spring clamp. The lead wires must not be soldered to the top caps.

from EIA registration # 309 Nov. 2, 1942
sponsor: Raytheon Production Corp.

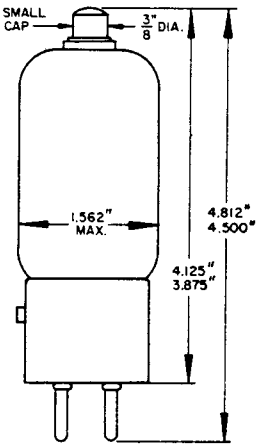

AVERAGE PLATE CHARACTERISTIC
RK-19 E_f = 7.5 V (ONE PLATE)
RK-22 E_f = 2.5 V (" ")
3B23
600
500
400
300
200
100
0
D-C PLATE CURRENT-MA
0
10
20
30
40
50
60
70
D-C PLATE VOLTAGE-VOLTS

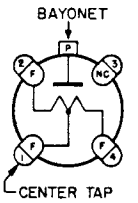

AVERAGE PLATE CHARACTERISTIC
E_f = 2.5 V (ONE PLATE)
3B23
600
500
400
300
200
100
0
D-C PLATE CURRENT-MA
0
10
20
30
40
50
60
70
D-C PLATE VOLTAGE-VOLTS

Excellence in Electronics

TYPE RK-3B24W

The RK3B24W is a half-wave, high vacuum rectifier tube with a thoriated tungsten filament. The tube may be operated with either half of the filament functioning separately, or with the two halves connected in series or parallel. When operating with half the filament energized, it is equivalent to the older type RK-72 diode. Convection cooling is normally used with this tube. As is the case with most other electrical components, operation of the RK3B24W at or near its maximum ratings is not conductive to long life, economy or reliability.





MECHANICAL DATA

ENVELOPE: T-12 Glass

BASE: Medium 4-Pin Bayonet, Phenolic Low-Loss, A 4-10

TERMINAL CONNECTIONS:

Pin 1 Filament Center Tap	Pin 4 Filament
Pin 2 Filament	Cap Plate
Pin 3 No Connection	

MOUNTING POSITION: Any

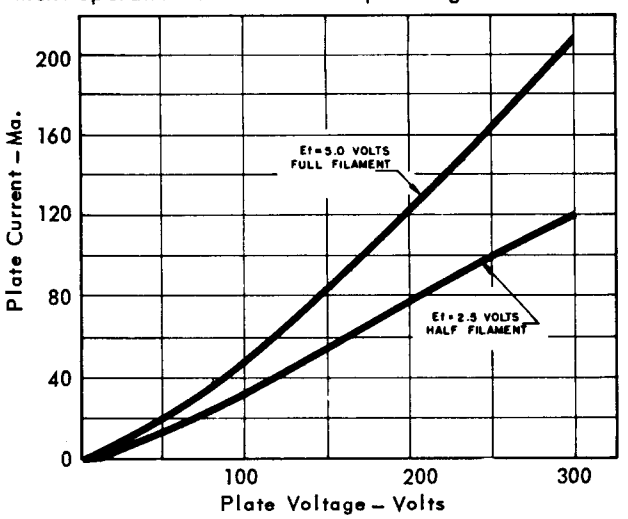
ELECTRICAL DATA

RATINGS ABSOLUTE-MAXIMUM VALUES:

	HF	FF	
Heater Voltage	2.5±5%	5.0±5%	volts
Peak Inverse Voltage	20000	20000	volts
Peak Plate Current	150	300	ma
Average Plate Current	30	60	ma
HEATER CHARACTERISTICS:			
Heater Voltage	2.5	5.0	volts
Heater Current	3.0	3.0	amps
Preheat Time	2	2	seconds

VOLTAGE CHARACTERISTICS

Figure 1 shows graphically the voltage characteristics on average tubes for both half and full filament operation under normal operating conditions.



Tentative Data

Printed in U.S.A.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

3B24WA

HALF-WAVE RECTIFIER

The 3B24WA is a half-wave, high vacuum rectifier tube with a "bonded thoria" tungsten filament. Its rugged construction makes it ideal for applications involving severe shock and vibration. The tube may be operated with either half of the filament functioning separately, or with the two halves connected in series or parallel. When operating with half the filament energized, it is equivalent to the older type RK-72 diode. Convection cooling is normally used with this tube. As is the case with most other electrical components, operation of the 3B24WA at or near its maximum ratings is not conductive to long life, economy or reliability.

MECHANICAL RATINGS: (Absolute Max.)

Impact Acceleration	450	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Altitude	10,000	ft.

ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absol. Min.	Normal Oper.	Test Limit or Absol. Max.	MIL-E-1 Units
Heater Voltage	Ef	4.75	5.0	5.25	V
	Ef(note 1)	2.375	2.5	2.625	V
Peak Plate Inverse Voltage	epx	---	---	20	Kv
Peak Plate Current	ib	---	---	300	ma
	ib	---	---	150 (note 1)	ma
DC Output Current	Io	---	---	60	mAdc
	Io	---	---	30 (note 1)	mAdc
Filament Current Ef=2.5 Vac (Notes 1&2)	If	2.75	3.0	3.25	Aac
Plate Current Eb=250 Vdc Ef=5.0 V	Ib	135	---	---	mAdc
Gas (Note 3) Pp=50 w min.; t=30; Ef=5.0 Vac	ΔIb	---	---	5	mAdc
Operation Ef=5.0 Vac; t=60; epx=20 Kv	Io	60	---	---	mAdc
Emission (1) Ef=5.0 Vac; eb= 1000 V max.	is	750	---	---	madc
Emission (2) Ef=2.5 Vac; eb= 1000 V max. (Note 2)	is	375	---	---	madc

Note 1: Using one-half of filament.

Note 2: Test each half of filament separately.

Note 3: The plate current shall not vary from the initial value at any time during the test by more than the specified amount.

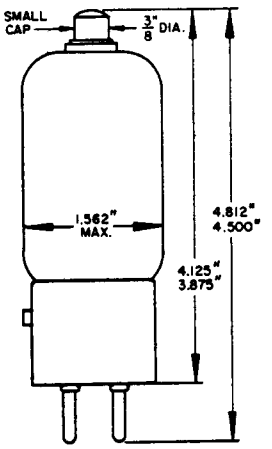
MECHANICAL DATA

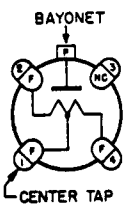
ENVELOPE ..... Glass T-12

BASE ..... Medium 4 Pin Bayonet, Phenolic Low Loss, A4-10

MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



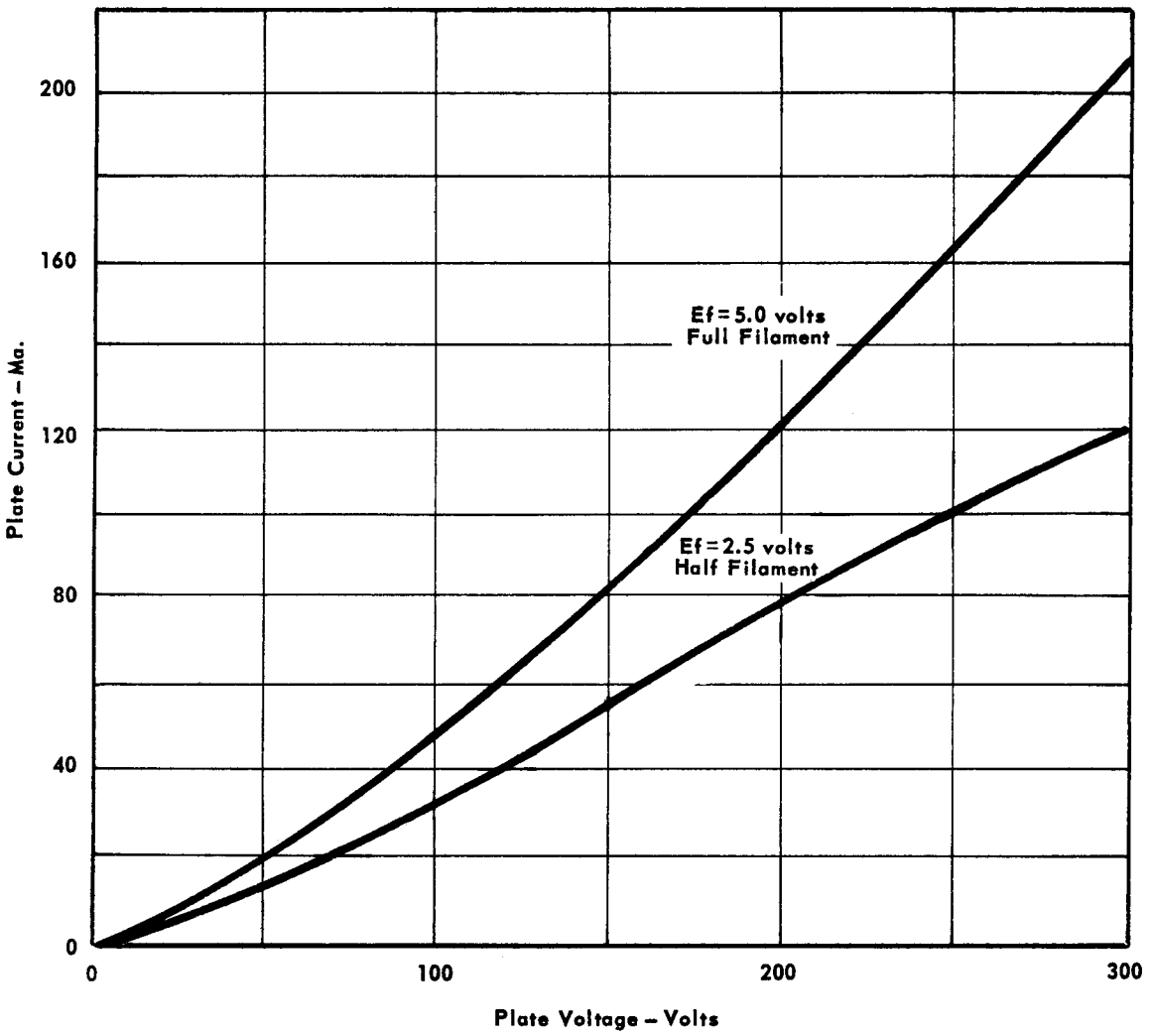


TERMINAL CONNECTIONS:

Pin 1 Filament Center Tap
Pin 2 Filament
Pin 3 No Connection
Pin 4 Filament
Cap Plate

HALF-WAVE RECTIFIER

VOLTAGE CHARACTERISTICS



The above curves show graphically the voltage characteristics on average tubes for both half and full filament operation under normal operating conditions.

RAYTHEON

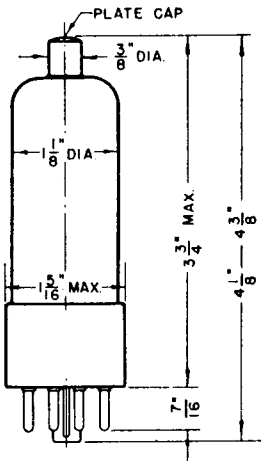
TECHNICAL INFORMATION

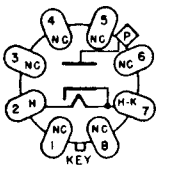
HIGH VACUUM CLIPPER DIODE

TYPE RK-3B26

Excellence in Electronics

The RK3B26 is a heater-cathode, high-vacuum clipper diode designed for use in high voltage application. It is mechanically ruggard and in addition uses a hard glass nonex envelope. The plates are gold plated and zirconium coated for better operation at high voltages. The cathode is heliarc welded making the internal connection more ruggard and giving better contact. The self supporting anodes eliminate use of mica spacers allowing high temperature during exhaust thereby obtaining less gas and longer life.





MECHANICAL DATA

ENVELOPE: T-9 Per Outline

BASE: Intermediate Shell Octal 8-Pin, B8-6, Phenolic

TERMINAL CONNECTIONS:

Pin 1 NC	Pin 6 NC
Pin 2 Heater	Pin 7 Heater and Cathode
Pin 3 NC	Pin 8 NC
Pin 4 NC	Cap Plate
Pin 5 NC	

MOUNTING POSITION: Vertical

Cooling: Freely Circulating Air

ELECTRICAL DATA

RATINGS – ABSOLUTE MAXIMUM:

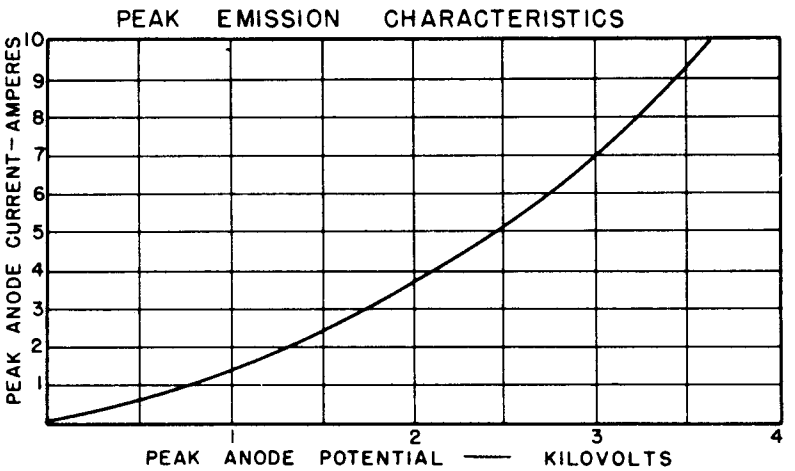
Heater Voltage (ac)	2.5±10% volts
Peak Plate Inverse Voltage ●	15 kv
Peak Plate Current ♦	8.0 amp
Average Plate Current	20 ma
Average Plate Dissipation	25 watts

CHARACTERISTICS AND TYPICAL OPERATIONS:

Heater Voltage (ac)	2.5 volts
Heater Current	4.75 amp
Cathode Heating Time	2 minutes min.
Voltage Drop at 100 ma.	130 volts
Plate Current (dc) Eb= 130 vdc	90 ma min
Peak Emission eb= 4000 v	8.0 amp min

● *This value of maximum peak inverse voltage is recommended for tube use in hermetically sealed units that are dry and free from dust.*

♦ *In clipper service, it is necessary to provide a series resistor in the plate circuit, so that the instantaneous peak plate current will not exceed the specified value under any conditions of equipment overload or arc over. This value of maximum peak current is for intervals of less than 5 micro seconds and repetition rate of less than 2000 times per second.*



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INDUSTRIAL TUBE DIVISION

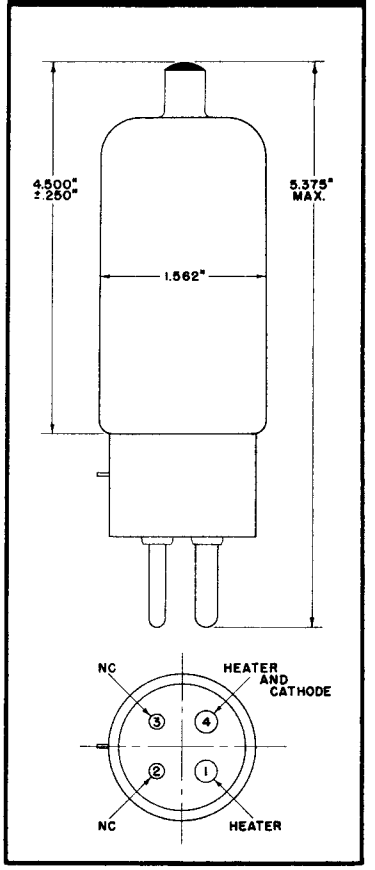
RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

Excellence in Electronics

TYPE RK-3B29

The RK3B29 is a heater-cathode, high vacuum type designed for use as a clipper diode or rectifier It is mechanically ruggard and in addition use a hard glass nonex envelope. The plates are gold plated, zirconium coated and radially cooled for better operation at high voltages. The cathode is heliarc welded making the internal connection more ruggard and giving better contact. The self supporting anodes eliminate use of mica spacers allowing high temperatures during exhaust thereby obtaining less gas and longer life.



MECHANICAL DATA

ENVELOPE: T–12

BASE: Medium 4-Pin Bayonet, A 4–10, Phenolic

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 4 Heater and Cathode
Pin 2 NC	Cap Plate
Pin 3 NC	

COOLING: Freely Circulating Air

ELECTRICAL DATA

RATINGS – ABSOLUTE MAXIMUM – RECTIFIER:

OPERATION 1		
Heater Voltage (ac)	2.5 ± 10%	volts
Peak Plate Inverse Voltage	16	kv
Peak Plate Current	.25	amp
Average Plate Current (dc)	64	ma
OPERATION 2		
Heater Voltage (ac)	2.5 ± 10%	volts
Peak Plate Inverse Voltage	7.7	kv
Peak Plate Current	.30	amp
Average Plate Current (dc)	80	ma
OPERATION 3		
Heater Voltage (ac)	2.5 ± 10%	volts
Peak Plate Inverse Voltage	5.0	kv
Peak Plate Current	.30	amp
Average Plate Current (dc)	95	ma

RATINGS – ABSOLUTE MAXIMUM – SHUNT DIODE:

Heater Voltage (ac)	2.5 ± 10%	volts
Peak Plate Inverse Voltage	10	kv
Peak Plate Current	8.0	amp
Average Plate Current (dc)	18	ma
Pulse Duration in 100μsec Interval	25	μsec

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Potential	2.5	volts
Heater Current	4.9	amp
Heating Time	2	minutes
Plate to Cathode Capacitance	2.5	μμf
Plate Current (dc)	90	ma min
Peak Emission (eb = 4000 v)	8.0	amp

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INDUSTRIAL TUBE DIVISION

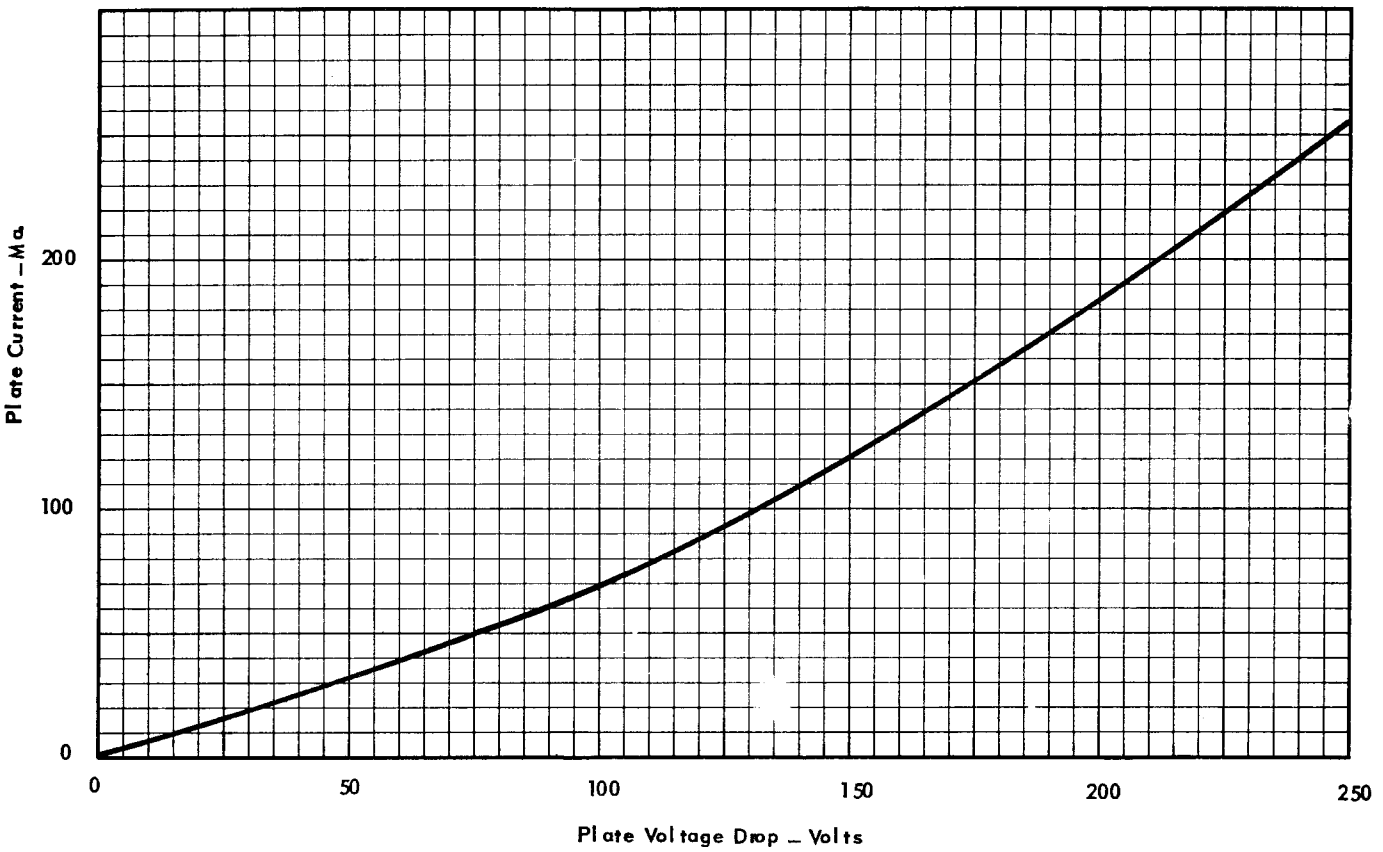
RAYTHEON COMPANY

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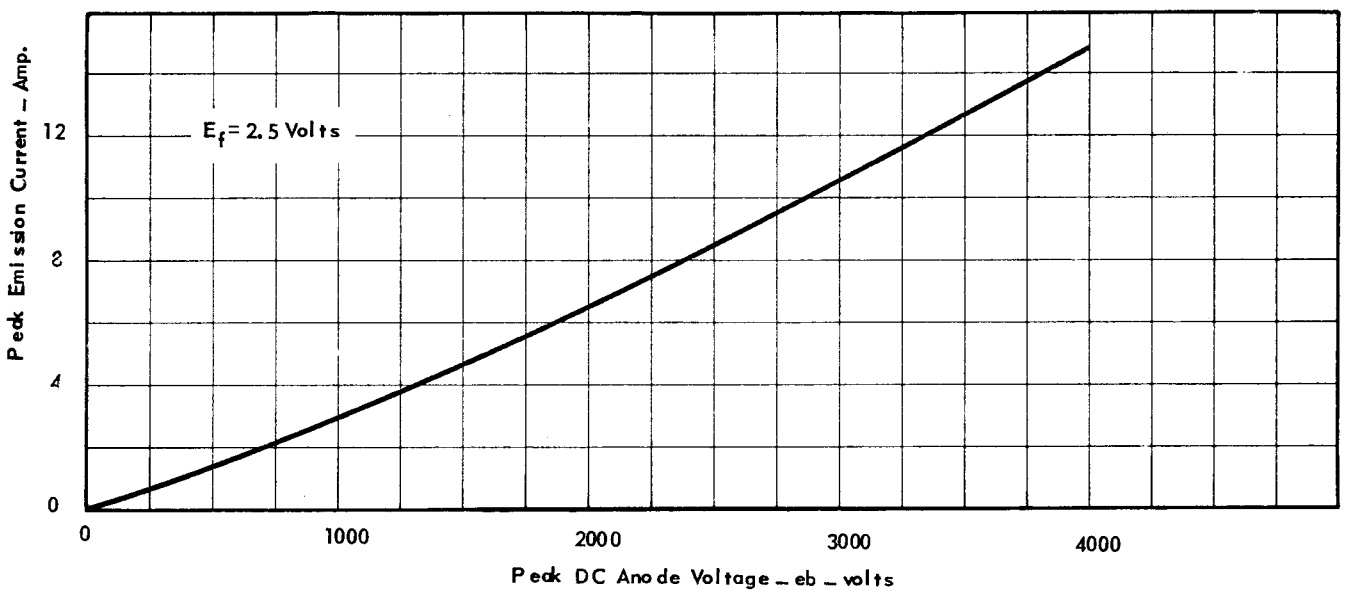
55 CHAPEL ST., NEWTON 58, MASS.

DIODE RECTIFIER

AVERAGE PLATE VOLTAGE DROP



PEAK DC ANODE VOLTAGE VS PEAK EMISSION CURRENT



CK3BAP7/ QK545



STORAGE TUBE SIMULATOR

GENERAL DESCRIPTION

The CK3BAP7/QK545 is a cathode ray tube which is used as a simulator for CK6835. This tube may be utilized for visual inspection of the input signal and for determining the focus and deflection capabilities of the circuitry.

GENERAL CHARACTERISTICS

ELECTRICAL

Phosphor	P7
Heater	
Heater Voltage	6.3 V±10%
Heater Current	0.6 A
Maximum Ratings	
Anode Voltage	6000 Vdc
Grid #1 (control electrode) Voltage	
Negative Bias	−125 Vdc
Positive Bias	0 Vdc
Positive Peak Value	+2 V
Typical Operation Conditions (All Voltages Measured with Respect to Cathode)	
Anode Voltage	3500 Vdc
Cathode Current	100 μa

MECHANICAL CHARACTERISTICS

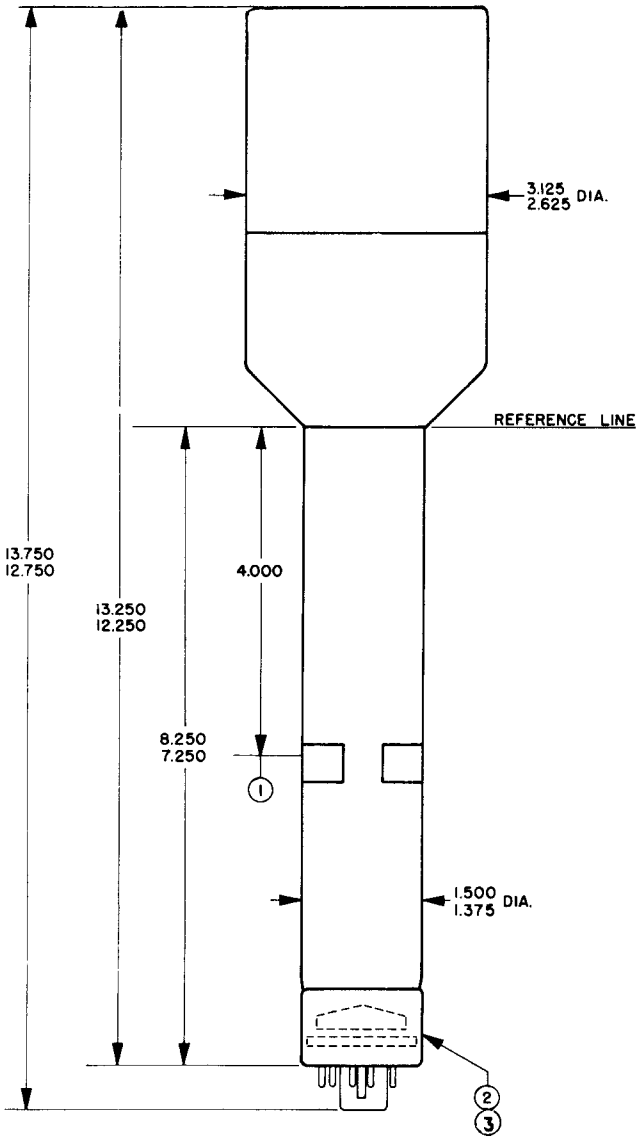
Terminal Connections:

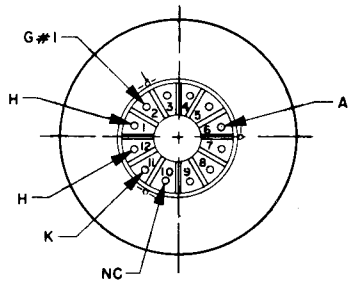
Pin 1	Heater	Pin 7	no connection
Pin 2	Grid #1	Pin 8	no connection
Pin 3	no connection	Pin 9	no connection
Pin 4	no connection	Pin 10	no connection
Pin 5	no connection	Pin 11	Cathode
Pin 6	Anode	Pin 12	Heater

Focusing	Magnetic
Deflection	Magnetic
Maximum Deflection Angle	20°
Over-all Length	13-3/4"
Bulb Diameter	3" Nominal
Neck Diameter	1-1/2" Maximum
Screen Diameter (approx.)	1-3/4"
Base	Small Shell Duodecal
Mounting Position	Any

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STORAGE TUBE SIMULATOR



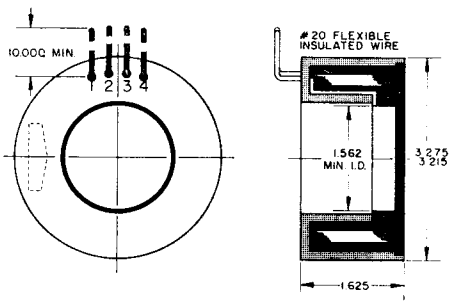


1) LOCATION OF DEFLECTION YOKE AND FOCUSING COIL MUST BE WITHIN THIS SPACE.

2) SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH CONE AXIS AND HAVING A DIAMETER OF 2.000.

3) B12-43 12 PIN BASE.

BM-411 FOCUS COIL



LEADS
#1 - S1
#2 - F1
#3 - S2
#4 - F2

TICKLER COIL
RESISTANCE - 35 TO 50 OHMS (AT 20°C)
MAX. CURRENT - 30 mA RMS
VOLTAGE RATING - 250 V.
INDUCTANCE - 45 MILLIHENRIES APPROX.

FOCUS COIL
RESISTANCE - 6500 TO 9000 OHMS (AT 20°C.)
MAX. CURRENT - 25 mAdc
VOLTAGE RATING - 250 V.

NOTES:

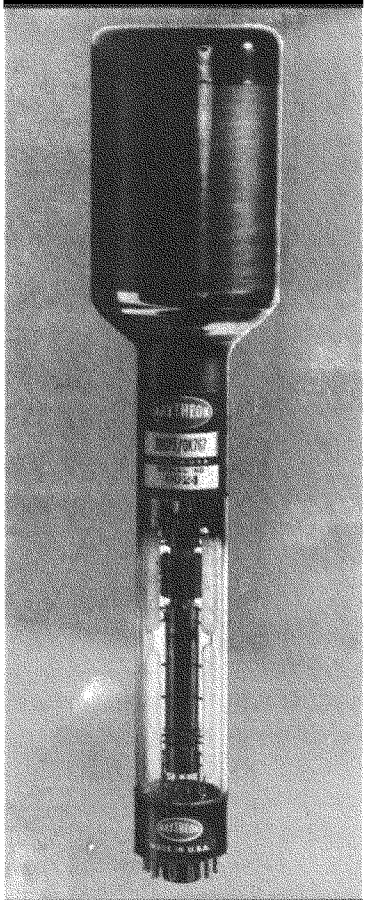
1) - FOR USE WITH RECORDING STORAGE TUBES AND SIMULATORS.

2) - TICKLER COIL IS PROVIDED TO PERMIT COMPENSATING FOR IMPROPER FOCUS AT THE EDGES OF A PATTERN CAUSED BY THE VARIATION IN DISTANCE FROM THE CENTER OF DEFLECTION TO a) THE CENTER OF A STORAGE AREA OF A STORAGE TUBE, AND b) THE PERIPHERY OF A STORAGE AREA. THIS TICKLER COIL USEFUL ONLY FOR SLOW SCANNING SPEEDS.

3) - WHEN NOT REQUIRED, THE TICKLER COIL MAY BE LEFT UNCONNECTED.

4) - SHELL MATERIAL - ANNEALED SWEDISH IRON OR EQUIVELENT.

CK3BCP7/ QK767



STORAGE TUBE SIMULATOR

GENERAL DESCRIPTION

The CK3BCP7/QK767 is a cathode ray tube which is used as a simulator for the CK7571. This tube may be utilized for visual inspection of the input signal and for determining the focus and deflection capabilities of the circuitry.

GENERAL CHARACTERISTICS

ELECTRICAL

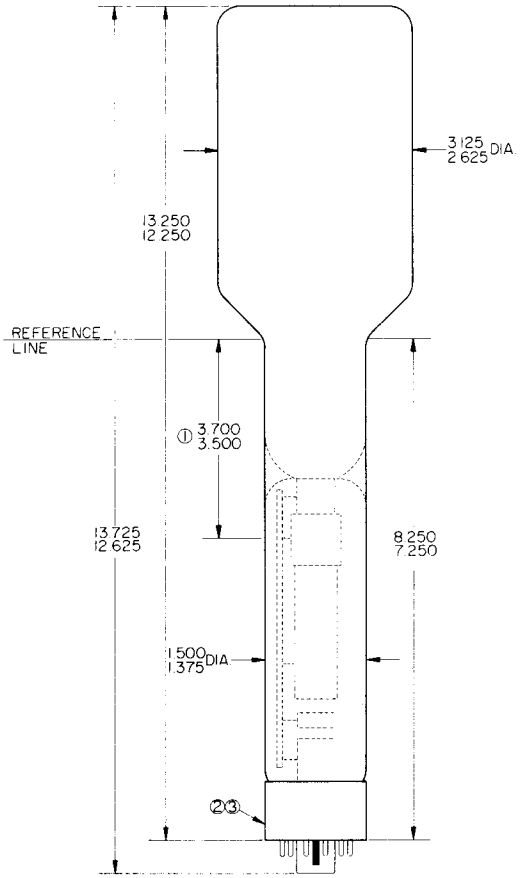
Phosphor	P7
Heater	
Heater Voltage	6.3 V±10%
Heater Current	0.6 A
Maximum Ratings	
Anode Voltage	6000 Vdc
Grid #1 (control electrode) Voltage	
Negative Bias	−125 Vdc
Positive Bias	0 Vdc
Positive Peak Value	+2 V
Grid #2	1000 Vdc
Focus Anode Voltage	4000 V
Typical Operating Conditions	
(All Voltages Measured With Respect to Cathode)	
Cathode	0V
G1 (Control Grid) Cutoff	−30V
G2	400V
Anode	3500V
Focus Anode	
Electrostatic	400V
Magnetic	3500V

MECHANICAL CHARACTERISTICS

Terminal Connections:	
Pin 1 Heater	Pin 7 no connection
Pin 2 Grid #1	Pin 8 no connection
Pin 3 no connection	Pin 9 no connection
Pin 4 Anode 2 (focus anode)	Pin 10 Grid #2
Pin 5 no connection	Pin 11 Cathode
Pin 6 Anode 1	Pin 12 Heater
Focusing	Magnetic & Electrostatic
Deflection	Magnetic
Maximum Deflection Angle	30°
Over-all Length	13-3/16"
Bulb Diameter	3" Nominal
Neck Diameter	1-1/2" Maximum
Screen Diameter	2" (approx.)
Base	Small Shell Duodecal
Mounting Position	Any

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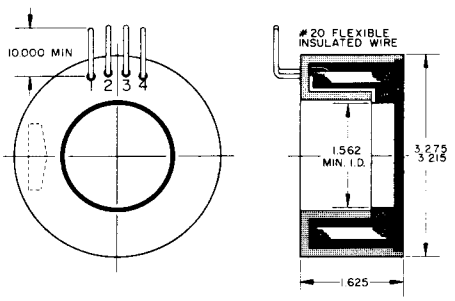
STORAGE TUBE SIMULATOR



NOTES:

1) LOCATION OF DEFLECTION YOKE AND THE GAP OF THE FOCUSING COIL MUST BE WITHIN THIS SPACE.
2) SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED, IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH CONE AXIS, AND HAVING A DIAMETER OF 2.000.
3) B12-43 12 PIN BASE.

BM-411 FOCUS COIL



LEADS
#1 - S1
#2 - F1
#3 - S2
#4 - F2

TICKLER COIL
RESISTANCE - 35 TO 50 OHMS (AT 20°C)
MAX. CURRENT - 30 mA RMS
VOLTAGE RATING - 250 V.
INDUCTANCE - 45 MILLIHENRIES APPROX.

FOCUS COIL
RESISTANCE - 6500 TO 9000 OHMS (AT 20°C.)
MAX. CURRENT - 25 mAdc.
VOLTAGE RATING - 250 V.

NOTES:

1) - FOR USE WITH RECORDING STORAGE TUBES AND SIMULATORS.
2) - TICKLER COIL IS PROVIDED TO PERMIT COMPENSATING FOR IMPROPER FOCUS AT THE EDGES OF A PATTERN CAUSED BY THE VARIATION IN DISTANCE FROM THE CENTER OF DEFLECTION TO a) THE CENTER OF A STORAGE AREA OF A STORAGE TUBE, AND b) THE PERIPHERY OF A STORAGE AREA. THIS TICKLER COIL USEFUL ONLY FOR SLOW SCANNING SPEEDS.
3) - WHEN NOT REQUIRED, THE TICKLER COIL MAY BE LEFT UNCONNECTED.
4) - SHELL MATERIAL - ANNEALED SWEDISH IRON OR EQUIVELENT.

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TYPE 3UP1 3UP7

The 3UP— is a 3" electrostatic focus and deflection cathode ray tube primarily designed for oscilloscope applications. The small size and rectangular face makes it well adapted for use in small portable equipment.

MECHANICAL DATA

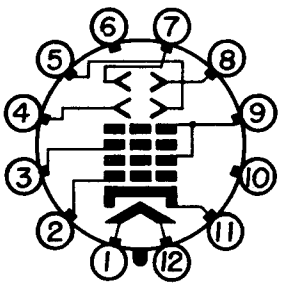
BASE: Small Shell Duodecal 12-Pin No. B12-43

BASE ALIGNMENT: D3–D4 Trace Aligns With Long Axis of Tube Face ± 5 Degrees
Positive Voltage on D3 With Respect To D4 Deflects Beam Approx. Toward Pin #2
Positive Voltage on D1 With Respect To D2 Deflects Beam Approx. Toward Pin #5

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 7 Deflecting Electrode D1
Pin 2 Grid #1	Pin 8 Deflecting Electrode D2
Pin 3 Anode #1	Pin 9 Anode #2 Grid #2
Pin 4 Deflecting Electrode D3	Pin 11 Cathode
Pin 5 Deflecting Electrode D4	Pin 12 Heater

MOUNTING POSITION: Any



BOTTOM VIEW

12F

GENERAL DATA

		3UP1	3UP7
Phosphor			
Fluorescence		Green	Blue
Phosphorescence		-----	Yellow
Persistence		Medium	Long
Focusing Method	Electrostatic		
Deflection Method	Electrostatic		

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.) (approx.)

Grid #1 to all other electrodes	10.5
Cathode to all other electrodes	2.0
D1 to D2	1.5
D3 to D4	1.0
D1 to all other electrodes except D2	4.5
D2 to all other electrodes except D1	5.5
D3 to all other electrodes except D4	5.0
D4 to all other electrodes except D3	4.5

DESIGN CENTER MAXIMUM RATINGS:

Heater Current	0.6 ± 10% amps.
Peak Heater-Cathode Voltage, Max. (Note 1)	
Heater Negative with respect to cathode	140 volts
Heater Positive with respect to cathode	140 volts
Anode #2 Voltage	2500 volts DC
Anode #1 Voltage	1000 volts DC
Grid #1 Voltage	
Negative-Bias Value	200 volts DC
Positive-Bias Value	0
Positive-Peak Value	2
Peak Voltage Between Anode #2 and Any Deflecting Electrode	500 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts
Anode #2 Voltage	2000 volts DC
Anode #1 Voltage (Note 2)	470 ± 150 volts DC
Anode #1 Current	−15 to +10 ma
Deflection Factors	
D1-D2	240 to 310 volts DC/inch
D3-D4	232 to 296 volts DC/inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg.
Resistance in any deflecting electrode current (Note 3)	5.0 meg.

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Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

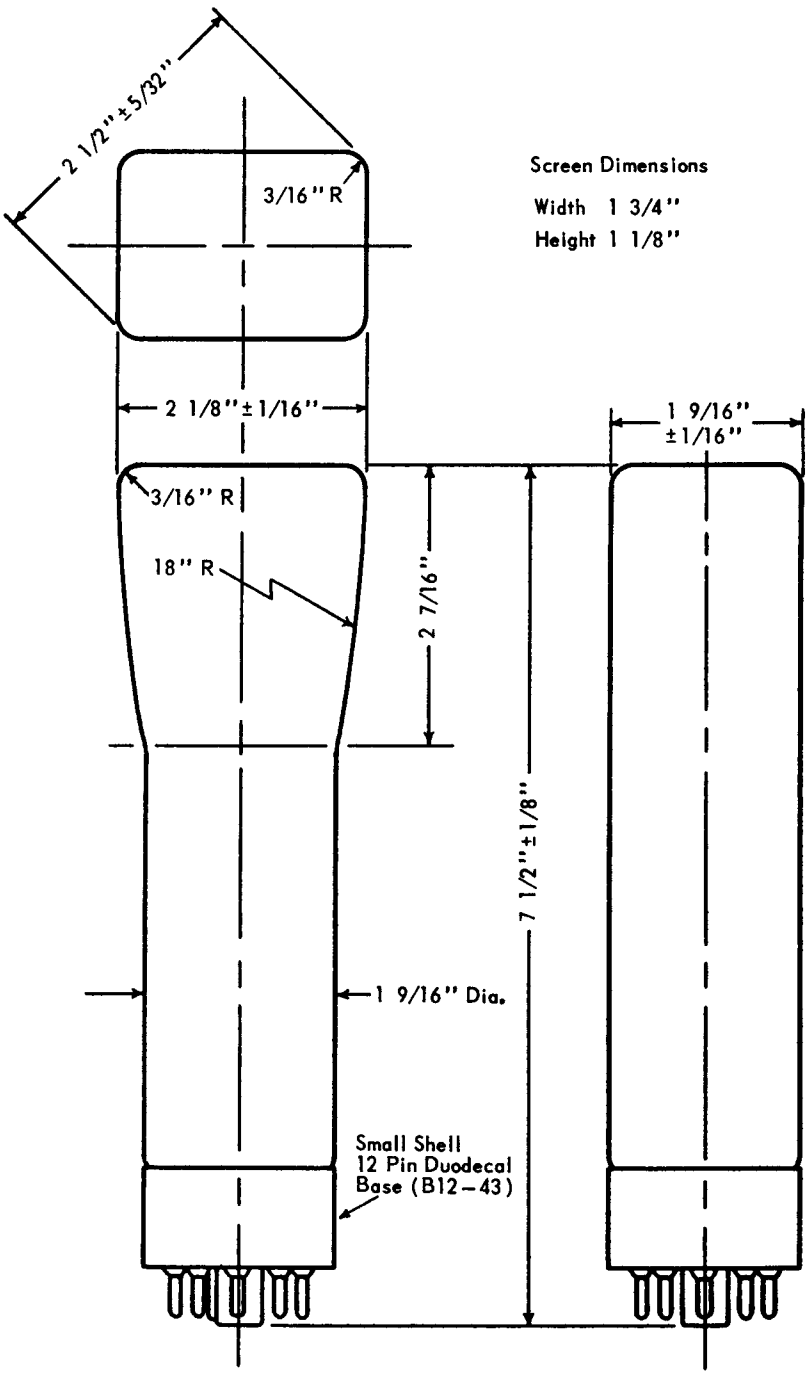
RAYTHEON

CATHODE RAY TUBE

Note 1 Cathode should be returned to one side or to the midtap of the heater transformer winding.

Note 2 Visual extinction of Focused Spot.

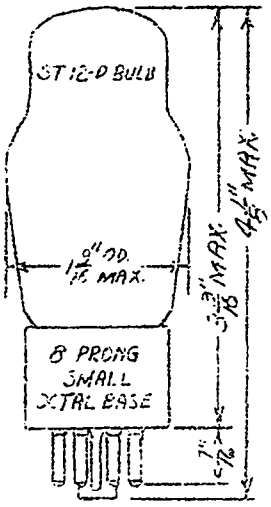
Note 3 It is recommended that the deflecting-electrode-circuit resistances be approximately equal.

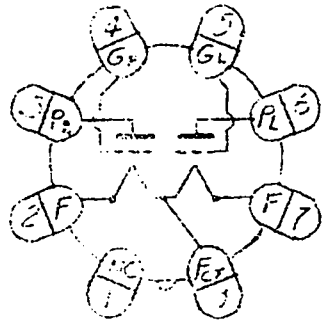


DATA SHEET
RAYTHEON TYPE 4A6G

4A6G

TWIN TRIODE
POWER AMPLIFIER
Filament Type Glass Bulb





The 4A6G is a twin triode power amplifier tube designed for service as a Class B power amplifier in the output stage of battery operated receivers. The filament center-tapis connected to base pin #8, allowing operation of the filaments in series at 4 volts or in parallel at 2 volts.

RATINGS

	Series Connection	Parallel Connection	
Filament Voltage	4	2	d-c volts
Filament Current	0.06	0.12	amp
Maximum Plate Voltage	90		volts
Maximum Peak Plate Current (per plate)	25		ma

AMPLIFIER - CLASS A - ONE TRIODE

Plate Voltage	90	volts
Grid Bias †	-1.5	volts
Amplification Factor	25	
Plate Resistance	28000	ohms
Transconductance	900	umhos
Plate Current	1.2	ma

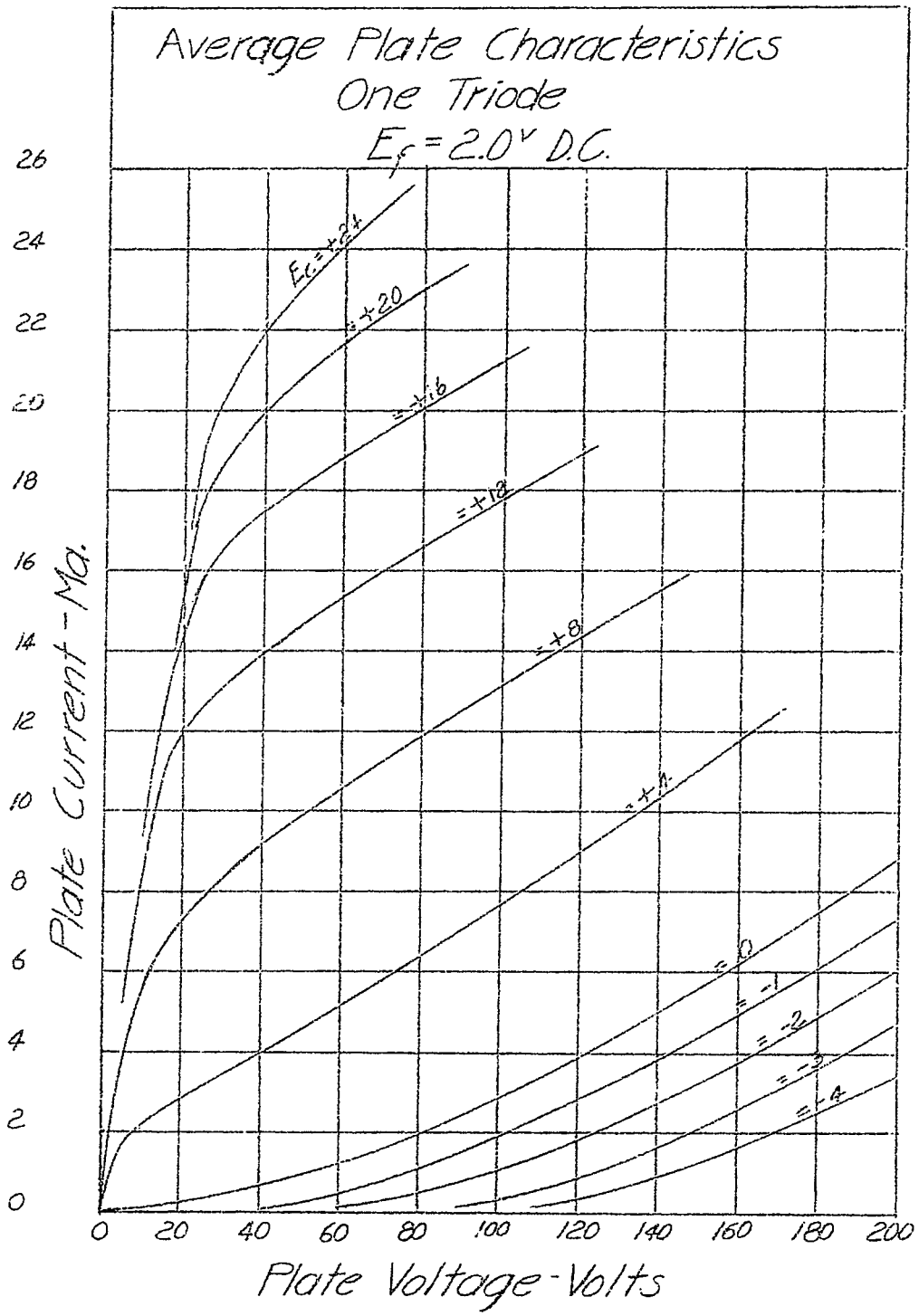
PUSH-PULL AMPLIFIER - CLASS B - Ideal Conditions

Plate Voltage	90	90	volts
Grid Bias †	0	-2	volts
No-Signal Plate Current (Total)	5	1.5	ma
Max. Signal Plate Current (Total)	21	21	ma
Load Resistance (plate to plate)	8000	8000	ohms
Power Output	1.0	1.0	watt
Power Input (at peak of a-f cycle)	65	75	mw
3rd Harmonic	5	5	percent

† Grid bias measured from negative filament of each section.

from RMA release #137, May 3, 1938

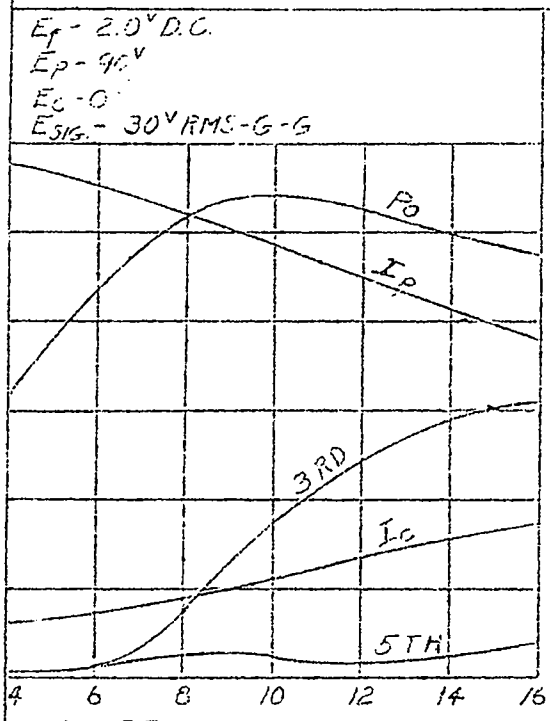
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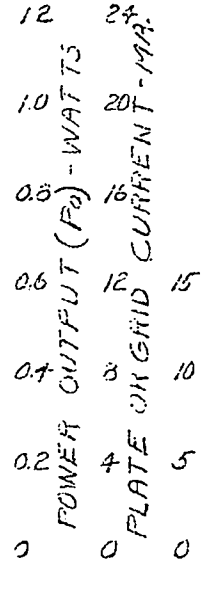

Average Plate Characteristics
One Triode
E_f = 2.0 V D.C.
Plate Current - Ma.
Plate Voltage - Volts
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
20
40
60
80
100
120
140
160
180
200
E_c = +24
= +20
= +16
= +12
= +8
= +4
= 0
= -1
= -2
= -3
= -4

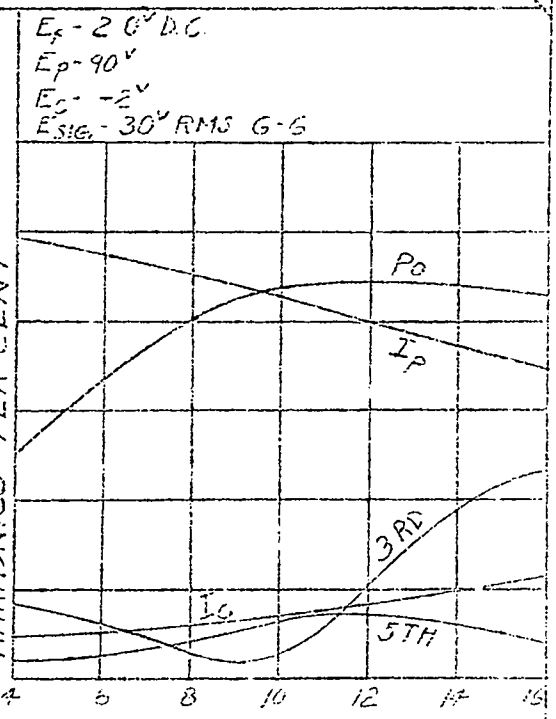
3-29-38

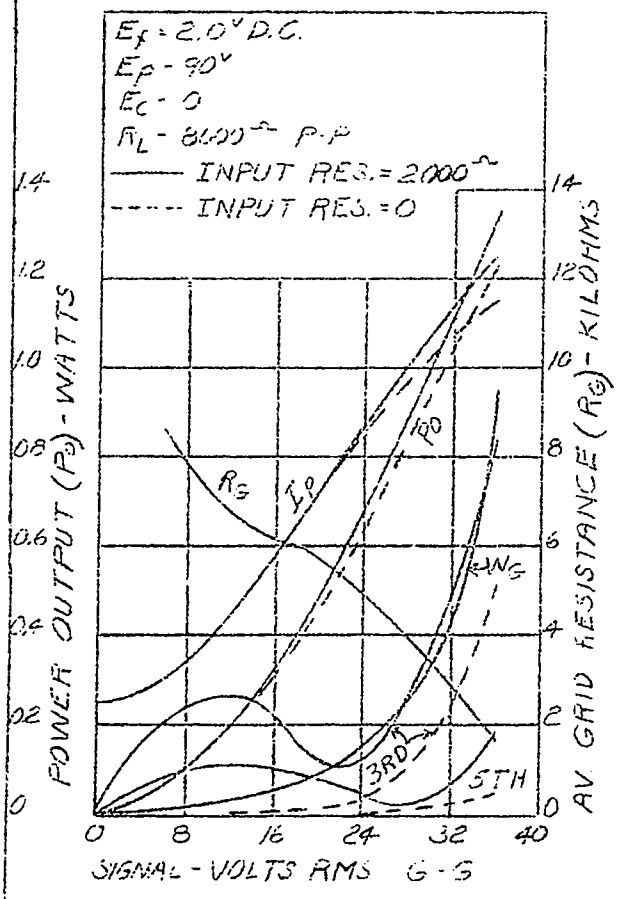
TENTATIVE CHARACTERISTICS
AMPLIFIER - CLASS B

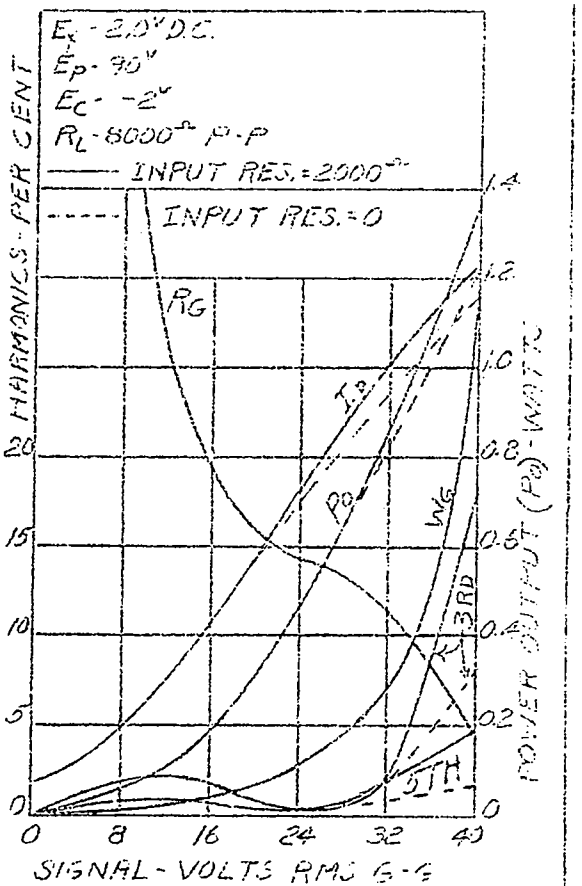
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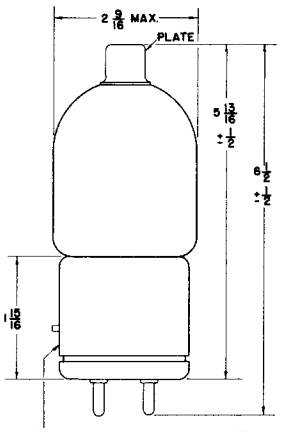
TECHNICAL INFORMATION

DIODE RECTIFIER

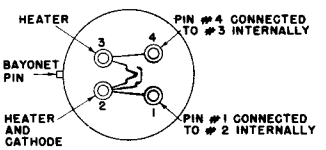
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TYPE RK-4B31

The RK4B31 is a heater-cathode, high vacuum power tube designed for use as a clipper diode or rectifier. It is mechanically ruggard and in addition uses a hard glass nonex envelope. The plates are gold plated and zirconium molybedenum coated for better operation at high voltages. The cathode is heliarc welded making the internal connection more ruggard and giving better contact. Two ceramic spacers allows high temperatures during exhaust thereby obtaining less gas and longer life.



4 PIN SUPER-JUMBO BASE (EXCEPT METAL SLEEVE 1 15/16 LENGTH)



BOTTOM VIEW OF BASE

MECHANICAL DATA

ENVELOPE: Per Outline

BASE: 4 Pin Super Jumbo, Special Sleeve

TERMINAL CONNECTIONS:

Pin 1 Heater and Cathode	Pin 4 Heater
Pin 2 Heater and Cathode	Cap Plate
Pin 3 Heater	

COOLING: Freely Circulating Air

ELECTRICAL DATA

RATINGS AND ABSOLUTE MAXIMUM VALUES – CLIPPER DIODE:

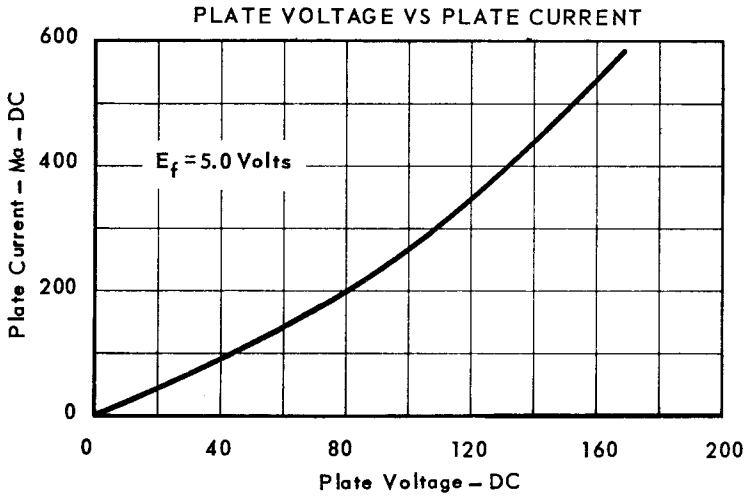
Heater Voltage (ac)	5.0 ± 10 %	volts
Peak Inverse Voltage	16	kv
Peak Plate Current	12	amp
Average Plate Current	60	ma
Heating Time	2	minutes

RATINGS AND ABSOLUTE MAXIMUM VALUES – RECTIFIER:

Heater Voltage (ac)	5.0 ± 10 %	volts
Peak Inverse Voltage	16	kv
Peak Plate Current	.470	amp
Average Plate Current	150	ma
Heating Time	2	minutes

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Potential (ac)	5.0	volts
Heater Current (ac)	5.0	amp
Heating Time	2	minutes
Plate Current (dc) (E_b = 130 Vdc)	300	ma min
Peak Emission (e_b = 2500 v)	18	amp min



Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

9/15/59/1

55 CHAPEL ST., NEWTON 58, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

4CN15A

CERAMIC TETRODE RF POWER AMPLIFIER OR OSCILLATOR

Raytheon tube type 4CN15A is a power tetrode of metal–ceramic construction with external anode and is designed for use in low–duty pulse applications. Although the plate dissipation rating is 15 watts, this may be increased by immersion in liquid coolant, or other suitable heat sinks. Electrically similar to type 4CX300A, the 4CN15A is ideal for applications where severe environmental stresses of vibration and shock are required and where size and weight are important.

Useful operation up to 500 megacycles is provided in Class C, RF power amplifier or oscillator, plate modulated RF amplifier, and Class AB1, RF Linear Power Amplifier – Single Sideband applications.

ELECTRICAL DATA

GENERAL:

	Min.	Nom.	Max.	
Seal Temperature, Maximum.			250	°C
Anode–Core Temperature, Maximum			250	°C
Altitude.			10000	ft.
Immersed in Coolant (e.g. FC–75)			35000	ft.
Maximum Frequency for full ratings (Note 1)			500	Mc
Cathode Heating Time	30	60	--	Seconds
Amplification Factor (G1 to G2)	4.0	4.8	5.6	
Transconductance (Ib = 200 mAdc)		12000	0 = μ	

HEATER CHARACTERISTICS:

Heater Voltage (Notes 1 and 2)	6.0	Volts
Heater Current	2.85	Amps

DIRECT INTERELECTRODE CAPACITANCES:

Cg–p	0.06 pf max.
Input	29.0 pf
Output	4.0 pf

CW RATINGS – ABSOLUTE MAXIMUM:

	Class C, R.F. Pwr. Amp. or Osc.	Class C Plate Mod. RF Amp.	Class ABl RF Linear Pwr. Amp.: SSB	
Heater Voltage, (Notes 1 and 2) . . .	6.0 ± 5%	6.0 ± 5%	6.0 ± 5%	Vac
Plate Voltage.	2000	1500	2500▲	Vdc
Screen Voltage.	300	200	250	Vdc
Control Grid Voltage	–250	–250	---	Vdc
Plate Current.	0.250	0.200	0.250	Amps
Plate Dissipation, (Note 3)	15	10	15	Watts
Screen Grid Dissipation	12	12	12	Watts
Control Grid Dissipation	2	2	2	Watts

▲ Up to 250 Mc

MECHANICAL DATA

RECOMMENDED SOCKET . . . . Eimac SK–700 series or equivalent

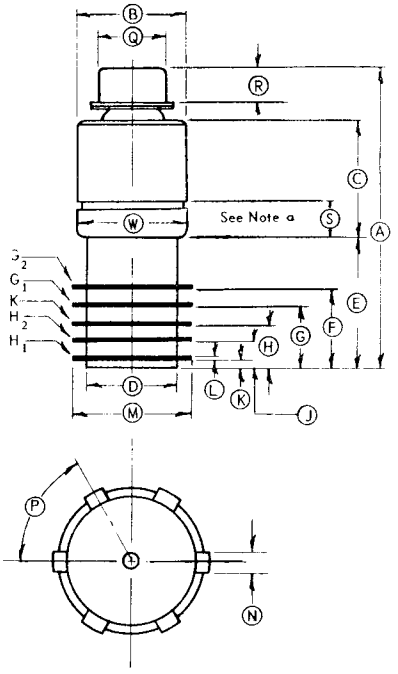
WEIGHT. . . . . 2.5 ozs.

OPERATING POSITION. . . . . Any

COOLING. . . convection or conduction

CATHODE . . . . . Coated unipotential

OUTLINE AND BASING



Note a : Do not contact this surface.

PHYSICAL DIMENSIONS
INCHES

	MIN.	MAX.
A	2.300	2.500
B	0.880 dia.	0.894 dia.
C	0.941	0.977
D	0.740 dia.	0.770 dia.
E	1.052	1.092
F	0.602	0.642
G	0.470	0.500
H	0.329	0.359
J	0.193	0.213
K	0.050	0.072
L	0.010	0.020
M	0.936 dia.	0.956 dia.
N	0.170	0.185
P	60° nom.	
Q	0.559 dia.	0.573 dia.
R	0.240	0.280
S	0.241	0.313
W	0.880	0.920

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ELECTRICAL DATA (Cont'd.)

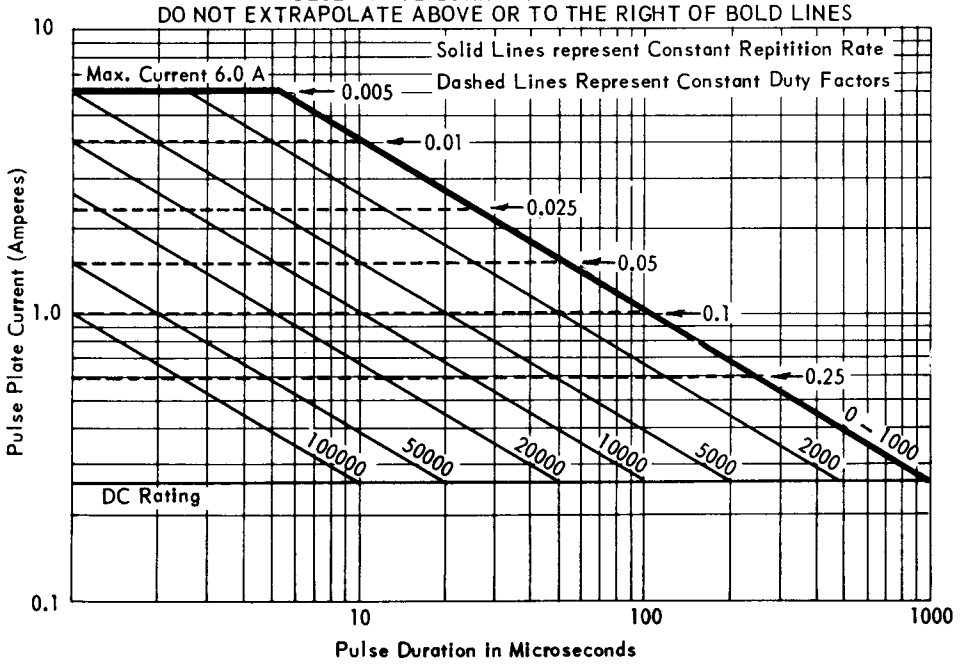
PULSE RATINGS – ABSOLUTE MAXIMUM:

	Class C Plate Pulsed	Class C Grid Pulsed	Pulse Modulator	
Heater Voltage	6.0 ± 5%	6.0 ± 5%	6.0 ± 5%	Vac
Plate Voltage (Ebb)	--	2500	3000	Vdc
Plate Voltage (eb) (pulsed)	7000	--	--	v
Grid #2 Voltage (Ec2)	--	750		Vdc
Grid #2 Voltage (ec2) (pulsed)	1500	--		v
Grid #1 Voltage (Ec1)	--	-300	-300	Vdc
Grid #1 Voltage (ec1)	-500	--	--	v
Plate Current (Ib)	--	0.250	0.250	Amp dc
Peak Plate Current (ib) (Pulse chart below)●	6.0●	--	6.0●	a
Plate Dissipation (Note 3)	15	15	15	watts
Screen Dissipation	12	12	12	watts
Grid Dissipation	2	2	2	watts
Heating time minimum	30	30	30	seconds

PULSE CHART

PULSE PLATE CURRENT vs PULSE LENGTH

DO NOT EXTRAPOLATE ABOVE OR TO THE RIGHT OF BOLD LINES



● With a pulse repetition rate (prr) of 1000 or less and a pulse duration (tp) of 5 μs or less, peak pulse current shall be limited to 6 amperes. For pulses of longer duration or higher repetition rates, peak plate current (ib) shall be reduced in accordance with the Pulse Chart.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTIC RANGES AND CONTROLS:

Test Conditions, except where otherwise specified:
Ef = 6.0 Vac; Ebb = 1000 Vdc; Ec_2 = 300 Vdc; Ec1/Ib = 150 mAdc, tk = 120 sec. min.; note 2; note 3.
Values are initial, unless otherwise noted.

PRODUCTION TESTS: (Insp. Level II, 0.65% AQL individual tests, 1% all tests combined).

	MIN.	MAX.	
Screen grid current (t = 15 Max.)	−5.0	+3.0	mAdc
Grid #1 voltage (t = 15 max.)	−32.0	−45.0	Vdc
Total grid current (t = 15 max.)	---	−15.0	μAdc
Primary control grid emission			
Ic_1 = 70 mAdc, t = 15; anode and screen grid floating	---	−25.0	μAdc
Primary screen grid emission			
Ec_1 = 0 Vdc; Ic_2 = 100 mAdc; t = 15; anode floating	---	−250	μAdc
Heater current	2.60	3.10	Aac
Pulse emission (1)			
Eb = Ec_2 = 250 Vdc; Ec_1 = −100 Vdc; egk/ik = 1.5a			
Ef = 5.4 Vac; prr = 11 ± 1 cps; tp = 4,500 μsec.			
Δik (from leading edge to trailing edge) shall not exceed	---	200	ma
Positive grid current division			
Eb = Ec_2 = 250 Vdc; Ec_1 = −100 Vdc; egk/Ib = 1.0a;			
prr = 11 ± 1 cps; tp = 4500 μsec.			
egk	+8.0	+18.0	v
Ic1	---	250	ma
Ic2	---	250	ma

DESIGN TESTS: (Lot Sampling, Insp. Level L 6, 6.5% AQL)

Direct Interelectrode capacitance			
Grid to plate (max.)	---	0.06	pf
Input	25.0	33.0	pf
Output	3.5	4.5	pf
Heater–cathode leakage (Ehk = ± 250 Vdc)	---	150	μAdc
Pulse emission (2), Same as Pulse Emission (1) except Ef = 6.0 Vac: Δik	---	100	ma

APPLICATION NOTES

Note 1. At frequencies above approximately 200 megacycles it may be necessary to reduce heater voltage to compensate for rf transit time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. Particular care should be used in the selection of stable circuit components and in final tuning of high–frequency circuits, as off–resonance operation, even to a small degree, may result in a marked and undesirable increase in cathode temperature. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for any particular set of operating conditions. A maximum variation of ± 5 per cent from optimum is permitted. For straight through, Class C CW amplifier operation, the following heater operation voltages are indicated:

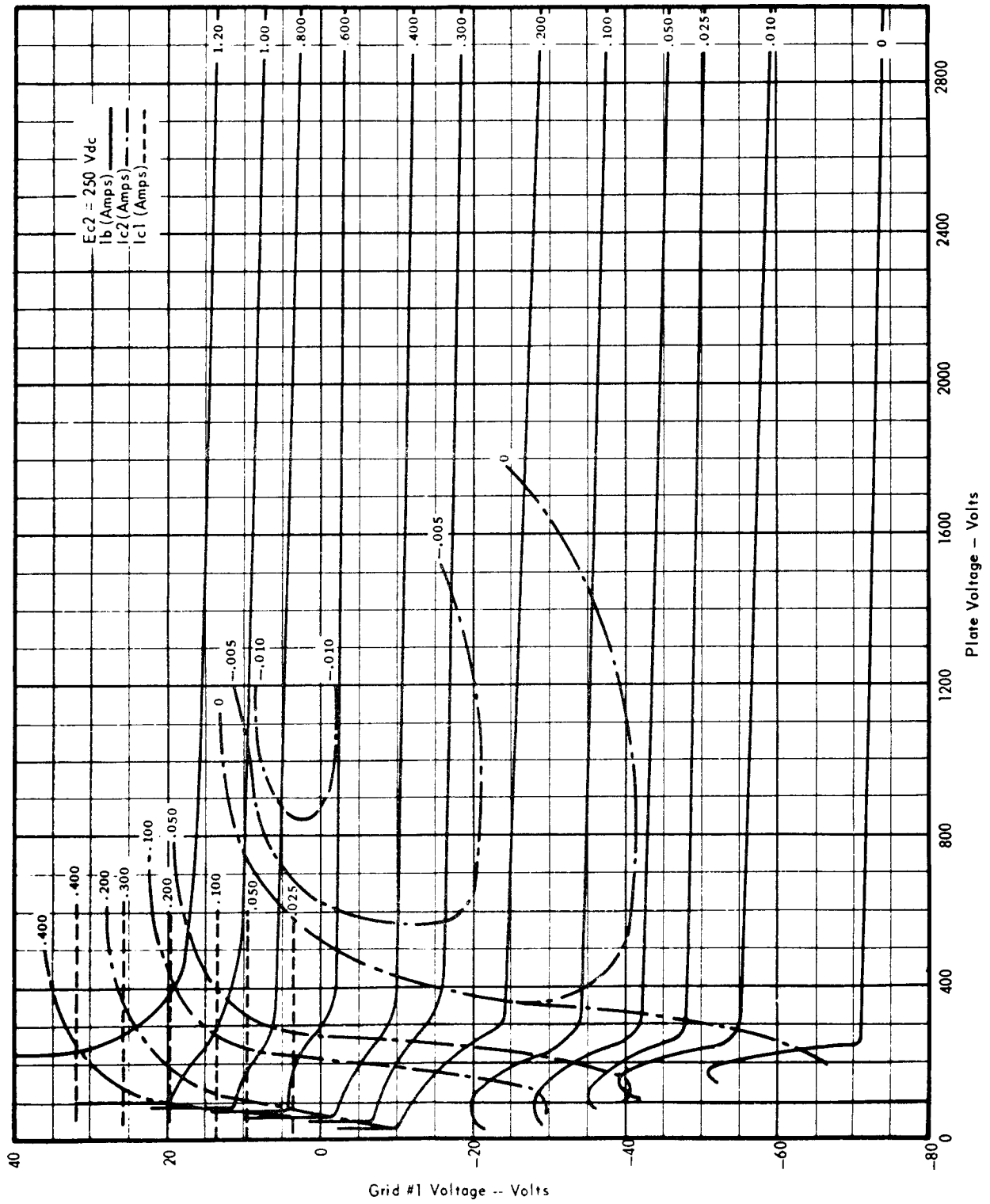
Frequency (Mc)	Ef (Vac)
201 to 300	5.75
301 to 400	5.50
401 to 500	5.00

Note 2. In all electrical tests involving application of heater voltage, sufficient cooling shall be allowed to prevent operation in excess of the specified maximum seal and anode core temperature.

Note 3. For natural air (convection) cooling of the tube, with air at 25°C at sea level, anode dissipation shall be limited to 15 watts. With the anode mounted in a properly designed heat sink, or immersion cooled, anode dissipation, not to exceed 300 watts is normally limited only by allowable temperature rise for the seals and the anode core. In all cases of operation, sufficient cooling must be provided to prevent seal and anode core temperatures in excess of the specified maximum values. Where long life and consistent operation are factors, operation at reduced temperatures is recommended.

CERAMIC TETRODE RF POWER AMPLIFIER OR OSCILLATOR

TYPICAL CONSTANT CURRENT CURVES

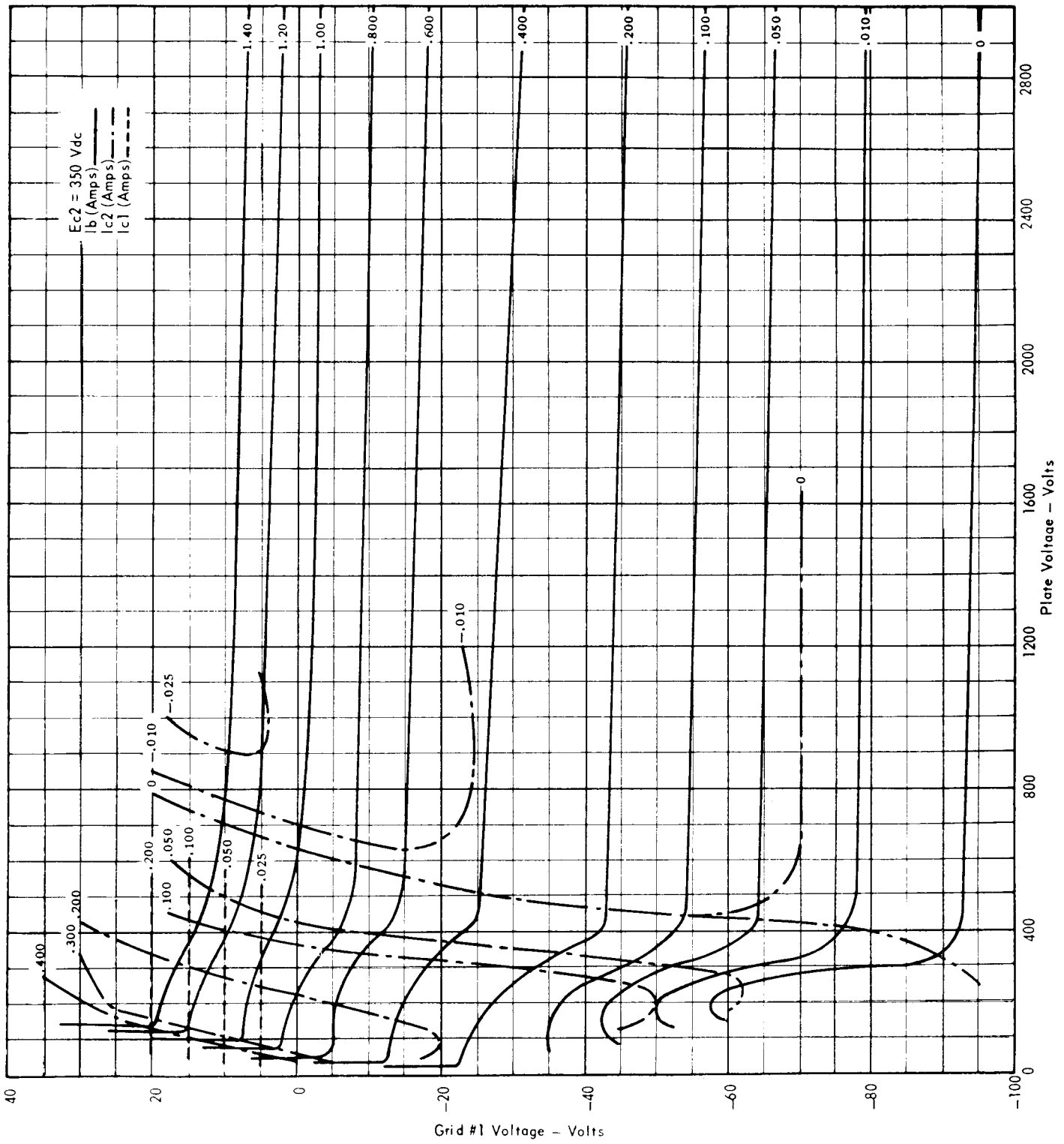


RAYTHEON

4CN15A

CERAMIC TETRODE RF POWER AMPLIFIER OR OSCILLATOR

TYPICAL CONSTANT CURRENT CURVES



RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

TYPE RK-4D22– RK-4D32

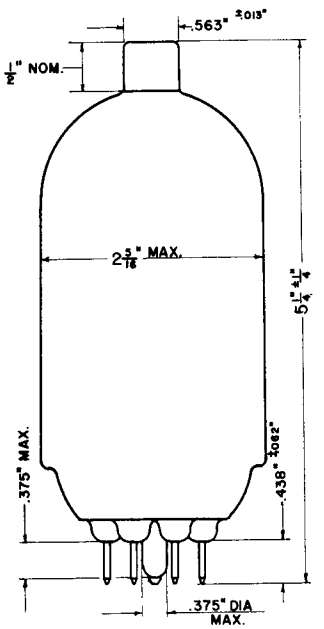
Excellence in Electronics

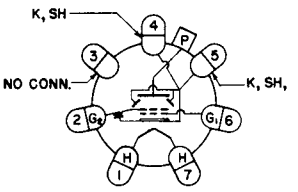
The Raytheon RK4D32 and RK4D22 tubes are beam type aligned grid power amplifiers. Each has a unipotential oxide-coated cathode, a hard glass nonex bulb, and a glass base with short tungsten leads. The type RK4D32 has a heater designed to operate from a 6.3 volt supply, while the type RK4D22 has a center-tapped heater providing for operation from either a 12.6 volt or 25.2 volt supply. The two types are identical with the exception of the heater voltages, and heater base pin connections. Mechanically both types have been ruggadized to withstand the shock and vibration encountered in mobile and aircraft applications.

A single tube may be operated as a "Class C" RF amplifier up to 60 megacycles without neutralization and without reducing the plate input power ratings. With a 600 volt plate supply and 1.25 watts grid driving power, single tube will produce 100 watts power output.

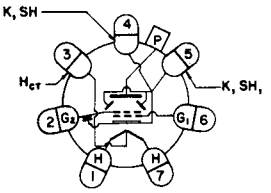
Two tubes may be used in a push-pull audio amplifier circuit under "Class AB_2" conditions to produce 125 watts output.

The tube may also be used as an oscillator, frequency multiplier or plate modulated RF amplifier.





BOTTOM VIEW OF SOCKET
TYPE RK-4D32



BOTTOM VIEW OF SOCKET
TYPE RK-4D22

MECHANICAL DATA

ENVELOPE: Hard Glass

BASE: Medium Molded Flare Septor 7-Pin. Will Fit Standard Johnson #247 Socket or similar type

TERMINAL CONNECTIONS: (Largest Diameter Pin is Pin #4)

Pin 1 Heater	Pin 5 Cathode, Internal Shield, Deflector
Pin 2 Grid #2	
Pin 3 Heater Center Tap ⊕	Pin 6 Grid #1
Pin 4 Cathode, Internal Shield, Deflector	Pin 7 Heater

MOUNTING POSITION: Any

COOLING: Freely Circulating Air

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCE: (Without External Shield) ($\mu\mu$fds)

Grid #1 to Plate	0.40
Input	30
Output	16
Screen-Cathode Capacitance (including internal screen by-pass condenser)	40 approx.

FILAMENT RATINGS:

	SERIES	PARALLEL	
TYPE RK4D22			
Heater Voltage	25.2	12.6	volts
Heater Current	0.8	1.6	amperes
TYPE RK4D32			
Heater Voltage		6.3	volts
Heater Current		3.75	amperes

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C —MAXIMUM C.C.S. RATINGS

	Telephony ♦ Plate and Screen Modulation	Telegraphy or Frequency Modulation Telephony	
DC Plate Voltage	600	600	volts
DC Grid Voltage	–200	–200	volts
DC Screen Voltage	350	350	volts
DC Plate Current	300	300	ma

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd)

R-F POWER AMPLIFIER OR OSCILLATOR - CLASS C - MAXIMUM C.C.S. RATINGS

	Telephony ♦ Plate and Screen Modulation	Telegraphy or Frequency Modulation Telephony	
DC Grid Current	15	15	ma
DC Screen Current	30	35	ma
Plate Input Watts	150	200	watts
Plate Dissipation	35	50	watts
Screen Dissipation	10	14	watts
Grid Dissipation	0.75	0.75	watts
Highest Frequency for Maximum Ratings	60	60	Megacycles

R-F POWER AMPLIFIER OR OSCILLATOR - CLASS C - TYPICAL OPERATION

		Telephony ♦ Plate and Screen Modulation	Telegraphy or Frequency Modulation Telephony	
DC Plate Voltage	550	600	600	volts
DC Screen Voltage	----	----	300	volts
Series Screen Resistor	15,000	10,000	----	ohms
DC Grid Voltage	-100	-100	-100	volts
DC Plate Current	175	220	215	ma
DC Screen Current	17	28	30	ma
DC Control Grid Current	6.0	10.0	10.0	ma
R-F Grid Driving Power (approx.)	0.6	1.25	1.25	watts
Carrier Power Output (approx.)	70	100	90	watts

A-F POWER AMPLIFIER - CLASS AB_1 - CLASS AB_2 - TYPICAL OPERATION ●

	Class AB_1	Class AB_2	
DC Plate Voltage	600	600	volts
DC Grid Voltage	-37.5	-25	volts
DC Screen Voltage	350	250	volts
Peak A-F Input Voltage (grid to grid)	74	70	volts
DC Plate Current (zero signal)	100	100	ma
DC Plate Current (max. signal)	350	365	ma
DC Screen Current (max. signal)	46	26	ma
Effective Load Resistance (plate to plate)	3,000	3,000	ohms
Maximum Signal Driving Power (approx.)	0	0.45	watts
Maximum Signal Power Output (approx.)	112	125	watts
Maximum Plate Dissipation (per tube - approx.)	49	47	watts
Maximum Screen Dissipation (per tube - approx.)	8	3	watts

♦ *Carrier conditions per tube for use with a maximum modulation factor of 1.*

● *Unless other wise specified, values are for two tubes.*

⊕ *Pin #3 for RK4D32 has no connection.*

OPERATING NOTES

HEATER

The heater voltage, under all possible conditions of line voltage, should be within 10% of the rated value. A minimum heating time of 2 minutes should be allowed before application of screen or plate voltages. The heater supply should be connected to the cathode where possible, but in no case should the voltage between heater and cathode exceed 100 volts.

R-F AMPLIFIER

EXCITATION

The Class C operation curves on the following pages show operating data against D.C. Grid Driving Current for 100 volts of fixed bias. In general, higher efficiencies cannot be achieved by increasing the D.C. bias above this value. Higher screen grid currents are produced by an increase in bias, therefore care should be taken to insure that screen grid dissipation ratings are not exceeded because of too much grid bias or excessive grid excitation current. It should be noted that on some of the Class C operation curves the maximum screen grid current rating is exceeded at the higher values of grid driving current.

BIAS

In Class C operation the usual forms of fixed bias, cathode resistor bias, or grid leak bias can be used. To prevent damage to the tube by a failure of excitation signal, grid leak bias alone should not be used. Circuit design should be such that at least 40 volts bias is provided in the event of signal failure. For C. W. Operation where the exciter or oscillator stages are keyed, a fixed bias voltage of at least 75 volts should be used.

SHIELDING

The input and output stages must be completely shielded to avoid regeneration or oscillation This may be accomplished by mounting the tube base below the chassis level, with the disc shield (located near the bottom of the elements in the tube) level with the chassis. The tube may be mounted through a 23/8" diameter hole in the chassis. This arrangement permits isolation of input and output circuits by locating each on opposite sides of the chassis.

SCREEN VOLTAGE SUPPLY

The screen voltage may be obtained from a fixed voltage supply or through a series resistor from the plate supply. When a fixed voltage is used, care should be taken when making tuning adjustments to prevent excessive screen grid current. The screen should be adequately bypassed to cathode at R-F frequencies in addition to the internal tube condenser. For plate and screen modulation, the series screen resistor should be connected to the plate side of the modulation transformer. The R-F bypass condenser on the screen should not be large enough to produce attenuation or phase shift of the screen modulation voltage through this series screen resistor.

PLATE CIRCUIT

Because this tube is a relatively low voltage-high power type, the ratio of D.C. plate voltage to D.C. plate current is lower than will be found in most other tube types. This condition requires a lower L/C ratio for optimum Q: i.e., a higher value of tank capacitance than is required by many other transmitting tube types. For typical operating conditions, the tank capacitance (including plate and wiring capacitances) should be approximately 4 $\mu\mu$f per meter

of wavelength. It should be noted that the Class C operation curves on the following pages were taken with the load coupling adjusted to produce maximum output with an average tube operating at the conditions indicated. Closer coupling will not increase the power output, but will increase the plate current and reduce efficiency. In general, looser coupling will produce slightly higher efficiencies than the values shown, with lower plate current and power output values. In adjusting the load in an R-F amplifier, the coupling should be less than the values indicated so that for a given set of operating conditions, the plate current will be slightly less than the values shown on the graphs and the screen current slightly higher. As suggested under the notes on "Screen Voltage Supply", the load coupling and plate current should not be low enough to cause excessive screen current with a fixed screen supply voltage.

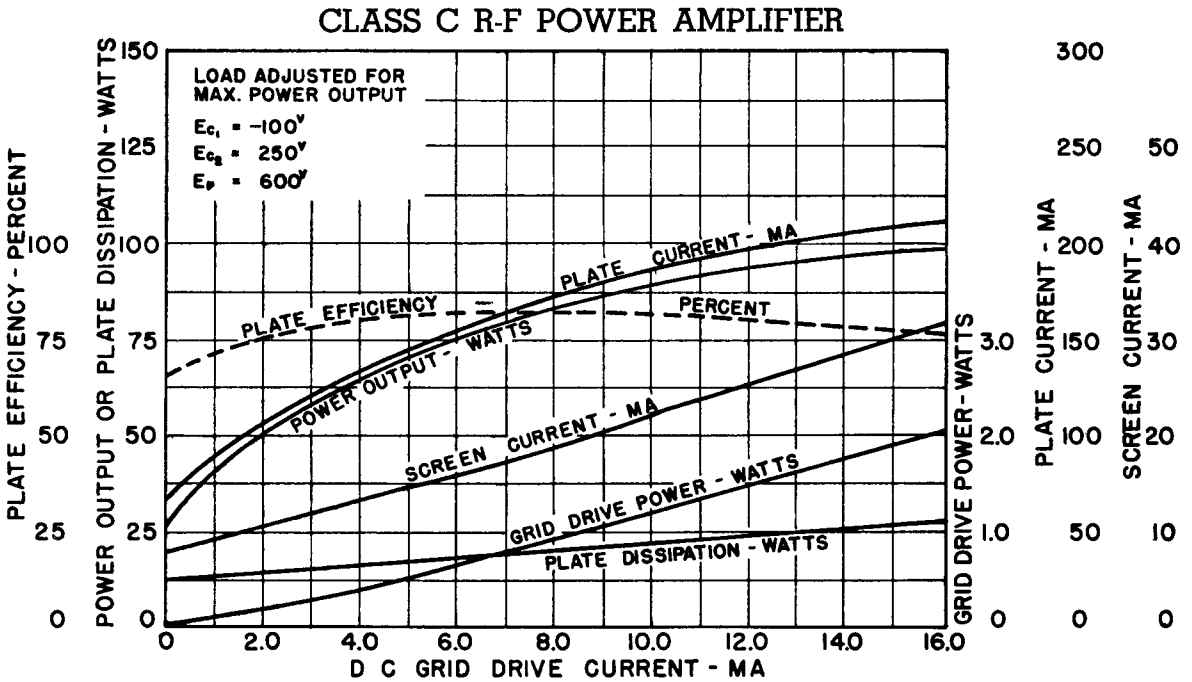
PLATE TEMPERATURE

At the maximum plate dissipation rating of 50 watts no color is visible on any portion of the plate. For this reason the place dissipation should be determined on the basis of plate input and power output measurements. Under no circumstances is the tube to be operated so that it shows plate color.

A-F AMPLIFIER

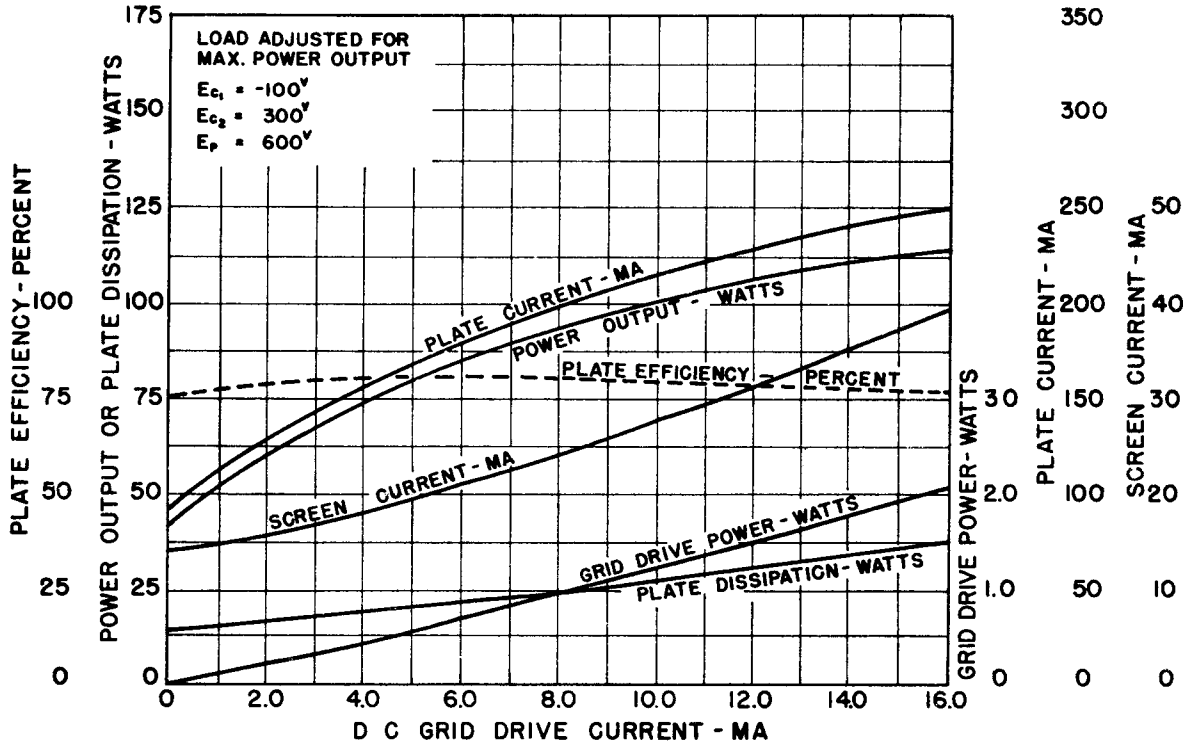
In push-pull audio service, two tubes may be operated in Class AB_1 or Class AB_2 service. For greatest efficiency, the tubes are best operated with a screen voltage of 250 volts in Class AB_2. Grid current flows during the most positive signal swing in this class of operation, and a fixed source of bias voltage with good regulation is necessary. Where driving power is not available, these tubes may be operated in Class AB_1. The values given to this type of operation are determined on the basis that no grid current flows at any time. The value of D.C. grid leak resistance should not exceed 25,000 ohms.

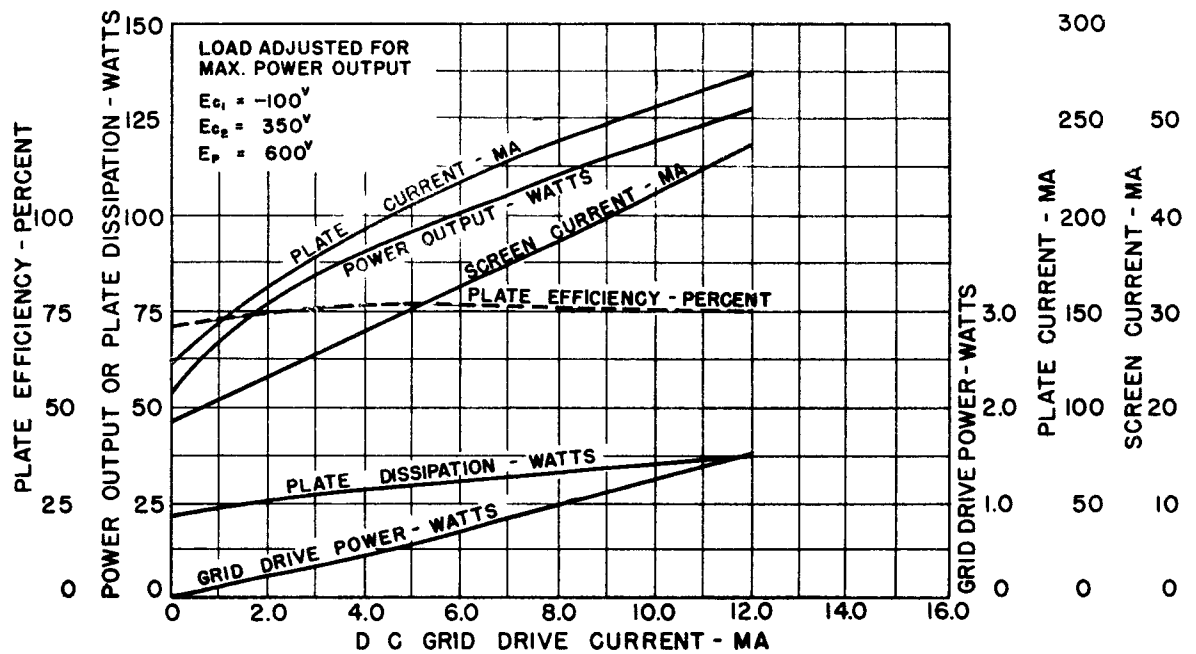
AVERAGE CHARACTERISTICS



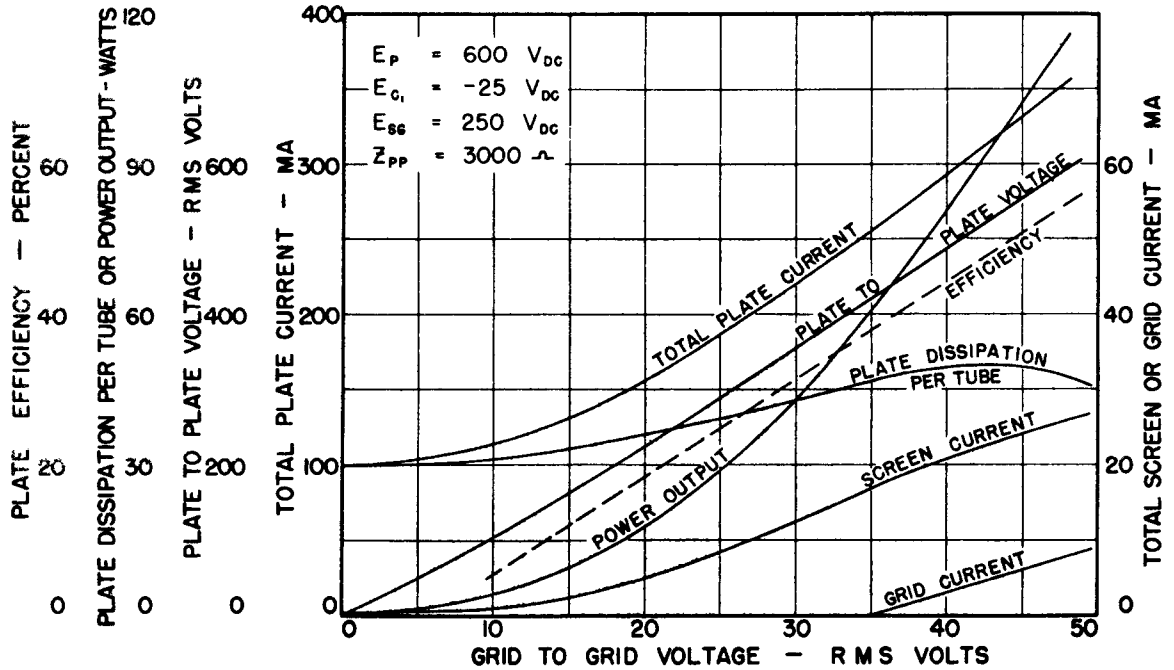
AVERAGE CHARACTERISTICS

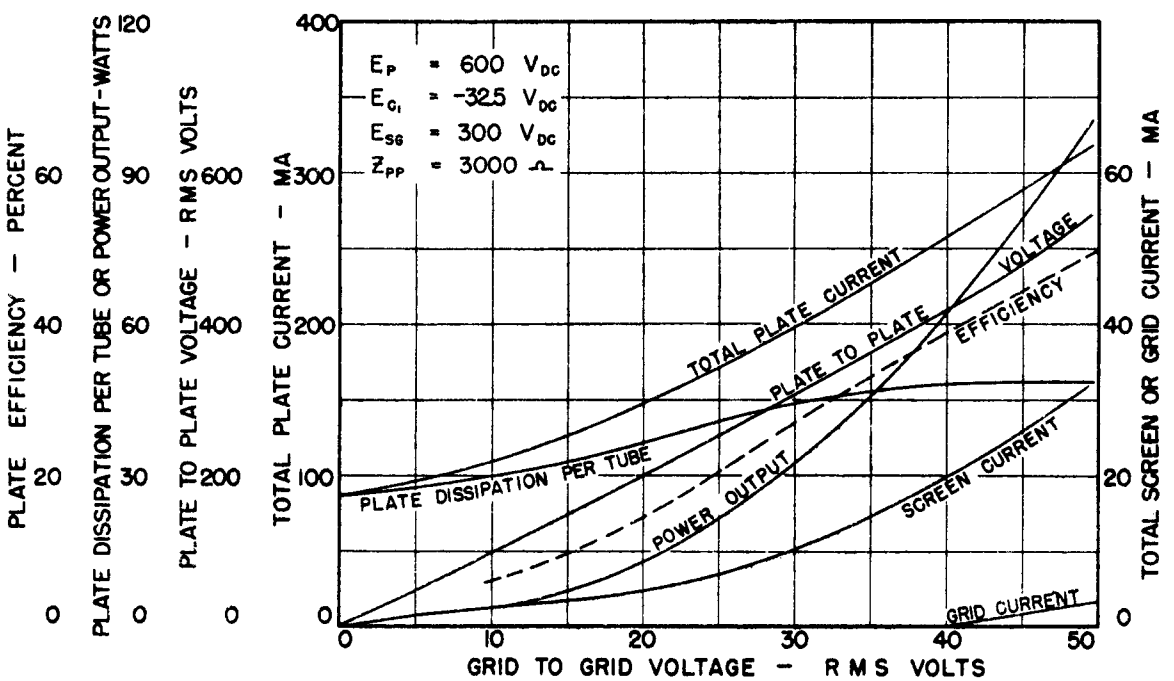
CLASS C R-F POWER AMPLIFIER



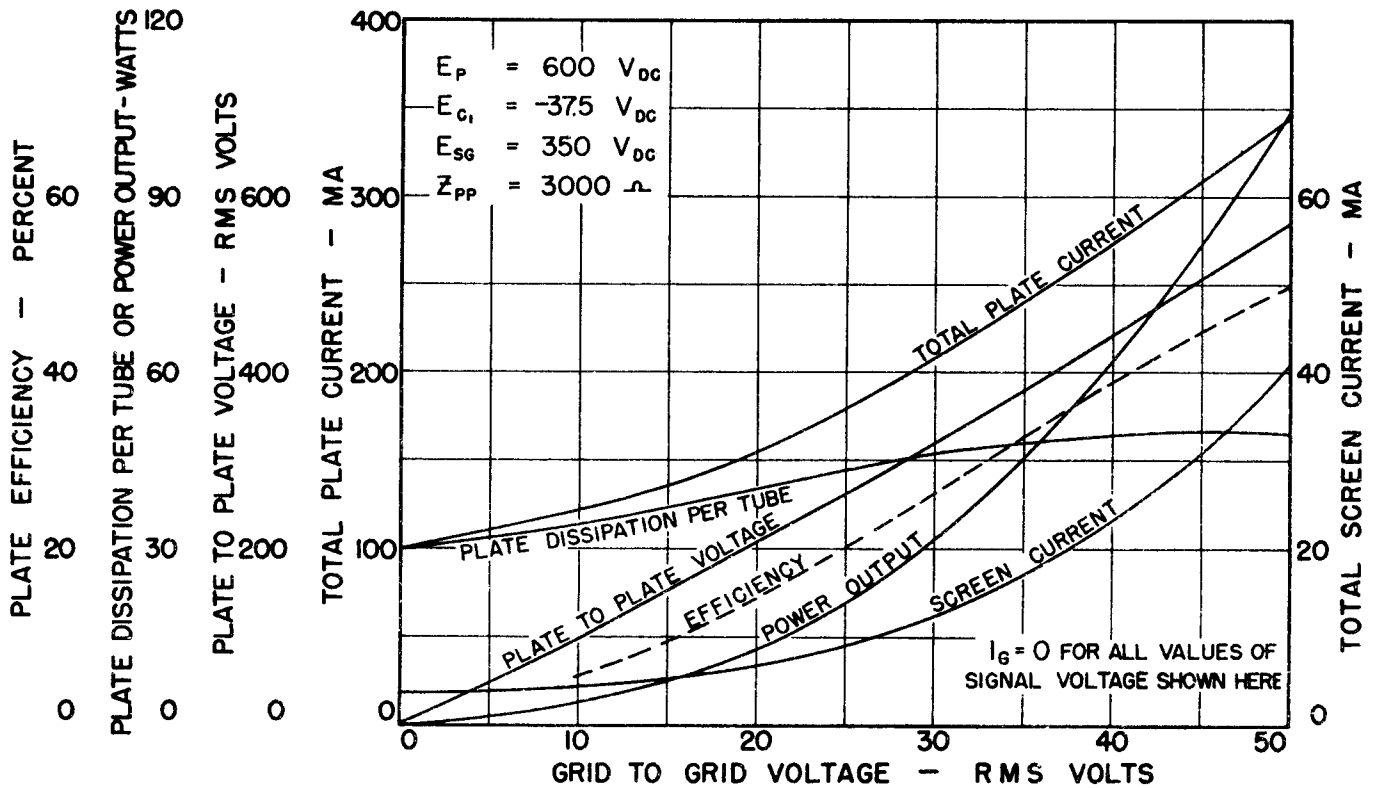


AVERAGE CHARACTERISTICS
CLASS AB_2 PUSH PULL AUDIO AMPLIFIER

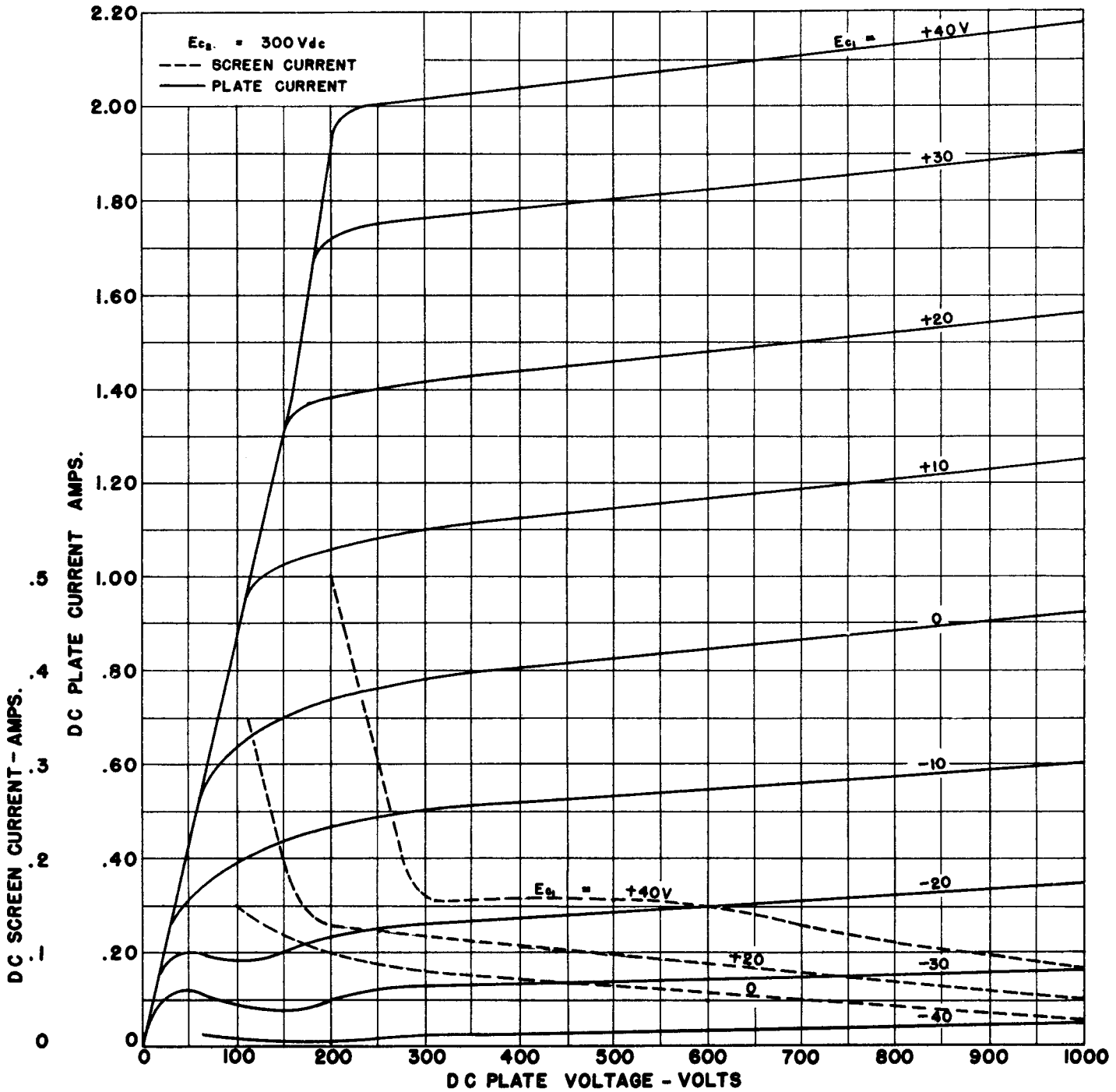




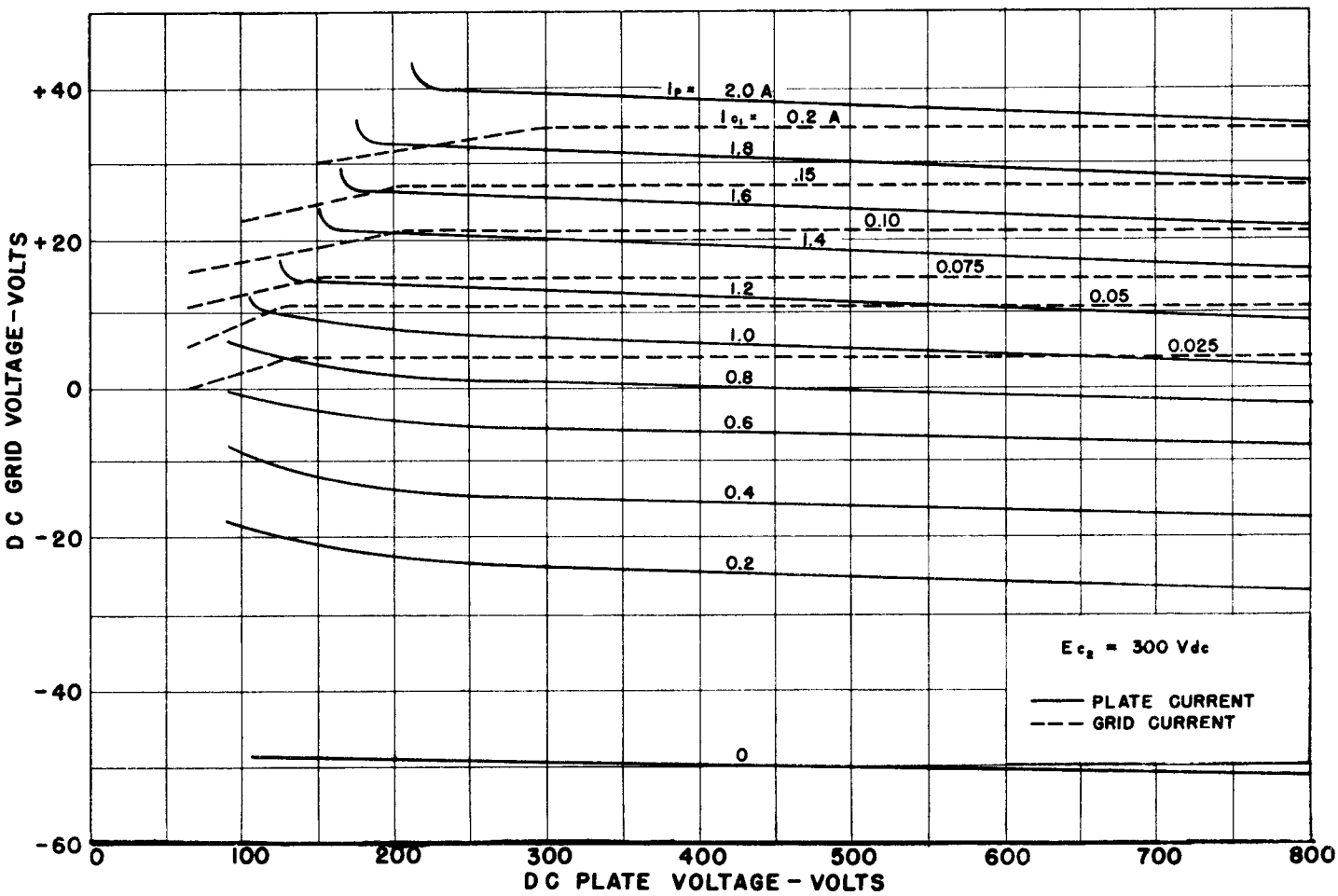
AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



CONSTANT CURRENT CHARACTERISTICS



RAYTHEON

RK-4D32
RK-4D22



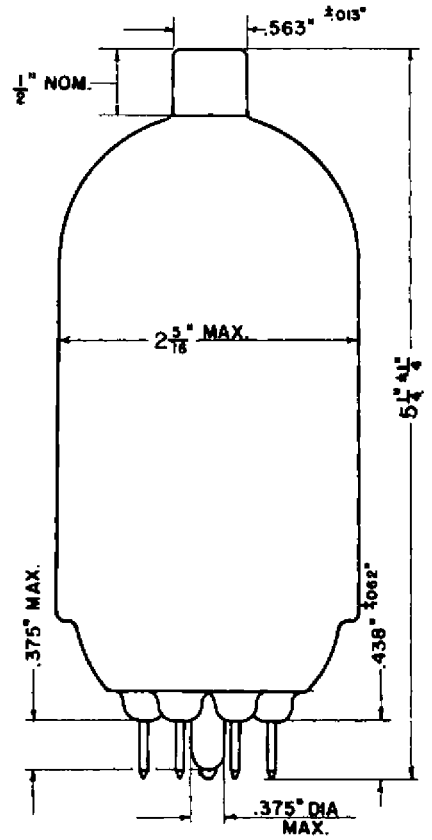
- 100 watts RF Power Output with only 600 volt plate supply.
- 1.25 watts grid drive.
- Low-loss construction; minimum lead inductance with short leads and moulded glass base.
- Full efficiency at 60 Mc.
- Neutralization not required.
- 125 watts audio power for pair in Class AB_2 operation.

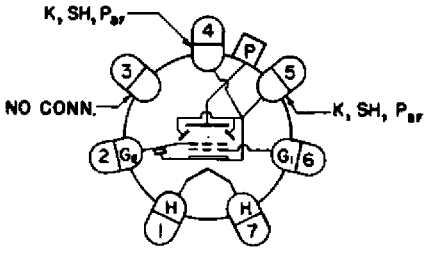
NOTE:
RK-4D32 fil. voltage 6.3 V
RK-4D22 fil. voltage 25.2 V
C.T. @ 12.6 V for mobile or airborne applications.

RAYTHEON
MANUFACTURING COMPANY
WALTHAM, MASS.

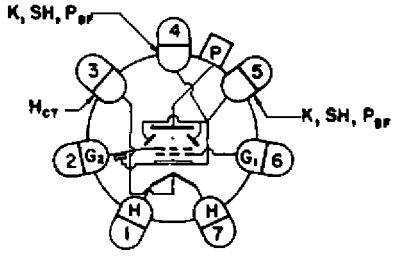
POWER TUBE DIVISION
Excellence in Electronics

from RTMA release #936, Dec. 5, 1950





BOTTOM VIEW OF SOCKET
TYPE RK-4D32



BOTTOM VIEW OF SOCKET
TYPE RK-4D22

BEAM POWER AMPLIFIER OSCILLATOR

The Raytheon RK-4D32 and RK-4D22 tubes are beam type aligned grid power amplifiers. Each has a unipotential oxide-coated cathode, a hard glass nonex bulb, and a glass base with short tungsten leads. The type RK-4D32 has a heater designed to operate from a 6.3 volt supply, while the type RK-4D22 has a center-tapped heater providing for operation from either a 12.6 volt or 25.2 volt supply. The two types are identical with the exception of the heater voltages, and heater base pin connections. Mechanically both types have been ruggedized to withstand the shock and vibration encountered in mobile and aircraft applications.

A single tube may be operated as a "Class C" RF amplifier up to 60 megacycles without neutralization and without reducing the plate input power ratings. With a 600-volt plate supply and 1.25 watts grid driving power, a single tube will produce 100 watts power output.

Two tubes may be used in a push-pull audio amplifier circuit under "Class AB_2" conditions to produce 125 watts output.

The tube may also be used as an oscillator, frequency multiplier or plate modulated RF amplifier.

FILAMENT RATINGS

Type 4D32		
Heater Voltage		6.3 volts ac-dc
Heater Current		3.75 amperes
Type 4D22	Series	Parallel
Heater Voltage	25.2	12.6 volts ac-dc
Heater Current	0.8	1.6 amperes

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate (with external shield)	0.27 μμf (max.)
Input	28.0 μμf (max.)
Output	13.0 μμf (max.)
Screen-Cathode Capacitance (including internal screen by-pass condenser)	40.0 μμf (approx.)

MECHANICAL

Base	7-pin moulded Glass Stem: Will fit the Standard Johnson No. 247 socket or similar type.
Mounting Position	Any
Cooling	Freely circulating air.

R-F POWER AMPLIFIER OR OSCILLATOR — CLASS C MAXIMUM C.C.S. RATINGS

	Telephony* Plate and Screen Modulation	Telegraphy or Frequency Modulation Telephony	
D.C. Plate Voltage	600	750	Volts
D.C. Grid Voltage	−200	−200	Volts
D.C. Screen Voltage	350	350	Volts
D.C. Plate Current	300	300	MA
D.C. Grid Current	15	15	MA
D.C. Screen Current	30	35	MA
Plate Input Watts	150	200	Watts
Plate Dissipation	35	50	Watts
Screen Dissipation	10	14	Watts
Grid Dissipation	0.75	0.75	Watts
Highest Freq. for Max. Ratings	60	60	Megacycles

* Carrier conditions per tube for use with a maximum modulation factor of 1.

R-F POWER AMPLIFIER OR OSCILLATOR — CLASS C

TYPICAL OPERATION

	Telephony* Plate and Screen Modulation		Telegraphy or Frequency Modulation Telephony		
D.C. Plate Voltage	550	600	600	750	Volts
D.C. Screen Voltage	...	...	300	300	Volts
Series Screen Resistor	15,000	10,000	...	...	Ohms
D.C. Grid Voltage	−100	−100	−100	−100	Volts
D.C. Plate Current	175	220	215	240	MA
D.C. Screen Current	17	28	30	26	MA
D.C.Control Grid Current	6.0	10.0	10.0	12.0	MA
R-F Grid Driving Power (approx.)	0.6	1.25	1.25	1.5	Watts
Carrier Power Output (approx.)	70	100	100	135	Watts

* Carrier conditions per tube for use with a maximum modulation factor of 1.

A-F POWER AMPLIFIER — CLASS AB_1 — CLASS AB_2

TYPICAL OPERATION*

	Class AB_1	Class AB_2	
D.C. Plate Voltage	600	600	Volts
D.C. Grid Voltage	−37.5	−25	Volts
D.C. Screen Voltage	350	250	Volts
Peak A-F Input Voltage (grid to grid)	74	70	Volts
D.C Plate Current (zero signal)	100	100	MA
D.C. Plate Current (max. signal)	350	365	MA
D.C. Screen Current (max. signal)	46	26	MA
Effective Load Resistance (plate to plate)	3,000	3,000	Ohms
Maximum Signal Driving Power (approx.)	0	0.45	Watts
Maximum Signal Power Output (approx.)	112	125	Watts
Maximum Plate Dissipation (per tube — approx.)	49	47	Watts
Maximum Screen Dissipation (per tube — approx.)	8	3	Watts

* Unless otherwise specified, values are for two tubes.

OPERATING NOTES

HEATER. The heater voltage, under all possible conditions of line voltage, should be within 10% of the rated value. A minimum heating time of 2 minutes should be allowed before application of screen or plate voltages. The heater supply should be connected to the cathode where possible, but in no case should the voltage between heater and cathode exceed 100 volts.

R-F AMPLIFIER

EXCITATION. The Class C operation curves on the following pages show operating data against D.C. Grid Driving Current for 100 volts of fixed bias. In general, higher efficiencies cannot be achieved by increasing the D.C. bias above this value. Higher screen grid currents are produced by an increase in bias, therefore care should be taken to insure that screen grid dissipation ratings are not exceeded because of too much grid bias or excessive grid excitation current. It should be noted that on some of the Class C operation curves the maximum screen grid current rating is exceeded at the higher values of grid driving current.

OPERATING NOTES — Concluded

BIAS. In Class C operation the usual forms of fixed bias, cathode resistor bias, or grid leak bias can be used. To prevent damage to the tube by a failure of excitation signal, grid leak bias alone should not be used. Circuit design should be such that at least 40 volts bias is provided in the event of signal failure. For C. W. Operation where the exciter or oscillator stages are keyed, a fixed bias voltage of at least 75 volts should be used.

SHIELDING. The input and output stages must be completely shielded to avoid regeneration or oscillation. This may be accomplished by mounting the tube base below the chassis level, with the disc shield (located near the bottom of the elements in the tube) level with the chassis. The Tube may be mounted through a 2⅜" diameter hole in the chassis. This arrangement permits isolation of input and output circuits by locating each on opposite sides of the chassis.

SCREEN VOLTAGE SUPPLY. The screen voltage may be obtained from a fixed voltage supply or through a series resistor from the plate supply. When a fixed voltage is used, care should be taken when making tuning adjustments to prevent excessive screen grid current. The screen should be adequately by-passed to cathode at R-F frequencies in addition to the internal tube condenser. For plate and screen modulation, the series screen resistor should be connected to the plate side of the modulation transformer. The R-F by-pass condenser on the screen should not be large enough to produce attenuation or phase shift of the screen modulation voltage through this series screen resistor.

PLATE CIRCUIT. Because this tube is a relatively low voltage-high power type, the ratio of D.C. plate voltage to D.C. plate current is lower than will be found in most other tube types. This condition requires a lower L/C ratio for optimum Q: i.e., a higher value of tank capacitance than is required by many other transmitting tube types. For typical operating conditions, the tank capacitance (including plate and wiring capacitances) should be approximately 4$\mu\mu$f per meter of wavelength. It should be noted that the Class C operation curves on the following pages were taken with the load coupling adjusted to produce maximum output with an average tube operating at the conditions indicated. Closer coupling will not increase the power output, but will increase the plate current and reduce efficiency. In general, looser coupling will produce slightly higher efficiencies than the values shown, with lower plate current and power output values. The curves for a 750-volt plate supply exceed the maximum plate dissipation rating at the higher values of grid driving current, and are included in the data for purposes of information only. In adjusting the load in an R-F amplifier, the coupling should be less than the values indicated so that for a given set of operating conditions, the plate current will be slightly less than the values shown on the graphs, and the screen current slightly higher. As suggested under the notes on "Screen Voltage Supply," the load coupling and plate current should not be low enough to cause excessive screen current with a fixed screen supply voltage.

PLATE TEMPERATURE. At the maximum plate dissipation rating of 50 watts no color is visible on any portion of the plate. For this reason the plate dissipation should be determined on the basis of plate input and power output measurements. Under no circumstances is the tube to be operated so that it shows plate color.

A.F. AMPLIFIER. In push-pull audio service, two tubes may be operated in Class AB_1 or Class AB_2 service. For greatest efficiency, the tubes are best operated with a screen voltage of 250 volts in Class AB_2. Grid current flows during the most positive signal swing in this class of operation, and a fixed source of bias voltage with good regulation is necessary. Where driving power is not available, these tubes may be operated in Class AB_1. The values given for this type of operation are determined on the basis that no grid current flows at any time. The value of D.C. grid leak resistance should not exceed 25,000 ohms.

AVERAGE CHARACTERISTICS

CLASS C R-F POWER AMPLIFIER

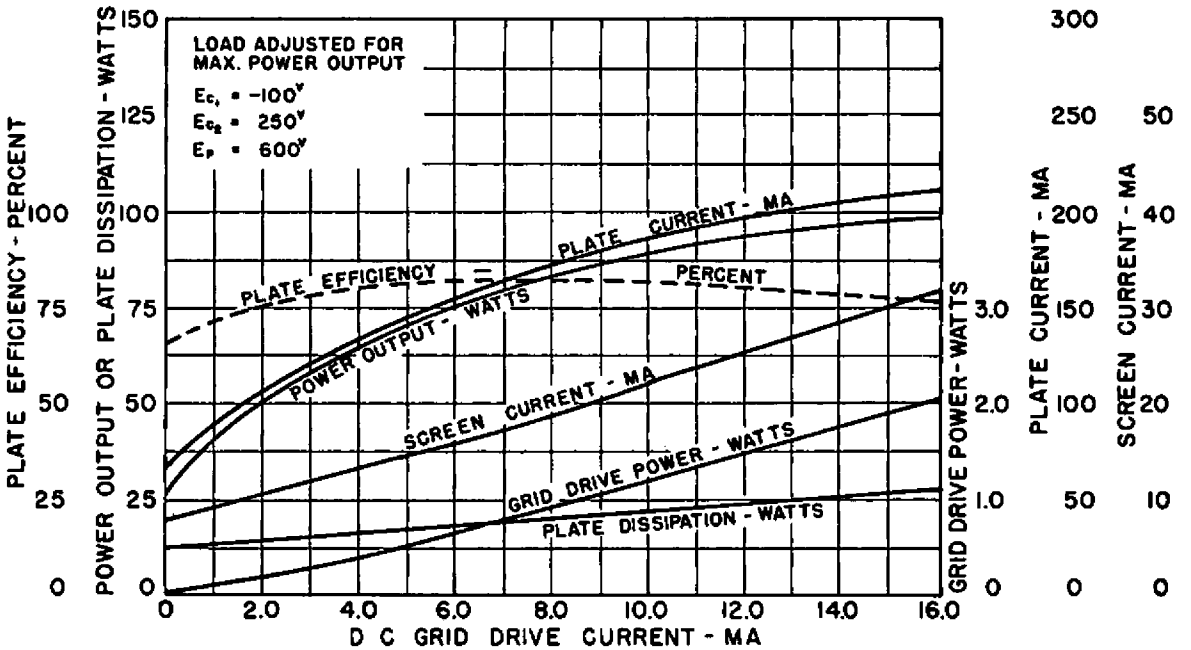


FIGURE 1

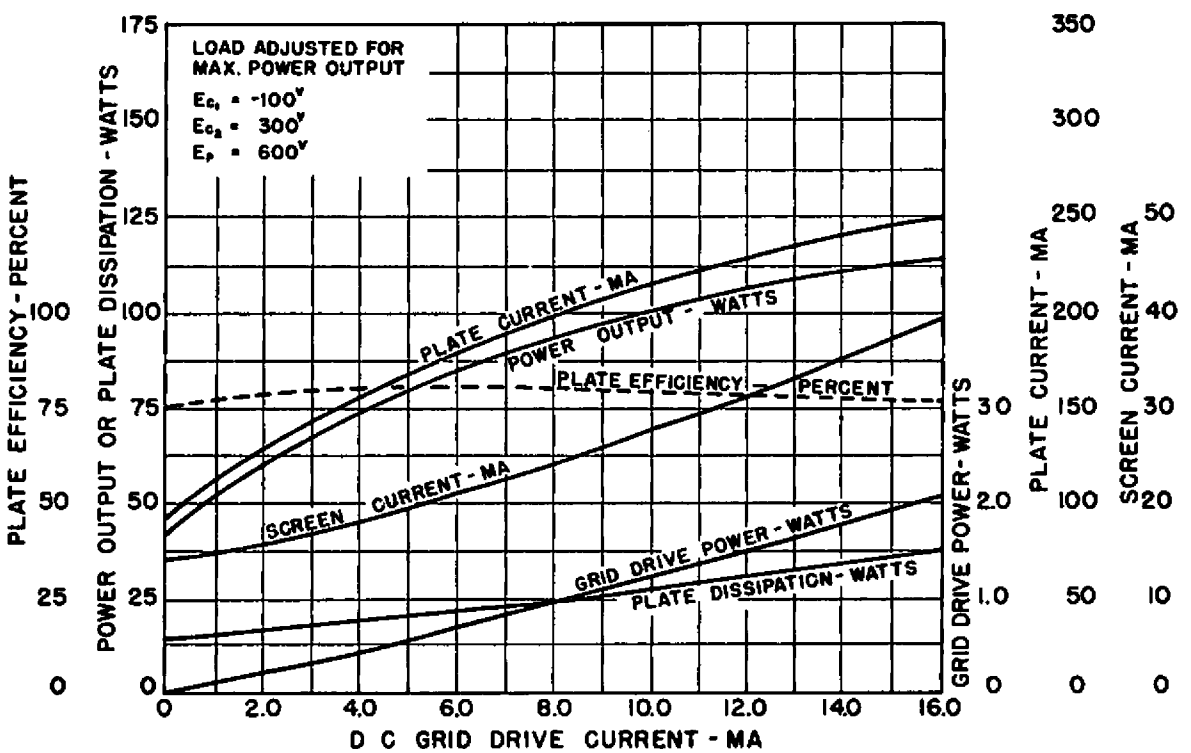


FIGURE 2

AVERAGE CHARACTERISTICS

CLASS C R-F POWER AMPLIFIER

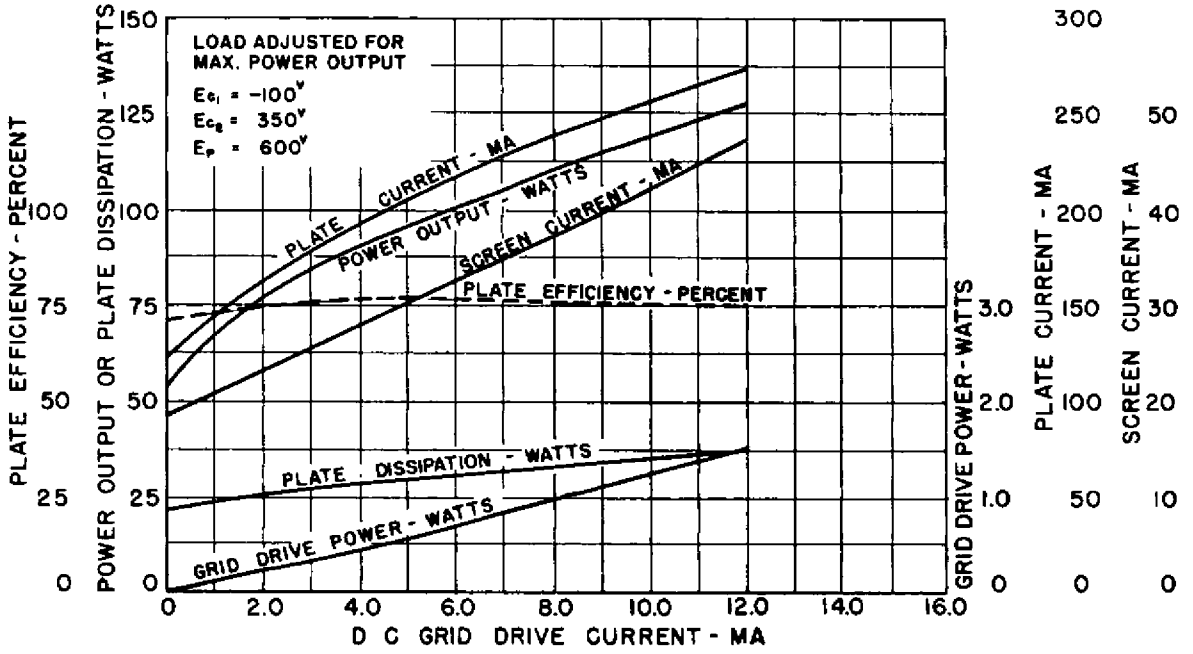


FIGURE 3

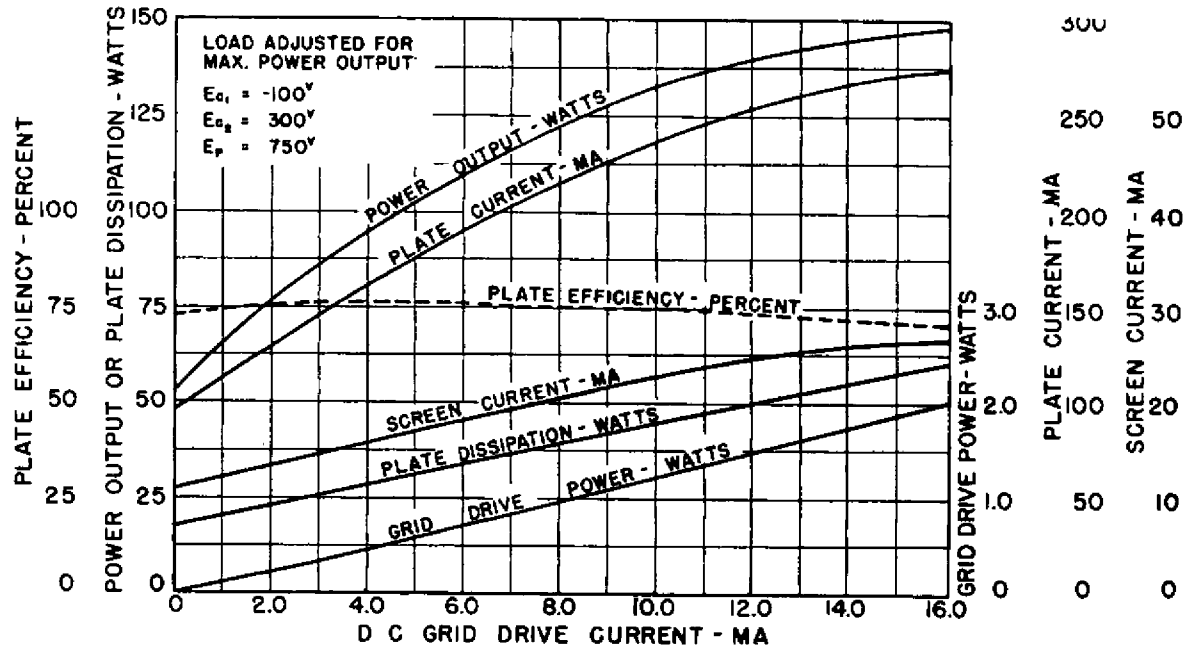


FIGURE 4

AVERAGE CHARACTERISTICS

CLASS AB$_2$ PUSH PULL AUDIO AMPLIFIER

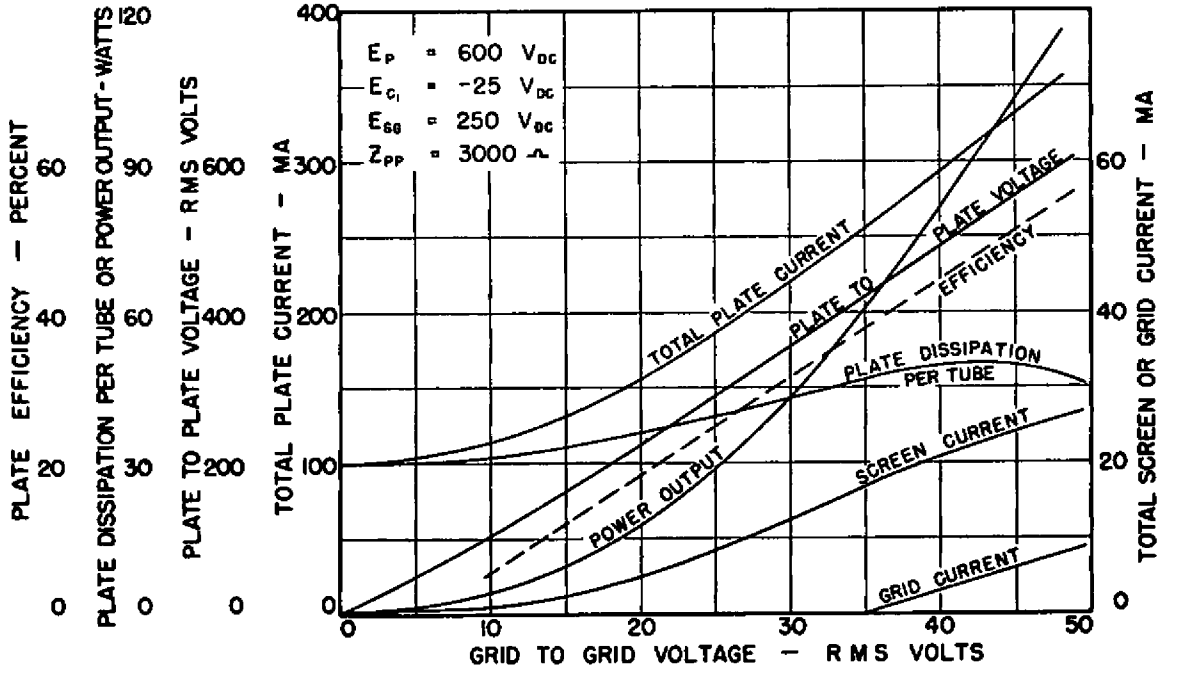


FIGURE 5

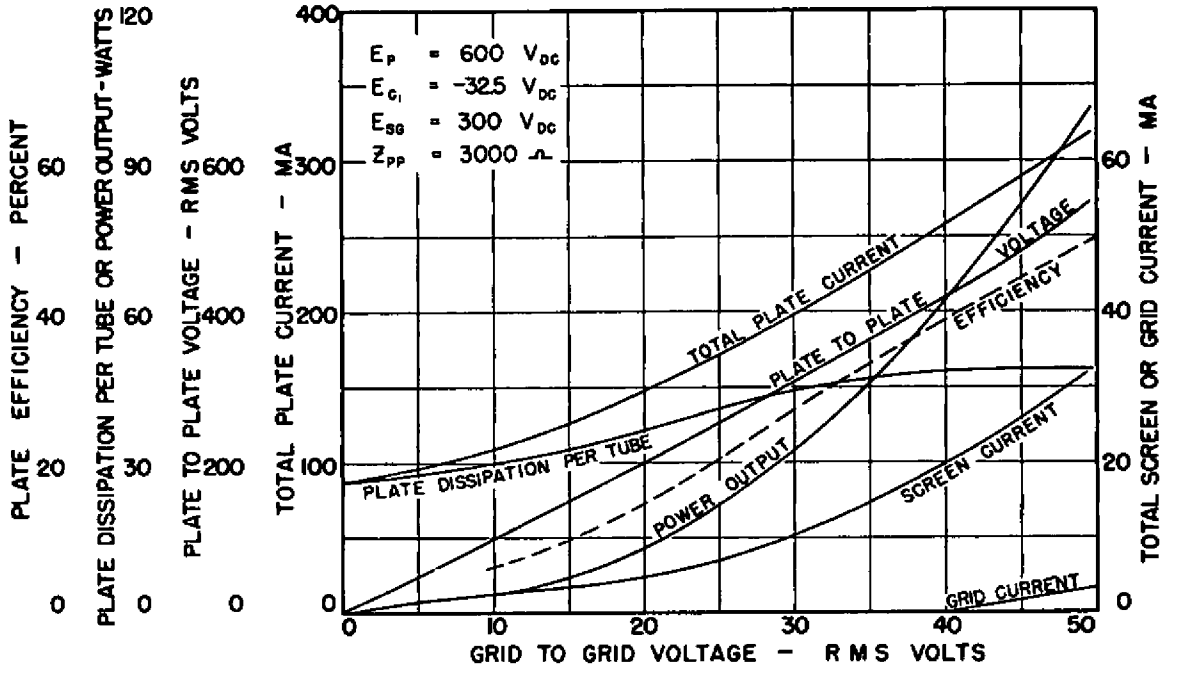


FIGURE 6

AVERAGE CHARACTERISTICS

CLASS AB$_1$ PUSH PULL AUDIO AMPLIFIER

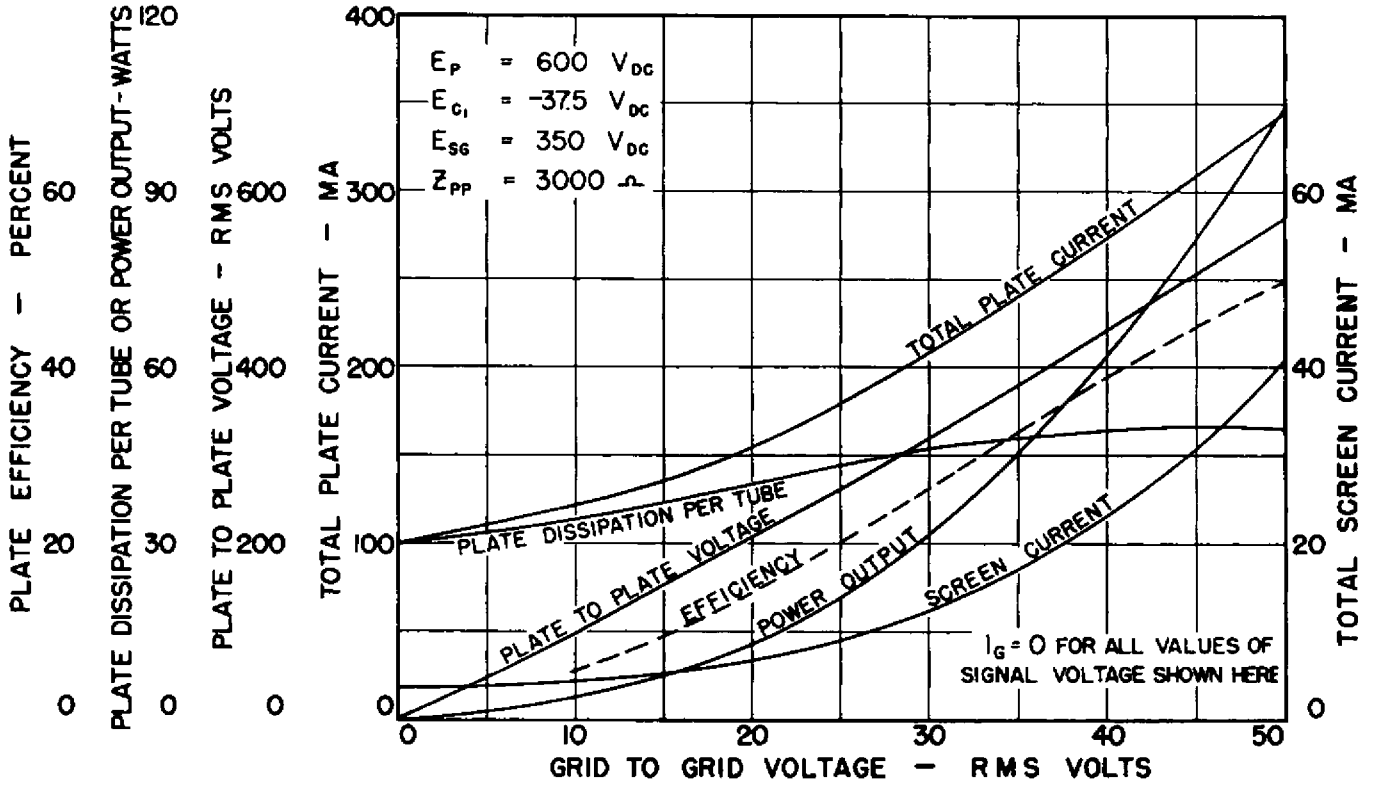


FIGURE 7

AVERAGE PLATE CHARACTERISTICS

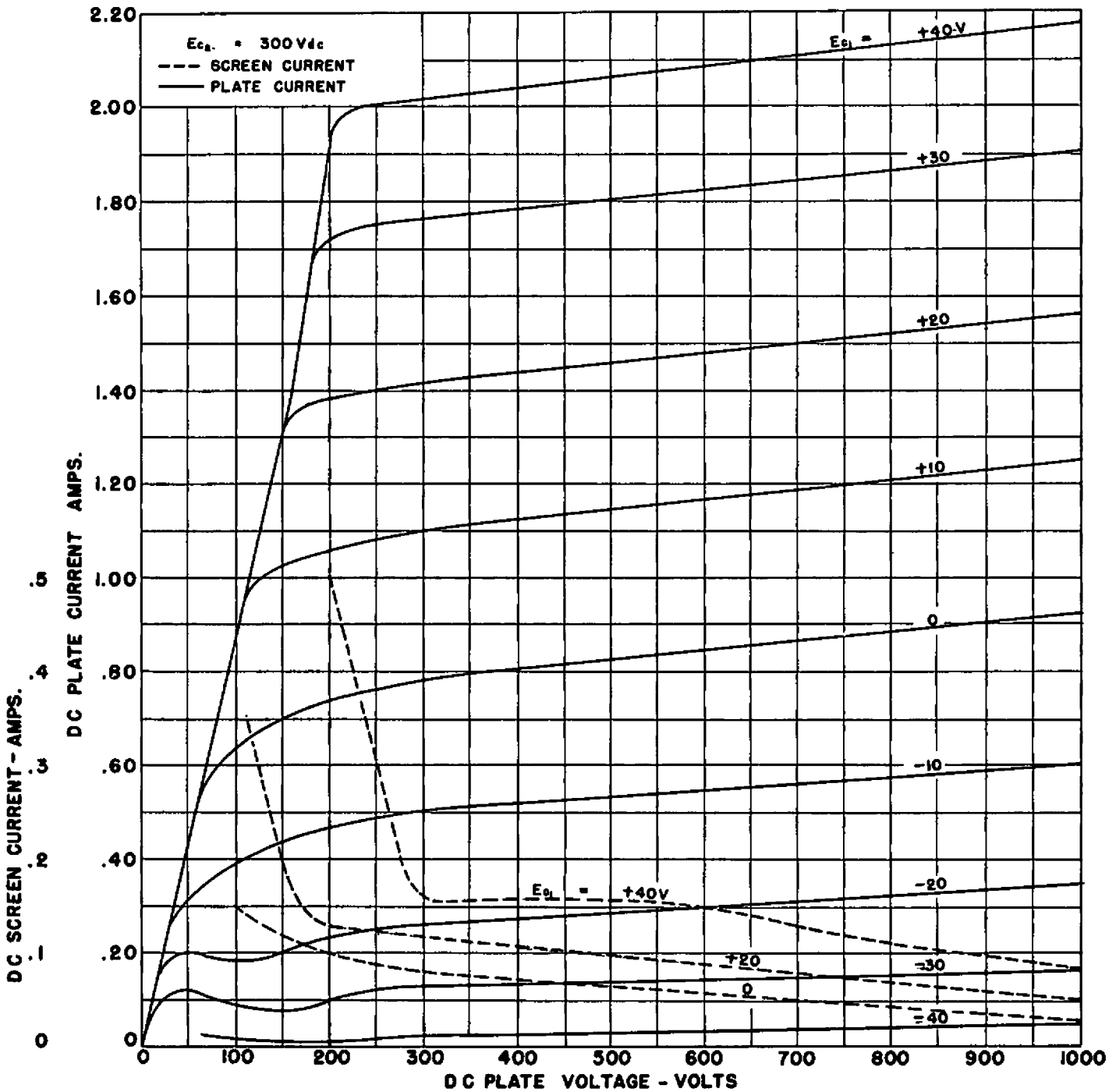


FIGURE 8

CONSTANT CURRENT CHARACTERISTICS

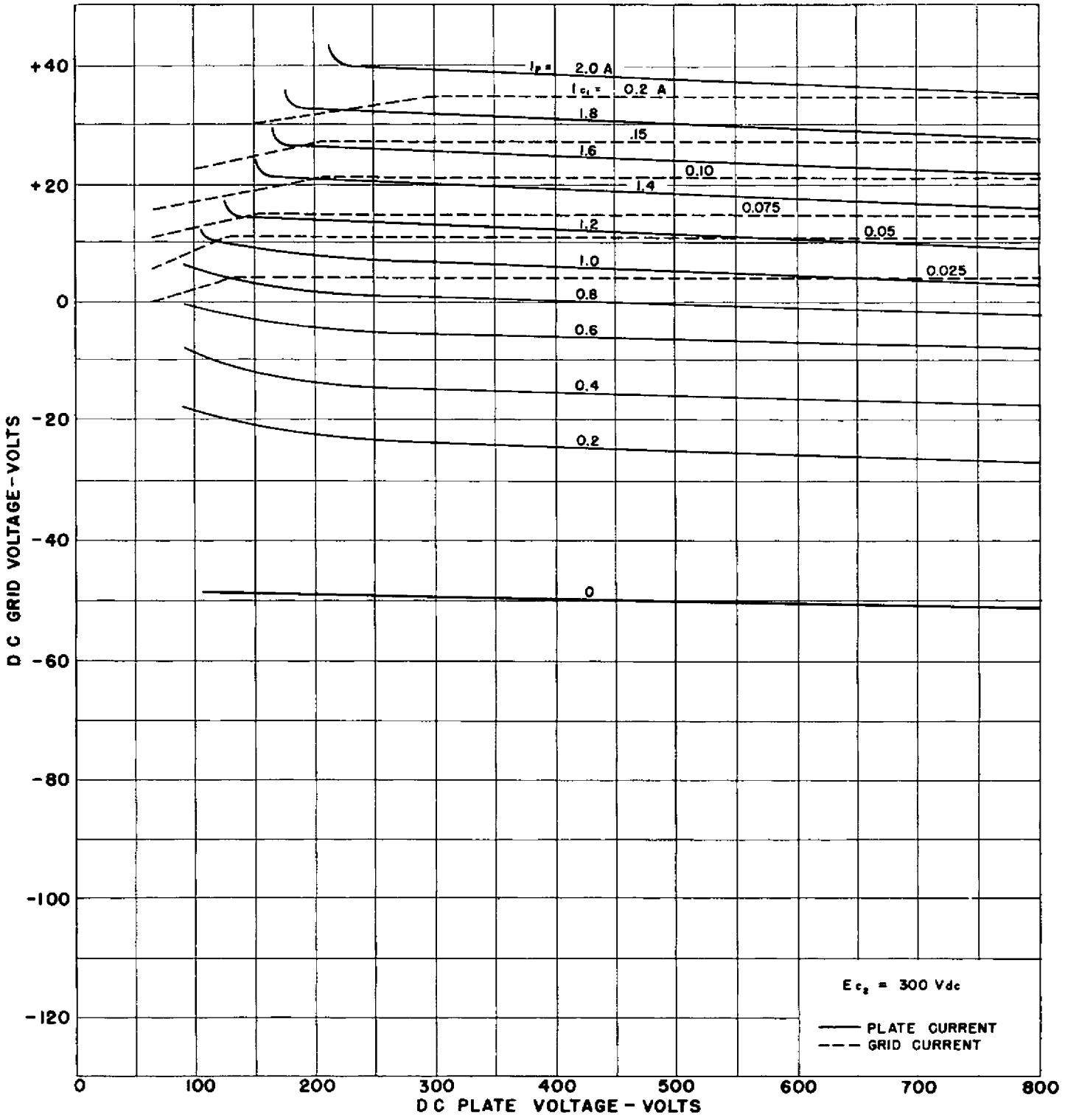


FIGURE 9

Security Classification: Confidential

Type 4J36-41
MAGNETRON

General Characteristics

Electrical

Filament or Cathode	Cathode type
Voltage	16 volts
Current	3.1 amps

Frequency	Type	Min.	Max.
	4J36	3650	3700 Mc
	4J37	3600	3650 Mc
	4J38	3550	3600 Mc
	4J39	3500	3550 Mc
	4J40	3450	3500 Mc
	4J41	3400	3450 Mc

Field Strength	2500 gauss
Power Output	1000 watts

Mechanical

See Outline Drawing

Maximum Ratings (Peak values for duty cycle specified)

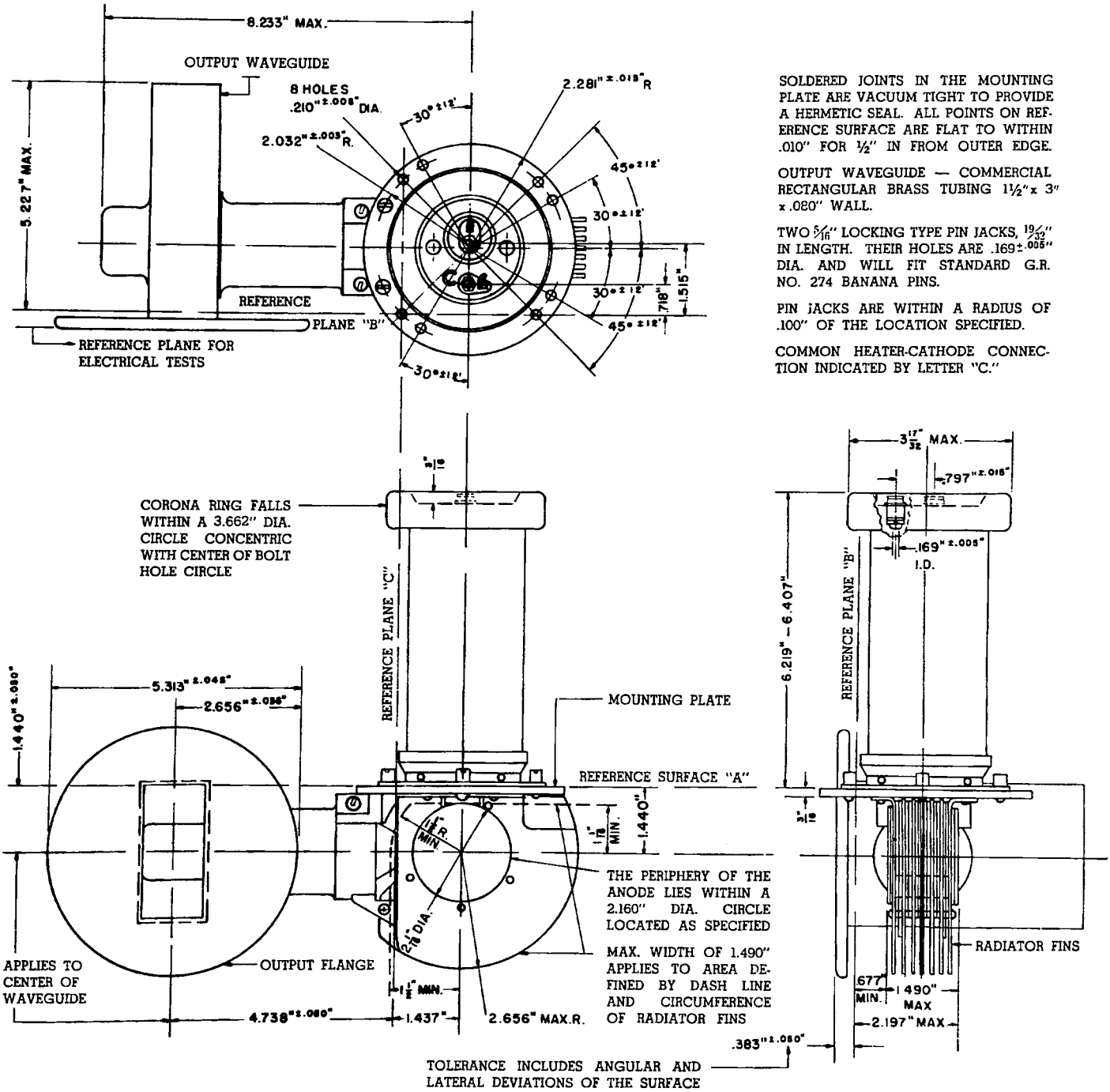
Duty Cycle	.001
Anode Voltage	30,000 volts
Anode Current	70 amps
Anode Dissipation	1200 watts
Pulse Width	2.5 microseconds

from RMA release # 456, Nov. 23, 1945

Sponsor: Raytheon Manufacturing Company, Power Tube Division

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING



SOLDERED JOINTS IN THE MOUNTING PLATE ARE VACUUM TIGHT TO PROVIDE A HERMETIC SEAL. ALL POINTS ON REFERENCE SURFACE ARE FLAT TO WITHIN .010" FOR ½" IN FROM OUTER EDGE.

OUTPUT WAVEGUIDE — COMMERCIAL RECTANGULAR BRASS TUBING 1½" x 3" x .080" WALL.

TWO 5/16" LOCKING TYPE PIN JACKS, 19/32" IN LENGTH. THEIR HOLES ARE .169±.005" DIA. AND WILL FIT STANDARD G.R. NO. 274 BANANA PINS.

PIN JACKS ARE WITHIN A RADIUS OF .100" OF THE LOCATION SPECIFIED.

COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C."

Security Classification: Confidential

Type 4J43-4J44
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Filament or Cathode	Cathode
Voltage	16 volts
Current	3.1 amps

	Type	Min.	Max.
Frequency	4J43	2992	- 3019 Mc
	4J44	2965	- 2992 Mc
Field Strength		2700 gauss	
Peak Power Output		750 kilowatts	

Mechanical

See outline drawing

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle	500
Anode voltage	30 kilovolts
Anode current	75 amps
Anode dissipation	500 watts

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 456, Nov. 23, 1945

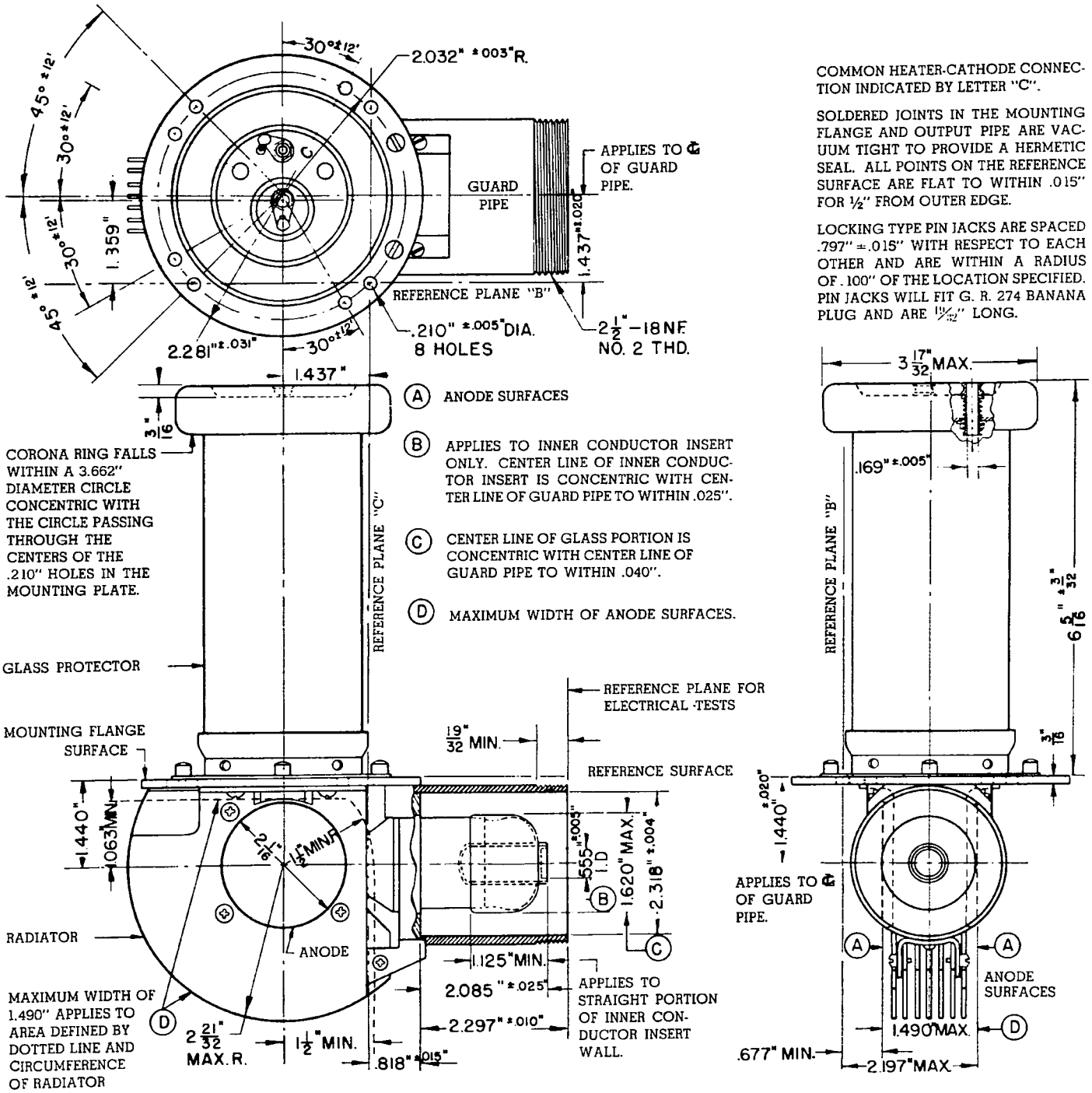
TYPES 4J31-4J35
4J43-4J44
4J53

RAYTHEON

TYPES 4J31-4J35
4J43-4J44
4J53

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING



COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C".

SOLDERED JOINTS IN THE MOUNTING FLANGE AND OUTPUT PIPE ARE VACUUM TIGHT TO PROVIDE A HERMETIC SEAL. ALL POINTS ON THE REFERENCE SURFACE ARE FLAT TO WITHIN .015" FOR ½" FROM OUTER EDGE.

LOCKING TYPE PIN JACKS ARE SPACED .797" ±.015" WITH RESPECT TO EACH OTHER AND ARE WITHIN A RADIUS OF .100" OF THE LOCATION SPECIFIED. PIN JACKS WILL FIT G. R. 274 BANANA PLUG AND ARE 1 19/32" LONG.

Security Classification: Confidential

Type 4J53
MAGNETRON

GENERAL CHARACTERISTICS

Electrical

Filament or Cathode	Cathode
Voltage	16 volts
Current	3.1 amp
Frequency	2793 - 2813 Mc
Field Strength	2700 gauss
Peak Power Output	750 kilowatts

Mechanical

See Outline Drawing

Maximum Ratings (Peak values for duty cycle specified)

Duty Cycle	500
Anode voltage	30 kilovolts
Anode current	75 amps
Anode dissipation	500 watts

Sponsor: Raytheon Manufacturing Company - Power Tube Division

from RMA release # 456, Nov. 23, 1945

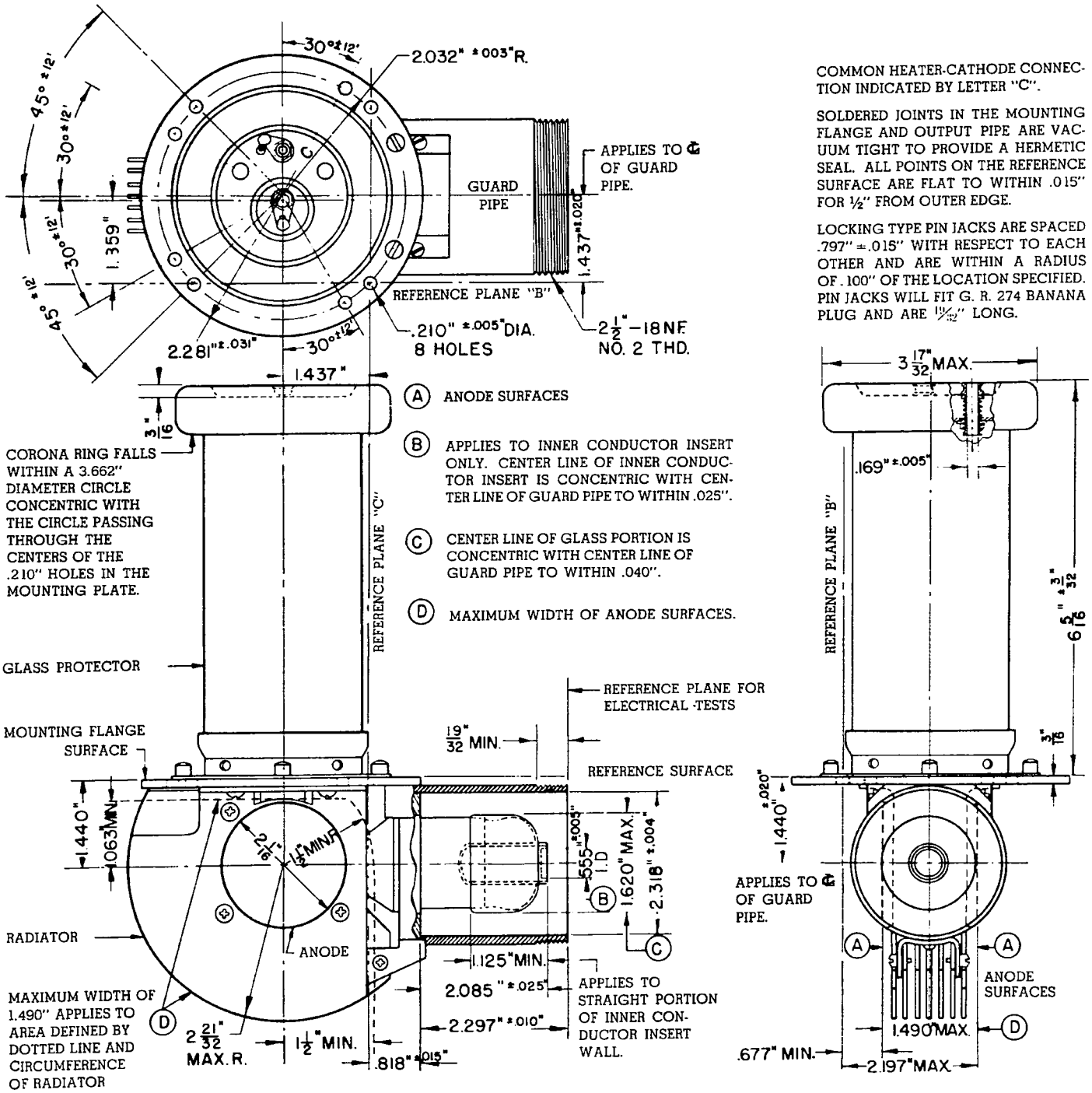
TYPES 4J31-4J35
4J43-4J44
4J53

RAYTHEON

TYPES 4J31-4J35
4J43-4J44
4J53

TECHNICAL INFORMATION
MAGNETRON OSCILLATOR

OUTLINE DRAWING



COMMON HEATER-CATHODE CONNECTION INDICATED BY LETTER "C".

SOLDERED JOINTS IN THE MOUNTING FLANGE AND OUTPUT PIPE ARE VACUUM TIGHT TO PROVIDE A HERMETIC SEAL. ALL POINTS ON THE REFERENCE SURFACE ARE FLAT TO WITHIN .015" FOR ½" FROM OUTER EDGE.

LOCKING TYPE PIN JACKS ARE SPACED .797" ±.015" WITH RESPECT TO EACH OTHER AND ARE WITHIN A RADIUS OF .100" OF THE LOCATION SPECIFIED. PIN JACKS WILL FIT G. R. 274 BANANA PLUG AND ARE 1 19/32" LONG.

SECURITY CLASSIFICATION: SECRET

Type 4J54-59

Packaged Magnetron

GENERAL CHARACTERISTICS

Electrical

Filament or Cathode	CathodeTType
Voltage	12.6 Volts
Current	3.25 amps

Frequency	Type	Min.	Max.
	4J54	6875	6775 Mc
	4J55	6775	6675 Mc
	4J56	6675	6575 Mc
	4J57	6575	6475 Mc
	4J58	6475	6375 Mc
	4J59	6375	6275 Mc

Typical Operation

Pulse Duration	1 uSec.
Repetition Rate	1000 cycles per Sec.
Anode Voltage	18.5 KV
Anode Current	30 amps
Peak Power Output	250 KW

Maximum Ratings

Peak Anode Voltage	20 KV
Peak Anode Current	35 amps
Anode Dissipation	450 Watts
Duty Cycle	.002
Anode Temperature	100° C

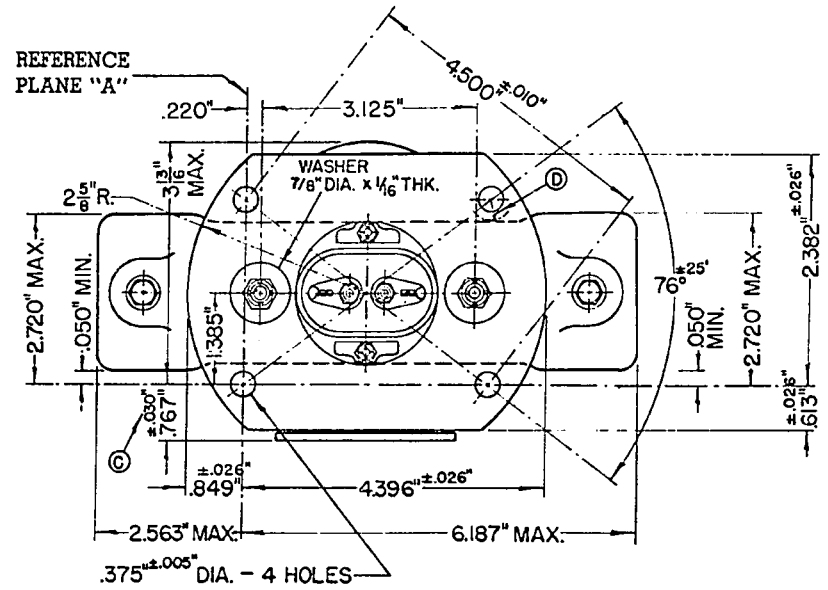
Tube shall not be operated longer than 5 uSec in any 100 uSec interval.

Sponsor: Raytheon Manufacturing Company - Waltham, Massachusetts

from RMA release # 464, Jan. 10, 1946

TECHNICAL INFORMATION
PACKAGE MAGNETRON OSCILLATOR

OUTLINE DRAWING

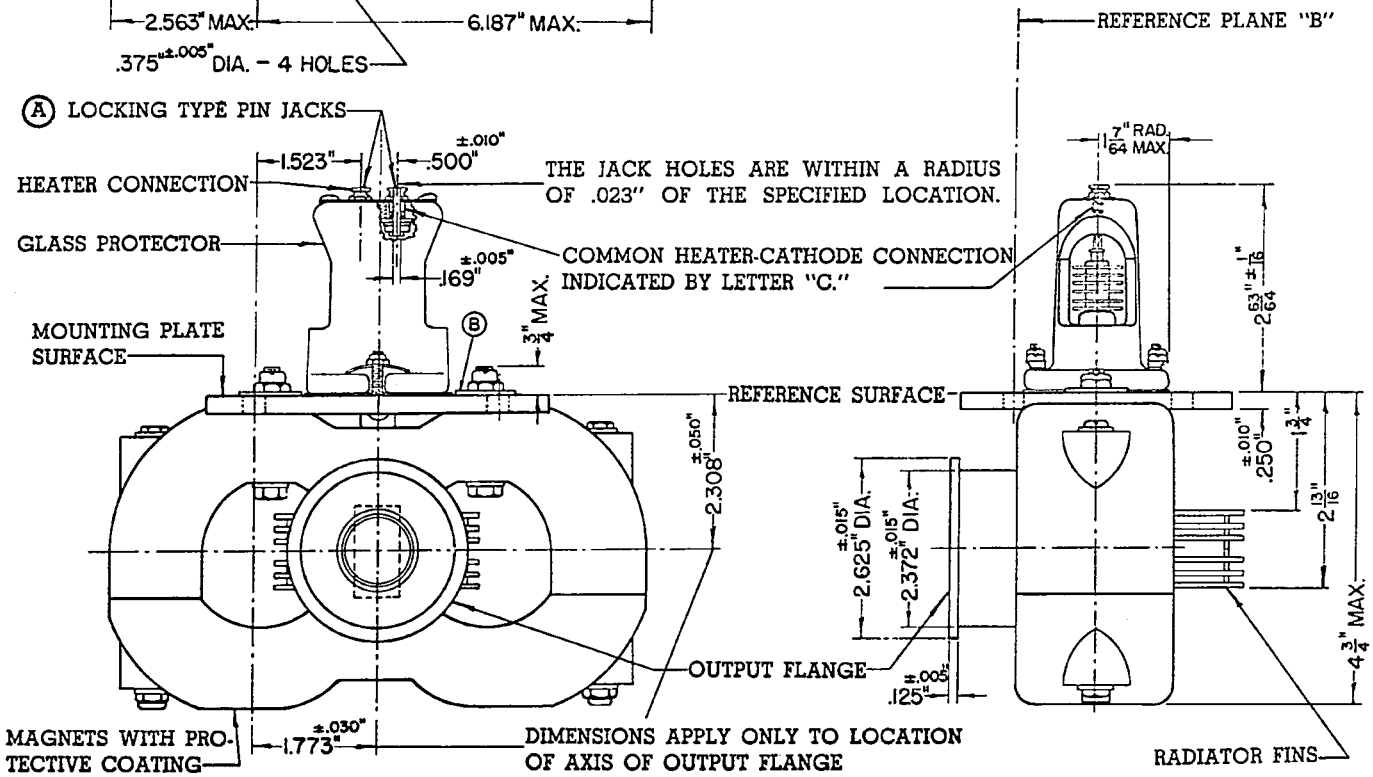


(A) TWO 5/16" LOCKING TYPE PIN JACKS, 19/32" IN LENGTH. THEIR HOLES ARE .169"±.005 DIA. AND WILL FIT STANDARD G.R. NO. 274 BANANA PINS.

(B) STOP NUTS AND WASHERS LIE WITHIN A 1.250" DIA. CIRCLE CENTERED AS SHOWN.

(C) TOLERANCE INCLUDES ANGULAR AND LATERAL DEVIATIONS OF THE OUTPUT FLANGE SURFACE.

(D) CLEARANCE BETWEEN AXIS OF PLATE HOLES AND SURFACE OF MAGNET COATING IS .312"



TYPE 5ABP1 5ABP7 5ABP11

The 5ABP— is a 5" electrostatic focus and deflection cathode ray tube designed for oscilloscope applications. The 5ABP— has very high sensitivity and low capacitance of the vertical deflecting electrodes making the tube well suited for wide band amplifiers with their characteristics low signal output and low capacitance load requirement. The gun features a small spot size of high brilliance, as well as a cutoff voltage not effected by focusing changes.

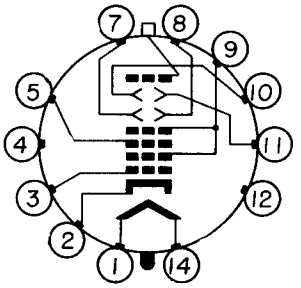
MECHANICAL DATA

BASE: Medium Shell Diheptal 12-pin No. B12-37

TERMINAL CONNECTIONS:

Pin 1 Heater
Pin 2 Cathode
Pin 3 Grid #1
Pin 4 No Connection (Do not use)
Pin 5 Grid #3
Pin 7 Deflecting Electrode D3
Pin 8 Deflecting Electrode D4
Pin 9 Anode #1 (Grid #2 and #4)
Pin 10 Deflecting Electrode D2
Pin 11 Deflecting Electrode D1
Pin 12 No Connection
Pin 14 Heater
Cap Anode #2 (Grid #5 and Collector)

MOUNTING POSITION: Any



BOTTOM VIEW

14J

GENERAL DATA

		5ABP1	5ABP7	5ABP11
Phosphor				
Fluorescence		Green	Blue	Blue
Phosphorescence		-----	Yellow	-----
Persistence		Medium	Long	Short
Focusing Method	Electrostatic			
Deflection Method	Electrostatic			

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	8
Cathode to all other electrodes	5
D1 to D2	2.5
D3 to D4	1.3
D1 to all other electrodes except D2	9
D2 to all other electrodes except D1	9
D3 to all other electrodes except D4	5.0
D4 to all other electrodes except D3	6

DESIGN CENTER MAXIMUM RATINGS

Heater Current	0.6±10%	amperes
Peak Heater-Cathode Voltage, Max. (Note 1)		
Heater Negative with respect to cathode	125	volts
Heater Positive with respect to cathode	125	volts
Anode #2 Voltage	6000	volts DC
Anode #1 Voltage	2600	volts DC
Grid #1 Voltage		
Negative-Bias Value	200	volts DC
Positive-Bias Value (Note 1)	0	
Positive-Peak Value	2	
Peak Voltage Between Anode #2 and Any Deflecting Electrode	500	volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3	6.3	6.3	volts
Anode #2 Voltage	2000	3000	4000	volts DC
Anode #1 Voltage (Note 2)	2000	1500	2000	volts DC
Grid #3 Voltage (Focusing Electrode)	400 to 690	400 to 515	400 to 690	volts DC
Grid #1 Voltage	−52 to −87	−33 to −65	−52 to −87	volts DC
Deflection Factors				
D1−D2	43 to 58	40 to 54	53 to 72	volts DC/inch
D3−D4	29 to 39	27 to 36	36 to 48	volts DC/inch
Spot Position (undeflected) (Note 4)			0.5	inch

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd)

MAXIMUM CIRCUIT VALUES:

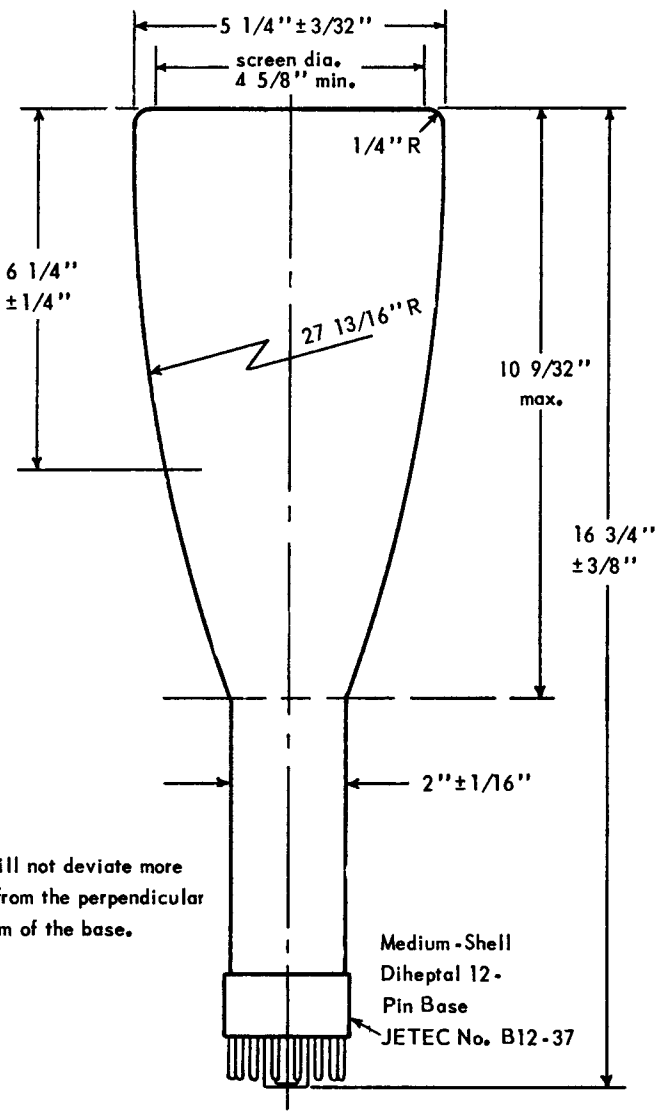
Grid #1 Circuit Resistance	1.5 meg.
Resistance in any deflecting electrode current (Note 3)	5.0 meg.

Note 1 At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.

Note 2 Visual extinction of undeflected focused spot.

Note 3 It is recommended that the deflecting-electrode-circuit resistances be approximately equal.

Note 4 With anode #2 at 4000 volts, anode #1 at 2000 volts, grid #3 adjusted for focus, grid #1 adjusted for barely perceptible spot, each deflecting electrode connected thru a 1 megohm resistor to collector, the center of the undeflected focused spot will fall within a circle of 1/2 inch radius concentric with the center of the tube face, with tube shielded.



The center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of the base.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5ADP-*

CATHODE RAY TUBE

The 5ADP–is a 5" electrostatic focus and deflection cathode ray tube designed for oscilloscope applications. The 5ADP– has very high sensitivity and low capacitance of the vertical deflecting electrodes making the tube well suited for wide band amplifiers with their characteristic low signal output and low capacitance load requirement. The gun features a small spot size of high brilliance, as well as a cutoff voltage not affected by focusing changes.

GENERAL DATA

		5ADP1	5ADP2	5ADP7	5ADP14
Phosphor					
Fluorescence		Green	Green	Blue	Blue
Phosphorescence		----	Green	Yellow	Orange
Persistence		Medium	Long	Long	Med. Long
Focusing Method	Electrostatic				
Deflection Method	Electrostatic				
Useful screen dia.	4 1/2" min.				

* *Available in all popular phosphors.*

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	4.5
D1 to D2	2.4
D3 to D4	1.0
D1 to all other electrodes except D2	4.4
D2 to all other electrodes except D1	4.4
D3 to all other electrodes except D4	3.1
D4 to all other electrodes except D3	3.6

RATINGS–ABSOLUTE MAXIMUM VALUES:

Heater Voltage	6.3±10 % volts
Peak Heater–Cathode Voltage, Max.	
Heater Negative with respect to cathode	200 volts
Heater Positive with respect to cathode	200 volts
Anode #2 Voltage	6600 volts DC
Anode #1 Voltage	2850 volts DC
Ratio of Anode #2 to Anode #1 Voltage	2.3:1 maximum
Grid #3 Voltage (Focus Electrode)	1100 volts DC
Grid #1 Voltage	
Negative–Bias Value	220 volts DC
Positive–Bias Value (Note 1)	0 volts DC
Positive–Peak Value	2 volts
Peak Voltage Between Anode #2 and Any Deflecting Electrode	550 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

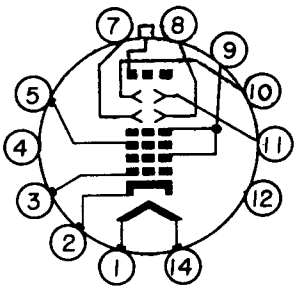
Heater Voltage	6.3 volts
Heater Current	600 mA
Anode #2 Voltage	3000 volts DC

MECHANICAL DATA

BASE:..... Medium Shell Diheptal 12–pin No. B12–37

MOUNTING POSITION:..... Any

BASING..... 14J



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Cathode
Pin 3	Grid #1
Pin 4	Do not use
Pin 5	Focus
Pin 7	D3
Pin 8	D4
Pin 9	Anode #1
Pin 10	D2
Pin 11	D1
Pin 12	No Connection
Pin 14	Heater
Cap	Anode #2

Printed in U.S.A.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (cont'd.)

Anode #1 Voltage	1500	volts DC
Grid #3 Voltage (Focusing Electrode)	300 to 515	volts DC
Grid #1 Voltage required for cutoff (Note 2)	−34 to −56	volts DC
Deflection Factors		
D1–D2	40 to 50	volts DC/inch
D3–D4	30.5 to 37.5	volts DC/inch
Modulation with Anode #2 Current = 25 μAdc	45	volts max.
Line Width with Anode #2 Current = 25 μAdc	0.03	inches max.
P1 Light Output with Anode #2 Current = 25 μAdc	15	Ft. L. min.
Undeflected Spot Position (Note 4)	Within 5/16	inch radius circle
Useful Scan	±2	inches from tube face center

BASE ALIGNMENT:

D1–D2 trace aligns with pin #5 and tube axis ±10 degrees

Positive Voltage on D1 deflects beam toward pin #5

Positive Voltage on D3 deflects beam toward pin #2

Angle between D3, D4 and D1, D2 traces	90	degrees approx.

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5	meg.
Resistance in any deflecting electrode current (Note 3)	5.0	meg.

NOTE 1: At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.

NOTE 2: Visual extinction of undeflected focused spot.

NOTE 3: It is recommended that the deflecting–electrode–circuit resistances be approximately equal.

NOTE 4: Centered on tube face with the tube shielded and with all deflection plates connected to Anode #2.

TYPE

5AHP7
5AHP7A
5AHP14
5AHP14A
5AHP19A

The type 5AHP— is a 5 inch electrostatic focus and magnetic deflection cathode ray tube suitable for radar applications. A low-voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the 5AHP— employs a high resolution electron gun. The final A designates a metallized screen, for greater light output, improved contrast, and to minimize screen charging effects.

MECHANICAL DATA

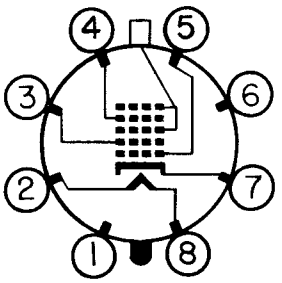
BASE: Medium Shell Octal 8-Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 No Connection
Pin 2 Heater
Pin 3 Grid #2
Pin 4 Grid #4
Pin 5 Grid #1
Pin 7 Cathode
CAP Grids #3 and #5 (Collector)
Pin 8 Heater

MOUNTING POSITION: Any



Bottom View

8EF

GENERAL DATA

	5AHP7 5AHP7A	5AHP14 5AHP14A	5AHP19A
Phosphor	#7	#14	#19
Fluorescence	Blue	Blue	Orange
Phosphorescence	Yellow	Orange	Orange
Persistence	Long	Medium-long	Long
Focusing Method	Electrostatic	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic	Magnetic
Deflection Angle	53°	53°	53°

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Heater Current	0.6 ± 10% volts
Peak Heater-Cathode Voltage: ♦	
Heater-Negative with Respect to Cathode	180 volts DC
Heater-Positive with Respect to Cathode	180 volts DC
Collector Voltage ▲	10,000 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative-Bias Value	180 volts DC
Positive-Bias Value *	0 volts DC
Positive-Peak Value	0 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3	6.3 volts
Collector Voltage ▲	5000	7000 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 200	0 to 250 volts DC
Grid #2 Voltage	300	300 volts DC
Grid #1 Voltage ⊕	−28 to −72	−28 to −72 volts DC
Line Width ■	.010	.009 inch max.
Spot Position (undeflected) □	5/16	5/16 inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 max. meg.

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.*

▲ *Collector, Grids #3 and #5 are connected internally and referred to as Collector. Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 5000 volts.*

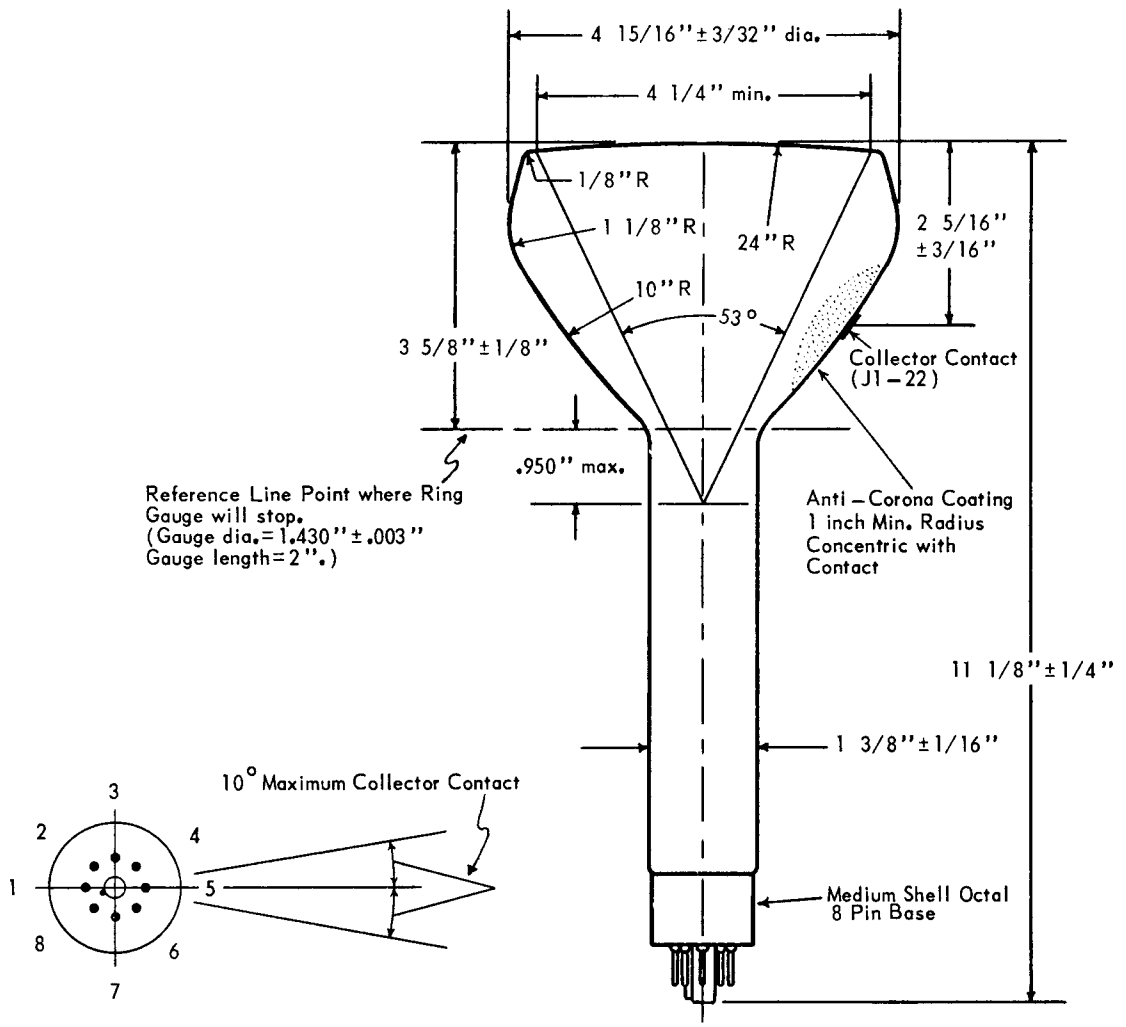
♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

● *With grid #1 voltage adjusted to produce a collector current of 100 μA, with the pattern adjusted for best overall focus. Measured with a 525 – line interlaced and synchronized 2¾" X 3¾" pattern, with interlaced line blanking (current measured before applying blanking).*

⊕ *Visual extinction of focused 2¾" X 3¾" raster pattern.*

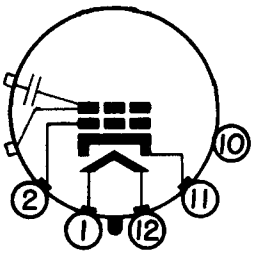
■ *Measured with a 525-line interlaced and synchronized pattern with interlaced line blanking. Pattern width adjusted to 90% of minimum useful screen diameter. Ib = 100 μA., measured before applying blanking. Line width is the merged raster height divided by the number of lines (262.5) (measured in center of tube face). To avoid damage to the screen, it is recommended that the screen currents be not more than 50 μA. when measuring line width. The line width under this condition will be 0.009 inch maximum (current measured before applying blanking).*

□ *The center of the undeflected, focused spot will fall within a circle of 5/16 inch radius concentric with the center of the tube face, with tube shielded.*



TYPE 5AKP24

The 5AKP24 is a flying spot scanner cathode ray tube, employing magnetic focus and deflection. This type features high resolution and a metal backed screen for high brightness. The external coating on the neck of the tube should be connected to ground to prevent corona between the yoke and neck. An external insulating coating on the bulb cone reduces arcing over the bulb.



12G

BOTTOM VIEW

MECHANICAL DATA

MINIMUM USEFUL SCREEN DIAMETER	
(Maximum assured diameter)	4 1/4 Inches
BASE:	B5–57
BASING:	12 G
ANODE CONTACT:	J1–21

ANODE CONTACT ALIGNS WITH VACANT PIN #3 ± 10°

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 11 Cathode
Pin 2 Grid #1	Pin 12 Heater
Pin 10 No Connection	Cap Grid #2, Anode (Note 4)

MOUNTING POSITION: Any

GENERAL DATA

Phosphor Number	P24
Fluorescent Color	Light Green
Persistence	Extremely Short
Focusing Method	Magnetic
Deflecting Method	Magnetic
Deflection Angle, approximate	50 degrees

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCE: (approx.) (μμfds)

Cathode to all	3.5	
Grid #1 to all	4.0	
External Coating Capacitance	100	min.
	500	max.

MAXIMUM RATINGS: (Design Center Values)

Heater Voltage	6.3	volts
Heater Current at 6.3 Volts	.60 ± 10%	amperes
Anode Voltage	40,000	volts DC
Grid #1 Voltage		
Negative Bias Value	350	volts DC
Positive Peak Value	2	volts
Positive Bias Value	0	volts DC
Peak Heater–Cathode Voltage (Note #1)		
Heater Negative with Respect to Cathode		
During Warmup Period not to exceed 15 Sec.	410	volts
After Equipment Warmup Period	180	volts
Heater Positive with Respect to Cathode	180	volts

CHARACTERISTICS AND TYPICAL OPERATION:

Anode Voltage	30,000	volts
Grid #1 Voltage (Note #2)	–80 to –140	volts
Focusing Coil Current, approximate (Note #3)	250	Ma.

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5	megs.

Tentative Data

NOTES:

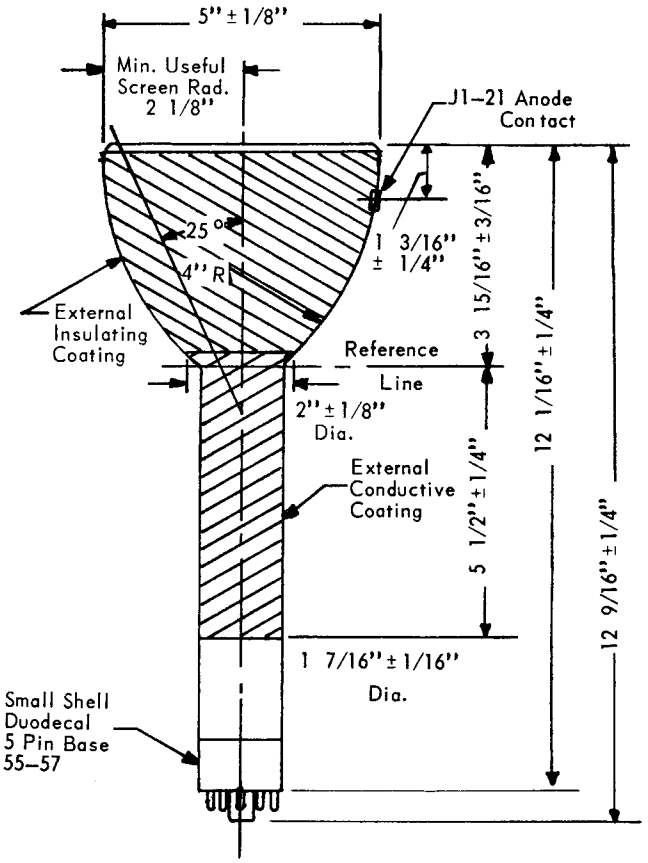
Note 1 Cathode should be returned to one side or to the mid–tap of the heater transformer winding.

Note 2 For visual extinction of the undeflected focused spot.

Note 3 For standard focus coil JEDEC #106 or equivalent, with the combined Grid #1 bias voltage and video signal voltage adjusted for 200 microamperes of anode current.

Note 4 The anode contact aligns with vacant pin position #3, ± 10°.

Note 5 The reference line is determined by the position where the reference line gauge JEDEC #112 rests against the funnel. The center line of the bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of the bottom of the base.



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5AMP— *

CATHODE RAY TUBE

The 5AMP— is a 5" electrostatic focus and deflection cathode ray tube designed for oscilloscope applications. The 5AMP— has very high sensitivity and low capacitance of the vertical deflecting electrodes making the tube well suited for wide band amplifiers with their characteristics low signal output and low capacitance load requirement. The gun features a small spot size of high brilliance, and a low voltage electrostatic focus lens is employed, requiring only a small fraction of the accelerator voltage for focusing.

GENERAL DATA

	5AMP1	5AMP2	5AMP7	5AMP11
Phosphor	#1	#2	#7	#11
Fluorescence	Green	Green	Blue	Blue
Phosphorescence	----	Green	Yellow	----
Persistence	Medium	Long	Long	Short

Focusing Method Electrostatic

Deflection Method Electrostatic

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3±10 % volts
Heater Current	0.6 amps.
Peak Heater-Cathode Voltage: ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: (μμfds) (approx.)

Grid #1 to all other electrodes	4.2
Cathode to all other electrodes	3.8
D1 to D2	3.0
D3 to D4	1.9
D1 to all other electrodes	6.1
D2 to all other electrodes	5.7
D3 to all other electrodes	4.2
D4 to all other electrodes	3.7

DESIGN CENTER MAXIMUM RATINGS:

Anode Voltage (Note 1)	6000 volts DC
Focusing Voltage	1500 volts DC
Grid #1 Voltage	
Negative Bias Value	200 volts DC
Positive Bias Value	0 volts DC
Positive Peak Value	0 volts
Peak Voltage Between Anode and Any Deflecting Electrode	1200 volts

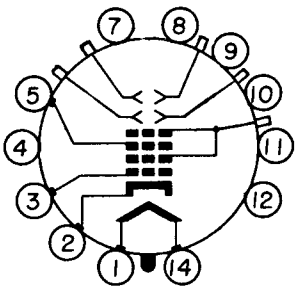
* *Available in all popular phosphors.*

MECHANICAL DATA

BASE . . . Medium Shell Diheptal 12—Pin

CAPS . . . . . J1—25

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Heater
Pin 2 Cathode
Pin 3 Grid #1
Pin 4 Intermal Connection (do not use)
Pin 5 Focus
Pin 14 Heater
Cap Anode
Caps Deflecting Electrodes

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts
Anode Voltage	2500 volts DC
Focusing Voltage	0 to 300 volts DC
Grid #1 Voltage (Note 2)	−34 to −56 volts DC
Deflection Factors	
D1–D2	40 to 50 volts DC /inch
D3–D4	20 to 25 volts DC/inch
P1 Light Output (Note 3)	15 Ft. L Min.
Modulation (Note 3)	45 Max. volts DC
Line Width A (Note 3)	0.032 Inch Max.
Anode Current (Note 3)	800 Microamperes DC Max.
Useful Scan	
D1–D2	4.00 (±2.00 min. from tube face center) inches
D3–D4	2.50 (±1.25 min. from tube face center) inches
Spot Position (Note 7)	Within a 5/16 inch radius circle

DESIGN VALUES:

Focusing Current for any operating condition	−15 to +15 μAdc
Grid #1 Voltage (Note 2)	−13.6 to −22.4 volts DC per kilovolt of accelerator voltage
Grid #1 Circuit Resistance	1.5 meg. max.
Deflection Factors:	
D1–D2	16 to 20 volts DC/inch/KV of accelerator Voltage
D3–D4	8 to 10 volts DC/inch/KV of anode voltage
Deflection Factor Uniformity (Note 4)	1 % Max.
Pattern Distortion @ 75% of useful scan (Note 5)	2 % Max.
Resistance in any Deflection Electrode Circuit (Note 8)	1 meg. max.

Base Alignment:

D1–D2 trace aligns with pin #5 and tube axis ±10 degrees
Positive Voltage on D1 deflects beam approximately toward pin #5
Positive Voltage on D3 deflects beam approximately toward pin #2
Angle between D3, D4 and D1, D2 traces

♦ *Cathode should be returned to one side or to the mid–tap of the heater transformer winding.*

Note 1: The product of anode voltage and average anode current should be limited to 6 watts.

Note 2: Visual extinction of undeflected focused spot.

Note 3: Measured in accordance with MIL–E–1 Specifications.

Note 4: The deflection factor (for both D1, D2, D3 and D4 plate pairs, separately) for any deflection of less than 75% of the useful scan will not differ from the deflection factor for a deflection at 25% of the useful scan by more than the indicated value.

Note 5: All portions of a raster pattern, adjusted so its widest points just touch the sides of a 1.912 x 3.060–inch rectangle, will fall within the area bounced by the 1.912 x 3.060–inch rectangle and an inscribed 1.837 x 2.940–inch rectangle.

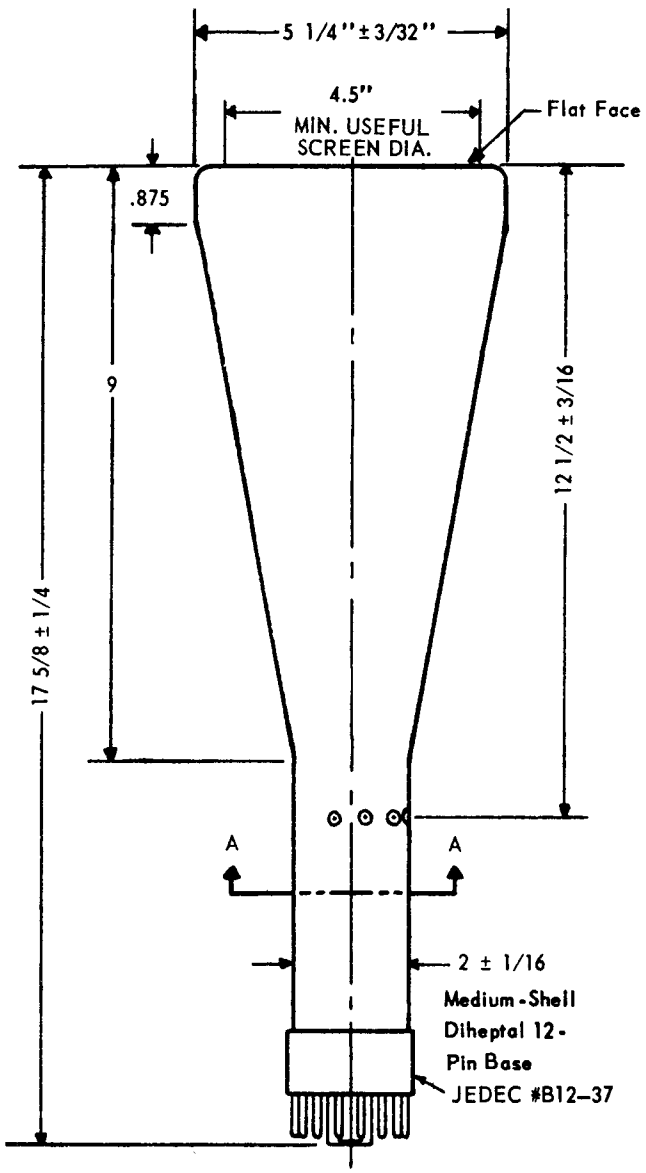
Note 6: Deflection accuracy may be obtained by combining angle between traces, deflection factor uniformity and pattern distortion characteristics. In general, for deflections less than those indicated, the accuracy will improve.

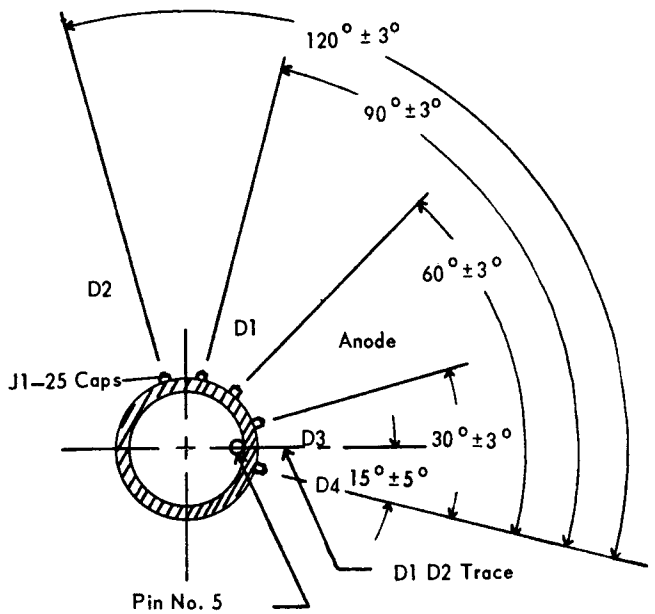
CATHODE RAY TUBE

Note 7: When the tube is operated at typical operating conditions (Ef = 6.3 V., Eb2 = 2500 V., Eb1 at focus); Ec1 adjusted to avoid damage to the screen; with each of the deflecting electrodes connected to the accelerator; and with the tube shielded against external influences, the spot will fall within a 5/16 inch radius circle, centered on the tube face. Under stable operating conditions, the position of the spot will not shift with changes in intensity by more than .025 inch.

Note 8: It is recommended that the deflecting electrode circuit resistances be approximately equal.

Note 9: An adjusted DC potential between the accelerator and the deflection plates may be used to secure best overall focus.





RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5CEP–

HIGH RESOLUTION CATHODE RAY TUBE

The 5CEP– is a 5 inch, high resolution, electrostatic focus magnetic deflection cathode ray tube designed primarily for use in flying spot scanners. The 5CEP– has a spot size less than 0.0015 inches and can therefore attain a resolution of approximately 3000 TV lines across the useful screen diameter. The tube is designed with an aluminized screen, and has a neutral gray face plate to improve contrast.

GENERAL DATA

	5CEP11	5CEP16
Phosphor	P11	P16
Fluorescence	Blue	Violet + Near U–V
Phosphorescence	Blue	Violet + Near U–V
Persistence	Short	Extremely Short
Focusing Method	Electrostatic	Electrostatic
Deflection Method	Magnetic	Magnetic
No-Ion Trap Gun	No Magnet Required	No Magnet Required
Deflection Angle (Approx.)	42°	42°

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage	6.3 volts
Heater Current	.6 amps.
Peak Heater - Cathode Voltage ♦	
Heater Negative with Respect to Cathode	180 volts
Heater Positive with Respect to Cathode	180 volts

DIRECT INTERELECTRODE CAPACITANCE (μμfds.)

Grid #1 to all other electrodes	9
Grid #2 to all other electrodes	7
Cathode to all other electrodes	7

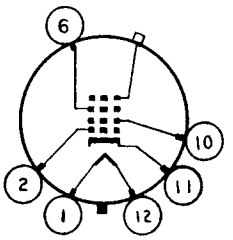
ABSOLUTE MAXIMUM RATINGS

Collector Voltage	22,000 volts
Grid #3 Voltage (focusing electrode)	5,000 volts
Grid #2 Voltage	600 volts
Grid #1 Voltage	
Negative Bias Value	180 volts
Positive Bias Value	0 volts
Positive Peak Value	0 volts
Line Width	.0015 inch

MECHANICAL DATA

BASE ..... JEDEC B6–63
BASING 12Q
MIN. SCREEN DIAMETER ..... 4.25"
MOUNTING POSITION.... Any
FACE PLATE.....Ground Polished Flat
Thickness = 0.245 ± .005"

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Grid #3
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Cap	Grid #4 (Collector)

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage	10,000	20,000	volts
Grid #3 Voltage (focusing electrode) □	2070–2370	4140–4740	volts
Grid #2 Voltage	300	300	volts
Grid #1 Cutoff Voltage ⊕	−40 to −65	−40 to −65	volts
Line Width ●	.0015	.0015	inch
Face Plate (Neutral Gray) Glass Transmission	75	75	%
Spot Position (See Note ▲)			

MAXIMUM CIRCUIT VALUES

Grid #1 Circuit Resistance	1.5	meg. max.

NOTES:

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

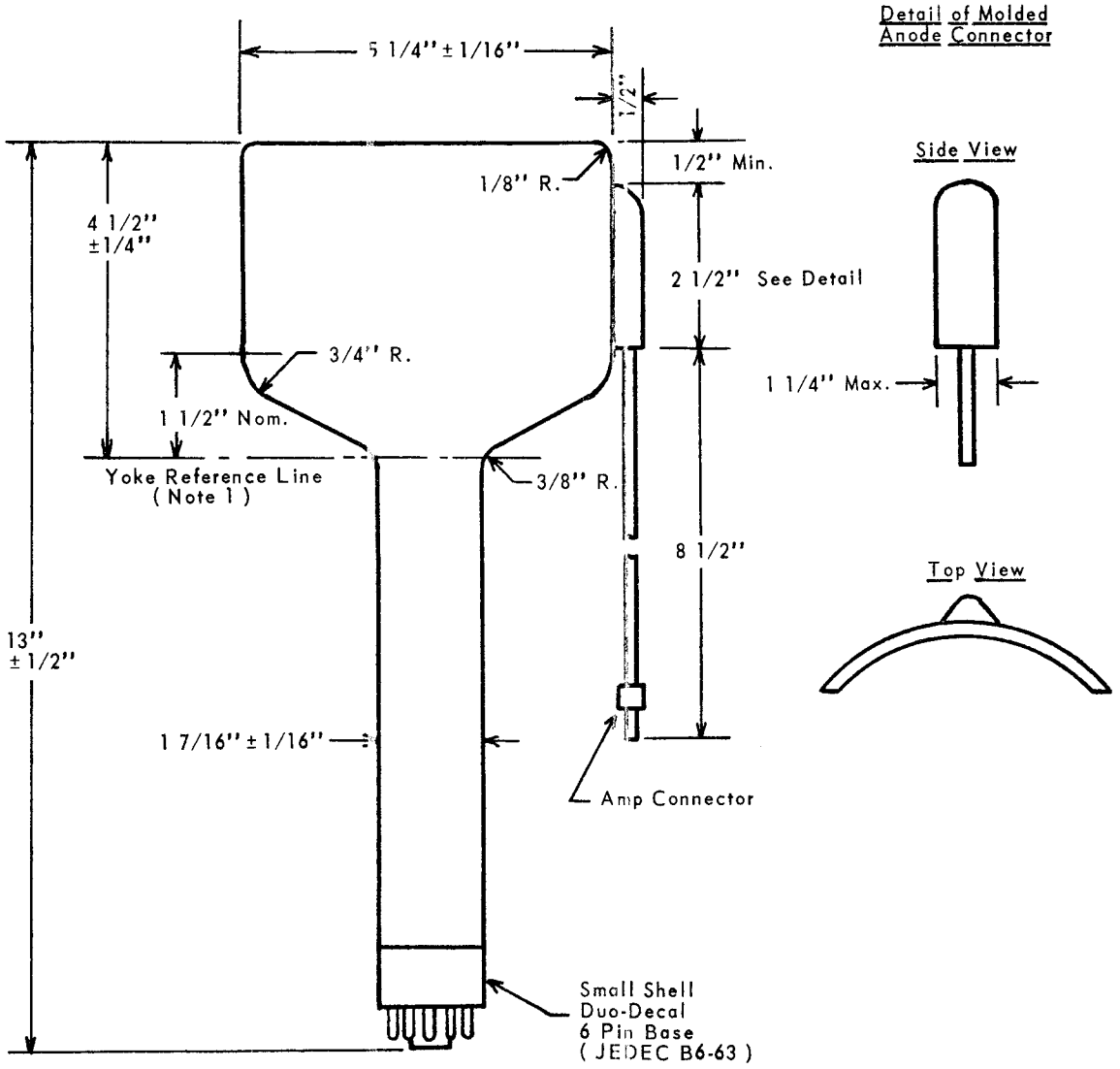
⊕ *Visual extinction of an undeflected focused spot.*

□ *For optimum and uniform focus over the entire useful screen it is recommended that dynamic focus be used. The waveshape of the dynamic focus voltage will depend on the type of scan used. However a variation of 100 volts on the focus electrode will maintain optimum focus across the diameter of the screen.*

● *Line Width is defined as the width at the half amplitude point of the light energy distribution of the line. The line width is measured at a peak current of 10 μa and a 30 μsec./inch scanning rate. The line width remains essentially constant over a wide range of brightness and current.*

▲ *The center of the undeflected, focused spot falls within a circle of 15 mm diameter centered on faceplate.*

HIGH RESOLUTION CATHODE RAY TUBE



Note 1: Yoke Reference Line is the plane where a 1.500" + 0.003", –0.000" I.D. Ring Gauge will stop.

Note 2: Molded Anode Connector alignment with vacant pin position No. 3 has angular tolerance of = 10° measured about the tube axis.

from RMA release # 464, Jan. 10, 1946

Reservation No._____ Registration No._____

Reservation Date_____ Registration Date_____

Type 5L23

Transmitting Tetrode, Power Amplifier, Oscillator

GENERAL CHARACTERISTICS

Electrical

Filament	Thoriated tungsten
Voltage	5.0 volts
Current	14.7 amps

Average Static Characteristics at (Eb-2000v):
Ec_1 - -15v); (Ec_2 - 500v); (Ef - 5v)

Gm	3600 umhos
Plate Current	150 ma
Screen Current	12 ma
Mu	150

Direct Interelectrode Capacitances

Grid-Plate no external shielding	(max.)	0.41 uuf
Input, grid-filament	(max.)	15.0 uuf
Output, plate-filament	(max.)	6.0 uuf

Frequency for Maximum Ratings 45 Mc

MECHANICAL

Type of Cooling

Convection (Maximum Ambient 60C)
Forced Air Cooling for High Frequency Operation

Base Description Jumbo 4 Pin Bayonet

Maximum Overall Dimensions (See outline drawing)

Length	9.146 in.
Diameter	3.900 in.

Base Connections (See outline drawing)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR, PLATE MODULATED

	Typical Operation	Max. Ratings
D-C Plate Voltage	2500 volts	2500 volts
D-C Grid Voltage (Ec_1)	-150 volts	-150 volts
D-C Grid Voltage (Ec_2)		500 volts
Screen Resistor (Note 1)	30,000 Ohms	
D-C Plate Current	200 ma	200 ma
D-C Grid Current	22 ma	30 ma
D-C Screen Current	70 ma	
Plate Input Power		500 watts
Screen Dissipation		35 watts
Plate Dissipation		140 watts
Peak R-F Grid Voltage	320 Volts	
Driving Power	6.3 Watts	
Carrier Power Output	380 Watts	

Note 1: Connected to plate end of modulation transformer and by-passed for R-F only.

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR, TELEGRAPHY

	Typical Operation	Max. Ratings
D-C Plate Voltage	3000 volts	3000 volts
D-C Grid Voltage (Ec_1)	-100 volts	-150 volts
D-C Grid Voltage (Ec_2)	400 volts	500 volts
D-C Plate Current	240 ma	250 ma
D-C Grid Current, approx.	24 ma	40 ma
D-C Screen Current	70 ma	
Plate Input Power	720 watts	750 watts
Screen Dissipation	28 watts	35 watts
Plate Dissipation	210 watts	215 watts
Peak R-F Grid Input Voltage approx.	280 volts	
Driving Power, approx.	6.0 watts	
Plate Power Output	510 watts	

FREQUENCY LIMITS

The upper frequency limit at which the type RK-65 tube may be operated at the ratings given above is 45 Mc. It may be operated above this frequency if the plate voltage and power input are appropriately decreased as the operating frequency is increased and if adequate ventilation of the bulb is provided.

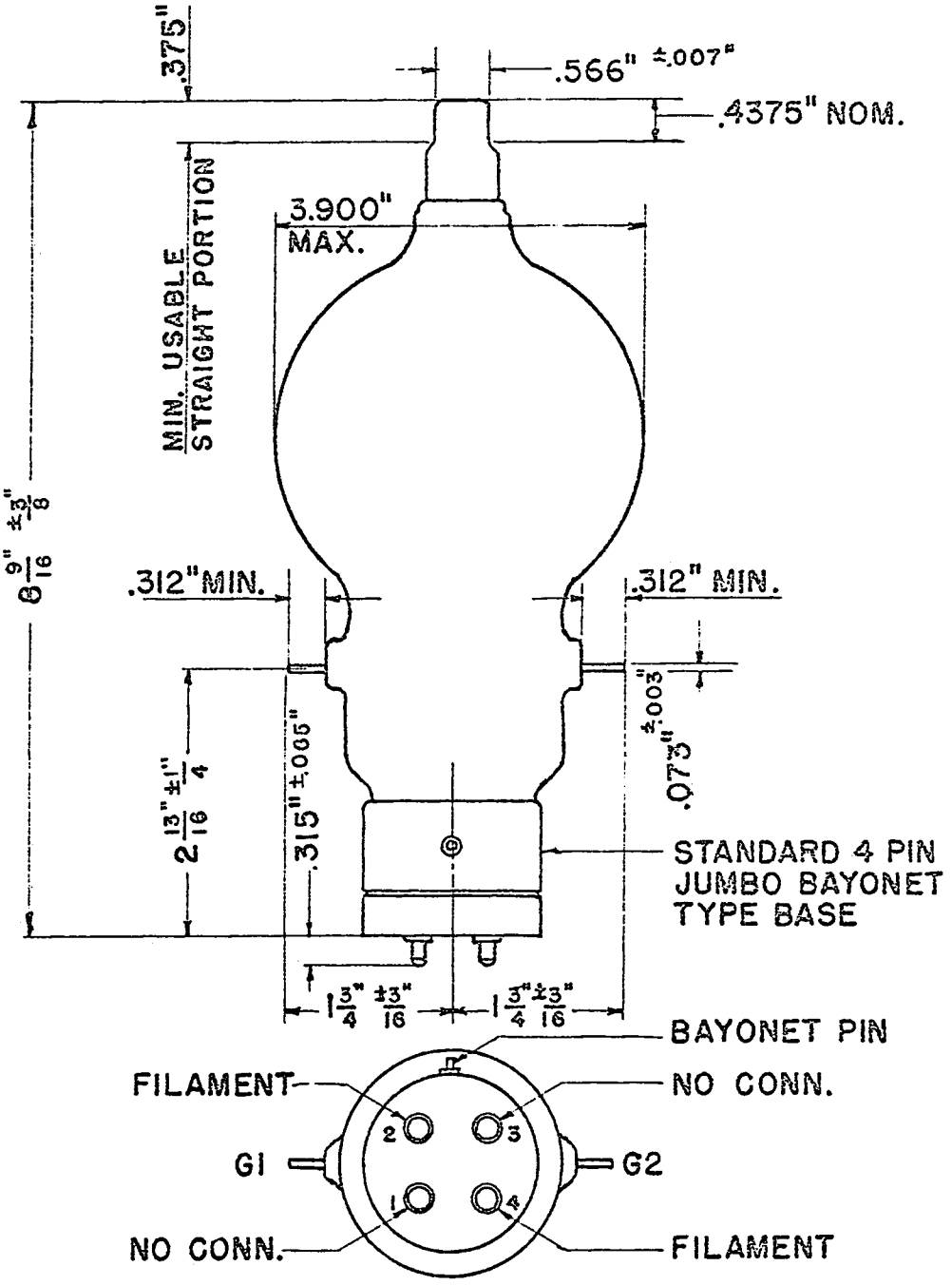
The maximum values of plate voltage and power input at which the tube may be operated at the higher frequencies is given below in which these maximum values are expressed as per cent of the rated values given above.

SERVICE

	Class C Plate Modulated	Class C Unmodulated
Max. Frequency - 45 Mc.	100%	100%
@65 Mc.	75	75
@85 Mc	50	50

Sponsor: Raytheon Manufacturing Company, Waltham, Massachusetts

TECHNICAL INFORMATION
TRANSMITTING TETRODE
OUTLINE DRAWING



BOTTOM VIEW OF BASE

RAYTHEON

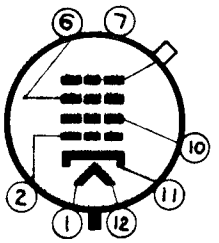
TECHNICAL INFORMATION

CATHODE RAY TUBE

Excellence in Electronics

TYPE 5ZP16

The 5ZP16 is a 5" diameter magnetic deflection and electrostatic focus cathode ray tube, designed for use as a flying spot scanner in high quality video signal generator. Such a generator produces not only a repetitive picture signal, like that produced by a monoscope, but also has the advantages of permitting change of picture or pattern at will, and of producing the picture with the halftone fidelity of photographic film. The 5ZP16 features a metallized screen with a spectral energy characteristic with peak in the near ultraviolet region. The faceplate has an optical quality and flatness that will not limit the performances of a high quality objective lens to produce maximum signal resolution. The tube also features a non browning faceplate. The gun is of a high resolution type. An external conductive coating on the neck, when grounded, prevents corona between neck and yoke, also an external insulator coating on the bulb cone minimizes sparking over the surface of the glass under conditions of high humidity.



BOTTOM VIEW

12C

MECHANICAL DATA

BASE: Small Shell Duodecal 7-Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 10 Grid #2
Pin 2 Grid #1	Pin 11 Cathode
Pin 6 Focus, Grid #3	Pin 12 Heater
Pin 7 Internal Connection	Cap Grid #4, Anode

GENERAL DATA

Phosphor	#16
Fluorescence	Violet & near ultra-violet
Phosphorescence	Violet & near ultra-violet
Persistence	Extremely short
Focusing method	Electrostatic
Deflecting method	Magnetic
Deflecting angle	40^0

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	5
Cathode to all other electrodes	8
External conductive neck coating to anode	500 max. 100 min

DESIGN CENTER MAXIMUM RATINGS:

Heater Current	0.6± 10 % amps.
Accelerator voltage	27,000 volts DC
Focusing electrode	7,000 volts DC
Grid #2 voltage	350 volts DC
Grid #1 voltage:	
Negative-bias value	150 volts DC
Positive-bias value	0 volts DC
Positive-peak value	2 volts
Peak heater-cathode voltage:	
Heater negative with respect to cathode	150 volts
Heater positive with respect to cathode	150 volts

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3	6.3 volts
Accelerator Voltage (Note 1)	20,000	27,000 volts DC
Focusing electrode voltage (Note 2)	4700± 12%	6300± 12% volts DC
Grid #2 Voltage (Note #3)	200	200 volts DC
Grid #1 Voltage (Note #4)	-70	-70 volts DC
Accelerator current	25	15 μA
Max. Focusing Electrode Current (Note 2)	75	25 μA
Grid #2 Current range	-15 to -15	-15 to -15 μA
Maximum Circuit Values		1.5 max. meg.

Tentative Data

inted in U.S.A.

ELECTRICAL DATA (Cont'd.)

NOTES:

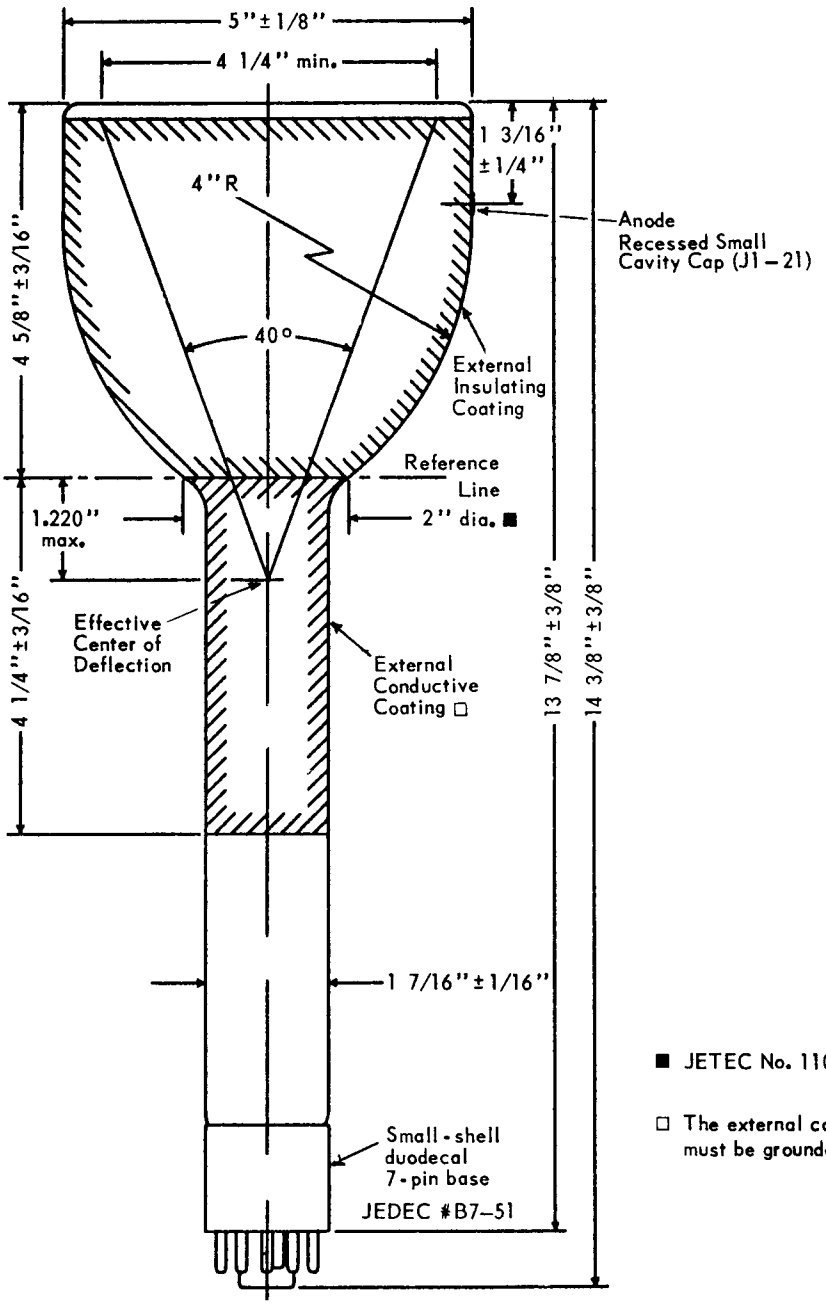
1. For best operation the accelerator voltage should not be less than 20,000 volts. At lower voltages, a decrease in brilliance and definition will occur.
2. For an accelerator current as indicated.
3. Subject to variation ±40% when grid No. 1 voltage is desired at the average cut-off value of −70 volts.
4. Visual extinction of undeflected focused spot can vary ±40% when G2 voltage is maintained at 200 volts.

OPERATING NOTES

1. To prevent the formation of corona between the neck and the yoke which may cause breakdown of the glass neck and/or yoke insulation, the external conductive coating must be grounded. This may be accomplished by fastening a flexible metal band at least 1/4" wide securely around the coated portion of the neck with sufficient tension to insure good electrical contact, but not so tight as to set up glass strains in the neck. Care should be exercised in connecting the band that the coating is not scratched or damaged in any way.
2. The yoke insulation must be adequate for operation of the yoke against the external grounded coating. It is recommended that a high-voltage insulating sleeve be placed between the deflection yoke and the grounded coating on the neck (available on request). The resistance of the coating is high enough that damping of the yoke deflecting energy is negligible.
3. Adequate clearance between the bulb body and all grounded portions of associated equipment and tube supports must be maintained to prevent corona and arc-over. Sharp points or irregularities on grounded surfaces around the tube and support must be advoided.
4. Before touching the tube or high voltage circuits, be sure the power supply is turned off, all high voltage capacitors grounded, and the static charge on the face and sides of the tube discharged by means of a wand connected to the ground.
5. Care should be taken to keep the tube and high voltage supply as free as possible from dust. The deposition of dust is accelerated by the high voltages used and will cause a decrease in light output from the face of the tube as well as a reduction of insulative qualities of the tube and associated circuits and equipment.
6. A neon or gas discharge protective circuit, not to break down below 100 volts, should be connected between the grid and cathode with leads as short as possible. Two (2) NE-48's (or equivalent), connected in series, are recommended. This is required because equipment arc-overs produce secondary discharges in the tube circuits which, if not protected, will cause loss of cathode emission.
7. The tube must be adequately shielded for X-ray radiation to protect personnel. These X-rays are generated when the tube is operated at its normal accelerating potential and can constitute a health hazard.
8. In the event of scan failure, in either one or both directions, serious damage to the tube may result due to concentration of the beam in one spot. Adequate precautions in circuitry should be taken to remove the high voltage and extinguish the beam immediately when this occurs.

RAYTHEON

CATHODE RAY TUBE



■ JETEC No. 110 Gauge.

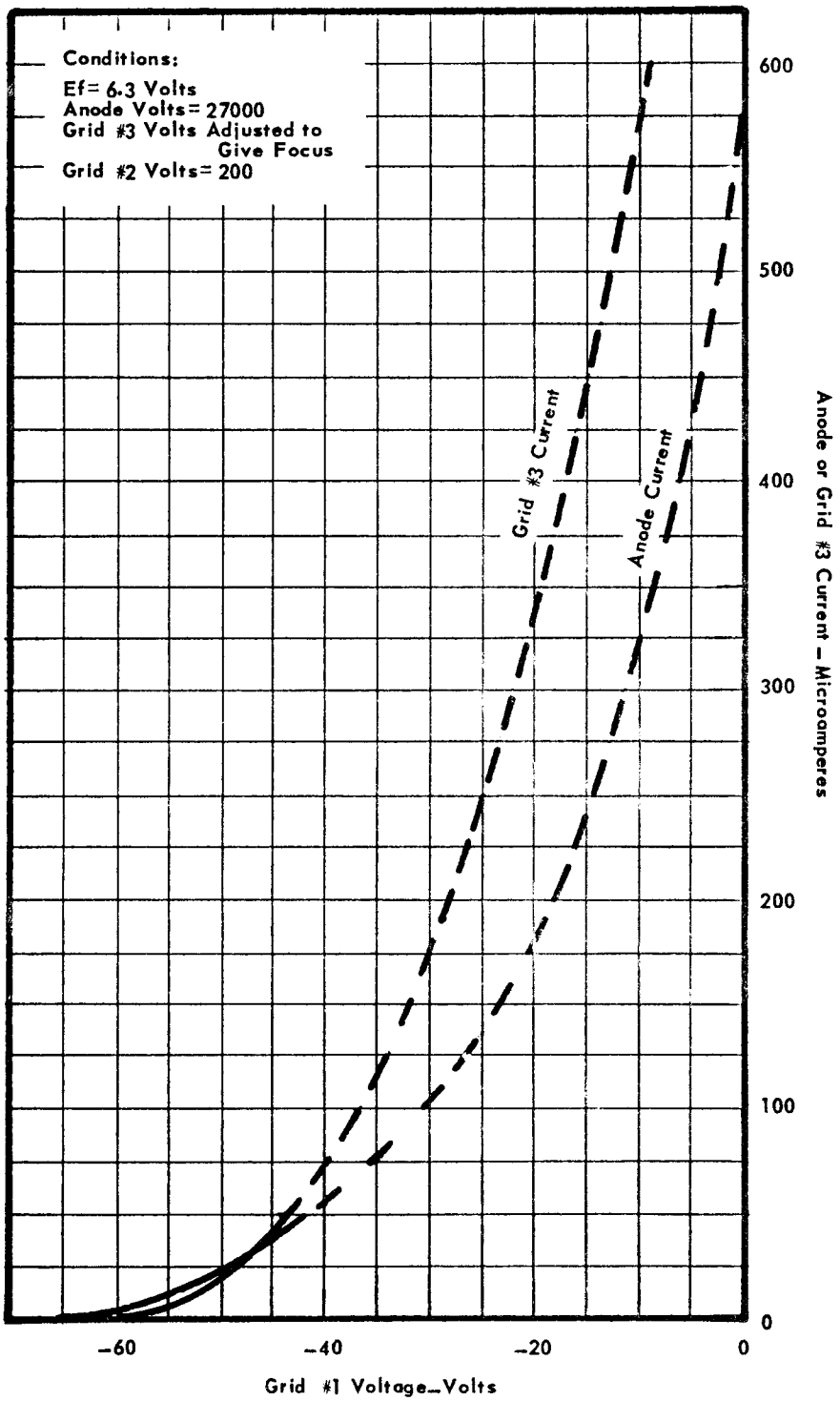
□ The external conductive coating must be grounded.

Reference line is determined by JEDEC 110 gauge.
Pin space #3 is to align with J1–21 contact ±10°.

RAYTHEON

CATHODE RAY TUBE

AVERAGE CHARACTERISTICS



INDUSTRIAL COMPONENTS DIVISION

6AB5 TENTATIVE DATA SHEET 6AB5
RAYTHEON RADIO TUBE

CATHODE RAY TUNING INDICATOR
(Uni-Potential Cathode Type)

Bulb-T-9 Base-Standard 6-pin

DIMENSIONS

Maximum Overall Length	4 3/16"
Maximum Diameter	1 3/16"

BASING - R.M.A. Numbering

Pin 1-Heater
Pin 2-Plate
Pin 3-Grid
Pin 4-Target
Pin 5-Cathode
Pin 6-Heater

RATINGS

Heater Voltage	6.3	volts
Heater Current	0.15	amp
Maximum Plate Supply Voltage	135	volts
Maximum Target Voltage	135	volts

TUNING INDICATOR

Target Voltage	135	volts
Plate Supply Voltage	135	volts
Plate Resistor	0.25	megohm
Target Current (Approximate)	4.5	ma
Plate Current (Zero Bias)	0.5	ma
Grid Bias for Shadow Angle = 0°	-12	volts
Grid Bias for Shadow Angle = 90°	0	volts

The 6AB5 is a high-vacuum tube designed to visually indicate the effect of changing the control grid bias. The shaded pattern produced on the fluorescent target varies through an angle from 90° to approximately 0° as the control voltage is varied. The voltage on the shadow control electrode, the extension of the triode plate between the cathode and target, controls the extent of the shaded area. The voltage of the shadow control electrode is determined by the voltage of the control grid of the triode connected as a dc amplifier. Thus the control grid voltage determines the extent of the shadow. An increase of control grid bias thus increases the shadow control voltage and decreases the shadow while a decrease of bias increases the shadow. In practical use the control grid voltage is obtained from a suitable point in the AVC network. The target current is controlled by a grid in the target section connected to the cathode within the tube.

The 6AB5 is identical with the 6N5 in all respects except bulb size. The 6AB5 is in a T-9 bulb and the 6N5 is in an ST-12 bulb.

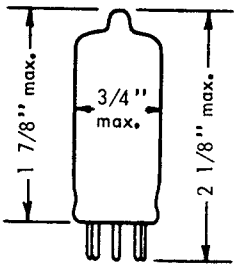
RAYTHEON ENGINEERING SERVICE

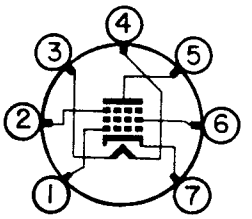
April 1, 1937. CS-1351

from RMA release #112, April 19, 1937

TYPE 6AH6WA

The 6AH6WA is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction designed for use as a wide band or IF amplifier. It will maintain its emission and freedom from excessive cathode interface resistance even after long periods of operation under cut-off conditions. It is designed for dependable operation under conditions of shock and vibration usually found in mobil and aircraft application. The heater-cathode construction is designed to withstand many thousands of cycles of intermittent operation.





BOTTOM VIEW

7BK

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Grid #1	Pin 5 Plate
Pin 2 Grid #3	Pin 6 Grid #2
Pin 3 Heater	Pin 7 Cathode
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test—Note 3)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test—Note 4)	2.5 G
Maximum Bulb Temperature	180 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 7)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	300	300	330	Vdc
Grid #1 Voltage	Ec1:	----	0	0	----	Vdc
Grid #2 Voltage	Ec2:	----	150	150	165	Vdc
Grid #3 Voltage	Ec3:	----	0	0	----	Vdc
Plate Dissipation	Pp:	----	----	3.0	3.3	W
Grid #2 Dissipation	Pg2:	----	----	0.38	0.45	W
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	v
Cathode Current	Ik:	----	----	12.5	28	mAdc
Cathode Resistance	Rk:	----	160	160	----	ohms
Plate Current (1)	Ib(1):	----	----	10	----	mAdc
Grid #2 Current	Ic2:	----	----	2.5	----	mAdc
Transconductance (1)	Sm(1):	----	----	9000	----	μmhos
Plate Resistance	rp:	----	----	0.5	----	Meg.

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

October 15, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			Combined AQL = 1.0% excluding Mechanical and Inoperatives							
Heater Current:		0.65	If:	420	432	450	468	480	36	mA
Heater-Cathode Leakage:	Ehk=+100 Vdc	0.65	Ihk:	----	----	----	----	15	----	μAdc
	Ehk=-100 Vdc		Ihk:	----	----	----	----	15	----	μAdc
Grid Current:	Rg1=1.0 Meg.	0.65	Ic(1):	----	----	----	----	-2.0	----	μAdc
Plate Current (1):		0.65	Ib(1):	7.5	8.7	10.0	11.3	12.5	2.5	mAdc
Plate Current (2):	Ec1=10.0 Vdc	0.65	Ib(2):	----	----	----	----	30	----	μAdc
Transconductance (1):		0.65	Sm(1):	7000	8000	9000	10000	11000	2000	μmhos
Screen Grid Current:		0.65	Ic2:	1.5	1.9	2.5	3.1	3.5	1.4	mAdc
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope T-5½(6-2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V Eg1-all=-100 Vdc Ep-all=-300 Vdc	2.5	Rg1-all: Rp-all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (3):	Ec1=-5.0 Vdc	2.5	Ib(3):	5	----	----	----	----	----	μAdc
Transconductance (2):	Ef=5.7 V (Note 8)	2.5	Δ_{Ef} Sm(2):	----	----	----	----	15	----	%
Grid Emission:	Ef=7.5 V; preheat 5 minutes at Ec1=0 Vdc; Test at Ec1=-10 Vdc	2.5	Ic1(2):	----	----	----	----	-2.0	----	μAdc
RF Noise:	Esig=35 mVac; Ck=0.2 μf	2.5	EB:	----	----	----	----	5	----	VU
Noise and Microphonics:	Ef=6.3 Vac; Ebb=Ecc2=300 Vdc; Ec1=0; Rk=200 ohms; Ec3 to ground; Rp=10,000 ohms; Rg2=60,000 ohms; Cg2=2 μf; Ck=1000 μf; Ecal=300 mVac	2.5	EB:	----	----	----	----	17	----	VU
Capacitance:			Cgp:	----	----	----	----	0.035	----	μμf
Capacitance:	Note 2	6.5	Cin:	8.0	----	10	----	12	----	μμf
Capacitance:			Cout:	3.0	----	4.5	----	6	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mmHg; Voltage=500 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	F=25 cps; G=2.5; Rp=2000 ohms; Ck=1000 μf	2.5	Ep:	----	----	----	----	100	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle=30°; Ehk=+100 Vdc; (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue:	96 Hours; G=2.5 Fixed Frequency; F=25 min., 60 max. (Note 4)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F=25 cps; G=2.5; Rp=2000 ohms; Ck=1000 μf	----	Ep:	----	----	----	----	200	----	mVac
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	----	----	----	30	----	μAdc
	Ehk=-100 Vdc		Ihk:	----	----	----	----	30	----	μAdc
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm(1):	----	----	----	----	20	----	%

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)								
Grid Current (1):		----	Ic1:	----	−4.0	μAdc		
Miniature Tube Base Strain:		----	----	----	----	----		
Glass Strain (Thermal Shock)		2.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef=7.5V; Eb=Ec1=Ec2=Ec3=0V; Ehk=+100 Vdc; 1 min. on, 4 min. off.	1.0	----	----	----	----		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	30	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	30	μAdc		
1 Hour Stability Life Test:	TA=Room; Ehk=+135 Vdc; Rg1=0.1 meg. min.	----	----	----	----	----		
1 Hour Stability Life Test End Points:								
Change in Transconductance (1) of individual tubes:	(Typical Sample Size=50 tubes)	1.0	Δ_tSm(1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+135 Vdc; Rg1=0.1 Meg. Min.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----		
Continuity and Shorts (Inoperatives):		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm(1):	6300	----	μmhos		
Intermittent High Temperature Life Test:	T Bulb=+180°C; Ehk=+135 Vdc; Rg1=0.1 Meg. Min.	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample; 40 tubes 2nd sample).							
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	0	−2.0	μAdc	1	3
Heater Current:		----	If:	410	490	mA	1	3
Change in Transconductance (1) of individual tubes:		----	Δ_tSm(1):	----	20	%	1	3
Transconductance (2):	(Note 8)	----	Δ_{Ef}Sm(2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	1	3
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
Electrode Insulation:								
g1−all		----	Rg1−all:	50	----	Meg.	2	5
p−all		----	Rp−all:	50	----	Meg.		
Transconductance (1) average change:		----	Avg.Δ_tSm(1):	----	15	%	---	---
Total Defectives		----	----	----	----	----	4	8

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
1000 Hour Intermittent Life Test End Points:	(Typical Sample Sizes=20 tubes 1st sample; 40 tubes 2nd sample).	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic1 (1):	0	−2.0	μAdc	2	5
Heater Current:		----	If:	410	490	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	20	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	20 20	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	5	10
500 Hour Cathode Interface Resistance Life Test:	TA=Room; Ef=7.5 Vac; Ehk=0; g1, g2, g3 and P Floating	----	----	----	----	----	---	---
500 Hour Cathode Interface Resistance Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)							
Interface Resistance:		----	ri:	----	25	ohms	1	3

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With cylindrical shield no. 316 connected to cathode lead.

Note 3: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 basic specifications.

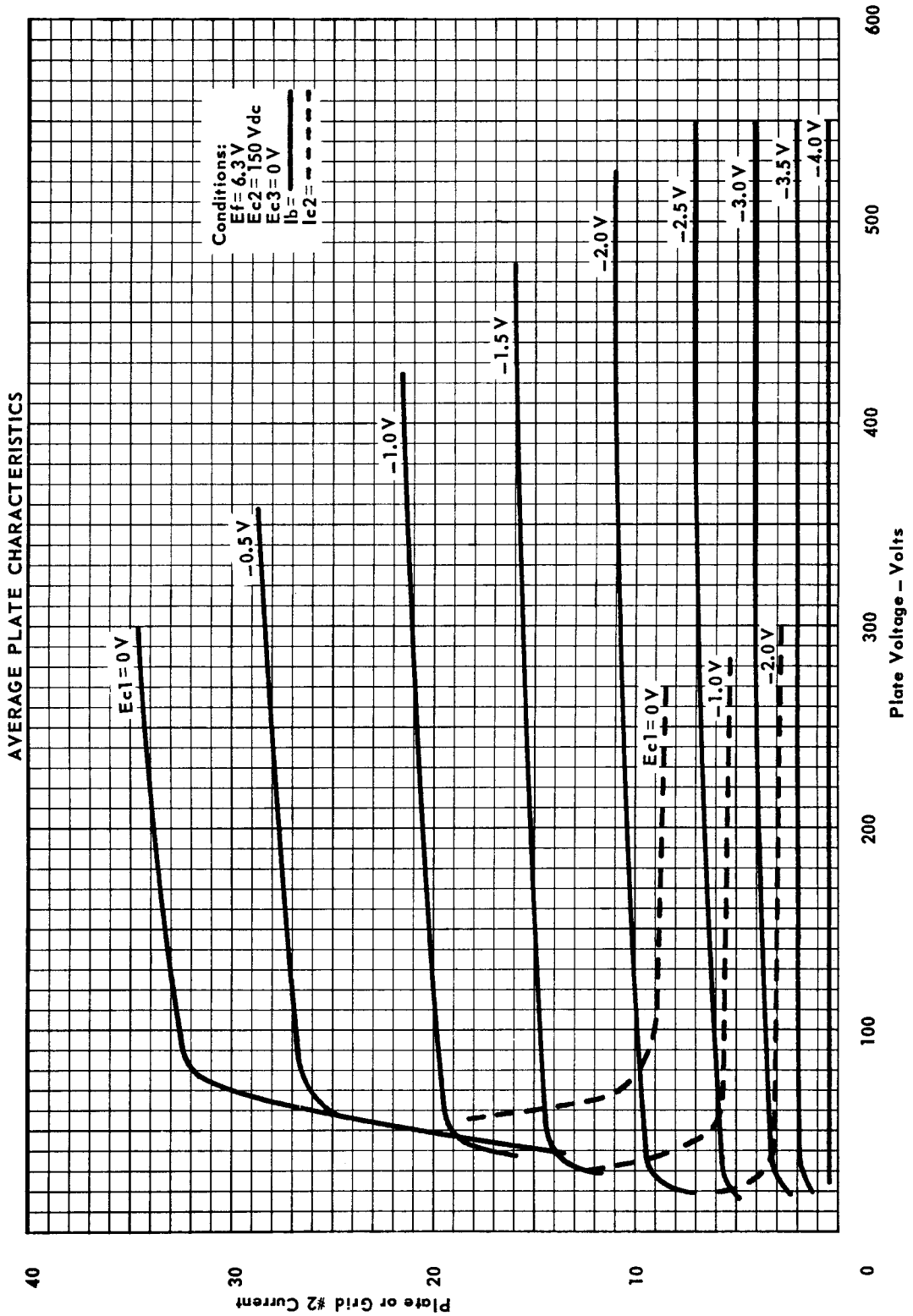
Note 4: Test Conditions and Acceptance Criteria per Fatigue Test Procedure of MIL-E-1 basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be expected.

Note 6: These normal test conditions are used for all characteristic tests unless otherwise stated under individual test items.

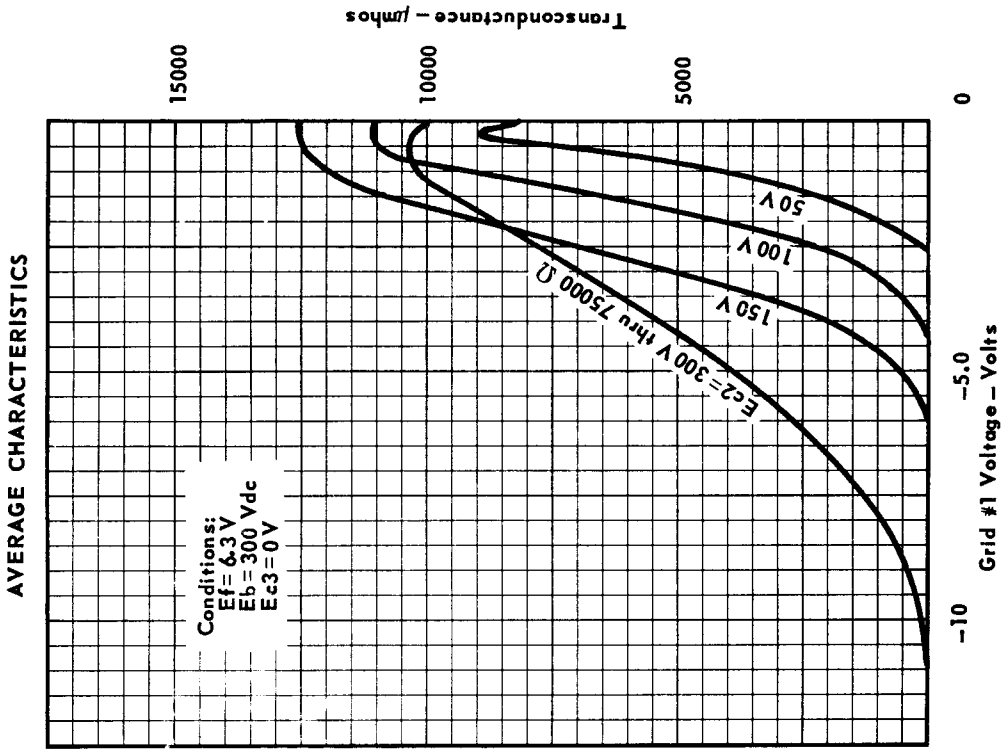
Note 7: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

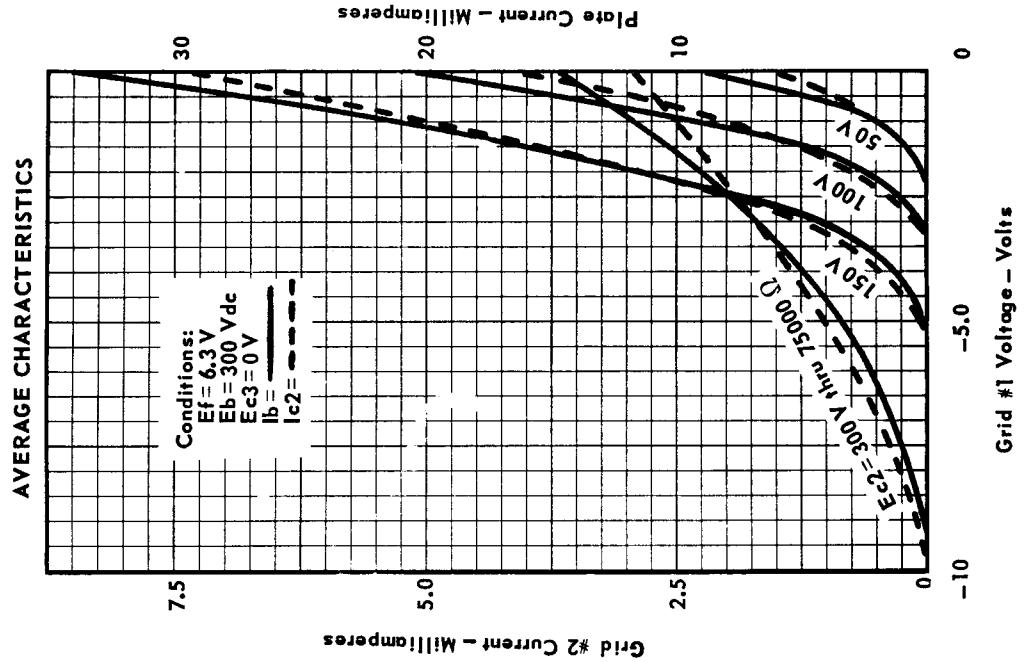
Note 8: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.


AVERAGE PLATE CHARACTERISTICS
Conditions:
Ef = 6.3 V
Ec2 = 150 Vdc
Ec3 = 0 V
Ib = ——
Ic2 = - - - -
Ec1 = 0 V
-0.5 V
-1.0 V
-1.5 V
-2.0 V
-2.5 V
-3.0 V
-3.5 V
-4.0 V
Ec1 = 0 V
-1.0 V
-2.0 V
Plate or Grid #2 Current
40
30
20
10
0
100
200
300
400
500
600
Plate Voltage - Volts

RAYTHEON

RELIABLE PENTODE





6AL6G

TENTATIVE DATA
RAYTHEON TYPE 6AL6G

6AL6G

TETRODE
POWER AMPLIFIER
Heater Type

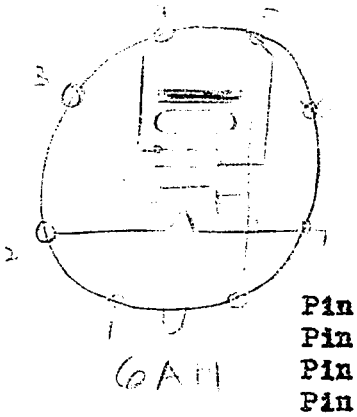
MOUNTING POSITION — Any

BULB: ST-16 Glass CAP: Skirted Miniature BASE: Medium Shell Octal 7-Pin

DIMENSIONS

Maximum Overall Length	5 11/16	inches
Maximum Seated Height	5 1/8	inches
Maximum Diameter	2 1/16	inches

BASING (RMA Designation 6AM)



Pin 1 - No Connection
Pin 2 - Heater
Pin 3 - No Connection
Pin 4 - Screen (G_2)
Pin 5 - Control Grid (G_1)
Pin 6 - Omitted
Pin 7 - Heater
Pin 8 - Cathode & Deflectors
Cap - Plate

RATINGS *

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	0.9	amp
Maximum D-C Plate Voltage	350	volts
Maximum D-C Screen Voltage	300	volts
Maximum Grid Resistor (Self-Bias)	0.5	megohm
Maximum Plate Dissipation	18.5	watts
Maximum Screen Dissipation	2.7	watts
Maximum Peak Plate Voltage (For less than 0.1 cycle)	5000	volts

TYPICAL AMPLIFIER OPERATION - CLASS A_1

	Fixed Bias	Self-Bias	
Heater Voltage	6.3	6.3	volts
Plate Voltage	250	250	volts
Screen Voltage	250	250	volts
Grid Bias	-14	-	volts
Self-Bias Resistor	-	170	ohms
Plate Resistance (approx.)	22500	-	ohms
Transconductance	6000	-	μmhos
No-Signal Plate Current	72	75	ma
No-Signal Screen Current	5	5.4	ma
Maximum-Signal Peak Voltage	14	14	volts
Maximum-Signal Plate Current	79	78	ma
Maximum Signal Screen Current	7.3	7.2	ma
Load Resistance	3500	2500	ohms
Total Harmonic Distortion	10	10	percent
Power Output	6.5	6.5	watts

* For interpretation of ratings, see "Receiving Tube Ratings." (CB-1800)

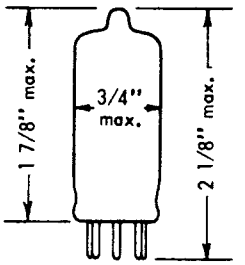
For other operating conditions, see 6L6G data.

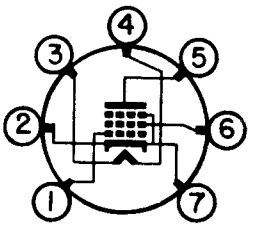
from RMA release #209, Aug. 21, 1939

Excellence in Electronics

TYPE 6AN5WA

The 6AN5WA is a heater-cathode type, pentode power amplifier of miniature construction. This tube is characterized by long life and stable performance. The design features of low triode mu, high transconductance, high pervience, high plate current, and relatively low interelectrode capacitances make it suitable for service as a wide band, RF or video power amplifier in equipment with low plate supply voltages. It is especially designed for frequency-divide and pulse amplifier circuits in electronic computers, and other "on-off" control applications requiring long periods of operation under cutoff conditions.





BOTTOM VIEW

7BD

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Grid #1	Pin 5 Plate
Pin 2 Cathode, Grid #3	Pin 6 Grid #2
Pin 3 Heater	Pin 7 Cathode, Grid #3
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 4)	2.5 G
Maximum Bulb Temperature	200 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION CLASS A (Note 5)	DESIGN MAXIMUM CLASS A (Note 9) (1)	(2)	MIL-E-1 UNITS
Heater Voltage (Note 7)	Ef:	5.7	6.3	6.3	6.9	6.9	V
Plate Voltage	Eb:	----	120	120	135	330	Vdc
Grid #1 Voltage	Ec1:	----	0	0	----	----	Vdc
Grid #2 Voltage	Ec2:	----	120	120	135	330	Vdc
Plate Dissipation	Pp:	----	----	4.0	4.6	----	W
Grid #2 Dissipation	Pg2:	----	----	1.3	1.55	----	W
Heater-Cathode Voltage	Ehk:	-200	----	100	200	200	v
Cathode Current	Ik:	----	----	44	55	55	mAdc
Cathode Resistance	Rk:	----	125	125	----	----	ohms
Useful Power Output	Po:	----	----	1.25	----	----	W
Plate Current (1)	Ib(1):	----	----	33	----	----	mAdc
Transconductance (1)	Sm(1):	----	----	8500	----	----	μmhos

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS – PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.65	If:	420	432	450	468	480	36	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	20	----	μAdc
	Ehk = –100 Vdc		Ihk:	----	----	----	----	20	----	μAdc
Grid Current (1):	Rg = 0.5 Meg. Min.	0.65	Ic1:	----	----	----	----	–2.0	----	μAdc
Plate Current (1):		0.65	Ib(1):	25	28	33	38	43	8	mAdc
Power Output:	Esig = 4.25 Vac; RL = 2500 ohms	0.65	Po:	1.0	1.1	1.25	----	----	----	W
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope T – 5½(6–2)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS – PART 2										
Insulation of Electrodes:	Ef = 6.3 V E (g1 – all) = –100 Vdc E (p – all) = –300 Vdc	2.5	R (g1 – all): R (p – all):	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Screen Current (1):		2.5	Ic2(1):	6	8	11	14	16	3.5	mAdc
Plate Current (2):	Ec1 = –20 Vdc	2.5	Ib(2):	----	----	----	----	1.0	----	mAdc
Transconductance (1):		2.5	Sm (1):	7000	7500	8500	9500	10000	1200	μmhos
Grid Emission:	After 5 min. preheat at Ef = 7.5 V; measure Grid Emission at Ef = 7.5 V; Ec1 = –45 Vdc; Rg1 = 0.01 Meg. Min.	2.5	Isg1:	----	----	----	----	–4.0	----	μAdc
Transconductance (2):	Ef = 5.7 V (Note 8)	2.5	Δ_{Ef}Sm (2):	----	----	----	----	15	----	%
Emission:	Eb = Ec2 = Ec1 = 15 Vdc	2.5	Is:	100	----	----	----	----	----	mAdc
Noise and Microphonics:	Esig = 500 mVac; Rp = 2000; Rg1 = 0.1 Meg.	2.5	EB:	----	----	----	----	17	----	VU
Capacitance			Cg1P:	----	----	----	----	0.075	----	μμf
Capacitance	Note 2	6.5	Cin:	6.0	----	9.0	----	12.0	----	μμf
Capacitance			Cout:	4.0	----	5.5	----	7.0	----	μμf
Low Pressure Voltage Breakdown:		6.5	----	500	----	----	----	----	----	Vac
Vibration (2):	F = 25 cps; G = 2.5; Rp = 2000 ohms	2.5	Ep:	----	----	----	----	100	----	mVac
Plate Current (3):	Eb = Ec2 = 60 Vdc; Ec1 = 0; Rk = 0	6.5	Ib (3):	25	----	----	----	----	----	mAdc
Screen Current (2):	Eb = Ec2 = 60 Vdc; Ec1 = 0; Rk = 0	6.5	Ic2 (2):	6.5	----	----	----	15.5	----	mAdc
DEGRADATION RATE ACCEPTANCE TESTS										
Fatigue:	96 Hours; G = 2.5; Fixed Frequency; F = 25 min., 60 max. (Note 4)	6.5	----	----	----	----	----	----	----	----
Shock:	Hammer Angle = 30°; Ehk = +100 Vdc; Rg1 = 0.1 Meg; (Note 3)	20	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F = 25 cps; G = 2.5; Rp = 2000 ohms	----	Ep:	----	----	----	----	500	----	mVac
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	----	----	----	50	----	μAdc
	Ehk = –100 Vdc	----	Ihk:	----	----	----	----	50	----	μAdc
Grid Current (1):	Rg = 0.5 Meg.	----	Ic1:	0	----	----	----	–4.0	----	μAdc

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)								
Power Output:	Esig=4.25 Vac; RL=2500 ohms	----	Po:	0.8	----	W		
Miniature Tube Base Strain		----	----	----	----	----		
Glass Strain (Thermal Shock):		2.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycle:	Ef=7.5 V; Eb=Ec2=Ec1=0 V; Ehk=100 V; 1 min. on, 4 min. off	1.0	----	2000	----	cycles		
1 Hour Stability Life Test:	TA=Room; Ehk=+135 Vdc; Rg1=0.1 meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:								
Change in Trans-conductance (1) of individual tubes:	(Typical Sample Size=50 tubes)	1.0	Δ_tSm(1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+135 Vdc; Rg1=0.1 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:								
Continuity and Shorts (Inoperatives):	(Typical Sample Size=200 tubes)	0.65	----	----	----	----		
500 and 1000 Hour Intermittent High Temperature Life Test:	T Bulb=+200°C; Ehk=+135 Vdc; Rg1=0.1 Meg.	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample.)							
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	0	-2.0	μAdc	1	3
Heater Current:		----	If:	410	490	mA	2	5
Change in Trans-conductance (1) of individual tubes:		----	Δ_tSm(1):	----	20	%	1	3
Power Output (1):		----	Po(1):	0.75	----	W	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	75 75	μAdc μAdc	2	5
Insulation of Electrodes:								
g1-all p-all		---- ----	Rg1-all: Rp-all:	50 50	---- ----	Meg. Meg.	2	5
Plate Current (1):		----	Ib(1):	25	----	mAdc	2	5
Transconductance (1) Average Change:		----	Avg.Δ_tSm(1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	----	2	5

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
Grid Current (1):		----	Ic (1):	0	–4.0	μAdc	2	5
Heater-Current:		----	If:	410	490	mA	2	5
Change in Trans-conductance (1) of individual tubes:		----	Δ_t Sm (1):	----	20	%	2	5
Power Output (1):		----	Po (1):	0.5	----	W	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=–100 Vdc	---- ----	Ihk: Ihk:	---- ----	75 75	μAdc μAdc	2	5
Insulation of Electrodes:								
g1–all: p–all:		---- ----	Rg1–all: Rp–all:	40 40	---- ----	Meg. Meg.	2	5
Plate Current (1):		----	Ib (1):	25	----	mAdc	2	5
Total Defectives:		----	----	----	----	----	5	10
500 Hour Cathode Interface Resistance Life Test:	TA=Room; Ef=7.5 Vac; Ehk=0; g1,g2, and P Floating	----	----	----	----	----	---	---
500 Hour Cathode Interface Resistance Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample 40 tubes 2nd sample)	----	----	----	----	----	---	---
Interface Resistance:	Ef=5.7 V; Rk=0; Ec1/Ib=4.0 mAdc	----	ri:	----	25	ohms	1	3

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With cylindrical shield No. 316 connected to cathode lead.

Note 3: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 4: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be expected.

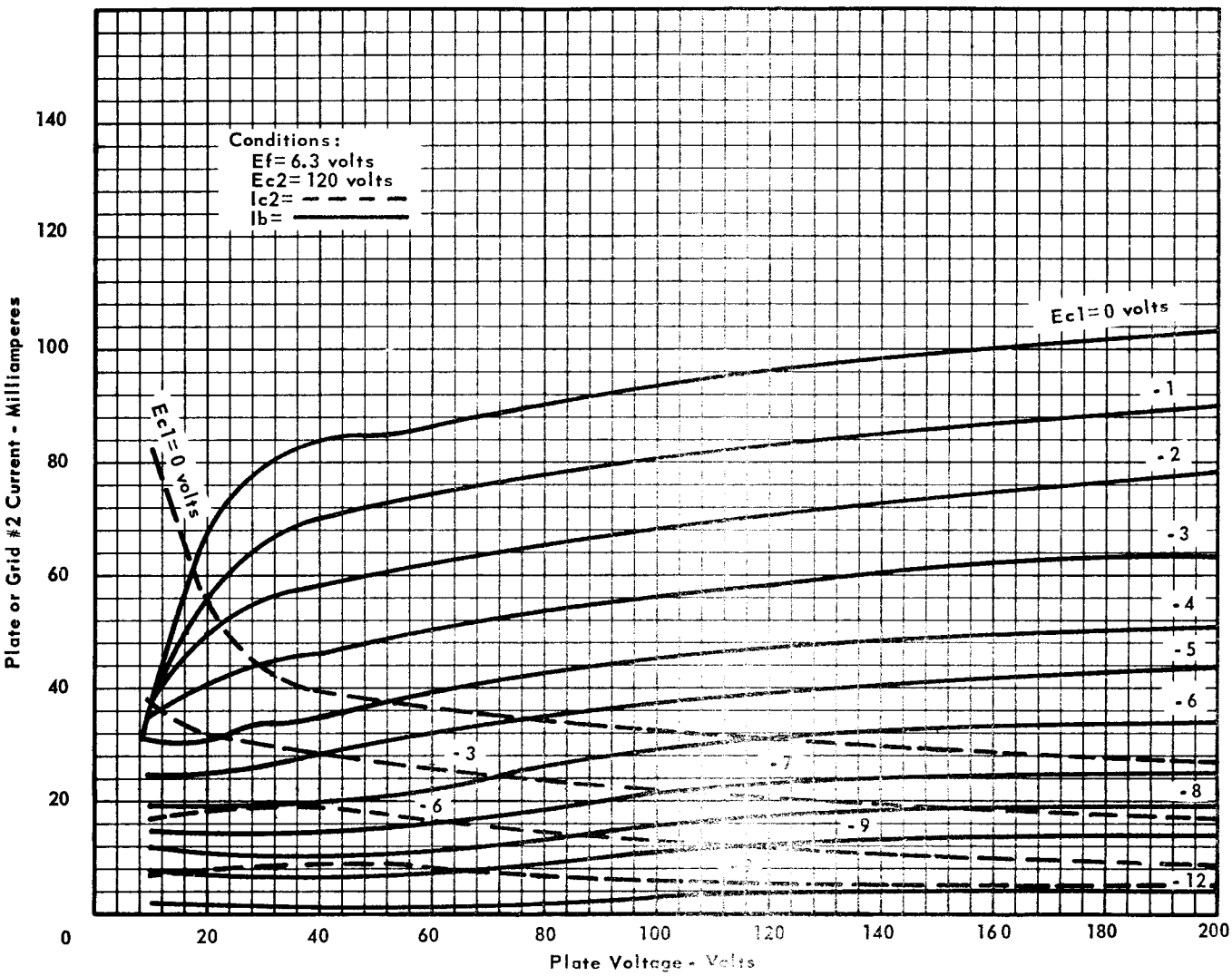
Note 6: These normal test conditions are used for all characteristic tests unless otherwise stated under individual test items.

Note 7: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

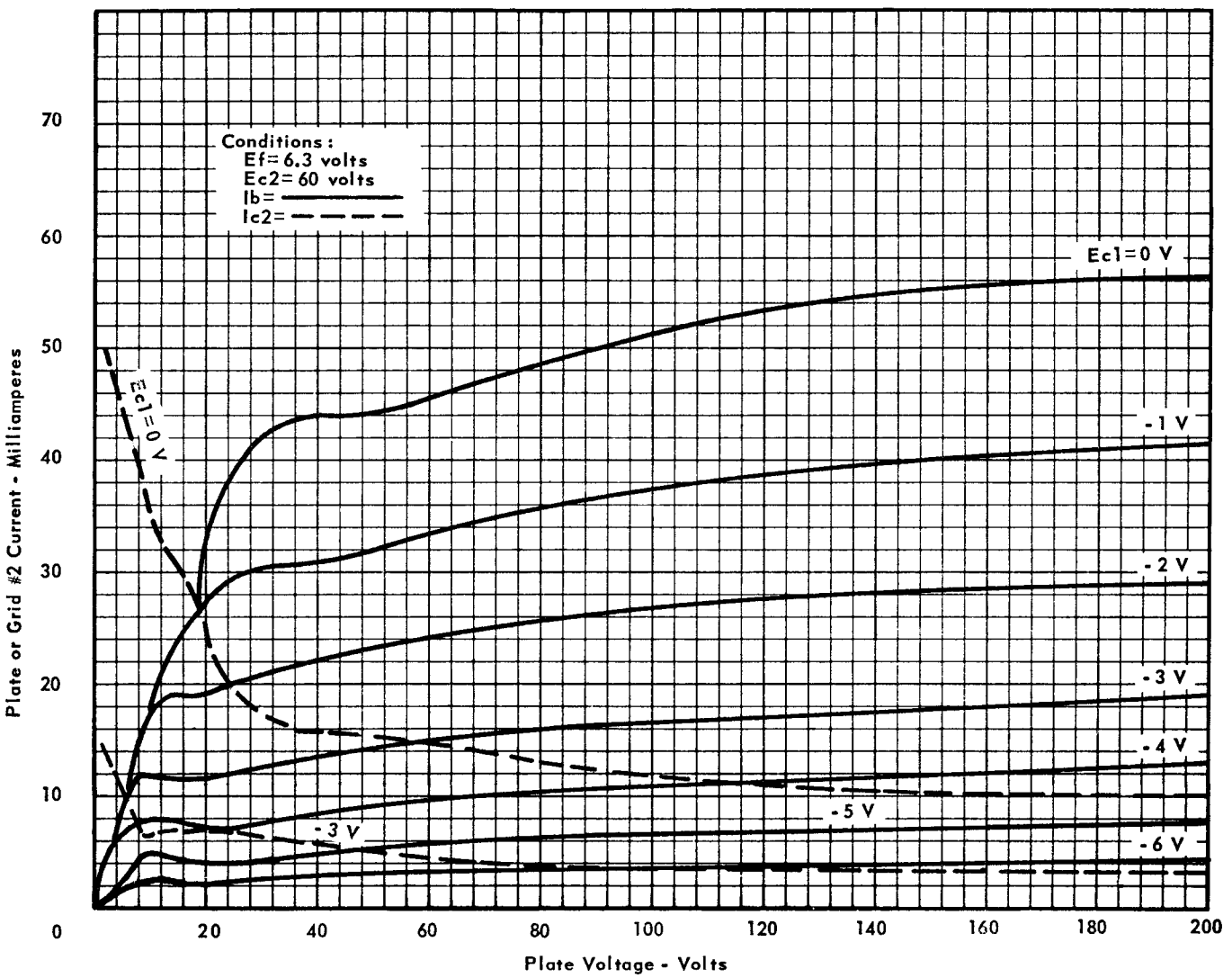
Note 8: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 9: The voltages at the plate or screen may be as high as rating (2) provided the following condition is met: When the average voltage at the electrode (taken over any (1) second interval exceeds rating (1) dc voltage for that electrode, the average dissipation for that electrode shall not exceed the rating (1) dissipation divided by the ratio of the average voltage to the rating (1) dc voltage.

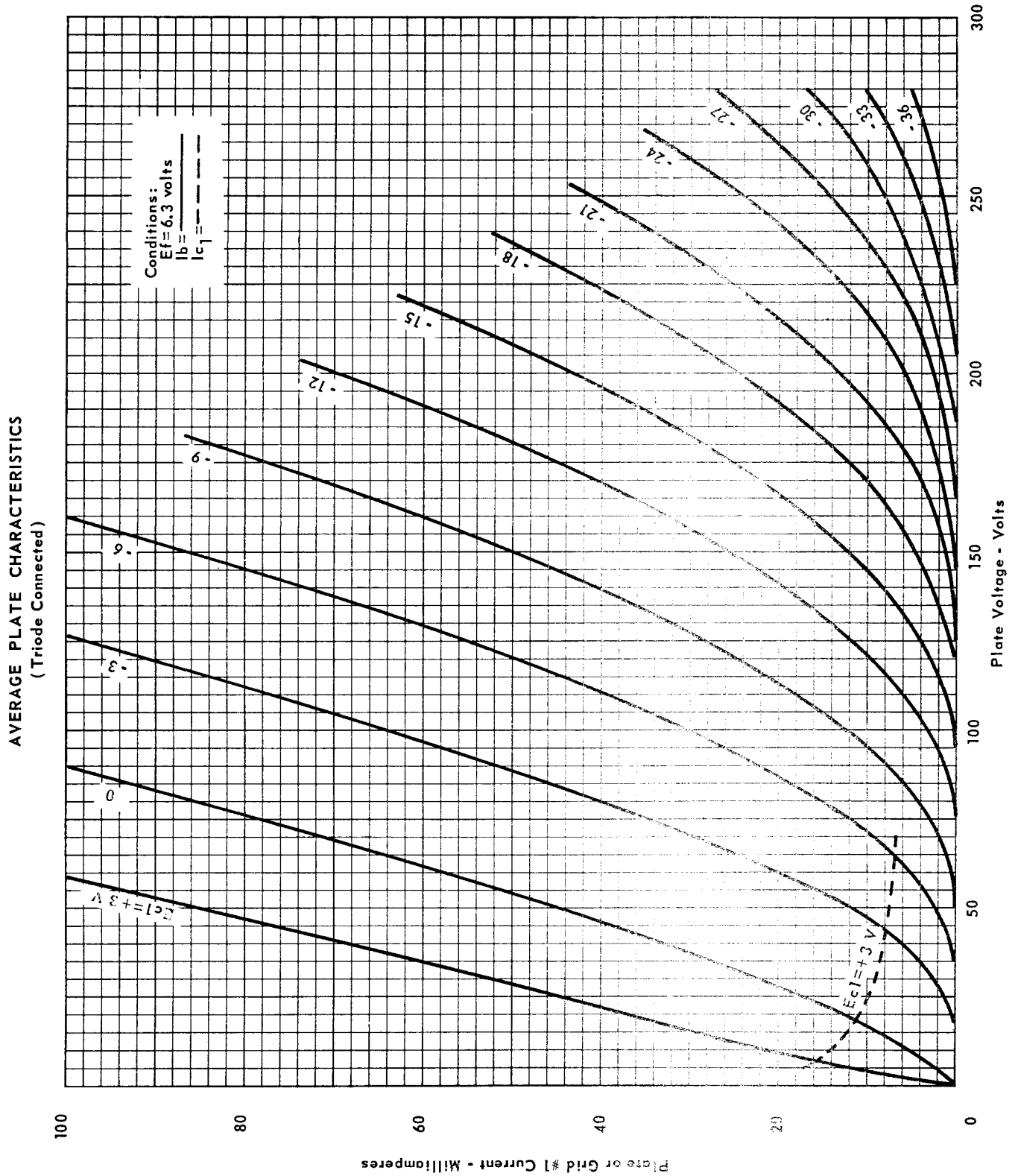
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



RELIABLE PENTODE

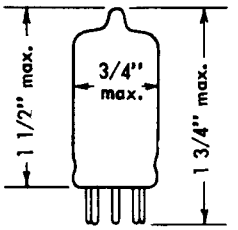


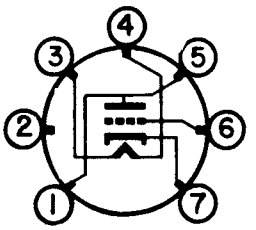
Printed in U.S.A.

Excellence in Electronics

TYPE 6C4W

The 6C4W is a heater-cathode type medium-mu triode of miniature construction, suitable for use as a class C amplifier and oscillator. It is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications.





BOTTOM VIEW

6BG

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Plate	Pin 5 Plate
Pin 2 Internal Connection	Pin 6 Grid
Pin 3 Heater	Pin 7 Cathode
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Note 1)	450 G
Minimum Intermittent Heater Voltage Cycles (Note 2)	2000

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3±10% volts
Heater Current	0.15 amps.
Heater-Cathode Voltage:	
Heater Negative with respect to Cathode	100 volts
Heater Positive with respect to Cathode	100 volts

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.)

	With Shield *	Without Shield
Grid to Plate	1.8	1.8
Input	1.8	1.7
Output	2.0	1.1

RATINGS-ABSOLUTE MAXIMUM VALUES:

	Class A1 Amplifier	Class C Amplifier
Plate Voltage	330	330 volts
Grid Voltage	-55	-55 volts
Plate Current	----	28 ma.
Grid Current	----	9 ma.
Plate Dissipation	3.8	5.5 watts
Minimum External Grid-Bias Voltage	0	---- volts
Grid Circuit Resistance:		
Fixed Bias	0.25	0.25 meg.
Cathode Bias	1.0	1.0 meg.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Plate Voltage	100	250 volts
Grid Voltage	0	-8.5 volts
Plate Resistance	5900	7700 ohms
Transconductance	3300	2200 μmhos
Amplification Factor	19.5	17.0
Plate Current	11.8	10.5 ma.

* *External shield #316 connected to pin.*

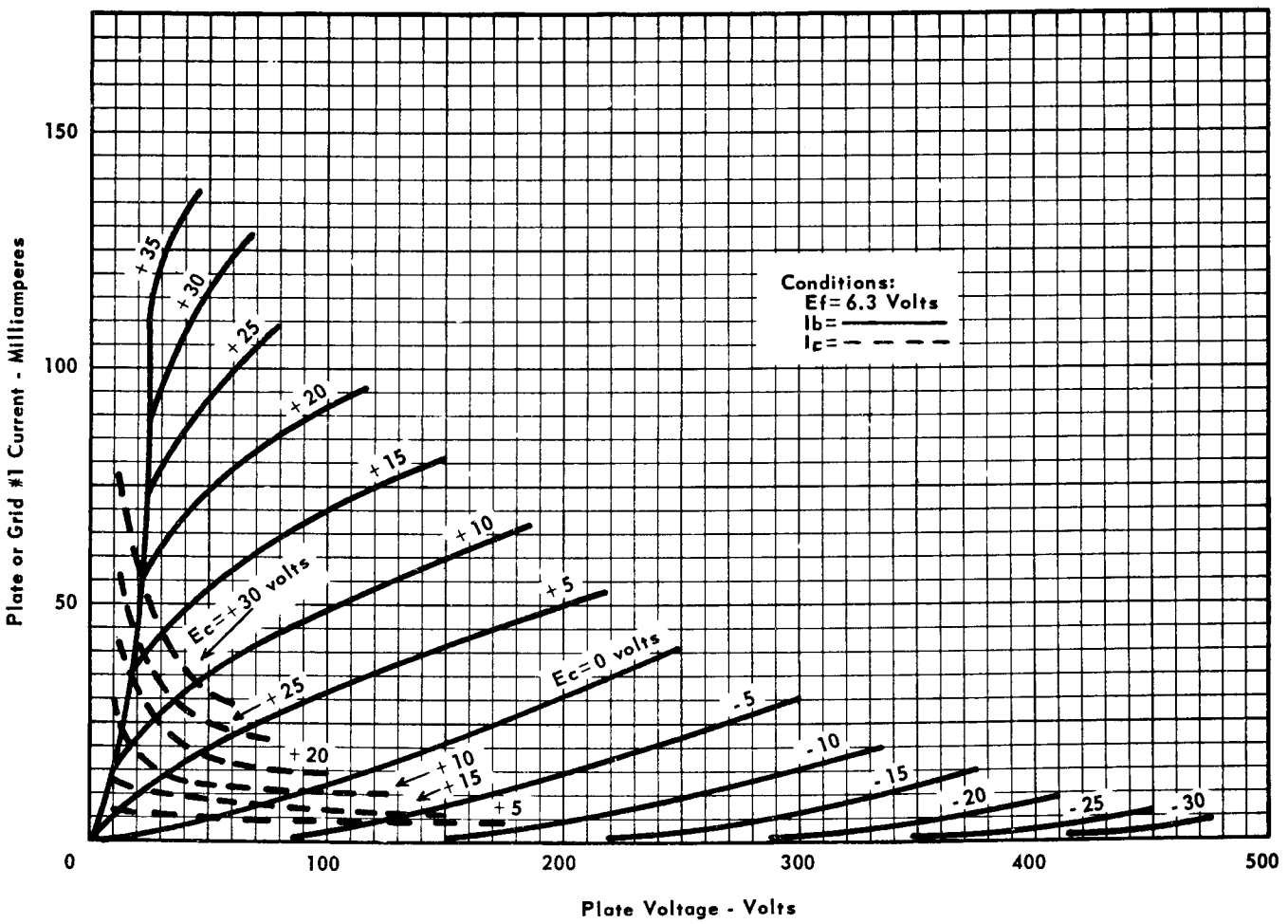
Note 1: Forces in any direction as applied by the Navy type High Impact Machine for Electronic Devices.

Note 2: As checked at Ef=7.5 volts ac, on one minute and off one minute.

RAYTHEON

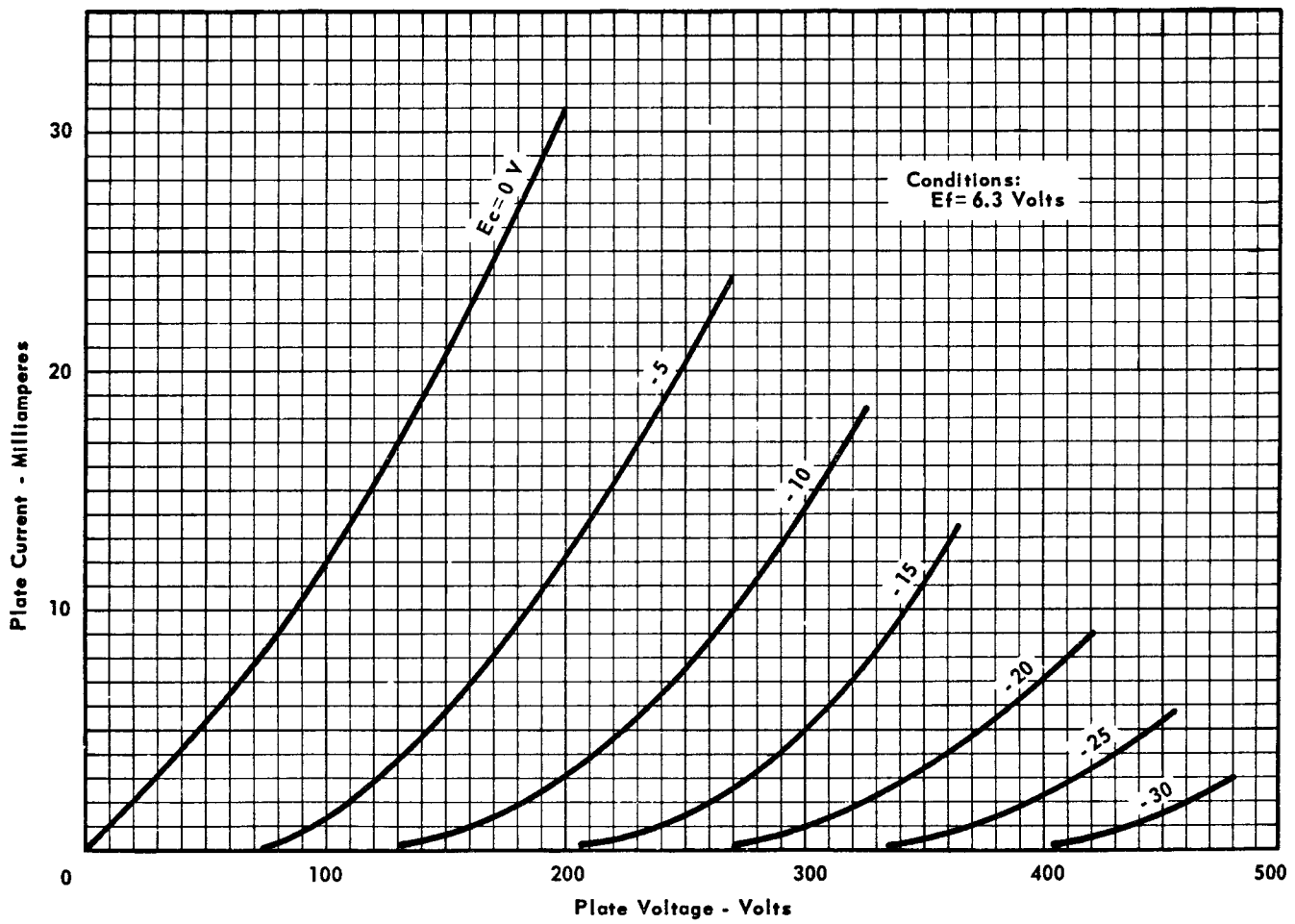
TRIODE

AVERAGE PLATE CHARACTERISTICS



TRIODE

AVERAGE PLATE CHARACTERISTICS



Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

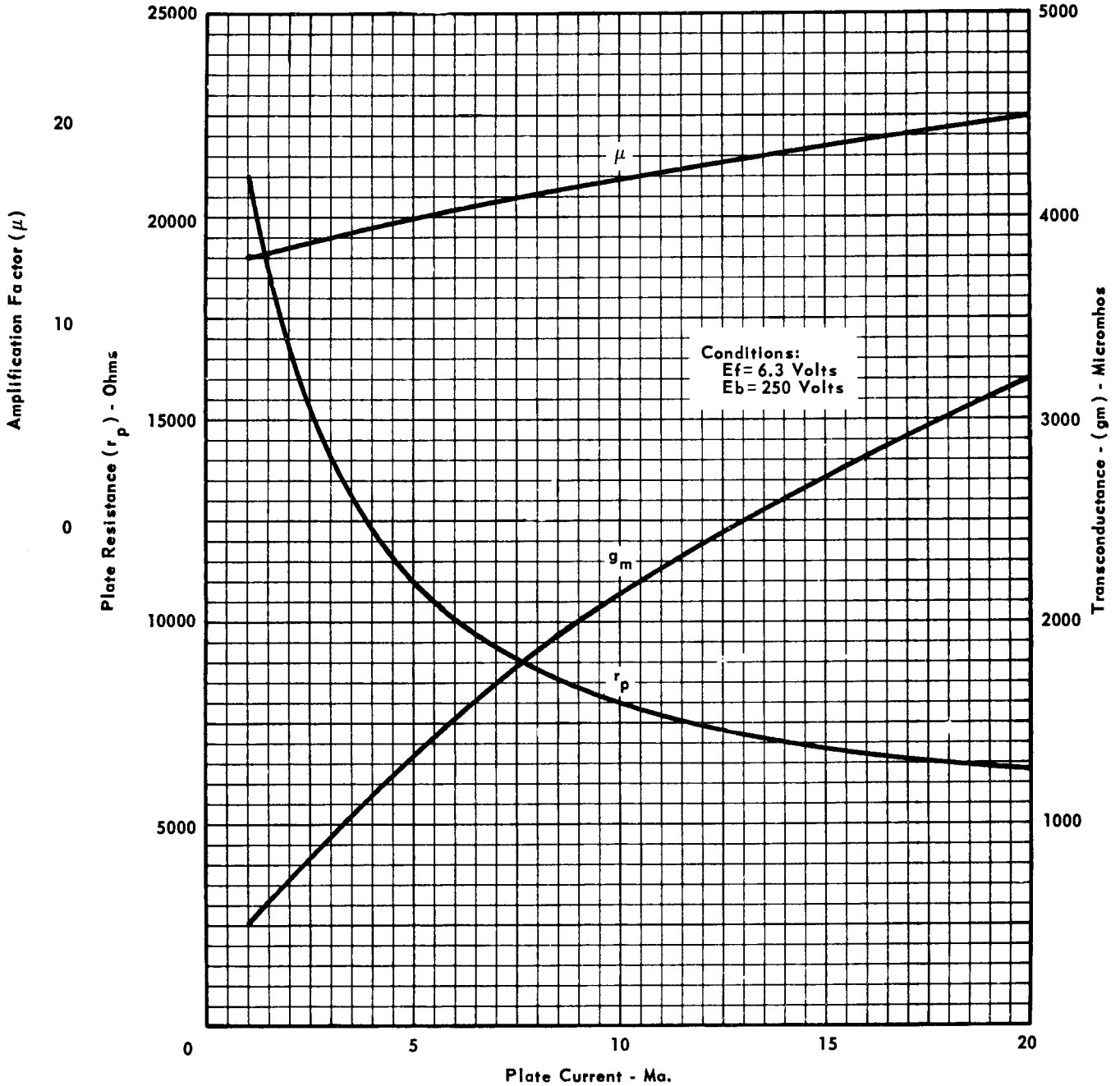
RECEIVING AND CATHODE RAY TUBE OPERATIONS

June 15, 1956 NEWTON 58, MASS.

RAYTHEON

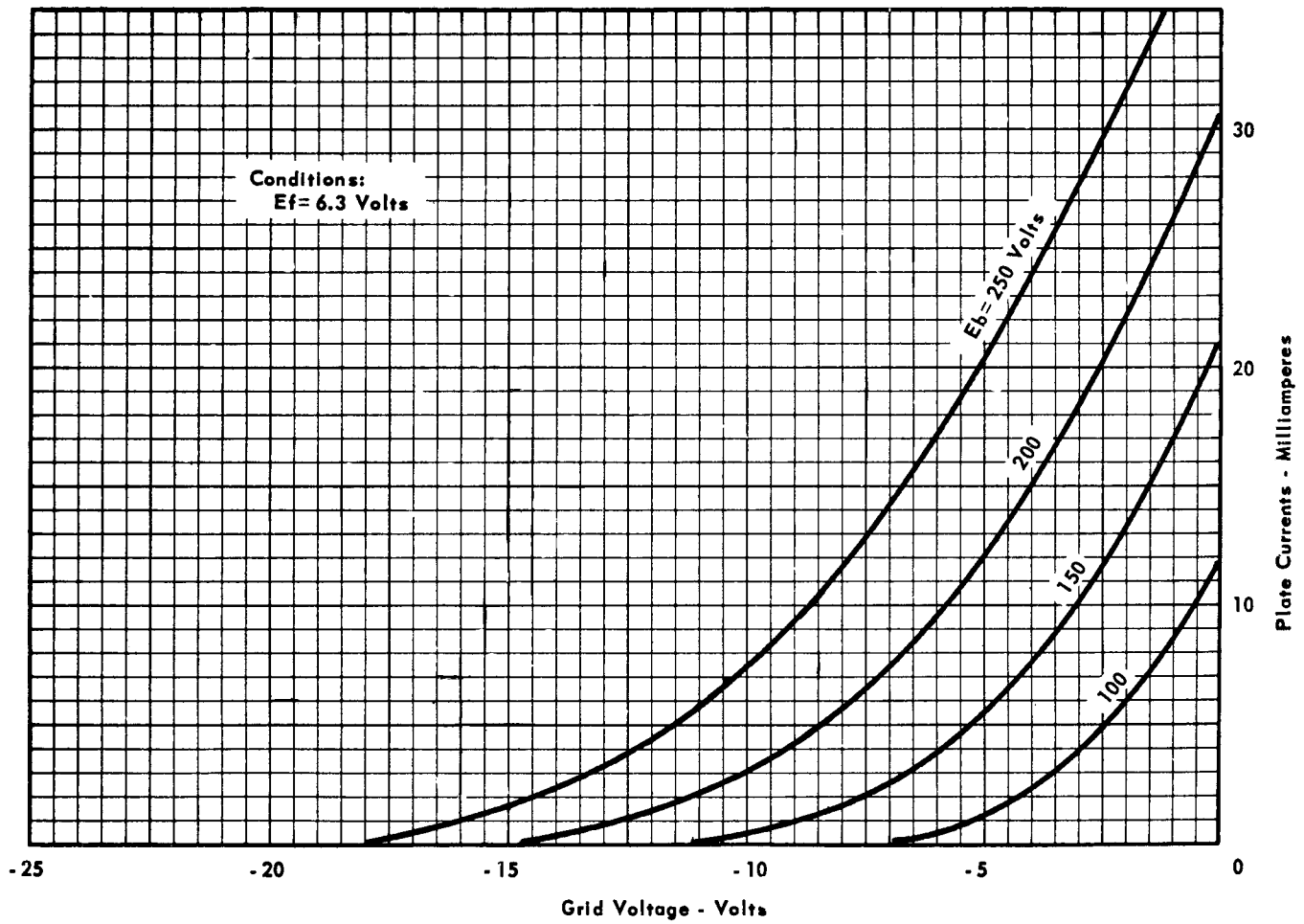
TRIODE

AVERAGE CHARACTERISTICS



TRIODE

AVERAGE CHARACTERISTICS



Reservation No._____ Registration No._____

Reservation Date_____ Registration Date_____

Type 6L21

Pulse Modulator Tetrode

GENERAL CHARACTERISTICS

Electrical

Filament	Thoriated tungsten
Voltage	7.5 volts
Current	20.0 amp.

Direct Interelectrode Capacitances

Grid-plate	(max.)	7.5 uuf
Input-grid-filament	(max.)	35.0 uuf
Output-plate-filament	(max.)	17.0 uuf

Mechanical

Type of Cooling:	Convection (Maximum Ambient 60°C)
Mounting	Vertical
Base Description	Giant 5-pin bayonet
Base Connections	See outline drawing

Maximum Overall Dimensions	(See outline drawing)
Length	12.50 inches
Diameter	5.187 inches

Typical Operation

D.C. plate supply	35.0 Kv
Output voltage	32.0 Kv
D.C. grid bias	-1000 volts
Peak positive grid drive	1500 volts
Equivalent load resistor	1660 ohms
Peak plate current	15.0 amp.
Pulse duration	1 usec (max.)
Repetition rate	1000 CPS
Average Ig2 range	4.0 to 9.0 ma
Average Ig1 range	3.0 to 6.0 ma

Type 6T21

Pulse Modulator Tetrode

Maximum Ratings

Plate voltage	37.5 Kv
Screen voltage	2.5 Kv
Peak plate current (duty cycle .001 or less)	15.0 amp
Peak positive control grid voltage	1750 volts
Negative control grid voltage	-1250 volts

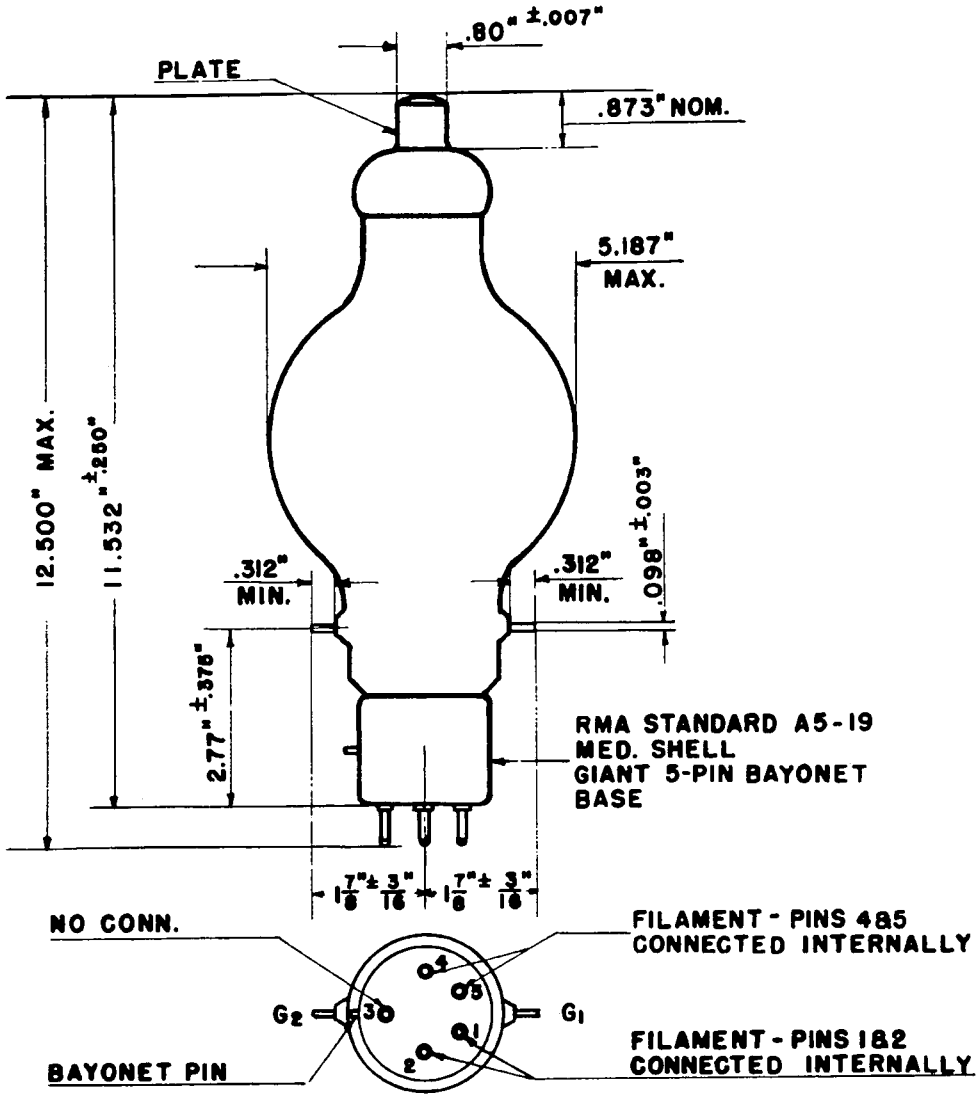
Sponsor: Raytheon Manufacturing Company, Waltham, Mass.

Release No. 478

March 20, 1946

TYPE 6D21

TECHNICAL INFORMATION
PULSE MODULATOR TETRODE
OUTLINE DRAWING



BOTTOM VIEW OF BASE

from JETEC release
#1932, May 27, 1957

VERTICAL DEFLECTION AMPLIFIER

The 6EF6 is a beam power pentode designed primarily for application as a vertical deflection amplifier in wide angle television receivers. Types 9EF6 and 12EF6 are identical to the 6EF6 except that they are designed for series heater operation and therefore, both the 9EF6 and the 12EF6 incorporate heater warm-up control characteristics to minimize surges during the warm-up cycle.

MECHANICAL DATA

Coated unipotential cathode	Bulb T-9
Base: Intermediate-shell octal	JETEC B7-7 or B6-81 or B7-59 or 36-84
Outline drawing	JETEC 9-13 or 9-42
Maximum diameter	1-9/32"
Maximum overall length	3-3/8"
Maximum seated height	2-13/16"
Base pin connections	Basing, JETEC 7S
Pin 1 - No connection	Pin 5 - Grid #1
Pin 2 - Heater	Pin 7 - Heater
Pin 3 - Plate	Pin 8 - Cathode, grid #3
Pin 4 - Grid #2	

ELECTRICAL DATA

Heater Characteristics

	6EF6	9EF6	12EF6	
Heater voltage	6.3	9.4	12.6	volts
Heater current	0.9	0.6	0.45	amps
Warm-up time (approx.)		11	11	secs.

Interelectrode capacitances (no external shield)

Grid #1 to plate	0.8 uuf
Grid #1 to cathode grid #3, grid #2, heater	11.5 uuf
Plate to cathode grid #3, grid #2, heater	9.0 uuf

RATINGS - DESIGN CENTER SYSTEM

Vertical deflection amplifier - pentode connected

Maximum heater - cathode voltage	
Heater positive with respect to cathode	
Total DC and peak	200 volts
DC	100 volts
Heater negative with respect to cathode	
Total DC and peak	200 volts
Maximum plate voltage	250 volts
Maximum grid #2 voltage	250 volts
** Maximum peak positive pulse plate voltage (abs. max.)	2000 volts
Maximum plate dissipation	10 watts
Maximum peak negative pulse grid #1 voltage	250 volts
Maximum grid #2 dissipation	2.0 watts
Maximum average cathode current	60 ma.
Maximum peak cathode current	180 ma.
* Maximum grid #1 circuit resistance (Rk=100 ohm minimum)	2.2 megohms

TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS

	6EF6	9EF6	12EF6
Heater voltage	6.3	9.4	12.6 volts
Heater warm-up time (approx.)	---	11	11 secs.
Plate voltage			250 volts
Grid #2 voltage			250 volts
Grid #1 voltage			-18 volts
Plate current			50 ma.
Grid #2 current			2 ma.
Transconductance			5000 umhos
Grid #1 voltage (approx.) for Ib = 1 milliampere			-40 volts
*** Plate current for Eb=75 V, Ec2=250 V, Ec1=0			170 ma.
*** Screen current - Eb=75 V, Ec2=250 V, Ec1=0			17 ma.

* In the case of grid resistor bias some protection is necessary for the tube in the no drive conditions.

** The duration of the voltage pulse must not exceed 15% of one scanning system which is 2.5 milliseconds in a 525 line, 30 frame system.

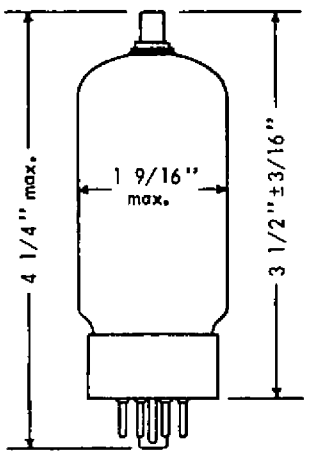
*** Instantaneous values.

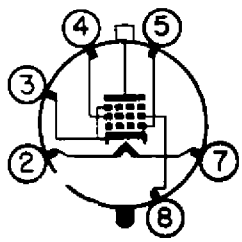
Excellence in Electronics

TYPE 6GC6 12GC6

The 6GC6 is a heater–cathode type Beam Pentode designed for use as a horizontal deflection amplifier in television receivers. The 6GC6 has extremely high perveance, such that the design of wide–angle deflection systems is made possible without the necessity of using an expensive deflection amplifier tube.

Except for heater characteristics, the 12GC6 is identical to the 6GC6. The 12GC6 has the controlled heater warm–up characteristic which makes it especially suited for use in series–string television receivers.





BOTTOM VIEW

8JX

MECHANICAL DATA

ENVELOPE: T–12 Glass

BASE: Short Medium Octal with External Barriers JEDEC #B6–122

TOP CAP: Skirted Miniature–JEDEC C1–3

TERMINAL CONNECTIONS:

Pin 1 No Pin	Pin 5 Grid #1
Pin 2 Heater	Pin 6 No Pin
Pin 3 Cathode; Beam Plates	Pin 7 Heater
Pin 4 Screen–Grid #2	Pin 8 Screen–Grid #2
	Cap Plate

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

	6GC6	12GC6	
Heater Voltage	6.3	12.6	volts
Heater Current	1.2	0.6	amp.
Heater–Cathode Voltage			
Heater Negative with Respect to Cathode			
Total DC and Peak	200	200	volts
Heater Positive with Respect to Cathode			
DC	100	100	volts
Total DC and Peak	200	200	volts
Heater Warm–Up Time *	....	11	sec.

DIRECT INTERELECTRODE CAPACITANCES: (μμfd.)

Grid #1 to Plate: (g1 to p)	0.55	
Input: g1 to (h+k+g2+b.p.)	15	
Output: p to (h+k+g2+b.p.)	7.0	

** DESIGN MAXIMUM RATINGS–HORIZONTAL DEFLECTION AMPLIFIER: ♦

Plate Supply Voltage (boost+DC power supply)	770	volts
Grid #2 Voltage	220	volts
Plate Dissipation ●	17.5	watts
Grid #2 Dissipation	4.5	watts
Average Cathode Current	175	ma.
Peak Cathode Current	550	ma.
Peak Positive Plate Voltage	6500	volts
Peak Negative Plate Voltage	1500	volts
Peak Negative Grid #1 Voltage	330	volts
Grid #1 Circuit Resistance	1.0	meg.
Bulb Temperature (at hottest point)	220	°C

AVERAGE CHARACTERISTICS:

Plate Voltage	250	volts
Grid #2 Voltage	150	volts
Grid #1 Voltage	–22.5	volts
Plate Current	75	ma.
Grid #2 Current	2.4	ma.
Triode Amplification Factor Δ	4.1	

Tentative Data

Printed in U.S.A.

RECEIVING TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

from JEDEC release #2644, Nov. 23, 1959

ELECTRICAL DATA

AVERAGE CHARACTERISTICS : (cont'd.)

Transconductance	6600 μmhos
Plate Resistance	20,000 ohms
Grid #1 Voltage (approx.) for Ib= 1 ma. (approx.)	−46 volts
Zero-Bias: With Eb= 60 volts, and Ec2= 150V (instantaneous values)	
Plate Current	345 ma.
Grid #2 Current	30 ma.
Cutoff: For Ib= 1 ma. with Eb= 5000v. and Ec2= 150v. (Approx. value)	−100 volts

♦ *For operation in a 525 line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting Stations; Federal Communications Commission." The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle.*

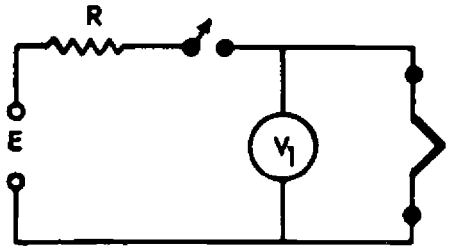
● *In stages operating with grid leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.*

▲ *Eb= Ec2= 150 Volts.*

• • *Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions. The device manufacturer chooses these values to provide acceptable serviceability of the device taking responsibility for the effects of changes in operating conditions due to variations in device characteristics. The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.*

• *Heater warm-up time is defined as the time required in the circuit shown to the right, for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1).*

FOR TYPE :	*12GC6*
E=	*50 volts (RMS or DC)*
V_1=	*10.0 volts (RMS or DC)*
R=	*63 ohms*



Heater of tube Under test

#93

6H5

CHARACTERISTIC DATA SHEET
RAYTHEON RADIO TUBE

CATHODE RAY TUNING INDICATOR
(Uni-Potential Cathode Type)

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.3	Amperes

TUNING INDICATOR
(Operating Conditions and Characteristics)

Plate Supply	100	200	250	volts
Series Triode Plate Resistor	.5	1.0	1.0	megohm
Target	100	200	250	volts
Target Current (approx.)	1.5	3.5	4.5	m.a.
Grid Voltage for Zero Shadow Angle	-8.0	-10.5	-22.0	volts
Grid Voltage for 90° Shadow Angle	0	0	0	volts

The 6H5 is a high-vacuum tube designed to visually indicate the effect of changing the control grid bias. The shaded pattern produced on the fluorescent target varies through an angle from 90° to approximately 0° as the control voltage is varied. The voltage on the shadow control electrode, the extension of the triode plate between the cathode and target, controls the extent of the shaded area. The voltage of the shadow control electrode is determined by the voltage of the control grid of the triode connected as a dc amplifier. Thus the control grid voltage determines the extent of the shadow. An increase of control grid bias increases the shadow control voltage and decreases the shadow while a decrease of bias reduces the shadow. In practical use the control grid voltage is obtained from a suitable point in the AVC network.

The 6H5 is similar to the type 6G5 except that the current to the target is controlled by a grid tied to the cathode within the tube instead of by omission saturation as in the 6G5. The addition of this grid causes a fixed 90° shadow to appear on the target opposite the controlled shadow and care should be used in installing the tube that this shadow is not mistaken for the controlled shadow.

Basing and dimensions of 6H5 are the same as 6G5.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

6HD5
21HD5
28HD5

BEAM PENTODES

The types 6HD5, 21HD5, and 28HD5 are heater–cathode type beam pentodes for use as horizontal deflection amplifiers in television receivers. They have been designed to meet the circuit requirements of low B supply receivers and color applications where high peak plate currents and high perveance are necessary.

Structural features of this type include a single–ended T–12 envelope and an integral all–glass twelve–pin base. The large diameter internal leads to the base of this tube assure firm support for the mount structure. The design permits cool operation of both grids and additional cooling of grids #1 & #2 can be obtained by employing connections to the dual base pins.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

	6HD5	21HD5	28HD5	
Heater Voltage	6.3±10%	21.5 ●●	28.0	volts ●●
Heater Current	2.25 ●	0.6±6% □	0.45±6%	amps. □
Heater Warm–Up Time		11	11	sec.
Maximum Heater Cathode Voltages:				
Heater Negative with Respect to Cathode				
Total DC and Peak		200		volts
Heater Positive with Respect to Cathode				
DC		100		volts
Total DC and Peak		200		volts

DESIGN MAXIMUM RATINGS – HORIZONTAL DEFLECTION AMPLIFIER: **

Plate Supply Voltage (boost + DC power supply)	770	volts
Grid #2 Voltage	220	volts
Plate Dissipation	24	watts
Grid #2 Dissipation	6.0	watts
Grid #2 Dissipation (Warm up Surge) +	12	watts
Average Cathode Current	280	ma
Peak Cathode Current	1000	ma
Peak Positive Plate Voltage	7000	volts
Peak Negative Plate Voltage	1500	volts
Peak Negative Grid #1 Voltage	330	volts
Grid #1 Circuit Resistance	1.0	meg.
Bulb Temperature (at hottest point on bulb surface)	240	°C

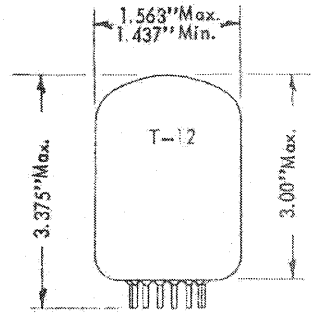
AVERAGE CHARACTERISTICS:

Plate Voltage	60	60	135	volts
Grid #2 Voltage	110	135	135	volts
Grid #1 Voltage	0	0	–22	volts
Plate Current	410 ++	540 ++	65	ma
Grid #2 Current	28 ++	48 ++	4	ma
Triode Amplification Factor			4.2	
Transconductance			10000	μmhos
Plate Resistance			5000	ohms
Grid #1 Voltage (approx.) for Ib=1 ma (Ep=3 KV)			–60	volts

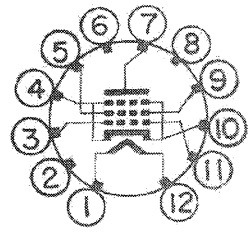
MECHANICAL DATA

ENVELOPE . . . . . T–12 Glass
BASE . . . . 12–Pin Button E12–74
MOUNTING POSITION . . . . . Any

PHYSICAL DIMENSIONS



BASING 12 ES



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1	Heater
Pin 2	No Connection
Pin 3	Grid #1
Pin 4	Cathode & Grid #3
Pin 5	Grid #2
Pin 6	Internal Conn. *
Pin 7	Plate
Pin 8	Internal Conn. *
Pin 9	Grid #2
Pin 10	Cathode & Grid #3
Pin 11	Grid #1
Pin 12	Heater

* Do not use – It is suggested that socket clips for these pins be omitted to improve insulation factor of socket.

Printed in U.S.A.

ELECTRICAL DATA (cont'd.)

** For operation in a 525 line, 30–frame system as described in "Standards of Good Engineering Practice for Television Broadcasting stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle and its duration is limited to 10 micro seconds.

Design–Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable servicability of the tube, taking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design–maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply–voltage variations, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

\+ Surge not to exceed 15 seconds duration.

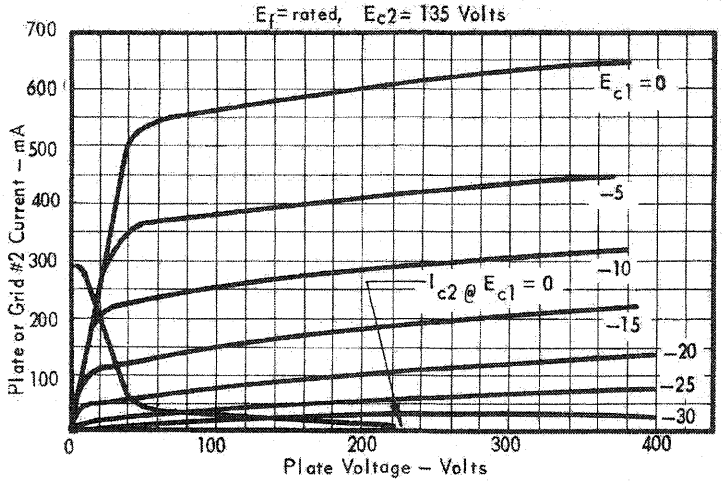
++ Instantaneous values.

● Heater current at bogie heater voltage.

●● Heater voltage at bogie heater current.

□ The equipment designer shall design equipment so that the heater voltage for the 6HD5 and the heater current for the 21HD5 and 28HD5 are centered at the specified bogey value with heater supply variations restricted to maintain heater voltage (or current) within the specified tolerance.

AVERAGE PLATE CHARACTERISTICS
E_f = rated, E_{c2} = 135 Volts



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

6HJ5
21HJ5
30HJ5

BEAM PENTODES

The types 6HJ5, 21HJ5, and 30HJ5 are heater–cathode type beam pentodes for use as horizontal deflection amplifiers in television receivers. They have been designed to meet the circuit requirements of low B supply receivers and color applications where high peak plate currents and high perveance are necessary characteristics. A separate connection to grid no. 3 provides for applying positive voltage to minimize "snivets" which may occur with "below knee" operation.

Structural features of this type include a single–ended T–12 envelope and a compactron base. The large diameter internal leads to the base of this tube assure firm support for the mount structure. The design permits cool operation of both grids and additional cooling of grids #1 & #2 can be obtained by employing connections to the dual base pins. Types 21HJ5 and 30HJ5 are identical to type 6HJ5 except for heater characteristics.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

	6HJ5	21HJ5	30HJ5	
Heater voltage	6.3 ± 10%	21.5●●	30.0	volts ●●
Heater current	2.25●	0.6 ± 6%□	0.45 ± 6%	amps. □
Heater warm–up time		11	11	sec.

Maximum heater cathode voltages:

Heater negative with respect to cathode		
Total DC and peak	200	volts
Heater positive with respect to cathode		
DC component	100	volts
Total DC and peak	200	volts

DESIGN MAXIMUM RATINGS(See EIA standard RS–239)–HORIZONTAL DEFLECTION AMPLIFIER:**

Plate voltage (boost + DC power supply)	770	volts
Grid #2 voltage	220	volts
Plate dissipation	24	watts
Grid #2 dissipation	6.0	watts
Grid #2 dissipation (warm up surge) +	12	watts
Average cathode current	280	ma
Peak cathode current	1000	ma
Peak positive plate voltage	7000	volts
Peak negative plate voltage	1500	volts
Peak negative gird #1 voltage	330	volts
Grid #1 circuit resistance	1.0	meg.
Bulb temperature (at hottest point on bulb surface)	240	°C
DC grid #3 voltage Δ	70	volts

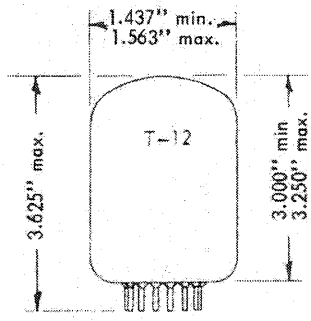
AVERAGE CHARACTERISTICS:

Plate voltage	20	40	60	135 volts
Grid #2 voltage	110	110	135	135 volts
Grid #1 voltage	0	0	0	–22 volts
Grid #3 voltage				0 volts
Plate current	240++	400++	540++	80 ma
Grid #2 current	160++	42++	48++	5.5 ma
Triode amplification factor				4.2

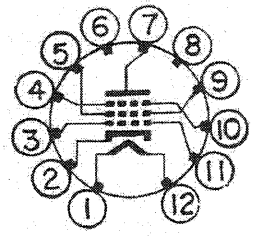
MECHANICAL DATA

ENVELOPE . . . . . T12 glass
BASE . . . 12–pin button, E12–74
MOUNTING POSITION . . . . any
CATHODE . . . . coated unipotential

PHYSICAL DIMENSIONS



BASING 12 ES



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 Heater
Pin 2 Cathode
Pin 3 Grid #1
Pin 4 Grid #3
Pin 5 Grid #2
Pin 6 No connection*
Pin 7 Plate
Pin 8 No connection*
Pin 9 Grid #2
Pin 10 Grid #3
Pin 11 Grid #1
Pin 12 Heater

*Do not use – It is suggested that socket clips for these pins be omitted to improve insulation factor of socket.

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ELECTRICAL DATA (cont'd.)

AVERAGE CHARACTERISTICS: (cont'd.)

Transconductance	10,000 μmhos
Plate resistance	5000 ohms
Grid #1 voltage (approx.) for Ib = 1 ma (Ep = 4.5 KV)	−70 volts

** For operation in a 525 line, 30-frame system as described in "Standards of Good Engineering Practice for Television Broadcasting stations; Federal Communications Commission". The duty cycle of the voltage pulse not to exceed 15% of a scanning cycle and its duration is limited to 10 micro seconds.

+ Surge not to exceed 15 seconds duration.

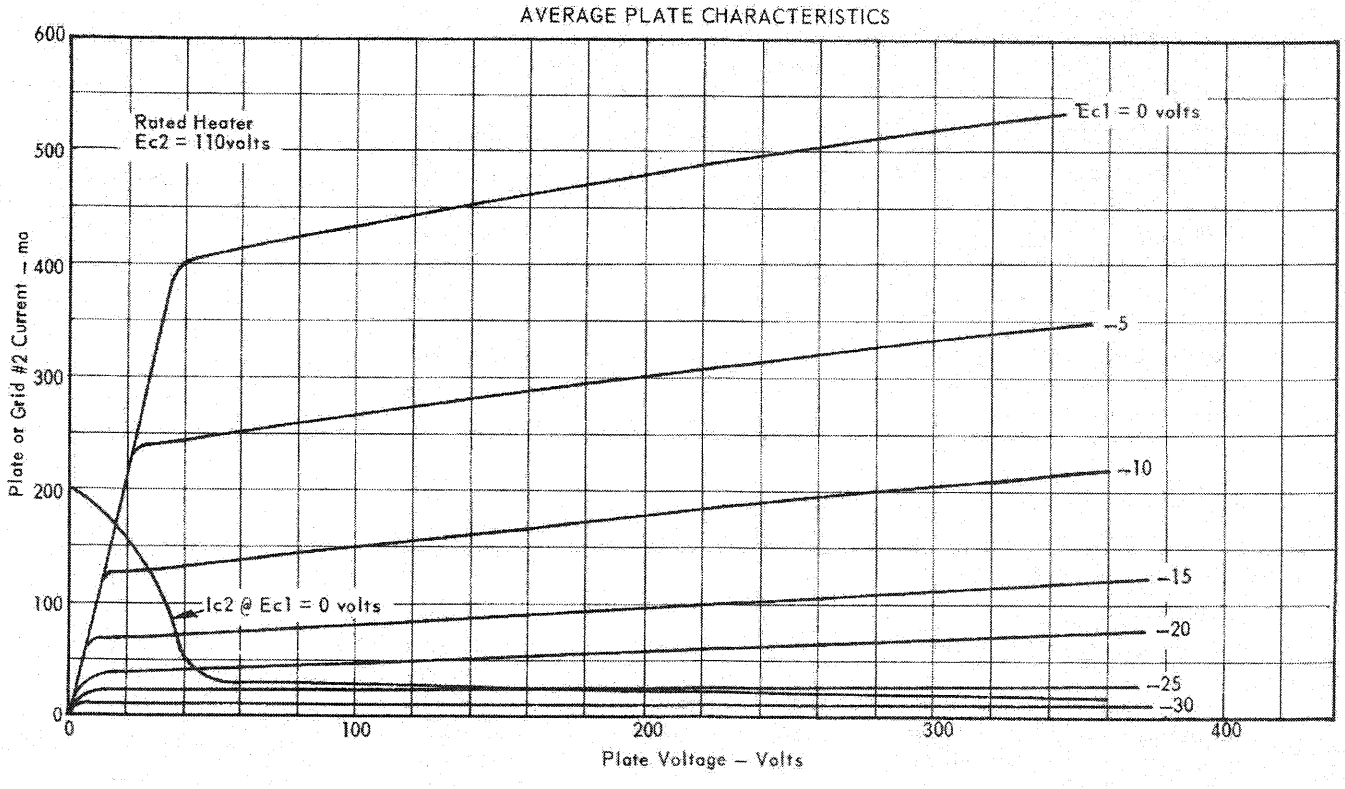
++ Instantaneous values.

● Heater current at bogie heater voltage.

●● Heater voltage at bogie heater current.

□ The equipment designer shall design equipment so that the heater voltage for the 6HJ5 and the heater current for the 21HJ5 and 30HJ5 are centered at the specified bogey value with heater supply variations restricted to maintain heater voltage (or current) within the specified tolerance.

AVERAGE PLATE CHARACTERISTICS

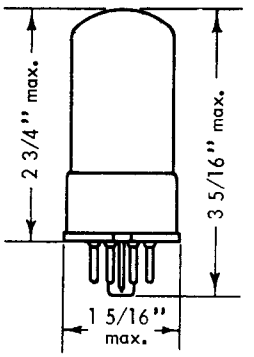


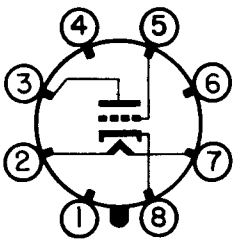
TYPE 6J5WGT 12J5WGT

Excellence in Electronics

The 6J5WGT is a heater-cathode type, medium-mu triode. Its principal application is as a detector, amplifier or oscillator tube and is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications.

The 12J5WGT is identical to the 6J5WGT except for heater characteristics and is especially useful in AC/DC equipment applications.





BOTTOM VIEW

6Q

MECHANICAL DATA

ENVELOPE: T-9 Glass

BASE: Small Wafer Octal 6-Pin, with Sleeve

TERMINAL CONNECTIONS:

Pin 1 Base Sleeve	Pin 7 Heater
Pin 2 Heater	Pin 8 Cathode
Pin 3 Plate	
Pin 5 Grid	

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

	6J5WGT	12J5WGT	
Heater Voltage (ac or dc)	6.3± 10%	12.6± 10%	volts
Heater Current	0.3	0.15	amps.
Maximum Heater-Cathode Voltage:			
Heater Positive with Respect to Cathode			
DC Component	100	100	volts
Total DC and Peak	200	200	volts
Heater Negative with Respect to Cathode			
Total DC and Peak	200	200	volts

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu fds$) ▲

Grid to Plate	3.1	
Grid to Cathode	3.2	
Plate to Cathode	3.2	

RATINGS - ABSOLUTE MAXIMUM VALUES:

Plate Voltage	330	volts
Grid Voltage	Never Positive	
Plate Dissipation	2.75	watts
Total Cathode Current	20	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Plate Voltage	90	250	volts
Grid Voltage ♦	0	-8	volts
Amplification Factor	20	20	
Plate Resistance	6700	7700	ohms
Transconductance	3000	2600	μmhos
Plate Current	10	9	ma.

▲ *With JETEC Shield #308 connected to Pin 8.*

♦ *Under maximum rated conditions, the dc resistance of the grid circuits should not exceed 1.0 megohm.*

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

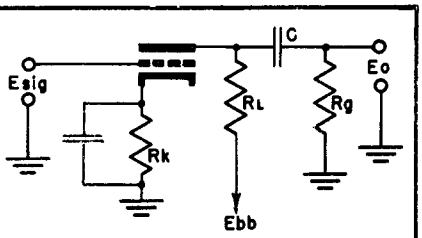
June 15, 1955 NEWTON 58, MASS.

TRIODE

RESISTANCE - COUPLED AMPLIFIER CHART

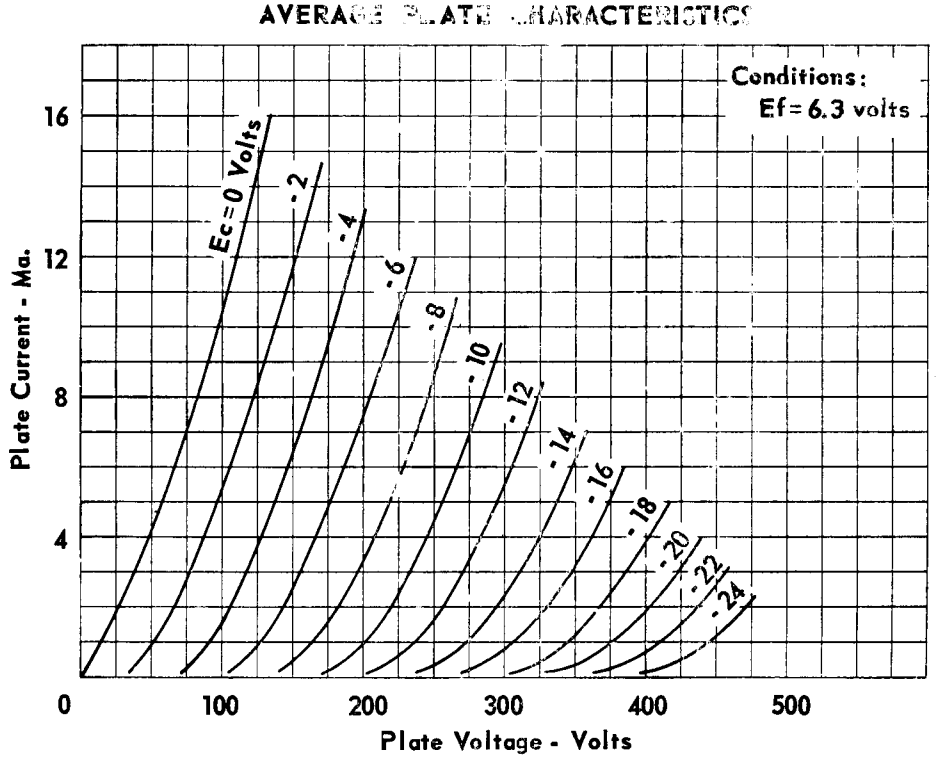
		Ebb = 90 volts			Ebb = 180 volts			Ebb = 300 volts		
R_L	Rg	Rk	Eo	Gain ●	Rk	Eo	Gain ●	Rk	Eo	Gain ●
0.05	0.05	1650	11	11	1190	24	13	1020	41	13
	0.1	2070	14	12	1490	30	13	1270	51	14
0.1	0.1	3470	12	13	2330	26	14	1900	43	14
	0.25	3940	17	13	2830	34	14	2440	56	14
0.25	0.25	7860	14	13	5560	28	14	4590	46	14
	0.5	9760	18	13	7000	36	14	5770	57	14

Eo = Voltage across Rg at grid-current point.
● = At 5 volts (RMS) output.



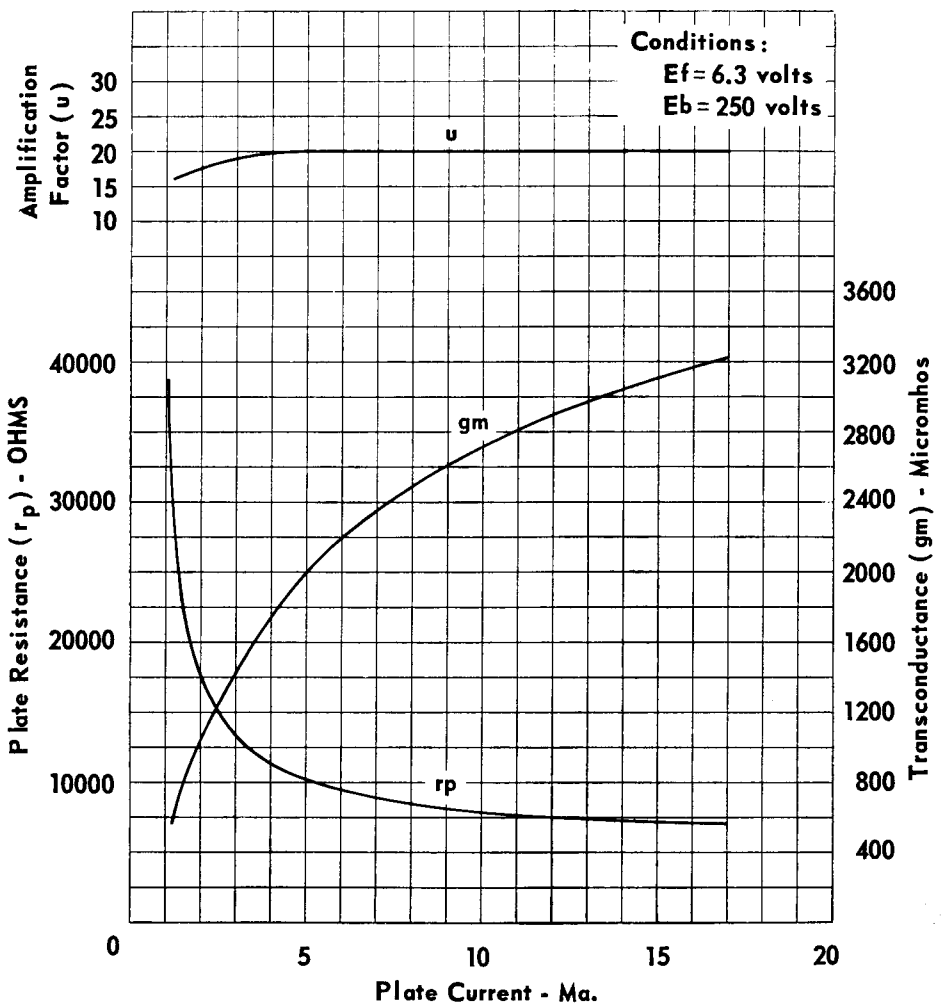
Value of C selected for desired frequency response. Rk should be adequately by-passed.

AVERAGE PLATE CHARACTERISTICS



TRIODE

AVERAGE CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

6JL8
8JL8

TRIODE–PENTODE

The 6JL8 is a heater–cathode type miniature tube containing a sharp cut–off pentode and a medium mu triode. The triode is suitable for use as a voltage amplifier or phase inverter and the pentode as a power amplifier.

The 8JL8 is identical to the 6JL8 except for heater characteristics. Also it has the controlled heater warm–up characteristic desirable for use in series–string operation.

ELECTRICAL DATA

HEATER CHARACTERISTICS:	6JL8	8JL8
Heater Voltage (ac or dc)	6.3	8.0 ± 10%□ volts
Heater Current	0.750●	0.600 amp
Maximum Heater–Cathode Voltage:		
Heater Positive with Respect to Cathode		
DC Component		100 volts
Total DC and Peak		200 volts
Heater Negative with Respect to Cathode		
Total DC and Peak	200	200 volts
Heater Warm-up Time *	---	11.0 sec.

DIRECT INTERELECTRODE CAPACITANCES: pf	Without shield
Pentode Section	
Grid #1 to plate: (g1 to p) (max.)	0.1 pf
Input: g1 to (h+k+g2+g3+int. shield)	11.0 pf
Output: p to (h+k+g2+g3+int. shield)	4.2 pf
Triode Section	
Grid to plate: (g to p)	4.4 pf
Input: g to (h + k)	2.4 pf
Output: p to (h + k)	0.36 pf
Coupling (max.)	
Triode grid to pentode plate	0.018 pf
Pentode g#1 to triode plate	0.005 pf
Pentode plate to triode plate	0.17 pf

DESIGN MAXIMUM RATINGS: (See EIA standard RS–239)

	Triode	Pentode
Plate voltage	330	330 volts
Grid #2 voltage	---	175 volts
Positive DC grid #1 voltage	0	0 volts
Plate dissipation	2.0	5.0 watts
Grid #2 dissipation	---	1.1 watts
Grid #1 resistance (max.)	---	---
Fixed bias	0.5	0.25 meg
Cathode bias	1.0	1.0 meg

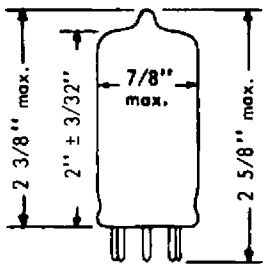
CHARACTERISTICS AND TYPICAL OPERATION:

	Triode	Pentode
Plate voltage	150	300 volts
Grid #2 voltage	---	150 volts

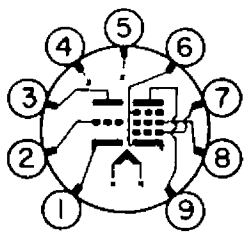
MECHANICAL DATA

ENVELOPE . . . . . T–6½ glass
BASE . . . . miniature button 9–pin
CATHODE . . . coated unipotential
MOUNTING POSITION . . . . any

PHYSICAL DIMENSIONS



BASING 9DX



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 cathode, triode
Pin 2 grid, triode
Pin 3 plate, triode
Pin 4 heater
Pin 5 heater
Pin 6 cathode grid #3 and shield, pentode
Pin 7 grid 1, pentode
Pin 8 grid 2, pentode
Pin 9 plate, pentode

Printed in U.S.A.

from JEDEC release #4370, Aug. 5, 1963

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (Cont'd.)

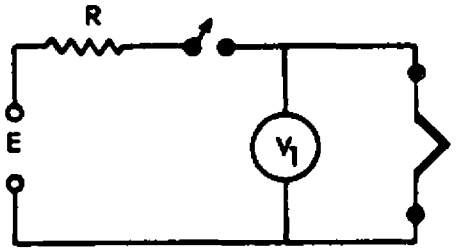
	Triode	Pentode	
Grid #1 voltage	---	−3.5	volts
Cathode resistor	150	---	
Amplification factor	35	---	
Transconductance	4700	11500	μmhos
Plate resistance (approx.)	7500	60000	ohms
Plate current	10	---	
Screen current	---	---	
Peak AF grid #1 voltage	---	3	volts
Zero-signal plate current	---	25	ma
Zero-signal grid #2 current	---	5	ma
Max.-signal plate current	---	30	ma
Max.-signal grid #2 current	---	7.5	ma
Load resistance	---	5000	ohms
Total harmonic distortions (approx.)	---	10	per cent
Max.-signal power output	---	1.8	watts

□ The equipment designer shall design equipment so that the heater voltage is centered at the specified bogey value heater supply variations restricted to maintain heater voltage within the specified tolerance.

● Heater current at bogey heater voltage.

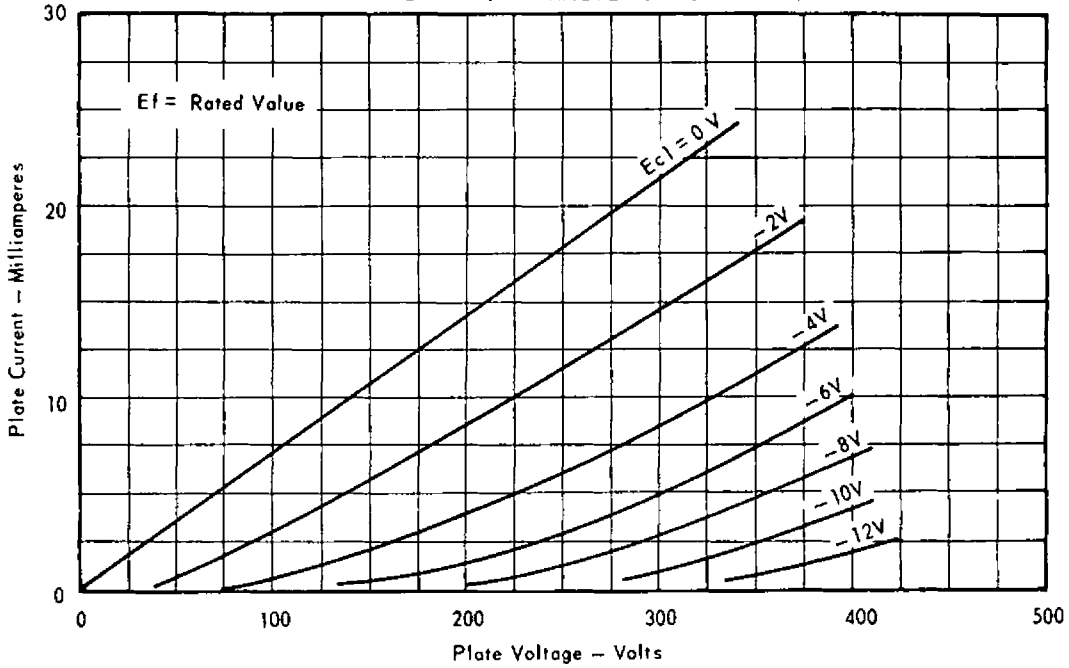
* *Heater warm-up time is defined as the time required, in the circuit shown at the right, for the voltage across the heater terminals to increase from zero to the heater test voltage (V_1).*

FOR TYPE	*8JL8*	
E =	*32*	*volts (RMS or DC)*
V_1 =	*6.4*	*volts (RMS or DC)*
R =	*40*	*ohms*

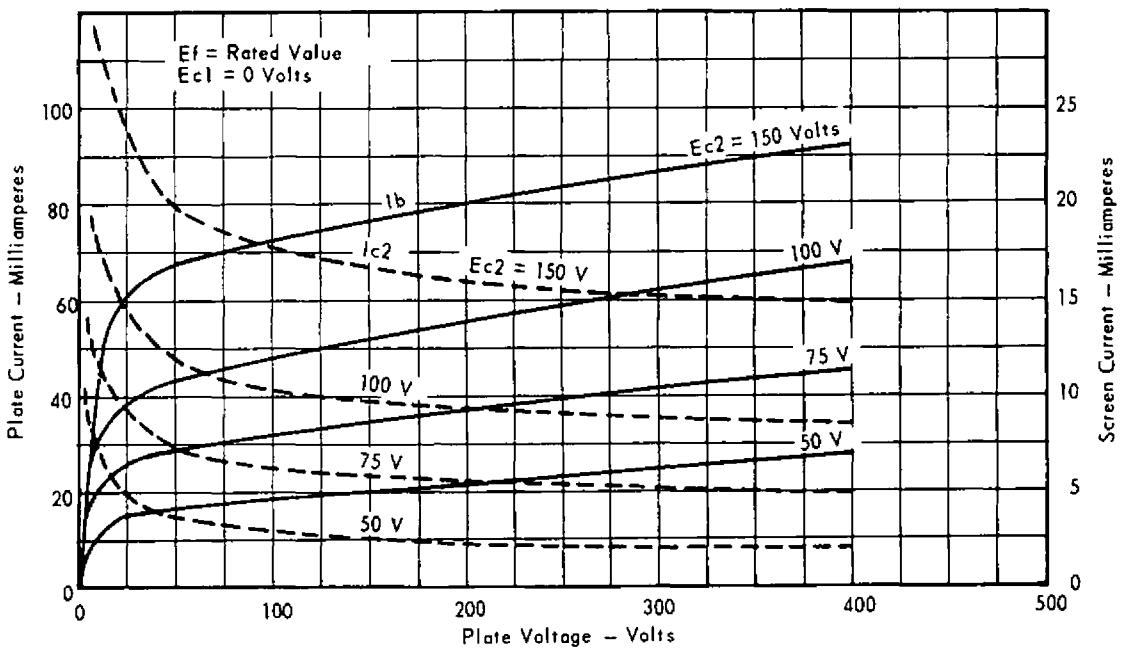


Heater of Tube under Test

AVERAGE PLATE CHARACTERISTICS – TRIODE



AVERAGE PLATE CHARACTERISTICS – PENTODE



from RMA registration #142,
June 15, 1938

TENTATIVE DATA SHEET
RAYTHEON TYPE 6K8G
TRIODE-HEXODE
FREQUENCY CONVERTER

Dual 6/15

Heater Type Glass Bulb

The 6K8G is a duplex tube containing a triode unit and a hexode unit with a common cathode, in the same envelope. The grid of the triode unit is common with the injector grid of the hexode unit. It is designed for converter service in superheterodyne receivers and will oscillate readily with good frequency stability in the high frequency bands.

BULB: ST-12 BASE: Small Shell Octal 8-pin CAP: Skirted Miniature
DIMENSIONS: Maximum Overall Length 4 15/32" Maximum Diameter 1 9/16"

BASING (RMA Numbering)

Pin 1-No Connection
Pin 2-Heater
Pin 3-Hexode Plate
Pin 4-Hexode Screen(Grid#2 & 4)
Pin 5-Hexode Grid #1 & Triode Grid
Pin 6-Triode Plate
Pin 7-Heater
Pin 8-Cathode & Internal Shields
Cap - Hexode Grid #3

RATINGS

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	0.3	amp
Maximum Hexode Plate Voltage	250	volts
Maximum Hexode Screen Voltage	100	volts
Minimum Hexode Control Grid Bias	-3	volts
Maximum Triode Plate Voltage	200	volts
Maximum Total Cathode Current	16	ma

DIRECT INTERELECTRODE CAPACITANCES (Approx.)*

G_{3H} to P_H = Mixer Grid to Plate	0.04	µµf
G_{3H} to P_T = Mixer Grid to Oscillator Plate	0.01	µµf
G_{3H} to $G_{T\&G1H}$ = Mixer Grid to Oscillator Grid	0.1	µµf
$G_{T\&G1H}$ to P_T = Oscillator Grid to Plate	2.0	µµf
G_{3H} to All Other Electrodes = R-F Input Electrode	5.5	µµf
P_T to All Other Electrodes except $G_{T\&G1H}$=Osc.Output Elec.	4.0	µµf
$G_{T\&G1H}$ to All Other Electrodes except P_T=Osc. Input Elec.	7.0	µµf
P_H to All Other Electrodes = Mixer Output Electrode	5.5	µµf

FREQUENCY CONVERTER

Hexode Plate Voltage	100	250	volts
Hexode Screen Voltage	100	100	volts
Hexode Control Grid Bias	-3	-3	volts
Triode Plate Voltage	100	100	volts
Triode Grid Resistor	50000	50000	ohms
Hexode Plate Resistance (approx.)	0.4	0.6	megohm
Conversion Transconductance	325	350	µmhos
Hexode Control Grid Bias (approx.) (For Conversion Transconductance 2 µmhos)	-30	-30	volts
Hexode Plate Current	2.3	2.5	ma
Hexode Screen Current	6.2	6.0	ma
Triode Plate Current	3.8	3.8	ma
Triode Grid & Hexode Grid #1 Current	0.15	0.15	ma

The transconductance of the oscillator section (not oscillating) is approximately 3000 umhos when the triode plate voltage is 100 volts and the triode grid voltage is 0 volts.

* With tube shield connected to cathode.

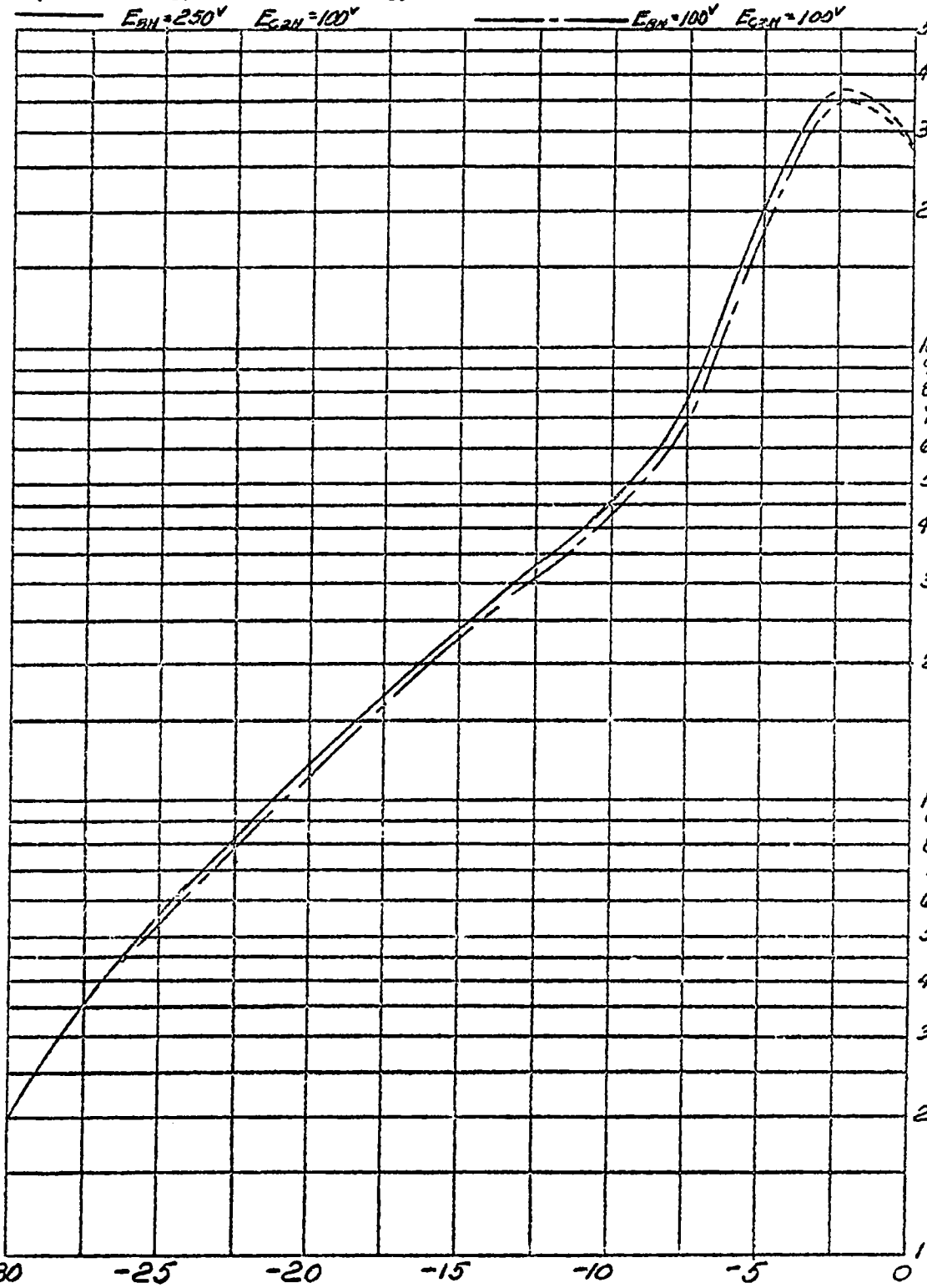
6K8G

CONVERSION TRANSCONDUCTANCE VS. CONTROL GRID BIAS

6K8 - 6K8G

$E_f = 6.3^V$ $I_{CT} = 0.15$ MA. $R_{GT} = 50000^{\Omega}$

——— $E_{BH} = 250^V$ $E_{C2H} = 100^V$ — - — - — $E_{BH} = 100^V$ $E_{C2H} = 100^V$

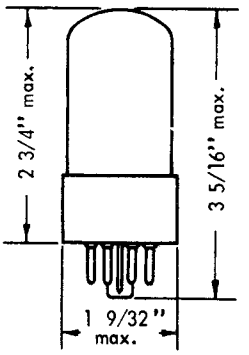


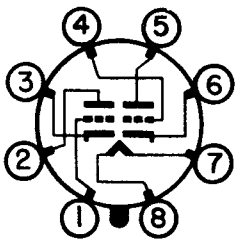
TYPE 6SN7WGT 12SN7WGT

Excellence in Electronics

The 6SN7WGT is a heater-cathode type medium-mu double triode designed for use as a voltage amplifier or phase inverter, in applications when severe conditions of shock and vibration are encountered.

The 12SN7WGT is identical to the 6SN7WGT except for heater characteristics and is especially useful in AC/DC applications.





BOTTOM VIEW

8BD

MECHANICAL DATA

ENVELOPE: T-9 Glass

BASE: Intermediate or Short Intermediate Shell Octal 8-Pin

TERMINAL CONNECTIONS:

Pin 1 Grid, Unit 2	Pin 5 Plate, Unit 1
Pin 2 Plate, Unit 2	Pin 6 Cathode, Unit 1
Pin 3 Cathode, Unit 2	Pin 7 Heater
Pin 4 Grid, Unit 1	Pin 8 Heater

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

	6SN7WGT	12SN7WGT	
Heater Voltage (ac or dc)	6.3	12.6	volts
Heater Current	0.6	0.3	amps.
Maximum Heater-Cathode Voltage:			
Heater Positive with Respect to Cathode			
DC Component	100	100	volts
Total DC and Peak	200	200	volts
Heater Negative with Respect to Cathode			
Total DC and Peak	200	200	volts

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.)

	Unit 1	Unit 2
Grid to Plate: (g to p)	3.7	3.7
Input: g to (h+k)	2.2	2.5
Output: p to (h+k)	0.7	0.8

DESIGN CENTER MAXIMUM RATINGS:

Plate Voltage	300	volts
Plate Dissipation ♦		
Each Plate	3.5	watts
Both Plates	5.0	watts
DC Cathode Current	20	ma.
Grid Circuit Resistance		
Fixed Bias	1.0	meg.
Cathode Bias	1.0	meg.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Plate Voltage	90	250	volts
Grid Voltage	0	-8.0	volts
Amplification Factor	20	20	
Transconductance	3000	2600	μmhos
Plate Resistance (approx.)	6700	7700	ohms
Plate Current	10	9	ma.
Plate Current at Ec=-12.5	----	1.3	ma.
Grid Voltage (approx.) for Ib=10 μa.	-7.0	-18	volts

♦ *In stages operating with grid-leak bias, an adequate cathode bias resistor or other suitable means is required to protect the tube in the absence of excitation.*

Tentative Data

Printed in U.S.A.

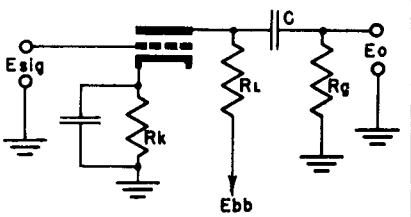
RAYTHEON

DOUBLE - TRIODE

RESISTANCE - COUPLED AMPLIFIER CHART

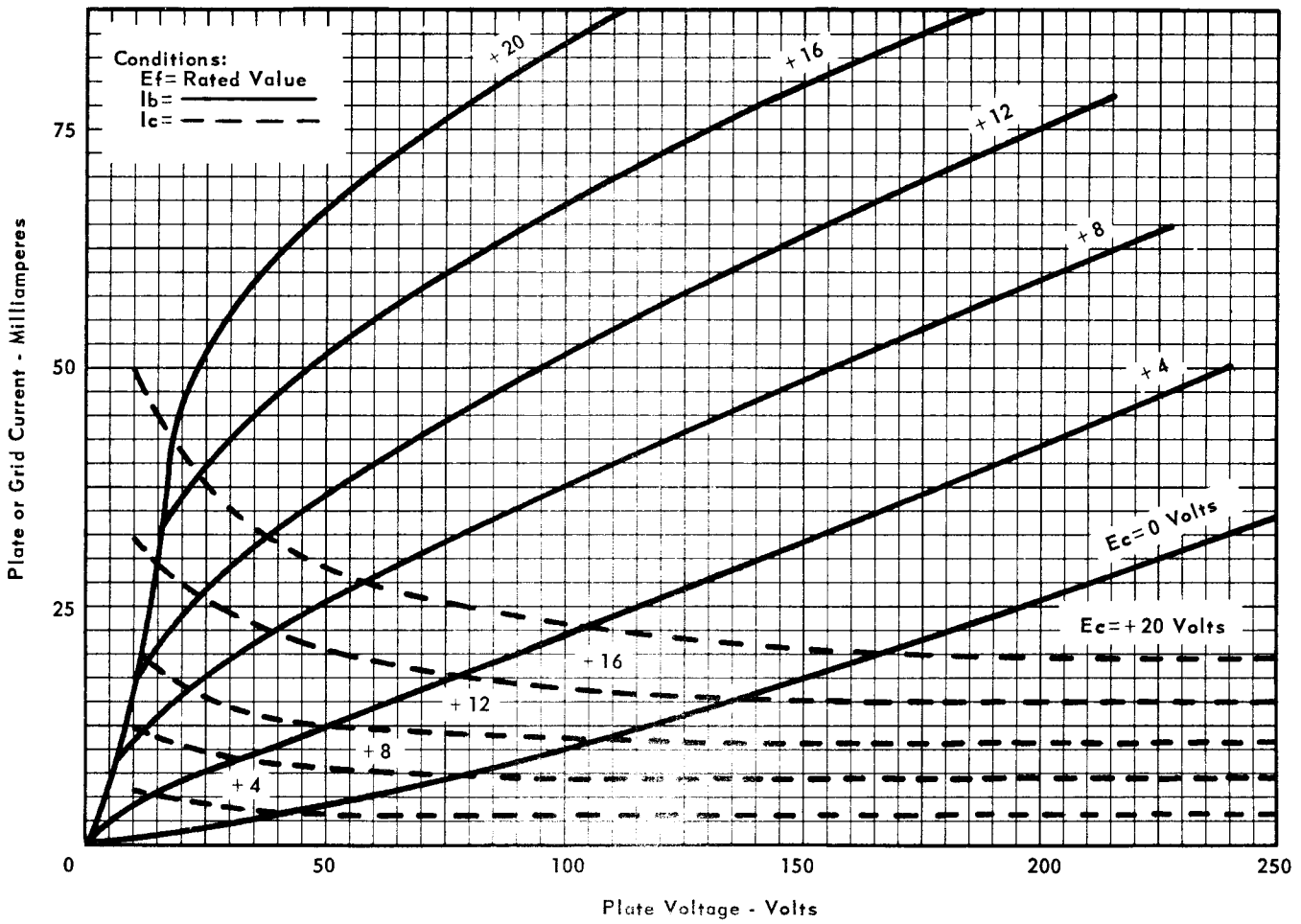
		Ebb = 90 volts			Ebb = 180 volts			Ebb = 300 volts		
R_L	Rg	Rk	Eo	Gain ●	Rk	Eo	Gain ●	Rk	Eo	Gain ●
0.05	0.05	1650	11	11	1190	24	13	1020	41	13
	0.1	2070	14	12	1490	30	13	1270	51	14
0.1	0.1	3470	12	13	2330	26	14	1900	43	14
	0.25	3940	17	13	2830	34	14	2440	56	14
0.25	0.25	7860	14	13	5560	28	14	4590	46	14
	0.5	9760	18	13	7000	36	14	5770	57	14

Eo = Voltage across Rg at grid-current point.
● = At 5 volts (RMS) output.

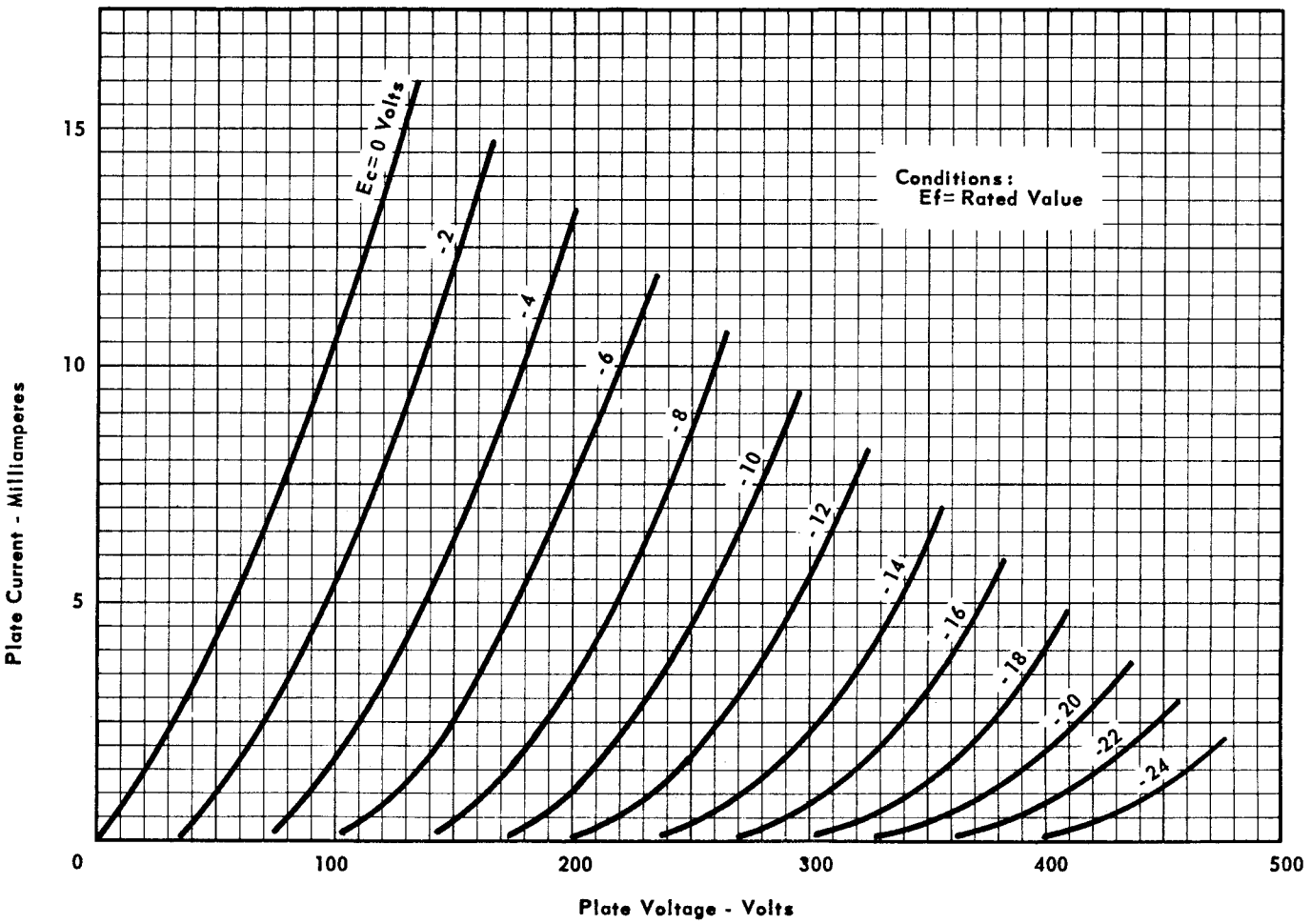


Value of C selected for desired frequency response. Rk should be adequately by-passed.

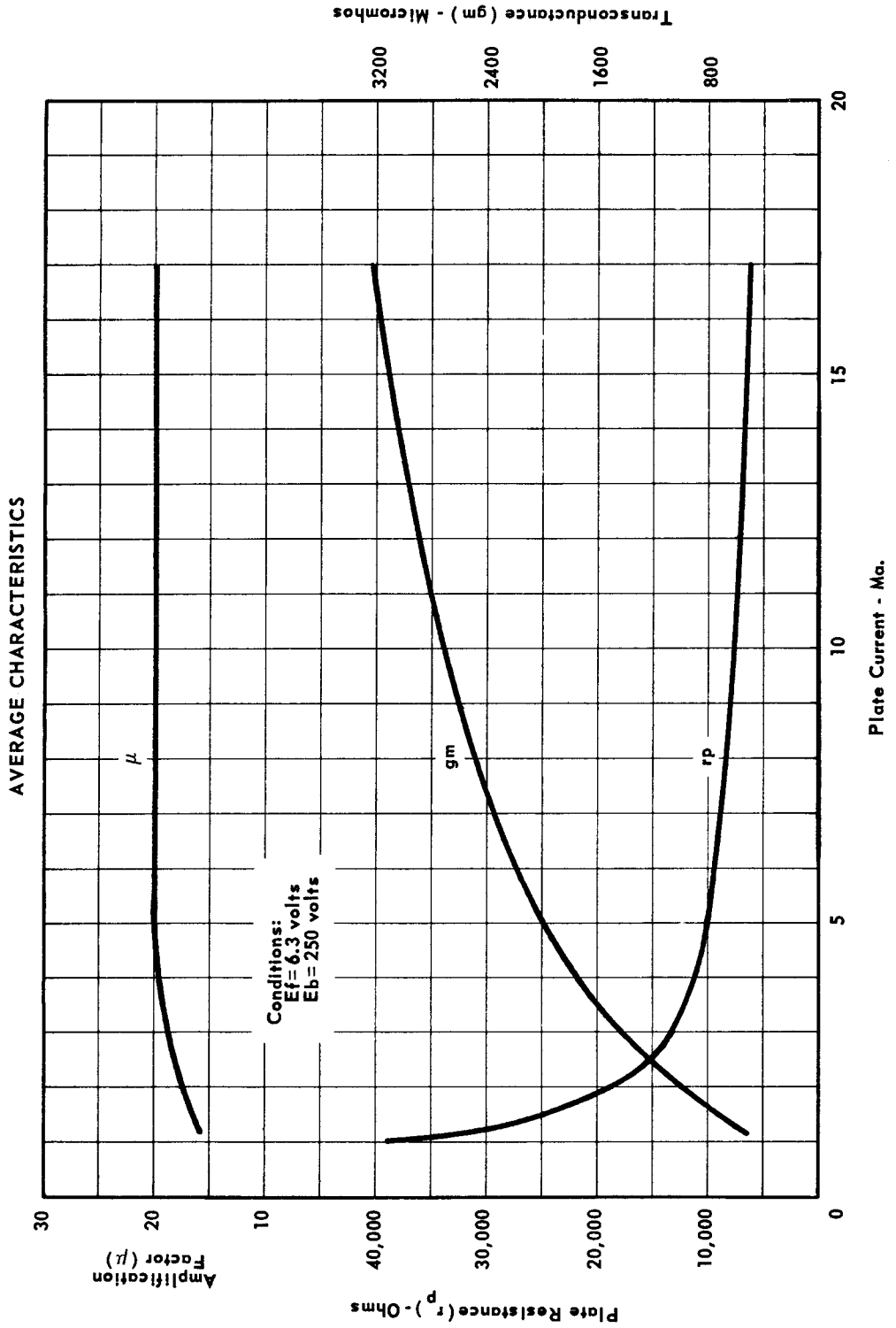
AVERAGE PLATE CHARACTERISTICS

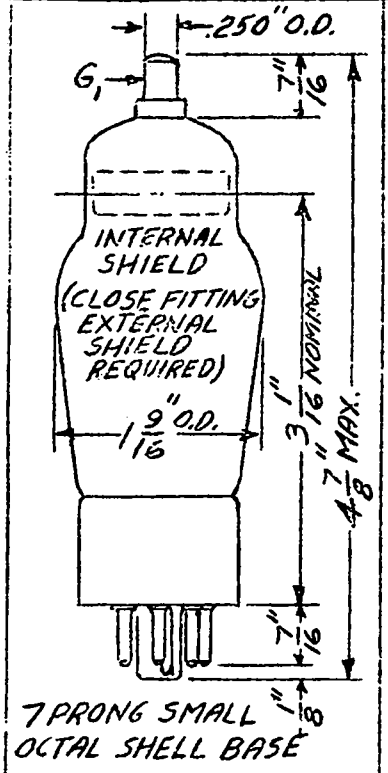


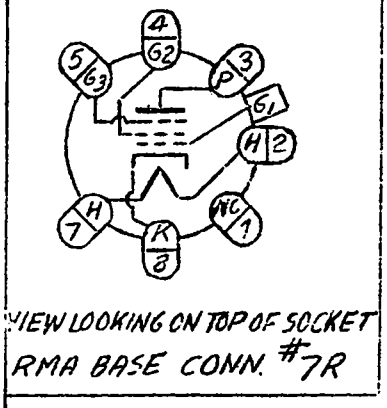
AVERAGE PLATE CHARACTERISTICS



DOUBLE - TRIODE







VIEW LOOKING ON TOP OF SOCKET
RMA BASE CONN. #7R

6U7G

CHARACTERISTIC DATA SHEET
RAYTHEON "G" TYPE TUBE

VARIABLE MU PENTODE AMPLIFIER
(Uni-Potential Cathode Type)

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.3	ampere

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	.007 max.	μμf
Input	5.2	μμf
Output	6.8	μμf

OPERATING CONDITIONS AND CHARACTERISTICS

AMPLIFIER - Class A

Plate	100	250	max.	volts
Screen	100	100		volts
Grid	-3	-3		
Suppressor	Connected to cathode at socket			
Ampli. Factor	375	1280		
Plate Resistance	.25	0.8		megohms
Mutual Conductance	1500	1300		μmhos
Grid Bias for Mutual Conductance 10 μmhos	-40	-40		volts
Grid Bias for Mutual Conductance 2 μmhos	-50	-50		volts
Plate Current	8	8.2		m.a.
Screen Current	2.3	2.0		m.a.

1st DETECTOR IN SUPERHETERODYNE CIRCUIT

Plate	100	250	max.	volts
Screen	100	100	max.	volts
Suppressor	Connected to cathode at socket			
Grid Bias	-10	-10	app. min.	volts

Grid bias voltage not critical with an oscillator peak swing 1 volt less than grid bias.

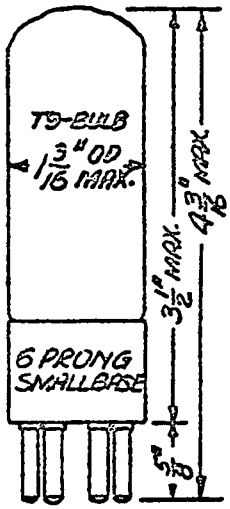
from RMA release #85, Aug. 11, 1936

6U5-6G5

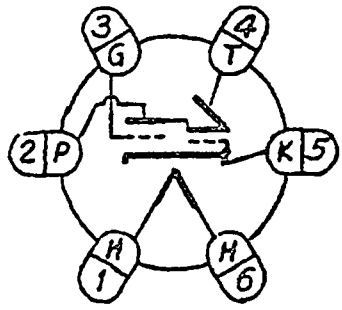
RAYTHEON

6U5-6G5

CATHODE RAY TUNING INDICATOR
Heater Type Glass Bulb



The 6U5/6G5 is a high vacuum type indicator tube with remote cutoff characteristics designed for service as a tuning indicator in radio receivers. The 6U5/6G5 may be used also to replace types 6H5 and 6T5.



BOTTOM VIEW OF SOCKET

RATINGS

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	0.3	amp
Maximum Plate Supply Voltage	250	volts
Maximum Target Voltage	250	volts
Minimum Target Voltage	90	volts

TUNING INDICATOR

Plate Supply Voltage	100	200	250	volts
Target Voltage	100	200	250	volts
Plate Resistor	0.5	1	1	megohm
Target Current *	1	3	4	ma
Plate Current (zero Bias)	0.19	0.19	0.24	ma
Grid Bias (approximate) (For Shadow angle = 0°)	-8	-18.5	-22	volts
Grid Bias (approximate) (For Shadow angle = 90°)	0	0	0	volts

The 6U5/6G5 is a high vacuum tube designed to indicate visually the effect of changing the control grid bias. The shaded pattern produced on the fluorescent target varies through an angle from 90° to approximately 0° as the control voltage is varied. The voltage on the shadow control electrode, the extension of the triode plate between the cathode and target, controls the extent of the shaded area. The voltage of the shadow control electrode is determined by the voltage of the control grid of the triode connected as a d-c amplifier. Thus the control grid voltage determines the extent of the shadow. An increase of control grid bias thus increases the shadow control voltage and decreases the shadow while a decrease of bias increases the shadow. In practical use the control grid voltage is obtained from a suitable point in the AVC network.

* Subject to wide variations.

from RMA release #146, Nov. 1, 1938

Revised October 6, 1938

146A
J5-6U5/6G5
RCA Sep. 29, 1947
APR 8 1938
FILE:

JETEC DATA
JOINT ELECTRON TUBE ENGINEERING COUNCIL
COMMITTEE ON RECEIVING TUBES

JETEC TYPE 6U5/6G5

TUNING INDICATOR

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	9-26
Bulb	T-9
Base	A6-7 small 6-pin
Maximum diameter	1-3/16"
Maximum overall length	4-3/16"
Maximum seated height	3-9/16"
Pin connections	Basing 6R-0-0

Pin 1 - Heater
Pin 2 - Plate
Pin 3 - Triode grid
Pin 4 - Target
Pin 5 - Cathode and target grid
Pin 6 - Heater

Mounting position . . . . . any

ELECTRICAL DATA

Ratings

Heater voltage (ac or dc)	6.3	volts
Heater current	0.300	ampere
Maximum plate-supply voltage	285	volts
Maximum target voltage	285	volts
Minimum target voltage	125	volts
Maximum plate dissipation	1.0	watt

Typical Operating Conditions and Characteristics

Heater voltage	6.3	6.3	volts
Plate and target supply	200	250	volts
Series triode-plate resistor	1	1	megohm
Target current* (subject to wide variations)	3	4	ma
Triode-plate current*	0.19	0.24	ma
Grid bias (approx.) for shadow angle = 0°	-18.5	-22	volts
Grid bias (approx.) for shadow angle = 90°	0	0	volts

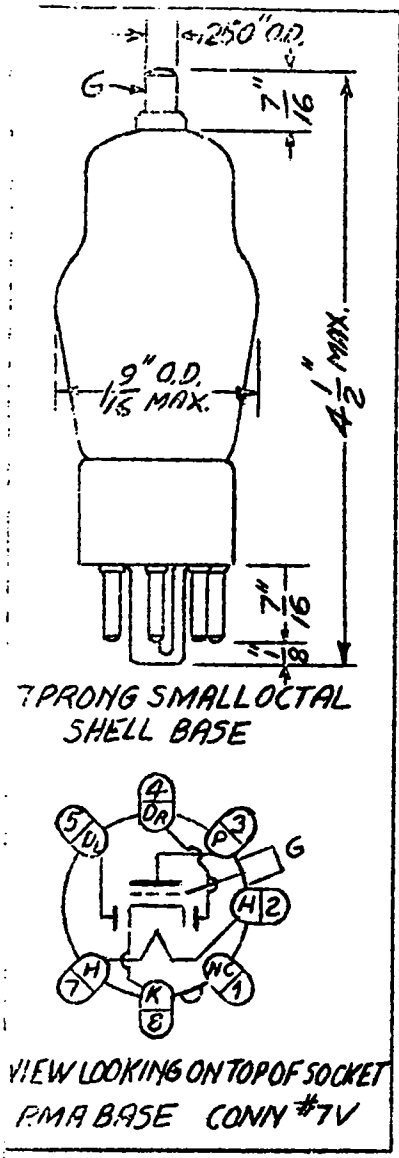
*Measured at zero grid bias

The 6U5/6G5 will supersede the 6G5 and 6U5. It can also be used to replace types 6H5 and 6T5.

Refer to "Interpretation of Receiving Tube Ratings"

#87

SU 76



7 PRONG SMALL OCTAL SHELL BASE

VIEW LOOKING ON TOP OF SOCKET

RMA BASE CONN #7V

CHARACTERISTIC DATA SHEET
RAYTHEON "G" TYPE TUBE

DUPLEX-DIODE TRIODE
(Uni-Potential Cathode Type)

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.3	ampere

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	1.5	μμf
Input	1.5	μμf
Output	4.3	μμf

OPERATING CONDITIONS AND CHARACTERISTICS

AMPLIFIER - Class A

Plate	135	180	250	volts
Grid	-10.5	-13.5	-20	volts
Ampli. Factor	8.3	10.4	8.3	
Plate Resis.	11000	9700	7500	ohms
Mutual Cond.	750	1050	1100	μmhos
Plate Current	3.7	6	8	m.a.
Load Resis.	25000	20000	20000	ohms
Power Output	75	160	350	m.w.

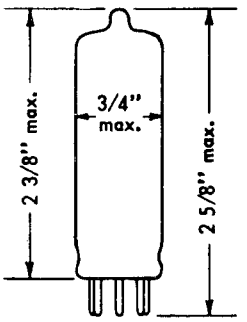
DIODE UNITS (Two)

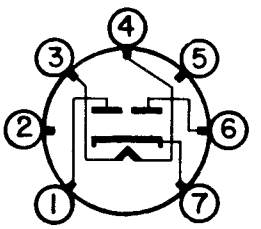
The two diode units are independent of each other and the triode section except for the common cathode. The diode units may be used either as a half wave or as a full wave rectifier or as a half wave rectifier with the other unit used for delayed AVC.

from RMA release #87, Aug. 14, 1936

TYPE 6X4W

The 6X4W is a heater-cathode type high-vacuum double diode of miniature construction designed for dependable operation as a full-wave power rectifier under conditions of shock and vibration usually found in mobile and aircraft applications.





BOTTOM VIEW

5BS

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Plate, Diode #2	Pin 5 No Connections
Pin 2 No Connection	Pin 6 Plate, Diode #1
Pin 3 Heater	Pin 7 Cathode
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 1)	700 G
Minimum Intermittent Heater Voltage Cycles (Note 2)	2000

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage (ac or dc)	6.3±10% volts
Heater Current	0.6 amps.
Maximum Heater-Cathode Voltage:	
Heater Positive with Respect to Cathode	495 volts
Heater Negative with Respect to Cathode	495 volts

RATINGS - ABSOLUTE MAXIMUM VALUES:

Peak Inverse Plate Voltage	1375 volts
Peak Plate Current, per Plate	230 ma.
DC Output Current	77 ma.

CHARACTERISTICS AND TYPICAL OPERATION - FULL-WAVE RECTIFIER:

	Choke Input	Condenser Input
AC Plate Voltage, per Plate (RMS)	450	325 volts
Filter Input Condenser	---	4 μf.
Minimum Filter Input Choke	8	--- henries
Total Effective Plate Supply Impedance, per Plate *	---	150 ohms
DC Output Current	70	70 ma.
DC Output Voltage at Input to Filter:		
At half-load (35 ma.)	390	385 volts
At full-load (70 ma.)	350	375 volts

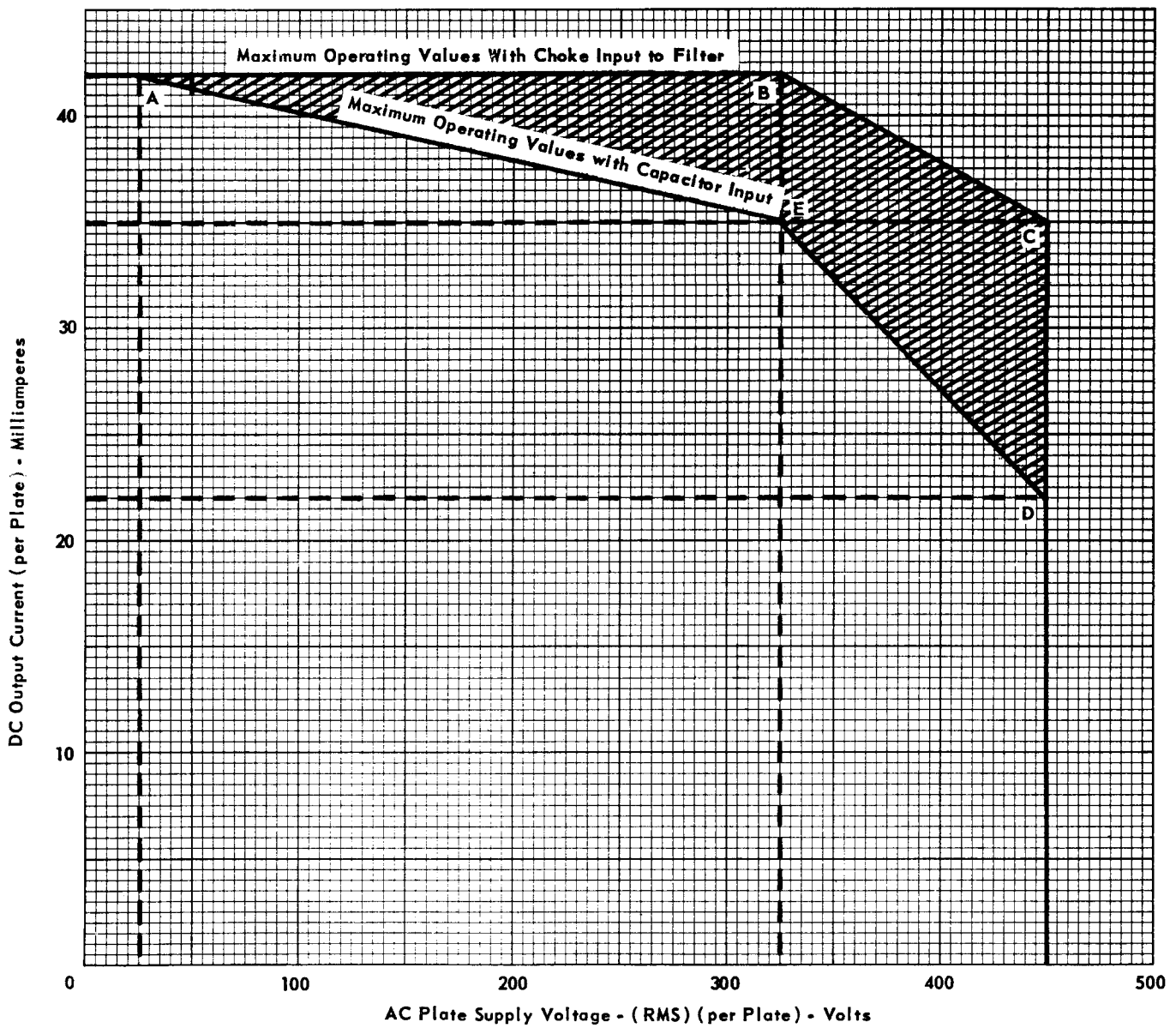
* *Indicated value for conditions shown will limit peak plate current to maximum rated value. When a filter input condenser larger than 4 μf. is used, it may be necessary to increase the plate supply impedance to limit the peak current to the rated value.*

Note 1 Test conditions and acceptance criteria per shock test procedures of JAN basic specifications.

Note 2 As checked at Ef = 7.5 volts ac, on one minute and off one minute.

DOUBLE DIODE

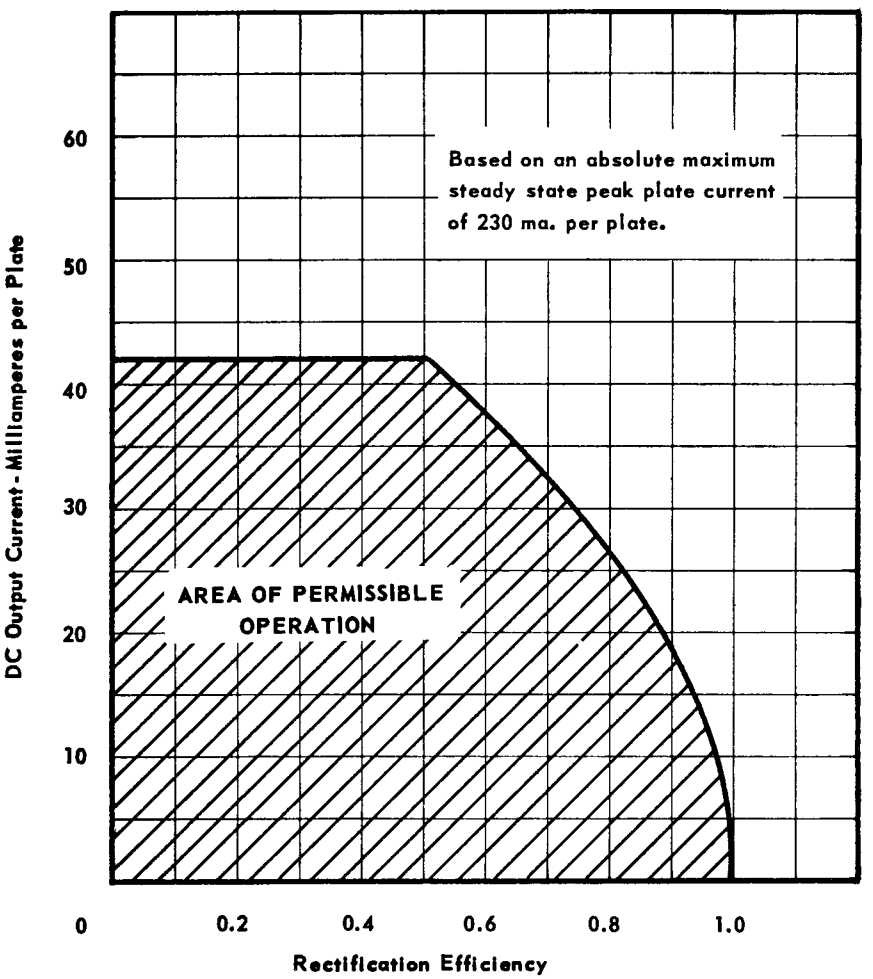
RATING CHART 1



DOUBLE DIODE

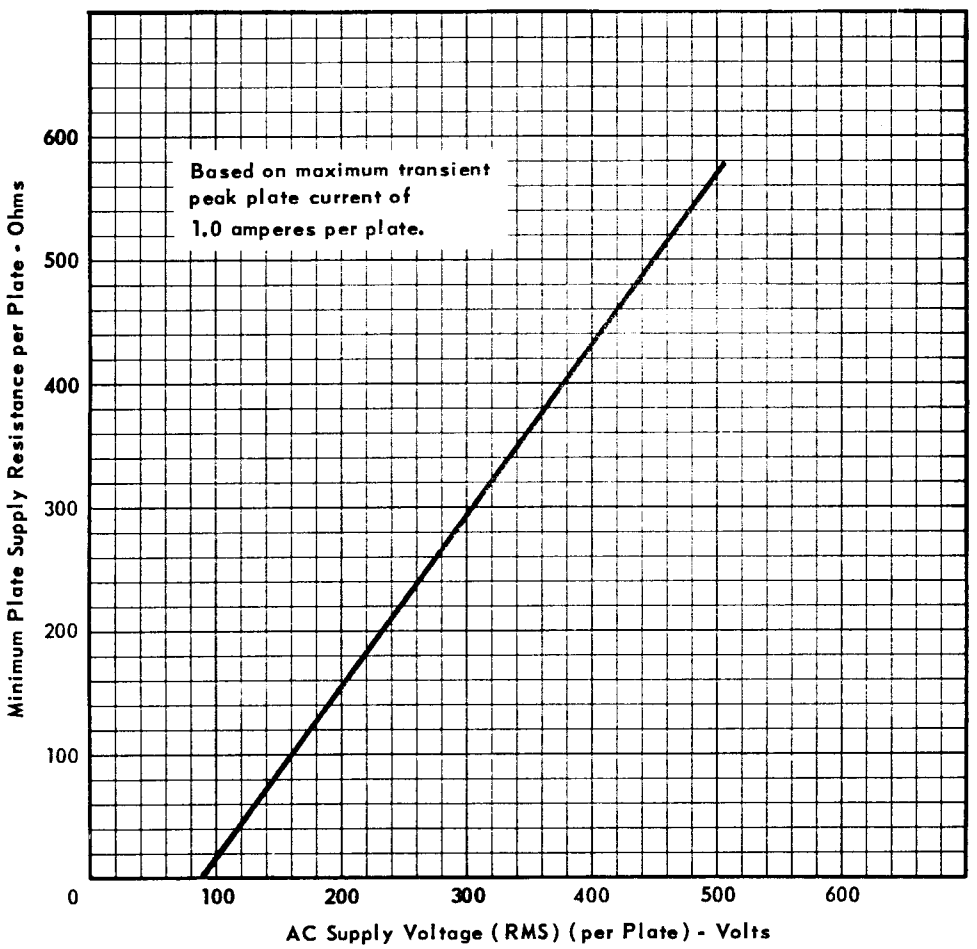
RATING CHART 2

Maximum Rectification Efficiency To Keep Steady State Peak Current in Rating Capacitor Input to Filter



RATING CHART 3

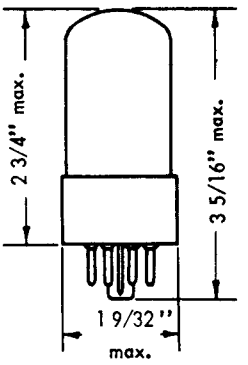
Minimum Source Resistance to Keep
Surge Current Within Rating

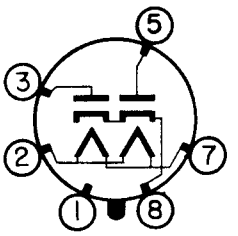


Excellence in Electronics

TYPE 6X5WGT

The 6X5WGT is a heater-cathode type, high-vacuum double diode designed for use as a full-wave power rectifier in equipment of moderate current requirements. It is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications.





BOTTOM VIEW

6S

MECHANICAL DATA

ENVELOPE: T-9 Glass

BASE: Intermediate or Short Intermediate Shell Octal 6-Pin

TERMINAL CONNECTIONS:

Pin 1 No Connection	Pin 5 Plate #1
Pin 2 Heater	Pin 7 Heater
Pin 3 Plate #2	Pin 8 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage (ac or dc)	6.3 volts
Heater Current	0.6 amp.
Heater-Cathode Voltage	450 volts

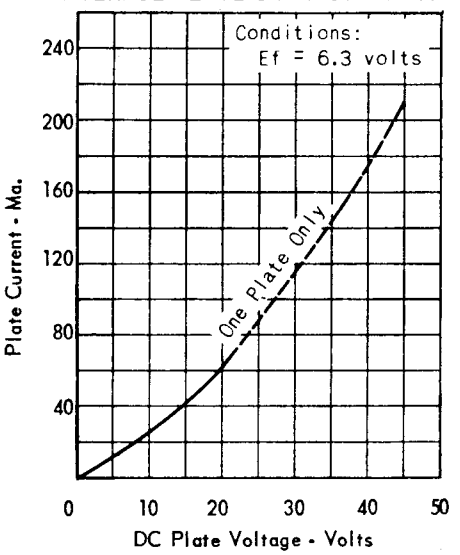
DESIGN CENTER MAXIMUM RATINGS:

Peak Inverse Plate Voltage	1250 volts
Peak Plate Current per Plate	210 ma.
DC Output Current	70 ma.

CHARACTERISTICS AND TYPICAL OPERATION - FULL-WAVE RECTIFIER:

	Choke Input	Condenser Input
AC Plate Voltage, per Plate (RMS)	450	325 volts
Min. Total Effective Plate Supply Impedance, per Plate		150 ohms
Filter Input Condenser		4 μfd.
Filter Input Choke	8	henries
DC Output Current	70	70 ma.
DC Voltage at Input to Filter (approx.)		
At 35 ma. load.	385	405 volts
At 70 ma. load.	380	370 volts
Regulation	5	35 volts
Tube Voltage Drop at 70 ma. per plate	22	volts

AVERAGE PLATE CHARACTERISTICS



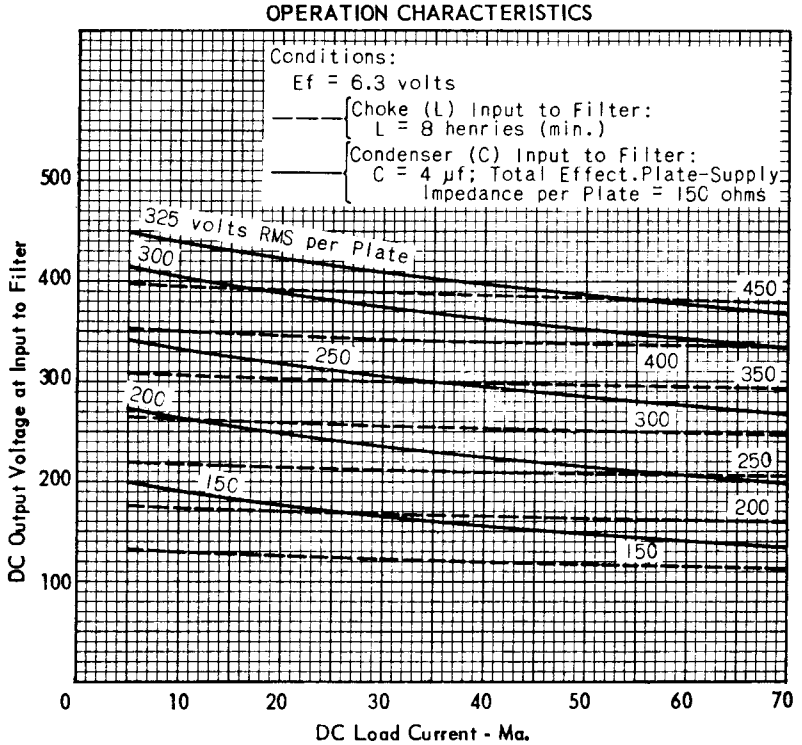
Tentative Data

Printed in U.S.A.

RAYTHEON

DOUBLE DIODE

OPERATION CHARACTERISTICS



TENTATIVE DATA SHEET
RAYTHEON G TYPE TUBE

6Y6G

TETRODE
POWER AMPLIFIER
Heater Type

Bulb: ST-14 Base: Medium Shell Octal 7-pin

DIMENSIONS

Maximum Overall Length	4 5/8"
Maximum Diameter	1 13/16"

BASING - RMA Numbering

Pin 1- No Connection
Pin 2- Heater
Pin 3- Plate
Pin 4- Screen
Pin 5- Grid
Pin 6- Omitted
Pin 7- Heater
Pin 8- Cathode

RATINGS

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	1.25	amp
Maximum Plate Voltage	135	volts
Maximum Screen Voltage	135	volts

AMPLIFIER - CLASS A

Plate Voltage	135	volts
Screen Voltage	135	volts
Grid Bias	-13.5	volts
Transconductance	7000	μmhos
No-Signal Plate Current	58	ma
Max.-Signal Plate Current	60	ma
No-Signal Screen Current	3	ma
Load Resistance	2000	ohms
Power Output	3.6	watts
2nd Harmonic	2.5	percent
3rd Harmonic	9	percent

from RMA release #119, July 15, 1937

RCA 119A
J5-6Y6G
Jan. 29, 1952
FILE:

JETEC DATA
JOINT ELECTRON TUBE ENGINEERING COUNCIL
COMMITTEE ON RECEIVING TUBES

JETEC TYPE 6Y6G

BEAM PENTODE

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	14-3	Bulb	ST-14
Base	B7-12 medium shell octal 7-pin		
Maximum diameter	1-13/16"		
Maximum overall length	4-5/8"		
Maximum seated height	4-1/16"		
Pin connections	Basing 7AC		

Pin 1 - No connection
Pin 2 - Heater
Pin 3 - Plate
Pin 4 - Grid #2
Pin 5 - Grid #1
Pin 7 - Heater
Pin 8 - Cathode, grid #3

Mounting position . . . . . any

ELECTRICAL DATA

Ratings

Heater voltage (ac or dc)	6.3	volts
Maximum heater-cathode voltage		
Heater negative with respect to cathode	180	volts
Heater positive with respect to cathode	180	volts
Maximum plate voltage	200	volts
Maximum grid #2 supply voltage	200	volts
Maximum grid #2 voltage	See J5-C4	
Maximum plate dissipation	12.5	watts
Maximum grid #2 dissipation	1.75	watts
Maximum grid #1 circuit resistance		
Fixed bias	0.1	megohm
Self bias	0.5	megohm

Typical Operating Conditions and Characteristics, Class A1 Amplifier

Heater voltage	6.3	6.3	volts
Heater current	1.25	1.25	amperes
Plate voltage	135	200	volts
Grid #2 voltage	135	135	volts
Grid #1 voltage	-13.5	-14	volts
Peak a-f grid #1 voltage	13.5	14	volts
Plate resistance (approx.)	9300	18,300	ohms
Transconductance	7000	7100	μmhos
Zero-signal plate current	58	61	ma
Maximum-signal plate current	60	66	ma
Zero-signal grid #2 current	3.5	2.2	ma
Maximum-signal grid #2 current	11.5	9	ma
Load resistance	2000	2600	ohms
Total harmonic distortion (approx.)	10	10	%
Power output:	3.6	6	watts

Refer to "Interpretation of Receiving Tube Ratings"

6Z7G

TENTATIVE DATA SHEET
RAYTHEON G TYPE TUBE

6Z7G

TWIN TRIODE POWER AMPLIFIER
DUAL GRID - HEATER TYPE

Bulb - ST-12 Base-Small Octal 8-Pin

DIMENSIONS

Maximum Overall Length	4 1/8"
Maximum Diameter	1 9/16"

BASING - R. N. A. Numbering

Pin 1 - No connection
Pin 2 - Heater
Pin 3 - Plate (Triode R)
Pin 4 - Grid (Triode R)
Pin 5 - Grid (Triode L)
Pin 6 - Plate (Triode L)
Pin 7 - Heater
Pin 8 - Cathode

RATINGS

Heater Voltage	6.3	volts
Heater Current	0.3	amp
Maximum Plate Voltage	180	volts
Maximum Peak Plate Current (per plate)	60	ma
Max. Average Plate Dissipation	8	watts

AMPLIFIER - CLASS B

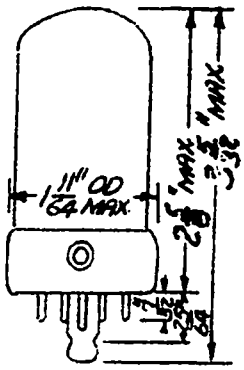
Plate Voltage	135	180	volts
Grid Bias	0	0	volts
No Signal Plate Current (per plate)	3	4.2	ma
Load Resistance (plate to plate)	15000	20000	ohms
Power Output	1.5	2.2	watts
(With average power input = 80 mw. grid to grid)			
Load Resistance	9000	12000	ohms
Power Output	2.5	4.2	watts
(With average power input = 320 mw. grid to grid)			

from RMA release #115, May 24, 1937

RAYTHEON ENGINEERING SERVICE

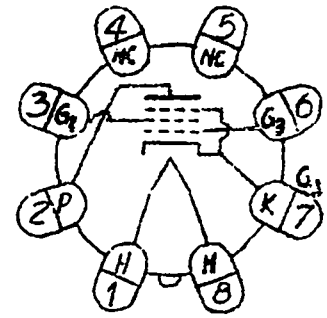
May 15, 1937 CS-1378

7B5



TENTATIVE DATA
RAYTHEON TYPE 7B5

PENTODE
POWER AMPLIFIER
Heater Type
Glass Bulb Loktal Base



BOTTOM VIEW OF SOCKET

The 7B5 is a pentode type power amplifier tube designed for service in the output stage of storage battery or a-c operated receivers.

NOMINAL RATINGS

Heater Voltage (a-c or d-c)	7.0	volts
Heater Current	0.43	amp
Maximum Plate Voltage	250	volts
Maximum Screen Voltage	250	volts

TYPICAL AMPLIFIER - CLASS A CONDITIONS

Heater Voltage	6.3	6.3	6.3	6.3	volts
Plate Voltage	100	135	180	250	volts
Screen Voltage	100	135	180	250	volts
Grid Bias	-7	-10	-13.5	-18 *	volts
Amplification Factor (approx.)	150	150	150	150	
Plate Resistance (approx.)	103500	94000	81000	68000	ohms
Transconductance	1450	1600	1850	2200	umhos
Plate Current	9	12.5	18.5	32	ma
Screen Current	1.6	3.2	3	5.5	ma
Load Resistance	12000	10400	9000	7600	ohms
Total Harmonic Distortion	10	10	10	10	percent
Power Output	0.33	0.75	1.5	3.4	watts

Transformer or impedance input coupling devices are recommended. If resistance coupling is used, the d-c resistance in the grid circuit should not exceed 1 megohm with self-bias, or 0.1 megohm with fixed bias.

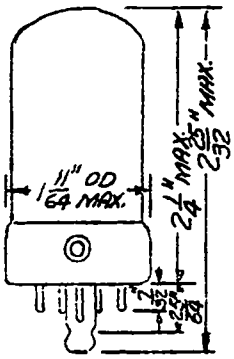
* A bias of -16.5 volts and load resistance of 7000 ohms will give power output of 3.2 watts with 7% total harmonic distortion.

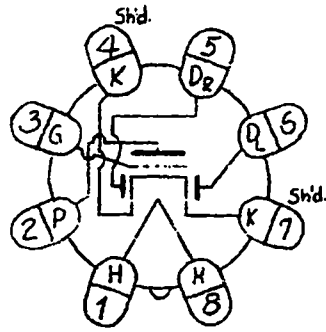
from RMA release #162, Feb. 16, 1939

7B6

TENTATIVE DATA
RAYTHEON TYPE 7B6

DUO-DIODE TRIODE
DETECTOR AMPLIFIER
Heater Type
Glass Bulb Loktal Base





BOTTOM VIEW OF SOCKET

The 7B6 is a duo-diode triode type amplifier tube designed for use as a combined diode detector, avc rectifier and resistance-coupled audio frequency amplifier in radio receivers.

NOMINAL RATINGS

Heater Voltage (a-c or d-c)	7.0	volts
Heater Current	0.32	amp

DIRECT INTERELECTRODE CAPACITANCES (NOMINAL) - TRIODE SECTION

G to P (Grid to Plate)	1.5	μμf
G to K (Input Electrode)	3.0	μμf
P to K (Output Electrode)	3.0	μμf

TYPICAL AMPLIFIER - CLASS A CONDITIONS - TRIODE SECTION

Heater Voltage	6.3	volts
Heater Current	0.3	amp
Plate Voltage	250 max.	volts
Grid Bias	-2	volts
Amplification Factor	100	
Plate Resistance	91000	ohms
Transconductance	1100	μmhos
Plate Current	1	ma

DIODE SECTION

The two diodes are independent of each other and of the triode section except for the common cathode. The diodes may be used as a half wave or a full wave rectifier; or one diode may be used as a half wave rectifier for detection and the other diode used as a rectifier to obtain delayed AVC voltage.

from RMA release #162, Feb. 16, 1939

RCA Laboratories Div.
Newark Industry Serv. Lab.
162A
APR 8 1958
FILE:

JETEC DATA
JOINT ELECTRON TUBE ENGINEERING COUNCIL
COMMITTEE ON RECEIVING TUBES

May 10, 1948

JETEC TYPE 7B6

DOUBLE DIODE TRIODE

MECHANICAL DATA

Coated unipotential cathode

Outline drawing 9-30	Bulb. T-9
Base. . . . . D8-1 lock-in 8-pin	
Maximum diameter. . . . . 1-3/16"	
Maximum overall length. . . . . 2-25/32"	
Maximum seated height . . . . . 2-1/4"	
Pin connections. . . . . Basing 8W-L-7	
Pin 1 + Heater	Pin 5 - #2 diode plate
Pin 2 - Triode plate	Pin 6 - #1 diode plate
Pin 3 - Triode grid	Pin 7 - Cathode, internal shield
Pin 4 - Internal connection	Pin 8 - Heater

Mounting position . . . . . any

ELECTRICAL DATA

Direct Interelectrode Capacitances*

Diode input (each unit): (1p or 2p to h+k).	1.7	μμf
Triode grid to #1 diode plate (g to 1p) (max.).	0.01	μμf

*External shield #308 connected to pin 7.

Ratings

Heater voltage (nominal) (ac or dc)	7.0	volts
Maximum heater-cathode voltage.	90	volts
Maximum plate voltage	300	volts
Maximum plate dissipation	0.5	watt
Maximum positive dc grid voltage.	0	volts
Maximum diode current each plate for continuous operation . . .	1.0	ma

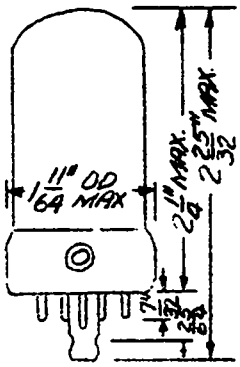
Typical Operating Conditions and Characteristics, Class A1 Amplifier

Heater voltage (ac or dc)	6.3	6.3	volts
Heater current.	300	300	ma
Plate voltage	100	250	volts
Grid voltage.	-1	-2	volts
Plate resistance (approx.).	110,000	91,000	ohms
Transconductance.	900	1100	μmhos
Plate current	0.4	0.9	ma
Amplification factor.	100	100	
Average diode current each plate with 10 volts dc applied	2.0	2.0	ma

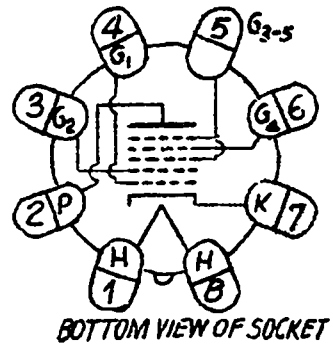
Refer to "Interpretation of Receiving Tube Ratings"

7B8 7B8

TENTATIVE DATA
RAYTHEON TYPE 7B8



HEPTODE
PENTAGRID CONVERTER
Heater Type
Glass Bulb Loktal Base



BOTTOM VIEW OF SOCKET

The 7B8 is a pentagrid type converter tube designed for use as a combined oscillator and mixer in superheterodyne receivers.

NOMINAL RATINGS		
Heater Voltage (a-c or d-c)	7.0	volts
Heater Current	0.32	amp

MAXIMUM AND MINIMUM RATINGS		
Maximum Plate Voltage	250	volts
Maximum Screen (G_3 & G_5) Voltage	100	volts
Maximum Anode Grid (G_2) Voltage	200	volts
Maximum Anode Grid Supply Voltage	250	volts
Minimum Control Grid (G_4) Bias	-3	volts
Maximum Total Cathode Current	14	ma

DIRECT INTERELECTRODE CAPACITANCES		
G_4 to P (Mixer Grid to Plate)	0.30 max.	μμf
G_4 to G_2 (Mixer Grid to Oscillator Plate)	0.20	μμf
G_4 to G_1 (Mixer Grid to Oscillator Grid)	0.15	μμf
G_1 to G_2 (Oscillator Grid to Plate)	0.8	μμf
G_4 to All Other Electrodes (Mixer Input Electrode)	9.5	μμf
G_2 to All Other Electrodes Except G_1 (Osc. Output Electrode)	3.0	μμf
G_1 to All Other Electrodes Except G2 (Osc. Input Electrode)	4.4	μμf
P to All Other Electrodes (Mixer Output Electrode)	9.0	μμf

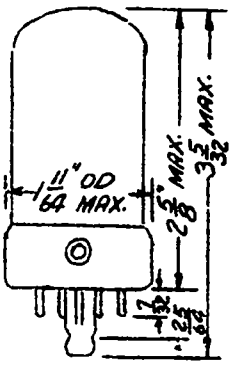
TYPICAL FREQUENCY CONVERTER CONDITIONS			
Heater Voltage	6.3	6.3	volts
Heater Current	0.3	0.3	amp
Plate Voltage	100	250	volts
Screen Voltage	50	100	volts
Anode Grid Voltage	100	-	volts
Anode Grid Supply Voltage	-	250 *	volts
Control Grid Bias	-1.5 min.	-3	volts
Oscillator Grid Resistor	50000	50000	ohms
Plate Resistance	0.6	0.36	megohm
Conversion Transconductance	360	550	μmhos
Plate Current	1.1	3.5	ma
Screen Current	1.3	2.7	ma
Anode Grid Current	2.0	4.0	ma
Oscillator Grid Current	0.25	0.4	ma
Control Grid Bias (approximate)			
For Conversion Transconductance = 6 μmhos	-	-35	volts
For Conversion Transconductance = 3 μmhos	-20		volts

* Applied through a 20000 ohm series resistor.

from RMA release #162, Feb. 16, 1939

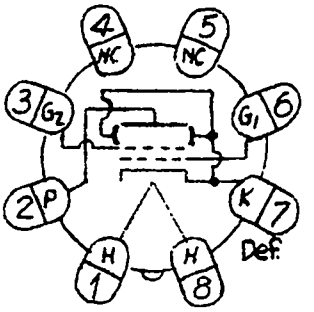
7C5

7C5



TENTATIVE DATA
RAYTHEON TYPE 7C5

TETRODE
POWER AMPLIFIER
Heater Type
Glass Bulb Loktal Base



BOTTOM VIEW OF SOCKET

The 7C5 is a tetrode type power amplifier tube designed for use in the output stage of radio receivers.

NOMINAL RATINGS

Heater Voltage (a-c or d-c)	7.0	volts
Heater Current	0.48	amp
Maximum Plate Voltage	250	volts
Maximum Screen Voltage	250	volts

TYPICAL AMPLIFIER - CLASS A CONDITIONS

Heater Voltage	6.3	6.3	volts
Heater Current	0.45	0.45	amp
Plate Voltage	180	250	volts
Screen Voltage	180	250	volts
Grid Bias	-8.5	-12.5	volts
Amplification Factor (approximate)	210	218	
Transconductance	3500	4100	umhos
Max.-Signal Voltage (RMS)	6.0	8.84	
No-Signal Plate Current	29	45	ma
Max.-Signal Plate Current	30	47	ma
No-Signal Screen Current	3	4.5	ma
Max.-Signal Screen Current	4	6.5	ma
Load Resistance	5500	5000	ohms
Total Harmonic Distortion	6	6	percent
2nd Harmonic Distortion	5.5	4.5	percent
3rd Harmonic Distortion	2.5	3.5	percent
Max.-Signal Power Output	2	4.25	watts

TYPICAL AMPLIFIER - PUSH-PULL - CLASS AB CONDITIONS - TWO TUBES

Heater Voltage	6.3	volts
Heater Current	0.45	amp
Plate Voltage	250	volts
Screen Voltage	250	volts
Grid Bias	-15	volts
Max.-Signal Voltage - Grid to Grid (RMS)	21.2	volts
No-Signal Plate Current	70	ma
Max.-Signal Plate Current	79	ma
No-Signal Screen Current	5	ma
Max.-Signal Screen Current	12	ma
Load Resistance	10000	ohms
Total Harmonic Distortion	4	percent
3rd Harmonic Distortion	3.5	percent
Max.-Signal Power Output	8.5	watts

from RMA release #162, Feb. 16, 1939

Rev. Jan 28, 1939

JETEC DATA
JOINT ELECTRON TUBE ENGINEERING COUNCIL
COMMITTEE ON RECEIVING TUBES

JETEC TYPE 7C5

BEAM PENTODE

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	9-31	Bulb	T-9
Base			D8-1 lock-in 8-pin
Maximum diameter			1-3/16"
Maximum overall length			3-5/32"
Maximum seated height			2-5/8"
Pin connections			Basing 6AA

Pin 1 - Heater
Pin 2 - Plate
Pin 3 - Grid #2
Pin 4 - No connection
Pin 5 - No connection
Pin 6 - Grid #1
Pin 7 - Cathode, beam plates
Pin 8 - Heater

Mounting position . . . . . Any

ELECTRICAL DATA

Ratings

Heater voltage (nominal) (ac or dc)	7.0 volts
Maximum heater-cathode voltage	90 volts
Maximum plate voltage	315 volts
Maximum grid #2 voltage	285 volts
Maximum plate dissipation	12 watts
Maximum grid #2 dissipation	2 watts

Typical Operating Conditions and Characteristics, Class A1 Amplifier (single tube)

Heater voltage	6.3	6.3	6.3	volts
Heater current	450	450	450	ma.
Plate voltage	180	250	315	volts
Grid #2 voltage	180	250	225	volts
Grid #1 voltage*	-8.5	-12.5	-13.0	volts
Peak AF grid #1 voltage	8.5	12.5	13.0	volts
Zero signal plate current	29	45	34	ma.
Maximum signal plate current	30	47	35	ma.
Zero signal grid #2 current	3.0	4.5	2.2	ma.
Maximum signal grid #2 current	4.0	7.0	6.0	ma.
Plate resistance (approx.)	58,000	52,000	77,000	ohms
Transconductance	3700	4100	3750	μmhos
Load resistance	5500	5000	8500	ohms
Maximum signal power output	2.0	4.5	5.5	watts
Total harmonic distortion (approx.)	8	8	12	%

Continued on Page 2

ELECTRICAL DATA (Continued)

Typical Operating Conditions and Characteristics,
Class AB-1 Push-Pull Amplifier**

Heater voltage	6.3	6.3	volts
Heater current	0.90	0.90	ampere
Plate voltage	250	285	volts
Grid #2 voltage	250	285	volts
Grid #1 voltage*	-15	-19	volts
Peak AF grid #1 to grid #1 voltage	30	38	volts
Zero-signal plate current	70	70	ma.
Maximum-signal grid #2 current	13	13.5	ma.
Maximum-signal plate current	79	92	ma.
Zero-signal grid #2 current	5	4	ma.
Plate-to-plate load resistance	10,000	8,000	ohms
Maximum-signal power output	10	14	watts
Total harmonic distortion	5	3.5	%

*Maximum grid #1 circuit resistance for fixed bias = 0.1 megohm.
Maximum grid #1 circuit resistance for cathode bias = 0.5 megohm.

**Unless otherwise specified values are for two tubes.

Refer to "Interpretation of Receiving Tube Ratings"

TYPE 7MP7 7MP14

The 7MP— is a 7" magnetic focus and magnetic deflection cathode ray tube suitable for oscilloscopic usage such as radar indicators. Because of its cascade type screen it is usable with either low-speed non repeating information or high-speed repeating information.

MECHANICAL DATA

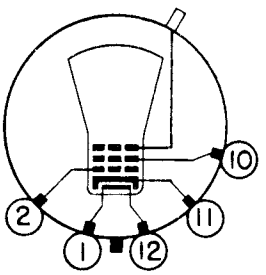
BASE: Small Shell Duodecal 5—Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 11 Cathode
Pin 2 Grid #1	Pin 12 Heater
Pin 10 Grid #2	Cap Grid #3 (Collector)

MOUNTING POSITION: Any



BOTTOM VIEW

12D

GENERAL DATA

	7MP7	7MP14
Phosphor	#7	#14
Fluorescence	Blue	Blue
Phosphorescence	Yellow	Orange
Persistence	Long	Med.-Long
Focusing Method	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic
Deflection Angle	50°	50°

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Heater Current	0.6 ± 10%	amps.
Peak Heater-Cathode Voltage: ♦		
Heater Negative with Respect to Cathode	125	volts DC
Heater Positive with Respect to Cathode	125	volts DC
Collector Voltage ▲	8000	volts DC
Grid #2 Voltage:		
Positive Value (DC or Peak AC)	700	volts max.
Negative Value (DC or Peak AC)	180	volts max.
Grid #1 Voltage:		
Negative-Bias Value	180	volts DC
Positive-Bias Value *	0	volts DC
Positive-Peak Value	2	volts

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3	6.3	volts
Collector Voltage ▲	4000	7000	volts DC
Grid #2 Voltage	250	250	volts DC
Grid #1 Voltage ⊕♦	−27 to −63	−28 to −63	volts DC
Focusing Coil Current DC (approx.)	64 ± 15%	85 ± 15%	ma.
Spot Position (undeflected) □	0.3	0.3	inches

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5	max. megohms

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.*

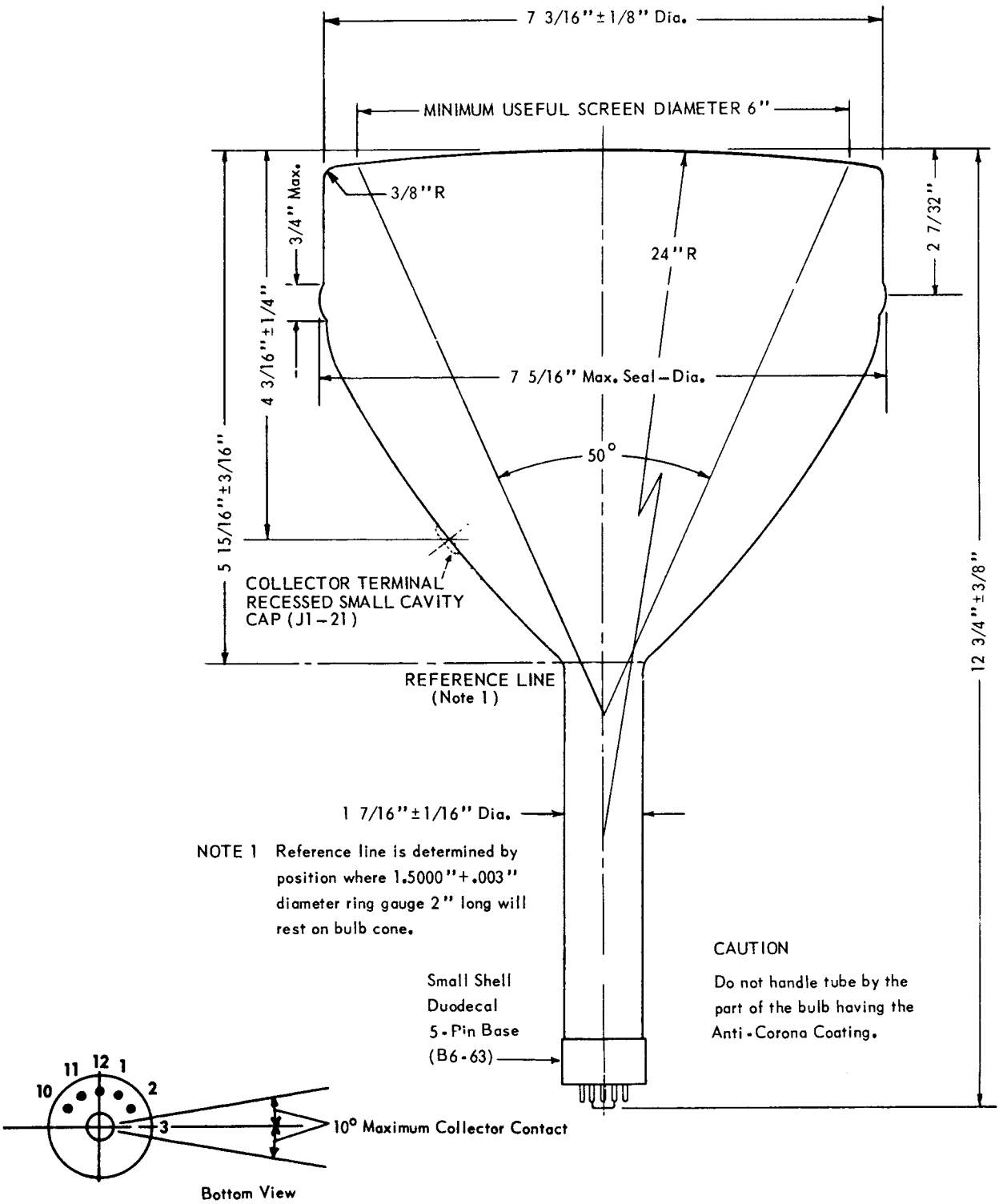
▲ *Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 4000 volts.*

⊕ *Visual extinction of undeflected focused spot.*

□ *The center of the undeflected, focused spot will fall within a circle of 0.30 inch radius concentric with the center of the tube face, with tube shielded.*

♦ *For focusing coil similar to JETEC coil no. 109 positioned with air gap toward faceplate and center line of air gap 2 ¼" from reference line and collector current of 200 μa.*

CATHODE RAY TUBE



TENTATIVE DATA

7T7 RAYTHEON TYPE 7T7 7TY

PENTODE
SHARP CUTOFF AMPLIFIER
Heater Type

The 7T7 is a pentode type amplifier tube with sharp cutoff characteristics designed for use as a high frequency amplifier in radio receivers.

BULB: T-9 Glass MOUNTING POSITION: Any

BASE: Looking-In 8-Pin

DIMENSIONS

Maximum Overall Length	2 5/32	inches
Maximum Seated Height	2 1/4	inches
Maximum Diameter	1 3/16	inches

BASING (RMA Designation 8V-L6)

Pin 1 - Heater	Pin 5 - Internal Shield
Pin 2 - Plate	Pin 6 - Control Grid (G_1)
Pin 3 - Screen (G_2)	Pin 7 - Cathode
Pin 4 - Suppressor (G_3)	Pin 8 - Heater

RATINGS *

Heater Voltage (a-c or d-c)	6.3	volts
Heater Current	0.3	amp
Maximum Plate Voltage	300	volts
Maximum Screen Supply Voltage	300	volts
Maximum Screen Voltage	150	volts
Maximum Plate Dissipation	3	watts
Maximum Screen Dissipation	0.7	watt

DIRECT INTERELECTRODE CAPACITANCES

G_1 to P (Grid to Plate)	0.005 max.	μμf
G_1 to All Other Electrodes Except P (Input)	7.5	μμf
P to All Other Electrodes Except G_1 (Output)	5.5	μμf

TYPICAL AMPLIFIER OPERATION - CLASS A_1

Heater Voltage	6.3	6.3	volts
Plate Voltage	100	250	volts
Screen Voltage	100	150	volts
Grid Bias	-1	-1	volts
Plate Resistance (Approx.)	0.35	0.9	megohm
Transconductance	4000	4900	μmhos
Plate Current	5.3	10.8	ma
Screen Current	2.1	4.1	ma
Grid Bias for Plate Current Cut-off	-4	-5.5	volts

* For interpretation of ratings, see "Receiving Tube Ratings". (CS-1800)

RADIO MANUFACTURERS ASSOCIATION
ENGINEERING DEPARTMENT

Release No. 407

May 15, 1945

TYPE 1007

FULL WAVE GASEOUS RECTIFIER

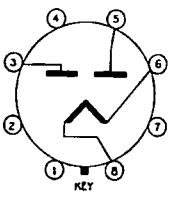
Bulb (Over glass bulb)		MT-8
Base		Small Wafer Octal 5-Pin
Dimensions		
Maximum Overall Length	2 5/8	Inches
Maximum Seated Height	2 1/16	Inches
Maximum Diameter	1 5/16	Inches
Basing		5AQ-1-O

Ratings (Full Wave Rectifier with Condenser Input)

	Fig. 1-A	Fig. 1-B	Fig. 2-A	Fig. 2-B	
*Filament Voltage (RMS or DC)	1.0	0	1.0	0	volts
Nominal Heater Current	1.2	0	1.2	0	amp
Abs.Min.D-C Output Current (Per tube)	0	30	0	30	ma
*Maximum D-C Output Current (Per tube)	110	110	85	85	ma
*Maximum Peak Anode Current (Per tube)	330	330	510	510	ma
Abs. Min. Peak Starting Voltage (Full Wave)	170	340	170	340	volts
Average Dynamic Voltage Drop	24	24	24	24	volts
*Maximum Peak Inverse Voltage	980	980	1200	1200	volts
*Maximum Peak Anode Voltage	490	490	600	600	volts

*For interpretation of ratings, see RMA Standards for Storage Battery Operation.

5AQ



sponsor:
Raytheon Manufacturing Co.

Release No. 407

May 15, 1945

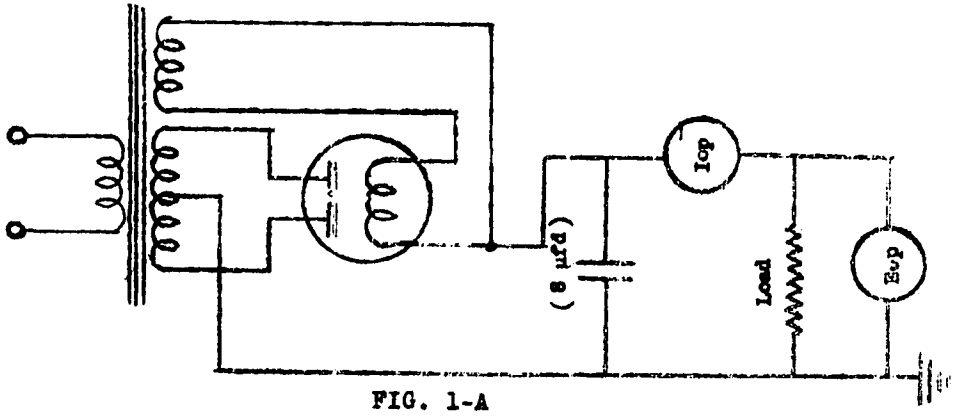


FIG. 1-A

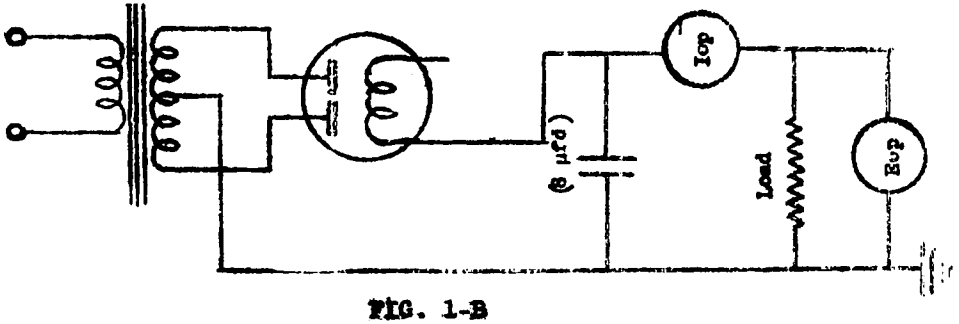


FIG. 1-B

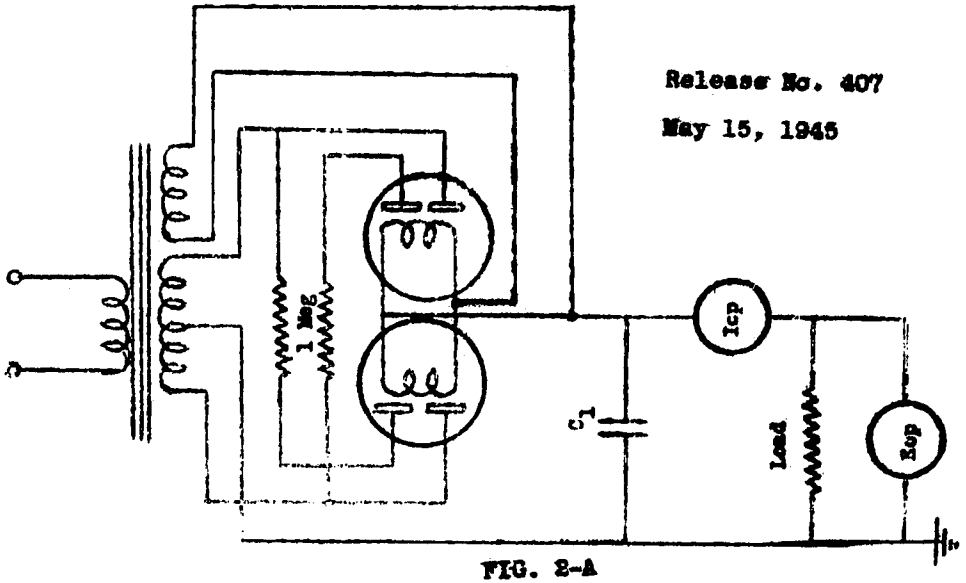


FIG. 2-A

Value of C_1 and regulation must assure that both tubes will start.

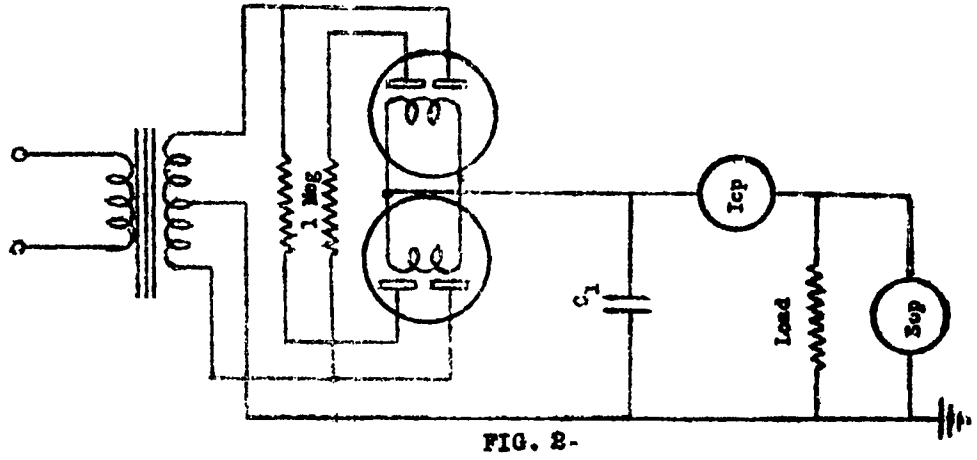


FIG. 2-

RAYTHEON

TECHNICAL INFORMATION

CATHODE RAY TUBE

Excellence in Electronics

TYPE 10AKP7

The 10AKP7 is a magnetic–focus and deflection type cathode–ray tube. This type features electron gun capabilities such as smaller spot size, high resolution and excellent depth of focus. This type is best suited for applications that require a long–persistence characteristic as in radar and oscillographs.

MECHANICAL DATA

MINIMUM USEFUL SCREEN DIAMETER: 9 inches

BASE: Small–shell Duodecal 5–Pin JEDEC No. B5–57 or
Small–shell Duodecal 7–Pin JEDEC No. B7–51

BASING: JEDEC Designation – 12D

ANODE CONTACT: Recessed Small–cavity Cap. JEDEC No. J1–21

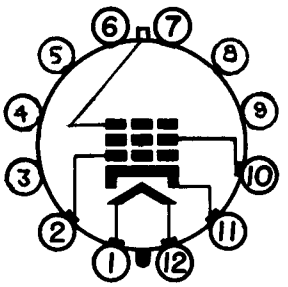
BULB NO.: ASA Designation–J84C

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 10 Grid #2
Pin 2 Grid #1	Pin 11 Cathode
Cap Grid #3, Anode	Pin 12 Heater

BULB CONTACT ALIGNMENT: Anode Contact Aligns with Pin No. 3 Position ±10 Degrees.

MOUNTING POSITION: Any



BOTTOM VIEW

12D

GENERAL DATA

Persistence	Long
Flourescent Color	Blue–White
Phosphor number	P7
Phosphorescent color	Yellow
Faceplate	Gray
Light Transmission at Center, approximate	77 percent
Focusing Method	Magnetic
Deflection Method	Magnetic
Deflection Angle, Approx.	50°

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCE: (approx.) (μμfds.)

Cathode to all	5
Grid #1 to all	8

DESIGN CENTER MAXIMUM RATINGS: (Note 1)

Heater Voltage	6.3	volts
Heater Current	0.6±10%	amperes
Anode Voltage Grid #3	10,000	volts DC max.
Grid #2 Voltage	1000	volts DC max.
Grid #1 Voltage		
Negative Bias Value	180	volts DC max.
Positive Bias Value	0	volts DC max.
Positive Peak Value	2	volts max.
Peak Grid #1 Drive from Cutoff	65	volts max.
Peat Heater–Cathode Voltages (Note 2)		
Heater Negative with Respect to Cathode	180	volts max.
Heater Positive with Respect to Cathode	180	volts max.

CHARACTERISTICS AND TYPICAL OPERATION:

Anode Voltage (Note 3)	8000	volts DC
Grid #2 Voltage	700	volts DC
Grid #1 Voltage (Note 4)	–20 to –80	volts DC
Focusing–Coil Current, Approx. (Note 5)	105	mAdc
Line Width (Note 6)	.30	mm max.
Spot Position (Note 7)	18	mm

MAXIMUM CIRCUIT VALUE:

Grid #1 Circuit Resistance	1.5	megohms max.

Tentative Data

inted in U.S.A.

ELECTRICAL DATA (Cont'd.)

Note 1: A 10% safety factor is encorporated within the maximum ratings according to the standard cathode ray tube design–center system. If the maximum design–center values are not exceeded by more than ten per cent, the tube will sustain the combined effects of line voltage and component variation.

Note 2: Cathode should be returned to the center tap or one side of the heater transformer winding.

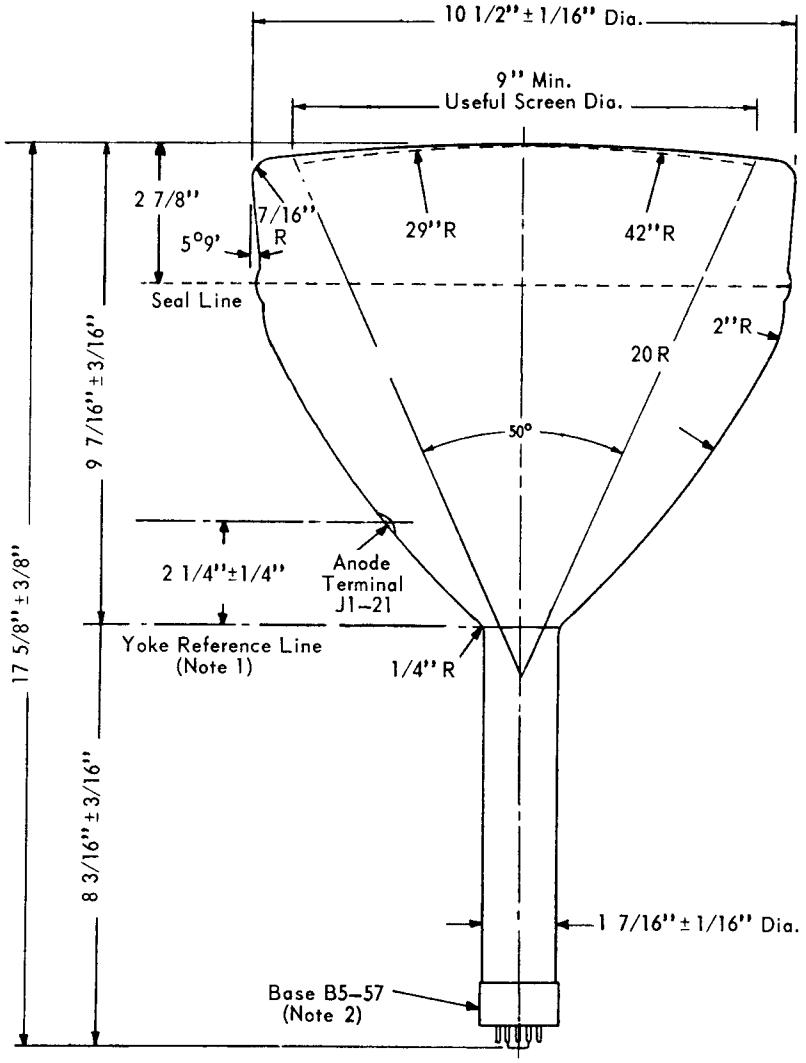
Note 3: Anode voltage, in general, should not be less than 5000 volts. With decreasing anode voltage, brightness and focus quality decrease.

Note 4: For visual extinction of undeflected focused spot.

Note 5: Distance from the yoke reference line to center of air gap is equal to 3 1/4 inches using RETMA focusing coil No. 106.

Note 6: Measured according to MIL–E–1, paragraph 4.12.6.2 at an anode current of 200 μA.

Note 7: The center of the unfocused, undeflected spot will fall within an 18 mm circle concentric with the tube face.

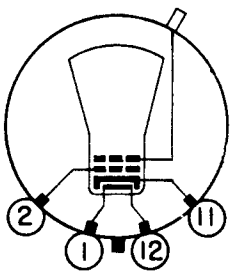


Note 1: Reference line is determined by the plane of the upper edge of the reference–line gage (RETMA No. 112) when the gage is resting on the cone.

Note 2: Anode terminal aligns with Pin No. 3 Position ± 10 degrees.

TYPE 10QP7

The 10QP7 is a magnetic focus and magnetic deflection cathode ray tube having a long persistence cascade fluorescent screen. A special feature of the 10QP7 is that it produces a small spot of high intensity.



BOTTOM VIEW

12H

MECHANICAL DATA

BASE: Small Shell Duodecal 6-Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 11 Cathode
Pin 2 Grid #1	Pin 12 Heater
	Cap Grid #2 & Collector

MOUNTING POSITION: Any

GENERAL DATA

Phosphor	#7
Fluorescence	Blue
Phosphorescence	Yellow
Persistence	Long
Deflection Method	Magnetic
Deflection Angle	50°

ELECTRICAL DATA

HEATER CHARACTERISTICS:		
Heater Voltage	6.3	volts
Heater Current	6.3 ± 10%	amps.
Peak Heater-Cathode Voltage: Max.		
Heater Negative with Respect to Cathode	175	volts DC
Heater Positive with Respect to Cathode	175	volts DC
DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)		
Grid #1 to all other electrodes	4.0	
Cathode to all other electrodes	3.5	
DESIGN CENTER MAXIMUM RATINGS:		
Collector Voltage (including Grid #2)	20,000	volts DC
Grid #1 Voltage:		
Negative – Bias Value	350	volts DC
Positive – Bias Value	0	volts DC
Positive – Peak Value	2	volts DC
CHARACTERISTICS AND TYPICAL OPERATION:		
Collector Voltage (including Grid #2)	20,000	volts DC
Grid #1 Voltage ⊕	−63 to −147	volts DC
Spot Position (undeflected)	.590	inch max.
MAXIMUM CIRCUIT VALUES:		
Grid #1 Circuit Resistance	1.5	meg. max.

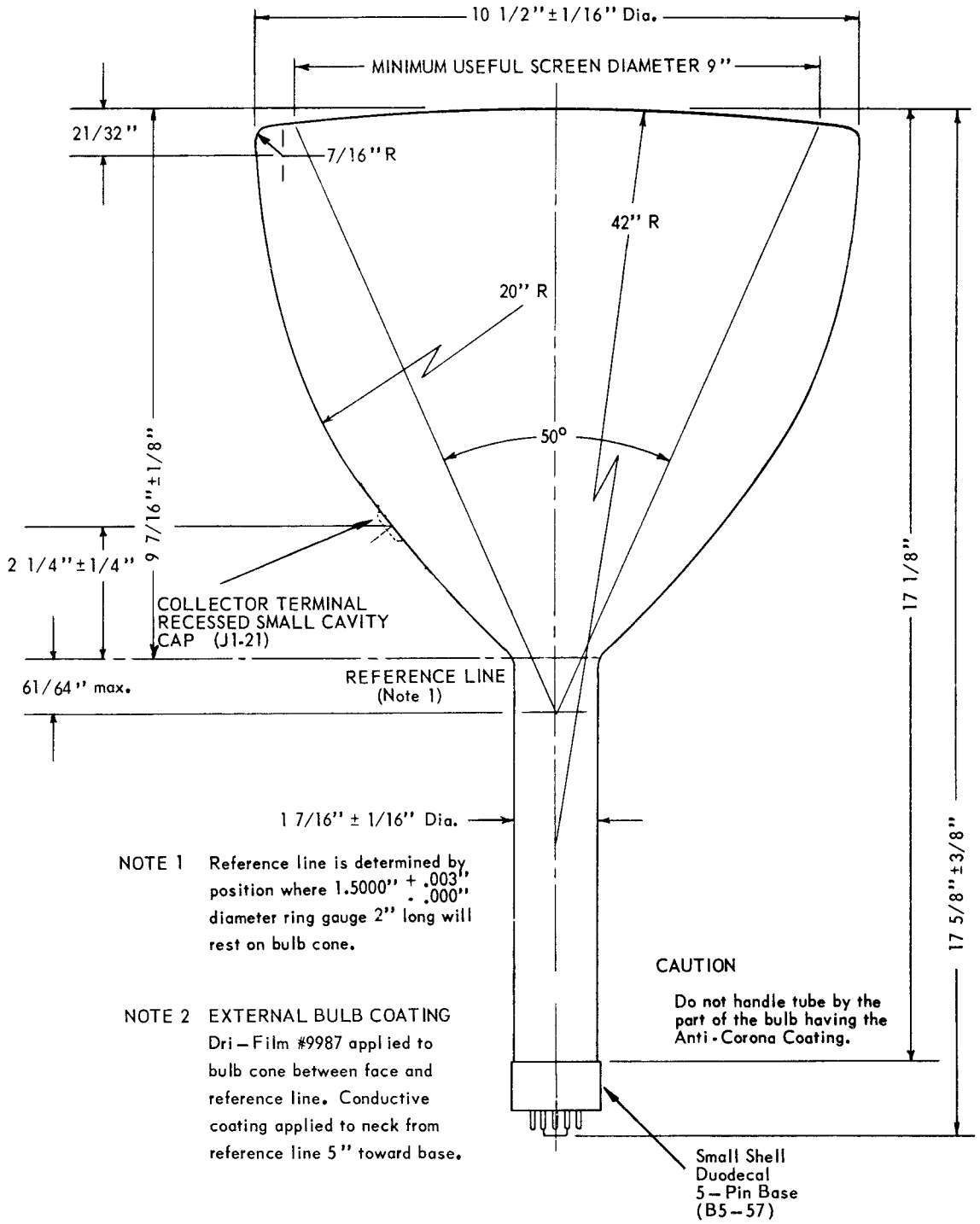
⊕ *Visual extinction of deflected focus spot.*

For standard focus coil #106 or equivalent, the focus coil current is approximately 190 MA. D.C. Grid #1 bias voltage and video signal voltage adjusted for 100 microamperes of anode current. The distance from air gap in the focus coil to reference line is 3.25 inches.

Tentative Data

RAYTHEON

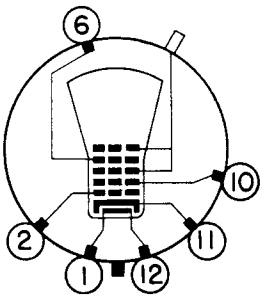
CATHODE RAY TUBE



TYPE 10UP7A 10UP14A

The type 10UP— is a 10 inch aluminized electrostatic focus and magnetic deflection cathode–ray tube suitable for radar applications. A low–voltage electrostatic focus lens is employed, designed to operate at near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the 10UP7A employs a high resolution gun.

The 10UP— utilizes a metallized screen for greater light output, improved contrast, and to minimize screen charging effects.



BOTTOM VIEW

12M

MECHANICAL DATA

BASE: Small Shell Duodecal 6–Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1	Heater	Pin 11	Cathode
Pin 2	Grid #1	Pin 12	Heater
Pin 6	Grid #4	Cap	Grids #3 and #5 (Collector)
Pin 10	Grid #2		

GENERAL DATA

	10UP7A	10UP14A
Phosphor	#7	#14
Fluorescence	Blue	Blue
Phosphorescence	Yellow	Orange
Persistence	Long	Medium–Long
Focusing Method	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic
Deflection Angle	50^0	50^0

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3	volts
Heater Current	0.6 ± 10%	amps.
Peak Heater–Cathode Voltage: ♦		
Heater Negative with Respect to Cathode	180	volts DC
Heater Positive with Respect to Cathode	180	volts DC

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to all other electrodes	6.5	
Cathode to all other electrodes	5	

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ▲	12,000	volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000	volts DC
Grid #2 Voltage	700	volts DC
Grid #1 Voltage:		
Negative–Bias Value	180	volts DC
Positive–Bias Value *	0	volts DC
Positive–Peak Value	0	volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage ▲	10,000	volts DC
Grid #4 Voltage (Focusing Electrode) ●	−150 to +150	volts DC
Grid #2 Voltage	300	volts DC
Grid #1 Voltage ⊕	−28 to −72	volts DC
Line Width ■	0.015	inch max.
Spot Position (undeflected) □	0.50	inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5	max. Megohm

Tentative Data

Printed in U.S.A.

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.*

▲ *Collector, Grids #3 and #5 are connected internally and referred to as Collector. Brilliance and definition decrease with decreasing collector voltages. In general collector voltage should not be less than 7,000 volts.*

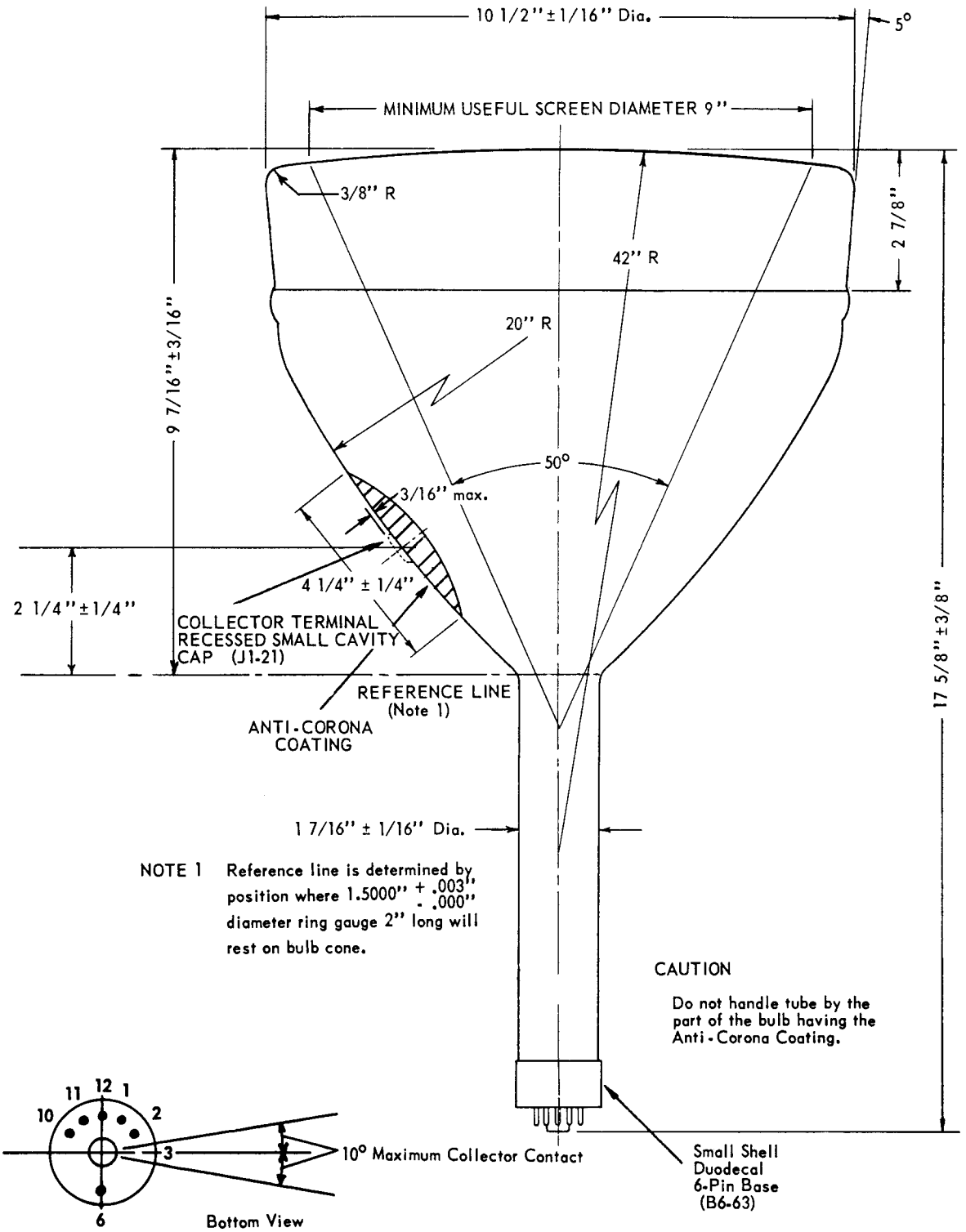
⧫ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

● *With grid #1 voltage adjusted to produce a collector current of 100 μA., with the pattern adjusted for best overall focus. Measured with a 525-line interlaced and synchronized 6X8 inch pattern, with interlaced line blanking (current measured before applying blanking).*

⊕ *Visual extinction of focused 6X8 inch raster pattern.*

■ *Measured with a 525-line interlaced and synchronized pattern with interlaced line blanking. Pattern width adjusted to 90% of minimum useful screen diameter. Ib-100 μA., measured before applying blanking. Line width is the merged raster height divided by the number of lines (262.5) (measured in center of tube face). The line width under this condition will be 0.015 inch maximum (current measured before applying).*

□ *The center of the undeflected, focused spot will fall within a circle of 1/2-inch radius concentric with the center of the tube face, with tube shielded.*


10 1/2" ± 1/16" Dia.
5°
MINIMUM USEFUL SCREEN DIAMETER 9"
3/8" R
42" R
20" R
2 7/8"
9 7/16" ± 3/16"
50°
3/16" max.
4 1/4" ± 1/4"
2 1/4" ± 1/4"
COLLECTOR TERMINAL
RECESSED SMALL CAVITY
CAP (J1-21)
REFERENCE LINE
(Note 1)
ANTI-CORONA
COATING
17 5/8" ± 3/8"
1 7/16" ± 1/16" Dia.
NOTE 1 Reference line is determined by position where 1.5000" + .003" - .000" diameter ring gauge 2" long will rest on bulb cone.
CAUTION
Do not handle tube by the part of the bulb having the Anti-Corona Coating.
11
12
1
10
2
3
6
10° Maximum Collector Contact
Small Shell
Duodecal
6-Pin Base
(B6-63)
Bottom View

Excellence in Electronics

TYPE 10WP7 10WP14 10WP19

The type 10WP — is a 10-inch electrostatic focus and magnetic deflection cathode-ray tube suitable for radar applications. A low-voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the 10WP — employs a high resolution electron gun,

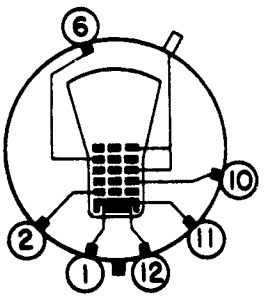
MECHANICAL DATA

BASE: Small Shell Duodecal 6-Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 11 Cathode
Pin 2 Grid #1	Pin 12 Heater
Pin 6 Grid #4	Cap Grids #3 and #5 (Collector)
Pin 10 Grid #2	



BOTTOM VIEW

12M

ELECTRICAL DATA

GENERAL CHARACTERISTICS:

	10WP7	10WP14	10WP19
Phosphor	#7	#14	#19
Fluorescence	Blue	Blue	Orange
Phosphorescence	Yellow	Orange	Orange
Persistence	Long	Medium-long	Long
Focusing Method	Electrostatic	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic	Magnetic
Deflection Angle	50°	50°	50°

HEATER CHARACTERISTICS:

Heater Voltage	6.3	volts
Heater Current	0.6 ± 10%	amps.
Peak Heater-Cathode Voltage: ♦		
Heater Negative with Respect to Cathode		
During warm-up period not to exceed 15 sec.	410	volts DC
After equipment warm-up period	180	volts DC
Heater Positive with Respect to Cathode	180	volts DC

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu fds.$) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ▲	12,000	volts DC
Grid #4 Voltage (Focusing Electrode)	-500 to +1000	volts DC
Grid #2 Voltage	700	volts DC
Grid #1 Voltage:		
Negative-Bias Value	180	volts DC
Positive-Bias Value *	0	volts DC
Positive-Peak Value	0	volts

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage ▲	10,000	volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300	volts DC
Grid #4 Current	-15 to +15	
Grid #2 Voltage	300	volts DC
Grid #1 Voltage ⊕	-28 to -72	volts DC
Line Width ■	0.017	inch max.
Spot Position (undeflected) □	0.5	inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5	inch max.

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

December 15, 1955 NEWTON 58, MASS.

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts. The screen of the 10WP19 can be permanently damaged should the current density be permitted to rise too high. To prevent burning, minimum beam current densities should be employed.*

▲ *Collector, Grids #3 and #5 are connected internally and referred to as Collector. Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 7,000 volts.*

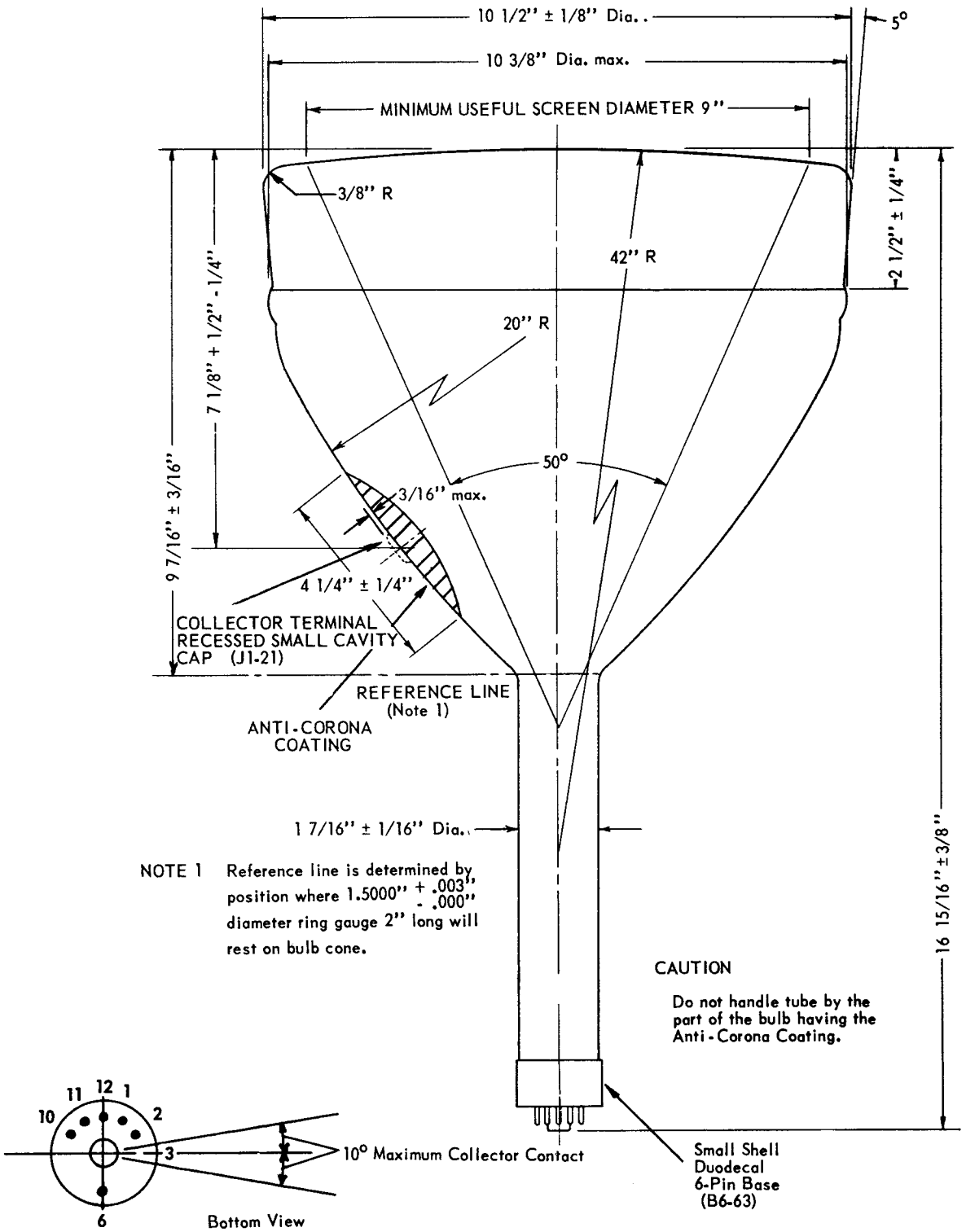
♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

● *With grid #1 voltage adjusted to produce a collector current of 100 μA, with the pattern adjusted for best overall focus. Measured with a 525-line interlaced and synchronized 6X8 inch pattern, with interlaced line blanking (current measured before applying blanking).*

⊕ *Visual extinction of focused 6X8 inch raster pattern.*

■ *Measured with a 525-line interlaced and synchronized pattern with interlaced line blanking. Pattern width adjusted to 90% of minimum useful screen diameter. Ib-100 μA., measured before applying blanking. Line width is the merged raster height divided by the number of lines (262.5) (measured in center of tube face). To avoid damage to the screen of the 10WP19, it is recommended that the screen current be not more than 50 μA. when measuring line width. The line width under this condition will be 0.016 inch maximum (current measured before applying blanking).*

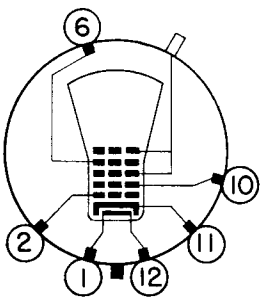
□ *The center of the undeflected, focused spot will fall within a circle of 1/2-inch radius concentric with the center of the tube face, with tube shielded.*


10 1/2" ± 1/8" Dia..
5°
10 3/8" Dia. max.
MINIMUM USEFUL SCREEN DIAMETER 9"
3/8" R
42" R
2 1/2" ± 1/4"
7 1/8" + 1/2" - 1/4"
20" R
9 7/16" ± 3/16"
50°
3/16" max.
4 1/4" ± 1/4"
COLLECTOR TERMINAL
RECESSED SMALL CAVITY
CAP (J1-21)
REFERENCE LINE
(Note 1)
ANTI-CORONA
COATING
1 7/16" ± 1/16" Dia.
16 15/16" ± 3/8"
NOTE 1 Reference line is determined by position where 1.5000" + .003" - .000" diameter ring gauge 2" long will rest on bulb cone.
CAUTION
Do not handle tube by the part of the bulb having the Anti-Corona Coating.
12
1
2
3
6
10
11
10° Maximum Collector Contact
Small Shell
Duodecal
6-Pin Base
(B6-63)
Bottom View

TYPE 12ABP7 12ABP7A 12ABP14 12ABP14A 12ABP19A

The type 12ABP— is a 12–inch electrostatic focus and magnetic deflection cathode–ray tube suitable for radar applications. A low–voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the 12ABP— employs a high resolution electron gun.

The final A designates a metallized screen for greater light output, improved contrast, and minimizing screen charging effects.



BOTTOM VIEW

12M

MECHANICAL DATA

BASE: Small Shell Duodecal 6–Pin

CAP: Recessed Small Cavity

TERMINAL CONNECTIONS:

Pin 1	Heater	Pin 11	Cathode
Pin 2	Grid #1	Pin 12	Heater
Pin 6	Grid #4	Cap	Grids #3 and #5 (Collector)
Pin 10	Grid #2		

MOUNTING POSITION: Any

GENERAL DATA

	12ABP7 12ABP7A	12ABP14 12ABP14A	12ABP19A
Phosphor	#7	#14	#19
Fluorescence	Blue	Blue	Orange
Phosphorescence	Yellow	Orange	Orange
Persistence	Long	Medium-Long	Long
Focusing Method	Electrostatic	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic	Magnetic
Deflection Angle	55°	55°	55°

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3 volts
Heater Current	0.6 ± 10% amps.
Peak Heater-Cathode Voltage: (Max.)	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ▲	12,000 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative–Bias Value	180 volts DC
Positive–Bias Value *	0 volts DC
Positive–Peak Value	0 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage ▲	10,000 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300 volts DC
Grid #2 Voltage	300 volts DC
Grid #1 Voltage ⊕	−28 to −72 volts DC
Line Width ■	0.019 inch max.
Spot Position (undeflected) □	5/8 inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 max. megohms

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

May 15, 1957

NEWTON 58, MASS.

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.*

▲ *Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 8000 volts.*

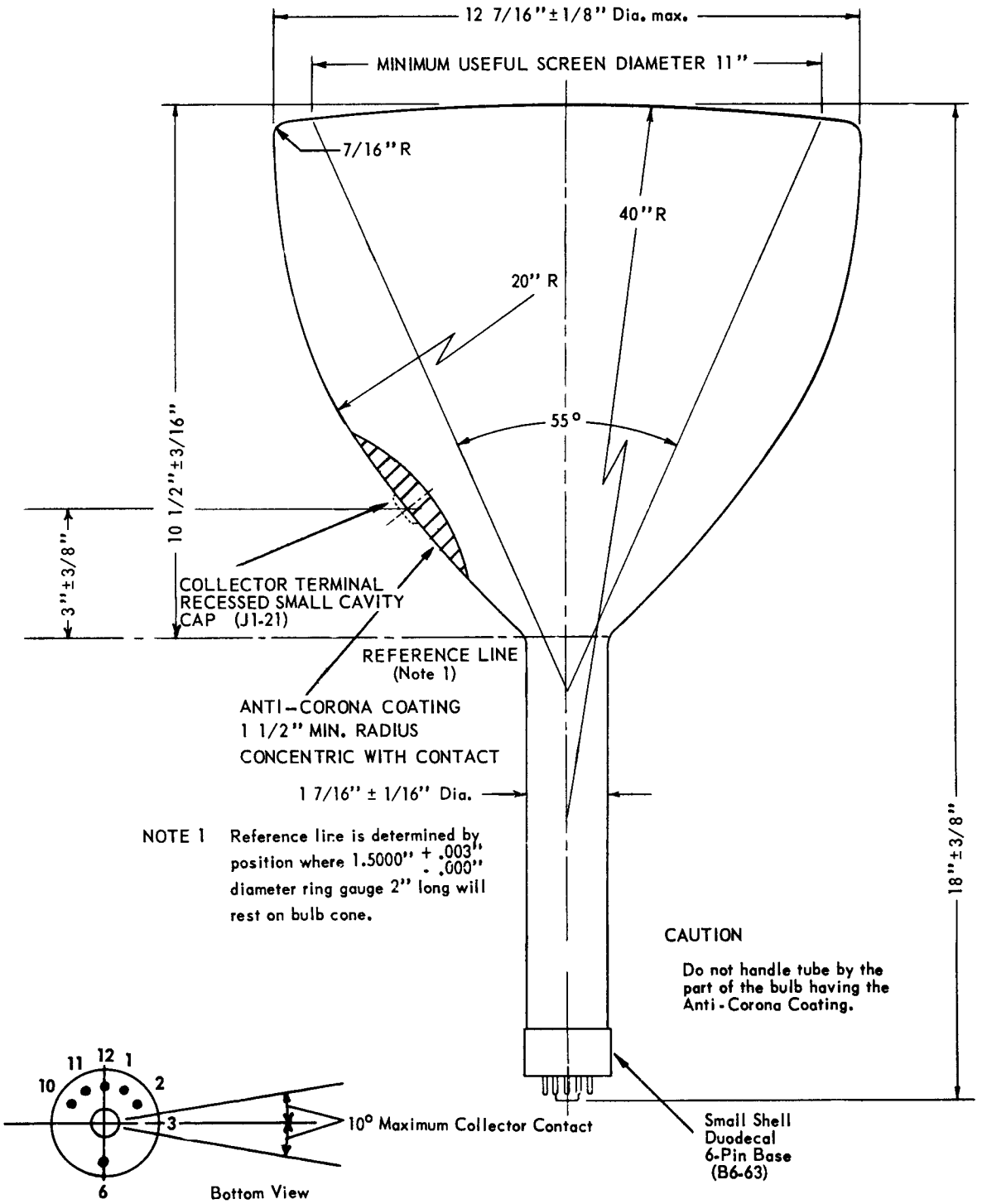
♦ *Cathode should be returned to one side or to the mid–tap of the heater transformer winding.*

● *With grid #1 voltage adjusted to produce a collector current of 100 μA, with the pattern adjusted for best overall focus. Measured with a 525–line interlaced and synchronized 7 ½X 10 inch pattern, with interlaced line blanking (current measured before applying blanking.)*

⊕ *Visual extinction of 7½X 10 inch raster pattern.*

■ *Measured with a 525–line interlaced and synchronized pattern with interlaced line blanking. Pattern width adjusted to 90% of minimum useful screen diameter. Ib – 100 μA., measured before applying blanking. Line width is the merged raster height of divided by the number of lines (262.5) (measured in center of tube face). To avoid damage to the screen of the 12ABP19A, it is recommended that the screen current be not more than 50 μA. when measuring line width. The line width under these conditions will be 0.019 inch maximum (current measured before applying blanking) for P7 and P14 phosphors, and 0.018 inch for the P19A*

□ *The center of the undeflected, focused spot will fall within a circle of 5/8 inch radius concentric with the center of the tube face, with tube shielded.*


12 7/16"±1/8" Dia. max.
MINIMUM USEFUL SCREEN DIAMETER 11"
7/16"R
40"R
20" R
55°
10 1/2"±3/16"
3"±3/8"
COLLECTOR TERMINAL
RECESSED SMALL CAVITY
CAP (J1-21)
REFERENCE LINE
(Note 1)
ANTI–CORONA COATING
1 1/2" MIN. RADIUS
CONCENTRIC WITH CONTACT
1 7/16" ± 1/16" Dia.
NOTE 1 Reference line is determined by position where 1.5000" + .003" - .000" diameter ring gauge 2" long will rest on bulb cone.
CAUTION
Do not handle tube by the part of the bulb having the Anti-Corona Coating.
18"±3/8"
12
1
2
3
6
10
11
10° Maximum Collector Contact
Bottom View
Small Shell
Duodecal
6-Pin Base
(B6-63)

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

12AT7WA

RELIABLE MINIATURE DOUBLE TRIODE

The 12AT7WA is a heater–cathode type, high–mu double triode of miniature construction, suitable for use in amplifier, mixer, oscillator, multivibrator and computer circuits. The high amplification factor (60) makes it ideal for audio amplifier service where a gain of 40 is easily realized. The low plate resistance plus the ample peak plate current make this type ideal for pulse amplifier and low power servo amplifier service. This type is controlled for cathode interface and is designed for dependable operation under conditions of shock and vibration encountered in mobile, aircraft and missile applications. A heater center tap is provided to permit operation at 12.6 volts or parallel operation at 6.3 volts.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock–Test–Note 3)	630 G
Maximum Vibrational Acceleration (96 hour Fatigue Test–Note 4)	2.5 G
Maximum Bulb Temperature	165 °C
Altitude	60,000 ft.

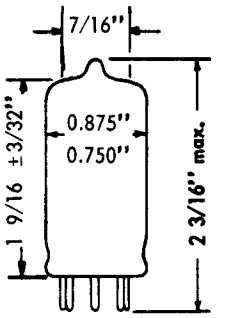
ELECTRICAL DATA

Ratings and Normal Operation		MIL–E–1 Symbol		Test Limit or Design Minimum	Normal Test Conditions	Normal Operation	Test Limit or Design Maximum	MIL–E–1 Units
					Ratings			
Heater Voltage		Ef:	Series	11.4	12.6	12.6	13.9	V
			parallel	5.7	6.3	6.3	6.9	V
Plate Voltage		Eb:		---	250	250	330	Vdc
Grid Voltage		Ec1:		–55	0	0	0	Vdc
Plate Dissipation (per Plate)		Pp/p:		---	---	2.5	2.5	W
Heater–Cathode Voltage		Ehk:		---	---	---	±100	v
Grid Resistance	Fixed Bias	Rg/g:		---	---	---	0.25	Meg.
	Cathode Bias	Rg/g:		---	---	---	0.5	Meg.
					Tests			
Plate Current (1) (per plate)		Ib/p:		7	---	10	14	mAdc
Cathode Resistance (per cathode)		Rk/k:		---	200	200	---	ohms
Transconductance per plate		Sm/p:		4500	---	5500	6500	μmhos
Amplification Factor		Mu/p:		50	---	60	70	---
Heater Current (Series)		If:		142	---	150	158	mA
Plate Current (2) Cut–off (Ec1 = –20 Vdc)		Ib/b:		---	---	---	100	μAdc
Plate Current (1) difference between sections		Δ Ib:		---	---	---	3.2	mAdc

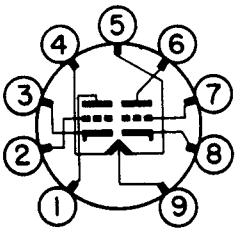
MECHANICAL DATA

ENVELOPE ..... T6½ Glass
OUTLINE ..... JEDEC (6–2)
BASE ..... 9 Pin Miniature
BASING 9A
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Plate, Unit #2
Pin 2	Grid, Unit #2
Pin 3	Cathode, Unit #2
Pin 4	Heater
Pin 5	Heater
Pin 6	Plate, Unit #1
Pin 7	Grid, Unit #1
Pin 8	Cathode, Unit #1
Pin 9	Heater Center–Tap

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Design Minimum	Normal Test Conditions	Normal Operation	Test Limit or Design Maximum	MIL-E-1 Units
			Tests			
Vibration (parallel) f=40 cps; G=10	Ep:	---	---	---	100	mVac
Capacitance (no shield)	Cgp:	1.3	---	1.6	1.9	μμf
Capacitance (no shield)	Cin:	2.0	---	2.5	3.0	μμf
Capacitance (no shield) Section 1	Cout:	0.20	---	0.45	0.70	μμf
Capacitance (no shield) Section 2	Cout:	0.16	---	0.38	0.60	μμf
Capacitance (no shield)	Cpp:	0.15	---	0.24	0.33	μμf
Capacitance (no shield)	Chk:	2.1	---	2.8	3.50	μμf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 630 G. 42° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100 °C for 15 seconds and immediately immersed in water at not more than 5 °C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test– A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.5V (heaters in parallel); Ehk = +135 Vdc and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits and meet a maximum Ihk leakage limit of 15 μAdc.

Stability Life Test– Sample is operated for two and twenty hours to evaluate initial electrical stability (Δ_t Sm < 10%).

Survival Rate Life Test – Sample is operated one hundred hours to evaluate inoperatives and early electrical stability.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 165 °C.

Interface Life Test– 500 hours. Sample is operated with Ef = 6.9 V (heaters in parallel) other electrodes disconnected. (Interface resistance < 50 ohms).

Altitude – Sample is subjected to a pressure of 55 ± 5 mmHg to evaluate flashover or corona at the pins of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL–E–1.

For miscellaneous requirements, see 3.6.

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min	Lal	Bogie	Ual	Max	Ald	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION TESTS (see note 3)												
---	Cathode	Coated unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	Outline E9–1	---	---	---	---	---	---	---	---	---	---
4.9.20.3	Variable frequency vibration (1)	Ec = –3 Vdc; Rp = 2,000; Rk = 0 (see note 4)	---	---	Ep	---	---	---	---	100	---	mVac
MEASUREMENT ACCEPTANCE TESTS, PART 1 (see note 5)												
4.10.8	Heater Current		---	---	If	---	146	150	154	---	9	mA
4.10.8	Heater Current		0.4	II	If	142	---	---	---	158	---	mA
4.10.15	Heater–Cathode Leakage	Ehk = +100 Vdc Ehk = –100 Vdc (see note 6)	0.4	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	7 7	--- ---	μAdc μAdc
4.10.6.1	Total Grid Current	Rg = 0.5 Meg (see note 6)	0.4	II	Ic	0	---	---	---	–0.7	---	μAdc
4.10.4.1	Plate Current (1)	(see note 6)	---	---	Ib	---	8.5	10.0	11.5	---	3.4	mAdc
4.10.4.1	Plate Current (1)	(See note 6)	0.4	II	Ib	7.0	---	---	---	14.0	---	mAdc
4.10.4.1	Plate Current (2)	Ec = –20 Vdc; Rp = 0.1 Meg; Rk = 0; Ck = 0 (see note 6)	0.4	II	Ib	---	---	---	---	100	---	μAdc
4.10.9	Transconductance (1)	Ck = 1,000 μf (see note 6)	---	---	Sm	---	5000	5500	6000	---	1000	μmhos
4.10.9	Transconductance (1)	Ck = 1000 μf (see note 6)	0.4	II	Sm	4500	---	---	---	6500	---	μmhos
4.7.5	Continuity and Shorts		0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical–production tests	Outline 6–7	---	---	---	---	---	---	---	---	---	---

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2) Min	Lal	Bogie	Ual	Max	Ald	Units
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.8	Insulation of electrodes	(see note 6) E (g–all) = –100 Vdc E (p–all) = –300 Vdc	2.5	L6	R R	500 500	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.4.1	Plate Current (1) (difference between sections)		2.5	I	Ib	---	---	---	---	3.2	---	mAdc
4.10.4.1	Plate Current (3)	Ec = –7.0 Vdc Rp = 0.1 Meg Rk/k = 0 (see note 6)	2.5	I	Ib	5	---	---	---	---	---	μAdc
4.10.9	Transconductance (2)	Ef = 11.4 V Ck = 1000 μf (see note 6)	2.5	I	$\Delta_{Ef}Sm$	---	---	---	---	15	---	%
4.10.6.2	Grid Emission	Ef = 15.0 V Ec = –20 Vdc; Rg/g = 0.5 Meg Rk = 0; Ck = 0 (see notes 6 and 7)	2.5	I	Ic	0	---	---	---	–1.5	---	μAdc
4.10.3.1	Radio–frequency noise (other than shot–effect noise)	Ecal = 15 mVac Rk = 100; Ck = 0.2 μf (see notes 4 and 8)	2.5	I	---	---	---	---	---	---	---	---
4.10.3.4	Noise and microphonics (for reliable receiving tubes)	Ef = 12.6 Vdc; Ebb = 300 Vdc; Ecal = 100 mVac; Rk = 200; Rp = 10,000; grid grounded; Ck = 1,000 μf (see notes 4 and 9)	2.5	I	---	---	---	---	---	---	---	---
---	Pulse cathode current	Ef = 12.6 V Eb = 250 Vdc; Ec = –30 Vdc; Rk = 1.0 (see notes 6 and 10)	2.5	Code H	ik	280	---	---	---	---	---	ma
4.10.11.1	Amplification factor	(see note 6)	6.5	L6	Mu	50	---	---	---	70	---	---
4.10.14	Direct Interelectrode capacitance	No shield No shield No shield; section 1 No shield; section 2 No shield No shield	6.5	Code E	Cgp Cin Cout Cout Cpp Chk	1.30 2.00 0.20 0.16 0.15 2.10	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	1.90 3.00 0.70 0.60 0.33 3.50	--- --- --- --- --- ---	μμf μμf μμf μμf μμf μμf
4.9.12.1	Low–pressure voltage breakdown	Pressure = 55 ± 5 mmHg; voltage = 500 Vac	6.5	(See Note 11	---	---	---	---	---	---	---	---
4.9.19.1	Low–frequency vibration (2)	Ec = –3 Vdc; Rp = 2,000; Rk = 0; Ck = 0; G = 10; F = 40 cps (see note 4)	6.5	Code I	Ep	---	---	---	---	100	---	mVac
DEGRADATION RATE ACCEPTANCE TESTS, (see note 12)												
4.9.20.5	Shock test	Hammer angle = 42°; Ehk = +100 Vdc (see note 13)	---	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min. 60 max.	6.5	(See Note 11	---	---	---	---	---	---	---	---
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep	---	---	---	---	150	---	mVac
		Heater-cathode leakage										
		Ehk = +100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Ehk = –100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Transconductance (1)	---	---	Sm	3800	---	---	---	---	---	μmhos
		Grid Current	---	---	Ic	0	---	---	---	–1.5	---	μAdc

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min	Lal	Bogie	Ual	Max	Ald	
4.9.6.1	Miniature–tube base–strain		---	---	---	---	---	---	---	---	---	---
4.9.6.3	Glass strain (for receiving tubes)		2.5	I	---	---	---	---	---	---	---	---
4.11.7	Heater–cycling life test	Ef=7.5 V; heaters in parallel Ehk=+135 Vdc (see note 14)	---	---	---	---	---	---	---	---	---	---
4.11.4	Life–test end points	Heater cathode leakage										
		Ehk=+100 Vdc	---	---	Ihk	---	---	---	---	15	---	μAdc
		Ehk=–100 Vdc	---	---	Ihk	---	---	---	---	15	---	μAdc
---	Stability life test	Ehk=+135 Vdc Rg/g=0.5 meg. TA=room (see note 15)	1.0	Code I	---	---	---	---	---	---	---	---
4.11.4	Life–test end points (stability) (2 and 20 hours)	Change in transconductance (1) of individual tubes	---	---	Δ_tSm	---	---	---	---	10	---	%
4.11.3.1(b)	Survival–rate life test	Stability life test conditions or equivalent (see notes 16 and 17)	---	II	---	---	---	---	---	---	---	---
4.11.4	Life–test end points (survival rate) (100 hours)	Continuity and shorts	0.65	---	---	---	---	---	---	---	---	---
		Transconductance (1)	1.0	---	Sm	3800	---	---	---	---	---	μmhos
4.11.5	Intermittent life–test operation	Stability life test conditions; T(envelope)= 165°C min (see notes 18 and 19)	---	---	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per characteristic		Sym.	LIMITS		Units
					First Sample	Combined Sample		Min	Max	
ACCEPTANCE LIFE TESTS (cont'd.)										
4.11.4	Life–test end points (intermittent) (500 hours)	(See note 20)								
		Inoperatives (See note 21)	---	---	1	3	---	---	---	---
		Total grid current	---	---	1	3	Ic	0	–0.7	μA
		Heater Current	---	---	1	3	If	142	162	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	20	%
		Transconductance (2)	---	---	1	3	Δ_{Ef}Sm	---	15	%
		Heater–cathode leakage								
		Ehk=+100 Vdc	---	---	1	3	Ihk	---	7	μAdc
		Ehk=–100 Vdc					Ihk	---	7	μAdc
		Insulation of electrodes								
		E(g–all)=–100V	---	---	1	3	R	250	---	Meg.
		E(p–all)=–300 V					R	250	---	Meg.
		Transconductance (1) average change	---	---	---	---	AvgΔ_tSm	---	15	%
		Total defectives	---	---	3	6	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Sym.	LIMITS		Units
					First Sample	Combined Sample		Min.	Max.	
ACCEPTANCE LIFE TESTS (cont'd.)										
4.11.4	Life–test end points (intermittent) (1000 hours)	(See note 20) Inoperatives (see note 21)	---	---	1	3	---	---	---	---
		Total grid current	---	---	1	3	Ic	0	–0.7	μAdc
		Heater current	---	---	1	3	If	142	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_{tSm}	---	25	%
		Transconductance (2)	---	---	1	3	Δ_{EfSm}	---	20	%
		Heater–cathode leakage								
		Ehk=+100 Vdc	---	---	1	3	Ihk	---	7	μAdc
		Ehk=–100 Vdc					Ihk	---	7	μAdc
		Insulation of electrodes								
		E(g–all)=–100 Vdc	---	---	1	3	R	100	---	Meg
		E(p–all)=–300 Vdc					R	100	---	Meg
		Total defectives	---	---	4	8	---	---	---	---
4.11.8	Cathode interface life test	Ef=6.9 V; heaters in parallel; other electrodes disconnected (see note 22)	---	---	---	---	t	500	---	hr
4.11.4	Life–test end points	Ef=5.7±0.05 Vdc, heaters in parallel, Eb=135 Vdc; Ec/Ib=2.0 mAdc (see notes 23 and 24)	---	---	1	3	Ri	---	50	ohm
4.9.18	Container drop (see note 25)	(d) Package group 1, container size B								

Note 1: The sequence of tests listed hereon is the suggested order in which the tests should be conducted.

Note 2: Variables sampling procedure (see 4.1.1.7).

Note 3: All tests listed hereon shall be performed during qualification; however, these three tests are normally performed qualification inspection only.

Note 4: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 5: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperatives and mechanical shall be 1 percent.

Note 6: Test each unit separately.

Note 7: Prior to this test, tubes shall be preheated a minimum of 5 minutes with all sections operating at the conditions indicated below. The 3–minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef V	Ec1 Vdc	Eb Vdc	Rk/k ohms	Rg/g Meg
15.0	0	250	200	0.5

Note 8: In addition to the rejection criteria of 4.10.3.1, the output shall be read on a VU meter using a rejection limit of 5 VU. Five VU is the meter deflection obtained with a steady state output of 3 mW from the amplifier.

NOTES (con't)

Note 9: The rejection level shall be set at the VU meter reading obtained during calibration.

Note 10: The grid is driven with a pulse voltage as follows: egk=+30 v; prr=1000; tp=10 μs; tr<1 μs; tf<1 μs (egk shall be defined as the instantaneous peak voltage between the grid and the negative end of the cathode resistor). Peak cathode current shall be measured by means of a high impedance oscilloscope, or equivalent, device connected across a cathode resistor of 1.0 ohm. Pre-heat at Ef=12.6 V for 5 minutes; no other voltages applied.

Note 11: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until one lot passes. Standard MIL-STD-105, sample size code letter F, shall apply.

Note 12: Destructive tests. Tubes subjected to the following destructive tests shall not be delivered on the contract or order:

- 4.9.20.5 Shock test
- 4.9.20.6 Fatigue test
- 4.11.7 Heater-cycling life test
- 4.11.5 Intermittent life-test operation
- 4.11.8 Cathode interface life test

Note 13: A grid resistor of 0.1 Meg shall be added to each section; however, this resistor shall not be used when a thyratron-type short indicator is employed.

Note 14: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater-cathode short, or heater-cathode leakage current in excess of the specified heater-cycling life-test end-point limit.

Note 15: Stability life test. See 20.2.5.1 of Appendix C.

Note 16: Survival-rate life test. See 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 17: For survival-rate life test, the equivalent stability life-test conditions shall be so specified in 20.2.5.2.5 of Appendix C.

Note 18: Intermittent life tests. See 20.2.5.3 of Appendix C.

Note 19: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B&S or smaller diameter elements welded to a ring of 0.025-inch diameter phosphor bronze in contact with the envelope. The envelope temperature requirement will be satisfied if a tube having bogie plate current (±5 percent) under normal test conditions, is determined to operate at or above the minimum specified temperature in any position of the life-test rack.

Note 20: Order for evaluation of life-test defects. See 4.11.3.1.2.

Note 21: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1 except tube shall not be tapped), permanent short (see 4.7.2 except tube shall not be tapped), air leaks. (See 4.7.6)

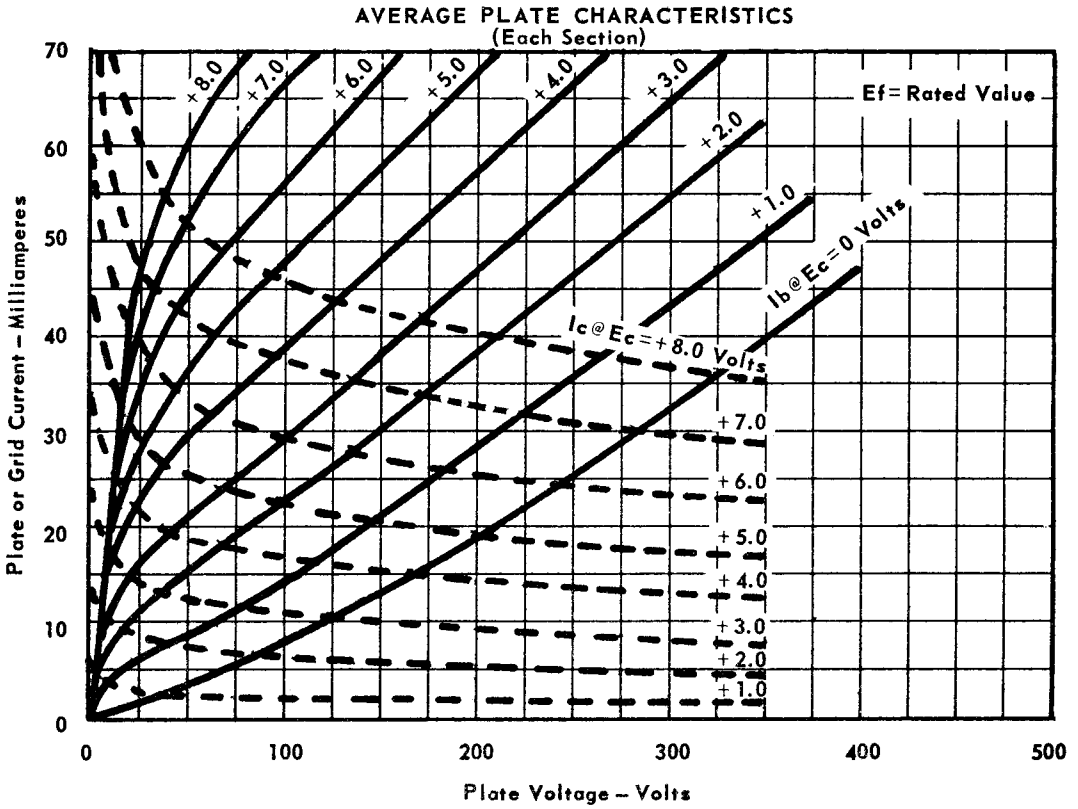
Note 22: The cathode interface life-test sample shall consist of 20 tubes, and not more than one tube failure shall be permitted. In the event of rejection of the first sample due to failure of more than one tube, a second sample of 40 tubes shall be selected from the lot. Acceptance shall then be based on the combined first and second samples. The total tube failures from the combined first and second samples shall not exceed three. A life-test defect is defined as a failure to meet the life-test end-point limits as specified on the tube specification sheet. The cathode interface life-test sample shall be read at zero hours and 500 hours (plus 48 hours, minus 24 hours).

NOTES: (cont'd.)

Note 23: Preheat approximately 5 minutes prior to testing, using either Ef=11.4 V (heaters in series) or Ef=5.7 V (heaters in parallel), other electrodes disconnected. No other test shall be made from the start of the cathode interface life test until after the measurement of the end point characteristic, following completion of the indicated minimum number of life–test hours.

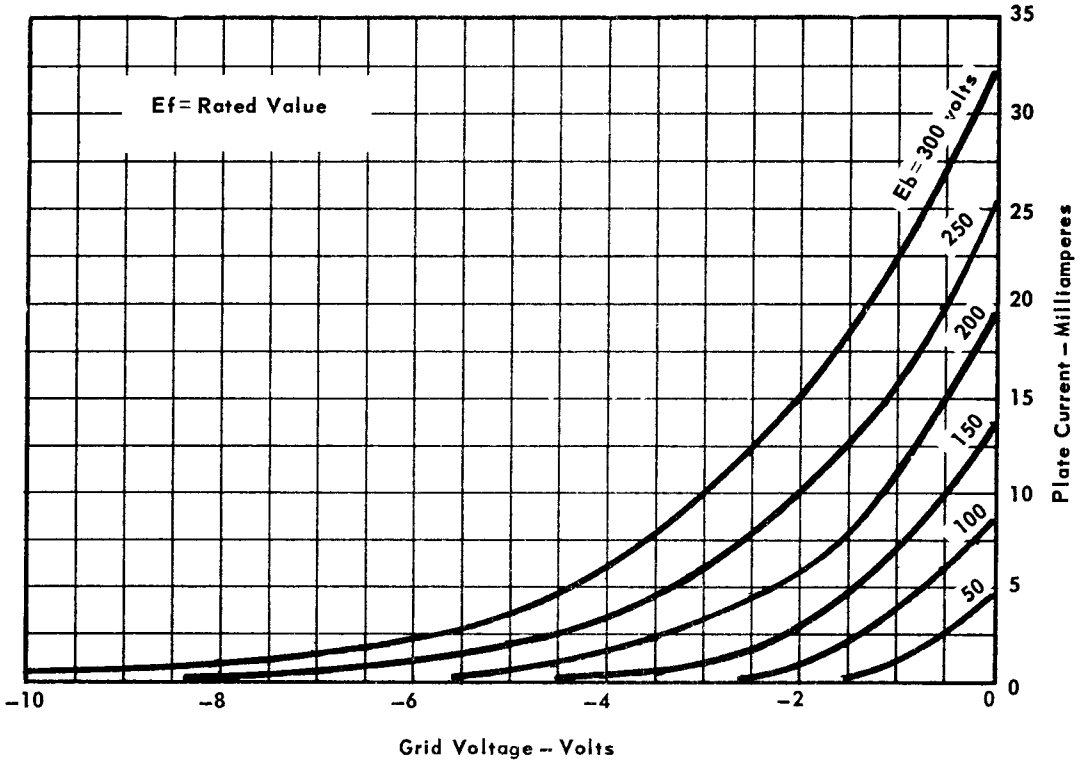
Note 24: The value of interface resistance shall be measured in the standard test circuit. Drawing 248–JAN. As an alternative, a test method known to correlate with the method and conditions specified in this specification sheet may be utilized.

Note 25: Not required for qualification.



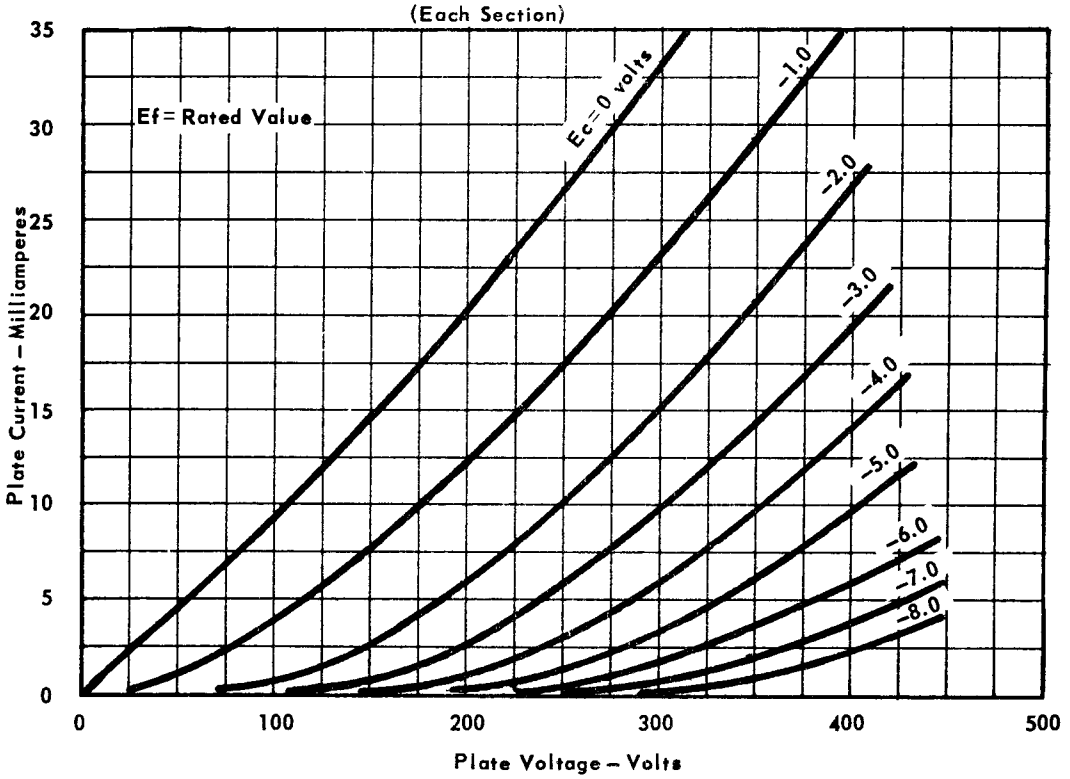
RELIABLE MINIATURE DOUBLE TRIODE

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

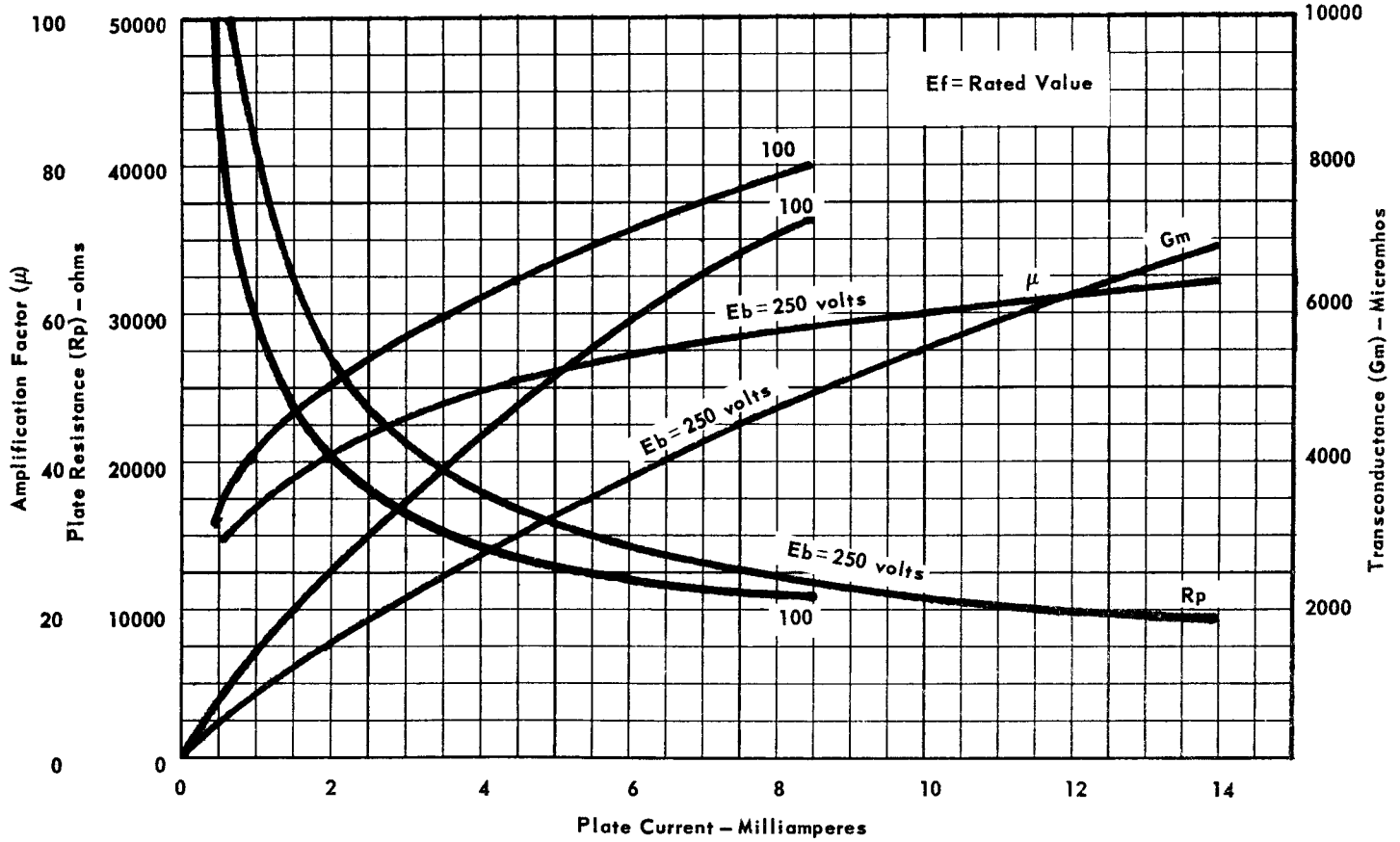
(Each Section)



12AT7WA

RELIABLE MINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS
(Each Section)



RMA Release # 1 9 2

12B7 TENTATIVE DATA 12B7
RAYTHEON TYPE 12B7

PENTODE
REMOTE CUTOFF AMPLIFIER
Heater Type
Glass Bulb Locking Base

The 12B7 is a pentode type amplifier tube with remote cutoff characteristics designed for use as a high frequency amplifier in radio receivers.

BULB: T-9 Glass

BASE: Locking 8-Pin

DIMENSIONS

Maximum Overall Length	2 25/32	inches
Maximum Seated Height	2 1/4	inches
Maximum Diameter	1 3/16	inches

BASING (RMA Numbering)

Pin 1 - Heater
Pin 2 - Plate
Pin 3 - Screen (G_2)
Pin 4 - Suppressor (G_3)
Pin 5 - Internal Shield
Pin 6 - Control Grid (G_1)
Pin 7 - Cathode
Pin 8 - Heater

8V

RATINGS

Heater Voltage (a-c or d-c)	12.6	volts
Heater Current	0.15	amp
Maximum Plate Voltage	250	volts
Maximum Screen Voltage	100	volts

DIRECT INTERELECTRODE CAPACITANCES

G_1 to P (Grid to Plate)	0.005 max.	µµf
G_1 to All Other Electrodes Except P (Input Electrode)	5.5	µµf
P to All Other Electrodes Except G_1 (Output Electrode)	7.0	µµf

TYPICAL AMPLIFIER - CLASS A CONDITIONS

Heater Voltage (a-c or d-c)	12.6	12.6	volts
Plate Voltage	100	250	volts
Screen Voltage	100	100	volts
Grid Bias	-3	-3	volts
Suppressor Voltage	0	0	volts
Plate Resistance (Approx.)	0.25	0.8	megohm
Transconductance	1900	2000	µmhos
Plate Current	8.9	9.2	ma
Screen Current	2.6	2.4	ma
Grid Bias (Approx.) (For Transconductance = 10 µmhos)	-	-55	volts

from RTMA release #1023,
Sept. 24, 1951

RAYTHEON®

TYPE CK512AX

SUBMINIATURE VOLTAGE AMPLIFIER PENTODE

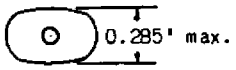
DESCRIPTION

The CK512AX is a filament type subminiature pentode designed primarily for use in resistance coupled audio frequency and direct coupled amplifiers. Typical applications are hearing aids and other wearable or portable instruments. The tube features low battery drain, long life, small size and low microphonic level. The tinned flexible leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length. The suppressor grid consists of two beam-forming detector plates.

MECHANICAL DATA

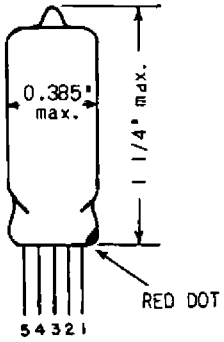
ENVELOPE: T-2X3 Glass

BASE: 0.016" tinned flexible leads with a length of 1.5" minimum and a center-to-center spacing of 0.05".



TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Grid #2
Lead 3 Filament, positive
Lead 4 Grid #1
Lead 5 Filament, negative



VIEW FACING TYPE NUMBER

MOUNTING POSITION: Any

WEIGHT: 0.07 ounces

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)* *

Grid to Plate	0.045
Input	2.0
Output	1.5

RATINGS:

Filament Voltage	0.625	volts
Absolute Maximum Filament Voltage	0.78	volts
Maximum Plate Voltage	45	volts
Maximum Grid #2 Voltage	45	volts

AVERAGE CHARACTERISTICS:

Filament Voltage	0.625	volts
Filament Current	20	ma.
Plate Voltage	22.5	volts
Grid #2 Voltage	22.5	volts
Grid #1 Voltage	-0.625	volts
Plate Current	125	ua.
Grid #2 Current	40	ua.
Transconductance	160	umhos
Plate Resistance	1.25	megohms

TYPICAL OPERATION IN RESISTANCE COUPLED AUDIO FREQUENCY AMPLIFIER:

	First Stage		Second Stage		
Filament Voltage	0.625	0.625	0.625	0.625	volts
Plate & Grid #2 Supply Voltage	15	22.5	15	22.5	volts
Grid #1 Voltage **	0	0	-0.625	-0.625	volts
Plate Resistor ≠	1.0	1.0	1.0	1.0	megohms
Grid #2 Resistor ≠	2.2	2.7	1.0	1.5	megohms
Average Voltage Gain (G1 to P) ≠≠	26:1	37:1	22:1	33:1	
Approx. Voltage Gain (G2 to P)	3:1	4:1	3:1	4:1	

* *Measured without shielding of bulb.*

** *Control grid should be returned through approximately 5 to 22 megohms to negative filament or bias voltage.*

≠ *Other plate and grid #2 resistor values may be used to obtain less variation in voltage gain between tubes at the possible expense of less average gain.*

≠≠ *The values of voltage gain are quoted for a coupled load of 5 megohms, zero source impedance, and a 5 megohm grid resistor. The reactive impedances (Cin, Cout, Cg1, Cg2, CL) are of such values that they have negligible effect upon the gain. See CS-2472-12 on page 4.*

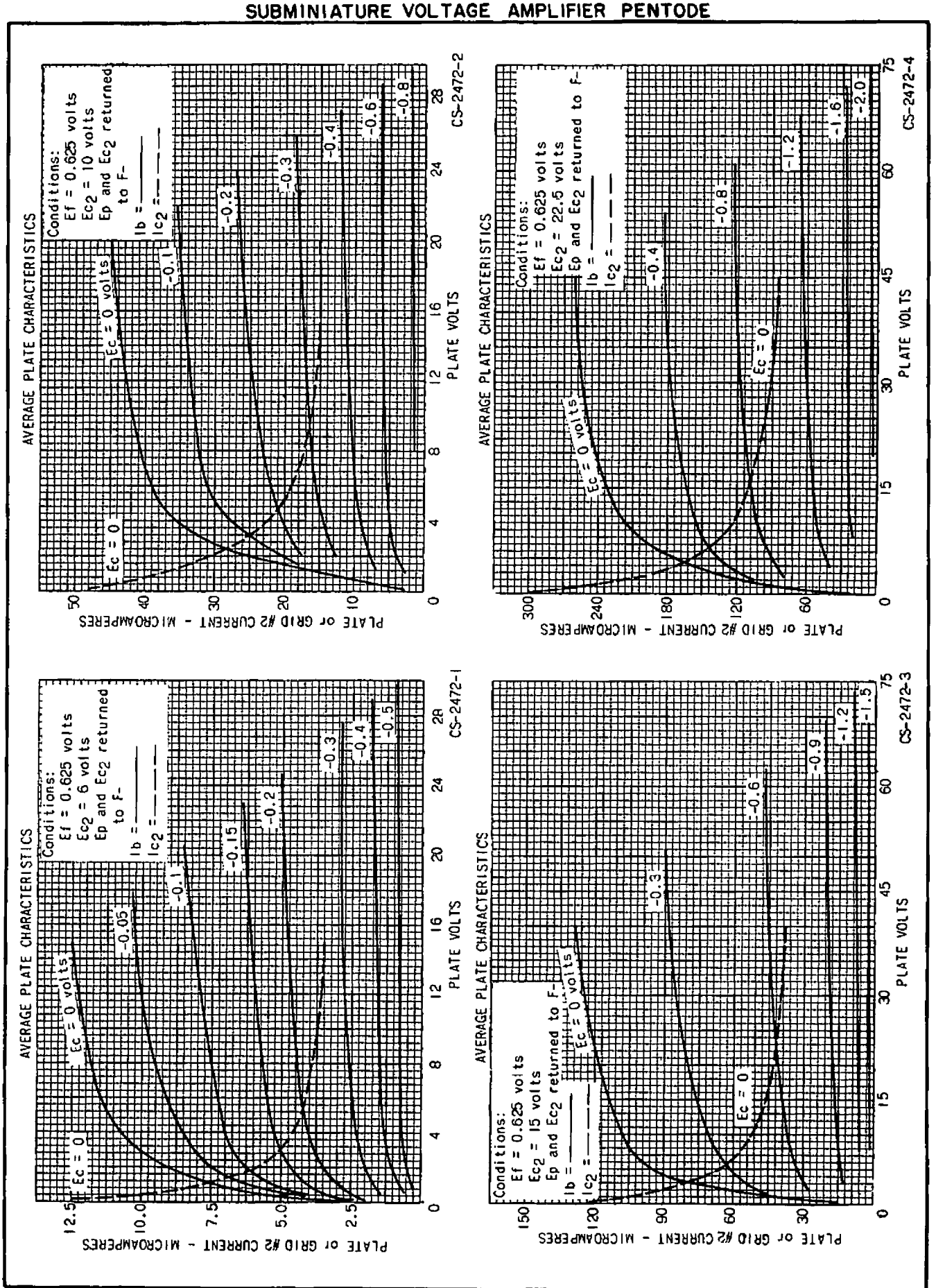
Tentative Data
August 21, 1947

SPECIAL TUBE SECTION — RAYTHEON MANUFACTURING CO.
NEWTON, MASS.

TYPE CK512AX

RAYTHEON®

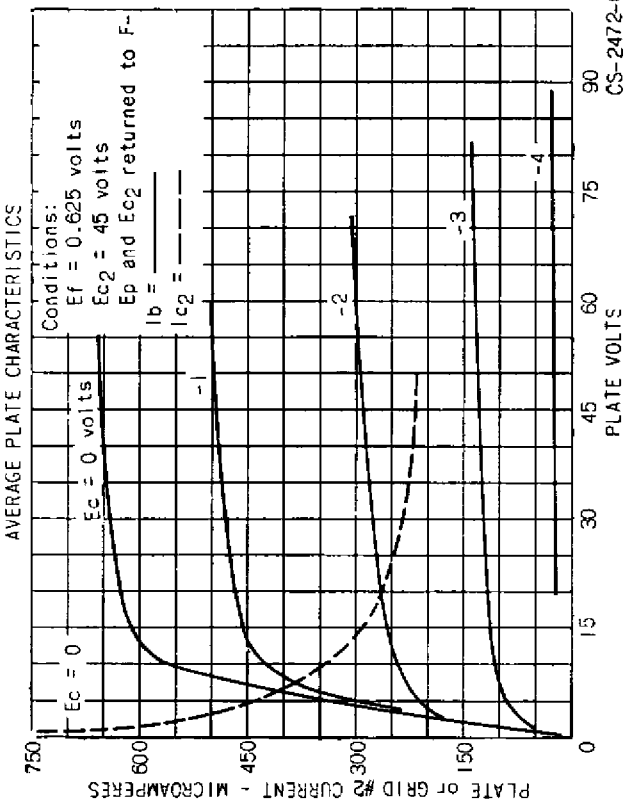
SUBMINIATURE VOLTAGE AMPLIFIER PENTODE

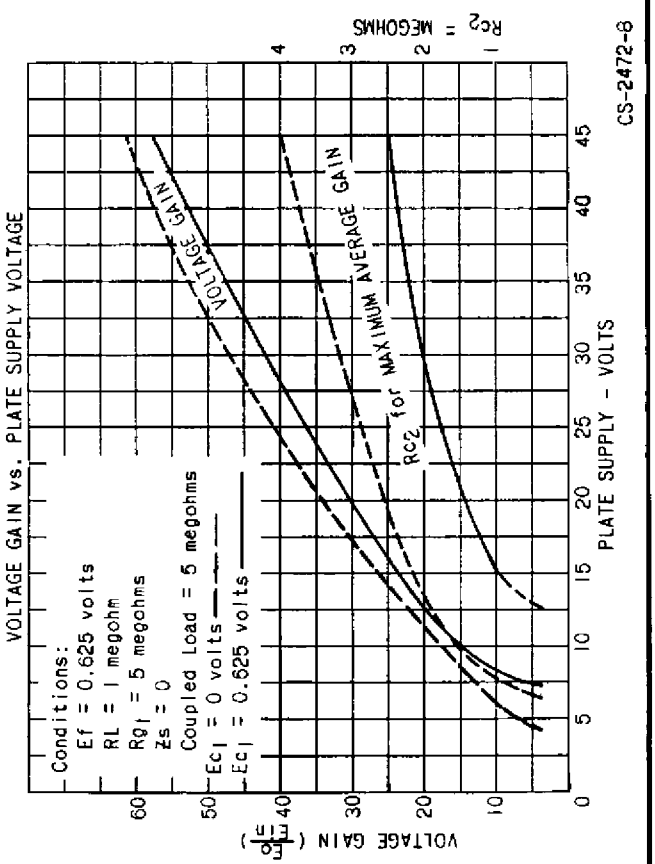


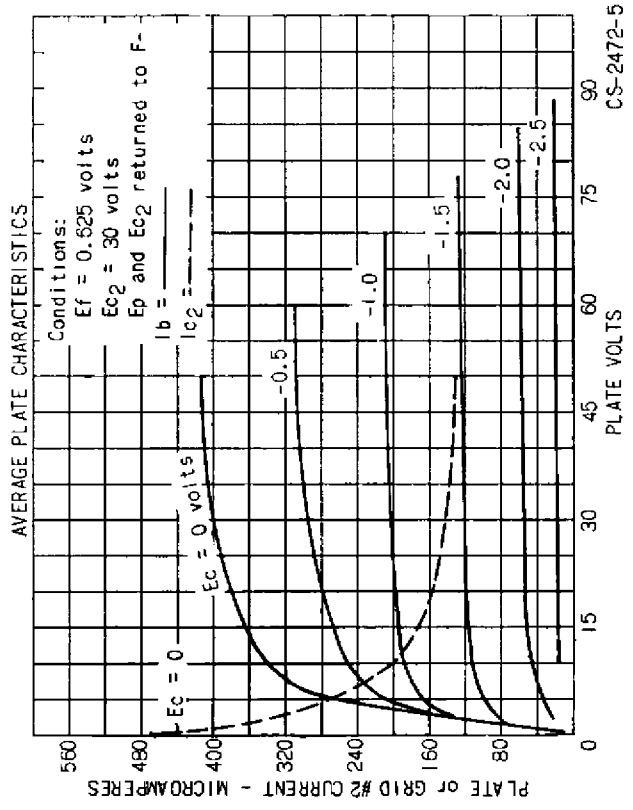
RAYTHEON®

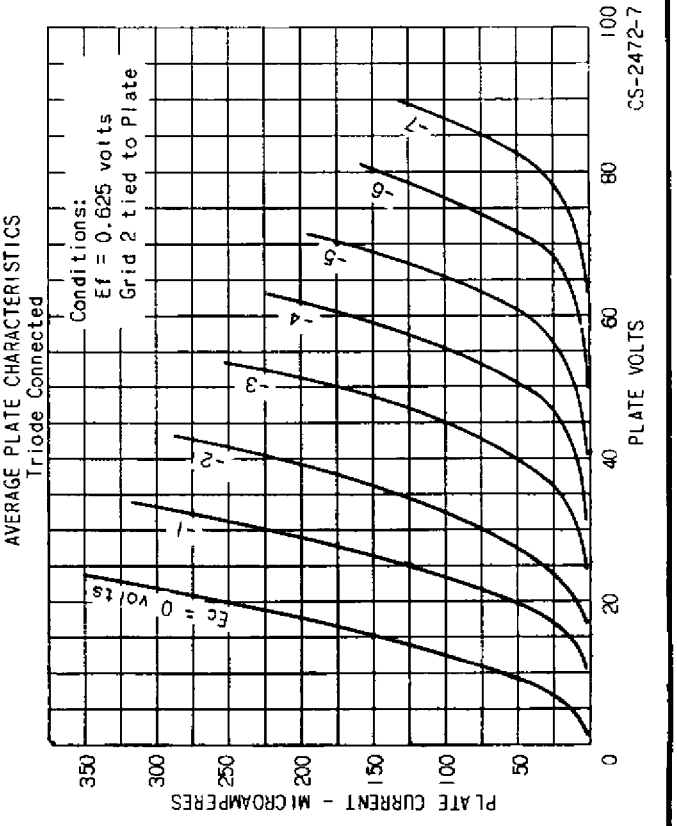
TYPE CK512AX

SUBMINIATURE VOLTAGE AMPLIFIER PENTODE





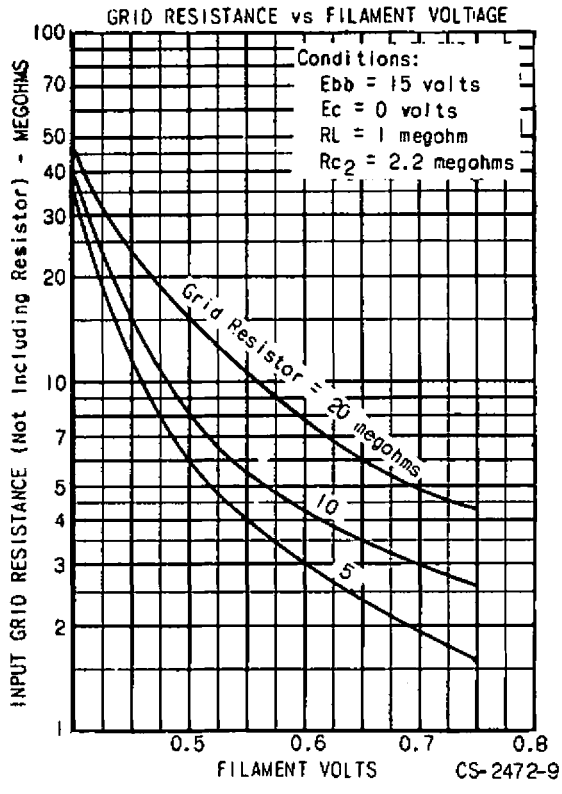


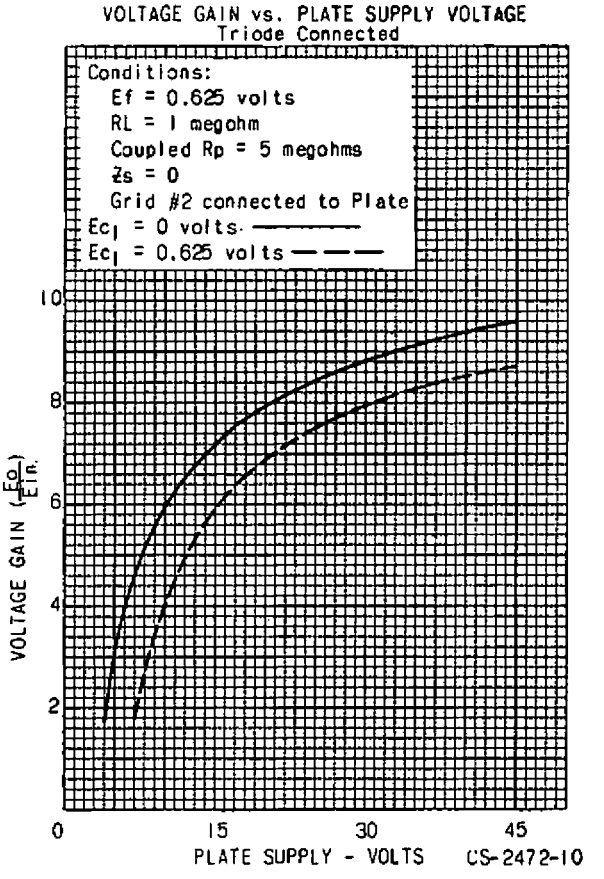


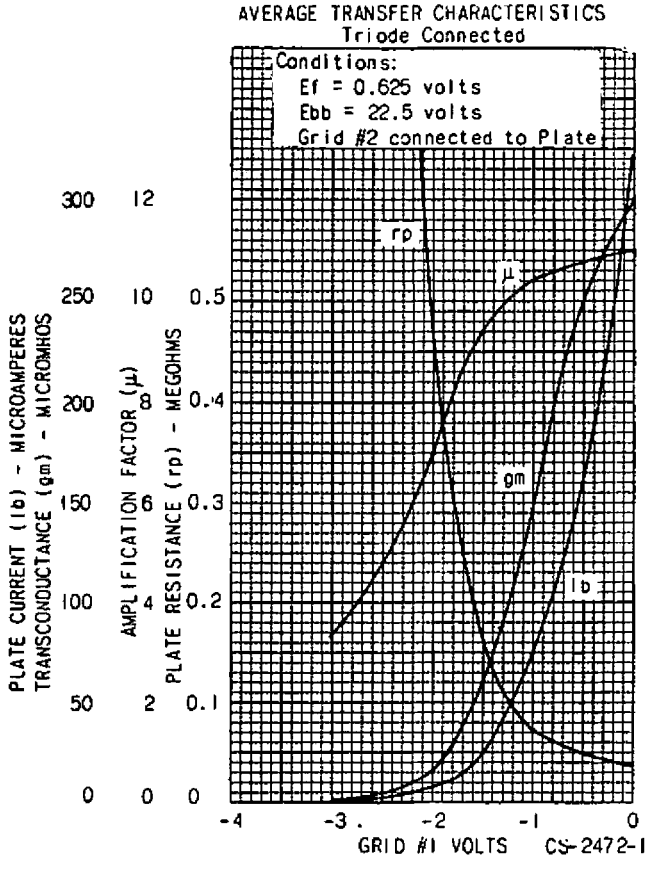
TYPE CK512AX

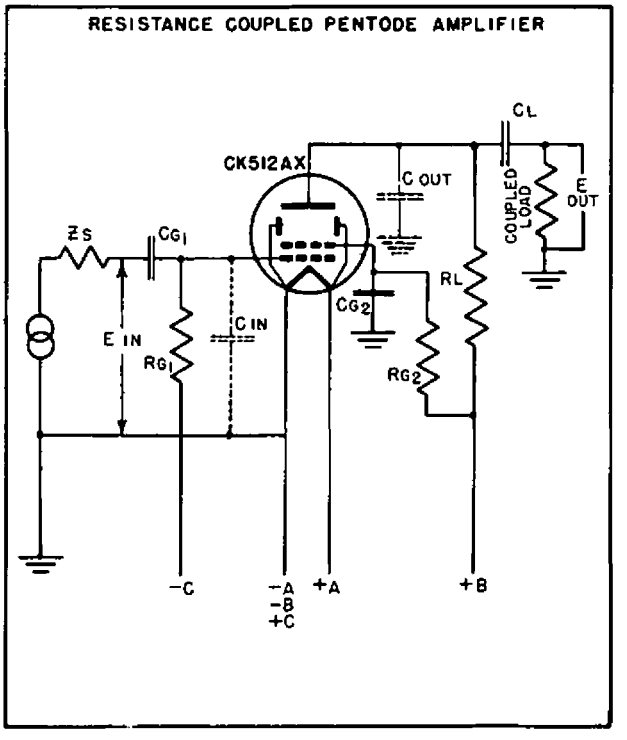
RAYTHEON®

SUBMINIATURE VOLTAGE AMPLIFIER PENTODE





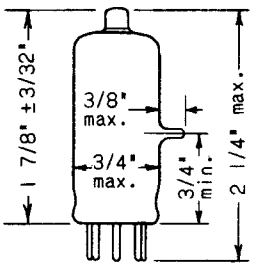


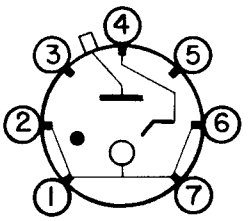


Raytheon Subminiature tubes are made under one or more of the following United States patents owned by Raytheon: 1,963,008; 2,330,838; 2,366,220; 2,376,397; 2,406,422; 2,413,338; 2,266,080; 2,355,083; 2,358,829; 2,366,756; 2,402,797; 2,467,390.

TYPE CK5517

The CK5517 is an instant starting, cold cathode, gas-filled, half-wave rectifier of miniature construction, suitable for high voltage low current power supplies up to 12 ma. output. Several tubes can be operated in cascade to produce very high voltages. The tube features small size, and a starter electrode which enables it to fire at reduced ignition voltage. The CK5517 should be used as a replacement for the former type CK1013 in equipment having load currents from 3 to 12 ma. For equipment having average load currents less than 3 ma., such as electronic photo-flash power supplies, the type CK6174/CK1027 should be used as a replacement for the former type CK1013.





BOTTOM VIEW

5BU

MECHANICAL DATA

ENVELOPE: T-5½ Glass
BASE: Miniature Button 7-Pin
TOP CAP: Skirted Miniature
TERMINAL CONNECTIONS:

Pin 1 Cathode	Pin 5 No Connection ●
Pin 2 Cathode	Pin 6 Cathode
Pin 3 No Connection ●	Pin 7 Cathode
Pin 4 Starter Electrode	Top Cap Anode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Peak Inverse Voltage	2800	volts
Peak Cathode Current (steady state) ♦	100	ma.
Peak Cathode Current (surge) ♦	300	ma.
Average Cathode Current (dc)	12	ma.
Maximum Anode Supply Voltage (peak)	1700	volts
Minimum Anode and Starter Electrode Supply Voltage (RMS) ▲	500	volts
Minimum Anode Supply Impedance	6000	ohms
Maximum Average Starter Electrode Current (Starter Electrode operating as a Cathode) ■	125	μa
Maximum Peak Starter Electrode Current (Starter Electrode operating as a Cathode) ■	300	μa.
Ambient Temperature Range	-50 to +60	°C

CHARACTERISTICS AND TYPICAL OPERATION - HALF-WAVE RECTIFIER 60~SINUSOIDAL OPERATION:

Anode Supply Voltage (Epp) (rms)	1200	volts
Anode Supply Impedance (Zp)	7500	ohms
Starter Electrode Limiting Resistance	10	meg.
Load Current (dc)	12	ma.
Approximate Anode to Cathode Voltage Drop	100	volts
Load Condenser	0.5	μf
Load Resistor	0.09	meg.

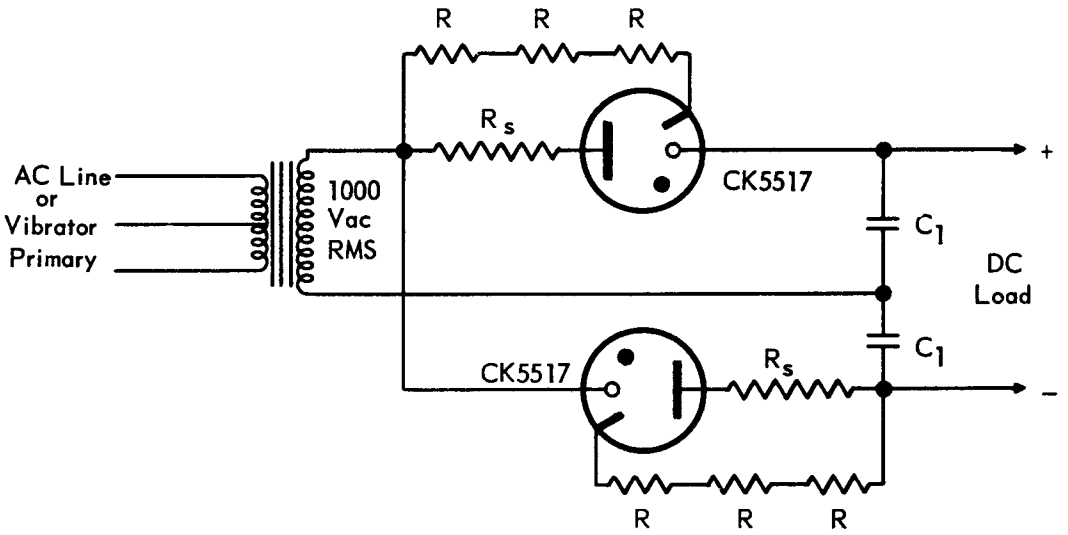
● *The socket terminals for pins 3 and 5 cannot be used as tie point terminal lugs and may not be connected to any other point in the circuit except to the cathode.*

♦ *To avoid damage to the equipment or tube, it is recommended that the anode supply impedance be adjusted to limit forward currents and intermittent reverse peak currents to stated values. Minimum resistance is 6000 ohms minus the effective equivalent transformer impedance, but never less than 2000 ohms dc resistance. For voltage multiplier circuits, a separate limiting resistor should be connected in series with the anode or cathode of each tube. In the event of a reverse arc, the absence of a 2000 ohm surge limiting resistor causes all of the energy of the filter condenser to be dissipated in the tube.*

▲ *With starter electrode connected to anode through 10 megohms of resistance.*

■ *With the starter electrode connected to operate as an anode on the forward half of the cycle, the starter cathode current rating is the only limitation on the starter electrode current.*

TYPICAL VOLTAGE DOUBLER CIRCUIT FOR COLD CATHODE RECTIFIER



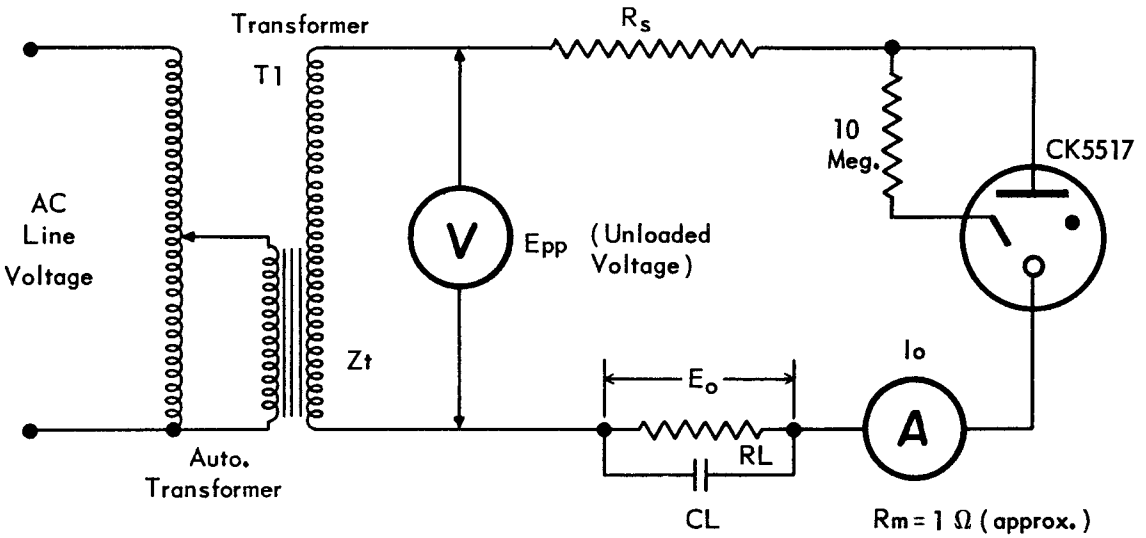
Rs= Surge Resistor. Adjust to keep Peak Cathode Current (steady state) and Peak Cathode Current (surge) within ratings of 100 ma. and 300 ma., respectively. Rs should not be less than 2000 ohms in voltage doubler circuits regardless of transformer characteristics.

R= 3.3 meg., 1/2 watt, 350 Vdc.

C1= 1.0 μf, 1500 V (Typical for 60 cycle operation.)

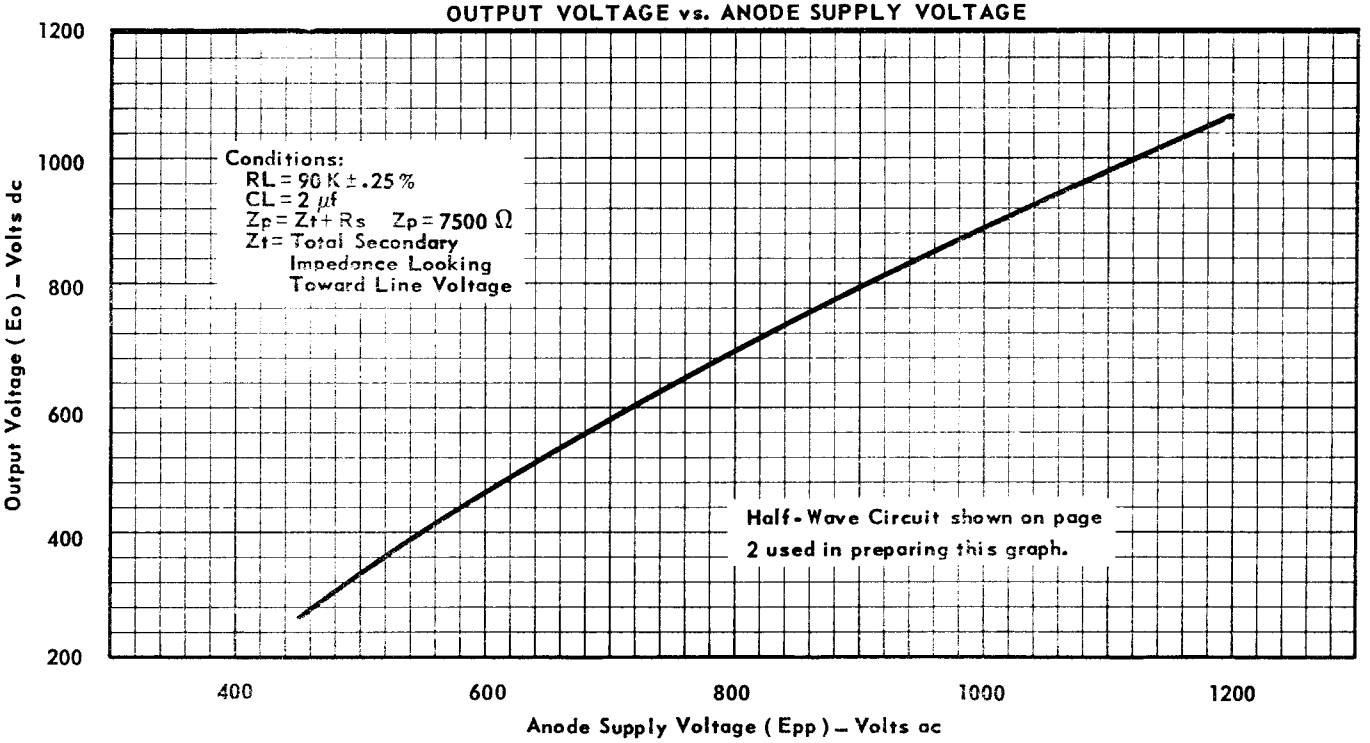
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TYPICAL HALF-WAVE CIRCUIT FOR COLD CATHODE RECTIFIER

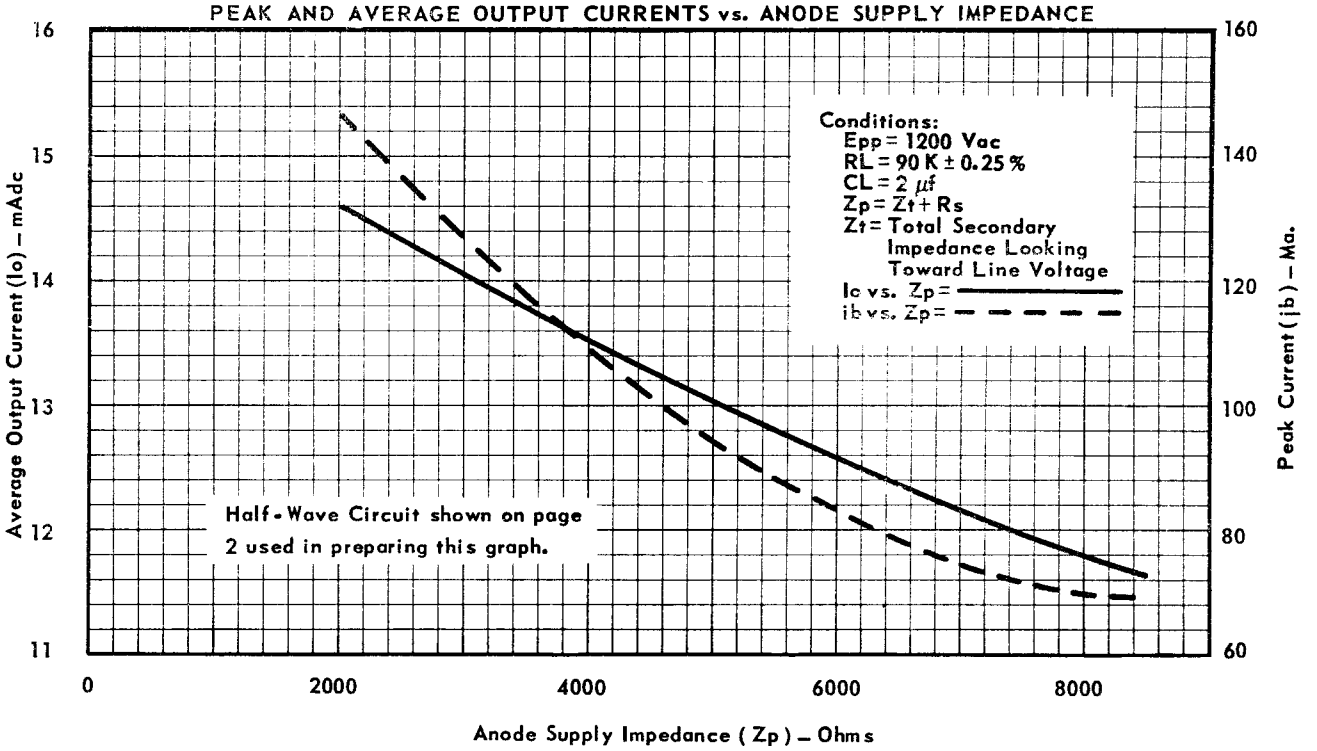


COLD CATHODE HALF-WAVE RECTIFIER

OUTPUT VOLTAGE vs. ANODE SUPPLY VOLTAGE



PEAK AND AVERAGE OUTPUT CURRENTS vs. ANODE SUPPLY IMPEDANCE



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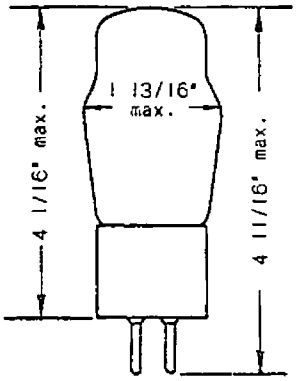
TYPE 5608

DOUBLE TRIODE

DESCRIPTION

The 5608 is a heater-cathode type, medium mu, double triode amplifier tube. Its principal application is in AC plate voltage operated amplifiers, and in circuits having critical grid leakage requirements.

MECHANICAL DATA



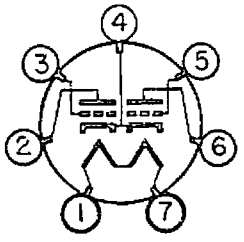
ENVELOPE: ST-14 Glass

BASE: Medium 7-Pin

TERMINAL CONNECTIONS: *(JETEC Designation 73)*

Pin 1 Heater	Pin 5 Grid, Unit #1
Pin 2 Plate, Unit #2	Pin 6 Plate, Unit #1
Pin 3 Grid, Unit #2	Pin 7 Heater
Pin 4 Cathode	

MOUNTING POSITION: Any



BOTTOM VIEW

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS: *(Values are for each triode unit)*

Heater Voltage (ac or dc)	2.5	volts
Plate Voltage	350	volts
Plate Dissipation	5.5	watts
DC Plate Current	30	ma.
DC Grid Current	5.0	ma.
DC Heater-Cathode Voltage	90	volts

CHARACTERISTICS AND TYPICAL OPERATION: *(Values are for each triode unit)*

Heater Voltage	2.5	2.5	volts
Heater Current	2	2	amp.
Plate Voltage	250	300	volts
Grid Voltage	-5	-6	volts
Amplification Factor	31.5	32	
Plate Resistance	14 300	13,000	ohms
Transconductance	2200	2450	μmhos
Plate Current	5.0	6.0	ma.
Maximum Negative Grid Current	0.25	0.25	μa.

Tentative Data
April 15, 1948

CS-2465

SPECIAL TUBE SECTION

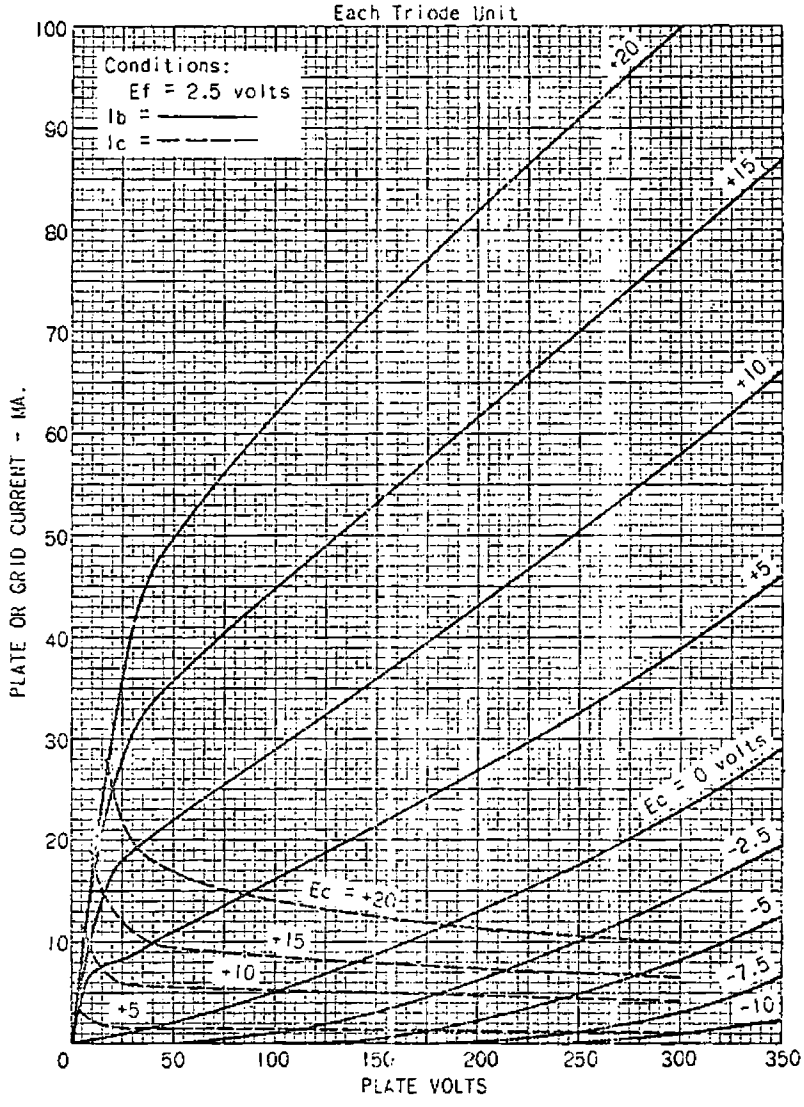
RAYTHEON MANUFACTURING CO.

NEWTON, MASS.

RAYTHEON®

DOUBLE TRIODE

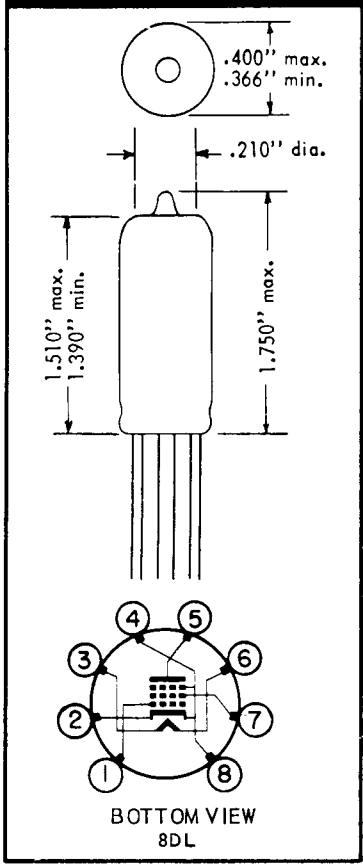
AVERAGE PLATE CHARACTERISTICS
Each Triode Unit



Excellence in Electronics

TYPE CK5639WA

The CK5639WA is a heater-cathode type video amplifier pentode of subminiature construction. This type is characterized by long life and stable performance. It is suitable for service where severe conditions of mechanical shock or vibration are encountered. It is designed for wide band, RF or video power amplifier service in equipments with low plate supply voltages. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW
8DL

MECHANICAL DATA

ENVELOPE: T – 3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads Length: 1.5".)

TERMINAL CONNECTIONS:

Lead 1 Grid #1	Lead 5 Plate
Lead 2 Cathode, Grid #3	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid #2
Lead 4 Cathode, Grid #3	Lead 8 Cathode, Grid #3

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciable if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	150	150	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid #1 Voltage	Ec1:	–55	0	0	0	Vdc
Grid #2 Voltage	Ec2:	----	100	100	155	Vdc
Plate Dissipation	Pp:	----	----	3.15	3.5	W
Grid #2 Dissipation	Pg2:	----	----	0.4	1.0	W
Grid #1 Circuit Resistance	Rg1:	----	----	----	0.5	Meg.
Heater-Cathode Voltage	Ehk:	–200	----	----	+200	Vdc
Cathode Current	Ik:	----	----	----	40	mAdc
Cathode Resistance	Rk:	----	100	100	----	ohms
Plate Current (1)	Ib(1):	----	----	21.0	----	mAdc
Grid #2 Current	Ic2:	----	----	4.0	----	mAdc
Transconductance (1)	Sm(1):	----	----	9000	----	μmhos
Plate Resistance	rp:	----	----	0.05	----	Meg.

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1				**Combined AQL = 1.0% excluding Mechanical and Inoperatives**						
Heater Current:		0.4	If:	427	----	----	----	473	----	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.4	Ihk:	----	----	----	----	10	----	μAdc
	Ehk = −100 Vdc		Ihk:	----	----	----	----	10	----	μAdc
Grid Current:	Rg = 1.0 Meg.	0.4	Ic(1):	----	----	----	----	−1.0	----	μAdc
Plate Current (1):		0.4	Ib(1):	14.0	----	21.0	----	28.0	----	mAdc
Plate Current (2):	Ec1 = −14.0 Vdc	0.4	Ib(2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.4	Sm(1):	7500	----	9000	----	10500	----	μmhos
Continuity and Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8−4) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3 V									
	Eg1-all = −100 Vdc	2.5	Rg1-all:	250	----	----	----	----	----	Meg.
	Ep-all = −300 Vdc		Rp-all:	250	----	----	----	----	----	Meg.
Power Output:	Esig = 2.0 Vac; Rp = 9000 ohms	2.5	Po:	0.75	----	----	----	----	----	W
Screen Current:		2.5	Ic2:	2.0	----	4.0	----	6.0	----	mAdc
Transconductance (2):	Ef = 5.7 V (Note 9)	2.5	Δ_{Ef} Sm(2):	----	----	----	----	10	----	%
Grid Emission:	Eb = 250 Vdc, Rg = 1.0 meg; Rk = 390 ohms; Ec2 = 150 Vdc; Ef = 7.5 V; preheat 5 minutes at Ec1 = 0; Test at Ec1 = −20 Vdc	6.5	Ic(2):	----	----	----	----	−2.0	----	μAdc
AF Noise:	Esig = 200 mVac; Ecc2 = 100 Vdc; Ec1 = −2.5 Vdc; Rg1 = 0.5 Meg.; Rg2 = 0.01 Meg.; Rp = 2000 ohms; Rk = 0; Cg2 = 4μf	2.5	EB:	----	----	----	----	17	----	VU
Plate Resistance:		6.5	rp:	0.040	----	----	----	----	----	Meg.
Capacitance:			Cgp:	----	----	----	----	0.13	----	μμf
Capacitance:	Note 2	6.5	Cin:	8.0	----	9.0	----	10.0	----	μμf
Capacitance:			Cout:	7.0	----	8.0	----	9.0	----	μμf
Low Pressure Voltage Breakdown:	Pressure = 21 ± 3 mmHg; Voltage = 300 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	F = 40 Cps; G = 15; Rp = 2000 ohms	2.5	Ep:	----	----	----	----	40	----	mVac
Vibration (3):	F = 70 − 2000 cps; G = 15; T = 3 minutes; Rp = 2000 ohms positions X1 and X2 only.	6.5	ep:	----	----	----	----	250 peak to peak	----	mv
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk = +100 Vdc; Rg = 0.1 Meg.; Hammer Angle = 30° (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 hours; G = 2.5; Fixed frequency; F = 25 min., 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)								
Shock (2):	Ehk=+100 Vdc; Rg= 0.1 Meg.; Hammer Angle= 120° + Rubber Pad; G= 75; t=10 milliseconds (Note 14)	20	----	----	----	----	----	----
Fatigue (2):	6 hours; G=10; F=130 – 2000 – 130 cps; (Note 13)	6.5	----	----	----	----	----	----
Post Shock (1) & (2) and Fatigue (1) & (2) Test End Points:								
Vibration (2):	F=40 Cps; G=15; Rp= 2000 ohms	----	Ep:	----	80	mVac	----	----
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	----	----
	Ehk= –100 Vdc	----	Ihk:	----	20	μAdc	----	----
Change in Transconductance (1) of individual tubes:	Ef= 6.3 V	----	Δ_t Sm (1):	----	15	%	----	----
Grid Current (1):		----	Ic1:	----	–3.0	μAdc	----	----
Glass Strain (Thermal Shock):		6.5	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef= 7.0 V; Eb=Ec1= Ec2=0 V; 1 min. on 4 min. off; Ehk= 140 Vac	1.0	----	2000	----	cycle	----	----
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	----	----
	Ehk= –100 Vdc	----	Ihk:	----	20	μAdc	----	----
2 & 20 Hour Stability Life Test:	Eb= 250 Vdc; Ec2= 150 Vdc; Rk=390 ohms; TA= Room; Ehk=+200 Vdc; Rg=0.47 Meg.	----	----	----	----	----	----	----
2 & 20 Hour Stability Life Test End Points:		----	----	----	----	----	----	----
Change in Transconductance (1) of individual tubes:	(Typical Sample Size=50 tubes)	1.0	Δ_t Sm (1):	----	10	%	----	----
100 Hour Survival Rate	Eb=250 Vdc; Ec2=150 Vdc; Rk=390 ohms; TA= Room; Ehk=+200 Vdc; Rg=0.47 Meg.	----	----	----	----	----	----	----
100 Hour Survival Rate Life Test:	(Typical Sample Size= 200 tubes)	----	----	----	----	----	----	----
Inoperatives:		0.65	----	----	----	----	----	----
Transconductance (1):		1.0	Sm (1):	6750	----	μmhos	----	----
200 Hour Intermittent Life Test (1):	Eb=250 Vdc; Ec2=150 Vdc; Rk=390 ohms; TA= Room; Ehk=+200 Vdc; Rg=0.47 Meg.	----	----	----	----	----	----	----
200 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size=10 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:								
Grid Current (1):		----	Ic (1):	0	–2.0	μAdc	1	3

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Heater Current:		----	If:	414	492	mA	1	3
Change in Transconductance (1) of Individual Tubes:		----	Δ_tSm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	20	%	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	1	3
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
Electrode Insulation:								
g1-all		----	Rg1-all	50	----	Meg.	1	3
p-all		----	Rp-all	50	----	Meg.		
Total Defectives:		----	----	----	----	----	3	6
Intermittent High Temperature Life Test (2):	T Bulb=220°C; Ehk=+200 Vdc; Rg=0.5 Meg.	----	----	----	----	----	----	----
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current:		----	Ic1:	----	−2.0	μAdc	1	3
Heater Current:		----	If:	414	492	mA	1	3
Change in Transconductance (1) of individual tubes		----	Δ_tSm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	15	%	1	3
Heater-Cathode Leakage:								
Ehk=+100 Vdc		----	Ihk:	----	20	μAdc	1	3
Ehk=−100 Vdc		----	Ihk:	----	20	μAdc		
Insulation of Electrodes:								
g1-all		----	Rg1-all:	50	----	Meg.	1	3
p-all			Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg.Δ_t	----	15	%	----	----
Total Defectives:		----	----	----	----	----	3	6
1000 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size=20 Tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic1:	----	−2.0	μAdc	1	3
Heater Current:		----	If:	414	496	mA	1	3
Transconductance (1) Change of Individual Tubes:		----	Δ_tSm:	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	20	%	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	1	3
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
Electrode Insulation:								
g1-all:		----	Rg1-all:	25	----	Meg.	2	5
p-all:		----	Rp-all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

ELECTRICAL DATA (Cont'd)

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D. 1 7/8" long) connected to cathode lead.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ± 5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of MIL-E-1 basic specifications.

Note 11: Operation time is the time in seconds required for the plate current to attain a value within ± 15% of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed. A cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300 ± 50 micro seconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent short	600,000 ohms
500 μsec.	500,000 ohms
100 μsec.	100,000 ohms
60 μsec.	1,000 ohms

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

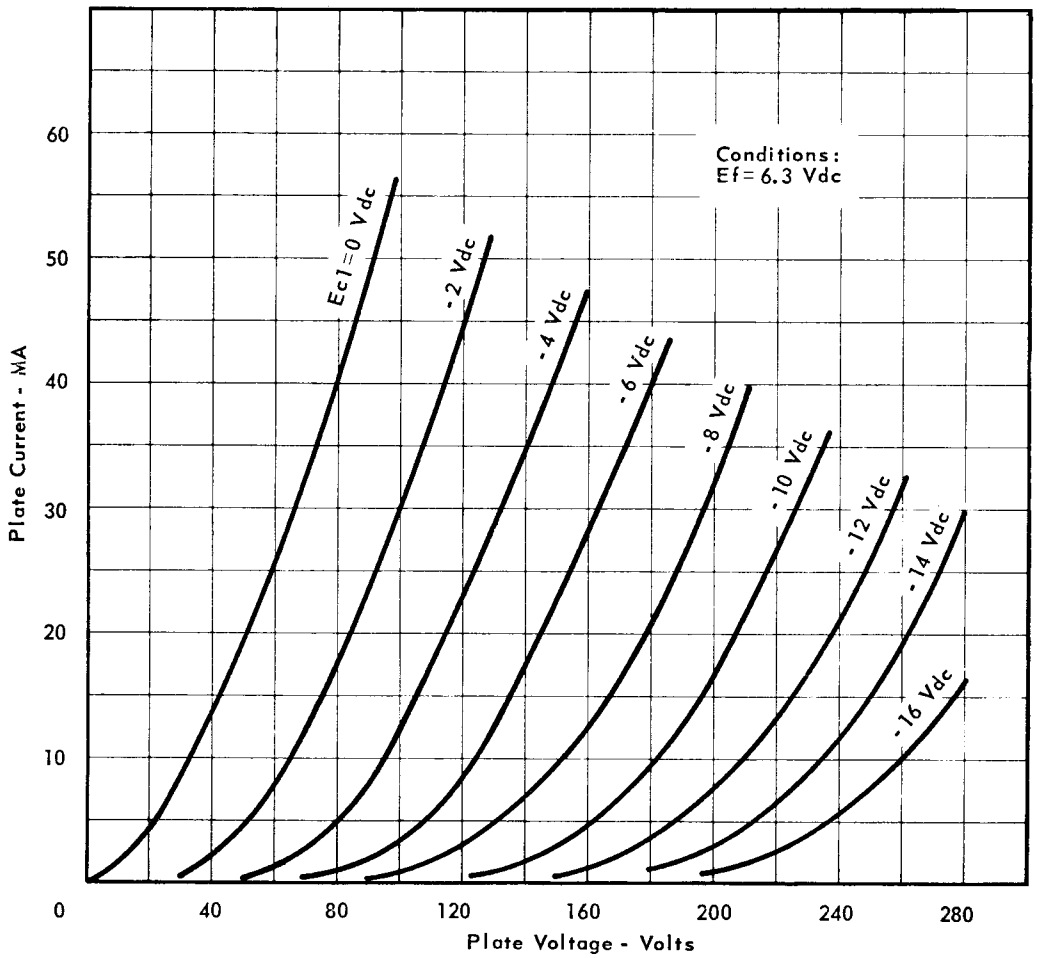
A. either a permanent or tap short at any time during the tapping procedure
B. any open circuit
C. any leaks

Note 13: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

A. tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.
B. tubes which do not comply with past fatigue limits, this is a destructive test

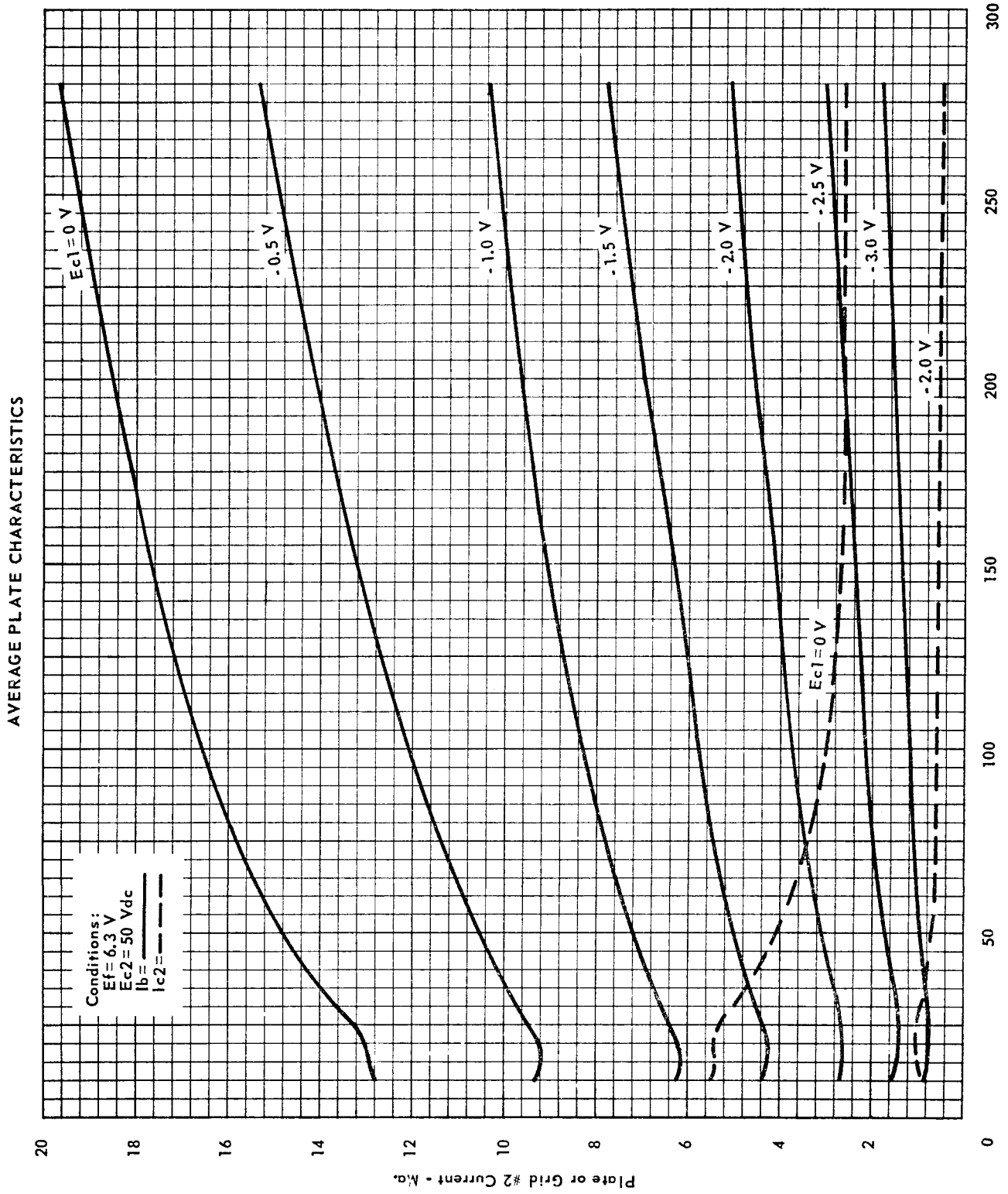
Note 14: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



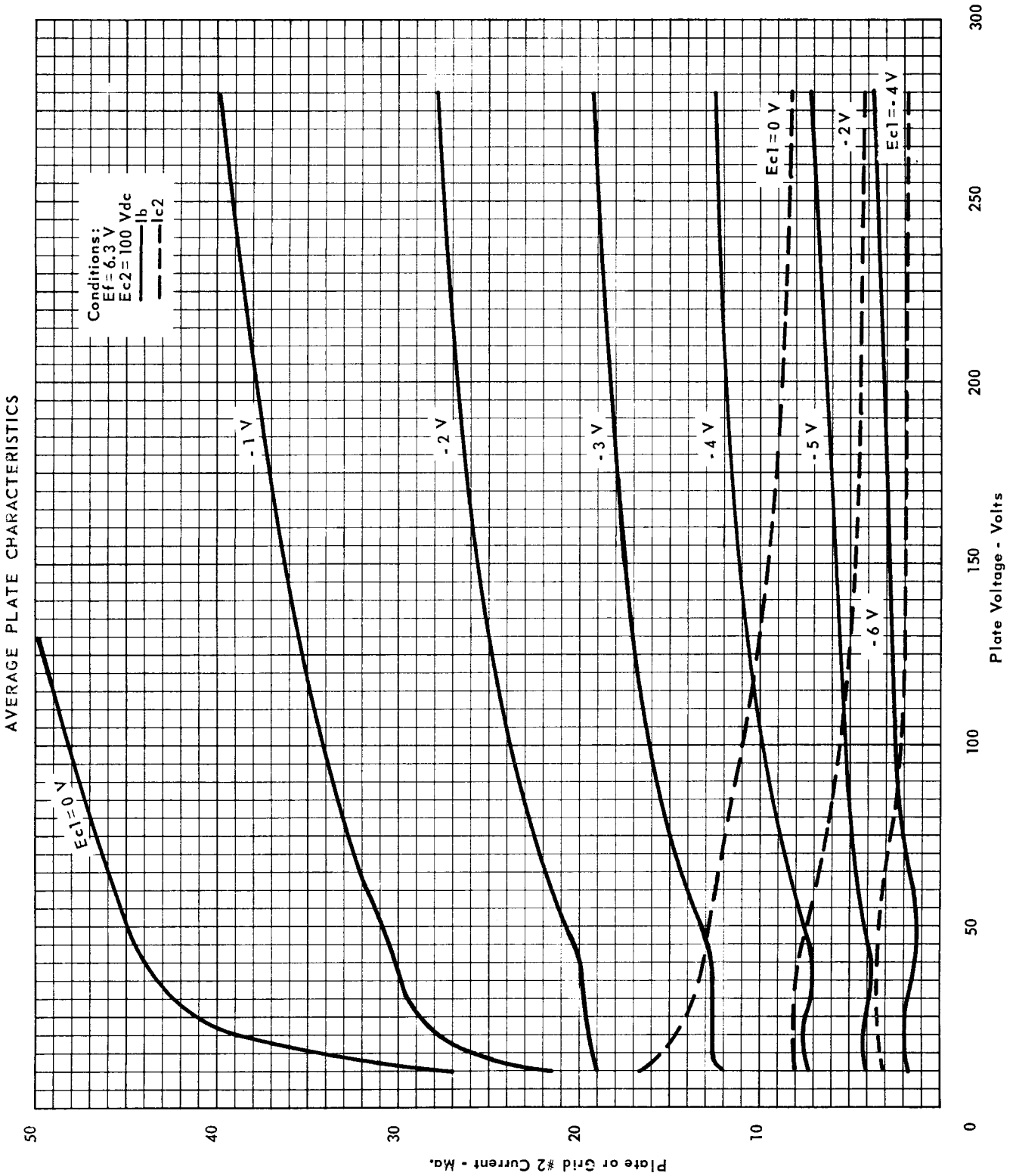
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RELIABLE SUBMINIATURE PENTODE



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RELIABLE SUBMINIATURE PENTODE



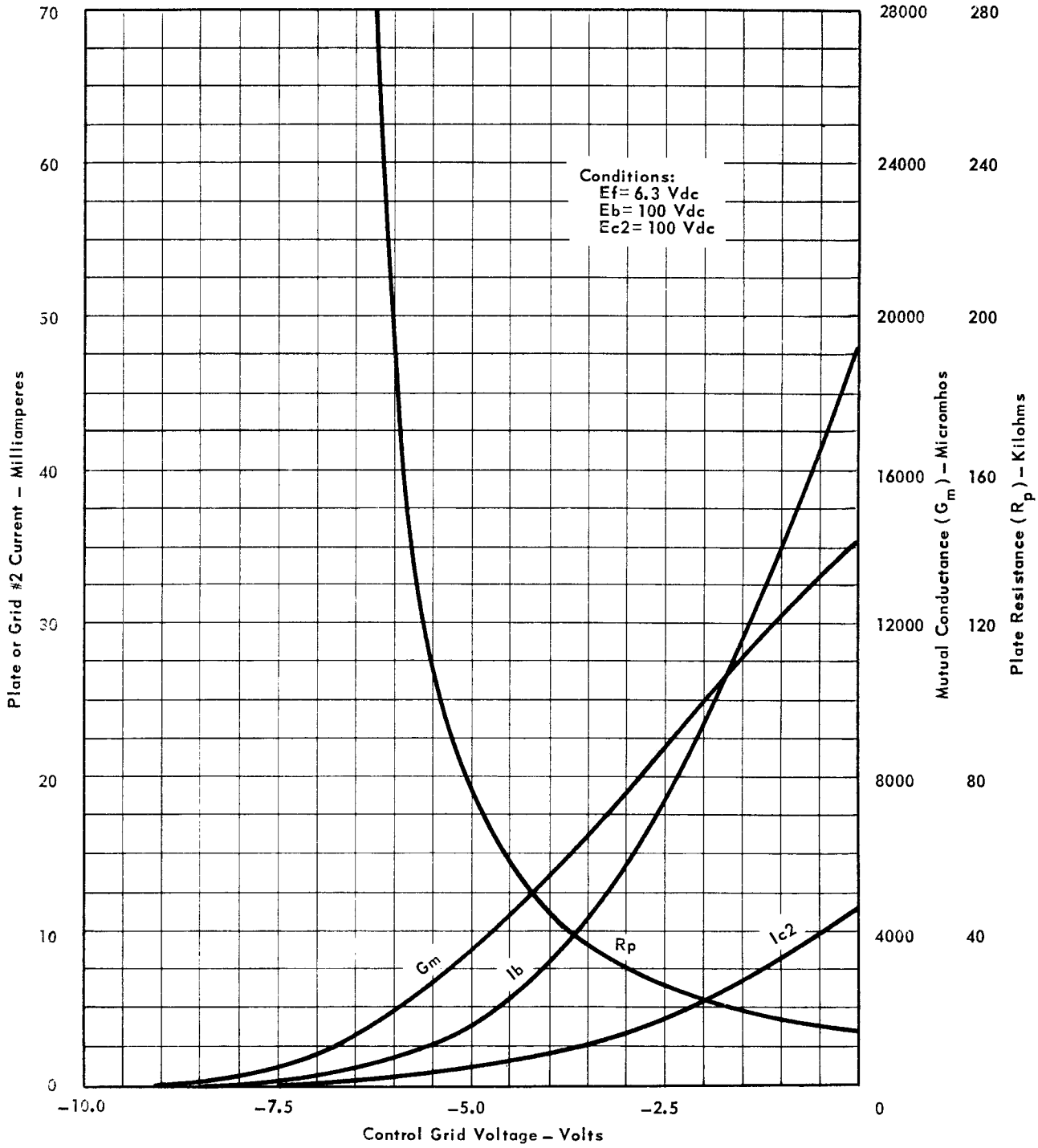
INDUSTRIAL TUBE DIVISION

RAYTHEON MANUFACTURING COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

RELIABLE SUBMINIATURE PENTODE

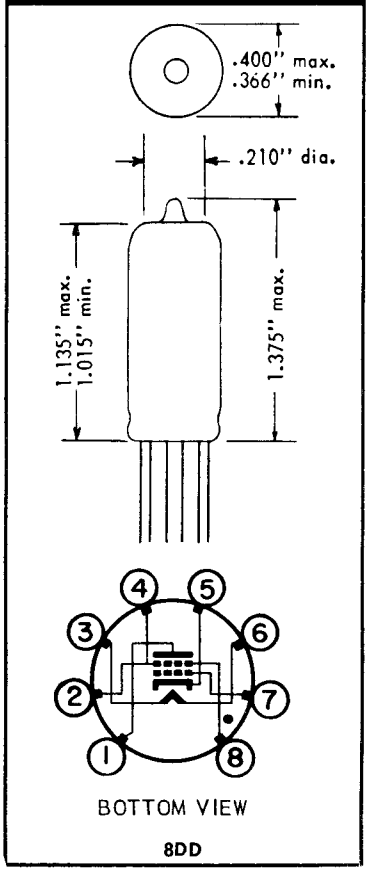
AVERAGE TRANSFER CHARACTERISTICS



Excellence in Electronics

TYPE CK5643

The CK5643 is a xenon tetrode thyratron of subminiature construction. This type is characterized by long life, stable performance and is suitable for service where severe conditions of mechanical shock or vibration are encounted. It is designed for use in counters, grid control rectifiers and other control circuits where freedom from early failures, long average life and uniform operating characteristics are required. The flexible terminal leads may be soldered or welded to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW

8DD

MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8–Pin (0.017" tinned flexible leads Length: 1.5" min.)

TERMINAL CONNECTIONS:

Lead 1 Plate	Lead 5 Cathode
Lead 2 Grid #2 (Note 13)	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid #1
Lead 4 Grid #2 (Note 13)	Lead 8 Grid #2 (Note 13)

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 2)	450 G
Maximum Uniform Acceleration (Centrifuge Test–Note 3)	1000 G
Maximum Vibrational Acceleration (96 hour Fatigue Test–Note 4)	2.5 G
Maximum Bulb Temperature	125 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electronic Equipment Design Engineers: Special Attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 7)	Ef:	6.0	6.3	6.3	6.6	V
Peak Forward Anode Voltage	epy:	----	----	----	500	v
Peak Inverse Anode Voltage	epx:	----	----	----	500	v
Grid #1 Voltage	Ec1:	–200	----	----	----	Vdc
Grid #2 Voltage	Ec2:	–100	0	0	----	Vdc
Heater-Cathode Voltage	Ehk:	–100	0	0	+25	Vdc
Cathode Conditioning Time	tk:	10	----	----	----	sec.
Peak Plate Current	ib:	----	----	----	100	ma.
Cathode Current	Ik:	----	----	----	16	mAdc
Ambient Temperature	TA:	–55	----	25±5	+90	°C
Anode Voltage	Ep:	----	----	150	----	Vac
Grid #1 Voltage (Note 8)	Eg1:	----	----	5.0	----	Vac
Peak Grid #1 Signal Voltage	eg1:	----	----	5.0	----	v
Anode Resistor	Rp:	----	----	3750	----	ohms
Grid #1 Resistance	Rg1:	----	----	1.0	10.0	Meg.

Tentative Data

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ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			Combined AQL = 1.0% Excluding Mechanical and Inoperatives							
Heater Current:		0.65	If:	140	144	150	156	160	12	mA
Heater-Cathode Leakage:	Ehk = +25 Vdc		+Ihk:	----	----	----	----	10	----	μAdc
	Ehk = −100 Vdc	0.65	−Ihk:	----	----	----	----	10	----	μAdc
Grid Voltage (1):	Epp = 350 Vac; Rg 1 = 0.1 Meg. Rp = 10,000 ohms. (Note 9)	0.65	Ecc 1:	−2.0	----	----	----	−4.0	----	Vdc
Grid Voltage (2):	Epp = 350 Vac; Rg 1 = 10 Meg.; Rp = 10,000 ohms. (Note 9)	0.65	Ecc 1:	----	----	----	----	−6.0	----	Vdc
Anode Voltage:	Vary Ebb; Ec 1 = 0 Vdc; Rg 1 = 0.1 Meg.; Rp = 10,000 ohms. (Note 10)	0.65	Ebb:	----	----	----	----	26	----	Vdc
Continuity and Shorts (Inoperatives):	(Note 11)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope T-3 (8-1) (Note 12)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Pulse Emission:	epy = egy 1 = egy 2 = 180 ± 9 v; tp = 5 ± 0.25 μsec.; tr = 0.5 μsec. max.; tf = 1.0 μsec. max.; Prr = 120 ± 5; tk = 5 minimum; Ra = 150 ± 5% noninductive; Rp = 100 ± 5% noninductive; Calibrating Resistor = 50 ± 5% noninductive; Zo = 75; t = 3 max.	2.5	etd:	----	----	----	----	76	----	v
Vibration:	No Voltage; F variable from 10-50 cps; G max. = 10; Fixed amplitude 0.040 inch; Post Shock and Fatigue Test End Points Apply	10.0	----	----	----	----	----	----	----	----
DEGRATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock:	Hammer Angle = 30° (Note 2)	20	----	----	----	----	----	----	----	----
Fatigue:	96 hours; G = 2.5; Fixed Frequency f = 25 min., 60 max. (Note 4)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Heater-Cathode Leakage:	Ehk = +25 Vdc	----	Ihk:	----	----	----	----	20	----	μAdc
	Ehk = −100 Vdc	----	Ihk:	----	----	----	----	20	----	μAdc
Anode Voltage:		----	Ebb:	----	----	----	----	26	----	Vdc
Glass Strain:		6.5	----	----	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS										
Heater Cycling:	Es = 7.0 V; Eb = Ec 1 = Ec 2 = 0V; Ehk = 18 Vac; 1 min. on, 4 min. off	2.5	Hcy:	2500	----	----	----	----	----	cycles
100 Hour Survival Rate Life Test Conditions:	Ib = 16 mAdc; ib = 100 ma; Rg 1 = 0.05 Meg.; Epp = 350 Vac; EHK = −100, +25 Vdc; Rp = 5000 ohms; TA = Room									

RAYTHEON

RELIABLE XENON TETRODE THYRATRON

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristics 1st Sample	Allowable Defects per Characteristics Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size = 200 tubes)							
Continuity and Shorts (Inoperatives)		0.65	----	----	----	----	----	----
500 Hour Intermittent Life Test Conditions:	Survival Rate Life Test Conditions T Bulb = 125 °C tk = 10 sec max. (Notes 14, 15)	----	----	----	----	----	----	----
500 Hour Intermittent Life Test End Points:	(Typical Sample Size = 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:	(Note 11)	----	----	----	----	----	1	3
Heater Current:		----	If:	138	164	mA	2	5
Grid Voltage (1):		----	Ecc 1:	-0.8	-5.0	Vdc	1	3
Anode Voltage:		----	Ebb:	----	70	Vdc	1	3
Pulse Emission:		----	etd:	----	100	v	2	5
Heater-Cathode Leakage:	Ehk = +25 Vdc Ehk = -100 Vdc	---- ----	Ihk: Ihk:	---- ----	20 20	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	4	8
1000 Hour High Temperature Information Life Test:	Same conditions as 500 Hour Intermittent Life Test. Limits not established.							

Note 1 Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instruction for Electron Tubes" and MIL-STD-105A.

Note 2 Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specification.

Note 3 Centrifuge Test with forces applied in any direction.

Note 4 Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 5 These normal values represent conditions at which control of reliability may be expected.

Note 6 These normal test conditions are used for all characteristic tests unless other wise stated under the individual test item.

Note 7 For most applications the performance will not be adversely affected by ± 5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 8 Bias voltage, 180° out of phase with anode voltage.

Note 9 Under the conditions specified, the control-grid voltage shall be changed in a positive direction until the tube starts to conduct current. The grid voltage measured at the grid voltage supply required to cause conduction shall be within the limits specified

Note 10 Under the conditions specified, the anode voltage shall be increased until the tube starts to conduct current. The anode voltage required to cause conduction shall be within the limits specified.

Note 11 The last sentence of paragraph 4. 7. 5. shall not apply.

Note 12 In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of Inspection Instructions for Electron Tubes.

Note 13 The Grid #2 shall not be used for control purposes.

Note 14 Phase of grid voltage shall be adjusted to provide start of conduction at the peak.

Note 15 The heater-cathode voltage shall be cycled 30 seconds positive and 30 seconds negative.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5644

RELIABLE SUBMINIATURE VOLTAGE REGULATOR

The 5644 is a cold cathode, gas-filled diode of subminiature construction designed for service as a voltage regulator. It has an operating current range of 5 to 25 milliamperes over which it maintains a substantially constant operating voltage of approximately 90 volts. Three cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered, or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450	G
Uniform Acceleration (Centrifuge Test)	1000	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	220	°C
Altitude	80,000	Ft.

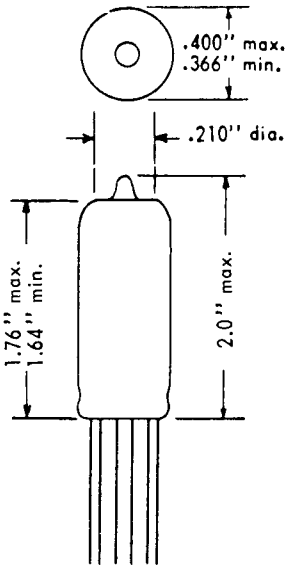
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
Supply Voltage	---	180	---	---	---	Vdc
Ionization Voltage (2) (Total Darkness) (5-25 mAdc)	Ez	---	125	---	175	Vdc
Ionization Voltage (1) (5-50 ft. Candles) (5-25 mAdc)	Ez	---	113	---	120	Vdc
Current Range	Ib	5	---	---	25	mAdc
Tube Voltage Drop (1) (25 mAdc)	Etd	85	90	---	105	Vdc
Operating Voltage	---	82	---	---	108	Vdc
Tube Voltage Drop (2) (5 mAdc)	Etd	85	89	---	105	Vdc
Regulation (25-5 mAdc)	Reg	---	1.0	---	±5.0	Vdc
Noise (25 mAdc)	Eb	---	---	---	15	mVac
Leakage	Ilb	---	---	---	10	μAdc

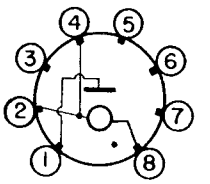
MECHANICAL DATA

ENVELOPE ..... Glass T-3
OUTLINE ..... JEDEC (3-4)
BASE: .. Subminiature 8-Pin with long leads (.017" +.002"-.001" Length =1.5" min.
BASING 4CN
CATHODE .... Glow Discharge
MOUNTING POSITION .... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 Plate
Pin 2 Cathode
Pin 3 No Connection
Pin 4 Cathode
Pin 5 No Connection
Pin 6 No Connection
Pin 7 No Connection
Pin 8 Cathode

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test – 450 G. 30° hammer angle in Navy High Impact Shock Machine. Sample subjected to five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability and freedom from inoperatives. Tubes are operated under the following conditions: Ebb/Ib = 25 mAdc; T_B = 220°C.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 220°C. under Survival Rate Life Test Conditions.

Altitude – Sample is subjected to pressure of 21 ± 2 mm Hg to evaluate flashover or corona at the press of the tube.

APPLICATION NOTES

Attention should be given to the specified minimum supply voltage to insure operation in darkness.

A series resistor must always be used with the 5644. The resistance value must be chosen so that the maximum current is not exceeded at the highest anode supply voltage and so that the minimum current rating is always exceeded at the lowest anode supply voltage.

When a shunt capacitor is used its maximum value should be limited to 0.1 μf. A large value may cause the tube to oscillate and this results in unstable performance.

Special attention should be given to the envelope temperature of the tubes. Reliability may be severely impaired if the maximum envelope temperature is exceeded.

Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperature without drawing current.

To insure minimum voltage drift, a warm-up period of 3 minutes should be allowed each time the equipment is turned on. After this time the bulb temperature should have reached equilibrium level.

The type 5644 should not be regarded as a source of standard voltage. Slow changes in voltage occur in this type during life and also during the first 15 minutes of operation following inactive periods.

RELIABLE SUBMINIATURE VOLTAGE REGULATOR

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS					Units
						Min	Lal	Typical	Ual	Max	
	QUALIFICATION APPROVAL TESTS										
3.1	Qualification Approval:	Required for JAN Marking	---	---	---	---	---	---	---	---	---
---	Cathode	Glow Discharge	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections		---	---	---	---	---	---	---	---	---
	MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 1										
4.13.1	× Ionization Voltage(1):	Ebb/Ib = 5–25mAdc; Illumination = 5–50 ft candles	0.65	II	Ez	---	---	113	---	120	Vdc
4.13.2	Tube Voltage Drop(1)	Ebb/Ib = 25 mAdc	0.65	II	Etd	85	---	90	---	105	Vdc
4.13.2	Tube Voltage Drop(2)	Ebb/Ib = 5 mAdc	0.65	II	Etd	85	---	89	---	105	Vdc
4.13.2.1	Regulation:	(1) Etd–(2) (Etd)	0.65	II	Reg.	---	---	1	---	±5.0	Vdc
4.7.5	Continuity and Shorts (Inoperatives)		0.4	II	---	---	---	---	---	---	---
4.9.1	Mechanical production tests	Envelope Outline No 8–5	---	---	---	---	---	---	---	---	---
	MEASUREMENTS ACCEPTANCE TEST, PART 2										
4.13.4.3	Noise test	Ebb/Ib = 25 mAdc	2.5	I	Eb:	---	---	<2	---	15	mVac
4.13.4.2	Oscillation test	Esig = 15 mVac; Ebb/Ib = 5–25 mAdc	2.5	I	---	---	---	---	---	---	---
4.13.1	Ionization Voltage(2):	Ebb/Ib = 5–25 mAdc Note 3	6.5	Code F	Ez	---	---	125	---	175	Vdc
4.13.3	Leakage Current	Eb = 50 Vdc	6.5	Code F	Llb	---	---	<1	---	10	μAdc
4.9.20.3	Vibration Note 2,6	No Voltages	10			---	---	---	---	---	---
	DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7										
4.9.5.3	Subminiature Lead Fatigue	Note 4	2.5	Code G	---	4	---	---	---	---	arcs
4.9.20.5	Shock test	Hammer Angle = 30° Note 5	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; Fixed Freq.; F = 25 min., 60 max.	6.5	Note 6	---	---	---	---	---	---	---
---	Post Shock and Fatigue Test End Points:		---	---	---	---	---	---	---	---	---
		Ionization Voltage(1)	---	---	Ez	---	---	113	---	130	Vdc
		Tube Voltage Drop(1)	---	---	Etd	82	---	90	---	108	Vdc
		Tube Voltage Drop(2)	---	---	Etd	82	---	89	---	108	Vdc
		Regulation	---	---	Reg.	---	---	1	---	±5	Vdc
---	Glass Strain	Note 8	2.5	I	---	---	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS		Units
					1st sample	Combined sample		Min	Max	
ACCEPTANCE LIFE TESTS, NOTE 7										
	Survival Rate Life Test	Intermittent Life Test, Conditions or Equivalent, Note 10, TA = Room	---	II	---	---	---	---	---	---
4.11.4	Survival Rate Life Test End Points	Continuity and Shorts (In-operatives)	0.65	---	---	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typical	Max.	
4.11.5	Intermittent Life Test	Ebb/Ib = 25 mAdc T Envelope = 220 °C min.; Notes 11, 12	---	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points (500 hours)	Note 13									
		Inoperatives; Note 14	---	---	1	3	---	---	---	---	---
		Regulation	---	---	1	3	Reg	---	2	5.0	Vdc
		Tube Voltage Drop (1)	---	---	1	3	Etd	82	91	108	Vdc
		Tube Voltage Drop (2)	---	---	1	3	Etd	82	89	108	Vdc
		Ionization Voltage (1)	---	---	1	3	Ez	---	113	125	Vdc
		Total Defectives	---	---	4	8	---	---	---	---	---
4.11.5	Information Life Test:	Intermittent Life Test Conditions: Notes 12, 9	---	---	---	---	---	---	---	---	---
4.11.4	Information Life Test End Points: (1000 hours)	Note 9	---	---	---	---	---	---	---	---	---
	PACKAGING REQUIREMENTS										
4.9.18.1.4	Container Drop:	(d) Package Group 1; Container Size D									

Note 1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical, shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 2: Post Shock and Fatigue Test End Points shall apply.

Note 3: Conditions for this test shall be those of Ionization Voltage (1) except testing shall be done in total darkness and the tube shall not have conducted or been exposed to light for at least 24 hours prior to testing. The tube shall fire within 20 seconds maximum.

Note 4: When a manufacturer submits tubes for Qualification Approval, five (5) extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 5: Leads may be clipped for application of voltages during impact.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL–STD–105, sample size code letter F shall apply.

Note 7: Destructive Tests:

Tubes subject to the following destructive tests are not to be accepted under this specification.

4.9.5.3	Subminiature Lead Fatigue
4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.5	Intermittent Life Test

Note 8: Glass strain procedures – All tubes subjected to this test shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperatures. The entire tube shall be immersed in water at not less than 97°C for 15 seconds and immediately thereafter immersed in water at not more than 5°C for 5 seconds. The volume of water shall be large enough that the water temperature will not be appreciably affected by the test. The holder shall be in accordance with Drawing #245–JAN, and the tubes shall be immersed quickly. The tubes shall be so placed in the water that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period the tubes shall be removed and allowed to return to room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks (see 4.7.6). Electrical rejects, other than inoperatives, may be used in the performance of this test.

Note 9: Information life test shall be conducted on a minimum of one sample of ten tubes each month of production. This sample shall be selected as the first ten serially marked, noninoperative tubes from a completed Intermittent Life Test sample. This life test shall be classified as a destructive test. Read at 1000 hours. On Information Life Tests, read same characteristics as Intermittent Life Test. Limits do not apply. This test shall not be a basis for lot acceptance. Six copies of these data will be forwarded to the Armed Services Electron Tube Committee.

Note 10: *Survival-rate life test.* See 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 11: *Intermittent life tests.* See 20.2.5.3 of Appendix C.

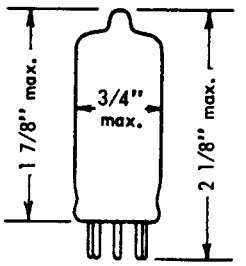
Note 12: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or small diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope.

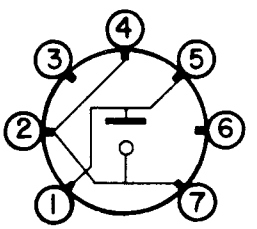
Note 13: *Order for evaluation of life-test defects.* See 4.11.3.1.2.

Note 14: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: discontinuity (see 4.7.1), shorts (see 4.7.2) air leaks (see 4.7.6).

TYPE CK5651WA

The CK5651WA is a cold cathode, glow-discharge diode of miniature construction designed for use as a voltage reference tube in electronically regulated DC power supplies. It has an operating current range of 1.5 to 3.5 milliamperes over which it maintains a substantially constant voltage of 85 volts. Sudden voltage fluctuations of the CK5651WA are less than 0.005 volts within the rated operating current range and voltage drift is reduced by careful manufacturing processing, concluded by a stabilization of 46 hours operation. The CK5651WA has a negative temperature coefficient of -3.5 millivolts per degree centigrade over the temperature range of 25 to 150 degrees centigrade. Three cathode pins are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered.





BOTTOM VIEW

5BO

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Anode	Pin 5 Anode
Pin 2 Cathode	Pin 6 Internal Connection Do Not Use
Pin 3 Internal Connection Do Not Use	Pin 7 Cathode
Pin 4 Cathode	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	450 G
Maximum Vibrational Acceleration (96 Hours Fatigue Test-Note 3)	2.5 G
Maximum Bulb Temperature	155 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION - To Electronic Equipment Design Engineers: Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions more severe than those specified for life test are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL OPERATION	ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Starting Voltage	Ez:			115	Vdc
Operating Current Range (Note 4)	Ib:	1.5	2.5	3.5	mAdc
Operating Voltage Range	Etd:	82	85	88	Vdc
Ambient Temperature (Note 4)	TA:	-55		+150	°C

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

Test	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD.	MIL-E-1B UNITS
Continuity & Tap Shorts:		0.4								
ACCEPTANCE TESTS GROUP D			**COMBINED AQL = 1.0%**							
Ionization Voltage (1):	Rp/Ib=1.5-3.5 mAdc; ambient room light	0.65	(1) Ez:	95				110		Vdc

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

June 15, 1955 NEWTON 58, MASS.

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

ACCEPTANCE TESTS GROUP D (cont'd)

Test	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL.	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
Tube Voltage Drop (2):	Rp / Ib = 3.5 mAdc	0.65	(2)Etd:		84.0	85.5	87.5	88.0	2.0	Vdc
Tube Voltage Drop (1):	Rp / Ib = 1.5 mAdc	0.65	(1)Etd:	82.0	82.5	84.5	86.0		2.0	Vdc
Regulation:	(2) Etd - (1) Etd	0.65	Reg:					2.0		Vdc
Voltage Jump:	(Note 6)	0.65	Jump:					5.0		mVdc
Tube Voltage Drop (3):	Rp / Ib = 2.5 mAdc	0.65	(3)Etd:	83.5		85.0		86.5		Vdc
ACCEPTANCE TEST GROUP E										
Noise:	Rp / Ib = 3.5 mAdc RL = 500 ohms	1.0	Eb:					5.0		mVac
Oscillation:	Esig = 100 mVac; Rp / Ib = 1.5 - 3.5 mAdc; RL = 500 ohms	1.0								
ACCEPTANCE TEST GROUP F										
Ionization Voltage (2):	Rp / Ib = 1.5 - 3.5 mAdc Total Darkness (Note 5)	6.5	(2)Ez:	95				115		Vdc
Leakage Current:	Eb = 50 Vdc; Rp = 3000 ohms	6.5	Lib:					5		μAdc
Vibration (2):	f = 40 cps; G = 15; Rp = 10,000 ohms; Ebb / Ib = 2.5 mAdc	6.5	Ep:					5		mVac
ACCEPTANCE TEST GROUP G										
Repeatability:	Rp / Ib = 2.5 mAdc Note 8, 9	6.5	Δ(3)Etd:					100		mVdc
ACCEPTANCE TEST GROUP A										
Fatigue:	96 hours (Note 3)	6.5								
Shock:	Hammer Angle = 30° (Note 2)									
Post Shock and Fatigue Limits:										
Ionization Voltage (1):	Rp / Ib = 1.5 - 3.5 mAdc		(1)Ez:	95				115		Vdc
Tube Voltage Drop (2):	Rp / Ib = 3.5 mAdc		(2)Etd:	82				90		Vdc
Tube Voltage Drop (1):	Rp / Ib = 1.5 mAdc		(1)Etd:	82				90		Vdc
Regulation:	(2) Etd - (1) Etd		Reg:					3		Vdc
ACCEPTANCE TEST GROUP B										
Glass Strain:		2.5								

ACCEPTANCE TESTS - LIFE

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	MAX. DEFECTS PER CHARACTERISTICS	
							1st Sample	Combined Sample
1 Hour Stability Life Test:	TA = Room; Rp / Ib = 2.5 mAdc							
1 Hour Stability Life Test End Points:	ΔTube Voltage Drop (3) (Note 7) Typical sample size = 35 tubes	2.5	Δ(3)Etd:		200	mVdc		
100 Hour Survival Rate Life Test:	TA = Room; Rp / Ib = 2.5 mAdc							

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

ACCEPTANCE TESTS - LIFE

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	MAX. DEFECTS PER CHARACTERISTICS	
							1st Sample	Combined Sample
100 Hour Survival Rate Life Test End Points:								
Inoperatives:	(Typical sample size=150 tubes)	0.4						
△Tube Voltage Drop (3):	Note 7 (Typical sample size=35 tubes)	2.5	△(3)Etd:		500	mVdc		
Intermittent Life Test (1):	T Bulb=155°C; Rp/Ib=2.5 mAdc							
500 Hour Intermittent Test End Points:	(Typical sample size=20 tubes 1st sample, 40 tubes 2nd sample. Total allowable number of defects; 3 1st sample; 6 combined samples)							
Inoperatives:							1	3
Regulation:			Reg:		3	Vdc	1	3
Tube Voltage Drop (2):			(2)Etd:	82	90	Vdc	1	3
Tube Voltage Drop (1):			(1)Etd:	82	87.5	Vdc	1	3
Tube Voltage Drop (3):			(3)Etd:	82	88.5	Vdc	1	3
Ionization Voltage (1):			(1)Ez:	95	115	Vdc	1	3
△Tube Voltage Drop (3):	(Note 7)		△(3)Etd:		1.5	Vdc	1	3
1000 Hour Intermittent Life Test End Points:	(Typical sample size=20 tubes 1st sample; 40 tubes 2nd sample)							
Inoperatives:							2	5
Regulation:			Reg.		3.2	Vdc	2	5
Tube Voltage Drop (2):			(2)Etd:	82	91	Vdc	2	5
Tube Voltage Drop (1):			(1)Etd:	82	88	Vdc	2	5
Tube Voltage Drop (3):			(3)Etd:	80	90	Vdc	2	5
Ionization Voltage (1):			(1)Ez:	95	115	Vdc	2	5

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1B basic specifications.

Note 3: Test Conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1B basic specifications.

Note 4: Limits beyond which normal tube performance and tube life may be impaired.

Note 5: This test conducted in total darkness after tubes have been held in darkness for 24 hours.

Note 6: Vary current slowly from 1.5 to 3.5 mA and back to 1.5 mA by adjusting Ebb. Sudden voltage jumps registered on an oscilloscope connected across the tube should not be greater than 0.005 volts.

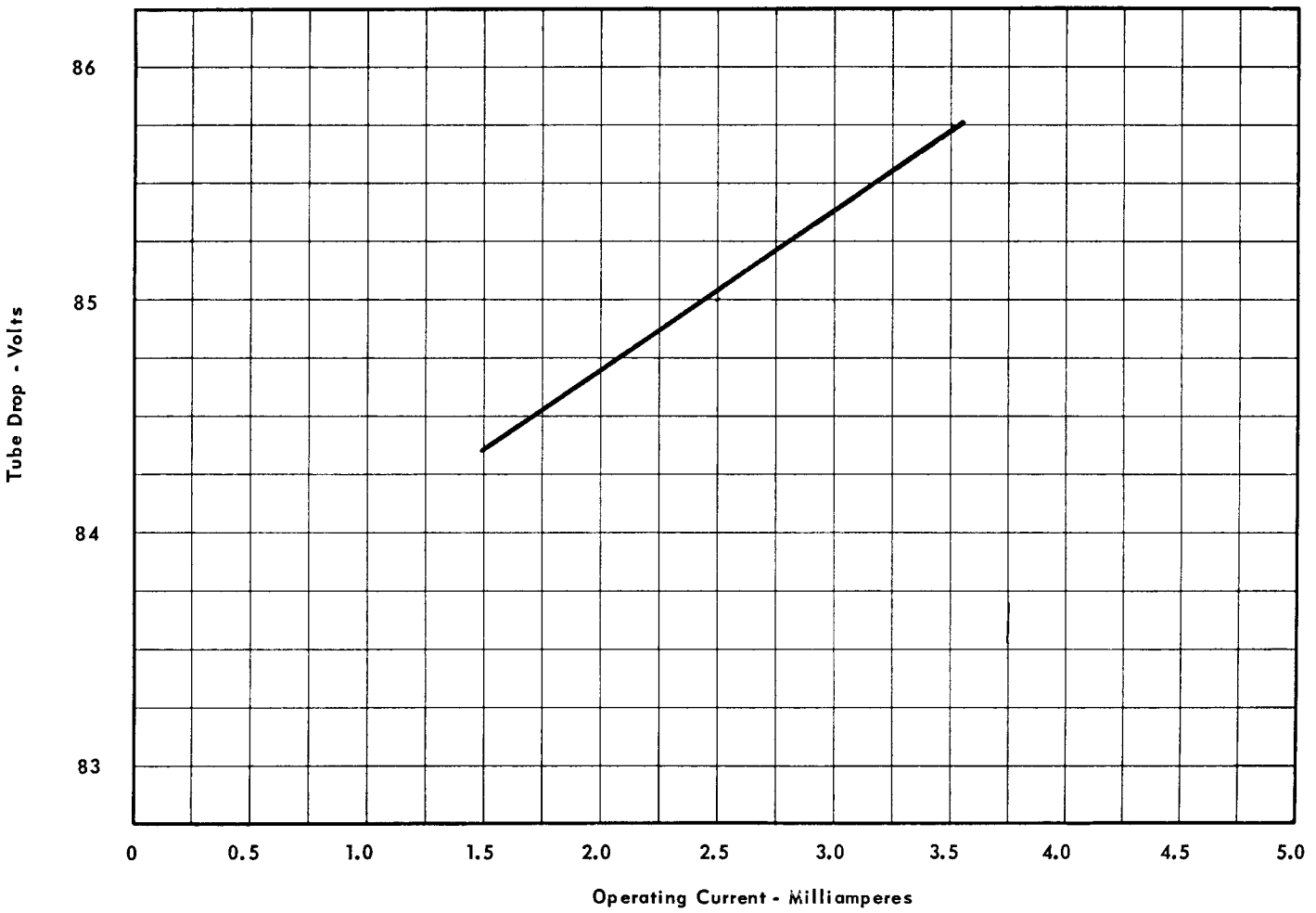
Note 7: △Tube Voltage Drop (3) is the change of tube voltage drop (3) from its initial value at the beginning of life to that at the specified life hour. The voltage drop △(3) Etd is the change in individual tubes.

Note 8: The Tube Voltage Drop will stabilize within 1 minute after starting.

Note 9: Repeatability shall be defined as the maximum shift in tube voltage drop between successive firings of the tube. The test shall be made in the following manner. The tube voltage drop is read at 2.5 mA drain, then the tube is turned off 1 minute. The tube is restarted and operated at the same current. The voltage drop is read after 1 minute of operation. The on-off cycle must be repeated a minimum of 5 times. The maximum difference in tube voltage is taken as the measure of repeatability.

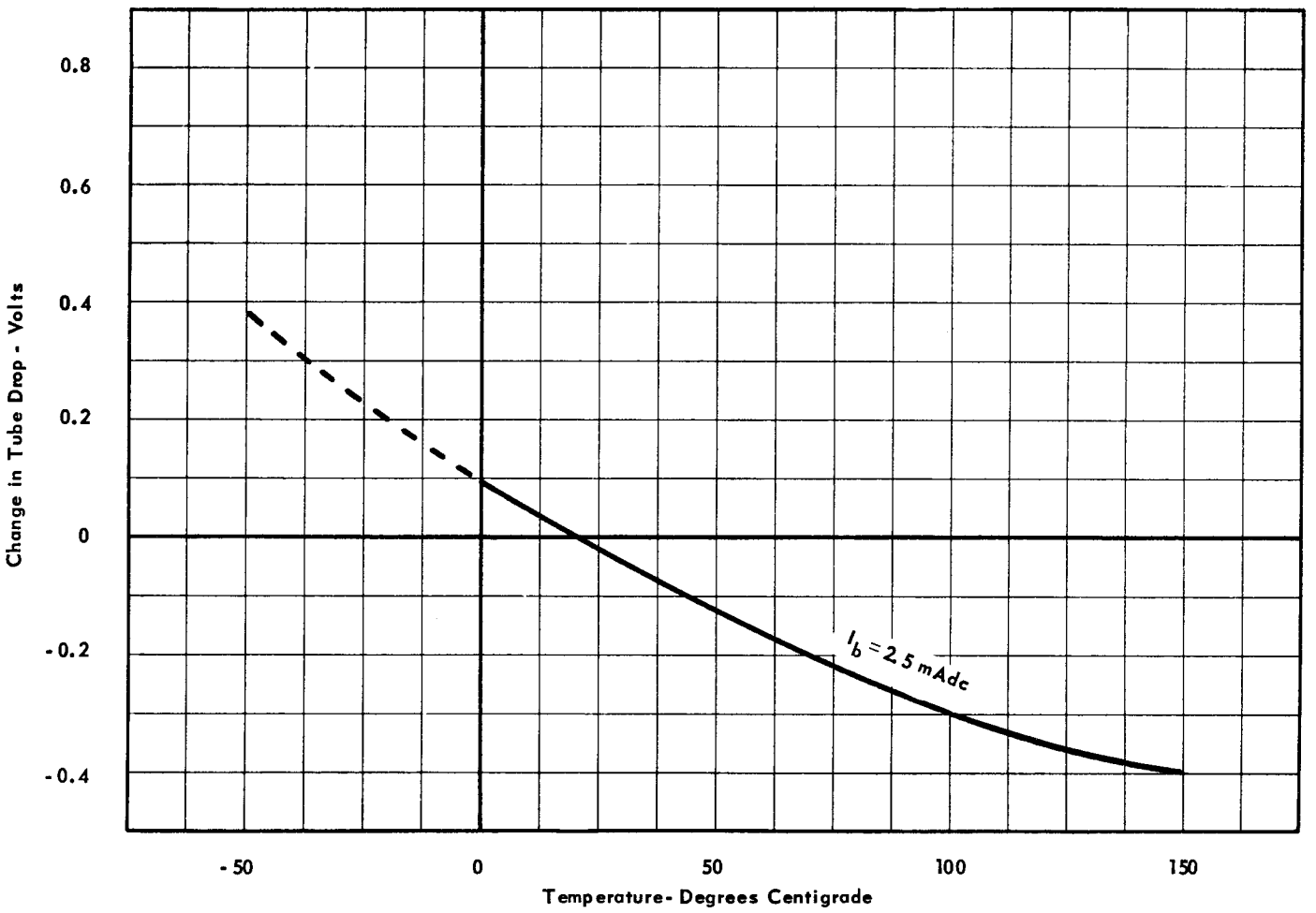
COLD CATHODE GAS DIODE

TYPICAL VOLTAGE - CURRENT CHARACTERISTICS



COLD CATHODE GAS DIODE

TYPICAL VOLTAGE - AMBIENT TEMPERATURE CHARACTERISTICS



Printed in U.S.A.

TYPE CK5654/6AK5W/6096

The CK5654/6AK5W/6096 is a heater-cathode type, sharp cutoff, RF pentode of miniature construction for use in low power applications at high and ultra-high frequencies. It is designed for dependable operation under conditions of shock vibration usually found in mobile and aircraft applications.

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

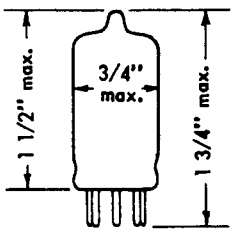
TERMINAL CONNECTIONS:

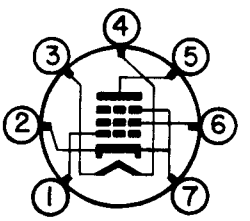
Pin 1 Grid #1	Pin 5 Plate
Pin 2 Cathode, Grid #3	Pin 6 Grid #2
Pin 3 Heater	Pin 7 Cathode, Grid #3
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 4)	2.5 G
Maximum Bulb Temperature	165 °C

MOUNTING POSITION: Any





BOTTOM VIEW

ELECTRICAL DATA

CAUTION-To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its centered rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)		ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 7):	Ef:	5.7	6.3	6.3	6.3	6.9	V
Plate Voltage:	Eb:		120	120	150	200	Vdc
Grid #1 Voltage:	Ec1:		-2.0	0	0		Vdc
Grid #2 Voltage:	Ec2:		120	120	140	155	Vdc
Plate Dissipation:	Pp:			0.9	1.05	1.65	W
Grid #2 Dissipation:	Pg2:			0.3	0.31	0.55	W
Heater-Cathode Voltage:	Ehk:	-130				+130	Vdc
Cathode Current (Note 9)	Ik:			10.0	9.2	20	mAdc
Cathode Resistance:	Rk:			200	330		ohms

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL.	BOGIE	UAL.	MAX.	ALD.	MIL-E-1B UNITS
ACCEPTANCE TEST-GROUP C										
Continuity and Short:		0.4								
ACCEPTANCE TESTS-GROUP D		**COMBINED AQL=1.0%**								
Heater Current:		0.65	If:	160		175		190		mA
Heater-Cathode Leakage	Ehk=100 Vdc, Heater Positive		Ihk:					10		μAdc
	Ehk=100 Vdc, Heater Negative	0.65	Ihk:					10		μAdc

Tentative Data

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL.	BOGIE	UAL.	MAX.	ALD.	MIL-E-1B UNITS
Grid Current (1):	Rg1 = 0.1 Meg.	0.65	Ic1(1):					-0.1		μAdc
Plate Current (1):		0.65	Ib(1):	5.0	6.5	7.5	8.5	11.0	2.5	mAdc
Screen Current:		0.65	Ic2:	0.8	1.8	2.5	3.2	4.0	1.5	mAdc
Transconductance (1):		0.65	Sm(1):	4000	4525	5000	5475	6250	1025	μmhos
ACCEPTANCE TESTS-GROUP E										
Insulation of Electrodes:	EF = 6.3 V E(g1-all) = 100 Vdc; g1 Negative	2.5	R(g1-all):	100						meg.
	E(g2-all) = 300 Vdc; g2 Negative		R(g2-all):	100						meg.
	E(p-all) = 300 Vdc P Negative		R(p-all):	100						meg.
Plate Current (2):	Ec1 = -10 Vdc	2.5	Ib(2):					200		μAdc
Plate Current (3):	Ec1 = -5.5 Vdc	2.5	Ib(3):	5.0						μAdc
Transconductance (2):	Ef = 5.7 V; (Note 8)	2.5	ΔSm:					15		%
Grid Current (2):	Eb = 150 Vdc; Ec2 = 125 Vdc; Ec1 = 0; Ef = 7.0 Vac; RK = 130 ohms; Rg1 = 0.1 Meg; after 5 min. at Ef = 7.0 Vac; measure grid current at Ef = 7.0 Vac; 3 min. test not permitted.	2.5	Ic1(2):	0				-0.5		μAdc
RF Noise:	Ec1 = 0; E cal = 15.0 m-Vac; RK = 200 ohms; CK = 0.2 uf	2.5						3.0		mW
Noise and Microphonics:	Ef = 6.3 Vac; Ebb = Ecc2 = 200 Vdc; Ec1 = 0; Rk = 1000 ohms; Rp = 0.1 meg.; Rg2 = 0.5 Meg.; Cg2 = 2 uf. Ehk = 0; CK = 1000μf.	2.5	Ep:					100		mVac
ACCEPTANCE TESTS-GROUP A										
Shock:	Hammer Angle = 30° (Note 3)									
Fatigue:	96 Hours: (Note 4)	6.5								
Post shock and Fatigue Test end Points:										
Vibration (2):	F = 25 cps; G = 2.5; Rp = 10,000 ohms		Ep(2):					450		mVac
Heater-Cathode Leakage (1):	Ehk = +100 Vdc:		Ihk(1):					30		μAdc
Heater-Cathode Leakage (2):	Ehk = -100 Vdc		Ihk(2):					30		μAdc
Transconductance (1):			Sm(1):	3500						μmhos
Grid Current (1):			Ic1(1):	0				-0.2		μAdc
ACCEPTANCE TEST-GROUP F										
Vibration (2):	F = 25 cps; G = 2.5; Rp = 10,000 ohms	6.5	Ep:					150		mVac
Capacitance:	(Note 2)		Cg1P:					0.020		uuf
Capacitance:	(Note 2)	6.5	Cin:	3.40				4.6		uuf
Capacitance:	(Note 2)		Cout:	2.45				3.25		uuf
Low Pressure Voltage Breakdown:		6.5		500						Vac

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL.	BOGIE	UAL.	MAX.	ALD	MIL-E-1B UNITS
ACCEPTANCE TEST - GROUP B										
Glass Strain:		2.5								
ACCEPTANCE LIFE TEST										
Heater Cycling:	Ef= 7.5 V; Ehk=+ 135 Vdc; Ec1= Eb= Ec2= 0			2000						cycles
Heater Cycling Life Test End Points:										
Heater-Cathode Leakage (1):	Ehk=+ 100 Vdc		Ihk(1):					20		μAdc
Heater Cathode Leakage (2):	Ehk=- 100 Vdc		Ihk(2):					20		μAdc
1 Hour Stability Life Test:	TA= Room; Ehk=+ 135 Vdc; Eb= 150 Vdc; Ec1= 0; Ec2= 125 Vdc; Rg1= 0.1 Meg.; Rk= 130 ohms									
1 Hour Stability Life Test End Points:										
Transconductance (1): Change of individual tube from initial:	(typical sample size= 50 tubes)	1.0	△Sm(1):					10		%
100 Hour Survival Rate Life Test:	TA= Room; Ehk=+ 135 Vdc; Eb= 150 Vdc; Ec1= 0; Ec2= 125 Vdc; Rg1= 0.1 Meg; Rk= 130 ohms									
100 Hour Survival Rate Life Test End Points:										
Inoperatives:	(Typical sample size= 200 tubes)	0.65								
500 and 1000 Hour Intermittent High Temperature Life Test:	T-Bulb= 165° C; Ehk= + 135 Vdc Eb= 150 Vdc; Ec1= 0; Ec2= 125 Vdc Rg1= 0.1 Meg; Rk= 130 ohms									

TEST	CONDITIONS	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	MAX. DEFECTS PER CHARACTERISTIC 1st Sample	Combined Sample
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size = 20 tubes 1st sample, 40 tubes 2nd sample (Total allowable combined defects= 4 tubes 1st sample, 8 tubes 1st and 2nd samples)						
Inoperatives:						1	3
Heater Current:		If;	160	190	mA	1	3
Heater-Cathode Leakage		Ihk:		10	μAdc	1	3
Grid Current (1):		Ic1(1):		-0.1	μAdc	1	3
Transconductance (1):		Sm(1):	3750	6250	μmhos	1	3
Transconductance (1) Average Change (Note 10):		ave. △ Sm(1):		15	%		

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	MAX. DEFECTS PER CHARACTERISTIC	
						1st Sample	Combined Sample
Plate Current (1):		Ib(1):	4.5	11.0	mAdc	2	5
Electrode Insulation:							
(g1-all)		Rg1-all:	50		meg.		
(g2-all)		Rg2-all:	50		meg.	2	5
(P-all)		Rp-all:	50		meg.		
Transconductance (2) (Note 8)		ΔSm(2):		15	%	2	5
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size=20 tubes 1st sample, 40 tubes 2nd sample)						
Inoperatives						2	5
Heater Current:		If:	160	190	mA	2	5
Heater-Cathode Leakage:		Ihk:		10	μAdc	2	5
Grid Current (1):		Ic1(1):		-0.1	μAdc	2	5
Transconductance (1):		Sm(1):	3500	6250	μmhos	2	5
Plate Current (1):		Ib(1):	4.0	11.0	mAdc	4	8

NOTES:

Note 1 Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2 With Shield #316 connected to cathode.

Note 3 Test Conditions and Acceptance criteria per Shock Test procedures of MIL-E-1B basic specification.

Note 4 Test Conditions and Acceptance criteria per Fatigue Test procedures of MIL-E-1B basic specification.

Note 5 These normal values represent conditions at which control reliability may be expected.

Note 6 These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 7 For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

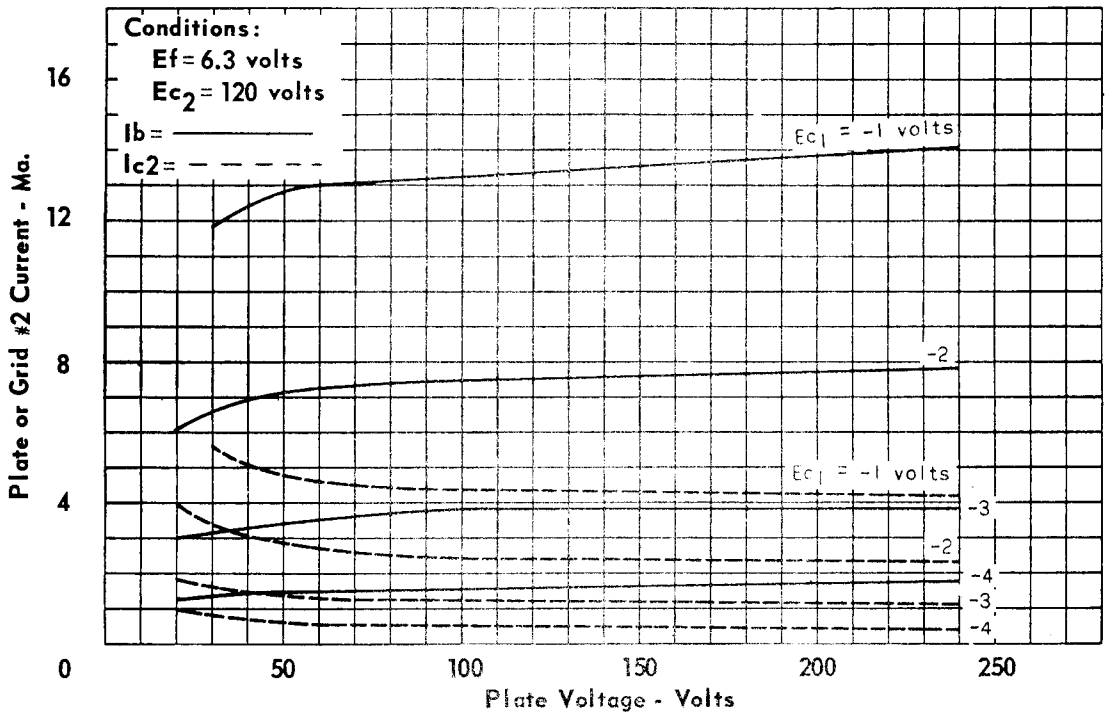
Note 8 Change of transconductance for individual tubes from that value measured at Ef=6.3V to that value measured at Ef=5.7V.

Note 9 Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

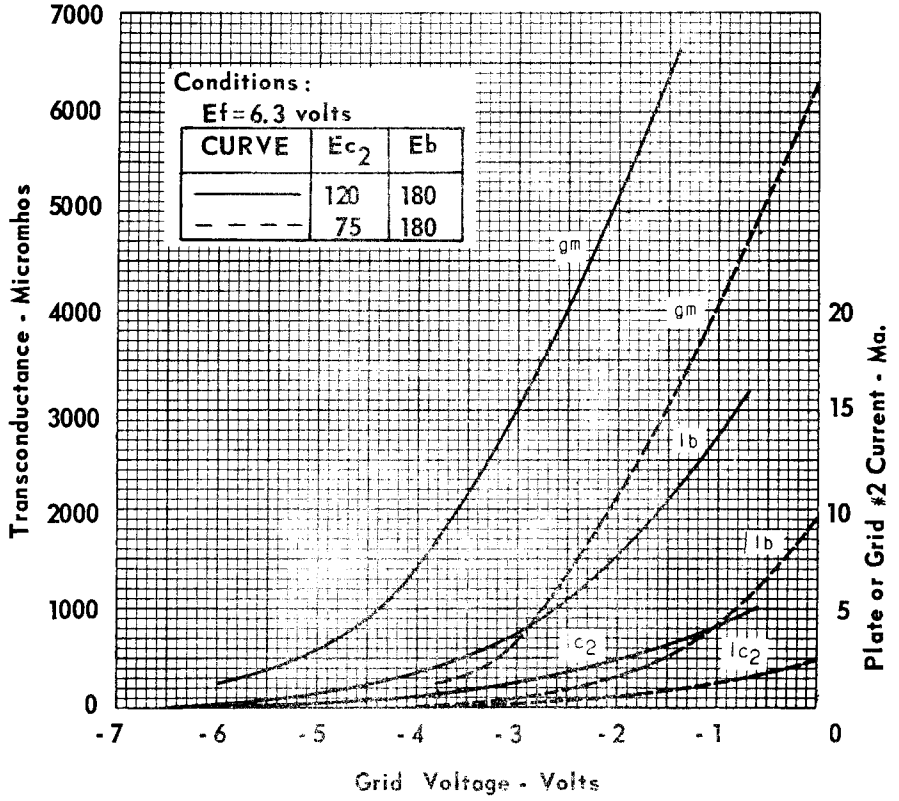
Note 10 The average percentage change shall be ascertained from the determination of the individual changes for each tube (inoperatives excluded) from the zero hour value for the referenced characteristic.

RELIABLE PENTODE

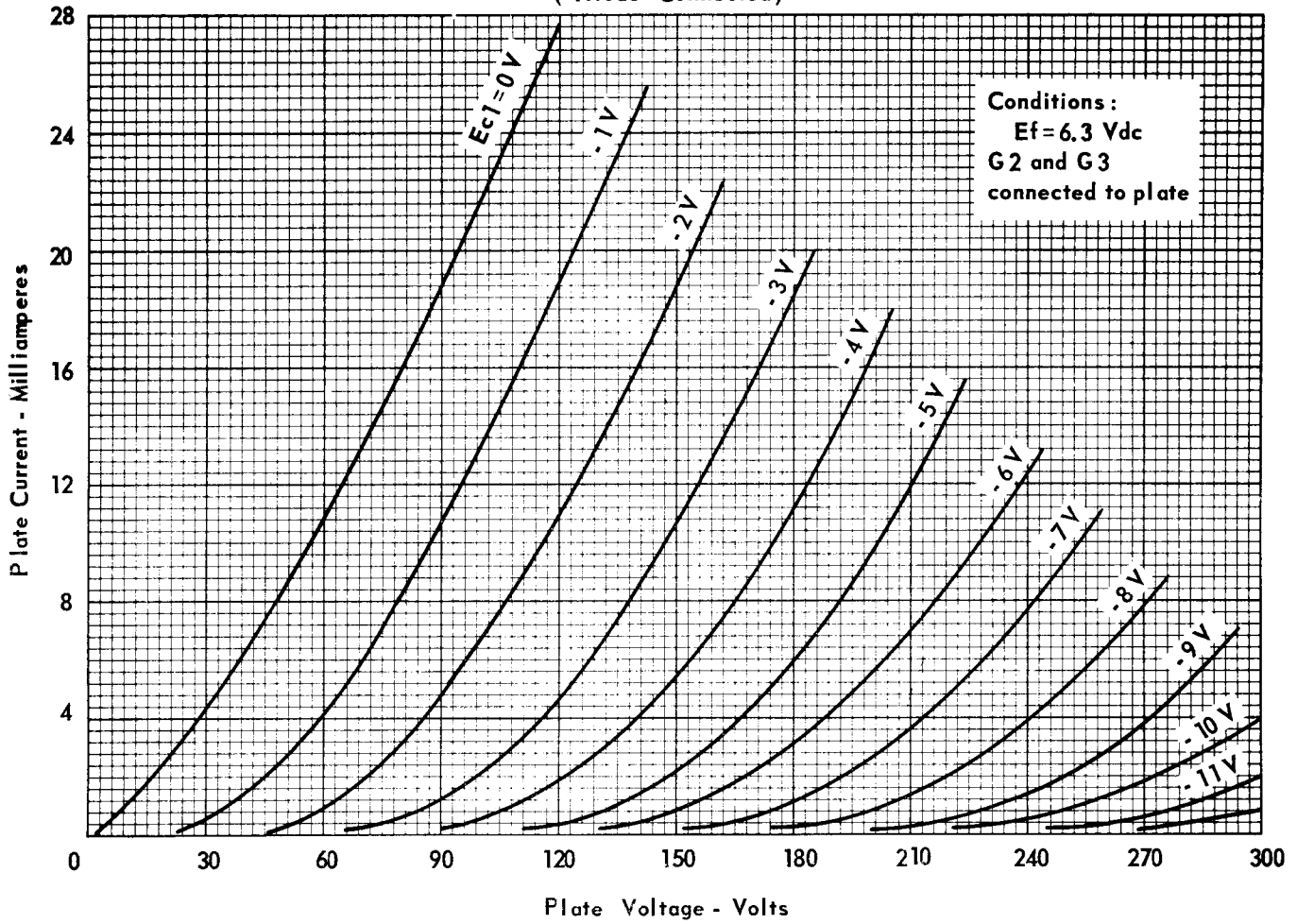
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS

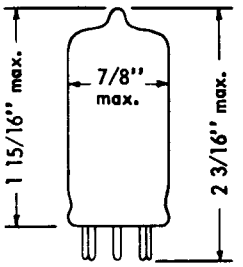


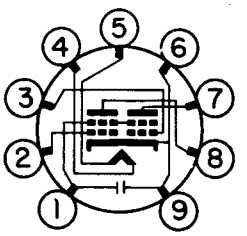
AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



TYPE CK5656

The CK5656 is a heater-cathode type, double tetrode of miniature construction, suitable for push-pull Class A and Class C RF amplifier service up to a frequency of 400 megacycles. The screen grids for the two sections are connected internally and are by-passed to the common cathode terminals by an internal condenser of approximately 15 $\mu\mu f$ capacitance. This terminal arrangement, by reducing the RF impedance between the separate screen grids and cathodes, permits the use of push-pull RF circuits which provide higher input impedance and lower plate circuit losses than other miniature tube types in the 200 to 400 megacycle frequency range.





BOTTOM VIEW

9F

MECHANICAL DATA

ENVELOPE: T-6½ Glass

BASE: Miniature Button 9-Pin

TERMINAL CONNECTIONS:

Pin 1 Grid #2 (Both Units)	Pin 6 Cathode (Both Units)
Pin 2 Grid #1 (Unit #1)	Pin 7 Plate (Unit #2)
Pin 3 Grid #1 (Unit #2)	Pin 8 Plate (Unit #1)
Pin 4 Heater	Pin 9 Cathode (Both Units)
Pin 5 Heater	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: Each Unit *(Without External Shield)* ($\mu\mu$fds)

Grid #1 to Plate	0.06 max.
Grid #1 to All Others Except Plate	3.6
Plate to All Others Except Grid	1.5
Common Screen to Cathode Internal By-pass Condenser (approx.)	15

RATINGS - ABSOLUTE MAXIMUM VALUES - CLASS A1:

Heater Voltage (ac or dc)	6.3±10% volts
Plate Voltage	250 volts
Grid #2 Voltage	165 volts
Plate Dissipation, Each Section	3.0 watts
Grid #2 Dissipation	1.5 watts
Plate Current, Each Section	20 ma.
Heater-Cathode Voltage	100 volts
DC Grid #1 Circuit Resistance, Each Section	100,000 ohms

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1: (Each Unit)

Heater Voltage (ac or dc)	6.3 volts
Heater Current (Total For Both Units)	0.40 amps.
Plate Voltage	150 volts
Grid #2 Voltage	120 volts
Grid #1 Voltage	−2.0 volts
Plate Resistance (approx.)	60,000 ohms
Transconductance	5800 μmhos
Plate Current	15.5 ma.
Grid #2 Current	2.7 ma.
Grid #1 Voltage (approx.) for Plate Current = 200 μa.	−8.5 volts

RATINGS ABSOLUTE MAXIMUM VALUES - PUSH-PULL CLASS C TELEGRAPHY: (Cont. Service)

(Values are total for both units unless otherwise noted)

Heater Voltage (ac or dc)	6.3±10% volts
Plate Voltage	220 volts
Grid #2 Voltage	165 volts
Negative Grid #1 Voltage	−50 volts
Plate Dissipation, Each Section	2.5 watts
Grid #2 Dissipation	1.5 watts
Plate Current, Each Section	17.5 ma.
Grid #1 Current, Each Section	4.0 ma.
Heater-Cathode Voltage	100 volts
DC Plate Input Power	7.0 watts
DC Grid #1 Circuit Resistance, Each Section	50,000 ohms

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

February 15, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd)

RATINGS ABSOLUTE MAXIMUM VALUES - PUSH-PULL CLASS C TELEGRAPHY INTERMITTENT "PUSH-to-TALK" SERVICE:

(Values are total for both units unless otherwise noted)

Heater Voltage (ac or dc)	6.3±10% volts
Plate Voltage	250 volts
Grid #2 Voltage	165 volts
Negative Grid #1 Voltage	−50 volts
Plate Dissipation, Each Section	3.5 watts
Grid #2 Dissipation	1.8 watts
Plate Current, Each Section	25 ma.
Grid #1 Current, Each Section	4.0 ma.
Heater-Cathode Voltage	100 volts
DC Plate Input Power	11 watts
DC Grid #1 Circuit Resistance, Each Section	50,000 ohms

CHARACTERISTICS AND TYPICAL OPERATION - PUSH-PULL CLASS C 225 MEGACYCLE RF AMPLIFIER

INTERMITTENT "PUSH-to-TALK" SERVICE:

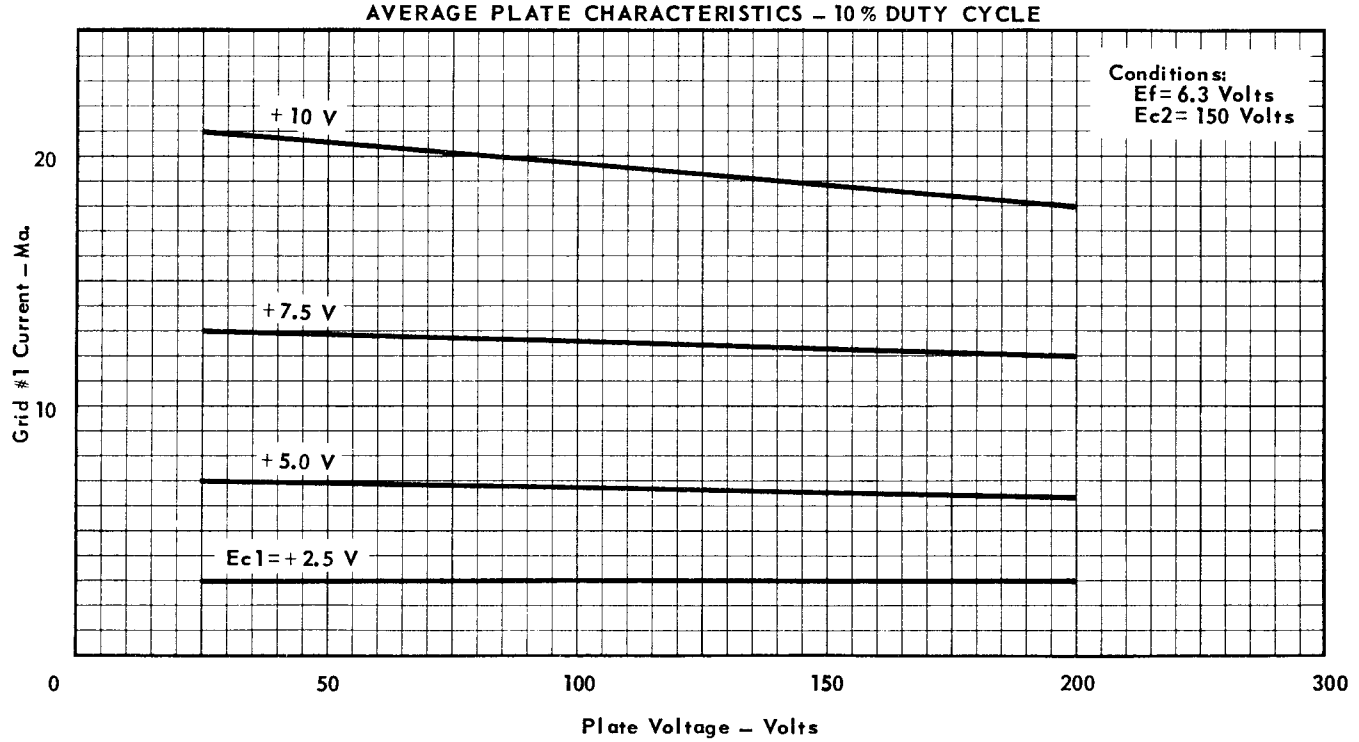
(Values are total for both units unless otherwise noted)

Heater Voltage (ac or dc)	6.3 volts
Heater Current	0.40 amps.
Plate Voltage	220 volts
Grid #2 Voltage (approx.)●	110 volts
DC Grid #1 Voltage	−15 volts
or Separate Grid #1 Resistance for Each Section■	5,000 ohms
Peak RF Grid #1 to Grid #1 Voltage	50.0 volts
Plate Current	45 ma.
Grid #2 Current	10.5 ma.
Grid #1 Current, Each Section	3.0 ma.
DC Plate Input Power	10 watts
Useful RF Power Output, 225 Mc.	4.6 watts

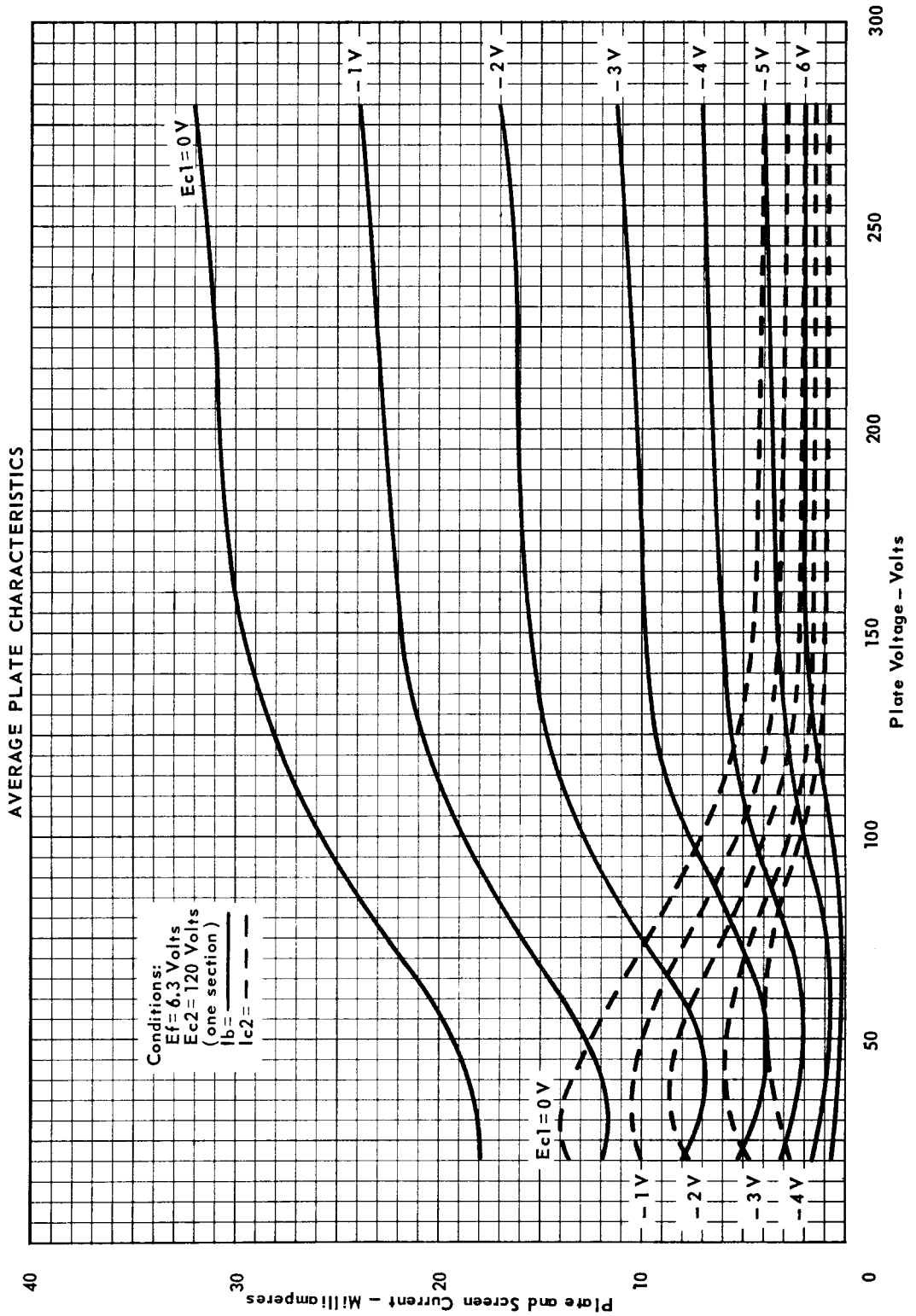
● *Adjust for the required plate current.*

■ *It is recommended that the push-pull RF grid signal be carefully balanced. The use of a separate dc grid resistance for each section from the rectified grid current, provides some compensation for unbalanced RF grid drive voltage.*

AVERAGE PLATE CHARACTERISTICS – 10% DUTY CYCLE

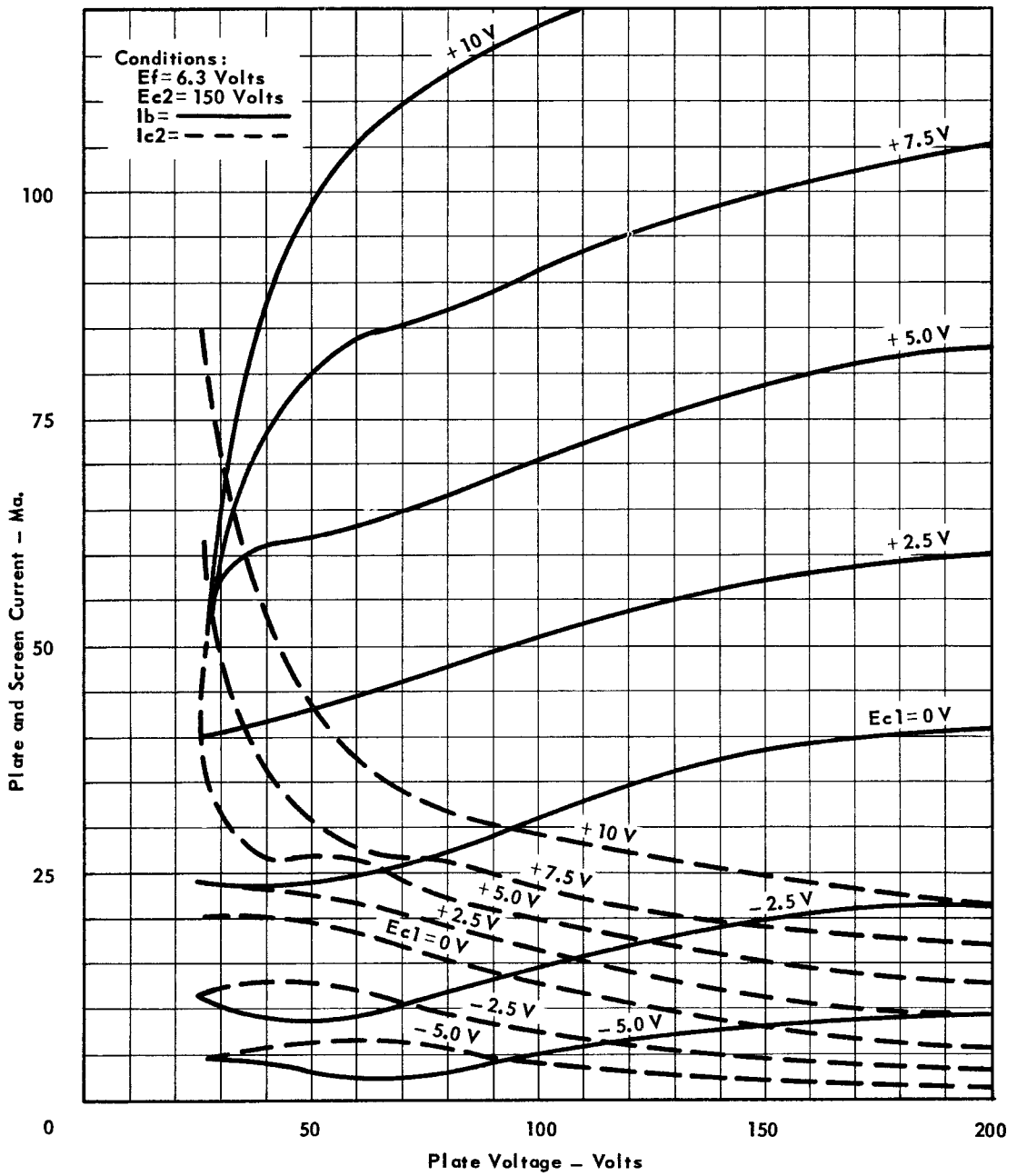


DOUBLE TETRODE



DOUBLE TETRODE

AVERAGE PLATE CHARACTERISTICS – 10% DUTY CYCLE



RAYTHEON

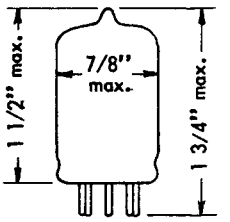
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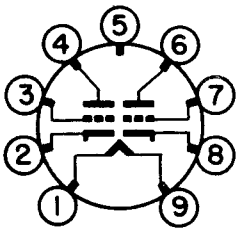
RELIABLE DOUBLE TRIODE

Excellence in Electronics

TYPE CK5670WA

The CK5670WA is a heater-cathode type, double triode of miniature construction, suitable for high frequency and general purpose amplifier service. It is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications.





MECHANICAL DATA

ENVELOPE: T-6 1/2 Glass

BASE: Miniature Button 9-Pin

TERMINAL CONNECTIONS:

Pin 1 Heater	Pin 6 Plate, Unit #1
Pin 2 Cathode, Unit #2	Pin 7 Grid, Unit #1
Pin 3 Grid, Unit #2	Pin 8 Cathode, Unit #1
Pin 4 Plate, Unit #2	Pin 9 Heater
Pin 5 Internal Shield	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock-Test-Note 3)	630G
Maximum Vibrational Acceleration (100 hour Fatigue Test-Note 4)	2.5G
Maximum Bulb Temperature	165°C

MOUNTING POSITION: Any

ELECTRICAL DATA

Caution----To Electron Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

Ratings and Normal Operation:	MIL-E-1B Symbol	Absolute Minimum	Normal Test Conditions (Note 6)	Normal Operation (Note 5)		Absolute Maximum	Mil-E-1B Units
Heater Voltage (Note 7)	Ef:	5.7	6.3	6.3	6.3	6.9	V
Plate Voltage	Eb:		150	150	300	330	Vdc
Grid Voltage	Ec1:		0	0	0		Vdc
Plate Dissipation (per plate)	Pp/p:			1.23	1.4	1.65	W
Heater-Cathode Voltage	Ehk:	-100				+100	Vdc
Plate Current (Note 9) per Plate	Ib/p:			8.2	4.9	18.0	mAdc
Cathode Resistance (per Cathode)	Rk/k:		240	240	800		ohms

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

In the following tests each unit is tested separately.

Test	Conditions	AQL %	MIL-E-1B Symbol	Min.	LAL	Bogie	UAL	Max.	ALD	MIL-E-1B Units
Acceptance Tests-Group C										
Continuity and Short:		0.4								
Acceptance Tests-Group D	**Combined AQL = 1.0%**									
Heater Current:		0.65	If:	330		350		370		mA

Tentative Data

Printed in U.S.A.

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

In the following tests each unit is tested separately

Test	Conditions	AQL %	MIL-E-1B Symbol	Min.	LAL	Bogie	UAL	Max.	ALD	MIL-E-1B Units
Heater-Cathode Leakage:	Ehk=100 Vdc Heater Positive	0.65	Ihk:					10		μAdc
	Ehk=-100 Vdc Heater Negative Units Connected in parallel		Ihk:					10		μAdc
Grid Current (1):	Rp=0.5 Meg.	0.65	Ic (1):					-0.3		μAdc
Plate Current (1):		0.65	Ib (1):	5.9	7.3	8.2	9.1	10.5	2.0	mAdc
Plate Current (2):	Ec=-10 Vdc; Rp=0.25 Meg: Rk=0	0.65	Ib (2):					45		μAdc
Transconductance (1):		0.65	Sm (1):	4500	5125	5500	5875	6500	850	μmhos
Acceptance Tests-Group E										
Insulation of Electrodes:	Ef=6.3 V									
	Eg-all=-100 Vdc	2.5	Rg-all:	100						Meg.
	Ep-all=-300 Vdc		Rp-all:	100						Meg.
Plate Current (1): difference between Sections:		2.5	Δlb (1):					2.0		mAdc
Transconductance (2):	Ef=5.7 V (Note 8)	2.5	ΔSm (2):					15		%
Rf Noise:	Eb=250 Vdc; Ecal=1.1 mVac; Ck=0.2 uf. Units Connected in parallel; Rk=240 ohms:	2.5						3.0		mW
Noise and Microphonics:	Ef=6.3 Vac; Eb=250 Vdc; Rp=10,000 ohms, Units connected in parallel; Rk=240 ohms.	2.5	Ep:					200		mVac
Grid Current (2):	After 5 minutes at Ef=7.0 V; measure grid current at Ef=7.0 V; 3 min. test not permitted.	2.5	Ic (2):					-0.5		μAdc
Acceptance Tests-Group F										
Vibration (2):	F=25 cps; G=2.5; Ec=-3 Vdc; Rk=0; Rp=2000 ohms; Units connected in parallel	6.5	Ep:					100		mVac
Amplification Factor:		6.5	Mu:	26	30	35	40	44	11.0	
Capacitance:			Cgp:	0.8				1.4		μμf
Capacitance:	Note 2	6.5	Cin:	1.7				2.7		μμf
Capacitance:			Cout:	0.7				1.3		μμf
Capacitance:			Cp-p:					0.10		μμf
Low Pressure Voltage Breakdown:		6.5		500						Vac
Acceptance Tests-Group A										
Shock:	Hammer Angle=42°; Note 3									
Fatigue:	96 Hours; Note 4	6.5								
Post Shock and Fatigue Test End Points:										
Vibration (2):	F=25 cps; G=2.5; Rp=2000 ohms units connected in parallel.		Ep:					300		mVac
Heater-Cathode Leakage:	Ehk=+100 Vdc		Ihk:					30		μAdc
	Ehk=-100 Vdc Units connected in parallel.		Ihk:					30		μAdc
Transconductance (1):			Sm (1):	3850						μmhos
Grid Current (1):			Ic (1):					-0.6		μAdc

RELIABLE DOUBLE TRIODE

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

In the following tests each unit is tested separately.

Test	Conditions	AQL %	MIL-E-1B Symbol	Min.	Max.	MIL-E-1B Units
Acceptance Tests - Group B						
Glass Strain:	(thermal shock)	2.5				
Acceptance Life Tests						
Heater Cycling:	Ef= 7.5 V: Ehk= 135 Vac; Eb= Ec= 0 Vdc; 1 min. on, 1 min. off			2000		cycles
Heater Cycling Life Test End Point:						
Heater-Cathode Leakage:	Heater Positive		Ihk:		20	μAdc
	Heater Negative		Ihk:		20	μAdc
1 Hour Stability Life Test:	TA= Room; Ehk=+ 135 Vdc; Rg1= 0.5 meg.					
1 Hour Stability Life Test End Points:						
Transconductance (1) Change of Individual Tubes from initial:	(Typical sample size= 50 tubes)	1.0	ΔSm(1):		10	%
100 Hour Survival Rate Life Test:	TA= Room; Ehk=+ 135 Vdc; Rg1= 0.5 Meg.					
100 Hour Survival Rate Life Test end points:						
Inoperative:	(Typical Sample Size= 200 tubes)	0.65				
500 and 1000 Hour Intermittent High Temperature Life Test:	T Bulb= 165°C; Ehk=+ 135 Vdc; Rg1= 0.5 Meg.					

Test	Conditions	AQL %	MIL-E-1B Symbol	Min.	Max.	MIL-E-1B Units	Max. defects per Characteristic 1st Sample	Max. defects per Characteristic Combined Sample
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample sizes= 20 tubes 1st sample, 40 tubes 2nd sample) (Total allowable combined defects= 4 tubes 1st sample; 8 tubes 1st and 2nd samples)							
Inoperatives:							1	3
Heater Current:			If:	330	370	mA	1	3
Heater-Cathode Leakage:			Ihk:		10	μAdc	1	3
Grid Current (1):			Ic(1):		-0.3	μAdc	1	3
Transconductance (1):			Sm(1):	3850	6500	μmhos	1	3
Transconductance (1) Average change (Note 10):		Avg.	ΔSm(1):		15	%		
Electrode Insulation: (g-all)			Rg-all:	50		Meg	2	5
(p-all)			Rp-all:	50		Meg.		
Transconductance (2) (Note 8):			ΔSm(2)		15	%		
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample 40 tubes 2nd sample)							
Inoperatives							2	5
Heater Current			If:	330	370	mA	2	5
Heater-Cathode Leakage			Ihk:		10	μAdc	2	5
Grid Current (1)			Ic (1):		-0.3	μAdc	2	5
Transconductance (1)			Sm(1):	3550	6500	μmhos	2	5

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B "Inspection Instructions for Electron Tubes", and MIL-STD-105A.

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

In the following tests each unit is tested separately.

NOTES (cont'd)

Note 2: Without Shield

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1B basic specifications.

Note 4: Test Conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1B basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be expected.

Note 6: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

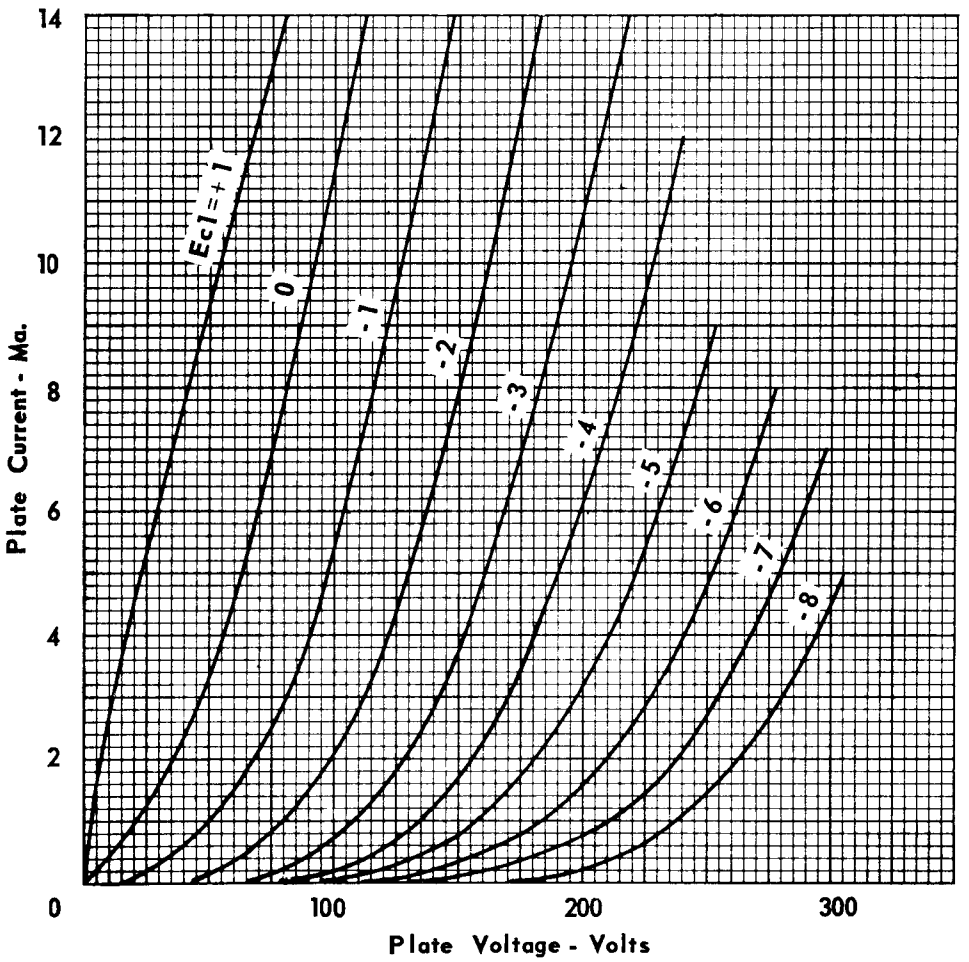
Note 7: For most applications the performance will not be adversely affected by + 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 8: Change of transconductance for individual tubes from that value measured at Ef= 6.3 V to that value measured at Ef= 5.7 V.

Note 9: Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

Note 10: The average percentage change shall be ascertained from the determination of the individual changes for each tube (inoperatives excluded) from the zero hour value for the referenced characteristics

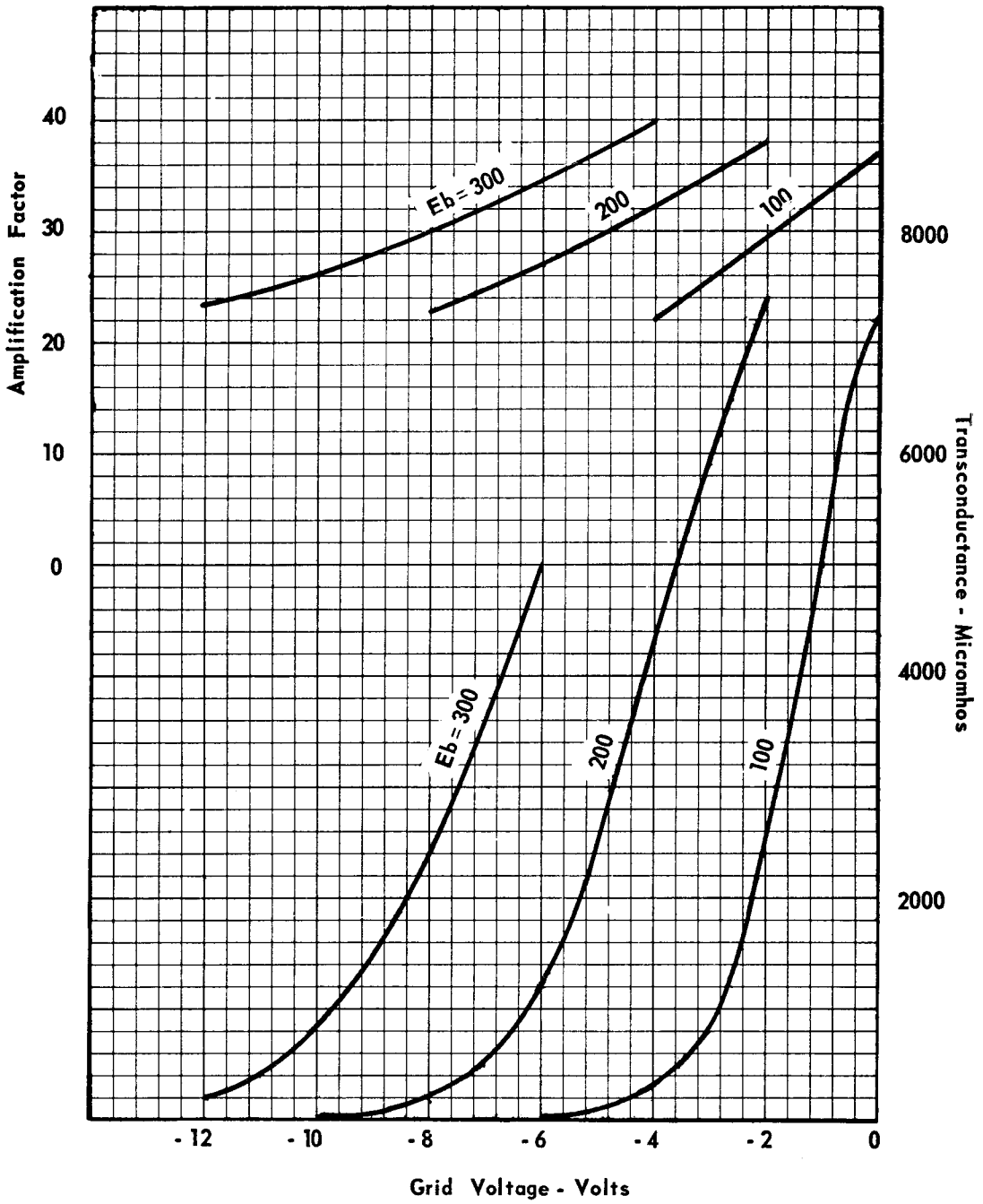
AVERAGE PLATE CHARACTERISTICS



RAYTHEON MANUFACTURING COMPANY

RELIABLE DOUBLE TRIODE

AVERAGE CHARACTERISTICS

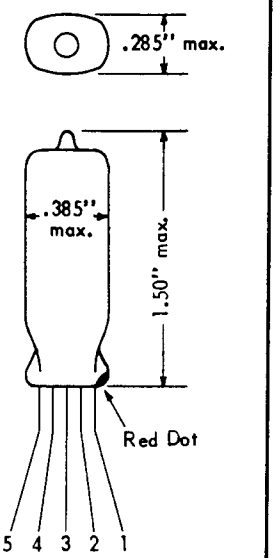


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Excellence in Electronics

TYPE CK5672

The CK5672 is a filament type pentode of subminiature construction designed for use as a power amplifier in wearable and portable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, negative: Grid #3
Lead 3 Filament, positive	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds) ▲

Grid #1 to Plate	0.14
Input	2.8
Output	3.5

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25± 20% volts
Plate Voltage	100 volts
Grid #2 Voltage	100 volts
Total Cathode Current	5.5 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	1.25 volts
Filament Current	50 ma.
Plate Voltage	67.5 volts
Grid #2 Voltage	67.5 volts
Grid #1 Voltage	-6.5 volts
Plate Current	3.25 ma.
Grid #2 Current	0.95 ma.
Transconductance	650 μmhos
Plate Resistance	125 kilohms
Load Resistance	20 kilohms
Distortion (approx.)	10 percent
Power Output	65 mw.
Peak AF Signal Voltage	6.5 volts

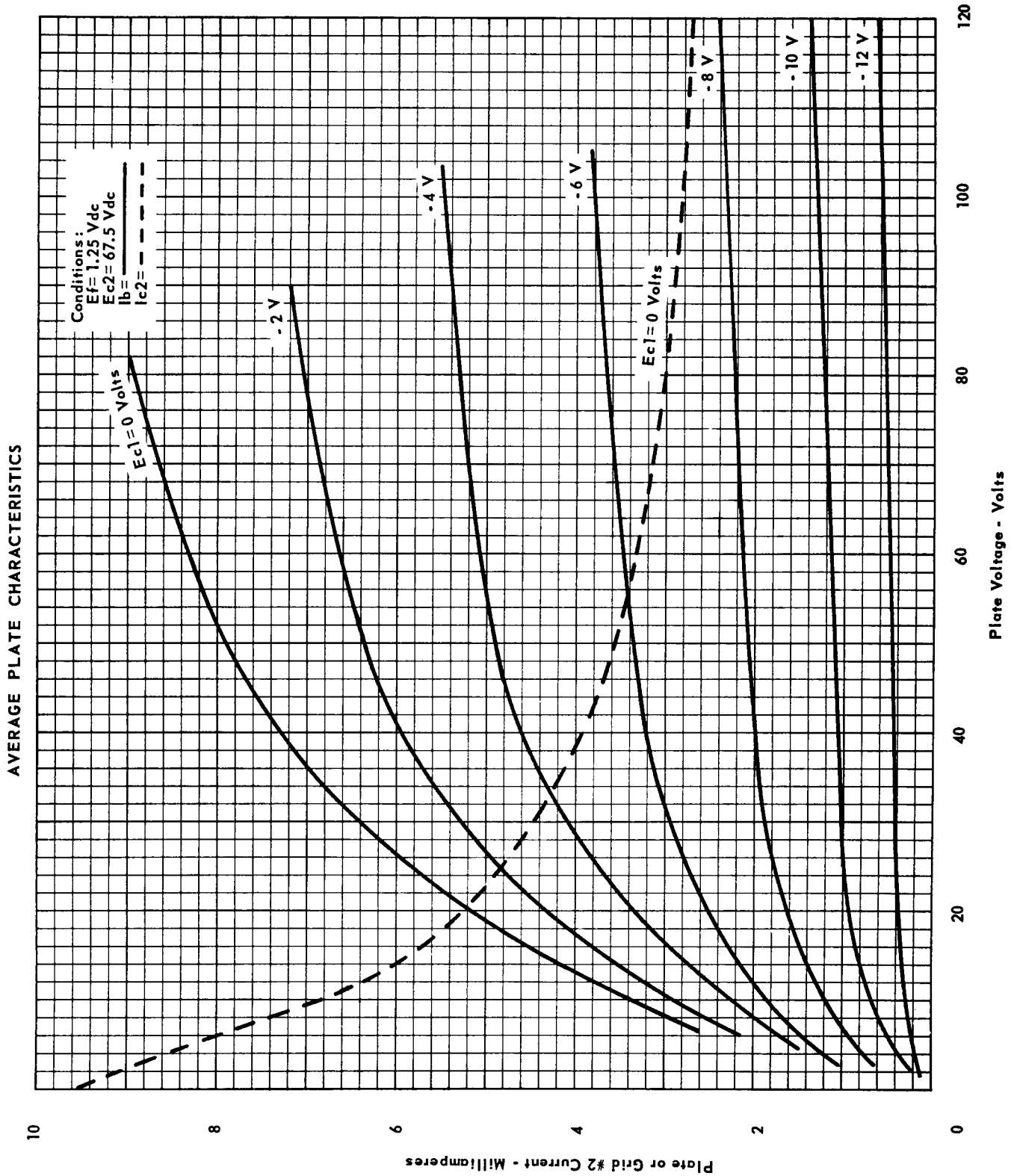
▲ *Without shield.*

Tentative Data

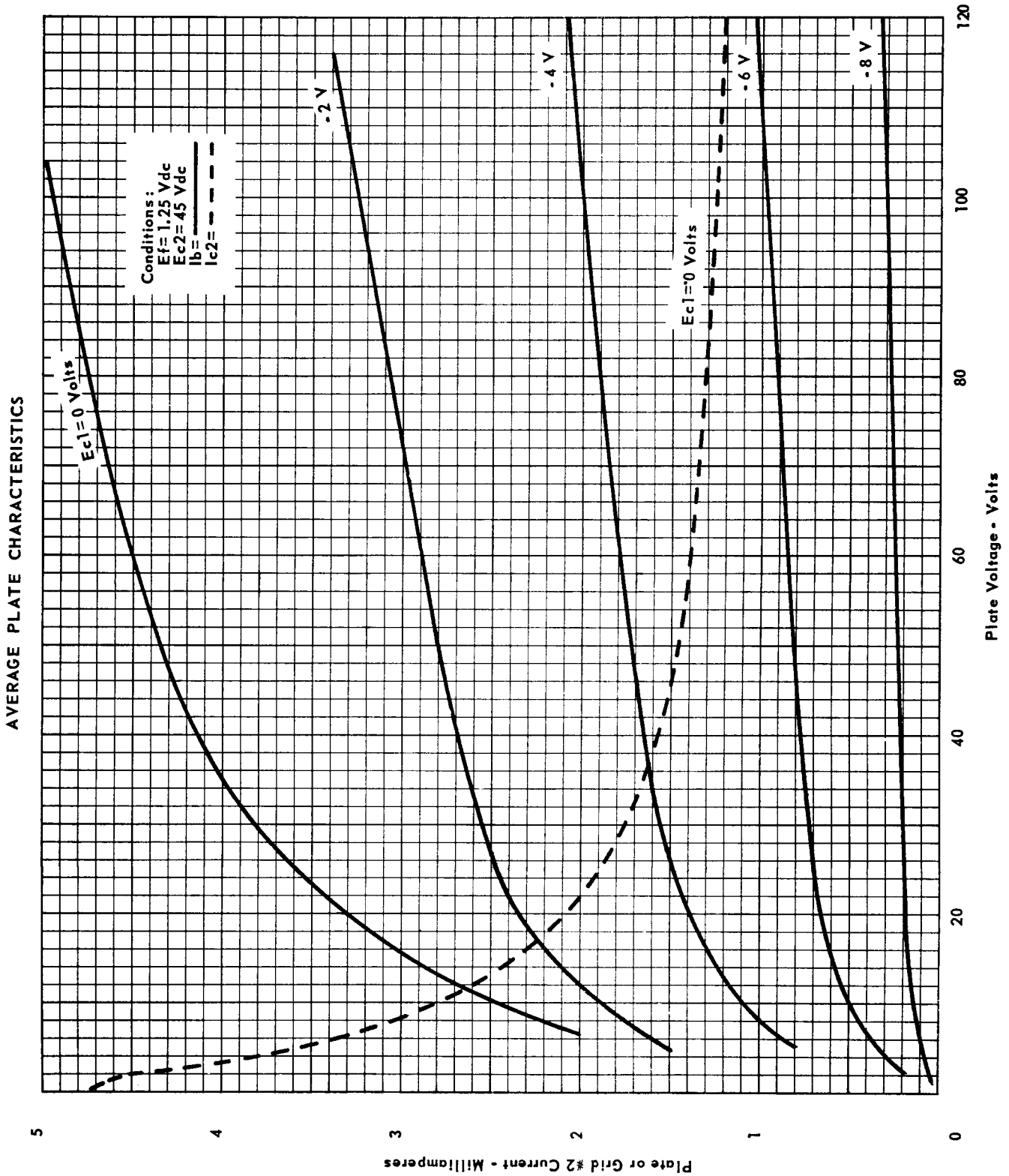
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SUBMINIATURE PENTODE

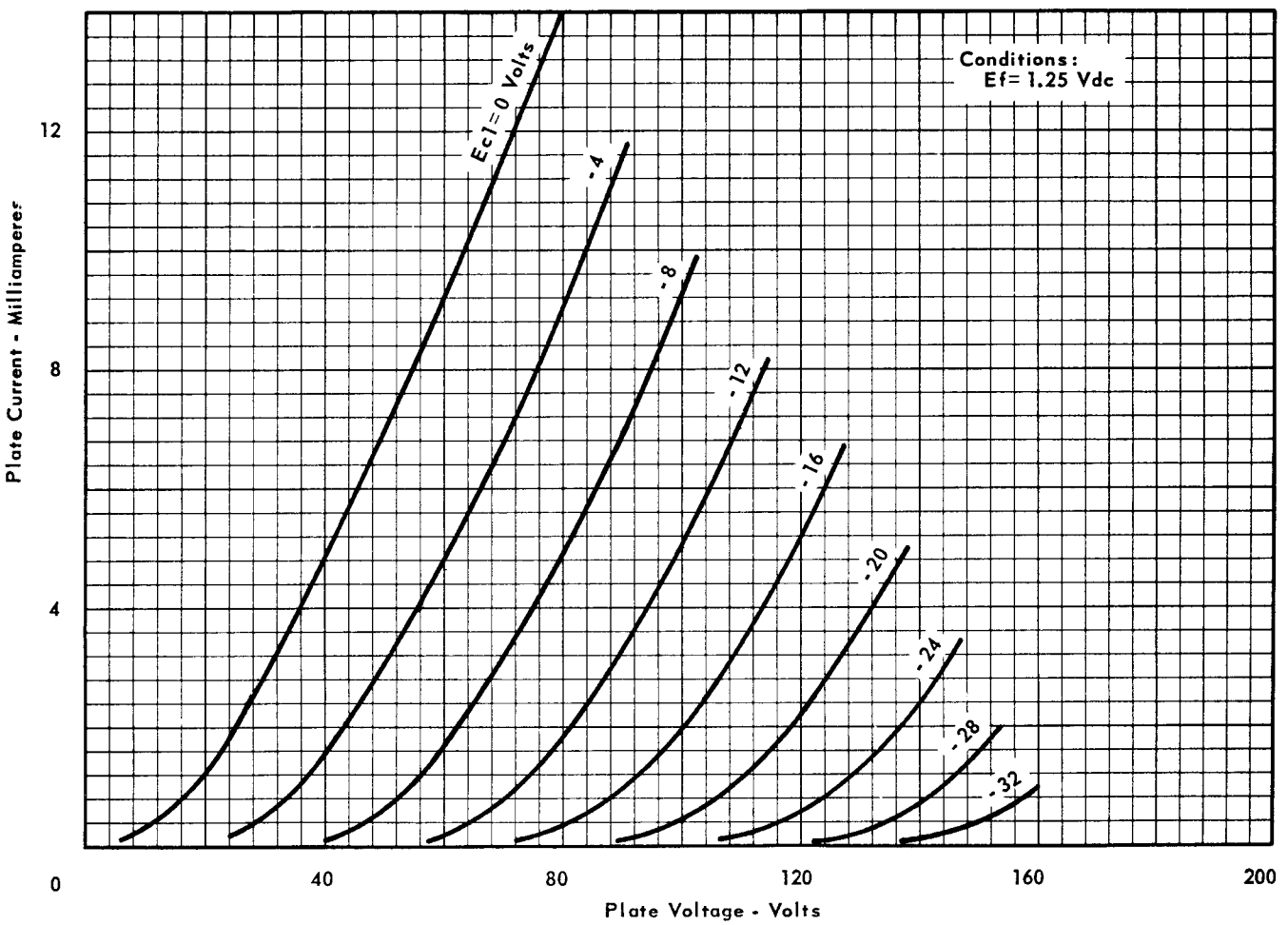


SUBMINIATURE PENTODE



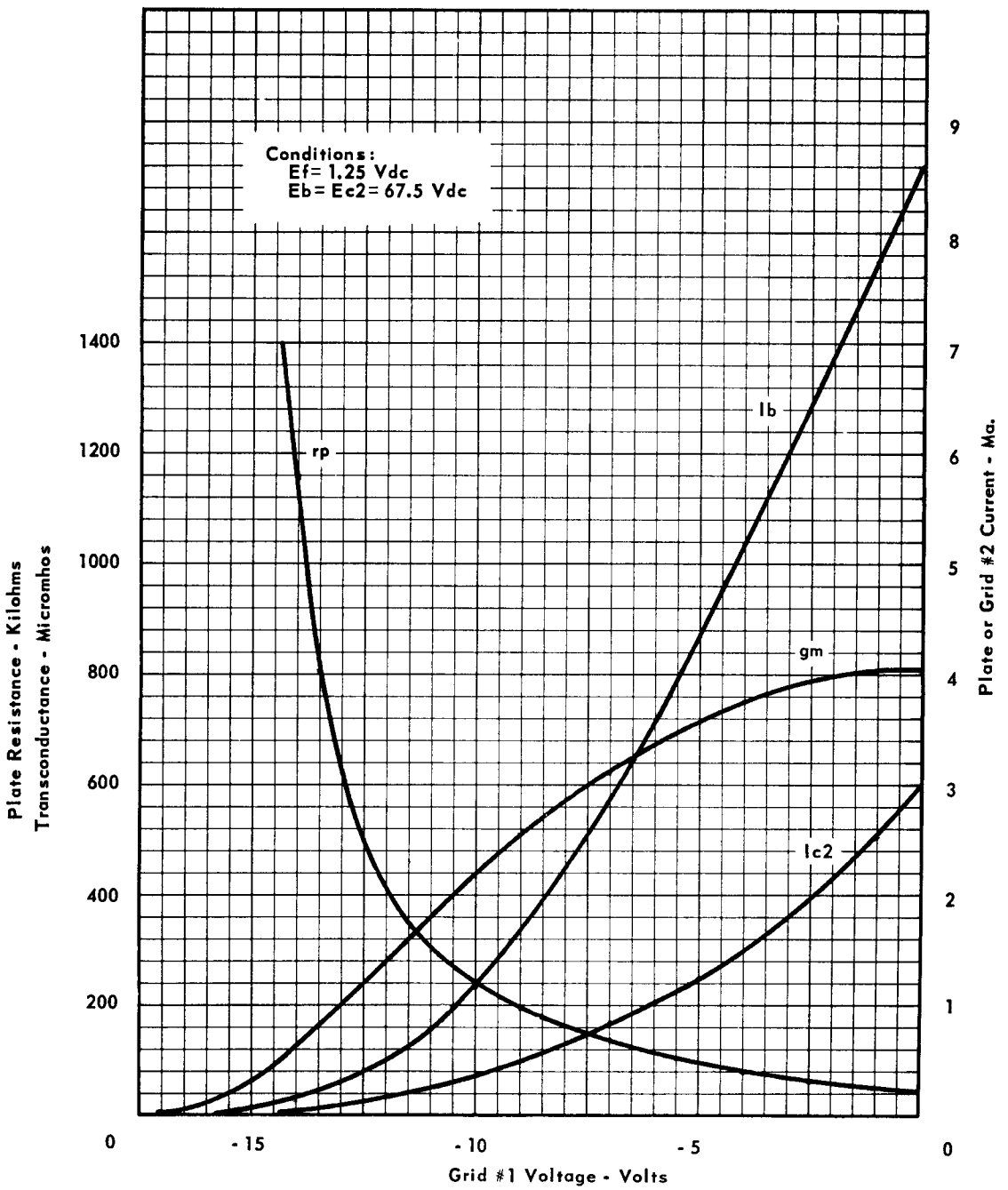
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS
(Triode Connected)

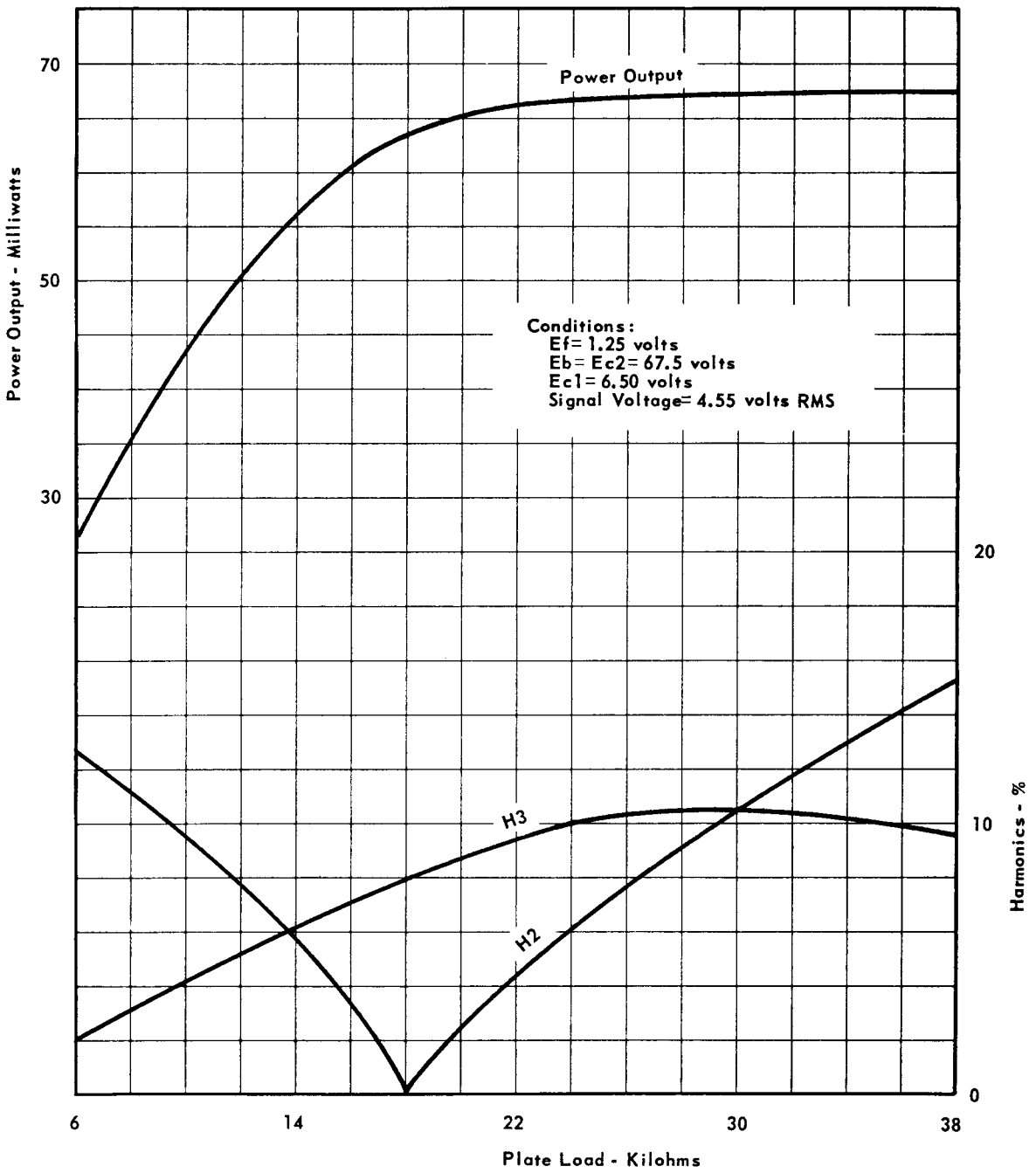


SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS
(Pentode Connected)



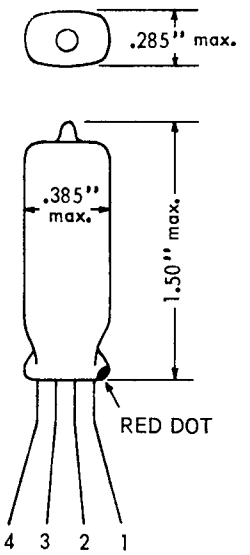
POWER OUTPUT CHARACTERISTICS



TYPE CK5676

Excellence in Electronics

The CK5676 is a filament type triode of subminiature construction designed for use as a high-frequency oscillator, Class C amplifier, or frequency multiplier up to several hundred megacycles. The design of this type is optimized for high peak current, high frequency operation at relatively low filament power. The CK5676 is suitable for intermittent service applications such as "push-to-talk" transmitters which do not require long life characteristics. The filament of the CK5676 should not be operated continuously inasmuch as its 100 hour life rating is chiefly a function of filament temperature and hours of filament operation. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standara in-line subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Filament, negative
Lead 3 Grid
Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*)

	Shielded ♦	Unshielded
Grid to Plate	1.4	1.4
Grid to Filament	1.3	1.2
Plate to Filament	3.4	1.9

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	150 volts
Plate Current	11 ma.

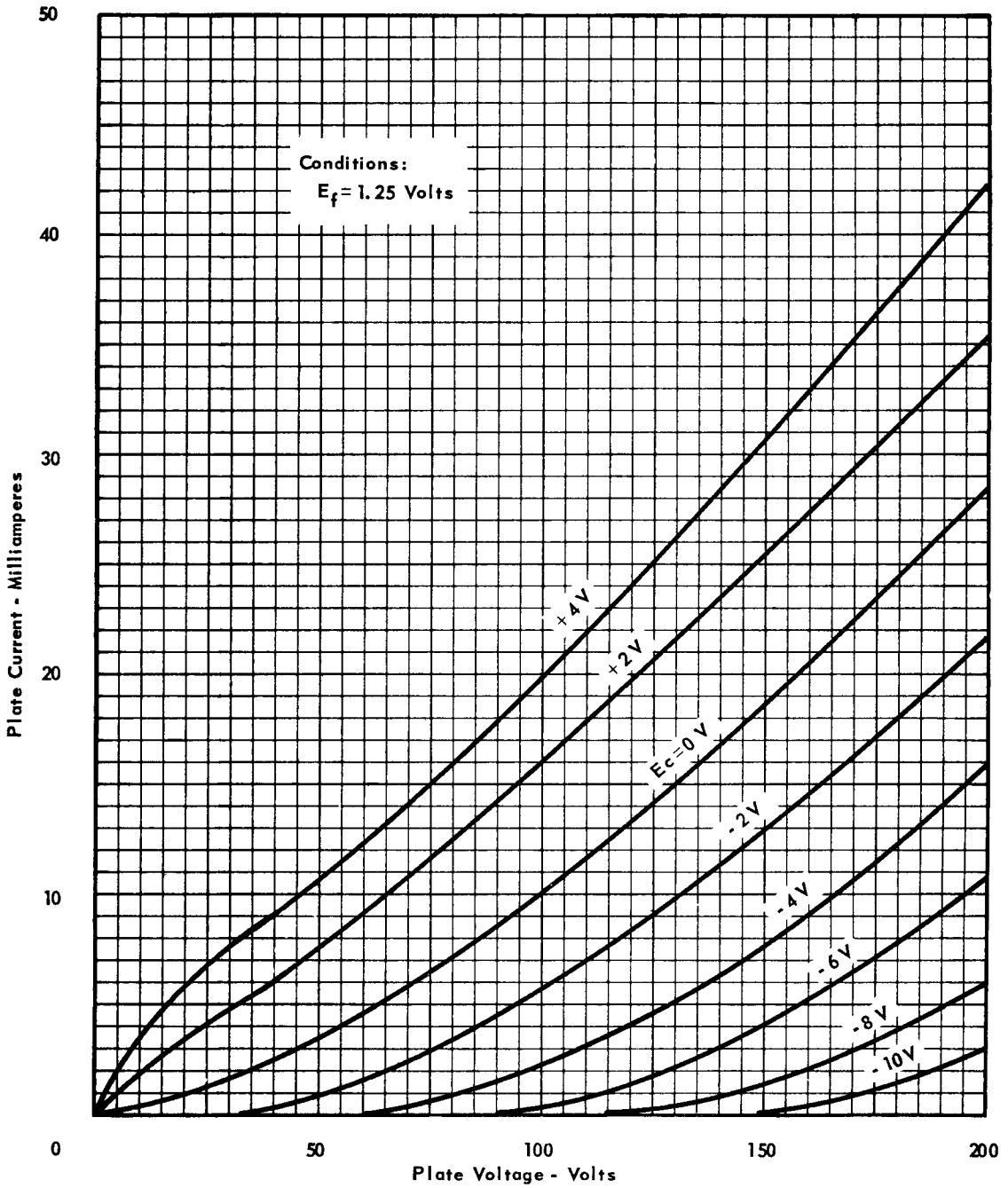
CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	0.12 amps.
Plate Voltage	135 volts
Grid Voltage	-5 volts
Transconductance	1600 μmhos
Amplification Factor	15
Plate Current	4.0 ma.
Grid Voltage (approx.) for Ib = 15 μa.	-10 volts

♦ *With close fitting shield connected to lead 2.*

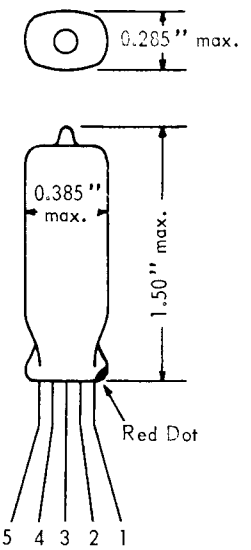
Tentative Data

AVERAGE PLATE CHARACTERISTICS



TYPE CK5678

The CK5678 is a filament type, fully shielded, subminiature pentode designed for service in RF applications requiring economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, positive;
Lead 3 Filament, negative; Shield; Grid #3 ■	

MOUNTING POSITION Any

ELECTRICAL DATA DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.)

Grid to Plate	0.01	max.
Input	3.3	
Output	3.8	

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20%	volts
Plate Voltage	90	volts
Grid #2 Voltage	67.5	volts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	1.25	volts
Filament Current	50	50	ma.
Plate Voltage	45	67.5	volts
Grid #2 Voltage	45	67.5	volts
Grid #1 Voltage ♦	0	0	volts
Plate Resistance	1.2	1.0	meg.
Transconductance	820	1100	μmhos
Plate Current	0.8	1.8	ma.
Grid #2 Current	0.22	0.48	
Grid #1 Voltage (approx.) for Gm=10 μmhos	-3	-4	volts

● *Bulb is entirely coated with a metallic shield connected to Lead 3.*

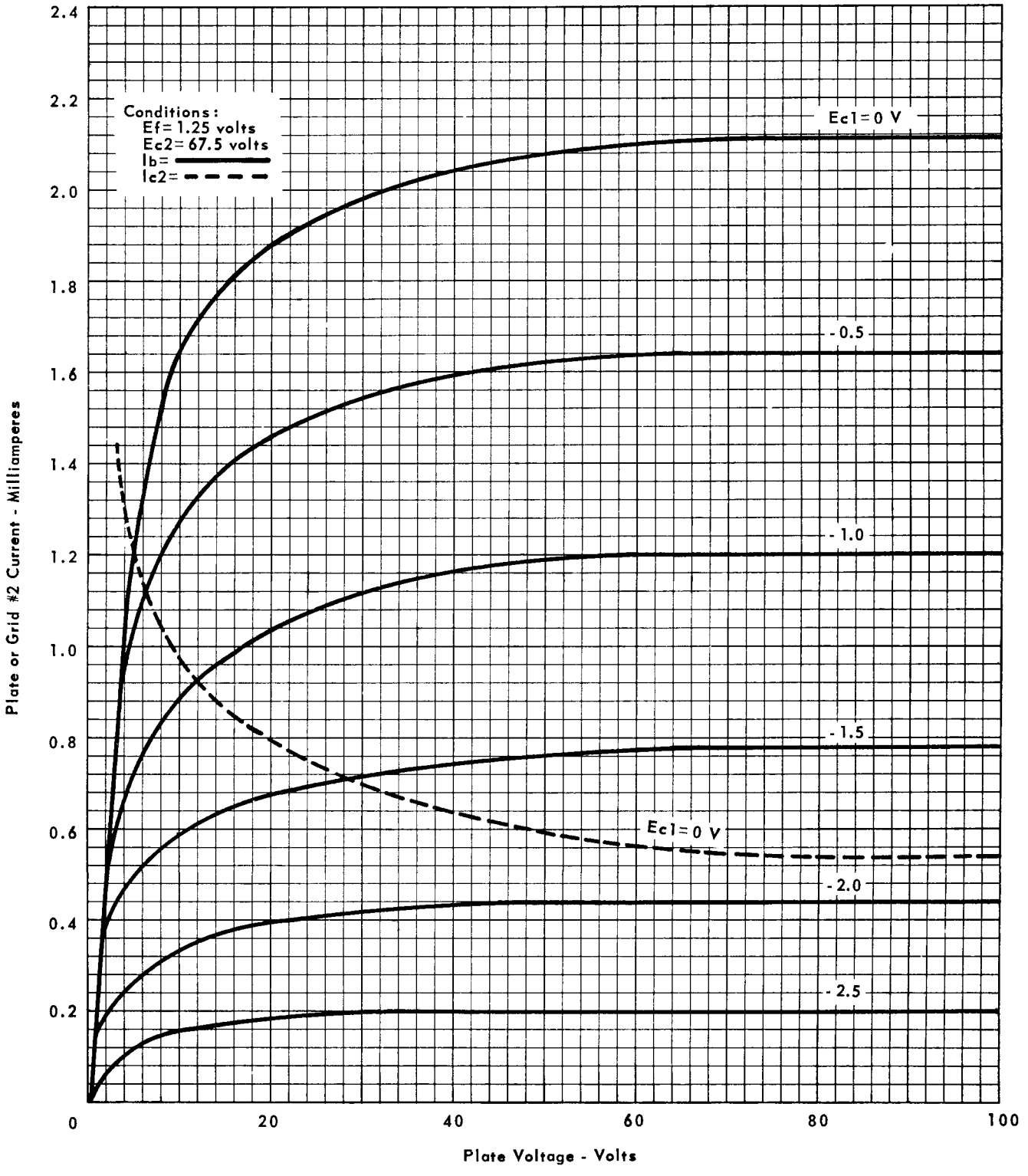
■ *Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5.*

♦ *Grid resistor=5 megohms.*

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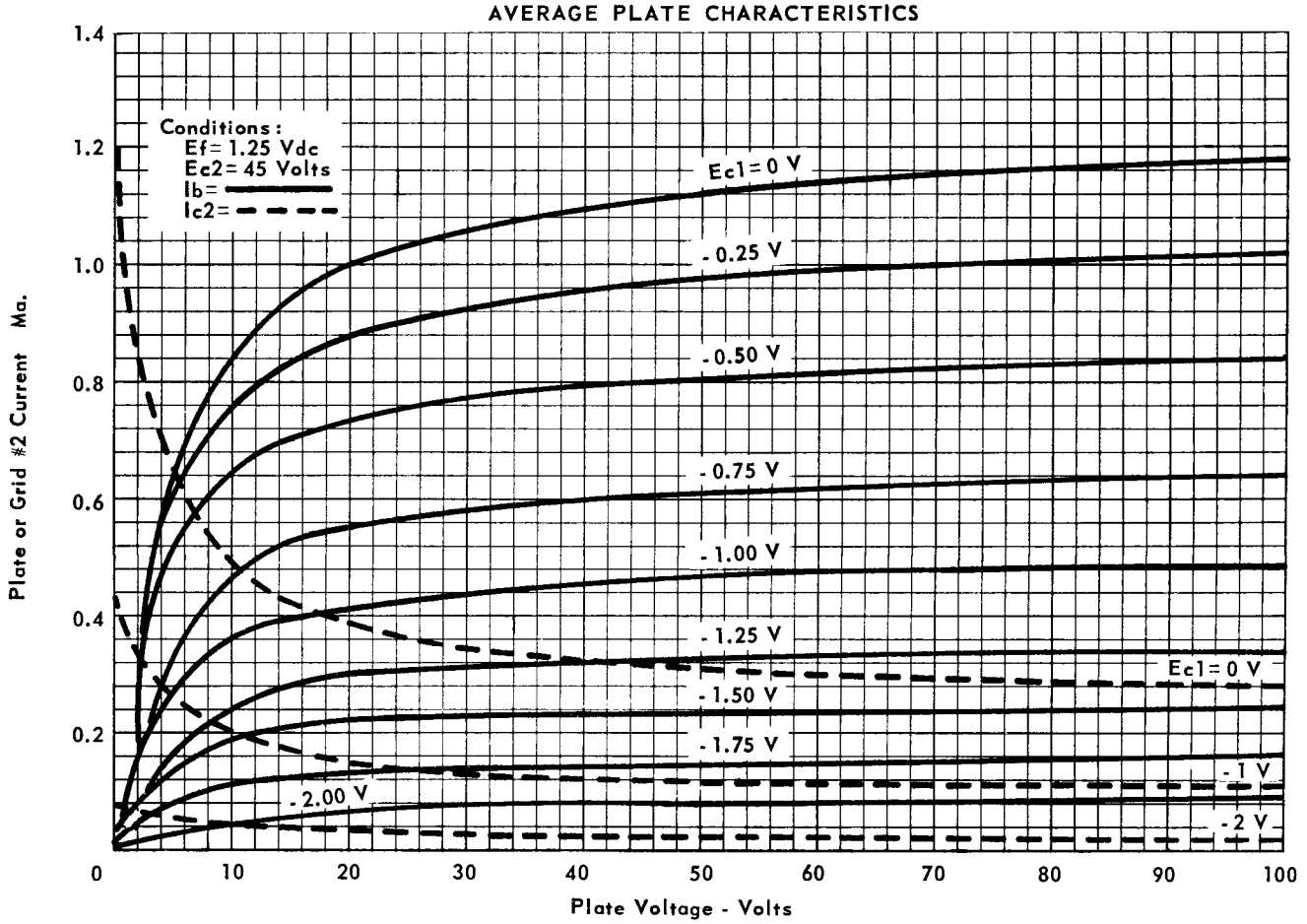
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



SUBMINIATURE PENTODE

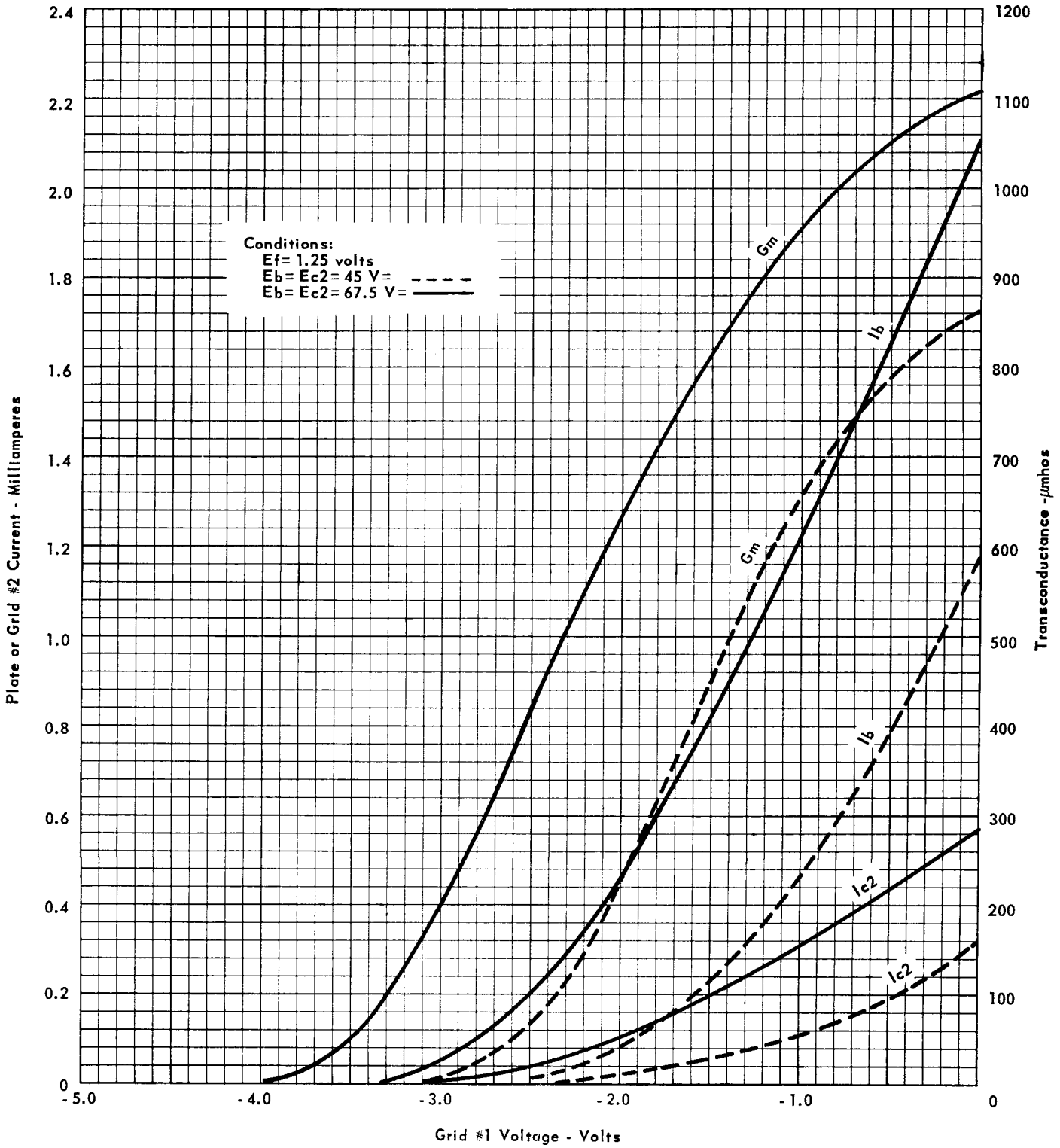
AVERAGE PLATE CHARACTERISTICS



RAYTHEON

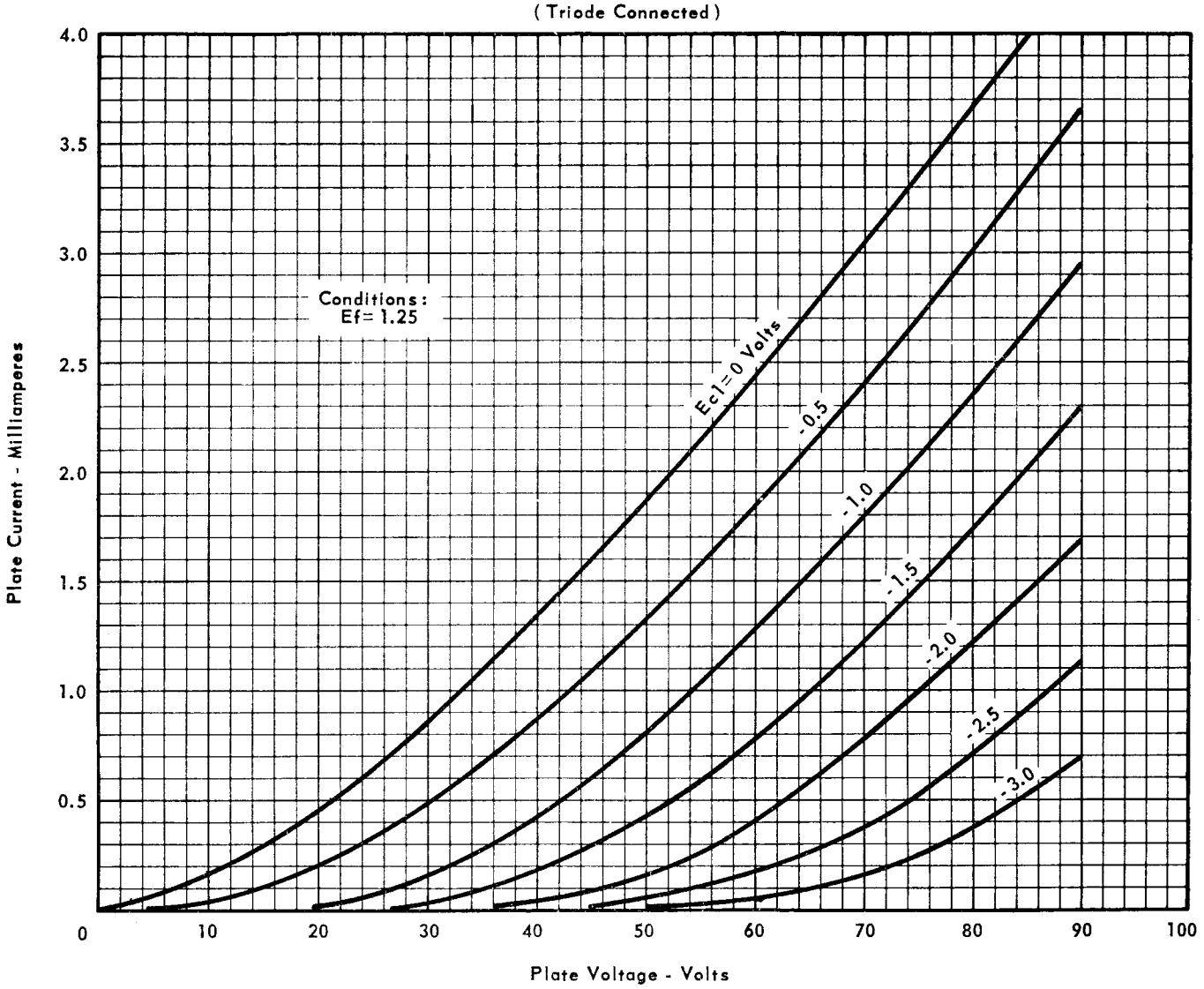
SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

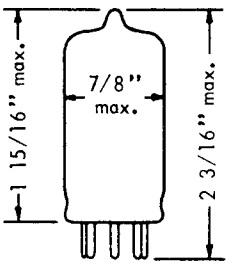
(Triode Connected)

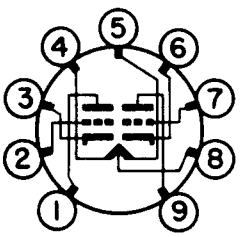


Excellence in Electronics

TYPE CK5687WA

The CK5687WA is a heater-cathode type medium-mu double triode of miniature construction designed for use in applications requiring high transconductance, high perveance or high emission capabilities. The cathode material in this type assures that high values of interface resistance will not develop when operated at cut-off conditions. This type employs separate cathode connections and a heater center-tap permitting either series or parallel operation. This type is characterized by long life and stable performance and is designed for service where severe conditions of mechanical shock or vibration are encountered.





BOTTOM VIEW

9H

MECHANICAL DATA

ENVELOPE: T – 6½ Glass

BASE: Miniature Button 9 – Pin

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2	Pin 6 Cathode, Unit #1
Pin 2 Grid, Unit #2	Pin 7 Grid, Unit #1
Pin 3 Cathode, Unit #2	Pin 8 Heater Center-Tap
Pin 4 Heater	Pin 9 Plate, Unit #1
Pin 5 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test – Note 3)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test – Note 4)	2.5 G
Maximum Bulb Temperature	225 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 7)	Ef: Series	12.0	12.6	12.6	13.2	V
	Parallel	6.0	----	6.3	6.6	V
Plate Voltage	Eb:	----	120	120	330	Vdc
Grid Voltage	Ec1:	–200	–2.0	–2.0	0	Vdc
Plate Dissipation (per Plate) (Note 9)	Pp/p:	----	----	----	3.75	W
Heater-Cathode Voltage	Ehk:	–100	----	----	+100	v
Plate Current (per Plate)	Ib/p:	----	----	36	----	mAdc
Cathode Current (per cathode)	Ik/k:	----	----	----	65	mAdc
Grid Circuit Resistance per Grid (Note 10)	Rg/g:	----	----	----	0.1	Meg.
Transconductance per Plate	Sm/p:	----	----	11,500	----	μmhos
Amplification Factor	Mu/p:	----	----	18.5	----	----

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

(In the following tests each unit is tested separately.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS – PART 1 (Combined AQL = 1.0% excluding Mechanical and Inoperatives)										
Heater Current:	Ef = 6.3 V	0.65	If:	820	850	880	910	940	50	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc Ehk = −100 Vdc	0.65	Ihk: Ihk:	----	----	----	----	30 30	---- ----	μAdc μAdc
Grid Current (1):	Rp = 0.1 Meg.	0.65	Ic (1):	0	----	----	----	−1.5	----	μAdc
Plate Current (1):		0.65	Ib (1):	27	33	36	39	45	7.0	mAdc
Emission:	Es = 15 Vdc	0.65	Is:	125	----	----	----	----	----	mAdc
Transconductance (1):		0.65	Sm (1):	8500	10500	11500	12500	14500	2500	μmhos
Continuity and Shorts: (Inoperatives)										
Mechanical:	Envelope Outline No. (6–7)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS – PART 2										
Insulation of Electrodes:	Ef = 12.6 V Eg-all = −100 Vdc Ep-all = −300 Vdc	---- 2.5	---- Rg – all: Rp-all:	---- 100 100	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	---- Meg. Meg.
Plate Current (2):	Eb = 300 Vdc; Ec1 = −20 Vdc	2.5	Ib (2):	----	----	----	----	6.0	----	mAdc
Plate Current (3):	Eb = 300 Vdc; Ec1 = −25 Vdc	2.5	Ib (3):	----	----	----	----	1.0	----	mAdc
Transconductance (2):	Ef = 11.4 V (Note 8)	2.5	Δ_{Ef} Sm (2):	----	----	----	----	15	----	%
Grid Emission:	Ef = 14.0 V; Rg/g = 1.0 Meg. After 5 minutes preheat	2.5	Ic (2):	0	----	----	----	−5.0	----	μAdc
AF Noise:	Ebb = 300 Vdc; Ec1 = 0; Rp = 2000 ohms; Eca1 = 70 mVac Rg = 1.0 Meg; Rk = 680 ohms (units connected in parallel)	2.5	EB:	----	----	----	----	17	----	VU
Plate Emission:	Eb = 195 Vac; Rk/Ib = 10.5 mAdc; Ec1 = 0; after 5 minutes, measure reverse plate current	2.5	Ib:	----	----	----	----	25	----	μAdc
Amplification Factor:		2.5	Mu:	16	----	18.5	----	21	----	----
Capacitance:	(Note 2)	6.5	Cgp:	2.8	----	4.0	----	5.2	----	μμf
Capacitance:			Cin:	2.8	----	4.0	----	5.2	----	μμf
Capacitance:			Cout (1):	0.42	----	0.6	----	0.78	----	μμf
Capacitance:			Cout (2):	0.34	----	0.5	----	0.66	----	μμf
Capacitance:			Chk:	----	----	----	----	9.7	----	μμf
Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mmHg; Voltage = 500 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	G = 2.5; F = 25 cps; Rp = 2000 ohms	6.5	Ep:	----	----	----	----	100	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle = 30°C; (Note 3)	----	----	----	----	----	----	----	----	----
Fatigue:	96 Hours; Fixed Frequency; F = 25 min. 60 max. (Note 4)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F = 25 cps; G = 2.5; Rp = 2000 ohms	----	Ep:	----	----	----	----	150	----	mVac

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	50	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	50	μAdc		
Transconductance (1):		----	Sm (1):	6500	----	μmhos		
Grid Current (1):		----	Ic (1):	0	−3.0	μAdc		
Miniature Tube Base Strain:		----	----	----	----	----		
Glass Strain:	(Thermal Shock)	2.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling:	Ef=7.5 V (heater in parallel); Ehk=+135 Vdc; Eb=Ec=0 Vdc; 1 min. on, 4 min. off	----	----	2000	----	cycles		
Heater Cycling Life Test End Point:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	30	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	30	μAdc		
1 Hour Stability Life Test:	TA=Room; Ec1=0; Ehk=+135 Vdc; Rg/g=1.0 meg.; Rk/k=68 ohms	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical Sample Size=50 tubes)	----	----	----	----	----		
Transconductance (1) Change of individual tubes from initial:		1.0	Δ_t Sm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ec1=0; Ehk=+135 Vdc; Rg/g=1.0 meg.; Rk/k=68 ohms	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----		
Shorts-Continuity		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	7500	----	μmhos		
500 and 1000 Hour Intermittent High Temperature life test:	T Bulb=225°C; Ec1=0; Ehk=+135 Vdc; Rg/g=1.0 meg.; Rk/k=68 ohms	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Sizes=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	0	−2.0	μAdc	1	3
Heater Current:		----	If:	800	960	mA	1	3
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	20	%	1	3
Transconductance (2) (Note 8)		----	Δ_{Ef} Sm (2):	----	25	%	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	50	μAdc	1	3
	Ehk=−100 Vdc	----	Ihk:	----	50	μAdc		
Electrode Insulation:								
(p−all)		----	Rp−all:	50	----	Meg.	2	5
(g−all)		----	Rg−all:	50	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable defects per Characteristics 1st Sample	Allowable defects per Characteristics Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd)								
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic (1):	0	−2.5	μAdc	2	5
Heater-Current:		----	If:	800	960	mA	2	5
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	25	%	2	5
Transconductance (2) (Note 8)		----	Δ_{Ef} Sm (2):	----	30	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	50	μAdc	2	5
	Ehk=−100 Vdc	----	Ihk:	----	50	μAdc		
Electrode Insulation:								
(p−all)		----	Rp−all:	25	----	Meg.	4	8
(g−all)		----	Rg−all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	5	10

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes", and MIL-STD-105A.

Note 2: Without Shield.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 4: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be expected.

Note 6: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 7: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

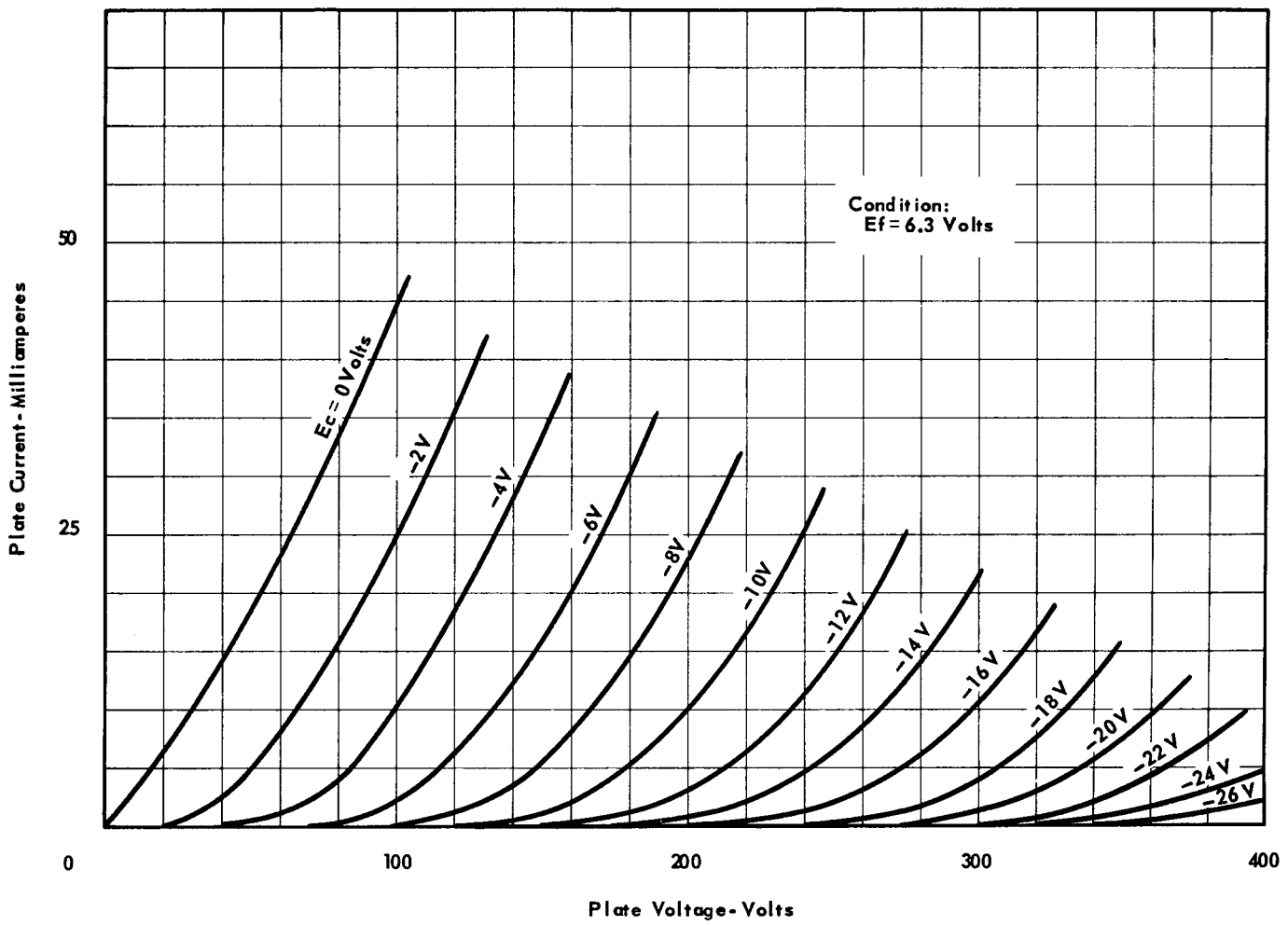
Note 8: Change of transconductance for individual tubes from that value measured at Ef= 12.6 volts to that value measured at Ef= 11.4 volts.

Note 9: The plate dissipation of one section may be as great as 4.2 watts provided that the maximum dissipation for both sections does not exceed 7.5 watts.

Note 10: The maximum Rg/g may be 1.0 meg. providing cathode bias is used.

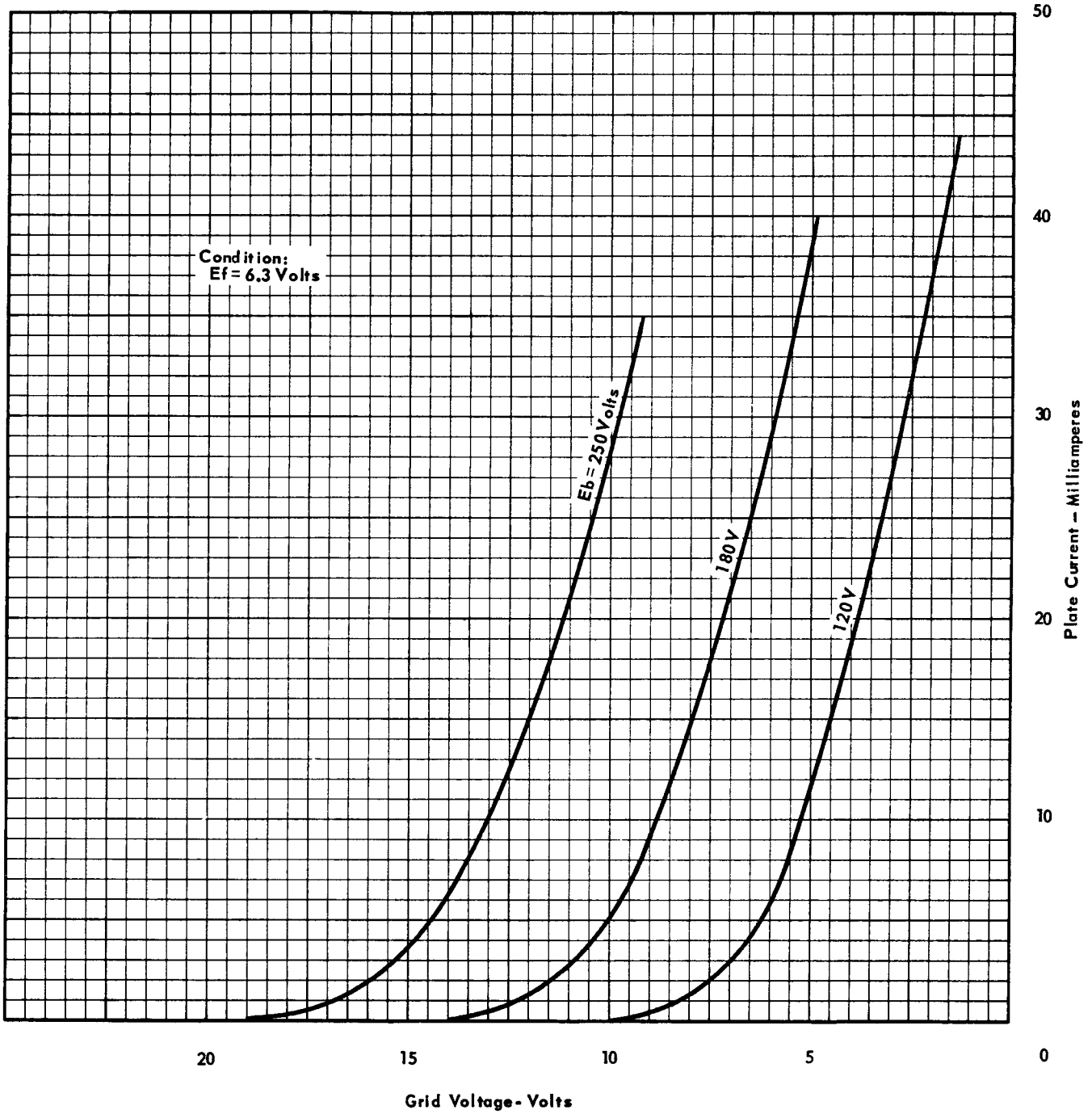
RELIABLE DOUBLE TRIODE

AVERAGE PLATE CHARACTERISTICS

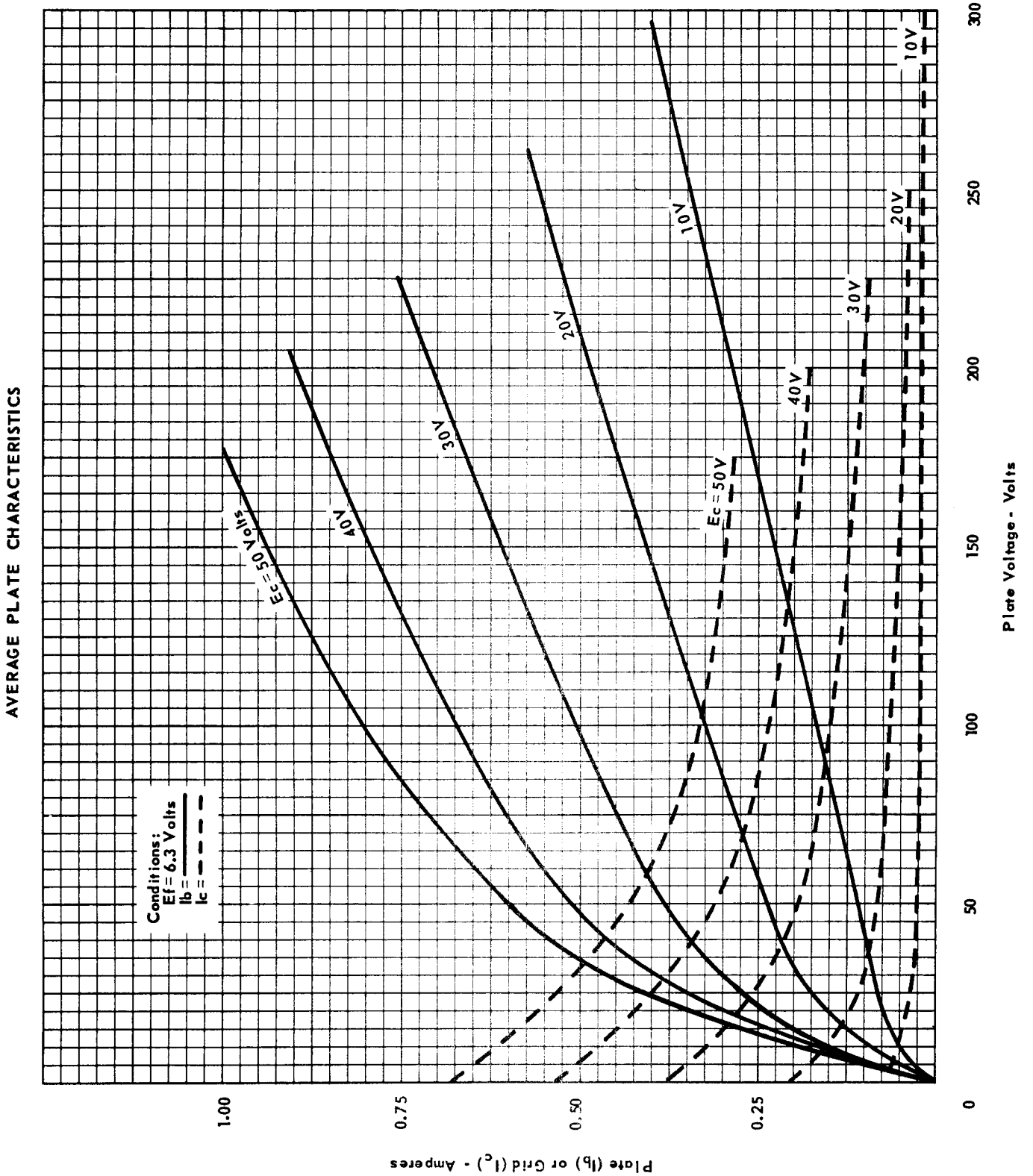


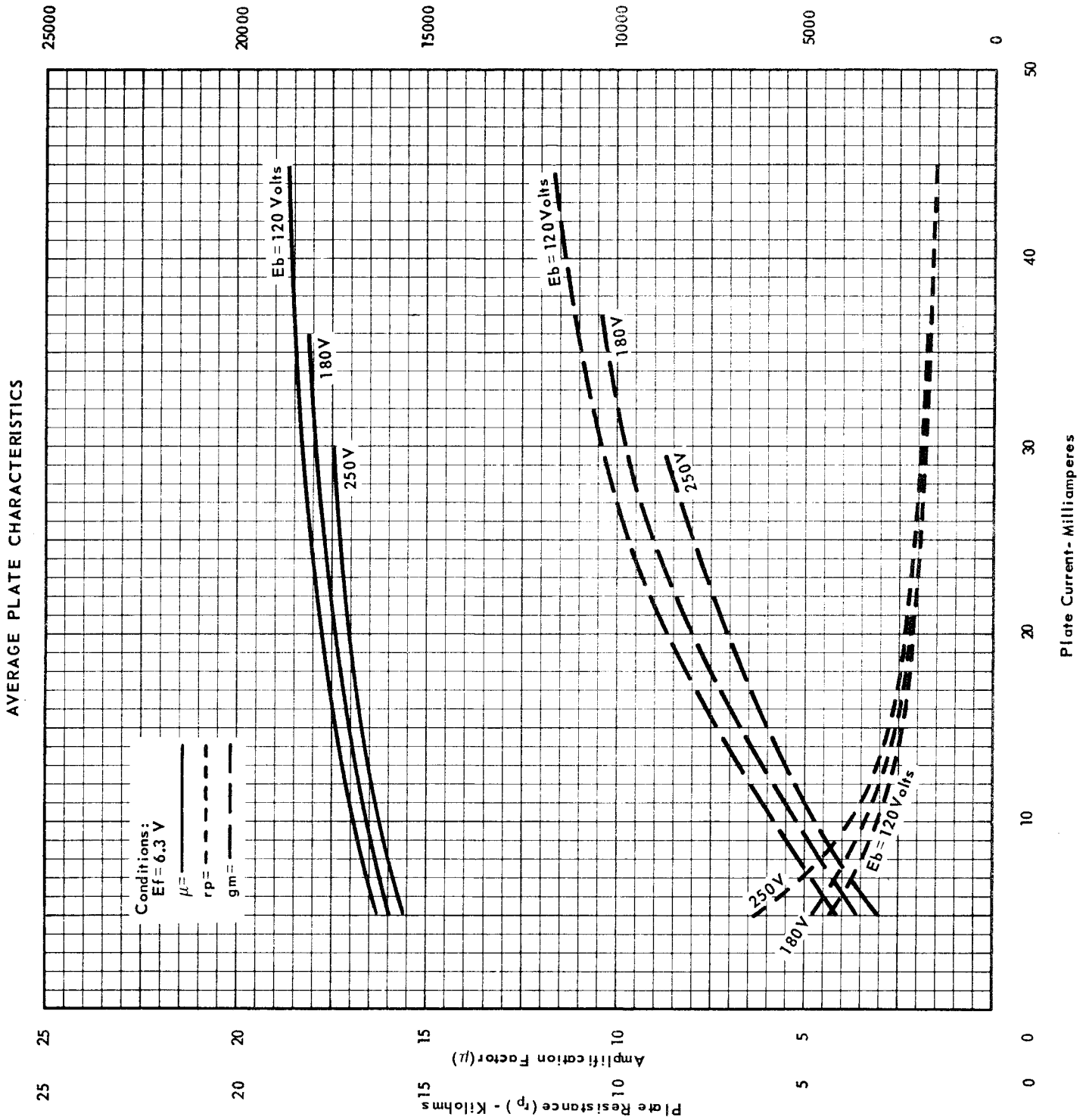
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AVERAGE CHARACTERISTICS



RELIABLE DOUBLE TRIODE




AVERAGE PLATE CHARACTERISTICS
Plate Current - Milliamperes
Plate Resistance (r_p) - Kilohms
Amplification Factor (μ)
25000
20000
15000
10000
5000
0
50
40
30
20
10
0
25
20
15
10
5
0
Eb = 120 Volts
180V
250V
Conditions:
Ef = 6.3 V
μ =
rp =
gm =

RAYTHEON®

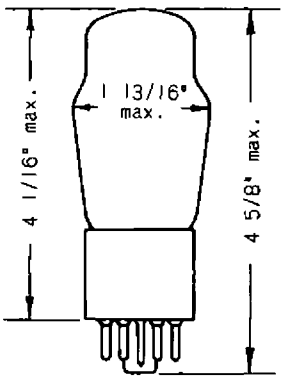
TYPE 5694

DOUBLE TRIODE

DESCRIPTION

The 5694 is a heater-cathode type, high mu, double triode amplifier tube. Its principal application is in communication equipment as a general purpose voltage amplifier, class B power amplifier, or low frequency oscillator. The electrical characteristics are similar to the type 6N7G. Each of the two cathodes are connected to separate base pins. Long aging schedules are used in the manufacture of this type to produce stable characteristics and dependable life.

MECHANICAL DATA



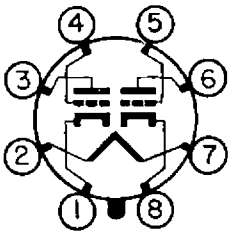
ENVELOPE: ST-14 Glass

BASE: Medium Shell Octal 8-Pin

TERMINAL CONNECTIONS: *(JETEC Designation 8CS)*

Pin 1	Cathode, Unit #2	Pin 5	Grid, Unit #1
Pin 2	Heater	Pin 6	Plate, Unit #1
Pin 3	Plate, Unit #2	Pin 7	Heater
Pin 4	Grid, Unit #2	Pin 8	Cathode, Unit #1

MOUNTING POSITION: Any



BOTTOM VIEW

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Heater Voltage (ac or dc)	6.3	volts
Plate Voltage	300	volts
Plate Dissipation, per Plate	5.5	watts
Peak Plate Current, per Plate	125	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER - TRIODES IN PARALLEL:

Heater Voltage (ac or dc)	6.3	6.3	volts
Heater Current	0.8	0.8	amp.
Plate Voltage	250	294	volts
Grid Voltage	-5	-6	volts
Amplification Factor	35	35	
Plate Resistance	11300	11000	ohms
Transconductance	3100	3200	μmhos
Plate Current	6	7	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS B AMPLIFIER: *

Heater Voltage (ac or dc)	6.3	volts
Heater Current	0.8	amp.
Grid Circuit Impedance (at 400 cycles, per Grid)	516	ohms
Plate Supply Impedance	1000	ohms
No-Signal Plate Voltage	300	volts
Grid Voltage	0	volts
No-Signal Plate Current, per Plate	17.5	ma.
Effective Load Resistance (P to P)	8000	ohms
Max. Signal Peak Voltage, per Grid	41	volts
Max. Signal Plate Current, per Plate	35	ma.
Peak Grid Current, per Grid	22	ma.
Total Harmonic Distortion	8	percent
Third Harmonic Distortion	7.5	percent
Fifth Harmonic Distortion	2.5	percent
Max. Signal Power Output	10	watts

* *Values are for two units.*

Tentative Data
August 17, 1948

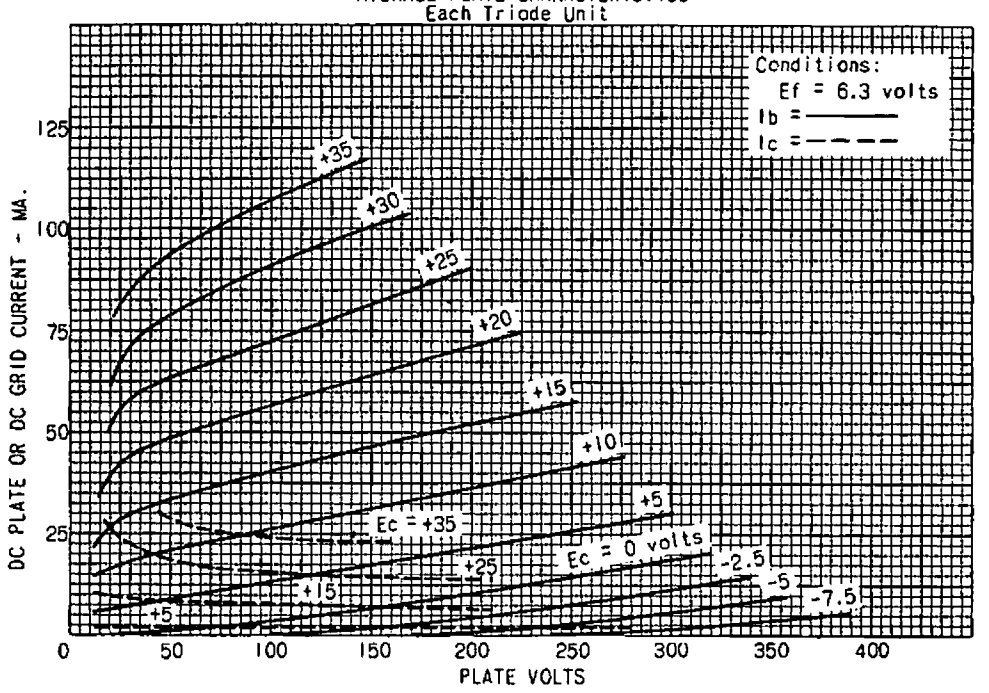
CS-2507

TYPE 5694

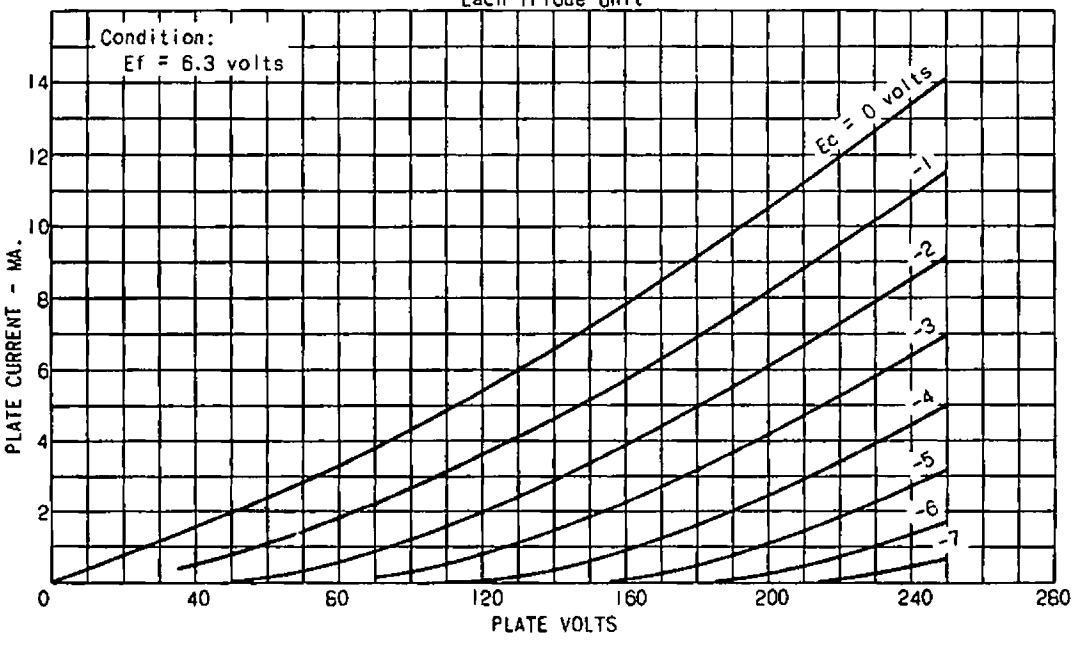
RAYTHEON®

DOUBLE TRIODE

AVERAGE PLATE CHARACTERISTICS
Each Triode Unit



AVERAGE PLATE CHARACTERISTICS
Each Triode Unit



RAYTHEON

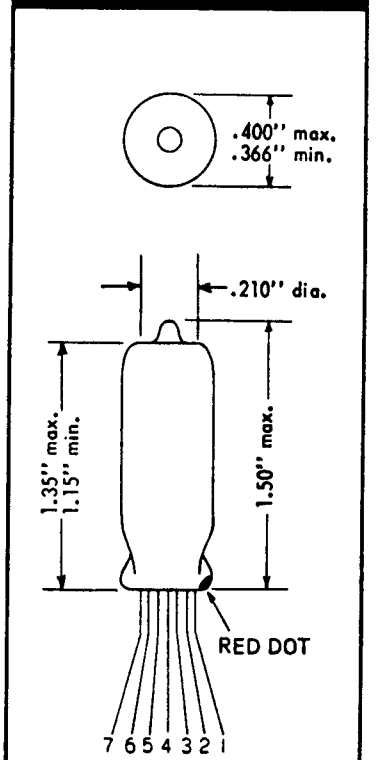
TECHNICAL INFORMATION

RELIABLE SUBMINIATURE PENTODE

Excellence in Electronics

TYPE CK5702WB

The CK5702WB is a heater–cathode type sharp–cutoff pentode of subminiature construction capable of operation in the VHF region. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. A separate terminal connection is provided for Grid #3, which under self–bias conditions can be connected directly to ground, permitting the cathode by–pass capacitor to be omitted for lower grid loading. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center–to–center)

TERMINAL CONNECTIONS: (Red *Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 5 Grid #3
Lead 2 Grid #2	Lead 6 Cathode
Lead 3 Heater	Lead 7 Grid #1
Lead 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test–Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION–To Electronic Equipment Design Engineers: Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL–E–1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL–E–1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	120	120	165	Vdc
Grid #1 Voltage	Ec1:	–55	0	0	----	Vdc
Grid #2 Voltage	Ec2:	----	120	120	155	Vdc
Grid #3 Voltage	Ec3:	----	0	0	0	Vdc
Plate Dissipation	Pp:	----	----	0.9	1.10	W
Grid #2 Dissipation	Pg2:	----	----	0.3	0.40	W
Grid #1 Circuit Resistance	Rg1:	----	----	1.0	1.2	Meg.
Heater–Cathode Voltage	Ehk:	–200	----	100	+200	v
Cathode Current	Ik:	----	----	----	16.5	mAdc
Cathode Resistance	Rk:	----	200	200	----	ohms
Plate Current (1)	Ib(1):	----	----	7.5	----	mAdc
Grid #2 Current	Ic2:	----	----	2.6	----	mAdc
Transconductance (1)	Sm(1):	----	----	5000	----	μmhos
Plate Resistance	rp:	----	----	0.34	----	Meg.

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

April 1, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1						Combined AQL = 1.0% excluding Mechanical and Inoperatives				
Heater Current:		0.65	If:	190	----	200	----	210	----	mA
Heater – Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	5	----	μAdc
	Ehk = –100 Vdc		Ihk:	----	----	----	----	5	----	μAdc
Grid Current (1):		0.65	Ic1 (1):	----	----	----	----	–0.1	----	μAdc
Plate Current (1):		0.65	Ib (1):	5.5	6.9	7.5	8.1	9.5	2.3	mAdc
Plate Current (2):	Ec1 = – 9.0 Vdc	0.65	Ib (2):	----	----	----	----	50	----	μAdc
Screen Current:		0.65	Ic2:	1.7	----	2.6	----	3.5	----	mAdc
Transconductance (1):		0.65	Sm (1):	4200	4775	5000	5225	5800	860	μmhos
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-7) (Note 10)									
MEASUREMENTS ACCEPTANCE TEST PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg-all = –100 Vdc Ep-all = –300 Vdc	2.5	Rg1-all: Rp-all:	250 250	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Transconductance (2):	Ef = 5.7 V (Note 9)	2.5	Δ_{Ef} Sm(2):	----	----	----	----	5	----	%
Grid Emission:	Ef = 7.5 V; preheat 5 minutes at Ec1 = 0; Test at Ec1 = – 10 Vdc	6.5	Ic(2):	----	----	----	----	–0.5	----	μAdc
AF Noise:	Esig = 70 mVac; Ec2 = 25 Vdc; Rg1 = 0.1 Meg; Rg2 = 1000 ohms; Rp = 0.2 Meg; Ck = 1000 μf; Rk = 4000 ohms.	2.5	EB:	----	----	----	----	17	----	VU
Plate Resistance:		6.5	rp:	0.15	----	----	----	----	----	Meg.
Capacitance:	(Note 2)	6.5	Cgp:	----	----	----	----	0.03	----	μμf
Capacitance:			Cin:	4.1	----	----	----	5.5	----	μμf
Capacitance:			Cout:	2.9	----	----	----	4.1	----	μμf
Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mm Hg; Voltage = 300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	F = 40 cps; G = 15; Rp = 10,000 ohms	2.5	Ep:	----	----	----	----	50	----	mVac
Vibration (3):	F = 30 – 1000 cps; G = 15; Rp = 10,000 ohms; t = 3 minutes; positions X_1 and X_2 only	4.0	Ep:	----	----	----	----	240 peak to peak	----	mv
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk = +100 Vdc; Rg = 0.1 Meg. Hammer Angle = 30° (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 hours; G = 2.5; Fixed frequency; F = 25 min. 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 hours; G = 10; Fixed frequency; F = 25 min, 60 max. (Note 12)	----	----	----	----	----	----	----	----	----
Post Shock (1) and Fatigue Tests (1) and (2) End points: Vibration (2):	F = 40 cps; G = 15; Rp = 10,000 ohms	----	Ep:	----	----	----	----	75	----	mVac

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1 st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_t Sm (1):	----	10	%		
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc		
Shock (2):	Ehk=+100 Vdc; Rg=0.1 Meg.; G=75; (hammer angle=120° + rubber pad); t=10 milliseconds duration (note 13)	----	----	----	----	----		
Post Shock Test (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	75	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_t Sm (1):	----	10	%		
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycle:	Ef=7.5 V; Eb=Ec1=Ec2=Ec3=0 V; Ehk=140 Vac; 1 min. on, 1 min. off.	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:								
Change in Transconductance (1) of individual tubes:	(Typical sample size=50 tubes)	1.0	Δ_t Sm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical sample size=200 tubes)	----	----	----	----	----		
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	3800	----	μmhos		
Intermittent High Temperature Life Tests:	T Bulb=220° C; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size=20 tubes 1 st sample 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	−0.5	μAdc	1	3
Heater Current:		----	If:	180	220	mA	1	3
Change in transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	20	%	1	3

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont')

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm (2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc	2	5
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Insulation of Electrodes: g1−all		----	Rg1−all:	50	----	Meg.	2	5
p−all		----	Rp−all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg.Δ_tSm (1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc	2	5
Heater Current:		----	If:	177	223	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_tSm(1):	----	30	%	2	5
Heater−Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	15	μAdc	2	5
	Ehk=−100 Vdc	----	Ihk:	----	15	μAdc		
Total Defectives		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D.−1 7/8" long) connected to lead 6.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specification.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes."

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the three minute plate current (1) value using a cold tube. No preheating before this test will be allowed.

Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

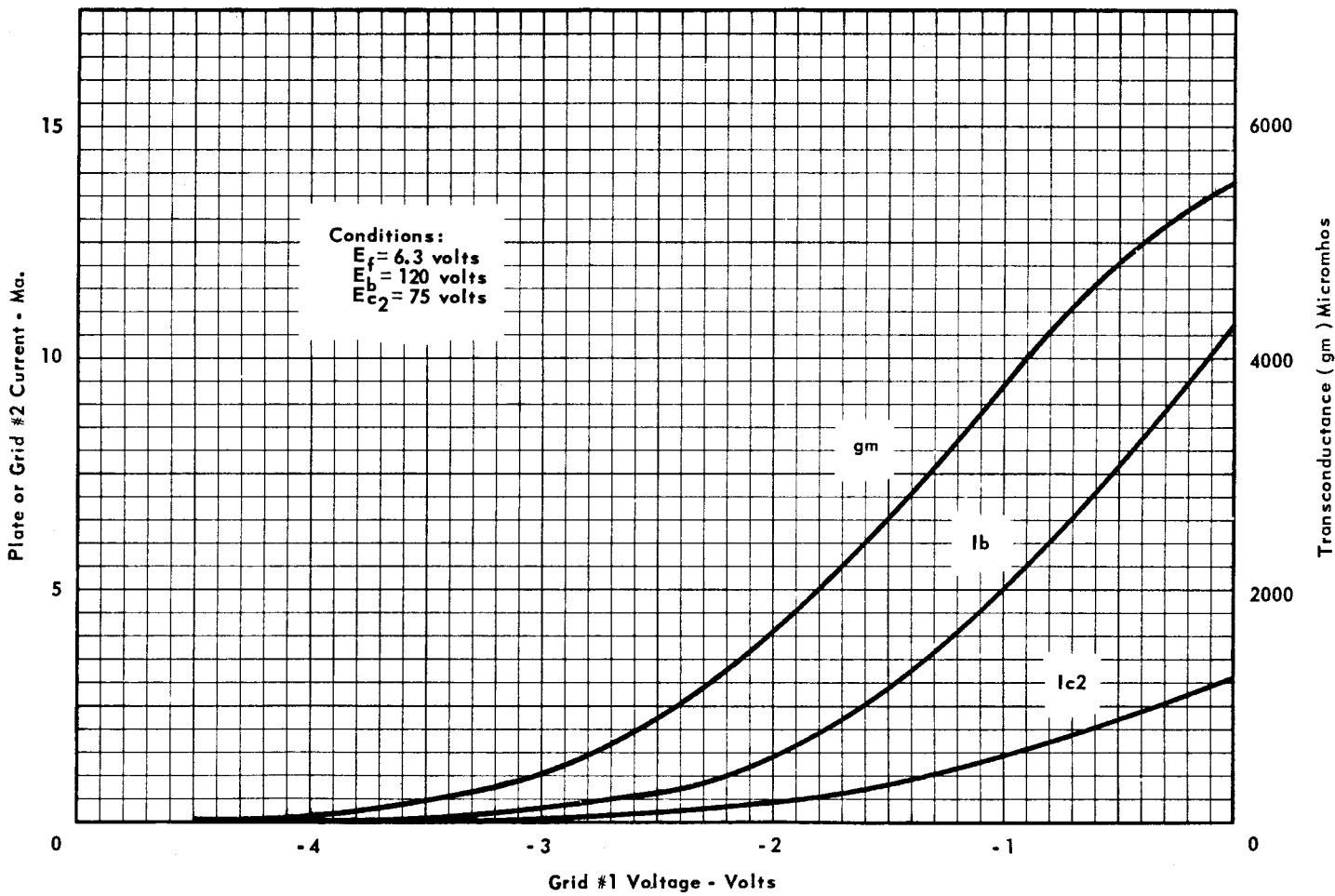
(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

Note 13: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

RELIABLE SUBMINIATURE PENTODE

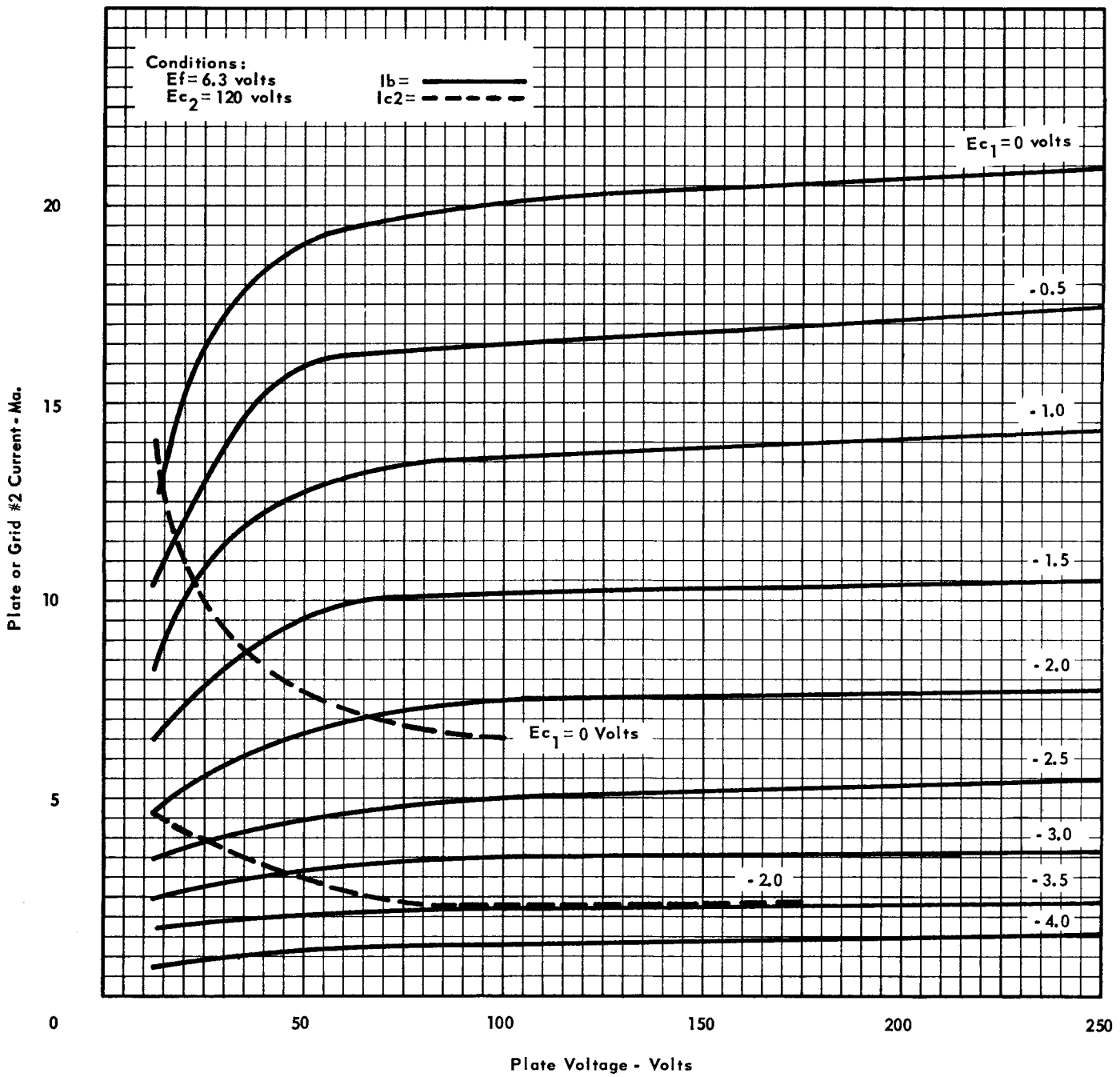
AVERAGE CHARACTERISTICS



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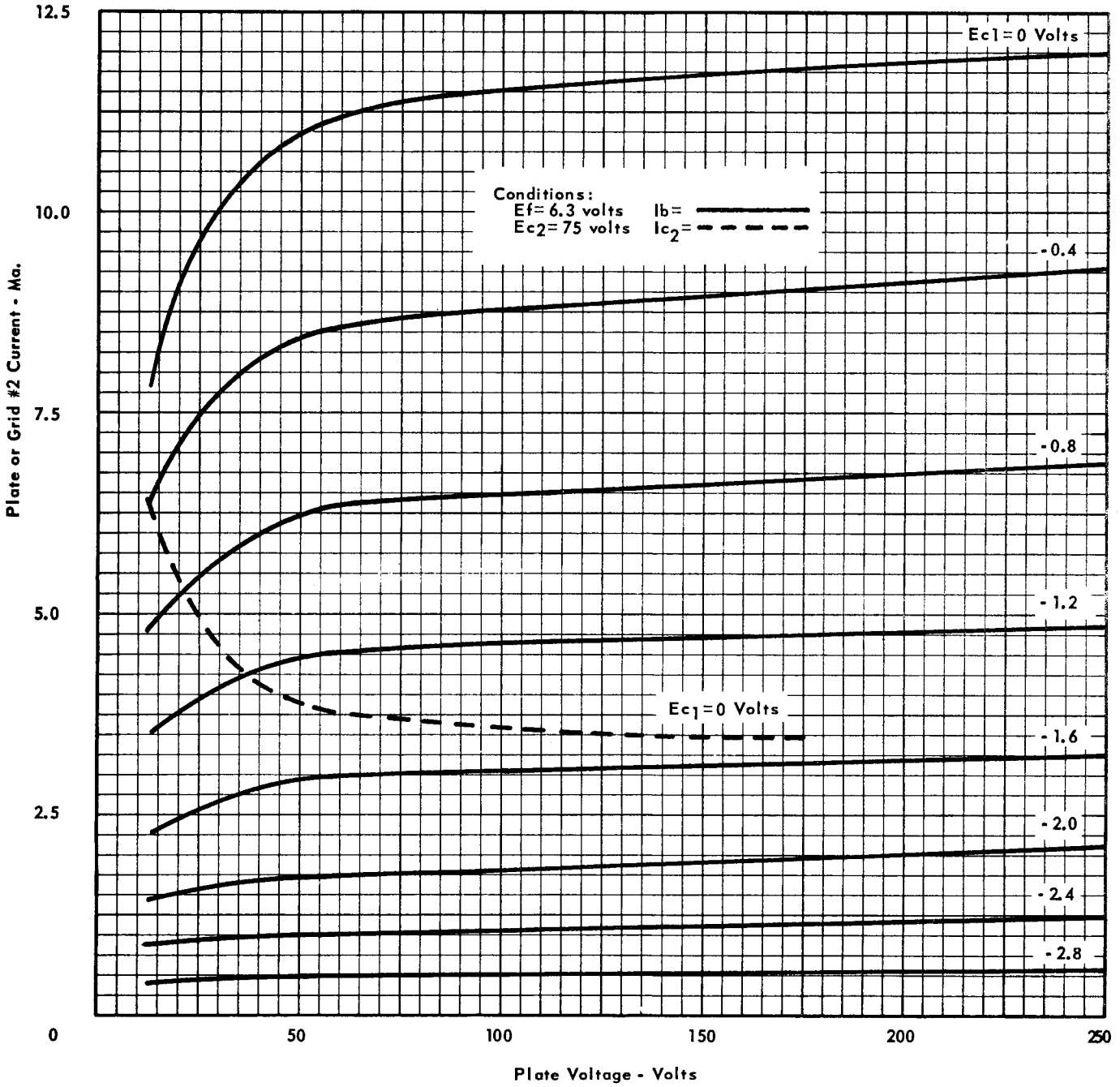
RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS

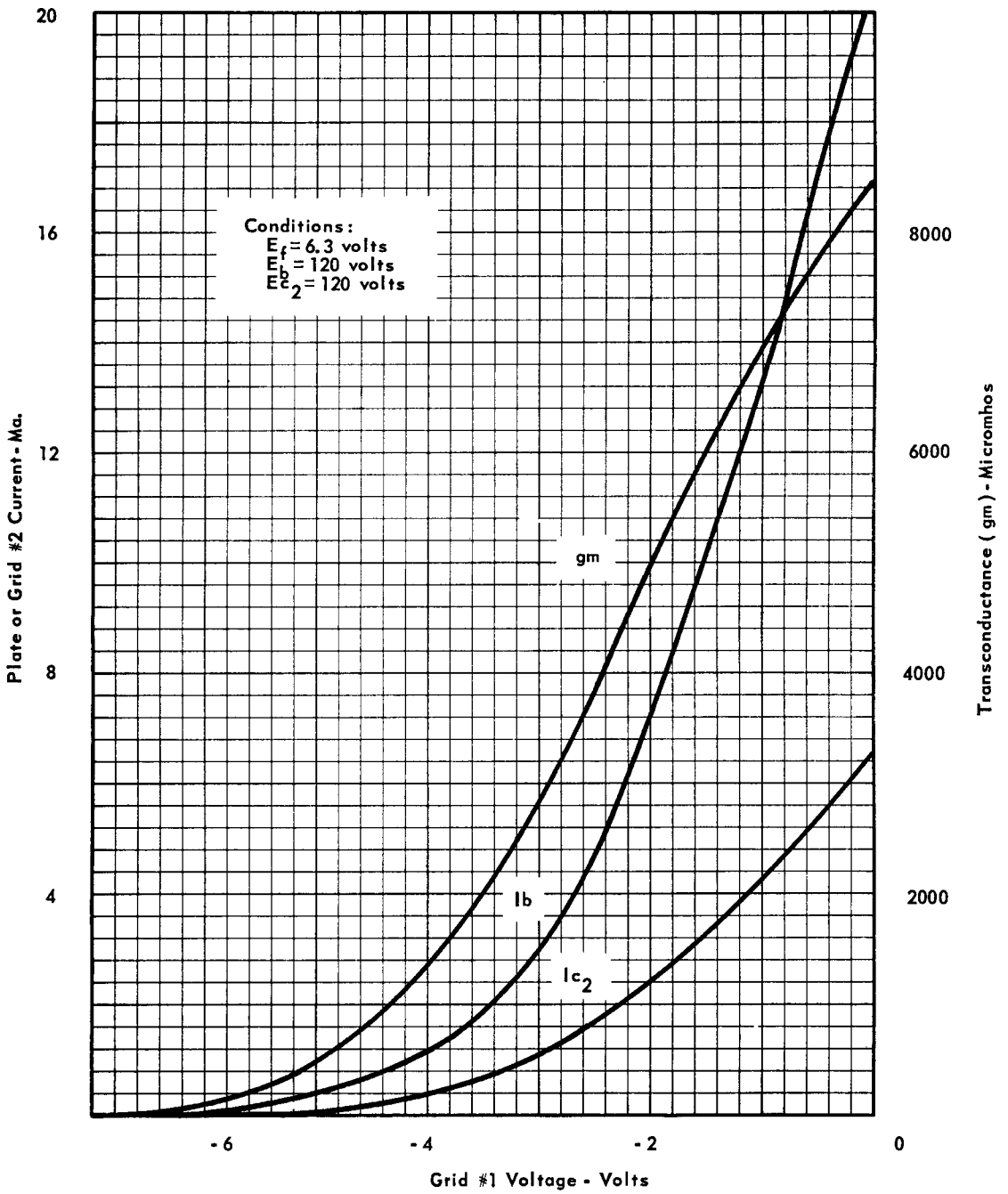


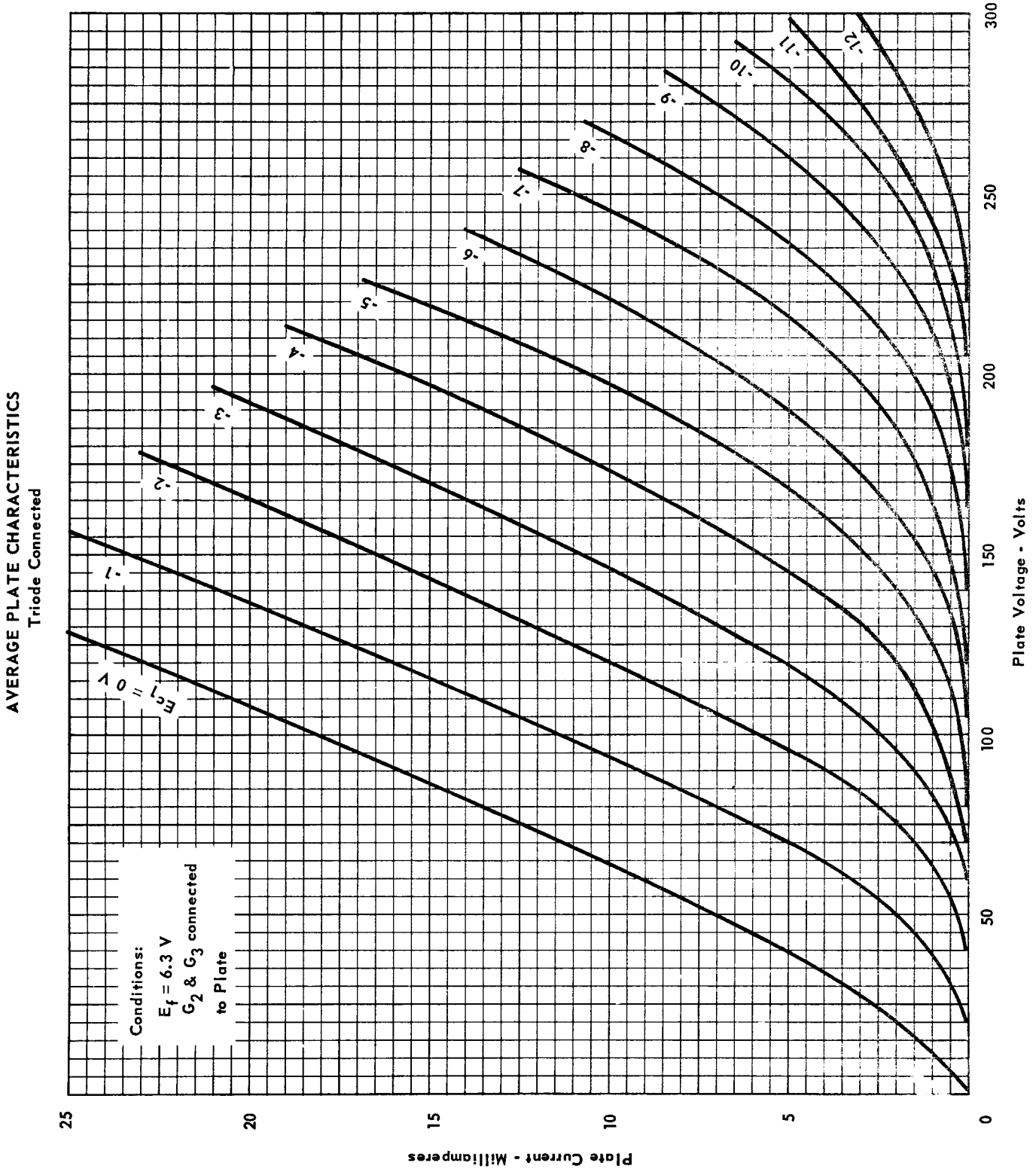
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RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS

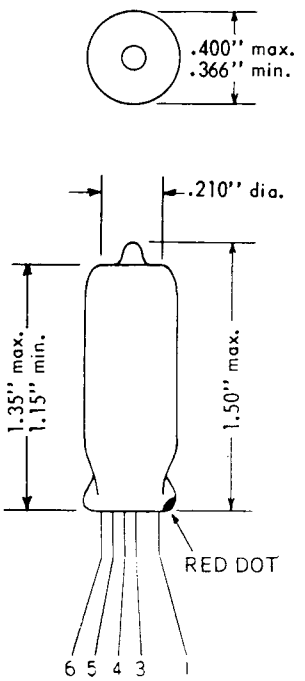



AVERAGE PLATE CHARACTERISTICS
Triode Connected
Conditions:
E_f = 6.3 V
G_2 & G_3 connected to Plate
E_{c1} = 0 V
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
Plate Current - Milliamperes
25
20
15
10
5
0
Plate Voltage - Volts
300
250
200
150
100
50

TYPE CK5703WB

Excellence in Electronics

The CK5703WB is a heater-cathode type medium-mu triode of subminiature construction capable of operation as an oscillator, Class C Amplifier, or frequency multiplier in the UHF region. This type is characterized by long life and stable performance. It is designed for service where conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.048" center-to-center
except leads 1-3=0.096" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	120	120	200	Vdc
Grid Voltage	Ec1:	----	0	0	----	Vdc
Plate Dissipation	Pp:	----	----	1.1	1.35	W
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	v
Plate Current	Ib:	----	----	9.4	15	mAdc
Grid Current	Ic1:	----	----	----	5.5	mAdc
Cathode Resistance	Rk:	----	220	220	----	ohms
Grid Circuit Resistance	Rg:	----	----	----	1.2	Meg.
Transconductance (1)	Sm(1):	----	----	5000	----	μmhos
Amplification Factor	Mu:	----	----	25.5	----	----

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.65	If:	190	----	200	----	210	----	mA

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

April 1, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1 (cont'd)										
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	0.65	Ihk: Ihk:	---- ----	---- ----	---- ----	---- ----	5 5	---- ----	μAdc μAdc
Grid Current:		0.65	Ic (1):	----	----	----	----	−0.3	----	μAdc
Plate Current (1):		0.65	Ib (1):	7.3	8.6	9.4	10.2	11.5	2.5	mAdc
Plate Current (2):	Ec1=−8.5 Vdc	0.65	Ib (2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.65	Sm (1):	4300	4700	5000	5300	5700	1050	μmhos
Continuity and Shorts (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8−7) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V Eg-all=−100 Vdc Ep-all=−300 Vdc	2.5	Rg1−all: Rp−all:	250 250	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (3):	Ec1=−5 Vdc	2.5	Ib (3):	20	----	----	----	----	----	μAdc
Transconductance (2):	Ef=5.7 V (Note 9)	2.5	Δ_{Ef} Sm (2):	----	----	----	----	5	----	%
Grid Emission:	Rg=1.0 meg.; Ef=7.5 V; Preheat 5 minutes at Ec1=0; Test at Ec1=−10 Vdc.	6.5	Ic (2):	----	----	----	----	−0.4	----	μAdc
AF Noise:	Esig=50 mVac; Ec1=−4.5 Vdc; Rp=0.01 Meg.; Rg1=0.1 Meg.; Rk=0	2.5	EB:	----	----	----	----	17	----	VU
Pulse Emission:	Ef=6.0 V; e pulse=50 v; tp=25 μsec.; Prr=200 pps	6.5	is:	300	----	----	----	----	----	ma.
Power Oscillation:	F=500 Mc; Eb=150 Vdc; Rg/Ib=20 mAdc	6.5	Po:	600	----	----	----	----	----	mw
Amplification Factor:		6.5	Mu:	22.5	----	25.5	----	28.5	----	----
Capacitance:			Cgp:	1.0	----	1.3	----	1.6	----	μμf
Capacitance:	(Note 2)	6.5	Cin:	2.0	----	2.6	----	3.2	----	μμf
Capacitance:			Cout:	0.65	----	0.85	----	1.05	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mm Hg; Voltage=300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	2.5	Ep:	----	----	----	----	10	----	mVac
Vibration (3):	F=30−1000 cps; G=15; Rp=10,000; t=3 min.; position X_1 and X_2 only.	4.0	ep:	----	----	----	----	50 peak to peak	----	mv
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Hammer Angle=30°; Ehk=+100 Vdc; Rg1=0.1 Meg.; (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 Hours; G=2.5; Fixed frequency; F=25 min. 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 Hours; G=10; Fixed frequency; F=25 min. 60 max. (Note 12)	6.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS								
Post Shock (1) and Fatigue Tests (1) and (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	20	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_t Sm (1):	----	10	%		
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc		
Shock (2):	75 G; (hammer angle=120°+rubber pad); t=10 milliseconds (note 13) Ehk=+100 Vdc; Rg1=0.1 Meg.	20	----	----	----	----		
Post Shock Test (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	15	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_t Sm (1):	----	10	%		
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc		
Glass Strain (Thermal Shock)		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef=7.5 V; Eb=Ec1=0 V; Ehk=140 Vac; 1 min. on, 1 min. off	1.0	----	2000	----	cycles		
Heater Cycling Life T End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=Room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:								
Change in Transconductance (1) of individual tubes:	(Typical Sample Size=50 tubes)	1.0	Δ_t Sm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----		
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	3800	----	μmhos		
Intermittent High Temperature Life Test:	T Bulb=220°C; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd)								
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd Sample)	----	----	----	---	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	-0.6	μAdc	1	3
Heater Current:		----	If:	180	220	mA	1	3
Change in transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5
Insulation of Electrodes:								
g1-all		----	Rg1-all:	50	----	Meg.	2	5
p-all		----	Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg. Δ_t Sm (1):	---	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	2	5
Heater Current:		----	If:	177	223	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	30	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	15 15	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.5 V.

Note 10: In addition to meeting the tightened electrical, physical, and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes".

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the three minute plate current (1) value. No preheating before this test will be allowed.

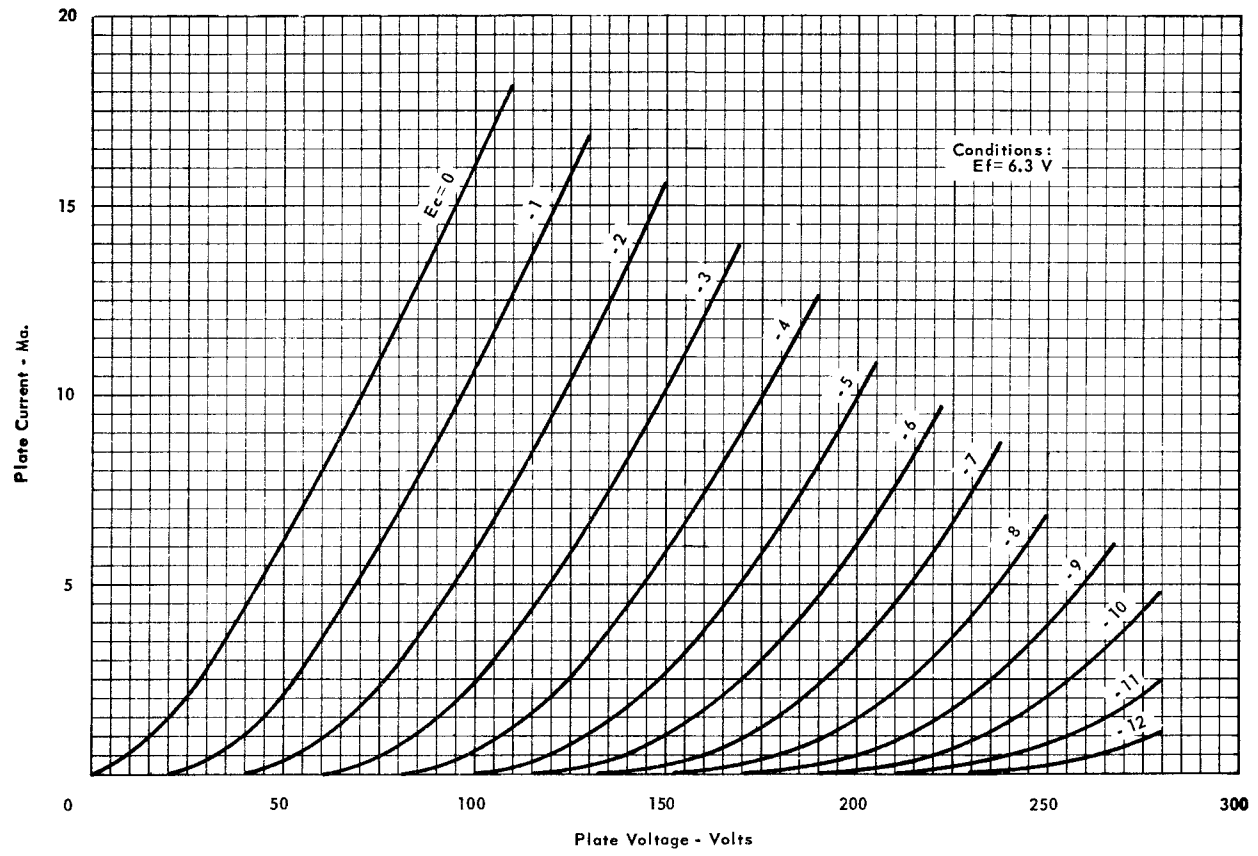
ELECTRICAL DATA (cont'd)

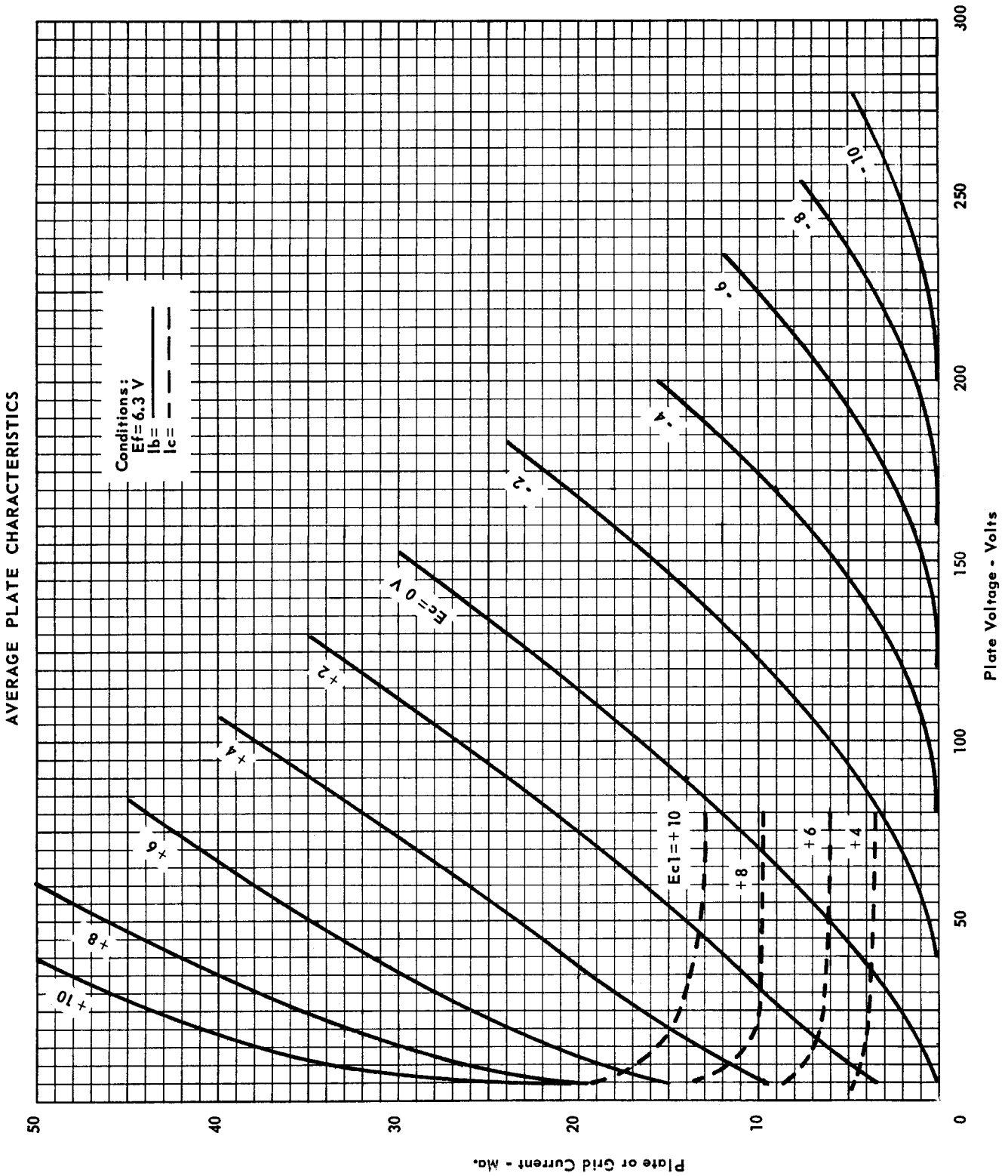
NOTES (cont'd)

Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures:
(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in paragraph 4.7.2 and 4.7.3 of Specification MIL-E-1.
(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

Note 13: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

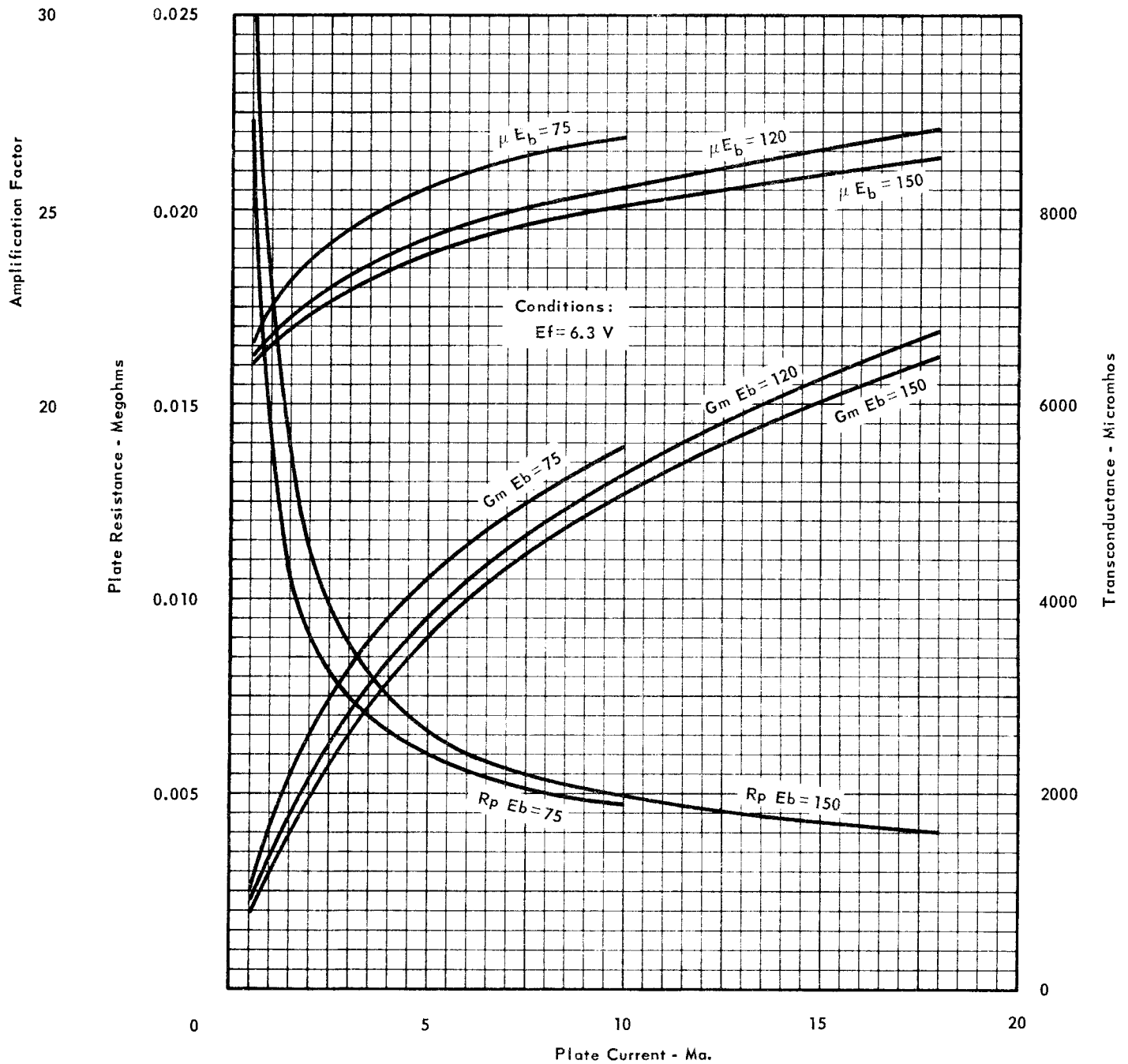
AVERAGE PLATE CHARACTERISTICS




AVERAGE PLATE CHARACTERISTICS
Conditions:
Ef= 6.3 V
Ib= ———
Ic= — — — —
Ec= 0 V
+2
+4
+6
+8
+10
-2
-4
-6
-8
-10
Ec1= +10
+8
+6
+4
Plate or Grid Current - Ma.
50
40
30
20
10
0
Plate Voltage - Volts
50
100
150
200
250
300

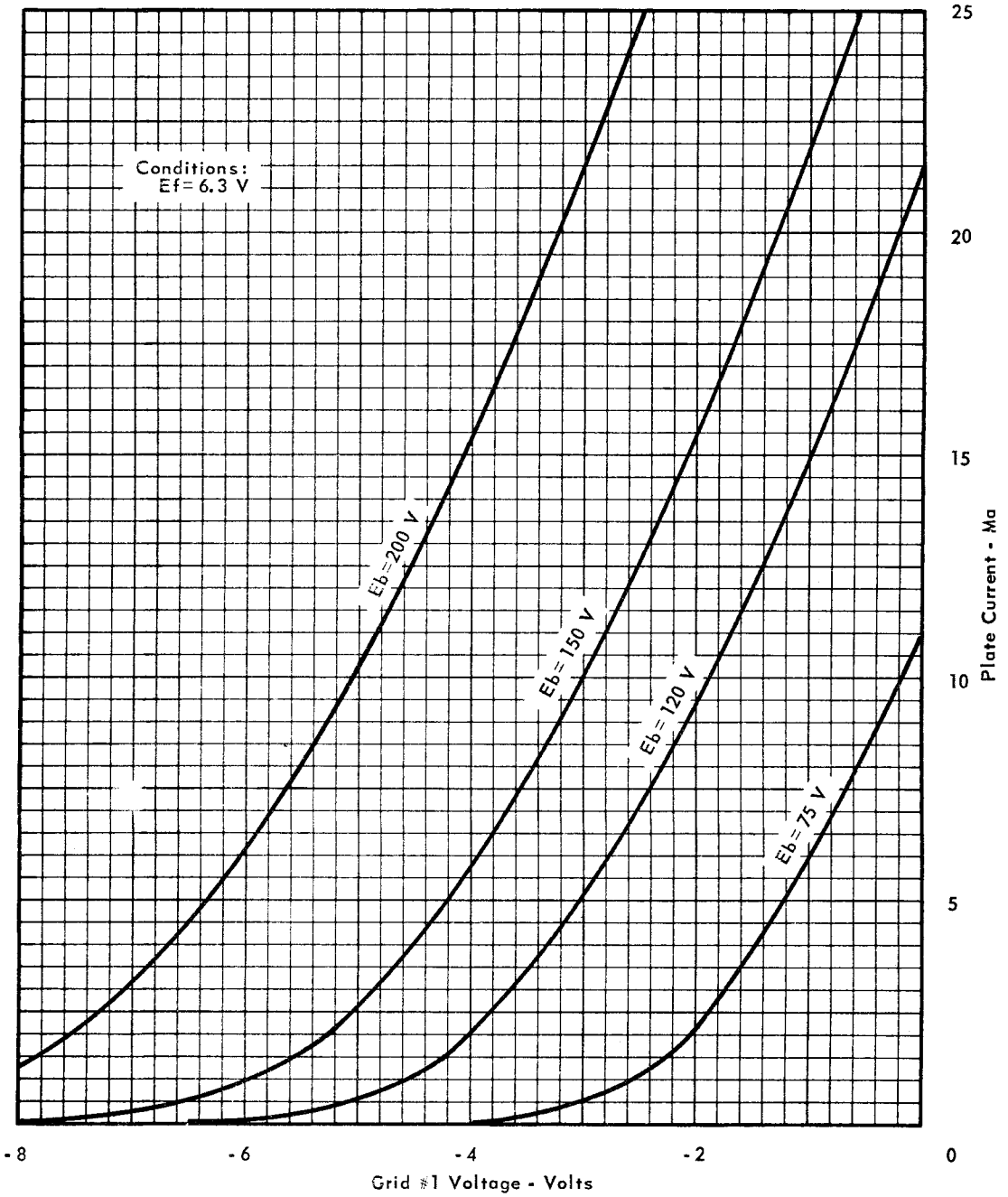
RELIABLE SUBMINIATURE TRIODE

AVERAGE CHARACTERISTICS



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AVERAGE CHARACTERISTICS



RAYTHEON®

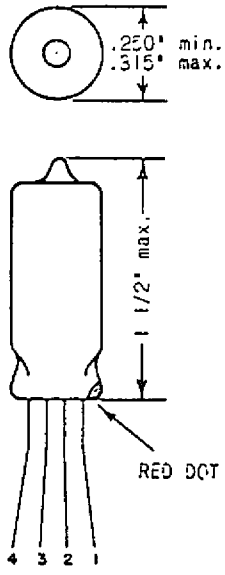
TYPE 5704

SUBMINIATURE DIODE

DESCRIPTION

The 5704 is an extremely small cathode-type diode. Two of these tubes effect considerable space and weight saving compared to any equivalent twin diode type. The characteristics are suitable for VHF detector applications. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL DATA



ENVELOPE: T-2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.050" center-to-center.

TERMINAL CONNECTIONS: *(Lead wire orientation shown by red dot adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Heater
Lead 3 Heater
Lead 4 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(μμfds.)*

Anode to Cathode	2.1
Anode to Heater	0.6
Heater to Cathode	2.8

DESIGN CENTER MAXIMUM RATINGS:

Heater Voltage	6.3	volts
Heater Current	0.15	amp.
Maximum A-C Plate Voltage (RMS)	150	volts
Peak Inverse Voltage	420	volts
Peak Plate Current	54	ma.
Heater-Cathode Potential (dc)	330	volts
Output Current (dc)	9	ma.

AVERAGE TUBE VOLTAGE DROP:

At 9 ma. Plate Current	2	volts

Tentative Data
January 21, 1948

CS-2297 Rev. 2

SPECIAL TUBE SECTION

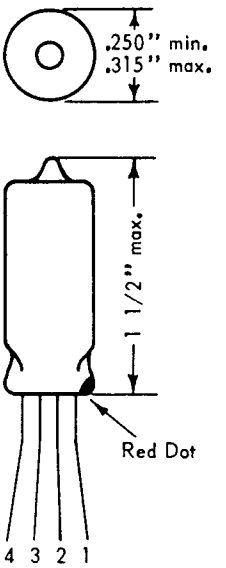
RAYTHEON MANUFACTURING CO.

NEWTON, MASS.

Excellence in Electronics

TYPE CK5704WA

The CK5704WA is a heater-cathode type diode of subminiature construction, designed for use as a detector capable of operation in the VHF region. This type is characterized by low heater current, long life, and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Lead wire orientation shown by red dot adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Heater
Lead 3 Heater
Lead 4 Cathode

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Supply Voltage (RMS)	Epp:	----	165	165	----	Vac
Load Resistance	RL:	----	19,000	19,000	----	ohms
Filter Input Capacitance	CL:	----	8	8	----	μf
Peak Inverse Plate Voltage	epx:	----	----	----	460	v
Steady State Peak Plate Current	ib:	----	----	----	60	ma
DC Output Current	Io:	----	----	9.0	10	mAdc
Peak Transient Plate Current	i surge:	----	----	----	350	ma
Heater-Cathode Voltage	Ehk:	----	----	----	360	v
Total Plate Supply Impedance	zp:	----	----	800	----	ohms

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			**Combined AQL = 1.0% Excluding Mechanical and Inoperatives**						
Heater Current:		0.65	If:	140	----	150	----	160	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	10	μAdc
	Ehk = −100 Vdc		Ihk:	----	----	----	----	10	μAdc
Operation:	Half-wave Operation	0.65	Io:	8.0	8.5	9.0	----	----	mAdc
Emission (1):	Es = 10 Vdc		Is:	43	50	----	----	----	mAdc
Continuity and Shorts: (Inoperatives):		0.4	----	----	----	----	----	----	----
Mechanical:	Envelope T−2 (Note 9)	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2									
Insulation of Electrodes:	Ef = 6.3 V; Ep−all = −300 Vdc	2.5	Rp−all:	100	----	----	----	----	Meg.
Anode Leakage:	Ef = 6.9 V; Eb = −100 Vdc	2.5	----	----	----	----	----	1.0	μAdc
Emission (2):	Ef = 5.7; Eb = 10 Vdc	2.5	Is:	40	----	----	----	----	mAdc
Plate Current:	Ebb = 0; Rp = 40,000 ohms	2.5	Ib:	2	----	----	----	20	μAdc
Pulse Emission:	Ef = 6.0 V; e pulse = 50 v; tp = 25 μsec; Prr = 200 pps	6.5	is:	300	----	----	----	----	ma.
Capacitance:			Cp−k+h:	1.5	----	2.2	----	2.9	μμf
Capacitance:	(Note 2)	6.5	Cp−h:	0.43	----	0.63	----	0.83	μμf
Capacitance:			Ch−k:	1.5	----	2.2	----	2.9	μμf
Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mmHg; Voltage = 330 Vac	6.5	----	----	----	----	----	----	----
Operation Time:	(Note 10)	4.0	t:	----	----	----	----	20	sec.
Vibration (2):	Eb = 100 Vdc; Rp = 10,000 ohms; G = 15; F = 30−1000 cps; t = 3 minutes; positions X_1 and X_2 only.	4.0	ep:	----	----	----	----	25 peak to peak	mv
DEGRADATION RATE ACCEPTANCE TESTS									
Subminiature Leak Fatigue:		2.5	----	4.0	----	----	----	----	arcs
Shock (1):	Hammer Angle = 30° (Note 3)	20	----	----	----	----	----	----	----
Fatigue (1):	96 hours; G = 2.5; Fixed frequency; F = 25 min., 60 max. (Note 5)	6.5	----	----	----	----	----	----	----
Fatigue (2):	6 hours; G = 10; Fixed frequency; F = 25 min., 60 max. (Note 11)	6.5	----	----	----	----	----	----	----
Post Shock (1) and Fatigue Tests (1) and (2) End Points:									
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	----	----	----	20	μAdc
	Ehk = −100 Vdc	----	Ihk:	----	----	----	----	20	μAdc
Operation:	Half-wave Operation	----	Io:	7.0	----	----	----	----	mAdc
Shock (2):	G = 75; (Hammer Angle = 120° + rubber pad); t = 10 milliseconds duration (Note 12)	----	----	----	----	----	----	----	----
Post Shock Test (2) End Points:									
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	----	----	----	20	μAdc
	Ehk = −100 Vdc	----	Ihk:	----	----	----	----	20	μAdc
Operation:	Half-wave Operation	----	Io:	7.0	----	----	----	----	mAdc

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defec per Characteris 1st Sample	Combine Sample
DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)								
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycle:	Ef=7.5V; Eb=0V; Ehk=140 Vac; 1 min. on, 1 min. off.	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	20 20	μAdc μAdc		
100 Hour Survival Rate Life Test:	TA=room; Ehk=Eo+117 Vac	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical sample size=200 tubes)	----	----	----	----	----		
Inoperatives:		0.65	----	----	----	----		
Operation:		1.0	Io:	7.0	----	mAdc		
Intermittent High Temperature Life Tests:	T Bulb=220°C; Ehk=Eo+117 Vac	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size=20 tubes 1st sample 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Heater Current:		----	If:	138	162	mA	1	3
Operation:		----	Io:	7.0	----	mAdc	1	3
Change in Operation of individual tubes:		----	Δ_t Io:	----	15	%	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	20 20	μAdc μAdc	1	3
Insulation of Electrodes:								
p−all:		----	Rp−all:	50	----	Meg.	2	5
Total Defective		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Heater Current:		----	If:	135	165	mA	2	5
Operation:		----	Io:	7.0	----	mAdc	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	30 30	μAdc μAdc	2	5
Total Defectives		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Without Shield.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specification.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes."

Note 10: Operation time is the time in seconds required for Io, the operation current, to attain a value within plus or minus 10 percent of the three minute Io value using a cold tube. No preheating before this test will be allowed.

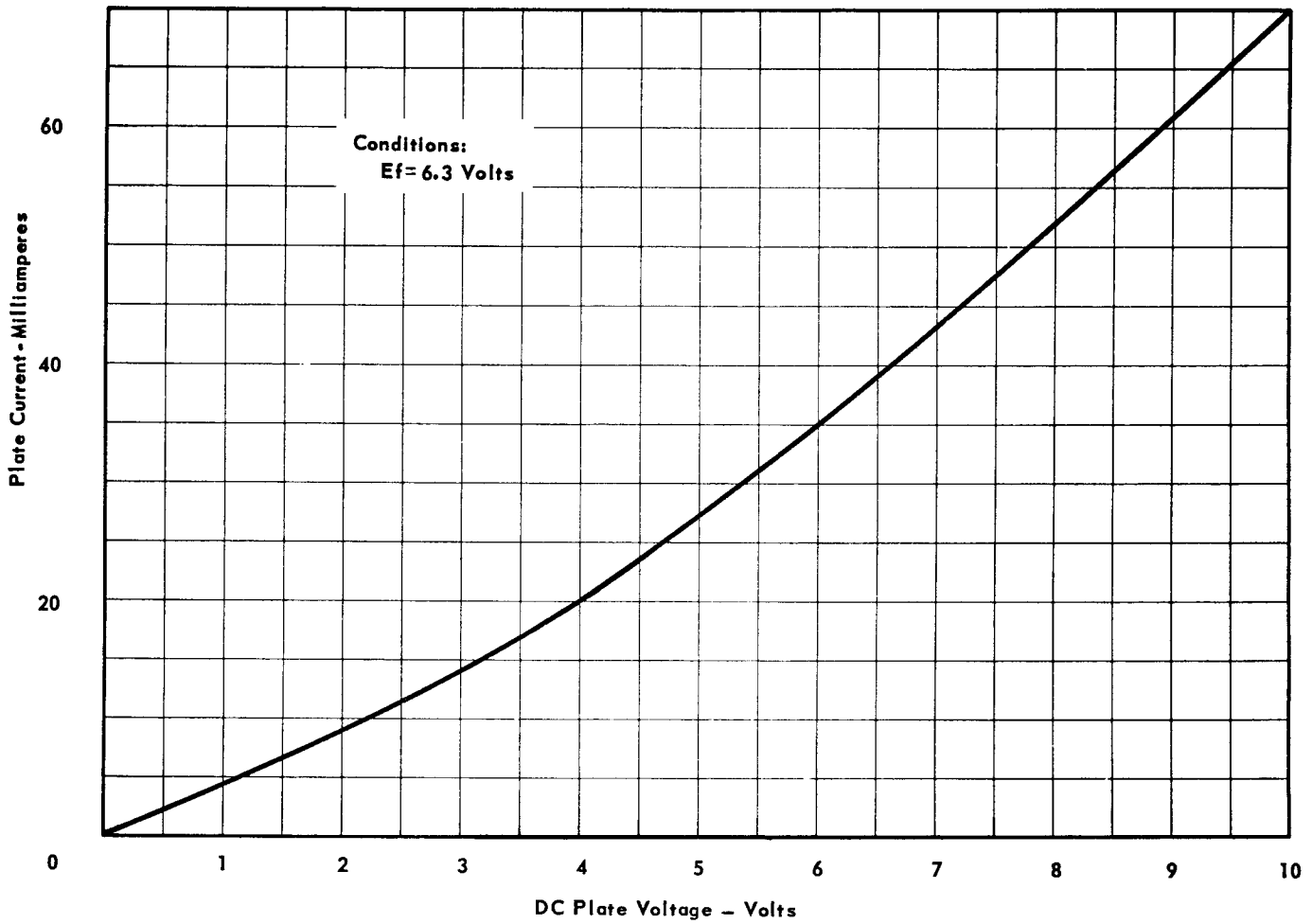
Note 11: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

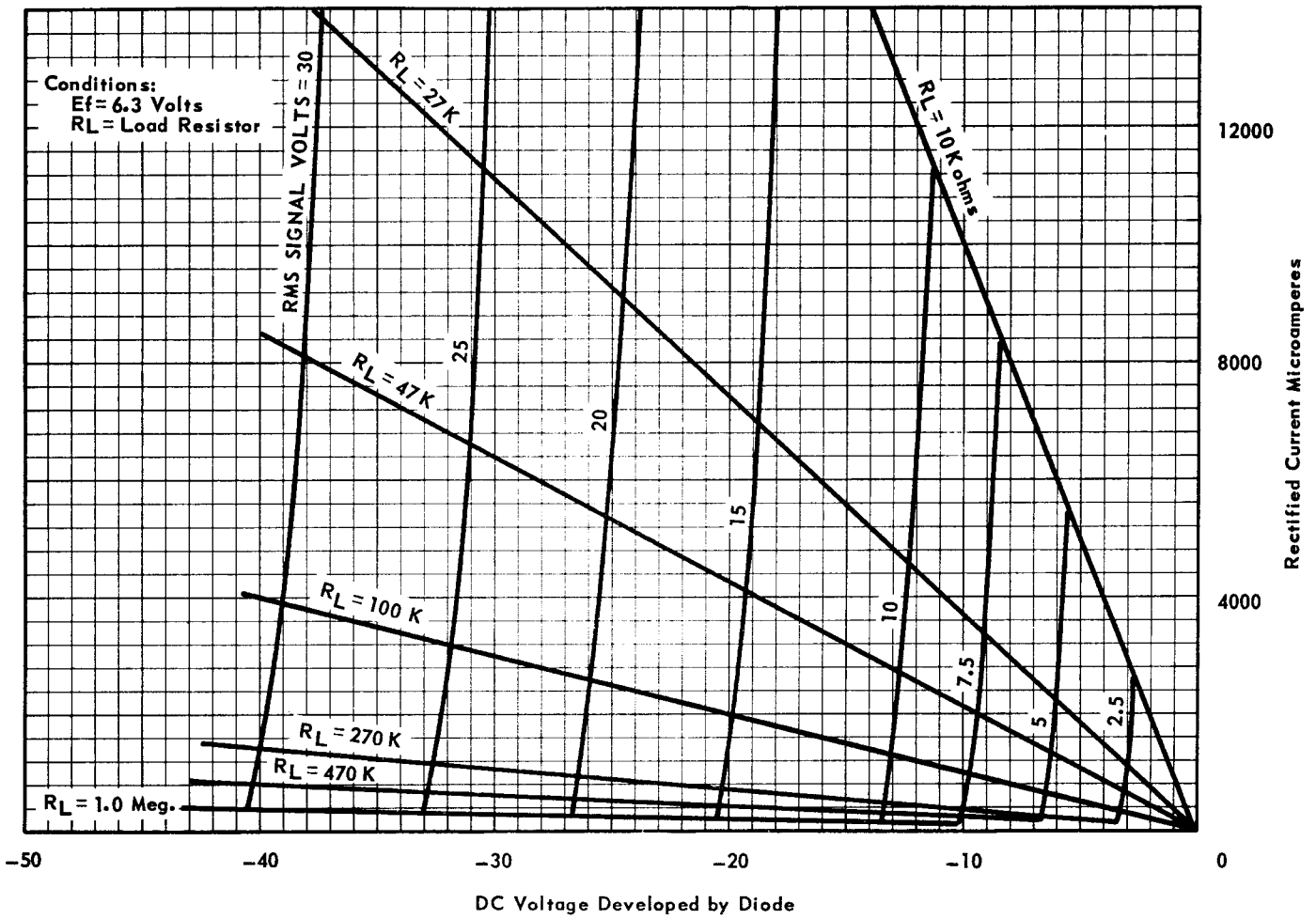
Note 12: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

AVERAGE PLATE CHARACTERISTICS



RELIABLE SUBMINIATURE DIODE

AVERAGE CHARACTERISTICS
(Half-Wave Rectification)



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5725/ 6AS6W

MINIATURE DUAL-CONTROL PENTODE

The 5725/6AS6W is a heater-cathode type pentode of miniature construction capable of operation in the UHF region. The control grid and suppressor grid may be used as independent control electrodes for circuits such as gated amplifiers, mixers, and gain controlled amplifiers. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered.

MECHANICAL RATINGS: (Maximum)

Impact Acceleration	450 G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5 G
Bulb Temperature	165 °C
Altitude	80,000 ft.

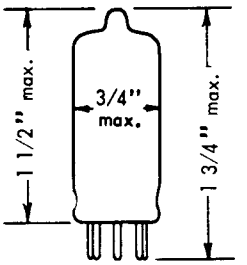
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Design Minimum	Normal Test Conditions	Test Limit or Design Maximum	MIL-E-1 Units
Heater Voltage	Ef	5.7	6.3	6.9	V
Plate Voltage	Eb	---	120	200	Vdc
D.C. Grid Voltage	Ec1	-55	-2.0	0	Vdc
Screen Grid Voltage	Ec2	---	120	155	Vdc
Grid #3 Voltage	Ec3	-55	0	30	Vdc
Heater-Cathode Voltage	Ehk	-100	0	+100	v
Grid Resistance	Rg1	---	---	0.1	Meg.
Cathode Current	Ik	---	---	18	mAdc
Plate Dissipation	Pp	---	---	1.5	Watts
Grid Current	Ic1	---	---	0.9	mAdc
Screen Dissipation	Pg2	---	---	0.5	Watts
Grid #3 Current	Ic3	---	---	0.18	mAdc
			Tests		
Heater Current	If	160	175	190	mA
Plate Current	Ib	2.5	5.2	9.0	mAdc
Transconductance (1)	Sm	2500	3200	4500	μmhos
Heater-Cathode Leakage Ehk = ± 100 Vdc	Ihk	---	---	10	μAdc
Plate Current Ec1 = -3 Vdc Ec3 = -10 Vdc	Ib	---	---	200	μAdc
Plate Current Ec1 = -3 Vdc Ec3 = -6 Vdc	Ib	5	---	---	μAdc
Plate Current Ec1 = -8 Vdc	Ib	---	---	200	μAdc

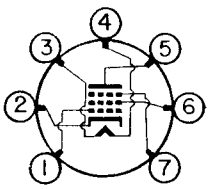
MECHANICAL DATA

ENVELOPE ..... Glass T5½
OUTLINE 6-1
BASE ....Miniature Button 7-Pin
BASING 7CM
MOUNTING POSITION ..... Any
CATHODE .....Coated Unipotential

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Grid #1
Pin 2 Cathode, Shield
Pin 3 Heater
Pin 4 Heater
Pin 5 Plate
Pin 6 Grid #2
Pin 7 Grid #3

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Design Minimum	Normal Test Conditions	Test Limit or Design Maximum	MIL-E-1 Units
			Tests		
Plate Current Ec1 = -6 Vdc	Ib	5	---	---	μAdc
Screen Grid Current	Ic2	1.5	3.5	5.5	mAdc
Transconductance (2)	ΔEf/Sm	---	---	15	%
Transconductance (3) Ec3 = -3 Vdc	Sm (g3-p)	350	700	1050	μmhos
Transconductance (4) Ec3 -5 Vdc	Sm (g1-p)	700	1000	1700	μmhos
Interelectrode	Cg1-p	---	---	.02	μμf
Capacitances (Shield #316)	Cin Cout	3.5 2.6	4.0 3.0	4.5 3.4	μμf μμf
Vibration Rp = 10K; G = 10; f = 40 cps	Ep	---	---	150	mVac

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests.

Shock Test – 450 G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C for 5 seconds. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions: Ef=7.5V; Ehk=+135 Vdc with all other elements floating. At the conclusion of this test, the tubes will not show open heater or cathode circuits or heater to cathode shorts.

Stability Life Test – Sample is operated for 2 + 20 hours to assure initial electrical stability. (Δ_t Sm < 10%). Tubes are operated with Eb = 180 Vdc, Ec2 = 125, Ec1 = 0, Ehk =+135 Vdc, Rk = 130 Ω and Rg1 = .1 meg.

Survival Rate Life Test – Sample is operated 100 hours to assure electrical stability (Sm > 2200 μmhos) and freedom from inoperatives. Tubes are operated under stability Life Test conditions.

Intermittent Life Test – 1000 hours. Sample is operated under Survival Rate Conditions with a minimum envelope temperature of 165°C.

Altitude – Sample is subjected to a pressure =21 ±2 mmHg (80,000 ft.) at 500 Vac to insure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

CAUTION – – – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions those than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

MINIATURE DUAL-CONTROL PENTODE

ACCEPTANCE CRITERIA

For purposes of acceptance inspection, use applicable reliable paragraphs.

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 1)						Unit
						Min	LAL	Bogie	UAL	Max	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION INSPECTION (see note 2)												
---	Cathode	Coated unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	E7-1	---	---	---	---	---	---	---	---	---	---
4.9.20.3	Variable frequency vibration (1)	Rp = 10,000	---	---	Ep	---	---	---	---	200	---	mVac
ACCEPTANCE INSPECTION, PART 1 (production) (see note 3)												
4.7.5	Continuity and short test (for reliable tubes)		0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical-production tests	Outline 6-1	---	---	---	---	---	---	---	---	---	---
4.10.4.1	Plate Current (1)		---	---	Ib	---	4.2	5.2	6.2	---	2.3	mAdc
4.10.4.1	† Plate Current (1)		0.4	II	Ib	2.5	---	---	---	9.0	---	mAdc
4.10.6.1	† Total Grid Current	Rg1 = 0.1 Meg (see note 4)	0.4	II	Ic1	0	---	---	---	-0.1	---	μAdc
4.10.8	Heater Current		---	---	If	---	168	175	182	---	14	mA
4.10.8	Heater Current		0.4	II	If	160	---	---	---	190	---	mA
4.10.9	Transconductance (1)		---	---	Sm	---	2900	3200	3500	---	750	μmhos
4.10.9	Transconductance (1)		0.4	II	Sm	2500	---	---	---	4500	---	μmhos
4.10.15	Heater-Cathode Leakage	Ehk = + 100 Vdc Ehk = -100 Vdc	0.4	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	10 10	--- ---	μAdc μAdc
ACCEPTANCE INSPECTION, PART 2 (design)												
4.8	Insulation of electrodes	g1 - all g3 - all p - all	2.5	L6	R R R	100 100 100	--- --- ---	--- --- ---	--- --- ---	--- --- ---	--- --- ---	Meg Meg Meg
4.9.12.1	Low-pressure voltage breakdown	Pressure = 21 ± 2 mmHg; voltage = 500 Vac (see note 5)	6.5	(See note 6)	---	---	---	---	---	---	---	---
4.9.19.1	Low-frequency vibration (2)	Rp = 10,000; G = 10; F = 40 cps	6.5	Code I	Ep	---	---	---	---	150	---	mVac
4.10.3.1	Radio-frequency noise (other than shot-effect noise)	Ecal = 15.0 mVac; Ec1 = 0; Rk = 200; Ck = 0.2 μf (see note 7)	2.5	I	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 1)						Unit
						Min	LAL	Bogie	UAL	Max	ALD	
ACCEPTANCE INSPECTION, PART 2 (design) (cont.)												
4.10.3.4	Noise and microphonics (for reliable receiving tubes)	Ef = 6.3 Vac; Ebb = 200 Vdc; Ecc2 = 200 Vdc; Ec1 = 0; Ecal = 175 mVac; Rk = 1,000; Rp = 0.1 Meg; Rg2 = 0.5 Meg; Cg2 = 2 μf; Ck = 1,000 μf min (see note 8)	2.5	I	---	---	---	----	---	---	---	---
4.10.4.1	Plate Current (2)	Ec1 = −3 Vdc; Ec3 = −10 Vdc	2.5	I	Ib	---	---	---	---	200	---	μAdc
4.10.4.1	Plate Current (3)	Ec1 = −3 Vdc; Ec3 = −6 Vdc	2.5	I	Ib	5	---	---	---	---	---	μAdc
4.10.4.1	Plate Current (4)	Ec1 = −8 Vdc	2.5	I	Ib	---	---	---	---	200	---	μAdc
4.10.4.1	Plate Current (5)	Ec1 = −6 Vdc	2.5	I	Ib	5	---	---	---	---	---	μAdc
4.10.4.3	Screen-Grid Current		2.5	I	Ic2	1.5	---	---	---	5.5	---	mAdc
4.10.6.2	Grid Emission	Ef = 7.5 V; Ec1 = −10 Vdc; Rg1 = 0.1 Meg; (see note 9)	2.5	I	Isc	0	---	---	---	−1.0	---	μAdc
4.10.9	Transconductance (2)	Ef = 5.7 V	2.5	I	$\frac{\Delta Sm}{Ef}$	---	---	---	---	15	---	%
4.10.9	Transconductance (3)	Ec3 = −3 Vdc	6.5	L6	Sm (g3-p)	350	---	---	---	1050	---	μmhos
4.10.9	Transconductance (4)	Ec3 = −5 Vdc	6.5	L6	Sm (g1-p)	700	---	---	---	1700	---	μmhos
4.10.14	Direct Interelectrode capacitance	Shield No. 316			Cg1p	---	---	---	---	0.02	---	μμf
		Shield No. 316	6.5	Code E	Cin	3.5	---	---	---	4.5	---	μμf
		Shield No. 316			Cout	2.6	---	---	---	3.4	---	μμf
ACCEPTANCE INSPECTION, PART 3 (degradation rate) (see note 10)												
4.9.6.1	Miniature-tube base-strain		---	---	---	---	---	---	---	---	---	---
4.9.6.3	Glass strain (for receiving tubes)		2.5	I	---	---	---	---	---	---	---	---
4.9.20.5	Shock test	Hammer angle = 30°; Ehk = +100 Vdc (see note 11)	---	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min. 60 max.	6.5	(See Note 6)	---	---	---	---	---	---	---	---
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep	---	---	---	---	300	---	mVac
		Heater-cathode leakage										
		Ehk = +100 Vdc	---	---	Ihk	---	---	---	---	30	---	μAdc
		Ehk = −100 Vdc	---	---	Ihk	---	---	---	---	30	---	μAdc
		Transconductance (1)	---	---	Sm(1)	2200	---	---	---	---	---	μmhos
		Grid Current	---	---	Ic1	0	---	---	---	−0.4	---	μAdc

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Unit
					First Sample	Combined Samples		Min.	Max.	
ACCEPTANCE INSPECTION, PART 3 (life) (see note 10)										
4.11.7	Heater-cycling life test	Ef = 7.5 V; Ehk = +135 Vdc; Ec1 = Ec2 = Ec3 = Eb = 0 (see note 12)	---	---	---	---	---	---	---	---
4.11.4	Life-test end points (heater-cycling)	Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	---	---	Ihk	---	20	μAdc
		Ehk = -100 Vdc	---	---	---	---	Ihk	---	20	μAdc
4.11.3.1(a)	Stability life test	Eb = 180 Vdc; Ec1 = 0; Ec2 = 125 Vdc; Ehk = +135 Vdc; Rk = 130; Rg1 = 0.1 meg; TA = room (see note 13)	1.0	Code I	---	---	---	---	---	---
4.11.4	Life-test end points (stability) (2 and 20 hours)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_tSm	---	10	%
4.11.3.1(b)	Survival-rate life test	Stability life test conditions, or equivalent (see notes 14 and 15)	---	II	---	---	---	---	---	---
4.11.4	Life-test end points (survival rate) (100 hours)	Continuity and short (inoperatives)	0.65	---	---	---	---	---	---	---
		Transconductance(1)	1.0	---	---	---	Sm	2200	---	μmhos
4.11.5	Intermittent life-test operation	Stability life test conditions; TE = +165° C min. (see notes 16 and 17)	---	---	---	---	---	---	---	---
4.11.4	Life-test end points (intermittent) (500 hours)	(See note 18)								
		Inoperatives (see note 19)	---	---	1	3	---	---	---	---
		Grid current	---	---	1	3	Ic1	0	-0.1	μAdc
		Heater current	---	---	1	3	If	160	190	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	20	%
		Transconductance(2)	---	---	1	3	Δ_{Ef}Sm	---	15	%
		Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	1	3	Ihk	---	10	μAdc
		Ehk = -100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes								
		g1 - all					R	50	---	Meg
		g3 - all	---	---	1	3	R	50	---	Meg
		p - all					R	50	---	Meg
		Transconductance(1) average change	---	---	---	---	AvgΔ_tSm	---	15	%
		Total defectives	---	---	3	6	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Unit
					First Sample	Combined Samples		Min.	Max.	
ACCEPTANCE INSPECTION, PART 3 (life) (see note 10) (cont.)										
4.11.4	Life-test end points (intermittent) (1,000 hours)	(See note 18) Inoperatives (see note 19)	---	---	1	3	---	---	---	---
		Grid current	---	---	1	3	Ic1	0	-0.1	μAdc
		Heater current	---	---	1	3	If	160	190	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	25	%
		Transconductance (2)	---	---	1	3	Δ_{Ef}Sm	---	20	%
		Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	1	3	Ihk	---	10	μAdc
		Ehk = -100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes								
		g1 - all					R	40	---	Meg
		g3 - all	---	---	1	3	R	40	---	Meg
		p - all					R	40	---	Meg
		Total defectives	---	---	4	8	---	---	---	---
4.9.18	Container drop	Required								
5.	Preparation for delivery	(See note 20)								

Note 1: Variables sampling procedure: See 4.1.1.7

Note 2: All tests listed hereon shall be performed during qualification inspection; however, these three tests are normally performed during qualification inspection only.

Note 3: The AQL for the combined defectives for attributes in acceptance inspection, part 1 (production), excluding inoperatives and mechanical, shall be 1 percent.

Note 4: Approved alternate test: The insertion of a 1.0-megohm resistor in the grid circuit shall change the plate current by not more than 0.5 mAdc.

Note 5: Socket need not be used in performing this test.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F shall apply.

Note 7: In addition to the rejection criteria of 4.10.3.1, the output shall be read on a VU meter using a rejection limit of 5 VU. Five VU is the meter deflection obtained with a steady-state output of 3 mW from the amplifier.

Note 8: The rejection limit shall be set at the VU meter reading obtained during calibration.

Note 9: Prior to this test, the tube shall be preheated a minimum of 5 minutes at the conditions indicated below. The 3-minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef V	Ec1 Vdc	Ec2 Vdc	Ec3 Vdc	Eb Vdc	Rk ohms	Rg1 Meg
7.5	0	125	0	180	130	0.1

Note 10: Destructive tests: Tubes subjected to the following destructive tests are not to be delivered on the contract or order:

4.9.20.5 Shock test
4.9.20.6 Fatigue test
4.11.7 Heater-cycling life test
4.11.5 Intermittent life-test operation.

Note 11: A grid No. 1 resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyratron-type short indicator is employed.

Note 12: The no-load to steady-state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis.

Note 13: Stability life test: See 20.2.5.1 of Appendix C.

Note 14: Survival-rate life test: The sampling and testing procedures for this test shall be as specified in 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C, with the following exceptions:

20.2.5.2.3: Replace second sentence with the following: If such selection results in a sample containing one or more tubes which are defective as defined under 4.7.5, such tubes shall be replaced by randomly selected good tubes.

20.2.5.2.4(b): Replace with the following: Tubes shall be tested at 100 hours for continuity and short (inoperative) under the same conditions as for the initial test. When any tap-short indication is obtained, the test shall be repeated. When any short indication is again obtained, the tube shall be rejected as inoperable.

Note 15: For survival-rate life test, the equivalent stability life-test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

Note 16: Intermittent life tests: See 20.2.5.3 of Appendix C.

Note 17: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B & S or smaller diameter elements welded to a ring of 0.025-inch diameter phosphor bronze in contact with the envelope. The envelope temperature requirement will be satisfied if a tube, having bogie plate current (±5 percent) under normal test conditions, is determined to operate at or above the minimum specified temperature at any position on the life-test rack.

Note 18: Order for evaluation of life-test defects: See 4.11.3.1.2

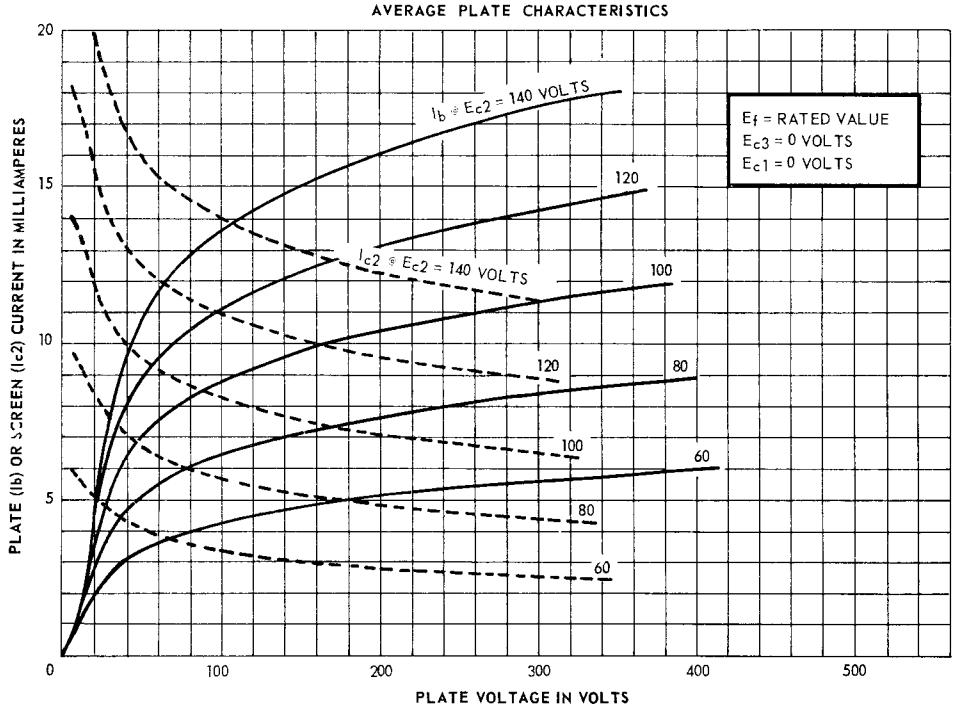
Note 19: An inoperative, as referenced in life test, is defined as a tube having one or more of the following defects: discontinuity or permanent short (see 4.7.5, except tube shall not be tapped); air leaks (see 4.7.6).

Note 20: Tubes shall be prepared for domestic or overseas shipment, as specified in the contract or order, in accordance with Specification MIL-E-75 and appendix thereto.

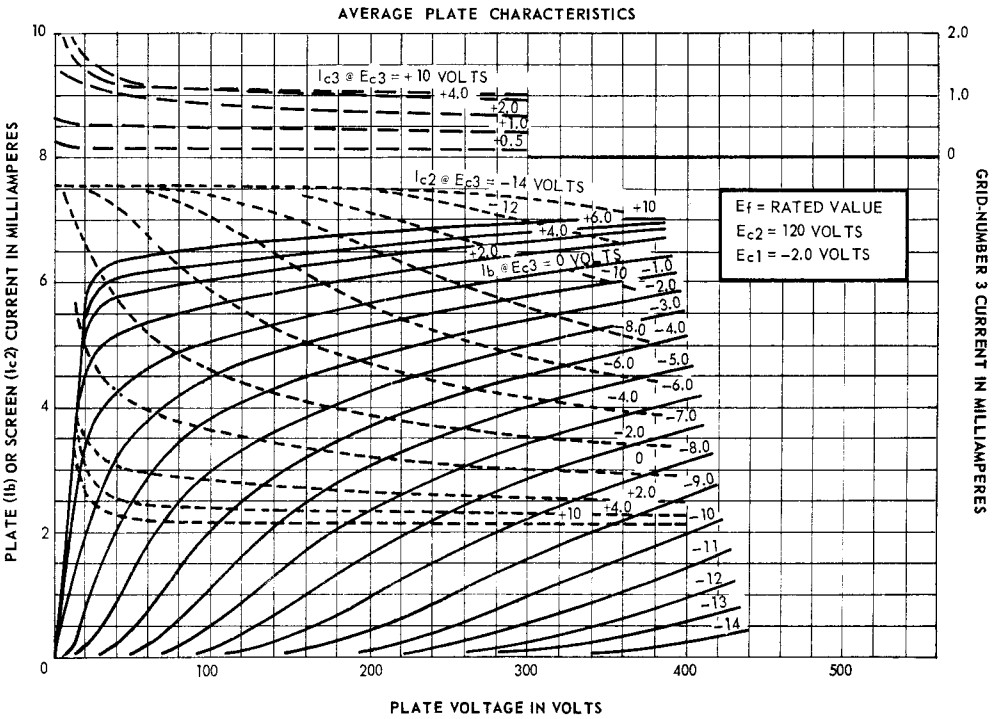
Note 21: All production lots shall be suitably identified.

MINIATURE DUAL-CONTROL PENTODE

AVERAGE PLATE CHARACTERISTICS



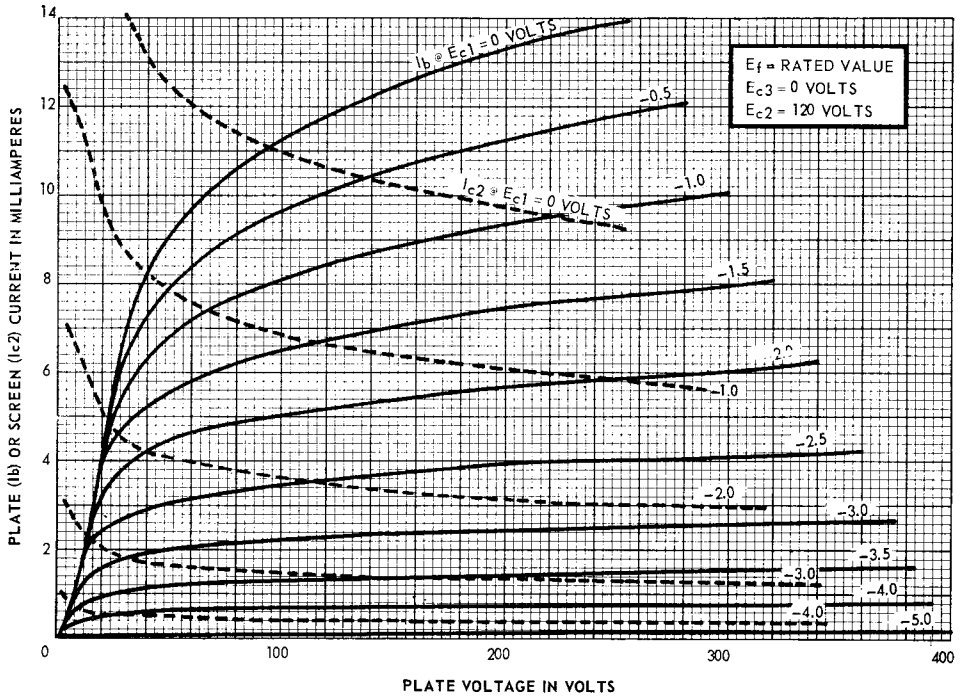
AVERAGE PLATE CHARACTERISTICS



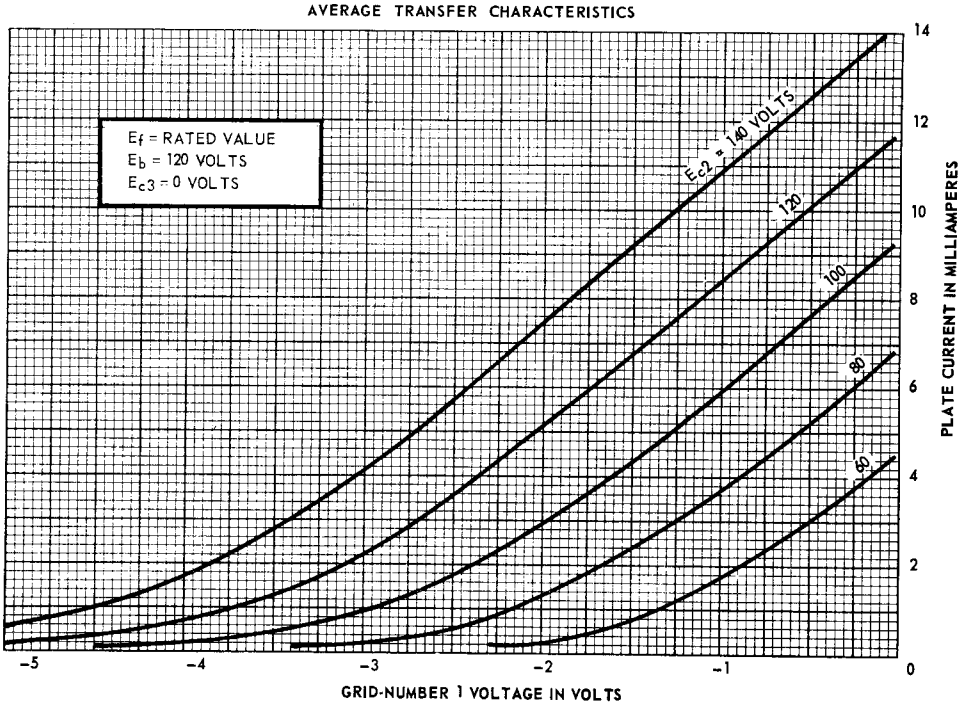
RAYTHEON COMPANY · 55 Chapel Street · Newton 38, Massachusetts

MINIATURE DUAL-CONTROL PENTODE

AVERAGE PLATE CHARACTERISTICS

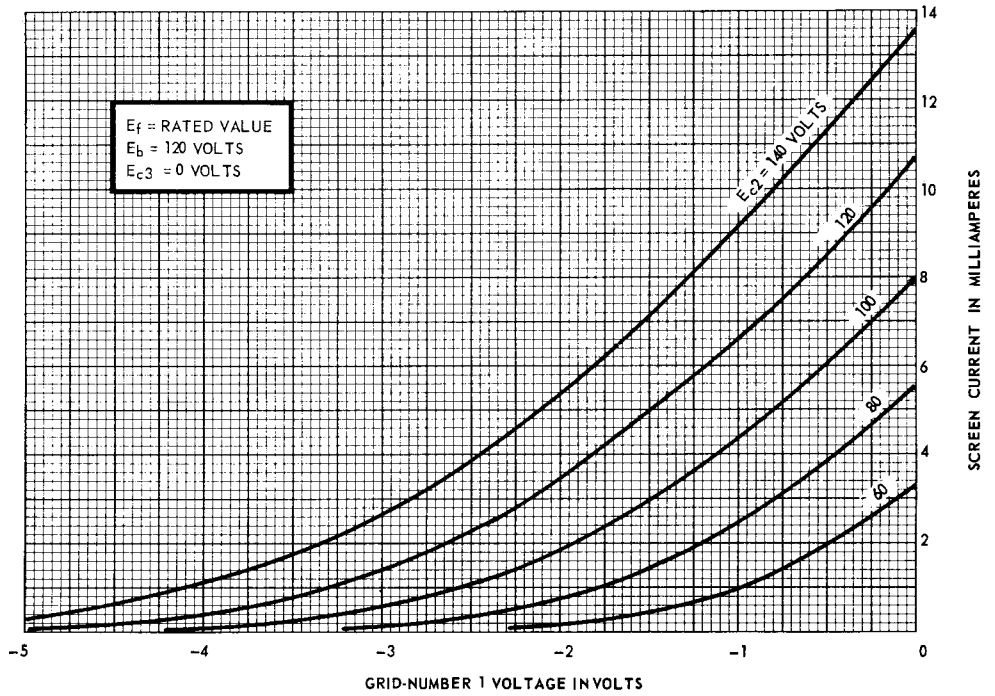


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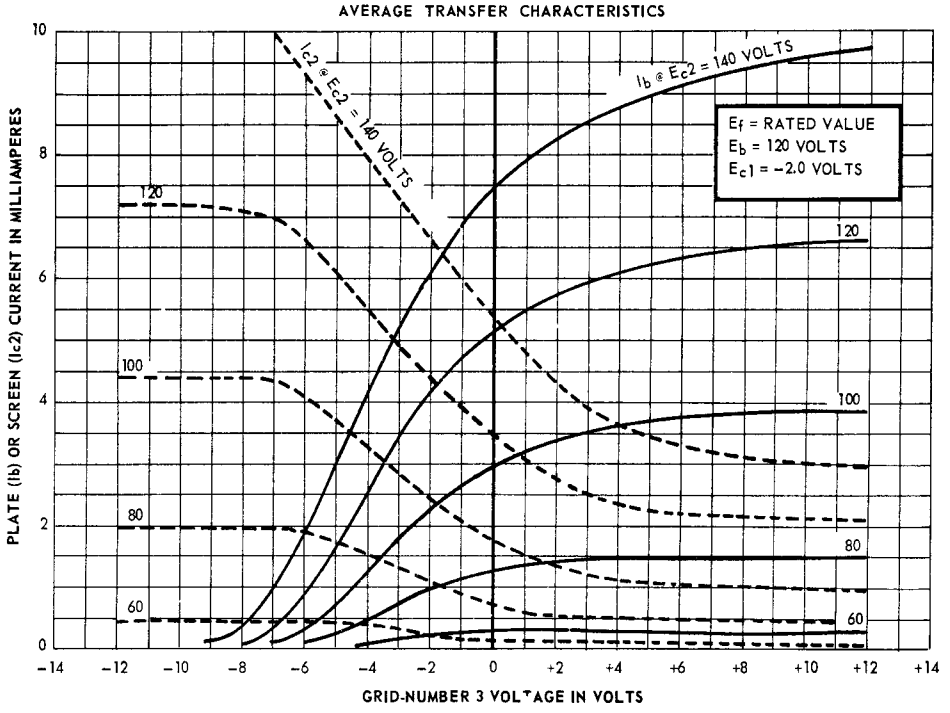


MINIATURE DUAL-CONTROL PENTODE

AVERAGE TRANSFER CHARACTERISTICS

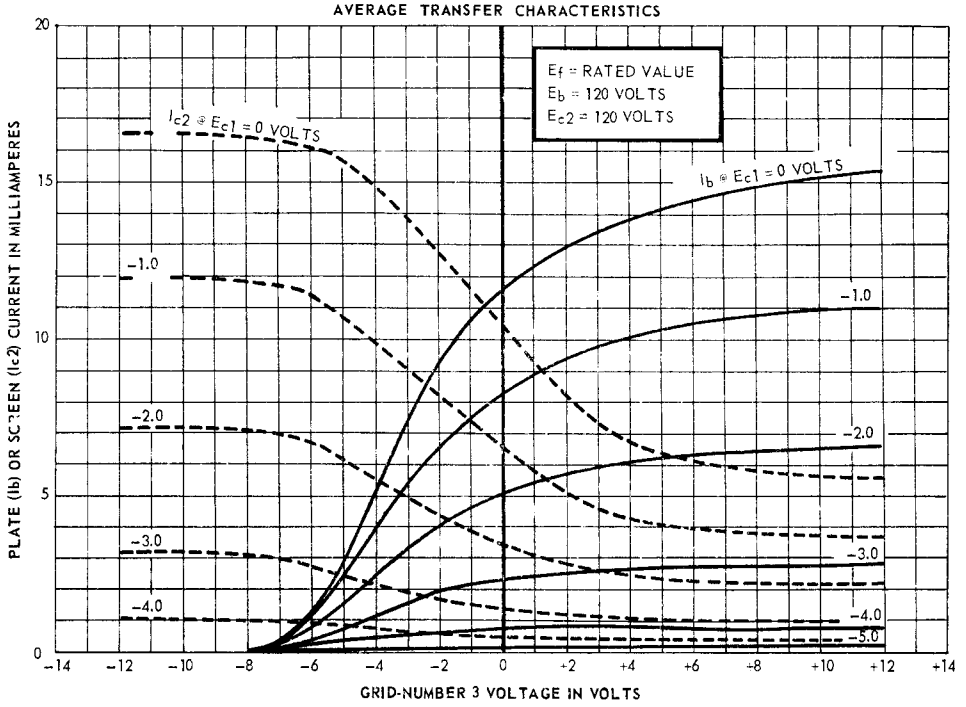


AVERAGE TRANSFER CHARACTERISTICS

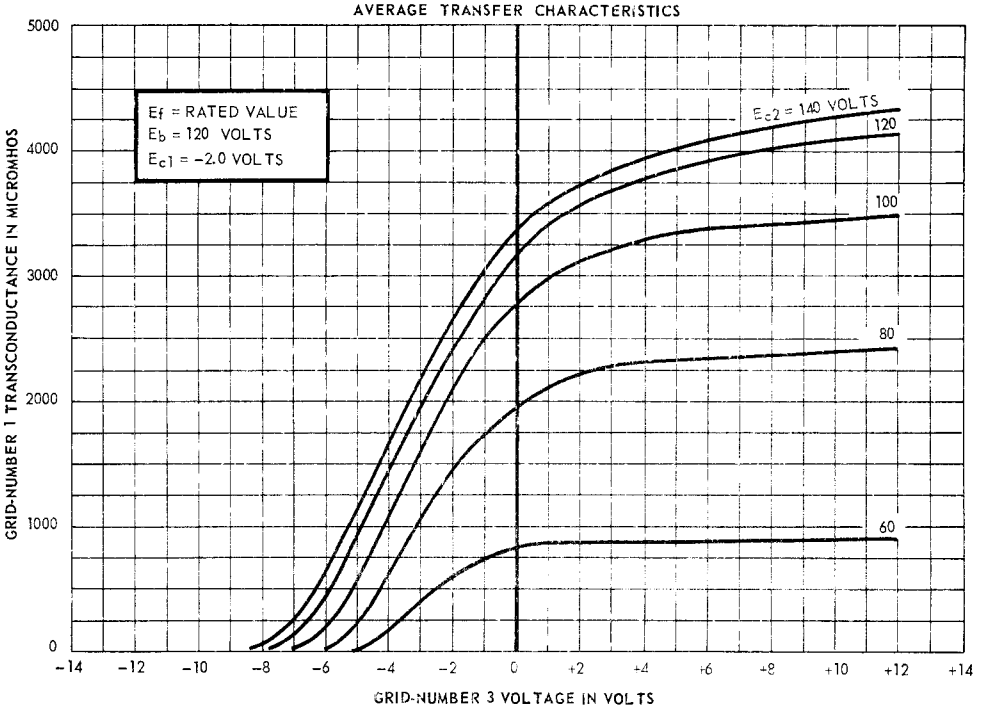


MINIATURE DUAL-CONTROL PENTODE

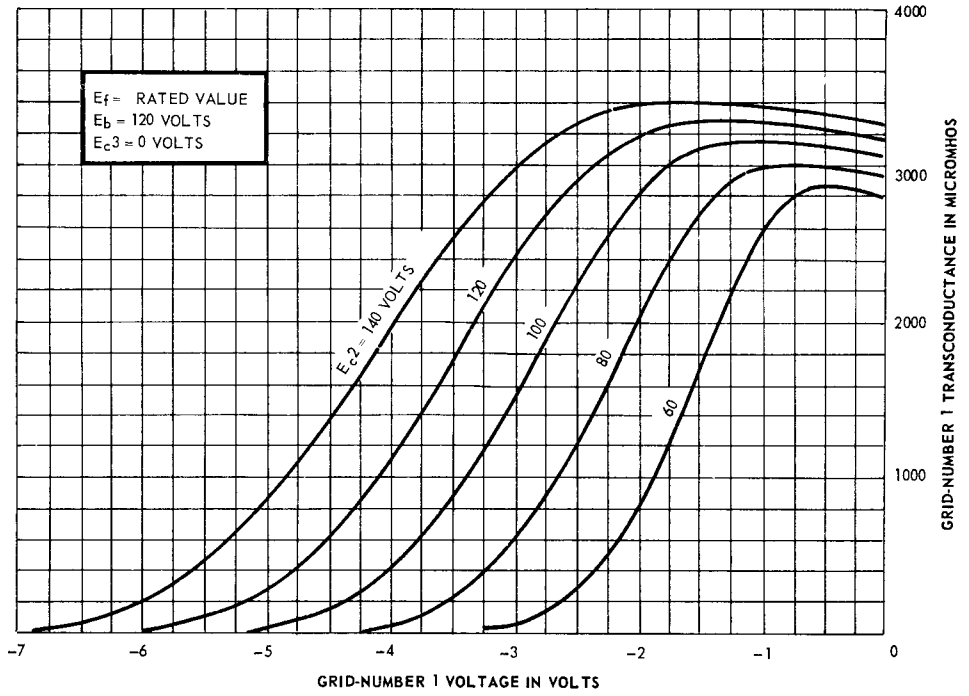
AVERAGE TRANSFER CHARACTERISTICS



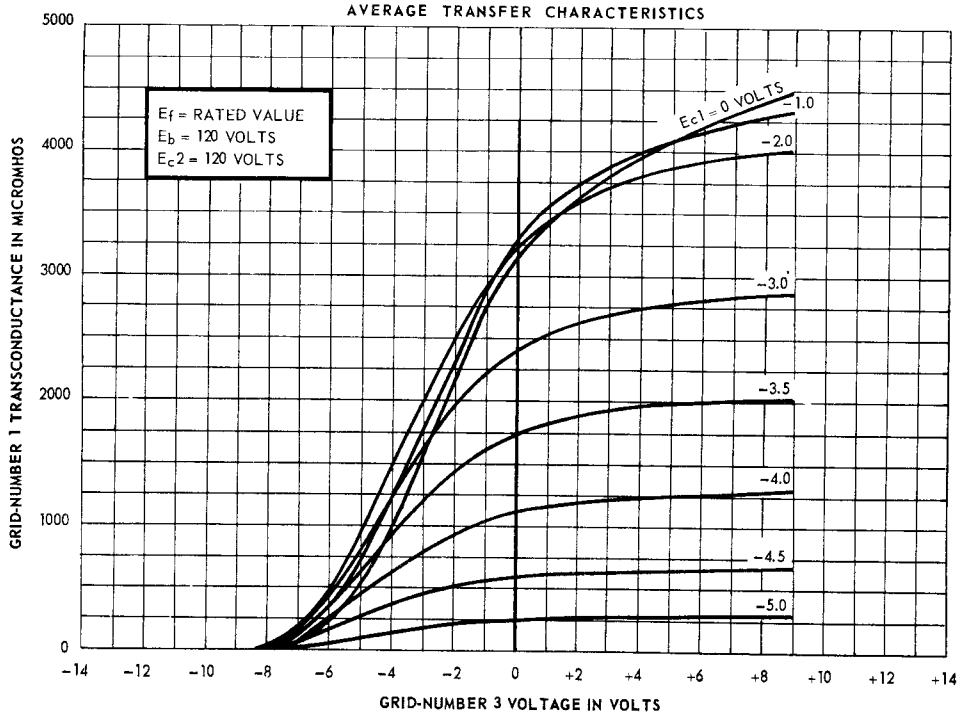
AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

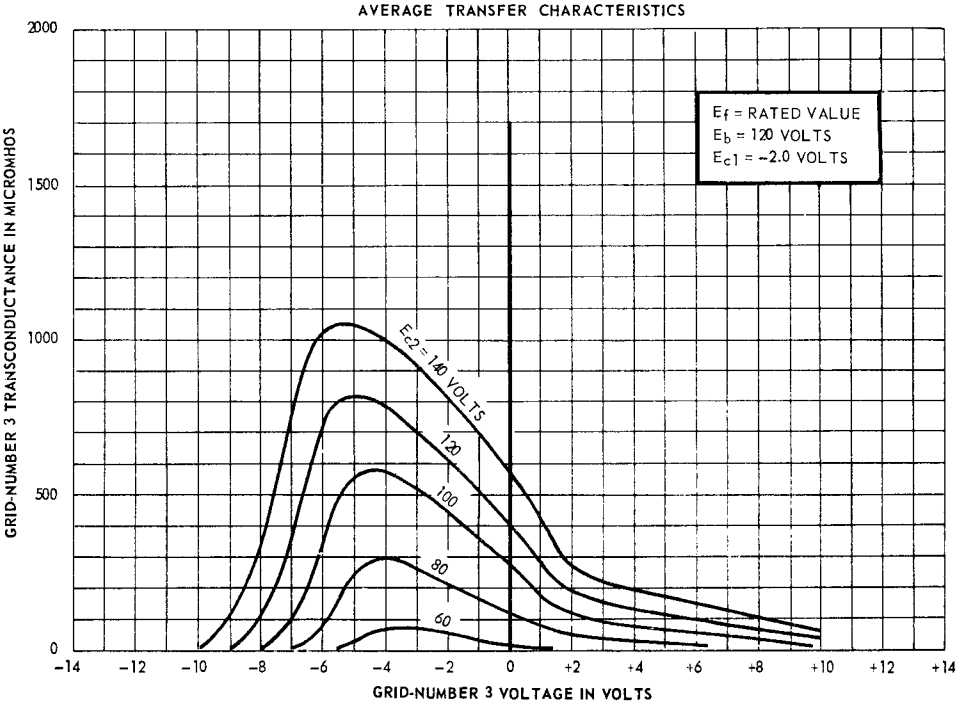


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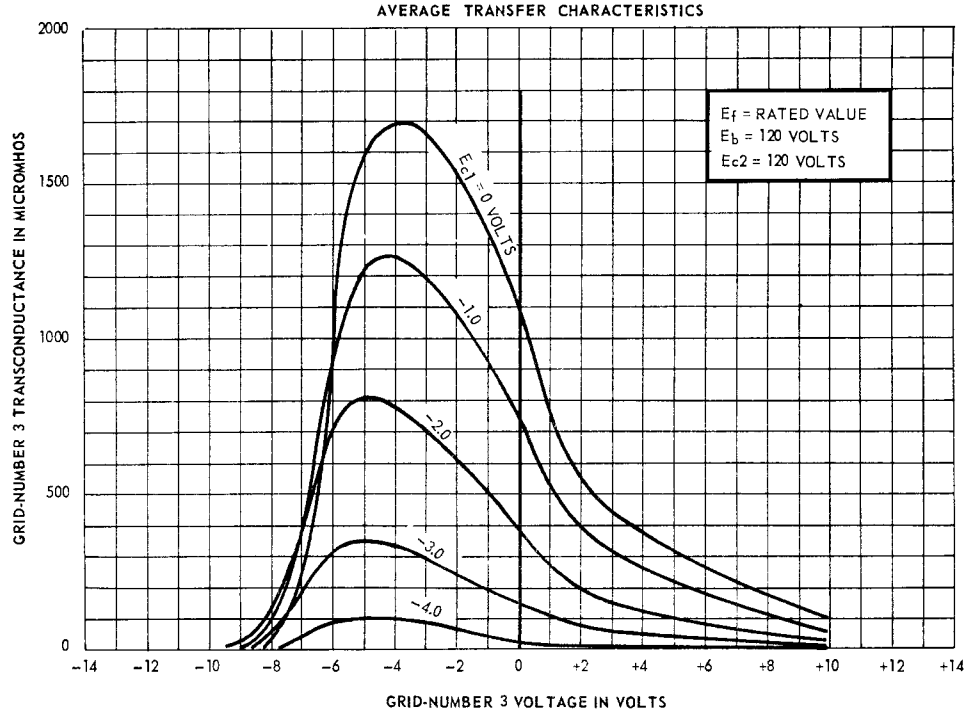


MINIATURE DUAL-CONTROL PENTODE

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



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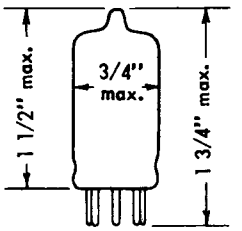
TECHNICAL INFORMATION

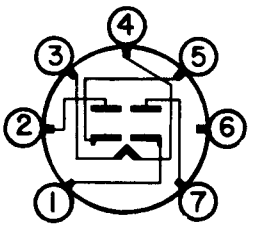
RELIABLE DOUBLE DIODE

Excellence in Electronics

TYPE CK5726/ 6AL5W/ 6097

The CK5726/6AL5W/6097 is a heater-cathode type double-diode of miniature construction designed for dependable operation under conditions usually found in mobile and aircraft applications. The heaters are designed to minimize the possibility of failure under severe intermittent on-off operation. The heaters for the two diode units are internally connected in series so that a heater failure makes both units inoperative.





BOTTOM VIEW

6BT

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Cathode, Unit #1	Pin 5 Cathode, Unit #2
Pin 2 Plate, Unit #2	Pin 6 Internal Shield
Pin 3 Heater	Pin 7 Plate, Unit #1
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test - Note 3)	720 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test - Note 4)	2.5 G
Maximum Bulb Temperature	165 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

Caution-----To Electron Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 7)	Ef:	5.7	6.3	6.3	6.9	V
Plate Supply Voltage (RMS)(each plate):	Epp:	----	165	117	----	Vac
Load Resistance	RL:	----	11,000	----	----	ohms
Filter Input Capacitance	CL:	----	8	8	----	μf
Peak Inverse Plate Voltage	epx:	----	----	----	360	v
Steady State Peak Plate Current (each plate)	ib/p:	----	----	----	60	mA
DC Output Current (each plate)	Io/p:	----	----	9	10	mAdc
Peak Transient Plate Current (each plate)	i surge/p:	----	----	----	350	mA
Heater-Cathode Voltage	Ehk:	----	----	----	360	V
Minimum Effective Plate Supply Impedance (per Plate)	Zp/p:	----	----	300	----	ohms

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)
(In the following tests, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	BOGIE	MAX.	MIL-E-1B UNITS
ACCEPTANCE TESTS - GROUP C							
Continuity and Short		0.4					
ACCEPTANCE TESTS - GROUP D.	**COMBINED AQL=1.0%**						
Heater-Current:		0.65	If:	275	300	325	mA

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	BOGIE	MAX.	MIL-E-1B UNITS
ACCEPTANCE TESTS GROUP D (cont'd)							
Heater-Cathode Leakage:	Ehk=100Vdc: Heater Positive	0.65	Ihk:	----	----	10	μAdc
	Ehk=100Vdc: Heater Negative		Ihk:	----	----	10	μAdc
Operation:	Full Wave Operation	0.65	Io:	16	18	----	mAdc
Emission (1):	Eb=10 Vdc	0.65	Is:	40	----	----	mAdc
ACCEPTANCE TESTS - GROUP E							
Insulation of Electrodes:	Ef=6.3V; Ep-all=-300Vdc	2.5	R (p-all):	100	----	----	Meg.
	Esd-all=-300 Vdc		R(sd-all):	100	----	----	Meg.
Emission (2):	Eb=7.0Vac: (Note 8)	2.5	Δ Is (2):	----	----	15	%
Plate Current:	Ebb=0; Rp=40,000 ohms	2.5	Ib:	2	----	20	μAdc
Plate Current Difference between diodes:	Ebb=0; Rp=40,000 ohms	2.5	Ib:	-----	----	5	μAdc
Hum:	Ef=7.0 Vac	2.5	Eo:	----	----	10	mVac
ACCEPTANCE TESTS - GROUP F							
Capacitance: (Note 2)	Plate #1 to Plate #2		Cpp:	----	----	0.026	μμf
	Plate to (h+k+int.sd.+ext.sd.)	6.5	C:	2.4	----	4.0	μμf
	Cathode to (h+p+int.sd.+ext.sd.)		C:	3.1	----	4.7	μμf
Low Pressure Voltage Breakdown:		6.5		500	----	----	Vac
ACCEPTANCE TESTS - GROUP A							
Shock:	Hammer Angle=48°; Epp/p=0 (Note 3)	----	-----	----	----	----	-----
Fatigue:	96 Hours: (Note 4)	6.5	-----	----	----	----	-----
Post Shock and Fatigue Test End Points:							
Heater-Cathode Leakage:	Ehk=+100Vdc		Ihk:	----	----	15	μAdc
	Ehk=-100Vdc		Ihk:	----	----	15	μAdc
Operation:	Full-Wave Circuit		Io:	14	----	----	mAdc
ACCEPTANCE TESTS - GROUP B							
Glass Strain:		2.5	-----	----	----	----	----

TESTS	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Maximum defects per Characteristics 1st Sample	Maximum defects per Characteristics Combined Sample
ACCEPTANCE LIFE TEST								
Heater Cycling:	Ef=7.5V; Ehk=+135Vdc; Epp=0; 1 min. on, 1 min. off	----	-----	2000	----	Cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Heater Positive	----	Ihk:	----	20	μAdc		
	Heater Negative	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=Room; Ehk=Eo+117Vac; Full wave circuit	----	-----	----	----	-----		
1 Hour Stability Life Test End Points:								
Change in Emission (2) of individual tubes from initial:	Eb=7.0 Vac (Typical sample size=50 tubes)	1.0	Δ_t Is (2):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ehk=Eo+117 Vac; full wave circuit	----	-----	----	----	----		
100 Hour Survival Rate Life Test End Points:								
Inoperatives:	(Typical sample size=200 tubes)	0.65	-----	----	----	----		
500 and 1000 Hour Intermittent High Temperature Life Test:	T Bulb=165°C; Ehk=Eo+117Vac; Full wave circuit.	----	-----	----	----	-----		

ELECTRICAL DATA (cont'd)

TESTS	CONDITIONS	AQL %	MIL-E-1B Symbol	MIN.	MAX.	MIL-E-1B UNITS	Maximum defects per Characteristics 1st Sample	Maximum defects per Characteristics Combined Samples
ACCEPTANCE LIFE TEST (cont'd)								
500 Hour Intermittent High Temperature Life End Points:	(Typical sample size=20 tubes 1st sample 40 tubes 2nd sample) (Total allowable combined defects=4 tubes 1st sample 8 tubes 1st and 2nd sample)							
Inoperatives:		----	-----	----	----	-----	1	3
Heater Current:		----	If:	275	325	mA	1	3
Heater-Cathode Leakage:		----	Ihk:	----	10	μAdc	1	3
Emission (1):		----	Is(1):	35	----	mAdc	1	3
Plate Current:		----	Ib:	2	20	μAdc	2	5
Electrode Insulation:	(p-all)	----	Rp-all:	50	----	Meg.	2	5
	(sd-all)	----	Rsd-all:	50	----	Meg.		
Emission (2):		----	Is(2):	----	15	%	2	5
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size=20 tubes 1st sample 40 tubes 2nd sample)							
Inoperatives:				----	----		2	5
Heater Current:			If:	275	325	mA	2	5
Heater-Cathode Leakage:			Ihk:	----	10	μAdc	2	5
Emission (1):			Is(1):	30	----	mAdc	2	5

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: With Shield #316.

Note 3: Test Conditions and Acceptance Criteria per Shock Test Procedures of Mil-E-1B basic specifications.

Note 4: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1B basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be excected.

Note 6: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

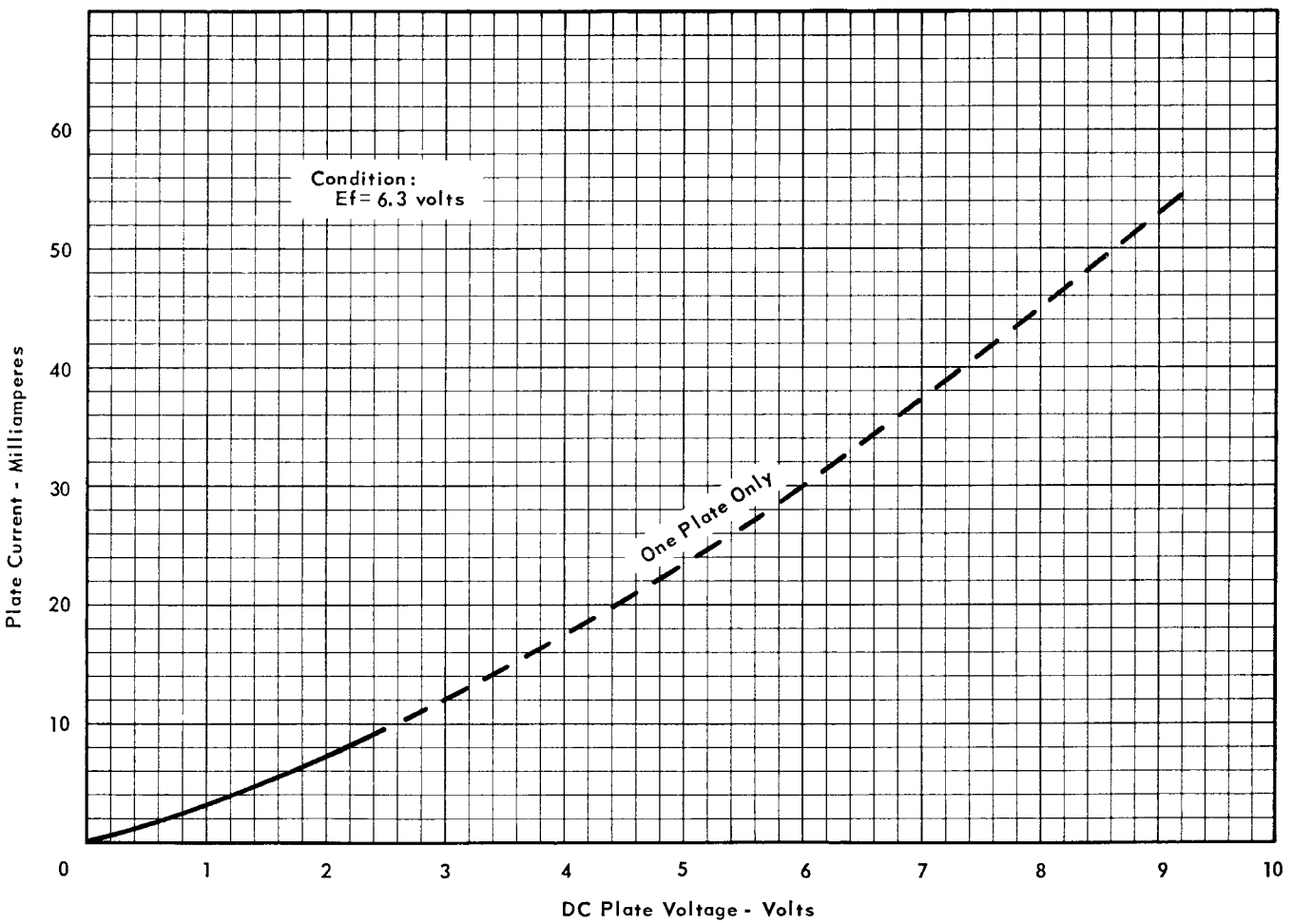
Note 7: For most applications the performance will not adversily affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage an improvement in reliability will be realized.

Note 8: Change of emission (2) for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

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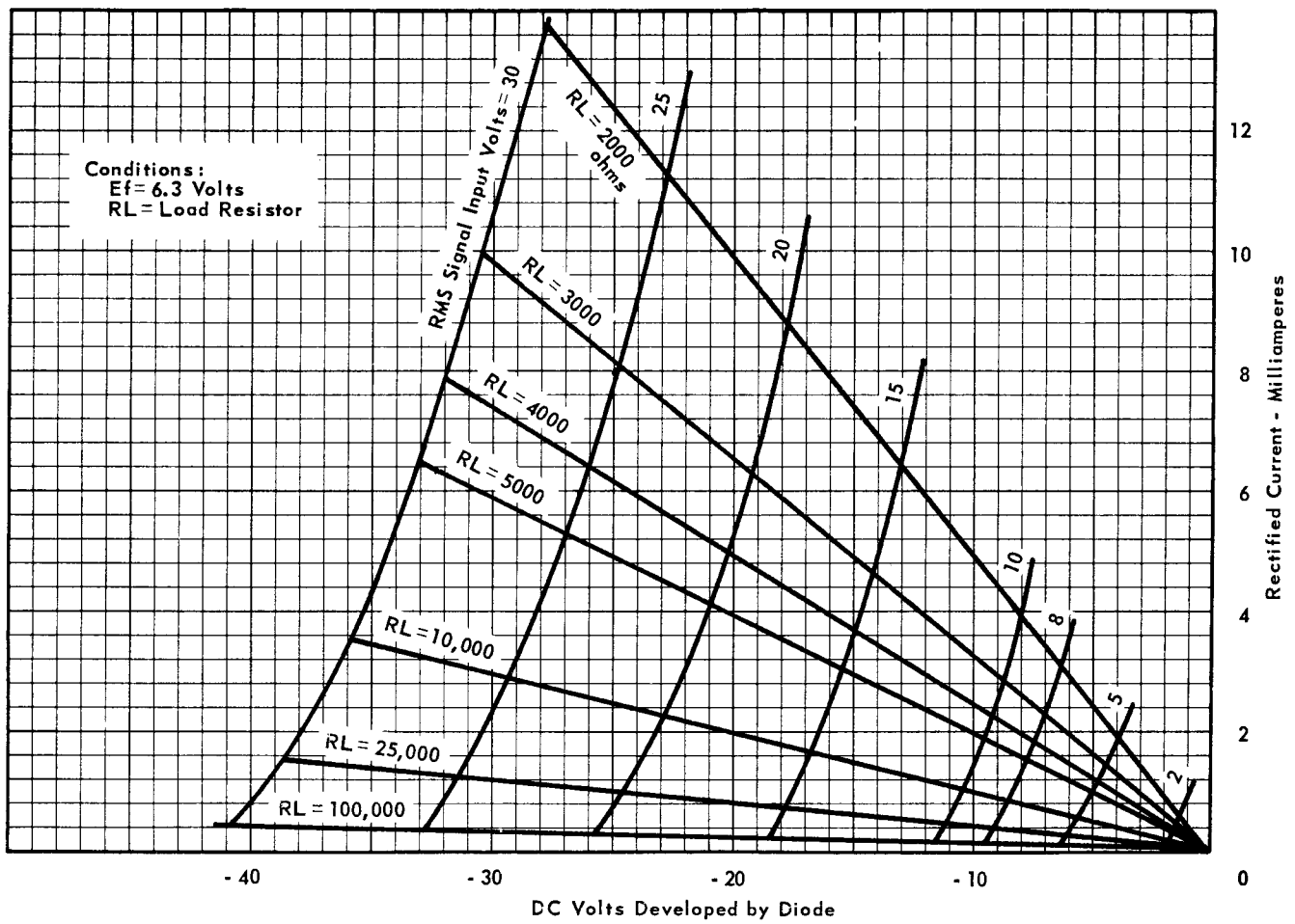
RELIABLE DOUBLE DIODE

AVERAGE PLATE CHARACTERISTICS



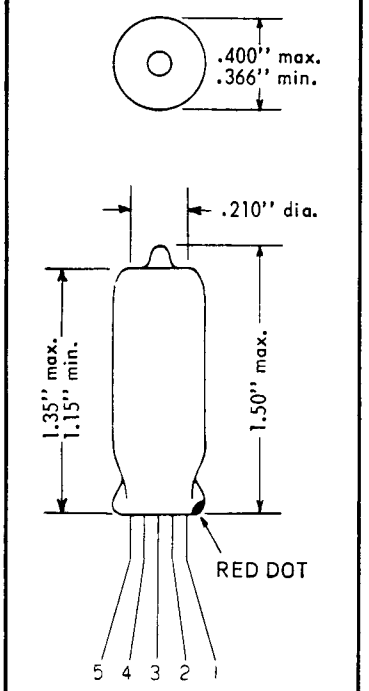
RELIABLE DOUBLE DIODE

AVERAGE CHARACTERISTICS
Half-Wave Rectification - Single Diode



TYPE CK5744WB

The CK5744WB is a heater-cathode type high-mu triode of subminiature construction capable of operation as a frequency converter or oscillator in the UHF region. It is also useful in general purpose audio frequency voltage amplifier service. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid
Lead 2 Heater	Lead 5 Cathode
Lead 3 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test—Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test—Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue—Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION—To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	250	250	275	Vdc
Grid #1 Voltage	Ec1:	−55	0	0	----	Vdc
Plate Dissipation	Pp:	----	----	1.1	1.3	W
Heater-Cathode Voltage	Ehk:	−200	----	100	+200	v
Plate Current	Ib:	----	----	4.2	6.5	mAdc
Cathode Resistance	Rk:	----	500	500	----	ohms
Grid Circuit Resistance	Rg:	----	----	----	1.2	Meg.
Grid Current	Ic:	----	----	----	1.0	mAdc
Transconductance (1):	Sm(1):	----	----	4000	----	μmhos
Amplification Factor	Mu:	----	----	70	----	----

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1				**Combined AQL = 1.0% excluding Mechanical and Inoperatives**						
Heater Current:		0.65	If:	190	----	200	----	210	----	mA

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

April 1, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1 (cont'd)										
Heater-Cathode Leakage:	Ehk=+100 Vdc	0.65	Ihk:	----	----	----	----	5	----	μAdc
	Ehk=-100 Vdc		Ihk:	----	----	----	----	5	----	μAdc
Grid Current:		0.65	Ic (1):	----	----	----	----	-0.3	----	μAdc
Plate Current (1):		0.65	Ib (1):	3.2	3.7	4.2	4.7	5.2	1.2	mAdc
Plate Current (2):	Ec1=-6.5 Vdc	0.65	Ib (2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.65	Sm (1):	3400	3700	4000	4300	4600	660	μmhos
AC Amplification:	Esig=0.2 Vac; Ebb=100 Vdc; Ecc=0; Rg1=10 Meg; Rk=0; Rp=0.5 Meg.	0.65	Ep:	6.5	----	----	----	----	----	Vac
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-7) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V; Eg-all=-100 Vdc; Ep-all=-300 Vdc	2.5	Rg1-all:	100	----	----	----	----	----	Meg.
			Rp-all:	100	----	----	----	----	----	Meg.
Plate Current (3):	Ec1=-4.0 Vdc	2.5	Ib (3):	5	----	----	----	----	----	μAdc
Transconductance (2):	Ef=5.7 V	2.5	Δ_{Ef}Sm (2):	----	----	----	----	5	----	%
Grid Emission:	Ef=7.5 V; Rg=1.0 Meg. Preheat 5 minutes at Ec1=0; Test at Ec1=-10 Vdc.	2.5	Ic (2):	----	----	----	----	-0.4	----	μAdc
AF Noise:	Esig=50 mVac; Rg=1.0 Meg.; Rp=0.2 Meg.	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	60	65	70	75	80	7	----
Capacitance:			Cgp:	0.65	----	0.8	----	0.95	----	μμf
Capacitance:	Note 2	6.5	Cin:	2.0	----	2.7	----	3.4	----	μμf
Capacitance:			Cout:	1.6	----	2.3	----	3.0	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mm Hg; Voltage=300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	Rp=10,000 ohms; F=40 cps; G=15;	2.5	Ep:	----	----	----	----	15	----	mVac
Vibration (3):	Rp=10,000 ohms; F=30-1000 cps; G=15; position X_1 and X_2 only.	4.0	ep:	----	----	----	----	75 peak to peak	----	mv
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Hammer Angle=30°; Ehk=+100 Vdc; Rg=0.1 Meg. (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 Hours; G=2.5; Fixed frequency; F=25 min. 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 Hours; G=10; Fixed frequency; F=25 min., 60 max. (note 12)	6.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)								
Post Shock (1) and Fatigue Tests (1) and (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	25	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm(1):	----	10	%		
Grid Current:		----	Ic:	----	−1.0	μAdc		
Shock (3):	G=75; (Hammer Angle=120°+rubber pad); t=10 milliseconds; Ehk=+100 Vdc; Rg=0.1 Meg. (Note 13)	20	----	----	----	----		
Post Shock (2) Test End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	25	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm(1):	----	10	%		
Grid Current:		----	Ic:	----	−1.0	μAdc		
Glass Strain (Thermal Shock)		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling:	Ef=7.5 V; Eb=Ec1=0 V; Ehk=140 Vac; 1 min. on, 1 min. off	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical sample size=50 tubes)	1.0	----	----	----	----		
Change in transconductance (1) of individual tubes:		----	Δ_tSm(1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical sample size=200 tubes)							
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm(1):	3000	----	μmhos		
Intermittent High Temperature Life Test:	T Bulb=220°C; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	----	-0.6	μAdc	1	3
Heater Current:		----	If:	180	220	mA	1	3
Change in transconductance (1) of individual tubes:		----	Δ_tSm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5
Insulation of Electrodes:								
g1-all		----	Rg1-all:	50	----	Meg.	2	5
p-all		----	Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	AvgΔ_tSm(1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic(1):	----	-1.0	μAdc	2	5
Heater Current:		----	If:	177	223	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_tSm(1):	----	30	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	15 15	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D.-1 7/8" long) connected to lead 5.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 10: In addition to meeting the tightened electrical physical and mechanical tests described in this data sheet these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by paragraph 5.3.8 of "Inspection Instructions for Electron Tubes."

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the 3 minute plate current (1) value. No preheating before this test will be allowed.

ELECTRICAL DATA (Cont'd)

NOTES (cont'd)

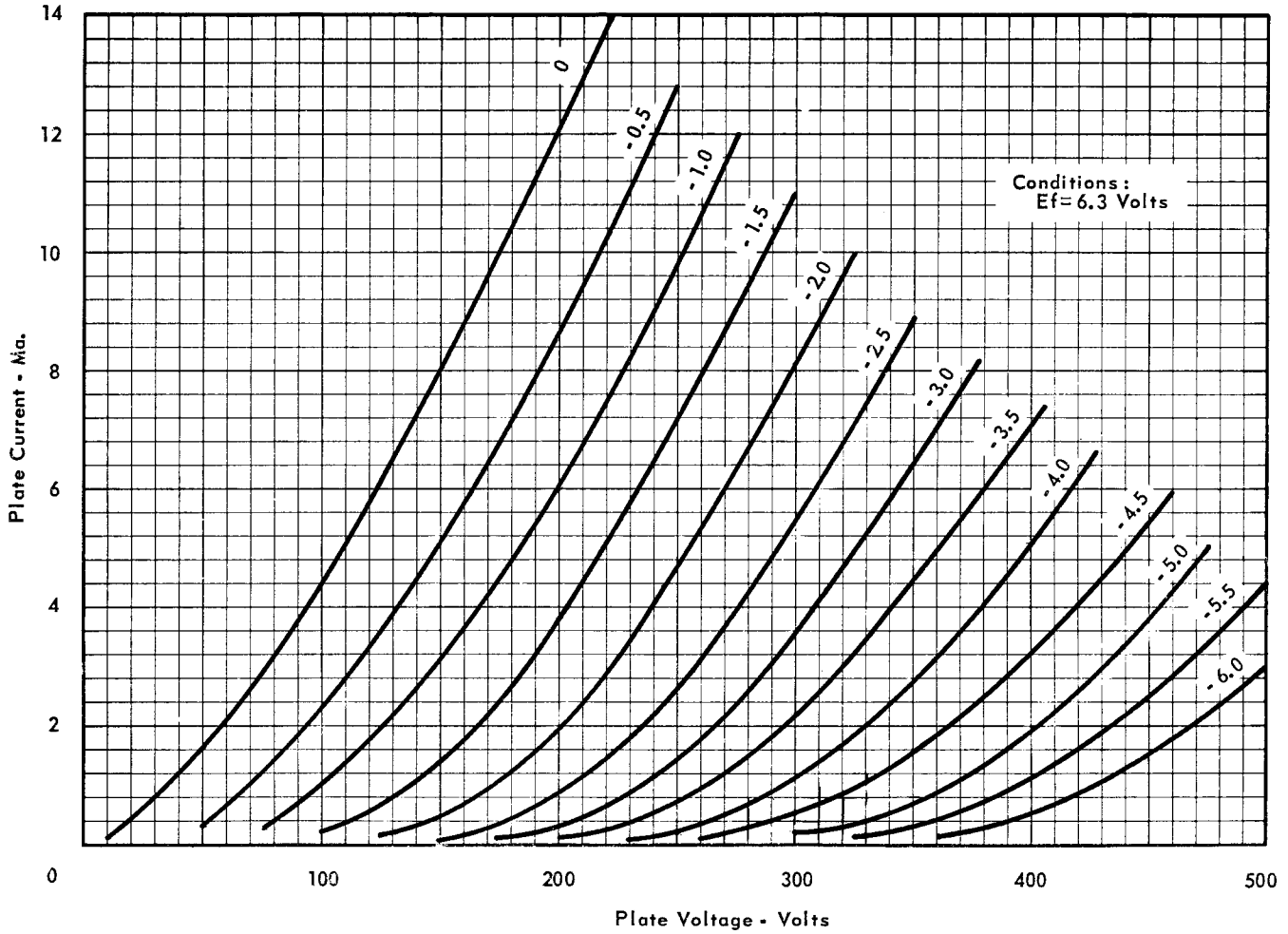
Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures:

(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3 of Specification MIL-E-1.

(b) Tubes which do not comply with post fatigue limits. (This is a destructive test).

Note 13: The provisions of 4.9.20.5 of Specification MIL-E-1 shall apply, except for the test conditions specified herein for Shock Test (2).

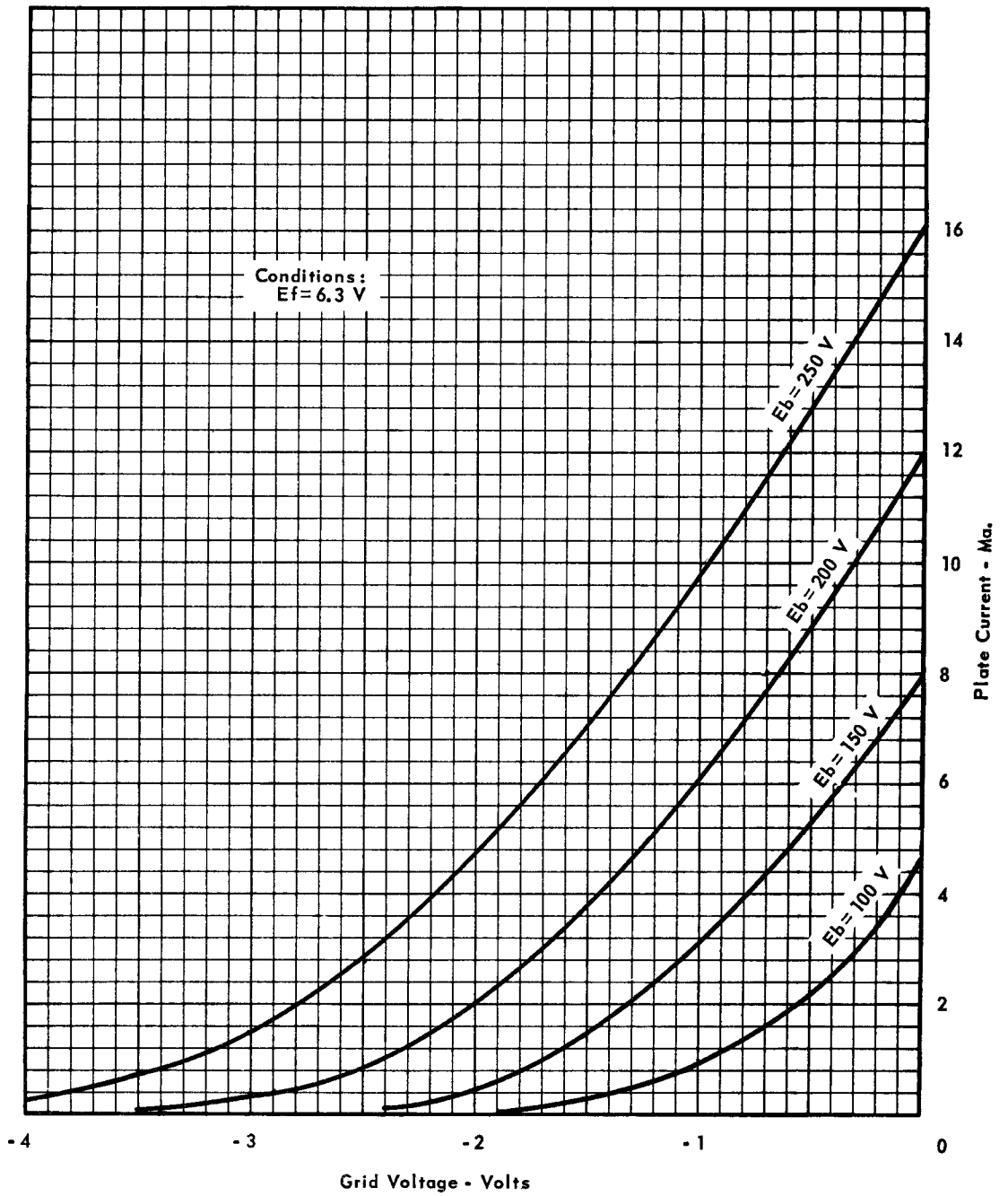
AVERAGE PLATE CHARACTERISTICS



RAYTHEON

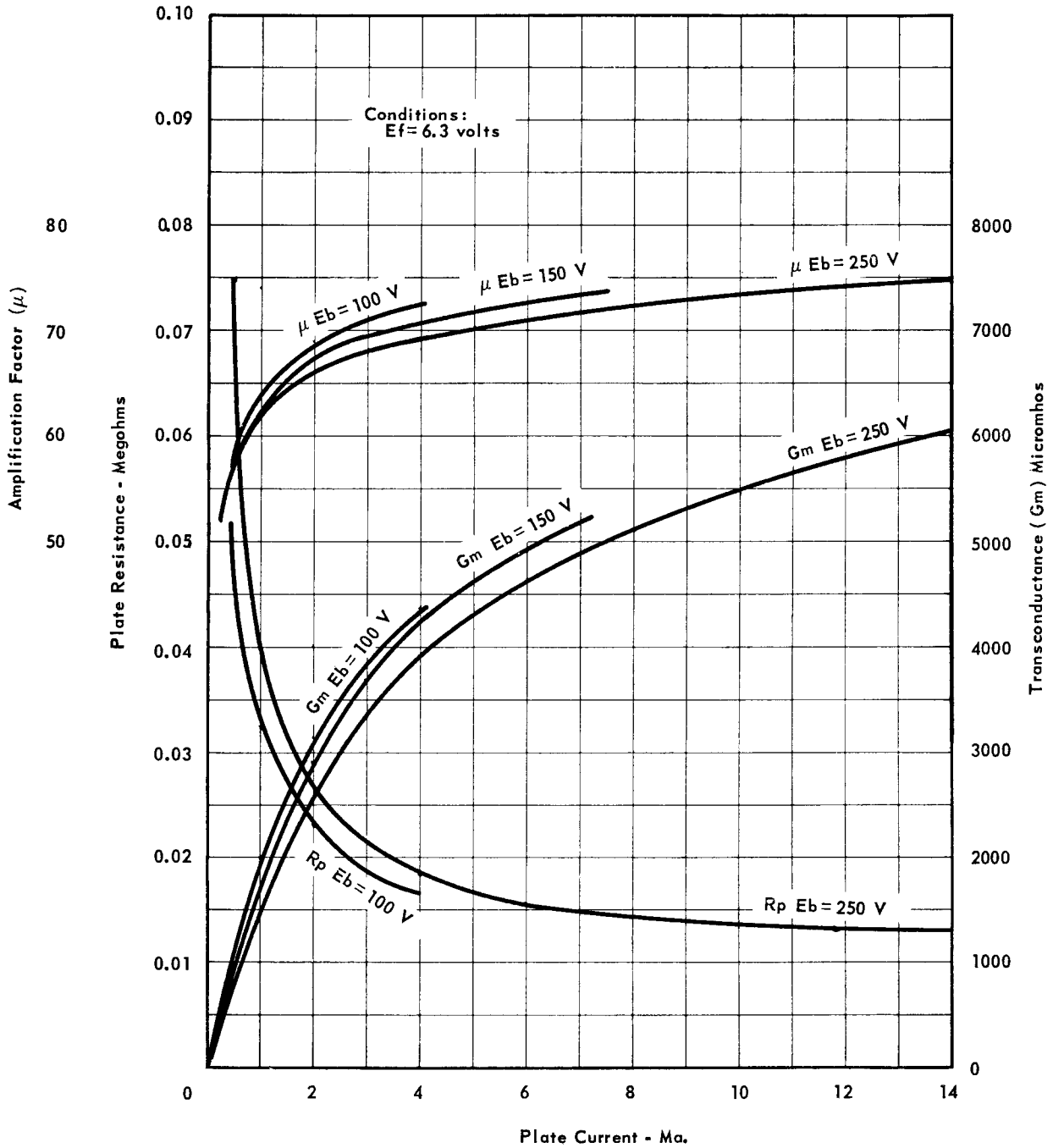
RELIABLE SUBMINIATURE TRIODE

AVERAGE CHARACTERISTICS



RELIABLE SUBMINIATURE TRIODE

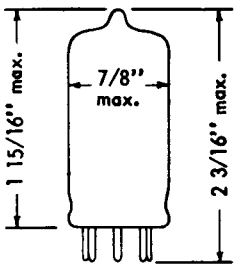
AVERAGE CHARACTERISTICS

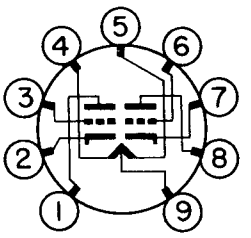


Excellence in Electronics

TYPE CK5755

The CK5755 is a heater–cathode type double–triode of miniature construction. This type has several unique features of construction and test specification controls which make it suitable for applications, such as precision DC amplifiers, computers, and regulated power supplies which require very stable characteristics. Among the features are special cathode springs which reduce microphonic response. This characteristic is controlled by a "microphonic stability" test for balance in which the tube is tapped at shock levels of 400 to 600 G. Other tests which serve to control the characteristics are: 150 hour stabilization, drift, electrical stability, plate current balance, and a maximum grid current limit of 10^{-9} Adc. These tests are described under Typical Operating Conditions and Characteristics.





BOTTOM VIEW

9J

MECHANICAL DATA

ENVELOPE: T–6½ Glass

BASE: Miniature Button 9–Pin

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit 2	Pin 6 Grid, Unit
Pin 2 Cathode, Unit 2	Pin 7 Cathode, Unit 1
Pin 3 Grid, Unit 2	Pin 8 Plate, Unit 1
Pin 4 Heater	Pin 9 Heater Center–Tap
Pin 5 Heater	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.)

	With Shield *	Without Shield
Grid, Unit 1 to Plate, Unit 1: (1g to 1p)	1.40	1.40
Grid, Unit 2 to Plate, Unit 2: (2g to 2p)	1.40	1.40
Input: 1g to (h+1k)	1.80	1.55
Input: 2g to (h+2k)	1.70	1.55
Output: 1p to (h+1k)	1.50	0.78
Output: 2p to (h+2k)	1.20	0.60
Plate, Unit 1 to Plate, Unit 2: (1p to 2p)	0.85	0.90
Grid, Unit 1 to Plate, Unit 2: (1g to 2p)	0.011	0.014
Grid, Unit 2 to Plate, Unit 1: (2g to 1p)	0.011	0.014

RATINGS–ABSOLUTE MAXIMUM VALUES: (Note 1) ▲

Heater Voltage	6.3/12.6±10%	volts
Plate Voltage (each unit)	250	volts
Plate Dissipation (each unit)	1.0	watt
Heater–Cathode Voltage (each unit)	75	volts

TYPICAL CHARACTERISTICS: ▲

Heater Supply Voltage (parallel connected)	6.3	6.3	volts
Heater Current (parallel connected)	0.360	0.360	amp.
Plate Voltage	180	110	volts
Grid Voltage	0	−0.95	volts
Plate Current	2.2	0.15	ma.
Transconductance	1500	500	μmhos
Amplification Factor		70	
Plate Resistance		0.14	meg.
Grid Current		10^{-9}	amp.
Initial Balance (Note 6) 1Δ (E1C–E2C)		±0.3	volts

TYPICAL OPERATING CONDITIONS–DC AMPLIFIER:

Heater Supply Voltage (parallel connected)	12.6	volts
Heater Ballast Resistor (each lead)	35	ohms
Plate Supply Voltage	310	volts
Cathode Bias Resistor (cathodes tied together)	0.15	meg.
Load Resistance (each unit)	0.9	meg.
Stabilization (Note 2)	150	hours
Drift (16 hours) (Note 3)	Ave. ΔEc=5	mVdc max.
Electrical Stability (Note 4)	ΔEc=2	mVdc max.
Mechanical Stability (Note 5)	Ave. ΔEc=25	mVdc max.

* *External Shield #315 connected to cathode of unit under test.*

▲ *Values are for each unit unless otherwise specified.*

NOTES:

Note 1: Limitations beyond which normal tube performance and tube life may be impaired. Quality level assured by sampling tests (Design Tests) on each production lot.

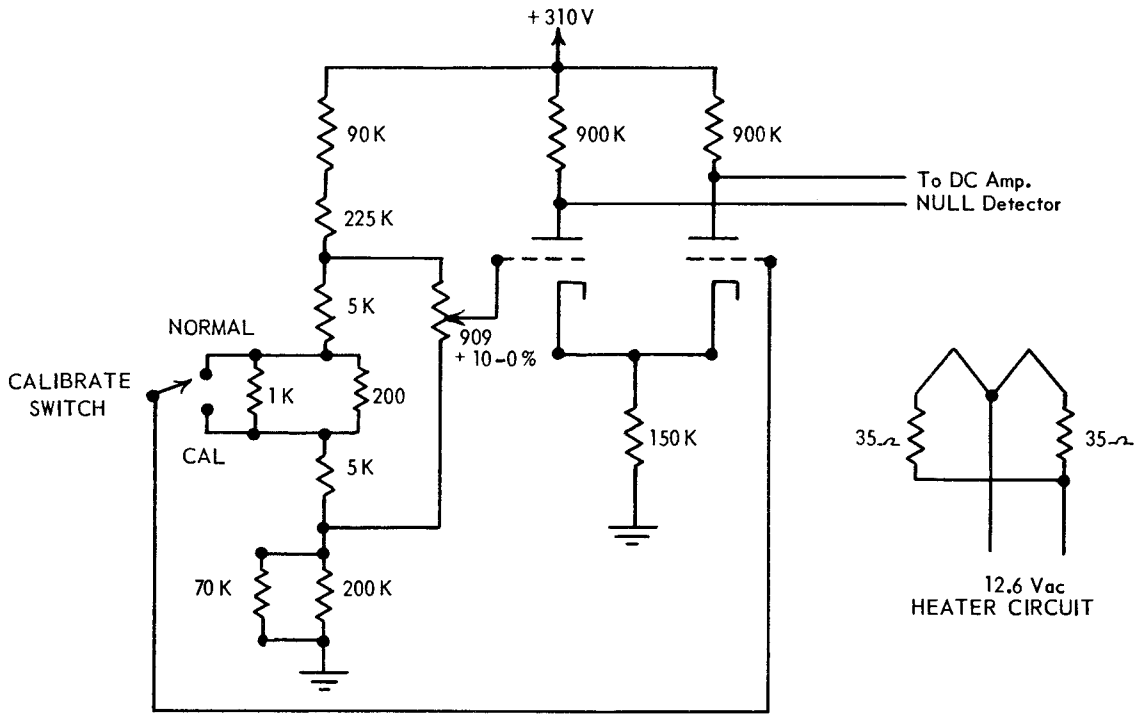
Note 2: All tubes are operated at least 150 hours in a typical operating circuit before testing.

Note 3: At the start of the test, an initial adjustment of grid bias shall be made to balance the plate currents in the two units within 1 μAdc. Drift, ΔEc is defined as a steady state change in grid bias that is required to return to the initial plate current conditions after operation for a specified period of time. No adjustment is allowed between observations. The test is made on at least a 15% sampling basis in the test circuit shown as Figure 1. The test period is a minimum of 16 hours; observations may be made at the start and finish of the final 7 hours period. The limit for ΔEc is 5 millivolts, DC, and applies to the arithmetic average of the sample disregarding the direction of change.

Note 4: Upon completion of the drift test ΔEc is observed for an operating period of 5 minutes with the tube in the same circuit. A ΔEc of 2 millivolts is permitted. The limit applies to individual tubes and any failure in the samples shall be cause for rejection of the lot.

Note 5: Upon completion of the electrical stability test each tube in the sample is tapped once in each of six directions with a shock between 400 and 600 G's of approximately one millisecond duration. ΔEc when measured in the circuit shown, shall be interpreted as the maximum variation from the initial setting that takes place following each of the six shocks. The 25 millivolt limit applies to the arithmetic average of the sample, disregarding the direction of the change.

Note 6: With E1b=E2b=110 Vdc and with I1b=I2b=0.150 mAdc, E1c−E2c for required Ib must not exceed ±0.3 Vdc.

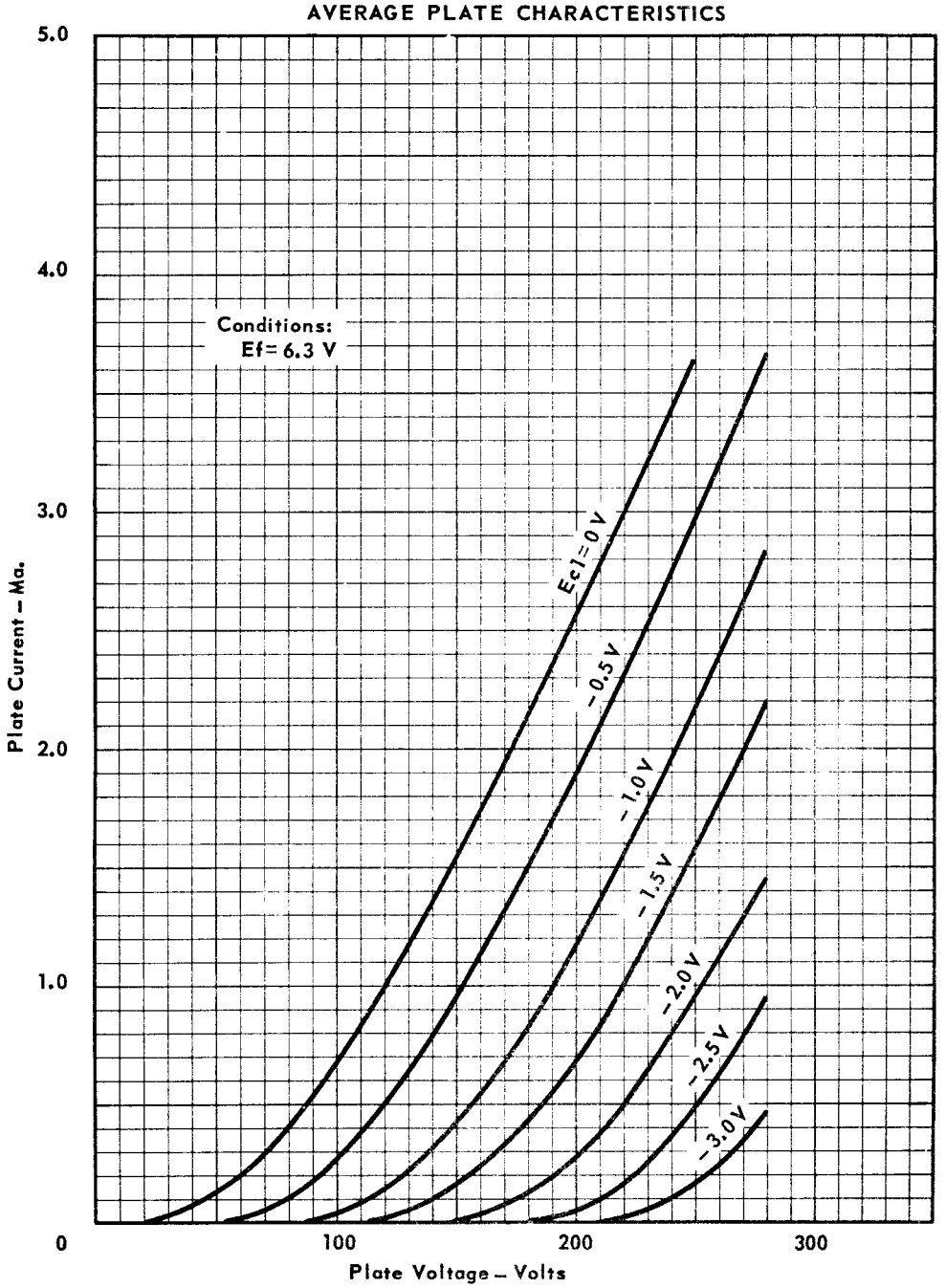


Max. Tolerance on Resistances to be 1%.

FIGURE 1

DOUBLE TRIODE

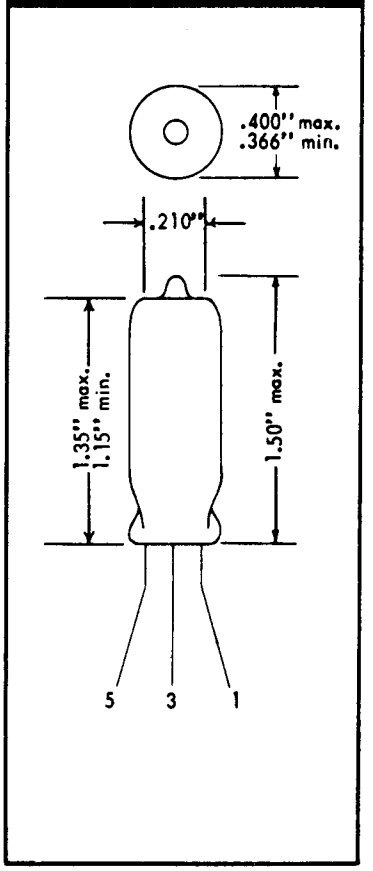
AVERAGE PLATE CHARACTERISTICS



TYPE CK5783WA

Excellence in Electronics

The CK5783WA is a cold-cathode, gas filled, glow-discharge diode of subminiature construction designed for use as a voltage reference tube in electronically regulated dc power supplies. It has an operating current range of 1.5 to 3.5 milliamperes over which it maintains a substantially constant operating voltage of 85 volts. Sudden voltage fluctuations of the CK5783WA are appreciably less than 0.005 volts within the rated operating current range and voltage drift is reduced by careful manufacturing processing. Two cathode leads are provided for use in circuits which serve to disconnect the load when the tube is removed from the socket. This type is characterized by long life and is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 3)	2.5 G
Maximum Bulb Temperature	165 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers. Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions more severe than those specified for life are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

RATINGS:	Ebb Vdc	Total Darkness Starting Voltage Vdc	Ambient Light Starting Voltage Vdc	Operating Voltage Range Vdc	Operating Current Range mAdc (Note 7)	Ambient Temperature °C (Note 7)	Bulb Temperature °C (Note 7)
Absolute:							
Maximum:	----	----	----	91	3.5	+150	+165
Minimum:	145	140	115	81	1.5	-55	----
Test Conditions:	150	----	----	----	----	25±5	----

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	AVERAGE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TEST – PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Ionization Voltage (1):	Rp/Ib = 1.5 – 3.5 mAdc Ambient Light	0.65	(1) Ez:	----	----	103	----	115	----	Vdc
Tube Voltage Drop (1):	Rp/Ib = 3.5 mAdc	0.65	(1) Etd:	83	----	86.3	----	88	----	Vdc
Tube Voltage Drop (2):	Rp/Ib = 1.5 mAdc	0.65	(2) Etd:	83	----	83.9	----	88	----	Vdc
Regulation:	(1) Etd – (2) Etd	0.65	Reg.:	----	----	2.4	----	3.0	----	Vdc
Voltage Jump:	Ebb/Ib = 1.5 – 3.5 mAdc; (Note 8)	0.65	Jump:	----	----	< 1.0	----	5.0	----	mVdc
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	(Note 9)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS – PART 2			**(Generally considered as Design Tests)**							
Ionization Voltage (2):	Rp/Ib = 1.5 – 3.5 mAdc Total Darkness	6.5	(2) Ez:	----	----	105	----	140	----	Vdc
Leakage:	Eb = 50 Vdc; Rp = 3000 ohms	6.5	Llb:	----	----	< 1	----	5	----	μAdc
Tube Voltage Drop (3):	Rp/Ib = 2.5 mAdc	6.5	(3) Etd:	83	----	85	----	86	----	Vdc
Noise:	Rp/Ib = 3.5 mAdc	1.0	EB:	----	----	< 1	----	5	----	mVac
Oscillation:	Esig = 5 mVac; RL = 500 ohms; Rp/Ib = 1.5 – 3.5 mAdc	1.0	----	----	----	----	----	----	----	----
Vibration:	Rp = 10,000; Ebb/Ib = 2.5 mAdc; F = 40 cps; G = 15	6.5	Ep:	----	----	< 1	----	20	----	mVac
Repeatability:	Rp/Ib = 2.5 mAdc (Note 5)	6.5	ΔEtd:	----	----	20	----	100	----	mVdc
DEGRADATION RATE ACCEPTANCE TEST										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock:	Hammer Angle = 30° (Note 2)	20	----	----	----	----	----	----	----	arcs
Fatigue:	G = 2.5; Fixed Frequency F = 25 min.; 60 max. (Note 3)	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration:	F = 40 cps; G = 15; Ebb/Ib = 2.5 mAdc; Rp = 10,000 ohms	----	Ep:	----	----	1	----	30	----	mVac
Ionization Voltage (1):	Rp/Ib = 1.5 – 3.5 mAdc	----	(1) Ez:	----	----	103	----	115	----	Vdc
Tube Voltage Drop (1):	Rp/Ib = 3.5 mAdc	----	(1) Etd:	83	----	86.3	----	88	----	Vdc
Tube Voltage Drop (2):	Rp/Ib = 1.5 mAdc	----	(2) Etd:	83	----	83.9	----	88	----	Vdc
Regulation:	(1) Etd – (2) Etd	----	Reg.:	----	----	2.4	----	3.0	----	Vdc
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	---

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	AVERAGE	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Combined Samples
ACCEPTANCE LIFE TESTS									
1 Hour Stability Life Test:	TA=Room; Rp/lb=2.5 mAdc	6.5	----	----	----	----	----		
1 Hour Stability Life Test End Points:	Typical Sample Size= 50 tubes	----	----	----	----	----	----		
Change in Tube Voltage Drop (3) of individual tubes	(Note 6)	----	Δ_t(3)Etd:	----	50	200	mVdc		
100 Hour Survival Rate Life Test:	TA=Room; Rp/lb= 2.5 mAdc	----	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	Typical Sample Size= 200 tubes	----	----	----	----	----	----		
(Inoperatives):		0.4	----	----	----	----	----		
Change in Tube Voltage Drop (3) of individual tubes:	(Note 6)	6.5	Δ_t(3)Etd:	----	100	500	mVdc		
Intermittent High Temperature Life Test:	T Bulb=155°C; Rp/lb= 2.5 mAdc	----	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	----	1	3
Regulation:		----	Reg:	----	2.5	4.0	Vdc	1	3
Tube Voltage Drop (1):		----	(1)Etd:	83	86.5	89	Vdc	1	3
Tube Voltage Drop (2):		----	(2)Etd:	83	84.0	89	Vdc	1	3
Tube Voltage Drop (3):		----	(3)Etd:	83	85.1	88	Vdc	1	3
Change in Tube Voltage Drop (3) of individual tubes:	(Note 6)	----	Δ_t(3)Etd:	----	----	2.0	Vdc	1	3
Ionization Voltage (1):		----	(1)EZ:	----	103	115	Vdc	1	3
Total Defectives:		----	----	----	----	----	----	2	3
1000 Hour Intermittent High Temperature Life Test End Points:	Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample	----	----	----	----	----	----	---	---
Inoperatives:		----	----	----	<1	----	----	3	4
Regulation:		----	Reg:	----	3.0	4.0	Vdc	3	4
Tube Voltage Drop (3):		----	(3)Etd:	83	85.5	88	Vdc	3	4
Change in Tube Voltage Drop (3) of individual tubes:	(Note 6)	----	Δ_t(3)Etd:	----	1.0	3.0	Vdc	3	4
Ionization Voltage (1):		----	(1)EZ:	----	103	115	Vdc	3	4
Total Defectives:		----	----	----	----	----	----	3	4

ELECTRICAL DATA (Cont'd.)

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 Basic Specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 Basic Specifications.

Note 4: Centrifuge Test with forces applied in any direction.

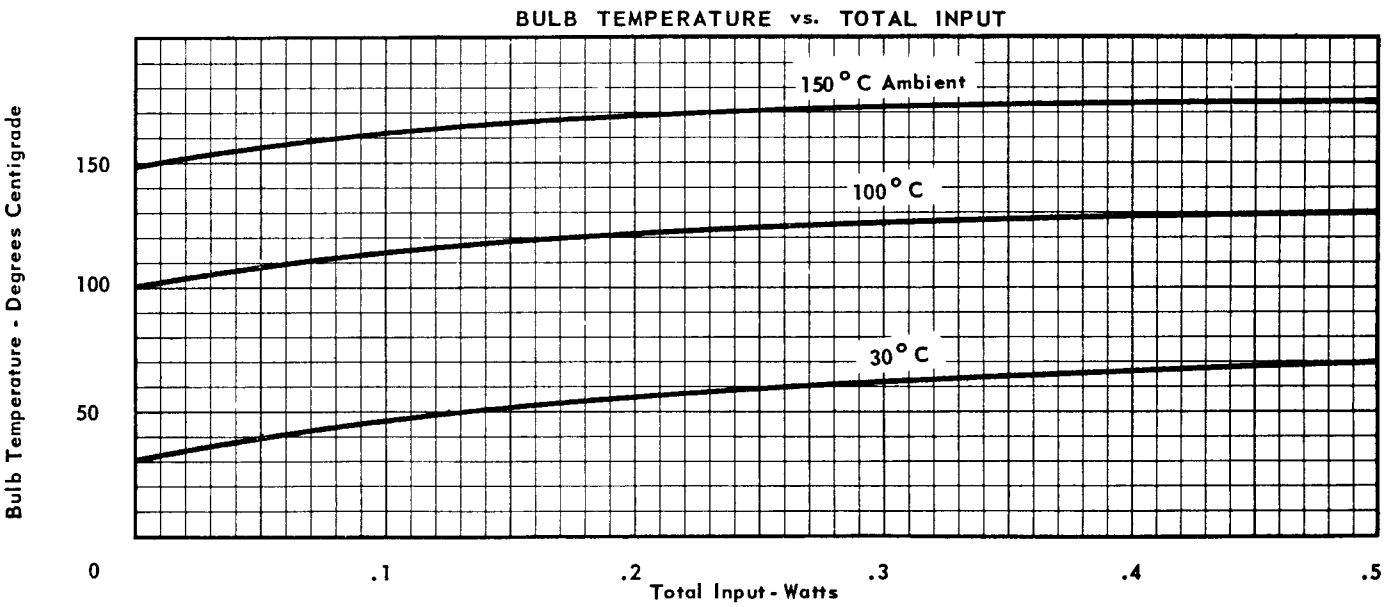
Note 5: Repeatability is the maximum shift in tube voltage drop between successive firings of the tube.

Note 6: ΔTube Voltage Drop is the change in individual tubes of tube voltage drop (3) from the beginning of life to its value at the specified life hour (s).

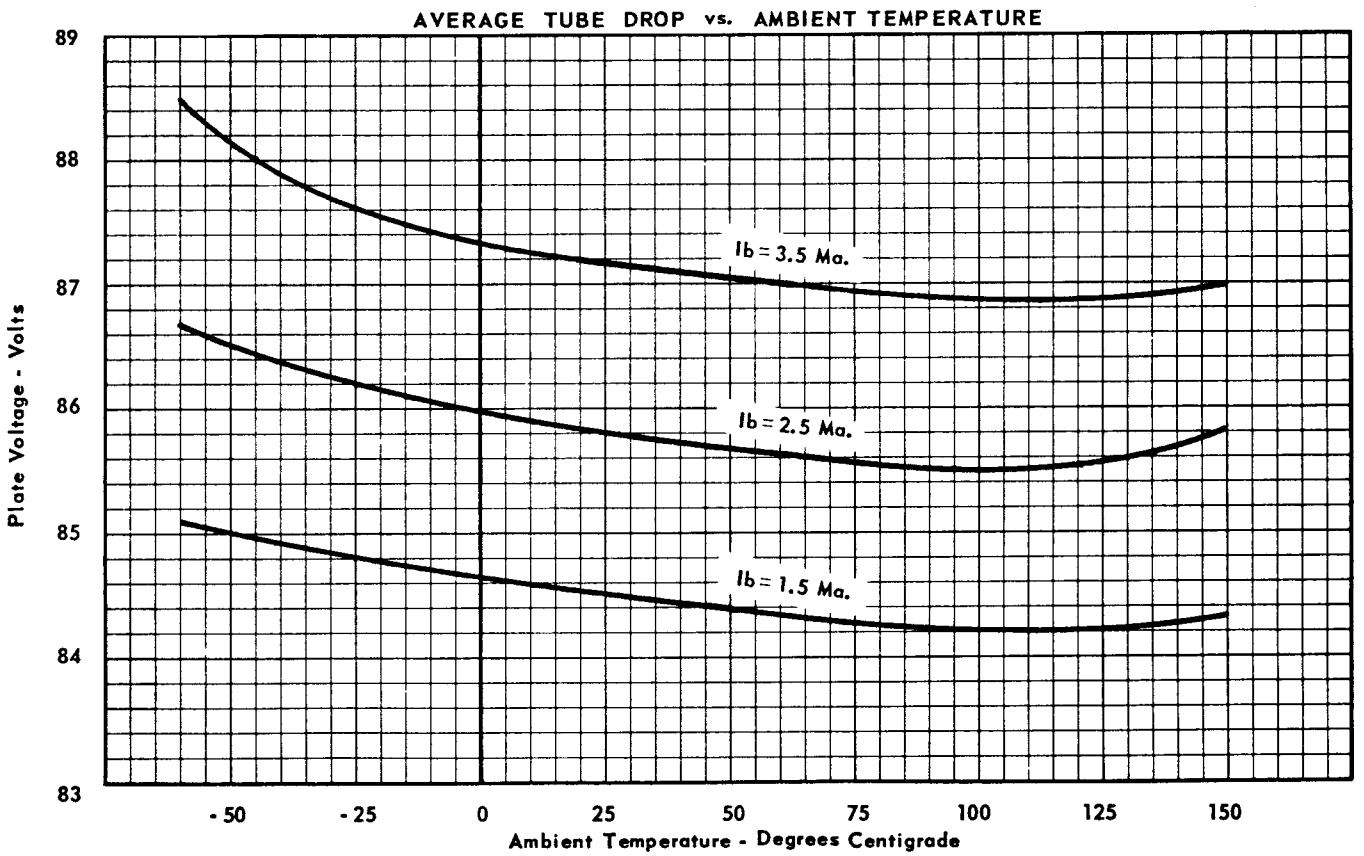
Note 7: Limits beyond which normal tube performance and tube life may be impaired.

Note 8: Sudden voltage jumps as measured on an oscilloscope connected across the tube, with the current through the tube varied slowly over its operating range, should be less than 5 mVdc.

Note 9: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by appendix B of Inspection Instructions for Electron Tubes.



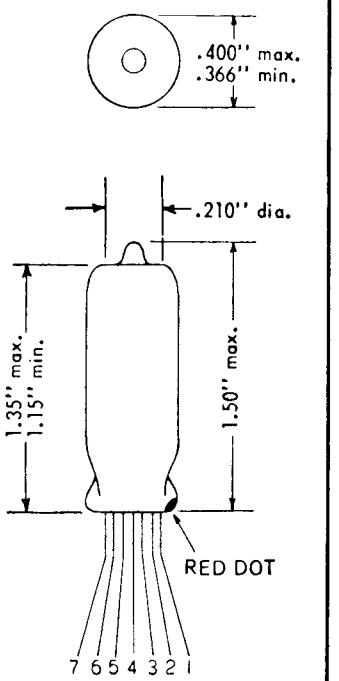
RELIABLE SUBMINIATURE GAS DIODE



Printed in U.S.A.

TYPE CK5784WB

The CK5784WB is a heater-cathode type pentode of subminiature construction capable of operation in the VHF region. The control grid and suppressor grid may be used as independent control electrodes for circuits such as gated amplifiers, mixers, and gain controlled amplifiers. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: (0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 5 Grid #1
Lead 2 Grid #2	Lead 6 Cathode
Lead 3 Heater	Lead 7 Grid #1
Lead 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test – Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test – Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test – Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	120	120	165	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Grid #2 Voltage	Ec2:	----	120	120	155	Vdc
Grid #3 Voltage	Ec3:	-55	0	0	30	Vdc
Plate Dissipation	Pp:	----	----	0.65	0.79	W
Grid #2 Dissipation	Pg2:	----	----	0.5	0.6	W
Grid #1 Circuit Resistance	Rg1:	----	----	1.0	1.2	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	v
Cathode Current	Ik:	----	----	----	16.5	mAdc
Grid #1 Current	Ic1:	----	----	----	1.0	mAdc
Grid #3 Current	Ic3:	----	----	----	0.2	mAdc
Cathode Resistance	Rk:	----	230	230	----	ohms
Plate Current (1)	Ib(1):	----	----	5.5	----	mAdc
Grid #2 Current	Ic2:	----	----	4.1	----	mAdc
Transconductance (1)	Sm(1):	----	----	3200	----	μmhos

Tentative Data

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.65	If:	190	----	200	----	210	----	mA
Heater – Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	5	----	μAdc
	Ehk = –100 Vdc		Ihk:	----	----	----	----	5	----	μAdc
Grid Current (1):		0.65	Ic1 (1):	----	----	----	----	–0.3	----	μAdc
Plate Current (1):		0.65	Ib (1):	3.9	4.8	5.5	6.2	7.1	2.5	mAdc
Transconductance (1):		0.65	Sm (1):	2650	2900	3200	3500	3950	900	μmhos
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (9–7) (Note 10)									
MEASUREMENTS ACCEPTANCE TEST PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg1-all = –100 Vdc Eg3–all = –100 Vdc Ep–all = –300 Vdc	2.5	Rg1-all: Rg3-all: Rp-all:	100 100 100	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	---- ---- ----	Meg. Meg. Meg.
Plate Current (2):	Ec3 = –10 Vdc (Note 14)	2.5	Ib (2):	----	----	----	----	200	----	μAdc
Plate Current (3):	Ec3 = –6 Vdc (Note 14)	2.5	Ib (3):	5	----	----	----	----	----	μAdc
Plate Current (4):	Ec1 = –9 Vdc	2.5	Ib (4):	----	----	----	----	200	----	μAdc
Plate Current (5):	Ec1 = –5 Vdc	2.5	Ib (5):	5	----	----	----	----	----	μAdc
Screen Current:		2.5	Ic2:	2.8	----	----	----	5.4	----	mAdc
Transconductance (2):	Ef = 5.7 V (Note 9)	2.5	Δ_{Ef}Sm(2):	----	----	----	----	10	----	%
Grid Emission:	Ef = 7.5 V; preheat 5 minutes at Ec1 = 0; Test at Ec1 = –10 Vdc	6.5	Ic1 (2):	----	----	----	----	–0.5	----	μAdc
AF Noise:	Esig = 70 mVac; Ec2 = 19 Vdc; Rg1 = 0.1 Meg; Rg2 = 1000 ohms; Rp = 0.2 Meg; Ck = 1000 μf	2.5	EB:	----	----	----	----	17	----	VU
Capacitance: Capacitance: Capacitance:	(Note 2)	6.5	Cg1p: Cin: Cout:	---- 3.5 2.8	---- ---- ----	---- 4.5 3.6	---- ---- ----	0.03 5.5 4.4	---- ---- ----	μμf μμf μμf
Transconductance (3):	Ec3 = –1.0 Vdc (Note 14)	6.5	Sg3–P:	400	----	----	----	1100	----	μmhos
Transconductance (4):	Ec3 = +22 Vdc (Note 14)	6.5	Sg3–P:	----	----	----	----	25	----	μmhos
Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mm Hg; Voltage = 300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	F = 40 cps; G = 15; Rp = 10,000 ohms	2.5	Ep:	----	----	----	----	75	----	mVac
Vibration (3):	F = 30–1000 cps; G = 15; Rp = 10,000 ohms; t = 3 minutes; positions X_1 and X_2 only	4.0	Ep:	----	----	----	----	300 peak to peak	----	mv
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk = +100 Vdc; Rg = 0.1 Meg. Hammer Angle = 30° (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 hours; G = 2.5; Fixed frequency; F = 25 min., 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 hours; G = 10; Fixed frequency; F = 25 min., 60 max. (Note 12)	6.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS								
Post Shock (1) and Fatigue Tests (1) and (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	125	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	20	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	15	%		
Grid Current (1):		----	Ic1 (1):	----	-1.0	μAdc		
Shock (2):	Ehk=+100 Vdc; Rg=0.1 Meg.; G=75; (hammer angle=120° + rubber pad); t=10 milliseconds duration (Note 13)	20	----	----	----	----		
Post Shock Test (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	125	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	20	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	15	%		
Grid Current (1):		----	Ic1 (1):	----	-1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycle:	Ef=7.5 V; Eb=Ec1=Ec2=Ec3=0V; Ehk=140 Vac; 1 min. on, 1 min. off.	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:								
Change in Transconductance (1) of individual tubes:	(Typical sample size=50 tubes)	1.0	Δ_tSm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical sample size=200 tubes)	----	----	----	----	----		
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	2400	----	μmhos		
Intermittent High Temperature Life Tests:	T Bulb=220°C; Ehk=+200 Vdc; Rg1=1.0 Meg.	----	----	----	----	----		

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	-0.6	μAdc	1	3
Heater Current:		----	If:	188	212	mA	1	3
Change in transconductance (1) of individual tubes:		----	Δ_tSm (1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm (2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5
Insulation of Electrodes:								
g1-all		----	Rg1-all:	50	----	Meg.		
g3-all		----	Rg3-all:	50	----	Meg.	2	5
p-all		----	Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg.Δ_tSm (1)	---	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	2	5
Heater Current:		----	If:	188	212	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_tSm (1):	----	25	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	15 15	μAdc μAdc	2	5
Total Defectives		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Wigh a cylindrical shield (0.405" I.D.-1 7/8" long) connected to lead 6.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specification.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

ELECTRICAL DATA (Cont'd)

NOTES (cont'd)

Note 8: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef= 6.3 V to that value measured at Ef= 5.7 V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes."

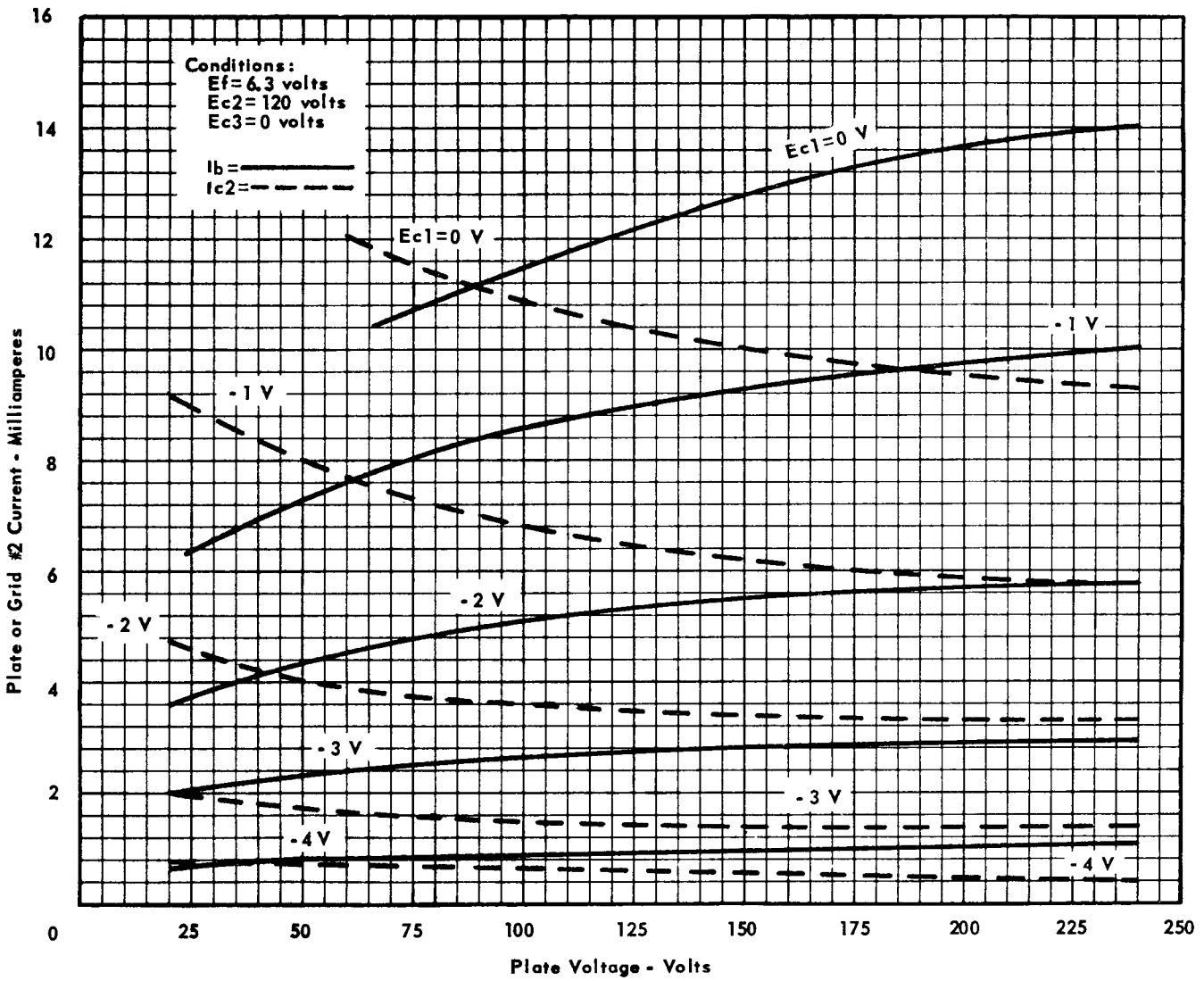
Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the three minute plate current (1) value using a cold tube. No preheating before this test will be allowed.

Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2 and Y1. Only rated heated voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.
(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.
(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

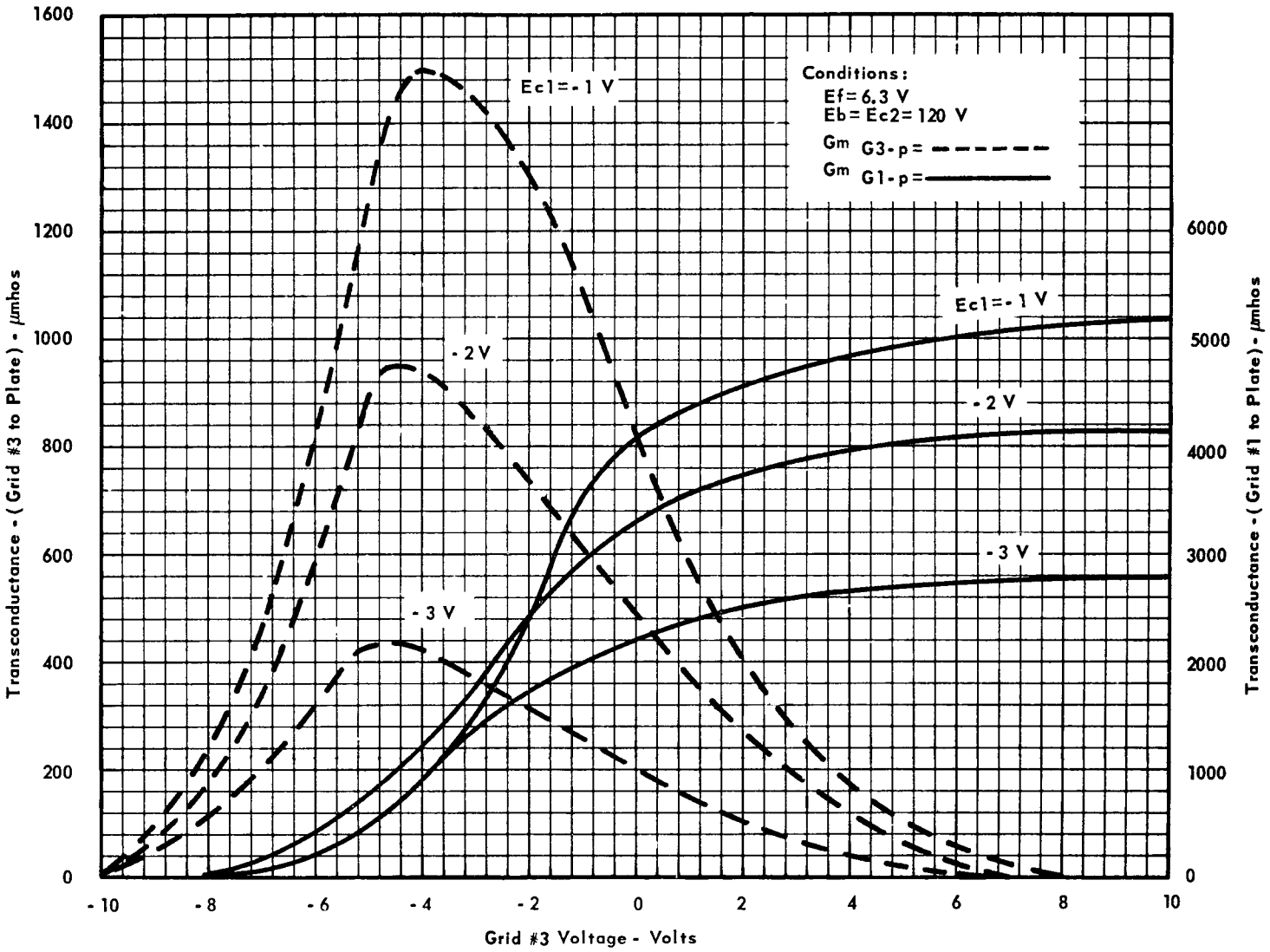
Note 13: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

Note 14: The reference point for Ec3, on this test, shall be the negative side of the cathode resistor.

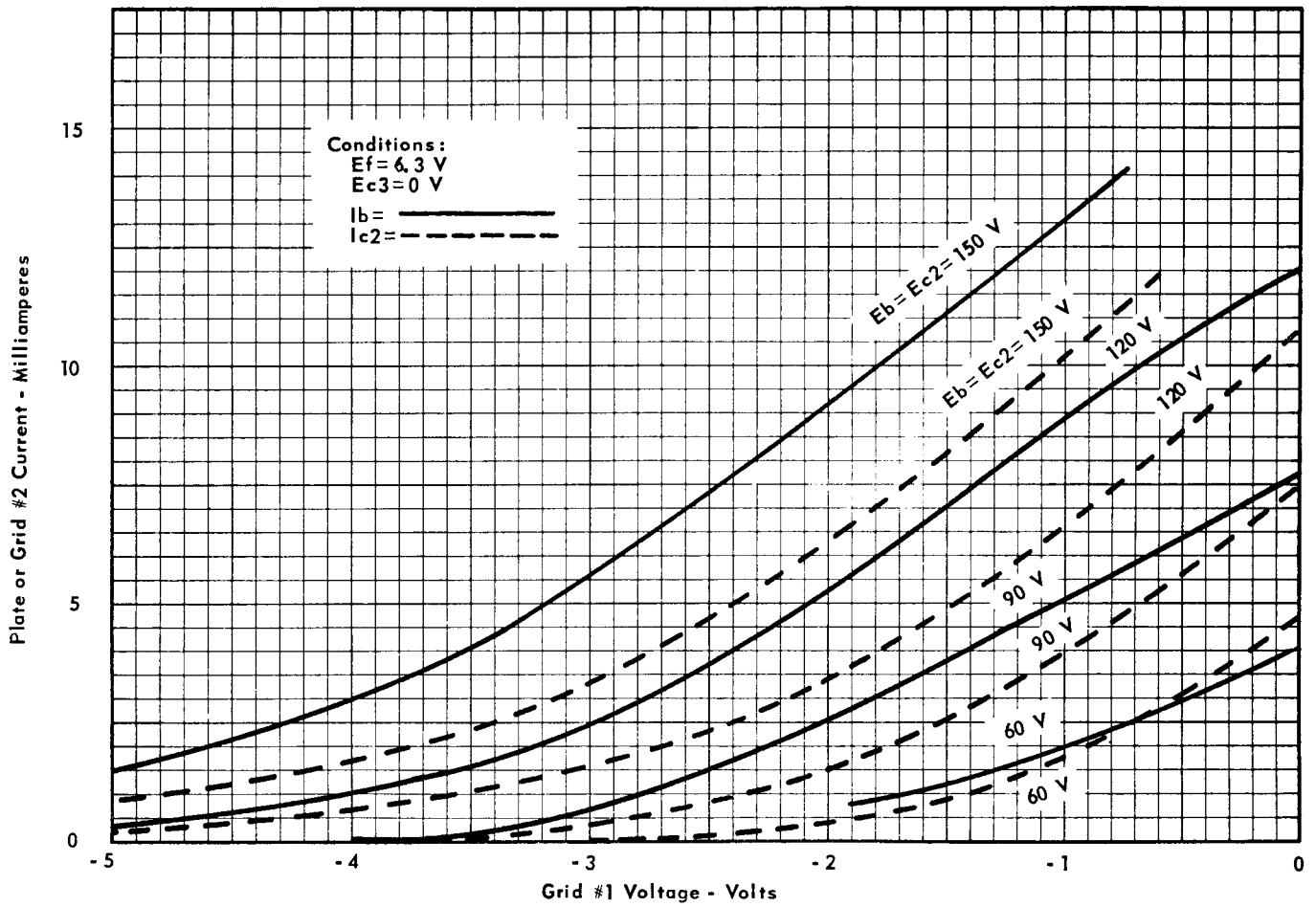
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS

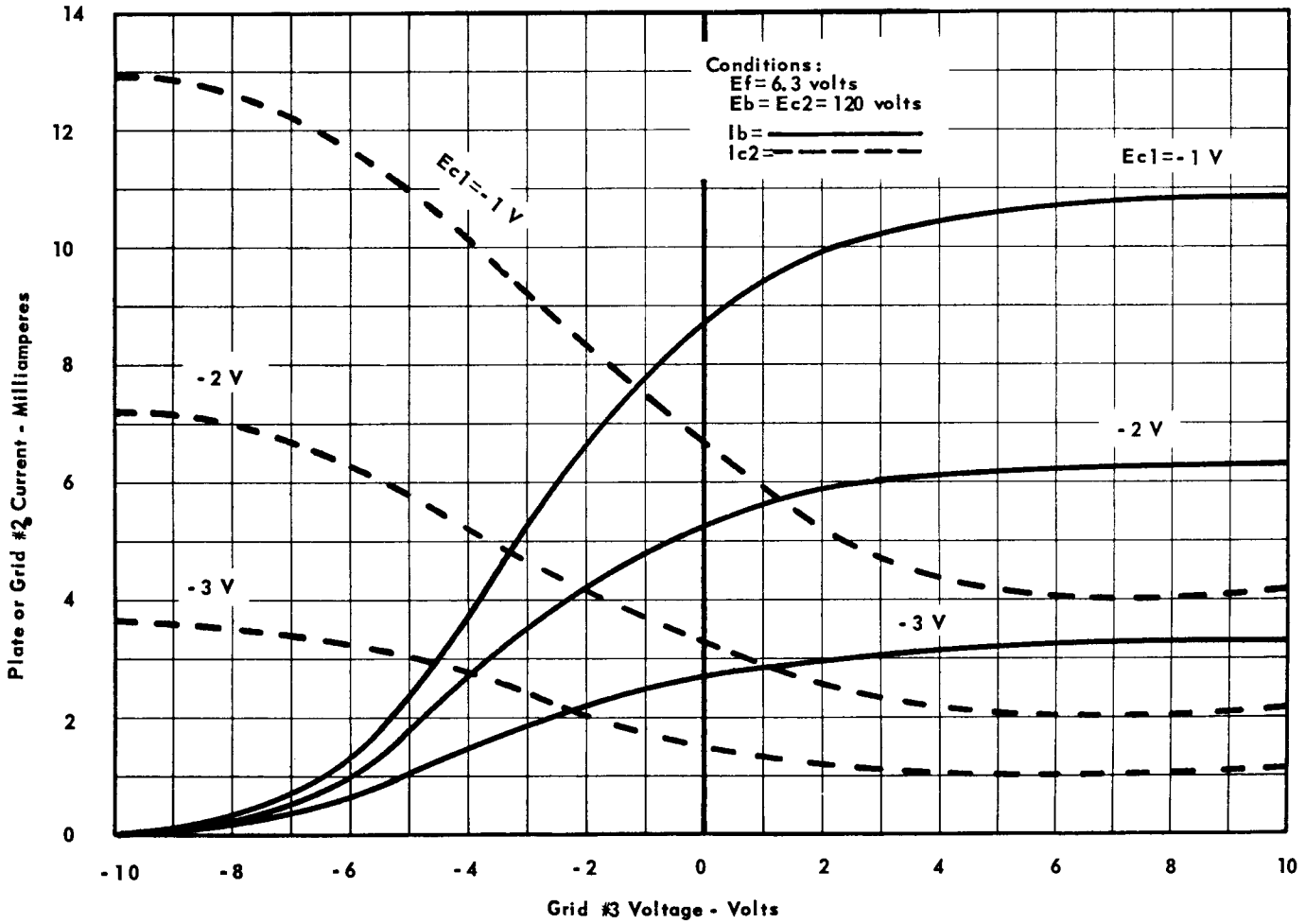


AVERAGE CHARACTERISTICS



RELIABLE SUBMINIATURE PENTODE

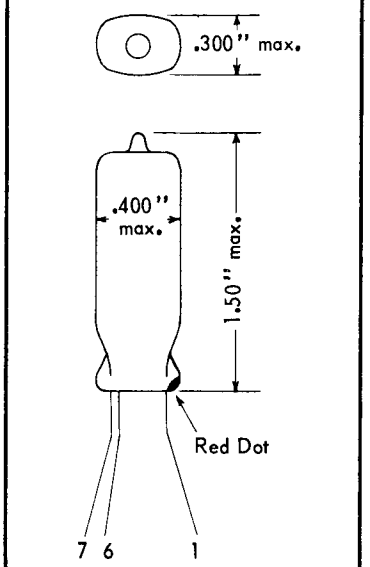
AVERAGE CHARACTERISTICS



Excellence in Electronics

TYPE CK5785

The CK5785 is a filament type diode rectifier of subminiature construction designed for use at comparatively high voltages and low currents. It is particularly suitable for use in battery operated power supplies for portable Geiger–Mueller counters. The low filament power and small tube size make the tube desirable where battery and space economy are important. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T–2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: Leads 1–6 0.240" center–to–center;
Leads 6–7 0.048" center–to–center.)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate
Lead 6 Filament, negative
Lead 7 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS – ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20%	volts
Peak Inverse Plate Voltage	4000	volts
Average Plate Current	100	μa.
Peak Plate Current (steady state) ♦	520	μa.
Maximum Plate Supply Voltage (Peak)	2300	volts
Minimum Plate Supply Impedance	1	megohm
Peak Plate Current (surge) ♦	2.5	ma.

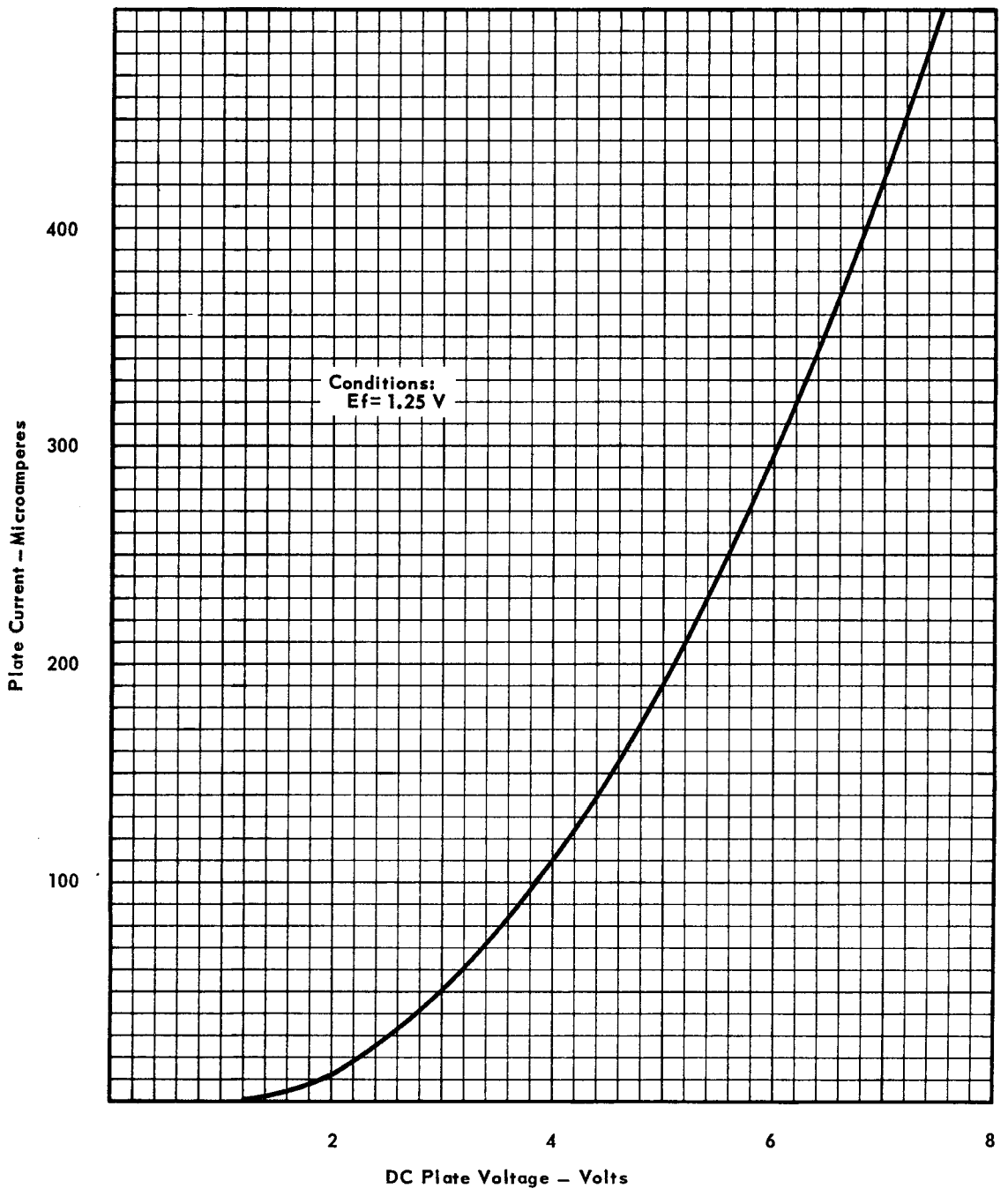
CHARACTERISTICS AND TYPICAL OPERATION – HALF-WAVE RECTIFIER: ▲

Filament Voltage (dc)	1.25	volts
Filament Current	15	ma.
Plate Supply Voltage (RMS Sinisoidal Wave Form)	1625	volts
Plate Supply Impedance	1.02	megohms
Load Current (dc)	80	μa.
Load Condenser	.01	μf
Load Resistor	20	megohms
DC Output Voltage	1600	volts
Tube Drop (approx.) at 500 μa.	7.5	volts
250 μa.	5.5	volts
80 μa.	3.5	volts

♦ *To avoid damage to the equipment or tube, it is recommended that the plate supply impedance be adjusted to limit forward and surge current to the stated value. Minimum resistance is 1 megohm minus the effective equivalent transformer impedance, but never less than 980,000 ohms dc resistance.*

▲ *60 cycle operation.*

AVERAGE PLATE CHARACTERISTICS



from RMA release #838
March 15, 1950

RAYTHEON®

TYPE 5787

SUBMINIATURE GAS DIODE

DESCRIPTION

The 5787 is a cold cathode, gas-filled diode of subminiature construction, designed for service as a voltage regulator. It has an operating current range of 5 to 25 ma. over which it maintains a substantially constant operating voltage of 100 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL DATA

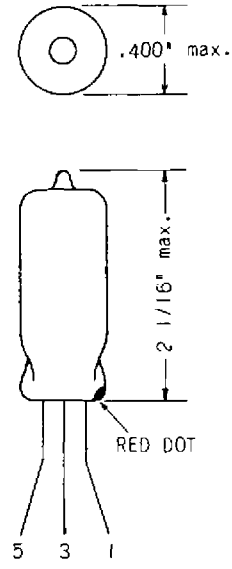
ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.10" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MOUNTING POSITION: Any



ELECTRICAL DATA

RATINGS:

DC Anode Supply Voltage *	145	volts
DC Operating Current (continuous)	5 to 25	ma.
Ambient Temperature Range	-55 to +90	°C

CHARACTERISTICS AND TYPICAL OPERATION:

DC Starting Voltage (approx)	135	volts
DC Operating Voltage (approx)	100	volts
DC Operating Current	5 to 25	ma.
Regulation (5 to 25 ma.)	3	volts

* *Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.*

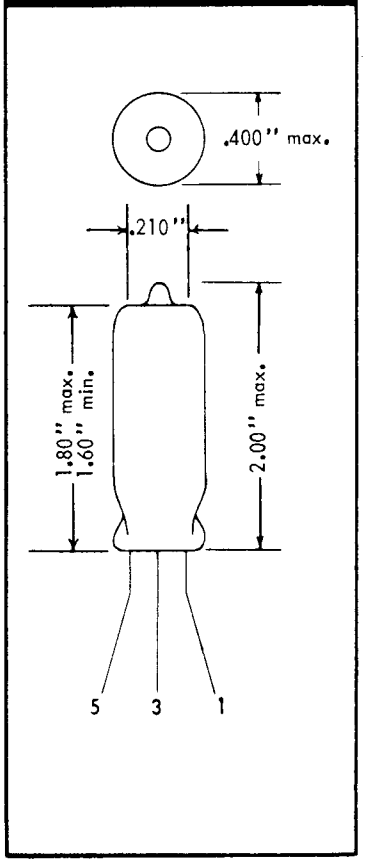
RAYTHEON

TECHNICAL INFORMATION

RELIABLE SUBMINIATURE GAS DIODE

Excellence in Electronics

TYPE CK5787WA



The CK5787WA is a cold cathode, gas-filled diode of subminiature construction designed for service as a voltage regulator. It has an operating current range of 5 to 25 milliamperes over which it maintains a substantially constant operating voltage of approximately 98 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered, or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test---Note 2)	450 G
Maximum Uniform Acceleration (Centrifuge Test---Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test---Note 3)	2.5 G
Maximum Bulb Temperature	225 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electronic Equipment Design Engineers. Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions more severe than those specified for life are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

RATINGS

	Ebb Vdc	Total Darkness Starting Voltage Vdc	Ambient Light Starting Voltage Vdc	Operating Voltage Range Vdc	Operating Current Range mAdc (Note 6)	Ambient Temperature °C (Note 6)	Bulb Temperatu °C (Note 6)
Absolute:							
Maximum:	----	----	----	103	25	+150	+225
Minimum:	155	150	135	95	5	–55	----

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	AVERAGE	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TEST – PART 1						(Combined AQL = 1.0% excluding Mechanical and Inoperatives)				
Ionization Voltage (1):	Rp/Ib = 5 – 25 mAdc Ambient Light	0.65	(1)Ez:	----	----	122	----	135	----	Vdc
Tube Voltage Drop (1):	Rp/Ib = 25 mAdc	0.65	(1)Etd:	95	----	98	----	101	----	Vdc
Tube Voltage Drop (2):	Rp/Ib = 5 mAdc	0.65	(2)Etd:	95	----	97	----	101	----	Vdc
Regulation:	(1)Etd – (2)Etd	0.65	Reg.:	----	----	1.0	----	3.0	----	Vdc
Continuity and Shorts: (Inoperatives)		0.4	-----	----	----	----	----	----	----	----
Mechanical:	Note 7									

Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION
RAYTHEON MANUFACTURING COMPANY
55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	AVERAGE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS—PART 2			**(Generally considered as Design Tests)**							
Ionization Voltage (2):	Rp/Ib=5—25 mAdc Total Darkness	6.5	(2)Ez:	----	----	125	----	150	----	Vdc
Leakage:	Eb=50 Vdc; Rp=3000 ohms	6.5	Llb:	----	----	<1	----	5	----	μAdc
Noise:	Ebb/Ib=25 mAdc	1.0	Eb:	----	----	<1	----	5	----	mVac
Oscillation:	Esig=5 mVac; RL=500 ohms; Rp/Ib=5—25 mAdc	1.0	----	----	----	----	----	----	----	----
Vibration:	Rp=10,000; Ebb/Ib=25 mAdc; F=40 cps; G=15	6.5	Ep:	----	----	<1	----	20	----	mVac
Repeatability:	Rp/Ib=10 mAdc (Note 5)	6.5	ΔEtd:	----	----	0.1	----	1.0	----	Vdc
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock:	Hammer Angle=30°; (Note 2)	20	----	----	----	----	----	----	----	----
Fatigue:	G=2.5; Fixed Frequency F=25 min., 60 max.	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration:	F=40 cps; G=15; Ebb/Ib=25 mAdc; Rp=10,000 ohms	----	Ep:	----	----	<1	----	30	----	mVac
Ionization Voltage (1):	Rp/Ib=5—25 mAdc	----	(1)Ez:	----	----	122	----	135	----	Vdc
Tube Voltage Drop (1):	Rp/Ib=25 mAdc	----	(1)Etd:	95	----	99	----	105	----	Vdc
Tube Voltage Drop (2):	Rp/Ib=5 mAdc	----	(2)Etd:	95	----	98	----	105	----	Vdc
Regulation:	(1) Etd—(2) Etd	----	Reg:	----	----	1	----	4.0	----	Vdc
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS										
1 Hour Stability Life Test:	TA=Room; Rp/Ib=25 mAdc	6.5	----	----	----	----	----	----	----	----
1 Hour Stability Life Test End Points:	(Typical Sample Size=50 tubes)	----	----	----	----	----	----	----	----	----
Change in Tube Voltage Drop (1) of individual tubes:		----	Δ_t(1)Etd:	----	----	0.3	----	1.0	----	Vdc
Change in Tube Voltage Drop (2) of individual tubes:		----	Δ_t(2)Etd:	----	----	0.3	----	1.0	----	Vdc
100 Hour Survival Rate Life Test:	TA=Room: Rp/Ib=25 mAdc	----	----	----	----	----	----	----	----	----
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----	----	----	----	----
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Change in Tube Voltage Drop (1) of individual tubes:		6.5	Δ_t(1)Etd:	----	----	0.3	----	1.0	----	Vdc
Change in Tube Voltage Drop (2) of individual tubes:		6.5	Δ_t(2)Etd:	----	----	0.3	----	1.0	----	Vdc
500 Hour Intermittent High Temperature Life Test:	T Bulb=225°C; Rp/Ib=25 mAdc	----	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	AVERAGE	MAX	MIL-E-1 UNITS	Allowable Defect per Characteristic 1st Sample	Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)									
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	----	1	3
Regulation:		----	Reg.:	----	2.0	4.0	Vdc	1	3
Tube Voltage Drop (1):		----	(1) Etd:	95	99	103	Vdc	1	3
Tube Voltage Drop (2):		----	(2) Etd:	95	97	103	Vdc	1	3
Change in Tube Voltage Drop (1) of individual tubes:		----	Δ_t (1) Etd:	----	1.0	2.5	Vdc	1	3
Change in Tube Voltage Drop (2) of individual tubes:		----	Δ_t (2) Etd:	----	1.0	2.5	Vdc	1	3
Ionization Voltage (1):		----	(1) EZ:	----	122	135	Vdc	1	3
Total Defectives:		----	----	----	----	----	----	2	3
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	---	---
Inoperatives:		----	----	----	<1	----	----	2	4
Regulation:		----	Reg.:	----	2.5	4.0	Vdc	2	4
Tube Voltage Drop (1):		----	(1) Etd:	95	99.5	103	Vdc	2	4
Tube Voltage Drop (2):		----	(2) Etd:	95	97	103	Vdc	2	4
Change in Tube Voltage Drop (1) of individual tubes:		----	Δ_t (1) Etd:	----	1.5	3.0	Vdc	2	4
Change in Tube Voltage Drop (2) of individual tubes:		----	Δ_t (2) Etd:	----	1.5	3.0	Vdc	2	4
Ionization Voltage (1):		----	(1) EZ:	----	122	135	----	2	4
Total Defectives:		----	----	----	----	----	----	3	4

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 Basic Specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 Basic Specifications.

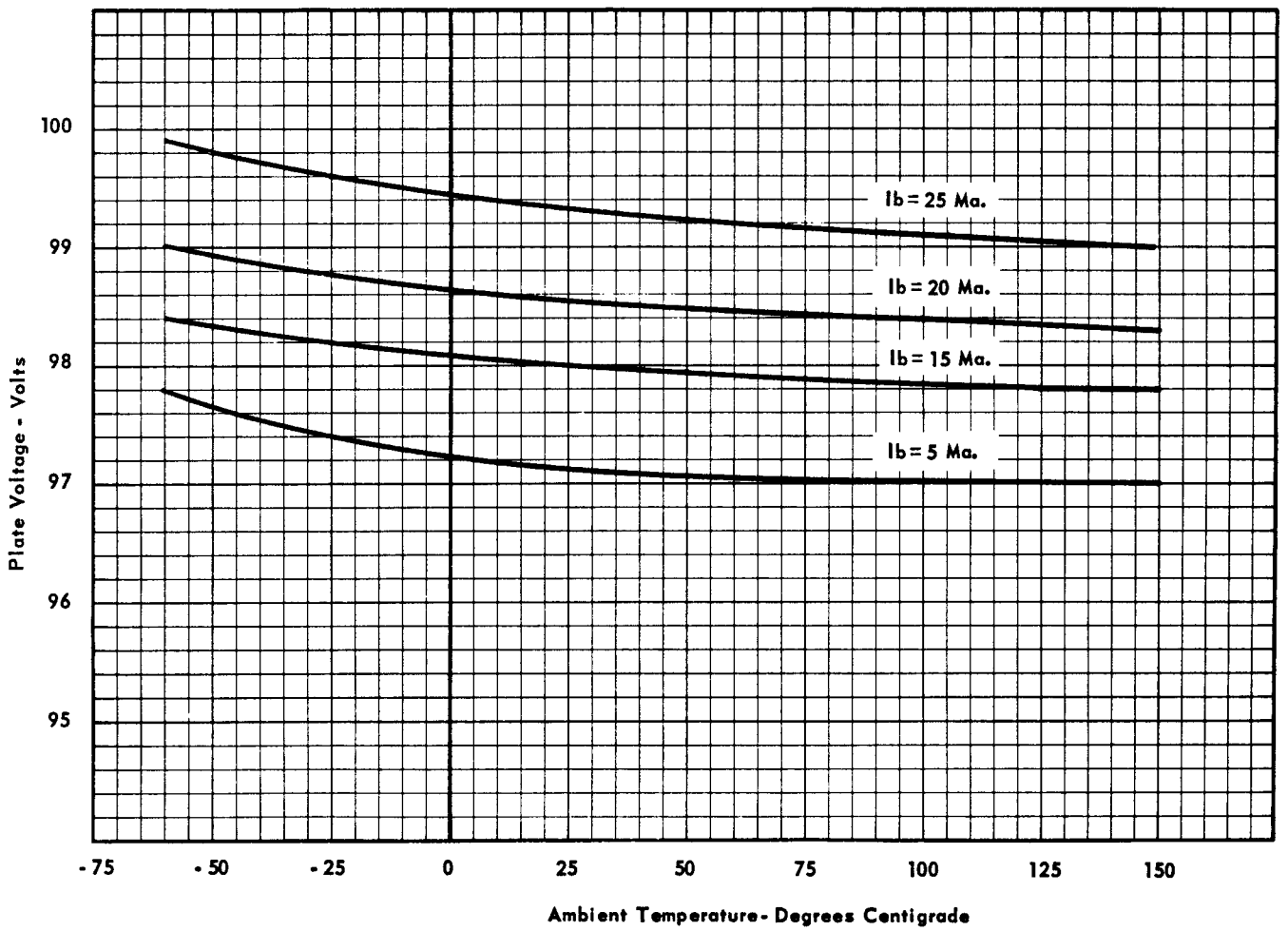
Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Repeatability is the maximum shift in tube voltage drop between successive firings of the tube.

Note 6: Limits beyond which normal tube performance and tube life may be impaired.

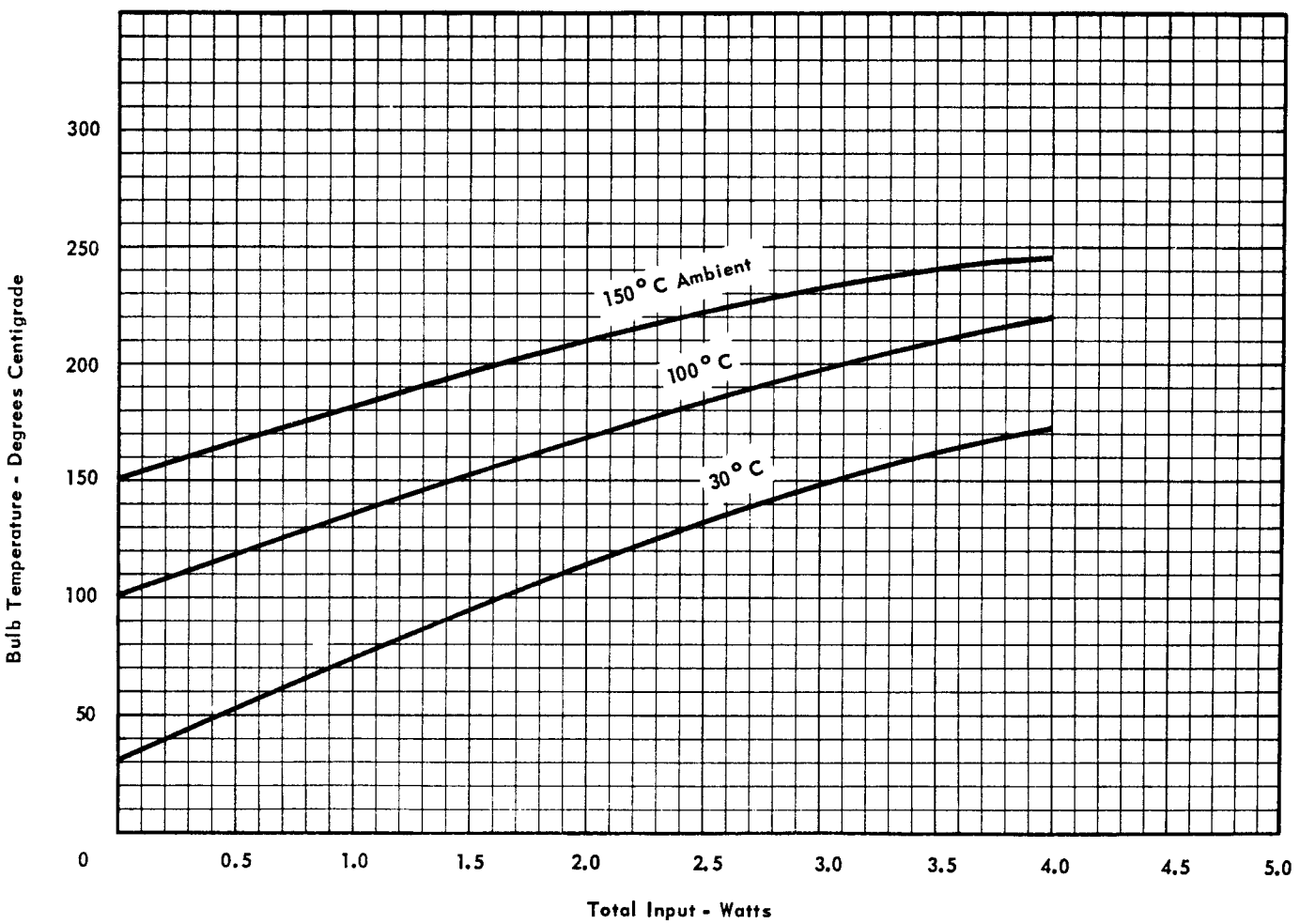
Note 7: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by appendix B of Inspection Instructions for Electron Tubes.

AVERAGE TUBE DROP vs. AMBIENT TEMPERATURE



RELIABLE SUBMINIATURE GAS DIODE

BULB TEMPERATURE vs. TOTAL INPUT



Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

October 15, 1957 NEWTON 58, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5814WA

DOUBLE TRIODE

ENVELOPE.....T-6½ Glass
BASE....Miniature Button 9-Pin
MOUNTING POSITION.....Any

The 5814WA is a heater-cathode type medium-Mu double triode of miniature construction designed for use in general purpose amplifier, oscillator, and multivibrator applications. It employs separate cathode connections and a heater center-tap permitting either series or parallel operation. The 5814WA is similar in characteristics to the type 12AU7 and is intended for use in applications requiring a tube of sturdy, shock resistant design to withstand rugged service conditions.

MECHANICAL RATINGS:

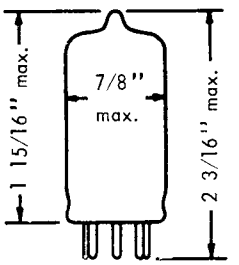
Maximum Impact Acceleration (Shock Test-Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 3)	2.5 G
Maximum Bulb Temperature	165 °C

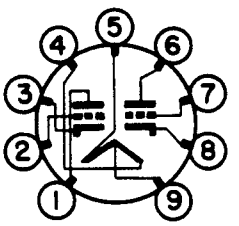
ELECTRICAL DATA

CAUTION - To electronic equipment design engineers: Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

Ratings and Normal Operation	MIL-E-1 Symbol	Absolute Minimum	Normal Test Conditions (Note 5)	Normal Operation (Note 4)		Absolute Maximum	MIL-E-1 Units
Heater Voltages (Note 6)	Ef	Series 11.4	12.6	12.6	12.6	13.8	V
		Parallel 5.7		6.3	6.3	6.9	V
Plate Voltage	Eb	---	250	100	250	330	Vdc
Grid Voltage	Ec1	---	-8.5	0	-8.5	---	Vdc
Plate Dissipation	Pp/p	---	---	1.18	2.62	3.0	W
Heater-Cathode Voltage	Ehk	-200	---	---	---	+200	Vdc
Plate Current (Note 8)	Ib/p	---	---	11.8	10.5	22	mAdc
Grid Circuit Resistance	Rg/g	---	---	1.0	0.25	---	Meg.

PHYSICAL DIMENSIONS





BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2
Pin 2 Grid, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Heater
Pin 5 Heater
Pin 6 Plate, Unit #1
Pin 7 Grid, Unit #1
Pin 8 Cathode, Unit #1
Pin 9 Heater Center-Tap

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

In the following tests, each unit is tested separately.

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1 UNITS
ACCEPTANCE TEST - GROUP C										
Continuity and Short:		0.4	---	---	---	---	---	---	---	---
ACCEPTANCE TEST - GROUP D	**Combined AQL = 1.0%**									
Heater Current:		0.65	If:	160	---	175	---	190	---	mA
Heater Cathode Leakage:	Ehk = 100 Vdc Heater Positive	0.65	Ihk:	---	---	---	---	10	---	μAdc
	Ehk = 100 Vdc Heater Negative		Ihk:	---	---	---	---	10	---	μAdc
	Units connected in parallel									
Grid Current (1):	Rg = 0.5 Meg.	0.65	Ic(1):	---	---	---	---	-0.5	---	μAdc
Plate Current (1):		0.65	Ib(1):	6.5	9.0	10.5	12.0	14.5	3.5	mAdc
Transconductance (1):		0.65	Sm(1):	1750	2000	2200	2400	2650	450	μmhos
ACCEPTANCE TESTS - GROUP E										
Insulation of Electrodes:	Ef = 12.6 V Eg-all = -100 Vdc	2.5	Rg-all:	500	---	---	---	---	---	Meg.
	Ep-all = -300 Vdc		Rp-all:	500	---	---	---	---	---	Meg.
Plate Current (2):	Ec = -25 Vdc	2.5	Ib(2):	---	---	---	---	20	---	μAdc
Plate Current (3):	Ec = -18 Vdc	2.5	Ib(3):	5	---	---	---	---	---	μAdc
Transconductance (2):	Ef = 11.4 V (Note 7)	2.5	ΔSm(2):	---	---	---	---	15	---	%
Grid Current (2):	After 5 minutes at Ef = 14.0 V; measure Grid Current at Ef = 14.0 V; 3 minutes test not permitted	2.5	Ic(2):	---	---	---	---	-1.5	---	μAdc
RF Noise:	Ec = -9 Vdc; Ecal = 7.0 mVac; Units connected in parallel	2.5		---	---	---	---	3.0	---	mW
Noise and Microphonics:	Ef = 12.6 Vac; Ebb = 300 Vdc; Ec = 0; Rp = 50,000 ohms: Units connected in parallel Rk = 1500 ohms	2.5	Ep:	---	---	---	---	50	---	mVac
Plate Current (1): Difference between sections		2.5	Δlb(1):	---	---	---	---	3.5	---	mAdc
ACCEPTANCE TESTS - GROUP F										
Vibration (2):	F = 25 cps; G = 2.5; Rp = 2000 ohms Units connected in parallel	6.5	Ep:	---	---	---	---	100	---	mVac
Transconductance (3):	Eb = 100 Vdc; Ec = 0	6.5	Sm(3):	2500	2775	3100	3425	3700	750	μmhos
Amplification Factor:		6.5	Mu:	15.5	16.2	17.0	17.8	18.5	1.8	---
Low Pressure Voltage Breakdown:		6.5	---	500	---	---	---	---	---	Vac

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd.)

In the following tests, each unit is tested separately.

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1 UNITS
ACCEPTANCE TESTS-GROUP A										
Shock:	Hammer angle=30°; Note 2									
Fatigue:	96 hours; Note 3									
Post Shock and Fatigue Test End Points:										
Vibration (2):	F=25 cps; G=2.5; Rp=2000 ohms; Units connected in parallel		Ep:	---	---	---	---	150	---	mVac
Heater-Cathode Leakage:	Ehk=+100 Vdc		Ihk:	---	---	---	---	30	---	μAdc
	Ehk=-100 Vdc Units connected in parallel		Ihk:	---	---	---	---	30	---	μAdc
Transconductance (3):	Eb=100 Vdc; Ec1=0		Sm(3):	2000	---	---	---	---	---	μmhos
Grid Current (1):			Ic(1):	---	---	---	---	-1.5	---	μAdc
ACCEPTANCE TESTS-GROUP B										
Glass Strain:		2.5	---	---	---	---	---	---	---	---

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS	Maximum Defects per Characteristics 1 st Sample	Combined Samples
ACCEPTANCE LIFE TEST								
Heater Cycling	Ef=7.5 V; Ehk=+135 Vdc; Eb=Ec=0; 1 min. on, 1 min. off	---	---	2000	---	Cycles	---	---
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Heater Positive	---	Ihk:	---	20	μAdc	---	---
	Heater Negative		Ihk:	---	20	μAdc	---	---
1 Hour Stability Life Test:	TA=room; Ehk=+135 Vdc; Rg=0.5 Meg.							
1 Hour Stability Life Test End Points:								
Transconductance (1) change of individual tubes from initial:	(Typical sample size=50 tubes)	1.0	ΔSm(1):	---	10	%	---	---
100 Hour Survival Rate Life Test:	TA=room; Ehk=+135 Vdc; Rg1=0.5 Meg.							
100 Hour Survival Rate Life Test End Points:								
Inoperatives:	(Typical Sample Size=200 tubes)	0.65	---	---	---	---	---	---

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd.)

In the following tests, each unit is tested separately.

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1	Maximum Defects per Characteristics 1st Sample	Maximum Defects per Characteristics Combined Samples
500 and 1000 Hour Intermittent High Temperature Life Test:	T Bulb=165 °C; Ehk=+135 Vdc; Rg1=0.5 Meg.							
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Sizes=20 tubes 1 st sample, 40 tubes 2nd sample, Total allowable combined defects=4 tubes 1 st sample, 8 tubes 1 st and 2nd samples)							
Inoperatives:		---	---	---	---	---	1	3
Heater Current:		---	If:	160	190	mA	1	3
Heater-Cathode Leakage:		---	Ihk:	---	10	μAdc	1	3
Grid Current (1):		---	Ic(1):	0	–0.5	μAdc	1	3
Transconductance (1)		---	Sm(1):	1600	2650	μmhos	1	3
Transconductance (1) Average change (Note 9)		---	Avg. ΔtSm(1):	---	15	%	---	---
Electrode Insulation: (g-all)		---	Rg-all:	50	---	Meg.	2	5
(p-all)		---	Rp-all:	50	---	Meg.		
Transconductance (2)	(Note 7)	---	ΔEfSm(2):	---	15	%	2	5
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)							
Inoperatives:		---	---	---	---	---	2	5
Heater Current:		---	If:	160	190	mA	2	5
Heater-Cathode Leakage:		---	Ihk:	---	10	μAdc	2	5
Grid Current (1):		---	Ic(1):	0	–0.5	μAdc	2	5
Transconductance (1):		---	Sm(1):	1500	2650	μmhos	2	5

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

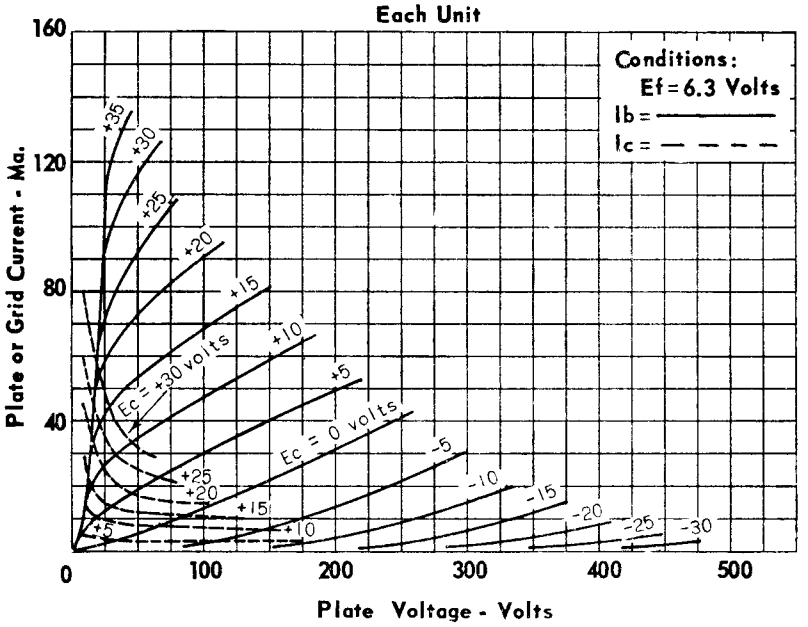
Note 7: Change of transconductance for individual tubes from that value measured at Ef=12.6 V to that value measured at Ef=11.4 V.

Note 8: Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

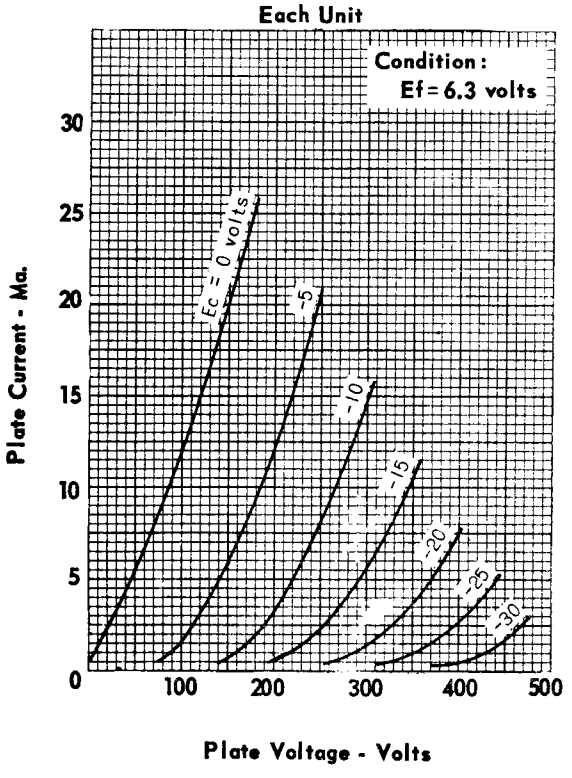
Note 9: The average percentage change shall be ascertained from the determination of the individual changes for each tube (inoperatives excluded) from the zero hour value for the referenced characteristic.

DOUBLE TRIODE

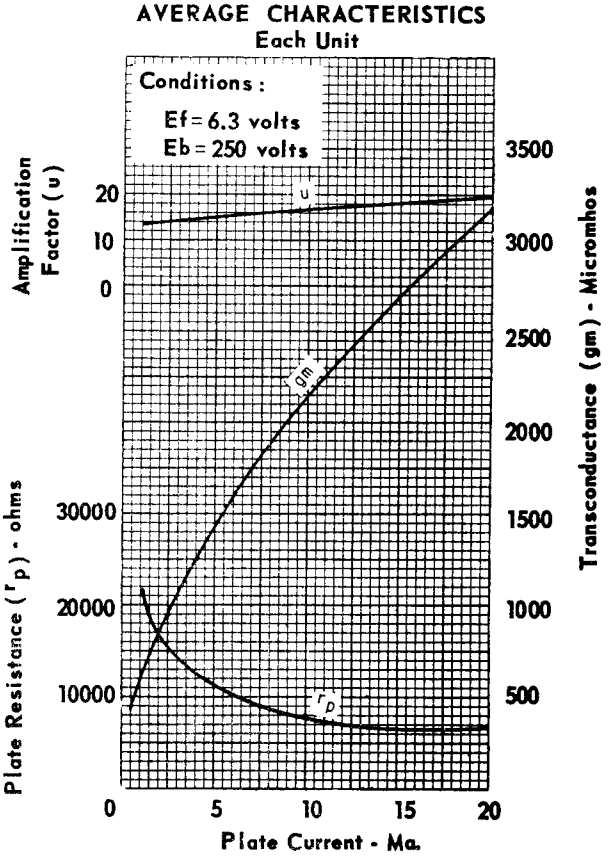
AVERAGE PLATE CHARACTERISTICS
Each Unit



AVERAGE PLATE CHARACTERISTICS
Each Unit



AVERAGE CHARACTERISTICS
Each Unit



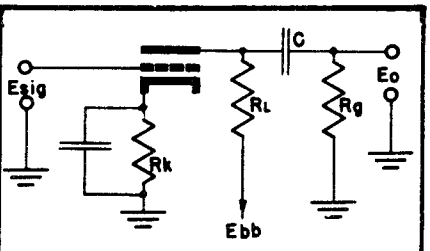
5814WA

DOUBLE TRIODE

RESISTANCE - COUPLED AMPLIFIER CHART
(One Triode Unit)

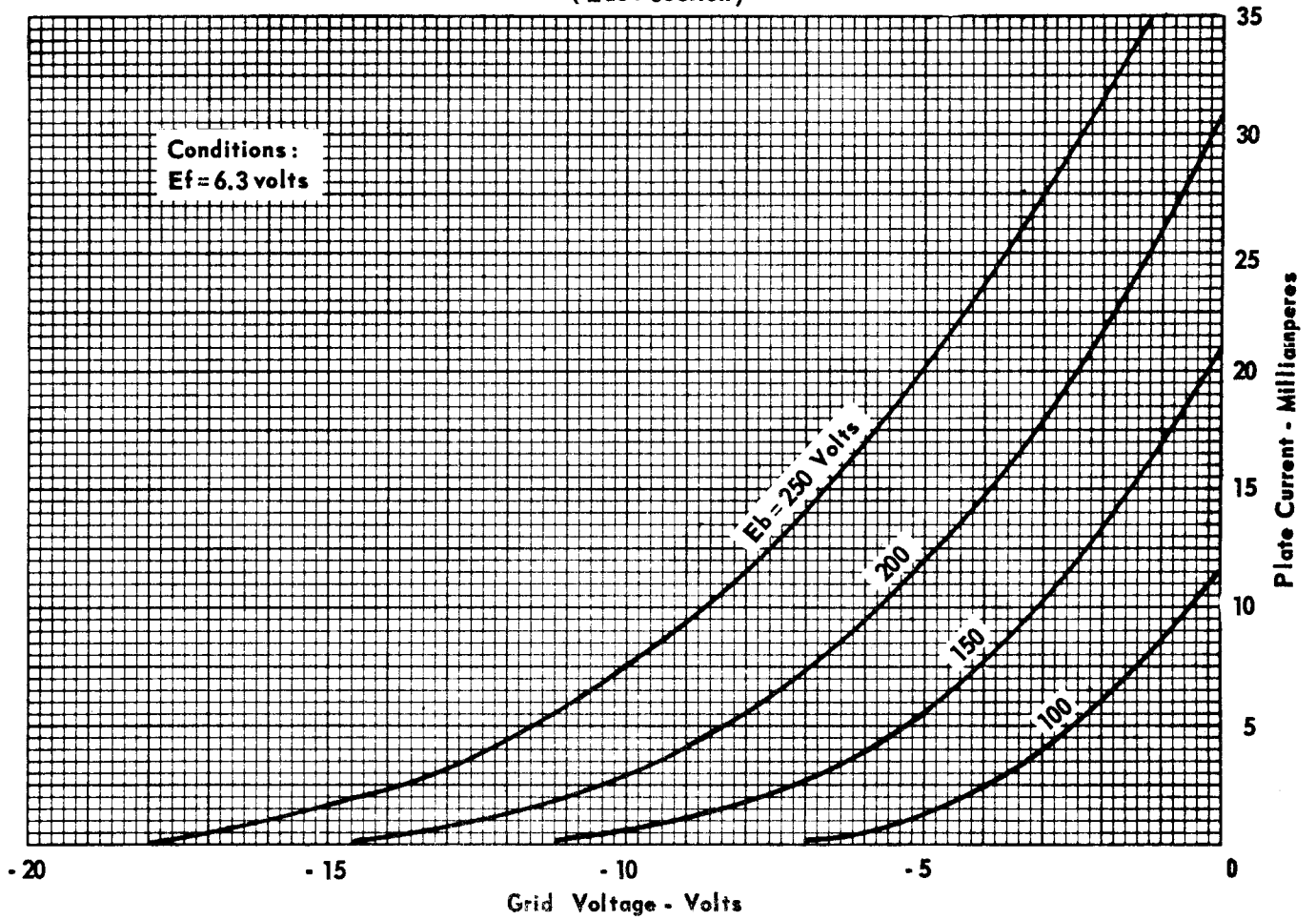
		Ebb = 90 Volts			Ebb = 180 Volts			Ebb = 300 Volts		
R_L	Rg*	Rk	Eo	Gain+	Rk	Eo	Gain+	Rk	Eo	Gain+
.047	.047	1600	9	10 a	920	20	11	870	38	12
	0.1	1800	11	11 b	1200	26	12	1200	52	12
0.1	0.1	3000	10	11 b	2000	24	12	1900	44	12
	0.22	3800	15	11	2800	33	12	3000	68	12
0.22	0.22	6800	14	11	5300	31	12	5300	57	12
	0.47	9500	20	11	8300	44	12	8800	82	12

Eo = Voltage across Rg at the grid-current point.
* = Megohms
\+ = At 5 volts (RMS) output unless index letter indicates otherwise.
a. At 3 volts (RMS) output.
b. At 4 volts (RMS) output.



Value of C selected for desired frequency response. Rk should be adequately by-passed.

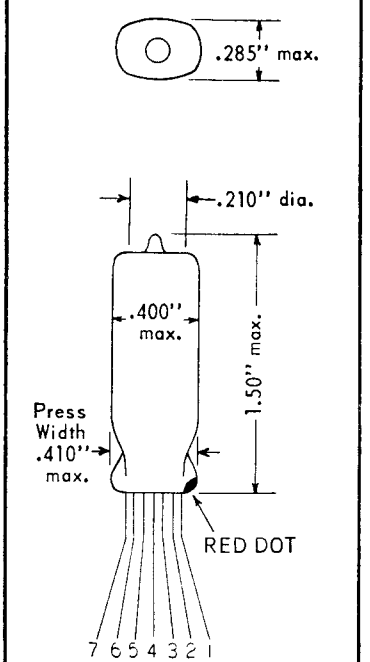
AVERAGE CHARACTERISTICS
(Each Section)



RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

TYPE CK5829WA

The CK5829WA is a heater-cathode type double diode of flat press-flat bulb subminiature construction, designed for use as a general purpose rectifier capable of operation in the UHF region and for use as a low current power rectifier. This type is characterized by low heater power, long life, and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate, Unit #2	Lead 5 Heater
Lead 2 Cathode, Unit #2	Lead 6 Plate, Unit #1
Lead 3 Heater	Lead 7 Cathode, Unit #1
Lead 4 Internal Shield	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test - Note 2)	450 G
Maximum Uniform Acceleration (Centrifuge Test - Note 3)	1000 G
Maximum Vibrational Acceleration (100 Hour Fatigue Test - Note 4)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 7)	Ef:	6.0	6.3	6.3	6.6	V
Plate Supply Voltage (RMS) (each plate)	Epp/p:	----	117	117	130	Vac
Load Resistance	RL:	----	14,000	14,000	----	ohms
Filter Input Capacitance	CL:	----	8	8	----	μf
Peak Inverse Plate Voltage	epx:	----	----	----	360	v
Steady State Peak Plate Current (each plate)	ib/p:	----	----	25	27.5	ma
DC Output Current (each plate)	Io/p:	----	----	5.0	5.0	mAdc
Peak Transient Plate Current (each plate)	i surge:	----	----	----	175	ma
Heater-Cathode Voltage	Ehk:	----	----	----	360	V

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	MIL-E-1B UNITS
Continuity and Tap Shorts:		0.4							
ACCEPTANCE TEST GROUP A.	**COMBINED AQL = 2.5%**								
Heater Current:		0.65	If:	138	----	150	----	162	mA

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

September 15, 1955 NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	MIL-E-1B UNITS
ACCEPTANCE GROUP A (cont'd)									
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	0.65	Ihk (1):	----	----	----	2	10	μAdc
Heater-Cathode Leakage (2):	Ehk=-100 Vdc	0.65	Ihk (2):	----	----	----	-2	-10	μAdc
Operation:	Full Wave Operation	0.65	Io:	9.0	9.5	10.0	----	----	mAdc
Emission:	Es=6.5 Vdc	0.65	Is:	15	16.5	----	----	----	mAdc
ACCEPTANCE TESTS GROUP B									
Insulation of Electrodes:	Ef=6.3 V Ep-all=-300 Vdc	2.5	Rp-all:	100	----	----	----	----	Meg.
Subminiature Lead Fatigue Test:		2.5	----	4.0	----	----	----	----	Arcs.
ACCEPTANCE TESTS GROUP C									
Plate Current:	Ebb=0: RP=40,000 ohms	6.5	Ib:	2	----	----	----	20	μAdc
Plate Current Difference Between Diodes:	Ebb=0; RP=40,000 ohms	6.5	△Ib:	----	----	----	----	5	μAdc
Capacitance:	Without Shield: 6.5								
	Plate #1 to Plate #2		C:	0.06	----	0.09	----	0.12	μμf
	Plate #1 to all others tied together (except Plate #2)		C:	1.9	----	2.7	----	3.5	μμf
	Plate #2 to all others tied together (except Plate #1)		C:	1.7	----	2.5	----	3.3	μμf
	Cathode #1 to all others tied together		C:	2.4	----	3.3	----	4.2	μμf
	Cathode #2 to all others tied together		C:	2.8	----	3.7	----	4.6	μμf
	Cathode #1 to Heater		C:	1.1	----	1.7	----	2.2	μμf
	Cathode #2 to Heater		C:	1.3	----	1.9	----	2.5	μμf

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE TESTS GROUP D						
Shock:	Hammer Angle=30° (Note 2)					
Post Shock Limits						
Heater-Cathode Leakage (1):	Ehk=+100 Vdc		Ihk (1):	----	15	μAdc
Heater-Cathode Leakage (2):	Ehk=-100 Vdc		Ihk (2):	----	-15	μAdc
Operation:			Io:	7.0	----	mAdc
Fatigue:	96 Hours (Note 4)					
Post Fatigue Limits						
Heater-Cathode Leakage (1):	Ehk=+100 Vdc		Ihk (1):	----	15	μAdc
Heater-Cathode Leakage (2):	Ehk=-100 Vdc		Ihk (2):	----	-15	μAdc
Operation:			Io:	7.0	----	mAdc
ACCEPTANCE TESTS GROUP E						
Glass Strain (Thermal Shock):		10				
Visual and Mechanical Inspection	Major Combined	0.4				
	Minor A Combined	2.5				
	Minor B Per Item	6.5				
ACCEPTANCE LIFE TESTS						
Heater Cycling:	Ef=7.5 V; Eb=0 V; Ehk=140 Vac; 1 min. on, 1 min. off			2000	----	cycles
100 Hour Survival Rate Life Test:	TA=room; Ehk=Eo+117 Vac					
100 Hour Survival Rate Life Test End Points:						

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE LIFE TESTS (cont'd)						
Inoperatives:	(Typical Sample Size=200 tubes)	0.65				
Electrode Insulation:			Rp-all:	50	-----	Meg.
Operation:			Io:	7.0	-----	mAdc
Heater Current:	(Typical Sample Size=25 tubes)	1.0	If:	138	162	mA
Heater-Cathode Leakage (1):			Ihk (1):	0	20	μAdc
Heater-Cathode Leakage (2):			Ihk (2):	0	-20	μAdc

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Max. defects per characteristic
500 Hour Intermittent High Temperature Life Test (1): 500 Hour Intermittent High Temperature Life Test (1) End Points:	TA=175°C; Ehk=Eo+117 Vac (Typical Sample Size=20 tubes) (Total allowable combined defects=4 tubes)						
Inoperatives:							1
Electrode Insulation:			Rp-all:	50	-----	Meg.	4
Heater Current:			If:	135	165	mA	4
Heater-Cathode Leakage (1):			Ihk: (1)	0	20	μAdc	2
Heater-Cathode Leakage (2):			Ihk: (2)	0	-20	μAdc	
Operation:			Io:	7.0	-----	mAdc	4
1000 Hour Intermittent Life Test (2):	TA=175°C						
	Ehk=Eo+117 Vac						
1000 Hour Intermittent Life Test (2):	Limits not established.						
	Read for same characteristics as for Life Test (1):						
1000 Hour Intermittent Life Test (2) End Points:	TA=Room						
	Ehk=Eo+117 Vac						
5000 Hour Intermittent Life Test (3):	Limits not established						
	Read for same characteristics as for Life Test (1).						
5000 Hour Intermittent Life Test (3) End Points:							

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1B basic specifications.

Note 3: Centrifuge Test with forces applied in any direction.

Note 4: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1B basic specifications.

Note 5: These normal values represent conditions of which control of reliability may be expected.

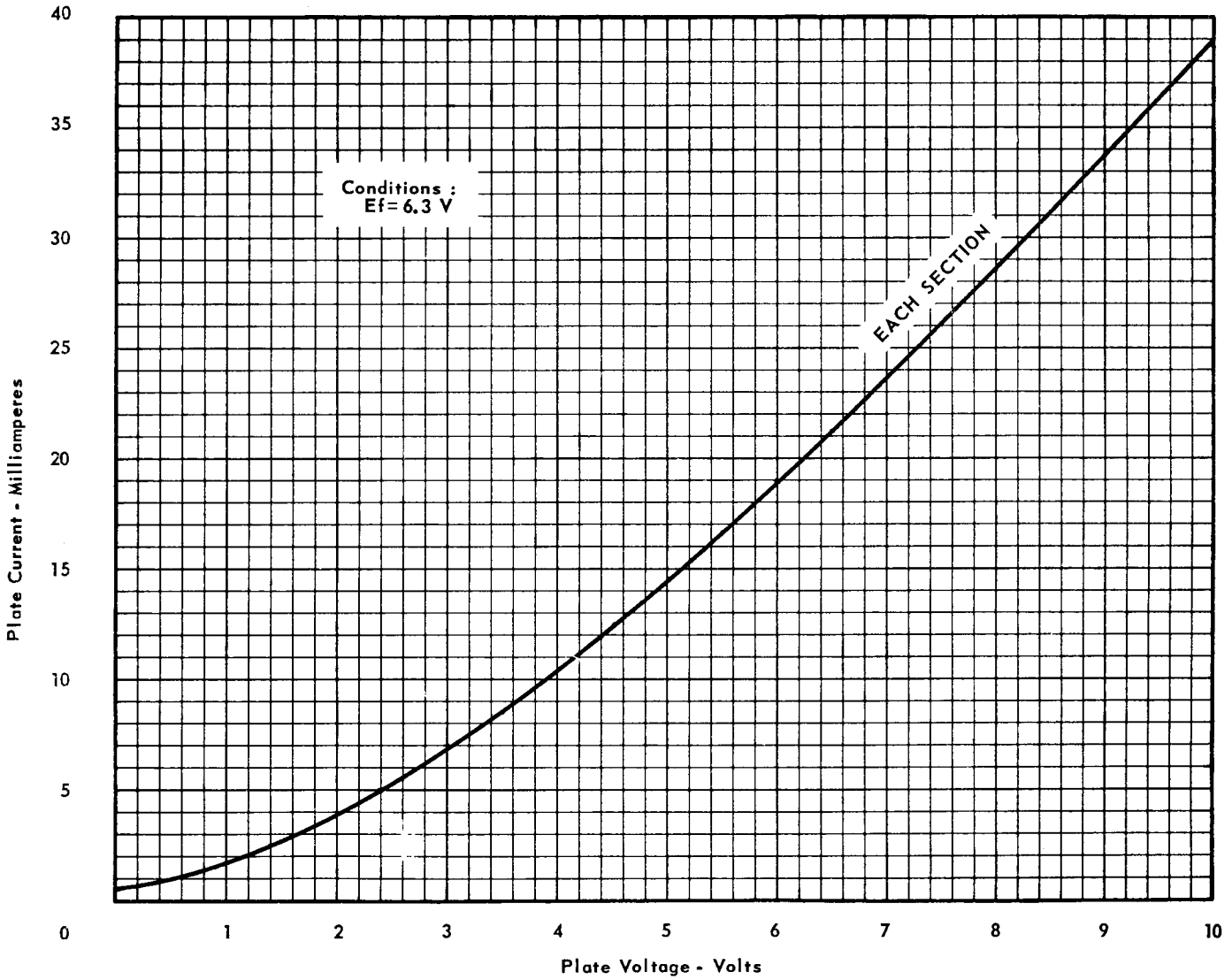
Note 6: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 7: For most applications the performance will not be adversely affected by ±5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

RAYTHEON

RELIABLE SUBMINIATURE DOUBLE DIODE

AVERAGE PLATE CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

583

HIGH VACUUM CLIPPER DIODE RECTIFIER

The 583 is a heater-cathode, high-vacuum clipper diode or rectifier designed for use in high voltage application. It is mechanically rugged and in addition uses a hard glass nonex envelope. The plates are gold plated and zirconium coated for better operation at high voltages. The cathode is heliarc welded making the internal connection more rugged and giving better contact. The self supporting anodes eliminate use of mica spacers allowing high temperature during exhaust thereby obtaining less gas and longer life.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock–Test)	375	G
Maximum Vibrational Acceleration (96 Hour Fatigue Test)	2.5	G
Maximum Bulb Temperature		
Rectifier	185	°C
Clipper	225	°C
Altitude	36,000	ft.

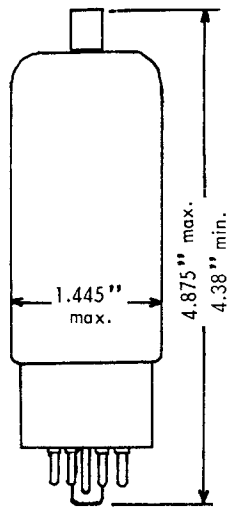
ELECTRICAL DATA

Ratings and Normal Operation	MIL–E–1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL–E–1 Units
			RATINGS			
Heater Voltage	Ef:	2.25	2.5	2.5	2.75	Vac
Peak Plate Inverse Voltage						
Rectifier	epx:	---	---	---	17.0	kv
Clipper	epx:	---	---	---	15.0	kv
Peak Plate Current						
Rectifier	ib:	---	---	---	0.25	a
Clipper	ib:	---	---	---	8.0	a
Plate Current						
Clipper	Ip:	---	---	---	240	mAac
Plate Current (DC Comp.)						
Rectifier	Ib:	---	---	---	65	mAdc
Plate Dissipation						
Clipper	Pp:	---	---	---	18	W
Cathode-Conditioning Time						
Rectifier	tk:	120	---	---	---	sec.
			TESTS			
Heater Current	If:	4.4	---	4.9	5.4	Aac
Peak Emission eb=4000 v	is:	8.0	---	---	---	a
Plate Current Eb=130 Vdc		100	---	---	---	mAdc

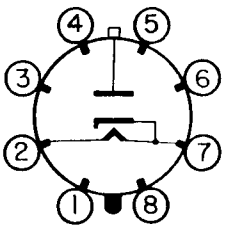
MECHANICAL DATA

ENVELOPE T–11
BASE .... Intermediate Shell Octal 8 Pin, B8–6 Phenolic
CAP ..... Small C1–1
MOUNTING POSITION .. Vertical

PHYSICAL DIMENSIONS



BASING

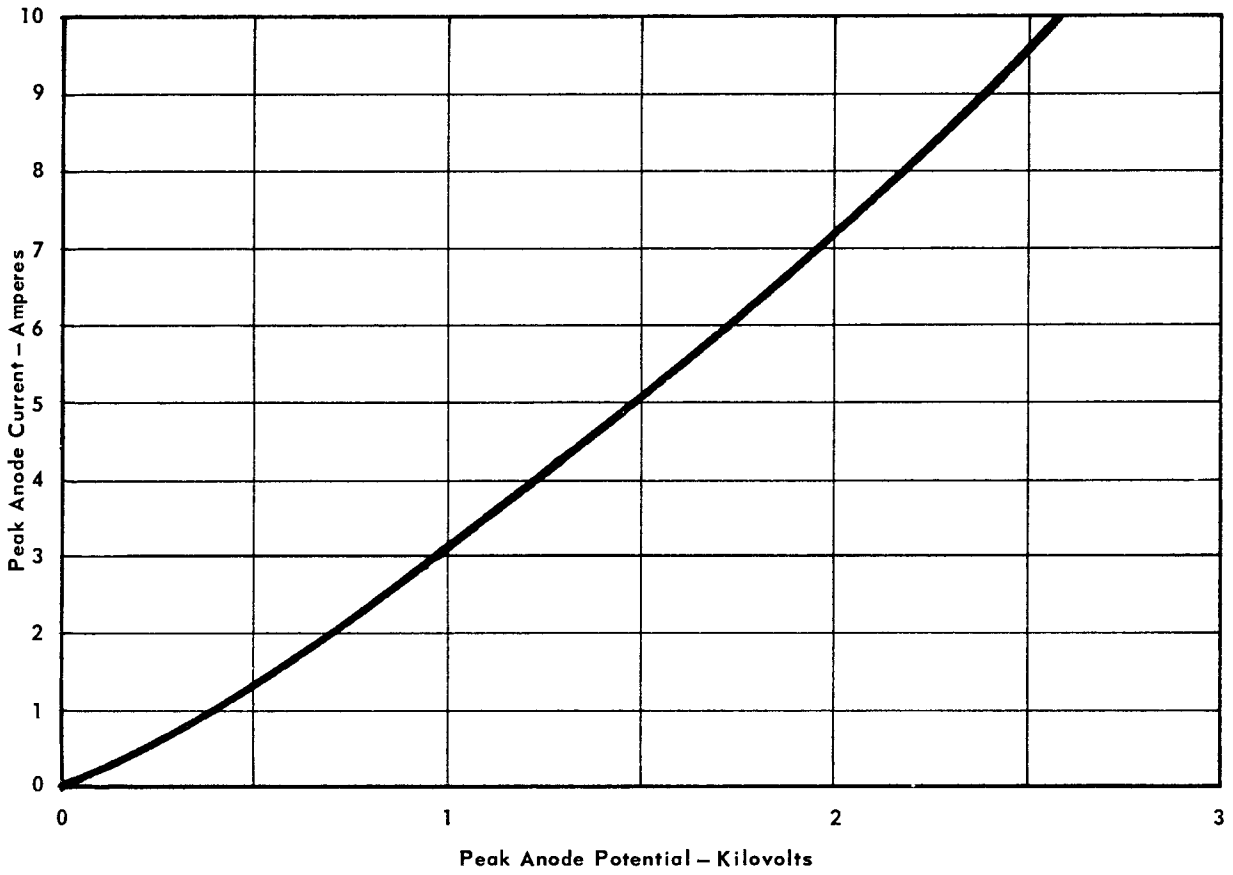


BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 NC
Pin 2 Heater
Pin 3 NC
Pin 4 NC
Pin 5 NC
Pin 6 NC
Pin 7 Heater and Cathode
Pin 8 NC
Cap Plate

PEAK EMISSION CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK5840
CK6205

SUBMINIATURE SHARP–CUTOFF PENTODES

The CK5840 and CK6205 are heater cathode type sharp–cutoff RF pentodes of subminiature construction capable of operation in the UHF region. Type CK6205 is identical to the CK5840 except for an external grid No. 3 connection. These types are characterized by long life and stable performance, and designed for service where severe conditions of high temperature, high altitude and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450	G
Uniform Acceleration (Centrifuge Test)	1000	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	220	°C
Altitude	80,000	Ft.

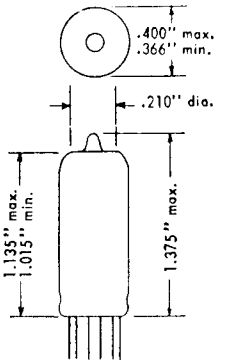
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Ratings			
Heater Voltage	Ef:	6.0	---	6.3	6.6	V
Plate Voltage	Eb:	---	---	100	165	Vdc
Grid Voltage	Ec1:	–55	---	0	0	Vdc
Grid #2 Voltage	Ec2:	---	---	100	155	Vdc
Grid #3 Voltage (Note A)	Ec3:	---	---	0	22	Vdc
Heater-Cathode Voltage	Ehk:	---	---	0	200	V
Cathode Resistance	Rk:	---	---	150	---	ohms
Grid Resistance	Rg1:	---	---	---	1.1	Meg
Cathode Current	Ik:	---	---	---	16.5	mAdc
Plate Dissipation	Pp:	---	---	---	0.90 *	W
Grid #2 Dissipation	Pg2:	---	---	---	0.30 *	W
* Design Maximum						
			Tests			
Plate Current (1)	Ib:	5.5	7.5	---	9.5	mAdc
Grid #2 Current	Ic2:	1.5	---	---	3.3	mAdc
Heater Current	If:	140	150	---	160	mA
Transconductance (1)	Gm:	4200	5000	---	5800	μmhos
Heater Cathode Leakage, Ehk=±100 Vdc	Ihk:	---	---	---	5.0	μAdc
Vibration (2) Low frequency F=40 cps; G=15; Rp=10,000; Ck=1000 μf	Ep:	---	---	---	60	mVac

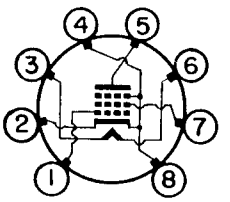
MECHANICAL DATA

ENVELOPE T-3
OUTLINE ..... JEDEC (3-1)
BASE .... Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.5" min.) E8-10
CATHODE..... Coated Unipotential
BASING 8DL, 8DC
MOUNTING POSITION..... Any

PHYSICAL DIMENSIONS



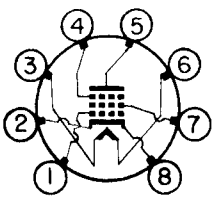
BASING – CK5840



TERMINAL CONNECTIONS: – 8DL

Lead 1 Grid #1
Lead 2 Cathode and Grid #3
Lead 3 Heater
Lead 4 Cathode and Grid #3
Lead 5 Plate
Lead 6 Heater
Lead 7 Grid #2
Lead 8 Cathode & Grid #3

BASING – CK6205



TERMINAL CONNECTIONS: – 8DC

Lead 1 Grid #1
Lead 2 Cathode and Shield
Lead 3 Heater
Lead 4 Grid #3
Lead 5 Plate
Lead 6 Heater
Lead 7 Grid #2
Lead 8 Cathode and Shield

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Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Tests (Continued)			
Transconductance (2) Ef = 5.7 V	Δ_{Ef}Gm:	---	---	---	10	%
Plate Resistance	rp:	0.175	---	---	---	Meg.
Interelectrode	Cg1p:	---	---	---	0.015	pf
Capacitance	Cin:	3.5	---	---	4.9	pf
0.405 in. dia. shield	Cout:	2.9	---	---	3.9	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5G. Sample subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.0 V; Ehk = 140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits, or heater to cathode shorts.

Stability Life Test – Sample is operated for one hour to assure initial electrical stability (Δ_t Sm < 10%). Ehk = +200 Vdc; Rg1 = 1.0 Meg; TA = Room.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability, (Gm > 3750 μmhos) and freedom from inoperatives. Tubes are operated under stability life-test conditions.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 220°C, at stability life-test conditions.

Altitude – Sample is subjected to a pressure of 21 ± 2 mmHg (80,000 ft.) at 300 Vac to assure freedom from flashover or corona at the leads of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

NOTE A: Types CK5840 and CK6205 are the same except for suppressor grid and cathode connections. The Ec3 column in the heading applies only to type CK6205. Type CK6205 has not been designed to use the number 3 grid for control or gating purposes.

ACCEPTANCE CRITERIA

The following tests shall be performed:
For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.
For miscellaneous requirements, see 3.6.

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION (see note 3)												
---	Cathode	Coated unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	E8-10	---	---	---	---	---	---	---	---	---	---
4.9.20.3	Variable frequency vibration (1)	No voltages applied; post shock and fatigue end points apply	---	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 1 (see note 4)												
4.10.8	Heater Current		---	---	If	---	144	150	156	---	12	mA
4.10.8	Heater Current		0.65	II	If	140	---	---	---	160	---	mA
4.10.15	Heater-Cathode Leakage	Ehk = +100 Vdc Ehk = -100 Vdc	.65	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	5.0 5.0	--- ---	μAdc μAdc
4.10.6.1	Total Grid Current	Rg1 = 1.0 Meg	.65	II	Ic1	0	---	---	---	-0.3	---	μAdc
4.10.4.1	Plate Current (1)		---	---	Ib	---	6.7	7.5	8.3	---	2.3	mAdc
4.10.4.1	Plate Current (1)		.65	II	Ib	5.5	---	---	---	9.5	---	mAdc
4.10.4.1	Plate Current (2)	Ec1 = -9.0 Vdc; Rk = 0	.65	II	Ib	---	---	---	---	50	---	μAdc
4.10.4.3	Screen-Grid Current		.65	II	Ic2	1.5	---	---	---	3.3	---	mAdc
4.10.9	Transconductance (1)		---	---	Sm	---	4700	5000	5300	---	900	μmhos
4.10.9	Transconductance (1)		.65	II	Sm	4200	---	---	---	5800	---	μmhos
4.7.5	Continuity and Short Tests (for reliable tubes) (inoperatives)		.40	II	---	---	---	---	---	---	---	
---	Suppressor	(See note 5)	.40	II	---	---	---	---	---	---	---	
4.9.1.1	Mechanical production tests (for reliable subminiature tubes)	Outline 8-1			---	---	---	---	---	---	---	

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2) Min	LAL	Bogie	UAL	Max	ALD	Units
	MEASUREMENTS ACCEPTANCE TESTS, PART 2											
4.8	Insulation of electrodes	g1 – all p – all	2.5	I	{R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance (2)	Ef = 5.7 V	2.5	I	$\Delta_{Ef}Sm$	---	---	---	---	10	---	%
4.10.6.2	Grid Emission	Ef = 7.5 V; Ec1 = –9.0 Vdc; Rg1 = 1.0 Meg; Rk = 0 (see note 6)	2.5	I	Ic1	0	---	---	---	–0.5	---	μAdc
4.10.3.2	Auto-frequency noise	Esig = 70 mVac; Ec2 = 19 Vdc; Rg1 = 0.1 Meg; Rg2 = 1,000; Rp = 0.2 Meg; Ck = 1,000 μf (see note 7)	2.5	I		---	---	---	---	---	---	
4.10.10	Plate Resistance		6.5	L6	rp	0.175	---	---	---	---	---	Meg
4.10.14	Direct Interelectrode capacitance	0.405 in. dia. shield 0.405 in. dia. shield 0.405 in. dia. shield	6.5	Code F	{Cg1p Cin Cout	--- 3.5 2.9	--- --- ---	--- --- ---	--- --- ---	0.015 4.9 3.9	--- --- ---	pf pf pf
4.9.12.1	Low-pressure voltage breakdown	Pressure = 21 ± 2 mm Hg; voltage = 300 Vac (see note 8)	6.5	(See note 9)		---	---	---	---	---	---	
4.9.19.1	Low-frequency vibration (2)	Rp = 10,000; Ck = 1,000 μf; F = 40 cps; G = 15	2.5	I	Ep	---	---	---	---	60	---	mVac
	DEGRADATION RATE ACCEPTANCE TESTS, (see note 10)											
4.9.5.3	Subminiature lead fatigue		2.5	Code F		4	---	---	---	---	---	arcs
4.9.20.5	Shock test	Hammer angle = 30°; Ehk = + 100 Vdc (see note 11)	---	---		---	---	---	---	---	---	
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min. 60 max.	6.5	(See note 9)		---	---	---	---	---	---	
---	Post shock and fatigue test end points	Vibration (2) Heater-cathode leakage	---	---	Ep	---	---	---	---	200	---	mVac
		Ehk = + 100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Ehk = – 100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Change in transconductance (1) of individual tubes	---	---	$\Delta_t Sm$	---	---	---	---	20	---	%
4.9.6.3	Glass strain		6.5	I		---	---	---	---	---	---	

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
ACCEPTANCE LIFE TESTS (see note 10)										
4.11.7	Heater-cycling life test	Ef = 7.0 V; 1 min. on, 4 min. off; Ehk = 140 Vac; Ec1 = Ec2 = Eb = 0 (see note 12)	2.5	Code II	---	---		---	---	
4.11.3.1(a)	Stability life test (1 hour)	Ehk = +200 Vdc; Rg = 1.0 Meg; TA = room (see note 13)	1.0	Code I	---	---		---	---	
4.11.4	Life test end points (stability)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_t Sm	---	10	%
4.11.3.1(b)	Survival-rate life test	Stability life test conditions or equivalent; TA = room (see notes 14 and 15)	---	II	---	---		---	---	
4.11.4	Life test end points (survival)	Continuity and short (Inoperatives)	0.65	---	---	---	---	---	---	
		Transconductance (1)	1.0	---	---	---	Sm	3750	---	μmhos
4.11.5	Intermittent life-test operation	Stability life test conditions; T (envelope) = +220°C min (see notes 16 and 17)	---	---	---	---	---	---	---	
4.11.4	Life test end points (500 hours)	(See note 18)								
		Inoperatives (see note 19)	---	---	1	3		---	---	
		Grid current	---	---	1	3	Ic1	0	−0.8	μAdc
		Heater current	---	---	1	3	If	138	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_t Sm	---	20	%
		Transconductance (2)	---	---	1	3	Δ_{Ef} Sm	---	15	%
		Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	1	3	Ihk	---	10	μAdc
		Ehk = −100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes								
		g − all	---	---	1	3	R	25	---	Meg
		p − all					R	25	---	Meg
		Transconductance (1) average change	---	---	---	---	Avg Δ_t Sm	---	15	%
		Total defectives	---	---	3	6	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
4.11.4	Life test end points (1000 hours)	(See note 18)								
		Inoperatives (see note 19)	---	---	1	3		---	---	
		Grid current	---	---	1	3	Ic1	0	-0.8	μAdc
		Heater current	---	---	1	3	If	138	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	25	%
		Transconductance (2)	---	---	1	3	Δ_{Ef}Sm	---	20	%
		Heater-cathode leakage								
		Ehk = + 100 Vdc	---	---	1	3	Ihk	---	10	μAdc
		Ehk = - 100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes								
		g - all	---	---	1	3	R	25	---	Meg
		p - all					R	25	---	Meg
		Total defectives	---	---	4	8	---	---	---	---
4.9.18	Container drop	(d) Package group 1; container size C								

NOTES:

Note 1: The sequence of tests used in this specification is the suggested order of tests, which has been determined to be most convenient for both the tube manufacturer and the Government laboratories.

Note 2: Variable sampling procedures. (See 4.1.1.7)

Note 3: All tests listed hereon shall be performed during qualification inspection, however, these three tests will normally be performed during qualification inspection only.

Note 4: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperatives and mechanical, shall be one (1) percent.

Note 5: Tube JAN-6205 shall be subjected to the following test or equivalent: Reject for open suppressor if plate current does not decrease by a minimum of 10 percent when Ec3 is changed from 0 to -100 Vdc.

Note 6: Prior to this test, tubes shall be preheated 5 minutes at conditions indicated below. The 3-minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef	Ec1	Ec2	Ec3	Eb	Rk	Rg1
V	Vdc	Vdc	Vdc	Vdc	ohms	Meg
7.5	0	100	0	100	150	1.0

Note 7: The rejection level shall be set at the VU meter reading obtained during calibration.

Note 8: No other voltages applied.

Note 9: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F shall apply.

NOTES (continued)

Note 10: Destructive tests. Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.5.3 Subminiature lead fatigue
4.9.20.5 Shock test
4.9.20.6 Fatigue test
4.11.7 Heater-cycling life test
4.11.5 Intermittent life-test operation

Note 11: A grid resistor of 0.1 megohm shall be added, however, this resistor will not be used when a thyratron-type short indicator is employed.

Note 12: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit, or heater-cathode short.

Note 13: Stability life test. The sampling and testing procedures for this test shall be in accordance with 20.2.5.1(a) to 20.2.5.1 (g), inclusive, of appendix C.

Note 14: Survival rate life test. The sampling and testing procedures for this test shall be as defined in 20.2.5.2 to 20.2.5.2.4 inclusive, of appendix C.

Note 15: For survival life test, the equivalent stability life test conditions shall be as defined in 20.2.5.2.5 of appendix C.

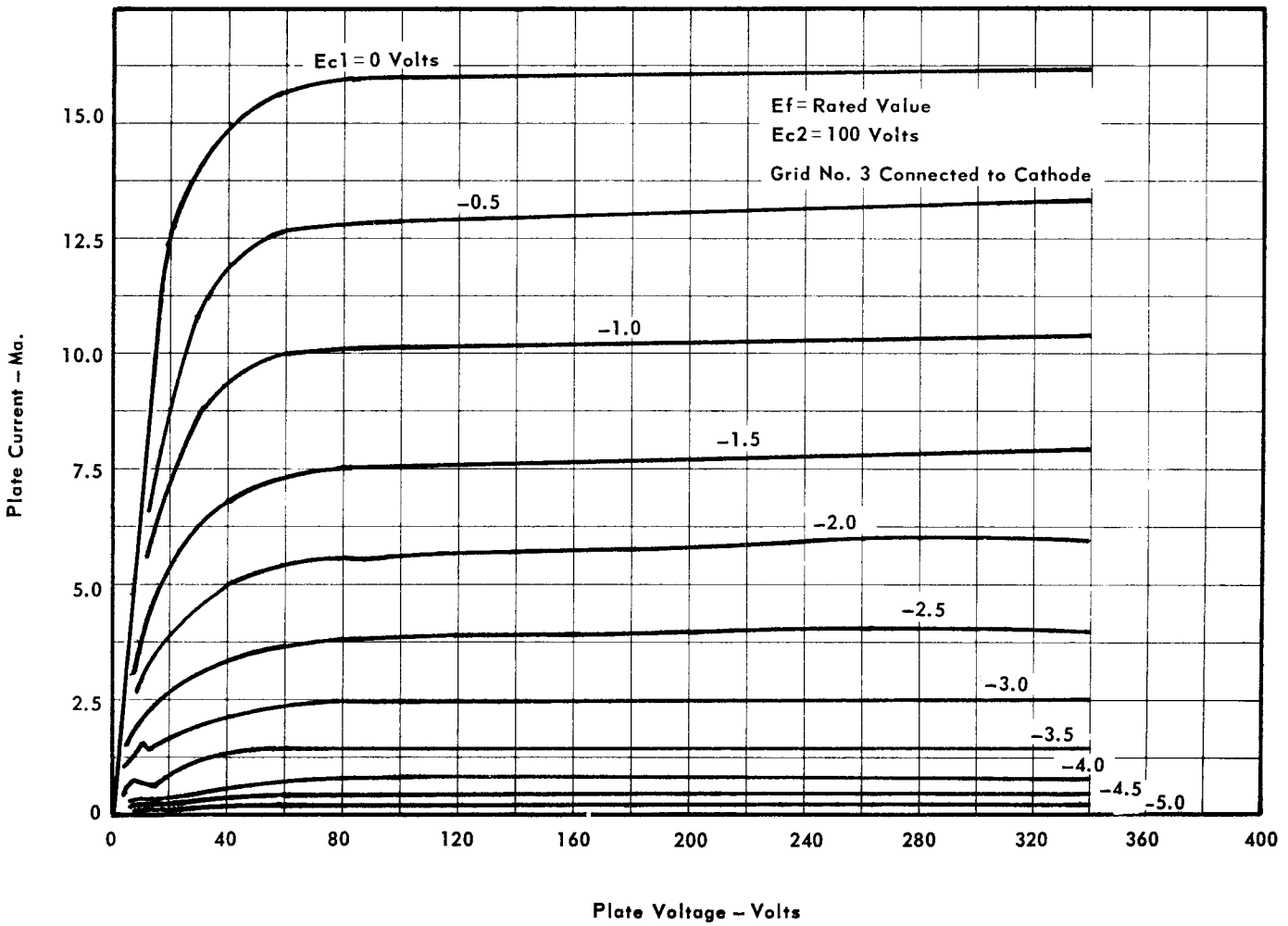
Note 16: Intermittent life tests. Sampling and acceptance procedures for these tests shall be as defined in 20.2.5.3(a) to 20.2.5.3 (i), inclusive, of appendix C.

Note 17: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B & S or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. Envelope temperature requirements will be satisfied if tube, having bogie Ib (±5 percent) under normal test conditions, is determined to operate at minimum specified temperature at any position in the life test rack.

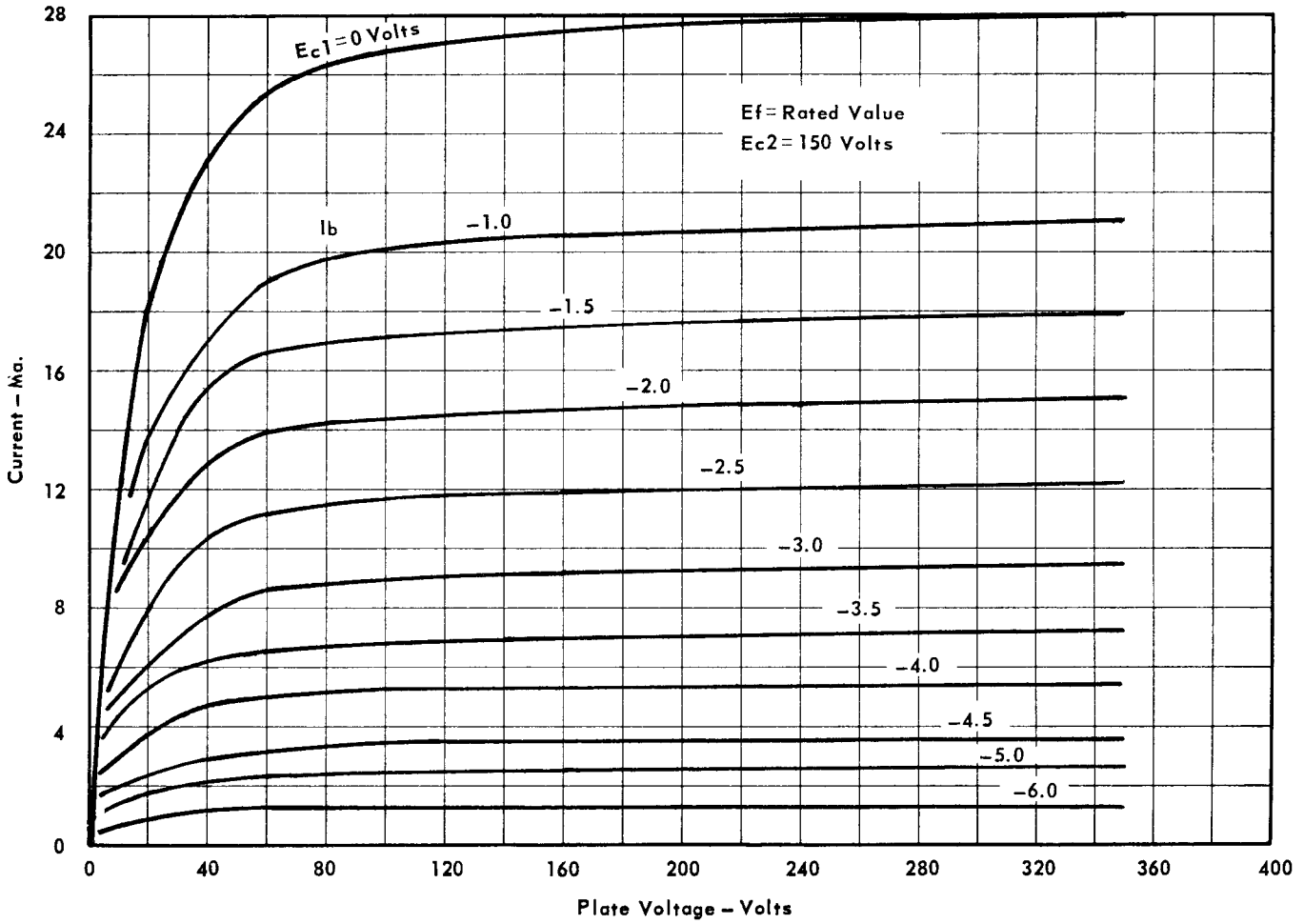
Note 18: Order for evaluation of life test. See 4.11.3.1.2.

Note 19: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1); Shorts (see 4.7.2); Air leaks (see 4.7.6).

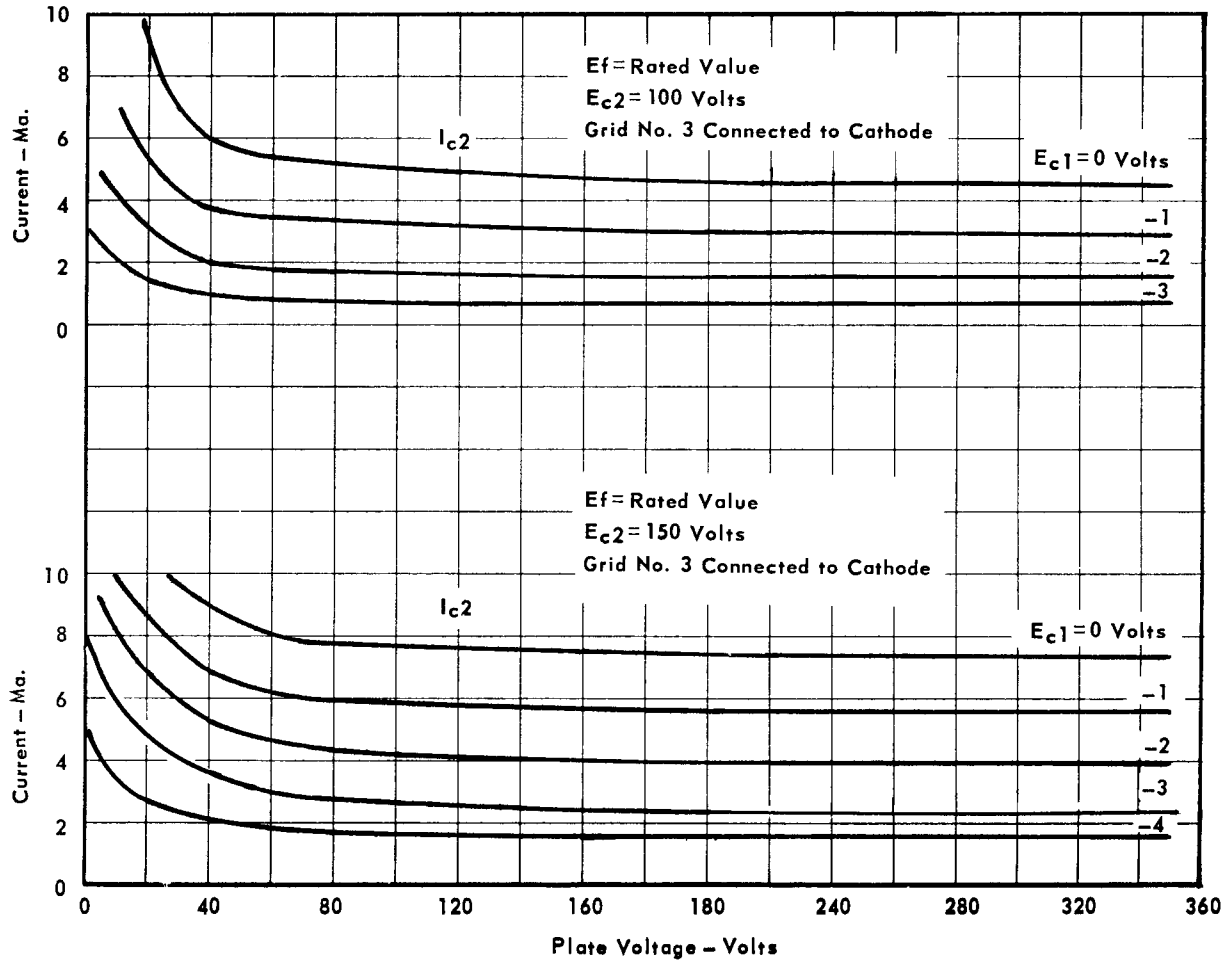
AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)



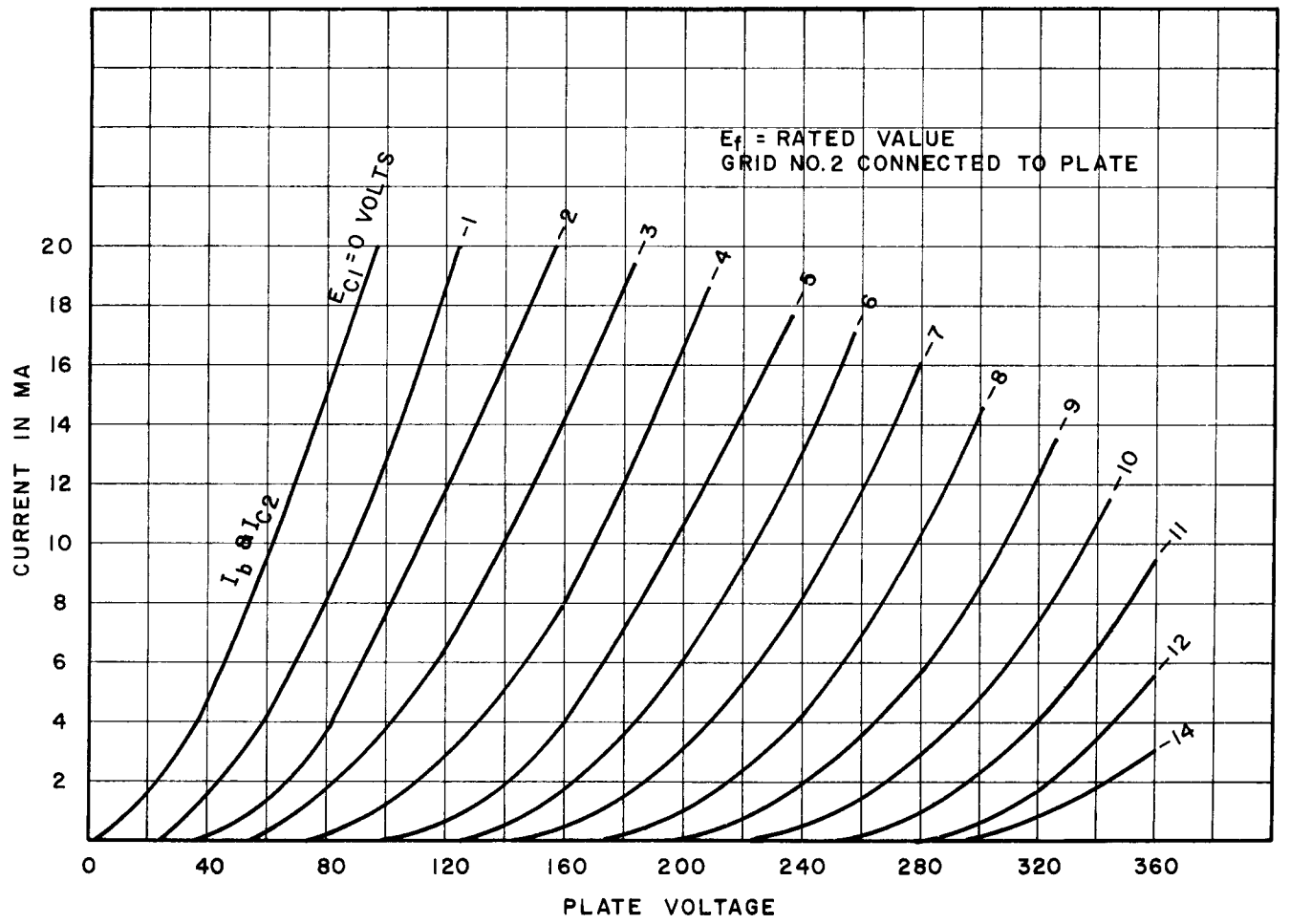
AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)



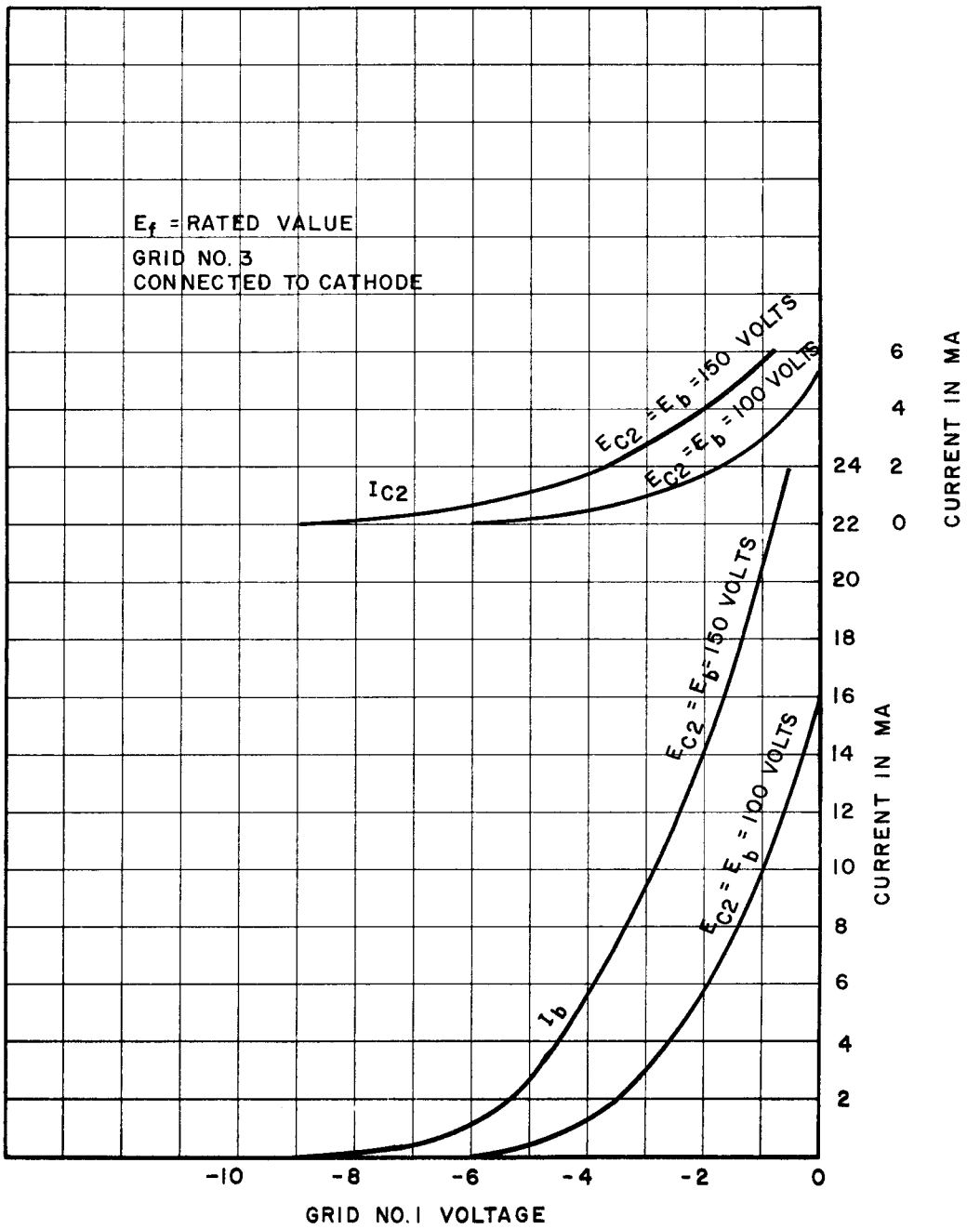
AVERAGE GRID #2 CHARACTERISTICS
(Pentode Connected)



AVERAGE PLATE CHARACTERISTICS
(TRIODE CONNECTED)

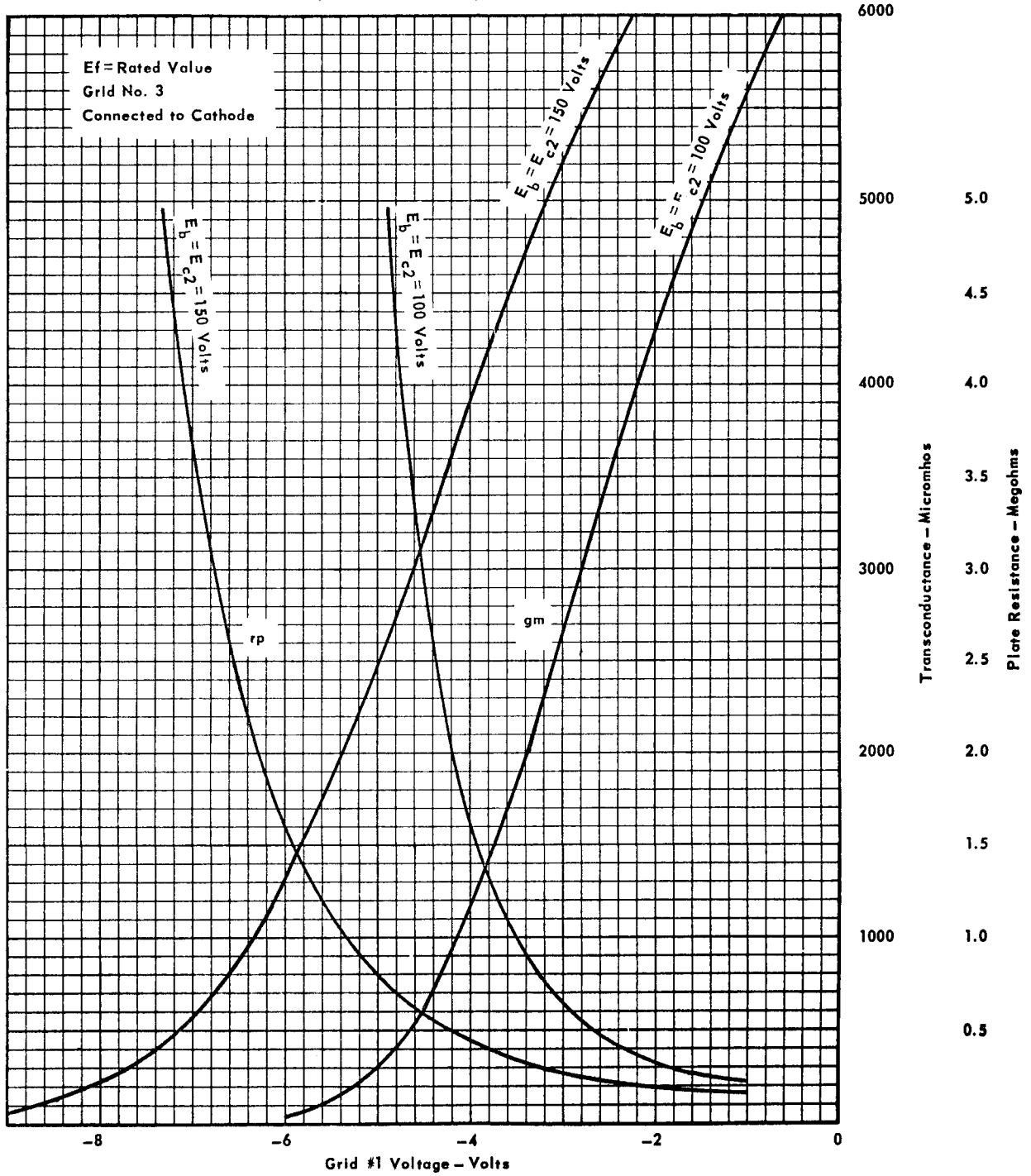


AVERAGE TRANSFER CHARACTERISTICS
(PENTODE CONNECTED)



SUBMINIATURE SHARP-CUTOFF PENTODES

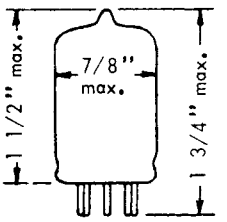
AVERAGE TRANSFER CHARACTERISTICS
(Pentode Connected)

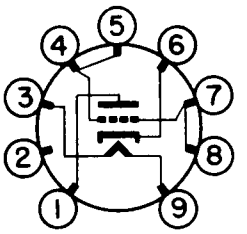


Excellence in Electronics

TYPE CK5842

The CK5842 (417A) is a heater-cathode type, high transconductance triode of miniature construction. The design features of low noise, low interelectrode capacitances, and very high transconductance make this type suitable for service in wide band amplifier stages, and especially grounded-grid operation. The useful frequency range extends from low to very high frequencies. The heater-cathode construction is designed to withstand many thousands of cycles of intermittent operation.





BOTTOM VIEW

9V

MECHANICAL DATA

ENVELOPE: T-6½ Glass

BASE: Miniature Button 9-Pin.

TERMINAL CONNECTIONS:

Pin 1 Plate	Pin 6 Cathode
Pin 2 No Connection	Pin 7 Grid
Pin 3 Heater	Pin 8 Grid
Pin 4 Grid	Pin 9 Heater
Pin 5 Grid	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds)

	Without Shield	
Plate to Cathode and Heater	0.55	max.
Input (k to g + h)	9.0	
Output (p to g + h)	1.8	

RATINGS-ABSOLUTE MAXIMUM VALUES:

Heater Voltage (ac or dc)	6.3± 10%	volts
Plate Voltage	200	volts
Plate Dissipation	4.5	watts
Cathode Current	38	ma
Heater-Cathode Voltage	55	volts
Bulb Temperature	160	°C

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3	6.3	volts
Heater Current	0.3	0.3	ma
Plate Voltage	150	130	volts
Cathode Bias Resistance	60	360	ohms
Grid Voltage	0	+9	volts
Plate Current	25	27	ma
Plate Resistance	1700	1600	ohms
Transconductance	25,000	27000	umhos
Amplification Factor	43	43	

Tentative Data

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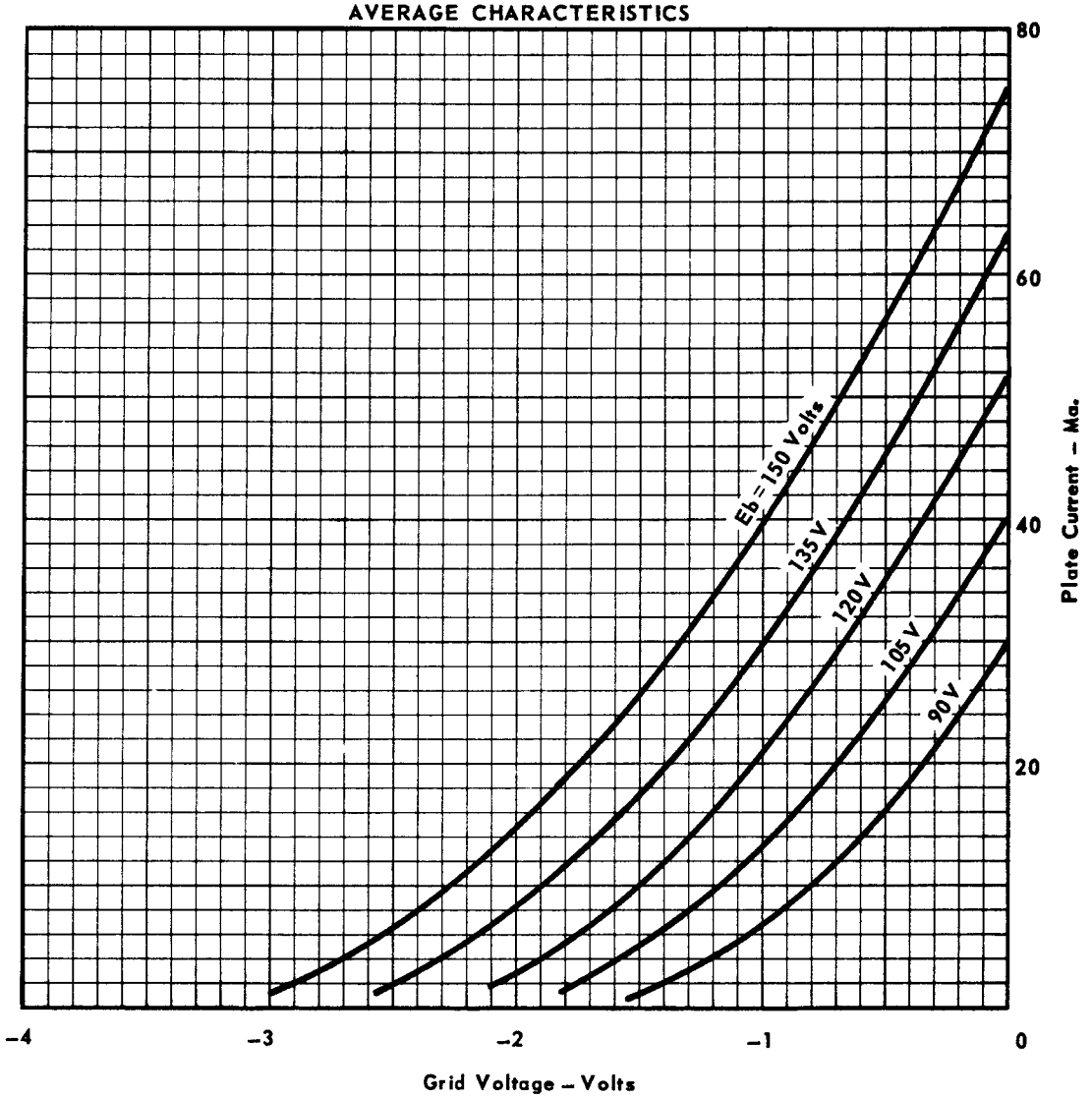
RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

5/15/58/1

NEWTON 58, MASS.

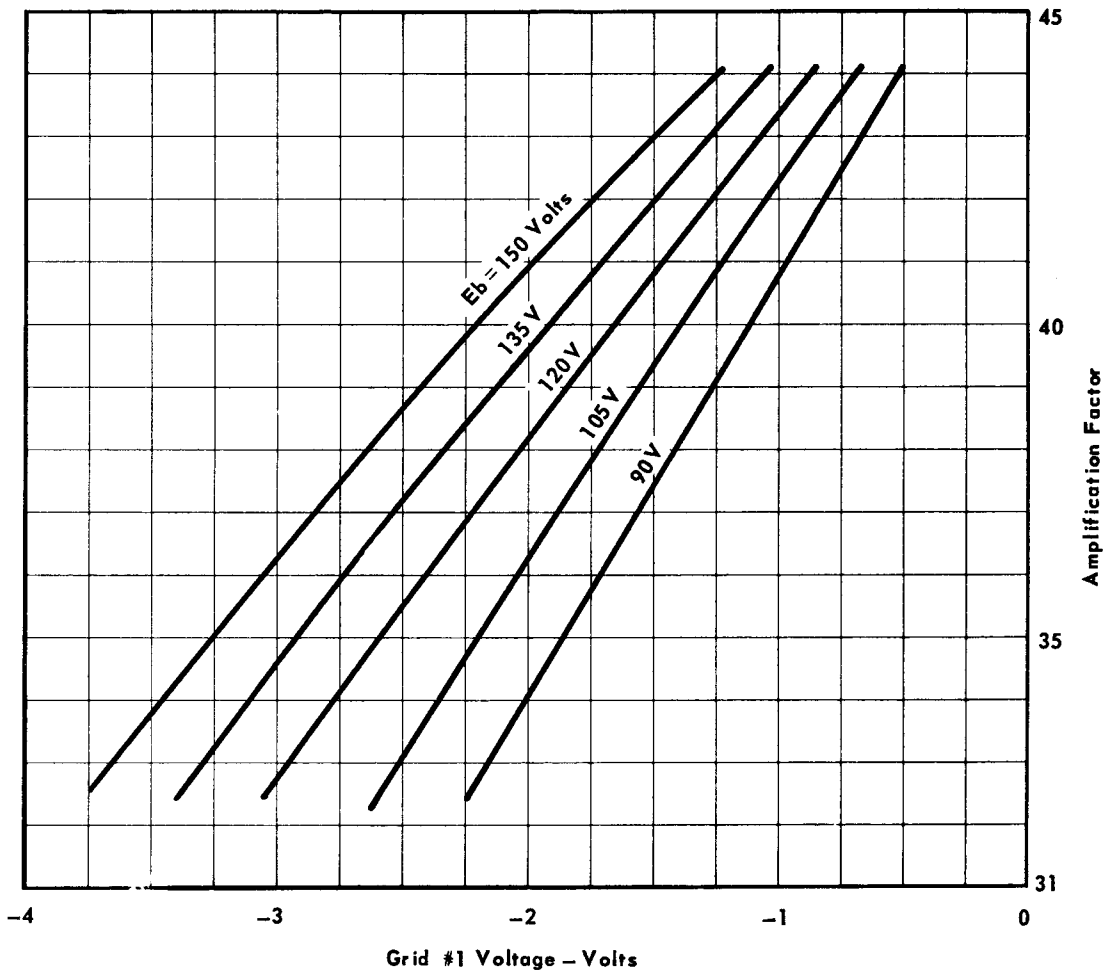
AVERAGE CHARACTERISTICS



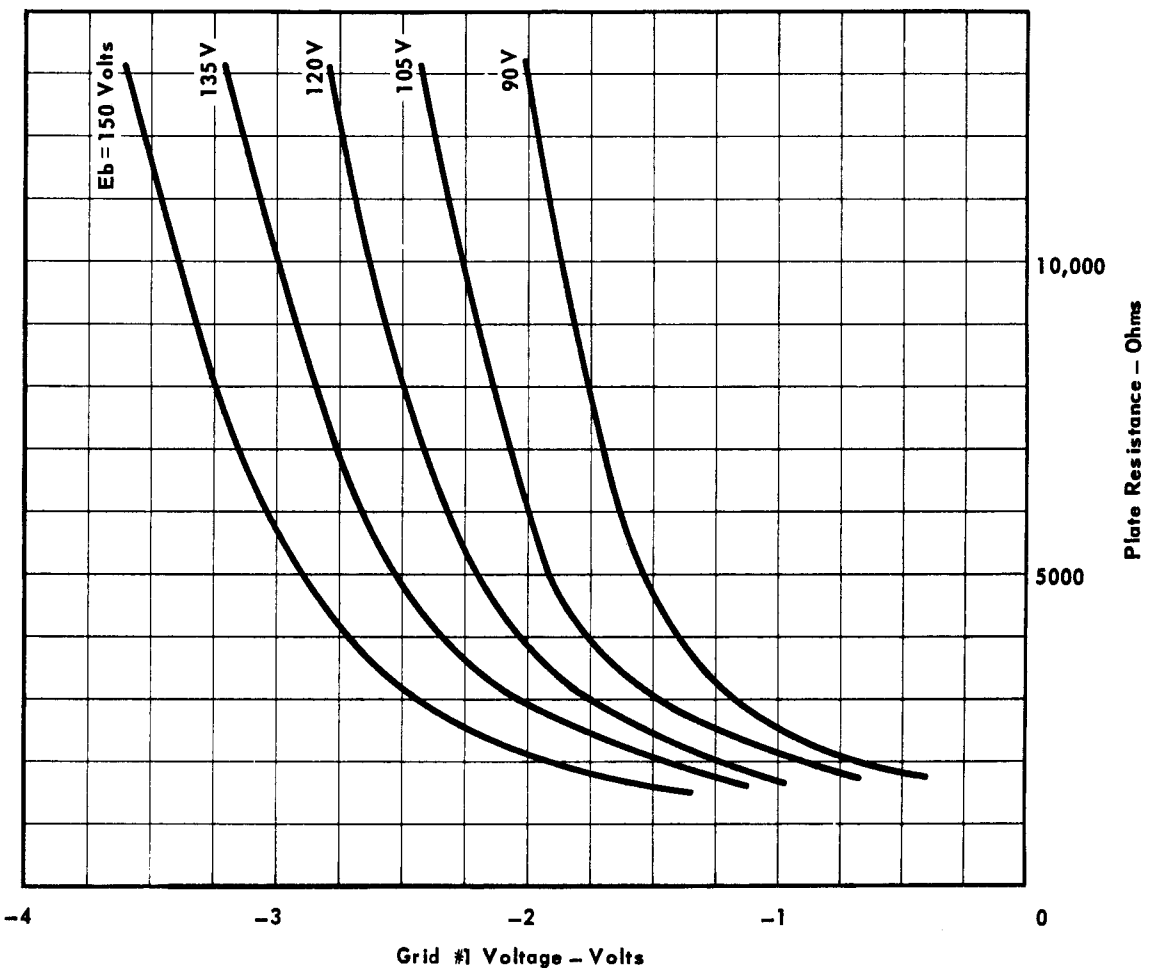
RAYTHEON

TRIODE

AVERAGE CHARACTERISTICS



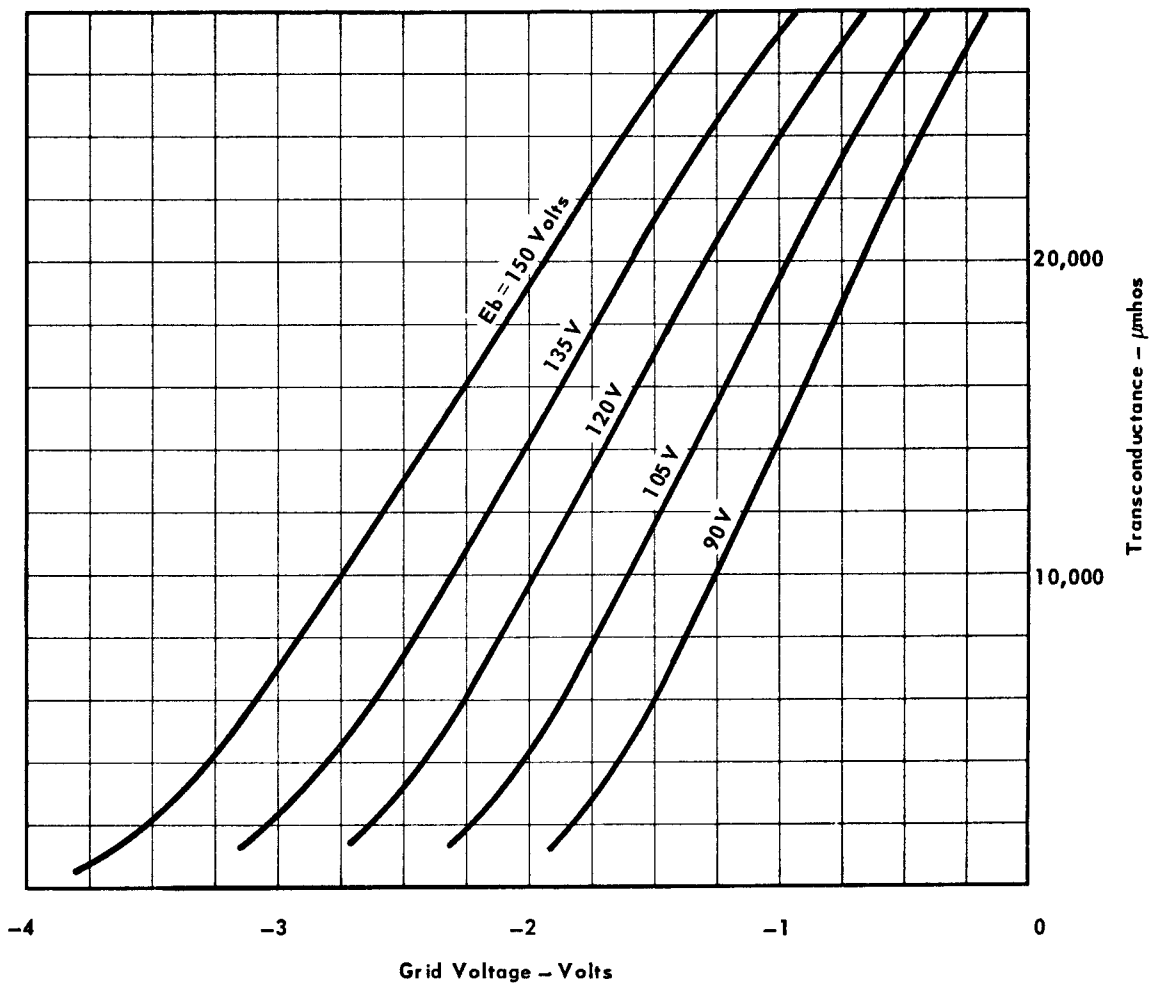
AVERAGE CHARACTERISTICS



RAYTHEON

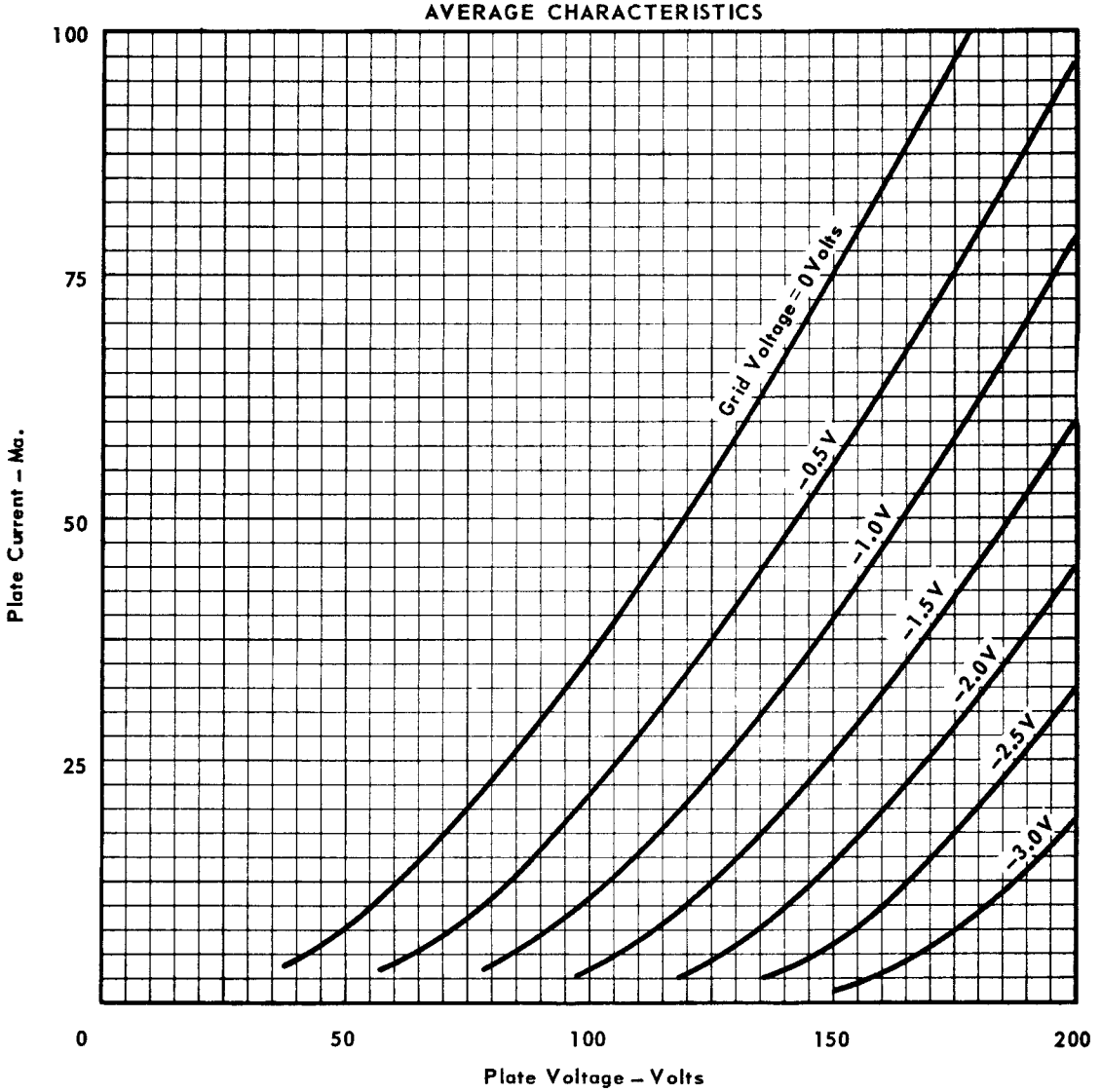
TRIODE

AVERAGE CHARACTERISTICS



Printed in U.S.A.

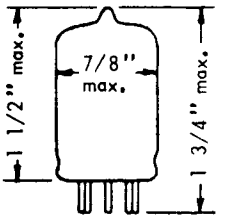
AVERAGE CHARACTERISTICS

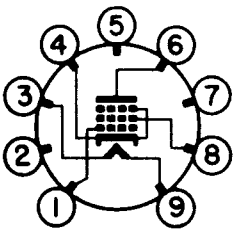


TYPE CK5847

Excellence in Electronics

The CK5847 (404A) is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction. The design features of low noise, low interelectrode capacitances, and high transconductance make it suitable for service as a wide band RF or IF amplifier. It is designed for dependable operation in equipment with low plate supply voltages. The heater-cathode construction is designed to withstand many thousands of cycles of intermittent operation.





BOTTOM VIEW

9X

MECHANICAL DATA

ENVELOPE: T–6½ Glass

BASE: Miniature Button 9–Pin

TERMINAL CONNECTIONS:

Pin 1 Grid #1	Pin 5 No Connection
Pin 2 No Connection	Pin 6 Plate
Pin 3 Heater, Lower Internal Shield	Pin 7 No Connection
Pin 4 Cathode, Grid #3 Upper Internal Shield	Pin 8 Grid #2
	Pin 9 Heater

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds) (With External Shield)

Grid to Plate	0.05	max.
Input	7.2	
Output	3.15	

RATINGS ABSOLUTE MAXIMUM VALUES:

Heater Voltage (ac or dc)	6.3± 10%	volts
Plate Voltage	200	volts
Grid #2 Voltage	165	volts
Plate Dissipation	3.3	watts
Grid #2 Dissipation	0.85	watts
Cathode Current	40	ma
Heater-Cathode Voltage	55	volts

CHARACTERISTICS AND TYPICAL OPERATION:

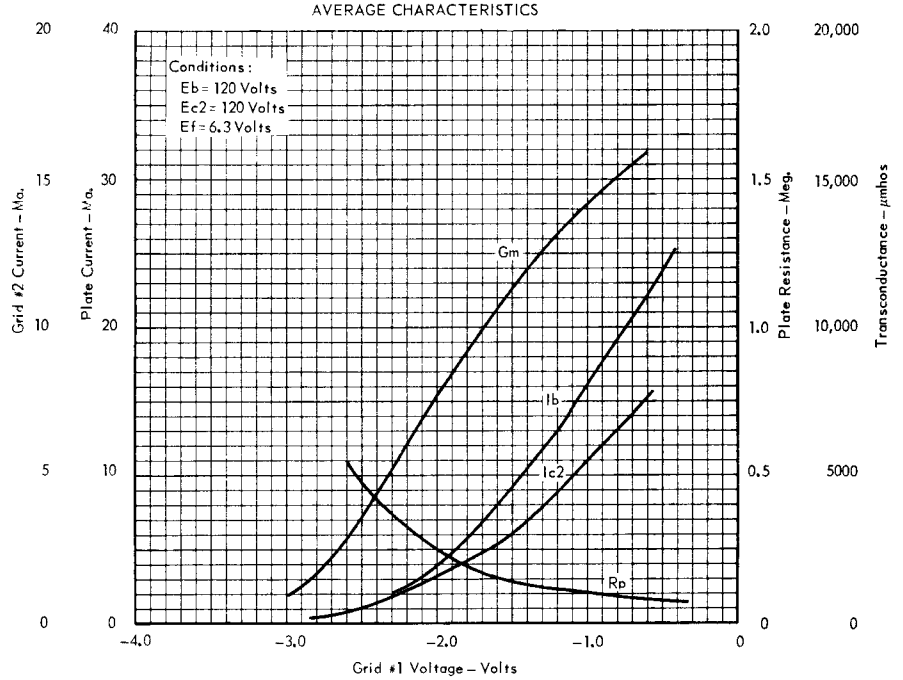
Heater Voltage	6.3	6.3	volts
Heater Current	0.3	0.3	A.
Plate Voltage	150	160	volts
Grid #2 Voltage	150	160	volts
Cathode Bias Resistance	110	600	ohms
Grid #1 Voltage	0	+8.5	volts
Plate Current	13.5	13.5	ma
Grid #2 Current	4.0	4.0	ma
Plate Resistance	0.2	0.2	meg
Transconductance	13,000	13,000	μmhos

Tentative Data

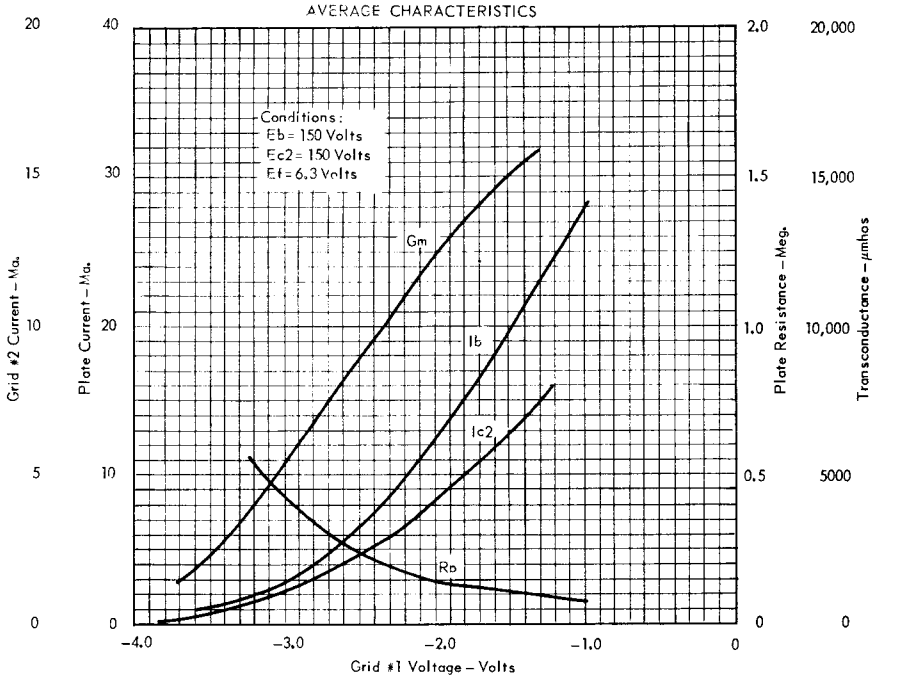
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PENTODE

AVERAGE CHARACTERISTICS

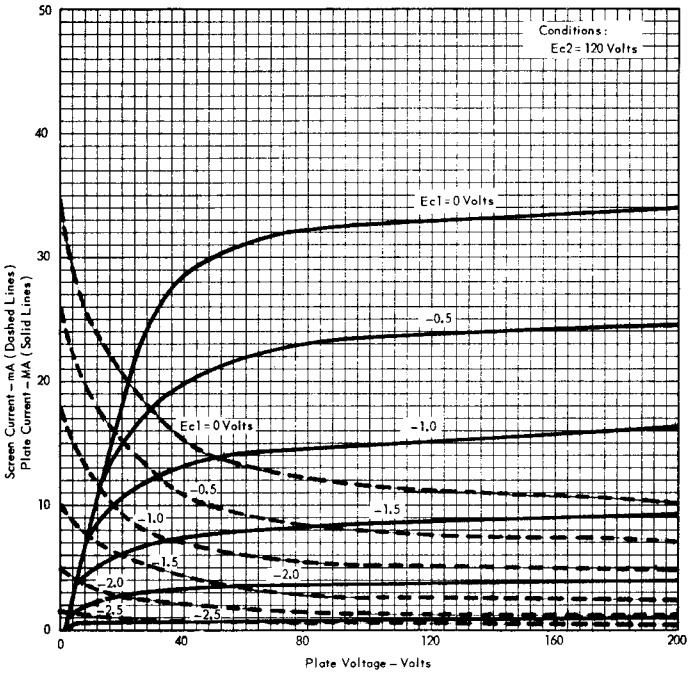


AVERAGE CHARACTERISTICS

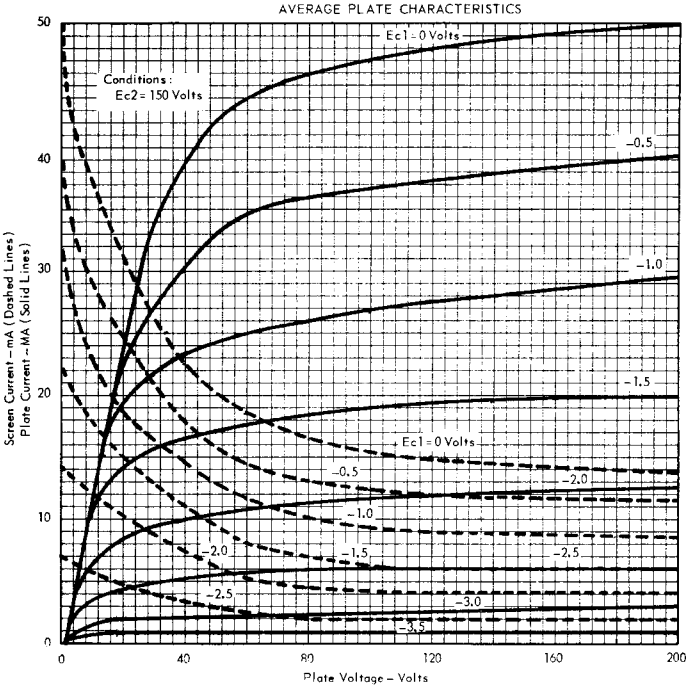


PENTODE

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



from RTMA release #1019,
Sept. 13, 1951

RAYTHEON

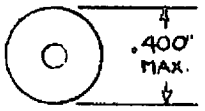
TYPE 5873

DOUBLE TRIODE

DESCRIPTION

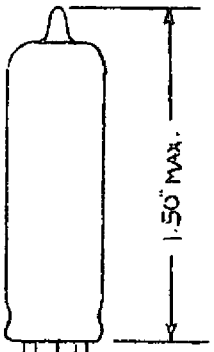
The 5873 is a heater-cathode type, medium mu, double triode of subminiature construction designed for general purpose service. It is particularly useful in applications requiring extreme economy of space and weight. It has electrical characteristics very similar to the miniature type 12AU7 and may be used in most 12AU7 applications without changing circuit values, providing the operating conditions are within the 5873 Design Center Maximum Ratings. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL DATA



Envelope: T-3 Glass

Base: Subminiature Button 8-Pin (0.016" tinned flexible leads. Length: 1.2" min.)



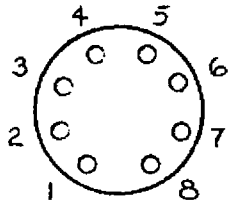
Terminal Connections:

Pin 1	Heater	Pin 5	Cathode, Unit #1
Pin 2	Plate, Unit #2	Pin 6	Grid, Unit #1
Pin 3	Grid, Unit #2	Pin 7	Plate, Unit #1
Pin 4	Cathode, Unit #2	Pin 8	Heater

Mounting Position: Any

ELECTRICAL DATA

Direct Interelectrode Capacitances:	Unshielded (umfds.)
Grid to Plate (Each Unit)	1.5
Grid to Cathode (Each Unit)	1.6
Plate to Cathode (Each Unit)	1.0
Grid to Grid	0.01
Plate to Plate	0.25
Heater to Cathode (Each Unit)	1.8



Bottom View

Design Center Maximum Ratings:		
Heater Voltage	6.3	volts
Plate Voltage	300	volts
Plate Dissipation (Each Unit)	1.60	watts
Cathode Current (Each Unit)	20	ma.
DC Heater-to-Cathode Voltage	±90	volts

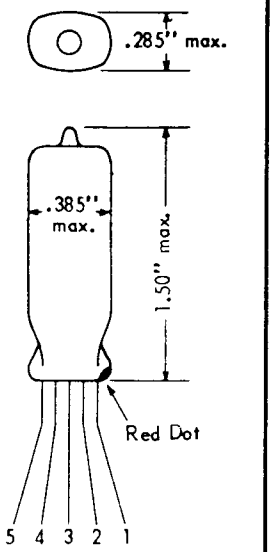
Characteristics and Typical Operation: -(Each Unit)			
Heater Voltage	6.3	6.3	volts
Heater Current	300	300	ma.
Plate Voltage	100	150	volts
Grid Voltage *	0	-3.0	volts
Plate Current	11.5	9.0	ma.
Transconductance	3600	2900	umhos
Amplification Factor	25	22	
Grid Voltage (approx.) for Plate Current = 50 ua.	11	14	volts

* Under maximum rated conditions, the dc resistance of the grid circuit should not exceed 1.0 megohms for cathode bias or .25 megohms for fixed bias operation.

Excellence in Electronics

TYPE CK5875

The CK5875 is a filament type, fully shielded, sharp-cutoff pentode of subminiature construction designed for use as a blocking oscillator in radiosonde applications. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0,20" length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive; Grid #3 ♦
Lead 3 Filament, Negative; Shield; Grid #3 ♦	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)*

Grid to Plate (g1 to p)	0.03 max.
Input: g1 to (f+g2+g3+shd.)	4.0
Output: p to (f+g2+g3+shd.)	4.0

RATINGS-ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25± 20% volts
Plate Voltage	100 volts
Grid #2 Voltage	100 volts
Total Cathode Current	7.0 ma.

CHARACTERISTICS AND TYPICAL OPERATION-CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	100 ma.
Plate Voltage	90 volts
Grid #2 Voltage	90 volts
Grid #1 Voltage	0 volts
Transconductance	2500 μmhos
Plate Current	3.5 ma.
Grid #2 Current	0.9 ma.
Grid #1 Voltage (approx.) for Gm= 10 μmhos	-3.5 volts

● *Bulb is entirely coated with a metallic shield connected to lead 3:*

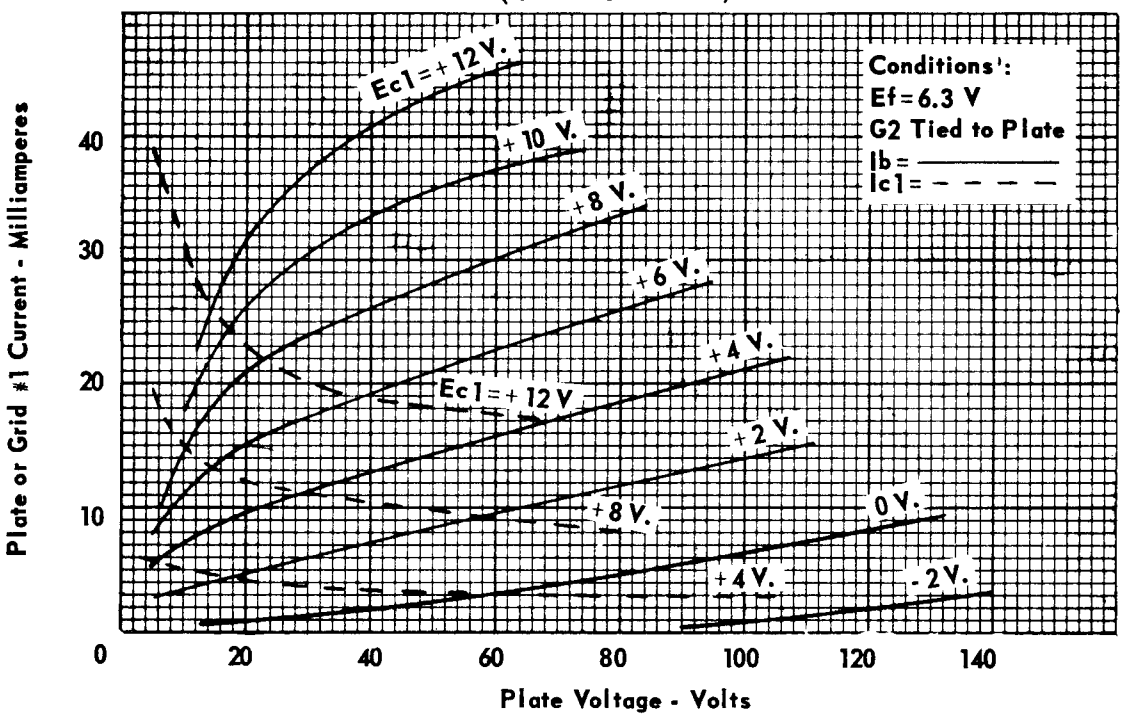
♦ *Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5.*

Tentative Data

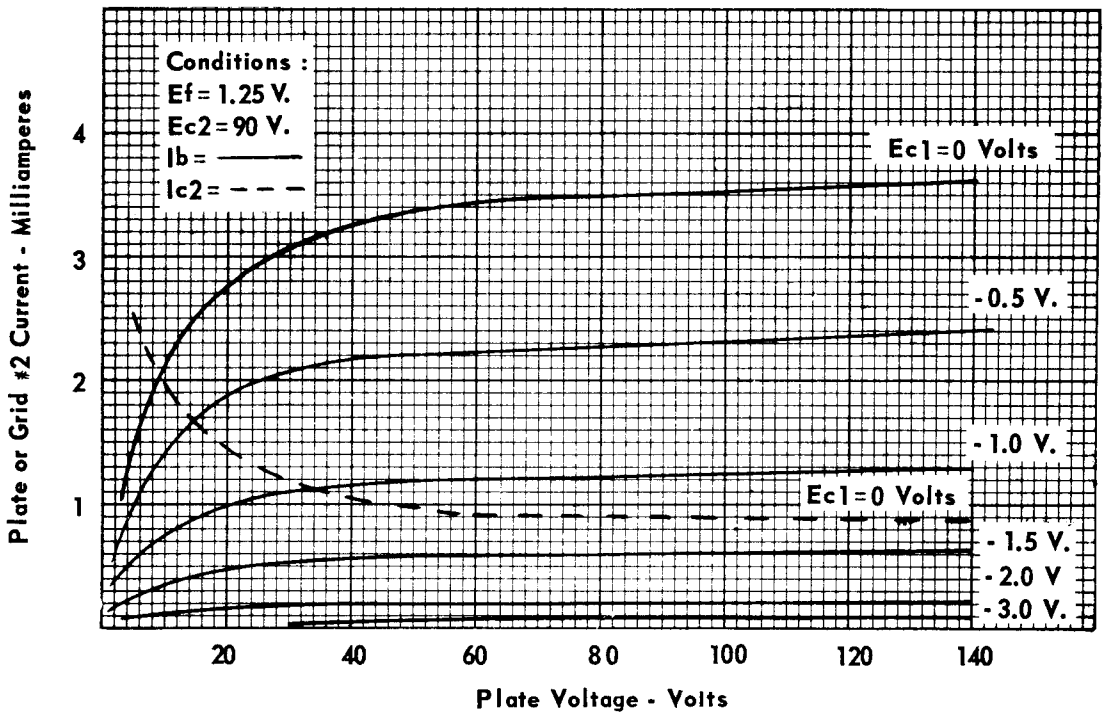
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SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



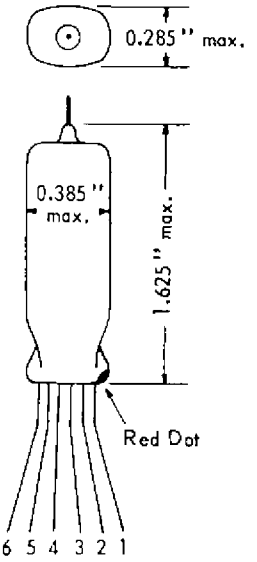
AVERAGE PLATE CHARACTERISTICS



Excellence in Electronics

TYPE CK5884

The CK5884 is a subminiature space-charge grid electrometer tube employing dual control grids and dual anodes designed primarily for use in balanced circuits for the measurement of extremely low current values.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: Pinch Press (0.016" dia. tinned flexible leads.
Length: 1.5" min. *
Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate, Unit #2	Lead 4 Space Charge Grid
Lead 2 Control Grid, Unit #2	Lead 5 Plate, Unit #1
Lead 3 Filament, Positive	Lead 6 Filament, Negative

Top Lead Control Grid, Unit #1

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltages (dc)	1.25±20%	volts
Plate Voltage	25	volts
Space Charge Grid Current	275	μAdc
Cathode Current	500	μAdc

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	volts
Filament Current	10	ma.
Plate Voltage	10.0	volts
Space-Charge Grid Current	100	μa.
Control Grid Voltage	-5.0	volts
Plate Current, per Plate	100	μa.
Amplification Factor, each Unit	1.05	
Transconductance, each unit	23	μmhos
Grid Current (Nominal)	1x10.14	amp.

OPERATION:

For operation at low current levels, top grid lead should be used as input grid. Envelope should be cleaned with methyl alcohol and allowed to dry thoroughly after which care should be taken to avoid contamination of the bulb by dirt or fingerprints. For best stability the tube should be operated in an electrostatic shield, and a dark enclosure to minimize photo-electron emission from the control grid and should be operated for a sufficiently long stabilizing period.

* *Excepting Top Lead which is 0.375" min. from top of bulb.*

These data identify a particular developmental tube design and the tube designation or the descriptive data may be subject to change or abandonment.

from JETEC release #1961, July 1, 1957

Objective Data

Printed in U.S.A.

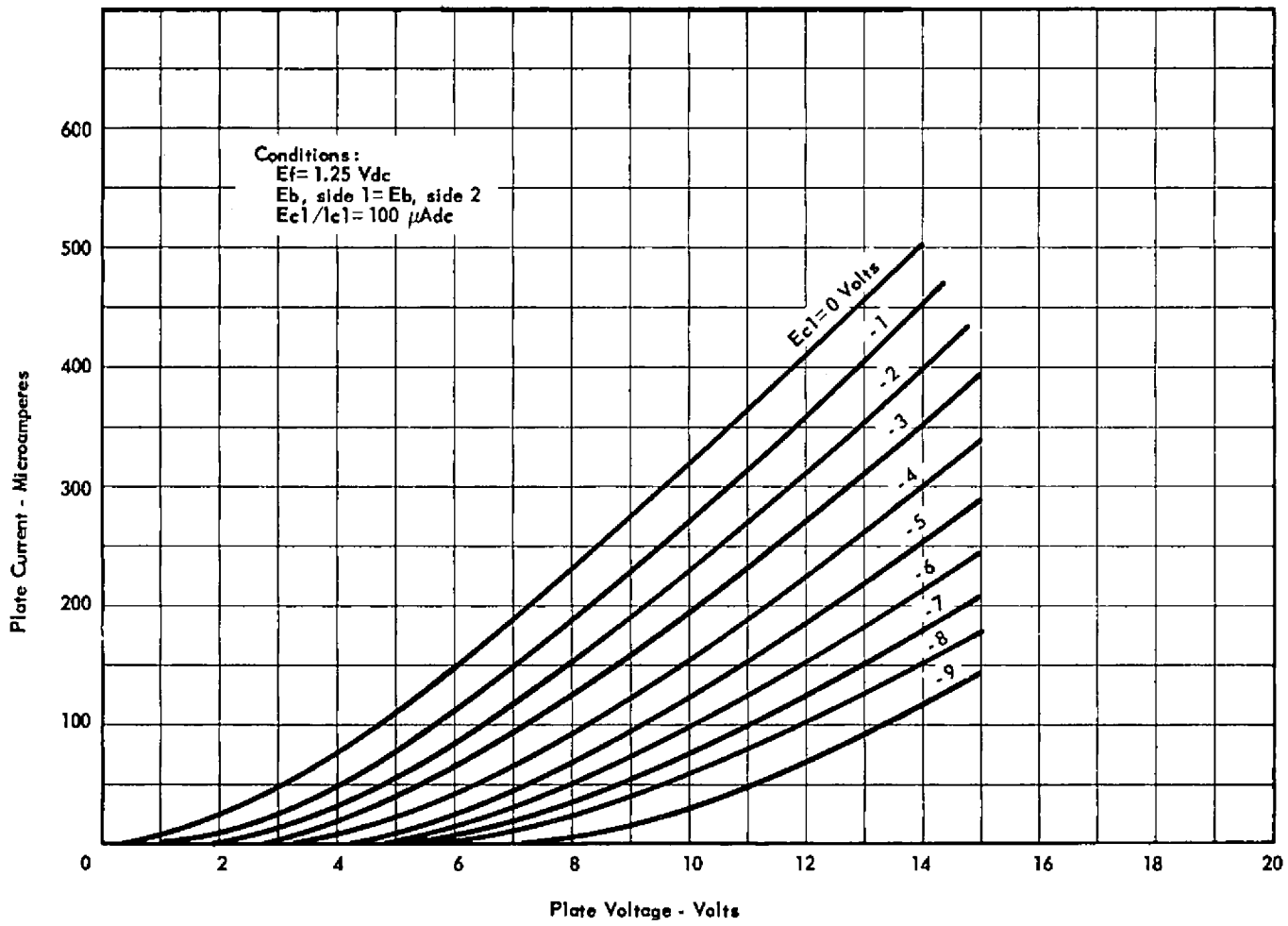
RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

March 30, 1956 NEWTON 58, MASS.

SUBMINIATURE ELECTROMETER TUBE

AVERAGE PLATE CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK5885

SUBMINIATURE DOUBLE TETRODE ELECTROMETER TUBE

Raytheon type CK5885 is a double tetrode electrometer tube designed for use in balanced circuits commonly employed in portable and wearable radiation instruments. Although rated as a triode, the use of a tetrode structure permits a greater degree of circuit flexibility.

Standard subminiature sockets may be used by cutting the leads to a 0.200" length, or the flexible terminal leads may be soldered or welded directly to circuit components.

ELECTRICAL DATA

FILAMENT CHARACTERISTICS

Filament Voltage	1.25	Volts
Filament Current	0.020	Amps

RATINGS - ABSOLUTE MAXIMUM VALUES

Filament Voltage	1.0 to 1.5	Volts
Plate Voltage	22.5	Volts
Grid #2 Voltage	22.5	Volts
Cathode Current, Each Unit	300	uAdc

AVERAGE CHARACTERISTICS Δ

Plate Voltage (tied to screen)	13.5	Volts
Grid Voltage	-3	Volts
Plate Current, Each Unit	185	uAdc
Amplification Factor, Either Unit	2.4	---
Transconductance, Each Unit	160	umhos
Grid Current (nominal)	1×10^{-12}	amps

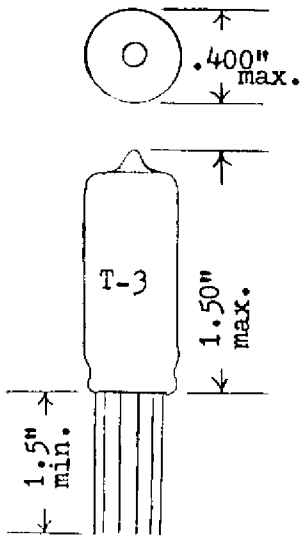
Δ Triode Connection - screen grid tied to plate

TENTATIVE DATA

MECHANICAL DATA

ENVELOPE..T3 glass
OUTLINE..JEDEC 3-2
(MIL 8-2)
BASE..E810, Sub-miniature button
LEADS...0.017" tinned Flexible Leads
MOUNTING POSITION..
ANY

OUTLINE DETAILS



8MB

TERMINAL CONNECTIONS

Lead 1	Control Grid, Unit 1
Lead 2	Screen Grid, Unit 1
Lead 3	Plate, Unit 1
Lead 4	Filament, Negative
Lead 5	Screen Grid, Unit 2
Lead 6	Control Grid, Unit 2
Lead 7	Plate, Unit 2
Lead 8	Filament, Positive

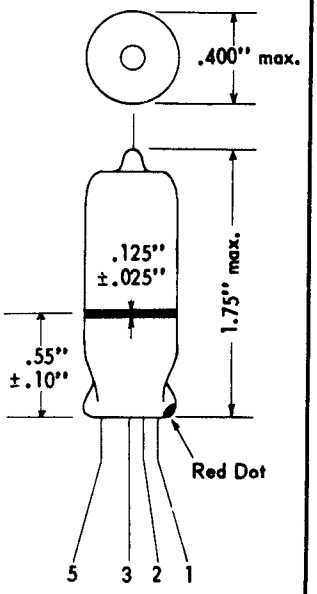
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from JEDEC release #3843, Aug. 13, 1962

Excellence in Electronics

TYPE CK5889

The CK5889 is a subminiature electrometer pentode with a 7.5 milliampere filament but otherwise electrically similar to type CK5886. The control grid is at the top of the bulb which is completely encircled by a permanently bonded guard ring. #



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. *
Spacing: Leads 3-5 0.10" center to center. Other Leads 0.05" center to center)

TERMINAL CONNECTIONS: *(Red dot adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Omitted
Lead 2 Screen Grid	Lead 5 Filament
Lead 3 Filament, Positive; One Deflector	Negative; One Deflector Top Lead Control Grid

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.55 volts
Plate Voltage	45 volts
Screen Voltage	45 volts
Cathode Current	300 μa

AVERAGE CHARACTERISTICS AND TYPICAL OPERATION: (Pentode Connection) ▲

Filament Voltage ■	1.25 volts
Filament Current	7.5 ma.
Plate Voltage	12 volts
Screen Grid Voltage ♦	4.5 volts
Control Grid Voltage	-2 volts
Plate Current	4 μa.
Screen Grid Current	4 μa.
Amplification Factor (approx.)	250
Transconductance	10 μmhos
Maximum Grid Current ●	3×10^{-15} amp.

\# *Connection to the guard ring should be made by means of a spring clip or a twisted wire lead.*

* *Excepting the control grid lead which is 0.375" min. from top of bulb.*

▲ *For the triode connection (Screen Grid connected to Plate) the average characteristics are: (Ep 10.5 V; Ec -3 V) Transconductance 150 μmhos; Plate Current 180 μA; Grid Current 10^{-13} A.*

■ *Nominal value for dry-cell operation. If the filament voltage is constant or nearly so for very long periods of time (as, for example, from a regulated supply in a line-operated instrument design) it is recommended that the design center value be reduced to 1.0 volt.*

♦ *In order to ensure operation in the desired region of the grid characteristic, the equipment design should provide for the adjustment of the operating plate current by means of a variable screen grid supply rather than a variable control grid supply. The recommended range is 3.0 to 6.0 volts.*

● *The grid current is determined at the rated filament voltage, plate voltage, control grid voltage and plate current. The screen grid voltage is varied as per the preceding note.*

NOTES ON GRID CURRENT MEASUREMENTS

1. ELECTRICAL CONDITIONS:

(a) The tube under test should be supplied with rated plate voltage, screen voltage, filament voltage and control grid bias, with the exception that, in the case of an operational condition aimed at the lowest possible grid current, it is preferable to fix the bias and adjust the screen voltage to give the required plate current within the limits of 3.0 to 6.0 volts, Esg.

(b) The stability of the supply potentials (including temperature stability) should be consistent with the expected grid current level together with a reasonable measuring time for a grid current determination. (See 3-d)

Tentative Data

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RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS
NEWTON 58, MASS.

NOTES ON GRID CURRENT MEASUREMENTS (cont'd)

2. ENVIRONMENTAL CONDITIONS:

(a) The tube must be shielded from electric and magnetic fields as well as from all forms of radiant energy, including light, gamma rays, X-rays, Grenz rays and high-energy particles such as deuterons, protons and electrons.

(b) If the surrounding gas is at atmospheric pressure or approximately so, the relative humidity should be no higher than 20%. No surface treatment known (including dri-film, ceresin wax, etc., etc.) is as effective, at 50% or higher R.H., as a clean surface at 20% R.H. or less.

(c) Where drift is important, the temperature coefficients of other components, particularly the dielectrics in the exterior portion of the grid circuit, is usually the limiting factor rather than any temperature effects of the tube itself.

3. GRID RESISTOR TECHNIQUE

Although complete information must be available concerning the temperature coefficient, voltage coefficient and polar characteristics of the grid resistor used, this method is never the less the most convenient for a grid current measurement of a precision commensurable with the measuring time. Certain precautions, however, should be observed:

(a) The plate current shift should be measured when the grid resistor is shorted out.

(b) The plate current, upon cutting the resistor into the circuit, should be allowed either (1) at least five minutes to stabilize or (2) time enough so that the drift, referred to the grid, is not much more than one or two millivolts per minute. This latter presupposes that the resistor is 10^{12} ohms and the expected grid current is 1 or 2×10^{-15} amps.

(c) The circuit should be arranged, if possible, so that C-(rather than A-) is grounded. This allows the use of a grounded resistor switch designed with a minimum of insulation.

(d) The grid circuit should be "padded" with a capacitance of the order of 20 or 25×10^{-12} F. Values appreciably higher than this build up an intolerable time constant while lower values begin to give considerable trouble from polar phenomena due to charges left on dielectrics (both interior and exterior to the tube) by the switching transient

(e) The padding condenser should be designed so that at least 90% of its total capacitance is across an air dielectric, with the insulating member in a relatively weak part of the field. Such a design will reduce polar phenomena at this point to an irreducible minimum.

(f) The high side of the grid circuit should be grounded before opening the enclosure to change the tube under test. The relaxation times for dielectric absorption and decay currents associated with these dielectrics (including the grid resistor itself which is virtually a semi-conductor) are such that the mere act of touching an ungrounded circuit can (and often does) leave a charge which, in terms of millivolts, requires several hours to decay completely.

4. GRID CAPACITANCE TECHNIQUE

The classical method of determining grid current by measuring the absolute value of the grid capacitance and using this value together with the transconductance and the rate of change of the plate current as in:

$$C\,dEg = T\,dIp$$

is not recommended. At extremely low grid currents (10^{-15} amperes or less) polar phenomena cannot be separated from the charge being measured without observational studies extending into hours if not days while at slightly higher currents more direct methods are preferable

5. CLEANING

Tubes subjected to excessive handling should be re-cleaned at the time of the grid current test. For this purpose alcohol is adequate unless severe contamination is suspected, in which case the alcohol dip may be preceded by other well-known glass cleaning agents. The container for the alcohol should be deep enough to allow dust, etc., from previous tubes to settle.

6. GENERAL

No tube of this class can be expected to show rated grid current in a few minutes of operation following a protracted period (a few weeks) of idleness. A re-distribution of residual gas molecules takes place when the filament is first raised to the temperature of operation and the practical result is an exponential decline of grid current with a time constant depending on:

(a) Total time the tube has been operated.

(b) Time since last operation.

(c) Required operating grid current level.

In equipments entailing the most exacting requirements, continuous operation is recommended.

ELECTROMETER CIRCUIT BIBLIOGRAPHY

1.	A Feedback Micromicroammeter	RSI, June 1939	S. Roberts
2.	A Feedback D-C Meter	Electronics, Sept. 1938	J. M. Brumbaugh & A. W. Vance
3.	Electrometer Input Circuits	Electronics, Dec. 1946	H. A. Thomas

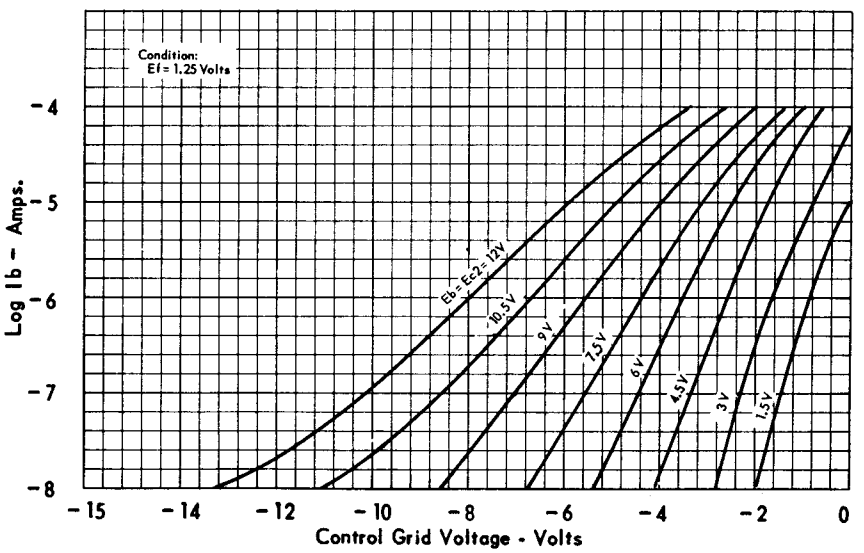
ELECTROMETER CIRCUIT BIBLIOGRAPHY (cont'd)

4.	An Improved Vacuum Tube Microammeter	RSI, Dec. 1936	A. W. Vance
5.	An Improved D-C Amplifier for Portable Ionization Chamber Instruments	RSI, Apr. 1951	N. F. Moody
6.	Improvements in the Stability of the F P-54 Electrometer Tube	Jour. of App. Physics, Nov. 1945	J. M. Lafferty & K. H. Kingdon
7.	Direct-Current Amplifier Circuits for Use with the Electrometer Tube	RSI, Apr. 1935	D. B. Penick
8.	An Improved Balanced Circuit for Use with Electrometer Tubes	RSI, Aug. 1933	L. A. Turner & C. O. Siegelin
9.	A Balanced Electrometer Tube and Amplifying Circuit for Small Direct Currents	RSI, Apr. 1934	G. P. Harnwell & S, N. Van Voorhis
10.	An Improved D-C Amplifying Circuit	RSI, Oct. 1933	L. A. DuBridge & H. Brown

N. B. References 1 to 5 deal with feedback circuits in which considerable gain is realized in the electrometer input stage. References 6 to 10 are concerned with the classical type of balanced circuit working directly into the galvanometer.

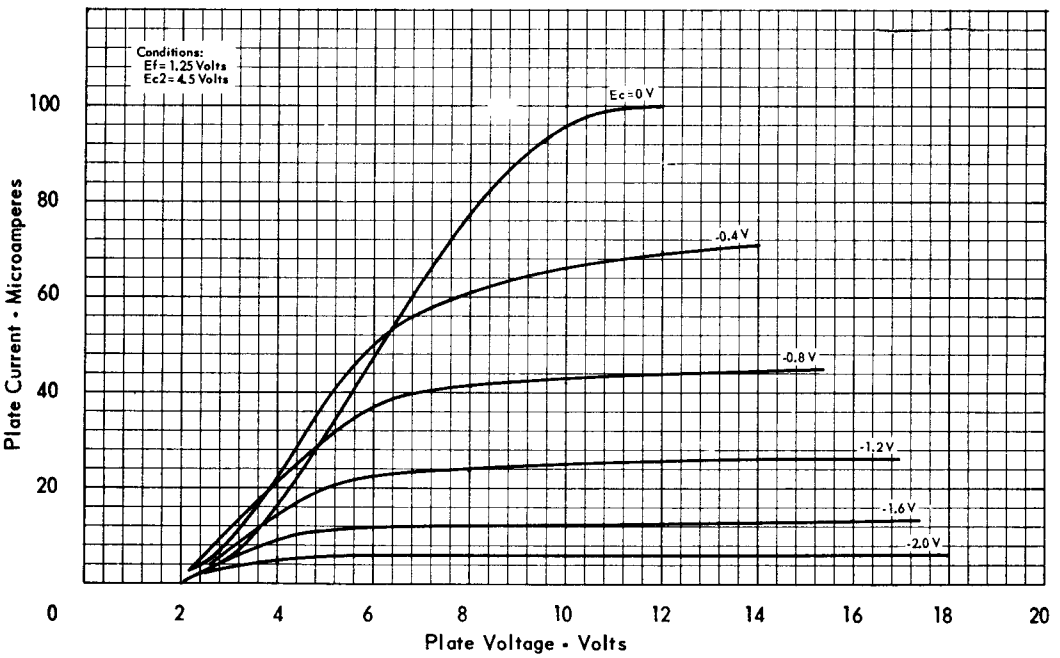
The CK5889 cannot be operated at low control grid currents in the space-charge connection because the amplification factor, G_2 to P, is much too high (approximately 125).

AVERAGE TRANSFER CHARACTERISTICS

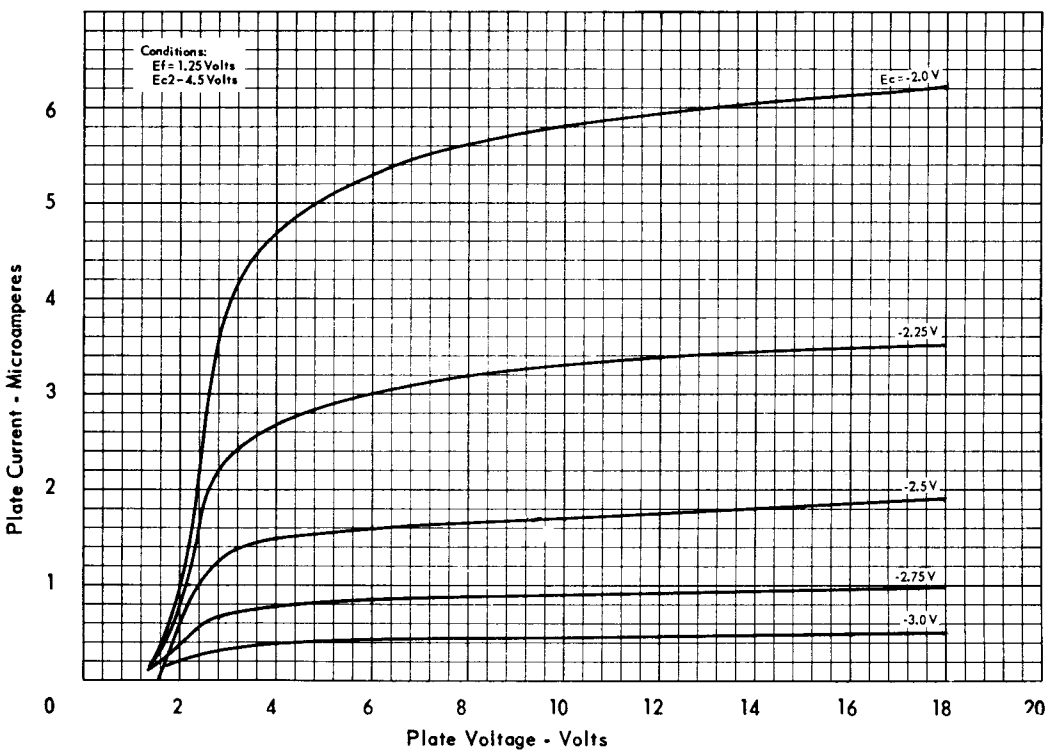


SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



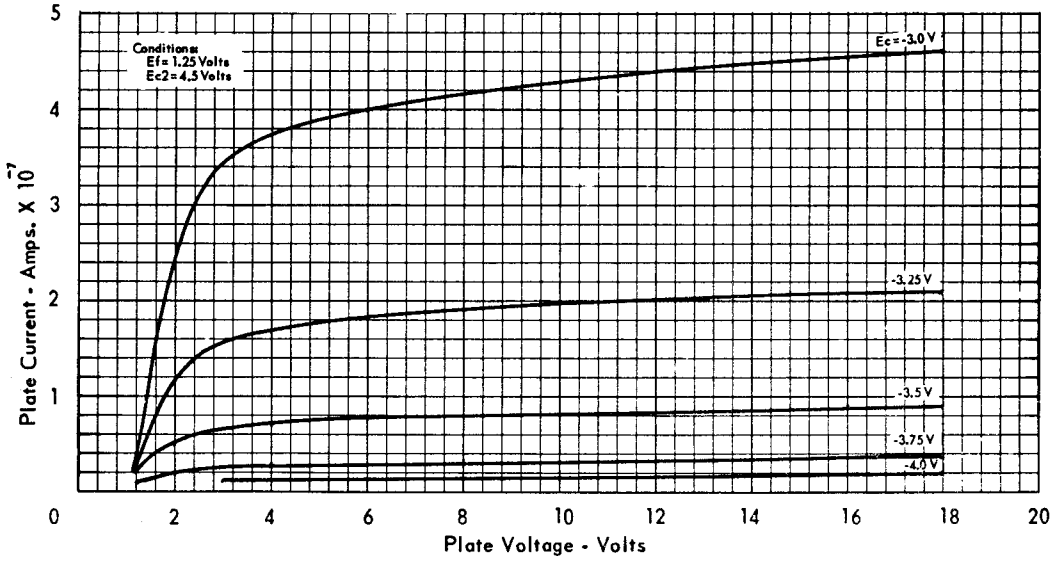
AVERAGE PLATE CHARACTERISTICS



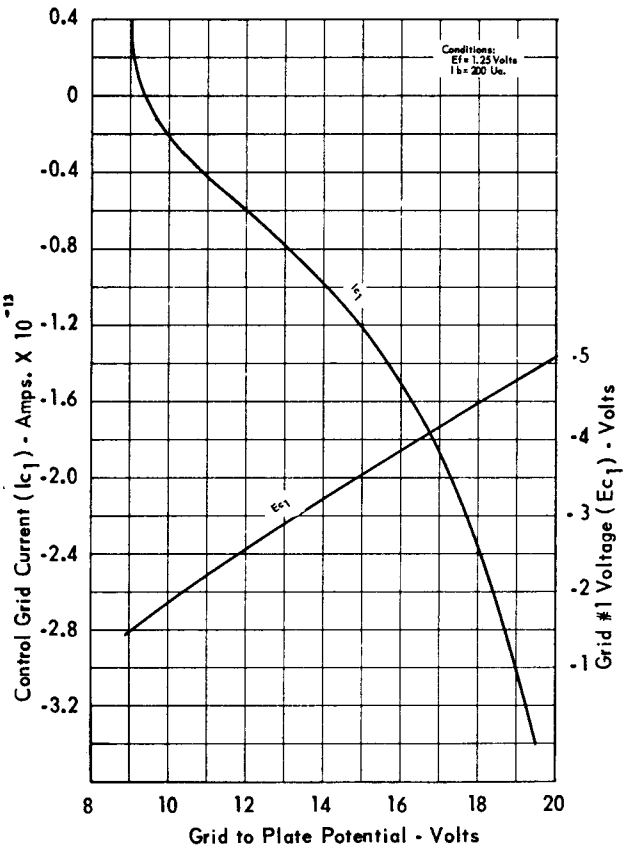
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SUBMINIATURE PENTODE

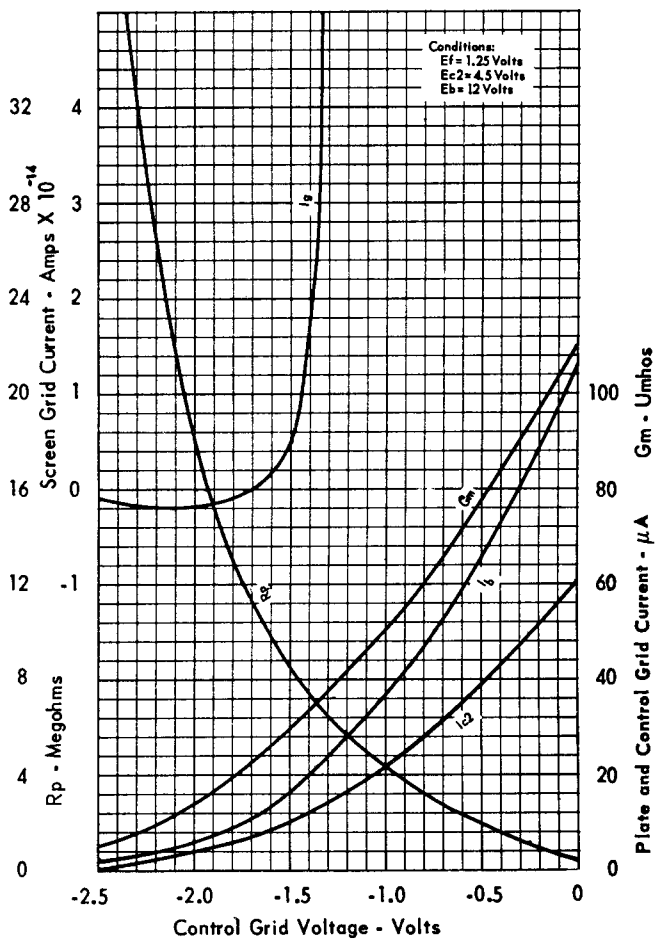
AVERAGE PLATE CHARACTERISTICS



GRID CURRENT vs. GRID TO PLATE POTENTIAL
Triode Connected
(Control Grid Voltage)

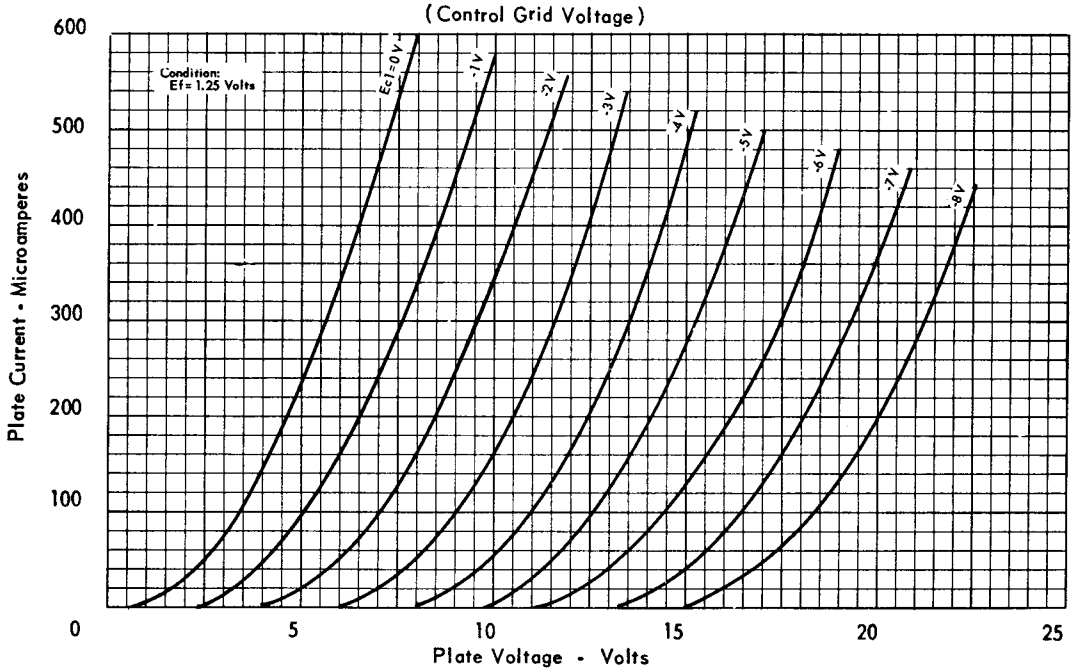


AVERAGE TRANSFER CHARACTERISTICS



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AVERAGE PLATE CHARACTERISTICS
Triode Connected
(Control Grid Voltage)



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK5899
CK6206

SUBMINIATURE SEMI-REMOTE PENTODES

The CK5899 and CK6206 are heater-cathode type semi-remote cut-off RF pentodes of subminiature construction capable of operation in the UHF region. Type CK6206 is identical to type CK5899 except for an external suppressor grid connection. These types are characterized by long life and stable performance in service where severe conditions of high temperature, high altitude and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock)	450	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Maximum Bulb Temperature	220	°C
Altitude	80,000	Ft.

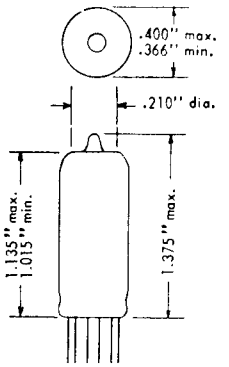
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Ratings			
Heater Voltage	Ef:	6.0	---	6.3	6.6	V
Plate Voltage	Eb:	---	---	100	165	Vdc
Grid Voltage	Ec1:	-55	---	0	0	Vdc
Grid #2 Voltage	Ec2:	---	---	100	155	Vdc
Grid #3 Voltage (Note A)	Ec3:	---	---	0	22	Vdc
Heater-Cathode Voltage	Ehk:	---	---	0	200	v
Cathode Resistance	Rk:	---	---	120	---	ohms
Grid Resistance	Rg1:	---	---	---	1.1	Meg
Cathode Current	Ik:	---	---	---	16.5	mAdc
Plate Dissipation	Pp:	---	---	---	0.85*	W
Grid #2 Dissipation	Pg2:	---	---	---	0.25*	W
*Design Maximum						
			Tests			
Plate Current (1)	Ib:	5.2	7.2	---	9.2	mAdc
Grid #2 Current	Ic2:	1.0	---	---	3.0	mAdc
Heater Current	If:	140	150	---	160	mA
Transconductance (1)	Gm:	3800	4500	---	5200	μmhos
Heater Cathode Leakage, Ehk = ± 100 Vdc	Ihk:	---	---	---	5.0	μAdc
Vibration (2) Low frequency F = 40 cps; G = 15; Rp = 10,000; Ck = 1000 μf	E_p	---	---	---	60	mVac

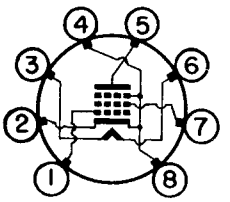
MECHANICAL DATA

ENVELOPE T-3
OUTLINE . . . . . JEDEC (3-1)
BASE . . . . . E8-10 Subminiature Button (0.017" tinned flexible leads. Length: 1.5" min.)
CATHODE . . . . . Coated Unipotential
MOUNTING POSITION . . . . . Any

PHYSICAL DIMENSIONS



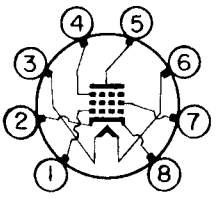
BASING—CK5899



TERMINAL CONNECTIONS: – 8DL

Lead 1 Grid #1
Lead 2 Cathode and Grid #3
Lead 3 Heater
Lead 4 Cathode and Grid #3
Lead 5 Plate
Lead 6 Heater
Lead 7 Grid #2
Lead 8 Cathode and Grid #3

BASING—CK6206



TERMINAL CONNECTIONS: – 8DC

Lead 1 Grid #1
Lead 2 Cathode and Shield
Lead 3 Heater
Lead 4 Grid #3
Lead 5 Plate
Lead 6 Heater
Lead 7 Grid #2
Lead 8 Cathode and Shield

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Ratings and Normal Operation:	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Tests (Continued)			
Transconductance (2) Ef = 5.7 V	Δ_{Ef}Gm:	---	---	---	10	%
Transconductance (3)	Gm:	1.0	25	---	75	μmhos
Plate Resistance	rp:	0.175	---	---	---	Meg
Interelectrode Capacitance 0.405 in. dia. shield	Cg1p:	---	---	---	0.015	pf
	Cin:	3.5	---	---	4.5	pf
	Cout:	2.9	---	---	3.9	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5G. Sample subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97 – 100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.0 V; Ehk = 140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits, or heater to cathode shorts.

Stability Life Test – Sample is operated for one hour to assure initial electrical stability (Δ_t Sm < 10%). Ehk = +200 Vdc; Rg1 = 1.0 Meg; TA = room.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability, (Gm > 3350 μmhos) and freedom from inoperatives. Tubes are operated under stability life-test conditions.

Intermittent Life Test – 500 hours. Sample is operated with minimum Envelope Temperature of 220°C, at stability life-test conditions. 1000 hours for information.

Altitude – Sample is subjected to a pressure of 21 ± 2 mmHg (80,000 ft.) at 300 Vac to assure freedom from flashover or corona at the leads of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

NOTE A: Types CK5899 and CK6206 are the same except for suppressor grid and cathode connections. The Ec3 column in the heading applies only to type CK6206. Type CK6206 has not been designed for control or gating purposes using the No. 3 grid.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 1)						Unit
						Min	LAL	Bogie	UAL	Max	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION INSPECTION (see note 2)												
---	Cathode	Coated unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	Outline E6-10	---	---	---	---	---	---	---	---	---	---
ACCEPTANCE INSPECTION, PART 1 (Production) (see note 3)												
4.7.5	Continuity and Short Tests (for reliable tubes) (inoperatives)		0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical production tests	Outline 8-1	---	---	---	---	---	---	---	---	---	---
4.10.4.1	Plate Current (1)		---	---	Ib	---	6.4	7.2	8.0	---	2.3	mAdc
4.10.4.1	Plate Current (1)		0.65	II	Ib	5.2	---	---	---	9.2	---	mAdc
4.10.4.3	Screen-Grid Current		0.65	II	Ic2	1.0	---	---	---	3.0	---	mAdc
4.10.6.1	Total Grid Current	Eb = Ec2 = 150 Vdc; Rk = 390; Rg1 = 1.0 Meg	0.65	II	Ic1	0	---	---	---	0.3	---	μAdc
4.10.8	Heater Current		---	---	If	---	144	150	156	---	12	mA
4.10.8	Heater Current		0.65	II	If	140	---	---	---	160	---	mA
4.10.9	Transconductance (1)		---	---	Sm	---	4200	4500	4800	---	800	μmhos
4.10.9	Transconductance (1)		0.65	II	Sm	3800	---	---	---	5200	---	μmhos
4.10.15	Heater-Cathode Leakage	Ehk = + 100 Vdc Ehk = - 100 Vdc	0.65	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	5.0 5.0	--- ---	μAdc μAdc
---	Suppressor	(See note 4)	0.4	II	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 1)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
ACCEPTANCE INSPECTION, PART 2 (Design)												
4.8	Insulation of electrodes	g1 – all p – all	2.5	I	R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.9.12.1	Low-pressure voltage breakdown	Pressure = 21 ± 2 mmHg; voltage = 300 Vac	6.5	(See note 5)	---	---	---	---	---	---	---	---
4.9.19.1	Low-frequency vibration (2)	F = 40 cps; G = 15; Rp = 10,000; Ck = 1,000 μf	2.5	I	Ep	---	---	---	---	60	---	mVac
4.9.20.3	Variable-frequency vibration (1)	No voltages; post shock and fatigue test end points apply	10.0	(See note 5)	---	---	---	---	---	---	---	---
4.10.3.2	Audio-frequency noise	Esig = 70 mVac; Ec2 = 19 Vdc; Rg1 = 0.1 Meg; Rg2 = 1,000; Rp = 0.2 Meg; Ck = 1,000 μf (see note 6)	2.5	I	---	---	---	---	---	---	---	---
4.10.6.2	Grid Emission	Ef = 7.5 V; Ec1 = −14 Vdc; Rg1 = 1.0 Meg; Rk = 0 (see note 7)	2.5	I	Ic1	0	---	---	---	−0.5	---	μAdc
4.10.9	Transconductance (2)	Ef = 5.7 V	2.5	I	$\Delta_{Ef}Sm$	---	---	---	---	10	---	%
4.10.9	Transconductance (3)	Ec1 = −14 Vdc; Rk = 0	2.5	I	Sm	1.0	---	25	---	75	---	μmhos
4.10.10	Plate Resistance		6.5	L6	rp	0.175	---	---	---	---	---	Meg
4.10.14	Direct Interelectrode capacitance	0.405 in. dia. shield 0.405 in. dia. shield 0.405 in. dia. shield	6.5	Code F	Cg1p Cin Cout	--- 3.5 2.9	--- --- ---	--- --- ---	--- --- ---	0.015 4.5 3.9	--- --- ---	pf pf pf
ACCEPTANCE INSPECTION, PART 3 (Degradation rate) (see note 8)												
4.9.5.3	Subminiature lead fatigue		2.5	Code F	---	4	---	---	---	---	---	arcs
4.9.20.5	Shock test	Hammer angle = 30°; Ehk = + 100 Vdc (see note 9)	---	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min. 60 max.	6.5	(See note 5)	---	---	---	---	---	---	---	---
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep	---	---	---	---	200	---	mVac
		Heater-cathode leakage										
		Ehk = + 100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Ehk = − 100 Vdc	---	---	Ihk	---	---	---	---	20	---	μAdc
		Change in transconductance (1) of individual tubes	---	---	$\Delta_t Sm$	---	---	---	---	20	---	%
4.9.6.3	Glass strain (for receiving tubes)		6.5	I	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defectives per Characteristic		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
ACCEPTANCE INSPECTION, PART 3 (Life) (see note 8)										
4.11.7	Heater-cycling life test	Ef = 7.0 V; 1 min. on, 4 min. off; Ehk = 140 Vac; Ec1 = Ec2 = Eb = Ec3 = 0 (see note 10)	2.5	Code II	---	---	---	---	---	---
4.11.3.1(a)	Stability life test (1 hour)	Ehk = + 200 Vdc; Rg1 = 1.0 Meg; TA = room (see note 11)	1.0	Code I	---	---	---	---	---	---
4.11.4	Life test end points (stability)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_t Sm	---	10	%
4.11.3.1(b)	Survival-rate life test	Stability life test conditions, or equivalent; TA = room (see notes 12 and 13)	---	II	---	---	---	---	---	---
4.11.4	Life test end points (survival rate)	Continuity and short (Inoperatives)	0.65	---	---	---	---	---	---	---
		Transconductance (1)	1.0	---	---	---	Sm	3350	---	μmhos
4.11.5	Intermittent life-test (operation)	Stability life test conditions; T (envelope) = +220°C min (see notes 14 and 15) 1000-hour requirements do not apply	---	---	---	---	---	---	---	---
4.11.4	Life test end points (intermittent) (500 hours)	(See note 16)								
		Inoperatives (see note 17)	---	---	1	3	---	---	---	---
		Grid current	---	---	1	3	Ic1	0	−0.8	μAdc
		Heater current	---	---	2	5	If	138	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_t Sm	---	20	%
		Transconductance (2)	---	---	2	5	Δ_{Ef} Sm	---	15	%
		Heater-cathode leakage								
		Ehk = + 100 Vdc	---	---	2	5	Ihk	---	10	μAdc
		Ehk = − 100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes								
		g1 − all	---	---	2	5	R	50	---	Meg
		p − all					R	50	---	Meg
		Transconductance (1) average change	---	---	---	---	Avg Δ_t Sm	---	15	%
		Total defectives	---	---	4	8	---	---	---	---
4.11.5	Intermittent life test operation (1000 hours) (information)	Intermittent life test conditions (see notes 15, 18 and 19)	---	---	---	---	---	---	---	---
4.9.18	Container drop	(d) Package group 1; container size C								

NOTES:

Note 1. Variable sampling. See 4.1.1.7.

Note 2. All tests listed hereon shall be performed during qualification inspection; however, these two tests are normally performed during qualification inspection only.

Note 3. The AQL for the combined defectives for attributes in acceptance inspection (production) part 1, excluding inoperatives and mechanical, shall be 1 percent.

Note 4. Reject for open suppressor if plate current does not decrease by a minimum of 10 percent when Ec3 is changed from 0 to −100 Vdc. This test is applicable only to tube type CK6206.

Note 5. This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test, until a lot passes. Standard MIL-STD-105, sample size code letter F, shall apply.

Note 6. The rejection level shall be set at the VU meter reading obtained during calibration.

Note 7. Prior to this test, tubes shall be preheated 5 minutes at conditions indicated below. Test within 3 seconds after preheating. A 3-minute test is not permitted. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef	Ec1	Ec2	Ec3	Eb	Rk	Rg1
V	Vdc	Vdc	Vdc	Vdc	ohms	Meg
7.5	0	100	0	100	120	1.0

Note 8. Destructive tests. Tubes subjected to the following destructive tests are not to be delivered on the contract or order.

4.9.5.3	Subminiature lead fatigue
4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.7	Heater-cycling life test
4.11.5	Intermittent life-test operation

Note 9. A grid resistor of 0.1 Meg shall be added; however, this resistor will not be used when a thyratron-type short indicator is employed.

Note 10. The no-load to steady-state full-load regulation of the heater-voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open-cathode circuit, or heater-cathode short.

Note 11. Stability life test. The sampling and testing procedures for this test shall be as specified in 20.2.5.1 of Appendix C.

Note 12. Survival-rate life test. The sampling and testing procedures for this test shall be as specified in 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 13. For survival-rate life test, the equivalent stability life-test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

Note 14. Intermittent life-test operation. Sampling and acceptance procedures for these tests shall be as specified in 20.2.5.3 of Appendix C.

NOTES (Cont'd.)

Note 15. Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B and S, or smaller diameter elements welded to a ring of 0.025-inch diameter phosphor bronze placed in contact with the envelope. The envelope temperature requirement will be satisfied if a tube, having bogey Ib (±5 percent) under normal conditions, is determined to operate at or above the minimum specified temperature in any socket of the life-test rack.

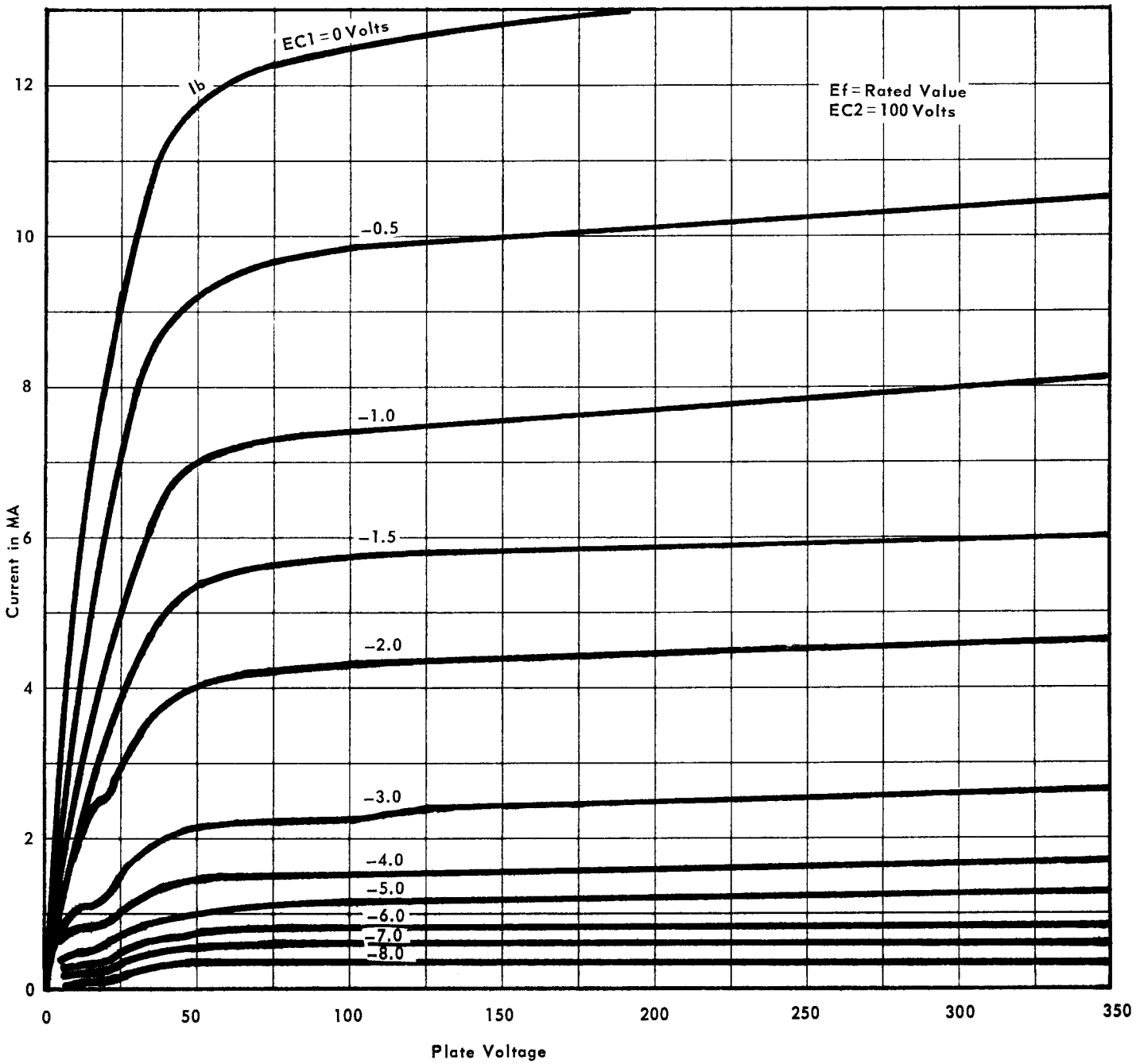
Note 16. Order for evaluation of life-test defects. See 4.11.3.1.2.

Note 17. An inoperative as referenced in life test is defined as a tube having one or more of the following defects: discontinuity (see 4.7.1), permanent shorts (see 4.7.2), air leaks (see 4.7.6).

Note 18. On information life tests, read same characteristics as for intermittent life test. Limits do not apply. Six copies of this data shall be forwarded to the Armed Services Electro-Standards Agency for distribution and file.

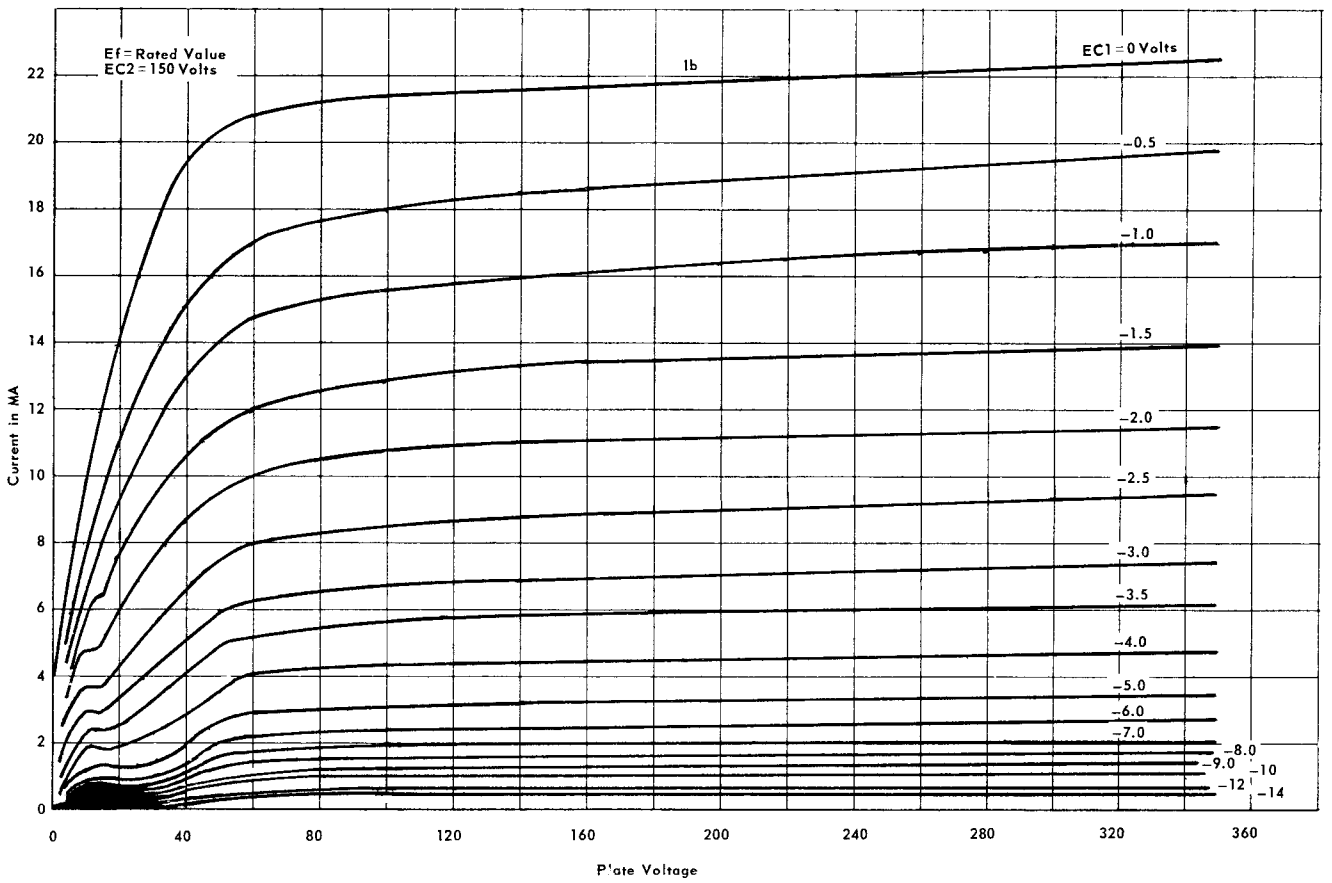
Note 19. This life test shall be conducted on a minimum of one sample of 10 tubes each month of production. This sample shall be selected as the first 10 serially marked, noninoperative tubes from a completed intermittent life-test sample. This life test shall be classified as a destructive test. Read at 1,000 hours.

AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)

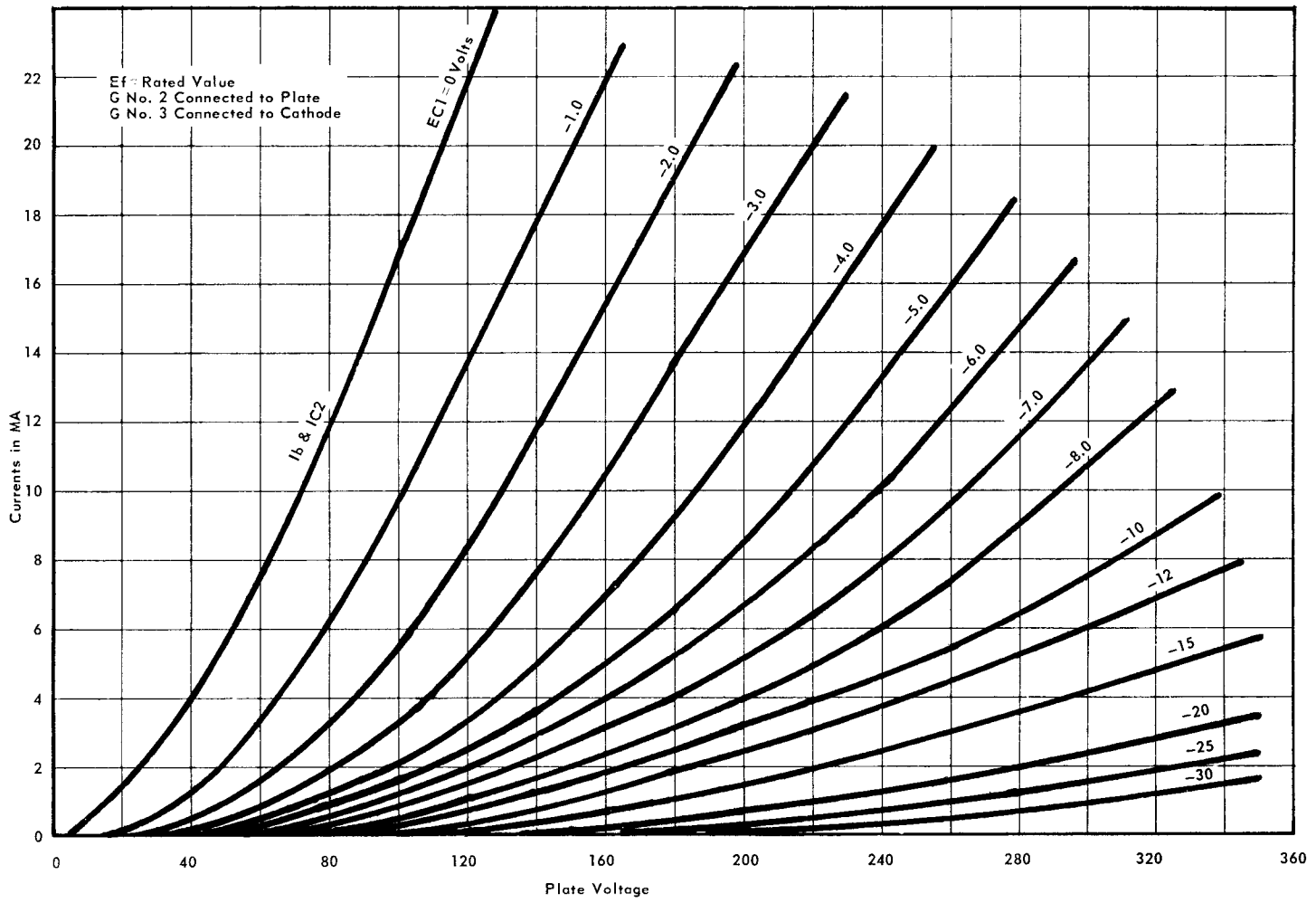


SUBMINIATURE SEMI-REMOTE PENTODES

AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)

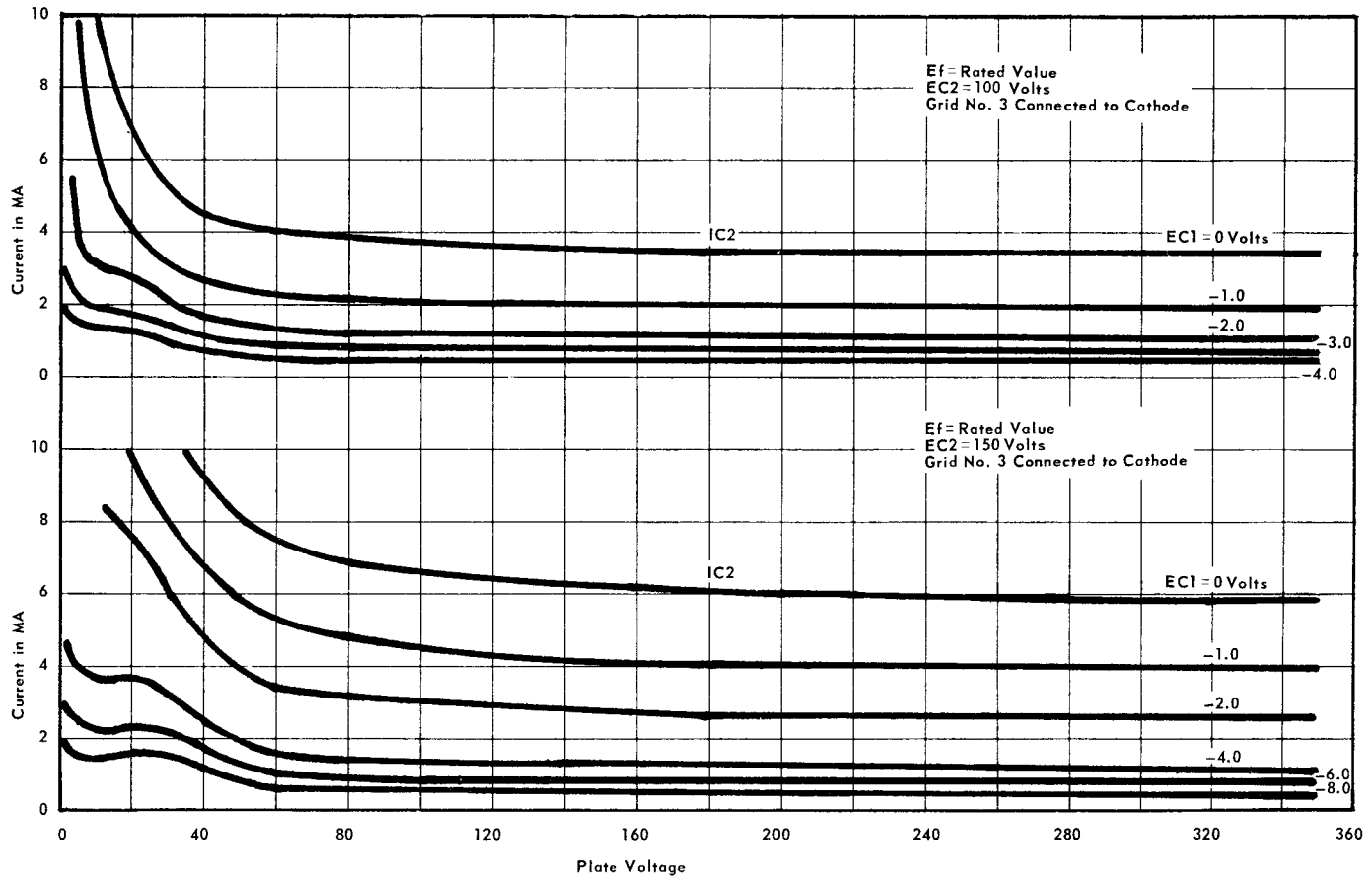


AVERAGE PLATE CHARACTERISTICS
(Triode Connected)

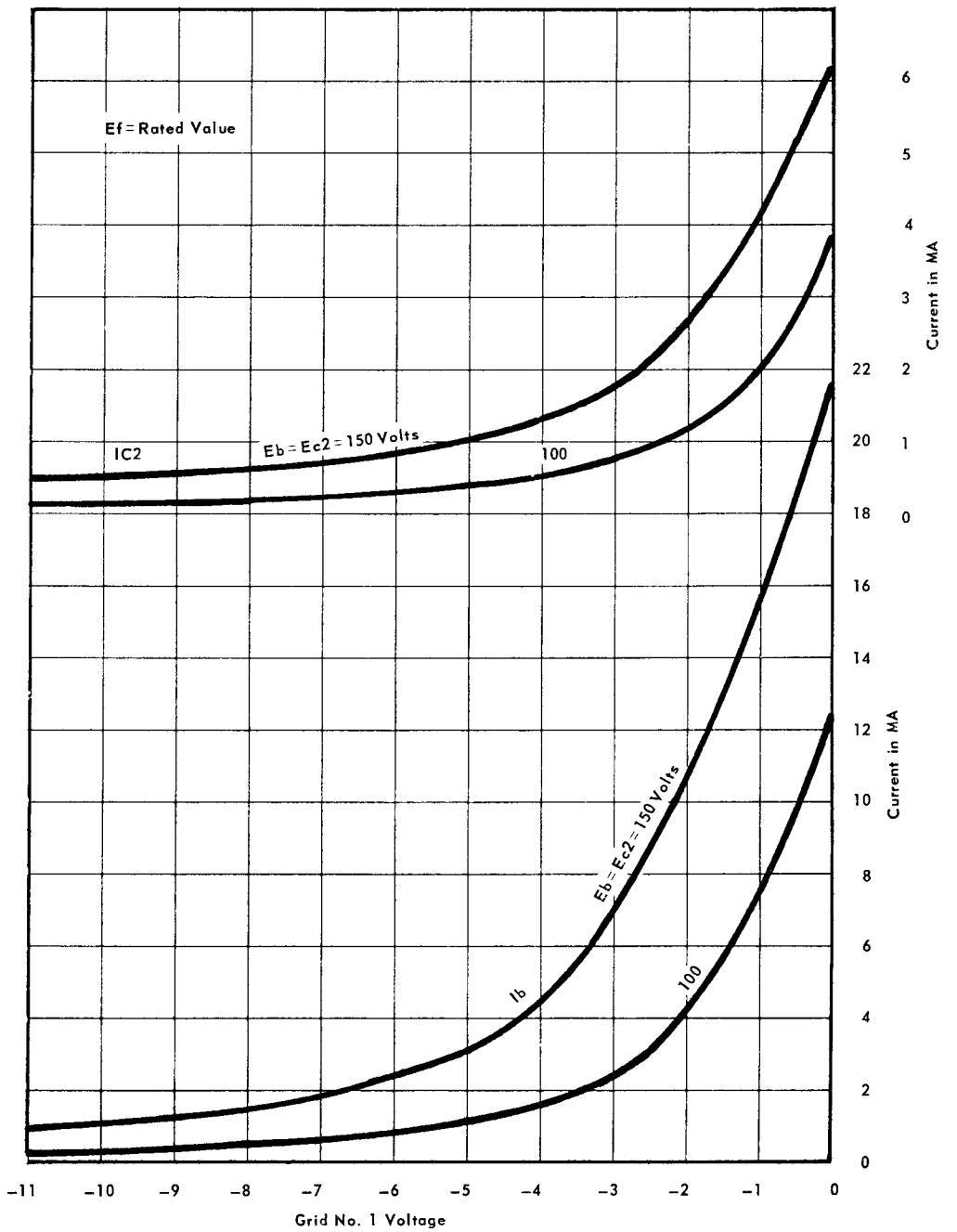


SUBMINIATURE SEMI-REMOTE PENTODES

AVERAGE GRID NO. 2 CHARACTERISTICS

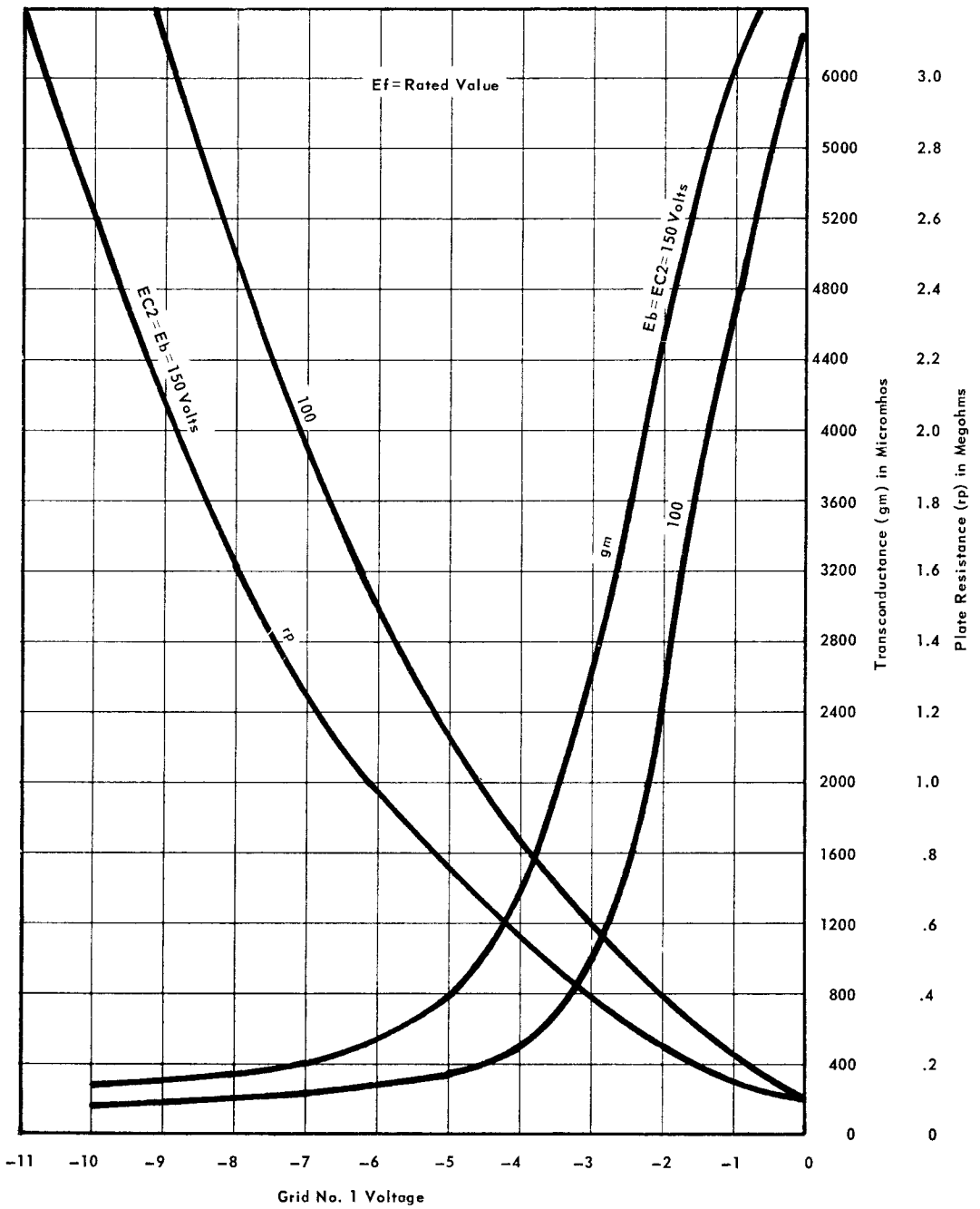


AVERAGE TRANSFER CHARACTERISTICS
(Pentode Connected)



SUBMINIATURE SEMI-REMOTE PENTODES

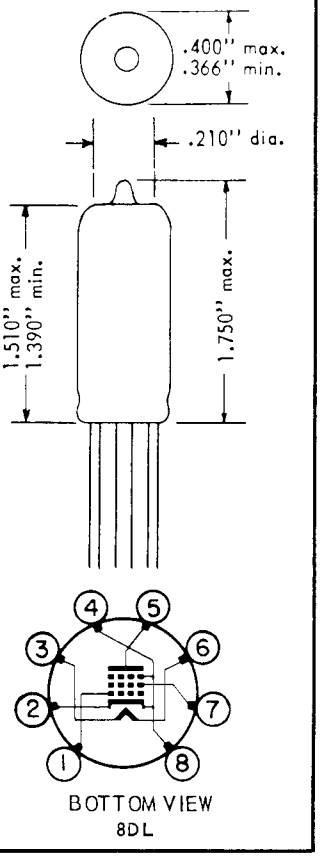
AVERAGE TRANSFER CHARACTERISTICS
(Pentode Connected)



TYPE CK5902WA

Excellence in Electronics

The CK5902WA is a heater–cathode type beam power pentode of subminiature construction. This type is characterized by long life and stable performance. It is suitable for service where severe conditions of mechanical shock or vibration are encountered. It is designed for audio power amplifier service in equipments with low plate supply voltages, and is capable of approximately one watt output in the audio range. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW
8DL

MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8–Pin (0.017" tinned flexible leads Length: 1.5".)

TERMINAL CONNECTIONS:

Lead 1 Grid #1	Lead 5 Plate
Lead 2 Cathode, Grid #3	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid #2
Lead 4 Cathode, Grid #3	Lead 8 Cathode, Grid #3

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test–Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION– – – –To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL–E–1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL–E–1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	110	110	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid #1 Voltage	Ec1:	–55	0	0	0	Vdc
Grid #2 Voltage	Ec2:	----	110	110	155	Vdc
Plate Dissipation	Pp:	----	----	3.3	3.7	W
Grid #2 Dissipation	Pg2:	----	----	0.24	0.4	W
Grid #1 Circuit Resistance	Rg1:	----	----	----	0.55	Meg.
Heater–Cathode Voltage	Ehk:	–200	----	----	+200	Vdc
Cathode Current	Ik:	----	----	----	50	mAdc
Cathode Resistance	Rk:	----	270	270	----	ohms
Plate Current (1):	Ib (1):	----	----	30	----	mAdc
Grid #2 Current	Ic2:	----	----	2.2	----	mAdc
Transconductance (1)	Sm(1):	----	----	4200	----	μmhos
Plate Resistance	rp:	----	----	0.015	----	Meg.

Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			Combined AQL = 1.0% excluding Mechanical and Inoperatives							
Heater Current:		0.4	If:	427	----	----	----	473	----	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.4	Ihk:	----	----	----	----	10	----	μAdc
	Ehk = -100 Vdc		Ihk:	----	----	----	----	10	----	μAdc
Grid Current:	Rg1 = 1.0 Meg.	0.4	Ic (1):	----	----	----	----	-1.0	----	μAdc
Plate Current (1):		0.4	Ib (1):	24.0	27.0	30.0	33.0	36.0	8.0	mAdc
Plate Current (2):	Ec1 = -40 Vdc	0.4	Ib (2):	----	----	----	----	100	----	μAdc
Power Output (1):	Esig = 6.4 Vac; Rp = 3000 ohms.	0.4	Po (1):	0.75	----	----	----	----	----	W
Continuity and Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-4) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg1-all = -100 Vdc Ep-all = -300 Vdc	2.5	Rg1-all: Rp-all:	250 250	----	----	----	----	----	Meg. Meg.
Screen Current:		2.5	Ic2:	0	----	2.2	----	4.0	----	mAdc
Transconductance (1):		2.5	Sm(1):	3500	3850	4200	4550	4900	950	μmhos
Grid Emission:	Eb = 250 Vdc; Ec2 = 150 Vdc; Rk = 1350 ohms; Ef = 7.5 V; Rg = 1.0 Meg. Preheat 5 minutes at Ec1 = 0 Vdc; Test at Ec1 = -40 Vdc.	6.5	Isc1:	----	----	----	----	-2.0	----	μAdc
Power Output (2):	Ef = 5.7 V; Esig = 6.4 Vac; Rp = 3000 ohms. (Note 9)	2.5	Δ_{Ef}Po(2):	----	----	----	----	15	----	%
AF Noise:	Esig = 150 mVac; Ecc2 = 110 Vdc; Ec1 = -8.7 Vdc; Rg1 = 0.5Meg.; Rg2 = 0.01Meg.; Rp = 2000 ohms; Rk = 0; Cg2 = 4μf	2.5	EB:	----	----	----	----	17	----	VU
Plate Resistance:		6.5	rp:	0.01	----	----	----	----	----	Meg.
Capacitance:			Cgp:	----	----	----	----	0.20	----	μμf
Capacitance:	(Note 2)	6.5	Cin:	5.5	----	6.5	----	7.5	----	μμf
Capacitance:			Cout:	6.5	----	7.5	----	8.5	----	μμf
Low Pressure Voltage Breakdown::	Pressure = 21 ± 3 mm Hg; Voltage = 300 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	F = 40 cps; G = 15; Rp = 2000 ohms.	2.5	Ep:	----	----	----	----	30	----	mVac
Vibration (3):	F = 70-2000 cps; G = 15; T = 3 minutes; Rp = 2000 ohms; Positions X_1 and X_2 only	6.5	ep:	----	----	----	----	200 peak to peak	----	mv
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk = +100 Vdc; Rg = 0.1 Meg.; Hammer Angle = 30° (Note 3)	20	----	----	----	----	----	----	----	----

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1 st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd.)								
Fatigue (1):	96 Hours; G= 2.5; Fixed frequency; F= 25 min., 60 max. (Note 5)	6.5	----	----	----	----		
Shock (2):	Ehk= + 100 Vdc; Rg= 0.1 Meg.; Hammer Angle= 120° + Rubber Pad; G= 75; t= 10 Milliseconds (Note 14)	20	----	----	----	----		
Fatigue (2):	6 Hours; G= 10; F= 130-2000-130 cps. (Note 13)	6.5	----	----	----	----		
Post Shock (1) & (2) and Fatigue (1) & (2) Test End Points:								
Vibration (2):	F= 40 cps; G= 15; Rp= 2000 ohms	----	Ep:	----	60	mVac		
Heater-Cathode Leakage:	Ehk= + 100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk= -100 Vdc	----	Ihk:	----	20	μAdc		
Change in Power Output (1) of individual tubes:		----	Δ_t Po(1):	----	20	%		
Grid Current (1):		----	I_{c1}	----	-3.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef= 7.0V; Eb= Ec1= Ec2= 0V; 1 min. on, 4 min. off; Ehk= 140Vac	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk= + 100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk= -100 Vdc	----	Ihk:	----	20	μAdc		
2 & 20 Hour Stability Life Test:	TA= Room; Eb= 250Vdc; Ec2= 150Vdc; Ehk= + 200 Vdc; Rg= 0.47Meg; Rk= 1350 ohms	----	----	----	----	----		
2 & 20 Hour Stability Life Test End Points:								
Change in Power Output (1) of individual Tubes:	(Typical Sample Size= 50 tubes)	1.0	Δ_t Po(1):	----	15	%		
100 Hour Survival Rate Life Test:	TA= Room; Eb= 250Vdc; Ec2= 150Vdc; Ehk= + 200 Vdc; Rg= 0.47 Meg.; Rk= 1350 ohms	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size= 200 tubes)	----	----	----	----	----		
Inoperatives:		0.65	----	----	----	----		
Power Output (1):		1.0	Po(1):	0.65	----	W		
200 Hour Intermittent Life Test (1):	Eb= 250Vdc; Ec2= 150Vdc; Rk= 1350 ohms; TA= Room; Ehk= + 200Vdc; Rg_1= 0.47 meg.	----	----	----	----	----		

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
200 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size= 20 Tubes 1st sample, 40 Tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	0	-2.0	μAdc	1	3
Heater Current:		----	If:	414	492	mA	1	3
Change in Power Output (1) of individual tubes:		----	Δ_t Po (1):	----	20	%	1	3
Power Output (2):	(Note 9)	----	Δ_{Ef} Po (2):	----	15	%	1	3
Heater Cathode Leakage:								
Ehk=+100 Vdc		----	Ihk:	----	20	μAdc	1	3
Ehk=-100 Vdc		----	Ihk:	----	20	μAdc		
Electrode Insulation								
g1-all		----	Rg1-all:	50	----	Meg.	1	3
p-all		----	Rp-all:	50	----	Meg.		
Total Defectives:		----	----	----	----	----	3	6
Intermittent High Temperature Life Test (2):	T Bulb= 220°C, Eb= Ec2= 100 Vdc; Ehk= +200 Vdc; Rg= 0.47 Meg.; Rk= 220 ohms	----	----	----	----	----	---	---
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	0	-2.0	μAdc	1	3
Heater Current:		----	If:	414	492	mA	1	3
Power Output (1) Change of individual tubes from initial:		----	Δ_t Po (1):	----	20	%	1	3
Power Output (2):	(Note 9)	----	Δ_{Ef} Po (2):	----	15	%	1	3
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	1	3
	Ehk=-100 Vdc	----	Ihk:	----	20	μAdc		
Insulation of Electrodes:								
g-all		----	Rg-all:	25	----	Meg.	1	3
p-all		----	Rp-all:	25	----	Meg.		
Power Output (1) Average Change:		----	Avg. Δ_t Po (1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	3	6
1000 Hour High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current:		----	Ic1:	----	-2.0	μAdc	1	3

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
Heater Current:		----	If:	414	496	mA	1	3
Power Output (1) change of individual tubes from initial:		----	Δ_t Po (1):	----	25	%	1	3
Power Output (2):	(Note 9)	----	Δ_{Ef} Po (2):	----	20	%	1	3
Heater Cathode Leakage:								
Ehk= +100 Vdc		----	Ihk:	----	20	μAdc	1	3
Ehk= -100 Vdc		----	Ihk:	----	20	μAdc		
Electrode Insulation:								
g1 - all		----	Rg1 - all:	25	----	Meg.	2	5
p - all		----	Rp - all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D. - 1 7/8" long) connected to cathode lead.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ± 5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of Power Output for individual tubes from that value measured at Ef= 6.3V to that value measured at Ef= 5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "MIL-E-1 Basic Specifications".

Note 11: Operation time is the time in seconds required for the plate current to attain a value within ± 15% of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed. A cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300± 50 microseconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent short	600,000 ohms
500 microseconds	500,000 ohms
100 microseconds	100,000 ohms
60 microseconds	1,000 ohms

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

A) either a permanent or tap short at any time during the tapping procedure
B) any open circuit
C) air leaks

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

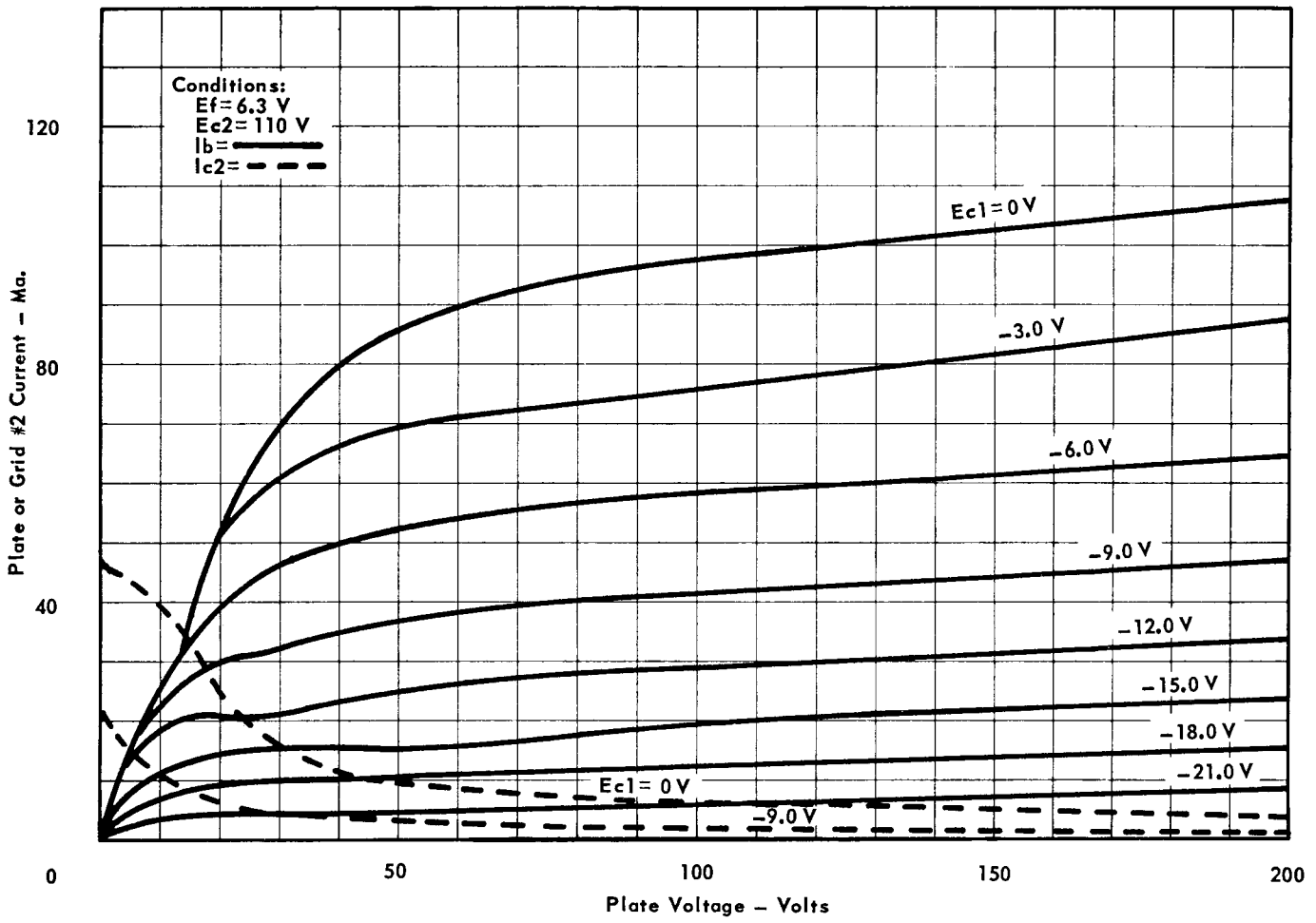
Note 13: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one more of the following defects shall be considered failures.

(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

Note 14: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

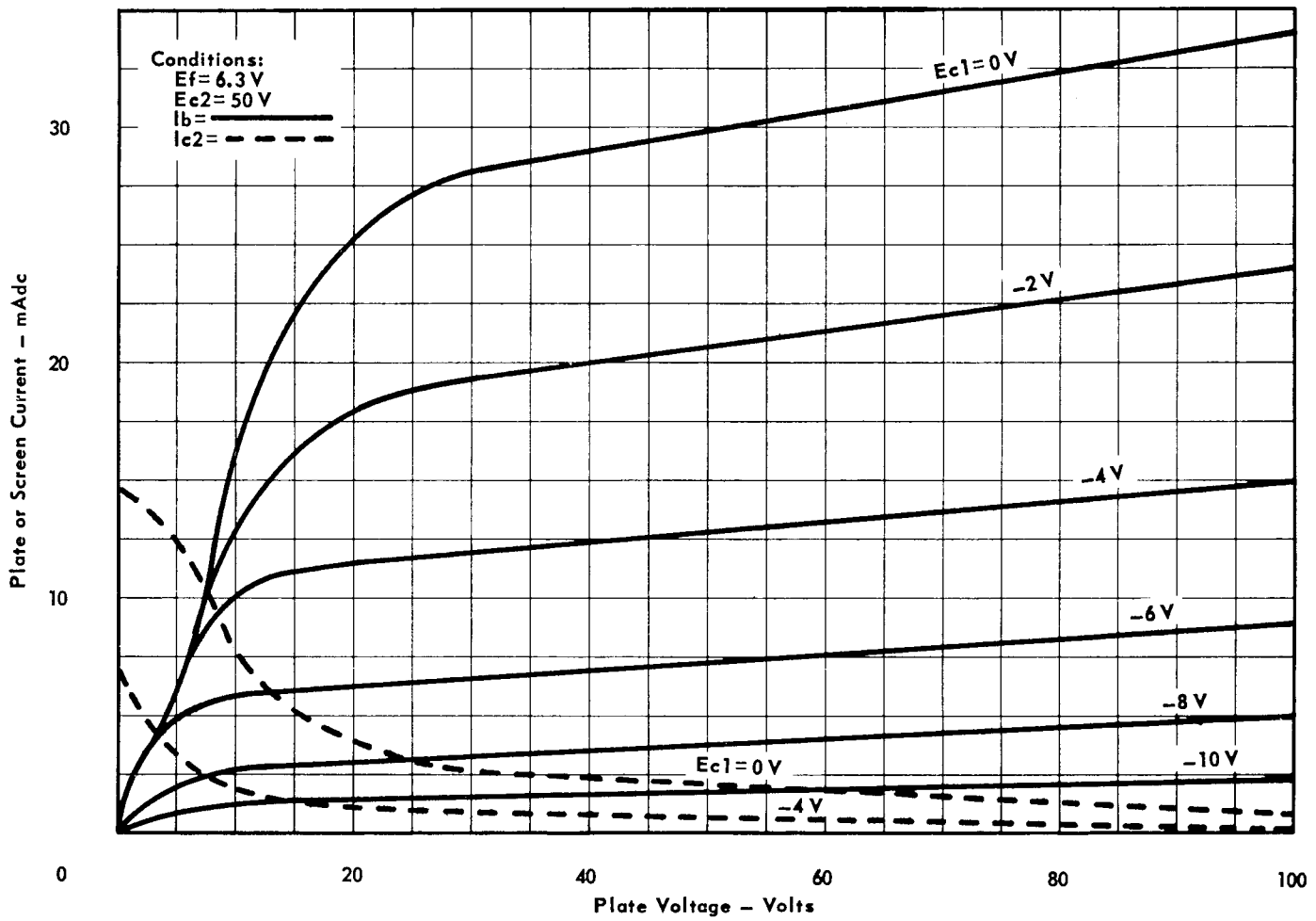
AVERAGE PLATE CHARACTERISTICS



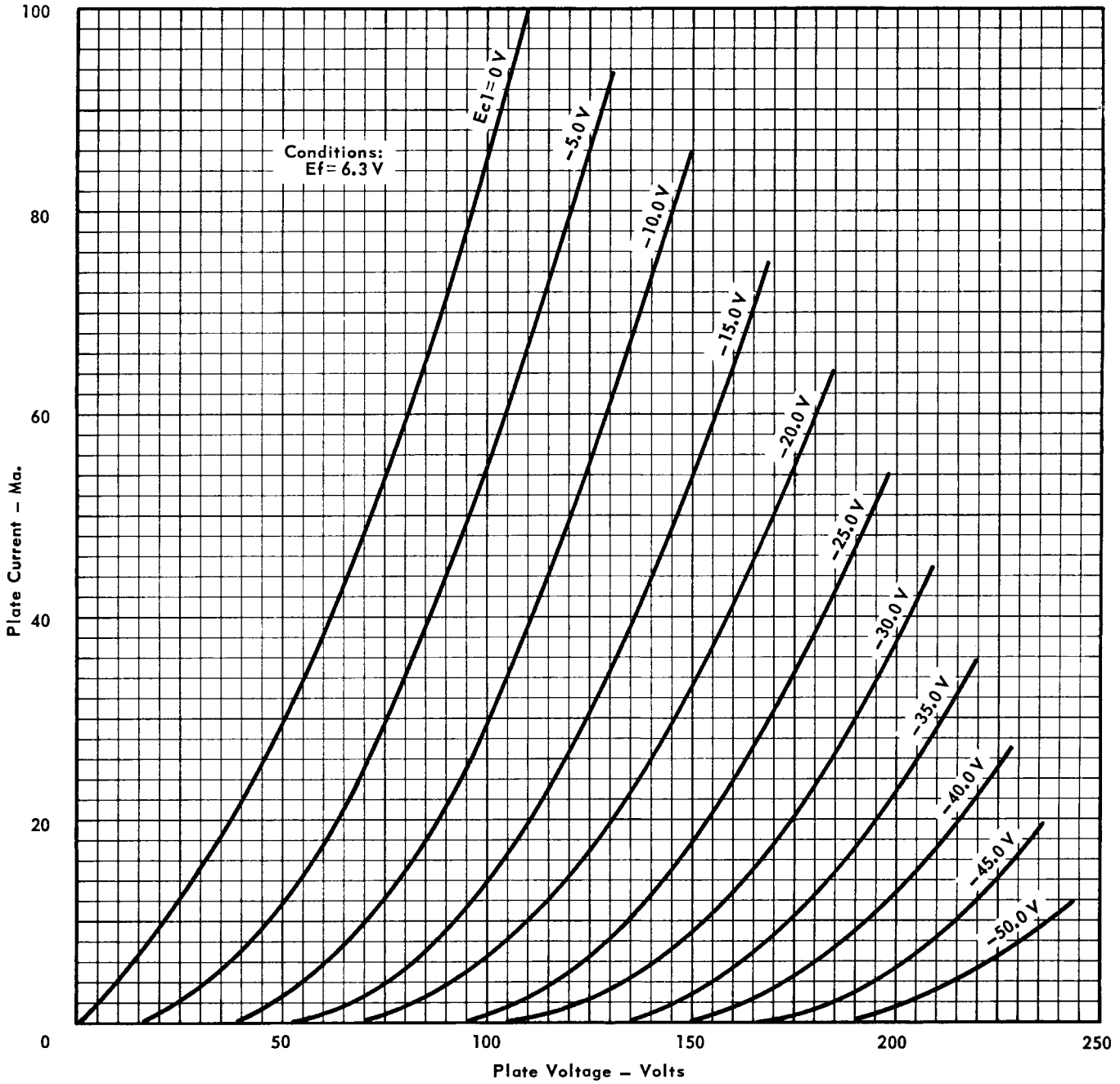
RAYTHEON

RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



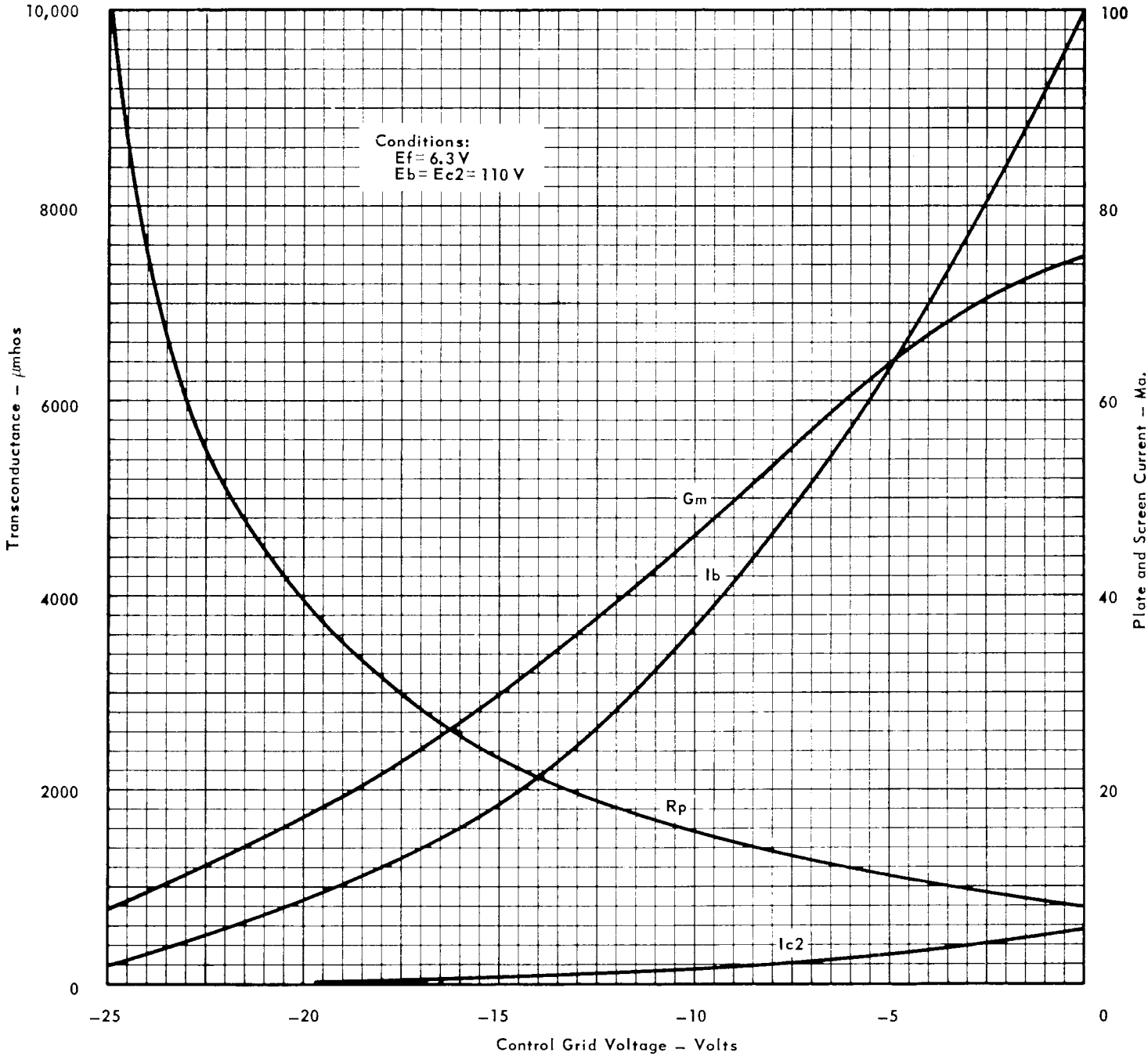
AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



RAYTHEON

RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



from RMA release #824
Jan. 25, 1950

TYPE 5910
Pentode

DESCRIPTION

The 5910 is a filament type sharp-cutoff pentode of miniature construction. It is designed for use in Radiosonde applications as a blocking oscillator where high grid leakage resistance (in excess of 500 megohms) rather than low microphonism is of paramount importance.

MECHANICAL DATA

Envelope: T-5 1/2 Glass

Base: Miniature Button 7-Pin

Dimensions:

Maximum Overall Length	2 1/8	inches
Maximum Seated Height	1 7/8	inches
Maximum Diameter	3/4	inches

Terminal Connections: (JETEC Designation 6AR)

Pin 1	Filament-Neg., Grid #3, and Internal Connection	Pin 5	Filament-Neg., Grid #3 and Internal Shield
Pin 2	Plate	Pin 6	Grid #1
Pin 3	Grid #2	Pin 7	Filament, Pos.
Pin 4	No Connection		

Mounting Position: Any

ELECTRICAL DATA

Direct Interelectrode Capacitances: (uufds.) *

Grid #1 to Plate	.008	max.
Input	3.6	
Output	7.5	

Ratings:

Filament Voltage	2.0	volts (Abs. Max.)
Plate Voltage	90	volts
Grid #2 Voltage	90	volts
Total Cathode Current	6.5	ma.
External Grid Bias	0	volts

Characteristics and Typical Operation - Class A1:

Filament Voltage	1.4	volts
Filament Current	0.05	amps
Plate Voltage	90	volts
Grid #2 Voltage	90	volts
Grid #1 Voltage **	0	volts
Plate Resistance (Approx.)	1.5	megohms
Transconductance	900	umhos
Plate Current	1.6	ma.
Grid #2 Current	0.45	ma.
Grid #1 Voltage for Transconductance = 10 umhos	-3.5	volts

N. B.

* With JEDEC Shield #316 connected to Pin 2.

** Return to negative filament.

RAYTHEON

TECHNICAL INFORMATION

GAS - FILLED DIODE

Excellence in Electronics

TYPE CK5962

The CK5962 is a cold cathode, corona-discharge tube of miniature construction, similar to the Bureau of Ships type BS-101, designed for use as a voltage regulator in high-voltage, low current supplies.

MECHANICAL DATA

ENVELOPE: T-5½ Glass

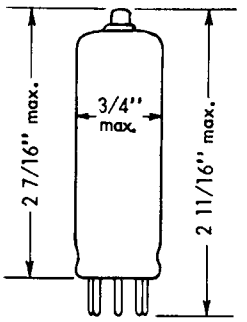
BASE: Miniature Button 7-Pin

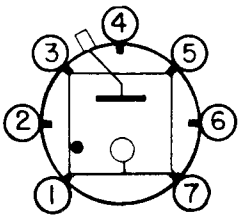
CAP: Skirted Miniature

TERMINAL CONNECTIONS:

Pin 1 Cathode	Pin 5 Cathode
Pin 2 Int. Connection, Do Not Use	Pin 6 Int. Connection, Do Not Use
Pin 3 Cathode	Pin 7 Cathode
Pin 4 Int. Connection, Do Not Use	Cap Anode

MOUNTING POSITION: Any





BOTTOM VIEW

7EX

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

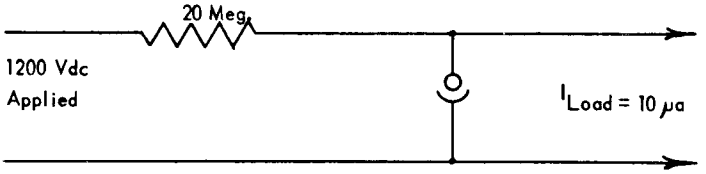
DC Anode Supply Voltage	2000 volts
Minimum DC Anode Supply Voltage *	750 volts
DC Operation Current	2 to 55 μa.
Ambient Temperature Range	-55 to +70 °C

CHARACTERISTICS AND TYPICAL OPERATION:

DC Starting Voltage	730 volts
DC Operating Voltage at 25μa. (approx.)	700 volts
Regulation (5 to 55 μa.)	15 volts
Leakage Current at 500 volts	0.5 μa. max.

* *Not less than indicated supply voltage should be provided to insure "starting" throughout life.*

TYPICAL CIRCUIT



Printed in U.S.A.

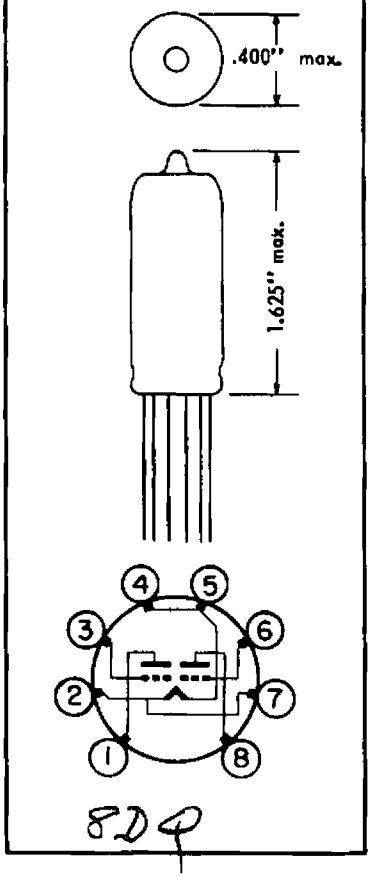
RAYTHEON

TECHNICAL INFORMATION

SUBMINIATURE DOUBLE TRIODE

Excellence in Electronics

TYPE CK5967



The CK5967 is a filament type double triode of subminiature construction with an amplification factor of approximately 17 designed for push-pull Class A RF amplifier service at VHF frequencies. It may also be used as a push-pull mixer or oscillator over this range. The flexible terminal leads may soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.016" tinned flexible leads Length: 1.5" minimum)

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2	Lead 5 Filament, Positive
Lead 2 Filament, Negative	Lead 6 Grid, Unit #1
Lead 3 Grid, Unit #2	Lead 7 Filament, Negative
Lead 4 Filament, Positive	Lead 8 Plate, Unit #1

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (each unit) ($\mu\mu fds.$) ♦

Grid to Plate: (g to p)	1.7
Input: (g to f)	0.9
Output: (p to f)	0.9
Grid to Grid: (1g to 2g)	0.2
Plate to Plate: (1p to 2p)	0.2

ABSOLUTE MAXIMUM RATINGS:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	50 volts
Total Cathode Current (each unit)	4.4 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	120 ma.
Plate Voltage	45 volts
Grid Voltage ▲	0 volts
Transconductance (each unit)	2000 μmhos
Amplification Factor (each unit)	17
Plate Current (each unit)	3.0 ma.
Grid Voltage for Ib=20 μAdc (each unit) (approx.)	-3 volts

♦ *No external Shield.*

▲ *Grid Resistor=5 megohms.*

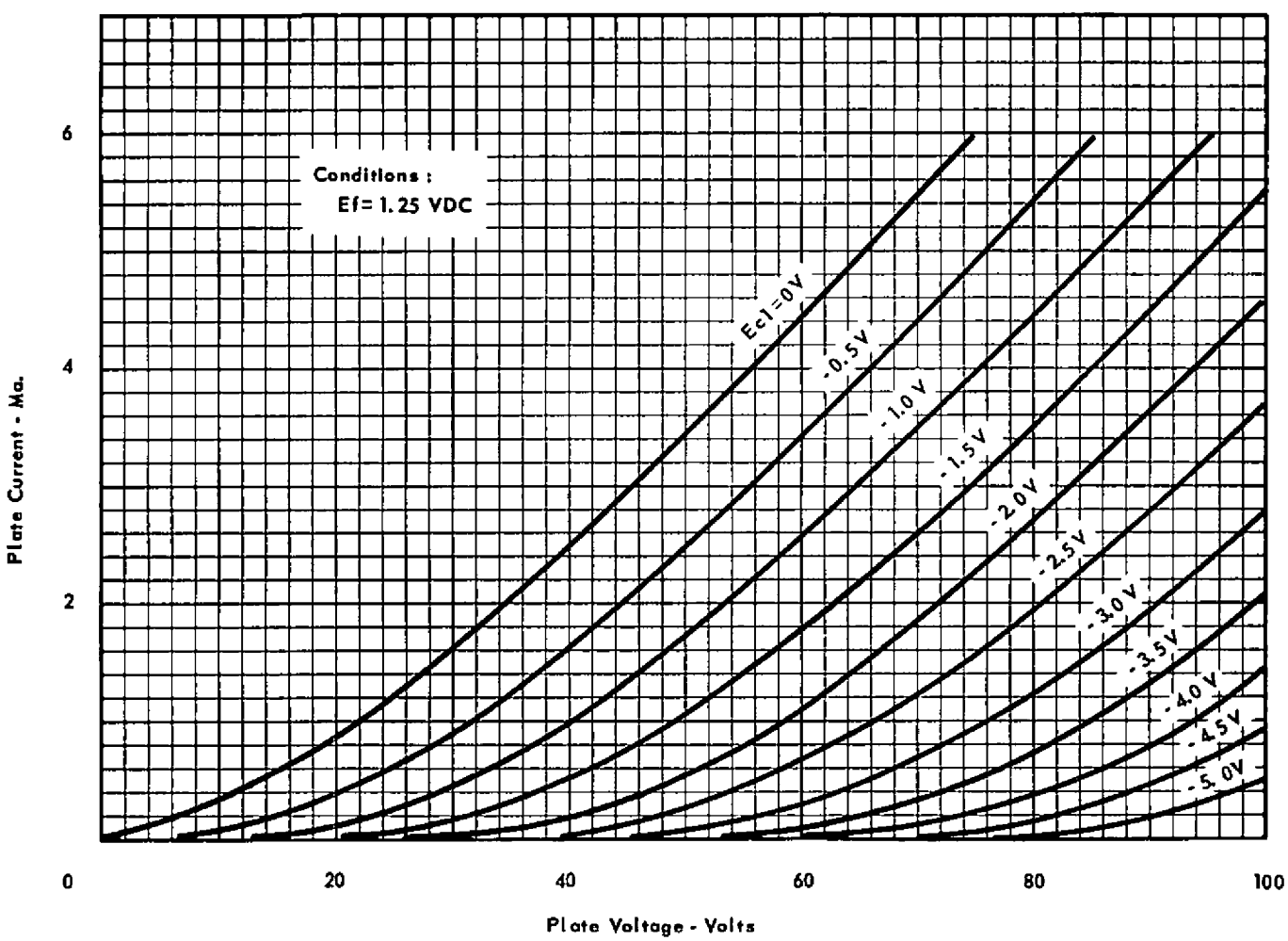
from JETEC release #1516, Sept. 12, 1955

Tentative Data

RAYTHEON

SUBMINIATURE DOUBLE TRIODE

AVERAGE PLATE CHARACTERISTICS

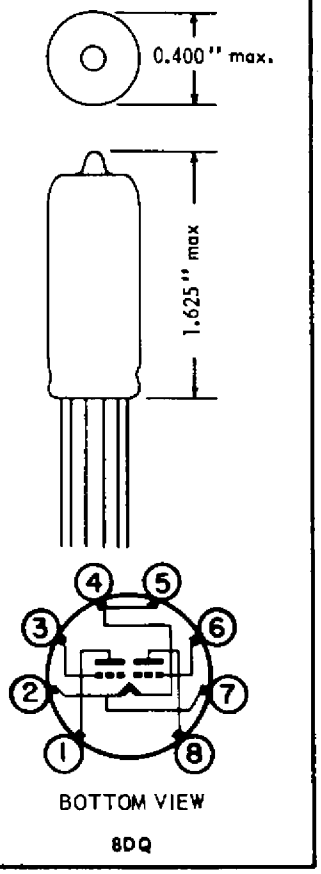


SUBMINIATURE DOUBLE TRIODE

TYPE CK5968

Excellence in Electronics

The CK5968 is a filament type double triode of subminiature construction with an amplification factor of approximately 50 designed for use as a push-pull mixer at frequencies in the VHF Range. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW

8DQ

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.50" minimum)

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit 2	Lead 5 Filament, Positive
Lead 2 Filament, Negative	Lead 6 Grid, Unit 1
Lead 3 Grid, Unit 2	Lead 7 Filament, Negative
Lead 4 Filament, Positive	Lead 8 Plate, Unit 1

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (Unshielded) (μμfds.)

Grid to Plate (each unit)	2.3
Plate to Filament (each unit)	0.9
Grid to Filament (each unit)	0.9
Grid to Grid	0.2
Plate to Plate	0.2

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25 ± 20% volts
Plate Voltage	45 volts
Total Cathode Current (each unit)	4 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	120 ma.
Plate Voltage	45 volts
Grid Voltage	0 volts
Transconductance (each unit)	1300 μmhos
Amplification Factor (each unit)	50
Plate Current (each unit)	0.7 ma.

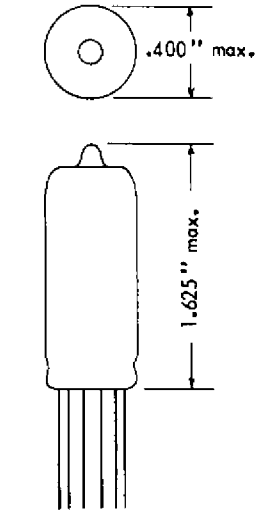
from JETEC release #1961, July 1, 1957

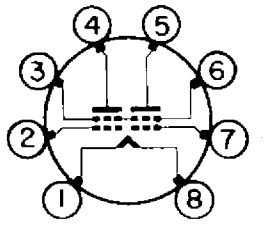
Tentative Data

RAYTHEON MANUFACTURING COMPANY
RECEIVING AND CATHODE RAY TUBE OPERATIONS
February 15, 1956 NEWTON 58, MASS.

TYPE CK5969

The CK5969 is a filament type double tetrode of subminiature construction designed for Push-Pull Class C RF amplifier service, without neutralization, at VHF frequencies. The screen grids for the two sections are connected internally, and to two of the base terminal leads. This feature, together with the common internal filament connections between the two sections, reduces the RF impedance between sections to facilitate Push-Pull RF performance. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.





BOTTOM VIEW

8DR

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.016" tinned flexible leads. Length: 1.50" minimum)

TERMINAL CONNECTIONS:

Lead 1 Filament, Negative	Lead 5 Plate, Unit 1
Lead 2 Grid #1, Unit 2	Lead 6 Grid #2, Unit 1 and 2
Lead 3 Grid #2, Unit 1 and 2	Lead 7 Grid #1, Unit 1
Lead 4 Plate, Unit 2	Lead 8 Filament, Positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (each unit) ($\mu\mu$fds.)●

Grid to Plate: (g to p)	0.30	max.
Input: g1 to (f+g2)	2.5	
Output: p to (f+g2)	2.5	
Grid to Grid: (1g to 2g)	0.14	
Plate to Plate: (1p to 2p)	0.30	

RATINGS – ABSOLUTE MAXIMUM VALUES – PUSH-PULL CLASS C AMPLIFIER:

Filament Voltage (dc)	1.25 ± 20%	volts
Plate Voltage	150	volts
Grid #2 Voltage	50	volts
Cathode Current	15	ma.
Plate Dissipation (each section)	0.96	watts

CHARACTERISTICS AND TYPICAL OPERATION – CLASS A AMPLIFIER:

Filament Voltage (dc)	1.25	volts
Filament Current	200	ma.
Plate Voltage	135	volts
Grid #2 Voltage	45	volts
Grid #1 Voltage	−3.0	volts
Transconductance (each unit)▲	1700	μmhos
Plate Current (each unit)▲	6.0	ma.
Grid #2 Current (each unit)▲	0.6	ma.
Grid #1 Voltage (approx.) for Ib = 50 μa. (each unit)▲	−12	volts

● *No External Shield.*

▲ *Ec1 = −15 on unit not under test.*

from JETEC release #1961, July 1, 1957

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

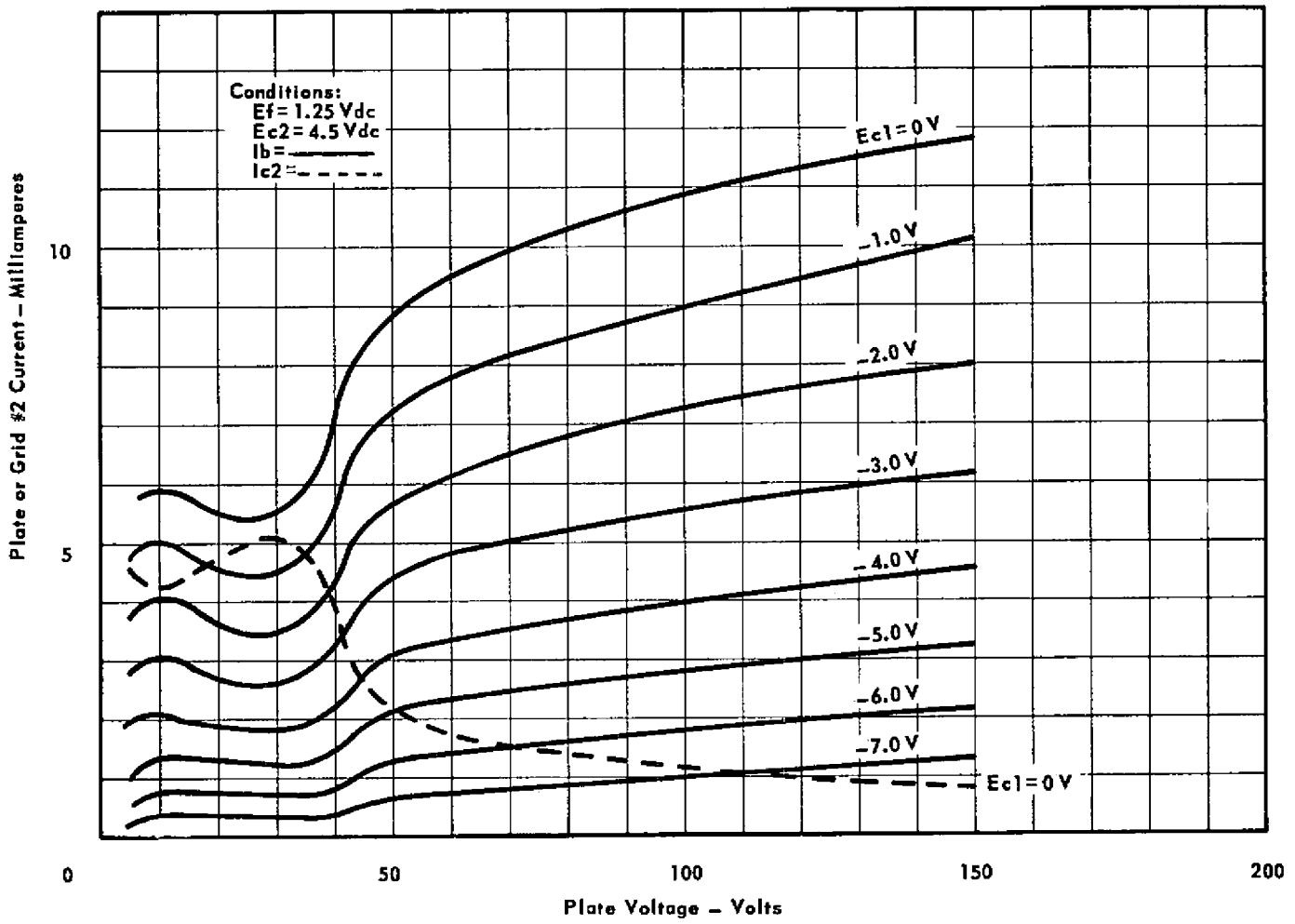
RECEIVING AND CATHODE RAY TUBE OPERATIONS

June 15, 1957 NEWTON 58, MASS.

RAYTHEON

SUBMINIATURE DOUBLE TETRODE

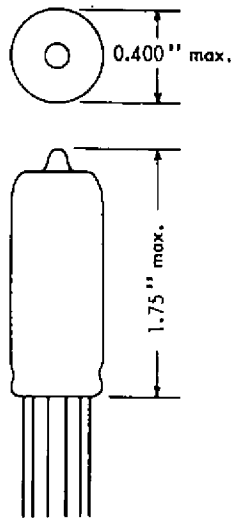
AVERAGE PLATE CHARACTERISTICS

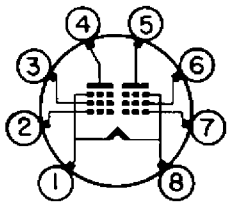


Excellence in Electronics

TYPE CK5970

The CK5970 is a filament type double pentode of subminiature construction with remote cut-off characteristics designed for use as a Class A RF amplifier at frequencies in the VHF range. The flexible terminal leads may be soldered or welded to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.





BOTTOM VIEW

8DS

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.50" minimum)

TERMINAL CONNECTIONS:

Lead 1 Filament Negative ●	Lead 5 Plate, Unit 1
Lead 2 Grid #1, Unit 2	Lead 6 Grid #2, Unit 1
Lead 3 Grid #2, Unit 2	Lead 7 Grid #1, Unit 1
Lead 4 Plate, Unit 2	Lead 8 Filament Positive ●

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (unshielded) (μμfds.)

Grid to Plate (each unit)	0.1	max.
Input (each unit)	3.3	
Output (each unit)	2.4	
Grid #1 to Grid #1	0.02	
Plate to Plate	0.3	

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20%	volts
Plate Voltage	45	volts
Grid #2 Voltage	45	volts
Total Cathode Current (each unit)	5	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	volts
Filament Current	160	ma.
Plate Voltage	45	volts
Grid #2 Voltage	45	volts
Grid #1 Voltage ♦	0	volts
Plate Resistance (each unit)	0.17	meg.
Transconductance (each unit)	1850	μmhos
Plate Current (each unit)	3.0	ma.
Grid #2 Current (each unit)	0.9	
Grid #1 Voltage (approx.) for Plate Current of 20 μA. (each unit)	-11.5	volts

● *Grid #3 is composed of two separate deflector plates, one of which is connected to Lead 1, and the other to Lead 8.*

♦ *Grid resistor = 5 megohms.*

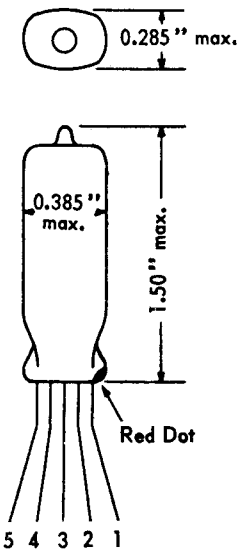
from JETEC release #1961, July 1, 1957

Tentative Data

Excellence in Electronics

TYPE CK5971

The CK5971 is a filament type triode of subminiature construction designed for use as an amplifier oscillator, or frequency multiplier in the VHF Range. The CK5971 features exceptional ruggedness and is suited for applications involving high impact shock. The flexible terminal leads may soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid
Lead 2 Grid	Lead 5 Filament, top, positive
Lead 3 Filament, bottom, negative	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.) ●

Grid to Plate: (g to p)	2.3
Input: (g to f)	1.6
Output: (p to f)	1.7

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	90 volts
Plate Current	5 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

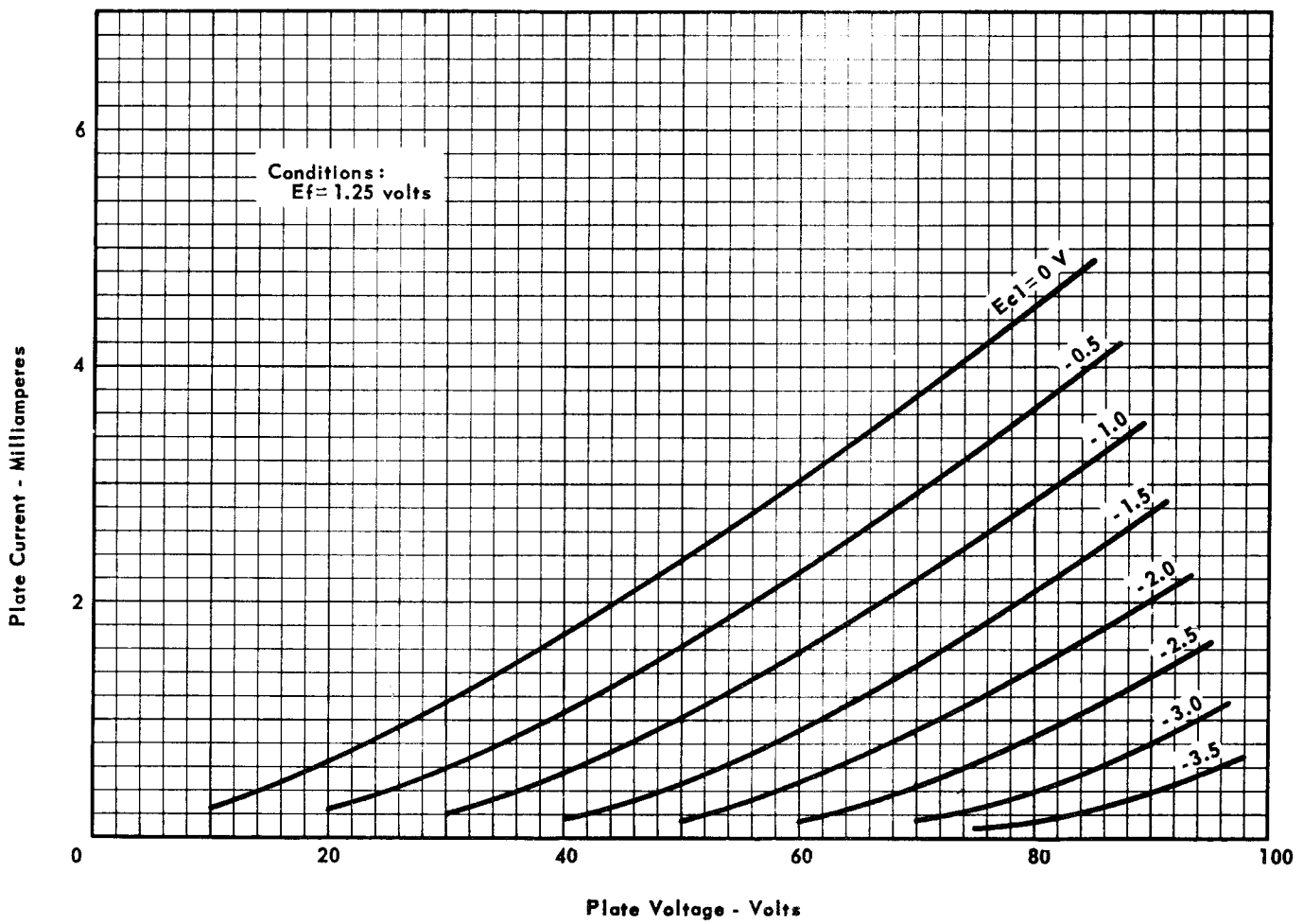
Filament Voltage (dc)	1.25 volts
Filament Current	80 ma.
Plate Voltage	67.5 volts
Grid Voltage	▲ 0 volts
Amplification Factor	23
Transconductance	2100 μmhos
Plate Current	3.5 ma.
Grid Voltage (approx.) for Ib=50 μa.	-3.5 volts

● *No shield.*

▲ *Grid Resistor=5 megohms.*

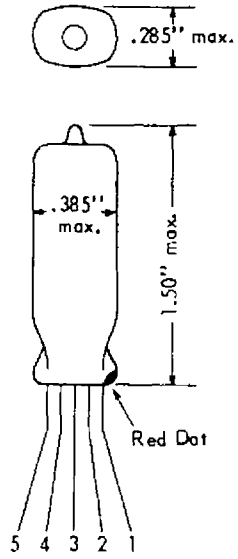
SUBMINIATURE TRIODE

PLATE CURRENT VS. PLATE VOLTAGE



TYPE CK5972

The CK5972 is a filament type, fully-shielded remote cut-off pentode of subminiature construction designed for service in RF applications to 100 megacycles requiring economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament,
Lead 3 Filament, negative; Grid #3; shield ■	positive; Grid #3 ■

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*)

Grid to Plate	0.01 max.
Input	4.3
Output	4.1

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25 ± 20% volts
Plate Voltage	75 volts
Grid #2 Supply Voltage	75 volts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	1.25 volts
Filament Current	60	60 ma.
Plate Voltage	45	67.5 volts
Grid #2 Voltage	45	67.5 volts
Grid #1 Voltage ♦	0	0 volts
Plate Resistance (approx.)	0.8	1.0 megohms
Transconductance	1100	1300 μmhos
Plate Current	1.5	2.5 ma.
Grid #2 Current	0.4	0.8 ma.
Grid #1 Voltage (approx.) at Ib=20 μa.	-8	-12 volts

● *Bulb is entirely coated with a metallic shield connected to Lead 3.*

♦ *Grid resistor=2 megohms.*

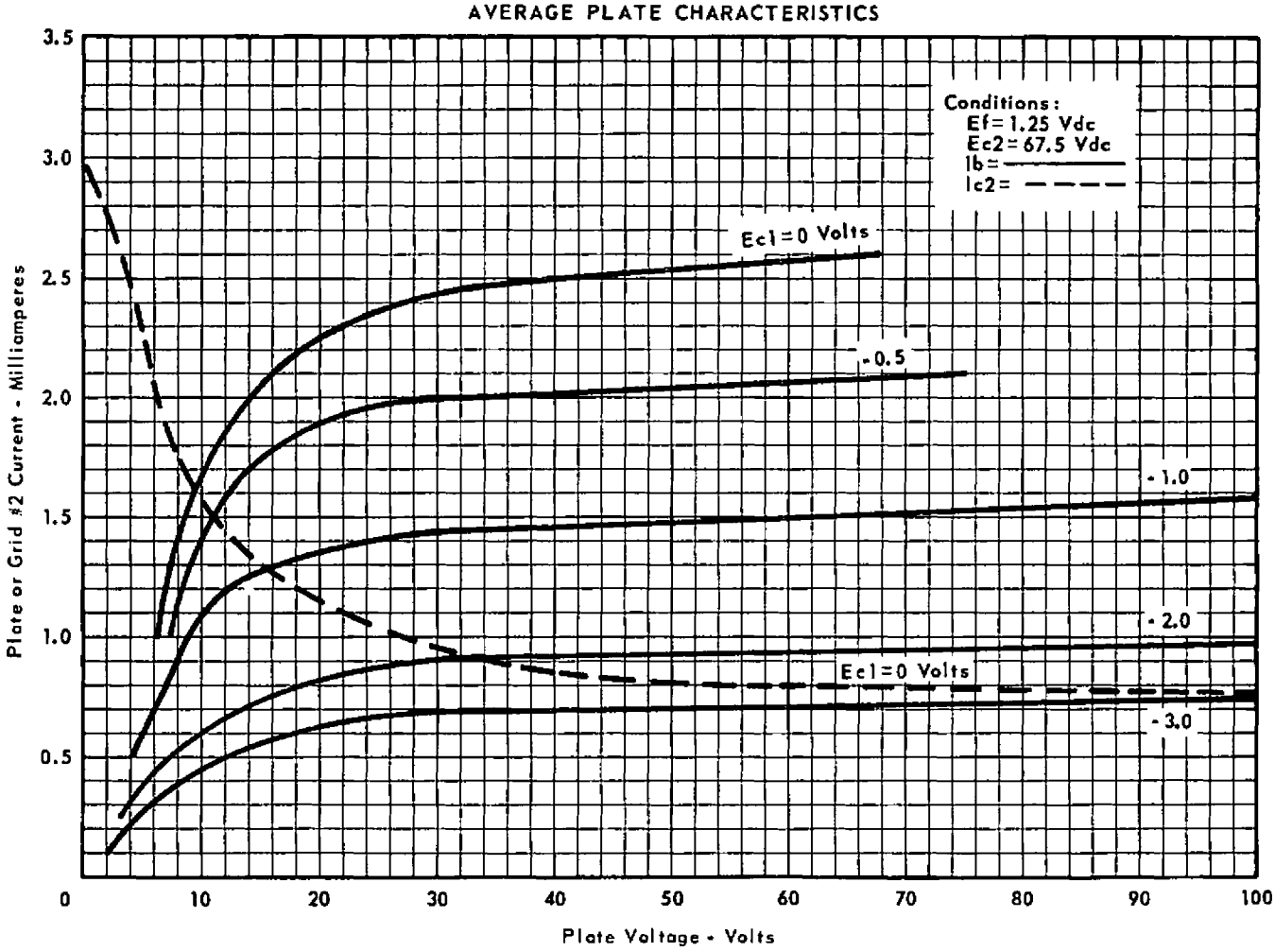
■ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

from JETEC release #1961, July 1, 1957

Tentative Data

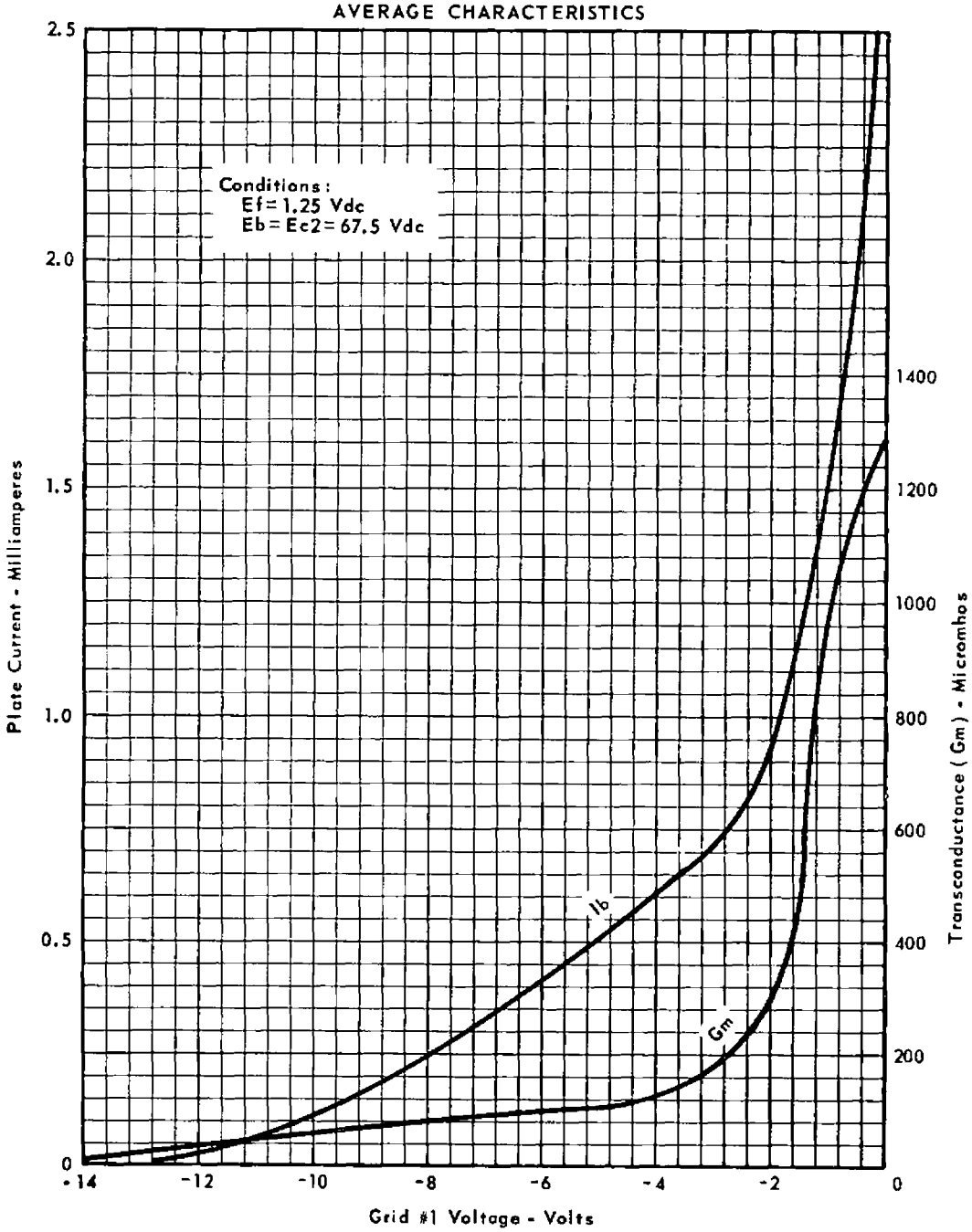
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



SUBMINIATURE PENTODE

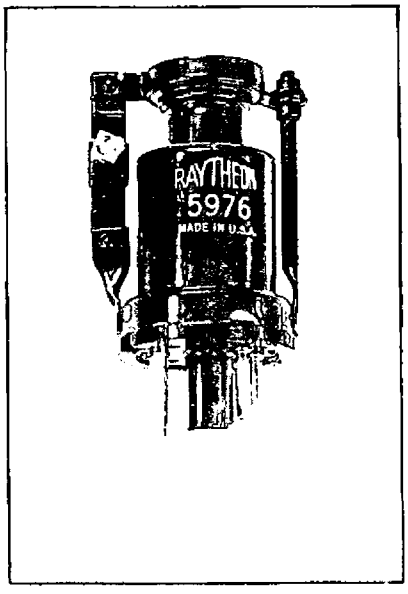
AVERAGE CHARACTERISTICS



from RMA release #903, Sept. 7, 1950

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

The type 5976 is a velocity variation oscillator of the single cavity (integral) reflex type, designed for operation in the frequency range of 6250 to 7425 megacycles with an average power output of 90 milliwatts. The mechanical tuning mechanism provides a simple method of making wide frequency adjustments. In addition, the 5976 can be electrically tuned to give a 40 megacycle vernier adjustment. The 5976 is designed for operation at any frequency within the specified range, and it is particularly suited for local oscillator service in microwave receivers. It is useful, also, as a local oscillator in microwave spectrum analyzers, as a pulse generator for testing circuit response and as a frequency modulated source in microwave relay links.



GENERAL CHARACTERISTICS

Heater, for oxide coated unipotential cathode	
Voltage (A.C. or D.C.)	6.3± .5 Volts
Current	0.44 Amperes
Frequency Range	6250 to 7425 Mc.

MAXIMUM RATINGS, Absolute Values:

D.C. Resonator Voltage	330 Max. Volts
D.C. Resonator Current	35 Ma.
D.C. Reflector Voltage	
Positive Value	0 Max. Volts
Negative Value	–350 Max Volts.
Heater-Cathode Voltage:	
Heater negative with respect to cathode	50 Max. Volts
Heater positive with respect to cathode	50 Max. Volts
Ambient Temperature of Air around Shell	110 Max. °C
Temperature of coaxial output line	75 Max. °C

TYPICAL OPERATING CONDITIONS: C.W. Oscillator: Frequency 6750 Mc.

D.C. Resonator Voltage	300 Volts
D.C. Resonator Current	24.0 Ma.
D.C. Reflector Voltage Range*	–78 to –158 Volts
D.C. Reflector Current	Less than 7μa
Electronic Tuning (Half Power)**	
Frequency Change	49 Mc.
Power Output	110 Mw.

*Adjusted for maximum power output at 6750 Mc.

**Change in frequency between the two ½ power points when the reflector is varied above and below the point of maximum power output corresponding to the given frequency.

MECHANICAL

Mounting	Any Position
Overall Dimensions	See Outline Drawing
Resonator Cavity	Integral part of tube
Envelope	Metal
Cap	Miniature
Base	To Fit Standard Octal with No. 4 pin enlarged to admit transducer
Net Weight	1.5 Ounces

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

INSTALLATION

The 5976 requires a standard octal socket modified with No. 4 pin enlarged to admit the coaxial transducer. The tube may be mounted in any position but should be rigidly clamped to insure proper contact of the tube with the transducer and to guard against excessive strains on the coaxial output line. The tube must be clamped on or below the header skirt.

The tube is coupled into the waveguide 1½" x ¾" through a wide band transducer coupling unit. (See outline drawing for transducer.) All the tabulated data contained in this data sheet was taken using this transducer operating into a matched load.

It is important that this transducer or its electrical equipment be used to insure tube interchangeability and satisfactory tuning range characteristics. The standing wave ratio at the transducer should not exceed a VSWR of 1.1.

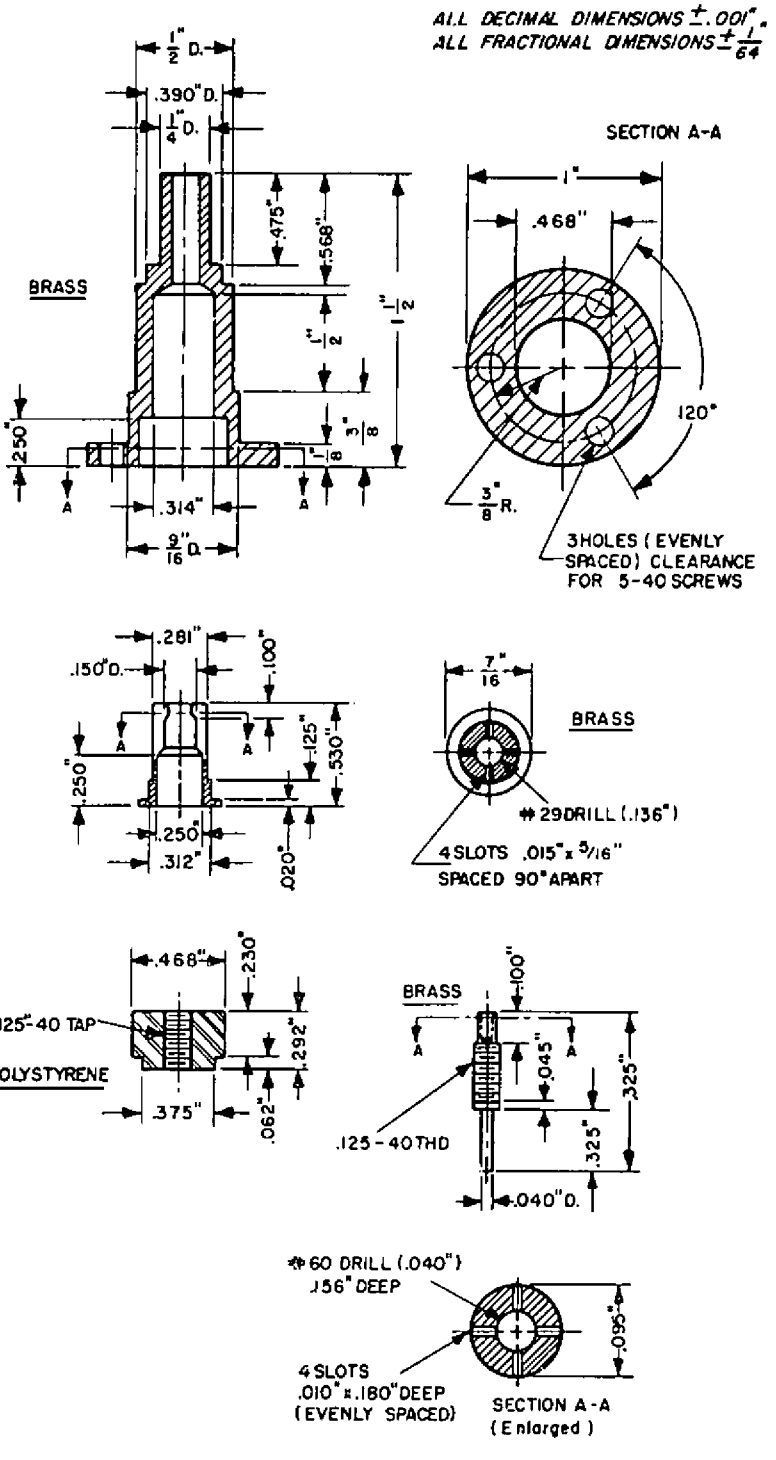
SHIELDING

Where the 5976 is to be operated in the presence of strong magnetic fields, shielding of the resonator and reflector voltage leads is usually required in order to avoid undesirable modulation of the tube output. In extremely troublesome conditions, it may be advisable to place the 5976 in a metal chamber with polyiron chokes provided to bring the voltages into the chamber.

CATHODE

In most applications, the metal envelope (resonator) of the 5976 is operated at ground potential. The cathode is therefore negative with respect to ground by the amount of the resonator potential, and must not be grounded. The cathode may be connected to one side of the heater or the center tap of the heater transformer secondary. When the cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to a heater lead. When cathode and heater are not connected together, the heater-cathode volt-

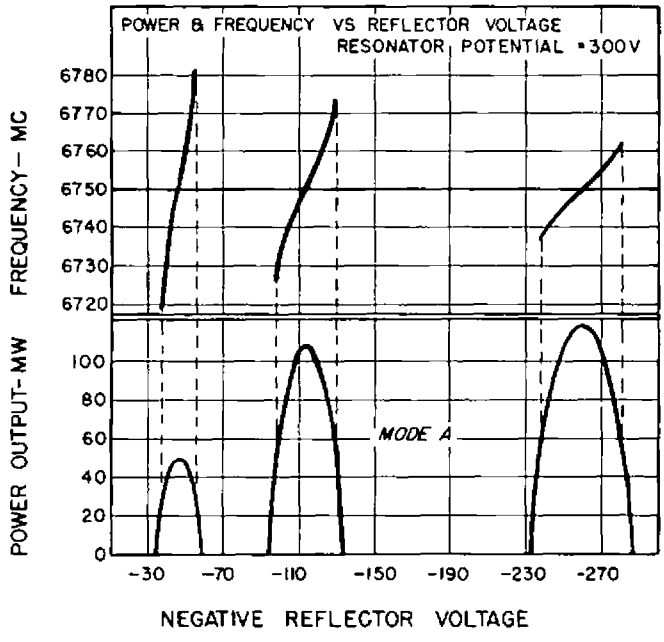
TRANSDUCER COUPLING

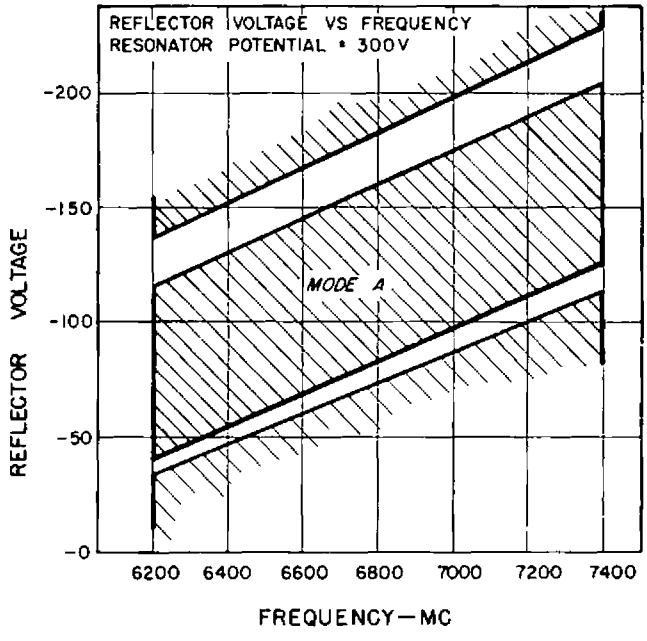


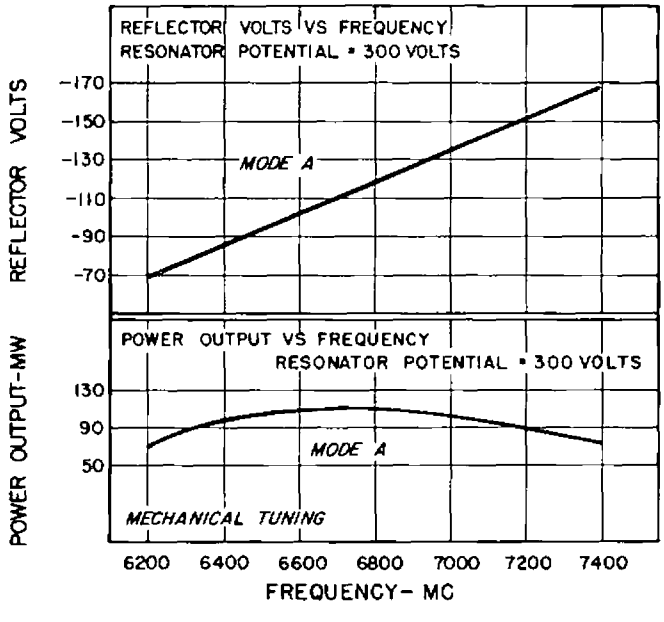
TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

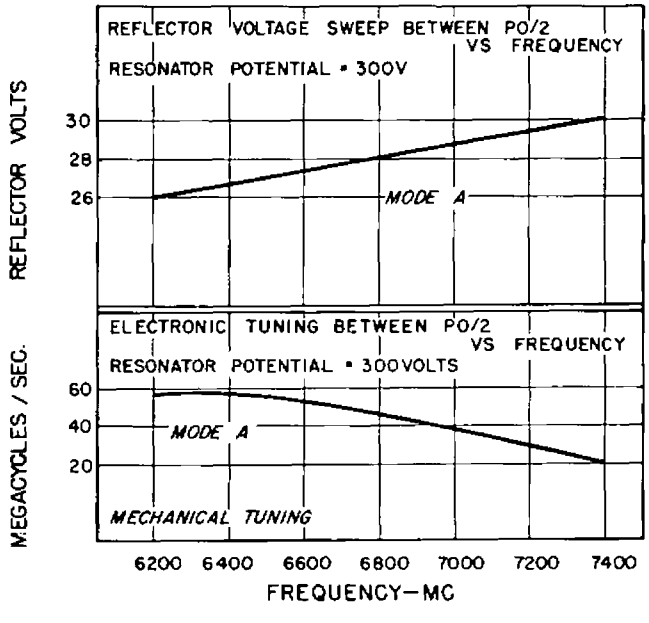
THE FOLLOWING DATA IS REPRESENTATIVE OF AVERAGE TUBES

TUBE DESIGNED FOR USE IN MODE A









TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

age should not exceed ±50 volts. In all cases where the resonator is operated at ground potential, the heater transformer must be insulated to withstand the maximum resonator voltage.

In applications where the metal envelope (resonator) of the 5976 is not at ground potential, it is essential that the tube be surrounded by a grounding shield, and be mechanically tuned with an insulated tool. Adequate ventilation must be provided through this shield to keep the ambient temperature of the chamber below the maximum specified value.

REFLECTOR

The reflector electrode is connected to the small cap on the top of the tube. The power supply furnishing the reflector potential must be insulated to withstand the total resonator and reflector voltage. The reflector must never be allowed to become positive with respect to the cathode. If this precaution is not observed, damage to the reflector may result. In cases where modulating potentials bring the reflector voltage close to zero volts, or where extremely high reflector circuit impedance are required, a diode should be connected between cathode and reflector to prevent the reflector from going positive.

MECHANICAL TUNING MECHANISM

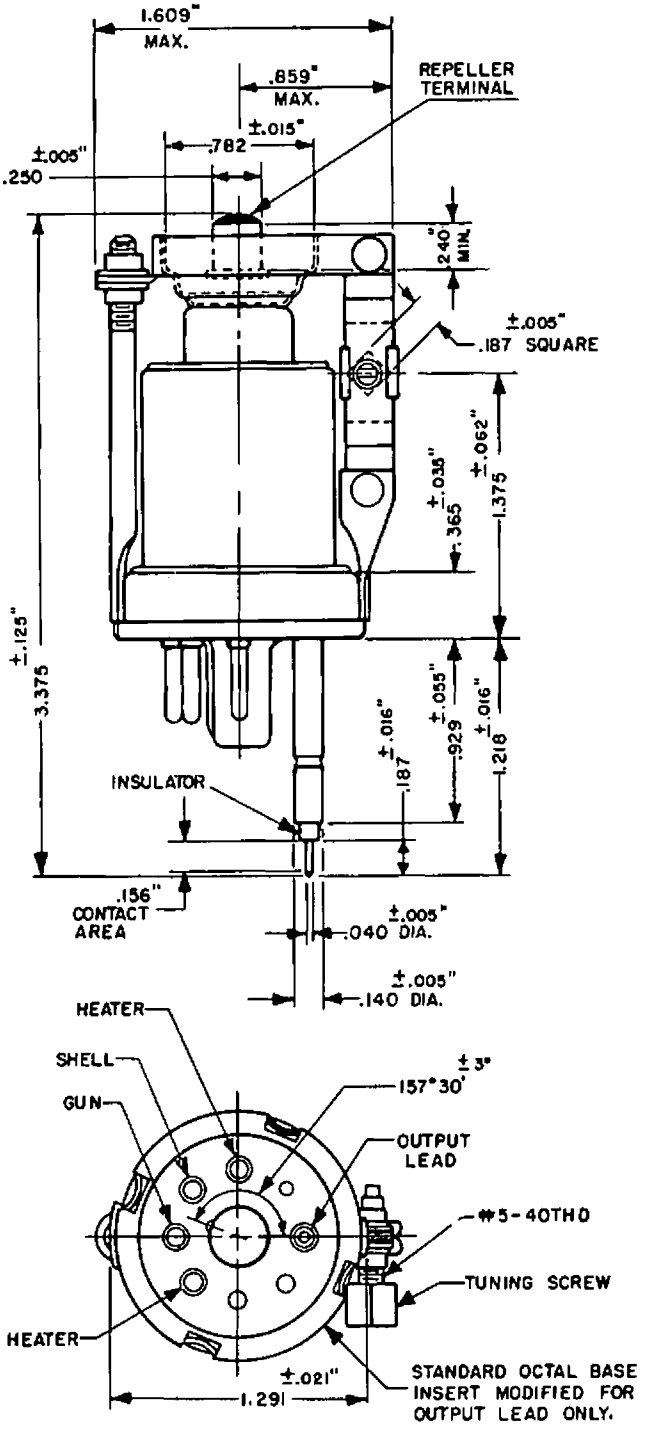
The mechanical tuning mechanism of the 5976 is designed to permit occasional frequency adjustments. Rotating the tuning screw in a clockwise direction reduces the frequency. Approximately 3 revolutions of the tuning nut are required to cover the recommended frequency range of the tube.

When the tube is first put into service, it should be mechanically tuned to the desired frequency. The tuning bows should then be flexed several times to relax the strains in the tuning mechanism. In this process the tuning screws should be adjusted to overshoot the desired frequency several times, each time decreasing the amount of tuning screw movement.

ELECTRONIC TUNING

With the mechanical tuning mechanism set near the desired frequency, vernier adjustment of the frequency may be accomplished by varying the reflector voltage. Maximum power output for a fixed mechanical tuner position, however, will be obtained at only one reflector value. If the mechanical tuning mechanism and the reflector voltage are mutually adjusted for a maximum power output, at a given frequency, and if the reflector voltage is then varied above and below the value for maximum power output, such that the power output is reduced to one-half, the frequency change between the half-power values is defined as electronic tuning range.

OUTLINE DRAWING



TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

The amount of the electronic tuning and the linearity of its variation with reflector voltage is dependent upon the type of load used, and the coupling to the load. When maximum electronic tuning range is required, it is recommended that the transducer be operated into a resistive load. A highly reactive load will shorten the electronic tuning range and cause non-linear variation of frequency with reflector voltage.

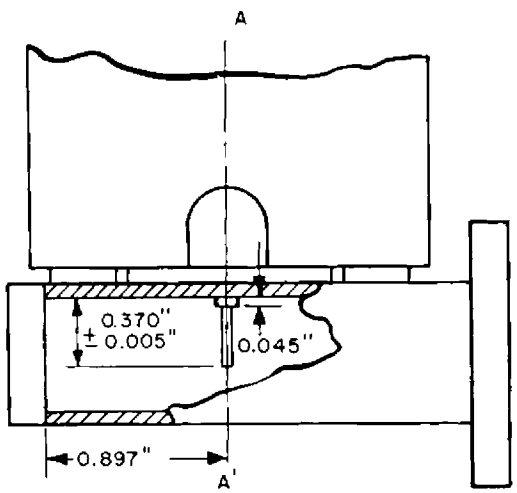
FREQUENCY STABILITY

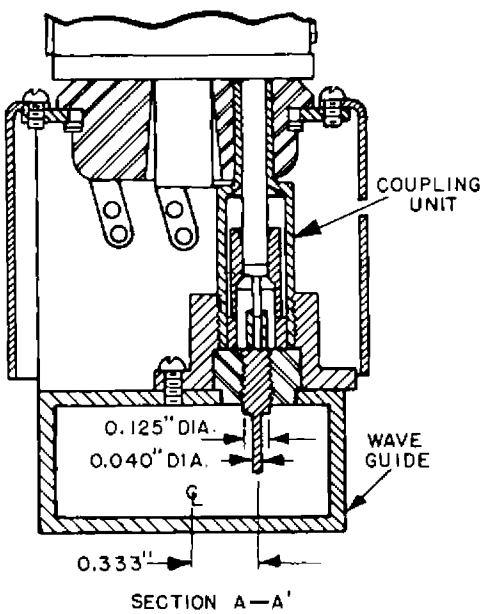
To obtain the most stable operation from the 5976, the reflector and resonator voltage supplies should be very well regulated. It is also essential that the 5976 be operated at a near constant ambient temperature. Under no circumstances should the temperature exceed the maximum specified values.

The materials used in the mechanical tuning mechanism of the 5976 have been selected in such a way that their thermal expansion coefficient will produce a desirable ambient temperature vs. frequency coefficient. In order that this desirable temperature coefficient will not be interfered with, a tube should not be clamped above the header skirt.

MODES OF OPERATION

Oscillation may be obtained in a given tube with several combinations of resonator and reflector voltages at a particular frequency. The regions where oscillation occurs within the reflector voltage range are referred to as voltage modes. The curves show characteristics of the average 5976 in the recommended mode. This mode has been chosen because it represents the best compromise between optimum power output and wide electronic tuning range.





POSITION OF TRANSDUCER COUPLING UNIT WITH RESPECT TO 1½" x ¾" WAVEGUIDE

from RTMA release #910,
Oct. 10, 1950

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

The type 5650 5981 is a velocity variation oscillator of the single cavity (integral) reflex type, designed for operation in the frequency range of 1,245 to 1,460 megacycles with an average power output of 100 milliwatts. The mechanical tuning mechanism provides a simple method of making wide frequency adjustments. In addition, the 5650/5981 can be electrically tuned to give a 4 megacycle vernier adjustment. The 5650 5981 is designed for operation at any frequency within the specified range, and is particularly suited for local oscillator service in microwave receivers. It is useful, also, as a local oscillator in microwave spectrum analyzers, as a pulse generator for testing circuit response, and as a microwave source for test purposes.



GENERAL CHARACTERISTICS

Heater, for oxide coated unipotential cathode:	
Voltage. (AC or DC)	6.3 ±.5 Volts
Current	0.455 Amperes
Frequency Range	1,245 to 1,460 Mc.

MAXIMUM RATINGS, Absolute Values

DC Resonator Voltage	250 Volts
DC Resonator Current	50 Ma.
DC Reflector Voltage	
Min. Negative Value	–30 Volts
Max. Negative Value	-220 Volts
Heater-Cathode Voltage	
Heater negative with respect to cathode	–50 Max. Volts
Heater positive with respect to cathode	–50 Max. Volts
Ambient temperature of air around shell	110 Max. °C
Temperature of coaxial output line	75 Max. °C

TYPICAL OPERATING CONDITIONS: C.W Oscillator: Frequency 1390 Mc.

DC Resonator Voltage	225 Volts
DC Resonator Current	35 Ma.
DC Reflector Voltage range*	–85 to –150 Volts
DC Reflector Current	Less than 7 Ma.
Electronic Tuning (Half Power)**	
Frequency change	5 Mc.
Power Output	134 MW
Thermal Compensation	±.05 Mc./°C

* Adjusted for maximum output at 1390 Mc.

** Change in frequency between the two ½ power points when the reflector voltage is varied above and below the point of maximum power output corresponding to the given frequency.

MECHANICAL

Mounting	Any Position
Overall dimensions	See outline drawing
Resonator Cavity	Integral part of tube
Envelope	Metal

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

Cap	Miniature
Base	To fit standard octal with No. 4 pin enlarged and tapped to admit transducer.

INSTALLATION

The 5650/5981 requires a standard octal socket modified with No. 4 pin enlarged and tapped to admit the coaxial transducer. The tube may be mounted in any position but should be rigidly clamped to insure proper contact of tube with the transducer, and to guard against excessive strains on the coaxial output line. The tube must be clamped on or below the shoulder of the header skirt.

The coaxial output line is coupled into a type "N" connector through a wide band transducer unit. (See outline drawing for transducer) All the tabulated data contained in this data sheet has been taken using this transducer operating into a matched load.

It is important that this transducer or its electrical equivalent be used to insure tube interchange ability and satisfactory tuning range characteristics. The standing wave ratio at the transducer should not exceed a VSWR of 1.1.

SHIELDING

Where the 5650/5981 is to be operated in the presence of strong magnetic fields, shielding of the resonator and reflector voltage leads is usually required in order to avoid undesirable modulation of the tube output. In extremely troublesome conditions, it may be advisable to place the 5650/5981 in a metal chamber with polyiron chokes provided to bring the voltages into the chamber. Adequate ventilation must be provided.

CATHODE

In most applications, the metal envelope (resonator) of the 5650/5981 is operated at ground potential. The cathode circuit is therefore negative with respect to ground by the amount of the resonator potential and must not be grounded. The cathode may be connected to one side of the heater or to the center tap of the heater transformer secondary. When cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to the heater lead. When cathode and heater are not connected together, the heater-cathode voltage should not exceed ± 50 volts.

In all cases where the resonator is operated at ground potential, the heater transformer must be insulated to withstand the maximum resonator voltage.

In applications where the metal envelope (resonator) of the 5650/5981 is not at ground potential, it is essential that the tube be surrounded by a grounding shield, and be mechanically tuned with an insulated tool. Adequate ventilation must be provided through this shield to keep the ambient temperature of the chamber below the maximum specified value.

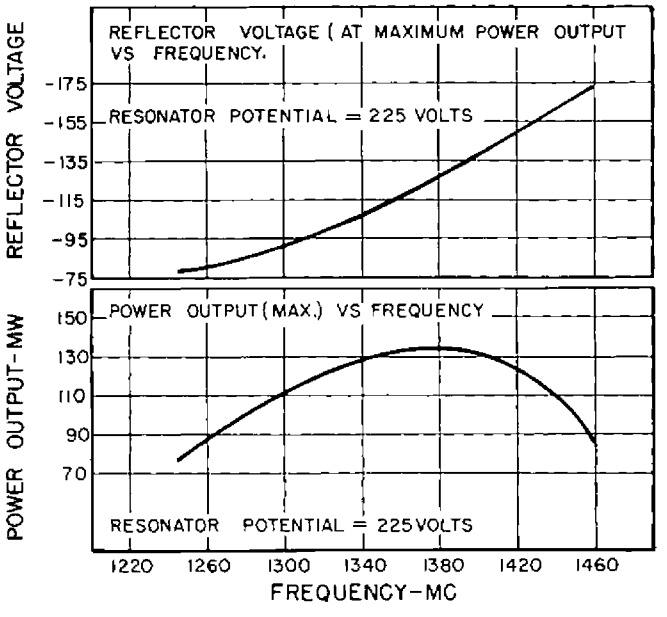
REFLECTOR

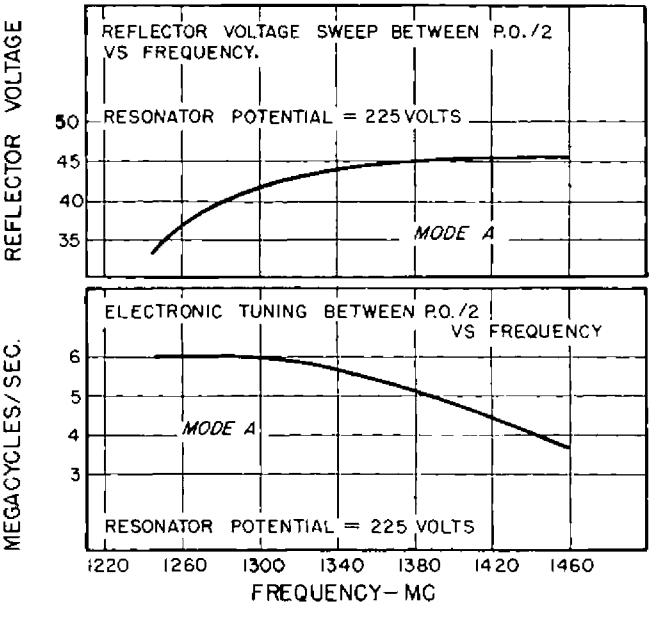
The reflector electrode is connected to pin No. 5, on the base of the tube. The power supply furnishing the reflector potential must be insulated to withstand the total resonator and reflector voltage. The reflector must never be allowed to become positive with respect to the cathode. If this precaution is not observed, damage to the reflector may result. In cases where modulating potentials bring the reflector voltage close to zero volts, or where extremely high reflector circuit impedances are required, a diode should be connected between cathode and reflector to prevent the reflector from going positive.

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

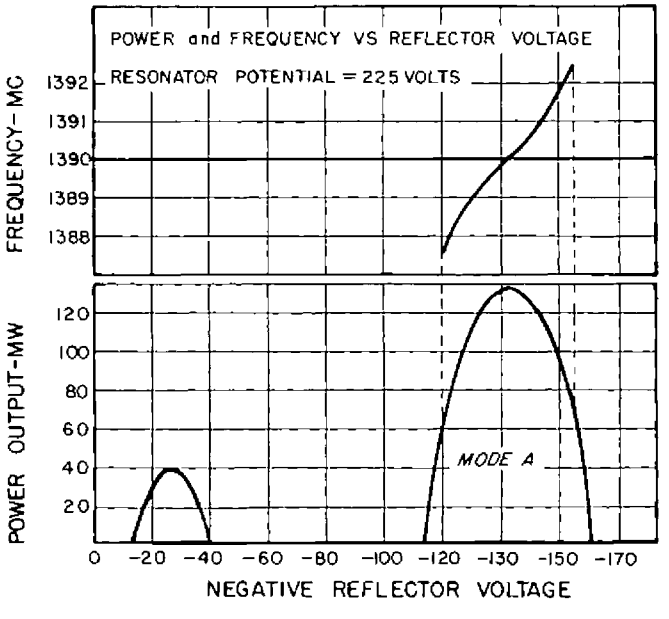
THE FOLLOWING DATA IS REPRESENTATIVE OF AVERAGE TUBES

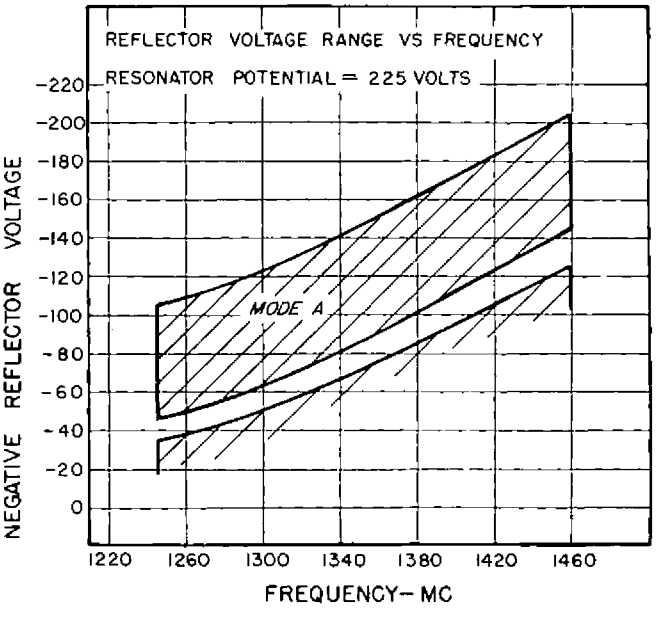
TUBES DESIGNED FOR USE IN MODE A





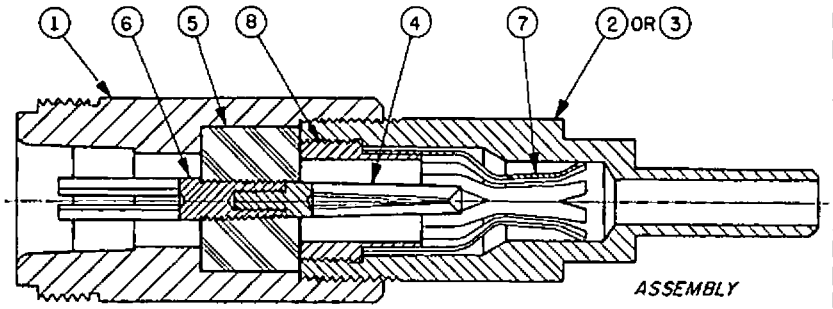
THE EXACT VALUE OF REFLECTOR VOLTAGE, PRODUCING MAXIMUM OUTPUT AT A CERTAIN FREQUENCY, VARIES FROM TUBE TO TUBE. THE VOLTAGE FOR ALL TUBES, AT EACH MODE, WILL FALL WITHIN THE SHADED AREA INDICATED BELOW.

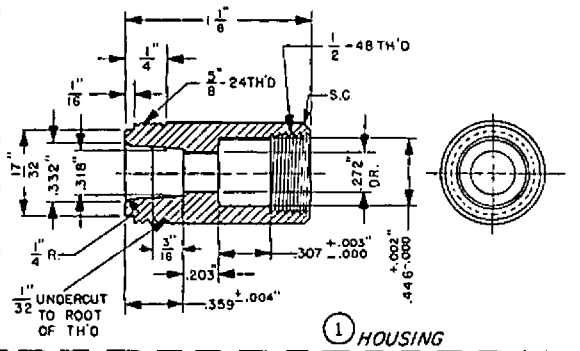




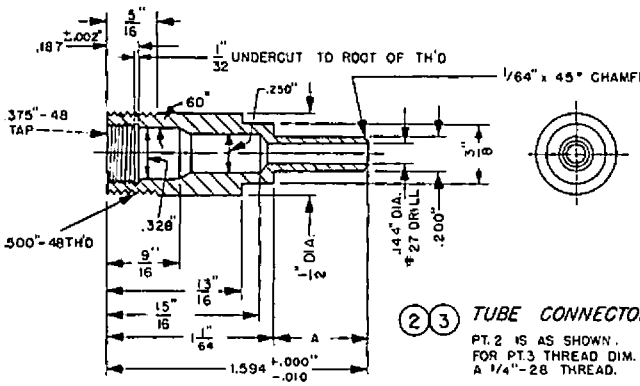
TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

5650/5981 TRANSDUCER COUPLING



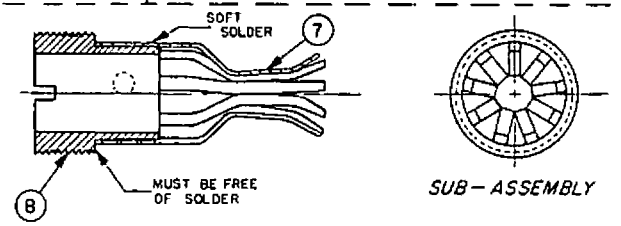


1 HOUSING

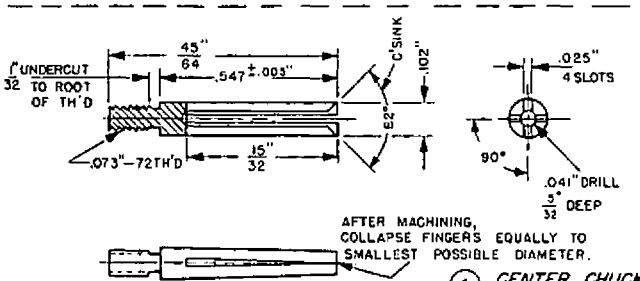


2 3 TUBE CONNECTOR

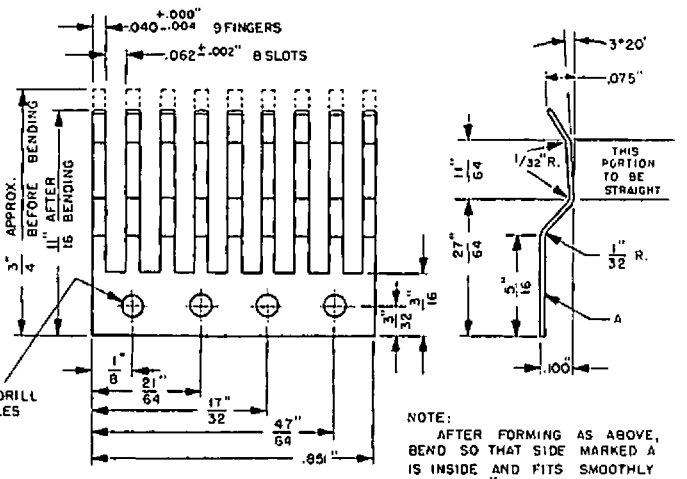
PT. 2 IS AS SHOWN.
FOR PT. 3 THREAD DIM. A 1/4"-28 THREAD.



SUB-ASSEMBLY

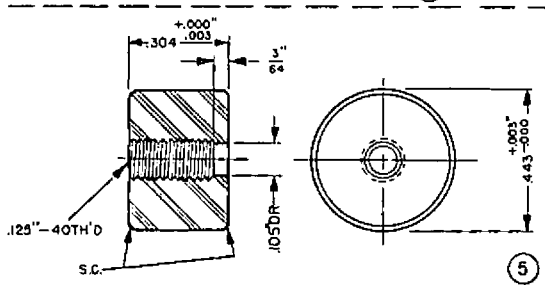


4 CENTER CHUCK

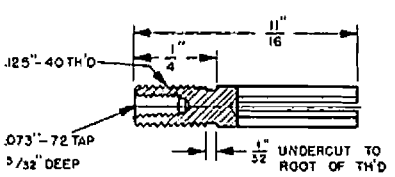


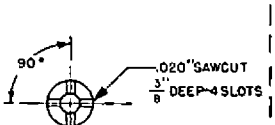
NOTE:
AFTER FORMING AS ABOVE, BEND SO THAT SIDE MARKED A IS INSIDE AND FITS SMOOTHLY ON A .261" DIAMETER.

7 CHUCK FINGERS

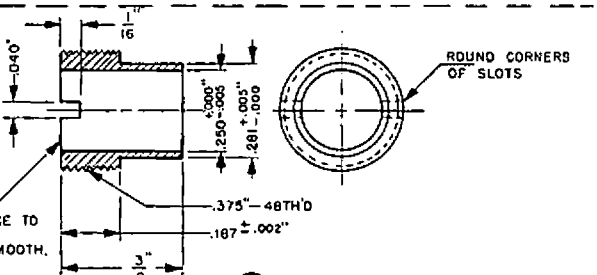


5 INSULATOR





6 INNER CONDUCTOR



8 CHUCK HOLDER

TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

MECHANICAL TUNING MECHANISM

The mechanical tuning mechanism of the 5650 5981 is designed to permit occasional frequency adjustments. Rotating the tuning screw in a clockwise direction increases the frequency. Approximately three revolutions of the tuning nut are required to cover the recommended frequency range of the tube.

When the tube is first put into service, it should be mechanically tuned to the desired frequency. The tuning nut should then be flexed several times to relax the strains in the tuning mechanism. In this process the tuning nut should be adjusted to overshoot the desired frequency several times, each time decreasing the amount of tuning nut movement.

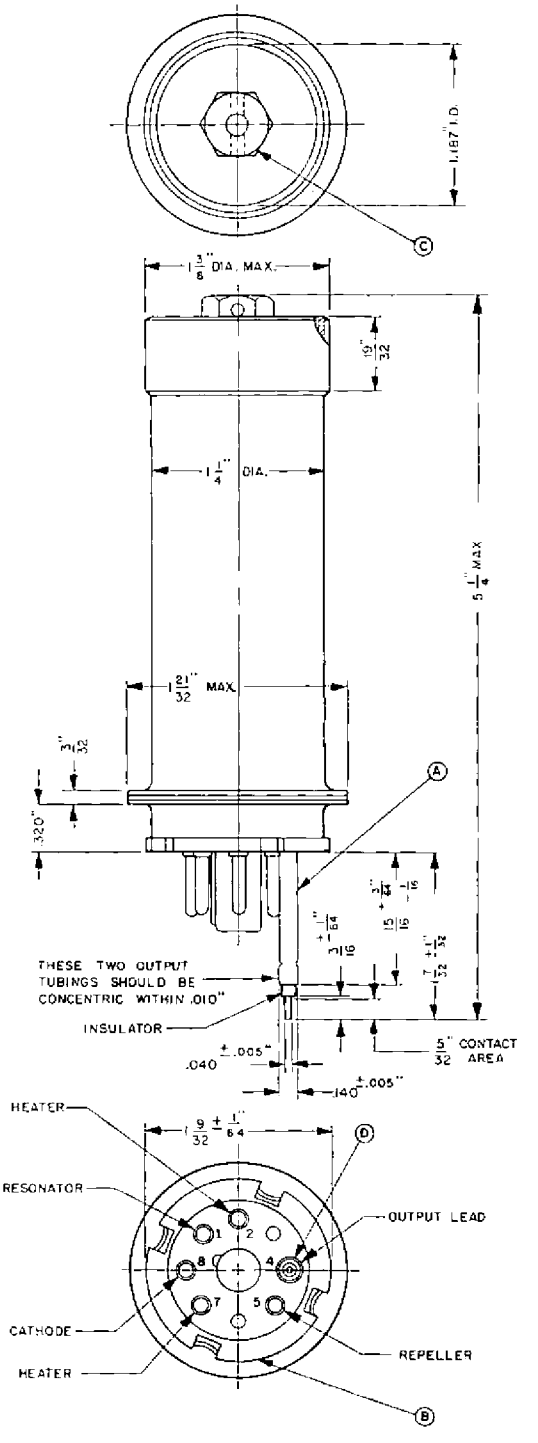
ELECTRONIC TUNING

With the mechanical tuning mechanism set near the desired frequency, vernier adjustment of the frequency may be accomplished by varying the reflector voltage. Maximum power output for a fixed mechanical tuner position, however, will be obtained at only one reflector value. If the mechanical tuning mechanism and the reflector voltage are mutually adjusted for a maximum power output at a given frequency, and if the reflector voltage is then varied above and below the value for maximum power output such that the power output is reduced to one half, the frequency change between the half-power values is defined as electronic tuning range. The amount of electronic tuning and the linearity of its variation with reflector voltage is dependent upon the type of load used, and the coupling to the load. When maximum electronic tuning range is required, it is recommended that the transducer be operated into a resistive load. A highly reactive load will shorten the electronic tuning range, and cause non-linear variation of frequency with reflector voltage.

FREQUENCY STABILITY

To obtain the most stable operation from the 5650/5981 the reflector and resonator voltage supplies should be very well regulated. It is also essential that the 5650/5981 be operated at a near constant ambient temperature. Under no circumstances should the temperature exceed the maximum specified values.

The materials used in the mechanical tuning mechanism of the 5650 5981 have been selected in such a way that their thermal expansion coefficient will produce a



TECHNICAL INFORMATION
VELOCITY VARIATION OSCILLATOR

desirable ambient temperature vs. frequency coefficient. In order that this desirable temperature coefficient will not be interfered with, a tube should not be clamped above the header skirt.

MODES OF OPERATION

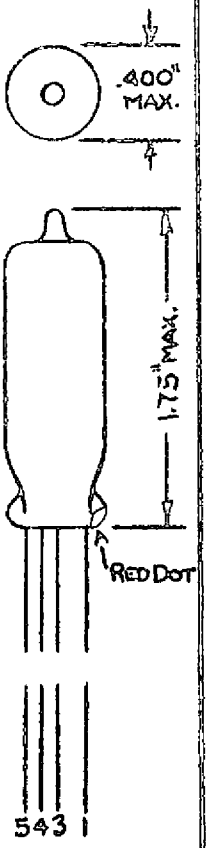
Oscillation may be obtained in a given tube with several combinations of resonator and reflector voltages at a particular frequency. The regions where oscillation occurs within the reflector voltage range are referred to as voltage modes. The curves show characteristics of the average 5650/5981 in the recommended mode. This mode has been chosen because it represents the best compromise between optimum power output and wide electronic tuning range.

TYPE 5995

SUBMINIATURE DIODE

DESCRIPTION

The 5995 is a heater-cathode type diode of subminiature construction designed for use in general rectifier applications. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.



MECHANICAL DATA

Envelope: T-3 Glass

Base: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: Leads 1 - 3 0.100" center-to-center.
Other Leads 0.050" center-to-center.)

Terminal Connections: (Red Dot is adjacent to Lead 1)

Lead 1 Plate	Lead 4 Heater
Lead 3 Heater	Lead 5 Cathode

Mounting Position: Any

ELECTRICAL DATA

Design Center Maximum Ratings:

Heater Voltage (ac or dc)	6.3	volts
Peak Inverse Voltage	850	volts
Peak Plate Current	275	ma.
AC Plate Voltage (RMS)	300	volts
Output Current (dc)	45	ma.
Peak Heater-Cathode Voltage	420	volts

Characteristics and Typical Operation - Half-Wave Rectifier:

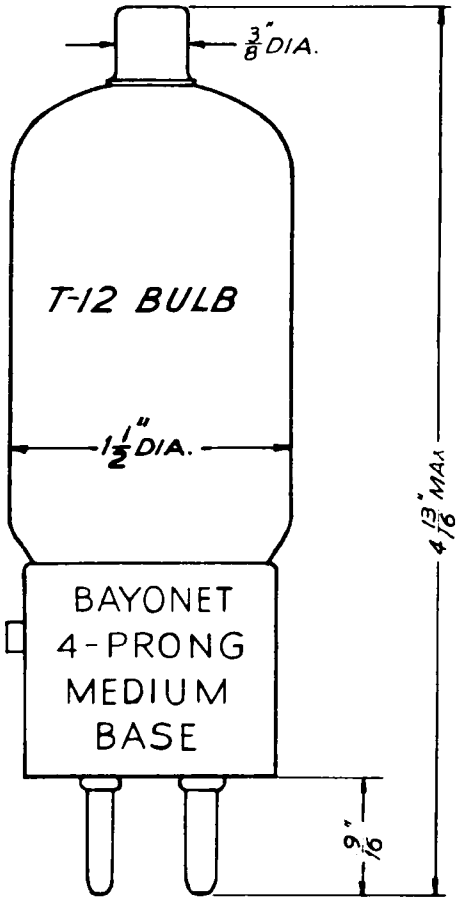
Heater Voltage (ac or dc)	6.3	volts
Heater Current	0.3	amp.
AC Plate Voltage (RMS)	275	volts
Filter Input Condenser for 60 Cycle Operation	16	uf.
DC Output Current	45	ma.
DC Output Voltage	270	volts
Average Tube Drop at Ib≥100 ma. (approx.)	25	volts

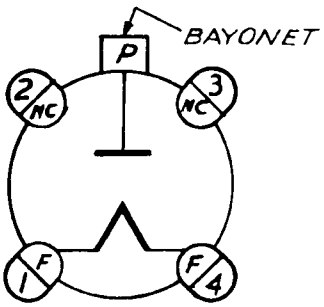
Tentative Data
February 15, 1951

Rev. 1
CS-2729

TENTATIVE TECHNICAL INFORMATION

HIGH VACUUM RECTIFIER





BOTTOM VIEW OF BASE

GENERAL CHARACTERISTICS

ELECTRICAL

Thoriated Tungsten Filament		
Voltage	2.5	volts
Current	3.0	amperes
Heating Time	2	seconds
Max. Tube Drop at 75 ma.	200	volts

MECHANICAL

Convection Cooling
Base Bayonet 4-prong Medium Bakelite
Maximum overall dimensions (see outline)
Height ---- 4-13/16"
Diameter ---- 1-9/16"

MAXIMUM RATINGS

Peak Inverse Voltage*	20,000	volts
Peak Plate Current	100	ma.
Average Plate Current	20	ma.

* This value of Maximum Peak Inverse Voltage is limited for tube use in hermetically-sealed units that are dry and free from dust.

from RMA release #331A, May 12, 1943
sponsored by Raytheon Manufacturing Co.

Reservation No._____ Registration No._____

Reservation Date_____ Registration Date_____

Type 721-B

Gas Switching Tube

General Characteristics

Electrical

Frequency Range	2800-3330 Mc.
Intrinsic Q	2500 (min.)
Ignitor Current	85 uAdc
Recovery Time (Note 1)	7 usecs (max.)

Note 1: Recovery time measured as follows: F=2800 to 3330 Mc; magnetron Po=50 Kv; pulse rate = 1000 pps; tp=1.0 usec (R-F); SWR=1.2 (mag. load)

Mechanical

Ionizable Medium	Hydrogen
Number of Electrodes	Three
Maximum Overall Height	(See Outline Drawing)
Maximum Diameter	" " "
Bulb	" " "
Mounting Position	any

Maximum Ratings

Peak Dissipation	100 watts
Average Dissipation	1 watt
Ionization Current	200 uAdc
Ignitor Open Circuit	-800 to -1000 Vdc

Note 2: A special disc processing increases life by a factor of 4 - 1 in comparison with the type 721A.

from RMA release # 478, March 20, 1946

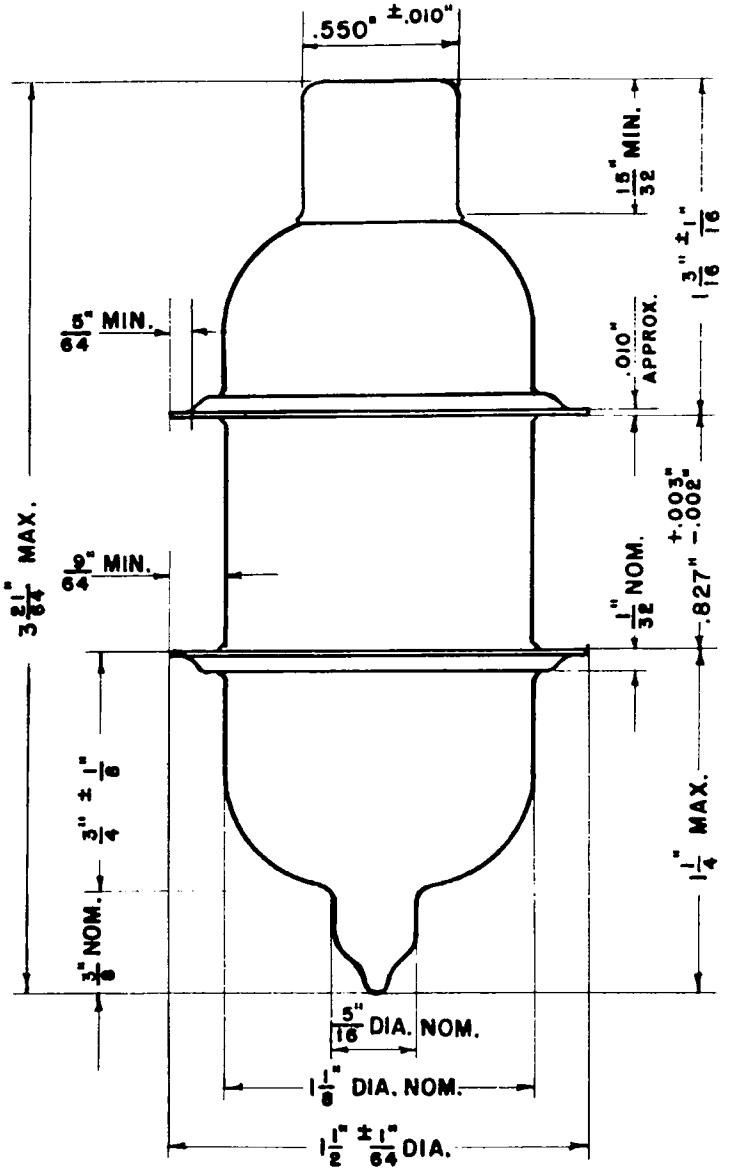
Sponsor: Raytheon Manufacturing Company Waltham, Mass.-

Release No. 478

March 20, 1946

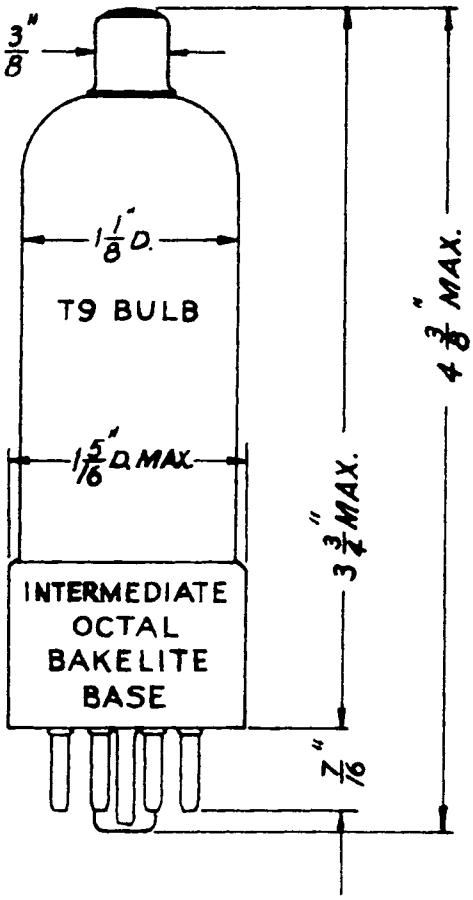
TYPE 721B

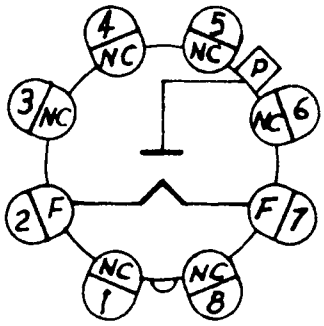
TECHNICAL INFORMATION
GAS SWITCHING TUBE
OUTLINE DRAWING



TENTATIVE TECHNICAL INFORMATION

HIGH VACUUM RECTIFIER





BOTTOM VIEW OF BASE

GENERAL CHARACTERISTICS

ELECTRICAL

Oxide Coated Filament	
Voltage	2.5 volts
Current	4.25 amperes
Heating Time	4 seconds
Max. Tube Drop at 100 ma.	135 volts

MECHANICAL

Convection Cooling
Base - Intermediate Octal Bakelite
Maximum overall dimensions (see outline)

Height	----	4-3/8"
Diameter	----	1-5/16"

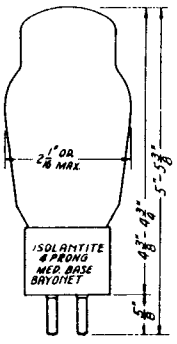
MAXIMUM RATINGS

Peak Inverse Voltage	13,000 volts
Peak Plate Current*	3 amperes
Average Plate Current	20 ma.

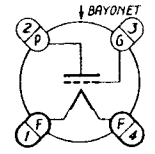
* This value of Maximum Peak Plate Current for intervals of less than 5 micro-seconds and repetition rate of less than 2000 times per second.

from RMA release #331A, May 12, 1943
sponsored by Raytheon Manufacturing Co.

841
TRIODE
POWER AMPLIFIER
OSCILLATOR



The 841 is a high-mu triode type power amplifier tube having a thoriated tungsten filament and an isolantite base. It is designed for use as a power amplifier or oscillator.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	7.5	volts
Filament Cur.	1.25	amp

DIR. INTERELEC. CAPAC.

Grid to Plate	7	μμf
Input	4	μμf
Output	3	μμf

A-F AMPLIFIER—CL. A—RES. COUPLED

MAXIMUM RATINGS

D-C Plate Voltage	425	volts
D-C Plate Supply Voltage	1250	volts
Plate Dissipation	12	watts

TYPICAL OPERATION

D-C Plate Supply Voltage	425‡	1000‡	volts
D-C Grid Voltage	−6	−9	volts
D-C Plate Current	0.7	2.2	ma
Amplification Factor	30	30	
Plate Resistance	63000	40000	ohms
Transconductance	450	750	μmhos
Peak A-F Grid Voltage	6	9	volts
Load Resistance	0.25	0.25	megohm
Voltage Output (5% second harmonic)	126	225	volts

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	425	volts
D-C Plate Current (with signal—per tube)	60	ma
Plate Dissipation (per tube)	15	watts

TYPICAL OPERATION

D-C Plate Voltage	350	425	volts
D-C Grid Voltage	−5	−5	volts
D-C Plate Current (no signal)	7	13	ma
D-C Plate Current (max. signal)	114	120	ma
Peak A-F Grid Voltage (grid to grid)	176	180	volts
Load Resistance (plate to plate)	5200	7000	ohms
Power Output (max. signal) (approximate)	21	28	watts
Driving Power (max. signal) (approximate)	3.2	3.6	watts

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	450	volts
D-C Plate Voltage—Telephony—Plate Modulation	350	volts
D-C Plate Current	60	ma
D-C Grid Current	20	ma
R-F Grid Current	4	amp
Plate Dissipation—Telegraphy	15	watts
Plate Dissipation—Telephony—Plate Modulation	10	watts

TYPICAL OPERATION

	Telephony, Plate Modulation		Telegraphy		
D-C Plate Voltage	250	350	350	450	volts
D-C Grid Voltage	−40	−47	−30	−34	volts
D-C Plate Current	50	50	50	50	ma
D-C Grid Current	15	15	15	15	ma
Peak R-F Grid Voltage	125	130	115	120	volts
R-F Driving Power	2	2	1.8	1.8	watts
Carrier Power Output	7	11	11	15	watts
A-F Modulating Power	6.3	8.8	—	—	watts
Peak Power Output	28	44	—	—	watts

‡Voltage effective at the plate is less than the plate supply voltage by the drop in the load resistor.

842
TRIODE
POWER AMPLIFIER

The 842 is a low-mu triode type power amplifier tube having a thoriated tungsten filament and an isolantite base. It is designed for use as an audio frequency power amplifier.

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	1.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	7	μμf
Input	4	μμf
Output	3	μμf

A-F POWER AMPLIFIER—CLASS A

MAXIMUM RATINGS

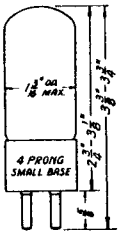
D-C Plate Voltage	425	volts
Plate Dissipation	12	watts

TYPICAL OPERATION

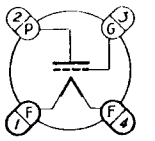
D-C Plate Voltage	350	425	volts
D-C Grid Voltage	−72	−100	volts
D-C Plate Current	34	28	ma
Peak A-F Grid Voltage	67	95	volts
Amplification Factor	3	3	
Transconductance	1250	1200	μmhos
Plate Resistance	2400	2500	ohms
Load Resistance	5000	8000	ohms
Power Output (5% second harmonic)	2.1	3.0	watts

For tube outline and basing view see type 841.

864
TRIODE
AMPLIFIER
DETECTOR



The 864 is a filament type triode amplifier tube designed for use as a detector or audio frequency amplifier in applications requiring a non-microphonic tube.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	1.1	volts
Filament Cur.	0.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	5.3	μμf
Input	2.3	μμf
Output	2.1	μμf

A-F AMPLIFIER—CLASS A

MAXIMUM RATING

D-C Plate Voltage	135	volts

TYPICAL OPERATION

D-C Plate Voltage	90	135	volts
D-C Grid Voltage	−4.5	−9.0	volts
D-C Plate Current	2.9	3.5	ma
Amplification Factor	8.2	8.2	
Transconductance	610	645	μmhos
Plate Resistance	13500	12700	ohms

Grid Coupling Resistor, if used, must not exceed 2.0 megohms.

DETECTOR—BIASED TYPE

MAXIMUM RATING

D-C Plate Voltage	135	volts

TYPICAL OPERATION

D-C Plate Voltage	90	135	volts
D-C Grid Voltage	−10.5	−15	volts
D-C Plate Current	Adjusted to 0.2 ma with no signal		

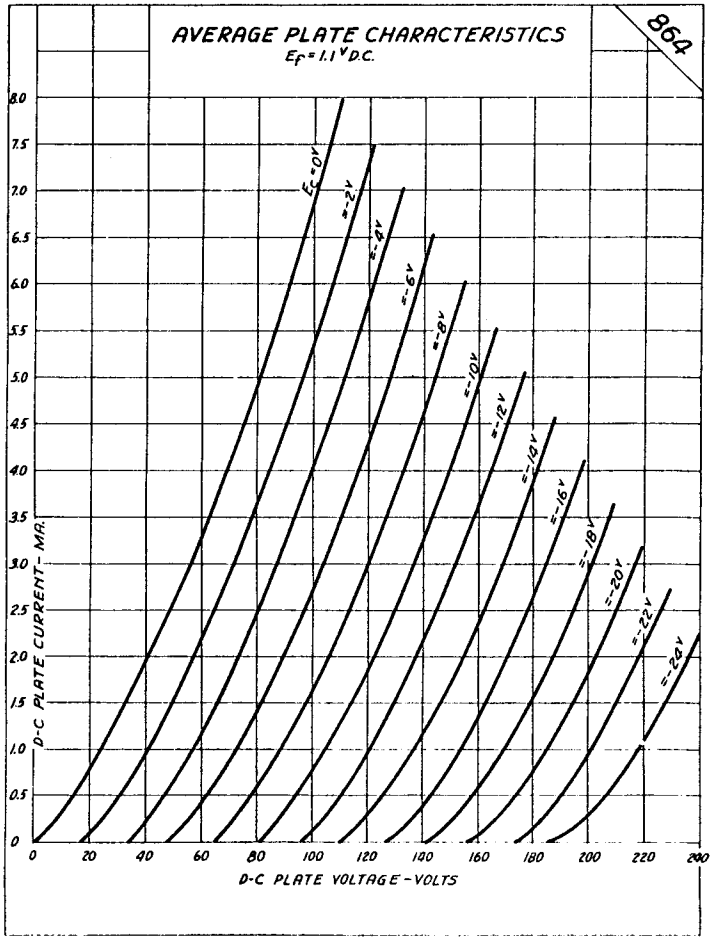
DETECTOR—GRID LEAK TYPE

MAXIMUM RATING

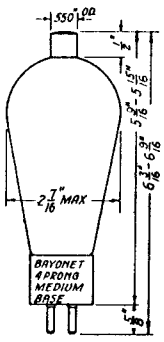
D-C Plate Voltage	45	volts

TYPICAL OPERATION

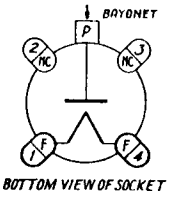
D-C Plate Voltage	45	volts
Grid Leak	0.25-5	megohms
Grid Condenser	0.0025	μf



MERCURY VAPOR TYPE HALF-WAVE RECTIFIER



The 866A is a half-wave, shielded filament type mercury vapor rectifier tube particularly suited for high voltage d-c power supplies. Two type 866A tubes in a full wave rectifier circuit with a choke input filter will supply a maximum of 3000 volts d.c. at a drain of 500 milliamperes.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	2.5	volts
Filament Cur.	5.0	amp

MAXIMUM RATINGS—TEMP. RANGE 25°—60° C.

Peak Inverse Voltage	10000	volts
Peak Plate Current	1.0	amp
Average Plate Current	0.25	amp
Tube Voltage Drop	10 approx.	volts

TYPICAL OPERATION

Circuit	A-C Input Voltage RMS Volts	Maximum D-C Output Volts To Filter	One Section Filter Minimum Choke Henries (L)	One Section Filter Maximum Condenser Mfds. (C)	Maximum D-C Output Current Amperes
Single-phase Full-Wave Two Tubes Choke Input	3535 per tube	3180	8.0	1.25	0.5
	3000 " "	2700	6.8	1.50	0.5
	2000 " "	1800	4.5	2.1	0.5
	1500 " "	1350	3.4	2.8	0.5
Single-phase Full-Wave Two Tubes Condenser Input	3535 " "	3950	—	—	0.25
	3000 " "	3390	—	—	0.25
	2000 " "	2260	—	—	0.25
	1500 " "	1700	—	—	0.25
Single-phase Full-Wave Bridge Circuit Four Tubes Choke Input	7070 total	6360	16.0	0.6	0.5
	6000 "	5400	13.5	0.7	0.5
	5000 "	4500	11.0	0.9	0.5
	4000 "	3600	8.9	1.1	0.5

OPERATING NOTES

Values of L and C given under "Typical Operation" are selected to hold the peak surge current within the maximum rating. If a larger value of L is used the capacity may be increased in proportion to the increase in L. L and C of a two section filter are determined as shown above. If two unequal chokes are used, place the larger choke nearer the tube. With a two section filter and the minimum L and the maximum C shown above, the total ripple will be less than 5%.

CAUTION

In shipment drops of mercury may be shaken onto the filament. Before the plate voltage is applied to a new tube the filament should be burned at normal voltage for at least 15 minutes. The filament should be allowed to come up to operating temperature before plate voltage is applied. For average conditions the delay is approximately 30 seconds.

The tube should always be mounted vertically with the top cap up.

A socket with heavy, tight prongs should be used and the filament voltage should measure exactly 2.5 volts at the socket in order to insure long life.

866

MERCURY VAPOR TYPE HALF-WAVE RECTIFIER

The 866 is a half-wave filament type mercury vapor rectifier tube particularly suited for medium drain d-c power supplies and linear amplifier bias packs. Two types 866 tubes in a full-wave rectifier circuit with a choke input filter will supply a maximum of 2000 d.c. at a drain of 500 ma.

FILAMENT RATING

Filament Voltage	2.5	volts
Filament Current	5.0	amp

MAXIMUM RATINGS—TEMP. RANGE 10°—60° C.

Peak Inverse Voltage	7500	volts
Peak Plate Current	1.0	amp
Average Plate Current	0.25	amp
Tube Voltage Drop (approximate)	15	volts

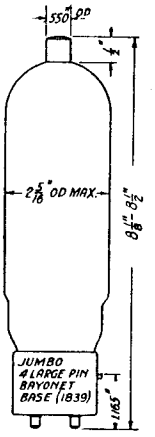
TYPICAL OPERATION

Circuit	A-C Input Voltage RMS Volts	Maximum D-C Output Volts To Filter	One Section Filter Minimum Choke Henries (L)	One Section Filter Maximum Condenser Mfds. (C)	Maximum D-C Output Current Amperes
Single-phase Full-Wave Two Tubes Choke Input	2650 per Tube	2385	2.0	1.6	0.5
	2000 " "	1800	4.9	1.8	0.5
	1500 " "	1350	3.3	2.8	0.5
	1000 " "	900	2.1	4.2	0.5
Single-phase Full-Wave Two Tubes Condenser Input	2650 " "	3000	—	—	0.25
	2000 " "	2260	—	—	0.25
	1500 " "	1700	—	—	0.25
	1000 " "	1150	—	—	0.25
Single-phase Full-Wave Bridge Circuit Four Tubes Choke Input	5000 total	4770	12.0	0.8	0.5
	4500 "	4050	10.0	1.0	0.5
	4000 "	3600	8.4	1.2	0.5
	3500 "	2700	6.8	1.5	0.5

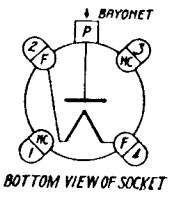
For tube outline, basing view and operating notes see type 866A.

872A

MERCURY VAPOR TYPE HALF-WAVE RECTIFIER



The 872A is a half-wave, shielded filament type mercury vapor rectifier tube designed for heavy current, high voltage power supplies. Two type 872A tubes in a full-wave rectifier circuit with a choke input filter will supply a maximum of 2.5 amperes at 5000 volts d.c.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	5.0	volts.
Filament Cur.	6.75	amp

MAXIMUM RATINGS—TEMP. RANGE 20°—60° C.

Peak Inverse Voltage	1000	volts
Peak Plate Current	5.0	amp
Average Plate Current	1.25	amp
Tube Voltage Drop (approx.)	10	volts

TYPICAL OPERATION

Circuit	Maximum A-C Input Volts (RMS)	Approx. D-C Output Volts To Filter	Maximum D-C Output Current—Amp.
Single-phase Full-Wave Two Tubes	3535 per tube	3180	2.5
Single-phase Full-Wave Bridge Circuit Four Tubes	7070 total	6360	2.5

The values given above are for a sine wave input voltage and with a suitable choke before the first filter condenser.

CAUTION

In shipment drops of mercury may be shaken onto the filament. Before the plate voltage is applied to a new tube the filament should be burned at normal voltage for at least 15 minutes.

In normal operation the filament should be brought up to operating temperature at least 30 seconds before the plate voltage is applied.

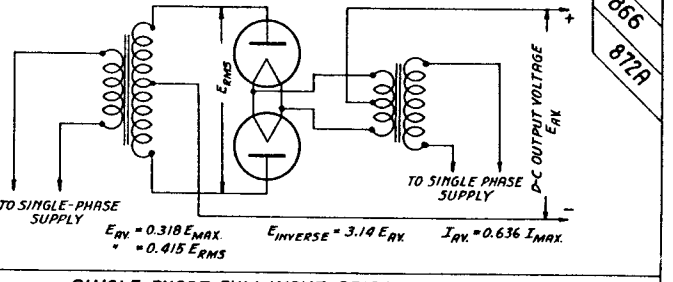
The tube should always be mounted vertically with the top cap up.

A socket with tight, heavy prongs should be used and the filament voltage should measure exactly 5.0 volts at the socket to insure long life.

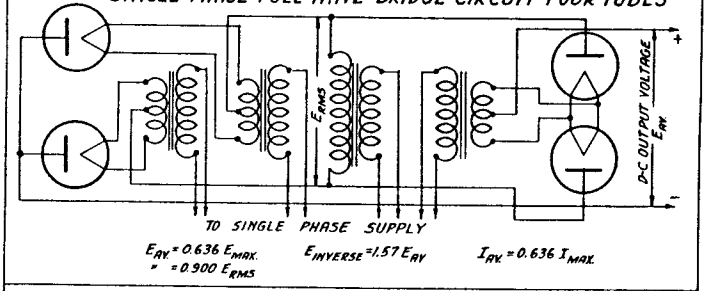
CIRCUITS FOR MERCURY-VAPOR RECTIFIER TUBES

866A 866 872A

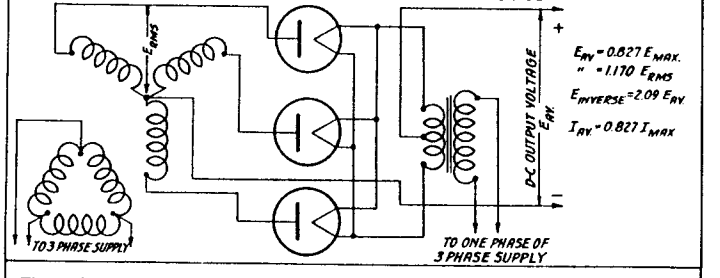
SINGLE-PHASE FULL WAVE TWO TUBES



SINGLE-PHASE FULL WAVE BRIDGE CIRCUIT FOUR TUBES



THREE PHASE HALF WAVE THREE TUBES



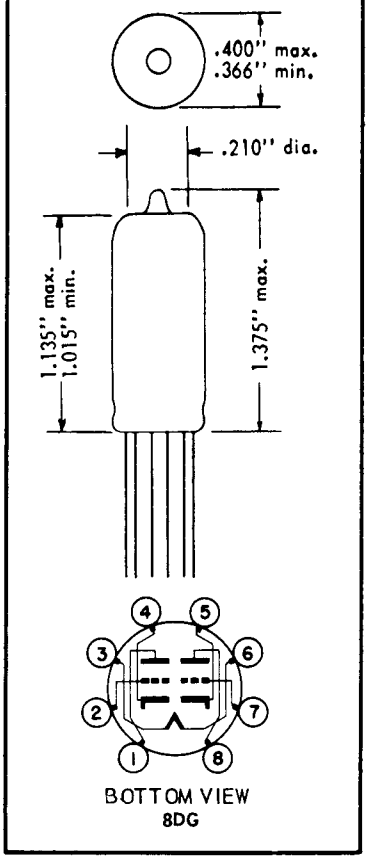
The values of E_{av}, $E_{inverse}$, and I_{av} are based on

1. Sine Wave Supply Voltage
2. Equal Phase Voltages
3. Zero Tube Voltage Drop
4. Pure Resistance Load—No Filter

Excellence in Electronics

TYPE CK6021WA

The CK6021WA is a heater–cathode type medium–mu double triode of subminiature construction capable of operation in the UHF region. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW
8DG

MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8–Pin (0.017" tinned flexible leads. Length: 1.5" min.)

TERMINAL CONNECTIONS

Lead 1 Plate, Unit #2	Lead 5 Cathode, Unit #1
Lead 2 Grid, Unit #2	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid, Unit #1
Lead 4 Cathode, Unit #2	Lead 8 Plate, Unit #1

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test–Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test–Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION---To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if design maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL–E–1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL–E–1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	100	100	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid Voltage	Ec1:	–55	0	0	----	Vdc
Plate Dissipation (per plate)	Pp/p:	----	----	0.65	0.7	W
Grid #1 Circuit Resistance	Rg/g:	----	----	1.0	1.1	Meg.
Heater–Cathode Voltage	Ehk:	–200	----	100	+200	Vdc
Plate Current (per plate)	Ib/p:	0.5	----	6.5	22	mAdc
Grid Current (per grid)	Ic/c:	----	----	----	5.5	mAdc
Cathode Resistance (per unit)	Rk:	----	150	150	----	ohms
Transconductance (per plate)	Sm/p:	----	----	5400	----	μmhos
Amplification Factor	Mu/p:	----	----	35	----	----

Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.4	If:	285	----	----	----	315	----	mA
Heater–cathode Leakage (1):	Ehk = +100 Vdc Ehk = –100 Vdc	0.4	Ihk (1): Ihk (1):	---- ----	---- ----	---- ----	---- ----	3.5 3.5	---- ----	μAdc μAdc
Grid Current:	Eb = 150 Vdc; Rk/k = 300 ohms; Rg = 1.0 Meg.	0.4	Ic (1):	----	----	----	----	–0.3	----	μAdc
Plate Current (1):		0.4	Ib (1):	4.5	5.6	6.5	7.3	8.5	2.3	mAdc
Plate Current (2):	Ec1 = –6.5 Vdc	0.4	Ib (2):	----	----	----	----	100	----	μAdc
Transconductance (1):		0.4	Sm (1):	4450	5000	5400	5800	6350	1100	μmhos
Continuity to Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8–1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg–all = –100 Vdc Ep–all = –300 Vdc	2.5	Rg1–all: Rp–all:	250 250	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (1) Difference between Sections:		2.5	Ib:	----	----	----	----	1.5	----	mAdc
Transconductance (2):	Ef = 5.7V; (Note 9)	2.5	Δ_{Ef} Sm (2):	----	----	----	----	10	----	%
Grid Emission:	Eb = 250 Vdc; Rg/g = 1.0 Meg.; Rk/k = 2200 ohms; Ef = 7.5 V; Preheat 5 minutes at Ec = 0; Test at Ec = –9.0 Vdc	6.5	Isc1:	----	----	----	----	–0.5	----	μAdc
AF Noise:	Esig = 65 mVac; Rg = 0.1 Meg; Rp = 0.01 Meg., Rk = 75 ohms; Ck = 1000 μf; Units connected in parallel	2.5	EB:	----	----	----	----	17	----	VU
Pulse Emission (1):	Eb = 150 Vdc; Ec1 = –25 Vdc; Egk = +30 V; Rk/k = 1.0 ohm; duty cycle = 1%; tp = 10 μsec. (Note 13)	2.5	ik: Δ_{tp} ik:	320 ----	---- ----	---- ----	---- ----	---- 10	---- ----	ma. %
Pulse Emission (2):	Ef = 5.9 V; Eb = 150 Vdc; Ec1 = –25 Vdc; tp = 10 μsec, duty cycle = 1%; egk = +30 v; Rk/k = 1.0 ohms; (Note 13)	6.5	ik:	300	----	----	----	----	----	ma
Heater–Cathode Leakage (2):	Ef = –6.7V (Pin 6 negative); Ehk = +100 Vdc (cathode neg.) t = 16 seconds (Note 14)	6.5	Ihk (2):	----	----	----	----	1.0	----	μAdc
Amplification Factor:		6.5	mu:	30	----	35	----	40	----	----
Capacitance:			Cgp:	1.2	----	1.5	----	1.8	----	μμf
Capacitance:			Cin:	1.8	----	2.4	----	3.0	----	μμf
Capacitance:	(Note 2)	6.5	Cout (Unit #1):	0.20	----	0.28	----	0.36	----	μμf
Capacitance:			Cout (Unit #2):	0.22	----	0.32	----	0.42	----	μμf
Capacitance:			Cgg:	----	----	----	----	0.013	----	μμf
Capacitance:			Cpp:	----	----	----	----	0.52	----	μμf
Operation Time:	Note 11	4.0	t:	----	----	----	----	20	----	sec.
Low Pressure Voltage Breakdown:	Pressure = 21 ± 3 mmHg; Voltage = 300 Vac.	6.5	----	----	----	----	----	----	----	----

RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd.)

In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
MEASUREMENTS ACCEPTANCE TESTS PART 2 (cont'd.)								
Vibration (2):	F= 40 cps; G= 15; Rp= 10,000 ohms	2.5	Ep:	----	20	mVac		
Vibration (3):	F= 70–2000; t= 3 minutes; G= 15; Rp= 10,000 ohms. Positions X_1 and X_2 only.	6.5	ep:	----	125 peak to peak	mv		
DEGRADATION RATE ACCEPTANCE TESTS								
Subminiature Lead Fatigue:		2.5	----	4.0	----	arcs		
Shock (1):	Ehk=+100 Vdc; Rg=0.1 Meg.; Hammer Angle=30°; (Note 3)	20	----	----	----	----		
Fatigue (1):	96 hours; G= 2.5; Fixed frequency; F= 25 min., 60 max. (Note 5)	6.5	----	----	----	----		
Shock (2):	Ehk= 100 Vdc; Rg= 0.1 Meg; Hammer Angle= 120°+ Rubber Pad; t= 10 milliseconds; G= 75; (Note 16)	20	----	----	----	----		
Fatigue (2):	6 hours; G= 10; F= 130–2000–130 cps (Note 15)	6.5	----	----	----	----		
Post Shock (1) & (2) and Fatigue (1) & (2) Test End Points:								
Vibration (2):	F= 40 cps; G= 15; Rp= 10,000 ohms	----	Ep:	----	80	mVac		
Heater–Cathode Leakage (1):	Ehk=+100 Vdc Ehk=–100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	7.0 7.0	μAdc μAdc		
Change in Trans-conductance (1) of individual tubes:	Ef= 6.3 V	----	Δ_t Sm (1):	----	15	%		
Grid Current (1):		----	Ic1:	----	–1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef= 7.0 V; Eb= Ec1= 0 V; Ehk= 140 Vac; 1 min on, 4 min off	1.0	----	2000	----	cycles		
Heater Cycle Life Test End Point:								
Heater–Cathode Leakage (1):	Ehk=+100 Vdc Ehk=–100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	7.0 7.0	μAdc μAdc		
2 & 20 Hour Stability Life Test:	TA= Room; Ehk=+200 Vdc; Rg/g= 1.0 Meg.	----	----	----	----	----		
2 & 20 Hour Stability Life Test End Points:								
Change in Trans-conductance (1) of individual tubes:	(Typical Sample Size= 50 tubes)	1.0	Δ_t Sm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA= Room; Ehk=+200 Vdc; Rg/g= 1.0 meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size= 200 tubes)							
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	4000	----	μmhos		

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd.)

In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd.)								
200 Hour Intermittent Life Test (1):	Eb= 250 Vdc; Ehk= +200 Vdc; Rg/g= 1.0 meg; Rk/k= 2200 ohms; TA= Room	----	----	----	----	----	---	---
200 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	−0.9	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm (1):	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	20	%	1	3
Hecter–Cathode Leakage (1):	Ehk= +100 Vdc Ehk= −100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Electrode Insulation:								
g–all: p–all:		---- ----	Rg1–all: Rp–all:	100 100	---- ----	Meg. Meg.	1	3
Total Defectives:		----	----	----	----	----	3	6
500 Hour Intermittent Pulse Life Test:	Eb= 250 Vdc; Ec1= −25 Vdc; Rk/k= 0; RL/p= 330 ohms; tp= 10 μsec; duty cycle= 1.0%; egk= +30± 1 v; TA= Room.	----	----	----	----	----	---	---
500 Hour Intermittent Pulse Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Pulse Emission (1):		----	ik:	300	----	ma	1	3
Change in Pulse Emission (1) of individual tubes from initial:		---- ----	Δ ik: Δ ik:	---- ----	−35 +50	% %	1	3
Total Defectives:		----	----	----	----	----	2	5
Intermittent High Temperature Life Test (2):	T Bulb= 220°C; Ehk= +200 Vdc; Rg/g= 1.0 Meg.	----	----	----	----	----	---	---
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	−0.7	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) change of individual tubes from initial:		----	Δ_t Sm (1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm (2):	----	15	%	1	3
Heater–Cathode Leakage (1):	Ehk= +100 Vdc Ehk= −100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Insulation of Electrodes:								
g–all: p–all:		---- ----	Rg1–all: Rp–all:	50 50	---- ----	Meg. Meg.	1	3

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)
In the following tests, each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd.)								
Transconductance (1) Average change:		----	Avg.Δ_tSm	----	15	%	---	---
Total Defectives:		----	----	----	----	----	3	6
1000 Hour High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	1	3
Heater-Current:		----	If:	276	328	mA	1	3
Transconductance (1) Change of individual tubes:		----	Δ_tSm (1):	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm (2):	----	20	%	1	3
Heater-Cathode Leakage (1):	Ehk= +100 Vdc	----	Ihk (1):	----	10	μAdc	1	3
	Ehk= -100 Vdc	----	Ihk (1):	----	10	μAdc		
Electrode Insulation:								
g-all:		----	Rg1-all:	25	----	Meg.	2	5
p-all:		----	Rp-all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef= 6.3V to the value measured at Ef= 5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in the data sheet, these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of MIL-E-1 basic specifications.

Note 11: Operation time is the time in seconds required for the plate current to attain a value within ± 10% of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed. A cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300± 50 micro seconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent Short	600,000 ohms
500 microseconds	500,000 ohms
100 microseconds	100,000 ohms
60 microseconds	1,000 ohms

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

Note 12: (cont'd.) Tubes which give an indication of one or more of the following shall be rejected as inoperable:

A) either a permanent or tap short at any time during the tapping procedure

B) any open circuit

C) air leaks

Note 13: Peak cathode current shall be measured by means of a high impedance oscilloscope or equivalent device connected across a 1.0± 1% cathode resistor. The specified limit refers to the maximum of the pulse amplitude. The variation of the output pulse amplitude between 20% tp and 80% tp shall not exceed the specified limit.

Note 14: Heater–Cathode Leakage (2) is performed as follows:

A) Preheat tubes for 10 seconds with Ef= 10.5 V.

B) Test immediately by the application of the specified test conditions of this test.

C) After 16 seconds read Heater–cathode Leakage of each section.

Note 15: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2 and Y1. Only rated heated voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

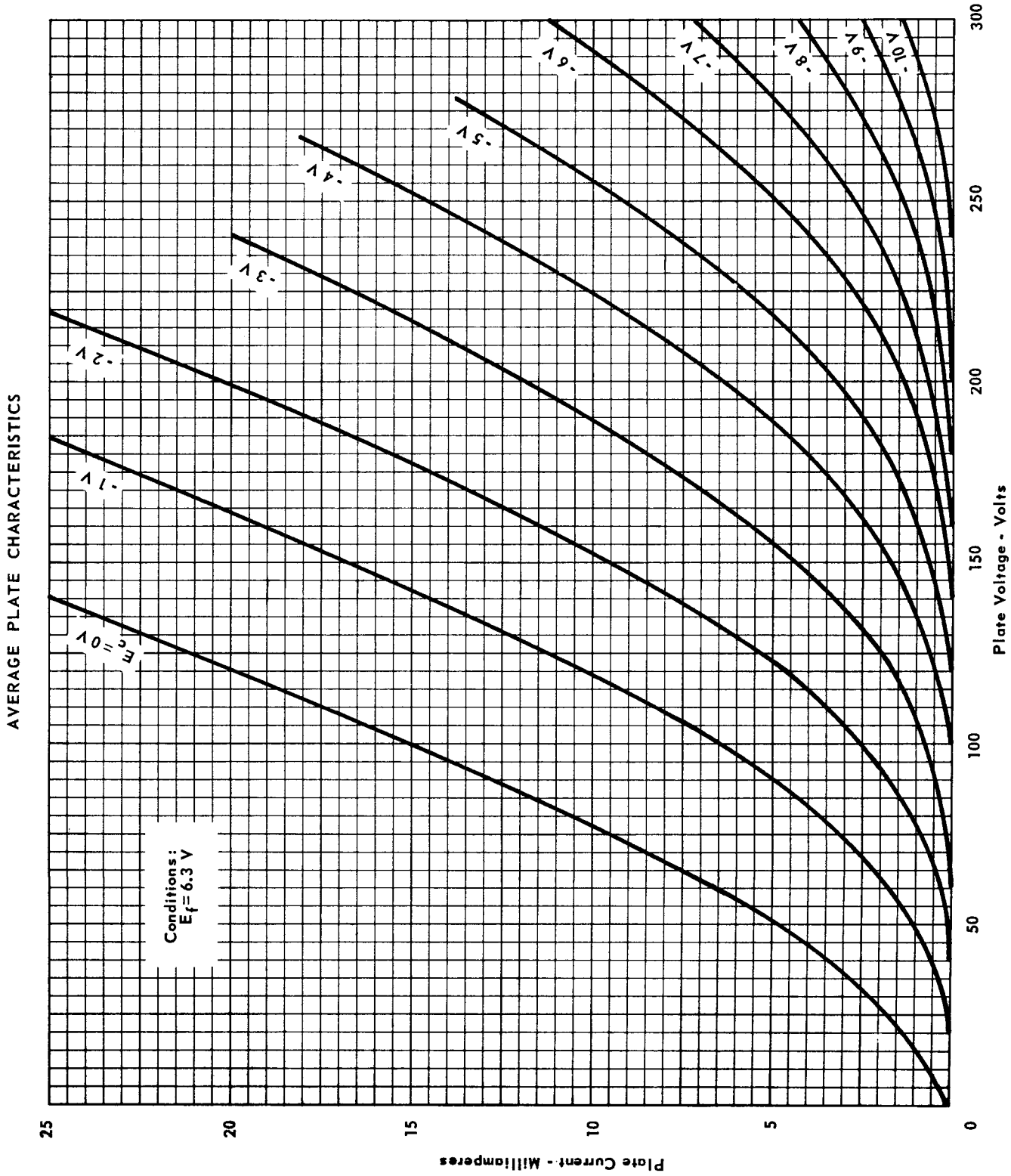
A) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

B) Tubes which do not comply with post fatigue limits. This is a destructive test.

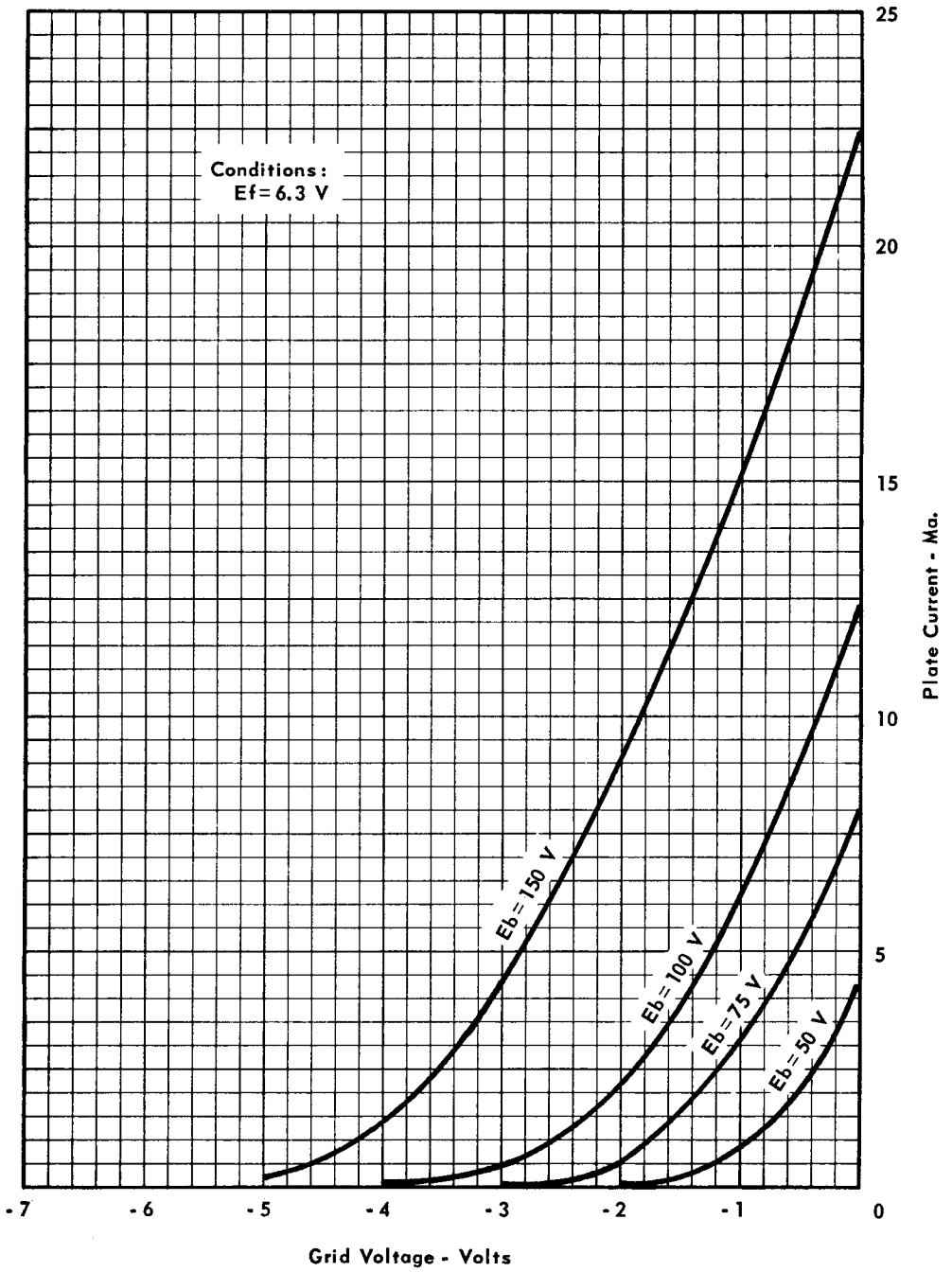
Note 16: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE



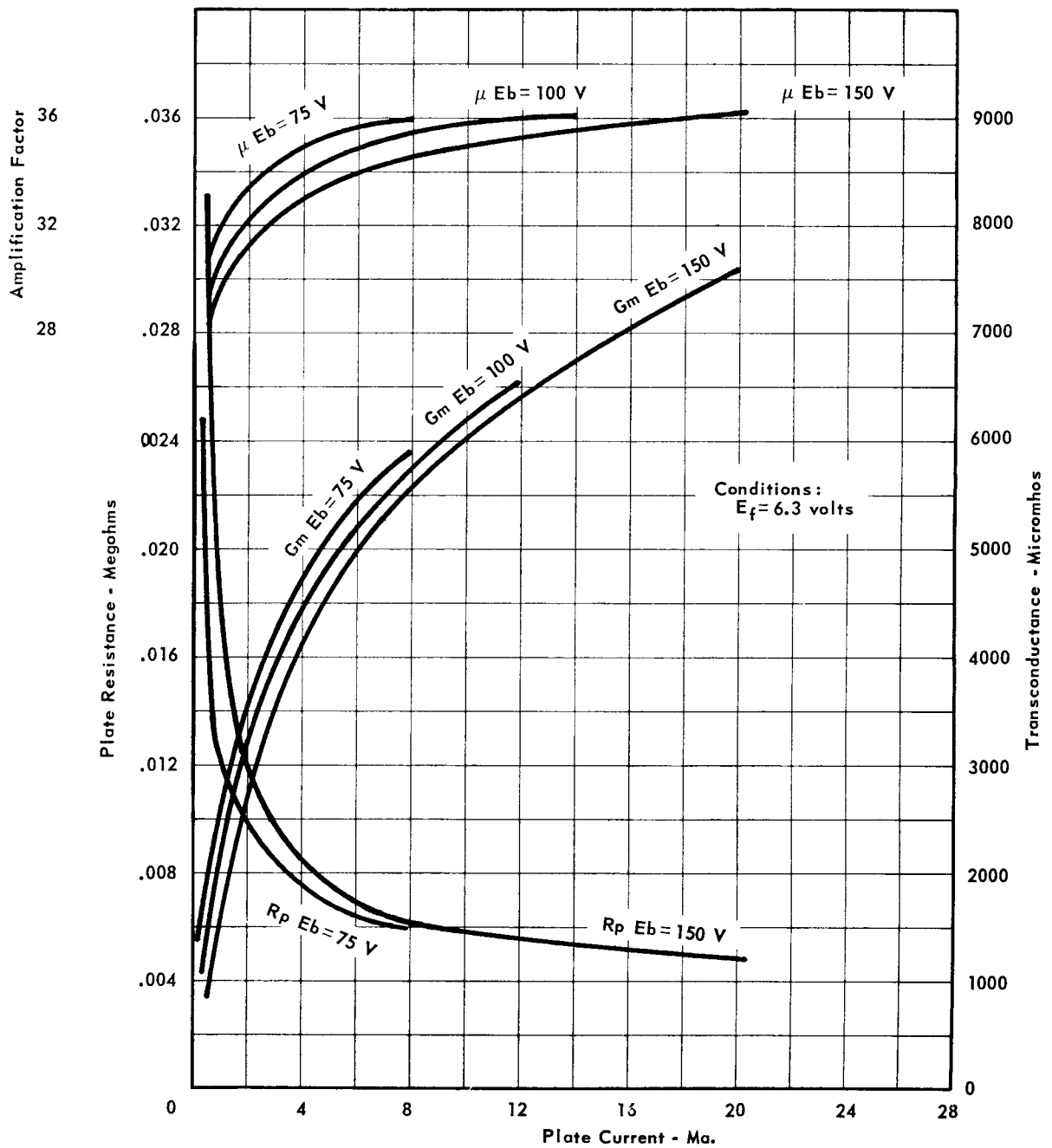
AVERAGE CHARACTERISTICS



RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

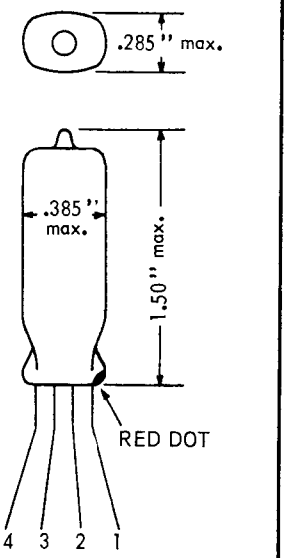
AVERAGE CHARACTERISTICS



Excellence in Electronics

TYPE CK6029

The CK6029 is a filament type triode of subminiature construction designed for use as a high frequency oscillator up to several hundred megacycles. The design characteristics are optimized for high peak current, high frequency operation at relatively low filament power. The CK6029 is suitable for intermittent service applications such as "push-to-talk" transmitters which do not require long life characteristics. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 3 Grid
Lead 2 Filament, Negative	Lead 4 Filament, Positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(μμfds.)* ▲

Grid to Plate	1.6
Grid to Filament	1.3
Plate to Filament	1.8

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.25 volts
Plate Voltage	135 volts
Plate Current	14 ma.
Plate Dissipation	1.0 watt

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	200 ma.
Plate Voltage	90 volts
Grid Voltage	-4.0 volts
Amplification Factor	8.5
Transconductance	2000 μmhos
Plate Current	11 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS C AMPLIFIER: *(At frequencies below 100 Mc.)* ■

Filament Voltage (dc)	1.25 volts
Filament Current	200 ma.
Plate Voltage	135 volts
Grid Resistor	5000 ohms
Grid Current (approx.)	4 ma.
Plate Current	14 ma.
Power Output (approx.)	1.1 watts

▲ *Without shield.*

■ *The CK6029 may be used as an oscillator at frequencies appreciably higher than 100 Mc. At 400 Mc. it has sufficient power output to be used as the local oscillator for a converter.*

Tentative Data

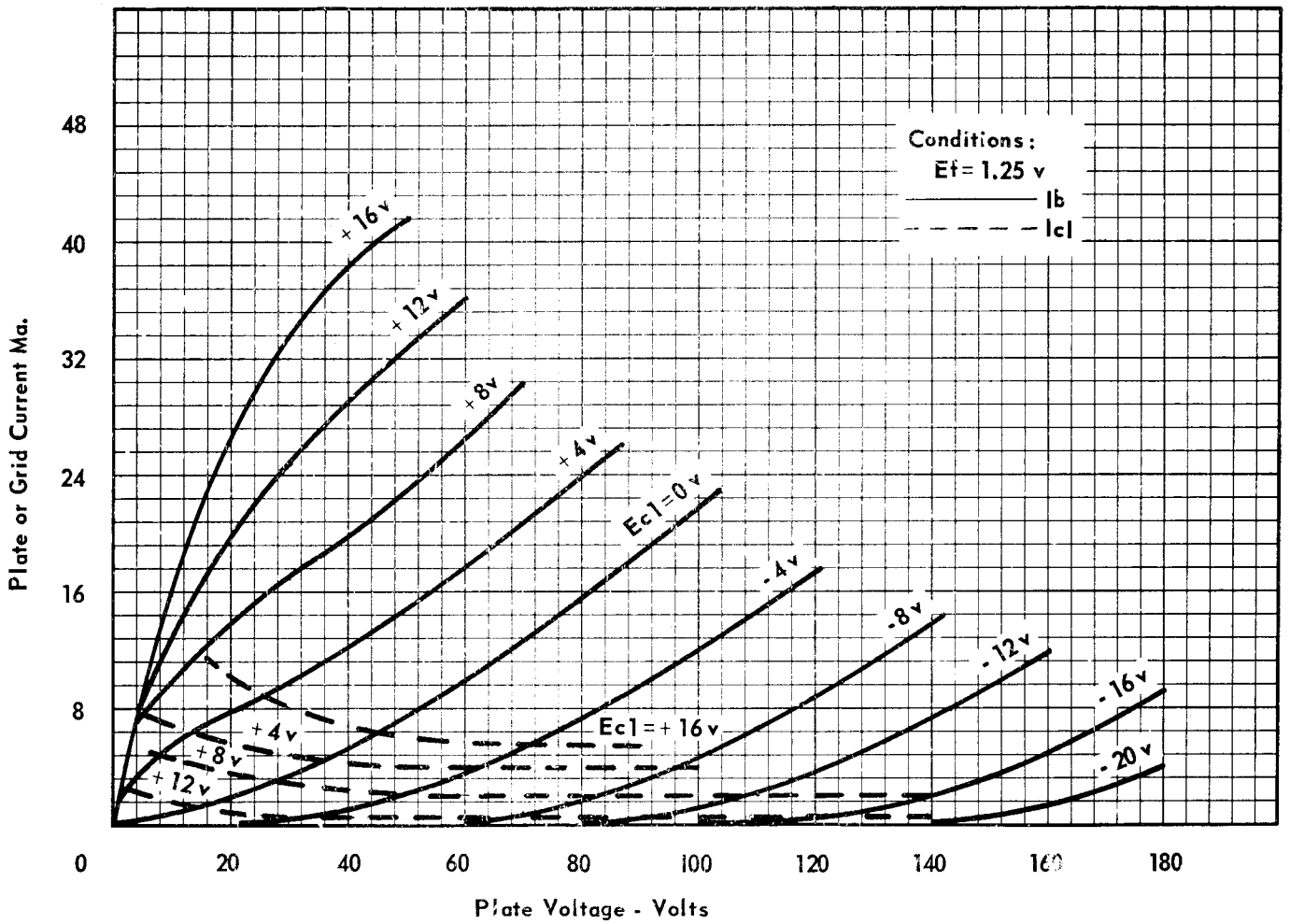
Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

June 30, 1955 NEWTON 58, MASS.

AVERAGE PLATE CHARACTERISTICS



from RTMA release #937, Jan. 4, 1951

TYPE 6043

Velocity Modulation Reflex Oscillator Type QK-159

General Characteristics

Microwave oscillator employing self-contained tunable cavity. Oxide coated, unipotential cathode.

Heater Voltage	6.3	Volts AC-DC
Heater Current	.65	Amperes

Maximum Ratings

Heater Voltage	6.3	± 10% Volts
Grid #1	300	Volts DC
Grid #2 and #3	300	Volts DC
Cathode Current	45	Ma DC
Reflector Voltage	0 to -300	Volts DC
Frequency Range	400	Mc.

Typical Operation

Grid #1	300	Volts DC
Grid #2 and #3	300	Volts DC
Reflector Voltage	-100 to -175	Volts DC
Cathode Current	20	Ma DC
Frequency Range	2950 - 3275	Mc.
Power Output	150	Mw.
Electrical Tuning Range between 1/2 power points	20	Mc.
Maximum Frequency change in any 20°C range	3.0	Mc.

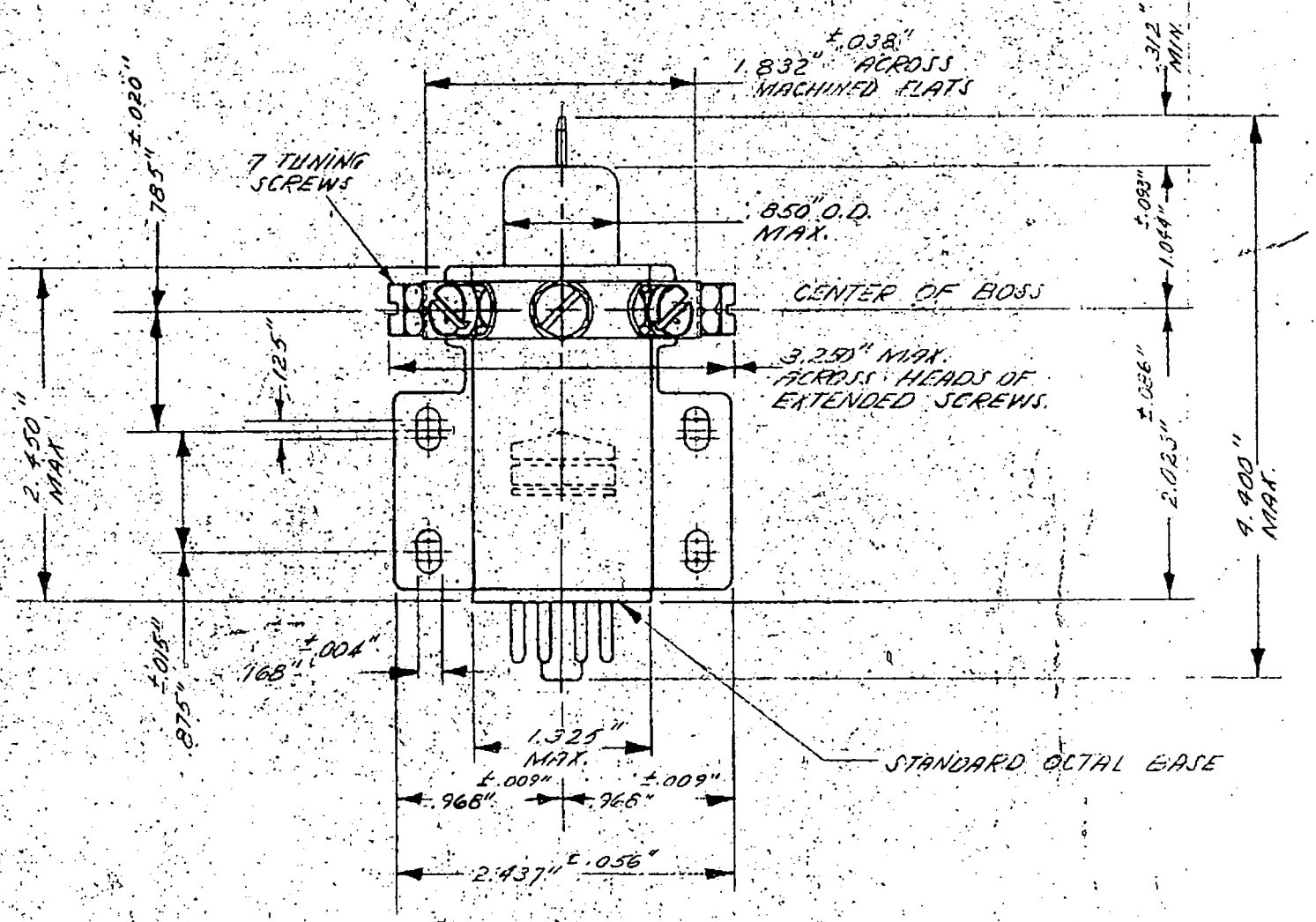
Mechanical

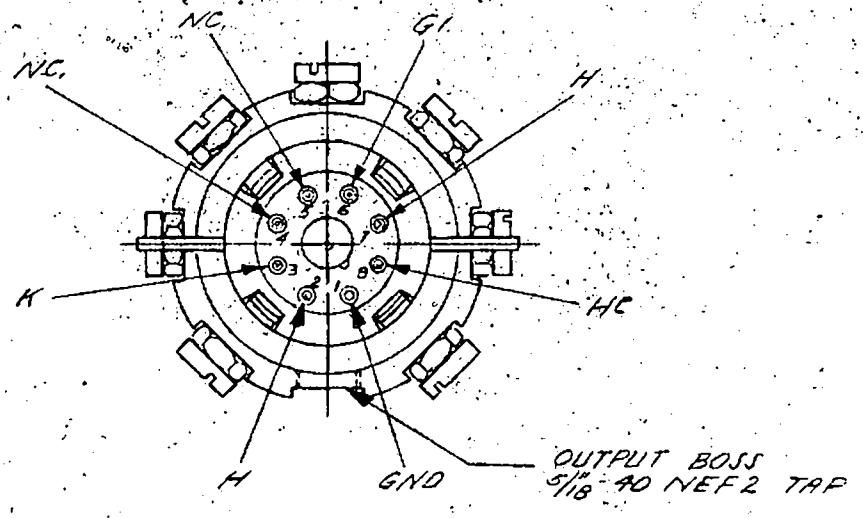
Base: Standard Intermediate Octal

Pin No:	1	2	3	6	7	Top Pin
	Shell, $G_{2\&3}$	Heater	Cathode	G_1	Heater	Reflector

Maximum Overall Dimensions	
Height	Max. 4.5"
Diameter - (a)	Max. with tuning screws turned out 3-3/16"
- (b)	Max. tube dimension with no tuning screws 1-15/16"
Mounting	Any position
Cooling	Freely circulating air

OUTLINE DRAWING



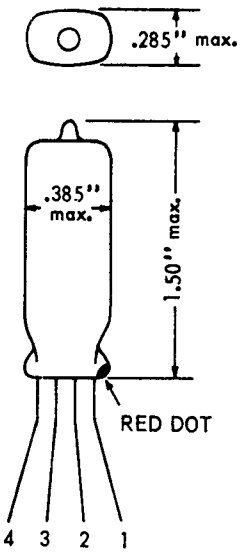


BOTTOM VIEW

TYPE CK6050

Excellence in Electronics

The CK6050 is a filament type triode of subminiature construction designed for use as a high-frequency oscillator, Class C amplifier, or frequency multiplier up to several hundred megacycles. The design of this type is optimized for high peak current, high frequency operation at relatively low filament power. This type is manufactured and controlled to insure more uniform operation at reduced filament voltages down to 1.0 volts, particularly for high frequency equipment whose performance level correlates with transconductance. The CK6050 is suitable for intermittent service applications such as "push-to-talk" transmitters which do not require long life characteristics. The filament of the CK6050 should not be operated continuously inasmuch as its 100 hour life rating is chiefly a function of the filament temperature and hours of filament operation. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Filament, negative
Lead 3 Grid
Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*)

	Shielded ▲	Unshielded
Grid to Plate	1.4	1.4
Grid to Filament	1.3	1.2
Plate to Filament	3.4	1.9

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25 ± 20% volts
Plate Voltage	150 volts
Plate Current	11 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	.12 amps
Plate Voltage	135 volts
Grid Voltage	-5 volts
Transconductance	1600 μmhos
Amplification Factor	15
Plate Current	4.0 ma.
Grid Voltage (approx.) for Ib = 15 μa.	-10 volts

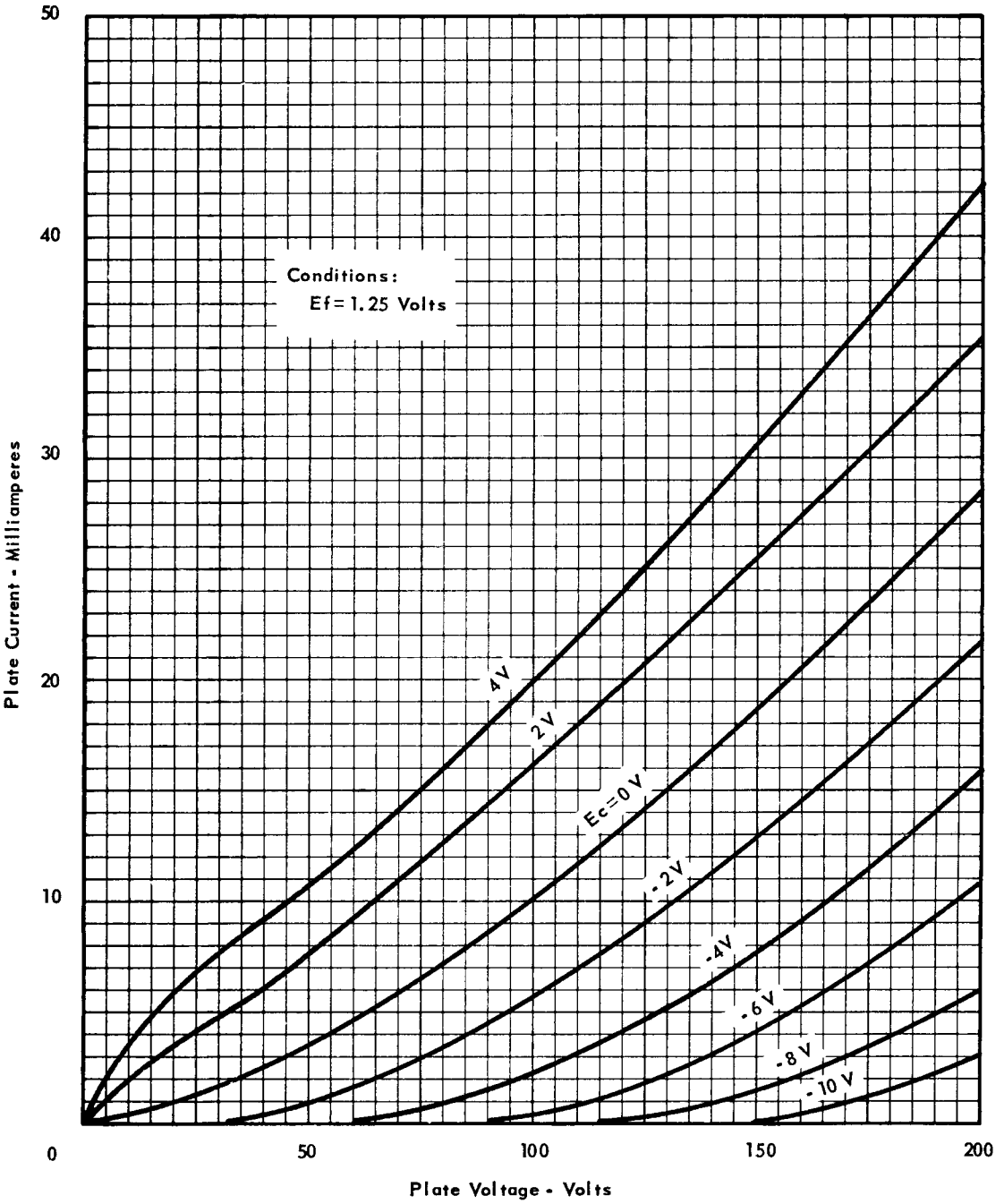
▲ *With close fitting shield connected to lead 2.*

Tentative Data

Printed in U.S.A.

SUBMINIATURE TRIODE

AVERAGE PLATE CHARACTERISTICS



from JEDEC release #3813, July 16, 1962

RAYTHEON

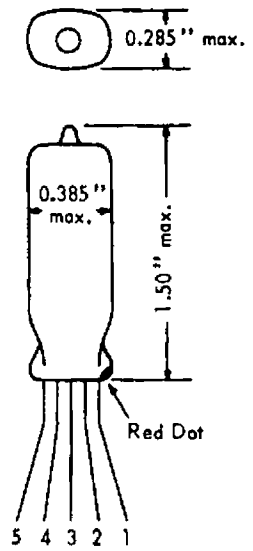
TECHNICAL INFORMATION

SUBMINIATURE PENTODE

TYPE CK6051

Excellence in Electronics

The CK6051 is a filament type subminiature power amplifier pentode, suitable for intermittent service applications such as "push-to-talk" transmitters which do not require long life characteristics. It is designed for use in portable or wearable communications equipment for Class C service. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red Dot is Adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive
Lead 3 Filament, Negative Grid #3 ▲	Grid #3 ▲

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (μμfds)

Grid to Plate: (g1 to p)	0.25 max.
Input: g to (f+g2+g3)	3.65
Output: p to (f+g2+g3)	3.0

RATINGS – DESIGN MAXIMUM VALUES:

Filament Voltage (dc)	1.25±10% volts
Plate Voltage	67.5 volts
Grid #2 Voltage	67.5 volts
Cathode Current	9.5 mA
Plate Dissipation	0.37 watt
Grid #2 Dissipation	0.11 watt

CHARACTERISTICS AND TYPICAL OPERATION – CLASS A1 AMPLIFIER:

Filament Voltage a	1.25 volts
Filament Current	100 mA
Plate Voltage	45 volts
Grid #2 Voltage	45 volts
Grid #1 Voltage	−4.0 volts
Plate Current	4.0 ma
Grid #2 Current	1.1 ma
Transconductance	1350 μmhos
Plate Resistance (approx.)	35000 ohms

CHARACTERISTICS AND TYPICAL OPERATION – CLASS C OSCILLATOR:

Filament Voltage (dc)	1.25 volts
Filament Current	100 ma
DC Plate Voltage	45 volts
DC Grid #2 Voltage	45 volts
Plate Current	4.8 ma
Grid #2 Current	2.0 ma
Grid #1 Current (approx.)	200 μa
Useful Power Output	75 mw
Frequency	50 Mc

▲ *Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5.*

These data identify a particular developmental tube design, and the tube designation or the descriptive data may be subject to change or abandonment.

Objective Data

Printed in USA

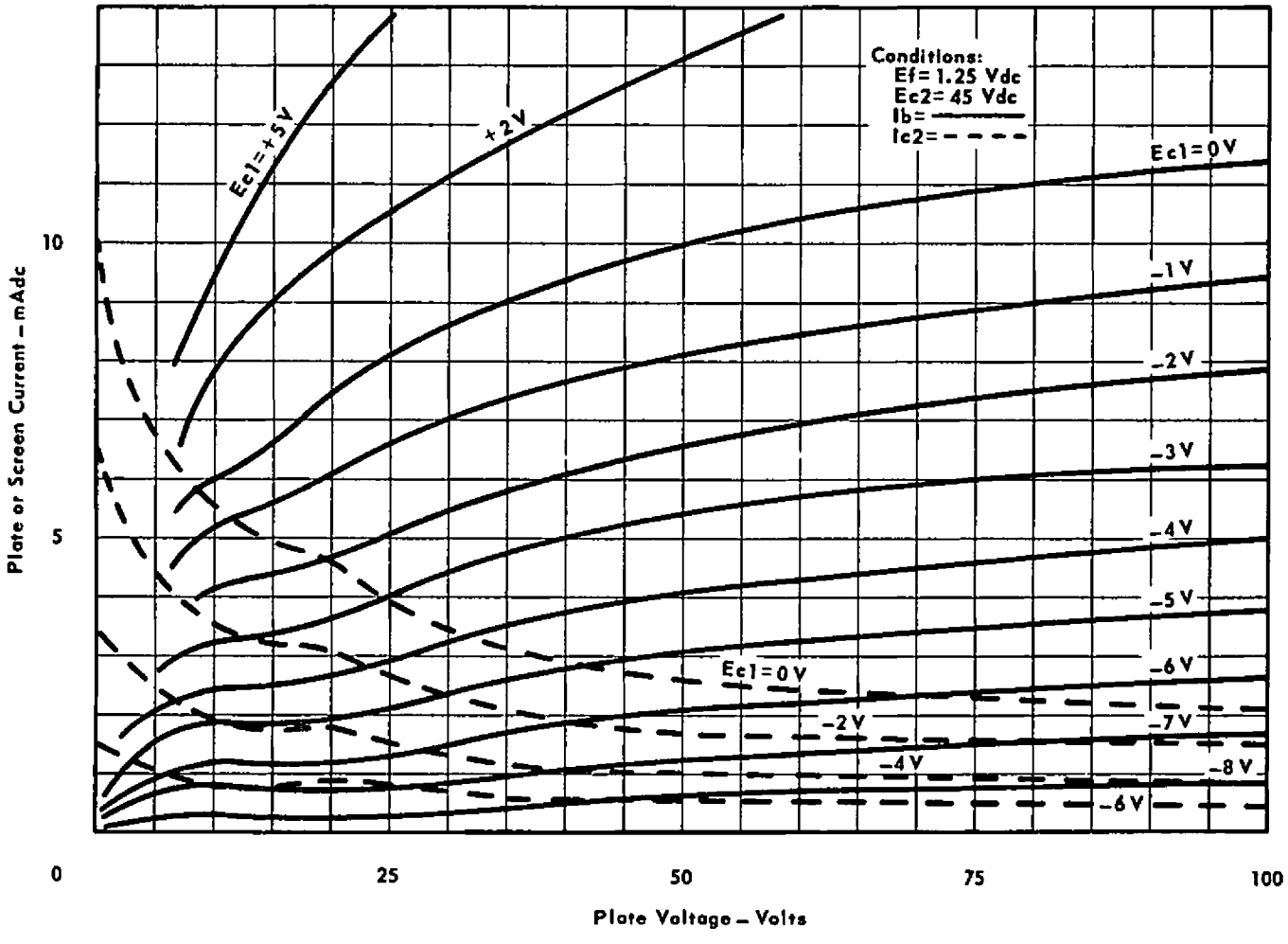
INDUSTRIAL COMPONENTS DIVISION

September 15, 1957 55 CHAPEL ST., NEWTON 58, MASS.

RAYTHEON

SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6080WA

RELIABLE TWIN POWER TRIODE

The CK6080WA is a reliable, heater-cathode type, low-mu, twin power triode, suitable for operation as a regulator tube in DC power supplies. It is designed for service where conditions of high temperature and mechanical shock or vibration are encountered. Several CK6080WA tubes can be paralleled as desired for increased levels of current or power.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock)	450 G
Fatigue (Vibrational Acceleration for extended periods)	2.5 G
Maximum Bulb Temperature	230 °C
Altitude (Note A)	60,000 ft.

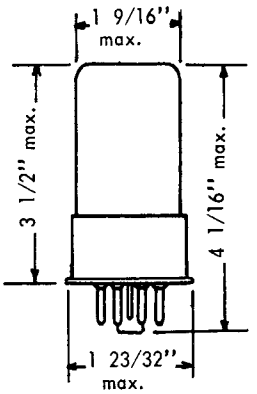
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Ratings			
Heater Voltage	Ef:	6.0	6.3	---	6.6	V
Plate Voltage	Eb:	---	135	---	250	Vdc
Grid Voltage	Ec:	---	0	---	0	Vdc
Heater-Cathode Voltage (Note B)	Ehk:	−300	---	---	+300	v
Cathode Resistance (per cathode)	Rk/k:	---	250	---	---	Ohms
Grid Resistance (per grid) Note C	Rg/g:	---	---	---	---	Meg.
Grid Current (per grid)	Ic/g:	---	---	---	5.0	mAdc
Plate Dissipation (per plate)	Pp/p:	---	---	---	13	W
			Tests			
Heater Current	If:	2.35	---	---	2.65	A
Heater Cathode (Leakage −(Ehk = ±100 Vdc) Note D	Ihk:	---	---	---	25	μAdc
Plate Current (Notes D, E)	Ib:	100	---	125	150	mAdc
Transconductance (Notes D, E)	Sm:	6,000	---	7,000	8,200	μmhos
Transconductance (2) (Notes D, E) Ef = 5.7V	Δ_{Ef} Sm:	---	---	---	10	%
Plate Current (1) difference between sections	Δ Ib:	---	---	---	25	mAdc
Amplification (Notes D, E)	Mu:	1.5	---	---	2.5	---

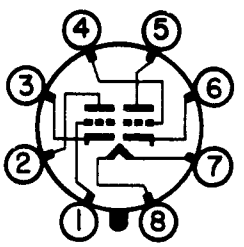
MECHANICAL DATA

ENVELOPE ..... T-12 Glass
BASE B8-98
CATHODE ... Coated Unipotential
BASING 8BD
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Grid, Unit #2
Pin 2 Plate, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Grid, Unit #1
Pin 5 Plate, Unit #1
Pin 6 Cathode, Unit #1
Pin 7 Heater
Pin 8 Heater

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Tests			
Vibration (2) Rp=2000; Ec=-7 Vdc (Note F) Rk=0; f=25 cps; G=2.5	Ep:	---	---	---	50	mVac
Plate Current (2) Eb = 250 Vdc; Ec = -200 Vdc (Notes D, E)	Ib:	---	---	---	10	mAdc

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5G. Sample subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Heater-Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.5 V; Ehk = 300 V and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits, heater-cathode shorts, or heater-cathode leakage current in excess of 50 μAdc.

Stability Life Test – Sample is operated for one hour to assure initial electrical stability (Δ_t Sm < 10%). Tubes operated at room temperature ambient, Rk = 125 Ω Rg/g = 1.0 meg; Ehk = 300 V.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability (Sm > 5800 μmhos) and freedom from inoperatives, at stability life test conditions.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 230°C. Tubes are operated at Rk = 125 ohms; Rg = 1.0 meg.; Ehk = 300V.

Altitude – Sample is subjected to a pressure of 55±5 mmHg (60,000 ft.) at 500 Vac to assure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

CAUTION – –**To Electronic Equipment Design Engineers:** Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

Note A If altitude rating is exceeded, reduction of instantaneous voltages (Ef, excluded) may be required.

Note B The reference point for heater-cathode potentials shall be the positive terminal of the cathode resistor.

Note C Maximum grid-circuit resistance:

(a) 1.0 megohm for Cathode-bias operation.
(b) 0.1 megohm for fixed-bias operation.
(c) 0.1 megohm for combined fixed and cathode-bias operation.

Note D Test each unit separately.

Note E Both units shall be operating.

Note F Tie 1k to 2k; 1g to 2g; and 1p to 2p.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1.

For miscellaneous requirements, see Paragraph 3.6.

TEST CONDITIONS

Heater Voltage	6.3 V
Plate Voltage	135 Vdc
Grid Voltage	0 Vdc
Cathode Resistance (per cathode)	250 ohms

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
QUALIFICATION APPROVAL TESTS (Note 19)												
3.1	Qualification Approval:	Required for JAN Marking	---	---								
4.9.20.3	Vibration (1):	Ec1 = −7Vdc; Rp = 2000 ohms; (note 13)	---	---	Ep:	---	---	---	---	100	---	mVac
---	Cathode:	Coated Unipotential	---	---								
3.4.3	Base Connections:	B8–98	---	---								
MEASUREMENTS ACCEPTANCE TESTS, PART 1 (Note 1)												
4.10.8	Heater Current:		0.65	II	If:	2.35	---	---	---	2.65	---	A
4.10.15	Heater-Cathode Leakage:	Note 12 Ehk = + 100 Vdc Ehk = − 100 Vdc	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	25 25	--- ---	μAdc μAdc
4.10.6.1	† Grid Current:	Rg = 1.0 Meg.; Rk = 125 ohms; (notes 5, 13)	0.65	II	Ic:	0	---	---	---	−2.0	---	μAdc
4.10.4.1	Plate Current (1):	(notes 12, 15)	0.65	II	Ib:	100	---	---	---	150	---	mAdc
4.10.4.1	Plate Current (1):	(notes 2, 12, 15)	---	---	Ib:	---	115	125	135	---	25	mAdc
4.10.9	Transconductance (1):	(notes 12, 15)	0.65	II	Sm:	6000	---	---	---	8200	---	μmhos
4.10.9	Transconductance (1):	(notes 2, 12, 15)	---	---	Sm:	---	6600	7000	7400	---	1000	μmhos
4.7.5	Continuity and Shorts: (Inoperatives)		0.4	II		---	---	---	---	---	---	
4.9.1	Mechanical:	Envelope: per outline	---	---		---	---	---	---	---	---	

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2) Min	LAL	Bogie	UAL	Max	ALD	Units
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.8	Insulation of Electrodes:	Eg-all = −100 Vdc Ep-all = −300 Vdc (note 12)	2.5	L6	R: R:	200 200	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance(2):	Ef = 5.7V; (notes 12, 15)	2.5	I	Δ_{Ef}^{Sm}:	---	---	---	---	10	---	%
4.9.12.1	Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mm Hg; Voltage = 500 Vac; (notes 3, 4)	6.5	Note 4	---	---	---	---	---	---	---	
4.10.4.1	Plate Current (1) Difference Between Sections:		2.5	I	Ib:	---	---	---	---	25	---	mAdc
4.10.11.1	Amplification Factor:	Rk = 250 ohms (notes 12, 15)	6.5	Code G	Mu:	1.5	---	---	---	2.5	---	
4.9.19.1	Vibration (2): (Low Frequency)	Rp = 2000; Ec = −7Vdc; (note 13)	6.5	Code G	Ep:	---	---	---	---	50	---	mVac
4.10.4.1	Plate Current (2):	Eb= 250 Vdc; Ec = −200 Vdc; (notes 12, 15)	2.5	I	Ib:	---	---	---	---	10	---	mAdc
DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7												
4.9.20.5	Shock:	Hammer angle = 30° Ehk = +100 Vdc; Ec = −7 Vdc; Rb = 2000 ohms; Rk = 0; (notes 13, 20)	---	---	---	---	---	---	---	---	---	
4.9.20.6	Fatigue:	G = 2.5 min. Fixed Frequency; F = 25 min. 60 max. Apply only Ef.	6.5	Note 4		---	---	---	---	---	---	
---	Post Shock and Fatigue End Points:	Vibration (2) Heater-Cathode Leakage	---	---	Ep:	---	---	---	---	100	---	mVac
		Ehk = +100 Vdc	---	---	Ihk:	---	---	---	---	50	---	μAdc
		Ehk = −100 Vdc	---	---	Ihk:	---	---	---	---	50	---	μAdc
		Change in Transconductance (1) of individual tubes.	---	---	Δ_t^{Sm}:	---	---	---	---	10	---	%
		Grid Current:	...	---	Ic:	---	---	---	---	-3.0	---	μAdc

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defectives per Characteristic: First Sample	Combined Sample	Sym.	LIMITS Min	Max	Units
ACCEPTANCE LIFE TESTS, NOTE 7										
4.11.3.1(a)	Stability Life Test:	Rk=125; Rg/g=1.0 Meg Notes 10,11,13 Ehk=300V								
4.11.4	Stability Life Test End Points: (1 hour)	Change in Transconductance(1) of individual tubes; Note 10	1.0	Code I			Δ_tSm:	---	10	%
4.11.3.1(b)	Survival Rate Life Test:	Notes 11,13,14,17 Stability Life Test Conditions or Equivalent								

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defectives per Characteristic: First Sample	Allowable Defectives per Characteristic: Combined Samples	Sym.	LIMITS: Min	LIMITS: Max	Units
ACCEPTANCE LIFE TESTS, NOTE 7 (Cont'd)										
4.11.4	Survival Rate Life Test End Points: (100 hours)	Inoperatives	0.65	II						
		Transconductance(1)	1.0	II	---	---	Sm:	5800	---	μmhos
4.11.7	Heater Cycling Life Test:	Ef=7.5V;Ehk=300Vdc; Eb=Ec=0; Note 8 1 min. on, 4 min. off								
4.11.4	Heater Cycling Life Test End Points:	Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	---	---	Ihk:	---	50	μAdc
		Ehk=-100Vdc	---	---	---	---	Ihk:	---	50	μAdc
		Note 8								
4.11.5	Intermittent Life Test	Rk=125 ohms; Rg=1.0 meg; Ehk=300V; T Envelope=230°C min.; Notes 9,13,16	---	---	---	---		---	---	
4.11.4	Intermittent Life Test End Points: (1000 hours)	Notes 6,16								
		Inoperatives; Note 18	---	---	1	3		---	---	
		Grid Current	---	---	1	3	Ic:	0	-10	μAdc
		Transconductance(2)	---	---	1	3	$\Delta \frac{Sm}{Ef}$:	---	10	%
		Combined Defectives			2	5				
		Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	1	3	Ihk:	---	25	μAdc
		Ehk=-100Vdc	---	---	1	3	Ihk:	---	25	μAdc
		Heater Current	---	---	1	3	If:	2.35	2.75	A
		Transconductance(1)	---	---	1	3	Sm:	5500	---	μmhos
		Insulation of Electrodes								
		g-all	---	---	1	3	R:	100	---	Meg
		p-all	---	---	1	3	R:	100	---	Meg
		Combined Defectives			3	6				
PACKAGING REQUIREMENTS										
4.9.18.1.1	Carton Drop:	(d) Package Group 1; Carton Size F								

Note 1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 2: Variables Sampling Procedure: See 4.1.1.7

Note 3: Low pressure voltage breakdown.- Tubes shall be tested in a chamber under the pressure specified. The specified voltage shall be applied between the base pins (or leads) of elements carrying B+ voltage and their adjacent pins (or leads). The voltage shall be of sinusoidal waveform with F = 60 cycles. Tubes showing evidence of arcing or corona shall be considered as defectives.

Note 4: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. MIL-STD-105, sample size code letter F shall apply.

Note 5: With both units operating, Ic is the sum of I1c and I2c.

NOTES: (Cont'd)

Note 6: Order for Evaluation of Life Test Defects.- See 4.11.3.1.2.

Note 7: Destructive tests: Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.20.5 Shock.
4.9.20.6 Fatigue
4.11.7 Heater-Cycling Life Test.
4.11.5 Intermittent Life Test.

Note 8: The no load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater-cathode short, or heater-cathode leakage current in excess of the specified heater cycling life test end point limit.

Note 9: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple #40 BS or smaller diameter elements welded to a ring of .025 inch diameter phosphor bronze placed in contact with the envelope. Envelope Temperature requirement will be satisfied if tube, having bogie Ib (±5%) under normal test conditions, is determined to operate at minimum specified temperature at any position on the life test rack.

Note 10: Stability Life Test: See 20.2.5.1 of Appendix C.

Note 11: Tubes shall be life tested at room temperature ambient.

Note 12: Test each unit separately.

Note 13: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 14: For Survival Rate Life Test, the equivalent Stability Life-Test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

Note 15: Both units shall be operating.

Note 16: Intermittent Life Tests: See 20.2.5.3 of Appendix C.

Note 17: Survival Rate Life Test: See 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

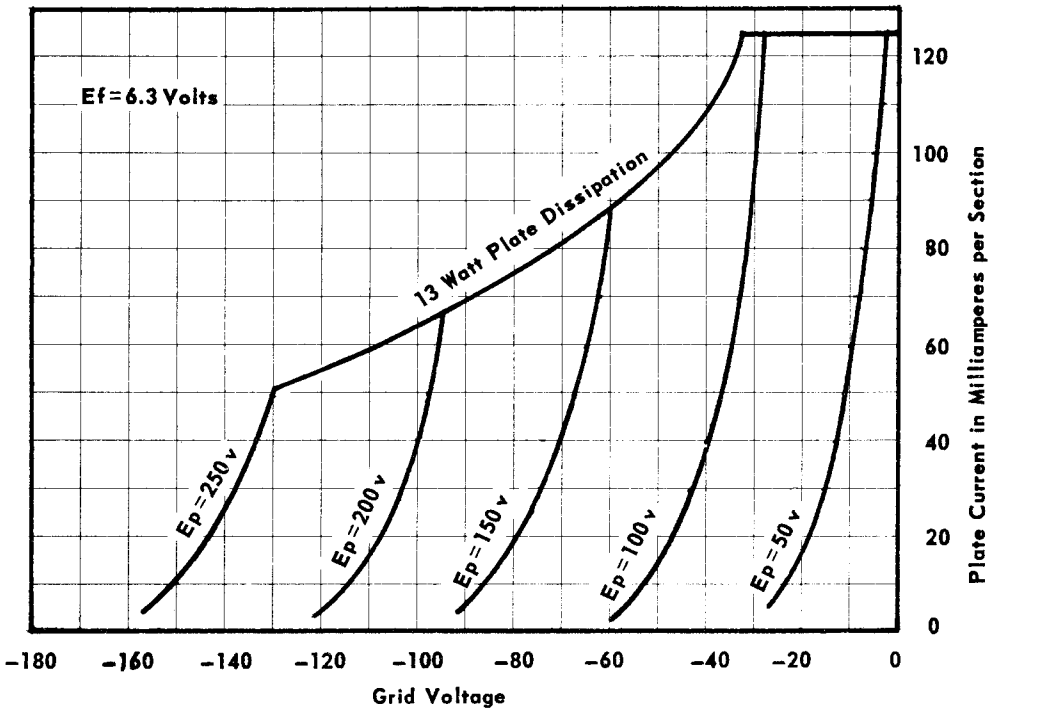
Note 18: An inoperative as referenced in Life Test is defined as a tube having one (1) or more of the following defects: discontinuity (Ref. MIL-E-1, par. 4.7.1), shorts, (Ref. MIL-E-1, par. 4.7.2), air leaks.

Note 19: All tests listed hereon shall be performed during qualification inspection; however, these three tests are normally performed during qualification inspection only.

Note 20: A common grid resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyratron-type short indicator is employed.

RELIABLE TWIN POWER TRIODE

TRANSFER CHARACTERISTICS FOR EACH TRIODE SECTION



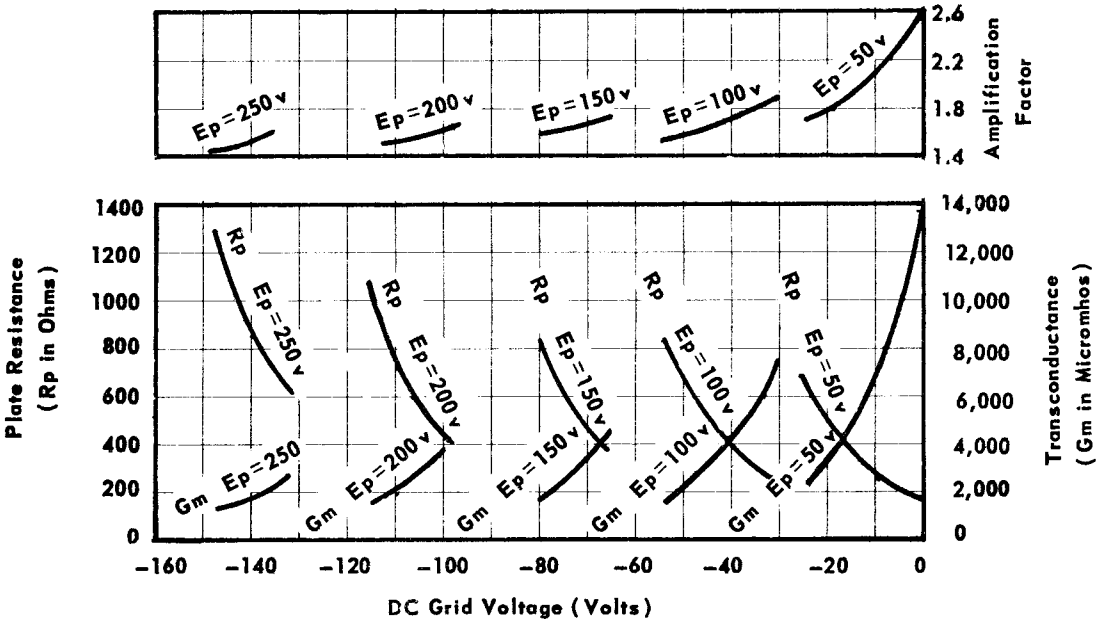
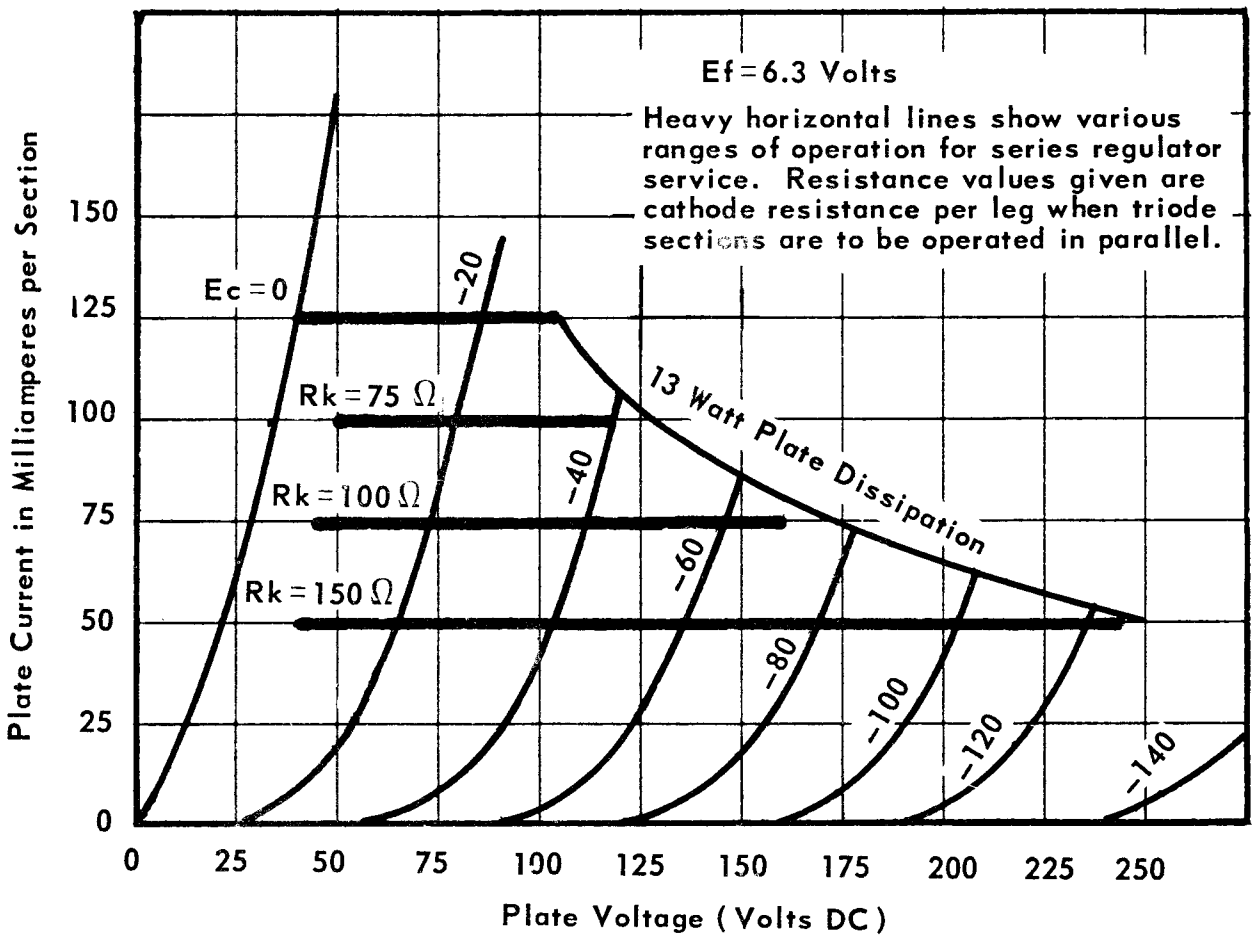


PLATE CHARACTERISTICS FOR EACH TRIODE SECTION



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6080WB

RELIABLE TWIN POWER TRIODE

The CK6080WB is a reliable, heater-cathode type, low mu, twin power triode, suitable for operation as a regulator tube in DC power supplies. It is designed for service where conditions of high temperature and mechanical shock or vibration are encountered. Several CK6080WB tubes can be paralleled as desired for increased levels of current or power.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock)	450 G
Fatigue (Vibrational Acceleration for extended periods)	2.5 G
Maximum Bulb Temperature	300 °C
Altitude	60,000 ft.

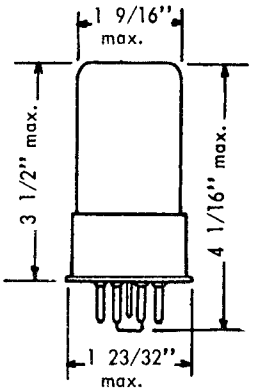
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Ratings			
Heater Voltage	Ef:	6.0	6.3	---	6.6	V
Plate Voltage	Eb:	---	135	---	250	Vdc
Grid Voltage	Ec:	---	0	---	0	Vdc
Heater-Cathode Voltage	Ehk:	-450	---	---	+450	v
Cathode Resistance (per cathode)	Rk/k:	---	250	---	---	Ohms
Grid Resistance (per grid) Note A	Rg/g:	---	---	---	---	Meg.
Grid Current (per grid)	Ic/g:	---	---	---	5.0	mAdc
Plate Dissipation (per plate)	Pp/p:	---	---	---	13 (Design Max.)	W
Cathode Current (per cathode)	Ik/k:	---	---	---	200	mAdc
			Tests			
Heater Current	If:	2.35	---	---	2.65	A
Heater Cathode Leakage -(Ehk=±450 Vdc) Note B	Ihk:	---	---	---	25	μAdc
Plate Current (Notes B, C)	Ib:	100	---	125	150	mAdc
Transconductance (Notes B, C)	Sm:	6000	---	7000	8200	μmhos
Transconductance (2) (Notes B,C) Ef=5.7V	Δ_{Ef} Sm:	---	---	---	10	%
Plate Current (1) Difference between sections	Δlb:	---	---	---	25	mAdc

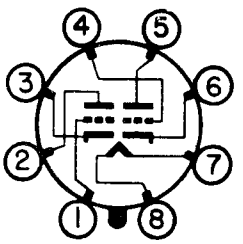
MECHANICAL DATA

ENVELOPE ..... T-12 Glass
BASE B8-98
CATHODE:.. Coated Unipotential
BASING 8BD
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Grid, Unit #2
Pin 2 Plate, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Grid, Unit #1
Pin 5 Plate, Unit #1
Pin 6 Cathode, Unit #1
Pin 7 Heater
Pin 8 Heater

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Tests			
Amplification (Notes B,C,D)	Mu:	1.5	---	---	2.5	---
Vibration (2) Rp=2000: Ec=-7Vdc (Note D) Rk=0, F=50-500 cps. G=2.5	Ep:	---	---	---	500	mVac
Plate Current (2) Eb=250Vdc; Ec=-200Vdc (Notes B,C)	Ib:	---	---	---	10	mAdc

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5G. Sample subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a sweep frequency of 50 to 500 and back to 50 cps. Ef=6.3V, no other voltage applied.

Heater-Cycling Life Test– A sample is subjected to 2000 on-off heater cycles at the following conditions. Ef=7.5V Ehk=300 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits, heater-cathode shorts, or heater-cathode leakage current in excess of 50 μAdc.

Stability Life Test– Sample is operated for one hour to assure initial electrical stability (Δ_tSm < 10%). Tubes operated at room temperature ambient with Eb=150; Ehk=300Vac; Rk/k=400.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability (Sm > 5800 μmhos) and freedom from inoperatives. Tubes are operated at Stability Life Test conditions.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 300 °C. Tubes are operated at Stability Life Test conditions.

Altitude – Sample is subjected to a pressure of 55±5 mmHg (60,000 ft) at 500 Vac to assure freedom from flashover of corona at the pins of the tube.

APPLICATION NOTES

CAUTION – – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

Note A: Maximum grid circuit resistance:
(a) 1.0 megohm for Cathode-bias operation.
(b) 0.1 megohm for fixed bias operation.
(c) 0.1 megohm for combined fixed and cathode-bias operation.

Note B: Test each unit separately.

Note C: Both units shall be operating.

Note D: Units connected in parallel.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of Inspection, use applicable reliable paragraphs of MIL-E-1

For miscellaneous requirements, see Paragraph 3.6.

TEST CONDITIONS

Heater Voltage	6.3 V
Plate Voltage	135 Vdc
Grid Voltage	0 Vdc
Cathode Resistance (per cathode)	250 Ω

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 4) Min.	LAL	Bogie	UAL	Max	ALD	Units
QUALIFICATION APPROVAL TESTS												
3.1	Qualification Approval:	Required for JAN Marking	---	---								
4.9.4	Base Material:		---	---								
---	Cathode:	Coated Unipotential	---	---								
3.4.3	Base Connections:	B8-98	---	---								
4.9.20.3	Vibration(1):	Ec1=-7Vdc; Rk=0; Rp=2000 ohms; Note 2	---	---	Ep:	---	---	---	---	500	---	mVac
MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 3												
4.10.8	Heater Current:		0.65	II	If:	2.35	---	---	---	2.65	---	A
4.10.15	Heater-Cathode Leakage:	Note 1										
		Ehk=+450Vdc	.65	II	Ihk:	---	---	---	---	25	---	μAdc
		Ehk=-450Vdc			Ihk:	---	---	---	---	25	---	μAdc
4.10.6.1	†Grid Current:	Rg=1.0 Meg; Rk=125 ohms; Note 2	.65	II	Ic:	0	---	---	---	-1.0	---	μAdc
4.10.4.1	†Plate Current(1):	Notes 1,5	.65	II	Ib:	100	---	---	---	150	---	mAdc
4.10.4.1	Plate Current(1):	Notes 1,5	---	---	Ib:	---	115	125	135	---	25	mAdc
4.10.9	Transconductance(1):	Notes 1,5,7	.65	II	Sm:	6000	---	---	---	8200	---	μmhos
4.10.9	Transconductance(1):	Notes 1,5,7	---	---	Sm:	---	6600	7000	7400	---	1000	μmhos
4.7.5	Continuity and Shorts (Inoperatives)		.4	II		---	---	---	---	---	---	
4.9.1	Mechanical	Envelope Outline per Figure 1	---	---		---	---	---	---	---	---	
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.8	Insulation of Electrodes:	Eg-all=-100Vdc	2.5	L6	R:	200	---	---	---	---	---	Meg
		Ep-all=-300Vdc			R:	200	---	---	---	---	---	Meg
		Note 1										
4.10.9	Transconductance(2):	Ef=5.7V: Notes 1,5,7	2.5	I	Δ_{Ef}Sm:	---	---	---	---	10	---	%
4.9.12.1	Low Pressure Voltage Breakdown:	Pressure=55+5mm Hg.; Voltage=500Vac	6.5	Note 6		---	---	---	---	---	---	

Ref.	Test	Conditions	AQL (Percent Defective	Inspection Level or Code	Symbol	LIMITS (See Note 4)						Units
						Min.	LAL	Bogie	UAL	Max	ALD	
MEASUREMENTS ACCEPTANCE TESTS, PART 2 (Cont.)												
4.10.4.1	Plate Current(1) Difference Between Sections:		2.5	I	ΔIb:	---	---	---	---	25	---	mAdc
4.10.11.1	Amplification Factor:	Rk=250 ohms; Notes 1,5,7	6.5	Code G	Mu:	1.5	---	---	---	2.5	---	
---	Vibration(2):	Rk=0; Rp=2000; Ec=-7Vdc; F=50-500 cps; G=2.5; Note 19	6.5	Code G	Ep:	---	---	---	---	500	---	mVac
4.10.4.1	Plate Current(2):	Eb=250Vdc; Ec=200 Vdc; Notes 1,5	2.5	I	Ib:	---	---	---	---	10	---	mAdc
DEGRADATION RATE ACCEPTANCE TESTS, NOTE 8												
4.9.20.5	Shock:	Hammer angle =30°; Ehk=+450Vdc; Ec=-7Vdc; Rp=2000 ohms; Rk=0; Note 2	---	---		---	---	---	---	---	---	
---	Fatigue:	F=50-500 cps; G=2.5; Ef=6.3 V; no other voltages applied; Note 19, except t=96 hours	6.5	Note 6		---	---	---	---	---	---	
---	Post Shock and Fatigue End Points:	Vibration	---	---	Ep:	---	---	---	---	500	---	mVac
		Heater-Cathode Leakage										
		Ehk=+450Vdc	---	---	Ihk:	---	---	---	---	50	---	μAdc
		Ehk=-450Vdc	---	---	Ihk:	---	---	---	---	50	---	μAdc
		Transconductance(1)	---	---	Δ_tSm:	---	---	---	---	10	---	%
		Grid Current	---	---	Ic:	---	---	---	---	-1.5	---	μAdc

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
ACCEPTANCE LIFE TESTS, NOTE 8										
4.11.7	Heater Cycling Life Test:	Ef=7.5V; Ehk=300Vac; Eb=Ec=0; 1 min. on 4 min. off; Note 9	---	---	---	---		---	---	
4.11.4	Heater Cycling Life Test End Points:	Heater-Cathode Leakage								
		Ehk=+450Vdc	---	---	---	---	Ihk:	---	50	μAdc
		Ehk=-450Vdc	---	---	---	---	Ihk:	---	50	μAdc
---	Stability Life Test: (1 hour)	Eb=150; Ehk=300Vac; Rk/k=400; TA=Room; Notes 1,10	1.0	Code I	---	---	---	---	---	
4.11.4	Stability Life Test End Points:	Change in Transconductance(1) of individual tubes	---	---	---	---	Δ_tSm:	---	10	%
---	Survival Rate Life Tests (100 hours)	Stability Life Test Conditions or Equivalent; Notes 11,12	---	II	---	---		---	---	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives)	0.65	---	---	---		---	---	
		Transconductance(1)	1.0	---	---	---	Sm:	5800	---	μmhos
4.11.5	Intermittent Life Test:	Stability Life Test Conditions; T Envelope=300°C min; Notes 13,14	---	---	---	---		---	---	

Ref.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defectives per Characteristic: First Sample	Allowable Defectives per Characteristic: Combined Samples	Sym.	LIMITS: Min	LIMITS: Max	Units
ACCEPTANCE LIFE TESTS, NOTE 8 (Cont.)										
4.11.4	Intermittent Life Test End Points, (1000 hrs)	Notes 15,17								
		Inoperatives; Note 16	---	---	1	3		---	---	
		Grid Current	---	---	1	3	I_c:	0	−5	μAdc
		Transconductance(2)	---	---	1	3	$\Delta_{Ef}Sm$:	---	10	%
		Heater-Cathode Leakage								
		Ehk=+450Vdc	---	---	1	3	Ihk:	---	25	μAdc
		Ehk=−450Vdc	---	---	1	3	Ihk:	---	25	μAdc
		Heater Current	---	---	1	3	If:	2.35	2.75	A
		Change in Transconductance(1) of individual tubes	---	---	1	3	$\Delta_t Sm$:	---	15	%
		Insulation of Electrodes								
		g—all	---	---	1	3	R:	100	---	Meg
		p—all	---	---	1	3	R:	100	---	Meg
4.11.5	Intermittent Life Test: (5000 hour Information)	Note 20	---	---	---	---	---		---	
PACKAGING REQUIREMENTS										
4.9.18.1.1	Container Drop:	(d) Package Group 1; Container Size G								

Note 1: Test each unit separately.

Note 2: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 3: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical, shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 4: Variables Sampling Procedure:
See paragraphs 5.3.3 to 5.3.3.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 5: Both units shall be operating.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30–day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL-STD-105, sample size code letter F shall apply.

Note 7: Rk bypassed with 1000 μf capacitor.

Note 8: Destructive Tests: Tubes subjected to the following destructive tests are not to be accepted under this specification.
4.9.20.5 Shock
4.9.20.6 Fatigue
4.11.7 Heater-Cycling Life Test
4.11.5 Intermittent Life Test

NOTES: (Cont'd)

Note 9: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater-cathode short, or heater-cathode leadage current in excess of the specified heater cycling life test end point limit.

Note 10: Stability Life Test: The sampling and testing procedures for this test shall be in accordance with paragraphs 5.3.4.1(a) to 5.3.4.1(g), inclusive, of the Inspection Instructions for Electron Tubes.

Note 11: SURVIVAL RATE LIFE TEST: The sampling and testing procedures for this test shall be as defined in paragraphs 5.3.4.2 to 5.3.4.2.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 12: For Survival Rate Life Test, the equivalent Stability Life Test conditions shall be as defined in paragraph 5.3.4.2.5 of the Inspection Instructions for Electron Tubes.

Note 13: Intermittent Life Test: Sampling and acceptance procedures for these tubes shall be as defined in paragraphs 5.3.4.3(a) to 5.3.4.3(i), inclusive, of the Inspection Instructions for Electron Tubes, except for the following:

a. Under Par. 5.3.4.3 d (2), delete reference to 500 hour requirements.
b. Delete Par. 5.3.4.3. e (1).
c. Add to Par. 5.3.4.3 e (2): "The life test sample meets the 1000 hour life requirements at 500 hours".
d. Under Par. 5.3.4.3 e (3), replace "500 hours" with "1000 hours".

Note 14: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements placed in contact with the envelope. Envelope Temperature requirement will be satisfied if tube, having bogie Ib (±5%) under normal test conditions, is determined to operate at minimum specified temperature at any position in the life test rack.

Note 15: Order for Evaluation of Life Test Defects: See Paragraph 5.3.4.4 of the Inspection Instructions for Electron Tubes.

Note 16: An inoperative as referenced in Life Test is defined as a tube having one (1) or more of the following defects: discontinuity (Ref. MIL-E-1, par. 4.7.1), shorts (Ref. MIL-E-1, par. 4.7.2), air leaks (Ref. MIL-E-1, par. 3.2.4.3).

Note 17: The total allowable combined defectives for Inoperatives, Grid Current and Transconductance(2) shall be 2 and 5, for first sample and combined samples, respectively. The total allowable combined defectives for Heater-Cathode Leakage, Heater Current, Change in Transconductance(1) of Individual Tubes and Insulation of Electrodes (g-all and p-all), shall be 3 and 6 for first sample and combined samples, respectively.

Note 18: Maximum grid circuit resistance:

(a) 1.0 megohm for Cathode-bias operation.
(b) 0.1 megohm for fixed bias operation.
(c) 0.1 megohm for combined fixed and cathode-bias operation.

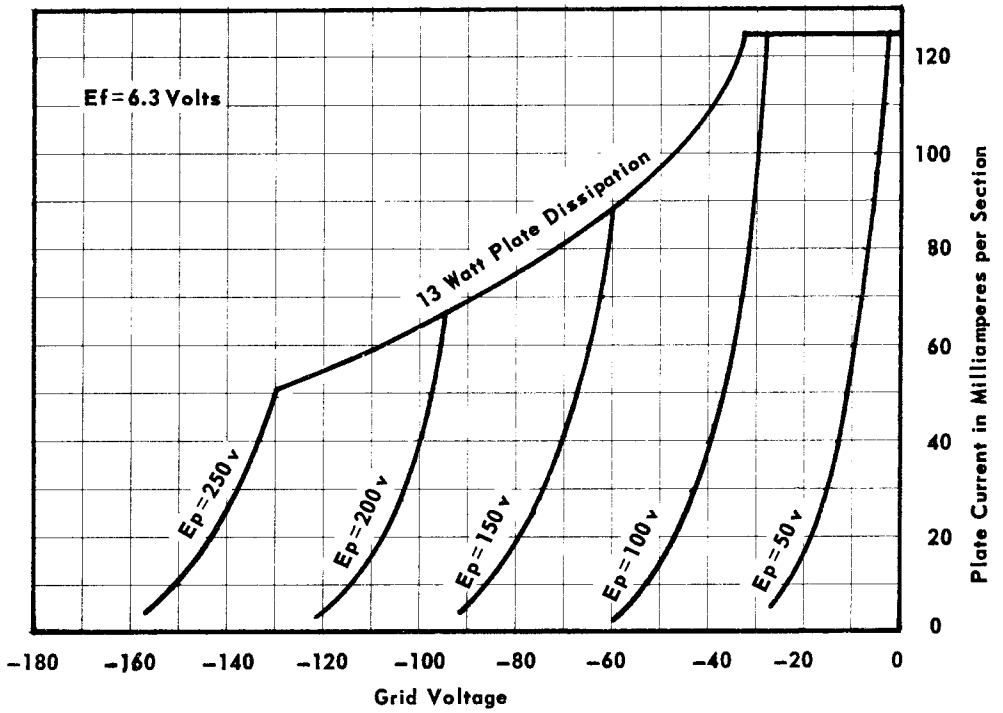
Note 19: Vibration and Fatigue Test Procedure

(a) This test is to be performed with an average acceleration level equal to the specified value while being swept continuously during a time of approximately one(1) minute through the frequency range of 50 to 500 and back to 50 cycles per second.
(b) The total excitation time for the test shall not be less than three (3) minutes. The tubes shall be mounted in each of three planes X-1, X-2 and Y-1 for one third of the total excitation time. In each mounting plane, the tubes shall experience at least one complete frequency sweep.

Note 20: Ten percent (10%) of the tubes placed on life for the 1000 hour test shall be continued on life until failure or 5000 hours have elapsed for the purpose of data collection to substantiate life expectancy. Five (5) copies of these data shall be forwarded to the Armed Services Electro-Standards Agency, Fort Monmouth, New Jersey, for information and evaluation.

RELIABLE TWIN POWER TRIODE

TRANSFER CHARACTERISTICS FOR EACH TRIODE SECTION



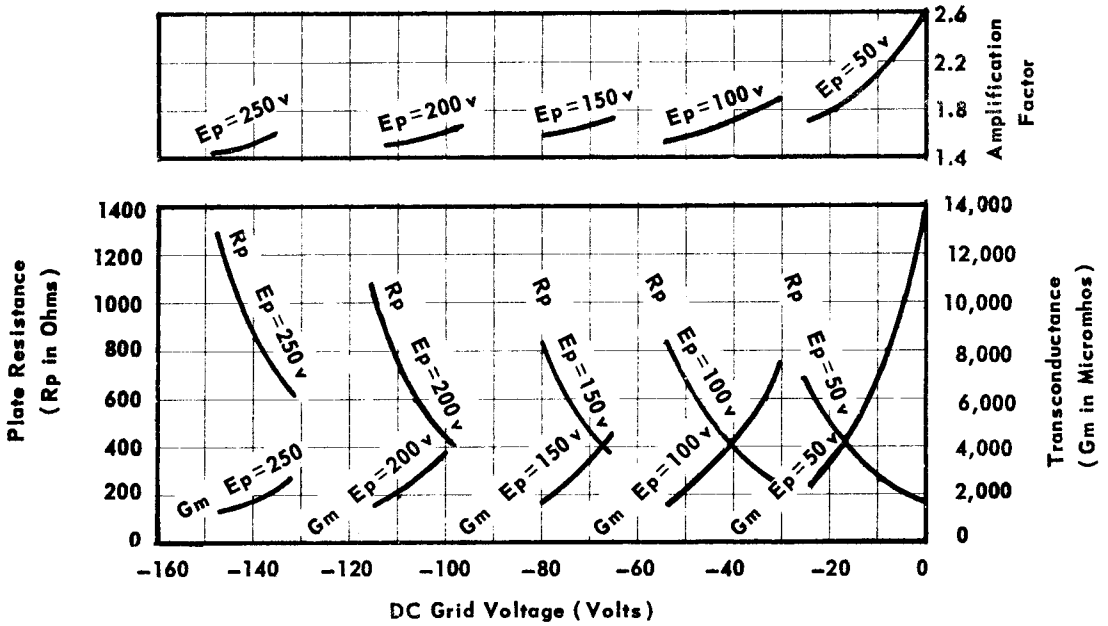
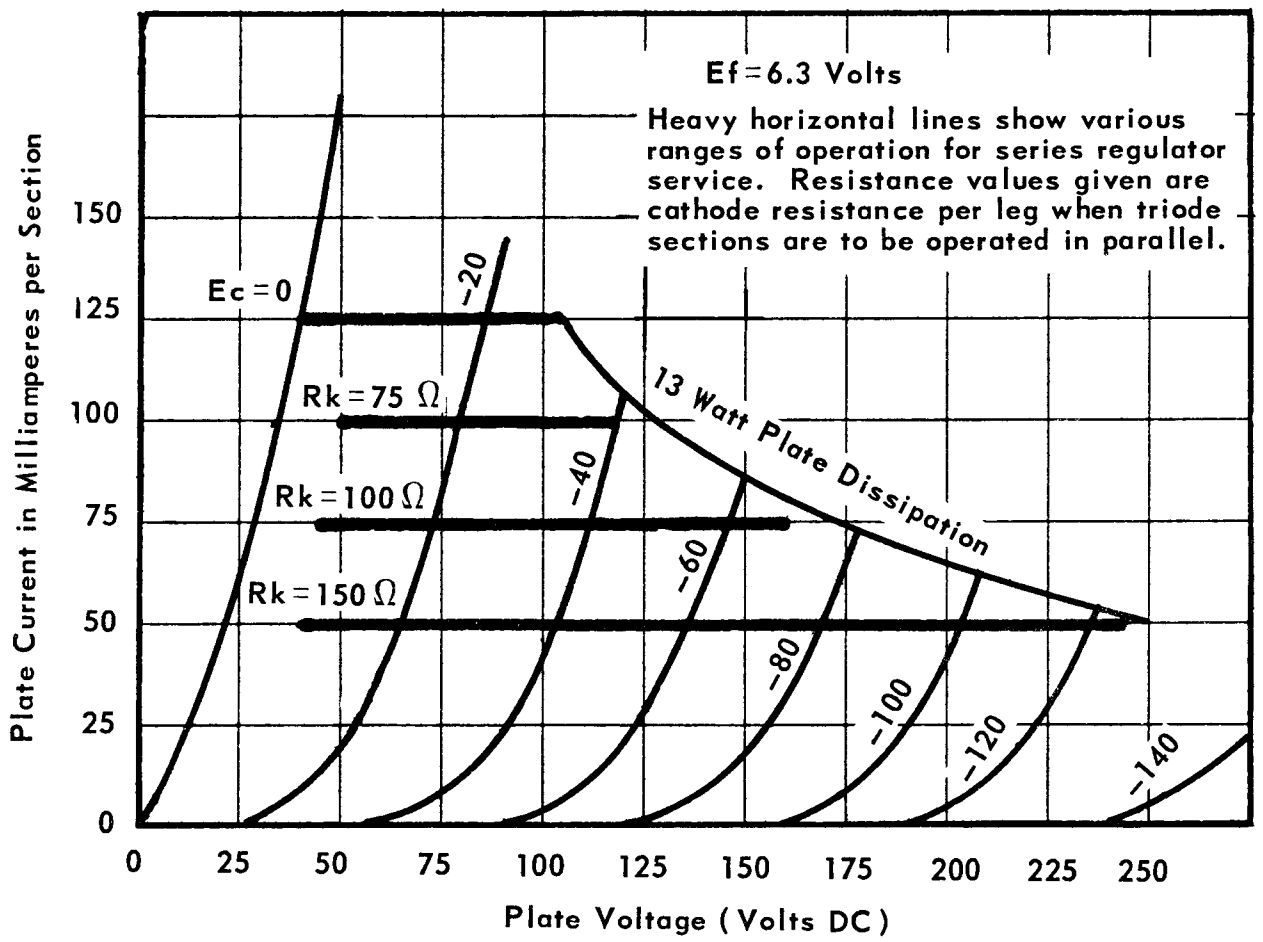
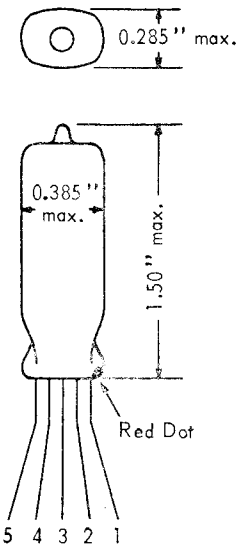


PLATE CHARACTERISTICS FOR EACH TRIODE SECTION



TYPE CK6088

The CK6088 is a subminiature power amplifier pentode of low filament current designed for use in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Positive
Lead 3 Filament, Negative One Deflector	One Deflector

MOUNTING POSITION: Any

ELECTRICAL DATA

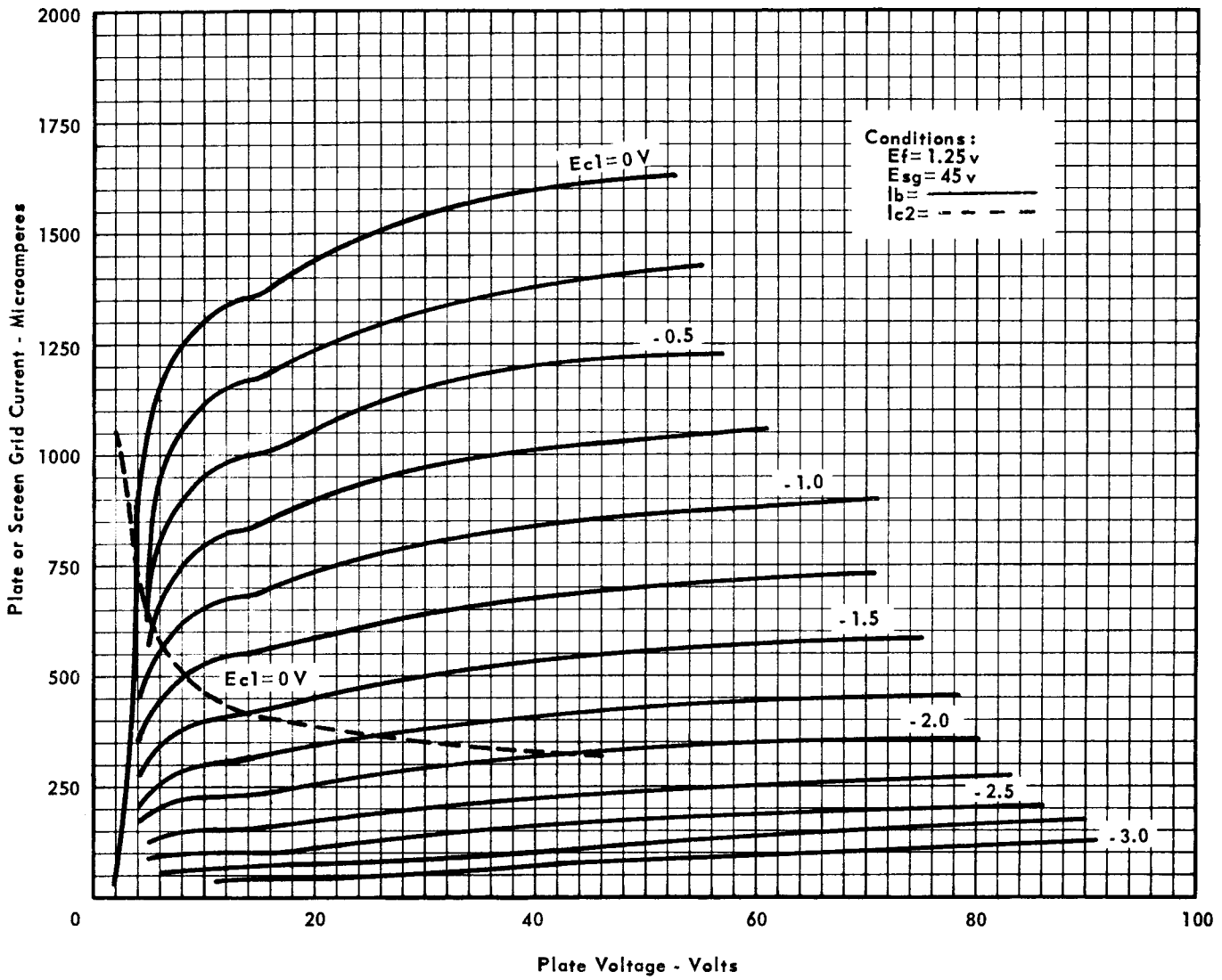
RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	1.25±20% volts
Plate Voltage	67.5 volts
Screen Grid Voltage	67.5 volts
Cathode Current	1.5 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

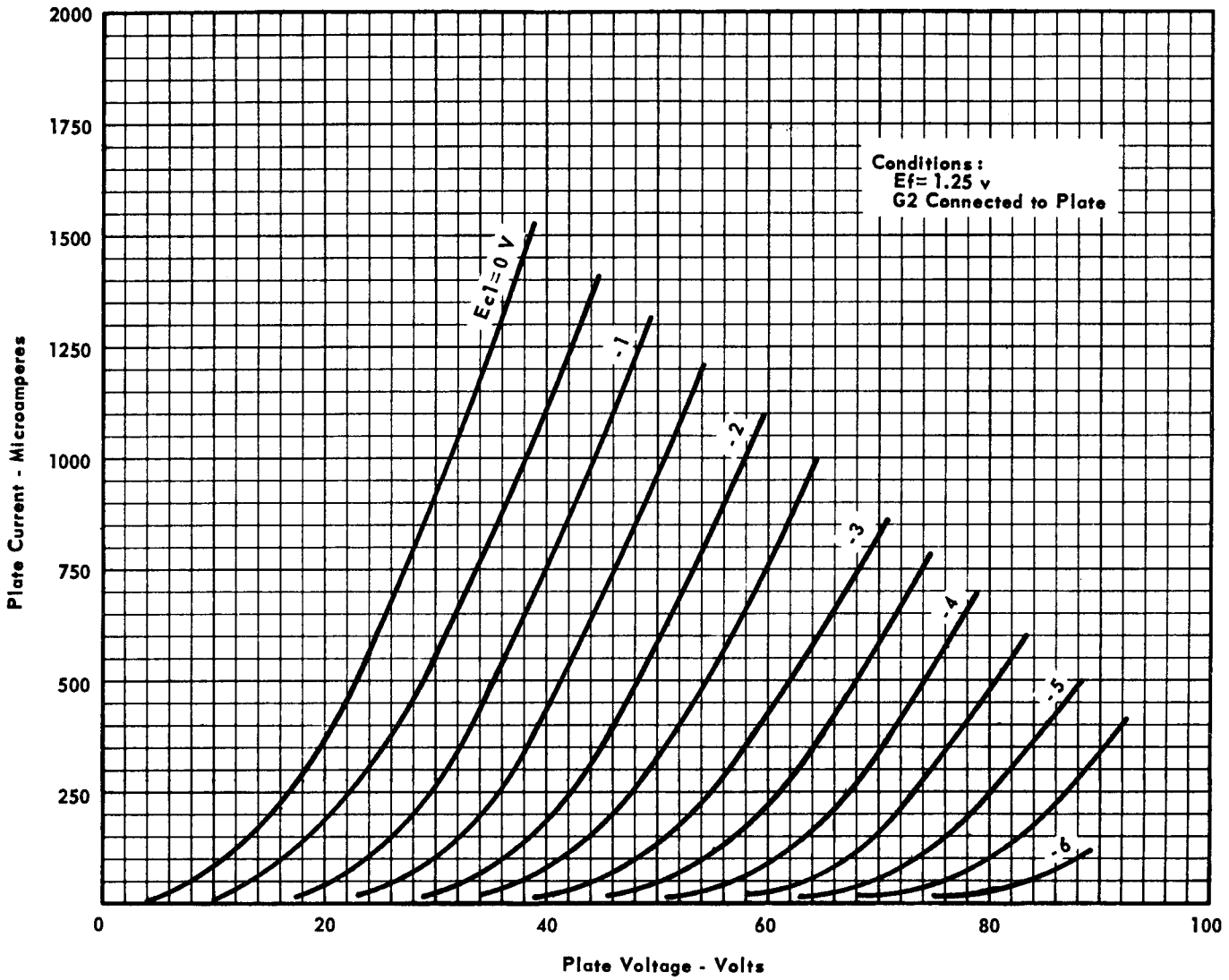
Filament Voltage	1.25 volts
Filament Current	20 ma.
Plate Voltage	45 volts
Screen Grid Voltage	45 volts
Control Grid Voltage	-1.25 volts
Zero-Signal Plate Current	650 μa.
Zero-Signal Screen Grid Current	150 μa.
Transconductance	625 μmhos
Plate Resistance (approx.)	0.7 meg.
Load Resistance	0.08 meg.
Power Output	10.5 mw.
Distortion (approx.)	10 percent

AVERAGE PLATE CHARACTERISTICS

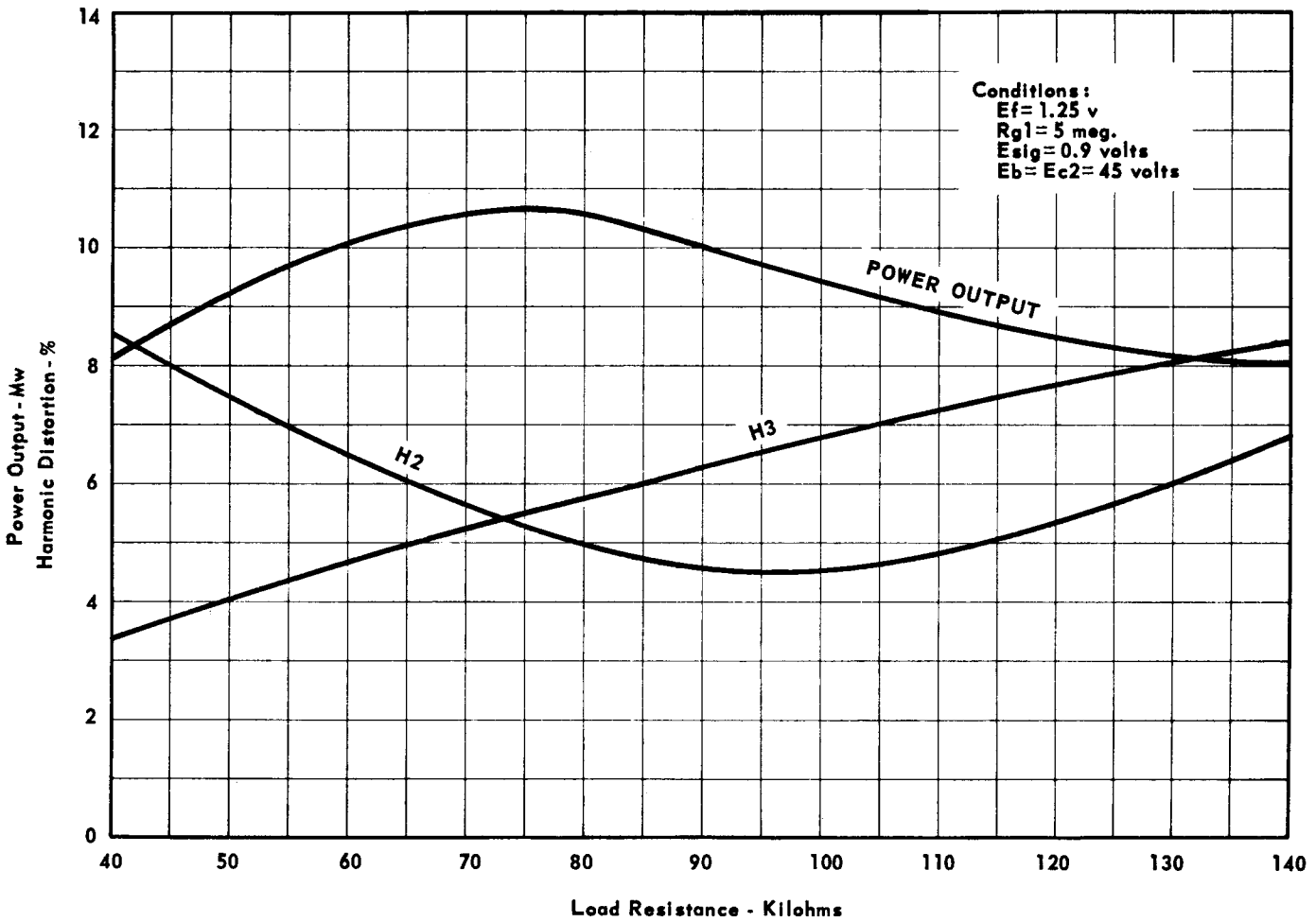


AVERAGE PLATE CHARACTERISTICS

(Triode Connected)



AVERAGE CHARACTERISTICS



RAYTHEON

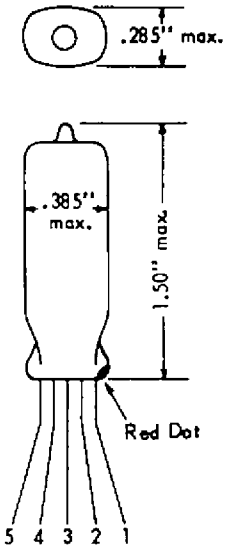
TECHNICAL INFORMATION

SUBMINIATURE PENTODE

Excellence in Electronics

TYPE CK6092

The CK6092 is a filament type pentode power amplifier of subminiature construction designed for use in wearable and portable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, negative: Grid #3
Lead 3 Filament, positive: Grid #3	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25± 20%	volts
Plate Voltage	67.5	volts
Grid #2 Voltage	67.5	volts
Total Cathode Current	3.5	ma.

CHARACTERISTICS AND TYPICAL OPERATION:

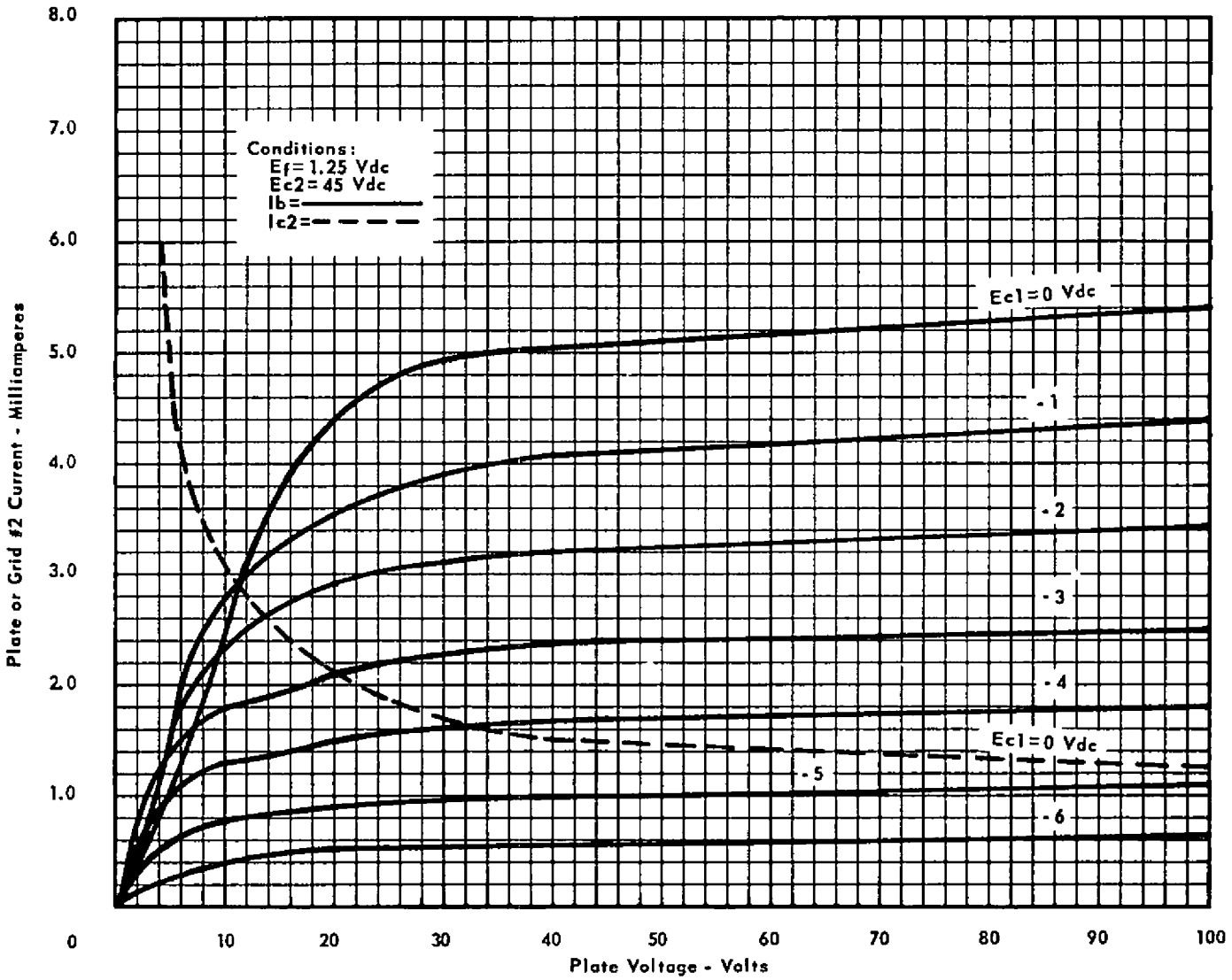
Filament Voltage (dc)	1.25	volts
Filament Current	50	ma.
Plate Voltage	45	volts
Grid #2 Voltage	45	volts
Grid #1 Voltage	-4.5	volts
Plate Current	1.4	ma.
Grid #2 Current	0.4	ma.
Transconductance	600	μmhos
Load Resistance	30	kilohms
Distortion (approx.)	10	percent
Power Output	25	mw.

from JETEC release #1609, March 19, 1956

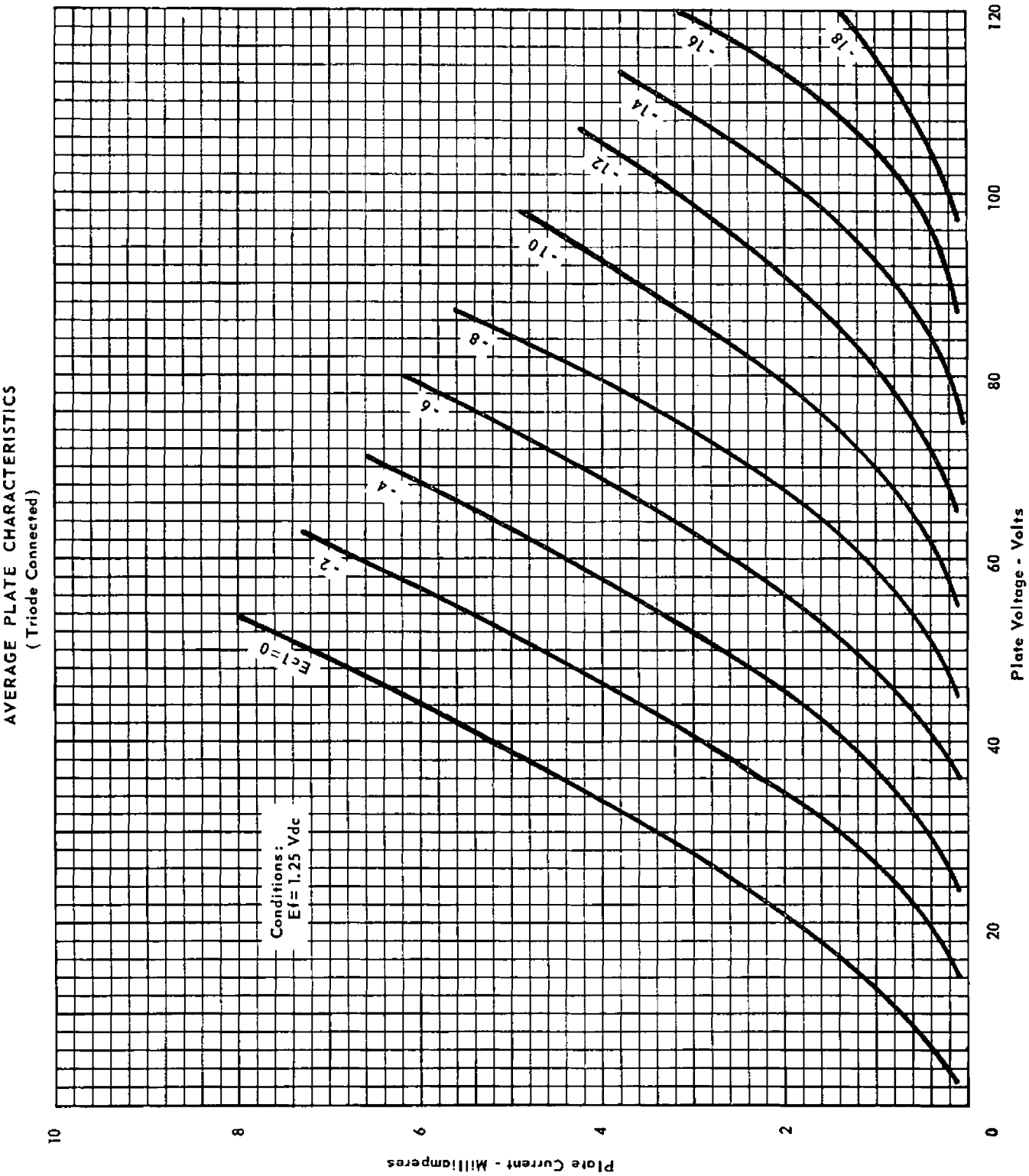
Tentative Data

SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS

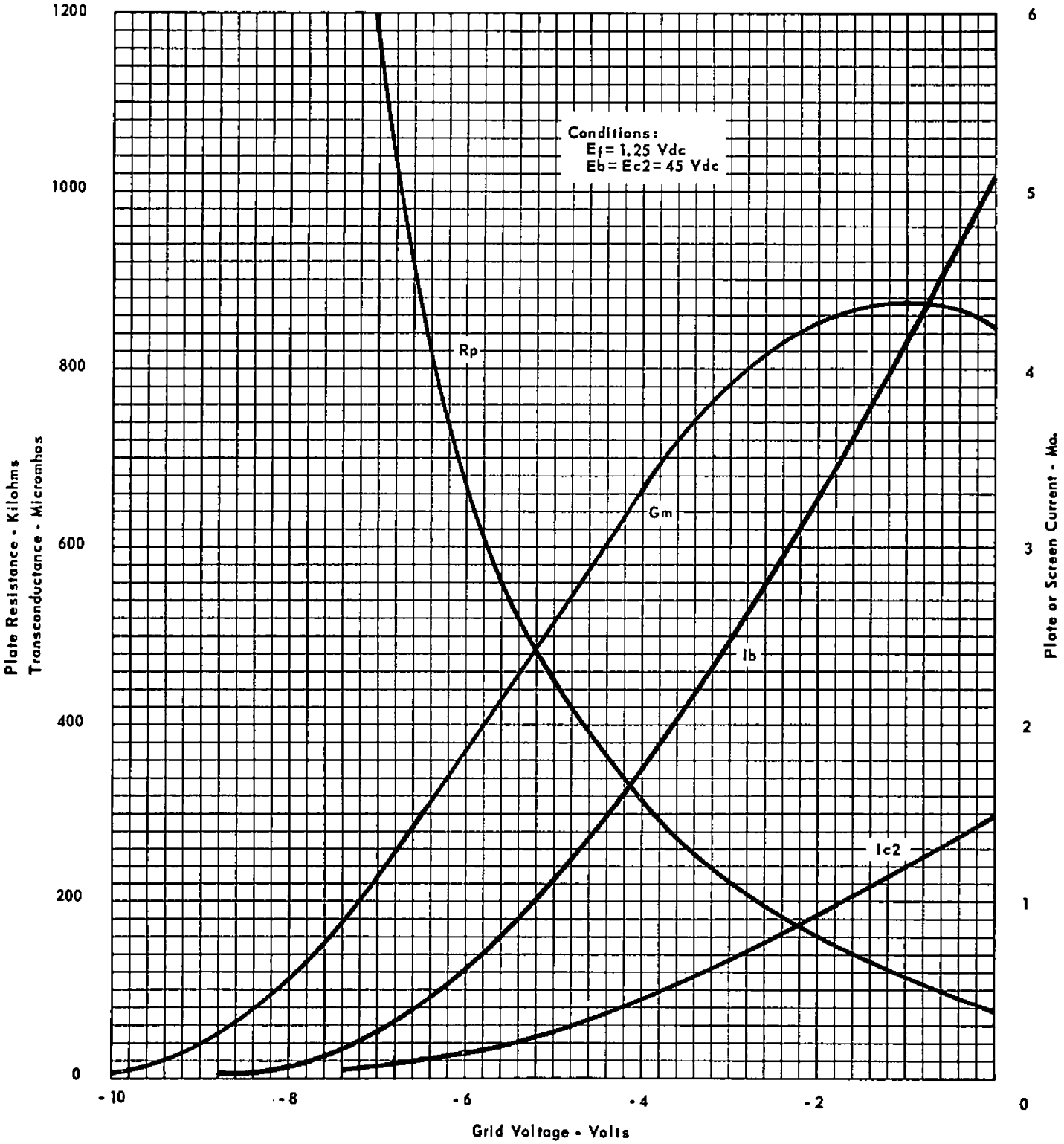


SUBMINIATURE PENTODE



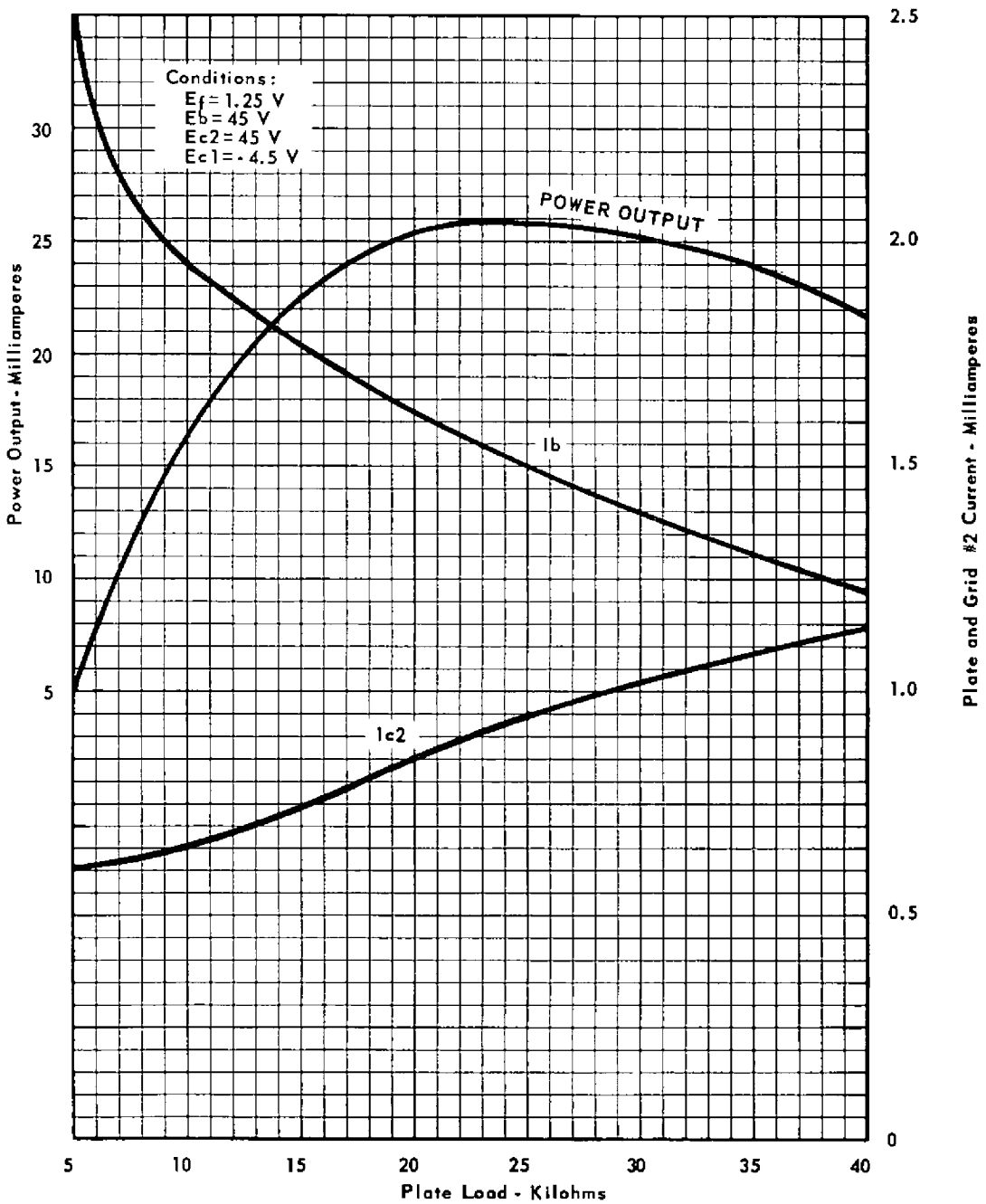
SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



SUBMINIATURE PENTODE

POWER OUTPUT CHARACTERISTICS



RAYTHEON

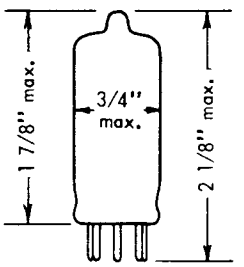
TECHNICAL INFORMATION

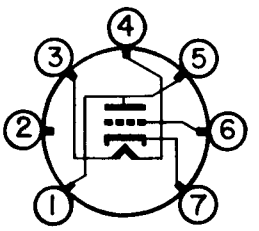
RELIABLE TRIODE

Excellence in Electronics

TYPE CK6100/ 6C4WA

The CK6100/6C4WA is a heater-cathode type medium-mu triode of miniature construction, suitable for use as a class c amplifier and oscillator. This type is characterized by long life and stable performance. It is designed for service where conditions of high temperature and mechanical shock or vibration are encountered.





BOTTOM VIEW

6BG

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button Base 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Plate	Pin 5 Plate
Pin 2 Internal connection	Pin 6 Grid
Pin 3 Heater	Pin 7 Cathode
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test---Note 3)	450 G
Maximum Vibrational Acceleration (100 Hour Fatigue Test---Note 4)	2.5 G
Maximum Bulb Temperature	165 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)		ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 7)	Ef:	5.7	6.3	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	250	100	250	330	Vdc
Grid #1 Voltage	Ec1:	----	-8.5	0	-8.5	----	Vdc
Plate Dissipation	Pp:	----	----	1.2	2.6	3.8	W
Grid #1 Circuit Resistance	Rg1:	----	----	----	----	1.2	Meg.
Grid Current	Ic:	----	----	----	----	5.5	mAdc
Heater-Cathode Voltage	Ehk:	-200	----	----	----	+200	Vdc
Plate Current (Note 9)	Ib:	----	----	11.8	10.5	20	mAdc

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
ACCEPTANCE TESTS - GROUP C										
Continuity and Shorts (Inoperatives):		0.4								
ACCEPTANCE TESTS - GROUP D		**Combined AQL = 1.0 %**								
Heater Current:		0.65	If:	138	----	150	----	162	----	mA
Heater-Cathode Leakage:	Ehk=+100 Vdc	0.65	Ihk:	----	----	----	----	10	----	μAdc
	Ehk=-100 Vdc		Ihk:	----	----	----	----	10	----	μAdc

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ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
ACCEPTANCE TESTS - GROUP D (cont't)										
Grid Current:	Rg=0.1 meg.	0.65	Ic(1):	----	----	----	----	-0.5	----	μAdc
Plate Current (1):		0.65	Ib(1):	6.5	9.0	10.5	12.0	14.5	3.5	mAdc
Transconductance (1):		0.65	Sm(1):	1750	2000	2200	2400	2650	450	μmhos
ACCEPTANCE TESTS - GROUP E										
Insulation of Electrodes:	Ef=6.3 V									
	Eg-all=-100 Vdc	2.5	Rg1-all:	100	----	----	----	----	----	Meg.
	Ep-all=-300 Vdc		Rp-all:	100	----	----	----	----	----	Meg.
Plate Current (2):	Ec1=-25 Vdc	2.5	Ib(2):	----	----	----	----	20	----	μAdc
Plate Current (3):	Ec1=-18 Vdc	2.5	Ib(3):	5	----	----	----	----	----	μAdc
Transconductance (2):	Ef=5.7 V	2.5	Δ_{Ef}Sm(2):	----	----	----	----	15	----	%
Transconductance (3):	Ec1=0; Eb=100 Vdc:	2.5	Sm(3):	2500	2900	3250	3600	4000	800	μmhos
Grid Current (2):	Eb=250 Vdc; Rg=0.5 Rk=470 ohms; Ec1=0; After 5 minutes at Ef=7.0 V measure grid current at Ef=7.0 V; 3 minutes test not permitted.	2.5	Ic(2):	----	----	----	----	-1.0	----	μAdc
RF Noise:	Eca1=15 mVac	2.5	-----	----	----	----	----	3.0	----	mW
Noise and Microphonics:	Eb=250 Vdc; Ec1=-8.5 Vdc; Rk=0; Rp=10,000; Ef=6.3 Vac: Ehk=0	2.5	Ep:	----	----	----	----	25	----	mVac
ACCEPTANCE TESTS - GROUP F										
Vibration (2):	Rp=2000 ohms; Rg=0.1 meg.	6.5	Ep:	----	----	----	----	50	----	mVac
Amplification Factor:		6.5	Mu:	15.5	16.2	17.0	17.8	18.5	1.8	
Capacitance:			Cgp:	1.2	----	1.6	----	2.0	----	μμf
Capacitance:	Note 2	6.5	Cin:	1.35	----	1.8	----	2.25	----	μμf
Capacitance:			Cout:	0.98	----	1.3	----	1.62	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mm Hg: Voltage=500 Vac	6.5	----	----	----	----	----	----	----	----
ACCEPTANCE TESTS - GROUP A										
Shock:	Ehk=100 Vdc; Rg=0.1 Meg.; Hammer Angle=30°; Note 3	20	-----	----	----	----	----	----	----	----
Fatigue:	96 hours; G=2.5; Fixed frequency; F=25 min. 60 max. (Note 4)	6.5	-----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F=25 Cps; G=2.5; Rp=2000 ohms	----	Ep:	----	----	----	----	100	----	mVac
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	----	----	----	15	----	μAdc
	Ehk=-100 Vdc	----	Ihk:	----	----	----	----	15	----	μAdc
Transconductance (1):		----	Sm(1):	1500	----	----	----	2650	----	μmhos
Grid Current (1):		----	Ic(1):	----	----	----	----	-1.0	----	μAdc
ACCEPTANCE TESTS - GROUP B										
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	-----

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Maximum Defects per Characteristic	
							1st Sample	Combined Sample
ACCEPTANCE LIFE TEST								
Heater Cycling:	Ef=7.5 V; Ehk=+135 Vdc; Eb=Ec=0; 1 min. on, 1 min. off	----	-----	2000	----	Cycles		
Heater Cycling Life Test End Points:		----	-----	----	----	-----		
Heater-Cathode Leakage:	Heater Positive	----	Ihk:	----	20	μAdc		
	Heater Negative	----	Ihk:	----	20	μAdc		

ELECTRICAL DATA (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Maximum Defects per Characteristic 1st Sample	Combined Samples
ACCEPTANCE LIFE TEST (cont'd)								
1 Hour Stability Life Test:	TA=room; Ehk=+135 Vdc. Rg=0.5 Meg; Rk=470 ohms Ec1=0.	----	-----	----	----	----		
1 Hour Stability Life Test End Points: Transconductance (1) change of individual tubes from initial:	(Typical Sample Size=50 tubes)	1.0	ΔSm(1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=room: Ehk=+135 Vdc: Rg1=0.5 Meg; Rk=470 ohms; Ec1=0.	----	-----	----	----	----		
100 Hour Survival Rate Life Test End Points: Inoperatives:	(Typical Sample Size=200 Tubes)L	0.65	-----	----	----	----		
500 and 1000 Hour Intermittent High Temperature Life Test:	T Bulb=165°C; Ehk=+135 Vdc; Rk=470 ohms; Ec1=0; Rg1=0.5 Meg.							
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample, Total Allowable combined defects=4 tubes 1st sample, 8 tubes 1st and 2nd samples).	----	-----	----	----	----		
Inoperatives		----	-----	----	----	----	1	3
Heater Current		----	If:	138	162	mA	1	3
Heater-Cathode Leakage		----	Ihk:	----	10	μAdc	1	3
Grid Current (1)		----	Ic(1):	0	-0.5	μAdc	1	3
Transconductance (1)		----	Sm(1):	1600	2650	μmhos	1	3
Transconductance (1) Average change (Note 10)		----	Ave.ΔSm(1):	----	15	%		
Electrode Insulation (g-all)		----	Rg-all:	50	----	Meg.	2	5
(p-all)		----	Rp-all:	50	----	Meg.		
Transconductance (2) (Note 8)		----	ΔSm(2):	----	15	%	2	5
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	-----	----	----	----		
Inoperatives:		----	-----	----	----	----	2	5
Heater Current		----	If:	138	162	mA	2	5
Heater-Cathode Leakage		----	Ihk:	----	10	μAdc	2	5
Grid Current (1)		----	Ic(1):	0	-0.5	μAdc	2	5
Transconductance (1)		----	Sm(1):	1500	2650	μmhos	2	5

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Without Shield.

Note 3: Test Conditions and Acceptance Criteria per Shock Test procedures of MIL-E-1B basic specifications.

Note 4: Test Conditions and Acceptance Criteria per Fatigue Test procedures of MIL-E-1B basic specifications.

Note 5: These normal values represent conditions at which control of reliability may be expected.

Note 6: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

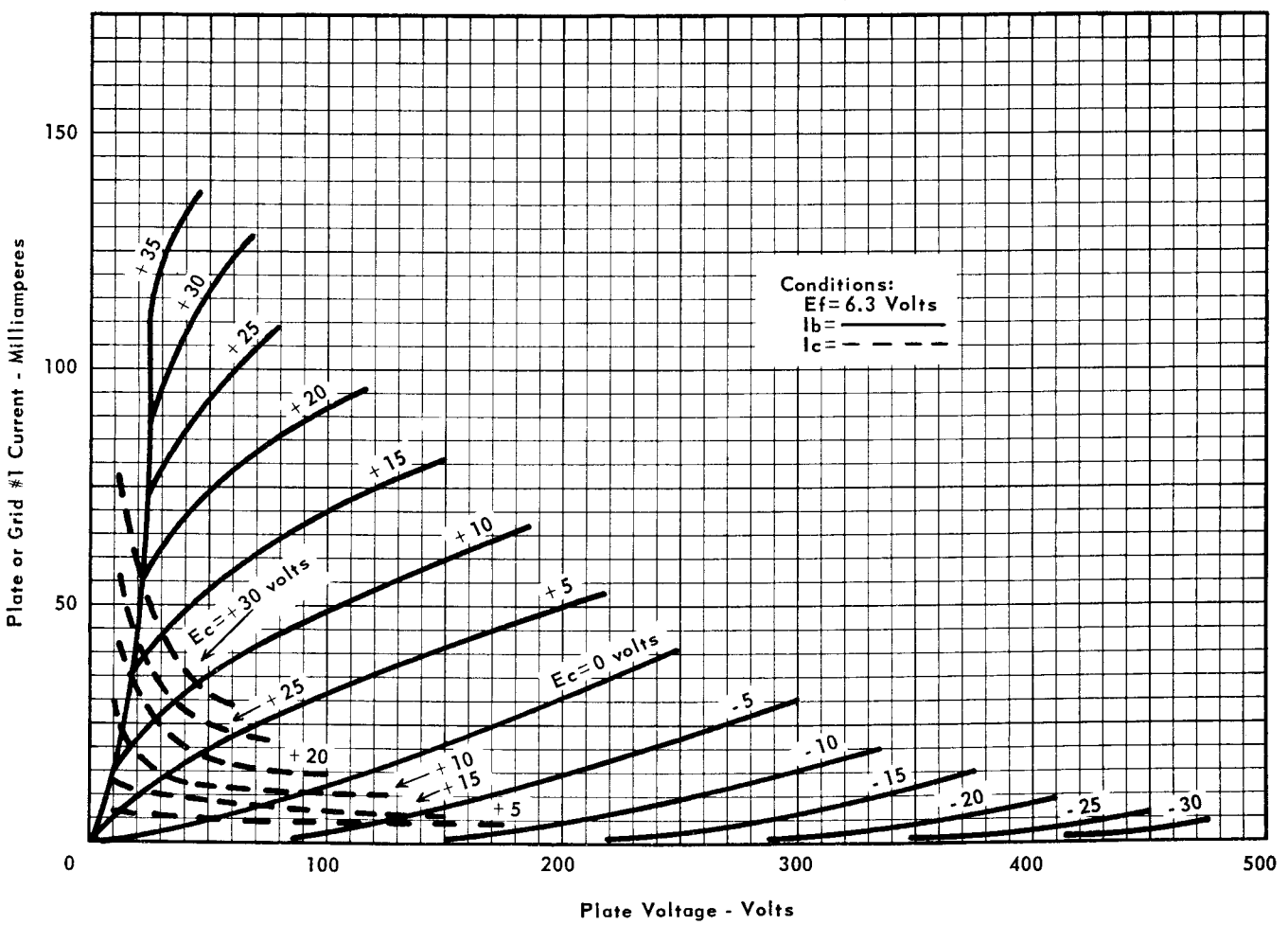
Note 7: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 8: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 9: Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

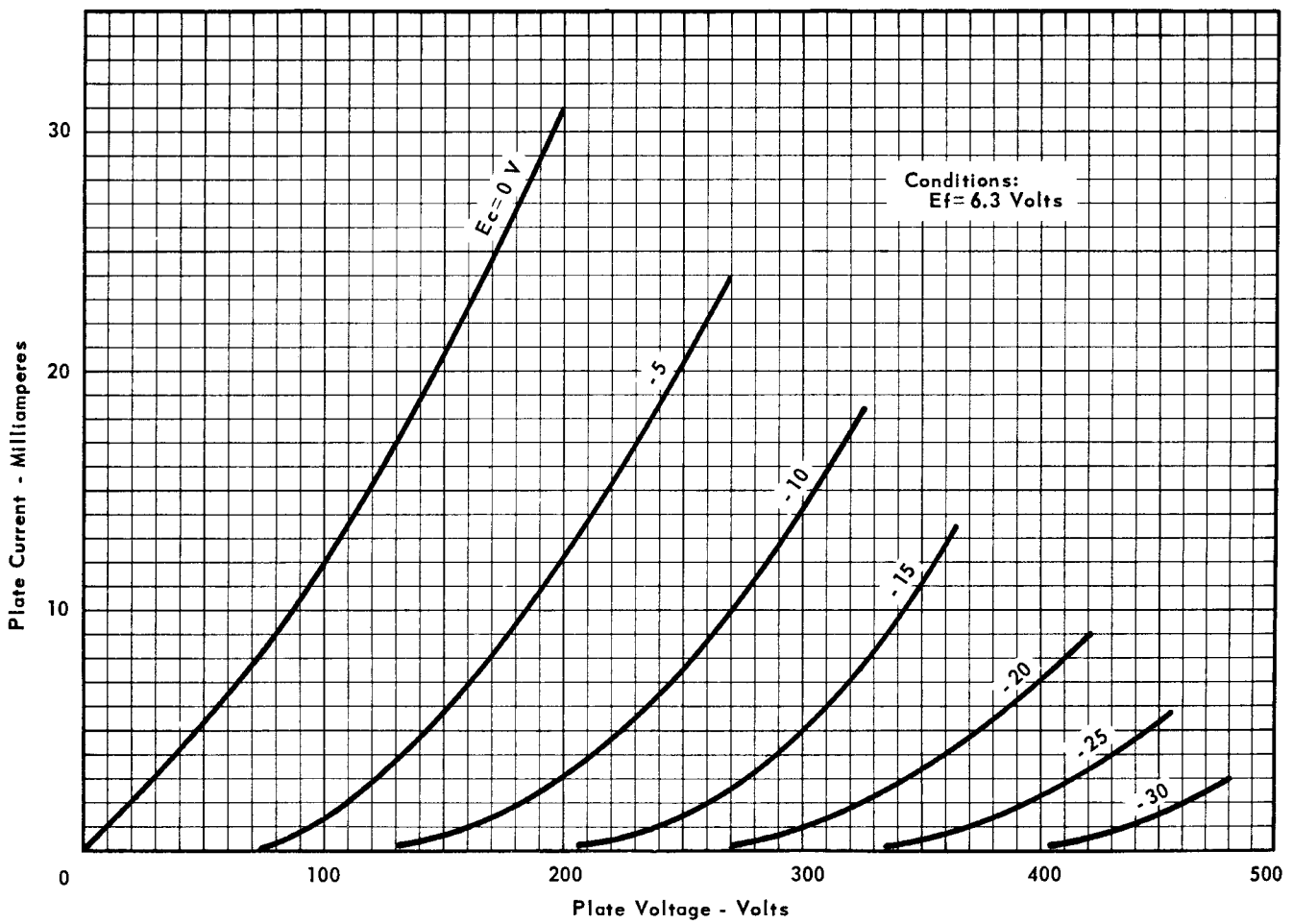
Note 10: The average percentage change shall be ascertained from the determination of the individual changes for each tube (inoperatives excluded) from the zero hour valve for the referenced characteristic.

AVERAGE PLATE CHARACTERISTICS



RELIABLE TRIODE

AVERAGE PLATE CHARACTERISTICS

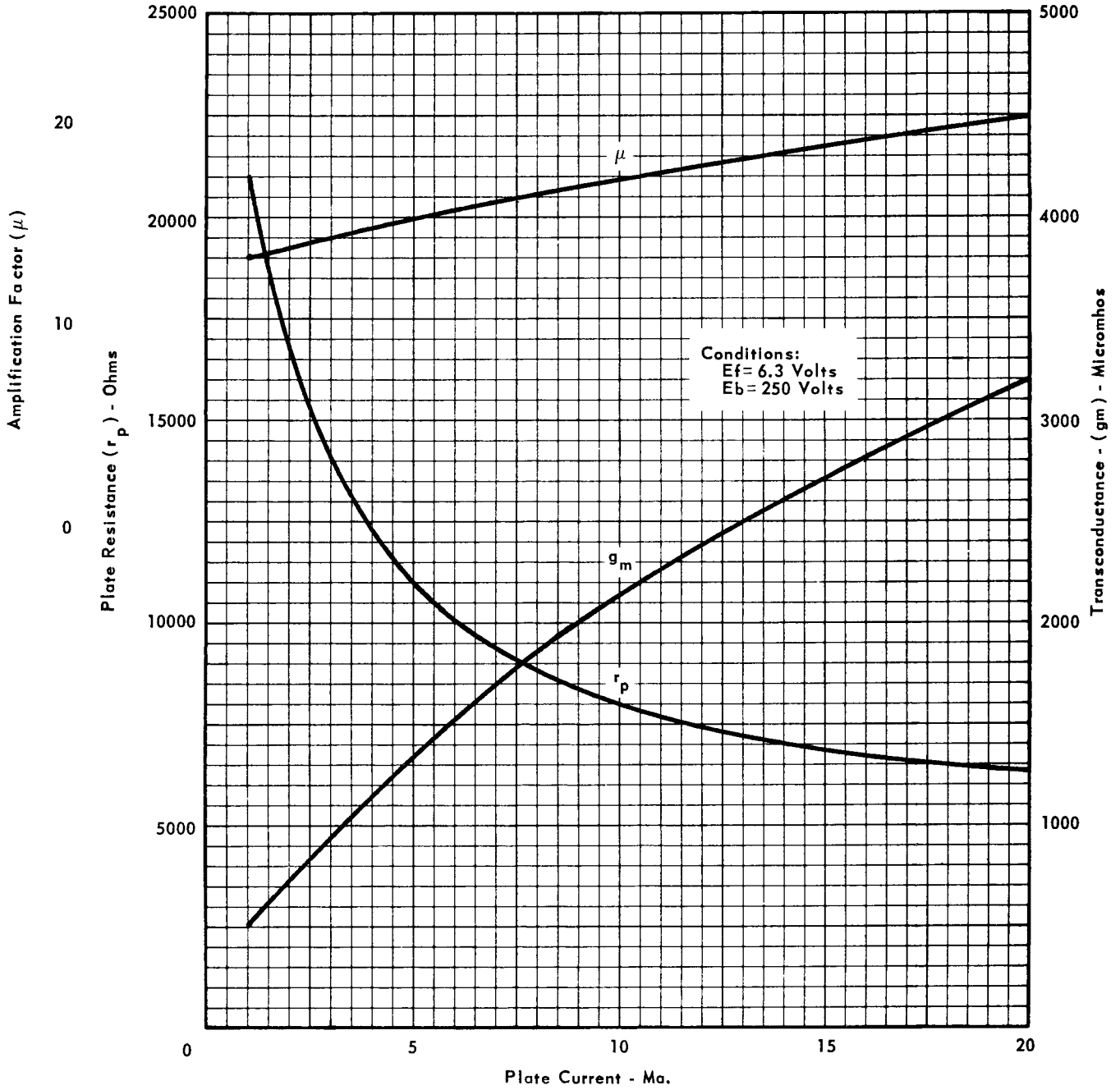


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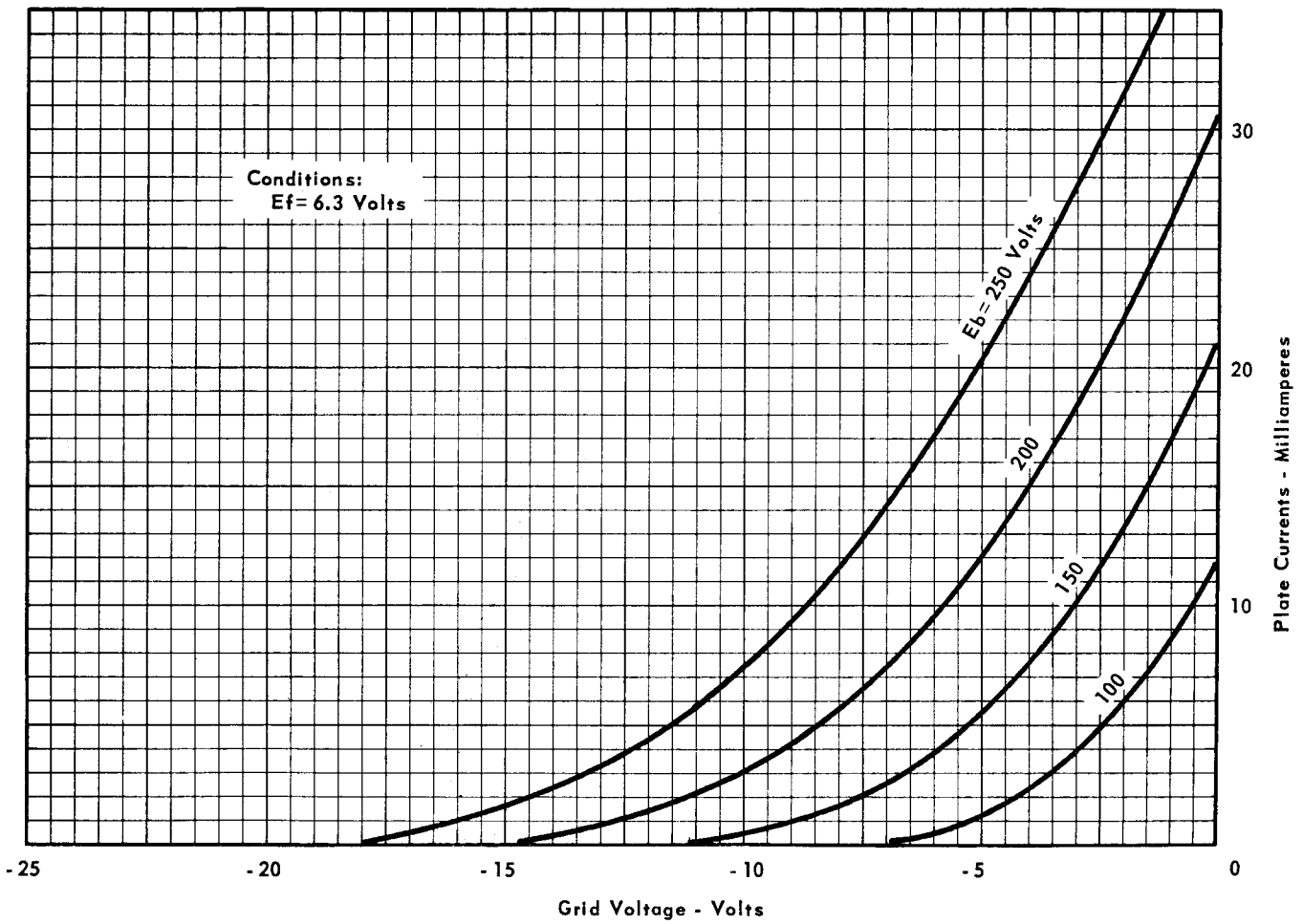
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RELIABLE TRIODE

AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



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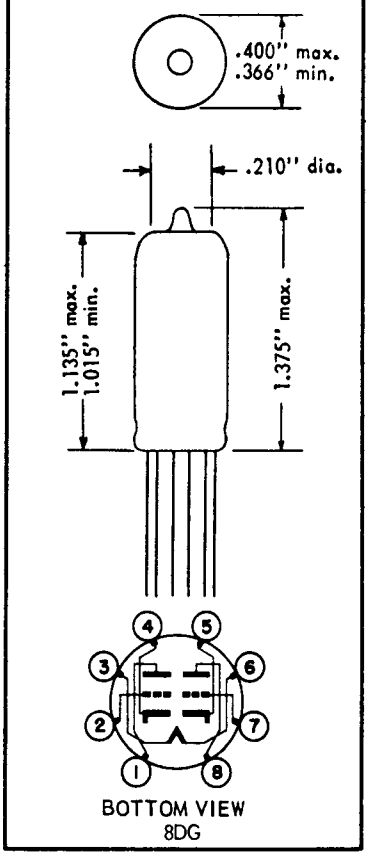
RECEIVING AND CATHODE RAY TUBE OPERATIONS

May 1, 1956

NEWTON 58, MASS.

TYPE CK6111WA

The CK6111WA is a heater-cathode type medium-mu double triode of subminiature construction, capable of operation in the UHF region. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW
8DG

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.17" tinned flexible leads. Length: 1.5" min.)

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2	Lead 5 Cathode, Unit #1
Lead 2 Grid, Unit #2	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid, Unit #1
Lead 4 Cathode, Unit #2	Lead 8 Plate, Unit #1

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	100	100	250	Vdc
Peak Plate Voltage	eb:	----	----	----	360	v
Grid #1 Voltage	Ec1:	-55	0	0	----	Vdc
Plate Dissipation (per plate)	Pp/p:	----	----	0.85	0.95	W
Grid #1 Circuit Resistance	Rg/g:	----	----	1.0	1.1	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	v
Plate Current (per plate)	Ib/p:	0.5	----	8.5	22	mAdc
Grid Current (per grid)	Ic/c:	----	----	----	5.5	mAdc
Cathode Resistance (per unit)	Rk:	----	220	220	----	ohms
Transconductance (per plate)	Sm/p:	----	----	5000	----	μmhos
Amplification Factor	Mu/p	----	----	20	----	----

Tentative Data

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ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

(In the following test, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			**Combined AQL = 1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.4	If:	285	----	----	----	315	----	mA
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	0.4	Ihk (1):	----	----	----	----	3.5	----	μAdc
	Ehk=–100 Vdc		Ihk (1):	----	----	----	----	3.5	----	μAdc
Grid Current:	Rg= 1.0 Meg.	0.4	Ic (1):	----	----	----	----	–0.3	----	μAdc
Plate Current (1):		0.4	Ib (1):	6.0	7.5	8.5	9.5	11.0	2.8	mAdc
Plate Current (2):	Ec1= –9.0 Vdc	0.4	Ib (2):	----	----	----	----	100	----	μAdc
Transconductance (1):		0.4	Sm (1):	4100	4650	5000	5350	5900	1000	μmhos
Continuity and Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef= 6.3 V Eg-all=–100 Vdc Ep-all=–300 Vdc	2.5	Rg1-all: Rp-all:	250 250	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (1) Difference between sections:		2.5	ΔIb:	----	----	----	----	1.5	----	mAdc
Transconductance (2):	Ef= 5.7 V (Note 9)	2.5	Δ_{Ef}Sm(2)	----	----	----	----	10	----	%
Grid Emission:	Ef=7.5 V; Rg/g= 1.0 Meg.; Eb=250 Vdc; Rk/k=2900 ohms pre-heat 5 minutes at Ec1= 0, test at Ec1=–20 Vdc	6.5	Isc1:	----	----	----	----	–0.5	----	μAdc
AF Noise:	Esig=65 mVac; Rg1= 0.1 Meg.; Rp=0.01 Meg.; Rk=100 ohms; Ck=1000μf Units connected in parallel	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	17	----	20	----	23	----	----
Pulse Emission (1):	Eb=150 Vdc; Ec1= –25 Vdc; tp=10μsec; duty cycle= 1%; egk= +30 v; Rk/k=1.0 ohm; (Note 13)	2.5	ik: Δ_{tp}ik:	320 ----	---- ----	---- ----	---- ----	---- 10	---- ----	ma %
Pulse Emission (2):	Ef=5.9 V; Eb=150 Vdc; Ec1=–25 Vdc; tp=10μsec duty cycle=1%; egk=+ 30 v; Rk/k=1.0 ohm; (Note 13)	6.5	ik:	300	----	----	----	----	----	ma
Heater-Cathode Leakage (2):	Ef= –6.7 V (pin 6 negative); Ehk=+100 Vdc; (cathode negative); t= 16 seconds (Note 14)	6.5	Ihk (2):	----	----	----	----	1.0	----	μAdc
Capacitance:			Cgp:	1.2	----	1.5	----	1.8	----	μμf
Capacitance:			Cin:	1.4	----	1.9	----	2.4	----	μμf
Capacitance:	(Note 2)	6.5	Cout (Unit #1)	0.20	----	0.28	----	0.36	----	μμf
Capacitance:			Cout (Unit #2)	0.22	----	0.32	----	0.42	----	μμf
Capacitance:			Cgg:	----	----	----	----	0.011	----	μμf
Capacitance:			Cpp:	----	----	----	----	0.50	----	μμf

ELECTRICAL DA TA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (cont'd)

(In the following test, each unit is tested separetly)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
MEASUREMENTS ACCEPTANCE TESTS, PART 2 (cont'd)								
Operation Time:	(Note 11)	4.0	t:	----	20	sec.	----	----
Low Pressure Voltage Breakdown:	Pressure=21±3 mmHg; Voltage= 300 Vac	6.5	----	----	----	----	----	----
Vibration (2):	F=40 cps; G=15; Rp = 10,000 ohms	2.5	Ep:	----	20	mVac	----	----
Vibration (3):	G=10; F=70-2000 cps; Rp=10,000 ohms; Positions X1 and X2 only	6.5	ep:	----	125 Peak to Peak	mv	----	----
DEGRADATION RATE ACCEPTANCE TESTS								
Subminiature Lead Fatigue:		2.5	----	4.0	----	arcs	----	----
Shock (1):	Ehk=+100 Vdc; Rg1= 0.1 Meg; Hammer Angle=30° (Note 3)	20	----	----	----	----	----	----
Fatigue (1):	96 hours; G=2.5; Fixed frequency; F=25 min., 60 max.; (Note 5)	6.5	----	----	----	----	----	----
Shock (2):	Ehk=100 Vdc; Rg1= 0.1 Meg; Hammer Angle =120°+ Rubber Pad; t=10 milliseconds; G= 75; (Note 16)	20	----	----	----	----	----	----
Fatigue (2):	6 hours; G=10; F= 130-2000-130 cps; (Note 15)	6.5	----	----	----	----	----	----
Post Shock tests (1) and (2) and Fatigue Tests (1) and (2) End Points:								
Vibration (2):	F=40 cps; G=15; Rp= 10,000 ohms	----	Ep:	----	80	mVac		
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	----	Ihk (1):	----	7	μAdc	----	----
	Ehk=−100 Vdc	----	Ihk (1):	----	7	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	15	%	----	----
Grid Current (1):		----	Ic (1):	----	−1.0	μAdc	----	----
Glass Strain (Thermal Shock):		6.5	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef=7.0 V; Eb=Ec= 0 V; Ehk=140 Vac; 1 min. on, 4 min. off	1.0	----	2000	----	Cycles	----	----
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	----	Ihk (1):	----	7	μAdc	----	----
	Ehk=−100 Vdc	----	Ihk (1):	----	7	μAdc	----	----
2&20 Hour Stability Life Test:	TA=Room; Ehk= +200 Vdc; Rg/g= 1.0 Meg.	----	----	----	----	----	----	----
2&20 Hour Stability Life Test End Points:	(Typical Sample Size= 50 tubes)	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (cont'd)

(In the following test, each unit is tested separately)

TEST	CONDITIONS	AQL	MIL-E-1	MIN	MAX	MIL-E-1	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Change in Transconductance (1) of individual tubes:		1.0	Δ_tSm(1):	----	10	%	----	----
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+200 Vdc; Rg/g=1.0Meg.	----	----	----	----	----	----	----
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size= 200 tubes)	----	----	----	----	----	----	----
Continuity and Shorts (Inoperatives):		0.65	----	----	----	----	----	----
Transconductance (1):		1.0	Sm(1):	3750	----	μmhos	----	----
200 Hour Intermittent Life Test (1):	Eb=250 Vdc; Ec1=0 Vdc; Ehk=+200 Vdc; Rg/g=1.0 Meg.; Rk/k=2900 ohms; TA=Room							
200 Intermittent Life Test (1) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	-----	1	3
Grid Current (1):		----	Ic1:	----	-0.9	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Change in Transconductance (1) of Individual Tubes:		----	Δ_tSm(1):	----	25	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	20	%	1	3
Heater-Cathode Leakage (1):	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk(1): Ihk(1):	---- ----	10 10	μAdc μAdc	1	3
Insulation of Electrodes:								
g-all p-all		---- ----	Rg-all: Rp-all:	100 100	---- ----	Meg. Meg.	1	3
Total Defectives:		----	----	----	----	----	3	6
500 Hour Intermittent Pulse Life Test:	Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; Rl/p=330 ohms; tp=10μsec; duty cycle=1.0%; egk=+30± 1 volts; TA=Room							
500 Hour Intermittent Pulse Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	----	1	3
Pulse Emission:		----	ik:	300	----	mA	1	3
Change in Pulse Emission of Individual Tubes from Initial:		---- ----	Δik: Δik:	---- ----	-35 +50	% %	1	3
Total Defectives:		----	----	----	----	----	2	5
Intermittent High Temperature Life Test (2):	T Bulb=220° C; Ehk=+200 Vdc; Rg/g=1.0 Meg.	----	----	----	----	----	----	----
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	----	-0.7	μAdc	1	3

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (cont'd)

(In the following test, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) Change in Individual Tubes from Initial:		----	$\Delta_t Sm(1)$:	----	20	%	1	3
Transconductance (2):	(Note 9)	----	$\Delta_{Ef} Sm(2)$:	----	15	%	1	3
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	----	Ihk(1):	----	10	μAdc	1	3
	Ehk=−100 Vdc		Ihk(1):	----	10	μAdc		
Insulation of Electrodes:		---						
g-all:		----	Rg-all:	50	----	Meg.	1	3
p-all:		----	Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg.$\Delta_t Sm$:	----	15	%	----	----
Total Defectives:		----	----	----	----	----	3	6
1000 Hour High Temperature Life Test End Points:	(Typical Sample Size =20 tubes 1st sample; 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	----	−1.0	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) Change of Individual Tubes from Initial:		----	$\Delta_t Sm(1)$:	----	25	%	1	3
Transconductance (2):	(Note 9)	----	$\Delta_{Ef} Sm(2)$:	----	20	%	1	3
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	----	Ihk(1):	----	10	μAdc	1	3
	Ehk=−100 Vdc	----	Ihk(1):	----	10	μAdc		
Insulation of Electrodes:								
g-all:		----	Rg-all:	25	----	Meg.	2	5
p-all:		----	Rp-all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ± 5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

ELECTRICAL DATA (Cont'd)

NOTES (Cont'd)

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by appendix B of MIL-E-1 basic specifications.

Note 11: Operation time is the time in seconds required for the plate current to attain a value within ± 10% of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed. A cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300 ± 50 microseconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A–305 accelerometer and KA–1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent	600,000 ohms
500 micro seconds	500,000 ohms
100 micro seconds	100,000 ohms
60 micro seconds	1,000 ohms

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

a. either a permanent or tap short at any time during the tapping procedure
b. any open circuit
c. air leaks

Note 13: Peak cathode current shall be measured by means of a high impedance osilloscope or equipment device connected across a 1.0 ± 1% cathode resistor. The specified limit refers to the maximums of the pulse complitude. The variation of the output pulse amplitude between 20% tp and 80% tp shall not exceed the specified limit.

Note 14: Heater-Cathode Leakage (2) is performed as follows:

a. preheat tubes for 10 seconds with Ef=10.5 V
b. test immediately by the applications of the specified test conditions of this test
c. after 16 seconds read heater-cathode leakage of each section.

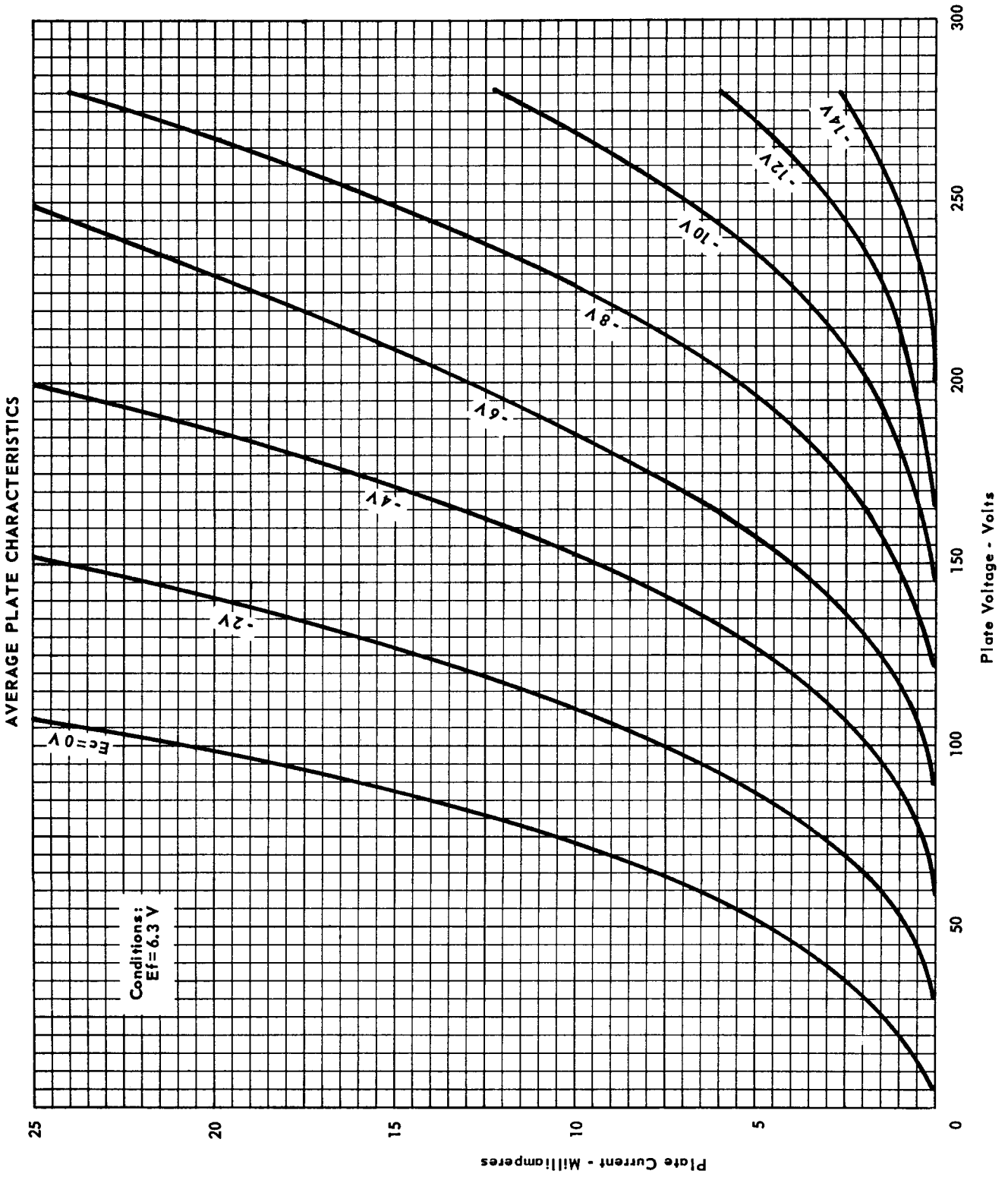
Note 15: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied, Tubes which show one or more of the following defects shall be considered failures.

a. tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3
b. tubes which do not comply with past fatigue limits, this is a destructive test

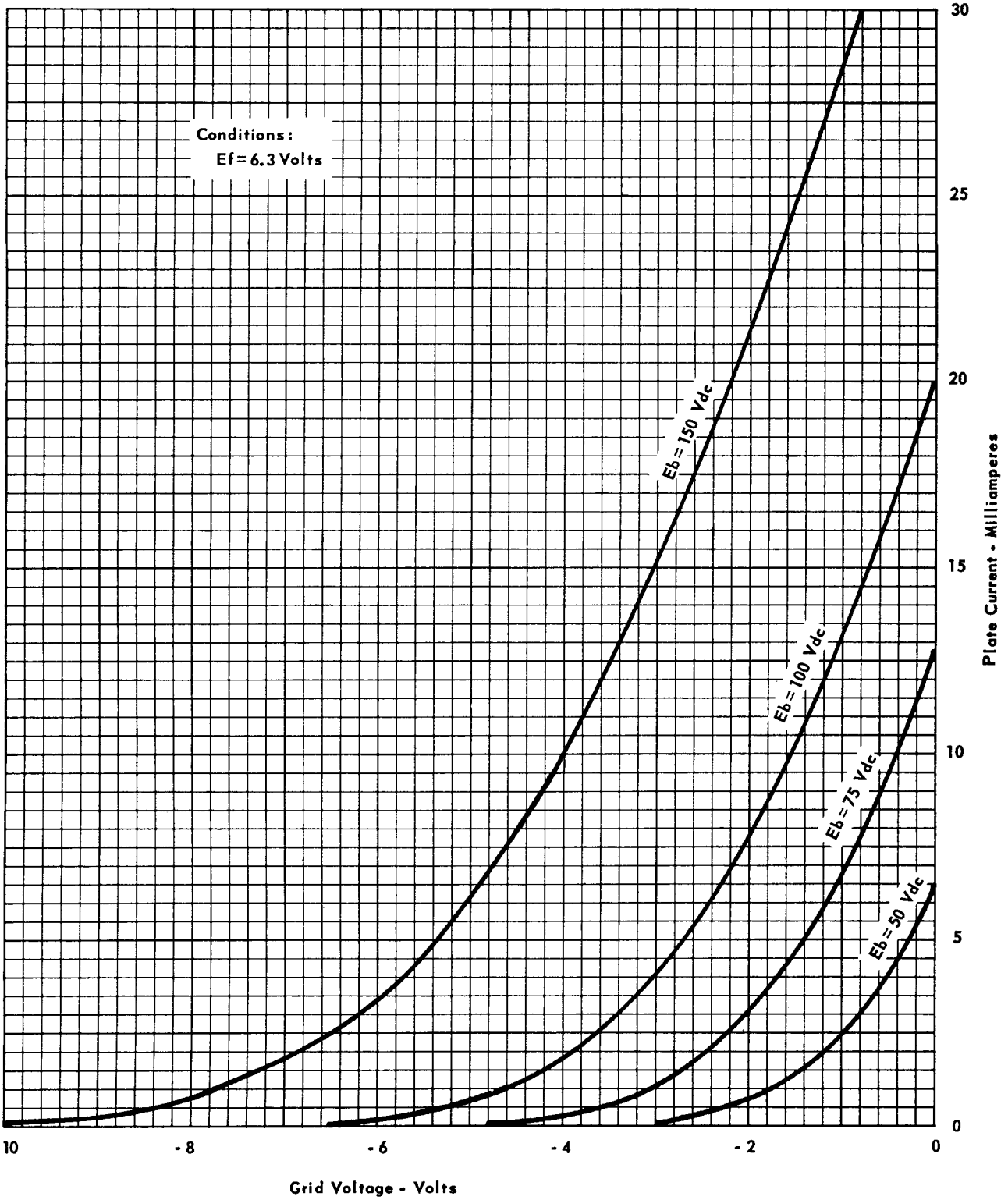
Note 16: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

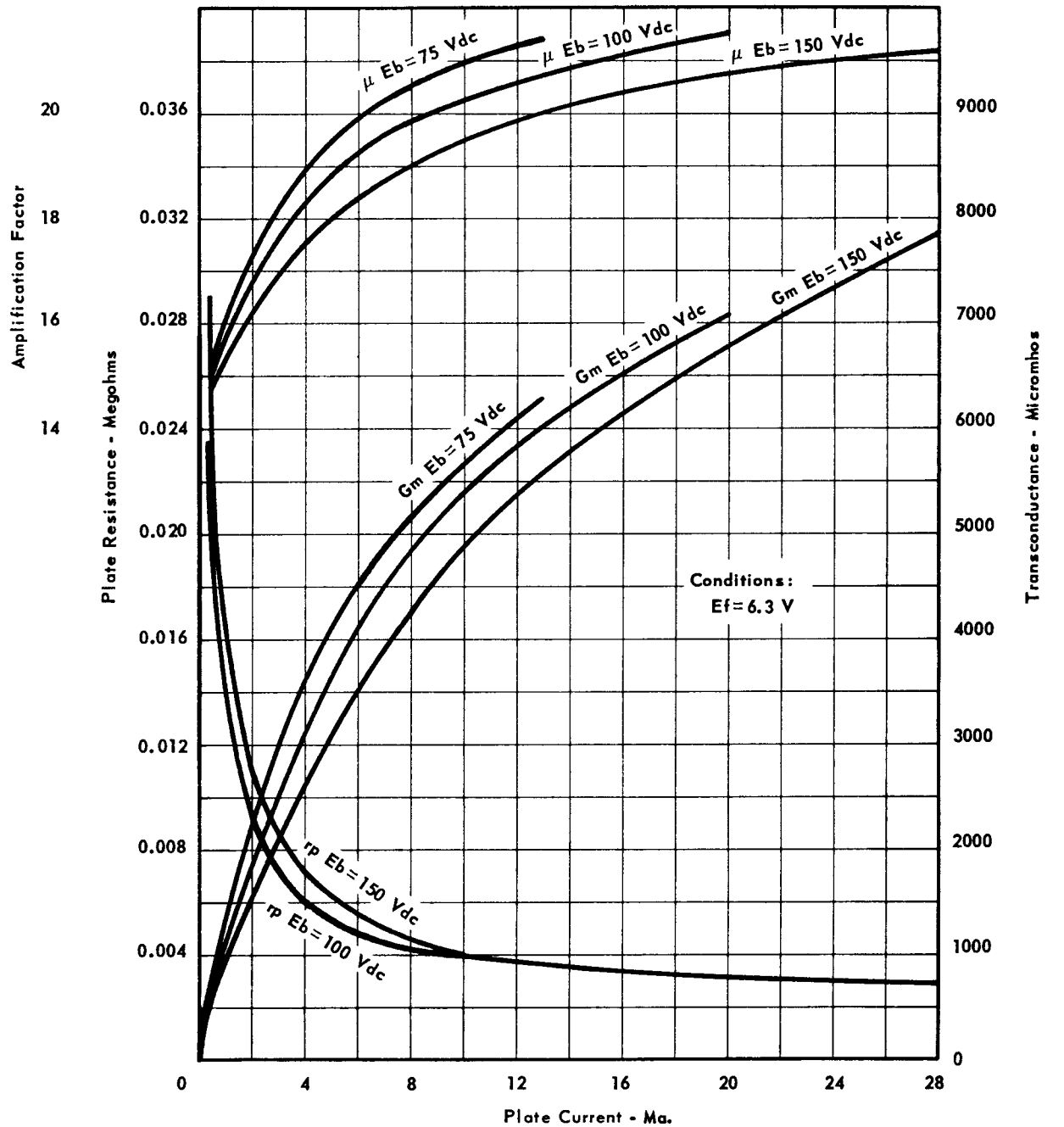


AVERAGE CHARACTERISTICS



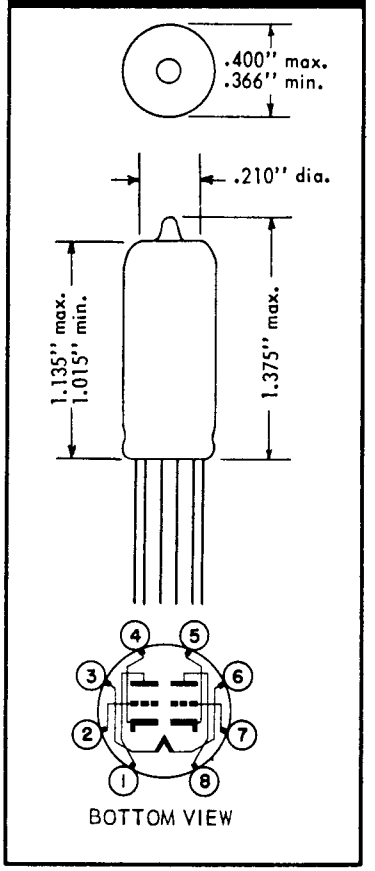
RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS



TYPE CK6112WA

The 6112WA is a heater-cathode type high-mu double triode of subminiature construction, capable of operation in the UHF region. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads Length: 1.5" min,)

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2	Lead 5 Cathode, Unit #1
Lead 2 Grid, Unit #2	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid, Unit #1
Lead 4 Cathode, Unit #2	Lead 8 Plate, Unit #1

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION----- To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if design maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	100	100	250	Vdc
Peak Plate Voltage	ep:	----	----	----	360	v
Grid #1 Voltage	Ec1:	–55	0	0	----	Vdc
Plate Dissipation (per plate)	Pp/p:	----	----	0.08	0.3	W
Grid #1 Circuit Resistance	Rg/g:	----	----	1.0	1.1	Meg.
Heater-Cathode Voltage	Ehk:	–200	----	100	+200	Vdc
Plate Current (per plate)	Ib/p:	----	----	0.8	3.3	mAdc
Grid Current	Ic/c:	----	----	----	----	mAdc
Cathode Resistance (per unit)	Rk:	----	1500	1500	----	ohms
Transconductance (per plate)	Sm/p:	----	----	1800	----	μmhos
Amplification Factor	Mμ/p:	----	----	70	----	----

Tentative Data

Printed in U.S.A.

INDUSTRIAL TUBE DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

(In the following tests, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOGIE	UAL.	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS-Part 1		**Combined AQL = 1.0% Excluding Mechanical and Inoperatives**								
Heater Current:		0.4	If:	285	----	----	----	315	----	mA
Heater-Cathode Leakage:	Ehk=+100 Vdc	0.4	Ihk:	----	----	----				
	Ehk=-100 Vdc		Ihk:	----	----	----	----	3.5	----	μAdc
							----	3.5	----	μAdc
Grid Current:	Eb=150 Vdc; Ec=0; Rk=820 ohms; Rg=1.0 Meg.	0.4	Ic (1):	----	----	----	----	-0.3	----	μAdc
Plate Current (1):		0.4	Ib (1):	0.50	----	0.8	----	1.10	----	mAdc
Plate Current (2):	Ec1=-2.8 Vdc	0.4	Ib (2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.4	Sm (1):	1500	1650	1800	1950	2100	350	μmhos
Continuity and Shorts (Inoperatives):	(Note 12)	0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V; Eg-all=-100 Vdc;	2.5	Rg-all:	250	----	----	----	----	----	Meg.
	Ep-all=-300 Vdc;		Rp-all:	250	----	----	----	----	----	Meg.
Transconductance (2):	Ef=5.7 V; (Note 9)	2.5	Δ_{Ef}Sm (2):	----	----	----	----	15	----	%
Grid Emission:	Eb=250 Vdc; Rg=1.0 Meg; Rk=2700 ohms; Ef=7.5 V; Preheat at Ec=0; Test at Ec=-9.0 Vdc	6.5	Ic (2):	----	----	----	----	-0.5	----	μAdc
AF Noise:	Esig=45 mVac; Rg=0.5 Meg.; Rp=0.2 Meg.; Rk=750 ohms; Ck=1000μf; Units connected in parallel	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	60	----	70	----	80	----	----
A. C. Amplification:	Esig=0.2 Vac; Ebb=100 Vdc; Ecc=0; Rk=0; Rg1=10 Meg.;	6.5	Ep:	8.0	----	----	----	----	----	Vac
Heater-Cathode Leakage (2):	Ef=-6.7 V; Pin 6 negative; Ehk=+100 Vdc; Cathode negative t=16 sec.; (Note 13)	6.5	Ihk (2):	----	----	----	----	1.0	----	μAdc
Capacitance:			Cgp:	0.8	----	1.00	----	1.20	----	μμf
Capacitance:			Cin:	1.30	----	1.70	----	2.10	----	μμf
Capacitance:	(Note 2)	6.5	Cout: Unit #1	0.16	----	0.23	----	0.30	----	μμf
Capacitance:			Cout Unit #2	0.21	----	0.28	----	0.35	----	μμf
Capacitance:			Cgg:	----	----	----	----	0.014	----	μμf
Capacitance:			Cpp:	----	----	----	----	0.80	----	μμf
Low Pressure Breakdown:	Pressure=21± 3 mmHG; Voltage=300 Vac	6.5								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	2.5	Ep:	----	----	----	----	20	----	mVac
Vibration (3):	F=70-2000; t=3 minutes; G=15; Rp=10,000 ohms; Positions X and X2 only.	6.5	ep:	----	----	----	----	75 peak to peak	----	mv
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS								
Subminiature Lead Fatigue:		2.5	----	4.0	----	arcs	----	----
Shock (1):	Ehk=+100 Vdc; Rg=0.1 Meg.; Hammer Angle = 30°; (Note 3)	20	----	----	----	----	----	----
Fatigue (1):	96 hours; G=2.5; Fixed frequency; F=25 min; 60 max.; (Note 5)	6.5	----	----	----	----	----	----
Shock (2):	Ehk=+100 Vdc; Rg=0.1 Meg.; Hammer Angle = 120°+ Rubber Pad; t=10 milliseconds; G=75; (Note 15)	20	----	----	----	----	----	----
Fatigue (2):	6 hours; G=10; F=130-2000-130 cps; (Note 14)	6.5	----	----	----	----	----	----
Post Shock and Fatigue (1) and (2) Test End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	80	mVac	----	----
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk (1):	----	7	μAdc	----	----
	Ehk=-100 Vdc	----	Ihk (1):	----	7	μAdc	----	----
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	15	%	----	----
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	----	----
Glass Strain (Thermal Shock):		6.5	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS								
Heater Cycling:	Ef=7.0 V; Eb=Ec=0V; Ehk=140 Vac; 1 min. on, 4 min. off	1.0	----	2000	----	cycles	----	----
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk (1):	----	10	μAdc	----	----
	Ehk=-100 Vdc	----	Ihk (1):	----	10	μAdc	----	----
2 & 20 Hour Stability Life Test:	TA=Room; Ehk=+200 Vdc; Rg/g=1.0 Meg.; Eb=150 Vdc; Rk/k=820 ohms	----	----	----	----	----	----	----
2 & 20 Hour Stability Life Test End Points:								
Change in Transconductance (1) of individual tubes:	(Typical Sample Size=50 tubes)	1.0	Δ_tSm (1):	----	10	%	----	----
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+200 Vdc; Rg/g=1.0 Meg.; Eb=150 Vdc; Rk/k=820 ohms							
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----	----	----
Continuity and Shorts (Inoperatives):		0.65	----	----	----	----	----	----
Transconductance (1):		1.0	Sm (1):	1200	----	μmhos	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
200 Hour Intermittent Life Test (1):	TA=Room; Eb=250 Vdc; Ehk=+200 Vdc; Rg/g=1.0 Meg.; Rk/k=2700 ohms							
200 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic1:	----	-0.9	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Change in Transconductance of individual tubes:		----	Δ_tSm (1):	----	25	%	1	3
Transconductance (2):		----	Δ_{Ef}Sm (2):	----	20	%	1	3
Heater-Cathode Leakage (1):	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Insulation of Electrodes:								
g-all:		----	Rg-all:	100	----	Meg.	1	3
p-all:		----	Rp-all:	100	----	Meg.		
Total Defectives:		----	----	----	----	----	3	6
Hour Intermittent High Temperature Life Test (2):	T Bulb=220°C; Ehk=+200 Vdc; Rg/g=1.0 Meg.; Eb=150 Vdc; Rk/k=820 ohms	----	----	----	----	----	----	----
500 Hour Intermittent High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic (1):	----	-0.7	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) change of individual tubes from initial:		----	Δ_tSm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm (2):	----	15	%	1	3
Heater-Cathode Leakage (1):	Ehk=+100 Vdc	---- ----	Ihk (1): Ihk (1):	---- ----	10 10	μAdc μAdc	1	3
Insulation of Electrodes:								
g-all:		----	Rg-all:	50	----	Meg.	1	3
p-all:		----	Rp-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg.Δ_tSm (1):	---	15	%	1	3
Total Defectives:		----	----	----	----	----	3	6
1000 Hour High Temperature Life Test (2) End Points:	(Typical Sample Size= 20 tubes 1st sample; 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic1:	----	-1.0	μAdc	1	3
Heater Current:		----	If:	276	328	mA	1	3
Transconductance (1) change of individual tubes from initial:		----	Δ_tSm (1):	----	25	%	1	3

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Transconductance (2):	(Note 9)	----	Δ_{Ef}Sm(2):	----	20	%	1	3
Heater-Cathode Leakage (1):	Ehk(1)=+100 Vdc	----	Ihk(1):	----	10	μAdc	1	3
	Ehk(1)=−100 Vdc	----	Ihk(1):		10	μAdc		
Insulation of Electrodes:								
g1-all:		----	Rg-all:	25	----	Meg.	2	5
p-all:		----	Rp-all:	25	----	Meg.		
Total Defectives:		----	----	----	----	----	4	8

NOTES

Note 1: Characteristics, Quality Control Test Precedures, and Inspection Levels are made according to the appropriate paragraph of MIL-E-1, "Inspection Instructions for Electron Tubes", and MIL-STD-105A.

Note 2: Without Shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ± 5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3V to that value measured at Ef=5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by Appendix B of MIL-E-1 basic specifications.

Note 11: Operation time is the time in seconds required for the plate current to attain a value within ± 10% of the three (3) minute plate current (1) value measured at plate current (1) test conditions. No preheating before this test is allowed, a cold tube must be used.

Note 12: During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° apart with a tapper which shall be adjusted to give an impulse of approximately one half sine wave of 300 ± 50 micro seconds duration and having a minimum average amplitude of 80 G's peak acceleration as measured with a Gulton A-305 accelerometer and KA-1 kit. The shorts detecting equipment shall be a device capable of detecting as shorts, the following interelement resistances of the given time duration.

Duration	Sensitivity
Permanent short	600,000 ohms
500 micro seconds	500,000 ohms
100 micro seconds	100,000 ohms
60 micro seconds	1,000 ohms

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

a. either a permanent or tap short at any time during the tapping procedure
b. any open circuit
c. air leaks

ELECTRICAL DATA (Cont'd)

NOTES (Cont'd)

Note 13: Heater - Cathode Leakage (2) shall be performed as follows:

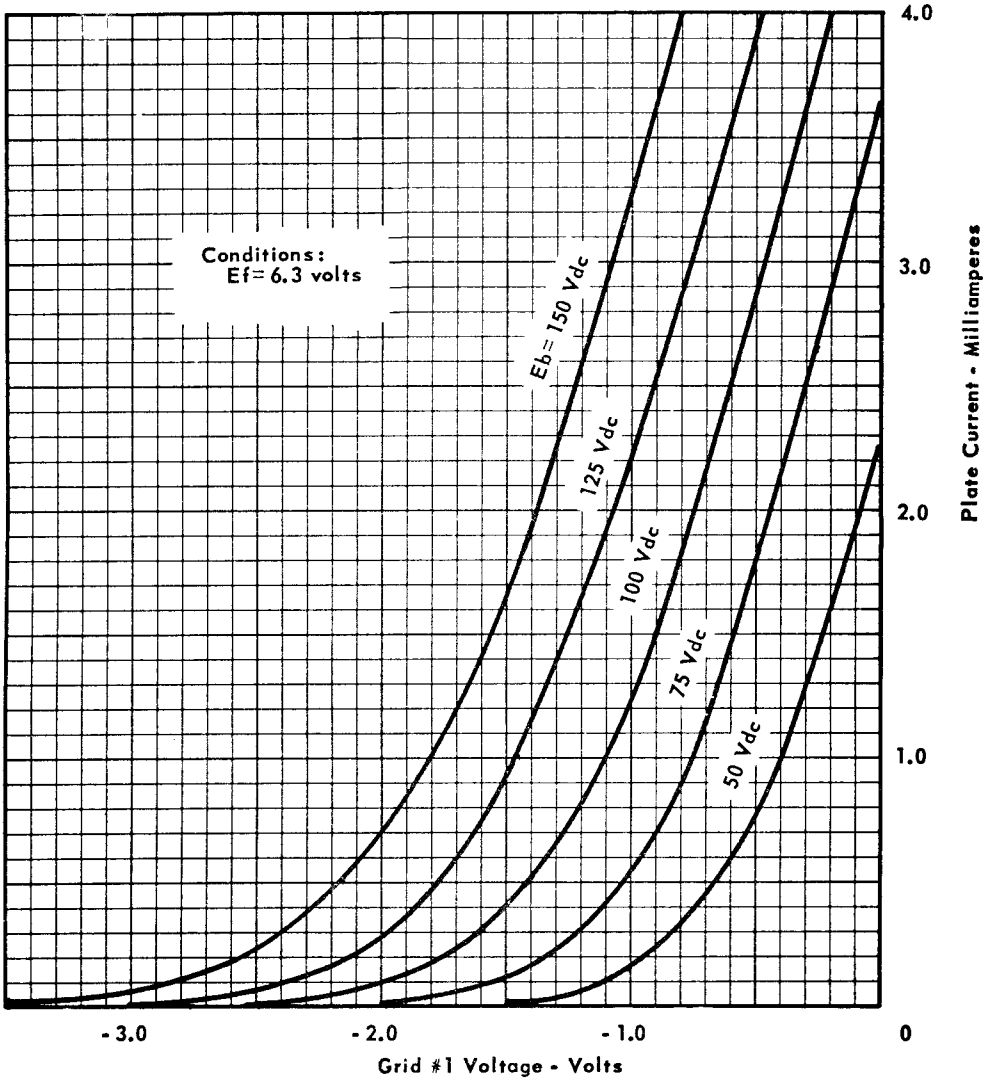
a. preheat tubes for 10 seconds with Ef = 10.5 V
b. test immediately by the application of the specified test conditions for this test
c. after 16 seconds read Heater - Cathode Leakage of each section.

Note 14: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2 and Y1. Only rated heated voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

a. tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2. and 4.7.3
b. tubes which do not comply with post fatigue limits, this is a destructive test

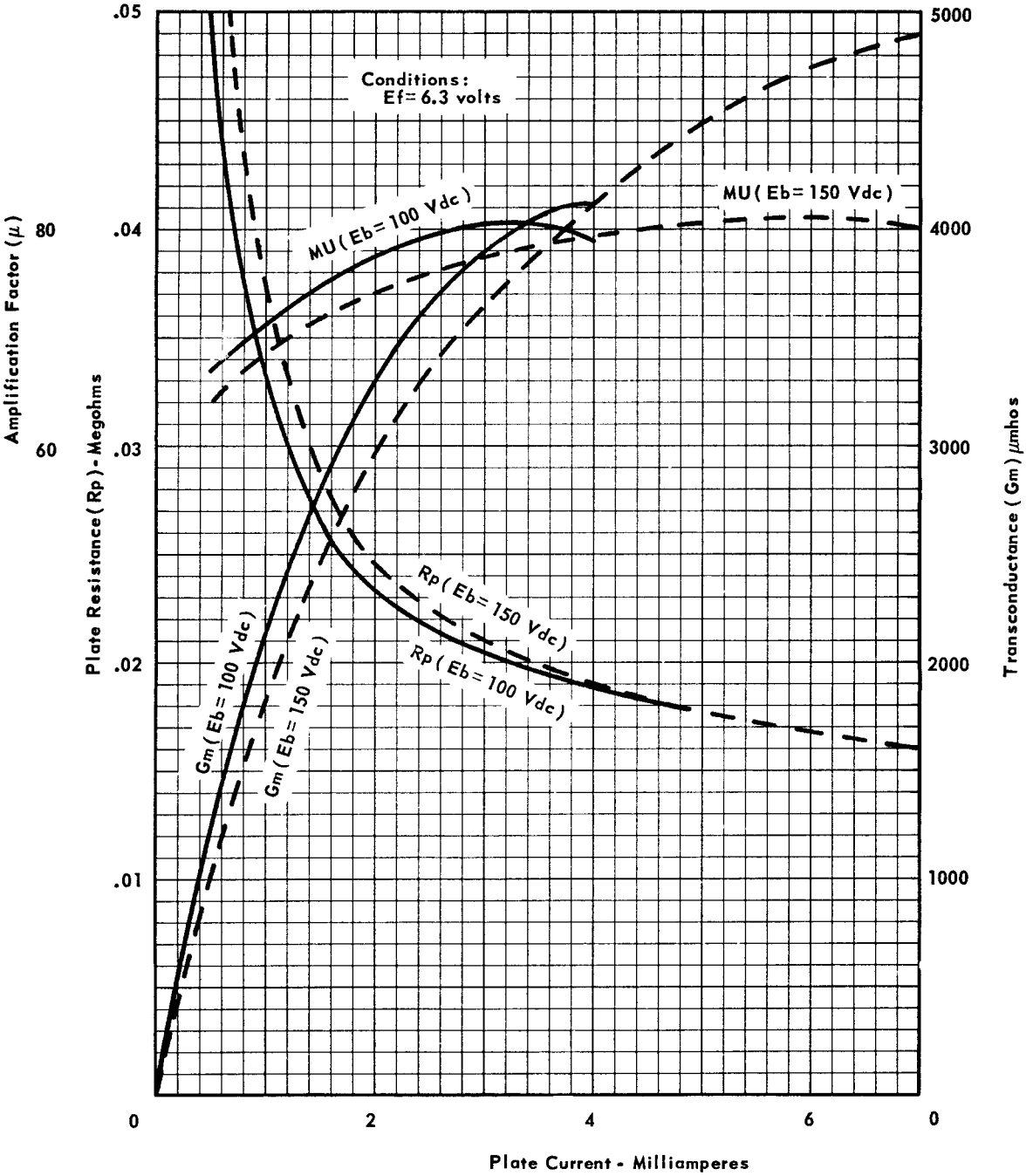
Note 15: The provisions of paragraph 4.9.20.5 of Specification MIL - E - 1 shall apply, except for test conditions listed for shock test (2).

AVERAGE CHARACTERISTICS

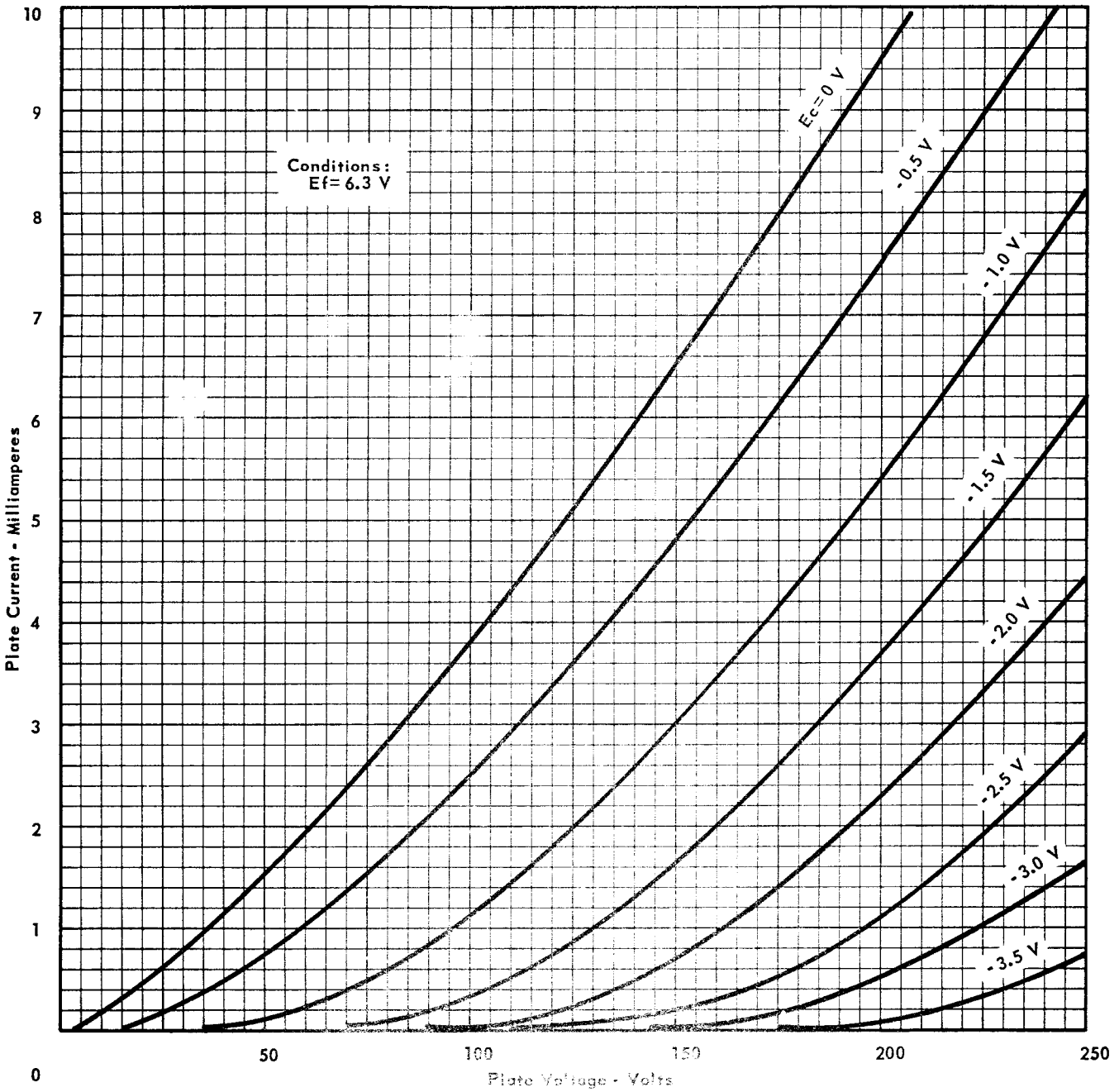


RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



from RTMA release #994, July 9, 1951

PRELIMINARY DATA

6K5 RAYTHEON 6K5

GENERAL CHARACTERISTICS

A microwave oscillator of the single cavity (cute gral) reflex type designed for operation in the frequency range from 5100 to 5900 megacycles with a minimum power output of 70 milliwatts at 5500 MC.

Heater Voltage (AC or DC)	6.3 Volts
Heater Current	440 MA.
Frequency Range	5100 to 5900 MC

MAXIMUM RATINGS

DC Resonator Voltage	350 Max. Volts
DC Resonator Current	35 MA.
DC Reflector Voltage	-350 Vdc.
Heater-Cathode Potential	±45 Volts

TYPICAL OPERATION

Resonator or Shell Voltage	300 Volts DC
Frequency	5100 - 5900 MC
Reflector Voltage (Mode A) Max. P.O.	
5100 MC	-85 to -145 Volts DC
5900 MC	-135 to -205 Volts DC
Power Output (Mode A) 5100 to 5900 MC	70 mW minimum
	95 mW Average
Resonator Current	30 mA DC
Reflector Current	7 uA Max
Electronic Tuning (P.O./2) 5100 to 5900 MC	30 MC Min.
Temperature Coefficient	-.05 to -.10 MC/°C

MECHANICAL

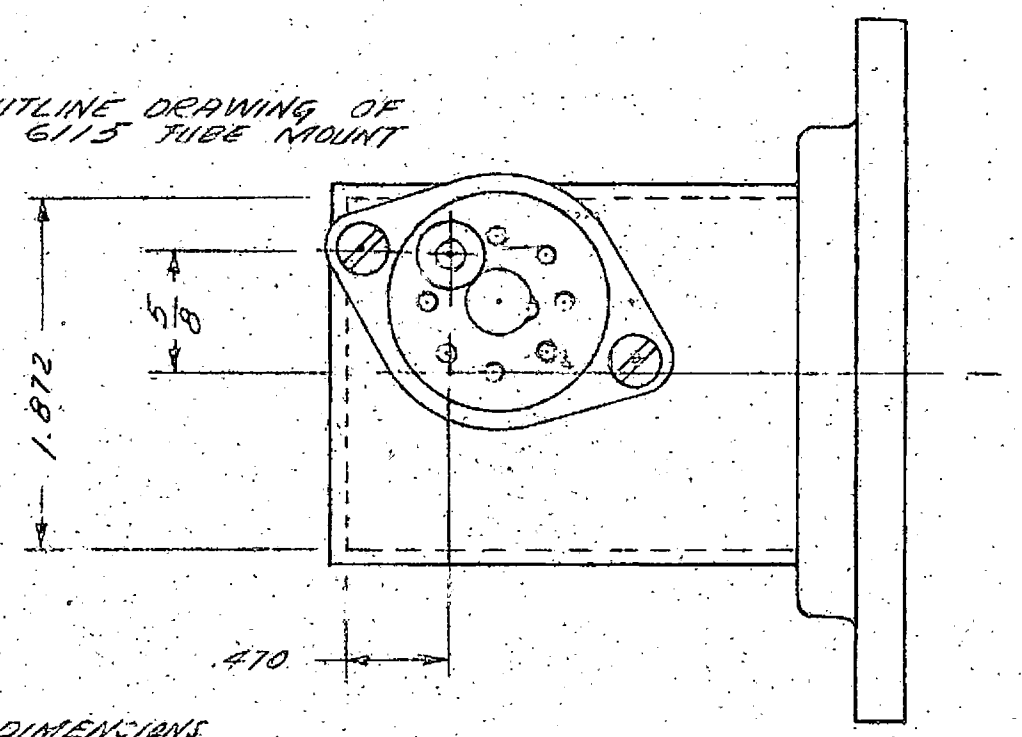
See attached drawing	
Cathode	Oxide coated, unipotential
Base	To fit standard octal with #6 pin enlarged to 11/64" diameter

Pin No.	1	2	3	7	6	Top Cap
Element	Shell	Heater	Output	Heater	Cathode	Reflector

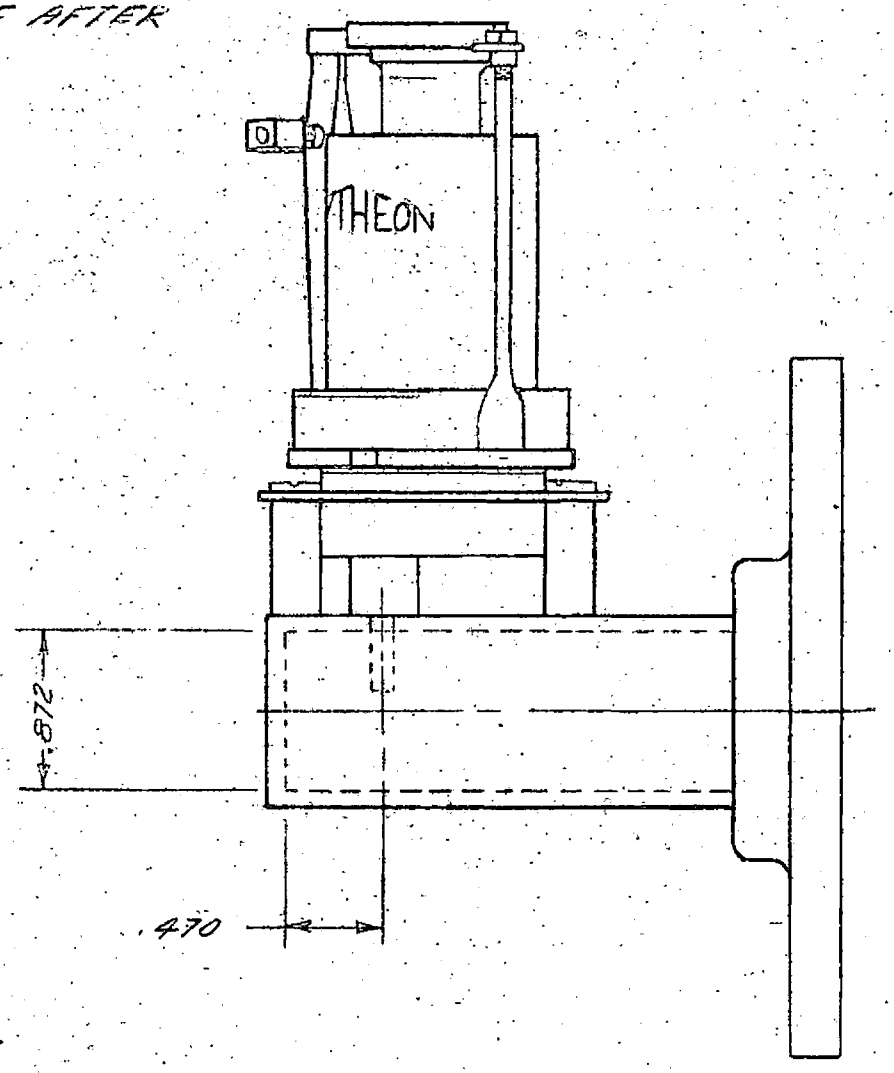
Mounting	Any Position
Cooling	Freely circulating Air

RAYTHEON MFG. CO. POWER TUBE DIVISION WALTHAM, MASS.	TITLE: TUBE MOUNT 6115	DRAWING NO. B	REV.	REVISIO

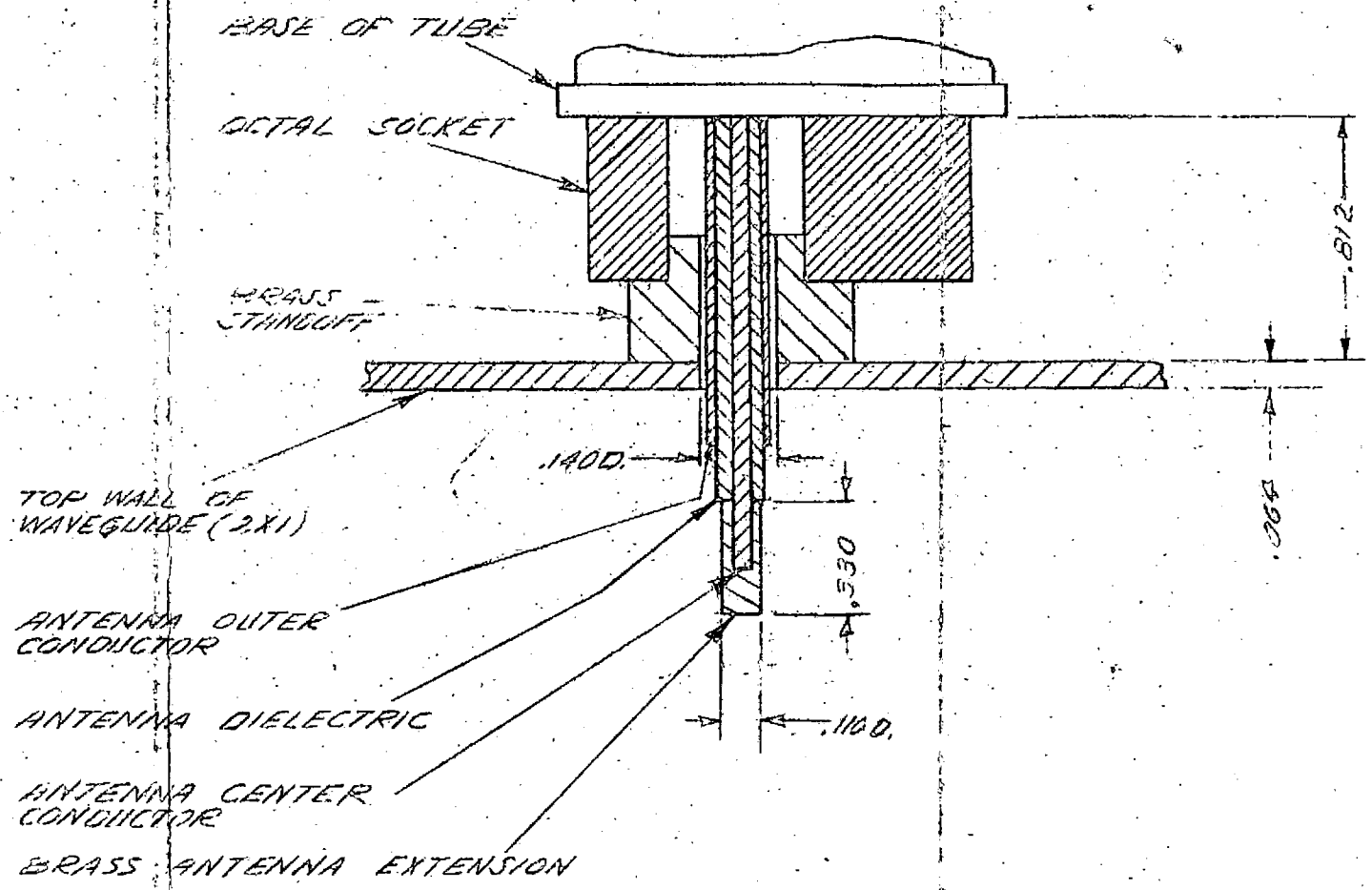
OUTLINE DRAWING OF 6115 TUBE MOUNT



NOTE. ALL DIMENSIONS SHOWN ARE AFTER PLATING.



TENTATIVE SPECIFICATIONS FOR ELECTRON TUBE TYPE 6115 PROPOSED BY THE RAYTHEON MANUFACTURING COMPANY



DETAIL OF 6115 TUBE MOUNT

SPECIAL COPIES	
COPIES	STATION
2	116
1	117

COPIES TUBE TYPE

FOLDER COPIES

PROCESS SPEC.

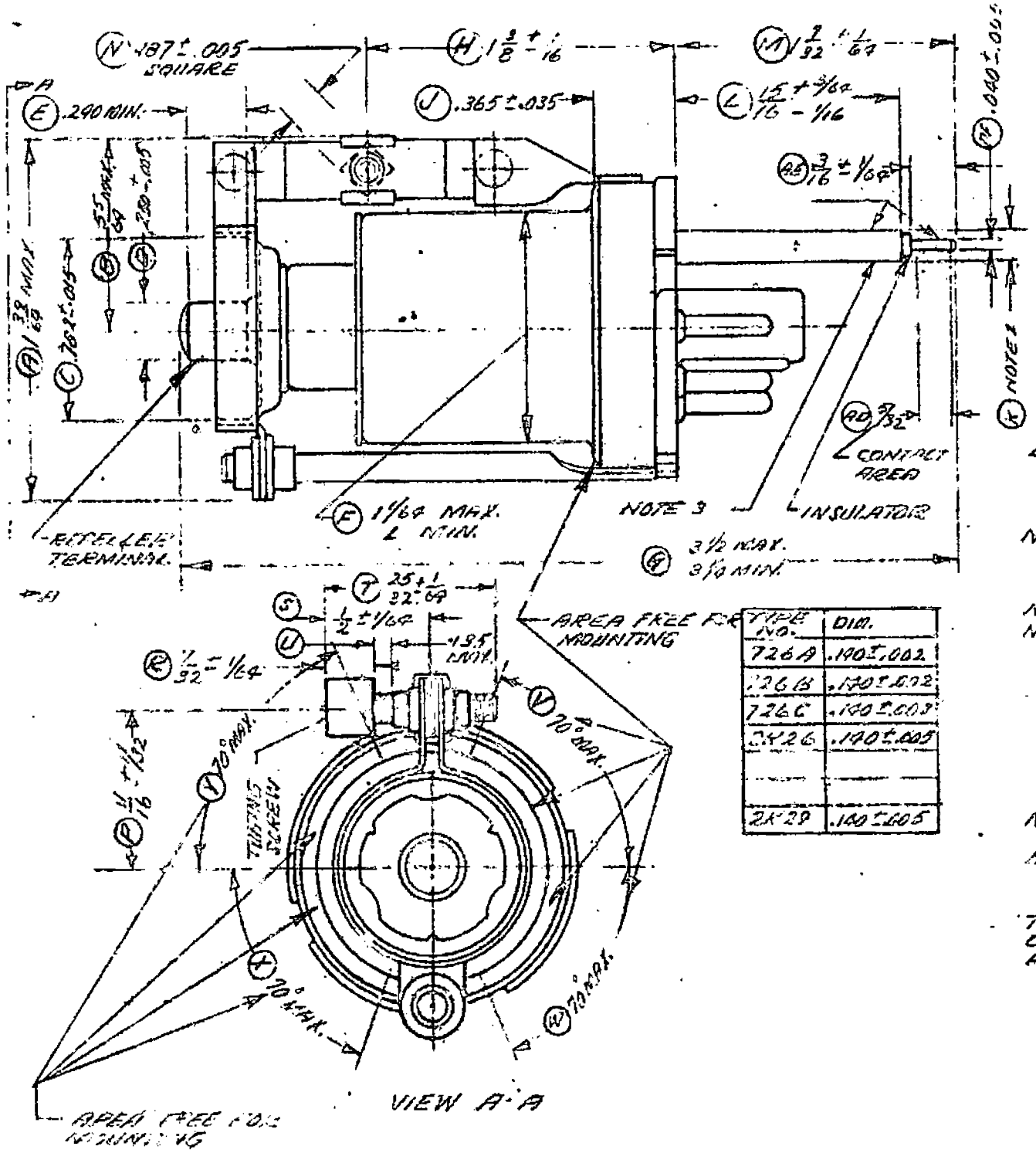
FORM T-720-E-5-15-50

Spaulding-Moss Co., Boston, Mass. Record

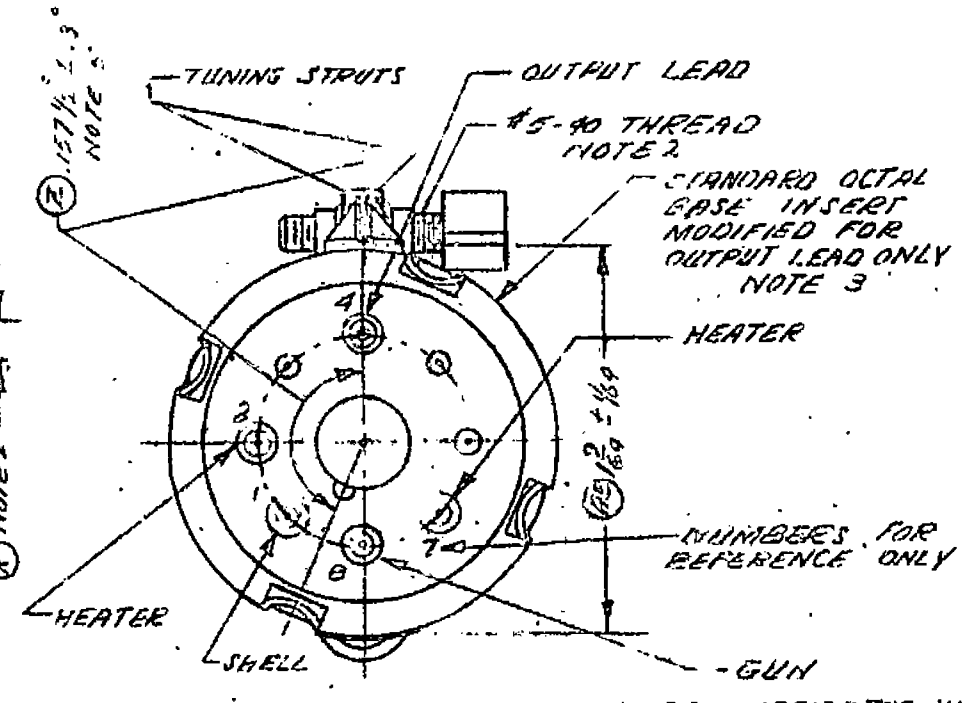
RAYTHEON

OUTLINE DRAWING

TYPE 6



TYPE NO.	DIM.
726A	.190 ± .002
726B	.190 ± .002
726C	.190 ± .003
2K26	.190 ± .005
2K29	.140 ± .005



NOTE 2 - THE TUNING SCREW SHALL BE LUBRICATED WITH DIAG OR EQUIVALENT NON-CORROSIVE LUBRICANT. IT SHALL BE CAPABLE OF BEING OPERATED SMOOTHLY THROUGH ITS ENTIRE RANGE WITHOUT PERCEPTIBLE BINDING.

NOTE 3 - NICKEL (30 M.S.I. SILVER PLATE PERMISSIBLE).

NOTE 4 - THIS BASE SHALL BE CAPABLE OF BEING INSERTED IN A GAGE 1 1/32 THICK HAVING 4 HOLES 1/4 DEEP FROM THE TOP OF GAGE WHOSE DIAMETERS ARE .103 FOR THE CONTACT PINS. REMAINING PORTION OF HOLE TO BE CLEARANCED APPROXIMATELY 1/64 LARGER IN DIAMETER AND A FIFTH HOLE WHOSE DIAMETER .100-1 1/32 DEEP FOR THE OUTPUT LEAD. ALL HOLES LOCATED ON THE TRUE CENTERS. ALSO A CENTER HOLE HAVING THE CONTOUR OF THE PILOT BUT WITH A CLEARANCE OF .002 OVER THE MAXIMUM DIAMETER.

NOTE 5 - APPLIES TO CENTERLINE PASSING THROUGH CENTER OF OUTPUT LEAD AND MIDWAY BETWEEN TUNING STRUTS

NOTE 6 - SHALL BE CONCENTRIC WITH EACHOTHER WITHIN .010

TYPE TEST FOLLOWING: C, E, T, V, W, X, Y, AB AND NOTE 3
DESIGN TEST FOLLOWING: B, B, C, F, G, N, P, S, U, AC
PRODUCTION TEST ALL CRITICAL DIMENSIONS AND NOTES.

RAYTHEON

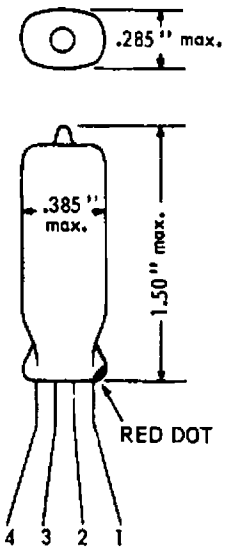
TECHNICAL INFORMATION

SUBMINIATURE TRIODE

Excellence in Electronics

TYPE CK6121

The CK6121 is a filament type triode of subminiature construction designed for use as a Class C amplifier or frequency multiplier in the VHF frequency band. The characteristics of this type are optimized for high grid drive conditions typical of frequency multiplier service. The CK6121 is suitable for battery operated, short life special applications at the typical Class C operation conditions indicated below. The filament of the CK6121 should not be operated continuously inasmuch as its 10 hour life rating is chiefly a function of the filament temperature and hours of filament operation. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Plate
Lead 2 Filament, negative
Lead 3 Grid
Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCE: (*μμfds.*) (unshielded)

Grid to Plate	1.4
Grid to Filament	1.4
Plate to Filament	1.9

RATINGS-ABSOLUTE MAXIMUM VALUES - CLASS C OPERATION:

Filament Voltage (dc)	1.25± 20%	volts
DC Plate Voltage	185	volts
DC Negative Grid Bias	90	volts
DC Plate Current	8	ma.
DC Grid Current	0.45	ma.
Peak RF Grid Drive Voltage	100	volts
Plate Dissipation	1.1	watts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	volts
Filament Current	0.12	amp.
Plate Voltage	135	volts
Grid Voltage	-5	volts
Transconductance	1600	μmhos
Amplification Factor	15	
Plate Current	4.0	ma.
Grid Voltage for Ib= 15 μa.	-10	volts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS C FREQUENCY DOUBLER:

Filament Voltage (dc)	1.5	volts
Filament Current	0.12	amp.
DC Plate Voltage	185	volts
Grid Resistor	0.24	meg.
Peak RF Grid Drive Voltage (F= 80 Mc)	95	volts
DC Grid Current (approx.)	0.35	ma.
DC Plate Current	7.0	ma.
Plate Input Power	1.3	watts
Useful RF Power Output (F= 160 Mc)	0.2	watts.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

August 30, 1955 NEWTON 58, MASS.

from RTMA release #1044, Dec. 17, 1951

TENTATIVE DATA

Type 6133 — RAYTHEON — Type 6133

GENERAL CHARACTERISTICS

Microwave oscillator employing a demountable tuning cavity. Oxide coated unipotential cathode. Frequency range from 1200 to 3750 megacycles.

Heater Voltage (AC or DC)	6.3 Volts
Heater Current	650 mA

MAXIMUM RATINGS

Grid #1	300 Volts dc
Grid #2	300 Volts dc
Grid #3	300 Volts dc
Cathode Current	45 mAdc
Reflector Voltage	0 to -300 V dc
Frequency Range with Suitable Cavity	1200 to 3750 mc
Heater Cathode Potential Difference	45 V dc

TYPICAL OPERATION

Grid #1	300 Volts dc
Grid #2	300 Volts dc
Grid #3	300 Volts dc
Cathode Current	40 mAdc max
Reflector Voltage	-182 to -227 dc
Frequency Range	3458 to 3592 mc
Power Output	95 mW Minimum 140 mW Average

Electronic Tuning Range (Between ½ Power Points from 3458 to 3592 mc). .20mc
Maximum Frequency Change in any 20°C Range from 20°C to 85°C using Navy Brass Cavity. (Raytheon Drawing C-16028 - S25). 3mc

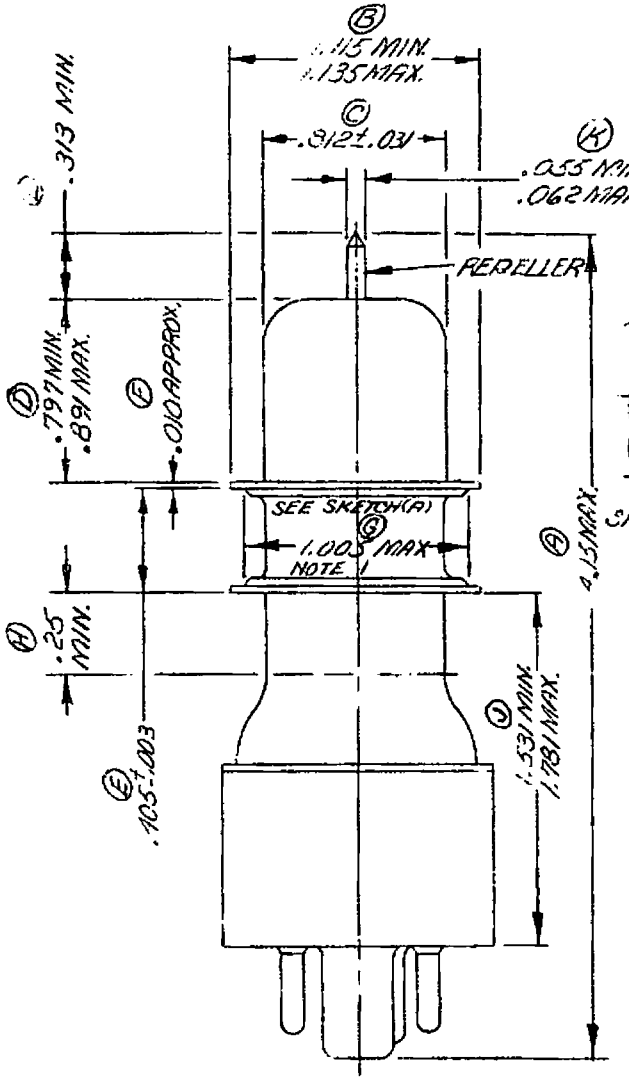
MECHANICAL

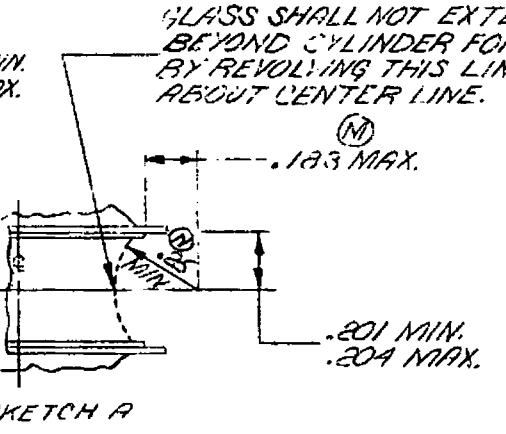
Base . . . . . Standard Intermediate Octal

Pin #:	2	7	3	6	Top Cap
Element	Heater	Heater	Cathode	Grid #1	Reflector

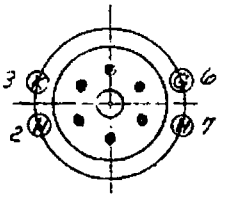
Maximum over-all dimensions: Height. . . 4.150" Diameter. . . 1 9/32"
Mounting . . . . . Any Position
Cooling. . . . . Freely Circulating Air

JAN-TYPE 6133





SKETCH A



BOTTOM VIEW OF STANDARD INTERMEDIATE OCTAL BASE

NOTE 1:
DIMENSION APPLIES TO EACH DISC SEPARATELY.

NOTE 2:
DISCS SHALL BE CONCENTRIC WITH EACH OTHER WITHIN 0.015". THE DISCS SHALL BE CONCENTRIC WITHIN .094."

NOTE 3:
DISCS SHALL BE SMOOTH, FREE FROM TEARS AND SHALL BE GOLD PLATED 30 MSI OR 10 MSI NICKEL PLUS 10 MSI SILVER.

NOTE 4:
THE CAVITY DIMENSIONS WHICH CORRESPOND TO THE 0.405±0.003 DIMENSIONS ON THE TUBES SHALL BE 0.401" MAX., 0.396" MIN.

ALL DIMENSIONS IN INCHES.

DESIGN TEST: A, C, D, H, J,
TYPE APPROVAL TEST: F, K, L,
NOTE 3.

PRODUCTION TEST: B, E, G, M, N,
NOTES 1 & 2.

6133

6 SEPT. 1951

from JETEC release #1961, July 1, 1957

RAYTHEON

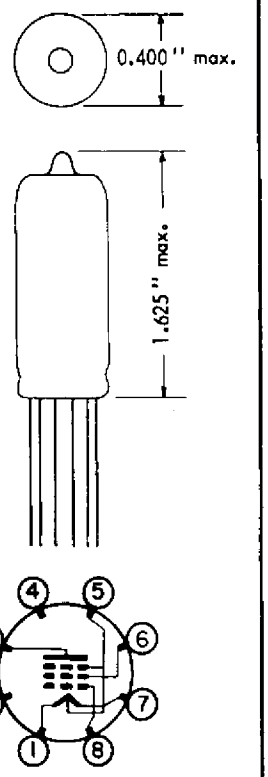
TECHNICAL INFORMATION

SUBMINIATURE BEAM PENTODE

Excellence in Electronics

TYPE CK6147

The CK6147 is a filament type R.F. power pentode of subminiature construction designed for use as an intermittent duty cycle Class A or Class C amplifier such as in portable transceiver equipment or as a frequency doubler at output frequencies as high as 400 mc. It is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW

6CL

MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8–pin (0.016" tinned flexible leads. Length: 1.50" min.)

TERMINAL CONNECTIONS:

Lead 1 Filament, negative	Lead 5 Filament Center–Tap, Grid #3, (F + parallel)
Lead 2 No Connection	
Lead 3 Plate	Lead 6 Grid #2
Lead 4 No Connection	Lead 7 Filament, positive
	Lead 8 Grid #1

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES:

	Unshielded	Shielded
Grid to Plate	0.06	0.055 max.
Input	2.6	2.6
Output	2.15	3.0

RATINGS–ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25/2.5 ± 12% volts
Plate Voltage	180 volts
Grid #2 Voltage	125 volts
Grid #1 Voltage	−100 volts
Plate Dissipation	1.5 watts
Grid #2 Dissipation	0.6 watts
Cathode Current	14 ma.
Altitude	60,000 feet
Impact	500 G

CHARACTERISTICS AND TYPICAL OPERATION–CLASS A1 AMPLIFIER:

Filament Voltage	1.25/2.5 volts
Filament Current	125/62.5 ma.
Plate Voltage	125 volts
Grid #2 Voltage	125 volts
Grid #1 Voltage	−7.5 volts
Plate Current	5.5 ma.
Grid #2 Current	0.9 ma.
Transconductance	1600 μmhos
Plate Resistance (approx.)	0.175 meg.

CHARACTERISTICS AND TYPICAL OPERATION–FREQUENCY DOUBLER TO 250 MC:

Filament Voltage (dc)	1.25 volts
Filament Current	125 ma.
DC Plate Voltage	120 volts
DC Grid #2 Voltage	120 volts
Grid Bias Resistance	0.22 meg.
Peak RF Grid Drive Voltage (125 Mc.)	80 volts
Plate Current	6.5 ma.
Grid #2 Current	2.6 ma.
Grid #1 Current (approx.)	325 μa.
Useful Power Output	120 mw.

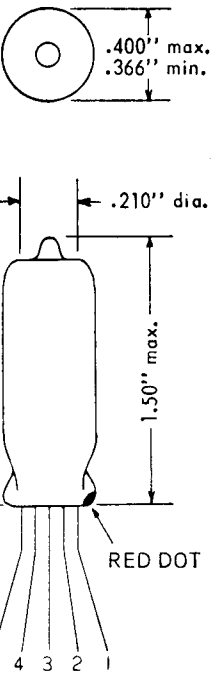
Tentative Data

Printed in U.S.A.

Excellence in Electronics

TYPE CK6152

The CK6152 is a heater-cathode type low-mu triode of subminiature construction capable of operation in the UHF region. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate
Lead 2 Cathode
Lead 3 Grid #1
Lead 4 Heater
Lead 5 Heater

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test - Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test - Note 4)	1000 G
Maximum Vibrational Acceleration (100 Hour Fatigue Test - Note 5)	2.5 G
Maximum Bulb Temperature	265 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	100	100	180	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Plate Dissipation	Pp:	----	----	1.0	1.1	W
Grid #1 Circuit Resistance	Rg1:	----	----	1.0	----	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	Vdc
Cathode Current	Ik:	----	----	----	22	mAdc
Cathode Resistance	Rk:	----	270	270	----	ohms

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1		**Combined AQL = 1.0% excluding Mechanical and Inoperatives.**								
Heater Current:		0.65	If:	183	190	200	210	217	16	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	5	----	μAdc
	Ehk = -100 Vdc		Ihk:	----	----	----	----	5	----	μAdc
Grid Current:		0.65	Ic (1):	----	----	----	----	-0.3	----	μAdc
Plate Current (1):		0.65	Ib (1):	7	8.5	10	11.5	13	3.4	mAdc
Plate Current (2):	Ec1 = -13.5 Vdc	0.65	Ib (2):	----	----	----	----	100	----	μAdc
Transconductance (1):		0.65	Sm (1):	4200	4600	5100	5600	6000	900	μmhos
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8-7) (Note 10)	----	----	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V Eg-all=-100 Vdc Ep-all=-300 Vdc	2.5	Rgl-all: Rp-all:	100 100	----	----	----	----	----	Meg. Meg.
Transconductance (2):	Ef=5.5 V	2.5	Δ_{Ef}Sm(2):	----	----	----	----	10	----	%
Grid Emission:	Eb=100 Vdc; Rg=1.0 meg; Ef=7.5 V; Rk=270 ohms; preheat 5 minutes at Ec1=0; Test at Ec1=-45 Vdc	2.5	Ic(2):	----	----	----	----	-0.6	----	μAdc
AF Noise:	Esig=70 mVac; Ec1=-5.5 Vdc; Rg=0.1 Meg; Rp=0.01 Meg; Rk=0	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	14.5	15.5	17.5	19.5	20.5	3.5	-----
Capacitance:			Cgp:	0.95	----	1.32	----	1.7	----	μμf
Capacitance:	Note 2	6.5	Cin:	2.1	----	2.9	----	3.7	----	μμf
Capacitance:			Cout:	0.91	----	1.28	----	1.61	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mm Hg; Voltage=300 Vac	6.5	-----	----	----	----	----	----	----	-----
Vibration (2):	F=40 Cps; G=15; Rp=10,000 ohms	2.5	Ep:	----	----	----	----	25	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	-----	4.0	----	----	----	----	----	arcs
Shock:	Hammer Angle=30° (Note 3)	20	-----	----	----	----	----	----	----	----
Fatigue:	96 Hours; G=2.5; Fixed frequency; F=25 min. 60 max. (Note 5)	6.5	-----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Vibration (2):	F=40 Cps; G=15; Rp=10,000 ohms	----	Ep:	----	----	----	----	100	----	mVac
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	----	----	----	20	----	μAdc
	Ehk=-100 Vdc	----	Ihk:	----	----	----	----	20	----	μAdc
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm(1):	----	----	----	----	20	----	%
Glass Strain (Thermal Shock):		2.5	-----	----	----	----	----	----	----	-----

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Max. Defects per characteristic 1st Sample	Max. Defects per characteristic Combined Sample
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef=7.5 V; Eb=Ec1=0 V; Ehk=140 Vac; 1 min. on, 1 min. off	----	----	2000	----	cycles	---	---
Heater Cycling Life Test End Points:								
Heater-Cathod Leakage:	Ehk=+100 Vdc	1.0	Ihk:	----	20	μAdc	---	---
	Ehk=-100 Vdc		Ihk:	----	20	μAdc	---	---
1 Hour Stability Life Test:	TA=Room; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----	---	---
1Hour Stability Life Test End Points:			----	----	----	----	---	---
Change in Transconductance (1) of individual tubes;	(Typical Sample Size=50 tubes)	1.0	Δ_tSm(1):	----	10	%	---	---
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+200 Vdc; Rg=1.0 Meg.	----	-----	----	----	----	---	---
100 Hour Survival Rate Life Test Points:	(Typical Sample Size=200 tubes)		-----	----	----	----	---	---
Inoperatives:		0.65	-----	----	----	----	---	---
Transconductance (1).		1.0	Sm(1):	3600	----	μmhos	---	---

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Max. Defects per characteristic 1st Sample	Max. Defects per characteristic Combined Sample
ACCEPTANCE LIFE TESTS (cont'd)								
500 Hour Intermittent High Temperature Life Test:	T Bulb = 250°C; Ehk = +200 Vdc; Rg = 1.0 Meg.	----	-----	----	----	-----	---	---
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size = 20 tubes 1st sample 40 tubes 2nd sample)	----	-----	----	----	-----	----	---
Inoperatives:		----	-----	----	----	-----	1	3
Heater-Current:		----	If:	180	220	mA	2	5
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	10	μAdc	2	5
	Ehk = -100 Vdc	----	Ihk:	----	10	μAdc		
Grid Current (1):		----	Ic (1):	----	-1.0	μAdc	1	3
Transconductance (1) change of individual tubes from initial:		----	Δ_t Sm(1):	----	20	%	1	3
Transconductance (1) Average Change:		----	Ave. Δ_t Sm (1):	----	15	%	---	---
Insulation of Electrodes:								
g-all		----	Rg1-all:	50	----	Meg.	2	5
p-all		----	Rp-all:	50	----	Meg.		
Transconductance (2):		----	Δ_{Ef} Sm (1):	----	15	%	2	5
Total Defectives		----	-----	----	----	-----	4	8
1000 Hour High Temperature Information Life Test:	T Bulb = 250°C; Ehk = +200 Vdc; Rg = 1.0 Meg.							
1000 Hour High Temperature Information Life Test End Points:	Read for same characteristics as for 500 Hour Intermittent High Temperature Life Test. Limits not established.							

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1B basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1B basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

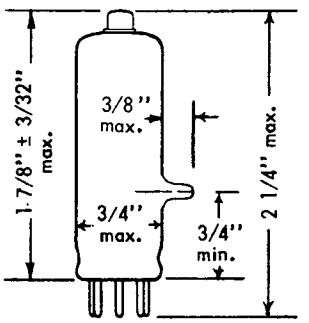
Note 9: Change of transconductance for individual tubes from that value measured at Ef = 6.3 V to that value measured at Ef = 5.5 V.

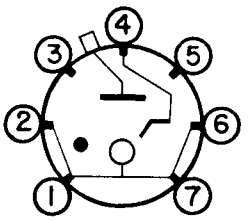
Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by paragraph 5.3.8 of "Inspection Instructions for Electron Tubes."

Excellence in Electronics

TYPE CK6174

The CK6174 is an instant starting, cold cathode, gas-filled, half-wave rectifier of miniature construction. Several tubes may be operated in cascade to produce very high voltages. Typical applications include electronic photo-flash devices, fence controllers, and oscilloscopes. The CK6174 should be used as a replacement in this type of equipment, originally designed to use the former type CK1013, and in new equipment having output currents up to 3 ma. The tube has a starter electrode which enables it to fire at the ignition voltages indicated in the ratings below.





BOTTOM VIEW

5BU

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TOP CAP: Skirted Miniature

TERMINAL CONNECTIONS:

Pin 1 Cathode	Pin 5 No Connection ▲
Pin 2 Cathode	Pin 6 Cathode
Pin 3 No Connection ▲	Pin 7 Cathode
Pin 4 Starter Electrode	Top Cap Anode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Peak Inverse Voltage	2800	volts
Peak Cathode Current (Steady State) ♦	30	ma
Peak Cathode Current (surge) ♦	300	ma
Average Cathode Current (dc)	3	ma
Maximum Anode Supply Voltage (peak)	1700	volts
Minimum Anode and Starter Electrode Supply Voltage (RMS) ●	550	volts
Minimum Anode Supply Impedance	20,000	ohms
Maximum Average Starter Electrode Current (Starter Electrode Operating as a Cathode) ■	125	μa.
Maximum Peak Starter Electrode Current (Starter Electrode Operating as a Cathode) ■	300	μa.
Ambient Temperature Range	-50 to +60	°C

CHARACTERISTICS AND TYPICAL OPERATION - HALF-WAVE RECTIFIER 60~ SINUSOIDAL OPERATION:

Anode Supply Voltage (RMS)	1200	volts
Anode Supply Impedance	20,000	ohms
Starter Electrode Limiting Resistance	10	meg.
Load Current (dc)	3	ma
Approximate Anode to Cathode Drop	100	volts
Load Condenser	0.2	μf
Load Resistor	0.4	meg.

▲ *The socket terminals for pins 3 and 5 cannot be used as tie point terminal lugs and may not be connected to any other point in the circuit except to the cathode.*

♦ *To avoid damage to the equipment or tube, it is recommended that the anode supply impedance be adjusted to limit forward currents and intermittent reverse peak currents to stated values. Minimum resistance is 20,000 ohms minus the effective equivalent transformer impedance, but never less than 2000 ohms dc resistance. For voltage multiplier circuits, a separate limiting resistor should be connected in series with the anode or the cathode of each tube. In the event of a reverse arc, the absence of a surge limiting resistor causes all of the energy of the filter condenser to be dissipated in the tube.*

● *With starter electrode connected to anode through 10 megohms of resistance. The starter electrode connection may be omitted in extremely low current supplies (dc output currents up to 100 microamperes) to eliminate the reverse ionization current through the starter electrode circuit. It is recommended that this "floating" starter electrode connection be confined to high resistance transformer circuits, such as vibrator supplies, where a high peak open circuit voltage will insure the ignition of the anode circuit. Normally, the starter electrode must be used on sinewave voltage sources. The minimum anode and starter electrode supply voltage rating above does not apply to the "floating" starter electrode condition.*

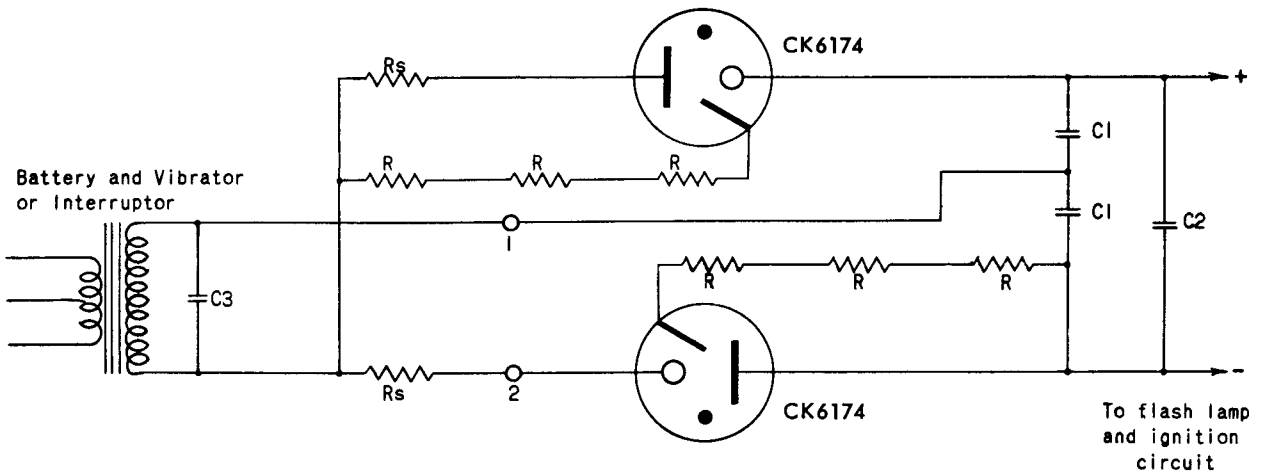
■ *With the starter electrode connected to operate as an anode on the forward half of the cycle, the cathode current rating is the only limitation on the starter electrode current.*

Tentative Data

RAYTHEON

COLD CATHODE HALF - WAVE RECTIFIER

CIRCUIT FOR BATTERY OPERATION OF ELECTRONIC PHOTO-FLASH



R= 3.3 meg. 1/2 watt 350 Vdc

Rs= Surge Resistor. Adjust to keep Peak Cathode Current (steady state) and Peak Cathode Current (surge) within ratings of 30 ma. and 300 ma., respectively. Rs should not be less than 2000 ohms in voltage doubler circuits regardless of transformer characteristics.

C1= 0.1 μf 1500 V

C2= 28 μf 2500 V

C3= Buffer Condenser 0.002 to 0.01 μf. The exact value depends on vibrator or interrupter frequency and transformer characteristics and represents a compromise between excessive transformer loading and excessive inverse voltage.

TENTATIVE SPECIFICATIONS FOR ELECTRON TUBE TYPE RK6177

The provisions of MIL-E-1B apply to this specification. Note 22

Description: Magnetron, continuous wave, fixed frequency, electro-mechanically frequency modulated.

ABSOLUTE RATINGS

	Ib mAdc	Pi W	Reed Drive V	Reed Drive W	FM Deviation Mc	Eb V
Maximum:	35	12	Note 1	.55	87	350
Minimum:	--	--	--	--	--	--

	Ef V	Ehk V	tk sec	Shell T °C	σ'
Maximum:	7.0	45	--	110	1.5
Minimum:	5.7	--	40	--	
	Note 2			Note 3	Note 4

The absolute ratings must not be exceeded under any conditions, otherwise the serviceability of the tube may be impaired. It does not necessarily follow that combinations of absolute ratings can be applied simultaneously. The provision of MIL-E-1B 6.5 apply on the selection of the operating point.

Storage, Handling, and Installation

Cooling: Convection
Magnet Isolation: Note 5
Mounting Support: Note 6
Mounting Position: Base Horizontal

Output Coupling: Note 7
Input Connections: Note 7
Vibration Shock: Note 8
Weight: Approx. 1 pound

Ref.		Test or Title	Conditions or Notes	Min.	Max.
3.1		Qualification Approval	Required for JAN marking		
3.7		Marking:			
4.5		Holding Period:	t = 168 hours		
4.9.2		Dimensions:	Raytheon Dwg. C-64910		
4.9.8	**	Salt Spray Corrosion	Omit		
4.9.18		Carton Drop	Package Group 9; Container Size A; Drop Test (i)		
4.9.19.1	*	Vibration:	No Voltage		

from JETEC release #1439, March 28, 1955

Ref.	Test or Title	Conditions		Min.	Max.	
4.10.8	*Heater Current:	Ef = 6.3 V	If:	0.54	0.66	A
4.10.15	*Insulation:	Ehk = ± 45 Vdc	Ihk:	—	75	uAdc
—	*Reed Coils D.C. Resistance:	Stabilized shell T = Approx. 25°C				
		Coil current = 25 mAdc max. for test	Drive Coil Resistance:	0.3	0.4	ohms
			Pickup Coil Resistance:	0.55	0.7	ohms
—	Transfer Loss (1):	F = 100 ± 3; Note 9	Voltage Ratio:	30	37	db
—	*Transfer Loss (2):	F = 5000 ± 3%; Note 9	Voltage Ratio:	12	—	db
—	*Natural Reed Frequency:	Note 10	F:	275	350	cps
—	Null Reed Frequency:	Note 11	F:	500	600	cps
—	**Reed Secondary Resonances:	Note 12				
4.16.3	Oscillation (1):	Note 13				
—	Standing Wave Ratio:	σ' = 1.10 max.				
4.16.3.2	Heater Cathode Warmup Time:	tk = 40 sec. at Ef = 6.3V Ef = 6.3V for test				
—	†Anode Voltage:	Ib = 30 mAdc	Eb:	280	330	Vdc
4.15.1	† Power Output:		Po:	1.10	—	W
4.16.5	* Pulling Factor:	Oscillation (1)	F:	—	4.0	Mc.
4.10.7.3	Frequency:	Note 14	F:	4268	4350	Mc.
4.16.3	Oscillation (2):	Note 13				
—	Standing Wave Ratio:	σ' = 1.15 max.				
—	FM Drive Voltage:	F = 100 ± 3; Note 15	Vac:	0.17	0.48	Vac
—	Distortion:	Note 16				
—	* Compression Linearity:	Note 17	Deviation:	—	15	%

Ref.	Test or Title	Conditions or Notes		Min.	Max.	
---	FM Deviation:	Note 18				
	*Room Temperature:	After t = 3 min.	Deviation:	---	±8	%
		After t = 12 min.	Deviation:	---	±4	%
	*Cold Test (-55°C):	After t = 10 min.	Deviation:	---	±8	%
		After t = 20 min.	Deviation:	---	±4	%
	*Hot Test (+70°C):	t = 20 min.	Deviation:	---	±4	%
---	Dynamic Impedance:	Note 19				
4.11	Life Test	Group C; Note 20	t: 500	---		hrs
4.11.4	Life Test End Point	Oscillation (1) Distortion; Note 16 Dynamic Impedance; Note 21	Po:0.88 Eb: 270	--- 345		W Vdc

Note 1: The maximum voltage applied to the reed drive coil shall not be sufficient to cause distortion of the pickup coil voltage.

Note 2: The maximum value specified is for a non-oscillating condition.

Note 3: The temperature is to be measured at the point indicated on the Electron Tube Dwg, Raytheon C-64910.

Note 4: Frequency skipping or unstable operation may be encountered at some phase positions when the mismatch occurs at the end of a "long" line.

Note 5: In handling and mounting the magnetron care must be exercised to prevent demagnetization. Ferromagnetic materials or energized magnets shall not be brought within one inch of the tube.

Note 6: Non-magnetic sheet metal clamps are recommended as additional support to that provided by the base pins.

Note 7: See electron tube drawing: Raytheon C-64910

Note 8: Reasonable care should be used in the storage, installation, and use of the tube to avoid imparting vibration or shock in excess of the values for which it is designed to withstand.

Note 9: A rms input of 0.1 Vac shall be applied to the drive coil of the reed modulator at the specified frequency. The rms output across the pickup coil terminals shall be within the specified amount with reference to 0.1 Vac. This test shall be made with a high grade volt meter.

Note 10: The reed modulator shall be driven over the required frequency range with an input of .01 Vac or less. The frequency shall be adjusted so the rms voltage across the pickup coil terminals is a maximum. The natural reed frequency shall be considered the frequency at which the rms voltage across the pickup coil is a maximum, and shall fall within the frequency limits specified.

Note 11: The reed modulator shall be driven over the required frequency range with approximately 0.1 Vac input. The frequency shall be adjusted so the rms voltage across the pickup coil terminals is a minimum. The null frequency shall be considered the frequency at which the rms voltage across the pickup coil is a minimum and shall fall within the frequency limits specified.

Note 12: When a constant sinusoidal voltage of 10 millivolts is applied to the reed drive coil, and the frequency of this voltage is varied from 1 to 10 kilocycles, the voltage across the pickup coil at any secondary resonance shall not increase more than 8.0 db above that voltage which would be measured in the absence of the secondary resonance.

Note 13: The heater shall be energized for 40 seconds before the application of Eb. After the application of Eb a two minute stabilizing period shall be observed. The rate of rise of Eb shall not exceed 50 kilovolts per second.

Note 14: To be measured at approximately 30°C ambient, and at approximately 3 minutes after application of Eb.

Note 15: This voltage shall be obtained from a high quality audio oscillator. With the reed coil connected in a closed loop circuit as per Raytheon Drawings T-30416 and T-30418 or equivalent, 76 Mc peak to peak frequency modulation of the carrier signal shall be obtained with the drive voltage adjusted within the specified limits. The measurement of rms drive voltage shall be made 6 minutes after the application of Eb, and at least 2 minutes after the application of 76 megacycle drive voltage.

Note 16: The tube shall be placed in operation as specified for frequency modulation, and the drive voltage shall be increased from 0 volts to 15% above that voltage required for 76 megacycles peak to peak frequency modulation. When viewed on an oscilloscope connected at the magnetron reed drive pins, the wave form of the drive voltage shall not show any visible distortion as compared to the wave form of the audio output voltage of the signal generator. This test shall be made at least two minutes after the application of the drive voltage required for 76 megacycles of peak to peak frequency deviation.

Note 17: The peak to peak r.f. bandwidth versus reed drive shall be obtained in the following manner: Plot the 42 and 84 mc. bandwidth versus drive points. A straight line passing through the origin and extending to the 84 mc. point shall be the reference line upon which calculations are based. At the 42 mc. drive level, compute the difference frequency between the actual 42 mc. point and that frequency indicated on the reference line. The calculated difference frequency divided by 42 mc. shall be considered the percentage of non linearity, and shall be below the maximum limit specified. This test shall be made with the tube stabilized before each measurement.

Note 18: The tube shall be placed in oscillation as in oscillation 2. The peak to peak bandwidth at the start of the room temperature test shall be approximately 60 megacycles, and the modulator input drive voltage used during the -55°C test and the +70°C test shall be the same as that used during the room temperature test. In each instance, the bandwidth deviation is with respect to the room temperature test bandwidth at t = 20 minutes. The bandwidth deviation must stay within the specified percentage of the reference bandwidth after the specified times.

Note 19: The anode current shall be continuously sinusoidally modulated from 5 to 60 milliamperes peak. The tube shall look into an r.f. system whose VSWR is 2.0 average and which is adjustable in phase. At any load phase, and between the current extremes of 15 and 45 milliamperes, the slope of the voltage current characteristic shall not become less than zero ohms. The rated heater and anode voltages must have been applied for at least 4 minutes previous to this test. The viewing oscilloscope shall be calibrated for a sensitivity of at least 12 milliamperes per inch horizontally, and 24 volts per inch vertically when performing this test.

Note 20: Life test shall be conducted with Ef and Eb as defined under conditions for Oscillation (1). A 60 cps potential of 0.2 Vac shall be applied to the Reed Drive Coil. The pickup coil shall remain open-circuited during this test. Voltages shall be cycled in the following manner:

Condition	Duration	Ef	Ib	E Reed
1	40 sec	6.3 V	0	0
2	105 min	6.3 V	30 mAdc	0.2 Vac
3	15 min	0 V	0	0

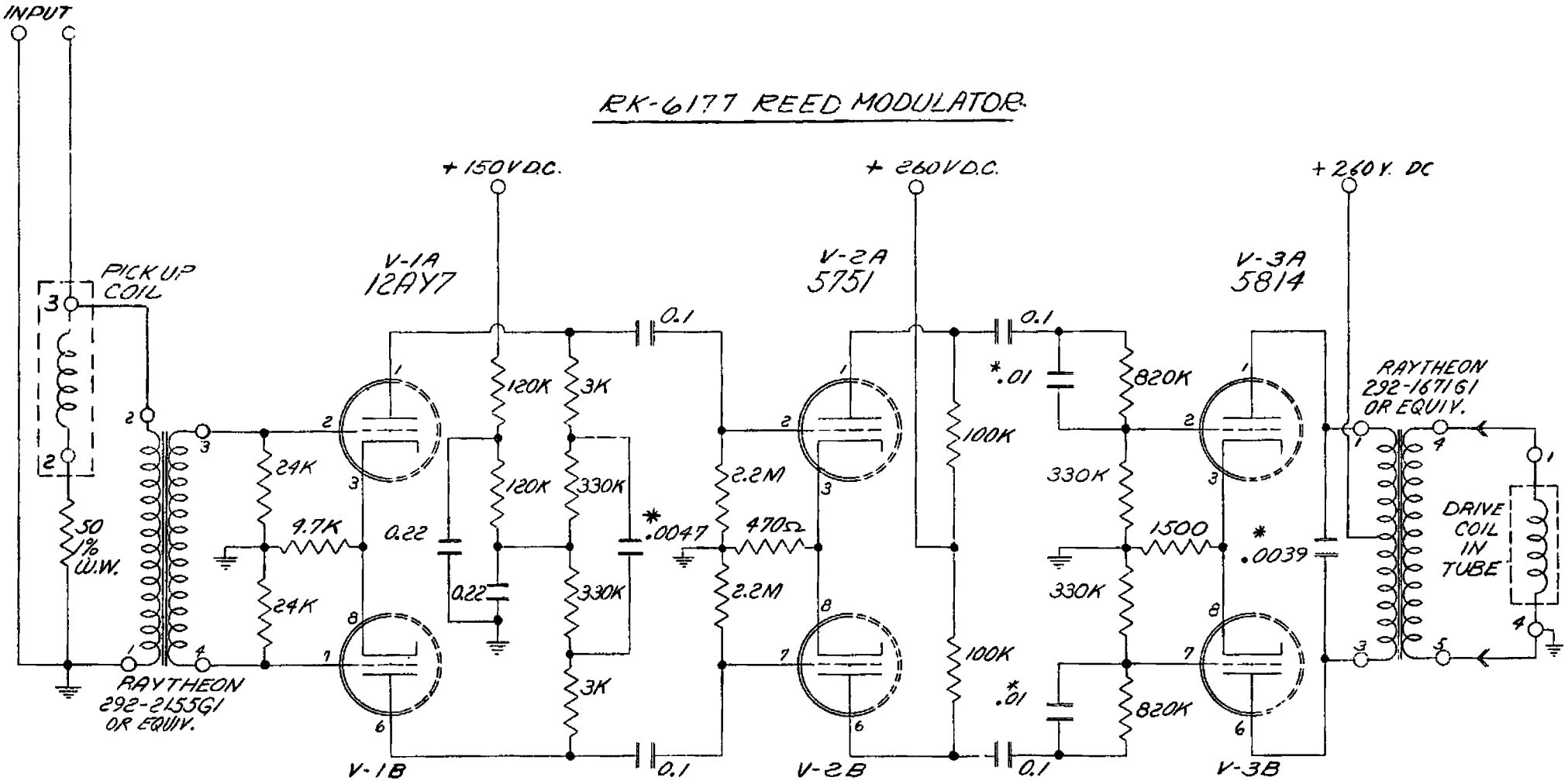
Total minimum life time is defined as a total of 500 hours of condition (2).

Note 21: The anode current shall be continuously modulated from 5 to 60 milliamperes peak. The tube shall look into a mismatched load whose VSWR is 1.50 minimum and which is adjustable in phase. At any load phase and between the current extremes of 15 and 45 milliamperes, there shall be no break in the voltage-current characteristic.

Note 22: The following drawings also form part of the specification:

Raytheon C-64910 Raytheon T-30416 Raytheon T-30418

RK-6177 REED MODULATOR



NOTES:

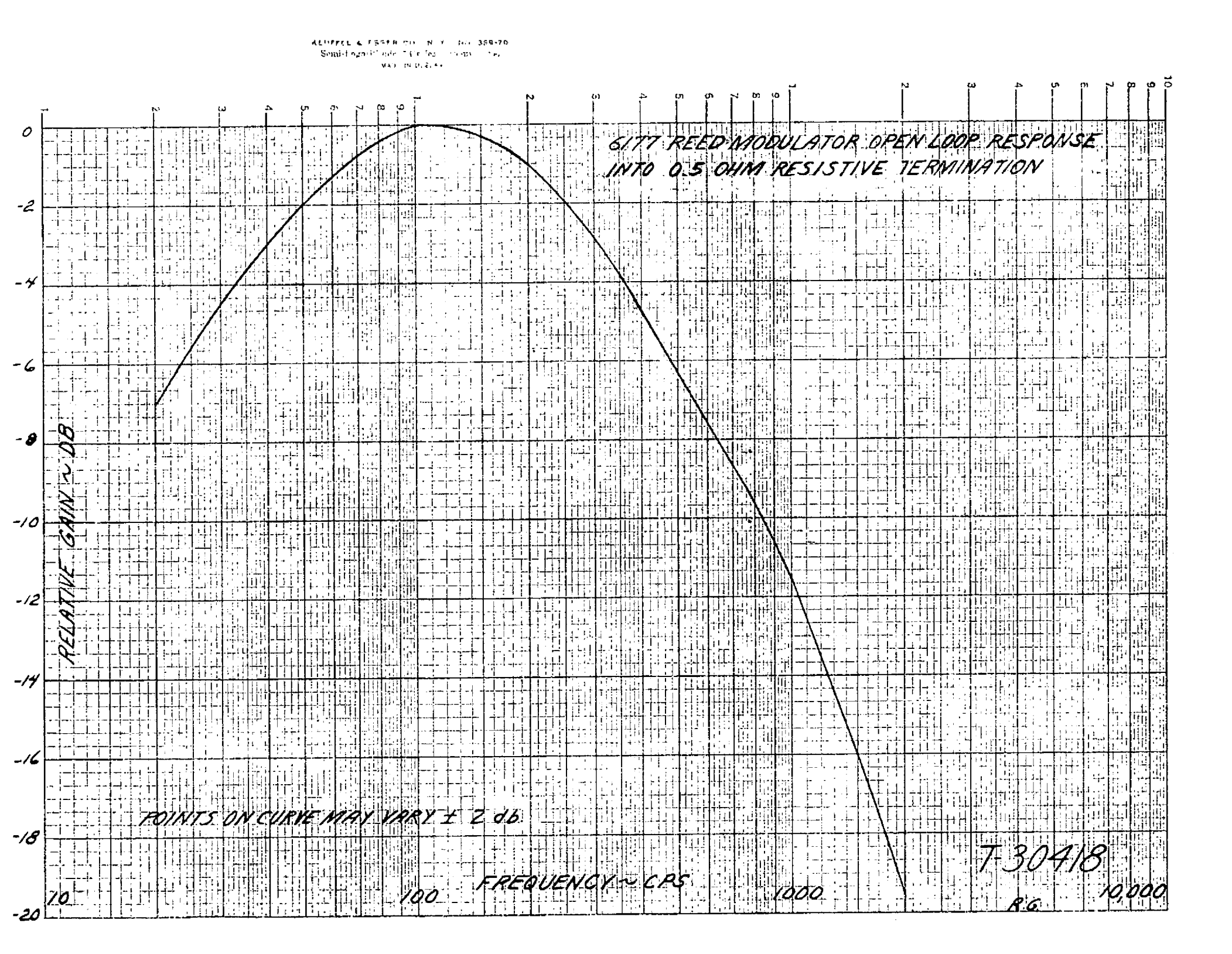
* EXTENDED FOIL TYPE

USE D.C. HEATER SUPPLY

T-30416

RAYTHEON MANUFACTURING CO.
MICROWAVE & POWER TUBE OPERATIONS

REV-1 6-17-54 am. 2-17- DES.


6177 REED MODULATOR OPEN LOOP RESPONSE
INTO 0.5 OHM RESISTIVE TERMINATION
RELATIVE GAIN ~ DB
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
POINTS ON CURVE MAY VARY ± 2 db
10
100
FREQUENCY ~ CPS
1000
10,000
T-30418
R.G.

RAYTHEON MFG. CO.
POWER TUBE DIVISION
WALTHAM, MASS.

TITLE: ELECTRON TUBE (RK-6177)

DRAWING NO. C 64910

SHEET 1 OF 3

DIMENSIONS IN INCHES UNLESS NOTED — DO NOT SCALE PRINT

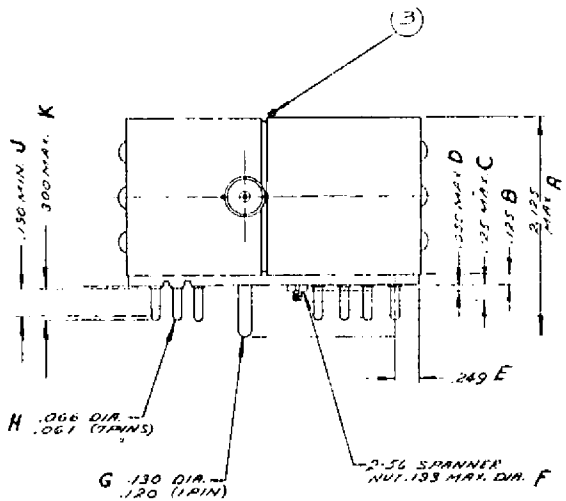
ITEM NO	DESCRIPTION OR MATERIAL

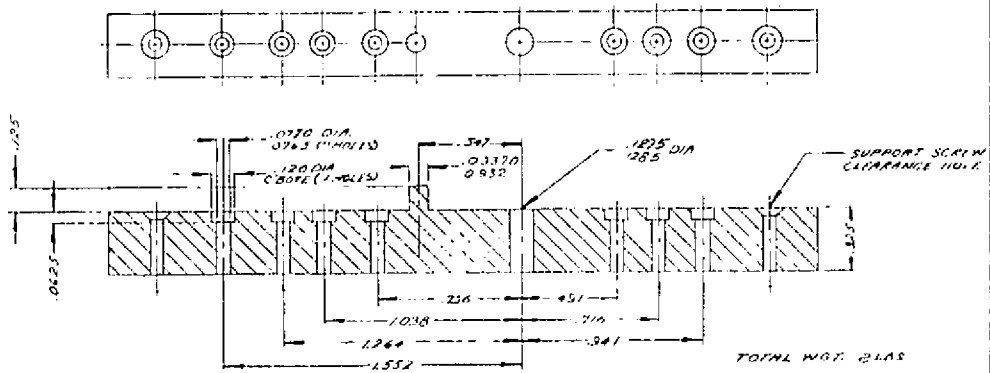
1 - TUBE BASE MUST BE CAPABLE OF BEING CHECKED IN ACCORDANCE WITH THE FOLLOWING PROCEDURE: THE GAUGE SHALL BE ATTACHED TO SUCH AN ACCESSORY WGT. AS WILL GIVE THE TOTAL WGT. PRESCRIBED ON THE GAUGE DWG. THE ENTIRE LENGTH OF PIN SHALL PASS INTO THE GAUGE & ON WITHDRAWAL, SHALL BECOME DISENGAGED WITHOUT LIFTING THE TOTAL WGT. OF ASSEMBLED GAUGE & ACCESSORY WGT.

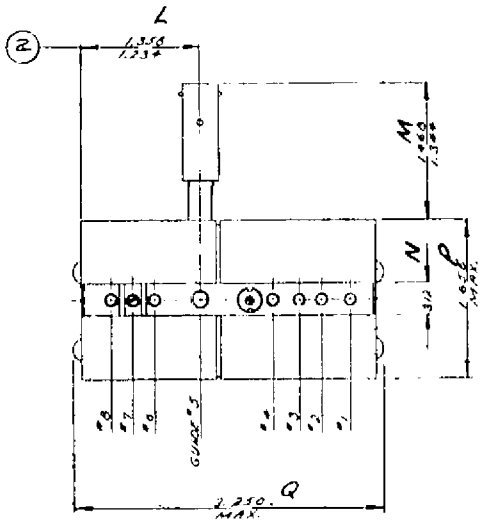
2. CENTER OF # 5 GUIDE PIN & CENTER OF OUTPUT SOCKET LIE ON SAME & WITHIN DIMENSION SHOWN.

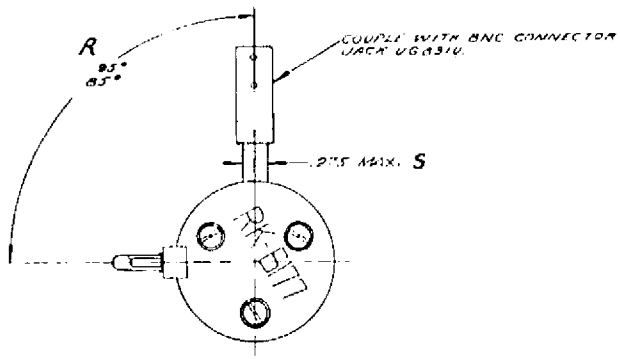
3. ANODE TRANSLUCENT TYPE TO BE MEASURED AT THIS POINT.

4. THE CATHODE SHALL NOT BE CONNECTED TO PIN # 7 THROUGH A 100 OHM WIRE WOUND RESISTOR ENCLOSED WITHIN THE BASE SHELL.









# PIN	RK-6177 PART
1	DRIVE (1)
2	PICKUP (1)
3	PICKUP
4	DRIVE GROUND
5	ANODE GROUND
6	HEATER
7	CATHODE
8	HEATER

COPIES	STATION
	118
	117
	41
	37
	11
	60
	1177

USED WITH REFERENCE DRAWING NUMBER

PROCESS SPEC.

FORM T-1754-3-BL

RAYTHEON

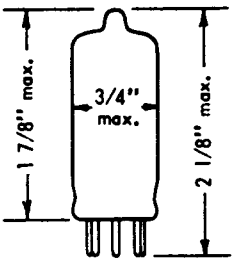
TECHNICAL INFORMATION

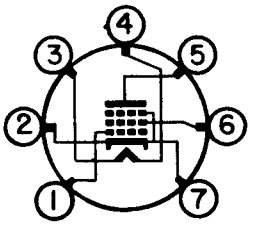
MINIATURE PENTODE

Excellence in Electronics

TYPE CK6186

The type CK6186 is a sharp cutoff pentode of miniature construction with a high gm, and low input and output capacitances. It is designed for use as an intermediate frequency amplifier or as an RF amplifier of frequencies up to 400 megacycles. Through the use of two (2) cathode leads, isolation of input and output circuits is made feasible.





BOTTOM VIEW

7BD

MECHANICAL DATA

ENVELOPE: T–5½ Glass (6–2)

BASE: Miniature Button 7–Pin, E7–1

TERMINAL CONNECTIONS:

Pin 1 Grid #1
Pin 2 Cathode; Internal Shield; Grid #3
Pin 3 Heater
Pin 4 Heater
Pin 5 Plate
Pin 6 Grid #2
Pin 7 Cathode; Internal Shield; Grid #3

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test – Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test–Note 3)	2.5 G
Maximum Bulb Temperature	165 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION – – – To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy maybe reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both Reliability and Performance will be jeopardized if filament voltage ratings are exceeded. Life and Reliability of Performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL–E–1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	ABSOLUTE MAXIMUM	MIL–E–1 UNITS
Heater Voltage (Note 6)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	250	250	330	Vdc
Grid Voltage	Ec1:	----	0	0	----	Vdc
Grid #2 Voltage	Ec2:	----	150	150	250	Vdc
Heater Cathode Voltage	Ehk:	----	----	----	100	V
Cathode Resistance	Rk:	----	200	200	----	Ohms
Plate Dissipation	Pp:	----	----	1.75	2.5	Watts
Grid #2 Dissipation	Pg2:	----	----	0.3	0.55	Watts
Transconductance	Gm:	----	----	5000	----	μmhos
Plate Current	Ib:	----	----	7.0	----	mAdc
Grid #2 Current	Ic2:	----	----	2.0	----	mAdc
Cathode Current	Ik:	----	----	9.0	----	mAdc

Tentative Data

Printed in U.S.A.

INDUSTRIAL COMPONENTS DIVISION
RAYTHEON COMPANY
55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (NOTE 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			**Combined AQL=1.0% excluding Mechanical and Inoperatives**							
Heater Current:		0.65	If:	275	----	300	----	375	----	mA
Heater Cathode Leakage:	Ehk=+ 100 Vdc	0.65	Ihk:	----	----	----	----	10	----	μAdc
	Ehk=-100 Vdc		Ihk:	----	----	----	----	10	----	μAdc
Grid Current (1):		0.65	Ic1:	----	----	----	----	-0.1	----	μAdc
Plate Current (1):		0.65	Ib1:	5.2	6.3	7.0	7.7	8.8	1.5	mAdc
Screen Current:		0.65	Ic2:	1.3	1.7	2.0	2.3	2.7	0.6	mAdc
Transconductance (1):		0.65	Sm (1):	4000	4625	5000	5375	6000	850	μmhos
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope: T-5½(6-2)									
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:	Ef= 6.3 V									
	Eg1-all= -100 Vdc	2.5	Rg-all:	100	----	----	----	----	----	Meg.
	Ep-all= -300 Vdc		Rp-all:	100	----	----	----	----	----	Meg.
Plate Current (2):	Rk= 0; Ec1= -4.5 Vdc	2.5	Ib (2):	5.0	----	----	----	----	----	μAdc
Plate Current (3):	Rk= 0; Ec1= -10 Vdc	2.5	Ib (3):	----	----	----	----	100	----	μAdc
Transconductance (2):	Ef= 5.7V; (Note 7)	2.5	Δ Ef Sm (2):	----	----	----	----	15	----	%
Grid Emission:	Ef= 7.0; Rg1= 0.1 Meg; Preheat 5 minutes at Ef= 7.0 Vdc	2.5	Isc:	0	----	----	----	-0.2	----	μAdc
RF Noise:	Ec1= -2 Vdc; Ecal= 15.0 mVac; (Note 8)	2.5	----	----	----	----	----	3.0	----	mW
Noise and Microphonics:	Ef= 6.3 Vac; Ehk= 0; Ebb= Ecc2= 300 Vdc; Rg2= 0.6 meg; Rp= 0.01 Meg; Rk= 200; (Note 9) Ck= 1000 μf	2.5	EB:	----	----	----	----	50	----	mVac
Capacitance:			Cg-p:	----	----	----	----	0.03	----	μμf
Capacitance:	No Shield	6.5	Cin:	5.2	----	----	----	7.8	----	μμf
Capacitance:			Cout:	1.3	----	----	----	2.3	----	μμf
Low Pressure Voltage Breakdown:	Pressure= 55± 5 mmHg; Voltage= 500 Vac	6.5	----	----	----	----	----	----	----	Vac
Vibration (2):	Rp= 2000 ohms; F= 25 cps; G= 2.5	6.5	Ep:	----	----	----	----	100	----	mVac
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Hammer Angle= 30°; Ehk= 100 Vdc, Heater Positive; Rg1= 0.1 meg; Note 2	----	----	----	----	----	----	----	----	----
Fatigue:	96 Hours; G= 2.5; Fixed Frequency; F= 25 min., 60 max., Note 3	6.5	----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:		----	----	----	----	----	----	----	----	----
Vibration (2):		----	Ep:	----	----	----	----	450	----	mVac
Heater Cathode Leakage:	Ehk=+ 100 Vdc	----	Ihk:	----	----	----	----	30	----	μAdc
	Ehk= -100 Vdc	----	Ihk:	----	----	----	----	30	----	μAdc
Transconductance (1):		----	Sm:	3500	----	----	----	----	----	μmhos
Grid Current (1):		----	Ic1:	0	----	----	----	-0.2	----	μAdc
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

ELECTRICAL DATA (cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS								
1 Hour Stability Lift Test:	Ehk= 100 Vdc, Heater Positive; Rg1= 1.0 meg; TA= room	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical Sample Size= 50 tubes)							
Transconductance (1) Change of individual tubes from initial:		1.0	Δ_tSm:	----	10	%		
100 Hour Survival Rate Life Test:	Ehk= 100 Vdc, heater positive; Rg1= 1.0 meg; TA= room; Min Bulb Temp.= + 165°C	6.5	----	----	----	----		
500 and 1000 Hours Intermittent Life Test:	Ehk= 100 Vdc; Heater Positive; Rg1= 1.0 meg; Min. Bulb Temp.= + 165°C	----	----	----	----	----		
500 Hour Intermittent Life Test End Points:	(Typical sample size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic1:	0	-0.1	μAdc	1	3
Heater Current:		----	If:	275	325	mA	1	3
Heater Cathode Leakage:	Ehk=+ 100 Vdc Ehk= -100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	1	3
Transconductance (1):		----	Sm:	3750	6000	μmhos	1	3
Transconductance (2):	(Note 7)	----	Δ_{EF}Sm:	----	15	%	2	5
Electrode Insulation: (p-all) (g-all)		---- ----	Rp-all: Rg-all:	50 50	---- ----	Meg. Meg.	2	5
Transconductance (1) Average Change:		----	Avg.Δ_tSm:	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic(1):	0	-0.1	mAdc	2	5
Heater Current:		----	If:	275	325	mA	2	5
Transconductance (1):		----	Sm:	3500	6000	μmhos	2	5
Heater Cathode Leakage:	Ehk=+ 100 Vdc Ehk= -100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd.)

Note 4: These normal values represent conditions at which control of reliability may be expected.

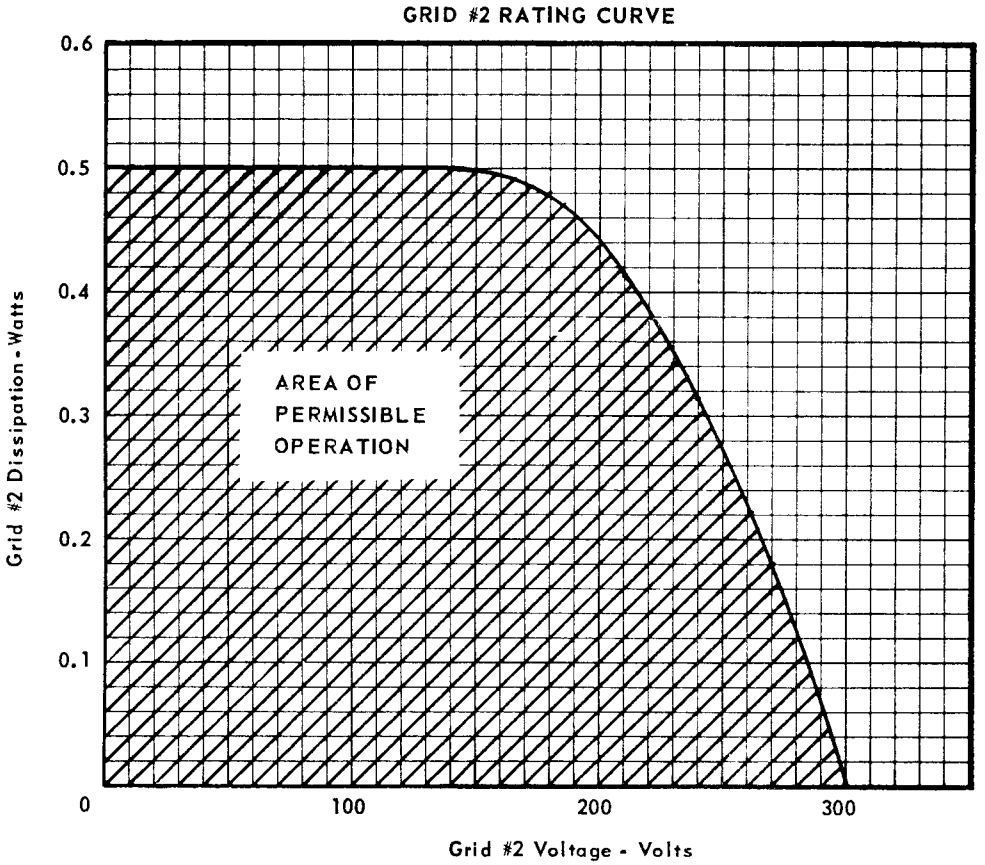
Note 5: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Change of transconductance for individual tubes from that value measured at Ef= 6.3 V to that value measured at Ef= 5.7 V.

Note 8: The output indicator shall be a VU meter. The three (3) milliwatt point shall be determined as a meter deflection of 25% the calibration point.

Note 9: The cathode resistor shall be shunted with a capacitive reactance not exceeding three (3) ohms at 60 cycles.

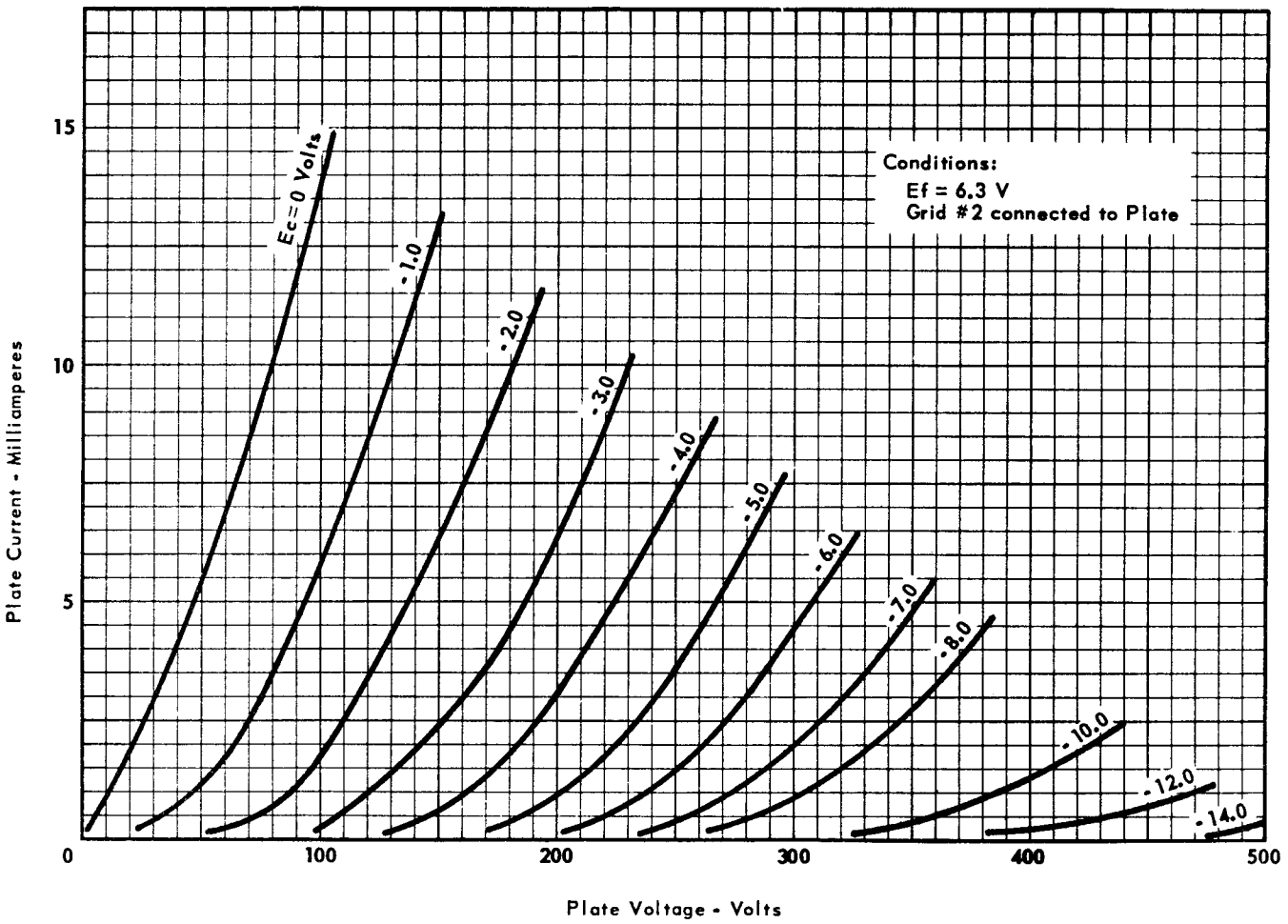


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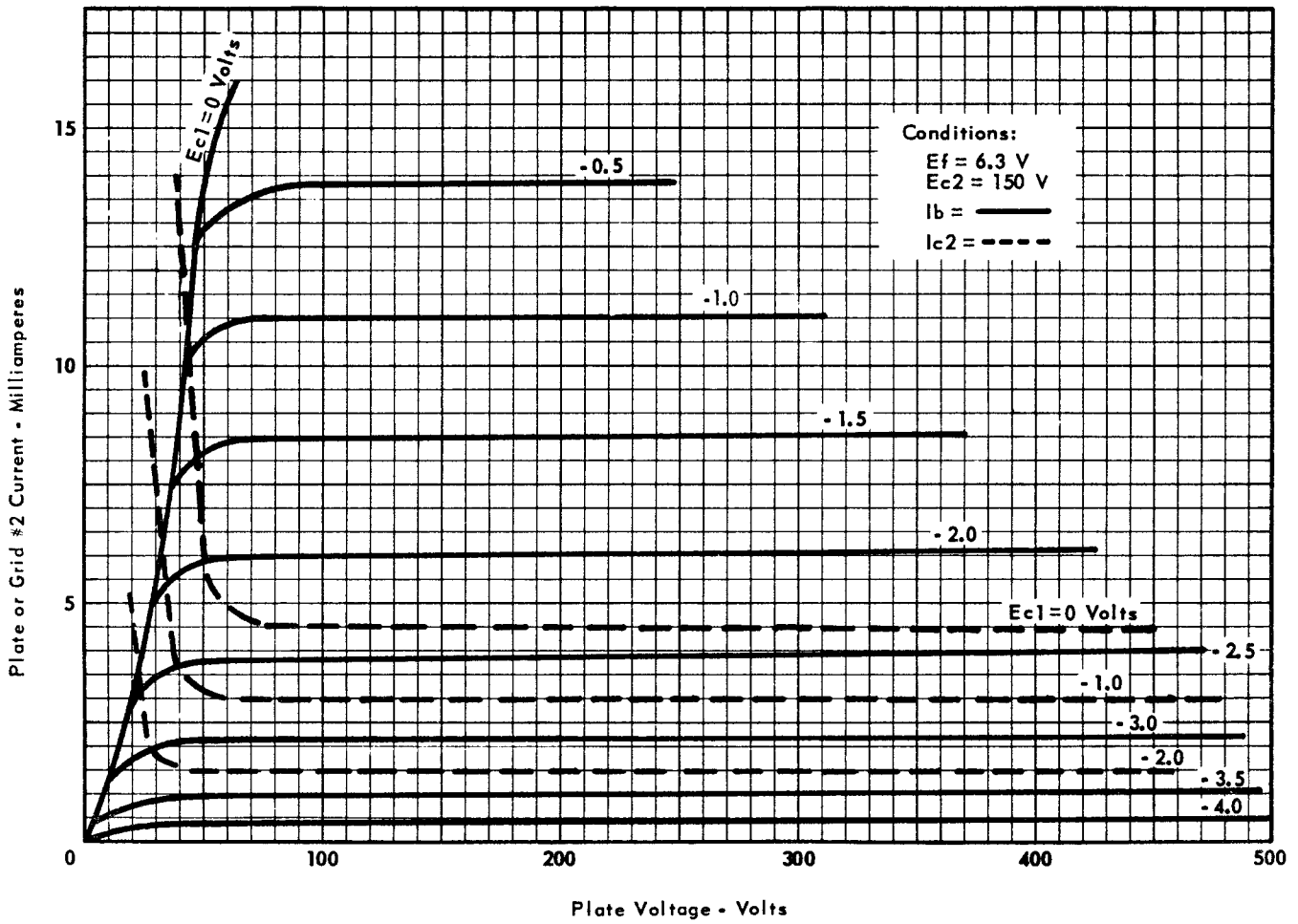
AVERAGE PLATE CHARACTERISTICS

(Triode Connected)



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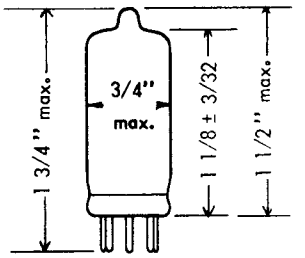
AVERAGE PLATE CHARACTERISTICS

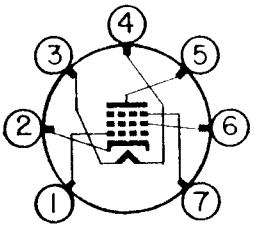


Excellence in Electronics

TYPE CK6187

The CK6187 is a miniature sharp cut off pentode designed for applications in RF amplifiers. This type features a control grid and suppressor grid which can be used as independent control elements. It is also suitable for use in delay circuits, gated amplifiers, gain controlled amplifiers and mixer circuits.





MECHANICAL DATA

ENVELOPE: T–5 1/2 (6–1)

BASE: Miniature Button 7 Pin, E7–1

TERMINAL CONNECTIONS:

Pin 1 Grid #1	Pin 5 Plate
Pin 2 Cathode, Internal Shield	Pin 6 Grid #2
Pin 3 Heater	Pin 7 Grid #3
Pin 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test– Note 2)	450 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test – Note 3)	2.5 G
Maximum Bulb Temperature	+165 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION– – –To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	120	120	200	Vdc
Grid Voltage	Ec1:	–55.0	–2.0	–2.0	0	Vdc
Grid #2 Voltage	Ec2:	----	120	120	155	Vdc
Grid #3 Voltage	Ec3:	–55	0	0	30	Vdc
Heater Cathode Voltage	Ehk:	----	0	0	100	V
Plate Dissipation:	Pp	----	----	0.624	1.65	Watts
Grid #2 Dissipation	Pg2:	----	----	0.42	0.55	Watts
Grid Resistance	Rg	----	----	----	0.1	Meg.
Transconductance	Gm:	----	----	3200	----	μmhos
Grid Current	Ic1:	----	----	----	1.0	mAdc
Plate Current	Ib1:	----	----	5.2	----	mAdc
Grid #2 Current	Ic2:	----	----	3.5	----	mAdc
Grid #3 Current	Ic3:	----	----	----	0.2	mAdc
Cathode Current	Ik:	----	----	8.7	20	mAdc

Tentative Data

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ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1		**Combined AQL= 1.0% excluding Mechanical and Inoperatives**								
Heater Current:		0.65	If:	160	168	175	182	190	14	mA
Heater Cathode Leakage:	Ehk=+ 100	0.65	Ihk:	----	----	----	----	10	----	μAdc
	Ehk=–100		Ihk:	----	----	----	----	10	----	μAdc
Grid Current (1):	Rg= 0.1 Meg.	0.65	Ic1:	0	----	----	----	–0.1	----	μAdc
Plate Current (1):		0.65	Ib1:	2.5	4.2	5.2	6.2	9.0	2.3	mAdc
Transconductance (1):		0.65	Sm(1):	2500	2900	3200	3500	4500	750	μmhos
Continuity and Shorts: (Inoperatives)		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope T–5½ (6–1)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:	g1-all = –100 Vdc		Rg1-all:	100	----	----	----	----	----	Meg.
	g3-all = –100 Vdc	2.5	Rp-all:	100	----	----	----	----	----	Meg.
	p-all = –300 Vdc		Rg3-all:	100	----	----	----	----	----	Meg.
Plate Current (2):	Ec1= –3 Vdc; Ec3= –10 Vdc	2.5	Ib(2):	----	----	----	----	200	----	μAdc
Screen Current		2.5	Ic(2):	1.5	----	----	----	5.5	----	mAdc
Plate Current (3):	Ec1= –3 Vdc; Ec3= –6 Vdc	2.5	Ib(3):	5.0	----	----	----	----	----	μAdc
Plate Current (4):	Ec1= –8 Vdc	2.5	Ib(4):	----	----	----	----	200	----	μAdc
Plate Current (5):	Ec1= –6 Vdc	2.5	Ib(5):	5.0	----	----	----	----	----	μAdc
Transconductance (2):	Ef= 5.7 V (Note 7)	2.5	Δ_{Ef} Sm(2):	----	----	----	----	15	----	%
Grid Emission:	Ef= 7.5 V; Rg= 0.1 meg; Ec1= –10 Vdc; Preheat 5 min. at Ef= 7.5 V; Rk= 130 ohms; Eb=180 Vdc; Ec2= 125 Vdc; Rg1= 0.1 meg.	2.5	ISc:	----	----	----	----	–1.0	----	μAdc
RF Noise:	Ec1= 0; Ecal= 15.0 mVac; Rk= 200 ohms; Ck= 0.2 mfd (Note 9)	2.5	----	----	----	----	----	----	----	----
Noise and Microphonics:	Ef= 6.3 Vac; Ebb= Ecc2= 200 Vdc; Ec1= 0; Ecal= 175 mVac; Rk= 1000 ohms; Rp= 0.1 meg.; Rg2= .5 meg; Cg2= 2 μfd; Ck= 1000 μfd min. (Note 10)	2.5	----	----	----	----	----	----	----	----
Transconductance (3):	Ec1= –3 Vdc	6.5	S(g3-p):	350	----	----	----	1050	----	μmhos
Transconductance (4):	Ec3= –5 Vdc	6.5	S(g1-p):	700	----	----	----	1700	----	μmhos
Capacitance:	Shield #316		Cg-p:	----	----	----	----	.02	----	μμf
Capacitance:	Shield #316	6.5	Cin:	3.5	----	----	----	4.5	----	μμf
Capacitance:	Shield #316		Cout:	2.6	----	----	----	3.4	----	μμf
Low Pressure Voltage Breakdown:	Pressure= 55± 5 mmHg; Voltage= 500 Vac	6.5	----	----	----	----	----	----	----	----
Vibration (2):	F= 25 cps; G= 2.5 Rp= 10,000 ohms	6.5	Ep:	----	----	----	----	150	----	mVac

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (Cont'd)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS	Allowable Defects per Characteristics 1st Sample	Allowable Defects per Characteristics Combined Sample
DEGRADATION RATE ACCEPTANCE TESTS								
Shock:	Hammer angle= 30°; Ehk=+100 Vdc; heater positive; Rg= 0.1 meg.	20	----	----	----	----	----	----
Fatigue:	96 hours; G= 2.5; fixed frequency; F= 25 min., 60 max.	6.5	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:								
Vibration (2):	F= 25 cps; G= 2.5; Rp= 10 Kohms	----	Ep:	----	300	mVac	----	----
Heater Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	30	μAdc	----	----
	Ehk=−100 Vdc	----	Ihk:	----	30	μAdc	----	----
Transconductance (1):		----	Sm:	2200	----	μmhos	----	----
Grid Current (1):		----	Ic:	0	−0.4	μAdc	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----
Miniature Tube Base Strain:		----	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef= 7.5 V; Ehk=+135 Vdc Ec1= Ec2= Ec3= Eb= 0 1 min. on, 1 min. off	1.0	----	2000	----	cycles	----	----
Heater Cycling Life Test End Points:								
Heater Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc	----	----
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc	----	----
1 Hour Stability Life Test:	Eb= 180 Vdc; Ec1= 0; Ec2= 125 Vdc; Ehk= +135 Vdc; Rk= 130 ohms; Rg1= 0.1 meg.; TA= Room	----	----	----	----	----	----	----
1 Hour Stability Life Test End Points:	(Typical Sample Size= 50 tubes)							
Transconductance (1) Change of individual tube from initial:		1.0	Δ_1 Sm:	----	10	%	----	----
100 Hour Survival Rate Life Test:	Eb= 180 Vdc; Ec1= 0; Ec2= 125 Vdc; Ehk=+135 Vdc; Rk= 130 ohms; Rg1= 0.1 meg.; TA= Room	----	----	----	----	----	----	----
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size= 200 tubes)							
Shorts and Continuity: (Inoperatives)		0.65	----	----	----	----	----	----
Transconductance (1):		1.0	Sm:	2200	----	μmhos	----	----
500 and 1000 hours Intermittent High Temperature Life Test:	Eb= 180 Vdc; Ec1= 0; Ec2= 125 Vdc; Ehk=+135 Vdc; Rk= 130 ohms; Rg1= 0.1 meg.; T Envelope= +165 °C min.	----	----	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)
In the following tests each unit is tested separately.

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1 st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (Cont'd)								
500 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size= 20 tubes 1 st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic1:	0	-0.1	μAdc	1	3
Heater Current:		----	If:	160	190	mA	1	3
Change in Transconductance (1) of Individual Tubes:		----	Δ_t Sm:	----	20	%	1	3
Heater Cathode Leakage:	Ehk=+ 100 Vdc	----	Ihk:	----	10	μAdc	1	3
	Ehk= -100 Vdc	----	Ihk:	----	10	μAdc	1	3
Transconductance (2):		----	Δ_{Ef} Sm:	----	15	%	2	5
Electrode Insulation:								
(p-all)		----	Rp-all:	50	----	Meg.		
(Rg1-all)		----	Rg1-all:	50	----	Meg.	2	5
(g3-all)		----	Rg3-all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg. Δ_t Sm:	----	15	%	----	----
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical sample size= 20 tubes 1 st sample, 40 tubes 2nd sample	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic (1):	0	-0.1	μAdc	2	5
Heater Current:		----	If:	160	190	mA	2	5
Change in Transconductance of Individual Tubes:		----	Δ_t Sm:	----	25	%	2	5
Heater Cathode Leakage:	Ehk=+ 100 Vdc	----	Ihk:	----	10	μAdc	2	5
	Ehk= -100 Vdc	----	Ihk:	----	10	μAdc		
Total Defectives:		----	----	----	----	----	5	10

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 3: Test conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Change of transconductance for individual tubes from that value measured at Ef= 6.3 V to that value measured at Ef= 5.7.

ELECTRICAL DATA (Cont'd)

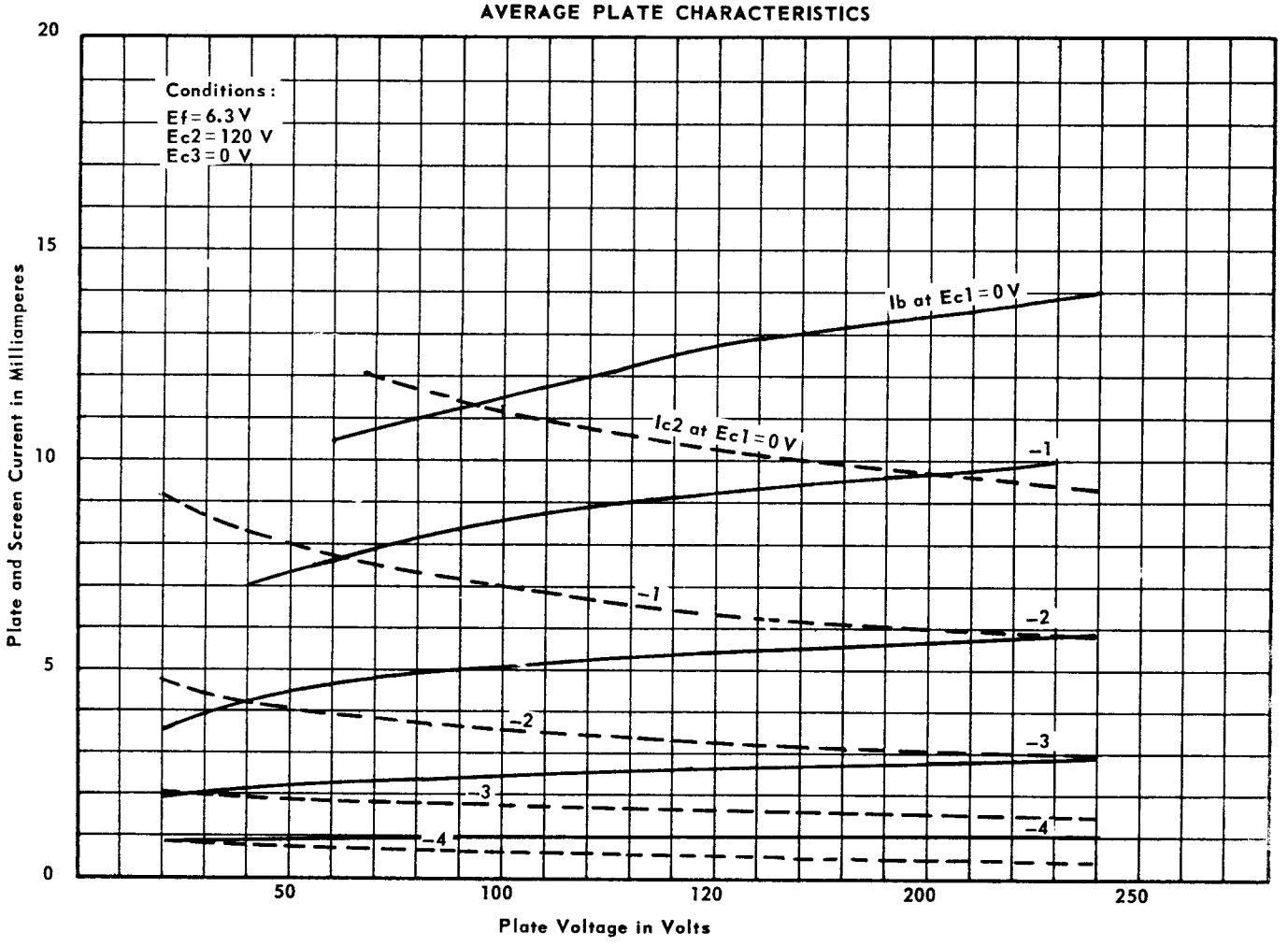
NOTES: (cont'd.)

Note 8 The output indicator shall be a VU meter. The three milliwatt point shall be determined as a meter deflection of 25% the calibration point.

Note 9 The output shall be read on a VU meter using a rejection limit of five (5) VU. Five (5) VU is the meter deflection obtained with a steady state output of 3 MW from the amplifier.

Note 10 The rejection limit shall be set at the VU meter reading obtained during calibration.

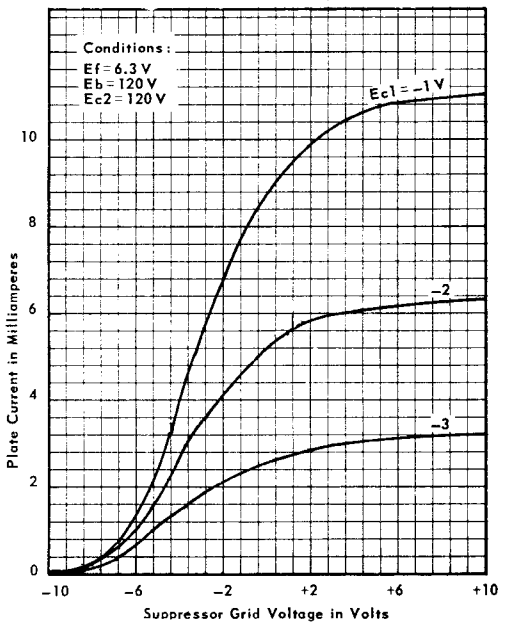
AVERAGE PLATE CHARACTERISTICS



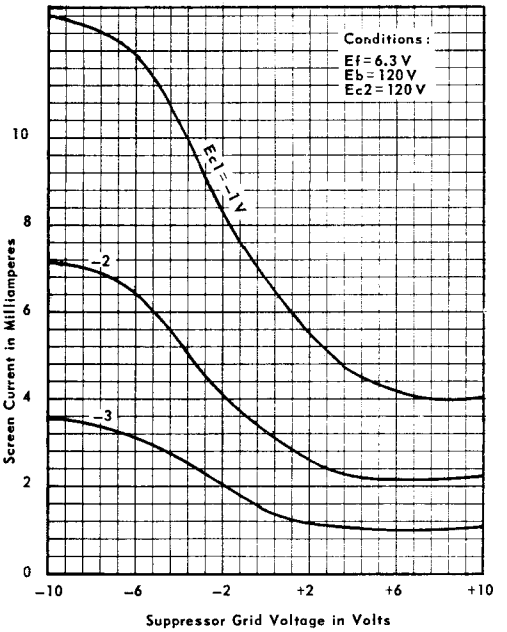
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MINIATURE PENTODE

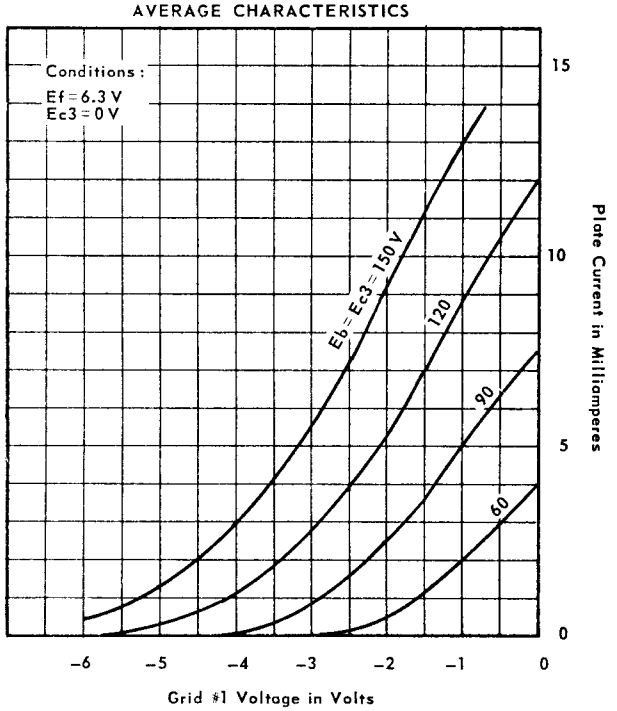
AVERAGE CHARACTERISTICS



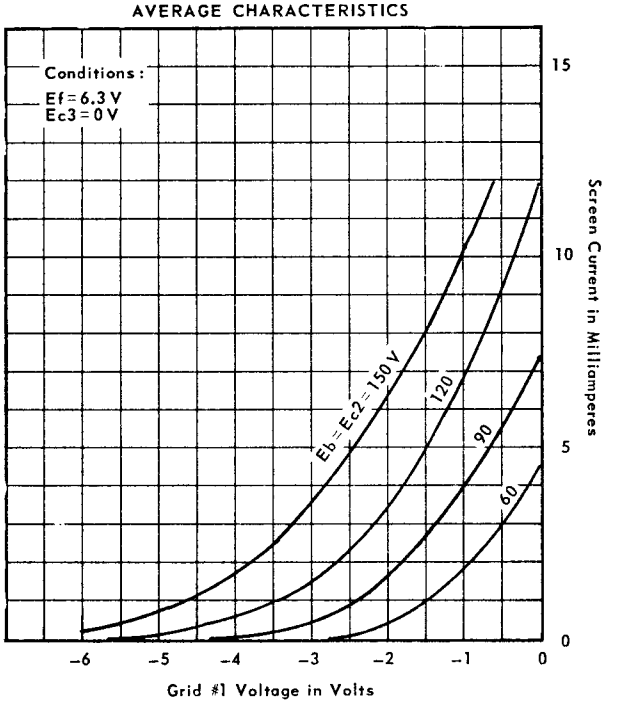
AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



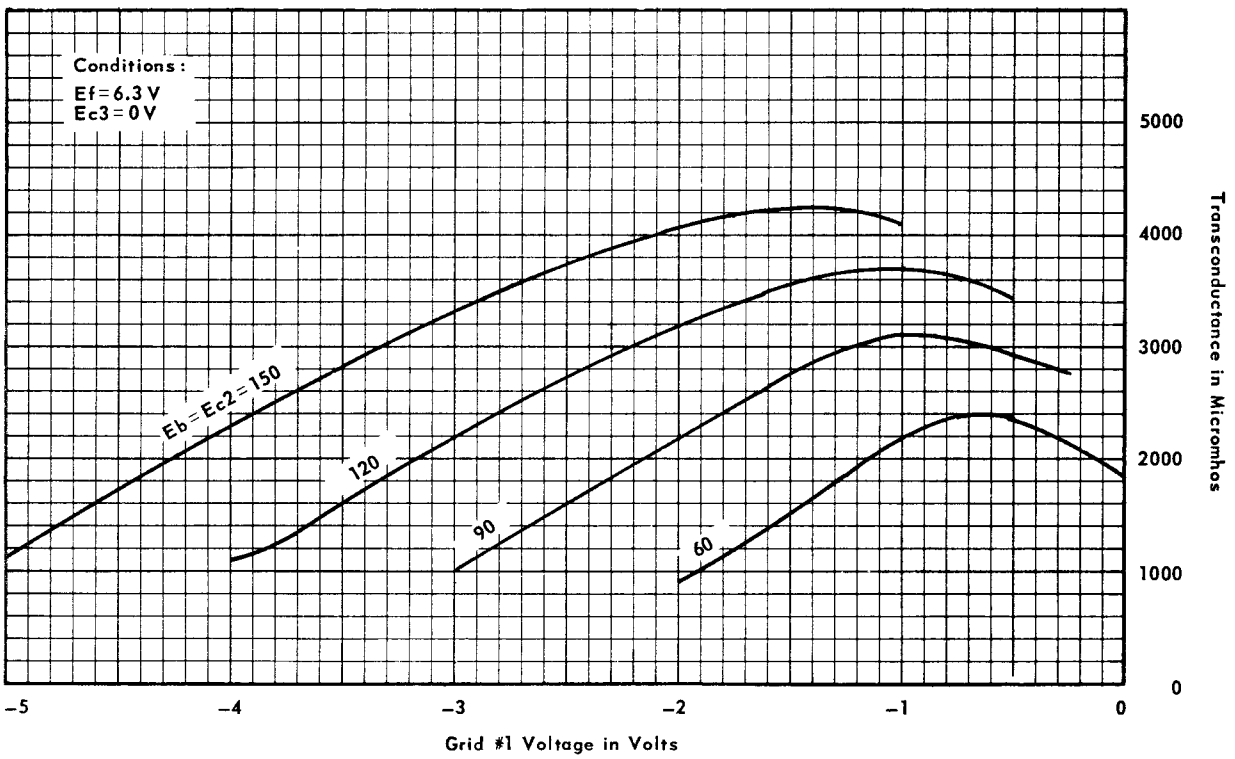
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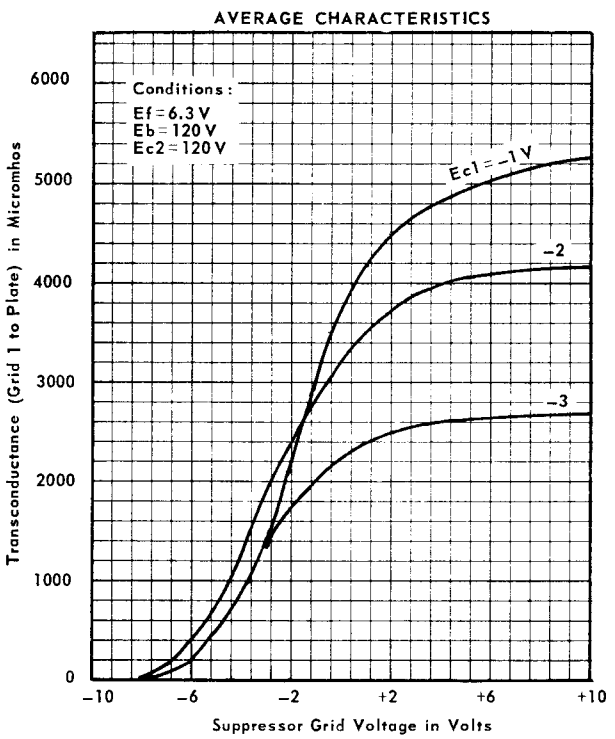
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MINIATURE PENTODE

AVERAGE CHARACTERISTICS



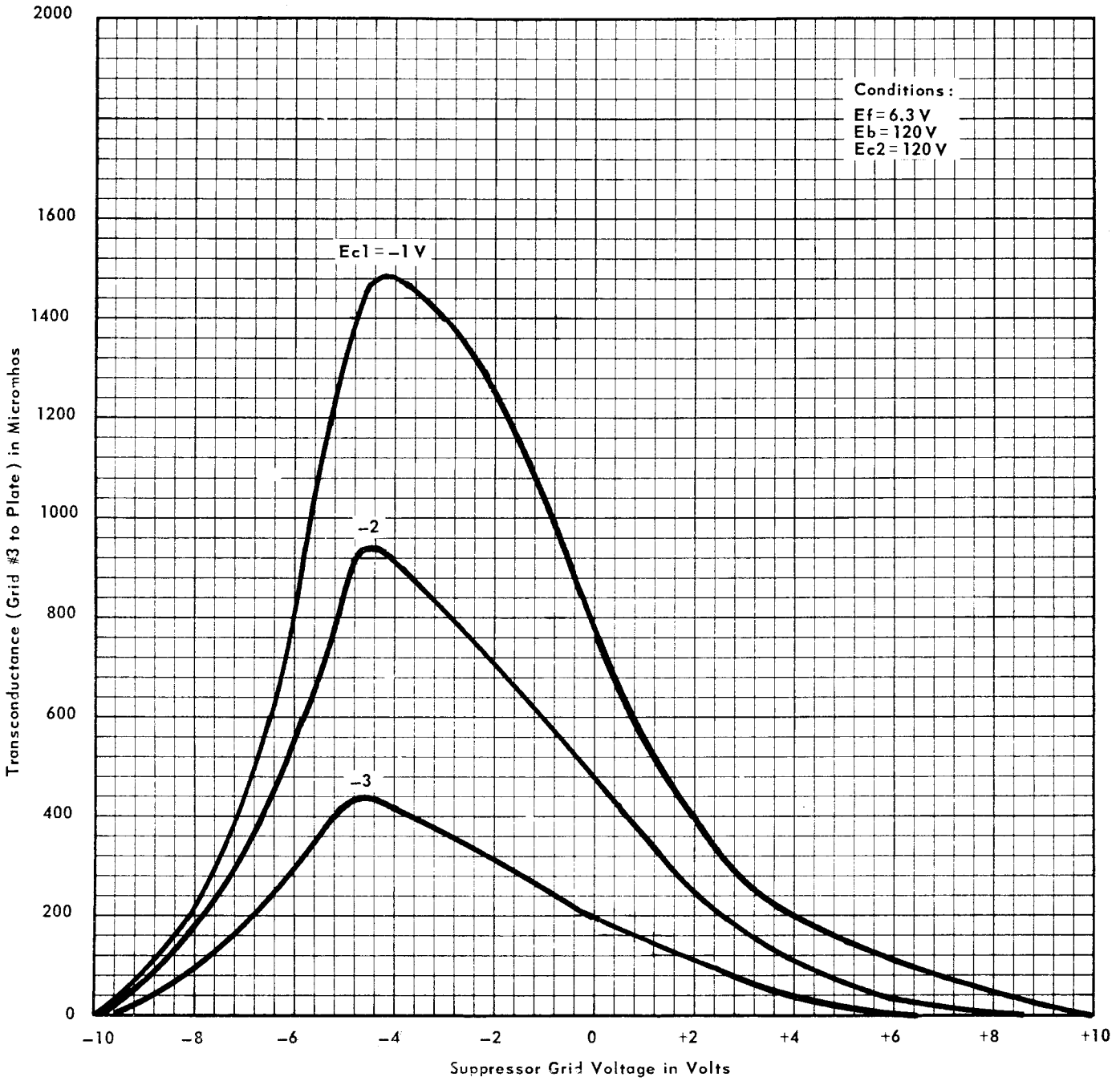
AVERAGE CHARACTERISTICS



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MINIATURE PENTODE

AVERAGE CHARACTERISTICS



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TECHNICAL INFORMATION SERVICE

Technical Information

CK6213

SUBMINIATURE GAS DIODE

The CK6213 is a cold cathode, glow-discharge diode of subminiature construction designed for use as a voltage reference tube in electronically regulated DC power supplies. It has an operating current range of 1.0 to 2.5 milliamperes over which it maintains a substantially constant operating voltage of 130 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminsockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

MECHANICAL RATINGS: (Absolute Maximum)

Bulb Temperature	−55 to +90	°C
Altitude	60,000	ft.

RATINGS: (Absolute Maximum Values)

Minimum DC Anode Supply Voltage (Note A)	200	Vdc
DC Operating Current (continuous, Note B)	2.5	mA

CHARACTERISTICS AND TYPICAL OPERATION

Starting Voltage (approx.)	170	Vdc
Operating Voltage (approx.)	130	Vdc
Regulation (1.0 to 2.5 ma) (max.)	1.0	Vdc

APPLICATION NOTES

Note A Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

Note B Sufficient resistance must always be used in series with the CK6213 to limit the current through the tube. The value of the series resistor is dependent on the maximum anode supply voltage and the ratio of the current through the load to the operating current of the CK6213, and should be chosen to limit the operating current through the tube to 2.5 ma. at all times after the starting period.

CAUTION---To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded.

MECHANICAL DATA

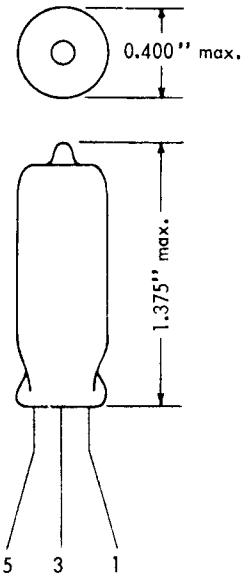
ENVELOPE T3

BASE ..... Subminiature 3 Pin Flat Press

CATHODE .... Glow Discharge

MOUNTING POSITION..... Any

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

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RAYTHEON

CK6213

SUBMINIATURE GAS DIODE

ACCEPTANCE CRITERIA

For the purpose of inspection, use applicable paragraphs of specification MIL–E–1.
For miscellaneous requirements, see 3.6.
The following tests shall be performed with an Ebb of 200 Vdc unless otherwise specified. (Note 2)

Ref.	Test	Conditions	AQL (percent defective)	Insp. Level or Code	SYM	LIMITS Min	LAL	Bogie	UAL	Max	ALD	Units
QUALIFICATION APPROVAL TESTS												
3.1	Qualification Approval:	Required Note 7	---	---								
	Cathode:	Glow Discharge	---	---								
3.4.3	Base Connections:		---	---								
3.7	Marking:	Note 3	---	---								
MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 1												
4.13.1.1	Ionization Voltage (1):	Ebb/Ib = 1-2.5 mA; RL = 30,000 ohms; Illumination = 5–50 ft. Candles	0.65	II	Ez(1):	160	---	---	---	180	---	Vdc
4.13.2	Tube Voltage Drop (1):	Ebb/Ib = 1.0 mA; RL = 30,000 ohms	0.65	II	Etd(1):	127	---	---	---	133	---	Vdc
4.13.2	Tube Voltage Drop (2):	Ebb/Ib = 2.5 mA; RL = 30,000 ohms	0.65	II	Etd(2):	127	---	---	---	133	---	Vdc
4.13.2.1	Regulation:	Etd(1)–Etd(2)	0.65	II	Reg:	---	---	---	---	1.0	---	Vdc
4.13.4.3	Noise:	Ebb/Ib = 2.5 mA RL = 5,000 ohms	0.65	II	Eb:	---	---	---	---	20	---	mVac
4.13.4.2	Oscillation:	Ebb/Ib = 1-2.5 mA RL = 5,000 ohms Esig = 50 mVac	0.65	II	---	---	---	---	---	---	---	---
4.7.5	Continuity and Shorts: (Inoperatives)		0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical Production Test:		---	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.13.1.2	Ionization Voltage (2):	Ebb/Ib = 1-2.5 mA; RL = 30,000 ohms Total Darkness	6.5	L6	Ez(2):	---	---	---	---	200	---	Vdc
4.13.3	Leakage:	Ebb = 50 Vdc; RL = 3,000 ohms	6.5	L6	Lib:	---	---	---	---	20	---	μAdc
4.9.19.1	Vibration (2):	Ebb/Ib = 2 mA Rb = 10,000 ohms F = 25 cps; G = 2.5	6.5	L6	Ep:	---	---	---	---	50	---	mVac
DEGRADATION RATE ACCEPTANCE TEST, NOTE 4												
4.9.5.3	Lead Fatigue:		4.0	L6	---	4.0	---	---	---	---	---	Arcs
ACCEPTANCE LIFE TESTS												
4.11	Intermittent Life Test Operation:	Ebb/Ib = 2.5 mA Group A	---	---	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points (500 hrs.):	Ionization Voltage (1)	---	---	Ez(1):	---	---	---	---	180	---	Vdc
		Tube Voltage Drop (2)	---	---	Etd(2):	127	---	---	---	133	---	Vdc
		Regulation	---	---	Reg:	---	---	---	---	1.5	---	Vdc
4.9.18	Container Drop:	Note 5										
5.1	Preparation for Delivery	Note 6										

Note 1: The AQL for the combined defectives for attributes in measurements acceptance test, part 1 excluding mechanical and Inoperatives shall be 1 percent. A tube having one or more defectives shall be counted as one defective. Stand MIL–STD–105, inspection level II shall apply.

Note 2: A fixed resistor may be used and Ebb varied to give desired current.

Note 3: Tubes shall be marked "USN–6213".

Note 4: Tubes subjected to the Intermittent Life Test (this is a Destructive Test) are not to be accepted under this specification.

Note 5: Not required for Qualification Approval of the tube.

Note 6: Tubes shall be prepared for domestic or overseas shipment as specified in the contract or order in accordance with Specification MIL–E–75/1. Rough handling (container drop) test (d) and container size C shall apply.

from JETEC release #1551, Dec. 12, 1955

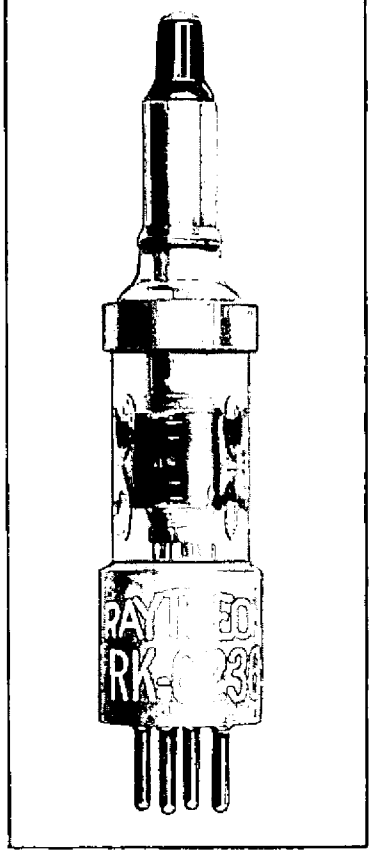
RAYTHEON

TECHNICAL INFORMATION

VELOCITY VARIATION OSCILLATOR

TYPE RK6236

Excellence in Electronics



The type RK6236 is a reflex velocity variation oscillator designed for use with a coaxial cavity in CW or pulsed operation over the 3800 to 7600 Mc range with an average power output of 125 milliwatts. Freely circulating and in some cases forced air is required for cooling of the grid ring cavity contacts. The extremely wide frequency range of this tube makes it ideally suited for signal generator and special local oscillator applications. A special control electrode facilitates low-voltage, pulsed modulation.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Voltage	6.3 ±0.5V
Heater Current	0.58 A

Ratings — Absolute Maximum Values

Resonator Voltage	1250 Vdc
Resonator Current	20 mAdc
Reflector Voltage	
Minimum Negative Value	−15 Vdc
Maximum Negative Value	−800 Vdc
Control Electrode Voltage	±25 V
Control Electrode Current	6 mA
Reflector Current	1 mAdc
Heater-Cathode Voltage	±50 V
Dissipation (Exclusive of Heater Power)	25.5 W
Temperature of G_3 Sleeve	160°C

Typical Operating Conditions (CW)

Coaxial Cavity as per Fig. 2	
Reflector Voltage Transit Mode	2¾ cycles
Cavity Mode	¾
Frequency Range	3800–7600
Resonator Voltage	1000 Vdc
Resonator Current (Exclusive of Control Electrode Current)	20 mAdc
*Reflector Voltage	−50 to −625 V
Reflector Current	0 mA
†Control Electrode Voltage	+4 to +18 Vdc
Control Electrode Current	5 mA (max.)
Control Electrode Cutoff Voltage	−8 to −23 Vdc
‡Electronic Tuning (Half Power)	12 Mc (min.)

*Adjusted for maximum power output.

†Adjusted for 20 milliamperes resonator current.

‡Change in frequency between the two ½ power points when the reflector voltage is varied above and below the point of maximum power output corresponding to the given frequency.

Reflector Modulation Sensitivity @ 7500 Mc	0.1 Mc/Volt
Power Output (Minimum)	90 mW
Power Output (Maximum)	150 mW
Power Output (Average)	100 mW
Thermal Compensation (Tube Without Cavity)	0.1 Mc/°C

Typical Operating Conditions (Pulsed)

Pulse Repetition Rate	40–4000 pps
Pulse Duration (Minimum)	0.5 μs
Rise Time	0.1 μs
Fall Time	0.1 μs
Beam Current During Off Time	10 μa

The general conditions for pulsed operation are the same as those given above for CW operation. Power output for pulsed operation will not be less than 1.5 db below the power output for CW operation over the band.

General Mechanical Characteristics

Mounting Position	Any
Over-all Dimensions	See Outline Drawing
Envelope	Glass
Seals	Glass to Copper Oxide
Banana Jack	Required Ucinite #152005 Mating Plug or Equivalent. Special Miniature 4 Pin, Fits Amphenol #78-545 Socket.
Base	Special
Vibration	10 G @ 50 cps
Altitude	50,000 ft (max.)

DETAILED ELECTRICAL INFORMATION

REFLECTOR

The reflector electrode is connected to the small banana jack on the top of the tube. Reflector voltages more positive than —15 volts with respect to the cathode may result in damage to the tube. Under conditions of vigorous oscillation and light loading, excessive reflector current may be drawn (in the order of one milliampere) on the long wavelength of the band. No damage will result, however, except in cases where the heavy reflector current flowing in a high reflector circuit impedance causes the reflector potential to swing increasingly positive with respect to the cathode. Where high reflector circuit impedances are used, it is advisable to shunt the reflector and cathode with a small diode to prevent the reflector from swinging positive.

CATHODE

In most applications, the metal cavity used with the RK6236 is operated at ground potential, and the cathode will be negative with respect to ground by the amount of this resonator potential. The cathode may be connected to one side of the heater or to the center tap of the heater transformer secondary. When the cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to a heater lead. When the cathode and heater are not tied together, the heater-cathode voltage should not exceed ±50 volts. In all cases where the resonator is operated at ground potential, the heater transformer must be insulated to withstand the maximum resonator voltage. Maximum tube life will be realized if a 30-second heater warmup period precedes the application of other voltages. The beam potential must never be applied before any other voltages.

CONTROL ELECTRODE

In applications where the RK6236 is to be used in both CW and pulsed operation, the circuit in Fig. 1 is recommended. With the selector switch in the CW position, the 6J6 is effectively out of the circuit and the bias on the RK6236 is set at a value that will yield a 20-milliampere beam current. With the selector set at the pulsed position, the 6J6 shunts the lower portion of the potentiometer and the volt-

age division is such that the RK6236 is biased to cutoff. A negative pulse of suitable amplitude applied to the grid of the 6J6 will drive it to cutoff and restore the grid of the RK6236 to the level set for CW operation.

ELECTRONIC TUNING

Vernier adjustment of the frequency of the RK6236 is accomplished by varying the reflector voltage. If the mechanical tuning mechanism employed in the external cavity and the reflector voltage are mutually adjusted to yield a maximum power output at a given frequency, and if then the reflector voltage is varied above and below the value for maximum power such that the power output is reduced to one half, the frequency change between the half power values is defined as the electronic tuning range. The range of electronic tuning and the linearity of its variation with reflector voltage is a function of the type of load and coupling used. Maximum electronic tuning range will be achieved with operation into a resistive load. Operation into a highly reactive load may be attended by excessive hysteresis, and nonlinear variation of frequency with reflector voltage.

FREQUENCY STABILITY

The regulation of the voltages applied to the reflector, resonator, and control grid will be reflected directly in the stability of the output frequency. Hence, the regulation of those voltage supplies must be commensurate with the stability requirements of the application.

The thermal frequency drift experienced with the RK6236 depends mainly on the changes in physical size of the resonant chamber with temperature. The RK6236 is temperature-compensated so that thermal coefficient of frequency drift will not exceed 0.1 Mc/°C when operating in a constant size cavity. The amount by which the frequency drift exceeds 0.1 Mc/°C is therefore dependent only on the thermal properties of the cavity. Careful consideration should be given to the material from which the external cavity is constructed.

MODE OF OPERATION

The RK6236 is designed for operation with contacting or noncontacting plunger-type coaxial cavities over the 3800 to 7600 Mc band in the 2¾ reflector mode. Design and construction of the above-mentioned cavities can be extremely troublesome, and certain design precautions must be observed to avoid interference from circumferential resonances, one-quarter wavelength modes, and multifrequency bunching. An extensive treatment of the design of wide-range coaxial cavities is beyond the scope of this publication; however, the following references contain adequate information pertinent to their design.

1. W. H. Huggins. "Multifrequency Bunching in Reflex Klystrons," Proc. I.R.E., XXXVI, 624-30.
2. W. H. Huggins. "Broad Band Non-Contacting Short Circuits for Coaxial Lines," Proc. I.R.E., XXXV, 1324-28.
3. Radio Research Laboratory Staff. "Very High Frequency Techniques." New York: McGraw-Hill, 1947, II, 916-19 and 900-11.

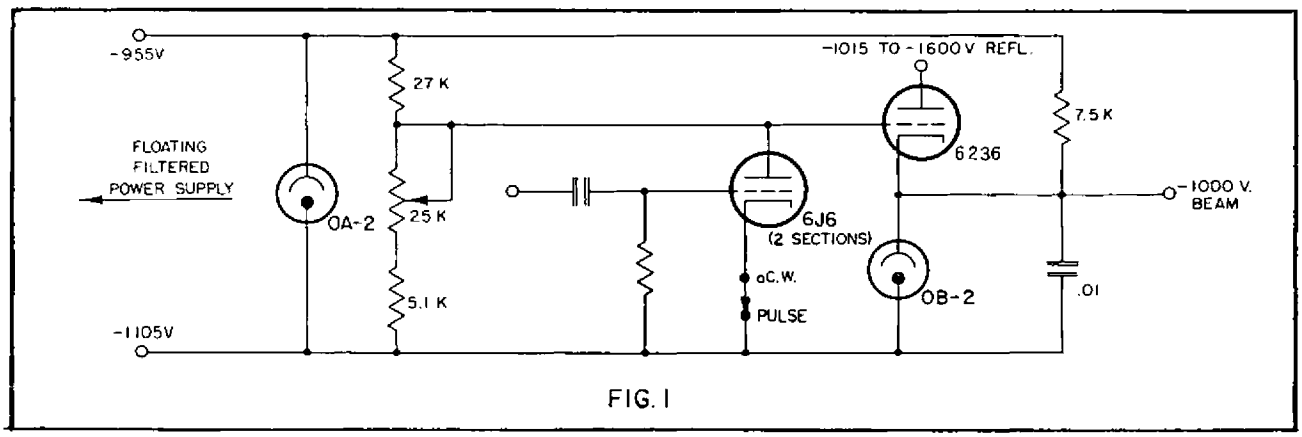


FIG. 1

DETAILED MECHANICAL INFORMATION

INSTALLATION

The tube mounts in any position and requires a special, miniature, 4-prong socket such as an Amphenol Type 78-545 or low-loss equivalent. Clamping to the G_2 ring should be made in such a manner that no mechanical strain be set up in the glass between G_2 and G_3 rings. A toroidal spring contact between the cavity and the G_2 ring, as shown in Fig. 2, is recommended.

Temperatures of the G_3 sleeve in excess of 160°C cannot be tolerated; and in cavities where center conductor conduction is insufficient to hold this tolerance, forced-air cooling is required. In general, the center conductor of wide-range coaxial cavities will have sufficient mass to provide adequate conduction. However, in situations where conduction is inadequate, a center conductor made of coin silver will improve conduction sufficiently to obviate forced-air cooling.

Optimum broad-band operation is best achieved with a load termination of 50 ohms and VSWR'S not greater than 1.25/1.

SHIELDING

Operation of the RK6236 in the presence of strong magnetic fields usually requires shielding of the resonator and reflector leads to avoid undesirable modulation of the tube output. In extremely troublesome environments, it may be necessary to place the parts of the RK6236 not covered by the cavity in a metal chamber with polyiron chokes provided on the leads bringing the voltages into the chamber.

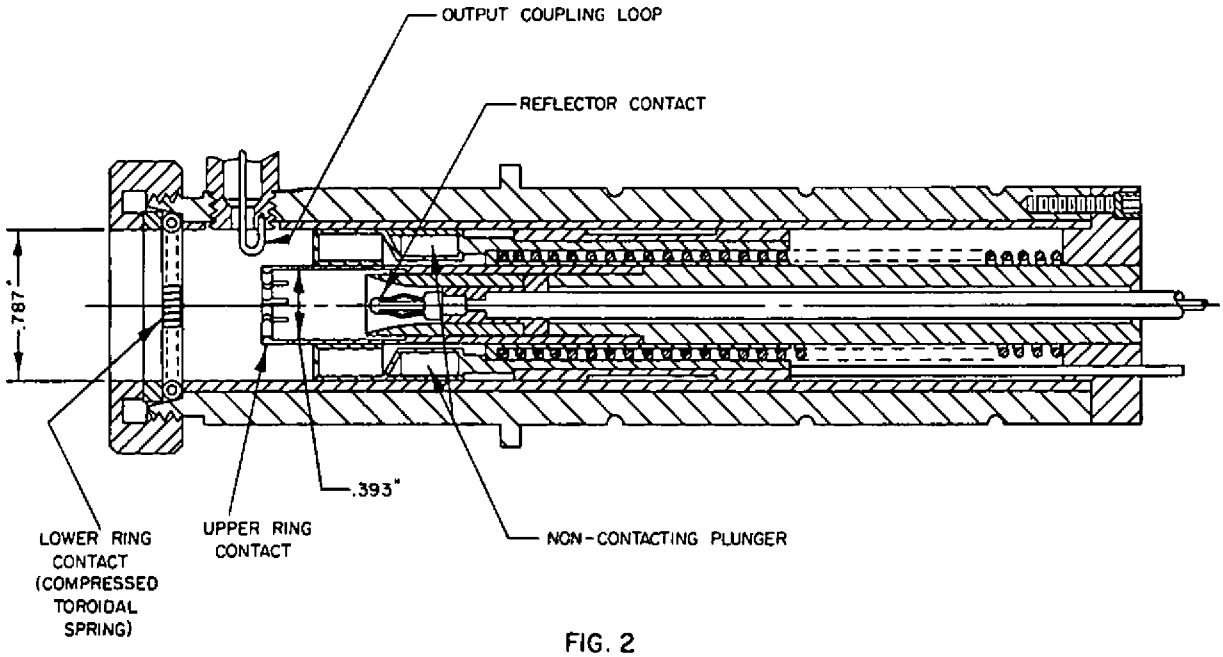
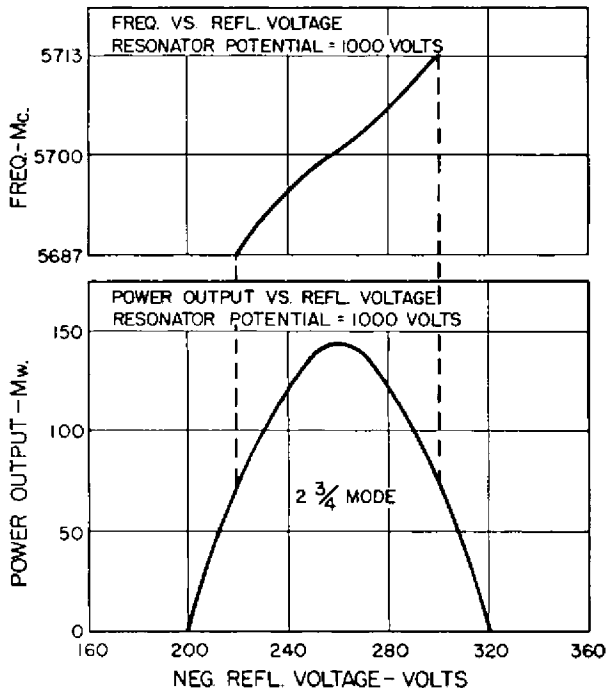
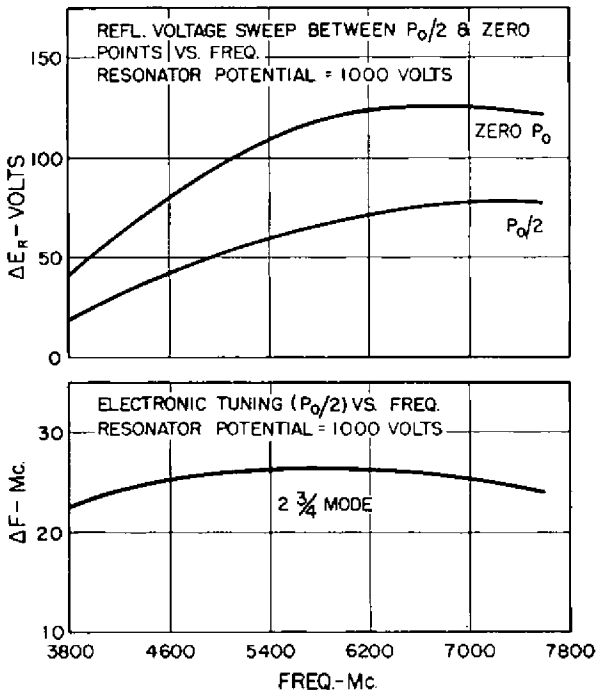


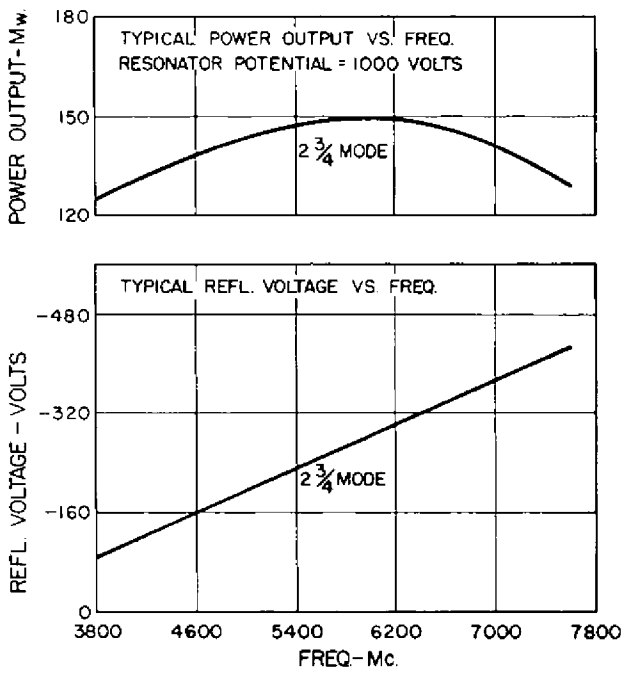
FIG. 2

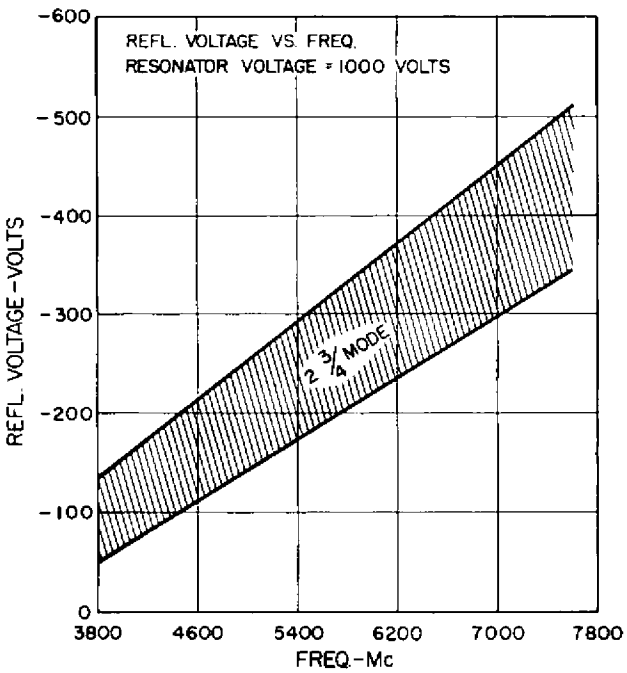
VELOCITY VARIATION OSCILLATOR

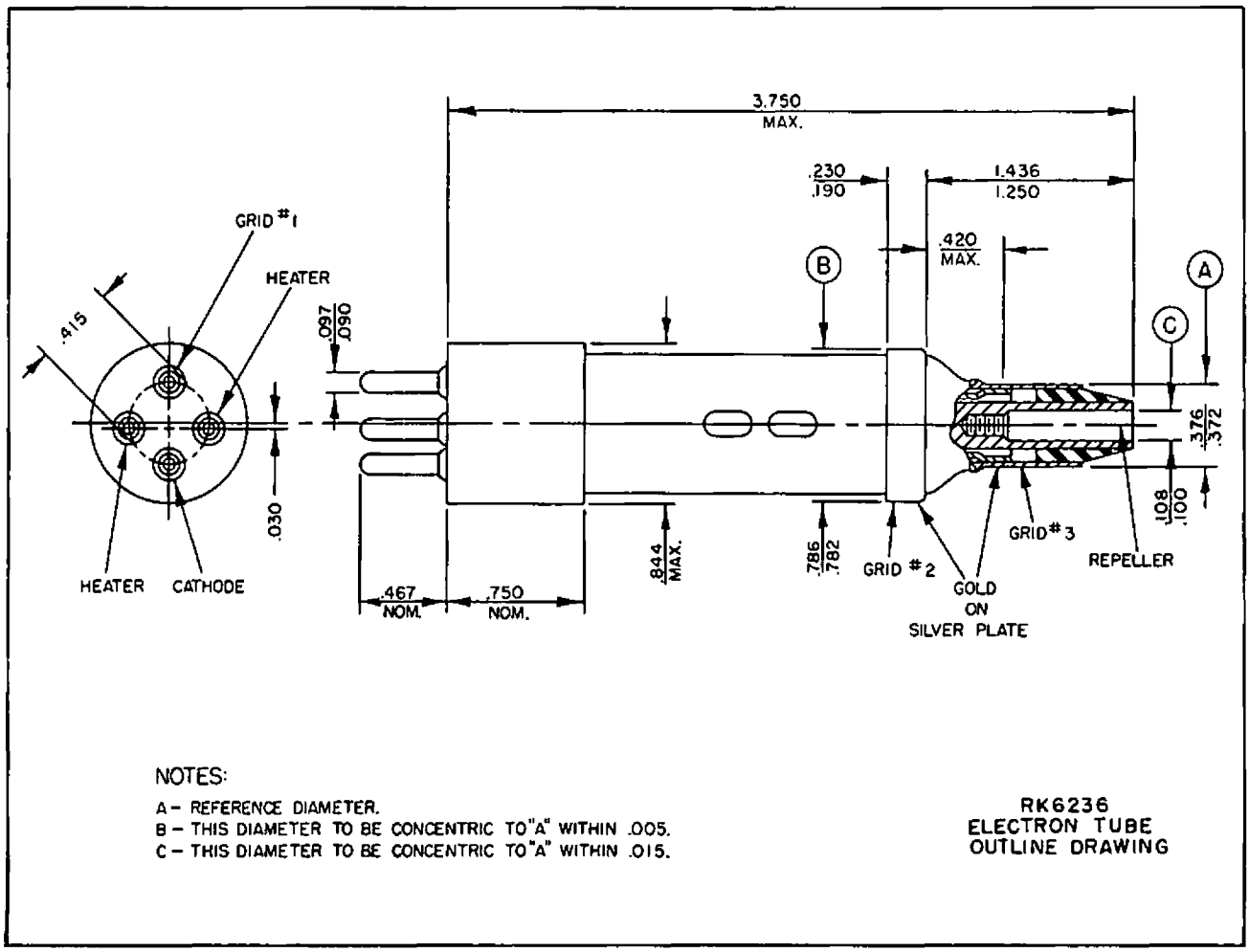




The exact value of reflector voltage producing maximum power output at a certain frequency varies from tube to tube. The voltage for all tubes, at each mode, will fall within the shaded area indicated below.







NOTES:

A – REFERENCE DIAMETER.
B – THIS DIAMETER TO BE CONCENTRIC TO "A" WITHIN .005.
C – THIS DIAMETER TO BE CONCENTRIC TO "A" WITHIN .015.

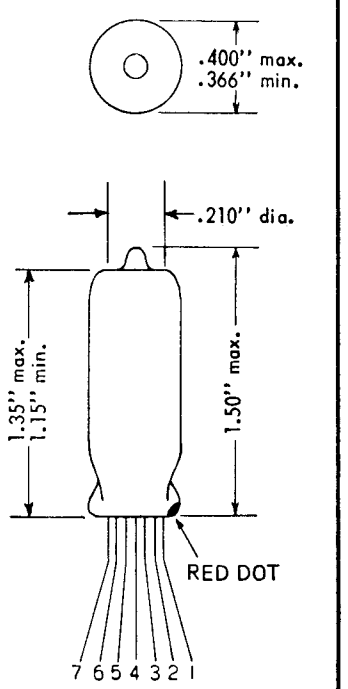
RK6236
ELECTRON TUBE
OUTLINE DRAWING

RELIABLE SUBMINIATURE PENTODE

TYPE CK6245

Excellence in Electronics

The CK6245 is a heater-cathode type sharp-cutoff pentode of subminiature construction capable of operation in the UHF region. The characteristics of this type are controlled to give uniform performance at low voltages. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. A separate terminal connection is provided for Grid #3, which under self-bias conditions can be connected directly to ground, permitting the cathode by-pass capacitor to be omitted for lower grid loading. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 5 Grid #3
Lead 2 Grid #2	Lead 6 Cathode
Lead 3 Heater	Lead 7 Grid #1
Lead 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	265 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION - To electronic equipment design engineers: Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1B SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	ABSOLUTE MAXIMUM	MIL-E-1B UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:		120	20	200	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Grid #2 Voltage	Ec2:		120	30	155	Vdc
Grid #3 Voltage	Ec3:		0	0	0	Vdc
Plate Dissipation	Pp:			0.05	1.85	W
Grid #2 Dissipation	Pg2:			0.03	0.55	W
Grid #1 Circuit Resistance	Rg1:			1.0		Meg.
Heater-Cathode Voltage	Ehk:	-200		100	+200	Vdc
Cathode Current	Ik:	0.5			20	mAdc
Cathode Resistance	Rk:		200	0		ohms

Tentative Data

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ELECTRICAL DATA (continued)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	LAL	BOGIE	UAL	MAX.	ALD	MIL-E-1B UNITS
Continuity & Tap Shorts:		0.4								
ACCEPTANCE TESTS GROUP A.		**COMBINED AQL = 2.5%**								
Heater Current:		0.65	If:	183		200		217		mA
Heater-Cathode Leakage (1):	Ehk = + 100 Vdc	0.65	Ihk (1):					7		μAdc
Heater-Cathode Leakage (2):	Ehk = - 100 Vdc	0.65	Ihk (2):					- 7		μAdc
Grid Current (1):		0.65	Ic1 (1):					- 0.1		μAdc
Plate Current (1):		0.65	Ib (1):	5.5	6.9	7.5	8.1	9.5	2.3	mAdc
Plate Current (2):	Ec1 = - 9.0 Vdc	0.65	Ib (2):					50		μAdc
Transconductance (1):		0.65	Sm (1):	4200	4775	5000	5225	5800	860	μmhos
Transconductance (3):	Eb = 20 Vdc: Ec2 = 30 Vdc: Ec1 = Ec3 = 0; Rg1 = 500 ohms max; Rk = 0.	0.65	Sm (3):	2250		3275		4300		μmhos
Plate Current (3):	Eb = 20 Vdc; Ec2 = 30 Vdc; Ec1 = Ec3 = 0; Rg1 = 500 ohms max. Rk = 0.	0.65	Ib (3):	1.0		2.5		4.0		mAdc
Screen Current (2):	Eb = 20 Vdc; Ec2 = 30 Vdc; Ec1 = Ec3 = 0; Rg1 = 500 ohms max. Rk = 0.	0.65	Ic2 (2):					1.5		mAdc
ACCEPTANCE TESTS GROUP B										
Insulation of Electrodes:	Ef = 6.3 V									
	Eg-all = - 100 Vdc	2.5	Rg1-all:	100						Meg.
	Ep-all = - 300 Vdc	2.5	Rp-all:	100						Meg.
Screen Current:		2.5	Ic2 (1):	1.7	2.4	2.6	2.8	3.5	0.8	mAdc
Transconductance (2):	Ef = 5.5 V (Note 9)	2.5	ΔSm (2):					10		%
AF Noise:	Esig = 50 mVac; Rg1 = 0.1 Meg; Ec2 = 19 Vdc; Rg2 = 1000 ohms; Rp = 0.2 Meg.	2.5	EB:					17		VU
Vibration:	F = 40 cps; G = 15; Rp = 10,000 ohms	2.5	Ep:					50		mVac
Subminiature Lead Fatigue Test:		2.5		4.0						arcs
ACCEPTANCE TESTS GROUP C										
Grid Current (2):	After 5 minutes at Ef = 7.0 V; measure grid current at Ef = 7.0 V; 3 minute test not permitted.	6.5	Ic1 (2):					- 0.1		μAdc
Plate Resistance:		6.5	Rp:	0.15						Meg.
Capacitance:			Cg1p:					0.03		μμf
Capacitance:	(Note 2)	6.5	Cin:	3.6		4.35		5.1		μμf
Capacitance:			Cout:	2.6		3.15		3.7		μμf

RAYTHEON

RELIABLE
SUBMINIATURE PENTODE

ELECTRICAL DATA (continued)

CHARACTERISTICS AND QUALITY CONTROL TESTS (continued)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS
ACCEPTANCE TESTS GROUP D						
Shock	Hammer Angle= 30°; Note 3					
Post Shock Limits:						
Vibration:	F= 40 cps; G= 15; Rp= 10,000 ohms		Ep:		100	mVac
Heater-Cathode Leakage (1):	Ehk=+ 100 Vdc		Ihk (1):		20	μAdc
Heater-Cathode Leakage (2):	Ehk= - 100 Vdc		Ihk (2):		-20	μAdc
Transc. (1) change of individual tubes from initial:	Ef= 6.3 V		△Sm (1):		20	%
Fatigue:	96 Hours; Note 5					
Post Fatigue Limits:						
Vibration:	F= 40 cps; G= 15; Rp= 10,000 ohms		Ep:		100	mVac
Heater-Cathode Leakage (1):	Ehk=+ 100 Vdc		Ihk (1):		10	μAdc
Heater-Cathode Leakage (2):	Ehk= - 100 Vdc		Ihk (2):		-10	μAdc
Transc. (1) change of individual tubes from initial:	Ef= 6.3 V		△Sm (1):		15	%
ACCEPTANCE TESTS GROUP E						
Glass Strain (Thermal Shock):		10				
Visual and Mechanical Inspection:	Major Combined	0.4				
	Minor A Combined	2.5				
	Minor B Per Item	6.5				
ACCEPTANCE LIFE TESTS						
Heater Cycle:	Ef= 7.5 V; Eb= Ec1= Ec2= Ec3= OV; Ehk= 140 Vac; 1 min. on, 1 min. off			2000		cycles
1 Hour Stability Life Test:	TA= room; Ehk=+ 200 Vdc; Rg1= 1.0 Meg.					
1 Hour Stability Life Test End Points:						
Transc. (1) change of individual tubes from initial:	(Typical sample size= 25 tubes)	10	△Sm (1):		8.0	%
100 Hour Survival Rate Life Test:	TA= room; Ehk=+ 200 Vdc; Rg1= 1.0 Meg.					
100 Hou Survival Rate Life Test End Points:						
Inoperatives:	(Typical sample size= 200 tubes)	0.4				
Transcond. (1):	(Typical sample size= 25 tubes)	1.0	Sm (1):	3250		μmhos

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Max. defects per characteristics
500 Hour Intermittent High Temperature Life Test (1):	TA= 200° C; Ehk=+ 200 Vdc; Rg1= 1.0 Meg.						
500 Hour Intermittent High Temperature Life Test (1) End Points:	(Typical sample size= 20 tubes) (Total allowable combined defects= 4 tubes)						
Inoperatives:							1
Heater Current:			If:	183	217	mA	4
Heater Cathode Leakage (1):			Ihk (1):	0	10	μAdc	2
Heater Cathode Leakage (2):			Ihk (2):	0	-10	μAdc	2
Grid Current (1):			Ic1 (1):	0	-0.3	μAdc	2
Grid Current (2):			Ic1 (2):	0	-0.3	μAdc	2
Transc (1) change of individual tubes from initial:			△Sm (1):		25	%	1

ELECTRICAL DATA (continued)

CHARACTERISTICS AND QUALITY CONTROL TESTS (continued)

TEST	CONDITIONS	AQL %	MIL-E-1B SYMBOL	MIN.	MAX.	MIL-E-1B UNITS	Max. defects per characteristics
Transc. (2) change of individual tubes from Ef= 6.3 to 5.5 V:			△Sm (2):		15	%	4
Insulation of Electrodes:			Rg1-all:	50		Meg.	4
Insulation of Electrodes:			Rp-all:	50		Meg.	4
5000 Hour Intermittent Life Test (2):	TA= room; Ehk= +200 Vdc; Rg1= 1.0 Meg.						
5000 Hour Intermittent Life Test (2) End Points:	Read for same characteristics as for Life Test (1). Limits not established.						

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1B, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D. - 17/8" long) connected to lead 6.

Note 3: Test conditions and acceptance criteria per shock Test procedures of MIL-E-1B basic specification.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1B basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

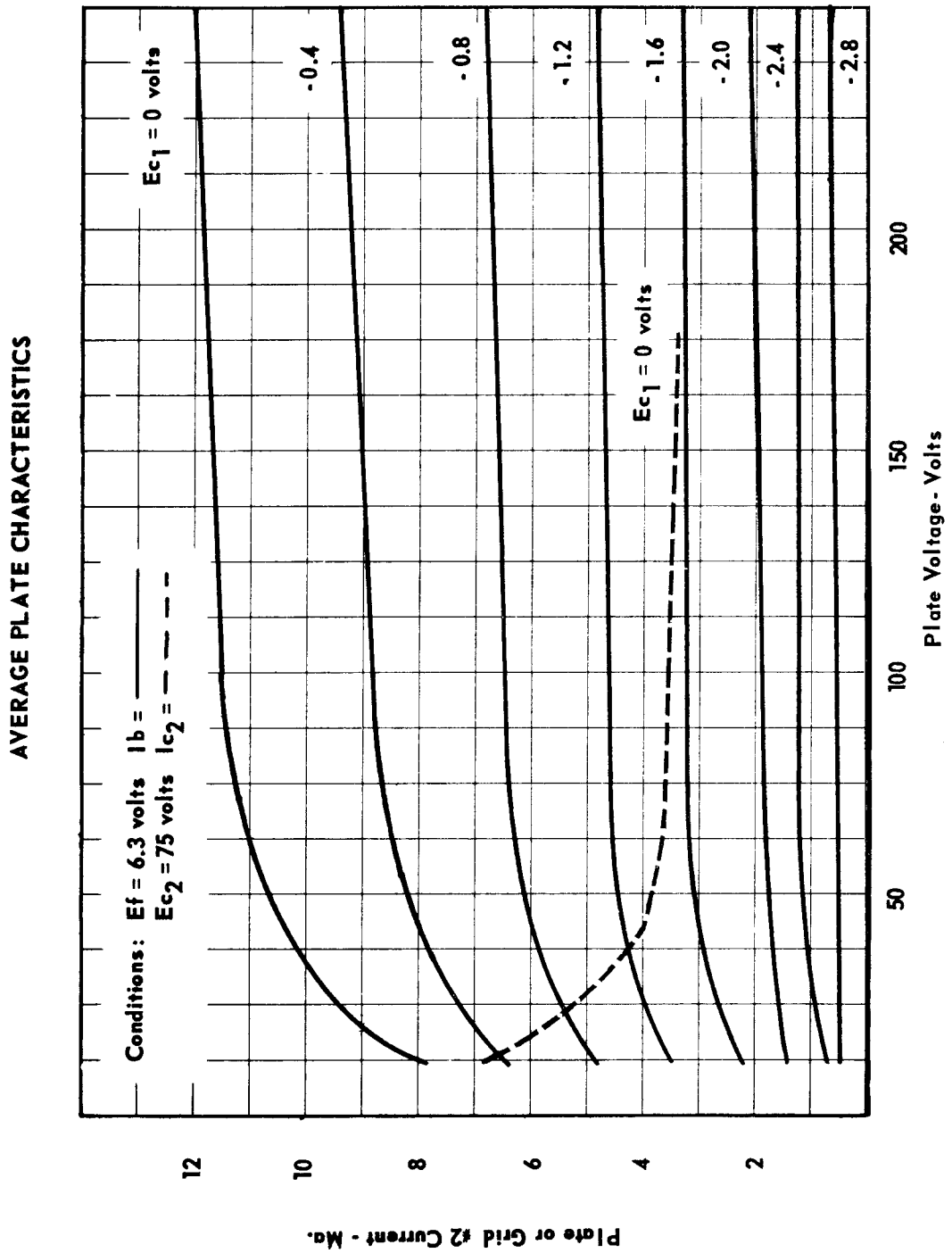
Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef= 6.3 V to that value measured at Ef= 5.5 V.

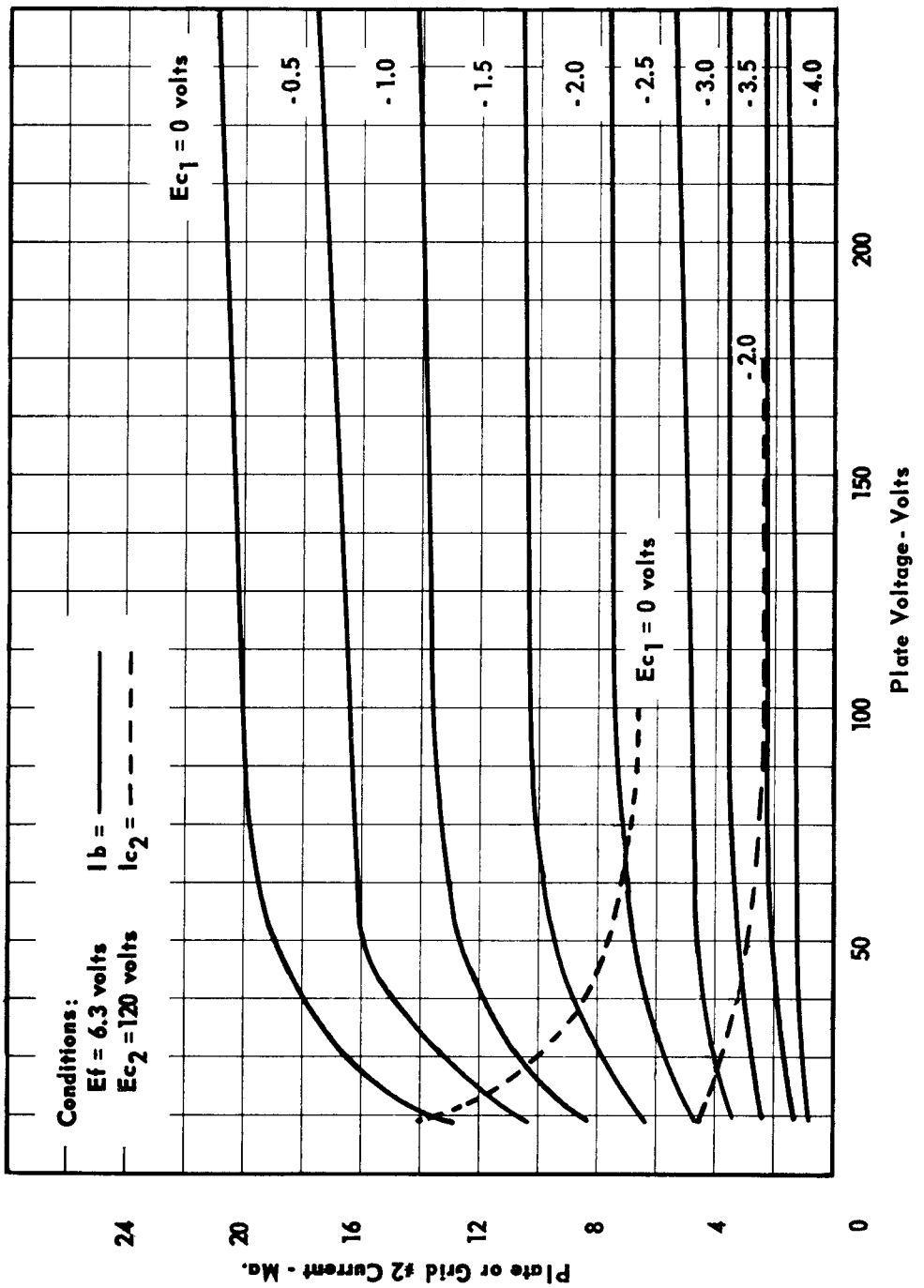
RAYTHEON

RELIABLE
SUBMINIATURE PENTODE

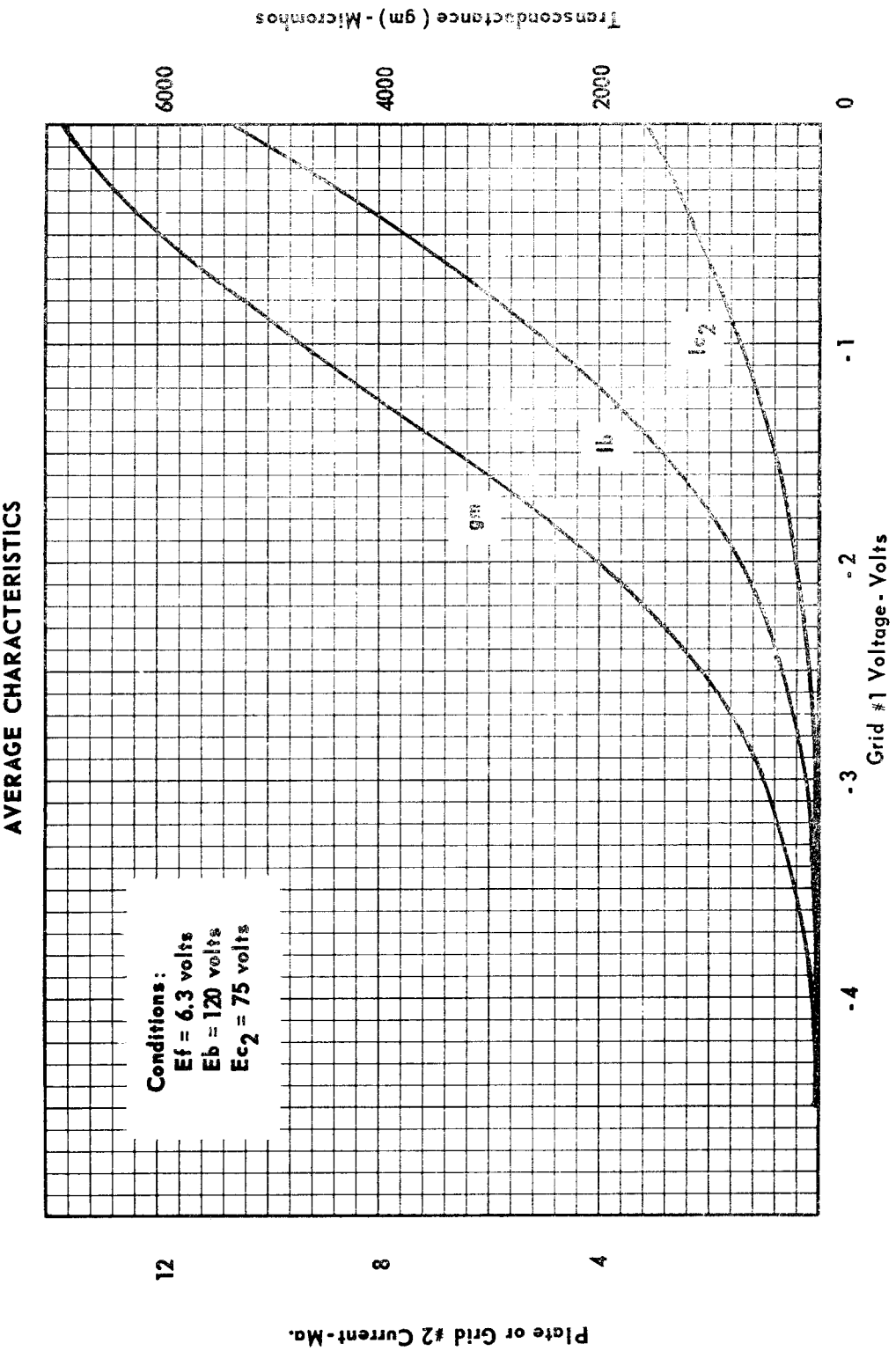
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

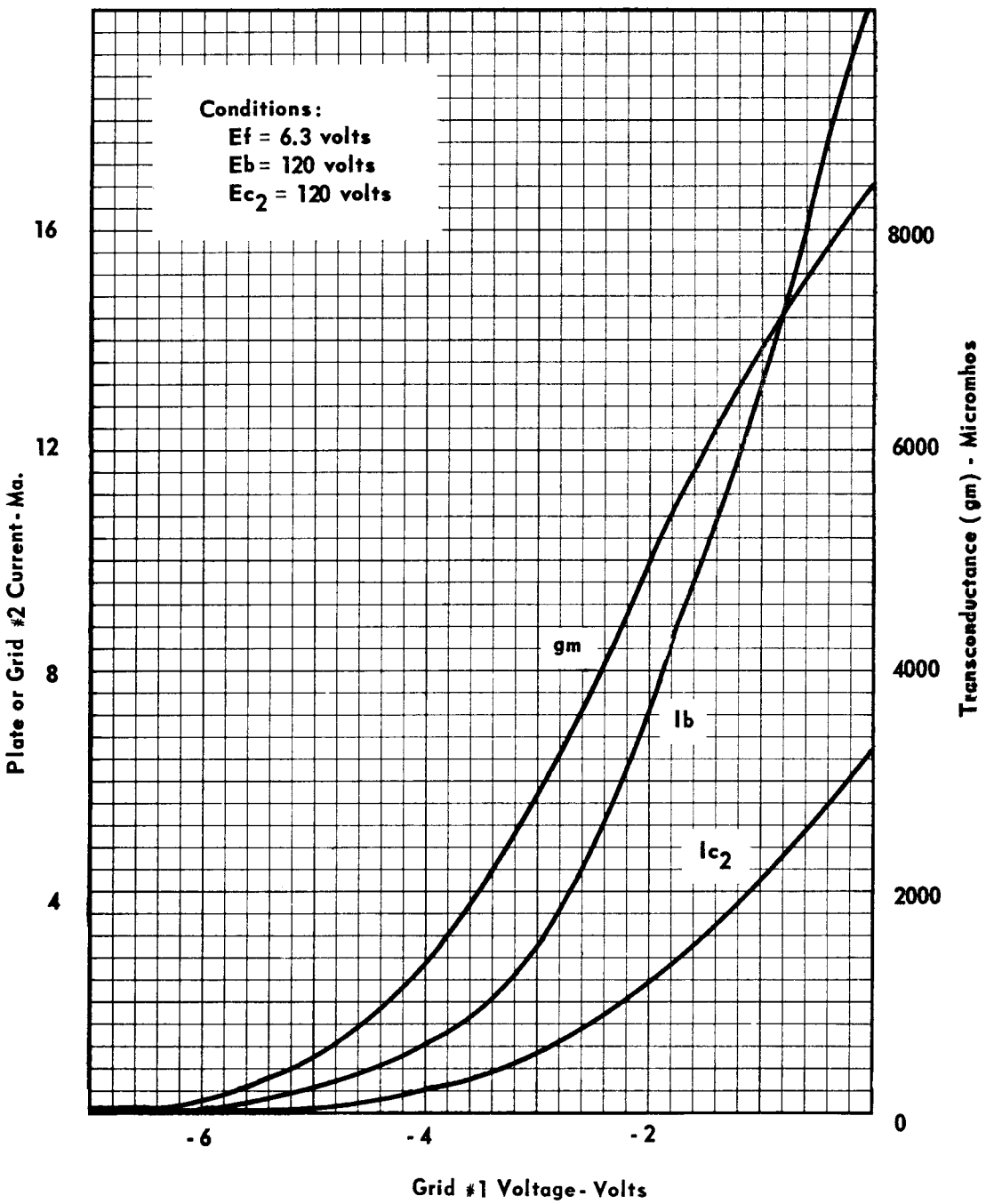


RELIABLE
SUBMINIATURE PENTODE

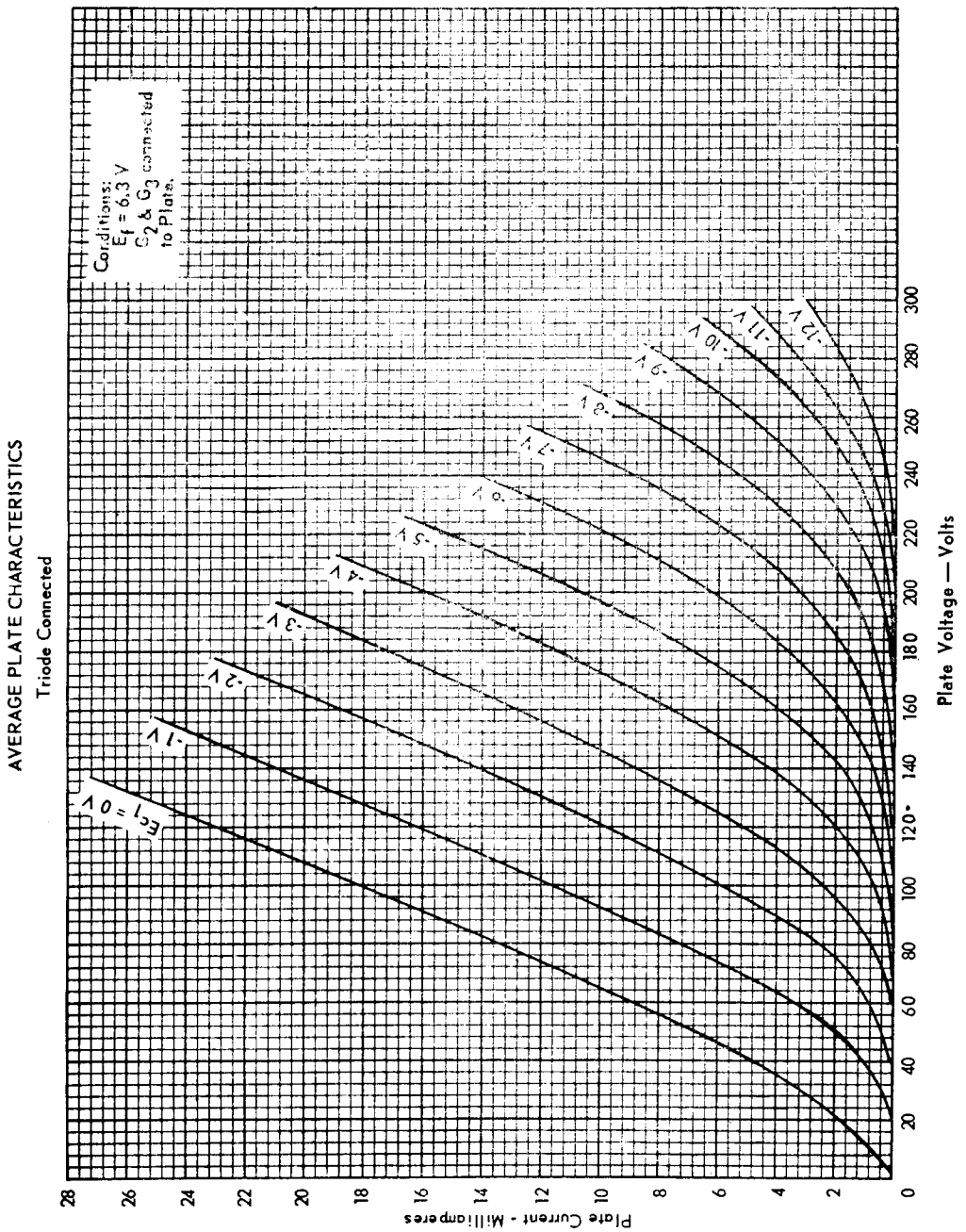


RELIABLE
SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



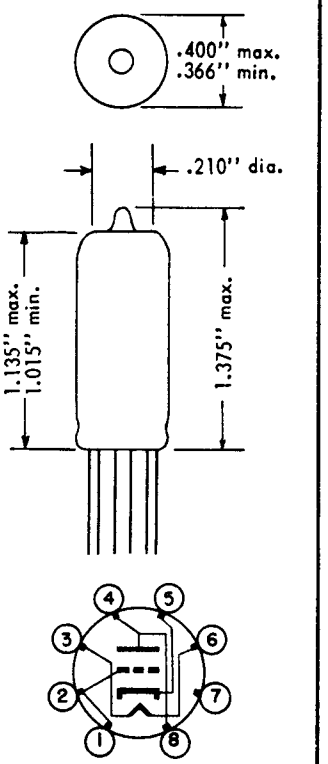
RELIABLE
SUBMINIATURE PENTODE



Excellence in Electronics

TYPE CK6247WA

The CK6247WA is a heater-cathode type high-mu triode of subminiature construction designed for applications where freedom from microphonic response is of primary importance. The mechanical design is such that microphonic output due to structural resonances is reduced throughout the audio frequency range by approximately 20 db as compared to more conventional triodes. It is particularly useful in voltage amplifier circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8 – Pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW
8FO

MECHANICAL DATA

ENVELOPE: T – 3 Glass

BASE: Subminiature Button 8 – Pin (0.017" tinned flexible leads. Length: 1.5" min.)

TERMINAL CONNECTIONS:

Lead 1 Grid	Lead 5 Cathode
Lead 2 Grid	Lead 6 Heater
Lead 3 Heater	Lead 7 No Connection
Lead 4 Plate	Lead 8 Plate

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test – Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test – Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test – Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	250	250	275	Vdc
Grid #1 Voltage	Ec1:	–55	0	0	----	Vdc
Plate Dissipation	Pp:	----	----	1.05	1.25	W
Grid #1 Circuit Resistance	Rg1:	----	----	1.0	1.2	Meg.
Heater-Cathode Voltage	Ehk:	–200	----	100	+200	v
Plate Current	Ib:	0.5	----	4.2	6.5	mAdc
Cathode Resistance	Rk:	----	500	500	----	ohms
Grid Current	Ic:	----	----	----	1.0	mAdc
Transconductance (1)	Sm(1):	----	----	2650	----	μmhos
Amplification Factor	Mu:	----	----	60	----	----

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1		**Combined AQL = 1.0% excluding Mechanical and Inoperatives**								
Heater Current:		0.65	If:	190	----	200	----	210	----	mA

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY
RECEIVING AND CATHODE RAY TUBE OPERATIONS

April 1, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1 (cont'd)										
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	0.65	Ihk: Ihk:	---- ----	---- ----	---- ----	---- ----	5 5	---- ----	μAdc μAdc
Grid Current:		0.65	Ic (1):	----	----	----	----	−0.3	----	μAdc
Plate Current (1):		0.65	Ib (1):	3.0	3.6	4.2	4.8	5.5	1.2	mAdc
Plate Current (2):	Ec1=−8.0 Vdc	0.65	Ib (2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.65	Sm (1):	2100	2350	2650	2950	3200	550	μmhos
AC Amplification:	Esig=0.2 Vac; Ebb=100 Vdc; Ecc1=0; Rg1=10 Meg; Rp=0.5 Meg; Rk=0.	0.65	Ep:	5.0	----	----	----	----	----	Vac
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8−1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef=6.3 V Eg−all=−100 Vdc Ep−all=−300 Vdc	2.5	Rg1−all: Rp−all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Transconductance (2):	Ef=5.7 V	2.5	Δ_{Ef} Sm (2):	----	----	----	----	7.5	----	%
Grid Emission:	Ef=7.5 V; Preheat 5 minutes at Ec1=0; Test at Ec1=−10 Vdc.	6.5	Ic (2):	----	----	----	----	−0.5	----	μAdc
AF Noise:	Esig=25 mVac; Rp=0.2 Meg; Rg1=1.0 Meg.	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	51	55	60	65	69	8	----
Capacitance:			Cgp:	1.1	----	1.7	----	2.3	----	μμf
Capacitance:	(Note 2)	6.5	Cin:	1.4	----	2.0	----	2.6	----	μμf
Capacitance:			Cout:	0.5	----	0.7	----	0.9	----	μμf
Low Pressure Voltage Breakdown:	Pressure=55±5 mm Hg; Voltage=300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	2.5	Ep:	----	----	----	----	2.5	----	mVac
Vibration (3):	F=30−1000 cps; G=15; Rp=10,000 ohms; Positions X_1 and X_2 only	6.5	ep:	----	----	----	----	25 peak to peak	----	mV
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Ehk=+100 Vdc; Rg=0.1 Meg.; Hammer Angle=30° (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 Hours; G=2.5; Fixed frequency; F=25 min. 60 max.; (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 Hours; G=10; Fixed frequency; F=25 min. 60 max.; (Note 12)	6.5	----	----	----	----	----	----	----	----
Post Shock (1) and Fatigue Tests (1) and (2) End Points:		----	----	----	----	----	----	----	----	----
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	----	----	----	5.0	----	mVac

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)								
Heater-Cathode Voltage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm(1):	----	10	%		
Grid Current:		----	Ic(1):	----	−1.0	μAdc		
Shock (2):	G=75; (Hammer Angle=120°+rubber pad); t=10 milliseconds; Ehk=+100 Vdc; Rg=0.1 Meg. (Note 13)	----	----	----	----	----		
Shock (2) End Points:		----	----	----	----	----		
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	5.0	mVac		
Heater-Cathode Voltage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm(1):	----	10	%		
Grid Current:		----	Ic(1):	----	−1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling:	Ef=7.5 V; Eb=Ec1=0V; Ehk=140 Vac; 1 min. on, 1 min. off	1.0	----	----	2000	cycles		
Heater Cycling Life Test End Points:		----	----	----	----	----		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=−100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=Room; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical Sample Size=50 tubes)	----	----	----	----	----		
Change in Transconductance (1) of individual tubes:		1.0	Δ_tSm(1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=Room; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical Sample Size=200 tubes)	----	----	----	----	----		
Continuity and Shorts (Inoperatives):		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm(1):	1850	----	μmhos		
Intermittent High Temperature Life Test:	T Bulb=220°C; Ehk=+200 Vdc; Rg=1.0 Meg.	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	---	----	----	----	1	3
Grid Current (1):		----	Ic(1):	----	−0.5	μAdc	1	3

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
Heater Current:		----	If:	180	220	mA	1	3
Change in Transconductance (1) of individual tubes:		----	Δ_t Sm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm(2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5
Insulation of Electrodes:								
g1-all p-all		---- ----	Rg1-all: Rp-all:	50 50	---- ----	Meg. Meg.	2	5
Transconductance (1) Average Change:		----	Avg.Δ_t Sm(1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic(1):	----	-1.0	μAdc	2	5
Heater Current:		----	If:	177	223	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_t Sm(1):	----	30	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	---- ----	Ihk: Ihk:	---- ----	15 15	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by paragraph 5.3.8 of "Inspection Instructions for Electron Tubes."

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the 3 minute plate current (1) value. No preheating before this test will be allowed.

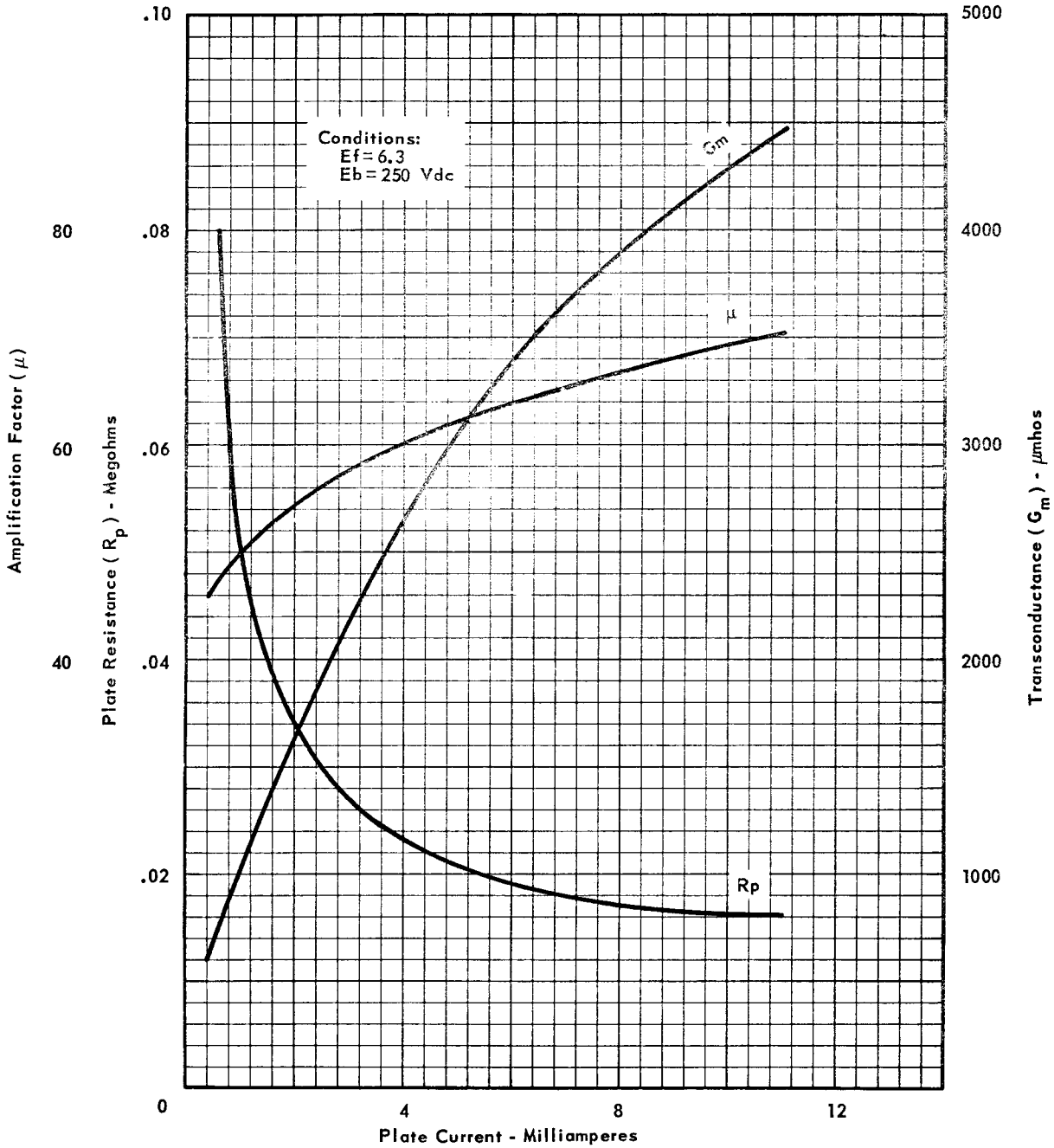
Note 12: The tube shall be rigidly mounted on a table vibrating with simple harmonic motion. The tube shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X_1, X_2 and Y_1. Only rated rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures:

(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.
(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

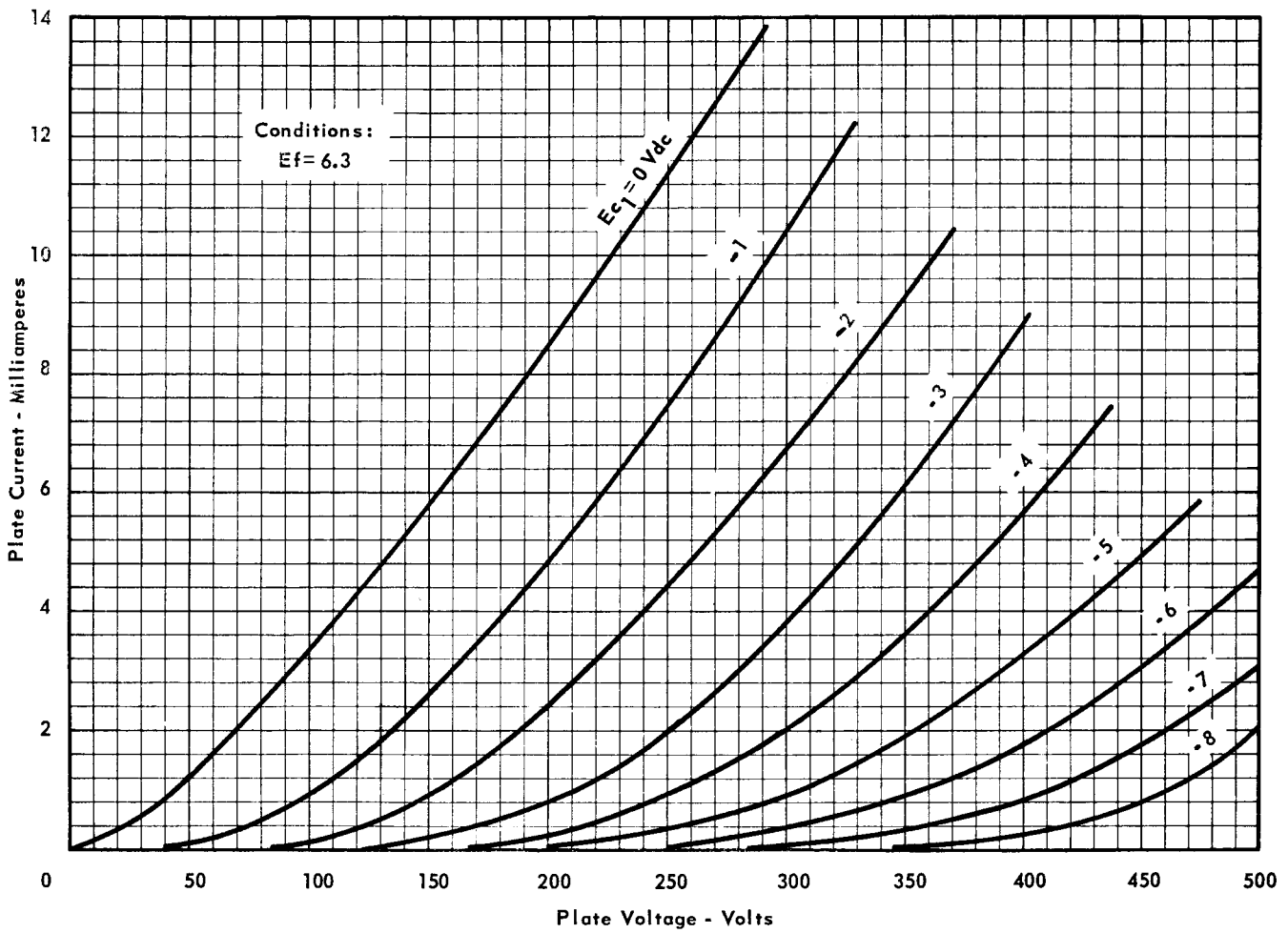
Note 13: The provisions of MIL-E-1 ref. 4.9.20.5 shall apply except for test conditions listed for Shock Test (2):

RELIABLE SUBMINIATURE TRIODE

AVERAGE CHARACTERISTICS

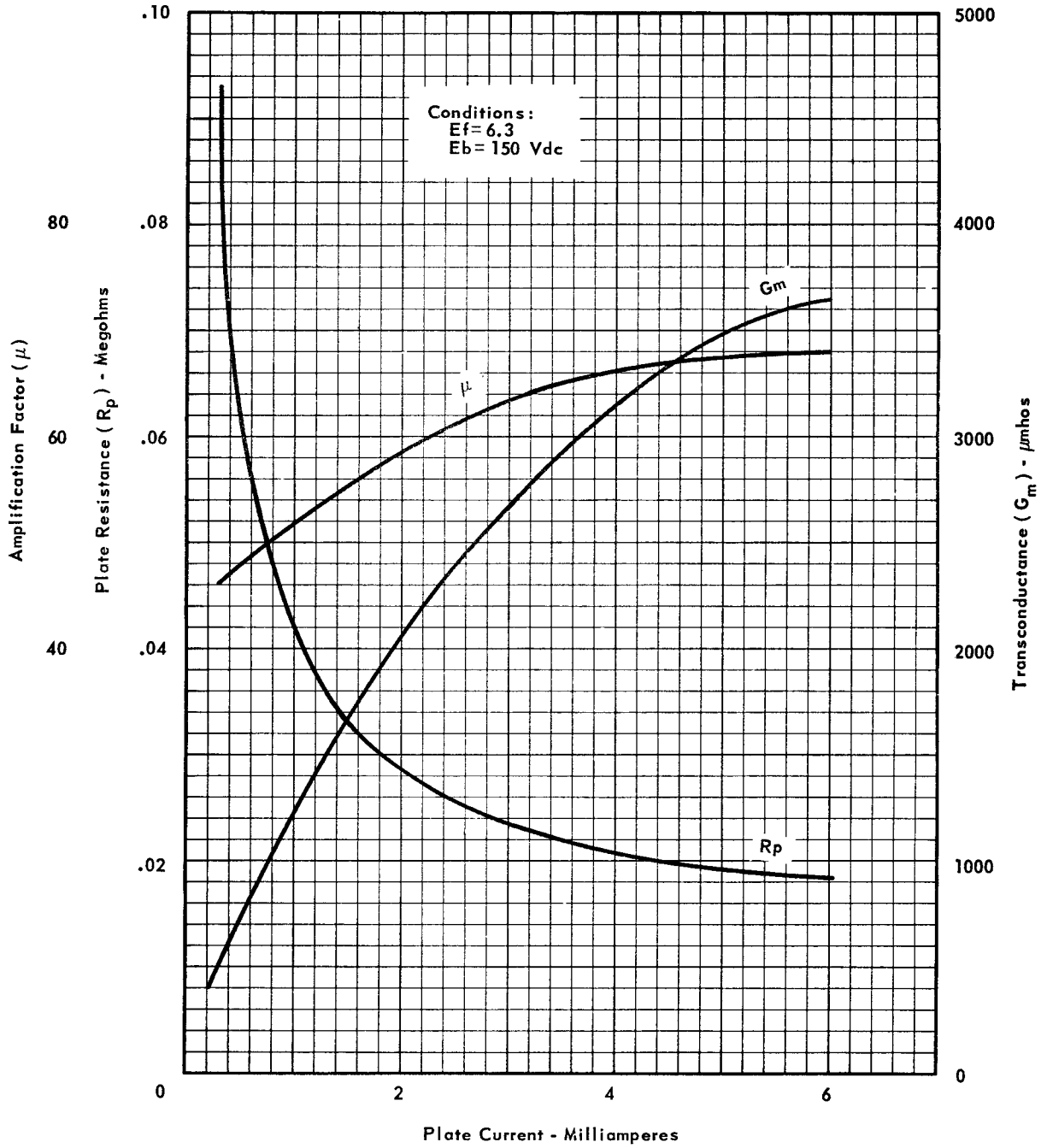


AVERAGE PLATE CHARACTERISTICS

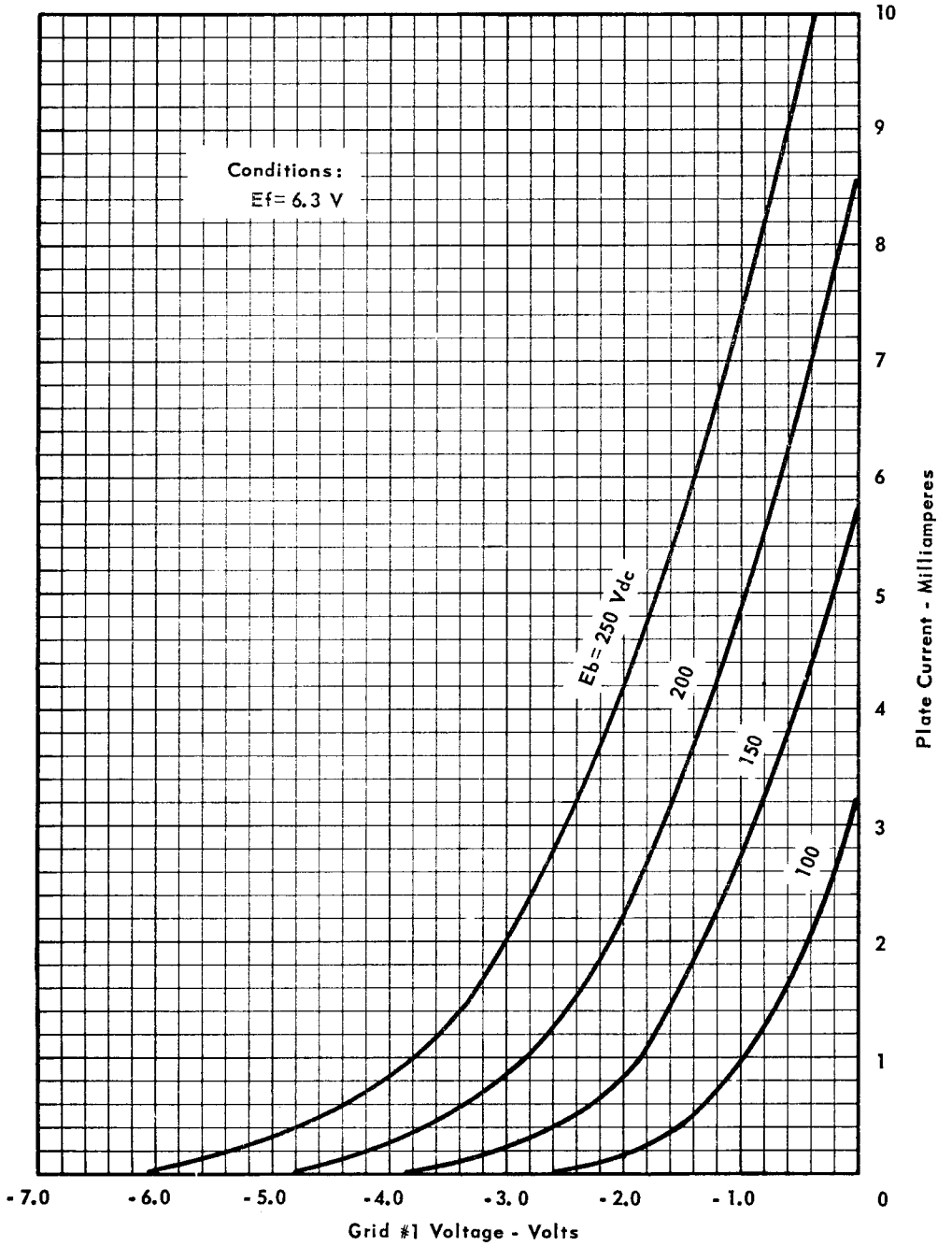


RELIABLE SUBMINIATURE TRIODE

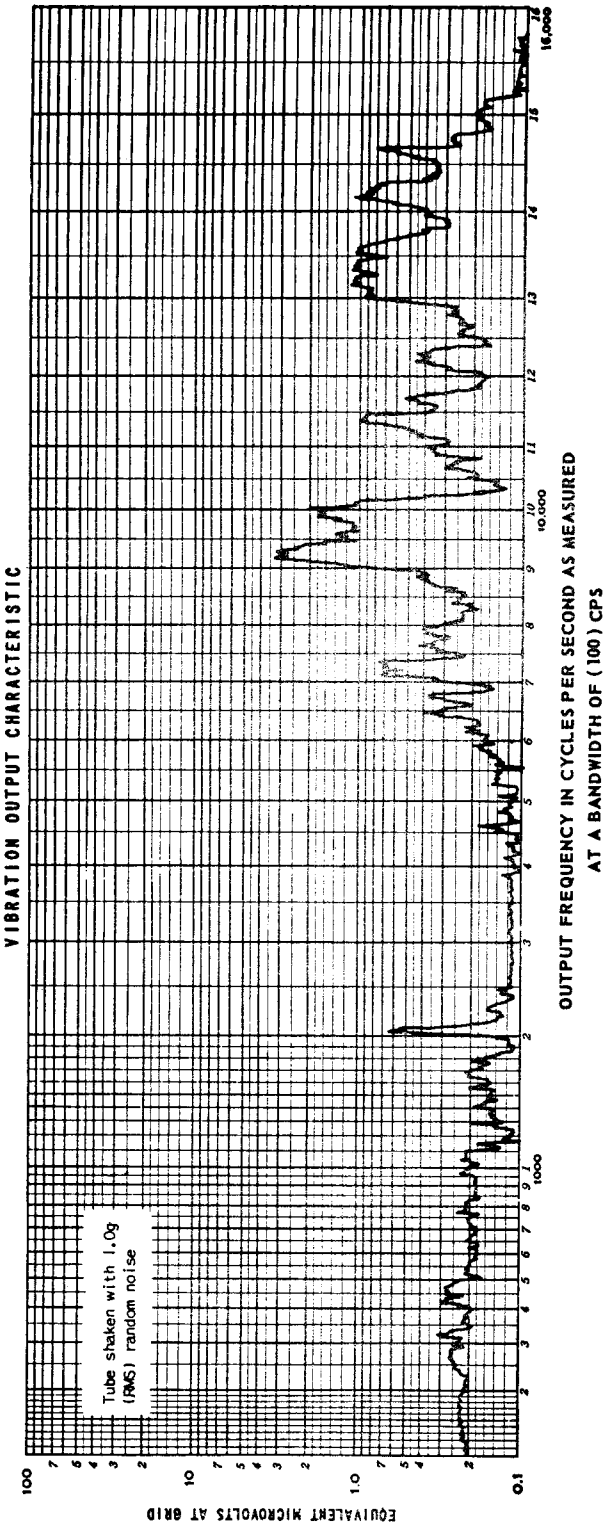
AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



RELIABLE SUBMINIATURE TRIODE



RAYTHEON

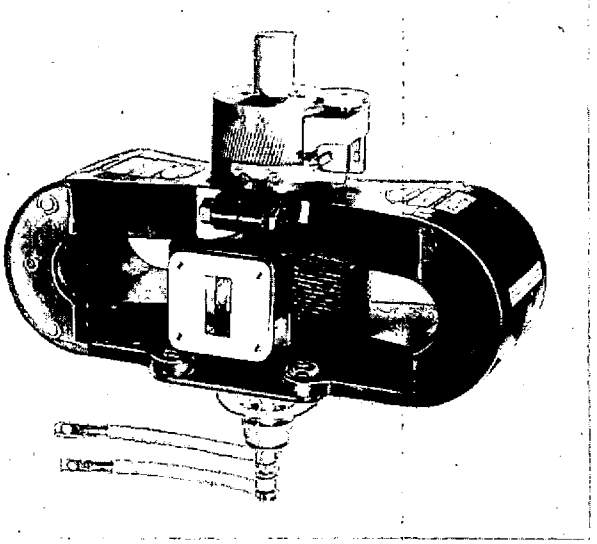
TECHNICAL INFORMATION

Excellence in Electronics

TYPE RK-6249A

GENERAL DESCRIPTION

The RK6249A magnetron is a mechanically tunable pulsed-type oscillator with a nominal peak power output of 240 kilowatts. This magnetron is capable of either rapid hand or motor tuning to any desired frequency in the 8500 to 9600 megacycle range. It is an integral magnet type, requiring forced air cooling, and is designed for coupling to a standard ⅝" x 1¼" pressurized waveguide.



TUNABLE PULSED-TYPE OSCILLATOR

GENERAL PRECAUTIONS

As is the case with other electrical components, if magnetrons are operated continuously at their maximum ratings, some deterioration in life will result. There are many problems peculiar to magnetrons in general which must be given special consideration in system design, such as r.f. radiation, pulse shaping, VSWR, and length of transmission line to the antenna. These problems are discussed in detail in the following pages. If for any reason it is desired to operate the RK6249A under conditions other than those recommended in this technical data sheet, the Applications Group at Raytheon must be consulted. In some special cases, additional evaluation and life test will be necessary.

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data sheet rather than the MIL-E-1C Government Purchase Specification should be used as a guide to equipment designers.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Voltage — Preheat	9.0 Volts
Heater Current @ 9.0 Volts	12.8-15.6 Amperes
Minimum Preheating Time	3 minutes

Maximum Ratings

Heater Voltage	10.0 Volts
Peak Current	32.0 Amperes
Peak Power Input	1000 Kilowatts
Duty Cycle	.0013
Minimum Pulse Voltage Rise Time	.1 us.
Maximum VSWR	1.5
Anode Temperature	125°C.

The values specified above are based on the "absolute system," and are not to be exceeded under any service conditions. The ratings are limiting values above which serviceability of any individual tube can be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

Typical Operation	Oscillation (1)	Oscillation (2)
Pulse Recurrence Frequency	2000	400
Pulse Duration	.5	2.5 us.
Peak Anode Voltage	28.0	28.0 kv
Peak Anode Current	25.0	25.0 a
Average Anode Current	25.0	25.0 mAdc

MECHANICAL

Mounting Position	Any
Detailed Dimensions	See Outline Drawing (Fig. 9)
Net Weight	16 lbs., 4 oz. (Approx.)
Cooling	Forced Air
Pressurization	45 p.s.i. Absolute
Output Coupling Flange	UG 52/U
Tuner Torque	6" lbs. Maximum

DETAILED ELECTRICAL INFORMATION

HEATER

The RK6249A should be preheated at 9.0 volts for a minimum time of 3 (three) minutes. For a .001 duty cycle on both the .5 and 2.5 usec pulse, the heater voltage should be reduced to 6.0 volts. If, however, the tube is to operate at a .0005 duty cycle, the operating heater voltage should be at 8.0 volts. Heater voltage must be kept at ±10% of the specified values at all times. Heater surge current must not exceed 2½ times the maximum rated current. Excessive heater surge current will cause the heater in the magnetron to fail.

See Figure 1 for heater voltage vs. input power curve.

RK6249A HEATER VOLTAGE VS. INPUT POWER

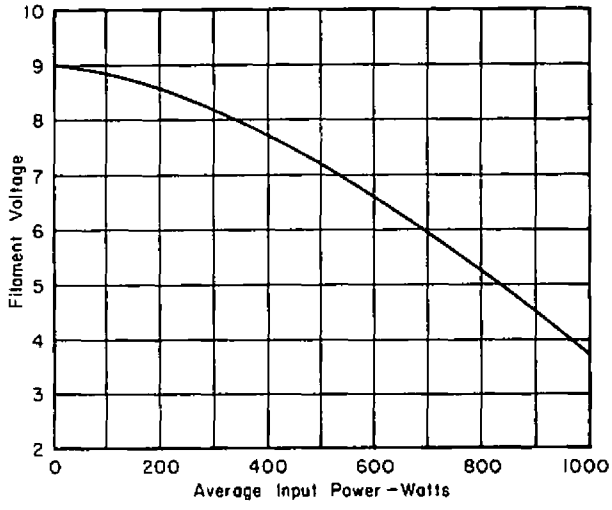


Figure 1

PULSE LENGTH AND DUTY CYCLE

The RK6249A has been utilized in systems which operate the tube at pulse lengths from 0.25 to 3.2 microseconds, and at duty cycles up to .001. Operation at pulse durations and duty cycles within these limits is entirely satisfactory. Consultation with the Applications Engineering Department is recommended before finalizing the operating conditions of any contemplated equipment design. The RK6249A is normally tested in the factory at a .001 duty cycle and 0.5 and 2.5 microseconds.

PULSE CHARACTERISTICS

The smooth peak is the maximum value of a smooth curve through the average of the fluctuation over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which the instantaneous current is 50 per cent of the smooth peak. The rise time is the time interval between points of 20 and 85 per cent of the smooth peak. Figure 2 shows

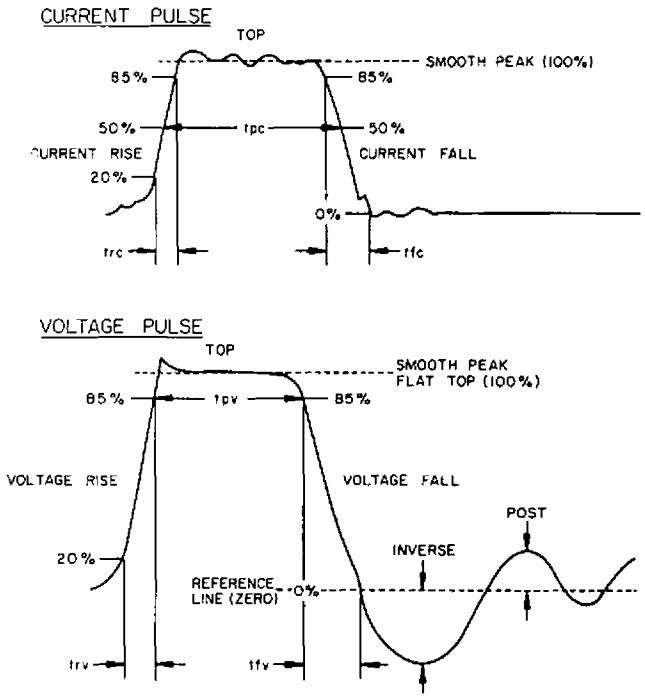


Figure 2

graphically the definitions mentioned. The voltage rise time must not be less than .10 usec for both the .5 and 2.5 usec pulse widths to realize good tube performance. Too fast a rise time may lead to instability. It is necessary to form the pulse so that the current pulse shows no sign of jitter and no large spikes on the leading edge, as these conditions also may cause instability. The ripple on the top of the current pulse must be kept at a minimum to avoid pushing effects which will tend to widen the spectrum. The trailing edge or decay time of the voltage pulse must be as short as possible to obtain optimum performance and high operating efficiencies.

Many magnetrons draw a certain amount of leakage or diode current at anode voltages as low as 100 volts. For this reason, it is not only advisable to keep the time duration of the voltage pulse trailing edge as short as possible; but also to prevent the positive voltage backswing from becoming negative again. The diode current can amount to several milliamperes at an average current of 25 milliamperes. Except for giving falsely exaggerated indications as to the actual peak current at which the magnetron is operating, diode current is not harmful unless it becomes excessive.

For optimum pulse shaping, the magnetron, pulse transformer, and pulse line must be treated as a unit. It is advisable to build up an experimental pulse line and hand tailoring it for optimum magnetron current and voltage pulse shape when used in conjunction with the pulse transformer and the RK6249A.

"Close in returns" or "false echoes" have frequently been related to the generation of r.f. noise from magnetrons during the duration of pulse backswing when voltage is present across the tube but of insufficient value to cause normal oscillation. There has been no experience of this sort with the RK6249A. If this is encountered more information regarding this phenomenon in general may be obtained from the Applications Engineering Department.

INITIAL OPERATION

No unusual precautions should be taken when first operating a new tube or one that has been in storage for some time. If any instability of the RK6249A is observed, however, it is usually very short term and its manifestation is related to the sensitivity of the modulator overload circuit and the pulse duration. Seldom is any initial instability encountered with magnetrons at pulse durations of less than one microsecond unless there is a basic problem (i.e., rise time) with the design of the modulator pulse shape. For pulse lengths greater than one microsecond, initial instability may occur. Every RK6249A is tested for "starting stability" at the factory at a 2.5 microsecond pulse width. The criteria for acceptance is a 1% maximum allowable number of "missing r.f. pulses" during the initial test interval immediately following the application of high voltage. This is a standard MIL-E-1C test procedure.

The sensitivity of the overload circuit and the operational requirements of a system are items which should be thoroughly discussed with the Applications Engineering Department.

LOAD DIAGRAM

Figure 3 is a load diagram of a typical RK6249A magnetron. The contours of constant power output and frequency change are related to the voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 3.5/1.0 are plotted, but operation at ratios greater than 1.5/1.0 is not recommended.

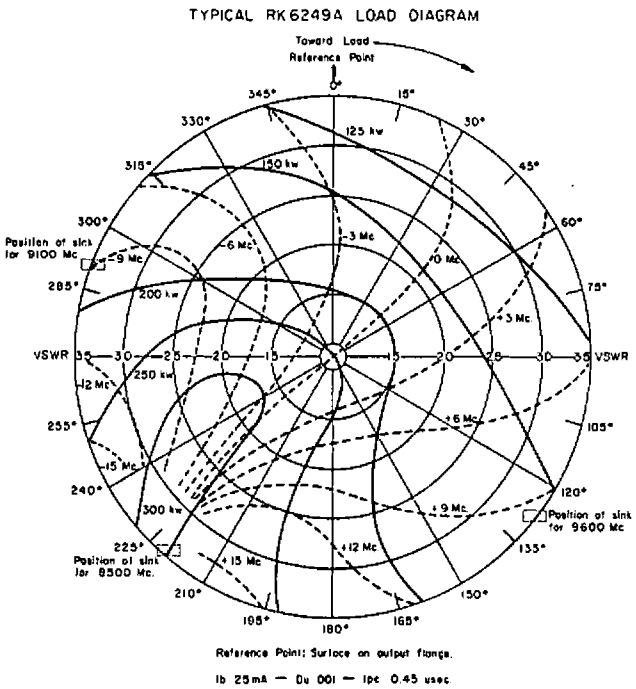


Figure 3

POWER INPUT

The impedance of the RK6249A is initially established at the factory by adjustment of the magnetic field. At a frequency of 9000 Mc (3.0 on the tuning dial) and at a peak anode current of approximately 25 amperes, the peak voltage is within the range of 27 to 29 kilovolts, corresponding to an impedance of 1080 to 1160 ohms. The impedance of the magnetron varies as its frequency is tuned. The change in voltage required to maintain a constant current from 8500 to 9600 Mc is 2.75 kilovolts.

If the RK6249A is used in a circuit which requires tunability without regulation of anode current, the power input to the tube will be determined by the load line characteristic of the modulator. If such is the case, and a conventional line type modulator is used, it is recommended that the power input be initially adjusted for the nominal anode current when the tuning gear is set at 3.0 on the dial. The power output may then be lower or higher than the published data, depending upon the anode current deviations from the rated value as the tube is tuned. If a hard tube modulator is used, regulation of anode current is mandatory.

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "Long Line Effects." Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case, the extent to which the long line effect is exhibited depends on the amount of coupling between the load and the oscillator as well as the degree of mismatch in the line. Figure 4 shows the relation between the VSWR and the line length with respect to the critical condition of the skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the tube's ordinarily smooth drift curve.

PRESSURIZATION

The waveguide output section must be pressurized with 15 p.s.i.a. of clean dry air or equivalent means to prevent electrical breakdown.

The input bushing is capable of operation without pressurization up to an altitude of 10,000 ft.

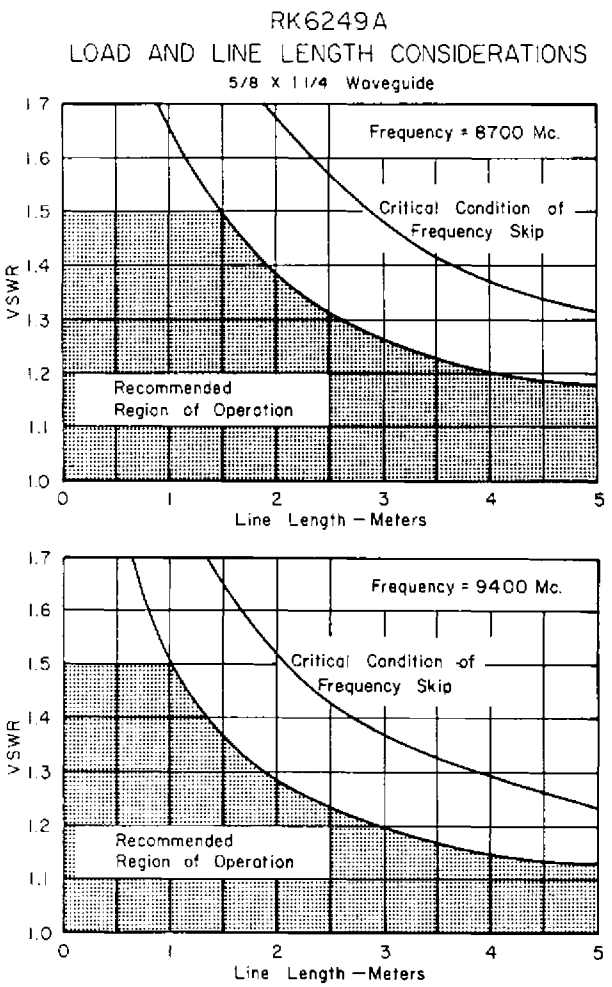


Figure 4

WAVEGUIDE BREAKDOWN

If an arc occurs anywhere in the waveguide run, it may immediately be reflected back to the magnetron output window. The arc effectively short circuits the magnetron output, heats the window, resulting in implosion of the glass.

The minimum power specification for the tube is 200kw at an average current of 25mAdc; however, an average tube can yield 240kw into a matched load, 300kw into a VSWR of 1.5/1.0 at 25mA, and 375kw into a VSWR of 1.5/1.0 at an average current of 28mAdc. For this reason, a large size "X" band waveguide is recommended, and *all* waveguide components should be capable of withstanding 400kw.

COOLING

The air stream for cooling the RK6249A should be directed to the air inlet of the radiator through a close fitting duct. Anode temperatures of 100°C or lower are recommended, although temperatures as high as 125°C can be tolerated. Sufficient circulating air or equivalent cooling must be supplied around the input bushing so that the bushing temperature will never exceed 270°C. See Figure 5 for cooling characteristics.

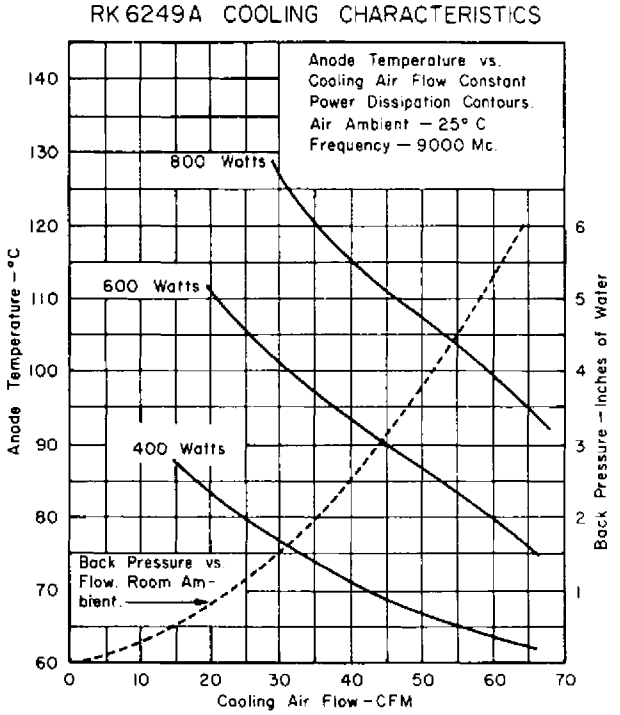


Figure 5

FREQUENCY DRIFT

After operation of the RK6249A is initiated, the tube's temperature increases with time until thermal equilibrium is reached. During this period, the dimensions of the tube change slightly and consequently the operating frequency changes or drifts. The average frequency drift characteristics of the RK6249A after starting at room temperature is presented in Figure 6. If the tube temperature is changed after thermal equilibrium has been established, such as will be the case with changes in ambient temperature or changing duty cycles, the operating frequency will also change until

the new equilibrium is reached. The resulting frequency change in this case will be less than .25 megacycles per centigrade degree.

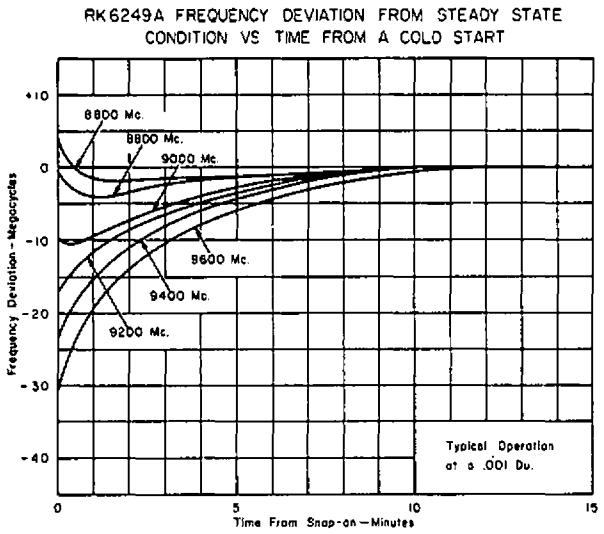


Figure 6

FILAMENT SUPPLY FREQUENCY

The RK6249A has a large alnico magnet which supplies the field energy. Interaction between the magnetic field and the AC field of the filament coil may excite electro-mechanical resonances of the filament structure. For this reason, variable frequency supplies must be avoided. Frequencies of 60, 400, or 1600 cycles should be used, as these regions have been investigated, and have been found to contain no resonances.

It may be necessary in MTI applications to use a DC source in order to avoid heater modulation.

R. F. SPECTRUM BANDWIDTH

The r.f. spectrum is related directly, but not exclusively to the shape of the input pulse. The property of the tube which contributes to the spectrum shape is called "pushing." Pushing is related to electron density within the interaction space. Electron density in turn is related to pulse width and current. As the pulse width increases the deviation of the spectrum from its direct relationship to the input pulse may be more pronounced.

With pulse widths shorter than 1 microsecond, a theoretical spectrum should not be expected until the magnetron current pulse shape has attained comparable properties, particularly a fast fall time. With pulse widths greater than 2 usec, the spectrum may deviate from the ideal at discrete currents usually above 9,000 mcs. Ordinarily this phenomenon of spectrum broadening is only apparent over very narrow phase changes in the reflections of loads having a high VSWR.

Factory specifications allow a maximum bandwidth of 1.5 Mcs. measured at the —6db point on the power spectrum. The test is performed at a pulsewidth of 2.5 usec. with an r.f. load having a 1.5 minimum VSWR phased for maximum bandwidth.

It is recommended in applications where VSWR's in excess of 1.3 are unavoidable that a ferrite type r.f. load isolator be used in conjunction with the magnetron.

POWER OUTPUT

At the nominal anode current of 25 amperes, the minimum power output from the RK6249A is 200 kilowatts. The actual distribution of power is greater, however, with the average minimum being 240 kilowatts. If the anode current is maintained constant as the magnetron is tuned, the power output is greater at each frequency extreme than at the minimum power frequency which occurs in the middle of the band.

The power output is directly related to the power input with the value being directly proportional to the anode current. The effect of load VSWR can result in a further variation as great as ±20% with a VSWR of 1.5.

In a typical system, under extreme conditions of line voltage, load VSWR, and frequency, the RK6249A may deliver 375 kilowatts of peak power.

During the operational life of the tube, power output may vary. Military specifications for any

magnetron consider a tube acceptable in this regard as long as the power output does not decrease by more than 20%. Such a decrease in power output rarely occurs in practice.

Absolute power measurements should only be made with a calorimetric standard.

R. F. RADIATION FROM CATHODE

All magnetrons radiate r.f. energy or noise from the input bushing. Proper shielding should be provided to prevent this energy from affecting sensitive circuits. This is normally accomplished if the magnetron is mounted in a compartment of a pulse transformer assembly.

X-RADIATION

Radiation from the internal anode structure of the RK6249A during oscillation emanates in a conical pattern through the glass of the input bushing and from the waveguide output window.

Exposure to this radiation, although not considered harmful, should be avoided inasmuch as the national trend is toward minimization of unnecessary exposure.

In normal mounting of the tube in a completed system where the input bushing is immersed in a compartment of oil and the waveguide output is connected to the r.f. plumbing, there is sufficient attenuation to absorb or shield the radiation. As a further precaution, the inside of the housing which the bushing fits into may be coated with a lead paint. The Applications Engineering Department can supply the details for procurement of this material.

In laboratory setups, care should be taken to shield these areas or by appropriate mounting to direct the input bushing away from personnel. Observation of the cathode in an oscillating tube by viewing through the output window should be avoided unless lead glass is used.

TUNER TORQUE

Not less than 10" ounces nor more than 6" pounds should be applied to the drive shaft of the tuner.

TUNING

Tuning is accomplished by rotating the double ended worm shaft driving the tuning dial gear. Counter clockwise rotation of the tuning gear increases the operating frequency of the tube.

155 ±15 turns of the tuning shaft (worm gear) covers the entire 1100 mc tuning range. The turns ratio of the worm gear to the dial gear is 25 to 1. Under the factory test conditions, dial readings corresponding to the following frequencies are stamped on the magnet of each tube.

Dial Reading	*Approximate Frequency*
A	8750 Mc
B	9250 Mc
C	9375 Mc

In addition, the dial gear is adjusted so that at a reading of 3.0 the frequency is approximately 9,000 Mc. Tuning linearity is a consistent characteristic of the RK6249A. The variation of any tube from the average tuning curve is within ±25 Mc. Refer to Figure 7.

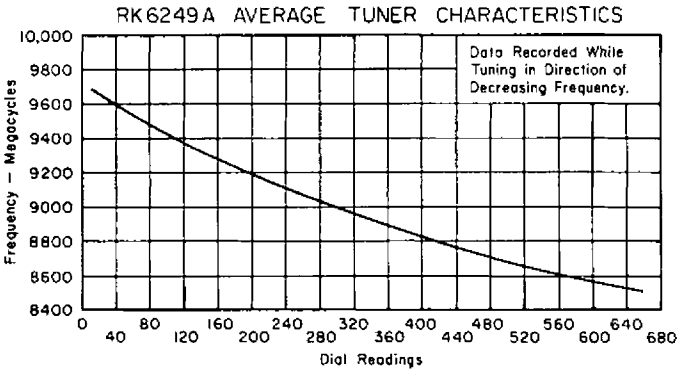


Figure 7

The RK6249A has been designed for rapid tunability. No appreciable wear, backlash, or changes in characteristics will occur for at least 5,000 cycles at tuning speeds of the drive shaft as high as 1500 rpm. Even higher speeds are feasible.

The tuning mechanism requires a maximum torque of 12 inch oz. under the most extreme conditions of temperature, minus 55°C. The stop mechanism is designed to withstand not more than 6 in. lbs. without damage.

RK6249A AVERAGE PERFORMANCE CHARACTERISTICS

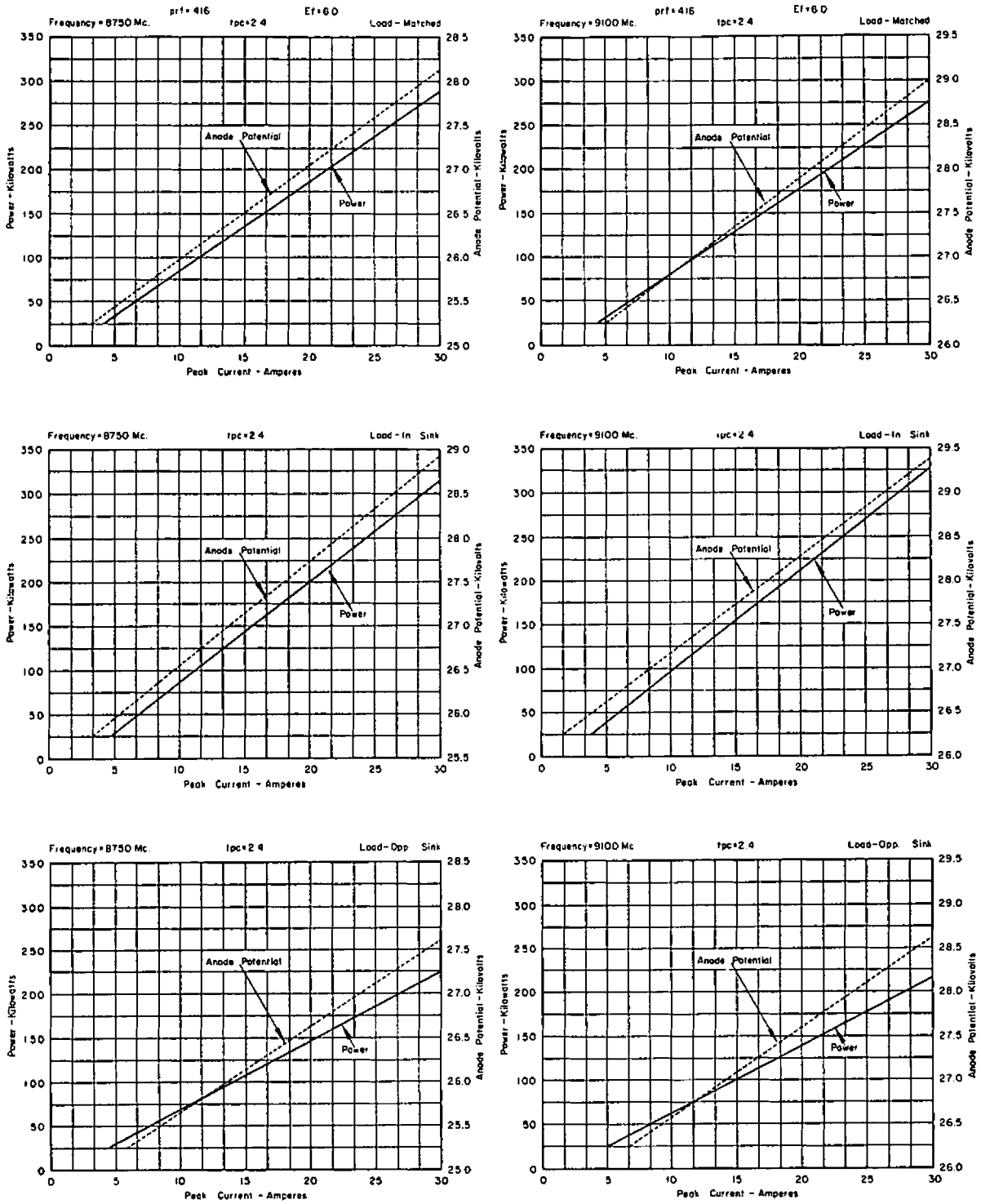


Figure 8

RK6249A AVERAGE PERFORMANCE CHARACTERISTICS

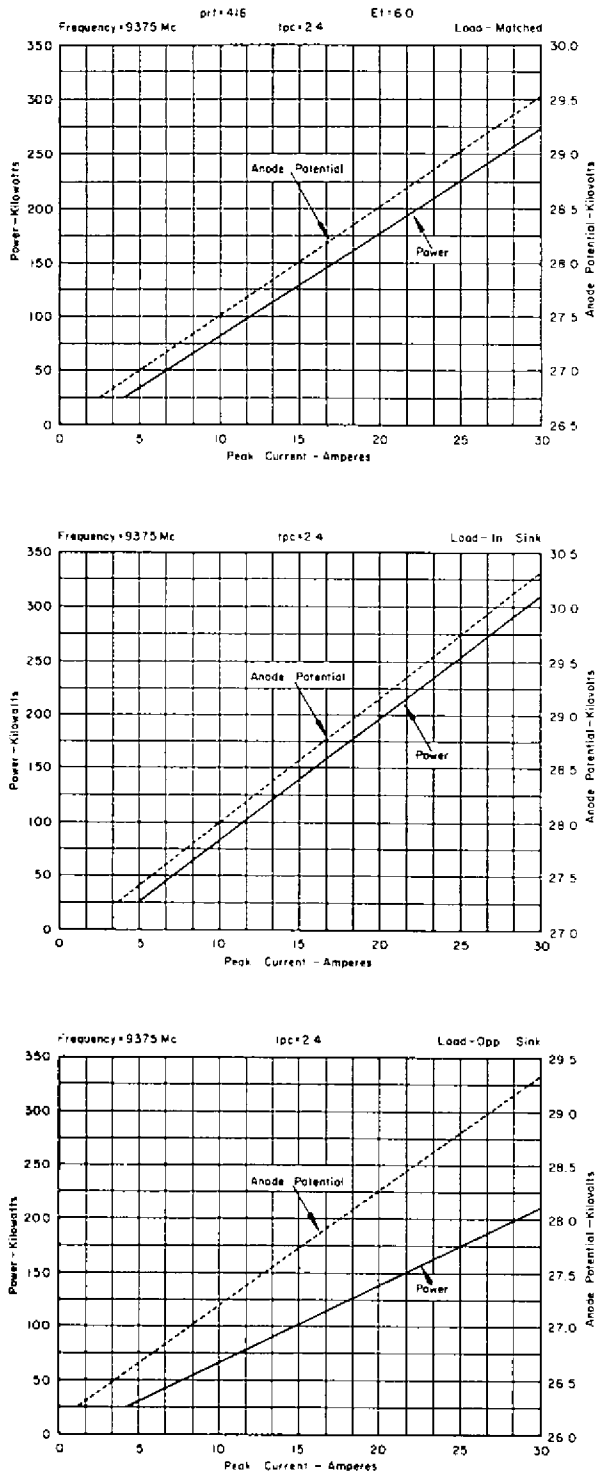


Figure 8

DETAILED MECHANICAL INFORMATION

INSTALLATION AND HANDLING PRECAUTIONS

The high voltage bushing and the output window are protected by guard covers during shipment. These covers must be removed before the tube is installed in its associated equipment. No mechanical strain should be applied to the bushing or the output window in handling or mounting the magnetron.

Care should be taken to keep magnetic materials 4" away and ferro-magnetic materials 12" away from the magnets. The aluminum coating on the magnets minimizes the danger of demagnetization by contact but cannot be guaranteed completely effective. Deterioration of the magnetic field will cause low power and instability.

Unnecessary jarring of the tube must be avoided. While a packaged magnetron may give an appearance of massiveness and great strength, the internal structure is delicate and involves critical alignment of parts. In the event of careless handling, the resulting shock may easily exceed the maximum allowable.

MOUNTING

The tube is mounted from the four holes in the mounting flange which provide clearance for ¼" bolts. The RK6249A may be mounted in any position.

ELECTRICAL CONNECTIONS

Electrical input connections are made to the frame of the tube and to two flexible leads terminated in lugs with clearance holes for #10-32 bolts. The positive high voltage lead should be grounded to the tube, preferably at the mounting surface. The heater lead projects radially from the extreme end of the cathode bushing. The other lead provides a common heater and cathode connection and can be identified by a band of brown paint.

When making connections to the filament, the circuit should be studied and arranged to prevent any portion of the filament supply voltage from being applied between the anode and cathode

of the magnetron. The magnetron would rectify this low ac voltage, and the average anode current meter would indicate a few milliamperes. Depending upon the circuit, this false indication of current could be exaggerated if the filament-cathode connections were reversed.

COUPLING

The magnetron output flange is designed to couple to a standard ⅝" x 1¼" pressurized waveguide. A standard X-band flange, type UG-52/U with holes modified to provide clearance for #8-32 bolts, mates with the tube output flange.

NOTES:

1 Reference Plane "A" is defined as a plane passing along the face of the mounting plate.

2 Reference Plane "B" is defined as a plane perpendicular to plane "A," passing through the center of holes as shown.

3 Reference Plane "C" is defined as a plane mutually perpendicular to planes "A" and "B" passing through the center of holes as shown.

4 Includes angular as well as lateral deviation.

5 Center line of tapped holes must be parallel to planes "A" and "B" within .030.

6 Brown paint to identify common cathode connection.

7 Refers to radiator size only.

8 Lug (25 amp).

9 It shall be possible for a sleeve .195 I.D. x .406 O.D. x 1" long to pass ends of shaft to face of worm bracket.

10 Entire surface outside a 1.187 radius from the center of circle through the nominal centers of the four mounting holes shall be flat within .020. The mounting plate shall extend to a radius not less than 1.750 from its center as here defined.

11 ***WARNING!!!*** Maintain min. 4 inches clearance between magnet and magnetic materials (magnets, steel tools, plates, etc.).

12 Refers to opening in cooling fins.

13 All joints in mounting plate must be vacuum tight to provide a hermetic seal at surface "A."

14 All joints in waveguide assembly to be vacuum tight to provide a hermetic seal at surface "B."

15 Anode temperature to be measured at this point on surface of waveguide 1.500" back from face to waveguide flange.

16 Bushing temperature to be measured at this point.

17 Slot in flange to be centered within .005 with respect to 4 tapped holes.

18 All points on cathode stem within 1.250 max. from Ref. Plane "A" shall fall within the circumference of a 2.250 max. dia. cylinder constructed concentric to a circle drawn through the nominal center of the 4 mounting holes, and perpendicular to Ref. Plane "A." All points on cathode stem beyond 1.970 max. from Ref. Plane "A" exclusive of leads must fall within a similarly constructed cylinder of .750 max. dia. and finally all points between 1.250 and 1.970 from Ref. Plane "A" must fall within a similarly constructed conical section of 2.250 major dia. and .750 minor dia. as shown.

19 Refers to projected radius of mounting plates.

20 The frequency increases as the tuner shaft is driven in a counter clockwise direction as viewed in direction indicated by arrow.

21 The complete frequency range is covered by approximately 175 turns of the tuner shaft.

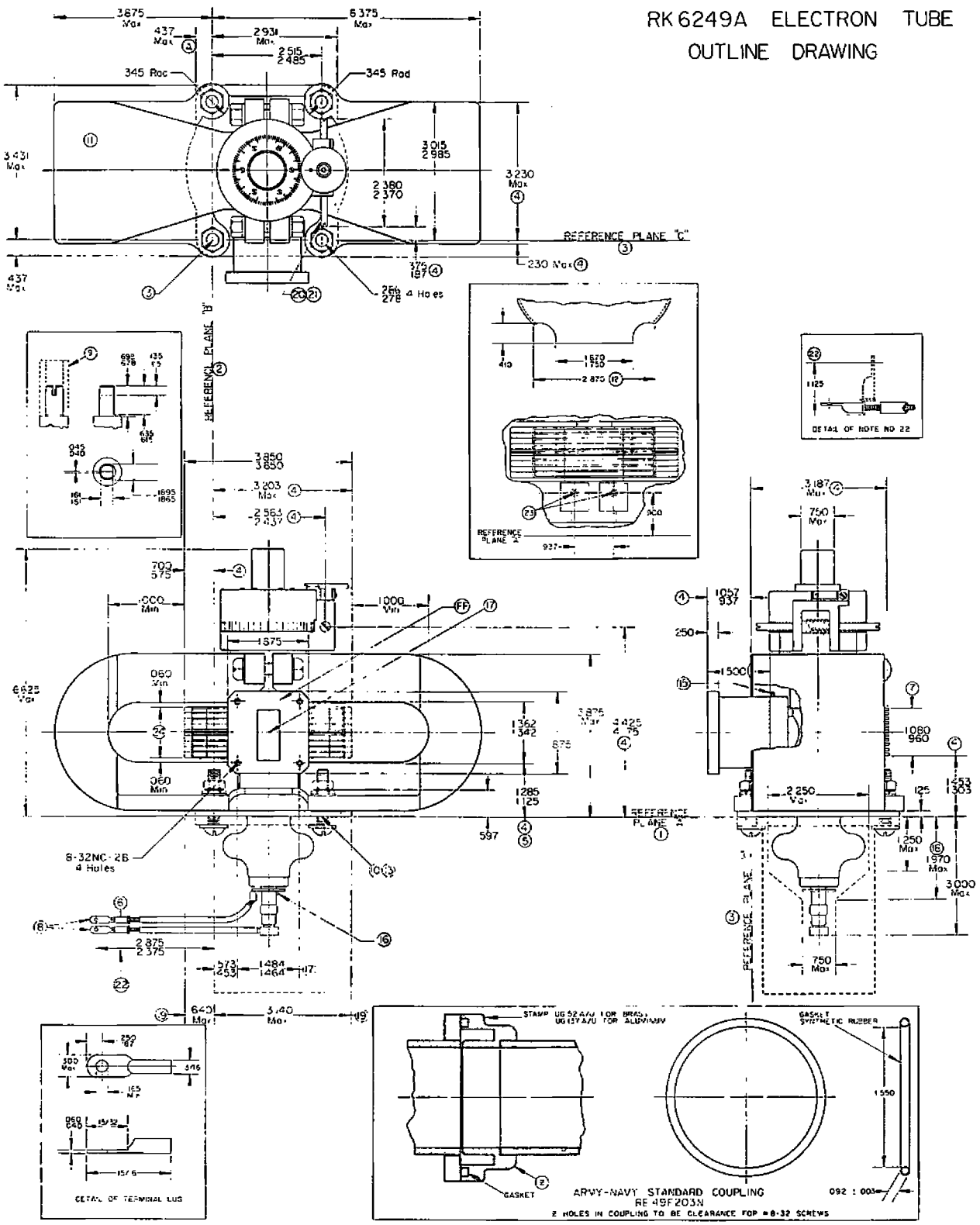
22 Leads must be capable of being bent as shown (detail viewed in direction of arrow).

23 Two No. 6-32 tapped holes with screws inserted are located as shown. The addition of the tapped holes and screws satisfy an Air Force equipment, and the magnetron serviceability will not be impaired with the screws inserted or removed.

24 Clearance between radiator and inside magnet leg.

TUNABLE PULSED-TYPE OSCILLATOR

RK 6249A ELECTRON TUBE OUTLINE DRAWING



Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON

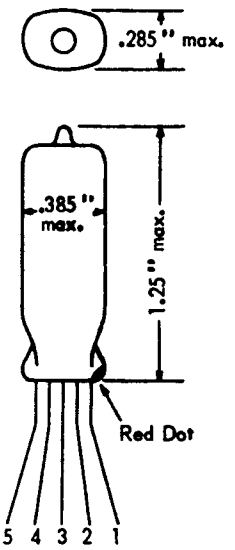
TECHNICAL INFORMATION

SUBMINIATURE PENTODE

Excellence in Electronics

TYPE CK6281

The CK6281 is a filament type pentode of subminiature construction designed primarily for use in resistance coupled audio frequency and direct coupled amplifiers. The tube features low battery drain, long life, small size, and low microphonic level. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate
Lead 2 Grid #2
Lead 3 Filament, Positive; Grid #3
Lead 4 Grid #1
Lead 5 Filament, Negative Grid #3; Shield

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds*)

Grid to Plate	0.01 max.
Input	2.5
Output	3.4

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	0.625±20% volts
Plate Voltage	25 volts
Grid #2 Voltage	25 volts
Cathode Current	0.1 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage	0.625 volts
Filament Current	20 ma.
Plate Voltage	15 volts
Grid #2 Voltage	15 volts
Grid #1 Voltage	1.0 volts
Plate Current	50 *μa.*
Grid #2 Current	20 *μa.*
Transconductance	105 *μmhos*
Plate Resistance	2.0 meg.

CHARACTERISTICS AND TYPICAL OPERATION - RESISTANCE COUPLED CLASS A1 AMPLIFIER:

	First Stage		Second Stage		
Filament Voltage	0.625	0.625	0.625	0.625	volts
Filament Current	20	20	20	20	ma.
Plate and Grid #2 Supply Voltage	15	22.5	15	22.5	volts
Grid #1 Voltage ■	0	0	-0.625	-0.625	volts
Plate Resistor ♦	1.0	1.0	1.0	1.0	meg.
Grid #2 Resistor ♦	2.2	2.7	1.0	1.5	meg.
Average Voltage Gain (G1 to P) ▲	26:1	37:1	22:1	33:1	
Approx. Voltage Gain (G2 to P)	3:1	4:1	3:1	4:1	

● *The bulb is entirely coated with a metallic shield connected to lead 5.*

■ *Control Grid should be returned through approximately 5 to 22 megohms to negative filament or bias voltage.*

♦ *Other plate and Grid #2 resistor values may be used to obtain less variation in voltage gain between tubes at the possible expense of less average gain.*

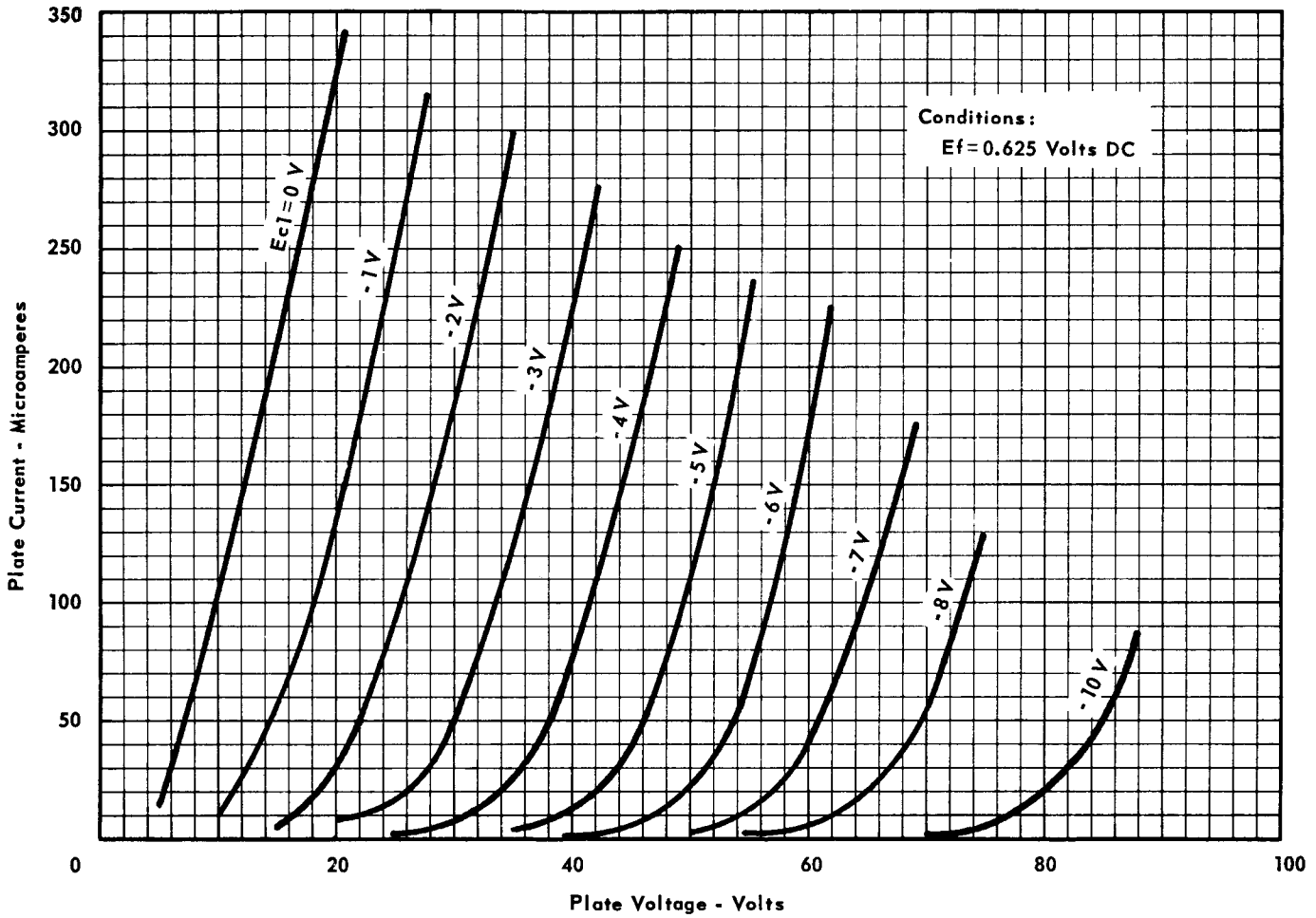
▲ *The values of voltage gain are quoted for a coupled load of 5 megohms, zero source impedance, and a 5 megohm grid resistor. The reactive impedances (Cin, Cout, Cg1, Cg2, CL) are of such values that they have negligible effect upon the gain.*

Tentative Data

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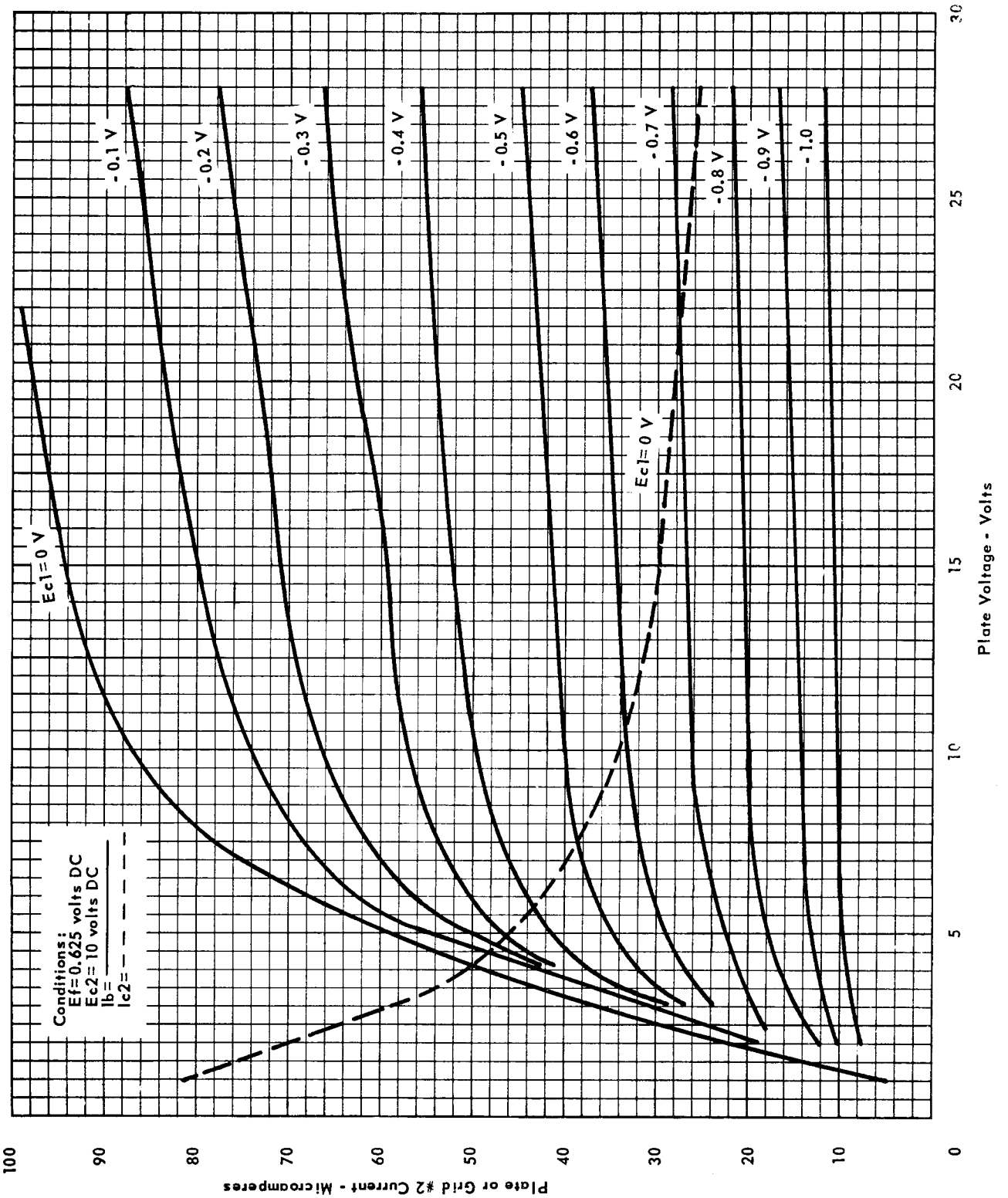
AVERAGE PLATE CHARACTERISTICS

(Triode Connected)



SUBMINIATURE PENTODE

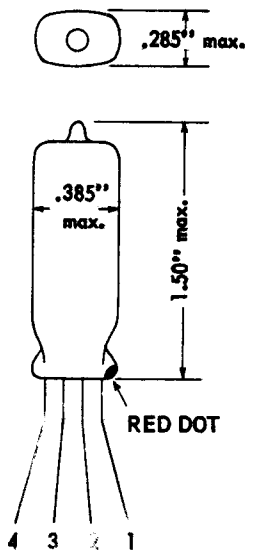
AVERAGE PLATE CHARACTERISTICS



Excellence in Electronics

TYPE CK6286

The CK6286 is a filament type triode of subminiature construction designed for use as an amplifier or oscillator. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads.
Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 3 Grid
Lead 2 Filament, negative	Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)* ▲

Grid to Plate	1.6
Grid to Filament	1.3
Plate to Filament	2.1

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	100 volts
Plate Current	7.0 ma.
Plate Dissipation	0.45 watt

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	0.125 amp.
Plate Voltage	67.5 volts
Grid Voltage	-2.0 volts
Amplification Factor	11.5
Transconductance	2100 umhos
Plate Current	6.0 ma.
Grid Voltage (approx.) for Ib=50 ua.	-8.5 volts

TYPICAL OSCILLATOR CHARACTERISTICS:

Filament Voltage	1.25 volts
Plate Voltage	67.5 volts
Plate Current	5.25 ma.
Grid Current	325 ua.
Plate Supply Resistance	1500 ohms
Grid Resistance	18000 ohms

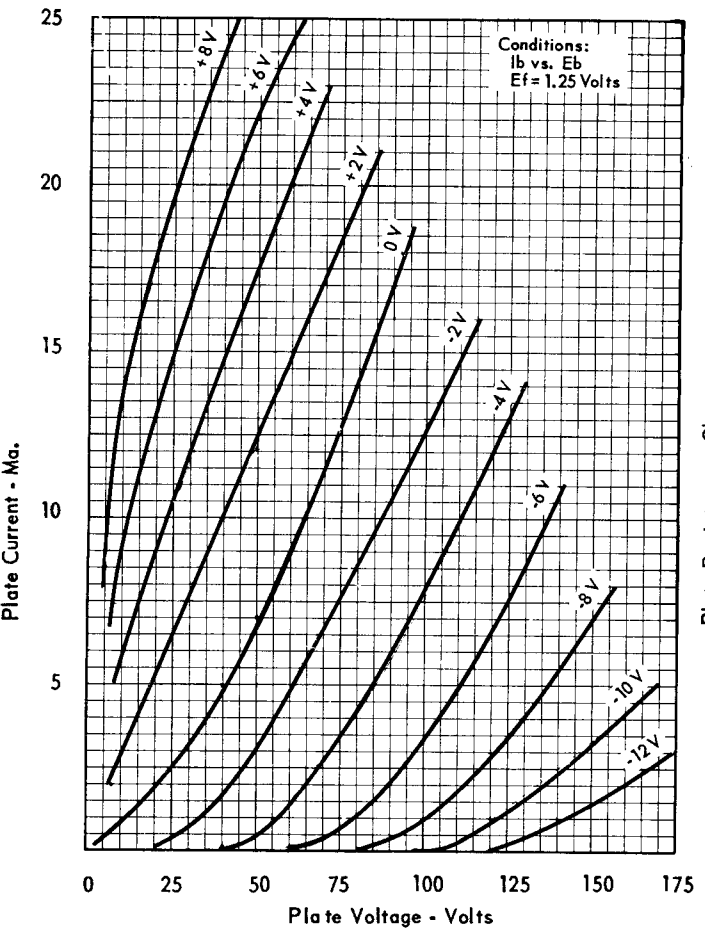
These data identify a particular developmental tube design and the type designation or the descriptive data may be subject to change or abondonment.

▲ *No external shield.*

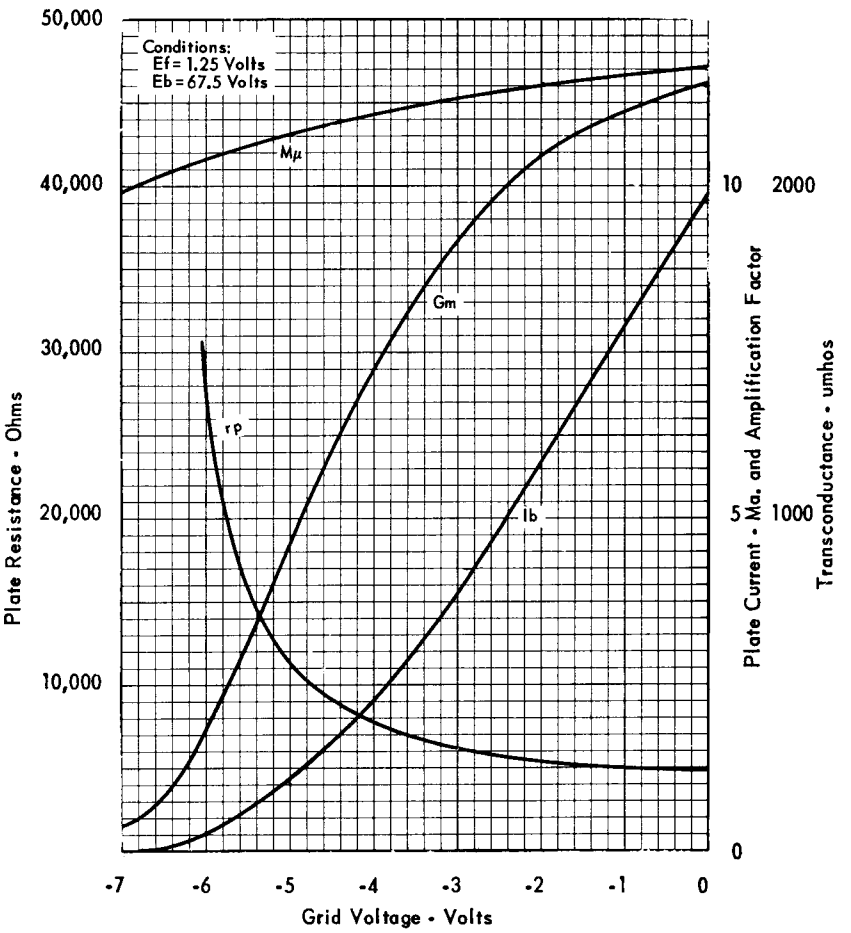
Tentative Data

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AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS



RAYTHEON

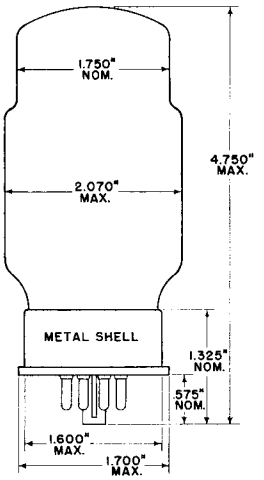
TECHNICAL INFORMATION

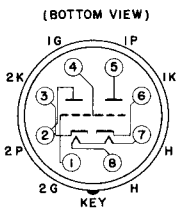
TWIN POWER TRIODE

TYPE CK6336A

Excellence in Electronics

The Raytheon CK6336A is a low MU twin power triode used especially in series regulated power supplies. It is mechanically rugged and is designed for long life operation. In operation it is able to handle large currents over a wide voltage range. The anodes are zirconium coated graphite supported by ceramic insulators. The use of large cathodes provides more than sufficient emission current. The grid wires are gold plated molybdenum and the mount is set on a rugged button stem supported by flexible metal vibration snubbers. The use of these elements and the hard glass envelope makes it possible to degas the tube at high temperature during processing, enabling the the tube to be used at high temperatures without the fear of harmful gases which may be given off by tube elements. The Raytheon CK6336A can in some circuits replace 2 or 3 type 6080WA or 6AS7G regulator tubes. Many CK6336A tubes can be paralleled as desired for increased levels of current or power.





MECHANICAL DATA

ENVELOPE: ST-16-Nonex

BASE: Large Wafer Octal With Metal Sleeve, 8-Pin, JEDEC #B8-86

TERMINAL CONNECTIONS:

Pin 1: Grid, Unit #2	Pin 5: Plate, Unit #1
Pin 2: Plate, Unit #2	Pin 6: Cathode, Unit #1
Pin 3: Cathode, Unit #2	Pin 7: Heater
Pin 4: Grid, Unit #1	Pin 8: Heater

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	720 G
Maximum Bulb Temperature	250 °C

MOUNTING POSITION: Any (Note 5)

ELECTRICAL DATA

CAUTION:---To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 4)	NORMAL OPERATION (Note 3)	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Heater Voltage: (Note 7)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage:	Eb:	----	190	190	400	Vdc
Grid Voltage:	Ec1:	-300	0	0	----	Vdc
Heater Cathode Voltage:	Ehk:	-300	----	----	+300	Vdc
Cathode Resistance (Per Cathode):	Rk/k:	(Note 6)	200	200	----	ohms
Plate Dissipation (Per Plate):	Pp/p:	----	----	----	30	watts
Grid Resistance (Total):	Rg:	500	500Min.	----	500,000	ohms
Resistance Per Grid Leg When Triode Sections Are Paralleled:	Rg/g:	500	----	----	----	ohms
Transconductance (Per Plate):	Sm/p:	----	----	13,500	----	μmhos
Amplification Factor:	Mu/p:	----	----	2.7	----	----
Grid Current (Per Grid):	Ic1/g:	----	----	----	0	μA
Plate Current (Per Plate):	Ib/p:	----	----	----	400	mAdc
Cathode Conditioning Time:	TK:	(Note 14)	----	----	----	mAdc

Tentative Data

Printed in U.S.A.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1			**Combined AQL = 1.0 % excluding Mechanical and Inoperatives**							
Heater Cathode Leakage:	Ehk=+300	0.65	Ihk:	----	----	----	----	40	----	μAdc
	Ehk=−300 (Note 10)	0.65	Ihk:	----	----	----	----	40	----	μAdc
Grid Current (1):	Rg/g=50 K (Note 11)	0.65	Ic1:	----	----	----	----	−4.0	----	μAdc
Plate Current (1):	(Note 8)	0.65	Ib1:	165	----	185	----	200	----	mAdc
Emission:	Eb=10 Vdc; Ec=10 Vdc; Rk/k=0 ohms; (Note 12)	0.65	Is:	150	----	----	----	----	----	mAdc
Plate Current (3):	Eb=200 Vdc; Ec=−100 Vdc; Rk/k=0 ohms; (Note 8)	0.65	Δ Ib(1):	----	----	----	----	10	----	mAdc
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope ST−16−Nonex	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:		6.5	Rg-all:	10	----	----	----	----	----	Meg
			Rp-all:	10	----	----	----	----	----	Meg
Transconductance (1):	Ck=1000 μf (Note 8)	6.5	Sm(1):	11,000	----	13,500	----	16,000	----	μmhos
Plate Current (2):	Eb=40 Vdc; Ec=0; Rk/k=0 ohms (Note 8)	6.5	Ib(2):	150	----	----	----	----	----	mAdc
Transconductance (2):	Ef=5.7 V; Ck=1000 μf; (Notes 8 & 9)	6.5	Δ_{Ef} Sm(2):	----	----	----	----	15	----	%
Amplification Factor:	(Note 8)	6.5	Mu:	2.0	----	2.7	----	3.4	----	----
Vibration (1):	F=10−50−10 cps; G=2.5; Ec/Ib=75 mAdc; Ck=1000 μf; Rp=2000 ohms; Per MIL-E-1 Ref. Par. 4.9.20.3	6.5	Ep:	----	----	----	----	200	----	mVac
Heater Current:	Ef=6.3 V	6.5	If:	4.75	----	5.0	----	5.25	----	A
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Ef=6.3 V Hammer Angle=48°; 720 G−1 msec (Note 2)	----	----	----	----	----	----	----	----	----
Post Shock Test End Points:										
Heater Cathode Leakage:	Ehk=+300 Vdc	----	Ihk:	----	----	----	----	100	----	μAdc
	Ehk=−300 Vdc (Note 10)		Ihk:	----	----	----	----	100	----	μAdc
Grid Current (1):	(Note 11)	----	Ic:	----	----	----	----	−8	----	μAdc
Plate Current (1):	(Note 8)	----	Ib(1):	150	----	----	----	----	----	mAdc
Transconductance (1):	(Note 8)	----	Gm(1):	9000	----	----	----	----	----	μmhos

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

In the following tests each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects Per Characteristic 1st Sample	Allowable Defects Per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS								
1000 Hours Intermittent Life Test:	Ef= 6.3 V; Eb= 190 Vdc; Ec=0 Vdc; Ehk= 300 V; Rg/g= 500,000 ohms; Rk/k= 200 ohms; T Bulb= 250° C ± 25° C Note 13–15	----	----	----	----	----	----	----
1000 Hour Intermittent Life Test End Points:	(Typical Sample Size= 5 Tubes)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	----	----
Plate Current (1):	(Note 8)	----	Ib:	150	----	mAdc	----	----
Grid Current (1):	(Note 11)	----	Ic1:	0	–8	μAdc	----	----
Transconductance (1):	(Note 8)	----	Sm:	9000	----	μmhos	----	----
Heater Cathode Leakage:	Ehk=+300 Vdc;	----	Ihk:	----	100	μAdc	----	----
	Ehk= –300 Vdc; (Note 10)		Ihk:	----	100	μAdc	----	----

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes," and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 basic specifications.

Note 3: These normal values represent conditions at which control of reliability may be expected.

Note 4: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 5: If the tube is to be mounted in a horizontal position it is recommended that it be mounted so that the base lug key be either directly up or directly down.

Note 6: Minimum cathode resistance per cathode leg shall be 270 ohms or that resistance necessary to provide 10% of the grid bias voltage, whichever is greater.

Note 7: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 8: Voltages are applied to both sections, but each section is tested separately. Values specified herein are for individual sections, expect for heater current. Readings shall be taken after tube has been drawing current at least 5 minutes.

Note 9: Change of transconductance for individual tubes from that value measured at Ef= 6.3 volts to that value measured at Ef= 5.7 V.

Note 10: IK shall be tied to 2K.

Note 11: With both units operating, Ic is sum of I1c and I2c.

Note 12: Each unit shall be read separately. Ground unit not under test.

ELECTRICAL DATA (Cont'd)

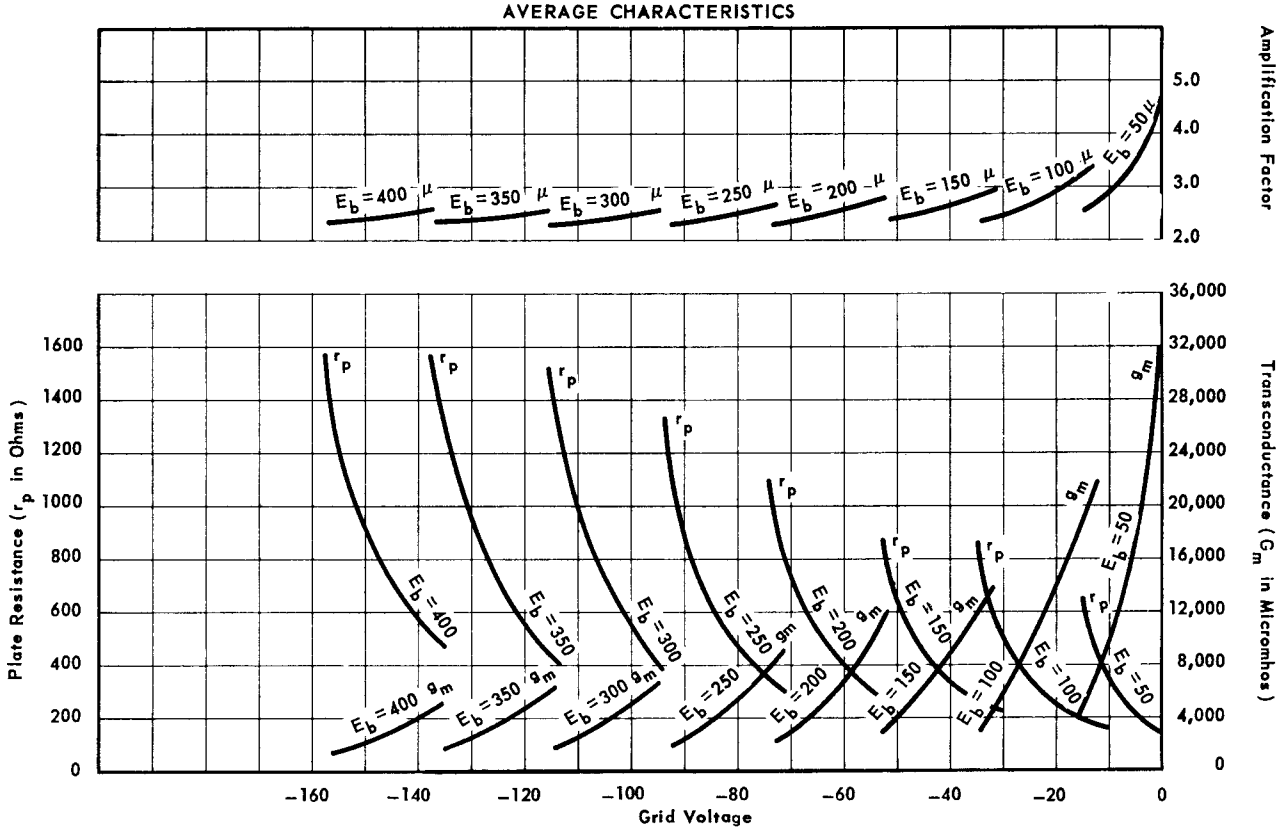
NOTES (Cont'd)

Note 13: The tube shall be cycled 30 seconds heater positive and 30 seconds heater negative.

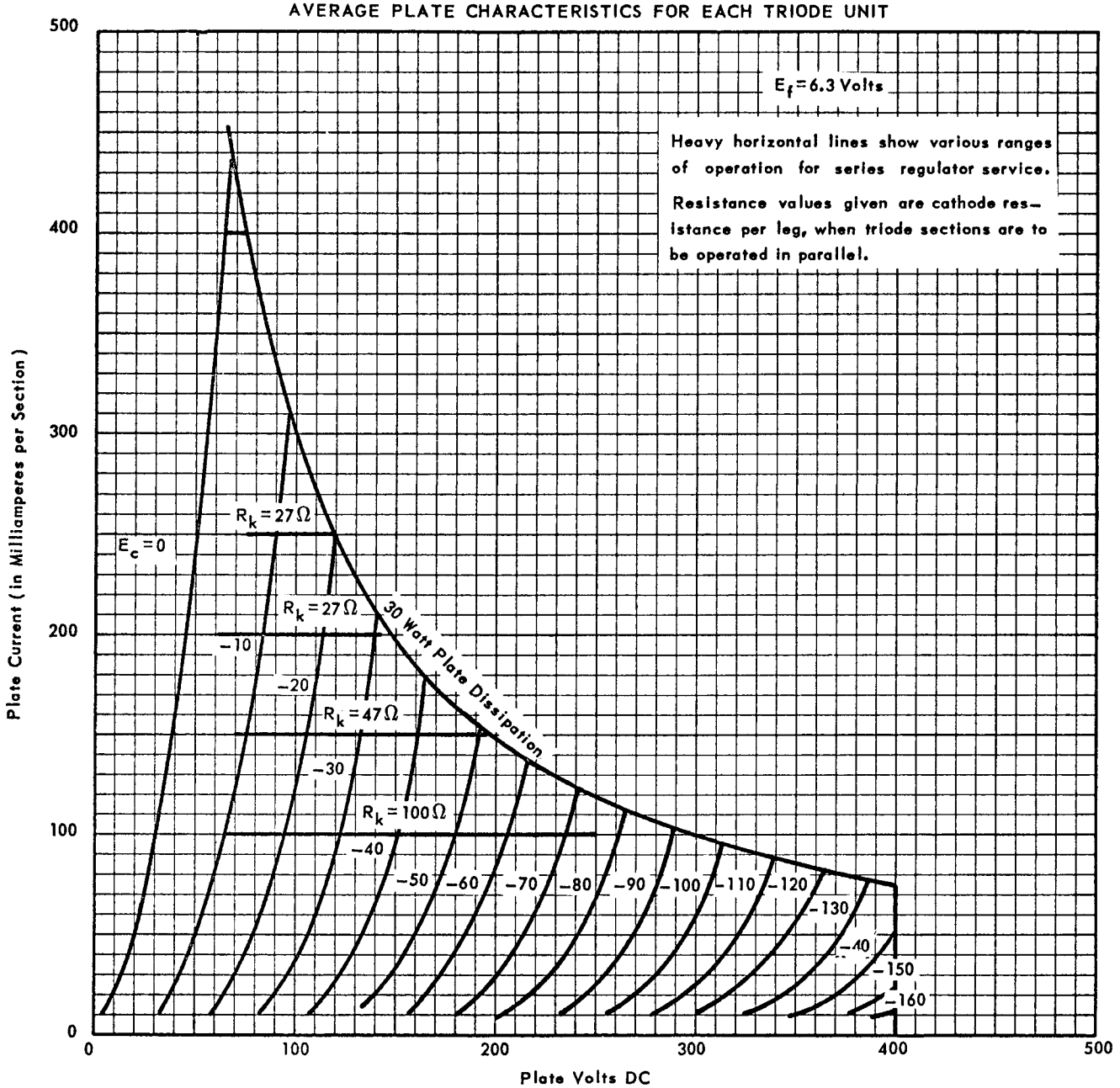
Note 14: TK = 30 seconds minimum. This is especially necessary in regulator circuits where the plate of the amplifier tube ties back to the plate side of the passing tube. In such a circuit, during warmup, the grid bias may swing highly positive causing the cathode to lose its ability to sustain current.

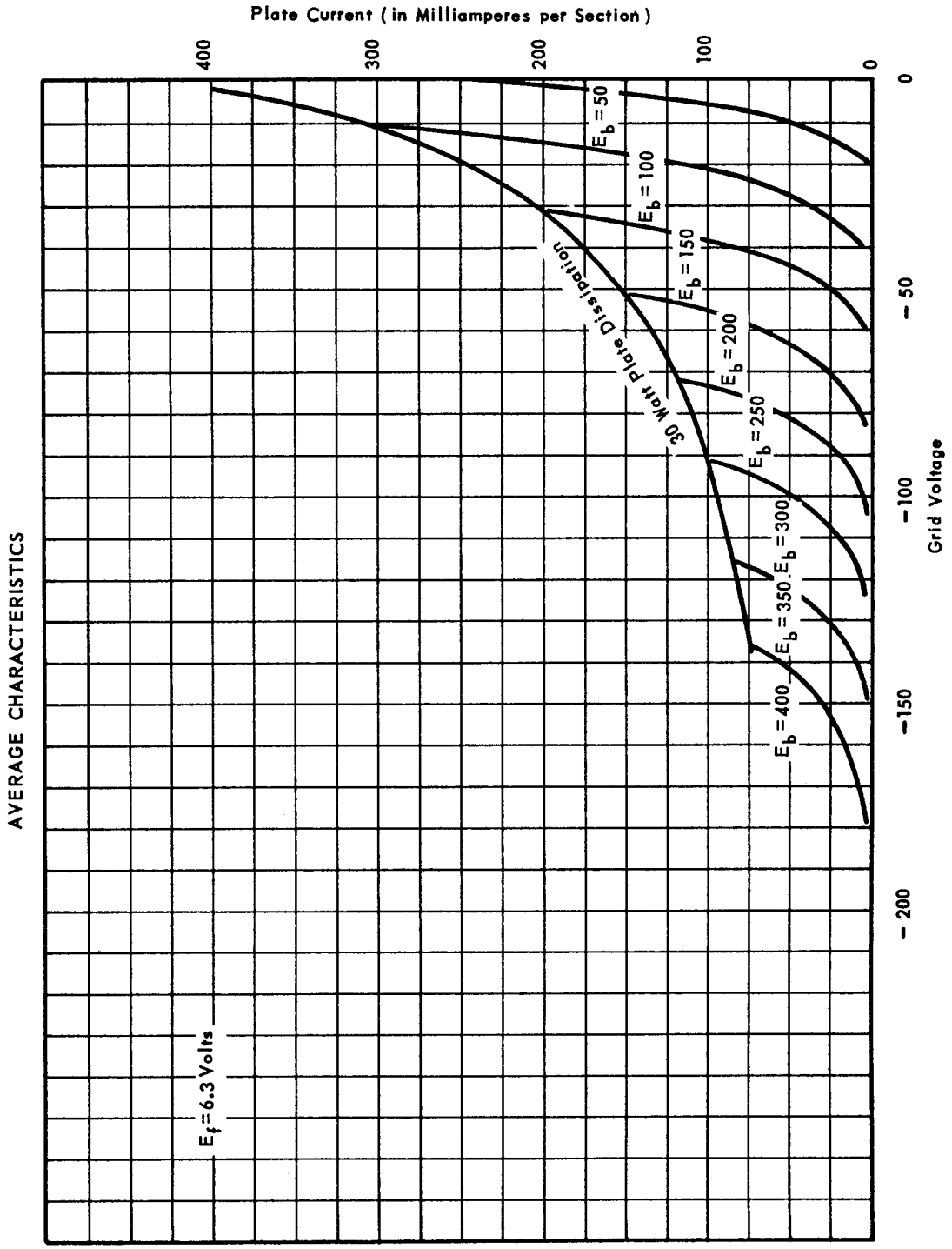
Note 15: Units shall be operated in parallel, with separate 200 ohm cathode resistors.

AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS FOR EACH TRIODE UNIT




Plate Current (in Milliamperes per Section)
400
300
200
100
0
AVERAGE CHARACTERISTICS
E_b = 50
E_b = 100
E_b = 150
E_b = 200
E_b = 250
E_b = 300
E_b = 350
E_b = 400
30 Watt Plate Dissipation
E_f = 6.3 Volts
0
- 50
- 100
- 150
- 200
Grid Voltage

from JETEC release #1551, Dec. 12, 1955

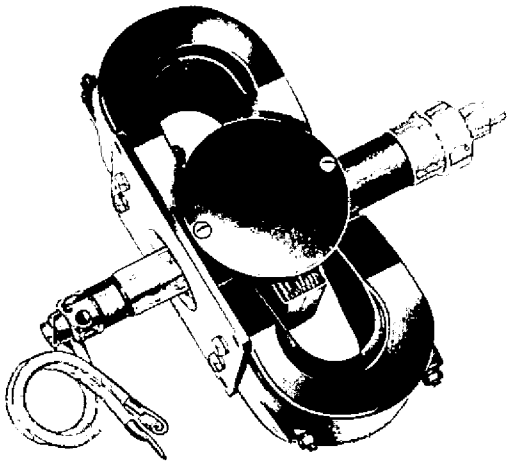
TECHNICAL INFORMATION

TUNABLE PULSED-TYPE MAGNETRON

TYPE RK6344/ QK-235

Excellence in Electronics

The RK6344/QK-235 is a mechanically tunable magnetron designed for pulsed operation in the frequency range of 5450 to 5825 megacycles. It is an integral magnet type tube rated for a minimum peak power of 175 kilowatts. It requires forced air cooling over fins integral with the anode block and is designed for coupling to standard 1 x 2 inch waveguide. Tuner construction facilitates rapid hand or motor tuning to any desired frequency within the specified range.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data, prepared by the Applications Group of Raytheon Manufacturing Company, rather than the MIL-E-1B Government purchase specifications, should be used as a guide to equipment designers. As is the case with other electrical components, if magnetrons are operated continuously at their maximum ratings, some deterioration in life will result. There are many problems peculiar to magnetrons in general that must be given special consideration in system design such as RF radiation, pulse shaping, VSWR and length of transmission line to the antenna. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the QK-235 under conditions other than those recommended in this technical data sheet, the Magnetron Application Group must be consulted; and in some cases additional life test must be run.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater voltage — preheat	11 V
Heater current @ 11 volts	10-12 A
Minimum preheat time	3 minutes

Maximum Ratings

Heater voltage	12.5 V
Peak anode current	30 a
Peak anode voltage	24 kv
Average anode power input	720 W
Peak anode power input	720 kw
Max. freq. pulling at VSWR = 1.5/1	15 Mc
Max. anode temp. at point specified on outline drawing	120° C
Maximum pulse duration	3.0 us
Maximum duty cycle	.001
Max. voltage pulse rise time	0.2 us
Min. voltage pulse rise time	0.1 us
Max. freq. change per degree change of temp.	.25Mc/°C

The values specified above are based on the absolute system and must not be exceeded under any service condition. Operation above these limiting values may affect tube life and serviceability adversely. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Typical Operation

Peak current	22 a
Current pulse duration	1.35 us
Duty cycle	.00085
Voltage pulse rise time	0.1 us min.
Heater voltage start	11.0 V
Heater voltage operate	10.5 V
VSWR	1.5/1 (max)
Frequency	5450-5825 Mc
Peak anode voltage	21.5 kv
Peak power output	260 kw
Average power output	221 W

MECHANICAL

Mounting	Cathode vertical
Overall dimensions	See drawing
Net weight	25 lbs.
Tuner torque required	30 inch ounces
Pressurization	30 inch Hg
Output coupling	UG 148B/U Choke

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 11 volts for a period of at least three minutes prior to the application of anode high voltage. Immediately subsequent to the application of anode high voltage, heater voltage must be reduced to 10 volts. For combinations of pulse widths and duty cycles different from those shown under typical operation, the manufacturer must be consulted for optimum heater schedules. Provisions must be made to keep heater current surges below 30 amps. Surges in excess of 30 amps may open the heater circuit and render the tube worthless. Any interruption of tube operation requires that the heater schedule be repeated.

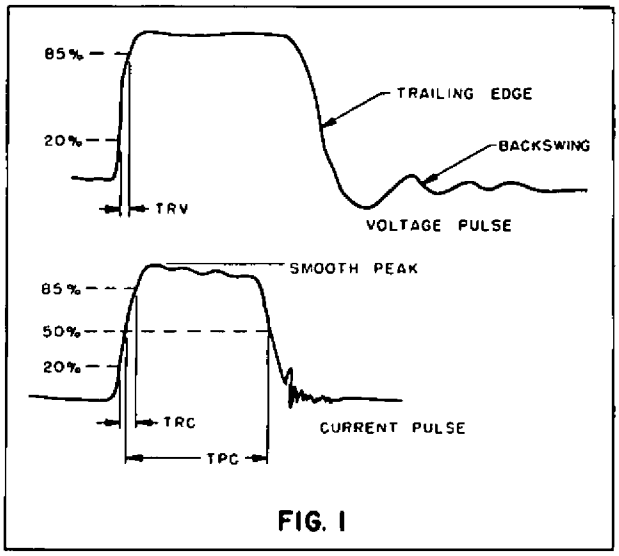


FIG. 1

PULSE CHARACTERISTICS

The smooth peak is the maximum value of a smooth curve through the average of the fluctuation over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which instantaneous current is 50 percent of the smooth peak. The rise time is the time interval between points of 20 and 85 percent of the smooth peak. Figure 1 shows graphically the definitions mentioned.

The voltage rise time must not be less than .10 usec for .4 usec pulse to realize good tube performance. Too fast a rise time will lead to moding or arcing. It is necessary to form the pulse so that the current pulse shows no sign of jitter and no large spikes on the leading edge as these conditions also may cause moding or arcing. The ripple on the top of the current pulse must be kept at a minimum to avoid pushing effects which will tend to widen the spectrum. Excessive backswing may cause noise. The backswing should not exceed 20% of the applied pulse.

Many magnetrons draw a certain amount of leakage or diode current at anode voltages as low as 100 volts. For this reason it is not only advisable

to keep the time duration of the voltage pulse trailing edge as short as possible; but also to prevent the positive voltage backswing from becoming negative again. This diode current can amount to several milliamperes at an average current of 30 milliamperes. Except for giving falsely exaggerated indication as to the actual peak current at which the magnetron is operating, diode current is not harmful, unless it becomes excessive.

For optimum pulse shaping, the magnetron, pulse transformer, and pulse line must be treated as a unit. We advise building up an experimental pulse line and hand tailoring it for optimum magnetron current and voltage pulse shape when used in conjunction with the pulse transformer and the QK-235.

It is impossible to design a pulse transformer to give optimum results on both long and short pulses. It is, therefore, necessary to decide which pulse is the more important and optimize the pulse transformer for the desired operation.

OPERATION

The operating characteristics of an average QK-235 are described in the following paragraphs and illustrated in Figures 2, 3. All measurements were made under conditions of typical performance. Variation of these characteristics can be expected from tube to tube or from use of the same tube in different systems. A 1 x 2 inch waveguide was used for all tests involving a magnetron load.

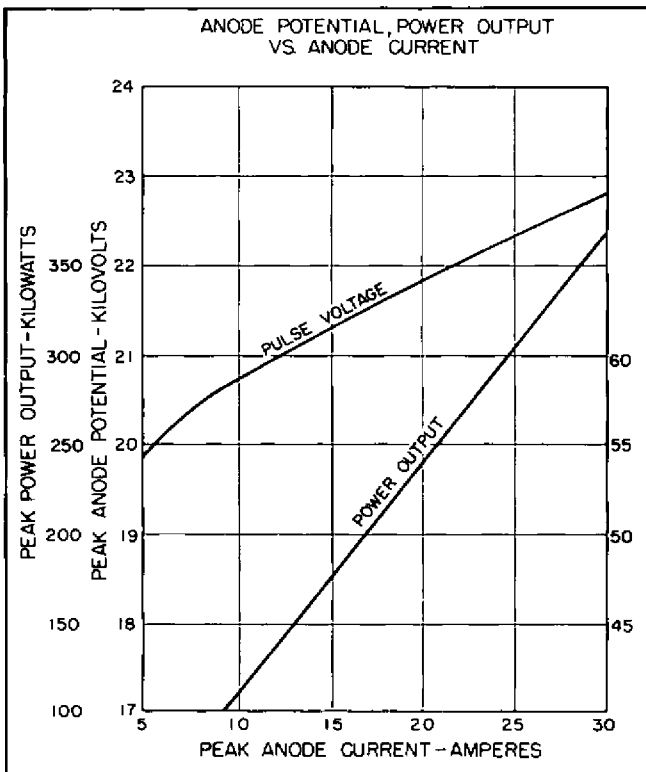


FIG. 2 -PERFORMANCE CHARACTERISTICS OF TYPICAL QK 235 MAGNETRON 5825 Mc.-1.0/1 VSWR.

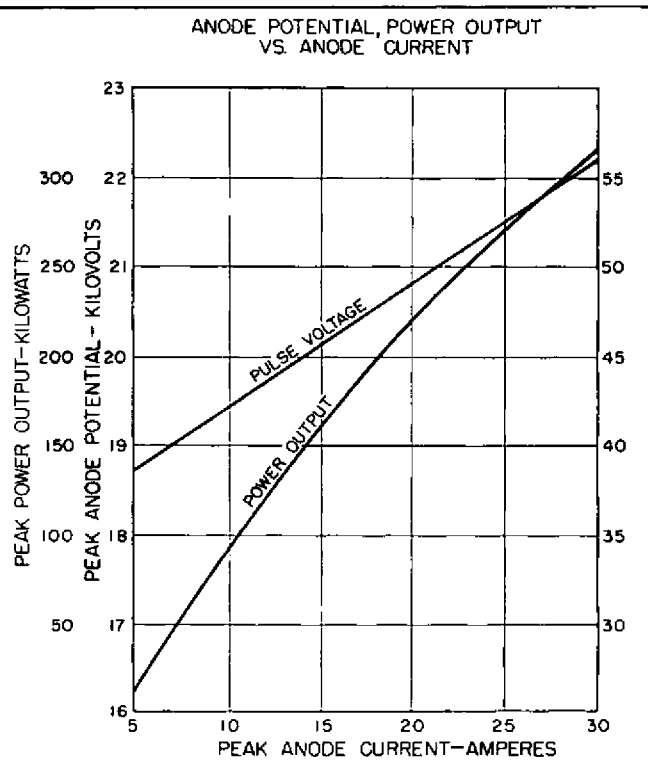


FIG. 3-PERFORMANCE CHARACTERISTICS OF TYPICAL QK 235 MAGNETRON 5450Mc.-1.0/1 VSWR.

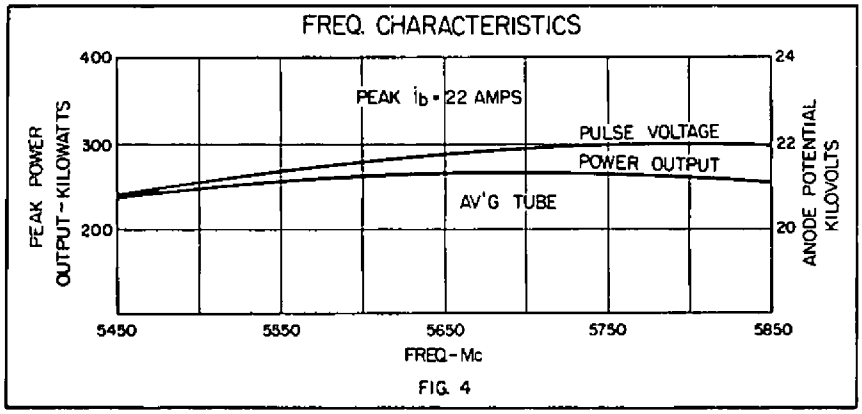


FIG. 4

FREQUENCY CHARACTERISTICS

The manner in which anode voltage and power output, vary with frequency is revealed in Figure 4.

LOAD DIAGRAMS

Figure 5 is a load diagram of a typical QK-235 magnetron operating at frequencies of 5500, 5700 and 5800 megacycles respectively. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 3.5/1 are plotted but ratios greater than 1.5/1 are not recommended.

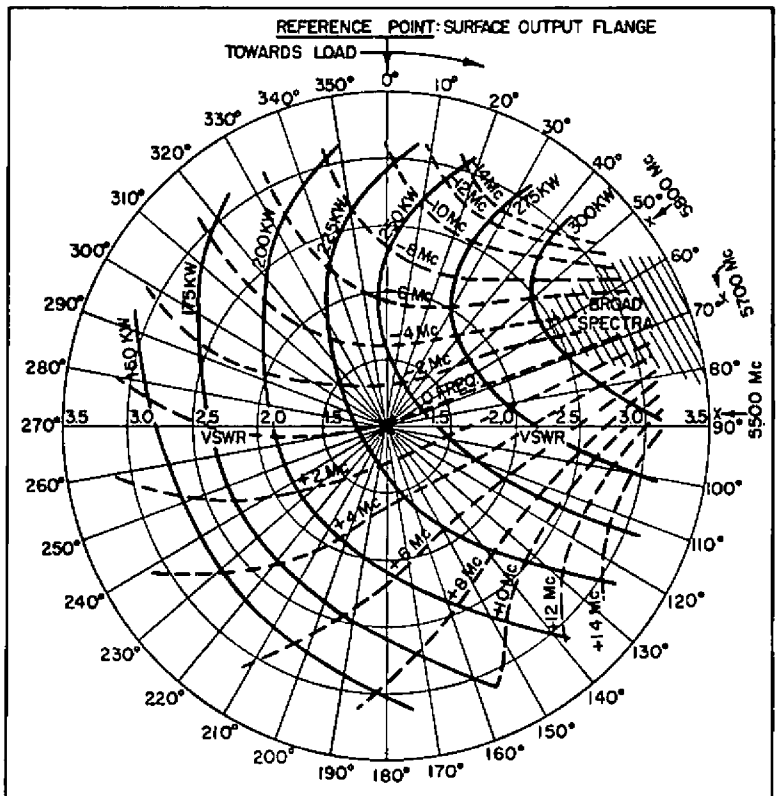


FIG 5—LOAD DIAGRAM OF TYPICAL QK235 MAGNETRON—5700 Mc

FREQUENCY DRIFT CHARACTERISTICS

After operation of the QK-235 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift and anode temperature are plotted as a function of time in Figure 6.

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes.

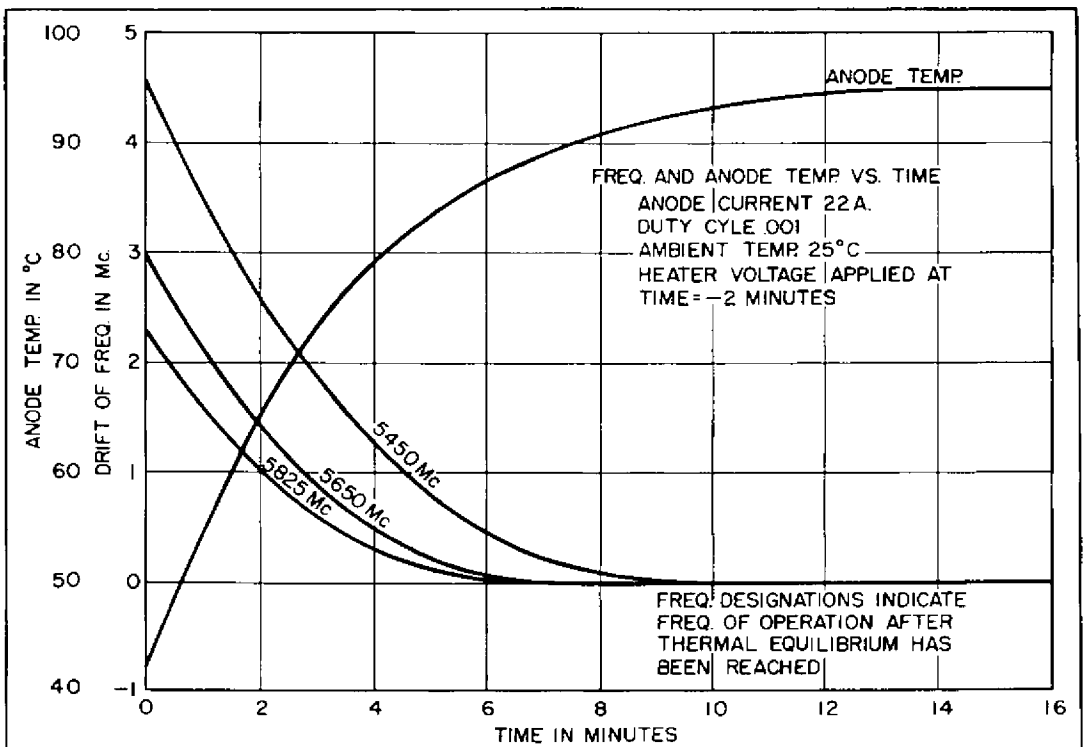


FIG. 6 — FREQ. DRIFT CHARACTERISTICS FROM COLD START OF TYPICAL QK 235 MAGNETRON

LOAD AND LINE LENGTH CONSIDERATIONS

Operation of the QK-235 into a line exceeding some critical length and terminated in an impedance different from the line or a short line terminated in a severe mismatch gives rise to undesirable phenomena collectively termed long line effects. Tuner curve discontinuities, spectrum broadening and intolerable attenuation are some of the associated phenomena. Figure 7 shows the line length and VSWR recommended for use with the QK-235. Although the curves apply specifically to an operating frequency of 5650 Mc, they do not change significantly at other frequencies in the tuning range. The critical conditions of frequency skip, where breaks in the tuning curve first appear depend somewhat on the pulling figure of individual tubes. However, operation within the recommended region indicated on the figure will yield satisfactory operation of all QK-235 magnetrons. An extensive treatment of long line effects is beyond the scope of this publication; however, additional information may be obtained on request from the Sales Department, Microwave & Power Tube Operations, Raytheon Mfg. Company.

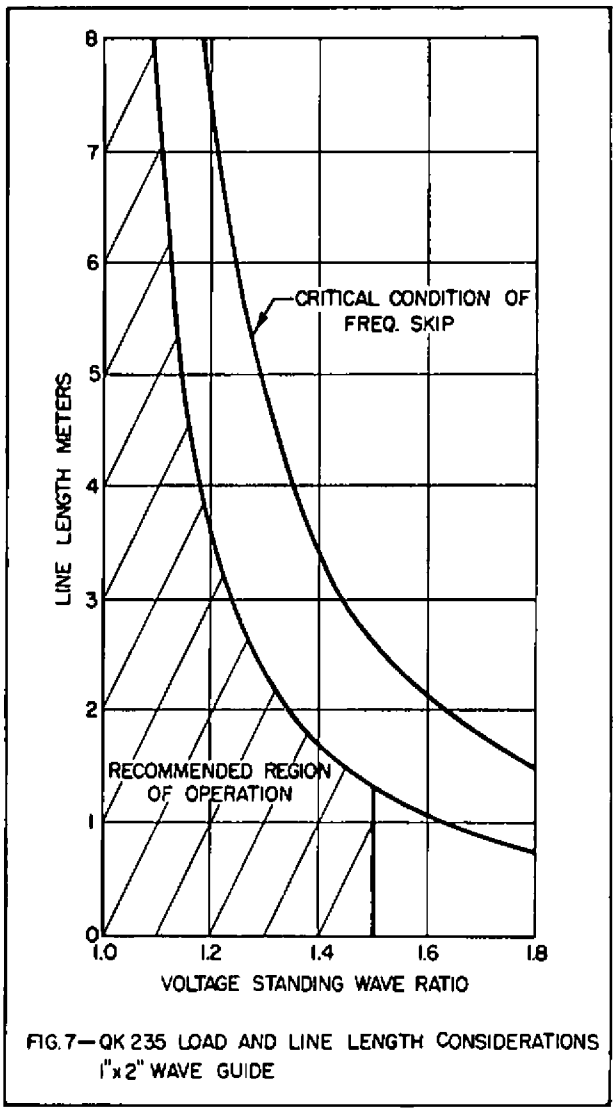


FIG. 7—QK 235 LOAD AND LINE LENGTH CONSIDERATIONS 1"x 2" WAVE GUIDE

COOLING

The cooling air stream for the QK-235 should be directed to the air inlet of the radiator through a close fitting duct. Operating anode temperatures below 90°C are recommended although temperatures as high as 120°C can be tolerated.

Figure 8 reveals the relationship between air flow (ft^3/min.) and back pressure (inches H_2O). Figure 9 shows anode temperature as a function of rate of air flow over the radiator at four values of power input. Tests were made at 30 in. Hg and an ambient temperature of 25°C. Higher ambient temperatures will result in correspondingly higher anode temperatures.

Use of a close fitting duct can be avoided if a compensating increase in rate of air flow is made.

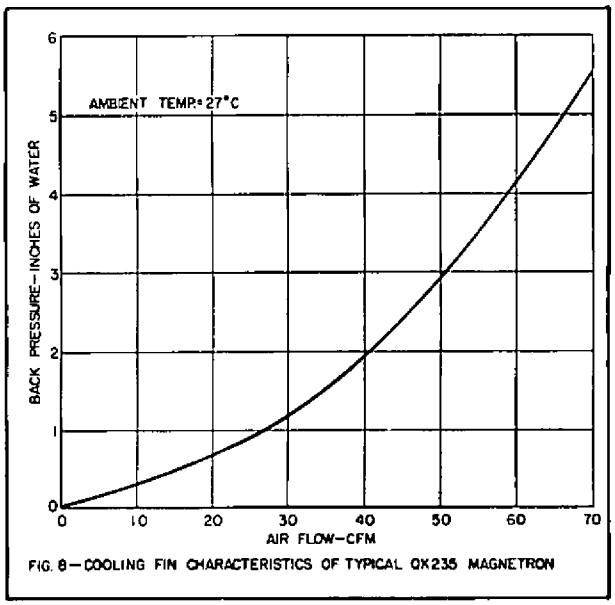


FIG. 8—COOLING FIN CHARACTERISTICS OF TYPICAL QK235 MAGNETRON

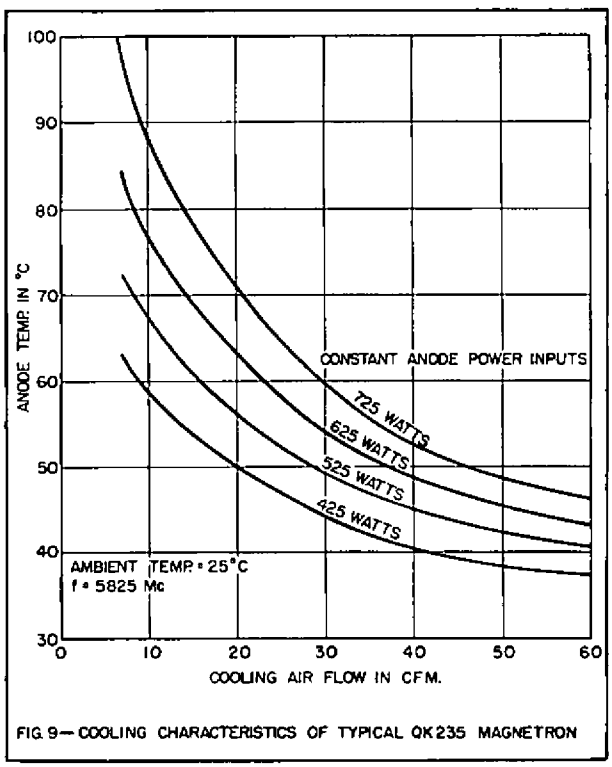
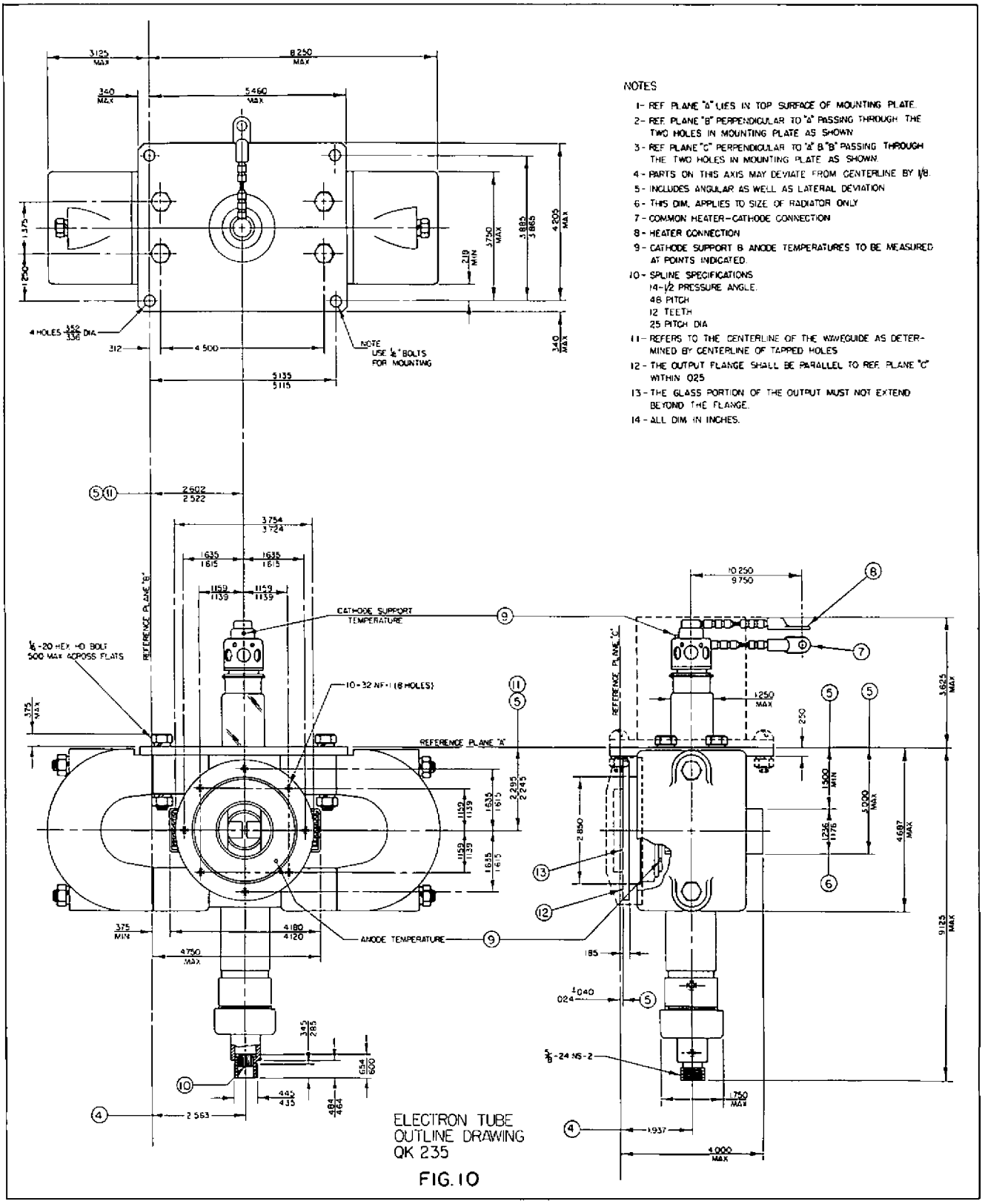


FIG. 9—COOLING CHARACTERISTICS OF TYPICAL QK235 MAGNETRON



ELECTRON TUBE
OUTLINE DRAWING
QK 235

FIG. 10

DETAILED MECHANICAL INFORMATION

OUTLINE DRAWING

The detailed mechanical dimensions are given in Figure 10. These dimensions should be used in designing a mechanical layout for an equipment rather than the dimensions of a sample tube.

INSTALLATION & HANDLING PRECAUTIONS

The high voltage bushing and output window are protected by guard covers during shipment. These covers must be removed before the tube is installed in its associated equipment. The bushing or output window must not be subjected to any mechanical strain in the handling or mounting of the magnetron.

Care should be taken to keep magnetic material 12 inches away from the magnets, since deterioration of the magnetic field results in low power and instability.

Unnecessary jarring of the tube must be avoided. Although a packaged magnetron lends the appearance of great structural strength, it is in reality quite fragile and the resulting shock of careless handling may easily exceed its maximum allowable vibration or shock rating.

MOUNTING

The tube is mounted within the equipment by four ¼ inch bolts passed through the four clearance holes of the mounting plate. The tube must be mounted with the longitudinal axis of the cathode high voltage bushing vertical. The tube should be operated in this position although small angular deviations can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short-circuited.

ELECTRICAL CONNECTIONS

Electrical input connections are made to the frame of the tube and to two flexible leads terminated in lugs with clearance holes for #10-32 screws. Positive high voltage is grounded to the frame, preferably the mounting plate. Both flexible leads project radially from the cathode high voltage bushing. The lead at the extreme end of the bushing is connected to the heater power supply; the other, identified by a brown band, serves as a common lead for the remaining heater connection and the negative high voltage cathode terminal.

COUPLING & PRESSURIZATION

The load is attached to the QK-235 output system through standard 1 x 2 inch waveguide connected to the tube output flange by a UG148B/U choke flange. The eight tapped holes of the choke flange should be drilled to provide clearance for #10-32 screws. The output section of the magnetron should not be used to support either the weight of the tube or that of the load.

The QK-235 magnetron is intended for operation at barometric pressure common to sea level. Electrical breakdown across the cathode high voltage bushing may occur at appreciably lower pressures. Also, if sustained arcing in the waveguide occurs, it will generally move along the guide towards the output window of the tube, and may result in failure of the window. To minimize the possibility of arcing in the guide and to achieve optimum tube performance, the VSWR in the guide should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended.

TUNER CHARACTERISTICS

Approximately 13 turns of the tuner spline, at an applied torque of 1½ inch lbs., are required to tune the QK-235 through its frequency range. Internal mechanical tuner stops designed to withstand a torque of 200 inch ounces allow a slightly wider tuning range than specified, but operation out of the specified band is not recommended. See Figure 12.

Further information on the operation and capabilities of this and other type magnetrons may be obtained on request from the Applications Engineering Department, Microwave & Power Tube Operations, Raytheon Manufacturing Company, Waltham, Mass.

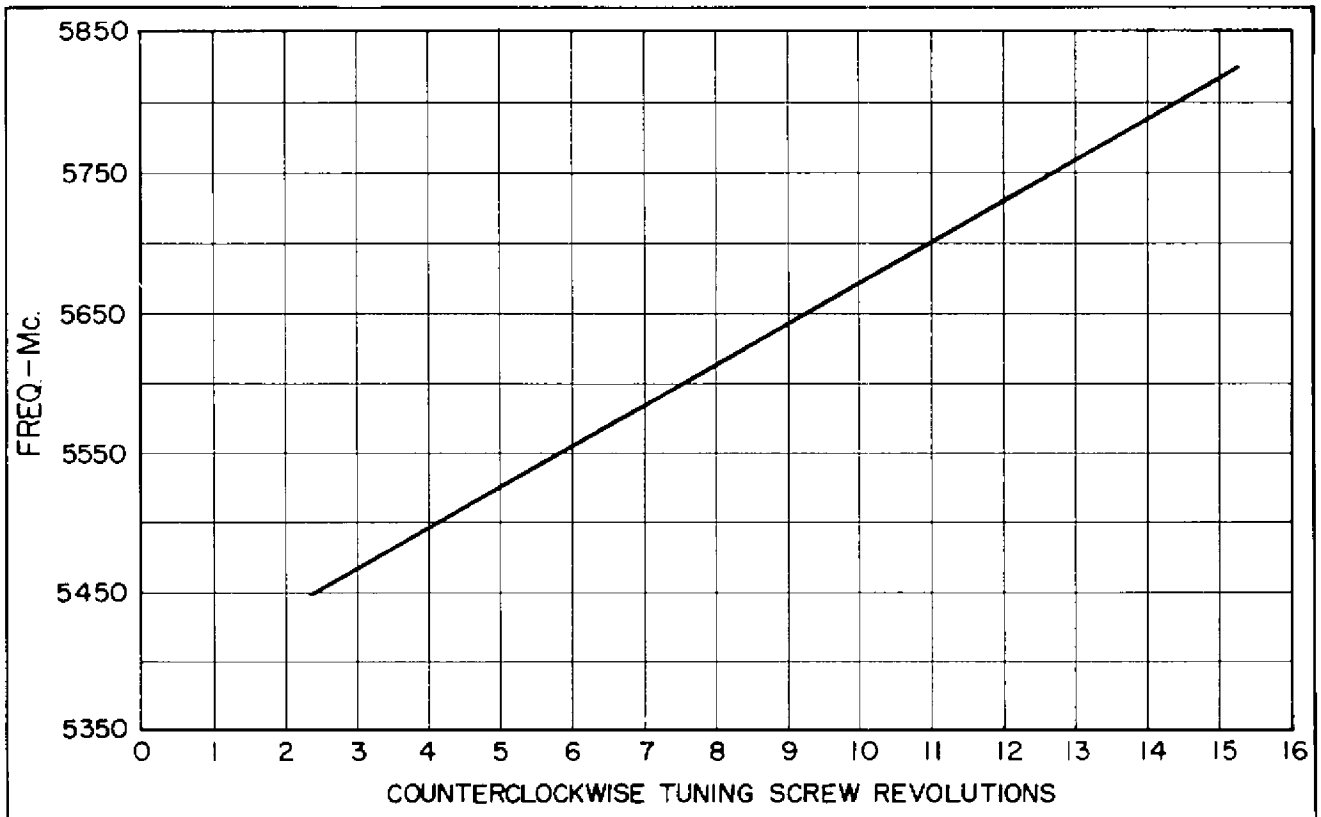


FIG. 11 – TUNING CHARACTERISTICS OF TYPICAL QK 235 MAGNETRON

from JETEC release #1551, Dec. 12, 1955

RAYTHEON

TECHNICAL INFORMATION

Excellence in Electronics

VELOCITY VARIATION OSCILLATOR

TYPE RK6390



The type RK6390 is a reflex velocity variation oscillator designed for use with a coaxial cavity in CW or pulsed operation over the 6700 to 11050 Mc range with an average power output of 60 milliwatts. Freely circulating and in some cases forced air is required for cooling of the grid ring cavity contacts. The extremely wide frequency range of this tube makes it ideally suited for signal generator and special local oscillator applications. A special control electrode facilitates low-voltage, pulsed modulation.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Voltage	6.3 ±0.5V
Heater Current	0.58 A

Ratings — Absolute Maximum Values

Resonator Voltage	1250 Vdc
Resonator Current	20 mAdc
Reflector Voltage	
Minimum Negative Value	—50 Vdc
Maximum Negative Value	—700 Vdc
Control Electrode Voltage	±25 V
Control Electrode Current	6 mA
Reflector Current	1 mAdc
Heater-Cathode Voltage	±50 V
Dissipation (Exclusive of Heater Power)	25.5 W
Temperature of G_3 Sleeve	160°C

Typical Operating Conditions (CW)

Coaxial Cavity	Special Design Required
Reflector Mode	3¾, 4¾ cycles
Cavity Mode	¾ wavelength
Frequency Range	7000-11000 Mc
DC Resonator Voltage	1250 Vdc
DC Resonator Current (exclusive of control electrode current)	20 mA
DC Reflector Voltage Range ★	—140 to —375 Vdc
DC Reflector Current	0 mA
DC Control Electrode Voltage •	+2 to +16 Vdc
DC Control Electrode Current	5 mA (max.)
Control Electrode Cutoff Voltage	—3 to —23 Vdc
Power Output (Average CW)	60 mW
Power Output (Minimum CW)	45 mW
Electronic Tuning (Half Power) ⌖ Bandwidth	12 Mc (min.)
Reflector Modulation Sensitivity @ 8340 Mc	0.1 Mc/Volt
Thermal Compensation (Tube Without Cavity)	0.1 Mc/°C

★ *Adjusted for maximum power output.*

• *Adjusted for 20 milliamperes resonator current.*

⌖ *Change in frequency between the two ½ power points when the reflector voltage is varied above and below the point of maximum power output corresponding to the given frequency.*

Typical Operating Conditions (Pulsed)

Pulse Repetition Rate	40–4000 pps
Pulse Duration (Minimum)	0.5 μs
Rise Time	0.1 μs
Fall Time	0.1 μs
Beam Current During Off Time	10 μa

The general conditions for pulsed operation are the same as those given above for CW operation. Power output for pulsed operation will not be less than 1.5 db below the power output for CW operation over the band.

General Mechanical Characteristics

Mounting Position	Any
Over-all Dimensions	See Outline Drawing
Envelope	Glass
Seals	Glass to Copper Oxide
Banana Jack	Required Ucinite #152005 Mating Plug or Equivalent.
Base	Special Miniature 4 Pin, Fits Amphenol #78-545 Socket.
Vibration	10 G @ 50 cps
Altitude	50,000 ft (max.)

DETAILED ELECTRICAL INFORMATION

REFLECTOR

The reflector electrode is connected to the small banana jack on the top of the tube. Reflector voltages more positive than —50 volts with respect to the cathode may result in damage to the tube. Under conditions of vigorous oscillation and light loading, excessive reflector current may be drawn (in the order of one milliampere) on the long wavelength of the band. No damage will result, however, except in cases where the heavy reflector current flowing in a high reflector circuit impedance causes the reflector potential to swing increasingly positive with respect to the cathode. Where high reflector circuit impedances are used, it is advisable to shunt the reflector and cathode with a small diode to prevent the reflector from swinging positive.

CATHODE

In most applications, the metal cavity used with the RK6390 is operated at ground potential, and the cathode will be negative with respect to ground by the amount of this resonator potential. The cathode may be connected to one side of the heater or to the center tap of the heater transformer secondary. When the cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to a heater lead. When the cathode and heater are not tied together, the heater-cathode voltage should not exceed ±50 volts. In all cases where the resonator is operated at ground potential, the heater transformer must be insulated to withstand the maximum resonator voltage. Maximum tube life will be realized if a 30-second heater warmup period precedes the application of other voltages. The beam potential must never be applied before any other voltages.

CONTROL ELECTRODE

In applications where the RK6390 is to be used in both CW and pulsed operation, the circuit in Fig. 1 is recommended. With the selector switch in the CW position, the 6J6 is effectively out of the circuit and the bias on the RK6390 is set at a value that will yield a 20-milliampere beam current. With the selector set at the pulsed position, the 6J6 shunts the lower portion of the potentiometer and the voltage division is such that the RK6390 is biased to cutoff. A negative pulse of suitable amplitude applied to the grid of the 6J6 will drive it to cutoff and restore the grid of the RK6390 to the level set for CW operation.

ELECTRONIC TUNING

Vernier adjustment of the frequency of the RK6390 is accomplished by varying the reflector voltage. If the mechanical tuning mechanism employed in the external cavity and the reflector voltage are mutually adjusted to yield a maximum power output at a given frequency, and if then the reflector voltage is varied above and below the value for maximum power such that the power output is reduced to one half, the frequency change between the half power values is defined as the electronic tuning range. The range of electronic tuning and the linearity of its variation with reflector voltage is a function of the type of load and coupling used. Maximum electronic tuning range will be achieved with operation into a resistive load. Operation into a highly reactive load may be attended by excessive hysteresis, and nonlinear variation of frequency with reflector voltage.

FREQUENCY STABILITY

The regulation of the voltages applied to the reflector, resonator, and control grid will be reflected directly in the stability of the output frequency. Hence, the regulation of those voltage supplies must be commensurate with the stability requirements of the application.

The thermal frequency drift experienced with the RK6390 depends mainly on the changes in physical size of the resonant chamber with temperature. The RK6390 is temperature-compensated so that thermal coefficient of frequency drift will not exceed 0.1 Mc/°C when operating in a constant size cavity. The amount by which the frequency drift exceeds 0.1 Mc/°C is therefore dependent only on the thermal properties of the cavity. Careful consideration should be given to the material from which the external cavity is constructed.

MODE OF OPERATION

The RK6390 is designed for operation with contacting or noncontacting plunger-type coaxial cavities over the 6700 to 11050 Mc band in the 3¾ and 4¾ reflector modes. Design and construction of the above-mentioned cavities can be extremely troublesome, and certain design precautions must be observed to avoid interference from circumferential resonances, one-quarter wavelength modes, and multifrequency bunching. An extensive treatment of the design of wide-range coaxial cavities is beyond the scope of this publication; however, the following references contain adequate information pertinent to their design.

1. W. H. Huggins. "Multifrequency Bunching in Reflex Klystrons," Proc. I.R.E., XXXVI, 624-30.
2. W. H. Huggins. "Broad Band Non-Contacting Short Circuits for Coaxial Lines," Proc. I.R.E., XXXV, 1324-28.
3. Radio Research Laboratory Staff. "Very High Frequency Techniques." New York: McGraw-Hill, 1947, II, 916-19 and 900-11.

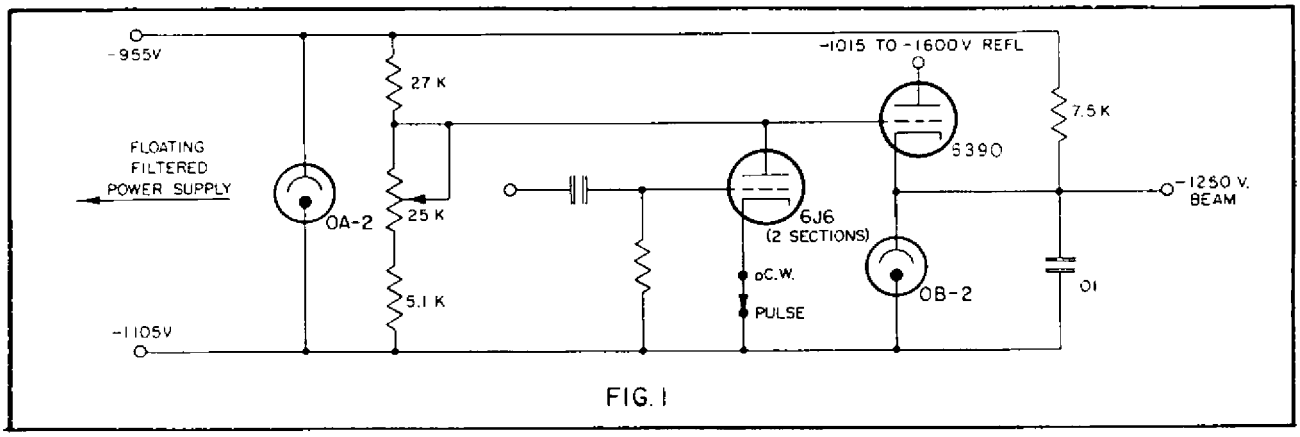


FIG. 1

DETAILED MECHANICAL INFORMATION

INSTALLATION

The tube mounts in any position and requires a special, miniature, 4-prong socket such as an Amphenol Type 78-545 or low-loss equivalent. Clamping to the G_2 ring should be made in such a manner that no mechanical strain be set up in the glass between G_2 and G_3 rings. A toroidal spring contact between the cavity and the G_2 ring, as shown in Fig. 2, is recommended.

Temperatures of the G_3 sleeve in excess of 160°C cannot be tolerated; and in cavities where center conductor conduction is insufficient to hold this tolerance, forced-air cooling is required. In general, the center conductor of wide-range coaxial cavities will have sufficient mass to provide adequate conduction. However, in situations where conduction is inadequate, a center conductor made of coin silver will improve conduction sufficiently to obviate forced-air cooling.

Optimum broad-band operation is best achieved with a load termination of 50 ohms and VSWR'S not greater than 1.25/1.

SHIELDING

Operation of the RK6390 in the presence of strong magnetic fields usually requires shielding of the resonator and reflector leads to avoid undesirable modulation of the tube output. In extremely troublesome environments, it may be necessary to place the parts of the RK6390 not covered by the cavity in a metal chamber with poly-iron chokes provided on the leads bringing the voltages into the chamber.

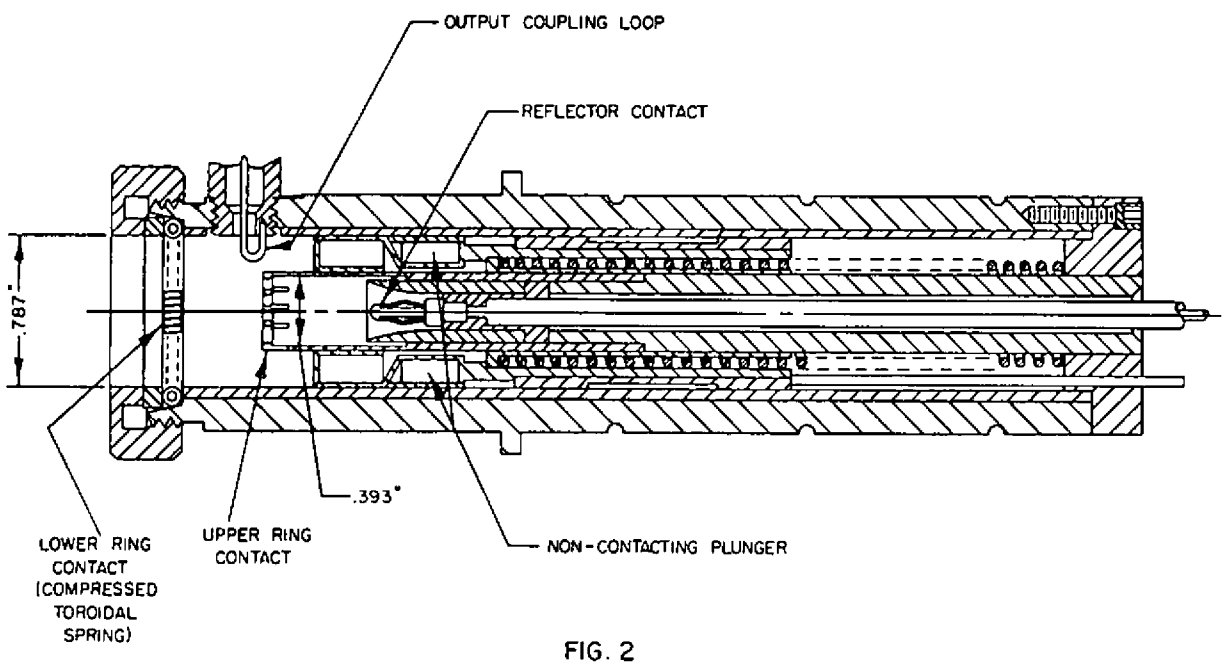
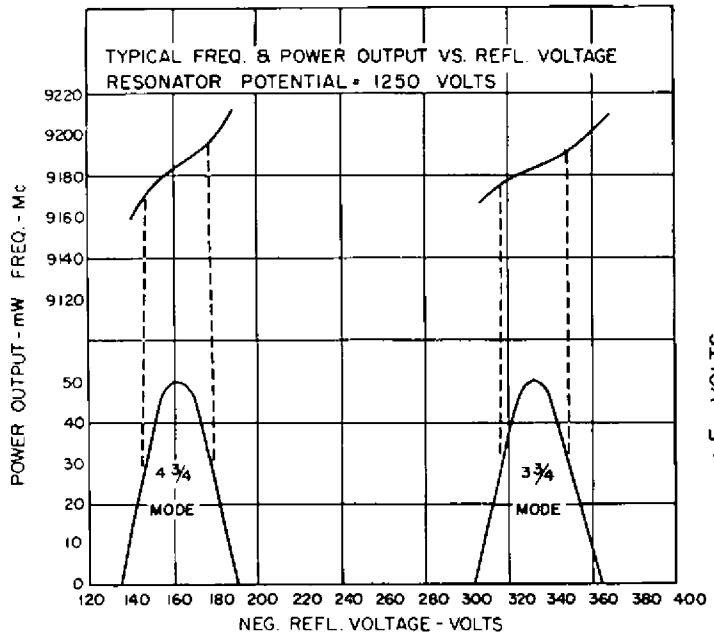
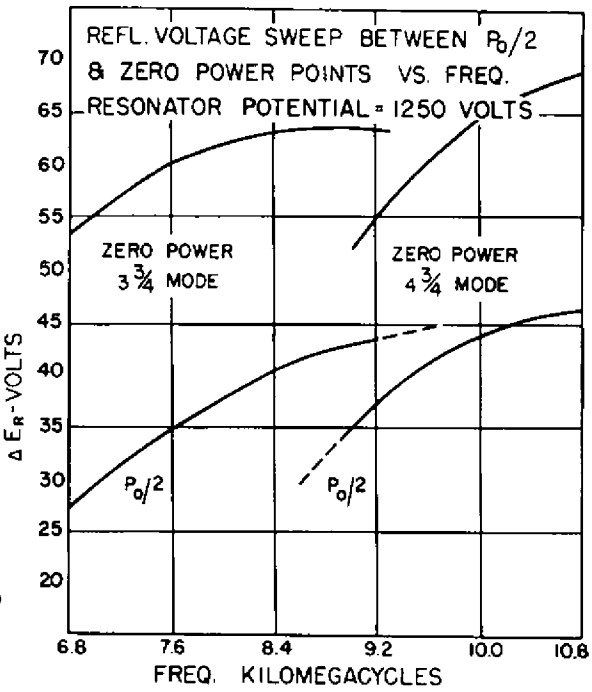
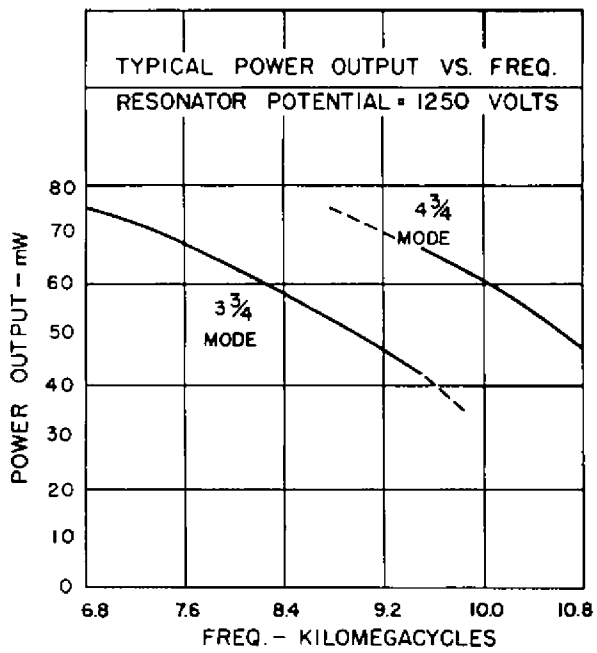


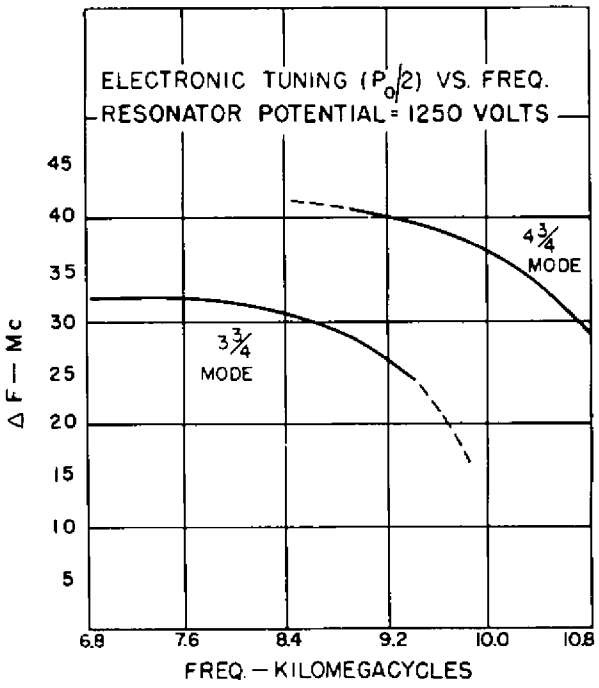
FIG. 2

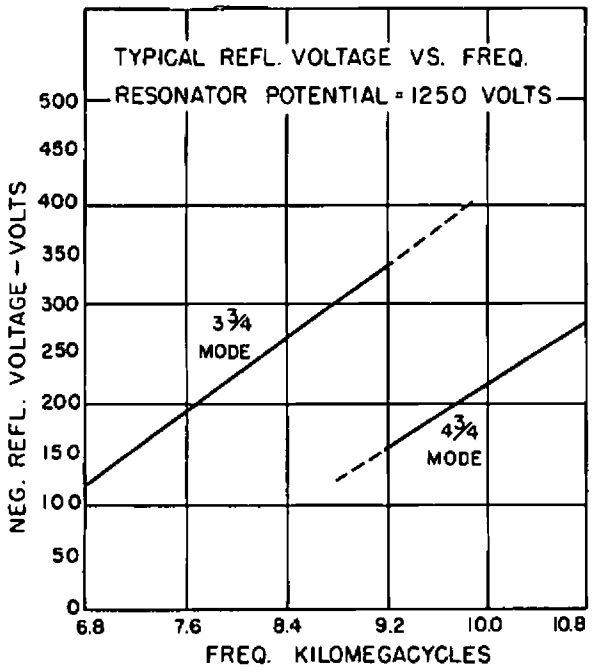
VELOCITY VARIATION OSCILLATOR

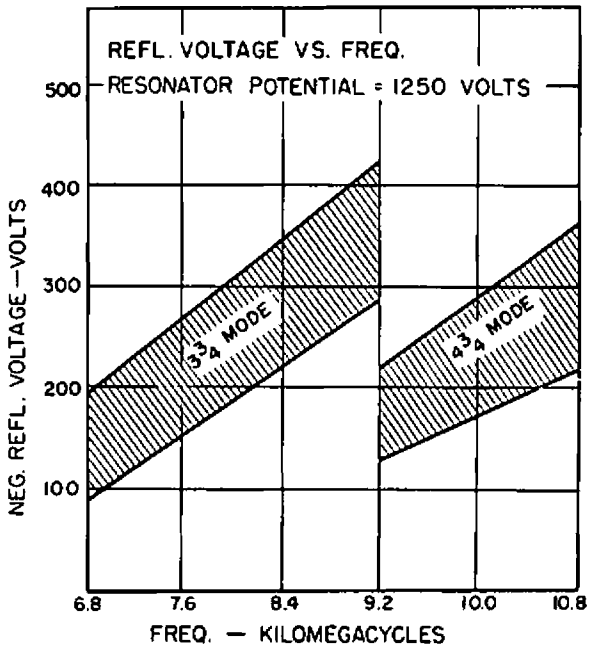


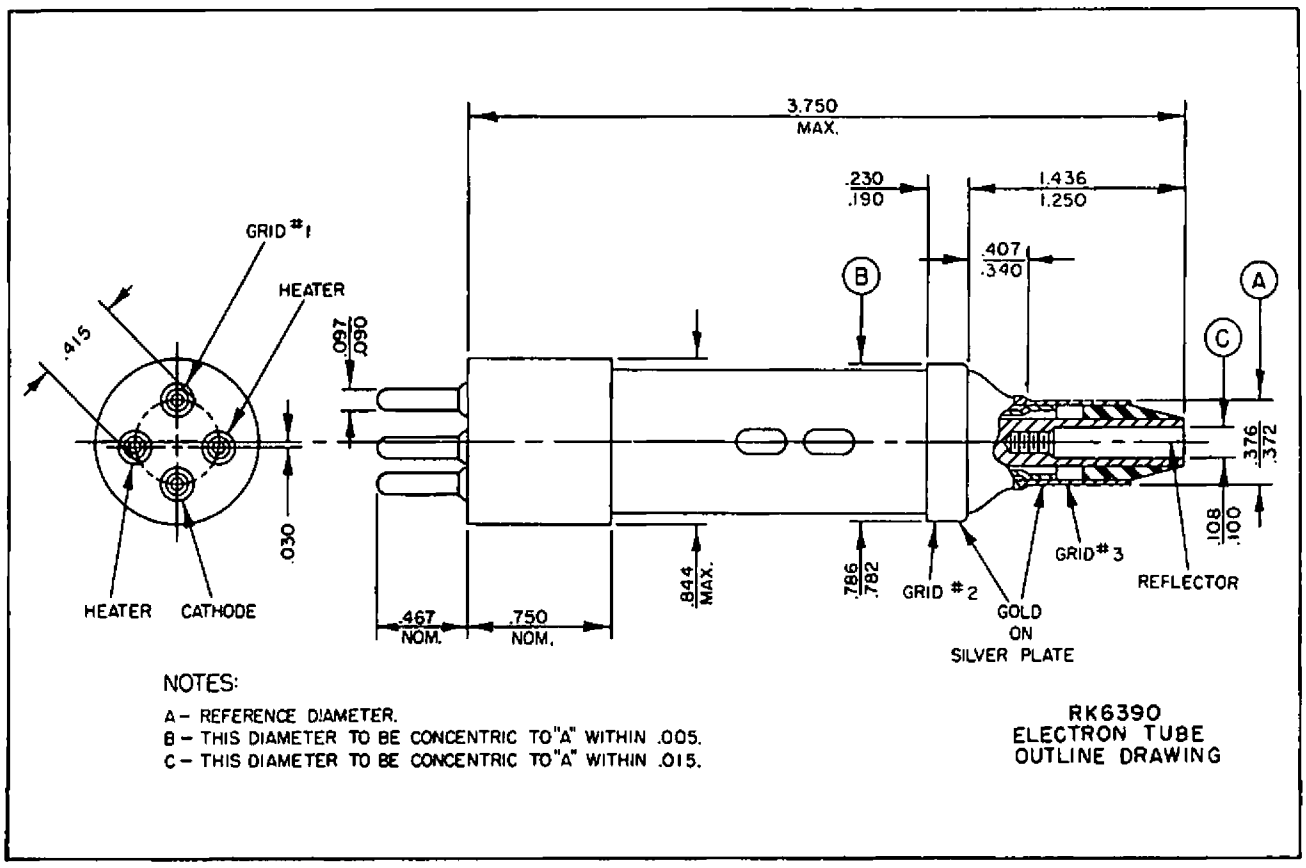












NOTES:

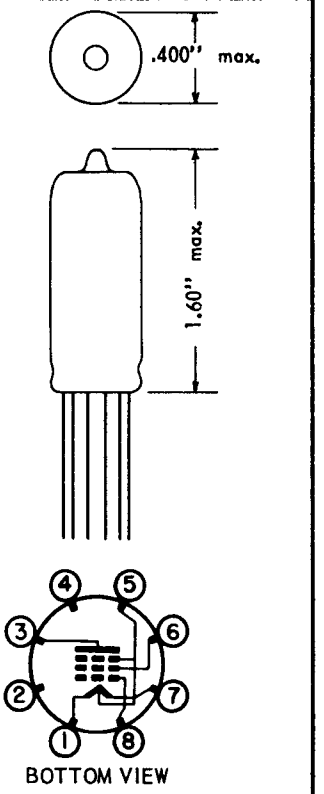
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RK6390
ELECTRON TUBE
OUTLINE DRAWING

Excellence in Electronics

TYPE CK6397

The CK6397 is a filament type RF Power Pentode of subminiature construction designed for use as an intermittent duty cycle Class A or Class C amplifier such as in portable transceiver equipment or as a frequency doubler at output frequencies in the VHF Range. It is designed for dependable operation under conditions of shock and vibration usually found in mobile and aircraft applications. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW

6CL

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.25" min.)

TERMINAL CONNECTIONS:

Lead 1 Filament, negative
Lead 2 No Connection
Lead 3 Plate
Lead 4 No Connection
Lead 5 Filament center-tap, Grid #3, (F+parallel)
Lead 6 Grid #2
Lead 7 Filament, positive
Lead 8 Grid #1

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu fds$)

	Unshielded	Shielded
Grid to Plate: (g1 to p)	0.06	0.055 max.
Input: g1 to (F+g2+g3)	2.6	2.75
Output: p to (F+g2+g3)	2.15	3.0

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25/2.5±12% volts
Plate Voltage	135 volts
Grid #2 Voltage	135 volts
Grid #1 Voltage	100 volts
Plate Dissipation	1.5 watts
Grid #2 Dissipation	0.6 watt
Cathode Current	14 ma.
Grid #1 Current	0.375 ma.
Altitude	60,000 feet
Impact	500 g

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A AMPLIFIER:

Filament Voltage	1.25/2.5 volts
Filament Current	125/62.5 ma.
Plate Voltage	125 volts
Grid #2 Voltage	125 volts
Grid #1 Voltage	-7.5 volts
Plate Current	7.25 ma.
Grid #2 Current	1.2 ma.
Transconductance	1950 μmhos

CHARACTERISTICS AND TYPICAL OPERATION - FREQUENCY DOUBLER:

Filament Voltage (dc)	1.25	1.25 volts
Filament Current	125	125 ma.
DC Plate Voltage	120	120 volts
DC Grid #2 Voltage	120	120 volts
Grid Bias Resistance	0.27	0.22 meg.
Peak RF Grid Drive Voltage	65	80 volts
Plate Current	6.5	7.5 ma.
Grid #2 Current	2.0	2.50 ma.
Grid #1 Current (approx.)	220	325 μa.
Useful Power Output	115	140 mw.
Output Frequency	125	250 Mc.

Printed in U.S.A.

Tentative Data

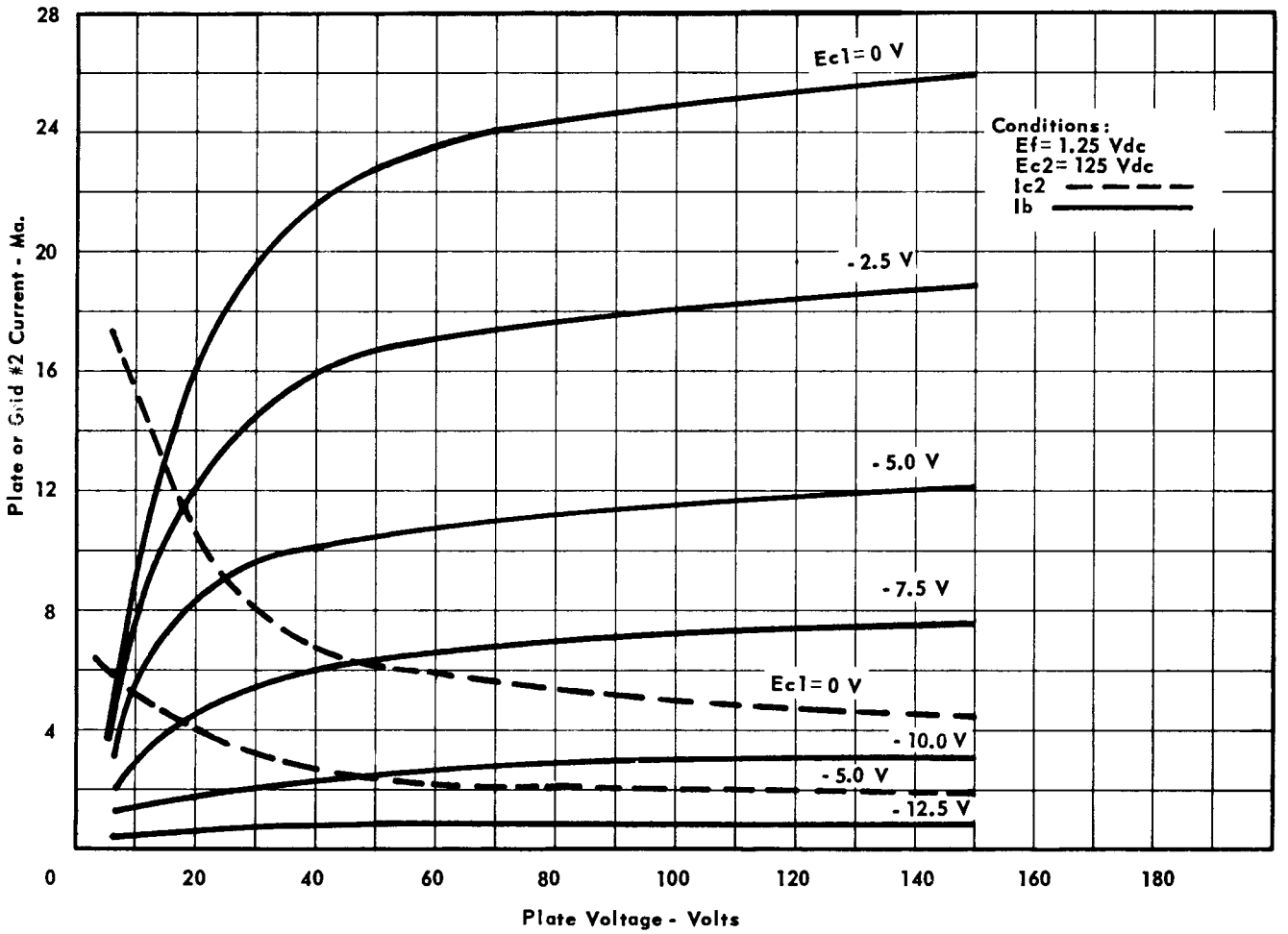
RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

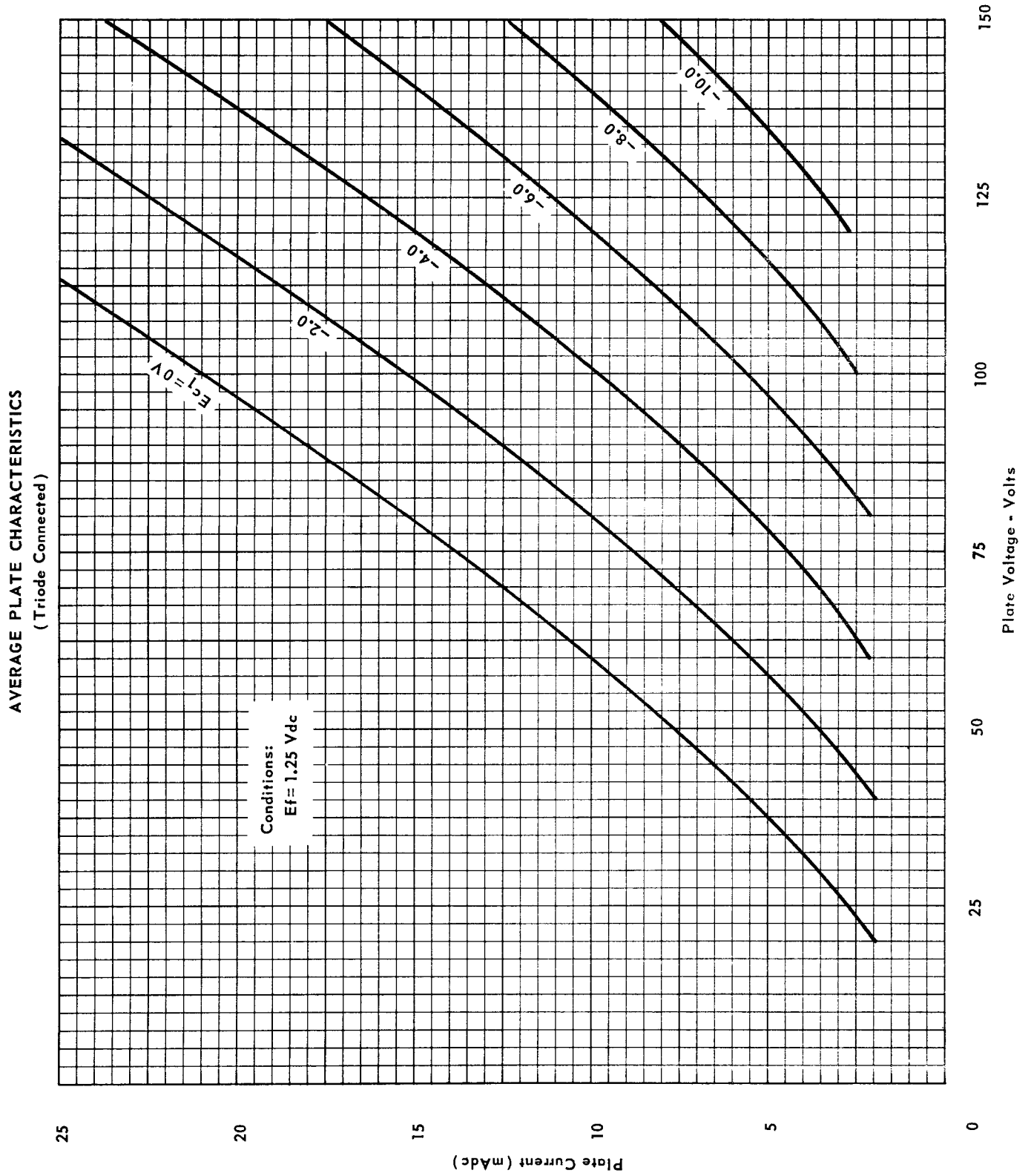
NEWTON 58, MASS.

SUBMINIATURE POWER PENTODE

AVERAGE PLATE CHARACTERISTICS



SUBMINIATURE POWER PENTODE



Printed in U.S.A.

from JETEC release
#1474, May 31, 1955

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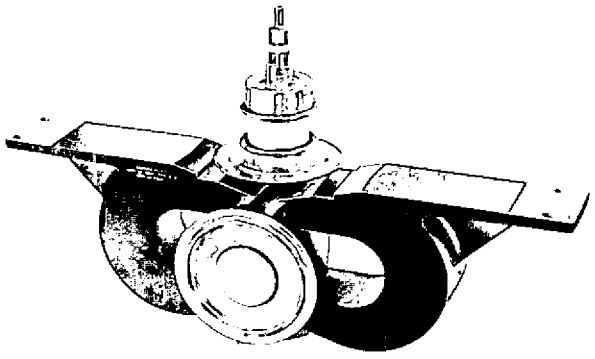
TECHNICAL INFORMATION

PULSED-TYPE MAGNETRON OSCILLATOR

Excellence in Electronics

TYPE RK6406/ QK428

The RK6406/QK428 magnetron is a fixed frequency pulsed type oscillator operating in the frequency region of 2850 to 2910 megacycles with a nominal peak power output of 2 megawatts. It is an integral magnet, waveguide output type tube requiring forced liquid cooling and is designed for coupling to standard 1.5" x 3" waveguide.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL–E–1B Government purchase specifications.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK6406/QK428 under conditions other than those recommended in this technical data sheet, the company's Magnetron Application Engineering Group should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Current Preheat	85 A
Heater Voltage @ 85A	7.3 – 9.3 V
Minimum Preheat Time	3 minutes
Cold Heater Resistance	0.0087 ± 1% ohms

Maximum Ratings

Heater Current	88 A
Peak Anode Voltage	56 kv
Peak Anode Current	95 a
Average Power Input	3200 W
Pulse Duration	2.2 usec
Voltage Pulse Rise Time	0.6 usec
Duty Cycle	0.0006
VSWR	1.5/1
Pulling @ VSWR = 1.5/1	10 Mc
Anode Temperature	100° C
Bushing Temperature	150° C
Output Pressurization	55 psia
Coolant Pressure	55 psia

The values specified above must not be exceeded under any service condition. The ratings are limiting values above which the serviceability of any individual tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Typical Operation

Heater Current-Operate	85 A
Pulse Duration	2.0 usec ± 10%
Duty Cycle	0.0006
Peak Anode Voltage	52 kv
Peak Anode Current	85 A
Average Anode Current	51 mAdc
Peak Power Output	2 Mw
Average Power Output	1200 W
Useful Range of Peak Current	75 — 95 A
VSWR	1.1/1
Frequency Region	2850 — 2910 Mc
RF Bandwidth	0.7 Mc (@ -6db level)

MECHANICAL

Over-all Dimensions	21.5" x 7.5" x 16"
Net Weight	40 lbs
Mounting	Cathode Vertical
Output Coupling	1.5" x 3" Choke Flange
Output Pressure	35 psia
Cooling	Forced Liquid
Cathode Bushing	Immersed in Oil
Vibration (nonoperating)	50 cycles @ 10 G
Shock (nonoperating)	15 G
Magnet Protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at $I_f = 85A \pm 3.5\%$ for a period of at least 3 minutes prior to the application of anode voltage. Optimum operation and maximum tube life will be realized only if provisions are made to maintain the specified heater current within the ± 3.5% tolerance. Heater current surges in excess of 100 amps cannot be tolerated. Operation of the tube at standby or preheat without forced liquid cooling may result in damage to the tube and is not permissible. See Fig. 1 for heater characteristics.

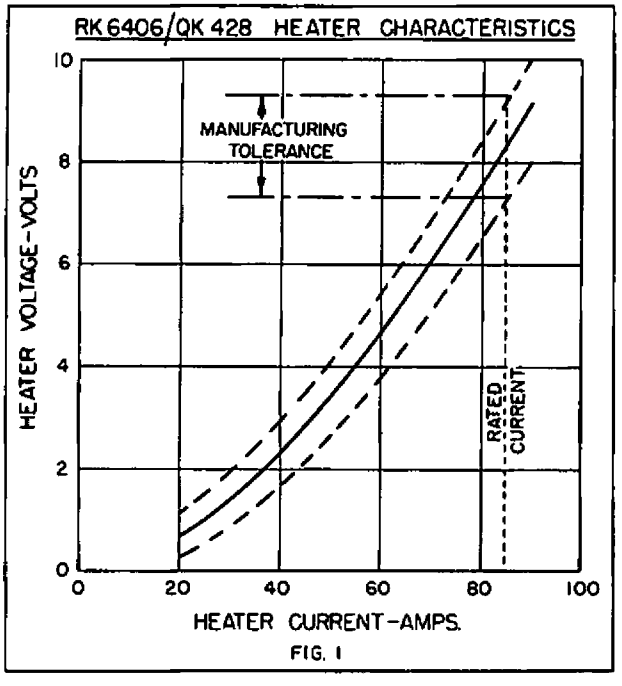


FIG. 1

STARTING NEW MAGNETRON

In starting a new magnetron or one that has not been operated for some time, sparking and some instability may occur. Sporadic arcing will not harm the magnetron, but if the tube tends to arc continuously, the following seasoning procedure is recommended:

1. Preheat magnetron for 15 minutes.
2. Gradually raise the magnetron current to a level just below that which produces continuous arcing. Allow the magnetron current to remain at this level for a few minutes until the arcing begins to decrease.
3. Repeat the above process for succeedingly higher levels of magnetron current until the desired operating point is reached.

It is usually possible to attain the desired operating point within 15 minutes.

PULSE LENGTH AND DUTY CYCLE

The RK6406/QK428 magnetron has been designed and tested for operation at the following pulse conditions: See Fig. 2.

tpc = 2.0 ± 10% usec @ DU = .0006
trc = 0.2 usec max. measured 20% to 85%
tfc = 0.5 usec max. measured 0% to 85%
trv = 0.6 usec max. measured 20% to 85%
tfv = 2.5 usec max. measured 0% to 85%

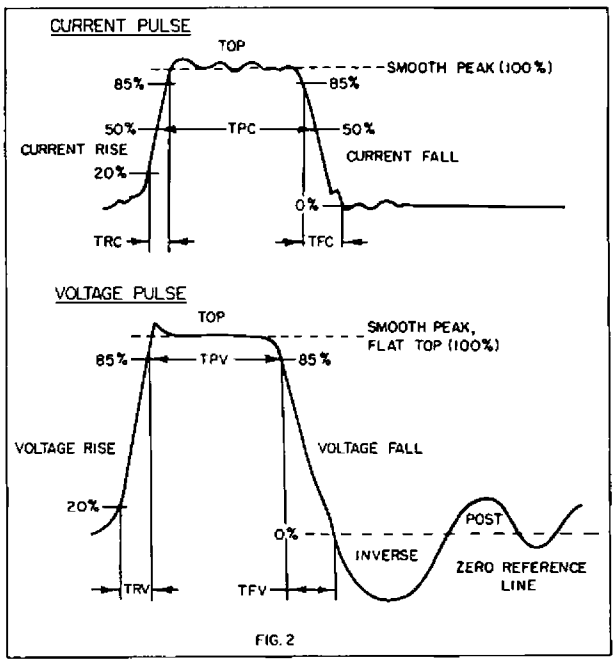


FIG. 2

No spike or ripple shall exceed ± 7% of the average peak value of voltage or current. Inverse voltage should not exceed 20% of the forward voltage. Post voltages should be held to a minimum as they may cause post pulse noise or oscillation.

Short pulse operation is currently under investigation and the preliminary results indicate that operation at the following pulse widths and duty cycles is feasible:

tpc — 0.6 usec @ Du = 0.0002
tpc — 0.6 usec @ Du = 0.0006

If operation at either of these short pulse conditions is anticipated, the manufacturer should be consulted for further information.

Optimum tube performance will be realized only if proper consideration is given to pulse shaping. Voltage rise times greater than maximum specified will result in moding and/or arcing and cannot be tolerated. Excessive ripple on the top of the current pulse causes frequency pushing and broadening of the spectrum. Most magnetrons draw a small amount of leakage or diode current at anode voltages as low as 100 volts. This leakage current may amount to several milliamperes if the voltage fall time is greater than 2.5 usec, and at a given duty cycle the calculated peak current will be in error. It is therefore advisable that the equipment design effect as rapid a decay time as possible. Inverse and post voltages may result in undesirable noise radiation and should be damped. Judicious matching of the pulse-forming network and pulse transformer will in most cases reduce post and inverse voltage amplitudes sufficiently to eliminate noise difficulties. For short-range radar applications where noise due to inverse and post voltages is most troublesome, it is recommended that a diode clipper be placed across the primary of the pulse transformer.

Optimum pulse shaping can best be achieved by treating the magnetron, pulse transformer, and pulse line as a unit; hand-tailoring the line and transformer for magnetron compatibility is recommended.

If operation at both long and short pulses is anticipated, the pulse transformer should be designed to optimize the more important pulse.

LOAD DIAGRAM

Fig. 3 is a load diagram for a typical RK6406/-QK428 magnetron. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 2.5/1 have been plotted, but operation at ratios greater than 1.5/1 is not recommended. The RK6406/QK428 is capable of operation at a VSWR of 1.5/1 phased opposite the sink with virtually no arcing, and therefore readily lends itself for operation in systems requiring extremely stable performance.

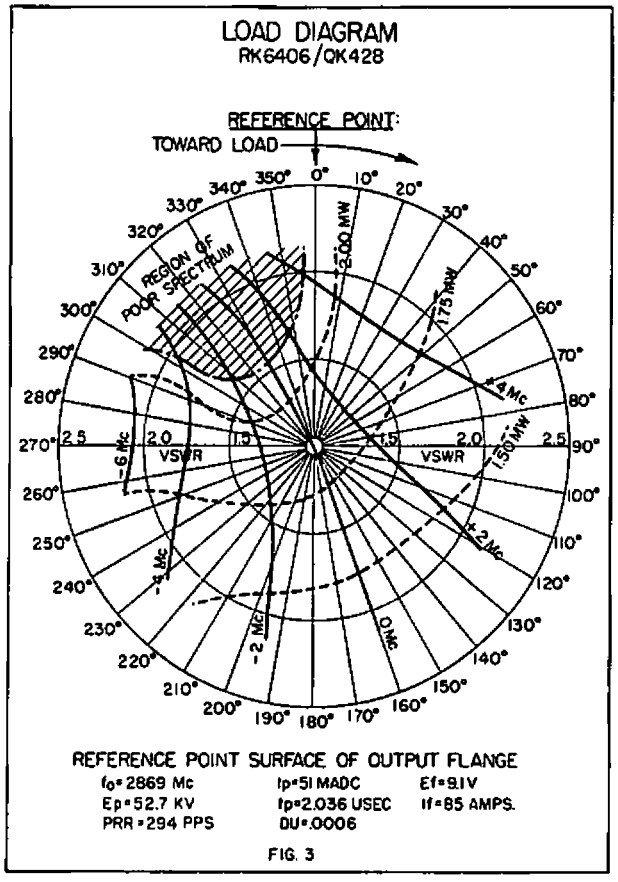


FIG. 3

COOLING

The RK6406/QK428 magnetron is a forced liquid cooled tube. The ambient temperature will dictate the type of coolant and flow rate necessary to maintain anode temperature below the specified maximum (100°C). Fig. 4 is a plot of anode temperature rise above ambient as a function of total power input and rate of water flow.

Sufficient cooling of the cathode insulating oil must also be provided to maintain the cathode bushing temperature below the maximum specified 150°C. If an insulating oil is used whose insulating properties deteriorate above normal operating temperatures, it is of course necessary to maintain the oil temperature at a value below the deterioration level. It is recommended that Esso Univolt 35 or its equivalent be used.

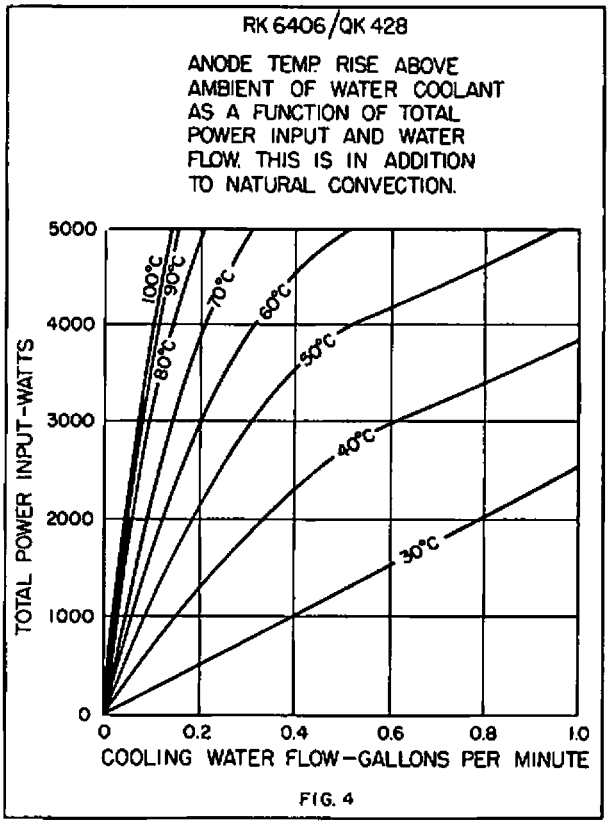


FIG. 4

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long-line effects". Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case the extent to which the long-line effect is exhibited depends on the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Fig. 5 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not critical in the RK6406/QK428 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectrum caused by this phenomena. It may in some cases permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Fig. 5, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although for close control of bandwidth the VSWR should be kept as low as possible.

More detailed information on the theories and remedies of long-line effects are available upon request.

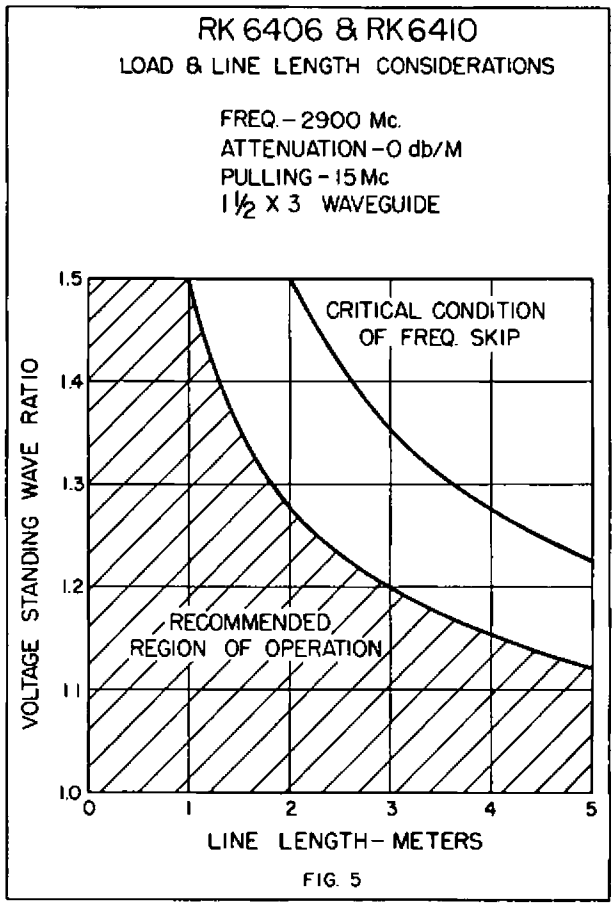


FIG. 5

FREQUENCY DRIFT

After operation of the RK6406/QK428 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift and anode temperature are plotted as a function of time in Fig. 6.

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes. The frequency change will not exceed 0.15 Mc/C° between 40° and 70°C anode temperature.

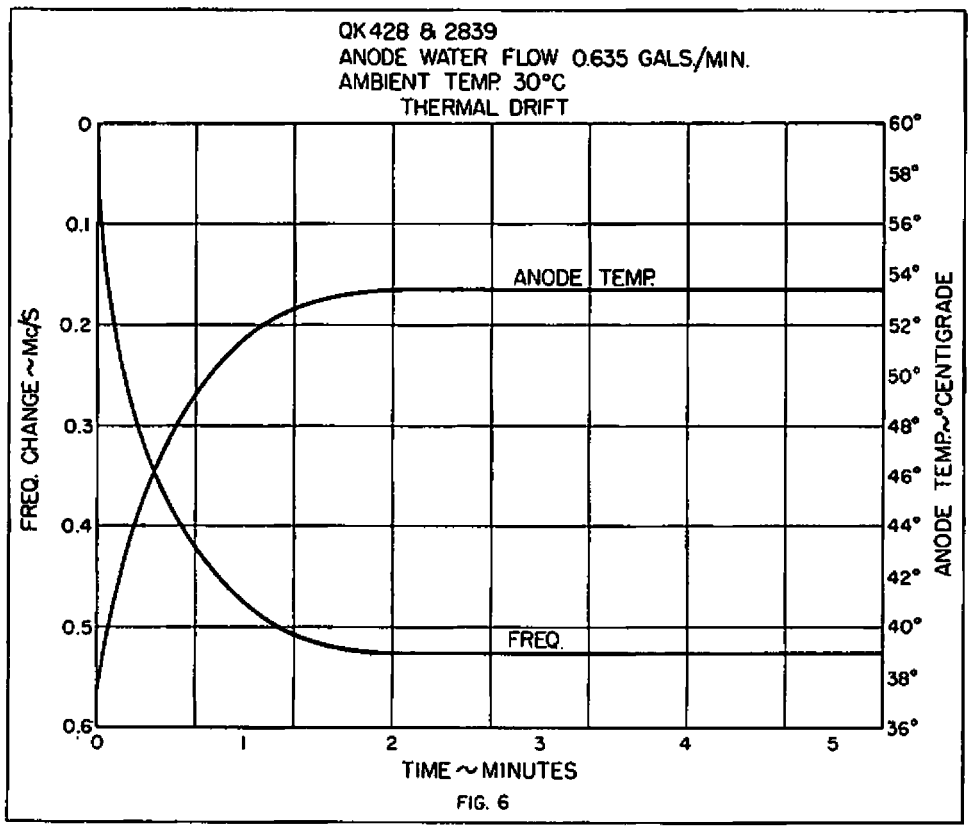


FIG. 6

RF RADIATION FROM CATHODE

The RK6406/QK428 is designed to minimize radiation from the cathode bushing which will in general be negligible. It is not possible, however, to guarantee it as being negligible, and in particularly critical environments shielding of the cathode bushing may be necessary to avoid radiation difficulties.

OPERATING CHARACTERISTICS

Fig. 7 is a plot of peak power output, anode voltage and efficiency as a function of peak anode current showing the maximum and minimum deviation from the average.

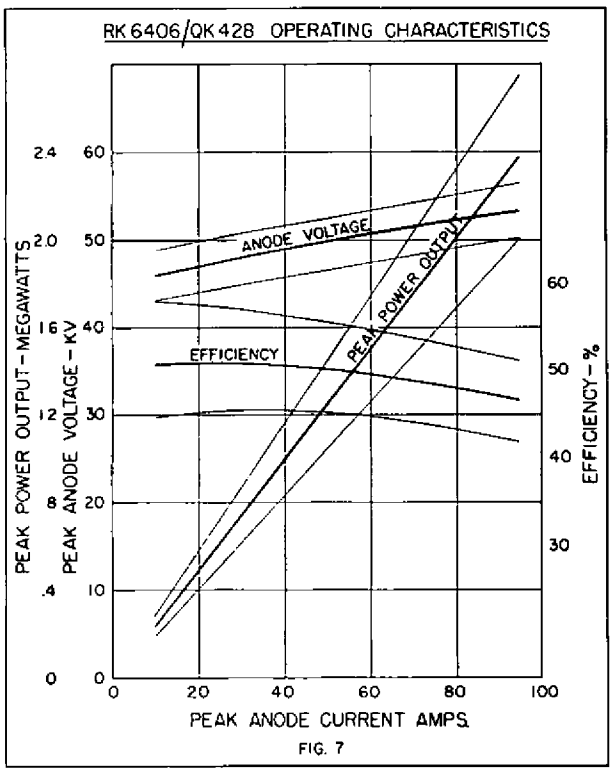


FIG. 7

INSTALLATION AND HANDLING PRECAUTIONS

Although magnetrons give the appearance of great structural strength, they are in reality quite fragile and may be easily damaged in handling or installation. Damage to the magnetron will be avoided if the following installation and handling precautions are carefully observed.

1. Leave magnetron in its shipping crate until ready to be used.
2. Remove neoprene guard covers from the RF output window and cathode bushing before installing tube in equipment.
3. Avoid setting up mechanical strains in output window or cathode bushing when handling or mounting.
4. Avoid unnecessary jarring or rough handling.
5. Do not let magnetron rest on any of its parts normally protected by the shipping crate.
6. If magnetron has been operated with water as a coolant, be sure to drain water from the cooling jacket before storing in a freezing environment.
7. If a magnetron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the RF window or cathode bushing and wipe dry before application of high voltage.
8. Do not place tube in closer proximity to magnetic materials than is indicated on tube magnet.

MOUNTING

The tube is mounted within the equipment by four bolts passed through the clearance holes of the mounting brackets. The tube must be mounted with the longitudinal axis of the cathode high voltage bushing vertical. The tube should be operated in this position although small angular deviations (15 degrees) can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short-circuited.

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two terminals on the high voltage cathode bushing. The positive high voltage should be grounded at the mounting surfaces. Heater and cathode connections are made to the terminals on the cathode bushing (see note 9 of tube outline drawing). Heater connectors should be designed to minimize contact resistance and lateral forces on the heater terminals. Drawings of suitable heater cathode connecting devices are available on request.

COUPLING AND PRESSURIZATION

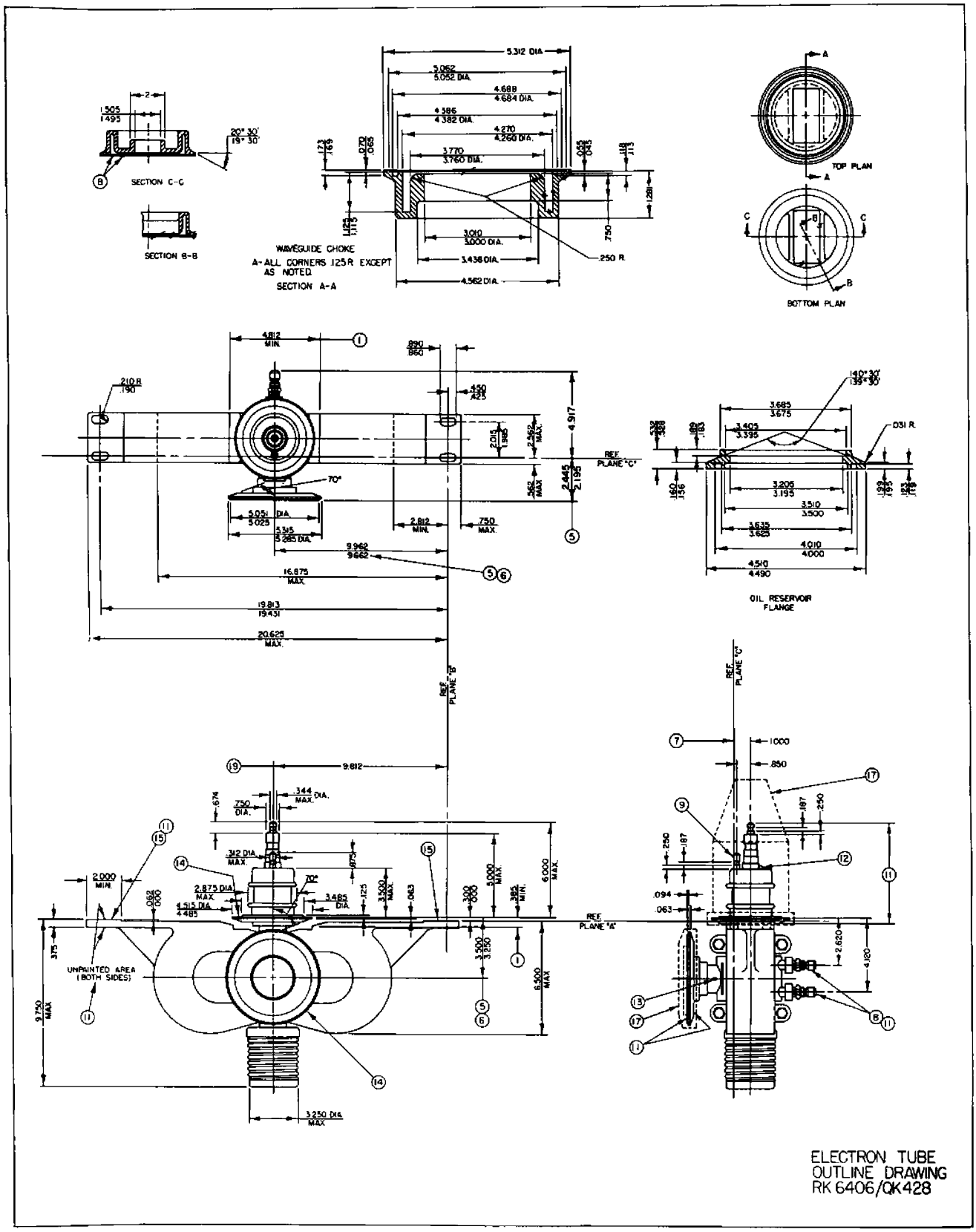
The magnetron output flange is designed to couple to standard 1.5" x 3" waveguide. Mechanical details of the recommended choke flange to mate to the magnetron are illustrated in the outline drawing. See Fig. 8.

Waveguide pressurization to 35 psia is required. Pressurization lower than 35 psia may result in waveguide breakdown. If sustained arcing in the waveguide occurs, failure of the output window may result. To minimize the possibility of the tube arcing in the guide and to achieve optimum tube performance, the VSWR of the waveguide system should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended.

NOTES:

1. This dimension applies to a 4.812" minimum.
2. Reference plane "A" lies on the mounting surface of the magnets.
3. Reference plane "B" passes through the center line of the holes in the bracket and is perpendicular to reference planes "A" and "B."
4. Reference plane "C" passes through the center line of the holes in the bracket and is perpendicular to reference planes "A" and "B."
5. Includes angular as well as lateral deviations.
6. Refers to the center line of the waveguide.
7. Parts on this center line may vary from the true location by 0.125".
8. Hansen 33-T20 coupling plug.
9. Common cathode connection.
10. All solder joints on the output section should be soldered to provide a hermetic seal.
11. The following should be free from paint: front and back faces of the oil-sealing sleeve, parts above the flange, front and back faces of the output flange, the exhaust cap, the mounting surface on the magnets, and the coolant plug connectors.
12. The cathode stem temperature is measured at this point.
13. The anode temperature is measured at the right side (facing output) of the output transformer by inserting a tapered thermocouple plug (see installation details in drawing C69659).
14. Equipment flanges mating to the oil-sealing and output flanges should provide compliance by means of a bellows or other flexible union. These flanges cannot be used to support the tube. The entire weight must be held by the magnet brackets.
15. These surfaces must be coplaner within 0.032".
16. WARNING: Maintain a minimum clearance of 8" between the magnets and ferromagnetic materials, except at bracket ends where the minimum clearance can be 3". Maintain a minimum clearance of 12" to the other magnets.
17. Protective cover for shipping purposes only.
18. Coat with black, heat-resistant, noncorrosive paint.
19. Parts on this center line may vary from the true location by 0.188".

PULSED-TYPE MAGNETRON OSCILLATOR



ELECTRON TUBE
OUTLINE DRAWING
RK 6406/QK428

from JETEC release #1575, Jan. 30, 1956

RAYTHEON

TECHNICAL INFORMATION

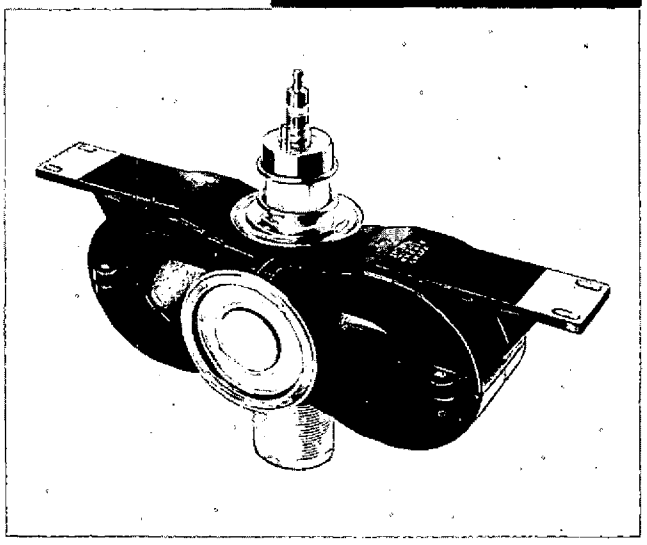
TENTATIVE DATA

Excellence in Electronics

PULSED-TYPE MAGNETRON OSCILLATOR

TYPE RK6410/ QK338

The RK6410/QK338 magnetron is a fixed-frequency pulsed-type oscillator operating in the frequency region of 2750 to 2860 megacycles with a nominal peak-power output of 5.0 megawatts. It is an integral-magnet, waveguide-output type tube requiring forced liquid cooling and is designed for coupling to standard 1.5" x 3" waveguide.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL-E-1B Government purchase specifications.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK6410/QK338 under conditions other than those recommended in this technical data sheet, the company's Magnetron Application Engineering Group should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Current Preheat	85 A
Heater Voltage @ 85A	7.3 — 9.3 V
Minimum Preheat Time	3 minutes
Cold Heater Resistance	0.0087 ± 1% ohms

Maximum Ratings

Heater Current	88 A
Peak Anode Voltage	76 kv
Peak Anode Current	135 a
Average Power Input	7000 W
Pulse Duration	2.2 usec
Voltage Pulse Rise Time	0.5 usec
Duty Cycle	.001
VSWR	1.5/1
Anode Temperature	100°C
Bushing Temperature	150°C
Output Pressurization	55 psia
Coolant Pressure	55 psia

The values specified above must not be exceeded under any service condition. The ratings are limiting values above which the serviceability of any individual tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

MECHANICAL

Over-all Dimensions	21.5" x 7.5" x 16"
Net Weight	58 lbs.
Mounting	Cathode Vertical
Output Coupling	1.5" x 3" Choke Flange
Output Pressure	35 psia
Cooling	Forced Liquid
Cathode Bushing	Immersed in Oil
Vibration (nonoperating)	50 cycles @ 10 G
Magnet Protection	12"

Typical Operation

Heater Current Preheat	85A ± 3.5%
Heater Current—Operate	82A ± 3.5%
Pulse Duration	2.0 usec ± 10%
Duty Cycle	.00072
Peak Anode Voltage	71 kv
Peak Anode Current	130 a
Average Anode Current	93.5 mAdc
Peak Power Output	4.8 Mw
Average Power Output	3450 W
Useful Range of Peak Current	90 — 135 a
VSWR	1.1/1
Frequency Region	2750 — 2860 Mc
RF Bandwidth	0.7 Mc @ (—6db level)

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at 85A for a period of at least 3 minutes prior to the application of anode high voltage. Heater current surges in excess of 100 amperes cannot be tolerated. Optimum operation and maximum tube life will be realized only if provisions are made to hold the specified heater current within the ± 3.5% tolerance.

Even though operation at heater currents higher or lower than specified may not be attended by immediate malfunctioning of the tube, some deterioration of life and performance is likely to result.

Excessive cycling or extended standby operation is detrimental to heater life. Therefore, once a heater is energized, it should remain energized insofar as is practicable; i.e., except in cases where repair or maintenance require shutdown or when standby operation is going to exceed 48 hours.

Figure 1 shows the influence of heater current variations on various operating parameters for the operating conditions tabulated on the graph.

Operation at preheat or standby without forced

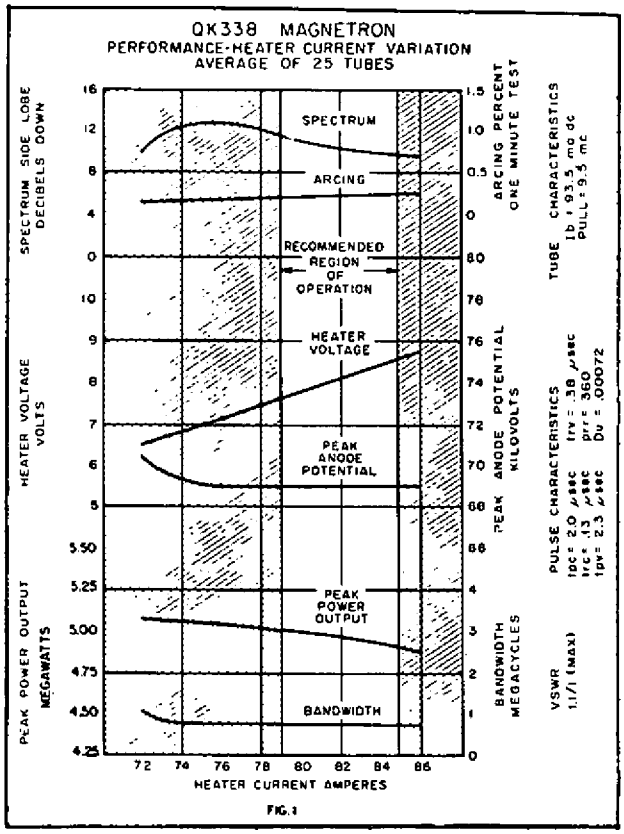


FIG. 1

liquid cooling may damage the tube and cannot be tolerated.

STARTING NEW MAGNETRON

New magnetrons, or those which have not been operated for some time, may conatin small quantities of gas. The presence of this gas may give rise to arcing when initially running the tube up to its rated current. If the arcing is sporadic with arc bursts of less than 1 or 2 seconds duration, the tube may be run up to rated current without hesitation. If, however, the arcing is severe — i.e., with arc bursts of about 5 seconds duration occurring frequently — it is essential that the following aging or gas clean-up procedure be employed:

1. Raise the average current level to a value just below that which produces sustained arcing. Allow the magnetron current to remain at this level until the arcing begins to decrease.

2. Repeat the above step for succeedingly higher levels of magnetron current until the desired operating point is reached.

NOTE: If difficulty is encountered in achieving stable operation at rated current, it is recommended that the tube be operated 2 or 3 mAdc above the rated current for a period of about 10 minutes. Stable operation will usually be attained in 5 to 15 minutes, although a considerably longer aging time may be required depending on the tube's condition and the experience of the operator.

NOTE: In equipments employing a runback or reverse current circuit, provisions must be made to allow desensitization of the device during the aging process. The runback circuit must be insensitive to arc bursts up to 5 seconds duration during aging, and insensitive to arc bursts up to 2 seconds duration after aging.

PULSE LENGTH AND DUTY CYCLE

The RK6410/QK338 magnetron has been designed and tested for operation at the following pulse conditions: See Figure 2.

tpc = 2.0 ± 10% usec @ DU = .00072
trc = 0.25 usec max. measured 20% to 85%
tfc = 0.60 usec max. measured 0% to 85%
trv = 0.50 usec max. measured 20% to 85%
tfv = 2.5 usec max. measured 0% to 85%

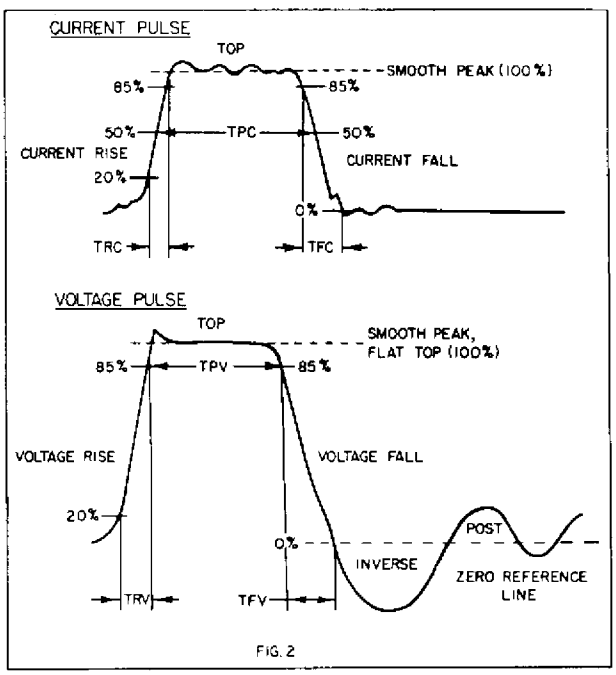


FIG. 2

No spike or ripple should exceed ± 7% of the average peak value of voltage or current. Inverse voltage should not exceed 20% of the forward voltage. Post voltages should be held to a minimum as they may cause post-pulse noise or oscillation and increased leakage current.

If operation at pulse conditions different from those given above is anticipated, the manufacturer should be consulted for further information.

Optimum tube performance will be realized only if proper consideration is given to pulse shaping. Voltage rise times slower than specified will result in moding and/or arcing and cannot be tolerated. Excessive ripple on the top of the current pulse causes frequency pushing and broadening of the spectrum. Most magnetrons draw a small amount of leakage or diode current at anode voltages as low as 100 volts. This leakage current may amount to several milliamperes if the voltage fall time is greater than 2.5 usec, and

at a given duty cycle the calculated peak current will be in error. It is therefore advisable that equipment design effect as rapid a decay as possible to prevent leakage. It is also advisable to prevent the positive voltage backswing from becoming negative again. Inverse and post-pulse voltages may result in undesirable noise radiation and should be damped. Judicious matching of the pulse-forming network and pulse transformer will, in most cases, reduce post and inverse voltage amplitudes sufficiently to eliminate noise difficulties. For short range radar applications where noise due to inverse and post voltages is most troublesome, it is recommended that a diode clipper be placed across the primary of the pulse transformer.

Optimum pulse shaping can best be achieved by treating the magnetron, pulse transformer, and pulse line as a unit; hand-tailoring the line and transformer for magnetron compatibility is recommended.

If operation at both long and short pulses is anticipated, the pulse transformer should be designed to optimize the more important pulse.

COOLING

The RK6410/QK338 magnetron is a forced-liquid cooled tube. The ambient temperature will dictate the type of coolant and flow rate necessary to maintain anode temperature below the specified maximum (100°C). Figure 3 is a plot of anode temperature rise above inlet water coolant temperature as a function of total power input and rate of water flow. Figure 4 is a plot of anode temperature rise above inlet water coolant temperature vs. waterflow for standby conditions.

Sufficient cooling of the cathode insulating oil must also be provided to maintain the cathode bushing temperature below the maximum specified 150°C. If the insulating oil used has insulating properties which deteriorate above the normal operating temperatures, it is of course necessary to maintain the oil temperature at a value below the deterioration level. It is recommended that Esso Univolt 35 or its equivalent be used.

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively

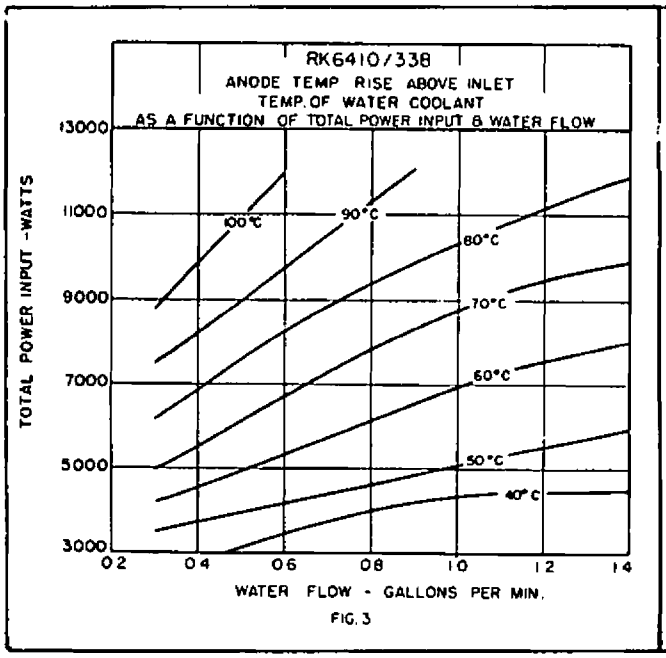


FIG. 3

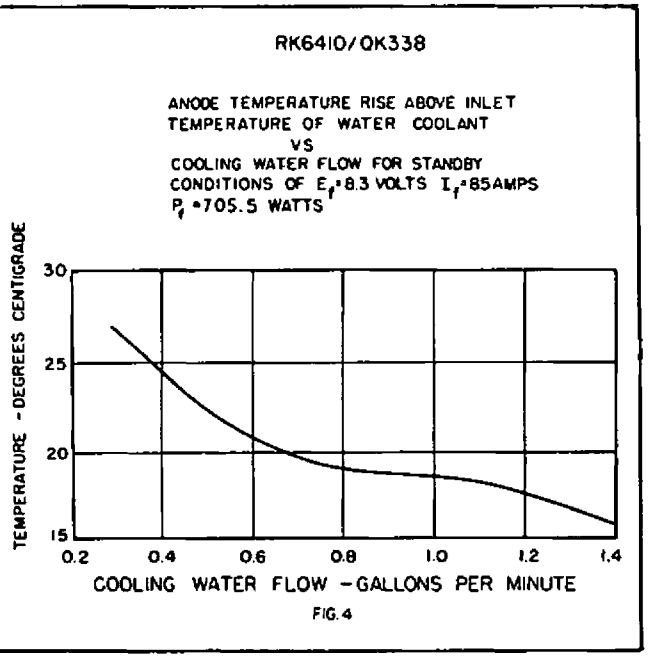


FIG. 4

termed "long-line effects". Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case, the extent to which the long-line effect is exhibited depends on the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Figure 5 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not critical in the RK6410/QK338 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectrum caused by this phenomena. It may in some cases permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Figure 5, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although for close control of bandwidth the VSWR should be kept as low as possible.

More detailed information on the theories and remedies of long-line effects is available upon request.

FREQUENCY DRIFT

After operation of the RK6410/QK338 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period, the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift and anode temperature are plotted as a function of time in Figure 6.

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibirum is again attained and tube geometry stabilizes. It might also be noted at this point, that there is some frequency drift during life due to erosion of internal tube parts.

DYNAMIC PUSHING

Figure 7 displays the dynamic pushing characteristics of the RK6410/QK338 magnetron for anode current excursions of ± 16.8%. Examination of the curve reveals that minimum pushing (Kc/a) occurs at rated plate current.

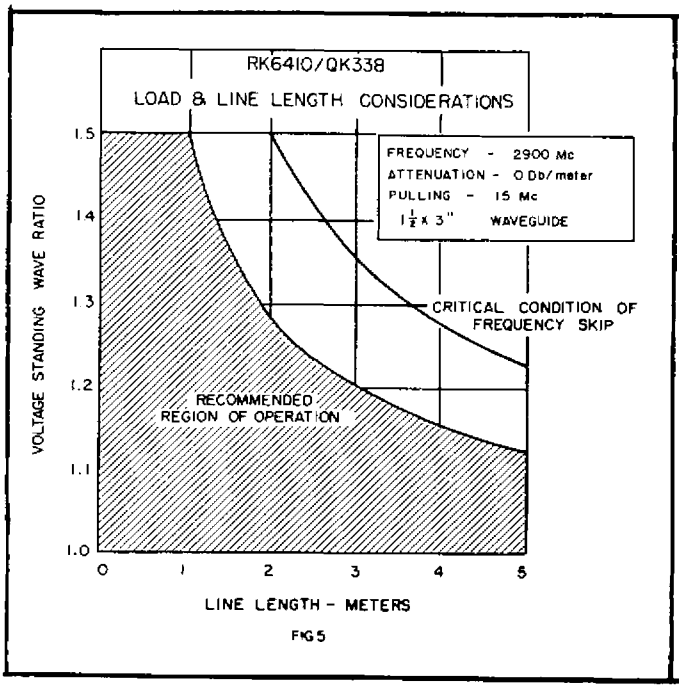


FIG 5

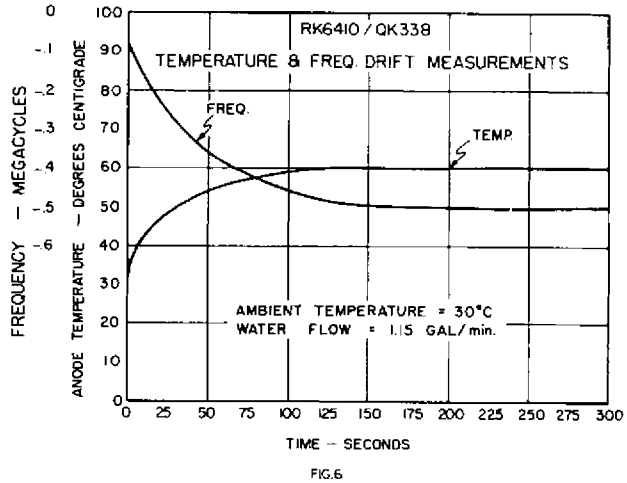


FIG.6

RF RADIATION FROM CATHODE

The RK6410/QK338 is designed to minimize radiation from the cathode bushing which will in general be negligible. It is not possible, however, to guarantee it as being negligible; in particularly critical environment, shielding of the cathode bushing may be necessary to avoid radiation difficulties.

CATHODE BUSHING PROTECTION

It is recommended that the RK6410/QK338 ceramic cathode bushing be immersed in a fluid insulating medium of "Univolt 35" transformer oil or equivalent. A minimum distance of 1½ inches must be maintained through the oil from high voltage to ground, with design considerations to avoid sharp edged objects in the vicinity of the ceramic cathode bushing.

For cases where it is necessary to mount the RK6410/QK338 magnetron such that the ceramic cathode bushing is situated vertically downward, extreme care should be exercised to remove all entrained air from the magnetron oil flange area. Any air trapped beneath this oil flange can impose a dangerous possibility of high voltage breakdown in oil resulting in ultimate puncture of the ceramic cathode bushing.

OPERATING CHARACTERISTICS

Figure 8 is a plot of peak power output, anode voltage, arc stability, bandwidth and efficiency as a function of peak anode current.

INSTALLATION AND HANDLING PRECAUTIONS

Although magnetrons give the appearance of great structural strength, they are in reality quite fragile and may be easily damaged during handling or installation. Damage to the magnetron will be avoided if the following installation and handling precautions are carefully observed:

1. Leave the magnetron in its shipping crate until it is ready to be used.
2. Remove the neoprene guard covers from the RF output window and cathode bushing just before installing the tube in the equipment.
3. Avoid setting up mechanical strains in the output window or cathode bushing when handling or mounting.
4. Avoid unnecessary jarring or rough handling.
5. Do not let the magnetron rest on any of its parts normally protected by the shipping crate.
6. If the magnetron has been operated with water as a coolant, be sure to drain the water from the cooling jacket before storing the tube in a freezing environment.

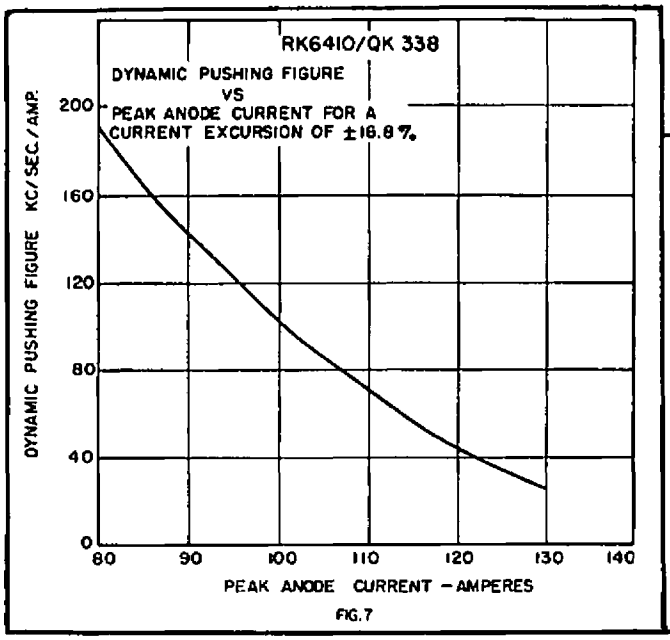


FIG.7

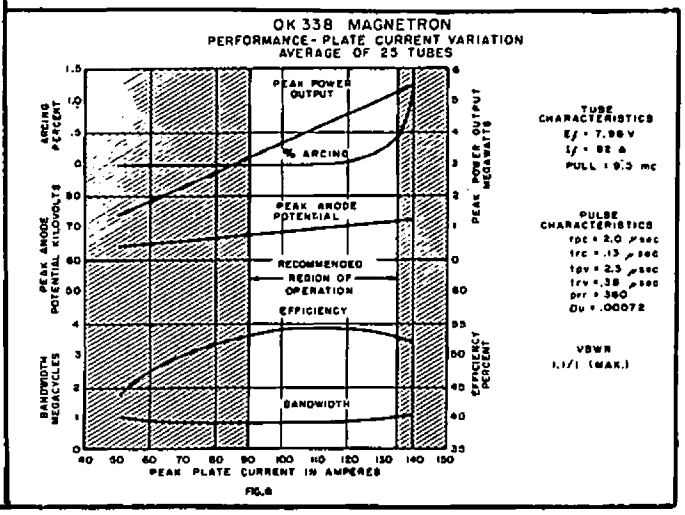


FIG.8

7. If a magnetron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the RF window or cathode bushing and wipe them dry before application of high voltage.
8. Do not place the tube in closer proximity to magnetic materials than is indicated on the tube magnet.

MOUNTING

The tube is mounted within the equipment by four bolts passed through the clearance holes of the mounting brackets. The tube must be mounted with the longitudinal axis of the cathode high-voltage bushing vertical. The tube should be operated in this position although small angular deviations (15 degrees) can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short-circuited.

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two terminals on the high-voltage cathode bushing. The positive high voltage should be grounded at the mounting surfaces. Heater and cathode connections are made to the terminals on the cathode bushing. Heater connectors should be designed to minimize contact resistance and lateral forces on the heater terminals. Drawings of suitable heater cathode connecting devices are available on request.

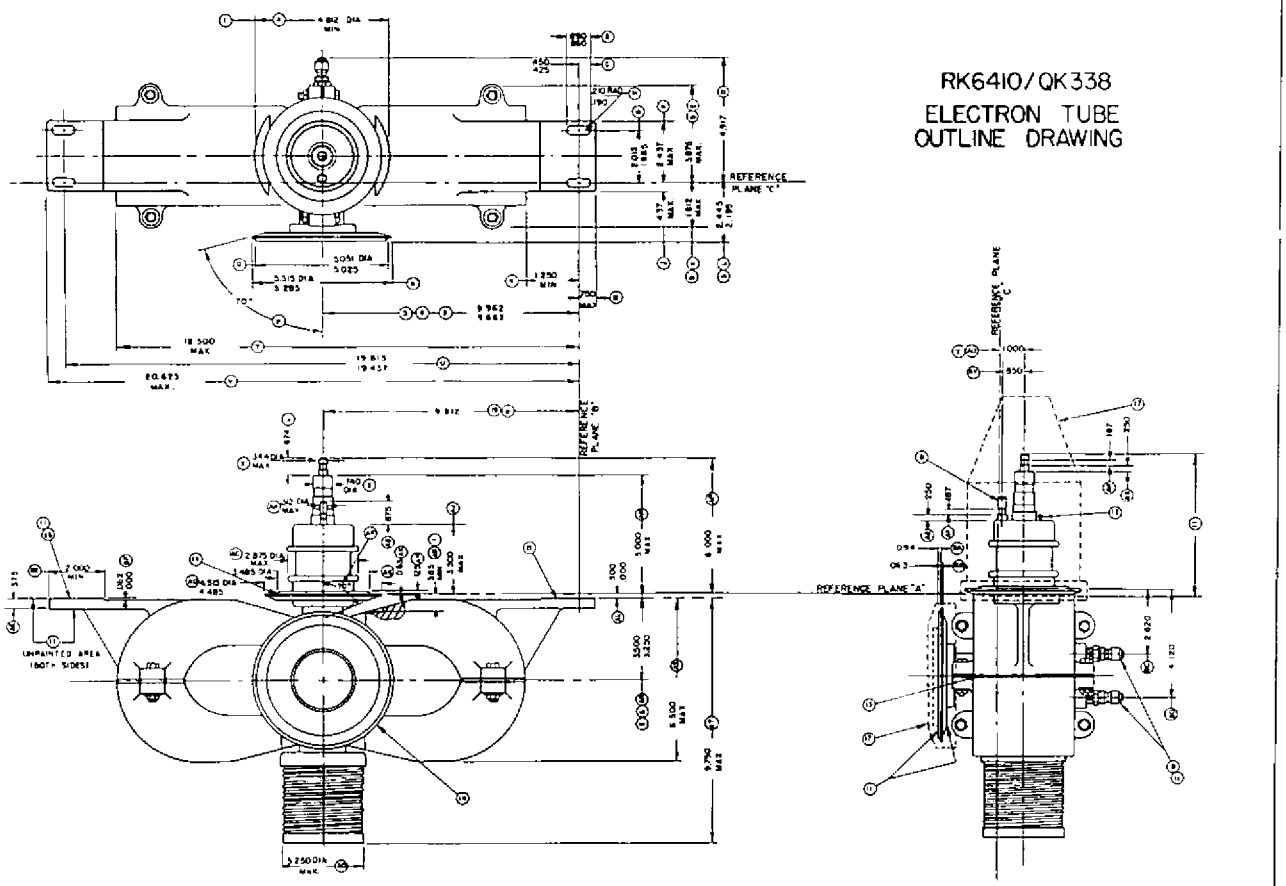


FIG. 9

COUPLING AND PRESSURIZATION

The magnetron output flange is designed to couple to standard 1.5" x 3" waveguide. Mechanical details of the recommended choke flange to mate to the magnetron are illustrated in the outline drawing. See Figure 9.

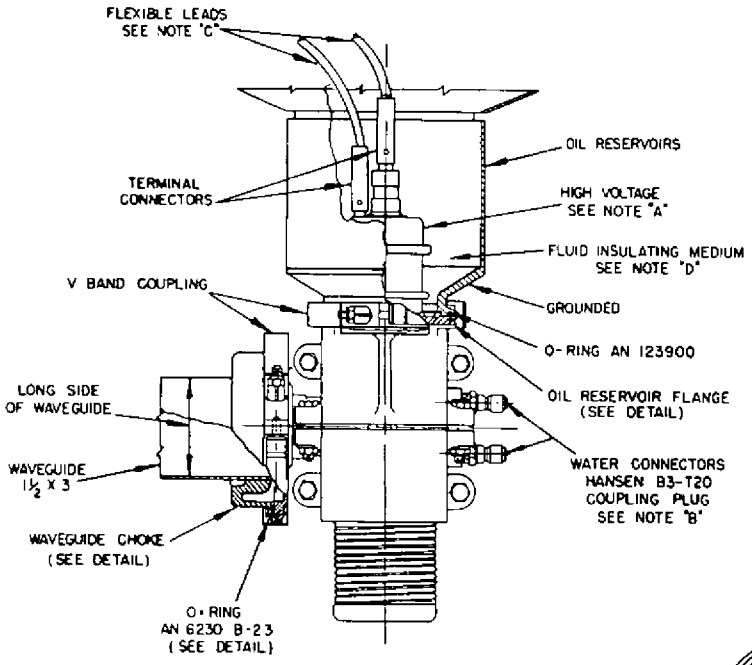
Waveguide pressurization to 45 psia is required. Pressurization lower than 45 psia may result in waveguide breakdown. If sustained arcing in the waveguide occurs, failure of the output window may result. To minimize the possibility of the tube arcing in the guide and to achieve optimum tube performance, the VSWR of the waveguide system should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended.

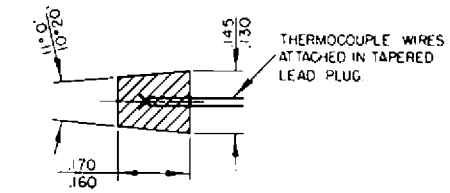
NOTES —

1 — THIS DIMENSION APPLIES TO 4.812" MIN DIAMETER.
2 — REFERENCE PLANE "A" LIES ON MOUNTING SURFACE OF MAGNETS.
3 — REFERENCE PLANE "B" PASSES THROUGH ℄ OF HOLES IN BRACKET AND IS PERPENDICULAR TO REFERENCE PLANE "A".
4 — REFERENCE PLANE "C" PASSES THROUGH ℄ OF HOLES IN BRACKET AND IS PERPENDICULAR TO REFERENCE PLANES "A" & "B".
5 — INCLUDES ANGULAR AS WELL AS LATERAL DEVIATIONS.
6 — REFERS TO ℄ OF WAVEGUIDE.
7 — PARTS ON THIS ℄ MAY VARY FROM TRUE LOCATION BY 0.125".
8 — HANSEN B3-T20 COUPLING PLUG.
9 — COMMON CATHODE CONNECTION.
10 — ALL SOLDER JOINTS ON OUTPUT SECTION SHALL BE SOLDERED TO PROVIDE AN HERMETIC SEAL.
11 — THE FOLLOWING SHALL BE FREE FROM PAINT: FRONT AND BACK FACES OF OIL SEALING SLEEVE, PARTS ABOVE FLANGE, FRONT AND BACK FACES OF OUTPUT FLANGE, EXHAUST CAP, MOUNTING SURFACE ON MAGNETS AND COOLANT PLUG CONNECTORS.
12 — CATHODE STEM TEMPERATURE MEASURED AT THIS POINT.
13 — ANODE TEMPERATURE MEASURED AT RIGHT SIDE (FACING OUTPUT) OF OUTPUT TRANSFORMER BY INSERTING TAPERED THERMOCOUPLE PLUG. (SEE INSTALLATION DETAILS DWG.)
14 — EQUIPMENT FLANGES MATING TO OIL SEALING FLANGE AND TO OUTPUT FLANGE SHOULD PROVIDE COMPLIANCE AS BY MEANS OF A BELLOWS OR OTHER FLEXIBLE UNION. THESE FLANGES MAY NOT BE USED IN SUPPORTING THE TUBE. ENTIRE WEIGHT IS TO BE HELD BY MAGNET BRACKETS.
15 — THESE SURFACES TO BE COPLANER WITHIN 0.032".
16 — WARNING: MAINTAIN 8 INCHES MIN. CLEARANCE BETWEEN MAGNETS AND FERROMAGNETIC MATERIALS EXCEPT AT BRACKET ENDS WHERE MIN. CLEARANCE MAY BE 3 INCHES. MAINTAIN 12 INCHES MIN. CLEARANCE TO OTHER CHARGED MAGNETS.
17 — PROTECTIVE COVER FOR SHIPPING PURPOSES ONLY.
18 — PAINT WITH BLACK HEAT RESISTANT, NON CORROSIVE PAINT.
19 — PARTS ON THIS CENTERLINE MAY VARY FROM TRUE LOCATION BY 0.188".

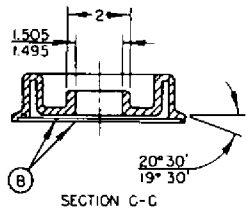
NOTES —

A — MINIMUM DISTANCE FROM HIGH VOLTAGE TO GROUND SHOULD BE 1.500" THROUGH OIL AND 10.000" THROUGH AIR AT ATMOSPHERIC PRESSURE.
B — PLUGS INTO HANSEN 3-S20 SOCKET.
C — LEADS MUST BE LARGE ENOUGH TO CARRY AT LEAST 100 AMPERES RMS.
D — USE "UNIVOLT 35" TRANSFORMER OIL OR EQUIVALENT FOR FLUID INSULATING MEDIUM.
E — FERROMAGNETIC MATERIALS MUST NOT BE PERMITTED AT ANY TIME CLOSER THAN 8" FROM TUBE MAGNET EXCEPT AT ENDS TO WHICH MOUNTING BRACKETS ARE ATTACHED WHERE CLEARANCE MAY BE 3" MINIMUM. ENERGIZED MAGNETS MUST NOT BE PERMITTED AT ANY TIME CLOSER THAN 12" FROM TUBE MAGNET.

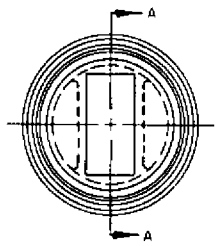




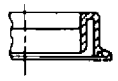
ANODE TEMP THERMOCOUPLE DETAIL



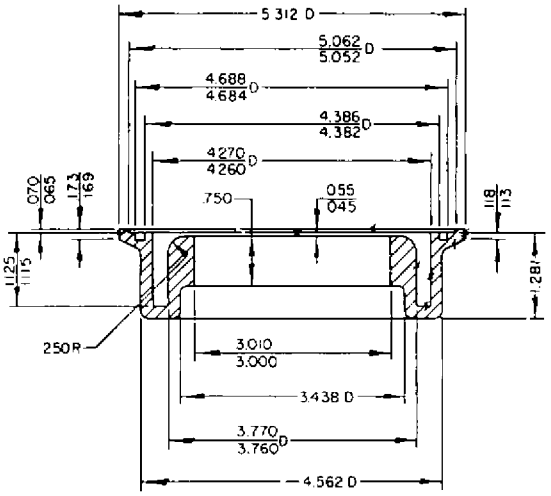
SECTION C-C



TOP PLAN



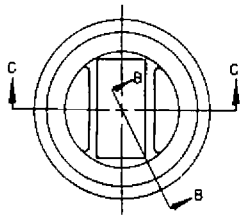
SECTION B-B



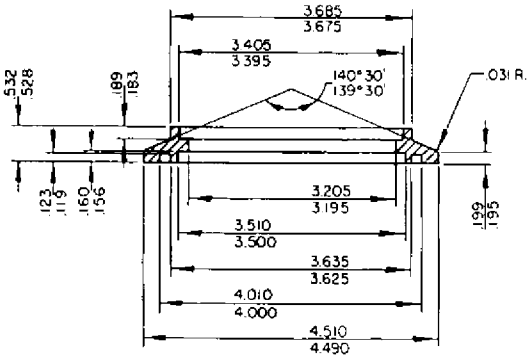
WAVEGUIDE CHOKE

ALL CORNERS .125 R EXCEPT AS NOTED

SECTION A-A



BOTTOM PLAN



OIL RESERVOIR FLANGE

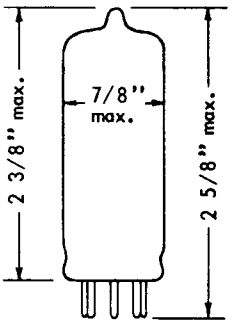
RK6410/QK338

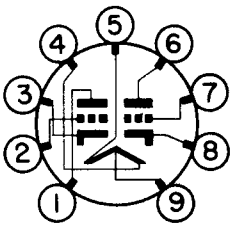
INSTALLATION DETAILS

Excellence in Electronics

TYPE CK6414

The CK6414 is a heater-cathode type, medium-mu double triode of miniature construction. This type is characterized by long life and stable performance. The tube features a high zero-bias plate current, a sharp cutoff characteristic, and separate cathode connections for the two sections. It is especially designed for use in electronic computer applications and other "on–off" control applications requiring long periods of operation under cutoff conditions.





BOTTOM VIEW

9A

MECHANICAL DATA

ENVELOPE: T-6½ Glass

BASE: Miniature Button Base 9-Pin

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2	Pin 5 Heater
Pin 2 Grid, Unit #2	Pin 6 Plate, Unit #1
Pin 3 Cathode, Unit #2	Pin 7 Grid, Unit #1
Pin 4 Heater	Pin 8 Cathode, Unit #1
	Pin 9 Heater Center Top

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	300 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 4)	2.5 G
Maximum Bulb Temperature	100 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 6)	NORMAL OPERATION (Note 5)	DESIGN MAXIMUM (Note 9)	MIL-E-1 UNITS
Heater Voltage (Note 10)	Ef: Series	12.0		12.6	13.2	V
	Ef: Parallel	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	----	180	180	200	Vdc
Grid #1 Voltage	Ec1:	−50	−2.0	−2.0	+1.0	Vdc
Peak Positive Pulse Plate Voltage (Note 7):	eb:	----	----	----	500	v
Peak Grid Voltage (Note 8):	ec:	−100	----	----	+10	v
Plate Dissipation (Per Plate)	Pp/p:	----	----	1.45	2.0	W
Total Plate Dissipation, Both Plates:	Pp:	----	----	----	3.6	W
Grid Current (Per Grid)	IC/c:	----	----	----	1.0	mAdc
Peak Grid Current (Per Grid) (Note 8):	ic/c:	----	----	----	50	ma
Heater-Cathode Voltage (Note 11):	Ehk:	−100	----	----	+100	v
Cathode Current (Each Unit):	Ik/k:	----	----	8.0	17.0	mAdc
Peak Cathode Current (Each Unit) (Note 8):	ik/k:	----	----	----	160	ma
Transconductance (1) (Each Unit):	Sm (1):	----	----	5500	----	μmhos
Amplification Factor (Each Unit):	Mu:	----	----	42.5	----	

Tentative Data

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RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)
(In the following tests, each unit is tested separately unless otherwise noted)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1			**Combined AQL = 1.0 % Excluding Mechanical, Inoperatives, and Short Test**							
Heater Cathode:		0.25	If:	425	435	450	465	475	36	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	7	----	μAdc
	Ehk = −100 Vdc		Ihk:	----	----	----	----	7	----	μAdc
Grid Current:	Rg = 0.5Meg.	0.25	Ic (1):	----	----	----	----	−0.3	----	μAdc
Plate Current (1):	Eb = 100 Vdc; G_1 tied to plate through a 0.5Meg. resistor	0.65	Ib (1):	13.6	15.5	17.0	18.5	20.4	4.8	mAdc
Plate Current (2):		0.65	Ib (2):	5.0	----	8.0	----	11.5	----	mAdc
Grid Voltage:	Eb = 150 Vdc; Ec 1/Ib = 150μAdc	0.25	Ec 1:	----	----	−4.8	----	−7.5	----	Vdc
Grid Voltage Difference between Sections:	Eb = 150 Vdc; Ec 1/Ib = 150μAdc	0.65	ΔEc 1:	----	----	----	----	1.5	----	Vdc
Continuity and Shorts (Inoperatives):		0.25	----	----	----	----	----	----	----	----
Shorts:	(Note 12)	----	----	----	----	----	----	----	----	----
Mechanical:	Envelope T-6½ (6-8)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2			**(Combined AQL = 4.0%)**							
Transconductance (1):		2.5	Sm (1):	4000	5000	5550	6100	7250	1600	μmhos
Transconductance (2):	Ef = 5.7 V (Note 13)	2.5	Δ_{ef} Sm (2):	----	----	----	----	15	----	%
Contact Potential:	Eb = 0; Ec1/Ic = 0.1μAdc; Rg = 0.1 Meg.	2.5	CP:	----	----	----	----	−1.5	----	Vdc
RF Noise:	Eb = 150 Vdc; Ec = 0; Ecal = 15 mVac; Rk = 220 ohms; ck = 0.2μf; (Units connected in parallel)	2.5	EB:	----	----	----	----	5	----	VU
MEASUREMENTS ACCEPTANCE TEST PART 3			**(Combined AQL = 10% excluding capacitance and vibration (2))**							
Insulation of Electrodes:	Ef = 6.3 V; Eg-all = −100 Vdc	2.5	Rg-all:	1000	----	----	----	----	----	Meg.
	Ep-all = −300 Vdc		Rp-all:	1000	----	----	----	----	----	Meg.
Pulse Cathode Current:	Eb = 150 Vdc; Ec = −20 Vdc; ec = +10 v; Prr = 1000 Pps; tp = 10μsec.	2.5	ik:	160	----	----	----	----	----	ma
Amplification Factor:		2.5	Mu:	37	39.6	42.5	45.4	48	7.0	----
Grid Emission:	Ef = 6.7 V; Eb = 180 Vdc; Rg = 0.5Meg.; Rk = 140 ohms Preheat 5 minutes at Ec1 = 0; Test at Ec1 = −30 Vdc	6.5	Isc 1:	0	----	----	----	−0.5	----	μAdc
Noise and Microphonics:	Ebb = 250 Vdc; Ecal = 100 mVac; Rp = 0.1 Meg.; Ec = 0; Rk = 1000 ohms; ck = 1000μf; (units connected in parallel)	6.5	EB:	----	----	----	----	17	----	VU
Capacitance:	(Note 2)	6.5	Cgp:	2.4	----	3.0	----	3.6	----	μμf
Capacitance:			C in:	3.0	----	4.0	----	5.0	----	μμf
Capacitance:			C out (Unit #1)	0.37	----	0.47	----	0.57	----	μμf
Capacitance:			C out (Unit #2)	0.30	----	0.38	----	0.46	----	μμf
Capacitance:			Cpp:	----	----	----	----	0.90	----	μμf
Capacitance:			Cgg:	----	----	----	----	0.03	----	μμf
Capacitance:			Chk:	----	----	4.0	----	5.0	----	μμf
Vibration (2):	Rp = 2000 ohms; F = 25 cps; G = 2.5	6.5	Ep:	----	----	----	----	300	----	mVac

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)
(In the following tests, each unit is tested separately unless otherwise noted.)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS								
Shock:	Hammer Angle = 20°; (Note 3)	20	----	----	----	----	----	----
Fatigue:	G = 2.5 Fixed Frequency; F = 25 min., 60 max., (Note 4)	6.5	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:								
Vibration (2):	Rp = 2000 ohms; F = 25 cps; G = 2.5	----	Ep:	----	600	mVac	----	----
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	20	μAdc	----	----
	Ehk = −100 Vdc	----	Ihk:	----	20	μAdc	----	----
Plate Current (1):		----	Ib(1):	11.5	----	mAdc	----	----
Grid Current:		----	Ic(1):	0	−0.5	μAdc	----	----
Miniature Tube Base Strain:		----	----	----	----	----	----	----
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----
ACCEPTANCE LIFE TESTS								
Heater Cycling Life Test:	Ef = 7.5 V; Ehk = +135 Vdc; Ec = Eb = 0; 1 min. on, 1 min. off	1.0	----	2000	----	Cycles	----	----
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk = +100 Vdc	----	Ihk:	----	15	μAdc	----	----
	Ehk = −100 Vdc	----	Ihk:	----	15	μAdc	----	----
100 Hour Stability Life Test:	TA = Room; Eb = 100 Vdc; Rk = 0; G1 tied to plate through a 0.5 Meg. resistor (Note 14)	----	----	----	----	----	----	----
100 Hour Stability Life Test End Points:	(Typical Sample Size = 50 tubes)	----	----	----	----	----	----	----
Plate Current (1):		2.5	Ib(1):	12.8	21.0	mAdc	----	----
Change in Plate Current (1) of individual tubes from initial:		2.5	Δ_iIb(1):	----	±1.7	mAdc	----	----
500 Hour Survival Rate Life Test:	(Sample consists of 20 tubes 1st sample 40 tubes second sample, of the 4 intermittent life tests) (Note 15)	----	----	----	----	----	2	5
1000 Hour Intermittent	T Bulb = 120° C; Eb = 180 Vdc; Ec = 0; Rk = 140; Rg = 0.1 Meg.; Ehk = +180 Vdc	----	----	----	----	----	----	----
1000 Hour Intermittent Life Test (1) End Points:	(Typical Sample Size = 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	2
Shorts:	(Notes 12, 16)	----	----	----	----	----	1	2
Grid Current:		----	Ic 1:	0	−0.5	μAdc	1	2
Plate Current (2):		----	Ib(2):	4.0	----	mAdc	1	2
Transconductance (1):		----	Sm(1):	3500	----	μmhos	1	2

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)
(In the following tests, each unit is tested separately unless otherwise noted)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per characteristic 1st Sample	Allowable Defects per characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS								
Heater Current:		----	If:	425	495	mA	1	2
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ink:	----	15	μAdc	1	2
	Ehk=−100 Vdc	----	Ihk:	----	15	μAdc		
Insulation of Electrodes:								
g1-all		----	Rg-all	100	----	Meg.	1	2
p-all		----	Rp-all	100	----	Meg.		
Contact Potential:		----	CP:	----	−1.5	Vdc	1	2
Total Defectives:		----	----	----	----	----	3	6
1000 Hour Intermittent Zero Bias Life Test (2):	T Bulb=120°C Eb=100 Vdc; Rk=0; G1 tied to plate through a 0.5 Meg. resistor	----	----	----	----	----	----	----
1000 Hour Intermittent Zero Bias Life Test (2) End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)							
Inoperatives:		----	----	----	----	----	1	2
Shorts:	(Notes 12, 16)	----	----	----	----	----	1	2
Grid Current:		----	Ic1:	0	−0.5	μAdc	1	2
Plate Current (1):		----	Ib(1):	11.5	21.0	mAdc	1	2
Total Defectives:		----	----	----	----	----	2	4
1000 Hour Intermittent Cutoff Life Test (3):	TA=Room; Eb=180 Vdc; Ec=−50 Vdc; Rg=0.1 Meg. (Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
1000 Hour Intermittent Cutoff Life Test (3) End Points:		----	----	----	----	----	----	----
Interface:	Ef=6.0 Vdc; Eb=125 Vdc; Ec1/Ib=2.5 mAdc; Rk=0. (Note 17)	----	Ri:	----	20	ohms	1	2
Inoperatives:		----	----	----	----	----	1	2
Shorts:	(Notes 12, 16)	----	----	----	----	----	1	2
Plate Current (1):		----	Ib(1):	11.5	21.5	mAdc	1	2
Pulse Cathode Current:		----	ik:	150	----	ma	1	2
Grid Emission:		----	Isc1:	0	−1.0	μAdc	1	2
Total Defectives:		----	----	----	----	----	2	4
1000 Hour Intermittent Pulse Life Test (4)	TA=Room; Eb=180 Vdc; Rb=200 ohms; Rg=50 ohms; Ec=−20 Vdc; ec=+11.5 volts on driver side 4 Rg; tp=10±1 μsec; duty cycle=1%	----	----	----	----	----	----	----
1000 Hour Intermittent Pulse Life Test (4) End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	----	----
Inoperatives:		----	----	----	----	----	1	2
Shorts:	(Notes 12, 16)	----	----	----	----	----	1	2
Grid Current:		----	Ic:	0	−0.5	μAdc	1	2
Pulse Cathode Current:		----	ik:	150	----	ma	1	2
Total Defectives:		----	----	----	----	----	2	4

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes", and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic section.

Note 4: Test conditions and acceptance criteria per Fatigue Test procedures of MIL-E-1 basic section.

Note 5: These normal values represent conditions at which control of reliability may be separated.

Note 6: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 7: Rating based on a half-sinusoidal pulse of 10 milliseconds duration and 10 percent duty cycle.

Note 8: Rating based on a pulse of 10 microsecond duration, 1 percent duty cycle and 1000 pps repitition rate.

Note 9: Under no circumstances should the tube be operated beyond the following ratings: Ef = 13.2 V (6.6 V with parallel connections) max. and 12.0 V (6.0 V with parallel connections) min; Eb = 200 Vdc; Ik/k = 20 mAdc; ik/k = 200 ma; Pp/p = 2.2 watts, and Pp total for both sections = 4.0 watts.

Note 10: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 11: For pulse voltage of less than 1 percent duty cycle, the peak voltage may be 150 volts maximum.

Note 12: Special Short Test of 8 blows at 40 ± 10 G and of approximately 0.5 millisecond duration. Short rejection criteria shall be a permanent or intermittent short using and indicator with the following minimum sensitivity: 0.1 meg-15 μsec; 2.5 meg-1.0 ms. This test shall not be used to detect heater-cathode shorts.

Note 13: Change of transconductance for individual tubes from that value measured at Ef = 6.3 V to that value measured at Ef = 5.7 V.

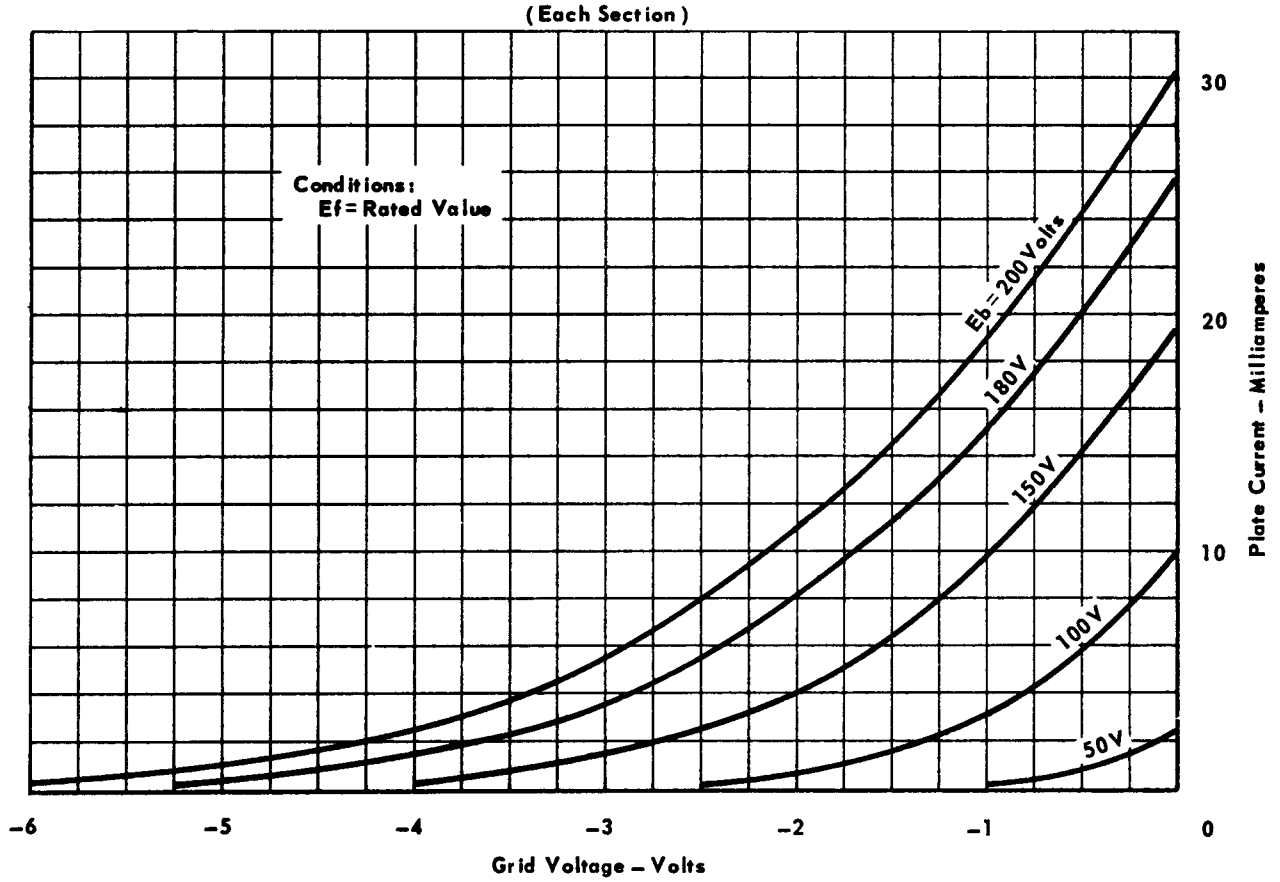
Note 14: Tubes to be read at 2, 48, and 100 hrs. for referenced characteristics.

Note 15: The Survival Rate Life Test sample shall consist of the same 80 tubes, (20 tubes on each Intermittent Life Test) which are subjected to the four Intermittent Life Tests. In the event of failure of the 1st sample for Survival Rate Life Test, a second sample of 160 shall be life tested for 500 hours (40 tubes on each Intermittent Life Test). Acceptance shall be based on the total number of inoperatives. The acceptance number shall be two for the first sample of 80 tubes and five for the combined first and second samples (240° tubes).

Note 16: Shorts to be tested at 0 and 1000 hrs. only and shall be the last test performed on sample.

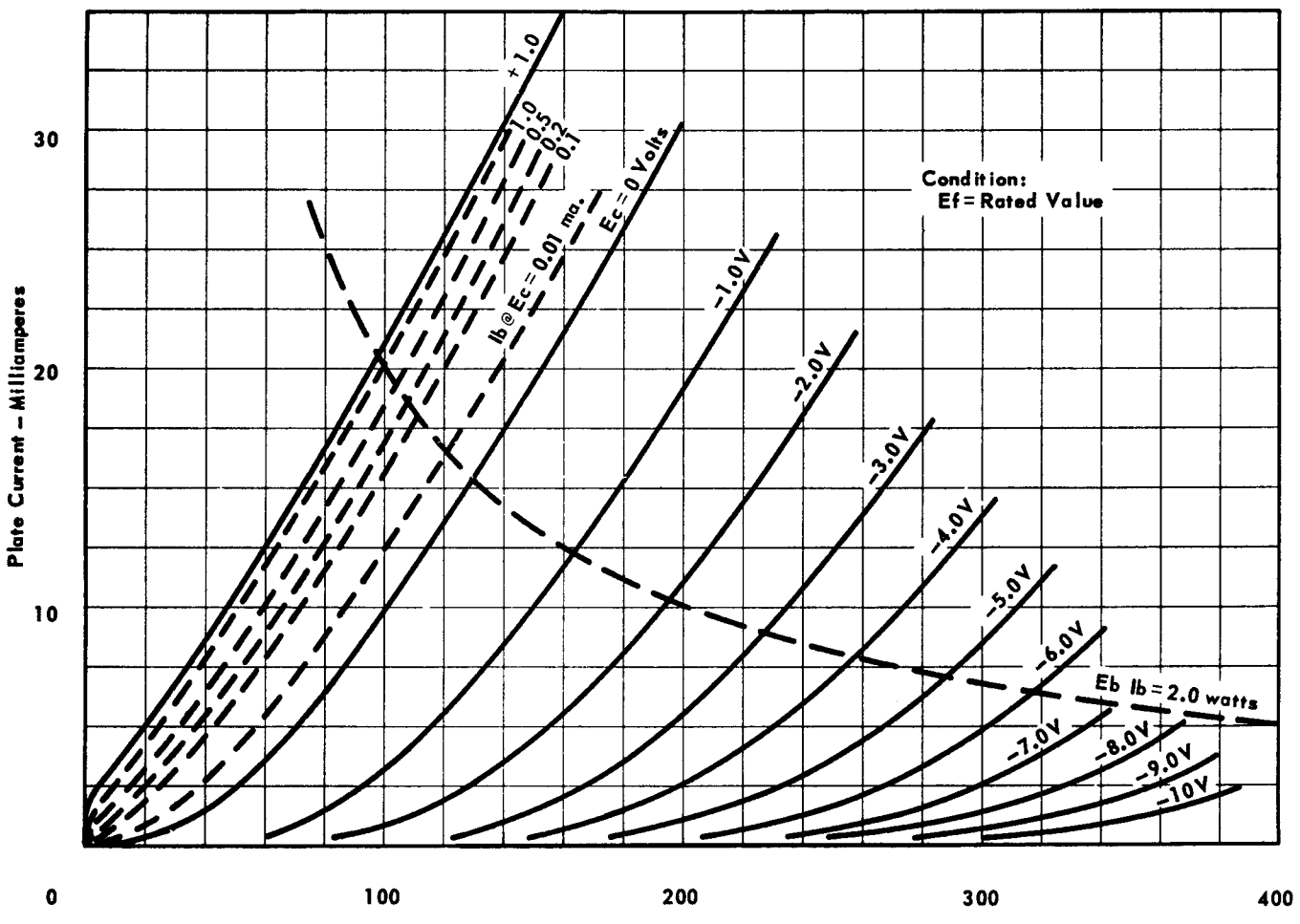
Note 17: Interface shall be measured before any other tests. Tubes shall be preheated (heaters in parallel) for five minutes with Ef = 6.0 V and all other elements disconnected.

AVERAGE TRANSFER CHARACTERISTICS
(Each Section)

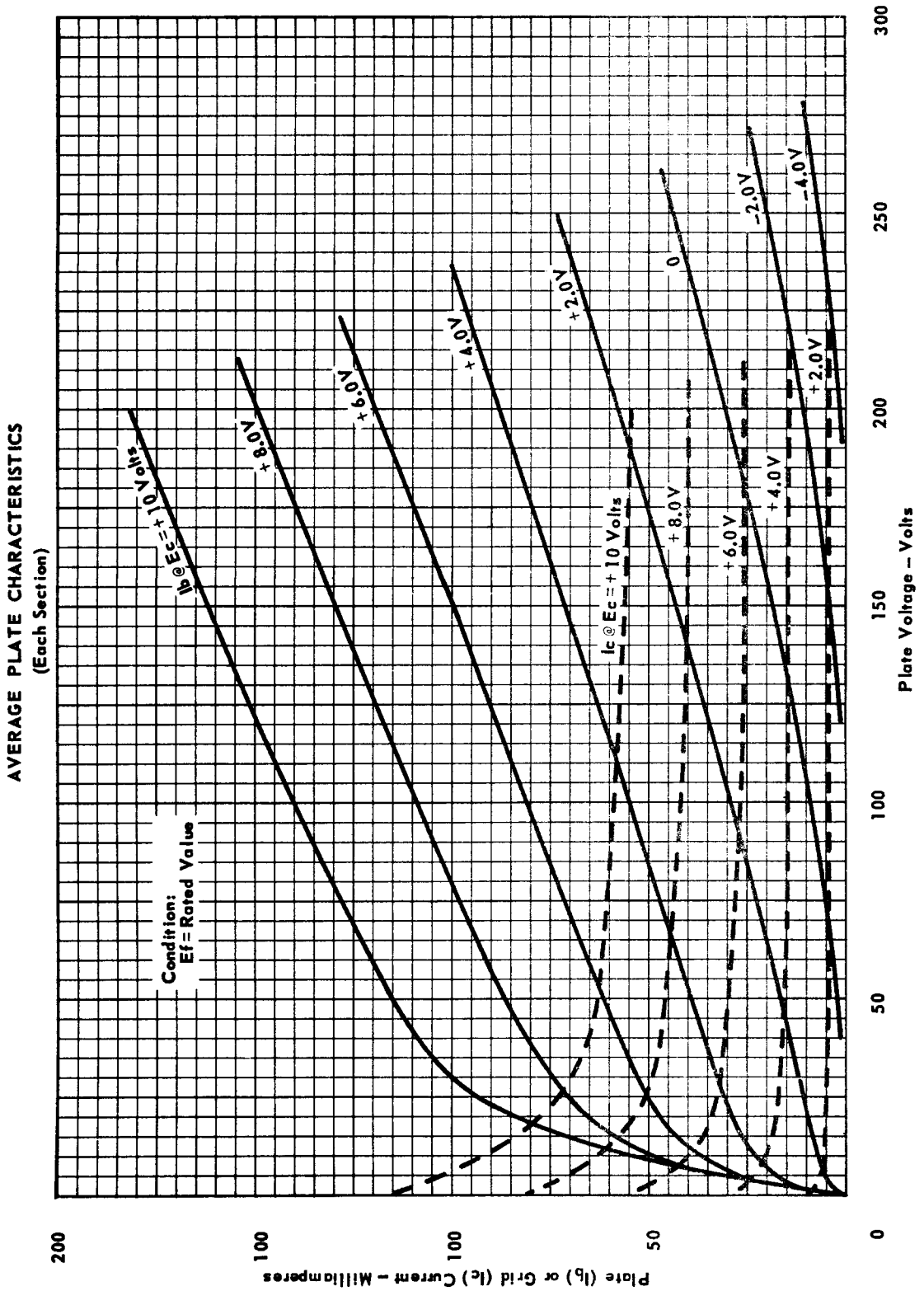


DOUBLE TRIODE

AVERAGE PLATE CHARACTERISTICS
(Each Section)

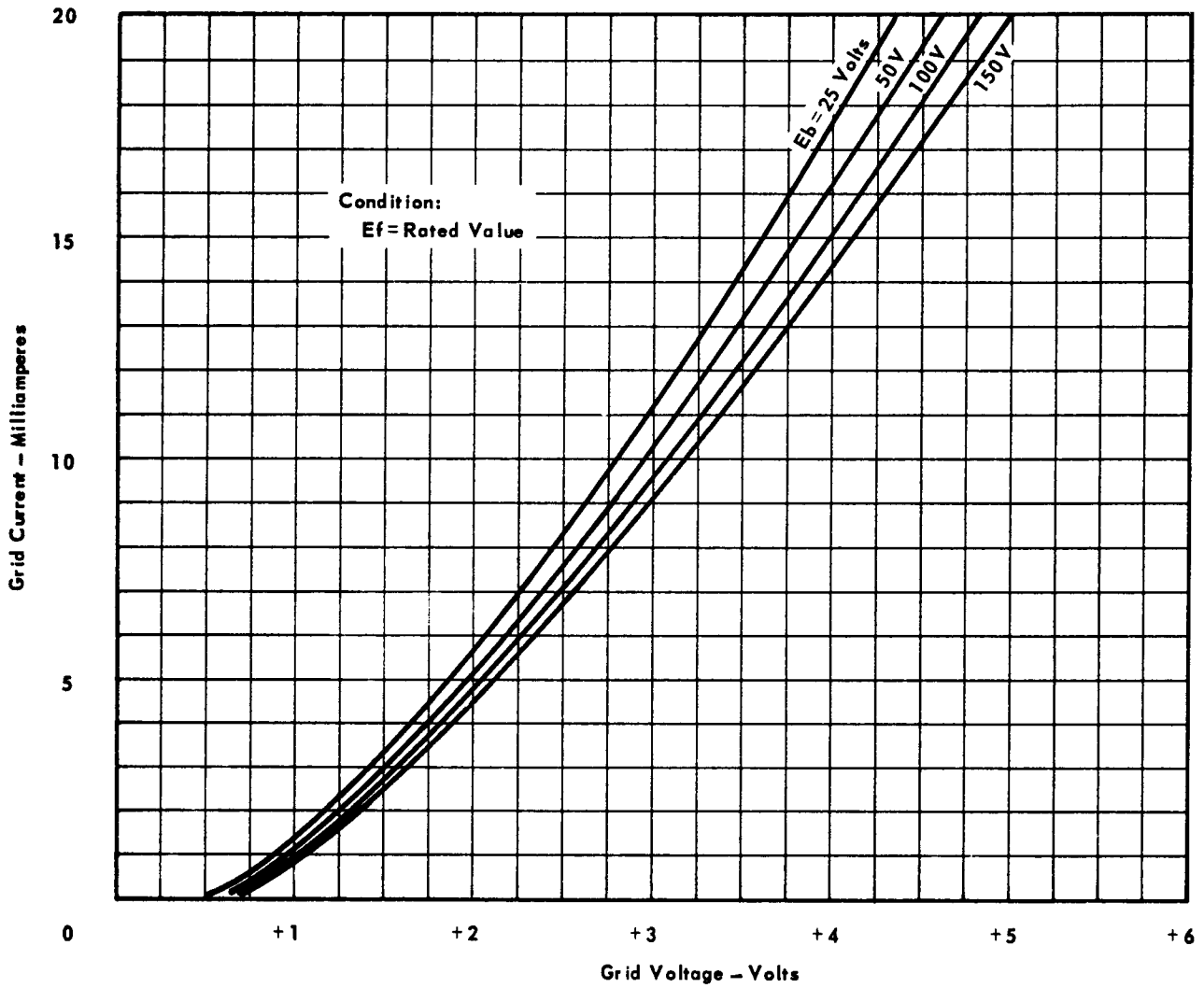


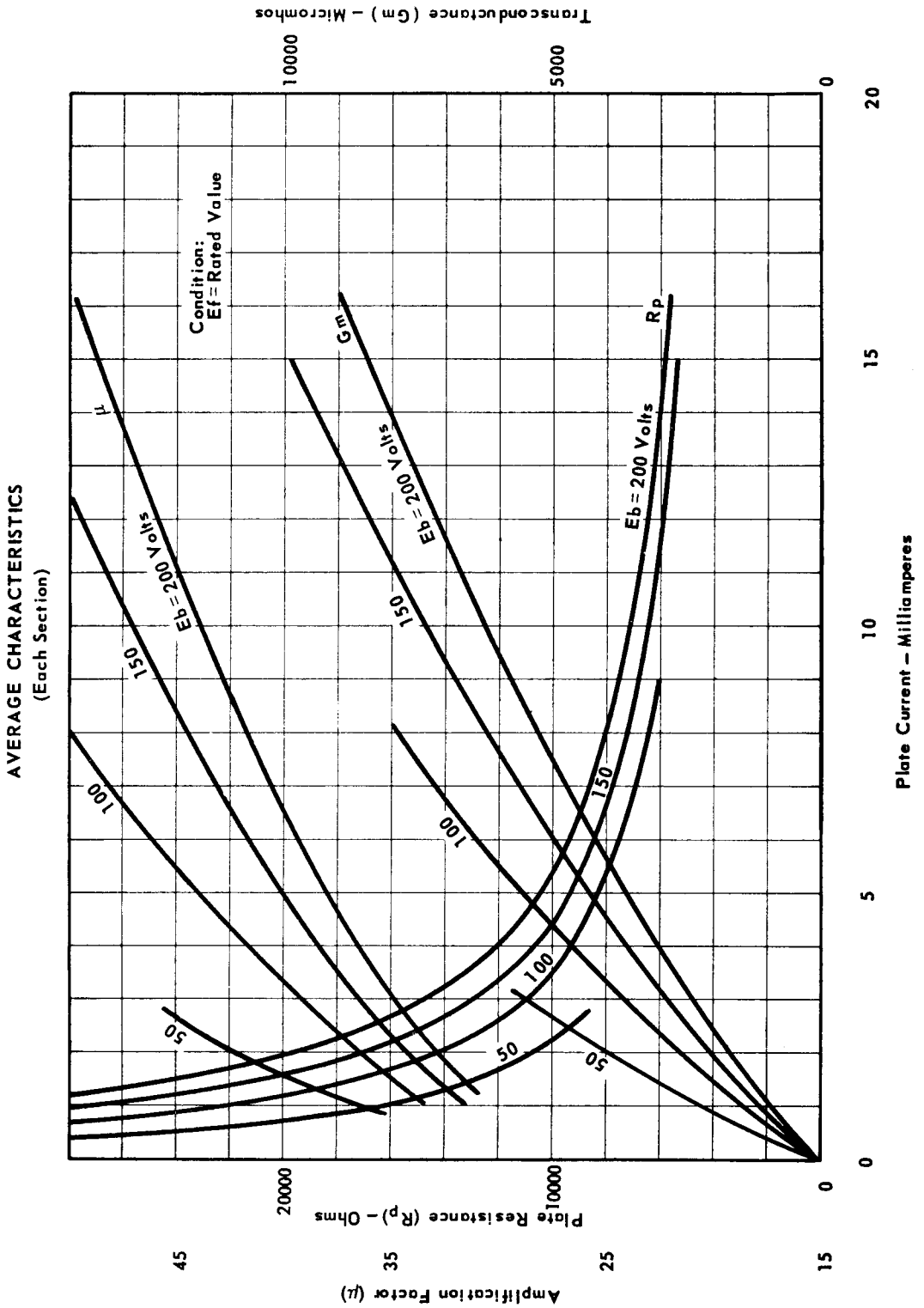
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AVERAGE PLATE CHARACTERISTICS
(Each Section)
Condition:
Ef = Rated Value
Ib @ Ec = +10 Volts
Ic @ Ec = +10 Volts
+8.0V
+6.0V
+4.0V
+2.0V
0
-2.0V
-4.0V
Plate (Ib) or Grid (Ic) Current – Milliamperes
200
100
100
50
0
Plate Voltage – Volts
300
250
200
150
100
50

DOUBLE TRIODE

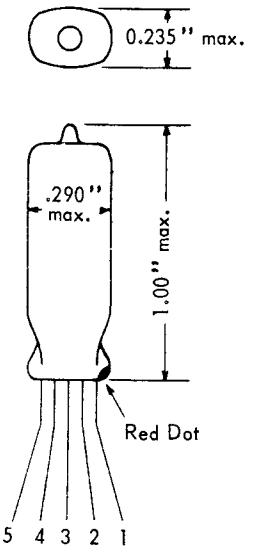
AVERAGE CHARACTERISTICS
(Each Section)




AVERAGE CHARACTERISTICS
(Each Section)
Condition:
Ef = Rated Value
μ
Eb = 200 Volts
150
100
50
Gm
Eb = 200 Volts
150
100
50
Rp
Eb = 200 Volts
150
100
50
Amplification Factor (μ)
45
35
25
15
Plate Resistance (Rp) – Ohms
20000
10000
0
Transconductance (Gm) – Micromhos
10000
5000
0
Plate Current – Milliamperes
0
5
10
15
20

TYPE CK6419

The CK6419 is a filament type pentode of subminiature construction designed for use as a voltage amplifier in portable and wearable equipment. It is similar in characteristics to type CK549DX. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-1½X2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.040" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive
Lead 3 Filament, Negative Grid #3 ♦	Grid #3 ♦

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	0.625±20% volts
Plate Voltage	25 volts
Grid #2 Voltage	25 volts
Cathode Current	0.1 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	0.625 volts
Filament Current	10 ma.
Plate Voltage	15 volts
Grid #2 Voltage	15 volts
Grid #1 Voltage	-0.625 volts
Plate Current	55 μa.
Grid #2 Current	20 μa.
Transconductance	100 μmhos
Plate Resistance (approx.)	2 meg.

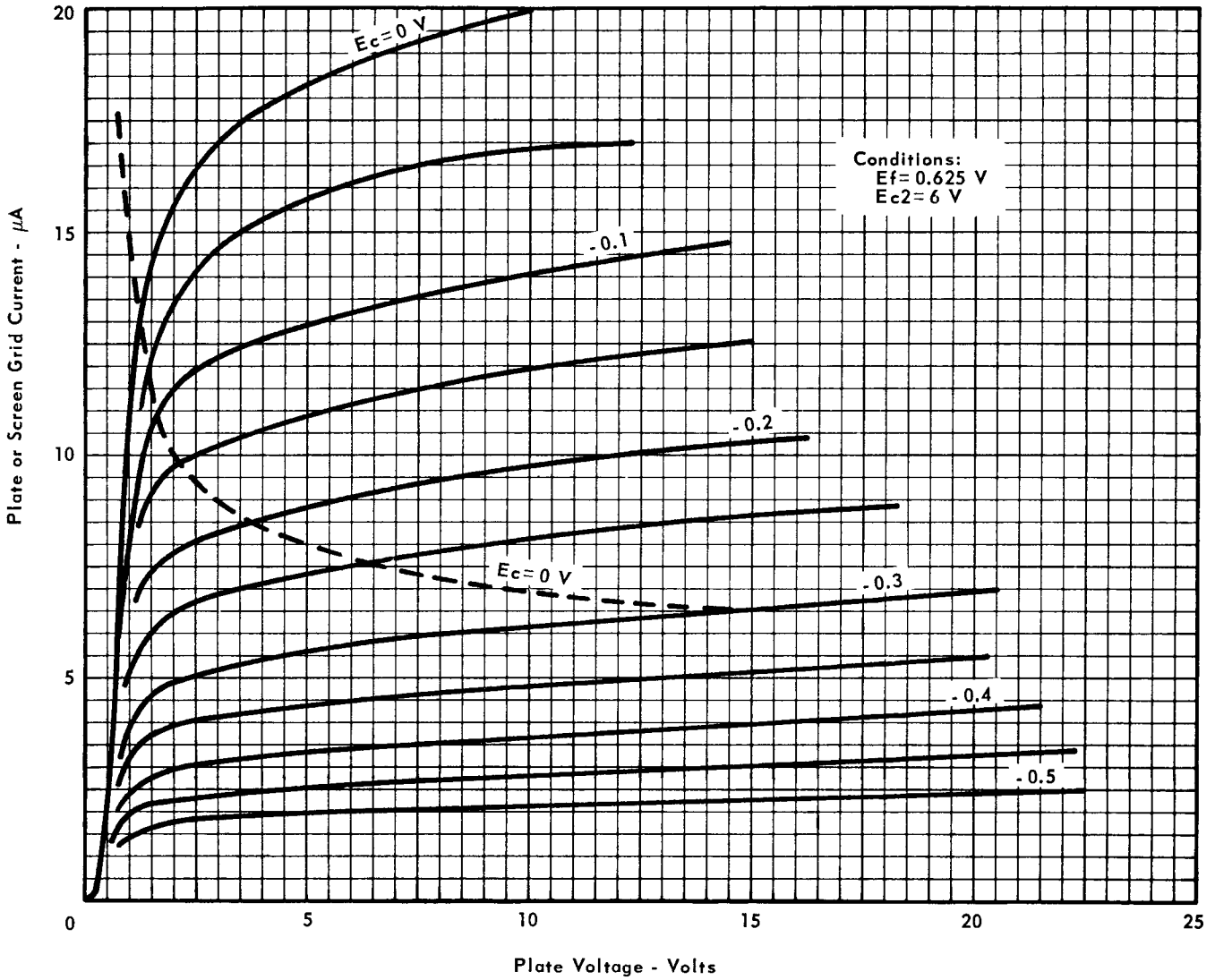
CHARACTERISTICS AND TYPICAL OPERATION - RESISTANCE COUPLED CLASS A1 AMPLIFIER:

Filament Voltage (dc)	0.625 volts
Filament Current	10 ma.
Plate and Grid #2 Supply Voltage	15 volts
Grid #1 Voltage	-0.625 volts
Load Resistance	2.2 meg.
Grid #2 Resistor	3.3 meg.
Grid #1 Resistor	10 meg.
Plate Current	4.6 μa.
Grid #2 Current	2.0 μa.
Transconductance	17 μmhos
Plate Resistance (approx.)	12 meg.
Average Voltage Gain ▲	27

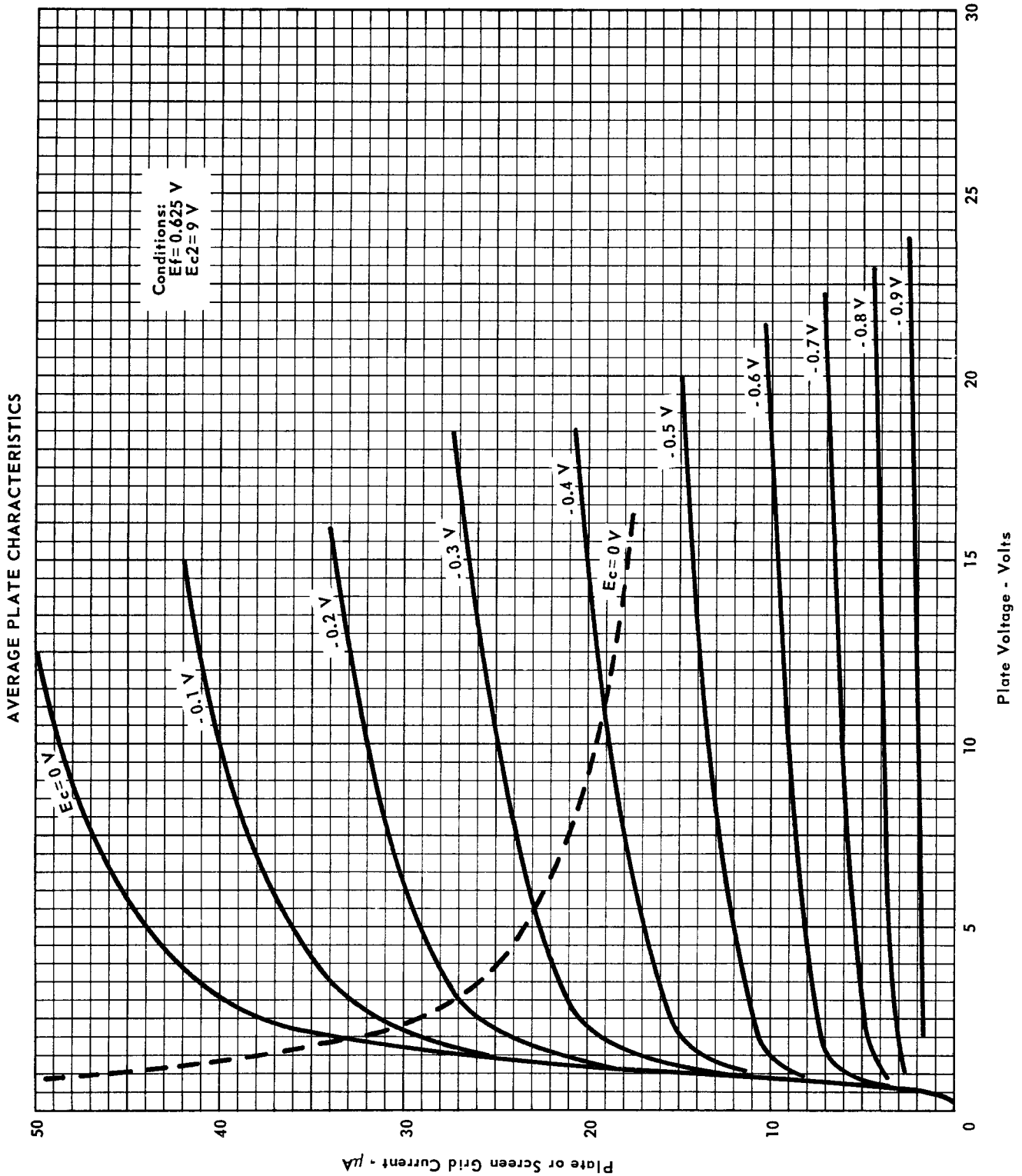
▲ *Measured with a signal of 0.05 volts (RMS) and a coupled load impedance of 10 megohms.*

♦ *Grid #3 is composed of two deflector plates, one being connected to lead 3 and the other to lead 5.*

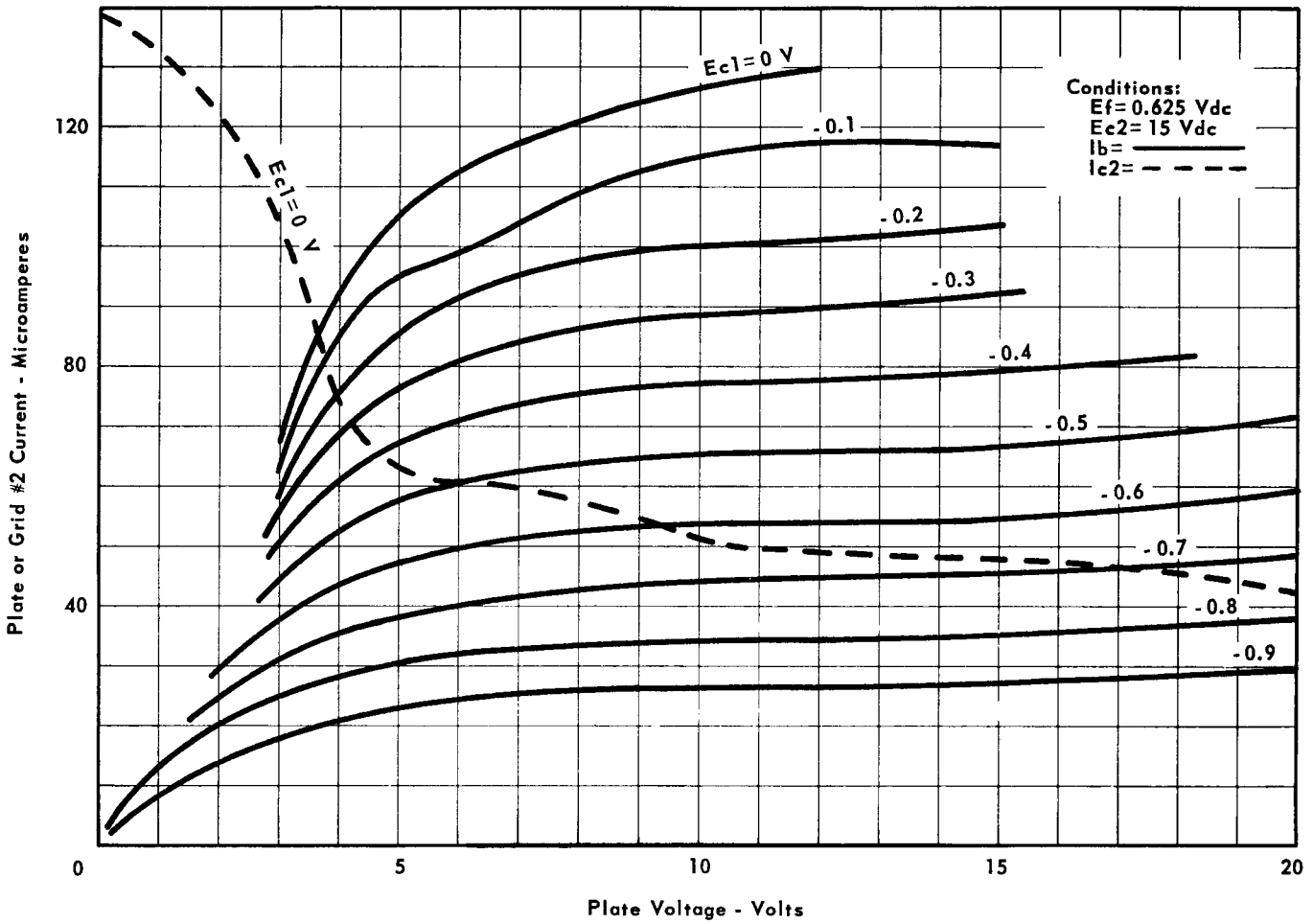
AVERAGE PLATE CHARACTERISTICS



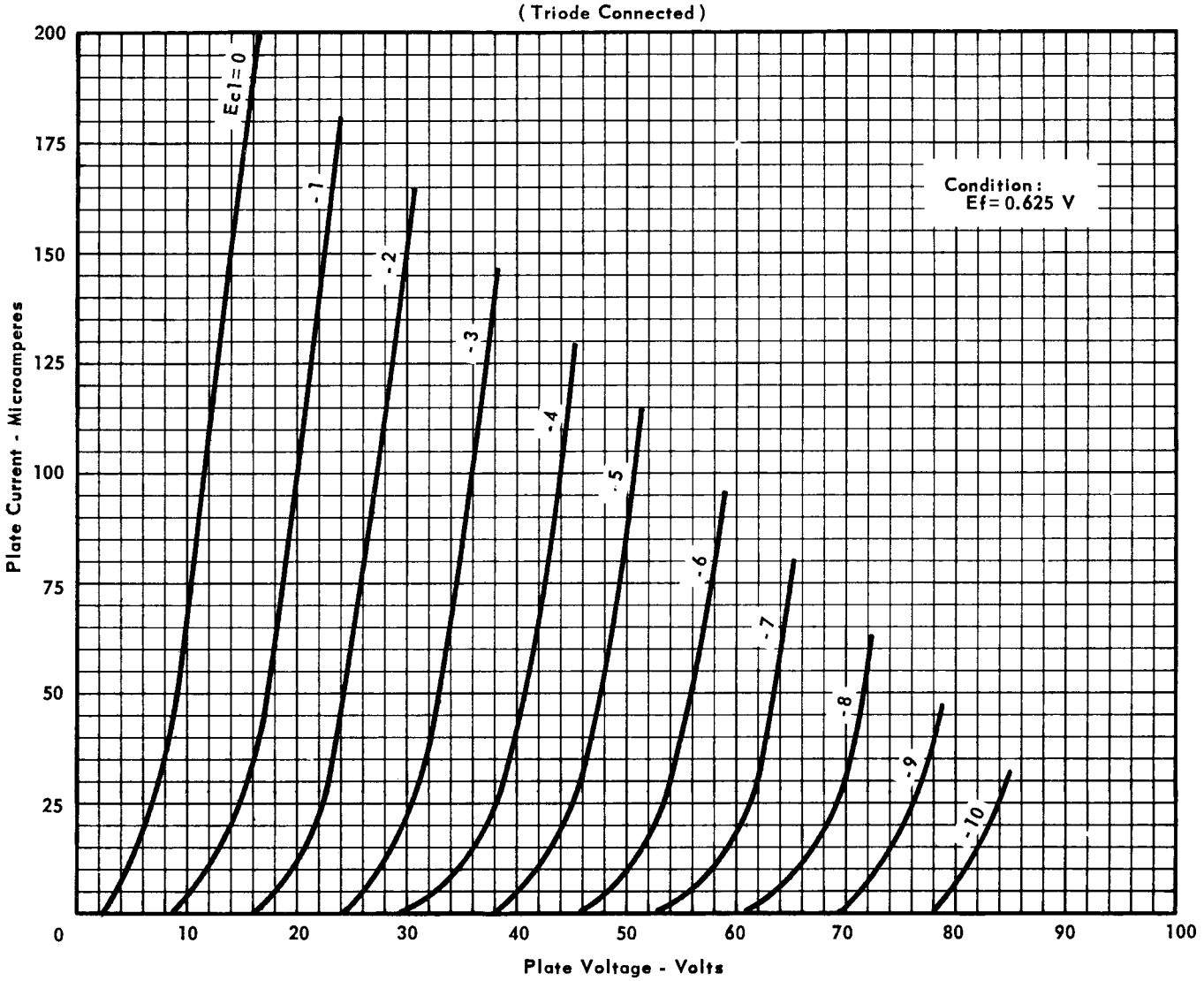
SUBMINIATURE PENTODE



AVERAGE PLATE CHARACTERISTICS



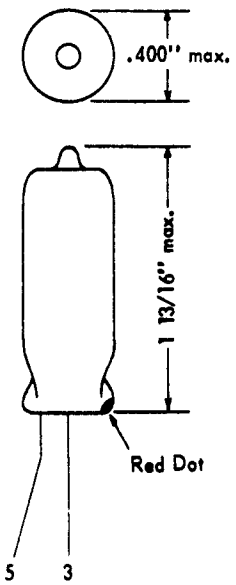
AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



Excellence in Electronics

TYPE CK6436/ CK1036

The CK6436/CK1036 is an instant starting, cold-cathode, gas-filled diode of subminiature construction designed primarily for use as a half-wave rectifier with vibrator power supplies having high transient voltages. Several tubes may be operated in cascade to generate very high voltages. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads: Length: 1.50" min. Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 3)*

Lead 3 Anode
Lead 5 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Peak Inverse Voltage ▲	1500 volts
Peak Cathode Current (Steady State)	10 ma.
Peak Cathode Current (Surge)	30 ma.
Average Cathode Current (dc)	100 μa.
Minimum Peak Anode Supply Voltage	1400 volts
Minimum Anode Supply Impedance	50,000 ohms
Ambient Temperature Range	-55 to +80 °C

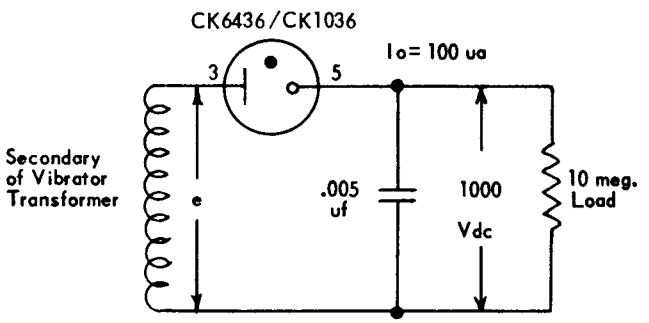
CHARACTERISTICS AND TYPICAL OPERATION: (Per Circuit Below)

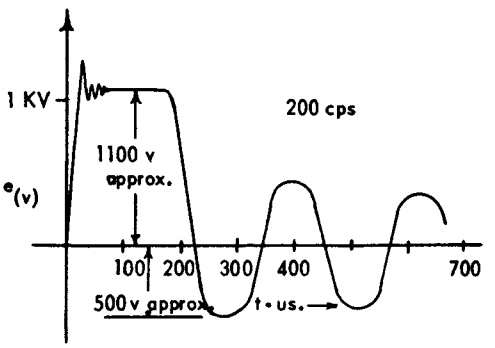
Maximum Inverse Current at -1500 volts DC	-8 μa. dc

VIBRATOR POWER SUPPLY OPERATION:

Vibrator Anode Supply Impedance	100,000 ohms
Peak Inverse Voltage	1500 volts
DC Output Voltage	1000 volts
DC Output Current	100 μa.

▲ *Instantaneous inverse voltage in excess of 1000 volts should not have a duty cycle factor greater than 10%.*





Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY
RECEIVING AND CATHODE RAY TUBE OPERATIONS
NEWTON 58, MASS.

RAYTHEON

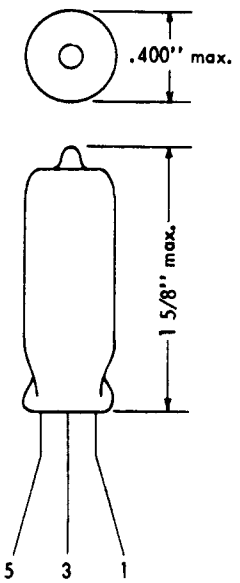
TECHNICAL INFORMATION

SUBMINIATURE
GAS - FILLED DIODE

Excellence in Electronics

TYPE CK6437/ CK1037

The CK6437/CK1037 is a cold cathode, corona-discharge tube of subminiature construction, designed for use as a voltage regulator in high voltage low current supplies. It has an operating current range of 5 to 125 μa. over which it maintains a substantially constant operating voltage of 700 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

DC Anode Supply Voltage	2000 volts
Minimum DC Anode Supply Voltage ▲	800 volts
DC Operating Current	5 to 125 μa
Ambient Temperature Range	-55 to +70 °C

CHARACTERISTICS AND TYPICAL OPERATION:

DC Starting Voltage (approx.)	800 volts max.
DC Operating Voltage (approx.) at 25 μa	700 volts
Regulation (5 to 100 μa.)	15 volts max.
Leakage current at 500 volts	0.5 μa max.

▲ *Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.*

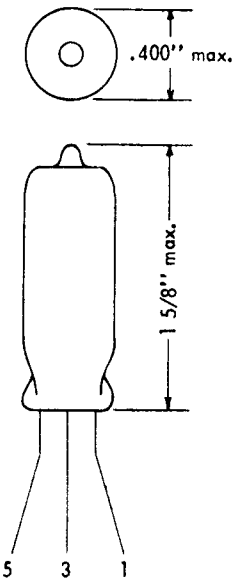
Tentative Data

Printed in U.S.A.

Excellence in Electronics

TYPE CK6438/ CK1039

The CK6438/CK1039 is a cold cathode, corona-discharge tube of subminiature construction, designed for use as a voltage regulator in high voltage low current supplies. It has an operating current range of 5 to 125 μa over which it maintains a substantially constant operating voltage of 1200 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

DC Anode Supply Voltage	2000 volts
Minimum DC Anode Supply Voltage ▲	1400 volts
DC Operating Current (continuous)	5 to 125 μa
Ambient Temperature Range	-55 to +70 °C

CHARACTERISTICS AND TYPICAL OPERATION:

DC Starting Voltage (approx.)	1400 volts max.
DC Operating Voltage (approx.) at 25 μa	1200 volts
Regulation (5 to 100 μa)	20 volts
Leakage Current at 500 volts	0.5 μa max.

▲ *Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.*

Tentative Data

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RAYTHEON

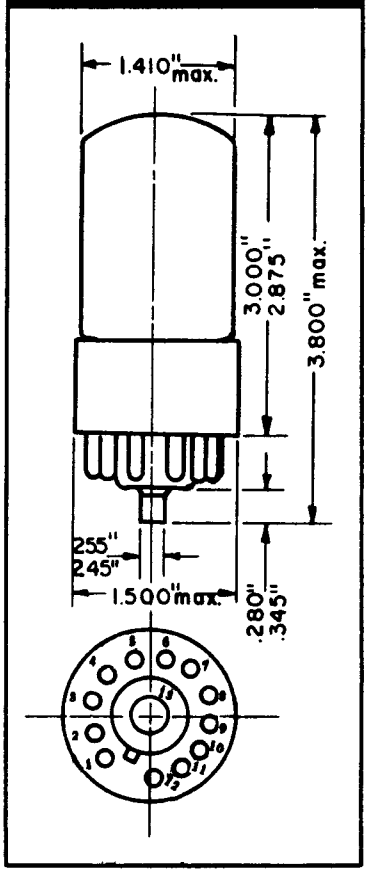
TECHNICAL INFORMATION

DECADE COUNTER

TYPE CK6476

Excellence in Electronics

The CK6476 is a cold cathode gas-filled 4KC medium speed bidirectional ring stepping decade counter tube. This type features direct visual neon glow readout or electrical readout in the form of a voltage from any of the cathode leads. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make this a very reliable counter device. Some of the many uses for this type include counting, timing, sampling, frequency dividing, coding matrixing, telemetering, and controlling.



MECHANICAL DATA

ENVELOPE: T-11 Glass

BASE: Modified Duo-Decal

TERMINAL CONNECTIONS:

Pin 1: Cathode #10	Pin 8: Cathode #3
Pin 2: Cathode #9	Pin 9: Cathode #2
Pin 3: Cathode #8	Pin 10: Cathode #1
Pin 4: Cathode #7	Pin 11: Guide 2
Pin 5: Cathode #6	Pin 12: Guide 1
Pin 6: Cathode #5	Pin 13: Anode
Pin 7: Cathode #4	

MOUNTING POSITION: Any (Visual Readout From Top Of Tube)

ZERO POSITION: Cathode #10 (Aligned with Pin Number 12 ± 10°)

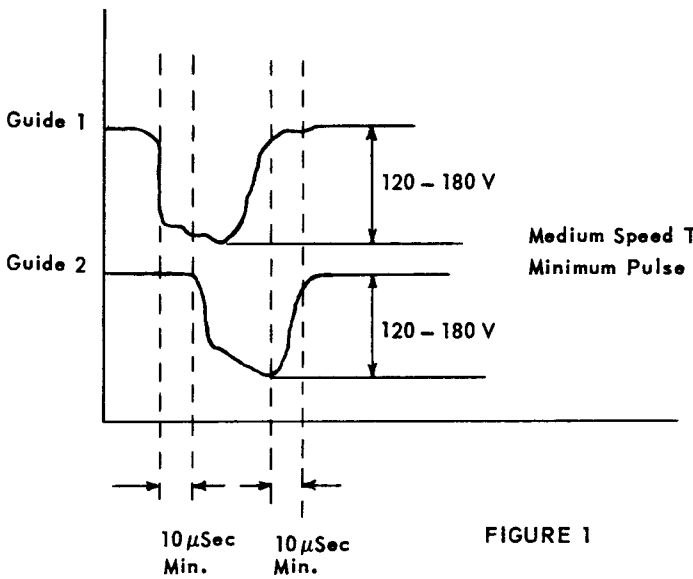
ELECTRICAL DATA (Note 1)

RATINGS – ABSOLUTE MAXIMUM VALUES

Total Anode Current	0.50 Ma
Voltage Between Electrodes (Excluding Anode)	140 volts
Supply Voltage (Anode to Cathode)	350 volts min.
Input Frequency	5000 cps

CHARACTERISTICS AND TYPICAL OPERATION:

DC Supply Voltage	425 volts
Anode Resistor	0.82 megohms
Nominal Tube Drop	195 volts
Cathode Resistor	100 Kohms
Output Voltage (Across Cathode Resistor)	30 volts



Medium Speed Tubes 30–40 μSec Minimum Pulse Widths

FIGURE 1

Printed in U.S.A.

Tentative Data

INDUSTRIAL COMPONENTS DIVISION

RAYTHEON COMPANY

55 CHAPEL ST., NEWTON 58, MASS.

1/15/60/1

APPLICATION NOTES

CONSTRUCTION

The Raytheon decade counter tube consists of thirty (30) thin rod shaped cathodes surrounding a circular anode, all of which are set in a glass envelope employing rare gases at low pressure. The thirty (30) cathodes are identical in construction and are radially spaced concentric to the anode. The cathodes are connected in groups of threes; main cathode, guide 1 cathode and guide 2 cathode. The guide 1's are connected together internally and are brought out to one of the base pins. The guide 2's are similarly connected and brought out to another base pin. The main cathodes may be brought out individually or connected in groups depending on the tube type. Conduction occurs between the anode and the most negative cathode pin causing an orange colored glow at the tip of that cathode. This glow can be viewed from the top of the tube or may be read as a voltage developed across a cathode resistor.

OPERATION

In operation the main cathodes are at a more negative potential than the guide pins. When a negative input pulse (more negative than the cathode) is applied to guide 1 the glow is transferred from the initial cathode (Ko) to guide 1. A similar pulse applied to guide 2 transfers the pulse to guide 2. When the potential of guide 2 returns to a value more positive than the main cathodes the glow transfers to the next closest main cathode. In order to insure reliable operation the phase relationship between pulses should be such that the pulse to guide 2 should overlap the pulse to guide 1. This overlap should have a minimum value of 10 microseconds for medium speed tubes and 2 microseconds for high speed tubes. Typical wave shapes are shown in figure 1 for a medium speed tube.

RESETTING

Usually the counting in a decade counter tube starts from a particular initial main cathode, and after the completion of a count it is desired to return the glow to the initial cathode. This may be accomplished two ways, (1) by opening the negative connection to all main cathodes and guides except the zero cathode, or (2) by pulsing the zero cathode 120-180 volts negative. Either method should cause the zero cathode to become 120 to 180 volts negative with respect to all other cathodes. It may become necessary in certain applications to reset the glow at such a speed so as not to lose count. Therefore, it is recommended that the reset pulse width be the same as the count signal pulse width received from the drivers.

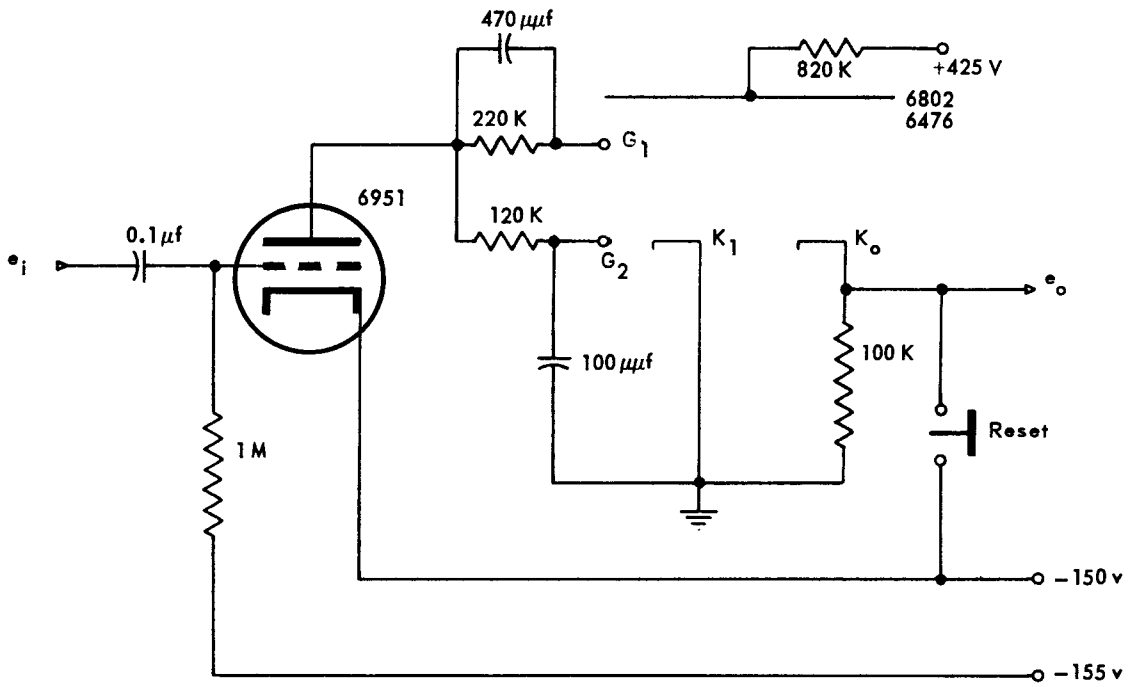
APPLICATION NOTES (Cont'd)

RESETTING (Cont'd)

When several tubes are used in cascade the reset for the first tube should be such that it is made to the zero cathode. The succeeding tubes should be set for the number 9 cathodes in order to account for the pulse passed to these tubes when the preceeding tubes are reset. This procedure will position the glow at all zero cathodes when the reset is complete.

DRIVE CIRCUITS

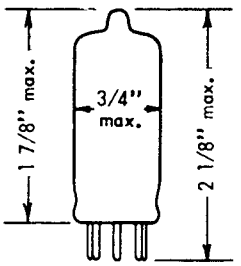
The circuit shown in figure 2 is that of a typical 0-4 KC medium speed drive circuit. The RC integrator network causes a delayed pulse to guide 2 and allows the initial pulse to be applied directly to guide 1. This allows a single negative pulse to step the glow instead of incurring the expense of generating two separate pulses. When the glow steps to the zero cathode (Ko) an output pulse in the form of a negative voltage is developed across the 100K cathode resistor. This pulse may then be used as the input pulse to a succeeding drive circuit. The order in which guide 1 and guide 2 receive the input pulses derermines the direction of rotation of the neon glow.

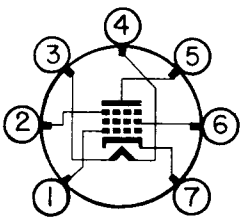


TYPE CK6485

Excellence in Electronics

The CK6485 is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction designed for use as a wide band or IF amplifier. It will maintain its emission and freedom from excessive cathode interface resistance even after long periods of operation under cut-off conditions. The CK6485 is otherwise identical with the 6AH6.





BOTTOM VIEW

7BK

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Grid #1	Pin 5 Plate
Pin 2 Grid #3	Pin 6 Grid #2
Pin 3 Heater	Pin 7 Cathode
Pin 4 Heater	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*)

	Unshielded	Shielded ●	
Grid #1 to Plate: (g1 to p)	0.030	0.020	max.
Input: g1 to (h+k+g2+g3)	10	10	
Output: p to (h+k+g2+g3)	2.0	3.6	

DESIGN CENTER MAXIMUM RATINGS:

Heater Voltage	6.3	volts
Plate Voltage	300	volts
Grid #2 Voltage	150	volts
Plate Dissipation ▲	3.2	watts
Grid #2 Dissipation	0.6	watt
Cathode Current	25	ma.

CHARACTERISTICS AND TYPICAL OPERATION:

	Pentode Connected	Triode Connected	
Heater Voltage	6.3	6.3	volts
Heater Current	0.45	0.45	amp.
Plate Voltage	300	150	volts
Grid #2 Voltage	150	⊕	volts
Cathode Resistor	160	160	ohms
Plate Resistance	0.5	.0036	meg.
Transconductance	9000	11,000	μmhos
Amplification Factor		40	
Plate Current	10	12.5	ma.
Grid #2 Current	2.5		ma.
Grid #1 Voltage for Ib= 10 μa. (approx.)	-7	-7	volts
Transconductance (Grid #3-Plate)	♦		

● *Using JETEC Shield #316 connected to cathode.*

▲ *At maximum ratings, it is necessary that at least one surface of the shield, if used, be blackened.*

♦ *Grid #3 has practically no control characteristic and it is not intended to be used as a control electrode. Its transconductance to the plate approximates 2 micromhos and the mu is 0.7 to 1.0.*

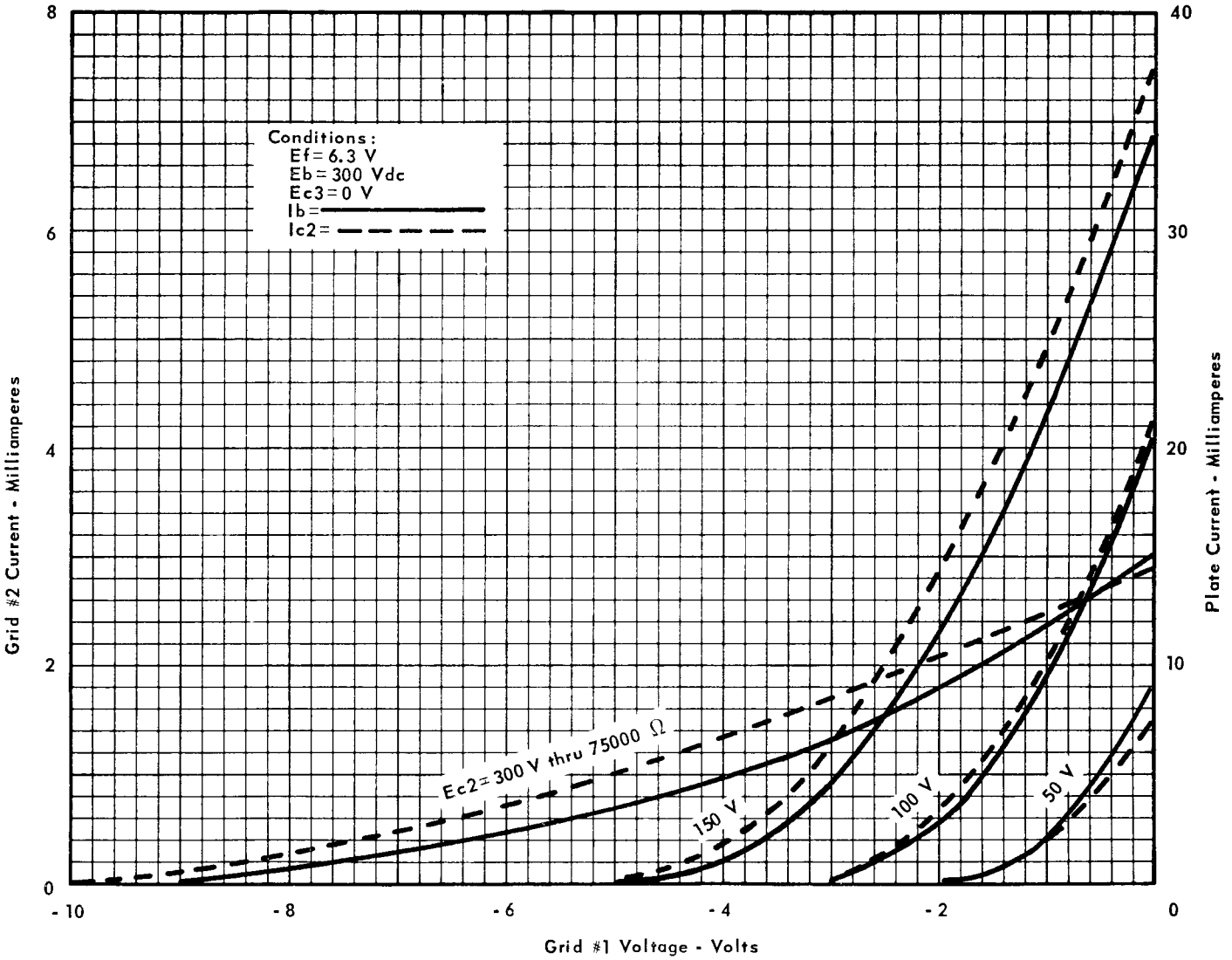
⊕ *Grid #2 and Grid #3 tied to plate.*

PENTODE

Input Coupling and Sync. Polarity	Output Volts P/P	Voltage Gain	Max. Watts Dissipation Screen	Plate	Cathode Resistor Ohms	Cathode Current No Sig. (ma.)	With Sig. (ma.)	Grid Resistor Ohms
DC−	66	22	0.6	3.2	39	20	13	5000
DC+	100	25	0.4	3.2	270	8	15	5000
AC−	100	25	0.6	3.2	39	20	21	1 meg.
AC+	100	25	0.6	3.2	39	20	18	1 meg.

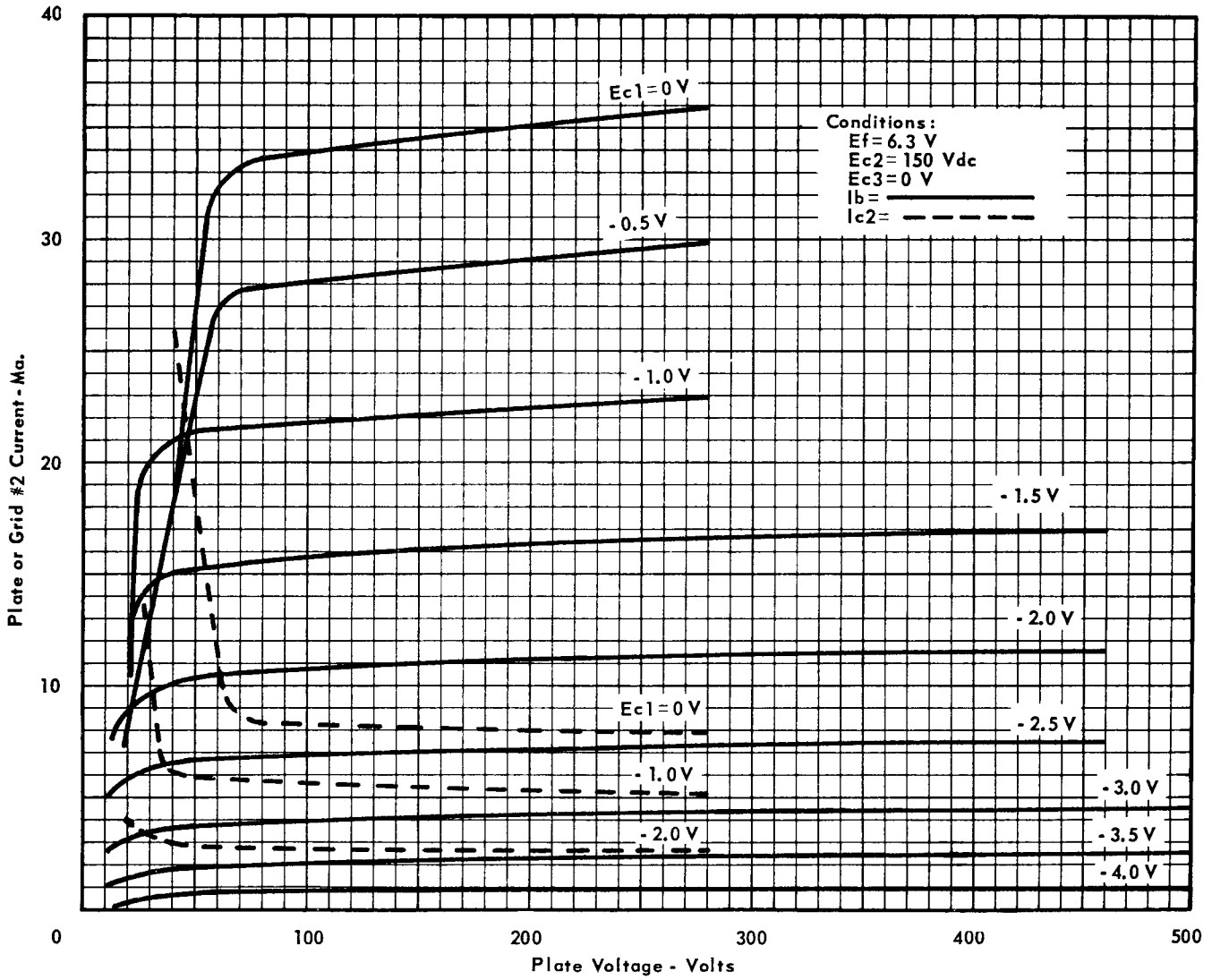
All data taken with Screen voltage of 150 and Plate load of 4000 ohms with typical on-the-air television signals and average production tubes.

AVERAGE CHARACTERISTICS



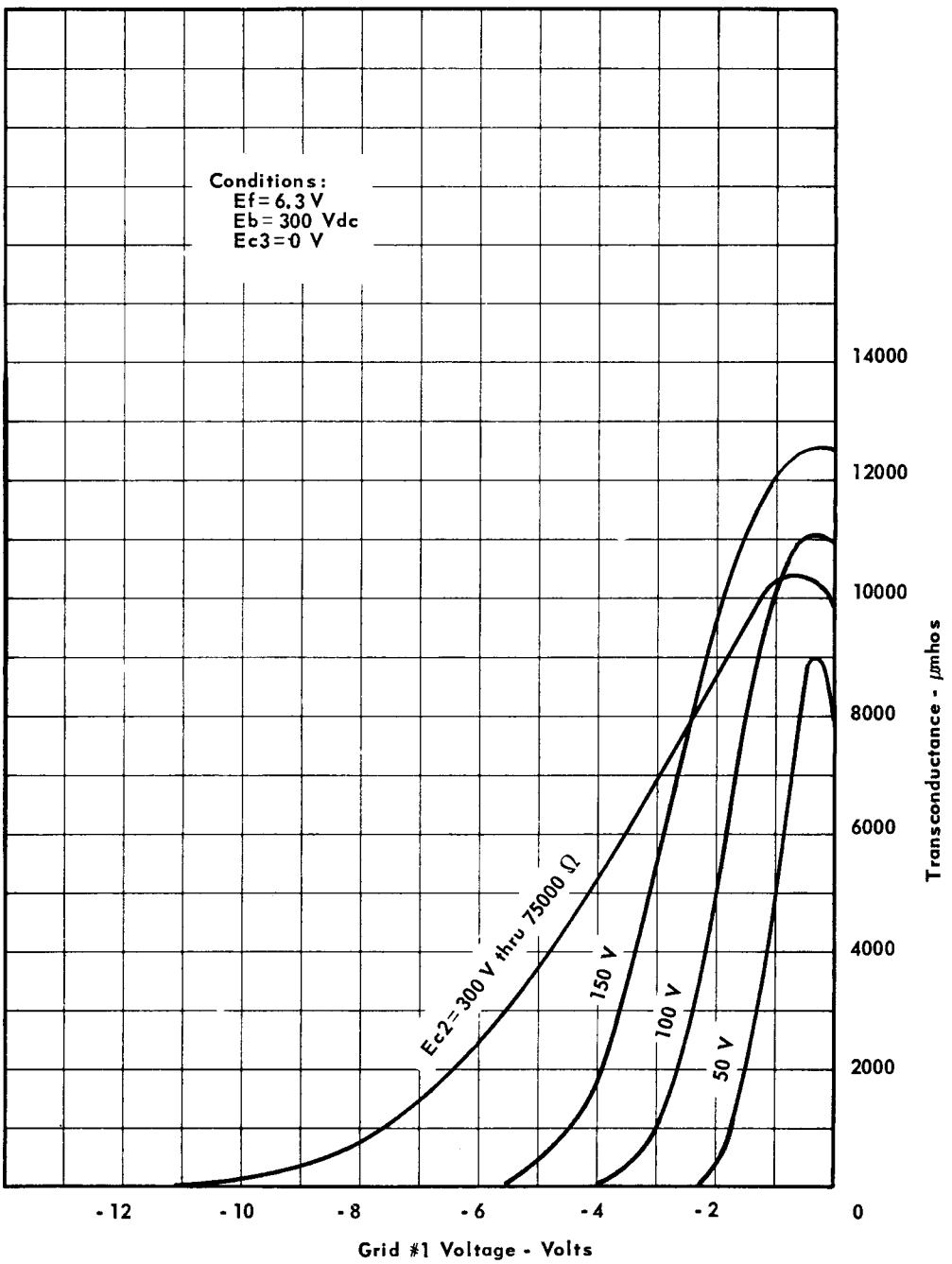
PENTODE

AVERAGE PLATE CHARACTERISTICS



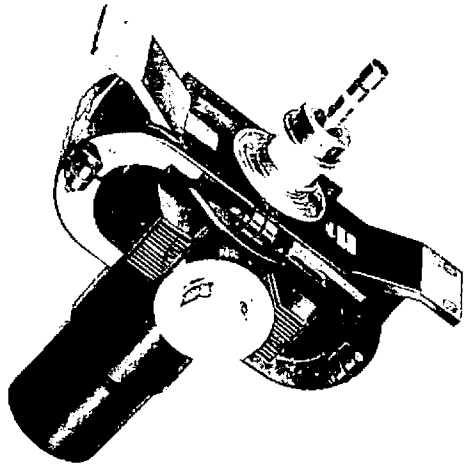
PENTODE

AVERAGE CHARACTERISTICS



TYPE RK6517/ QK358

The RK 6517/QK 358 magnetron is a mechanically tunable pulsed type oscillator with a nominal peak power output of 1.3 megawatts and capable of rapid hand or motor tuning to any desired frequency in the 1250 to 1350 megacycle region. It is an integral magnet type requiring forced air cooling and is designed for coupling to a standard 3" x 6" waveguide.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the Government technical specification sheet.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK 6517/QK 358 under conditions other than those recommended in this technical data sheet, the manufacturer should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater current preheat	75 A
Heater voltage @ 75 A	2.6 — 3.0 V
Minimum preheat time	10 minutes
Cold heater resistance	.00752 ohms (approx.)

Maximum Ratings

Heater current	90 A
Peak anode voltage	70 Kv
Peak anode current	60 a
Average power input	4300 W
Peak power input	3.5 Mw
VSWR	1.5/1
Frequency pulling at VSWR — 1.5/1	5 Mc
Pulse duration	3.3 μsec
Duty Cycle	.0013
Voltage pulse rise time	.8 μsec
Anode temperature	100° C
Bushing temperature	150° C
Output pressurization	45 psia

The values specified above must not be exceeded under any service condition. The ratings are limiting values above which the serviceability on any individual tube may be impaired. It does not necessarily follow that combinations of absolute ratings can be attained simultaneously.

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

from JEDEC release #3478, Nov. 6, 1961

Typical Operation

Heater current-preheat	75 A ± 3.5%
Heater current-operate	75 A ± 3.5%
Pulse duration	3.0 μsec
Duty cycle	0.00125
Peak anode voltage	54 kv
Peak anode current	50 a
Average anode current	62.5 mAdc
Peak power output	1.3 Mw
Average power output	1630 W
Useful range of peak current	35 — 55 a
VSWR	1.1/1
Frequency region	1250 — 1350 Mc
RF Bandwidth	0.45 Mc (—6 db level)

MECHANICAL

Overall dimensions	22.2" x 12.1" x 18.4"
Net weight	90 lbs. (approx.)
Mounting	Cathode vertical
Output coupling	Round Flange, 4½" diameter
Output pressure	15 psia (normally)
Cooling	Forced air
Cathode bushing	Immersed in oil
Vibration (non-operating)	25 cps @ 2.5 G
Magnet protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at 75 amperes for a period of at least ten minutes prior to the application of pulse high voltage. Heater current surges in excess of 100 amperes cannot be tolerated. Optimum operation and maximum tube life will be realized only if provisions are made to hold the specified heater current within the ± 3.5% tolerance.

Even though operation at heater currents higher or lower than specified may not be attended by immediate malfunctioning of the tube, some deterioration of life and performance is likely to result.

Figure 1 shows the influence of heater current variation on various operating parameters for the operating conditions tabulated on the graph.

Operation at preheat or standby without forced air cooling may damage the tube and cannot be tolerated.

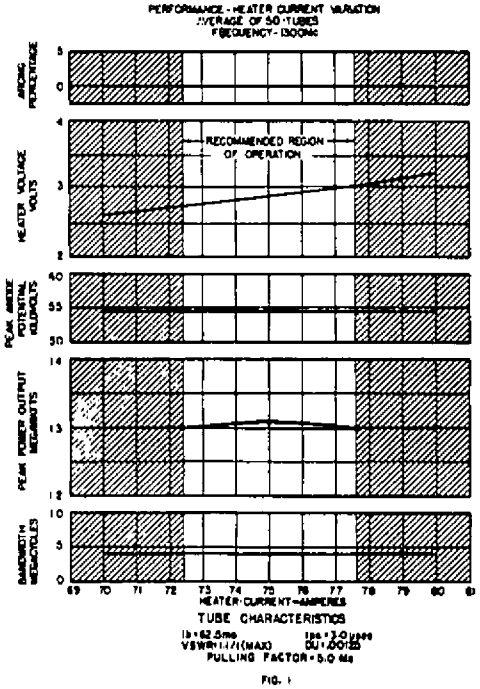


FIG. 1

STARTING NEW MAGNETRON

New magnetrons, or those which have not been operated for some time, may contain small quantities of gas. The presence of this gas may give rise to arcing when initially running the tube up to its rated current. If the arcing is sporadic with arc bursts of less than 1 or 2 seconds duration, the tube may be run up to rated current without hesitation. If, however, the arcing is severe; i.e., with arc bursts of about 5 seconds duration occurring frequently, it is essential that the following aging or gas clean-up procedure be employed:

1. Raise the average current level to a value just below that which produces sustained arcing. Allow the magnetron current to remain at this level until the arcing begins to decrease.
2. Repeat the above step for succeedingly higher levels of magnetron current until the desired operating point is reached.

NOTE: If difficulty is encountered in achieving stable operation at rated current, it is recommended that the tube be operated 2 or 3 mAdc above the rated current for a period of about 10 minutes. Stable operation will usually be attained in 5 to 15 minutes, although a considerably longer aging time may be required depending on the tube's condition and the skill of the operator.

NOTE: In equipments employing a reverse current and high voltage run down circuit, provisions must be made to allow desensitization of the device during the aging process. The runback circuit must be insensitive to arc bursts up to 5 seconds duration during aging, and insensitive to arc bursts up to 1 second duration after aging.

PULSE LENGTH AND DUTY CYCLE

The RK 6517/QK 358 magnetron has been designed and tested for operation at the following pulse conditions: (See figure 2)

tpc = 3.0 μsec (measured at 50%)

trc = 0.25 μsec (measured 20 to 85%)

tfc = 1.5 μsec (measured 0 to 85%)

trv = 0.70 μsec (measured 20 to 85%)

tfv = 3.0 μsec (measured 0 to 85%)

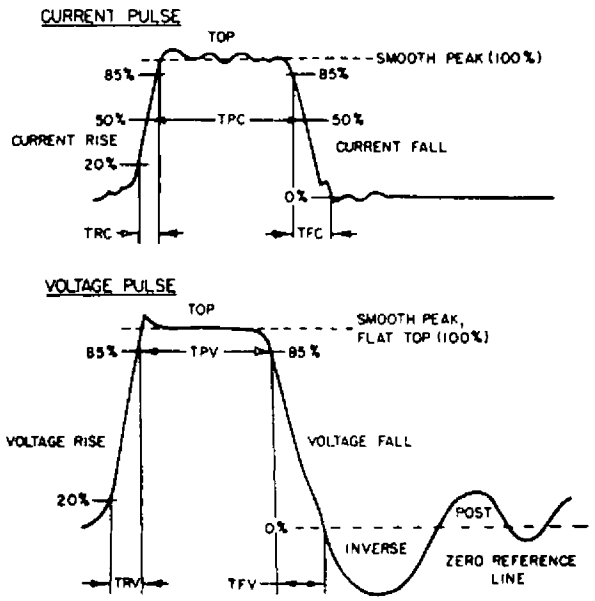


Figure 2

No spike or ripple should exceed ± 5% of the average peak value of voltage or current. Inverse voltage should not exceed 12% of the forward voltage. Post voltages should be held to a minimum as they may cause post-pulse noise or oscillation.

If operation at pulse conditions different from those given above is anticipated, the manufacturer should be consulted for further information.

Optimum tube performance will be realized only if proper consideration is given to pulse shaping. Voltage rise times less than 0.6 μsec will result in moding and/or arcing and cannot be tolerated. Excessive ripple on the top of the current pulse causes frequency pushing and broadening of the spectrum. Most magnetrons draw a small amount of leakage or diode current at anode voltages as low as 100 volts. This leakage current may amount to several milliamperes if the voltage fall time is greater than specified, and at a given duty cycle the calculated peak current will be in error.

It is therefore advisable that the equipment design effect as rapid a decay time as possible. Inverse and post-pulse voltages may result in undesirable noise radiation and should be damped. Judicious matching of the pulse forming network and the pulse transformer will, in most cases, reduce post and inverse voltage amplitudes sufficiently to eliminate noise difficulties. For short range radar applications where noise due to inverse and post voltages is most troublesome, it is recommended that a diode clipper be placed across the primary of the pulse transformer.

Optimum pulse shaping can best be achieved by treating the magnetron, pulse transformer and pulse line as a unit; hand tailoring the line and transformer for magnetron compatibility is recommended.

If operation at both long and short pulses is anticipated, the pulse transformer should be designed to optimize the more important pulse.

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance differing from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long line effects". Although these phenomena are usually associated with electrically long transmission lines, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case, the extent to which the long line effect is exhibited depends on the amount of coupling between the load and the oscillator, as well as the degree of mismatch.

Figure 3 shows the relation between the VSWR and the line length with respect to the critical condition at which frequency skipping will occur. The frequency skips will be noticed as the tube is mechanically tuned. It may also prove troublesome as the frequency changes due to thermal drift with breaks appearing in the ordinarily smooth drift curve. Even more serious consequences of "long line effect" may be the broadening deterioration of spectra. In some cases spectra of two frequencies may appear simultaneously. Operation into loads specified in the recommended region of figure 3 should eliminate the above difficulties, although the VSWR of the load should be kept as low as possible if minimum bandwidth is important.

More detailed information on "long line effects" is available upon request.

RK-6517/QK358
LOAD AND LINE LENGTH CONSIDERATIONS

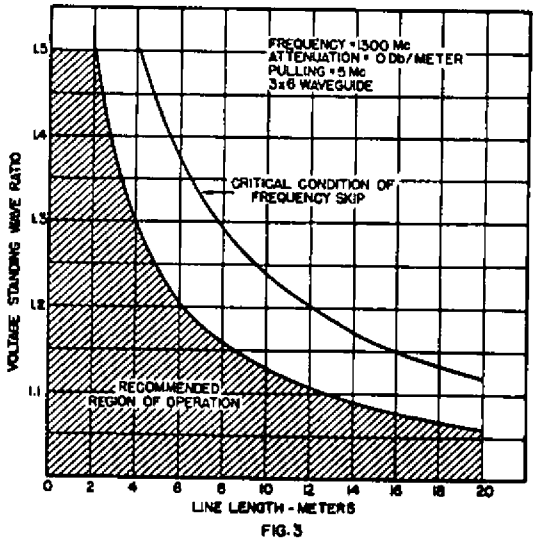
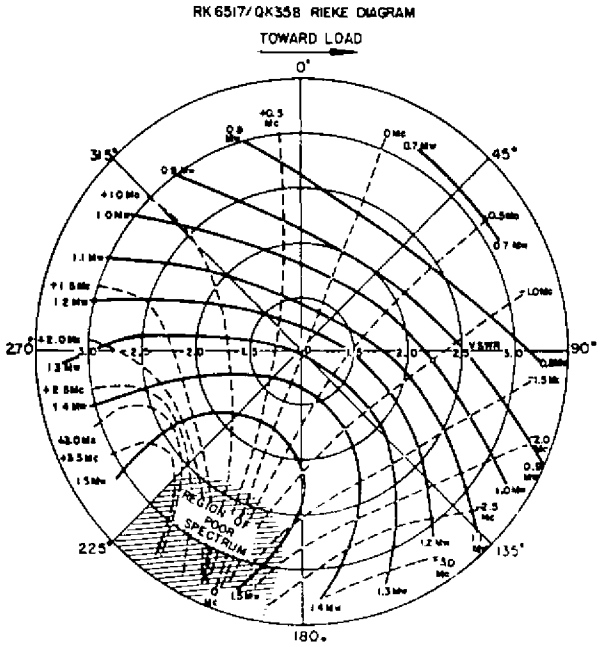


FIG. 3

LOAD DIAGRAMS

Figures 4, 5, and 6 are load diagrams of a typical RK 6517/QK 358 operating at frequencies of 1250, 1300, and 1350 megacycles. The contours of constant power output and frequency change are related to the voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWRs as high as 3.0/1 are plotted but operation at ratios greater than 1.5/1 is not recommended.

RK 6517/QK358 RIEKE DIAGRAM



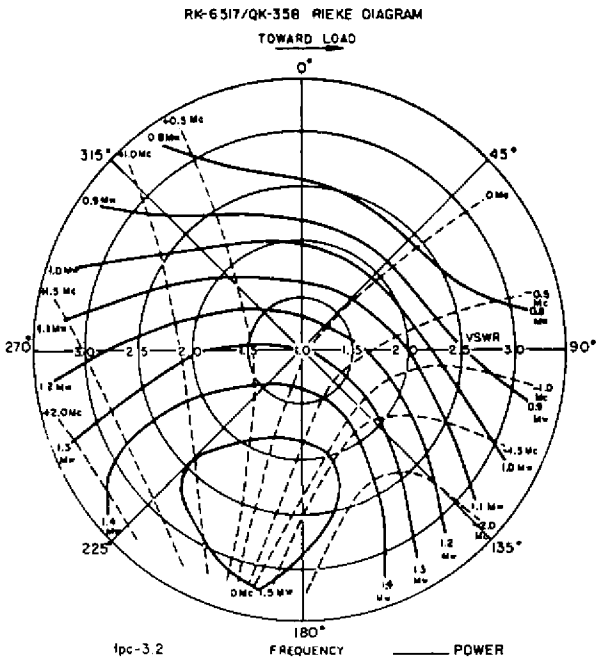
tpc - 3.2
prf - 391
DU - .00125
Ib - 62.5 mAdc
ib - 50a

FREQUENCY 1250Mc

——— POWER
- - - - - - - FREQ

FIG. 4

RK-6517/QK-358 RIEKE DIAGRAM



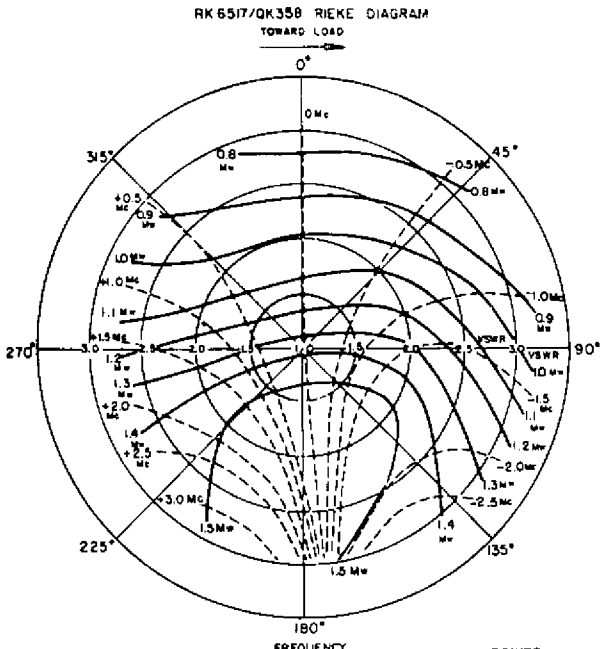
tpc-3.2
Prf-391
DU-00125
Ib - 62.5 mAdc
ib - 50a

FREQUENCY 1300Mc

——— POWER
- - - - - - - FREQ.

FIG. 5

RK 6517/QK358 RIEKE DIAGRAM



tpc - 3.2
prf - 391
DU - 00125
Ib - 62.5 mAdc
ib - 50a

FREQUENCY 1350Mc

——— POWER
- - - - - FREQ.

FIG. 6

FREQUENCY CHARACTERISTICS

The manner in which anode voltage and power output vary with frequency is revealed in Figure 7.

RK 6517/QK358 FREQUENCY CHARACTERISTICS

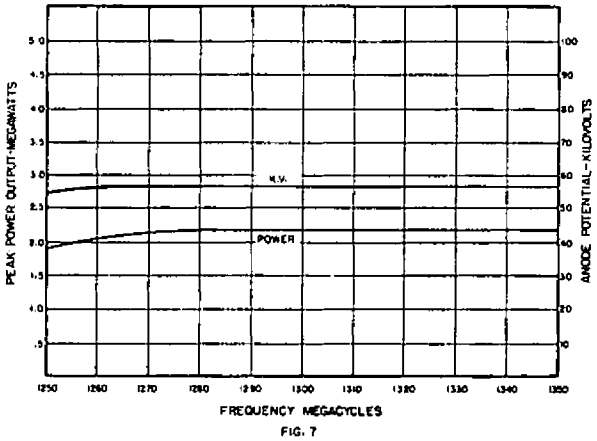


FIG. 7

FREQUENCY DRIFT

After operation of the RK 6517/QK 358 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift is plotted as a function of time in Figure 8. If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes. Because of cavity dimensions and the mass of metal involved in a magnetron at these low frequencies, thermal equilibrium from a cold start will naturally take considerable time.

RK-6517/QK358 FREQUENCY DRIFT CHARACTERISTICS

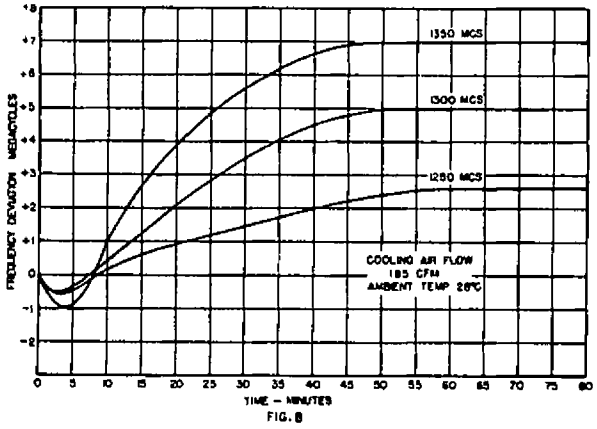
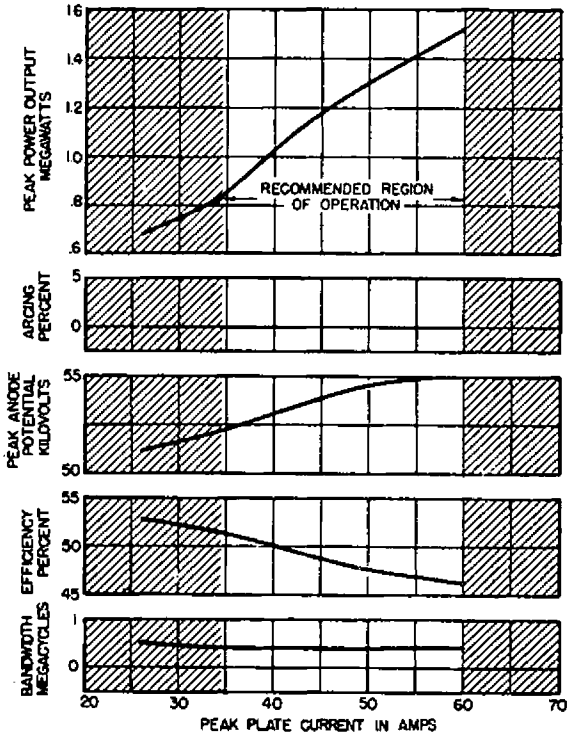


FIG. 8

OPERATING CHARACTERISTICS

Figure 9 is a plot of efficiency, arc stability, bandwidth, anode voltage, and peak power output as a function of peak anode current.

RK-6517/QK358
PERFORMANCE - PLATE CURRENT VARIATION
AVERAGE OF 50 TUBES
FREQUENCY - 1300Mc



TUBE CHARACTERISTICS
If = 80A
PULL = 5Mc
tpc = 3.0 sec
Du = .00125
VSWR = 1.0/1 (MAX)

FIG. 9

RF RADIATION FROM CATHODE

The RK 6517/QK 358 magnetron is designed to minimize radiation from the cathode bushing which will in general be negligible. It is not possible, however, to guarantee it as being negligible; in particuarly critical environments, shielding of the cathode bushing may be necessary to avoid radiation difficulties.

INSTALLATION & HANDLING PRECAUTIONS

Although magnetrons give the appearance of great structural strength, they are in reality quite fragile and may be easily damaged during handling or installation. Damage to the magnetron will be avoided if the following installation and handling precautions are carefully observed.

1. Leave the magnetron in its shipping crate until it is ready to be used.
2. Remove the neoprene guard covers from the RF output window and cathode bushing just before installing the tube in the equipment.
3. Avoid setting up mechanical strains in the output window or cathode bushing when handling or mounting.
4. Avoid unnecessary jarring or rough handling.
5. Do not let the magnetron rest on any of its parts normally protected by the shipping crate.
6. If the magnetron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the RF window or cathode bushing and wipe them dry before application of high voltage.
7. Do not place the tube in closer proximity to magnetic materials than indicated on the tube magnet.

MOUNTING

The tube is mounted within the equipment by four bolts passed through the clearance holes of the mounting brackets. The tube must be mounted with the longitudinal axis of the high voltage cathode bushing vertical. The tube should be operated in this position although small angular deviations ($\pm$ 15°) can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short circuited.

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two terminals on the high voltage cathode bushing. The positive high voltage should be grounded at the mounting surfaces. Heater and cathode connections are made to the terminals on the cathode bushing. Heater connectors should be designed to minimize contact resistance and lateral forces on the heater terminals. Drawings of suitable heater-cathode connecting devices are available on request.

COUPLING AND PRESSURIZATION

The magnetron output flange is designed to couple to standard 3" x 6" waveguide. Mechanical details of the recommended flange to mate to the magnetron are illustrated in the outline drawing. See figure 12

Waveguide pressurization is not required at altitudes up to 10,000 feet. If sustained arcing in the waveguide occurs, failure of the output window may result. To minimize the possibility of the tube arcing in the guide and to achieve optimum tube performance, the VSWR of the waveguide system should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended.

COOLING

The RK 6517/QK 358 magnetron is a forced air cooled tube. The ambient temperature will dictate the flow rate necessary to maintain anode temperature below the specified maximum (100° C). Figure 10 is a plot of anode temperature rise above ambient as a function of cooling fin air flow and anode power dissipation. It is also a plot of back pressure as a function of rate of air flow. (c.f.m.)

Sufficient cooling of the cathode insulating oil must be provided to maintain the cathode bushing temperature below the maximum specified 150° C. If the insulating oil used has insulating properties which deteriorate above the normal operating temperatures, it is, of course, necessary to maintain the oil temperature at a value below the deterioration level.

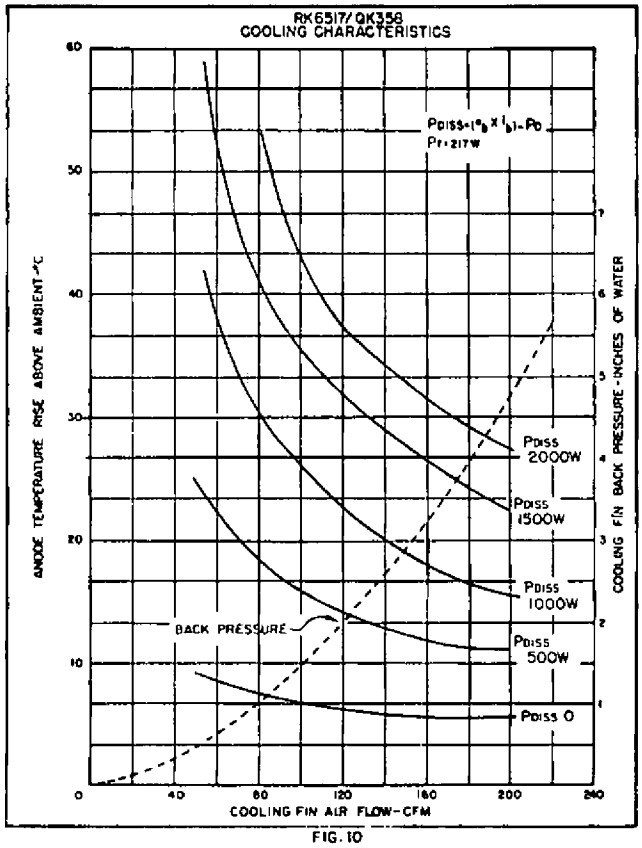


FIG. 10

CATHODE BUSHING PROTECTION

It is recommended that the RK 6517/QK 358 ceramic cathode bushing be immersed in a fluid insulating medium of "Univolt 35" transformer oil or equivalent. A minimum distance of 1½" must be maintained through the oil from high voltage to ground with design considerations to avoid sharp edged objects in the vicinity of the ceramic cathode bushing.

In cases where it is necessary to mount the RK 6517/QK 358 magnetron such that the ceramic cathode bushing is situated vertically downward, extreme care should be exercised to remove all entrained air from the magnetron oil flange area.

Any air trapped beneath this oil flange can impose a dangerous possibility of high voltage breakdown in oil resulting in ultimate puncture of the ceramic cathode bushing.

DYNAMIC PUSHING

Dynamic pushing is the change in frequency with a given change of anode peak current. With a peak current variation between 45 amperes and 55 amperes, RK6517/QK358 pushing has been found to be less than 26 KC/ampere.

TUNER CHARACTERISTICS

Approximately 34 turns of the tuner spline at an applied torque of 70 inch-ounces are required to tune the tube through its frequency range.

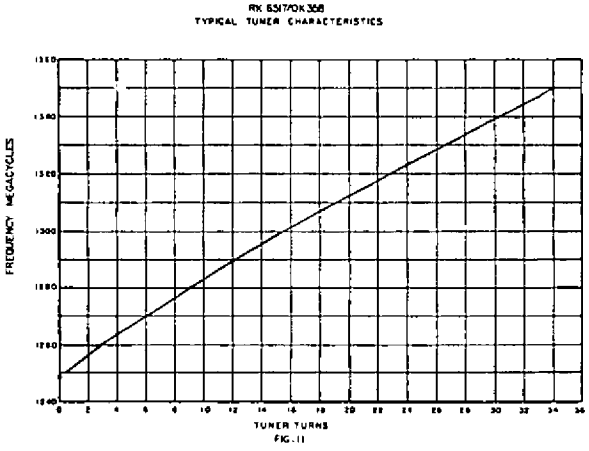
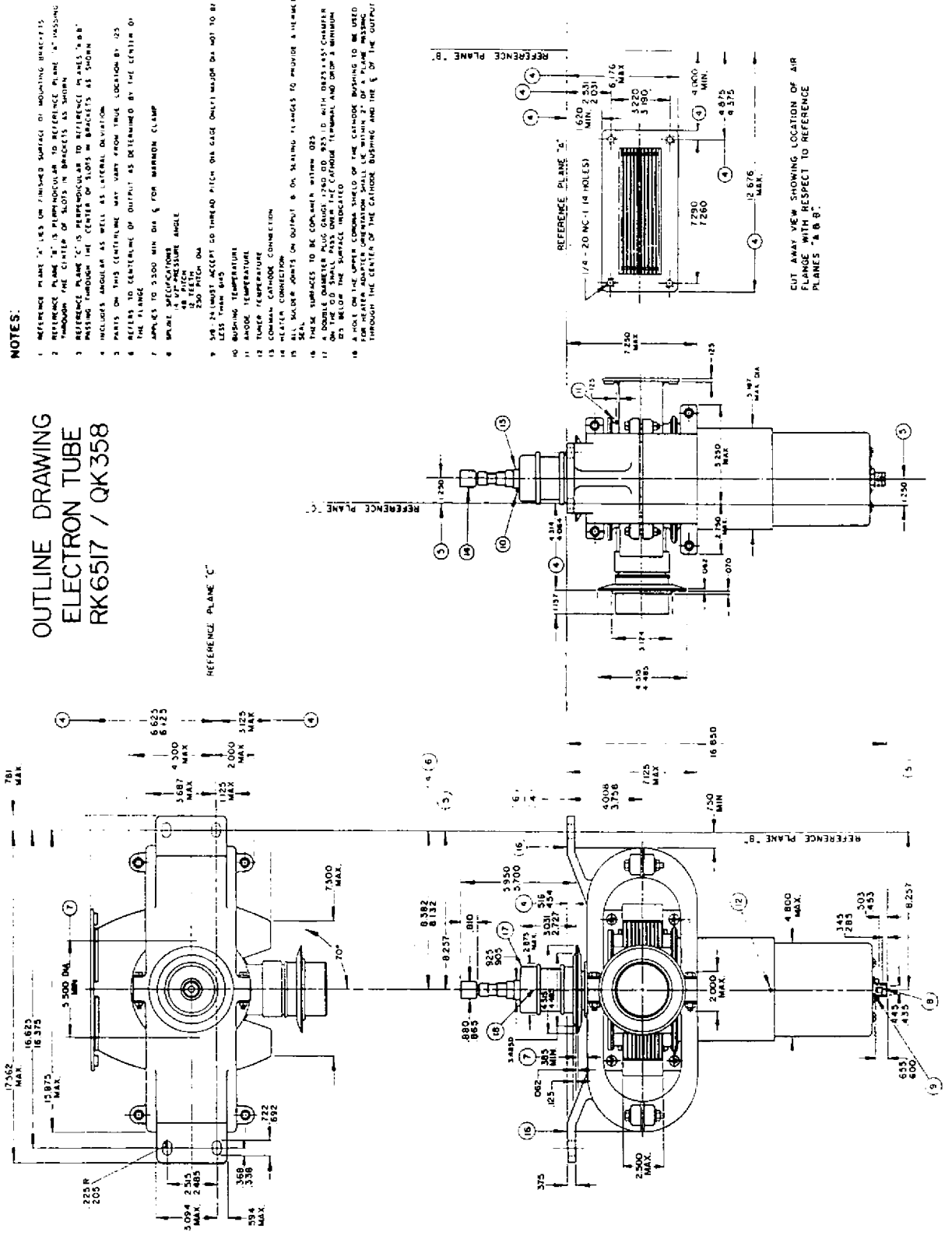
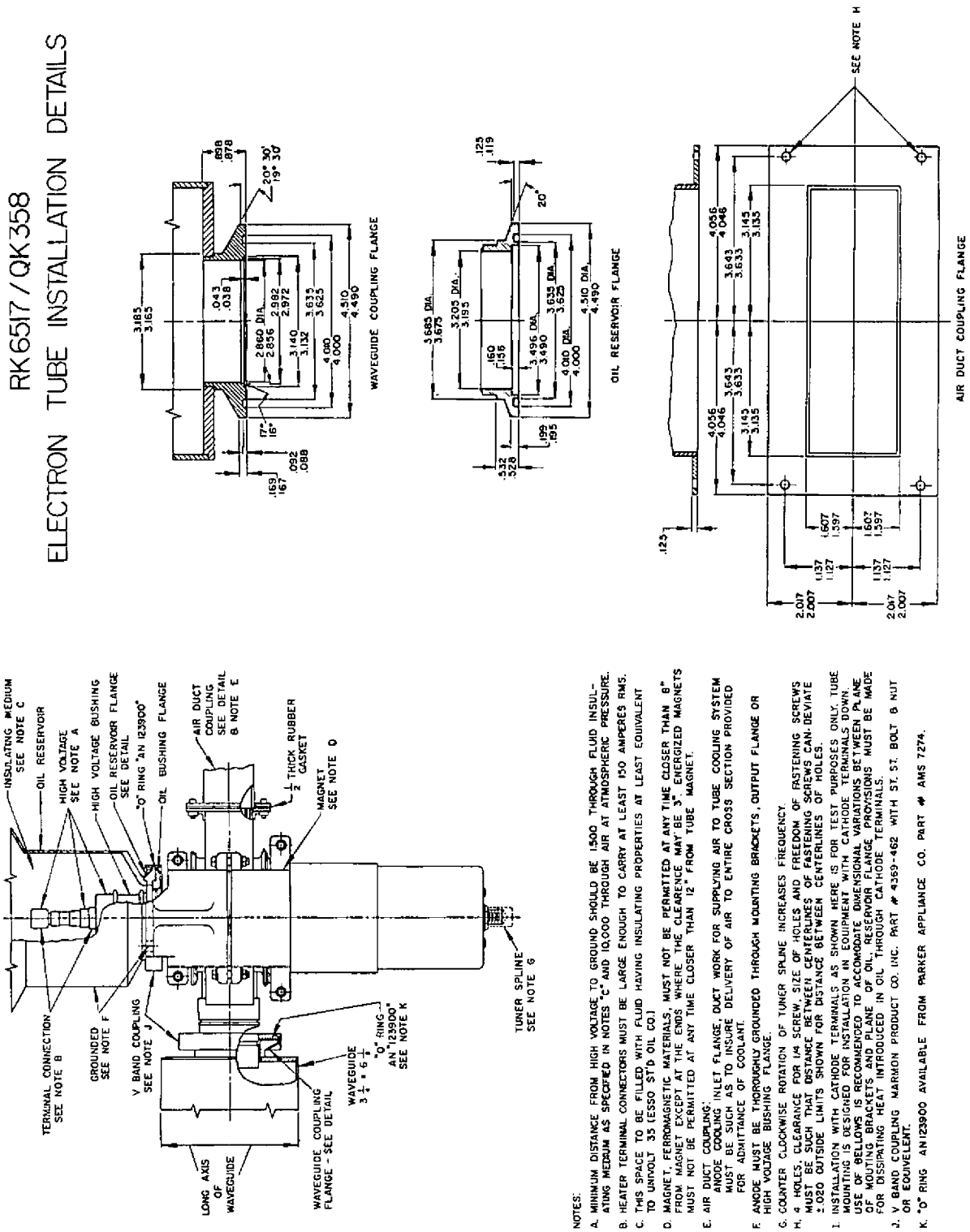


FIG. 11

OUTLINE DRAWING
ELECTRON TUBE
RK6517 / QK358



RK6517/QK358
ELECTRON TUBE INSTALLATION DETAILS



NOTES:

A. MINIMUM DISTANCE FROM HIGH VOLTAGE TO GROUND SHOULD BE 1.500 THROUGH FLUID INSULATING MEDIUM AS SPECIFIED IN NOTES "C" AND 10,000 THROUGH AIR AT ATMOSPHERIC PRESSURE.

B. HEATER TERMINAL CONNECTORS MUST BE LARGE ENOUGH TO CARRY AT LEAST 150 AMPERES RMS.

C. THIS SPACE TO BE FILLED WITH FLUID HAVING INSULATING PROPERTIES AT LEAST EQUIVALENT TO UNIVOLT 35 (ESSO ST'D OIL CO.)

D. MAGNET, FERROMAGNETIC MATERIALS, MUST NOT BE PERMITTED AT ANY TIME CLOSER THAN 8" FROM MAGNET EXCEPT AT THE ENDS WHERE THE CLEARENCE MAY BE 3". ENERGIZED MAGNETS MUST NOT BE PERMITTED AT ANY TIME CLOSER THAN 12" FROM TUBE MAGNET.

E. AIR DUCT COUPLING:
ANODE COOLING INLET FLANGE, DUCT WORK FOR SUPPLYING AIR TO TUBE COOLING SYSTEM MUST BE SUCH AS TO INSURE DELIVERY OF AIR TO ENTIRE CROSS SECTION PROVIDED FOR ADMITTANCE OF COOLANT.

F. ANODE MUST BE THOROUGHLY GROUNDED THROUGH MOUNTING BRACKETS, OUTPUT FLANGE OR HIGH VOLTAGE BUSHING FLANGE.

G. COUNTER CLOCKWISE ROTATION OF TUNER SPLINE INCREASES FREQUENCY.

H. 4 HOLES, CLEARANCE FOR ¼4 SCREW, SIZE OF HOLES AND FREEDOM OF FASTENING SCREWS MUST BE SUCH THAT DISTANCE BETWEEN CENTERLINES OF FASTENING SCREWS CAN DEVIATE ±.020 OUTSIDE LIMITS SHOWN FOR DISTANCE BETWEEN CENTERLINES OF HOLES.

I. INSTALLATION WITH CATHODE TERMINALS AS SHOWN HERE IS FOR TEST PURPOSES ONLY. TUBE MOUNTING IS DESIGNED FOR INSTALLATION IN EQUIPMENT WITH CATHODE TERMINALS DOWN. USE OF BELLOWS IS RECOMMENDED TO ACCOMODATE DIMENSIONAL VARIATIONS BETWEEN PLANE OF MOUNTING BRACKETS AND PLANE OF OIL RESERVOIR FLANGE. PROVISIONS MUST BE MADE FOR DISSIPATING HEAT INTRODUCED IN OIL THROUGH CATHODE TERMINALS.

J. V BAND COUPLING MARMON PRODUCT CO. INC. PART # 4369-462 WITH ST. ST. BOLT & NUT OR EQUIVELENT.

K. "O" RING AN123900 AVAILABLE FROM PARKER APPLIANCE CO. PART # AMS 7274.

from JETEC release #1503, Aug. 8, 1955

RAYTHEON

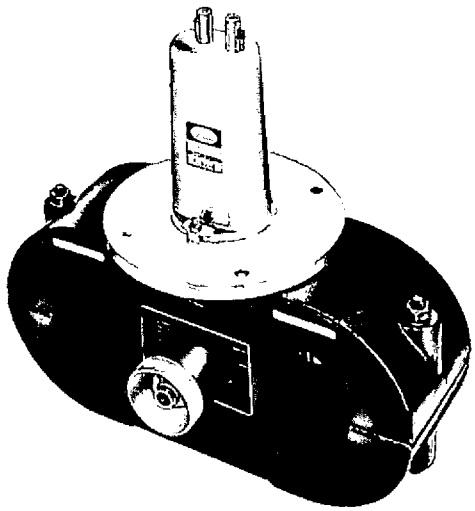
TECHNICAL INFORMATION

PULSED-TYPE MAGNETRON OSCILLATOR

TYPE RK6518/ QK254

Excellence in Electronics

The RK6518/QK254 is a fixed frequency pulsed-type oscillator operating in the frequency region of 2860 to 2900 megacycles with a nominal peak power output of 2 megawatts. It is an integral magnet coaxial output type tube requiring forced air cooling and designed for coupling to standard 1⅝", 50 ohm, coaxial line.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL-E-1B Government purchase specifications.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK6518/QK254 under conditions other than those recommended in this technical data sheet, the company's Magnetron Application Engineering Group should be consulted.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage Preheat	13.0 V ±4.5%
Heater Current @ 13 V	36 — 44 A
Minimum Preheat Time	3 minutes

Maximum Ratings

Heater Voltage	13.6 V
Peak Anode Voltage	48 kv
Peak Anode Current	92 a
Average Power Input	3000 W
Pulse Duration	2.2 μsec
Voltage Pulse Rise Time	0.3 μsec
Duty Cycle	.0007
VSWR	1.5/1
Pulling @ VSWR = 1.5/1	16 Mc
Anode Temperature	100° C
Input Bushing Pressure	45 psia
Output Pressurization	45 psia

The values specified above must not be exceeded under any service condition. The ratings are limiting value above which the serviceability of any individual tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Typical Operation

Heater Voltage Operate	13.0 V ±4.5%
Pulse Duration	2.0 μsec ±10%
Duty Cycle	0.0006
Peak Anode Voltage	41 kv
Peak Anode Current	87.5 a
Average Anode Current	52.5 mAdc
Peak Power Output	2.1 Mw
Average Power Output	1260 W
Useful Range of Peak Current	65 — 92 a
VSWR	1.1/1
Frequency Region	2860 — 2900 Mc
RF Bandwidth	0.7 Mc (@ —6db level)

MECHANICAL

Over-all Dimensions	16.4" x 8.5" x 16.3"
Net Weight	82 lbs.
Mounting	Cathode Vertical
Output Coupling	1⅝" coax
Output Pressure	35 psia
Cooling	Forced Air
Cathode Bushing	Pressurized
Vibration (nonoperating)	50 cycles @ 10 G
Shock (nonoperating)	15 G
Magnet Protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 13.0 V ±4.5% for a period of at least 3 minutes prior to the application of anode voltage. Optimum operation and maximum tube life will be realized only if provisions are made to maintain the specified heater voltage within the ±4.5% tolerance. Heater current surges in excess of 200 amps cannot be tolerated. Operation of the tube at standby or preheat without forced air cooling may result in damage to the tube and is not permissible. See Fig. 1 for heater characteristics.

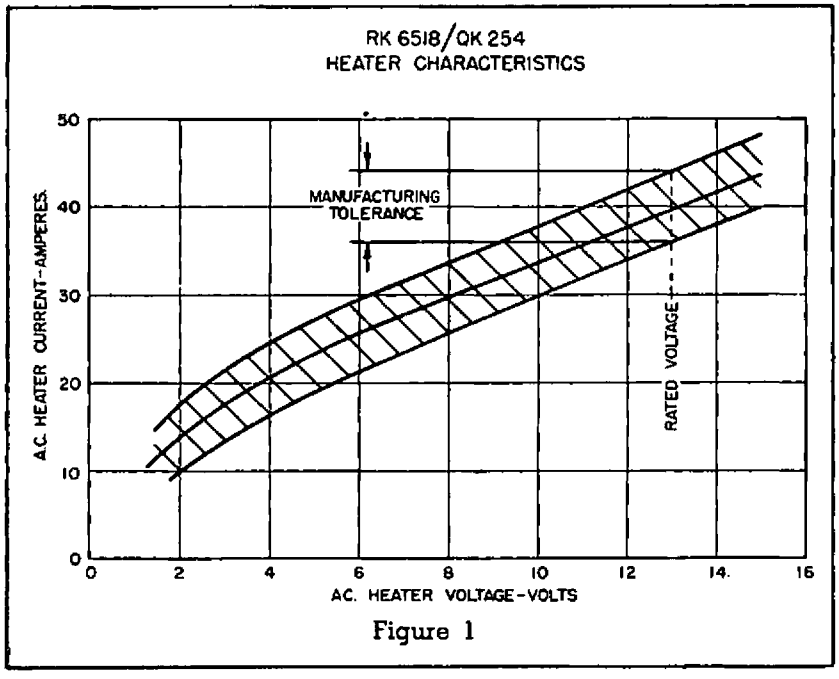


Figure 1

STARTING NEW MAGNETRON

In starting a new magnetron or one that has not been operated for some time, sparking and some instability may occur. Sporadic arcing will not harm the magnetron, but if the tube tends to arc continuously, the following seasoning procedure is recommended:

1. Preheat magnetron for 15 minutes.
2. Gradually raise the magnetron current to a level just below that which produces continuous arcing. Allow the magnetron current to remain at this level for a few minutes until the arcing begins to decrease.
3. Repeat the above process for succeedingly higher levels of magnetron current until the desired operating point is reached.

It is usually possible to attain the desired operating point within 15 minutes.

NOTE:—Once a tube has been aged in at the specified operating level, it is recommended that the tube be operated throughout its life as close to this level as is feasible. Operation at plate currents lower than the aged in level results in the cathode conditioning itself to this new lower level, and attempts to resume operation at the specified level may be attended by excessive arcing and require the aging process to be repeated.

PULSE LENGTH AND DUTY CYCLE

The RK6518/QK254 magnetron has been designed and tested for operation at the following pulse conditions: See Fig. 2.

tpc = 2.0 ±10% μsec @ DU = .0006

trc = 0.25 μsec max. measured 20% to 85%

tfc = 0.60 μsec max. measured 0% to 85%

trv = 0.15 — 0.30 μsec max. measured 20% to 85%

tfv = 2.5 μsec max. measured 0% to 85%

No spike or ripple shall exceed ±5% of the average peak value of voltage or current. Inverse voltage should not exceed 10% of the forward voltage. Post voltages should be held to a minimum as they may cause post pulse noise or oscillation.

Optimum tube performance will be realized only if proper consideration is given to pulse shaping. Voltage rise times greater than maximum specified will result in moding and/or arcing and cannot be tolerated. Excessive ripple on the top of the current pulse causes frequency pushing and broadening of the spectrum. Most magnetrons draw a small amount of leakage or diode current at anode voltages as low as 100 volts. This leakage current may amount to several milliamperes if the voltage fall time is greater than 2.5 μsec, and at a given duty cycle the calculated peak current will be in error. It is therefore advisable that the equipment design effect as rapid a decay time as possible. Inverse and post voltages may result in undesirable noise radiation and should be damped. Judicious matching of the pulse-forming network and pulse transformer will in most cases reduce post and inverse voltage amplitudes sufficiently to eliminate noise difficulties. For short-range radar applications where noise due to inverse and post voltages is most troublesome, it is recommended that a diode clipper be placed across the primary of the pulse transformer.

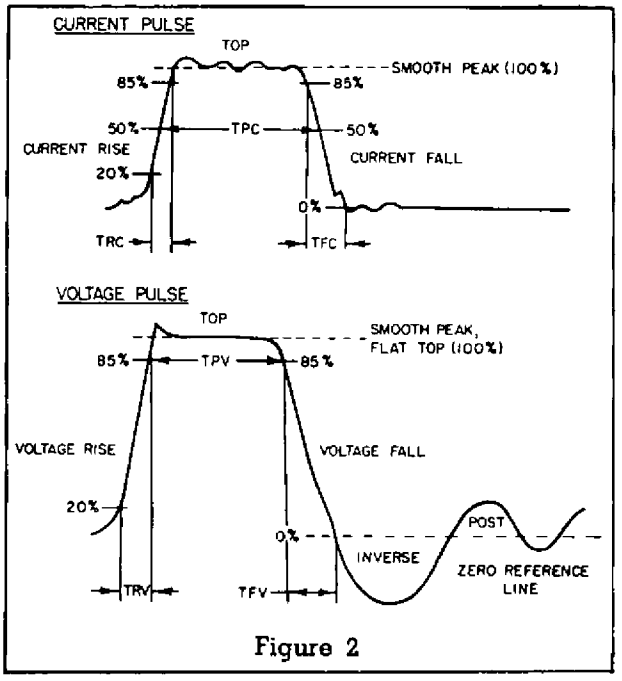


Figure 2

Optimum pulse shaping can best be achieved by treating the magnetron, pulse transformer, and pulse line as a unit; hand-tailoring the line and transformer for magnetron compatibility is recommended.

If operation at both long and short pulses is anticipated, the pulse transformer should be designed to optimize the more important pulse. For operation at pulse conditions different than above, the manufacturer should be consulted.

LOAD DIAGRAM

Fig. 3 is a load diagram for a typical RK6518/QK254 magnetron. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 2.2/1 have been plotted, but operation at ratios greater than 1.5/1 is not recommended.

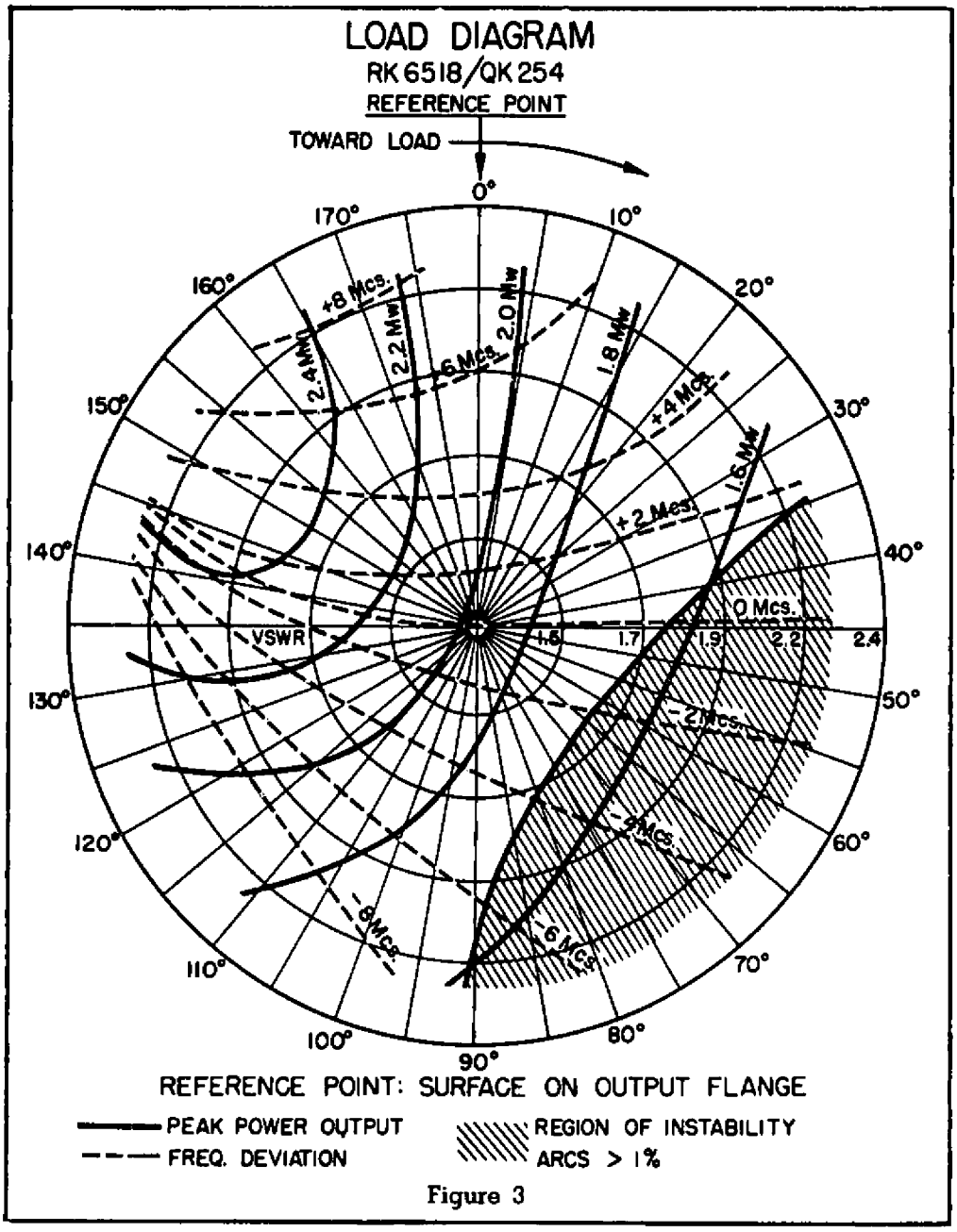


Figure 3

COOLING

The RK6518/QK254 magnetron is a forced air cooled tube. The ambient temperature will dictate the flow rate necessary to maintain anode temperature below the specified maximum (100°C). Fig. 4 is a plot of anode temperature rise above ambient as a function of total power input and rate of air flow. Fig. 5 is a plot of back pressure as a function of rate of air flow (Cfm).

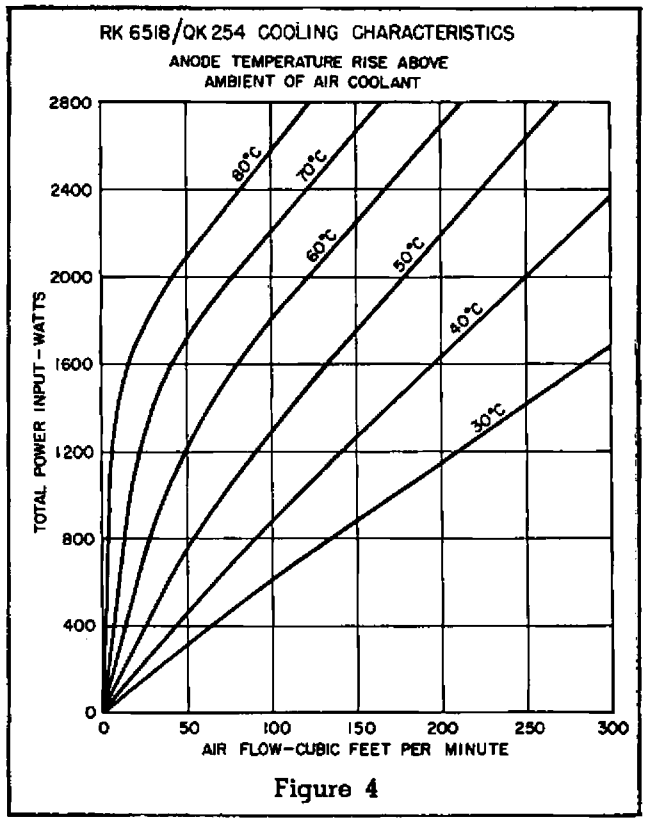


Figure 4

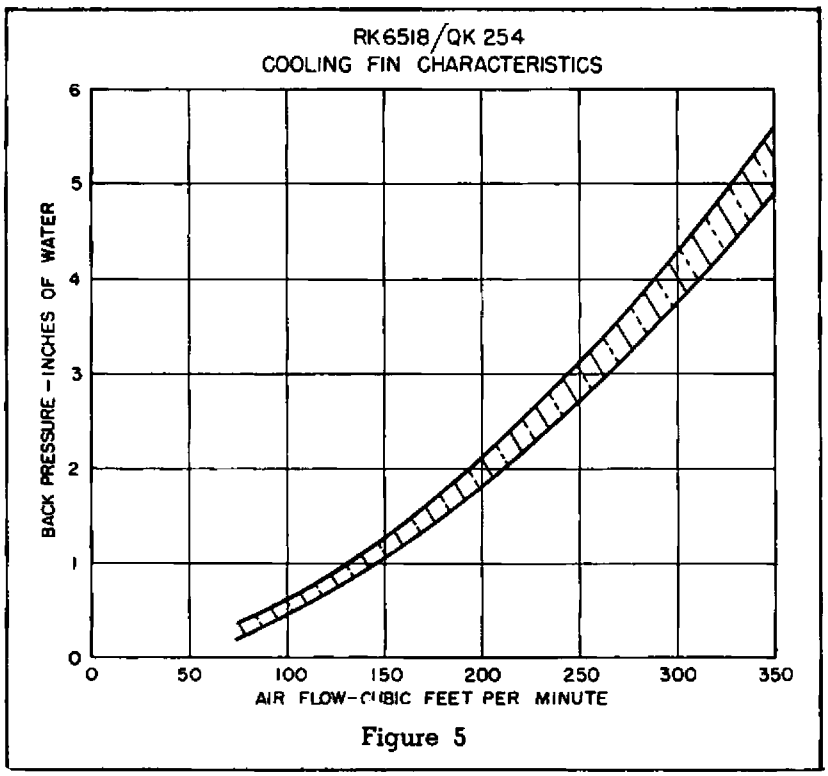


Figure 5

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long-line effects". Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case the extent to which the long-line effect is exhibited depends on the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Fig. 6 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not critical in the RK6518/QK254 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectrum caused by this phenomena. It may in some cases permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Fig. 6, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although for close control of bandwidth the VSWR should be kept as low as possible.

More detailed information on the theories and remedies of long-line effects are available upon request.

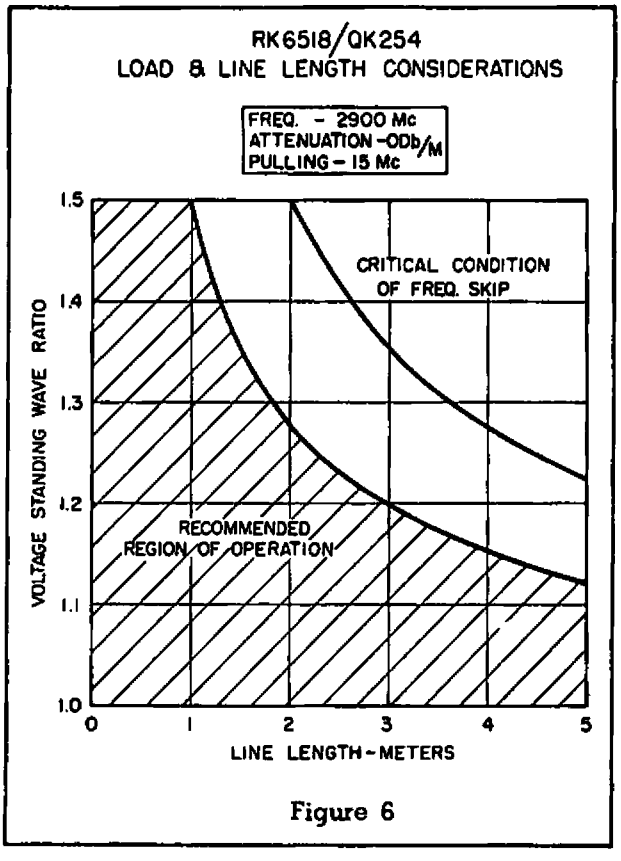


Figure 6

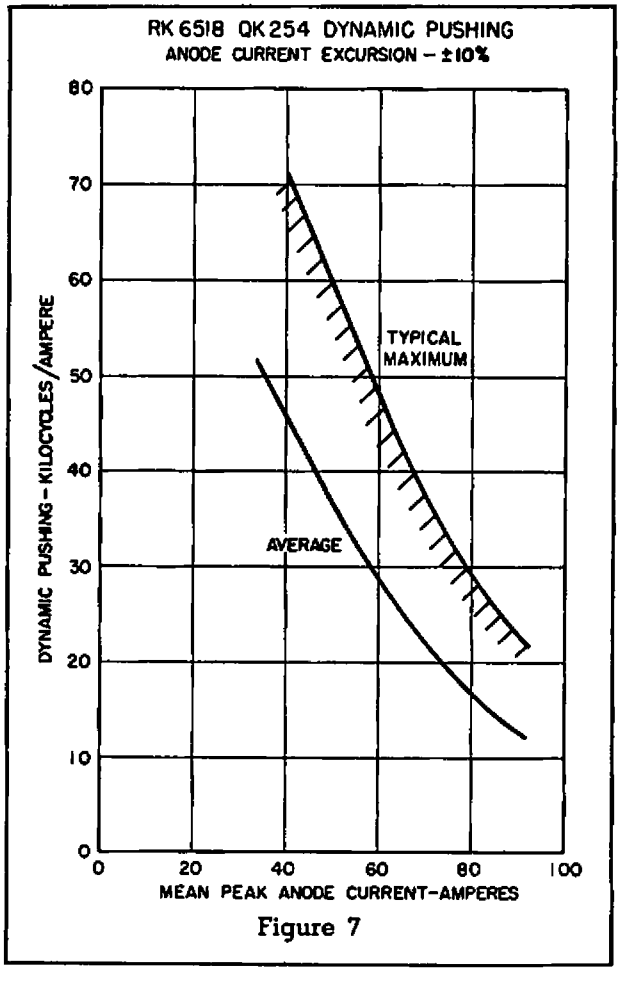


Figure 7

FREQUENCY DRIFT

After operation of the RK6518/QK254 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift.

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes.

DYNAMIC PUSHING

Fig. 7 displays the dynamic pushing characteristics of the RK6518/QK254 magnetron for anode current excursions of ±10%. Examination of the curve reveals that minimum pushing (Kc/a) occurs at rated plate current.

RF RADIATION FROM CATHODE

The RK6518/QK254 is designed to minimize radiation from the cathode bushing which will in general be negligible. It is not possible, however, to guarantee it as being negligible, and in particularly critical environments shielding of the cathode bushing may be necessary to avoid radiation difficulties.

OPERATING CHARACTERISTICS

Fig. 8 is a plot of peak power output, anode voltage and efficiency as a function of peak anode current showing the maximum and minimum deviation from the average.

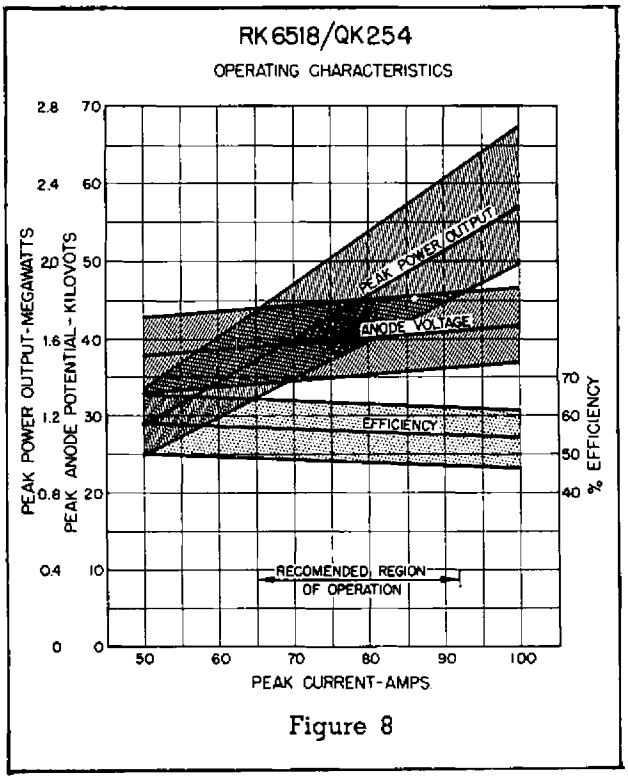


Figure 8

INSTALLATION AND HANDLING PRECAUTIONS

Although magnetrons give the appearance of great structural strength, they are in reality quite fragile and may be easily damaged in handling or installation. Damage to the magnetron will be avoided if the following installation and handling precautions are carefully observed.

1. Leave magnetron in its shipping crate until ready to be used.
2. Remove guard cover from the RF output pipe before installing tube in equipment.
3. Avoid setting up mechanical strains in R.F. output pipe or cathode bushing when handling or mounting.
4. Avoid unnecessary jarring or rough handling.
5. Do not let magnetron rest on any of its parts normally protected by the shipping crate.
6. It is essential that the bullet be properly aligned in the receptacle to avoid setting up mechanical strains in the glass to metal seal of the coaxial center conductor of the R.F. output.
7. If a magnetron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the RF output pipe or base tube insulator and wipe dry before application of high voltage.

8. Do not place tube in closer proximity to magnetic materials than is indicated on tube magnet.

MOUNTING

The tube is mounted within the equipment by four bolts passed through the clearance holes of the circular mounting plate with the longitudinal axis of the cathode high voltage bushing vertical. Small angular deviations (15 degrees) can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short-circuited.

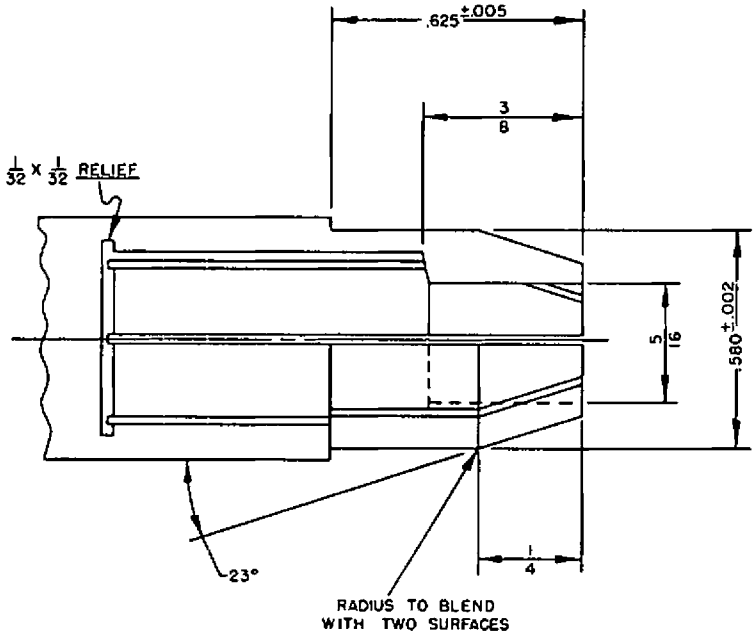
ELECTRICAL CONNECTIONS

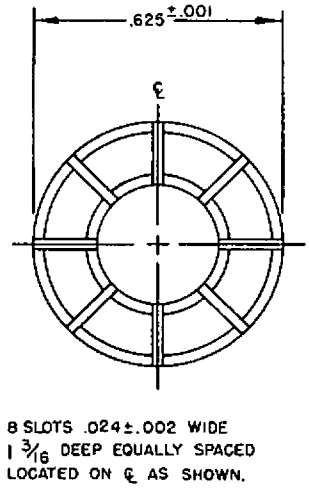
The positive high voltage should be grounded at the mounting surfaces. Heater and cathode connections are made to the terminals on the base tube insulator (see note 17 of tube outline drawing). Heater connectors should be designed to minimize contact resistance and lateral forces on the heater terminals.

CAUTION: R.F. arcing and melting of the metal to kovar seal of the center conductor of the coaxial output will result, if the bullet connector does not make positive contact and is not properly seated.

COUPLING AND PRESSURIZATION

The output pipe is designed for coupling to standard 1⅝", 50 ohm coaxial line. A coaxial to standard 1½" x 3" waveguide transition may be effected by use of a suitable doorknob coupler. Pressurization of the RF transmission system to 35 psia is required. Pressurization lower than 35 psia may result in arcing in the system. If sustained arcing in the coaxial output section occurs, failure of the metal to kovar seal of the coaxial center conductor is likely. To minimize the possibility of arcing in the RF transmission system and to achieve optimum tube performance, the VSWR should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended. See outline dwg. for mechanical details of RF output coupling.





MATING BULLET DETAIL OUTLINE DRAWING

NOTES:

1 - REF. PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FACE OF THE MOUNTING PLATE.

2 - REF. PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO PLANE "A" PASSING THRU THE CENTER OF HOLES AS SHOWN.

3 - REF. PLANE "C" IS DEFINED AS A PLANE MUTUALLY PEPENDICULAR TO PLANE "A" & "B" PASSING THRU THE CENTER OF HOLES AS SHOWN.

4 - THIS DIM. INCLUDES ANGULAR AS WELL AS LATERAL DEVIATIONS.

6 - REFERS TO THE CENTER LINE OF THE GUARD PIPE.

7 - THE CENTER LINE OF THE JACK HOLES SHALL BE WITHIN A RADIUS OF .100 OF LOCATION SPECIFEID BUT SHALL BE SPACED 1.054 $\pm$.015 WITH RESPECT TO EACH OTHER.

8 - BANANA PIN JACK .281 $\pm$.005 HOLE DIA. 25/32 MIN. DEEP.

9 - THIS SURFACE TO BE FLAT WITHIN .015.

10 - LEADS SHALL BE FLEXIBLE AND SLACK.

11 - PYREX GLASS OR EQUIVALENT.

12 - NO SHARP EDGES ON OUTSIDE DIA. AT END OF INNER CONDUCTOR.

13 - APPLIES TO STRAIGHT PORTION OF INNER CONDUCTOR WALL.

14 - APPLIES TO INNER CONDUCTOR INSERT ONLY ℄ OF INNER CONDUCTOR INSERT SHALL BE CONCENTRIC WITH ℄ OF GUARD PIPE TO WITHIN .025.

15 - ℄ OF MAX. DIA. SHALL BE CONCENTRIC WITH ℄ OF GUARD PIPE TO WITHIN .040.

17 - COMMON CATHODE CONNECTION MARKED WITH LETTER C.

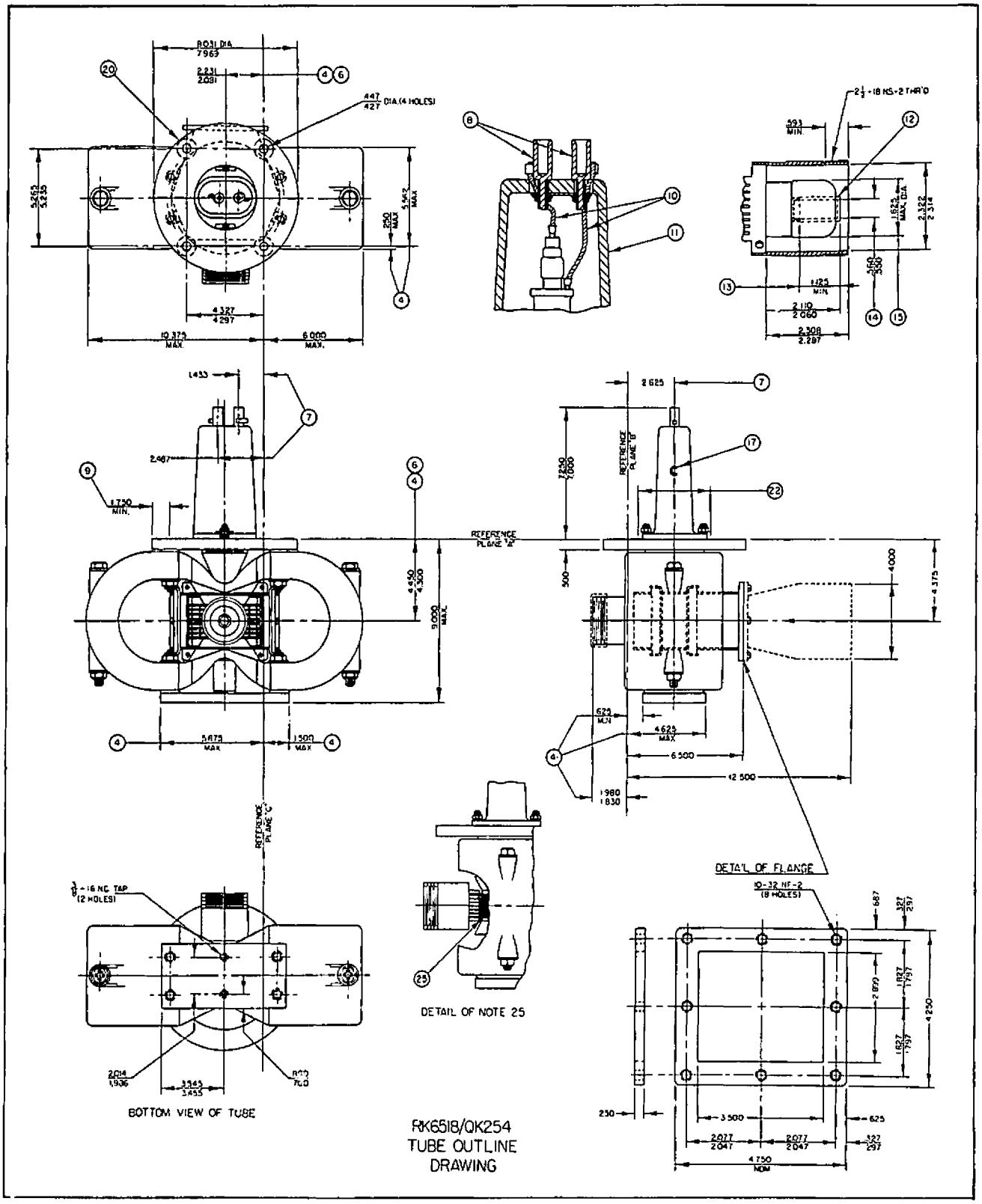
18 - ALL SOLDER JOINTS ON MOUNTING PLATE & GUARD PIPE SHALL BE SOLDERED TO PROVIDE AN HERMETIC SEAL.

19 - PAINT WITH BLACK HEAT-RESISTANT NON-CORROSIVE PAINT. THE FOLLOWING SHALL BE FREE FROM PAINT, TOP SURFACE OF MOUNTING PLATE, PARTS ABOVE MOUNTING PLATE SCREW THR'DS ON GUARD PIPE & ALL SURFACES INSIDE GUARD PIPE, BOTTOM SURFACE OF MAGNET PLATE, & EDGE OF MOUNTING PLATE.

20 - MIN. CLEARANCE BETWEEN AXIS OF PLATE HOLES & SURFACE OF MAGNET TO BE .563.

22 - ANY PORTION OF THE ASSEMBLY EXTENDING ABOVE THIS SURFACE SHALL BE WITHIN 2.125 RADIUS OF THE TRUE CENTER OF THE PLATE.

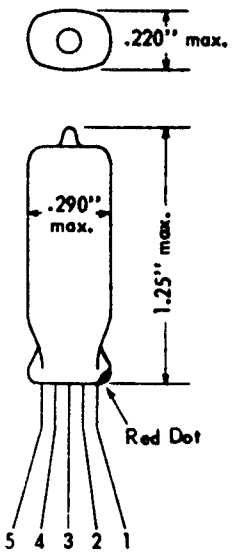
24 - FERROMAGNETIC MATERIALS SHALL NOT BE BROUGHT WITHIN 12 INCHES OF TUBE MAGNETS.



RK6518/QK254
TUBE OUTLINE
DRAWING

TYPE CK6519

The CK6519 is a filament type pentode designed for use as a power amplifier in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-1½X2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Negative ●
Lead 3 Filament, Positive ●	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	1.25±20% volts
Plate Voltage	30 volts
Grid #2 Voltage	30 volts
Cathode Current	0.6 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage	1.25 volts
Filament Current	10 ma.
Plate Voltage	22.5 volts
Grid #2 Voltage	22.5 volts
Grid #1 Voltage ■	0 volts
No-Signal Plate Current	400 μa.
No-Signal Grid #2 Current	100 μa.
Signal Voltage (RMS) ♦	0.8 volts
Transconductance	450 μmhos
Plate Resistance	0.3 meg
Load Resistance	0.1 meg.
Distortion (approx.)	12 percent
Power Output	1.50 mw.

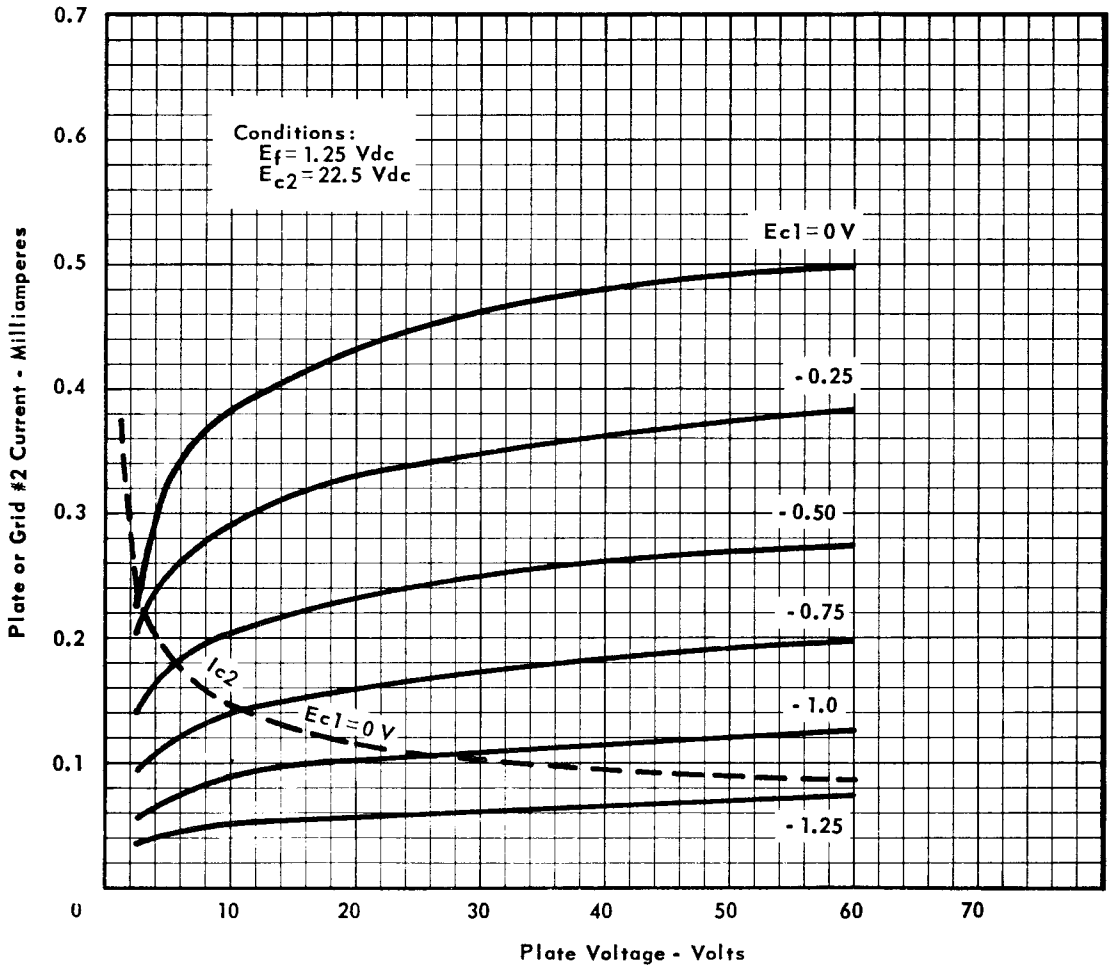
● *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

■ *Grid returned to negative filament thru 10 megohms.*

♦ *From a source having an internal impedance of 2 megohms.*

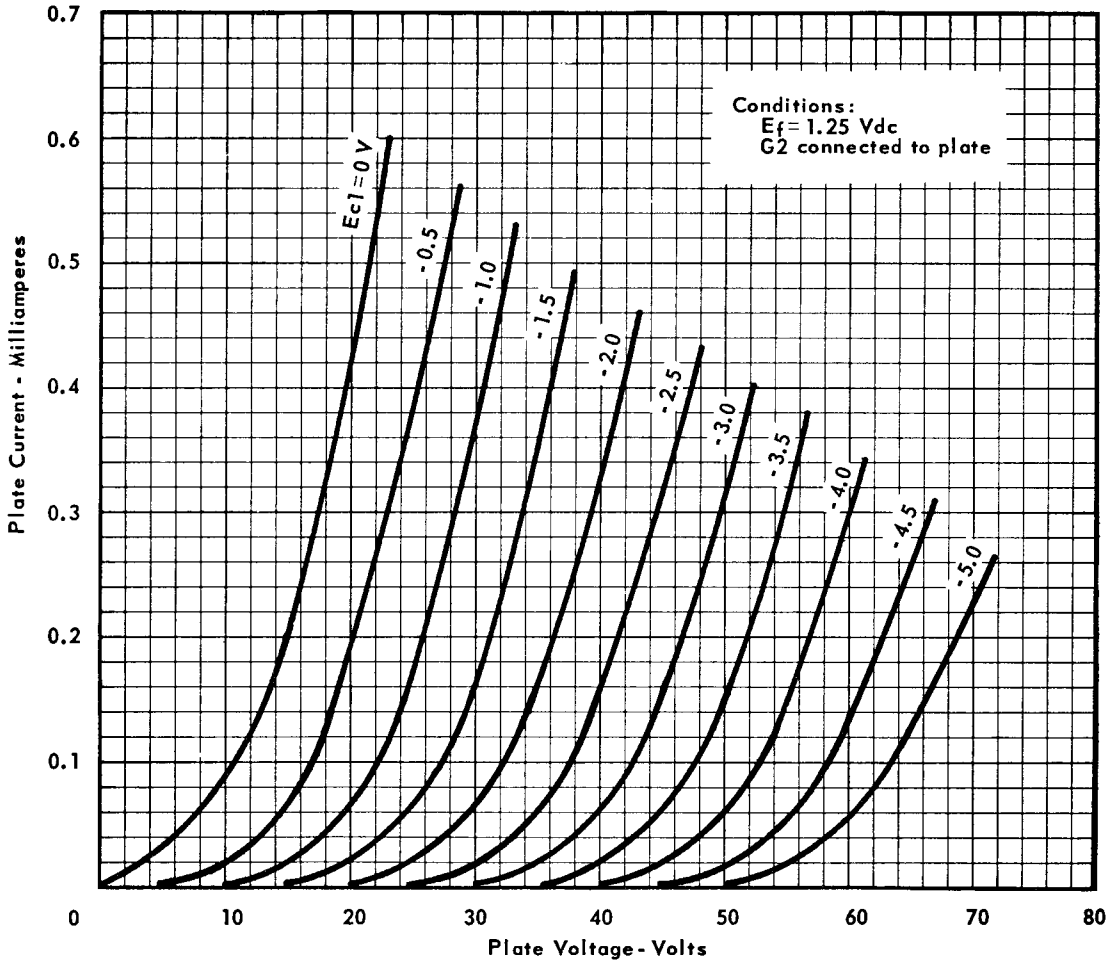
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS

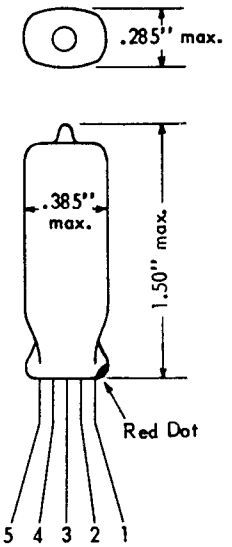
(Triode Connected)



Excellence in Electronics

TYPE CK6526

The CK6526 is a filament type pentode power amplifier of subminiature construction designed for Class A amplifier applications in intermittent duty-cycle or "push-to-talk" service in portable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1).*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive, ▲ Grid #3
Lead 3 Filament, Negative, ▲ Grid #3	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25 ± 10% volts
Plate Voltage	135 volts
Grid #2 Voltage	135 volts
Cathode Current	12 mA
Plate Dissipation	1.1 watts
Grid #2 Dissipation	0.40 watts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage	1.25 volts
Filament Current	125 mA
Plate Voltage	110 volts
Grid #2 Voltage	110 volts
Grid #1 Voltage	-6.0 volts
Zero-Signal Plate Current	6.5 mA
Grid #2 Current	1.15 mA
Transconductance	1900 μmhos
Plate Resistance (approx.)	0.140 meg.
Load Resistance	10 Kilohms
Distortion (approx.)	12 percent
Power Output	375 mW
Peak AF Signal Voltage	6.0 volts

▲ *Grid #3 is comprised of two separate deflector plates, one of which is connect to lead 3 and the other to lead 5.*

Printed in U.S.A.

Tentative Data

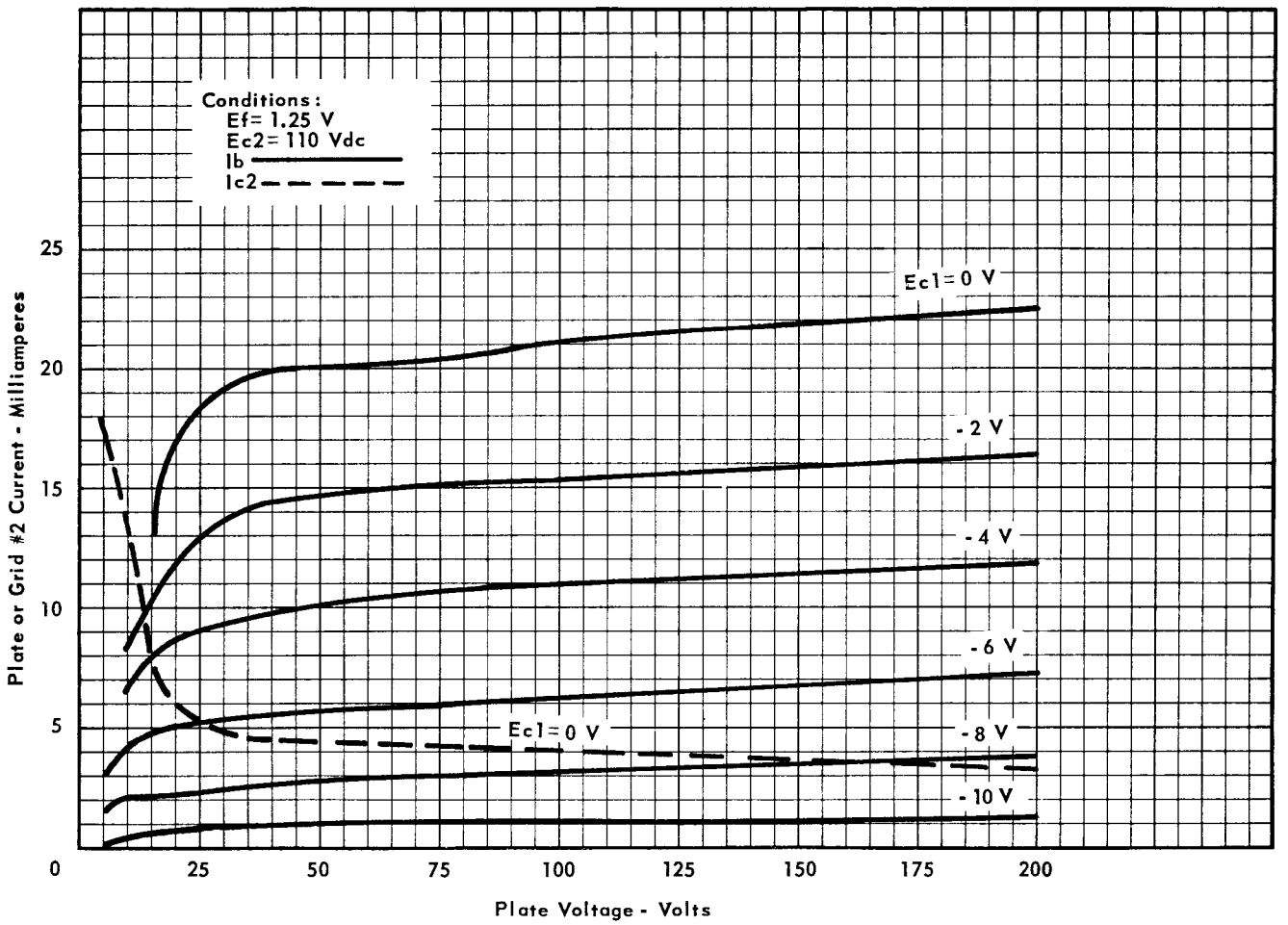
RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

February 15, 1957 NEWTON 58, MASS.

SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



RAYTHEON

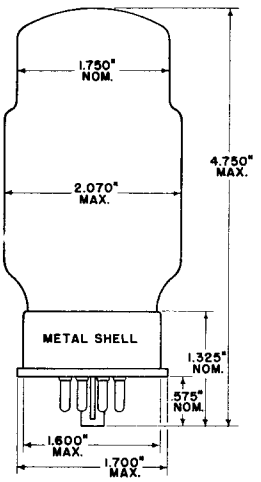
TECHNICAL INFORMATION

TWIN POWER TRIODE

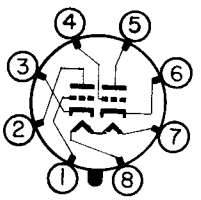
Excellence in Electronics

TYPE CK6528

The Raytheon CK6528 is a medium MU twin power triode used especially in series regulated power supplies. It is mechanically rugged and is designed for long life operation. In operation it is able to handle large currents over a wide voltage range. The anodes are zirconium coated graphite supported by ceramic insulators. The use of large cathodes provide more than sufficient emission current. The grid wires are gold plated molybdenum and the mount is set on a rugged button stem supported by flexible metal vibration snubbers. The use of these elements and the hard glass envelope makes it possible to degas the tube at high temperatures during processing enabling the tube to be used at high temperatures without the fear of harmful gases which may be given off by tube elements. The Raytheon CK6528 can in some circuits replace 2 or 3 type CK6080WA or 3 or 4 beam power tubes. Many CK6528 tubes can be paralleled as desired for increased levels of current or power.



(BOTTOM VIEW)



MECHANICAL DATA

ENVELOPE: ST-16-Nonex

BASE: Large wafer octal with metal sleeve, 8-Pin, JEDEC #B8-86

TERMINAL CONNECTIONS:

Pin 1 Grid, Unit #2	Pin 5 Plate, Unit #1
Pin 2 Plate, Unit #2	Pin 6 Cathode, Unit #1
Pin 3 Cathode Unit #2	Pin 7 Heater
Pin 4 Grid, Unit #1	Pin 8 Heater

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 2)	720 G
Maximum Bulb Temperature	250 °C

MOUNTING POSITION: Any (Note 5)

ELECTRICAL DATA

CAUTION----- To Electron Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy maybe reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both Reliability and Performance will be jeopardized if filament voltage ratings are exceeded. Life and Reliability of Performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 4)	NORMAL OPERATION (Note 3)	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Heater Voltage: (Note 7)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage:	Eb:	----	100	100	400	Vdc
Grid Voltage:	Ec1:	-300	-4.0	-4.0	----	Vdc
Heater Cathode Voltage:	Ehk:	-300	----	----	+300	Vdc
Cathode Resistance (Percathode):	Rk/k:	(Note 6)	0	0	----	Ohms
Plate Dissipation (Per Plate):	Pp/p:	----	----	----	30	Watts
Grid Resistance (Total):	Rg:	500	500 Min.	----	500,000	Ohms
Resistance Per Grid Leg When Triode Sections Are Paralleled:	Rg/g:	500	----	----	----	Ohms
Transconductance (Per Plate):	Sm/p:	----	----	37,000	----	μmhos
Amplification Factor:	Mu/p:	----	----	9.0	----	----
Plate Current (Per Plate):	Ib/p:	----	----	----	300	mAdc
Cathode-Conditioning Time:	TK:	(Note 13)	----	----	----	Sec.

Tentative Data

Printed in U.S.A.

INDUSTRIAL COMPONENTS DIVISION

55 CHAPEL ST., NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL (Note 1)

In the following tests each unit is tested separately.

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1		**Combined AQL = 1.0% excluding Mechanical and Inoperatives**								
Heater Cathode Leakage:	Ehk=+300	0.65	Ihk:	----	----	----	----	40	----	μAdc
	Ehk=–300 (Note 11)	0.65	Ihk:	----	----	----	----	40	----	μAdc
Grid Current (1):	Rg/g=50 K (Note 8)	0.65	Ic1:	----	----	----	----	–2.0	----	μAdc
Plate Current (1):	(Note 8)	0.65	Ib1:	140	----	185	----	230	----	mAdc
Emission:	Eb=10 Vdc; Ec=10 Vdc (Note 10)	0.65	Is:	150	----	----	----	----	----	mAdc
Plate Current (1):	Eb=400 Vdc; Ec=–75 Vdc; Rk=0 (Note 3)	0.65	Δ Ib (1):	0	----	----	----	3.0	----	mAdc
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope ST–16–Nonex	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Insulation of Electrodes:		6.5	Rg-all:	10	----	----	----	----	----	Meg.
			Rp-all:	10	----	----	----	----	----	Meg.
Transconductance (1):	(Note 8)	6.5	Sm (1):	29000	----	37000	----	45000	----	μmhos
Plate Current (2):	Eb=60 Vdc; Ec=0; (Note 8)	6.5	Ib (2):	135	----	----	----	----	----	mAdc
Transconductance (2):	Ef=5.7 V; (Note 8 & 9)	6.5	Δ_{Ef} Sm (2):	----	----	----	----	15	----	%
Amplification Factor:	(Note 8)	6.5	Mu:	7.0	----	9.0	----	11.0	----	----
Vibration (1):	F=10–50–10 cps; G=2.5; Ebb=190 Vdc; Ec/Ib=75 mAdc; Rp=2000 ohms; Per MIL-E-1 ref. par. 4.9.20.3	6.5	Ep:	----	----	----	----	500	----	mVac
Heater Current:	Ef=6.3 V	6.5	If:	4.75	----	5.0	----	5.25	----	A
DEGRADATION RATE ACCEPTANCE TESTS										
Shock:	Ef=6.3 V; Hammer Angle=48°; 720G–1 Msec; (Note 2)	----	----	----	----	----	----	----	----	----
Post Shock End Points:										
Heater Cathode Leakage:	Ehk=+300 Vdc	Note 11	Ihk:	----	----	----	----	100	----	μAdc
	Ehk=–300 Vdc Units Connected in Parallel		Ihk:	----	----	----	----	100	----	μAdc
Grid Current (1):	Note 8	----	Ic:	----	----	----	----	–8	----	μAdc
Plate Current (1):	Note 8	----	Ib (1):	130	----	----	----	----	----	mAdc
Transconductance (1) per Section:	Note 8	----	Gm (1):	23000	----	----	----	----	----	μmhos

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY TESTS (Note 1)
In the following test each unit is tested separately

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNIT
ACCEPTANCE LIFE TESTS						
1000 Hours Intermittent Life Test:	Ef = 6.3 V; Eb = 100 Vdc; Ec = −4 Vdc; Ehk = 300 V; Rg/g = 500,000 ohms Rk/k = 0 ohms; T Bulb = 250 °C ± 25° C Note 12	----	----	----	----	----
1000 Hour Intermittent Life Test End Points:	(Typical sample size = 5 tubes)	----	----	----	----	----
Inoperatives:		----	----	----	----	----
Plate Current (1):	Note 8	----	Ib:	130	----	mAdc
Grid Current (1):	Note 8	----	Ic1:	0	−8	μAdc
Transconductance (1):	Note 8	----	Sm:	23000	----	μmhos
Heater Cathode Leakage:	Ehk = + 300 Vdc Ehk = −300 Vdc Note 11	----	Ihk: Ihk:	---- ----	100 100	μAdc μAdc

NOTES:

Note 1: Characteristic, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes", and MIL-STD-105A.

Note 2: Test Conditions and Acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 3: These normal values represent conditions at which control of reliability may be expected.

Note 4: These normal test conditions are used for all characteristics unless otherwise stated under the individual test item.

Note 5: If the tube is to be mounted in a horizontal position it is recommended that it be mounted so that the base lug key be either directly up or directly down.

Note 6: Minimum cathode resistance per cathode leg shall be 10 ohms or that resistance necessary to provide 10 percent of the grid bias voltage, whichever is greater.

Note 7: For most applications the performance will not be adversely affected by ± 10 % heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 8: Voltages are applied to both sections, but each section is tested separately. Values specified herein are for individual sections, except for heater current. Readings shall be taken after the tube has been preheated for at least 2 minutes under conditions EF = 6.3 V, Ebb = 190 V, Ec = 0, Rk = 200 ohms.

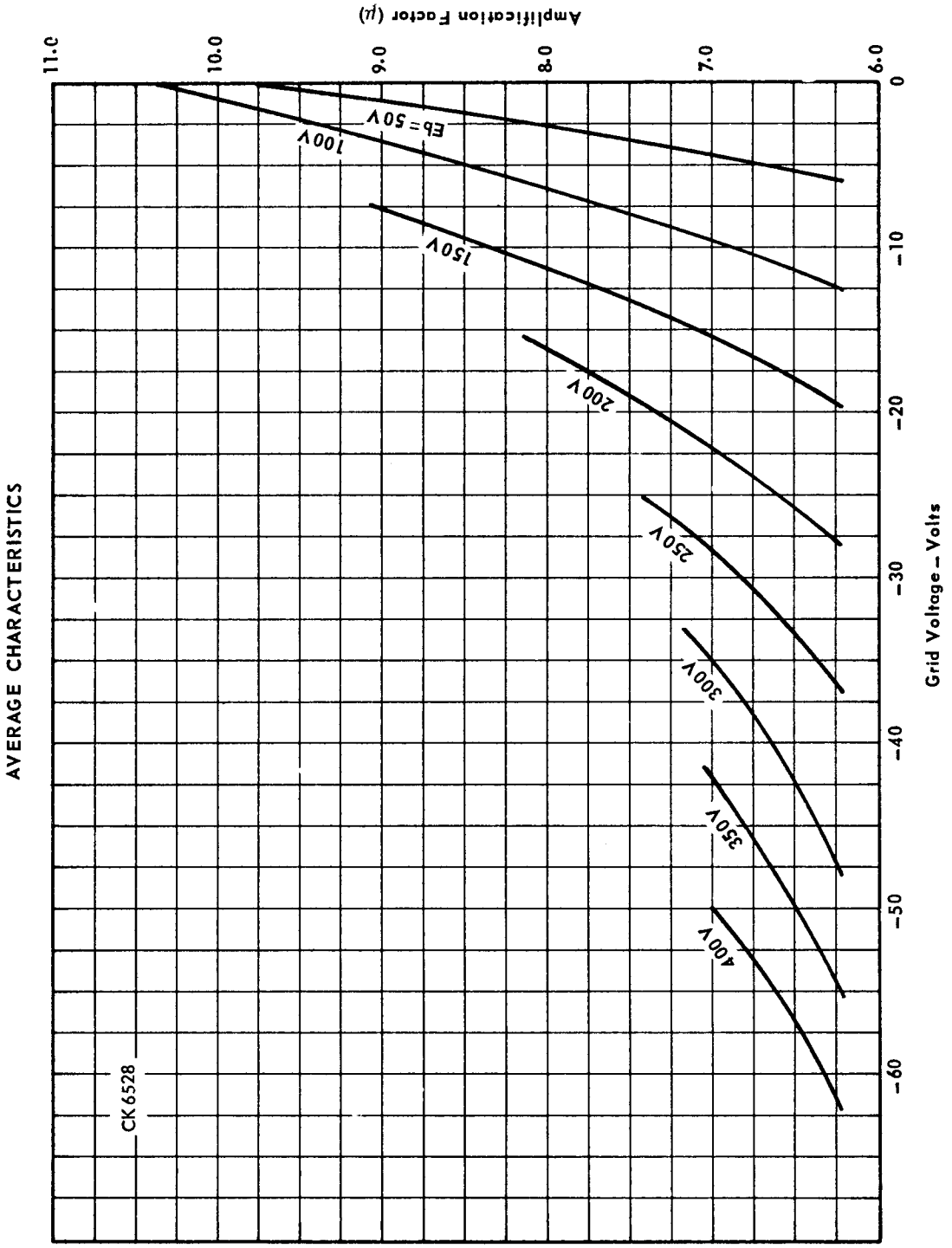
Note 9: Change of transconductance for individual tubes from that value measured at Ef = 6.3 volts to that value measured at Ef = 5.7 volts.

Note 10: Each unit shall be read separately. Unit not under test shall be grounded.

Note 11: IK shall be tied to 2K.

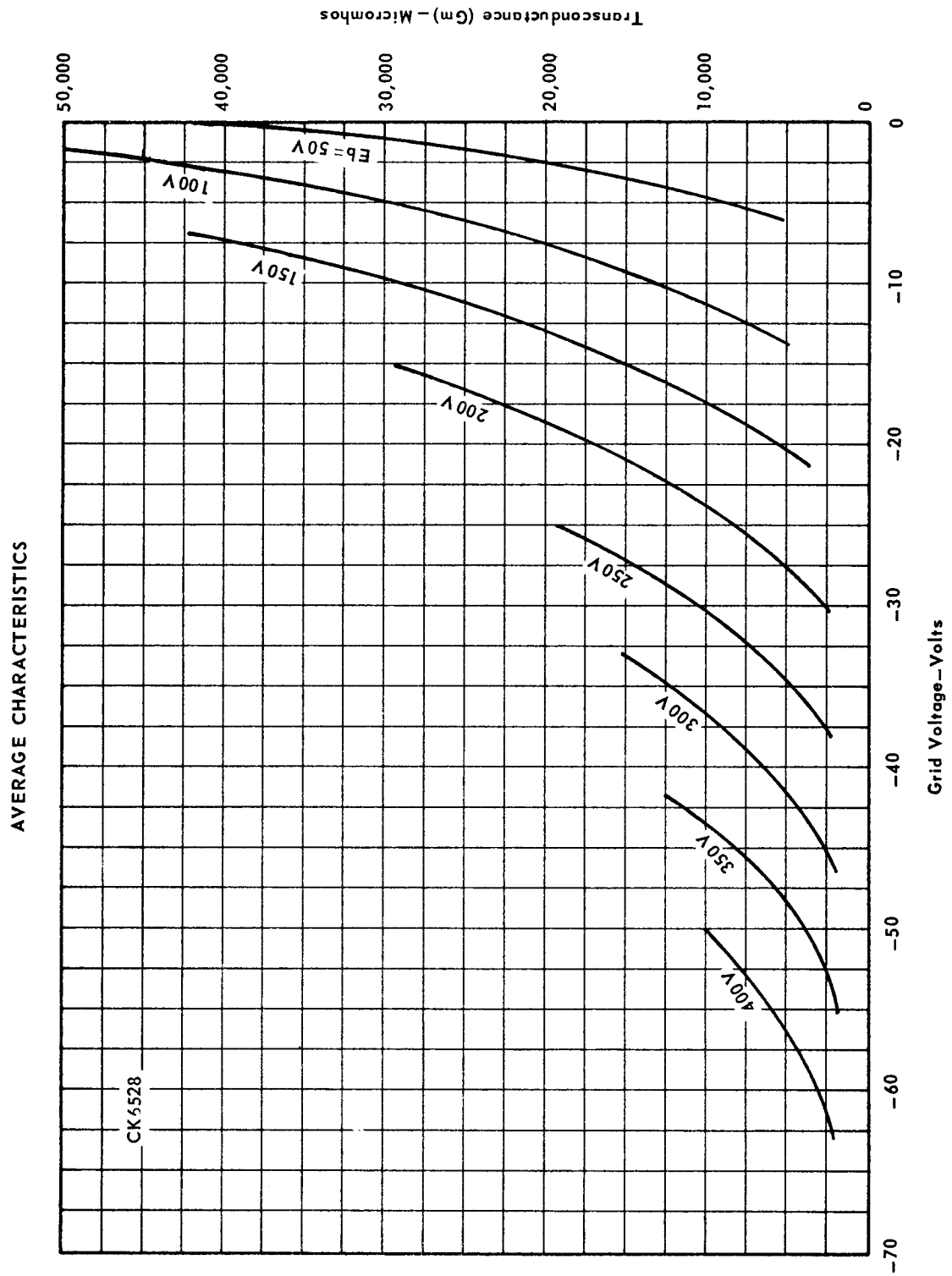
Note 12: The tube shall be cycled 30 seconds heater positive and 30 seconds heater negative.

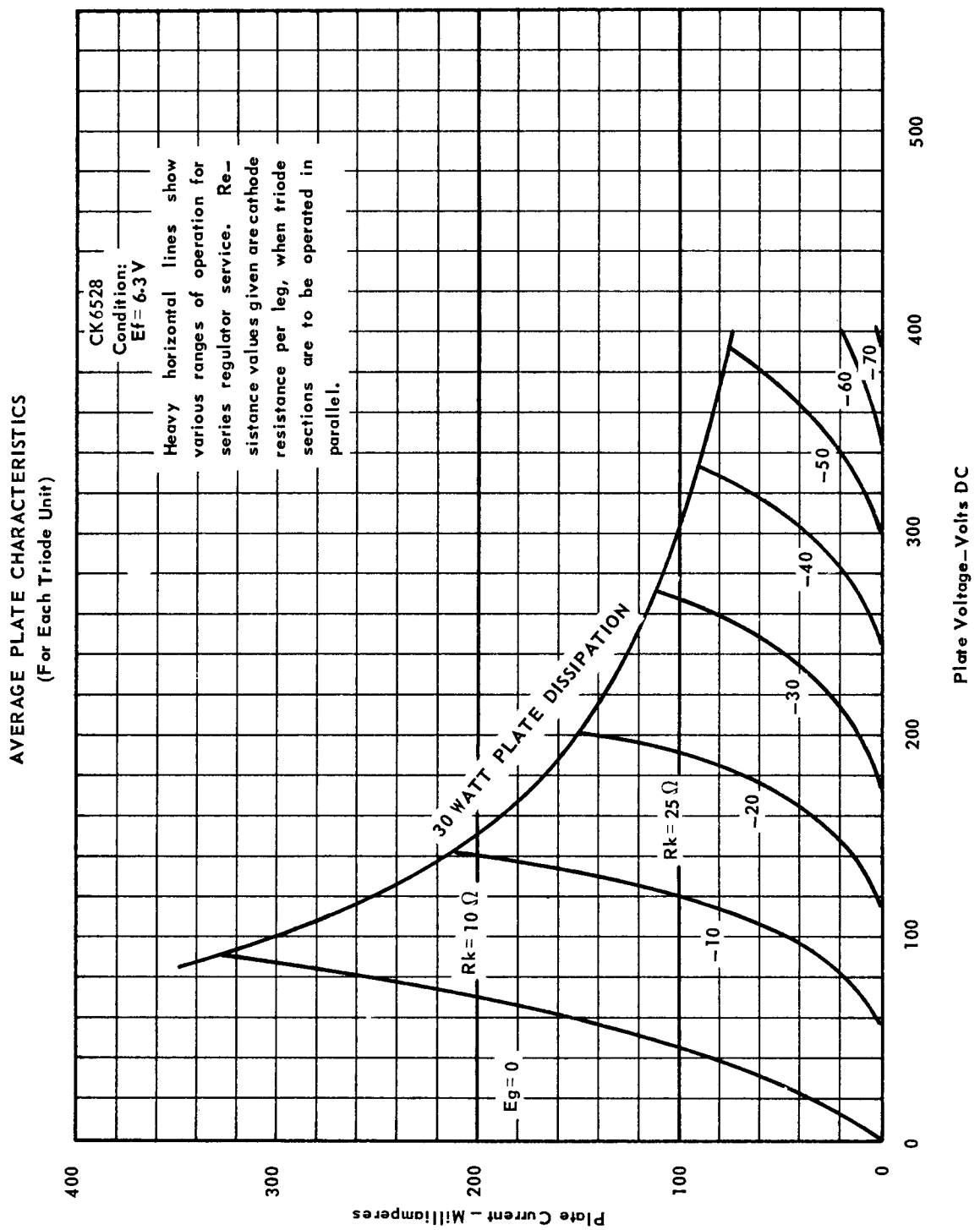
Note 13: TK = 30 seconds minimum. This is especially necessary in regulator circuits where the plate of the amplifier tube ties back to the plate side of the passing tube. In such a circuit, during warmup, the grid bias may swing highly positive causing the cathode to lose its ability to sustain current.


Amplification Factor (μ)
11.0
10.0
9.0
8.0
7.0
6.0
0
-10
-20
-30
-40
-50
-60
Grid Voltage - Volts
AVERAGE CHARACTERISTICS
CK6528
Eb = 50V
100V
150V
200V
250V
300V
350V
400V

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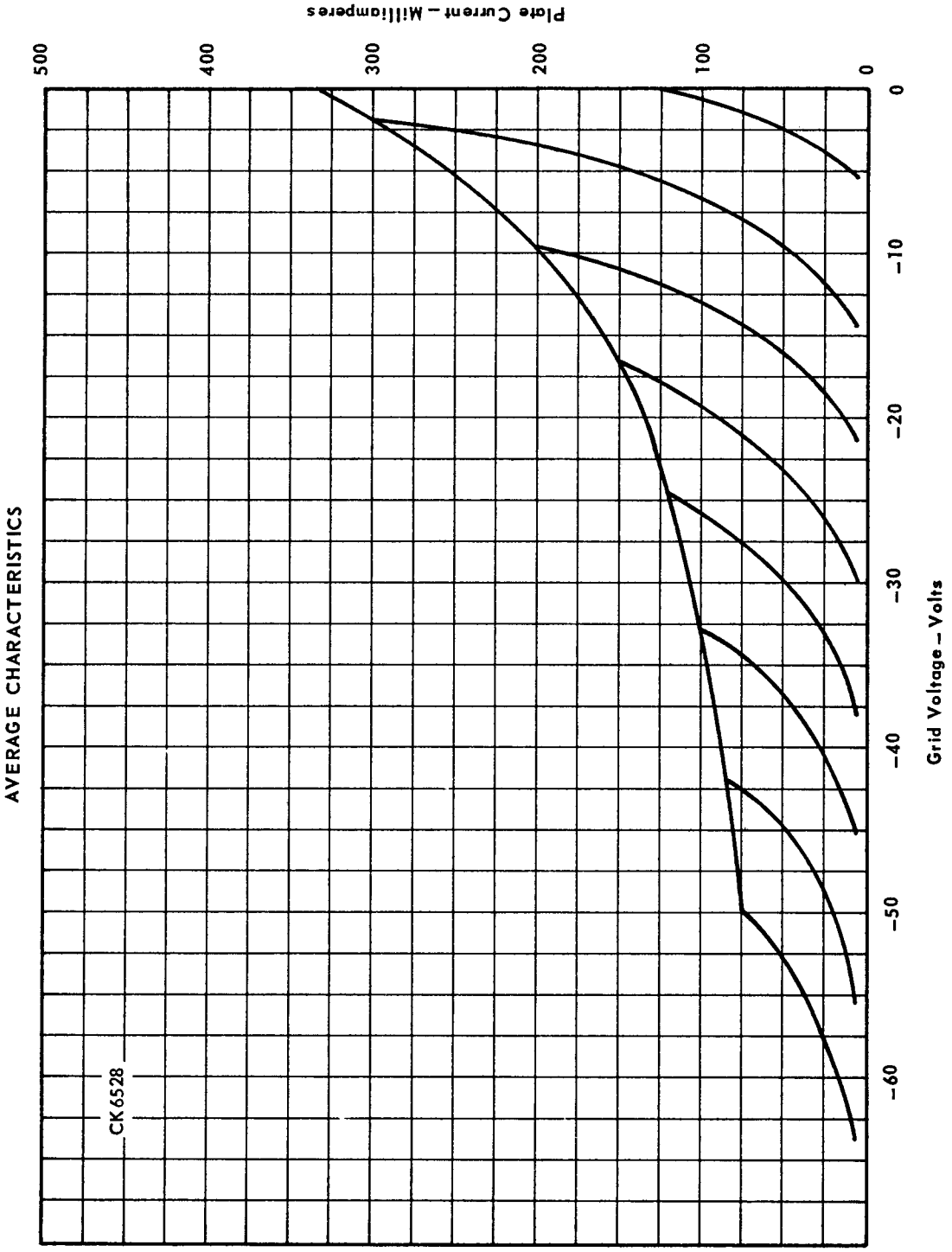
TWIN POWER TRIODE



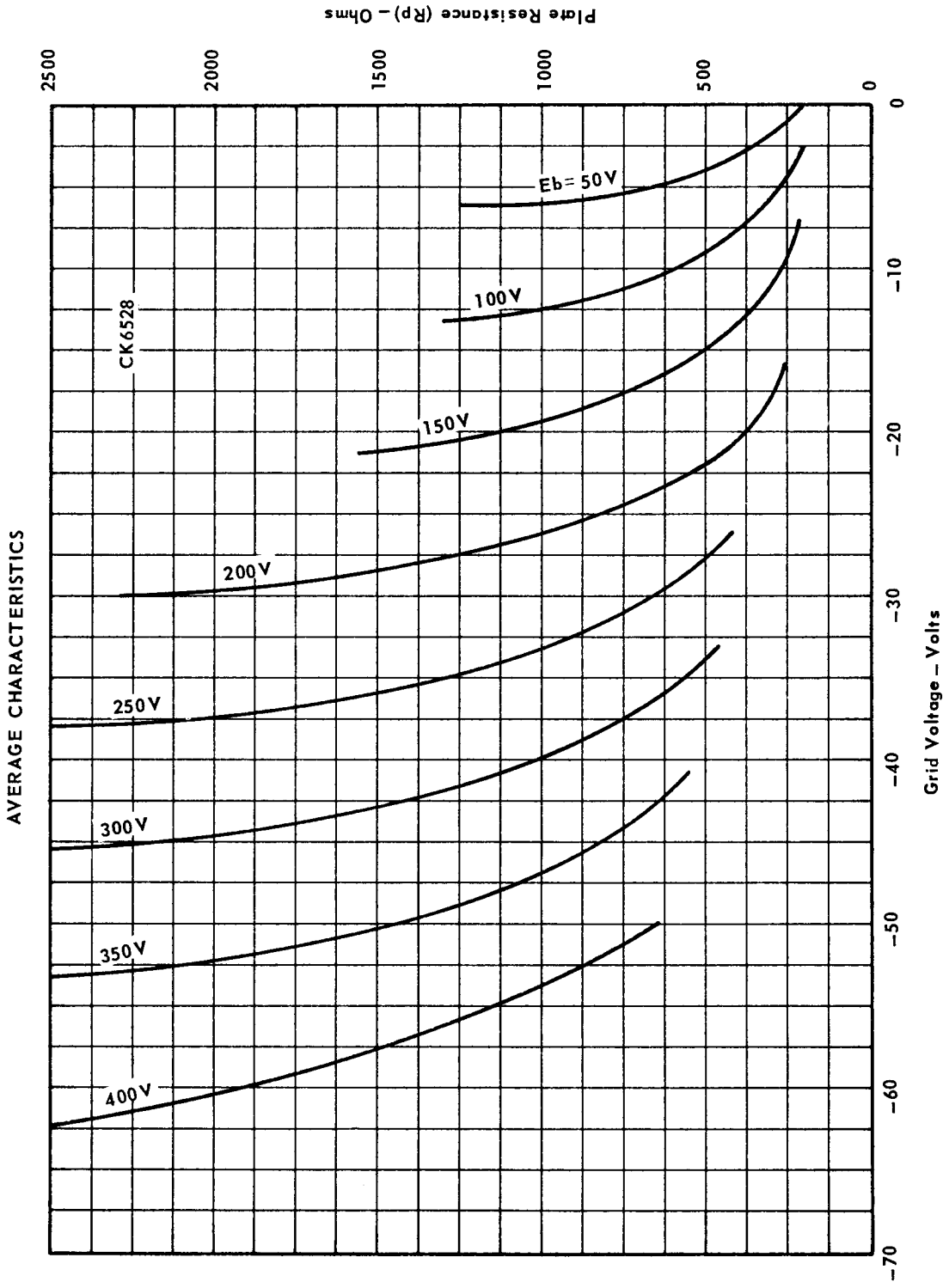

AVERAGE PLATE CHARACTERISTICS
(For Each Triode Unit)
CK6528
Condition:
Ef = 6.3 V
Heavy horizontal lines show various ranges of operation for series regulator service. Resistance values given are cathode resistance per leg, when triode sections are to be operated in parallel.
30 WATT PLATE DISSIPATION
Rk = 10 Ω
Rk = 25 Ω
Eg = 0
-10
-20
-30
-40
-50
-60
-70
Plate Current – Milliamperes
400
300
200
100
0
Plate Voltage–Volts DC
0
100
200
300
400
500

RAYTHEON

TWIN POWER TRIODE



Printed in U.S.A.


Plate Resistance (Rp) – Ohms
2500
2000
1500
1000
500
0
AVERAGE CHARACTERISTICS
CK6528
Eb = 50V
100V
150V
200V
250V
300V
350V
400V
0
-10
-20
-30
-40
-50
-60
-70
Grid Voltage – Volts

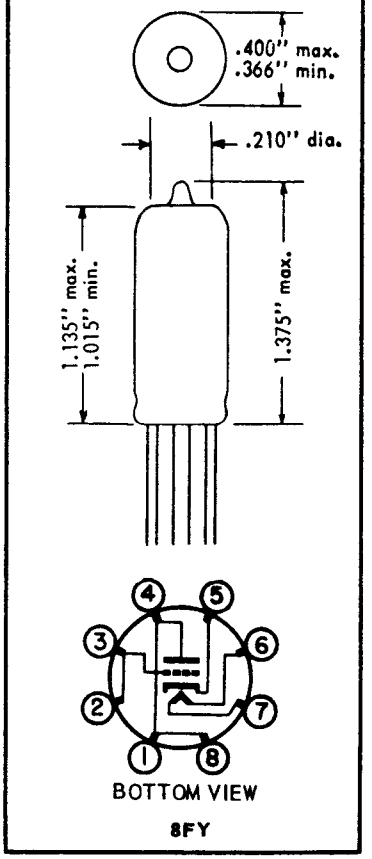
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TECHNICAL INFORMATION

RELIABLE SUBMINIATURE TRIODE

Excellence in Electronics

TYPE CK6533WA



The CK6533WA is a heater-cathode type high-mu triode of subminiature construction designed for applications where freedom from microphonic response is of primary importance. The mechanical design is such that microphonic output due to structural resonances is reduced throughout the audio frequency range by approximately 20 db as compared to more conventional triodes. The maximum equivalent grid noise voltage with applied vibrational acceleration of 15 G at 40 cps is 85 μVac. It is particularly useful in voltage amplifier circuits where its low microphonic noise and vibration output are essential for specialized military electronic equipment. It is intended for service where extreme conditions of mechanical shock or vibration are encountered. The CK6533WA is similar to the type CK6247WA but is improved for microphonics. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Subminiature Button 8–Pin (0.017" tinned flexible leads. Length: 1.5" min.)

TERMINAL CONNECTIONS:

Lead 1 Plate	Lead 5 Cathode
Lead 2 Grid	Lead 6 Heater
Lead 3 Grid	Lead 7 Heater
Lead 4 Plate	Lead 8 Plate

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	450 G
Maximum Uniform Acceleration (Centrifuge Test-Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test-Note 5)	2.5 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 7)	NORMAL OPERATION (Note 6)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 8)	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	----	120	120	150	Vdc
Grid #1 Voltage	Ec1	–55	0	0	0	Vdc
Plate Dissipation	Pp:	----	----	0.11	0.5	W
Heater-Cathode Voltage	Ehk:	–200	----	100	+200	v
Plate Current	Ib:	----	----	0.9	2.5	mAdc
Cathode Resistance	Rk:	----	1500	1500	----	ohms
Grid Circuit Resistance	Rg:	----	----	----	1.2	Meg.
Transconductance (1):	Sm(1):	----	----	1750	----	μmhos
Amplification Factor	Mu:	----	----	54	----	----

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

October 15, 1957 NEWTON 58, MASS.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOGIE	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1						Combined AQL = 1.0% excluding Mechanical and Inoperatives				
Heater Current		0.65	If:	190	----	200	----	210	----	mA
Heater-Cathode Leakage:	Ehk = +100 Vdc	0.65	Ihk:	----	----	----	----	5	----	μAdc
	Ehk = −100 Vdc		Ihk:	----	----	----	----	5	----	μAdc
Grid Current		0.65	Ic(1):	----	----	----	----	−0.1	----	μAdc
Plate Current (1):		0.65	Ib(1):	0.6	----	0.9	----	1.25	----	mAdc
Plate Current (2):	Ec1 = −3.5 Vdc	0.65	Ib(2):	----	----	----	----	50	----	μAdc
Transconductance (1):		0.65	Sm(1):	1400	1575	1750	1925	2100	360	μmhos
Continuity and Shorts (Inoperatives):		0.4	----	----	----	----	----	----	----	----
Mechanical:	Envelope (8–1) (Note 10)	----	----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS PART 2										
Insulation of Electrodes:	Ef = 6.3 V Eg − all = −100 Vdc Ep − all = −300 Vdc	2.5	Rg1-all: Rp-all:	100 100	---- ----	---- ----	---- ----	---- ----	---- ----	Meg. Meg.
Plate Current (3):	Ec1 = −2.0 Vdc	2.5	Ib(3):	5	----	----	----	----	----	μAdc
Transconductance (2):	Ef = 5.7 V (Note 9)	2.5	Δ_{Ef}Sm(2):	----	----	----	----	7.5	----	%
Grid Emission:	Ef = 7.5 V; Rg = 1.0 Meg. Preheat 5 minutes at Ec1 = 0; Test at Ec1 = −3.5 Vdc.	6.5	Ic(2):	----	----	----	----	−0.3	----	μAdc
AF Noise:	Esig = 35 mVac; Rg = 1.0 Meg.; Rp = 0.2 Meg.	2.5	EB:	----	----	----	----	17	----	VU
Amplification Factor:		6.5	Mu:	48	----	54	----	60	----	----
Capacitance:			Cgp:	1.2	----	1.6	----	2.0	----	μμf
Capacitance:	Note 2	6.5	Cin:	1.3	----	1.75	----	2.2	----	μμf
Capacitance:			Cout:	0.4	----	0.6	----	0.8	----	μμf
Low Pressure Voltage Breakdown:	Pressure = 55 ± 5 mm Hg; Voltage = 300 Vac	6.5	----	----	----	----	----	----	----	----
Operation Time:	(Note 11)	4.0	t:	----	----	----	----	20	----	sec.
Vibration (2):	Rp = 10,000 ohms; F = 40 cps; G = 15	2.5	Ep:	----	----	----	----	1.0	----	mVac
Vibration (3):	Rp = 10,000 ohms; F = 30 – 1000 cps; G = 15; position X_1 and X_2 only.	4.0	ep:	----	----	----	----	15 peak to peak	----	mv
DEGRADATION RATE ACCEPTANCE TESTS										
Subminiature Lead Fatigue:		2.5	----	4.0	----	----	----	----	----	arcs
Shock (1):	Hammer Angle = 30°; Ehk = +100 Vdc; Rg = 0.1 Meg. (Note 3)	20	----	----	----	----	----	----	----	----
Fatigue (1):	96 Hours; G = 2.5; Fixed frequency; F = 25 min., 60 max. (Note 5)	6.5	----	----	----	----	----	----	----	----
Fatigue (2):	6 Hours; G = 10; Fixed frequency; F = 25 min., 60 max. (Note 12)	6.5	----	----	----	----	----	----	----	----
Post Shock (1) and Fatigue Tests (1) and (2) End Points:										
Vibration (2):	F = 40 cps; G = 15; Rp = 10,000 ohms	----	Ep:	----	----	----	----	3.0	----	mVac

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	10	%		
Grid Current:		----	Ic:	----	-1.0	μAdc		
Shock (2):	G=75; (Hammer Angle=120°+rubber pad); t=10 milliseconds; Ehk=+100 Vdc; Rg=0.1 Meg. (Note 13)	20	----	----	----	----		
Post Shock (2) Test End Points:								
Vibration (2):	F=40 cps; G=15; Rp=10,000 ohms	----	Ep:	----	3.0	mVac		
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	10	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	10	μAdc		
Change in Transconductance (1) of individual tubes:	Ef=6.3 V	----	Δ_tSm (1):	----	10	%		
Grid Current:		----	Ic:	----	-1.0	μAdc		
Glass Strain (Thermal Shock):		6.5	----	----	----	----		
ACCEPTANCE LIFE TESTS								
Heater Cycling:	Ef=7.5 V; Eb=Ec1=0 V; Ehk=140 Vac; 1 min. on, 1 min. off	1.0	----	2000	----	cycles		
Heater Cycling Life Test End Points:								
Heater-Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	20	μAdc		
	Ehk=-100 Vdc	----	Ihk:	----	20	μAdc		
1 Hour Stability Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.; Eb=150 Vdc; Rk=680 ohms	----	----	----	----	----		
1 Hour Stability Life Test End Points:	(Typical sample size=50 tubes)	1.0	----	----	----	----		
Change in transconductance (1) of individual tubes:		----	Δ_tSm (1):	----	10	%		
100 Hour Survival Rate Life Test:	TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg.; Eb=150 Vdc; Rk=680 ohms	----	----	----	----	----		
100 Hour Survival Rate Life Test End Points:	(Typical sample size=200 tubes)							
Inoperatives:		0.65	----	----	----	----		
Transconductance (1):		1.0	Sm (1):	1200	----	μmhos		
Intermittent High Temperature Life Test:	T Bulb=220°C; Ehk=+200 Vdc; Rg1=1.0 Meg.; Eb=150 Vdc; Rk=680 ohms	----	----	----	----	----		
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----		
Inoperatives:		----	----	----	----	----	1	3
Grid Current (1):		----	Ic(1):	----	-0.5	μAdc	1	3
Heater Current:		----	If:	180	220	mA	1	3

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS (cont'd)								
Change in transconductance (1) of individual tubes:		----	Δ_t Sm(1):	----	20	%	1	3
Transconductance (2):	(Note 9)	----	Δ_{Ef} Sm(2):	----	15	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	10 10	μAdc μAdc	2	5
Insulation of Electrodes:								
g1−all		----	Rg1−all:	50	----	Meg.	2	5
p−all		----	Rp−all:	50	----	Meg.		
Transconductance (1) Average Change:		----	Avg Δ_t Sm(1):	----	15	%	---	---
Total Defectives:		----	----	----	----	----	4	8
1000 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample)	----	----	----	----	----	---	---
Inoperatives:		----	----	----	----	----	2	5
Grid Current (1):		----	Ic(1):	----	−1.0	μAdc	2	5
Heater Current:		----	If:	177	223	mA	2	5
Change in transconductance (1) of individual tubes:		----	Δ_t Sm(1):	----	30	%	2	5
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc	---- ----	Ihk: Ihk:	---- ----	15 15	μAdc μAdc	2	5
Total Defectives:		----	----	----	----	----	5	10

NOTES

Note 1: Characteristics, Quality Control Test Procedures and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Without shield.

Note 3: Test conditions and acceptance criteria per Shock Test procedures of MIL-E-1 basic specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 8: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3V to that value measured at Ef=5.7V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet these Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by paragraph 5.3.8 of "Inspection Instructions for Electron Tubes."

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the 3 minute plate current (1) value. No preheating before this test will be allowed.

ELECTRICAL DATA (Cont'd.)

NOTES (cont'd)

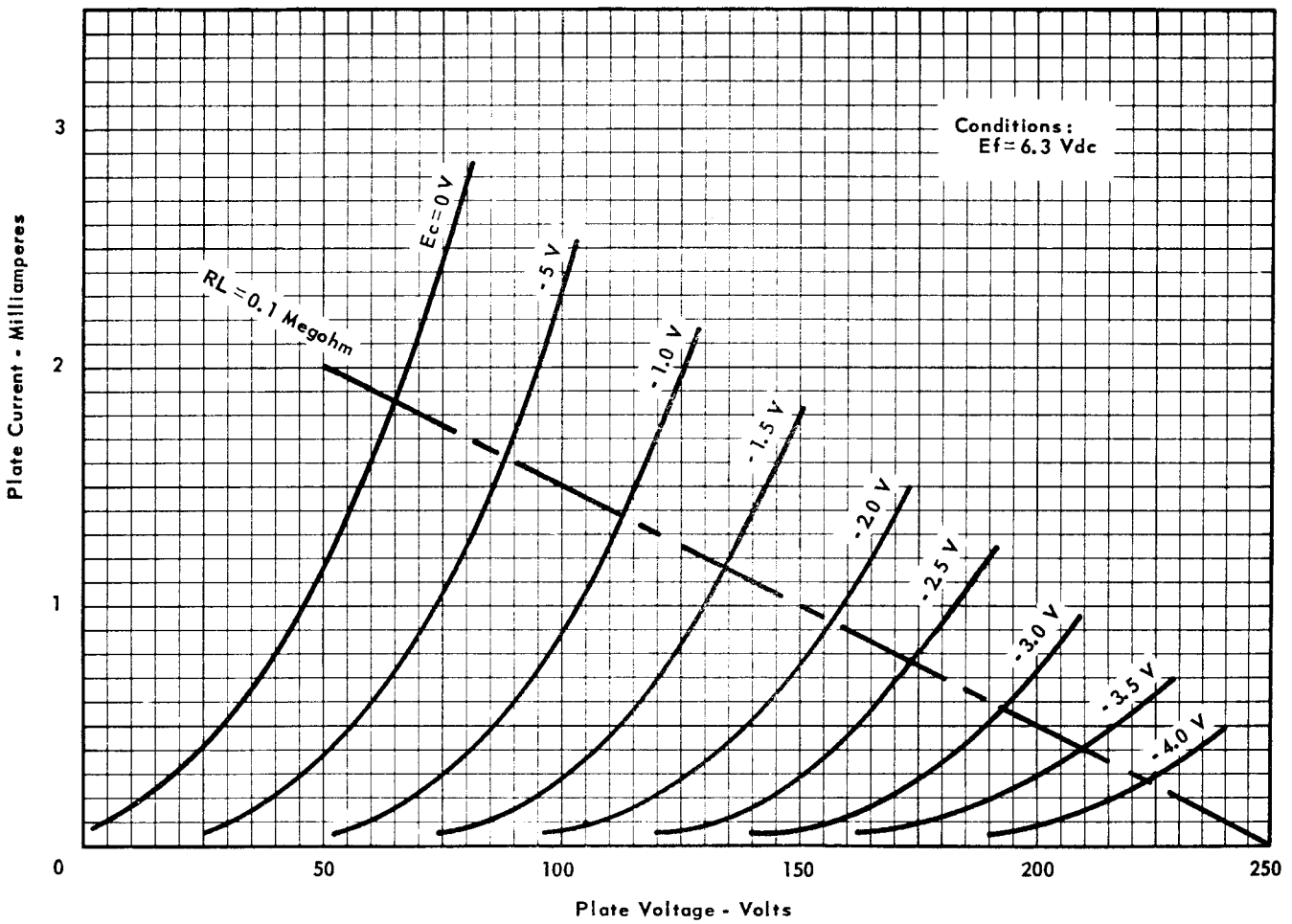
Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2, and Y1. Only rated heater voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures:

(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3 of Specification MIL-E-1.

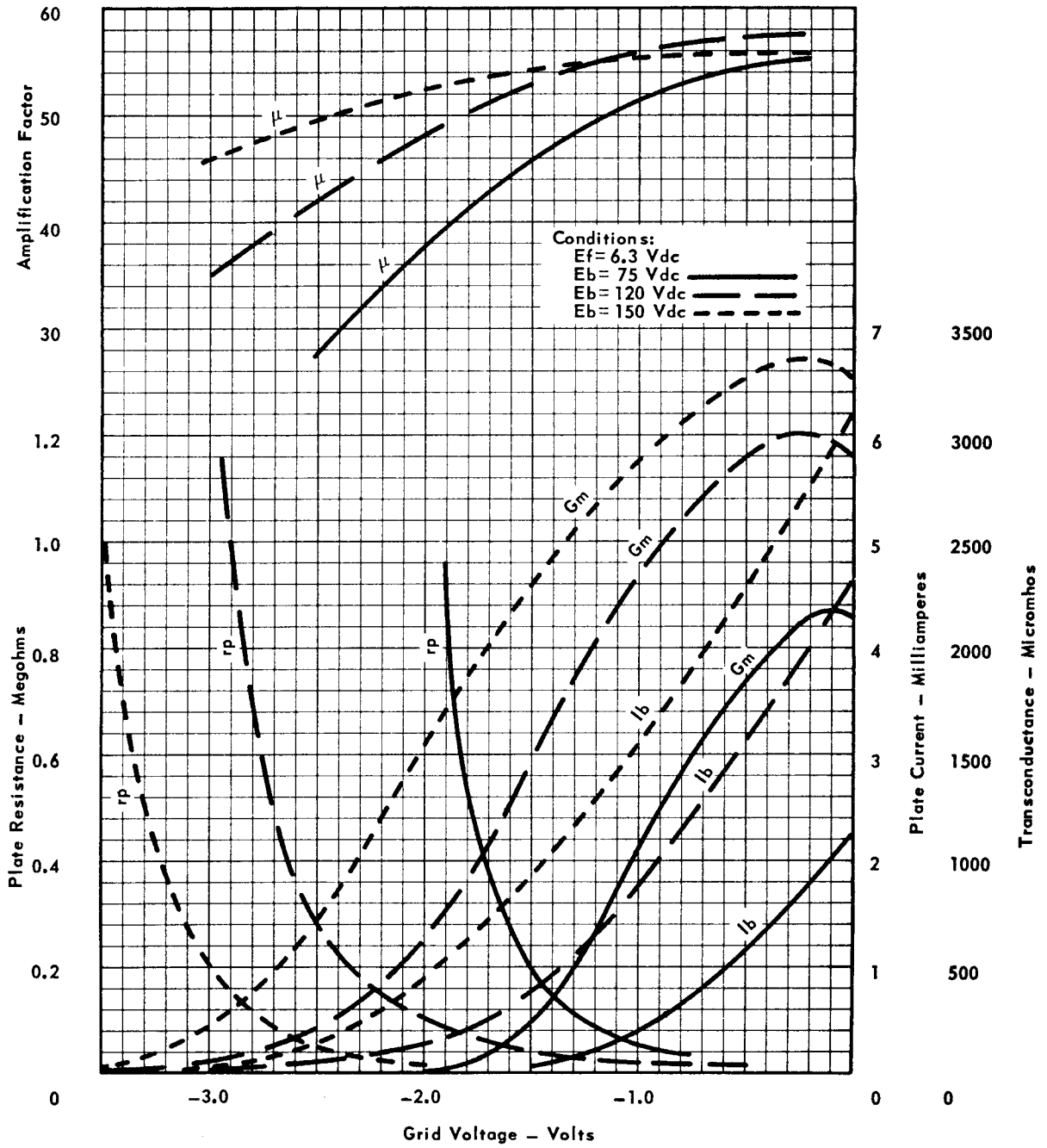
(b) Tubes which do not comply with post fatigue limits. (This is a destructive test).

Note 13: The provisions of 4.9.20.5 of Specification MIL-E-1 shall apply, except for the test conditions specified herein for Shock Test (2).

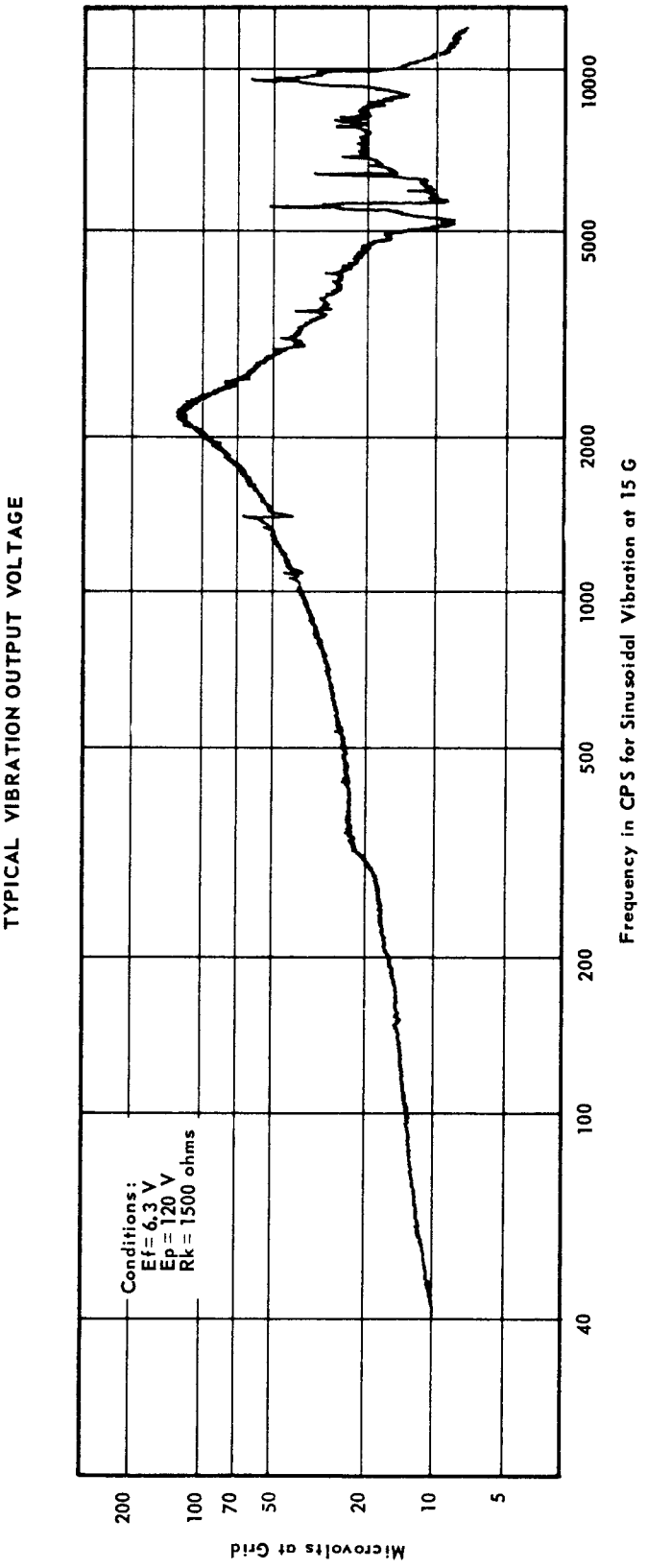
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS



RELIABLE SUBMINIATURE TRIODE



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RAYTHEON

TECHNICAL INFORMATION SERVICE

from JEDEC release #3908, Oct. 1, 1962

Technical Information

CK6540
RELIABLE
SUBMINIATURE
SHARP CUT-OFF
PENTODE

The CK6540 is a heater cathode type sharp cut-off pentode of subminiature construction capable of operation in the VHF region. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. A separate terminal connection is provided for Grid #3, which under self-bias conditions can be connected directly to ground, permitting the cathode by-pass capacitor to be omitted for lower grid loading. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

The Raytheon CK6540 is manufactured and controlled to meet the applicable MIL-E-1 specification for reliability.

RATINGS (Design Maximum):

Bulb Temperature	220°C
Altitude	60,000 ft.

ENVIRONMENTAL Tests (Maximum Values)

Impact Acceleration (Shock, 3/4 msec. duration)	450 G
Vibration Acceleration for Extended Periods (Fatigue) (F = 25 min., 60 max, 96 hours.)	2.5G
Vibration Output at F=40 Cps, G=15 (Ep)	50 mVac
On-Off Heater Cycles	2000 min.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3 V
Heater Current	200 mA

DIRECT INTERELECTRODE CAPACITANCE: (With 0.405 in. dia. shield)

Grid # 1 to Plate (max.)	0.03 pf
Input	4.8 pf
Output	3.5 pf

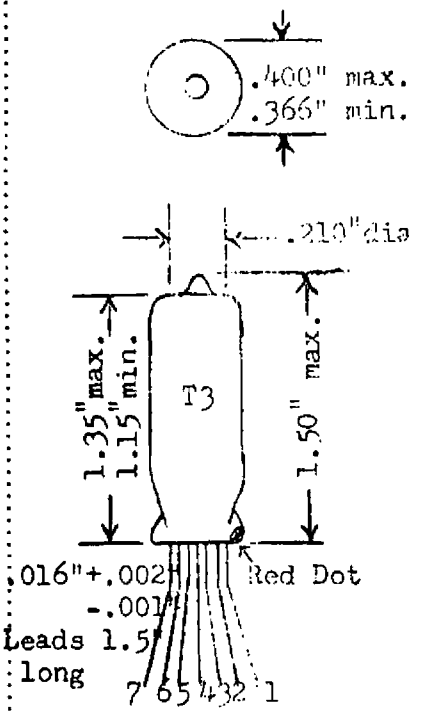
RATINGS: (Design Maximum)

Heater Voltage	6.3(±10%)V
Heater Cathode Voltage	
Heater Negative with Respect to Cathode	200 v
Heater Positive with respect to cathode	200 v
Plate Voltage	165 Vdc
Plate Power Dissipation	1.1 W
Screen Grid Voltage	155 Vdc
Screen Grid Power Dissipation	0.40 W
Suppressor Grid Voltage	0 Vdc
Control Grid Resistor	1.2 Meg
Cathode Current	16.5 mAdc

MECHANICAL DATA

Envelope ....Glass T-3
Outline .....(8-7) 3-6
Base.....Pinch Press7
leads in line spacing
0.048" center to center
Cathode .....Coated
unipotential
Mounting Position..Any

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS

Lead 1	Plate
Lead 2	Grid # 2
Lead 3	Heater
Lead 4	Heater
Lead 5	Grid #3
Lead 6	Cathode
Lead 7	Grid # 1

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TYPICAL OPERATION

Plate Voltage	120 Vdc
Plate Current	7.5 mAdc
Screen Grid Voltage	120 Vdc
Screen Grid Current	2.6 mAdc
Suppressor Grid Voltage	0 Vdc
Control grid voltage	0 Vdc
Control grid cut-off voltage @ Ib=50 uAdc max.	-9.0 Vdc
Cathode Resistor	200 ohms
Transconductance	5000 umhos
Plate Resistance (rp) (Min.)	0.15 Meg
Peak positive plate voltage overshoot (max.)	2.0 v

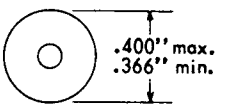
RAYTHEON

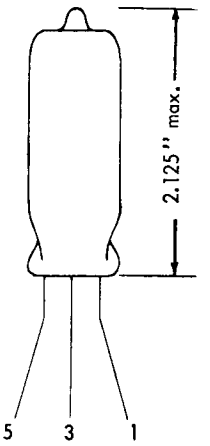
TECHNICAL INFORMATION RELIABLE SUBMINIATURE GAS DIODE

Excellence in Electronics

TYPE CK6542

The CK6542 is a **cold** cathode, gas-filled diode of subminiature construction, designed for service as a voltage regulator. It has an operating current range of 5 to 25 milliamperes over which it maintains a substantially constant operating voltage of approximately 150 volts. Two cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.





MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.096" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test---Note 2)	450 G
Maximum Uniform Acceleration (Centrifuge Test---Note 4)	1000 G
Maximum Vibrational Acceleration (96 Hour Fatigue Test---Note 3)	2.5 G
Maximum Bulb Temperature	155 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers. Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions more severe than those specified for life are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

RATINGS:

	Ebb Vdc	Total Darkness Starting Voltage Vdc	Ambient Light Starting Voltage Vdc	Operating Voltage Range Vdc	Operating Current Range mAdc (Note 5)	Bulb Temperature °C (Note 5)	Ambient Temperature °C (Note 5)
Absolute:							
Maximum:	----	----	----	168	25	155	----
Minimum:	225	225	185	140	5	----	-55

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	AVERAGE	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TEST PART 1						(Combined AQL=1.0% excluding Mechanical and Inoperatives)				
Ionization Voltage (1):	Rp/Ib=5-25 mAdc; Ambient Light	0.65	(1) Ez:	----	----	155	----	180	----	Vdc
Tube Voltage Drop (1):	Rp/Ib=25 mAdc	0.65	(1) Etd:	142	----	149	----	165	----	Vdc
Tube Voltage Drop (2):	Rp/Ib=5 mAdc	0.65	(2) Etd:	142	----	147	----	165	----	Vdc
Regulation:	(1) Etd-(2) Etd	0.65	Reg.:	----	----	2.0	----	6.0	----	Vdc
Continuity and Shorts: (Inoperatives)		0.4	-----	----	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2										
Ionization Voltage (2):	Rp/Ib=5-25 mAdc Total Darkness	6.5	Ez (2):	----	----	160	----	225	----	Vdc
Leakage:	Eb=50 Vdc, Rp=3000 ohms	6.5	Lib:	----	----	<1	----	20	----	μAdc

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ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	AVERAGE	UAL	MAX.	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 2 (cont'd)										
Noise:	Ebb/Ib=25 mAdc; RL=500 ohms	2.5	Eb:	----	----	<1	----	20	----	mVac
Oscillation:	Esig=100 mVac; RL=500 ohms; Rp/Ib=5-25 mAdc	2.5	-----	----	----	----	----	----	----	----
DEGRADATION RATE ACCEPTANCE TEST										
Subminiature Lead Fatigue:		2.5	-----	4.0	----	----	----	----	----	arcs
Shock:	Hammer Angle=30° (Note 2)	20	-----	----	----	----	----	----	----	----
Fatigue:	G=2.5; Fixed Frequency F=25 min., 60 max. (Note 3) no voltage	6.5	-----	----	----	----	----	----	----	----
Post Shock and Fatigue Test End Points:										
Ionization Voltage (1):	Rp/Ib=5-25 mAdc		(1) Ez:	----	----	155	----	185	----	Vdc
Tube Voltage Drop (1):	Rp/Ib=25 mAdc		(1) Etd:	140	----	149	----	168	----	Vdc
Tube Voltage Drop (2):	Rp/Ib=5 mAdc		(2) Etd:	140	----	147	----	168	----	Vdc
Regulation:	(1) Etd - (2) Etd		Reg:	----	----	2	----	8	----	Vdc
Glass Strain (Thermal Shock):		2.5	----	----	----	----	----	----	----	----

TESTS	CONDITIONS	AQL %	MIL-E-1 Symbol	MIN.	MAX.	MIL-E-1 Units	Allowable Defects per Characteristic 1st Sample	Allowable Defects per Characteristic Combined Samples
ACCEPTANCE LIFE TESTS								
500 Hour Intermittent High Temperature Life Test:	T Bulb=155°C; Rp/Ib=25 mAdc	----	-----	----	----	----	---	---
500 Hour Intermittent High Temperature Life Test End Points:	(Typical Sample Size=20 tubes 1st sample, 40 tubes 2nd Sample)							
Inoperatives:		----	-----	----	----	----	1	3
Regulation:		----	Reg:	----	8	Vdc	2	4
Tube Voltage Drop (1):		----	(1) Etd:	140	168	Vdc	2	4
Tube Voltage Drop (2):		----	(2) Etd:	140	168	Vdc	2	4
Ionization Voltage (1):		----	(1) EZ:	----	185	Vdc	2	4
Total Defectives		----	-----	----	----	----	4	8
1000 Hour High Temperature Life Test:	T Bulb=155°C; Rp/Ib=25 mAdc							
1000 Hour High Temperature Test End Points:	Read for same characteristics as for 500 hour Intermittent Life Test. Limits not established.							

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Test Conditions and Acceptance Criteria per Shock Test Procedures of MIL-E-1 Basic Specifications.

Note 3: Test Conditions and Acceptance Criteria per Fatigue Test Procedures of MIL-E-1 Basic Specifications.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Limits beyond which normal tube Performance and Tube life may be impaired.

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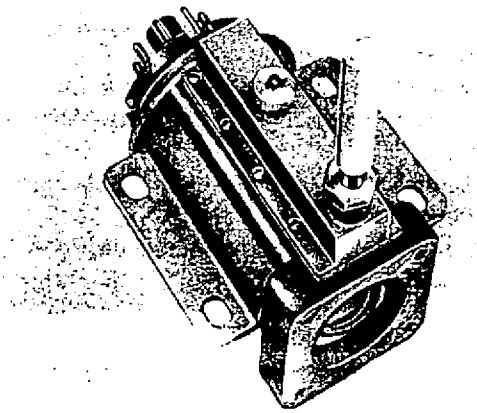
TECHNICAL INFORMATION

VARIATION OSCILLATOR

Excellence in Electronics

TYPE RK6573/ QK483

The RK6573/QK483 is a mechanically tuned velocity variation oscillator of the single cavity (integral) reflex type designed for CW operation in the 15,500 to 17,000 Mc range with an average power output of 40 milliwatts. Adequate cooling for this type tube is usually provided by freely circulating air. It is a waveguide output type fitted with a fiber flange which is capable of insulating the shell of the tube from the coupling guide. It is therefore convenient to operate the shell of this tube above ground, and to power the resonator circuit from the same supply which furnishes plate potential to other tubes in an equipment. The compound lever system of the mechanical tuner is free of backlash and yields an extremely smooth fine tuning adjustment which is linear with tuner shaft rotation.



GENERAL CHARACTERISTICS

ELECTRICAL:

Heater Characteristics:

Heater Voltage (AC or DC)	6.3 V
Heater Current @ 6.3 volts	450-600 mAdc

Maximum Ratings:

Heater Voltage	6.3 ±8% V
DC Resonator Voltage	330 Vdc
DC Resonator Current	45 mA
DC Reflector Voltage	—25 to —300 Vdc
Heater Cathode Potential Difference	±45 V
Envelope Temperature	175° C

Typical Operation:

Frequency Range	15500-17000 Mc
DC Resonator Voltage	300 Vdc
DC Resonator Current	30-45 mA
DC Reflector Voltage (15500 to 17000 Mc 4¾ cycle reflector mode)	—60 to —210 Vdc
Power Output (average)	40 mW
Electronic Tuning Range (to half power points)	75 Mc minimum

MECHANICAL:

Mounting Position	Any
Overall Dimension	See Outline Dwg.
Envelope	Metal
Base	Std Intermediate Octal

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

from JEDEC release #3478, Nov. 6, 1961

DETAILED ELECTRICAL INFORMATION

CATHODE

In applications where the metal envelope is operated at ground potential, the cathode is negative with respect to ground by the amount of the resonator potential and must not be grounded. The cathode may be connected to one side of the heater or to the center tap of the heater transformer secondary. When the cathode and heater are connected together, connections to the cathode should be made directly to the cathode contacts on the tube socket and never to a heater lead. When cathode and heater are not connected together, the heater cathode voltage should not exceed ±45 volts. In all cases where the resonator is operated at ground potential, the heater transformer must be insulated to withstand the maximum resonator voltage.

In applications where the metal envelope is operated above ground potential, it is recommended that the tube be surrounded with a protective shield to eliminate the attendant shock hazard. This shield must be designed so as to allow sufficient convection circulation to maintain the shell temperature below the maximum specified value.

REFLECTOR

The reflector electrode is connected to pin #5 on the base of the tube. The power supply furnishing the reflector potential must be insulated to withstand the total resonator and reflector voltage. The reflector must never be allowed to become positive with respect to the cathode. If this precaution is not observed, damage to the reflector may result. In cases where modulating potentials bring the reflector voltage close to zero volts, or where extremely high reflector circuit impendance is required, a diode should be connected between cathode and reflector to prevent the reflector from going positive.

MECHANICAL TUNING

Extremely smooth, backlash free, mechanical tuning is obtained with a unique tuner design. A compound lever system actuated by a tuning shaft is linked mechanically to a diaphragm which is integral with the resonant cavity and coupled to the resonator grids. Tuning shaft rotation effects the flexing of the diaphragm, changing the geometry of the resonant cavity and altering the grid spacing in such a manner as to cause the frequency of the oscillator to track linearly with tuner shaft rotation. See Fig. 1.

MECHANICAL TUNING CHARACTERISTICS

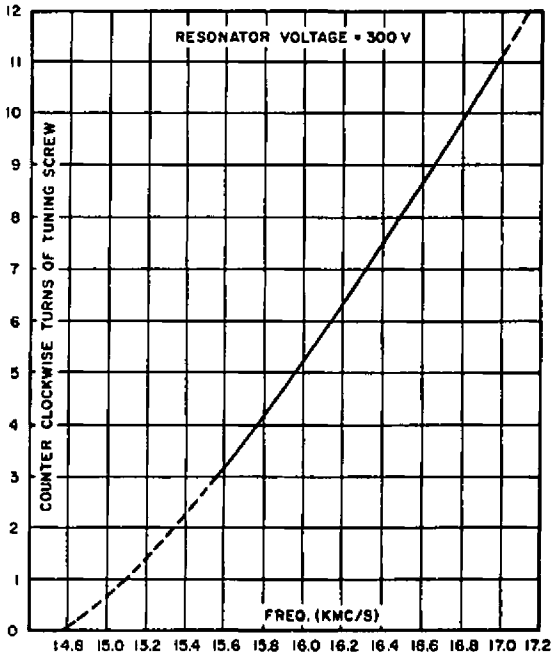
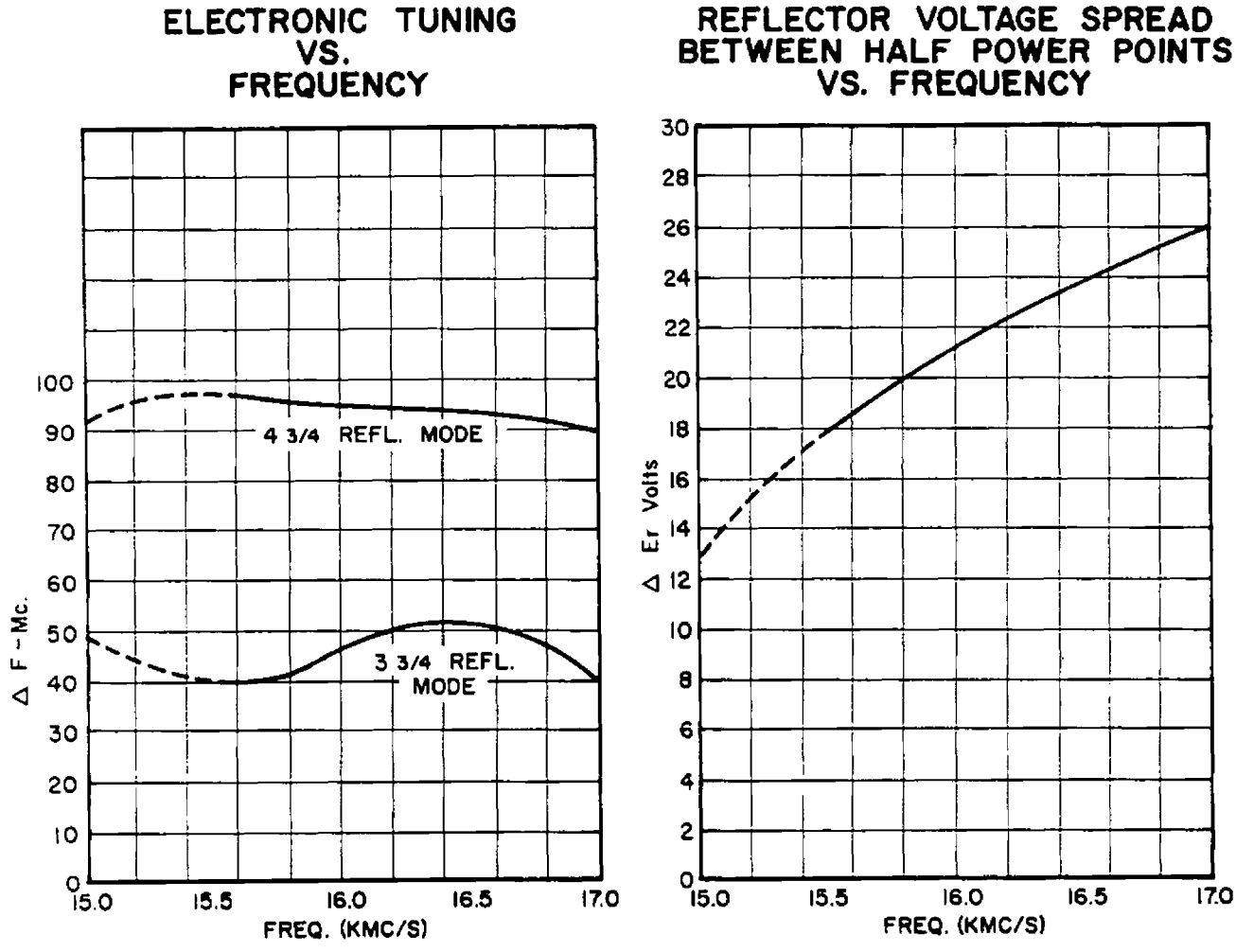


FIGURE 1

ELECTRONIC TUNING

With the mechanical tuner adjusted so that the tube is operating near the desired frequency, vernier frequency adjustment may be made by varying the reflector voltage. Maximum power output for a given mechanical tuner setting, however, will be obtained at only one value of reflector voltage. If the mechanical tuner and reflector voltage are mutually adjusted for maximum power output at a given frequency, and if then the reflector voltage is varied above and below the value for maximum power output such that the power output is reduced by one half, the frequency

change between the half power values is defined as the electronic tuning range. The electronic tuning range and linearity depend on the type of load and coupling used. A highly reactive load may shorten the electronic tuning range and cause non-linear variation of frequency with reflector voltage. See Fig. 2.



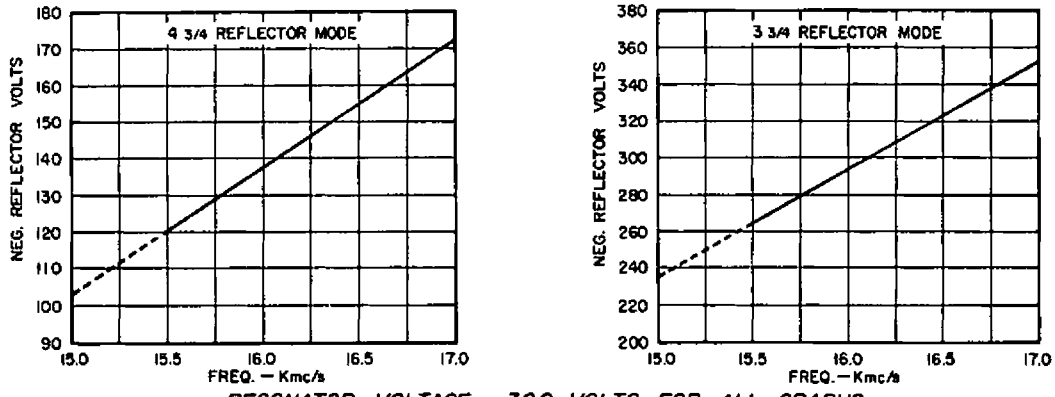
RESONATOR VOLTAGE = 300 VOLTS

FIGURE 2

MODE OF OPERATION

Oscillation may be obtained in a given tube with several combinations of resonator and reflector voltage at a given frequency. The region where oscillations occur within the reflector voltage range are referred to as voltage modes. The curves of Figure 3 show the characteristics of the RK6573/QK483 in the recommended mode. The 4¾ mode has been chosen because it represents the best compromise between optimum power and wide electronic tuning range.

REFLECTOR VOLTAGE (AT MAX. POWER OUTPUT) VS. FREQUENCY



RESONATOR VOLTAGE = 300 VOLTS FOR ALL GRAPHS

POWER OUTPUT VS. FREQUENCY

POWER & FREQUENCY VS. REFLECTOR VOLTAGE

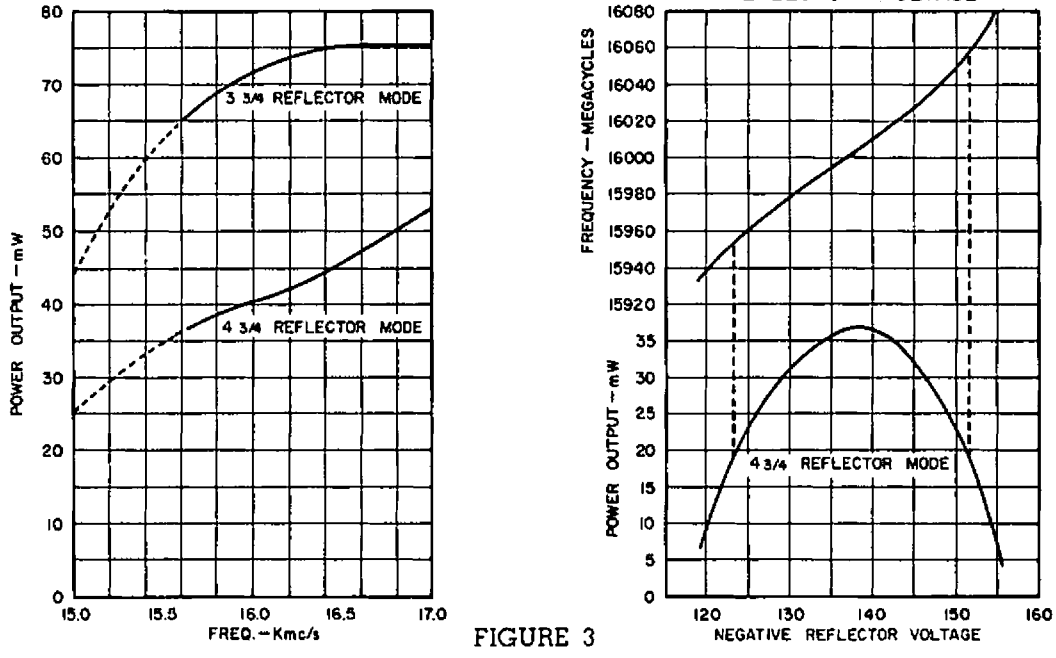


FIGURE 3

INSTALLATION

The RK6573/QK483 requires a standard intermediate octal socket, and may be mounted in any position supported by either the output coupling flange, the mounting flange, or both.

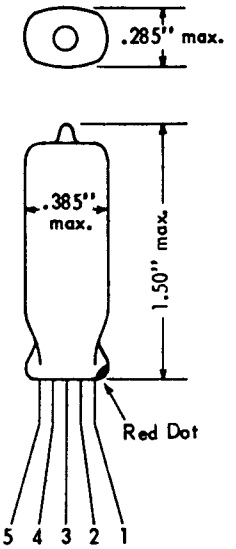
The tube couples directly to standard RG91/U waveguide with UG541/U choke flange required. See tube outline drawing for pin connections.

SHIELDING

Operation of the RK6573/QK483 in the presence of a strong magnetic field usually requires shielding of the resonator and reflector leads to avoid undesirable modulation of the tube output. In extremely troublesome magnetic environments it may be necessary to place the RK6573/QK483 in a metal chamber with polyiron chokes provided to bring the voltages into the chamber.

TYPE CK6611

The CK6611 is a filament type, fully shielded, subminiature pentode designed for use in RF applications requiring economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive; Grid #3 ⊕
Lead 3 Filament, Negative: Shield: Grid #3 ⊕	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*)

Grid #1 to Plate	0.008 max.
Input	4.0
Output	4.0

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25 ± 20% volts
Plate Voltage ♦	50 volts
Grid #2 Voltage ♦	50 volts
Plate Dissipation	0.10 watts
Grid #2 Dissipation	0.02 watts
Total Cathode Current	1.9 ma

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltages (dc)	1.25	1.25 volts
Filament Current	0.02	0.02 amps
Plate Voltage	30	45 volts
Grid #2 Voltage	30	▲ 45 volts
Grid #1 Voltage	■ 0	■ 0 volts
Plate Resistance (approx.)	0.4	0.4 meg.
Transconductance	1000	1000 μmhos
Plate Current	1.0	1.0 ma
Grid #2 Current	0.35	0.35 ma
Grid #1 Voltage (approx.) For Gm= 10 μmhos	-3.0	---- volts

■ *Grid Resistor= 5 megohms*

● *Bulb is entirely coated with a metallic shield connected to lead 3.*

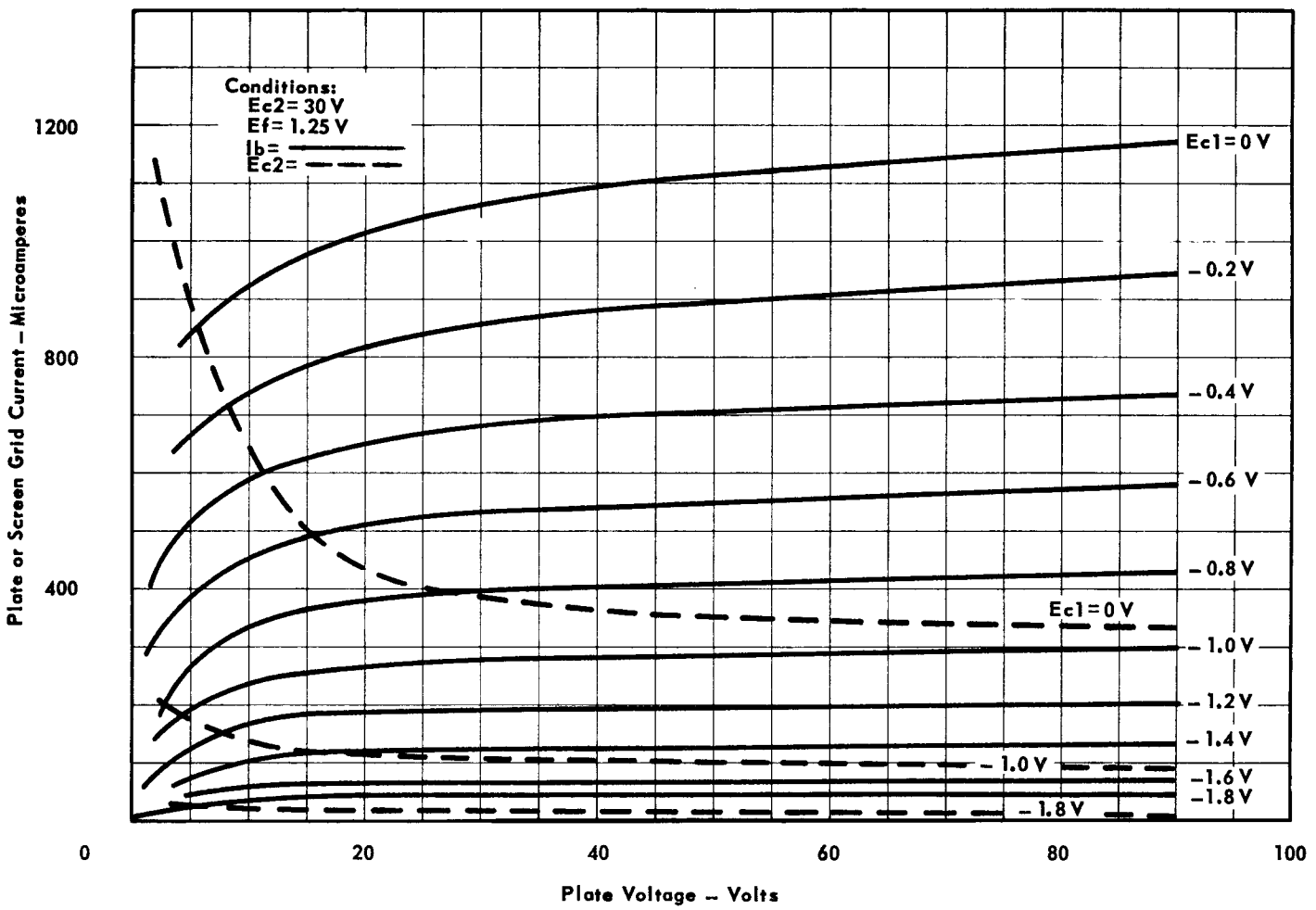
⊕ *Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5*

▲ *Screen Supply Voltage through series 47,000 ohms supply resistor.*

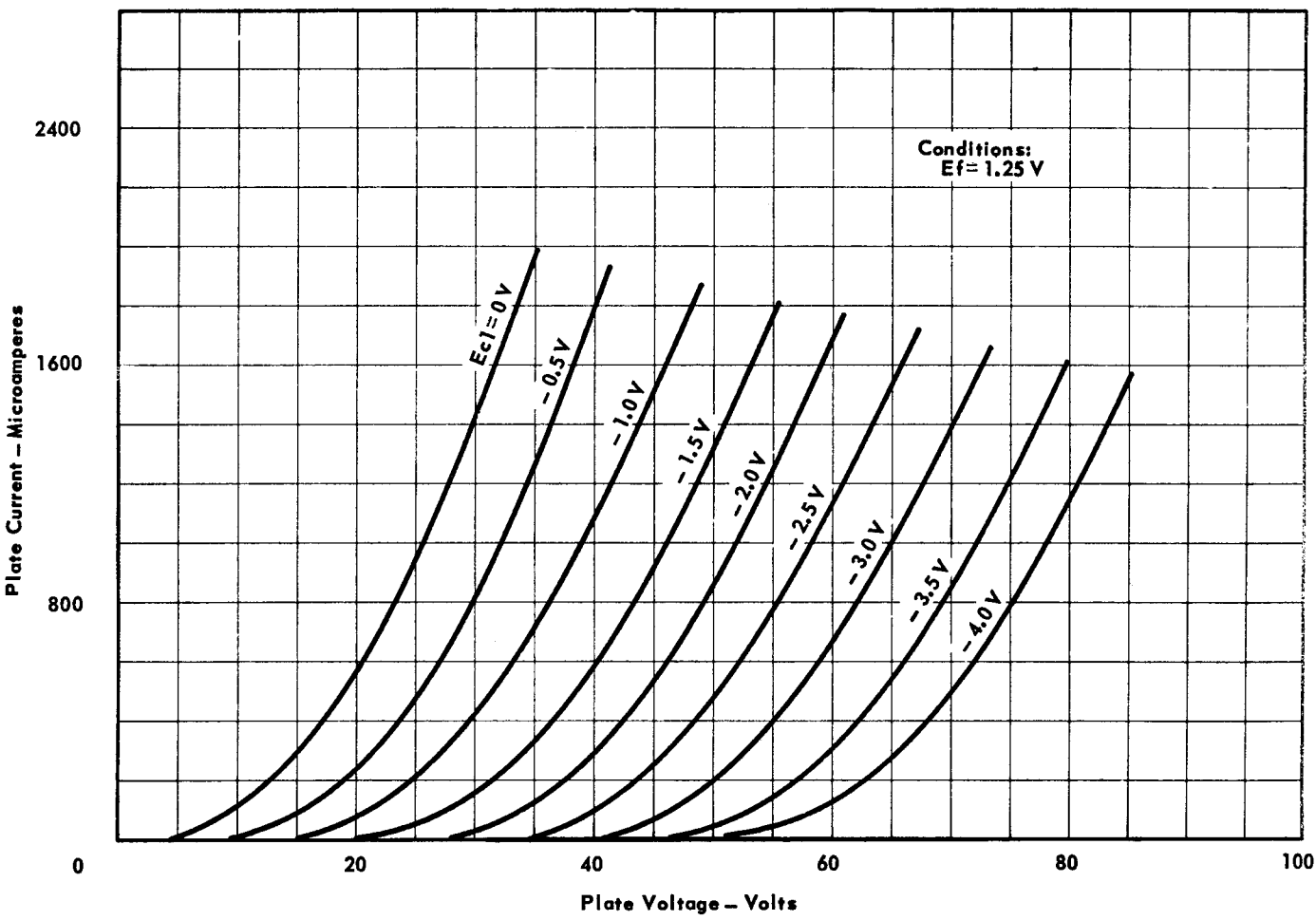
♦ *Plate and Screen Supply Voltages should not exceed these values under any circumstances.*

SUBMINIATURE PENTODE

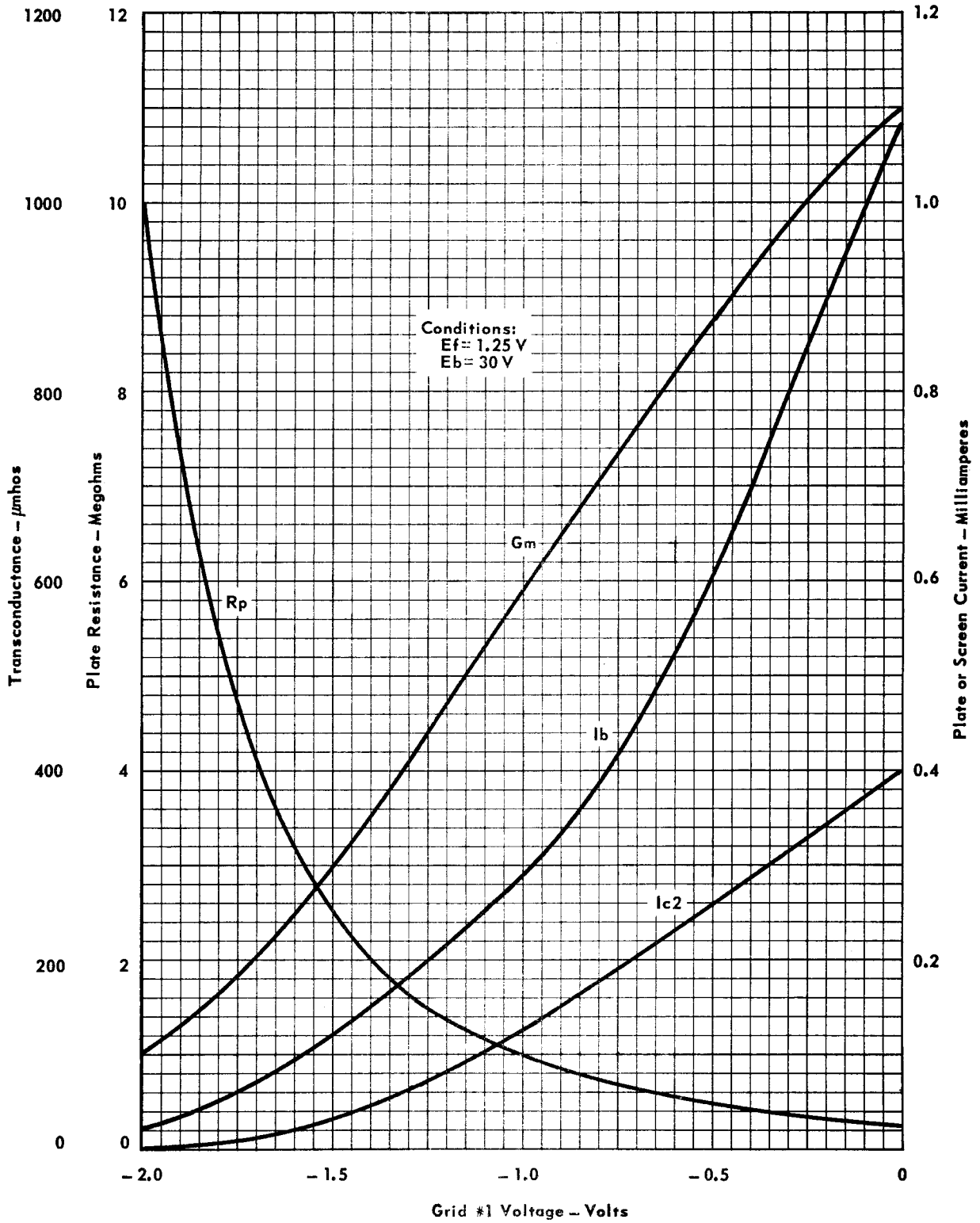
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS
(Triode Connected)

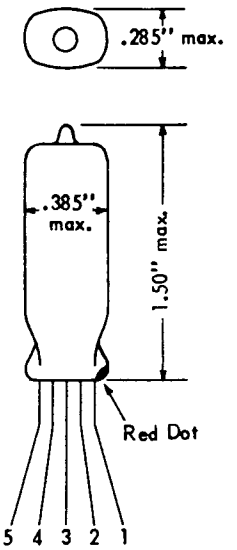


AVERAGE CHARACTERISTICS



TYPE CK6612

The CK6612 is a filament type, fully shielded, subminiature pentode designed for use in RF applications requiring economy of space, weight, and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass ●

BASE: None (0.016" tinned flexible leads. Length: 1.5"
Spacing: 0.048" Center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate
Lead 2 Grid #2
Lead 3 Filament, Negative; Shield; Grid #3 ♦
Lead 4 Grid #1
Lead 5 Filament, Positive; Grid #3 ♦

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCE: (*μμfds.*)

Grid #1 to Plate	0.01	max.
Input	5.5	
Output	4.2	

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20%	volts
Plate Voltage ■	50	volts
Grid #2 Voltage ■	50	volts
Plate Dissipation	0.20	watt
Grid #2 Dissipation	0.05	watt
Total Cathode Current	5.5	ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25	1.25	volts
Filament Current	0.08	0.08	amps.
Plate Voltage	30	45	volts
Grid #2 Voltage	30	⊕ 45	volts
Grid #1 Voltage	▲ 0	▲ 0	volts
Plate Resistance (approx.)	0.18	0.18	meg.
Transconductance	3000	3000	μmhos
Plate Current	3.0	3.0	ma.
Grid #2 Current	1.0	1.0	ma.
Grid #1 Voltage (approx.) For Gm=10 μmhos	-3.5	----	volts

⊕ *Screen Supply Voltage through series 15,000 ohms Supply resistor.*

▲ *Grid #1 risistor=2 megohms.*

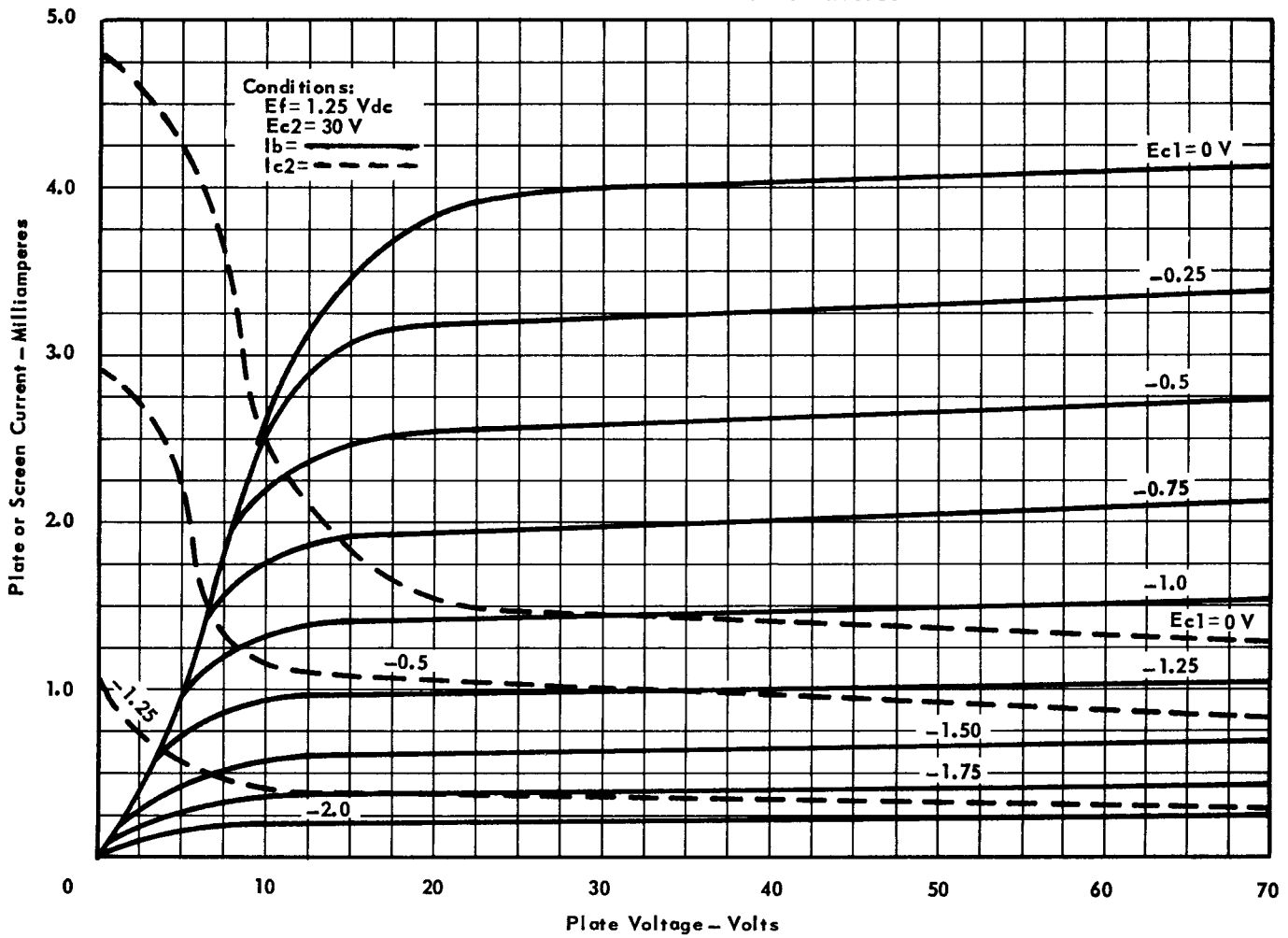
♦ *Grid #3 is composed of two separater deflector plates, one of which is connected to lead 3 and the other to lead 5.*

● *Bulb is entirely coated with a metallic shield connected to lead 3.*

■ *Plate and Screen Supply voltages should not exceed these values under any circumstances.*

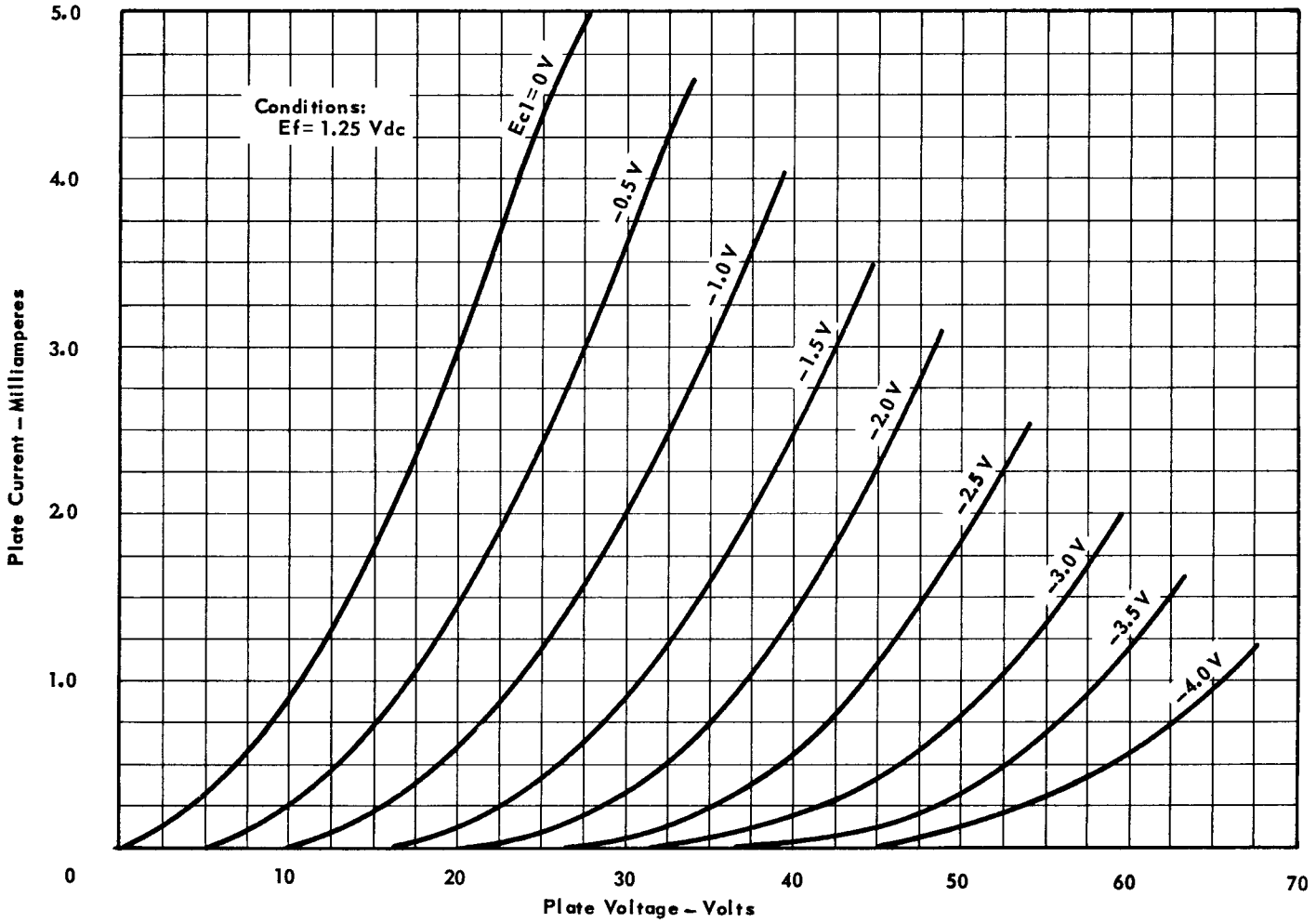
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



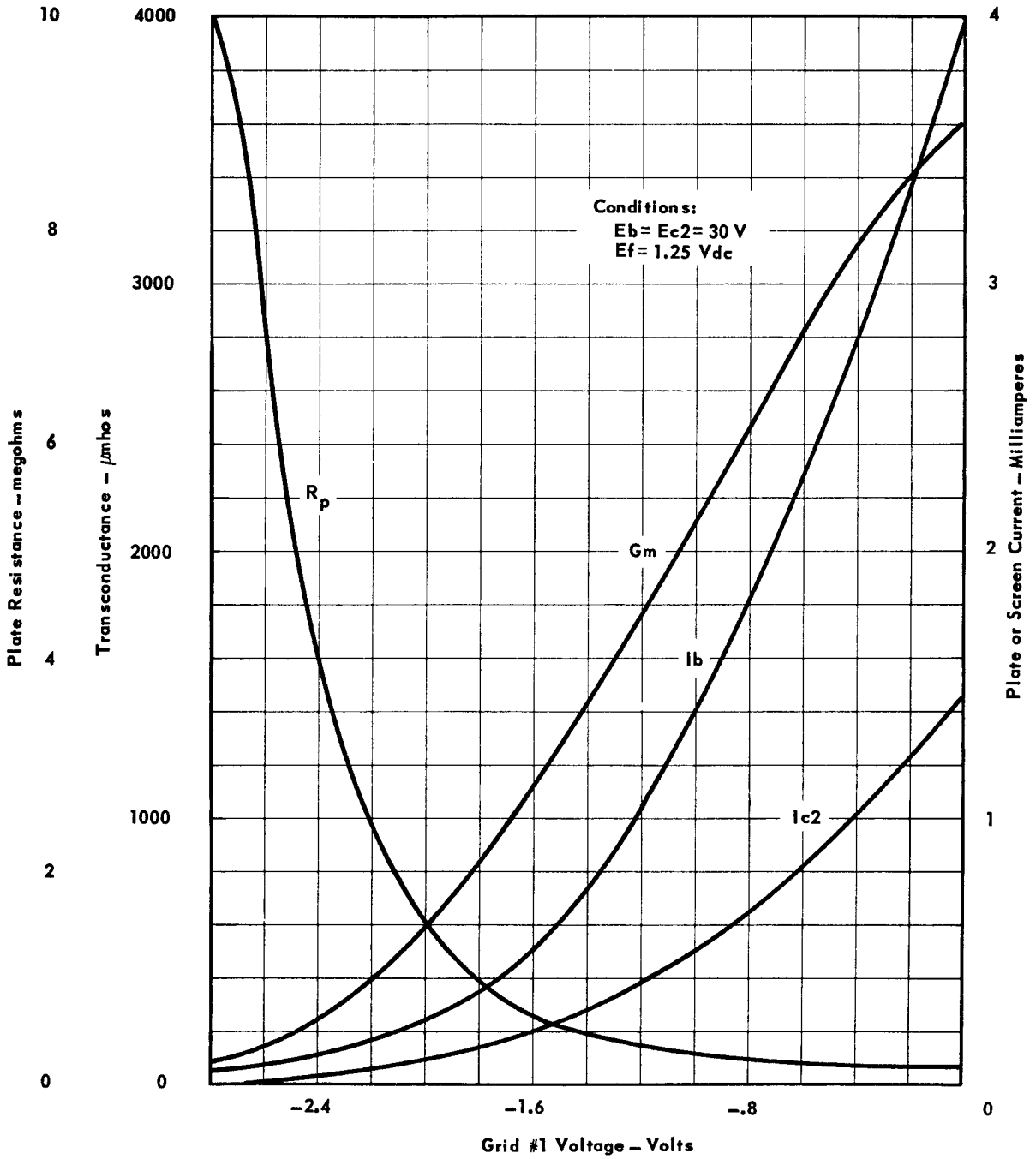
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



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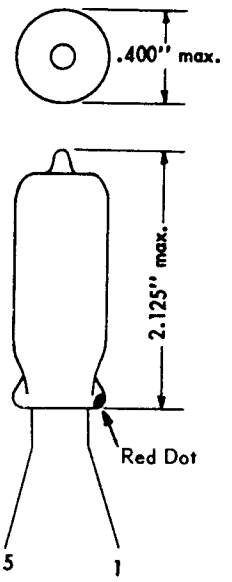
AVERAGE CHARACTERISTICS



Excellence in Electronics

TYPE CK6659/ CK1042

The CK6659/CK1042 is an instant starting, cold-cathode, gas-filled diode of subminiature construction designed for use as a half-wave rectifier with vibrator power supplies having high transient voltages. Several tubes may be operated in cascade to generate very high voltages. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: 0.20" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Anode
Lead 5 Cathode

MOUNTING POSITION: Any

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Peak Inverse Voltage	2800	volts
Peak Cathode Current (steady state) ▲	40	ma.
Peak Cathode Current (surge) ▲	300	ma.
Average Cathode Current	8	ma.
Minimum Anode Supply Voltage (peak)	700	volts
Ambient Temperature Range	-65 to + 250	°F

CHARACTERISTICS AND TYPICAL OPERATION - HALF-WAVE RECTIFIER: ♦

AC Anode Supply Voltage (RMS)	1400	volts
Series Anode Resistance	30000	ohms
Load Current	8	ma.
Tube Drop at 8 ma. (approx.)	120	volts
Load Resistor	0.1	meg.
Load Condenser	2	μf.
Life Expectancy (minimum)	100	hours

♦ *The above 60 cycle sine wave, half-wave rectifier operating conditions are used to control the quality of tube lots. Life in vibrator type circuits may be expected to be much greater due to the non-sinusoidal wave form.*

▲ *To avoid damage to the equipment or tube, it is recommended that the anode supply impedance be adjusted to limit forward currents and intermittent reverse peak currents to stated values. Typical resistance is 5000 ohms minus the effective equivalent transformer loss, but never less than 2000 ohms dc resistance. For voltage multiplier circuits, a separate limiting resistor should be connected in series with the anode or the cathode of each tube. In the event of a reverse arc, the absence of a surge limiting resistor causes all of the energy of the filter condenser to be dissipated in the tube.*

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

August 30, 1955 NEWTON 58, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6688
CK6688A

RELIABLE MINIATURE PENTODE

The CK6688 and CK6688A are heater-cathode type, high transconductance, sharp-cutoff pentodes of miniature construction utilizing a frame grid and are designed for wide-band amplifier service. It is a reliable quality tube designed for dependable operation under condition of shock and vibration encountered in critical industrial and military applications.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450 G
Fatigue (Vibrational Acceleration for Extended Periods	2.5 G
Bulb Temperature	155 °C
Altitude	60,000 Ft

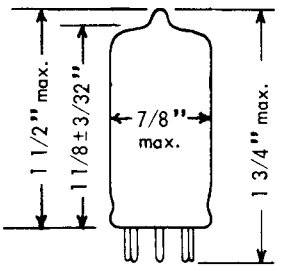
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
			Ratings			
Heater Voltage	Ef:	6.0	6.3	6.3	6.6	V
Plate Voltage	Eb:	---	190	190	210	Vdc
Grid #1 Voltage	Ec1	-50	+9	+9	0	Vdc
Grid #2 Voltage	Ec2:	---	160	160	175	Vdc
Grid #3 Voltage	Ec3:	---	0	0	0	Vdc
Cathode Resistance	Rk:	---	630	630	---	ohms
Plate Dissipation (Design Max.)	Pp:	---	---	---	2.7	Watts
Grid #2 Dissipation (Design Max.)	Pg2:	---	---	---	0.6	Watts
Heater-Cathode Voltage	Ehk:	---	---	---	60	v
Grid Resistance	Rg1:	---	---	---	0.1	Meg.
Cathode Current	Ik:	---	---	---	25	mAdc
Peak Negative Grid #1 Voltage	ec1:	---	---	---	-100	v

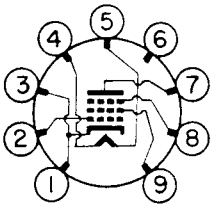
MECHANICAL DATA

ENVELOPE . . . . . Glass T-6½
OUTLINE 6-6
BASE E9-1
BASING 9EQ
CATHODE . . . . . Unipotential
MOUNTING POSITION . . . . .Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Cathode
Pin 2	Grid Number 1
Pin 3	Cathode
Pin 4	Heater
Pin 5	Heater
Pin 6	Internal Connection
Pin 7	Plate
Pin 8	Internal Shield and Grid No. 3 (Suppressor)
Pin 9	Grid No. 2 (Screen)

ELECTRICAL DATA (cont'd)

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
			Tests			
Heater Current	If:	285	300	---	315	mA
Plate Current (1) Ebb=180 Vdc, Ec1=Ec3=0 Ec2=150 Vdc, Rk=78 ohms	Ib:	8	13	---	18	mAdc
Grid #2 Current	Ic2:	2.9	3.3	---	3.7	mAdc
Transconductance	Sm:	14,200	16,500	---	18,800	μmhos
Plate Resistance (Approx.)	rp:	---	0.09	---	---	Meg.
Plate Current (2) Ec1=-6 Vdc	Ib:	---	---	---	100	μAdc
Capacitance (Note A)	Cgp:	---	---	---	0.03	pf
Capacitance (Note A)	Cin:	6.7	7.5	---	8.5	pf
Capacitance (Note A)	Cout:	2.5	3.0	---	3.5	pf

Note A: With external shield. Pin #6 is left floating.

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450 G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100° C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef=7.5V; Ehk=+60Vdc and other elements floating. At the conclusion of this test the tubes will not show open heater, cathode circuits or heater–cathode short, and meet a maximum Ihk leakage limit of 20 μAdc.

Stability Life Test – Sample is operated for two and twenty hours to assure initial electrical stability (Δ_t Sm < 10%).

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 155°C.

Altitude – Sample is subjected to a pressure of 55±5 mm Hg to assure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL–E–1.

For miscellaneous requirements, see 3.6.

TEST CONDITIONS

Ef=6.3 V
Eb=190 Vdc
Ec1=+9 Vdc
Ec2=160 V
Ec3=0 Vdc
Rk=630 ohms

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION (SEE NOTE 3)												
---	Cathode	Coated Unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base connections		---	---	---	---	---	---	---	---	---	---
---	Sweep frequency vibration (1)	Ef=6.3 Vdc; Eb=180 Vdc; Ec2=150 Vdc; Rp=2000; RL/Ib= 13 mAdc (see Note 4)	---	---	Ep:	---	---	---	---	500	---	mVac
MEASUREMENT ACCEPTANCE TESTS, PART 1 (SEE NOTE 5)												
4.10.8	Heater current		0.65	II	If:	285	---	---	---	315	---	mA
4.10.15	Heater–cathode leakage	Ehk=+100 Vdc	0.65	II	Ihk:	---	---	---	---	15	---	μAdc
		Ehk=–100 Vdc			Ihk:	---	---	---	---	15	---	μAdc
4.10.6.1	Total grid current		0.65	II	Ic1:	0	---	---	---	–0.5	---	μAdc

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2) Min.	LAL	Bogie	UAL	Max.	ALD	Units
MEASUREMENT ACCEPTANCE TESTS, PART 1 (SEE NOTE 5) Cont'd.												
4.10.4.1	Plate current (1)	Ebb=180 Vdc; Ecc1=150 Vdc; Ecc2=150 Vdc; Ecc3=0 Vdc; Ek=78 ohms	---	---	Ib:	---	11.0	13.0	15.0	---	5.0	mAdc
4.10.4.1	Plate current (1)		0.65	II		8.0	---	---	---	18.0	---	mAdc
4.10.4.1	Plate current (2)	Ec1=-6.0 Vdc	0.65	II	Ib:	---	---	---	---	100	---	μAdc
4.10.4.3	Screen-grid current		---	---	Ic2:	---	3.1	3.3	3.5	---	0.3	mAdc
4.10.4.3	Screen-grid current		0.65	II	Ic2:	2.9	---	---	---	3.7	---	mAdc
4.10.9	Transconductance (1)		---	---	Sm:	---	15,000	16,500	18,000	---	2,500	μmhos
4.10.9	Transconductance (1)		0.65	II	Sm:	14,200	---	---	---	18,800	---	μmhos
4.7.5	Continuity and short tests (for reliable tubes) (inoperative)		0.65	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical-production tests	Outline 6-6	---	---	---	---	---	---	---	---	---	---
MEASUREMENT ACCEPTANCE TESTS, PART 2												
4.8	Insulation of electrodes	g1-all p-all	2.5	L6	R: R:	20 20	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance (2)	Ef=5.7 V	2.5	I	Δ_{Ef}Sm	---	---	---	---	15	---	%
4.10.6.2	Grid emission	Ef=7.5 V Ec1=-6.0 Vdc; Rk=0 (see note 6)	2.5	I	Ic1:	0	---	---	---	-0.5	---	μAdc
4.10.3.1	Radio-frequency noise (other than shot-effect noise)	Ecal=30 mVac (see note 7)	2.5	I	---	---	---	---	---	---	---	---
4.10.3.4	Noise and microphonics (for reliable receiving tubes)	Ef=6.3, Ehk=0; Ebb=Ecc2=200; Ec1=0; Ecal=600 mVac; Rk=1000; Rp=0.1 Meg; Rg2=0.5 Meg; Ck=1000 μf; Cg2=3μf (see note 8)	2.5	I	---	---	---	---	---	---	---	---
4.10.14	Direct interelectrode capacitance	Shield No. 315 (see note 9)	6.5	Code E	Cglp:	---	---	---	---	0.030	---	pf
		Shield No. 315 (see note 9)			Cin:	6.7	---	---	---	8.5	---	pf
		Shield No. 315 (see note 9)			Cout:	2.50	---	---	---	3.50	---	pf
4.9.12.1	Low-pressure voltage breakdown	Pressure=55+5 mm Hg; voltage=500 Vac	6.5	(See note 10)	---	---	---	---	---	---	---	---
4.9.10.1	Low-frequency vibration (2)	Rp=2000	6.5	Code I	Ep:	---	---	---	---	300	---	mVac

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Insp. Level or Code	Symbol	LIMITS (See Note 2) Min.	LAL	Bogie	UAL	Max.	ALD	Units
DEGRADATION RATE ACCEPTANCE TESTS (SEE NOTE 11)												
4.9.20.5	Shock test	Hammer angle=30° Ehk=+100 Vdc (see note 12)	---	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G=2.5; F=25 min. 60 max; fixed frequency	6.5	(See note 10)	---	---	---	---	---	---	---	---
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep:	---	---	---	---	400	---	mVac
		Heater–cathode leakage										
		Ehk=+100 Vdc	---	---	Ihk:	---	---	---	---	30	---	μAdc
		Ehk=–100 Vdc	---	---	Ihk:	---	---	---	---	30	---	μAdc
		Transconductance (1)	---	---	Sm:	12,500	---	---	---	---	---	μmhos
		Grid current	---		Ic1:	0	---	---	---	–1.0	---	μAdc
4.9.6.1	Miniature–tube base–strain		---	---	---	---	---	---	---	---	---	---
4.9.6.3	Glass strain (for receiving tubes)	(See note 13)	2.5	I	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Insp. Level or Code	Allowable Defectives per Characteristic First sample	Combined samples	Symbol	LIMITS Min.	Max.	Unit
ACCEPTANCE LIFE TESTS (SEE NOTE 11)										
4.11.7	Heater–cycling life test	Ef=7.5 V; Ehk=60 Vdc; Eb=Ec1=Ec2=0 (see note 14)	---	---	---	---	---	---	---	---
4.11.4	Life–test end points	Heater–cathode leakage								
		Ehk=+100 Vdc	---	---	---	---	Ihk	---	20	μAdc
		Ehk=–100 Vdc	---	---	---	---	Ihk	---	20	μAdc
4.11.3.1(a)	Stability life test	Eb=200 Vdc; Ec1=+9 Vdc; Ec2=170 Vdc; Ec3=0; Rk=680; Rg1=0.5 Meg; TA=room (see note 15)	1.0	Code I	---	---	---	---	---	---
4.11.4	Life–test end point (stability)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_tSm	---	10	%
4.11.3.1(b)	Survival–rate life test	Stability life test conditions, or equivalent (see notes 16 and 17)	---	II	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Insp. Level or Code	Allowable Defectives per characteristic		Symbol	LIMITS		Unit
					First sample	Combined samples		Min.	Max.	
ACCEPTANCE LIFE TESTS (SEE NOTE 11) Cont'd										
4.11.4	Life–test end points (100 hours)	Continuity and shorts (inoperatives)	0.65	---	---	---	---	---	---	---
		Transconductance (1)	1.0	---	---	---	Δ_tSm	---	15	%
4.11.5	Intermittent life–test operation	Stability life test conditions; T (envelope)=+155° C min (see notes 18 and 19)	---	---	---	---	---	---	---	---
4.11.4	Life–test end points (500 hours)	(See note 20)								
		Inoperatives (see note 21)	---	---	1	3	---	---	---	---
		Grid current	---	---	1	3	Ic1	0	–0.9	μAdc
		Heater current	---	---	1	3	If	285	315	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_tSm	---	20	%
		Transconductance (2)	---	---	2	5	Δ_{Ef}Sm	---	15	%
		Heater–cathode leakage								
		Ehk=+100 Vdc	---	---	1	3	Ihk	---	20	μAdc
		Ehk=–100 Vdc					Ihk	---	20	μAdc
		Insulation of electrodes								
		g1–all	---	---	2	5	R	10	---	Meg
		p–all					R	10	---	Meg
		Transconductance (1) average change	---	---	---	---	AvgΔ_tSm	---	15	%
		Total defectives	---	---	4	8	---	---	---	---
4.11.4	Life–test end points (1000 hours)	(See note 20)								
		Inoperatives (see note 21)	---	---	2	5	---	---	---	---
		Grid current	---	---	2	5	Ic1	0	–0.9	μAdc
		Heater current	---	---	2	5	If	285	315	mA
		Change in transconductance (1) of individual tubes	---	---	2	5	Δ_tSm	---	25	%
		Heater–cathode leakage								
		Ehk=+100 Vdc	---	---	2	5	Ihk	---	20	μAdc
		Ehk=–100 Vdc					Ihk	---	20	μAdc
		Insulation of electrodes								
		g1–all	---	---	3	5	R	10	---	Meg
		p–all					R	10	---	Meg
		Total defectives	---	---	5	10	---	---	---	---
4.9.10	Container drop	(d) Package group 1; Container size B								

NOTE 1: The sequence of tests listed herein is the suggested order in which the tests should be conducted.

NOTE 2: Variable sampling. See 4.1.1.7.

NOTE 3: All tests listed herein shall be performed during qualification inspection; however, these three tests are normally performed during qualification inspection only.

NOTE 4: Sweep frequency vibration. The tubes shall be fastened rigidly to the vibration platform and vibrated with simple harmonic motion over a frequency range of 50 to 500 cps at an acceleration value of 2.5 G. The acceleration over the frequency range shall be within ±30 percent of the reference acceleration at 100 cps. The frequency shall increase from 50 to 500 cps with approximately logarithmic progression and shall require 4 minutes minimum, 5 minutes maximum, to traverse the range. Each tube shall be vibrated in positions X1 and X2, except that if the cumulative result of test on 50 or more tubes of a construction show that more than 75 percent of the tubes have higher output voltages in one position, subsequent measurements need to be taken only in the position giving the higher readings. The tubes shall be tested with the specified voltages applied thereto during vibration. The value of Ebb shall be the same as the value of Eb under the test conditions and shall be applied to the tube through the specified resistor, Rp. The value of the alternating voltage, Ep, produced across the resistor Rp, as a result of vibration, shall be measured with a suitable device. This device shall have an appropriate voltage range; shall have the ability to measure, with an error of less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 5000 cps; and shall have dynamic response characteristics equivalent to or faster than a VU meter (as described in Publication ASA Standard No. C16.5-1954). The value of Ep shall not exceed the limit specified at any point in the frequency range, nor shall this test result in open circuits, permanent shorts, or tap shorts as specified in 4.7.1, 4.7.2, and 4.7.3.

NOTE 5: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperative and mechanical, shall be 1 percent.

NOTE 6: Prior to this test, tubes shall be preheated a minimum of 5 minutes at the conditions indicated below. Three-minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid-emission test.

Ef	Ec1	Ec2	Eb	Rk
Vdc	Vdc	Vdc	Vdc	ohms
7.5	+9	160	190	630

NOTE 7: In addition to the rejection criteria of 4.10.3.1, the output shall be read on a VU meter using a rejection limit of 5 VU. Five VU is the meter deflection obtained with a steady output of 3 mW from the amplifier.

NOTE 8: The rejection level shall be set at the VU meter reading obtained during calibration.

NOTE 9: Pin 6 floating.

NOTE 10: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F, shall apply.

NOTE 11: Destructive tests. Tubes subjected to the following destructive tests are not to be delivered on the contract or order.

4.9.20.5	Shock test	4.11.7	Heater-cycling test
4.9.20.6	Fatigue test	4.11.5	Intermittent life-test operation

NOTE 12: A grid resistor of 0.1 megohm shall be added; however, this resistor will not be used when a thyratron-type short indicator is employed.

NOTE 13: The following modifications apply to 4.9.6.3:

a. Replace fifth sentence with the following:

The holder shall be in accordance with Drawing 245-JAN and the tubes shall be immersed quickly.

b. Replace seventh sentence with the following:

After the 5-second submersion period, the tubes shall be removed and allowed to return to room temperature on a wooden surface.

NOTE 14: The no–load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot–by–lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater–cathode short, or heater–cathode leakage in excess of the specified heater–cycling life–test end point limit.

NOTE 15: Stability life test. The sampling and testing procedures for this test shall be in accordance with 20.2.5.1 of Appendix C.

NOTE 16: Survival–rate life test. The sampling and testing procedures for this test shall be as specified in 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

NOTE 17: For survival–rate life test, the equivalent stability–life–test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

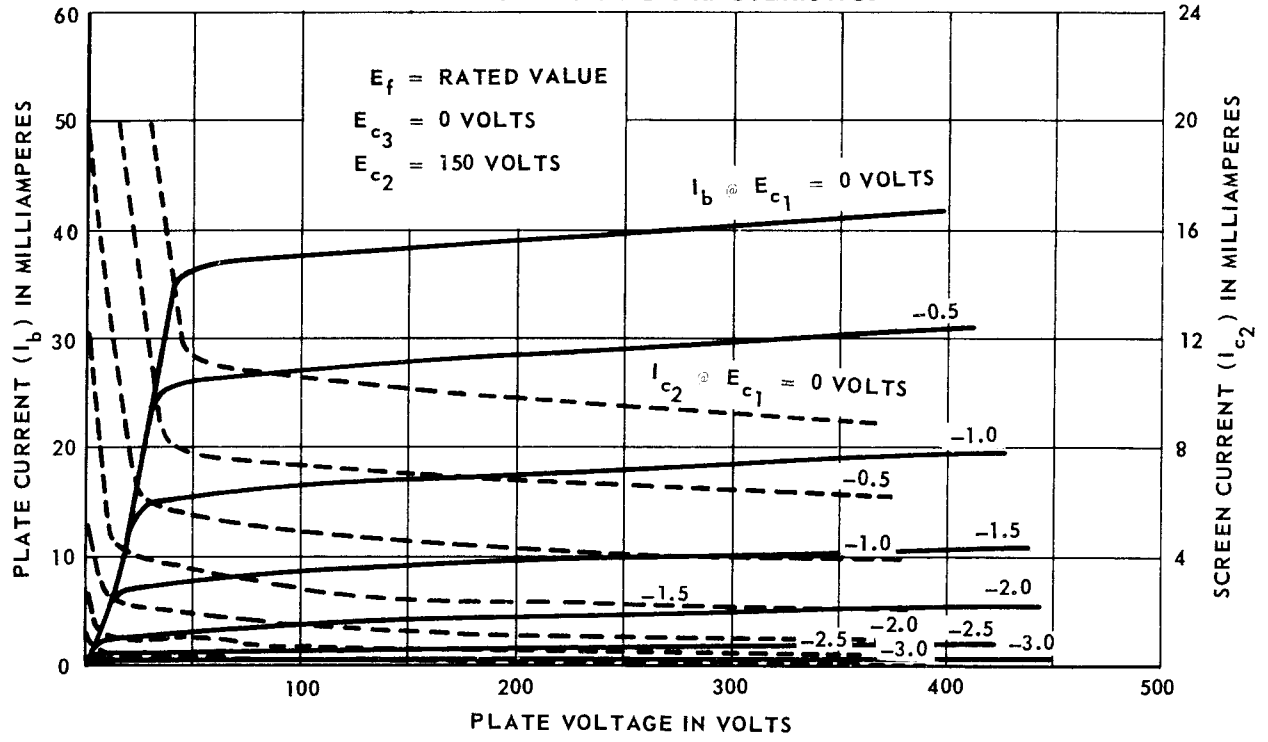
NOTE 18: Intermittent life test. See 20.2.5.3 of Appendix C.

NOTE 19: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of 40 B&S or smaller diameter elements welded to a ring of 0.025–inch diameter phosphor bronze placed in contact with the envelope. Envelope temperature requirement will be satisfied if the tube, having bogie Ib±5 percent under normal test conditions, is determined to operate at minimum specified temperature at any position on the life–test rack.

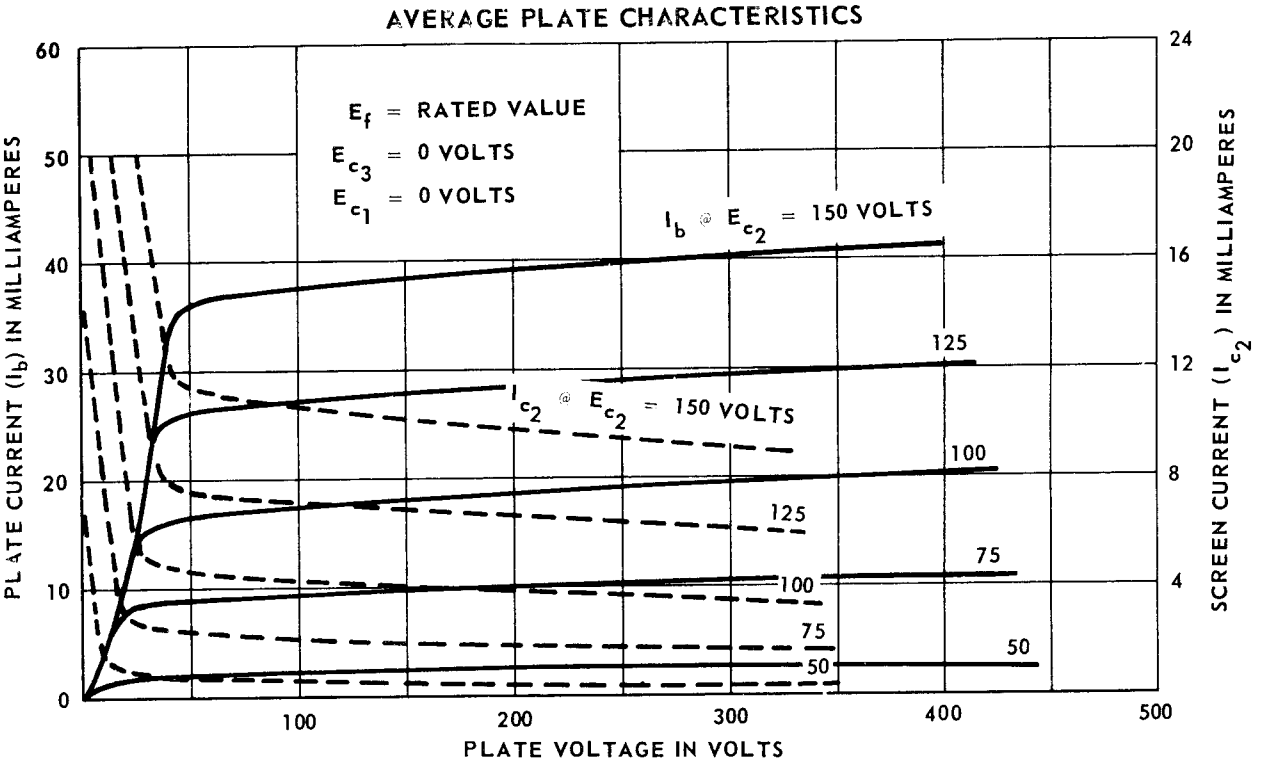
NOTE 20: Order of evaluation for life test defects. See 4.11.3.1.2.

NOTE 21: An inoperative, as referenced in life test, is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1), permanent shorts (see 4.7.2), air leaks (see 4.7.6).

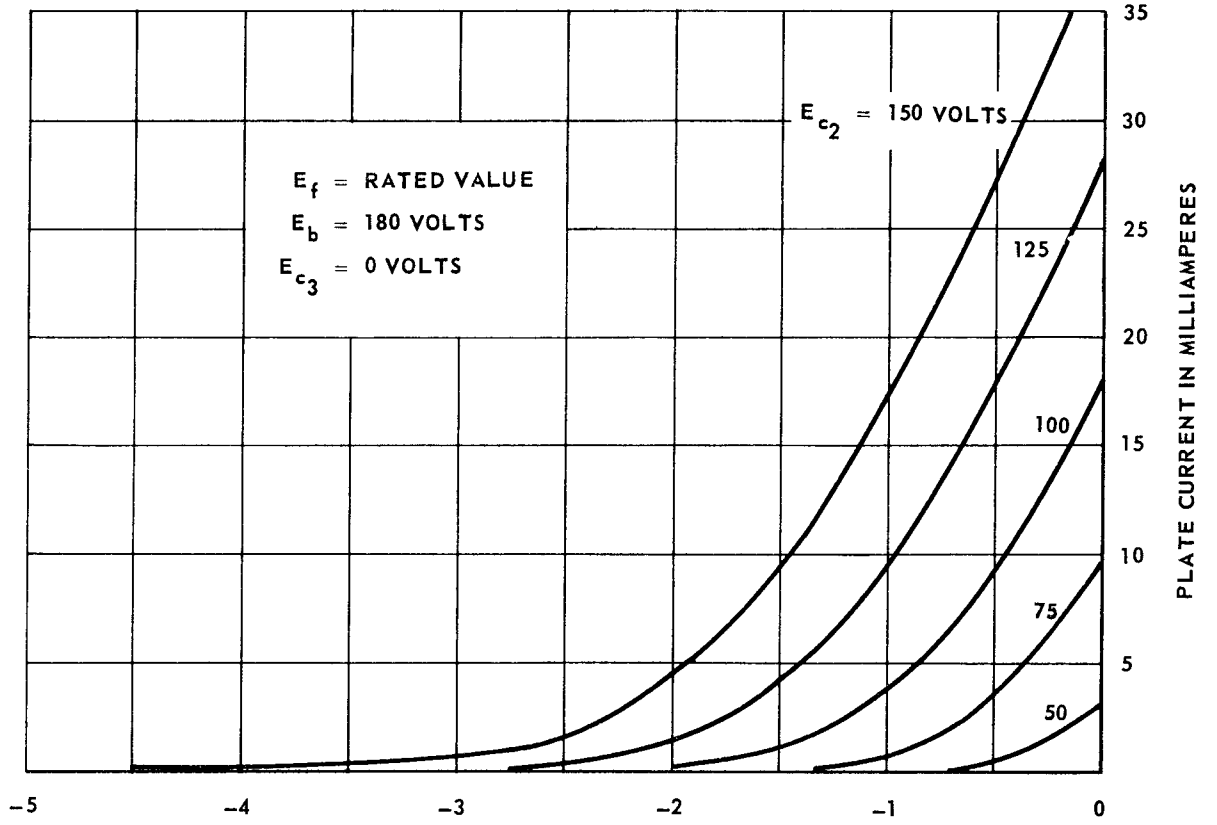
AVERAGE PLATE CHARACTERISTICS



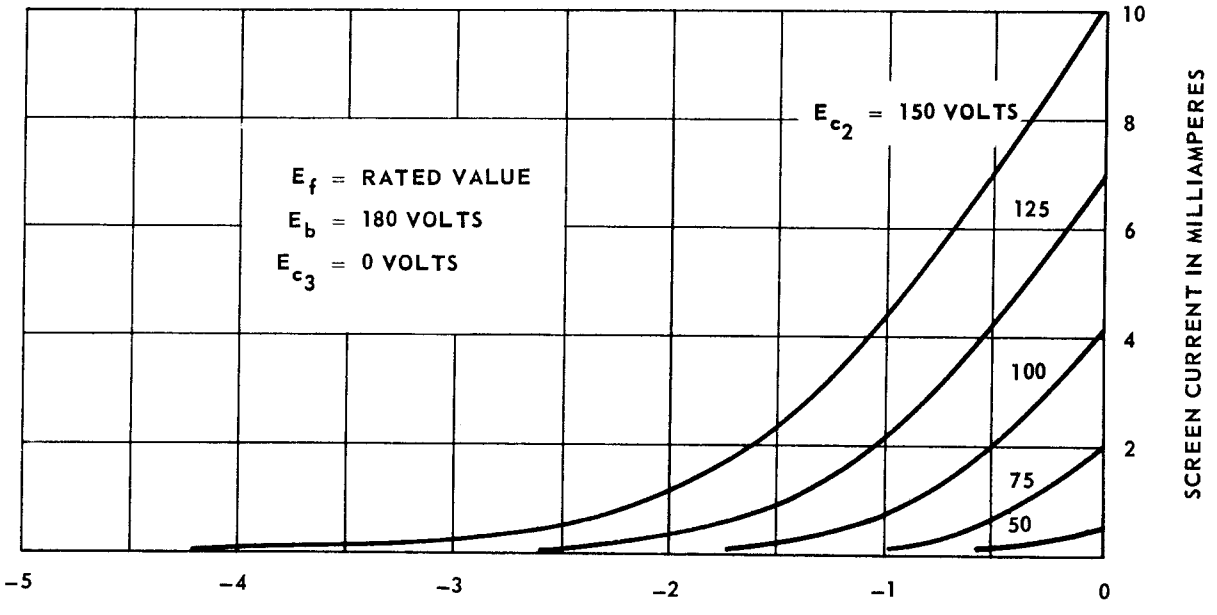
AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

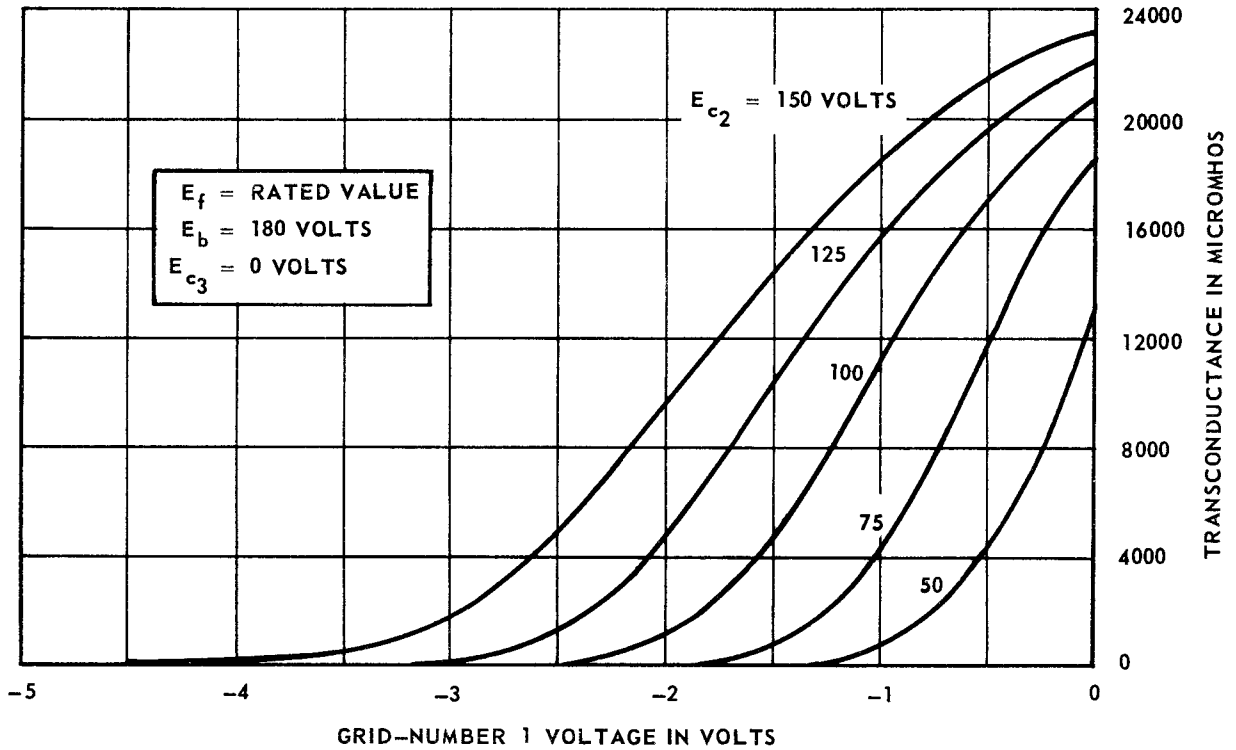


AVERAGE TRANSFER CHARACTERISTICS



RELIABLE MINIATURE PENTODE

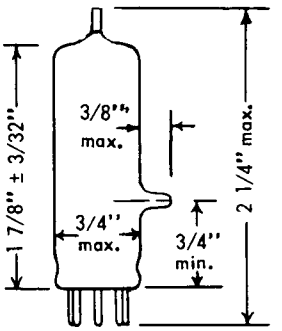
AVERAGE TRANSFER CHARACTERISTICS

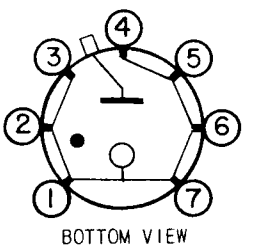


Excellence in Electronics

TYPE CK6763

The CK6763 is a ruggedized, instant starting, cold cathode, gas-filled, half-wave rectifier of miniature construction suitable for high voltage, low current power supplies up to 12 mAdc output. Several tubes can be operated in cascode to produce very high voltages. The CK6763 is designed for use in high vibration environmental conditions such as found in mobile and aircraft equipments.





BOTTOM VIEW

MECHANICAL DATA

ENVELOPE: T-5½ Glass

BASE: Miniature Button 7-Pin

TERMINAL CONNECTIONS:

Pin 1 Cathode	Pin 5 Cathode
Pin 2 Cathode	Pin 6 Cathode
Pin 3 Cathode	Pin 7 Cathode
Pin 4 Cathode	Top Lead Anode

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

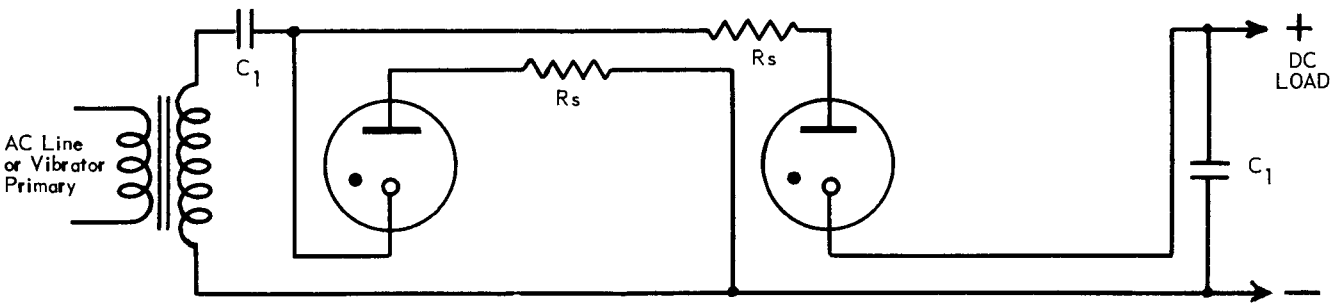
Peak Inverse Voltage	2800	volts
Peak Cathode Current (Steady state) *	100	ma
Peak Cathode Current (surge) *	300	ma
Average Cathode Current (dc)	12	mAdc
Maximum Anode Supply Voltage (RMS)	1200	volts
Minimum Anode Supply Voltage (RMS)	500	volts
Minimum Surge Limiting Impedance *	6000	ohms
Ambient Temperature Range	-55 to +90	°C

CHARACTERISTICS AND TYPICAL OPERATION - HALF-WAVE RECTIFIER:

Anode Supply Voltage (RMS)	1200	volts
Minimum Anode Supply Impedance	6000	ohms
Load Current (dc)	12	mAdc
Approximate Anode to Cathode Drop	85	volts

* *To avoid damage to the equipment or tube, it is recommended that the anode supply impedance be adjusted to limit forward currents and intermittent reverse peak currents to stated values. Typical resistance is 6000 ohms minus the effective equivalent transformer loss, but never less than 2000 ohms dc resistance. For voltage multiplier circuits, a separate limiting resistor should be connected in series with the anode or cathode of each tube. In the event of a reverse arc, the absence of a surge limiting resistor causes all of the energy of the filter condensor to be dissipated in the tube.*

VOLTAGE DOUBLER HIGH VOLTAGE POWER SUPPLY
TYPICAL CIRCUIT FOR AC LINE OR BATTERY OPERATION



Rs= Surge Resistor. Adjust to keep Peak Cathode Current (steady state) and Peak Cathode Current (surge) within ratings of 100 ma. and 300 ma., respectively. Rs should not be less than 2000 ohms in voltage doubler circuits regardless of transformer characteristics.

C1= 1.0 μf, (Typical for 60 cycle operation).

Tentative Data

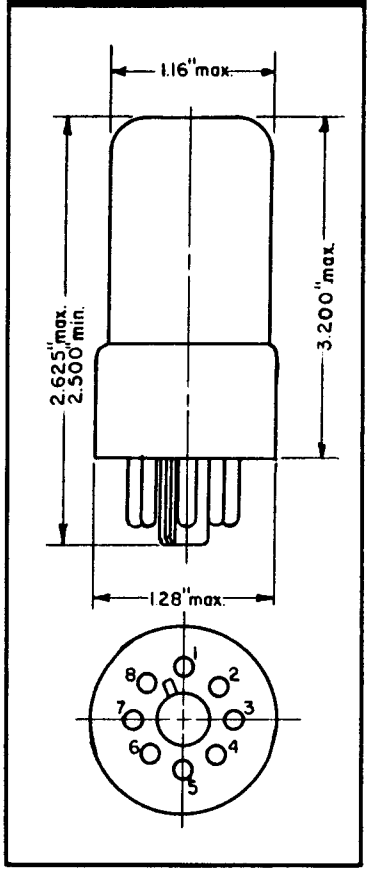
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RAYTHEON MANUFACTURING COMPANY
RECEIVING AND CATHODE RAY TUBE OPERATIONS
NEWTON 58, MASS.

TYPE CK6802

Excellence in Electronics

The 6802 is a cold cathode gas–filled 4KC medium speed bi–directional ring stepping decade counter tube. This type features direct visual neon glow readout on any of the ten radially spaced cathodes or electrical output in the form of a voltage from cathode numbers 0, 5, 8, and 9. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make this a very reliable counter device. Some of the many uses for this type include; counting, timing, sampling, frequency dividing, coding, matrixing, telemetering, and controlling.



MECHANICAL DATA

ENVELOPE: T–9 Glass

BASE: Intermediate Shell Octal 8–Pin

TERMINAL CONNECTIONS:

Pin 1 Common Cathodes	Pin 5 Guide 2
Pin 2 Cathode #5	Pin 6 Cathode #9
Pin 3 Guide 1	Pin 7 Cathode #0
Pin 4 Anode	Pin 8 Cathode #8

MOUNTING POSITION: Any (Visual Readout From Top Of Tube)

ZERO POSITION: Cathide #0 (Aligned With Pin #6 ± 10°)

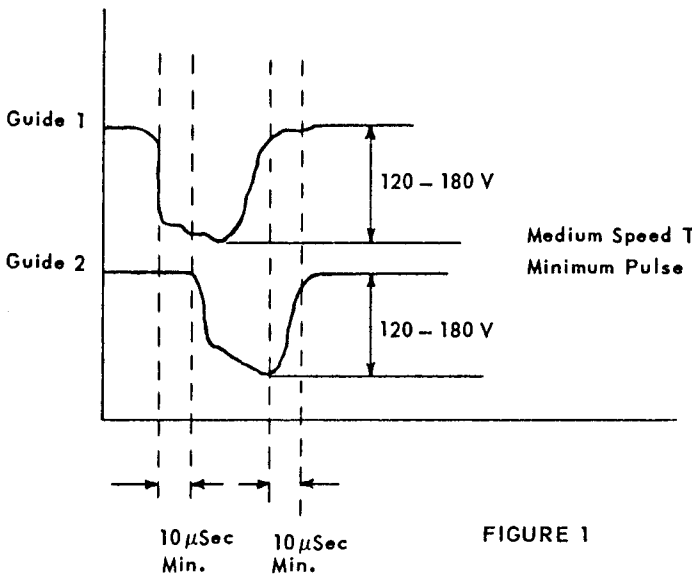
ELECTRICAL DATA (Note 1)

RATINGS–ABSOLUTE MAXIMUM VALUES:

Total Anode Current	0.5 Ma
Voltage Between Electrodes (Excluding Anode)	140 volts
Supply Voltage (Anode to Cathode)	350 volts min.
Input Frequency	5000 cps

CHARACTERISTICS AND TYPICAL OPERATION:

DC Supply Voltage	425 volts
Anode Resistor	0.82 megohms
Nominal Tube Drop	195 volts
Cathode Resistor	100 Kohms
Output Voltage (Across Cathode Resistor)	30 volts



Medium Speed Tubes 30–40 μSec Minimum Pulse Widths

FIGURE 1

Tentative Data

INDUSTRIAL COMPONENTS DIVISION

Printed in U.S.A.

APPLICATIONS NOTES

CONSTRUCTION

The Raytheon decade counter tube consists of thirty (30) thin rod shaped cathodes surrounding a circular anode, all of which are set in a glass envelope employing rare gases at low pressure. The thirty (30) cathodes are identical in construction and are radially spaced concentric to the anode. The cathodes are connected in groups of threes; main cathode, guide 1 cathode and guide 2 cathode. The guide 1's are connected together internally and are brought out to one of the base pins. The guide 2's are similarly connected and brought out to another base pin. The main cathodes may be brought out individually or connected in groups depending on the tube type. Conduction occurs between the anode and the most negative cathode pin causing an orange colored glow at the tip of that cathode. This glow can be viewed from the top of the tube or may be read as a voltage developed across a cathode resistor.

OPERATION

In operation the main cathodes are at a more negative potential than the guide pins. When a negative input pulse (more negative than the cathode) is applied to guide 1 the glow is transferred from the initial cathode (K0) to guide 1. A similar pulse applied to guide 2 transfers the pulse to guide 2. When the potential of guide 2 returns to a value more positive than the main cathodes the glow transfers to the next closest main cathode. In order to insure reliable operation the phase relationship between pulses should be such that the pulse to guide 2 should overlap the pulse to guide 1. This overlap should have a minimum value of 10 microseconds for medium speed tubes and 2 microseconds for high speed tubes. Typical wave shapes are shown in figure 1 for a medium speed tube.

RESETTING

Usually the counting in a decade counter tube starts from a particular initial main cathode, and after the completion of a count it is desired to return the glow to the initial cathode. This may be accomplished two ways, (1) by opening the negative connection to all main cathodes and guides except the zero cathode, or (2) by pulsing the zero cathode 120-180 volts negative. Either method should cause the zero cathode to become 120 to 180 volts negative with respect to all other cathodes. It may become necessary in certain applications to reset the glow at such a speed so as not to lose count. Therefore, it is recommended that the reset pulse width be the same as the count signal pulse width received from the drivers. When several tubes are used in cascade the reset for the first tube should be such that it is made to the zero cathode.

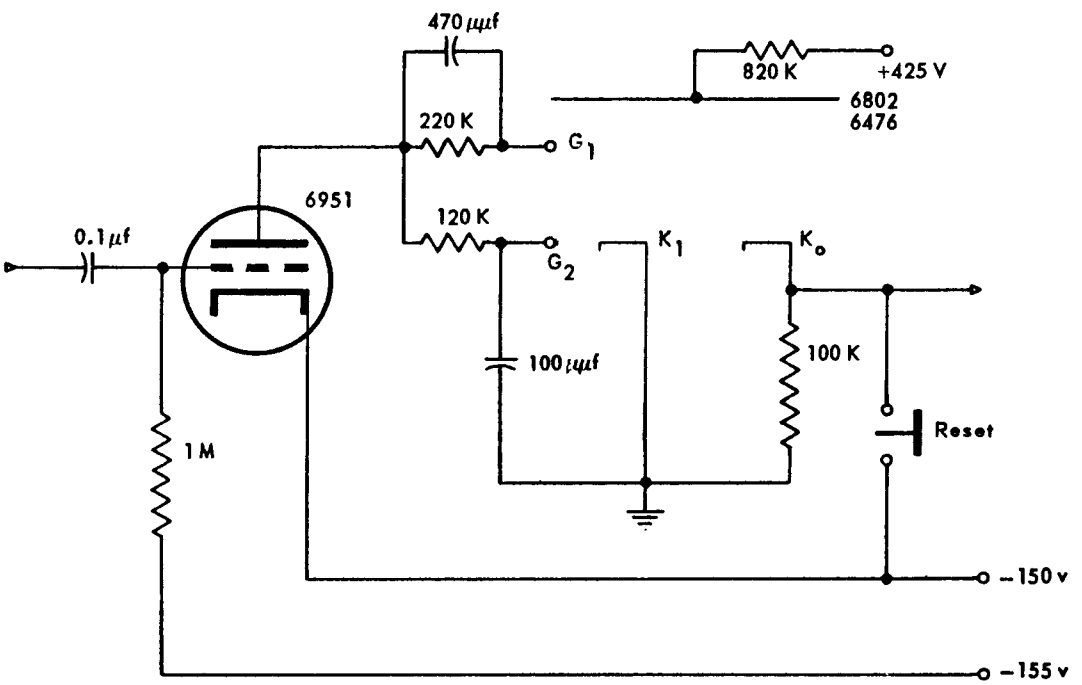
APPLICATION NOTES (Cont'd)

RESETTING (Cont'd)

The succeeding tubes should be set for the number 9 cathodes in order to account for the pulse passed to these tubes when the preceeding tubes are reset. This procedure will position the glow at all zero cathodes when the reset is complete.

DRIVE CIRCUITS

The circuit shown in figure 2 is that of a typical 0-4KC medium speed drive circuit. The RC integrator network causes a delayed pulse to guide 2 and allows the initial pulse to be applied directly to guide 1. This allows a single negative pulse to step the glow instead of incurring the expense of generating two separate pulses. When the glow steps to the zero cathode (Ko) an output pulse in the form of a negative voltage is developed across the 100K cathode resistor. This pulse may then be used as the input pulse to a succeeding drive circuit. The order in which guide 1 and guide 2 receive the input pulses determines the direction of rotation of the neon glow.



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

6814

SUBMINIATURE MEDIUM–MU TRIODE

The 6814 is a heater–cathode type medium–mu triode of subminiature construction designed primarily for multivibrator, frequency divider, and other electronic computer applications requiring high reliability during on–off service. To assure reliable operation in these applications, it is controlled by a 500 hour Interface Life Test and for minimum zero bias plate current and cut–off voltage during 1000 hour High Temperature Life Test. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Ratings)

Impact Acceleration	450 G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5 G
Bulb Temperature	165 °C
Altitude	80,000 Ft.

ELECTRICAL DATA (3)

Ratings and Normal Operations	MIL–E–1 Symbol	Test Limit or Absol. Min.	Norm. Test Cond.	Test Limit or Absol. Max.	MIL–E–1 Units
Heater Voltage	Ef	6.0	6.3	6.6	V
Plate Voltage	Eb	---	100	275(2)	Vdc
Peak Plate Forward Voltage	eb	---	---	600(2)	v
Plate Dissipation	Pp	---	---	2.2	Watts
DC Grid Voltage	Ec	–55	0	5.5	Vdc
Peak Grid Voltage	eg	–220	---	27.5(1)	v
Average Positive Grid Current	Ic	---	---	5.5(1)	mAdc
Peak Positive Grid Current	ic	---	---	110(1)	ma
Cathode Current Average	Ik	---	---	22	mAdc
Peak	ik	---	---	440(1)	ma
Heater Cathode Voltage	Ehk	---	0	±200	v
Grid Circuit Res.	Rgl	---	---	1.0	meg.
Cathode Resistance	Rk	---	150	---	ohms
		TESTS			
Amplification Factor	Mu	25	29	33	
Transconductance	Sm	5000	6000	7000	μmhos
Plate Resistance	rp	---	4800	---	ohms
Heater Current	If	138	150	162	mA
Heater Cathode Leakage Ehk=±100 Vdc	Ihk	---	---	5	μA
Plate Current	Ib	7.5	10	12.5	mAdc
Plate Current Ebb=140 Vdc; Rp=2700 ohms; Rg=60 kilohms; Ec1=–8.5 Vdc	Ib	---	---	100	μAdc

MECHANICAL DATA

ENVELOPE..... Glass T–3

OUTLINE..... 8–1

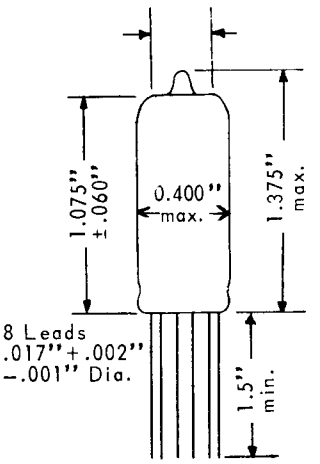
BASE ..... E8–10 Submin., Button Flexible Leads

BASING..... 8DK

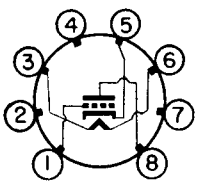
CATHODE.. Coated Unipotential

MOUNTING POSITION..... Any

PHYSICAL DIMENSIONS



BASING



TERMINAL CONNECTIONS:

Lead 1 Grid
Lead 2 N.C.
Lead 3 Heater
Lead 4 N.C.
Lead 5 Cathode
Lead 6 Heater
Lead 7 N.C.
Lead 8 Plate

ELECTRICAL DATA (3) (cont'd.)

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absol. Min.	Normal Test Conditions	Test Limit or Absol. Max.	MIL-E-1 Units
Plate Current Eb=125 Vdc; Ec=+3 Vdc Rp=2700 ohms; Rg=60 kilohms	Ib	14	15.5	---	mAdc
Low Freq. Vibration freq.=40 cps; G=15; Rp=10 k; Ck=1000 μf	Ep	---	---	50	mVac
INTERELECTRODE CAPACITANCES (No Shield)					
Grid to Plate	Cgp	1.1	---	1.8	$\mu\mu$fd
Input	Cin	1.6	---	2.8	$\mu\mu$fd
Output	Cout	0.5	---	0.9	$\mu\mu$fd

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test – 450 G. 30° hammer angle in Navy High Impact Shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97–100 °C for 15 seconds and immediately immersed in water at not more than 5 °C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater Cycling – Life Test A sample is subjected to 2000 on-off heater cycles at the following conditions: Ef=7.0 volts; Ehk=140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts.

Stability Life Test – Sample is operated for 2 and 20 hours to assure initial electrical stability (Δ_tIb $\leq$10 %). Tubes are operated with a plate voltage of 250 Vdc and an Ehk of +200 Vdc. Rk=1000 ohms.

Survival Rate – Life Test Sample is operated 100 hours to assure electrical stability (Ib $\geq$13 mAdc) and freedom from inoperatives. Tubes operated under Stability Life Test Conditions.

Intermittent Life – Test 1000 hours. Sample is operated under Survival Rate conditions with a minimum envelope temperature of 165 °C.

Cathode Interface – Life Test 500 hours. Sample is operated with Ef=6.9 V, other electrodes disconnected. (Interface Resistance $\leq$50 ohms).

Altitude – Sample is subjected to a pressure=21 ±2 mm Hg (80,000 ft.) at 300 Vac to insure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

(1) The absolute maximum ratings for pulse characteristics apply to a square topped pulse of 1000 cps. frequency and 1.0 percent duty factor. The total DC and peak heater cathode voltage shall not exceed 200 volts and the max. positive DC heater with respect to cathode voltage shall never exceed +100 Vdc.

(2) When the load impedance is of such type that the instantaneous voltage at the plate never exceeds the supply voltage, the supply voltage may be 300 Vdc, provided the maximum rated average dissipation is never exceeded on any electrode.

(3) CAUTION – – – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed.

For the purpose of inspection, use applicable paragraphs of Spec. MIL-E-1.

For misc. requirements see 3.6.

Par. No.	Test	Conditions	AQL	Inspection Level or Code	Symbol	LIMITS			Units
						Min.	Bogie	Max.	
GENERAL									
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---
QUALIFICATION (see note 3)									
---	Cathode	Coated unipotential	---	---	---	---	---	---	---
3.4.3	Base Connections	Outline E8-10	---	---	---	---	---	---	---
MEASUREMENT ACCEPTANCE TESTS, PART 1 (see note 4)									
4.9.1	Mechanical-production tests	Outline 8-1	---	---	---	---	---	---	---
4.10.4.1	Plate Current (1)	Eb=125 Vdc; Ec=+3 Vdc; Rp=2700 ohms; Rg=0.06 Meg.	0.65	II	Ib	14	15.5	---	mAdc
4.10.5.2	Grid Voltage	Eb=140 Vdc; Rp=2700 ohms; Rg=0.06 Meg. Ec/Ib=100 μAdc	0.65	II	Ec	---	---	-8.5	Vdc
4.10.6.1	Total grid current	Eb=150 Vdc; Rk=220 ohms; Rg=1.0 Meg.	0.65	II	Ic1	0	---	-0.4	μAdc
4.10.8	Heater Current		0.65	II	If	138	---	162	mA
4.10.15	Heater-cathode leakage	Ehk=+100 Vdc Ehk=-100 Vdc	0.65	II	Ihk Ihk	--- ---	--- ---	5.0 5.0	μAdc μAdc
4.7.5	Continuity and shorts	(See note 5)	0.4	II	---	---	---	---	---
MEASUREMENT ACCEPTANCE TESTS, PART 2									
4.8	Insulation of electrodes	g-all=-100 V p-all=-300 V	2.5	I	R R	50 50	--- ---	--- ---	Meg. Meg.
4.9.12.1	Low Pressure Voltage Breakdown	Pressure=21 ± 2 mm Hg; voltage=300 Vac	6.5	See Note 6	---	---	---	---	---
4.9.19.1	Low frequency vibration	F=40 cps; G=15; Rp=10,000 ohms; Ck=1000 μf	2.5	I	Ep	---	---	50	mVac
4.10.4.1	Plate current (2)	Ef=5.7 V; Eb=125 Vdc; Ec=+3 Vdc; Rp=2700 ohms; Rg=0.06 Meg	2.5	I	Ib	13	---	---	mAdc
4.10.4.1	Plate current (3)		6.5	L6	Ib	7.5	---	12.5	mAdc
4.10.6.2	Grid emission	Ef=7.5 V; Rg1=1.0 Meg; Ec1=-8.5 Vdc (see note 7)	2.5	I	Ic1	0	---	-0.5	μAdc
4.10.9	Transconductance		2.5	I	Sm	5000	---	7000	μmhos

Par. No.	Test	Conditions	AQL	Inspection Level or Code	Allowable Defects per characteristic		Symbol	LIMITS		Units
					First Sample	Combined Sample		Min.	Max.	
MEASUREMENT ACCEPTANCE TESTS, PART 2 (cont'd.)										
4.10.11.1	Amplification factor		6.5	L6	---	---	Mu	25	33	---
4.10.14	Direct Interelectrode Capacitance	No Shield	6.5	Code F	---	---	Cgp	1.1	1.8	μμf
		No Shield					Cin	1.6	2.8	μμf
		No Shield					Cout	0.5	0.9	μμf
DEGRADATION RATE ACCEPTANCE TESTS (see note 8)										
4.9.5.3	Subminiature lead fatigue		2.5	Code F	---	---	---	4	---	arcs
4.9.20.5	Shock test	Hammer angle = 30° (see note 9)	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min, 60 max.	6.5	See Note 6	---	---	---	---	---	---
---	Post Shock and fatigue test end points	Vibration	---	---	---	---	Ep	---	200	mVac
		Heater–cathode leakage								
		Ehk = +100 Vdc	---	---	---	---	Ihk	---	15	μAdc
		Ehk = –100 Vdc	---	---	---	---	Ihk	---	15	μAdc
		Plate Current (1)	---	---	---	---	Ib(1)	13	---	mAdc
		Grid Voltage	---	---	---	---	Ec	---	–8.5	Vdc
4.9.6.3	Glass Strain	See note 10	6.5	I	---	---	---	---	---	---
ACCEPTANCE LIFE TESTS (see note 8)										
4.11.7	Heater–cycling life test	Ef = 7.0 V; 1 min on. 4 min. off; Ehk = 140 Vac; Eb = Ec = 0 (see note 11)	2.5	Code H	---	---	---	---	---	---
---	Stability Life Test	Ef = 6.3 V; Eb = 250 Vdc; Ec = 0; Ehk = +200 Vdc; Rk = 1000; Rg = 1.0 Meg; TA = room (see note 12)	1.0	Code I	---	---	---	---	---	---
---	Life test end point (Stability) (2 and 20 hours)	Change in plate current (1) of individual tubes	---	---	---	---	Δ_tIb	---	10	%
4.11.3.1(b)	Survival Rate Life Test	Stability Life test conditions, or equivalent (see notes 13 and 14)	---	Code II	---	---	---	---	---	---
4.11.4	Life Test end points (Survival rate)	Continuity and shorts (see note 5)	0.65	---	---	---	---	---	---	---
	(100 hours)	Plate Current (1)	1.0	---	---	---	Ib	13	---	mAdc
4.11.5	Intermittent life test operation	Survival rate life test conditions; TE = +165°C min. (see notes 15 and 16)	---	---	---	---	---	---	---	---
4.11.4	Life–test end points (intermittent)	(See note 17)								
	(500 hours)	Inoperatives	---	---	1	3	---	---	---	---
		Plate current (1)	---	---	1	3	Ib	13	---	mAdc

Par. No.	Test	Conditions	AQL	Inspection Level or Code	Allowable Defects per characteristic		Symbol	LIMITS		Units
					First Sample	Combined Sample		Min	Max	
4.11.4 (cont'd.)		Grid Voltage	---	---	1	3	Ec	---	-8.5	Vdc
		Grid Current	---	---	1	3	Ic	0	-0.6	μAdc
		Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	2	5	Ihk	---	10	μAdc
		Ehk = -100 Vdc					Ihk	---	10	μAdc
		Heater current	---	---	2	5	If	136	166	mA
		Insulation of electrodes								
		g-all	---	---	2	5	R	25	---	Meg
		p-all					R	25	---	Meg
		Total defectives	---	---	4	8	---	---	---	---
4.11.4	Life test end points (intermittent) (1000 hours)	(See note 17)								
		Inoperatives	---	---	2	5	---	---	---	---
		Plate Current (1)	---	---	2	5	Ib	13	---	mAdc
		Grid Voltage	---	---	2	5	Ec	---	-8.5	Vdc
		Grid Current	---	---	2	5	Ic	0	-0.6	μAdc
		Insulation of electrodes								
		g-all	---	---	3	6	R	25	---	Meg
		p-all					R	25	---	Meg
		Total defectives	---	---	5	10	---	---	---	---
4.11.8	Cathode interface life test	Ef = 6.9 V; other elements disconnected (see note 18)	---	---	---	---	---	---	---	---
4.11.4	Life test end points (interface) (500 hours)	Ef = 5.7 ± 0.05 Vdc; Eb = 100 Vdc; Ec/Ib = 1.0 mAdc (see note 19)	---	---	1	3	Ri	---	50	ohms
4.9.18	Container drop	Required								
	Preparation for delivery	(See note 20)								

Note 1: The absolute-maximum ratings for pulse characteristics apply to a square-topped pulse of 1,000 cps frequency and 1.0 percent duty factor.

Note 2: The requirements of 6.5.1.1 shall apply with the following exception: When the load impedance is of such type that the instantaneous voltage at the plate never exceeds the supply voltage, the supply voltage may be 300 Vdc, provided the maximum rated average dissipation is never exceeded on any electrode.

Note 3: All tests listed herein shall be performed during qualification; however, these two tests are normally performed during qualification inspection only.

Note 4: The AQL for the combined defectives for attributes in measurement acceptance tests, part 1, excluding inoperatives and mechanical, shall be 1 percent.

Note 5: Tubes shall be tested for continuity of all possible circuits, for shorts between the tube elements, and for air leaks. During both continuity and short testing, the tube under test shall be tapped at least three times in each of two planes 90° to 120° apart with a tapper, which shall be adjusted to give an impulse of approximately one-half sine wave of 300 ± 50 microseconds duration, as measured 10 percent from the base, and having a minimum average amplitude equivalent to 40 G's peak acceleration.

During tapping, the tube shall be supported only by the socket and light finger or soft cushioned mechanical pressure on the dome of the bulb. The finger or mechanical pressure on the dome of the bulb shall be used only when necessary to prevent the tube from coming out of the socket and shall be so applied that it offers negligible restraint to lateral motion at the top of the bulb.

The tap blows shall be delivered to the tube approximately two-thirds up on the seated height.

NOTES (cont'd.)

Note 5: (cont'd.) The tapper impulse shall be measured with a Gulton Manufacturing Company type A-305 accelerometer, or equivalent, mounted in a standard production type (replaceable cap and clips) 7-pin socket and having no other support. The tap blows shall be delivered to the accelerometer at the approximate midpoint of its seated height and in a direction parallel to the plane of maximum sensitivity of the accelerometer. The output of the accelerometer shall be coupled through a cathode follower and low-pass filter-amplifier combination to a suitable calibrated oscilloscope. The low-pass filter shall have a minimum high-frequency cutoff at 5,000 cycles per second. The Gulton KA-1 test set, on 5-kc filter position, possesses appropriate characteristics.

The tube under test shall be connected to the shorts test equipment in such a manner that a specified minimum sensitivity is maintained between all elements in the tube. Except for heater to cathode, a short circuit shall be defined as an equivalent resistance between adjacent elements which persists for a period of time in excess of that determined by a limiting curve of resistance versus time duration passing through the following points: 600,000 ohms, constant value (permanent shorts); 500,000 ohms, 500 microseconds; 100,000 ohms, 100 microseconds; and 1,000 ohms, 60 microseconds. For heater to cathode, the minimum sensitivity shall be 10 percent of the above resistance value.

The maximum voltage between adjacent elements during shorts test shall be 70 Vdc, and the minimum shall be 20 Vdc.

Tubes which give an indication of one or more of the following shall be rejected as inoperable:

(a) Either a permanent or tap short at any time during the tapping procedure.
(b) Any open circuit.
(c) Air leaks (see 4.7.6).

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test, until a lot passes. Standard MIL-STD-105, sample size code letter F, shall apply.

Note 7: Prior to this test, tubes shall be preheated a minimum of 5 minutes at the conditions indicated below. The 3-minute test is not permitted. Test immediately after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef V	Eb Vdc	Ec Vdc	Rk ohms	Rg1 Meg
7.5	150	0	220	1.0

Note 8: *Destructive tests.* Tubes subjected to the following destructive tests are not to be delivered on the contract or order:

4.9.5.3	Subminiature lead fatigue
4.9.20.5	Shock test
4.9.20.6	Fatigue test
4.11.7	Heater-cycling life test
4.11.5	Intermittent life-test operation
4.11.8	Cathode interface life test

Note 9: A grid resistor of 0.1 megohm shall be added; however, this resistor will not be used when a thyratron-type short indicator is employed.

Note 10: The following modifications apply to 4.9.6.3:

(a) Replace fifth sentence with the following: The holder shall be in accordance with Drawing 245-JAN, and the tubes shall be immersed quickly.

(b) Replace seventh sentence with the following: After the 5-second submersion period, the tubes shall be removed and allowed to return to room temperature on a wooden surface.

Note 11: The no-load to steady full load regulation of heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit, or a heater-cathode short.

Note 12: *Stability life test.*

(a) Life test samples shall be selected from a lot at random in such a manner as to be representative of the lot. If such a selection results in a sample containing tubes which are outside the initial specification sheet limits for the relevant life test end-point characteristics, such tubes shall be replaced by randomly selected acceptable tubes.

NOTES (cont'd.)

Note 12: (cont'd.)

(b) Serially mark all tubes of the sample.

(c) Record referenced characteristic measurements on the entire sample after a maximum operation of 15 minutes under specified voltage and current conditions.

(d) The regular stability life test sample shall be operated at specified stability life test conditions or equivalent for 20±4 hours with an intermediate down–period reading point at 2 hours (±30 minutes). Intermittent or continuous operation may be used. The regular stability life test shall be in effect initially and shall continue in effect until eligibility criteria for the reduced hours stability life test have been met.

(e) *Reduced hours stability life test:*

1. Eligibility for reduced hours stability life test shall be as follows: No lot failure due to the regular stability life test has occured in the preceding five consecutive lots.

2. Reduced hours stability life test shall be conducted for 2 ±1/2 hours. Acceptance shall be based on the stability life test end–point limit. One lot failing the reduced hours stability life test shall result in loss of eligibility for the reduced hours stability life test.

3. The stability life test sample from the first lot accepted each month shall continue on stability life test to the 20±4 hours duration. Failure of this sample to meet the regular stability life test end–point limit shall result in loss of eligibility for the reduced hours stability life test.

(f) Life test shall be conducted (see 4.11 and 4.11.5) except that the following shall be substituted for 4.11.1(b): The mean electrode potentials, except heater or filament, may be established at values differing by not more than 5 percent from the specified values, provided the same average electrode dissipations are obtained that occur with the specified voltages. Fluctuations of all voltages, including heater or filament voltage, shall be as small as practicable.

(g) Record referenced characteristics measurements at the specified reading period. Referenced characteristic measurements shall be taken immediately following the specified reading periods or tubes shall be preheated 15 minutes under specified voltage and current conditions, and immediately measured following the specified reading periods. The 15–minute preheat shall be considered as part of the test time.

(h) A defective shall be defined as a tube having a change in referenced characteristic greater than that specified on the specification sheet at either the 2–hour or the 20–hour reading point.

(i) A resubmitted lot shall be subjected to all measurement acceptance tests except mechanical inspection, capacitance, vibration, and low–pressure voltage breakdown tests.

Note 13: The sampling and testing procedures for survival–rate life test shall be as specified in 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 14: For survival–rate life test, the equivalent stability life–test conditions shall be as specified in 20.2.5.2.5 of Appendix C.

Note 15: *Intermittent life tests.* Sampling and acceptance procedures for these tests shall be as specified in 20.2.5.3 of Appendix C.

Note 16: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B&S or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. The envelope temperature requirements will be satisfied if a tube, having bogie Ib (±5 percent) under normal test conditions, is determined to operate at the minimum specified temperature at any position in the life–test rack.

Note 17: Order for evaluation of life–test defects: See 4.11.3.1.2.

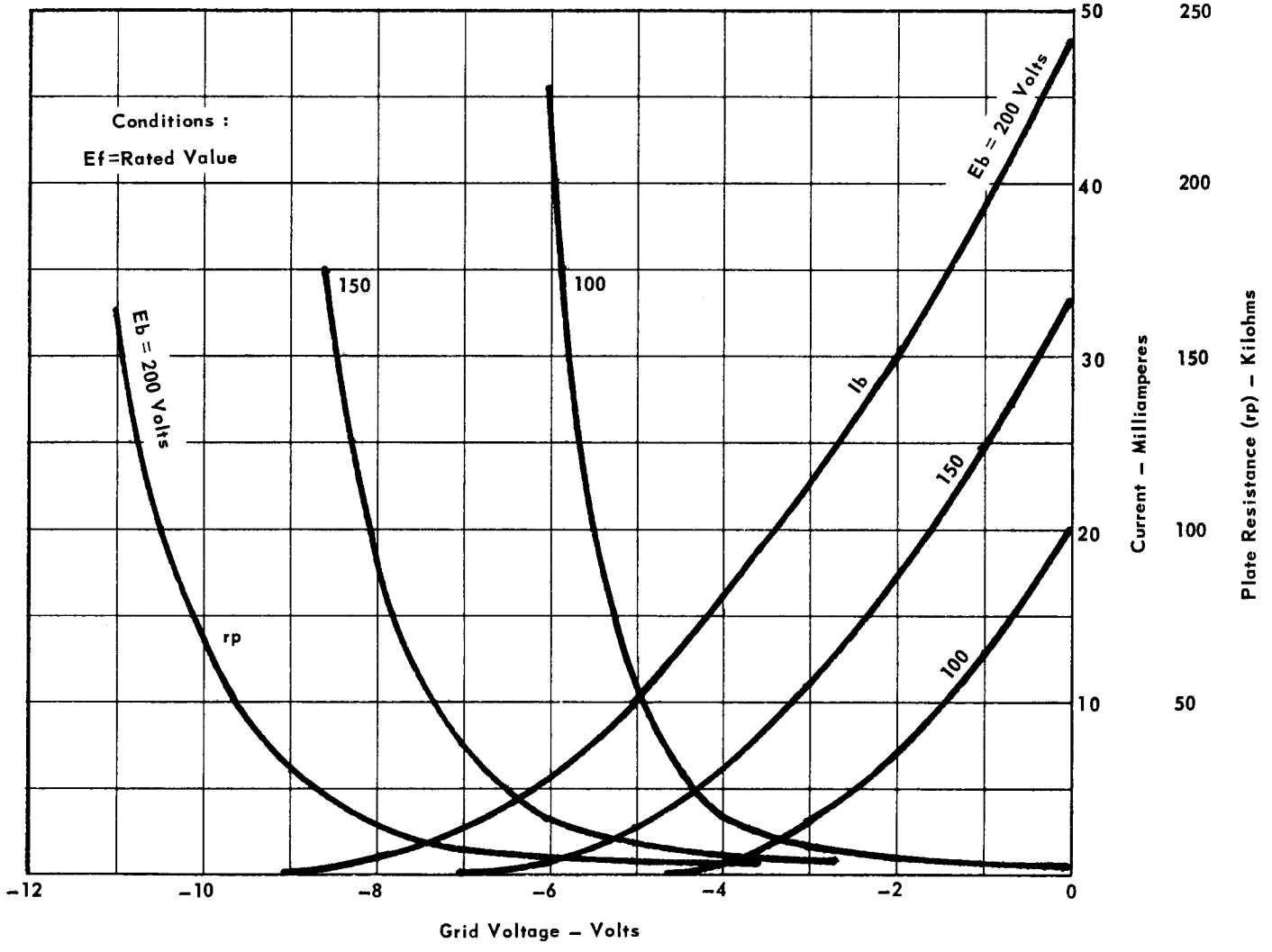
Note 18: The life–test sample shall consist of 20 tubes, and not more than two tube failures shall be permitted. In the event of rejection of the first sample due to failure of more than two tubes, a second sample of 40 tubes shall be selected from the lot. Acceptance shall then be based on the combined first and second samples. The total tube failures from the combined first and second samples shall not exceed five. A life–test defect is defined as a failure to meet the life test end point limits as specified on the tube specification sheet. The life test sample shall be read at zero hours and 500 hours (+48 hours, −24 hours)

NOTES (cont'd.)

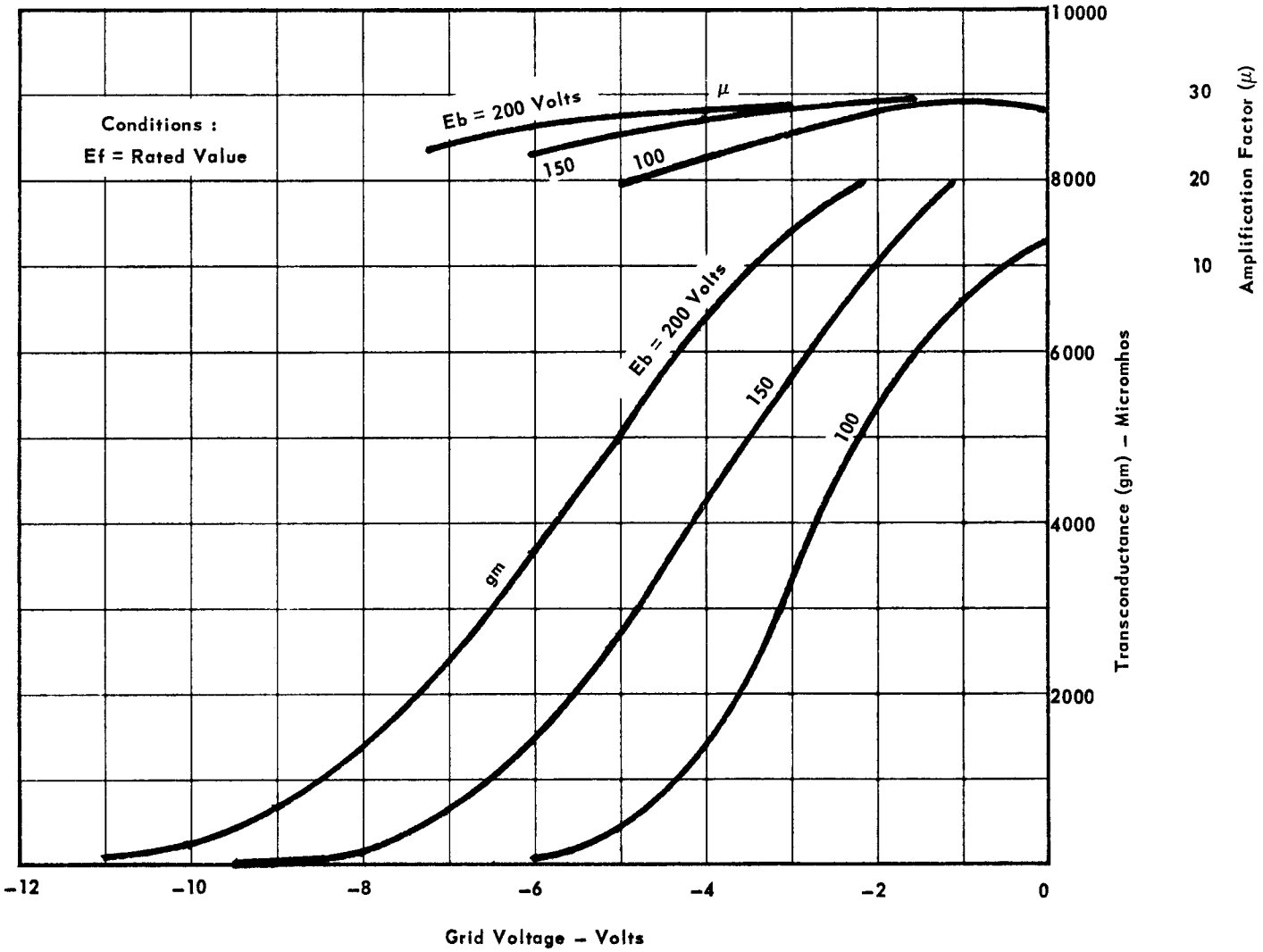
Note 19: Preheat approximately 5 minutes prior to testing, using Ef=6.0 V; other electrodes disconnected. No other test shall be made from the start of the cathode interface life test until after the measurement of the end-point characteristic, following completion of the indicated minimum number of life-test hours.

Note 20: Tubes shall be prepared for domestic or overseas shipment, as specified in the contract or order, in accordance with Specification MIL-E-75/1. Rough handling (container drop) test (d) and container size C shall apply.

AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS

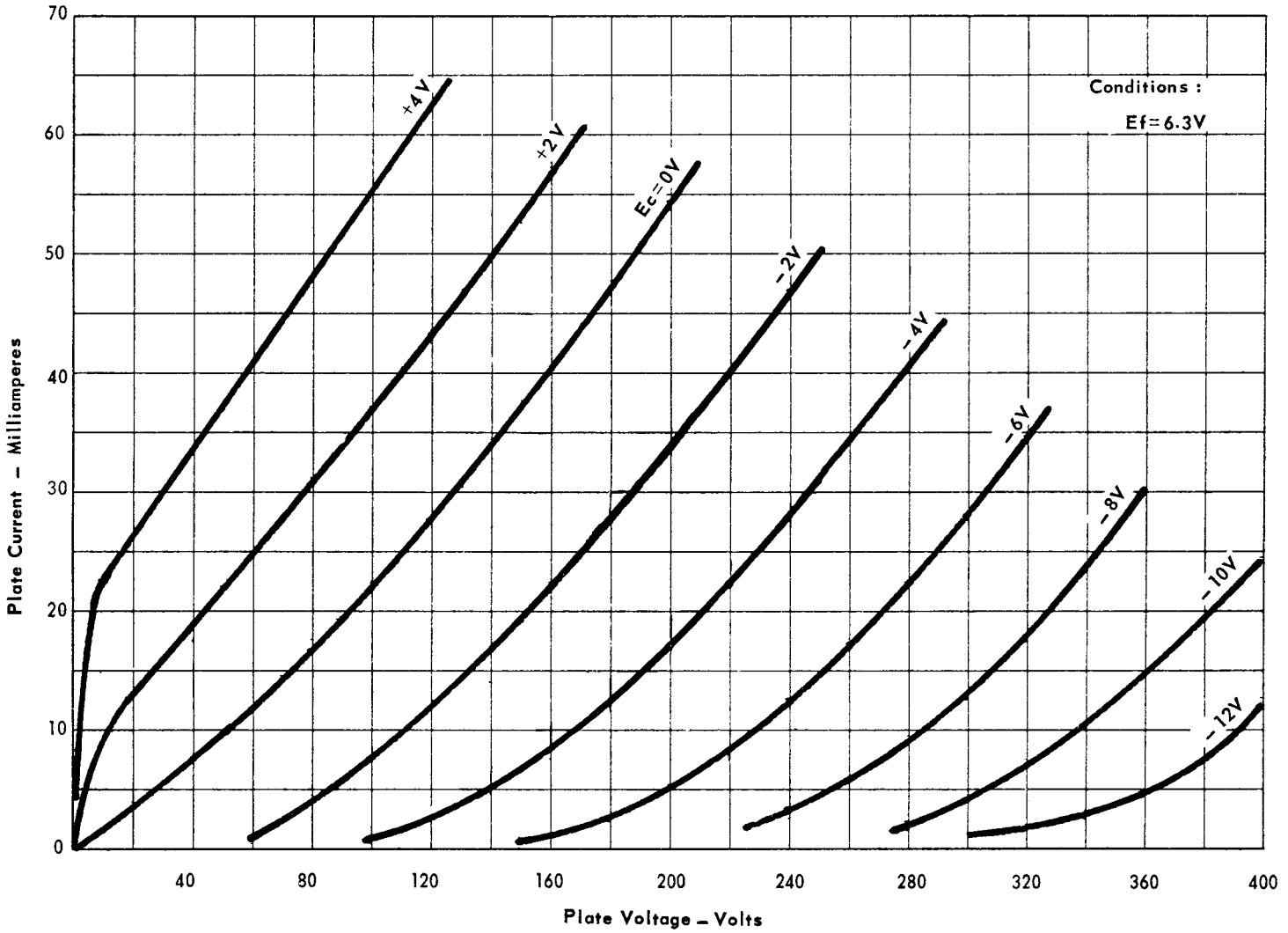


RAYTHEON

6814

SUBMINIATURE MEDIUM-MU TRIODE

PLATE CURRENT vs. PLATE VOLTAGE



RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6829

MINIATURE MEDIUM-MU DOUBLE TRIODE

The 6829 is a heater-cathode type, medium-mu double triode of miniature construction. The tube features a high zero-bias plate current, a sharp cutoff characteristic, and separate cathode connections for the two sections. It is especially designed for use in electronic computer applications and other "on-off" control applications requiring long periods of operation under cutoff conditions. The 6829 is mechanically rugged and has a heater-cathode structure capable of thousands of cycles of intermittent use.

MECHANICAL RATINGS: (Maximum)

Impact Acceleration	450G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5 G
Bulb Temperature	140°C
Altitude	60,000ft.

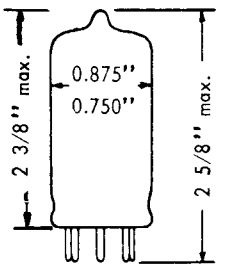
ELECTRICAL DATA

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Design * Min.	Norm. Test Cond.	Test Limit or Design * Max.	MIL-E-1 Units
Heater Voltage Series Parallel	 Ef: Ef:	 12.0 6.0	 --- 6.3	 13.2 6.6	 V V
Plate Voltage	Eb:	---	150	275	Vdc
Peak Plate Forward Volt.	eb:	---	---	550	v
Plate Dissipation	Pp/p:	---	---	2.2 (Note 4)	Watts
D.C. Grid Voltage	Ec:	-50	0	1.0	Vdc
Peak Grid Volt.	ec:	-100	--- (Note 1)	10	v
Aver. Positive Grid Current	Ic/g:	---	---	1.0	mAdc
Peak Positive Grid Current	ic/g:	---	---	50 (Note 1)	ma
Cathode Current Average Peak	 Ik/k: ik/k:	 --- ---	 --- ---	 20 160 (Note 1)	 mAdc ma
Heater to Cathode Volt.	Ehk:	100 (Note 3)	0	100 (Note 2)	v
Cathode Resist.	Rk/k:	---	220	---	ohms
Grid Resistance	Rg/g:	---	---	0.1 Fixed Bias 0.5 Cathode Bias	Meg.
Plate Resistance	rp:	---	7000	---	ohms
			Tests		
Heater Current	If:	420	450	480	mA
Heater Cathode Leakage Ehk = ±100 Vdc	Ihk: (Note 5)	---	---	7	μAdc
Plate Current Eb = 100 Vdc Rk=0	Ib: (Notes 5 & 6)	12	17	22	mAdc

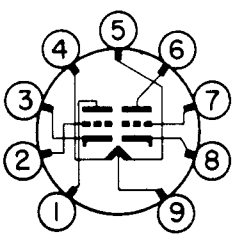
MECHANICAL DATA

ENVELOPE ..... Glass T6½
OUTLINE 6-8
BASE .. Miniature Button 9-Pin
BASING 9A
MOUNTING POSITION ..... Any
CATHODE . Coated Unipotential

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2
Pin 2 Grid, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Heater
Pin 5 Heater
Pin 6 Plate, Unit #1
Pin 7 Grid, Unit #1
Pin 8 Cathode, Unit #1
Pin 9 Heater Center-Tap

RAYTHEON

CK6829

MINIATURE MEDIUM-MU DOUBLE TRIODE

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Design Min.	Norm. Test Cond.	Test Limit or Design Max.	MIL-E-1 Units
		Tests			
Grid Voltage Ec/Ib = 150 μ Adc Rk = 0	Ec: (Note 5)	---	---	-7.5	Vdc
Grid Voltage Diff. Between Sections Ec/Ib = 150μAdc RK = 0	Δ Ec: (Note 5)	---	---	1.5	Vdc
Plate Current Ef = 5.7V Eb = 100 Vdc Rk = 0	Δ Ib_{Ef}:	--- (Notes 3, 6, 5, 7)	---	15	%
Plate Current Eb = 150 Vdc	Ib:	6.3 (Note 5)	---	10.7	mAdc
Transconductance	Sm:	5300 (Note 5)	---	8100	μmhos
Amplification Factor	Mu:	39 (Note 5)	---	55	
Pulse Cathode Curr.	ik:	160 (Note 8)	---	---	ma
Interelectrode Capacitances (No shield)	Cgp:	2.4 (Note 5)	---	3.6	$\mu\mu$f
	Cin:	3.0 (Note 5)	---	5.0	$\mu\mu$f
	Cout: Section 1	.37	---	0.57	$\mu\mu$f
	Cout: Section 2	.30	---	0.46	$\mu\mu$f
	Cpp:	---	---	0.90	$\mu\mu$f
	Cgg:	---	---	0.03	$\mu\mu$f
	Chk:	3.0 (Note 5)	---	5.0	$\mu\mu$f
Vibration Rp = 2000 Ω (F = 25 cps: G = 2.5)	Ep:	--- (Note 5)	---	300	mVac

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450 G. 30° hammer angle in Navy High Impact Shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C for 5 seconds. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions: Ef = 7.5V (htrs. in parallel) Ehk = + 135 Vdc; Ec = Eb = 0; Rk = 0. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts.

Stability Life Test – Sample is operated for 1 hour to assure initial electrical stability. (Δ_t Ib < 10%). Tubes are operated with Ebb = Ecc = 180 Vdc and an Ehk = + 135 Vdc Rk = 0 and an Rg/g of 3.9 meg is used.

Survival Rate Life Test –	Sample is operated 100 hrs to assure electrical stability (Ib > 11 mAdc) and freedom from inoperatives. Tubes are operated under Stability Life Test conditions.
Intermittent Life Test –	1000 hours. Sample is operated under Survival Rate Conditions with a minimum envelope temp. of 140°C.
Cathode Interface Life Test –	500 hours. Sample is operated with Ef = 6.6V, other electrodes disconnected. (Interface Resistance < 50 Ω.)
Pulse Life Test –	500 hrs. Sample is subjected to a grid input pulse of 1% duty cycle.
Altitude –	Sample is subjected to a pressure = 55 ± 5 mm Hg (60,000 ft.) at 500 Vac. to assure freedom from flashover or corona at the pins of the tube.

APPLICATION NOTES

Note 1 – Rating based on a pulse of 10 μsec. duration, 1 percent duty cycle, and 1000 pps repetition rate.

Note 2 – For pulse voltage of less than 1 percent duty cycle, the peak voltage may be 150 volts maximum.

Note 3 – Tie heaters in parallel.

Note 4 – The design max. rating for the combined plate dissipation of both plates is 4.0 watts.

Note 5 – Test each unit separately.

Note 6 – Tie each grid through a 500K resistor (±1%) to the corresponding plate.

Note 7 – Plate Current 2 is the percent change in Plate Current (1) of an individual tube resulting from the change in Ef.

Note 8 – E1c = E2c = –20 Vdc. Grid is driven with pulse circuit as follows: e1c = e2c = +10v; Prr = 1000 pps; tp = 10 μs; tr < 1 μs; tf < 1 μsec. Read peak cathode current in each section separately with opposite section operating under pulse conditions. Preheat at Ef = 6.3 V, with heaters in parallel, for 5 minutes and with no other Voltages applied.

CAUTION – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

* Design maximum ratings, in general, are limiting values, based on bogie tubes, at which satisfactory tube life can be expected under the types of service for which the tube is rated. The design maximum rating for plate dissipation is defined as 120 percent of the product of the plate voltage applied during intermittent life test and the plate current of an average (bogie) tube during the life test, expressed in watts.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.

For miscellaneous requirements, use Paragraph 3.3, Inspection Instructions for Electron Tubes.

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS, NOTE 4						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
	QUALIFICATION APPROVAL TESTS											
3.1	Qualification Approval:	Required for JAN Marking	---	---								
---	Cathode:	Coated Unipotential	---	---								
3.4.3	Base Connections:	E9-1	---	---								
4.9.20.3	Vibration (1):	Rp= 2000; Note 2	---	---	Ep	---	---	---	---	300	---	mVac
	MEASUREMENTS ACCEPTANCE TESTS, Part 1, Note 3											
4.10.8	Heater Current		---	---	If:	---	432	450	468	---	36	mA
4.10.8	Heater Current:		0.65	II	If:	420	---	---	---	480	---	mA
4.10.15	Heater-Cathode Leakage:	Ehk=+ 100 Vdc Ehk=- 100 Vdc Note 2	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	7 7	--- ---	μAdc μAdc
4.10.6.1	† Grid Current:	Rg=0.5 Meg;Note 2	0.65	II	Ic:	0	---	---	---	-0.5	---	μAdc
4.10.4.1	Plate Current (1):	Eb= 100 Vdc; Rk = 0; Notes 2, 26	---	---	Ib:	---	14.7	17.0	19.3	---	4.8	mAdc
4.10.4.1	† Plate Current: (1)	Eb= 100 Vdc; Rk= 0; Notes 2, 26	0.65	II	Ib:	12.0	---	---	---	22.0	---	mAdc
4.10.5.2	Grid Voltage:	Ec/Ib= 150uAdc; Rk=0; Note 2	0.65	II	Ec:	---	---	---	---	-7.5	---	Vdc
4.10.5.2	Grid Voltage Difference Between Sections:	Ec/Ib=150μAdc; Rk= 0; Note 2	0.65	II	ΔEc:	---	---	---	---	1.5	---	Vdc
4.7.5	Continuity and Short: (Inoperatives)		0.4	II		---	---	---	---	---	---	
4.9.1	Mechanical:	Envelope Outline No. 6-8	---	---		---	---	---	---	---	---	
	MEASUREMENTS ACCEPTANCE TESTS, Part 2											
4.8	Insulation of Electrodes:	Eg-all= -100Vdc Ep-all= -300Vdc Note 2	2.5	L6	R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.4.1	Plate Current (2):	Ef=5.7V; Eb=100 Vdc; Rk=0; Notes 1, 2, 25, 26	2.5	I	Δ Ib: Ef	---	---	---	---	15	---	%
4.10.6.2	Grid Emission:	Ef=7.5V; Ec= -30Vdc; Rg=0.5Meg; Notes 2, 18, 25	2.5	I	Isc:	0	---	---	...	-1.0	---	μAdc
4.10.3.1	RF Noise:	Ecal=15mVac; Rk=220; Ck=0.2uf; Notes 7, 19	2.5	I		---	---	---	---	---	---	
4.10.3.5	Noise & Microphonics:	Ef=6.3Vac; Ebb=250Vdc; Ecal=200mVac; Rp=0.1Meg, Rk=1000; Ck=1000uf; Notes 7, 20, 25	2.5	I		---	---	---	---	---	---	
4.10.4.1	Plate Current (3):	Note 2	2.5	I	Ib:	6.3	---	---	---	10.7	---	mAdc
4.10.9	Transconductance:	Note 2	2.5	I	Sm:	5300	---	---	---	8100	---	μmhos
4.10.11.1	Amplification Factor	Note 2	6.5	L6	Mu:	39	---	---	---	55	---	

MINIATURE MEDIUM-MU DOUBLE TRIODE

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	LIMITS Min.	LAL	Bogie	UAL	Max.	ALD	Units
	MEASUREMENTS ACCEPTANCE TESTS, Part 2, (cont'd.)											
4.10.7.5	Pulse Cathode Current:	Rk=0; Note 27	6.5	L6	ik:	160	---	---	---	---	---	ma
4.10.14	Capacitance:	No Shield; Note 2			Cgp:	2.4	---	---	---	3.6	---	μμf
		No Shield; Note 2			Cin:	3.0	---	---	---	5.0	---	μμf
		No Shield; Section 1			Cout:	0.37	---	---	---	0.57	---	μμf
		No Shield; Section 2	6.5	Code E	Cout:	0.30	---	---	---	0.46	---	μμf
		No Shield			Cpp:	---	---	---	---	0.90	---	μμf
		No Shield			Cgg:	---	---	---	---	0.03	---	μμf
		No Shield; Note 2			Chk:	3.0	---	---	---	5.0	---	μμf
4.9.12.1	Low Pressure Voltage Breakdown:	Pressure=55±5mm Hg.; Voltage=500Vac	6.5	Note 5		---	---	---	---	---	---	
4.9.19.1	Vibration(2):	Rp=2000; Note 2	6.5	Code I	Ep:	---	---	---	---	300	---	mVac
	DEGRADATION RATE ACCEPTANCE TESTS, Note 6											
4.9.20.5	Shock:	Hammer Angle=30°; Ehk=+100Vdc; Note 8	---	---		---	---	---	---	---	---	
4.9.20.6	Fatigue:	G=2.5; Fixed Frequency; F=25 min., 60 max.	6.5	Note 5		---	---	---	---	---	---	
---	Post Shock & Fatigue Test End Points:	Vibration(2)	---	---	Ep:	---	---	---	---	450	---	mVac
		Heater-Cathode Leakage										
		Ehk=+100Vdc	---	---	Ihk:	---	---	---	---	20	---	μAdc
		Ehk=-100Vdc	---	---	Ihk:	---	---	---	---	20	---	μAdc
		Plate Current (1)	---	---	Ib:	11.0	---	---	---	---	---	mAdc
		Grid Current	---	---	Ic:	0	---	---	---	-0.7	---	μAdc
4.9.6.1	Miniature Tube Base Strain:		---	---		---	---	---	---	---	---	
---	Glass Strain:	Note 9	2.5	I		---	---	---	---	---	---	

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic: 1st Sample	Allowable Defectives per Characteristic: Combined Samples	Sym.	LIMITS Min.	LIMITS Max.	Units
	ACCEPTANCE LIFE TESTS, Note 6									
4.11.7	Heater Cycling Life Test:	Ef=7.5V; Ehk=+135 Vdc; Ec=Eb=0; Rk=0; Notes 10,25	---	---	---	---		---	---	
4.11.4	Heater Cycling Life Test End Points:	Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	---	---	Ihk:	---	15	μAdc
		Ehk=-100Vdc	---	---	---	---	Ihk:	---	15	μAdc
---	Stability Life Test: (1 hour)	Ebb=Ecc=180Vdc; Ehk=+135 Vdc; Rk=0; Rg/g=3.9Meg; Rp/p=3900; TA=Room; Notes 2, 11	1.0	Code 1	---	---		---	---	
4.11.4	Stability Life Test End Points:	Change in Plate Current (1) of Individual tubes	---	---	---	---	Δ Ib: t	---	10	%
---	Survival Rate Life Test: (100 hours)	Stability Life Test Conditions or Equivalent; Notes 2, 12, 13	---	II	---	---		---	---	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives)	0.65	---	---	---		---	---	
		Plate Current (1)	1.0	---	---	---	Ib:	11.0	---	mAdc

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units
					1st Sample	Combined Samples		Min.	Max.	
ACCEPTANCE LIFE TESTS, Note 6, (cont'd)										
4.11.5	Intermittent Zero Bias Life Test (1):	Stability Life Test Conditions; T Envelope=140°C min.; Notes 2, 14, 15	---	---	---	---		---	---	
4.11.4	Intermittent Zero Bias Life Test (1):End Points (500 hours)	Note 16								
		Inoperatives; Note 17	---	---	1	3		---	---	
		Grid Current	---	---	1	3	Ic:	0	-0.5	μAdc
		Change in Plate Current (1) of individual tubes	---	---	1	3	Δ_t^{Ib}:	---	20	%
		Plate Current (2)	---	---	2	5	Δ_{Ef}^{Ib}:	---	15	%
		Plate Current (1) average change	---	---	---	---	$Avg\Delta_t^{Ib}$:	---	15	%
		Total Defectives	---	---	3	7		---	---	
4.11.4	Intermittent Zero Bias Life Test(1) End Points: (1000 hours)	Note 16								
		Inoperatives;Note 17	---	---	2	5		---	---	
		Grid Current	---	---	2	5	Ic:	0	-0.5	μAdc
		Change in Plate Current (1) of individual tubes	---	---	2	5	Δ_t^{Ib}:	---	25	%
		Total Defectives	---	---	4	8		---	---	
4.11.5	Intermittent Life Test(2):	Eb=250Vdc;Ec=0;Ehk=-135 Vdc;Rk/k=560;Rg/g=0.5 Meg; Notes 2, 14	---	---	---	---		---	---	
4.11.4	Intermittent Life Test(2): End Points: (500 hours)	Note 16								
		Inoperatives; Note 17	---	---	1	3		---	---	
		Grid Current	---	---	1	3	Ic:	0	-0.5	μAdc
		Heater Current	---	---	1	3	If:	420	485	mA
		Transconductance	---	---	1	3	Sm:	4800	8100	μmhos
		Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	1	3	Ihk:	---	7	μAdc
		Ehk=-100Vdc					Ihk:	---	7	μAdc
		Insulation of Electrodes								
		Eg-all=-100Vdc	---	---	2	5	R:	125	---	Meg
		Ep-all=-300Vdc					R:	125	---	Meg
		Total Defectives	---	---	4	8		---	---	
4.11.4	Intermittent Life Test(2) End Points: (1000 hours)	Note 16								
		Inoperatives; Note 17	---	---	2	5		---	---	
		Grid Current	---	---	2	5	Ic:	0	-0.5	μAdc
		Heater Current	---	---	2	5	If:	420	490	mA
		Transconductance	---	---	2	5	Sm	4350	8100	μmhos
		Heater-Cathode Leakage								
		Ehk=+100Vdc	---	---	2	5	Ihk:	---	7	μAdc
		Ehk=-100Vdc					Ihk:	---	7	μAdc
		Insulation of Electrodes								
		Eg-all=-100Vdc	---	---	2	5	R:	100	---	Meg
		Ep-all=-300Vdc					R:	100	---	Meg
		Total Defectives	---	---	5	10		---	---	
---	Interface Life Test:	Ef=6.6V;other electrodes disconnected;Notes 25, 28	---	---	---	---	t:	500	---	hrs
4.11.4	Interface Life Test End Points:	Ef=6.0±0.05Vdc; Eb=125 Vdc; Ec/Ib=2.5mAdc; Rk=0; Notes 25, 29, 30	---	---	1	3	Ri:	---	50	ohms
---	Pulse Life Test:	Eb=180Vdc;Rk=0; Notes 25, 31	---	Code F	---	---	t:	500	---	hrs

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units
					1st Sample	Combined Samples		Min.	Max.	
	ACCEPTANCE LIFE TESTS, Note 6 (cont'd)									
4.11.4	Pulse Life Test	Inoperatives; Note 17	---	---	1	3	ik:	---	---	
	End Points:	Pulse Cathode Current	---	---	1	3		150	---	ma
	PACKAGING REQUIREMENTS									
4.9.18.1.1	Container Drop:	(d) Package Group 1; Container Size C								

Note 1: Plate Current (2) is the percent change in Plate Current (1) of an individual tube resulting from the change in Ef.

Note 2: Test each unit separately.

Note 3: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 4: Variables Sampling Procedure:
See paragraphs 5.3.3 to 5.3.3.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 5: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL-STD-105, sample size code letter F shall apply.

Note 6: Destructive Tests:
Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.7	Heater-Cycling Life Test
4.11.5	Intermittent Life Test
---	Interface Life Test

Note 7: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 8: Rg/g = 0.1 Meg; Rg not to be used when thratron type short indicator is used.

Note 9: Glass Strain Procedures – All tubes subjected to this test shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperature. The entire tube shall be immersed in water at not less than 97°C for 15 seconds and immediately thereafter immersed in water at not more than 5°C for 5 seconds. The volume of water shall be large enough that the temperature will not be appreciably affected by the test. The holder shall be in accordance with Drawing #245-JAN, and the tubes shall be immersed quickly. The tubes shall be so placed in the water that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period, the tubes shall be removed and allowed to return to room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks (Ref. MIL-E-1, Par. 3.2.4.3). Electrical rejects, other than inoperatives, may be used in the performance of this test.

Note 10: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defeat shall consist of an open heater, open cathode circuit, heater-cathode short, or heater-cathode leakage current in excess of the specified heater cycling life test end point limit.

Note 11: Stability Life Test: The sampling and testing procedure for this test shall be in accordance with paragraphs 5.3.4.1(a) to 5.3.4.1(g), inclusive, of the Inspection Instructions for Electron Tubes.

Note 12: SURVIVAL RATE LIFE TEST: The sampling and testing procedure for this test shall be as defined in paragraphs 5.3.4.2 to 5.3.4.2.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 13: For Survival Rate Life Test, the equivalent Stability Life Test conditions shall be as defined in paragraph 5.3.4.2.5 of the Inspection Instructions for Electron Tubes.

Note 14: Intermittent Life Tests: Sampling and acceptance procedures for these tests shall be as defined in paragraphs 5.3.4.3(a) to 5.3.4.3(i), inclusive, of the Inspection Instructions for Electron Tubes, except that the following sub-paragraph shall be added to 5.3.4.3(e): (4) The life test sample from the first lot accepted each month shall continue on life test for an additional 500 hours (1000 hours total life test time). Failure of this sample to meet the 1000-hour life test end points shall result in loss of eligibility for reduced hours testing.

Note 15: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. Envelope Temperature requirement will be satisfied if tube, having bogie Ib(± 5%) under normal test conditions, is determined to operate at minimum specified temperature at any point in the life test rack.

Note 16: Order for Evaluation of Life Test Defects: See Paragraph 5.3.4.4 of the Inspection Instructions for Electron Tubes.

Note 17: An inoperative as referenced in Life Test is defined as a tube having one (1) or more of the following defects: discontinuity (Ref. MIL-E-1, par. 4.7.1), shorts (Ref. MIL-E-1, par. 4.7.2), air leaks (Ref. MIL-E-1, par. 3.2.4.3).

Note 18: Prior to this test, tubes shall be preheated a minimum of five (5) minutes with all sections operating at the conditions indicated below. Three minute test is not permitted. Test within three seconds after preheating. Grid Emission shall be the last test performed on the sample selected for Grid Emission test.

Ef	Ecc	Ebb	Rg/g	Rp/p	Rk/k
V	Vdc	Vdc	Meg	ohms	ohms
7.5	180	180	3.9	3900	0

Note 19: In addition to the rejection criteria of Par. 4.10.3.1, MIL-E-1, the output shall be read on a VU meter using a rejection limit of five (5) VU. Five (5) VU is the meter deflection obtained with a steady state output of 3 mW from the amplifier.

Note 20: The rejection level shall be set at the VU meter reading obtained during calibration.

Note 21: Test each unit separately with normal test voltages applied to the opposite section.

Note 22: Rating based on a pulse of 10 microsecond duration, 1 percent duty cycle, and 1000 pps repetition rate.

Note 23: For pulse voltage of less than 1 percent duty cycle, the peak voltage may be 150 volts maximum.

Note 24: The design-maximum rating for the combined plate dissipation of both plates is 4.0 watts.

Note 25: Tie heaters in parallel.

Note 26: Tie each grid through a 500,000 ohms resistor (±1%) to the corresponding plate.

Note 27: E1c= E2c = −20Vdc. Grid is driven with pulse circuit as follows: e1c= e2c=+ 10v; prr = 1000pps; tp = 10us; tr < 1us; tf < 1us; Read peak cathode current in each section separately with opposite section operating under pulse conditions. Preheat at Ef = 6.3V, with heaters in parallel, for 5 minutes and with no other voltages applied.

Note 28: The life test sample shall consist of 20 tubes, and not more than one (1) tube failure shall be permitted. In the event of rejection of the first sample due to failure of more than one (1) tube, a second sample of 40 tubes shall be selected from the lot. Acceptance shall then be based on the combined first and second samples. The total tube failures from the combined first and second samples shall not exceed three (3). A life test defect is defined as a failure to meet the life test end point limits as specified in the tube specification sheet. The life test sample shall be read at zero hours and 500 hours (plus 48 hours, minus 24 hours).

Note 29: Preheat approximately 5 minutes prior to testing, using either Ef = 12.0V (heaters in series) or Ef = 6.0V (heaters in parallel) & other electrodes disconnected. Test each section separately. No other test shall be made from the start of the Interface Life Test until after the measurement of the end point characteristic following completion of the indicated minimum of life test hours.

Note 30: The value of interface resistance shall be measured in the standard test circuit, Drawing 248-JAN. As an alternative, a test method known to correlate with the method and conditions specified in this specification sheet may be utilized.

Note 31: E1c = E2c = -20Vdc (grid leak bias is permissible); Rg/g = 50 ohms; Rp/p = 200 ohms. Grid is driven with pulse circuit as follows: tp = 10 us ± 1 us; duty cycle = 1% ± 0.1%; tr < 1.5us; tf < 2.5us; e1c = e2c = + 11.5 volts (driver side of Rg).

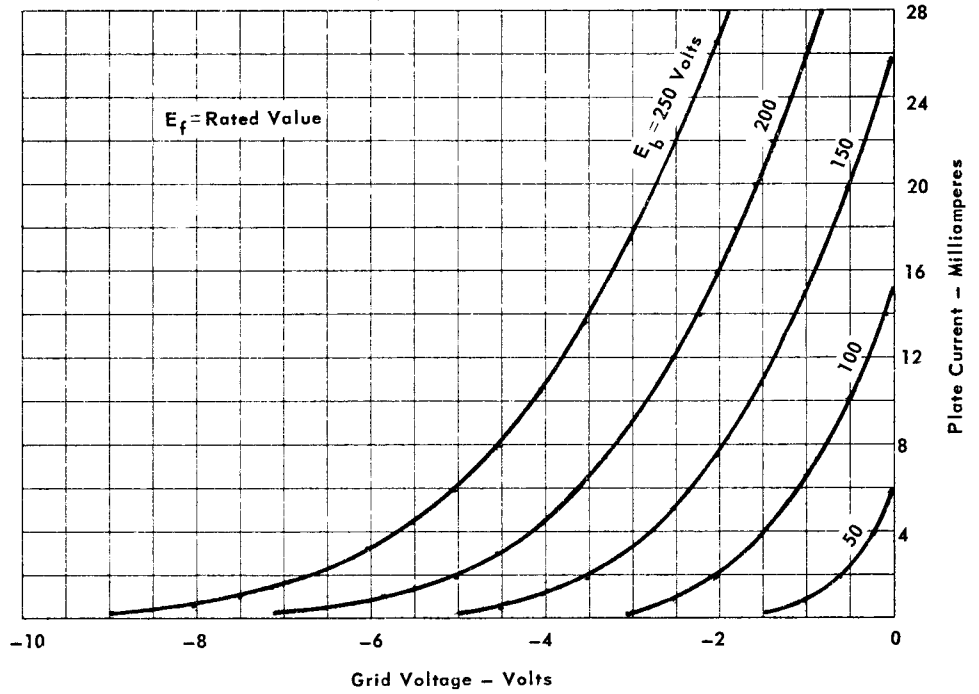
RAYTHEON

CK6829

MINIATURE MEDIUM-MU DOUBLE TRIODE

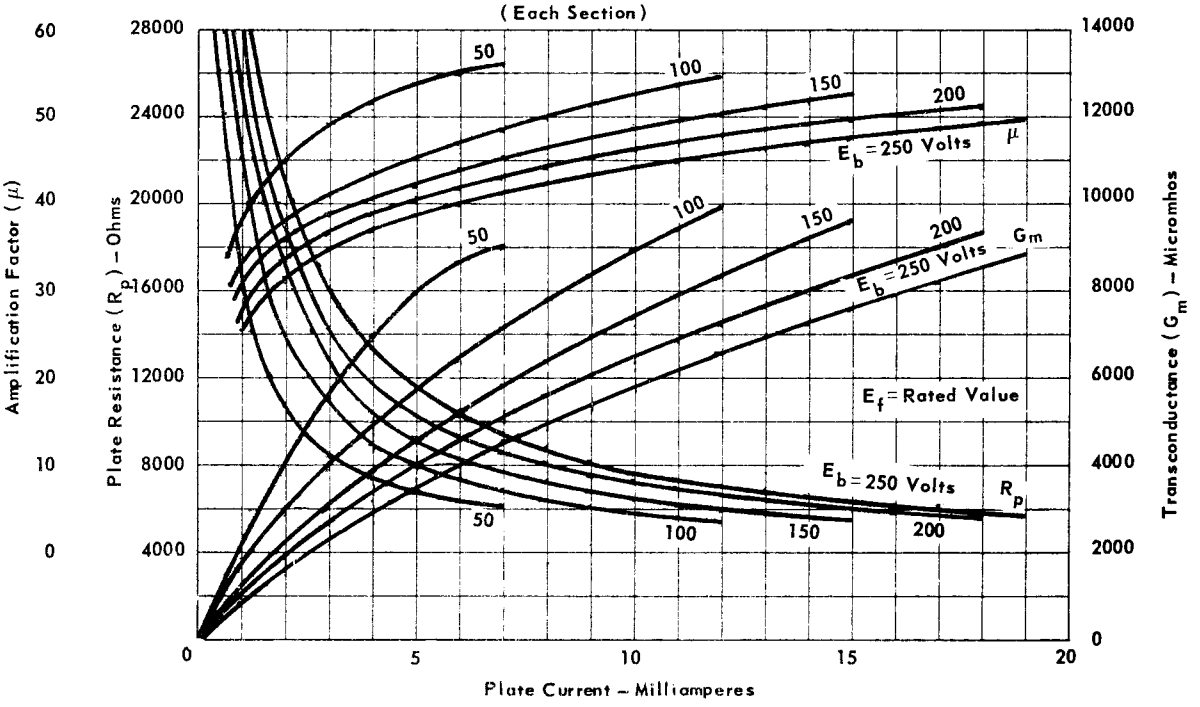
AVERAGE TRANSFER CHARACTERISTICS

(Each Section)



AVERAGE CHARACTERISTICS

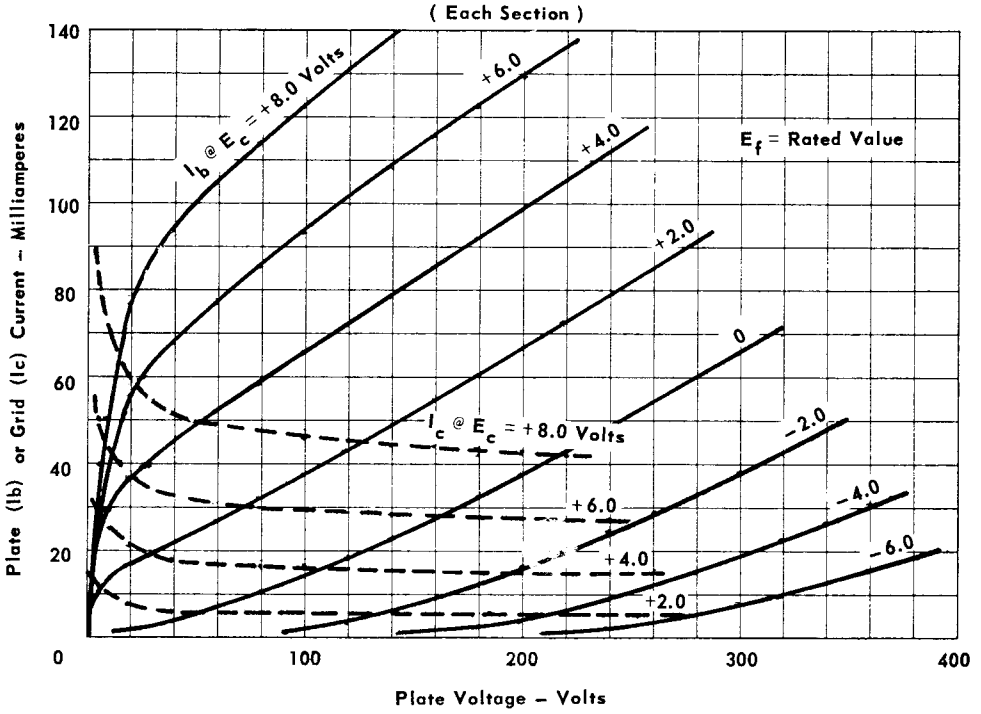
(Each Section)



MINIATURE MEDIUM-MU DOUBLE TRIODE

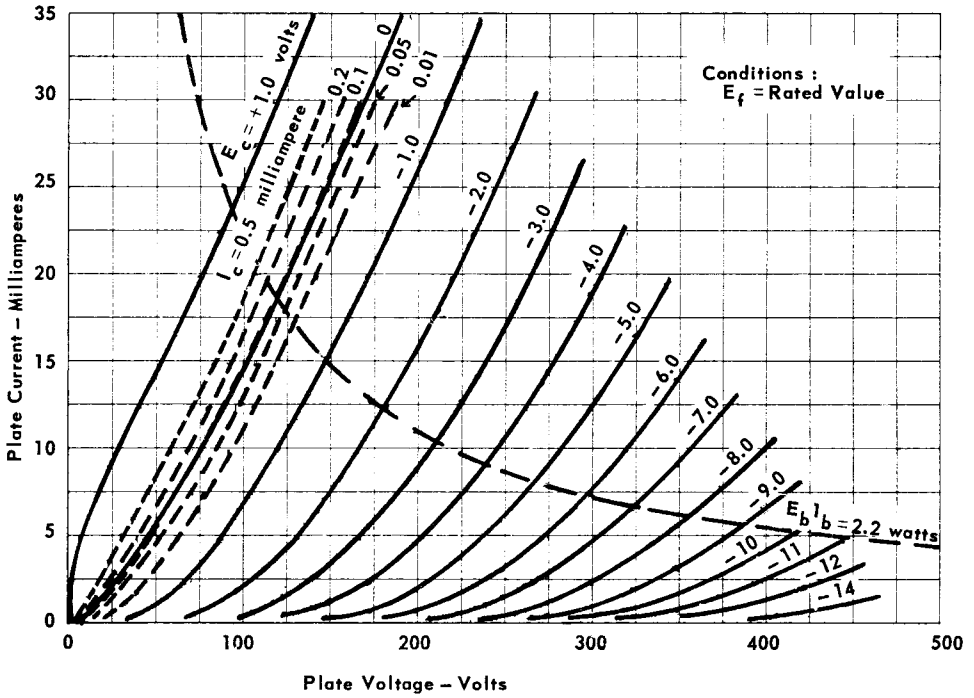
AVERAGE PLATE CHARACTERISTICS

(Each Section)



AVERAGE PLATE CHARACTERISTICS

(Each Section)



CK6835/ QK464A



The CK6835/QK464A is a cathode ray Recording Storage Tube capable of repeating information stored for many hours up to 30,000 times without appreciable deterioration of signal strength of quality. Magnetic Focusing and deflection are required. This tube is unique in its speed of operation, its dynamic range and in the quantity of data which it can store.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage	6.3 V ±10%
Heater Current	0.6 A

Maximum Ratings

Anode Voltage	4000 Vdc
Grid #1 (control electrode) Voltage	
Negative Bias	—125 Vdc
Positive Bias	0 Vdc
Positive Peak Value	150 V
Deceleration Screen Voltage	500 Vdc
Storage Screen Voltage	500 Vdc
Signal Electrode Voltage	500 Vdc

Typical Operating Conditions

(All Voltages Measured With Respect to Cathode)

	Prime	Read	Erase	Write
Anode Voltage	3500 Vdc	3500 Vdc	3500 Vdc	3500 Vdc
Deceleration Screen Voltage	350 Vdc	350 Vdc	350 Vdc	350 Vdc
Storage Screen Voltage	20 Vdc	10 Vdc	350 Vdc	350 Vdc
Signal Electrode Voltage	350 Vdc	350 Vdc	350 Vdc	350 Vdc
Signal Electrode Current (pk)		0.2 ua		
Cathode Current	100 ua	1 ua	50 ua	*

*This value must be determined empirically depending on scan speeds and electrode settings.

MECHANICAL CHARACTERISTICS

Focusing	Magnetic
Deflection	Magnetic
Maximum Deflection Angle	20°
Over-all Dimensions	13¾" x 3" Dia.
Storage Screen Diameter (approx)	1¾"
Base	Small Shell Duodecal
Resolving Power (on diameter as specified for television)	600 lines minimum
Capacitance — Signal Electrode to all other elements	20 uuf (approx)
Mounting Position	Any

Printed in U.S.A.

DETAILED ELECTRICAL INFORMATION

CONDITIONS OF OPERATION

Application of the recording storage tube involves four operations, namely: prime, write, read and erase. Any form of scanning may be utilized for the above operations. These operations are performed in the following manner and sequence:

Prime — Priming is accomplished by uniformly charging the storage surface. To prime the storage screen reduce the screen voltage below the critical potential (usually 30 V) and scan the raster with 10 to 50 uA depending on priming speed desired.

Write — Set control grid bias at cutoff either manually or automatically and apply signal to be stored. Signal voltage amplitude required will depend on the sweep speed employed and is measured in terms of average cathode current.

Read — Set grid bias to permit an unmodulated beam current of approximately 2 uA. If the storage screen voltage is properly set, the stored signal will modulate the beam and an output can be taken from the signal electrode.

Erase — Erasing is performed by writing a DC signal into the tube, thus normalizing the storage element at full modulation level. Both the signal electrode and storage screen voltage should be 350 volts for this operation. If erase speeds are of no importance, cathode currents of less than 50 uA are recommended.

WRITING AND ERASING TIME

Writing time is defined as the time required for the electron beam to change the storage element charge to a potential corresponding to the full modulation range. With the proper current adjustment for high speed writing, less than 0.05 microseconds per spot element is required for full modulation.

The erasing time will be comparable to the writing time since the erasing operation is simply the writing in of an unmodulated signal.

STORAGE ABILITY

The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the cathode current.

When reading with a low beam current of about 2 uA at a television repetition rate and scan, 20,000 to 30,000 consecutive readings can be made without any appreciable deterioration of the stored signal. This indicates that a single spot element can be read continuously for approximately 5 milliseconds without significant fading or reorientation of the charge.

The tube is capable of storing information for many hours without appreciable change or deterioration and may be read over 10,000 times after the delay period and still yield satisfactory results.

RESOLVING POWER

The resolution of the storage tube at the 50% modulation level is usually in excess of 650 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coil magnetic shell is designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often desirable.

FIGURE OF MERIT

A storage element is defined as: "An area of the storage surface which retains information distinguishable from that of adjacent areas". (55 IRE 7.PS5.) Assuming 600 line resolution across a diameter, the number of storage elements in the tube will be $\frac{\pi d^2}{4}$ or $\frac{\pi(600)^2}{4} \approx 283000$ and is defined as the figure of merit (η). (Resolution measurements include both black and white lines in a television test pattern.)

RECORDING STORAGE TUBE

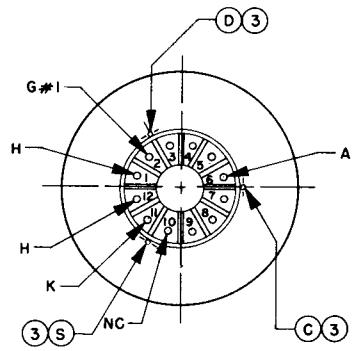
NOTES

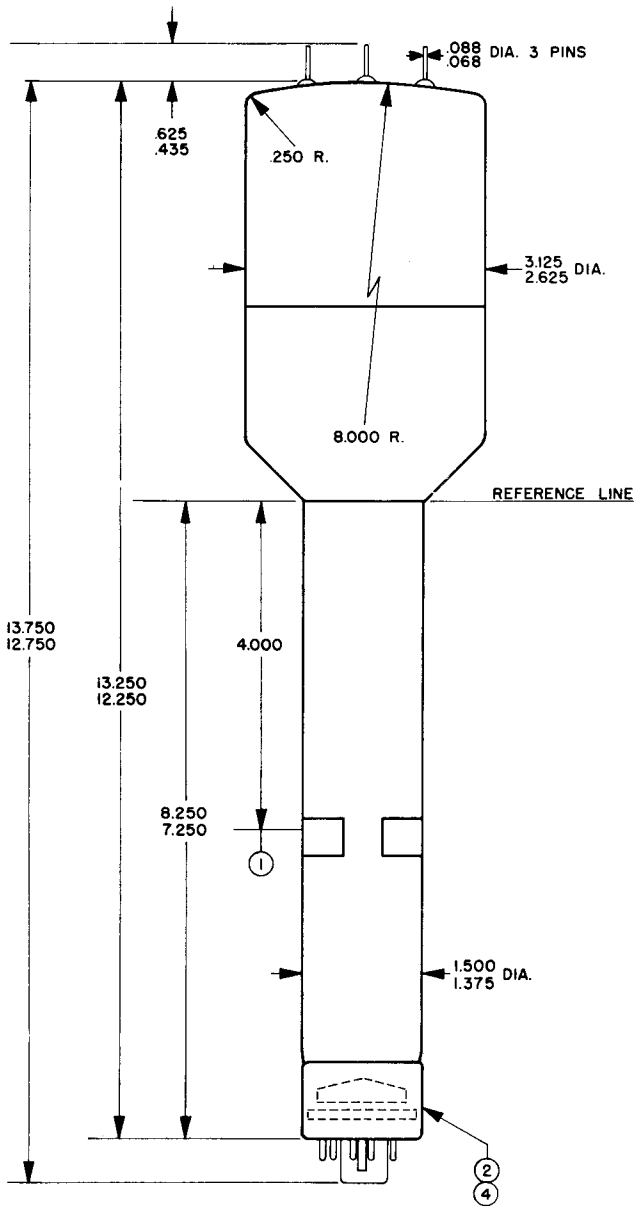
1) LOCATION OF DEFLECTION YOKE AND FOCUSING COIL MUST BE WITHIN THIS SPACE.

2) SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH CONE AXIS AND HAVING A DIAMETER OF 2.000.

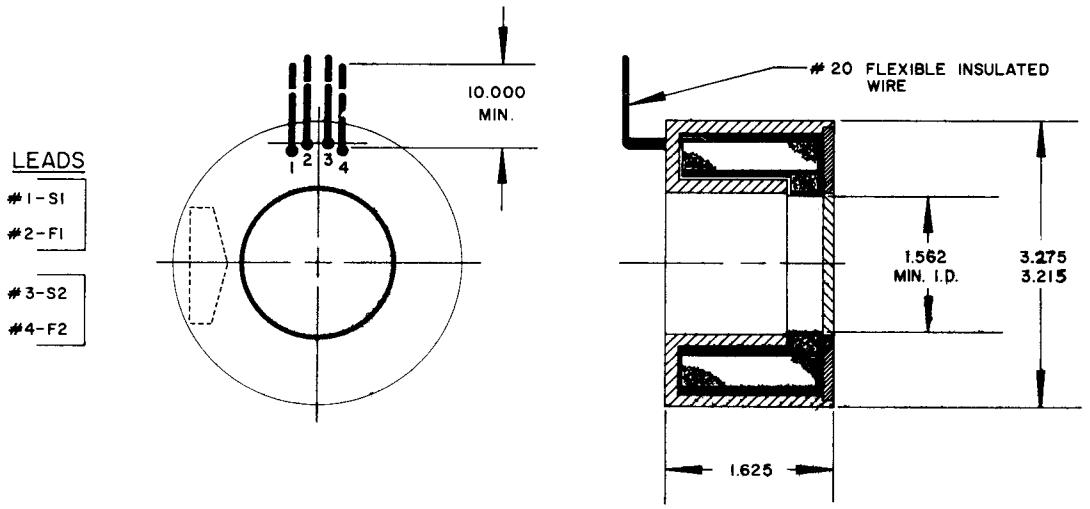
3) TOP PIN CONNECTIONS SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.
   S-STORAGE SCREEN (BLACK)
   C-COLLECTOR (RED)
   D-DECELERATOR (YELLOW)

4) B12-43 12 PIN BASE.





BM-411 FOCUS COIL



NOTES:

1) FOR USE WITH QK357 OR CK6835/QK464A RECORDING STORAGE TUBES.
2) TICKLER COIL IS PROVIDED TO PERMIT COMPENSATING FOR IMPROPER FOCUS AT THE EDGES OF A PATTERN CAUSED BY THE VARIATION IN DISTANCE FROM THE CENTER OF DEFLECTION TO a) THE CENTER OF A STORAGE AREA OF A STORAGE TUBE, AND b) THE PERIPHERY OF THE STORAGE AREA.
3) WHEN NOT REQUIRED, THE TICKLER COIL MAY BE LEFT UNCONNECTED.
4) SHELL MATERIAL — ANNEALED SWEDISH IRON OR EQUIVALENT.

TICKLER COIL
RESISTANCE — 35 TO 50 OHMS (AT 20°C)
MAX. CURRENT — 30 mA RMS
VOLTAGE RATING — 250 V
INDUCTANCE — 45 MILLIHENRIES APPROX.

FOCUS COIL
RESISTANCE — 6500 TO 9000 OHMS (AT 20° C)
MAX. CURRENT — 25 madc
VOLTAGE RATING — 250 V

NOTES FOR SCHEMATIC OUTLINE ON PAGE 5

1. The unblanking circuit shown is designed to cut off the storage tube during retrace and when the scan is off. Insertion of a negative pulse to the unblanking amplifier permits the storage tube to conduct during scan.

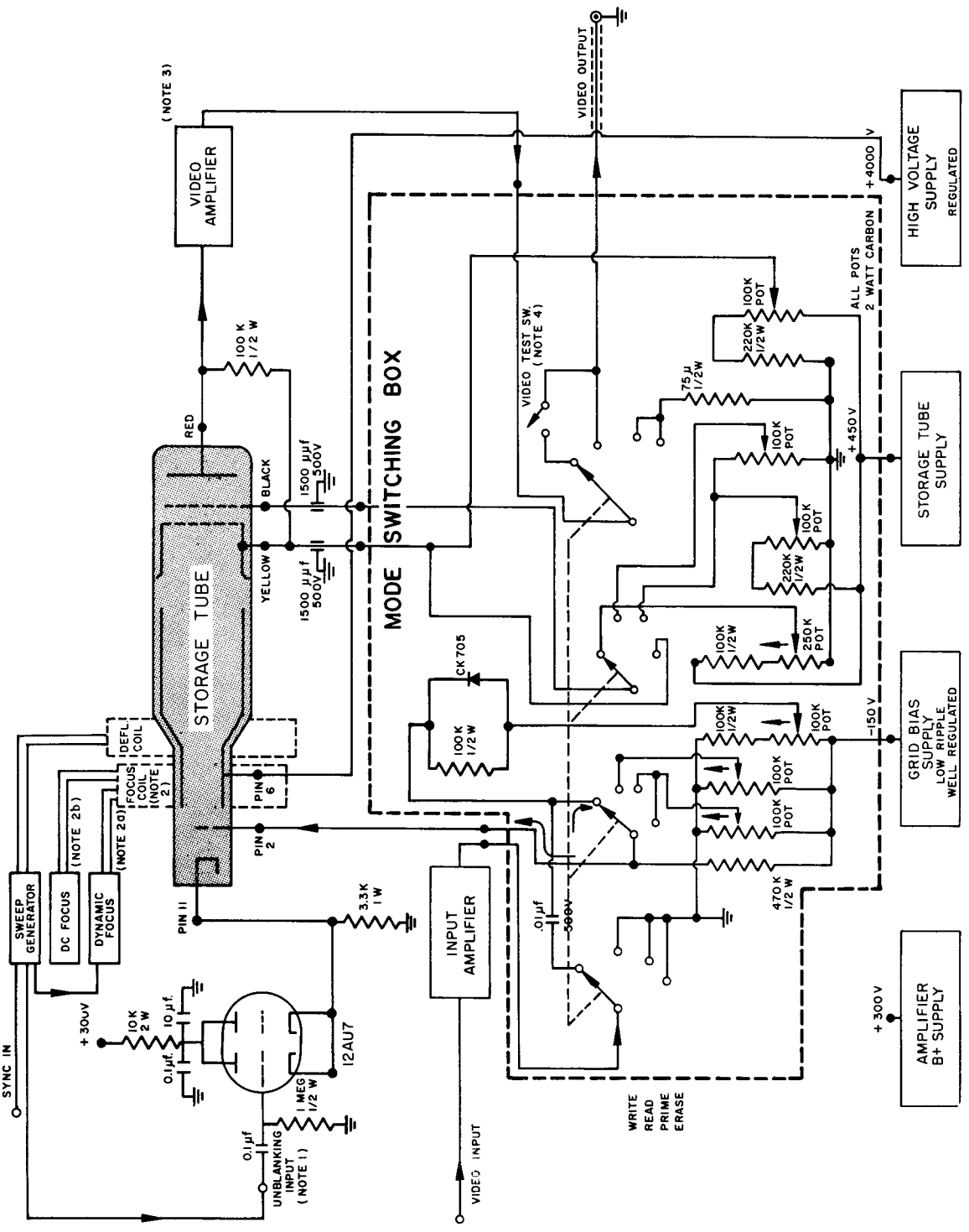
2. Since the storage tube anode voltage is considerably lower than most magnetically focused cathode ray tubes, a non-astigmatic focus coil is recommended where high resolution is desired. Resolution near the edges of the storage area can be further improved by use of dynamic focusing. (A focus coil providing both these features is being manufactured by Raytheon for use with the QK464A. It is designated as coil #BM411.)

2a. Since the dynamic focus correction is a function of the displacement of the electron beam from the axis of the tube at any instant, it can be generated from an output equivalent to the algebraic sum of two parabolas generated from the horizontal and vertical sweeps respectively.

2b. It is suggested that the dc focus be provided from a constant current source to minimize focus drift caused by the change in resistance of the focus coil during warm-up.

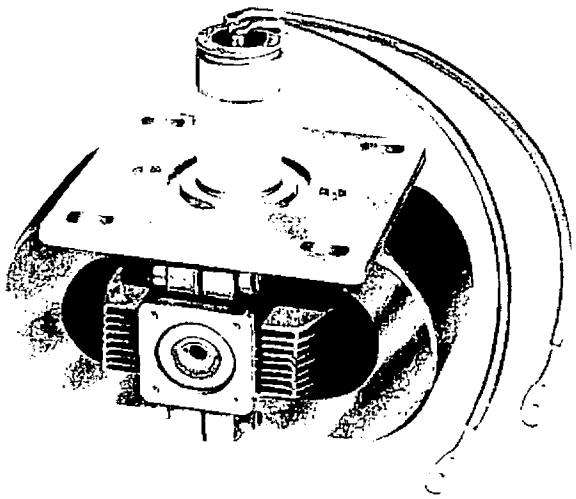
3. Design considerations for the video output amplifier must include the output capacitance of the storage tube (10-20μμf) and its output signal (0.5-1.0μ amps). When using a high load resistor to minimize noise, frequency compensation within the amplifier is necessary. (See "Television" by V. K. Zworykin etc., John Wiley & Sons, 1940. P.P. 432-5.)

RECORDING STORAGE TUBE



TYPE RK6841

The RK6841 is a fixed frequency pulsed type oscillator operating in the region of 16,500 megacycles with a minimum peak power output of 50 kilowatts. It is an integral magnet waveguide output type requiring forced air cooling, designed for coupling to standard RG-91/u waveguide. The RK6841 is a ruggedized, very compact, light-weight magnetron well suited for use in portable and aircraft equipment.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data sheet, rather than the MIL-E-1B Government test specifications, should be used as a guide to equipment designers.

There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desirable to operate the RK6841 under conditions other than those recommended in this technical data sheet, the manufacturer should be consulted. Operation of magnetrons at or near maximum ratings is not conducive to long life, economy, and reliability.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage — Preheat	4.0 V ± 5%
Heater Current @ 4.0 V	10.5 A
Minimum Preheat Time	3 minutes

Maximum Ratings

The values specified below must not be exceeded under any service conditions. The ratings are limiting values above which the serviceability of any tube may be impaired. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

Heater Voltage	4.25 V
Peak Anode Voltage	19 kv
Peak Anode Current	16 A
Peak Anode Power Input	290 kw
Average Anode Power Input	290 W
Anode Temperature	125° C
Pulse Duration	3.5 us
Duty Cycle	.001
Frequency change due to change of steady state temperature	—0.4 Mc/°C
VSWR	1.5
Pulling @ VSWR = 1.5	15 Mc

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

3666 — 2-56

from JEDEC release #3478, Nov. 6, 1961

Typical Operation

Oscillation 1

Current pulse duration	0.3 μs
Duty cycle	.0009
Voltage pulse rise time	0.09 μs
Heater voltage start	4.0 V
Heater voltage operate	2.0 V
Frequency	16,500 Mc approx.
Peak anode voltage	16.5 kv
Peak power output (Min.)	50 kw
Average power output (Min.)	45 W
Peak current	14 A

Oscillation 2

Current pulse duration	3.0 μs
Duty cycle	.0009
Voltage pulse rise time	0.2 μs
Heater voltage start	4.0 V
Heater voltage operate	2.0 V
Frequency	16,500 Mc. approx.
Peak anode voltage	16.5 kv
Average power output (Min.)	45 W
Peak current	14 A

MECHANICAL

Mounting position	Cathode vertical
Over-all dimensions	See outline drawing
Net weight	5¾ lbs., approx.
Cooling	Forced air
Output cooling	See outline drawing

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 4.0 V ± 5% for a period of at least 3 minutes prior to the application of anode pulse voltage. Immediately after the application of anode pulse voltage, the heater voltage must be reduced to 2.0 V. Excessive heater current surges must be avoided. For operation at conditions differing from those under typical operation, the manufacturer should be consulted for the recommended value of heater voltage.

STARTING NEW TUBE

"Aging" of the RK6841 is rarely necessary. If, however, some instability is observed in a new magnetron, it is recommended that it be "seasoned" under the prevailing conditions of oscillations until stable operation is attained.

PULSE CHARACTERISTICS

The smooth peak of a pulse is defined as the maximum value of a smooth curve through the average of the fluctuation over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which the instantaneous current is 50% of the smooth peak. (True only for approximately rectangular waveshapes.) The rise time is the time interval between points 20 and 85% of the smooth peak. Figure 1 shows graphically the definitions mentioned.

The voltage rise time should not be greater than 0.22 μs or less than 0.18μs on the 3.0 μs pulse and not greater than 0.1 μs or less than 0.08μs on the 0.3 μs pulse. Too fast a rise time will lead to moding or arcing. The ripple on the top of the current pulse must be kept to a minimum to avoid pushing effects which will tend to widen the spectrum. The decay time of the trailing edge of the voltage pulse must be as short as possible to obtain optimum performance and high operating efficiencies. Backswing should not exceed 20% of the applied pulse.

For optimum pulse shaping, the magnetron pulse transformer and pulse line must be treated as a unit. Careful tailoring of the pulse line in any application is recommended.

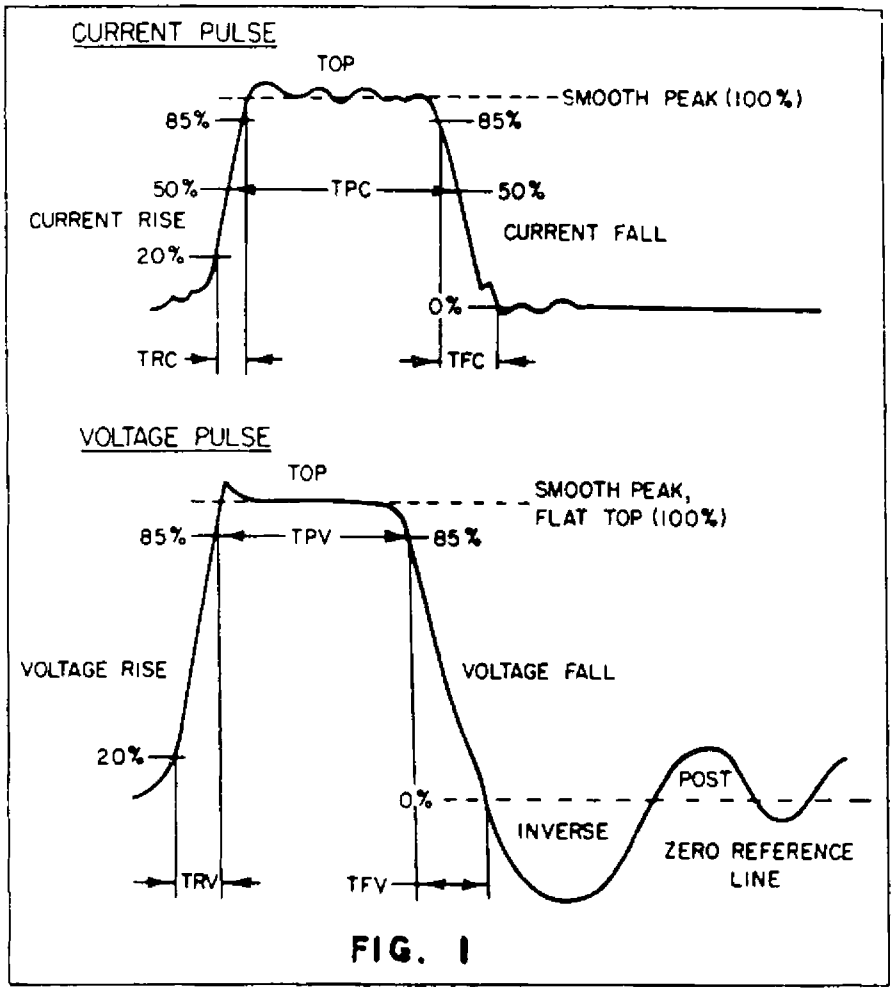


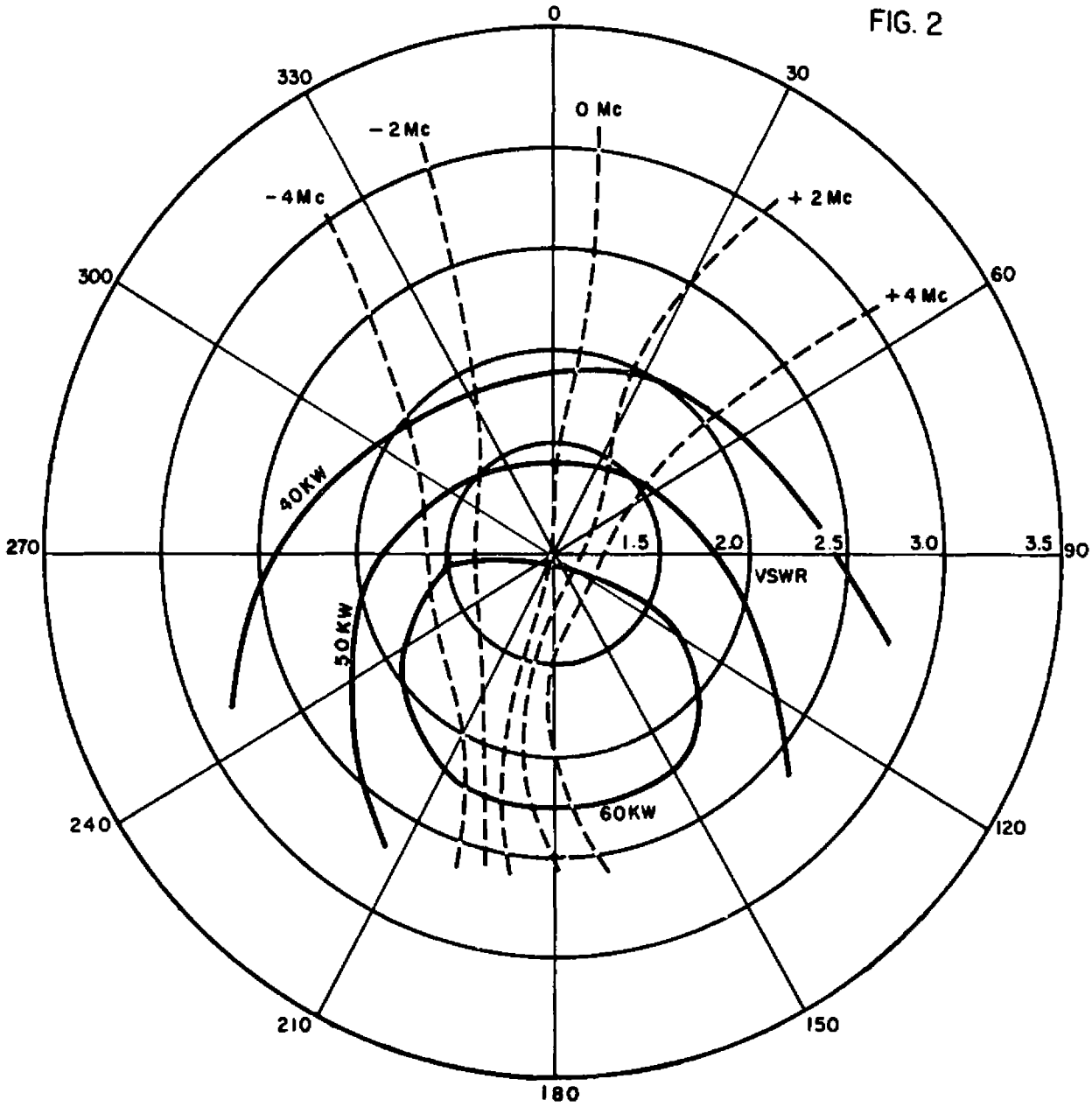
FIG. 1

MICROWAVE AND POWER TUBE DIVISION

LOAD DIAGRAM

Figure 2 is a load diagram of a typical RK6841 magnetron. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 3:1 are plotted, but operation with ratios greater than 1.5:1 is not recommended.

FIG. 2



RK6841 TYPICAL LOAD DIAGRAM

COOLING

The RK6841 requires forced air for cooling. The ambient temperature will dictate the flow rate necessary to maintain the anode temperature below the maximum specified 115°C. Figure 3 is a plot of anode temperature and pressure drop as a function of air flow.

RK 6841
COOLING CHARACTERISTICS

FIG. 3

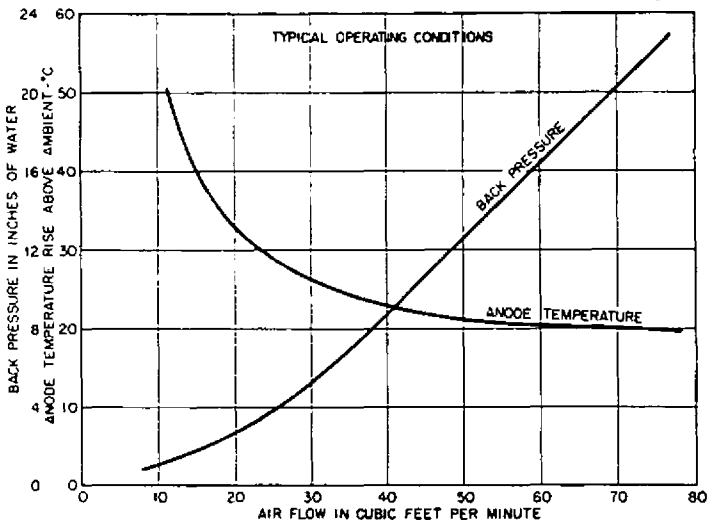
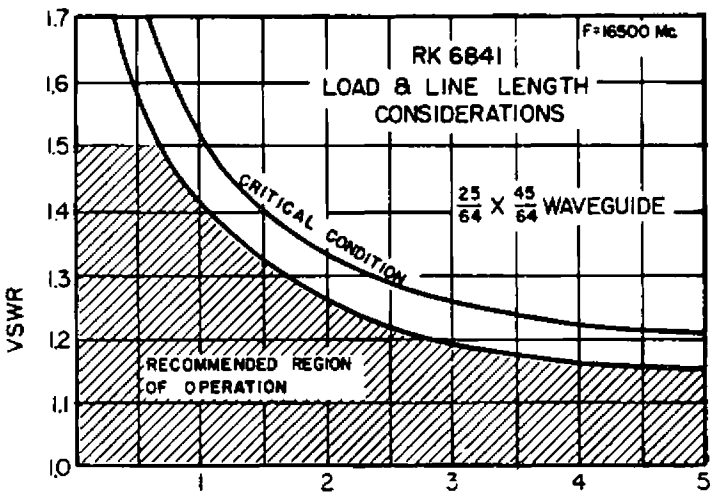


FIG. 4



FREQUENCY DRIFT

After operation of the RK6841 is initiated, its temperature rises with time until thermal equilibrium is obtained. During this transient period, the geometry of the tube changes slightly and is attended by a slight frequency change or drift. If the tube temperature changes after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained. The frequency change between two equilibrium positions will not exceed —0.4 Mc/°C.

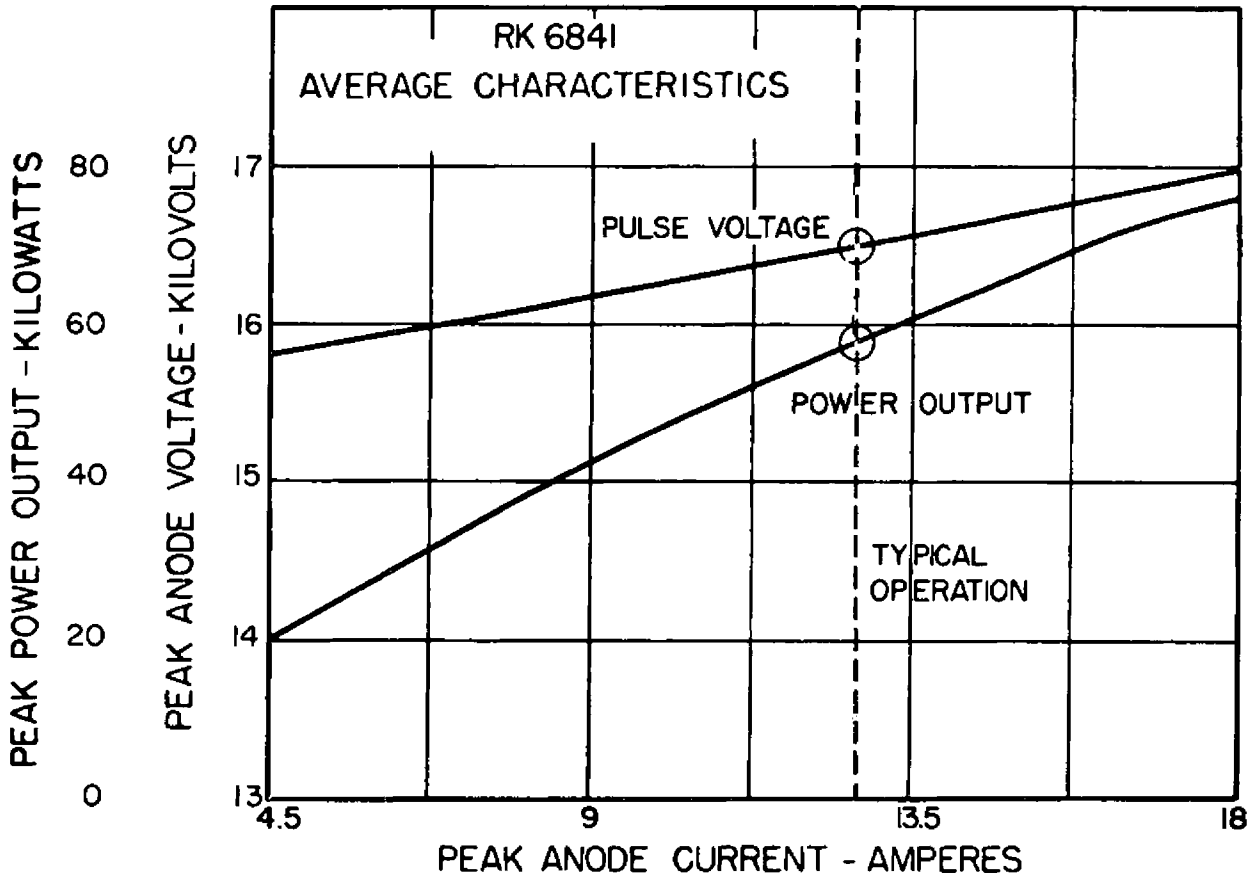
R.F. RADIATION FROM CATHODE

The RK6841 incorporates an R.F. choke in the cathode stem to minimize radiation from this end of the tube. It is not possible, however, to guarantee that the radiation will be negligible; and in particularly critical environments, shielding of the cathode stem may be necessary.

OPERATING CHARACTERISTICS

Figure 5 is a plot of peak power output and peak anode voltage as a function of anode current for a typical RK6841 magnetron.

FIG.5



DETAILED MECHANICAL INFORMATION

OUTLINE DRAWING

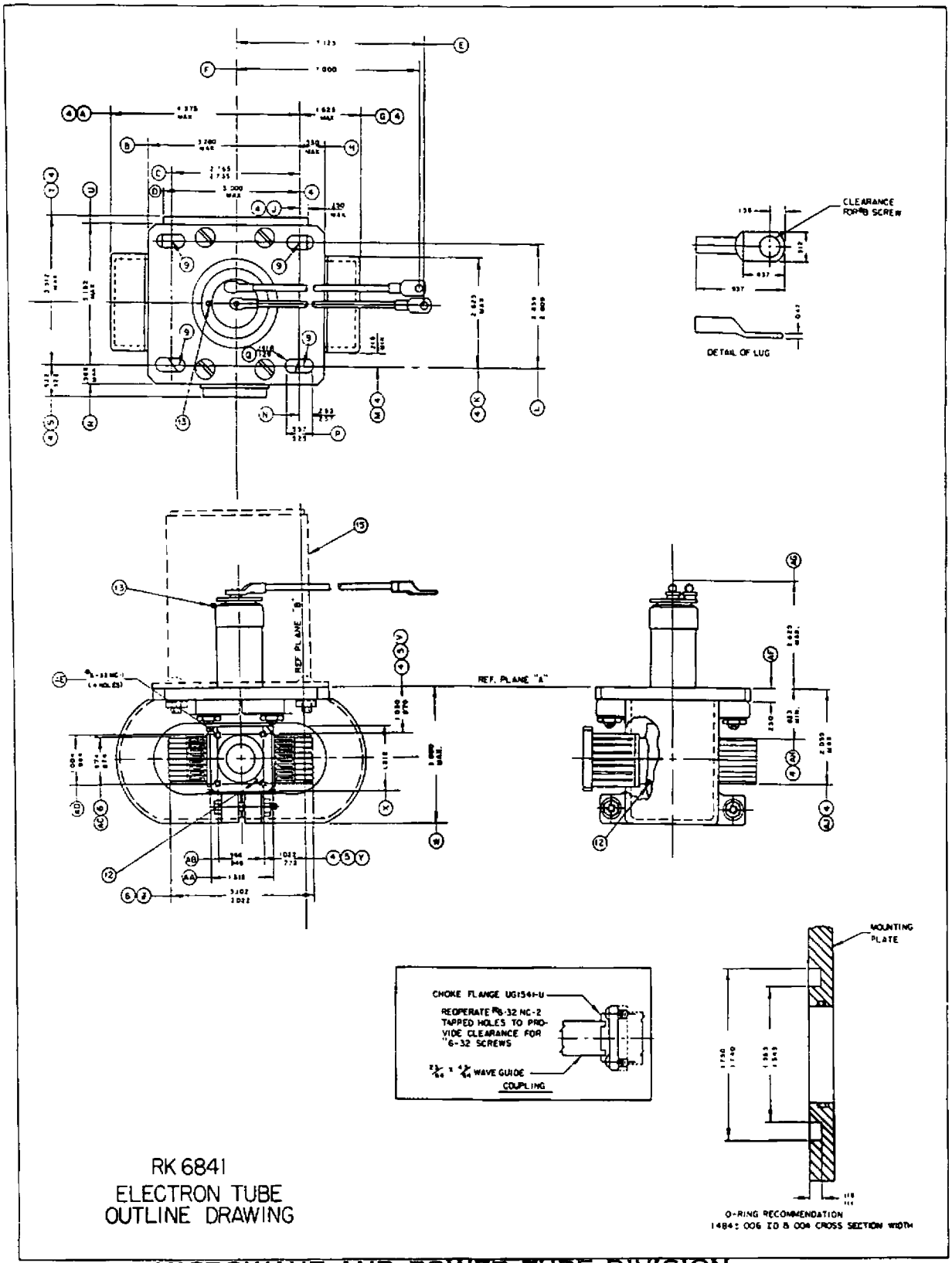
The detailed mechanical dimensions of the RK 6841 are given in figure 6. These dimensions should be used in designing the mechanical layout of an equipment rather than those of a sample tube.

INSTALLATION AND HANDLING PRECAUTIONS

No mechanical stress should be applied to the high voltage bushing or output flange in handling or mounting the magnetron. Care should be taken to keep ferromagnetic materials such as steel, iron, or magnets 2 inches away from the tube, since deterioration of the magnetic field results in low power and instability.

Unnecessary jarring of the tube must be avoided. Although a packaged magnetron appears to have great structural strength, the internal structure is delicate, and involves critical alignment of parts.

PULSED-TYPE MAGNETRON OSCILLATOR



RK 6841
ELECTRON TUBE
OUTLINE DRAWING

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK 6872

RELIABLE SUBMINIATURE PENTODE

The CK6872 is a heater-cathode type semi-remote-cutoff pentode of subminiature construction capable of operation in the VHF region. It is applicable to amplifier service in which it is desirable to apply automatic gain control. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. A separate terminal connection is provided for Grid #3, which under self-bias conditions can be connected directly to ground permitting the cathode by-pass capacitor to be omitted for lower grid loading. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450	G
Uniform Acceleration (Centrifuge Test)	1000	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	220	°C
Altitude	60,000	Ft

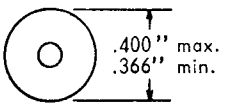
ELECTRICAL DATA

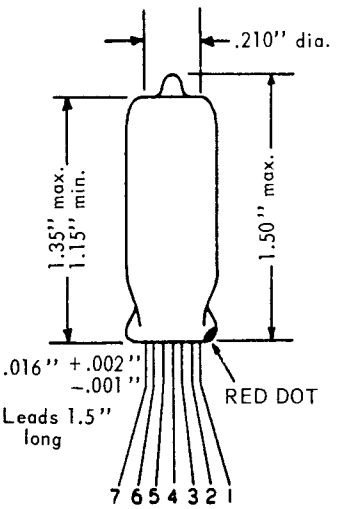
Ratings and Normal Operation:	MIL-E-1 Symbol	Test Limit or Design Minimum	Normal Operation	Normal Test Conditions	Test Limit or Design Maximum	MIL-E-1 Units
			Ratings			
Heater Voltage	Ef:	5.7	6.3	6.3	6.9	V
Plate Voltage	Eb:	---	120	120	165	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	---	Vdc
Grid #2 Voltage	Ec2:	---	120	120	155	Vdc
Grid #3 Voltage	Ec3:	---	0	0	0	Vdc
Cathode Resistance	Rk:	---	200	200	---	ohms
Plate Dissipation	Pp:	---	0.95	---	1.1	W
Grid #2 Dissipation	Pg2:	---	0.32	---	0.4	W
Grid #1 Circuit Resistance	Rg:	---	1.0	---	1.2	Meg.
Heater-Cathode Voltage	Ehk:	---	100	---	200	V
Cathode Current	Ik:	---	---	---	16.5	mAdc

MECHANICAL DATA

ENVELOPE ..... Glass T-3
OUTLINE ..... (8-7)
BASE ..... Flat Press, 7 leads in line spacing 0.048" center to center
CATHODE ..... Coated unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS





TERMINAL CONNECTIONS

Lead 1	Plate
Lead 2	Grid #2
Lead 3	Heater
Lead 4	Heater
Lead 5	Grid #3
Lead 6	Cathode
Lead 7	Grid #1

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ELECTRICAL DATA (cont'd)

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Design Minimum	Normal Operation	Normal Test Conditions	Test Limit or Design Maximum	MIL-E-1 Units
			Tests			
Heater Current	If:	183	200	---	217	mA
Plate Current (1)	Ib:	5.7	7.75	---	9.8	mAdc
Screen Grid Current	Ic2:	1.7	2.7	---	3.7	mAdc
Transconductance (1)	Sm:	3400	4100	---	4800	μmhos
Transconductance (2) Ef = 5.5 V	Δ_{Ef}Sm:	---	---	---	10	%
Transconductance (3) Ec1 = −14 Vdc	Sm:	---	---	---	125	μmhos
Plate Resistance	rp:	0.15	0.34	---	---	Meg.
Vibration Rp = 10,000; f = 40 cps; G = 15	Ep:	---	---	---	50	mVac
Capacitance (Note A)	Cgp:	---	---	---	0.03	pf
Capacitance (Note A)	Cin:	4.2	5.0	---	5.8	pf
Capacitance (Note A)	Cout:	2.9	3.5	---	4.15	pf
Tube Operation Time (Note B)	t:	---	---	---	20	seconds

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450 G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.5 V; Ehk = +135 Vdc and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits and meet a maximum Ihk leakage limit of 20 μAdc.

Stability Life Test –	Sample is operated for one hour to evaluate initial electrical stability (Δ_t Sm < 10%).
Survival Rate Life Test –	Sample is operated one hundred hours to evaluate inoperatives and early electrical stability.
Intermittent Life Test –	1000 hours. Sample is operated with minimum Envelope Temperature of 220°C.
Altitude –	Sample is subjected to a pressure of 55 ± 5 mm Hg (60,000 ft.) to assure freedom from flashover or corona at the leads of the tube. Voltage = 300 Vac.

APPLICATION NOTES

Note A: With a cylindrical shield (0.405" I.D. – 1-7/8" long) connected to lead 6.

Note B: Tube operation time is the time in seconds required for the plate current to reach at least 90% of the permanent 3 minute plate current.

CAUTION – – To Electronic Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RAYTHEON

CK 6872

RELIABLE SUBMINIATURE PENTODE

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

TEST CONDITIONS

Ef = 6.3 V
Eb = 120 Vdc
Ec2 = 120 Vdc

Ec1 = Ec3 = 0 Vdc
Rk = 200 ohms

Ref.	Test	Conditions	AQL %	Insp. Level or Code	Symbol	Limits, See Note 4						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
	QUALIFICATION APPROVAL TESTS											
3.1	Qualification Approval:	Required, Note 21	---	---								
3.7	Marking:	Note 19:	---	---								
---	Cathode:	Coated unipotential:	---	---								
3.4.3	Base Connections:		---	---								
4.9.20.3	Vibration (1):	Rp=10,000; CK=1000μf:	---	---	Ep:	---	---	---	---	50	---	mVac
	MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 3											
4.10.9	Heater Current:		---	---	If:	---	192	200	208	---	16	mA
4.10.8	Heater Current:		0.65	II	If:	183	---	---	---	217	---	mA
4.10.15	Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	5.0 5.0	--- ---	μAdc μAdc
4.10.6.1	Grid Current:	Rg1=1.0 Meg.	0.65	II	Ic1:	0	---	---	---	-0.3	---	μAdc
4.10.4.1	Plate Current (1):		---	---	Ib:	---	6.9	7.75	8.6	---	2.6	mAdc
4.10.4.1	Plate Current (1):		0.65	II	Ib:	5.7	---	---	---	9.8	---	mAdc
4.10.4.3	Screen Grid Current:		0.65	II	Ic2:	1.7	---	---	---	3.7	---	mAdc
4.10.9	Transconductance (1):		---	---	Sm:	---	3800	4100	4400	---	800	μmhos
4.10.9	Transconductance (1):		0.65	II	Sm:	3400	---	---	---	4800	---	μmhos
4.7.5	Continuity and Shorts (Inoperatives):		0.40	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical:	Envelope outline No. (8-7)										
	MEASUREMENTS ACCEPTANCE TESTS, PART 2											
4.8.2	Insulation of Electrodes:	g1-all p-all	2.5	L6	R: R:	100 100	---	---	---	---	---	Meg Meg
4.10.9	Transconductance (2):	Ef=5.5 V; Note 1	2.5	I	ΔSm: Ef:	---	---	---	---	10	---	%

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RELIABLE SUBMINIATURE PENTODE

Ref.	Test	Conditions	AQL %	Insp. Level or Code	Symbol	Limits						Units
						Min.	LAL	Bogie	UAL	Max.	ALD	
	MEASUREMENTS ACCEPTANCE TESTS, PART 2 (Cont'd.)											
4.10.9	Transconductance (3):	Ec1=−14 Vdc; Rk=0	2.5	I	Sm:	5	---	---	---	125	---	μmhos
4.10.6.2	Grid Emission:	Note 18	6.5	L6	Ic1:	0	---	---	---	−0.5	---	μAdc
4.10.3.2	AF Noise:	Esig=70mVac; Ecc2=25Vdc; Rg1=0.1 Meg; Rg2=1000 ohms; RK=3000 ohms; Rp=0.15 Meg; CK=1000μf Note 20	2.5	I		---	---	---	---		---	
4.10.10	Plate Resistance:		6.5	L6	rp:	0.15	---	---	---	---	---	Meg
4.10.14	Capacitance:	0.405 in. dia shield			Cg1p:	---	---	---	---	0.03	---	μμf
		0.405 in. dia shield	6.5	Code E	Cin:	4.2	---	---	---	5.8	---	μμf
		0.405 in. dia shield			Cout:	2.9	---	---	---	4.15	---	μμf
4.9.12.1	Low Pressure Voltage Breakdown:	Pressure=55 ±5 mm Hg. Voltage=300 Vac	6.5	Note 5		---	---	---	---	---	---	
---	Operation Time:	t=20 sec; Note 6	4.0	L6	Ib(1):	90	---	---	---	110	---	%
4.9.19.1	Vibration (2):	Rp=10,000; Ck=1000μf F=40 cps; G=15	2.5	I	Ep:	---	---	---	---	50	---	mVac
	DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7											
4.9.5.3	Subminiature Lead Fatigue:	Note 8	2.5	Code C		4	---	---	---	---	---	arcs
4.9.20.5	Shock:	Hammer angle=30° Ehk=+100 Vdc; Notes 2 and 9		---	---	---	---	---	---	---	---	
4.9.20.6	Fatigue:	G=2.5; fixed frequency F=25min., 60 max.	6.5	Note 5		---	---	---	---	---	---	
---	Post Shock and Fatigue Test End Points:	Vibration (2)	---	---	Ep:	---	---	---	---	100	---	mVac
		Heater cathode leakage										
		Ehk=+100 Vdc	---	---	Ihk:	---	---	---	---	20	---	μAdc
		Ehk=−100 Vdc	---	---	Ihk:	---	---	---	---	20	---	μAdc
		Change in transconductance (1) of individual tubes	---	---	ΔSm: t	---	---	---	---	20	---	%
	DEGRADATION RATE ACCEPTANCE TESTS, NOTE 8											
4.9.6.3	Glass Strain:		6.5	I		---	---	---	---	---	---	

Ref.	Test	Conditions	AQL %	Insp. Level or Code	Allowable Defectives per Characteristics		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min.	Max.	
	ACCEPTANCE LIFE TESTS, NOTE 7									
4.11.7	Heater Cycling Life Test:	Ef=7.5 V; 1 min. on, 1 min. off; Ehk=140 Vac; Ec1=Ec2=Ec3=Eb=0; Note 10			---	---		---	---	
4.11.4	Heater Cycling Life Test End Points:	Heater-cathode Leakage								
		Ehk=+100 Vdc	---	---	---	---	Ihk:	---	20	μAdc
		Ehk=−100 Vdc	---	---	---	---	Ihk:	---	20	μAdc
4.11.3.1	Stability Life Test (1 Hour):	Ehk=+200 Vdc; Rg1=1.0 Meg; TA=Room; Note 11	1.0	Code I	---	---		---	---	
4.11.4	Stability Life Test End Points:	Change in transconductance (1) of individual tubes	---	---	---	---	ΔSm: t	---	10	%
4.11.3.1	Survival Rate Life Test (100 Hours):	Stability life test conditions or equivalent; TA=Room; Notes 12 and 13	---	II	---	---		---	---	
4.11.4	Survival Rate Life Test End Points:	Continuity and shorts (Inoperatives)	0.65	---	---	---	---	---	---	
		Transconductance (1)	1.0	---	---	---	ΔSm: t	3000	---	μmhos
4.11.3.1	Intermittent Life Tests:	Stability life test conditions T Bulb=220°C. min. Notes 14 and 15								
4.11.4	Intermittent Life Test End Points (500 Hours):	Note 16								
		Inoperative; Note 17	---	---	1	3	---	---	---	---
		Grid current (1)	---	---	1	3	Ic1:	---	−0.8	μAdc
		Heater current	---	---	1	3	If:	180	220	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	ΔSm: t	---	20	%

Ref.	Test	Conditions	AQL %	Insp. Level or Code	Allowable Defectives per Characteristics		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min.	Max.	
		Transconductance (2)	---	---	2	5	ΔSm: Ef:	---	15	%
		Heater-cathode leakage Ehk=+100 Vdc Ehk=-100 Vdc	---	---	2	5	Ihk: Ihk:	--- ---	10 10	μAdc μAdc
		Insulation of electrodes g1-all p-all	---	---	2	5	R: R:	50 50	--- ---	Meg Meg
		Transconductance (1) Average change	---	---	---	---	Avg ΔSm: †	---	15	%
		Total defectives	---	---	4	8	---	---	---	---
4.11.4	Intermittent Life Test End Points (1000 Hours):	Note 16 Inoperatives; Note 17	---	---	2	5	---	---	---	---
		Grid current (1)	---	---	2	5	Ic1:	---	-1.0	μAdc
		Heater current	---	---	2	5	If:	190	220	mA
		Change in transconductance (1) of individual tubes	---	---	2	5	ΔSm: †	---	30	%
		Heater-cathode leakage Ehk=+100 Vdc Ehk=-100 Vdc	--- ---	--- ---	2	5	Ihk: Ihk:	--- ---	15 15	μAdc μAdc
		Total defectives	---	---	5	10	---	---	---	---
4.9.18.1.1	Container Drop	Required								
5.1	Preparation for Delivery	(d) Package group 1; container size D; container drop test in accordance with Specification MIL-P-75								

Note 1: Transconductance (2) is the percent change in Transconductance (1) of an individual tube resulting from the change in Ef.

Note 2: A grid resistor of 0.1 megohm shall be added; however, this resistor will not be used when a thyratron-type short indicator is employed.

Note 3: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding inoperatives and mechanical shall be one percent. A tube having one or more defects shall be counted as one defective. Standard MIL-STD-105, inspection level II shall apply.

Note 4: Variables sampling procedure. – See paragraph 5.3.3 to 5.3.3.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 5: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F shall apply.

Note 6: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the 3-minute plate current (1) value when measured at the test conditions specified for plate current (1). No preheating is allowed prior to this test.

Note 7: Destructive tests. – Tubes subjected to the following destructive tests will not be accepted under this specification:

4.9.5.3 Subminiature lead fatigue	4.11.7 Heater-cycling life test
4.9.20.5 Shock	4.11.3.1 Intermittent life test
4.9.20.6 Fatigue	

Note 8: When a manufacturer submits tubes for qualification approval, five extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 9: Leads may be clipped for application of voltages during impact.

Note 10: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater-cathode short, or heater-cathode leakage in excess of the specified heater-cycling life test end point limit.

Note 11: Stability life test. – The sampling and testing procedure for this test shall be in accordance with paragraphs 5.3.4.1(a) to 5.3.4.1(g), inclusive, of the Inspection Instructions for Electron Tubes.

Note 12: Survival rate life test. – The sampling and testing procedure for this test shall be defined in paragraphs 5.3.4.2 to 5.3.4.2.4, inclusive, of the Inspection Instructions for Electron Tubes.

Note 13: For survival rate life test, the equivalent stability life test conditions shall be as defined in paragraph 5.3.4.2.5 of the Inspection Instructions for Electron Tubes.

Note 14: Intermittent life tests. – Sampling and acceptance procedures for these tests shall be as defined in paragraphs 5.3.4.3(a) to 5.3.4.3(i), inclusive, of the Inspection Instructions for Electron Tubes, except that the following subparagraph shall be added to 5.3.4.3(e); (4) The life test samples from the first lot accepted each month shall continue on life test for an additional 500 hours (1000 hours total life test time). Failure of this sample to meet the 1000-hour life test end points shall result in loss of eligibility for reduced hours testing.

Note 15: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. Envelope temperature requirement will be satisfied if tube, having bogie Ib (±5 percent) under normal test conditions, is determined to operate at minimum specified temperature at any position in the life test rack.

Note 16: Order for evaluation of life test defects. – See paragraph 5.3.4.4 of the Inspection Instructions for Electron Tubes.

Note 17: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1 of Specification MIL–E–1), shorts (see 4.7.2 of Specification MIL–E–1), air leaks (see 4.7.6 of Specification MIL–E–1).

Note 18: Prior to this test, the tube shall be preheated a minimum of 5 minutes at the conditions indicated hereinafter. Three minute test is not permitted. Test at preheat conditions, except Ec1 = -15Vdc; within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

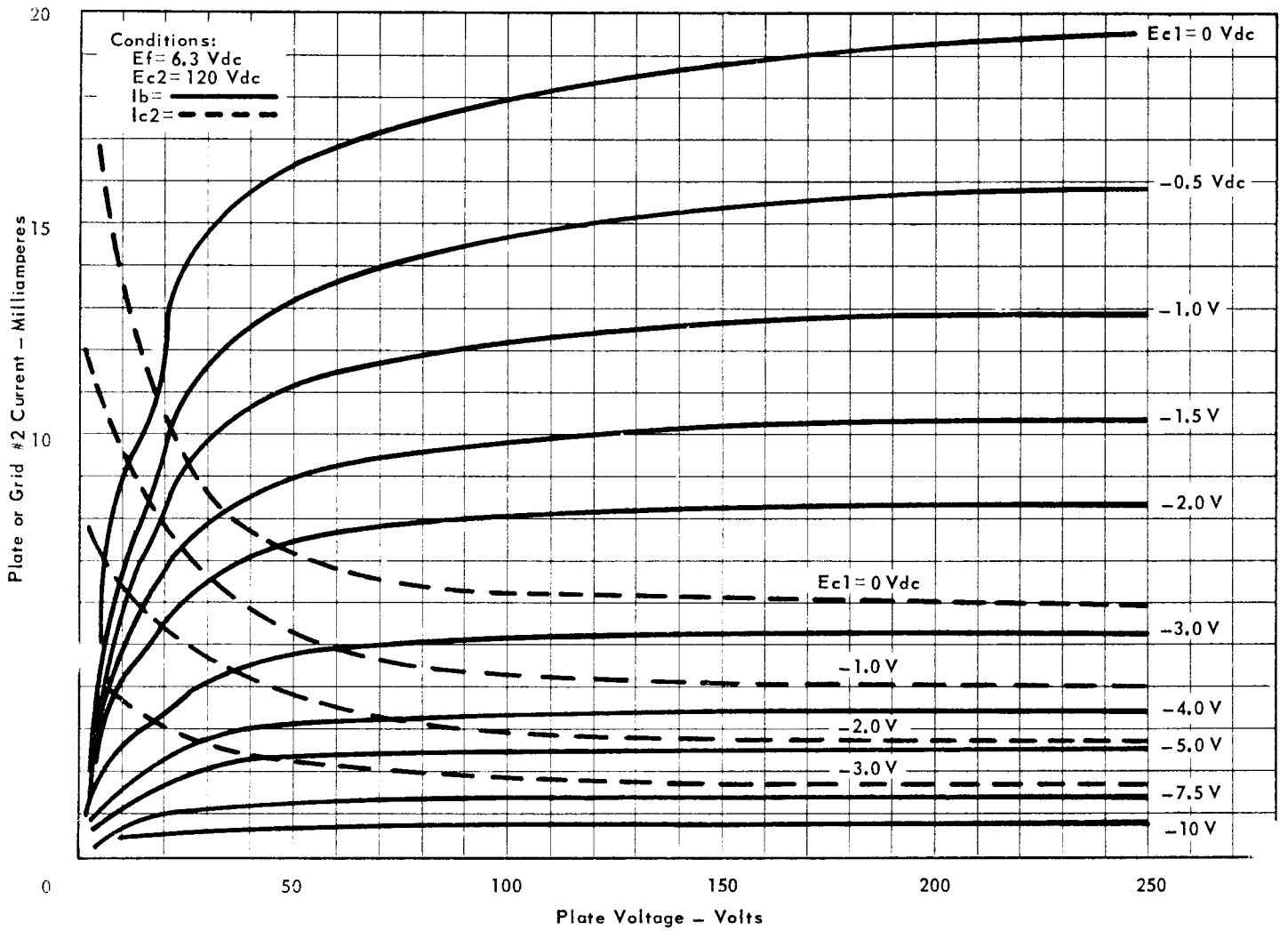
Ef	Ec1	Ec2	Ec3	Eb	Rk	Rg1
V	Vdc	Vdc	Vdc	Vdc	ohms	Meg
7.5	0	120	0	120	200	1.0

Note 19: Tubes shall be marked "USN–6872".

Note 20: The rejection level shall be set at the VU meter reading obtained during calibration.

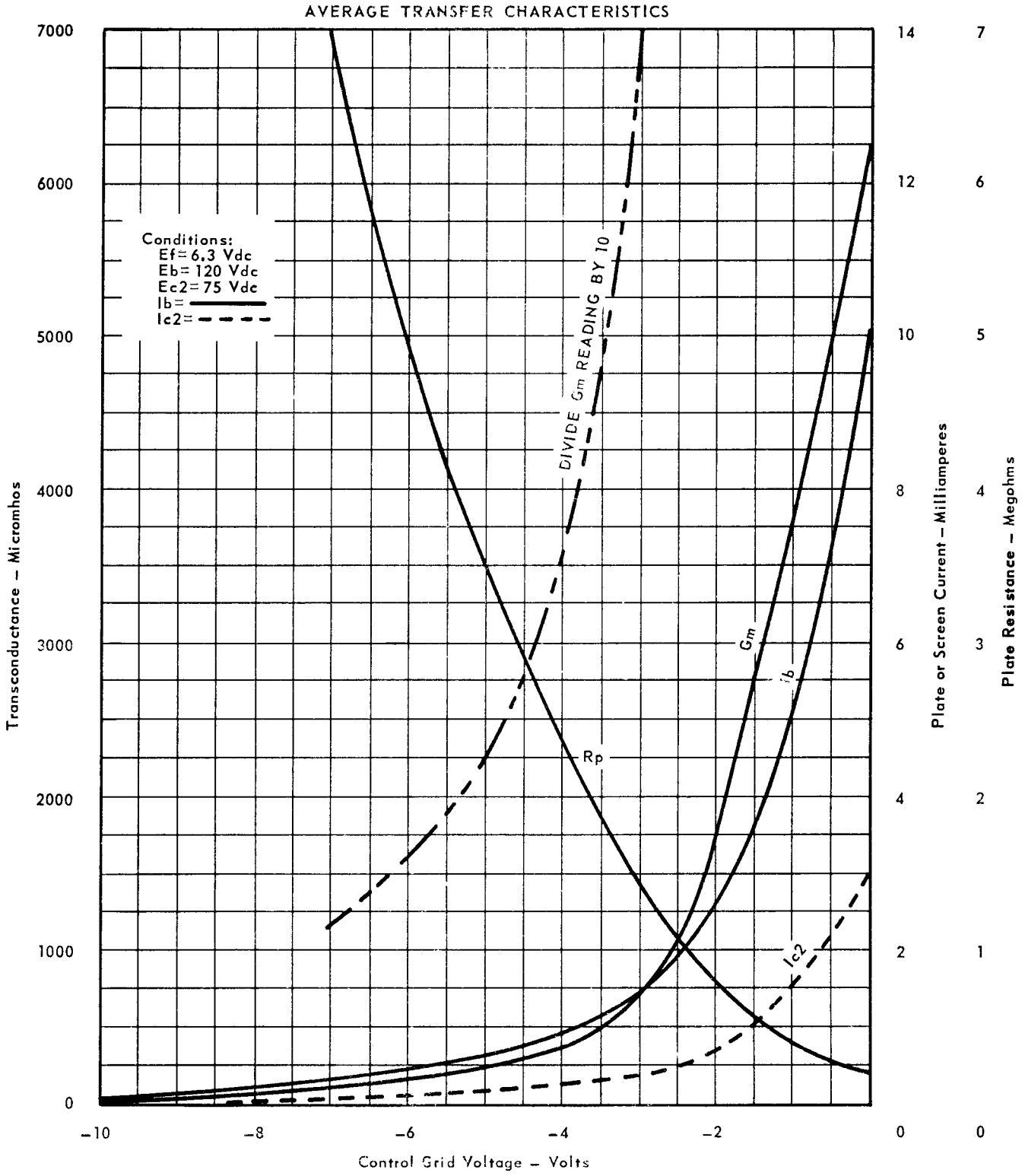
RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



CK6872

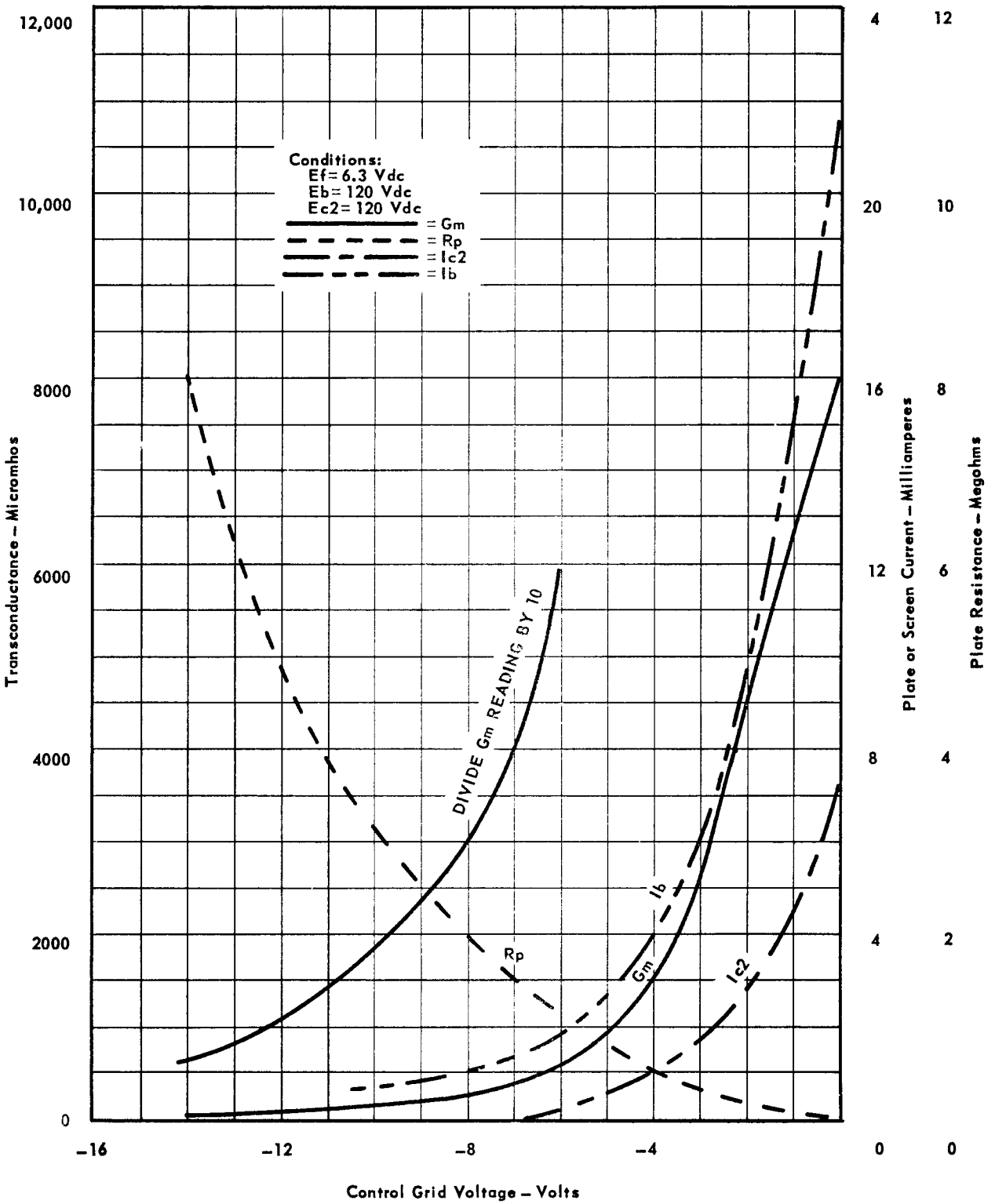
RELIABLE SUBMINIATURE PENTODE



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RELIABLE SUBMINIATURE PENTODE

AVERAGE TRANSFER CHARACTERISTICS



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6909

DECADE COUNTER

The CK6909 is a cold cathode gas-filled 100 KC high speed bi-directional ring stepping decade counter tube. This type features direct visual neon glow readout on any of the ten radially spaced cathodes or electrical output in the form of a voltage from cathode numbers 0, 5, 8, and 9. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make this a very reliable counter device. Some of the many uses for this type include; counting, timing, sampling, frequency dividing, coding, matrixing, telemetering, and controlling.

ELECTRICAL DATA

RATINGS—ABSOLUTE MAXIMUM VALUES:

Total Anode Current	1.2 Ma
Voltage Between Electrodes (Excluding Anode)	140 volts
Supply Voltage (Anode to Cathode)	400 volts
Input Frequency	100,000 cps

CHARACTERISTICS AND TYPICAL OPERATION:

DC Supply Voltage	450 volts
Anode Resistor	0.27 megohms
Nominal Tube Drop	235 volts
Cathode Resistor	24 K ohms
Output Voltage (Across Cathode Resistor)	15 volts

MECHANICAL DATA

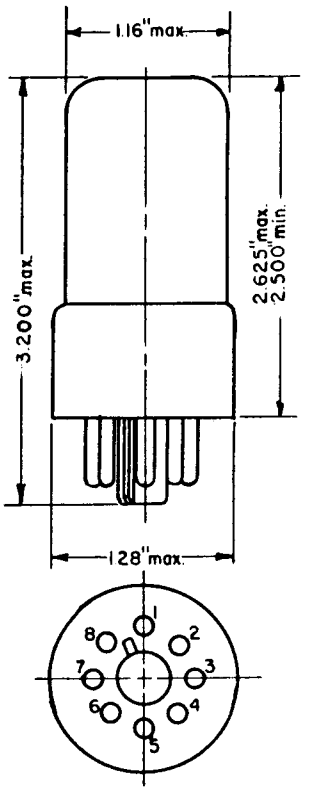
ENVELOPE ..... T-9 Glass

BASE ..... Intermediate Shell Octal 8-Pin

MOUNTING POSITION ..... Any (Visual Readout from Top of Tube)

ZERO POSITION ..... Cathode #0 (Aligned With Pin #6 ± 10°)

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Pin 1 Common Cathodes
Pin 2 Cathode #5
Pin 3 Guide 1
Pin 4 Anode
Pin 5 Guide 2
Pin 6 Cathode #9
Pin 7 Cathode #0
Pin 8 Cathode #8

APPLICATION NOTES

CONSTRUCTION

The Raytheon decade counter tube consists of thirty (30) thin rod shaped cathodes surrounding a circular anode, all of which are set in a glass envelope employing rare gases at low pressure. The thirty (30) cathodes are identical in construction and are radially spaced concentric to the anode. The cathodes are connected in groups of threes; main cathode, guide 1 cathode and guide 2 cathode. The guide 1's are connected together internally and are brought out to one of the base pins. The guide 2's are similarly connected and brought out to another base pin. The main cathodes may be brought out individually or connected in groups depending on the tube type. Conduction occurs between the anode and the most negative cathode pin causing an orange colored glow at the tip of that cathode. This glow can be viewed from the top of the tube or may be read as a voltage developed across a cathode resistor.

OPERATION

In operation the main cathodes are at a more negative potential than the guide pins. When a negative input pulse (more negative than the cathode) is applied to guide 1 the glow is transferred from the initial cathode (K0) to guide 1. A similar pulse applied to guide 2 transfers the pulse to guide 2. When the potential of guide 2 returns to a value more positive than the main cathodes the glow transfers to the next closest main cathode. In order to insure reliable operation the phase relationship between pulses should be such that the pulse to guide 2 should overlap the pulse to guide 1. This overlap should have a minimum value of 10 microseconds for medium speed tubes and 2 microseconds for high speed tubes. Typical wave shapes are shown in figure 1 for a high speed tube.

RESETTING

Usually the counting in a decade counter tube starts from a particular initial main cathode, and after the completion of a count it is desired to return the glow to the initial cathode. This may be accomplished two ways, (1) by opening the negative connection to all main cathodes and guides except the zero cathode, or (2) by pulsing the zero cathode 120-180 volts negative. Either method should cause the zero cathode to become 120 to 180 volts negative with respect to all other cathodes. It may become necessary in certain applications to reset the glow at such a speed so as not to lose count. Therefore, it is recommended that the reset pulse width be the same as the count signal pulse width received from the drivers. When several tubes are used in cascade the reset for the first tube should be such that it is made to the zero cathode.

APPLICATION NOTES (Cont'd.)

RESETTING (Cont'd)

The succeeding tubes should be set for the number 9 cathodes in order to account for the pulse passed to these tubes when the preceeding tubes are reset. This procedure will position the glow at all zero cathodes when the reset is complete.

DRIVE CIRCUITS

The circuit shown in figure 2 is that of a typical 0-30 KC medium speed drive circuit. The RC integrator network causes a delayed pulse to guide 2 and allows the initial pulse to be applied directly to guide 1. This allows a single negative pulse to step the glow instead of incurring the expense of generating two separate pulses. When the glow steps to the zero cathode (Ko) an output pulse in the form of a negative voltage is developed across the 100K cathode resistor. This pulse may then be used as the input pulse to a succeeding drive circuit. The order in which guide 1 and guide 2 receive the input pulses determines the direction of rotation of the neon glow.

Figure 3 is that of a typical 0-100 Kc high speed drive circuit. The sinewave input is fed directly to one side of the 5814 amplifier tube and hence to the 1st guide electrode. The other guide electrode is fed from the same input waveform but it is first passed through a phase changing network. This is an active filter using one section of another 5814. The tube provides a 180° phase shift which is increased to 270° by the small 10 uuf capacity. This waveform then mixes with the signal input to provide a resultant sinewave of the same fundamental frequency as the input but with a phase lag. This lag is sufficient to permit consistent operation of the counter tube.

DECADE COUNTER

FIGURE 1

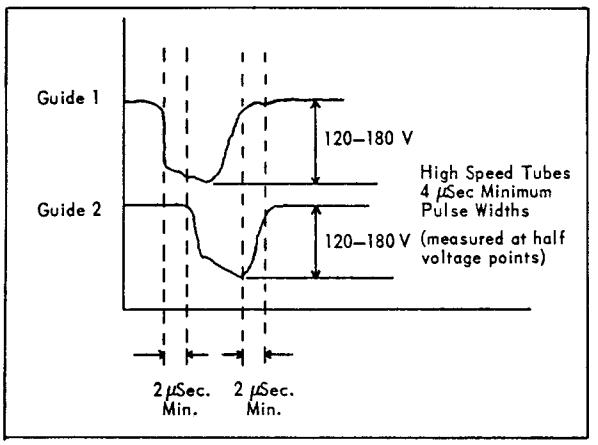


FIGURE 2

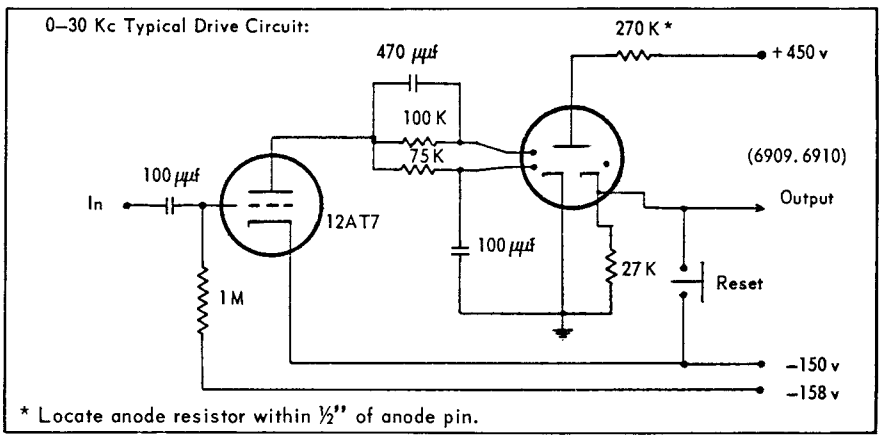
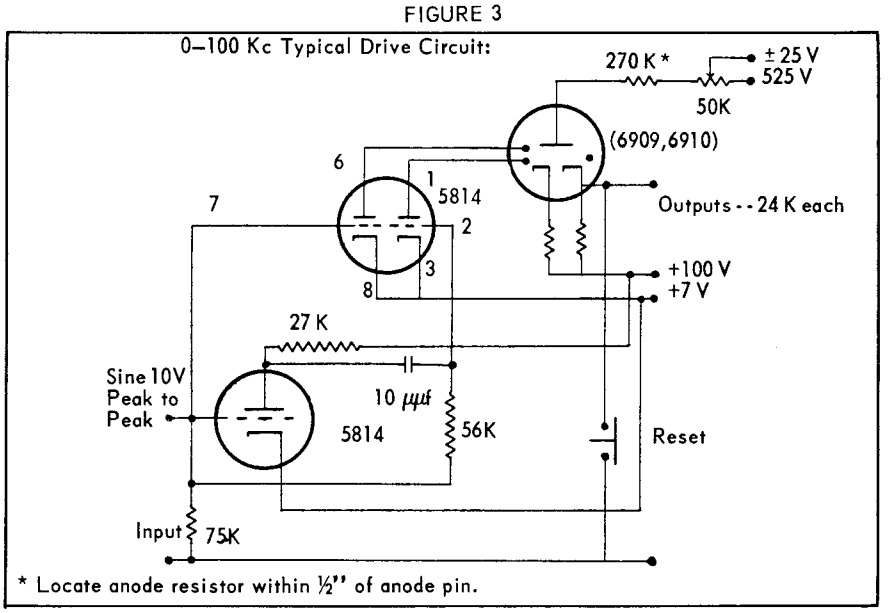


FIGURE 3



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6910

DECADE COUNTER

The CK6910 is a cold cathode gas–filled 100 KC high speed bidirectional ring stepping decade counter tube. This type features direct visual neon glow readout or electrical readout in the form of a voltage from any of the cathode leads. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make this a very reliable counter device. Some of the many uses for this type include counting, timing, sampling, frequency dividing, coding, matrix–ing, telemetering, and controlling.

ELECTRICAL DATA

RATINGS–ABSOLUTE MAXIMUM VALUES:

Total Anode Current	1.2 Ma
Voltage Between Electrodes (Excluding Anode)	140 volts
Supply Voltage (Anode to Cathode)	400 volts
Input Frequency	100,000 cps

CHARACTERISTICS AND TYPICAL OPERATION:

DC Supply Voltage	450 volts
Anode Resistor	0.27 megohms
Nominal Tube Drop	235 volts
Cathode Resistor	24 K ohms
Output Voltage (Across Cathode Resistor)	15 volts

MECHANICAL DATA

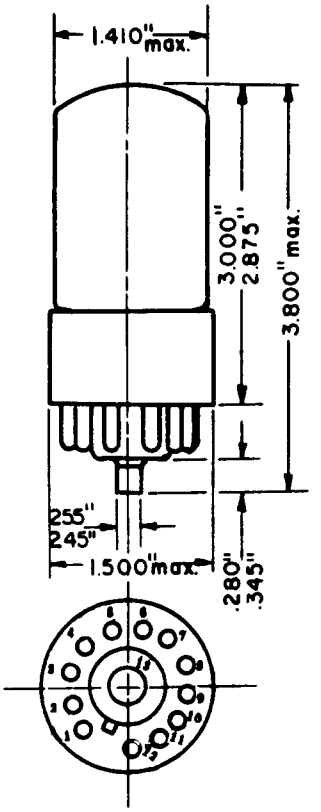
ENVELOPE:..... T–11 Glass

BASE:..... Modified Duo–Decal

MOUNTING POSITION..... Any
(Visual Readout From Top Of Tube)

ZERO POSITION..... Cathode #10
(Aligned with Pin Number 12 ± 10°)

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Pin 1	Cathode #10	Pin 8	Cathode #3
Pin 2	Cathode #9	Pin 9	Cathode #2
Pin 3	Cathode #8	Pin 10	Cathode #1
Pin 4	Cathode #7	Pin 11	Guide 2
Pin 5	Cathode #6	Pin 12	Guide 1
Pin 6	Cathode #5	Pin 13	Anode
Pin 7	Cathode #4		

APPLICATION NOTES

CONSTRUCTION

The Raytheon decade counter tube consists of thirty (30) thin rod shaped cathodes surrounding a circular anode, all of which are set in a glass envelope employing rare gases at low pressure. The thirty (30) cathodes are identical in construction and are radially spaced concentric to the anode. The cathodes are connected in groups of threes; main cathode, guide 1 cathode and guide 2 cathode. The guide 1's are connected together internally and are brought out to one of the base pins. The guide 2's are similarly connected and brought out to another base pin. The main cathodes may be brought out individually or connected in groups depending on the tube type. Conduction occurs between the anode and the most negative cathode pin causing an orange colored glow at the tip of that cathode. This glow can be viewed from the top of the tube or may be read as a voltage developed across a cathode resistor.

OPERATION

In operation the main cathodes are at a more negative potential than the guide pins. When a negative input pulse (more negative than the cathode) is applied to guide 1 the glow is transferred from the initial cathode (Ko) to guide 1. A similar pulse applied to guide 2 transfers the pulse to guide 2. When the potential of guide 2 returns to a value more positive than the main cathodes the glow transfers to the next closest main cathode. In order to insure reliable operation the phase relationship between pulses should be such that the pulse to guide 2 should overlap the pulse to guide 1. This overlap should have a minimum value of 10 microseconds for medium speed tubes and 2 microseconds for high speed tubes. Typical wave shapes are shown in figure 1 for a high speed tube.

RESETTING

Usually the counting in a decade counter tube starts from a particular initial main cathode, and after the completion of a count it is desired to return the glow to the initial cathode. This may be accomplished two ways, (1) by opening the negative connection to all main cathodes and guides except the zero cathode, or (2) by pulsing the zero cathode 120-180 volts negative. Either method should cause the zero cathode to become 120 to 180 volts negative with respect to all other cathodes. It may become necessary in certain applications to reset the glow at such a speed so as not to lose count. Therefore, it is recommended that the reset pulse width be the same as the count signal pulse width received from the drivers.

APPLICATION NOTES (Cont'd.)

RESETTING (Cont'd)

When several tubes are used in cascade the reset for the first tube should be such that it is made to the zero cathode. The succeeding tubes should be set for the number 9 cathodes in order to account for the pulse passed to these tubes when the preceeding tubes are reset. This procedure will position the glow at all zero cathodes when the reset is complete.

DRIVE CIRCUITS

The circuit shown in figure 2 is that of a typical 0-30 KC medium speed drive circuit. The RC integrator network causes a delayed pulse to guide 2 and allows the initial pulse to be applied directly to guide 1. This allows a single negative pulse to step the glow instead of incurring the expense of generating two separate pulses. When the glow steps to the zero cathode (Ko) an output pulse in the form of a negative voltage is developed across the 100K cathode resistor. This pulse may then be used as the input pulse to a succeeding drive circuit. The order in which guide 1 and guide 2 receive the input pulses determines the direction of rotation of the neon glow.

Figure 3 is that of a typical 0-100 Kc high speed drive circuit. The sinewave input is fed directly to one side of the 5814 amplifier tube and hence to the 1st guide electrode. The other guide electrode is fed from the same input waveform but it is first passed through a phase changing network. This is an active filter using one section of another 5814. The tube provides a 180° phase shift which is increased to 270° by the small 10 uuf capacity. This waveform then mixes with the signal input to provide a resultant sinewave of the same fundamental frequency as the input but with a phase lag. This lag is sufficient to permit consistent operation of the counter tube.

DECADE COUNTER

FIGURE 1

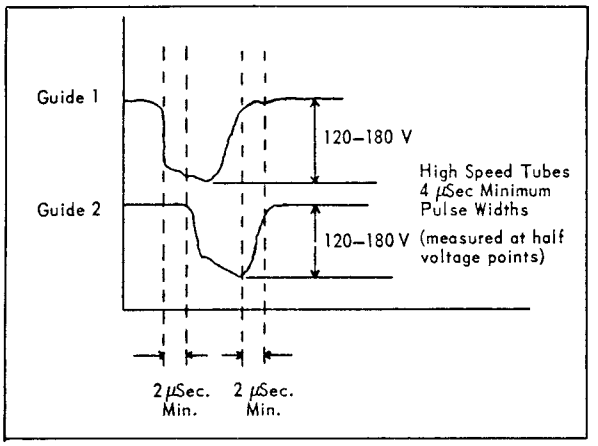


FIGURE 2

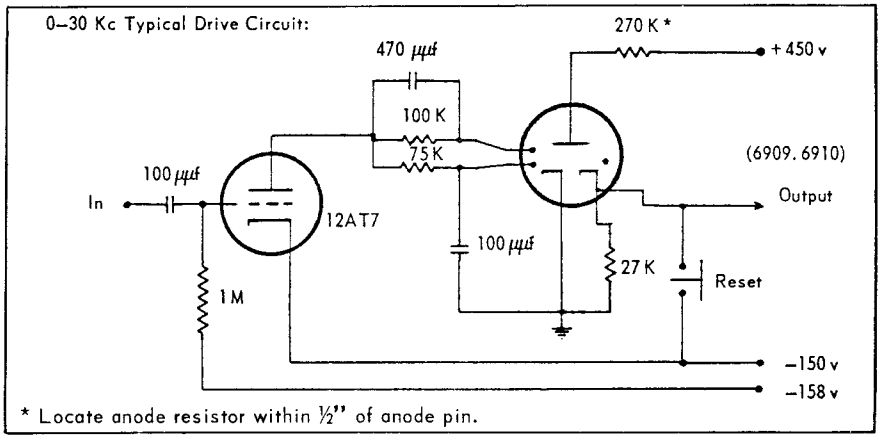
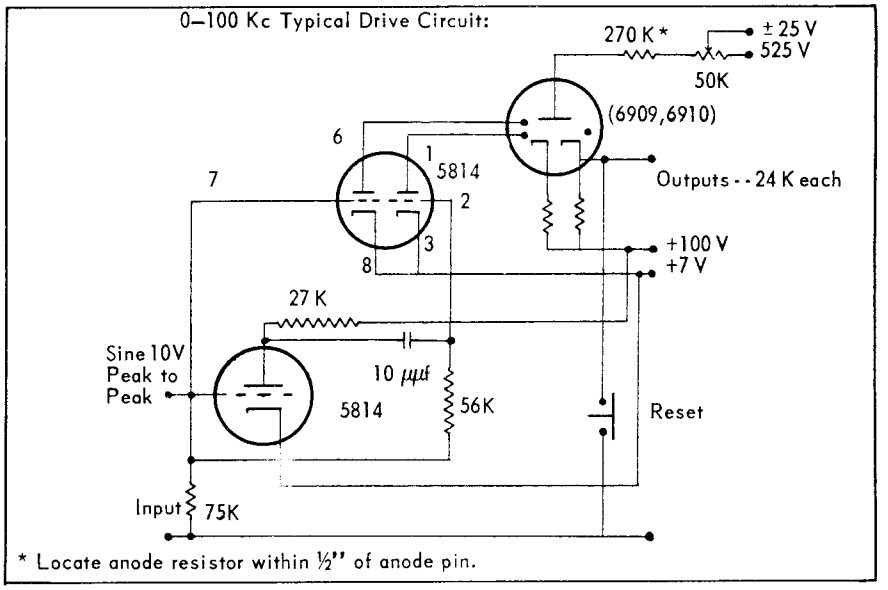


FIGURE 3



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6922

MINIATURE DOUBLE TRIODE

The CK6922 is a heater-cathode type double triode of miniature construction expressly designed for application in cascode circuits as a low noise broad band RF amplifier. The tube is also suitable as a mixer and phase inverter, or as an AF amplifier. The tube uses frame grid construction which allows closer grid to cathode spacing, thus enabling higher transconductance values to be obtained.

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock-Test)	450 G
Maximum Vibrational Acceleration (96 hour Fatigue Test)	2.5 G
Maximum Bulb Temperature	170 °C

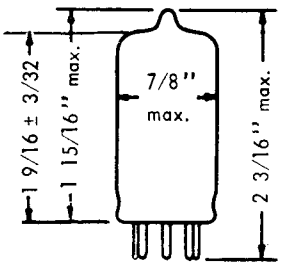
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Ratings			
Heater Voltage	Ef:	6.0	6.3	6.3	6.6	V
Plate Supply Voltage	Ebb:	---	100	100	250	Vdc
Grid Voltage	Ecc	---	+9	+9	---	Vdc
Plate Dissipation (per Plate)	Pp/p	---	---	---	1.65	W
Heater-Cathode Voltage	Ehk	-135	---	---	70	v
Grid Resistance Fixed Bias	Rg/g:	---	---	---	0.5	Meg.
Grid Resistance Cathode Bias	Rg/g:	---	---	---	1.0	Meg.
Cathode Current (per Cathode)	Ik/k:	---	---	---	22	mAdc
Cathode Resistance	Rk/k:	---	680	680	---	ohms
			Tests			
Plate Current Ebb=91 Vdc; Ec=0 Rk=80 ohms (Note A)	Ib:	11.6	---	15.2	18.9	mAdc
Heater Current	If:	285	---	300	315	mA
Transconductance (1) (Note A)	Sm/p	10,000	---	12,500	15,000	μmhos
Transconductance (2) Ef=5.7 V; (Note A)	$\frac{\Delta Sm/p:}{Ef}$	---	---	---	15	%
Amplification Factor (Note A)	Mu:	26.5	33	33	39.5	---
Vibration F=25 cps; G=2.5 Rp=2000; Ck=1000 (Note B)	Ep:	---	---	---	100	mVac

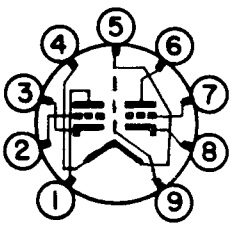
MECHANICAL DATA

ENVELOPE . . . . . T6½ Glass
OUTLINE . . . . . JEDEC (6-2)
BASE . . . . . 9 Pin Miniature
BASING 9DE
MOUNTING POSITION . . . . Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2
Pin 2 Grid, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Heater
Pin 5 Heater
Pin 6 Plate, Unit #1
Pin 7 Grid, Unit #1
Pin 8 Cathode, Unit #1
Pin 9 Internal Shield

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			Tests			
Capacitance (no shield)	Cgp:	---	---	---	1.6	pf
Capacitance (no shield)	Cin:	2.7	---	---	3.9	pf
Capacitance (no shield) Section 1	Cout:	1.55	---	---	1.95	pf
Capacitance (no shield) Section 2	Cout:	1.45	---	---	1.85	pf
Capacitance (no shield)	Cgg:	---	---	---	0.006	pf
Capacitance (no shield)	Cpp:	---	---	---	0.050	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450 G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency of 50 cps.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97 – 100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following cond., Ef = 7.0 V; Ehk = +100 Vdc and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits and meet a maximum Ihk leakage limit of 8 μAdc.

Stability Life Test – Sample is operated for one hour to assure initial electrical stability (Δ_t Sm < 10%).

Survival Rate Life Test – Sample is operated one hundred hours to assure freedom from inoperatives and early electrical instability.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 170 °C.

Note A – Test each unit separately.

Note B – Units connected in parallel.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6

Ef = 6.3 V
Ebb = 100 Vdc
Ecc = +9 Vdc
Rk = 680 ohms

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	Limits, Note 4						
						Min.	LAL	Bogie	UAL	Max	ALD	Units
3.1	Qualification Approval:	Required	---	---	---	---	---	---	---	---	---	---
3.7	Marking:	Note 21	---	---	---	---	---	---	---	---	---	---
---	Cathode:	Coated Unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections:		---	---	---	---	---	---	---	---	---	---
4.9.20.3	Vibration:	Rp=2000; Ck=1000 μf; Note 16	---	---	Ep:	---	---	---	---	100	---	mVac
MEASUREMENTS ACCEPTANCE TESTS PART 1, NOTE 3												
4.10.8	Heater Current:		---	---	If:	---	292	300	308	---	22	mA
4.10.8	Heater Current:		0.65	II	If:	285	---	---	---	315	---	mA
4.10.15	Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=-100 Vdc	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	6 6	--- ---	μAdc μAdc
4.10.6.1	Grid Current (1):	Note 2	0.65	II	Ic:	0	---	---	---	-0.1	---	μAdc
4.10.4.1	Plate Current (1):	Ebb=91 Vdc; Ecc=0; Rk=80; Note 2	---	---	Ib:	---	13.5	15.2	16.7	---	5.4	mAdc
4.10.4.1	Plate Current (1):	Ebb=91 Vdc; Ecc=0; Rk=80; Note 2	0.65	II	Ib:	11.6	---	---	---	18.9	---	mAdc
4.10.4.1	Plate Current (2):	Ec=-8.5; Eb=150 V; Note 2	0.65	II	Ib:	---	---	---	---	100	---	μAdc
4.10.9	Transconductance (1):	Note 2	---	---	Sm:	---	11,500	12,500	13,500	---	3,500	μmhos
4.10.9	Transconductance (1):	Note 2	0.65	II	Sm:	10,000	---	---	---	15,000	---	μmhos
4.7.5	Continuity and short (Inoperatives):	Note 5	0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical:	Envelope Outline No. (6-7)	---	---	---	---	---	---	---	---	---	
MEASUREMENTS ACCEPTANCE TESTS PART 2												
4.8	Insulation of Electrodes:	Note 2 g-all; p-all (10 meg in series)	6.5	L6	R: R:	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance(2):	Ef=5.7 Vac; Notes 2 and 17	2.5	I	ΔSm: Ef	---	---	---	---	15		%
4.10.11.2	Amplification Factor:		6.5	I	Mu:	26.5	---	33	---	39.5	---	---
4.10.6.1	Grid Current (2):	Notes 2 and 15	2.5	I	Ic:	0	---	---	---	-0.2	---	μAdc
4.10.3.1	R.f. Noise:	Ecal=30 mV Notes 16 and 18	2.5	I	---	---	---	---	---	---	---	---

RAYTHEON

CK6922

MINIATURE DOUBLE TRIODE

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	Limits, Note 4 Min.	LAL	Bogie	UAL	Max.	ALD	Units
4.10.3.5	Noise and Microphonics	Ebb=300 Vdc; Rk=340 ohms; Ecal=100 mVac; Ck=100 μf Rp=10,000; Notes 16 and 20	2.5	I	---	---	---	---	---	---	---	---
4.10.14	Capacitance:											
	No Shield	Note 2			Cgp:	---	---	---	---	1.6	---	pf
	No Shield	Note 2			Cin:	2.7	---	---	---	3.9	---	pf
	No Shield	Sect. 1	6.5	Code E	Cout:	1.55	---	---	---	1.95	---	pf
	No Shield	Sect. 2			Cout:	1.45	---	---	---	1.85	---	pf
	No Shield				Cgg:	---	---	---	---	0.006	---	pf
	No Shield				Cpp:	---	---	---	---	0.050	---	pf
4.9.19.1	Vibration (2):	Rp=2000; Ck=1000 Note 16	6.5	Code I	Ep:	---	---	---	---	100	---	mVac
DEGRADATION RATE ACCEPTANCE TESTS, NOTE 6												
4.9.20.5	Shock:	Hammer Angle=(30)°	---	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue:	G=2.5; Fixed Frequency; 50 c.p.s.	6.5	Note 19	---	---	---	---	---	---	---	---
---	Post Shock and Fatigue Test End Points	Vibration (2)	---	---	Ep:	---	---	---	---	150	---	mVac
		Heater-Cathode Leakage; Ehk=+100 Vdc	---	---	Ihk:	---	---	---	---	9	---	μAdc
		Transconductance (1)	---	---	Sm:	8500	---	---	---	16,500	---	μmhos
		Grid Current (1)	---	---	Ic:	0	---	---	---	0.2	---	μAdc
4.9.6.1	Miniature Tube Base Strain:		---	---	---	---	---	---	---	---	---	---
4.9.6.3	Glass Strain:		2.5	I	---	---	---	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic 1st sample	Combined sample	Sym.	LIMITS Min.	Max.	Units
ACCEPTANCE LIFE TESTS, NOTE 6										
4.11.7	Heater-Cycling Life Test	Ef=7.0 V; Ehk=+100; Ec=Eb=0 1 min. on, 4 min. off; Note 7	---	---	---	---	---	---	---	---
4.11.4	Heater-Cycling Life Test End Points:	Heater-Cathode Leakage								
		Ehk=+100 Vdc	---	---	---	---	Ihk:	---	8	μAdc
		Ehk=-100 Vdc	---	---	---	---	Ihk:	---	8	μAdc
4.11.3.1	Stability Life Test: (1 Hour)	Ehk=+70 Vdc; Rg=47,000; TA=Room Notes 2 and 8	1.0	Code I	---	---	---	---	---	---
4.11.4	Stability Life Test End Points:	Change in Transconductance (1) of individual tubes	---	---	---	---	Δ_tSm:	---	10	%
4.11.3.1	Survival Rate Life Tests (100 Hours)	Stability Life Test Conditions or Equivalent Notes 2, 9 and 10	---	II	---	---	---	---	---	---

MINIATURE DOUBLE TRIODE

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	Min.	Max.	Units
					1st sample	Combined sample				
4.11.4	Survival Rate Life Test End Points:	Continuity and shorts (Inoperatives)	0.65	---	---	---	---	---	---	---
		Transconductance (1)	1.0	---	---	---	Sm:	8000	---	μmhos
4.11.3.1	Intermittent Life Test:	Stability Life Test Conditions; T Bulb= 170° C. Min. Notes 2, 11 and 12	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points: (500 Hours)	Note 13	---	---	1	3	---	---	---	---
		Inoperatives (Note 14)	---	---						
		Grid Current (1)	---	---	1	3	Ic:	0	-0.9	μAdc
		Heater Current	---	---	1	3	If:	285	315	mA
		Change in Transconductance (1) of individual tubes	---	---	1	3	Δ_t Sm:	---	15	%
		Transconductance (2)	---	---	2	5	Δ Sm:	---	15	%
		Heater-Cathode Leakage					Ef			
		Ehk=+100 Vdc	---	---	1	3	Ihk:	---	8	μAdc
		Ehk=-100 Vdc	---	---			Ihk:	---	8	μAdc
		Insulation of Electrodes								
		g-all	---	---	2	5	R:	50	---	Meg
		p-all	---	---			R:	50	---	Meg
		Transconductance (1) average change	---	---	---	---	Avg_tSm:	---	15	%
		Total Defectives	---	---	4	8	---	---	---	---
4.11.4	Intermittent Life Test End Points: (1000 Hours)	Note 13								
		Inoperatives: Note 14	---	---	2	5	---	---	---	---
		Grid Current (1)	---	---	2	5	Ic:	0	-0.9	μAdc
		Heater Current	---	---	2	5	If:	285	315	mA
		Change in Transconductance (1) of individual tubes	---	---	2	5	Δ_tSm:	---	25	%
		Heater-Cathode Leakage								
		Ehk=+100 Vdc	---	---	2	5	Ihk:	---	8	μAdc
		Ehk=-100 Vdc	---	---			Ihk:	---	8	μAdc
		Insulation of Electrodes								
		g-all	---	---	3	6	R:	50	---	Meg
		p-all					R:	50	---	Meg
		Total Defectives	---	---	5	10	---	---	---	---

PACKAGING REQUIREMENTS

4.9.18.1.1	Container Drop	(d) Package Group 1; Container Size (B)

Note 1: This value is for operation under fixed bias conditions. With cathode bias, Rg may be 1 megohm maximum.

Note 2: Test each unit separately:

Note 3: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperatives and mechanical shall be 1.0 percent. A tube having one or more defects shall be counted as one defective. Standard MIL-STD-105, inspection level II shall apply.

Note 4: Variables sampling procedures: See paragraphs 5.3.3 to 5.3.3.4, inclusive of Inspection Instructions for Electron Tubes.

Note 5: A grid resistor of 0.1 megohm shall be added; however, this resistor will not be used when a thyratron type short indicator is employed.

Note 6: Destructive tests: Tubes subjected to the following destructive tests are not to be accepted under this specification:

4.9.20.5	Shock	4.11.7	Heater-Cycling Life Test
4.9.20.6	Fatigue	4.11.5	Intermittent Life Test

Note 7: The no load to steady full load regulation of the heater voltage supply shall not be more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, heater–cathode short, or heater cathode leakage current in excess of the specified heater cycling life test end point limit.

Note 8: Stability life test: The sampling and testing procedure for this test shall be in accordance with paragraphs 5.3.4.1 (a) to 5.3.4.1 (g), inclusive of the Inspection Instructions for Electron Tubes.

Note 9: Survival rate life test: The sampling and testing procedure for this test shall be as defined in paragraphs 5.3.4.2 to 5.3.4.2.4, inclusive of the Inspection Instructions for Electron Tubes.

Note 10: For survival rate life test, the equivalent stability life test conditions shall be as defined in paragraph 5.3.4.2.5 of the Inspection Instructions for Electron Tubes.

Note 11: Intermittent life tests: Sampling and acceptance procedures for these tests shall be as defined in paragraphs 5.3.4.3 (a) to 5.3.4.3 (i) inclusive, of the Inspection Instructions for Electron Tubes, except that the following subparagraph shall be added to 5.3.4.3 (e); (4) the life test sample from the first lot accepted each month shall continue on life test for an additional 500 hours (1000 hours total life test time). Failure of this sample to meet the 1000–hour life test end points shall result in loss of eligibility for reduced hours testing.

Note 12: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. Envelope temperature requirements will be satisfied if tube, having bogie Ib (± 5%) under normal test conditions, is determined to operate at minimum specified temperature at any point in the life test rack.

Note 13: Order for evaluation of life test defects: See paragraph 5.3.4.4 of the Inspection Instructions for Electron Tubes.

Note 14: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: discontinuity (ref. Specification MIL–E–1, par. 4.7.1), shorts (ref. Specification MIL–E–1, par. 4.7.2), air leaks (ref. Specification MIL–E–1, par.3.2.4.3).

Note 15: Prior to this test, tubes shall be preheated a minimum of 5 minutes with all sections operating at the conditions indicated below. A 3 minute test is not permitted. Test at preheat conditions within 3 seconds after preheating. Grid current (2) shall be the last test performed on the sample selected for the grid current (2) test.

Ef	Ecc	Ebb	Rk	Rg
V	Vdc	Vdc	ohms	Meg
(7.0)	(+9)	(100)	(680)	(0.047)

Note 16: Tie 1 k to 2k; 1g to 2g and 1 p to 2p. Parasitic suppressors of 50 ohms permitted.

Note 17: Transconductance (2) is the percent change in Transconductance (1) of an individual tube resulting from the change in Ef.

Note 18: In addition to the rejection criteria of par. 4.10.3.1 of Specification MIL–E–1, the output shall be read on a VU meter using a rejection limit of 5 VU. Five VU is the meter deflection obtained with a steady state output of 3 Mw from the amplifier.

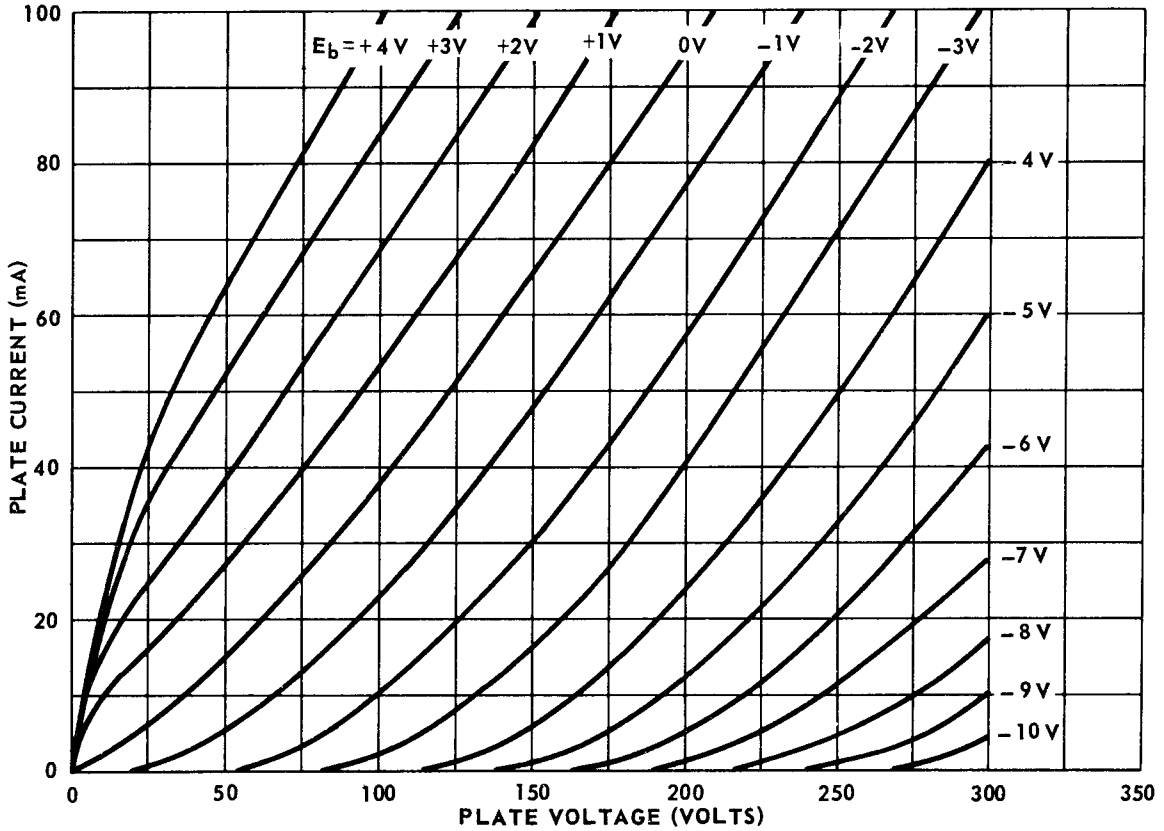
Note 19: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30–day rule shall apply. In the event of lot failure, the lot shall be rejected.

Note 20: The rejection level shall be set at the VU meter reading obtained during calibration.

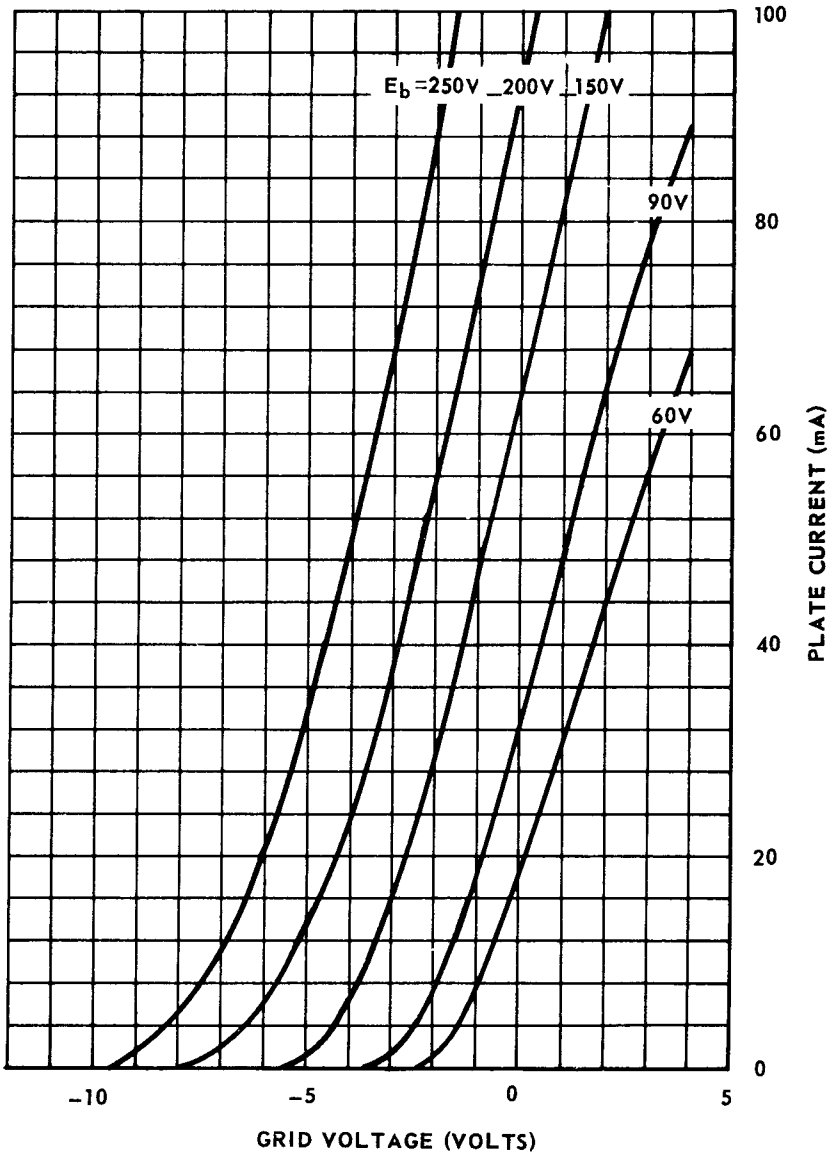
Note 21: Tubes shall be marked "USN 6922".

MINIATURE DOUBLE TRIODE

PLATE CHARACTERISTICS



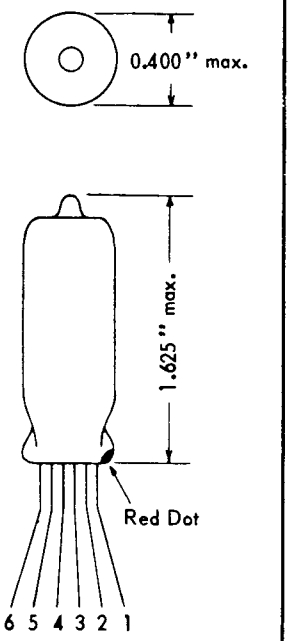
TRANSFER CHARACTERISTICS



Excellence in Electronics

TYPE CK6932

The CK6932 is a filamentary type subminiature pentode of low filament current designed for service in portable equipment. The suppressor grid may be used as an independent control electrode for circuits such as gated amplifiers. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T–3 Glass

BASE: Pinch Press (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center–to–center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive
Lead 3 Filament, Negative	Lead 6 Grid #3

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES (μμfds.) ●

Grid #1 to Plate	0.030
Input	3.5
Output	3.85
Grid #1 to Grid #3	0.2

RATINGS–ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20%	volts
Plate Voltage	67.5	volts
Screen Grid Voltage	67.5	volts
Cathode Current	1.5	mA

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage	1.25	1.25	volts
Filament Current	20	20	mA
Plate Voltage	22.5	45	volts
Screen Grid Voltage	22.5	45	volts
Grid #1 Voltage	0	–1.25	volts
Grid #3 Voltage	0	0	volts
Plate Current	300	560	μA
Screen Grid Current	300	320	μA
Transconductance G1–P	250	475	μmhos
Grid #1 Voltage for Ib=10 μA (approx.)	–2.0	–4.0	volts
Grid #3 Voltage for Ib=10 μA (approx.)	–3.0	–8.0	volts
Screen Grid Current at Ec3=–8.0	----	750	μA
Screen Grid Current at Ec3=–3.0	500	----	μA

● *With cylindrical shield (0.405" i.d. by 1 7/8" long) connected to Lead 6.*

These data identify a particular developmental tube design and the tube designation or the descriptive data may be subject to change.

Objective Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

October 15, 1957 NEWTON 58, MASS.

AVERAGE PLATE CHARACTERISTICS

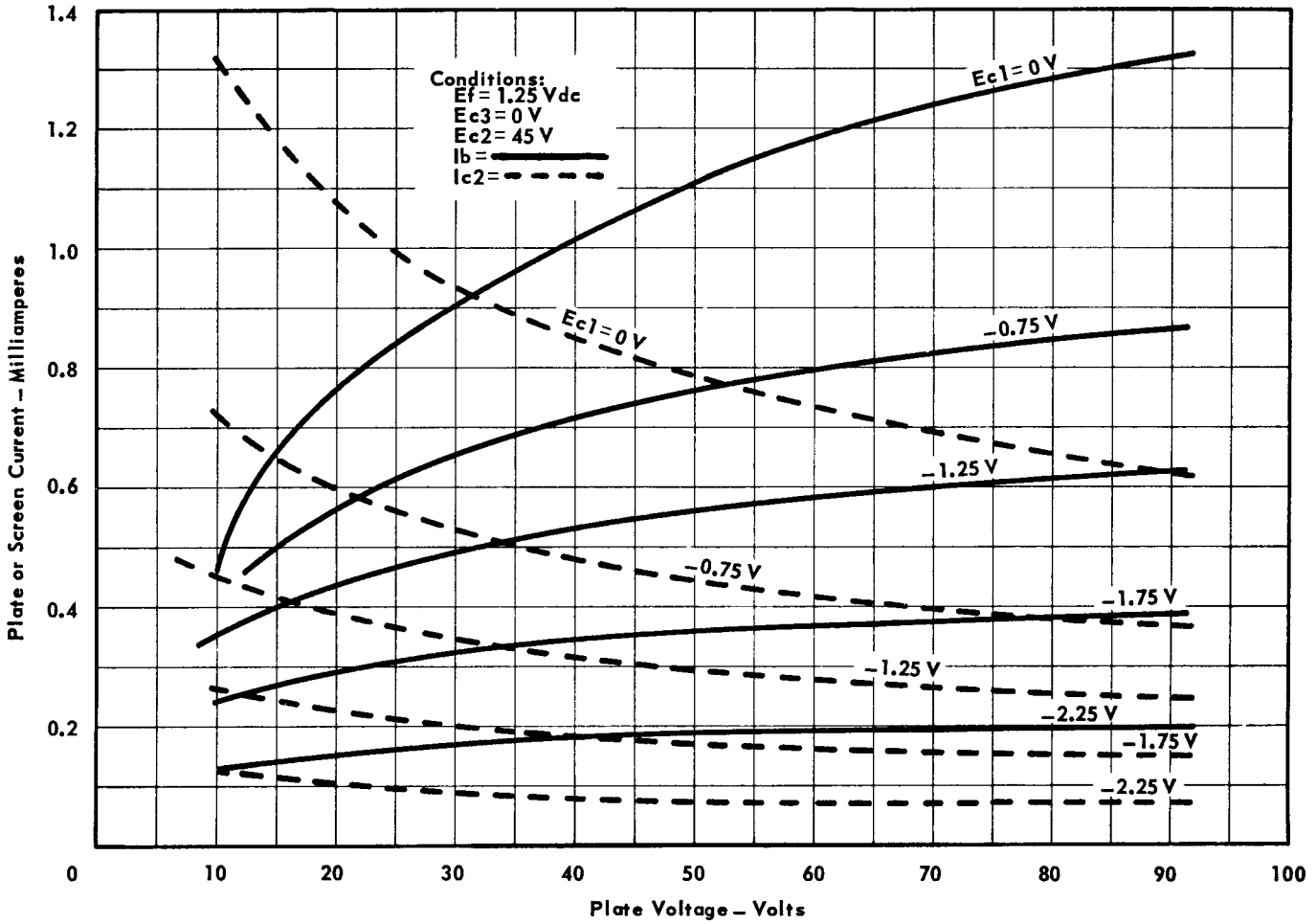
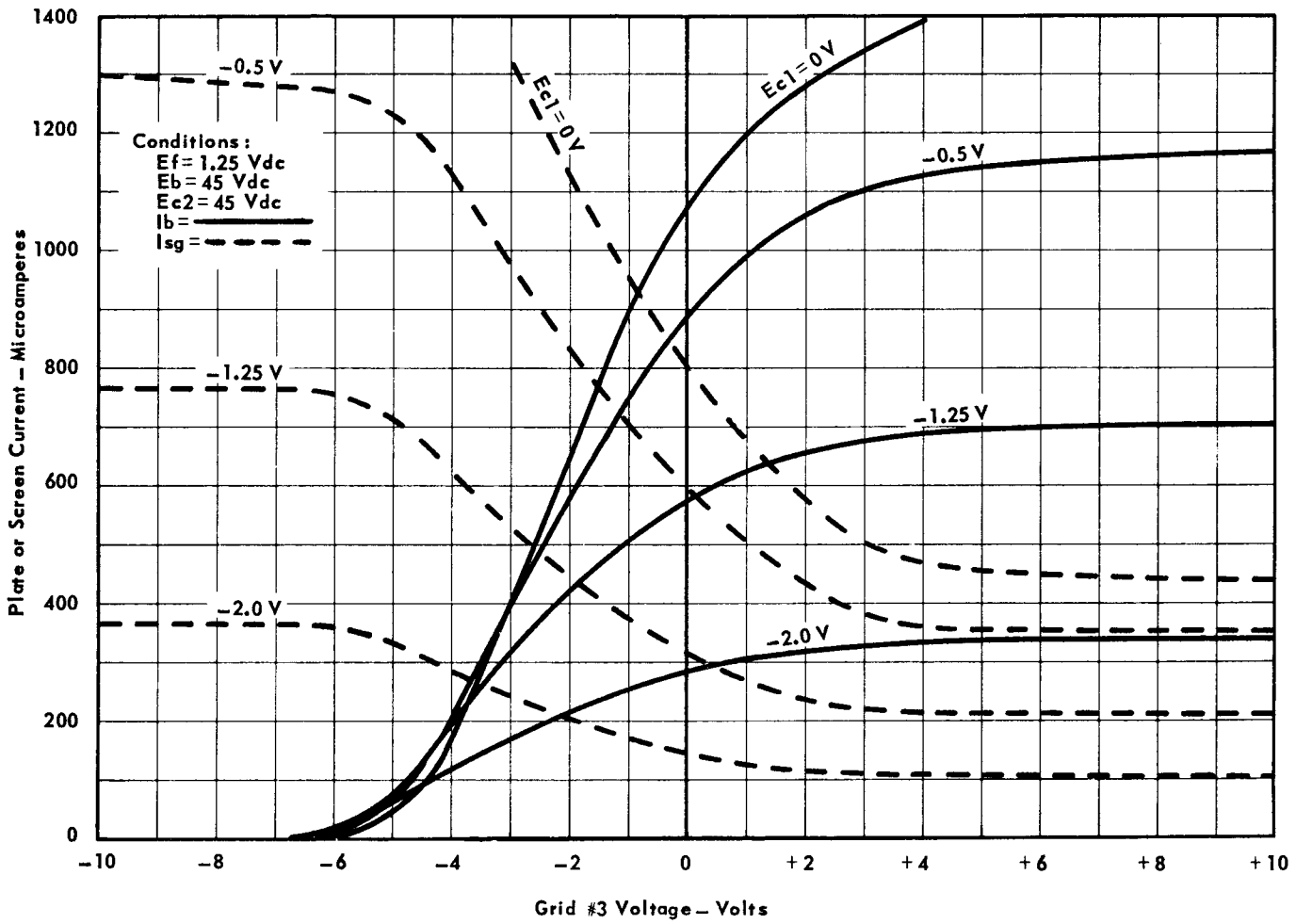
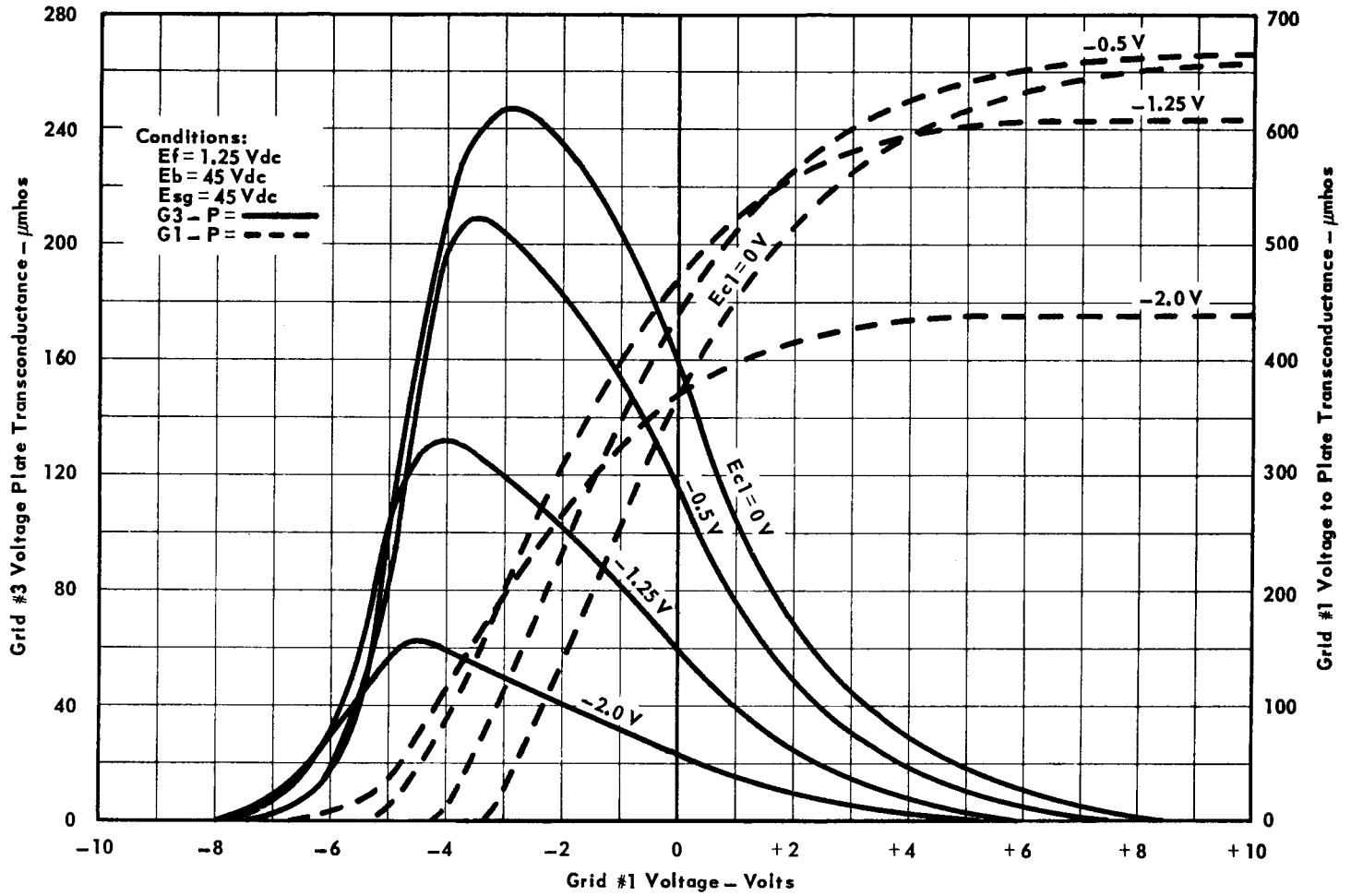


PLATE AND SCREEN CURRENT vs. GRID #3 CURRENT



TRANSCONDUCTANCE vs. GRID #3 Voltage



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6939

TWIN POWER PENTODE

The CK6939 is a miniature heater–cathode type double pentode designed for use as a UHF power amplifier and frequency multiplier in communication equipment. For improved performance and greater stability, the CK6939 contains internal neutralization enabling high power gain at frequencies up to 500 megacycles. The frame grid construction, allowing close spacing between grid and cathode, reduces transit time, and reduces the chance of shorts due to rigid tolerances obtainable only with this type of construction. This type is characterized by long life and stable performance and is designed for service where conditions of high temperature and mechanical shock or vibration are encountered.

MECHANICAL RATINGS: (Maximum Ratings)

Impact Acceleration (Shock)	450	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	225	°C
Altitude	60,000	Ft.

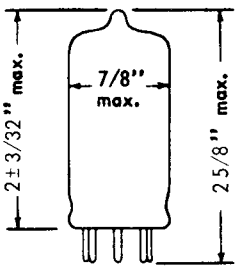
ELECTRICAL DATA

Ratings and Normal Operation:	MIL–E–1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL–E–1 Units
			Ratings			
Heater Voltage	Ef:	5.7/11.3	6.3/12.6	6.3/12.6	6.9/13.9	V
Plate Voltage						
C Telep. Intermittent	Eb:	----	----	150	200	Vdc
C Telep. Continuous	Eb:	----	----	150	200	Vdc
C Teleg. Intermittent	Eb:	----	----	150	250	Vdc
C Teleg. Continuous	Eb:	----	----	150	250	Vdc
Grid #1 Voltage	Ec1:	----	----	–3.0	–50	Vdc
Grid #2 Voltage	Ec2:	----	----	150	200	Vdc
Heater–Cathode Voltage	Ehk:	----	----	----	100	Vdc
Cathode Current						
C Telep. Intermittent	Ik:	----	----	----	2X48	mAdc
C Telep. Continuous	Ik:	----	----	----	2X40	mAdc
C Teleg. Intermittent	Ik:	----	----	----	2X60	mAdc
C Teleg. Continuous	Ik:	----	----	----	2X50	mAdc
Plate Current						
C Telep. Intermittent	Ib:	----	----	----	2X40	mAdc
C Telep. Continuous	Ib:	----	----	----	2X32	mAdc
C Teleg. Intermittent	Ib:	----	----	----	2X50	mAdc
C Teleg. Continuous	Ib:	----	----	----	2X45	mAdc
Grid #1 Current						
C Telep. Intermittent	Ic1:	----	----	----	2X4	mAdc
C Telep. Continuous	Ic1:	----	----	----	2X3	mAdc
C Teleg. Intermittent	Ic1:	----	----	----	2X4	mAdc
C Teleg. Continuous	Ic1:	----	----	----	2X3	mAdc

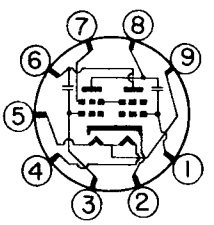
MECHANICAL DATA

ENVELOPE ..... Glass T–6½
OUTLINE 6–8
BASE ..... E9–1 9 Pin Min. Button
CATHODE ..... Oxide Coated Unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Grid #1 Unit #1
Pin 2 Cathode, Shield
Pin 3 Grid #1 Unit #2
Pin 4 Heater
Pin 5 Heater
Pin 6 Plate Unit #1
Pin 7 Grid #2
Pin 8 Plate Unit #2
Pin 9 Heater Center Tap

ELECTRICAL DATA (cont'd.)

Ratings and Normal Operation:	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
			Ratings			
Grid #1 Power Dissipation						
C Telep. Intermittent	Pg1:	----	----	----	2X0.12	watts
C Telep. Continuous	Pg1:	----	----	----	2X0.1	watts
C Teleg. Intermittent	Pg1:	----	----	----	2X0.12	watts
C Teleg. Continuous	Pg1:	----	----	----	2X0.1	watts
Grid #2 Power Dissipation						
C Telep. Intermittent	Pg2:	----	----	----	2X1.15	watts
C Telep. Continuous	Pg2:	----	----	----	2X1.0	watts
C Teleg. Intermittent	Pg2:	----	----	----	2X1.75	watts
C Teleg. Continuous	Pg2:	----	----	----	2X1.5	watts
Plate Power Dissipation						
C Telep. Intermittent	Pp:	----	----	----	2X2.5	watts
C Telep. Continuous	Pp:	----	----	----	2X2.0	watts
C Teleg. Intermittent	Pp:	----	----	----	2X3.75	watts
C Teleg. Continuous	Pp:	----	----	----	2X3.0	watts
Power Input (Plate)						
C Telep. Intermittent	Pi:	----	----	----	2X5.0	watts
C Telep. Continuous	Pi:	----	----	----	2X4.0	watts
C Teleg. Intermittent	Pi:	----	----	----	2X7.0	watts
C Teleg. Continuous	Pi:	----	----	Note A	2X6.0	watts
			Tests			
Heater Current Ef=6.3	If:	575	----	----	625	mAac
Plate Current (1) Ec1=0; Note A	Ib:	33	----	----	82	mAdc
Plate Current (2) Note A	Ib:	7.5	----	----	31	mAdc
Plate Current (3) Ec1=-11.0 Vdc; Note A	Ib:	----	----	----	125	μAdc
Screen Current Note A	Ic2:	1.5	----	----	7.5	mAdc
Heater-Cathode Leakage Ehk=±100 Vdc	Ihk:	----	----	----	40	μAdc
Transconductance Ec1/ib=25 mAdc; Note A	Sm:	7800	----	----	13200	μmhos
Capacitance (Note B)	Cgp:	----	----	----	0.2	pf
Capacitance (Note B)	Cin:	5.1	----	----	7.7	pf
Capacitance (Note B)	Cout:	1.4	----	----	1.8	pf
Power Output (1): Push pull Class C Amplifier F=470-500 mc; Eb=Ec2=180 Vdc; Ic1=1.5 mAdc; Rg1/g=27 k ohms Rg2=0.1 k ohm; Ib=65 mAdc max. Ic2=15 mAdc max.	Po:	4.1	----	----	----	W
Power Output (2) Ef=5.3 Vac; Note C		----	----	----	15	%

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test –	450 G. 30° hammer angle in Navy High Impact Shock Machine. Sample subjected to five impact accelerations in each of four different positions.
Fatigue Test –	2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency of 50 c.p.s., Ef=6.3 Vac.
1000 Hr. Life Test –	Sample is operated for 1000 hours to assure electrical stability and freedom from inoperatives. Tubes are operated under Power Output (1) Test Conditions.
Altitude –	Sample is subjected to pressure of 55 ± 5 mmHg (60,000 ft.) to assure freedom from flashover or corona at the pins of the tube .

APPLICATION NOTES

Note A: Each unit shall be read separately. Control grid of unit not under test shall be connected to –20 Vdc.

Note B: Without external shield.

Note C: Po(1) and Po(2) shall be recorded. The percentage difference shall not exceed the maximum percentage indicated.

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

Test Conditions
Ef = 6.3/12.6 V ± 10%
Eb = 150 Vdc
Ec1 = −3.0 Vdc
Ec2 = 150 Vdc

Ref.	Test	Conditions	AQL %	Insp. Level or Code	Sym.	LIMITS Min	LAL	Bogie	UAL	Max	ALD	Units
QUALIFICATION APPROVAL TESTS												
3.1	Qualification approval:	Required										
3.7	Marking:											
---	Cathode:	Coated unipotential										
3.4.3	Base connections:	E9-1										
4.9.18	Container drop:	Required										
MEASUREMENT ACCEPTANCE TESTS, PART 1, NOTE 2												
4.10.8	Heater current:	Ef = 6.3	0.65	II	If:	575	---	---	---	625	---	mA
4.9.1	Mechanical envelope Outline:		---	---	---	---	---	---	---	---	---	
4.10.4.1	Plate current (1):	Ec1 = 0 Vdc; Note 3	0.65	II	Ib:	33	---	---	---	82	---	mAdc
4.10.4.1	Plate current (2):	Note 3	0.65	II	Ib:	7.5	---	---	---	31	---	mAdc
4.10.4.1	Plate current (3):	Ec1 = −11.0 Vdc; Note 3	0.65	II	Ib:	---	---	---	---	125	---	μAdc
4.10.6.1	Grid current:	Rc1 = 0.1 meg; Note 3	0.65	II	Ic1:	---	---	---	---	1.0	---	μAdc
4.10.4.3	Screen current:	Note 3	0.65	II	Ic2:	1.5	---	---	---	7.5	---	mAdc
4.10.1.3	Peak emission:	Eb = Ec2 = 200 Vdc; Note 4 ec1 = +25 V; Ef = 5.3V	0.65	II	is:	650	---	---	---	---	---	mA
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.8	Insulation of Electrodes:	Eg-all = −100 Vdc Ep-all = −300 Vdc Notes 5 and 6	2.5	IA	R: R:	10 10	--- ---	--- ---	--- ---	--- ---	--- ---	Meg. Meg.
4.10.15	Heater cathode leakage:	Ehk = +100 Ehk = −100	6.5	IA	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	40 40	--- ---	μAdc μAdc
4.10.9	Transconductance:	Ec1/ib = 25 mAdc Note 3	6.5	IA	Sm:	7800	---	---	---	13200	---	μmhos
4.10.14	Capacitance:		6.5	IA	Cgp: Cin: Cout:	--- 5.1 1.4	--- --- ---	--- --- ---	--- --- ---	0.2 7.7 1.8	--- --- ---	pf pf pf
4.10.6.6	Primary control grid emission:	Ef = 7.0 Vac; Note 5 Pg1 = 0.15 w Eb = Ec2 = 0 Vdc	6.5	IA	Isg1:		---	---	---	−10	---	μAdc
4.10.6.6	Primary screen grid emission:	Ef = 7.0 Vac Pg2 = 3.5 w Eb = Ec1 = 0	6.5	IA	Isg2:	---	---	---	---	−200	---	μAdc
4.9.20.6	Fatigue test:	Apply 2.5 G t = 96 hrs Ef = 6.3 Vac; F = 50 c.p.s. No other voltages	6.5	Note 9	---	---	---	---	---	---	---	---
4.9.20.5	Shock:	Hammer angle = 30° Ef = 6.3 Vac No other voltages	20	---	---	---	---	---	---	---	---	---

TWIN POWER PENTODE

Ref.	Test	Conditions	AQL %	Insp. level or code	Allowable defectives per characteristics 1st sample	Allowable defectives per characteristics combined samples	Sym.	LIMITS Min	LIMITS Max	Units
----	Post shock and fatigue test end points:	Insulation of electrodes:								
		Eg–all=–100; Notes 5 and 6	---	---	---	---	R:	10	---	Meg.
		Ep–all=300	---	---	---	---	R:	10	---	Meg.
		Heater cathode leakage								
		Ehk=+100 Vdc	---	---	---	---	Ihk:	---	70	μAdc
		Ehk=–100 Vdc	---	---	---	---	Ihk:	---	70	μAdc
		Power output (1):	---	---	---	---	Po:	4.0	---	W
		Peak emission:	---	---	---	---	is:	600	---	mA
4.10.2.2	Power output (1):	Push pull Class C amplifier, F=470–500 Mc Eb=Ec2=180 Vdc; Ic1=1.5 mAdc Rg1/g=27 Kohm Rc2=0.1 Kohm Ib=65 mAdc max Ic2= 15 mAdc max.	6.5	IA	---	---	Po:	4.1	---	W
4.10.2.2	Power output (2):	Power output (1): Ef=5.3 V; Note 8	6.5	IA	---	---	---	---	15	%
ACCEPTANCE LIFE TESTS										
4.11	Life test (1):	Group C Power Output (1)	---	---	---	---	t	1000	---	hrs
4.11.4	Life test (1) end points:	Power output (1)	---	---	---	---	Po(1):	3.5	---	W
		Power output (2):	---	---	---	---	Δ_{Ef} Po:	---	15	%
		Peak emission	---	---	---	---	is:	450	---	mA
		Grid current	---	---	---	---	Ic1:	---	–1	μAdc
		Primary control grid emission	---	---	---	---	Isg1:	---	–50	μAdc
		Primary screen grid emission	---	---	---	---	Isg2:	---	–200	μAdc
4.11	Life test(2):	Group C Power output (1) Ef=7.8 V Eb=200; Note 7	---	---	---	---	t:	100	---	hrs.
4.11.4	Life test (2) end points:	Power output (1)	---	---	---	---	Po(1):	3.5	---	W
		Power output (2)	---	---	---	---	Δ_{Ef}Po	---	1-5	%
		Peak emission	---	---	---	---	is:	450	---	mA
		Grid current	---	---	---	---	Ic1:	---	–1	μAdc
		Primary control grid emission	---	---	---	---	Isg1:	---	–50	μAdc
		Primary screen grid emission	---	---	---	---	Isg2:	---	–200	μAdc
5.1	Preparation for delivery:	Package group 1, container drop test (d) in accordance with Specification MIL–E–75								

Note 1: Temperature of bulb shall be 225 °C. maximum.

Note 2: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Mechanical, shall be 1.0 percent. A tube having one or more defects shall be counted as one defective. Standard MIL–STD–105 inspection level II shall apply

NOTES: (cont'd.)

Note 3: Each unit shall be read separately. Control grid of unit not under test shall be connected to –20 Vdc.

Note 4: Test both units in parallel. Ec1 is a rectangular pulse voltage with a pulse width of 800 μsec; this pulse voltage is superimposed on Ec1 = –100 Vdc (total pulse voltage = 125 V). Duty cycle = 0.04.

Note 5: Each unit shall be tested separately.

Note 6: Voltage shall be applied in series with 10 megohm resistor.

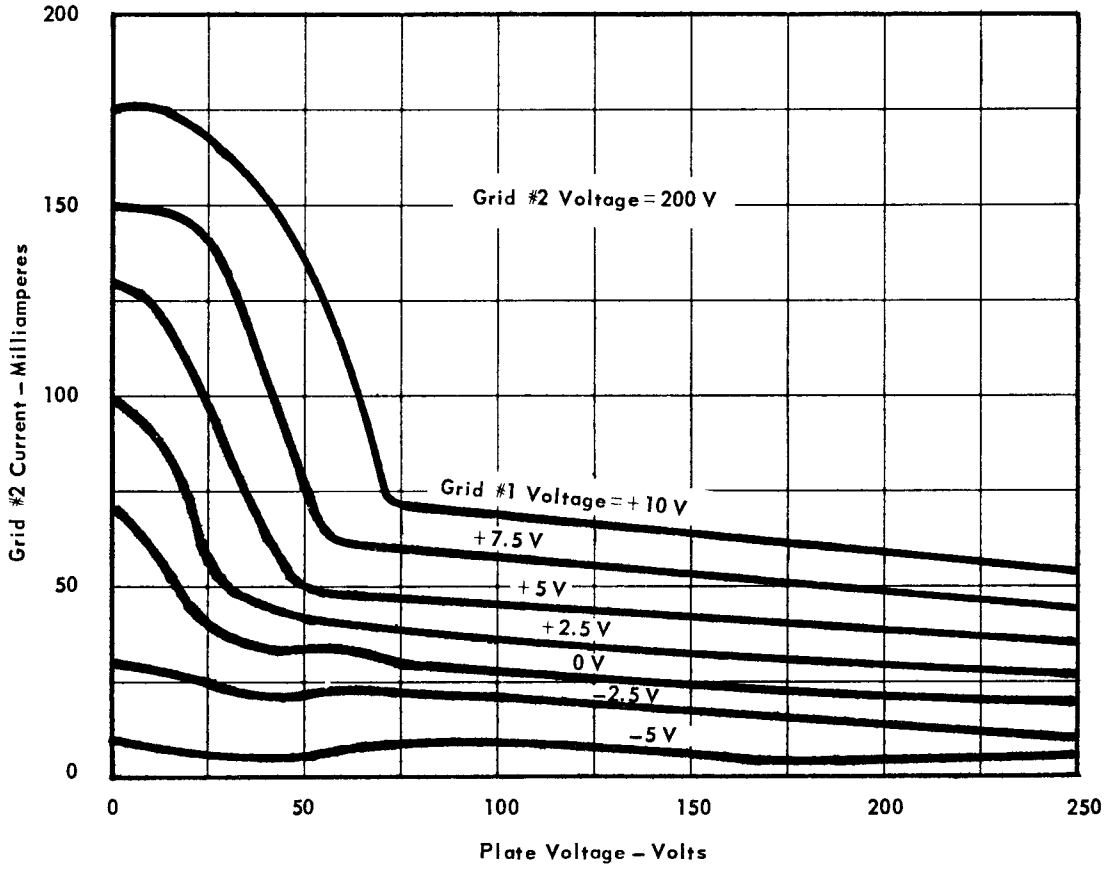
Note 7: Plate voltage shall be applied intermittently, 2 minutes on, 8 minutes off.

Note 8: Po(1) and Po(2) shall be recorded. The percentage difference shall not exceed the maximum percentage indicated.

Note 9: The Fatigue test shall be conducted on the initial lot and thereafter on a lot approximately ever 30 days. Once a lot has passed the 30 days rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. Standard MIL–STD–105, sample size code letter F shall apply.

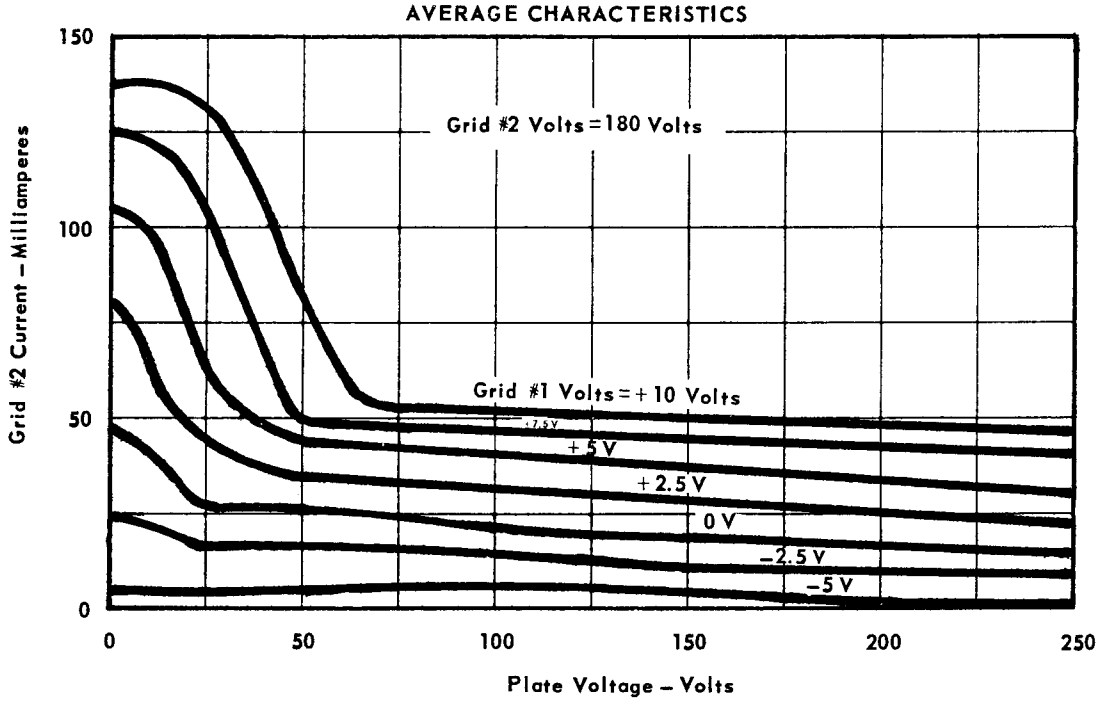
Note 10: If altitude rating is exceeded, a reduction of instantaneous voltage is required (filament voltage Ef is excluded).

AVERAGE CHARACTERISTICS

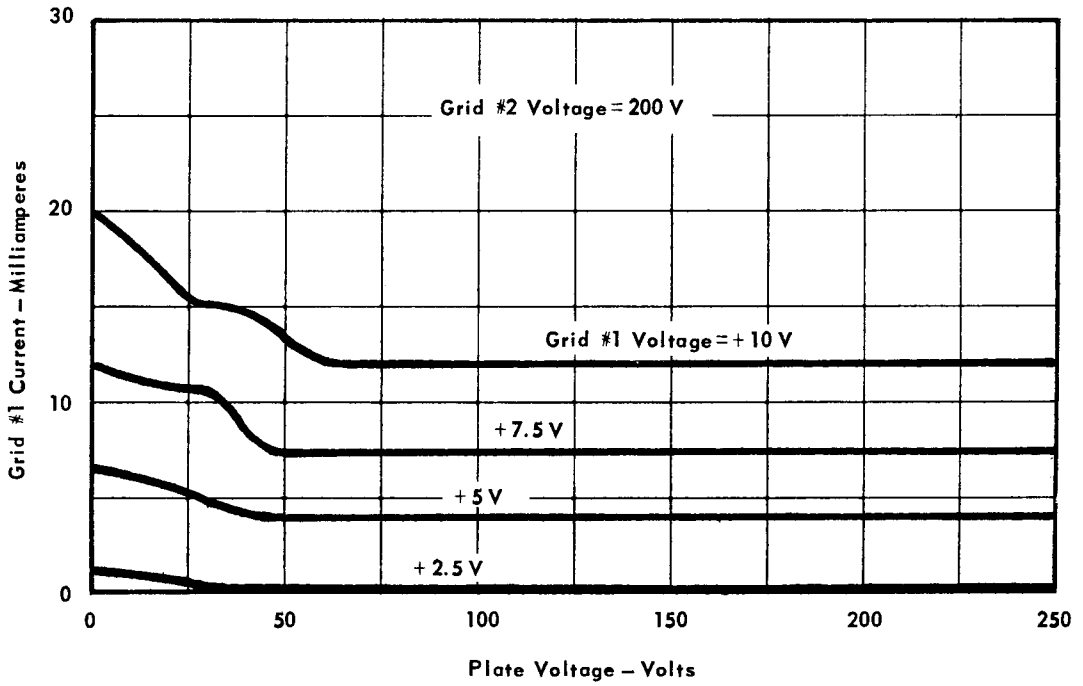


TWIN POWER PENTODE

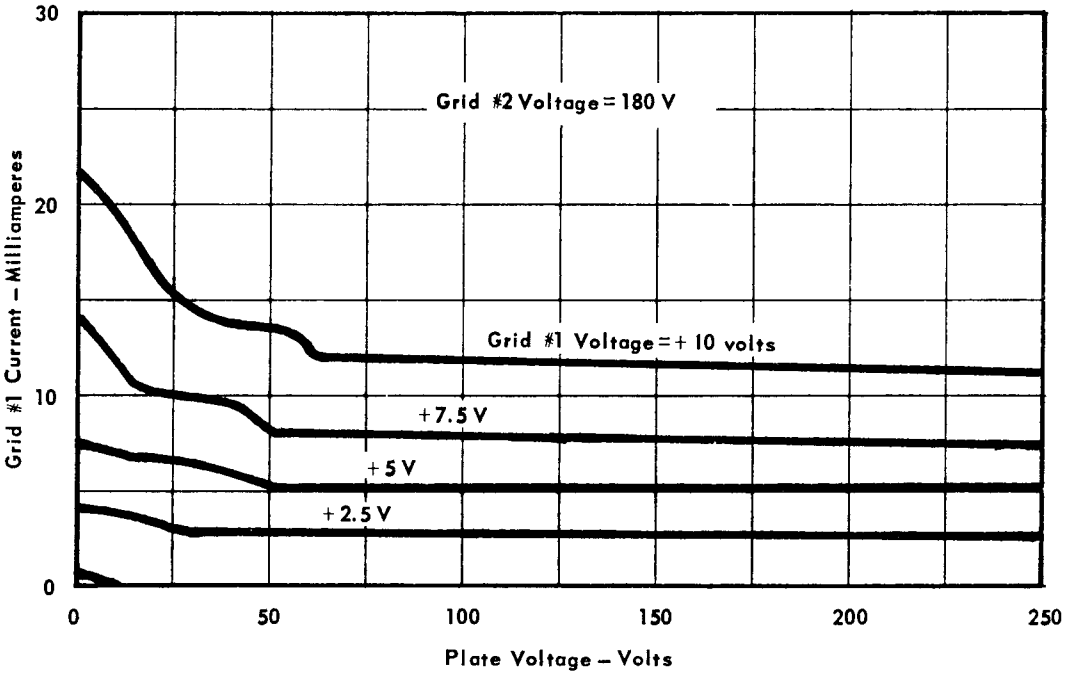
AVERAGE CHARACTERISTICS



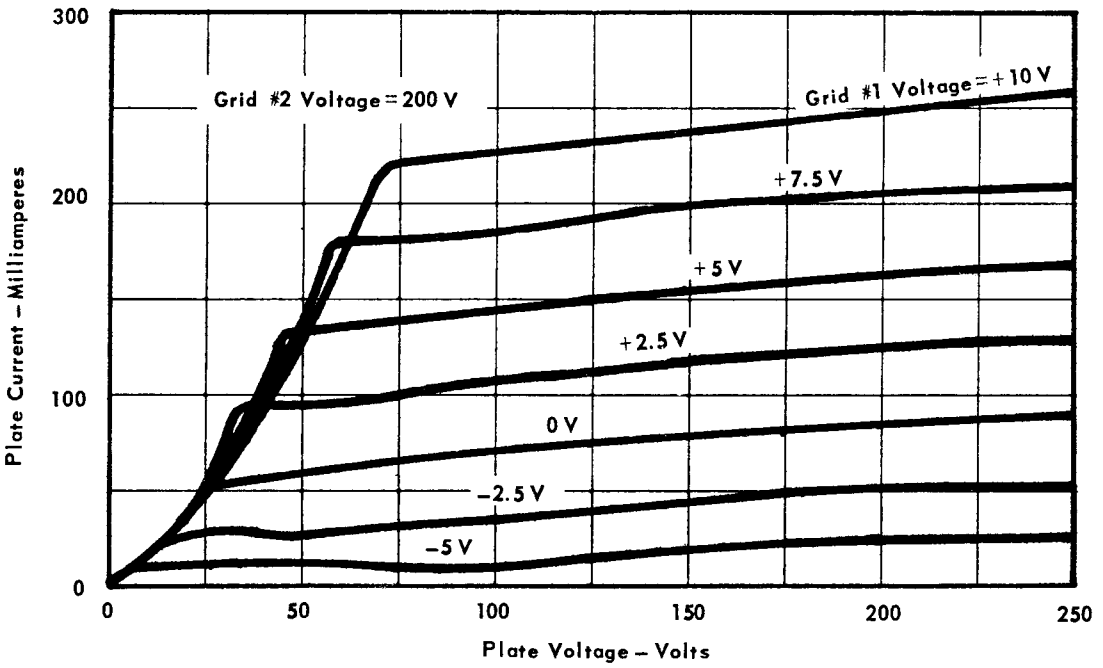
AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS

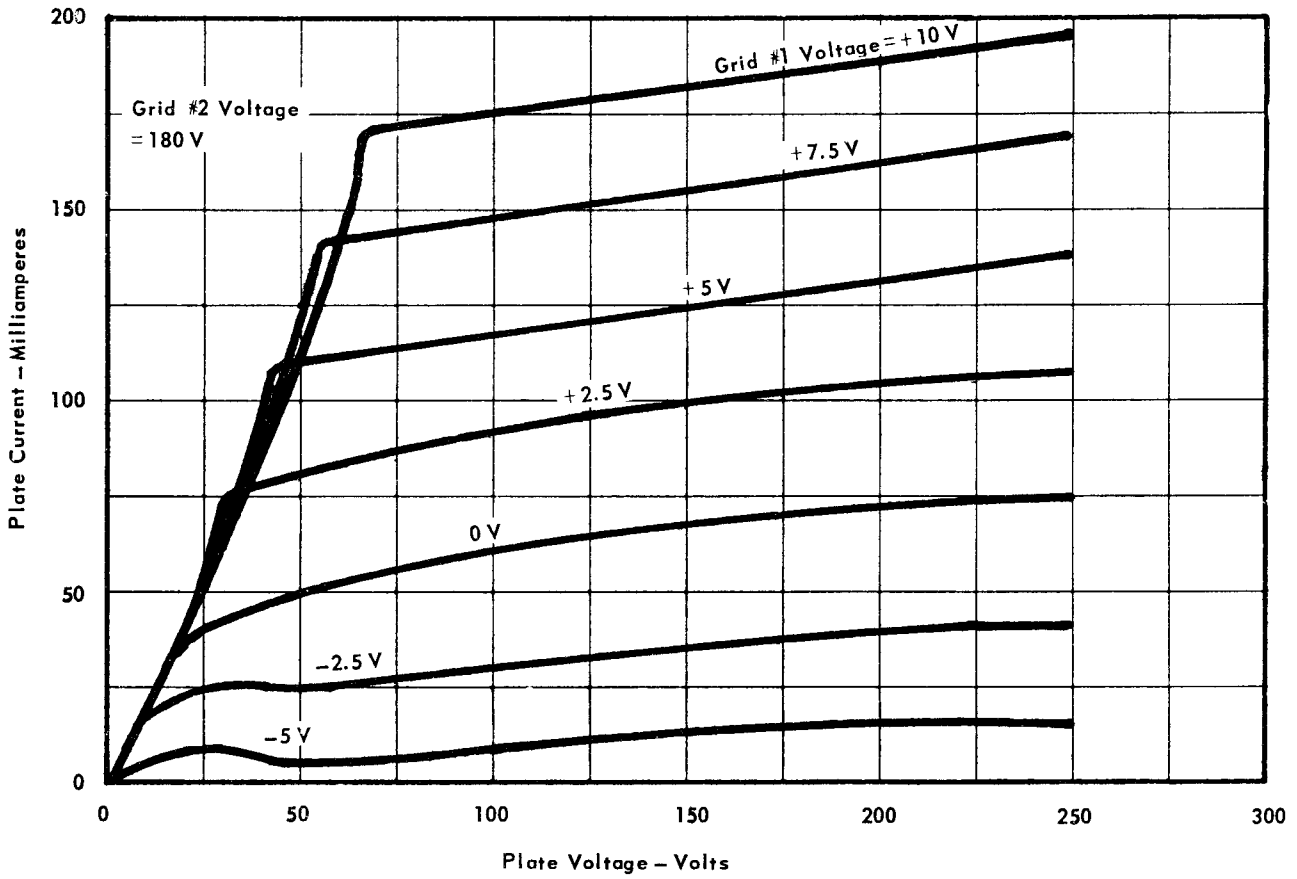


AVERAGE CHARACTERISTICS

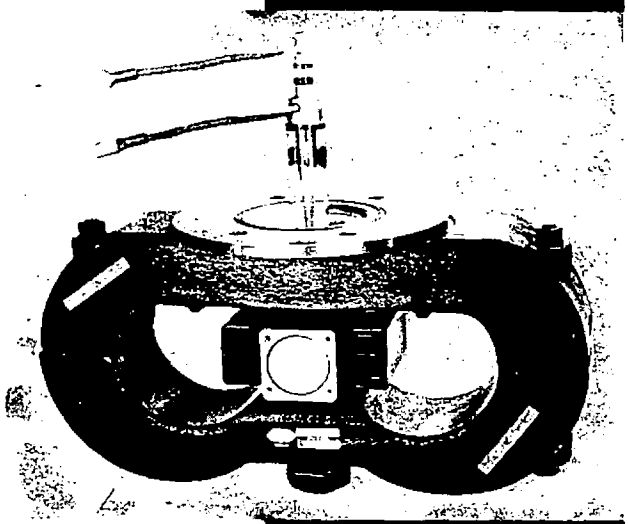


TWIN POWER PENTODE

AVERAGE CHARACTERISTICS



TYPE RK6959/ QK172



PULSED-TYPE MAGNETRON OSCILLATOR

GENERAL DESCRIPTION

The RK6959/QK172 magnetron is a fixed frequency pulsed type oscillator operating in the frequency region of 9330 to 9420 megacycles with a nominal peak power output of 500 kilowatts. It is an integral magnet type tube requiring forced air cooling and is designed for coupling to standard 5/8" x 1¼" waveguide.

GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the over-all radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This technical data should be used as a guide for equipment designers rather than the MIL-E-1C Government purchase specifications. There are many problems peculiar to magnetrons in general which must be given special consideratic system design. These problems are discussed in d on the following pages. If for any reason it is desired to operate the RK6959/QK172 under conditions other than those recommended in this technical data sheet, the Applications Group at Raytheon must be consulted. In some special cases, additional evaluation and life test will be necessary.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater current @ 6.0 V	27 — 33 A
Minimum preheat time	5 minutes
Cold heater resistance	.025 ohms

Typical Operation

Heater voltage preheat	6.0 V	
Heater voltage operate	3.0 V	6.5 V
Pulse duration	3.2 μsec ± 10%	0.5 μsec ±10%
Duty cycle	.00105	.0003
Peak anode voltage	33 kv	33 kv
Peak anode current	38 a	67 a
Average anode current	40 mAdc	20 mAdc
Peak power output	500 kw	800 kw
Average power output	525 W	240 W
VSWR	1.5/1	1.5/1
Frequency region	9330 — 9420 Mc	9330 — 9420 Mc
RF bandwidth	1.1 Mc @ —6 db level	4.0 Mc @ —6 db level

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION
RAYTHEON COMPANY
FOUNDRY AVE., WALTHAM 54, MASS.

from JEDEC release #3478, Nov. 6, 1961

MECHANICAL

Over-all dimensions	15" x 13" x 4.5"
Net weight	45 lbs.
Mounting	Cathode vertical
Output coupling	⅝" x 1¼" Choke Flange
Output pressure	45 psia
Cooling	Forced air
Vibration (non-operating)	50 cycles @ 10 G
Magnet protection	6"

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 6.0 V ± 5.0% for a period of at least 5 minutes prior to the application of anode voltage. Optimum operation and maximum tube life will be realized only if provisions are made to maintain the specified heater current within the ± 5.0% tolerance. Heater current surges in excess of 55 amps cannot be tolerated. Operation of the tube at standby or preheat without forced air cooling may result in damage to the tube and is not permissible. See Figure 1 for heater characteristics.

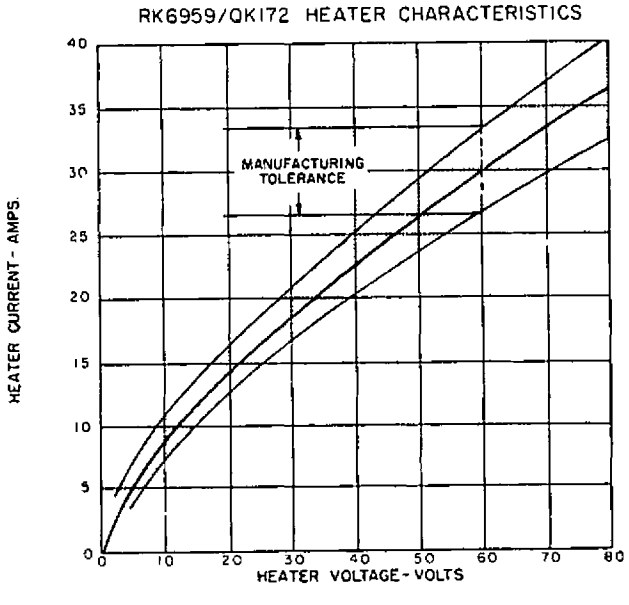


Figure 1

For .001 duty cycle at peak current over 25 amperes the heater voltage should be reduced to 3.0 volts. For other duty cycles the manufacturer should be consulted for the optimum heater schedule.

If the tube has been running at reduced heater voltage and high voltage is temporarily removed, it will be necessary to preheat the tube again at 6.0 volts to resume normal operation.

PULSE CHARACTERISTICS

The RK6959/QK172 Magnetron has been designed and tested for operation at the following pulse conditions. See Figure 2.

tpc = 3.2 ± 10% μsec @ Du = .00105	tpc = 0.5 ± 10% μsec @ Du = .003
tfc = 1.0 μsec Max.	tfc = 0.2 μsec Max.
rrv = 75 to 150 KV/μsec	rrv = 150 to 270 KV/-μsec
tfv = 2.5 μsec Max.	tfv = 0.5 μsec Max.

If operation at pulse conditions different from those given above is anticipated, the manufacturer should be consulted for further information. No spike or ripple should exceed ± 7% of the average peak value of voltage or current. Inverse voltage should not exceed 20% of the forward voltage.

Optimum tube performance will be realized only if proper consideration is given to pulse shaping. Rate of voltage rise faster than specified will result

RK6959/QK172

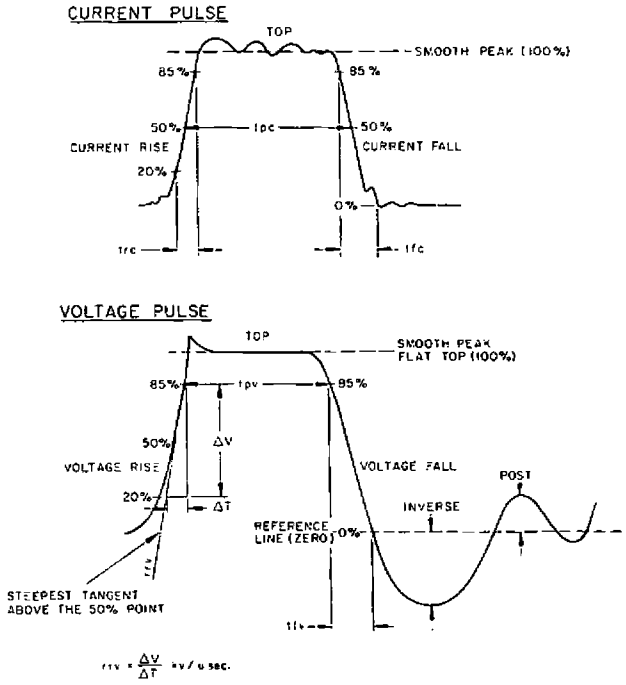


Figure 2

in moding and/or arcing and cannot be tolerated. Excessive ripple at the top of the current pulse causes frequency pushing and broadening of the spectrum. Most magnetrons draw a small amount of leakage or diode current at anode voltages as low as 100 volts. This leakage current may amount to several milliamperes if the voltage fall time is greater than 2.5 μsec, and at a given duty cycle the calculated peak current will be in error. It is therefore advisable that equipment design effect as rapid a decay as possible.

Optimum pulse shaping can best be achieved by treating the magnetron, pulse transformer, and pulse line as a unit; hand-tailoring the line and transformer for magnetron compatibility is recommended.

If operation at both long and short pulses is anticipated, the pulse transformer should be designed to optimize the more important pulse.

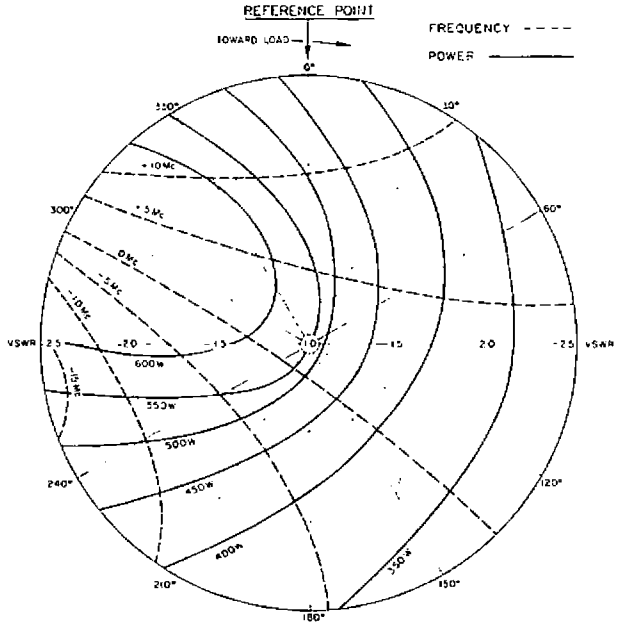
POST PULSE NOISE

It is possible that some RK6959/QK172 magnetrons may exhibit RF noise output unless the post pulse backswing is controlled very closely. A backswing in the negative direction of several hundred volts may be enough to cause an RF output in the order of a microwatt. If this low level energy is fed directly to the receiver, noise or false targets will appear on the radar indicators. By judicious matching of the pulse line, pulse transformer and magnetron, and by the use of a clipper tube across the primary of the pulse transformer, the voltage backswing can be controlled so that its magnitude is quite small; and more important, that the backswing is completely damped out within a very short interval after the pulse.

LOAD DIAGRAM

Figure 3 is a load diagram for a typical RK6959/QK172 magnetron. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 3.5/1 have been plotted, but operation at ratios greater than 1.5/1 is not recommended.

RK6959/QK172 TYPICAL LOAD DIAGRAM



REFERENCE POINT SURFACE ON OUTPUT FLANGE

fo = 9410 Mc	tp = 3.0 μs
Eo = 33.5 kv	Du = 0.0105
prr = 350 pps	Ef = 6.0 V
Ip = 40 mA	If = 29.0 A

Figure 3

LOAD AND LINE LENGTH CONSIDERATIONS

If an oscillator is loaded by an electrically long transmission line which is terminated by an impedance different from that of the line, the impedance of the load will be a periodic function of frequency. Operation of the oscillator under these conditions gives rise to phenomena collectively termed "long-line effects". Although these phenomena are usually associated with an electrically long transmission line, they can also be exhibited by a short line terminated by a sufficiently mismatched impedance. In any case the extent to which the long-line effect is exhibited depends on the amount of coupling between the load and oscillator as well as the degree of mismatch in the line. Figure 4 shows the relation between the VSWR and the line length with respect to the critical condition of skip. This skip condition occurs when the tube is changing frequency (thermal drift) and causes breaks in the ordinarily smooth drift curve. This condition is not critical in the RK6959/QK172 because the tube is not tunable. Of far more serious consequence, however, is the broadening and deterioration of the spectrum caused by this phenomena. It may in some cases permit spectra of two frequencies to appear simultaneously. By operating into loads specified under the region of recommended operation in Figure 4, satisfactory operation should be obtained. In this region no significant broadening of the spectrum will take place, although for close control of bandwidth the VSWR should be kept as low as possible.

RK6959/QK172

LOAD AND LINE LENGTH CONSIDERATIONS

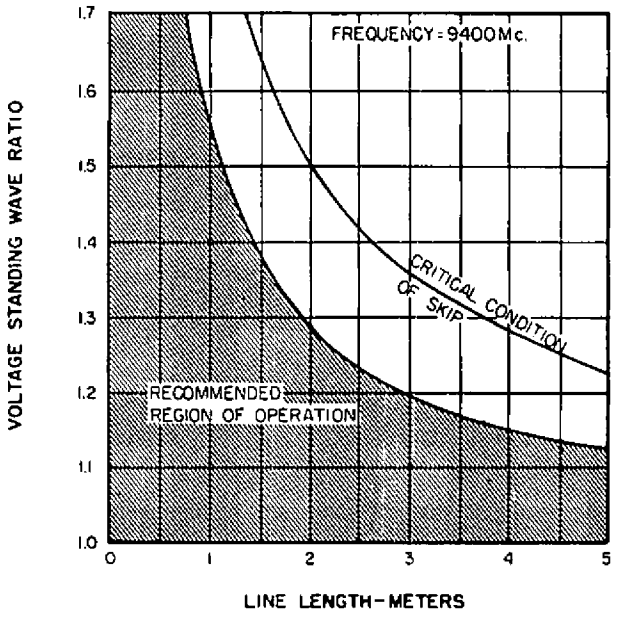


Figure 4

More detailed information on the theories and remedies of long-line effects is available upon request.

COOLING

The air stream for cooling the RK6959/QK172 should be directed to the air inlet of the radiator through a close fitting duct. During tube operation an anode temperature below 100° C is recommended, although temperatures as high as 130° C can be tolerated. Figure 5 shows the relation between air flow in cubic feet per minute and back pressure in inches of water at the entrance to the RK6959/QK172 cooling fin structure.

RK6959/QK172

COOLING FIN CHARACTERISTICS

Back Pressure vs. Air Flow

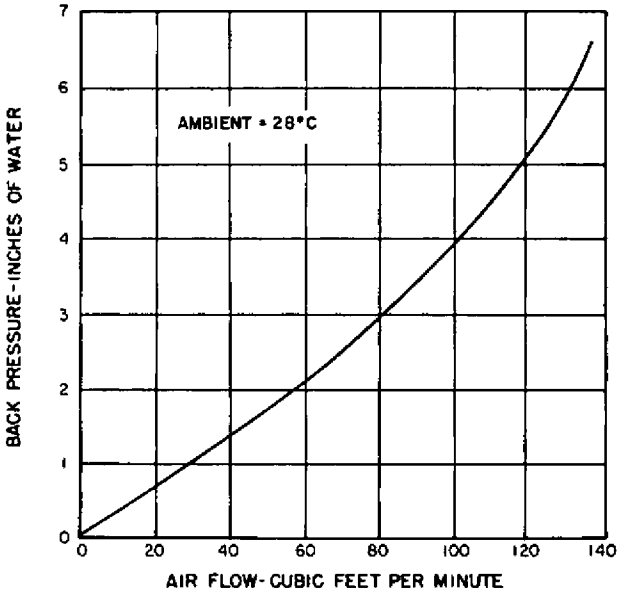


Figure 5

Figure 6 shows the anode temperature as a function of forced air flow through the cooling fins at different values of anode input power (exclusive of heater power). These measurements were made at an ambient temperature of 28 degrees centigrade and normal atmospheric pressure. Higher ambient temperatures will result in correspondingly higher anode temperatures.

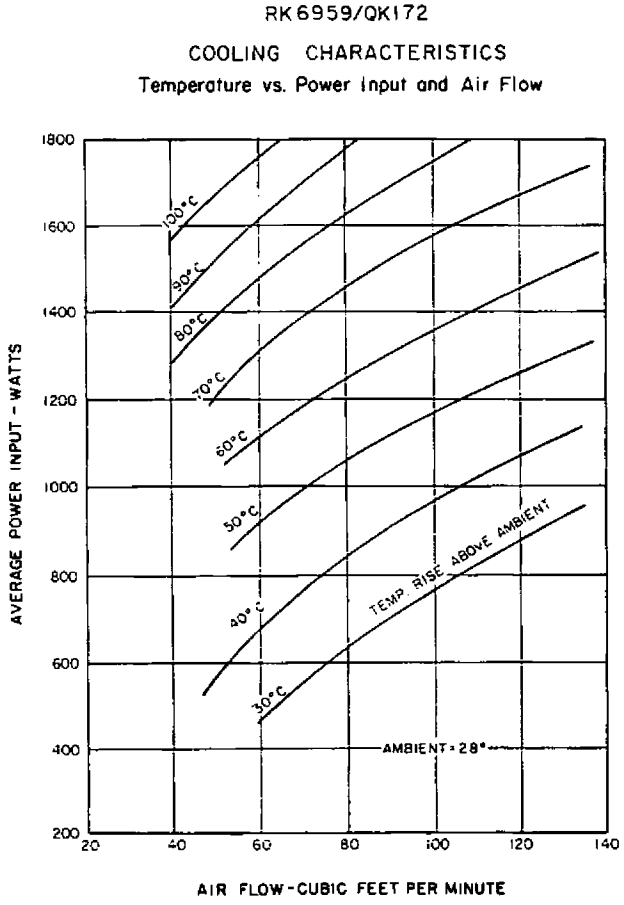


Figure 6

Sufficient circulating air, or equivalent cooling, must be supplied around the cathode bushing so that the cathode bushing temperature will never exceed 270° C. The exact point at which this temperature is measured is indicated on the electron tube drawing, Figure 9.

FREQUENCY DRIFT

After operation of the RK6959/QK172 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift and anode temperature are plotted as a function of time in Figure 7.

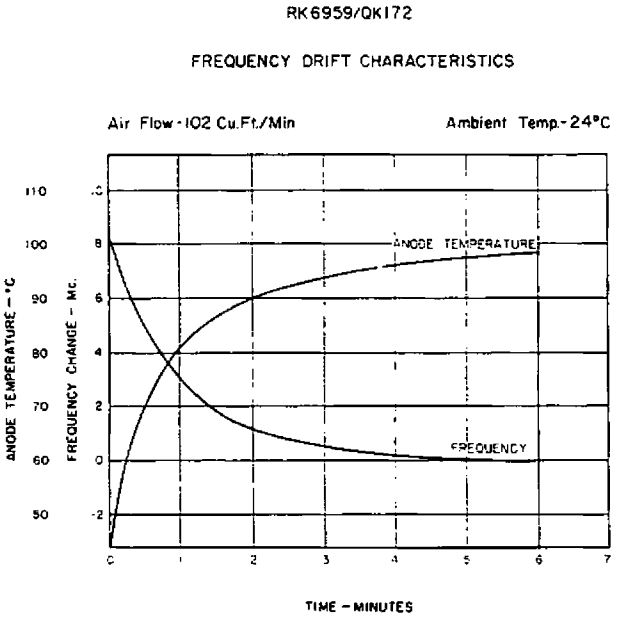


Figure 7

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilizes. The frequency change will not exceed ±0.40 Mc/C° of anode temperature.

OPERATING CHARACTERISTICS

Figure 8 is a plot of power output, anode voltage and efficiency as a function of peak anode current, showing the deviation from the average.

RK6959/QK172 OPERATING CHARACTERISTICS

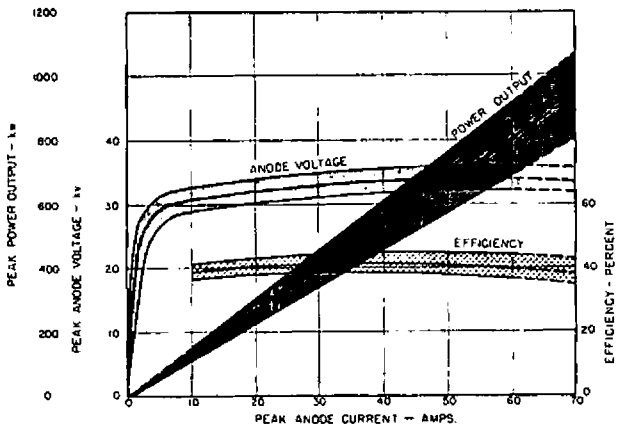


Figure 8

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two terminals on the high voltage cathode bushing. The positive high voltage should be grounded at the mounting surfaces. Heater and cathode connections are made to the terminals on the cathode bushing (see note 11 of tube outline drawing).

RF RADIATION FROM CATHODE

The RK6959/QK172 is designed to minimize radiation from the cathode bushing which will in general be negligible. It is not possible, however, to guarantee it as being negligible, and in particular critical environment shielding of the cathode bushing may be necessary to avoid radiation difficulties.

COUPLING AND PRESSURIZATION

The magnetron output flange is designed to couple to standard ⅝ x 1¼ waveguides. Mechanical details of the recommended choke flange to mate to the magnetron are illustrated in the outline drawing. See Figure 9.

MOUNTING

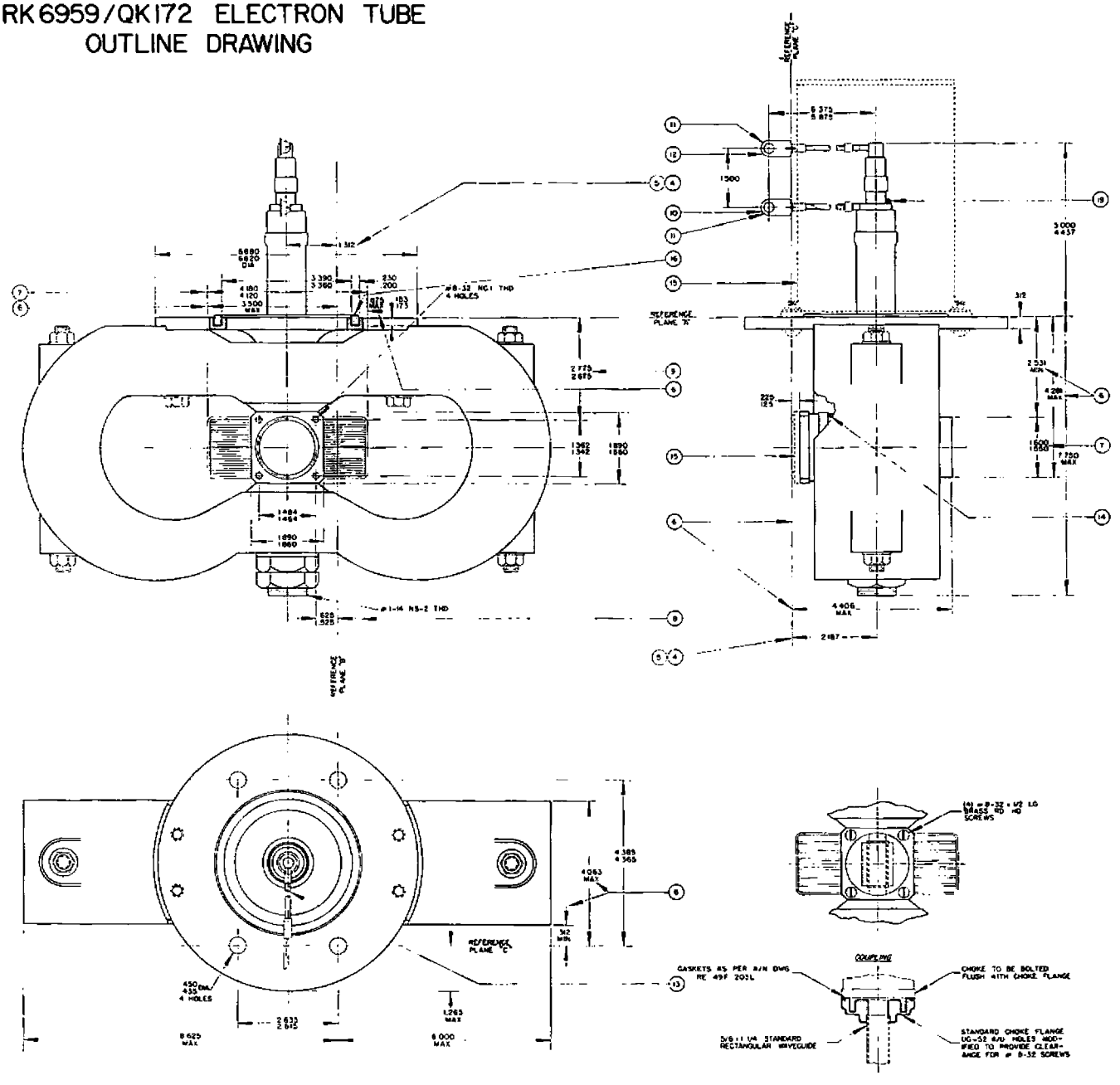
The tube is mounted within the equipment by four bolts passed through the clearance holes of the mounting brackets. The tube must be mounted with the longitudinal axis of the cathode high voltage bushing vertical. The tube should be operated in this position although small angular deviations (15 degrees) can be tolerated for short intervals as long as the mean position of the above axis remains vertical during the period of operation. If the mean position differs from that described, the heater may become short-circuited.

INSTALLATION AND HANDLING PRECAUTIONS

Although magnetrons give appearance of great structural strength, they are in reality quite fragile and may easily be damaged in handling or installation. Damage to the magnetron will be avoided if the following installation and handling precautions are carefully observed.

1. Leave magnetron in its shipping crate until ready to be used.
2. Remove neoprene guard covers from the RF output window or cathode bushing before installing tube in equipment.
3. Avoid setting up mechanical strains in output window or cathode bushing when handling or mounting.
4. Avoid unnecessary jarring or rough handling.
5. Do not let magnetron rest on any of its parts normally protected by the shipping crate.
6. If a magnetron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the RF window or cathode bushing and wipe dry before applying high voltage.
7. Do not place tube in closed proximity to magnetic materials than is indicated on tube magnet.

RK6959/QK172 ELECTRON TUBE OUTLINE DRAWING



NOTES

1) REFERENCE PLANE "A" LIES IN TOP SURFACE OF MOUNTING PLATE
2) REFERENCE PLANE "B" IS PERPENDICULAR TO "A" PASSING THROUGH THE TWO HOLES OF MOUNTING PLATE AS SHOWN
3) REFERENCE PLANE "C" IS MUTUALLY PERPENDICULAR TO "A" AND "B" PASSING THROUGH THE TWO HOLES IN MOUNTING PLATE AS SHOWN
4) THIS DIMENSION REFERS TO THE CENTER LINE OF THE TUBE
5) PARTS ON THIS CENTER LINE MAY VARY FROM TRUE LOCATION BY .125
6) THIS DIMENSION INCLUDES ANGULAR AS WELL AS LATERAL DEVIATION
7) THESE DIMENSIONS APPLY TO RADIATOR SIDE ONLY
8) THIS DIMENSION IS TO END OF RADIATOR
9) TAPPED HOLES MUST BE PARALLEL TO REF PLANE WITHIN .030
10) BROWN PAINT TO IDENTIFY COMMON HEATER-CATHODE CONNECTION
11) STANDARD 50 AMP SOLDER LUGS, CLEARANCE FOR 1/4 DIA BOLT
12) HEATER CONNECTION
13) HEATER LEADS TO BE PARALLEL TO REFERENCE PLANE "B" WITHIN 20°
14) ANODE TEMPERATURE TO BE MEASURED AT THIS POINT
15) GUARD FOR SHIPPING PURPOSES ONLY
16) GROOVE FOR PARKER AIRCRAFT O-RING AN-6227B-43
17) PRESSURE TEST WAVEGUIDE FLANGE WITH 55 PSI ABSOLUTE
18) PRESSURE TEST OIL SEAL RING JOINTS AT MOUNTING PLATE WITH 30 PSI ABSOLUTE
19) CATHODE SUPPORT TEMPERATURE

Figure 9

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK6999

SUBMINIATURE PENTODE

The CK6999 is a filament type pentode of subminiature construction designed for service as a power amplifier in wearable and portable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

RATINGS – ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.32/2.64 ± 20 %	volts
Plate Voltage	145	volts
Grid #2 Voltage	95	volts
Total Cathode Current	7	ma.
Plate Dissipation	0.75	watts
Grid #2 Dissipation	0.12	watts

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc) ▲	2.64	volts
Filament Current	50	ma.
Plate Voltage	67.5	volts
Grid #2 Voltage	67.5	volts
Grid #1 Voltage	−4.0	volts
Plate Current	4.0	ma.
Grid #2 Current	0.9	ma.
Transconductance	1650	μmhos
Load Resistance	12	kilohms
Distortion (approx.)	11.5	percent
Power Output	135	mw.
Peak AF Signal Voltage	4.0	volts

▲ *A resistor of 680 ohms is connected in parallel with leads 2 and center tap lead 4.*

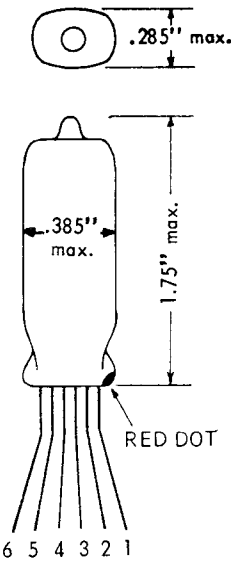
* *Grid #3 is composed of two deflector plates, one being connected to lead 2 and the other to lead 6.*

MECHANICAL DATA

ENVELOPE.....T–2X3 Glass

BASE..... None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS

Lead 1 Plate

Lead 2 Filament negative, Grid #3 *

Lead 3 Grid #2

Lead 4 Filament center-tap (F-parallel) ▲

Lead 5 Grid #1

Lead 6 Filament positive, Grid #3 *

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7044

MINIATURE DOUBLE TRIODE

The CK7044 is a heater-cathode type, medium-mu double triode of miniature construction designed for use in computer and other applications requiring long life, high transconductance, high perveance or high emission. The cathode material used in this type assures exceptional freedom from the development of cathode interface when operated for long periods of time under cut-off conditions. This type employs separate cathode connections and o heater center-tap permitting either series or parallel heater operation.

MECHANICAL DATA

ENVELOPE..... Glass T 6½
OUTLINE ..... JEDEC (6–3)
BASE... 9 Pin Miniature (E9–1)
BASING 9H
CATHODE..Coated unipotential
MOUNTING POSITION.... Any

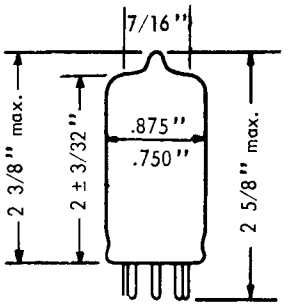
ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES (Without Shield) $\mu\mu f$

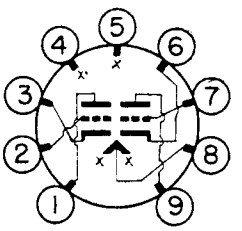
	SECTION 1		SECTION 2
Grid to Plate	6.0		6.0
Input	4.8		4.8
Output	0.65		0.55
Heater to Cathode	6.0		6.0
Grid to Grid		0.10	
Plate to Plate		1.4	

RATINGS AND NORMAL OPERATION (Each Section)	MIL – E – 1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Test Limit or Absolute Maximum	MIL – E – 1 Units
Heater Voltage Series	Ef:	12.0	12.6	13.2	V
Heater Voltage Parallel	Ef:	6.0	6.3	6.6	V
Plate Voltage	Eb:	---	120	300	Vdc
Peak Plate Voltage (Note 1)	eb:	---	---	600	v
Grid Voltage	Ec1:	–100	–2.0	+1.0	Vdc
Peak Grid Voltage (Note 1)	eg:	–300	---	+30	v
Plate Dissipation (Note 2)	Pp/p:	---	4.3	4.5	W
Grid Current	ic1/g:	---	---	5.0	mAdc
Peak Positive Grid Current (Note 1)	ic1/g:	---	---	200	ma
Cathode Current	Ik/k:	---	---	50	mAdc
Peak Cathode Current (Note 1)	ik/k:	---	---	400	ma
Heater-Cathode Voltage (Note 3)	Ehk:	---	---	200	v
Grid Circuit Resistance:					
Fixed bias	Rg/g:	---	---	0.1	Meg.
Cathode bias	Rg/g:	---	---	0.47	Meg.
Bulb Temperature	T Bulb	---	---	160	°C

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1 Plate, Unit #2
Pin 2 Grid, Unit #2
Pin 3 Cathode, Unit #2
Pin 4 Heater
Pin 5 Heater
Pin 6 Cathode, Unit #1
Pin 7 Grid, Unit #1
Pin 8 Heater Center-Tap
Pin 9 Plate, Unit #1

ELECTRICAL DATA (Cont'd.)

RATINGS AND NORMAL OPERATION (Each Section)	MIL – E – 1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Test Limit or Absolute Maximum	MIL – E – 1 Units
TESTS (Note 4)					
Heater Current Series	If:	410	450	490	mA
Heater Current Parallel	If:	820	900	980	mA
Heater - Cathode Leakage	Ihk:	---	---	30	μAdc
Plate Current	Ib/p:	26	36	45	mAdc
Transconductance	Sm/p:	8000	12,000	17,000	μmhos
Amplification Factor	Mu/p:	16	21	26	---
Plate Resistance	rp/p:	---	1750	---	ohms
Plate Current at Eb=90 Vdc; Ec1=–14 Vdc	Ib/p:	41	47	62	mAdc

NOTES:

Note 1: This Rating is based on a rectangular pulse of 10μsecond duration, 1% duty factor, rise time<1 μsecond, fall time <2 μsecond. The overshoot shall be<5% and the droop<10%.

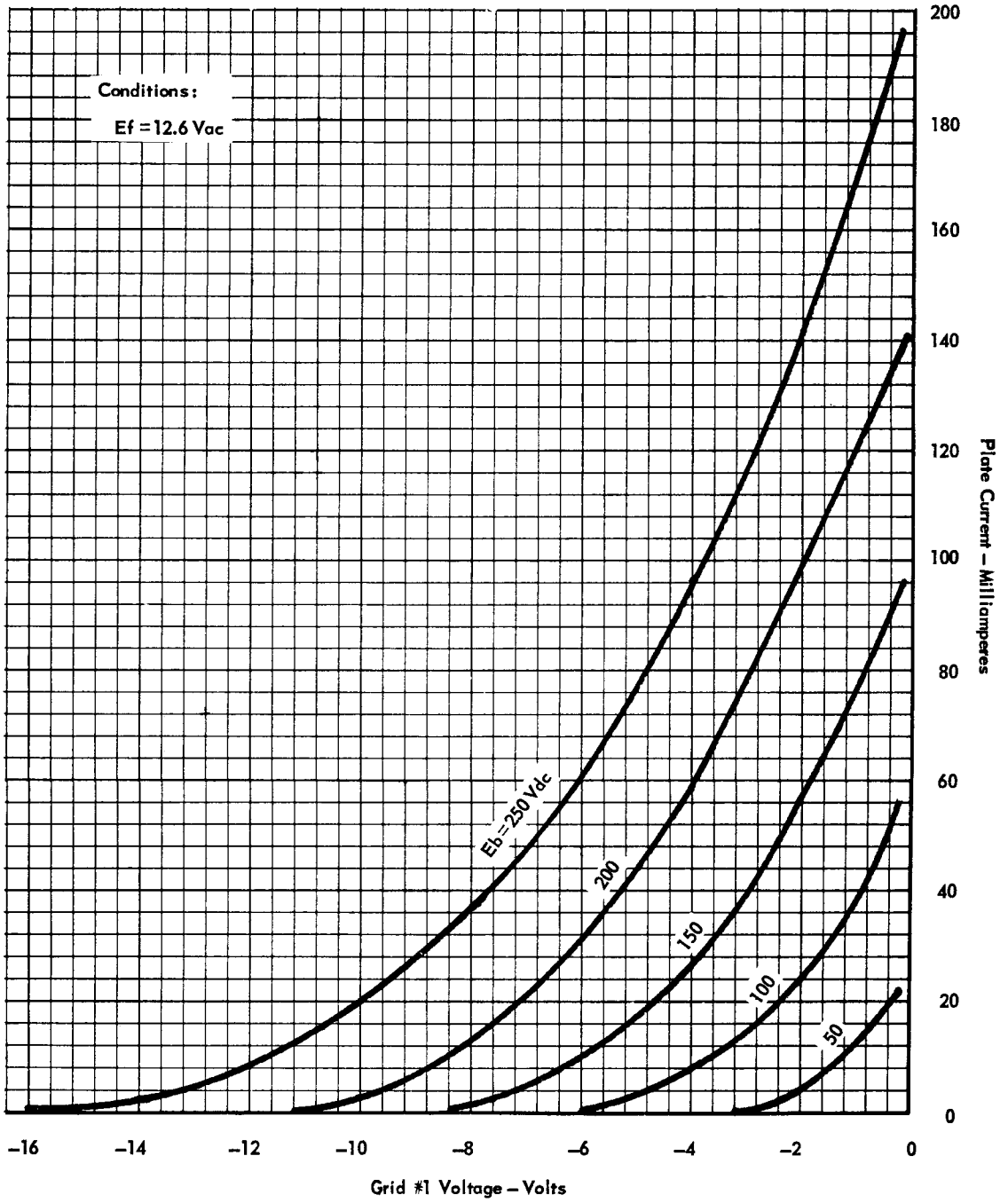
Note 2: The plate dissipation of one section may be as great as 4.5 watts provided that the maximum dissipation for both sections does not exceed 8.0 watts.

Note 3: Heater positive is not recommended for reliable operation. The total DC and peak heater - cathode voltage shall not exceed 200 **volts** and the maximum positive DC heater with respect to cathode voltage shall never exceed +100 Vdc.

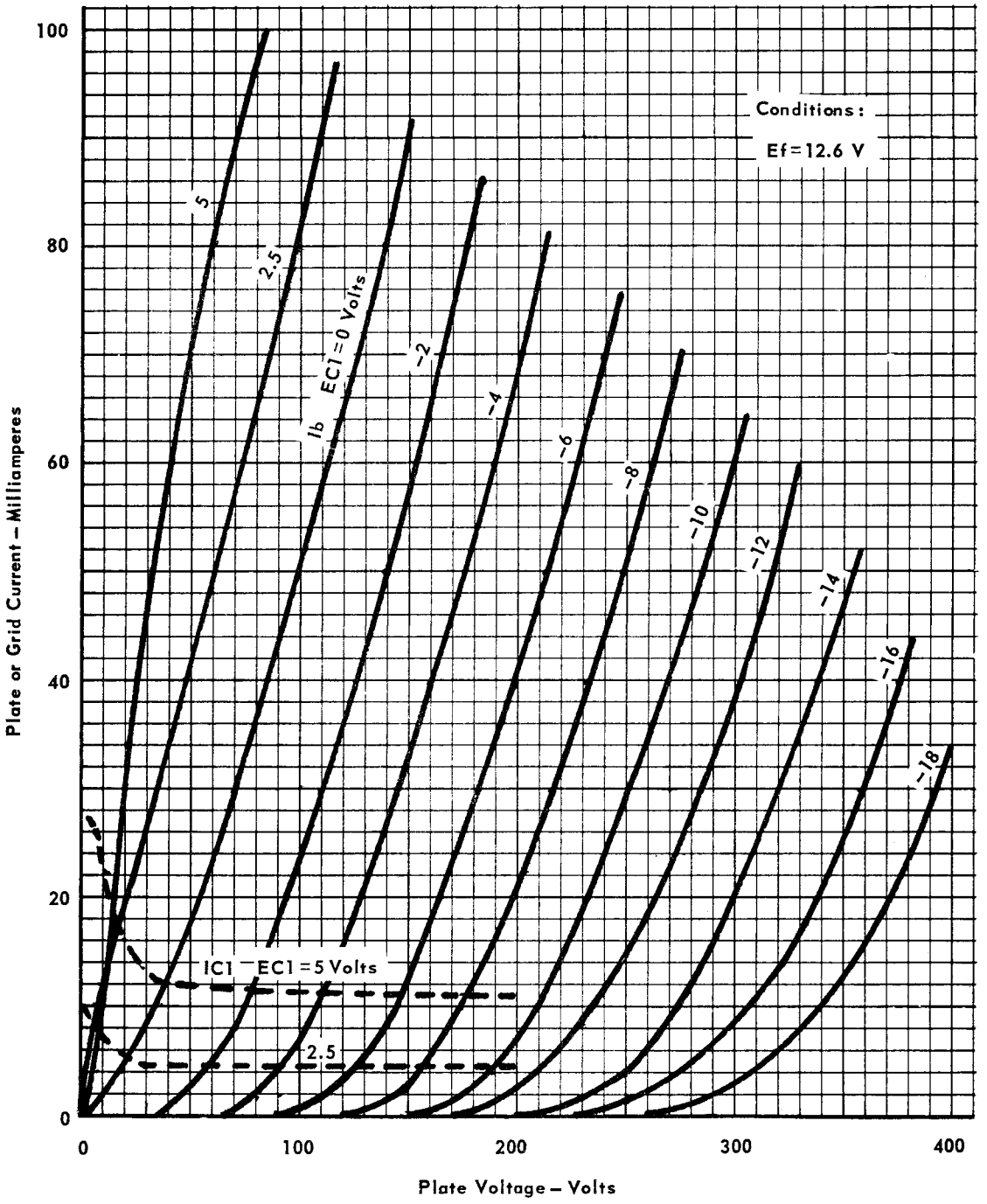
Note 4: Elements of the section not under test shall be grounded.

MINIATURE DOUBLE TRIODE

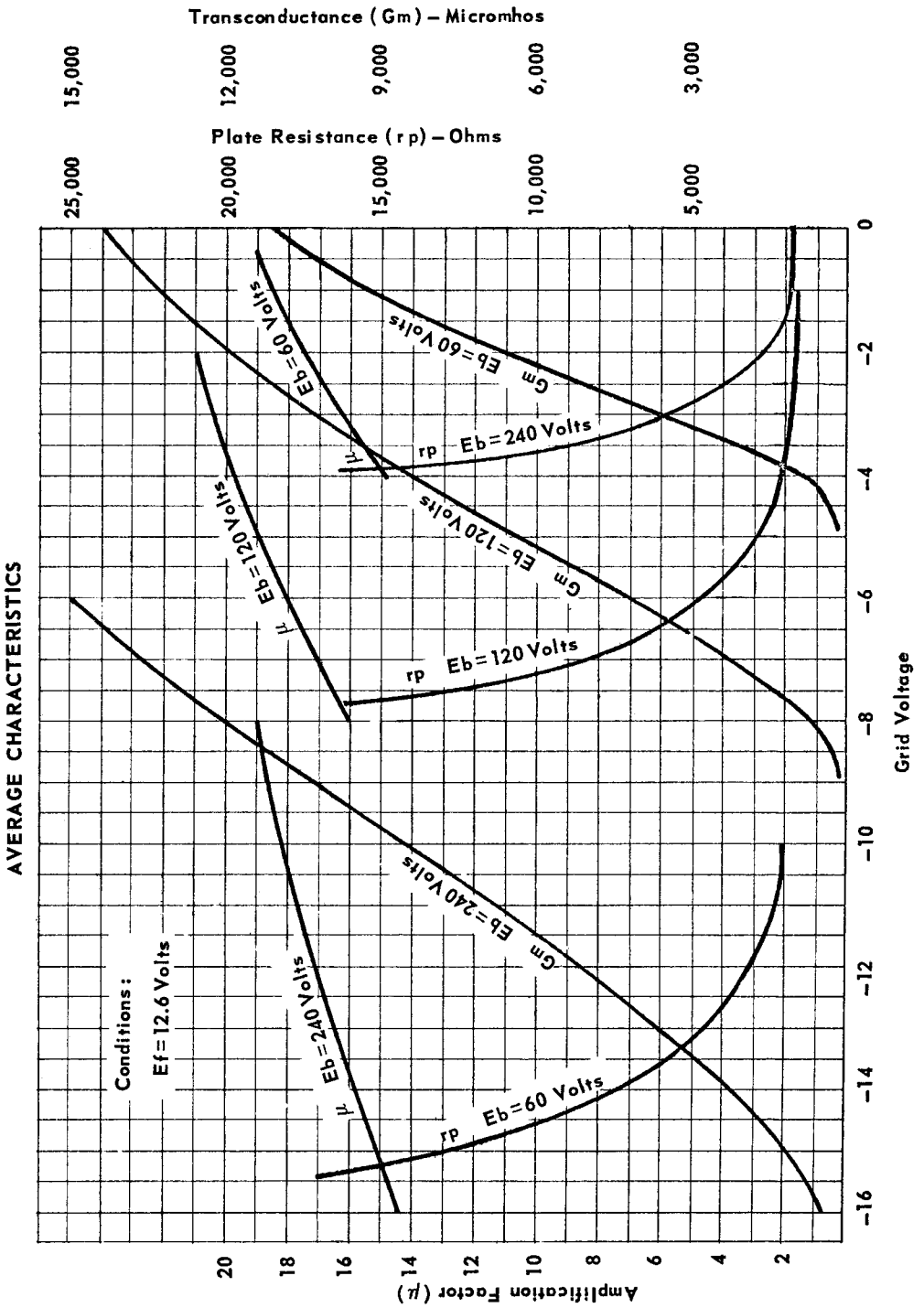
AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



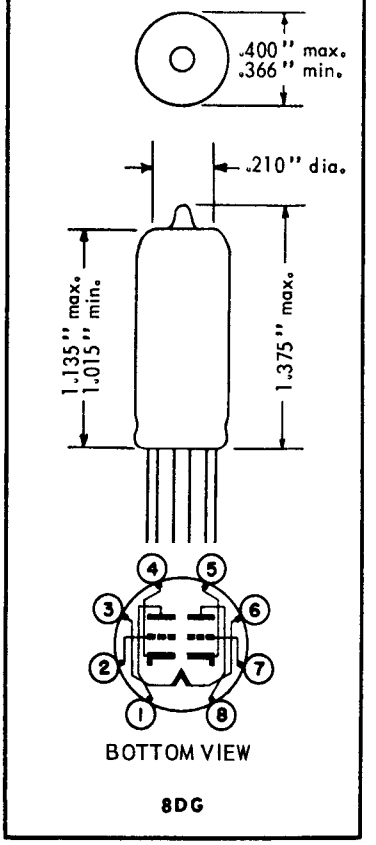
MINIATURE DOUBLE TRIODE



TYPE CK7079

Excellence in Electronics

The CK7079 (CK632) is a heater-cathode type medium-mu double triode controlled for fast warm-up time and high peak current pulse emission. It is of subminiature construction, capable of operation in the UHF region and is designed to have a high degree of reliability under adverse environmental conditions. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of temperature and vibration are encountered. This type has electrical characteristics similar to the CK6111. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-Pin subminiature sockets may be used by cutting the leads to a suitable length.



BOTTOM VIEW

8DG

MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.5" min.)

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2	Lead 5 Cathode, Unit #1
Lead 2 Grid, Unit #2	Lead 6 Heater
Lead 3 Heater	Lead 7 Grid, Unit #1
Lead 4 Cathode, Unit #2	Lead 8 Plate, Unit #1

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test-Note 3)	30 G
Maximum Bulb Temperature	220 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To Electrical Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	ABSOLUTE MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	ABSOLUTE MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	5.6	6.3	6.3	7.0	V
Plate Voltage	Eb:	----	100	100	165	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Plate Dissipation (per plate)	Pp/p:	----	----	0.85	0.95	W
Grid #1 Circuit Resistance	Rg/g:	----	----	1.0	1.1	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	Vdc
Plate Current (per plate)	Ib/p:	0.5	----	----	22	mAdc
Grid Current	Ic/c:	----	----	----	5.5	mAdc
Cathode Resistance (per unit)	Rk:	----	220	220	----	ohms
Transconductance (1) (per unit)	Sm(1):	----	----	5000	----	μmhos
Amplification Factor (per unit)	Mu:	----	----	20	----	

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

(In the following tests, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	BOGIE	MAX	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1							
Heater Current:		0.65	If:	275	300	325	mA
Heater–Cathode Leakage:	Ehk=+100Vdc	0.65	Ihk:	----	----	5.0	μAdc
	Ehk=–100Vdc		Ihk:	----	----	5.0	μAdc
Grid Current:	Rg=1.0 Meg.	0.65	Ic (1):	----	----	–0.3	μAdc
Plate Current (1):		0.65	Ib (1):	6.0	8.5	11.0	mAdc
Plate Current (2):	Ec1=–9.0 Vdc	0.65	Ib (2):	----	----	100	μAdc
Transconductance (1):		0.65	Sm (1):	4100	5000	5900	μmhos
Continuity and Shorts (Inoperatives):		0.25	----	----	----	----	----
Mechanical:	Envelope (8–1) (Note 8)	----	----	----	----	----	----
MEASUREMENTS ACCEPTANCE TESTS, PART 2							
Insulation of Electrodes:	Ef=6.3 V Eg–all=–100 Vdc Ep–all=–300 Vdc	2.5	Rg1–all: Rp–all:	100 100	----	----	Meg. Meg.
Plate Current (1) Difference between sections:		2.5	Δ Ib:	----	----	2.0	mAdc
Transconductance (2):	Ef=5.6V (Note 7)	2.5	Δ_{Ef} Sm (2):	----	----	15	%
Warm–Up Time:	(Note 9)	2.5	t:	----	----	11	sec.
Pulse Emission:	Ef=6.3 V; Ebb=150 Vdc; tp=10 μsec.; RL=100 ohms; Prr=200 pps; egy/ik=1 amp; Ec1=–9 Vdc; Rk=1 ohm	1.0	egy:	----	----	100	v
Amplification Factor:		4.0	Mu:	17	20	23	----
Capacitance:	(Note 2)	6.5	Cgp:	1.2	1.5	1.8	μμf
Capacitance:			Cin:	1.4	1.9	2.4	μμf
Capacitance:			Cout (Unit #1)	0.20	0.28	0.36	μμf
Capacitance:			Cout (Unit #2)	0.22	0.32	0.42	μμf
Capacitance:			Cgg:	----	----	0.011	μμf
Capacitance:			Cpp:	----	----	0.50	μμf
Temperature Cycles:	T=–62°C to +100°C. (Note 11)	6.5	----	----	----	----	----
DEGRADATION RATE ACCEPTANCE TESTS							
Vibration (1):	F variable 10–75–10 cps; G max.=10; fixed amplitude; Rp=10,000 ohms; t=30 minutes (Note 10)	6.5	Ep:	----	----	100	mVac
Vibration (2):	F variable 75–500–75 cps; G=10; Rp=10,000 ohms; t=30 minutes (note 10)		Ep:	----	----	100	mVac
Subminiature Lead Fatigue:		4.0	----	4.0	----	----	arcs
Shock:	Ehk=+100 Vdc; Rg=0.1 Meg; G=30; t=11 milliseconds duration; (Note 3)	6.5	----	----	----	----	----
Post Shock and Vibration Test End Points:							
Change in Pulse Emission of individual tubes:		----	Δ_t egy:	----	----	20	%
Heater–Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	----	20	μAdc
	Ehk=–100 Vdc	----	Ihk:	----	----	20	μAdc

RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

ELECTRICAL DATA (cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)(cont'd)

(In the following tests, each unit is tested separately)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS
DEGRADATION RATE ACCEPTANCE TESTS (cont'd)						
Change in Transconductance (1) of individual tubes:			Δ_tSm(1):	----	20	%
Heater Current:			If:	275	325	mA
Glass Strain (Thermal Shock):		6.5	----	----	----	----
ACCEPTANCE LIFE TESTS						
Intermittent Life Test (1):	TA=room; Ehk=+200 Vdc; Rg/g=1.0 meg.; (Note 12)		t:	200	----	hours
Intermittent Life Test (1) End Points:						
Heater Current:			If:	275	325	mA
Heater-Cathode Leakage:	Ehk=+100 Vdc Ehk=−100 Vdc		Ihk: Ihk:	---- ----	10 10	μAdc μAdc
Grid Current:			Ic:	0	−0.9	μAdc
Change in Transconductance (1) of individual tubes:			Δ_tSm(1):	----	15	%
Insulation of Electrodes:			Rgl−all: Rp−all:	50 50	---- ----	Meg. Meg.
Transconductance (2):	(Note 7)		Δ_{Ef}Sm(2):	----	15	%
Intermittent Pulse Life Test (2):	Ef=6.3 V; Ebb=150 Vdc; tp=1 μsec.; tr=tf=0.1 μsec.; Prr=2300 Pps; Ec1/ik=800 ma; Ec1=−9 Vdc (min.); Rk=1 ohm; E pulse≈110 V (Note 12)		t:	200	----	hours
Intermittent Pulse Life Test (2) End Points:						
Pulse Emission:			$\Delta_t$egy:	----	20	%
Grid Current:			Ic:	0	−1.0	μAdc
Insulation of Electrodes:			Rgl−all: Rp−all:	50 50	---- ----	Meg. Meg.

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1, "Inspection Instructions for Electron Tubes, and MIL-STD-105A.

Note 2: Without shield.

Note 3: The tube is subjected to 18 impacts of 30 G each. Of this total, three shock impulses shall be applied in each of 3 mutually perpendicular axes. There shall be no shorts during shock test.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ±5% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.6 V.

Note 8: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, these Raytheon Reliable tubes are now guaranteed to be free from "Potential" defects identifiable by microscopic inspection as described by paragraph 5.3.8 of "Inspection Instructions for Electron Tubes."

Note 9: Warm-up time is the time in seconds required for the plate current to attain a value within 10 percent of the stabilized plate current measured after one minute of operation. No preheating before this test is allowed.

ELECTRICAL DATA (cont'd)

NOTES (cont'd)

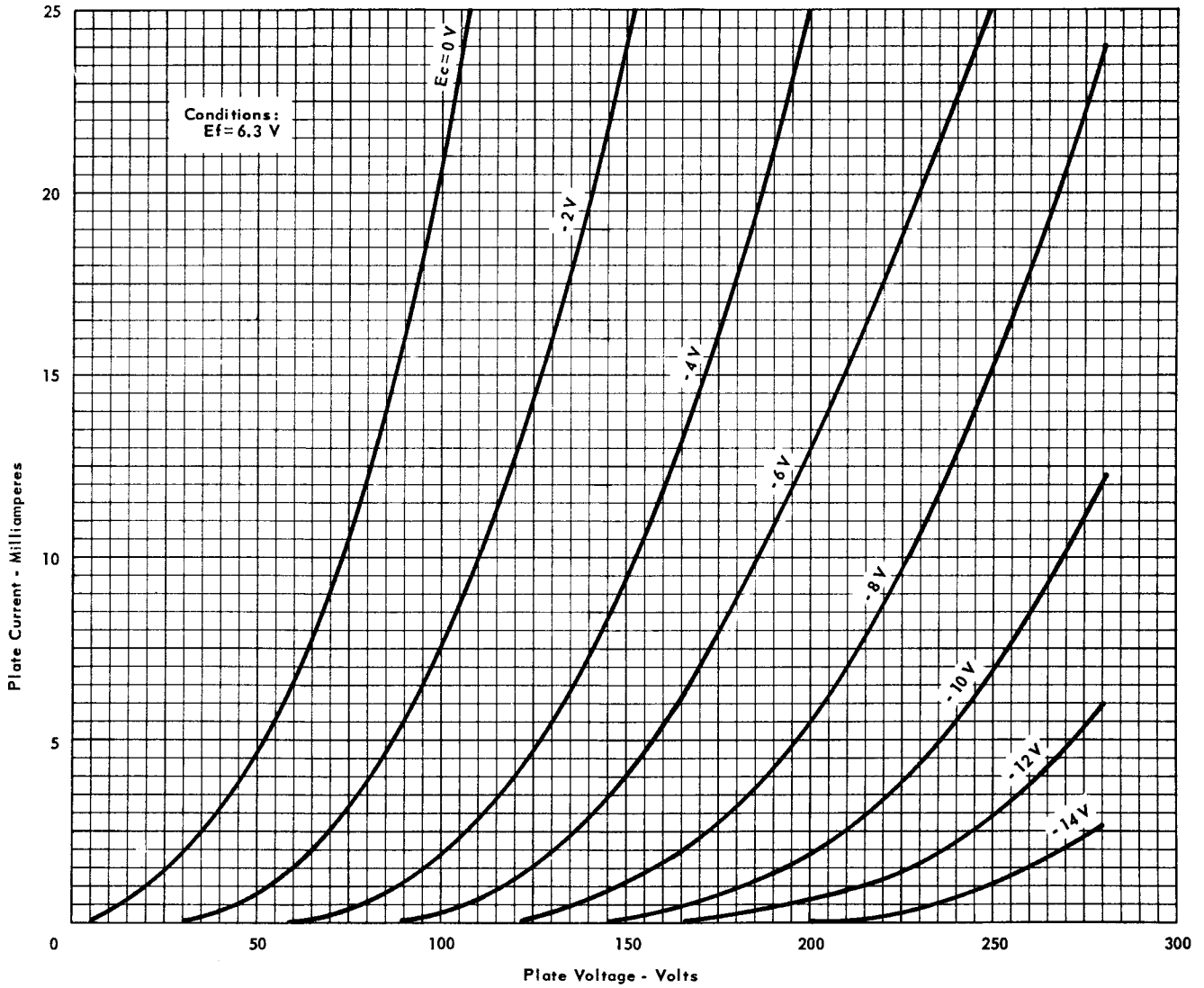
Note 10: The tubes shall be vibrated for 30 minutes in each of three mutually perpendicular planes. The time of a frequency cycle shall be 15 minutes. During the last vibration cycle the noise output shall be measured and the frequency recorded. The tube shall then be vibrated in each of the three planes for 30 minutes at a fixed frequency between 50 and 60 cps for Vibration (1) and 450 and 500 cps for Vibration (2). The same tubes shall be used for both vibration tests.

Note 11: (a) The temperature shall be reduced to −62°C and after the tubes have stabilized at this temperature, warm-up time shall be recorded.

(b) The tubes shall be operated continuously for 24 hours at an ambient temperature of +100°C under the conditions specified for intermittent life test (1). Upon the conclusion of this test the tubes shall meet the requirements of Pulse Emission measured at room temperature.

Note 12: The intermittent life test (1) and (2) shall be cycled 12 minutes "on", 12 minutes "off", for a total "on" time of 200 hours. The lot shall be rejected if any individual tube becomes inoperative before 100 hours.

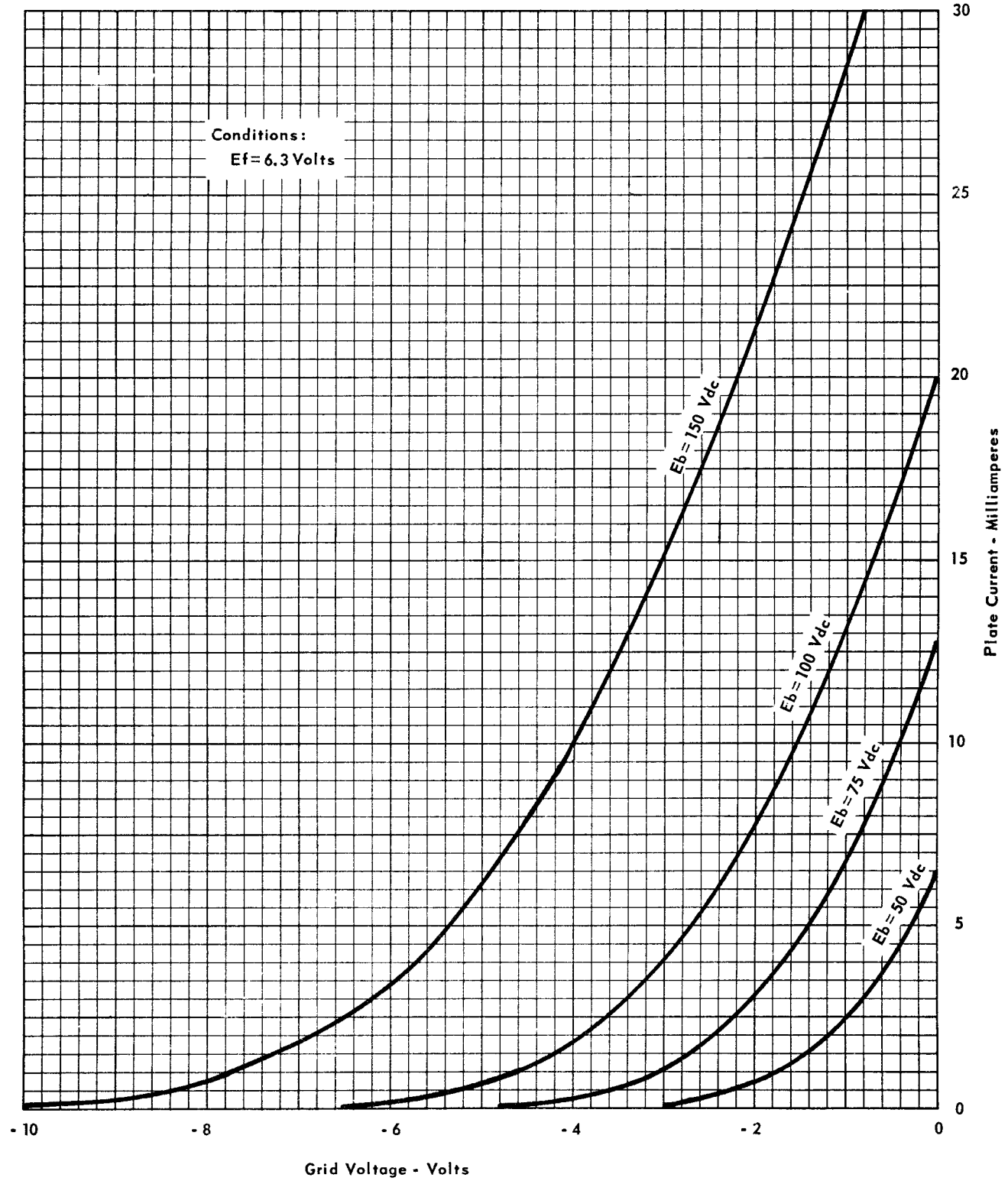
AVERAGE PLATE CHARACTERISTICS



RAYTHEON

RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS

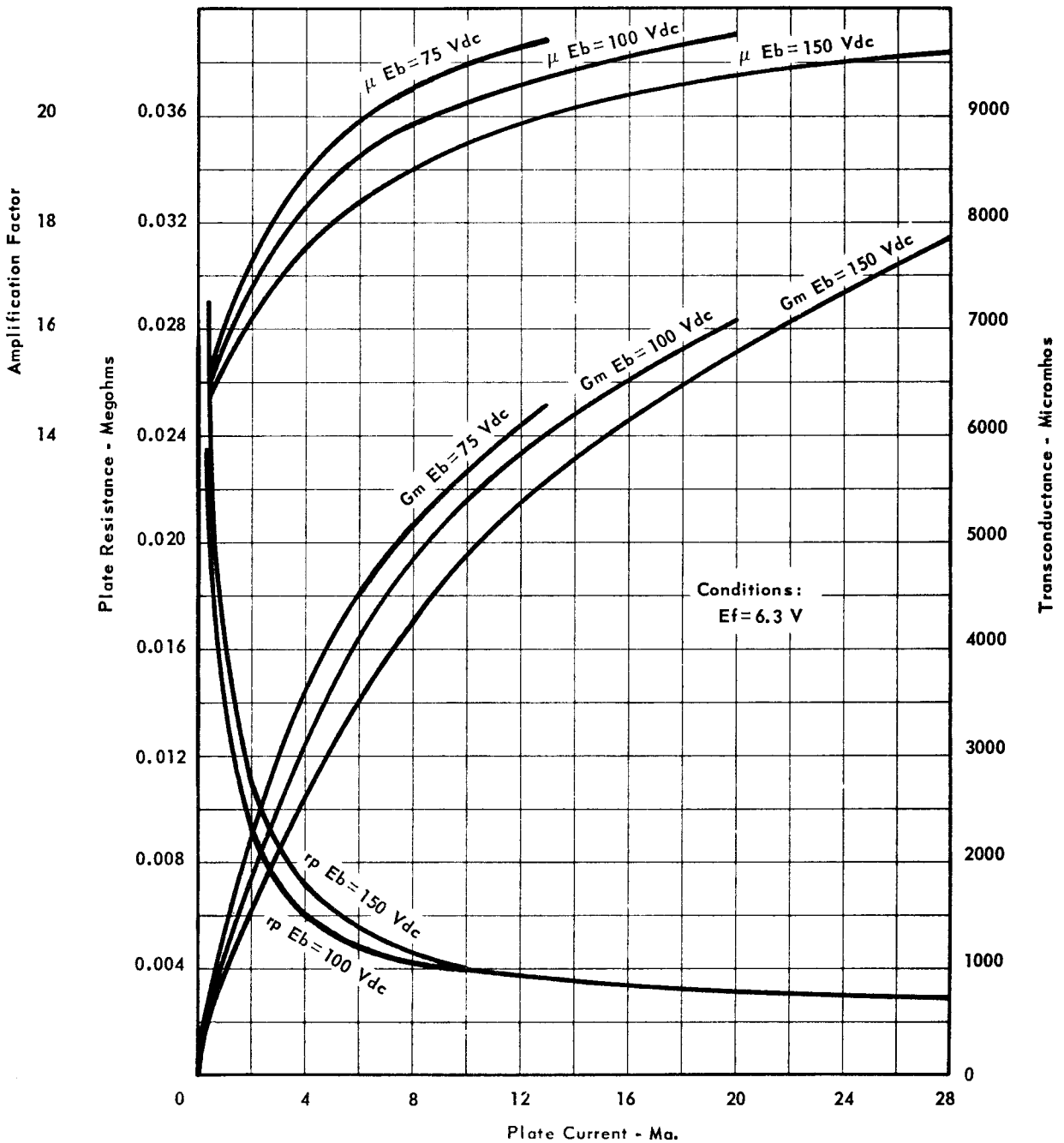


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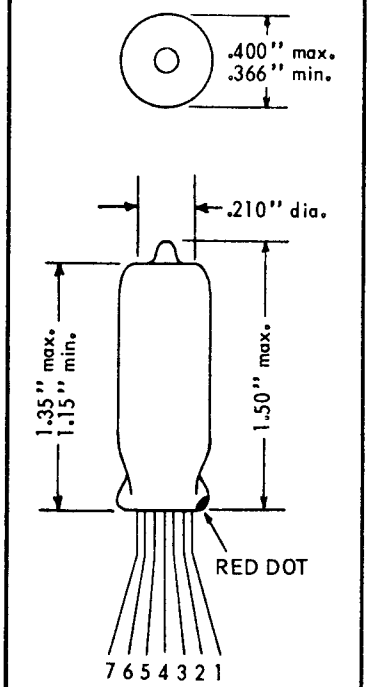
RELIABLE SUBMINIATURE DOUBLE TRIODE

AVERAGE CHARACTERISTICS



TYPE CK7083

The CK7083 (CK631) is a heater-cathode type sharp-cutoff pentode controlled for fast warm-up time and designed to have a high degree of reliability under adverse environmental conditions. It is of subminiature construction capable of operation in the VHF region. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of temperature and vibration are encountered. In addition to the limits and AQL's specified on this data sheet the tubes are subjected to other special quality control sampling procedures. This type has electrical characteristics similar to the type CK5702WA. A separate terminal connection is provided for Grid #3, which under self-bias conditions can be connected directly to ground, permitting the cathode by-pass capacitor to be omitted for lower grid loading. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to lead 1)*

Lead 1 Plate	Lead 5 Grid #3
Lead 2 Grid #2	Lead 6 Cathode
Lead 3 Heater	Lead 7 Grid #1
Lead 4 Heater	

MECHANICAL RATINGS:

Maximum Impact Acceleration (Shock Test – Note 3)	30 G
Maximum Bulb Temperature	265 °C

MOUNTING POSITION: Any

ELECTRICAL DATA

CAUTION-----To electronic equipment design engineers: Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Heater Voltage (Note 6)	Ef:	5.6	6.3	6.3	7.0	V
Plate Voltage	Eb:	----	120	120	200	Vdc
Grid #1 Voltage	Ec1:	-55	0	0	0	Vdc
Grid #2 Voltage	Ec2:	----	120	120	155	Vdc
Grid #3 Voltage	Ec3:	----	0	0	0	Vdc
Plate Dissipation	Pp:	----	----	0.9	1.85	W
Grid #2 Dissipation	Pg2:	----	----	0.3	0.55	W
Grid #1 Circuit Resistance	Rg1:	----	----	1.0	1.2	Meg.
Heater-Cathode Voltage	Ehk:	-200	----	100	+200	Vdc
Cathode Current	Ik:	0.5	----	----	20	mAdc
Cathode Resistance	Rk:	----	200	200	----	ohms
Plate Current	Ib:	----	----	7.5	----	mAdc
Grid #2 Current	Ic2:	----	----	2.6	----	mAdc

Tentative Data

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RAYTHEON MANUFACTURING COMPANY

RECEIVING TUBE AND SEMICONDUCTOR OPERATIONS

NEWTON 58, MASS.

ELECTRICAL DATA (cont'd)

RATINGS AND NORMAL OPERATION:	MIL-E-1 SYMBOL	DESIGN MINIMUM	NORMAL TEST CONDITIONS (Note 5)	NORMAL OPERATION (Note 4)	DESIGN MAXIMUM	MIL-E-1 UNITS
Transconductance (1)	Sm(1):	----	----	5000	----	μmhos
Plate Resistance	rp:	----	----	0.34	----	Meg.

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

TEST	CONDITIONS	AQL %	MIL-E-1 SYMBOL	MIN	BOGIE	MAX	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1							
Heater Current:		0.65	If:	183	200	217	mA
Heater – Cathode Leakage:	Ehk=+100 Vdc	0.65	Ihk:	----	----	7	μAdc
	Ehk=–100 Vdc		Ihk:	----	----	7	μAdc
Grid Current (1):		0.65	Ic1 (1):	----	----	–0.1	μAdc
Plate Current (1):		0.65	Ib (1):	5.5	7.5	9.5	mAdc
Transconductance (1):		0.65	Sm (1):	4200	5000	5800	μmhos
Continuity and Shorts (Inoperatives):		0.25	----	----	----	----	----
Mechanical:	Envelope (8–7) (Note 8)						
MEASUREMENTS ACCEPTANCE TEST PART 2							
Insulation of Electrodes:	Ef=6.3 V Eg–all=–100 Vdc Ep–all=–300 Vdc	2.5	Rg1–all: Rp–all:	100 100	---- ----	---- ----	Meg. Meg.
Transconductance (2):	Ef=5.6 V (Note 7)	2.5	Δ_{Ef} Sm (2):	----	----	15	%
Warm Up Time:	(Note 9)	2.5	t:	----	----	11	sec.
Plate Current (2):	Ec1/Ib=50 μAdc	1.0	Ec1:	–5.0	----	–9.0	Vdc
Screen Grid Current:		2.5	Ic2:	1.7	2.6	3.5	mAdc
Plate Resistance:		4.0	rp:	0.15	----	----	Meg.
Capacitance:	(Note 2)	4.0	Cgp:	----	----	0.03	μμf
Capacitance:			Cin:	4.5	----	5.6	μμf
Capacitance:			Cout:	3.25	----	4.25	μμf
Temperature Cycles:	T=–62°C to+100°C; (Note 11)	6.5	----	----	----	----	----
DEGRADATION RATE ACCEPTANCE TESTS							
Vibration (1):	F variable 10–75–10 cps; G max=10; fixed amplitude; Rp=10,000 ohms; t=30 minutes (Note 10)	6.5	Ep:	----	----	50	mVac
Vibration (2):	F variable 75–500–75 cps; G=10; Rp=10,000 ohms; t=30 minutes. (Note 10)		Ep:	----	----	70	mVac
Subminiature Lead Fatigue:		4.0	----	4.0	----	----	arcs
Shock:	Ehk=+100 Vdc; Rg=0.1 Meg. G=30; t=11 milliseconds duration. Note 3	6.5	----	----	----	----	----
Post Shock and Vibration Test End Points:							
Heater – Cathode Leakage:	Ehk=+100 Vdc	----	Ihk:	----	----	15	μAdc
	Ehk=–100 Vdc	----	Ihk:	----	----	15	μAdc
Change in Trans-conductance (1) of individual tubes:		----	Δ_t Sm (1):	----	----	20	%
Glass Strain (Thermal Shock):		6.5	----	----	----	----	----

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

TEST	CONDITIONS	MIL-E-1 SYMBOL	MIN	MAX	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS					
Intermittent Life Test:	TA=room; Ehk=+200 Vdc; Rg=1.0 Meg.; (Note 12).	t	200	----	hours
Intermittent Life Test End Points:		----	----	----	----
Change in Transconductance (1) of individual tubes:		Δ_t Sm(1):	----	20	%
Heater Current:		If:	183	217	mA
Heater–Cathode Leakage:	Ehk=+100 Vdc Ehk=–100 Vdc	Ihk: Ihk:	---- ----	10 10	μAdc μAdc
Transconductance (1):		Gm(1):	3250	----	μmhos
Grid Current:		Ic1:	----	–0.3	μAdc
Insulation of Electrodes:		Rg1–all: Rp–all:	10 10	---- ----	Meg. Meg.

NOTES:

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: With a cylindrical shield (0.405" I.D.–1 7/8" long) connected to lead 6.

Note 3: The tube is subjected to 18 impacts of 30 G each, of this total, three shock impulses shall be applied in each of 3 mutually perpendicular axes. There shall be no shorts during shock test.

Note 4: These normal values represent conditions at which control of reliability may be expected.

Note 5: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

Note 6: For most applications the performance will not be adversely affected by ±10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 7: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.6 V.

Note 8: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet, Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes."

Note 9: Warm–up time is the time in seconds required for the plate current to attain a value within 10 percent of the stabilized plate current measured after 45 seconds of operation. No preheating before this test shall be allowed.

Note 10: The tubes shall be vibrated for 30 minutes in each of three mutually perpendicular planes. The time of a frequency cycle shall be 15 minutes. During the last vibration cycle the noise output shall be measured and the frequency recorded. The tube shall then be vibrated in each of the three planes for 30 minutes at a fixed frequency between 50 and 60 cps for Vibration (1) and 450 and 500 cps for Vibration (2). The same tubes shall be used for both vibration tests.

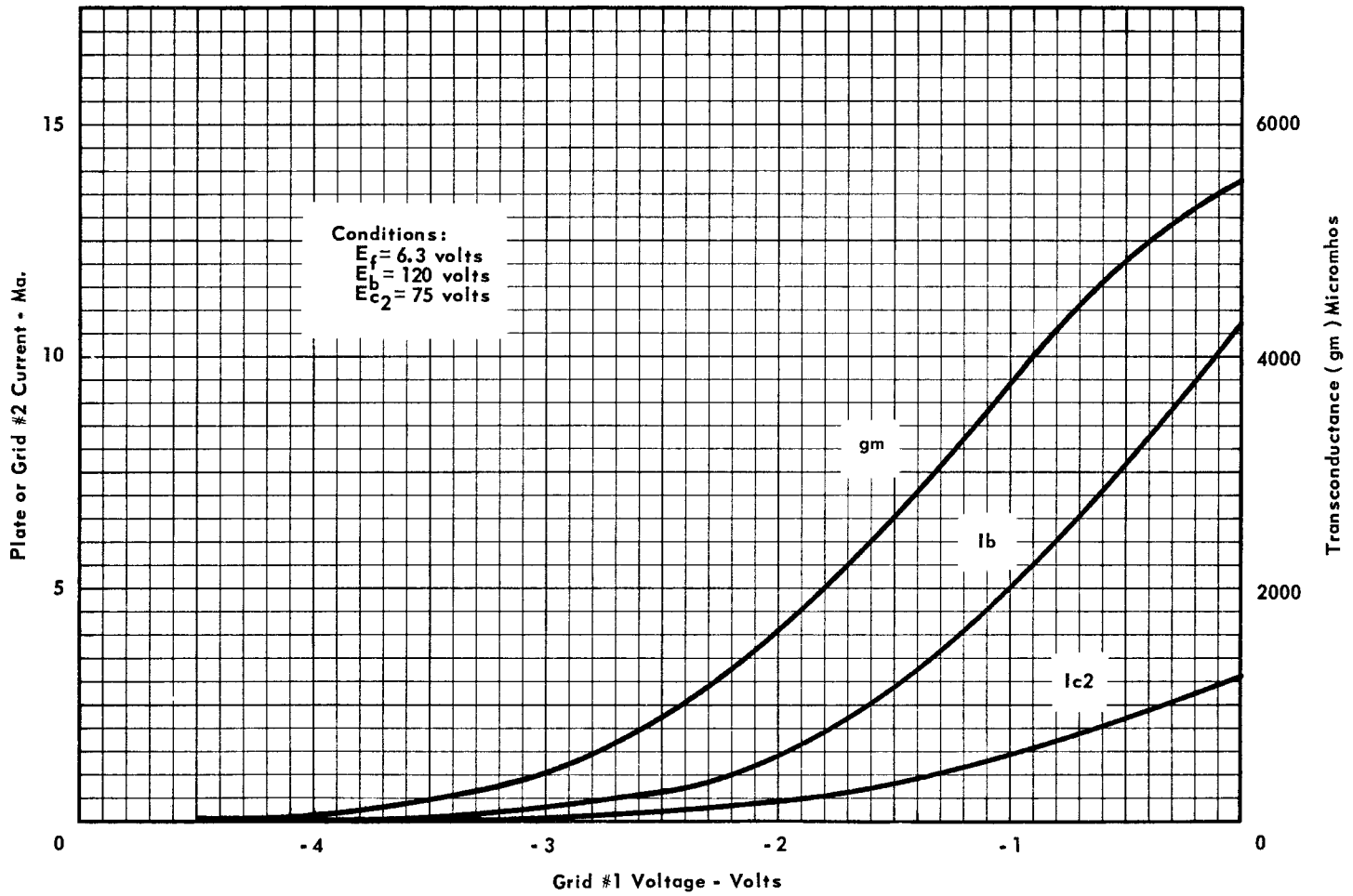
Note 11: (a) The temperature shall be reduced to –62°C and after the tubes have stabilized for 15 minutes at this temperature, Heater Current, Grid Current and Warm–Up Time shall be recorded.
(b) The tubes shall be operated for 24 hours at an ambient temperature of +100°C under the conditions specified for Intermittent Life Test. Upon the conclusion of this test the tubes shall meet the requirements of Transconductance (2) measured at room temperature.

Note 12: The intermittent Life Test shall be cycled 12 minutes "on", 12 minutes "off". Total "on" time shall be 200 hours. The lot shall be rejected if any individual tube becomes inoperative before 100 hours.

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RELIABLE SUBMINIATURE PENTODE

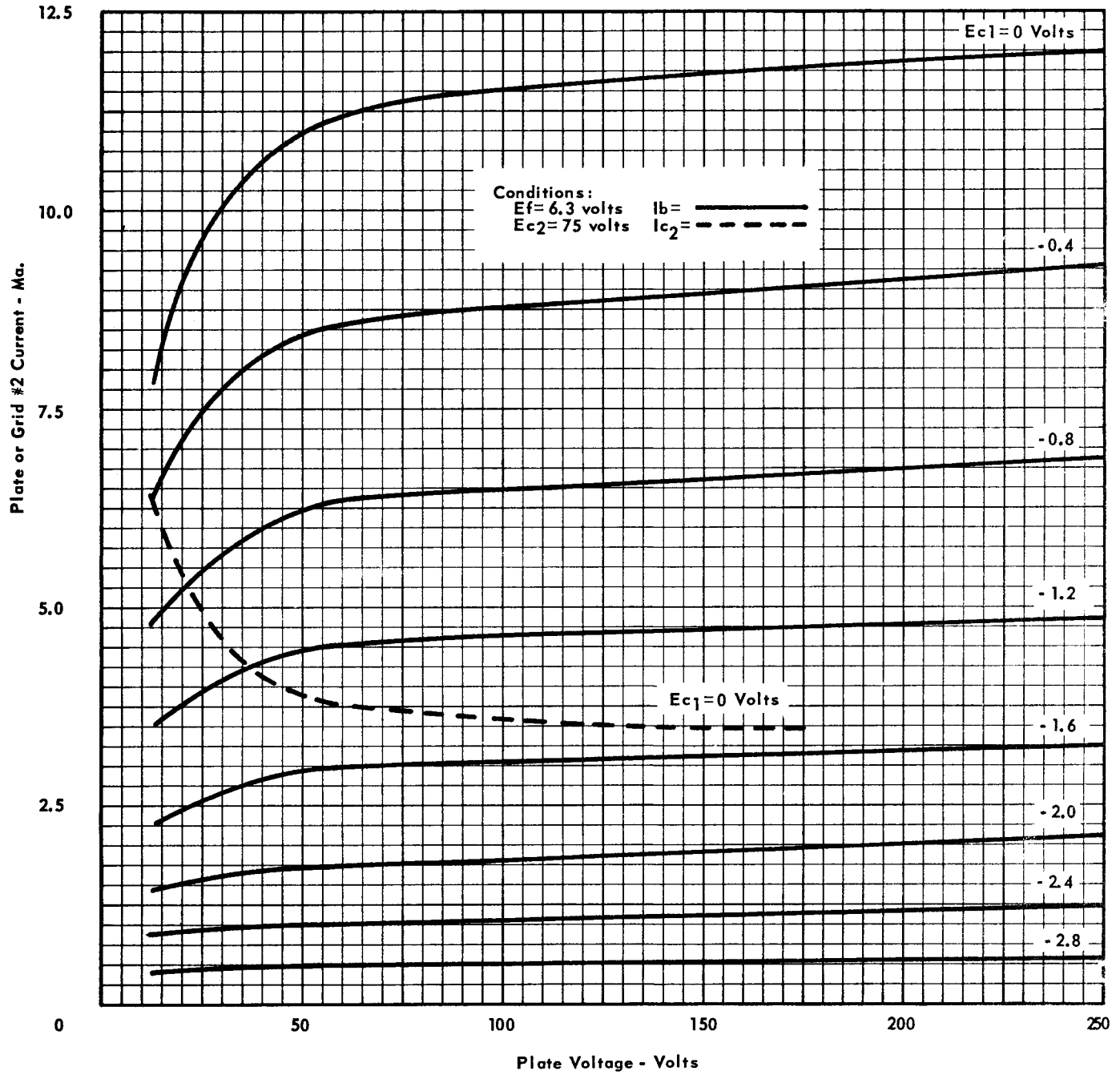
AVERAGE CHARACTERISTICS



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RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS

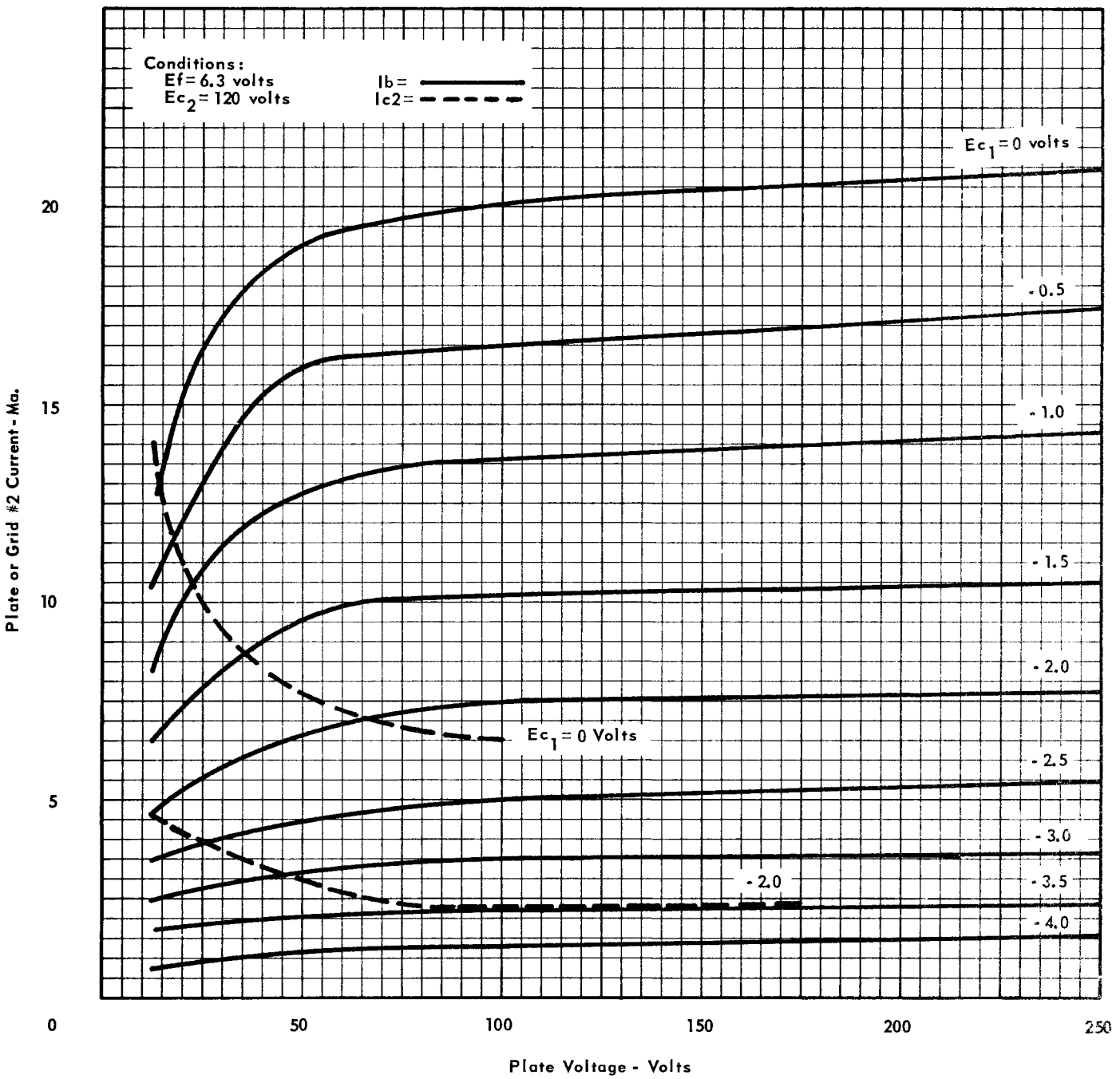


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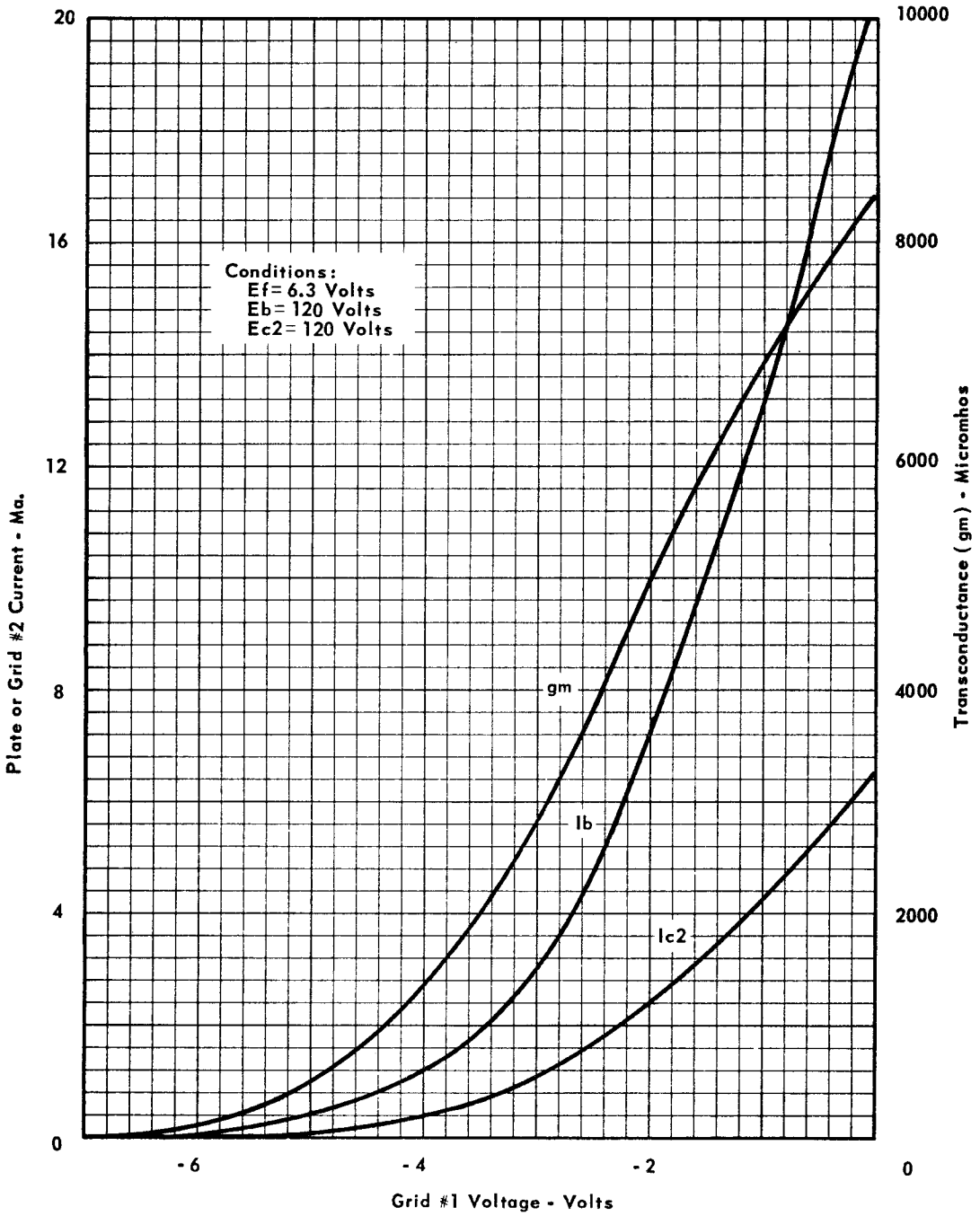
RELIABLE SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



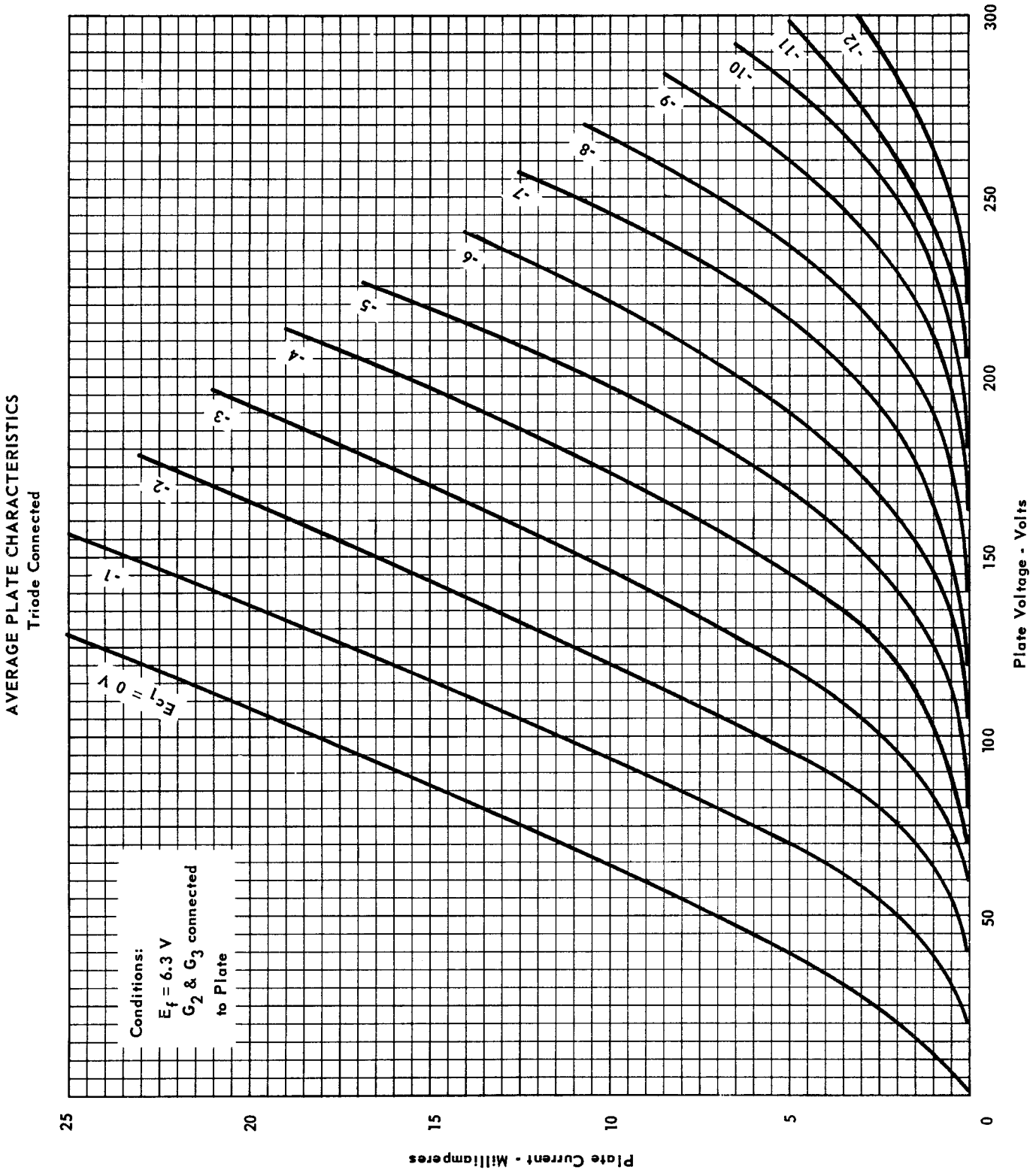
RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



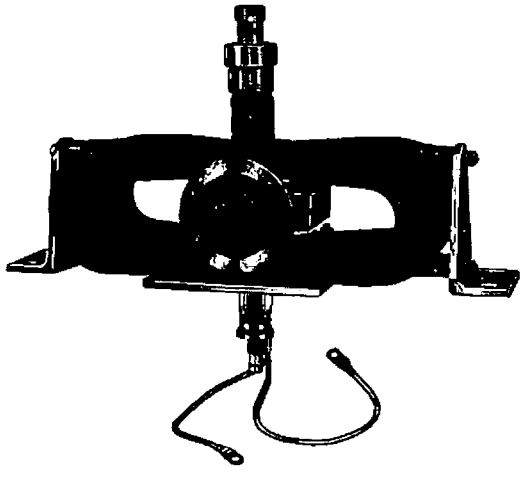
RAYTHEON

RELIABLE SUBMINIATURE PENTODE



TYPE RK7156

The RK-7156 is a mechanically tunable magnetron designed for pulsed operation in the frequency range 5450 to 5825 megacycles. It is an integral magnet type tube rated for a minimum peak power output of 250 kilowatts. Forced air cooling over fins integral with the anode block is required, and output coupling is made to standard 1 x 2 inch waveguide. Tuner construction facilitates rapid hand or motor tuning to any desired frequency within the specified range.



GENERAL PRECAUTIONS

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. There are many problems peculiar to magnetrons in general which must be given special consideration in system design. These problems are discussed in detail on the following pages. If for any reason it is desired to operate the RK-7156 under conditions other than those recommended in this technical data sheet, the manufacturers must be consulted.

TUNABLE PULSED-TYPE MAGNETRON

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater voltage — preheat	5.0 V
Heater current @ 5.0 volts	4.5 — 5.4 A
Minimum preheat time	3 minutes

Typical Operation

Peak current	24 a	Heater voltage operate	0.0 V
Current pulse duration	2.0 us	VSWR	1.5/1 (max.)
Duty cycle	.001	Frequency	5450-5825 Mc.
Voltage pulse rise time	0.1 us min.	Peak anode voltage	24.5 kv
Heater voltage start	5.0 V	Peak power output	300 kw
		Average power output	300 W

MECHANICAL

Mounting	Any
Overall dimensions	See drawing
Net weight	35 lbs. (approx.)
Tuner torque required	30 inch oz.(approx.)
Pressurization	30 inch Hq
Output coupling	UG 148B/U Choke

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION
RAYTHEON COMPANY
FOUNDRY AVE., WALTHAM 54, MASS.

from JEDEC release #3471, Oct. 30, 1961

DETAILED ELECTRICAL INFORMATION

HEATER

The cathode must be preheated at Ef = 5.0 volts for a period of at least three minutes prior to the application of anode high voltage. Immediately after the application of anode high voltage, the heater voltage should be reduced to 0.0 volts. For combinations of pulse widths and duty cycles other than those shown under typical operation, the manufacturer should be consulted for optimum heater schedules. Provisions must be made to keep heater current surges below 30 amps. Surges in excess of 30 amps may open circuit the heater. The cathode preheat schedule must be repeated in case of any interruption in the operation of the tube.

PULSE CHARACTERISTICS

The smooth peak is defined as the value of a smooth curve through the average of the fluctuations over the top portion of the pulse. The pulse width is the time interval between the two points on the current pulse at which instantaneous current is 50 percent of the smooth peak. The rise time is the time interval between points of 20 and 85 percent of the smooth peak. Figure 1 shows graphically the definitions mentioned.

The voltage rise time must not be less than .10 usec for a .4 usec pulse to realize good tube performance. Too fast a rise time will lead to moding or arcing. It is necessary to form the pulse so that the current pulse shows no sign of jitter and no large spikes on the leading edge as these conditions also may cause moding or arcing. The ripple on the top of the current pulse must be kept at a minimum to avoid pushing effects which will tend to widen the spectrum. Excessive backswing in the voltage pulse may cause post pulse noise. The backswing should in no case exceed 20% of the applied pulse.

Many magnetrons draw a certain amount of leakage or diode current at anode voltages as low as 100 volts. For this reason it is not only advisable to keep the time duration of the voltage pulse trailing edge as short as possible; but also to prevent the positive voltage backswing from becoming negative again. This diode current can amount to several milliamperes at an average current of 30 milliamperes. Except for giving a false indication as to the actual peak current at which the magnetron is operating, diode current is not harmful unless it becomes excessive.

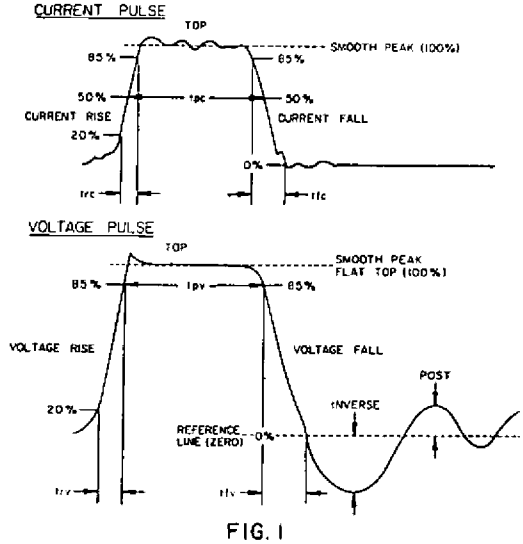


FIG. 1

For optimum pulse shaping, the magnetron, pulse transformer, and pulse line must be treated as a unit. It is advisable to hand tailor an experimental pulse line with careful observation of the current and voltage pulse shapes before a system is placed in production.

It is impossible to design a pulse transformer to give optimum results on both long and short pulses. It is, therefore, necessary to decide which pulse is the more important and to optimize the pulse transformer for the more important operation.

OPERATION

The operating characteristics of an average RK-7156 are described in the following paragraphs and illustrated in Figures 2, 3. All measurements were made under conditions of typical performance. Slight variations of these characteristics may be expected from tube to tube, or from use of the same tube in different systems. A 1 x 2 inch waveguide was used for all tests involving a magnetron load.

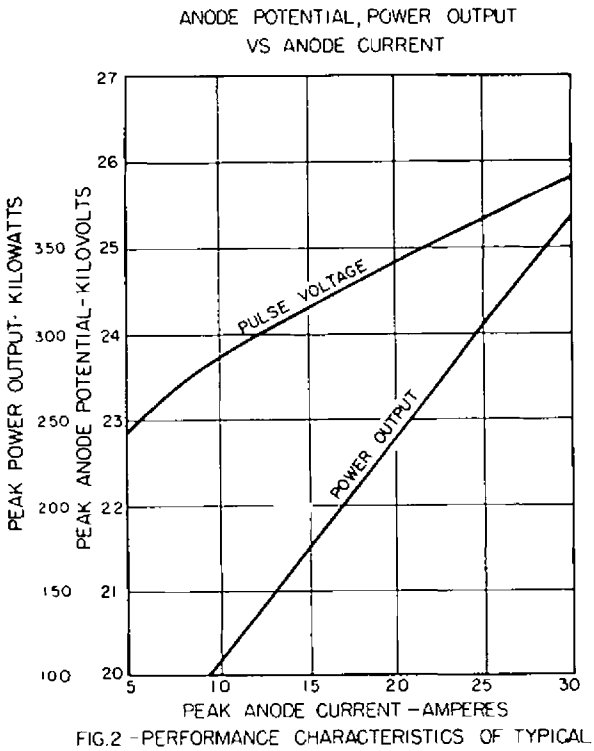


FIG.2 -PERFORMANCE CHARACTERISTICS OF TYPICAL RK7156 MAGNETRON 5825 Mc.-1.1/1 VSWR

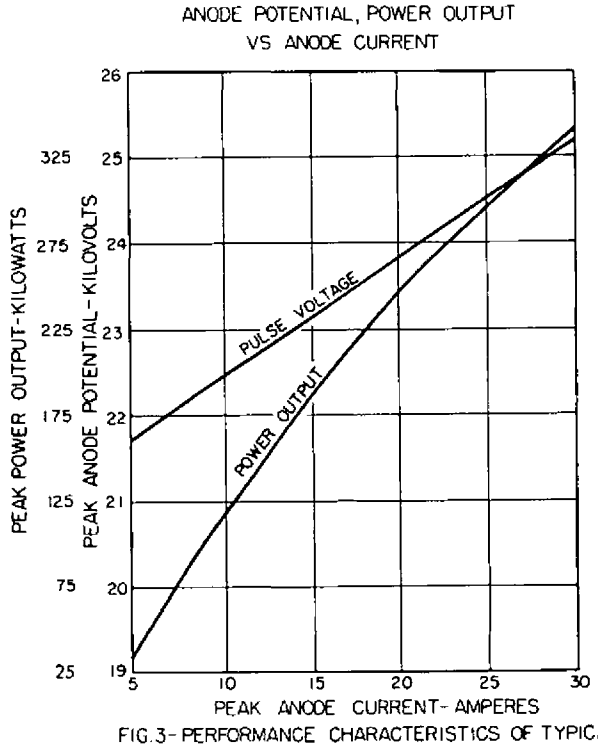


FIG.3-PERFORMANCE CHARACTERISTICS OF TYPICAL RK 7156 MAGNETRON 5450 Mc.-1.1/1 VSWR

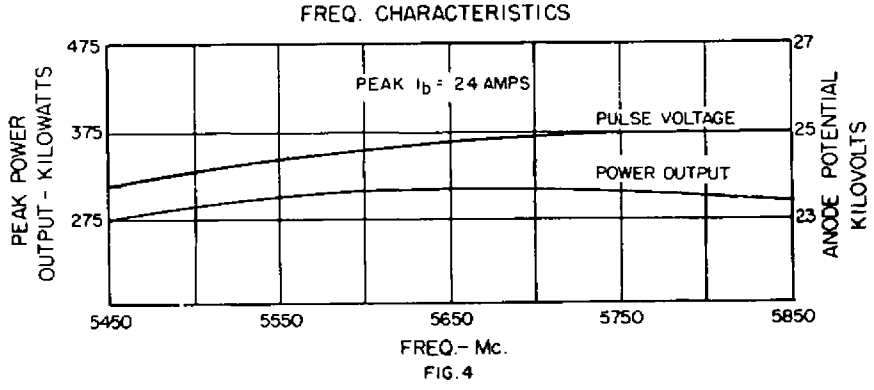


FIG.4

FREQUENCY CHARACTERISTICS

The manner in which anode voltage and power output vary with frequency is shown in Figure 4.

LOAD DIAGRAMS

Figure 5 is a load diagram of a typical RK-7156 magnetron indicating the position of the sink region for frequencies of 5500, 5700 and 5800 megacycles. The contours of constant power output and frequency change are related to voltage standing wave ratios introduced by mismatched loads at various phase positions. Values of VSWR as high as 3.0/1 are plotted, but ratios greater than 1.5/1 are not recommended in systems operation.

FREQUENCY DRIFT CHARACTERISTICS

After operation of the RK-7156 is initiated, its temperature rises with time until thermal equilibrium is reached. During this transient period the geometry of the tube changes slightly and is attended by a slight frequency change or drift. Frequency drift and anode temperature are plotted as a function of time in Figure 6.

If the tube temperature is changed after thermal equilibrium has been established, the operating frequency will also change until thermal equilibrium is again attained and tube geometry stabilized.

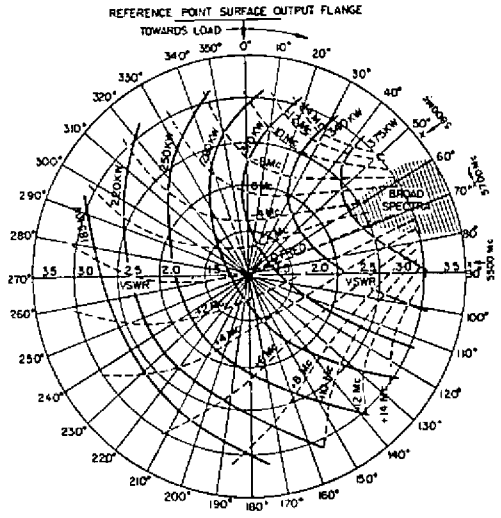


FIG 5- LOAD DIAGRAM OF TYPICAL RK 7156 MAGNETRON- 5700 Mc

LOAD AND LINE LENGTH CONSIDERATIONS

Operation of the RK-7156 into a line exceeding a critical length and terminated in an impedance different from the line gives rise to undesirable phenomena collectively termed long line effects. Tuner curve discontinuities and spectrum broadening are samples of the associated results. Figure 7 shows the line length and VSWR recommended for use with the RK-7156. Although the curves apply specifically to an operating frequency of 5650 Mc, they do not change significantly at other frequencies in the tuning range. The critical conditions of frequency skip, where breaks in the tuning curve first appear depend somewhat on the pulling figure of individual tubes. Operation within the recommended region indicated on the figure will yield satisfactory operation of all RK-7156 magnetrons. An extensive treatment of long line effects is beyond the scope of this publication. Additional information may be obtained on request from the Applications Engineering Dept., Microwave & Power Tube Operations, Raytheon Mfg. Company.

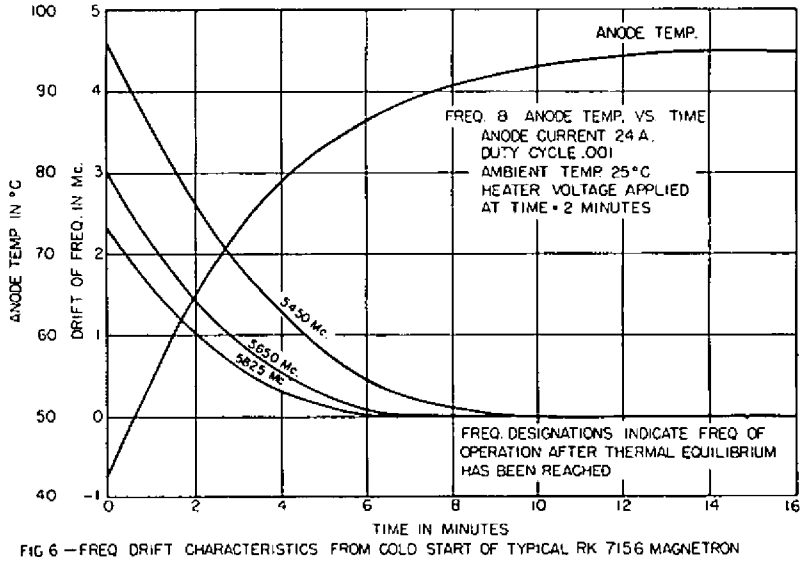


FIG 6 — FREQ DRIFT CHARACTERISTICS FROM COLD START OF TYPICAL RK 7156 MAGNETRON

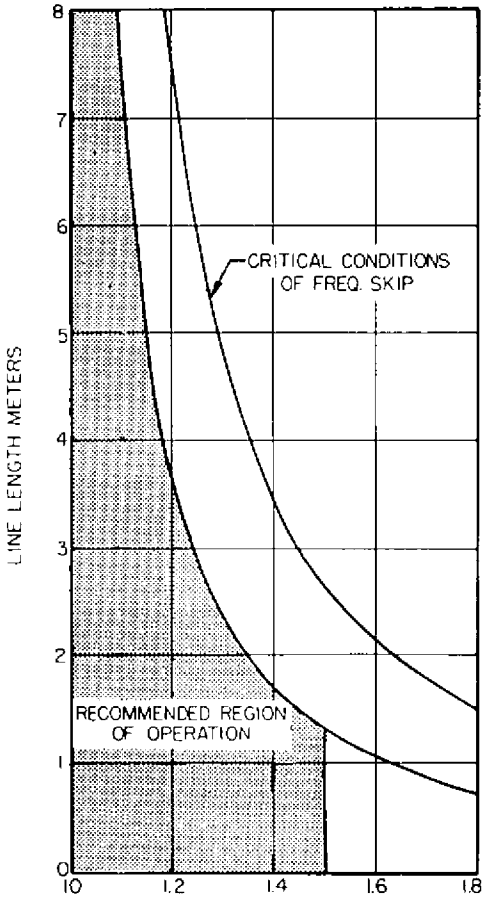


FIG 7- RK 7156 LOAD & LINE LENGTH CONSIDERATIONS 1"x 2" WAVE GUIDE

COOLING

The cooling air stream for the RK-7156 should be directed to the air inlet of the radiator through a close fitting duct. Operating anode temperatures below 90°C are recommended although temperatures as high as 120°C can be tolerated.

Figure 8 shows the relationship between air flow (ft^3/min.) and back pressure (inches H_20). Figure 9 shows anode temperature as a function of rate of air flow over the radiator at four values of power input. Tests were made at 30 in. Hg and an ambient temperature of 25°C. Higher ambient temperatures will result in correspondingly higher anode temperatures.

Use of a close fitting duct can be avoided if a compensating increase in rate of air flow is made.

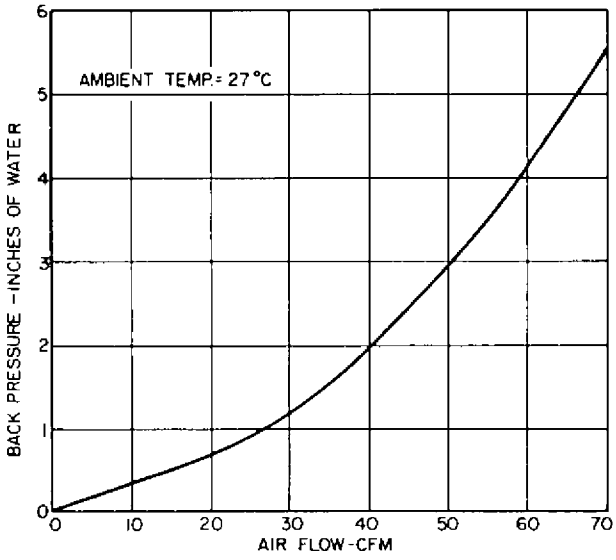


FIG.8-COOLING FIN CHARACTERISTICS OF TYPICAL RK7156 MAGNETRON

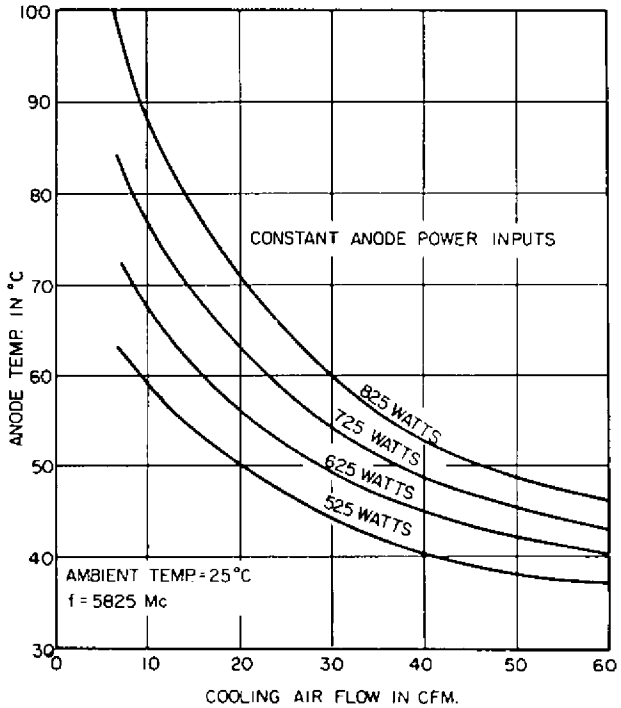


FIG.9-COOLING CHARACTERISTICS OF TYPICAL RK7156 MAGNETRON

DETAILED MECHANICAL INFORMATION

OUTLINE DRAWING

The detailed mechanical dimensions are given in Figure 11. These dimensions should be used in designing a mechanical layout for an equipment rather than the dimensions of a sample tube.

INSTALLATION & HANDLING PRECAUTIONS

The high voltage bushing and output window are protected by guard covers during shipment. These covers must be removed before the tube is installed in its associated equipment. The bushing or output window must not be subjected to any mechanical strain in the handling or mounting of the magnetron.

Care should be taken to keep magnetic material at least 12 inches away from the magnets, since deterioration of the magnetic field results in low power and instability.

Unnecessary jarring of the tube must be avoided. Although a packaged instrument lends the appearance of great structural strength, it is in reality quite fragile. The shocks of careless handling may easily exceed the maximum allowable shock rating.

MOUNTING

The tube is mounted within the equipment by four ¼ inch bolts passed through the four clearance holes of the mounting plate. The tube may be mounted with the longitudinal axis of the cathode high voltage bushing in any position.

ELECTRICAL CONNECTIONS

Electrical input connections are made to the frame of the tube and to two flexible leads terminated in lugs with clearance holes for #10-32 screws. Positive high voltage is grounded to the frame, preferably the mounting plate. Both flexible leads project radially from the cathode high voltage bushing. The lead at the extreme end of the bushing is connected to the heater power supply; the other, identified by a brown band, serves as a common lead for the remaining heater connection and the negative high voltage cathode terminal.

COUPLING & PRESSURIZATION

The load should be attached to the RK-7156 output system through standard 1 x 2 inch waveguide equipped with a type UG148B/U choke flange. The eight tapped holes of the choke flange should be drilled to provide clearance for #10-32 screws. The output section of the magnetron should not be used to support either the weight of the tube or that of the load.

The RK-7156 magnetron is intended for operation at the barometric pressure common at sea level. Electrical breakdown across the cathode high voltage bushing may occur at appreciably lower pressures. If sustained arcing in the waveguide occurs, it will generally move along the guide towards the output window of the tube, and may result in failure of the window. To minimize the possibility of arcing in the guide, and to achieve optimum tube performance, the VSWR in the guide should be kept as low as possible; VSWR values greater than 1.5/1 are not recommended.

TUNER CHARACTERISTICS

Approximately 13 turns of the tuner spline, at an applied torque of 1½ inch lbs., are required to tune the RK-7156 through its frequency range. Internal mechanical tuner stops designed to withstand a torque of 200 inch ounces allow a slightly wider tuning range than specified, but operation out of the specified band is not recommended. See Figure 10.

Further information on the operation and capabilities of this and other type magnetrons may be obtained on request from the Applications Engineering Department, Microwave & Power Tube Operations, Raytheon Manufacturing Company, Waltham, Mass.

TUNABLE PULSED-TYPE MAGNETRON

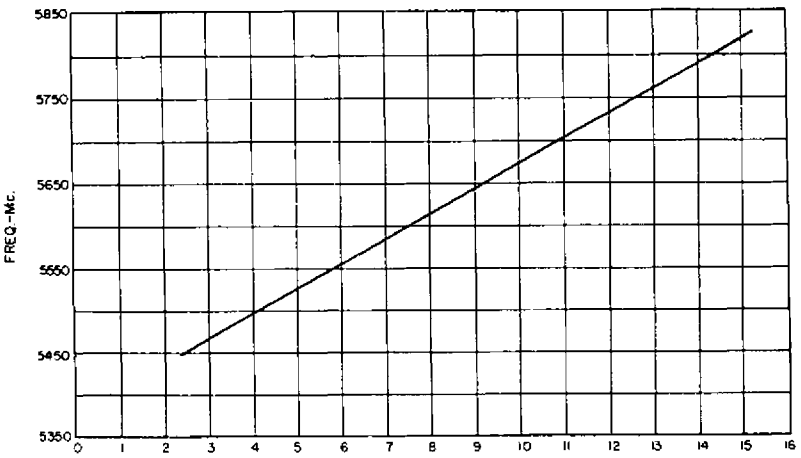
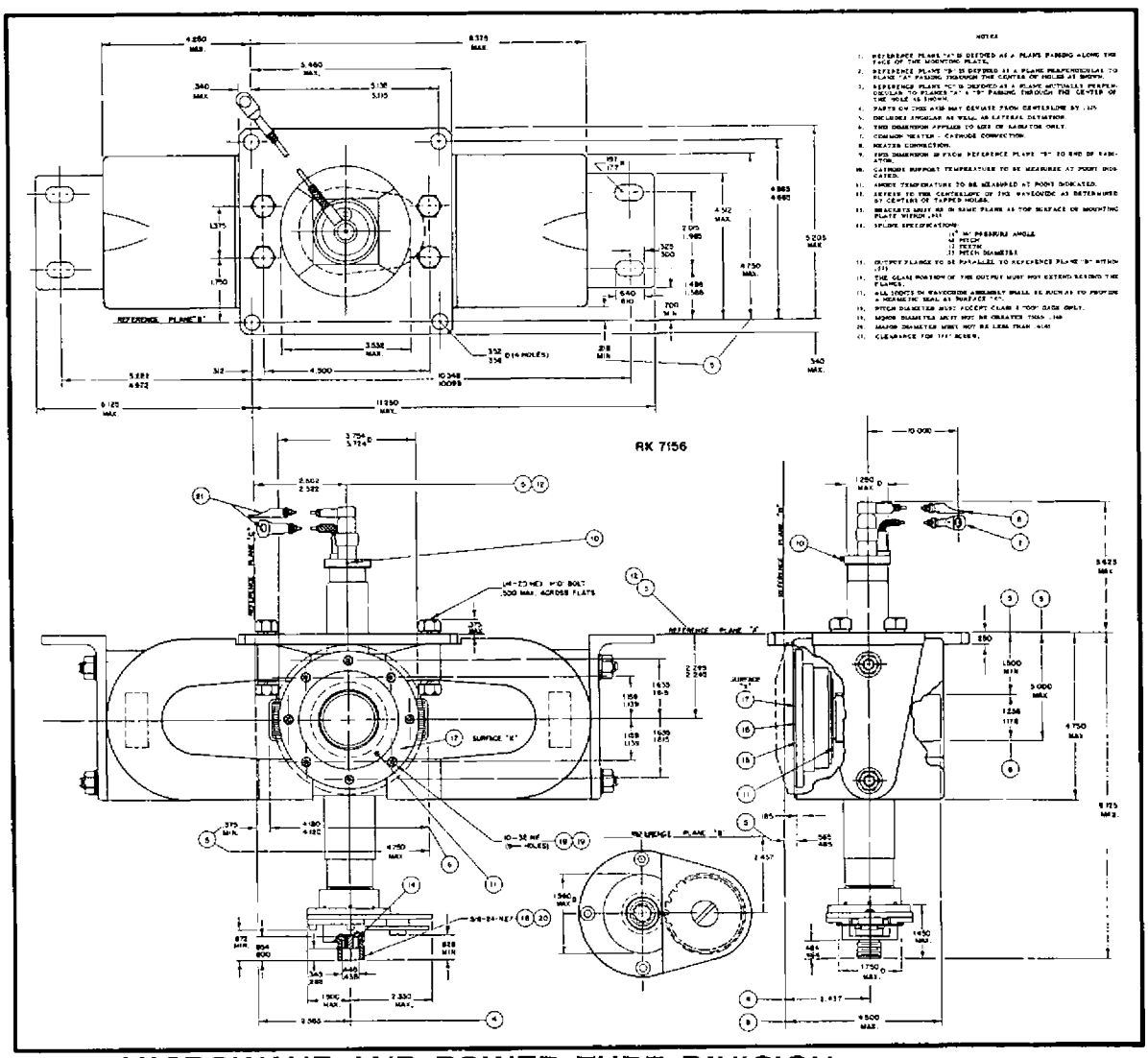


FIG.10-TUNING CHARACTERISTICS OF TYPICAL RK 7156 MAGNETRON



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MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

RAYTHEON

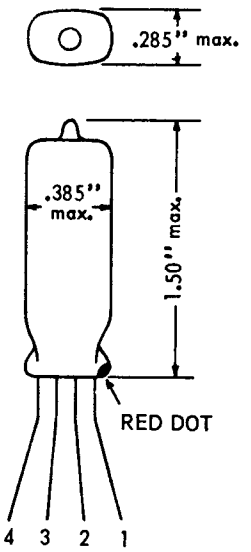
TECHNICAL INFORMATION

SUBMINIATURE TRIODE

TYPE CK7246

Excellence in Electronics

The CK7246 is a 500 megacycle, filament type triode of subminiature construction designed for use as a high frequency oscillator, Class C amplifier, superregenerative detector, frequency multiplier or mixer. It is particularly useful in applications requiring economy of space, weight and battery drain The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. spacing: 0.048" center-to-center)

TERMINAL CONNECTORS: (Red dot is adjacent to lead 1)

Lead 1 Plate	Lead 3 Grid
Lead 2 Filament (negative)	Lead 4 Filament (positive)

MOUNTING POSITIONS: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds)

	Without Shield
Grid to Plate	1.5
Input	1.6
Output	1.9

RATINGS-ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25± 12% volts
Plate Voltage	150 volts
Plate Current	7.5 ma.
Grid Current	1.2 ma.
Grid Voltage	-30 volts
Plate Dissipation	0.7 watts

CHARACTERISTICS AND TYPICAL OPERATION-CLASS A1 AMPLIFIER:

Filament Voltage (dc)	1.25 volts
Filament Current	150 ma.
Plate Voltage	105 volts
Grid Voltage	-2.5 volts
Transconductance	2700 μmhos
Amplification Factor	22
Plate Current	4.5 ma

These data identify a particular developmental tube design and type designation or the descriptive data may be subject to change or abandonment.

Objective Data

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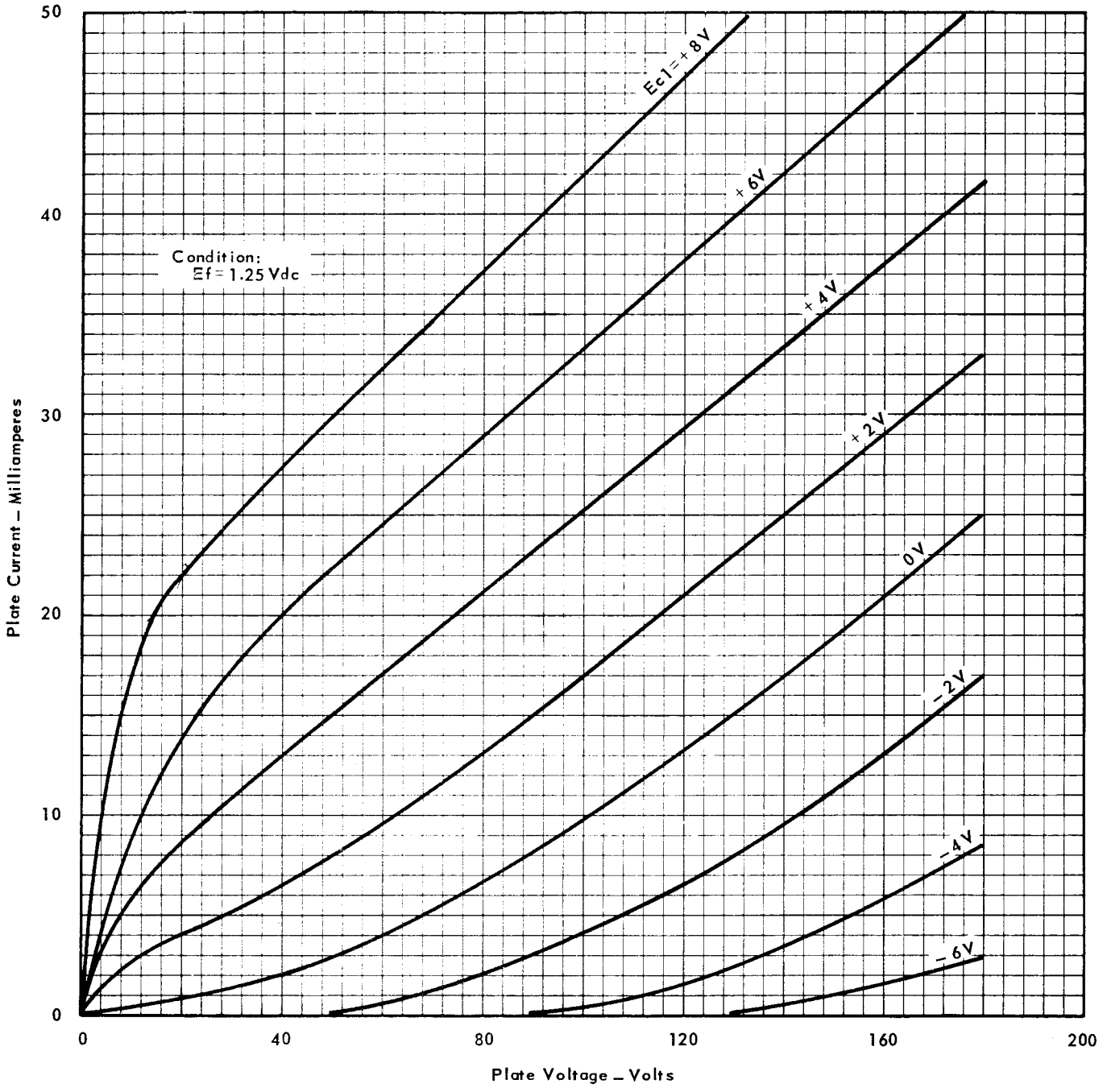
INDUSTRIAL TUBE DIVISION

55 CHAPEL ST., NEWTON 58, MASS.

RAYTHEON

SUBMINIATURE TRIODE

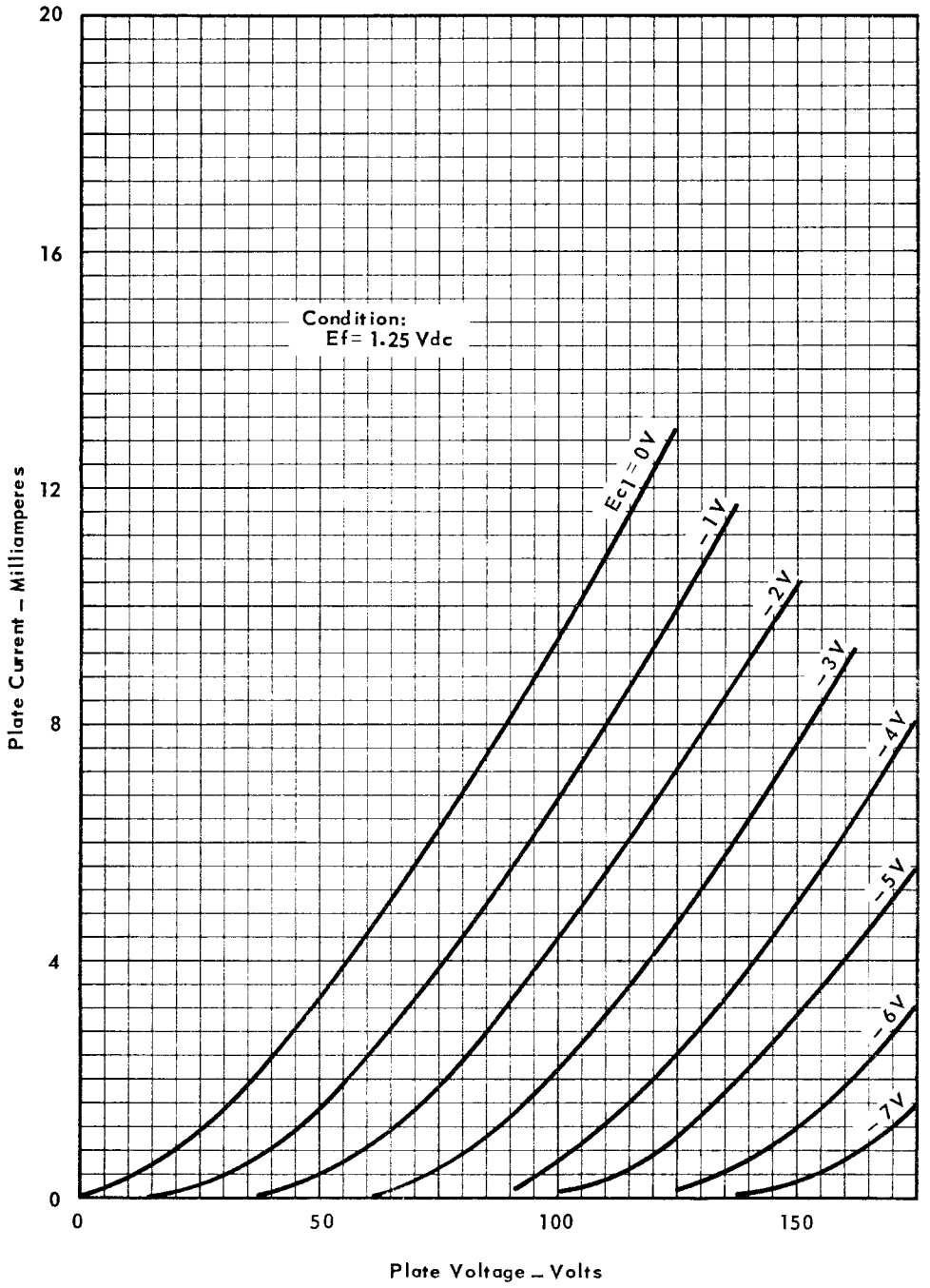
AVERAGE PLATE CHARACTERISTICS



RAYTHEON

SUBMINIATURE TRIODE

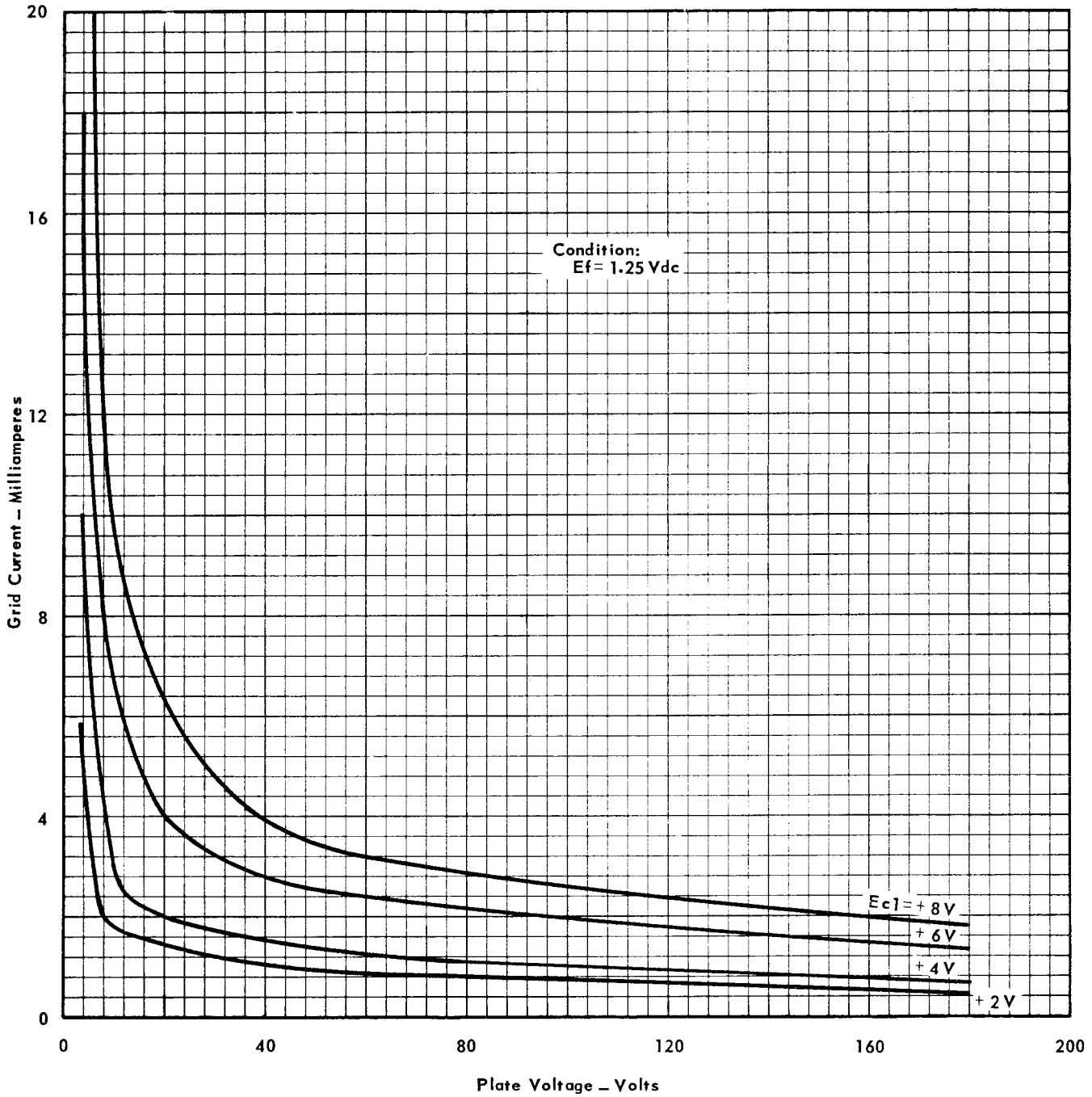
AVERAGE PLATE CHARACTERISTICS



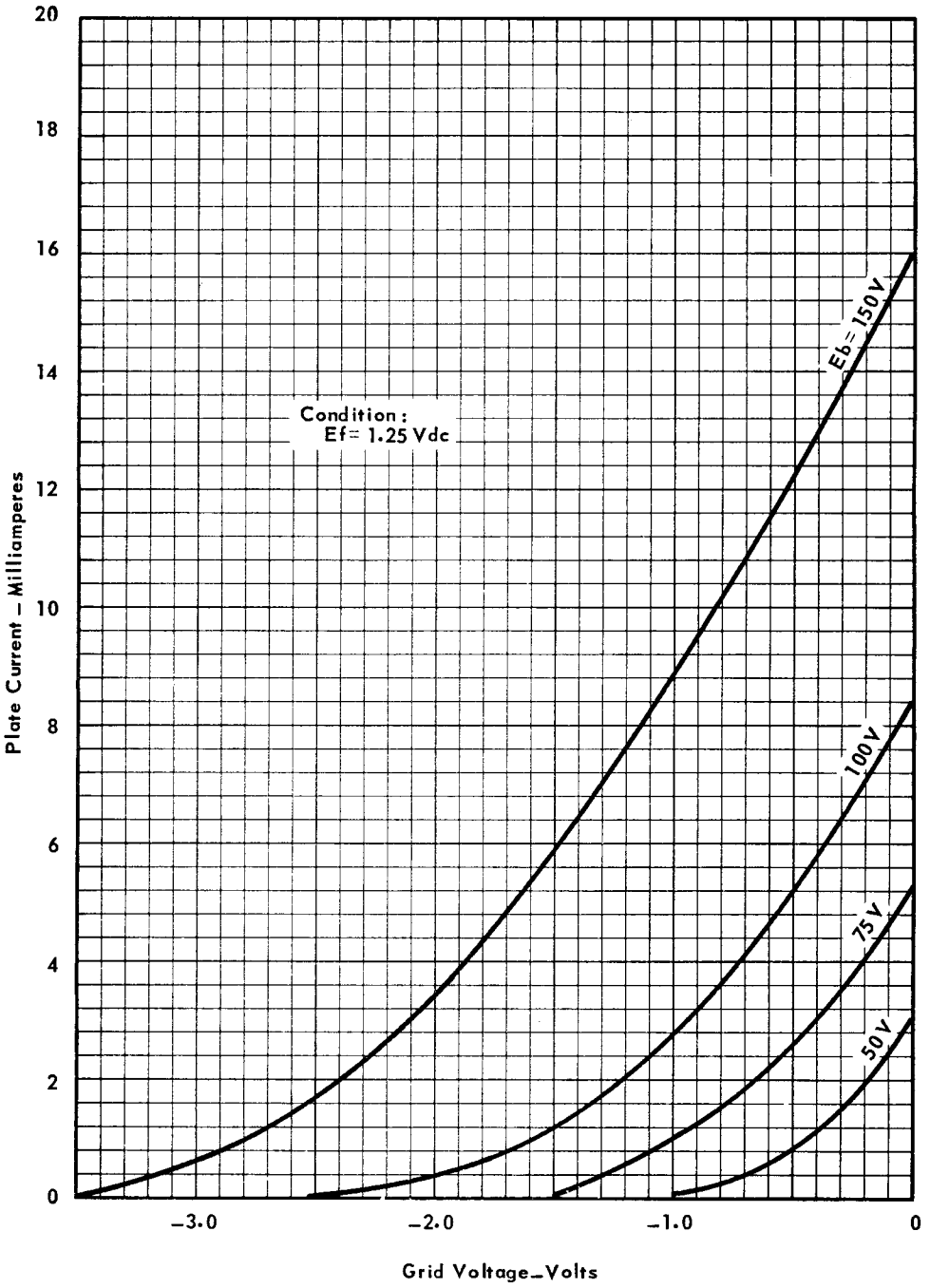
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INDUSTRIAL TUBE DIVISION

AVERAGE GRID CHARACTERISTICS



AVERAGE CHARACTERISTICS



from JETEC release #2239, July 7, 1958

JOINT ELECTRON TUBE ENGINEERING COUNCIL

JETEC TYPE DESIGNATION REGISTRATION FORM FOR PULSED MAGNETRONS

Manufacturers's Designation QKH 713

JETEC Designation 7256

Manufacturer Raytheon

GENERAL CHARACTERISTICS

The 7256 is a pulsed magnetron oscillator tube which operates at a tunable frequency of 8500 to 9600 Mc. The peak power output is approximately 55 kilowatts and the tube is air cooled. The tube uses a integral magnet.

With the exception of a .375" increase in the dimension between the mounting plate and the top of the tuner and the addition of a "forward lash" measurement, the 7256 is identical to an RK 2J51A.

General Electrical Data

Pre-heat Heater Voltage 6.3 ± 5 %

Pre-heat Heater Current at 6.3 Volts: 1.0 ± 0.1 Amperes

Minimum Preheat Time 180 seconds

Heater Cold Resistance 1.0 ohms

Anode-Cathode Capacitance 4.0 to 8.0 uuf

ABSOLUTE MAXIMUM RATINGS

Heater Voltage	7.0	Volts
Peak Anode Voltage	16.0	Kilovolts
Peak Anode Current	15.5	Amperes
Average Power Output	230	Watts
Duty Cycle	.0011	
Pulse Duration	3.4	Microseconds

Rate of Rise of Anode Voltage (above 85 % point)	115	kv/us
Output Circuit Pressurization	45	psia
Maximum Altitude without Pressurization		
Output Circuit	10,000	ft.
Input Terminals	10,000	ft.
Anode Temperature		
(See Outline Drawing)	150 °C	
VSWR (Magnetron Load)	1.5/1	

TYPICAL OPERATION

Oscillation 1

Current pulse duration	0.10	us
Duty cycle	.0004	
Voltage pulse rise time	0.1	us
Number of magnetic shunts	2	
Heater voltage start	6.3	V
Heater voltage operate	4.7	V
Frequency	9000	Mc
Peak anode voltage	12	kv
Peak power output	54	kw
Average power output	22	W
Peak current	14	a

Oscillation 2

Current pulse duration	1.0	us
Duty cycle	.001	
Number of magnet shunts	No shunts	
Heater voltage preheat	6.3	V
Heater voltage operate	0	V

Oscillation 2 (Con't)

Peak anode current	14	a
Frequency	9000	Mc
Peak anode voltage	13.8	kv
Peak power output	64	kw
Average power output	64	W
Peak current	14	a

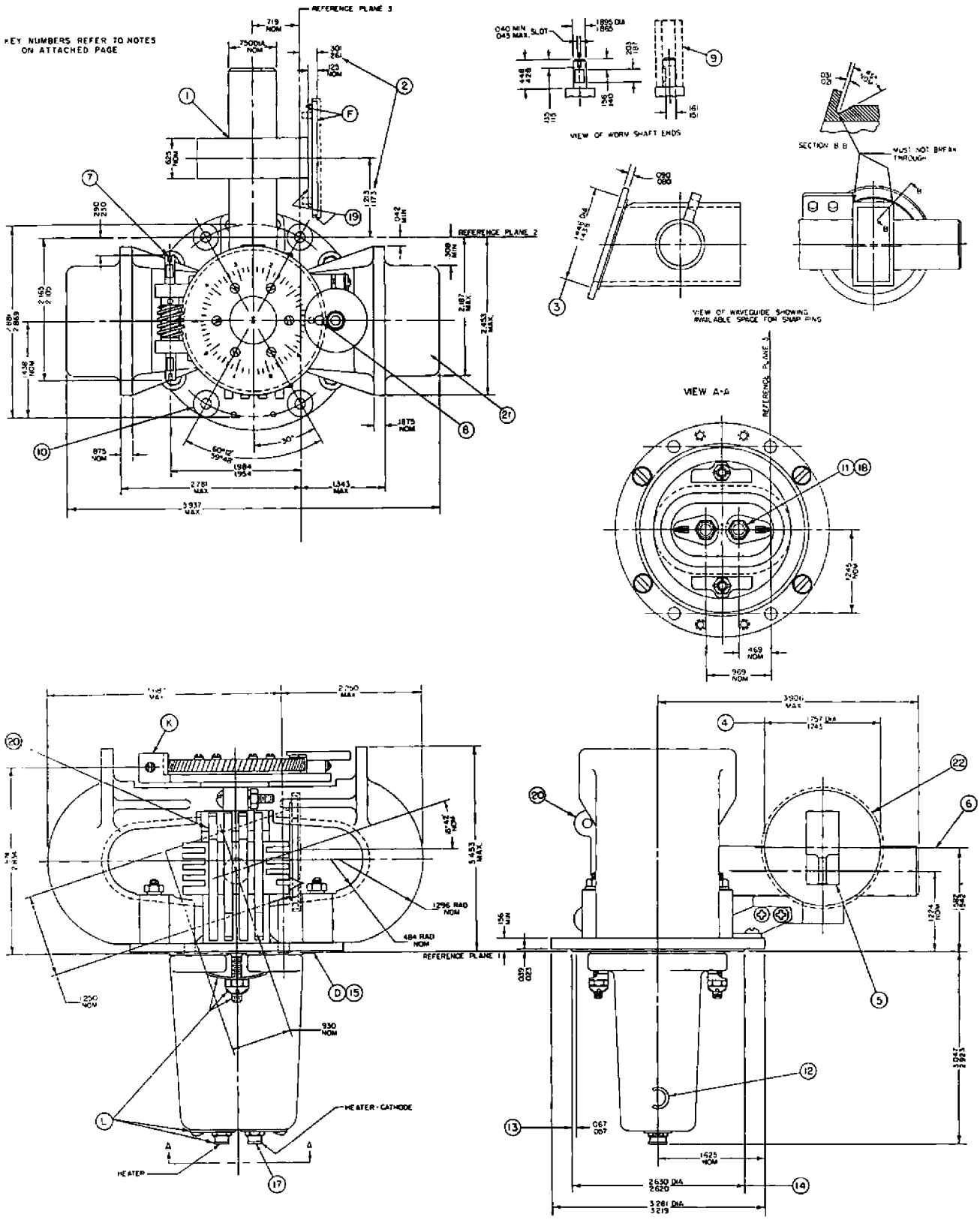
General Mechanical Characteristics

Mounting	Any position
Overall dimensions	See outline dwg.
Net weight	4 lb. 14 ox. Approx.
Cooling	Forced air
Pressurization	40-45 psia
Output	Choke UG52/AU
Vibration (non-operating)	50 cps @ 10G

RAYTHEON

RK 7256

TUNABLE PULSED-TYPE OSCILLATOR



RAYTHEON MANUFACTURING COMPANY

MICROWAVE AND POWER TUBE OPERATIONS

WALTHAM 54, MASS.

TUNABLE PULSED-TYPE OSCILLATOR

RK 7256

NOTES:

1. All solder joints on waveguide assembly shall be soldered to provide a hermatic seal at surface "F."
2. The ±0.020" tolerance of 0.281" dimension includes angular as well as lateral deviations of the surface. These dimensions define relation of surface "F" to respective holes.
3. This diameter shall be concentric with the diameter of the flange within 0.005".
4. This diameter shall be concentric with opening in waveguide within 0.010".
5. The opening in the waveguide shall be enclosed by a dust cover when the tube is not in use.
6. Center line of waveguide opening.
7. To increase frequency, drive this end of worm shaft in counterclockwise direction. Complete frequency range covered in approx. 125 turns. Tuning mechanism shall operate smoothly over the entire mechanical range when subjected to a torque of 1-½ in. -lbs. applied at the worm shaft. In equipment no less than 1½ in. -lbs. nor more than 2½ in. -lbs. shall be applied at drive shaft. The gear and worm threads must be free from corrosion, paint, and other imperfections.
8. Number appearing here indicates number of complete revolutions of gear from 0 to 6. With the Geneva and gear seat at 3 and 0 respectively, the frequency of tube is 9000 ± 25 mc under oscillation 3 on TSS.
9. It shall be possible for a sleeve 0.195" I.D. x 0.406" O.D. x 1" long to pass over ends of shaft to face of worm bracket.
10. Four 0.193" ± 0.003" dia. holes 7/32" min. clearance around four holes at base plate. This clearance shall be free from black finish.
11. The jack holes shall be within a radius of 0.023" of the specified location but shall be spaced 0.500" ± 0.010" with respect to each other. The center line of the jack holes shall be perpendicular to mounting plate within 3°.
12. "C" indicates adjacent jack is the common heater-cathode connection.
13. With 1/16" seat resting on a plane surface, the flatness of the seat shall be such that a 0.010" thickness gauge ⅛" wide shall not pass under.
14. All solder joints on base plate shall be soldered to provide a hermatic seal.
15. Any portion of the assembly extending below this surface shall be within a 1-7/64" radius on the true center of the plate.
16. All metal surfaces covered by black finish except surfaces "D" and "F," drive and stop mechanism "K," surface around holes as specified in Note 10, parts associated with glass insulator "L," and shunts.
17. Locking-type jack — see latest issue of JAN-1A.
18. Hex-head banana pin jack 19/32" long, hole 0.169" ± 0.005" dia.
19. Black finish may be omitted from the edges and back of waveguide.
20. Four magnet shunts. For number of magnet shunts to be retained, see Technical Information. To remove surplus, grip firmly at tabs with suitable pliers and pull away from tube.
21. WARNING — Maintain 2"-min. clearance between this magnet and magnetic materials (magnet, steel tools, plates, etc.).
22. Waveguide cover required for shipping purposes only.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7327

RELIABLE SUBMINIATURE DOUBLE TRIODE

The CK 7327 is a heater-cathode type double triode of sub-miniature construction designed for pulse application only. The CK 7327 is a direct replacement for types 6111 and 6021 in pulse applications. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8-pin sub-miniature socket may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Ratings)

Impact Acceleration	735 G
Fatigue (Vibrational Acceleration for Extended Periods)	10 G
Bulb Temperature	150 °C
Altitude	80,000 Ft.

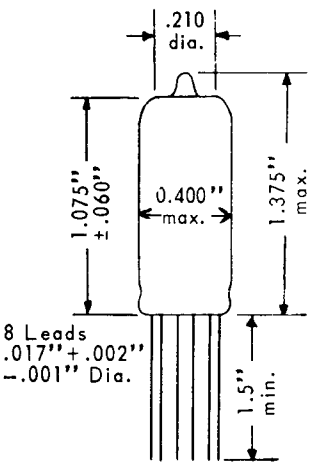
ELECTRICAL DATA

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absol. Min.	Norm. Test Cond.	Normal Operation	Test Limit or Absol. Max.	MIL-E-1 Units
			RATINGS			
Heater Voltage	Ef	5.7	6.3	---	6.9	V
Plate Voltage (Average)	Eb	---	---	---	250	Vdc
Peak Plate to Cathode Voltage (Note D)	eb	---	---	---	300	v
Plate Dissipation (per plate)	Pp/p	---	---	---	0.95	Watts
DC Grid Voltage	Ec	-55	---	---	0	Vdc
Grid Dissipation (per grid)	Pg/g	---	---	---	0.2	Watts
Peak Tube Drop	etd	---	---	---	150	v
Forward Plate Voltage (Instantaneous) Note A	epy	---	---	---	400	v
Instantaneous Grid Cathode Voltage	egk	-100	---	---	80	v
Heater Cathode Voltage	Ehk	---	---	---	±200	v
Grid Circuit Res.	Rg1	---	---	---	1.1	meg.
			TESTS			
Heater Current	If:	280	---	300	320	mA
Heater-Cathode Leakage Ehk=±100Vdc Note B	Ihk:	---	---	---	5.0	μAdc
Plate Current Eb=300 Vdc; Rk=0 Ec=-32Vdc; (Note B)	Ib:	---	---	---	10	μAdc

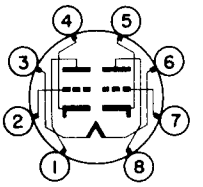
MECHANICAL DATA

ENVELOPE ..... Glass T-3
OUTLINE .....JEDEC (3-1)
BASE .....E8-10 Submin., Button Flexible Leads
BASING 8DG
CATHODE .....Coated Unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2
Lead 2 Grid, Unit #2
Lead 3 Heater
Lead 4 Cathode, Unit #2
Lead 5 Cathode, Unit #1
Lead 6 Heater
Lead 7 Grid, Unit #1
Lead 8 Plate, Unit #1

ELECTRICAL DATA (cont'd.)

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absol. Min.	Normal Test Cond.	Normal Operation	Test Limit or Absol. Max.	MIL-E-1 Units
		TESTS (cont'd)				
Pulse Cathode Current (1) (Notes B, C) Eb = 150 Vdc; Ef = 5.7V; egk = +50V; Rg = 47 ohms max.; Rp = 0	ik:	400	---	---	---	ma
Pulse ib/ic2 (1) Eb = 150 Vdc; (Notes B,C) egk = +50 V Rg = 47 ohms max.; Rp = 0	----	2.5	---	3.5	---	---
Pulse Cathode Current (2) (Notes B, C) Eb = 150 Vdc; egk = 50V; Rp = 0; RL = 0 Rg = 47 ohms max.	ik:	500	---	750	---	mA
Pulse Cathode Current (3) (Notes B, C) eb = egk = +50V; Ec_1 = −10 Vdc; Rg = Rp = 0	ik:	370	---	---	---	mA
Capacitance: no shield (Note B)	Cgp:	1.2	---	1.5	1.8	pf
Capacitance: no shield (Note B)	Cin:	1.4	---	1.9	2.4	pf
Capacitance: no shield Section No. 1	Cout:	0.20	---	0.28	0.36	pf
Capacitance: no shield Section No. 2	Cout:	0.22	---	0.32	0.42	pf
Capacitance: no shield	Cgg:	---	---	---	0.011	pf
Capacitance: no shield	Cpp:	---	---	---	0.50	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

Shock Test –	735 G. 49° hammer angle in Navy High Impact Shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.
Fatigue Test –	10 G. Sample subjected to vibrational acceleration of 10 G for 6 hours (2 hours in each of three positions). The frequency of vibration is varied from 30 cps to 3000 cps and back to 30 cps.
Glass Strain –	A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.
Heater Cycling – Life Test	A sample is subjected to 2000 1 min. on, 4 min. off heater cycles at the following conditions: Ef = 7.0 volts; Ehk = 140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts.
Grid Pulse – Life Test 500 Hours	Sample is operated with Ef = 6.3; Eb = 250V; Ec_1 = −30 Vdc; egk = +50 v; Rp/p = 180 ohms; Rg/g = 47 ohms max. T Envelope = 150°C for 500 hrs.

APPLICATION NOTES

A. The maximum rating for epy applies only to the spike occurring at the leading edge of the pulse waveform. The spike duration must be limited to 0.1 tp. (See Figure 31, paragraph 4.10.7.5 of MIL–E–1.)

B. Test each section separately.

C. The tube shall be operated in a pulse circuit as follows: tp = 10 μsec; (between 80% amplitude points) prr = 100 pps; tr = 1.0 μsec Max. (between 10% and 80% amplitude points); tf = 1.0 μsec Max. (between 80% and 10% amplitude points):

APPLICATION NOTES (cont'd)

Measure peak current across a 1.0 ohm ±0.1% resistor in the specified circuit.

Prior to testing preheat tubes with Ef = Test Volts the only applied voltage for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute minimum at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

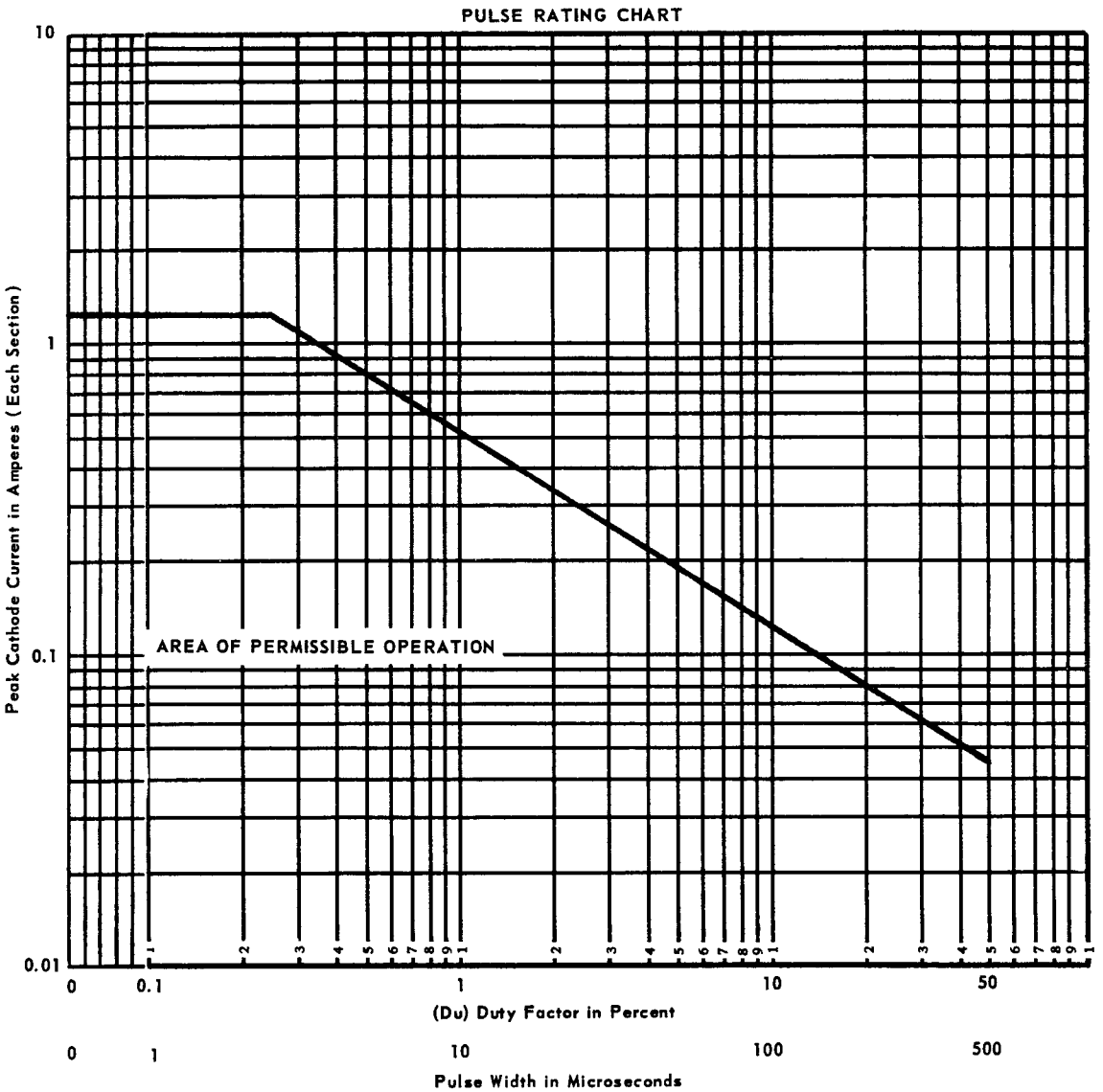
D. eb is defined as the peak voltage between plate and cathode (non-conducting).

DISCUSSION AND EXPLANATION OF PULSE RATING CHART

The following chart is applicable for operation where the duty factor does not exceed 50 per cent and the pulse width does not exceed 500 micro seconds. It is believed that these ranges include well over 90 per cent of pulse applications, and applications beyond these limits should be referred to Raytheon Field Engineering.

The area under the heavy boundary line is the area of "permissible operation", provided that other parameters are maintained within their absolute maximum values. The maximum permissible peak cathode current is limited by both duty factor (Du) and Pulse Width (tp), and for a given application is determined as the lower peak current obtained by the intersection with the bondary line of either the Du or tp coordinates. Within these limitations normal life performance may be expected. During manufacture control life tests are performed under operating conditions which yield peak currents exceeding those permitted by the chart, thus assuring satisfactory life when the tube is operated within the area of permissible operation.

APPLICATION NOTES (cont'd)



CAUTION --- To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

ACCEPTANCE CRITERIA

The following tests shall be performed.

For the purpose of inspection, use applicable reliable paragraphs of Spec. MIL–E–1.

For misc. requirements, see 3.6.

Test Conditions:

Heater Voltage 6.3 V
Plate Voltage 150 Vdc
Grid Voltage −30 Vdc

MIL–E–1 Ref.	Test	AQL (%)	Level or Code	Max. LTPD % (Note 1)	Min. Sample Size	Symbol	LIMITS Min.	LIMITS Bogey	LIMITS Max.	Units
	MEASUREMENTS ACCEPTANCE TESTS									
4.10.8	Heater Current	0.65	II	4.4	Code L	If	280	300	320	mA
4.10.15	Heater-Cathode Leakage: Note 3 Ehk = ±100 Vdc	0.65	II	4.4	Code L	Ihk	---	---	5.0	μAdc
4.10.6.1	Grid Current: Note 3 Eb = 100 Vdc; Ec = 0; Rk = 220 ohms	0.65	II	4.4	Code L	Ic_1	0	---	−0.5	μAdc
4.10.4.1	Plate Current: Note 3 Eb = 300 Vdc; Ec = −32 Vdc; Rk = 0	0.65	II	4.4	Code L	Ib	---	---	10	μAdc
4.10.7.5	Pulse Cathode Current (1): Notes 3 and 5 Ef = 5.7V; egk = +50v; Rg = 47 ohms Max.; Rp = 0	2.5	I	13.0	Code I	ik	400	---	---	ma
-------	Pulse ib/icl (1): Notes 3, 5 egk = +50v; Rg = 47 ohms Max.; Rp = 0	6.5	I	22.0	Code I	---	2.5	3.5	---	
4.10.7.5	Pulse Cathode Current (2): Notes 3 and 5 egk = +50 v; RL = 0; Rg = 47 ohms Max.; Rp = 0	0.65	II	4.4	Code L	ik	500	750	---	ma
-------	Pulse Cathode Current (3): Notes 3 and 5 eb = egk = +50 v; Ecl = −10 Vdc; Rg = Rp = 0	6.5	I	22.0	Code I	ik	370	---	---	ma
-------	Continuity and Shorts: Note 2	0.4	II	3.5	Code L	---	---	---	---	
4.9.1	Mechanical: Envelope (8-1)	---	---	---	---	---	---	---	---	
4.8.2	Insulation of Electrodes: Note 3	2.5	L6	12.8	Code H		---	---	---	
	Eg = all = −100 Vdc					R(g−all)	100	---	---	Meg
	Ep = all = −300 Vdc					R(p−all)	100	---	---	Meg
4.10.14	Capacitance: No Shield	6.5	Code	---	---	---	---	---	---	
	Cgp Note 3	---	E	---	---	Cgp	1.2	1.5	1.8	pf
	Cin Note 3	---		---	---	Cin	1.4	1.9	2.4	pf
	Cout Section No. 1	---		---	---	Cout	0.20	0.28	0.36	pf
	Section No. 2	---		---	---	Cout	0.22	0.32	0.42	pf
	Cgg	---		---	---	Cgg	---	---	0.011	pf
	Cpp	---		---	---	Cpp	---	---	0.50	pf
4.9.12.1	Low Pressure Voltage Breakdown: Note 6 Pressure = 21±2 mm Hg; Voltage = 300 Vac	6.5	L6	25.0	Code G	---	---	---	---	
-------	White Noise: Notes 3 and 7 Eb = 100 Vdc; Rp = 10,000 Ohms; Rk = 220 ohms; Cg = 1000 μf	1.0	I	7.7	Code I	---	---	---	200 30	mV pk-pk mVac

MIL-E-1 Ref.	Test	AQL (%)	Level or Code	Max. LTPD % (Note 1)	Min. Sample Size	Symbol	LIMITS Min.	LIMITS Bogey	LIMITS Max.	Units
DEGRADATION RATE ACCEPTANCE TESTS: Note 4										
4.9.5.3	Subminiature Lead Fatigue	2.5	L6	12.8	Code H	---	4	---	---	Arcs
4.9.20.5	Shock: Note 8 Hammer Angle = 49° Eb = 100 Vdc; Ehk = +100 Vdc; Rg = 0.1 Meg	20	---	---	---	---	---	---	---	
4.9.20.6	Fatigue: Notes 6 and 9 Eb = 100 Vdc; Ec = -2.0 Vdc; Rk = 0; G = 10; Variable Frequency	6.5	L6	25.0	Code G	---	---	---	---	
-------	Post Shock and Fatigue Test End Points: White Noise	---	---	---	---	---	---	---	300 45	Mv pk-pk mVac
	Heater-Cathode Leakage Ehk = ± 100 Vdc	---	---	---	---	Ihk	---	---	20	μAdc
	Change in Pulse Cathode Current (2) of Individual Tubes	---	---	---	---	$\Delta_{\dagger}$ik	---	---	15	%
4.9.6.3	Glass Strain:	6.5	I	22.0	Code I	---	---	---	---	

MIL-E-1 Ref.	Test		Symbol	LIMITS Min.	LIMITS Max.	Units
ACCEPTANCE LIFE TFSTS: Note 4						
4.11.7	Heater Cycling Life Test: Note 10 Ef = 7.0V; 1 min. on, 4 min. off; Ehk = 140 Vac; Eb = Ec = OV		---	---	---	
-------	Grid Pulse Life Test: Notes 5 cnd 11; Ef = 6.3V; Eb = 250 Vdc; egk = +50 v; Ecl = -30 Vdc; Rp/p = 180 ohms; Rg/g = 47 ohms Max.; T-Envelope = 150°C		---	---	---	
-------	Grid Pulse Life Test End Points					
	Inoperatives		---	---	---	
	Grid Current		Ic	---	-1.0	μAdc
	Change of Pulse Cathode Current of Individual Tubes		Δik	---	-25 +50	% %
	Heater-Cathode Leakage +Ihk		Ihk	---	10	μAdc
	Total Defectives		---	---	---	

ACCEPTANCE CRITERIA NOTES:

Note 1: The maximum LTPD (Lot Tolerance Percent Defective) is defined as the percent defective in the lot for which the probability of acceptance is 10%.

Note 2: Per MIL-E-1 ref. 4.7.

Note 3: Test each section separately.

Note 4: Destructive Tests: Tubes subjected to the following destructive tests are not to be accepted under this specification:

4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.7	Heater Cycling Life Test
4.9.5.3	Lead Fatigue
-------	Grid Pulse Life Test

Note 5: The tube shall be operated in a pulse circuit as follows: tp = 10 μsec (between 80% amplitudepoints); prr = 100 ρps; tr = 1.0 μsec Max. (between 10% and 80% amplitude points); tf = 1.0 μsec Max. (between 80% and 10% amplitude points):

Measure peak current across a 1.0 ohm ± 0.1% resistor in the specified circuit.

Prior to testing, preheat tubes with Ef= Test Volts, the only applied voltage, for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute minimum at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. Once a lot has passed, the 30 day rule shall apply.

Note 7: The tube shall be rigidly mounted on a table vibrating such that the instantaneous values of acceleration shall constitute approximately a "White Noise" spectrum which is free from discontinuities from 100 to 5000 cps and such that the RMS value of acceleration for frequencies outside this band shall con stitute no more than five percent of the total RMS acceleration. The spectrum of instantaneous acceleration shall be such that each octave of bandwith delivers 2.3 ± 0.2 G's RMS acceleration. With this the case, the RMS value of acceleration for any bandwidth within the specified spectrum is equal to

$$Grms = 2.3 \sqrt{3.32 \log_{10} (f2/f1)}$$

where f2 and f1 are the upper and lower frequencies respectively of the band under consideration. The degree of clipping of the peak accelerations shall be such that the peak value of acceleration is at least 15 G's.

Half the tubes in each sample shall be vibrated in position X1, the other half in position X2.

The voltage (ep) produced across the resistor (Rp) as a result of vibration shall be coupled through a compensating amplifier to a low pass filter. The compensating amplifier shall have a high input impendance (250 Kohms or more) and shall be adjusted to compensate for any insertion losses in the filer. The combined frequency response of amplifier shall be flat within ± 0.5 db from 50 to 8000 cps, shall be down no more than 5 db at 10,000 cps and at 20 cps, and down at least 30 db at 13,000 cps. For reading the peak to peak value of output voltage, the filter output shall be fed directly to the input of a Ballantine Model 305 peak to peak electronic voltmeter or equal, while the RMS value shall be measured with a Hewlett-Packard Model 400 C or equal. The impedance of the plate and screen voltage supplies shall not exceed that of a 40 μf capacitor at 10 cps.

Note 8: A grid resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyratron - type short indicator is employed.

Note 9: The tubes shall be rigidly mounted on a table vibrating at a constant acceleration level of 10G. The frequency of vibration shall be varied from 30 cps to 3000 cps and back to 30 cps with three minutes being the time required to sweep the range in each direction. The rate of change of frequency with time shall be such that the frequency varies logarithmically with time. The tubes shall be vibrated for a total of six hours, that is two hours in each of the three positions X1, X2 and Y1. Heater voltage only shall be applied to the tube under test.

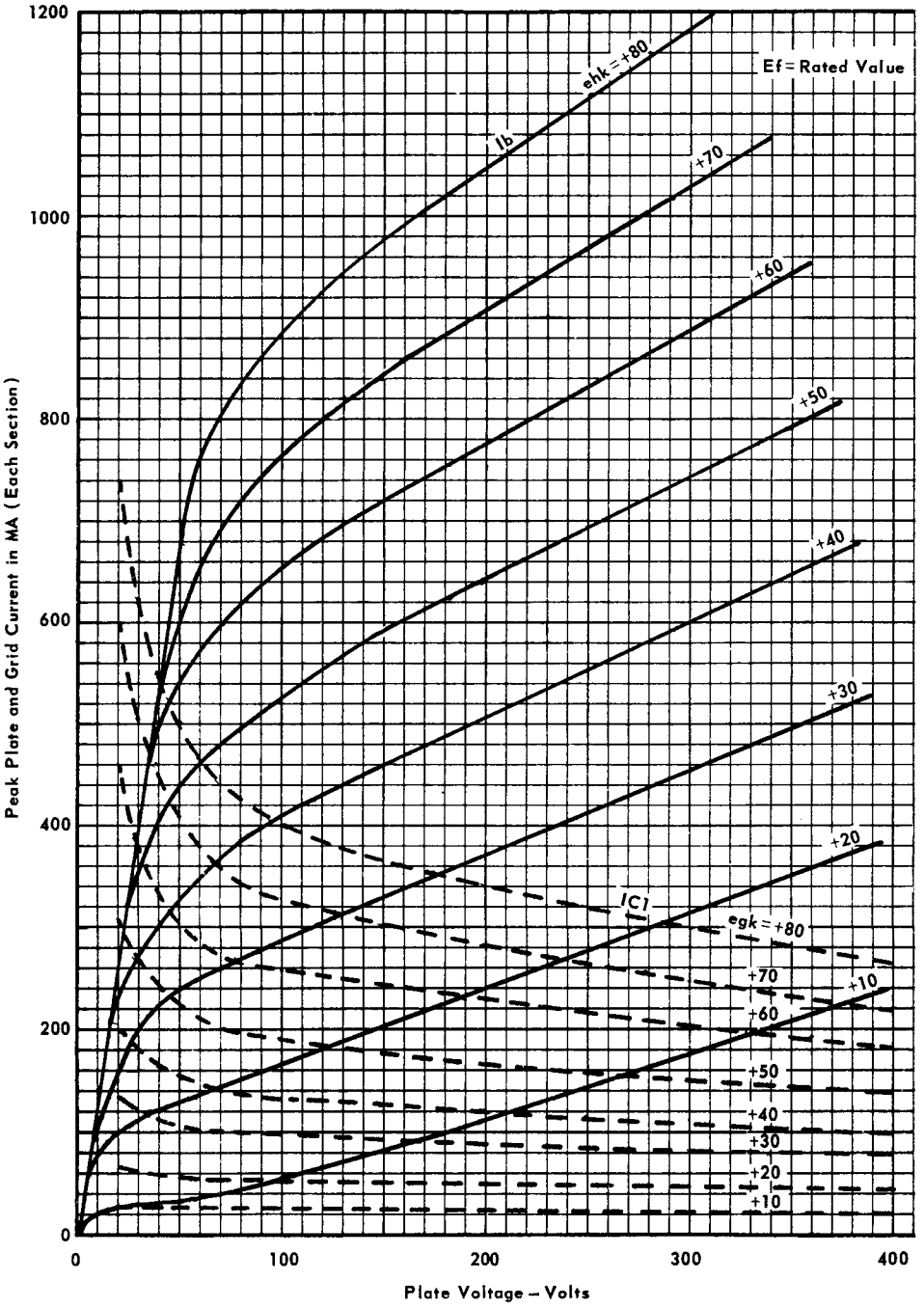
Note 10: The no-load to steady state full load regulation of the heater voltage supply shall not be more than 3.0%. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit or a heater-cathode short.

Note 11: Grid Pulse Life Test shall be conducted for 500 hours with interim readings of Pulse Cathode Current end point made at zero; 20 plus or minus 4 hours and 200 (+48, −24) hours. Readings of Ic1 and Ihk shall be made at zero (0) hours and at the completion of the life test.

Change of Pulse Cathode Current shall be calculated as the percentage change from zero hours to each reading period.

Life test shall be conducted under a double sampling plan of which the first sample shall consist of 20 tubes. If a tube is defective for more than one characteristic, the characteristic appearing first in the life-test end points shall constitute the failure.

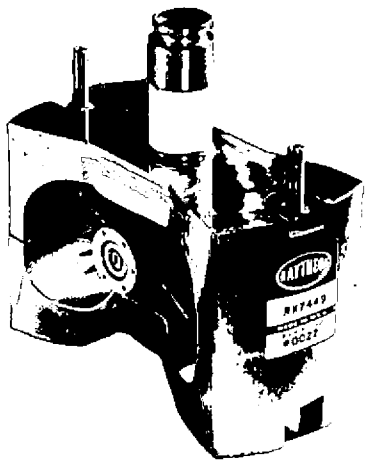
AVERAGE PLATE CHARACTERISTICS



from JEDEC release #2587, Sept. 14, 1959

RK 7449 PRELIMINARY DATA SHEET

RAYTHEON *Excellence in Electronics*



RK 7449

GENERAL DESCRIPTION

The RK7449 magnetron is a rugged, pulsed-type oscillator operating in the frequency region of 23,700 to 24,300 megacycles, with a minimum power output of 45.0 kilowatts. It is an integral magnet, unipotential cathode, waveguide output type tube requiring forced air cooling.

The RK7449 is designed to operate while being subjected to vibration frequencies of 20 to 2000 C.P.S. at a constant acceleration of 30.0 G's, (below 54 C.P.S. the maximum total excursion is 0.2 inches). It will also withstand 50 G's shock acceleration on three mutually perpendicular axes.

Mechanical Data

Mounting Position	Any
Net Weight	7.5 Lbs.
Cooling	Forced Air
Pressurization (Input)	Required below 10 P.S.I.A.
Pressurization (Output)	Required (40 P.S.I.A. Min.)

Electrical Data

Heater Voltage-Preheat/90 sec	5.0 Volts
Heater Current at 5.0 volts	2.6-3.2 Amps
Voltage Rise Time	0.02 usec Min.
R.F. Bandwidth	1.96/tpc
Maximum V.S.W.R.	1.5

Typical Operation

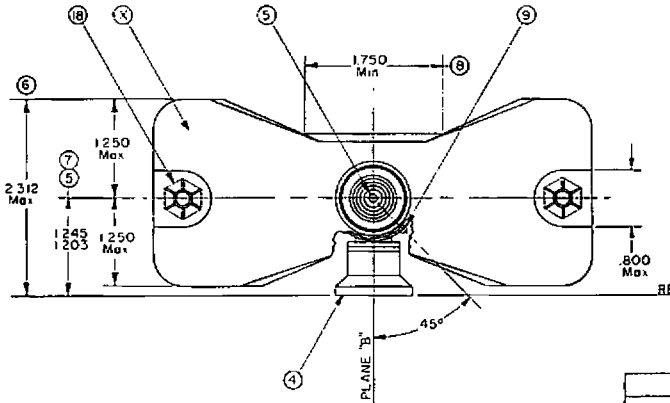
Pulse Duration	0.02 to 0.09 usec
Duty Cycle	0.0003
Peak Anode Current	15 Amps
Peak Power Output	55 kilowatts
Peak Anode Voltage	14 kilovolts

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary Data Sheet is intended only as an introduction to this type magnetron and not as an absolute guide to users. Specific problems and applications should be directed to the Applications Engineering Department at Raytheon Waltham, Massachusetts.

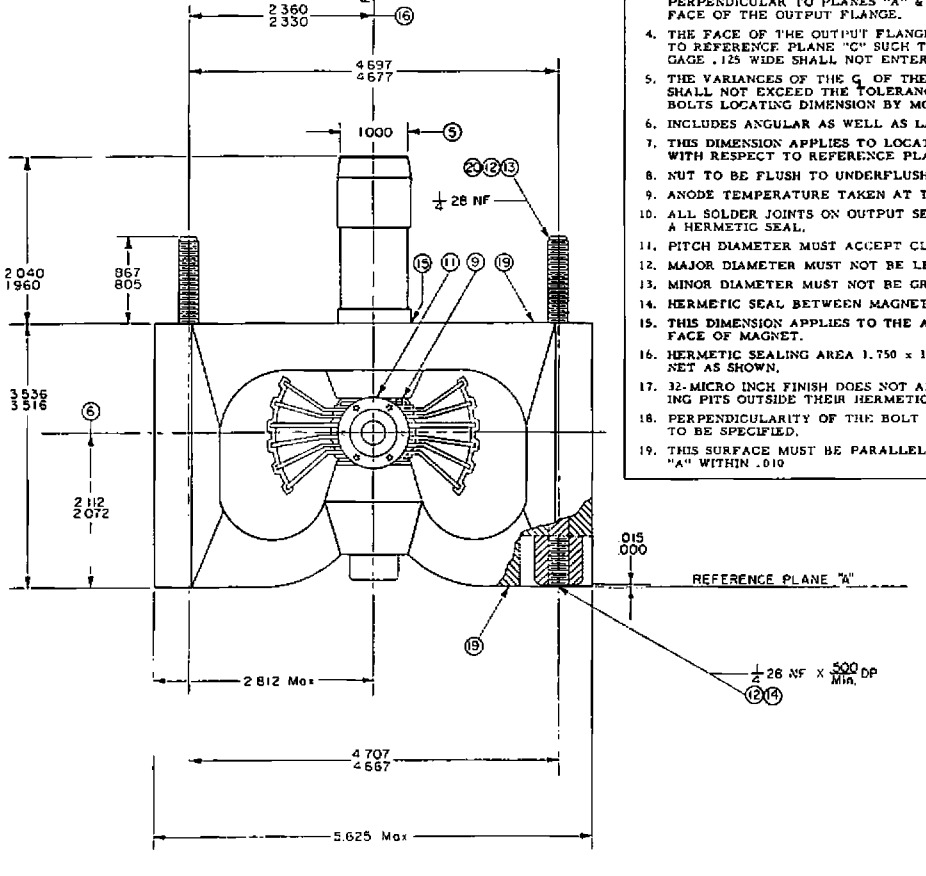
RAYTHEON

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preliminary data sheet



RK7449 ELECTRON TUBE OUTLINE DRAWING



NOTES

1. REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE SURFACE OF THE MAGNET AS SHOWN.
2. REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO PLANE "A".
3. REFERENCE PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO PLANES "A" & "B" PASSING ALONG THE FACE OF THE OUTPUT FLANGE.
4. THE FACE OF THE OUTPUT FLANGE MUST BE PARALLEL TO REFERENCE PLANE "C" SUCH THAT A .010 THICKNESS GAGE . 125 WIDE SHALL NOT ENTER.
5. THE VARIANCES OF THE ℄ OF THE CATHODE BUSHING SHALL NOT EXCEED THE TOLERANCES OF THE MAGNET BOLTS LOCATING DIMENSION BY MORE THAN .0325
6. INCLUDES ANGULAR AS WELL AS LATERAL DEVIATION.
7. THIS DIMENSION APPLIES TO LOCATION OF MOUNTING BOLTS WITH RESPECT TO REFERENCE PLANE "C".
8. NUT TO BE FLUSH TO UNDERFLUSH WITH SURFACE "X".
9. ANODE TEMPERATURE TAKEN AT THIS POINT.
10. ALL SOLDER JOINTS ON OUTPUT SECTION SHALL PROVIDE A HERMETIC SEAL.
11. PITCH DIAMETER MUST ACCEPT CLASS 2 GO GAGE ONLY.
12. MAJOR DIAMETER MUST NOT BE LESS THAN . 240
13. MINOR DIAMETER MUST NOT BE GREATER THAN . 221
14. HERMETIC SEAL BETWEEN MAGNET AND CATHODE POLE.
15. THIS DIMENSION APPLIES TO THE AXIS OF CATHODE AT SURFACE OF MAGNET.
16. HERMETIC SEALING AREA 1.750 x 1.750 ON FACE OF MAGNET AS SHOWN.
17. 32-MICRO INCH FINISH DOES NOT APPLY TO MINUTE CASTING PITS OUTSIDE THEIR HERMETIC SEAL AREA.
18. PERPENDICULARITY OF THE BOLT TO THE MAGNET SURFACE TO BE SPECIFIED.
19. THIS SURFACE MUST BE PARALLEL TO REFERENCE PLANE "A" WITHIN .010

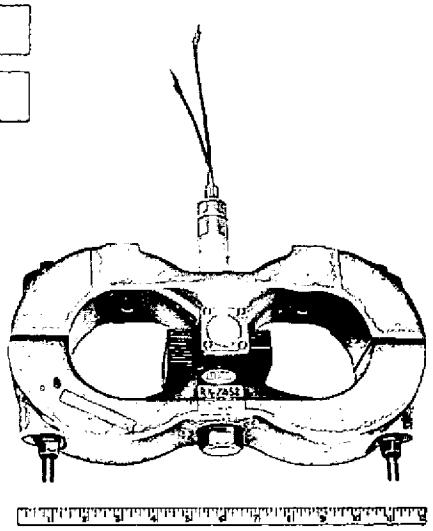
from JEDEC release #3471, Oct. 30, 1961

The technical information on this data sheet is of a proprietory nature and is furnished as a customer service for private use only.

RK 7452 | **PRELIMINARY**

DATA SHEET

RAYTHEON *Excellence in Electronics*



RK 7452

GENERAL DESCRIPTION

The RK7452 is a fixed frequency, pulsed-type oscillator operating within the frequency limits of 15,840 - 16,160 megacycles, with a minimum peak power output of 70 kilowatts. It is an integral magnet, waveguide output type tube requiring forced air cooling and is designed for coupling to standard RG 91 U waveguide (0.702 x 0.391).

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	25 Lbs.
Cooling	Forced Air
Output Pressurization	Required (25 psia Min.)

Electrical Data

Heater Voltage - Preheat/180 sec	4.8 Volts
Heater Current at 4.8 Volts	10.8 - 13.2 Amperes
Voltage Rise Time	.09 to .14 usec
R. F. Bandwidth	2.0/tpc Max.
Maximum V.S.W.R.	1.5

Typical Operation

Pulse Duration	0.25 usec
Duty Cycle	.00215
Average Anode Current	26 Milliamperes
Average Power Output	150 Watts (Min.)
Peak Anode Voltage	24 KV

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics clearly in mind. This preliminary Data Sheet is intended as an introduction to this type magnetron and not as an absolute guide to users. Inquiries on this magnetron and its application should be directed to the Applications Engineering Department at Raytheon Company, Waltham, Massachusetts.

The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

RAYTHEON

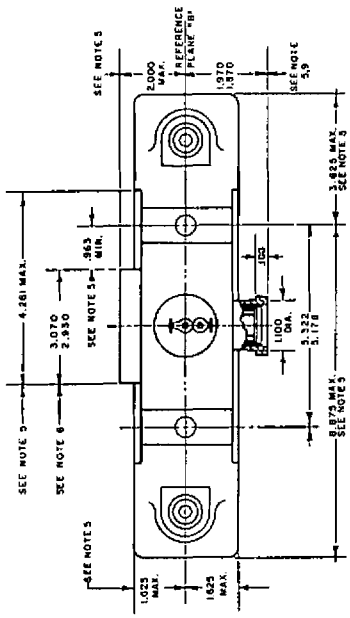
Excellence in Electronics

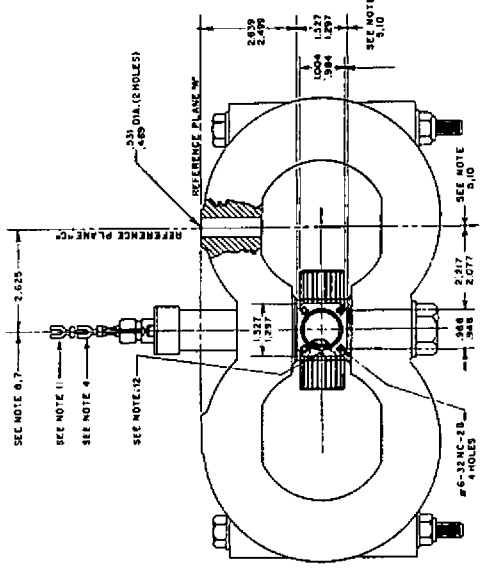
preliminary data sheet

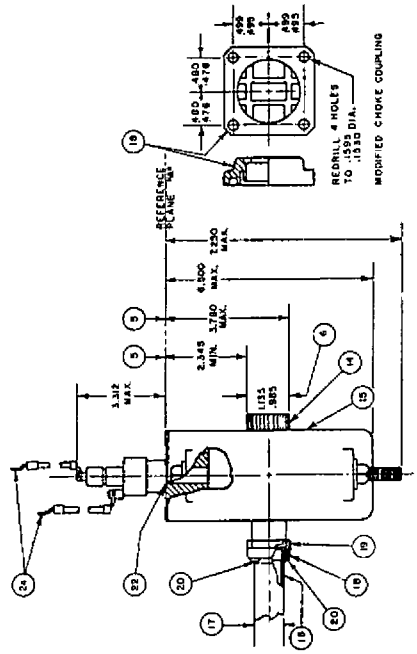
OUTLINE DRAWING
ELECTRON TUBE
RK 7452

NOTES

1. REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FINISHED SURFACE OF THE MAGNET AS SHOWN.
2. REFERENCE PLANE "B" IS DEFINED AS A PLANE PASSING THROUGH THE CENTERS OF THE MOUNTING HOLES AND PERPENDICULAR TO REFERENCE PLANE "A".
3. REFERENCE PLANE "C" IS DEFINED AS A PLANE, PASSING THROUGH THE CENTER OF THE MOUNTING HOLE AND MUTUALLY PERPENDICULAR TO REFERENCE PLANES "A" AND "B".
4. BROWN PAINT TO IDENTIFY COMMON CATHODE CONNECTION. (OUTER TERMINAL).
5. TOLERANCE INCLUDES ANGULAR AS WELL AS LATERAL DEVIATION.
6. THESE DIMENSIONS APPLY TO RADIATOR SIZE ONLY.
7. PARTS ON THIS CENTERLINE MAY VARY BY 1/8".
8. THIS DIMENSION REFERS TO THE CENTERLINE OF TUBE.
9. SURFACE OF OUTPUT FLANGE TO BE PARALLEL TO REFERENCE PLANE "B" WITHIN .000".
10. TAPPED HOLES MUST BE PARALLEL TO REFERENCE PLANES WITHIN .030".
11. HEATER CONNECTION.
12. POINT AT WHICH TEMPERATURE SHALL BE MEASURED ON ANODE BODY.
13. MINIMUM DISTANCE FROM HIGH VOLTAGE TO GROUND SHOULD BE 1.50 THROUGH AIR AT ATMOSPHERIC PRESSURE.
14. ANODE COOLING FIN INLET DUCT FOR SUPPLYING AIR TO THE TUBE COOLING SYSTEM MUST BE SUCH AS TO INSURE DELIVERY OF AIR TO THE ENTIRE CROSS-SECTION OF THE INLET WITH MINIMUM SIDE LEAKAGE.
15. MAGNET FERRO-MAGNET MATERIALS MUST NOT BE PERMITTED AT THE SIDES OF THE MAGNETS WITHIN 3 INCHES OF THE PLANE AT THE ENDS WHERE THE CLEARANCE MAY BE 3 INCHES. ENERGIZED MAGNETS MUST NOT BE PERMITTED AT ANYTIME CLOSER THAN 12 INCHES FROM TUBE MAGNET.
16. WAVEGUIDE .622 x .311 I.D.
17. LONG AXIS OF WAVEGUIDE.
18. WAVEGUIDE CHOKE COUPLING FLANGE, MODIFIED UG-541/U. (SEE DETAIL FIG. 3.)
19. ALL JOINTS OF WAVEGUIDE OUTPUT TO BE HERMETICALLY TIGHT. GASKET WITH "O" RING AN6227B-10 AT THIS SURFACE FOR TEST.
20. FOUR 6-32 SCREWS REQUIRED TO ATTACH WAVEGUIDE CHOKE TO TUBE.
21. HEATER CONNECTION (CENTER TERMINAL). HIGH VOLTAGE ELECTRODE CONNECTION. (OUTSIDE TERMINAL)
22. MOUNTING HOLES, ENTIRE SUPPORT AND FASTENING OF TUBE TO BE EFFECTED FROM THESE HOLES. SEE NOTE 23.
23. THE ANODE MUST BE GROUNDED EFFECTIVELY SUCH AS THROUGH THE MOUNTING BOLTS.
24. FLEXIBLE LEADS CONNECTING TERMINALS FIT #10 SCREW.







from JEDEC release #2603, Oct. 12, 1959

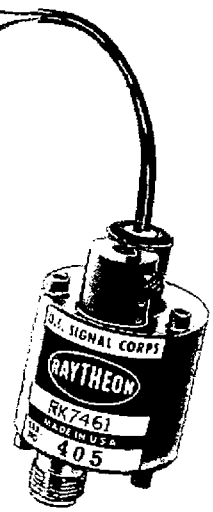
RAYTHEON

TECHNICAL INFORMATION

TENTATIVE DATA

Excellence in Electronics

TYPE RK7461



PULSED-TYPE MAGNETRON OSCILLATOR

GENERAL DESCRIPTION

The RK7461 is a mechanically tunable pulsed type magnetron oscillator delivering a peak power output of 60 to 120 watts. It is capable of being tuned to any frequency within the 9300 to 9500 Mc range.

The RK7461 is small (1.25" dia. × 2.5") lightweight (6 ounces) and has been designed primarily for missile beacon transponder applications where extreme environmental conditions are encountered. The RK7461 is capable of sustaining shock acceleration of 500G and vibrational acceleration during operation of 15G at frequencies up to 2000 cycles per second.

GENERAL PRECAUTIONS

The precautions to be observed during the application of the RK7461 magnetron are the same as for any oscillator of this type. Experience has indicated that the areas where application problems frequently arise include the magnetron voltage pulse shape — particularly its rate of rise — the load VSWR, and anode current regulation. It is recommended that the Applications Engineering Department be consulted regarding the details of any contemplated equipment design utilizing the RK7461.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Voltage — Preheat and Operate	5.0 to 5.5 volts
Heater Current	0.65 Ampere at 5.0 Volts
Minimum Preheat Time	45 seconds
Temperature Coefficient	±0.1 Mc/°C Maximum
Operational Altitude	50,000 Feet Maximum
Operational Vibration Frequency Deviation at 15G, 20 to 2000 cps	3.0/tp Mc, Max. Bandwidth
Frequency Shift due to constant acceleration 500G	2.5 Mc Maximum

Typical Operation

Pulse Duration	0.35 to 1.0 Microseconds
Duty Cycle	.0001 to .002
Peak Anode Current	0.95 Amperes
Peak Anode Voltage	1.35 to 1.55 Kilovolts
Peak Power Output	60 to 120 Watts
Voltage Rise Time (20 to 85%)	0.11 us

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

DETAILED MECHANICAL INFORMATION

MOUNTING

The tube may be mounted in any position by means of the tapped mounting studs or by a suitably designed holder made of non-ferrous material which will utilize the diameter of the tube for support. When mounted by studs, both ends must be secured in order for the tube to meet environmental requirements. Compression, rather than tension, should be put on the studs when mounted in this manner.

Magnetic material should not be mounted within 2 inches of the tube.

INPUT CONNECTIONS

Two flexible leads approximately 5 inches long provide connections for heater voltage and pulse voltage. One lead is black, the other red. The red lead is the common heater-cathode to which negative high voltage should be connected. Ground return is accomplished through the output connector or the mounting screws.

R.F. OUTPUT COUPLING

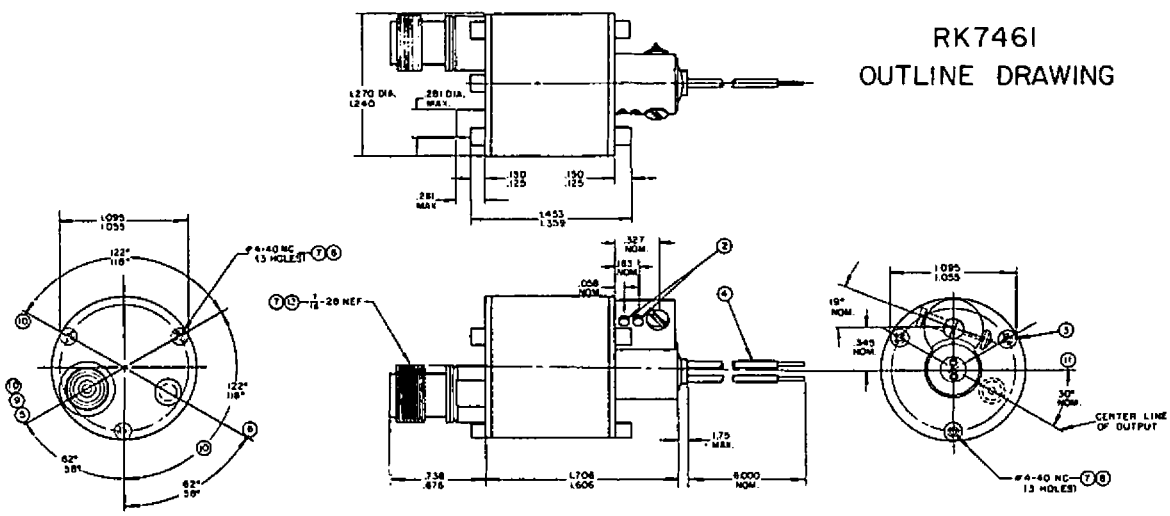
Mates with TNC male coaxial fitting or TNC to ½" × 1" O.D. Waveguide Transition.

TUNER

The tuning mechanism is actuated by a screwdriver adjustable cam. Bristol set screws are provided to lock the tuner in position. The tuner must be locked prior to the subjection of the tube to environmental conditions. Care should be taken not to mechanically tune the tube beyond the extremes of its normal operating range, 9300 to 9500. Permanent damage may result from attempting to tune the tube with the tuner locked.

DIMENSIONS

Figure 1 is the mechanical outline drawing.



NOTES

1. NON-MAGNETIC TOOLS MUST BE USED WHEN INSPECTING THIS TUBE
2. LOCATION OF #2-56 SET SCREWS (NO. 8-4 FLUTE MULTIPLE-SPLINE SOCKET SCREW KEY TO BE USED)
3. TAPPED HOLE IN MOUNTING NUT TO BE USED FOR MEASURING ANODE TEMPERATURE
4. RED LEAD IS COMMON CATHODE CONNECTION
5. CENTER OF OUTPUT TO LIE ON .685-.747 DIAMETER CIRCLE AS SHOWN
6. CENTER OF EXHAUST GUARD TO LIE ON .789-.851 DIAMETER CIRCLE AS SHOWN
7. PITCH DIAMETER MUST ACCEPT CLASS 2 GO GAUGE ONLY
8. MINOR DIAMETER MUST NOT BE GREATER THAN .6940
9. LOCATION OF MOUNTING NUTS WITH RESPECT TO OUTPUT
10. LOCATION OF MOUNTING NUTS ON OPPOSITE END TO BE WITHIN 3° OF POSITION OF MOUNTING NUTS SHOWN
11. THIS PLANE PASSES THROUGH THE CENTER OF DIAMETER "XX" 10° FROM OUTPUT AS SHOWN
12. ONE OF THE FOLLOWING GENERAL RADIO STANDARD FITTINGS OR THEIR EQUIVALENT SHOULD BE USED TO ATTACH THE LOAD TO THE MAGNETRON:
GRFF #1344 (FITTING) WITH RG55 OR RG58 (CABLE)
GRFF #2016 (FITTING) WITH RG8B OR RG8A (CABLE)
13. MAJOR DIAMETER MUST NOT BE LESS THAN .4235

Figure 1

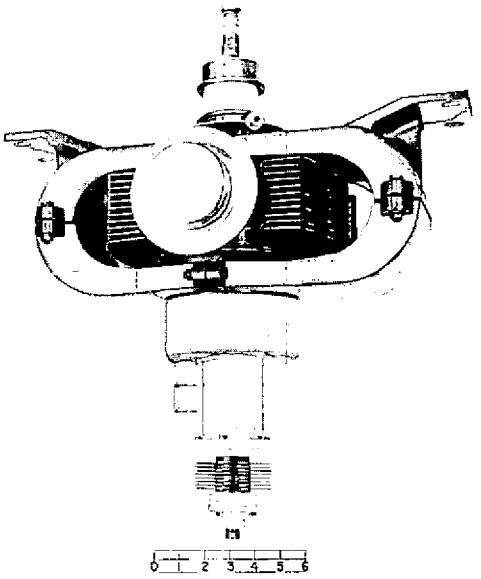
MICROWAVE AND POWER TUBE DIVISION

from JEDEC release #2647, Nov. 23, 1959

RK 7484 | **PRELIMINARY**

DATA SHEET

RAYTHEON *Excellence in Electronics*



RK 7484

GENERAL DESCRIPTION

The RK7484/QK470 magnetron is a tuneable, high power, pulsed oscillator which is capable of delivering a minimum of 2.0 megawatts peak power and 2000 watts average power. The RK7484/QK470 is tuneable within the frequency region of 1250-1350 megacycles. The tube requires forced air cooling, is of the integral magnet type and the r.f. output is designed to couple directly to standard 3" x 6" waveguide.

The RK7484/QK470 magnetron may be used in MTI radar systems which require the generation of r.f. pulse energy that is relatively free from time, frequency, and amplitude jitter.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	90 Pounds
Cooling	Forced Air
Input Bushing	Oil Immersed
Output Pressurization	25 p.s.i.a. Min.

Typical Electrical Data

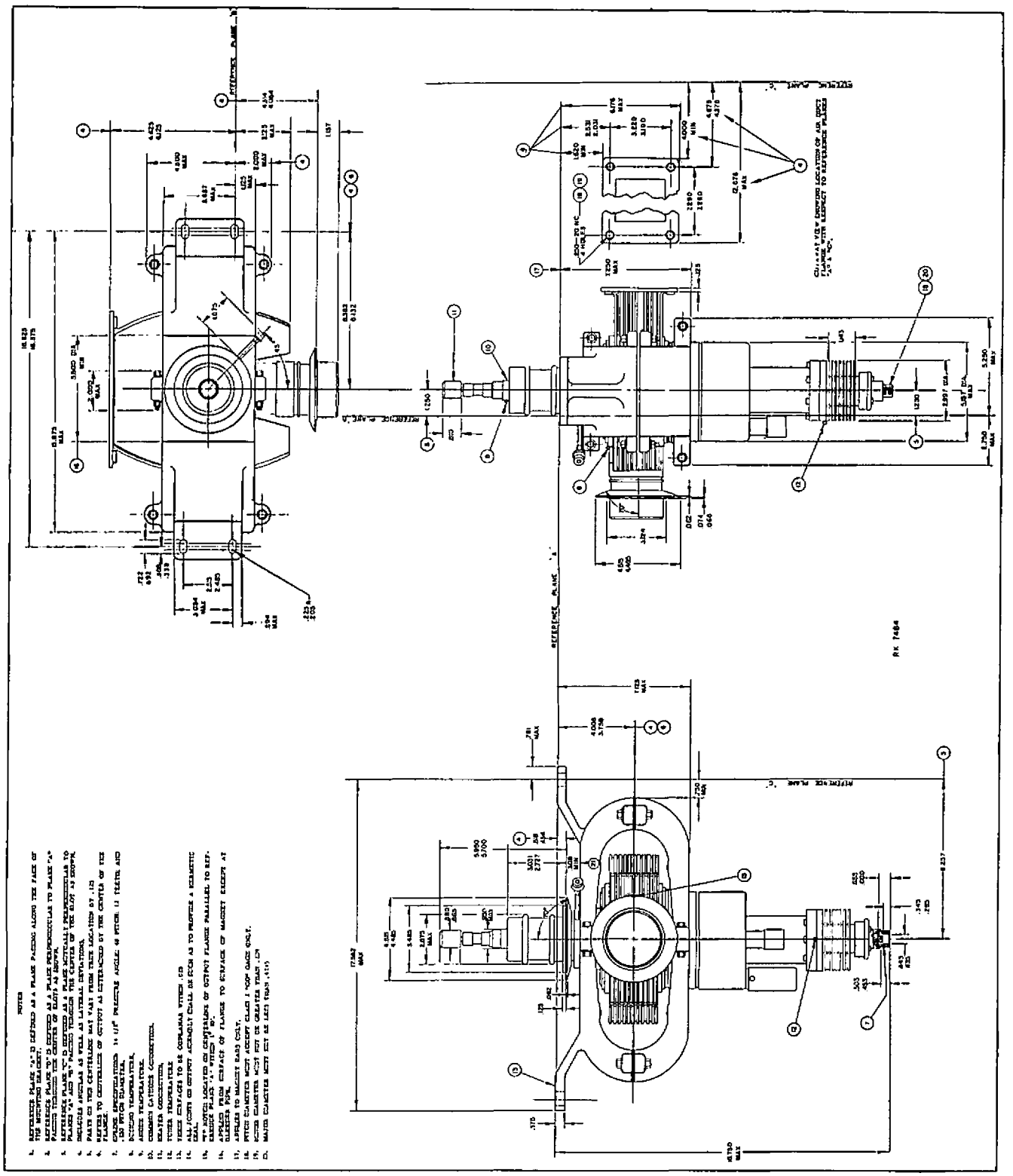
Heater Current - Preheat	75 Amperes
Heater Voltage @ 75 A, 600 Sec.	2.7 Volts
Current Pulse Width (tpc)	2.0 usec
Duty Cycle	.001
Peak Anode Voltage	60 Kilovolts
Voltage Rise Time	0.55-0.65 usec
Peak Anode Current	90 Amperes
Maximum VSWR	1.5
Average Power Output	2250 Watts
R. F. Bandwidth - 1.5 VSWR	2 / tpc Max.
Life - 1.5 VSWR, Off-On Cycled	300 Hours
	1000 Hours Objective

Reliable operation and optimum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary data sheet is intended only to acquaint the reader with the basic characteristics of the magnetrons and should not be used as an absolute guide. Detailed test specifications are available upon request, and specific problems pertaining to applications should be directed to the Applications Engineering Department of the Raytheon Company, Microwave and Power Tube Division, Waltham, Massachusetts.

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preliminary data sheet



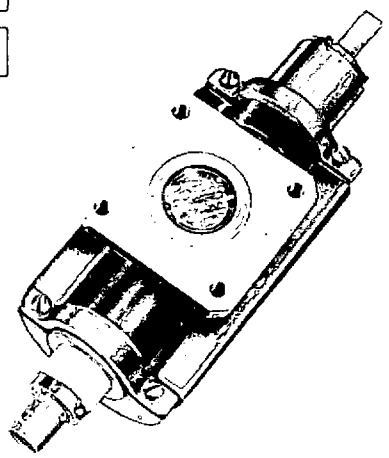
The technical information on this data sheet is of a proprietory nature and is furnished as a customer service for private use only.

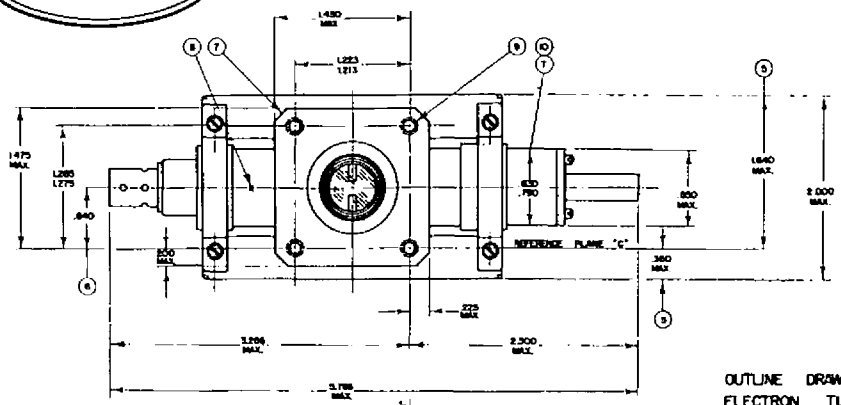
RK7521

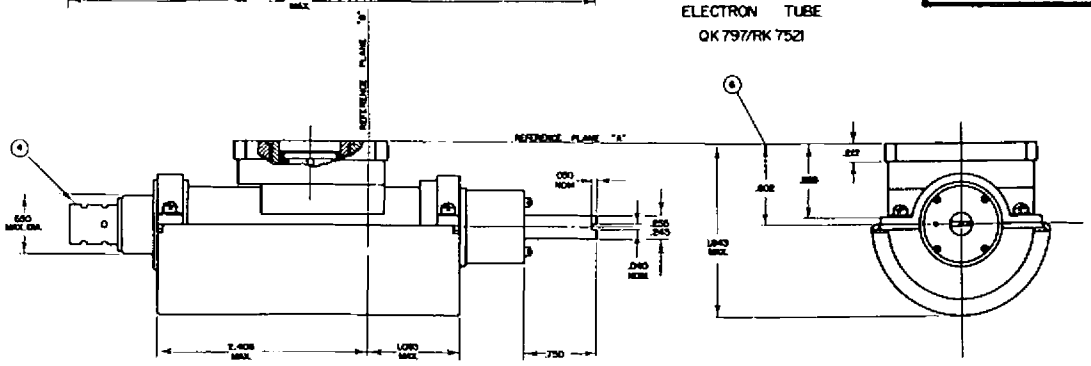
PRELIMINARY

DATA SHEET

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OUTLINE DRAWING
ELECTRON TUBE
QK797/RK7521

GENERAL DESCRIPTION

The RK7521 is a small low power pulsed magnetron tunable over the range 8900 to 9400 megacycles. The RK7521 is designed primarily for small portable ground equipment or aircraft equipment.

MECHANICAL DATA

Magnet	Integral
Mounting Position	Any
Weight	Less than 1.5 Pounds
Cooling	None Required
Output Coupling	Mates with UG40A/U
Input Connections	BNC

TYPICAL ELECTRICAL DATA

Heater Voltage	5 Volts
Heater Current	.45 Amperes
Pulse Duration	.2 Microseconds
Duty Cycle	.001
Peak Anode Voltage	4.3 Kilovolts
Voltage Rise Time	.09 Microseconds
Peak Anode Current	.95 Amperes
Peak Power Output	950 Watts Minimum
RF Bandwidth	$\frac{2.2}{tpc}$
Life	300 Hours Minimum

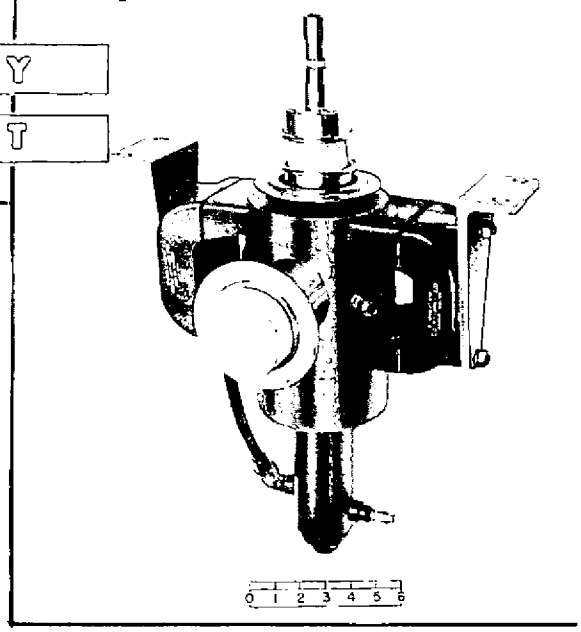
The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/ or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

from JEDEC release #2647, Nov. 23, 1959

RK 7528 | PRELIMINARY

DATA SHEET

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RK 7528

GENERAL DESCRIPTION

The RK7528/QK264 magnetron is a tuneable, high power, pulsed oscillator which is capable of delivering a minimum of 2.0 megawatts peak power and 2400 watts average power. The RK7528/QK264 is tuneable within the frequency region of 1250-1350 megacycles. The tube requires liquid cooling, is of the integral magnet type and the r.f. output is designed to couple directly to standard 3" x 6" waveguide.

The RK7528/QK264 magnetron may be used in MTI radar systems which require the generation of r.f. pulse energy that is relatively free from time, frequency, and amplitude jitter.

The generated power of this magnetron may be increased by 10-15% and satisfactory life still maintained by operating the tube into a 1.5 VSWR with the phase adjusted to the "in sink" position.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	70 Pounds
Cooling	Liquid
Input Bushing	Oil Immersed
Output Pressurization	25 p.s.i.a. Min.

Typical Electrical Data

Heater Current - Preheat	90 Amperes
Heater Voltage @ 90 A - 600 Sec.	3.7 Volts
Current. Pulse Width (tpc)	4.3 usec
Duty Cycle	.0012
Peak Anode Voltage	60 Kilovolts
Voltage Rise Time	0.55-0.65 usec
Peak Anode Current	90 Amperes
Maximum VSWR	1.5
Average Power Output	2650 Watts
R.F. Bandwidth	2.1/tpc Max.
Life - 1.5 VSWR, Off-On Cycled	250 Hrs., 500 Hrs. Objective

Reliable operation and optimum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary data sheet is intended only to acquaint the reader with the basic characteristics of the magnetrons and should not be used as an absolute guide. Detailed test specifications are available upon request, and specific problems pertaining to applications should be directed to the Applications Engineering Department of the Raytheon Company, Microwave and Power Tube Division, Waltham, Massachusetts.

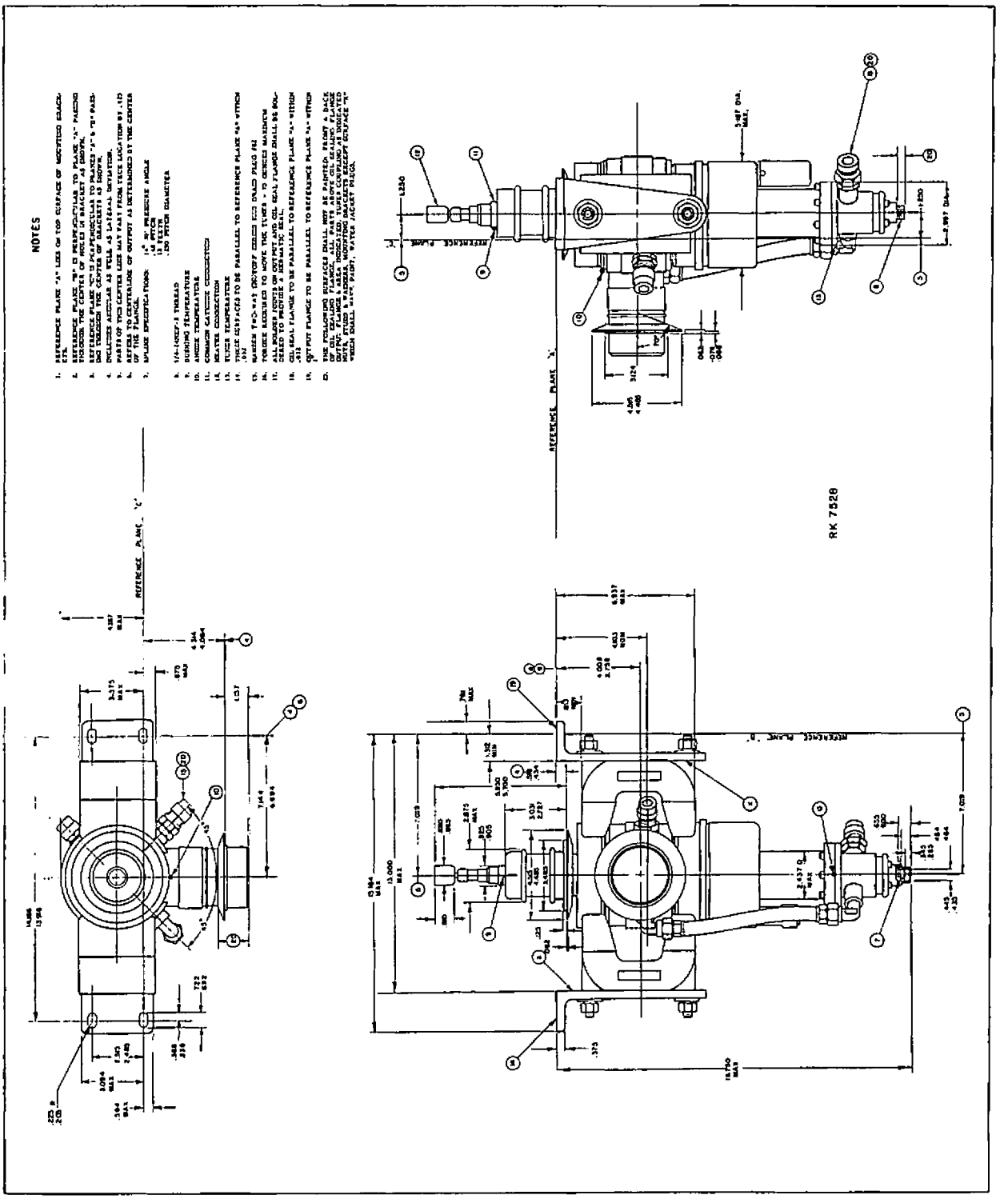
RAYTHEON COMPANY MICROWAVE AND POWER TUBE DIVISION

Waltham 54, Mass.

RAYTHEON

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preliminary data sheet



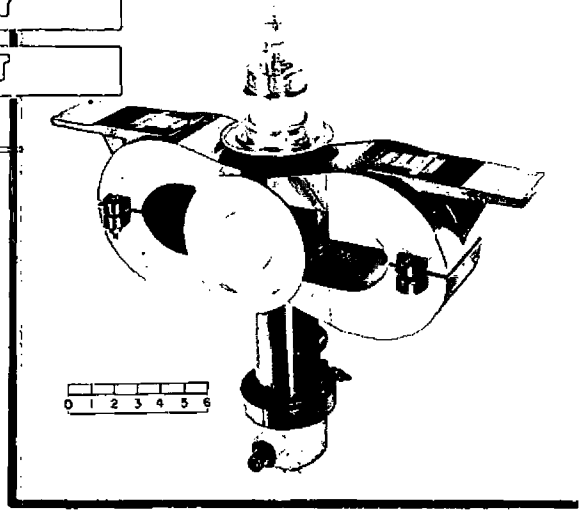
from JEDEC release #2712, Feb. 7, 1960

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RK 7529 | **PRELIMINARY**

DATA SHEET

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RK 7529

GENERAL DESCRIPTION

The RK7529 magnetron is a mechanically tunable, high power, pulsed-type oscillator which is capable of delivering a minimum of 3.5 megawatts peak power and 2520 watts average power. The RK7529 may be rapid hand or motor tuned to any desired frequency in the 2700 to 2850 megacycle region. It is an integral magnet, unipotential cathode type tube requiring liquid cooling, with an output designed to couple directly into a 1 1/2" x 3" waveguide.

This tube was designed to be interchangeable with the RK6410A/QK338A and at the present time is the highest power tunable S-band magnetron available.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	66 lbs.
Cooling	Forced Liquid
Input Bushing	Oil Immersed
Pressurization (Output)	45 p.s.i.a. Min.

Typical Electrical Data

Heater Current (Preheat - 300 Sec.)	78 Amperes
Heater Voltage @ 78 Amperes	8.2 Volts
Pulse Duration (tpc)	2.0 usec
Peak Anode Voltage	62 Kilovolts
Peak Anode Current	115 Amperes
Average Power Output	2800 Watts
Voltage Rise Time	0.3 usec. Min.
Maximum VSWR	1.5
RF Bandwidth (@ 6.0 db)	3.0/tpc Max.
Life (1.5 VSWR, Cycled)	150 Hrs. Min. 1000 Hrs. Min. Objective

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary Data Sheet is intended to serve as an introduction only and should not be used as an absolute guide to users. Detailed tube specifications are available on request, specific problems and applications should be directed to the Applications Engineering Department, Microwave and Power Tube Division, Raytheon Company, Waltham, Massachusetts.

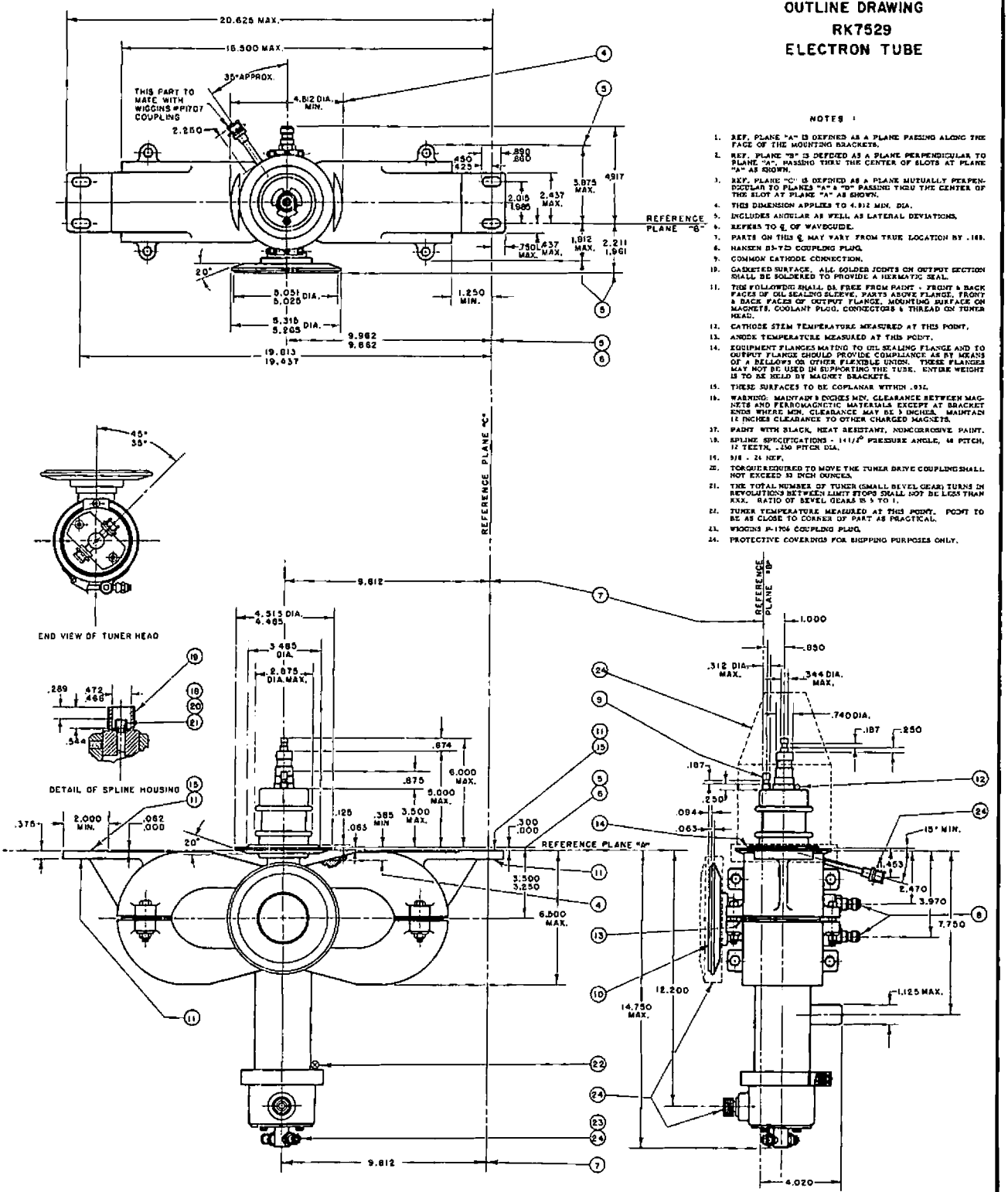
The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/ or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

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Excellence in Electronics

preliminary data sheet

OUTLINE DRAWING
RK7529
ELECTRON TUBE



NOTES :

1. REF. PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FACE OF THE MOUNTING BRACKETS.
2. REF. PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO PLANE "A", PASSING THRU THE CENTER OF SLOTS AT PLANE "A" AS SHOWN.
3. REF. PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO PLANES "A" & "B" PASSING THRU THE CENTER OF THE SLOT AT PLANE "A" AS SHOWN.
4. THIS DIMENSION APPLIES TO 4.812 MIN. DIA.
5. INCLUDES ANGULAR AS WELL AS LATERAL DEVIATIONS.
6. REFERS TO ℄ OF WAVEGUIDE.
7. PARTS ON THIS ℄ MAY VARY FROM TRUE LOCATION BY .188.
8. NANSEN 83-T2D COUPLING PLUG.
9. COMMON CATHODE CONNECTION.
10. GASKETED SURFACE. ALL SOLDER JOINTS ON OUTPUT SECTION SHALL BE SOLDERED TO PROVIDE A HERMATIC SEAL.
11. THE FOLLOWING SHALL BE FREE FROM PAINT - FRONT & BACK FACES OF OIL SEALING SLEEVE, PARTS ABOVE FLANGE, FRONT & BACK FACES OF OUTPUT FLANGE, MOUNTING SURFACE ON MAGNETS, COOLANT PLUG, CONNECTORS & THREAD ON TUNER HEAD.
12. CATHODE STEM TEMPERATURE MEASURED AT THIS POINT.
13. ANODE TEMPERATURE MEASURED AT THIS POINT.
14. EQUIPMENT FLANGES MATING TO OIL SEALING FLANGE AND TO OUTPUT FLANGE SHOULD PROVIDE COMPLIANCE AS BY MEANS OF A BELLOWS OR OTHER FLEXIBLE UNION. THESE FLANGES MAY NOT BE USED IN SUPPORTING THE TUBE. ENTIRE WEIGHT IS TO BE HELD BY MAGNET BRACKETS.
15. THESE SURFACES TO BE COPLANAR WITHIN .03".
16. WARNING: MAINTAIN 8 INCHES MIN. CLEARANCE BETWEEN MAGNETS AND FERROMAGNETIC MATERIALS EXCEPT AT BRACKET ENDS WHERE MIN. CLEARANCE MAY BE 5 INCHES. MAINTAIN 12 INCHES CLEARANCE TO OTHER CHARGED MAGNETS.
17. PAINT WITH BLACK, HEAT RESISTANT, NONCORROSIVE PAINT.
18. SPLINE SPECIFICATIONS - 14½° PRESSURE ANGLE, 48 PITCH, 12 TEETH, .250 PITCH DIA.
19. 5/8 - 24 NEF.
20. TORQUE REQUIRED TO MOVE THE TUNER DRIVE COUPLING SHALL NOT EXCEED 32 INCH OUNCES.
21. THE TOTAL NUMBER OF TUNER (SMALL BEVEL GEAR) TURNS IN REVOLUTIONS BETWEEN LIMIT STOPS SHALL NOT BE LESS THAN XXX. RATIO OF BEVEL GEARS IS 5 TO 1.
22. TUNER TEMPERATURE MEASURED AT THIS POINT. POINT TO BE AS CLOSE TO CORNER OF PART AS PRACTICAL.
23. WIGGINS P-1704 COUPLING PLUG.
24. PROTECTIVE COVERINGS FOR SHIPPING PURPOSES ONLY.

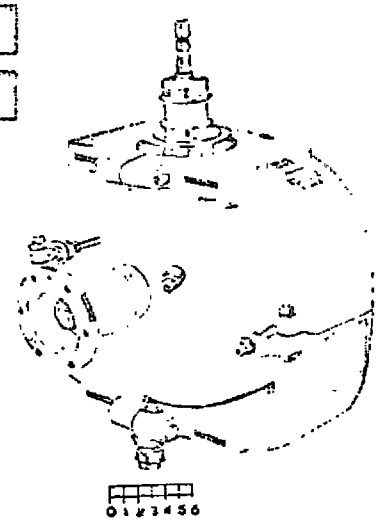
from JEDEC release #3215, April 3, 1961

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RK7547 PRELIMINARY

DATA SHEET

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GENERAL DESCRIPTION

The RK7547 magnetron is a mechanically tunable, high power, pulsed-type oscillator which is capable of delivering a minimum of 2.0 megawatts peak power and 3600 watts average power. The RK7547 may be rapid hand or motor tuned to any desired frequency in the 406 to 450 megacycle region. It is an integral magnet, unipotential cathode type tube requiring liquid cooling and having a 3 1/8" coaxial output.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	220 Lbs.
Cooling	Forced Liquid
Input Bushing	Oil Immersed
Pressurization (Output)	30 p.s.i.a.

Typical Electrical Data

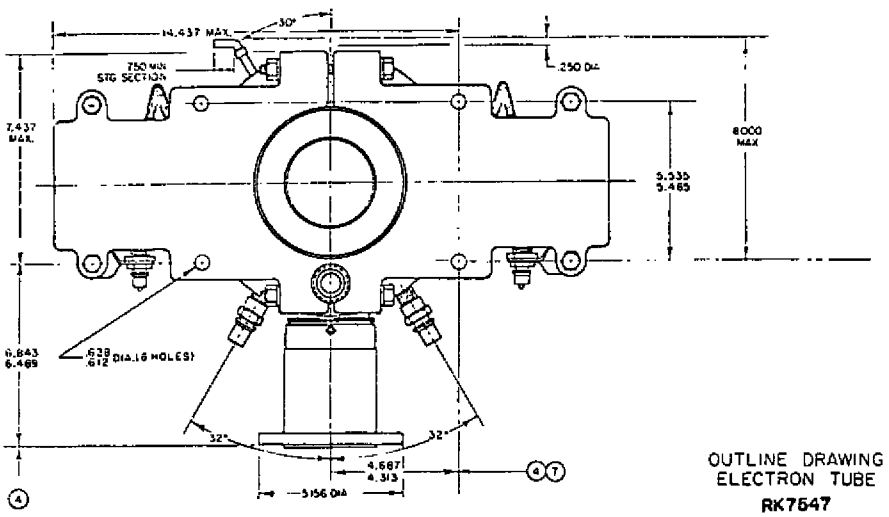
Heater Current (Preheat - 600 sec.)	55 Amperes
Heater Voltage @ 55 A.	6.5 Volts
Pulse Duration (tpc)	6.0 usec.
Peak Anode Voltage	55 Kilovolts
Peak Anode Current	97.2 Amperes
Average Power Output	3950 Watts
Voltage Rise Time	0.95 usec. Min.
Maximum VSWR	1.5
RF Bandwidth (@ 6 db level)	2.0/tpc Max.
Life (1.5 VSWR, Cycled)	1000 Hrs. Min.

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary Data Sheet is intended to serve as an introduction only and should not be used as an absolute guide to users. Detailed tube specifications are available on request, specific problems and applications should be directed to the Applications Engineering Department, Microwave and Power Tube Division, Raytheon Company, Waltham, Massachusetts.

The specifications for the above tube are subject to change. Certain parameters may be altered in being manufactured to comply with the engineering information. Before using, however, consult your Raytheon representative. Although every sample tube is tested to comply with the specifications, all dimensions may be checked by the customer. For further information concerning this tube contact

RAYTHEON

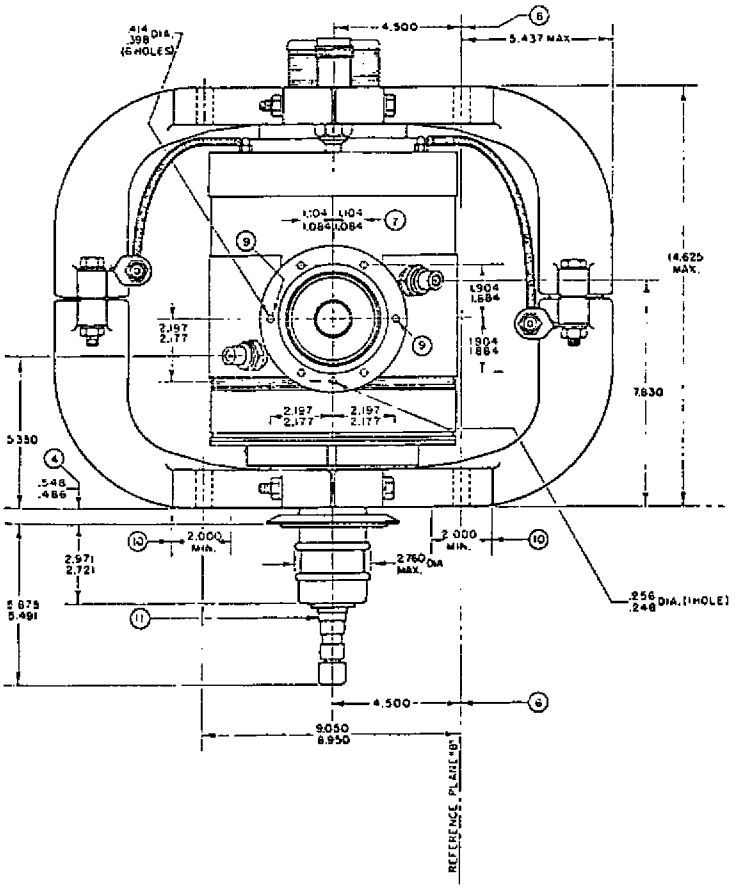
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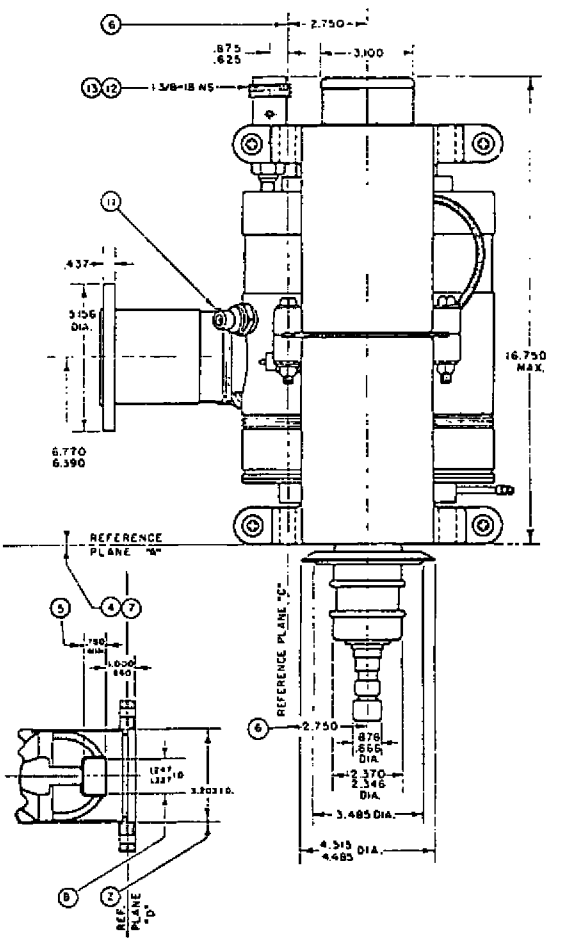


OUTLINE DRAWING
ELECTRON TUBE
RK7547

NOTES

1. REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FACE OF THE MOUNTING SURFACE AS SHOWN.
2. REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO PLANE "A" AND PASSING THROUGH THE CENTER OF HOLES AT PLANE "A" AS SHOWN.
3. REFERENCE PLANE "C" IS DEFINED AS A PLANE PERPENDICULAR TO PLANES "A" AND "B" PASSING THROUGH THE CENTER OF THE HOLE AT PLANE "A" AS SHOWN.
4. INCLUDES ANGULAR AS WELL AS LATERAL DEVIATION.
5. APPLIES TO STRAIGHT PORTION OF INNER CONDUCTOR WALL.
6. PARTS ON THIS CENTER-LINE MAY VARY FROM TRUE LOCATION BY .125
7. APPLIES TO CENTER OF DIAMETER "Z".
8. CENTER-LINE OF INNER CONDUCTOR SHALL BE CONCENTRIC WITH CENTER-LINE OF OUTER CONDUCTOR WITHIN .545
9. CENTER-LINE PASSING THROUGH THESE HOLES MUST BE PARALLEL TO REFERENCE PLANE "A" WITHIN .010 T.I.R.
10. THESE SURFACES MUST BE COPLANAR WITHIN .015
11. TEMPERATURE MEASURING POINTS.
12. PITCH DIAMETER MUST ACCEPT CLASS 1 "GO" GAGE ONLY.
13. MAJOR DIAMETER MUST NOT BE LESS THAN 1.164
14. REFERENCE PLANE "D" IS DEFINED AS A PLANE ALONG THE SURFACE OF THE OUTPUT FLANGE AS INDICATED.
15. EPOXY BASE PAINT HAVING EQUIVALENT PROPERTIES OF DURACHEM BAKING ENAMEL TO BE USED.





RAYTHEON COMPANY	MICROWAVE AND POWER TUBE DIVISION	WALTHAM 54, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7550

RELIABLE DOUBLE TRIODE

The CK7550 is a heater-cathode type double triode of subminiature construction, designed for pulse application only. This type is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Ratings)

Impact Acceleration	735	G
Fatigue (Vibrational Acceleration for Extended Periods)	10	G
Bulb Temperature	160	°C
Altitude	80,000	Ft.

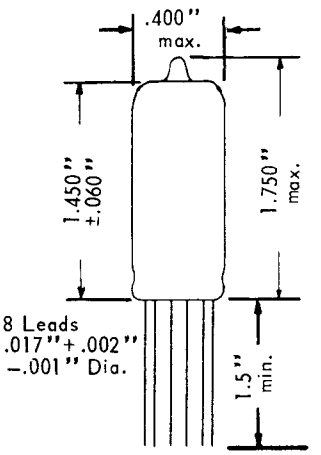
ELECTRICAL DATA

Ratings and Normal Operations	MIL–E–1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL–E–1 Units
			RATINGS			
Heater Voltage	Ef:	5.7	6.3	---	6.9	V
Plate Voltage (Average)	Eb:	---	---	---	250	Vdc
Peak Plate to Cathode Voltage (Note D)	eb:	---	---	---	300	v
Peak Tube Drop	etd:	---	---	---	150	v
Plate Voltage (Instantaneous Forward) Note A	epy:	---	---	---	400	v
Plate Dissipation (per Plate)	Pp/p:	---	---	---	1.5	W
Grid Dissipation	Pg/g:	---	---	---	0.4	W
DC Grid Voltage	Ec:	–100	---	---	0	Vdc
Heater-Cathode Voltage	Ehk:	---	---	---	±200	v
Grid-Cathode Voltage	egk:	---	---	---	±100	v
Grid Circuit Resistance	Rgl:	---	---	---	0.5	Meg
			TESTS			
Heater Current	If:	475	---	500	525	mA
Heater-Cathode Leakage (Note B) Ehk=±100 Vdc	Ihk:	---	---	---	20	μAdc
Plate Current Eb=300 Vdc; Rk=0; Ec1=–30 Vdc; (Note B)	Ib:	---	---	---	10	μAdc
Pulse Cathode Current (1) Ef=5.7 V; Eb=300 Vdc; egk=+40 v; Prr=500 pps; tp=10 μsec; Rp=0; Rg=47 ohms max. (Notes B, C)	ik:	900	---	---	---	mA
Pulse ib/ic1 (1) Eb=300 Vdc; egk=+40 v; Rp=0; Prr=500 pps; Rg=47 ohms max. (Notes B, C)	---	2:1	---	---	7.5:1	---

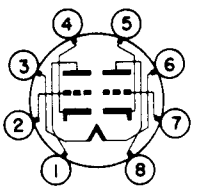
MECHANICAL DATA

ENVELOPE ..... Glass T–3
OUTLINE 3–3
BASE ..... EB–10 Submin., Button Flexible Leads
BASING 8DG
CATHODE .. Coated Unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Lead 1 Plate, Unit #2
Lead 2 Grid, Unit #2
Lead 3 Heater
Lead 4 Cathode, Unit #2
Lead 5 Cathode, Unit #2
Lead 6 Heater
Lead 7 Grid, Unit #1
Lead 8 Plate, Unit #1

ELECTRICAL DATA (Cont'd.)

Ratings and Normal Operations	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
			TESTS (Cont'd.)			
Pulse Cathode Current (2) Eb=300 Vdc; (Notes B, C) egk=+40 v; Rp=0; Prr=500 pps; Rg=47 ohms max.	ik:	1200	---	---	---	mA
Pulse Cathode Current (3) (Notes B, C, D) eb=egk=+50 v; Prr=500 pps; Ec1=-7.5 Vdc; Rg=Rp=0	ik:	1000	---	---	---	mA
Capacitance: No Shield (Note B)	Cgp:	3.0	---	4.0	5.0	pf
Capacitance: No Shield (Note B)	Cin:	3.0	---	4.0	5.0	pf
Capacitance: No Shield Section No. 1	Cout:	0.18	---	0.24	0.30	pf
Capacitance: No Shield Section No. 2	Cout:	0.21	---	0.28	0.35	pf
Capacitance: No Shield	Cgg:	---	---	---	0.16	pf
Capacitance: No Shield	Cpp:	---	---	---	1.2	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test— 735 G. 49° hammer angle in Navy High Impact Shock machine. Sample subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test— 10 G. Sample subjected to vibrational acceleration of 10 G for 6 hours (2 hours in each of three positions). The frequency of vibration is varied from 30 cps to 3000 cps and back to 30 cps.

Glass Strain— A sample is subjected to a forty-eight hour holding period at room temperature. The sample is immersed in water at 97-100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater Cycling-Life Test— A sample is subjected to 2000 1 minute on, 4 minutes off heater cycles at the following conditions: Ef=7.0 volts; Ehk=140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts.

Grid Pulse-Life Test 500 Hours— Sample is operated with Ef=6.3; Eb=250 Vdc; Ec1=-30Vdc; egk=+40v; Rp/p=100 ohms; prr=1000 pps; T Envelope=160°C for 500 hours. (Note C)

APPLICATION NOTES

A. The maximum rating for epy applies only to the spike occuring at the leading edge of the plate waveform. The spike duration must be limited to 0.1 of tp. (See Figure 31, paragraph 4.10.7.5 of MIL-E-1).

APPLICATION NOTES (Cont'd.)

B. Test each section separately.

C. The tube shall be operated in a pulse circuit as follows: tp = 10 μsec. (Between 80% amplitude points), tr = 1.0 μsec max. (between 10% and 80% amplitude points); tf = 1.0 μsec max. (between 80% and 10% amplitude points):

Measure peak current across a 1.0 ohm ± 0.1% resistor in the specified circuit.

Prior to testing, preheat tubes with Ef = Test Volts, the only applied voltage, for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

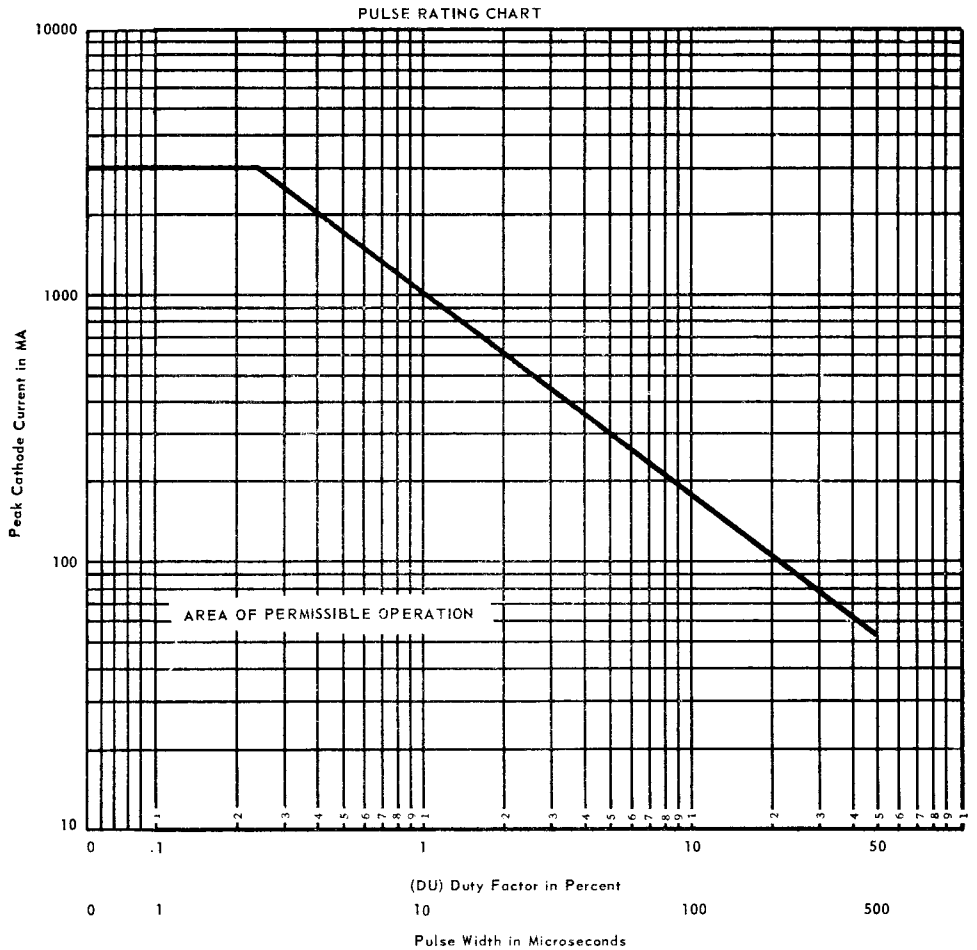
D. eb is defined as the peak voltage between plate and cathode (non–conducting).

CAUTION – – – To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if max – imum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

DISCUSSION AND EXPLANATION OF PULSE RATING CHART

This chart is applicable for operation where the duty factor does not exceed 50 percent and the pulse width does not exceed 500 micro seconds. It is believed that these ranges include well over 90 percent of pulse applications, and applications beyond these limits should be referred to Raytheon Field Engineering.

The area under the heavy boundary line is the area of "permissible operation", provided that other parameters are maintained within their absolute maximum values. The maximum permissible peak cathode current is limited by both duty factor (Du) and Pulse Width (tp), and for a given application is determined as the lower peak current obtained by the intersection with the boundary line of either the Du or tp coordinates. Within these limitations normal life performance may be expected. During manufacture control life tests are performed under operating conditions which yield peak currents exceeding those permitted by the chart, thus assuring satisfactory life when the tube is operated within the area of permissible operation.



ACCEPTANCE CRITERIA

The following tests shall be performed.

For the purpose of inspection, use applicable paragraphs of Spec. MIL–E–1.

For misc. requirements see 3.6.

TEST CONDITIONS

Heater Voltage	6.3 V
Plate Voltage	300 Vdc
Grid Voltage	–30 Vdc

MIL–E–1 Ref.	Test	AQL %	Level or Code	Maximum LTPD % (Note 1)	Minimum Sample Size	Symbol	LIMITS Min	LIMITS Bogey	LIMITS Max.	Units
	MEASUREMENTS ACCEPTANCE TESTS									
4.10.8	Heater Current	0.65	II	4.4	code L	If	475	500	525	mA
4.10.15	Heater–Cathode Leakage: Note 3 Ehk=±100 Vdc	0.65	II	4.4	code L	Ihk	---	---	20	μAdc
4.10.6.1	Grid Current: Note 3 Eb=125 Vdc; Ec=0; Rk=150 ohms	0.65	II	4.4	code L	Ic1	0	---	–1.5	μAdc
4.10.4.1	Plate Current: Note 3 Eb=300 Vdc; Rk=0	0.65	II	4.4	code L	Ib	---	---	10	μAdc
4.10.7	Pulse Cathode Current (1) Notes 3 and 5: Ef=5.7 V; egk=+40 v; prr=500 pps; tp=10 μsec.; Rp=0; Rg=47 ohms Max.	2.5	I	13.0	code I	ik	900	---	---	ma
---	Pulse ib/ic1 (1): Notes 3 and 5 egk=+40 v; Rp=0; prr=500 pps; Rg=47 ohms Max.	6.5	I	22.0	code I	---	2:1	---	7.5:1	---
4.10.7.5	Pulse Cathode Current (2): Notes 3 and 5 egk=+40 v; Rp=0; prr=500 pps; Rg=47 ohms Max.	0.65	II	4.4	code L	ik	1200	---	---	ma
----	Pulse Cathode Current (3): Notes 3 and 5: eb=egk=+50 v; prr= 500 pps; Ec1=–7.5 Vdc; Rg=Rp=0	6.5	I	22.0	code I	ik	1000	---	---	ma
----	Continuity and Shorts: Note 2	0.4	II	3.5	code L	---	---	---	---	---
4.9.1	Mechanical: Envelope (8–4)	---	---	---	---	---	---	---	---	---
4.8.2	Insulation of Electrodes: Note 3	2.5	L6	12.8	code H	---	---	---	---	---
	Eg–all=–100 Vdc	---	---	---	---	R(g–all)	50	---	---	Meg.
	Ep–all=–300 Vdc	---	---	---	---	R(p–all)	50	---	---	Meg.
4.10.4	Capacitance: No Shield	6.5	code E	---	---	---	---	---	---	---
	Cgp Note 3	---	---	---	---	Cgp	3.0	4.0	5.0	pf
	Cin Note 3	---	---	---	---	Cin	3.0	4.0	5.0	pf
	Cout Section No. 1	---	---	---	---	Cout	0.18	0.24	0.30	pf
	Section No. 2	---	---	---	---	Cout	0.21	0.28	0.35	pf
	Cgg	---	---	---	---	Cgg	---	---	0.16	pf
	Cpp	---	---	---	---	Cpp	---	---	1.2	pf
4.9.12.1	Low Pressure Voltage Breakdown: Note 6 Pressure=21±2 mm Hg; Voltage=300 Vac	6.5	L6	25.0	code G	---	---	---	---	---
----	White Noise: Notes 3 and 7 Eb=125 Vdc; Ec=0; Rp=2,000 ohms; Rk=150 ohms Ck=1000 μf	1.0	I	7.7	code I	---	--- ---	--- ---	1500 200	Mv pk–pk mVac

MIL-E-1 Ref.	Test	AQL %	Level or Code	Maximum LTPD % (Note 1)	Minimum Sample Size	Symbol	LIMITS Min	LIMITS Bogey	LIMITS Max	Units
DEGRADATION RATE ACCEPTANCE TESTS: Note 4										
4.9.5.3	Subminiature Lead Fatigue	2.5	L6	12.8	code H	---	4	---	---	Arcs
4.9.20.5	Shock: Note 8 Hammer Angle=49° Ehk=+100 Vdc; Rg=0.1 Meg.	20	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue: Notes 6 and 9 Eb=125Vdc; Ec=-2.5Vdc; Rk=0; G=10; Variable Frequency;	6.5	L6	25.0	code G	---	---	---	---	---
----	Post Shock and Fatigue Test End Points:								1500	Mv pk-pk
	White Noise:	---	---	---	---	---	---	---	200	mVac
	Heater Cathode Leakage Ehk=±100 Vdc	---	---	---	---	Ihk:	---	---	50	μAdc
	Change in Pulse Cathode Current (2) of individual tubes	---	---	---	---	Δ_tIk	---	---	15	%
4.9.6.3	Glass Strain:	6.5	I	22.0	code I	---	---	---	---	---
ACCEPTANCE LIFE TESTS: Note 4										
4.11.7	Heater Cycling Life Test Note 10 Ef=7.0 V; 1 min. on, 4 min. off; Ehk=140 Vac; Eb=Ec=0 V	---	---	---	---	---	---	---	---	---
---	Grid Pulse Life Test: (500 hrs.) Notes 5 and 11 Ef=6.3 V; Eb=250 Vdc; Ec1=-30Vdc; egk=+40 v; Rp/p=100 ohms; prr=1000 pps; T Envelope=160 °C	---	---	---	---	---	---	---	---	---
---	Grid Pulse Life Test End Points: Inoperatives	---	---	---	---	---	---	---	---	---
	Grid Current	---	---	---	---	Ic1	---	---	-5.0	μAdc
	Change of Pulse Cathode Current (2) of individual tubes	---	---	---	---	$\Delta_t$ik	---	---	-30 +50	%
	Heater-Cathode Leakage	---	---	---	---	Ihk:	---	---	30	μAdc

ACCEPTANCE CRITERIA NOTES

Note 1: The maximum LTPD (Lot Tolerance Percent Defective) is defined as the percent defective in the lot for which the probability of acceptance is 10%.

Note 2: Per MIL-E-1 ref. 4.7.

Note 3: Test each section separately.

ACCEPTANCE CRITERIA NOTES (cont'd.)

Note 4: Destructive Tests: Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.20.5 Shock
4.9.20.6 Fatigue
4.11.7 Heater Cycling Life Test
4.9.5.3 Lead Fatigue
---- Grid Pulse Life Test

Note 5: The tube shall be operated in a pulse circuit as follows: tp = 10 μsec. (Between 80% amplitude points); tr = 1.0 μsec Max. (between 10% and 80% amplitude points); tf = 1.0 μsec Max. (between 80% and 10% amplitude points):

Measure peak current across a 1.0 ohm ± 0.1% resistor in the specified circuit.

Prior to testing, preheat tubes with Ef = Test Volts, the only applied voltage, for a minimum of five minutes. After insertion into the test socket, each tube must be permitted to stabilize for one minute at pulse conditions.

DIFFICULTIES MAY BE ENCOUNTERED WHEN ATTEMPTING TO MAKE ACCURATE MEASUREMENTS OF PULSE CURRENTS. IT IS RECOMMENDED THAT THE TEST PROCEDURES AND TECHNIQUES BE DISCUSSED WITH THE TUBE MANUFACTURER.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. Once a lot has passed, the 30 day rule shall apply.

Note 7: The tube shall be rigidly mounted on a table vibrating such that the instantaneous values of acceleration shall constitute approximately a "White Noise" spectrum which is free from discontinuities from 100 to 5000 cps and such that the RMS value of acceleration for frequencies outside this band shall constitute no more than five percent of the total RMS acceleration. The spectrum of instantaneous acceleration shall be such that each octave of bandwidth delivers 2.3 ± 0.2 G's of RMS acceleration. With this the case, the RMS value of acceleration for any bandwidth within the specified spectrum is equal to

$$G_{rms} = 2.3\sqrt{3.32 \log_{10}(f_{2}/f_{1})}$$

where f2 and f1 are the upper and lower frequencies respectiviely of the band under consideration. The degree of clipping of the peak accelerations shall be such that the peak value of acceleration is at least 15 G's.

Half the tubes in each sample shall be vibrated in position X1, the other half in position X2.

The voltage (ep) produced across the resistor (Rp) as a result of vibration shall be coupled through a compensating amplifier to a low pass filter. The compensating amplifier shall have a high input impedance (250 Kohms or more) and shall be adjusted to compensate for any insertion losses in the filter. The combined frequency response of amplifier and filter shall be flat within ± 0.5 db from 50 to 8000 cps, shall be down no more than 5 db at 10,000 cps and at 20 cps, and down at least 30 db at 13,000 cps. For reading the peak to peak value of output voltage, the filter output shall be fed directly to the input of a Ballantine Model 305 peak to peak electronic voltmeter or equal, while the RMS value shall be measured with a Hewlett-Packard Model 400 C or equal. The impedance of the plate and screen voltage supplies shall not exceed that of a 40 μf capacitor at 10 cps.

Note 8: A grid resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyratron-type short indicator is employed.

Note 9: The tubes shall be rigidly mounted on a table vibrating at a constant acceleration level of 10 G. The frequency of vibration shall be varied from 30 cps to 3000 cps and back to 30 cps with three minutes being the time required to sweep the range in each direction. The rate of change of frequency with time shall be such that the frequency varies logarithmically with time. The tubes shall be vibrated for a total of six hours, that is two hours in each of the three positions X1, X2, and Y1. Heater voltage only shall be applied to the tube under test.

Note 10: The no-load to steady state full load regulation of the heater voltage supply shall not be more than 3.0%.

Note 11: Grid Pulse Life Test shall be conducted from 500 hours with interim readings of Pulse Cathode Current end point made at zero; 20 plus or minus 4 hours and 200 (+48, −24) hours Readings of Ic1 and Ihk shall be made at zero (0) hours and at the completion of the life test.

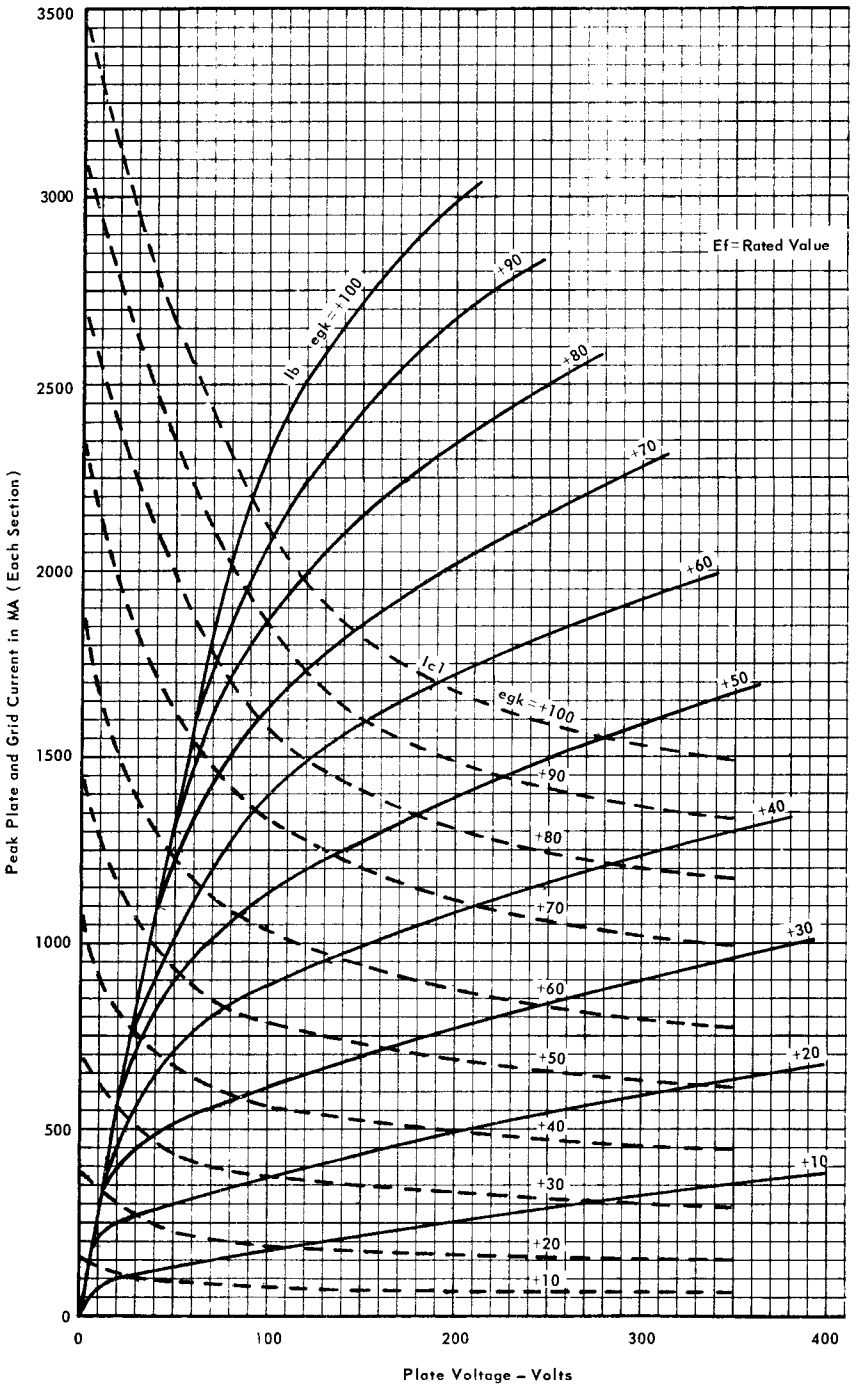
Life test shall be conducted under a double sampling plan of which the first sample shall consist of 20 tubes. The second sample, if required, shall consist of 40 tubes. If a tube is defective for more than one characteristic, the characteristic appearing first in the life-test end points shall constitute the failure.

RAYTHEON

CK7550

RELIABLE DOUBLE TRIODE

AVERAGE PLATE CHARACTERISTICS



RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

CK7570/ QK411A



The CK7570/QK411A is a cathode ray Recording Storage Tube capable of repeating information stored for many hours up to 30,000 times without appreciable deterioration of signal strength or quality. Electrostatic focusing and deflection are required. This tube is similar to the CK6835/-QK464A except for deflection and focusing methods.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater

Heater Voltage	6.3 V ±10%
Heater Current	0.6 A

Maximum Ratings

Anode No. 1 Voltage	2800 volts
Anode No. 2 and Grid No. 2 Voltage	6000 volts
Grid No. 1 (control electrode) Voltages	
Negative Bias Value	200 Vdc
Positive Bias Value	0 Vdc
Positive Peak Value	2 V
Peak Heater-Cathode Voltage	±150 Vdc
Deceleration Screen Voltage	500 Vdc
Storage Screen Voltage	500 Vdc
Signal Electrode Voltage	500 Vdc
Deflection Drive (for full screen deflection)	1000 Vdc

Typical Operating Conditions

(All Voltages Measured With Respect to Cathode)

	Prime	Read	Write
Anode Voltage	5000	5000	5000
Deceleration Screen Voltage	500	500	500
Storage Screen Voltage	+20	+10	+500
Signal Electrode Voltage	+500	+500	+500
Cathode Current (μa)	150μa	5μa	*
Signal Electrode Output Current		0.5μa	

MECHANICAL CHARACTERISTICS:

Focusing Method	electrosatic
Deflection Method	electrostatic
Maximum Deflection Angle	20°
Overall Length	13½" ± ½"
Storage Screen Diameter (approx.)	1 ¾
Resolving Power (on diameter as specified for TV)	400 line nom.
Mounting Position	Any
Base	Medium Shell Di Heptal
Capacitance — Signal Electrode to all other elements	20μμf (approx.)

*This value must be determined empirically depending on scan speeds and operating voltages.

Printed in U.S.A.

DETAILED ELECTRICAL INFORMATION

CONDITIONS OF OPERATION

Application of the recording storage tube involves four operations, namely: prime, write, read and erase. Any form of scanning may be utilized for the above operations. These operations are performed in the following manner and sequence:

Prime — Priming is accomplished by uniformly charging the storage surface. To prime the storage screen reduce the screen voltage below the critical potential (usually 30 V) and scan the raster with 10 to 50 uA depending on priming speed desired.

Write — Set control grid bias at cutoff either manually or automatically and apply signal to be stored. Signal voltage amplitude required will depend on the sweep speed employed and is measured in terms of average cathode current.

Read — Set grid bias to permit an unmodulated beam current of approximately 2 uA. If the storage screen voltage is properly set, the stored signal will modulate the beam and an output can be taken from the signal electrode.

Erase — Erasing is performed by writing a dc signal into the tube, thus normalizing the storage element at full modulation level. Both the signal electrode and storage screen voltage should be at the decelerator potential for this operation. If "erase" speeds are of no importance, cathode currents of less than 50 μA are recommended.

WRITING AND ERASING TIME

Writing time is defined as the time required for the electron beam to change the storage element charge to a potential corresponding to the full modulation range. With the proper current adjustment for high speed writing, less than 0.12 microseconds per spot element is required for full modulation.

The erasing time will be comparable to the writing time since the erasing operation is simply the writing in of an unmodulated signal.

STORAGE ABILITY

The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the cathode current.

When reading with a low cathode current of about 2 uA at a television repetition rate and scan, 20,000 to 30,000 consecutive readings can be made without any appreciable deterioration of the stored signal. This indicates that a single spot element can be read continuously for approximately 5 milliseconds without significant fading or reorientation of the charge.

The tube is capable of storing information for many hours without appreciable change or deterioration and may be read over 10,000 times after the delay period and still yield satisfactory results.

RESOLVING POWER

The resolution of the storage tube at the 50% modulation level is in excess of 400 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the deflector plate dc voltage level is properly set to minimize astigmatism. Resolution is also dependent on the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often desirable.

FIGURE OF MERIT

A storage element is defined as: "An area of the storage surface which retains information distinguishable from that of adjacent areas". (55 IRE 7.PS5.) Assuming 400 line resolution across a diameter, the number of storage elements in the tube will be $\frac{\pi d^2}{4}$ or $\frac{\pi(400)^2}{4} \approx 125{,}000$ and is defined as the figure of merit (η). (Resolution measurements include both black and white lines in a television test pattern.)

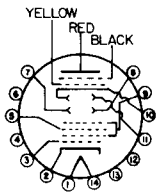
RECORDING STORAGE TUBE

NOTES:

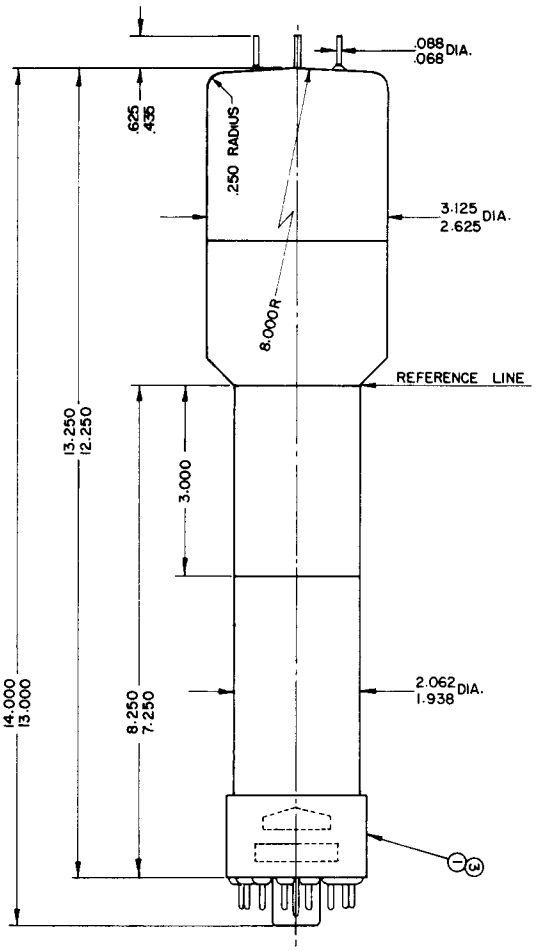
1- SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED. IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY. BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH CONE AXIS AND HAVING A DIAMETER OF 2.250.

2- TOP PIN CONNECTIONS SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY.
S-STORAGE SCREEN (BLACK DOT)
E-SIGNAL ELECTRODE (RED DOT)
D-DECELERATOR (YELLOW DOT)

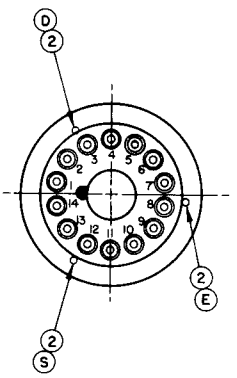
3- 14 PIN MEDIUM SHELL DI-HEPTOL BASE.



SOCKET CONNECTIONS
BOTTOM VIEW

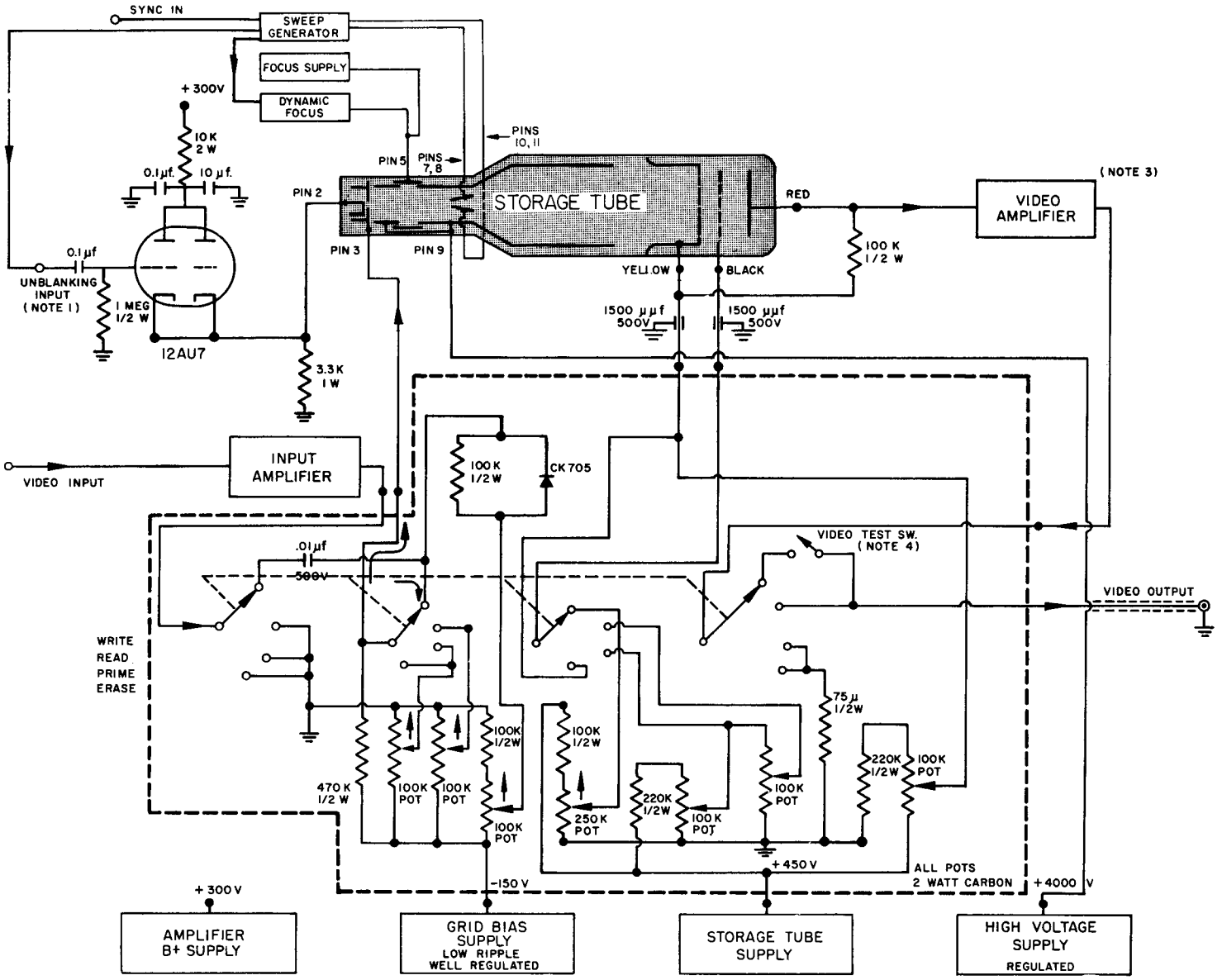


PIN 1 - HEATER
PIN 2 - CATHODE
PIN 3 - GRID No.1
PIN 4 - INTERNAL CONNECTION
PIN 5 - ANODE No.1
PIN 6 - NO CONNECTION
PIN 7 - DEFLECTING ELECTRODE DJ3
PIN 8 - DEFLECTING ELECTRODE
PIN 9 - ANODE No.2 GRID No.2
PIN 10 - DEFLECTING ELECTRODE DJ2
PIN 11 - DEFLECTING ELECTRODE DJ1
PIN 12 - INTERNAL CONNECTION
PIN 13 - NO CONNECTION
PIN 14 - HEATER



RAYTHEON

RECORDING STORAGE TUBE



NOTES FOR SCHEMATIC OUTLINE

1. The unblanking circuit shown is designed to cut off the storage tube during retrace and when the scan is off. Insertion of a negative pulse to the unblanking amplifier permits the storage tube to conduct during scan.
2. Resolution near the edges of the storage area can be further improved by use of dynamic focusing.

2a. Since the dynamic focus correction is a function of the displacement of the electron beam from the axis of the tube at any instant, it can be generated from an output equivalent to the algebraic sum of two parabolas generated from the horizontal and vertical sweeps respectively.

3. Design considerations for the video output amplifier must include the output capacitance of the storage tube (10-20μμf) and its output signal (0.5-1.0μ amps). When using a high load resistor to minimize noise, frequency compensation within the amplifier is necessary. (See "Television" by V. K. Zworykin etc., John Wiley & Sons, 1940. P.P. 432-5.)

CK7571/ QK685



RECORDING STORAGE TUBE

GENERAL DESCRIPTION

The CK7571/QK685 is a high resolution electrical output Recording Storage Tube capable of repeating information stored for many hours up to 20,000 times without serious deterioration of signal strength or quality. It requires magnetic deflection but it can be focused either magnetically or electro-statically, or using a combination of both. The properties of integration ability, dynamic range, storage duration and speed of operation in the various modes are approximately equivalent quantitatively with those found in the prototype tube CK6835/QK464A.

GENERAL CHARACTERISTICS

Resolution (Magnetic Focus)	1000 Lines Minimum
Resolution (Electrostatic Focus)	700 Lines Nominal
Output Capacitance	12 uuf Nominal
Grey Levels	5
Gun Type	Tetrode
Deflection	Magnetic
Max. Defl. Angle	30°
Focusing	Electrostatic or Magnetic
Mounting Position	Any

MECHANICAL CHARACTERISTICS

Overall Length	13-3/16 Nominal
Bulb Diameter	2¾" Nominal
Neck Diameters	1½" Maximum
Storage Screen Diameter	2"
Base	Small Shell Duodecal
Lens Buttons	JETEC Type J1-22

Printed in USA

DETAILED ELECTRICAL INFORMATION

CONDITIONS OF OPERATION

Application of the recording storage tube involves four operations, namely: prime, write, read and erase. Any form of scanning may be utilized for the above operations. These operations are performed in the following manner and sequence:

Prime — Priming is accomplished by uniformly charging the storage surface. To prime the storage screen reduce the screen voltage below the critical potential (usually 30 V) and scan the raster with 10 to 50 uA depending on priming speed desired.

Write — Set control grid bias at cutoff either manually or automatically and apply signal to be stored. Signal voltage amplitude required will depend on the sweep speed employed and is measured in terms of average cathode current.

Read — Set grid bias to permit an unmodulated beam current of approximately 2 uA. If the storage screen voltage is properly set, the stored signal will modulate the beam and an output can be taken from the signal electrode.

Erase — Erasing is performed by writing a DC signal into the tube, thus normalizing the storage element at full modulation level. The signal electrode and storage screen voltages should be the same for this operation. A beam current of 10 uA is normally used. This operation can be eliminated in many applications where only partial erasures are desired or where the time which can be allotted *priming* is one second or more.

STORAGE ABILITY

The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the cathode current.

When reading with a low beam current of about 1.0 uA at a television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal. This indicates that a single spot element can be read continuously for approximately 5 milliseconds without significant fading or reorientation of the charge.

The tube is capable of storage information for many hours without appreciable change or deterioration and may be read up to 20,000 times after the delay period and still yield satisfactory results.

RESOLVING POWER

The resolution of the storage tube at the 50% modulation level is usually in excess of 1000 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coil magnetic shell is designed to minimize astimagtism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often desirable.

FOCUS

Using a standard BM411 focus coil, approximately 19 MA of current will be required for dc magnetic focusing. If dc electrostatic focus is used, the focus voltage will be approximately 400 volts. For magnetic dc focus and electrostatic dynamic focus, it is recommended that the electrostatic focus electrode be set at 1000 volts dc and that the magnetic focus current be adjusted for optimum spot size in the center of the storage screen (approximately 16 MA will be required). With these static conditions, the dynamic waveform applied to the electrostatic focus element will rise from the 1000 volts dc value to approximately 1150 volts dc as the beam is scanned from the center of the screen to the edge. (The rise will be slow for the first half of this distance and then at an increasing rate.)

ELECTRICAL

(All Voltages Measured With Respect to Cathode)

Heater

Heater Voltage	6.3 V±10%
Heater Current	0.6 A

Maximum Ratings

Anode Voltage (A1)	5000 Vdc
Grid #1 (control electrode) Voltage	
Negative Bias	−125 Vdc
Positive Bias	0 Vdc
Positive Peak Value	+2 Vdc
Grid #2	1000 Vdc
Focus Anode Voltage (A2)	5000 V
Lens #1	800 Vdc
Lens #2	500 Vdc
Decelerator Screen	800 Vdc
Storage Screen	500 Vdc

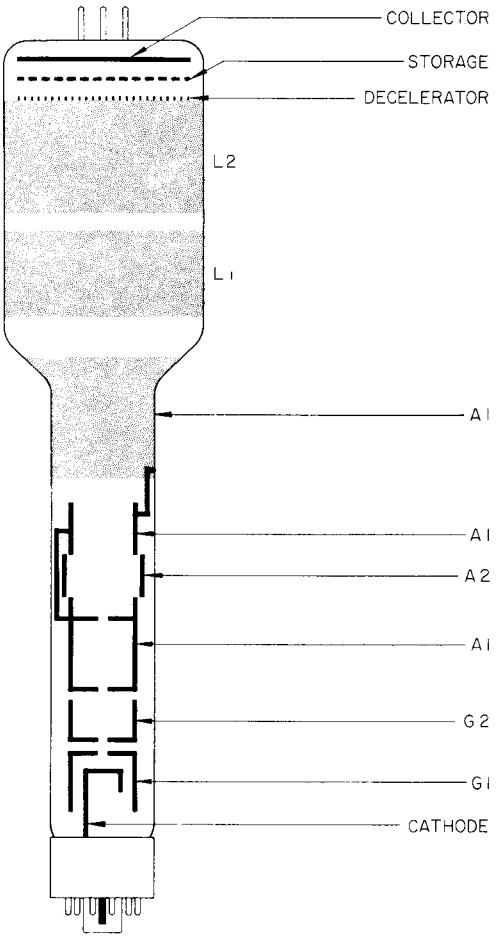
Typical Operating Conditions

Cathode	0 V
G1 (Control Grid) Cutoff	−30 V
G2 (Screen Grid)	400 V
L1 (Collimating Lens)	750 V
L2 (Collimating Lens)	400 V
Anode (A1)	3500 V
Focus Anode (A2)	
Electrostatic	400 V
Magnetic	3500 V
Decelerator	750 V
Collector	750 V

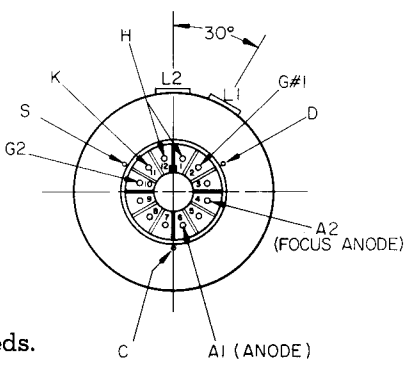
	Prime	Read	Erase	Write
Storage Screen	20 V	15 V	†	300 V
Cathode Current	25 μa	5 μa	50 μa	*
Signal Electrode Current (peak)		0.5 μa		

* This value must be determined experimentally depending on scan speeds.

† Should be shorted to Decelerator Screen during Erase.



S-STORAGE SCREEN (BLACK DOT), C-COLLECTOR (RED DOT), D-DECELERATOR (YELLOW DOT)

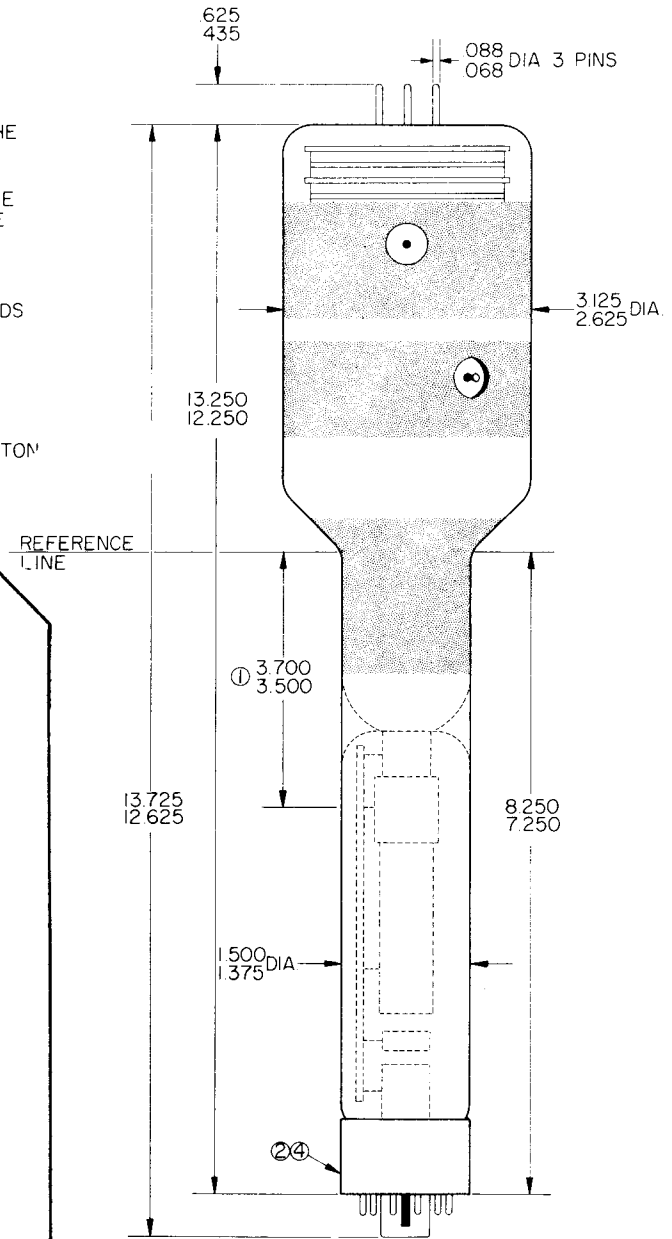


RAYTHEON

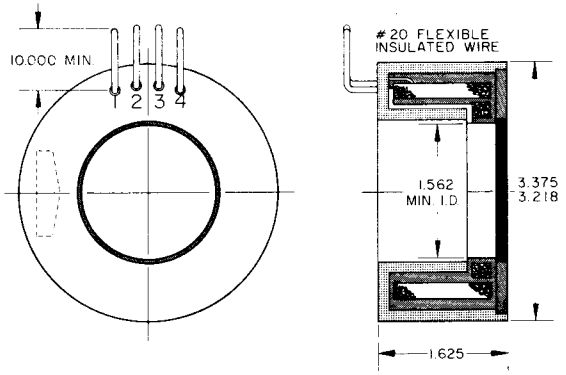
RECORDING STORAGE TUBE

NOTES:

1) LOCATION OF DEFLECTION YOKE AND THE GAP OF THE FOCUSING COIL MUST BE WITHIN THIS SPACE
2) SOCKET FOR THIS BASE SHOULD NOT BE RIGIDLY MOUNTED; IT SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY BOTTOM CIRCUMFERENCE OF BASE SHELL WILL FALL WITHIN A CIRCLE CONCENTRIC WITH CONE AXIS, AND HAVING A DIAMETER OF 2.000
3) TOP PIN CONNECTIONS SHOULD HAVE FLEXIBLE LEADS AND BE ALLOWED TO MOVE FREELY
   S - STORAGE SCREEN (BLACK DOT)
   C - COLLECTOR (RED DOT)
   D - DECELERATOR (YELLOW DOT)
4) B12-43 12 PIN BASE
5) LENS BUTTONS JETEC TYPE J1-22 LENS #2 BUTTON NEAR STORAGE ASSEMBLY



BM-411 FOCUS COIL



LEADS
#1 - S1
#2 - F1
#3 - S2
#4 - F2

TICKLER COIL
RESISTANCE - 35 TO 50 OHMS (AT 20°C)
MAX. CURRENT - 30 mA RMS
VOLTAGE RATING - 250 V.
INDUCTANCE - 45 MILLIHENRIES APPROX

FOCUS COIL
RESISTANCE - 6500 TO 9000 OHMS (AT 20°C.)
MAX. CURRENT - 25 mAdc.
VOLTAGE RATING - 250 V.

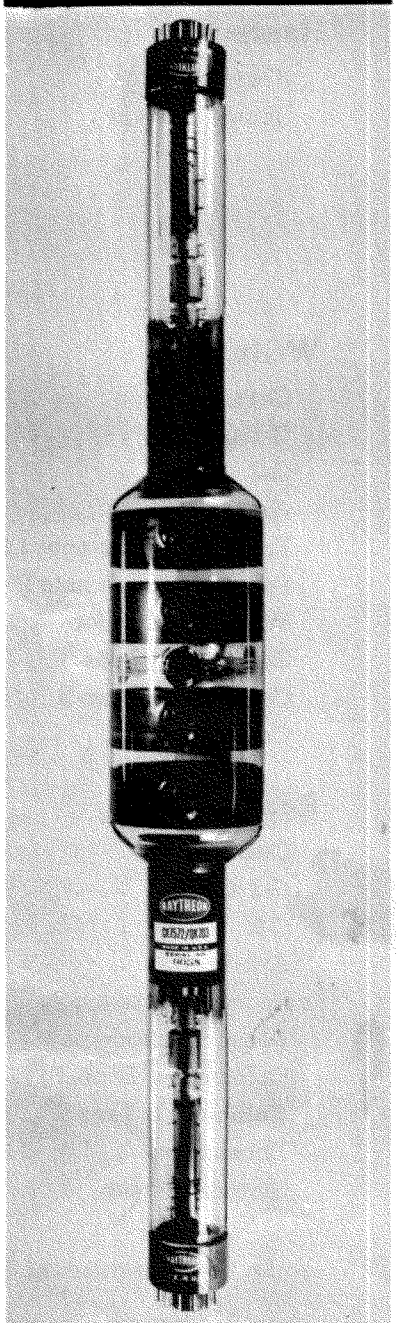
NOTES:

1) - FOR USE WITH CK6835/QK464A, CK7571, OR CK7572 RECORDING STORAGE TUBES.
2) - TICKLER COIL IS PROVIDED TO PERMIT COMPENSATING FOR IMPROPER FOCUS AT THE EDGES OF A PATTERN CAUSED BY THE VARIATION IN DISTANCE FROM THE CENTER OF DEFLECTION TO a) THE CENTER OF A STORAGE AREA OF A STORAGE TUBE, AND b) THE PERIPHERY OF A STORAGE AREA. THIS TICKLER COIL USEFUL ONLY FOR SLOW SCANNING SPEEDS.
3) - WHEN NOT REQUIRED, THE TICKLER COIL MAY BE LEFT UNCONNECTED
4) - SHELL MATERIAL - ANNEALED SWEDISH IRON OR EQUIVELENT

CK7572
QK703

GENERAL DESCRIPTION

The CK7572/QK703 is a dual-gun cathode-ray Recording Storage Tube of which one gun can be used for writing and the second for reading. Stored signals can be held for many hours, read several thousand times, or erased in a fraction of a second if desired. Both the writing and reading guns use magnetic deflection and can be operated with either electrostatic or magnetic focus or a combination form of focus. The guns are scanned independently, making it possible to use the tube for scan conversion. The properties of integration ability, dynamic range, storage duration and speed of operation in the various modes are approximately equivalent quantitatively with those found in the prototype tube, the CK6835/QK464A. Where simultaneous writing and reading and high level read output are prime considerations, the CK7575/QK787 is frequently preferred.



RECORDING STORAGE TUBE

GENERAL CHARACTERISTICS

Gun Locations	Co-axial
Gun Type (Both Guns)	Tetrode, High Resolution
Deflection (Both Guns)	Magnetic
Max. Defl. Angle (Both Guns)	30°
Focusing	Electrostatic or Magnetic
Mounting Position	Any
Resolution (Magnetic Focus)	1000 Lines Nominal
Resolution (Electrostatic Focus)	700 Lines Nominal
Output Capacitance (Col. plus Write Dec. to all elements.)	30 uuf
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Overall Length	24" Nominal
Bulb Diameter	3" Nominal
Neck Diameters	1½" Maximum
Storage Screen Diameter	2"
Bases (Both Ends)	Small Shell Duodecal
Storage Assembly Buttons	JETEC Type J1-22

Printed in U.S.A.

ELECTRICAL CHARACTERISTICS

Heater

Heater Voltage	6.3 ± 10%
Heater Current	0.6A

Maximum Ratings

Anode Voltage	4000 Vdc
Grid #1 Negative Bias	—125 Vdc
Grid #2 Voltage	1000 Vdc
Inter-Screen Voltage (between any pair)	600 Vdc
Focus Electrode Voltage	4000 Vdc

TYPICAL OPERATING CONDITIONS

Write Gun	*Mode #1*	*Mode #2*
Cathode	0 Vdc	0 Vdc
G-1 Cut-off	—30 Vdc	—30 Vdc
G-2	400 Vdc	400 Vdc
Anode	3500 Vdc	3500 Vdc
Focus Electrode note 1	400 Vdc	400 Vdc
Focus Electrode note 2	3500 Vdc	3500 Vdc
Write Decelerator	500 Vdc	500 Vdc
Collimating Lens 1	500 Vdc	500 Vdc
Collimating Lens 2	300 Vdc	300 Vdc
Collector	500 Vdc	500 Vdc note 4

Read Gun	*Mode #1*	*Mode #2*
Cathode	E_{KR} note 3	200 Vdc
G-1 Cut-off	E_{KR} —30 Vdc	170 Vdc
G-2	E_{KR}+ 400 Vdc	600 Vdc
Anode	E_{KR}+3500 Vdc	3700 Vdc
Focus Electrode note 1	E_{KR}+ 400 Vdc	600 Vdc
Focus Electrode note 2	E_{KR}+3500 Vdc	3700 Vdc
Collimating Lens 1	E_{KR}+ 500 Vdc	700 Vdc
Collimating Lens 2	E_{KR}+ 300 Vdc	500 Vdc
Decelerator	E_{KR}+ 500 Vdc	700 Vdc
Storage Screen	E_{KR}+ 20 Vdc	205 Vdc

Note 1. If electrostatic focus is used

Note 2. If magnetic focus is used

Note 3. The read gun potential will be switched during the various modes of operation. The values of E_{KR} are as follows:

Erase	300 Vdc
Prime	10 Vdc
Write	300 Vdc

Note 4. Gradual automatic priming is controllable by varying the value of collector voltage from 500 Vdc (for slow erasing) down to 200 Vdc (for fast erasing). The same effect may also be achieved by varying the value of read cathode from 200 Vdc (for slow erasing) to 500 Vdc (for fast erasing) while keeping all read gun voltages the same with respect to read cathode.

DETAILED ELECTRICAL INFORMATION

In mode 1 operation, in order to erase and write a picture on the storage screen, the storage screen must be about 300 Vdc positive with respect to the write gun cathode. For priming the storage screen must be about 30 Vdc positive to the write gun cathode. While all of these modes are in operation, the storage screen must remain about 20 volts positive with respect to the read gun cathode.

In Mode 2, one technique for simultaneous writing and reading is RF modulation of the read beam. The output signal is obtained from the collector and write decelerator. Video cancellation techniques may also be practical.

RESOLVING POWER

The resolution of the storage tube at the 50% modulation level is usually in excess of 1000 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coil magnetic shell is designed to minimize astimagtism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed.

STORAGE ABILITY

The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current.

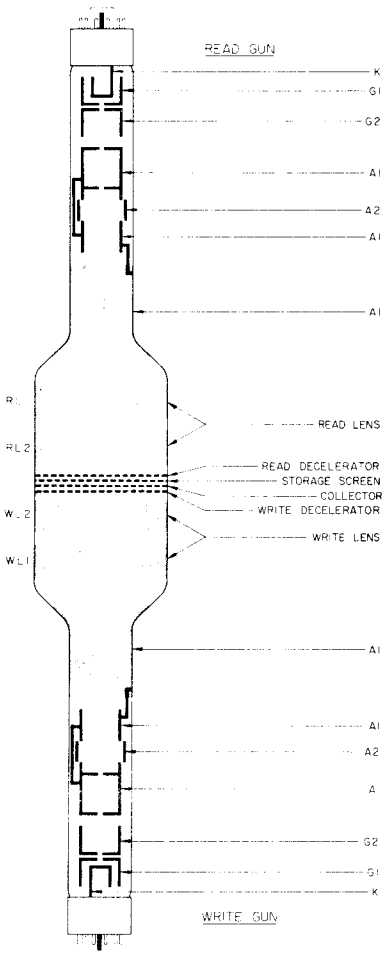
When reading with a low beam current of about 2 uA at a television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal.

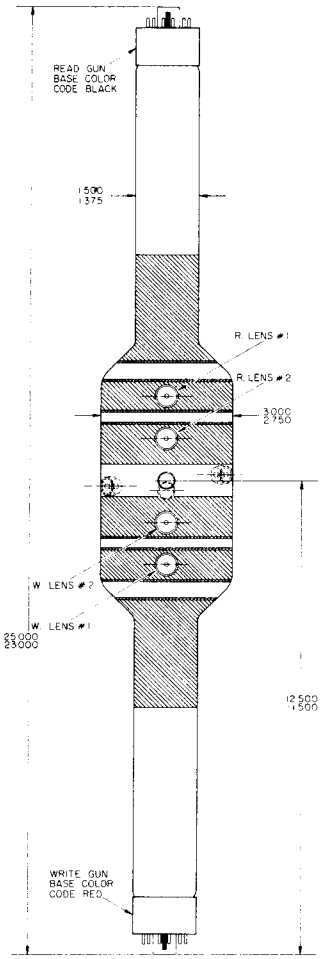
The tube is capable of storing information for many hours without appreciable change or deterioration when not reading.

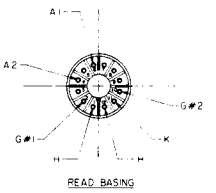
FOCUSING TECHNIQUE

This tube can be focused electrostatically, magnetically or using a combination of fixed focus by one technique and dynamic focus correction by the second. Magnetic dc focusing provides higher resolution than does electrostatic but frequently requires more power. When magnetic focusing is being used, the Focus Electrode is set at anode potential; when electrostatic focusing is being used, the Focus Electrode is typically set at 400 Vdc when the anode is set at 3500 Vdc.

The recommended technique for dynamic focusing is to apply 1000 to 1500 Vdc to the focus electrode, then adjust the magnetic focus for optimum resolution near the center of the storage target, and finally apply the base-damped parabolic correction waveform to the focus electrode such that the edges of the target are brought into focus. Approximately 350 Vac pk to pk correction signal will provide correction across the diameter of the target at the above focus electrode voltage.

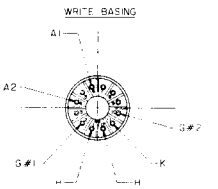




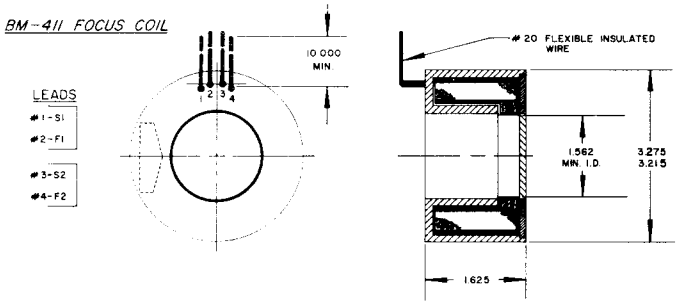


SCREEN ASSEMBLY BUTTONS TO BE COLOR CODED AS FOLLOWS

READ DECELERATOR - YELLOW
STORAGE SCREEN - BLACK
COLLECTOR - RED
WRITE DECELERATOR - NO COLOR



BM-411 FOCUS COIL



FOCUS COIL

Resistance — 6500 to 9000 ohms (at 20°C)
Max. Current — 25 madc
Voltage Rating — 250 V

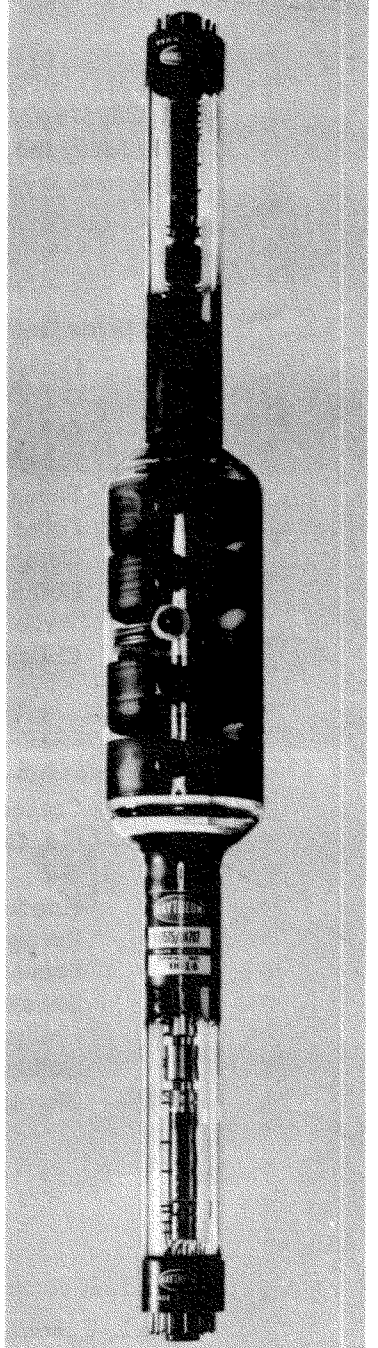
Notes:

1) For use with recording storage tubes and simulators.
2) Tickler coil is provided to permit compensating for improper focus at the edges of a pattern caused by the variation in distance from the center of deflection to a) the center of a storage area of a storage tube, b) the periphery of the storage area.
3) When not required, the tickler coil may be left unconnected.
4) Shell material — annealed swedish iron or equivalent.

TICKLER COIL

Resistance — 35 to 50 ohms (at 20°C)
Max. current — 30 mA RMS
Voltage rating — 250 V
Inductance — 45 Millihenries Approx.

CK7575
QK787



RECORDING STORAGE TUBE

GENERAL DESCRIPTION

The CK7575/QK787 is a dual-gun cathode-ray Recording Storage Tube capable of simultaneous writing and reading. This tube combines high output signal with high quality resolution. In addition, this tube features improved automatic priming speeds. Stored signals can be held for many hours, read several thousand times, or erased in a fraction of a second if desired. Both the writing and reading guns use magnetic deflection and can be operated with either electrostatic or magnetic focus or a combination form of focus. The guns are scanned independently, making it possible to use the tube for scan conversion. The properties of integration ability, dynamic range, storage duration and speed of operation in the various modes are approximately equivalent quantitatively with those found in the prototype tube, the CK6835/QK464A.

GENERAL CHARACTERISTICS

Gun Locations	Co-axial
Gun Type (Both Guns)	Tetrode, High Resolution
Deflection (Both Guns)	Magnetic
Max. Defl. Angle (Both Guns)	30°
Focusing	Electrostatic or Magnetic
Mounting Position	Any
Resolution (Magnetic Focus)	900 Lines Nominal
Resolution (Electrostatic Focus)	600 Lines Nominal
Output Capacitance (Col. plus Write Dec. to all elements)	30 μμf
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Overall Length	24" Nominal
Bulb Diameter	3" Nominal
Neck Diameters	1½" Maximum
Storage Screen Diameter	2"
Bases (Both Ends)	Small Shell Duodecal
Storage Assembly Buttons	JETEC Type J1-22

ELECTRICAL CHARACTERISTICS

Heater

Heater Voltage	6.3±10%
Heater	0.6 A

Maximum Ratings

Anode Voltage	4000 Vdc
Grid #1 Negative Bias	−125 Vdc
Grid #2 Voltage	1000 Vdc
Inter-Screen Voltage (between any pair)	600 Vdc
Focus Electrode Voltage	4000 Vdc

Printed in U.S.A.

TYPICAL OPERATING CHARACTERISTICS

The CK7575/QK787 may be operated sequentially through erasing, priming, writing and reading, or by utilizing the automatic priming feature continuous writing and reading can be done simultaneously. The former we shall call Mode #1, the latter Mode #2.

Write Gun	Mode #1	Mode #2
Cathode	0 Vdc	0 Vdc
G-1 Cut-off	−30 Vdc	−30 Vdc
G-2	400 Vdc	400 Vdc
Anode	3500 Vdc	3500 Vdc
Focus Electrode (note 1)	400 Vdc	400 Vdc
Focus Electrode (note 2)	3500 Vdc	3500 Vdc
Collimating Lens 1	500 Vdc	500 Vdc
Collimating Lens 2	300 Vdc	300 Vdc
Write Decelerator	500 Vdc	500 Vdc
Collector	500 Vdc	500 Vdc note 4

Read Gun	Mode #1	Mode #2
Cathode	E_{KR} note 3	200 Vdc
G-1 Cut-off	E_{KR} −100 Vdc	100 Vdc
G-2	E_{KR} +400 Vdc	600 Vdc
Anode	E_{KR} +3500 Vdc	3700 Vdc
Focus Electrode (note 1)	E_{KR} +400 Vdc	600 Vdc
Focus Electrode (note 2)	E_{KR} +3500 Vdc	3700 Vdc
Decelerator	E_{KR} +500 Vdc	700 Vdc
Collimating Lens 1	E_{KR} +500 Vdc	700 Vdc
Collimating Lens 2	E_{KR} +300 Vdc	500 Vdc
Storage Screen	E_{KR} +20 Vdc	205 Vdc

Note 1. If electrostatic focus is used.

Note 2. If magnetic focus is used.

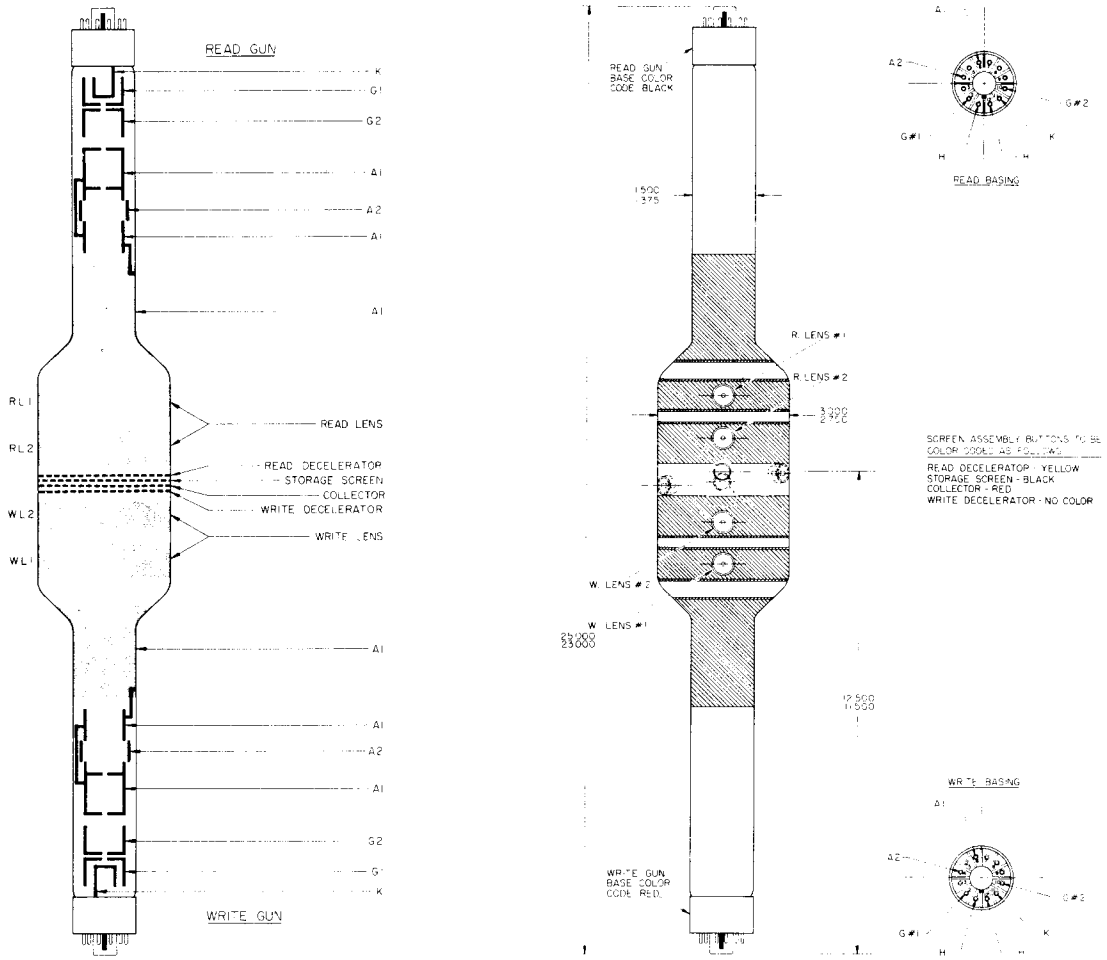
Note 3. In mode #1, the read gun potential will be switched during the various operations. The values of $E_{\widetilde{KR}}$ are as follows:

Erase	300 Vdc
Prime	10 Vdc
Write	300 Vdc

Note 4. Gradual automatic priming is controllable by varying the value of collector voltage from 500 Vdc (for slow erasing) down to 200 Vdc (for fast erasing). The same effect may also be achieved by varying the value of read cathode from 200 Vdc (for slow erasing) to 500 Vdc (for fast erasing) while keeping all read gun voltages the same with respect to read cathode.

RAYTHEON

RECORDING STORAGE TUBE



DETAILED ELECTRICAL INFORMATION

In Mode #1 operation, in order to erase and write a picture on the storage screen, the storage screen must be about 300 Vdc positive with respect to the write gun cathode. For priming the storage screen must be about 30 Vdc positive to the write gun cathode. While all of these modes are in operation, the storage screen must remain about 20 volts positive with respect to the read gun cathode.

In Mode #2 one technique for simultaneous writing and reading is RF modulation of the read beam. The output signal is obtained from the collector and write decelerator. Video cancellation techniques may also be practical.

Printed in U.S.A.

RESOLVING POWER

The resolution of the storage tube at the 50% modulation level is usually in excess of 900 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coil magnetic shell is designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed.

STORAGE ABILITY

The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current.

When reading with a low beam current of about 2 μA at a television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal.

The tube is capable of storing information for many hours without appreciable change or deterioration when not reading.

FOCUSING TECHNIQUE

This tube can be focused electrostatically, magnetically or using a combination of fixed focus by one technique and dynamic focus correction by the second. Magnetic dc focusing provides higher resolution than does electrostatic but frequently requires more power. When magnetic focusing is being used, the Focus Electrode is set at anode potential; when electrostatic focusing is being used, the Focus Electrode is typically set at 400Vdc when the anode is set at 3500 Vdc.

The recommended technique for dynamic focusing is to apply 1000 to 1500 Vdc to the focus electrode, then adjust the magnetic focus for optimum resolution near the center of the storage target, and finally apply the base-damped parabolic correction waveform to the focus electrode such that the edges of the target are brought into focus. Approximately 350 Vac peak to peak correction signal will provide correction across the diameter of the target at the above focus electrode voltage.

LEADS

#1 — S1
#2 — F1
#3 — S2
#4 — F2

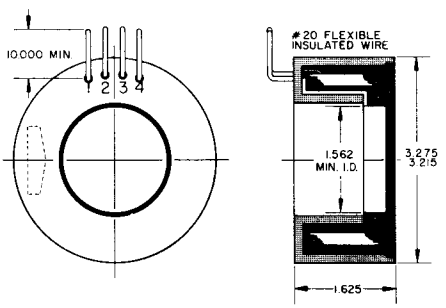
TICKLER COIL

Resistance — 35 to 50 ohms (at 20°C)
Max. current — 30 mA RMS
Voltage rating — 250 V
Inductance — 45 Millihenries Approx.

FOCUS COIL

Resistance — 6500 to 9000 ohms (at 20°C)
Max. Current — 25 madc
Voltage Rating — 250 V

BM-411 FOCUS COIL



Notes:

1) For use with recording storage tubes and simulators.
2) Tickler coil is provided to permit compensating for improper focus at the edges of a pattern caused by the variation in distance from the center of deflection to a) the center of a storage area of a storage tube, b) the periphery of the storage area.
3) When not required, the tickler coil may be left unconnected.
4) Shell material — annealed swedish iron or equivalent.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7576

SUBMINIATURE TRIODE

The CK7576 is a heater-cathode type high-Mu triode of subminiature construction especially designed for grounded grid RF power amplifier service in the VHF and UHF regions. Excellent isolation between input and output circuits coupled with high transconductance, high amplification factor, and good power handling ability make it suitable for a wide variety of applications. The flexible terminal leads may be soldered or welded directly to the terminal of circuit components without the use of sockets. Standard 8-pin subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu f$)

	With Shields (Note 1)	Without Shield
Plate to Cathode (P to K)	0.15 max.	0.2 max
Output (Grounded Grid) (P to G + H)	5.3	3.5
Cathode to Heater (K to H)	5.8	5.8
Input (Grounded Grid) (K to G + H)	12	12
Grid to Cathode + Heater (G to K + H)	7.9	6.3
Cathode to Grid (H + P Gnd.)	6.0	5.9

RATINGS—ABSOLUTE MAXIMUM VALUES:

Heater Voltage	6.3±5% volts
Plate Voltage	250 volts
DC Grid Voltage	−55 volts
Cathode Current	50 mAdc
Grid Current	10 mAdc
Grid Dissipation	0.2 watts
Plate Dissipation	4.1 watts
Peak Heater-Cathode Voltage	±90 volts
Grid Circuit Resistance	
class A	0.1 Meg
fixed bias class C	0.01 Meg
cathode bias class C	0.05 Meg
Peak Positive RF Grid Voltage	10 volts

CHARACTERISTICS AND TYPICAL OPERATION CLASS A:

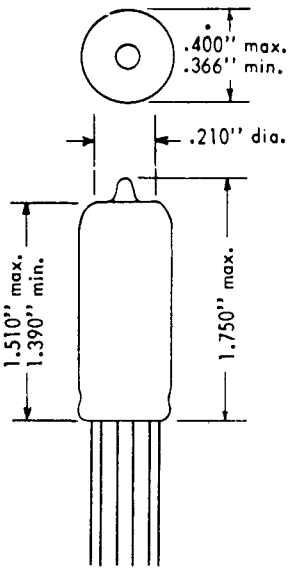
Filament Voltage	6.3±5% volts
Heater Current	450 mA
Plate Voltage	200 volts
Grid Voltage	0
Cathode Resistance	150 ohms
Plate Current	15.5 mAdc
Transconductance	10,700 μmhos
Amplification Factor	46
Grid Bias for I_b=100μAdc (Approx.)	−6.0 volts

● Note 1 Shield tied to grid.

MECHANICAL DATA

ENVELOPE..... T-3 Glass
BASE...Subminiature Button 8-Pin
(0.017" tinned flexible leads
Length: 1.5)
MOUNTING POSITION:..... Any

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Lead 1 Heater
Lead 2 Grid
Lead 3 Plate
Lead 4 Grid
Lead 5 Grid
Lead 6 Cathode
Lead 7 Grid
Lead 8 Heater

Printed in U.S.A.

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND TYPICAL OPERATION: 235 Mc GROUNDED GRID RF AMPLIFIER:

Filament Voltage	6.3 ± 5% volts
Plate Voltage	200 volts
Cathode Resistance	150 ohms
Peak RF Grid to Cathode Voltage	14 volts
Grid Current	10 mAdc
Plate Current	37 mAdc
RF Driving Power (Approx.)	0.5 watts
Useful Power Output	3.25 watts

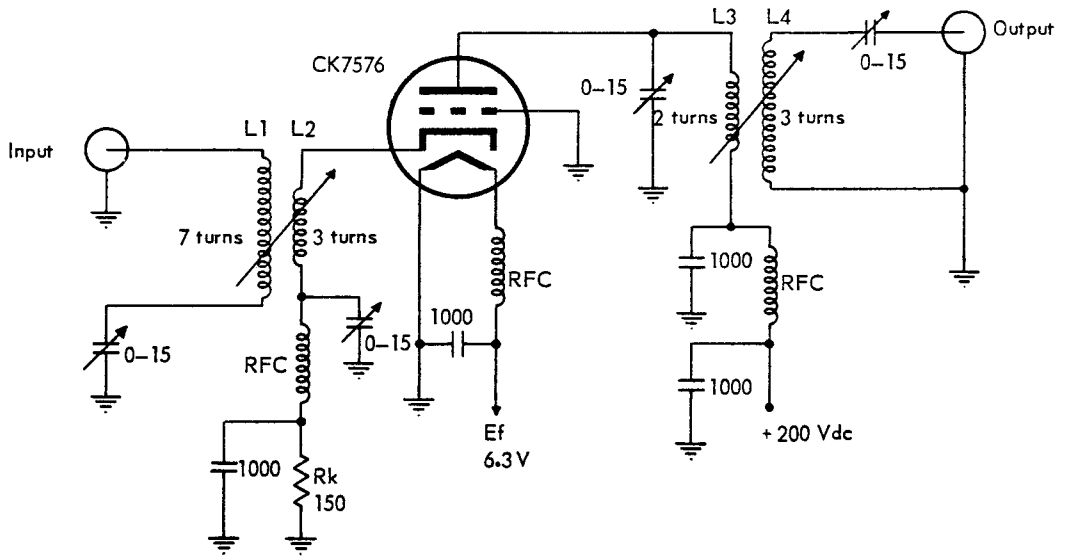


FIGURE 1

TYPICAL 235 Mc GROUNDED GRID, RF AMPLIFIER USING THE CK7576

All capacitances in micro microfarads–RFC–Z235 RF chokes.

Coils L1, L2, L3 and L4 are of #14 copper, enamel covered wire wound with an inside diameter of 5/16".

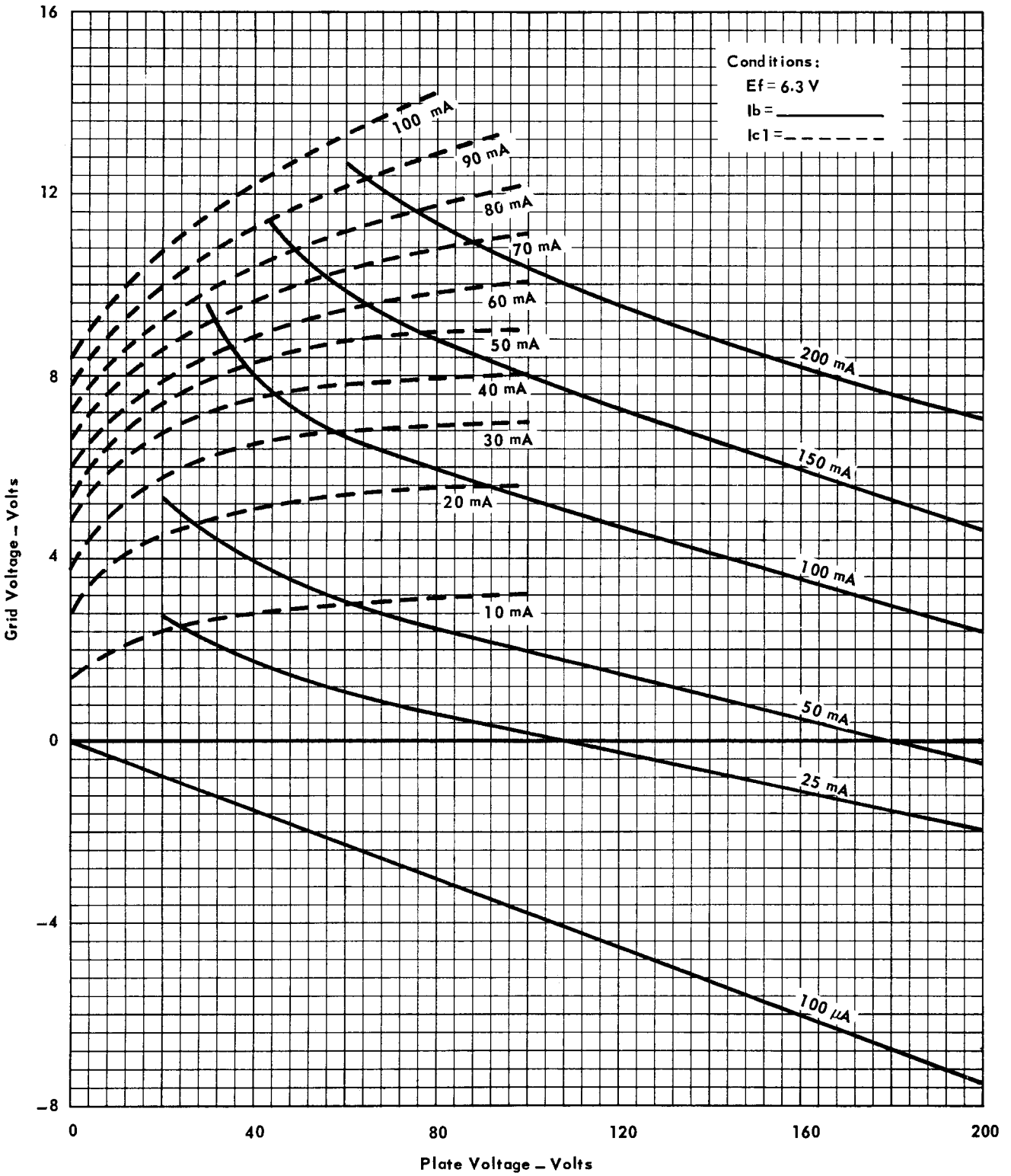
Due to the relatively high heater to cathode capacitance of the CK7576, in a grounded heater circuit of 200 to 300 MC it is necessary to resort to series tuning of the input circuit. In a circuit with the heater floating above ground by filament chokes it is possible to use parallel tuning. In the circuit shown in Figure 1, operation under Typical Operating 235 Mc Grounded Grid Amplifier, the input impedance is approximately 250 ohms. If all grid pins of the tube are grounded directly to the chassis with as short leads as possible and coupling between input and output tuned circuits is kept to a minimum, the tube will be perfectly stable.

When the tube is operated under the conditions shown under typical operation 235 Mc grounded grid amplifier, a power gain of approximately 8.5 db is obtained. With a plate supply of 250 Vdc, a power gain of approximately 10 db may be realized.

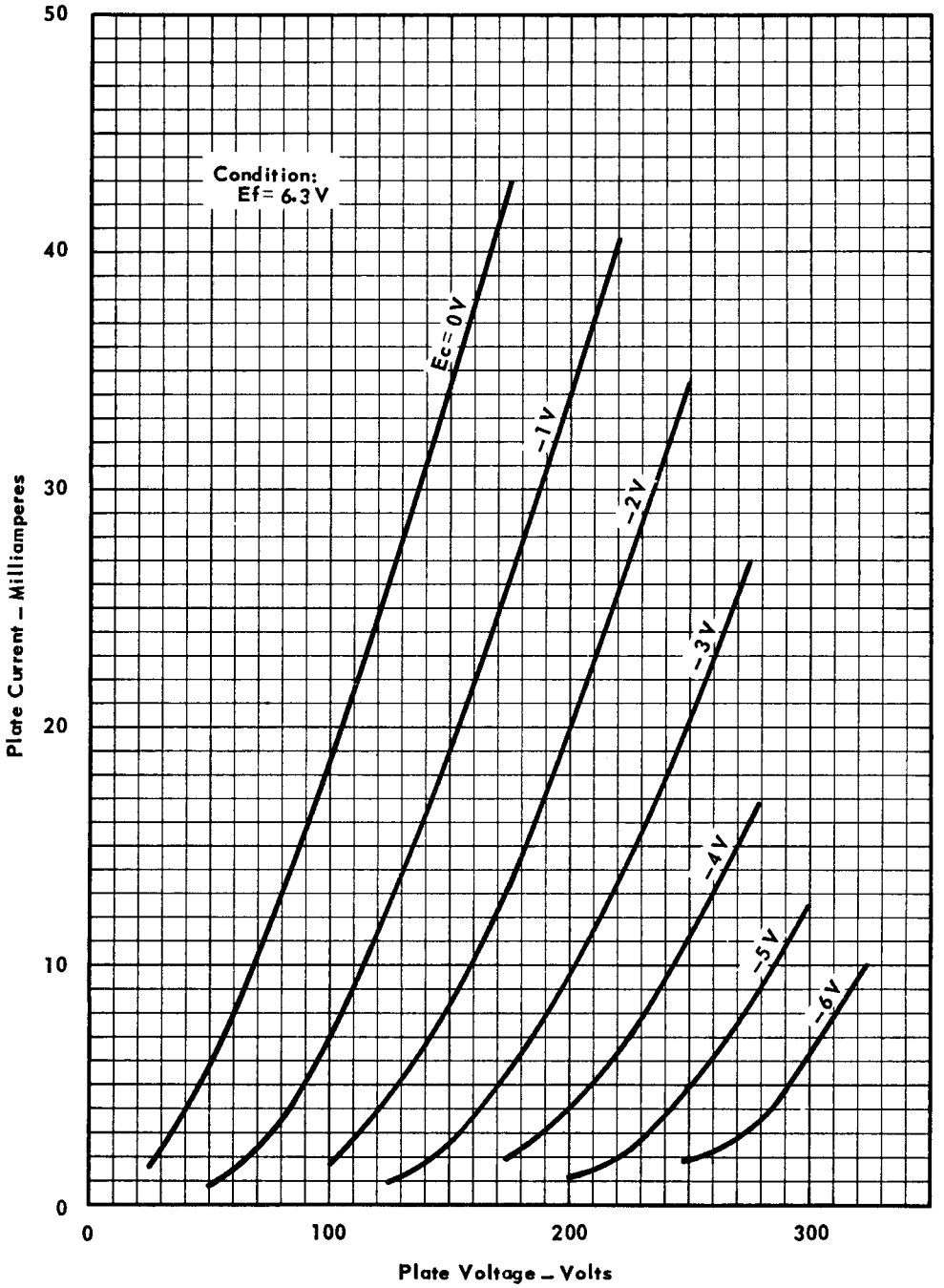
Under no circumstances should the Absolute Maximum Ratings be exceeded.

SUBMINIATURE TRIODE

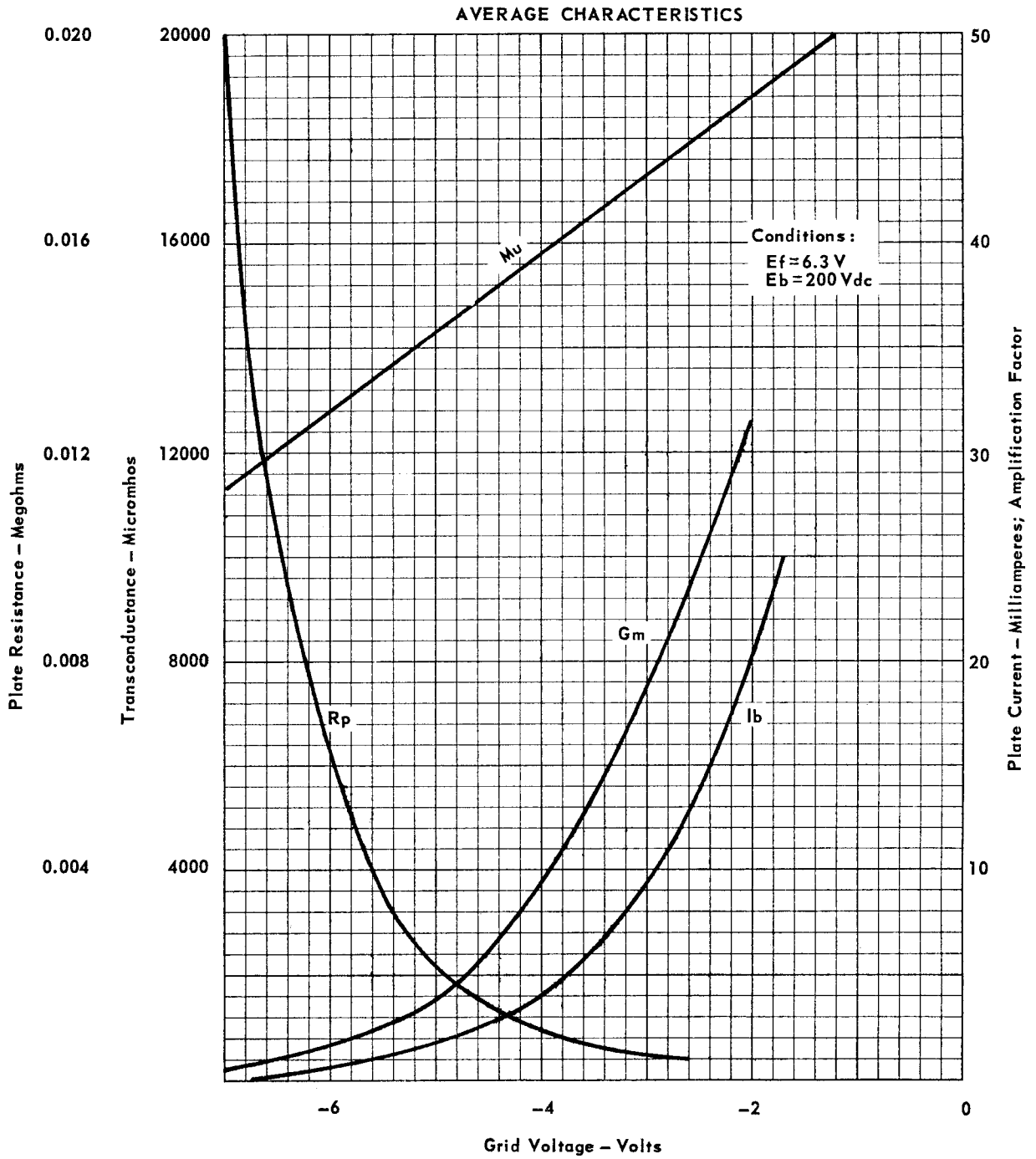
AVERAGE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



SUBMINIATURE TRIODE

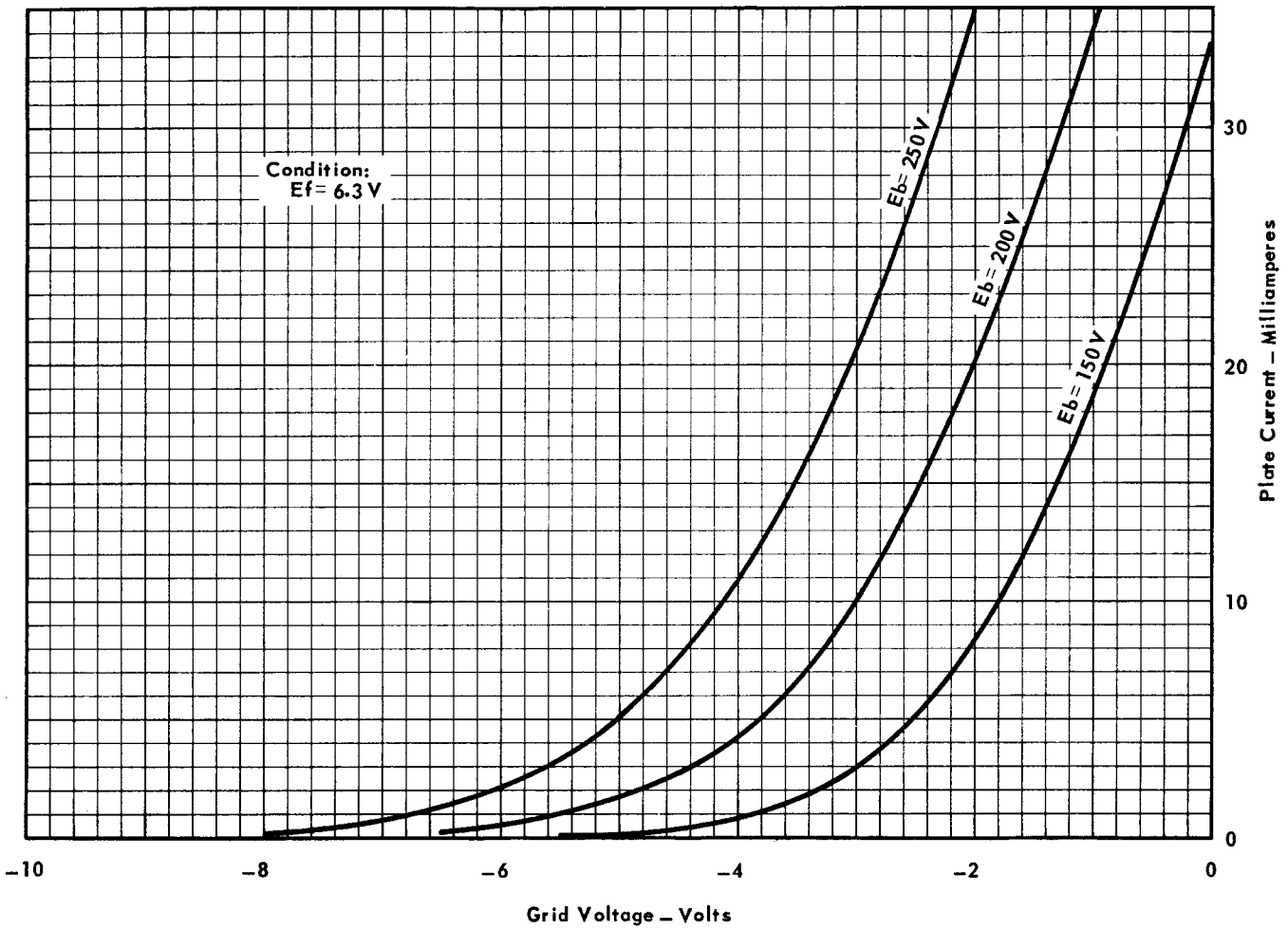


RAYTHEON

CK7576

SUBMINIATURE TRIODE

AVERAGE CHARACTERISTICS

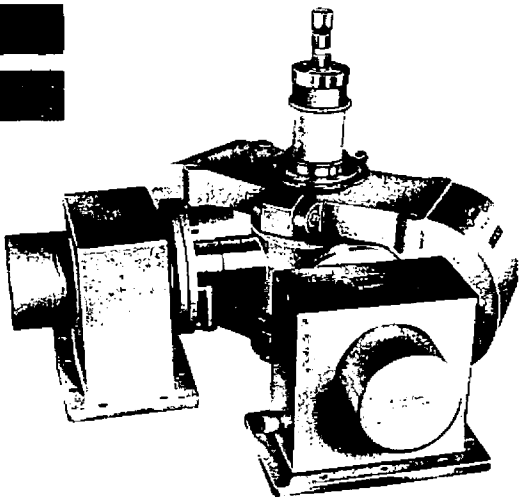


RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

The technical information on this data sheet is of a proprietory nature and is furnished as a customer service for private use only.

RK7577/QK653 PRELIMINARY DATA SHEET

RAYTHEON



GENERAL DESCRIPTION

The RK7577/QK653 is a pulsed-type Amplitron capable of producing a minimum peak power of 5.3 megawatts when an rf drive power of no less than 400 kilowatts is applied to its input. When used with a modulator having proper load line characteristics, such as a "line type" modulator, it will cover the frequency band 1280 to 1350 Mc without electrical or mechanical adjustment. It is an integral magnet type tube with waveguide input and output. It requires forced liquid cooling.

Reliable operation and optimum Amplitron life can be achieved only if the radar transmitter is designed with the Amplitron characteristics and peculiarities clearly in mind. This preliminary data sheet is intended only to acquaint the reader with the basic characteristics of this Amplitron and should not be used solely in the system design. The data herein presented a representative of only a small number of prototype models and should not be interpreted as necessarily defining the characteristics of the final tube.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	120 Lbs.
Cooling	Liquid
Input Bushing	Oil Immersed
Pressurization	30 psia Min.
RF Couplings	Waveguide

Typical Electrical Data

Heater Current, Preheat	60 Amperes *
Heater Current, Operate	0 Amperes
Heater Voltage @ 60 A	3.8 Volts *
Pulse Duration	1.8 usec
Duty Cycle	.00068
Peak Anode Voltage	97 kilovolts
Peak Anode Current	98 Amperes
Average Power Output	3600 Watts
Life	1000 Hours Min.
Driver Peak Power	400 kilowatts, Min.
Driver Pulse Duration	1.9 usec, Min.

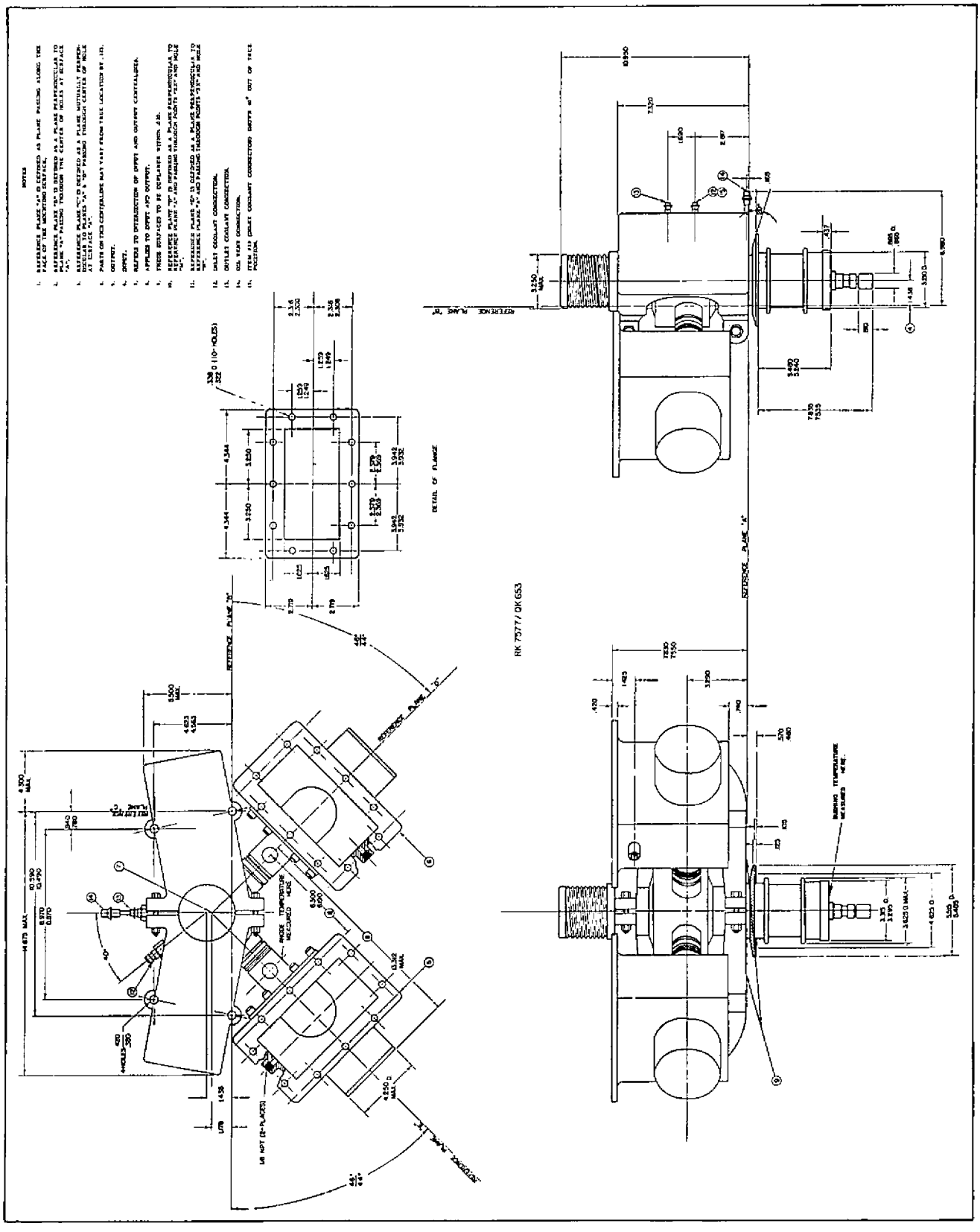
* Not final values

from JEDEC release #3478, Nov. 6, 1961

The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

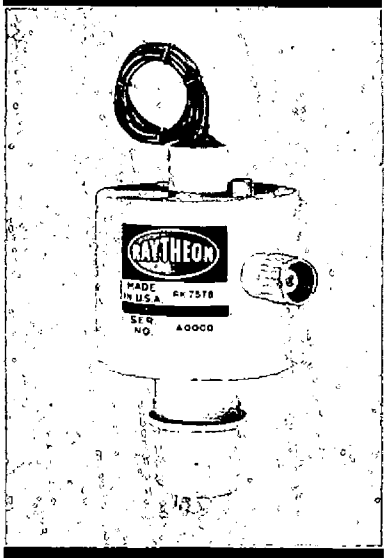
preliminary data sheet.

RAYTHEON



RAYTHEON COMPANY	MICROWAVE AND POWER TUBE DIVISION	WALTHAM 54, MASS.

TYPE RK 7578



PULSED-TYPE MAGNETRON OSCILLATOR

GENERAL DESCRIPTION

The RK7578 is a mechanically tunable pulsed-type magnetron oscillator delivering a minimum peak power output of 800-1200 watts. It is capable of being tuned to any frequency within the 5400 to 5900 Mc range.

The RK7578 is small (1.75" dia. x 3.5") lightweight (14 ounces) and has been designed primarily for missile beacon transponder applications where extreme environmental conditions are encountered. The RK7578 is capable of sustaining shock acceleration of 100G and vibrational acceleration during operation of 15G at frequencies up to 2000 cycles per second.

GENERAL PRECAUTIONS

The precautions to be observed during the application of the RK7578 magnetron are the same as for any oscillator of this type. Experience has indicated that the areas where application problems frequently arise include the magnetron voltage pulse shape — particularly its rate of rise, the load VSWR, and anode current regulation. It is recommended that the Applications Engineering Department be consulted regarding the details of any contemplated equipment design utilizing the RK7578.

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Voltage — Preheat and Operate	4.5 to 5.5 Volts
Heater Current	1.75 Ampere at 5.0 Volts
Minimum Preheat Time	30 Seconds
Temperature Coefficient	±0.1 Mc/°C Maximum
Operational Altitude	70,000 Feet Maximum
Operational Vibration Frequency Deviation at 15G, 20 to 2000 cps	1.5 Mc Peak to Peak Maximum
Frequency Shift Due to Shock 100G, 1 Millisecond	1 Mc Maximum
Frequency Shift Due to 100G Acceleration	1 Mc Maximum

Typical Operation

Pulse Duration	0.25 to 0.75 Microseconds
Duty Cycle	.000025 to .002
Peak Anode Current	2.0 Amperes
Peak Anode Voltage	2.8 Kilovolts
Peak Power Output	800-1200 Watts
Voltage Rise Time (20 to 85%)	0.11 us

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

from JEDEC release #3471, Oct. 30, 1961

DETAILED MECHANICAL INFORMATION

MOUNTING

The tube may be mounted in any position and must be supported by a suitably designed holder made of non-ferrous material which will utilize the diameter of the tube for support. Magnetic material should be mounted within 2 inches of the tube.

INPUT CONNECTIONS

Two flexible leads approximately 5 inches long provide connections for heater voltage and pulse voltage. One lead is black, the other red. The red lead is the common heater-cathode to which negative high voltage should be connected. A "ground" lug on the body of the tube provides for positive high voltage connection.

R.F. OUTPUT COUPLING

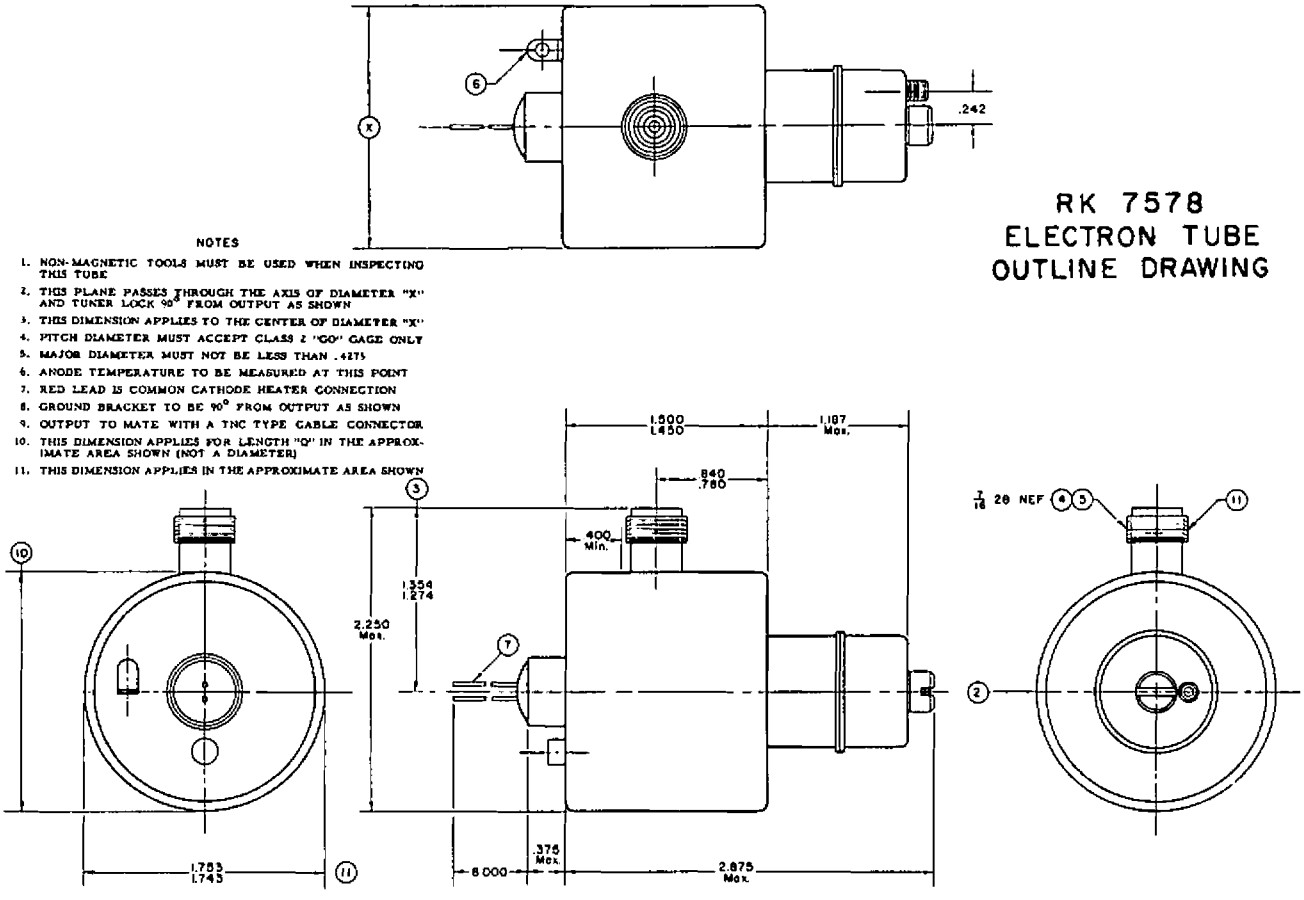
Mates with TNC coaxial Fitting or TNC to ¾" x1½" or 1" x 2" O.D. Waveguide Transition.

TUNER

The tuning mechanism is actuated by a screwdriver adjustable shaft. A set screw is provided to lock the shaft in position prior to the subjection of the tube to environmental conditions. Care should be taken not to mechanically tune the tube beyond the extremes of its normal operating range, 5400 to 5900 Mc.

DIMENSIONS

Figure 1 is the mechanical outline drawing.



NOTES

1. NON-MAGNETIC TOOLS MUST BE USED WHEN INSPECTING THIS TUBE
2. THIS PLANE PASSES THROUGH THE AXIS OF DIAMETER "X" AND TUNER LOCK 90° FROM OUTPUT AS SHOWN
3. THIS DIMENSION APPLIES TO THE CENTER OF DIAMETER "X"
4. PITCH DIAMETER MUST ACCEPT CLASS 2 "GO" GAGE ONLY
5. MAJOR DIAMETER MUST NOT BE LESS THAN .4275
6. ANODE TEMPERATURE TO BE MEASURED AT THIS POINT
7. RED LEAD IS COMMON CATHODE HEATER CONNECTION
8. GROUND BRACKET TO BE 90° FROM OUTPUT AS SHOWN
9. OUTPUT TO MATE WITH A TNC TYPE CABLE CONNECTOR
10. THIS DIMENSION APPLIES FOR LENGTH "Q" IN THE APPROXIMATE AREA SHOWN (NOT A DIAMETER)
11. THIS DIMENSION APPLIES IN THE APPROXIMATE AREA SHOWN

RK 7578
ELECTRON TUBE
OUTLINE DRAWING

Figure 1

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7626

SUBMINIATURE PENTODE

The CK7626 is a filament type pentode power amplifier of subminiature construction designed for R.F. Amplifier and frequency multiplier service in portable and mobile equipment. The CK7626 is suitable for intermittent service applications such as "push to talk" transmitters which do not require long life characteristics. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

FILAMENT RATINGS:

Filament Voltage	1.25	Volts
Filament Current	0.125	Amps

DIRECT INTERELECTRODE CAPACITANCE: (Unshielded)

Grid to Plate: (g1 to p)	.10	uuf
Input: (g1 to -f + g2 + g3)	3.2	uuf
Output: (p to -f + g2 + g3)	2.9	uuf

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc) #	1.1-1.4	Vdc
Plate Voltage	135	Vdc
Grid #2 Voltage	135	Vdc
Cathode Current	12	mAdc
Plate Dissipation	1.1	Watts
Grid #2 Dissipation	0.4	Watts
Grid #1 Voltage	-55	Vdc

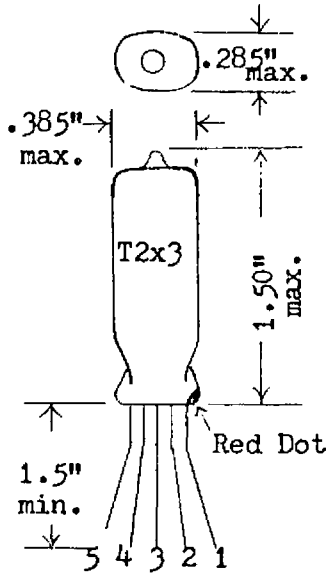
TENTATIVE DATA

from JEDEC release #3843, Aug. 13, 1962

MECHANICAL DATA

ENVELOPE...T2x3 glass
OUTLINE...JEDEC 2-1
(MIL 8-8)
BASE...Pinch Press
LEADS...0.016" tinned
Flexible Leads
Leads 0.048"
Center-to-Center
MOUNTING POSITION..
ANY

OUTLINE DETAILS



TERMINIAL CONNECTIONS:
Lead 1 Plate(red dot)
Lead 2 Grid #2
Lead 3 Filament
Negative △, G3
Lead 4 Grid #1
Lead 5 Filament
Positive, ∠ G3

Printed in U.S.A.

RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts 1 January 1960

CHARACTERISTICS AND TYPICAL OPERATION: Class "C" R.F. Amplifier at 175 Mc

Plate Voltage	120	Vdc
Grid #2 Supply Voltage	120	Vdc
Plate Current	10	mAdc
Grid #2 Current	2	mAdc
Grid #1 Current	0.2	mAdc
Power Output	600	mW
Grid #1 Circuit Resistance	100	Kilohms
E Signal (RMS)	16	Vac
Grid #2 Resistance	--	--
Adjust for Ik = 12 mAdc	--	--

CHARACTERISTICS AND TYPICAL OPERATION: Class "A" Amplifier

Plate Voltage	110	Vdc
Grid #2 Voltage	110	Vdc
Grid #1 Voltage	-6	Vdc
Plate Current	7.0	mAdc
Grid #2 Current	1.1	mAdc
Transconductance	1950	umhos

△ Grid #3 is comprised of two separate deflector plates, one of which is connected to lead 3 and the other to lead 5.

* Operation at all maximum ratings simultaneously is not permitted.

\# Operation at reduced filament voltage requires derating of Absolute Maximum values.

TENTATIVE DATA

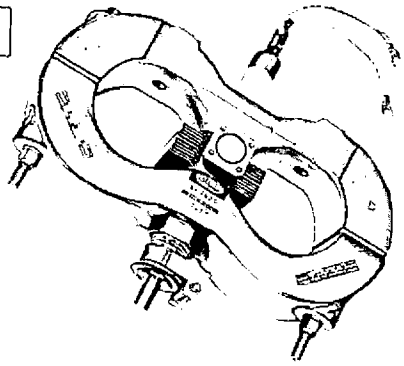
1 January 1960

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RK7630/QK702 | **PRELIMINARY**

DATA SHEET

RAYTHEON — *Excellence in Electronics*



GENERAL DESCRIPTION

The RK7630/QK702 is a tunable, medium power, pulsed type oscillator capable of delivering 70 kilowatts of peak power. The RK7630/QK702 is tunable within the frequency region of 15,840 - 16,160 megacycles. The magnetron is an integral magnet, waveguide output type tube requiring forced air cooling and is designed for coupling to standard RG 91 U waveguide (0.702 x 0.391).

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	26 Lbs.
Cooling	Forced Air
Output Pressurization	Required (25 psia Min.)

Electrical Data

Heater Voltage - Preheat/180 sec	4.8 Volts
Heater Current at 4.8 Volts	10.8 - 13.2 Amperes
Voltage Rise Time	.09 to .14 usec
R. F. Bandwidth	2.0/tpc Max.
Maximum V.S.W.R.	1.5

Typical Operation

Pulse Duration	0.25 usec
Duty Cycle	.00215
Average Anode Current	26 Milliamperes
Average Power Output	150 Watts (Min.)
Peak Anode Voltage	24 KV

Reliable operation and maximum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics clearly in mind. This preliminary Data Sheet is intended as an introduction to this type magnetron and not as an absolute guide to users. Inquiries on this magnetron and its application should be directed to the Applications Engineering Department at Raytheon Company, Waltham, Massachusetts.

The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/ or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

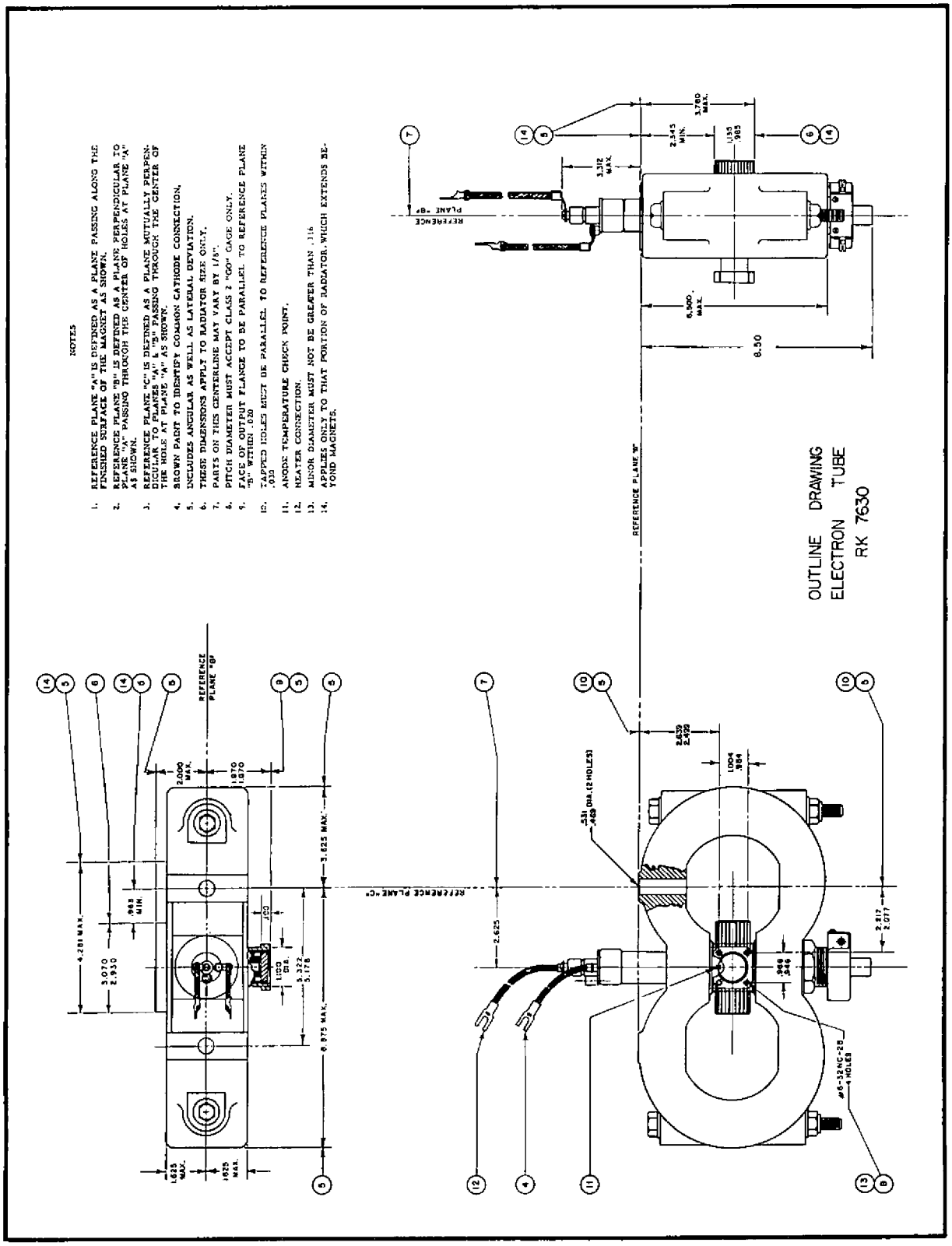
RAYTHEON

Excellence in Electronics

preliminary data sheet

NOTES

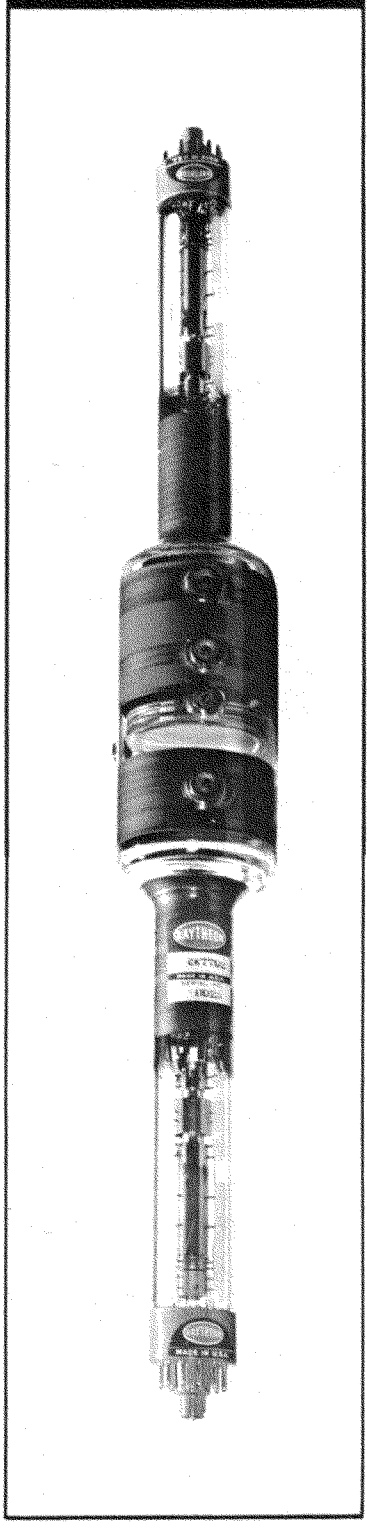
1. REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FINISHED SURFACE OF THE MAGNET AS SHOWN.
2. REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO PLANE "A" PASSING THROUGH THE CENTER OF HOLES AT PLANE "A" AS SHOWN.
3. REFERENCE PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO PLANES "A" AND "B" AND PASSING THROUGH THE CENTER OF THE HOLE AT PLANE "A" AS SHOWN.
4. BROWN PAINT TO IDENTIFY COMMON CATHODE CONNECTION.
5. INCLUDES ANGULAR AS WELL AS LATERAL DEVIATION.
6. THESE DIMENSIONS APPLY TO RADIATOR SIZE ONLY.
7. PARTS ON THIS CENTERLINE MAY VARY BY 1/8".
8. PITCH DIAMETER MUST ACCEPT CLASS 2 "GO" GAGE ONLY.
9. FACE OF OUTPUT FLANGE TO BE PARALLEL TO REFERENCE PLANE "B" WITHIN .020
10. TAPPED HOLES MUST BE PARALLEL TO REFERENCE PLANES WITHIN .030
11. ANODE TEMPERATURE CHECK POINT.
12. HEATER CONNECTION.
13. MINOR DIAMETER MUST NOT BE GREATER THAN .116
14. APPLIES ONLY TO THAT PORTION OF RADIATOR WHICH EXTENDS BEYOND MAGNETS.



OUTLINE DRAWING
ELECTRON TUBE
RK 7630

Excellence in Electronics

TYPE CK7702



The CK7702 is a dual–gun cathode–ray recording storage tube capable of simultaneous writing and reading. It is an electronic input–electronic output storage device which combines high output signal with high resolution. The major application is scan conversion such as radar PPI to television type presentation. This makes possible bright video display, with high resolution and adjustable automatic priming or erasing, which may be used to generate target trails indicating elapsed time position.

Stored signals can be held for many hours, read several thousand times, or erased in a fraction of a second if desired. The storage capabilities permit additional coherence of target information under conditions of high noise levels.

Both the writing and reading guns use magnetic deflection and can be operated with either electrostatic or magnetic focus or a combination of both.

The design of the tube results in a wide dynamic range of gray shades fast writing speeds, and selective erasure of the stored information is desired.

GENERAL CHARACTERISTICS

Gun Locations	Co–axial
Gun Type (Both Guns)	Tetrode High Resolution
Deflection (Both Guns)	Magnetic
Max. Deflection Angle (Both Guns)	30°
Focusing	Electrostatic or Magnetic
Mounting Position	Any
Resolution (Magnetic Focus) TV lines per diameter	1200 lines minimum
Resolution (Electrostatic Focus) TV lines per diameter	800 lines nominal
Output Capacitance (Collector & Write Decelerator to all other elements)	19 $\mu\mu f$ (approx.)
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Seated Length	22 7/8" Nominal
Bulb Diameter	3" Maximum
Neck Diameters	1 1/2" Maximum
Bases (Both Ends)	Special High Altitude MI #5025
Storage Assembly Buttons	JEDEC Type J1–22

ELECTRICAL CHARACTERISTICS

HEATER:

Heater Voltage	6.3+ 10% volts
Heater Current	0.6 amp.

RATINGS–ABSOLUTE MAXIMUM VALUES:

Anode Voltage	4000 Vdc
Grid Voltage Positive	0 Vdc
Grid Voltage Negative	–150 Vdc
Grid #2 Voltage	700 Vdc
Inter Screen Voltage (Between any pair)	500 Vdc
Anode #2 (Focus) Electrode Voltage	4000 Vdc
Grid Circuit Resistance	0.5 Meg.
Heater Cathode Voltage	
Heater Positive	+ 10 Vdc
Heater Negative	–125 Vdc

Tentative Data

Printed in U.S.A.

TYPICAL OPERATING CHARACTERISTICS

The CK7702 may be operated sequentially through erasing, priming and writing. Conditions for this type of operation are shown in Mode #1. Reading in this mode can be simultaneous if desired, by scanning with the read beam in operation during the write voltage conditions.

Mode #2 describes operation of the tube with the automatic prime (erase) feature. This permits simultaneous reading with controllable erasure.

WRITE GUN (Magnetic Deflection) See Note 5

	MODE #1	MODE #2
Cathode	0 Vdc	0 Vdc
G–1 Cut–off	–40 Vdc	–40 Vdc
G–2	400 Vdc	400 Vdc
Anode	3500 Vdc	3500 Vdc
Focus Electrode (Note 1)	400 Vdc	400 Vdc
Focus Electrode (Note 2)	3500 Vdc	3500 Vdc
Collimating Lens	300 Vdc	300 Vdc
Write Decelerator	500 Vdc	Variable See
Collector	500 Vdc	Note 4

READ GUN (Magnetic Deflection) See Note 5

Cathode	Ekr Note 3	200 Vdc
G–1 Cut–off	Ekr–110 Vdc	+110 Vdc
G–2	Ekr+400 Vdc	600 Vdc
Anode	Ekr+3500 Vdc	3700 Vdc
Focus Electrode (Note 1)	Ekr+400 Vdc	600 Vdc
Focus Electrode (Note 2)	Ekr+3500 Vdc	3700 Vdc
Decelerator	Ekr+500 Vdc	700 Vdc
Collimating Lens 1	Ekr+500 Vdc	700 Vdc
Collimating Lens 2	Ekr+300 Vdc	500 Vdc
Storage Screen	Ekr+5 Vdc	205 Vdc

Note 1: If electrostatic focus is used.

Note 2: If magnetic focus is used.

Note 3: In Mode #1, the read cathode gun potential will be switched during the various operations.
The values of Ekr (voltage from write cathode to read cathode) are as follows:

Erase	+300 Vdc
Prime	+10 Vdc
Write and Read Simultaneous	+300 Vdc

Note 4: Gradual automatic priming is controllable by varying the value of collector and decelerator voltage from 500 Vdc (for slow erasing) down to 200 Vdc (for fast erasing). The same effect may also be achieved by varying the value of read cathode from 200 Vdc (for slow erasing) to 500 Vdc (for fast erasing) while keeping all read gun voltages the same with respect to read cathode.

Note 5: Deflection drive in at least one direction must be applied to both guns whenever the tube is conducting to avoid damage to the storage assembly.

DETAILED ELECTRICAL INFORMATION

In Mode #1 operation in order to erase and write a picture on the storage screen, the storage screen must be about 300 Vdc positive with respect to the write gun cathode. For priming the storage screen must be about 30 Vdc positive to the write gun cathode. While all of these modes are in operation, the storage screen must remain about 20 volts positive with respect to the read gun cathode.

In Mode #2 one technique for simultaneous writing and reading is RF modulation of the read beam. The output signal is obtained from the collector and write decelerator. Video cancellation techniques may also be practical.

PRINCIPLES OF OPERATION

When an electron beam strikes any material, secondary electrons are emitted. The quantity of secondary electrons emitted is a function of the velocity of the primary electron beam.

The secondary electron emitting surface in the Recording Storage Tube is a dielectric that has been deposited on a metal mesh or screen. Figure 1 illustrates this storage screen mesh. This screen has more than 2000 cross wires per diameter.

Figure 2 shows the characteristic curve for secondary to primary emission ratio for the dielectric material used. Since the velocity of the electron beam will be proportional to the voltage on the dielectric material the ordinate of velocity in Figure 2 can be voltage. The crossover, called critical potential, where the secondary to primary ratio is unity occurs at approximately 50 volts.

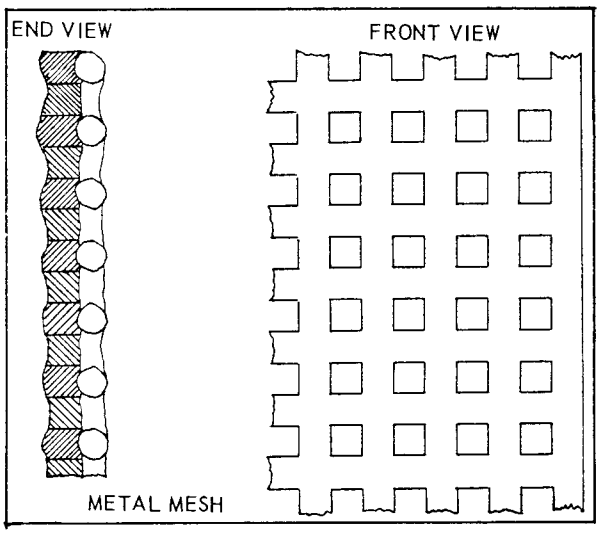


FIGURE 1
MAGNIFIED SECTION OF STORAGE SCREEN

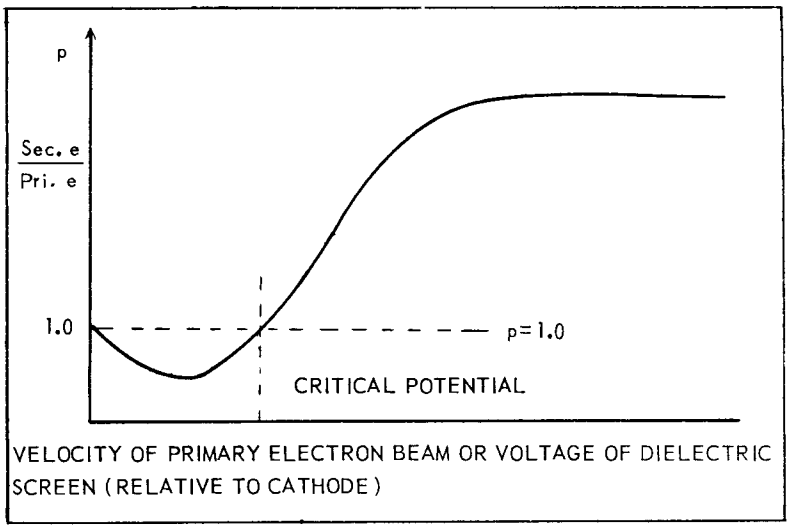


FIGURE 2
SECONDARY EMISSION CHARACTERISTIC
OF RECORDING STORAGE TUBE DIELECTRIC

Using the secondary emission character shown by Figure 2, the dielectric screen surface can be discreetly charged or discharged as a function of the potential on the metal screen and the position and magnitude of the primary electron beam.

The various modes of operation are described as follows:

PRIME - This is the basic form of erasure and prepares the storage screen for subsequent writing. It is accomplished by scanning the storage screen dielectric with an unmodulated beam. The storage screen mesh is operated at a voltage below critical potential and since the secondary to primary emission ratio is less than unity the dielectric surface can store electrons and become negatively charged to cathode gun potential. A total prime can be used if complete erasure of old patterns is desired or a partial prime can be used if it is desired to gradually decrease old signals in

PRIME (cont'd.)
amplitude (e.g.: to generate target trails in radar). Selective priming of only part of the storage screen can be accomplished by only scanning the area where it is desired to erase previously stored information. Typical storage screen voltage for prime is +20 volts.

WRITE - "Writing" of the charge pattern is accomplished by modulation of a scanning electron beam and operation at a storage screen voltage that yields a high secondary to primary emission ratio. This is any voltage above critical potential and is nominally 300 volts for fastest writing speeds. Since during the prime mode the dielectric surface was negatively charged, the surface is discreetly discharged towards the positive direction by the writing beam. As the modulated beam scans over the surface varying amounts of secondary electrons depending on the instantaneous beam amplitude are emitted at the surface and the stored pattern is established. Fastest writing time is approximately .01 usec. per stored element for max. stored signal.

READ - Once a charge pattern has been written in, it can be read out by scanning the storage screen with an unmodulated beam. The storage screen is operated at 5 to 15 volts, with respect to the reading gun cathode. The dielectric surface with its charged pattern is now actually negative with respect to the electron gun cathode. Depending on the charged pattern the electron beam is therefore modulated as it passes through the storage screen to the collector element. By selecting the proper storage screen voltage the most negative areas of the dielectric (established by the prime mode) can completely cut off the electron beam from the collector and thus the "black" level is established. Various gray shades will appear in any areas where the dielectric is less negative. This is shown in Figure 3.

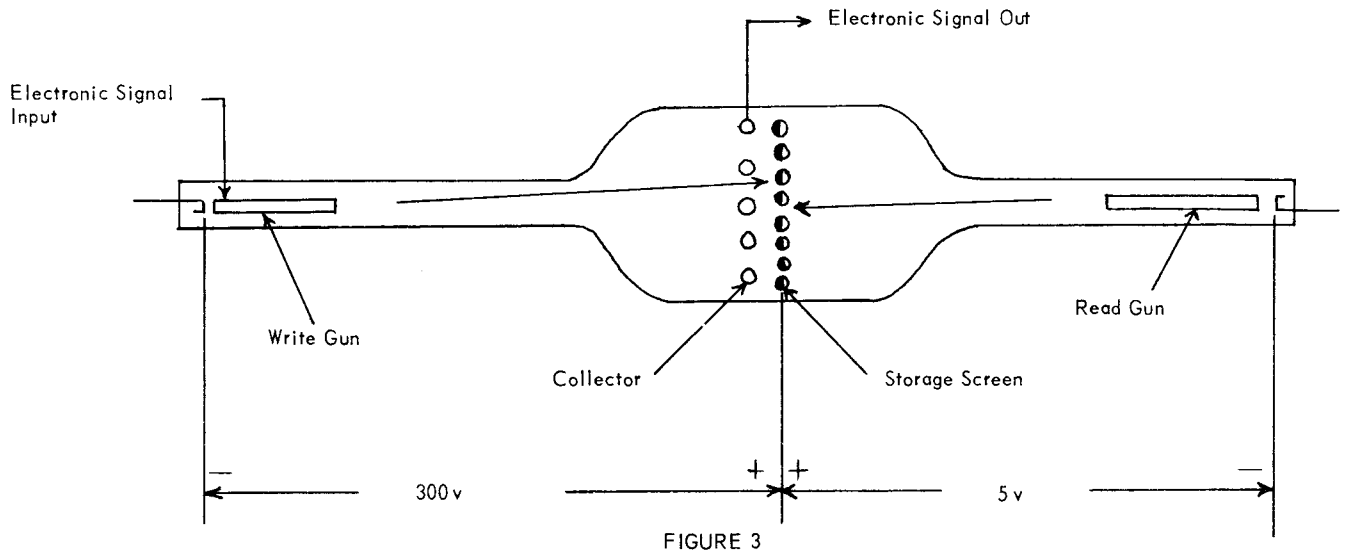


FIGURE 3
TWO GUN RECORDING STORAGE TUBE – SIMPLIFIED DRAWING

READ (cont'd.)

Long storage time with readout is possible because the storage dielectric in the read mode is negative with respect to the electron gun cathode and therefore the electron beam does not strike the dielectric surface.

Simultaneous Write and Read modes are possible with the use of two electron guns. This is desirable in most scan-conversion applications. Since two independent potentials can be maintained on the storage screen with respect to the two electron gun cathodes, the tube can be truly writing a charge pattern and reading it at the same time.

Since the collector is a metal screen that is scanned across by the writing beam some write information signal appears in the collector output. This can be removed by cancellation techniques or by use of RF modulation of the reading beam. The signal output by the RF method is an RF carrier signal with the charge pattern as amplitude modulation. It can be amplified with usual RF amplifiers and detected for subsequent display. Usual RF frequencies used are 30 mc. or 60 mc.

ERASE - Where total erasure is needed, it is frequently desirable to operate the tube in the positive erase mode. To accomplish this, the storage screen voltage is set at or above the value used for Write and the storage surface is scanned with an unmodulated electron-beam. This action discharges any stored pattern, bringing the whole storage surface to a uniform equilibrium potential. The tube must then be primed prior to subsequent writing.

SPECIAL APPLICATION NOTES:

AUTOMATIC PRIME - During simultaneous writing and reading the tube can be operated at conditions that will allow either short or long storage of the charge pattern. It can also be variable for storage time between the two limits. Thus, in PPI to TV scan-conversion, target trails can be generated and the length of these trails are controllable by adjusting the storage time. This gradual automatic prime is obtained by varying the value of collector voltage from a high voltage for long storage (slow Prime) to a low voltage for short storage (fast Prime).
The priming is accomplished by some of the electrons between the collector and storage screen dielectric returning to the dielectric to recharge it negatively in the specific areas where the negative charge was reduced by the written-in pattern.

COLLIMATION - Electrostatic lenses and deceleration screens are provided to collimate the beam as it arrives in the region of the storage screen. For optimum shading characteristics the reading and writing beam should arrive at the storage screen dielectric orthognally to it. The voltage on the lenses should therefore be adjusted for the most uniform background shading.

SHIELDING - Since any extraneous fields will cause unwanted deflection, it is recommended that good magnetic and electrostatic shielding techniques be used in the design of the tube mount.

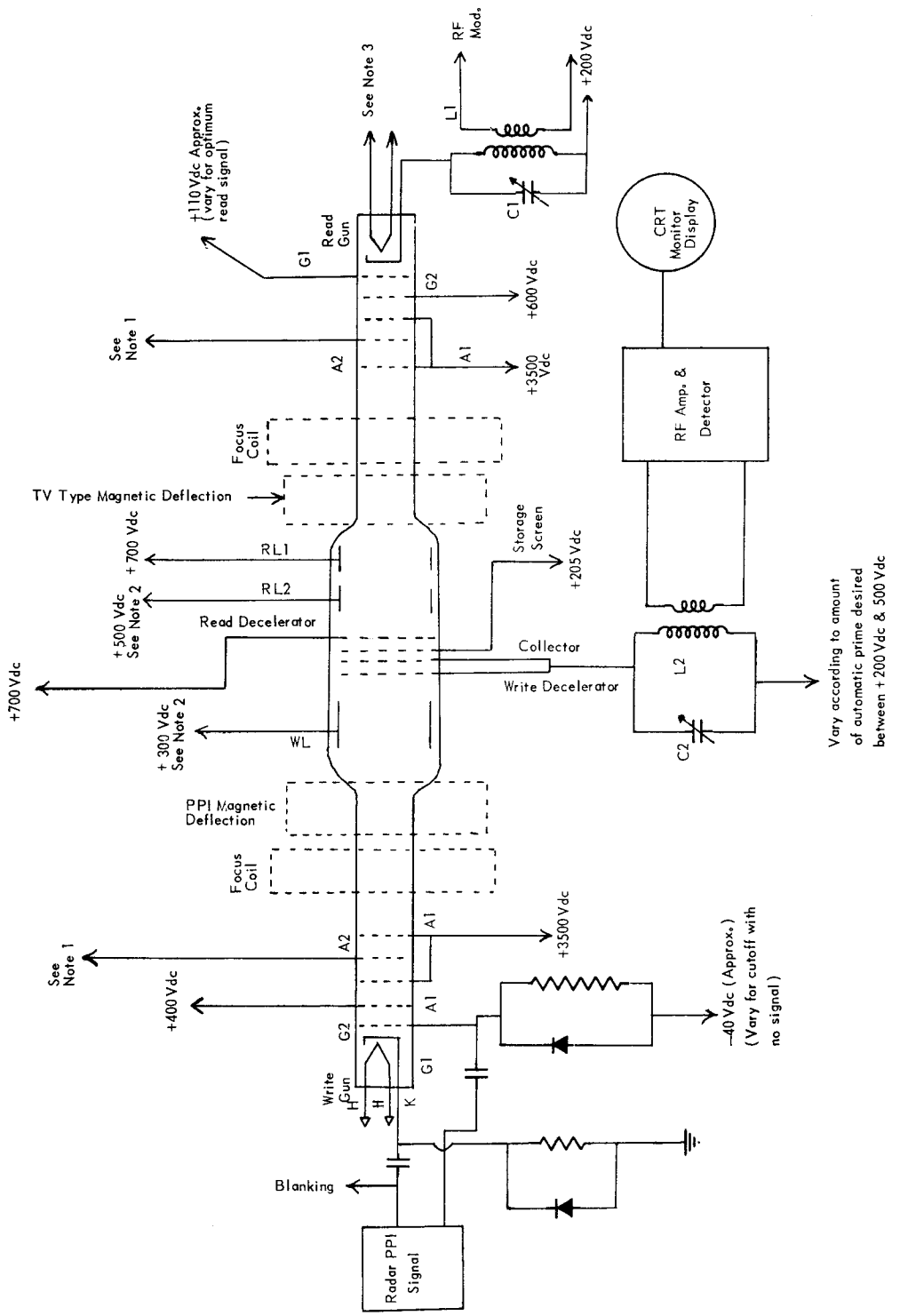
RESOLVING POWER - The resolution of the storage tube at the 50% modulation level is usually in excess of 1200 lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coil magnetic shell is designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed.

STORAGE ABILITY - The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current. When reading with a low beam current of about 0.2 uA at a television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal. The tube is capable of storing information for many hours withour appreciable change or deterioration when not reading.

FOCUSING TECHNIQUE - This tube can be focused electrostatically, magnetically or using a combination of fixed focus by one technique and dynamic focus correction by the second. Magnetic dc focusing provides higher resolution than does electrostatic but frequently requires more power. When magnetic focusing is being used, the focus electrode is set at anode potential; when electrostatic focusing is being used, the focus electrode is typically set at 400 Vdc when the anode is set at 3500 Vdc. The recommended technique for dynamic focusing is to apply 1000 to 1500 Vdc to the focus electrode, then adjust the magnetic focus for optimum resolution near the center of the storage target, and finally apply the base clamped parabolic correction waveform to the focus electrode such that the edges of the target are brought into focus. Approximately 350 Vac peak to peak correction is necessary to maintain focus as the beam is scanned across the diameter of the target at the above focus electrode voltage.

TYPICAL SCHEMATIC

Radar PPI to TV Scan Conversion, Simultaneous Write and Read with automatic prime (erasure) and RF separation.



NOTES FOR SCHEMATIC OUTLINE

Note 1: If electrostatic focus only is used A2 voltage should be adjusted for optimum focus, approximately +400 Vdc. If magnetic focus is used A2 should be approximately +3500 volts. Best resolution can be obtained by dynamic focusing. This can be obtained by either of the following methods:

Since the storage tube anode voltage is considerably lower than most magnetically focused cathode ray tubes, a non-astigmatic focus coil is recommended where high resolution is desired. Resolution near the edges of the storage area can be further improved by use of dynamic focusing. (A focus coil providing both these features is being manufactured by Raytheon for use with the CK7702. It is designated as coil #BM411).

Since the dynamic focus correction is a function of the displacement of the electron beam from the axis of the tube at any instant, it can be generated from an output equivalent to the algebraic sum of two parabolas generated from the horizontal and vertical sweeps respectively.

It is suggested that the dc focus be provided from a constant current source to minimize focus drift caused by the change in resistance of the focus coil during warmup.

Dynamic focus correction can also be obtained with a combination of magnetic and electrostatic focus. A parabolic wave shape is superimposed on the electrostatic focus element A2. The DC value of A2 under this condition will be approximately +1200 volts.

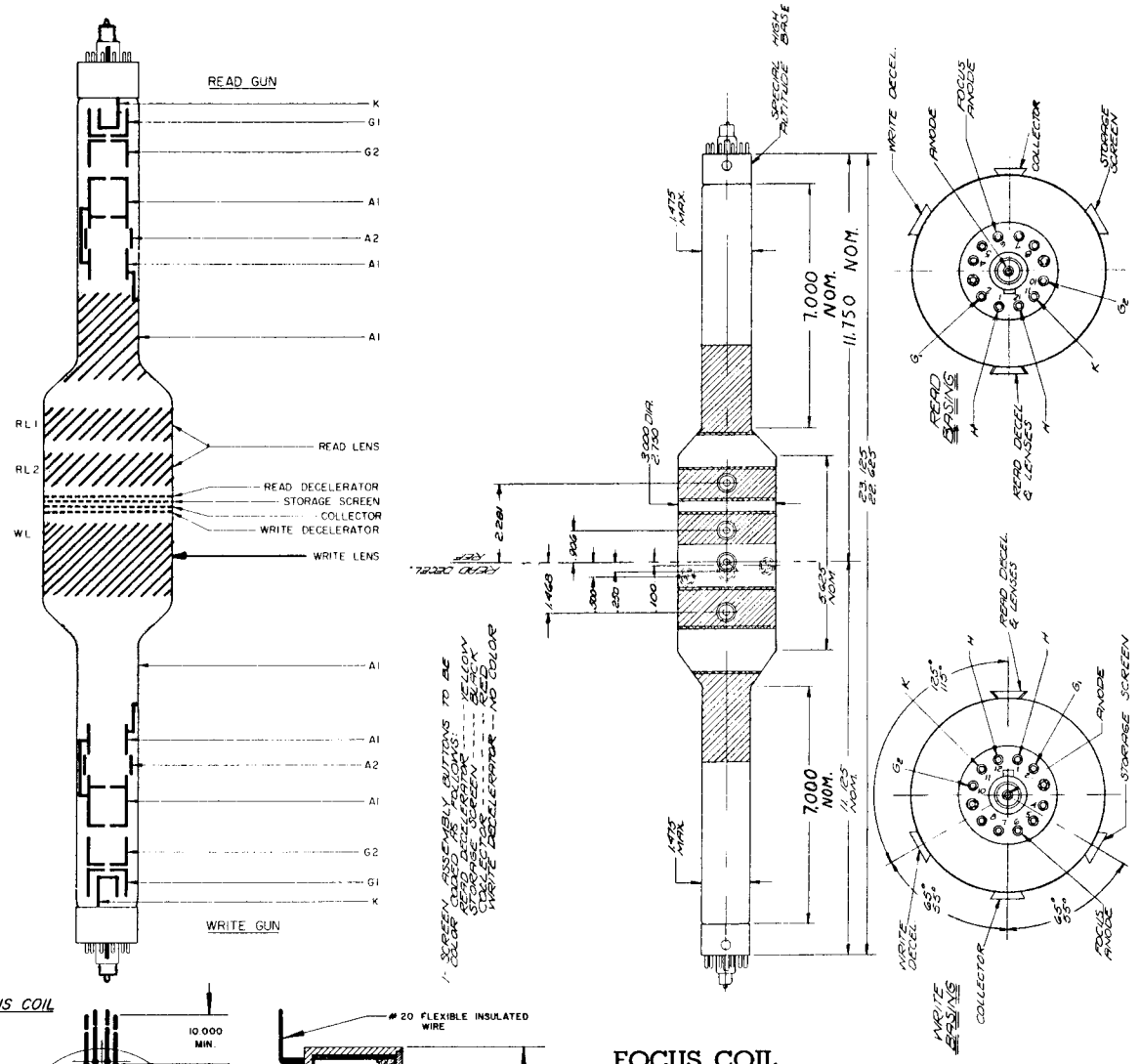
Note 2: Vary for most uniform background of stored video information.

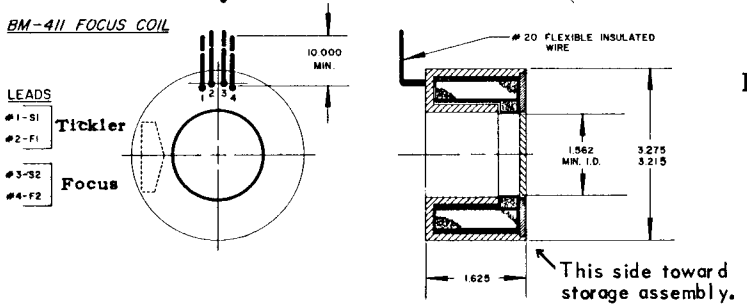
Note 3: The maximum heater cathode voltage rating should be adhered to. An isolated heater supply should be used for the read gun.

Note 4: L1 C1 is provided to permit RF modulation of the read current. The frequency of the RF used is typically 30 or 60 megacycles. L2 C2 is a tuned circuit to permit reading of the RF signal output. Its band pass should be sufficient to pass all video frequencies desired. C2 is a combination of the collector and accelerator capacitance to all other elements and an adjustable capacitor.

RAYTHEON

RECORDING STORAGE TUBE





FOCUS COIL

Resistance — 6500 to 9000 ohms (at 20°C)
Max. Current — 25 madc
Voltage Rating — 250 V

TICKLER COIL

Resistance-105 to 145 ohms (at 20°C)
Max. Current-30mA RMS
Voltage Rating-250V
Inductance-45 Millihenries Approx.

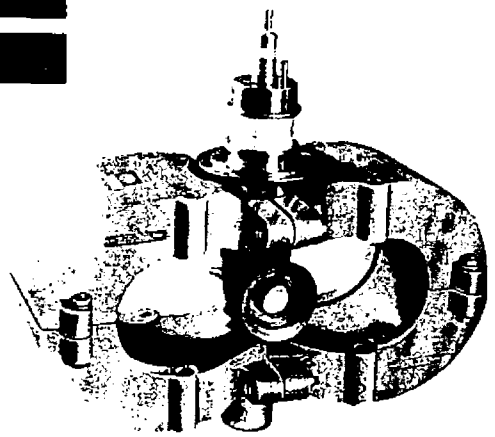
Notes:

1) For use with recording storage tubes and simulators.
2) Tickler coil is provided to permit compensating for improper focus at the edges of a pattern caused by the variation in distance from the center of deflection to a) the center of a storage area of a storage tube, b) the periphery of the storage area.
3) When not required, the tickler coil may be left unconnected.
4) Shell material — annealed swedish iron or equivalent.

The technical information on this data sheet is of a proprietary nature and is furnished as a customer service for private use only.

RK7718 **PRELIMINARY DATA SHEET**

RAYTHEON



RK7718

GENERAL DESCRIPTION

The RK7718 magnetron is a fixed frequency, high power, pulsed oscillator which is capable of delivering a minimum of 1.0 megawatt peak power and 875 watts average power. The RK7718 operates within 9340-9440 megacycles. The tube has an integral magnet, unipotential cathode, waveguide output coupling and is liquid cooled.

Mechanical Data

Mounting Position	Cathode Vertical
Net Weight	80 lbs. Approx.
Cooling	Liquid
Input Bushing	Oil Immersed
Pressurization (Output)	45 p.s.i.a. Min.

Typical Electrical Data

Heater Current (Preheat - 600 sec.)	36 Amperes *
Heater Voltage @ 150 A	3.6 Volts *
Pulse Duration	2.0 usec
Duty Cycle	.000875
Peak Anode Voltage	39 Kilovolts
Voltage Rise Time	.45 usec Min.
Peak Anode Current	68.6 Amperes
Maximum VSWR	1.5
Average Power Output	975 Watts
R.F. Bandwidth	2.0/tpc. Max.
Objective Life - 1.5 VSWR, Off-On Cycle	1000 Hrs. Min.

* Not Final Values

Reliable operation and optimum magnetron life can be achieved only if the overall radar transmitter is designed with the magnetron characteristics and peculiarities clearly in mind. This preliminary data sheet is intended only to acquaint the reader with the basic characteristics of the magnetrons and should not be used as an absolute guide. Detailed test specifications are available upon request, and specific problems pertaining to applications should be directed to the Applications Engineering Department, Microwave and Power Tube Division at Raytheon, Waltham, Massachusetts.

from JEDEC release #3478, Nov. 6, 1961

The specifications for this tube have not been finalized. The tube is being manufactured in limited quantities and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/or dimensions may be made at our discretion as deemed advisable by engineering experience or other considerations. For current information concerning this tube contact the Receiving Tube, Microwave and Power Tube Regional Sales Representative.

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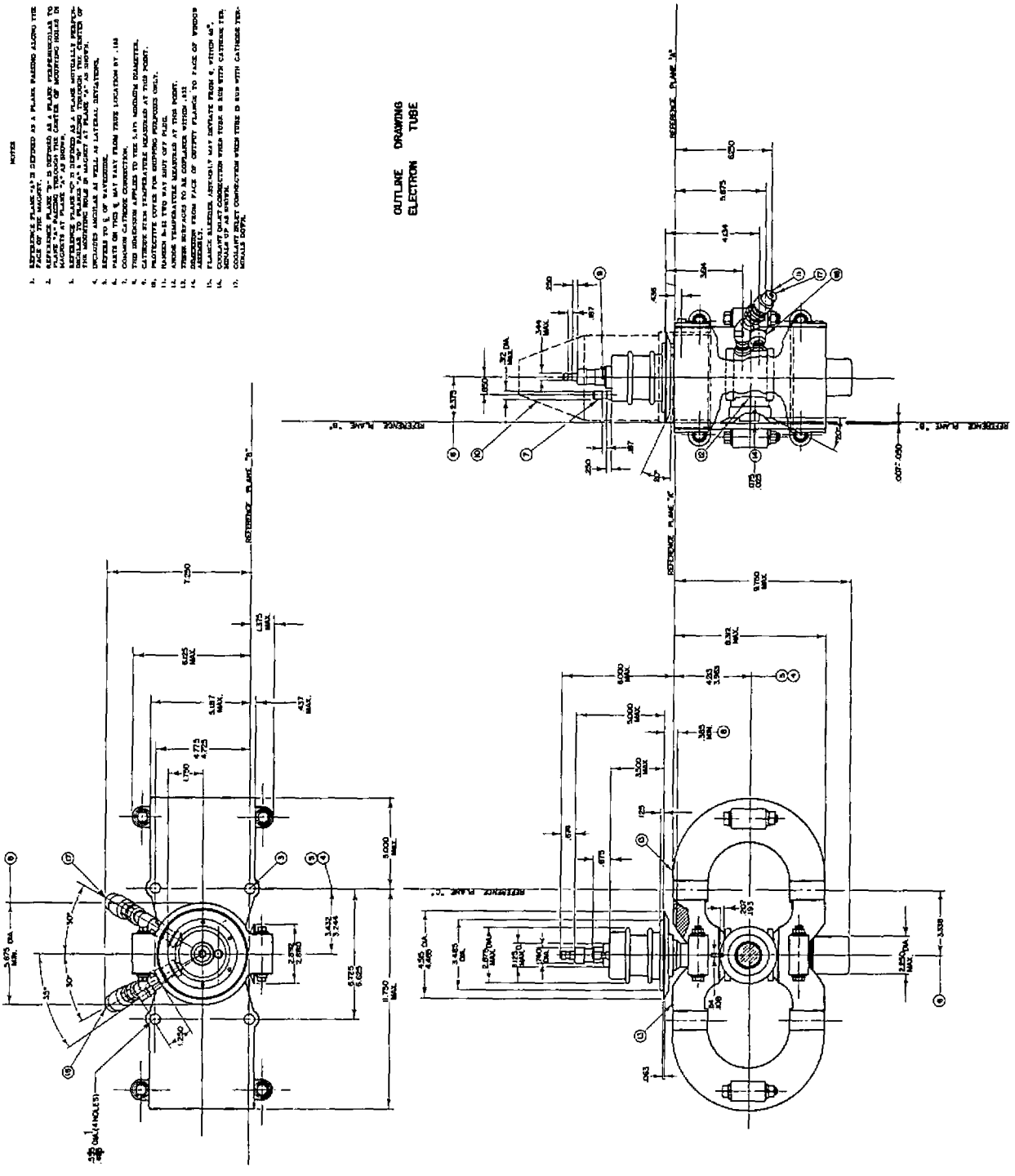
Excellence in Electronics

preliminary data sheet

NOTES

1. REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FACE OF THE MAGNET.
2. REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO REFERENCE PLANE "A" AND PASSING THROUGH THE CENTER OF MOUNTING HOLES IN MAGNETS AT PLANE "A" AS SHOWN.
3. REFERENCE PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO REFERENCE PLANES "A" AND "B" AND PASSING THROUGH THE CENTER OF THE MOUNTING RING OF MAGNET AT PLANE "A" AS SHOWN.
4. DIMENSIONS ARE IN INCHES.
5. DIMENSIONS ANGULAR AT WELLS AS LATERAL DEVIATIONS.
6. REFERS TO S OF WAVEGUIDE.
7. PLATE OR TYPE N, MAY RANT FROM THESE LOCATION BY .125
8. COUPLING FLANGE CONNECTION.
9. TUBE MOUNTING HOLES TO BE .149 MINIMUM DIAMETER.
10. CATHODE WITH THERMISTOR MEASURED AT THIS POINT.
11. PROTECTIVE COVER FOR SHIPPING PURPOSES ONLY.
12. NUMBER 8-32 TPD WAY SHUT OFF PLUG.
13. ANODE TEMPERATURE MEASURED AT THIS POINT.
14. THESE SURFACES TO BE COPLANER WITHIN .010
15. FLANGE ELECTRICAL ASYMMETRY MAY DEVIATE FROM 0, WITHIN 60°.
16. COUPLING FLAT CONNECTION WHEN TUBE IS SUB WITH CATHODE TERMINALS NEGATIVE.
17. COUPLING FLAT CONNECTION WHEN TUBE IS SUB WITH CATHODE TERMINALS GOPPS.

OUTLINE DRAWING
ELECTRON TUBE

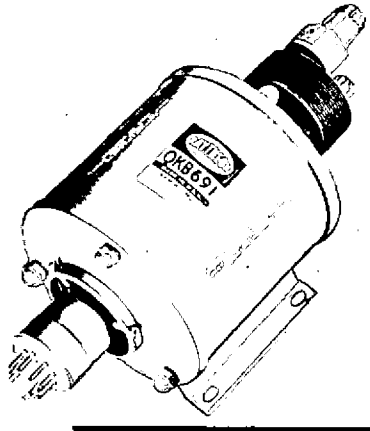


TYPE QKB691

from JEDEC release #4487, Nov. 11, 1963

GENERAL DESCRIPTION

The QKB691 is a voltage-tunable backward wave oscillator designed for CW or pulsed operation over the 2000- to 4000-Mc range with a typical power output of 500 milliwatts at mid band. It is an integral magnet, coaxial output type tube requiring forced-air cooling and is designed for coupling to standard type "N" connector. A special control electrode, normally at cathode potential, facilitates low-voltage, pulsed or amplitude modulation.



BACKWARD WAVE OSCILLATOR

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Voltage	6.3 V
Heater Current	1.3 A
Cathode Heating Time	1.0 minute min.

Maximum Ratings

Anode Voltage	250 Vdc
Anode Current	20 mAdc
Delay-Line Voltage	1600 Vdc Max. 100 Vdc Min.*
Delay-Line Current	45 mAdc
Delay-Line Dissipation	68 W
Control Electrode Voltage	
Positive Value	0 Vdc
Negative Value	100 Vdc

The values specified above must not be exceeded under any service condition. The ratings are limiting values above which the serviceability of any individual tube may be impaired. It does not necessarily follow that combinations of maximum ratings can be attained simultaneously.

* Minimum value may be exceeded provided care is taken that the attendant increased anode current will not result in excessive anode dissipation.

Typical Operation CW

Frequency Range	2000—4000 Mc
Delay-Line Voltage	150—1400 Vdc
Delay-Line Current	40 mAdc
Anode Voltage	130 Vdc
Anode Current	1-10 mAdc
Grid Voltage	0 Vdc
Power Output	0.1-1.0 W

Printed in USA

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

6-60

MECHANICAL

Over-all Dimensions	See outline drawing
Net Weight	8.5 lbs. approx.
Mounting Position	Any
Cooling	Forced air, 10 cu. ft/ min.
Output Coupling	Coaxial Type "N" Female
Base	Standard Intermediate Octal

DETAILED ELECTRICAL INFORMATION

CONTROL ELECTRODE

For CW operation at maximum power output, the control grid is tied to the cathode. In applications where pulsed or amplitude modulation is required, the circuit given in Figure 1 is recommended. The control grid must never be operated positive with respect to the cathode.

SIMPLIFIED MODULATION CIRCUIT

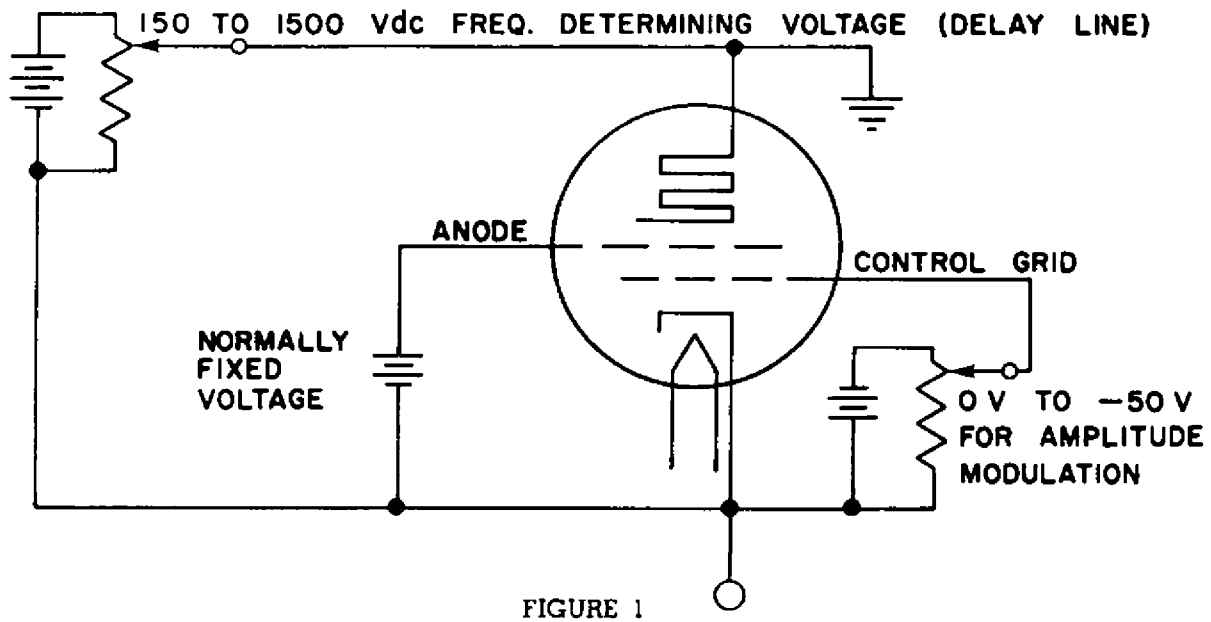


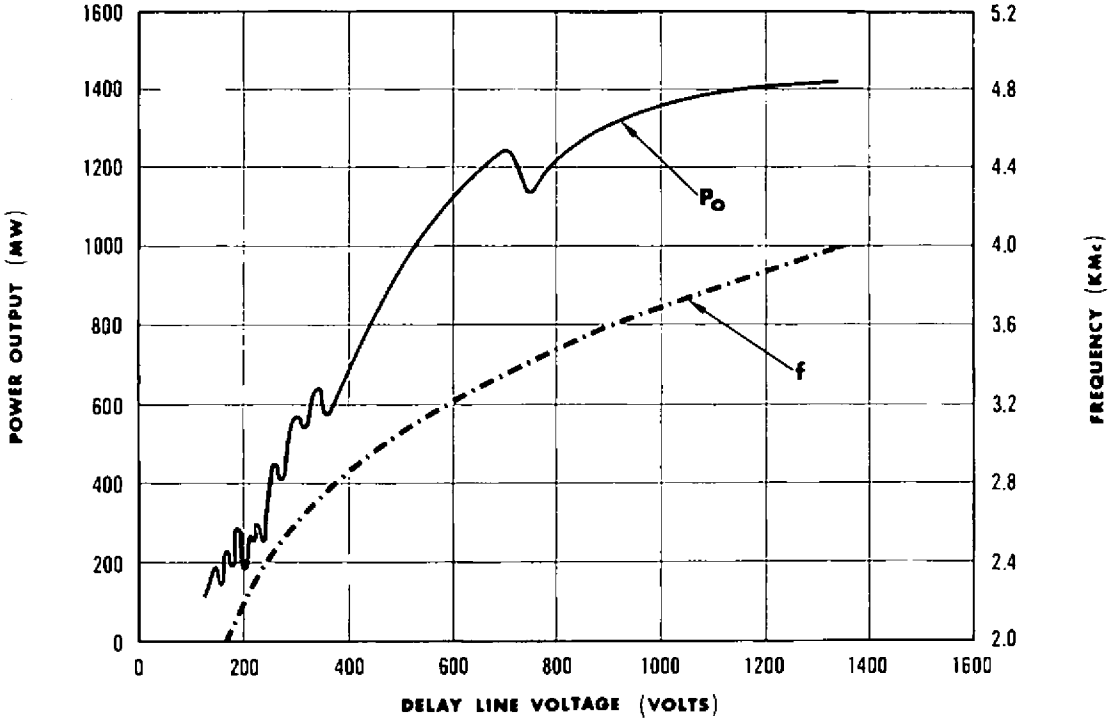
FIGURE 1

FREQUENCY STABILITY

The regulation of the voltage supplied to the delay line and anode will be reflected directly in the stability of the output frequency.

The regulation of the control electrode bias supply will be reflected directly in the power output of the tube. Therefore, the regulation of these supplies must be commensurate with the power and frequency stability requirements of the application.

QKB691 POWER OUTPUT & FREQUENCY VS. DELAY LINE VOLTAGE



OPERATING PRECAUTIONS

In order to prevent damage to the tube, the anode voltage must not be applied without the minimum delay line voltage being applied before the anode voltage. Failure to observe this precaution will result in excessive anode current and possible burn out. Simultaneous application of all voltages after the preheat time is permissible. The grid must always be either zero or negative — never positive and can be applied or removed at any time with or without anode or delay line voltage except in the special case where the anode voltage is set high enough so that with operation without negative grid bias, the maximum cathode-delay line current would be exceeded. In this case, the negative grid voltage must be applied before or simultaneously with but never after the anode. The grid and anode should not be allowed to float with respect to the cathode since these tubes contain a tetrode gun.

The cooling system capacity must be sufficient to maintain the delay-line temperature below 125° C and must be in operation before the application of the above voltages.

Adequate clearance must be maintained between the tube magnet and ferromagnetic materials or other magnets to avoid deterioration of the tube's gauss level. Generally a 4 inch clearance is sufficient.

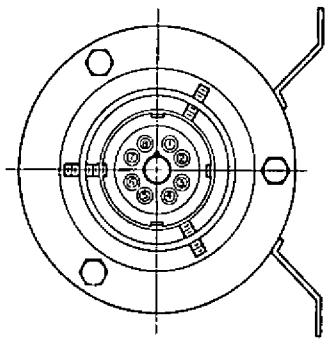
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RAYTHEON

VOLTAGE-TUNABLE BACKWARD WAVE OSCILLATOR

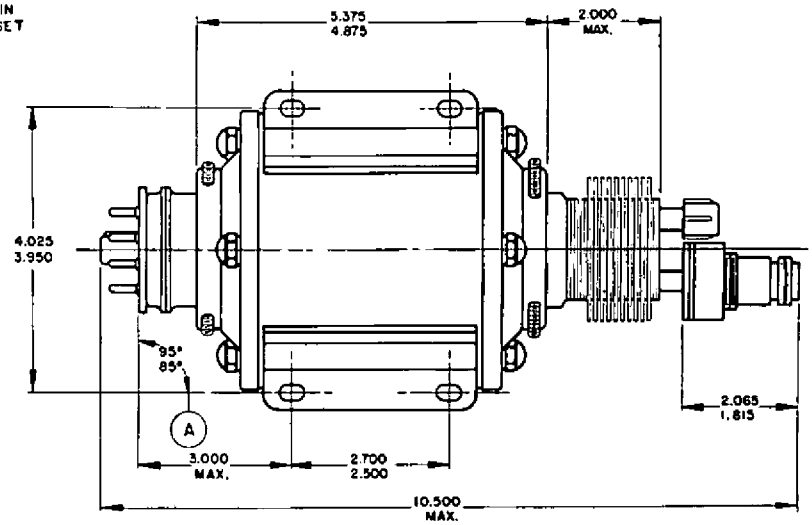
NOTE:

A. THESE TOLERANCES OCCASIONED BY THE NECESSITY FOR MANUFACTURERS ADJUSTMENT OF TUBE BODY WITHIN MAGNET ASSEMBLY. ADJUSTING SCREWS ARE PRE-SET BY MANUFACTURER.



PIN CONNECTIONS

1) SHELL & DELAY LINE
2) ANODE
3) N.C.
4) N.C.
5) GRID
6) N.C.
7) HEATER
8) H-CATHODE



QKB691 ELECTRON TUBE OUTLINE DRAWING

The tabluated data and accompanying graphs are representative of only a small sample and are presented as general information for the circuit designer. They should not be interpreted as completely defining the expected spread of the tube's characteristics. Detailed information necessary for specific applications may be obtained by contacting the Applications Engineering Department, Microwave and Power Tube Operations.

REFERENCES

"New Oscillator Tubes With Wide-Band Electronic Tuning At Microwave Frequencies," P. Guénard, O. Doehler, B. Epsztein and R. Warnecke, C. R. Acad. Sci. (Paris) vol. 235, pp. 236-8 (July 21, 1952). In French.

"Understanding the Backward Wave Oscillator", D. A. Dunn, *Electronic Industries*, January, 1958.

"Fundamental Phenomena In Traveling-Wave Tubes," R. Warnecke, P. Guénard and O. Doehler, Onde Élect. vol. 34, No. 325, pp. 323-38 (April 1954). In French.

"The OType Carcinotron Tube", Palluel and Goldberger, *Proceedings of the I.R.E.*, March 1956, pp. 333-345.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK 7978

DECADE COUNTER

The CK7978 is a cold cathode gas-filled 5 KC medium speed bi-directional ring stepping decade counter tube. This type features direct visual neon glow readout or electrical readout in the form of a voltage from any of the cathode leads. Negligible power dissipation, short resolution time, simple low cost circuitry, and no moving parts make this a very reliable counter device. Some of the many uses for this type include counting, timing, sampling, frequency dividing, coding, matrixing, telemetering, and controlling.

ELECTRICAL DATA

RATINGS–ABSOLUTE MAXIMUM VALUES:

Total Anode Current Maximum	0.60	Ma
Total Anode Current Minimum	0.30	Ma
Voltage Between Electrodes (Excluding Anode)	200	volts
Supply Voltage (Anode to Cathode)–Minimum	350	volts
Minimum Transfer Voltage	35	volts
Input Frequency	5000	cps

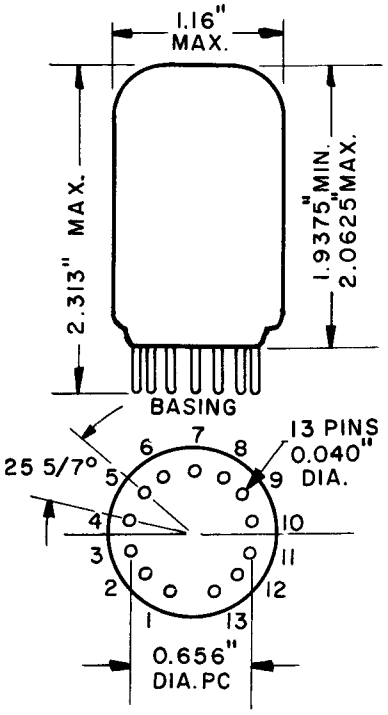
CHARACTERISTICS AND TYPICAL OPERATION:

DC Supply Voltage	425	volts
Anode Resistor	0.68	megohms
Nominal Tube Drop	190	volts
Guide Bias–Minimum	35	volts
Cathode Resistor	100	K ohms
Output Voltage (Across Cathode Resistor)	30	volts
Double Pulse Drive Amplitude–Minimum	−75	volts
Double Pulse Drive Duration–Minimum	60	μsec.
Double Pulse Drive Overlap	10	μsec.
Reset Pulse Width–Minimum	50	μsec.
Forced Reset Pulse Amplitude–Minimum	−120	volts

MECHANICAL DATA

ENVELOPE.....T–9 Glass
BASE .....13 Pin
MOUNTING POSITION..... Any (Visual Readout From top of Tube)
ZERO POSITION ..... Cathode #0 (Aligned with Pin Number 8 ±10°)

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS

Pin 1	Anode
Pin 2	Cathode #5
Pin 3	Cathode #4
Pin 4	Guide #2
Pin 5	Cathode #3
Pin 6	Cathode #2
Pin 7	Cathode #1
Pin 8	Cathode #0
Pin 9	Cathode #9
Pin 10	Guide #1
Pin 11	Cathode #8
Pin 12	Cathode #7
Pin 13	Cathode #6

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RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7979

SUBMINIATURE GAS TRIODE

The CK7979 is a grid controlled neon filled triode of subminiature construction. It has a directly heated cathode and is designed for use either as an indicator lamp or a low current negative grid control device. The low working and control voltages permit its use in association with transistor circuitry. Using an AC anode supply with an anode current of 3.0 milliamperes, the light output is several times greater than that obtainable from a NE–2 glow lamp at maximum rating. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

RATINGS–ABSOLUTE MAXIMUM VALUES: (Note 1)

Filament Voltage (RMS)	1.25±5%	Vac
Peak Forward and Inverse Anode Voltage (Anode to filament or grid)	±118	v max.
Grid Supply Voltage	–12	Vdc min.
Anode Current (Average)	3	mAdc max.
Peak Anode Current (Note 3)	11	ma. max.
Minimum Anode Supply Voltage (RMS) Note 2	60	Vac min.
Maximum Anode Supply Voltage (RMS) Note 2	75	Vac max.
Maximum Preconduction Grid Current at 75 volts (RMS) Anode Supply Voltage	0.5	μAdc max.

CHARACTERISTICS AND TYPICAL OPERATION:

	Fig. B (Note 6)	Fig. C (Note 7)	D.C. Operation Fig. A
Filament Voltage (RMS)	1.25 Vac	1.25 Vac	1.25 Vac
Filament Current	250 mA	250 mA	250 mA
Anode Supply Voltage Epp (RMS) or Vdc	65 Vac	65 Vac	80 Vdc
Anode Current (Grid Supply Voltage=0 Volts)	1.9 mAdc	0.67 mA	0.6 mAdc
Grid Supply Voltage (Tube non conducting)	–4.5 Vdc	–4.5 Vdc	–4.5 Vdc
Grid Supply Voltage (Tube conducting)	–1.0 Vdc	–1.0 Vdc	–1.0 Vdc
Grid Isolation Resistor	0.1 meg.	.068 meg	.033 meg.
Series Anode Limiting Resistor	0.01 meg.	.033 meg.	.033 meg.

PULSE OPERATION: (Fig. A)

Typical Input Triggering pulse characteristics	
Pulse Amplitude (Tube conducting) (eg1 to k)	+5.0 v
Pulse Width	8.0 μsec
Typical Ionization Time	2 μsec
Typical Deionization Time	30 μsec

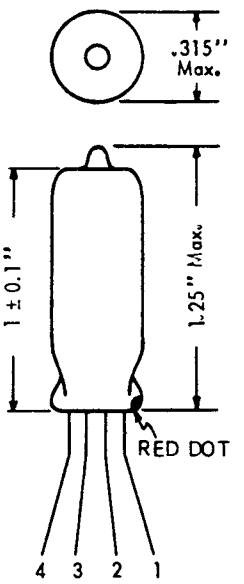
MECHANICAL DATA

ENVELOPE ..... T–2 Glass

BASE ..... None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center to center)

MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



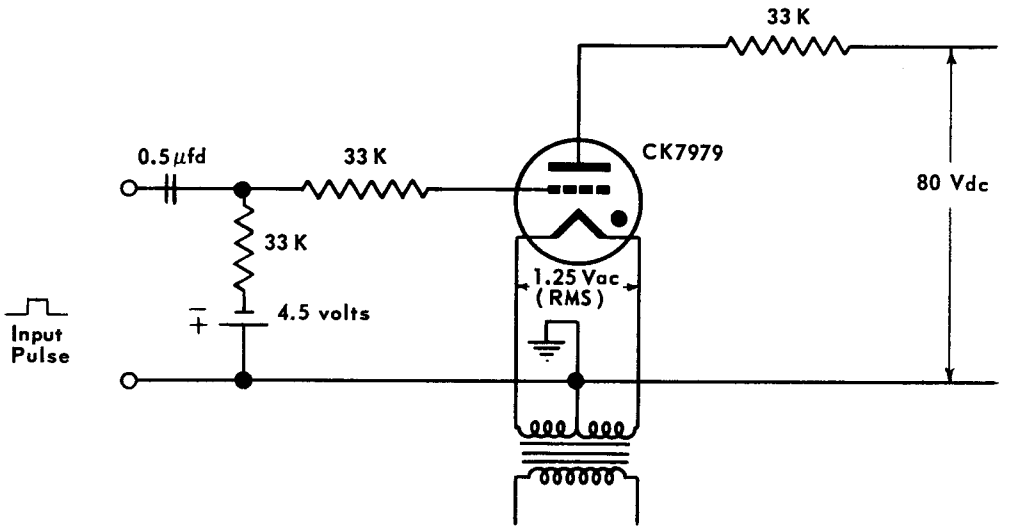
TERMINAL CONNECTIONS:

(Red dot is adjacent to lead 1)

Lead 1 Filament
Lead 2 Grid
Lead 3 Anode
Lead 4 Filament

Printed in U.S.A.

FIGURE A



NOTE 1: Operation at all maximum ratings simultaneously is not permitted.

NOTE 2: As indicated under "Ratings–Absolute Maximum Values", the anode supply voltage (Epp) must be maintained within the limits of 60 Vac (RMS) and 75 Vac (RMS) to ensure reliable operation. In terms of peak anode supply voltage the range of reliable operation is 84 to 106 peak positive volts. In installations using large numbers of tubes where distortion may be a factor it is important to maintain the anode supply voltage within peak voltage limits described above.

NOTE 3: In applications where capacity may be employed to shunt either all or part of the series anode limiting resistor or its equivalent, it is necessary to consider the peak anode current limitation. Also the minimum positive amplitude of anode supply voltage must be low enough to cause deionization each cycle.

NOTE 4: Anode Current at cut–off may be considered relatively independent of Grid Supply Voltage for a range of Anode Supply Voltage from 60 Vac to 75 Vac.

NOTE 5: The critical anode potential (peak positive) is equal to $\sqrt{2}$ X Epp, where Epp is the RMS value of a symmetrical and undistorted alternating voltage.

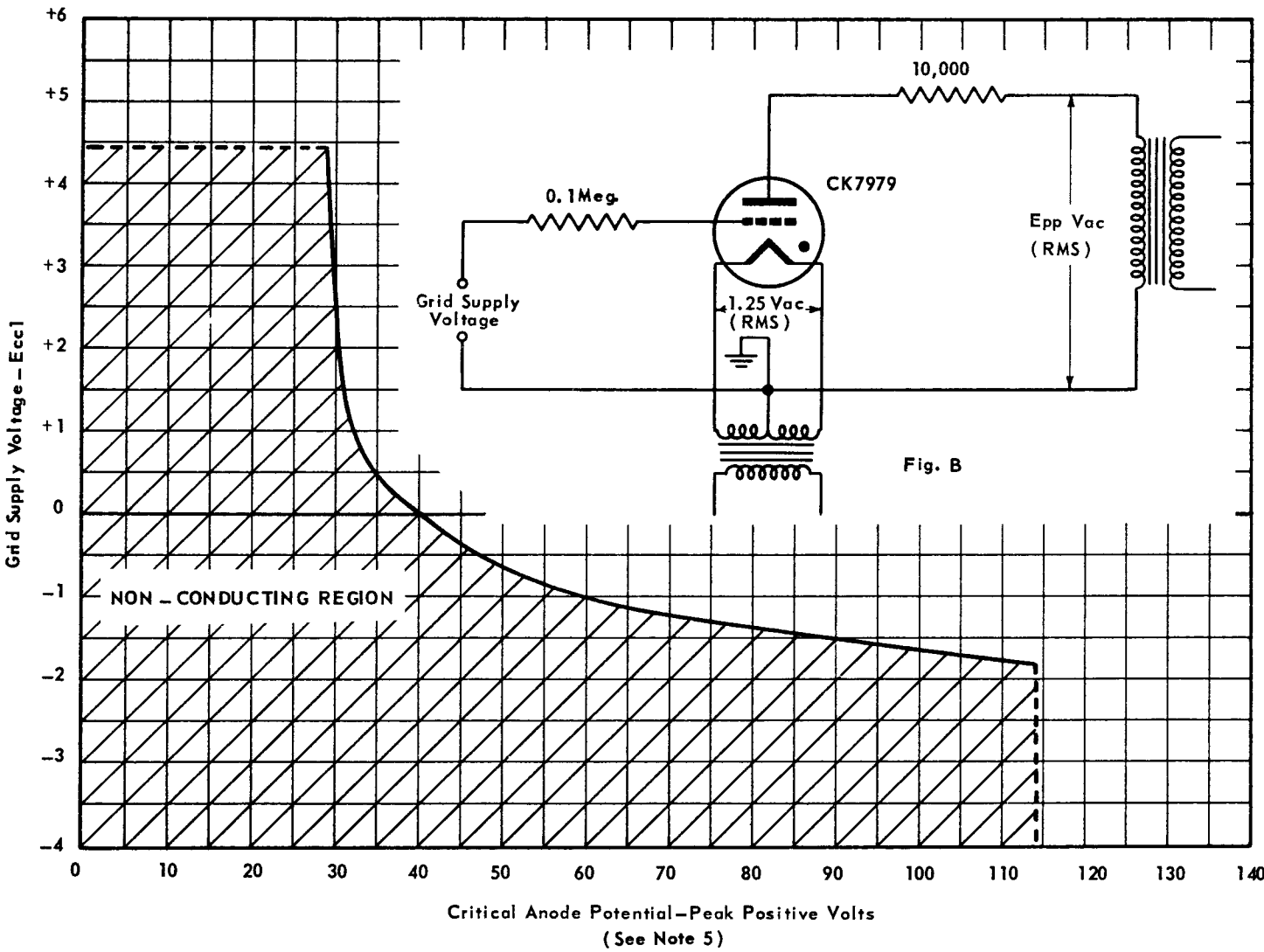
NOTE 6: This circuit can be used where maximum light output is desired.

NOTE 7: This circuit can be used where maximum tube life is desired.

SUBMINIATURE GAS TRIODE

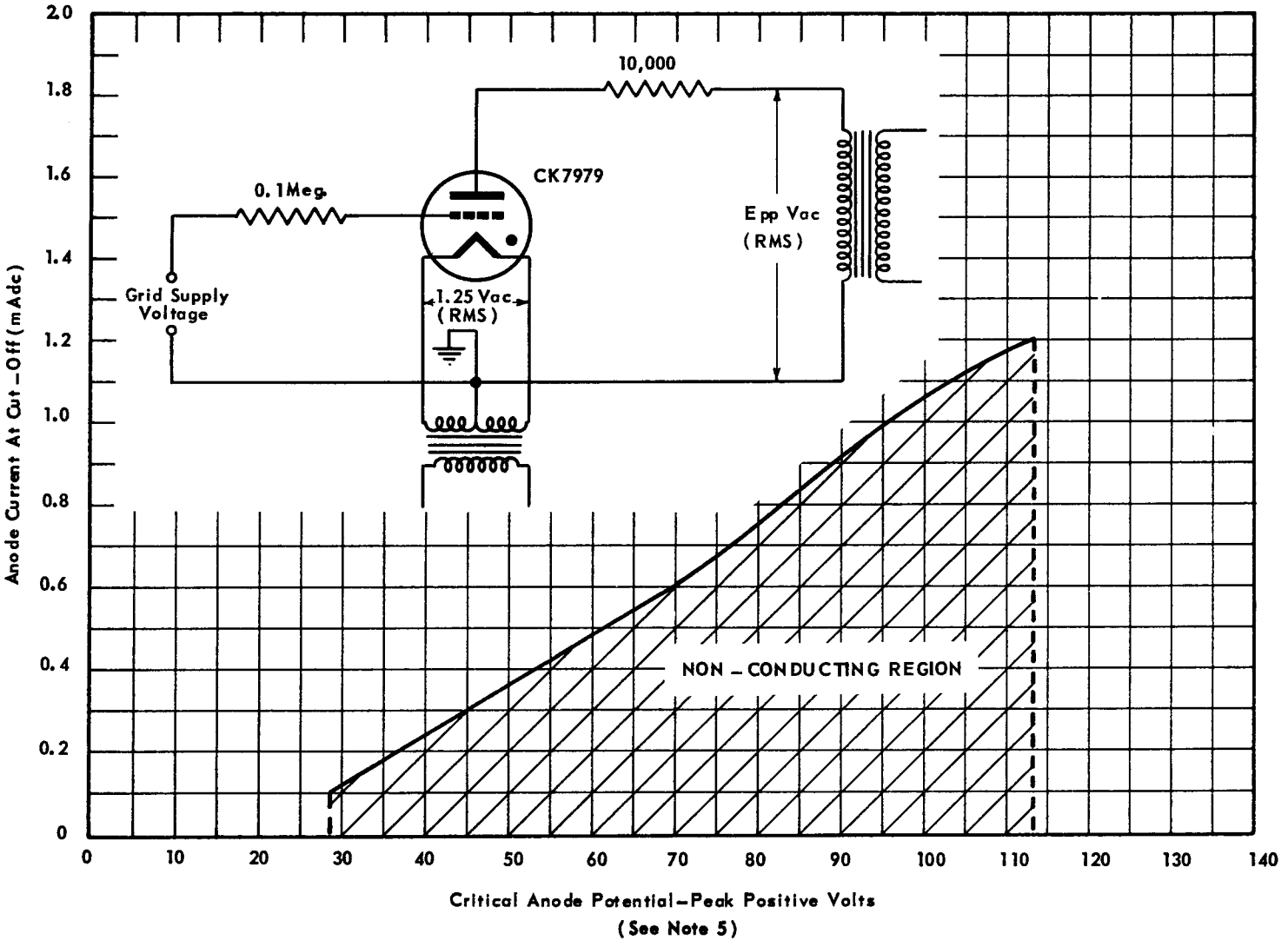
AVERAGE CHARACTERISTICS

GRID SUPPLY VOLTAGE VS CRITICAL ANODE POTENTIAL



AVERAGE CHARACTERISTICS

TYPICAL ANODE CURRENT AT CUT-OFF VS CRITICAL ANODE POTENTIAL (See Note 4)



AVERAGE CHARACTERISTICS

GRID SUPPLY VOLTAGE VS. CRITICAL ANODE POTENTIAL

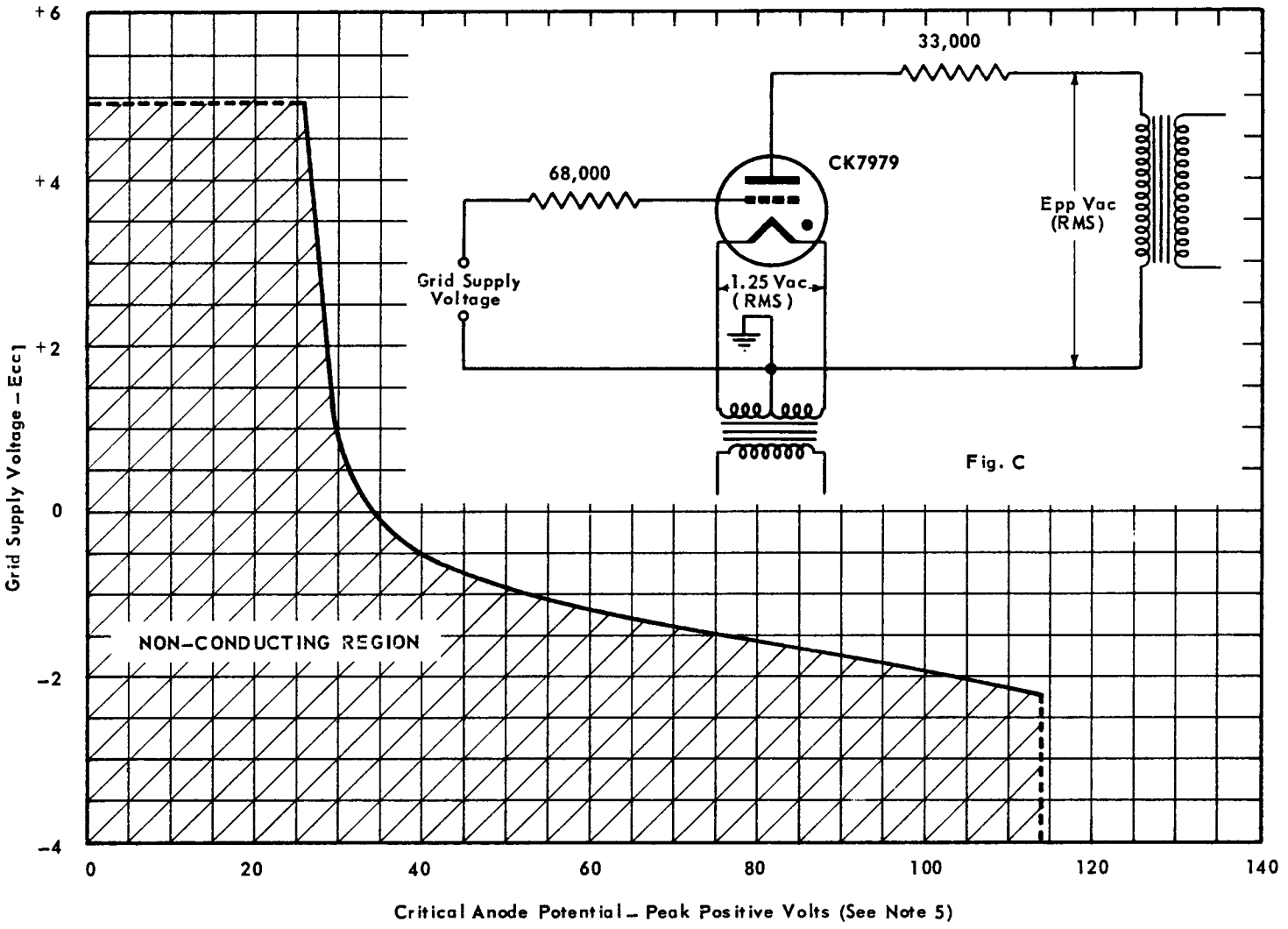
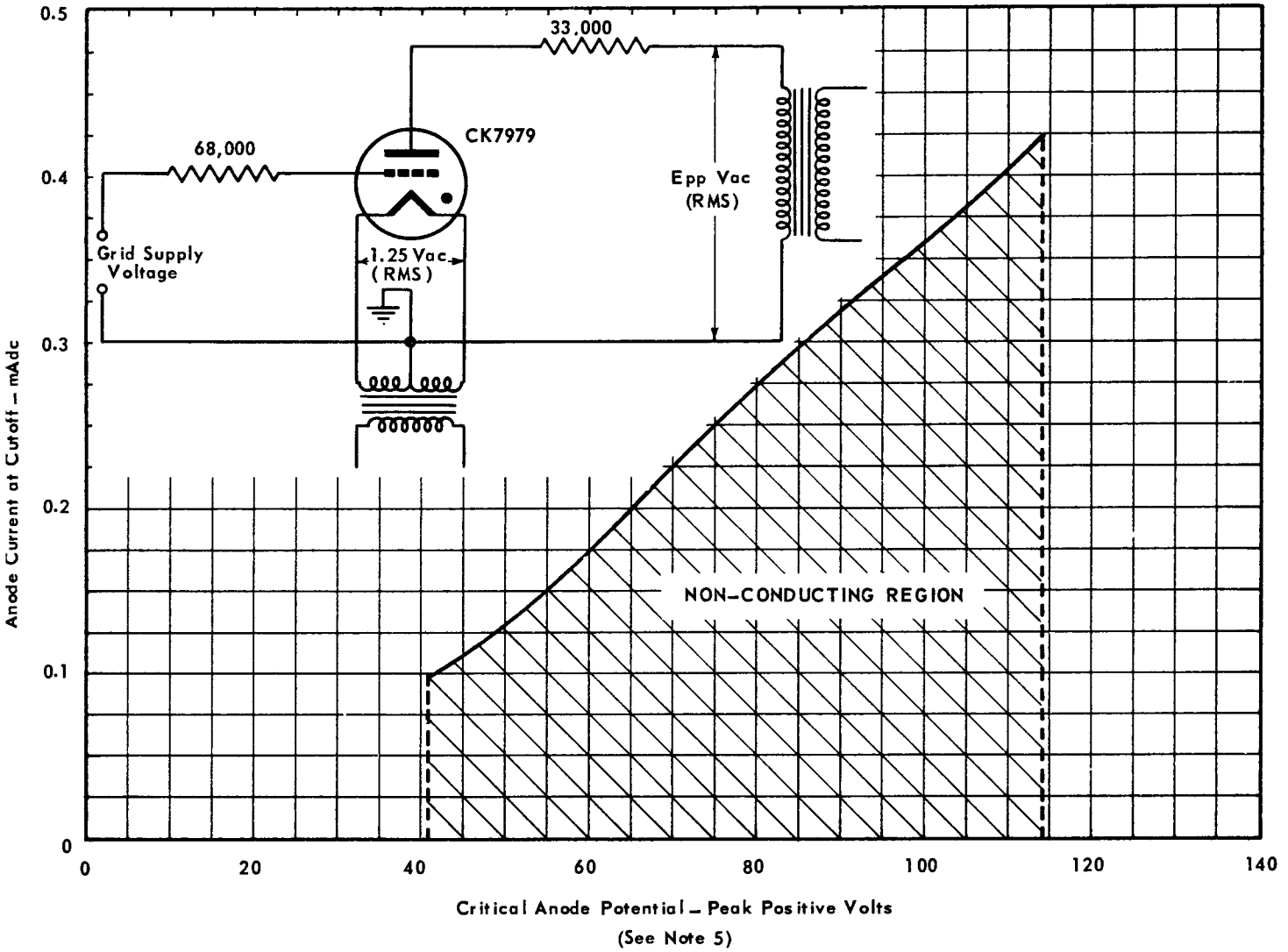


Fig. C

AVERAGE CHARACTERISTICS

TYPICAL ANODE CURRENT AT CUTOFF vs. CRITICAL ANODE POTENTIAL (See Note 4)



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK7994

SUBMINIATURE TRIODE

The CK7994 is a heater–cathode type, high transconductance triode of subminiature construction. The design features of low noise, low interelectrode capacitances featuring low Cp–K+H, and very high transconductance make this type suitable for service in wide band amplifier stages, and especially grounded–grid operation. The useful frequency range extends from low to very high frequencies. The flexible terminal leads may be soldered, or welded directly to the terminals of circuit components without the use of sockets. Standard 8–Pin subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (pf) (without shield)

Plate to cathode and heater	0.25 Max.
Input (k to g + h)	8.5
Output (p to g + h)	2.5

RATINGS – ABSOLUTE MAXIMUM VALUES:

Heater Voltage (ac or dc)	6.3 ± 10% Volts
Plate Voltage	200 Volts
Plate Dissipation	2.0 Watts
Cathode Current	30 ma.
Heater–Cathode Voltage	100 Volts
Bulb Temperature	220 °C

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 Volts
Heater Current	0.3 Amp.
Plate Voltage	100 Volts
Cathode Bias Resistance	82 Ohms
Grid Voltage	0 Volts
Plate Current	15 mA
Plate Resistance	25 K ohms
Transconductance	18,000 umhos
Amplification Factor	43
Ec1 for Ib = 10 uA	−6 Volts

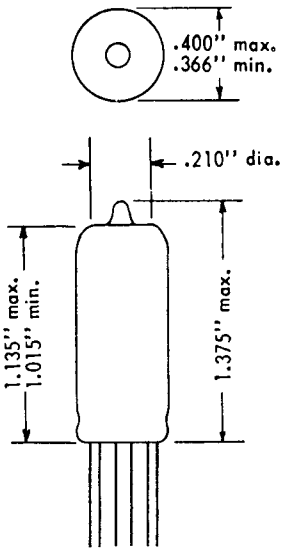
OBJECTIVE DATA

These data identify a particular developmental tube design and the type designation or the descriptive data may be subject to change or abandonment.

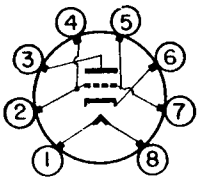
MECHANICAL DATA

ENVELOPE ..... T3 Glass
OUTLINE ..... JEDEC (3–1)
BASE ..... 8–Pin Submin. Button (0.017" Tinned Flexible Leads. Length = 1.5" Min.)
CATHODE .. Coated Unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



TERMINAL CONNECTIONS

Lead 1	Heater
Lead 2	Grid Number 1
Lead 3	Plate
Lead 4	Grid Number 1
Lead 5	Grid Number 1
Lead 6	Cathode
Lead 7	Grid Number 1
Lead 8	Heater

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TECHNICAL INFORMATION SERVICE

Technical Information

CK7995

SUBMINIATURE SHARP CUTOFF PENTODE

The CK7995 is a heater–cathode type, high transconductance, sharp cutoff pentode of subminiature construction. The design features of low noise, low interelectrode capacitances and high transconductance and high transconductance to plate current ratio make it suitable for service as a wide band RF or IF amplifier. It is designed for dependable operation in equipment with low plate supply voltages. The flexible leads may be soldered, or welded directly to the terminals of circuit components without the use of sockets. Standard 8–Pin subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (pf) (with External Shield)

Grid to Plate	.03 Max.
Input	8.0
Output	3.5

RATINGS – ABSOLUTE MAXIMUM VALUES:

Heater Voltage (ac or dc)	6.3 ± 10% Volts
Plate Voltage	200 Volts
Grid #2 Voltage	165 Volts
Plate Dissipation	1.6 Watts
Grid #2 Dissipation	.6 Watts
Cathode Current	30 ma
Heater–Cathode Voltage	100 Volts
Bulb Temperature	220 °C

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 Volts
Heater Current	0.3 Amps
Plate Voltage	150 Volts
Grid #2 Voltage	150 Volts
Cathode Bias Resistance	160 Ohms
Grid #1 Voltage	0 Volts
Plate Current	8.0 mA
Grid #2 Current	2.0 mA
Plate Resistance	.1 Meg
Transconductance	13,000 umhos
Ec1 for Ib = 10 uA	−6 Volts

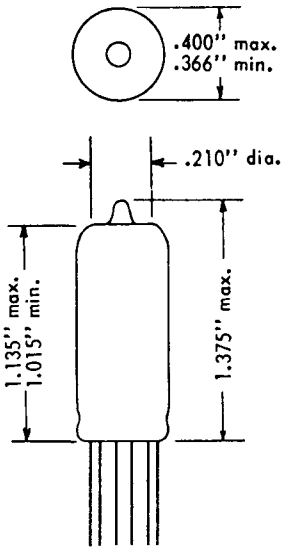
OBJECTIVE DATA

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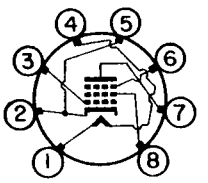
MECHANICAL DATA

ENVELOPE ..... T3 Glass
OUTLINE ..... JEDEC (3–1)
BASE ... 8–Pin Submin. Button (0.017" Tinned Flexible Leads Length=1.5" Min.)
CATHODE ..Coated Unipotential
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



TERMINAL CONNECTIONS

Lead 1	Heater
Lead 2	Cathode
Lead 3	Grid Number 1
Lead 4	Heater
Lead 5	Cathode
Lead 6	Grid Number 3
Lead 7	Plate
Lead 8	Grid Number 2

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RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK8096

RELIABLE LOW NOISE SUBMINIATURE TRIODE

The Raytheon Reliable type CK8096 is a heater–cathode, low noise, high mu triode of subminiature construction, designed for applications requiring low quiescent noise (a function of 1/F), and freedom from microphonic response. Its cathode is designed for long periods of operation with freedom from interface or electrode insulation resistance. The CK8096 is electrically similar to the type CK6533WA. The mechanical design is such that microphonic output due to structural resonances is reduced throughout the audio frequency range by approximately 20 db as compared to more conventional triodes.

The CK8096 is intended for service where extreme conditions of mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard 8–pin subminiature sockets may be used by cutting the leads to a suitable length.

ENVIRONMENTAL CHARACTERISTICS:

Quiescent Noise (Referred to Grid)		
at 10 cps	–130	dbV/cycle Min.
at 1000 cps	–153	dbV/cycle Min.
Impact Acceleration (Shock, 3/4 msec duration)	450	G Max.
Uniform Acceleration (Centrifuge)	1,000	G Max.
Vibrational Acceleration for Extended Periods (Fatigue)		
96 Hour	2.5	G Max.
6 Hour	10	G Max.
Vibration Output at F=40 cps, G=15 (Ep)	1.0	mVac Max.
Variable Frequency Vibration Output at F=30–1000 cps, 15 G (ep)	15	mvpp Max.
On–Off Heater Cycles	2,000	Min.
Bulb Temperature	220	°C Max.
Altitude	60,000	Ft. Max.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3	V
Heater Current	200	mA

DIRECT INTERELECTRODE CAPACITANCES: (Without Shield)

Grid to Plate	2.0	pf max.
Input	1.75	pf
Output	0.60	pf

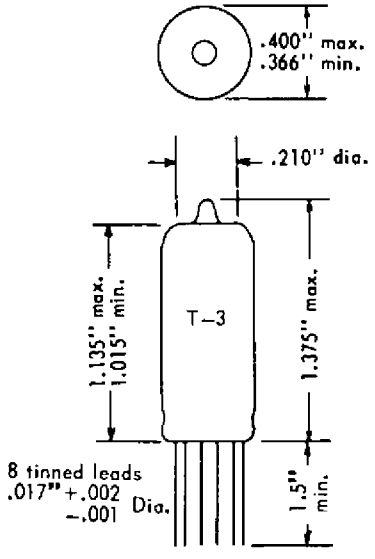
RATINGS (Absolute Maximum) *

Heater Voltage	6.3(±10%)	V
Plate Voltage	150	Vdc
Grid Voltage	0	Vdc
Grid Voltage (Minimum)	–55	Vdc
Heater–Cathode Voltage		
Heater Positive with Respect to Cathode	200	Vdc
Heater Negative with Respect to Cathode	200	Vdc
Grid Resistor **	0.1	Meg.
Plate Current	2.5	mAdc
Plate Dissipation	0.5	W

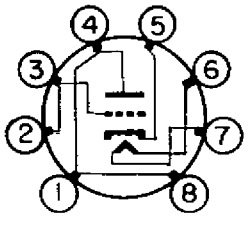
MECHANICAL DATA

ENVELOPE . . . . . T–3 Glass
OUTLINE . . . . . JEDEC (3–1)
BASE . . . . . E8–10 Subminiature Button flexible leads.
BASING 8FY
CATHODE . . . Coated Unipotential
MOUNTING POSITION . . . . Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS

Lead 1 Plate
Lead 2 Grid
Lead 3 Grid
Lead 4 Plate
Lead 5 Cathode
Lead 6 Heater
Lead 7 Heater
Lead 8 Plate

Printed in U.S.A.

from JEDEC release #3813, July 16, 1962

ELECTRICAL DATA (cont'd.)

* To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if heater voltage ratings or bulb temperature maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

** Value is for operation under fixed bias conditions. With cathode bias, Rg may be 5.6 megohms maximum.

AVERAGE CHARACTERISTICS:

Plate Voltage	120 Vdc
Grid #1 Voltage	0 Vdc
Cathode Resistance	1500 ohms
Plate Current	0.9 mAdc
Transconductance	1750 μmhos
Amplification Factor	54
Grid Voltage for Ib=50 μAdc max.	−3.5 Vdc

CHARACTERISTIC RANGES AND CONTROLS:

PRODUCTION TESTS (Inspection Level II, 0.65% AQL individual tests, 1.0% all tests combined)

	Min.	Max.
Heater Current (Ef=6.3 V)	190	210 mA
Heater–Cathode Leakage (Ehk=±100 Vdc; Ef=6.3 V)	---	5 μAdc
Grid Current (Ef=6.3 V)	---	−0.1 μAdc
Plate Current (1) (Ef=6.3 V)	0.6	1.25 mAdc
Plate Current (2) (Ec1=−3.5 Vdc; Ef=6.3 V)	---	50 μAdc
Transconductance (1) (Ef=6.3 V)	1400	2100 μmhos

DESIGN TESTS (Lot Sampling Tests)

	Min.	Max.
Insulation of Electrodes (Ef=6.3 V)		
Eg–all=−300 V	1000	--- Meg.
Ep–all=−100 V	1000	--- Meg.
Transconductance (2) Δ_{Ef} Sm		
Ef=5.7 V	---	7.5 %
Grid Emission		
Ef=7.5 V; Ec1=−3.5 Vdc	---	−0.3 μAdc
Amplification Factor	48	62
Capacitance		
Grid to Plate (No Shield)	1.2	2.0 pf
Input (No Shield)	1.3	2.2 pf
Output (No Shield)	0.4	0.8 pf
Vibration (1), Fixed Frequency		
F=40 cps; Acc=15 G; Rp=10,000 ohms; Ck=1000 μf	---	1.0 mVac
Vibration (2), Variable Frequency		
F=30 cps tp 1000 cps; Acc=15 G; Rp=10,000 ohms; Ck=1000 μf	---	15 mvpp
Quiescent Noise (1)		
cps=10, Circuit per Figure 1	−130	--- dbV/cycle
Quiescent Noise (2)		
cps=1000, Circuit per Figure 1	−153	--- dbV/cycle

SPECIAL TESTS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests:

LOT SAMPLED TESTS

Shock Test – 30° hammer angle in Navy High Impact Shock machine. Sample is subjected to twenty (20) impact accelerations, five impact accelerations in each of four different positions. Ehk=+100 Vdc; Rgl=0.1 meg. Voltages applied. At the end of this test tubes are required to meet established limits for low frequency vibration, heater–cathode leakage current, grid current, quiescent noise (1) and (2), and change in transconductance individual tubes.

Glass Strain – Sample is subjected to a forty–eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater Cycling – Life Test Sample is subjected to 2000 on–off heater cycles at the following conditions: Ef=7.5 volts; Ehk=140 Vac and other elements grounded. At the conclusion of this test the tubes will not show open heater or cathode circuits or heater to cathode shorts, or heater–cathode leakage current in excess of 20 μAdc.

Stability Life Test– Sample is operated for 1 hour to assure initial electrical stability (Δ_t Sm= 10% max.). Tubes are operated with a plate voltage of 150 Vdc and an Ehk of +200 Vdc. Rk=680 ohms; Rgl=1.0 Meg; TA=Room.

Survival Rate – Life Test Sample is operated 100 hours to assure electrical stability (Sm=1200 μmhos min.) and freedom from inoperatives. Tubes operated under Stability Life Test Conditions.

Intermittent Life – Test (1) 1000 hours. Sample is operated under Stability Life conditions with a minimum envelope temperature of +220°C, for 500 and 1000 hours. At the end of 1000 hours, tubes will not show shorts, discontinuities, or air leaks, and will be monitored for total defects and tubes failing to meet established limits of grid current, heater current,change in transconductance (1) of individual tubes, heater–cathode leakage, and insulation of electrodes.

Life Test (2) – 1000 hours. Sample is operated under conditions per circuit, Figure 2, at TA=Room, for 500 and 1000 hours At the end of 1000 hours, tubes will be monitored for total defects and failure to meet established limits of quiescent noise (1) and (2) and insulation of electrodes.

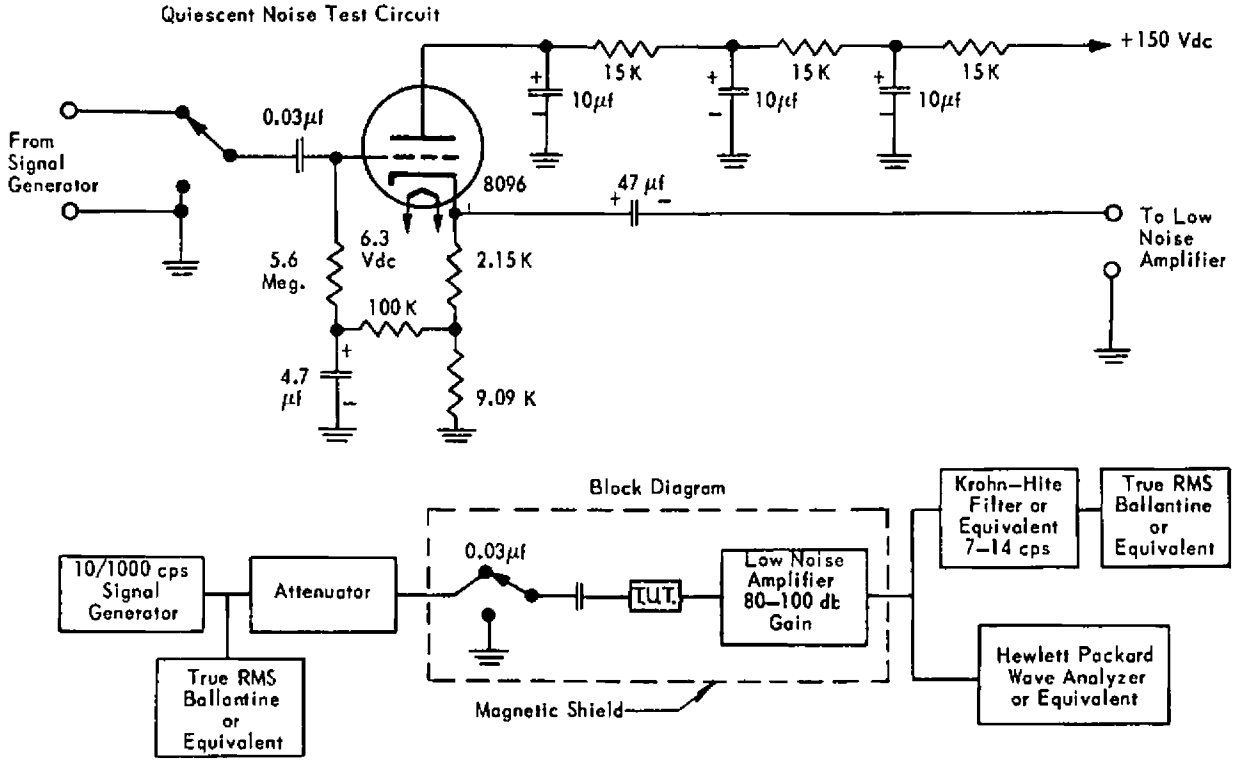
PERIODICALLY CHECKED TESTS

Altitude – Sample is subjected to a pressure=55±5 mmHg (60,000 ft) at 500 Vac to assure freedom from flashover or corona at the leads of the tube.

Fatigue (1) – Sample is subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second. Post Fatigue (1) End Points are the same as for Shock Test.

Fatigue (2) – Sample is subjected to vibrational acceleration of 10G for 6 hours (2 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second. Post Fatigue (2) End Points are the same as for Shock Test.

FIGURE 1



The Low Noise Amplifier shall have an equivalent noise level of not less than –140 dbV/cycle at 10 cps and not less than –163 dbV/cycle at 1000 cps.

E noise – input/cycle = E out (in db) – Gain (db) – Bandwidth Factor (db)

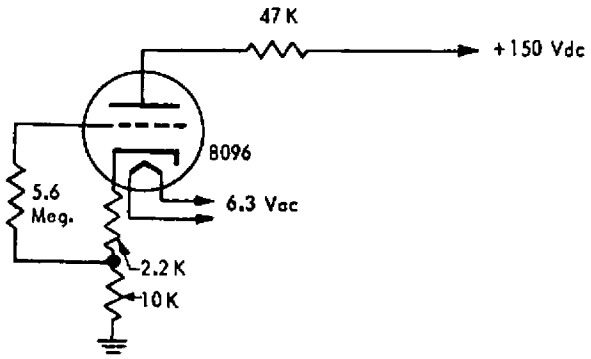
Where Bandwidth Factor = 8.5 db for 10 cps
Bandwidth Factor = 5.5 db for 1000 cps

METHOD OF MEASUREMENT

1. Measure the gain of the system at both 10 cps and 1000 cps.
2. Remove signal generator and terminate amplifier with a 0.03 μf capacitor.
3. After 30 seconds record average level indicated on the wave analyzer and also on the Ballantine VTVM.
4. Noise is referred to the input on a per cycle basis.

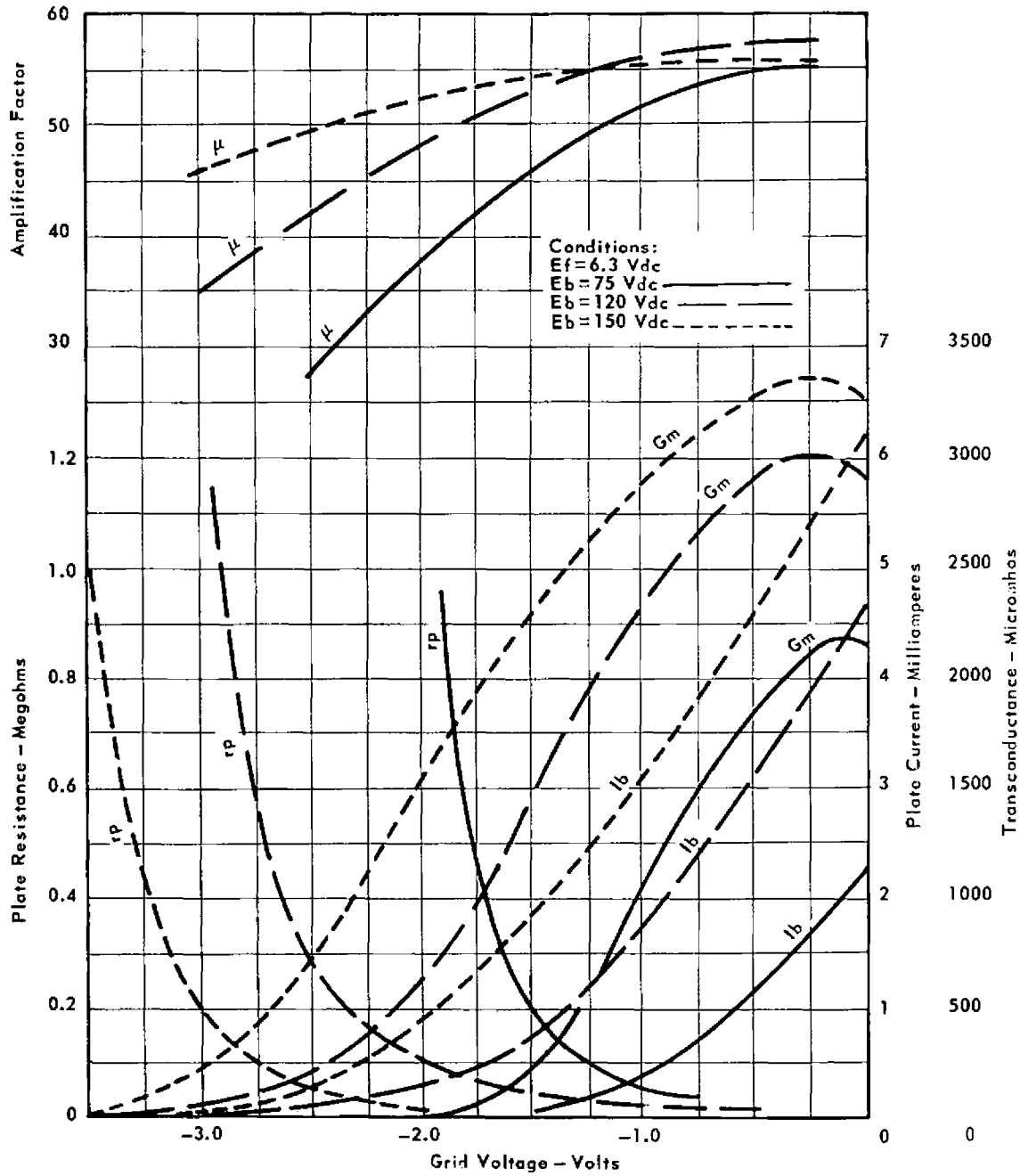
FIGURE 2

Life Test (2) Circuit:



RELIABLE LOW NOISE SUBMINIATURE TRIODE

AVERAGE CHARACTERISTICS

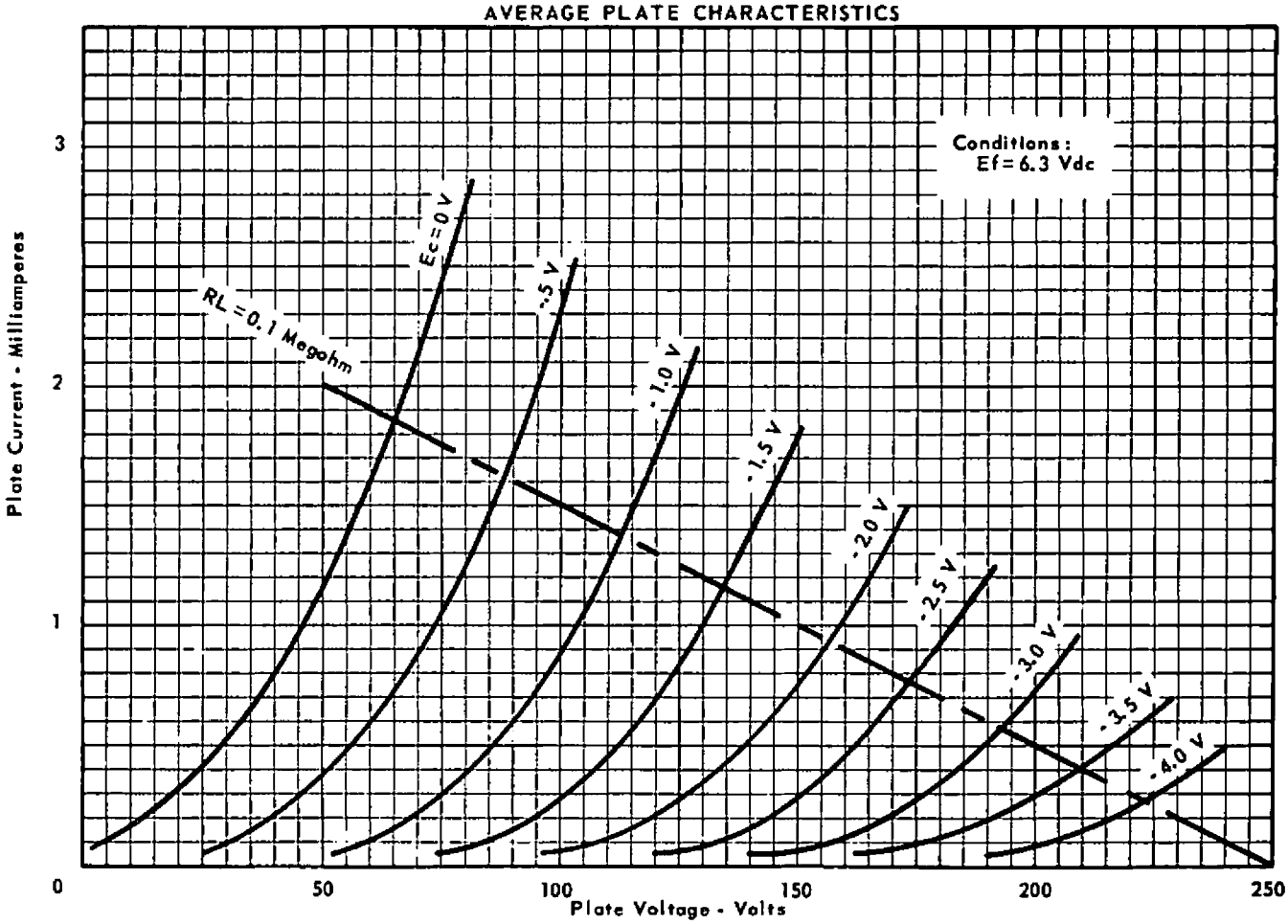


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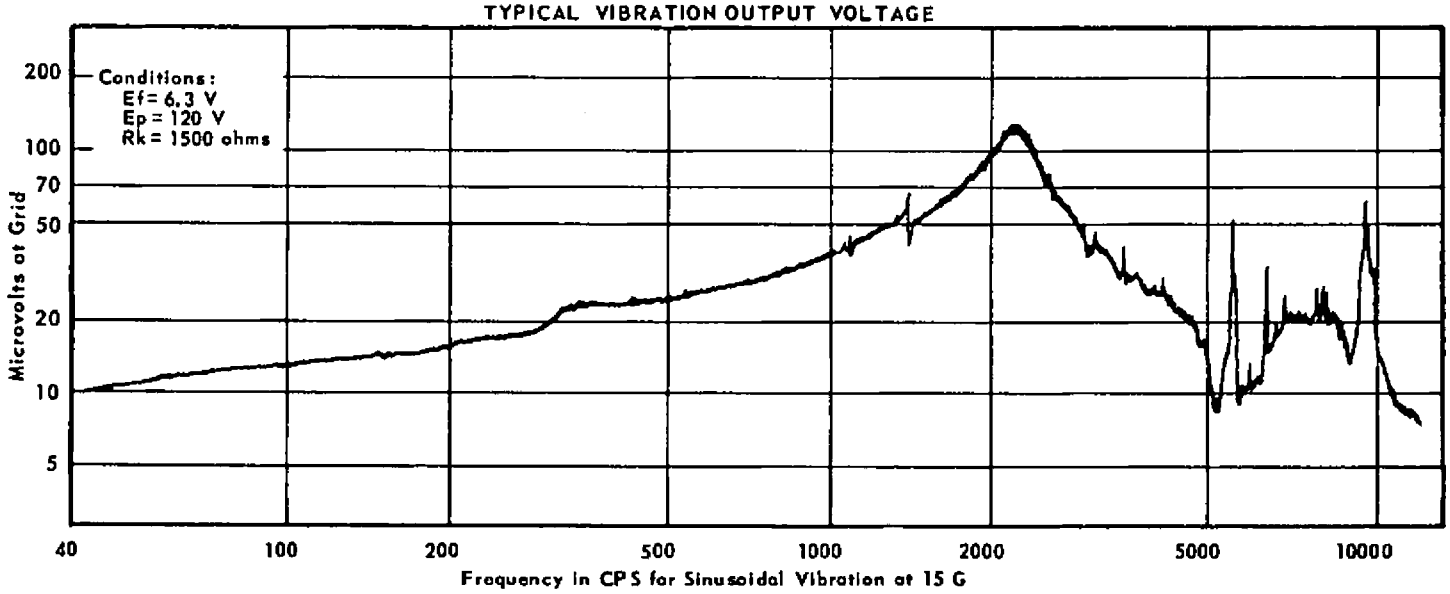
CK8096

RELIABLE LOW NOISE SUBMINIATURE TRIODE

AVERAGE PLATE CHARACTERISTICS



TYPICAL VIBRATION OUTPUT VOLTAGE



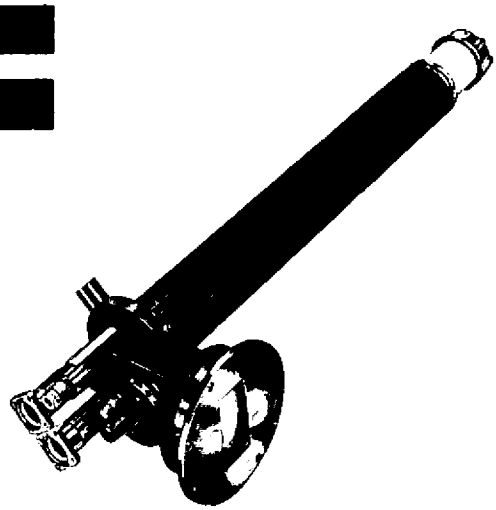
RAYTHEON COMPANY · 55 Chapel Street · Newton 58, Massachusetts

from JEDEC release #4487, Nov. 11, 1963

The technical information on this data sheet is of a proprietory nature and is furnished as a customer service for private use only.

8128 OBJECTIVE DATA SHEET

RAYTHEON



The 8128 is a wide band, 60 kw, (minimum) traveling wave tube designed for pulsed operation over the 2900 to 3100 megacycle range. This tube has a minimum gain of 20 db, and it utilizes a solenoid for the focusing magnetic field. This is a high duty cycle version of the QKW750 which was originally developed under BuShips Contract No. NObsr-72820

The 8128 is designed for use as a driver for the 8129 Amplitron, and it is ideal for frequency diversity type radar applications.

GENERAL CHARACTERISTICS

Typical Electrical Data

Heater Voltage	8 Volts
Heater Current	8.0 Amperes
Cathode Heating Time	5 Minutes
Frequency Range	2900 - 3100 Mc
Peak Power	60 kilowatts (min.)
Average Power Output	1260 Watts (min.)
Magnetic Field	700 Gauss
Pulse Width	30 usec
Duty Cycle	.021
Pulse Voltage	34.5 kilovolts
Peak Current	12 amperes
Perveance	1.9 uperv.
Load VSWR	1.5 Max.

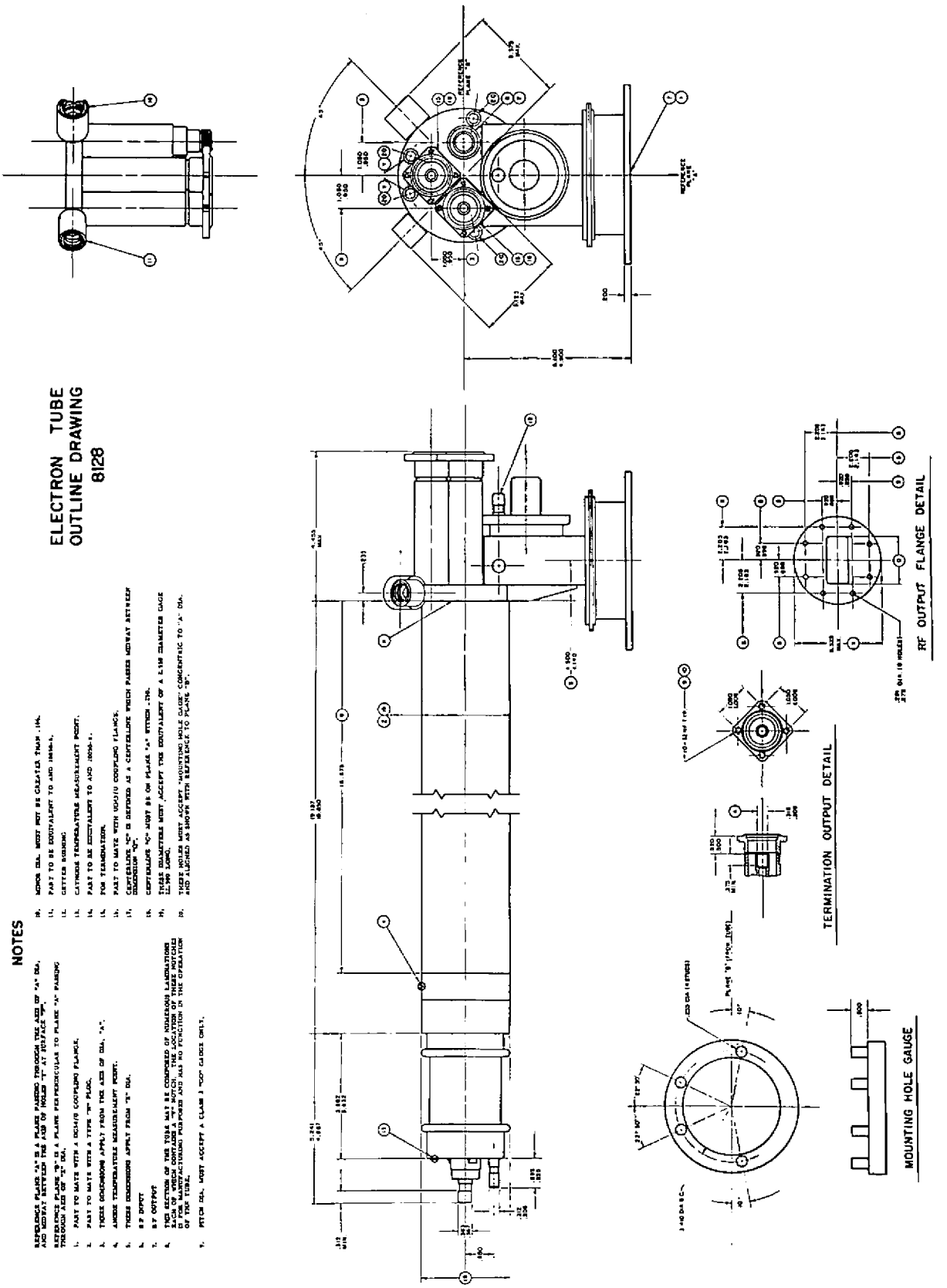
Mechanical Data

Overall Dimensions	See Outline Drawing
Net Weight	20 Pounds (approx.)
Cooling	Liquid
Output Coupling	UG 54 A/U
Mounting Position	Any
Solenoid	Raytheon SWS 100
Termination	Raytheon Le SH 1

RAYTHEON COMPANY | Microwave and Power Tube Division | WALTHAM 54, MASS.

The specifications for this tube have not been finalized. The tube is in the development stage and is available for engineering analysis purposes only. This engineering information and/or delivery of sample tubes do not imply availability of tubes with the same electrical and/or mechanical characteristics. Changes in ratings and/or dimensions may be made at our discretion as deemed advisable by manufacturing experience or other considerations. For current information concerning this tube contact the nearest Microwave and Power Tube Regional Sales Representative.

ELECTRON TUBE OUTLINE DRAWING 8128



NOTES

REFERENCE PLANE "A" IS A PLANE PASSING THROUGH THE AXIS OF "A" DIA. AND NORMAL BETWEEN THE AXIS OF HOLES "F" AT SURFACE "B".

REFERENCE PLANE "B" IS A PLANE PERPENDICULAR TO PLANE "A" PASSING THROUGH AXIS OF "E" DIA.

1. PART TO MATE WITH A UG149/U COUPLING FLANGE.
2. PART TO MATE WITH A TYPE "N" PLUG.
3. THESE DIMENSIONS APPLY FROM THE AXIS OF DIA. "A".
4. ANODE TEMPERATURE MEASUREMENT POINT.
5. THESE DIMENSIONS APPLY FROM "B" DIA.
6. RF INPUT
7. RF OUTPUT
8. THE SECTION OF THE TUBE MAY BE COMPOSED OF KOVAR-IRON LAMINATIONS EACH OF WHICH CONTAINS A "N" NOTCH. THE LOCATION OF THESE NOTCHES HAS NO FUNCTION OTHER THAN ACTUATING PURPOSES AND HAS NO FUNCTION IN THE OPERATION OF THE TUBE.
9. PITCH DIA. MUST ACCEPT A CLASS 3 "GO" GAUGE ONLY.
10. MINOR DIA. MUST NOT BE GREATER THAN .194.
11. PART TO BE EQUIVALENT TO AND INTER-.
12. GETTER SIGNAL.
13. CATHODE TEMPERATURE MEASUREMENT POINT.
14. PART TO BE EQUIVALENT TO AND INTER-.
15. FOR TERMINATION.
16. PART TO MATE WITH UG419/U COUPLING FLANGE.
17. CENTERLINE "C" IS DEFINED AS A CENTERLINE WHICH PASSES MIDWAY BETWEEN DIAMETER "C".
18. CENTERLINE "C" MUST BE ON PLANE "A" WITHIN .176.
19. THREE DIAMETERS MUST ACCEPT THE EQUIVALENT OF A 1.138 DIAMETER GAGE PLANE WITHIN .005.
20. THREE HOLES MUST ACCEPT "MOUNTING HOLE GAUGE" CONCENTRIC TO "A" DIA. AND LOCATED AS SHOWN WITH REFERENCE TO PLANE "B".

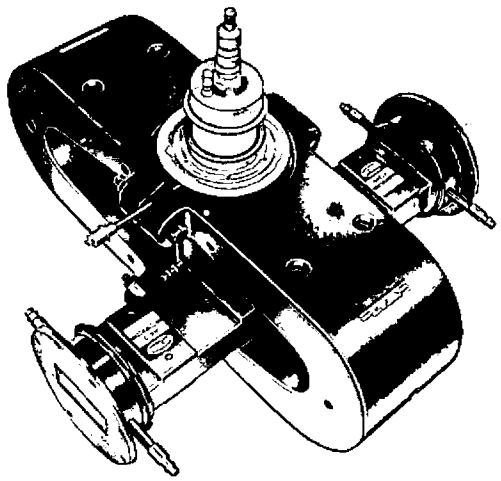
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TECHNICAL INFORMATION

Excellence in Electronics

TYPE 8129

GENERAL DESCRIPTION



The 8129 is a pulsed-type Amplitron capable of producing a minimum peak power output of 3 megawatts when an rf drive power no less than 550 kilowatts is applied to its input. When used with a modulator having proper load line characteristics, such as a "line type" modulator, it will cover the frequency band 2900 Mc to 3100 Mc without mechanical or electrical adjustment. It is an integral magnet type tube with waveguide input and output and requires forced liquid cooling.

Detailed information necessary for specific applications may be obtained by contacting the Product Programs Department, Microwave and Power Tube Division, Raytheon Company, Spencer Laboratory, Burlington, Massachusetts.

PULSED-TYPE AMPLITRON

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

No Heater Power Required For Most Applications

Typical Operation

Pulse Duration	11	10 usec
Duty Cycle	.0055	.0050
Peak Anode Voltage @ 2900 Mc	48	50 kv
Peak Anode Voltage @ 3100 Mc	52	54 kv
Peak Anode Current	20	66 a
Average Anode Current	110	330 mAdc
Peak Power Output	600 kw	3.0 Mw
Average Power Output	3300	15,000 W
Frequency Band	2900-3100	2900-3100 Mc
RF Driver Characteristics		
Peak Drive Power	48 kw	550 kw min.
Frequency Band	2900-3100	2900-3100 Mc

The driver rf pulse must coincide with or overlap the Amplitron current pulse.

Cold Insertion Loss	0.5 db

Printed in U.S.A.

MECHANICAL

Over-all Dimensions	20" x 16.8" x 16.7"
Net Weight	110 lbs.
Mounting	Cathode Axis Vertical
Output Coupling	Mates with UG54A/U type flange
Input Coupling	Mates with UG54A/U type flange
Input Pressurization	35 psia
Output Pressurization	45 psia
Cooling	Forced Liquid
Magnet Protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER-CATHODE

This tube does not require heater power for most applications. Satisfactory starting and operation will occur whenever the pulse voltage is applied in the presence of normal rf drive power.

TYPICAL OPERATION

Figure 1 illustrates a typical Amplitron circuit. The driver tube may be a magnetron, Amplitron, traveling wave tube, or other device capable of supplying at least the minimum required rf input power. An isolator will normally be required between the Amplitron and its driver because reverse directed power reflected from the load mismatch is practically unattenuated by the Amplitron. The amount of isolation necessary will depend upon the gain of the Amplitron, the VSWR of the load and the amount of mismatch the driver can withstand.

The relationship $|\Gamma_i| |\Gamma_o| G < 1$ must be maintained to eliminate oscillation, where G is the power gain of the Amplitron and Γ_i and Γ_o are the input and output reflection coefficients measured at the input and output terminals looking away from the tube.

TYPICAL OPERATION

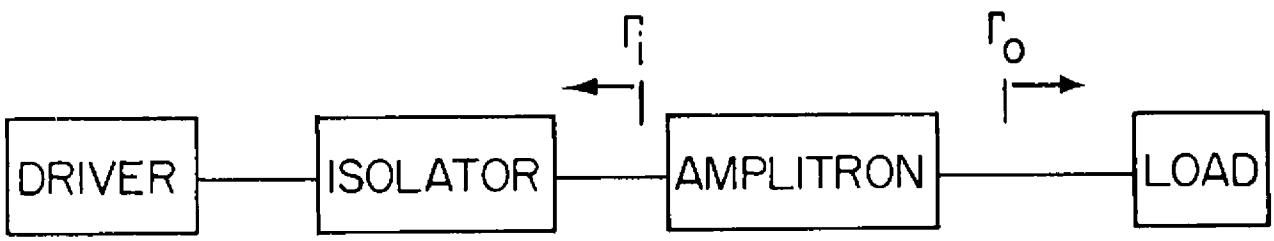


Figure 1

OPERATING CHARACTERISTICS

The operating characteristics of the 8129 for high power operation is shown in Figure 2 below. With peak current and driver power held constant the output power, gain, efficiency and peak voltage are plotted versus frequency. Gain and efficiency are defined as follows:

$$\text{Gain} = \frac{\text{rf power output}}{\text{rf power input}}$$

$$\text{Efficiency} = \frac{\text{rf power output} - \text{rf power input}}{\text{Modulator power input to Amplitron}}$$

8129 TYPICAL OPERATING CHARACTERISTICS

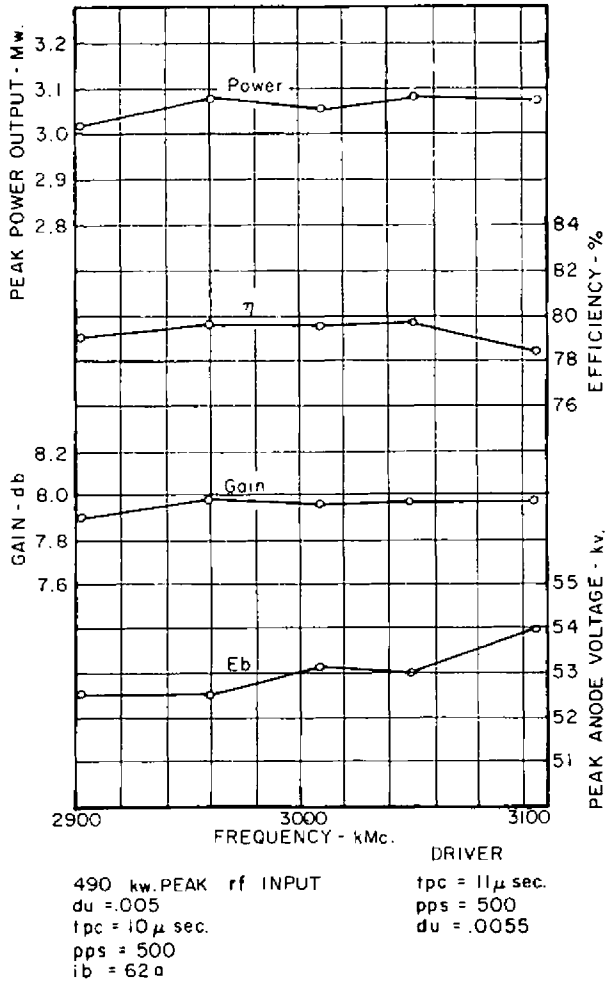


Figure 2

LOAD MISMATCH

The nature of the 8129 is such that output power is less sensitive to load mismatch than is common in magnetrons. Power is a maximum with a matched load and decreases as the load mismatch becomes greater causing more power to be reflected back through the Amplitron into the input circuit.

PHASE SHIFT CHARACTERISTICS

In many applications, MTI operation in particular, it is desirable that the phase delay in a given tube be as independent as possible of variations of voltage or current pulse amplitude. Phase pushing in the 8129 is on the order of 0.5 degrees per 1% change in peak current. The total phase change occurring in the 8129 during the pulse rise and fall is only a few degrees and takes place during the last small part of the voltage rise as well as during the first small part of the voltage fall.

DRIVER REQUIREMENTS

Amplitrons must have a driving signal applied to them for proper operation. The driving signal may be applied either before or at the same instant the Amplitron is turned on and may be removed either after or at the same time the Amplitron is turned off. The magnitude of the rf output is insensitive to rf input but dependent on the pulsed dc input. If the rf drive for a given level of pulsed dc input is reduced to too low a value, the tube ceases to operate properly. Moreover, the consequent instability can damage the tube.

VOLTAGE-CURRENT CHARACTERISTICS

The voltage-current characteristic of an Amplitron is non-linear, resembling that of a magnetron oscillator. A representative value for the dynamic impedance of an 8129 would be 160 ohms.

COOLING

The 8129 is a forced liquid cooled tube. The coolant to be used will depend on the average power level and ambient temperature requirements which will determine the coolant flow rate. Figure 3 is a plot of water coolant flow rate as a function of pressure drop.

CATHODE BUSHING PROTECTION

It is recommended that the ceramic cathode bushing be immersed in a fluid insulating medium of "Univolt 35" transformer oil or equivalent. A minimum distance of 1½" must be maintained through the oil from high voltage to ground. No sharp-edged objects should be in the vicinity of the cathode bushing.

If the 8129 is mounted with the cathode bushing vertically downward, the oil vent pipe provided on the tube must be used to remove all air trapped in the Amplitron oil flange area. A puncture and loss of the vacuum seal may result from arcing near the ceramic cathode bushing.

PRESSURIZATION

Output waveguide pressurization to 45 psia is required. An input waveguide pressure of 35 psia is satisfactory. Pressures lower than those recommended may result in waveguide breakdown If sustained arcing in the waveguide occurs, failure of the output window may result. To minimize the possibility of arcing in the guide, and to achieve optimum performance, the load VSWR should be kept as low as possible.

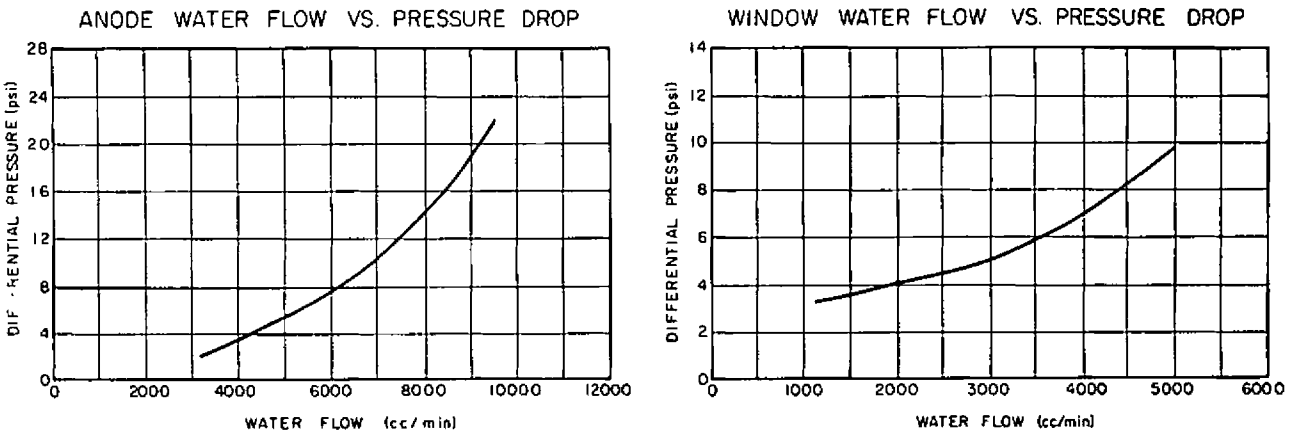


Figure 3

GENERAL PRECAUTIONS

Damage to the Amplitron will be avoided if the following installation and handling precautions are carefully observed:

1. Avoid setting up mechanical strains on input and output windows and cathode bushing when handling or mounting.
2. If the Amplitron has been operated with water as a coolant, be sure to drain the water from the coolant jacket before storing in a freezing environment.
3. If an Amplitron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the rf windows and wipe dry before application of high voltage.
4. Avoid unnecessary jarring or rough handling.
5. Do not place tube in closer proximity to magnetic materials than is specified.

8129 ELECTRON TUBE OUTLINE DRAWING

REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE MOUNTING SURFACE OF THE MAGNET AS SHOWN.

REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO REFERENCE PLANE "A" PASSING THRU THE ℄ OF HOLES AT REFERENCE PLANE "A" AS SHOWN.

REFERENCE PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO REFERENCE PLANES "A" & "B" PASSING THRU THE ℄ OF "Y" HOLE AT REFERENCE PLANE "A" AS SHOWN.

1. THIS FLANGE TO MATE WITH UG-54 A/U WITH CLEARANCE HOLES.
2. MATES WITH HANSEN SERIES #3000 SOCKET OR EQUIVALENT.
3. ANODE TEMPERATURE POINT.
4. MATES WITH WIGGINS #P1700 SERIES OR EQUIVALENT.
5. THIS DIMENSION APPLIES TO THE ℄ OF 5.300 - 5.325 DIAMETER.
6. COMMON CATHODE CONNECTION.
7. THESE SURFACES TO BE COPLANER WITHIN .032.
8. RF OUTPUT.
9. RF INPUT.
10. THESE HOLES WILL ACCEPT A GAGE CONSISTING OF FOUR .385 DIAMETER PINS, 7.125 LONG, 3.000 APART x 10.500 APART.
11. THIS DIMENSION APPLIES TO THE AXIS OF DIAMETER "X".

REFERENCES

Answers on the Amplitron: Raytheon Co.

The Amplitron: Raytheon Technical Information Bulletin, June, 1958.

Final Engineering Report, Volume I on the Design and Development of the Platinotron, Amplitron, and Stabilotron: W. C. Brown, Signal Corps Contract No. DA-36-039-sc-56644, December, 1955.

Platinotron Increases Search Radar Range: W. C. Brown, Electronics, August, 1957.

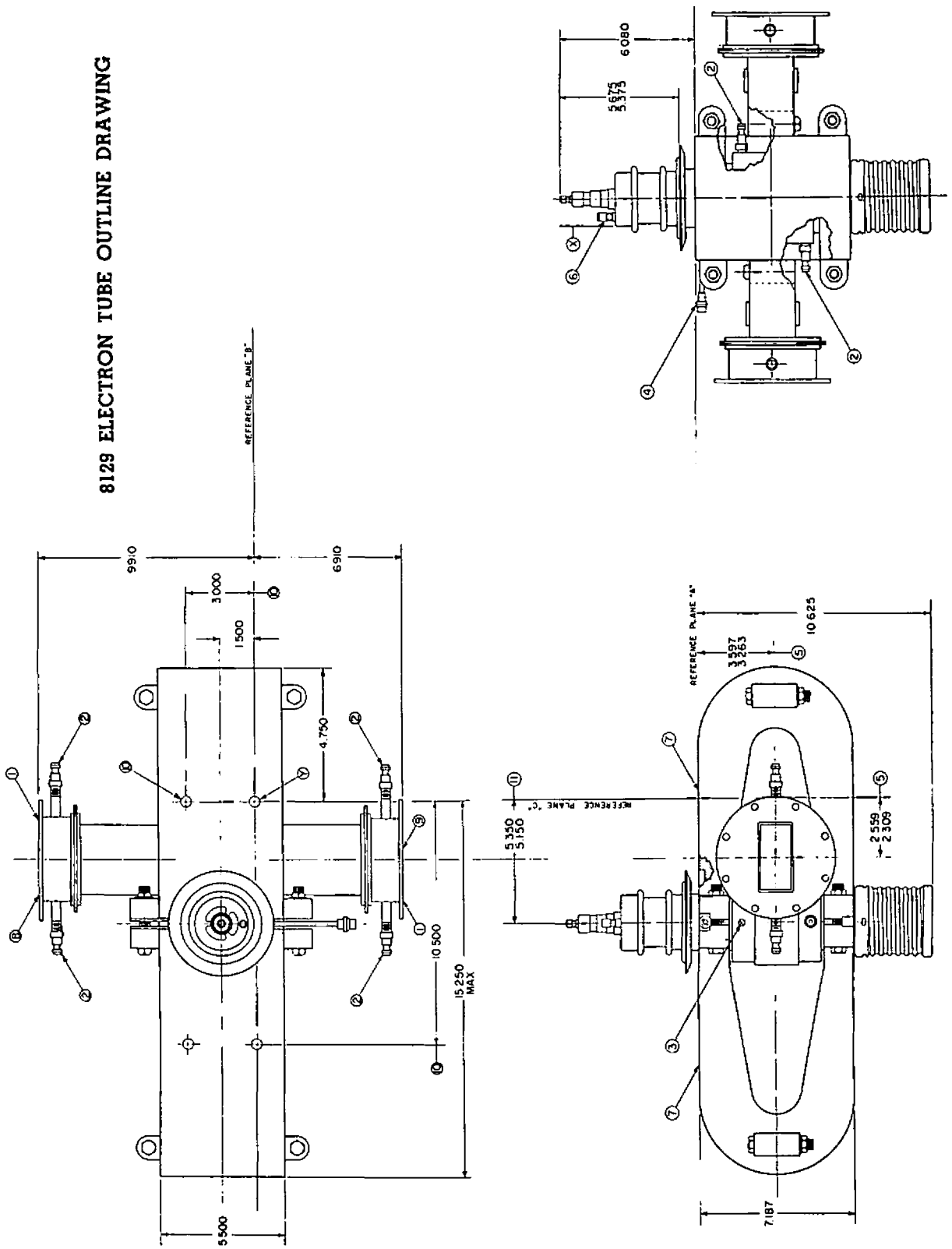
Description and Operating Characteristics of the Platinotron — A New Microwave Tube Device: W. C. Brown, Proceedings of the IRE, September, 1957.

QKS622 Final Engineering Report, BuShips Contract No. NObsr-72589.

A 3-Megawatt, 15 Kilowatt S-Band Amplitron — Smith and Zawada, Microwave Journal, October 1959.

PULSED-TYPE AMPLITRON

8129 ELECTRON TUBE OUTLINE DRAWING



MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

10-61

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK8167/ 4CX300A

CERAMIC TETRODE RF POWER AMPLIFIER OR OSCILLATOR

The Raytheon CK8167/4CX300A is a power tetrode of metal–ceramic construction, designed with an external anode and integral cooling fins. In combination with the unique basing, this provides useful operation up to 500 megacycles in typical oscillator, linear amplifier and class C power amplifier service.

Compact mechanical design and forced air–cooling assure dependable performance under severe environmental conditions of temperature, vibration and shock as well as long standby periods.

CK8167/4CX300A is manufactured and controlled to meet the requirements of the applicable MIL–E–1 specification.

ENVIRONMENTAL RATINGS (ABSOLUTE MAXIMUM):

Temperature (seal)	250 °C
Temperature (anode core)	250 °C
Altitude	10000 ft.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater voltage – See application note 1	6.0 Volts
Heater current	2.85 Amps

DIRECT INTERELECTRODE CAPACITANCES:

Input	29.0 pf
Output	4.0 pf
Grid to plate (max.)	0.06 pf
C k to g1 (p, g2, and h grounded)	16.0 pf
C p to (g1 + h + g2) (k grounded)	4.0 pf
C k to p	0.01 pf

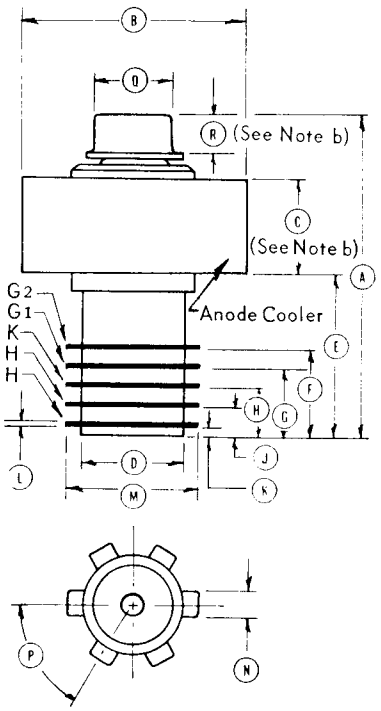
RATINGS – ABSOLUTE MAXIMUM (CCS):

Class:	C telegraphy	C telephony	AB1	
Heater voltage, See note 1	6.0 ± 5%	6.0 ± 5%	6.0 ± 5%	Vac
Plate voltage	2000	1500	2500	Vdc
Screen voltage	300	300	400	Vdc
Grid #1 voltage	–250	–250	–250	Vdc
Plate current	250	200	250	mAdc
Plate dissipation, See note 2	300	200	300	W
Screen dissipation	12	12	12	W
Grid #1 dissipation	2	2	2	W
Plate input power	500	300	625	W
Heater–cathode voltage				
Heater negative to cathode	150	150	150	Vdc
Heater positive to cathode	150	150	150	Vdc

MECHANICAL DATA

BASE	Special, see below
OUTLINE	See below
RECOMMENDED SOCKET	Eimac SK–700 series or equivalent
OPERATING POSITION	Any
COOLING	Forced air
CATHODE	Coated, unipotential

OUTLINE AND BASING



NOTES : a. All dimensions in inches unless otherwise specified.

b. Available anode contact surface.

PHYSICAL DIMENSIONS

	MIN.	MAX.
A	2.300	2.500
B	1.610 dia	1.640 dia
C	0.710	0.790
D	0.740 dia	0.770 dia
E	1.133	1.195
F	0.602	0.642
G	0.470	0.500
H	0.329	0.359
J	0.193	0.213
K	0.050	0.072
L	0.010	0.020
M	0.936 dia	0.956 dia
N	0.170	0.185
P	60° nom.	
Q	0.559 dia	0.573 dia
R	0.240	0.280

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ELECTRICAL DATA (Cont'd.)

GENERAL RATINGS:

Maximum frequency for full input power – See application note 1	500	Mc
Cathode conditioning time (tk)		
Nominal	60	sec
Absolute minimum	30	sec
Amplification factor (G1 to G2)	4.8	
Transconductance at Ib = 200 mAdc	12000	μmho

TYPICAL OPERATIONS:

RADIO–FREQUENCY POWER AMPLIFIER OR OSCILLATOR – CLASS C

					See Note 7	
Plate voltage	500	1000	1500	2000	2000	Vdc
Screen grid voltage, see note 3	250	250	250	250	250	Vdc
Grid voltage	–90	–90	–90	–90	–90	Vdc
Plate current	250	250	250	250	250	mAdc
Screen grid current (approx.)	45	38	21	19	10	mAdc
Grid #1 current (approx.)	35	31	28	26	25	mAdc
Peak RF grid voltage (approx.)	114	114	112	112	---	v
Driving power (approx.), see note 5	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Useful power output (approx.), see note 6	67	180	265	370	225	W
Heater voltage (note 1)	6.0	6.0	6.0	6.0	5.5	Vac

AUDIO FREQUENCY AMPLIFIER OR MODULATOR, CLASS AB1 (TWO TUBES IN PUSH–PULL)

Plate voltage	1000	1500	2000	2500	Vdc
Screen voltage, see note 3	350	350	350	350	Vdc
Grid voltage, see note 4	–55	–55	–55	–55	Vdc
Zero signal plate current	200	200	200	200	mAdc
Max. signal plate current	500	500	500	500	mAdc
Max. signal screen grid current	20	16	10	8	mAdc
Effective load resistance	3500	6200	9500	11600	ohms
Peak AF G1 to G1 voltage (approx.)	100	100	100	100	v
Driving power	0	0	0	0	W
Max. signal power output	240	430	600	800	W

RADIO FREQUENCY LINEAR AMPLIFIER, SINGLE SIDE BAND

SUPPRESSED–CARRIER OPERATION (SINGLE TUBE), FREQ. UP TO APPROX. 175 Mc/s CLASS AB1

SINGLE TONE AND/OR TWO TONE OPERATION

Plate voltage, note 8	1000	1500	2000	2500	Vdc
Screen grid voltage, see notes 3 and 8	350	350	350	350	Vdc
Grid voltage, see note 4	–55	–55	–55	–55	Vdc
Zero signal plate current	100	100	100	100	mAdc

CERAMIC TETRODE
RF POWER AMPLIFIER
OR OSCILLATOR

ELECTRICAL DATA (Cont'd.)

RADIO FREQUENCY LINEAR AMPLIFIER, SINGLE SIDE BAND (Cont'd.)

SINGLE TONE MODULATION

Max. signal plate current	250	250	250	250	mAdc
Max. signal screen grid current	10	8	5	4	mAdc
Max. sig. peak RF grid voltage (approx.)	50	50	50	50	v
Max. signal grid current	0	0	0	0	mAdc
Useful power output (approx.),see note 6	115	205	285	380	W

TWO TONE MODULATION

Peak Envelope conditions for a signal having a min. peak–to–average power ratio of 2.

Ave. plate current	190	190	190	190	mAdc
Ave. screen current (approx.)	2	–1	–2	–2	mAdc
Ave. grid #1 current	0	0	0	0	mAdc
Resultant peak RF grid voltage	50	50	50	50	v
Peak envelope power output, see note 6	115	205	285	380	W

PLATE–MODULATED RADIO–FREQUENCY AMPLIFIER CLASS C

Plate voltage	500	1000	1500	Vdc
Screen voltage	250	250	250	Vdc
Grid voltage	–100	–100	–100	Vdc
Plate current	200	200	200	mAdc
Screen current (approx.)	31	22	20	mAdc
Grid #1 current	15	14	14	mAdc
Peak RF grid input voltage (approx.)	118	117	117	volts
Driving power, see note 5	1.8	1.7	1.7	W
Plate input power	100	200	300	W
Useful power output, (approx.) Note 6	57	138	223	W

APPLICATION NOTES

Note 1. At frequencies above approximately 200 megacycles it may be necessary to reduce heater voltage to compensate for rf transit time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. Particular care should be used in the selection of stable circuit components and in final tuning of high–frequency circuits as off–resonance operation, even to a small degree, may result in a marked and undesirable increase in cathode temperature. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for any particular set of operating conditions. A maximum variation of ±5 percent from optimum is permitted. For straight through, Class C CW amplifier operation, the following heater operation voltages are indicated:

Frequency (Mc)	Ef(Vac)
201 to 300	5.75
301 to 400	5.50
401 to 500	5.00

APPLICATION NOTES (Cont'd.)

Note 2. When the tube is operated at 100 percent of maximum rated plate dissipation at an incoming air temperature of 25°C maximum, a minimum air flow of 5.0 cfm at sea level shall pass through the anode cooler. If the socket Drawing Eimac No. SK–710, or equivalent, is used, an incoming air flow of 5.0 cfm to the lower end of the socket is required. At this flow of 5.0 cfm, the static pressure drop directly across the tube and socket is approximately 0.4 inch of water. This pressure drop varies with the amount of escaping air and with the shape and construction of the air director. The air flow rating applies at bias voltages of less than 100 volts and frequencies of less than 500 Mc. Air cooling of the tube shall be increased with increased negative grid bias, increased incoming air temperatures, or increased frequency of operation, or a combination of both. In all cases of operation, a socket which provides forced–air cooling of the base shall be used, and maximum seal and anode core temperature ratings shall not be exceeded. The air flow shall be applied before or simultaneously with electrode voltages, and may be removed simultaneously with them.

Note 3. Since screen grid current may be reversed under certain operating conditions, precautions must be taken to assure the proper maintenance of screen grid voltage. Recommended methods are the use of a stiff voltage divider or of a regulated screen voltage. Conversely the use of a screen dropping resistor for obtaining proper screen voltage is not recommended.

Note 4. To obtain indicated zero–signal plate current, adjust grid bias.

Note 5. Driving power values are approximately correct at low frequencies. At high frequencies, approaching the maximum capabilities of the tube, electron transit time losses and other tube and circuit losses increase rapidly. It is therefore generally necessary to use a driver stage capable of supplying from 2 to 10 times the values shown.

Note 6. The values for "Useful Power Output, approx." are based upon an output circuit efficiency of 95%.

Note 7. Typical values obtained in a 450–500 Mc cavity amplifier per JAN Dwg. 285 or equivalent. Power output is the minimum measured useful power output.

Note 8. For the maximum signal to intermodulation distortion ratio (S/D), it is recommended that low impedance regulated supplies be used for grid bias and screen voltage.

CHARACTERISTIC RANGES AND CONTROLS:

Test Conditions, except where otherwise specified.
Ef = 6.0 Vac; Ebb = 1000 Vdc; Ec_2 = 300 Vdc; $Ec_{1/Ib}$ = 150 mAdc
Values are initial, unless otherwise noted.

PRODUCTION TESTS: (Insp. Level II, 0.65% AQL individual tests, 1% all tests combined).	MIN.	MAX.	
Screen grid current	–5.0	+3.0	mAdc
Grid #1 voltage (Initial and post Vibration Noise and Shock limit)	–32.0	–46.0	Vdc
Total grid current (Ebb = 2000 Vdc)	---	–15.0	μAdc
Post vibration noise, shock and 100 hour life test (3) limit	---	–20.0	μAdc
Primary control grid emission			
Ic_1 = 70 mAdc, t = 15; anode and screen grid floating.			
Initial and 500 hour life test (1) limit	---	–25	μAdc
Primary screen grid emission			
Ec_1 = 0 Vdc; Ic_2 = 100 mAdc; t = 15; anode floating.			
Initial and 500 hour life test (1) limit	---	–250	μAdc
Heater current, initial	2.60	3.10	Aac
Life test (4) 200 hour limit	2.20	3.20	Aac

CERAMIC TETRODE
RF POWER AMPLIFIER
OR OSCILLATOR

CHARACTERISTIC RANGES AND CONTROLS (Cont'd):

PRODUCTION TESTS: (Cont'd.)	MIN.	MAX.	
Pulse emission (1)			
Eb = Ec_2 = 250 Vdc; Ec_1 = –100 Vdc; $e_{gk/ik}$ = 1.5a			
Ef = 5.4 Vac; prr = 11 ± 1 cps; tp = 4,500 μsec.			
Δik (from leading edge to trailing edge) shall not exceed	---	200	ma
Positive grid current division			
Eb = Ec_2 = 250 Vdc; Ec_1 = –100 Vdc; egk/Ib = 1.0a;			
prr = 11 ± 1 cps; tp = 4500 μsec			
egk	+8.0	+18.0	v
ic1	---	250	ma
ic2	---	250	ma
DESIGN TESTS: (Lot Sampling, Insp. Level L6, 6.5% AQL)			
Direct interelectrode capacitance			
Grid to plate (max.)	---	0.06	pf
Input	25.0	33.0	pf
Output	3.5	4.5	pf
Pulse emission (2)			
Eb = Ec2 = 250 Vdc; Ec1 = –100 Vdc; $egk/_{ik}$ = 1.5a,			
Ef = 6.0 Vac; prr = 11 ± 1 cps; tp = 4500 μsec. Maximum			
Δik (from leading edge to trailing edge) initial, 500 hour			
life test (1) and 100 hour life test (3) limit	---	100	ma
Power output			
Class C amplifier; F = 450 to 500 $Mc/_s$; Ebb = 2000 Vdc;			
Ec_1 = –90 Vdc; Ec_2 = 250 to 300 Vdc; Ic1 = 25 mAdc max.;			
Ef = 5.0 Vac; $Eg_{1/Ib}$ = 250 mAdc. Circuit and cavity in			
accordance with drawing 285–JAN or equivalent	225	---	W
Heater–cathode leakage (Ehk = ± 250 Vdc)			
Initial 500 hour life test (1), and 200 hour life test (4) limit	---	150	μAdc

SPECIAL PERFORMANCE TESTS TO INSURE PRODUCT QUALITY

SHOCK TEST

Impact acceleration = 50 G; duration = 11 ± 1 milliseconds; 18 total blows.

Sample is randomly selected from each production run and test is performed in three different positions. Shorts during test, whether permanent or temporary, are rejected as well as after the test. Tubes following tests also must meet initial limits for Grid Voltage and a maximum grid current limit of –20 μAdc.

VIBRATION NOISE TEST

Frequency range: 5 to 500 to 5 cps; acceleration = 20 G peak; t = 30 minutes total.

This test is performed on a randomly selected sample from each production run. Tubes are swept in each of three positions through the specified range, then vibrated for sixty seconds at the frequency which gives the maximum vibration output voltage. During test, vibration output limit (Ep) is 20 Vac. Following test, tubes must be free of shorts, permanent or temporary, and meet initial limits for Grid Voltage and a maximum grid current limit of –20 μAdc.

SPECIAL PERFORMANCE TESTS TO INSURE PRODUCT QUALITY (Cont'd.)

LIFE TESTS

LIFE TEST (1) 500 hour test

This test is performed on a randomly selected sample, Group C, from each production run under Power Output conditions. Following this test, tubes will not show shorts or open circuits and pass initial limits for Pulse Emission (2), primary control grid emission, primary screen grid emission and heater cathode leakage.

LIFE TEST (2) 500 hour test

This test is operated at accelerated heater voltage (Ef = 6.6), no voltage on other elements on a randomly selected sample, Group C, from each production run. Tested a minimum of 30 minutes after Ef is turned off, tubes shall pass a minimum resistance limit of 100 Megs for Rg1g2 and Rg1k.

LIFE TEST (3) 100 hour test

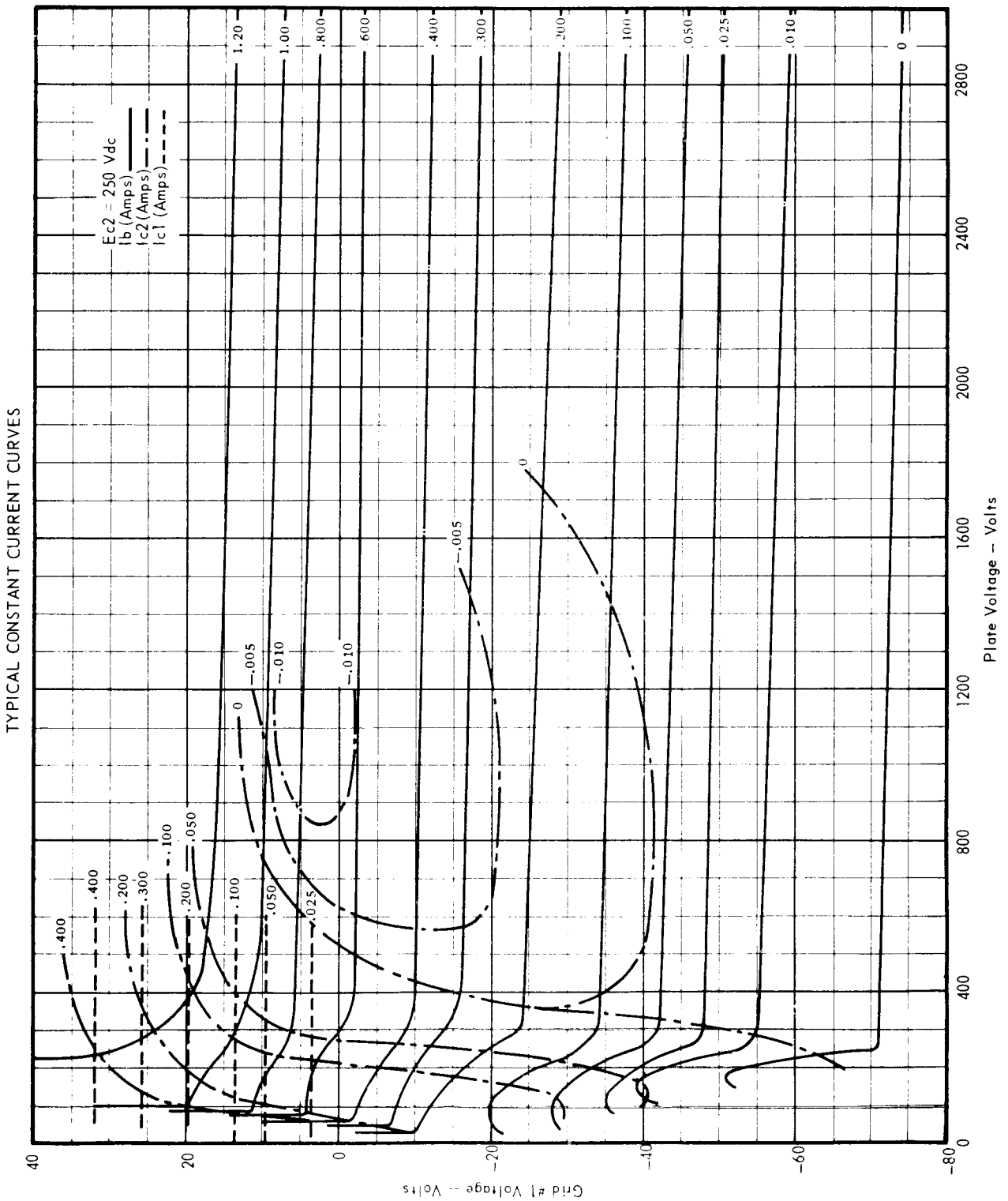
This test is performed on a randomly selected sample, Group D, from each production lot at: F = 1 kc min.; Ebb = 1000 Vdc; Ec2 = 250 Vdc; Ec1/Ib = 50 mAdc; Eg1/Ib = 100 mAdc; Rp = 1000 ohms; T ambient = 200°C min. After 100 hours, tubes must be free of all shorts and open circuits and pass the initial limit for Pulse Emission (2) and a maximum Grid Current limit of $-20\ \mu$Adc.

LIFE TEST (4) 200 hour test – Heater Cycling Life Test.

With normal test conditions on all elements except Ec1 = –100 Vdc, and heater voltage cycling 2 minutes ON and 4 minutes OFF, this test is performed on a randomly selected sample from each production run. No grid–cathode shorts are allowed during or after life test. In addition, after tests, tubes must pass initial limits for heater–cathode leakage and heater current limits of 2.2 to 3.2 Aac.

CERAMIC TETRODE

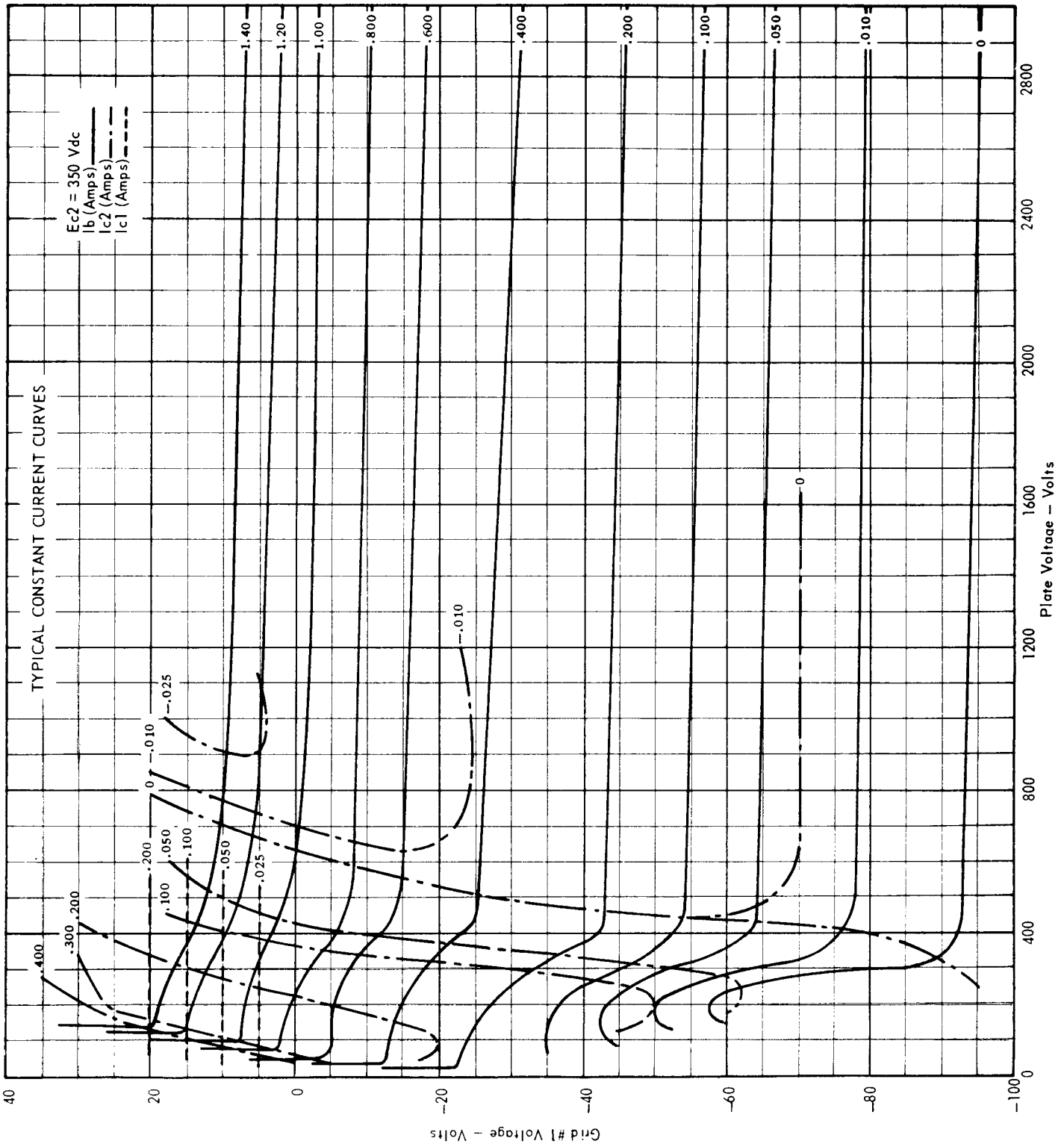
RF POWER AMPLIFIER
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CK8167/ 4CX300A

CERAMIC TETRODE
RF POWER AMPLIFIER OR OSCILLATOR

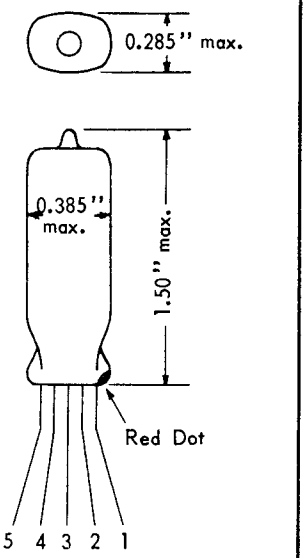


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Excellence in Electronics

TYPE CK502AX

The CK502AX is a filament type pentode of subminiature construction designed for use as a power amplifier in applications requiring economy of space, weight and battery drain. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, positive ■
Lead 3 Filament, negative ■	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) ▲

Grid to Plate: (g1 to p)	0.2 max.
Input: g1 to (−f+g2)	2.7
Output: p to (−f+g2)	5.7

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc) ●	1.25±20% volts
Plate Voltage	45 volts
Grid #2 Voltage	45 volts
Total Cathode Current	1.0 ma.

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage (dc) ●	1.25	1.25 volts
Filament Current	30	30 ma.
Plate Voltage	22.5	45 volts
Grid #2 Voltage	22.5	45 volts
Grid #1 Voltage	0 ♦	−1.25 volts
Plate Resistance (approx.)	0.22	0.25 meg.
Transconductance	385	500 μmhos
Plate Current	0.27	0.45 ma.
Grid #2 Current	0.07	0.11 ma.
Load Resistance	0.15	0.10 meg.
Total Harmonic Distortion	10	10 percent
Power Output	1.2	6 mw

▲ *With shield connected to Lead 3.*

■ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

● *Do not use in series filament circuits. Filament voltage must never exceed 1.55 volts.*

♦ *Grid resistor=5 megohms.*

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

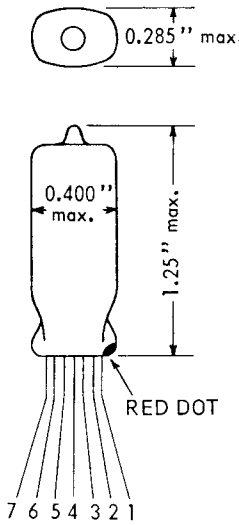
RECEIVING AND CATHODE RAY TUBE OPERATIONS

September 14, 1956 NEWTON 58, MASS.

Excellence in Electronics

TYPE CK510AX

The CK510AX is a filament type double space-charge tetrode of subminiature construction. The two tetrodes are mutually isolated to a degree sufficient for operation in cascade at audio frequencies. The tinned flexible leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.50" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Grid, Unit 1	Lead 5 Plate, Unit 2
Lead 2 Plate, Unit 1	Lead 6 Grid, Unit 2
Lead 3 Space Charge Grid	Lead 7 Filament, Negative
Lead 4 Filament, Positive	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds)●

Control Grid to Plate (each unit)	0.6
Input (each unit)	2.4
Output (each unit)	2.1
Control Grid, Unit 1 to Control Grid, Unit 2	0.7
Plate, Unit 1 to Plate, Unit 2	0.1

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	0.78 volts
Plate Voltage	45 volts

CHARACTERISTICS AND TYPICAL OPERATION - CLASS A1 AMPLIFIER:

Filament Voltage	0.625 volts
Filament Current	50 ma.
Plate Voltage (each unit)	30 volts
Control Grid Voltage (each unit)	0 volts
Space-Charge Grid Resistance ♦	0.2 meg.
Amplification Factor	30
Transconductance (each unit)	50 μmhos
Plate Resistance (each unit)	0.6 meg.
Plate Current (each unit)	50 μa.
Space-Charge Grid Current	135 μa.

CHARACTERISTICS AND TYPICAL OPERATION - RESISTANCE COUPLED AMPLIFIER:

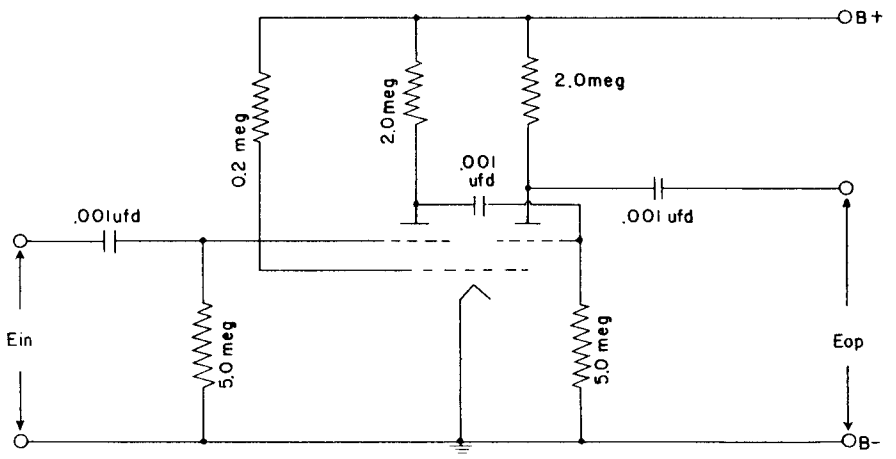
Filament Voltage	0.625 volts
Filament Current	50 ma.
Plate Supply Voltage	30 volts
Control Grid Voltage	0 volts
Grid Resistance	5 meg.
Space-Charge Grid Resistance ♦	0.2 meg.
Load Resistance	2 meg.
Plate Current (each unit)	7.5 μa.
Space-Charge Grid Current	135 μa.
Cascade Voltage Gain (both units)	150

● *With shield.*

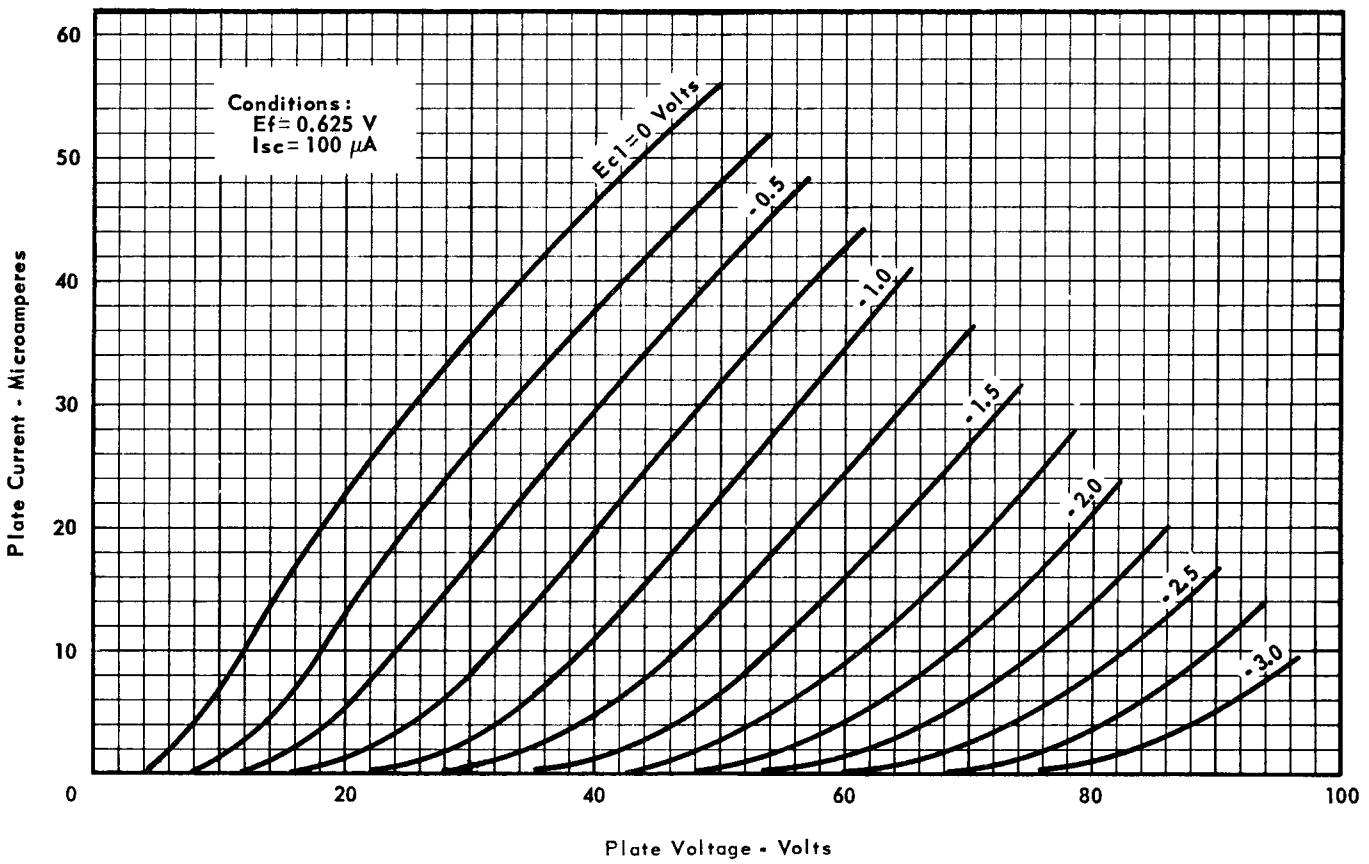
♦ *Returned to positive of plate supply voltage.*

SUBMINIATURE DOUBLE TETRODE

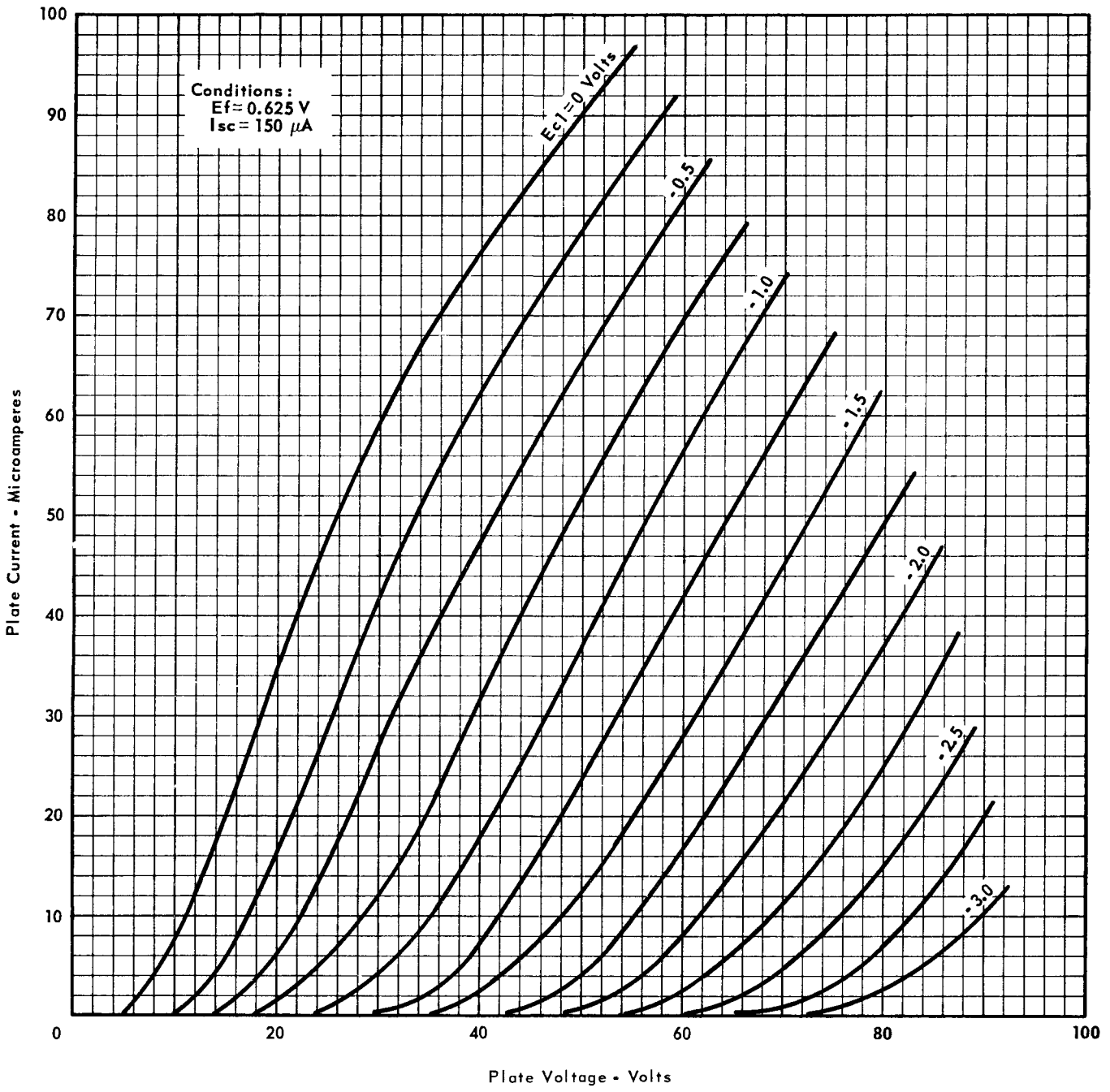
TYPICAL AMPLIFIER CIRCUIT



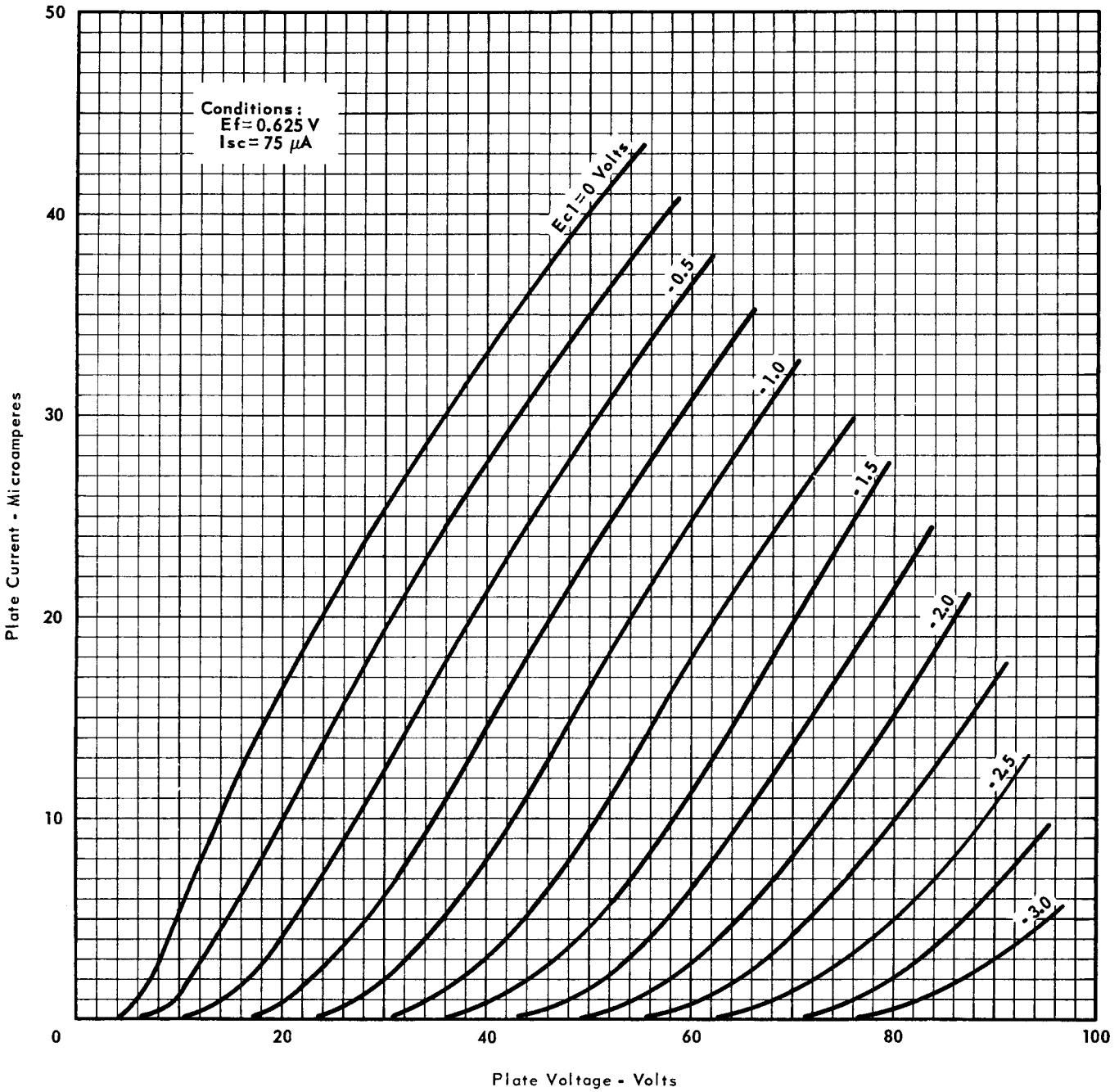
AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS



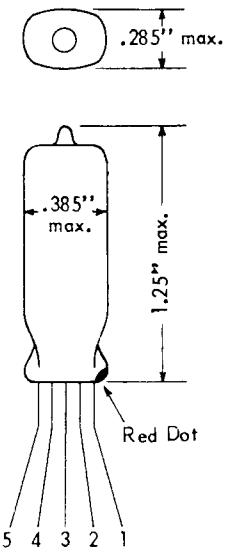
AVERAGE PLATE CHARACTERISTICS



Excellence in Electronics

TYPE CK512AX

The CK512AX is a filament type pentode of subminiature construction designed primarily for use in resistance coupled audio frequency and direct coupled amplifiers. Typical applications are wearable or portable instruments. The tube features low battery drain, long life, small size and low microphonic level. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Negative; Grid #3●
Lead 3 Filament, Positive; Grid #3●	

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: *(uufds.)* *

Grid to Plate: (g to p)	0.10 max.
Input: g 1 to (f+g 2+g 3)	2.3
Output: p to (f+g 2+g 3)	1.5

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	0.625 ± 20% volts
Plate Voltage	25 volts
Grid #2 Voltage	25 volts
Cathode Current	0.1 ma.

AVERAGE CHARACTERISTICS:

Filament Voltage (dc)	0.625 volts
Filament Current	20 ma.
Plate Voltage	15 volts
Grid #2 Voltage	15 volts
Grid #1 Voltage	-1.0 volt
Plate Current	50 μa.
Grid #2 Current	20 μa.
Transconductance	105 μmhos
Plate Resistance	2.0 meg.

TYPICAL OPERATION - RESISTANCE COUPLED AUDIO FREQUENCY AMPLIFIER:

	First Stage		Second Stage		
Filament Voltage (dc)	0.625	0.625	0.625	0.625	volts
Plate and Grid #2 Supply Voltage	15	22.5	15	22.5	volts
Grid #1 Voltage ▲	0	0	-0.625	-0.625	volts
Plate Resistor	1.0	1.0	1.0	1.0	meg.
Grid #2 Resistor	2.2	2.7	1.0	1.5	meg.
Average Voltage Gain (G 1 to P)♦	26:1	37:1	22:1	33:1	
Approx. Voltage Gain (G 2 to P)	3:1	4:1	3:1	4:1	

* *With no external Shield.*

▲ *Control grid should be returned through approximately 5 to 22 megohms to negative filament or bias voltage.*

♦ *The values of voltage gain are quoted for a coupled load of 5 megohms, zero source impedance, and a 5 megohm grid resistor.*

● *Grid #3 is comprised of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

Printed in U.S.A.

Data

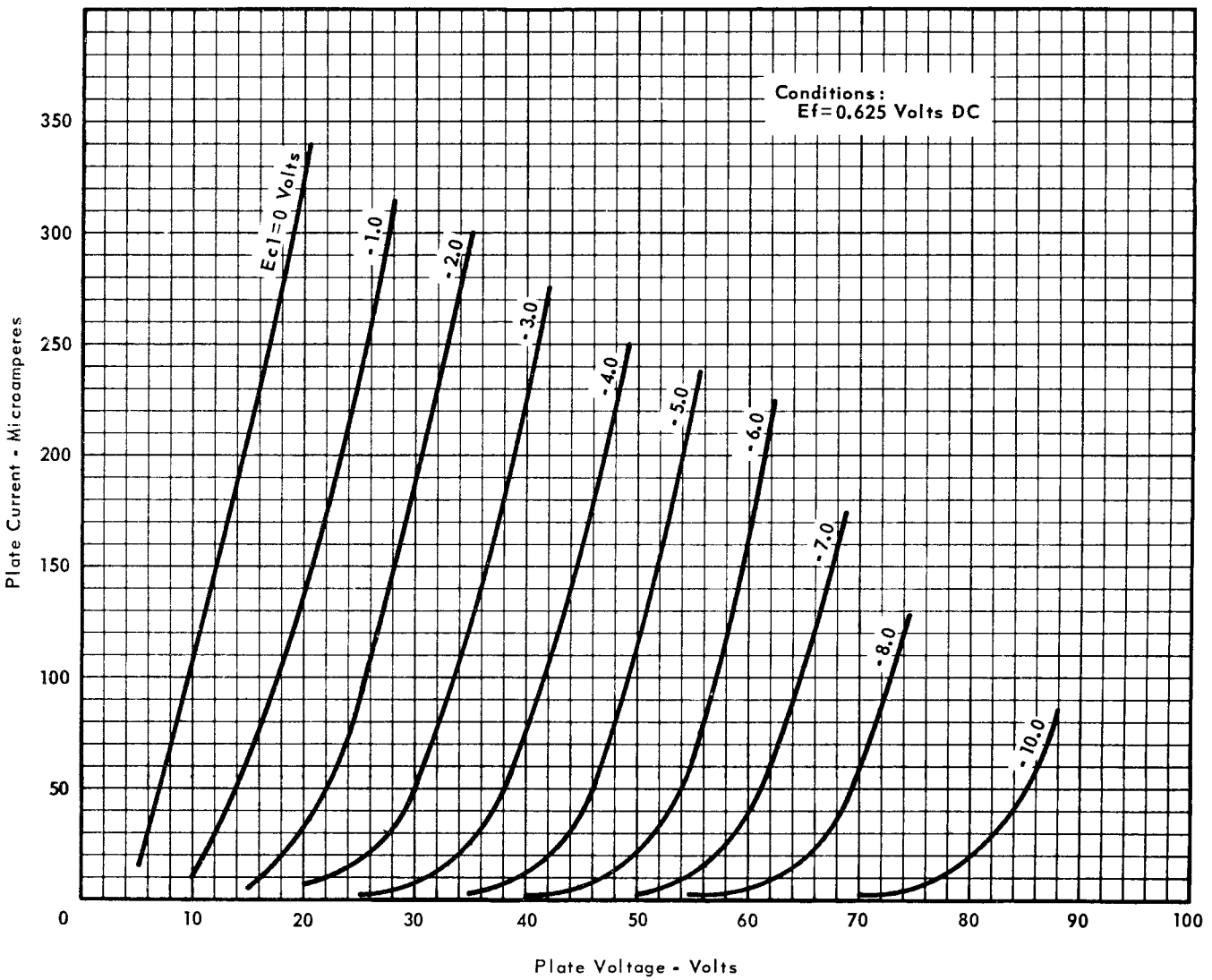
RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

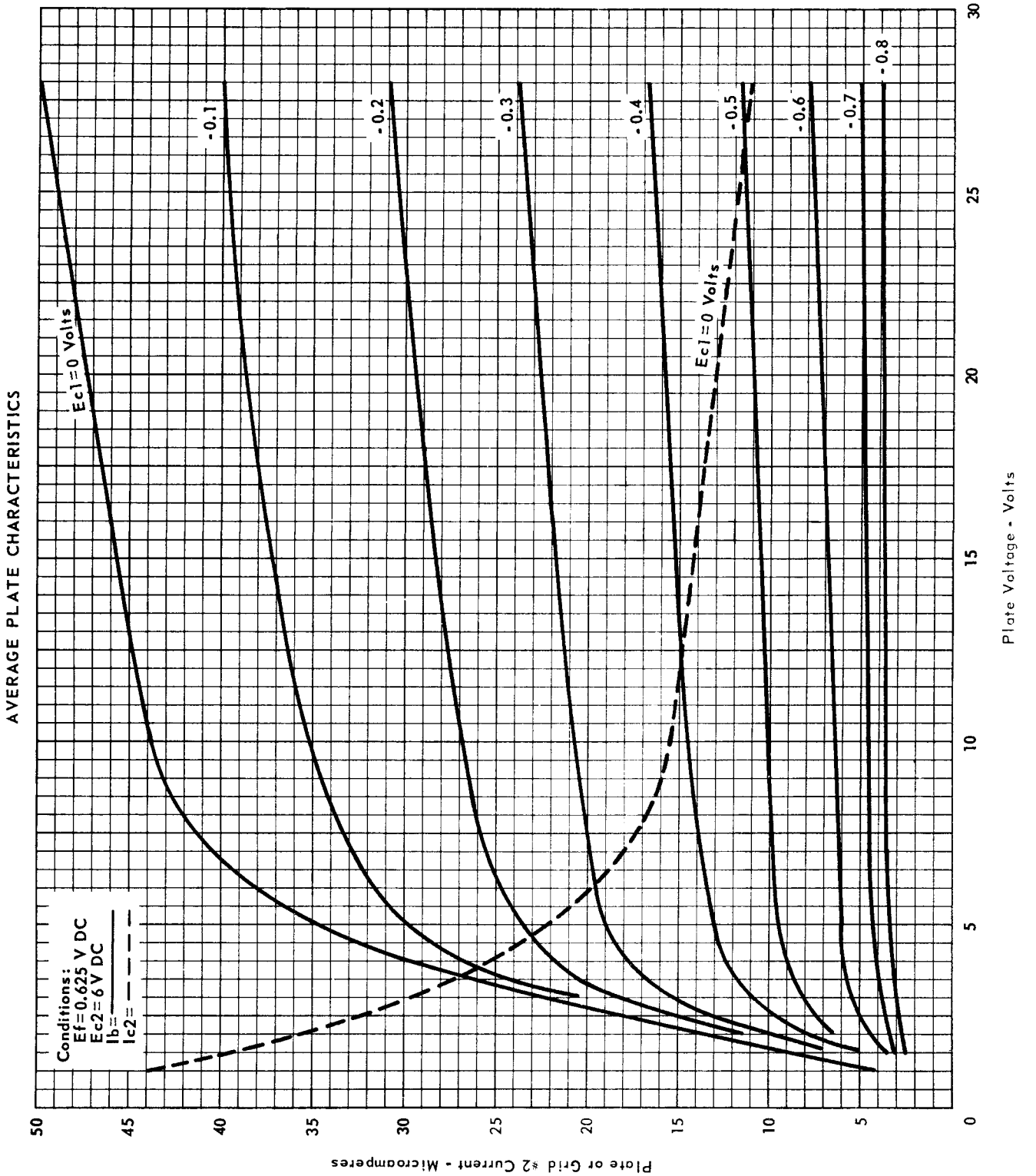
March 1, 1956 NEWTON 58, MASS.

SUBMINIATURE PENTODE

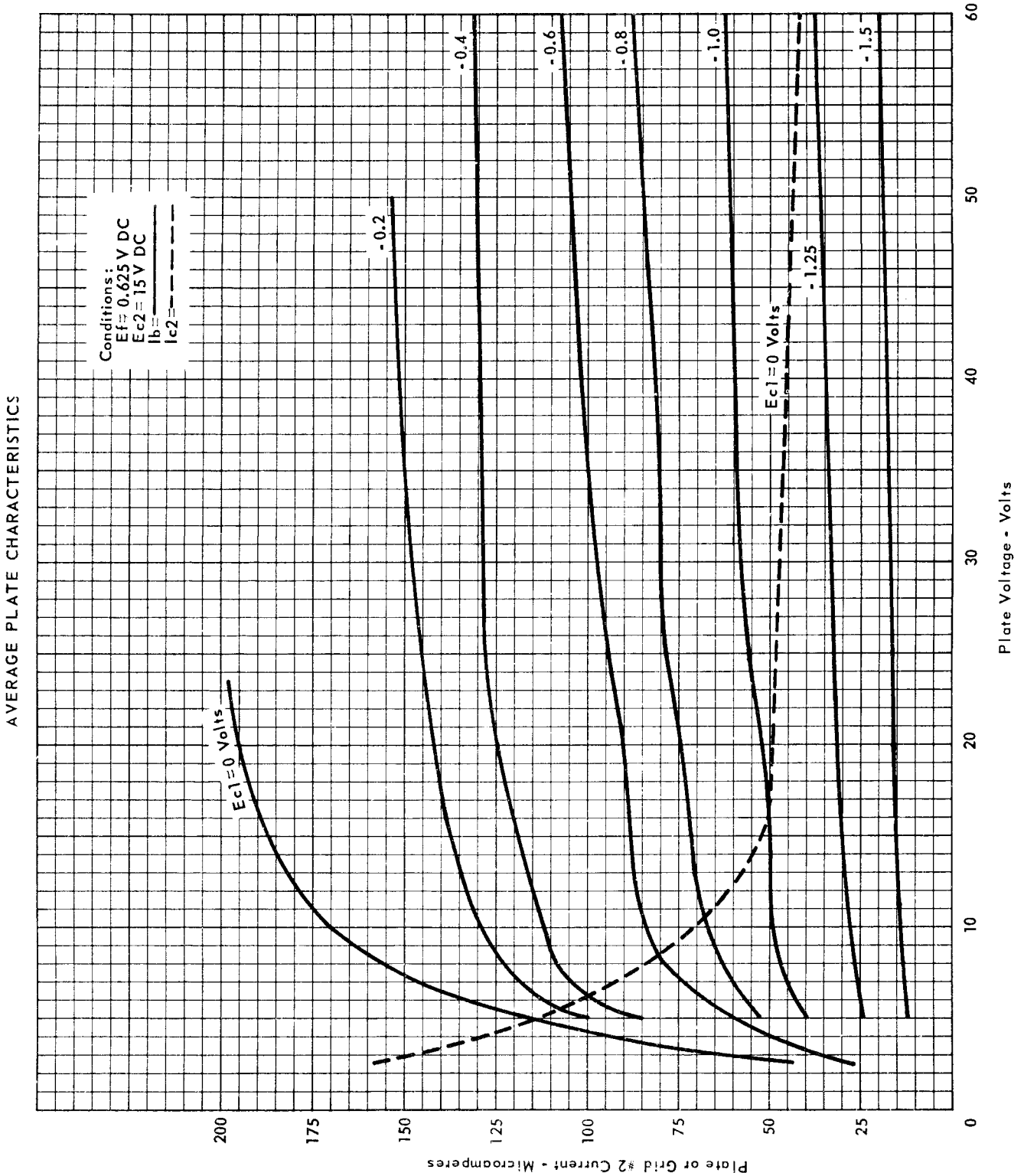
AVERAGE PLATE CHARACTERISTICS
(Triode Connected)



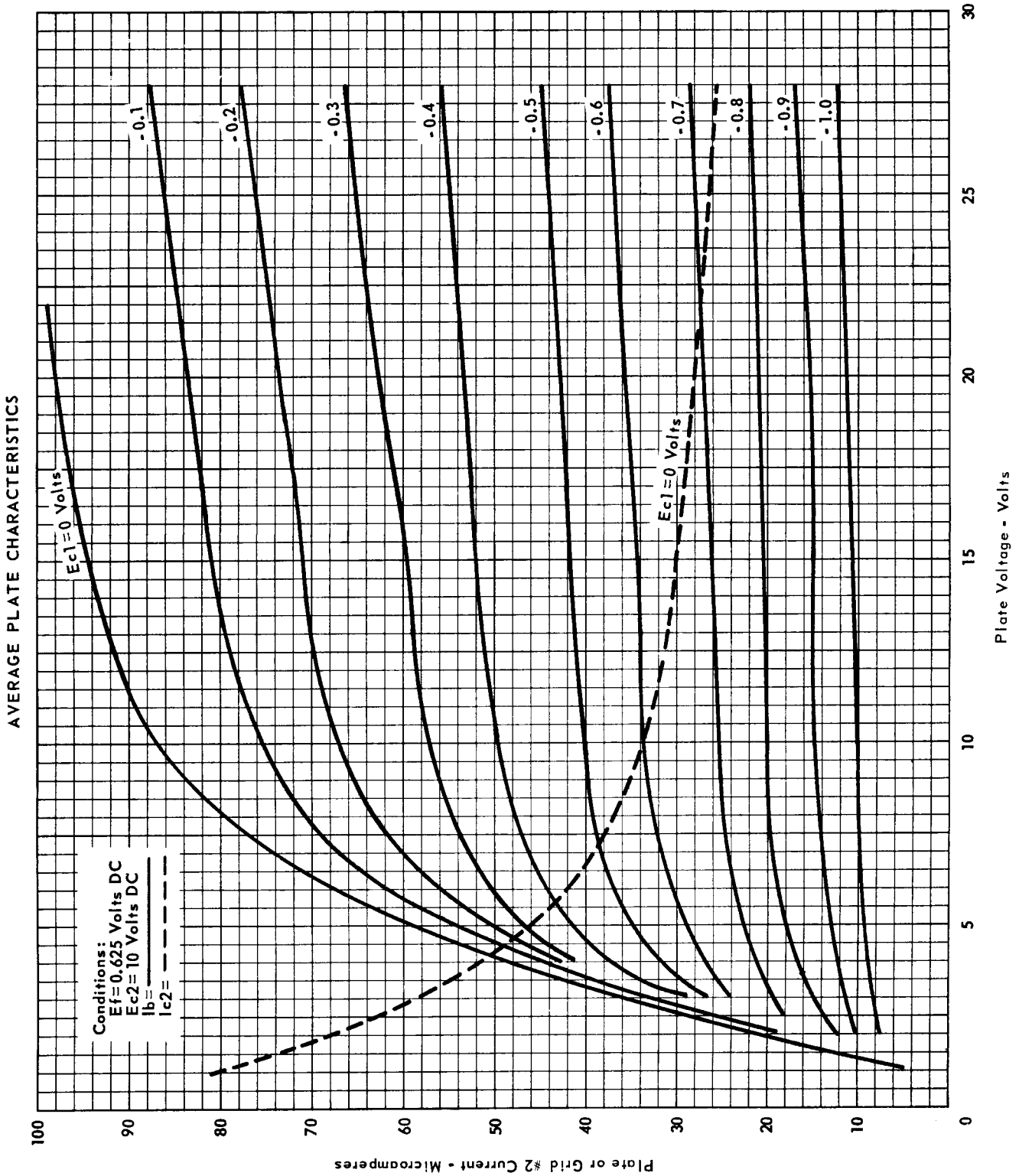
SUBMINIATURE PENTODE



SUBMINIATURE PENTODE



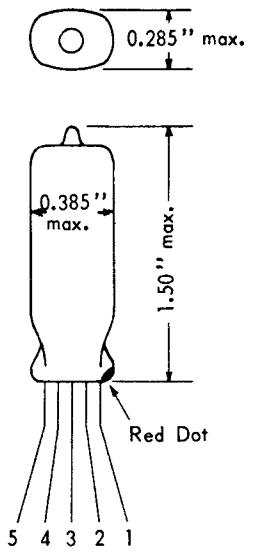
SUBMINIATURE PENTODE



Excellence in Electronics

TYPE CK526AX

The CK526AX is a filament type pentode of subminiature construction designed for use as a power amplifier in portable and wearable equipment. The tinned flexible leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Negative ♦
Lead 3 Filament, Positive ♦	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	45 volts
Screen Grid Voltage	45 volts
Cathode Current	1.0 ma.

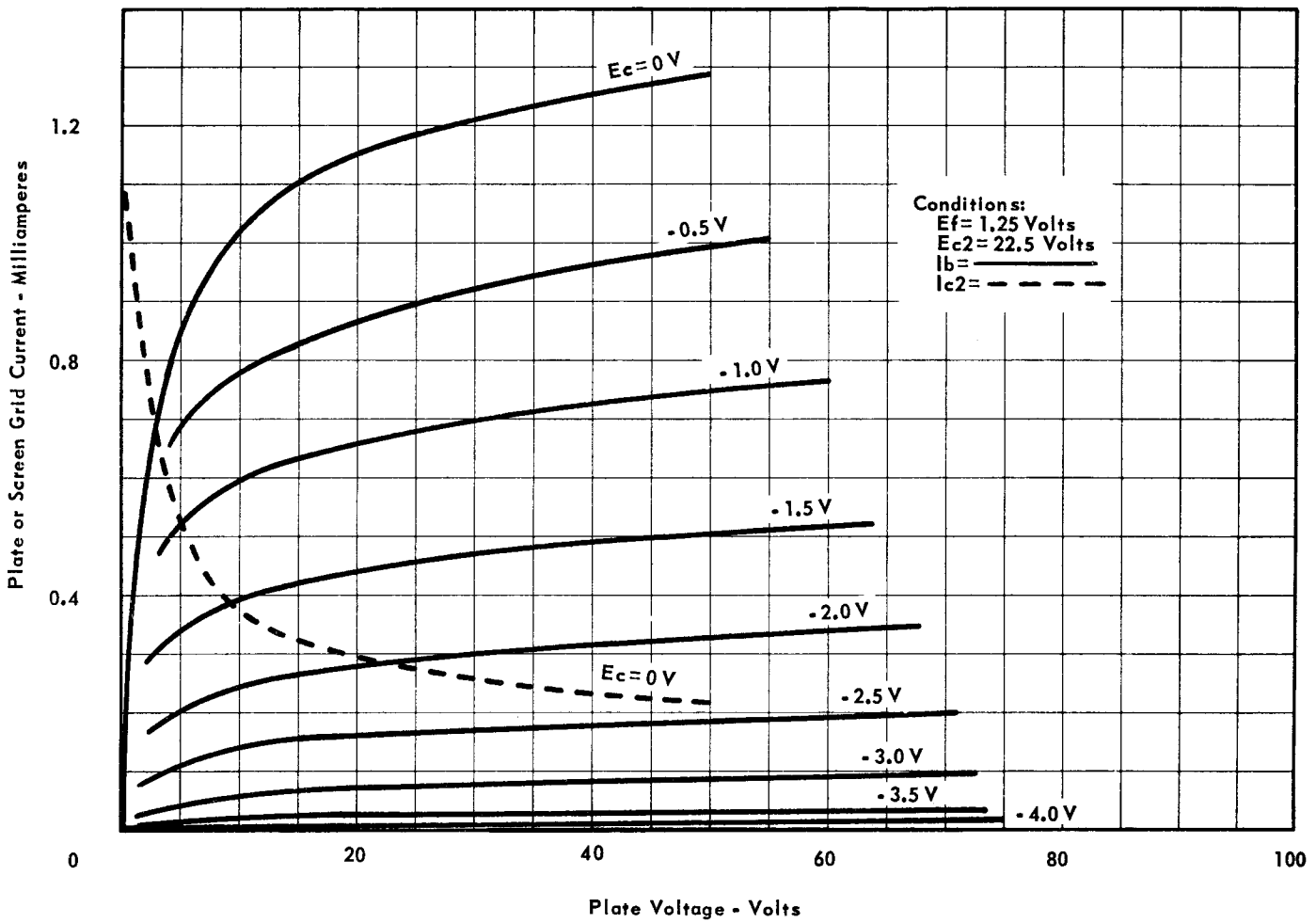
CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	1.25 volts
Filament Current	20 ma.
Plate Voltage	22.5 volts
Screen Grid Voltage	22.5 volts
Control Grid Voltage	-1.5 volts
Peak AF Control Grid Voltage	1.5 volts
Plate Current	0.45 ma.
Screen Grid Current	0.12 ma.
Transconductance	400 μmhos
Plate Resistance	0.22 meg.
Load Resistance	0.05 meg.
Distortion (approx.)	10 percent
Power Output	3.75 mw.

♦ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

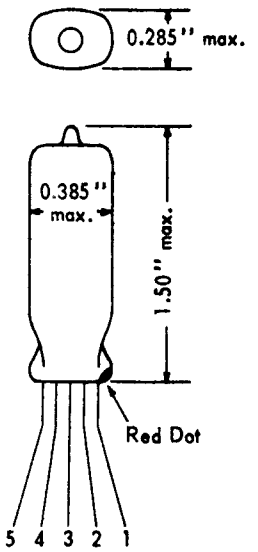
SUBMINIATURE PENTODE

AVERAGE PLATE CHARACTERISTICS



TYPE CK533AX

The CK533AX is a filament type pentode of subminiature construction designed for use as a power amplifier in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE None (0.016' tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Positive ●
Lead 3 Filament, Negative ●	

MOUNTING POSITION: ANY

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	45 volts
Screen Grid Voltage	45 volts
Total Cathode Current	650 μa.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	1.25 volts
Filament Current	15 ma.
Plate Voltage	225 volts
Screen Grid Voltage	225 volts
Control Grid Voltage ▲	0 volts
Plate Current	360 μa.
Screen Grid Current	90 μa.
Transconductance	450 μmhos
Plate Resistance	0.5 meg.
Load Resistance	75,000 ohms
Distortion (approx.)	12 percent
Power Output ♦	1.3 mw.

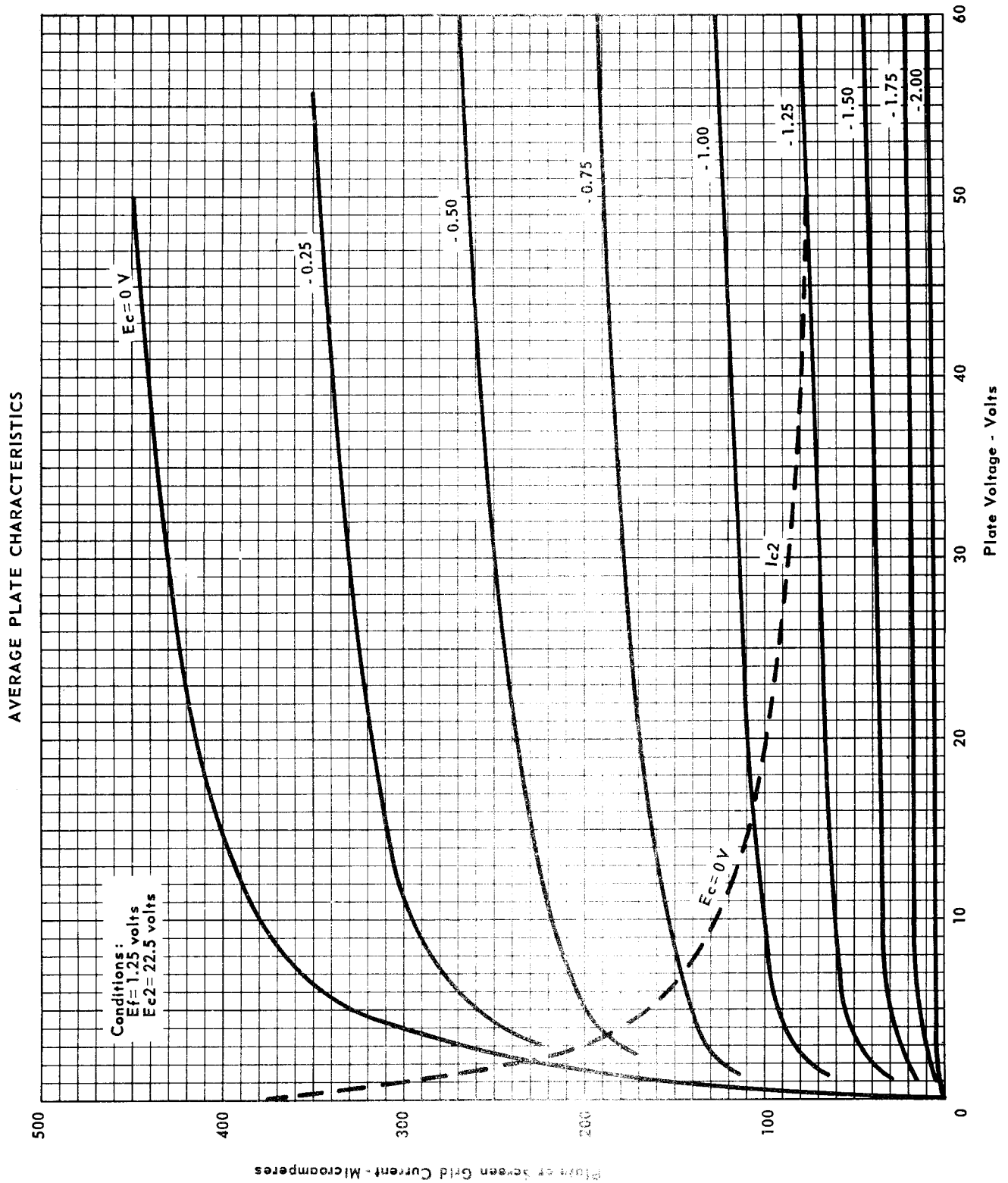
● *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

▲ *Grid Resistor: 5 megohms to negative filament.*

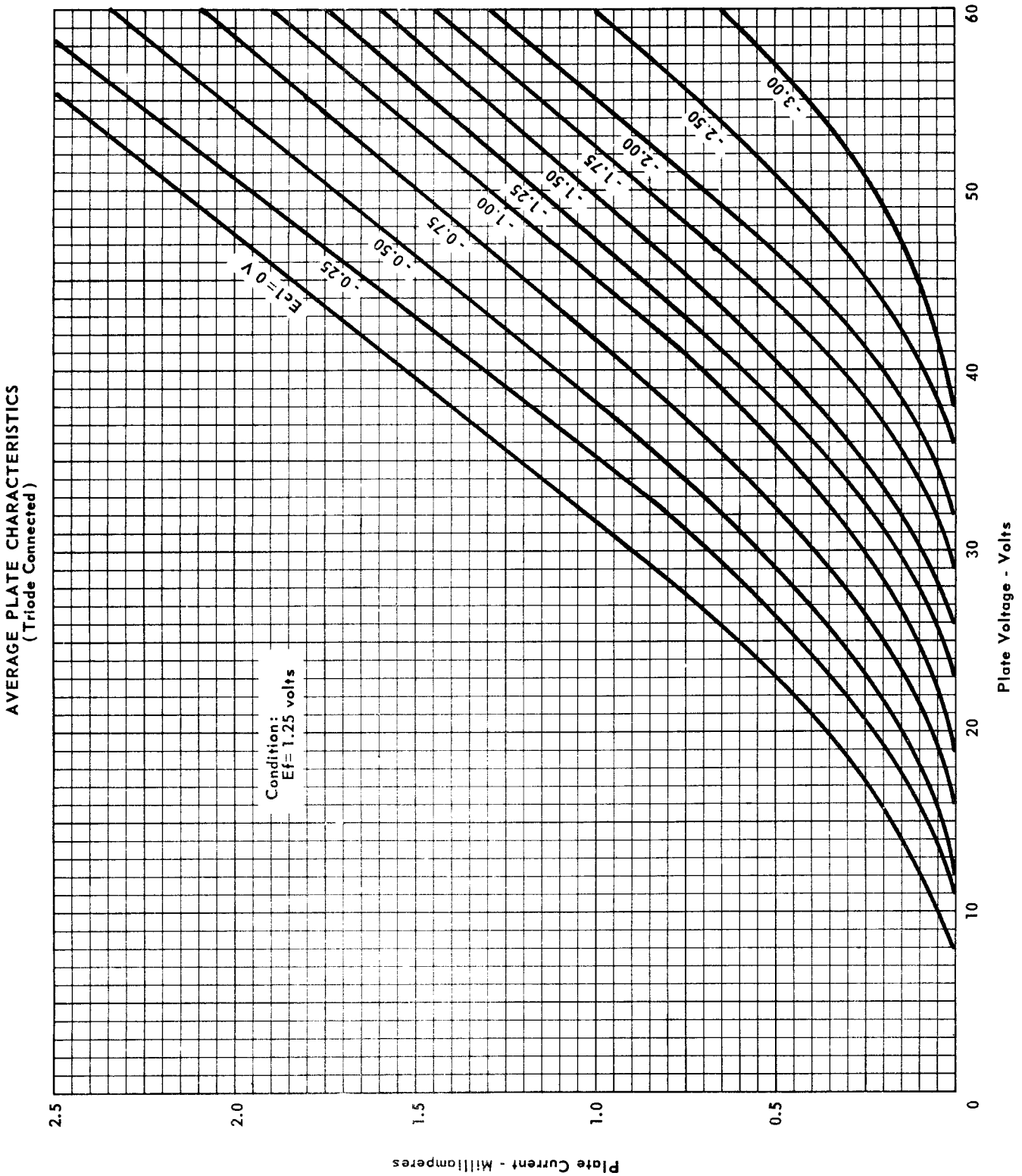
♦ *Signal: 0.6 volt, RMS, Source Impedance: 1 megohm.*

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SUBMINIATURE PENTODE



SUBMINIATURE PENTODE

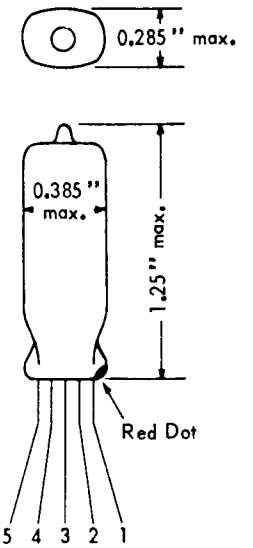


Printed in U.S.A.

Excellence in Electronics

TYPE CK534AX

The CK534AX is a subminiature voltage amplifier pentode designed for use in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.



MECHANICAL DATA

ENVELOPE: T-2X3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

DIMENSIONS:

Max. Length	1.25 inches
Max. Width	0.385 inches
Max. Thickness	0.285 inches

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Negative *
Lead 3 Filament, Positive *	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	0.625±20% volts
Plate Voltage	30 volts
Screen Grid Voltage	30 volts
Cathode Current	0.1 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	0.625 volts
Filament Current	15 ma.
Plate and Screen Supply Voltage	15 volts
Control Grid Voltage	−0.625 volts
Plate Resistor	1 meg.
Screen Grid Resistor	1.5 meg.
Control Grid Resistor	5 meg.
Plate Current	9.2 μa.
Screen Grid Current	3.7 μa.
Transconductance	36 μmhos
Plate Resistance (approx.)	5 meg.
Voltage Gain (average) ♦	24

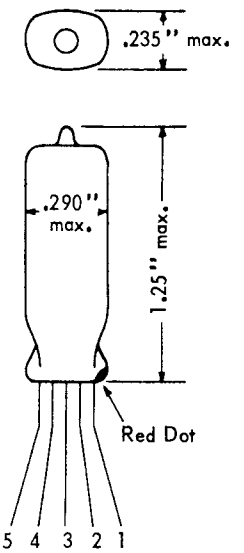
* *Grid #3 is composed of two deflector plates, one being connected to lead 3 and the other to lead 5.*

♦ *With a following grid resistor of 5 megohms and a signal of 0.1 Volts RMS.*

Excellence in Electronics

TYPE CK542DX

The CK542DX is a subminiature power amplifier pentode designed for use in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length. It is electrically similar to type CK526AX.



MECHANICAL DATA

ENVELOPE: T-1½X2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.040" center-to-center.)

DIMENSIONS:

Maximum Overall Length	1.25 inches
Maximum Width	0.290 inches
Maximum Thickness	0.235 inches

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Negative *
Lead 3 Filament, Positive *	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage (dc)	1.25±20% volts
Plate Voltage	30 volts
Screen Grid Voltage	30 volts
Cathode Current	0.7 ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage (dc)	1.25	1.25 volts
Filament Current	15	15 ma.
Plate Voltage	15	22.5 volts
Screen Grid Voltage	15	22.5 volts
Control Grid Voltage	-1.5	-2.0 volts
No-Signal Plate Current	175	425 μa.
No-Signal Screen Grid Current	60	130 μa.
Peak A-F Grid Voltage	1.5	2.0 volts
Transconductance	210	325 μmhos
Plate Resistance	0.25	0.15 megohms
Load Resistance	75	50 kilohms
Total Distortion (approx.)	10	10 percent
Power Output	1.0	3.75 mw

* *Grid #3 is composed of two deflector plates, one being connected to lead 3 and the other to lead 5.*

Printed in U.S.A.

Tentative Data

RAYTHEON MANUFACTURING COMPANY

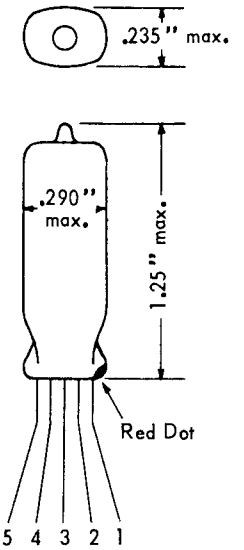
RECEIVING AND CATHODE RAY TUBE OPERATIONS

September 14, 1956 NEWTON 58, MASS.

Excellence in Electronics

TYPE CK547DX

The CK547DX is a subminiature power amplifier pentode designed for use in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length. It is electrically similar to type CK541DX.



MECHANICAL DATA

ENVELOPE: T-1½X2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center.)

DIMENSIONS:

Max. Overall Length	1.25	inches
Max. Width	0.290	inches
Max. Thickness	0.235	inches

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Control Grid
Lead 2 Screen Grid	Lead 5 Filament, Negative ●
Lead 3 Filament, Positive ●	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	1.25±20%	volts
Plate Voltage	45	volts
Screen Grid Voltage	45	volts
Cathode Current	0.5	ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage	1.25	1.25	1.25	volts
Filament Current	10	10	10	ma.
Plate Voltage	22.5	30	45	volts
Screen Grid Voltage	22.5	30	45	volts
Control Grid Voltage ♦	0	0	-1.25	volts
No-Signal Plate Current	100	270	170	μa
No-Signal Screen Grid Current	25	65	40	μa
Transconductance	250	425	320	μmhos
Plate Resistance	1.2	0.75	1.6	meg.
Load Resistance	0.3	0.2	0.2	meg.
Input Signal (RMS) ■	0.5	0.6	0.7	volts
Distortion	12	12	12	percent
Power Output	0.5	2.0	3.5	mw

● *Grid #3 is composed of two deflector plates, one being connected to lead 3 and the other to lead 5.*

♦ *Grid returned to negative filament through 10 megohms.*

■ *From a source having an internal impedance of 2 megohms.*

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK579

HALF-WAVE RECTIFIER

The CK579 is a filament type, high vacuum, high voltage, half-wave rectifier of subminiature construction designed for use in a metascope power supply. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage		
Series	2.5±10%	volts
Parallel	1.25	volts
Heater Current		
Series	180	mA
Parallel	360	mA

DIRECT INTERELECTRODE CAPACITANCE:

Plate to Filament	0.5	$\mu\mu$fd max.

ABSOLUTE MAXIMUM RATINGS:

Peak Inverse Plate Voltage	15	Kv
Average Plate Current	550	μA
Peak Plate Current (steady state)	4	ma
Minimum Plate Supply	600	K
Peak Plate Current (surge)	20	ma

CHARACTERISTICS AND TYPICAL OPERATING–HALF WAVE RECTIFIER 60 CYCLE:

Plate Supply Voltage (RMS sinusoidal waveform)	6.0	Kv
Plate Supply Impedance	660	K
Load Current DC	500	μA
Load Condenser	.003	μfd.
Load Resistor	12	meg.
DC Output Voltage	6.0	Kv
Tube Voltage Drop at 500 μAdc	50	volts

These data identify a particular developmental tube design and the tube designation, or the descriptive data may be subject to change or abandonment.

OBJECTIVE DATA

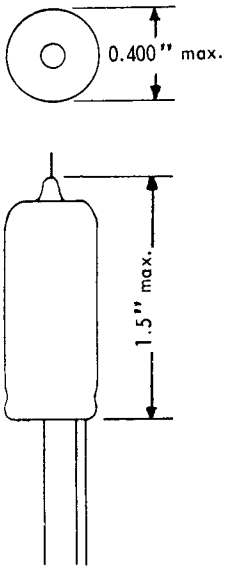
MECHANICAL DATA

ENVELOPE:..... Glass T-3

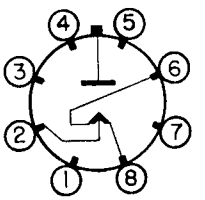
BASE... Subminiature Button 8-Pin (.017" tinned Flexible Leads Length=1.5" min.)

MOUNTING POSITION..... Any

PHYSICAL DIMENSIONS



BASING



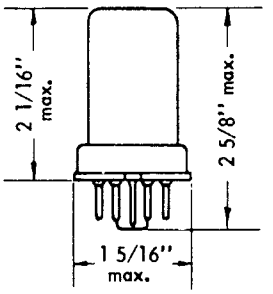
TERMINAL CONNECTIONS:

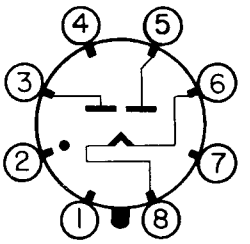
Lead 2 Fil. Cent. Tap
Lead 6 Filament
Lead 8 Filament
Top Lead Plate

Excellence in Electronics

TYPE CK1005

The CK1005 is a gas filled, full-wave rectifier with an ionic heated cathode designed to work on storage batteries with the vibrator supplying the filament power. The tube may also be used as a cold-cathode rectifier on ac/dc lines having 100 to 130 volts provided that the filament is heated to start the tube.





BOTTOM VIEW

5AQ

MECHANICAL DATA

ENVELOPE: MT-8 Metal

BASE: Small-Wafer Octal 8-Pin

TERMINAL CONNECTIONS:

Pin 1 Shield	Pin 5 Plate-Left
Pin 2 No Connection	Pin 6 Filament
Pin 3 Plate-Right	Pin 7 No Connection
Pin 4 No Connection	Pin 8 Filament

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - FULL-WAVE RECTIFIER - CONDENSER INPUT: ■

	Cond. 1▲		Cond. 2 ♦	
Filament Voltage (ac or dc) ●	4.0	6.3	11.0	volts
Nominal Filament Current	0.08	0.05	0.125	amps.
Maximum Peak Voltage per Plate	225	225	225	volts
Maximum Peak Inverse Voltage	450	450	450	volts
Average Dynamic Voltage Drop	20	20	20	volts
Maximum DC Output Current	70	70	70	ma.
Minimum DC Output Current	15	0	30	ma.
Minimum Starting Peak Voltage	175	125	100	volts
Maximum Steady Peak Plate Current per plate	210	210	210	ma.

■ *For interpretation of ratings, see RMA Standards for storage battery operation.*

▲ *Cond. applies when filament is heated during operation.*

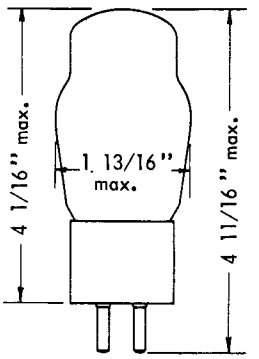
♦ *Cond. 2 applies when filament is heated only for starting.*

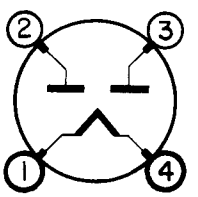
● *When used in full-wave vibrator operation with the filament heated from the transformer, the filament should be poled so that the end next to the corresponding plate should be in phase with the plate voltage when a center-tap is used.*

TYPE CK1006

Excellence in Electronics

The CK1006 is a full-wave gas-filled rectifier with an ionically or directly heater emitter designed for use where a relatively high current and voltage are desired to supply the requirements of transmitters, receivers or other equipment.





BOTTOM VIEW

4C

MECHANICAL DATA

ENVELOPE: ST-14 Glass

BASE: Medium 4-Pin

TERMINAL CONNECTIONS:

Pin 1 Filament	Pin 3 Plate-Left
Pin 2 Plate-Right	Pin 4 Filament

MOUNTING POSITION: Any

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

	Condenser Input		Square Wave	
Filament Voltage	0	1.75	0 or 1.75	volts
Peak Inverse Plate Voltage	1600	1600	1600	volts
Peak Plate Current, per Plate	600	600	320	ma.
Absolute Minimum Peak Starting Voltage, per Plate (Half-Wave)	650	450	----	volts
Absolute Minimum Peak Starting Voltage, per Plate (Full-Wave)	550	420	----	volts
DC Output Current	200	200	225	ma.
Absolute Minimum DC Output Current	70	0	----	ma.

CHARACTERISTICS AND TYPICAL OPERATION - FULL-WAVE RECTIFIER:

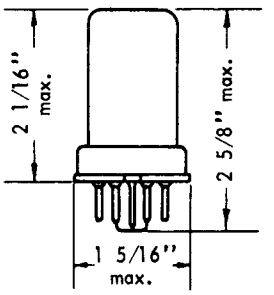
	Condenser Input		Square Wave	
Filament Voltage	0	1.75	0 or 1.75	volts
Filament Current	0	2.00	----	amps.
Peak Plate Voltage, per Plate ♦	800	800	800	volts
Average Dynamic Voltage Drop	30	25	----	volts
DC Output Voltage	550	550	630	volts

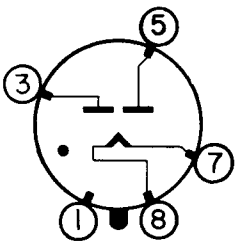
♦ *No load.*

TYPE CK1007

Excellence in Electronics

The CK1007 is a full-wave gas-filled rectifier with an ionically or directly heater emitter designed for use in vibrator type power supplies where a relatively high current and voltage are desired to supply the requirements of transmitters, receivers or other equipment.





BOTTOM VIEW

MECHANICAL DATA

ENVELOPE: MT-8 Metal

BASE: Small wafer octal 5-Pin

TERMINAL CONNECTIONS:

Pin 1 Shield	Pin 7 Filament
Pin 3 Plate, Right	Pin 8 Filament
Pin 5 Plate, Left	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - FULL WAVE RECTIFIER (Condenser Input):

	Cond. 1 ● (A)	Cond. 1 ● (B)	Cond. 2 ■ (A)	Cond. 2 ■ (B)	
Filament Voltage (ac or dc)	1.0	0	1.0	0	volts
Nominal Heater Current	1.2	0	1.2	0	amps.
Abs. Min. DC Output Current (per tube)	10	30	0	30	ma.
Maximum DC Output Current (per tube)	110	110	85	85	ma.
Maximum Peak Anode Current (per tube)	330	330	510	510	ma.
Abs. Min. Peak Starting Voltage (Full Wave)	170	340	170	340	volts
Average Dynamic Voltage Drop	24	24	24	24	volts
Max. Peak Inverse Voltage	980	980	1200	1200	volts
Max. Peak Anode Voltage	490	490	600	600	volts

● *Cond. 1 (A) applies to single tube operation when filament is heated.*
Cond. 1 (B) applies to single tube operation with no heater supply required.

■ *Cond. 2 (A) applies to resistance-parallel operation when filament is heated.*
Cond. 2 (B) applies to resistance-parallel operation when no heater supply is required.

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Tentative Data

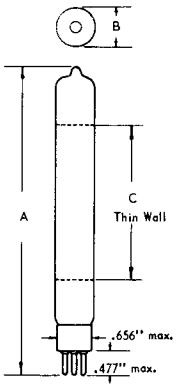
TYPE CK1020 CK1021

These tubes are glass, thin-wall, organic self-quenching counter tubes for detecting beta and gamma radiation. They are designed for use in battery operated survey instruments and prospector's units for locating radioactive material.

The CK1020 or CK1021 can be used as replacements in present survey instrument probes by using a connector inside the probe, such as Amphenol #91-MPF3S.

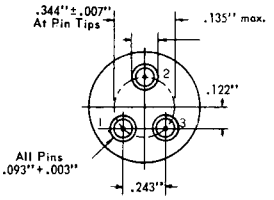
There are available, microphone connectors, such as Amphenol #91-MC3F, which could provide the basic unit for a simple probe using type CK1021. A splash-proof fitting, having a rubber washer which clamps around the cable, is also available from Amphenol as #91-714.

As the connector terminal numbers do not agree with the RMA base numbering system, the wiring to the connector should be carefully checked before inserting the tube.



TUBE DIMENSIONS

Tube	A max.	B max.	C min.
CK1020	6"	3/4"	3"
CK1021	5/1/4"	21/32"	2 1/2"



BASE DIMENSIONS

MECHANICAL DATA

BULB: CK1020 = T-5 ½ Glass, CK1021 = T-5 Glass

BASE: 3 Pin (See Base Diagram)

THIN WALL: 35 mg. per sq. cm. (Note 1)

TERMINAL CONNECTIONS:

Pin 1 Cathode
Pin 2 Plate
Pin 3 No Connection

MOUNTING POSITION: Any

ELECTRICAL DATA

MAXIMUM RATINGS:

Testing Voltage (dc) (Note 2)	1000 volts
Counting Rate	12000 CPM
Temperature Range	-40 to +55 °C
Geiger Threshold (dc)	850 volts

CHARACTERISTICS AND TYPICAL OPERATION:

Plateau Length (dc)	150 volts
Relative Plateau Slope (Per 100 volts)	3 %
Operating Voltage (dc)	900 volts
Background (approx.) (Note 3)	60 CPM
Efficiency (min)	90 %
Life	10^8 counts
Capacity (avg.)	1.6 $\mu\mu$fd

NOTE 1: Use caution when handling thin wall of bulb.

NOTE 2: The plateau length for new tubes is longer than indicated, however, *do not test* for maximum length as tubes are readily damaged by very short discharges at the end of plateau. The maximum rating test voltage should not be exceeded during voltage for the *tubes* with 900 volts recommended operating voltage.

NOTE 3: The tube is covered with an opaque coating to exclude light.

NOTE 4: Capacity includes pins.

Tentative Data

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Excellence in Electronics

TYPE CK1022

The CK1022 is a cold cathode, corona-discharge tube of miniature construction, designed for use as a voltage regulator in high-voltage, low-current supplies.

MECHANICAL DATA

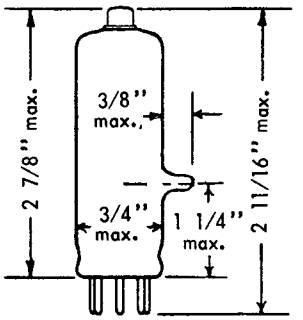
BULB: T-5½ Glass

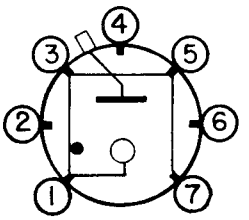
BASE: Miniature Button 7-Pin

CAP: Skirted Miniature

TERMINAL CONNECTIONS:

Pin 1 Cathode	Pin 5 Cathode
Pin 2 No Connection	Pin 6 No Connection
Pin 3 Cathode	Pin 7 Cathode
Pin 4 No Connection	Cap Anode





BOTTOM VIEW

ELECTRICAL DATA

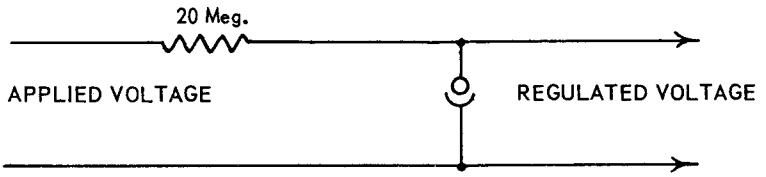
RATINGS - ABSOLUTE MAXIMUM VALUES:

DC Operating Current	5 to 55 μa.
Ambient Temperature Range	-55 to +70 °C

CHARACTERISTICS AND TYPICAL OPERATION:

Minimum DC Starting Voltage	1100 volts
DC Operating Voltage at 25 μa. (approx.)	1000 volts
Regulation (5 to 55 μa.)	20 volts

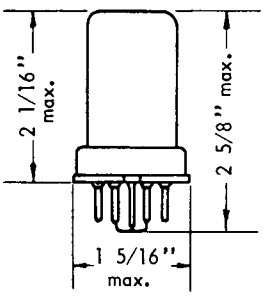
TYPICAL CIRCUIT

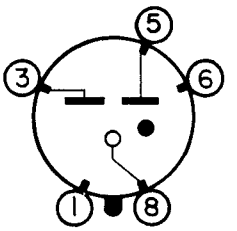


Excellence in Electronics

TYPE CK1024

The CK1024 is a gas-filled double diode with an ionically heated cathode designed for intermittent or "push-to-talk" service in portable and mobile transmitting equipment. Its principal application is as a full-wave power rectifier in equipment employing vibrator type power supplies. The CK1024 is capable of over twice as many starts at maximum output current as similar gas rectifiers with ionically heated cathodes.





BOTTOM VIEW

4B

MECHANICAL DATA

ENVELOPE: MT-8 Metal

BASE: Small Wafer Octal 5-Pin

TERMINAL CONNECTIONS:

Pin 1 Shell	Pin 6 No Connection
Pin 3 Plate #2	Pin 8 Cathode
Pin 5 Plate #1	

MOUNTING POSITION: Any

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Peak Inverse Plate Voltage	1000	volts
Peak Plate Current	480	ma.
Absolute Minimum Peak Starting Voltage, per Plate (Full-Wave)	300	volts
DC Output Current	175	ma.
Absolute Minimum DC Output Current ■	50	ma.
Minimum Total Effective Plate Supply Impedance, per Plate ♦	300	ohms

CHARACTERISTICS AND TYPICAL OPERATION ▲ - VIBRATOR OPERATION - FULL-WAVE:

Peak Plate Voltage, per Plate ●	500	volts
Filter Input Condenser	8	μfds.
Total Effective Plate Supply Impedance, per Plate ♦	375	ohms
Average Dynamic Voltage Drop	24	volts
DC Output Current	160	ma.
DC Output	395	volts

■ *Under no circumstances should the tube be operated with less than 50 ma. of cathode current.*

▲ *Continuous or typical "push-to-talk" transmitter service as used in portable or mobile equipment*

● *Open circuit voltage-flat portion of vibrator - transformer voltage wave.*

♦ *Including vibrator, transformer, and wiring.*

Tentative Data

RAYTHEON

TECHNICAL INFORMATION RADIATION COUNTER TUBE

Excellence in Electronics

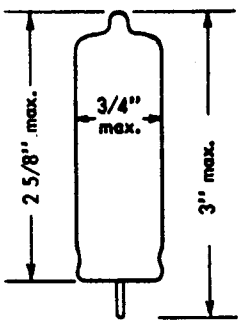
TYPE CK1026

The CK1026 is a low-cost glass, heavy-wall, halogen-quenched counter tube for use in detecting gamma radiation. A halogen quenched counter tube has a marked superiority over conventional organic quenched counters.

The major improvements are:

1. Relatively unlimited life (Note 1).
2. Not damaged by accidental over voltages (Note 2).
3. Increased pulse height.
4. Operation over a wider temperature range (Note 3).
5. Sturdy construction (Note 4).

The CK1026 is used in inexpensive prospectors units and demonstration units.



MECHANICAL DATA

ENVELOPE: T-5½ Glass Heavy wall. Nominal: 175 mg. per sq. cm.

BASE: None (.030" pin. Length: 3/8")

TERMINAL CONNECTIONS:

Anode: Pin at end of tube
Cathode: Connect to coating on outside of bulb (Note 5).

MOUNTING POSITION: Any

ELECTRICAL DATA

Ratings and Normal Operation	Absolute Minimum	Normal Operation	Absolute Maximum	Units
Starting Voltage (Note 6)	700	750	800	Vdc
Operating Voltage	------	900	----	Vdc
Plateau Length (Note 7)	200	------	----	Vdc
Plateau Slope (Note 7)	------	0.10	0.20	%/V
Background at 900 V (Note 8)	------	60	100	cpm
Operating Temperature	-55	------	+75	°C
Life	Unaffected by operation			

Note 1 The life of organic quenched counters is limited because the quenching mechanism results in the dissociation of a definite number of organic molecules per pulse. The end of life in an organic quenched tube is reached when the amount of quenching gas is exhausted. This does not happen in a halogen quenched tube because the halogen gas is not consumed during life.

Note 2 When overvoltages are accidentally applied, the halogen quenched tube will not be damaged even when the tube goes into a continuous discharge.

Note 3 Halogen quenched counters will operate satisfactorily over a temperature range of -50°C to +75°C. The organic quenched tubes operate over a much narrower range because the quenching gas condenses out of the filling mixture.

Note 4 Wall thickness is the same as used in conventional miniature tube types so the CK1026 will stand much greater shock and vibration conditions than conventional thin wall glass and aluminum cathode tubes.

Note 5 The cathode is an externally applied film of colloidial graphite, which will not scratch or peel off. Connection may be made by any type of spring clamp or wire strap which can contact the cathode area.

Note 6 Starting voltage for this tube is that voltage at which uniform pulses of 1/4 volt amplitude appear across a 1 megohm series resistor (500 $\mu\mu$fs coupling condenser).

Note 7 The characteristics of a counter tube can be seriously affected by the associated circuit. The following conditions were used in obtaining the above data.

A scaler was used having a resolving time of 1 microsecond, series resistor of 1 megohm, and a coupling condenser of 500 micromicrofarads. Average counting rate was 100 counts per second.

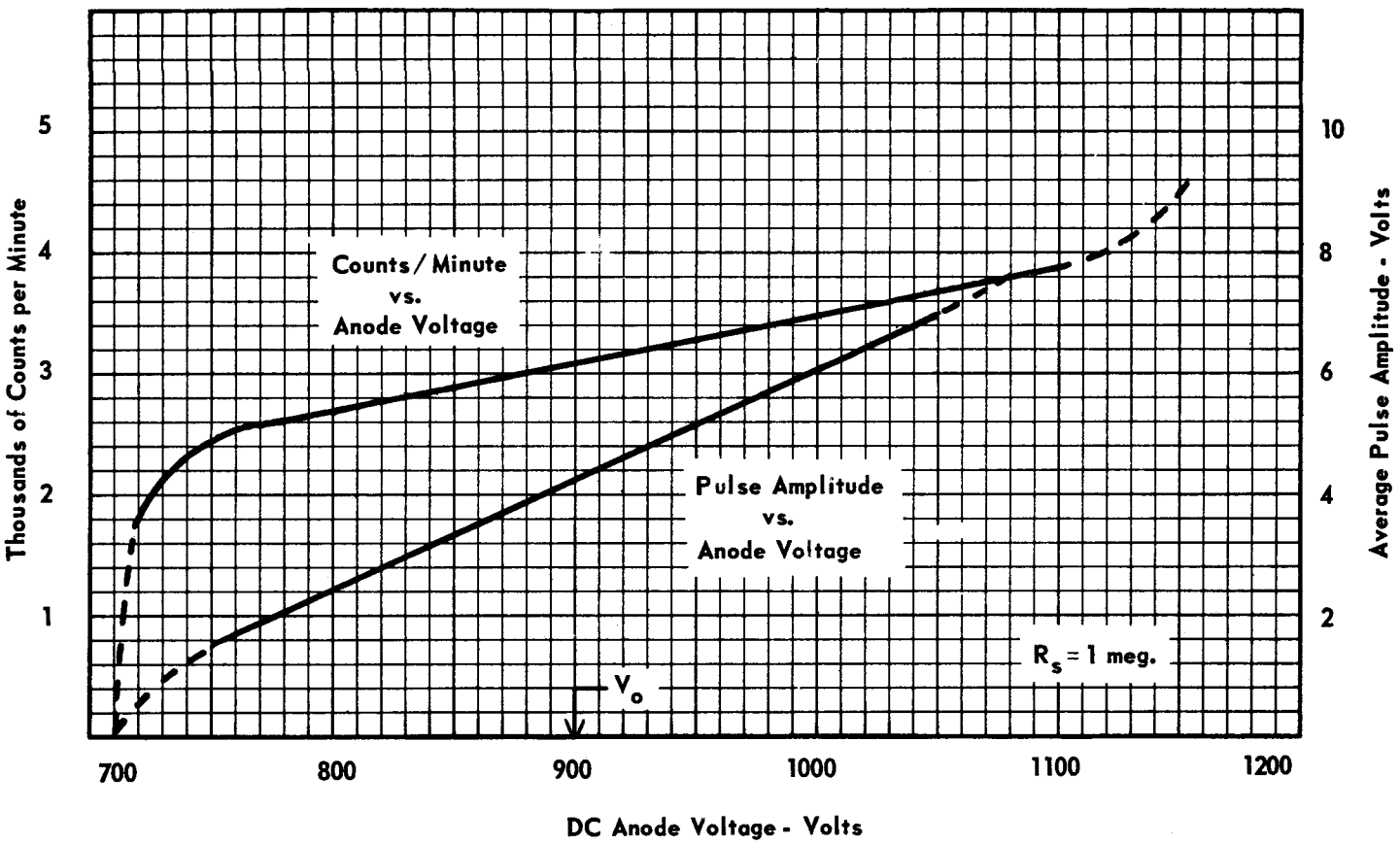
Note 8 No shielding. Ambient light - 5-50 ft. candles. The CK1026 is non-photosensitive, so it is not generally necessary to enclose the tube in a light-tight box or shield.

Tentative Data

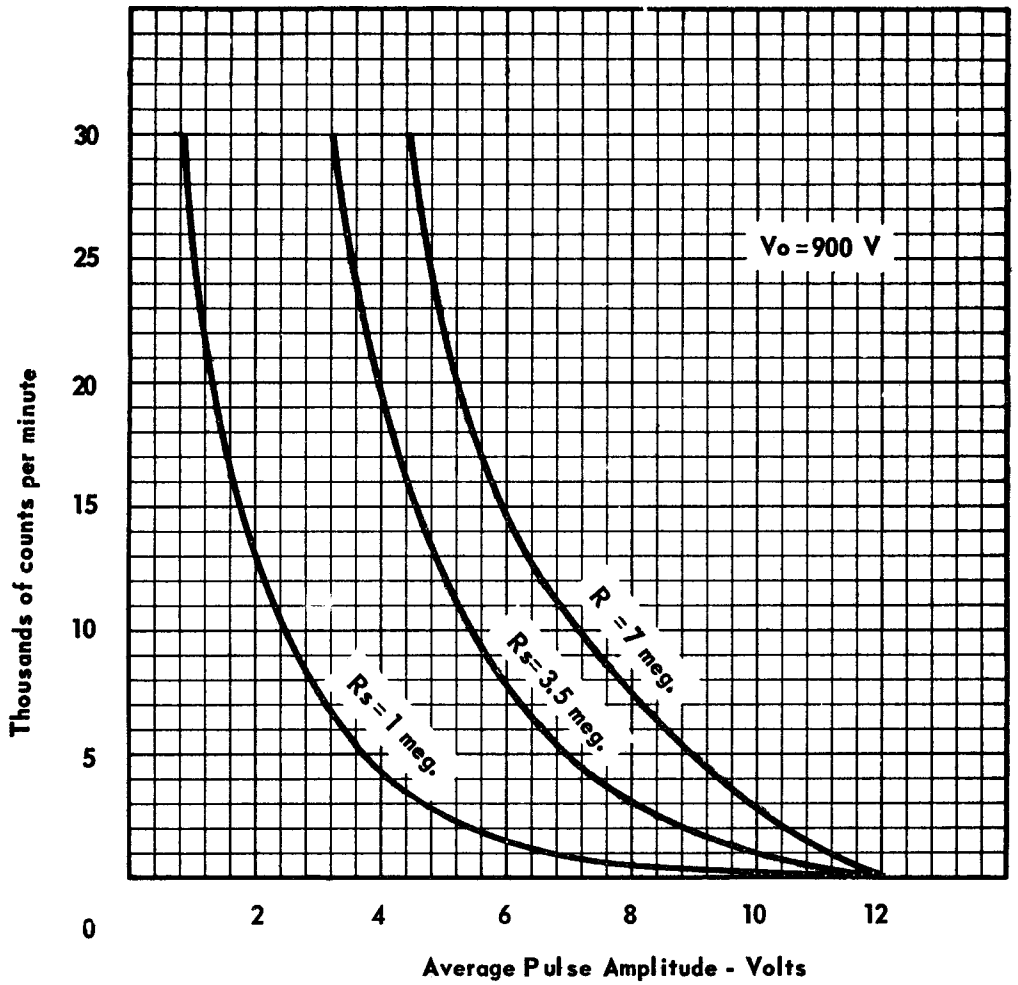
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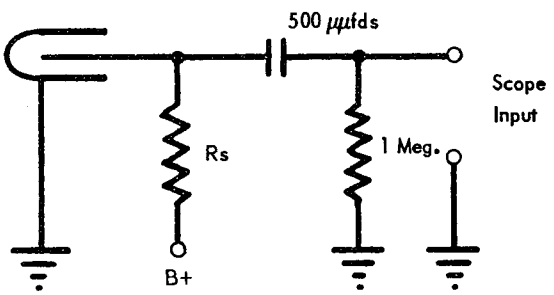
RADIATION COUNTER TUBE



RADIATION COUNTER TUBE



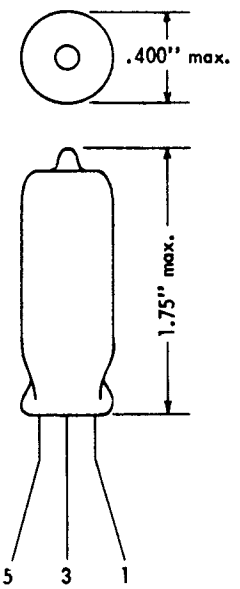
TEST CIRCUIT



Excellence in Electronics

TYPE CK1038

The CK1038 is a corona discharge voltage regulator tube of subminiature construction designed for 900 volt operation and a current range of 5 to 55 microamperes. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to 0.20" length.



MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.50"
Spacing: 0.10" center-to-center)

TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 3 Anode
Lead 5 Cathode

ELECTRICAL DATA

DESIGN CENTER MAXIMUM RATINGS:

Regulator Current	125 μa.
Temperature Range	-55 to +70 °C

CHARACTERISTICS AND TYPICAL OPERATION:

DC Starting Voltage (approx.)	930 volts
Operating Current Range	5 to 55 μa.
Operating Voltage Range at 25 μa.	885 to 915 volts D.C.
Operating Voltage at 5 μa.	880 volts min.
Operating Voltage at 55 μa.	925 volts max.
Life	500 hrs. min.
Regulation	15 volts max.

Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

August 30, 1955 NEWTON 58, MASS.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1047

COLD CATHODE HALF-WAVE RECTIFIER

The CK1047 is a ruggedized, instant starting, cold cathode, gas-filled, half-wave rectifier of miniature construction suitable for high voltage, low current power supplies up to 12 mAdc output. Several tubes can be operated in cascode to produce very high voltages. The CK1047 is designed for use in high vibration environmental conditions such as found in mobile and aircraft equipments.

MECHANICAL RATINGS: (Absolute Maximum)

Fatigue (Vibrational Acceleration for Extended Periods)	35G
Bulb Temperature	−55 to +90°C
Altitude	10,000 Ft.

ELECTRICAL DATA

RATINGS: (Absolute Maximum Values)

Peak Inverse Voltage	2800 v
Plate Supply Voltage (Minimum)	500 Vac
Peak Plate Current (Steady State)	100 ma
Output Current	12 mAdc
Peak Surge Current	300 ma
Plate Circuit Impedance (Minimum, Note A)	6000 ohms

CHARACTERISTICS AND TYPICAL OPERATION

	60~ Half Wave Rectifier
Plate Supply Voltage	1200 Vac
Plate Supply Impedance	7500 ohms
Load Current	12 mAdc
Load Resistor	90,000 ohms
Load Capacitor	2.0 μf
Anode to Cathode Drop (Approx.)	100 Vdc

APPLICATION NOTES

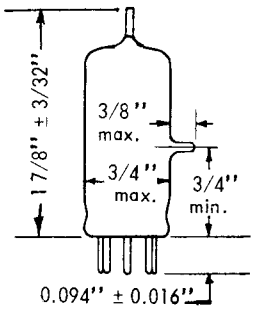
NOTE A: To avoid damage to the equipment or tube, it is recommended that the anode supply impedance be adjusted to limit forward currents and intermittent reverse peak currents to stated values. Typical resistance is 7500 ohms minus the effective equivalent transformers loss, but never less than 2000 ohms dc resistance. For voltage multiplier circuits, a separate limiting resistor should be connected in series with the anode or cathode of each tube. In the event of a reverse arc, the absence of a surge limiting resistor causes all of the energy of the filter condensor to be dissipated in the tube.

CAUTION: To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded.

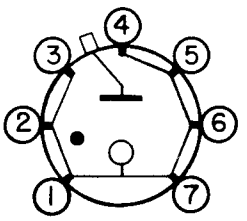
MECHANICAL DATA

ENVELOPE T–5½
BASE ..... 7 Pin Miniature (with cut pins)
CATHODE ..... Glow Discharge
MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



BASING



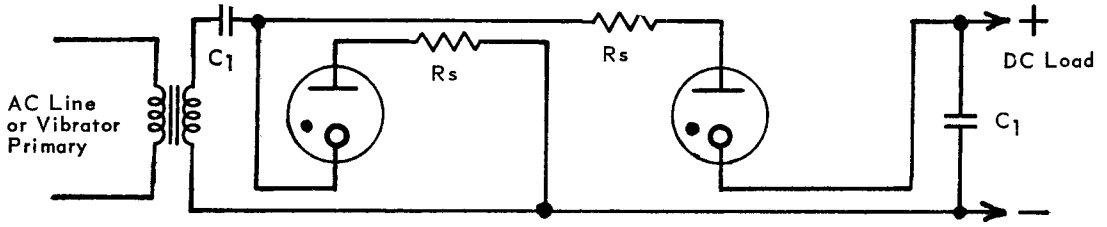
BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Cathode
Pin 2	Cathode
Pin 3	Cathode
Pin 4	Cathode
Pin 5	Cathode
Pin 6	Cathode
Pin 7	Cathode
Cap	Anode

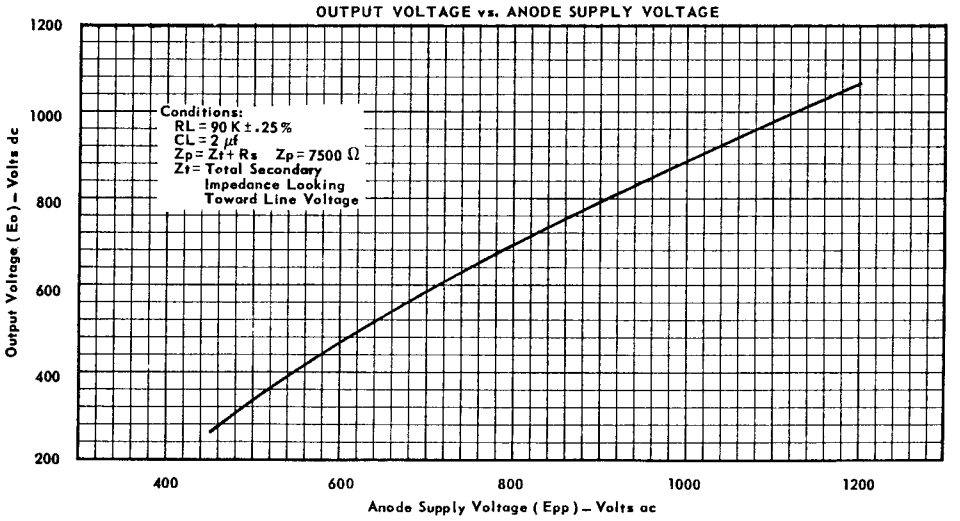
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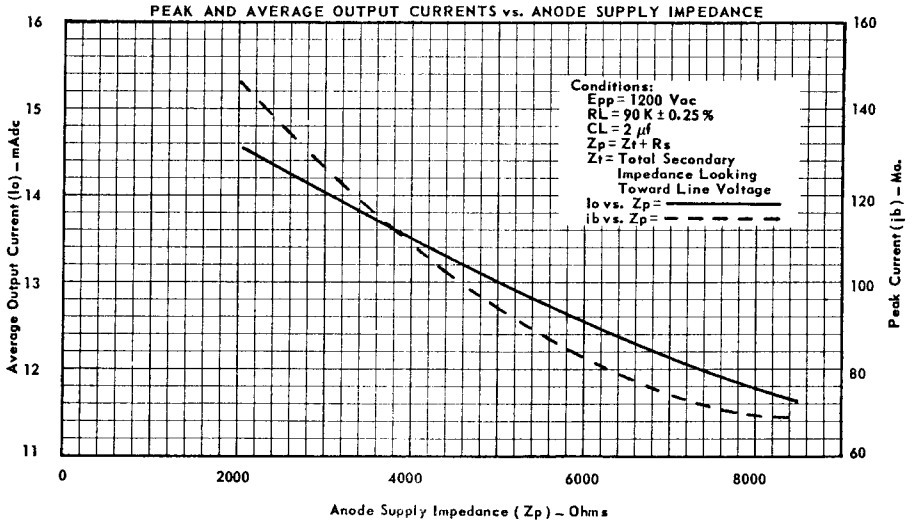
VOLTAGE DOUBLER HIGH VOLTAGE POWER SUPPLY
TYPICAL CIRCUIT FOR AC LINE OR BATTERY OPERATION



Rs = Surge Resistor. Adjust to keep Peak Cathode Current (steady state) and Peak Cathode Current (surge) within ratings of 100 ma. and 300 ma., respectively. Rs should not be less than 2000 ohms in voltage doubler circuits regardless of transformer characteristics.

C1 = 1.0 μf, (Typical for 60 cycle operation).





RAYTHEON

TECHNICAL INFORMATION

RADIATION COUNTER TUBE

Excellence in Electronics

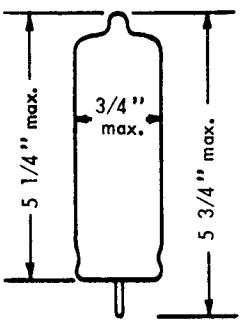
TYPE CK1049

The CK1049 is a low-cost glass, thin wall, halogen-quenched counter tube for use in detecting beta and gamma radiation.

A halogen quenched counter tube has a marked superiority over conventional organic quenched counters. The major improvements are:

1. Relatively unlimited life (Note 1)
2. Not damaged by accidental over voltages (Note 2)
3. Increased pulse height
4. Operation over a wider temperature range (Note 3)

The CK1049 is designed for use in inexpensive prospectors units and demonstration units.



MECHANICAL DATA

ENVELOPE: T-5½ Glass. Thin wall section approximately 3" long. Nominal 35 mg per sq. cm.

BASE: None (.030" pin. Length: 3/8" approximately)

TERMINAL CONNECTIONS:

Anode: Pin at end of tube
Cathode: Connect to graphite coating on outside of bulb (Note 4)

MOUNTING POSITION: Any

ELECTRICAL DATA

Ratings and Normal Operation	Absolute Minimum	Normal Operation	Absolute Maximum	Units
Starting Voltage	700	750	800	Vdc
Operating Voltage	----	900	----	Vdc
Plateau Length (Note 6)	200	----	----	Vdc
Plateau Slope (Note 6)	----	0.10	0.20	%/V
Background at 900 V (Note 7)	----	150	300	cpm
Operating Temperature	-55	25	+75	°C
Life	Unaffected by operation			

Note 1 The life of organic quenched counters is limited because the quenching mechanism results in the dissociation of a definite number of organic molecules per pulse. The end of life in an organic quenched tube is reached when the amount of quenching gas is exhausted. This does not happen in a halogen quenched tube because the halogen gas is not consumed during life.

Note 2 When overvoltages are accidentally applied, the halogen quenched tube will not be damaged even when the tube goes into a continuous discharge.

Note 3 Halogen quenched counters will operate satisfactorily over a temperature range of -50°C to +75°C. The organic quenched tubes operate over a much narrower range because the quenching gas condenses out of the filling mixture.

Note 4 The cathode is an externally applied film of colloidial graphite, which will not scratch or peel off. Connection may be made by any type of spring clamp or wire strap which can contact the cathode area. Do not place clamps around the 3 inch long thin wall section in the center of the bulb.

Note 5 Starting voltage for this tube is that voltage at which uniform pulses of 1/4 volt amplitude appear across a 1 megohm series resistor (500 $\mu\mu$fs coupling condenser).

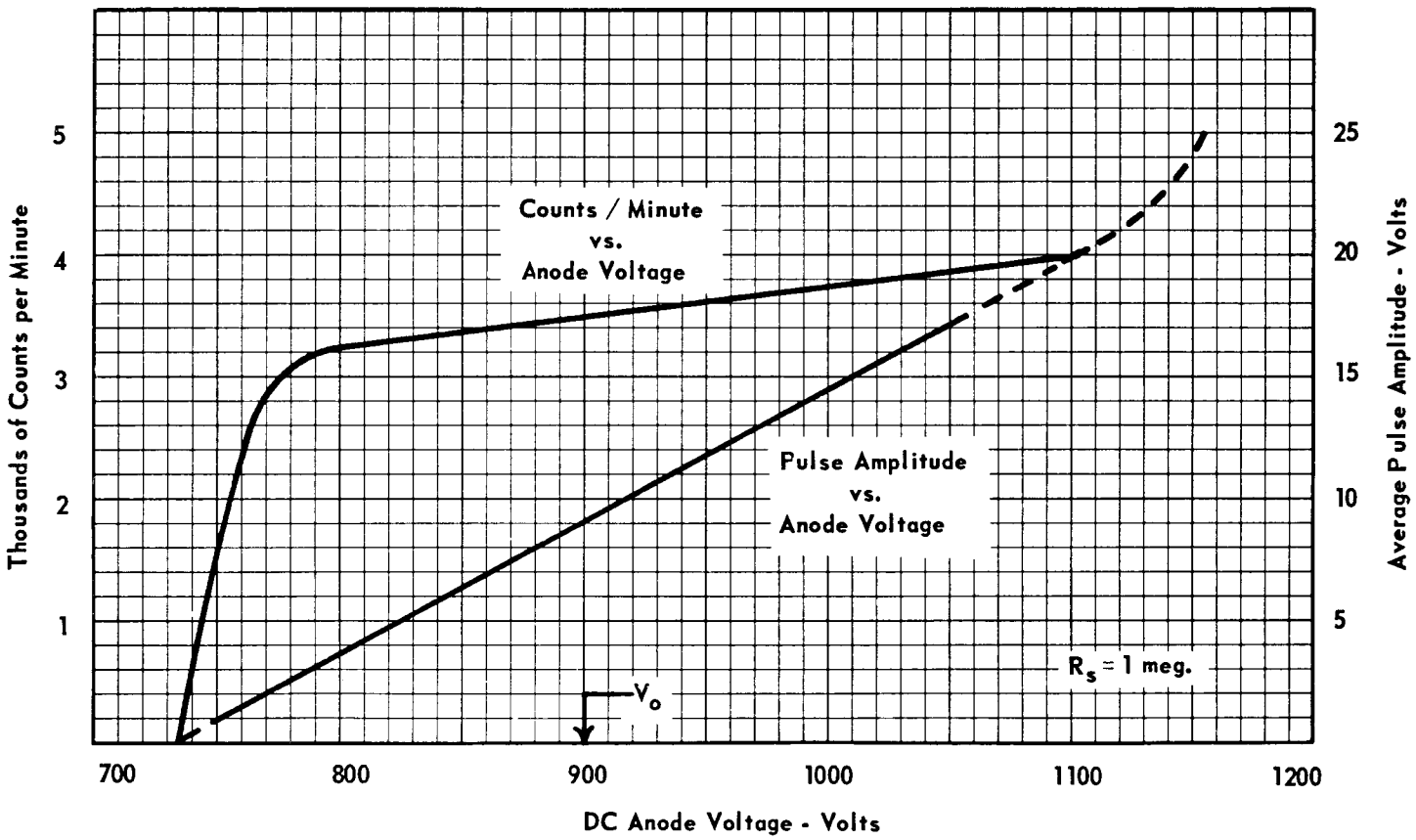
Note 6 The characteristics of a counter tube can be seriously affected by the associated circuit. The following conditions were used in obtaining the above data.

A scaler was used having a resolving time of 1 microsecond, series resistor of 1 megohm, and a coupling condenser of 500 micromicrofarads. Average counting rate was 100 counts per second.

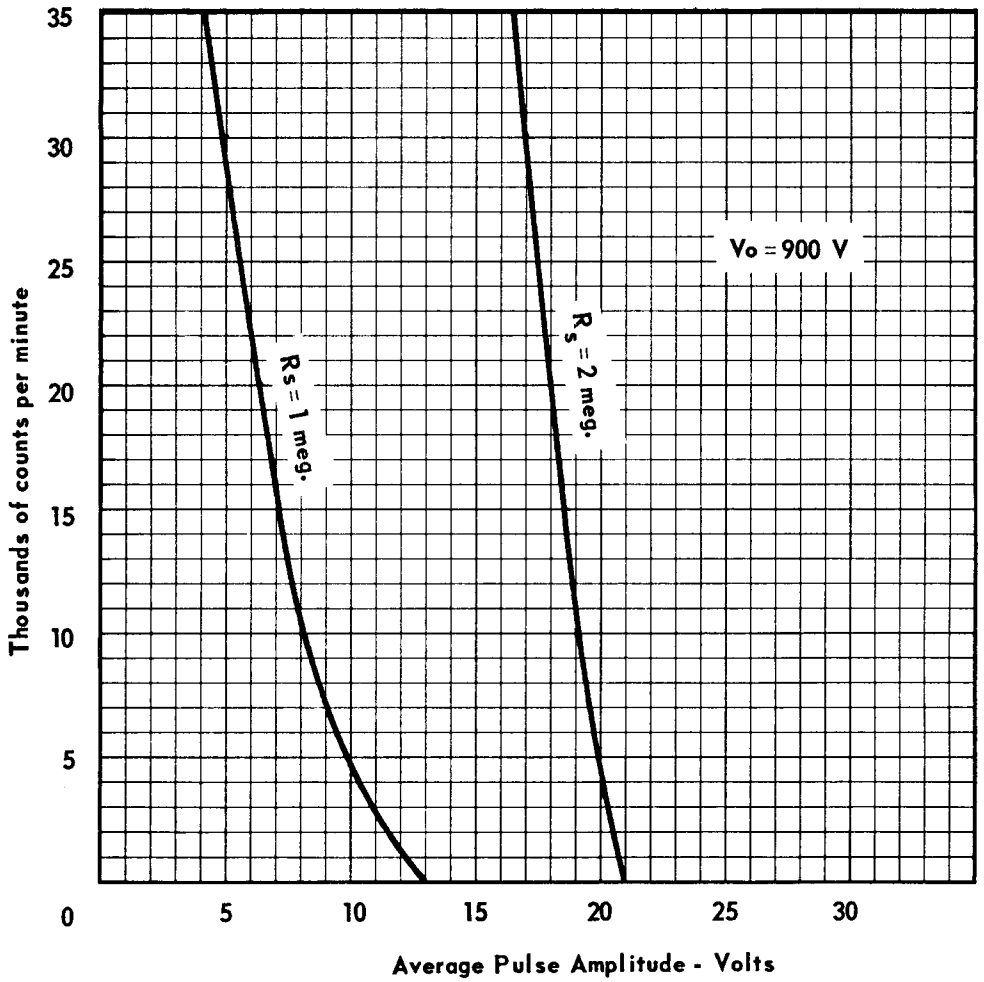
Note 7 No shielding. Ambient light-5-50 ft. candles. The CK1049 is non-photosensitive, so it is not generally necessary to enclose the tube in a light-tight box or shield.

Tentative Data

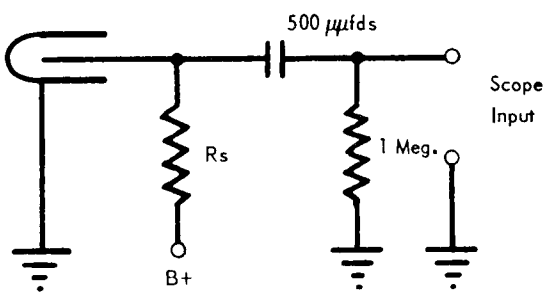
Printed in U.S.A.


Counts / Minute
vs.
Anode Voltage
Pulse Amplitude
vs.
Anode Voltage
R_s = 1 meg.
V_o
Thousands of Counts per Minute
Average Pulse Amplitude - Volts
DC Anode Voltage - Volts
1
2
3
4
5
5
10
15
20
25
700
800
900
1000
1100
1200

GEIGER - MUELLER



TEST CIRCUIT



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1050A

SUBMINIATURE GAS TRIODE

The CK1050A is a grid controlled neon filled triode of subminiature construction. It has a directly heated cathode and is designed for use either as an indicator lamp or a low current negative grid control device. The low working and control voltages permit its use in association with transistor circuitry. Using an AC anode supply with an anode current of 3.0 milliamperes, the light output is several times greater than that obtainable from a NE–2 glow lamp at maximum rating. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

ELECTRICAL DATA

RATINGS–ABSOLUTE MAXIMUM VALUES: (Note 1)

Filament Voltage (RMS)	1.25±5%	Vac
Peak Forward and Inverse Anode Voltage (Anode to filament or grid)	±118	v max.
Grid Supply Voltage	–12	Vdc min.
Anode Current (Average)	3	mAdc max.
Peak Anode Current (Note 3)	11	ma. max.
Minimum Anode Supply Voltage (RMS) Note 2	60	Vac min.
Maximum Anode Supply Voltage (RMS) Note 2	75	Vac max.
Maximum Preconduction Grid Current at 75 volts (RMS) Anode Supply Voltage	0.5	μAdc max.

TYPICAL PULSE CHARACTERISTICS: (See Figure A)

Grid Supply Voltage (Tube non conducting)	–10.0	Vdc
Input Pulse Voltage (For tube conducting)		
8 μsec. pulse width:	+5.0	Vdc G1–K
Typical Ionization Time (Approx.)	2	μsec
Typical Deionization Time (Approx.)	30	μsec

CHARACTERISTICS AND TYPICAL OPERATION:

	Figure B	Figure C
Filament Voltage (RMS)	1.25 Vac	1.25 Vac
Filament Current	250 mA	250 mA
Anode Supply Voltage Epp (RMS)	65 Vac	65 Vac
Anode Current (Grid Supply Voltage = 0 Volts)	1.9 mAdc	0.67 mA
Grid Supply Voltage (Tube non conducting)	–4.5 Vdc	–4.5 Vdc
Grid Supply Voltage (Tube conducting)	–1.0 Vdc	–1.0 Vdc
Grid Isolation Resistor	0.1 meg.	.068 meg.
Series Anode Limiting Resistor	0.01 meg.	.033 meg.

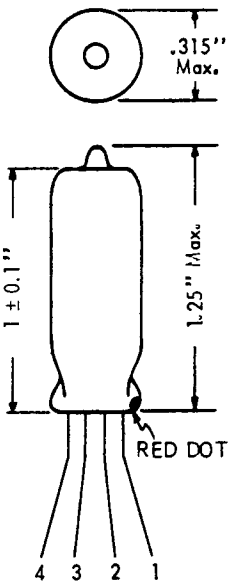
MECHANICAL DATA

ENVELOPE ..... T–2 Glass

BASE ..... None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center to center)

MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS

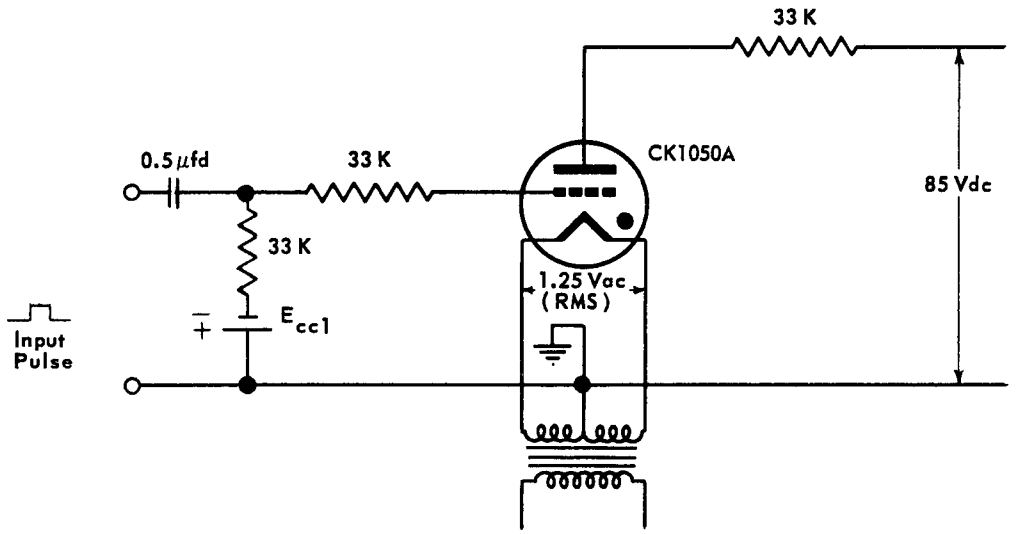


TERMINAL CONNECTIONS:

(Red dot is adjacent to lead 1)

Lead 1 Filament
Lead 2 Grid
Lead 3 Anode
Lead 4 Filament

FIGURE A



NOTE 1: Operation at all maximum ratings simultaneously is not permitted.

NOTE 2: As indicated under "Ratings–Absolute Maximum Values", the anode supply voltage (Epp) must be maintained within the limits of 60 Vac (RMS) and 75 Vac (RMS) to ensure reliable operation. In terms of peak anode supply voltage the range of reliable operation is 84 to 106 peak positive volts. In installations using large numbers of tubes where distortion may be a factor it is important to maintain the anode supply voltage within peak voltage limits described above.

NOTE 3: In applications where capacity may be employed to shunt either all or part of the series anode limiting resistor or its equivalent, it is necessary to consider the peak anode current limitation. Also the minimum positive amplitude of anode supply voltage must be low enough to cause deionization each cycle.

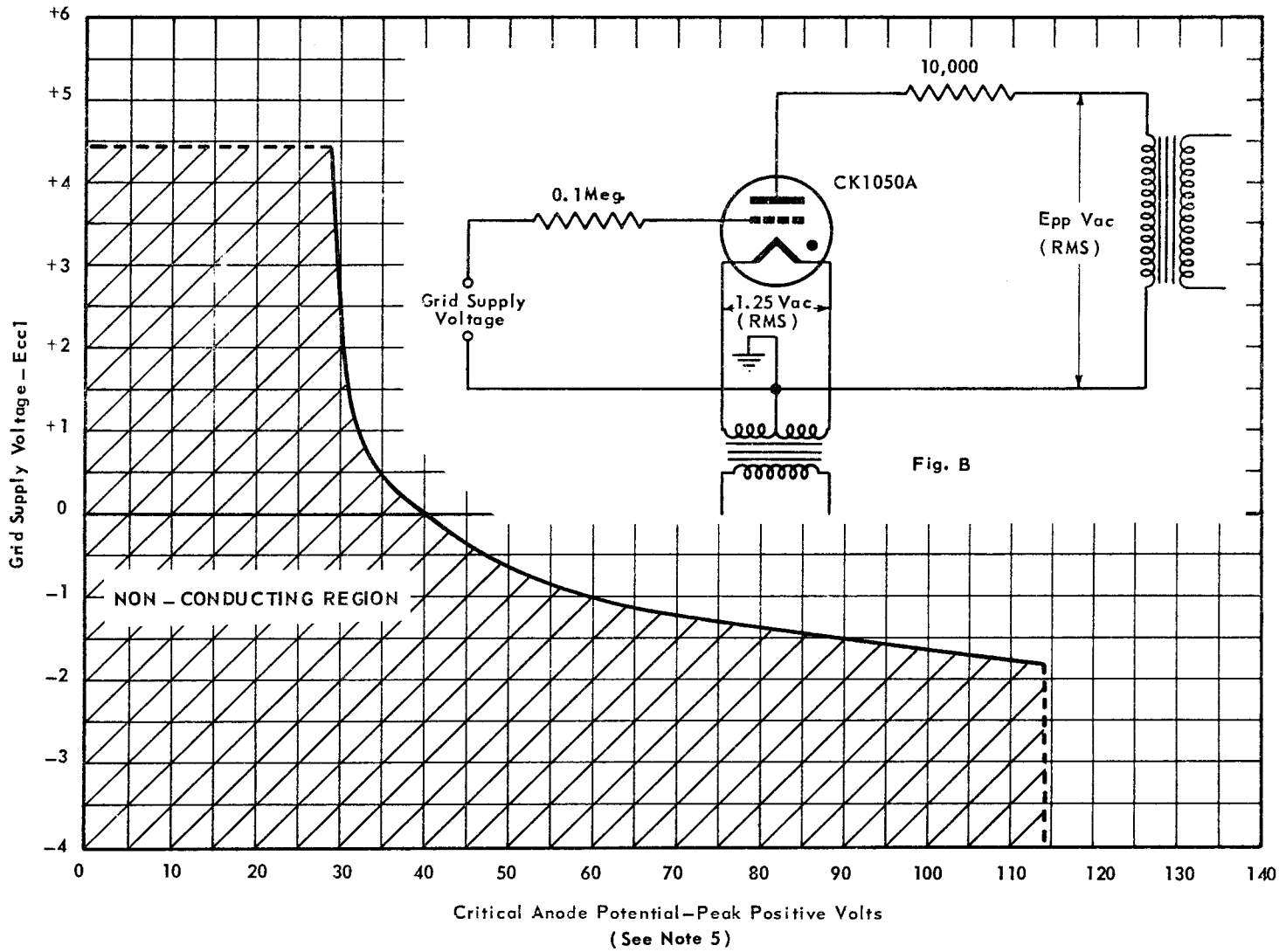
NOTE 4: Anode Current at cut–off may be considered relatively independent of Grid Supply Voltage for a range of Anode Supply Voltage from 60 Vac to 75 Vac.

NOTE 5: The critical anode potential (peak positive) is equal to $\sqrt{2}$ X Epp, where Epp is the RMS value of a symmetrical and undistorted alternating voltage.

SUBMINIATURE GAS TRIODE

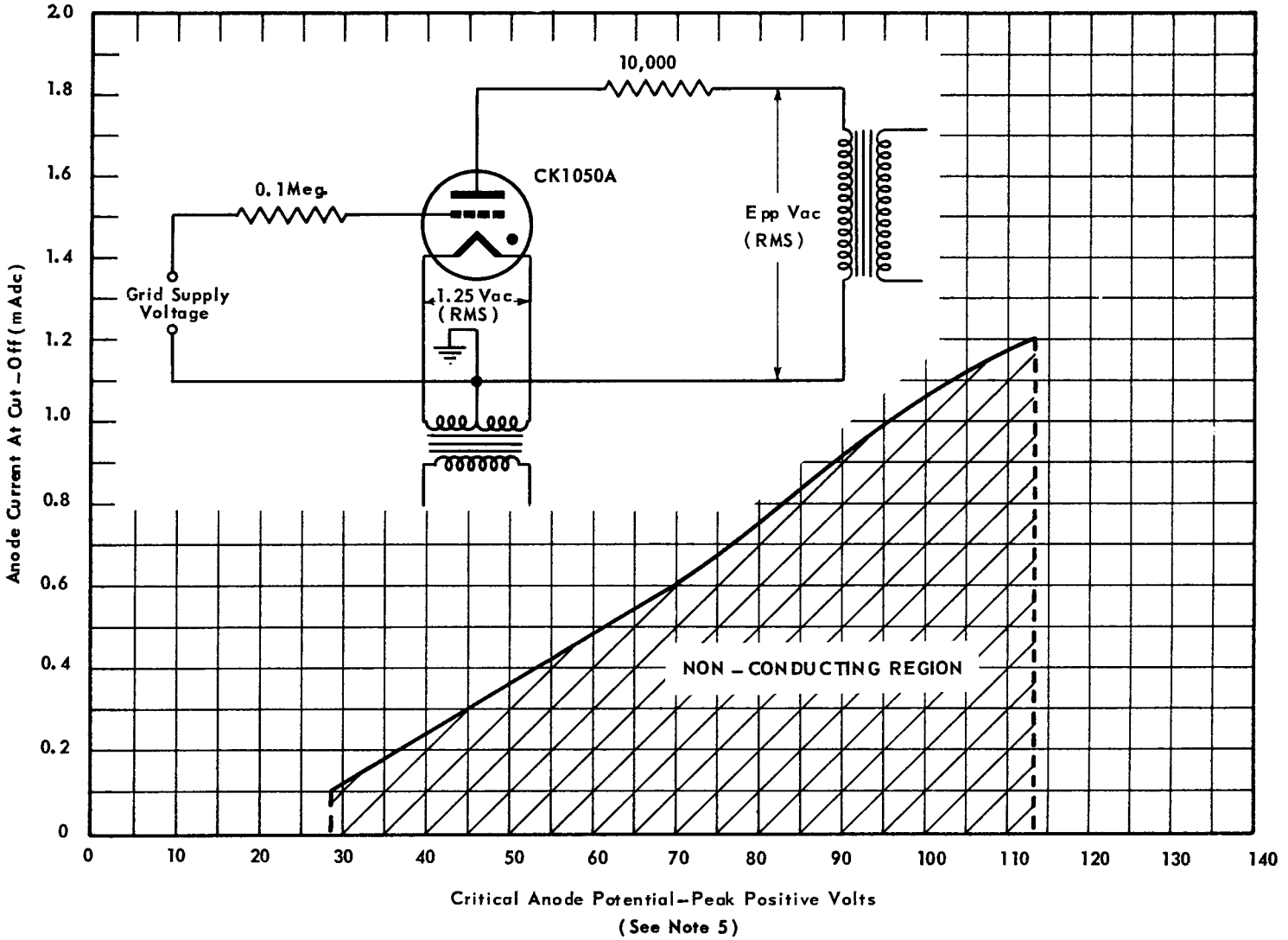
AVERAGE CHARACTERISTICS

GRID SUPPLY VOLTAGE VS CRITICAL ANODE POTENTIAL



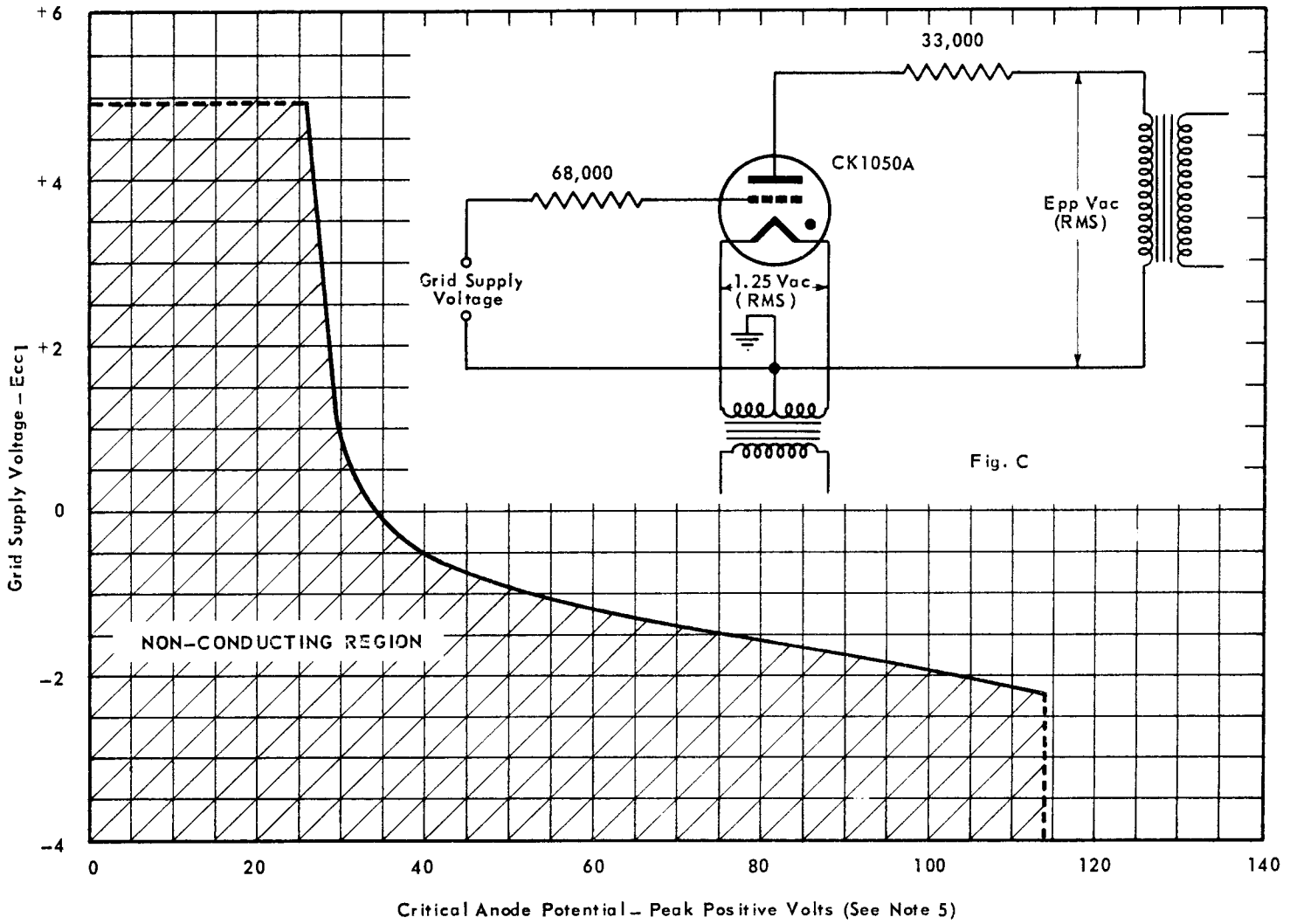
AVERAGE CHARACTERISTICS

TYPICAL ANODE CURRENT AT CUT-OFF VS CRITICAL ANODE POTENTIAL (See Note 4)



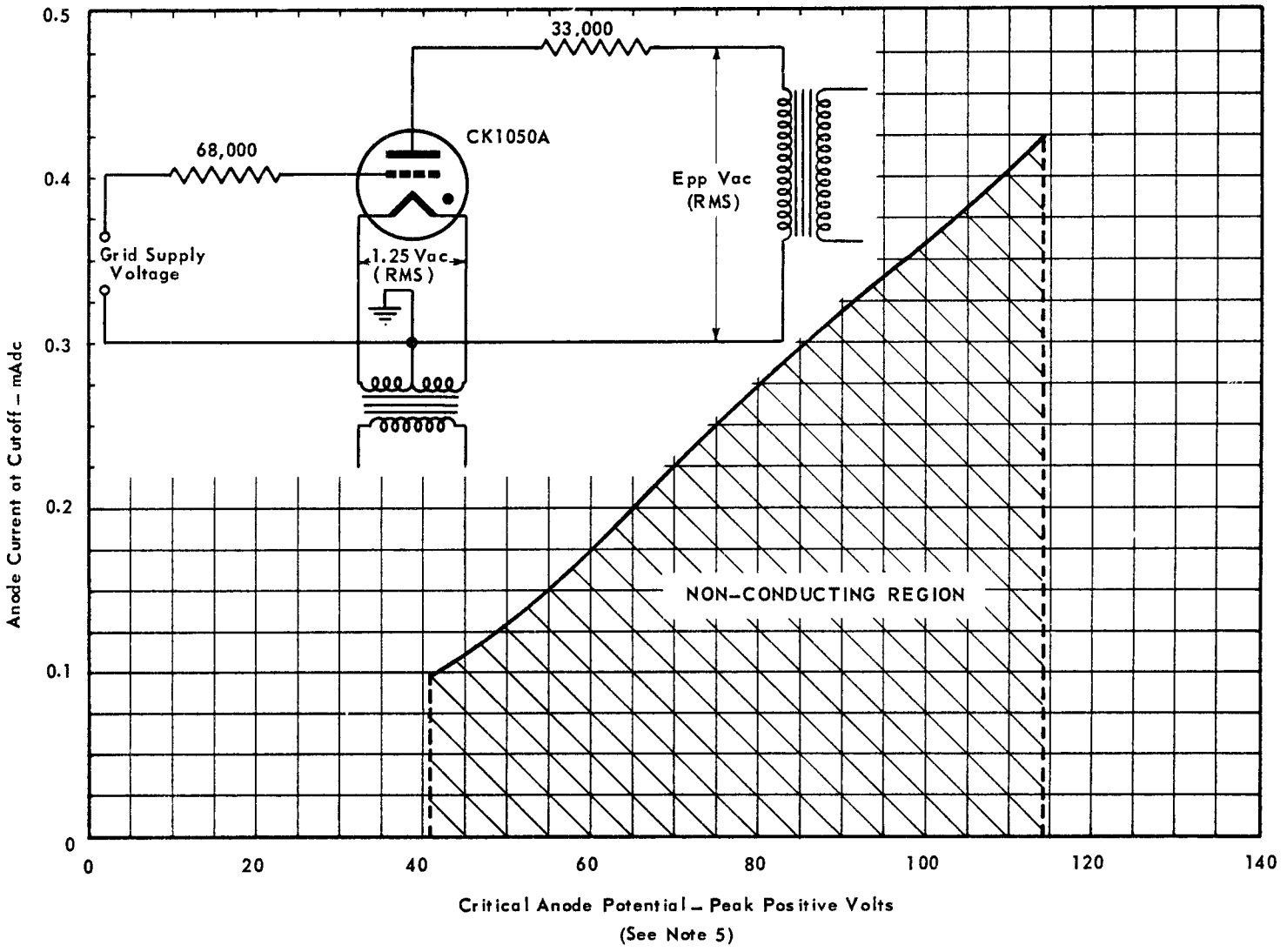
AVERAGE CHARACTERISTICS

GRID SUPPLY VOLTAGE VS. CRITICAL ANODE POTENTIAL



AVERAGE CHARACTERISTICS

TYPICAL ANODE CURRENT AT CUTOFF vs. CRITICAL ANODE POTENTIAL (See Note 4)



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TECHNICAL INFORMATION

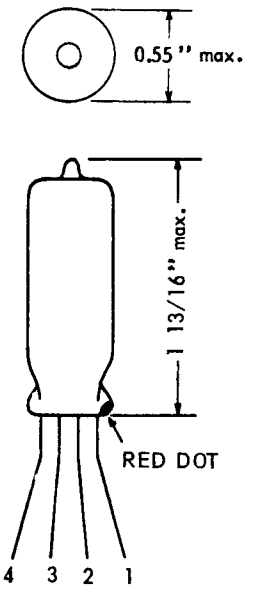
THYRATRON

TYPE CK1054

Excellence in Electronics

The CK1054 is a small size 3-element thyratron useful in applications requiring extreme economy of space, weight, and battery drain. It is designed for use as a self-quenching super-regenerative detector in a two stage receiver which will operate a high resistance relay in the anode circuit of the 2nd stage upon reception of a radio signal in the 1st (detector) stage. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

Type CK1054 is rated for operation of 27.225 Mc. for amateur and intermittent service and it is recommended for those applications in which circuit adjustments are available or in which variations of tube characteristics that will occur during life, can be tolerated.



MECHANICAL DATA

ENVELOPE: T-4½ Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

Lead 1 Anode
Lead 2 Filament, negative
Lead 3 Grid
Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (approx.) *

Grid to Anode	1.7 μμfd
Grid to Filament	1.2 μμfd
Filament to Anode	1.3 μμfd

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.4+ 10%-15% Vdc
DC Anode Voltage	45 Vdc
DC Anode Current	700 μAdc

CHARACTERISTICS AND TYPICAL OPERATION (See Figure 1)

Filament Voltage (dc)	1.4 Vdc
Filament Current	50 mAdc
Anode Supply Voltage	45 Vdc
Average Tube Voltage Drop (at 500 μAdc)	27 Vdc
Anode Current (No Signal)	350-450 μAdc
Anode Current, maximum (With Signal)	80 μAdc

* *With no external shield.*

APPLICATION DATA

A circuit typical of the one shown in Figure 1 is recommended for use with the CK1054 for remote control purposes. The tube must always be operated with sufficient series resistance in the anode circuit to limit the anode current to the maximum rated value. If the anode idling current without signal is adjusted to less than 300 μAdc (by L_1 and R_3 adjustments) difficulty may be experienced in some equipments due to excessive anode idling current flutter.

When operating properly, the tube should be oscillating at an audible audio-frequency except during reception of a radio-frequency whereupon the audio-frequency oscillation should disappear. The average anode current may be increased by increasing the antenna coupling, by decreasing the L/C ratio of the tank circuit, by decreasing the value of R_3 or a combination of all three. The maximum controllable current may be increased by increasing the anode by-pass capacitance, by decreasing the grid-leak resistance or both.

NOTE: The CK1054 is designed to operate at plate currents of 350 to 450 μAdc as is typical of the 1st (detector) stage of the two stage receiver.

These data identify a particular developmental tube design and the descriptive data or type designation may be subject to change or abandonment.

Objective Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

RECEIVING AND CATHODE RAY TUBE OPERATIONS

January 30, 1958 NEWTON 58, MASS.

RAYTHEON

THYRATRON

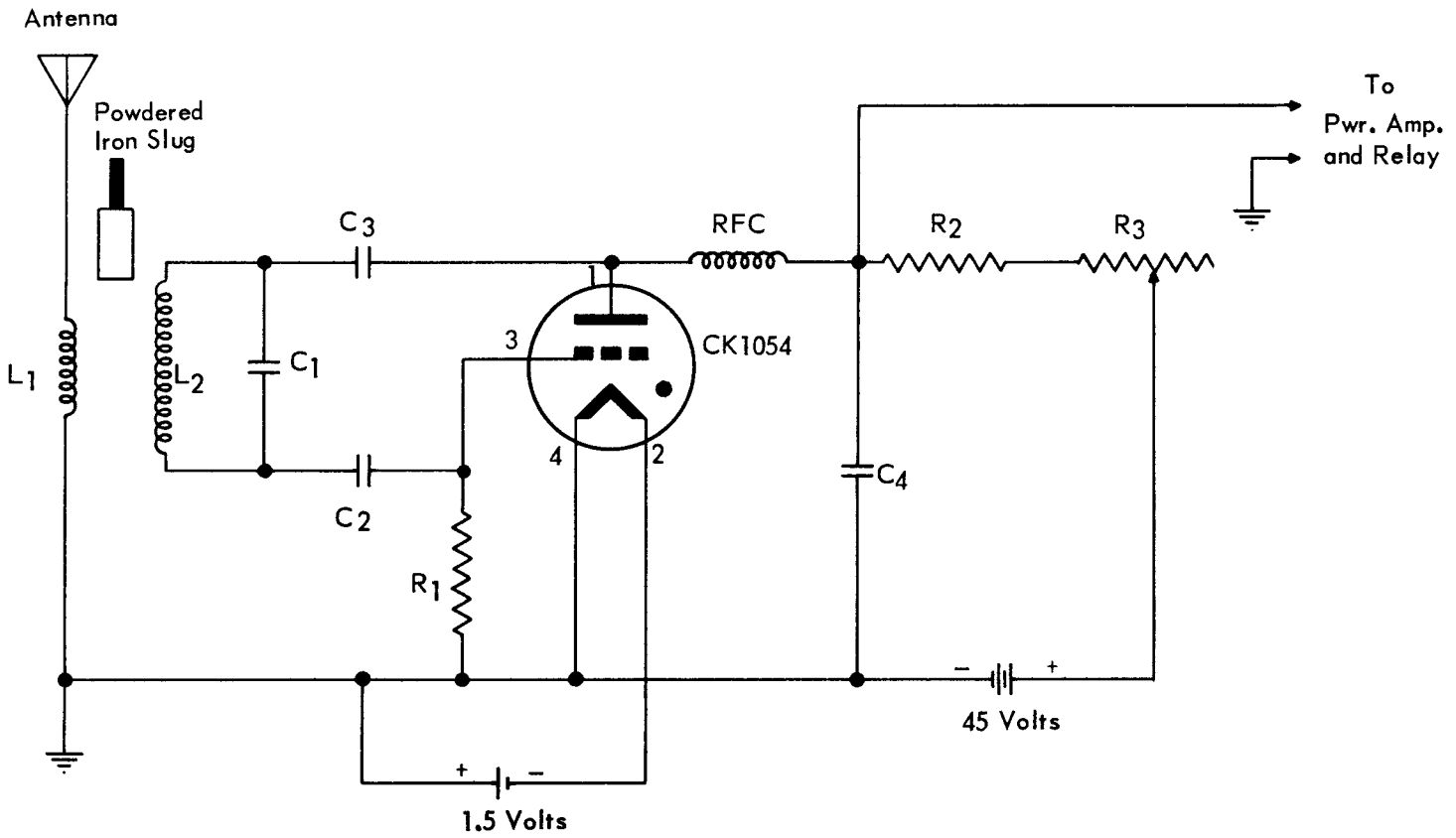


FIGURE 1

R_1 –	4.7 Megohms	C_2 –	120 $\mu\mu$fd	L_1 –	Antenna Coil Primary – 3 turns #22 standard copper insulated wire – close wound around L_2
R_2 –	5 Kilohms	C_3 –	47 $\mu\mu$fd	L_2 –	Antenna Coil Secondary – 18 turns #22 solid copper wire spaced one wire diameter between turns and wound on 3/8" O.D. Phenolic Tubing.
R_3 –	100 Kilohms	C_4 –	.02 μfd		
C_1 –	15 $\mu\mu$fd	RFC –	15 μh Choke		

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TECHNICAL INFORMATION SERVICE

Technical Information

CK1055

SUBMINIATURE GAS DIODE

The CK1055 is a cold cathode, gas-filled diode of subminiature construction, designed for service as a voltage regulator tube. It has an operating current range of 75 to 300 microamperes over which it maintains a substantially constant operating voltage of approximately 150 volts. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS:

Maximum Bulb Temperature ..... +85°C
Altitude ..... 60,000 ft.

ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
Ratings					
Plate Voltage	Ebb:	250	250 (Note A)	---	Vdc
Ionization Voltage (Total Darkness)	Ez:	---	---	225	Vdc
Operating Voltage	Ez:	143	---	157	Vdc
Operating Current	Ib:	0.075	---	0.300	mAdc
Plate Resistance	Rp:	---	0.75	---	Meg.
Temperature	T:	-55	25±5	+85	°C
Tests					
Ionization Voltage (1) Ebb/Ib=0.075-0.3 mAdc Illumination=5-50 ft. candles	Ez:	---	---	200	Vdc
Tube Voltage Drop (1) Etd (1): Ebb/Ib=0.3 mAdc	Etd (1):	145	---	155	Vdc
Tube Voltage Drop (2) Ebb/Ib=0.075 mAdc	Etd (2):	145	---	155	Vdc
Regulation (1) Ebb/Ib=0.075 to 0.3 mAdc	Reg.	---	---	4.0	Vdc
Regulation (2) Ebb/Ib=0.075 to 0.15 mAdc	Reg:	---	---	2.5	Vdc

APPLICATION NOTES

CAUTION - - - To Electronic Equipment Design Engineers. Special attention should be given to the temperature of the tubes. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions more severe than those specified for life are imposed on the tube and will be reduced appreciably if absolute ratings are exceeded. Attention should be given to the specified minimum supply voltage to insure operation in total darkness. Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperatures without drawing current.

NOTE A: Fixed resistor may be used and Ebb varied to obtain the desired current.

MECHANICAL DATA

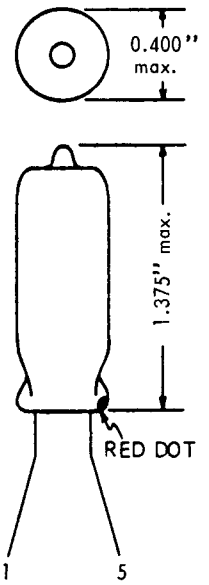
ENVELOPE ..... T-3 Glass

BASE ..... None (0.016" tinned flexible leads. Length: 1.5" min Spacing: 0.192" center to-center

CATHODE ..... Glow Discharge

MOUNTING POSITION ..... Any

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Lead 1 Cathode
Lead 5 Anode

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

Par. No.:	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS		Units
						Min.	Max.	
GENERAL								
3.1	Qualification:	Required for JAN Marking	---	---	---	---	---	---
3.6	Performance:		---	---	---	---	---	---
QUALIFICATION (see note 8)								
---	Cathode:	Glow discharge	---	---	---	---	---	---
3.4.3	Base Connections:		---	---	---	---	---	---
4.13.1	Ionization Voltage (2)	Note 1	---	---	Ez:	---	200	Vdc
4.9.20.3	Vibration:	No Voltage	---	---	---	---	---	---
---	Altitude:	Note 5	---	---	---	---	---	---
MEASUREMENT ACCEPTANCE TEST, PART 1 (see note 2)								
4.13.1	Ionization Voltage (1):	Ebb/Ib = 0.075 - 0.3 mAdc: Illumination = 5-50 Ft. Candles	0.65	II	Ez:	---	200	Vdc
4.13.2	Tube Voltage Drop (1):	Ebb/Ib = 0.3 mAdc	0.65	II	Etd (1):	145	155	Vdc
4.13.2	Tube Voltage Drop (2):	Ebb/Ib = 0.075 mAdc	0.65	II	Etd (2):	145	155	Vdc
4.13.2.1	Regulation (1):	Ebb/Ib = 0.075 to 0.3 mAdc	0.65	II	Reg:	---	4.0	Vdc
4.13.2.1	Regulation (2):	Ebb/Ib = 0.075 to 0.15 mAdc	0.65	II	Reg.	---	2.5	Vdc
4.7	Continuity and Shorts: (Inoperatives)		0.4	II	---	---	---	---
4.9.1	Mechanical:	Seated height 1.375 in. max. Bulb diameter 0.400 in. max. Lead Length 1.5 in. max.	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TEST, PART 2								
---	Noise and Oscillation:	Ebb/Ib = 0.075 thru 0.3 mAdc (Note 4)	6.5	L 6	Eb:	---	50	mVp/p
4.9.15	Low - Temperature Operation:	Ebb/Ib = 0.1 mAdc; T Ambient = 55°C; (Note 3)	1.0	L 6	ΔErd:	-3.0	+3.0	Vdc.
4.9.16	High - Temperature Operation:	Ebb/Ib = 0.1 mAdc; T Ambient = + 85°C; (Note 3)	1.0	L 6	ΔEtd:	-3.0	+4.0	Vdc.
4.13.3	Leakage:	Eb = - 50 Vdc; Rp = 3000 ohms	6.5	L 6	LIb	---	2	μAdc
DEGRADATION RATE ACCEPTANCE TESTS								
4.9.5.3	Lead Fatigue:	Note 6	2.5	Code G	---	4.0	---	arcs

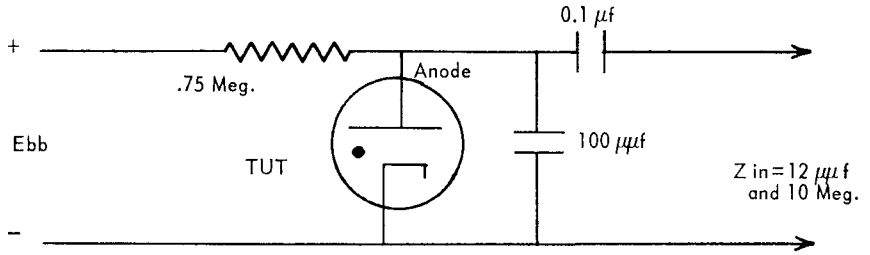
Par No.:	Test	Condition.	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS Min.	LIMITS Max.	Units
ACCEPTANCE LIFE TESTS								
4.11	Life - test:	Group A Ebb/Ib = 0.1 mAdc TA = room. (Note 7)	---	---	---	---	---	---
4.11.4	Life - test end points: (500 hours)	Ionization Voltage (1)	---	---	Ez:	---	225	Vdc
		Tube Voltage Drop (1)	---	---	Etd (1):	143	157	Vdc
		Tube Voltage Drop (2)	---	---	Etd (2):	143	157	Vdc
		Regulation (2)	---	---	Reg:	---	**6.0**	**Vdc**
4.11.4	Life - test end points: (1000 hours)	Ionization Voltage (1)	---	---	Ez:	---	225	Vdc
		Tube Voltage Drop (1)	---	---	Etd (1):	143	157	Vdc
		Tube Voltage Drop (2)	---	---	Etd (2):	143	157	Vdc
		Regulation (2)	---	---	Reg:	---	6.0	Vdc
PACKAGING INFORMATION								
4.9.18.1.4	Carton Drop:	(A) Package Group 1; Carton Size C	---	---	---	---	---	---

Note 1: Conditions for this test shall be those of Ionization Voltage (1) except testing shall be done in total darkness and the tube shall not have conducted or have been exposed to light for at least 24 hours prior to testing.

Note 2: The AQL for the combined defectives for attributes in Measurements Acceptance Test, Part 1, excluding Inoperatives and Mechanical, shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) **defective**. MIL–STD–105, Inspection Level II shall apply.

Note 3: The tube voltage drop shall be measured under the specified conditions. The change in tube voltage drop from that value measured at TA = 25 ± 5°C shall not exceed the value specified. This test shall be made at least once per month.

Note 4:



Note 5: There shall be no evidence of flashover or corona at the leads of these tubes at the absolute maximum current.

Note 6: When a manufacturer submits tubes for qualification approval, five extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 7: Intermittent Life Test.

(a) **Regular Life Test:** (1) Regular life test shall be conducted for 1000 hours. (2) Regular life test acceptance shall be on the basis of the 500 and 1000 **hour** requirements as indicated on the specification sheet. (3) Regular life test shall be in effect initially and shall continue in effect until the eligibility criteria for the Reduced hours life test have been met.

(b) **Reduced Hours Life Test** (1) Reduced hours life test shall be conducted for 500 hours and acceptance shall be based on the 500 hour end point limits. (2) Eligibility for Reduced hours life **test:** No lot failure due to the 1000 hour life test has occurred in the preceding three consecutive lots. (3) Loss of eligibility for Reduced hours life **test:** Two or more 500 hour life test lot failures occurring in the last three consecutive lots.

NOTES (cont'd)

Note 7: (cont'd)

(f) **The Life Test sample shall be read at the following times.**

0 hours

500 hours (plus 48 hours; minus 24 hours)

1000 hours (plus 48 hours; minus 24 hours; when in force)

Additional **reading** periods may be used.

Note 8: All Tests listed herein shall be performed during qualification; however these 5 tests are normally performed during qualification inspection only.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1057

SUBMINIATURE TETRODE-TRIGGER TUBE

The CK1057 is a neon filled cold cathode tetrode designed for use as an indicator lamp in circuits requiring low standby and operating power. The tube has control sensitivity such that it is suitable for use in transistor circuitry. Under typical operating conditions, the light output is several times greater than that obtainable from an NE-2 glow lamp at recommended operating conditions. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components or the leads may be cut, permitting the use of inline subminiature sockets.

ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Test Limit or Absolute Maximum	MIL-E-1 Units
		Ratings			
Peak Forward and Inverse Anode Voltage (to cathode or Control grid)	---	---	---	123	v
Anode Supply Voltage (Note A, B)	Ebb	64	68	72	Vdc
DC Anode Current	Ib	---	---	2.0	mAdc
Peak Anode Current	ib	---	---	8.0	ma
Control Grid Supply Voltage	Ic	–10	---	---	Vdc
Keep Alive Cathode Supply Voltage	Ek	–200	–250	–300	Vdc
DC Keep Alive Cathode Current	Ik	---	17	100	μAdc
		Tests			
Anode Current (Ecc =0, Note A)	Ib	0.8	1.3	1.8	mAdc
Control Grid Supply Voltage (Ebb = 68 Vdc. Note A,E)	Ecc	0	---	–3.0	Vdc
Control Grid Supply Voltage (Ebb = 72 Vdc. Note A, E)	Ecc	0	---	–3.3	Vdc
Anode Voltage (Ecc = 0 Note B, F)	Eb	---	---	61	Vdc
Anode Voltage (Ecc = –10 Vdc Note B, G)	Eb	74	---	---	Vdc
Leakage (Note H)	LIB	---	---	1.0	μAdc
Leakage (Note I)	LIB	---	---	1.0	μAdc

CHARACTERISTICS AND TYPICAL OPERATION (Note A)

60~ Anode Supply Voltage (Rectified, full wave, unfiltered) (Note B)	Ebb	68	Vdc
Keep-Alive Cathode Supply Voltage		–250	Vdc
Control Grid Supply Voltage For Anode Conduction		0.0	Vdc
Control Grid Supply Voltage No Anode Conduction		–2.0	Vdc
DC Anode Current	Ib	1.3	mAdc

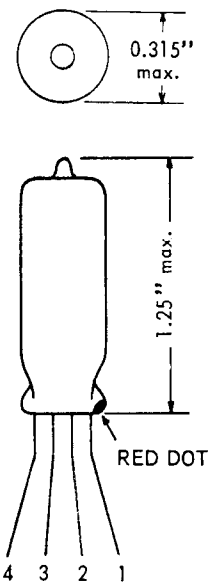
OBJECTIVE DATA

These data identify a particular tube design, and the type designation or the descriptive data may be subject to change or abandonment.

MECHANICAL DATA

ENVELOPE T2
BASE ..... Pinch Press 4 Leads in line
CATHODE .... Glow Discharge
MOUNTING POSITION .... Any

PHYSICAL DIMENSIONS



TERMINAL CONNECTIONS:

Lead 1 Anode
Lead 2 Keep-alive Cathode
Lead 3 Control grid
Lead 4 Cathode

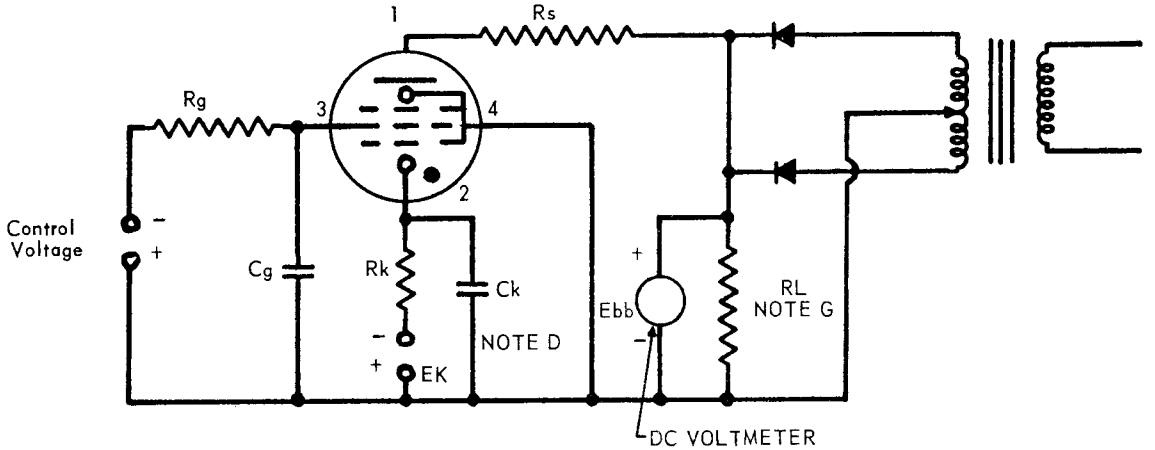
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ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND TYPICAL OPERATION (Note A) (Cont'd)

DC Keep-Alive Cathode Current	Ik	17	μAdc
Control Grid Series Resistance	Rg	0.1	Meg
Anode Limiting Resistance	Rs	5000	ohms
Keep-Alive Cathode Resistance	Rk	10	Meg
Keep-Alive Cathode Shunt Capacitor (Note D)	Ck	50	pf
Control Grid Shunt Capacitor	Cg	0.001	μf

Note A: The above ratings and operating values refer to operation in the following circuit.



Note B: Ebb = 68 Vdc is the average of the rectified sine wave whose peak value is $\pi/2$ times 68 volts and is read with a dc Voltmeter.

Note C: To ensure regaining grid control after each positive excursion of anode apply voltage, it is necessary that the minimum positive amplitude of anode supply voltage be low enough to cause deionization each cycle. RL is chosen to improve regulation as well as to discharge circuit capacitances each cycle.

Note D: Since the critical grid voltage is a function of the keep-alive cathode to ground capacitance, it is recommended that CK be 50 pf including stray capacitances. Critical grid voltage is also a function of the control grid to ground capacitance and the peak positive anode potential.

Note E: Per MIL-E-1 ref. 4.10.17.1. With Ecc = −10 Vdc initially and with tube non-conducting, decrease the value of Ecc until conduction (visible glow above the top mica) begins. This value of Ecc shall be within the limits specified. The glow referred to in this note is in addition to the normal keep-alive (K1) glow.

Note F: Per MIL-E-1 ref. 4.10.17.2 Ecc = 0. Under the conditions specified the anode voltage shall be increased until the tube conducts a minimum of 50 μAdc of anode current with visible glow above the top mica. The anode voltage shall be within the limits specified. The glow referred to in this note is in addition to the normal keep-alive cathode (K1) glow.

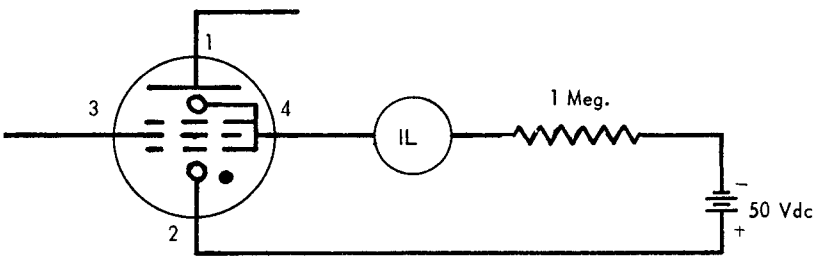
Note G: Under the conditions specified the anode voltage shall be increased to 74 Vdc and no anode current in excess of 50 μAdc or visible glow in the region above or below the top mica shall occur. For tubes failing this test the value of Ebb first indicating glow or in excess of 50 μAdc of anode current shall be recorded. The glow reffered to in this note is any in addition to the normal keep-alive cathode (K1) glow.

OBJECTIVE DATA

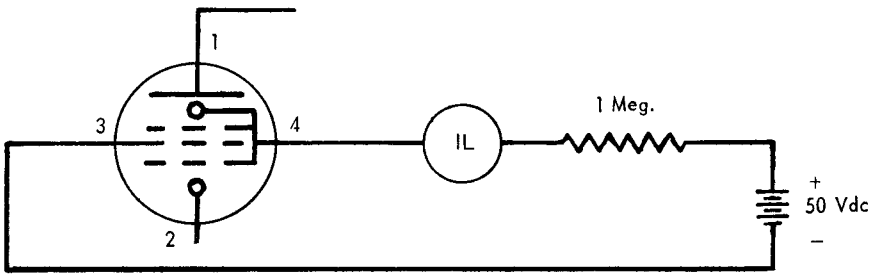
These data identify a particular developmental tube design and the type designation or the descriptive data may be subject to change or abandonment.

NOTES: (Cont'd)

Note H: Test the following circuit for Leakage (1) K1 to K2 G1 G3; anode and control grid floating .



Note I: Test in the following circuit for Leakage (2) G2 to K2 G1 G3; anode and keep-alive cathode K1 floating.



OBJECTIVE DATA

These data identify a particular developmental tube design and the type designation or the descriptive data may be subject to change or abandonment.

TYPE CK1352P– CK1352P–A

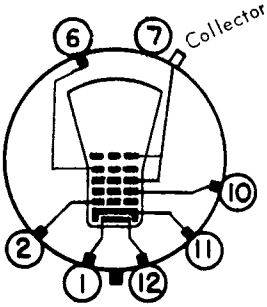
The CK1352P– is a 16-inch electrostatic focus, magnetic deflection, filtered glass faceplate, metal-shell type cathode ray tube with a long persistence screen suitable for radar applications. The additional of a final "A" designates a metalized screen.

MECHANICAL DATA

BASE: Small Shell Duodecal 7–Pin

TERMINAL CONNECTIONS:

Pin 1	Heater	Pin 10	Grid #2
Pin 2	Grid #1	Pin 11	Cathode
Pin 6	Focus	Pin 12	Heater
Pin 7	No Connection	Cap	Collector



BOTTOM VIEW

ELECTRICAL DATA

GENERAL CHARACTERISTICS:

Phosphor	#7
Fluorescence	Blue
Persistence	Short
Phosphorescence	Greenish–Yellow
Persistence	Long
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle (approx.)	53°

HEATER CHARACTERISTICS:

Heater Voltage	6.3 volts
Heater Current	0.6 ± 10% amps.
Peak Heater–Cathode Voltage:	
Heater Negative with Respect to Cathode	125 volts DC
Heater Positive with Respect to Cathode	125 volts DC

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds.) (approx.)

Grid #1 to All Other Electrodes	9.0
Cathode to All Other Electrodes	7.0

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage	15,000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative–Bias Value	180 volts DC
Positive–Bias Value	0 volts DC
Positive–Peak Value	2 volts DC
Peak Grid #1 Drive from Cutoff	65 volts DC
Focus Electrode Voltage	+6000 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage	12,000 volts DC
Grid #2 Voltage	300 volts DC
Grid #1 Voltage ●	–35 to –75 volts DC
Grid #2 Current	–15 to +15 μa.
Focusing Voltage ■	+3300 to +4000 volts DC
Spot Position (undeflected)	0.5 " radius (concentric to faceplate)
Line Width	0.17 "

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg.

● *Visual extinction of undeflected focused spot.*

■ *Ib = 25 μAdc (beam current).*

RAYTHEON

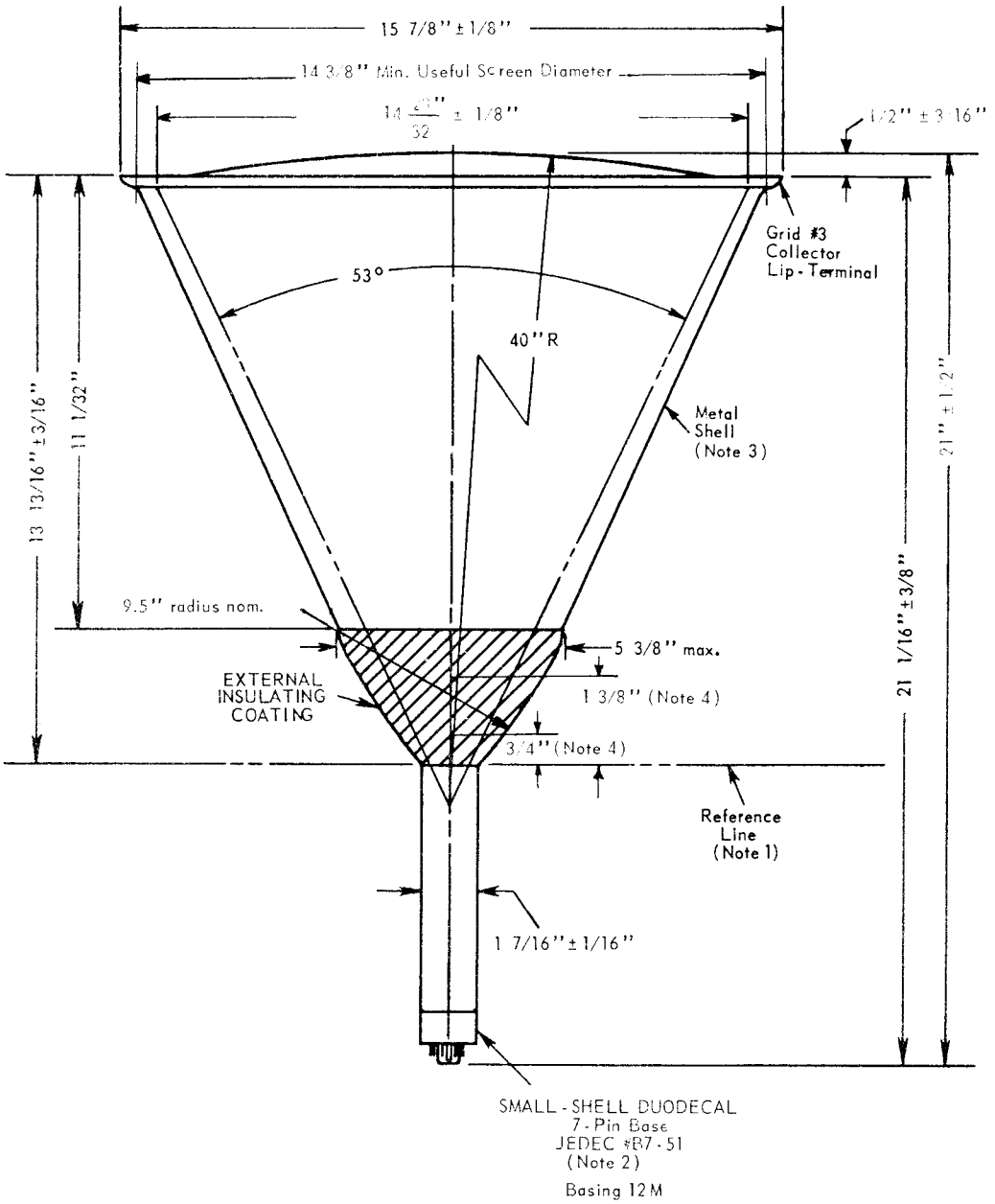
CATHODE RAY TUBE

Note 1: Reference line is determined by position where reference–line gauge (JEDEC #112) 1.500" + 0.003" – 0.000" I.D. and 2" long will rest on funnel.

Note 2: Socket for this base should not be rigedly mounted; it should have flexible leads and be allowed to move freely. Bottom circumference of base shell will fall within circle concentric with metal–shell axis and having diameter of 3".

Note 3: Metal shell and glass face operate at high voltage. Any material in contact with the shell or the face must be insulated to withstand the maximum applied collector voltage.

Note 4: A 3 1/4" diameter ring gauge shall fall within the region indicated. (3/4" to 1 3/8" from reference line).



INDUSTRIAL COMPONENTS DIVISION

TYPE CK1353P– CK1353P–A

Excellence in Electronics

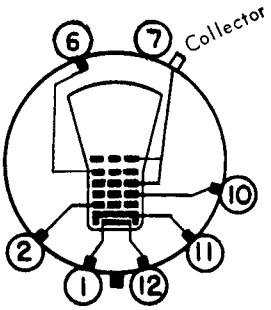
The CK1353P– is a 16 inch electrostatic focus, magnetic deflection, filtered glass faceplate, metal shell type cathode ray tube with a long persistence screen suitable for radar applications. The addition of a final "A" designates a metalized screen.

MECHANICAL DATA

BASE: Small Shell Duodecal 7–Pin

TERMINAL CONNECTIONS:

Pin 1	Heater	Pin 10	Grid #2
Pin 2	Grid #1	Pin 11	Cathode
Pin 6	Focus	Pin 12	Heater
Pin 7	No Connection	Cap	Collector



BOTTOM VIEW

ELECTRICAL DATA

GENERAL CHARACTERISTICS:

Phosphor	#7
Fluorescence	Blue
Persistance	Short
Phosphorescence	Greenish – Yellow
Persistence	Long
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle (approx.)	53°

HEATER CHARACTERISTICS:

Heater Voltage	6.3 volts
Heater Current	0.6 ±10% amps.
Peak Heater-Cathode Voltage:	
Heater Negative with Respect to Cathode	125 volts DC
Heater Positive with Respect to Cathode	125 volts DC

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds) (approx.)

Grid #1 to All Other Electrodes	9.0
Cathode to All Other Electrodes	7.0

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage	15,000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative-Bias Value	180 volts DC
Positive-Bias Value	0 volts DC
Positive-Peak Value	2 volts DC
Peak Grid #1 Drive from Cutoff	65 volts DC
Focus Electrode Voltage	–500 to +1000 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage	12,000 volts DC
Grid #2 Voltage	300 volts DC
Grid #1 Voltage ●	–35 to –75 volts DC
Grid #2 Current	–15 to +15 μa
Focusing Voltage ■	–135 to +400 volts DC
Spot Position (undeflected)	0.625 " radius (concentric to faceplate)
Line Width ■	0.018 "

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg.

● *Visual extinction of undeflected focused spot.*

■ *Ib2=25 μa beam (current).*

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ELECTRICAL DATA (Cont'd)

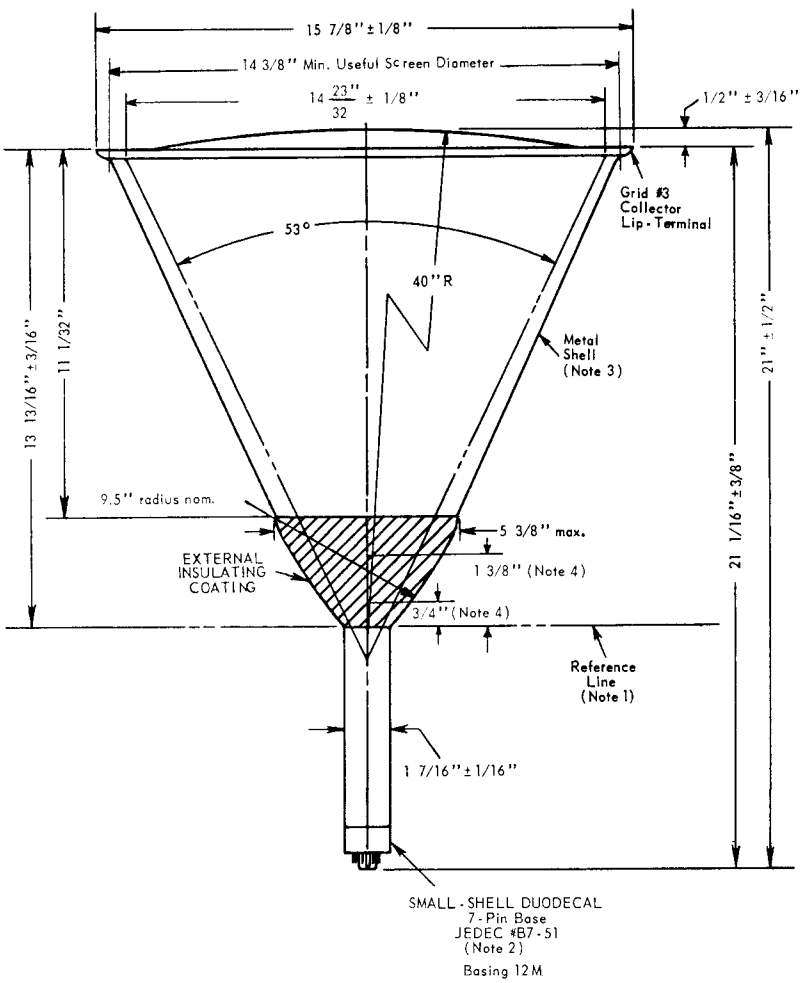
NOTES:

Note 1: Reference line is determined by position where reference-line gauge (JEDEC #112) 1.500" +0.003" –0.000" I.D. and 2" long will rest on funnel.

Note 2: Socket for this base should not be rigedly mounted; it should have flexible leads and be allowed to move freely Bottom circumference of base shell will fall within circle concentric with metal-shell axis and having diameter of 3".

Note 3: Metal shell and glass face operate at high voltage. Any material in contact with the shell or the face must be insulated to withstand the maximum applied collector voltage.

Note 4: A 3 1/4" diameter gauge shall fall within the region indicated (3/4" to 1 3/8" from reference line).



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1354P11A

CATHODE RAY TUBE

The type CK1354P11A is a 3 inch electrostatic focus and magnetic deflection cathode-ray tube suitable for radar photographic applications. A low-voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the CK1354P11A employs a high resolution electron gun. The final A designates a metallized screen for greater light output, improved contrast, and to minimize charging effects.

The tube envelope was designed to meet the stringent requirements of "rotating yoke" applications. The mechanical tolerances are therefore controlled to a greater extent than those of a standard cathode-ray tube. A unique high voltage connector is used that permits quick disconnect and meets the requirements of high altitude operation with freedom from corona.

The faceplate has an optical quality and flatness that will not limit the performance of a high quality objective lens to produce maximum resolution.

GENERAL DATA

Phosphor	#11
Fluorescence	Blue
Persistence	Short
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle	44°

ELECTRICAL DATA

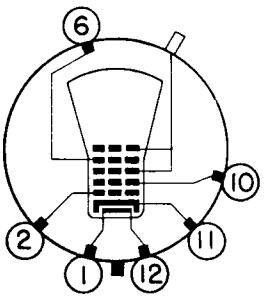
HEATER CHARACTERISTICS:	
Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater-Cathode Voltage ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC
DIRECT INTERELECTRODE CAPACITANCES:	
Grid #1 to all other electrodes	8.5 μμfd
Cathode to all other electrodes	5 μμfd
ABSOLUTE MAXIMUM RATINGS:	
Anode Voltage■	10,000 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to + 1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative - Bias Value	180 volts DC
Positive - Bias Value *	0 volts DC
Positive - Peak Value	0 volts

MECHANICAL DATA

BASE.....Small Shell Duodecal 6 Pin

CAP.....Special—high altitude connector

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Grid #4 (focus)
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Cap	Anode

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts
Anode Voltage ■	7500 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300 volts DC
Grid #2 Voltage	300 volts DC
Grid #1 Voltage □	-30 to -75 volts DC
Line Width ⊕	.005 inch max.
Spot Position (undeflected) †	.25 inch max.

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg. max.
Grid #2 Circuit Resistance	0.1 meg. max.

NOTES:

* *At or near this rating, the effective resistance of the anode supply should be adequate to limit the anode input power to 6 watts.*

■ *Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 5000 volts.*

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

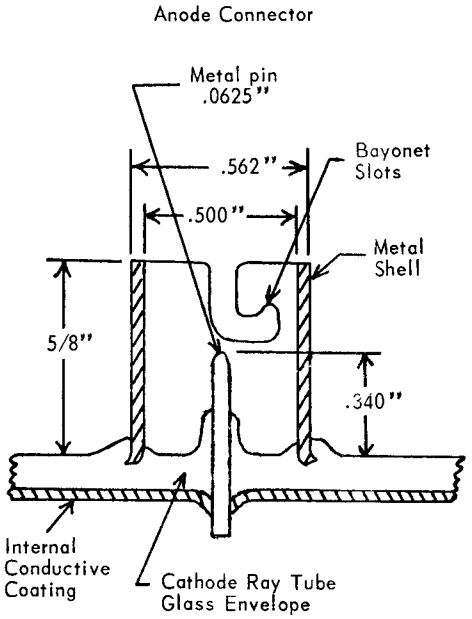
● *With grid #1 voltage adjusted to produce a collector current of 25 μa with the pattern adjusted for best overall focus. Measured with a 525-line interlaced and synchronized pattern.*

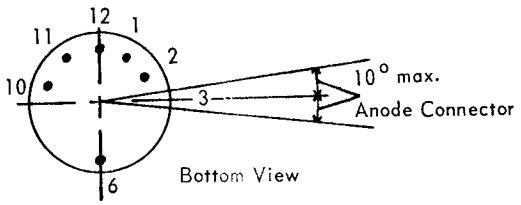
□ *Visual extinction of focused undeflected spot.*

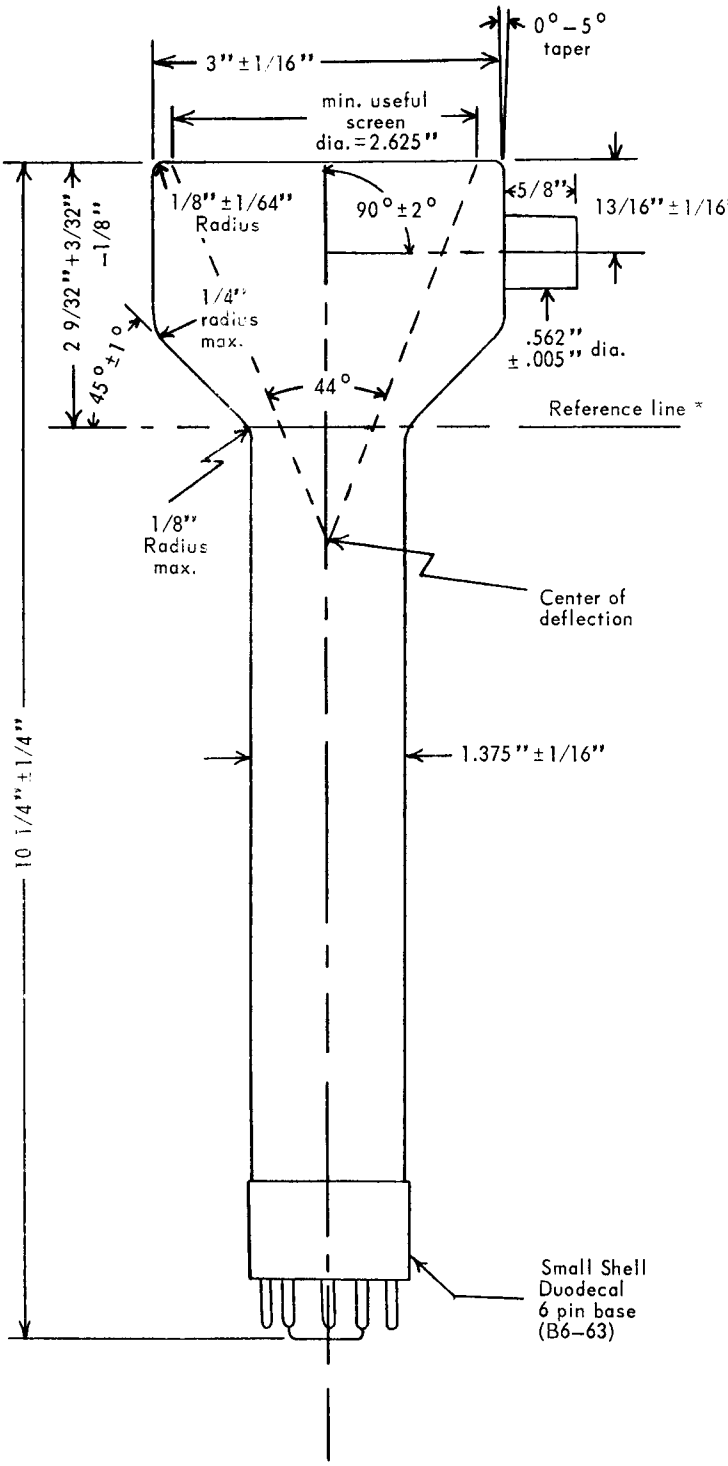
⊕ *Measured with a merging 525-line interlaced and synchronized pattern at Ib = 25 μa.*

† *The center of the undeflected, focused spot will fall within a circle of ¼" radius concentric with the center of the tube face, with tube shielded.*

CATHODE RAY TUBE







* Reference line determined by position where a 1.500"±.003" diameter ring guage 2" long will rest against bulb cone.

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TECHNICAL INFORMATION SERVICE

Technical Information

CK1355P19A

CATHODE RAY TUBE

The type CK1355P19A is a 7 inch electrostatic focus and magnetic deflection cathode ray tube suitable for radar applications. A low voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the CK1355P19A employs a high resolution electron gun. The final A designates a metallized screen for greater light output, improved contrast, and to minimize charging effects.

The tube envelope was designed to meet the stringent requirements of "rotating yoke" applications. The mechanical tolerances are therefore controlled to a greater extent than those of a standard cathode-ray tube. A unique high voltage connector is used that permits quick disconnect and meets the requirements of high altitude operation with freedom from corona.

GENERAL DATA

Phosphor	#19
Fluorescence	Orange
Phosphorescence	Orange
Persistence	Long
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle	50°

ELECTRICAL DATA

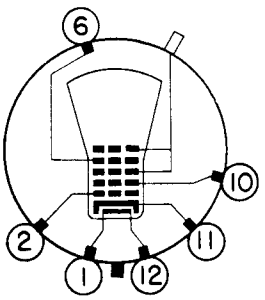
HEATER CHARACTERISTICS:	
Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater-Cathode Voltage	
Heater Negative with respect to cathode	180 volts DC
Heater Positive with respect to cathode	180 volts DC
DIRECT INTERELECTRODE CAPACITANCES:	
Grid #1 to all other electrodes	8.5 $\mu\mu$fd max.
Cathode to all other electrodes	5 $\mu\mu$fd max.
DESIGN MAXIMUM RATINGS:	
Anode Voltage	10,000 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative-Bias Value	180 volts DC
Positive-Bias Value *	0 volts DC
Positive-Peak Value	0 volts

MECHANICAL DATA

BASE ..... Small Shell Duodecal Six Pin

CAP ..... Special high altitude connector

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Grid #4 (focus)
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Cap	Anode

ELECTRICAL DATA (Cont'd)

CHARACTERISTICS AND TYPICAL OPERATIONS.

Heater Voltage	6.3 volts
Anode Voltage ■	7500 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300 volts DC
Grid #2 Voltage	300 volts DC
Grid #1 Voltage □	−30 to −65 volts DC
Line Width ⊕	.010 inch max.
Spot Position (undeflected) †	.375 inch max.

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg. max.
Grid #2 Circuit Resistance	0.1 meg. max.

NOTES.

* *The P19 phosphor is more easily damaged than other type phosphors if current densities are extremely high. To avoid burning of the phosphor, low current densities should be maintained.*

■ *Brilliance and definition decrease with decreasing anode voltage. In general, anode voltage should not be less than 5000 volts.*

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

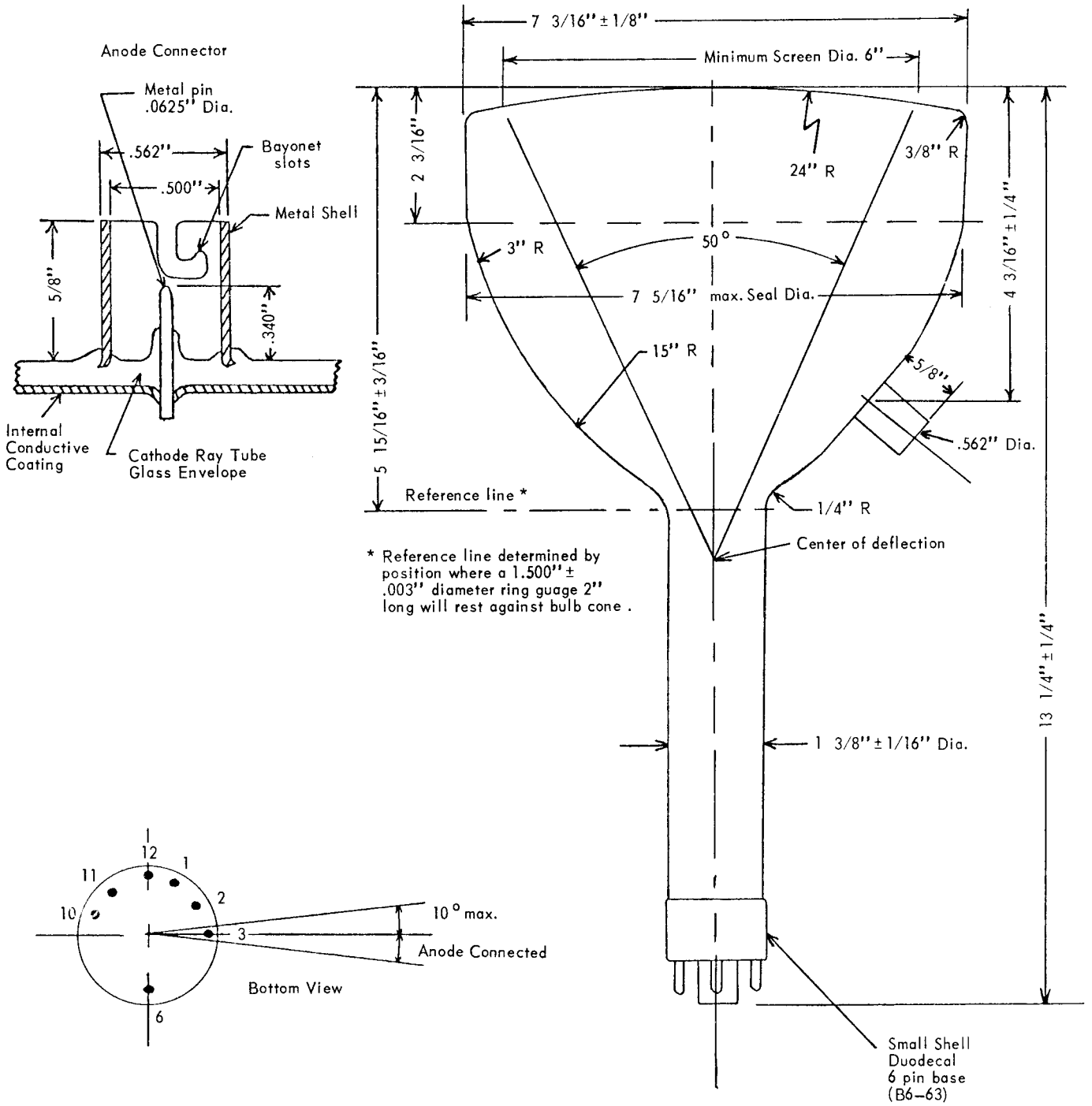
● *With grid #1 voltage adjusted to produce a collector current of 60 μA, with the pattern adjusted for best overall focus. Measured with a 525-line interlaced and synchronized pattern.*

□ *Visual extinction of focused undeflected spot.*

⊕ *Measured with a merging 525-line interlaced and synchronized pattern at Ib = 60 μa.*

† *The center of the undeflected, focused spot will fall within a circle of 3/8" radius concentric with the center of the tube face, with tube shielded.*

CATHODE RAY TUBE



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TECHNICAL INFORMATION SERVICE

Technical Information

CK1359P-A

CATHODE RAY TUBE

The type CK1359P-A is a 16-inch electrostatic focus and magnetic deflection cathode-ray tube suitable for radar applications. A low-voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantially automatic focus, independent of accelerator voltage variations. In addition, the CK1359P-A employs a high resolution electron gun. The faceplate is of gray filter glass.

The final A designates a metallized screen for greater light output, improved contrast, and minimizing screen charging effects.

GENERAL DATA

	CK1359P2A	CK1359P7A	CK1359P25A
Phosphor	#2	#7	#25
Fluorescence	Blue-Green	Blue	Orange
Phosphorescence	Green	Yellow	Orange
Persistence	Long	Long	Long
Focusing Method	Electrostatic	Electrostatic	Electrostatic
Deflecting Method	Magnetic	Magnetic	Magnetic
Deflection Angle (Approx.)	52°	52°	52°

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater-Cathode Voltage: (Max.): ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ▲	16,500 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000 volts DC
Grid #2 Voltage	700 volts DC
Grod #1 Voltage:	
Negative – Bias Value	180 volts DC
Positive – Bias Value *	0 volts DC
Positive – Peak Value	0 volts DC

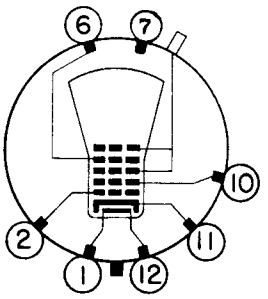
CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage ▲	12,000 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300 volts DC
Grid #4 Current	−15 to +15 μAdc

MECHANICAL DATA

BASE...Small Shell Duodecal 7-Pin
CAP.....Recessed Small Cavity
MOUNTING POSITION ..... Any

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Grid #4
Pin 7	No Connection
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Cap	Grids #3 and #5 (Collector

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION (Cont'd.)

Grid #2 Voltage	300 volts DC
Grid #1 Voltage ⊕	−28 to −72 volts DC
Line Width ■	0.025 inch max.
Spot Position (undeflected) □	5/8 inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 max. megohms

* *At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts. The screen of the P25 can be permanently damaged should the current density be permitted to rise too high. To prevent burning, minimum beam current densities should be employed.*

▲ *Collector grids #3 and #5 are connected internally and are referred to as collector. Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 7000 volts.*

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

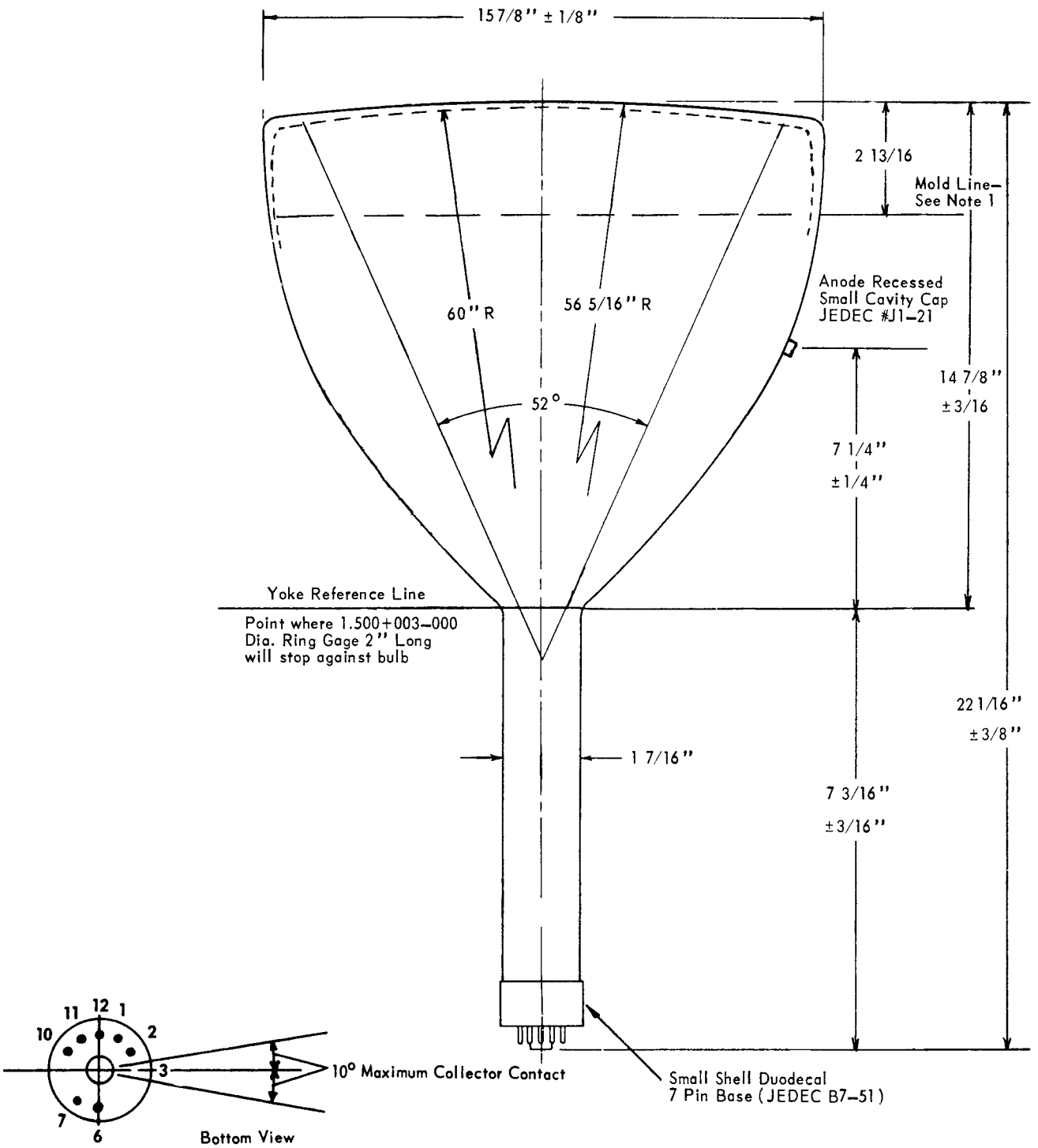
● *With grid #1 voltage adjusted to produce a collector current of 100 μA, with the pattern adjusted for best overall focus. Measured with a 525-line interlaced and synchronized 13 1/4 X 13 1/4 inch pattern, with interlaced line blanking (current measured before applying blanking).*

⊕ *Visual extinction of 13 1/4 X 13 1/4 inch raster pattern.*

■ *Measured with a 525-line interlaced and synchronized pattern with interlaced line blanking. Pattern width adjusted to 90% of minimum useful screen diameter. Ib-100 μA, measured before applying blanking. Line width is the merged raster height divided by the number of lines (262.5) (measured in center of tube face).*

□ *The center of the undeflected, focused spot will fall within a circle of 5/8 inch radius concentric with the center of the tube face, with tube shielded.*

CATHODE RAY TUBE



NOTE 1: It is recommended that the tube mounting clamps not be positioned on the mold line.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1362

CATHODE RAY TUBE

The type CK1362 is a low-voltage electrostatic focus, magnetic deflection ten inch cathode ray tube with a special Infrared Stimulable Phosphor. Except for the phosphor screen characteristics, it is similar in all respects to the 10WP7A which included a desirable aluminized screen for high brightness and contrast. A unique feature of this tube is the ability to store energy in the phosphor of the screen and later, when irradiated by infrared, to release it in the form of light. The details of the storage characteristics are described in the notes.

GENERAL DATA

Storage Phosphor	
Fluorescence	Blue
Phosphorescence	Yellow–Green
Persistence	Long (variable via the storage characteristic)
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle	50°

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater-Cathode Voltage: ♦	
Heater Negative with Respect to Cathode	
During warm-up period not to exceed 15 sec.	410 volts DC
After equipment warm-up period	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: μμfds. (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ■	12,000 volts DC
Grid #4 Voltage (Focusing Electrode)	−500 to +1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative–Bias Value	180 volts DC
Positive–Bias Value	0 volts DC
Positive–Peak Value	0 volts

CHARACTERISTICS AND TYPICAL OPERATION:

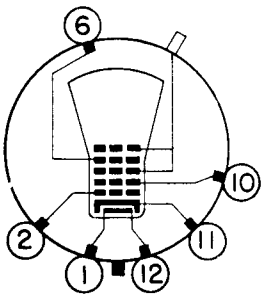
Collector Voltage ■	10,000 volts DC
Grid #4 Voltage (Focusing Electrode) ●	0 to 300 volts DC
Grid #4 Current	−15 to +15 μAdc

MECHANICAL DATA

BASE . . . . Small Shell Duodecal 6–Pin

CAP . . . Recessed Small Cavity

BASING



12 M
BOTTOM VIEW

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Grid #4
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Cap	Grids #3 and #5 (Collector)

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (Cont'd.)

Grid #2 Voltage	300 volts DC
Grid #1 Voltage □	–28 to –72 volts DC
Line Width ⊕	0.017 inch max.
Spot Position (undeflected) ▲	0.5 inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg. max.

■ *Collector, Grids #3 and #5 are connected internally and referred to as Collector. Brilliance and definition decrease with decreasing collector voltage. In general, collector voltage should not be less than 7000 volts.*

♦ *Cathode should be returned to one side or to the mid–tap of the heater transformer winding.*

● *With grid #1 voltage adjusted to produce a collector current of 50 μA, with the pattern adjusted for best overall focus. Measured with a 525–line interlaced and synchronized 6 X 8 inch pattern.*

□ *Visual extinction of focused 6 X 8 inch raster pattern.*

⊕ *Measured with a 525–line interlaced and synchronized pattern. Pattern width adjusted to 90% of minimum useful screen diameter. Ib – 50 μA. Line width is the merged raster height divided by the number of lines (525) (measured in center of tube face).*

▲ *The center of the undeflected, focused spot with fall within a circle of 1/2" radius concentric with the center of the tube face, with tube shielded.*

APPLICATION NOTES:

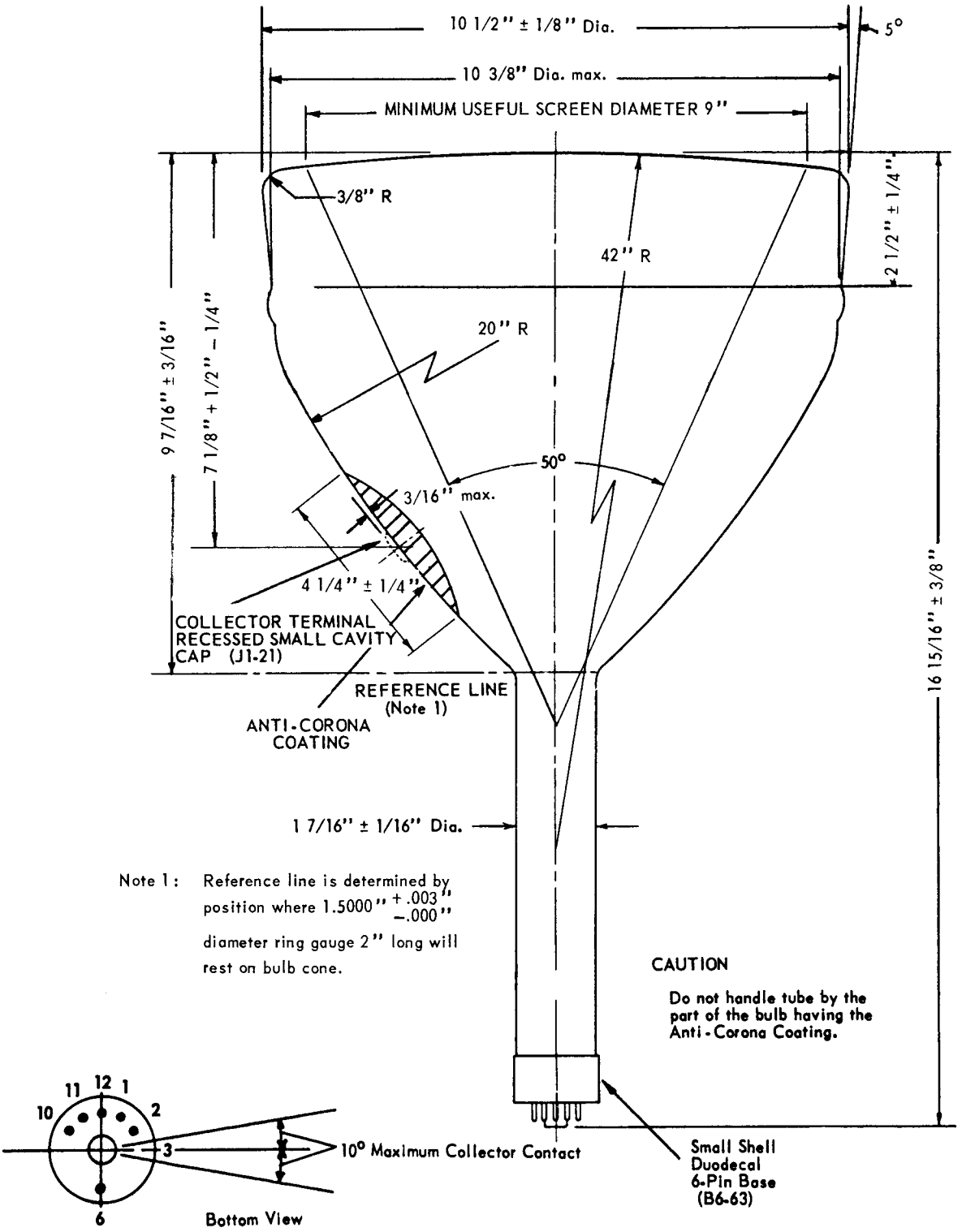
The CK1362 is capable of storing information on the screen for 20 minutes or less after the beam is cut–off, depending on how the tube screen is scanned. Readout is accomplished by irradiating the screen with infrared in the 1 micron range.

The infrared stimulated display is, in effect, a form of controlled persistence. The readout, with nominal excitation, will persist for about 30 seconds. By reducing, however, the voltage to the infrared sources at first and increasing it as desired when the picture is viewed, longer storage times, up to a minute or more, can be obtained. The readout display brightness will be higher with an increase in infrared, but the higher brightness will reduce the usable readout viewing time. If erasure is desired, an increased input to the infrared source will decay the stored image in a few seconds.

Since white light will fog the stored picture and reduce the contrast, it is advisable to reduce even stray light by both the use of a viewing hood on the face of the tube and a filter system on the infrared lamp. A suggested display set–up would be to use an infrared source consisting of a circle of six 25 watt 115–125 V #25 T8 DC G.E. lamp arranged to evenly stimulate the screen. The lamp filters should pass 1 micron or higher (Polaroid #XRX70 .010" thickness) and the lamps should be mounted in light–tight boxes. If improved operation is desired, the viewing hood should fit the operator's face and an additional infrared attenuating filter should be placed over the face of the tube. The total number of lamps would be used to erase the screen, while four would be used for readout. These lamps should be operated at 30–75 volts for readout, and 115 V for erasure. The actual arrangement of parts and conditions will dictate the voltage necessary to obtain optimum results. This information is offered for explanatory purposes covering an actual condition. Better combinations for individual requirements may be derived by experimentation.

One suitable application for the CK1362 is in a True Motion Radar Indicator where, after ten minutes operation, an infrared application will show the actual direction of moving objects by the trails present on the radar screen.

CATHODE RAY TUBE



RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1366
CK1367

PRINTER–TYPE CATHODE RAY TUBES

The CK1366 and CK1367 are 3" Printer-Type Cathode Ray tubes that can deposit an electrostatic charge on paper. The major application is in high–speed label printing equipment.

They employ a high-resolution, high-current gun. The small wire size and spacing, together with the thinness of the element contribute to the excellent printing quality. Equipment designs using these types are capable of printing many thousands of characters per second.

GENERAL DATA

PRINTING ELEMENT CHARACTERISTICS:

CK1366 (single row)
- Effective length – 2.75"
- Number of wires per inch – 250
- Thickness of element – .040"

CK1367 (multi–row)
- Effective length – 2.75"
- Number of wires per inch – 250
- Thickness of element – .040"
- Spacing of wire centers between rows – .004"
- Number of rows – 40

Phosphor (see application Note 1)	P1
Fluorescence	Green
Persistence	Medium
Focusing Method	Magnetic
Deflecting Method	Magnetic
Deflection Angle	40°

ELECTRICAL DATA

DIRECT INTERELECTORDE CAPACITANCES: (approx.)

Grid #1 to all other electrodes	8 μμf
Cathode to all other electrodes	5 μμf

DESIGN MAXIMUM RATINGS:

Peak Heater-Cathode Voltage: ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC
Anode (Collector) Voltage ▲	25,000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage	
Negative – Bias Value	200 volts DC
Positive – Bias Value	0 volts DC
Positive – Peak Value	0 volts DC

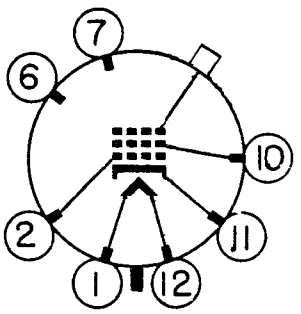
CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts ± 10%
Heater Current	0.6 amps
Collector Voltage ▲	20,000 volts DC
Focus Coil Current *	656 ampere turns approx.
Grid #2 Voltage	450 volts DC
Grid #1 Voltage ⊕(for cut–off)	–60 to –115 volts DC

MECHANICAL DATA

BASE ..... Small Shell Duodecal 7–Pin

MOUNTING POSITION ..... Any



BOTTOM VIEW

TERMINAL CONNECTIONS:

- Pin 1 Heater
- Pin 2 Grid #1
- Pin 6 NC
- Pin 7 NC
- Pin 10 Grid #2
- Pin 11 Cathode
- Pin 12 Heater
- Metal Face Plate – Anode (Collector)

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (Cont'd.)

Spot Position (undeflected) □	1/4 " radius

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 Megohm max.

▲ *At or near this rating the effective resistance of the collector supply should be adequate to limit the collector input to 6 watts.*

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

⊕ *Undeflected focused spot.*

□ *The center of the undeflected, focused spot will fall within a circle of 1/4 inch radius concentric with the geometric center of the tube face, with tube shielded.*

* *Ampere turns using "typical operating" voltages and a distance of 7.0 inches from center of focus coil airgap to the face of the tube. The focus current for 656 A.T. is approximately 145 made on a JEDEC 106 coil.*

PRINCIPLES OF OPERATION:

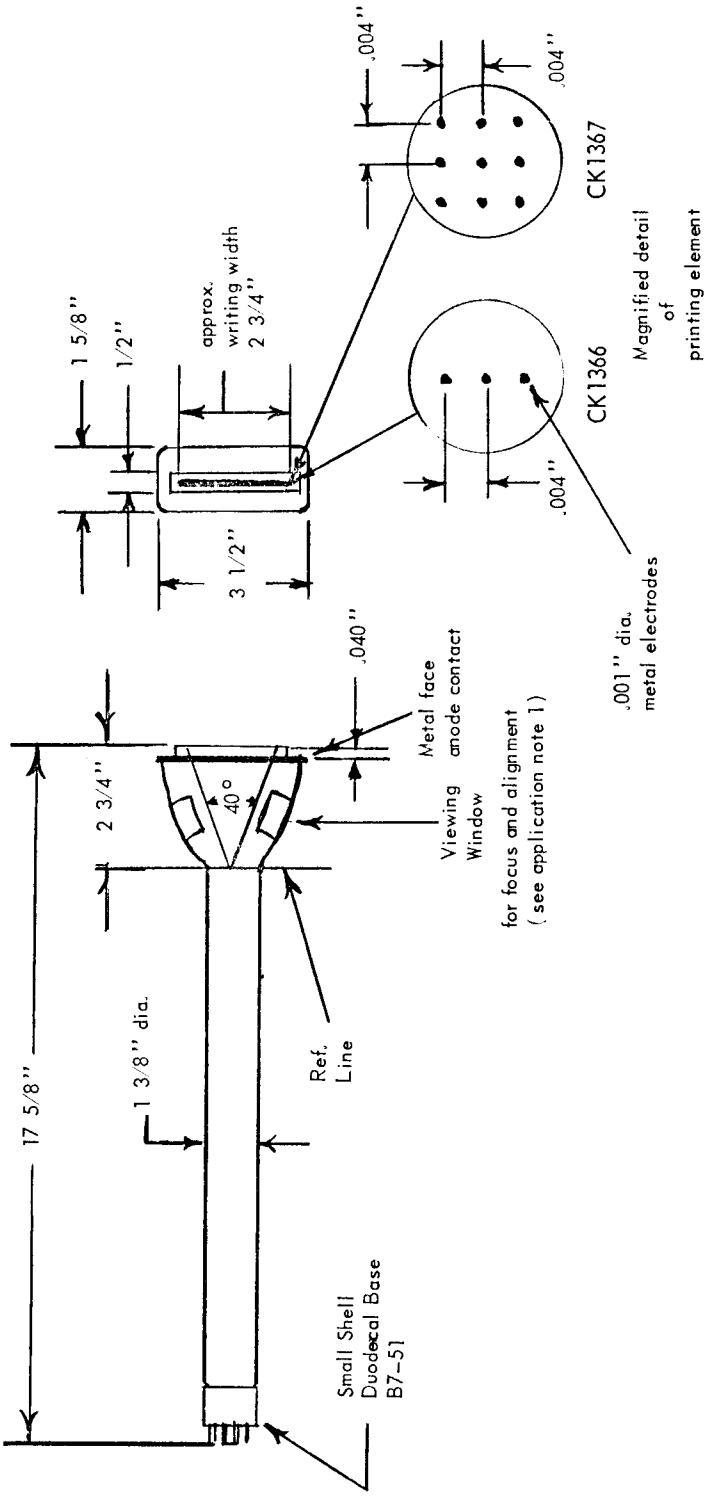
The printing element is made of fine wires imbedded in glass that permit electrons from the cathode ray beam to pass through the wires to the outside surface. Deflection and amplitude modulation of the electron beam striking the wires causes electron charges to be established on paper which acts as a dielectric. As the paper moves across the printing-element face plate, the electron charges actually form the characters that are desired. The characters can be made visible by developing the paper in a positively charged ink and fixing. Since the electron charge on the paper is proportional to the cathode ray beam current, it should be possible to obtain half tones.

APPLICATION NOTES:

1. Proper focus and sweep-scan alignment are accomplished by observing the electron beam as it strikes the phosphor. Side-viewing windows are provided for this purpose. The phosphor is on an area adjacent to the printing element. After initial adjustment are made, the scanning beam is moved to the printing element and final adjustments are made by actual printing process tests.
2. The beam spot size at optimum focus is approximately .003" for beam currents up to 200 μA. Nominal resolution is approximately 100 TV lines per inch.

These data identify a particular developmental tube design and the type designation or the descriptive data may be subject to change or abandonment.

PRINTER – TYPE CATHODE RAY TUBES



* All dimensions are approximate and there may be variations in samples supplied.

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TECHNICAL INFORMATION SERVICE

Technical Information

CK1368
CK1369

PRINTER–TYPE CATHODE RAY TUBES

The CK1368 and CK1369 are 10" Printer–Type Cathode Ray tubes that can deposit an electrostatic charge on paper. The major application is in high speed printing equipment.

They employ a high–resolution, high–current gun. The small wire size, together with the thinness of the element, contribute to the excellent printing quality. Equipment designs using these types are capable of printing many thousands of characters per second.

GENERAL DATA

PRINTING ELEMENT CHARACTERISTICS:

CK1368 (single row)
- Effective length–8 5/8"
- Number of wires per inch–250
- Thickness of element–.040"

CK1369 (multi-row)
- Effective length–8 5/8"
- Number of wires per inch–250
- Thickness of element–.040"
- Number of rows–40
- Spacing of wire centers between rows–.004"

Phosphor (see application note 1)	P1
Fluorescence	Green
Persistence	Medium
Focusing Method	Magnetic
Deflecting Method	Magnetic
Deflection Angle	40°

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (approx.)

Grid #1 to all other electrodes	8 μμf
Cathode to all other electrodes	5 μμf

DESIGN MAXIMUM RATINGS:

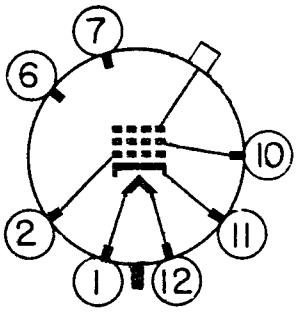
Peak Heater-Cathode Voltage: Max. ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC
Anode Voltage ▲	25,000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage	
Negative – Bias Value	180 volts DC
Positive – Bias Value	0 volts DC
Positive – Peak Value	0 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Heater Voltage	6.3 volts ± 10%
Heater Current	0.6 amps.
Collector Voltage ▲	20,000 volts DC
Grid #2 Voltage	450 volts DC
Grid #1 Voltage ⊕	–60 to –115 volts DC

MECHANICAL DATA

BASE ..... Small Shell Duodecal 7 Pin
CAP ..... Small Cavity (J1–21)
MOUNTING POSITION ..... Any



BOTTOM VIEW

TERMINAL CONNECTIONS:

- Pin 1 Heater
- Pin 2 Grid #1
- Pin 6 NC
- Pin 7 NC
- Pin 10 Grid #2
- Pin 11 Cathode
- Pin 12 Heater
- Cap Anode (Collector)

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (Cont'd)

Focusing Coil Current ■	717 ampere turns
Spot Position (undeflected) □	1/2 inch radius

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg. max.

▲ *At or near this rating, the effective resistance of the collector supply should be adequate to limit the anode input power to 6 watts.*

♦ *Cathode should be returned to one side or to the mid-tap of the heater transformer winding.*

⊕ *Visual extinction of focused undeflected spot.*

□ *The center of the undeflected focused spot will fall within a circle of 1/2 inch radius concentric with the center of the tube face, with tube shield.*

■ *For Standard Focus Coil #106 or equivalent, positioned with air gap toward faceplate and center line of air gap 14" from reference line and collector current of 200 microamperes, the current will be approximately 160 Ma.*

PRINCIPLES OF OPERATION:

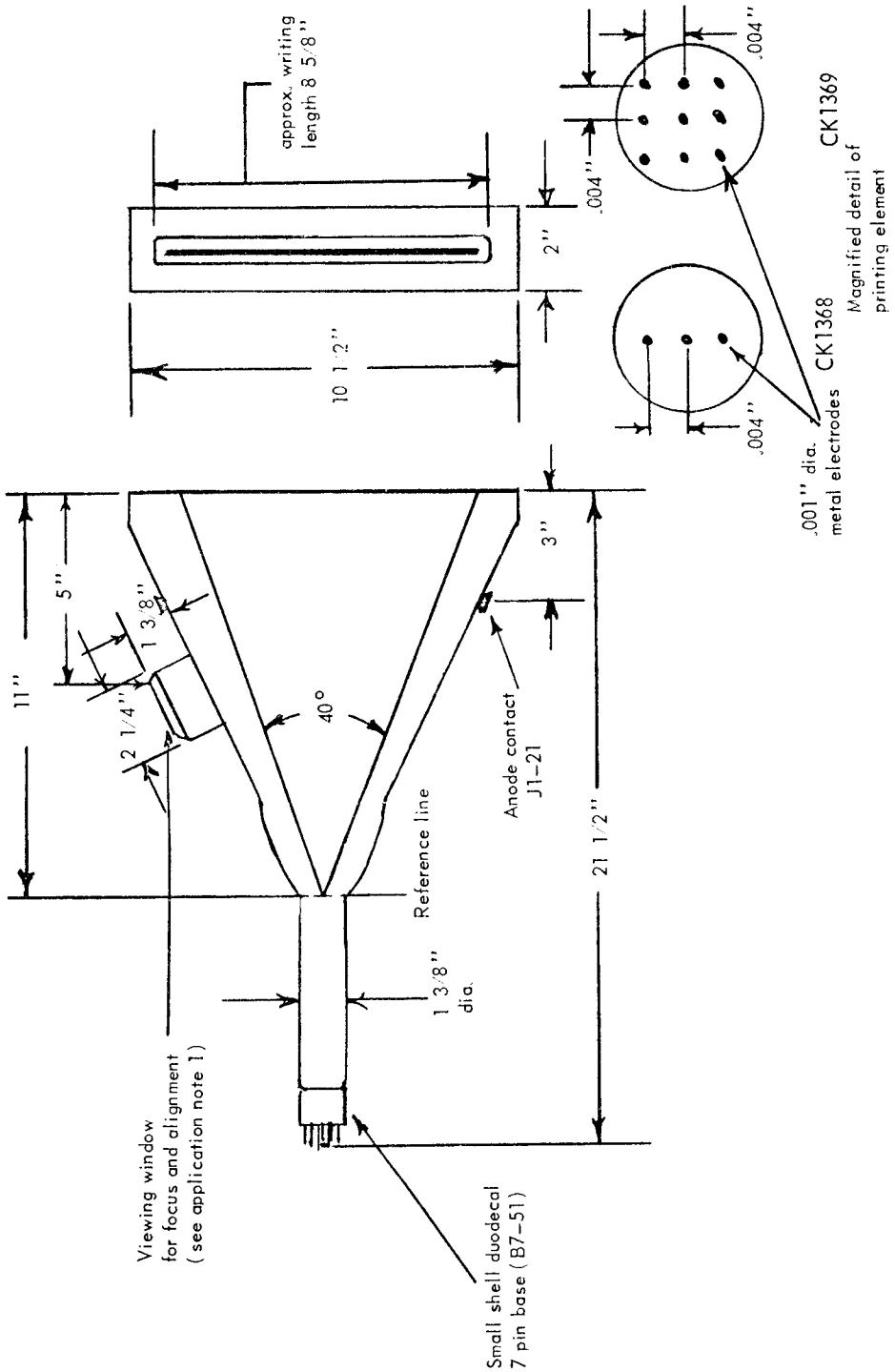
The printing element is made of fine wires imbedded in glass that permit electrons from the cathode ray beam to pass through the wires to the outside surface. Deflection and amplitude modulation of the electron beam striking the printing wires causes electron charges to be established on paper which acts as a dielectric. As the paper moves across the printing-element face plate, the electron charges actually form the characters that are desired. The characters can be made visible by developing the paper in a positively charged ink and fixing. Since the electron charge on the paper is proportional to the cathode ray beam current, it should be possible to obtain half tones.

APPLICATION NOTES:

1. Proper focus and sweep-scan alignment are accomplished by observing the electron beam as it strikes the phosphor. Side-viewing windows are provided for this purpose. The phosphor is on an area adjacent to the printing element. After initial adjustments are made, the scanning beam is moved to the printing element and final adjustments are made by actual printing process tests.
2. The beam spot size at optimum focus is approximately .003" for beam currents up to 200 μA. Nominal resolution is approximately 100 TV lines per inch.

These data identify a particular developmental tube design and the type designation or the descriptive da a may be subject to change or abandonment.

PRINTER-TYPE CATHODE RAY TUBES



* All dimensions are approximate and there may be variations in samples supplied.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK1381 P-

CATHODE RAY TUBE

The type CK1381P– is a 16–inch electrostatic focus and magnetic deflection cathode–ray tube suitable for radar applications. A low–voltage electrostatic focus lens is employed, designed to operate at or near cathode potential to afford substantiallv automatic focus, independent of ac–celerator voltage variations. In addition, the CK1381P– employs a high resolution electron gun. The faceplate is of gray filter glass.

This type has a metallized hi–efficiency screen for greater light output, improved contrast, and minimizing screen charging effects.

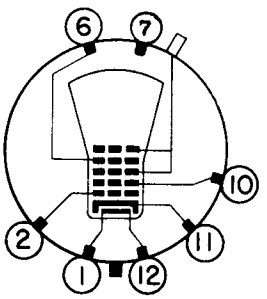
MECHANICAL DATA

BASE. . . Small Shell Duodecal 7–Pin
CAP . . . . . Recessed Small Cavity
MOUNTING POSITION. . . . . Any

GENERAL DATA

Phosphor	#2	#7	#25
Fluorescence	Blue–Green	Blue	Orange
Phosphorescence	Green	Yellow	Orange
Persistence	Medium	Long	Long
Focusing Method	Electrostatic		
Deflecting Method	Magnetic		
Deflection Angle (Approx.)	52°		

BASING



BOTTOM VIEW

ELECTRICAL DATA

HEATER CHARACTERISTICS:

Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater–Cathode Voltage: (Max.):♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: (μμfds.) (approx.)

Grid #1 to all other electrodes.	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Collector Voltage ▲	18,000 volts DC
Grid #4 Voltage (Focusing Electrode)	–500 to + 1000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative–Bias Value.	180 volts DC
Positive–Bias Value*	0 volts DC
Positive–Peak Value	0 volts DC

CHARACTERISTICS AND TYPICAL OPERATION:

Collector Voltage ▲.	14,000 volts DC
Grid #4 Voltage (Focusing Electrode) ●.	0 to 350 volts DC
Grid #4 Current	
Grid #2 Voltage	350 volts DC
Grid #1 Voltage ⊕	–40 to –70 volts DC

TERMINAL CONNECTIONS

Pin 1 Heater
Pin 2 Grid #1
Pin 6 Grid #4
Pin 7 No Connection
Pin 10 Grid #2
Pin 11 Cathode
Pin 12 Heater
Cap Grids #3 and #5 Collector

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CHARACTERISTICS AND TYPICAL OPERATION (Cont'd.):

Line Width ■	.015 inch max.
Light Output ★	75 F.L. (P2 only)
Spot Position (undeflected) □	5/8 inch

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 max. megohms

* At or near this rating, the effective resistance of the collector supply should be adequate to limit the collector input power to 6 watts.

▲ Collector grids #3 and #5 are connected internally and are referred to as collectors. Brilliance and definition decrease with decreasing collector voltages. In general, collector voltage should not be less than 7000 volts.

♦ Cathode should be returned to one side or to the mid–tap of the heater transformer winding.

● With grid #1 voltage adjusted to produce a collector current of 250 μA, with the pattern adjusted for best overall focus. Measured with a 525–line interlaced and synchronized 14 X 14 inch pattern.

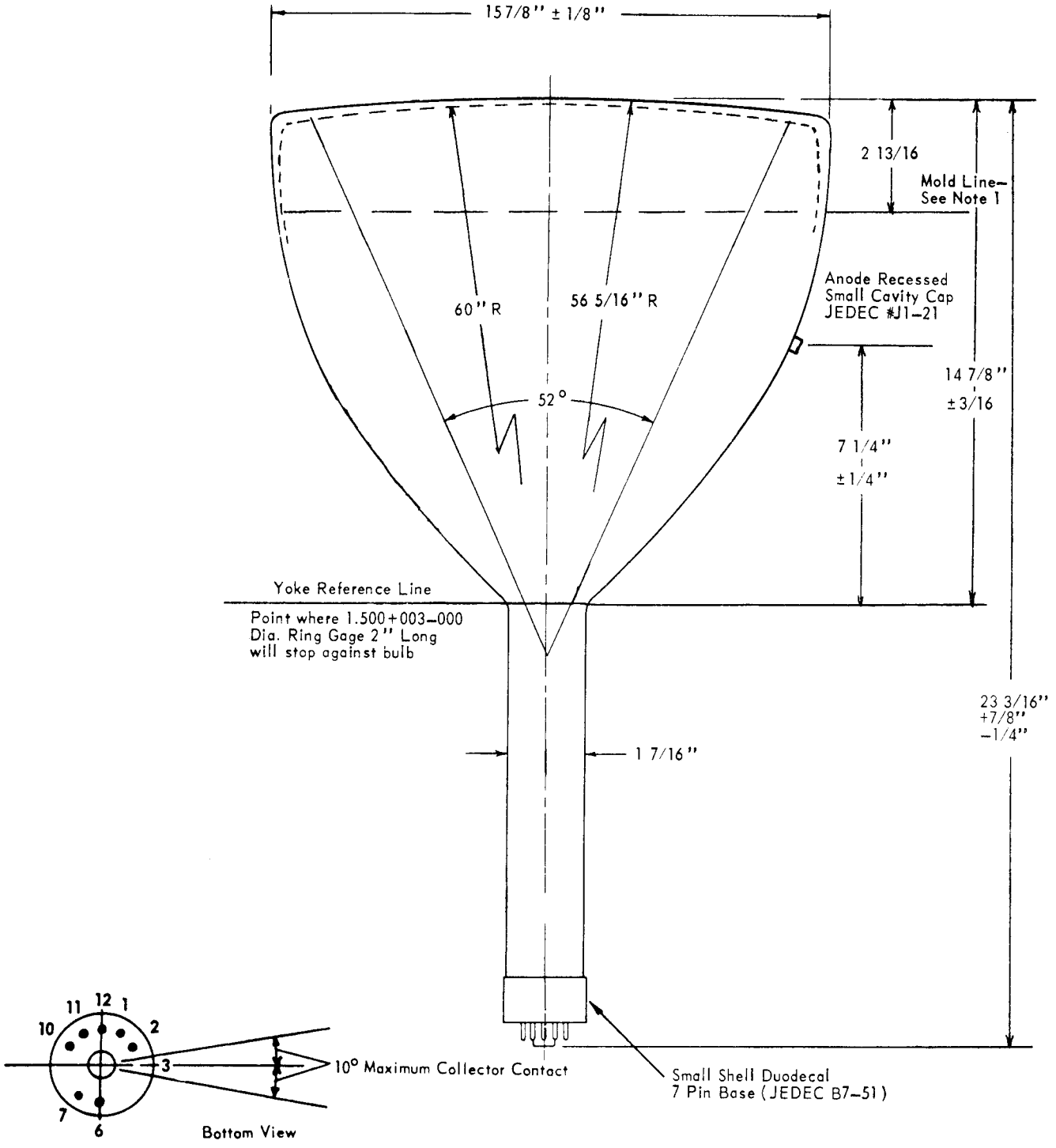
⊕ Spot cutoff (undeflected focused spot).

■ 525 line raster 14" wide $IA_2 = 250\ \mu A$.

□ The center of the undeflected, focused spot will fall within a circle of 5/8 inch radius concentric with the center of the tube face, with tube shielded.

★ 525 line raster, retrace blanked, 14" square IA_2 will be no more than 250 μA to reach 75 F.L. at screen.

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NOTE 1: It is recommended that the tube mounting clamps not be positioned on the mold line.

RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

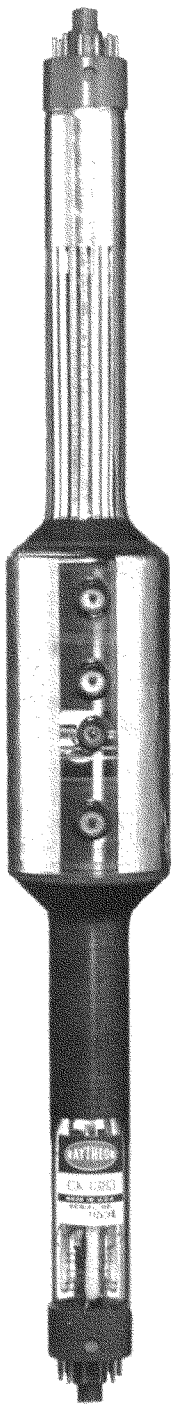
CK1383

RECORDING STORAGE TUBE

The CK1383 is a dual–gun cathode–ray recording storage tube capable of simultaneous writing and reading. It is an electronic input–electronic output storage device which combines high output signal with high resolution. The major application is scan conversion such as radar PPI to tele–vision type presentation. This type of system yields a bright video display, with high resolution and adjustable automatic priming or erasing, which may be used to generate target trails indicating elapsed time position. It is similar to the CK7702 except that no electrostatic focus elements are used. Stored signals can be held for a long period, read several thousand times, or erased in a fraction of a second if desired. The storage capabilities permit additional coherence of target information under conditions of high noise levels.

Both the writing and reading guns use magnetic deflection and magnetic focus. For uniform resolution over the storage surface, dynamic focus correction is recommended.

The design of the tube results in a wide dynamic range of gray shades, fast writing speeds, and selective erasure of the stored information is desired.



ELECTRICAL DATA

GENERAL CHARACTERISTICS

Gun Locations	Co–axial
Gun Type (Both Guns)	Tetrode High Resolution
Deflection (Both Guns)	Magnetic
Max. Deflection Angle (Both Guns)	30°
Focusing	Magnetic
Mounting Position	Any
Resolution (Magnetic Focus)	
TV lines per diameter	1200 lines minimum
Output Capacitance	
(Collector and Write Decelerator to all other elements)	19 pf (approx.)
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Seated Length	22 ½" Nominal
Bulb Diameter	3" Maximum
Neck Diameters	1.450" Maximum
Bases (Both Ends)	Special High Altitude
Sockets (Both Ends – not supplied)	See Note 2
Storage Assembly Buttons	JEDEC Type J1–22

ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES

Heater Voltage	6.3 ± 5% Volts
Anode Voltage (Either Gun)	5200 Vdc
Grid Voltage Positive (Either Gun)	0 Vdc
Write Control Grid Voltage Negative	–150 Vdc

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ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES (Cont'd.)

Read Control Grid Voltage	–275 Vdc
Write Grid #2 Voltage	500 Vdc
Read Grid #2 Voltage	650 Vdc
Inter Screen Voltage (Between any pair)	1000 Vdc
Grid Circuit Resistance	0.5 Meg.
Heater Cathode Voltage	
Heater Positive	+10 Vdc
Heater Negative	–125 Vdc
Write Collimating Lens Voltage	800 Vdc
Read Collimating Lens #1 Voltage	800 Vdc
Read Collimating Lens #2 Voltage	700 Vdc
Read Decelerator Voltage	800 Vdc
Write Decelerator Voltage	1000 Vdc

NOTE: Except for heater rating and interscreen voltages, all voltages shown above are referenced to the respective gun cathode.

TYPICAL OPERATING CHARACTERISTICS

Deflection drive must be applied to both guns whenever the tube is conducting to avoid damage to the storage assembly.

All Voltages except RF drive and read G1 with respect to write cathode.

WRITE GUN

Cathode Voltage	0 Vdc
G–1 Cut–off	–20 Vdc to –50 Vdc
G–2	450 Vdc
Anode	4500 Vdc
Collimating Lens	400 Vdc
Write Decelerator	800 Vdc
Collector	Variable – See Note 1.

READ GUN

Cathode Voltage	+400 Vdc
Cathode Current (nominal)	80 μA
G–1 Cut–off (with respect to Read K)	–100 Vdc to –250 Vdc
G–1 RF Drive (see Special Application Notes section on RF separation)	30 Vrms See Note 3.
G–2	1000 Vdc
Anode	4500 Vdc
Decelerator	900 Vdc
Collimating Lens 1	900 Vdc
Collimating Lens 2	800 Vdc
Storage Screen	405 Vdc

NOTE 1: Gradual automatic priming is controllable by varying the value of collector voltage from 900 Vdc (for slow priming) down to 400 Vdc (for fast priming.)

NOTE 2: Sockets obtainable from Alden Products Co., 117 N. Main St., Brockton, Mass., part no. 212 FTSISL.

NOTE 3: To adjust for proper RF drive, set read G1 bias for a read cathode current of apprx. 10 μA dc with RF drive at zero. Increase RF drive until the read cathode current is apprx. 80 μA.

PRINCIPLES OF OPERATION

When an electron beam strikes any material, secondary electrons are emitted. The quantity of secondary electrons emitted is a function of the velocity of the primary electron beam.

The secondary electron emitting surface in the Recording Storage Tube is a dielectric that has been deposited on a metal mesh or screen. Figure 1 illustrates this storage screen mesh. This screen has more than 2000 cross wires per diameter.

Figure 2 shows the characteristic curve for secondary to primary emission ratio for the dielectric material used. Since the velocity of the electron beam will be proportional to the voltage on the dielectric material the ordinate of velocity in Figure 2 can be voltage. The crossover, called critical potential, where the secondary to primary ratio is unity occurs at approximately 50 volts.

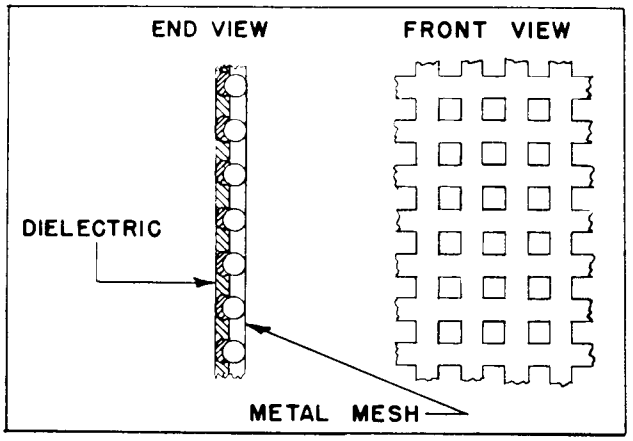


FIGURE 1
MAGNIFIED SECTION OF STORAGE SCREEN

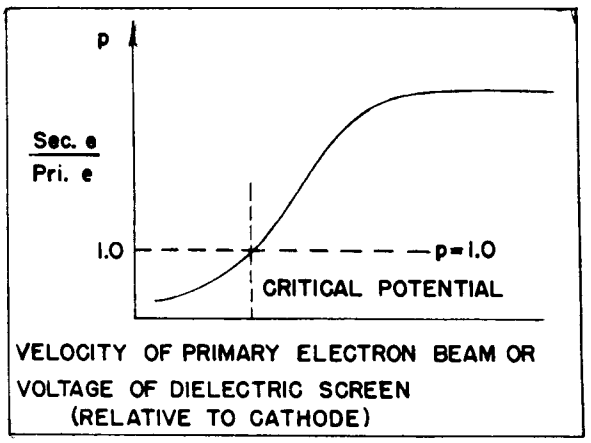


FIGURE 2
SECONDARY EMISSION CHARACTERISTIC OF RECORDING STORAGE TUBE DIELECTRIC

Using the secondary emission character shown by Figure 2, the dielectric screen surface can be discretely charged or discharged as a function of the potential on the metal screen and the position and magnitude of the primary electron beam.

The various modes of operation are described as follows:

PRIME – This is the basic form of erasure and prepares the storage screen for subsequent writing. It is accomplished by scanning the storage screen dielectric with an unmodulated beam. The storage screen mesh is operated at a voltage below critical potential and since the secondary to primary emission ratio is less than unity the dielectric surface can store electrons and become negatively charged to cathode gun potential. A total prime can be used if complete erasure of old patterns is desired or a partial prime can be used if it is desired to gradually decrease old signals in amplitude (e.g.: to generate target trails in radar). Selective priming of only part of the storage screen can be accomplished by only scanning the area where it is desired to erase previously stored information. Typical storage screen voltage for prime is +5 volts. Priming can be accomplished with either beam. When the writing beam is used for priming, the storage screen is switched to +5 volts above write cathode and the beam is turned on and scanned over the area to be primed.

When the read beam is used it is only necessary to switch the collector to or more negative than read cathode potential and the read beam is then scanned over the area to be erased. Under these conditions, the read beam primes the dielectric surface by reflection from the collector after it has passed through the storage screen. The read beam electrons recharge the dielectric surface.

WRITE – "Writing" of the charge pattern is accomplished by modulation of a scanning electron beam and operation at a storage screen voltage that yields a high secondary to primary emission ratio. This is any voltage above critical potential and is nominally 400 volts. Since during the prime mode the dielectric surface was negatively charged, the surface is discretely discharged towards the positive direction by the writing beam. As the modulated beam scans over the surface varying amounts of secondary electrons, depending on the instantaneous beam amplitude, are emitted at the surface and the stored pattern is established.

READ – Once a charge pattern has been written in, it can be read out by scanning the storage screen with an unmodulated beam. The storage screen is operated at 5 volts with respect to the reading gun cathode. Depending on the charged pattern the electron beam is therefore modulated as it passes through the storage screen to the collector element. By selecting the proper storage screen voltage the most negative areas of the dielectric (established by the prime mode) can completely cut off the electron beam from the collector and thus the "black" level is established. Various gray shades will appear in any areas where the dielectric is less negative.

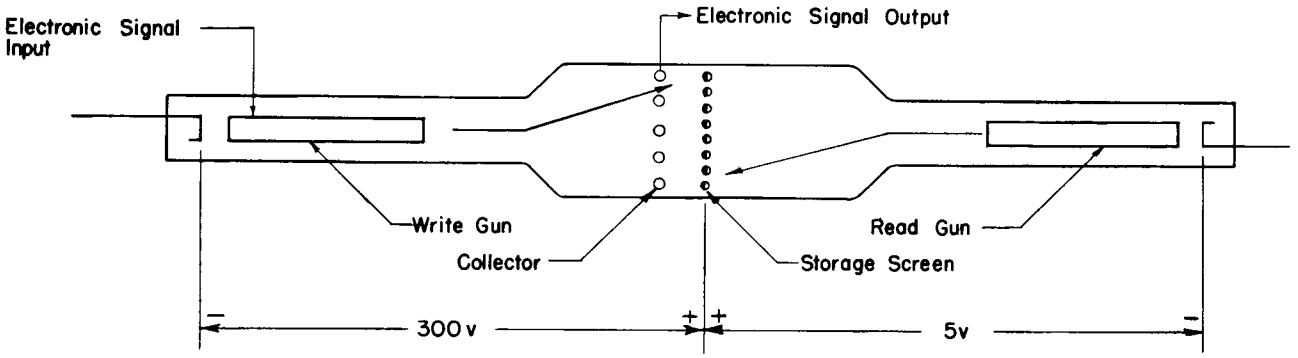


FIGURE 3
TWO GUN RECORDING STORAGE TUBE — SIMPLIFIED DRAWING

Simultaneous Write and Read modes are possible with the use of the two electron guns. This is desirable in most scan–conversion applications. Since two independent potentials can be maintained on the storage screen with respect to the two electron gun cathodes, the tube can be truly writing a charge pattern and reading it at the same time. (This is shown in Fig. 3.)

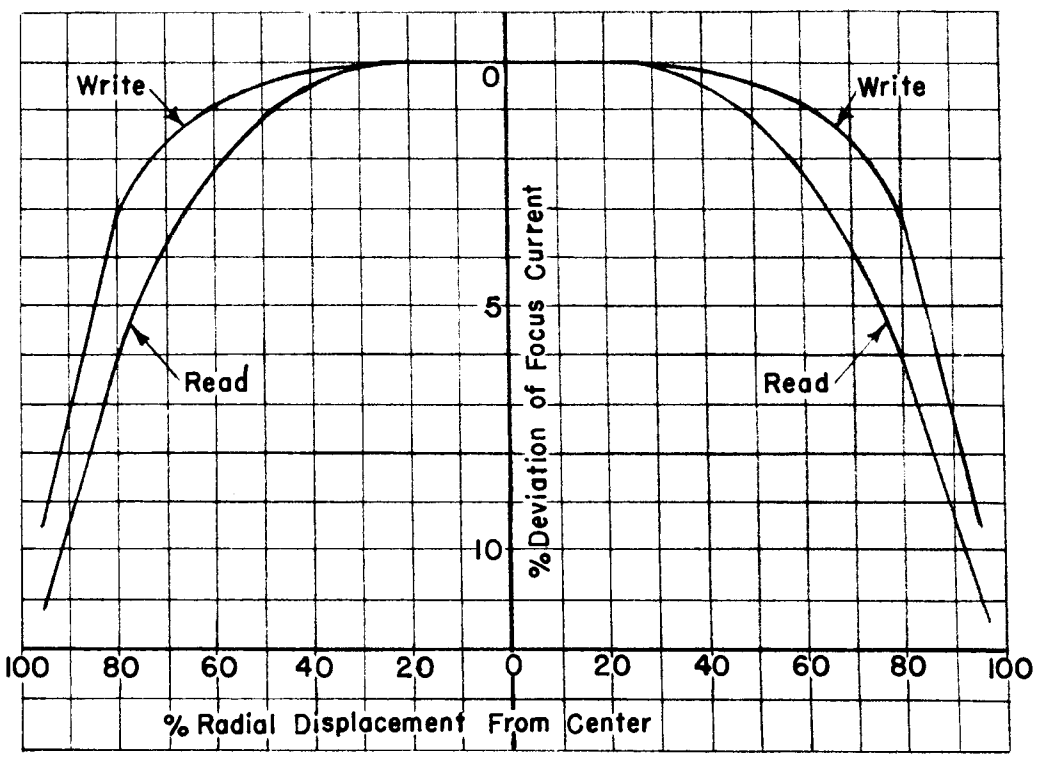


FIGURE 4
MAGNETIC DYNAMIC FOCUS CHARACTERISTIC

ERASE – Where total erasure is needed, it is frequently desirable to operate the tube in the positive erase mode. To accomplish this, the storage screen voltage is set at or above the value used for Write and the storage surface is scanned with an unmodulated electron–beam. This action discharges any stored pattern, bringing the whole storage surface to a uniform equilibrium potential. The tube must then be primed prior to subsequent writing.

SPECIAL APPLICATION NOTES: (See Figure 6)

RF SEPARATION – Since the collector intercepts the writing beam as well as the reading beam, a spurious output signal will result from the writing signal at the collector. This can be removed by cancellation techniques or by RF separation. RF separation is accomplished by modulating the read beam with insertion of an RF signal at the read gun control grid. As the RF read beam passes through the storage screen it is amplitude modulated by the stored charge pattern. This amplitude modulated signal then appears at the collector. The center frequency chosen is much higher than the highest write video frequencies and therefore a tuned circuit will reject the writing signal and accept only the read signal. This is amplified and typical amplitude–modulation detection re–establishes a read–out video signal with no writing signal. Typical RF center frequencies used are 30 mc and 50 mc.

AUTOMATIC PRIME – (Controlable erasure while reading) – During simultaneous writing and reading the tube can be operated at conditions that will allow either short or long storage of the charge pattern. It can also be variable for storage time between the two limits. Thus, in PPI to TV scan–conversion, target trails can be generated and the length of these trails are controllable by adjusting the storage time. This gradual automatic prime is obtained by varying the value of collector voltage from a high voltage for long storage (slow Prime) to a low voltage for short storage (fast Prime). The priming is accomplished by some of the read beam electrons between the collector and storage–screen dielectric returning to the dielectric to recharge it negatively in the specific areas where the negative charge was reduced by the written–in pattern.

COLLIMATION – Electrostatic lenses and deceleration screens are provided to collimate the beam as it arrives in the region of the storage screen. For optimum shading characteristics the reading and writing beam should arrive at the storage screen dielectric orthognally to it. The voltage on the lenses should therefore be adjusted for the most uniform background shading.

SHIELDING – Since any extraneous fields will cause unwanted deflection, it is recommended that good magnetic and electrostatic shielding techniques be used in the design of the tube mount.

RESOLVING POWER – The resolution of the storage tube at the 50% modulation level is usually in excess of 1200 TV lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coils designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed.

STORAGE ABILITY – The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current. When reading with a low beam current at standard television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal. The tube is capable of storing information for many hours without appreciable change or deterioration when not reading.

FOCUSING TECHNIQUE – Raytheon type BM–411 focus coils (Figure 5) should be used. This provides a tickler coil for dynamic focus correction for optimum resolution across the diameter of the storage surface. Typical current correction curves are shown in Figure 4.

The focus coil mounting should be mechanically adjustable in all directions for proper positioning. A suggested mount is shown in Figure 7.

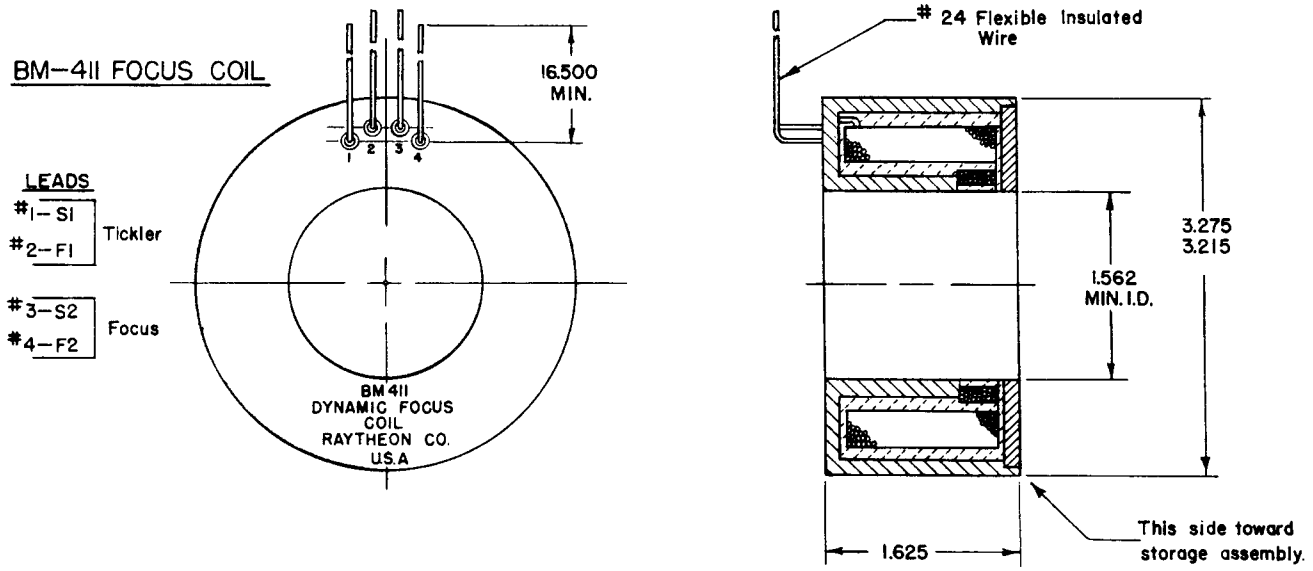


FIGURE 5

FOCUS COIL

Resistance – 6500 to 9000 ohms (at 20° C)
Max. Current – 25 madc
Voltage Rating – 250 V

TICKLER COIL

Resistance – 105 to 145 ohms (at 20° C)
Max. Current – 30mA RMS
Voltage Rating – 25 OV
Inductance – 45 Millihenries Approx.

NOTES:

1. For use with recording storage tubes and simulators.
2. Tickler coil is provided to permit dynamic focus correction. See Fig. 4.
3. When not required, the tickler coil may be left unconnected.
4. Shell material – annealed swedish iron or equivalent.

TYPICAL SCHEMATIC

Radar PPI to TV Scan Conversion, Simultaneous Write and Read with automatic prime (erasure) and RF separation.

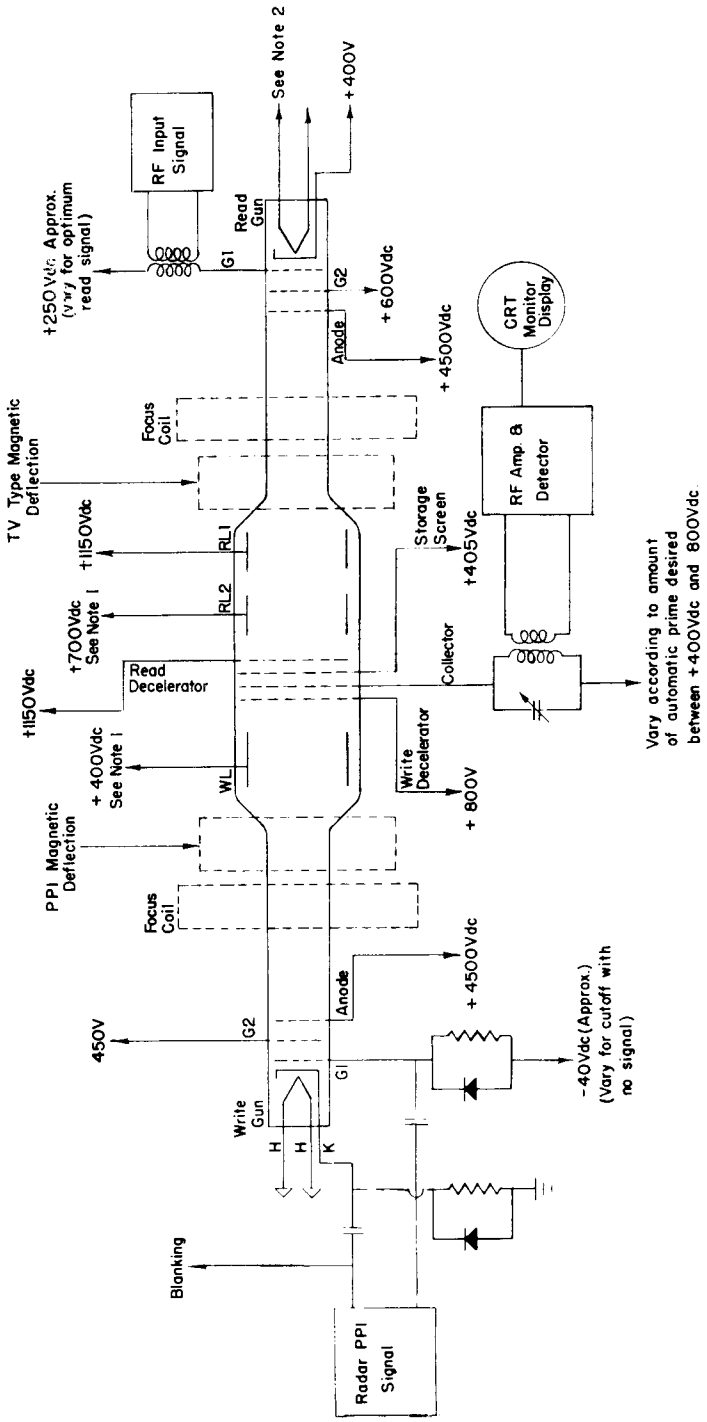


FIGURE 6

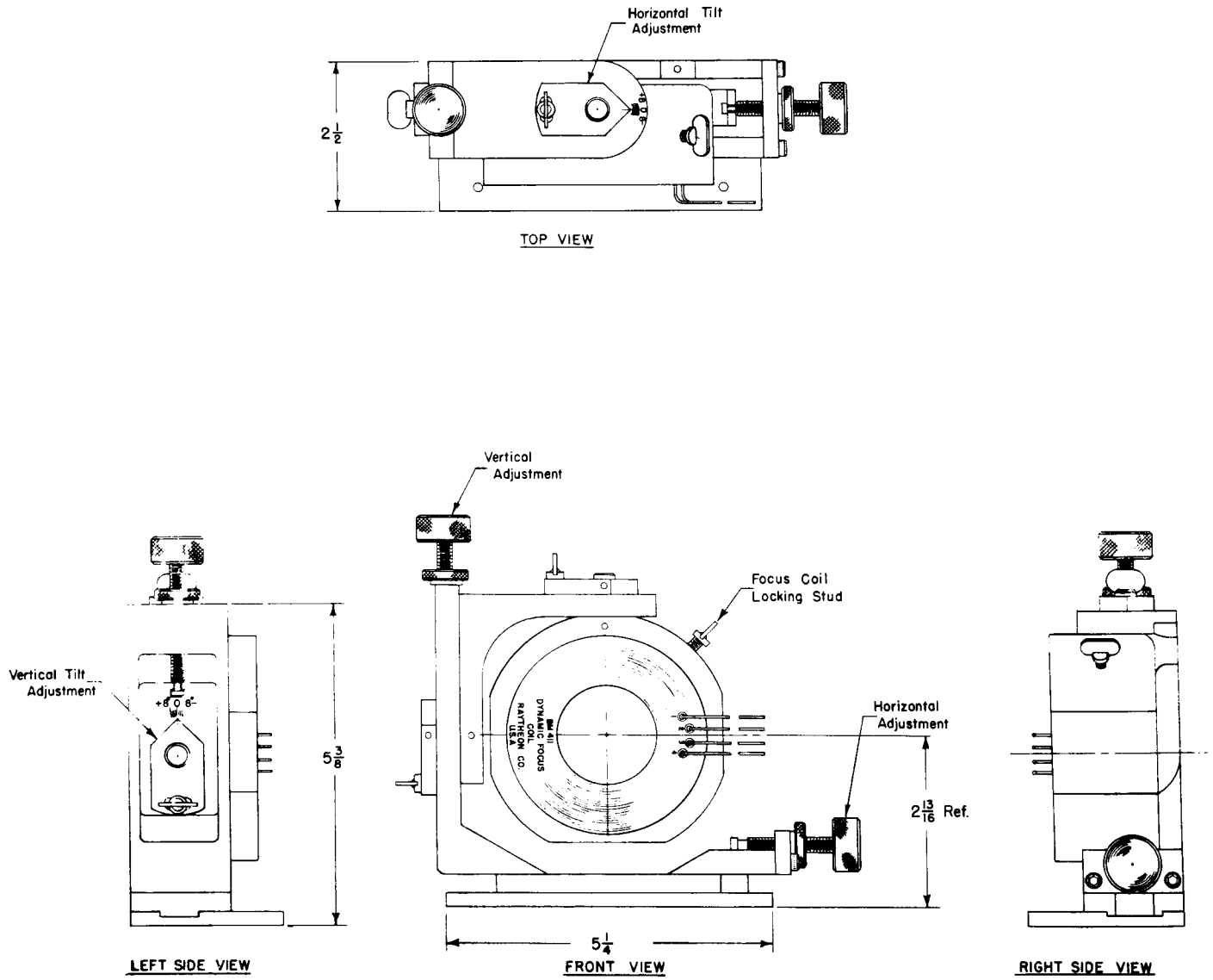


FIGURE 7

RECOMMENDED FOCUS COIL

MOUNTING ASSEMBLY

MECHANICAL OUTLINE

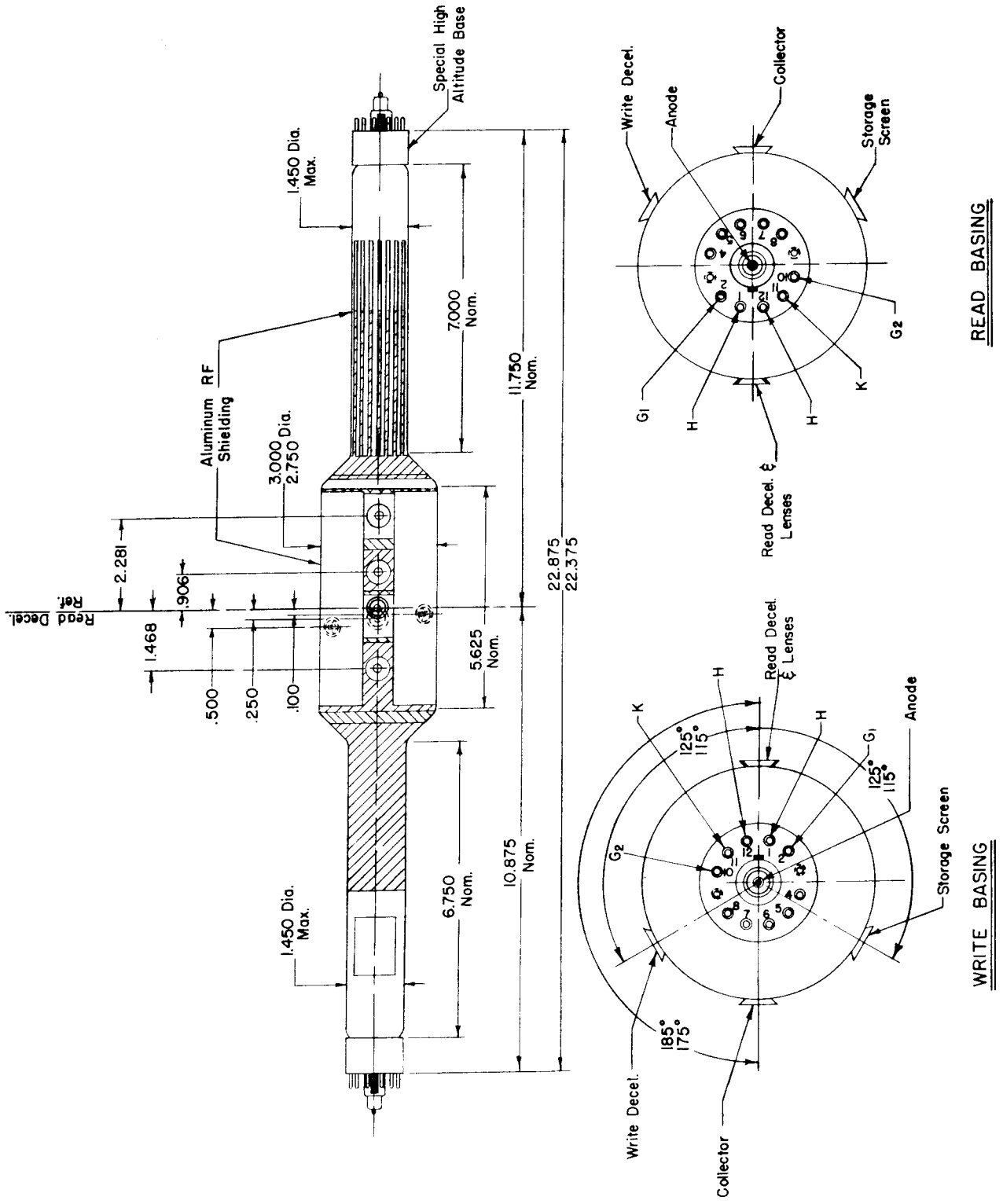


FIGURE 8

RAYTHEON

CATHODE RAY TUBE CK1395P-

The CK1395P– is a 24" rectangular cathode–ray tube which features magnetic major deflection and electrostatic minor deflection. The low–capacitance deflection design permits high speed character formation. Character positioning is accomplished magnetically. High resolution and high brightness are also major features of this tube type. The CK1395P– can be obtained with any of the JEDEC standard phosphors.

ELECTRICAL DATA

GENERAL CHARACTERISTICS:

Heater Voltage	6.3 volts
Heater Current at 6.3 Volts	.6 ± 10% amperes
Focusing Method	Electrostatic
Deflection Method	
Major: Deflection Angle Diagonal	90° Magnetic
Minor: Deflection	Electrostatic 2.5°

DIRECT INTERELECTRODE CAPACITANCES:

Cathode to All	6 pf
Grid No. 1 to All	9 pf
D1 to All	2.5 pf
D2 to All	2.5 pf
D3 to All	2.5 pf
D4 to All	2.5 pf

OPTICAL DATA

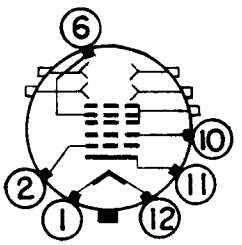
Screen	P31 Aluminized
Fluorescence	Green
Persistence	Medium
Face Plate (neutral gray) transmission	76%

MAXIMUM RATINGS: (Absolute Maximum Ratings)

Anode Voltage	18,000 Max. Volts
Focus Electrode	1,000 Max. Volts
Deflection Plate–to–Plate Voltage (MEAN = EA_2)	1,000 Max. Volts
Grid No. 2 Voltage	700 Max. Volts
Grid No. 1 Voltage	180 Max. Volts
Negative Bias Value	180 Max. Volts
Positive Bias Value	0 Max. Volts
Positive Peak Value	2 Max. Volts
EHK	± 180 Max. Volts
Grid No. 1 Circuit Resistance	1.5 Max. Megohms
Grid No. 2 Circuit Resistance	.1 Max. Megohm
Deflection Plate Circuit Resistance	5.0 Max. Megohms

MECHANICAL DATA

Overall Length	23" ± 1/4"
Bulb Number	J192A
Bulb Contact	Recessed
E. S. Deflection Contacts	Modified J1–22



BASING 12M
Base (6–63)

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Grid #1
Pin 6	Focus Electrode
Pin 10	Grid #2
Pin 11	Cathode
Pin 12	Heater
Metal Cap	Anode

RAYTHEON CATHODE RAY TUBE CK1395P-

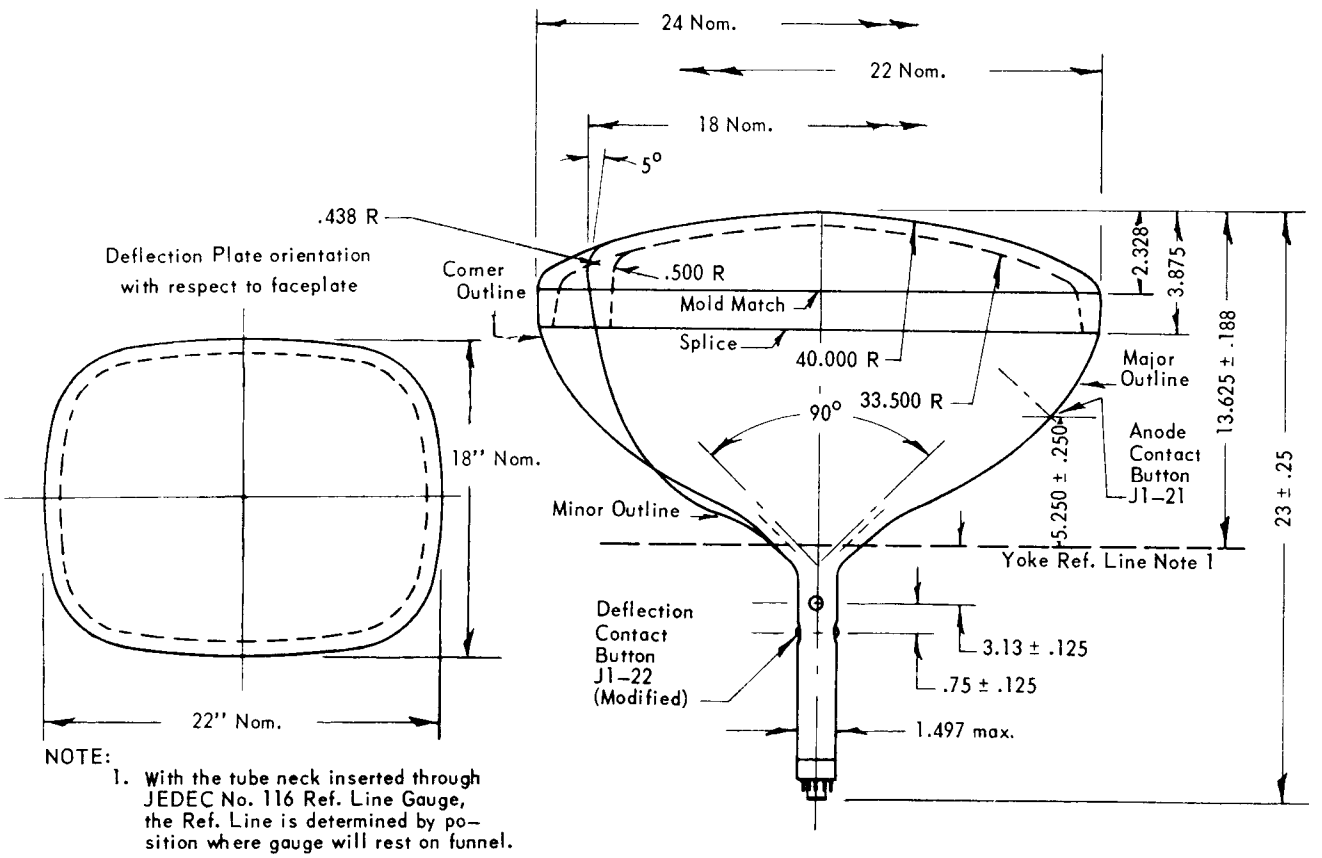
TYPICAL OPERATING CONDITIONS:

Anode Voltage	14,000 Volts
Focus Electrode Voltage	0 to 400 Volts
Grid No. 2 Voltage	400 Volts
Grid No. 1 Voltage (for cutoff)	−30 to −60 Volts
Grid drive for 125 μa I_k (nominal)	25 Volts
Light Output Note 1	50 FL
Dynamic Focus Voltage Required	Δ500 Volts
Resolution Note 1	.015"
Spot Position, Focused and Undeflected	.625" Radius of true center

ELECTROSTATIC DEFLECTION CHARACTERISTICS:

D1, D2 Deflection Factor	230 Volts Per Inch Max.
D3, D4 Deflection Factor	230 Volts Per Inch Max.
Deflection (ES) Orthagonality	
D1, D2 to D3, D4	± 1°
D1, D2 to Bulb Axes	± 3°
Maximum Useful Scan	
D1, D2	3/4"
D3, D4	3/4"

NOTE 1: Light output stated is at .5" per microsecond writing rate, refreshed 60 times per second. Line width stated is also under the same conditions. I_k = 125 μa approx.



NOTE:
1. With the tube neck inserted through JEDEC No. 116 Ref. Line Gauge, the Ref. Line is determined by position where gauge will rest on funnel.

TECHNICAL INFORMATION

RAYTHEON

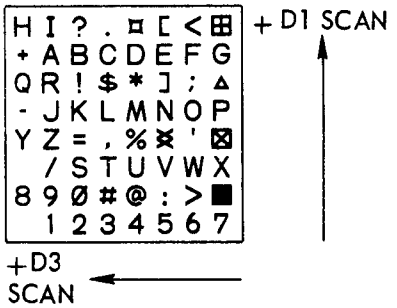
SYMBOLRAY* CHARACTER GENERATING CATHODE RAY TUBE

CK1414

GENERAL DATA

The CK1414 is a cathode ray device used for electrical generation of alphanumeric characters and symbols. The tube is operated in the monoscope mode and output signals are generated by scanning the symbol that appears on the target pattern.

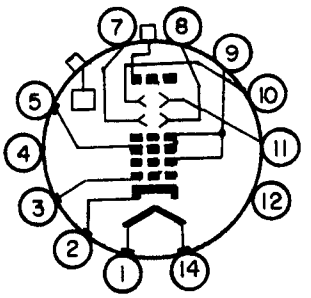
This type has applications with business data processing equipments as an economical method for generating characters for hard copy print-out or for cathode ray display.



TARGET PATTERN
(Actual Size)

ELECTRON GUN:
Focus Method – Electrostatic
Deflection – Electrostatic

MECHANICAL DATA



BASE:.....Medium Shell Dihoptal 12-pin No. B12-37
MOUNTING POSITION:.....Any
BASING.....14J

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: ($\mu\mu$fds. approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	4.5
D1 to D2	2.4
D3 to D4	1.0
D1 to all other electrodes except D2	4.4
D2 to all other electrodes except D1	4.4
D3 to all other electrodes except D4	3.1
D4 to all other electrodes except D3	3.6
Collector to all other electrodes	6.0
Target to all other electrodes	2.5

RATINGS – ABSOLUTE MAXIMUM VALUES:

Heater Voltage	6.3±10 % volts
Peak Heater–Cathode Voltage, Max.	
Heater Negative with respect to cathode	200 volts
Heater Positive with respect to cathode	200 volts
Anode, Target, and Collector Voltage	2850 volts DC
Focus Electrode Voltage	1100 volts DC
Grid #1 Voltage	
Negative – Bias Value	220 volts DC
Positive – Bias Value	0 volts DC
Positive – Peak Value	0 volts
Peak Voltage Between Anode and Any Deflecting Electrode	550 volts DC

TERMINAL CONNECTIONS:

Pin 1	Heater
Pin 2	Cathode
Pin 3	Grid #1
Pin 4	Do not use
Pin 5	Focus
Pin 7	D3
Pin 8	D4
Pin 9	Anode
Pin 10	D2
Pin 11	D1
Pin 12	No Connection
Pin 14	Heater
Cap 1	Collector
Cap 2	Target Pattern

*Trademark

ELECTRICAL DATA (Cont'd.)

CHARACTERISTICS AND TYPICAL OPERATION: (See Caution Note)

Anode and Target Voltage	1200 volts DC
Collector Voltage (vary)	+1203 VDC
Focusing Electrode	150 to 515 volts DC
Grid #1 Voltage required for cutoff of beam current (vary)	25 to 65 volts DC
Deflection Factors: (See Note 3)	
D1–D2 (vertical scan of 1 symbol)	9.0 volts nominal
D3–D4 (horizontal scan of 1 symbol)	6.5 volts nominal
D1–D2 Deflection Voltage required to scan from lower row (1,2,3,---) to Upper Row (H,I,?,---) Note 2	90 volts nominal
D3–D4 Deflection Voltage required to scan from left row (H+Q--) to right row (⊞ GΔ---) Note 2	55 volts nominal
Target Output Resistance	500 ohms
Typical Peak Output Signal	5 μa

ALIGNMENT OF TRACES:

D1–D2 trace aligns with pin #5 and collector button	
Positive Voltage on D1 deflects beam toward top row of target (HI---⊞)	
Positive Voltage on D3 deflects beam toward left side of target (H+Q---)	
Angle between D3, D4 and D1, D2 traces	90 degrees ± 1 degree
Angle between traces and target symbols	±1 degree

MAXIMUM CIRCUIT VALUES:

Grid #1 Circuit Resistance	1.5 meg.
Resistance in any deflecting electrode current (Note 1)	5.0 meg.

NOTE 1: It is recommended that the deflecting–electrode–circuit resistances be approximately equal.
NOTE 2: Undeflected beam normally dwells on center of target pattern between L, M, (comma) and % symbols.
NOTE 3: Nominal voltage of deflection plates should be approximately equal to anode voltage (+1200 Vdc).

CAUTION: Electron beam should be cut–off when no raster is being developed. A blemish may be generated by a change in secondary emission of the target.

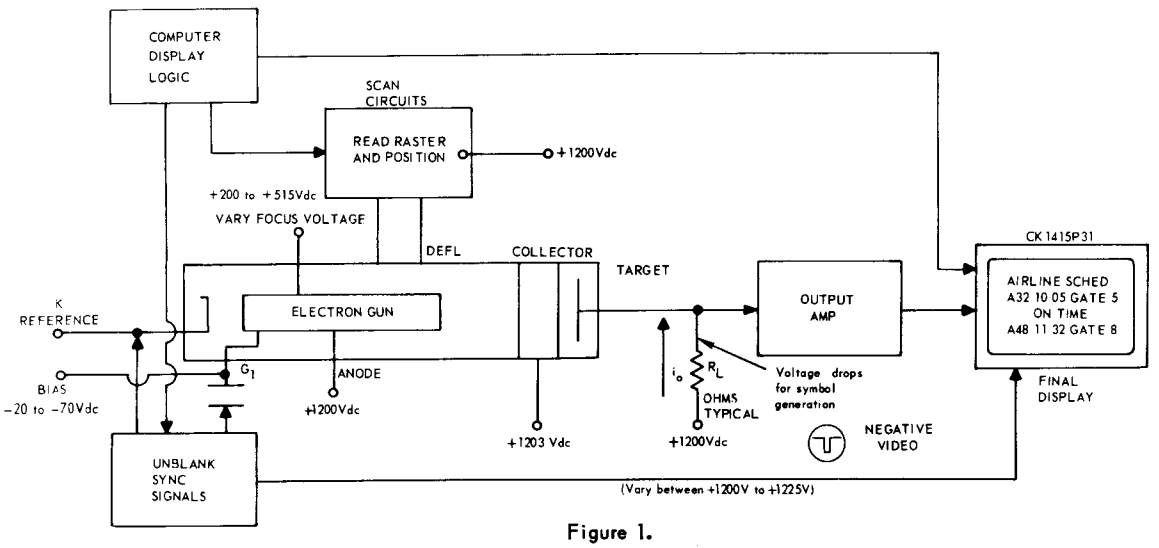


Figure 1.
OPERATION BLOCK DIAGRAM
***Trademark**

APPLICATION DATA

Figure 1 shows basic circuit for operation of the tube.

A small TV type raster is generated in the scan circuit block. This raster is just large enough to scan a single symbol on the target. The scan circuit also selects and positions the beam on the character to be generated.

As the electron beam lands on the target surface a difference in secondary emission of electrons from that surface is caused by the printed portion of the symbols which lowers the current flow from the target. The secondary electrons emitted are attracted to the collector which is at a more positive voltage. See Figure 2.

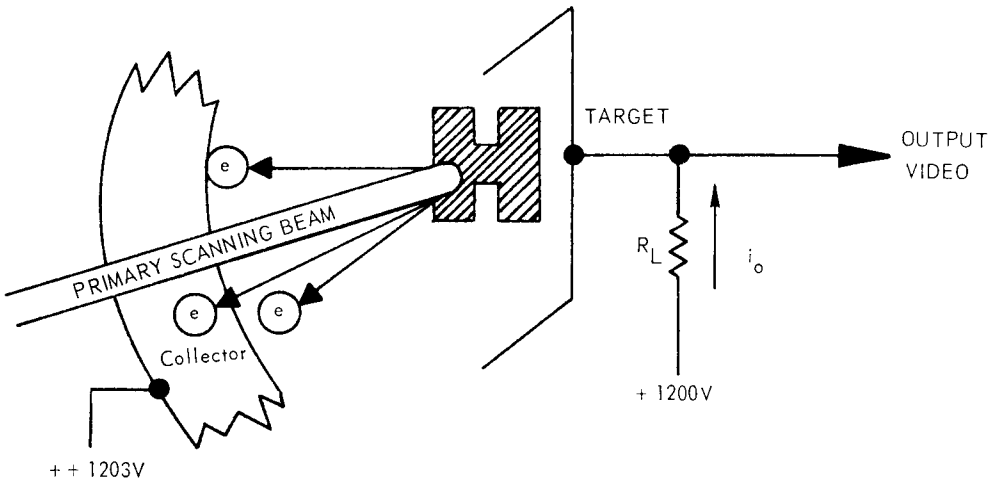
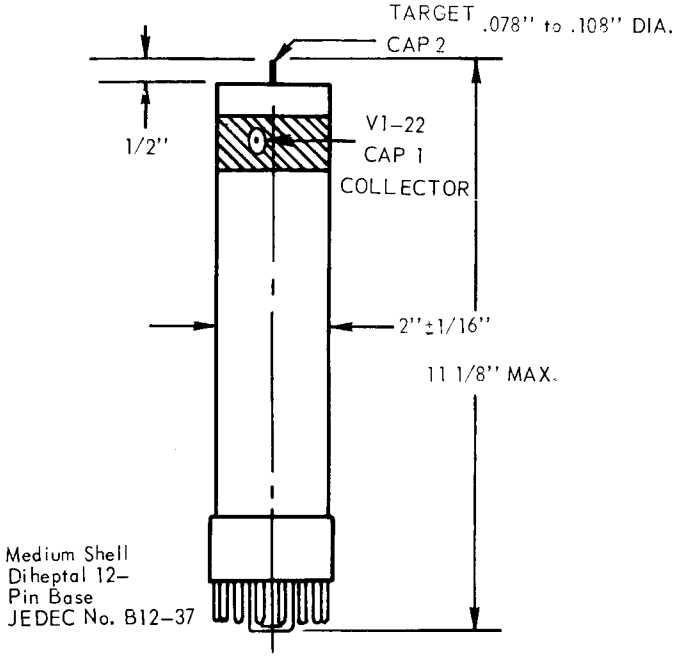


Figure 2.

A lower secondary emission occurs when the cathode ray beam scans the lines of the symbol. Therefore, the current through RL changes and the output video signal is created. By proper synchronization of scan and scan position, the entire character is recreated on the final display cathode ray tube.

Figure #1 shows a system application using the CK1414 Symbolray* tube and a Dataray cathode ray display tube of CK1415P31, featuring magnetic and electric deflection for high quality character display. The Symbolray* tube provides instant access to information retrieved from a computer.



*Trademark

RAYTHEON

CATHODE RAY TUBE CK1415P-

The CK1415P– is a 12–inch diagonal, rectangular face, electrostatic focus and magnetic deflection cathode–ray tube for monitor use in closed–circuit television, industrial and business equipment. A particular feature of this tube is a high–resolution electron gun which gives smaller spot size, improved spot shape, and greater resolution than heretofore available. Sharp focus is obtainable over the entire picture area. The fluorescent screen is aluminized to improve picture contrast and brightness. A 50% transmission faceplate is utilized to further enhance contrast in high ambient light locations.



ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10% Amperes
Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflection Angle, approximate	70 Degrees
Direct Interelectrode Capacitances, approximate	
Cathode to all other electrodes	8.5 uuf
Grid No. 1 to all other electrodes	10.0 uuf

MAXIMUM RATINGS

Anode Voltage (See Note 1)	18,000 Max. Volts
Focus Electrode Voltage	800 Max. Volts
Grid No. 2 Voltage	800 Max. Volts
Grid No. 1 Voltage:	
Negative Bias Value	180 Max. Volts
Positive Bias Value	0 Max. Volts

OPTICAL DATA

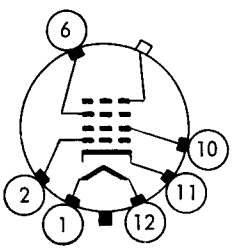
Screen	P31 Aluminized
Fluorescence	Green
Persistence	Medium

(This type is offered with any available phosphor desired)

MECHANICAL DATA

BASING. . . . . JEDEC 12L
MOUNTING POSITION . . . Any
OVERALL LENGTH 17" ±3/8" Inches Max.
BULB CONTACT Recessed Small Cavity Cap, JEDEC No. J1–21

BASING



BOTTOM VIEW

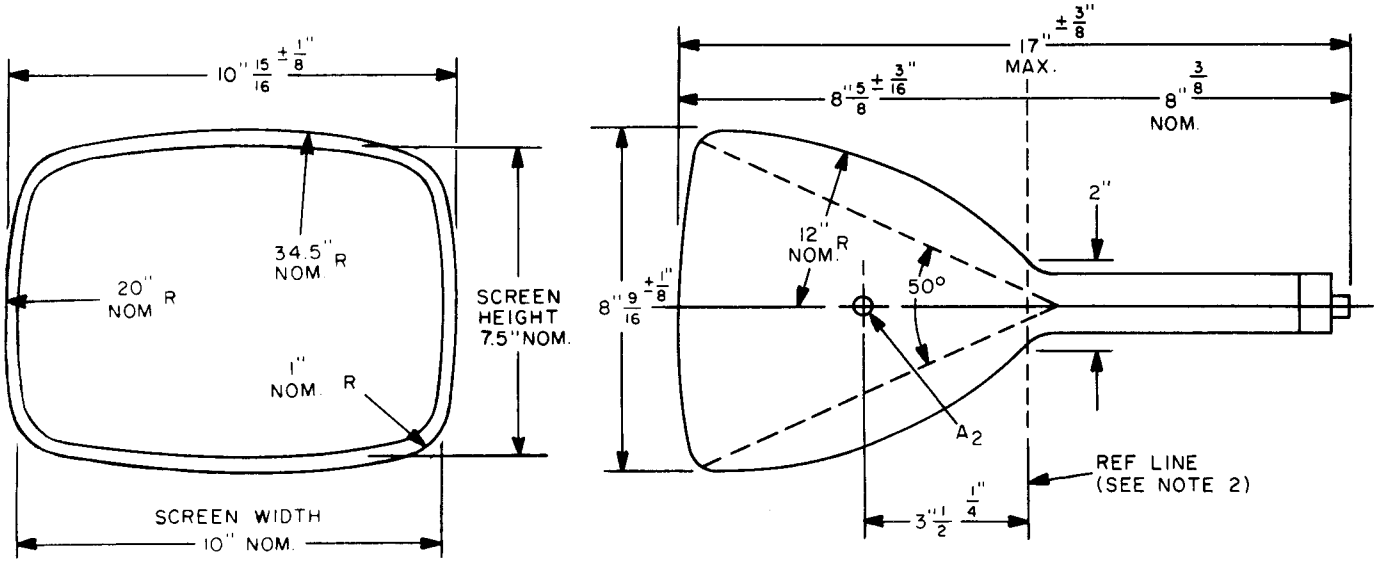
TERMINAL CONNECTIONS:

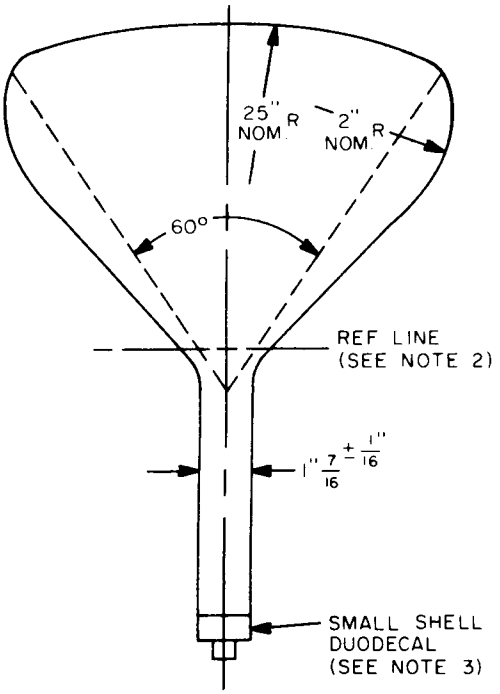
Pin 1 Heater
Pin 2 Grid #1
Pin 6 Focus
Pin 10 Grid #2
Pin 11 Cathode
Pin 12 Heater
Cap Anode

Printed in U.S.A.

TYPICAL OPERATING CONDITIONS

Anode Voltage	12,000 Volts
Focus Electrode Voltage	0 to +400 Volts
Grid No. 2 Voltage	400 Volts
Grid No. 1 Voltage (Cut–off)	–30 to –70 Volts
Line Width A (I_k = 150 ua)	0.015 Inches Max.





NOTE 1: Shielding of the tube for x–ray radiation may be required wherever the operating potential is in excess of 16 kilovolts.

NOTE 2: With tube neck inserted through flared end of reference line gauge (JETEC No. 110) and with tube seated in gauge, the reference line is determined by the inter–section of the plane CS of the gauge with the glass funnel. The I.D. of this gauge is 2".

NOTE 3: Socket for the base should not be rigidly mounted; it should have flexible leads and be allowed to move freely.

RAYTHEON

CATHODE RAY TUBE CK1419P-

The CK1419P– is a projection cathode ray tube that will yield high light output with excellent resolution and long life. It is intended for use in large display systems with television type format and raster scans. It can also be used for large Radar displays using scan conversion to television format.

The tube uses a removable heat exchanger to cool the phosphor screen surface during operation. This permits the screen to be energized to high light output levels and prolongs the life of the phosphor.



GENERAL DATA

Phosphor	31
Fluorescence	Blue–Green
Phosphorescence	Green
Persistence	Medium
Focusing Method	Magnetic
Deflecting Method	Magnetic
Deflection Angle (Approx.)	38° Maximum
Ion Trap Gun	See Note ▲

HEATER CHARACTERISTICS:

Heater Voltage	6.3 ± 10% volts
Heater Current	0.6 amps.
Peak Heater–Cathode Voltage: (Max.) ♦	
Heater Negative with Respect to Cathode	180 volts DC
Heater Positive with Respect to Cathode	180 volts DC

DIRECT INTERELECTRODE CAPACITANCES: (pf) (approx.)

Grid #1 to all other electrodes	6
Cathode to all other electrodes	5

DESIGN CENTER MAXIMUM RATINGS:

Anode Voltage	50,000 volts DC
Grid #2 Voltage	700 volts DC
Grid #1 Voltage:	
Negative–Bias Value	250 volts DC
Positive–Bias Value	0 volts DC
Positive–Peak Value	0 volts DC

CHARACTERISTICS AND TYPICAL OPERATION: (With Coolant System Operating)

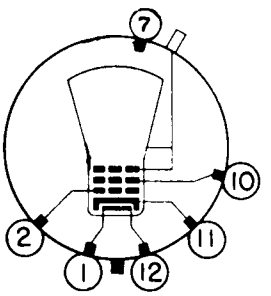
Anode Voltage	40,000 volts DC
Grid #2 Voltage	+600 volts DC
Grid #1 Voltage	–100 to 200
Resolution	600 TV lines ⊕
Light Output	38,000 Foot–lamberts

MECHANICAL DATA

BASE . . . . . Small Shell Duodecal 7–Pin

MOUNTING POSITION . . . Any

BASING



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 Heater
Pin 2 Grid #1
Pin 7 No Connection
Pin 10 Grid #2
Pin 11 Cathode
Pin 12 Heater
Cap Anode

RAYTHEON CATHODE RAY TUBE CK1419P-

MAXIMUM CIRCUIT VALUES:

♦ Grid #1 Circuit Resistance . . . . . 1.5 max. megohms

Cathode should be returned to one side or to the mid–top of the heater transformer winding.

⊕ Spot cutoff (undeflected focused spot).
Anode Current – 500 μa

▲ An ion trap gun has been used to minimize phosphor and cathode damage from ions present in the tube. A magnetic or fixed permanent type may be used. It is necessary to use the trap magnet to produce a beam.

* 525 line raster, retrace blanked, 3" x 4", $1A_2$ will be no more than 500 μa to reach 20,000 FL at the face of the tube.

APPLICATION DATA

1. HEAT EXCHANGER DATA:
   Type – Esso univolt 30 or equivalent

   Flow Rate – 5 Gallons per minute minimum.

   It is recommended that a constant displacement type pump be used.

   Cooling capacity of system must be sufficient for 40 watts maximum heat dissipation at 70° F.

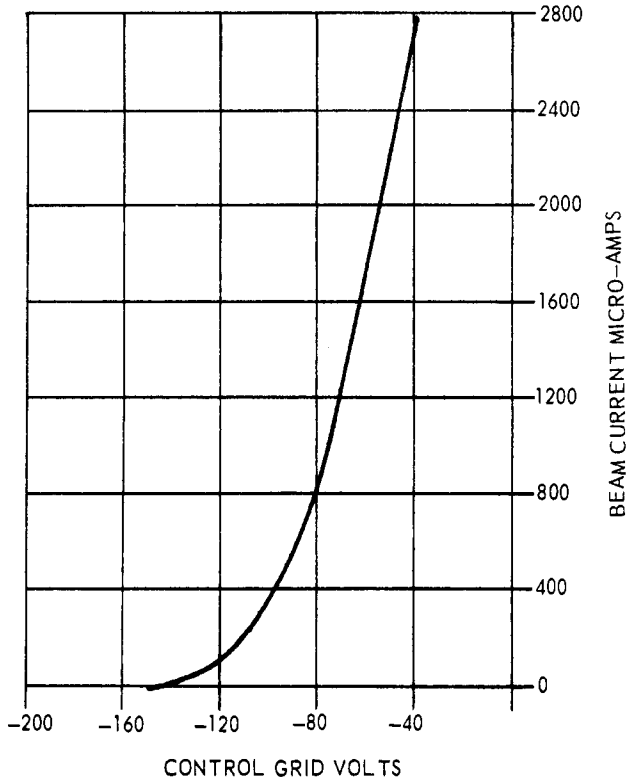
   If anode is operated above ground potential flexible insulating type tubing should be used. "Tygon" tubing made by U.S. Stoneware or equivalent is recommended.

2. CAUTION – OPERATION AT HIGH VOLTAGE
   presents potential X–ray and shock hazard.

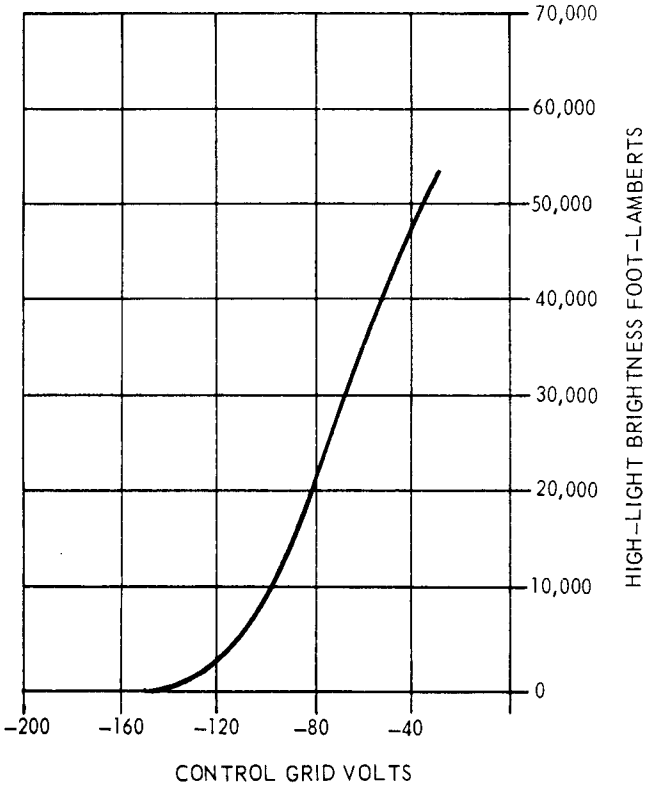
TYPICAL CHARACTERISTICS

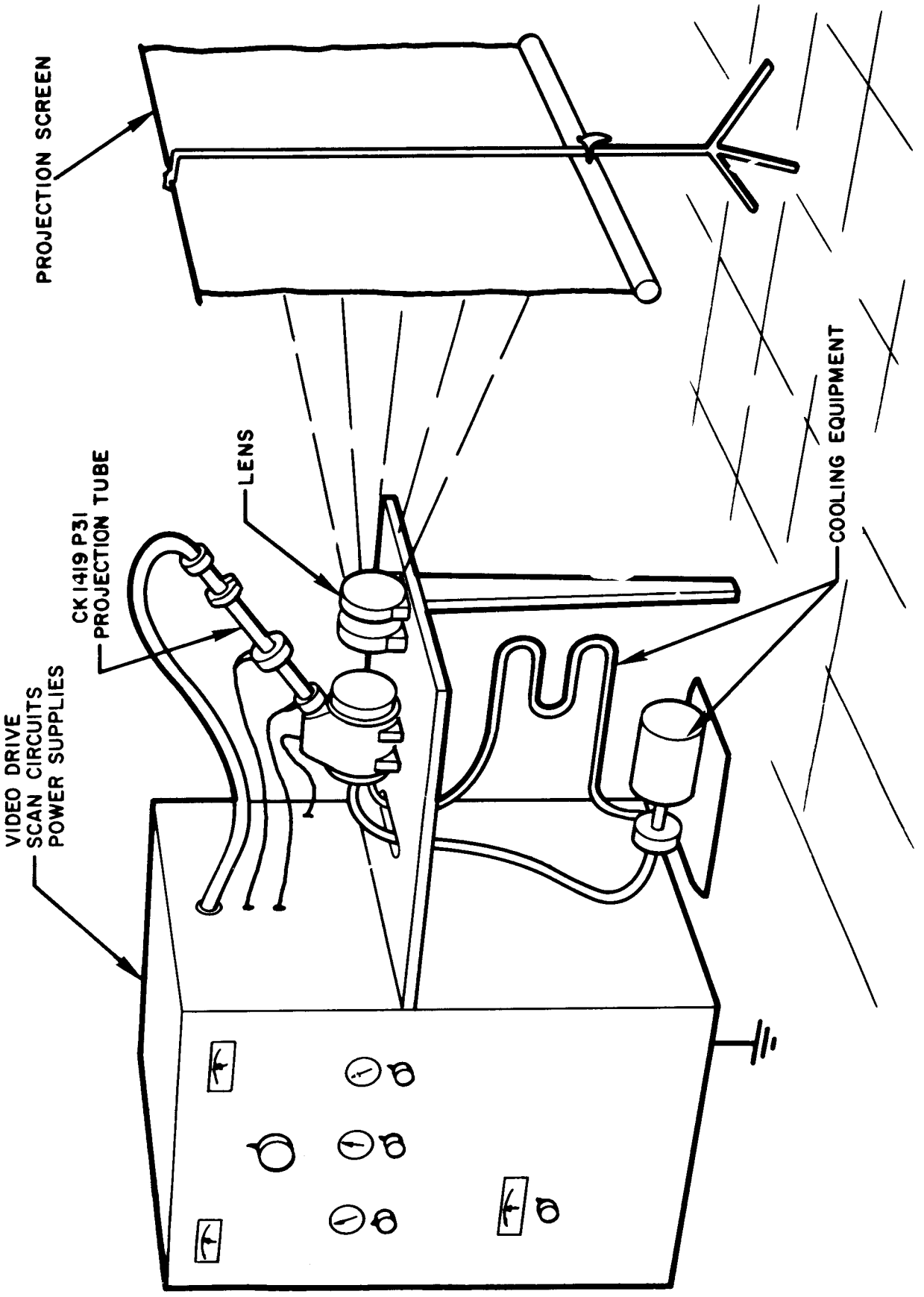
PHOSPHOR TYPE –P31
Eh = 6.3V
Eanode = +40KV
Eg2 = +600 VDC

BEAM CURRENT VS GRID VOLTAGE



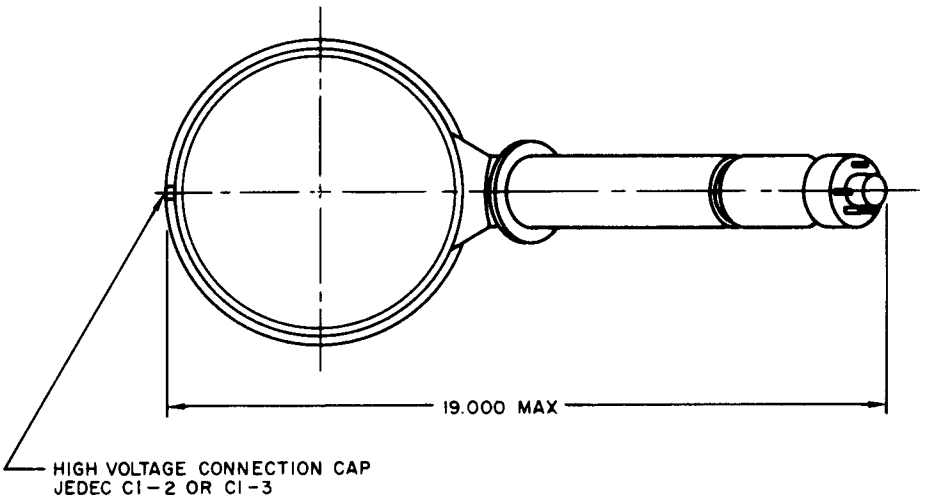
HIGH–LIGHT BRIGHTNESS VS GRID VOLTAGE

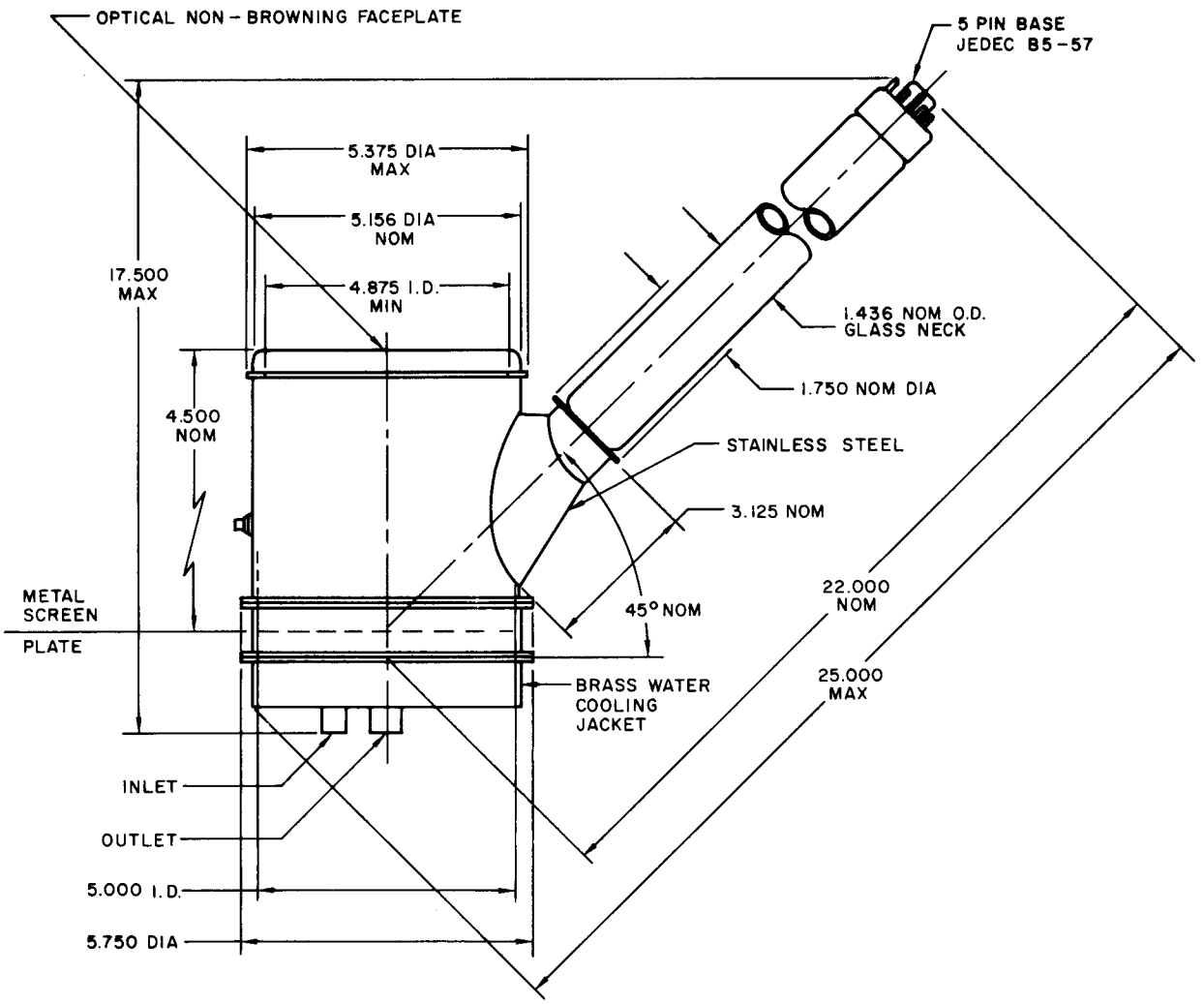




TYPICAL CK1419 P31 PROJECTION DISPLAY SYSTEM

CATHODE RAY TUBE CK1419P-





RAYTHEON

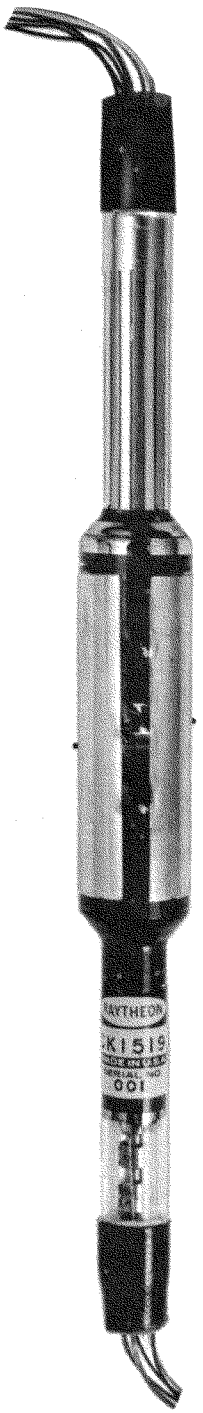
MINIATURE RECORDING STORAGE TUBE

CK1519

The CK1519 is a miniature dual–gun cathode–ray recording storage tube capable of simultaneous writing and reading. It is an electronic input–electronic output storage device which combines high output signal with high resolution. The major application is scan conversion in airborne equipment, such as sonar, infrared and radar to television type presentation. This type of system yields a bright video display, with high resolution and adjustable automatic erasing. Stored signals can be held for a long period, read several thousand times, or erased in a fraction of a second if desired. The storage capabilities permit additional coherence of target information under conditions of high noise levels.

Both the writing and reading guns use magnetic deflection and magnetic focus. For uniform resolution over the storage surface, dynamic focus correction is recommended.

The design of the tube results in a wide dynamic range of gray shades, fast writing speeds, and selective erasure of the stored information if desired. Erasure of stored information can be carried out by either the reading or writing gun.



ELECTRICAL DATA

GENERAL CHARACTERISTICS

Gun Locations	Co–axial
Gun Type (Both Guns)	Tetrode High Resolution
Deflection (Both Guns)	Magnetic
Max. Deflection Angle (Both Guns)	20°
Focusing	Magnetic
Mounting Position	Any
Resolution	
TV lines per diameter (See Note 1)	850 TV lines typical
Output Capacitance	
(Collector and Write Decelerator to all other elements)	5 pf (approx.)
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Seated Length	16½" Nominal
Bulb Diameter	1.5" Maximum
Neck Diameters	0.875" Maximum
Storage Assembly Buttons	JEDEC Type J1–22

ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES (See Note 2)

Heater Voltage	6.3 ± 5% Volts
Anode Voltage (Either Gun)	4500 Vdc
Grid Voltage Positive (Either Gun)	0 Vdc
Write Control Grid Voltage Negative	–150 Vdc
Read Control Grid Voltage	–275 Vdc
Write Grid #2 Voltage	500 Vdc
Read Grid #2 Voltage	650 Vdc
Inter Screen Voltage (Between any pair)	1000 Vdc
Grid Circuit Resistance	0.5 Meg.

ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES (Cont'd.)

Heater Cathode Voltage

Heater to Cathode Voltage	±125 Vdc
Write Collimating Lens Voltage	800 Vdc
Read Collimating Lens Voltage	800 Vdc
Read Decelerator Voltage	800 Vdc
Write Decelerator Voltage	1000 Vdc

NOTE 1: Resolution Versus Anode Potential at 50% modulation measured in the center of the storage area.

850 TV lines min.	4000V (Anode) Max.
600 TV lines min.	2500V (Anode)

NOTE 2: Except for heater rating and interscreen voltages, all voltages shown above are referenced to the respective gun cathode.

TYPICAL OPERATING CHARACTERISTICS

Deflection drive must be applied to both guns whenever the tube is conducting to avoid damage to the storage assembly.

All Voltages except RF drive and read G1 with respect to write cathode.

WRITE GUN

Cathode Voltage	0 Vdc
G–1 Cut–off	–20 Vdc to –70 Vdc
G–2	450 Vdc
Anode	4000 Vdc
Collimating Lens (Vary for best scan shape and linearity)	±200 Vdc
Write Decelerator	700 Vdc
Collector	Variable – See Note 3.

READ GUN

Cathode Voltage	+400 Vdc
Cathode Current (nominal)	50 μA
G–1 Cut–off (with respect to Read K)	–100 Vdc to –250 Vdc
G–1 RF Drive (see Special Application Notes section on RF separation) (See Page 5)	30 Vrms
G–2	900 Vdc
Anode	4000 Vdc
Decelerator	+1150 Vdc
Collimating Lens (Vary for best shading)	+800 to 1100 Vdc
Storage Screen	405 Vdc
Output Signal (Peak Level at Collector)	3 μa

NOTE 3: Gradual automatic priming is controllable by varying the value of collector voltage from 900 Vdc (for slow priming) down to 400 Vdc (for fast priming.) Also see special application notes for further information.

PRINCIPLES OF OPERATION

When an electron beam strikes any material, secondary electrons are emitted. The quantity of secondary electrons emitted is a function of the velocity of the primary electron beam.

The secondary electron emitting surface in the Recording Storage Tube is a dielectric that has been deposited on a metal mesh or screen. Figure 1 illustrates this storage screen mesh.

Figure 2 shows the characteristic curve for secondary to primary emission ratio for the dielectric material used. Since the velocity of the electron beam will be proportional to the voltage on the dielectric material the ordinate of velocity in Figure 2 can be voltage. The crossover, called critical potential, where the secondary to primary ratio is unity occurs at approximately 50 volts.

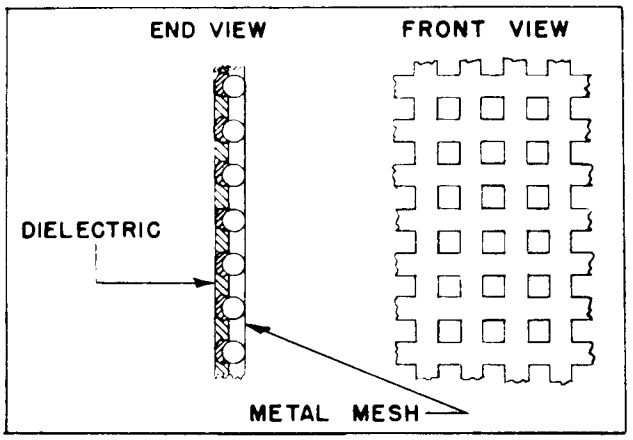


FIGURE 1
MAGNIFIED SECTION OF STORAGE SCREEN

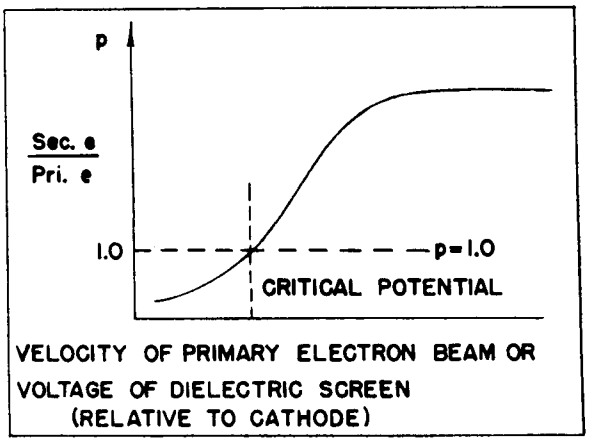


FIGURE 2
SECONDARY EMISSION CHARACTERISTIC OF RECORDING STORAGE TUBE DIELECTRIC

Using the secondary emission character shown by Figure 2, the dielectric screen surface can be discretely charged or discharged as a function of the potential on the metal screen and the position and magnitude of the primary electron beam.

The various modes of operation are described as follows:

PRIME – This is the basic form of erasure and prepares the storage screen for subsequent writing. It is accomplished by scanning the storage screen dielectric with an unmodulated beam. The storage screen mesh is operated at a voltage below critical potential and since the secondary to primary emission ratio is less than unity the dielectric surface can store electrons and become negatively charged to cathode gun potential. A total prime can be used if complete erasure of old patterns is desired or a partial prime can be used if it is desired to gradually decrease old signals in amplitude (e.g.: to generate target trails in radar). Selective priming of only part of the storage screen can be accomplished by only scanning the area where it is desired to erase previously stored information. Typical storage screen voltage for prime is +5 volts. Priming can be accomplished with either beam. When the writing beam is used for priming, the storage screen is switched to +5 volts above write cathode and the beam is turned on and scanned over the area to be primed.

When the read beam is used it is only necessary to switch the collector to a more negative potential than read cathode and read beam is then scanned over the area to be erased. Under these conditions, the read beam primes the dielectric surface by reflection from the collector after it has passed through the storage screen. The read beam electrons recharge the dielectric surface. Storage screen voltage should be separately adjustable between prime and read modes. Normally the prime voltage will be slightly lower than read voltage.

WRITE – "Writing" of the charge pattern is accomplished by modulation of a scanning electron beam and operation at a storage screen voltage that yields a high secondary to primary emission ratio. This is any voltage above critical potential and is nominally 400 volts. Since during the prime mode the dielectric surface was negatively charged, the surface is discretely discharged towards the positive direction by the writing beam. As the modulated beam scans over the surface varying amounts of secondary electrons, depending on the instantaneous beam amplitude, are emitted at the surface and the stored pattern is established.

READ – Once a charge pattern has been written in, it can be read out by scanning the storage screen with an unmodulated beam. The storage screen is operated at 5 volts with respect to the reading gun cathode. Depending on the charged pattern the electron beam is therefore modulated as it passes through the storage screen to the collector element. By selecting the proper storage screen voltage the most negative areas of the dielectric (established by the prime mode) can completely cut off the electron beam from the collector and thus the "black" level is established. Various gray shades will appear in any areas where the dielectric is less negative.

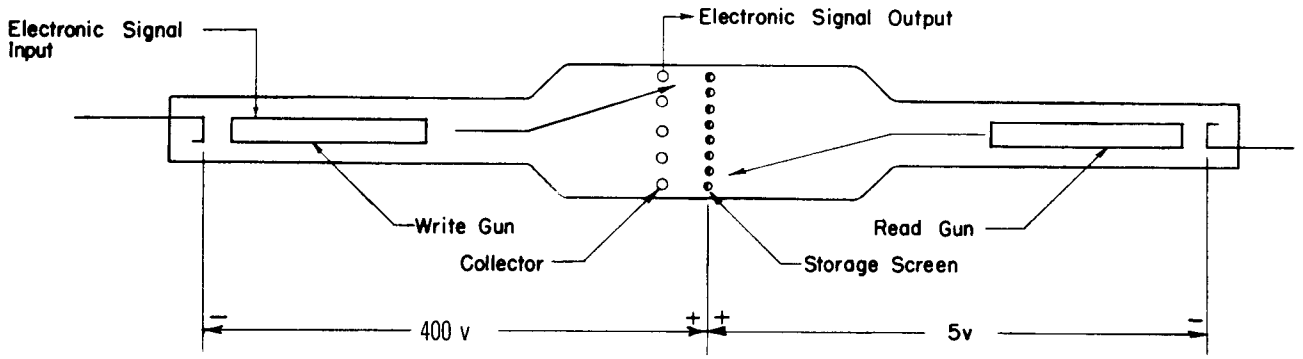


FIGURE 3
TWO GUN RECORDING STORAGE TUBE — SIMPLIFIED DRAWING

Simultaneous Write and Read modes are possible with the use of the two electron guns. This is desirable in most scan–conversion applications. Since two independent potentials can be maintained on the storage screen with respect to the two electron gun cathodes, the tube can be truly writing a charge pattern and reading it at the same time. (This is shown in Fig. 3.)

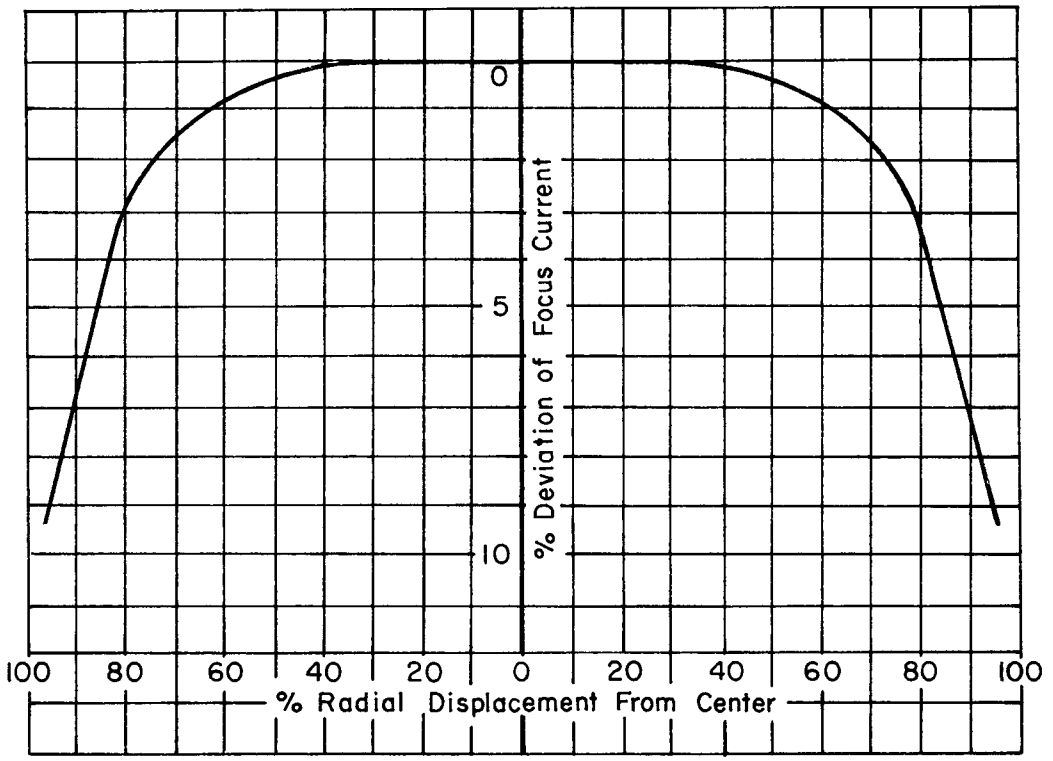


FIGURE 4
MAGNETIC DYNAMIC FOCUS CHARACTERISTIC

ERASE – Where total erasure is needed, it is frequently desirable to operate the tube in the positive erase mode. To accomplish this, the storage screen voltage is set at or above the value used for Write and the storage surface is scanned with an unmodulated electron–beam. This action discharges any stored pattern, bringing the whole storage surface to a uniform equilibrium potential. The tube must then be primed prior to subsequent writing. This can also be done with the read gun by operating the storage screen at +250 Vdc above read cathode. The collector must be negative by approximately 25 volts with respect to the read cathode. A prime cycle must follow.

SPECIAL APPLICATION NOTES: (See Figure 5)

RF SEPARATION – Since the collector intercepts the writing beam as well as the reading beam, a spurious output signal will result from the writing signal at the collector. This can beremoved by cancellation techniques or by RF separation. RF separation is accomplished by modulating the read beam with insertion of an RF signal at the read gun control grid. As the RF read beam passes through the storage screen it is amplitude modulated by the stored charge pattern. This amplitude modulated signal then appears at the collector. The center frequency chosen is much higher than the highest write video frequencies and therefore a tuned circuit will reject the writing signal and accept only the read signal. This is amplified and typical amplitude–modulation detection re–establishes a read–out video signal with no writing signal. Typical RF center frequencies used are 30 mc and 50 mc. To adjust for proper RF drive, set read G1 bias for a read current of approximately 10 μadc with RF drive at zero. Increase RF drive until the read cathode current is approximately 50 μa.

VIDEO SEPARATION – A no–RF alternate method to the above is use of the secondary emission characteristic of the collector. This can be adjusted for a ratio of one–to–one by operating the write decelerator at approximately +20 Vdc above the collector. The writing signal is then cancelled automatically. Write decelerator to collector voltage should be variable between 0 volts and +30V for proper adjustment.

AUTOMATIC PRIME –(Controllable erasure while reading) – During simultaneous writing and reading the tube can be operated at conditions that will allow either short or long storage of the charge pattern. It can also be variable for storage time between the two limits. Thus, in PPI to TV scan–conversion, target trails can be generated and the length of these trails are controllable by adjusting the storage time. This gradual automatic prime is obtained by varying the value of collector voltage from a high voltage for long storage (slow Prime) to a low voltage for short storage (fast Prime). The priming is accomplished by some of the read beam electrons between the collector and storage–screen dielectric returning to the dielectric to recharge it negatively in the specific areas where the negative charge was reduced by the written–in pattern.

COLLIMATION – An electrostatic lens and deceleration screen are provided to collimate the beam as it arrives in the region of the storage screen. For optimum shading characteristics the reading and writing beams should arrive at the storage screen dielectric orthognally to it. The voltage on the lens should therefore be adjusted for the most uniform background shading.

SHIELDING – Since any extraneous fields will cause unwanted deflection, it is recommended that good magnetic and electrostatic shielding techniques be used in the design of the tube mount.

RESOLVING POWER – The resolution of the storage tube at the 50% modulation level is usually in excess of 800 TV lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed with max. limit of anode potential and the focus coils designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed. (Typical correction curves are shown in Figure 4.)

STORAGE ABILITY –The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current. When reading with a low beam current at standard television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal. The tube is capable of storing information for many hours without appreciable change or deterioration when not reading.

TYPICAL SCHEMATIC

Radar PPI to TV Scan Conversion, Simultaneous Write and Read with automatic prime (erasure) and RF separation.

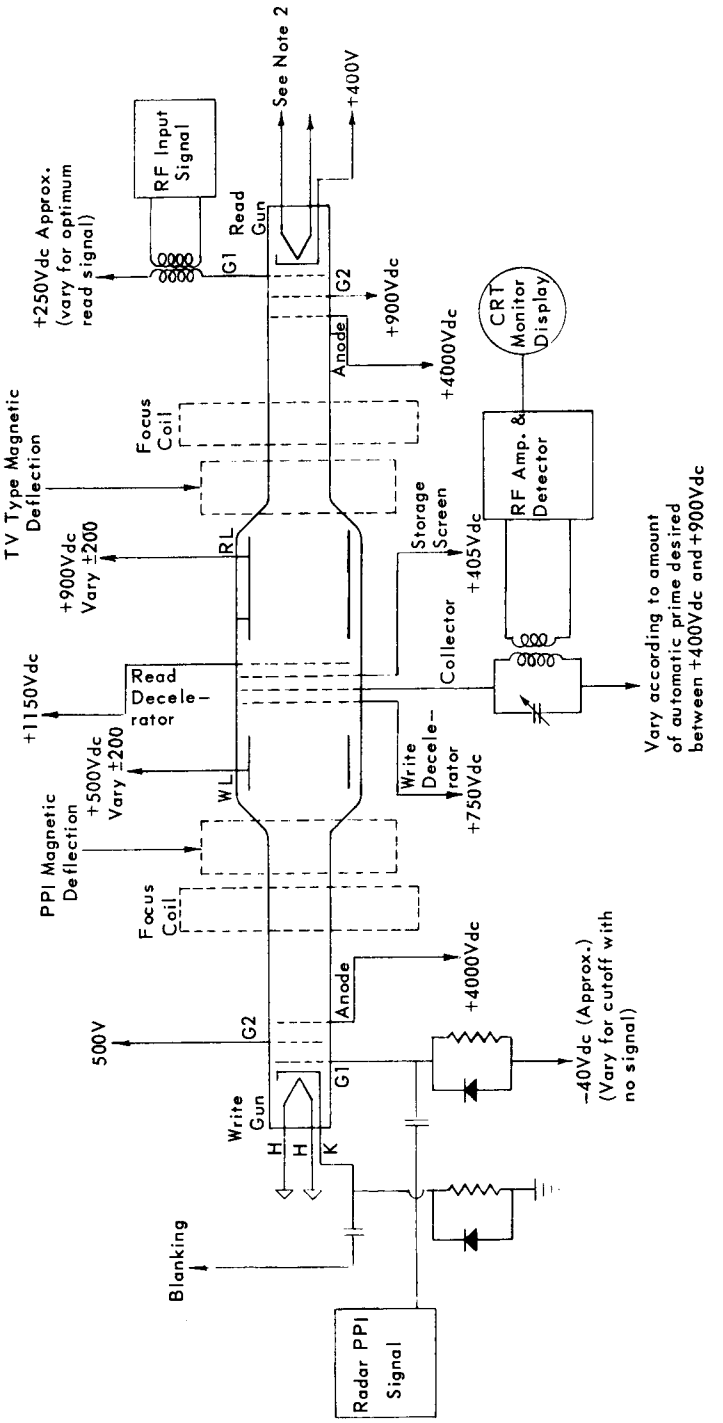
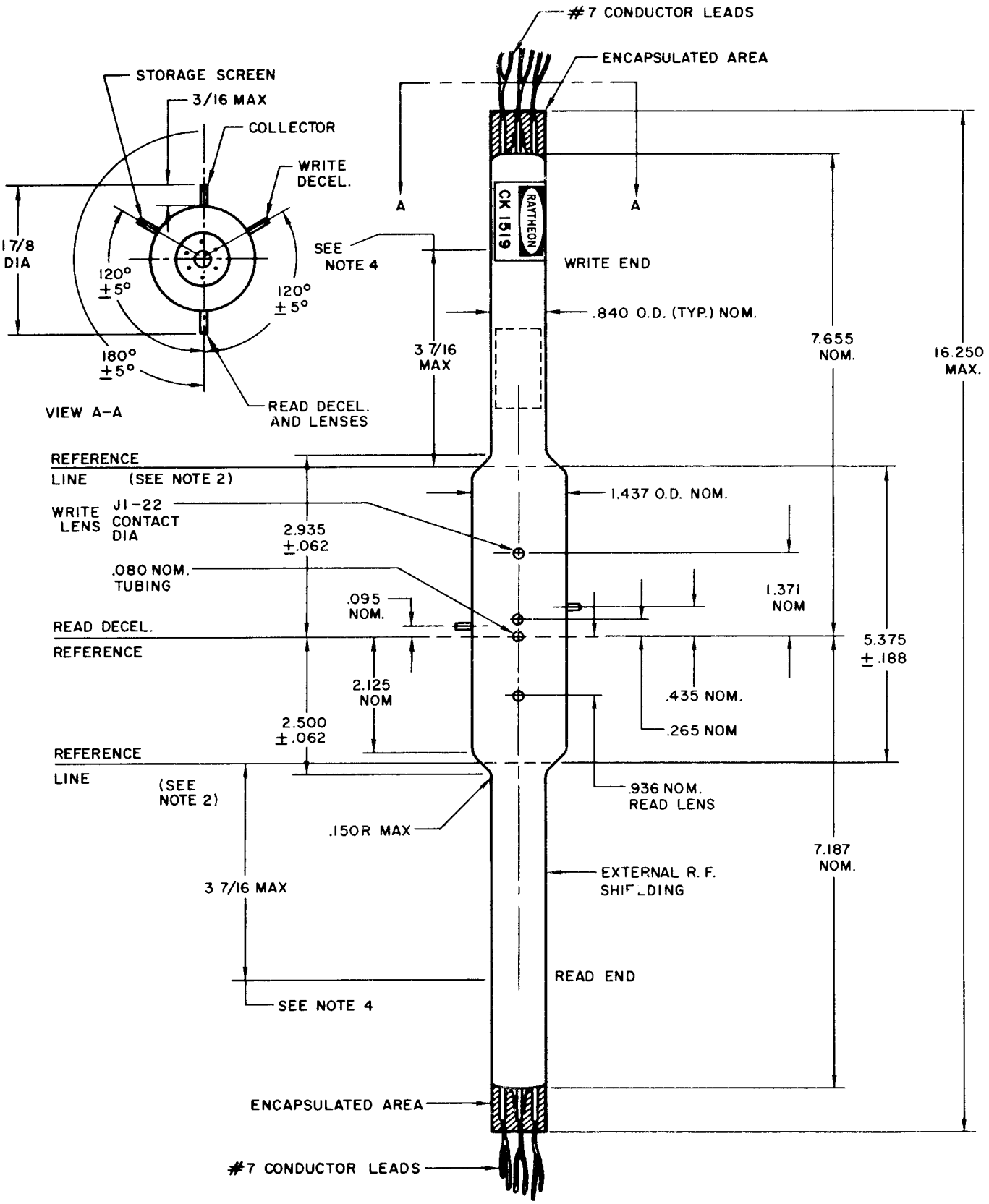


FIGURE 5

MINIATURE RECORDING STORAGE TUBE CK1519

RAYTHEON



NOTES FOR CK1519 OUTLINE DRAWING ON PAGE SEVEN

1. Basing Color Code

Lead	Write End	Read End
H1	Brown	Brown
H2	Brown	Brown
Anode	Red	Red
G1	Green	Green
G2	Orange	Orange
K	Clear	White

2. Reference Line is determined by that point where a ring gauge .995–.000 + .003 I.D. and 1.500 long comes to rest on neck flare.
3. Aluminum R.F. shielding on Read End of tube.
4. Magnetic deflection yoke and focus coil should be mounted so that they do not fall beyond this dimension. Beam current and resolution can be seriously reduced if the focus coils are too close to the electron guns.
5. The air gap of the focus coil is adjacent to deflection yoke. The magnetic fields of both should not interact on each other. Follow yoke manufacturer's recommendations.

RAYTHEON RECORDING STORAGE TUBE CK1521

The CK1521 is an ultra–high resolution, high output–signal, electronic output single–gun recording storage tube. The CK1521 is similar to the 7571/QK685 in operating principle. Rugged design makes the CK1521 suitable for operation in environments such as military airborne applications.

A unique electron gun design makes possible fast erasure, fast writing speed, high output–signal amplitude, and wide dynamic range, all at very high resolution. At intermediate levels of output–signal, the CK1521 is capable of long storage of information. Several thousand readouts are possible without serious deterioration of signal strength or quality. Without readout, signals may be stored for many hours.

Output uniformity or shading characteristics have been enhanced in the CK1521 through the use of very accurately spaced and aligned elements in an improved collimating lens system.

The CK1521 design yields important improvements in virtually all critical storage tube operating parameters, suggesting its use in improved versions of existing systems and allowing its use in new applications demanding extended storage tube capabilities.

The CK1521 employs magnetic deflection and magnetic and/or electrostatic focus. For highest resolution magnetic focus is recommended. For uniform resolution over the storage surface, dynamic focus correction is necessary.



MECHANICAL CHARACTERISTICS

See Page 4

Overall Length	13½'' Maximum
Bulb Diameter	3'' Maximum
Neck Diameter	1½'' Maximum
Electrode Connections	Teflon–insulated Flying Leads

PERFORMANCE CHARACTERISTICS

Resolution (Magnetic Focus) TV lines per diameter	2500 Minimum*
Resolution (Electrostatic Focus) TV lines per diameter	1800 Nominal*
Writing Speed – nanoseconds per element	40 Nominal
Erasure Speed – nanoseconds per element	100 Nominal
Output Signal – microamps peak	0.5 Nominal
Output Capacitance	16pf Nominal
Beam & Cathode Current Transfer Characteristics	Figure 1

*At 50% Modulation.

GENERAL CHARACTERISTICS

Deflection	Magnetic
Focusing	Magnetic and/or Electrostatic
Max. Deflection Angle	30°
Gun Type	Tetrode, High Resolution
Mounting Position	Any

RAYTHEON RECORDING STORAGE TUBE CK1521

ELECTRICAL CHARACTERISTICS

HEATER

Heater Voltage	6.3V ± 5%
Heater Current	0.6 amp. Nominal

RATINGS – ABSOLUTE MAXIMUM VALUES

All voltages with respect to cathode unless otherwise noted.

Anode Voltage	5000 Vdc
Focus Anode Voltage	5000 Vdc
Condenser Lens Voltage	5000 Vdc
Grid #2 Voltage	1000 Vdc
Grid #1 Voltage Positive	0 Vdc
Grid #1 Voltage Negative	–150 Vdc
Heater Cathode Voltage	
Positive	+10 Vdc
Negative	–125 Vdc
Storage Assembly Voltage (between adjacent elements in storage assembly)	1000 Vdc
Collimating Lens #1	1000 Vdc
Collimating Lens #2	1000 Vdc

TYPICAL OPERATING CONDITIONS

All voltages with respect to cathode unless otherwise noted.

Cathode (with respect to ground)	0 Vdc
Grid #1 (cutoff)	–30 to –80 Vdc
Grid #2	600 Vdc
Anode	3500 Vdc
Focus Electrode (Magnetic Focus) Note 1	3500 Vdc
Focus Electrode (Electrostatic Focus) Note 2	100 to 500 Vdc
Focus Electrode (Magnetic and Electrostatic Focus) Note 3	1000 Vdc
Condenser Lens (Write & Read Modes) Note 4	3500 Vdc
Condenser Lens (Erase & Prime Modes) Note 4	400 Vdc
Collimating Lens #1	750 Vdc
Collimating Lens #2 Note 5	200 to 500 Vdc
Decelerator Screen	750 Vdc
Storage Screen Note 6	Adjust Vdc
Collector (Signal Electrode)	750 Vdc

NOTES

1. Operation with all magnetic focus is necessary to achieve highest resolution. Magnetic dynamic focus is necessary to obtain uniform resolution over the storage surface. The approximate shape and amplitude of the magnetic dynamic focus waveform are given in Figure 2.

2. If electrostatic focus is used, focus electrode voltage is adjusted for best focus. For the anode voltage given, best focus will be obtained with focus voltage between the limits shown in typical operating conditions.

3. For certain applications, the combined use of electrostatic and magnetic focus is desirable. The principle purpose of this mode of operation is to facilitate dynamic focus correction by superimposing a time varying voltage on the quiescent value of focus voltage noted in typical operating conditions. The approximate shape and amplitude of the electrostatic dynamic focus waveform are given in Figure 3.

4. The condenser lens is used as a beam current enhancement electrode in the electron gun to achieve the high levels of beam current necessary to accomplish fast erasure. This electrode is operated at anode voltage in the write and read modes. During erasure (erase and prime modes) the condenser lens voltage is pulsed from anode voltage to the level noted in typical operating conditions. The condenser lens voltage for optimum beam–current enhancement varies with anode voltage as shown in Figure 4.

5. Output uniformity is controlled by the voltages of the elements in the collimating lens system of the storage tube. For the operating conditions given in typical operating conditions, output uniformity is optimized by the adjustment of the collimating lens #2. Optimum output uniformity will be obtained with a setting of collimating lens #2 voltage between limits shown in typical operating conditions.

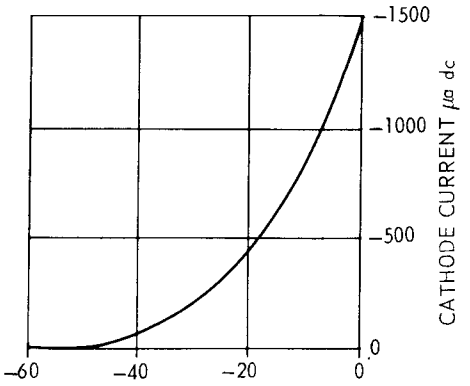
6. In the storage assembly, storage screen voltage is switched to achieve the various modes of operation (erase, prime, write, read) in the storage tube. The following table shows typical operating conditions for the storage screen voltage:

Erase	Prime	Write	Read
750 Vdc	20 Vdc	500 Vdc	15 Vdc (approx)

The exact setting of storage screen voltage in the read mode is determined experimentally by adjustment to the value at which output signal on the collector electrode is uniformly cut off across the storage surface.

RECORDING STORAGE TUBE CK1521

TYPICAL ELECTRON GUN TRANSFER CHARACTERISTICS



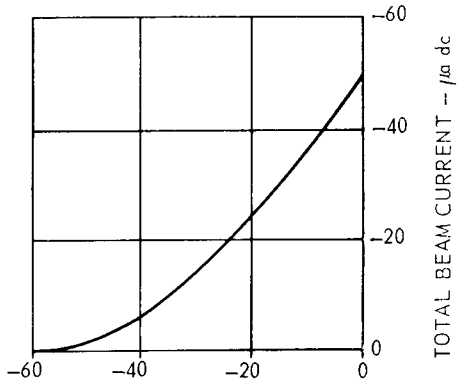


FIGURE 1

TYPICAL MAGNETIC DYNAMIC FOCUS CHARACTERISTIC

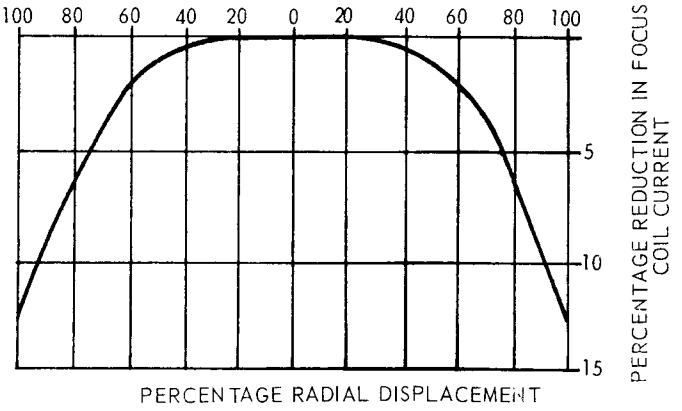


FIGURE 2

TYPICAL ELECTROSTATIC DYNAMIC FOCUS CHARACTERISTIC

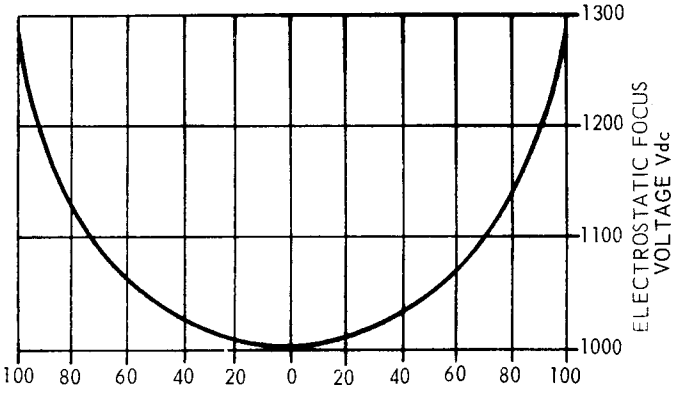


FIGURE 3

TYPICAL BEAM CURRENT ENHANCEMENT CHARACTERISTIC

$$\text{ENHANCEMENT \%} = \frac{\text{TOTAL BEAM CURRENT}}{\text{CATHODE CURRENT}} \times 100\%$$

E_{A_1} = ACCELERATING ANODE VOLTAGE

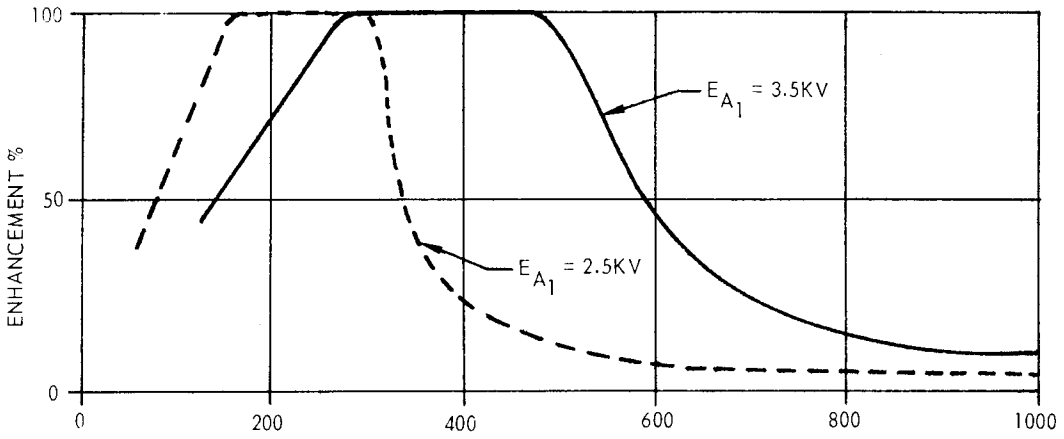
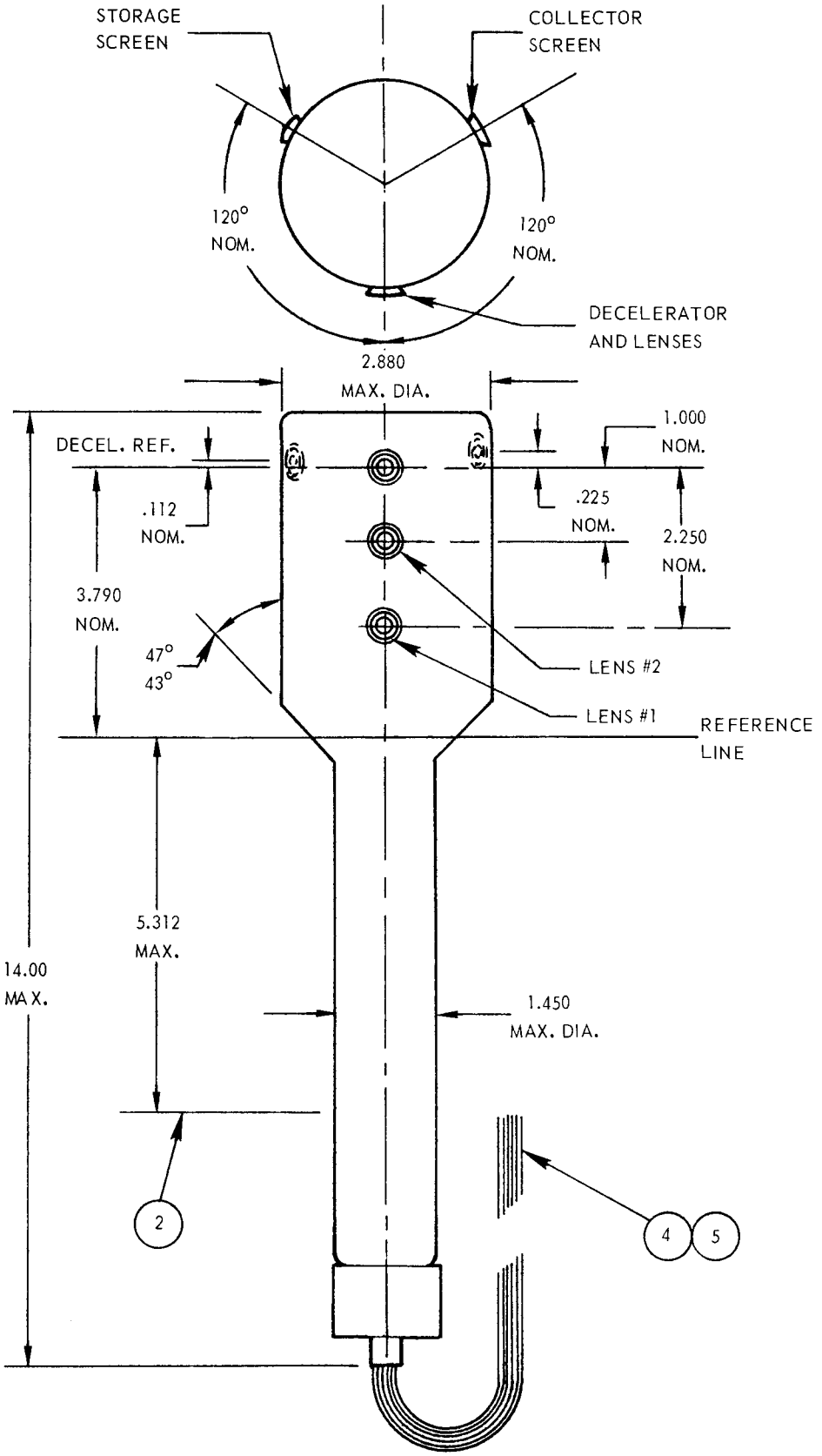


FIGURE 4

NOTES:

1. All contact buttons are JEDEC type J1-22.
2. Dimensions applies to plane nearest base beyond which magnetic focus or centering coils should not be located due to possible interference from internal gun structures.
3. Reference line is defined as that plane where a ring gauge 2.000 I.D. and parallel to neck axis comes to rest on neck flare.
4. Wire color coding as follows:
   Heaters – Brown
   Cathode – Clear
   Grid #1 – Green
   Grid #2 – Orange
   Condenser Lens – White
   Electrostatic Focus – Blue
   Anode – Red
5. Wire length: 12.000 in. approx.



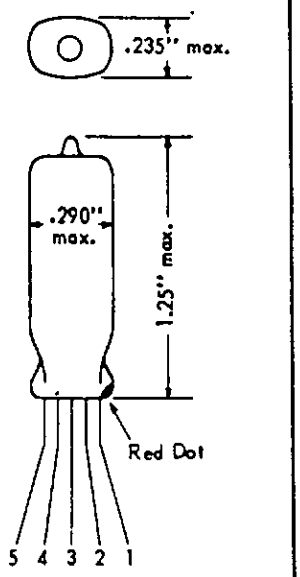
TECHNICAL INFORMATION

SUBMINIATURE PENTODE

TYPE
CK6418

Excellence in Electronics

The CK6418 is a filament type pentode of subminiature construction designed for use as a power amplifier in portable and wearable equipment. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length. It is similar in characteristics to type CK548DX.



MECHANICAL DATA

ENVELOPE: T-1½X2 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacings: 0.040" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to Lead 1)*

Lead 1 Plate	Lead 4 Grid #1
Lead 2 Grid #2	Lead 5 Filament, Positive; Grid #3 ▲
Lead 3 Filament, Negative; Grid #3 ▲	

MOUNTING POSITION: Any

ELECTRICAL DATA

RATINGS - ABSOLUTE MAXIMUM VALUES:

Filament Voltage	1.25±20%	volts
Plate Voltage	30	volts
Grid #2 Voltage	30	volts
Cathode Current	0.5	ma.

CHARACTERISTICS AND TYPICAL OPERATION:

Filament Voltage	1.25	1.25	volts
Filament Current	10	10	ma.
Plate Voltage	15	22.5	volts
Grid #2 Voltage	15	22.5	volts
Grid #1 Voltage	-0.8	-1.2	volts
Zero-Signal Plate Current	100	240	μa.
Zero-Signal Grid #2 Current	25	60	μa.
Peak A-F Grid #1 Voltage	0.8	1.2	volts
Transconductance	190	300	μmhos
Plate Resistance	0.72	0.42	meg.
Load Resistance	150	100	kilohms
Total Distortion (approx.)	12	12	percent
Power Output	0.6	2.2	mw

▲ *Grid #3 is composed of two deflector plates, one being connected to Lead 3 and the other to Lead 5.*

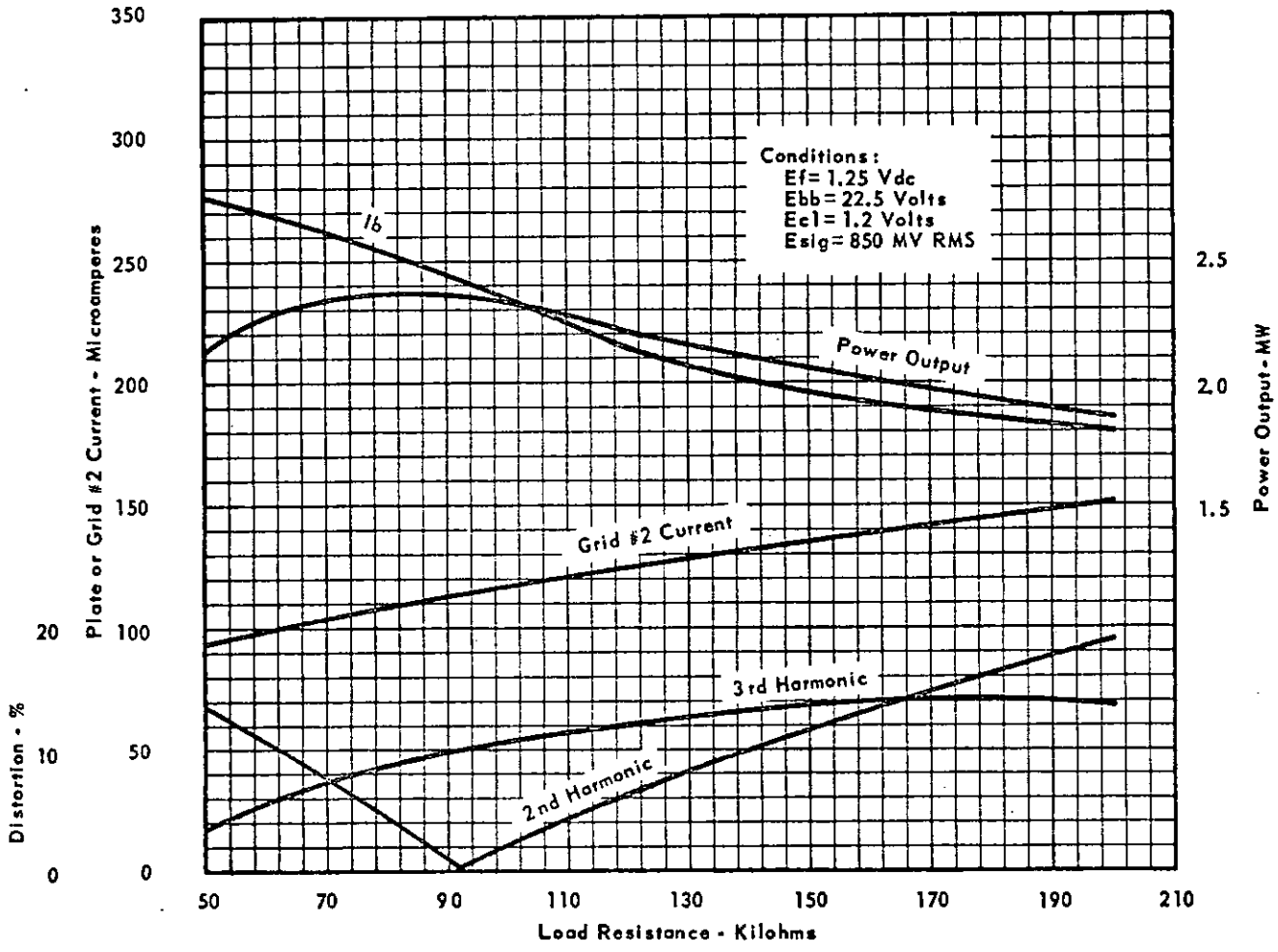
Tentative Data

Printed in U.S.A.

RAYTHEON MANUFACTURING COMPANY

SUBMINIATURE PENTODE

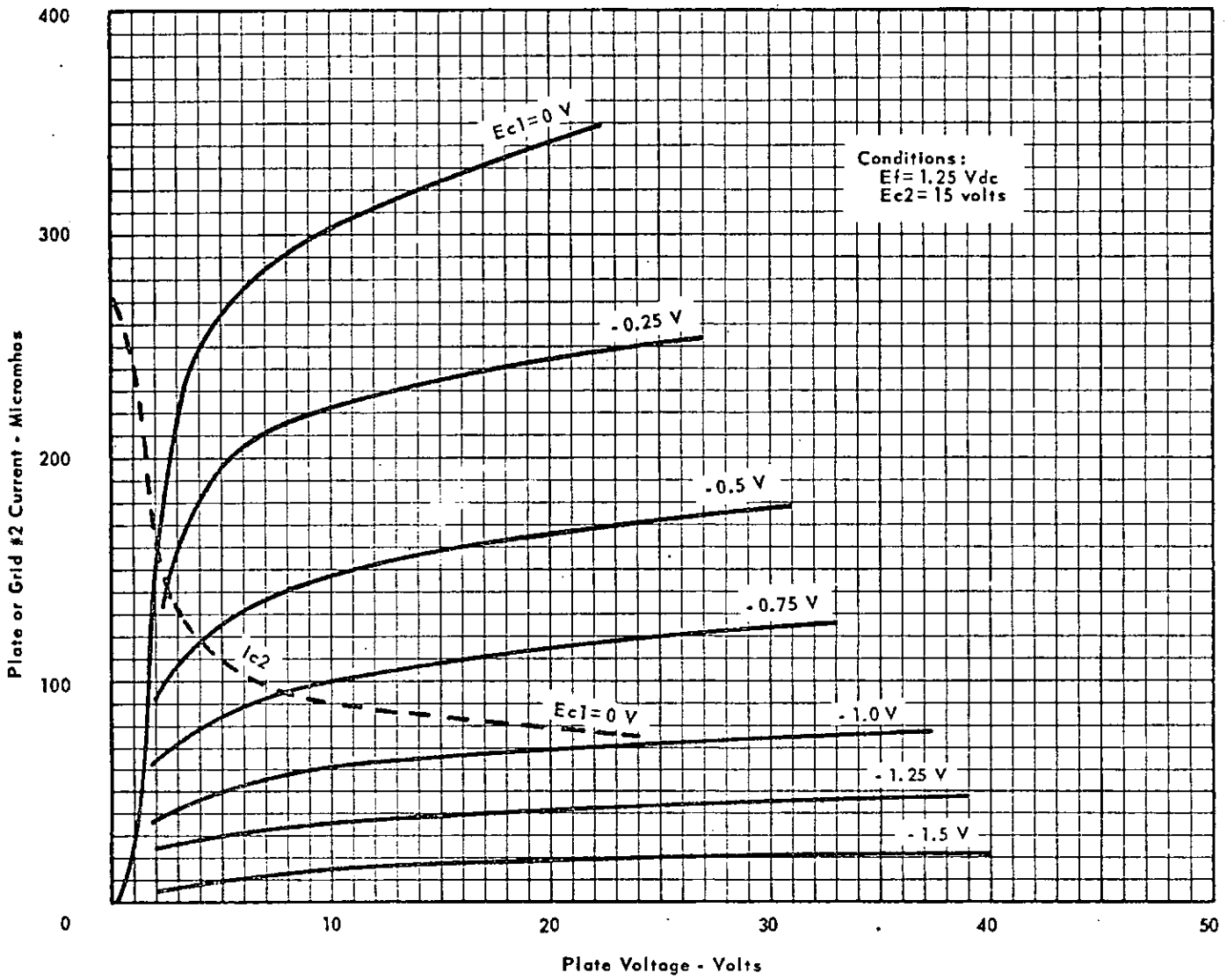
TYPICAL POWER OUTPUT CHARACTERISTICS



RAYTHEON MANUFACTURING COMPANY

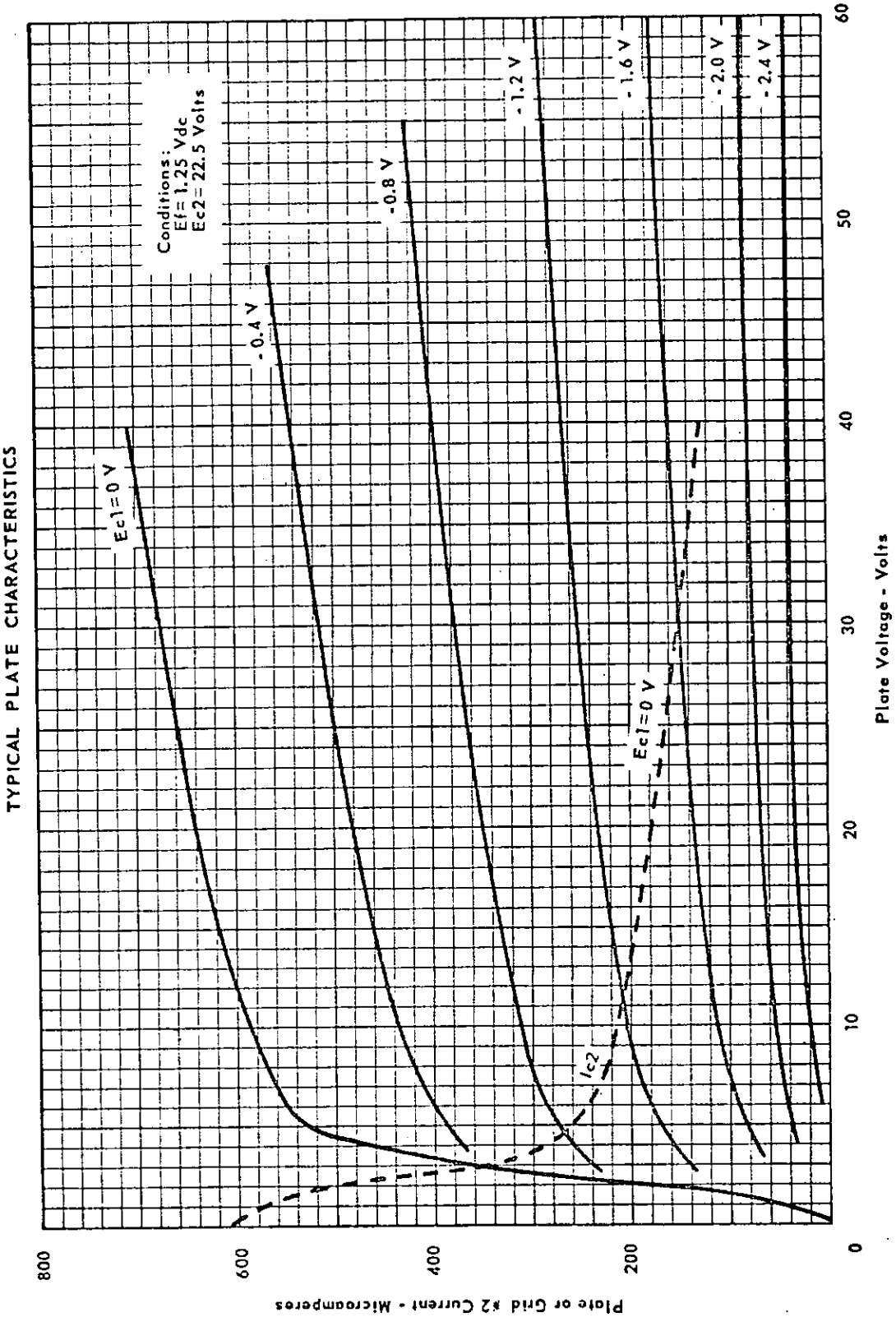
SUBMINIATURE PENTODE

TYPICAL PLATE CHARACTERISTICS



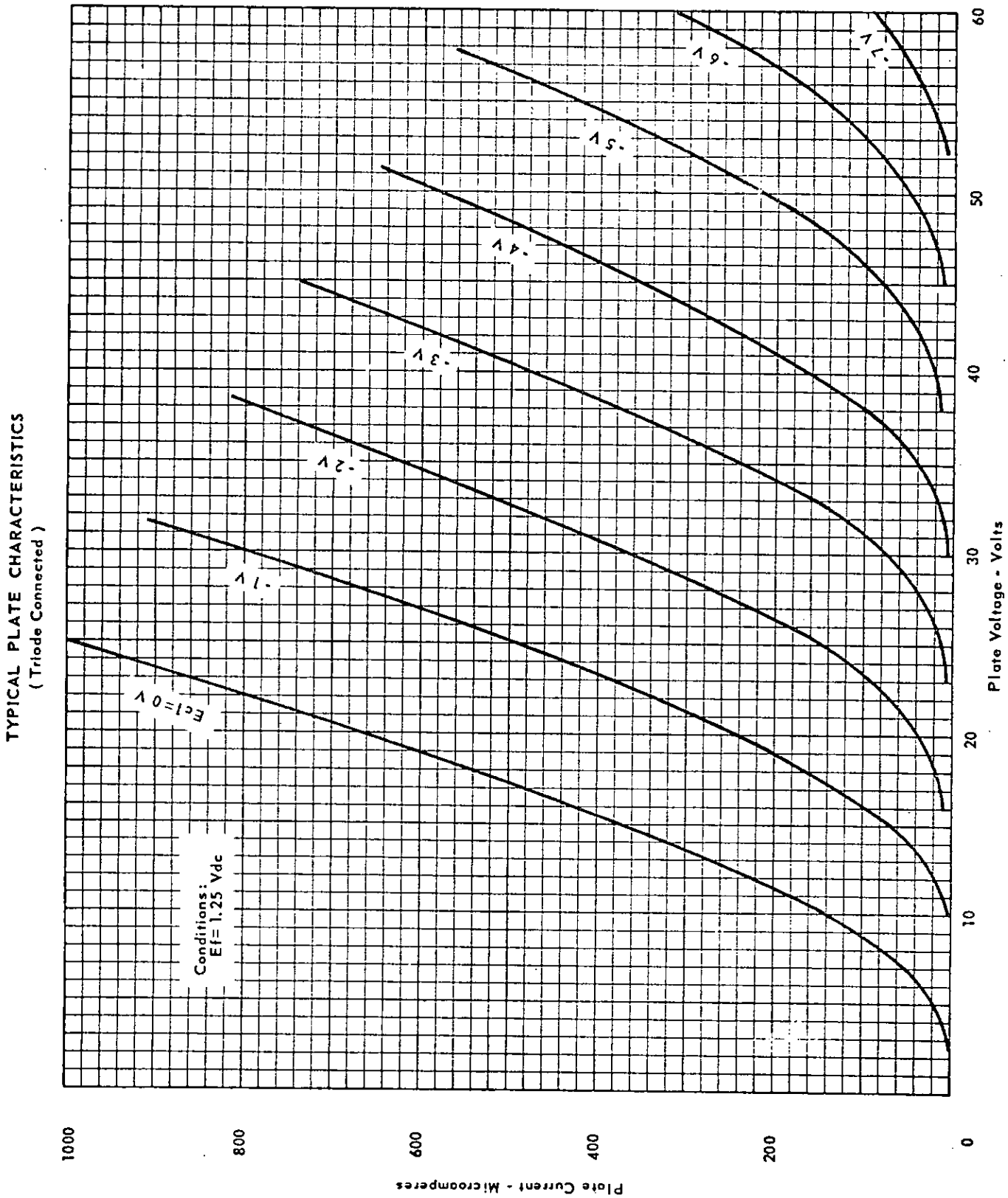
Printed in U.S.A.

SUBMINIATURE PENTODE



RAYTHEON MANUFACTURING COMPANY

SUBMINIATURE PENTODE



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RAYTHEON MANUFACTURING COMPANY

RAYTHEON

TECHNICAL INFORMATION

TENTATIVE DATA

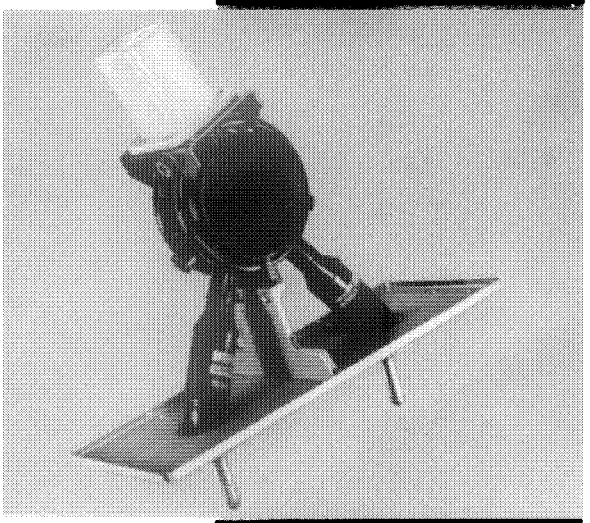
Excellence in Electronics

TYPE QK630

GENERAL DESCRIPTION

The QK630 is a self-excited oscillator capable of producing a minimum of 550 kilowatts peak power output. Used with a tunable, external cavity the combination is an oscillator frequency stabilized to a high degree and tunable from 1270 to 1350 Mc.

The information contained herein is representative of a small number of prototypes and is not necessarily representative of the final tube. Detailed information on specific applications may be obtained by contacting the Applications Engineering Department, Microwave and Power Tube Division, Raytheon Company, Waltham 54, Massachusetts.



PULSED-TYPE STABILOTRON OSCILLATOR

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater current preheat	2.4 A
Heater current operate	2.4 A
Heater voltage @ 2.4 A	27-33 V
Minimum preheat time	3 Minutes
Cold heater resistance	2.0 ohms (Approx.)

Typical Operation

Pulse duration	3.0 usec
Duty cycle	.0024
Peak anode voltage	35 kv
Peak anode current	37 A
Average anode current	89 mAdc
Peak power output	550 kw
Average power output	1320 W
VSWR	1.1/1
Frequency region	1270-1350 Mc
RF bandwidth	0.67 Mc

MECHANICAL

Overall dimensions	19.625" x 18.3" x 8.125"
Net weight: tube	16 lbs.
magnet, typically	40 lbs.
Mounting	Any
Output coupling	Round flange, 3 5/8" diameter
Input coupling	Round flange, 3 5/8" diameter

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

TENTATIVE DATA

Output Pressure	35 psia
Input Pressure	35 psia
Cooling	Forced Water
Cathode bushing	Glass @ atmos. Press.
Vibration	50 cps @ 2.5G
Shock	15G
Magnet Protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER-CATHODE

The cathode must be preheated at 2.4 amperes for at least three minutes prior to the application of the high voltage pulse. Heater current surges in excess of five amperes may cause damage to the tube. When the average anode current is greater than 50 milliamperes, the heater current should be reduced to zero. The application of heater power without forced liquid cooling may cause permanent damage to the tube.

TYPICAL OPERATION

As illustrated in Figure 1 the Stabilotron circuit consists of a Stabilotron tube, a high Q tunable stabilizing system and a feedback mismatch in the output circuit of the tube. The circuit will oscillate when the following conditions are satisfied.

1. $|\Gamma_1|\ |\Gamma_2|$ Gain $\geq$ 1
2. Total loop phase shift from plane $l\ l^1$ to plane $r\ r^1$ is an integral multiple of 360 degrees.

A portion of the output power is reflected from the reference plane $l\ l^1$. This reflected power travels back through the Stabilotron network with little or no attenuation or reflection and out to the reference plane $r\ r^1$. The energy at the resonant frequency of the cavity is again reflected, amplified by the backward wave principle and arrives at the reference plane $l\ l^1$ at full power level. The energy not at the resonant frequency of the cavity is absorbed by the damping resistor. A line stretcher provides phase adjustment for optimum system performance.

Figure 2 shows a QK630 Stabilotron tube used with a QK629 Stabilizing System. The input of the QK630 is connected to a 1⅝" coax line stretcher which in turn is connected to a cylindrical, tunable cavity. A damping resistor for the purpose of absorbing off resonant energy is connected through a fixed length of 1⅝" coax line to the other side of the cavity. As the cavity is tuned it moves physically toward or away from the tube, changing the line length between the cavity and tube and thus maintaining proper loop phase shift.

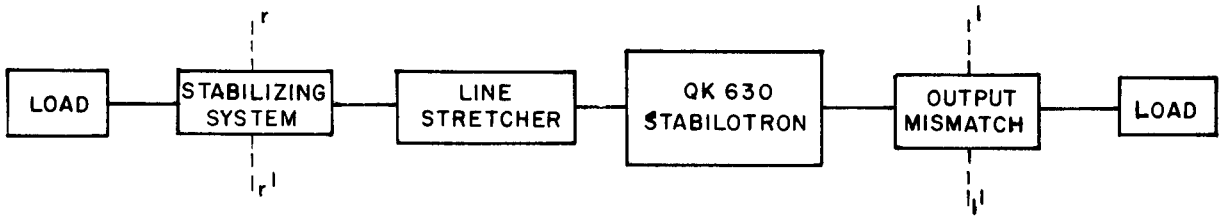


Figure 1

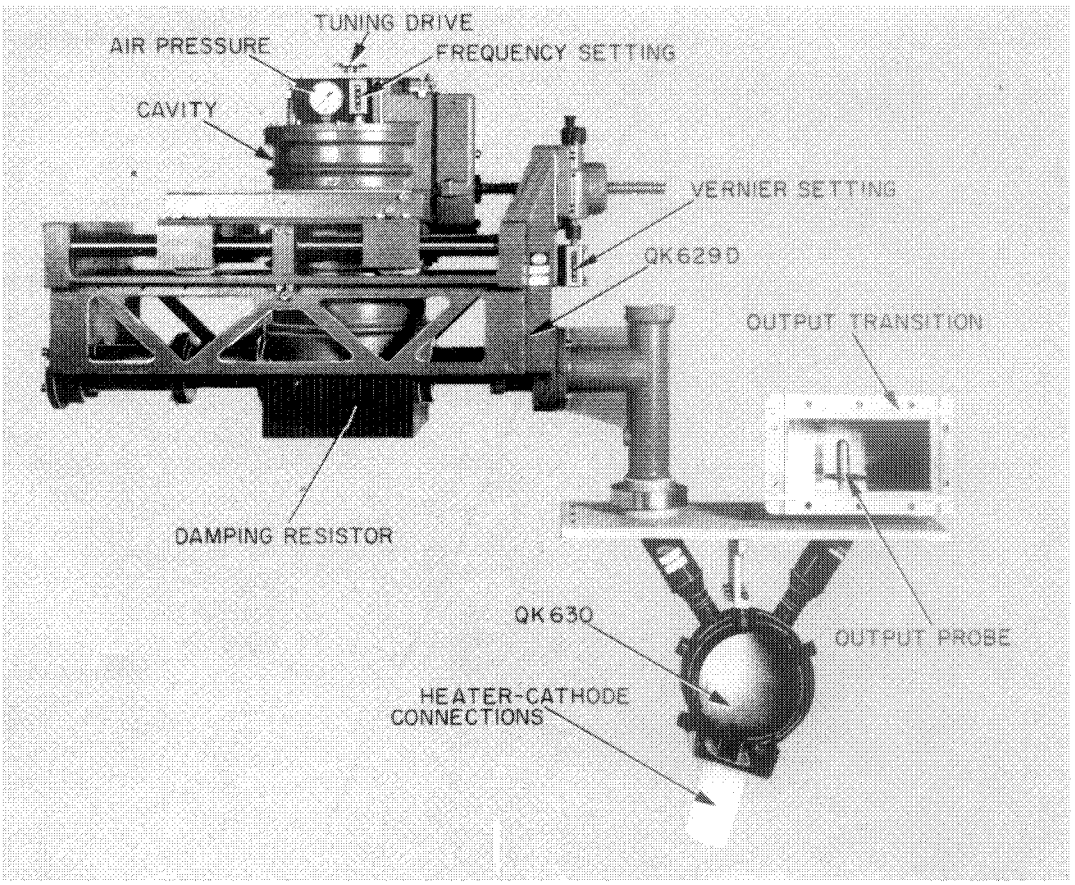


Figure 2

FREQUENCY STABILITY

The phase shift vs frequency characteristics of the stabilizing cavity in the region of cavity resonance has a slope many times greater than that of any other element in the circuit. A slight change in frequency will result when the cavity is subjected to a substantial shift in phase which might be introduced by the antenna load, frequency pushing, etc. Figure 3 demonstrates the frequency shift which occurs for the same phase shift increment in a stabilized and unstabilized system. It is seen that in the stabilized case the resulting frequency change, Δfs, caused by the $\Delta\theta$ increment of phase is much less than the frequency change, Δfu, in the unstabilized case.

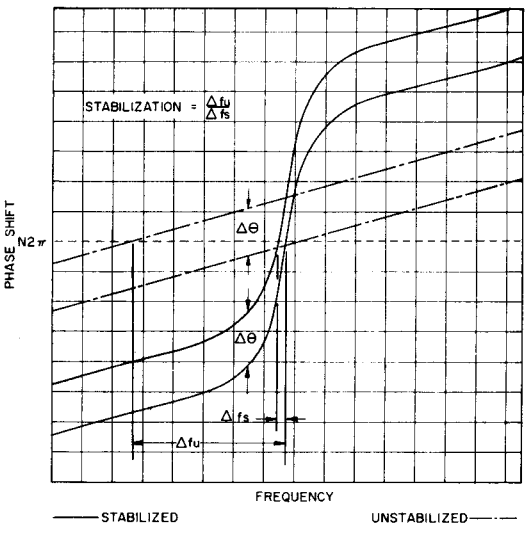


Figure 3

TENTATIVE DATA

OPERATING CHARACTERISTICS

Figure 4 is a plot of peak power output, peak anode voltage, efficiency, and bandwidth variation with respect to frequency.

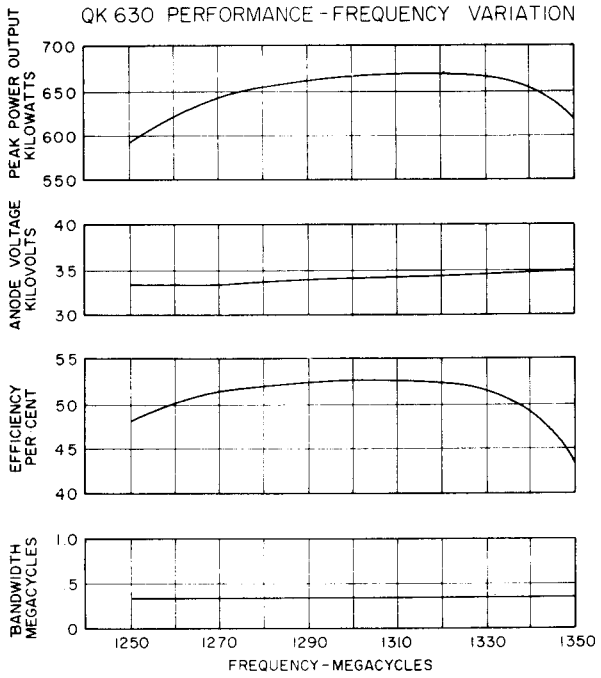


Figure 4

COOLING

The QK630 Stabilotron is a forced liquid cooled tube. The input temperature of the coolant will dictate the flow rate necessary to maintain the anode temperature below the specified maximum of 125°C. Figure 5 shows cooling water flow versus the total input power plotted for different values of anode temperature rise, Δt, above the inlet temperature of the coolant. The relationship of back pressure and water flow is also shown.

PULSE LENGTH AND DUTY CYCLE

The QK630 Stabilotron has been designed and tested at the following pulse conditions. See Figure 6.

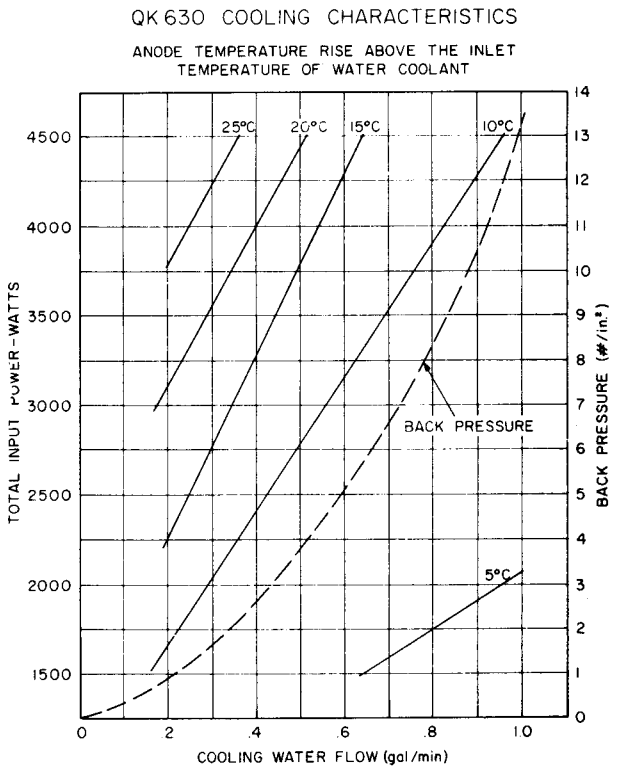


Figure 5

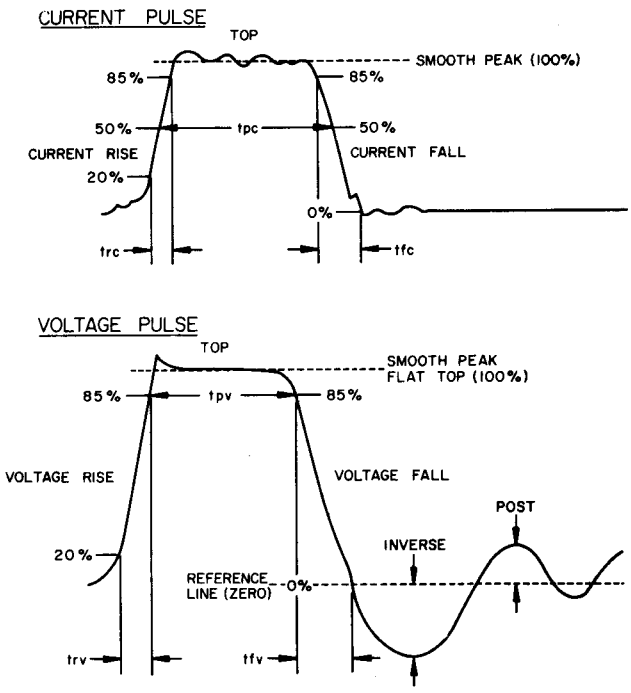


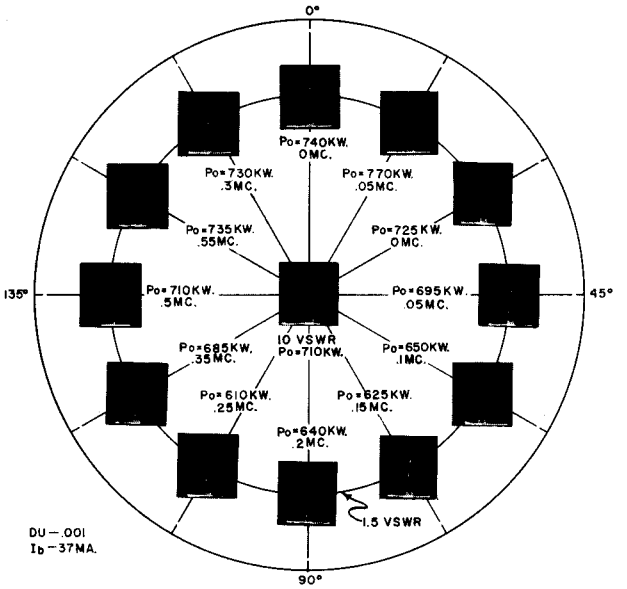
Figure 6

t_{pc} = 3.0 usec (measured at 50%)
t_{rc} = 0.20 usec (measured 20 to 85%)
t_{fc} = 1.30 usec (measured 0 to 85%)
t_{rv} = 0.45 usec (measured 20 to 85%)
t_{fv} = 2.0 usec (measured 0 to 85%)

No spike or ripple should exceed ±2.5% of the average peak value of current or voltage. Inverse voltage should not exceed 25% of the forward voltage. Post voltages should be held to a minimum to avoid post pulse noise or oscillations. If operation at pulse conditions different from those given above is anticipated, the manufacturer should be consulted for further information.

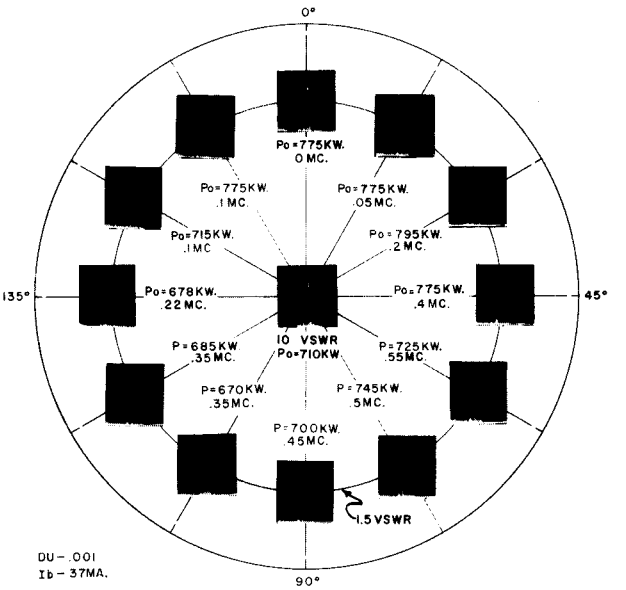
LOAD DIAGRAMS

Figures 7, 8, and 9 are load diagrams of the QK630 Stabilotron at 1270 Mc, 1300 Mc, and 1350 Mc. The output spectrum, peak power output and frequency deviation are shown at a matched load position and several phase positions with a load VSWR of 1.5/1.



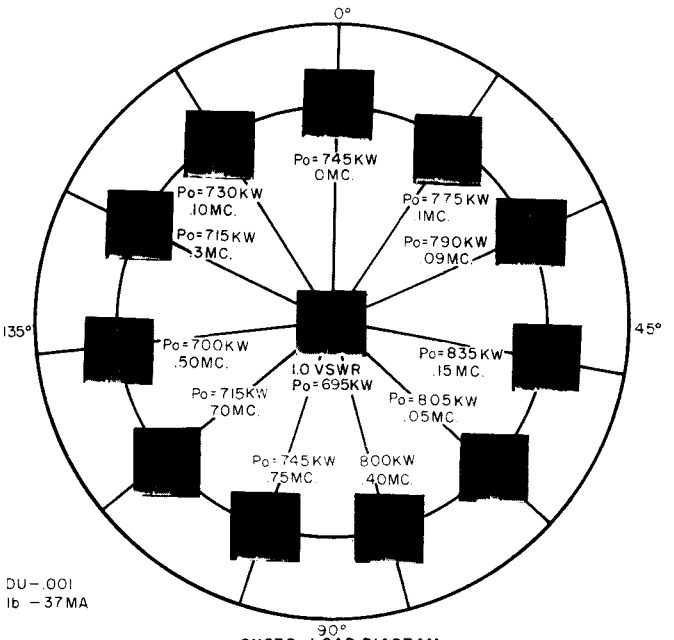
QK630-LOAD DIAGRAM
FREQUENCY-1270MC/S

Figure 7



QK 630-LOAD DIAGRAM
FREQUENCY-1300MC/S.

Figure 8



QK630-LOAD DIAGRAM
FREQUENCY-1350MC/S

Figure 9

ELECTRICAL CONNECTIONS

Electrical connections are made to the frame of the tube and to the two terminals located on the

high voltage cathode bushing. The positive high voltage should be grounded on the mounting surface. Heater connections should be designed to minimize contact resistance and lateral forces on the heater terminals. The common heater-cathode terminal is marked with the letter "C". Drawings of suitable heater-cathode connecting devices are available on request.

MOUNTING

The tube is mounted within the equipment by twelve bolts passed through clearance holes in the rectangular mounting plate. The relative position of the tube is unimportant. Details of the mounting plate are shown in the outline drawing.

COUPLING AND PRESSURIZATION

The input pipe of the tube has been designed to mate with the connection of the QK629 Stabilizing System. The output pipe, identical to the input pipe, is intended to couple into a standard 3" x 6" waveguide (RG-69/U) through the mounting flange shown in the outline drawing. Pressurization of the input and output RF transmission system to 35 psia is required to prevent arcing in the system.

REFERENCES

Final Engineering Report, Volume I on the Design and Development of the Platinotron, Amplitron and Stabilotron: W. C. Brown, Signal Corps Contract No. DA-36-039-sc-56644, December, 1955.

Description and Operating Characteristics of the Platinotron — A New Microwave Tube Device: W. C. Brown, Proceedings of the IRE, September 1957.

Raytheon Technical Information Bulletin — Eng. I: June 1958.

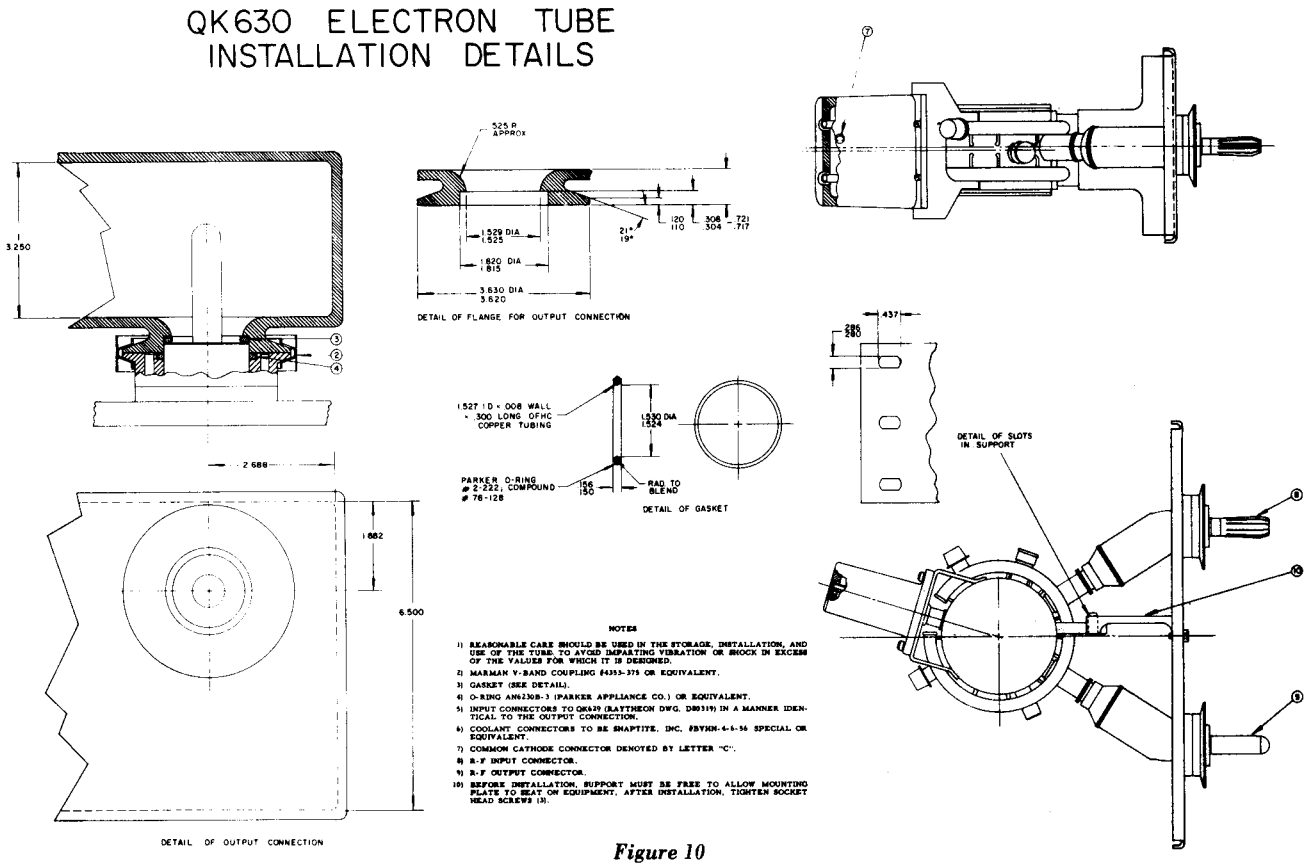
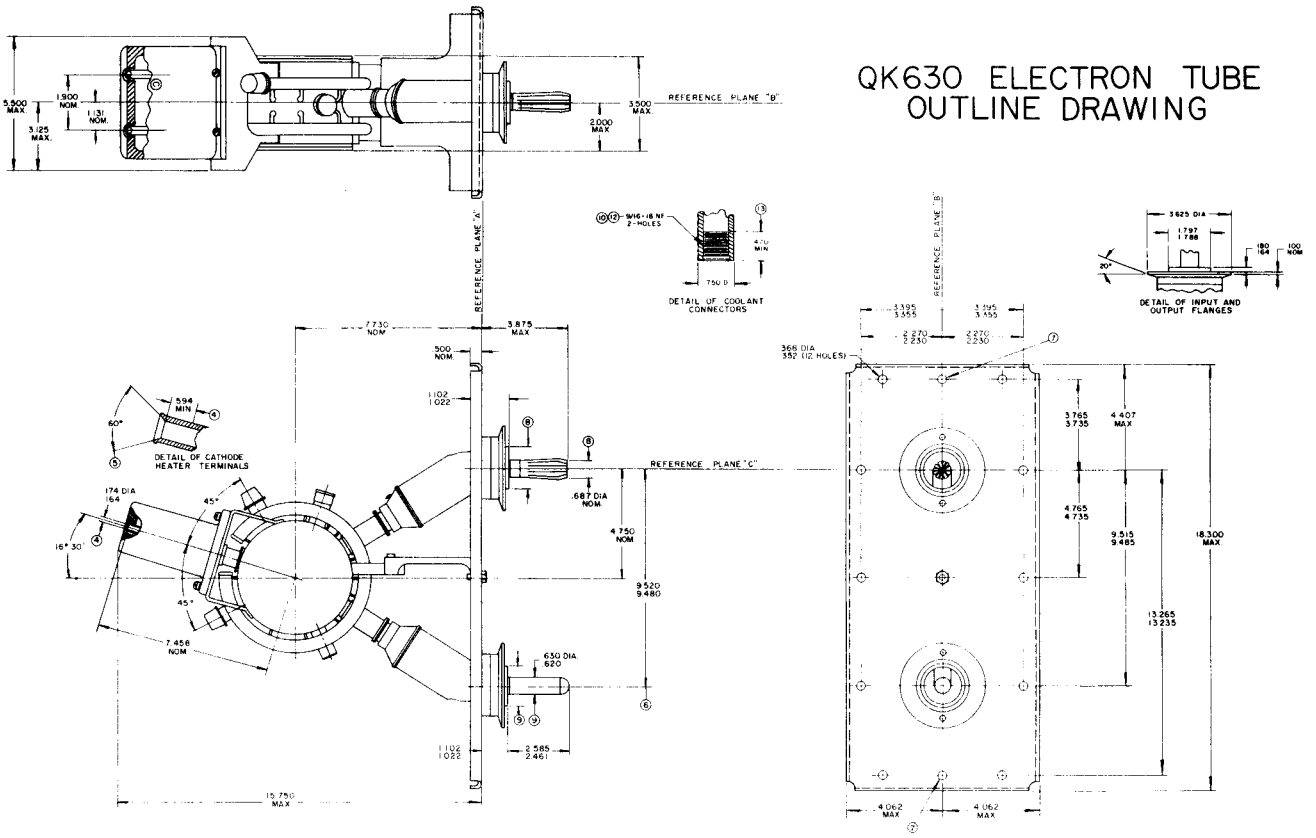


Figure 10

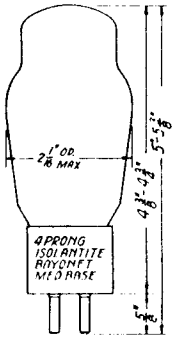
QK630 ELECTRON TUBE OUTLINE DRAWING



NOTES

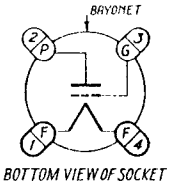
1) REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE FACE OF THE MOUNTING PLATE AS SHOWN
2) REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO REFERENCE PLANE "A" AND PASSING THROUGH THE CENTERS OF DIAMETERS "XX" AND "YY" AS SHOWN
3) REFERENCE PLANE "C" IS DEFINED AS A PLANE PERPENDICULAR TO REFERENCE PLANES "A" AND "B" AND PASSING THROUGH THE CENTER OF DIAMETER "XX" AS SHOWN
4) JACK HOLE DIAMETERS APPLY FOR DEPTH SHOWN
5) THIS COUNTERSINK SHALL BE CAPABLE OF ACCEPTING A CONE HAVING A 60° INCLUDED ANGLE AND A BASE DIAMETER OF 0.234 AND SHALL REJECT A SIMILAR CONE HAVING A BASE DIAMETER OF 0.254
6) THIS DIMENSION REFERS TO THE CENTERLINE OF DIAMETER "Y"
7) THESE HOLES TO BE LOCATED ON REFERENCE PLANE "B" WITHIN .015
8) WITH A GAGE HAVING AN 1.820 I.D. AND CONCENTRIC 0.640 I.D. PLACED OVER THESE DIAMETERS, ALL FINGERS OF THE INPUT CONNECTOR MUST CONTACT THE 0.640 DIAMETER
9) A GAGE HAVING A 1.797 I.D. AND CONCENTRIC 0.655 I.D. MUST PASS OVER THESE DIAMETERS
10) PITCH DIAMETER MUST ACCEPT CLASS 2 "GO" GAGE ONLY
11) MINOR DIAMETER MUST NOT BE GREATER THAN 0.513
12) APPLIES TO DEPTH OF FULL THREAD

Figure 11



TRIODE POWER AMPLIFIER OSCILLATOR

The RK-10 is a triode type power amplifier tube having a thoriated tungsten filament and an isolantite base. It is designed for use as an amplifier, oscillator or frequency multiplier.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	1.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	8	μμf
Input	3	μμf
Output	4	μμf

A-F POWER AMPLIFIER—CLASS A

MAXIMUM RATINGS

D-C Plate Voltage	425	volts
Plate Dissipation	12	watts

TYPICAL OPERATION

D-C Plate Voltage	250	350	425	volts
D-C Grid Voltage	−23.5†	−32 †	−40 †	volts
D-C Plate Current	10	16	18	ma
Amplification Factor	8	8	8	
Plate Resistance	6000	5150	5000	ohms
Transconductance	1330	1550	1600	μmhos
Load Resistance	13000	11000	10200	ohms
Power Output	0.4	0.9	1.6	watts

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	450	volts
D-C Plate Voltage—Telephony		
With Grid Modulation	450	volts
With Plate Modulation	350	volts
D-C Plate Current	65	ma
D-C Grid Current	15	ma
R-F Grid Current	5	amp
Plate Dissipation	15	watts

†Grid Voltage measured from mid-point of a-c operated filament.

TYPICAL OPERATION

	Telephony Grid Modulation	Telephony Plate Modulation	Telegraphy	
D-C Plate Voltage	450	350	450	volts
D-C Grid Voltage	−170	−100	−100	volts
D-C Plate Current	40	50	65	ma
D-C Grid Current	1	12	15	ma
Peak R-F Input Voltage	240	200	235	volts
R-F Driving Power	2.4*	2.2	3.2	watts
Carrier Power Output	6	12	19	watts
Peak A-F Voltage—Plate	—	350*	—	volts
Peak A-F Voltage—Grid	70 *	—	—	volts
A-F Modulating Power	0.7*	9	—	watts
Peak Power Output	24 *	48 *	—	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	450	volts
D-C Plate Current (Carrier)	40	ma
Plate Dissipation (Carrier)	12	watts

TYPICAL OPERATION

D-C Plate Voltage	450	volts
D-C Grid Voltage	−60	volts
D-C Plate Current	40	ma
D-C Grid Current	1.5	ma
Peak R-F Input Voltage	200*	volts
R-F Driving Power	4.1 *	watts
Carrier Power Output	6	watts
Peak Power Output	24 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

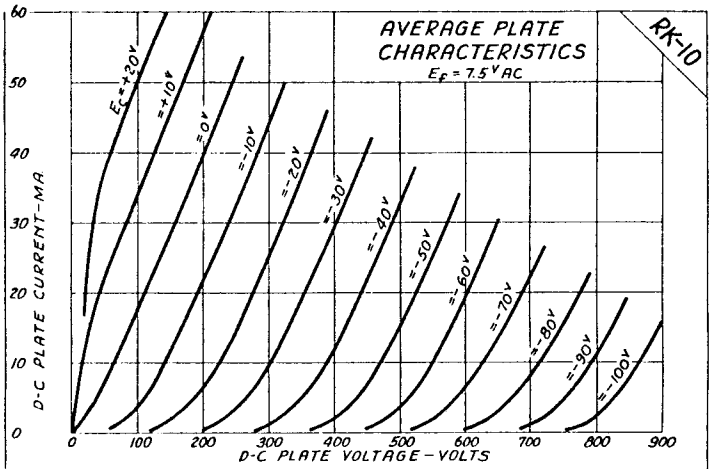
The RK-10 may be operated at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

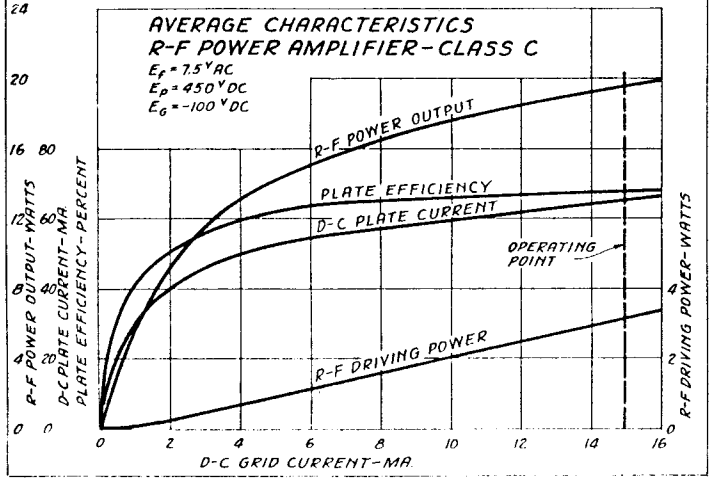
BIAS

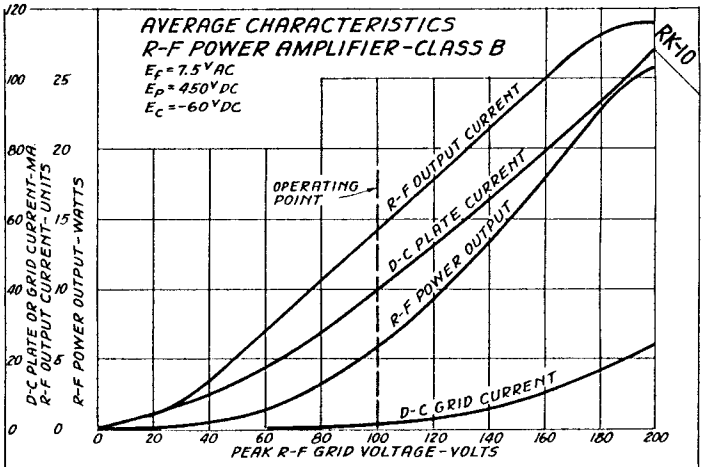
At least 40 volts of fixed bias should be used with 450 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

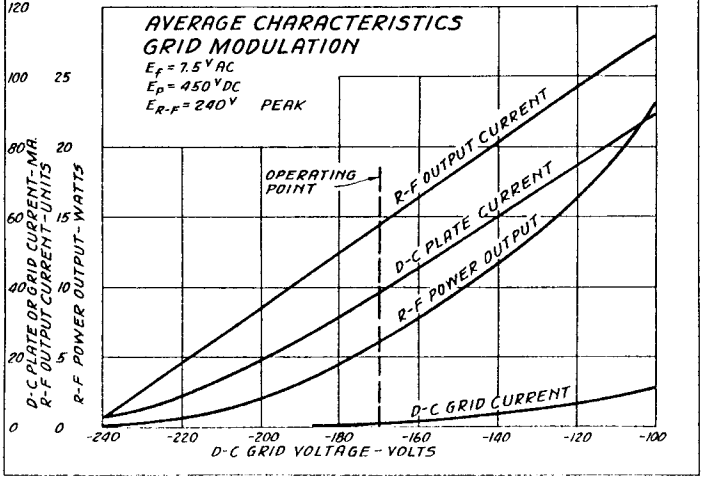
PLATE TEMPERATURE

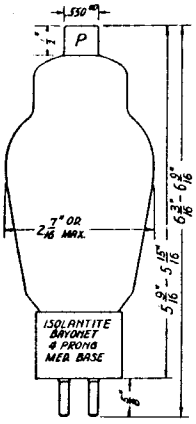
The plate of the RK-10 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.





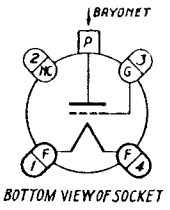






TRIODE POWER AMPLIFIER OSCILLATOR

The RK-11 is a triode type power amplifier tube having a thoriated tungsten filament, and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.



BOTTOM VIEW OF SOCKET

AMPLIFICATION FACTOR 20

FILAMENT RATING

Filament Voltage	6.3	volts
Filament Current	3.0	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	7	μμf
Input	7	μμf
Output	0.9	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	750	volts
D-C Plate Current	105	ma
D-C Grid Current	35	ma
Plate Dissipation	25	watts

TYPICAL OPERATION

D-C Plate Voltage	500	750	volts
D-C Grid Voltage	−100	−120	volts
D-C Plate Current	100	105	ma
D-C Grid Current	21	21	ma
Peak R-F Input Voltage	165	170	volts
R-F Driving Power	3.1	3.2	watts
Power Output	35	55	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	750	volts
D-C Plate Current (Carrier)	50	ma
Plate Dissipation (Carrier)	25	watts

TYPICAL OPERATION

D-C Plate Voltage	750	volts
D-C Grid Voltage	−40	volts
D-C Plate Current	44	ma
D-C Grid Current	1	ma
Peak R-F Input Voltage	110*	volts
R-F Driving Power	2 *	watts
Carrier Power Output	12	watts
Peak Power Output	48 *	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Plate Modulation	Grid Modulation	
D-C Plate Voltage	600	750	volts
D-C Plate Current (Carrier)	83	50	ma
D-C Grid Current (Carrier)	35	5	ma
Plate Dissipation (Carrier)	17	25	watts

TYPICAL OPERATION

	Plate Modulation		Grid Modulation	
D-C Plate Voltage	500	600	750	volts
D-C Grid Voltage	−100	−120	−130	volts
D-C Plate Current	83	85	38	ma
D-C Grid Current	26	24	1.2	ma
Peak R-F Input Voltage	160	170	150	volts
R-F Driving Power	3.7	3.7	2.7*	watts
Carrier Power Output	28	38	12	watts
Peak A-F Modulating Voltage	500*	600*	30 *	volts
A-F Modulating Power	21	26	0.5*	watts
Peak Power Output	112*	152*	48 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

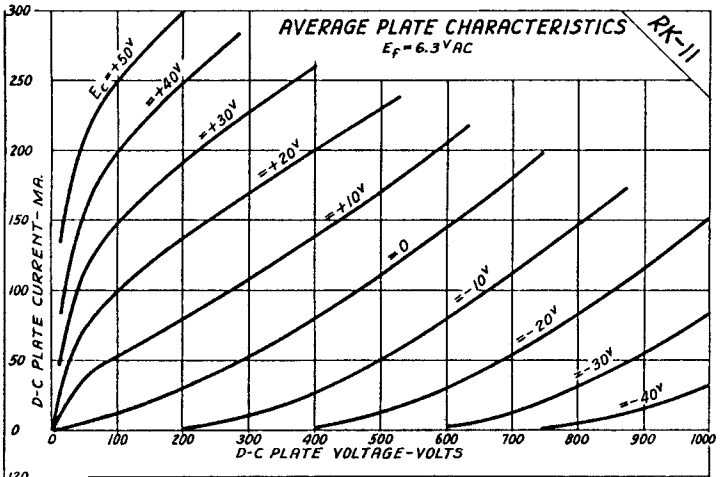
The construction of the RK-11 allows operation at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

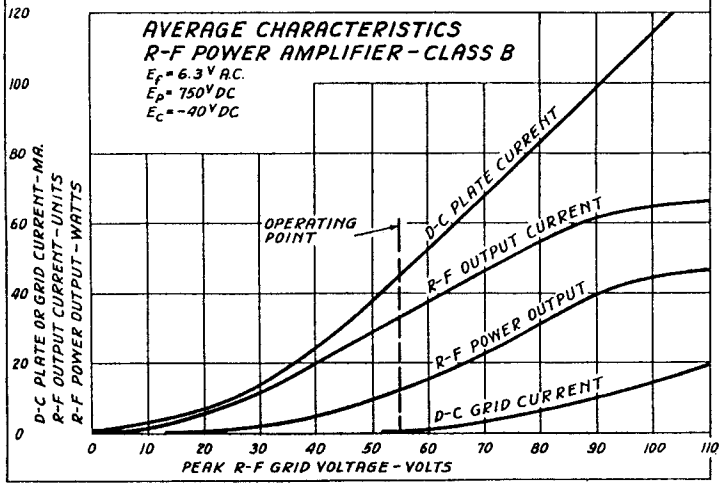
BIAS

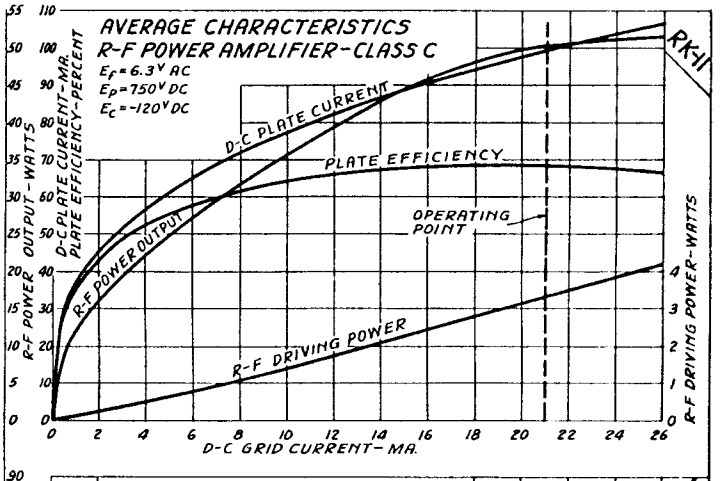
A fixed bias voltage of at least 30 volts should be used with a plate voltage of 750 volts in order to protect the tube in case of failure of bias or excitation. The fixed bias may be reduced with lower plate voltage.

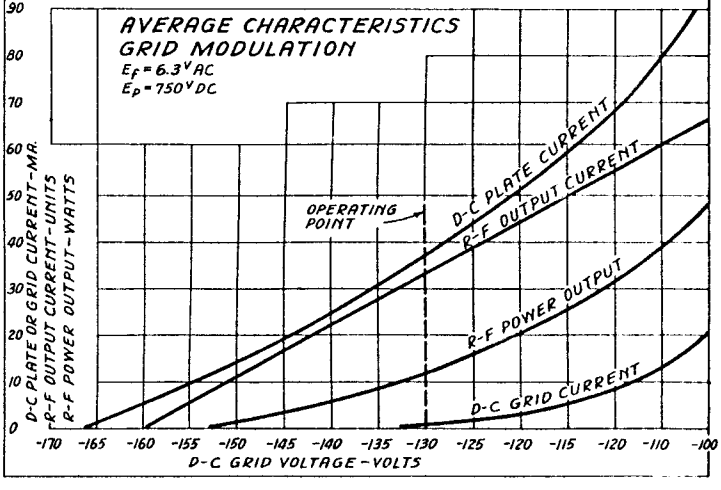
PLATE TEMPERATURE

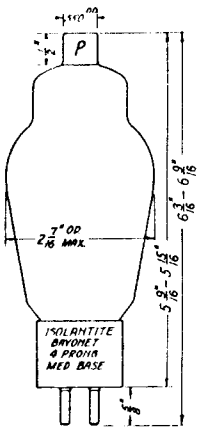
The plate of the RK-11 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



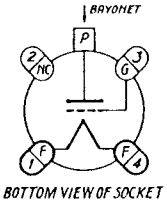








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-12 is a high-mu triode type power amplifier tube having a thoriated tungsten filament and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	6.3	volts
Filament Current	3.0	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	7	μμf
Input	7	μμf
Output	0.9	μμf

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	750	volts
D-C Plate Current (per tube)	105	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	25	watts

TYPICAL OPERATION

D-C Plate Voltage	750	volts
D-C Grid Voltage	0	volts
D-C Plate Current (no signal)	50	ma
D-C Plate Current (max. signal)	200	ma
D-C Grid Current (max. signal)	65	ma
Peak A-F Grid Voltage (grid to grid)	129	volts
A-F Driving Power	3.4	watts
Load Resistance (plate to plate)	9600	ohms
Power Output	100	watts

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	750	volts
D-C Plate Current	105	ma
D-C Grid Current	40	ma
Plate Dissipation	25	watts

TYPICAL OPERATION

D-C Plate Voltage	500	750	volts
D-C Grid Voltage	−100	−100	volts
D-C Plate Current	100	105	ma
D-C Grid Current	32	35	ma
Peak R-F Input Voltage	160	165	volts
R-F Driving Power	4.6	5.2	watts
Power Output	35	55	watts

R-F POWER AMPLIFIER—CLASS C—TELEPHONY PLATE MODULATION

MAXIMUM RATINGS

D-C Plate Voltage	600	volts
D-C Plate Current	85	ma
D-C Grid Current	40	ma
Plate Dissipation	17	watts

TYPICAL OPERATION

D-C Plate Voltage	500	600	volts
D-C Grid Voltage	−100	−100	volts
D-C Plate Current	85	85	ma
D-C Grid Current	27	27	ma
Peak R-F Input Voltage	148	155	volts
R-F Driving Power	3.6	3.8	watts
Carrier Power Output	30	38	watts
A-F Modulating Power	21	26	watts
Peak Power Output	120	152	watts

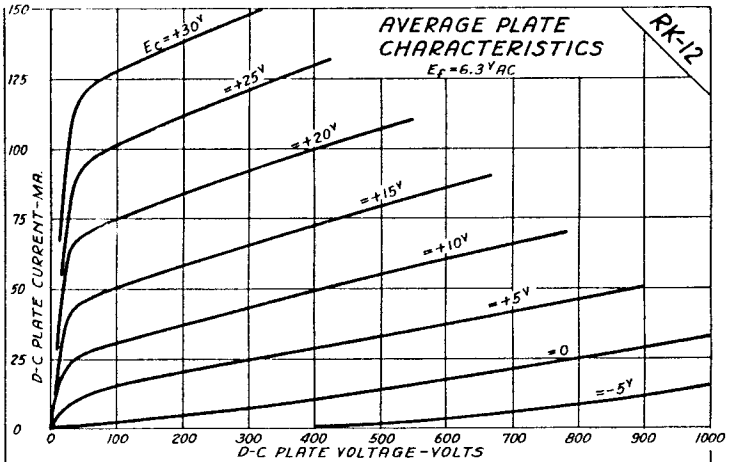
OPERATING NOTES

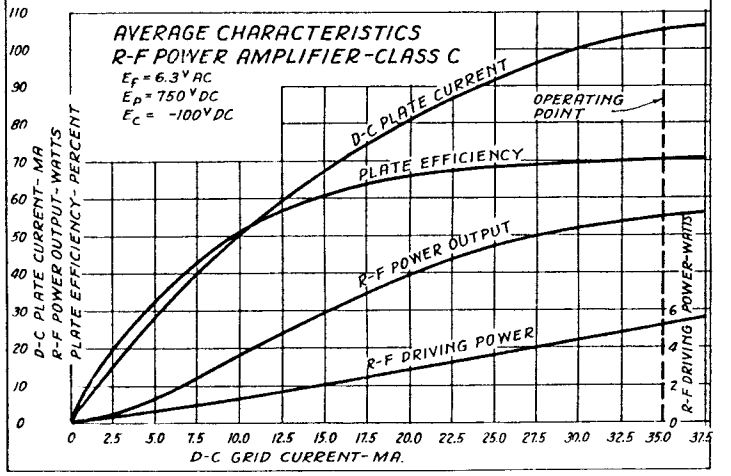
FREQUENCY RANGE

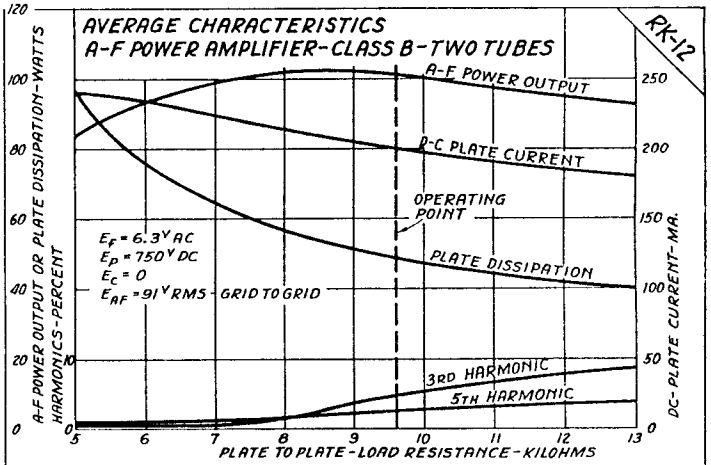
The construction of the RK-12 allows operation at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles reduced efficiency requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

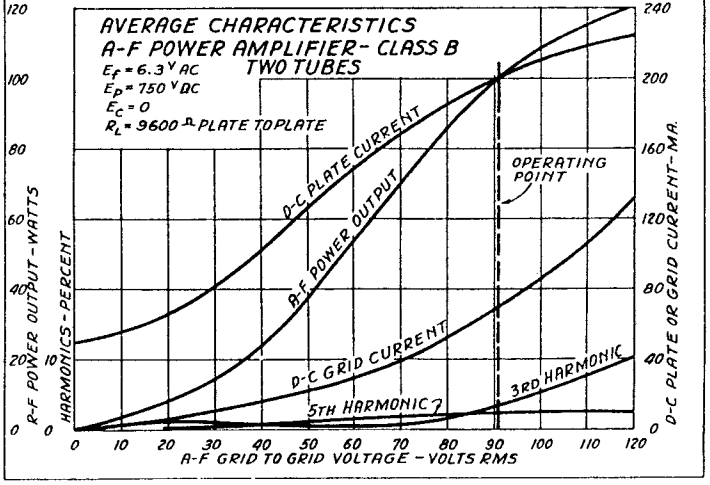
PLATE TEMPERATURE

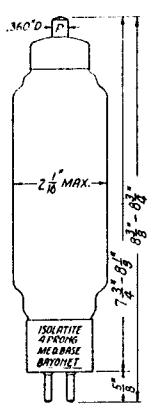
The plate of the RK-12 will not show color when operated at the rated plate dissipation. Dissipations above the rated value should be avoided.



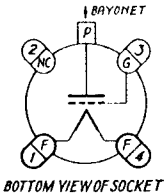








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-18 is a triode type power amplifier tube having a thoriated tungsten filament, a molybdenum plate and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	4.8	μμf
Input	6	μμf
Output	1.8	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1250	volts
D-C Plate Voltage—Telephony		
With Grid Modulation	1250	volts
With Plate Modulation	1000	volts
D-C Plate Current	100	ma
D-C Grid Current	40	ma
R-F Grid Current	5	amp
Plate Dissipation	40	watts

TYPICAL OPERATION

	Telephony Grid Modulation	Telephony Plate Modulation	Telegraphy	
D-C Plate Voltage	1250	1000	1250	volts
D-C Grid Voltage	—140	—160	—160	volts
D-C Plate Current	38	80	100	ma
D-C Grid Current	0.5	13	12	ma
Peak R-F Input Voltage	150	265	255	volts
R-F Driving Power	3.8*	3.1	2.8	watts
Carrier Power Output	18	64	95	watts
Peak A-F Voltage—Plate	—	1000*	—	volts
Peak A-F Voltage—Grid	60 *	—	—	volts
A-F Modulating Power	1.5*	40	—	watts
Peak Power Output	72 *	256 *	—	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (Carrier)	50	ma
Plate Dissipation (Carrier)	40	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—70	volts
D-C Plate Current	40	ma
Peak R-F Input Voltage	160*	volts
R-F Driving Power	2.1 *	watts
Carrier Power Output	18	watts
Peak Power Output	72 *	watts

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (per tube)	115	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	40	watts

TYPICAL OPERATION

D-C Plate Voltage	1000	1250	volts
D-C Grid Voltage	—45	—60	volts
D-C Plate Current (no signal)	35	35	ma
D-C Plate Current (max. signal)	230	220	ma
D-C Grid Current (max. signal)	38	60	ma
Peak A-F Input Voltage (grid to grid)	268	352	volt
A-F Driving Power	4.3	9	watts
Load Resistance (plate to plate)	12000	18000	ohms
Power Output	150	190	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

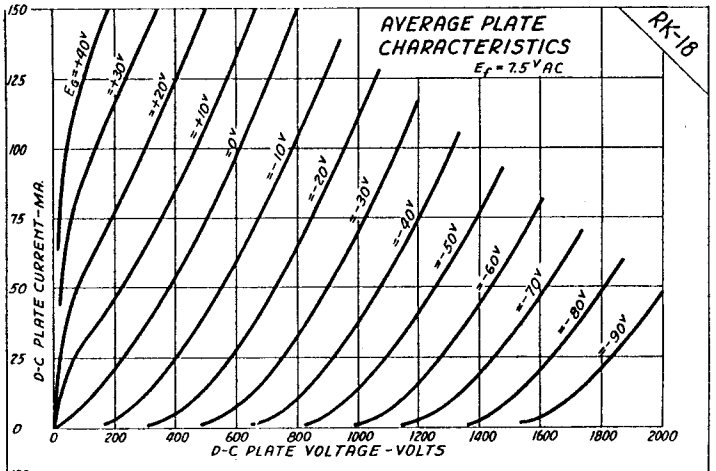
The RK-18 may be operated at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles, the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

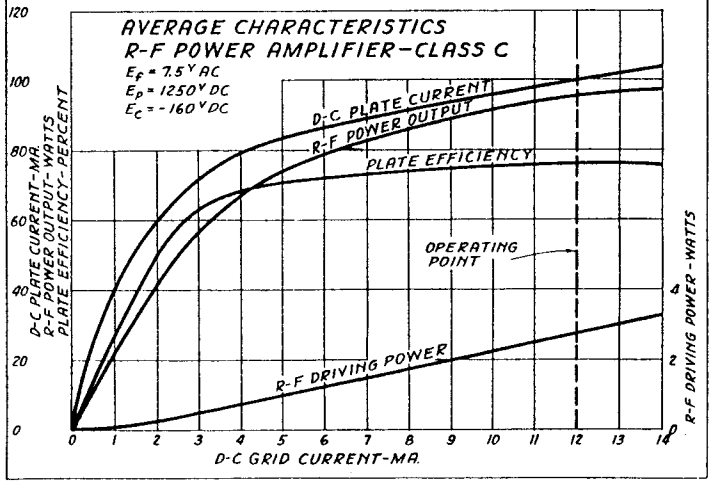
BIAS

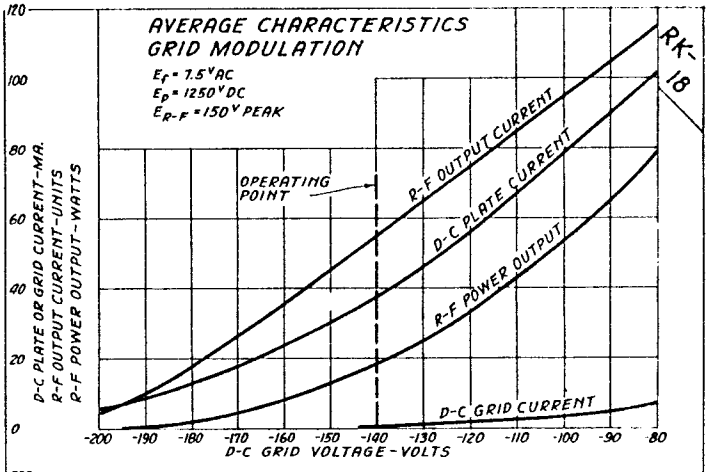
At least 60 volts of fixed bias should be used with 1250 volts on the plate to protect the tube in case of failure of the bias or excitation.

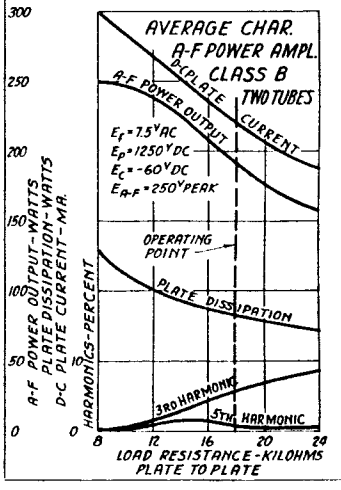
PLATE TEMPERATURE

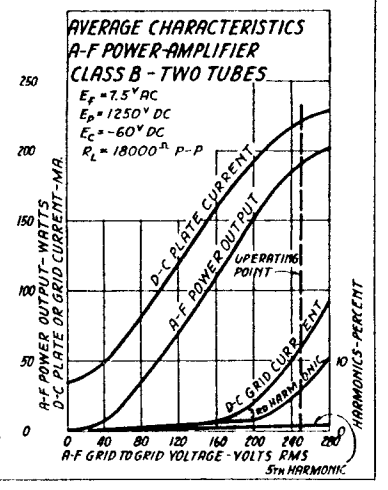
The RK-18 will show a light cherry color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



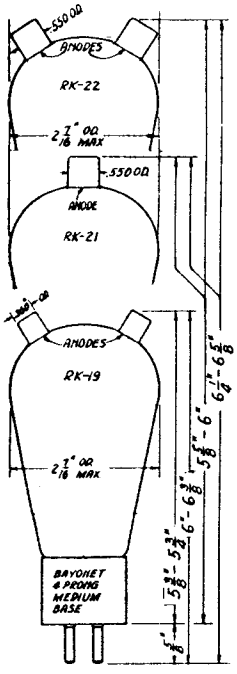








TWIN DIODE
FULL-WAVE HIGH VACUUM RECTIFIER



The RK-19 is a heater type full-wave high vacuum rectifier tube designed for use in d-c power supplies delivering approximately 1000 volts d.c. The RK-19 has a low internal voltage drop approaching that of mercury vapor type tubes and operates without generating the r-f noise common to mercury vapor tubes.

HEATER RATING

Heater Voltage	7.5	volts
Heater Current	2.5	amp

MAXIMUM RATINGS

A-C Voltage per Plate	1250	volts
Peak Inverse Voltage	3500	volts
Peak Plate Current per Plate	0.6	amp
D-C Output Current (Condenser input filter)	0.2	amp

OPERATING NOTES

CAUTION

The cathode should always be allowed to reach operating temperature before the plate voltage is applied. For average conditions this delay should be at least 30 seconds.

The plate leads from the power transformer should be of flexible wire to prevent strain on the top caps. Connection to the top caps should be made with a clip or spring clamp. The lead wires must not be soldered to the top caps.

TWIN DIODE
FULL-WAVE HIGH VACUUM RECTIFIER

The RK-22 is a heater type full-wave high vacuum rectifier tube designed for use in d-c power supplies delivering approximately 1000 volts d.c. The RK-22 has a low internal voltage drop approaching that of mercury vapor type tubes and operates without generating the r-f noise common to mercury vapor tubes.

HEATER RATING

Heater Voltage	2.5	volts
Heater Current	8	amp

MAXIMUM RATINGS

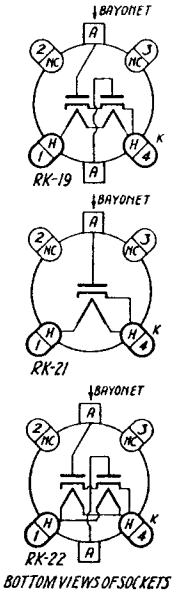
A-C Voltage per Plate	1250	volts
Peak Inverse Voltage	3500	volts
Peak Plate Current per Plate	0.6	amp
D-C Output Current (Condenser input filter)	0.2	amp

OPERATING NOTES

CAUTION

The cathode should always be allowed to reach operating temperature before the plate voltage is applied. For average conditions this delay should be at least 30 seconds.

The plate leads from the power transformer should be of flexible wire to prevent strain on the top caps. Connection to the top caps should be made with a clip or spring clamp. The lead wires must not be soldered to the top caps.



RK-21

DIODE
HALF-WAVE HIGH VACUUM RECTIFIER

The RK-21 is a heater type half-wave high vacuum rectifier tube designed for use in d-c power supplies delivering approximately 1000 volts d.c. The RK-21 has a low internal voltage drop approaching that of mercury vapor tubes and operates without generating the r-f noise common to mercury vapor tubes.

HEATER RATING

Heater Voltage	2.5	volts
Heater Current	4	amp

MAXIMUM RATINGS

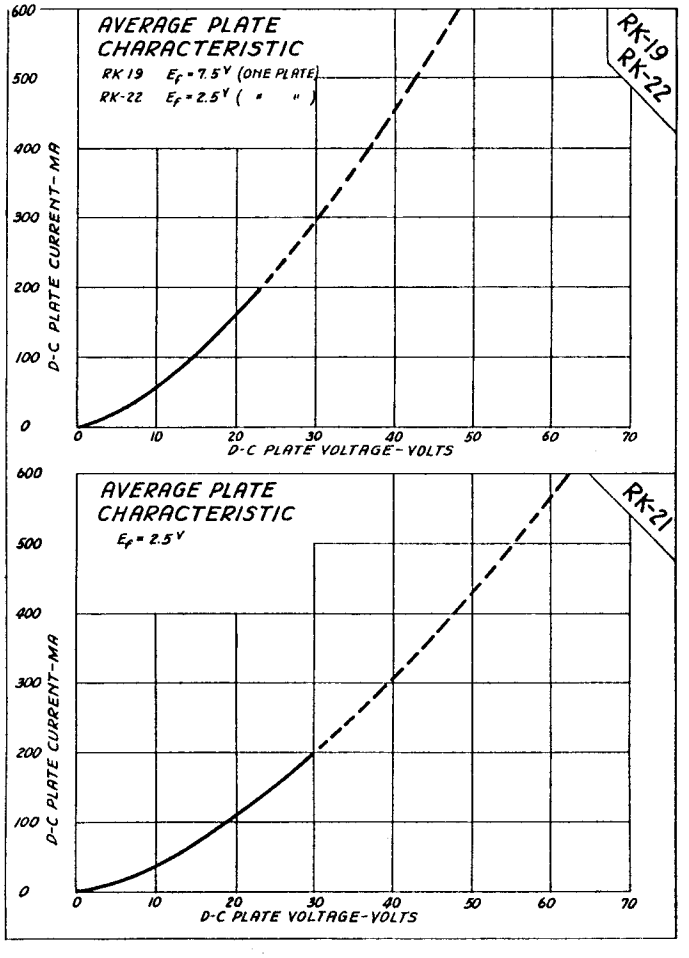
A-C Voltage per Plate	1250	volts
Peak Inverse Voltage	3500	volts
Peak Plate Current	0.6	amp
D-C Output Current (condenser input filter)	0.2	amp

OPERATING NOTES

CAUTION

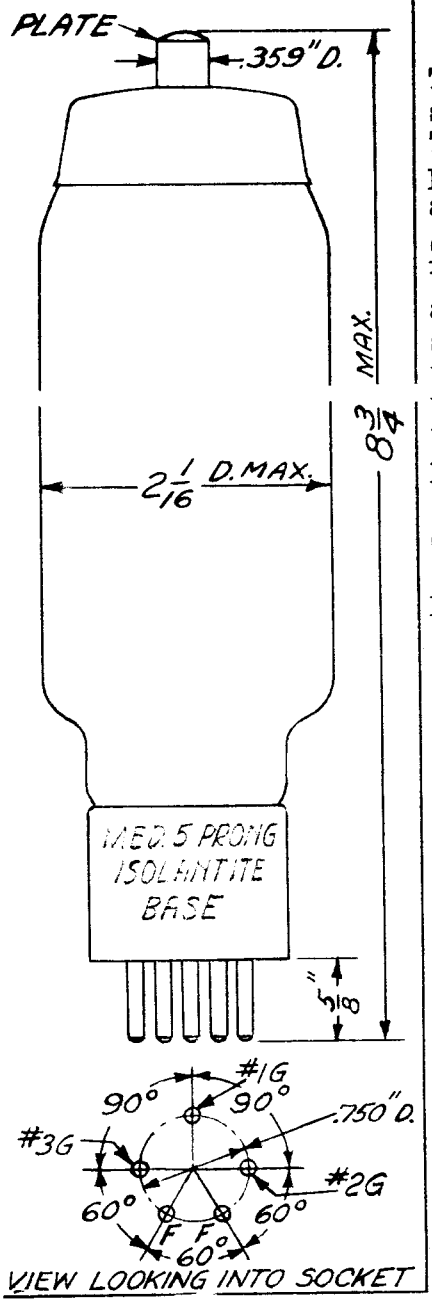
The cathode should always be allowed to reach operating temperature before the plate voltage is applied. For average conditions this delay should be at least 30 seconds.

The plate lead from the power transformer should be of flexible wire to prevent strain on the top cap. Connection to the top cap should be made with a clip or spring clamp. The lead wire must not be soldered to the top cap.



CHARACTERISTIC DATA SHEET
RAYTHEON 4-PILLAR TUBE

RK-20



The RK-20 is a thoriated filament type pentode with suppressor grid brought out to a separate base pin. This opens up the possibilities of modulating the plate current stream by means of the suppressor grid as well as by the conventional methods.

Crystal or Electron Coupled Oscillators. The low control grid-plate capacitance makes possible the use of a plate load circuit tuned to the fundamental in crystal or electron coupled oscillator circuits such as the Tri-Tet. Using crystal control, 50W r-f power can be taken from the plate load circuit without overloading the crystal.

FILAMENT

Voltage = 7.5 Volts Current = 3.0 Amperes

CAPACITIES

G-P = .012 mmf. Input = 11 mmf. Output = 10 mmf.

RATING

DC Plate Voltage	1250 (max)	Volts
DC Screen Voltage (Grid 2)	300 (max)	Volts
DC Suppressor Voltage (Grid 3)	45 (max)	Volts
Plate Dissipation	40 (max)	Watts
Screen Dissipation	15 (max)	Watts
DC Grid Current (Grid 1)	10 (max)	M.A.
RF Grid Current (Grid 1)	5 (max)	Amps.

TYPICAL OPERATION

RF Power Amplifier Class B Telephony Carrier Conditions for use with a Modulation Factor of 1.0.

DC plate Voltage	1250	Volts
DC Screen Voltage	300	Volts
DC Grid Voltage (Grid 1)	-30	Volts
DC Suppressor Voltage	0	Volts
Peak RF Input	70	Volts
DC Plate Current	43	M.A.
DC Screen Current	15	M.A.
Screen Resistor	60000	Ohms
Driving Power	.5	Watts
Peak Power Output	64	Watts
Carrier Power Output	16	Watts

Suppressor or Suppressor Screen Modulated RF Power Amplifier Class C Telephony. Carrier Conditions for use with a Modulation Factor of 1.0.

	Supp.	Supp.Scr.	
Eb Plate DC	1250	1250	Volts
Ec2 Screen DC	300	300	Volts
Ec1 Cont. Gr. DC	-100	-100	Volts
Ec3 Suppressor DC	-45	-40	Volts
Peak AF Eg3	75	75	Volts
Peak AF Eg2	0	150	Volts
Peak RF Input	175	175	Volts
Ib Plate DC	43	47	M.A.
Ic2 Screen DC	36	36	M.A.
Screen Res.	25000	25000	Ohms
Ic1 Cont.Gr. DC	5	5	M.A.
RF Input Power	0.9	0.9	Watts
AF Power	0.3	0.8	Watts
Peak Output	72	84	Watts
Carrier Output	18	21	Watts

Control Grid Modulated R-F Power Amplifier Class C Telephony. Carrier Conditions for use with a Modulation Factor of 1.0.

Eb Plate DC	1250	1250	Volts
Ec2 Screen DC	300	300	Volts
Ec1 Cont.Grid DC	-140	-140	Volts
Ec3 Suppressor DC	0	+45	Volts
Ib Plate DC	42	44	M.A.
Ic2 Screen DC	10	10	M.A.
Screen Res.	95000	95000	Ohms
Ic1 Cont.Gr. DC	1.8	1.8	M.A.
Pk.RF Input Eg1	160	160	Volts
Peak AF Eg1	60	60	Volts
AF Power	0.75	0.75	Watts
Pk.RF Input Power	2	2	Watts
Peak Output	72	84	Watts
Carrier Output	18	21	Watts

Combined Plate and Screen Modulation Class C Telephony. Carrier Conditions for use with a Modulation Factor of 1.0		
Eb Plate DC	900	Volts
Ec2 Screen DC	300	Volts
Ec1 Control Grid DC	-100	Volts
Ec3 Suppressor DC	0	Volts
Ib Plate DC	62	M.A.
Ic2 Screen DC	50	M.A.
Screen Resistor	12000	Ohms
Ic1 Cont.Gr. DC	6	M.A.
Peak AF Plate Ep	900	Volts
Peak AF Screen Eg2	150	Volts
Peak RF Input Eg1	180	Volts
RF Input Power	1.1	Watts
Peak Output	140	Watts
Carrier Output	35	Watts
AF Power	28	Watts

RF Power Amplifier and Oscillator Class C Telegraphy.		
Eb Plate DC	1250	1250 Volts
Ec2 Screen DC	300	300 Volts
Ec1 Control Gr. DC	-100	-100 Volts
Ec3 Suppressor DC	0	+45 Volts
Ib Plate DC	80	92 M.A.
Ic2 Screen DC	37	32 M.A.
Screen Resistance	26000	26000 Ohms
Ic1 Cont.Gr. DC	5	5 M.A.
Peak RF Input Eg1	175	175 Volts
RF Input Power	.9	.9 Watts
Carrier Output	64	80 Watts

OPERATING NOTES

CS-1064 shows the power output and plate and screen dissipation plotted vs. excitation as denoted by the grid current in milliamps. The power output flattens off arround 5 or 6 m.a. grid current with very little gained beyond these values of grid current. The screen dissipation increases with excitation and for this reason the excitation should be kept at reasonable values.

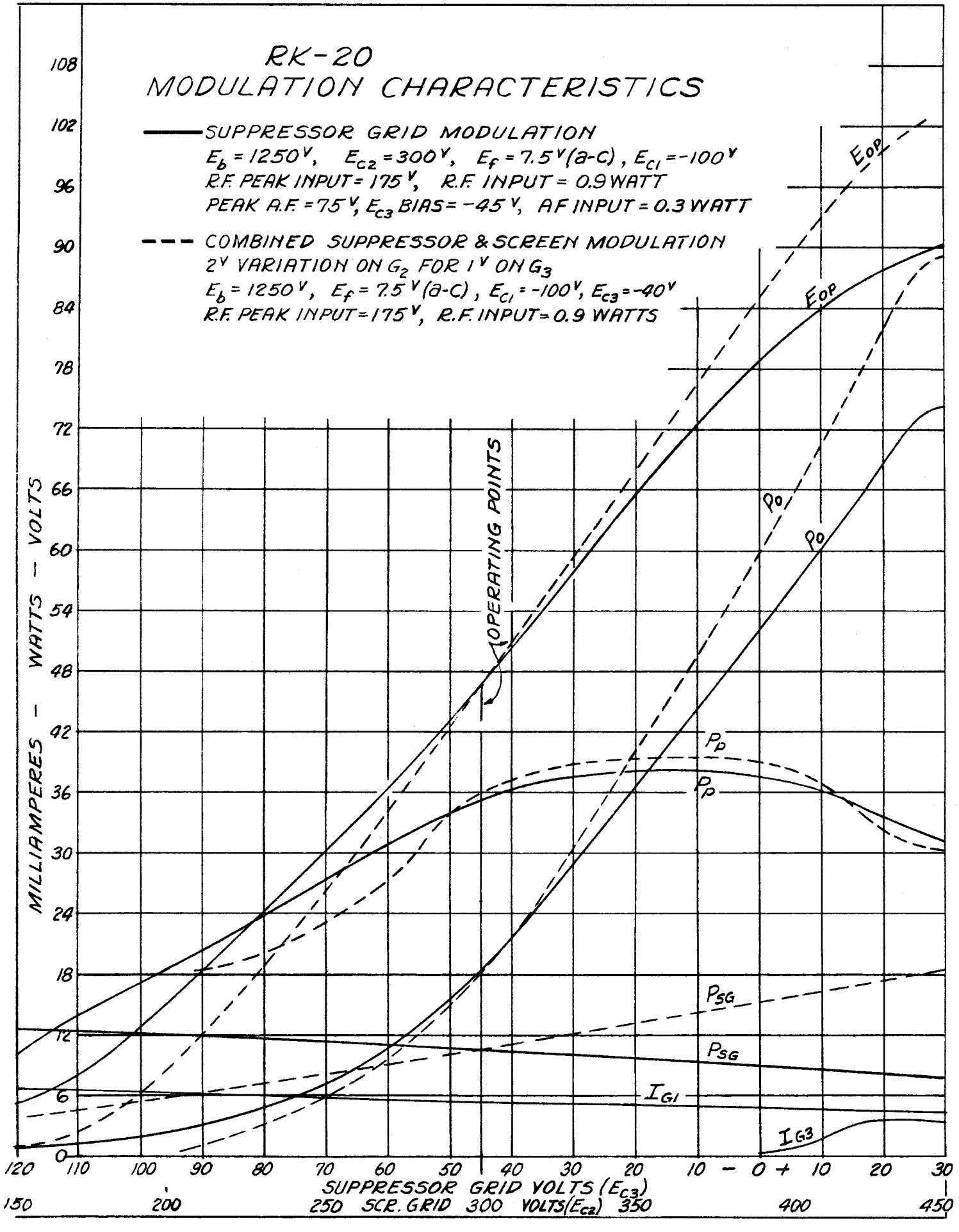
Load Resistance There are two methods of adjusting the plate load. One is to adjust for maximum efficiency which adjustment usually shows a decided dip in the plate current at resonance. The other is to obtain the maximum power for rated plate dissipation. There will usually be very little dip in the plate current when this is done. The load resistance should be adjusted by applying a d-c voltage to the modulating grid equal to peak a-f swing. Otherwise if the load is set at the no modulation condition, trouble will be experienced on the up modulation and the excitation will be set too high with resultant poor modulation and gross overloading on the screen. Care should be taken not to set the load resistance too low, however, because if this is done the plate will be overloaded. In case of combined plate and screen modulation the d-c plate voltage for adjustment should not exceed 1250 volts.

Screen Supply The screen voltage may be obtained either from a separate source or through a dropping resistor. The dropping resistor aids modulation but not very much. For example, the combined suppressor and screen modulation curve shows an upper limit of the effect of the screen on modulation. Actually, however, the results obtained will be closer to the curve for suppressor alone than to the combined modulation curves. The screen should in all cases be by-passed for r.f.

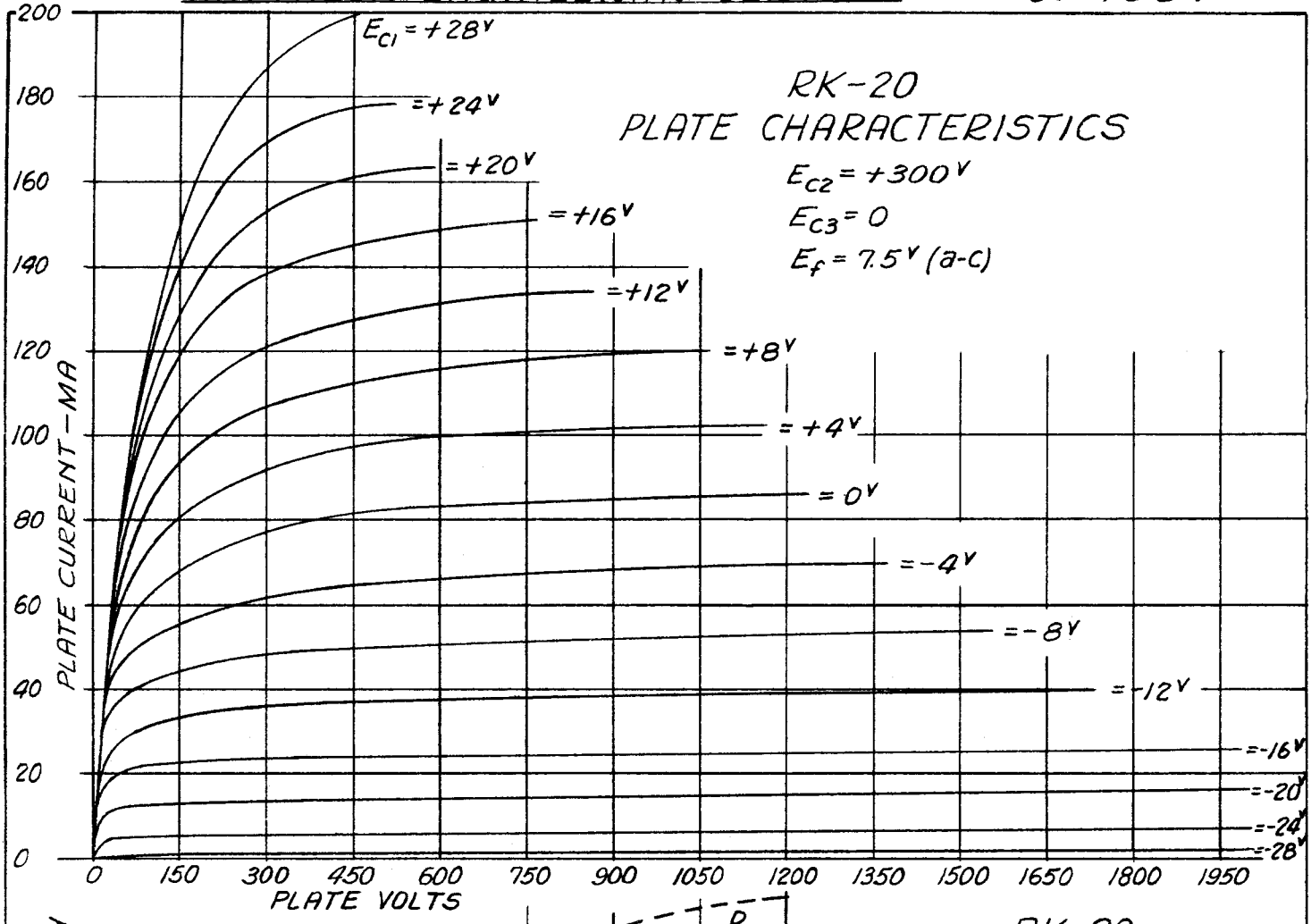
Frequency Doubler The power ratings given should be decreased when used in this service. The adjustments are much more critical than for a straight amplifier or modulator. If care is taken in the adjustment about 50 watts should be obtained with reasonable plate dissipation with at least 100 volts bias on the control grid.

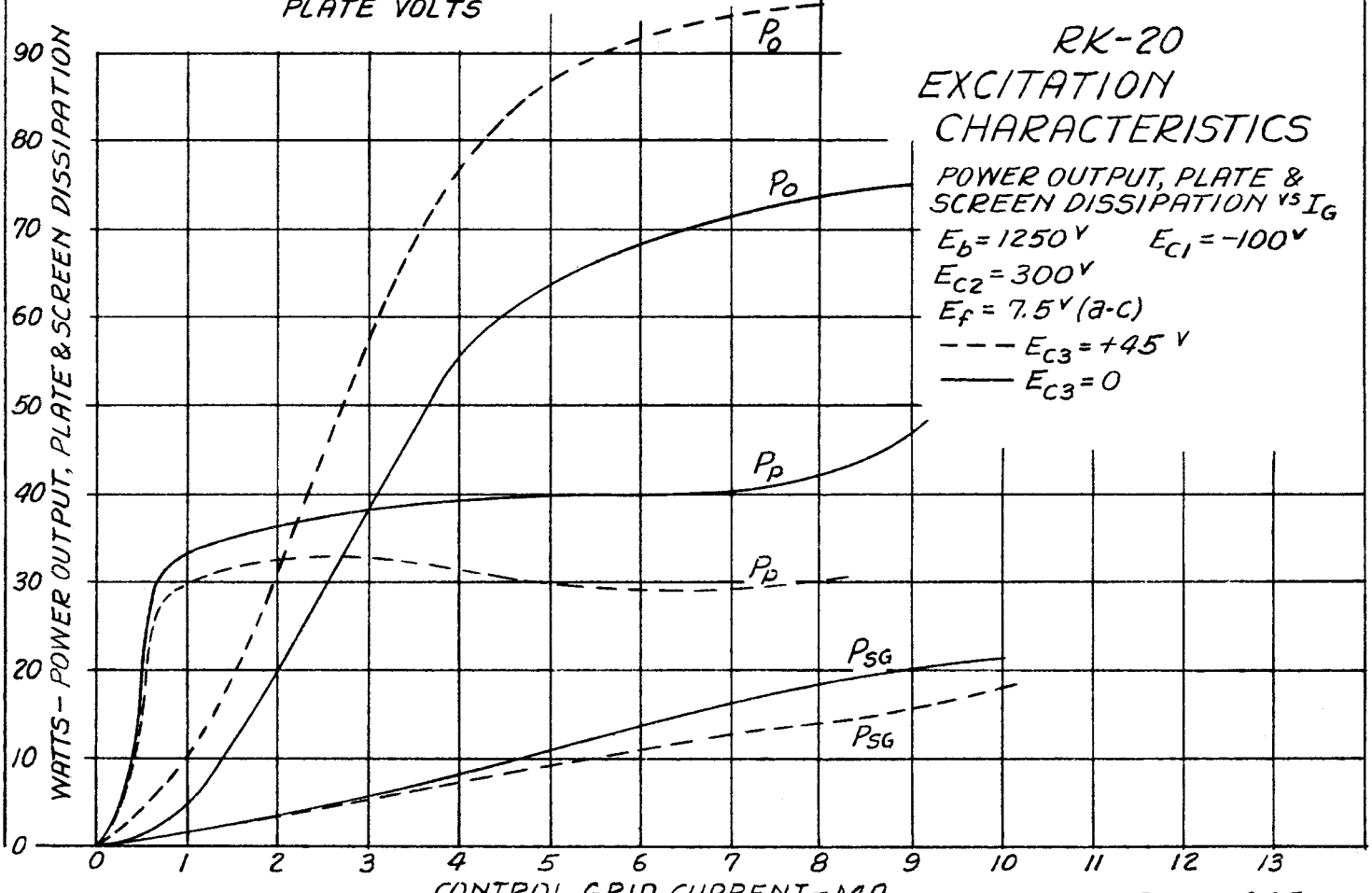
Shielding Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-20, it should enclose the base end and extend up only to the lower internal shield and should clear the glass bulb by at least 1/16 of an inch.

Bias Supply Battery bias or at least partial battery bias in the control grid is recommended. Additional bias may be obtained by placing a resistor in series with the battery.


RK-20
MODULATION CHARACTERISTICS
SUPPRESSOR GRID MODULATION
E_b = 1250 V, E_{c2} = 300 V, E_f = 7.5 V (a-c), E_{c1} = -100 V
R.F. PEAK INPUT = 175 V, R.F. INPUT = 0.9 WATT
PEAK A.F. = 75 V, E_{c3} BIAS = -45 V, AF INPUT = 0.3 WATT
COMBINED SUPPRESSOR & SCREEN MODULATION
2 V VARIATION ON G_2 FOR 1 V ON G_3
E_b = 1250 V, E_f = 7.5 V (a-c), E_{c1} = -100 V, E_{c3} = -40 V
R.F. PEAK INPUT = 175 V, R.F. INPUT = 0.9 WATTS
E_{OP}
E_{OP}
P_O
P_O
OPERATING POINTS
P_P
P_P
P_{SG}
P_{SG}
I_{G1}
I_{G3}
MILLIAMPERES - WATTS - VOLTS
108
102
96
90
84
78
72
66
60
54
48
42
36
30
24
18
12
6
0
120 110 100 90 80 70 60 50 40 30 20 10 - 0 + 10 20 30
SUPPRESSOR GRID VOLTS (E_{c3})
150 200 250 SCR. GRID 300 VOLTS (E_{c2}) 350 400 450

4-12-35


RK-20
PLATE CHARACTERISTICS
E_{c2} = +300 V
E_{c3} = 0
E_f = 7.5 V (a-c)
E_{c1} = +28 V
+24 V
+20 V
+16 V
+12 V
+8 V
+4 V
0 V
-4 V
-8 V
-12 V
-16 V
-20 V
-24 V
-28 V
PLATE CURRENT - MA
PLATE VOLTS
0 150 300 450 600 750 900 1050 1200 1350 1500 1650 1800 1950
0 20 40 60 80 100 120 140 160 180 200


RK-20
EXCITATION
CHARACTERISTICS
POWER OUTPUT, PLATE & SCREEN DISSIPATION VS I_G
E_b = 1250 V
E_{c1} = -100 V
E_{c2} = 300 V
E_f = 7.5 V (a-c)
--- E_{c3} = +45 V
—— E_{c3} = 0
P_o
P_o
P_p
P_p
P_{SG}
P_{SG}
WATTS - POWER OUTPUT, PLATE & SCREEN DISSIPATION
CONTROL GRID CURRENT - MA
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 10 20 30 40 50 60 70 80 90

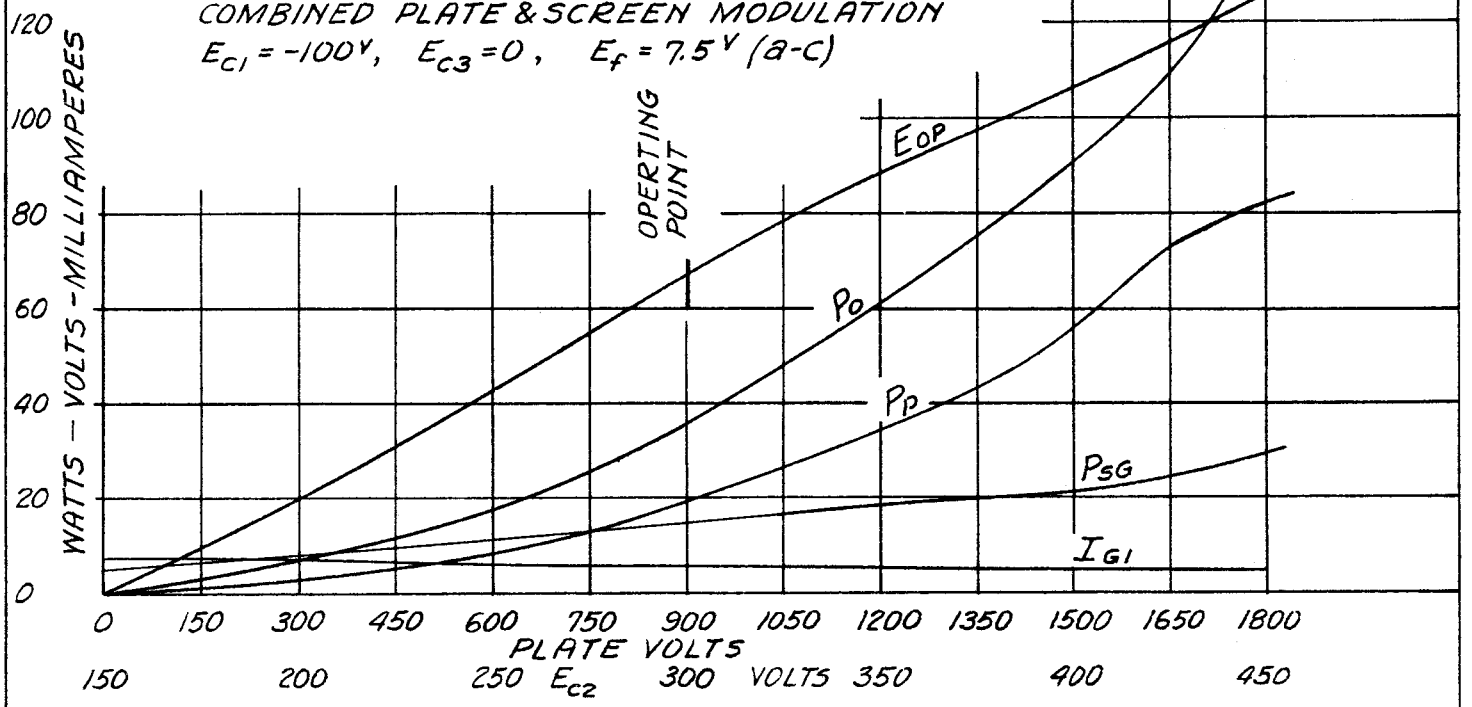
REV 5-14-35

RAYTHEON ENGINEERING SERVICE

RK-20 MODULATION CHARACTERISTICS

COMBINED PLATE & SCREEN MODULATION

$E_{c1} = -100^V$, $E_{c3} = 0$, $E_f = 7.5^V$ (a-c)

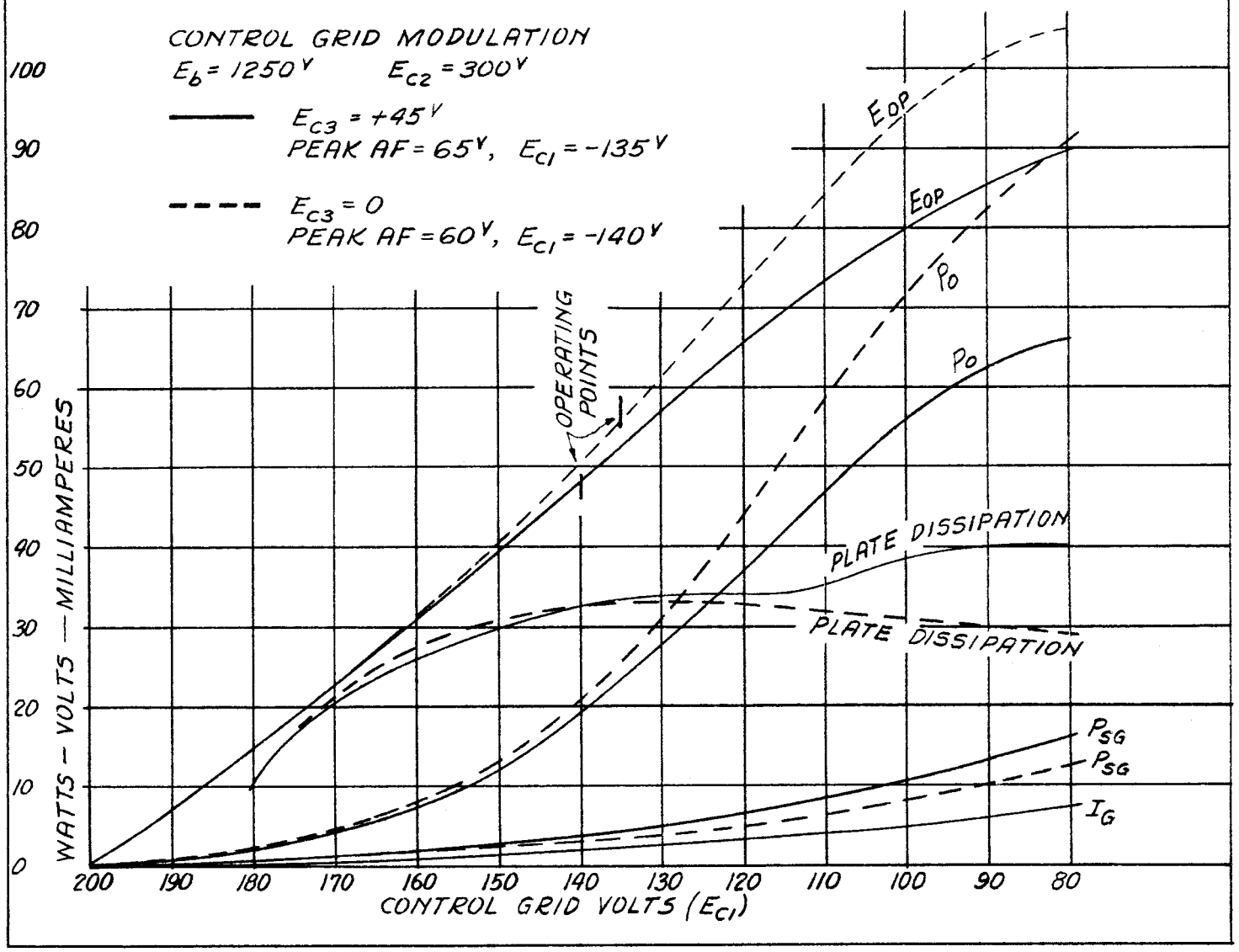


CONTROL GRID MODULATION

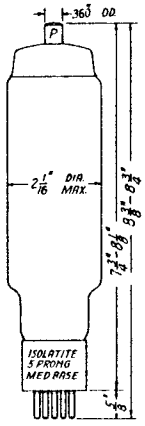
$E_b = 1250^V$ $E_{c2} = 300^V$

——— $E_{c3} = +45^V$
PEAK AF = 65^V, $E_{c1} = -135^V$

– – – – $E_{c3} = 0$
PEAK AF = 60^V, $E_{c1} = -140^V$

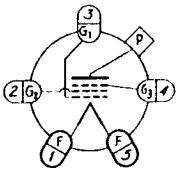


REV 4-26-35



PENTODE POWER AMPLIFIER OSCILLATOR

The RK-20A is a pentode type power amplifier tube having a thoriated tungsten filament, a molybdenum plate, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier. The RK-20A may also be used in circuits employing suppressor or control grid modulation.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.01	μμf
Input	14	μμf
Output	12	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1250	volts
D-C Plate Voltage—Telephony		
With Control or Sup. Grid Modulation	1250	volts
With Plate & Screen Modulation	1000	volts
D-C Screen Voltage	300	volts
D-C Plate Current	92	ma
D-C Control Grid Current	15	ma
R-F Control Grid Current	5	amp
Plate Dissipation	40	watts
Screen Dissipation	15	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Suppressor Grid Modulation	Telephony Plate & Screen Modulation	Telegraphy		
D-C Plate Voltage	1250	1250	1250	1000	1250	1250	volts
D-C Screen Voltage	300	300	300	300	300	300	volts
D-C Sup. Grid Volt.	0	+45	−45	0	0	+45	volts
D-C Con. Grid Volt.	−142	−142	−100	−100	−100	−100	volts
D-C Plate Current	40	40	48	75	80	92	ma
D-C Screen Current	7	7	44	30	43	36	ma
D-C Con. Grid Current	1.8	1.8	11.5	10	11.5	11.5	ma
Screen Resistor	—	—	—	23000‡	—	—	ohms
Peak R-F Input Volt.	160	160	140	145	155	155	volts
R-F Driving Power	1.5*	1.5*	1.5	1.3	1.6	1.6	watts
Carrier Power Output	17	20	21	52	64	84	watts
Peak A-F Volt.—Plate	—	—	—	1000*	—	—	volts
Peak A-F Volt.—Grid	30 *	30 *	75 *	300 *	—	—	volts
A-F Modulating Power	0.3*	0.3*	0.36*	52	—	—	watts
Peak Power Output	68 *	80 *	84 *	208 *	—	—	watts

*At the peak of the a-f cycle with 100% modulation.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Plate Current (Carrier)	70	ma
Plate Dissipation (Carrier)	40	watts
Screen Dissipation (Carrier)	15	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Suppressor Grid Voltage	0	volts
D-C Grid Voltage	−30	volts
D-C Plate Current	43	ma
D-C Screen Current	15	ma
Peak R-F Input Voltage	70 *	volts
R-F Driving Power	0.5*	volts
Carrier Power Output	16	watts
Peak Power Output	64 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE
The RK-20A may be operated at the maximum ratings at frequencies up to 30 megacycles. At frequencies between 30 megacycles and 60 megacycles the maximum d-c plate voltage should not exceed 900 volts. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

EXCITATION
The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the control grid current in milliamperes. The power output flattens off around 11 or 12 ma. of grid current with very little gained beyond these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

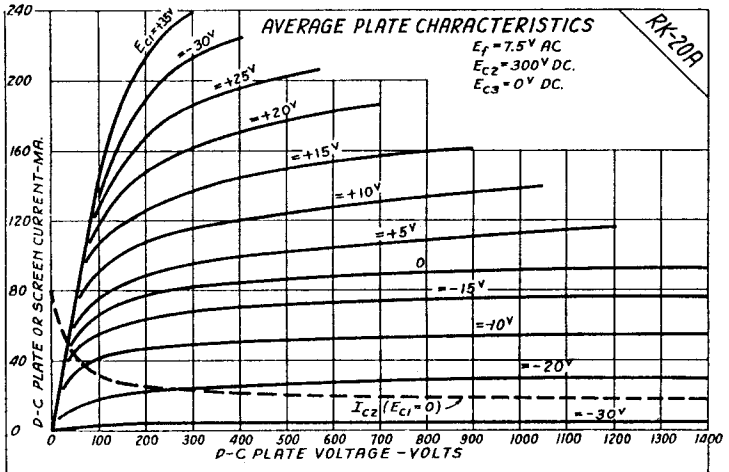
SCREEN VOLTAGE
The screen voltage may be obtained either from a separate source or through a dropping resistor from the plate supply. The screen should always be by-passed to the filament midpoint for r.f.

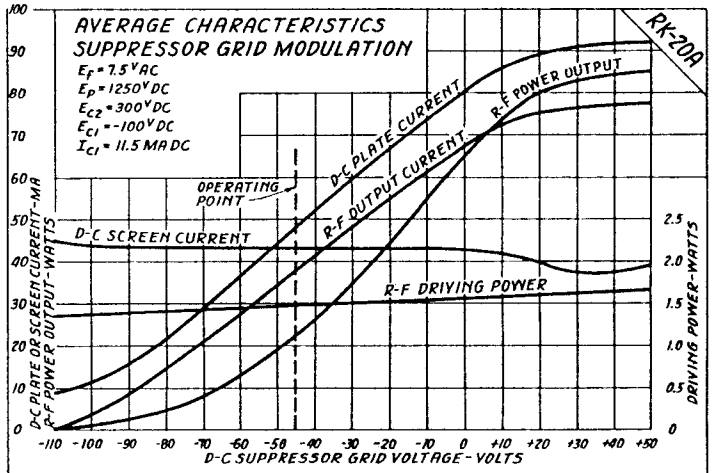
SHIELDING
Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-20A it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

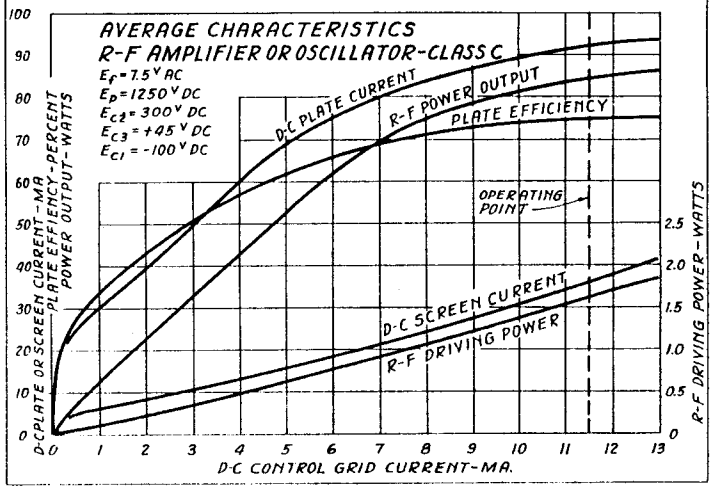
BIAS
Battery bias, or at least partial battery bias on the control grid is recommended. Additional bias may be obtained by placing a resistor in series with the battery.

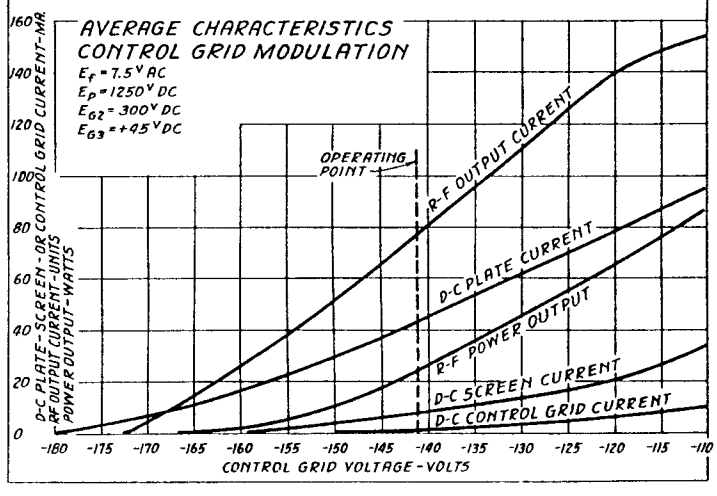
CRYSTAL OSCILLATOR
Using crystal control, 50 watts of r-f power output may be obtained without overheating the crystal.

PLATE TEMPERATURE
The plate of the RK-20A will not show color when operated at its rated plate dissipation. Dissipations above the rated value should be avoided.

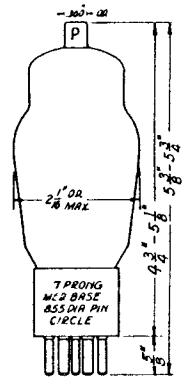


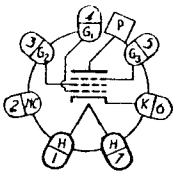






PENTODE POWER AMPLIFIER OSCILLATOR





BOTTOM VIEW OF SOCKET

The RK-23 and the RK-25 are heater type pentode power amplifier tubes having isolantite bases. The RK-25B is similar to the RK-25 except that the base is of bakelite. These tubes are designed for use as power amplifiers, oscillators or frequency multipliers. They may also be used in circuits employing suppressor or control grid modulation.

HEATER RATING

	RK-23	RK-25 RK-25B	
Heater Voltage	2.5	6.3	volts
Heater Current	2	0.9	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.2	μμf
Input	10	μμf
Output	10	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	500	volts
D-C Plate Voltage—Telephony		
With Con. or Sup. Grid Modulation	500	volts
With Plate & Screen Modulation	400	volts
D-C Screen Voltage	250	volts
D-C Plate Current	60	ma
D-C Control Grid Current	10	ma
Plate Dissipation	10	watts
Screen Dissipation	8	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Suppressor Grid Modulation	Telephony Plate & Screen Modulation	Telegraphy		
D-C Plate Voltage	500	500	500	400	500	500	volts
D-C Screen Voltage	200	200	200	150	200	200	volts
D-C Sup. Grid Voltage	0	+45	−45	0	0	+45	volts
D-C Con. Grid Volt.	−125	−125	−90	−90	−90	−90	volts
D-C Plate Current	32	34	31	43	50	55	ma
D-C Screen Current	20	20	39	30	40	38	ma
D-C Con. Grid Current	1.5	1.5	4	6	4	4	ma
Screen Resistor	—	—	—	8300‡	—	—	ohms
Peak R-F Input Volt.	150	150	135	145	135	135	volts
R-F Driving Power	1.2*	1.3*	0.5	0.8	0.5	0.5	watts
Carrier Power Output	5.5	6.5	6	13.5	18	22	watts
Peak A-F Volt.—Plate	—	—	—	400*	—	—	volts
Peak A-F Volt.—Grid	45 *	45 *	75 *	150*	—	—	volts
A-F Modulating Power	0.5*	0.55*	0.3*	14.5	—	—	watts
Peak Power Output	22 *	26 *	24 *	54 *	—	—	watts

*At the peak of the a-f cycle with 100% modulation.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	500	volts
D-C Screen Voltage	250	volts
D-C Plate Current (Carrier)	35	ma
Plate Dissipation (Carrier)	10	watts
Screen Dissipation (Carrier)	8	watts

TYPICAL OPERATION

D-C Plate Voltage	500	volts
D-C Screen Voltage	200	volts
D-C Suppressor Grid Voltage	0	volts
D-C Control Grid Voltage	−38	volts
D-C Plate Current	30	ma
D-C Screen Current	12	ma
Peak R-F Input Voltage	80 *	volts
R-F Driving Power	0.24*	watts
Carrier Power Output	5	watts
Peak Power Output	20 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE
The RK-23, RK-25 and RK-25B may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

EXCITATION
The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 4 or 5 ma. of grid current with very little gained beyond these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

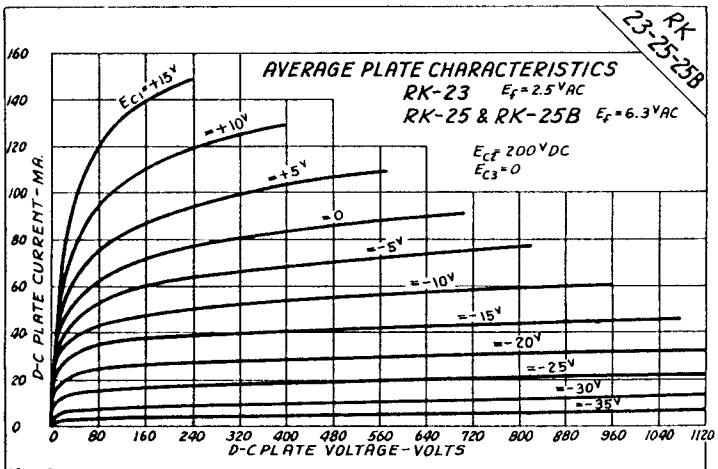
SCREEN VOLTAGE
The screen voltage may be obtained either from a separate source or through a dropping resistor from the plate supply. The screen should always be by-passed to the cathode for r.f.

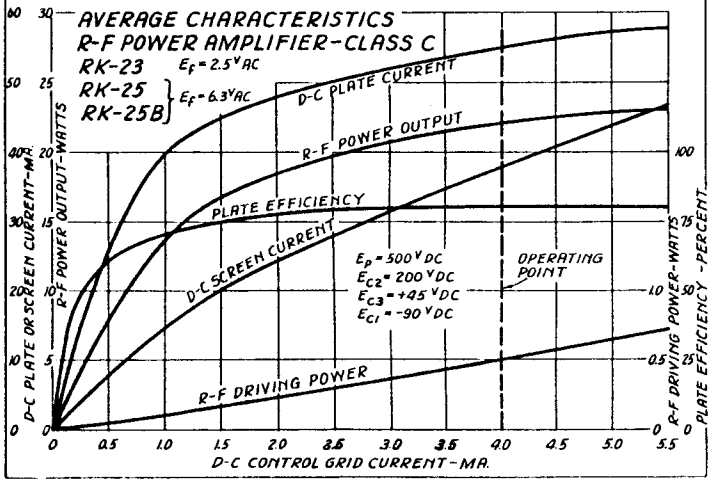
SHIELDING
Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-23, RK-25 or RK-25B, it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

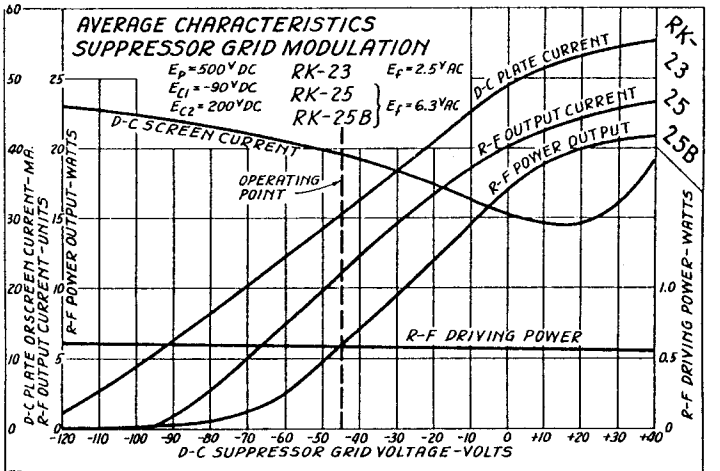
BIAS
At least 25 volts of fixed bias should be used with 500 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

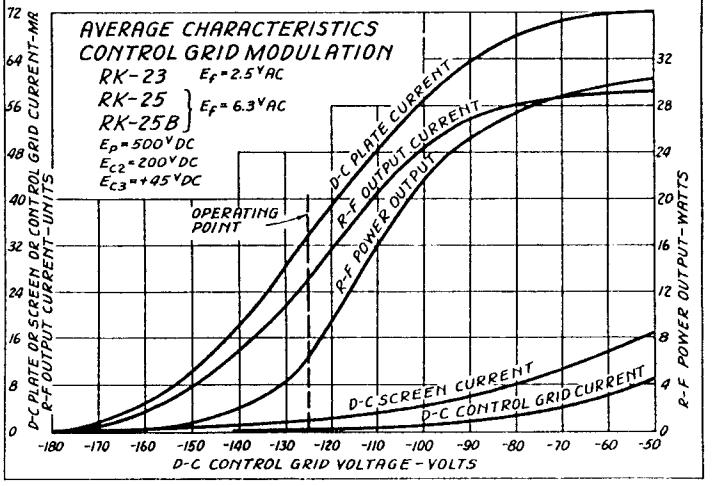
CRYSTAL OSCILLATOR
Using crystal control, 20 watts of r-f power output may be obtained without overheating the crystal.

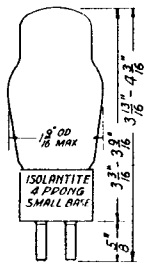
PLATE TEMPERATURE
The plate of the RK-23, RK-25 or RK-25B will not show color when operated at the rated plate dissipation. Dissipations above the rated value should be avoided.



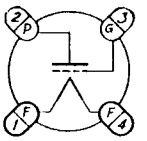








TRIODE AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-24 is a triode type amplifier tube having a coated filament and an isolantite base. It is designed for use as an amplifier or oscillator in transceivers and portable equipment at ultra-high frequencies. It will supply more power output and give better life than the type 30 in these applications.

FILAMENT RATING

Filament Voltage	2.0 d-c	volts
Filament Current	0.12	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	5.5	μμf
Input	3.5	μμf
Output	3.0	μμf

A-F AMPLIFIER—CLASS A

MAXIMUM RATINGS

D-C Plate Voltage	180	volts
Plate Dissipation	1.5	watts

TYPICAL OPERATION

D-C Plate Voltage	90	135	180	volts
D-C Grid Voltage	−4.5	−9	−13.5	volts
D-C Plate Current	4.5	6	8	ma
Amplification Factor	8	8	8	
Plate Resistance	5500	5300	5000	ohms
Transconductance	1450	1500	1600	μmhos
Load Resistance	5000	9000	12000	ohms
Power Output	25	110	250	mw

R-F AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage	180	volts
D-C Plate Current	20	ma
D-C Grid Current	6	ma
Plate Dissipation	1.5	watts

TYPICAL OPERATION

D-C Plate Voltage	180	volts
D-C Grid Voltage	−45	volts
D-C Plate Current	16.5	ma
D-C Grid Current	6	ma
Peak R-F Input Voltage	92	volts
R-F Driving Power	0.5	watts
Power Output	2	watts

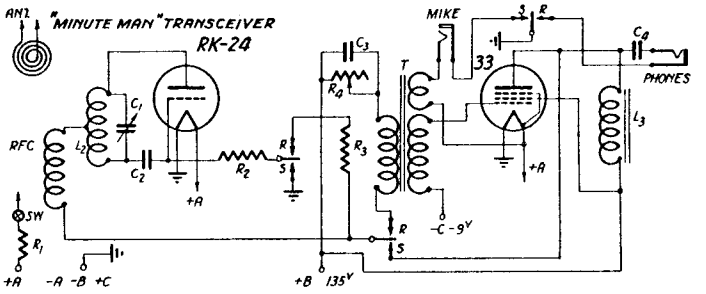
OPERATING NOTES

FREQUENCY RANGE
The RK-24 is particularly adapted for use in circuits operating at frequencies from 60 to 112 megacycles.

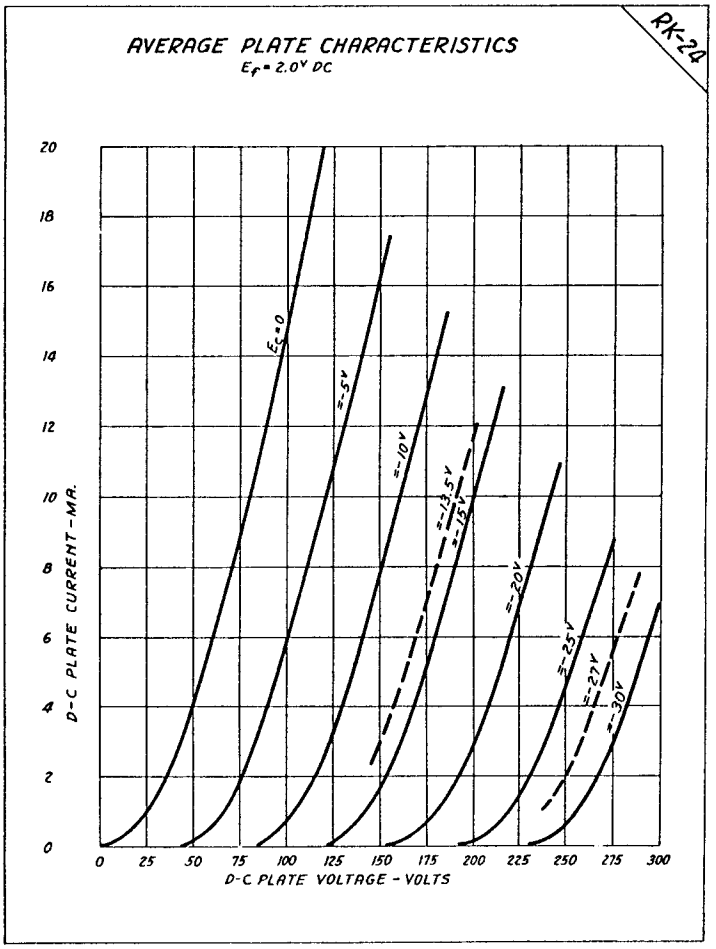
FILAMENT VOLTAGE
The filament voltage at the socket of the RK-24 should be maintained at 2 volts in order to insure long life.

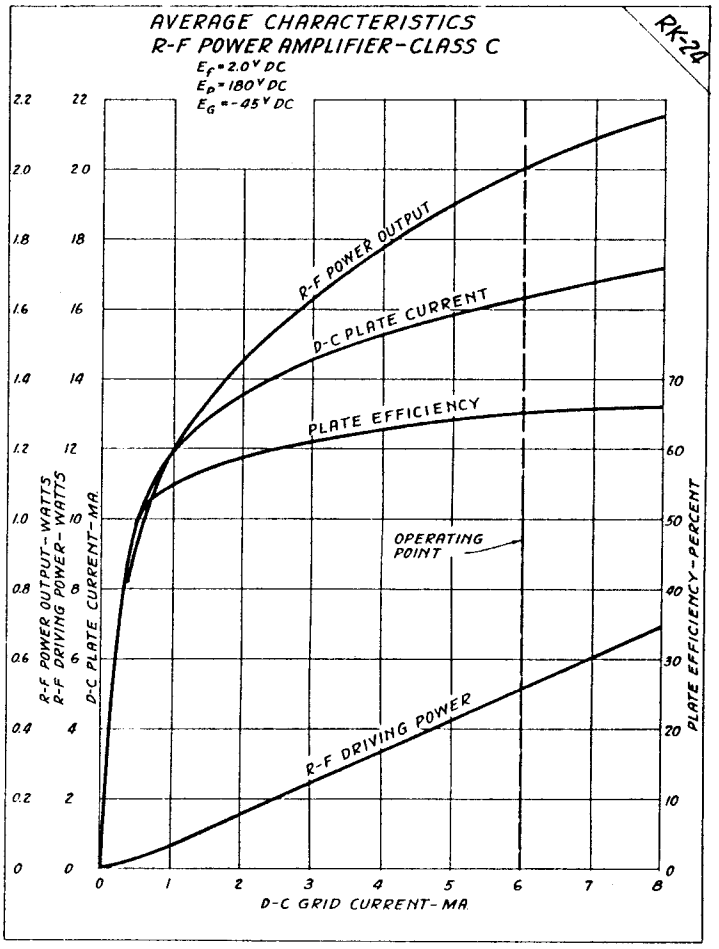
PLATE TEMPERATURE
The plate of the RK-24 will not show color when operated at the maximum rated dissipation. Dissipations above the rated value should be avoided.

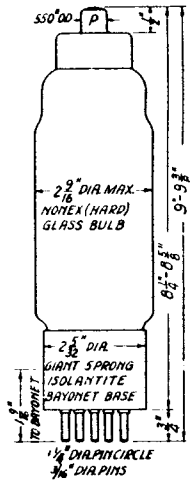
TRANSCEIVER
The circuit below is the "Minute Man" receiver converted for use as a transceiver as shown in A.R.R.L.'s QST-magazine for September 1936.



C_1 —Two-plate midget variable, low loss
C_2 —100 μμfd.
C_3 —0.25 μfd.
C_4 —0.1 μfd.
L_2 —10 turns No. 14, ½ inch inside diameter, spaced diameter of wire.
T —Transceiver Transformer.
RFC—45 turns No. 25 cotton-covered wire, inside diameter ¼ inch, close wound and self-supporting.
R_1 —3 ohms
R_2 —10,000 ohms
R_3 —5 megohms.
R_4 —50,000 ohms variable
L_1 —Four turns in flat spiral

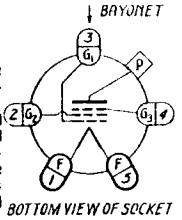






PENTODE POWER AMPLIFIER OSCILLATOR

The RK-28 is a pentode type power amplifier tube having a thoriated tungsten filament, a molybdenum plate, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier. The RK-28 may also be used in circuits employing suppressor or control grid modulation.



FILAMENT RATING

Filament Voltage	10	volts
Filament Current	5	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.02	μμf
Input	15	μμf
Output	15	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	2000	volts
D-C Plate Voltage—Telephony With Con. Grid or Sup. Grid Modulation	2000	volts
With Plate—Screen Mod.	1500	volts
D-C Screen Voltage	400	volts
D-C Plate Current	150	ma
D-C Control Grid Current	25	ma
R-F Control Grid Current	8	amp
Plate Dissipation	100	watts
Screen Dissipation	35	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Suppressor Grid Modulation	Telephony Plate & Screen Modulation		Telegraphy		
D-C Plate Voltage	2000	2000	2000	1500	1500	2000	2000	volts
D-C Screen Voltage	400	400	400	400	400	400	400	volts
D-C Sup. Grid. Volt.	0	+45	−45	0	+45	0	+45	volts
D-C Con. Grid Volt.	−140	−140	−100	−100	−100	−100	−100	volts
D-C Plate Current	85	80	85	135	135	120	150	ma
D-C Screen Current	20	20	65	64	52	75	55	ma
D-C Con. Grid Current	4	4	13	13	13	13	13	ma
Screen Resistor	—	—	—	17000‡	21000‡	—	—	ohms
Peak R-F Input Volt.	170	170	150	170	170	170	170	volts
R-F Driving Power	3.5 *	3.5 *	1.8	2.0	2.0	2.0	2.0	watts
Carrier Power Output	70	75	60	135	155	160	210	watts
Peak A-F Volt.—Plate	—	—	—	1500*	1500*	—	—	volts
Peak A-F Volt.—Grid	50 *	50 *	90 *	400 *	400 *	—	—	volts
A-F Modulating Power	1.0 *	1.0 *	1.2 *	150	140	—	—	watts
Peak Power Output	280*	300*	240*	540 *	620 *	—	—	watts

*At the peak of the a-f cycle with 100% modulation.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	2000	volts
D-C Screen Voltage	400	volts
D-C Plate Current	80	ma
Plate Dissipation (Carrier)	100	watts
Screen Dissipation (Carrier)	35	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Screen Voltage	400	volts
D-C Suppressor Grid Voltage	0	volts
D-C Control Grid Voltage	−38	volts
D-C Plate Current	75	ma
D-C Screen Current	30	ma
Peak R-F Input Voltage	90 *	volts
R-F Driving Power	0.9 *	watts
Carrier Power Output	50	watts
Peak Power Output	200*	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

The RK-28 may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to a maximum of 1500 volts to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

EXCITATION

The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 12 or 13 ma. of grid current with very little gained above these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

SHIELDING

Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-28 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS

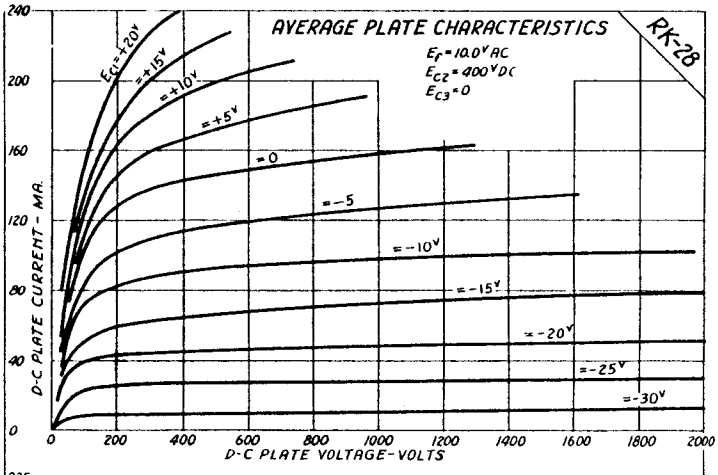
At least 20 volts of fixed bias should be used with 2000 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

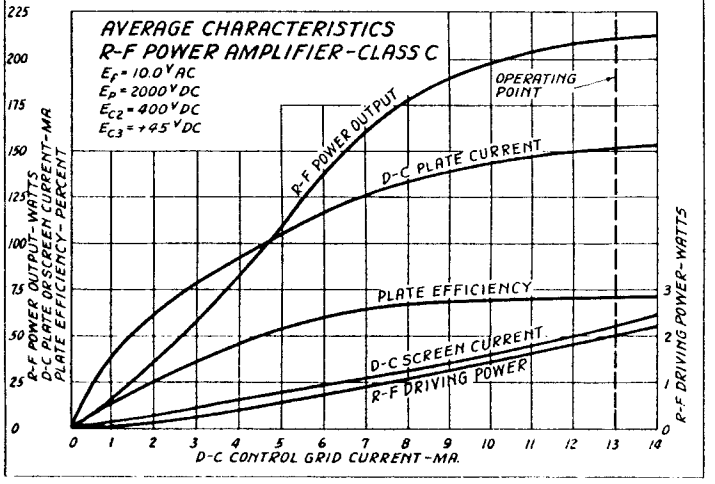
CRYSTAL OSCILLATOR

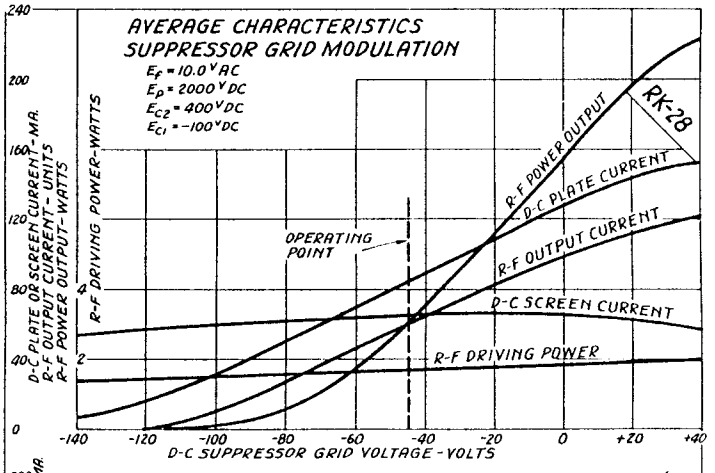
Using crystal control, 150 watts of r-f power output may be obtained without overheating the crystal.

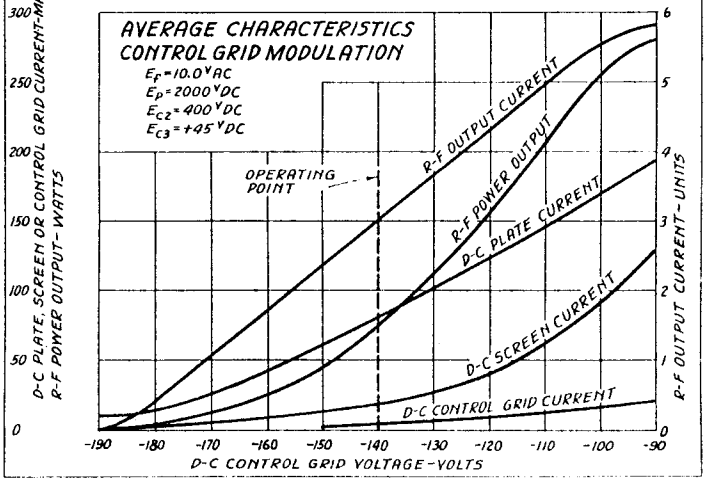
PLATE TEMPERATURE

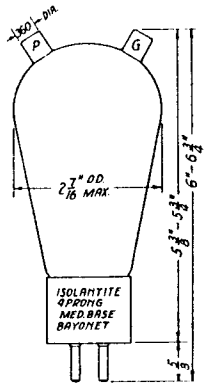
The plate of the RK-28 will show a light red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



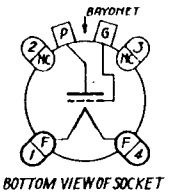








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-30 is a triode type power amplifier tube having a thoriated tungsten filament, a molybdenum plate and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

AMPLIFICATION FACTOR 15

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	2.5	μμf
Input	2.75	μμf
Output	2.75	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1250	volts
D-C Plate Voltage—Telephony		
With Grid Modulation	1250	volts
With Plate Modulation	1000	volts
D-C Plate Current	80	ma
D-C Grid Current	25	ma
Plate Dissipation—Telegraphy	35	watts
Plate Dissipation—Telephony		
With Grid Modulation (Carrier)	35	watts
With Plate Modulation (Carrier)	23	watts

TYPICAL OPERATION

	Telephony Grid Modulation	Telephony Plate Modulation	Telegraphy	
D-C Plate Voltage	1250	1000	1250	volts
D-C Grid Voltage	—140	—200	—180	volts
D-C Plate Current	40	80	90	ma
D-C Grid Current	1.5	15	18	ma
Peak R-F Input Voltage	170	320	320	volts
R-F Driving Power	1.5*	4.5	5.2	watts
Carrier Power Output	18	60	85	watts
Peak A-F Modulating Voltage	60 *	1000*	—	volts
A-F Modulating Power	0.5*	40	—	watts
Peak Power Output	72 *	240 *	—	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (Carrier)	55	ma
Plate Dissipation (Carrier)	35	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—70	volts
D-C Plate Current	40	ma
D-C Grid Current	1.3	ma
Peak R-F Input Voltage	200*	volts
R-F Driving Power	2.5 *	watts
Carrier Power Output	18	watts
Peak Power Output	72 *	watts

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (per tube)	80	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	35	atts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—70	volts
D-C Plate Current (no signal)	30	ma
D-C Plate Current (max. signal)	130	ma
D-C Grid Current (max. signal)	26	ma
Peak A-F Input Voltage (grid to grid)	300	volts
A-F Driving Power	3.4	watts
Load Resistance (plate to plate)	21000	ohms
Power Output	106	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

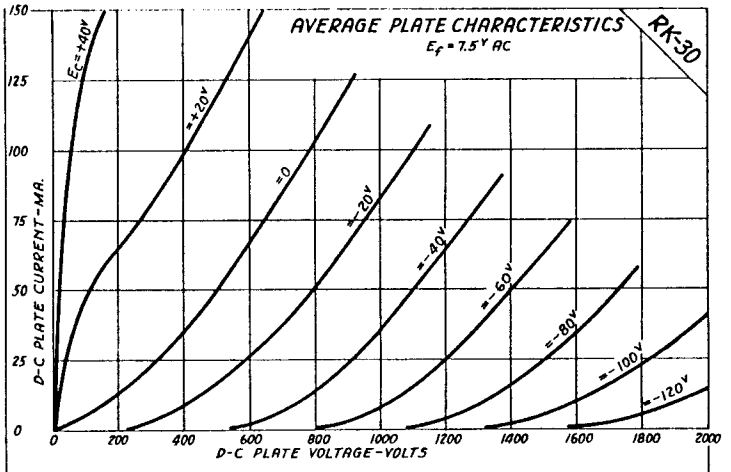
The RK-30 may be operated at the maximum ratings at frequencies up to 60 megacycles. At frequencies between 60 megacycles and 120 megacycles the maximum d-c plate voltage should not exceed 1000 volts. Above 120 megacycles the maximum d-c plate voltage should not exceed 750 volts.

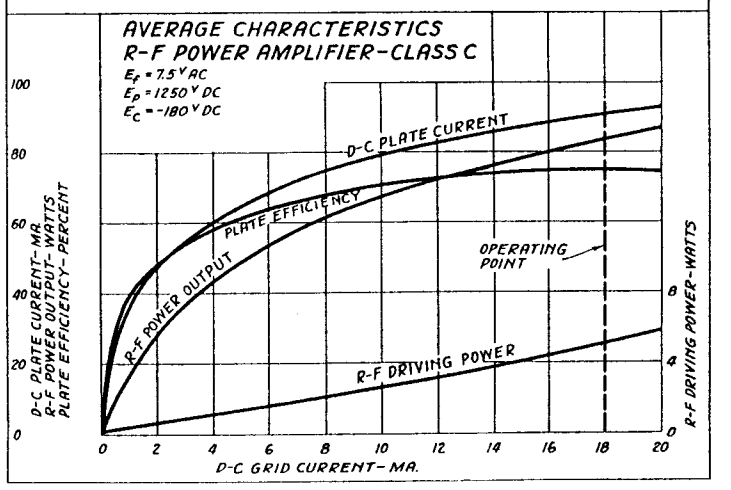
BIAS

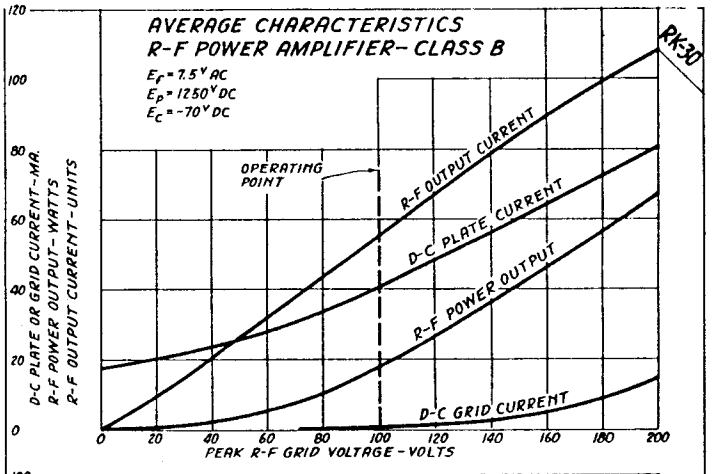
At least 55 volts of fixed bias should be used with 1250 volts on the plate to protect the tube in case of failure of the bias or excitation. The fixed bias may be reduced with lower plate voltages.

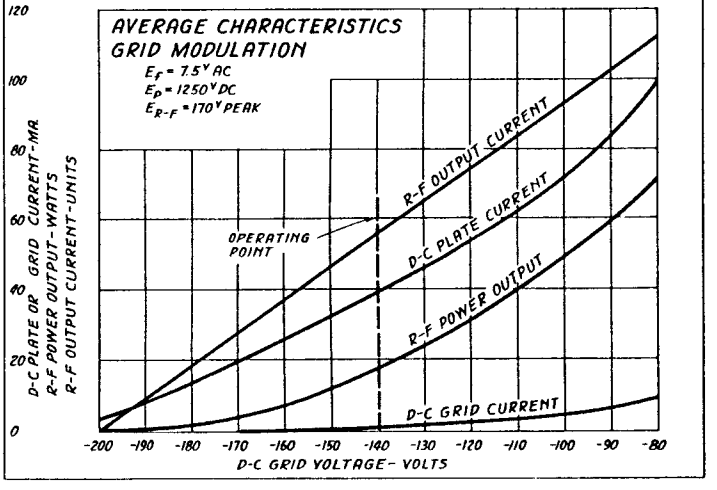
PLATE TEMPERATURE

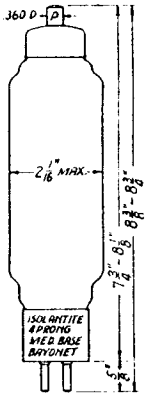
The plate of the RK-30 will show a dull, cherry red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



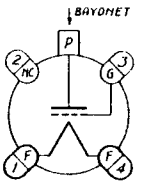








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKE

The RK-31 is a high-mu triode power amplifier tube having a thoriated tungsten filament, a molybdenum plate and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.0	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	10	μμf
Input	7	μμf
Output	2	μμf

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (per tube)	115	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	40	watts

TYPICAL OPERATION

D-C Plate Voltage	1000	1250	volts
D-C Grid Voltage	0	0	volts
D-C Plate Current (no signal)	25	35	ma
D-C Plate Current (max. signal)	230	220	ma
D-C Grid Current (max. signal)	65	76	ma
Peak A-F Input Voltage (grid to grid)	141	141	volts
A-F Driving Power	3.7	4.4	watts
Load Resistance (plate to plate)	11000	18000	ohms
Power Output	160	190	watts

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current	100	ma
D-C Grid Current	35	ma
R-F Grid Current	5	amp
Plate Dissipation	40	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	−80	volts
D-C Plate Current	100	ma
D-C Grid Current	30	ma
Peak R-F Input Voltage	145	volts
R-F Driving Power	3.9	watts
Power Output	90	watts

R-F POWER AMPLIFIER—CLASS C—PLATE MODULATION

MAXIMUM RATINGS

D-C Plate Voltage	1000	volts
D-C Plate Current	100	ma
D-C Grid Current	35	ma
Plate Dissipation	30	watts

TYPICAL OPERATION

D-C Plate Voltage	1000	volts
D-C Grid Voltage	−80	volts
D-C Plate Current	100	ma
D-C Grid Current	28	ma
Peak R-F Input Voltage	140	volts
R-F Driving Power	3.5	watts
Carrier Power Output	70	watts
A-F Modulating Power	50	watts
Peak Power Output	280	watts

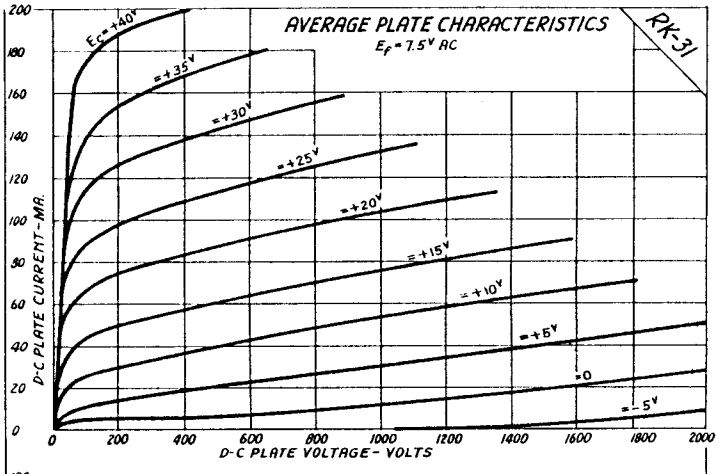
OPERATING NOTES

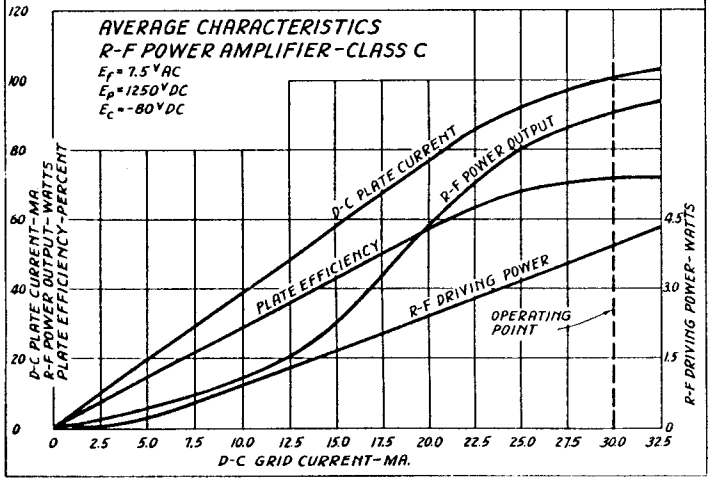
FREQUENCY RANGE

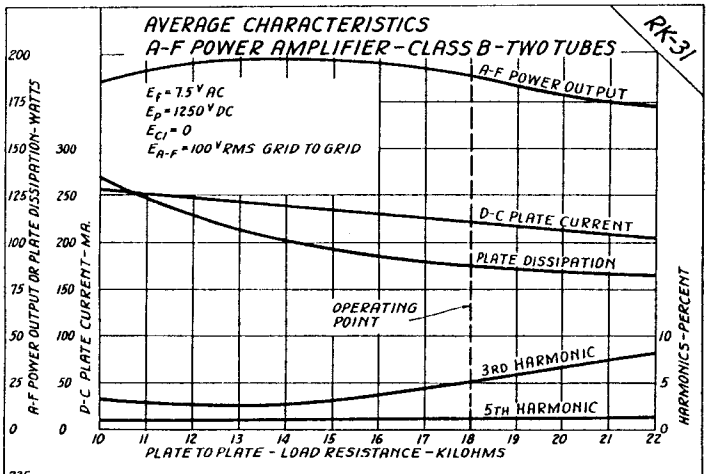
The RK-31 may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

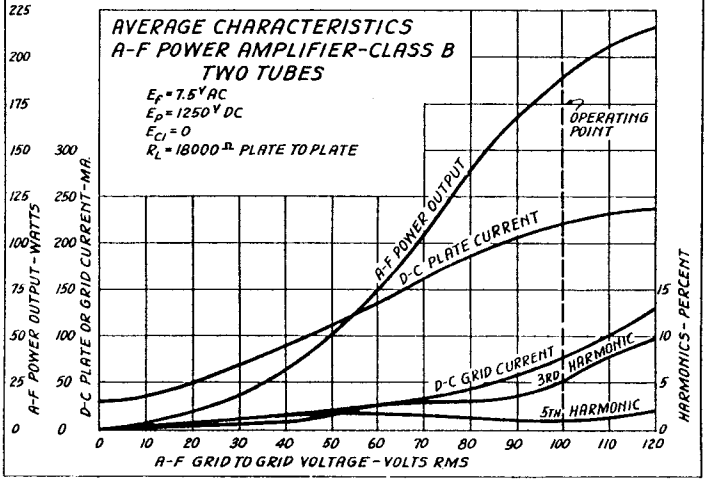
PLATE TEMPERATURE

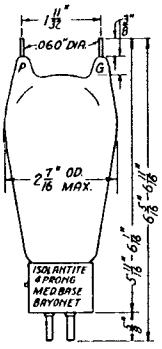
The plate of the RK-31 will show a light cherry red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.





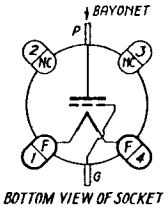






TRIODE POWER AMPLIFIER OSCILLATOR

The RK-32 is a triode type power amplifier tube having a thoriated tungsten filament, a tantalum plate and grid, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.



BOTTOM VIEW OF SOCKET

AMPLIFICATION FACTOR 11

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	3.4	μμf
Input	2.5	μμf
Output	0.7	μμf

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current	100	ma
D-C Grid Current	25	ma
Plate Dissipation	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—225	volts
D-C Plate Current	100	ma
D-C Grid Current	14	ma
Peak R-F Input Voltage	380	volts
R-F Driving Power	4.8	watts
Power Output	90	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current	66	ma
Plate Dissipation	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—120	volts
D-C Plate Current	50	ma
Peak R-F Input Voltage	200*	volts
R-F Driving Power	2.5 *	watts
Carrier Power Output	21	watts
Peak Power Output	84	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	1250	1000	volts
D-C Plate Current (Carrier)	100	100	ma
D-C Grid Current (Carrier)	25	25	ma
Plate Dissipation (Carrier)	50	32	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	1000	volts
D-C Grid Voltage	—200	—310	volts
D-C Plate Current	60	100	ma
D-C Grid Current	1.2	21	ma
Peak R-F Input Voltage	235	415	volts
R-F Driving Power	5 *	8.7	watts
Carrier Power Output	25	70	watts
Peak A-F Modulating Voltage	100*	1000*	volts
A-F Modulating Power	2.1 *	50	watts
Peak Power Output	100*	280 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

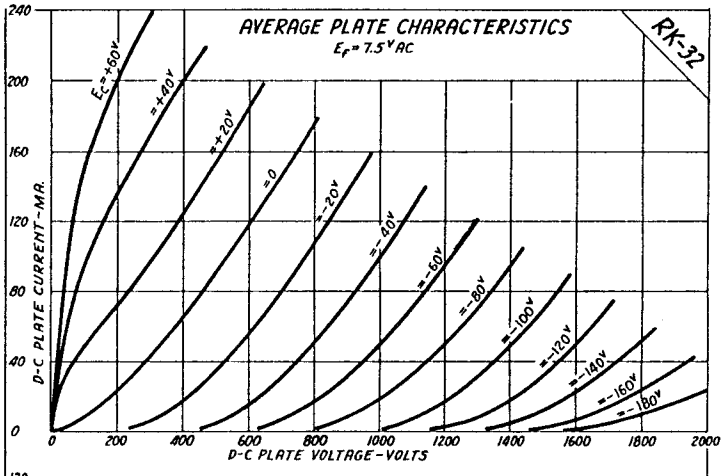
The RK-32 may be operated at the maximum ratings at frequencies up to 150 megacycles. Above 150 megacycles the reduced efficiency realized requires that the plate voltage be reduced to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tube at frequencies higher than 300 megacycles is not recommended.

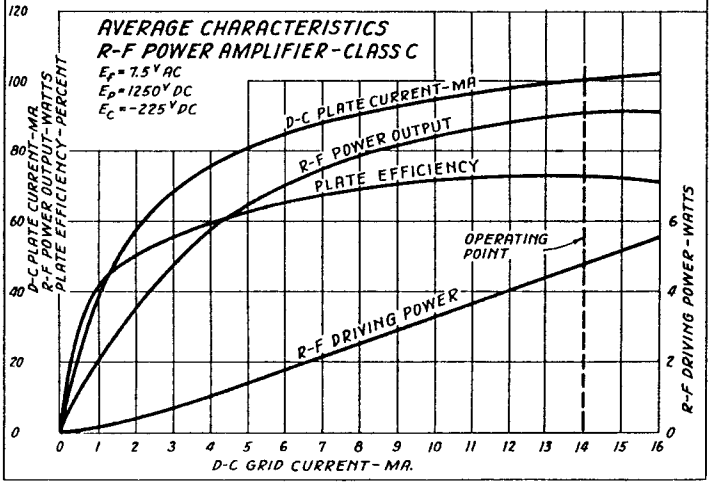
BIAS

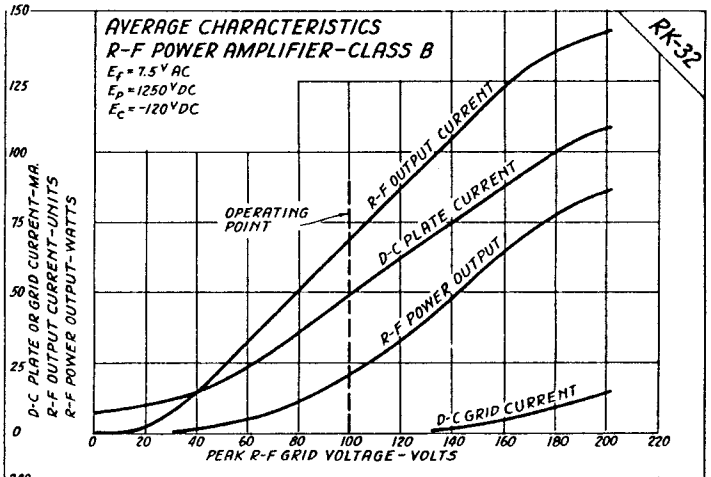
At least 90 volts of fixed bias should be used with 1250 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

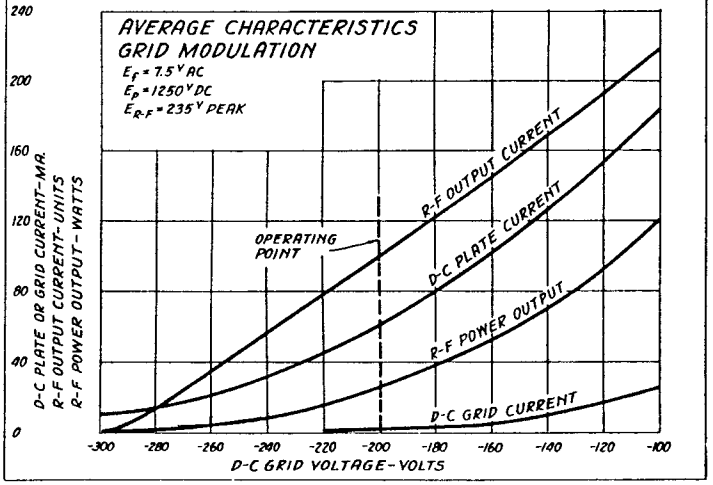
PLATE TEMPERATURE

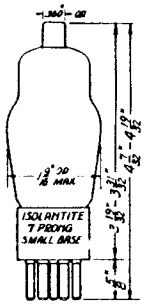
The plate of the RK-32 will show an orange color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.





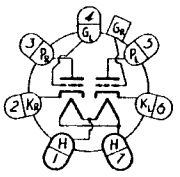






TWIN TRIODE AMPLIFIER OSCILLATOR

The RK-33 is a heater type twin triode amplifier tube having an isolantite base. It is designed for use in circuits where but one triode is operated at the maximum ratings. One triode may be operated at the maximum ratings as a Class C amplifier or oscillator while the other triode is operated as a low power oscillator, resistance coupled amplifier or detector.



BOTTOM VIEW OF SOCKET

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.6	amp

DIRECT INTERELECTRODE CAPACITANCES

	Left Triode	Right Triode	
Grid to Plate	3	2	μμf
Input	3	2	μμf
Output	2.5	2.5	μμf

A-F AMPLIFIER—CLASS A—ONE TRIODE

MAXIMUM RATINGS

D-C Plate Voltage	250	volts
Plate Dissipation	2.5	watts

TYPICAL OPERATION

D-C Plate Voltage	250	volts
D-C Grid Voltage	−16.5	volts
D-C Plate Current	8	ma
Amplification Factor	10.5	
Plate Resistance	8750	ohms
Transconductance	1200	μmhos
Load Resistance	20000	ohms

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY—ONE TRIODE

MAXIMUM RATINGS

D-C Plate Voltage	250	volts
D-C Plate Current	20	ma
D-C Grid Current	6	ma
Plate Dissipation	2.5	watts

TYPICAL OPERATION

D-C Plate Voltage	250	volts
D-C Grid Voltage	−60	volts
D-C Plate Current	20	ma
D-C Grid Current	6	ma
Peak R-F Input Voltage	100	volts
R-F Driving Power	0.54	watts
Power Output	3.5	watts

OPERATING NOTES

FREQUENCY RANGE

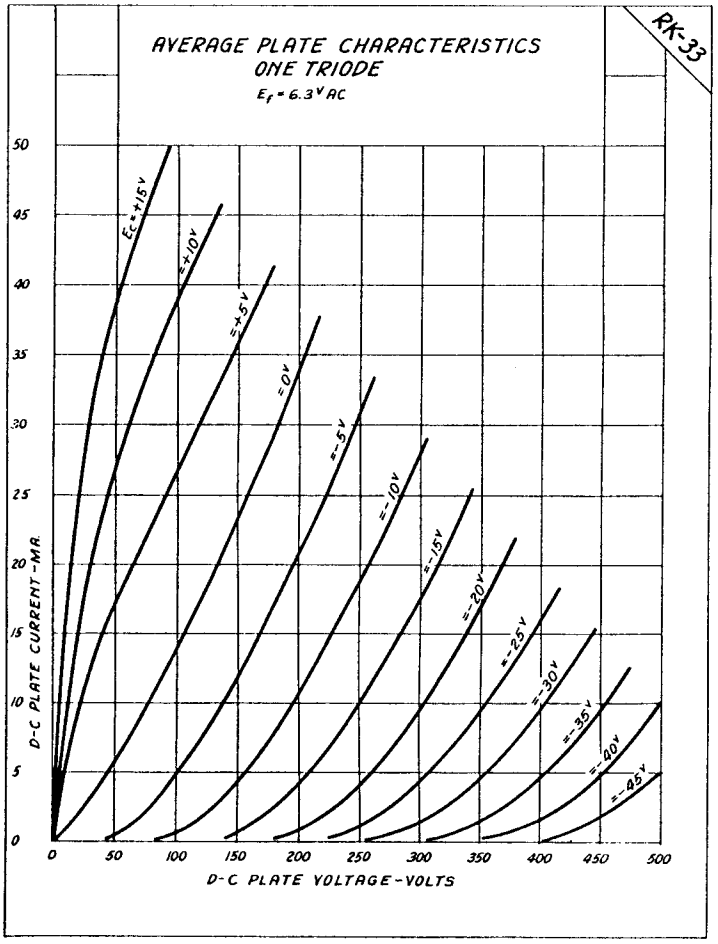
One triode of the RK-33 may be operated at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be reduced to prevent the plate dissipation from exceeding the maximum rated value.

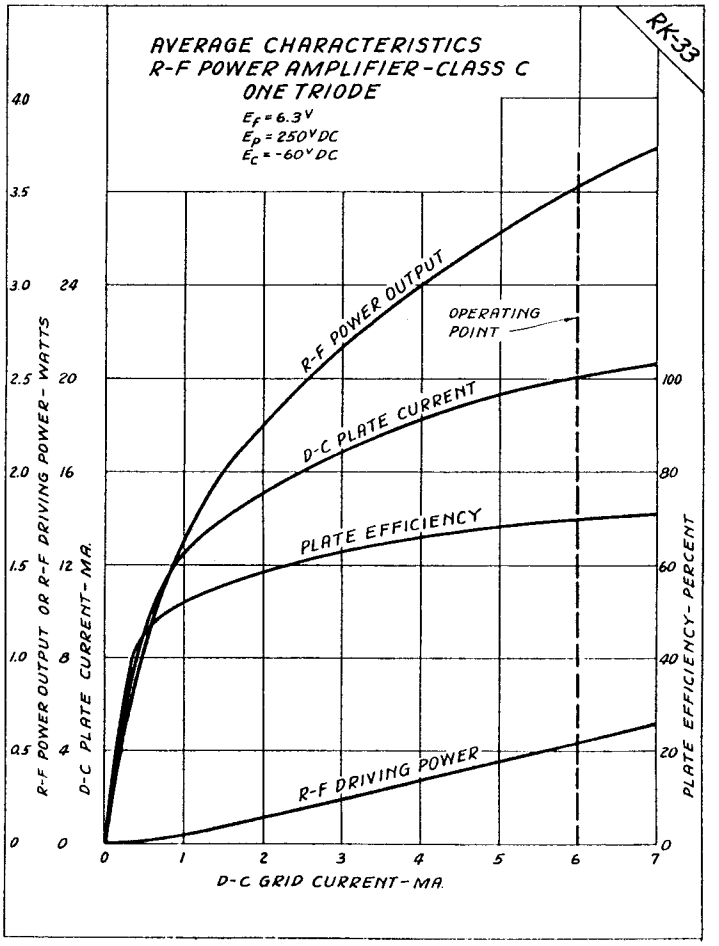
BIAS

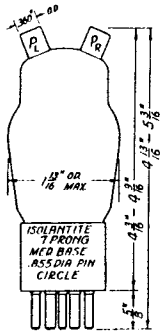
At least 15 volts of fixed bias should be used with 250 volts on the plate to protect the tube in case of failure of the bias or excitation.

PLATE TEMPERATURE

The plate of the RK-33 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.

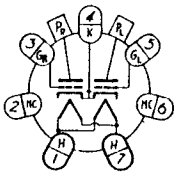






TWIN TRIODE POWER AMPLIFIER OSCILLATOR

The RK-34 is a heater type twin triode power amplifier tube having an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.



BOTTOM VIEW OF SOCKET

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.8	amp

DIRECT INTERELECTRODE CAPACITANCES—EACH TRIODE

Grid to Plate	2.7	μμf
Input	4.2	μμf
Output	0.8	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—PUSH-PULL—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage	300	volts
D-C Plate Current (both triodes)	80	ma
Plate Dissipation (both triodes) (Averaged over 1 cycle)	10	watts

TYPICAL OPERATION

D-C Plate Voltage	300	volts
D-C Grid Voltage	—36	volts
D-C Plate Current	80	ma
D-C Grid Current	20	ma
Peak R-F Input Voltage (grid to grid)	196	volts
R-F Driving Power	1.8	watts
Power Output	16	watts

A-F POWER AMPLIFIER—CLASS B

MAXIMUM RATINGS

D-C Plate Voltage	300	volts
Peak Plate Current (both triodes)	125	ma
Plate Dissipation (both triodes) (Averaged over 1 cycle)	10	watts

TYPICAL OPERATION

D-C Plate Voltage	180	300	volts
D-C Grid Voltage	—6	—15	volts
D-C Plate Current (no signal)	30	30	ma
D-C Plate Current (max. signal)	70	70	ma
D-C Grid Current (max. signal)	16	12	ma
Peak A-F Input Voltage (grid to grid)	100	100	volts
A-F Driving Power	0.7	0.5	watts
Load Resistance (plate to plate)	6000	10000	ohms
Power Output	7.8	13	watts

A-F POWER AMPLIFIER—CLASS A

(Two Triodes Connected in Parallel)

MAXIMUM RATINGS

D-C Plate Voltage	300	volts
Plate Dissipation	10	watts

TYPICAL OPERATION

D-C Plate Voltage	300	volts
D-C Grid Voltage	—16	volts
D-C Plate Current	25	ma
Amplification Factor	13	
Plate Resistance	2950	ohms
Transconductance	4400	μmhos
Load Resistance	5000	ohms
Power Output	0.8	watts

OPERATING NOTES

FREQUENCY RANGE

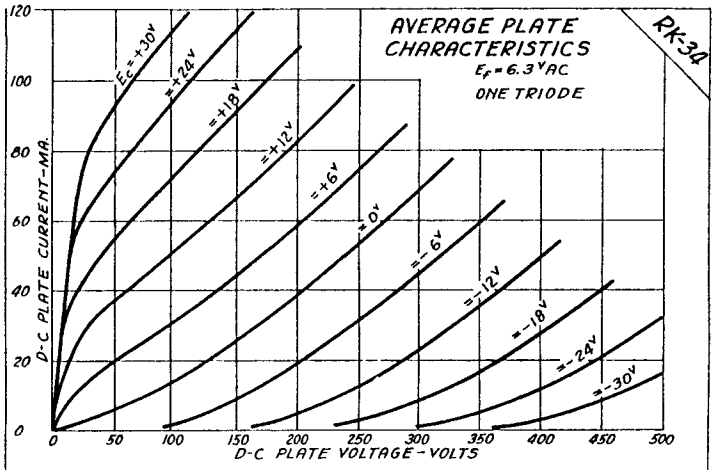
The RK-34 may be operated at the maximum ratings at frequencies up to 240 megacycles. Above 240 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

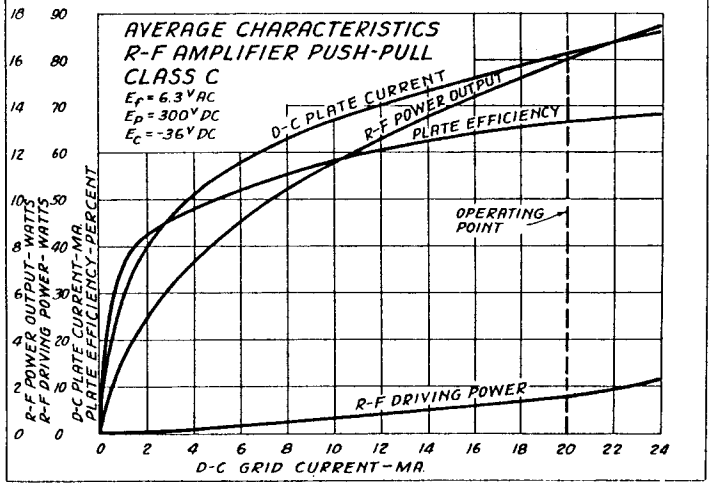
BIAS

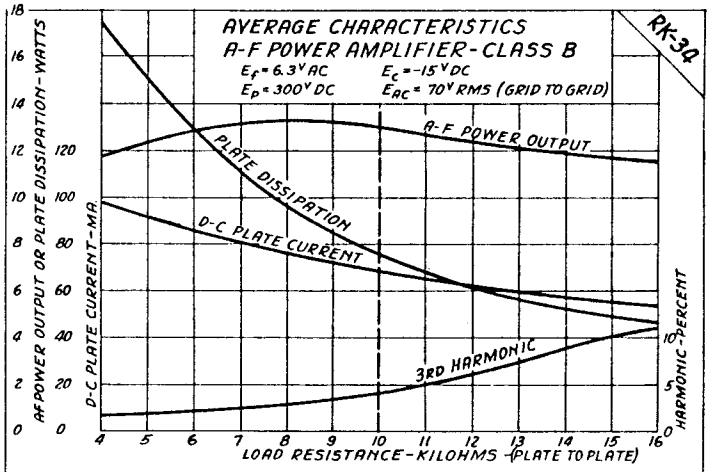
At least 15 volts of fixed bias should be used with 300 volts on the plate to protect the tube in case of failure of the bias or excitation.

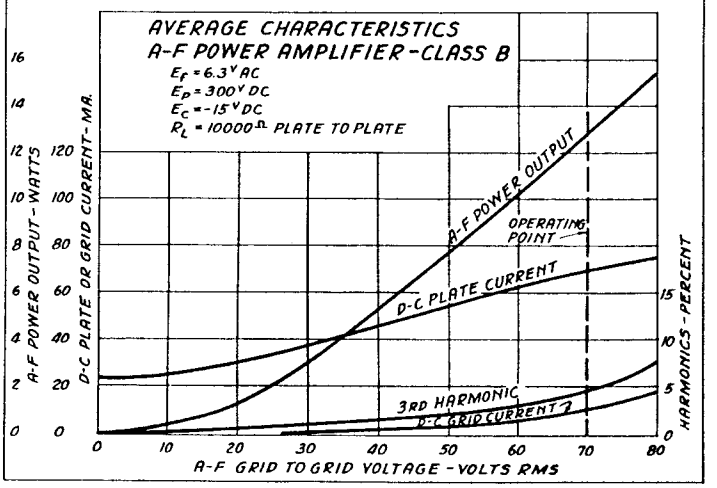
PLATE TEMPERATURE

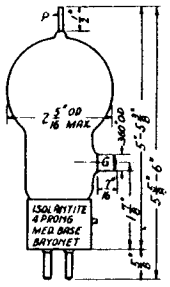
The plates of the RK-34 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



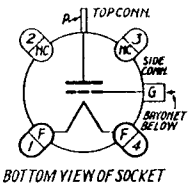








TRIODE POWER AMPLIFIER OSCILLATOR



The RK-35 is a triode type power amplifier tube having a tantalum plate and grid and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

AMPLIFICATION FACTOR 9

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	4	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	2.7	μμf
Input	3.5	μμf
Output	0.4	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current	125	ma
D-C Grid Current	20	ma
Plate Dissipation	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1500	volts
D-C Grid Voltage	—250	volts
D-C Plate Current	115	ma
D-C Grid Current	15	ma
Peak R-F Input Voltage	375	volts
R-F Driving Power	5	watts
Power Output	120	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current (Carrier)	50	ma
Plate Dissipation (Carrier)	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1500	volts
D-C Grid Voltage	—180	volts
D-C Plate Current	37	ma
D-C Grid Current	0	ma
Peak R-F Input Voltage	280*	volts
R-F Driving Power	2 *	watts
Carrier Power Output	25	watts
Peak Power Output	100*	watts

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	1500	1250	volts
D-C Plate Current (Carrier)	50	125	ma
Plate Dissipation (Carrier)	50	66	watts

TYPICAL OPERATION

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	1500	1250	volts
D-C Grid Voltage	—250	—250	volts
D-C Plate Current	50	100	ma
D-C Grid Current	0	14	ma
Peak R-F Input Voltage	230	365	volts
R-F Driving Power	1.7 *	4.6	watts
Carrier Power Output	25	93	watts
Peak A-F Modulating Voltage	100*	1250*	volts
A-F Modulating Power	0.3 *	63	watts
Peak Power Output	100*	372 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

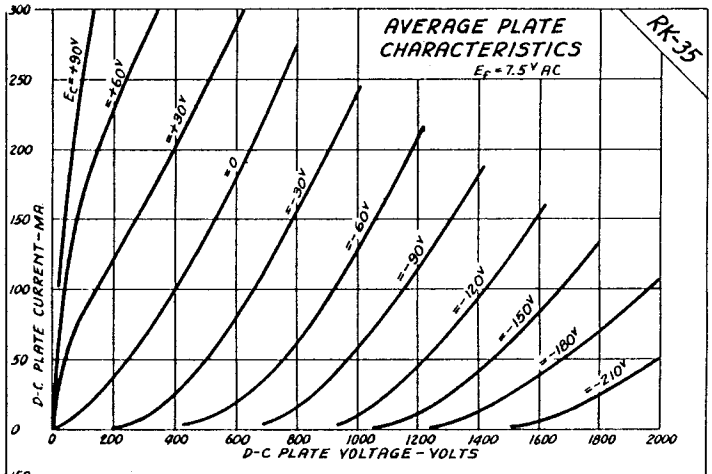
The RK-35 may be operated at the maximum ratings at frequencies up to 60 megacycles. At frequencies between 60 megacycles and 120 megacycles, the maximum d-c plate voltage should not exceed 1000 volts. Above 120 megacycles the maximum d-c plate voltage should not exceed 750 volts.

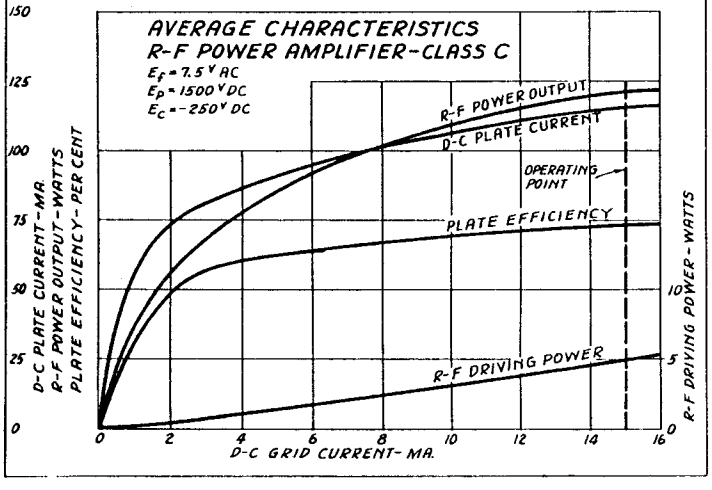
BIAS

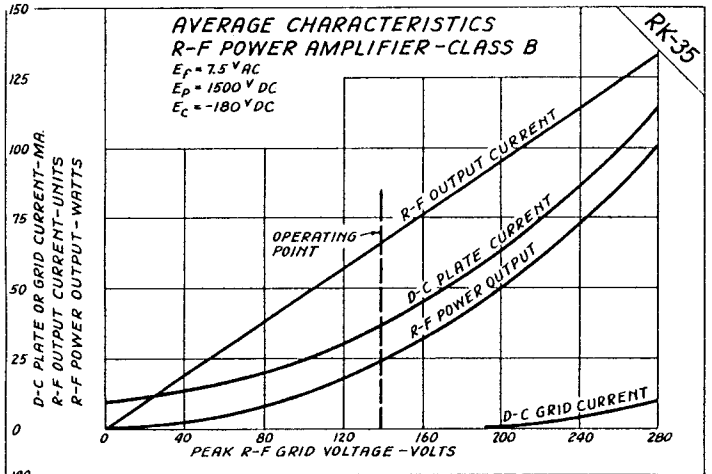
At least 170 volts of fixed bias should be used with 1500 volts on the plate to protect the tube in case of failure of the bias or excitation. The fixed bias may be reduced at lower plate voltages.

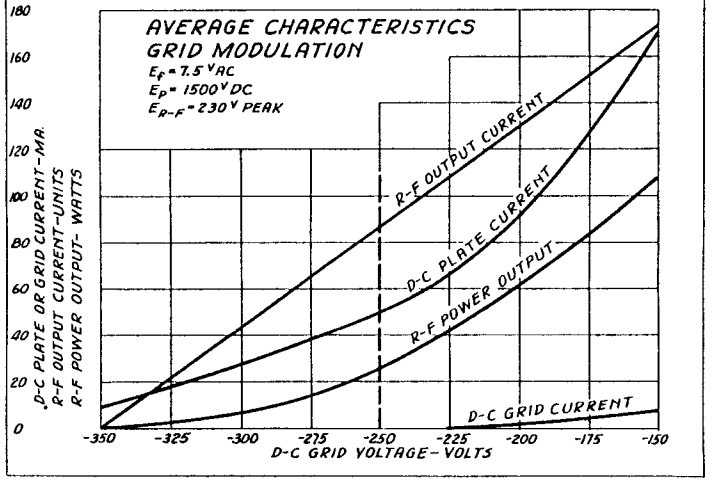
PLATE TEMPERATURE

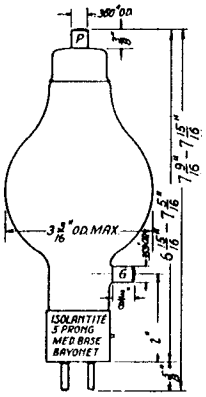
The plate of the RK-35 will show a light yellowish red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



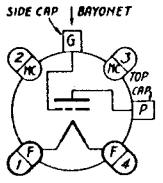








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-36 is a triode type power amplifier tube having a thoriated tungsten filament, a tantalum plate and grid, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	5.0	volts
Filament Current	8.0	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	5	μμf
Input	4.5	μμf
Output	1.0	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	3000	volts
D-C Plate Current	165	ma
D-C Grid Current	35	ma
Plate Dissipation	100	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Grid Voltage	—360	volts
D-C Plate Current	150	ma
D-C Grid Current	30	ma
Peak R-F Input Voltage	560	volts
R-F Driving Power	15	watts
Power Output	200	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	3000	volts
D-C Plate Current (Carrier)	100	ma
Plate Dissipation (Carrier)	100	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Grid Voltage	—180	volts
D-C Plate Current	75	ma
D-C Grid Current	3	ma
Peak R-F Input Voltage	420*	volts
R-F Driving Power	10 *	watts
Carrier Power Output	50	watts
Peak Power Output	200*	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	3000	2000	volts
D-C Plate Current (Carrier)	100	165	ma
D-C Grid Current (Carrier)	5	35	ma
Plate Dissipation (Carrier)	100	100	watts

TYPICAL OPERATION

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	2000	2000	volts
D-C Grid Voltage	—270	—360	volts
D-C Plate Current	72	150	ma
D-C Grid Current	1	30	ma
Peak R-F Input Voltage	315	560	volts
R-F Driving Power	3.5 *	15	watts
Carrier Power Output	42	200	watts
Peak A-F Modulating Voltage	110*	2000*	volts
A-F Modulating Power	1 *	150	watts
Peak Power Output	168*	800 *	watts

A-F POWER AMPLIFIER—CLASS A

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current	165	ma
Plate Dissipation	100	watts

TYPICAL OPERATION

D-C Plate Voltage	1500	volts
D-C Grid Voltage	—77.5	volts
D-C Plate Current	67	ma
Amplification Factor	14	
Plate Resistance	5600	ohms
Transconductance	2500	μmhos
Load Resistance	10000	ohms
Power Output	21	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

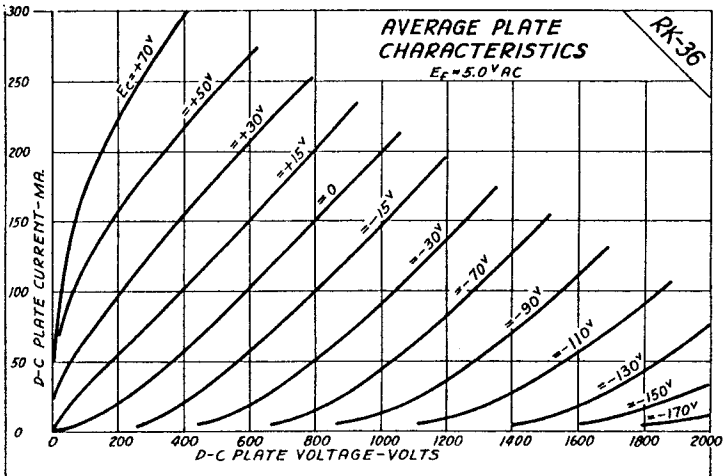
The construction of the RK-36 allows efficient operation at frequencies up to 60 megacycles. Above 60 megacycles reduced efficiency requires that the plate voltage be reduced to prevent the plate dissipation from exceeding the maximum rated value.

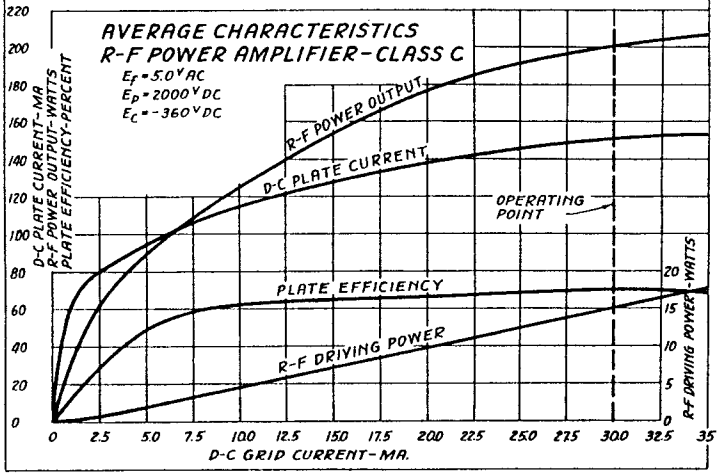
BIAS

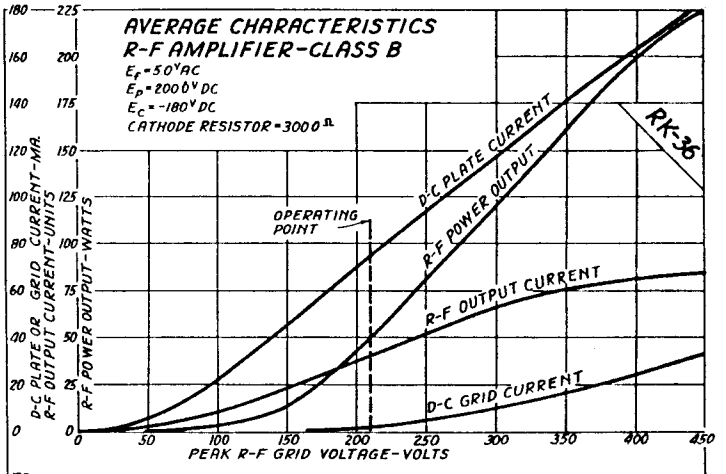
At least 150 volts of fixed bias should be used with 2000 volts on the plate to protect the tube in case of failure of the bias or excitation.

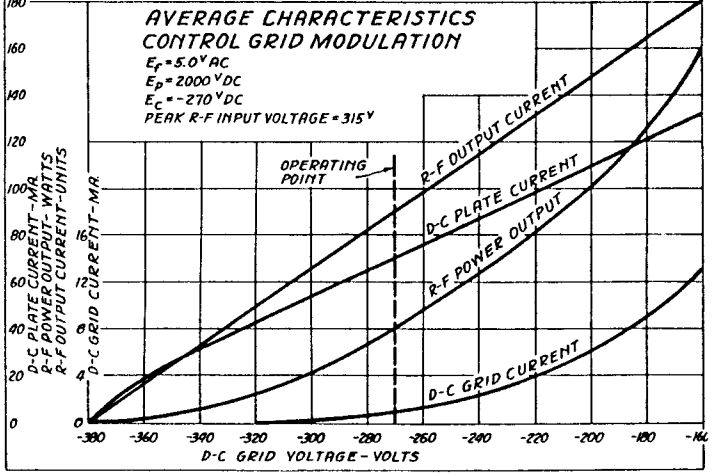
PLATE TEMPERATURE

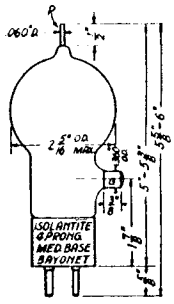
The plate of the RK-36 will show a light yellowish red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



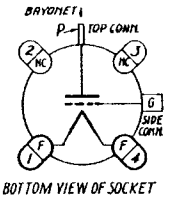








TRIODE POWER AMPLIFIER OSCILLATOR



The RK-37 is a high-mu triode type power amplifier tube having a thoriated tungsten filament, a tantalum plate and grid, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	4	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	3.2	μμf
Input	3.5	μμf
Output	0.2	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1500	volts
D-C Plate Voltage—Telephony		
With Grid Modulation	1500	volts
With Plate Modulation	1250	volts
D-C Plate Current	125	ma
D-C Grid Current	35	ma
Plate Dissipation	50	watts

TYPICAL OPERATION

	Telephony Grid Modulation	Telephony Plate Modulation	Telegraphy	
D-C Plate Voltage	1500	1250	1500	volts
D-C Grid Voltage	—200	—150	—130	volts
D-C Plate Current	44	100	115	ma
D-C Grid Current	5	23	30	ma
Peak R-F Input Voltage	260	270	260	volts
R-F Driving Power	6 *	5.6	7	watts
Carrier Power Output	26	90	122	watts
Peak A-F Volt.—Plate	—	1250*	—	volts
Peak A-F Volt.—Grid	60 *	—	—	volts
A-F Modulating Power	1.4 *	63	—	watts
Peak Power Output	104*	360 *	—	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current (Carrier)	50	ma
Plate Dissipation (Carrier)	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1500	volts
D-C Grid Voltage	—50	volts
D-C Plate Current	50	ma
Peak R-F Input Voltage	120*	volts
R-F Driving Power	2.4 *	watts
Carrier Power Output	26	watts
Peak Power Output	104*	watts

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current (per tube)	125	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	50	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	—35	volts
D-C Plate Current (no signal)	25	ma
D-C Plate Current (max. signal)	235	ma
D-C Grid Current (max. signal)	60	ma
Peak A-F Input Voltage (grid to grid)	282	volts
A-F Driving Power	7.2	watts
Load Resistance (plate to plate)	18000	ohms
Power Output	200	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

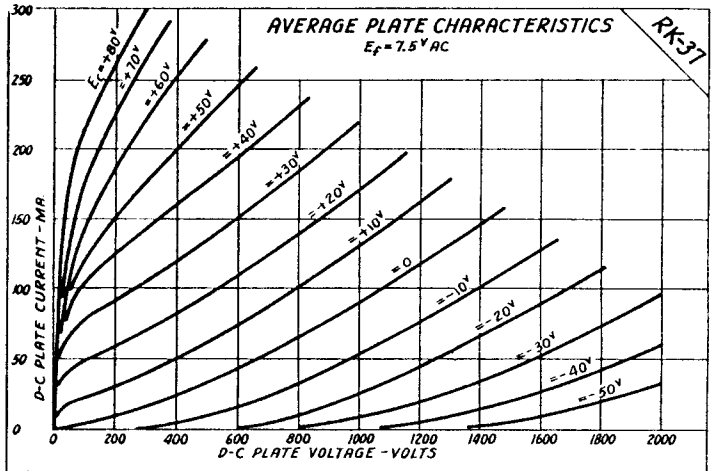
The RK-37 may be operated at the maximum ratings at frequencies up to 60 megacycles. At frequencies between 60 megacycles and 120 megacycles the maximum d-c plate voltage should not exceed 1000 volts. Above 120 megacycles, the maximum d-c plate voltage should not exceed 750 volts.

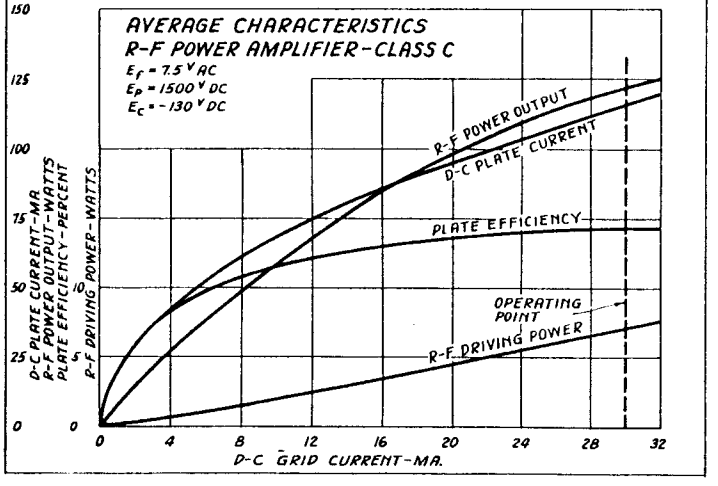
BIAS

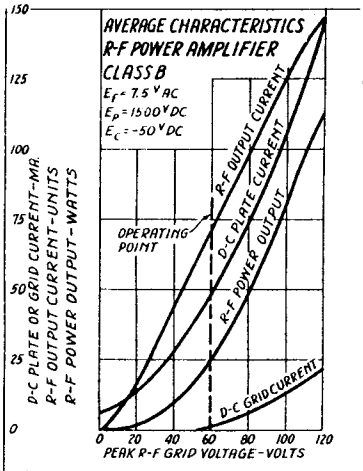
At least 35 volts of fixed bias should be used with 1500 volts on the plate to protect the tube in case of failure of the bias or excitation. The fixed bias may be reduced at lower plate voltages.

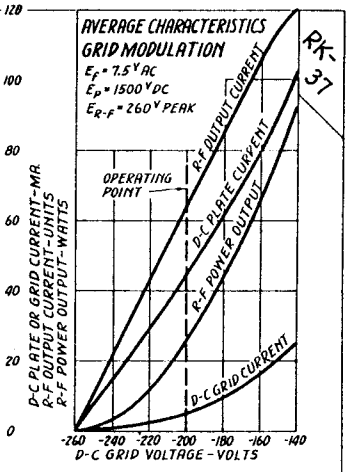
PLATE TEMPERATURE

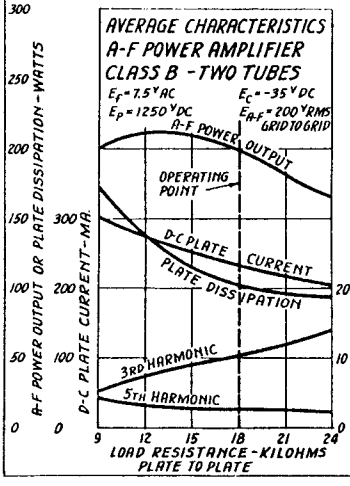
The plate of the RK-37 will show a light yellowish red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.

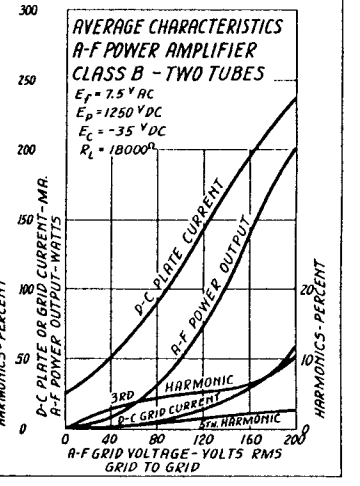


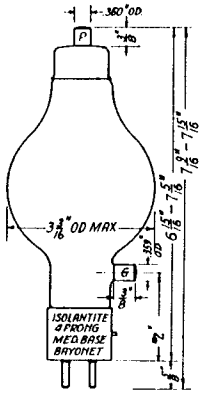






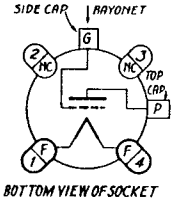






TRIODE POWER AMPLIFIER OSCILLATOR

The RK-38 is a high-mu triode type power amplifier tube having a thoriated tungsten filament, a tantalum plate and grid, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier oscillator, or frequency multiplier.



FILAMENT RATING

Filament Voltage	5	volts
Filament Current	8	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	4.3	μμf
Input	4.6	μμf
Output	0.9	μμf

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	3000	volts
D-C Plate Current (per tube)	165	ma
Plate Dissipation (per tube) (Averaged over 1 cycle)	100	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Grid Voltage	—52	volts
D-C Plate Current (no signal)	36	ma
D-C Plate Current (max. signal)	265	ma
D-C Grid Current (max. signal)	39	ma
Peak A-F Grid Voltage (grid to grid)	357	volts
A-F Driving Power	5.8	watts
Load Resistance (plate to plate)	16000	ohms
Power Output	330	watts

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	3000	volts
D-C Plate Current	165	ma
D-C Grid Current	40	ma
Plate Dissipation	100	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Grid Voltage	—200	volts
D-C Plate Current	160	ma
D-C Grid Current	30	ma
Peak R-F Input Voltage	375	volts
R-F Driving Power	10	watts
Power Output	225	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	3000	volts
D-C Plate Current (Carrier)	100	ma
Plate Dissipation (Carrier)	100	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Grid Voltage	—100	volts
D-C Plate Current	75	ma
D-C Grid Current	2	ma
Peak R-F Input Voltage	300*	volts
R-F Driving Power	7 *	watts
Carrier Power Output	55	watts
Peak Power Output	220*	watts

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	3000	2000	volts
D-C Plate Current (Carrier)	100	165	ma
D-C Grid Current (Carrier)	5	40	ma
Plate Dissipation (Carrier)	100	100	watts

TYPICAL OPERATION

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	2000	2000	volts
D-C Grid Voltage	—150	—200	volts
D-C Plate Current	80	160	ma
D-C Grid Current	2	30	ma
Peak R-F Input Voltage	220	375	volts
R-F Driving Power	5.5 *	10	watts
Carrier Power Output	60	225	watts
Peak A-F Modulating Voltage	100*	2000*	volts
A-F Modulating Power	1 *	150	watts
Peak Power Output	240*	900 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

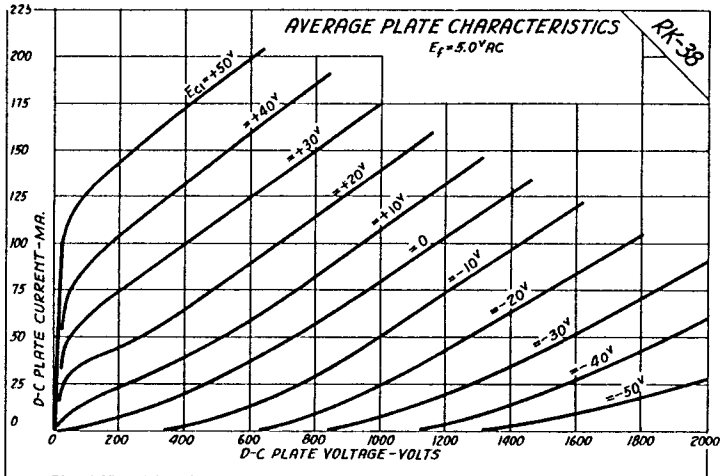
The construction of the RK-38 allows efficient operation at frequencies up to 60 megacycles. Above 60 megacycles reduced efficiency requires that the plate voltage be reduced to prevent the plate dissipation from exceeding the maximum rated value.

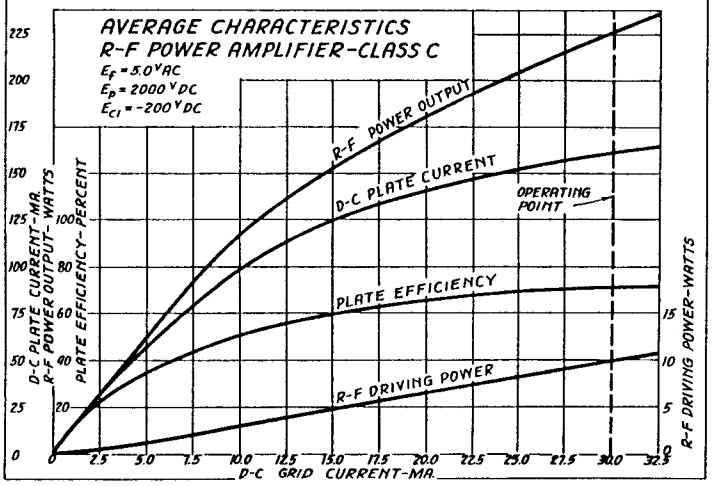
BIAS

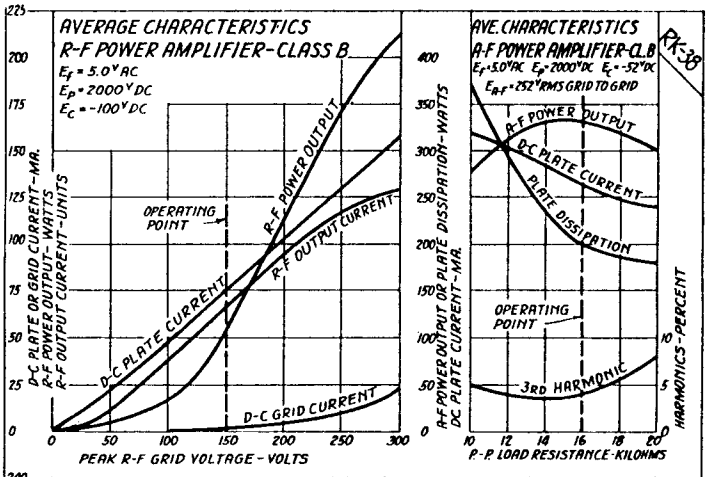
At least 60 volts of fixed bias should be used with 2000 volts on the plate to protect the tube in case of failure of the bias or excitation.

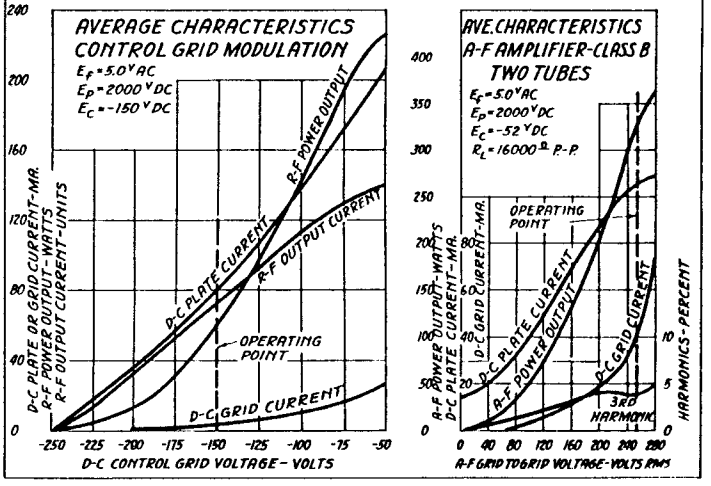
PLATE TEMPERATURE

The plate of the RK-38 will show a light yellowish red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.

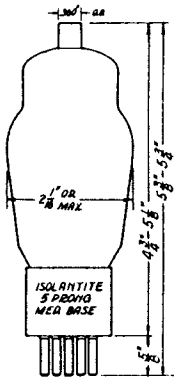




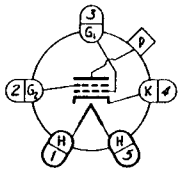




TETRODE POWER AMPLIFIER OSCILLATOR



The RK-39 and RK-41 are heater type aligned grid beam power amplifier tubes having isolantite bases. The use of aligned grids reduces the ratio of screen current to plate current and allows more efficient utilization of the total space current. The deflector plates in the RK-39 and RK-41 are connected internally to the cathode.



BOTTOM VIEW OF SOCKET

HEATER RATING

	RK-39	RK-41	
Heater Volt.	6.3	2.5	volts
Heater Cur.	0.9	2.4	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.2	μμf
Input	13	μμf
Output	10	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Volt.—Telegraphy	600	volts
D-C Plate Volt.—Telephony		
With Control Grid Modulation	600	volts
With Plate or Plate & Screen Modulation	475	volts
D-C Screen Voltage	300	volts
D-C Plate Current	100	ma
D-C Control Grid Current	5	ma
Plate Dissipation	25	watts
Screen Dissipation	3.5	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Plate Only Modulation		Telephony Plate & Screen Modulation		Telegraphy		
D-C Plate Volt	500	600	400	475	400	475	500	600	volts
D-C Screen Volt.	250	300	200	200	250	250	250	300	volts
D-C Con. Gd. Vlt.	−50	−70	−45	−45	−50	−50	−60	−90	volts
D-C Plate Current	60	60	60	65	95	85	95	93	ma
D-C Screen Current	3	3	17.5	17.5	8	9	12	10	ma
D-C Con. Grid Cur.	0.6	0.2	4.0	4.0	2.5	2.5	3	3	ma
Screen Resistor	—	—	11400†	15700†	19000‡	25000‡	—	—	ohms
Peak R-F Input Vlt.	60	78	70	70	75	75	84	117	volts
R-F Driving Power	0.5	*0.54*	0.25	0.25	0.2	0.2	0.25	0.38	watts
Carrier Pr. Output	10	12	17	21	25	26	35	36	watts
Peak A-F Vlt., Plate	—	—	400*	475*	400*	475*	—	—	volts
Peak A-F Vlt., Grid	25	*25*	—	—	250*	250*	—	—	volts
A-F Mod. Power	0.28*	0.17*	12	16	21	20	—	—	watts
Peak Pr. Output	40	*48*	*68*	*84*	100*	104*	—	—	watts

*At the peak of the a-f cycle with 100% modulation.
†Connected direct to the plate supply voltage and by-passed for r.f. only.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	600	volts
D-C Screen Voltage	300	volts
D-C Plate Current (Carrier)	63	ma
Plate Dissipation (Carrier)	25	watts
Screen Dissipation (Carrier)	3.5	watts

TYPICAL OPERATION

D-C Plate Voltage	600	volts
D-C Screen Voltage	250	volts
D-C Grid Voltage	−25	volts
D-C Plate Current	63	ma
D-C Screen Current	4	ma
D-C Grid Current (at 100% modulation)	9	ma
Peak R-F Input Voltage	50 *	volts
R-F Driving Power	0.4 *	watts
Carrier Power Output	12.5*	watts
Peak Power Output	50 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

The RK-39 and RK-41 may be operated at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be lowered to a maximum of 300 volts to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tubes at frequencies higher than 120 megacycles is not recommended.

EXCITATION

The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 3 or 4 ma. of grid current with very little gained above these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

SHIELDING

Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-39 or RK-41 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS

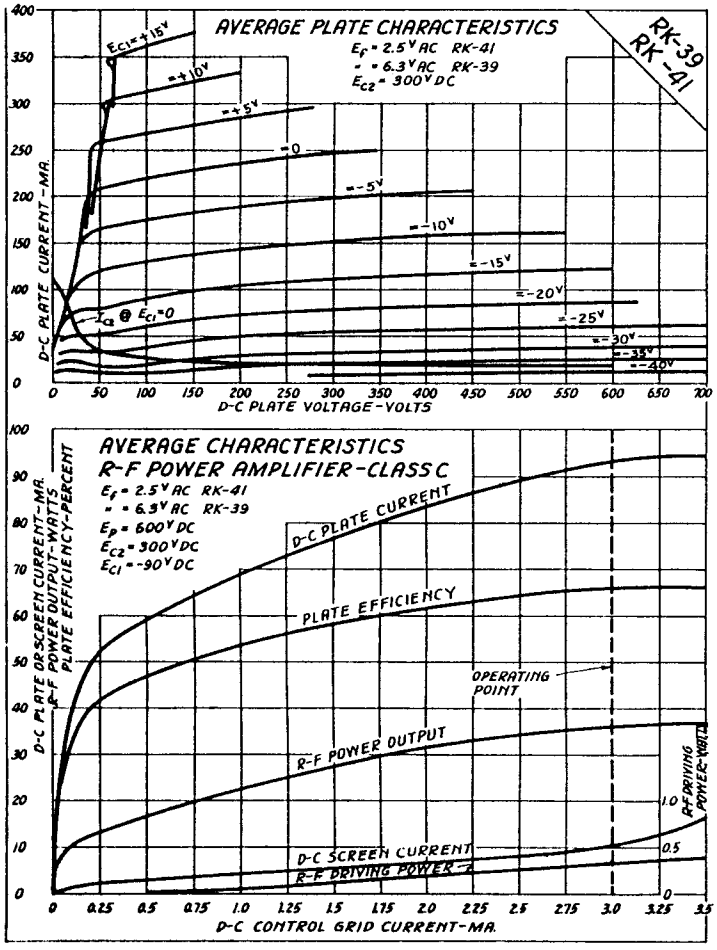
At least 25 volts of fixed bias should be used with 600 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

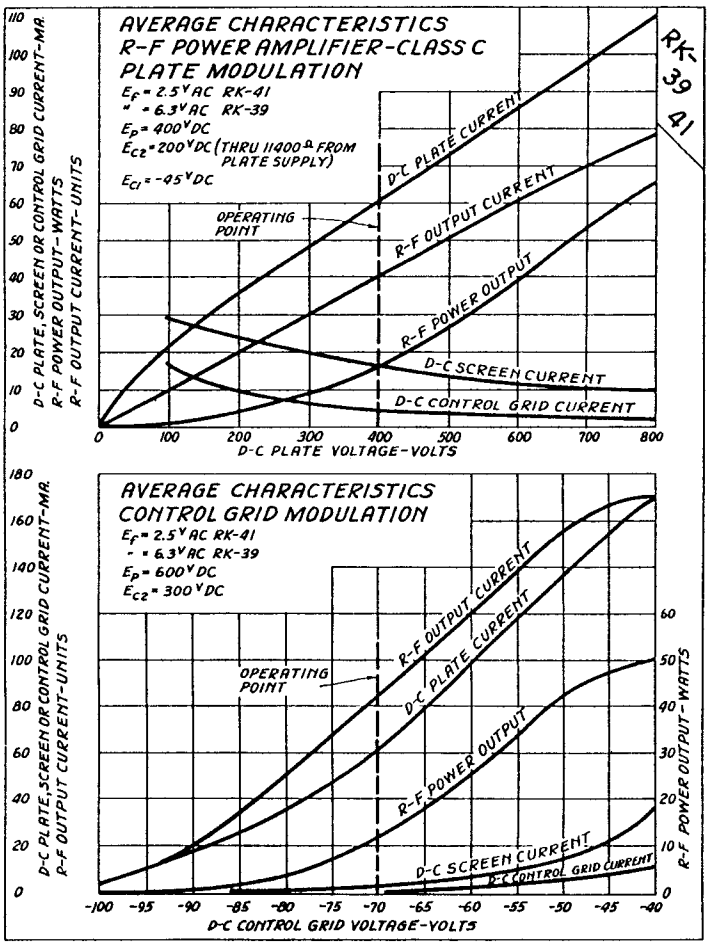
CRYSTAL OSCILLATOR

When the RK-39 or RK-41 is used as a crystal controlled oscillator, a 10000 ohm grid leak and a 400 ohm cathode resistor are recommended. At the lower frequencies, it may be necessary to increase the grid to plate capacitance in order to start the oscillator. An additional capacitance of 2 μμf. should be sufficient. Larger values will cause excessive feedback and may damage the crystal.

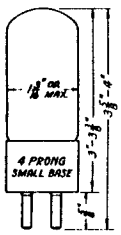
PLATE TEMPERATURE

The plate of the RK-39 or RK-41 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.

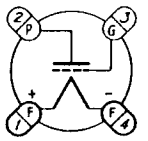




RK-42
TRIODE AMPLIFIER OSCILLATOR



The RK-42 is a low filament current triode type amplifier tube having an oxide coated filament. It is designed for use in portable equipment with dry cell filament supply.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Voltage	1.5	volts
Filament Current	0.06	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	6	μμf
Input	3	μμf
Output	2.1	μμf

A-F AMPLIFIER—CLASS A

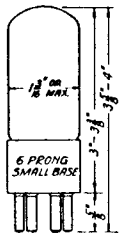
MAXIMUM RATINGS

D-C Plate Voltage	180	volts
D-C Plate Current	7.5	ma

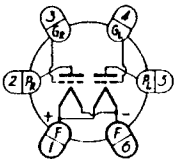
TYPICAL OPERATION

D-C Plate Voltage	180	volts
D-C Grid Voltage	−13.5	volts
D-C Plate Current	3.9	ma
Amplification Factor	8.2	
Plate Resistance	10300	ohms
Transconductance	800	μmhos

RK-43
TWIN TRIODE POWER AMPLIFIER OSCILLATOR



The RK-43 is a low filament current twin triode type amplifier tube having an oxide coated filament. It is designed for use in portable equipment with dry cell filament supply.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	1.5	volts
Filament Cur.	0.12	amp

DIRECT INTERELECTRODE CAPACITANCES —EACH TRIODE

Grid to Plate	4.2	μμf
Input	1.9	μμf
Output	2.1	μμf

A-F AMPLIFIER—CLASS A—ONE TRIODE

D-C Plate Voltage	135 max.	volts
D-C Grid Voltage	−4.5	volts
D-C Plate Current	3	ma
Amplification Factor	13	
Plate Resistance	14500	ohms
Transconductance	900	μmhos

A-F POWER AMPLIFIER—CLASS B

MAXIMUM RATINGS

D-C Plate Voltage	135	volts
D-C Plate Current (Average—both triodes)	15	ma

TYPICAL OPERATION

D-C Plate Voltage	135	volts
D-C Grid Voltage	−6	volts
D-C Plate Current (no signal)	4	ma
D-C Plate Current (max. signal)	12.5	ma
D-C Grid Current (max. signal)	1	ma
Peak A-F Input Voltage (grid to grid)	24	volts
A-F Driving Power	27.5	mw
Load Resistance (plate to plate)	24000	ohms
Power Output	0.95	watt

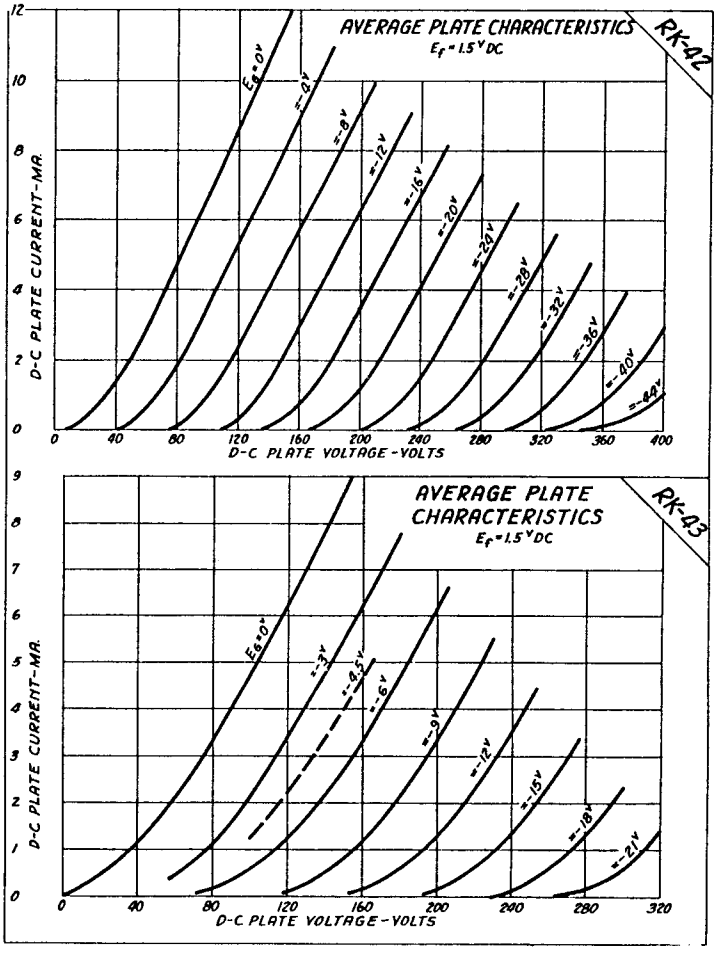
R-F AMPLIFIER OR OSCILLATOR—CLASS C—PUSH-PULL

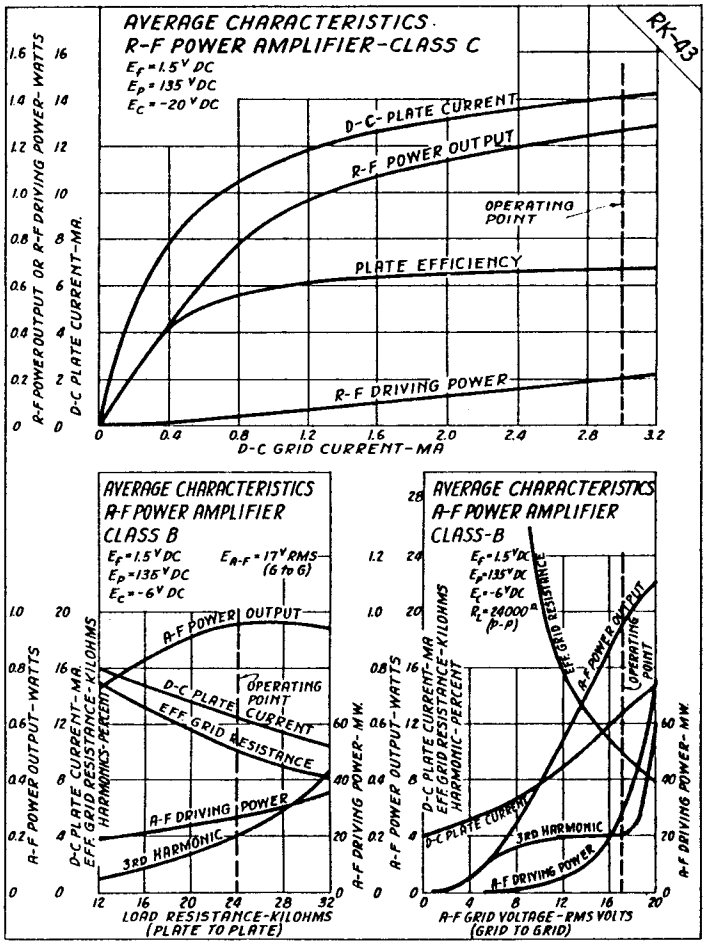
MAXIMUM RATINGS

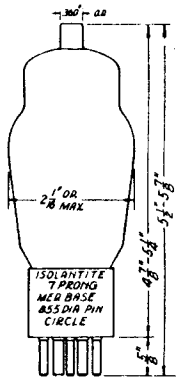
D-C Plate Voltage	135	volts
D-C Plate Current (Average—both triodes)	15	ma

TYPICAL OPERATION

D-C Plate Voltage	135	volts
D-C Grid Voltage	−20	volts
D-C Plate Current	14	ma
D-C Grid Current	3	ma
Peak R-F Input Voltage (grid to grid)	70	volts
R-F Driving Power	0.2	watts
Power Output	1.25	watts

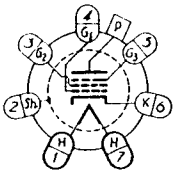






PENTODE POWER AMPLIFIER OSCILLATOR

The RK-44 is a heater type pentode power amplifier having an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier. The RK-44 may also be used in circuits employing suppressor or control grid modulation.



HEATER RATING

Heater Voltage	12.6	volts
Heater Current	0.7	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.2	μμf
Input	16	μμf
Output	10	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

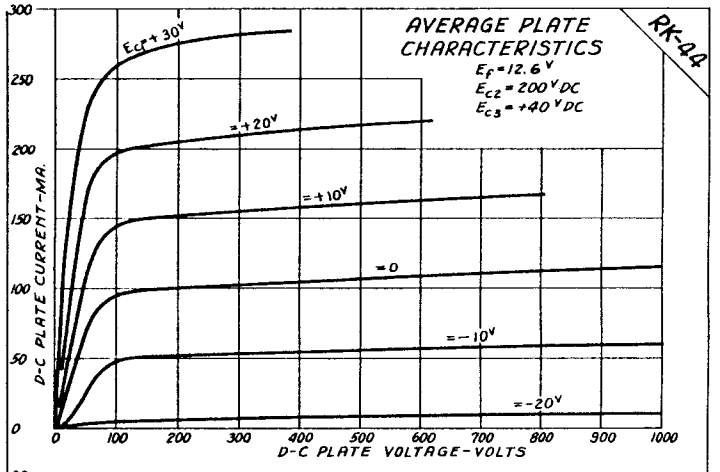
MAXIMUM RATINGS

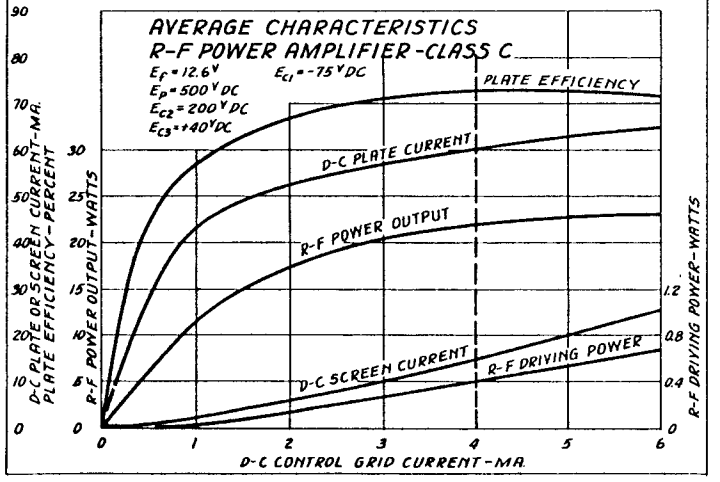
D-C Plate Voltage—Telegraphy	500	volts
D-C Plate Voltage—Telephony		
With Control or Suppressor Grid Modulation	500	volts
With Plate & Screen Modulation	400	volts
D-C Screen Voltage	200	volts
D-C Plate Current	80	ma
D-C Control Grid Current	8	ma
Plate Dissipation	12	watts
Screen Dissipation	8	watts

TYPICAL OPERATION

	Telephony Con. Grid Modulation		Telephony Supp. Grid Modulation	Telephony Plate & Scr. Modulation	Telegraphy		
D-C Plate Voltage	500	500	500	400	500	500	volts
D-C Screen Voltage	200	200	180	140	200	200	volts
D-C Sup. Grid Volt.	0	+40	−65	+40	0	+40	volts
D-C Con. Grid Volt.	−45	−43	−20	−40	−85	−75	volts
D-C Plate Current	30	30	30	45	60	60	ma
D-C Screen Current	7	6	23	20	30	15	ma
D-C Con. Grid Current	0.1	0.1	3.5	5	8	4	ma
Screen Resistor	—	—	14000†	13000‡	—	—	ohms
Peak R-F Input Volt.	48	44	32	60	120	100	volts
R-F Driving Power	0.2*	0.15*	0.1	0.3	0.8	0.4	watts
Carrier Power Output	5	5.5	5	11	20	22	watts
Peak A-F Volt.—Plate	—	—	—	400*	—	—	volts
Peak A-F Volt.—Grid	20 *	18 *	65*	140*	—	—	volts
A-F Modulating Power	0.1*	0.06*	0	13	—	—	watts
Peak Power Output	20 *	22 *	20*	44 *	—	—	watts

*At the peak of the a-f cycle with 100% modulation.
†Connected direct to plate supply voltage and by-passed for r.f. only.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.





R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	500	volts
D-C Screen Voltage	200	volts
D-C Plate Current (Carrier)	40	ma
Plate Dissipation (Carrier)	12	watts
Screen Dissipation (Carrier)	5	watts

TYPICAL OPERATION

D-C Plate Voltage	500	500	volts
D-C Screen Voltage	200	200	volts
D-C Suppressor Grid Voltage	0	+40	volts
D-C Control Grid Voltage	−25	−25	volts
D-C Plate Current	30	30	ma
D-C Screen Current	15	12	ma
Peak R-F Input Voltage	50 *	48 *	volts
R-F Driving Power	0.2*	0.1*	watts
Carrier Power Output	5	5.5	watts
Peak Power Output	20 *	22 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

The RK-44 may be operated at the maximum ratings at frequencies up to 20 megacycles. Above 20 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

SCREEN SUPPLY

The screen voltage may be obtained either from a voltage divider or through a series resistor from the plate supply. The screen should always be by-passed to the cathode for r.f.

SHIELDING

The internal shield in the RK-44 is connected to base pin #2 and normally should be connected to the cathode pin #6. Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-44 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS

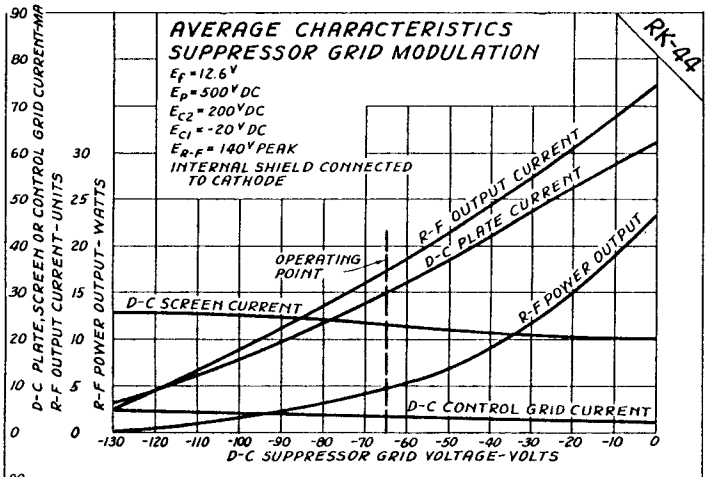
At least 15 volts of fixed bias should be used with 500 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

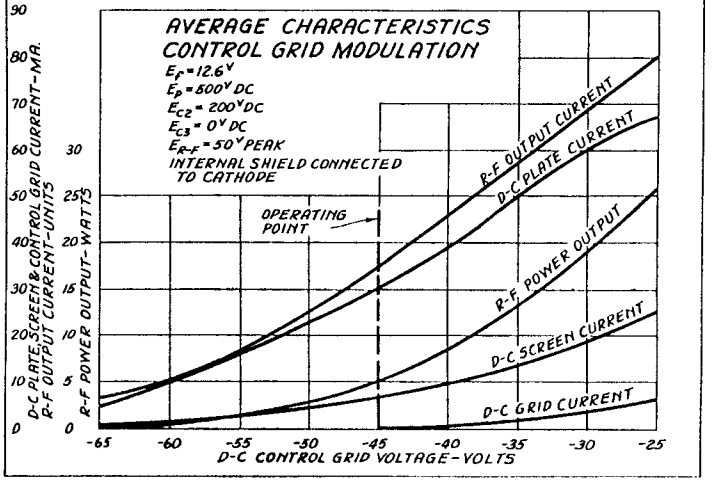
CRYSTAL OSCILLATOR

Using crystal control, 20 watts of r-f power output may be obtained without overheating the crystal.

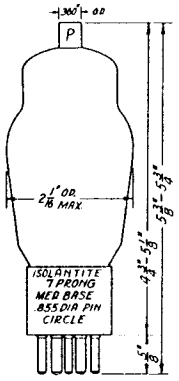
PLATE TEMPERATURE

The plate of the RK-44 will not show color when operated at the maximum rated dissipation. Dissipations above the rated value should be avoided.

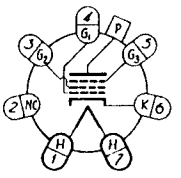




RK-45
PENTODE POWER AMPLIFIER OSCILLATOR



The RK-45 is a heater type pentode power amplifier tube having an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier. The RK-45 may also be used in circuits employing suppressor or control grid modulation.



BOTTOM VIEW OF SOCKET

HEATER RATING

Heater Voltage	12.6	volts
Heater Current	0.45	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.02	μμf
Input	10	μμf
Output	10	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	500	volts
D-C Plate Voltage—Telephony With Control or Sup. Grid Modulation	500	volts
With Plate & Screen Mod.	400	volts
D-C Screen Voltage	250	volts
D-C Plate Current	60	ma
D-C Control Grid Current	10	ma
Plate Dissipation	10	watts
Screen Dissipation	8	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Suppressor Grid Modulation	Telephony Plate & Screen Modulation	Telegraphy		
D-C Plate Voltage	500	500	500	400	500	500	volts
D-C Screen Voltage	200	200	200	150	200	200	volts
D-C Sup. Grid Voltage	0	+45	−45	0	0	+45	volts
D-C Con. Grid Volt.	−125	−125	−90	−90	−90	−90	volts
D-C Plate Current	32	34	31	43	50	55	ma
D-C Screen Current	20	20	39	30	40	38	ma
D-C Con. Grid Current	1.5	1.5	4	6	4	4	ma
Screen Resistor	—	—	—	8300‡	—	—	ohms
Peak R-F Input Volt.	150	150	135	145	135	135	volts
R-F Driving Power	1.2*	1.3 *	0.5	0.8	0.5	0.5	watts
Carrier Power Output	5.5	6.5	6	13.5	18	22	watts
Peak A-F Volt.—Plate	—	—	—	400 *	—	—	volts
Peak A-F Volt.—Grid	45 *	45 *	75 *	150 *	—	—	volts
A-F Modulating Power	0.5*	0.55*	0.3*	14.5	—	—	watts
Peak Power Output	22 *	26 *	24 *	54 *	—	—	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	500	volts
D-C Screen Voltage	250	volts
D-C Plate Current (Carrier)	35	ma
Plate Dissipation (Carrier)	10	watts
Screen Dissipation (Carrier)	8	watts

TYPICAL OPERATION

D-C Plate Voltage	500	volts
D-C Screen Voltage	200	volts
D-C Suppressor Grid Voltage	0	volts
D-C Control Grid Voltage	−38	volts
D-C Plate Current	30	ma
D-C Screen Current	12	ma
Peak R-F Input Voltage	80 *	volts
R-F Driving Power	0.24*	watts
Carrier Power Output	5	watts
Peak Power Output	20 *	watts

*At the peak of the a-f cycle with 100% modulation.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

OPERATING NOTES

CHARACTERISTIC CURVES
For average characteristic curves refer to the type RK-25. The characteristics of the RK-45 and RK-25 are the same except for the heater rating.

FREQUENCY RANGE
The RK-45 may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

EXCITATION
The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 4 or 5 ma. of grid current with very little gained beyond these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

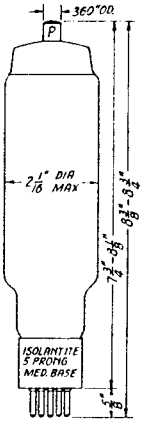
SHIELDING
Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-45 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS
At least 25 volts of fixed bias should be used with 500 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

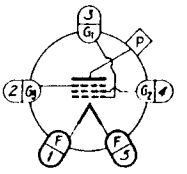
CRYSTAL OSCILLATOR
Using crystal control, 20 watts of r-f power output may be obtained without overheating the crystal.

PLATE TEMPERATURE
The plate of the RK-45 will not show color when operated at the rated plate dissipation. Dissipations above the rated value should be avoided.

RK-46
PENTODE POWER AMPLIFIER OSCILLATOR



The RK-46 is a pentode type power amplifier tube having a thoriated tungsten filament, a molybdenum plate, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier. The RK-46 may also be used in circuits employing suppressor or control grid modulation.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Volt.	12.6	volts
Filament Cur.	2.5	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.1	μμf
Input	14	μμf
Output	12	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1250	volts
D-C Plate Voltage—Telephony With Control or Sup. Grid Modulation	1250	volts
With Plate & Screen Mod.	1000	volts
D-C Screen Voltage	300	volts
D-C Plate Current	92	ma
D-C Control Grid Current	15	ma
R-F Control Grid Current	5	amp
Plate Dissipation	40	watts
Screen Dissipation	15	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation		Telephony Suppressor Grid Modulation	Telephony Plate & Screen Modulation	Telegraphy		
D-C Plate Voltage	1250	1250	1250	1000	1250	1250	volts
D-C Screen Voltage	300	300	300	300	300	300	volts
D-C Sup. Grid Volt.	0	+45	−45	0	0	+45	volts
D-C Con. Grid Volt.	−142	−142	−100	−100	−100	−100	volts
D-C Plate Current	40	40	48	75	80	92	ma
D-C Screen Current	7	7	44	30	43	36	ma
D-C Con. Grid Current	1.8	1.8	11.5	10	11.5	11.6	ma
Screen Resistor	—	—	—	23000‡	—	—	ohms
Peak R-F Input Volt.	160	160	140	145	155	155	volts
R-F Driving Power	1.5*	1.5*	1.5	1.3	1.6	1.6	watts
Carrier Power Output	17	20	21	52	64	84	watts
Peak A-F Volt.—Plate	—	—	—	1000*	—	—	volts
Peak A-F Volt.—Grid	30 *	30 *	75 *	300 *	—	—	volts
A-F Modulating Power	0.3*	0.3*	0.36*	52	—	—	watts
Peak Power Output	68 *	80 *	84 *	208 *	—	—	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Plate Current (Carrier)	70	ma
Plate Dissipation (Carrier)	40	watts
Screen Dissipation (Carrier)	15	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Suppressor Grid Voltage	0	volts
D-C Grid Voltage	−30	volts
D-C Plate Current	43	ma
D-C Screen Current	15	ma
Peak R-F Input Voltage	70 *	volts
R-F Driving Power	0.5*	watts
Carrier Power Output	16	watts
Peak Power Output	64 *	watts

*At the peak of the a-f cycle with 100% modulation.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

OPERATING NOTES

CHARACTERISTIC CURVES
For average characteristic curves refer to the type RK-20A. The characteristics of the RK-46 and RK-20A are the same except for the filament rating.

FREQUENCY RANGE
The RK-46 may be operated at the maximum ratings at frequencies up to 30 megacycles. At frequencies between 30 megacycles and 60 megacycles the maximum d-c plate voltage should not exceed 900 volts. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

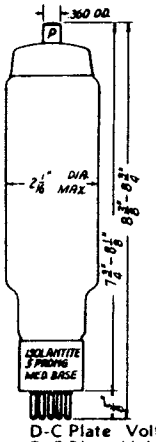
EXCITATION
The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the control grid current in milliamperes. The power output flattens off around 11 or 12 ma. of grid current with very little gained beyond these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

SHIELDING
Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-46 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS
Battery bias, or at least partial battery bias on the control grid is recommended. Additional bias may be obtained by placing a resistor in series with the battery.

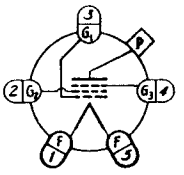
CRYSTAL OSCILLATOR
Using crystal control, 50 watts of r-f power output may be obtained without overheating the crystal.

PLATE TEMPERATURE
The plate of the RK-46 will not show color when operated at the rated plate dissipation. Dissipations above the rated value should be avoided.



TETRODE POWER AMPLIFIER OSCILLATOR

The RK-47 is a beam type aligned grid tetrode having a thoriated tungsten filament, a hard glass bulb and an isolantite base. The use of aligned grids reduces the ratio of screen current to plate current and allows more efficient utilization of the total space current. The deflector plates in the RK-47 are connected to base pin #4 which should be connected to the filament center-tap.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Voltage	10	volts
Filament Current	3.25	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.12	μμf
Input	13	μμf
Output	10	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	1250	volts
D-C Plate Voltage—Telephony		
With Control Grid Modulation	1250	volts
With Plate or Plate & Screen Modulation	900	volts
D-C Screen Voltage	300	volts
D-C Plate Current	150	ma
D-C Control Grid Current	10	ma
R-F Control Grid Current	5	amp
Plate Dissipation	50	watts
Screen Dissipation	10‡	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation	Telephony Plate Only Modulation	Telephony Plate & Screen Modulation	Telegraphy	
D-C Plate Voltage	1250	900	900	1250	volts
D-C Screen Voltage	300	300	250	300	volts
D-C Control Grid Voltage	—135	—100	—120	—70	volts
D-C Plate Current	60	80	90	138	ma
D-C Screen Current	9	50	23	14	ma
D-C Con. Grid Current	1.6	10	7.5	7	ma
Screen Resistor	—	12000†	28000‡	—	ohms
Peak R-F Input Voltage	155	160	180	160	volts
R-F Driving Power	1.43*	1.5	1.2	1.0	watts
Carrier Power Output	28.5	50	55	120	watts
Peak A-F Volt.—Plate	—	900*	900*	—	volts
Peak A-F Volt.—Grid	40 *	—	250*	—	volts
A-F Modulating Power	0.37*	36	51	—	watts
Peak Power Output	114 *	200*	220*	—	watts

‡15 watts allowable if average plate dissipation does not exceed 40 watts.
*At the peak of the a-f cycle with 100% modulation.
†Connected direct to plate supply voltage and by-passed for r.f. only.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Plate Current (Carrier)	75	ma
Plate Dissipation (Carrier)	50	watts
Screen Dissipation (Carrier)	10	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Screen Voltage	300	volts
D-C Grid Voltage	—30	volts
D-C Plate Current	60	ma
D-C Screen Current	2	ma
D-C Grid Current	0.9	ma
Peak R-F Input Voltage	90 *	volts
R-F Driving Power	4 *	watts
Carrier Power Output	25	watts
Peak Power Output	100*	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

The RK-47 may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to a maximum of 900 volts to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

EXCITATION

The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 7 or 8 ma. of grid current with very little gained above these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

SHIELDING

Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-47, it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS

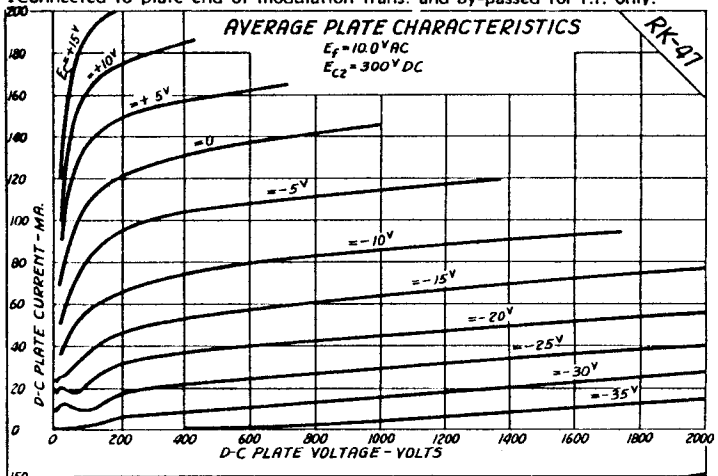
At least 25 volts of fixed bias should be used with 1250 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

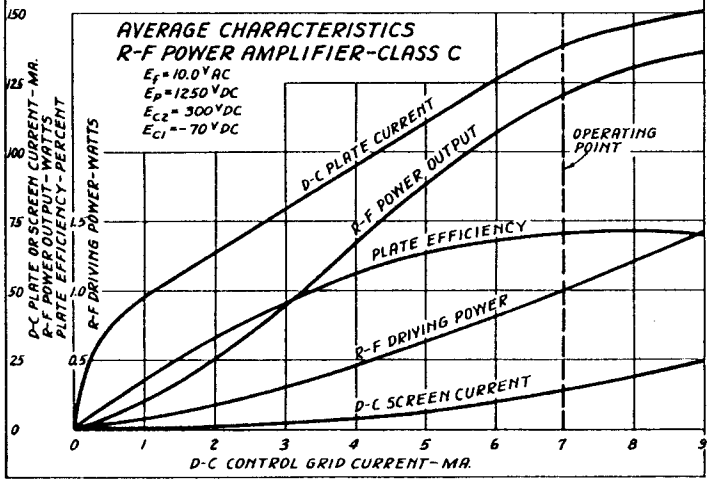
CRYSTAL OSCILLATOR

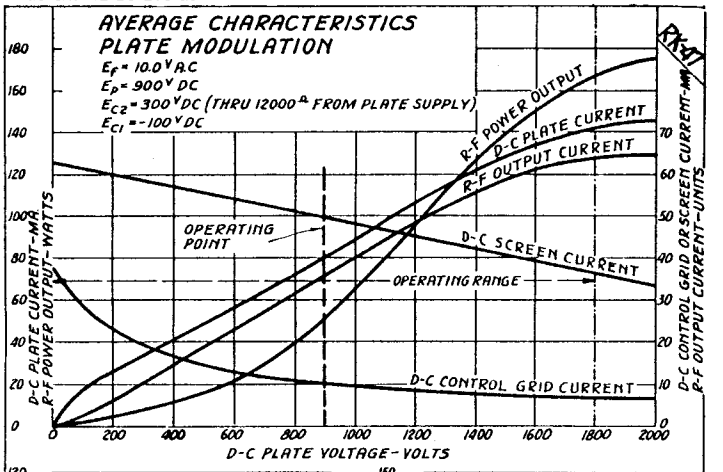
The RK-47 is not recommended for use as a crystal controlled oscillator.

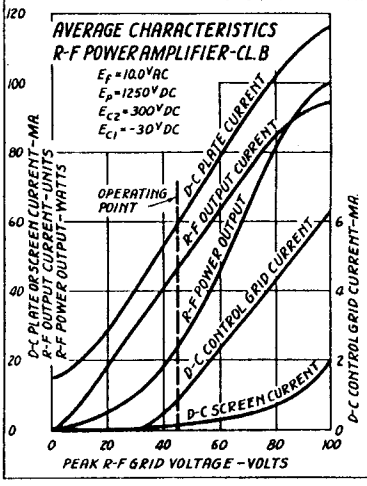
PLATE TEMPERATURE

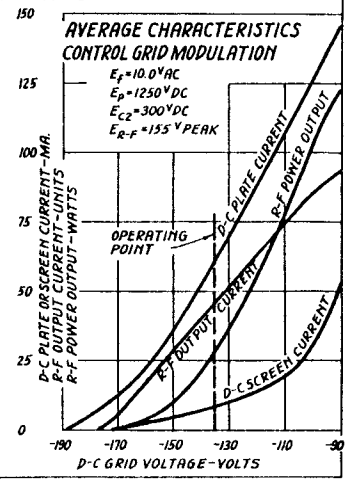
The plate of the RK-47 will show a dull cherry red color (See Plate Temperature Color Scale) at the center of the plate, if viewed in the dark, when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided

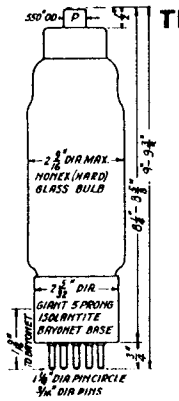






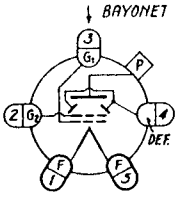






TETRODE POWER AMPLIFIER OSCILLATOR

The RK-48 is a beam type aligned grid power amplifier tube having a thoriated tungsten filament, a molybdenum plate, a hard glass bulb and an isolantite base. The use of aligned grids reduces the ratio of screen current to plate current and allows more efficient utilization of the total space current. The deflector plates in the RK-48 are connected to base pin #4 which should be connected to the filament center-tap.



BOTTOM VIEW OF SOCKET

FILAMENT RATING

Filament Voltage	10	volts
Filament Current	5	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	0.13	μμf
Input	17	μμf
Output	13	μμf

R-F POWER AMP. OR OSC.—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	2000	volts
D-C Plate Voltage—Telephony		
With Control Grid Modulation	2000	volts
With Plate or Plate & Screen Modulation	1500	volts
D-C Screen Voltage	400	volts
D-C Plate Current	180	ma
D-C Control Grid Current	25	ma
R-F Control Grid Current	8	amp
Plate Dissipation	100	watts
Screen Dissipation	22	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation	Telephony Plate Only Modulation	Telephony Plate & Screen Modulation		Telegraphy	
D-C Plate Voltage	1500	2000	1500	1500	2000	volts
D-C Screen Voltage	400	400	400	400	400	volts
D-C Con. Grid Voltage	—145	—155	—100	—100	—100	volts
D-C Plate Current	77	74	148	156	180	ma
D-C Screen Current	10	8	50	31	40	ma
D-C Con. Grid Current	1.5	0.9	6.5	6.0	6.5	ma
Screen Resistor	—	—	22000†	35000‡	—	ohms
Peak R-F Input Voltage	162	167	165	160	170	volts
R-F Driving Power	1.6 *	1.05*	1.0	0.9	1.0	watts
Carrier Power Output	40	50	165	175	250	watts
Peak A-F Volt.—Plate	—	—	1500*	1500*	—	volts
Peak A-F Volt.—Grid	45 *	45 *	—	400 *	—	volts
A-F Modulating Power	0.45*	0.28*	115	140	—	watts
Peak Power Output	160 *	200 *	660 *	700 *	—	watts

*At the peak of the a-f cycle with 100% modulation.
†Connected direct to plate supply voltage and by-passed for r.f. only.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	2000	volts
D-C Screen Voltage	400	volts
D-C Plate Current (Carrier)	100	ma
Plate Dissipation (Carrier)	100	watts
Screen Dissipation (Carrier)	10	watts

TYPICAL OPERATION

D-C Plate Voltage	2000	volts
D-C Screen Voltage	400	volts
D-C Control Grid Voltage	—35	volts
D-C Plate Current	76	ma
D-C Screen Current	6	ma
D-C Grid Current	0.35	ma
Peak R-F Input Voltage	80 *	volts
R-F Driving Power	0.22*	watts
Carrier Power Output	60	watts
Peak Power Output	240 *	watts

OPERATING NOTES

FREQUENCY RANGE

The RK-48 may be operated at the maximum ratings at frequencies up to 30 megacycles. Above 30 megacycles the reduced efficiency realized requires that the plate voltage be lowered to a maximum of 1500 volts to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

EXCITATION

The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 6 or 7 ma. of grid current with very little gained above these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value

SHIELDING

Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. If a shield is applied to the RK-48 it should enclose the base and extend to the lower internal shield and should clear the glass bulb by at least 1/16".

BIAS

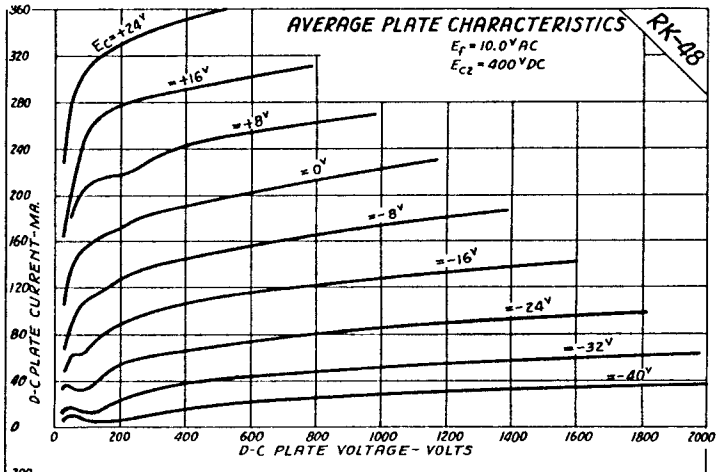
At least 35 volts of fixed bias should be used with 2000 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

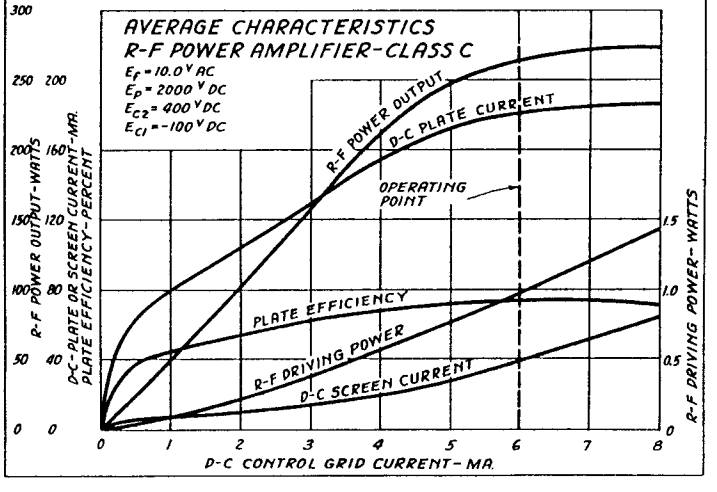
CRYSTAL OSCILLATOR

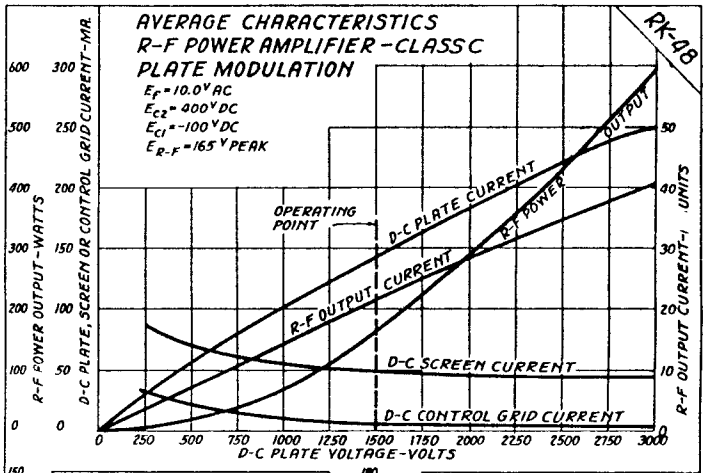
The RK-48 is not recommended for use as a crystal controlled oscillator.

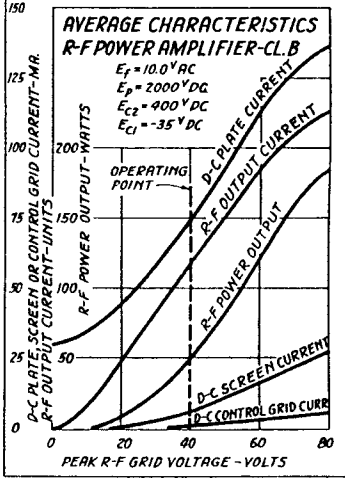
PLATE TEMPERATURE

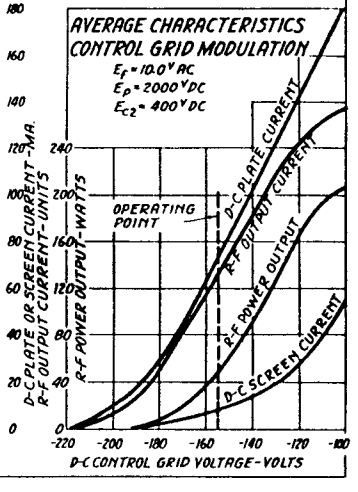
The plate of the RK-48 will show a light red color (See Plate Temperature Color Scale) when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided.



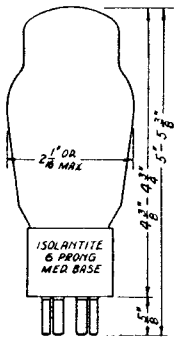




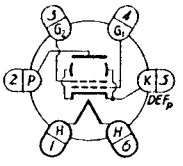




TETRODE POWER AMPLIFIER OSCILLATOR



The RK-49 is a heater type aligned grid beam power amplifier tube having an isolantite base. The use of aligned grids reduces the ratio of screen current to plate current and allows more efficient utilization of the total space current. The electrical characteristics are similar to those of the type 6L6G.



BOTTOM VIEW OF SOCKET

HEATER RATING

Heater Volt.	6.3	volts
Heater Cur.	0.9	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	1.4	μμf
Input	11.5	μμf
Output	10.6	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage—Telegraphy	400	volts
D-C Plate Voltage—Telephony—With Control Grid Mod.	400	volts
With Plate or Plate and Screen Modulation	300	volts
D-C Screen Voltage	300	volts
D-C Plate Current	100	ma
D-C Control Grid Current	6	ma
Plate Dissipation	21	watts
Screen Dissipation	3.5	watts

TYPICAL OPERATION

	Telephony Control Grid Modulation	Telephony Plate Only Modulation	Telephony Plate & Screen Modulation	Telegraphy	
D-C Plate Voltage	400	300	300	400	volts
D-C Screen Voltage	250	200	200	250	volts
D-C Control Grid Voltage	−40	−45	−45	−50	volts
D-C Plate Current	55	60	60	95	ma
D-C Screen Current	4	18	15	8	ma
D-C Control Grid Current	0.5	6	5	3	ma
Screen Resistor	—	5500†	6700‡	—	ohms
Peak R-F Input Voltage	47	64	64	80	volts
R-F Driving Power	0.3 *	0.34	0.3	0.2	watts
Carrier Power Output	7	12	13	25	watts
Peak A-F Volt.—Plate	—	300*	300*	—	volts
Peak A-F Volt.—Grid	25 *	—	200*	—	volts
A-F Modulating Power	0.15*	9	11	—	watts
Peak Power Output	28 *	48 *	52 *	—	watts

*At the peak of the a-f cycle with 100% modulation.
†Connected direct to plate supply voltage and by-passed for r.f. only.
‡Connected to plate end of modulation trans. and by-passed for r.f. only.

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	400	volts
D-C Screen Voltage	300	volts
D-C Plate Current (Carrier)	75	ma
Plate Dissipation (Carrier)	21	watts
Screen Dissipation (Carrier)	3.5	watts

TYPICAL OPERATION

D-C Plate Voltage	400	volts
D-C Screen Voltage	250	volts
D-C Grid Voltage	−30	volts
D-C Plate Current	52	ma
D-C Screen Current	5	ma
D-C Grid Current	0.1	ma
Peak R-F Input Voltage	60 *	volts
R-F Driving Power	0.5*	watts
Carrier Power Output	7	watts
Peak Power Output	28 *	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

The RK-49 may be operated at the maximum ratings at frequencies up to 15 megacycles. Above 15 megacycles the reduced efficiency realized requires that the plate voltage be reduced to a maximum of 300 volts to prevent the plate dissipation from exceeding the maximum rated value. The operation of the tube at frequencies higher than 60 megacycles is not recommended.

EXCITATION

The Class C amplifier characteristic curves show the power output, plate current and screen current plotted vs. excitation as denoted by the d-c control grid current in milliamperes. The power output flattens off around 3 or 4 ma. of grid current with very little gained above these values. The screen dissipation increases with excitation and for this reason the excitation should be kept at a reasonable value.

SHIELDING

Shielding of the grid input tuning system from the plate tuning apparatus is desirable and will provide improved stability. Due to the high grid to plate capacitance, the RK-49 requires neutralization.

BIAS

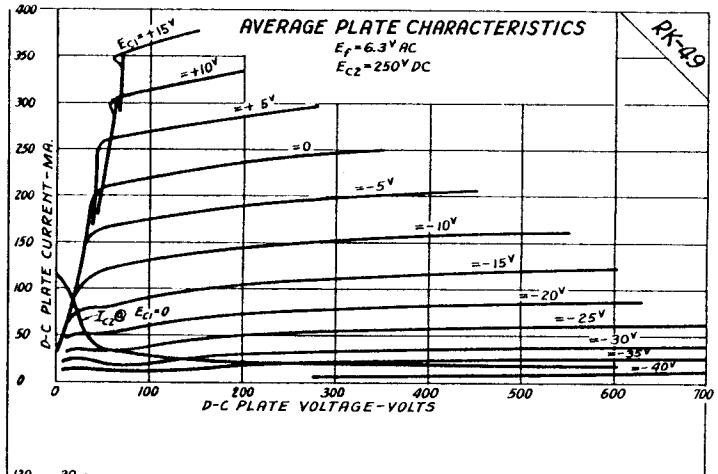
At least 25 volts of fixed bias should be used with 400 volts on the plate to protect the tube in case of failure of the bias or excitation. Additional bias may be obtained by the use of a grid or cathode resistor.

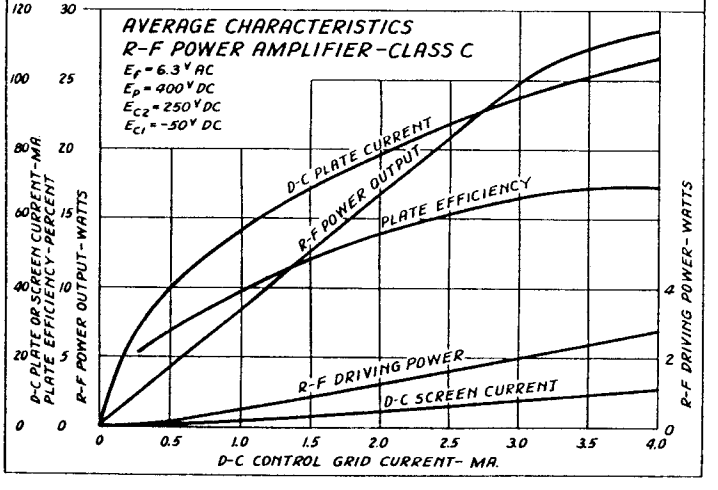
CRYSTAL OSCILLATOR

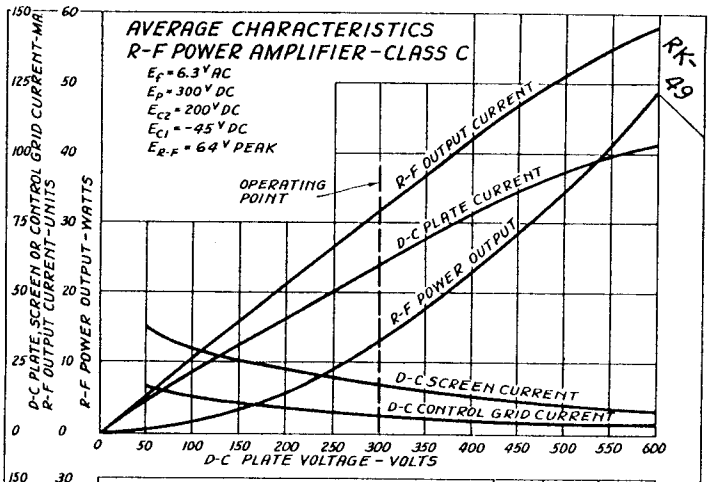
When the RK-49 is used as a crystal controlled oscillator, a 10000 ohm grid leak and a 400 ohm cathode resistor are recommended to give maximum power output and easy starting.

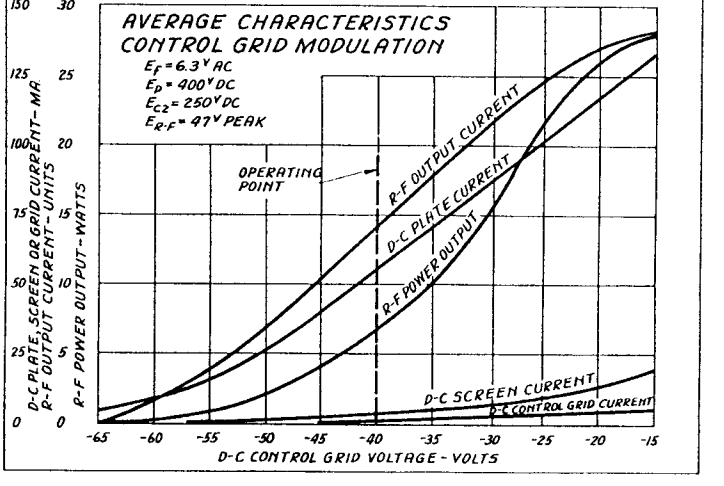
PLATE TEMPERATURE

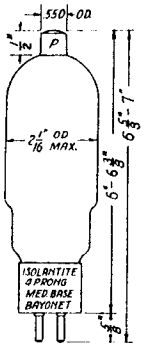
The plate of the RK-49 will not show color when operated at the maximum rated plate dissipations. Dissipations above the rated value should be avoided.





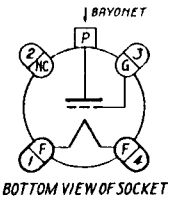






TRIODE POWER AMPLIFIER OSCILLATOR

The RK-51 is a triode type power amplifier tube having a thoriated tungsten filament, a carbon plate, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.



BOTTOM VIEW OF SOCKET

AMPLIFICATION FACTOR 20

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.75	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	6	μμf
Input	6	μμf
Output	2.5	μμf

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current	150	ma
D-C Grid Current	40	ma
Plate Dissipation	60	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	1500	volts
D-C Grid Voltage	—200	—250	volts
D-C Plate Current	150	150	ma
D-C Grid Current	38	31	ma
Peak R-F Input Voltage	320	365	volts
R-F Driving Power	11	10	watts
Power Output	135	170	watts

R-F POWER AMPLIFIER—CLASS B—TELEPHONY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current (Carrier)	60	ma
Plate Dissipation (Carrier)	60	watts

TYPICAL OPERATION

D-C Plate Voltage	1500	volts
D-C Grid Voltage	—75	volts
D-C Plate Current	60	ma
Peak R-F Input Voltage	170*	volts
R-F Driving Power	3.5 *	watts
Carrier Power Output	30	watts
Peak Power Output	120*	watts

*At the peak of the a-f cycle with 100% modulation.

R-F POWER AMPLIFIER—CLASS C—TELEPHONY

MAXIMUM RATINGS

	Grid Modulation	Plate Modulation	
D-C Plate Voltage	1500	1250	volts
D-C Plate Current (Carrier)	60	105	ma
D-C Grid Current (Carrier)	5	40	ma
Plate Dissipation (Carrier)	60	40	watts

TYPICAL OPERATION

	Grid Modulation	Plate Modulation		
D-C Plate Voltage	1500	1000	1250	volts
D-C Grid Voltage	—130	—150	—200	volts
D-C Plate Current	60	115	105	ma
D-C Grid Current	0.4	30	17	ma
Peak R-F Input Voltage	140	245	290	volts
R-F Driving Power	2.3*	6.6	4.5	watts
Carrier Power Output	32	83	96	watts
Peak A-F Modulating Voltage	65 *	1000*	1250*	volts
A-F Modulating Power	1.05*	58	67	watts
Peak Power Output	128*	332*	384*	watts

*At the peak of the a-f cycle with 100% modulation.

OPERATING NOTES

FREQUENCY RANGE

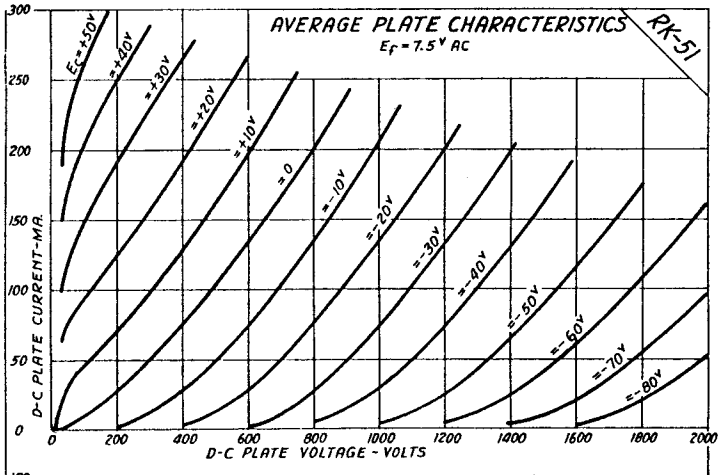
The construction of the RK-51 allows operation at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

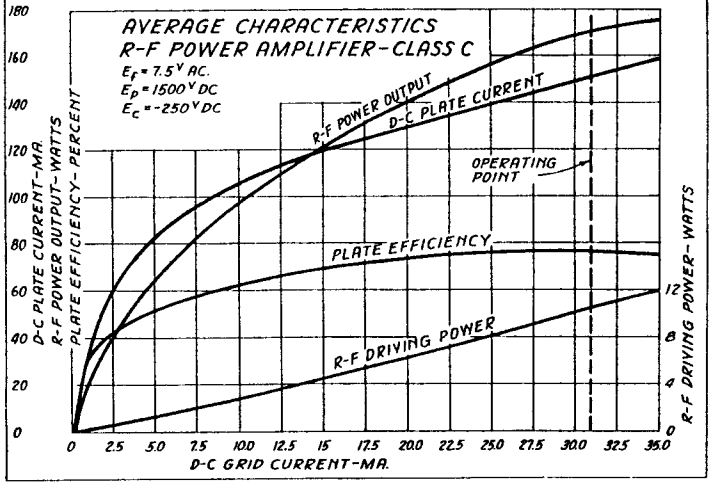
BIAS

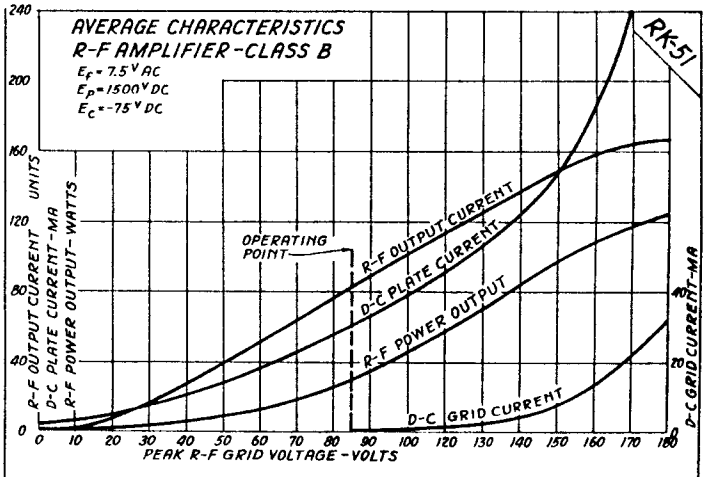
A fixed bias voltage of at least 60 volts should be used with a plate voltage of 1500 volts to protect the tube in case of failure of the bias or excitation. The fixed bias may be reduced with lower plate voltage.

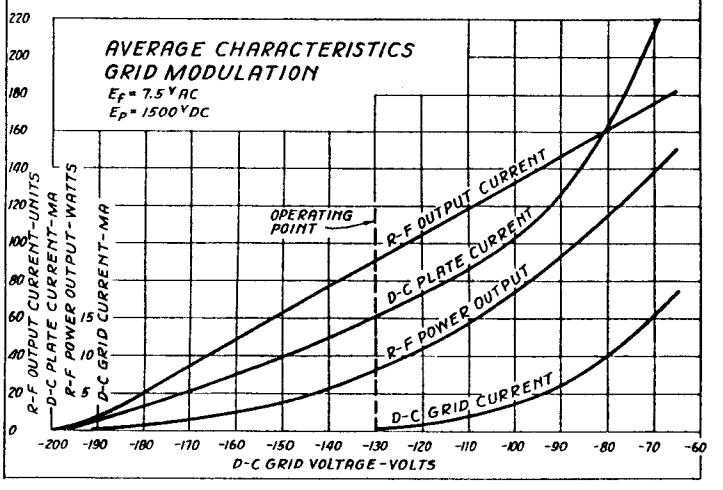
PLATE TEMPERATURE

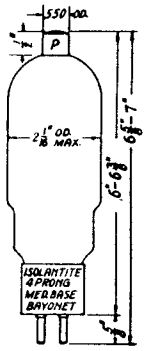
The plate of the RK-51 will not show color when operated at the maximum rated plate dissipation. Dissipations above the rated value should be avoided



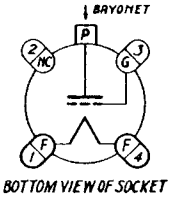








TRIODE POWER AMPLIFIER OSCILLATOR



BOTTOM VIEW OF SOCKET

The RK-52 is a high-mu triode type power amplifier tube having a thoriated tungsten filament, a carbon plate, a hard glass bulb and an isolantite base. It is designed for use as a power amplifier, oscillator or frequency multiplier.

FILAMENT RATING

Filament Voltage	7.5	volts
Filament Current	3.75	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	12	μμf
Input	6.6	μμf
Output	2.2	μμf

A-F POWER AMPLIFIER—CLASS B—TWO TUBES

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current (per tube)	150	ma
Plate Dissipation (per tube) (Average over 1 cycle)	62.5	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	volts
D-C Grid Voltage	0	volts
D-C Plate Current (no signal)	40	ma
D-C Plate Current max. signal)	300	ma
D-C Grid Current (max. signal)	100	ma
Peak A-F Grid Voltage (grid to grid)	180	volts
A-F Driving Power	7.5	watts
Load Resistance (plate to plate)	10000	ohms
Power Output	250	watts

R-F POWER AMPLIFIER—CLASS C—TELEGRAPHY

MAXIMUM RATINGS

D-C Plate Voltage	1500	volts
D-C Plate Current	130	ma
D-C Grid Current	50	ma
Plate Dissipation	60	watts

TYPICAL OPERATION

D-C Plate Voltage	1250	1500	volts
D-C Grid Voltage	—120	—120	volts
D-C Plate Current	150	130	ma
D-C Grid Current	41	40	ma
Peak R-F Input Voltage	200	195	volts
R-F Driving Power	7.4	7	watts
Power Output	130	135	watts

R-F POWER AMPLIFIER—CLASS C—TELEPHONY—PLATE MODULATION

MAXIMUM RATINGS

D-C Plate Voltage	1250	volts
D-C Plate Current	115	ma
D-C Grid Current	50	ma
Plate Dissipation	40	watts

TYPICAL OPERATION

D-C Plate Voltage	1000	1250	volts
D-C Grid Voltage	—120	—120	volts
D-C Plate Current	125	115	ma
D-C Grid Current	41	47	ma
Peak R-F Input Voltage	195	200	volts
R-F Driving Power	7.2	8.5	watts
A-F Modulating Power	63	72	watts
Carrier Power Output	90	105	watts
Peak Power Output	360	420	watts

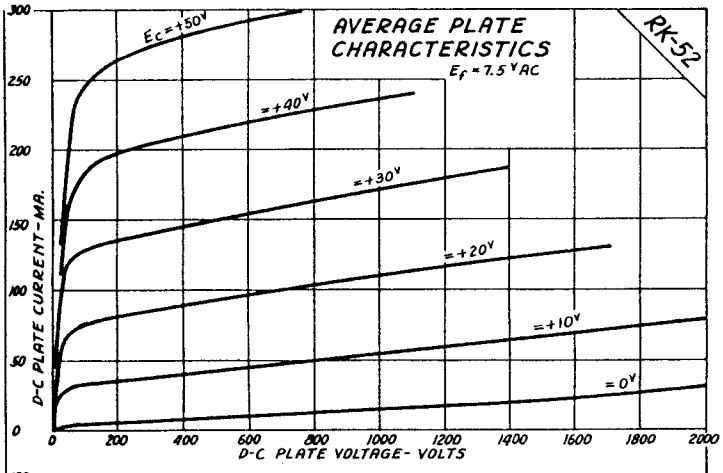
OPERATING NOTES

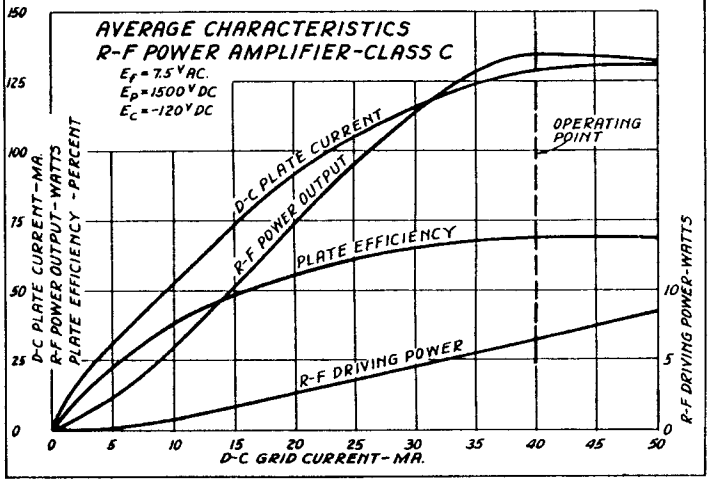
FREQUENCY RANGE

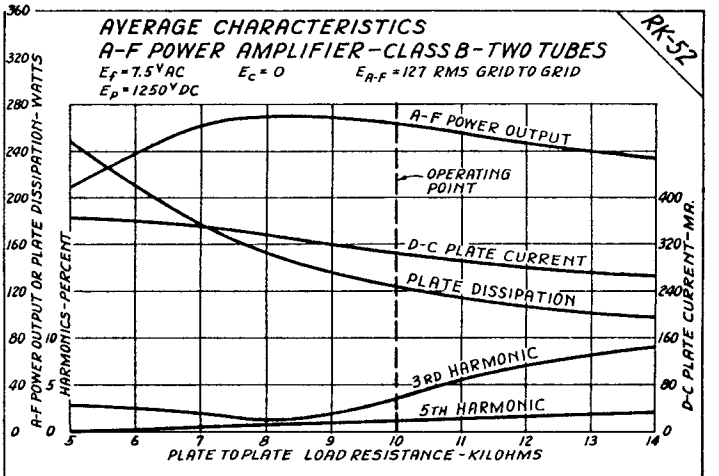
The construction of the RK-52 allows operation at the maximum ratings at frequencies up to 60 megacycles. Above 60 megacycles the reduced efficiency realized requires that the plate voltage be lowered to prevent the plate dissipation from exceeding the maximum rated value.

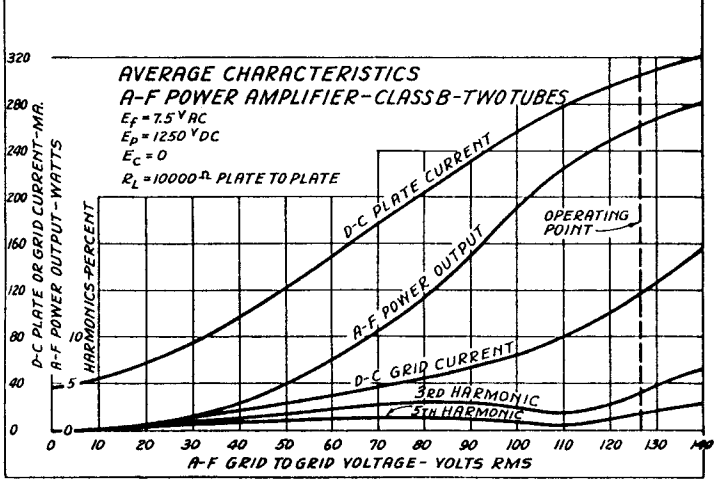
PLATE TEMPERATURE

The plate of the RK-52 will not show color when operated at the rated plate dissipation. Dissipations above the rated value should be avoided.







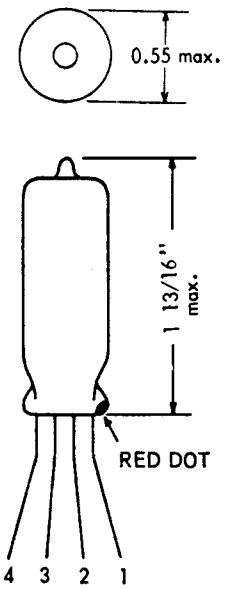


Excellence in Electronics

TYPE RK61

The RK61 is a small size 3-element thyratron useful in applications requiring extreme economy of space, weight, and battery drain. It is designed for use as a self-quenching super-regenerative detector which will operate a high resistance relay in the anode circuit upon reception of a radio signal. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.

Super-regenerative operation at frequencies above 100 megacycles is apt to be unstable and lower frequencies are recommended. Type RK61 is rated for amateur and intermittent service and is suggested for those applications in which circuit adjustments are available or in which variation of tube characteristics that will occur during life can be tolerated.



MECHANICAL DATA

ENVELOPE: T-4½ Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min. Spacing: 0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red dot is adjacent to Lead 1)*

Lead 1 Anode
Lead 2 Filament, negative
Lead 3 Grid
Lead 4 Filament, positive

MOUNTING POSITION: Any

ELECTRICAL DATA

DIRECT INTERELECTRODE CAPACITANCES: (*μμfds.*) (approx.) *

Grid to Anode	1.6
Grid to Filament	1.1
Filament to Anode	1.0

DESIGN CENTER MAXIMUM RATINGS:

Filament Voltage (dc)	1.4 volts
DC Anode Voltage	45 volts
DC Anode Current	1.5 ma.

CHARACTERISTICS AND TYPICAL OPERATION: (See Figure A)

Filament Voltage (dc)	1.4 volts
Filament Current	0.05 ampere
Average Tube Voltage Drop (At 1.5 ma)	30 volts
Anode Voltage	45 volts
Relay Resistance	5000 ohms
Anode Current (No Signal)	1.0 to 1.5 ma.
Anode Current (With Signal)	0.1 to 0.5 ma.

* *With no external shield.*

The tube must always be operated with sufficient series resistance in the anode circuit to limit the anode current to the maximum rated value. The useful life of the tube depends upon the anode current and may be prolonged by operating the tube with as low an anode current as possible.

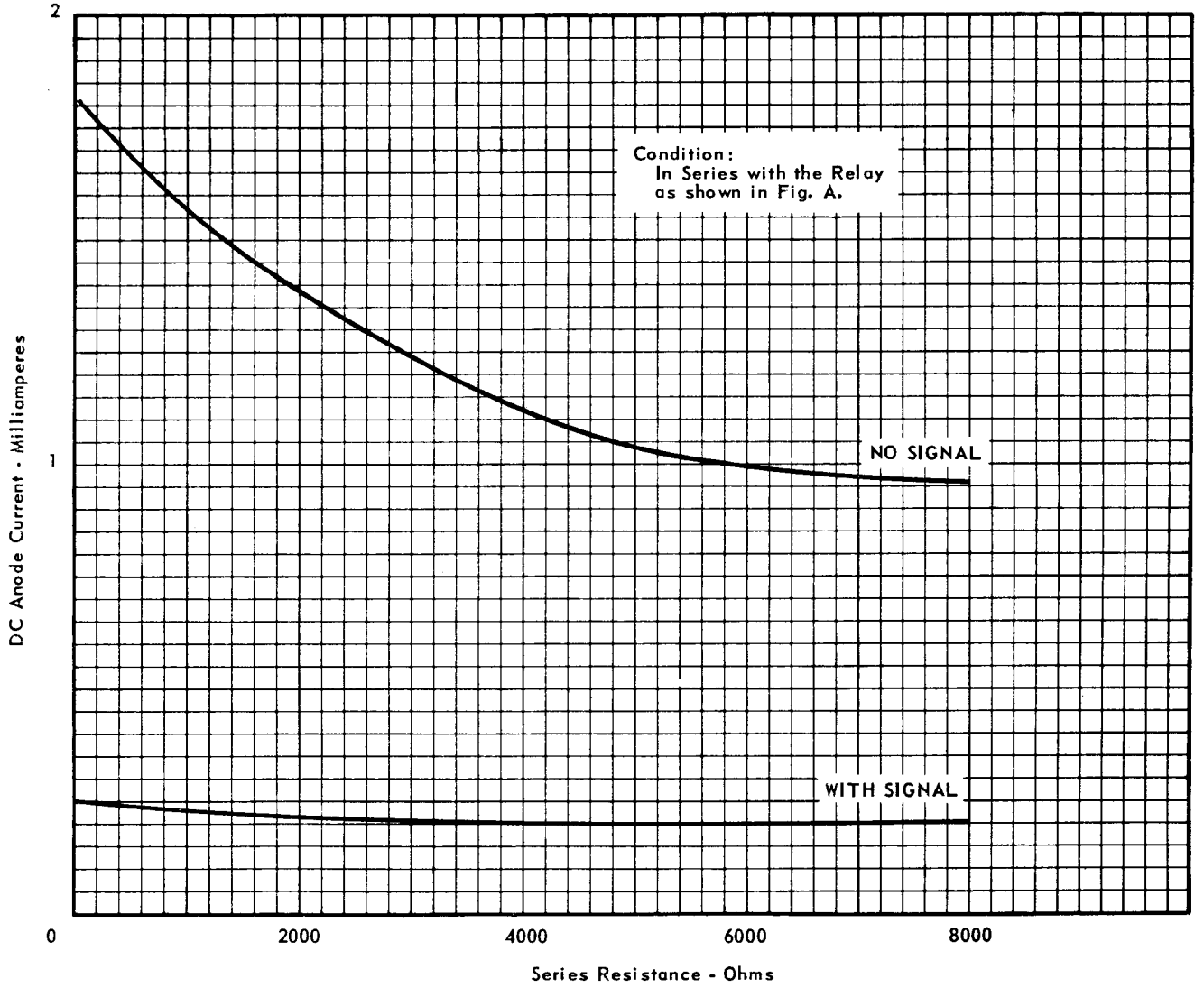
The circuit in Figure A is recommended for use with the RK61 for remote control purposes. If it is desired, the 45-volt anode supply battery can be removed, and the circuit adapted for use with a 60-cycle a-c anode supply. When operating properly, the tube should be oscillating at audio-frequency except during reception of a radio frequency signal whereupon the audio-frequency oscillation should disappear. The average anode current may be increased by increasing the antenna coupling, by decreasing the L/C ratio of the tank circuit, or both. The maximum controllable current may be increased by increasing the anode by-pass capacitance by decreasing the grid leak resistance or both.

Tentative Data

Printed in U.S.A.

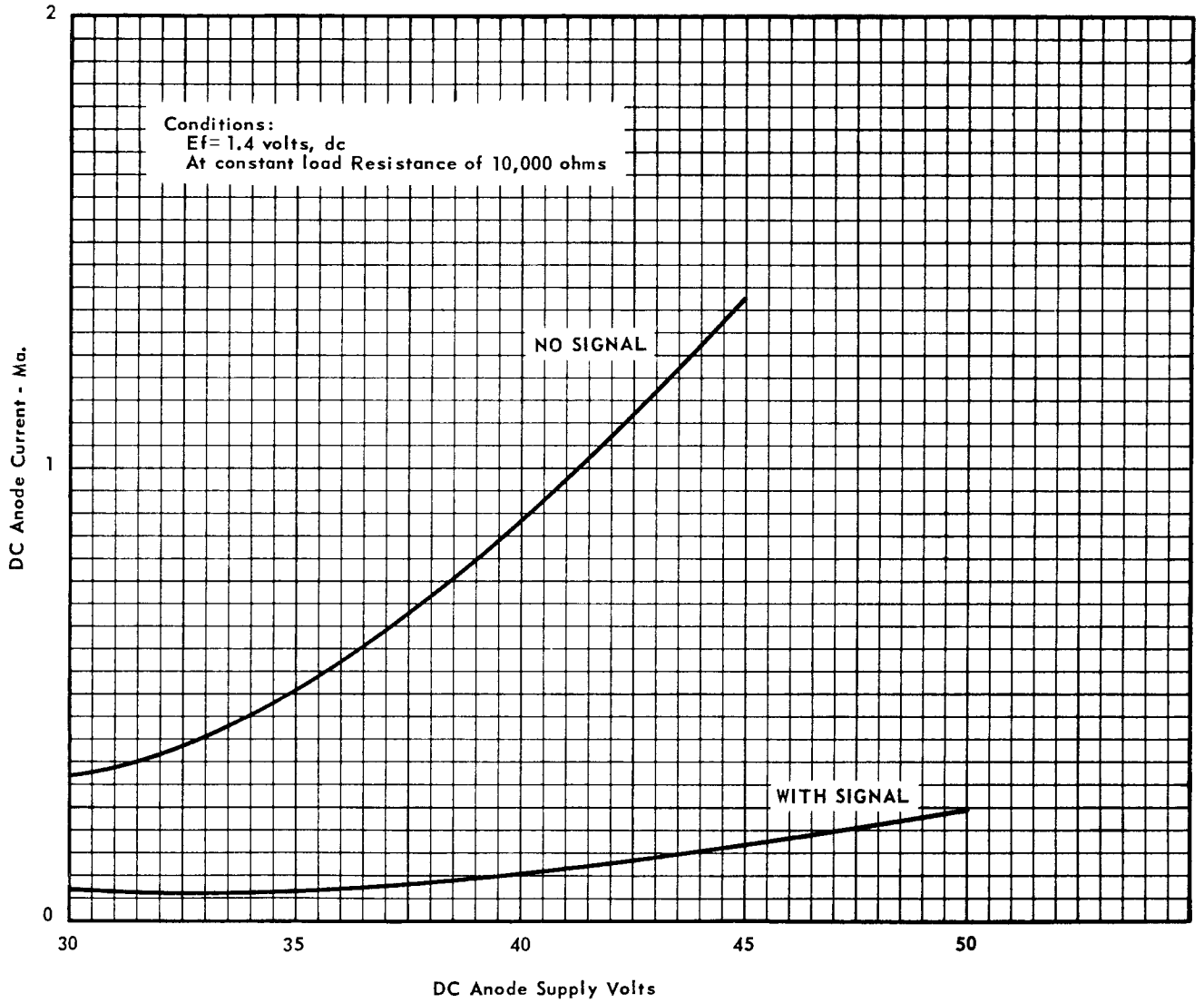
If the capacitance of the anode by-pass condenser is reduced and the relay replaced by a pair of phones, the circuit will operate as a conventional super-regenerative receiver with an anode supply voltage as low as 30 volts. Anode supply voltages higher than 30 volts require the use of a series resistor to limit the anode current to the maximum rated value.

VARIATION OF ANODE CURRENT
WITH RESISTANCE

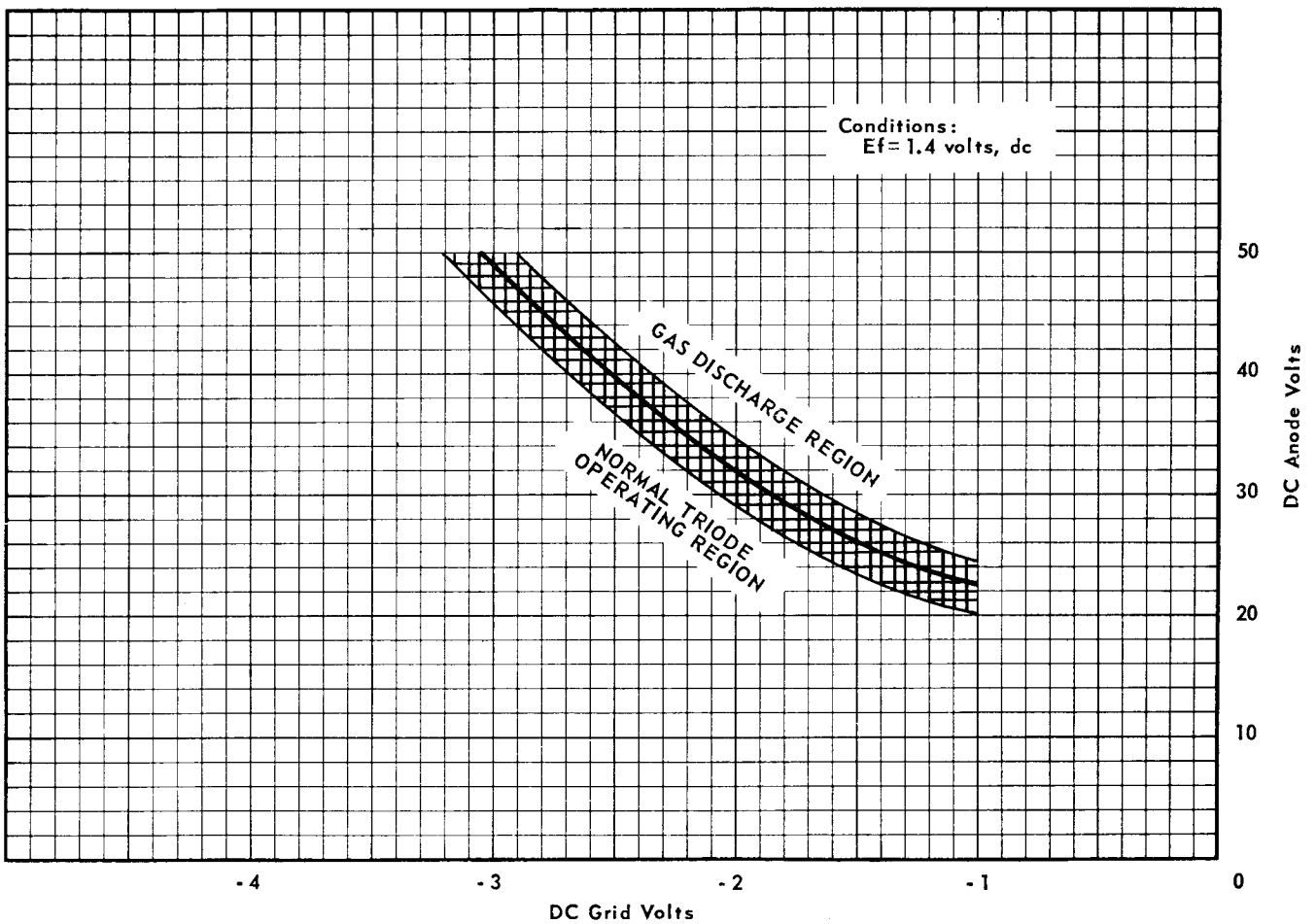


SUBMINIATURE GAS TRIODE

VARIATION OF ANODE CURRENT
WITH ANODE VOLTAGE SUPPLY

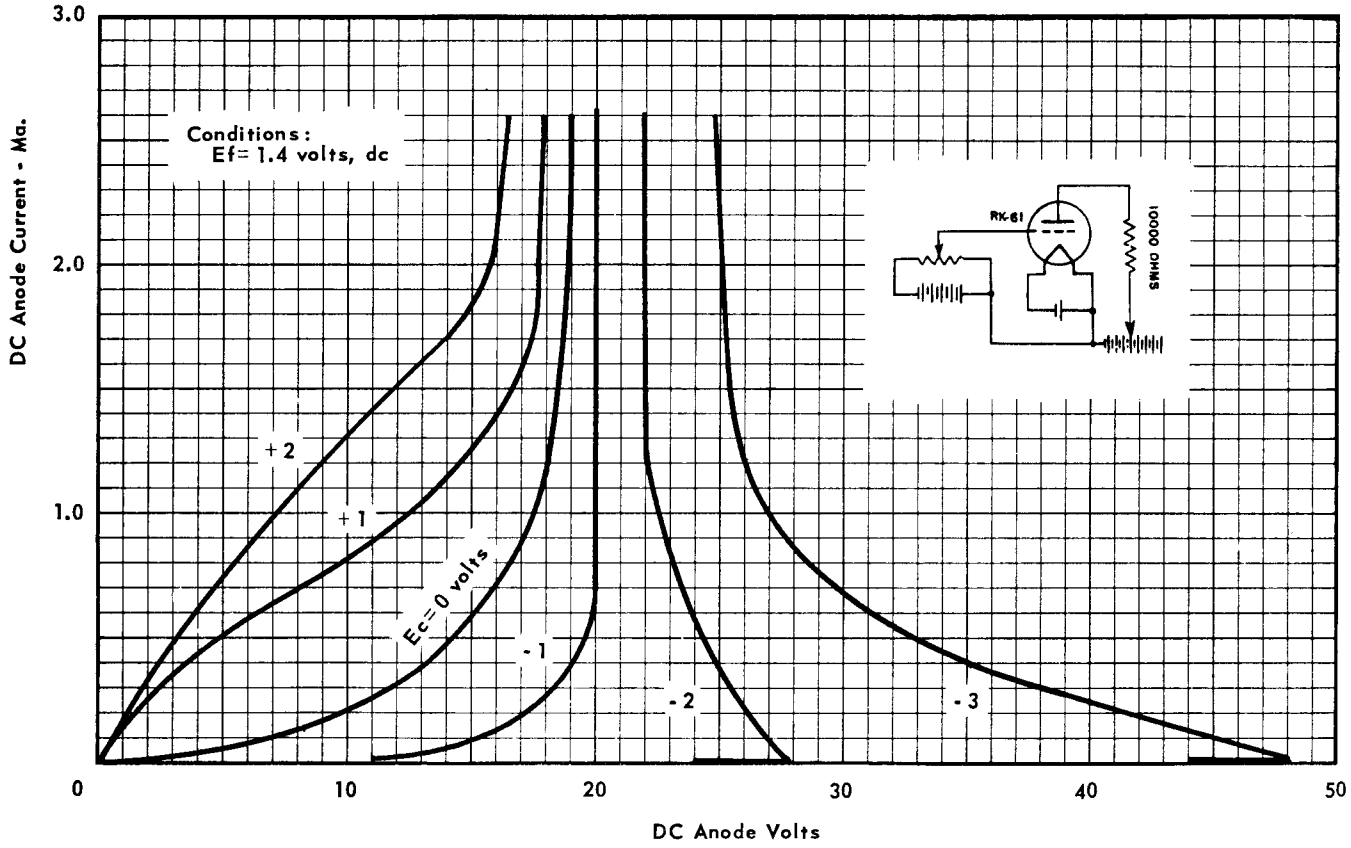


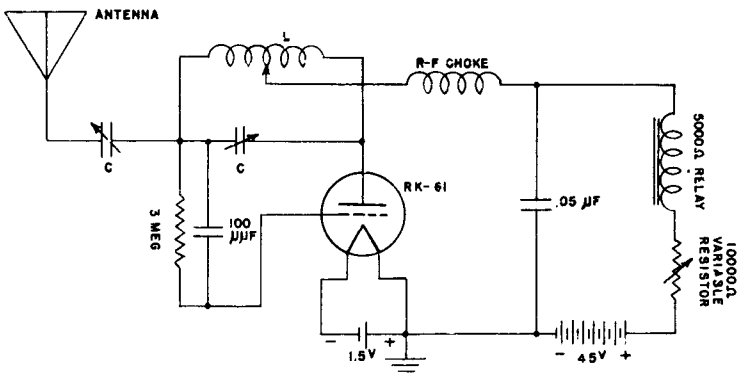
AVERAGE CONTROL CHARACTERISTICS



SUBMINIATURE GAS TRIODE

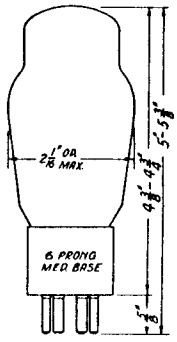
AVERAGE PLATE CHARACTERISTICS



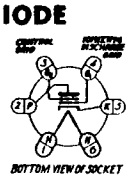


Adjust L and C for Frequency Band Desired

Fig. A



GASEOUS DISCHARGE TRIODE POWER AMPLIFIER OSCILLATOR



The RK-100 is a heater type gaseous discharge tube designed for use as a power amplifier or oscillator. The RK-100 differs from conventional tubes in that it contains mercury vapor and an auxiliary grid, number one grid, which acts as an anode for the ionizing discharge and as a virtual cathode for the amplifier section of the tube. In practice the actual cathode is used as the zero potential point for the circuit returns.

HEATER RATING

Heater Voltage	6.3	volts
Heater Current	0.9	amp

DIRECT INTERELECTRODE CAPACITANCES

Grid to Plate	19	μμf
Input	23	μμf
Output	3	μμf

A-F POWER AMPLIFIER—CLASS A

MAXIMUM RATINGS

D-C Plate Voltage	150	volts
D-C Plate Current	250	ma
D-C Control Grid Current	100	ma
D-C Ionizing Current	250	ma
Plate Dissipation	15	watts

TYPICAL OPERATION—SINGLE TUBE

D-C Plate Voltage	110	110	volts
D-C Control Grid Voltage	—1.6	—1.6	volts
D-C Ionizing Current	150	250	ma
D-C Plate Current (no signal)	50	65	ma
D-C Control Grid Current (max. signal)	7	8.5	ma
A-F Grid Voltage (RMS)	6	6	volts
Amplification Factor	40	40	
Plate Resistance	3600	2500	ohms
Transconductance	12000	16000	μmhos
Load Resistance	1600	1100	ohms
Power Output (10% Total Distortion)	3.2	4.2	watts

TYPICAL OPERATION—PUSH-PULL—TWO TUBES

D-C Plate Voltage	110	110	volts
D-C Control Grid Voltage	—1.6	—1.6	volts
D-C Ionizing Current (per tube)	150	250	ma
D-C Plate Current (no signal)	100	130	ma
D-C Control Grid Current (max. signal)	14	17	ma
A-F Grid Voltage (grid to grid) (RMS)	13	13	volts
Load Resistance (plate to plate)	2000	2000	ohms
Power Output (10% Total Distortion)	7	9	watts

R-F POWER AMPLIFIER OR OSCILLATOR—CLASS C

MAXIMUM RATINGS

D-C Plate Voltage	150	volts
D-C Plate Current	250	ma
D-C Control Grid Current	100	ma
D-C Ionizing Current	250	ma
Plate Dissipation	15	watts

TYPICAL OPERATION—R-F OSCILLATOR—CLASS C

D-C Plate Voltage	110	volts
D-C Ionizing Current	150	ma
D-C Plate Current	80	ma
D-C Control Grid Current	8	ma
Control Grid Resistor	500	ohms
Power Output	3.5	watts

TYPICAL OPERATION—R-F AMPLIFIER—CLASS C

D-C Plate Voltage	110	110	volts
D-C Ionizing Current	150	250	ma
D-C Plate Current	175	185	ma
D-C Control Grid Current	39	40	ma
Control Grid Resistor	500	500	ohms
Peak R-F Input Voltage	55	55	volts
Driving Power	2	2.1	watts
Power Output	11	12	watts

OPERATING NOTES

IONIZING DISCHARGE CIRCUIT

Under all conditions a separate current limiting resistor should be used in series with the number one grid of each tube in order to limit the discharge current to or under the rated value, as the voltage drop from the number one grid to the cathode is approximately 10 volts.

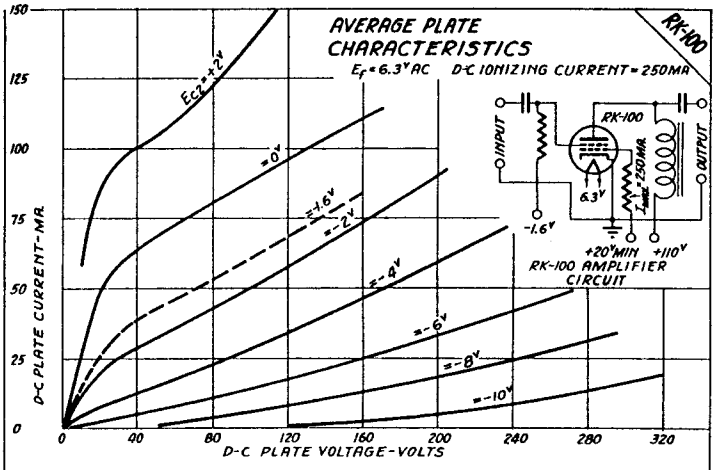
CIRCUIT OPERATION

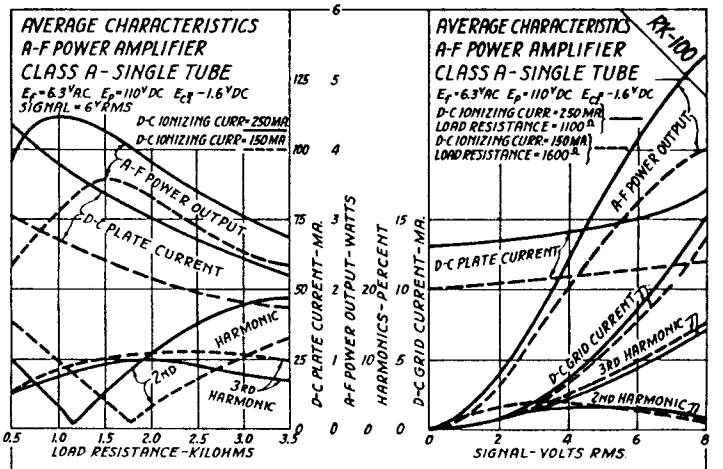
The operation of the RK-100 is similar to that of a conventional high vacuum tube except for the ionizing discharge mentioned above and the markedly different values of tube parameters such as high transconductance and high grid current.

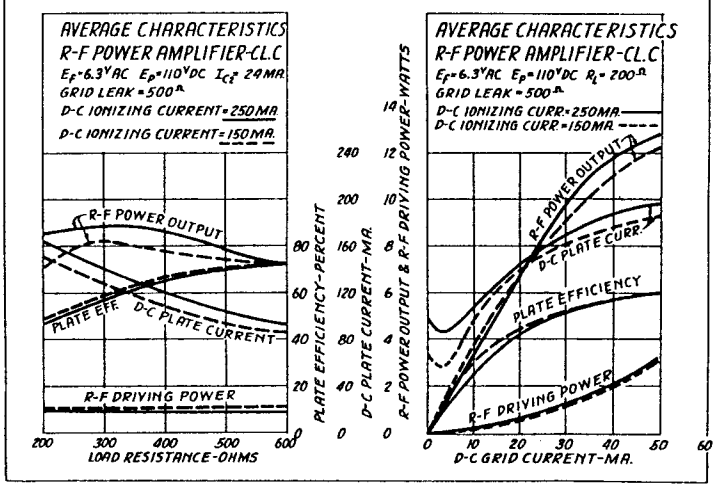
The internal impedance of the RK-100 is very low with a large signal on the grid. This makes it necessary to tap down on the output plate coil to match the low tube impedance. The input impedance is low so relatively few turns are required on the secondary of the driver transformer for optimum conditions. The above characteristics, low input and output impedances, make it difficult to obtain the same power from a self-excited oscillator as can be obtained from a driven amplifier. The power necessary to drive the tube may be obtained from conventional tubes such as the type 48 or one RK-100 will drive two RK-100 tubes.

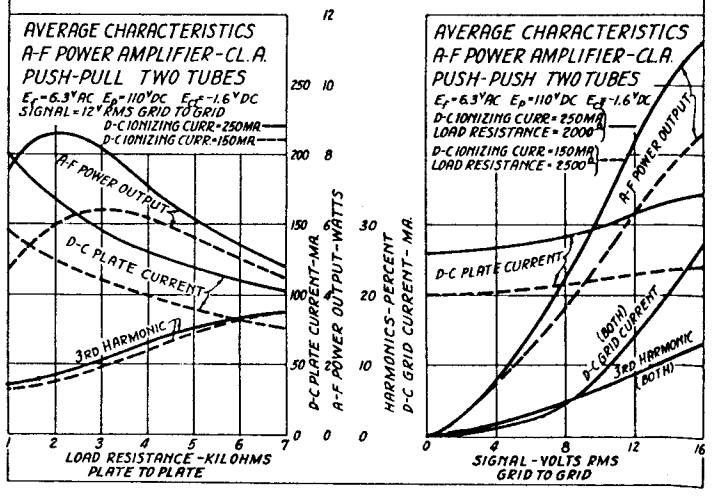
IMPORTANT

When first placing the RK-100 in operation it should be allowed to warm up for about 15 minutes to insure that no drops of mercury are shorting the elements. Thereafter, this precaution need not be taken unless the tube has been handled in such a way as to get mercury on the elements.



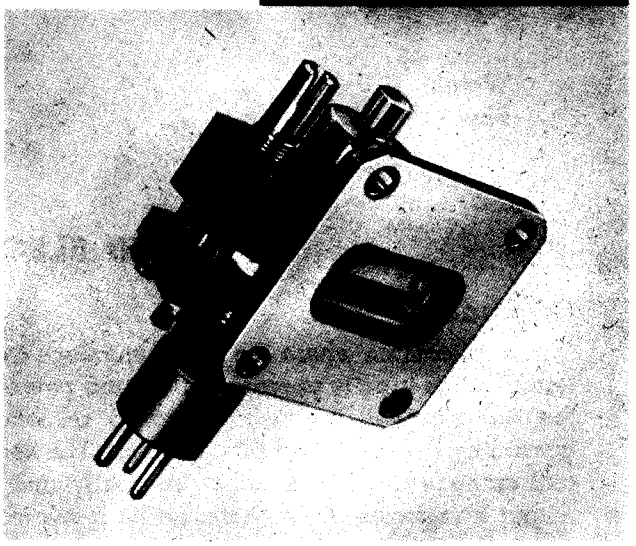






TYPE RK6310/ QK417

The RK6310/QK417 is a mechanically tuned velocity variation oscillator of the single cavity (integral) reflex type designed for CW operation in the 8500 to 10000 Mc range with an average power output of 40 milliwatts. No special provisions are ordinarily required for cooling the tube. It is a waveguide output type which can quite simply be fitted with a gasket and inserts capable of insulating the shell of the tube from the coupling guide. It is therefore convenient to operate the shell of this tube above ground, and to power the resonator circuit from the same supply which furnishes plate potential to other tubes in an equipment. The RK6310/QK417 is a rugged tube intended for radar applications where conditions of shock, vibration and sustained acceleration are encountered.



VELOCITY VARIATION OSCILLATOR

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

Heater Voltage	6.3 ±10% V
Heater Current	1.2 A

Maximum Ratings

Resonator Voltage	350 Vdc
Resonator Current	42 mAdc
Reflector Voltage	0 to −1000 Vdc
Ambient Temperature	150°C

Typical Operation

Frequency	9300 Mc
Mode	5¾
Resonator Voltage	300 Vdc
Resonator Current	28 mAdc
Reflector Voltage	−160 Vdc
Power Output	50 mW
Electronic Tuning Range	48 Mc
Modulation Sensitivity	1.5 Mc/v
Temperature Coefficient	60 Kc/°C

MECHANICAL

Mounting Position	Any
Overall Dimensions	See Outline Dwg.
Envelope	Metal
Base	Pee Wee, 3 Pin (A3-1)
Top Cap	Miniature (C1-4)
Tuner	Single Screw

Printed in U.S.A.

MICROWAVE AND POWER TUBE DIVISION

RAYTHEON COMPANY

FOUNDRY AVE., WALTHAM 54, MASS.

3400 — 6-55

Output	Bolts to UG 39/U flange or UG 40/U Choke for 1" x ½" x .050" Waveguide
Weight	7 oz.
Shock	250 G (Max.)
Vibration	10 G

DETAILED ELECTRICAL INFORMATION

Cathode

In applications where the metal envelope (resonator) of the tube is operated at ground potential, the cathode will be negative with respect to ground by the amount of this potential. The heater and cathode are tied together internally and the heater transformer must therefore be insulated to withstand maximum resonator voltage for all applications where the resonator is operated at ground potential.

In applications where the metal envelope is operated above ground potential, the tube should be surrounded by a grounded enclosure or insulator for the protection of the operator. In such an installation, tuning and mechanical adjustments made while the tube is in operation require an insulated tool, and coupling must be made with an insulating gasket interposed between the flanges of the tube and waveguide, and with insulating bushings in the clearance holes of the tube flange.

Whenever an insulator or grounded enclosure is used, adequate ventilation must be provided to maintain the ambient below the maximum specified limit.

Reflector

The power supply furnishing the reflector potential must be insulated to withstand the total resonator and reflector voltage in applications where the resonator is grounded. The reflector must never be allowed to become positive with respect to the cathode. Failure to observe this precaution may result in damage to the tube. In cases where modulating potentials bring the reflector potential close to zero volts, or where an extremely high reflector circuit impedance is required, a diode should be connected between cathode and reflector to prevent the reflector from going positive.

MECHANICAL TUNING

The mechanical tuner is designed to permit occasional frequency adjustments over the operating frequency range. Rotation of the tuning screw indicated in the outline drawing distorts the flexible cavity wall altering the spacing between the resonator grids to effect a frequency change. High and low frequency mechanical stops are provided to prevent tuning so far outside the specified tuning range that damage to the tube will result.

ELECTRONIC TUNING

With the mechanical tuner adjusted so that the tube is operating near the desired frequency, vernier frequency adjustments may be made by varying the reflector voltage. Maximum power output for a given mechanical tuner setting, however, will be obtained at only one value of reflector voltage. If the mechanical tuner and reflector voltage are mutually adjusted for maximum power output at a given frequency, and if then the reflector voltage is varied above and below the value for maximum power output, such that the power output is reduced by one half, the frequency between the half power values is defined as the electronic tuning range. The electronic tuning range and linearity depend on the type of load and coupling used. A highly reactive load may shorten the electronic tuning range and cause nonlinear variation of frequency with reflector voltage. See Fig. 1.

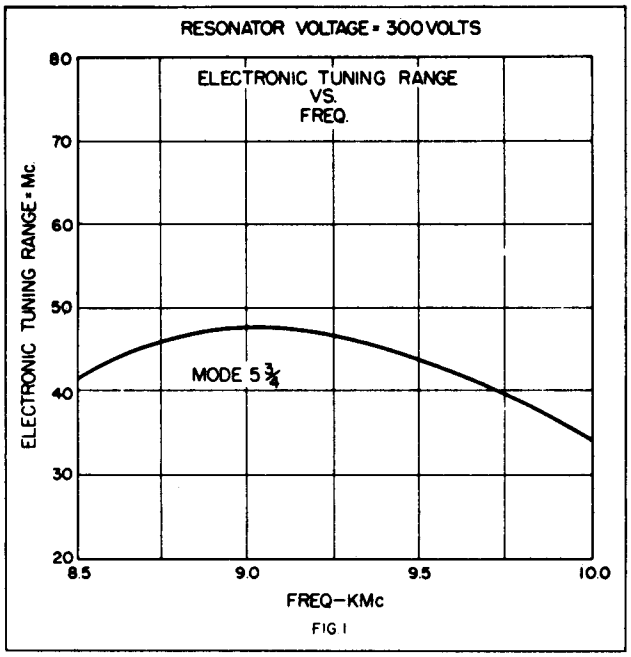


FIG 1

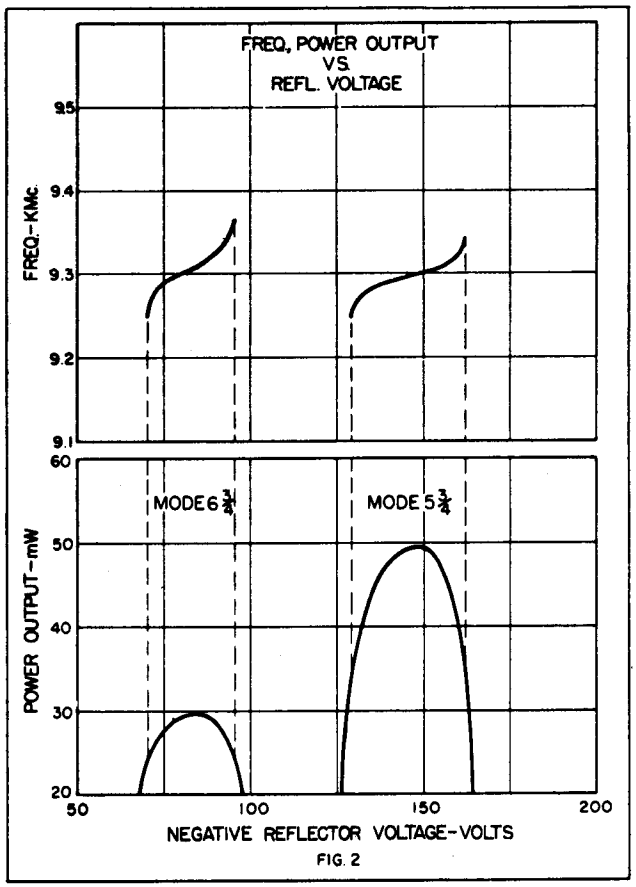


FIG. 2

MODE OF OPERATION

Oscillation may be obtained in a given tube with several combinations of resonator and reflector voltage at a particular frequency. See Fig. 2. The regions where oscillations occur within the reflector voltage range, are referred to as reflector transit modes. The curves of Fig. 3 show the RK6310/QK417 in the recommended 5¾ mode. This mode has been chosen because it represents the best compromise between optimum power and wide electronic tuning range. See Fig. 4.

VELOCITY VARIATION OSCILLATOR

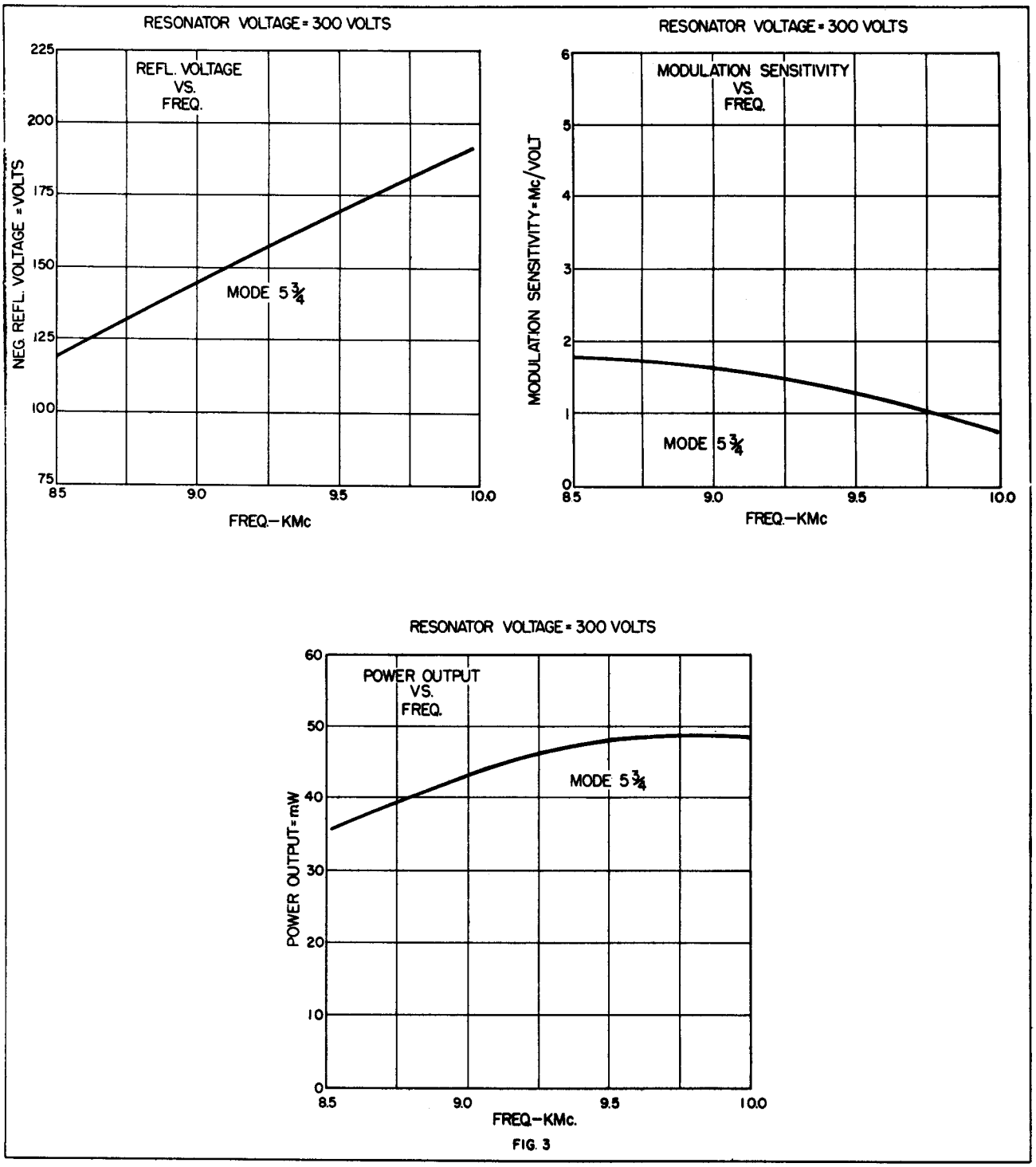


FIG. 3

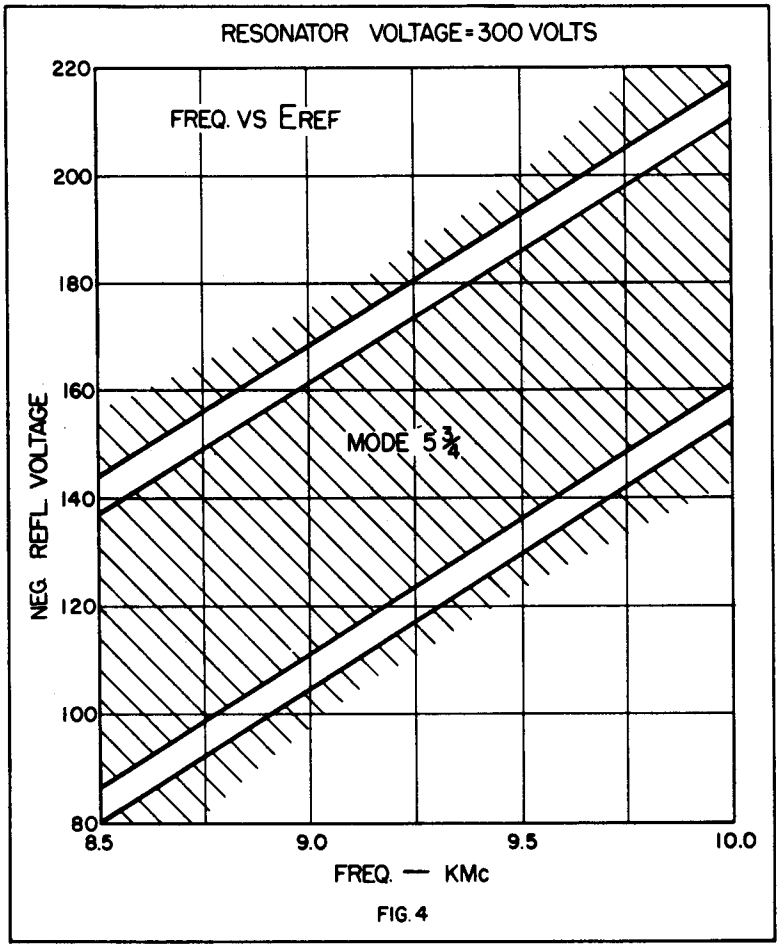


FIG. 4

DETAILED MECHANICAL INFORMATION

INSTALLATION

The RK6310/QK417 mounts in any position and is supported by the waveguide coupling flange.

SHIELDING

Operation of the RK6310/QK417 in the presence of strong magnetic fields usually requires shielding of the resonator and reflector leads to avoid undesirable modulation of the R.F. power output. In extremely troublesome envrionments, magnetic shielding of the whole tube may be necessary. Whenever shielding is used, adequate ventilation must be provided to keep the ambient below the maximum specified limit.

WAVEGUIDE WINDOW

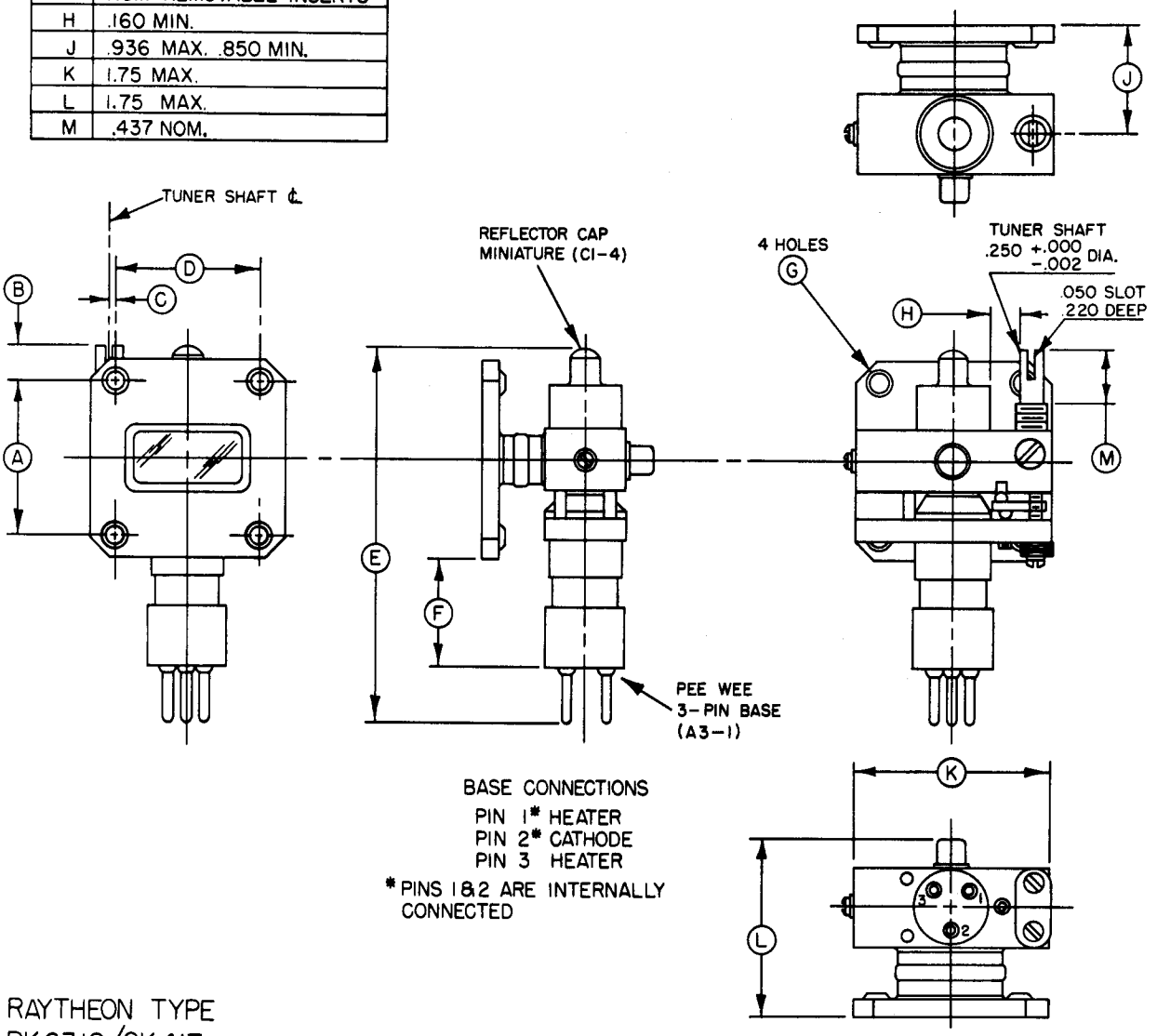
The waveguide output section contains a thin, low reflection mica window which is part of the vacuum envelope. This window can be cleaned when necessary with a soft material. Care should be exercised not to scratch or puncture the mica.

VELOCITY VARIATION OSCILLATOR

REF.	DIMENSIONS
A	1.284 MAX. 1.276 MIN.
B	.187 NOM.
C	.070 MAX. .010 MIN.
D	1.224 MAX. 1.216 MIN.
E	3.125 MAX.
F	1.00 MAX.
G	.219 DIA. NOM. WITH .185 DIA.
	NOM REMOVABLE INSERTS
H	.160 MIN.
J	.936 MAX. .850 MIN.
K	1.75 MAX.
L	1.75 MAX.
M	.437 NOM.

NOTE:

EYELET-TYPE INSERTS IN THE FLANGE MOUNTING HOLES ARE 0.219 O.D., 0.185 I.D., NOMINAL, AND ARE EASILY REMOVABLE FROM REAR OF FLANGE. WITH INSERTS IN PLACE, THE MOUNTING HOLES PROVIDE CLEARANCE FOR #8 SCREWS. WITH INSERTS REMOVED, THE MOUNTING HOLES PERMIT USE OF INSULATING BUSHINGS WHERE d-c ISOLATION BETWEEN TUBE FLANGE AND WAVEGUIDE SYSTEM IS DESIRED.



BASE CONNECTIONS

PIN 1* HEATER
PIN 2* CATHODE
PIN 3 HEATER

* PINS 1 & 2 ARE INTERNALLY CONNECTED

RAYTHEON TYPE
RK6310/QK417
OUTLINE DRAWING