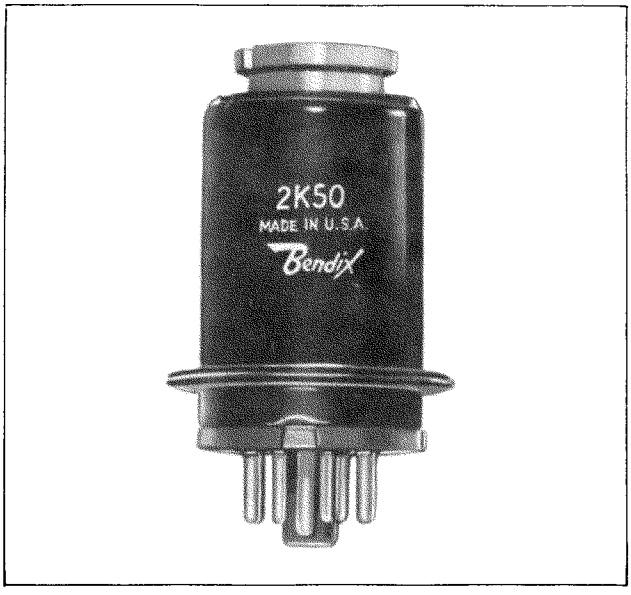
2K50
Bendix Type TK-4

REFLEX KLYSTRON

(THERMALLY TUNED)



MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	330 Vdc
Reflector Voltage	—150 Vdc
Tuner Grid Voltage	—50 Vdc
Filament Voltage	6.3 ± 8% V
Gun Cathode Current	28 mAdc
Tuner Cathode Current	10 mAdc
Altitude	10,000 ft.

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Base:* Small Octal 8-Pin, B8-21, Low Loss Phenolic Wafer.
- *Coupling to Wave Guide:* Direct, by means of an insulating fitting. (See Typical Adapter Assembly Drawing.)
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Silver Plated Steel.
- *Bulb:* Metal.
- *Output Window:* Low Loss glass.

DESCRIPTION

The 2K50 Reflex Klystron (Bendix Red Bank Type TK-4) is a thermally tuned K band reflex oscillator. The tube is designed for use as a CW oscillator over the range of 23.5 kMc/sec. to 24.5 kMc/sec. The tube is thermally tuned over this frequency range by varying the grid bias voltage of a triode section incorporated in the metal envelope. The plate of this triode section is attached to the klystron structure and thermal expansion of the plate caused by variations of plate current is transmitted to the klystron section causing a change of gap spacing and a corresponding frequency change.

The wave guide coupling is accomplished by means of a tapered wave guide which couples to the cavity through a non-resonant iris. The guide tapers in the narrow dimension only, from the iris to a circular output window. External to the tube there is an insulating fitting which permits the tube to be coupled directly to the guide by means of a coupling (see Typical Adaptor Assembly drawing). This construction makes it possible to operate the shell of the tube at a different potential from that of the guide.

APPLICATION NOTES

The 2K50 is unique in that its thermal tuning feature allows it to be tuned remotely by circuitry as in applications where direct mechanical tuning is impossible because of space limitations or inaccessibility. The type of thermal tuner employed in the 2K50 tends to be self compensating for ambient temperature changes, a factor which is highly desirable for most applications. In addition, the speed of the thermal tuner is remarkable. The tube will tune the prescribed frequency range from 23,500 Mc/sec. to 24,500 Mc/sec. in 1.2 to 2.6 seconds and, near the middle of the range, tuning speeds of 600 to 800 Mc/sec./sec. are obtained.

In addition to its application in radar circuitry, the 2K50 is finding wide application in microwave test gear and portable microwave spectroscopic equipment where ease and speed of tuning are desirable.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

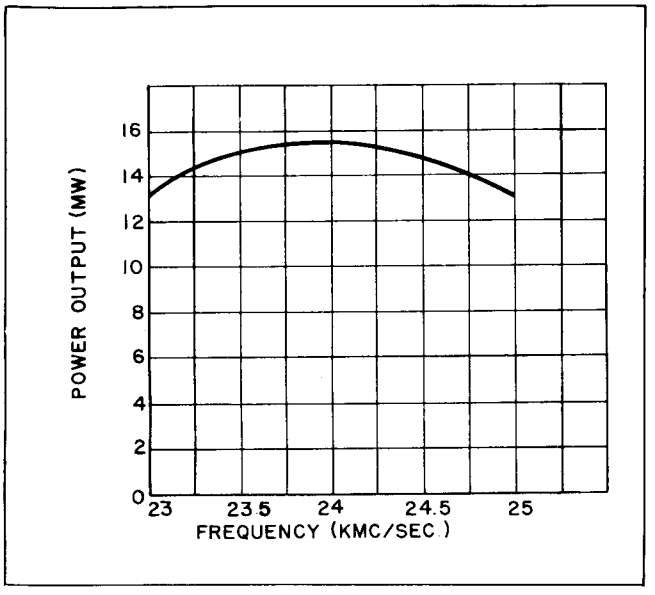
Publication No. R410-6 (Supersedes Pub. No. R310-5)

Printed in U.S.A.

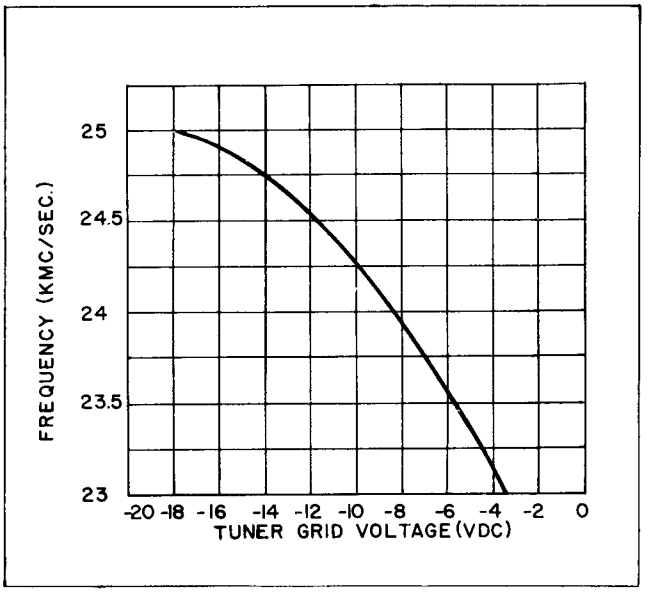
REFLEX KLYSTRON
(THERMALLY TUNED)

2K50
Bendix Type TK-4

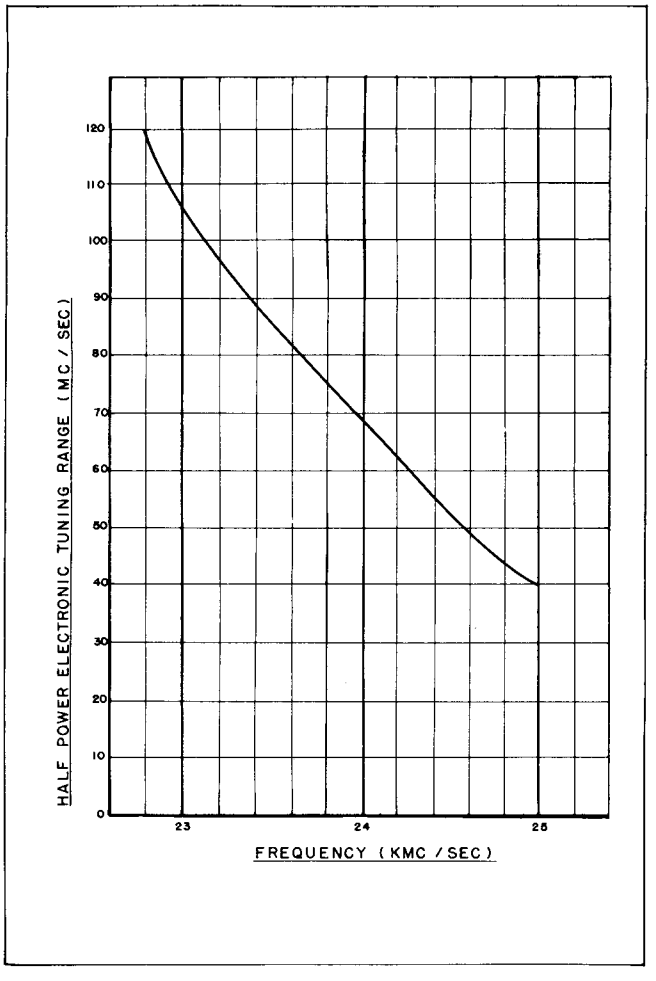
AVERAGE CHARACTERISTICS



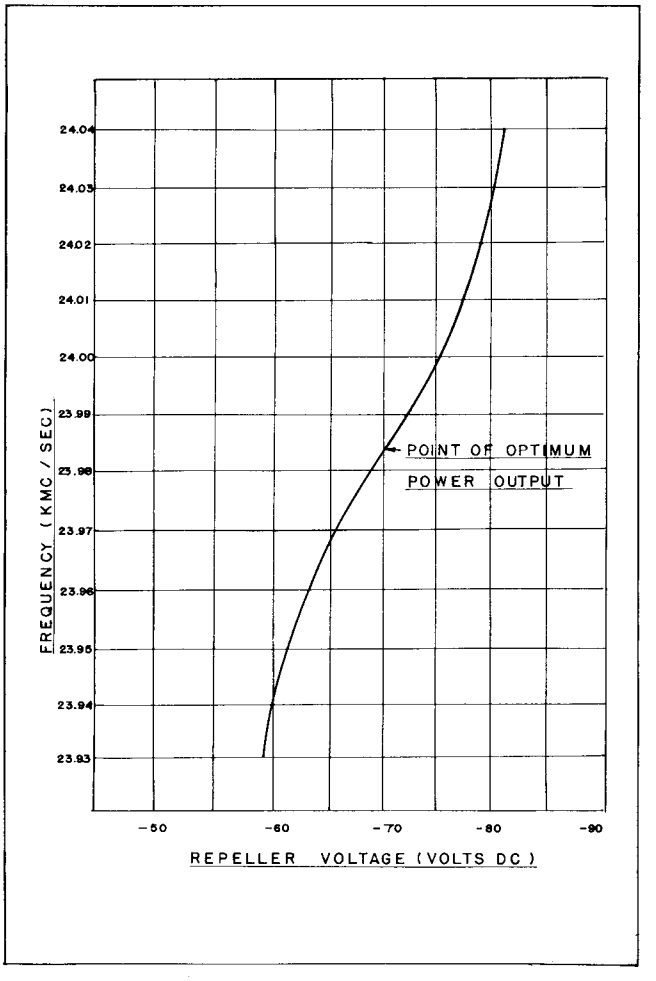
POWER OUTPUT VS. FREQUENCY
(REPELLER VOLTAGE OPTIMIZED
FOR EACH FREQUENCY)



FREQUENCY VS. TUNER GRID
VOLTAGE



VARIATION OF HALF POWER ELECTRONIC
TUNING RANGE WITH FREQUENCY



VARIATION OF FREQUENCY
WITH REPELLER VOLTAGE

REFLEX KLYSTRON
(THERMALLY TUNED)

2K50
Bendix Type TK-4

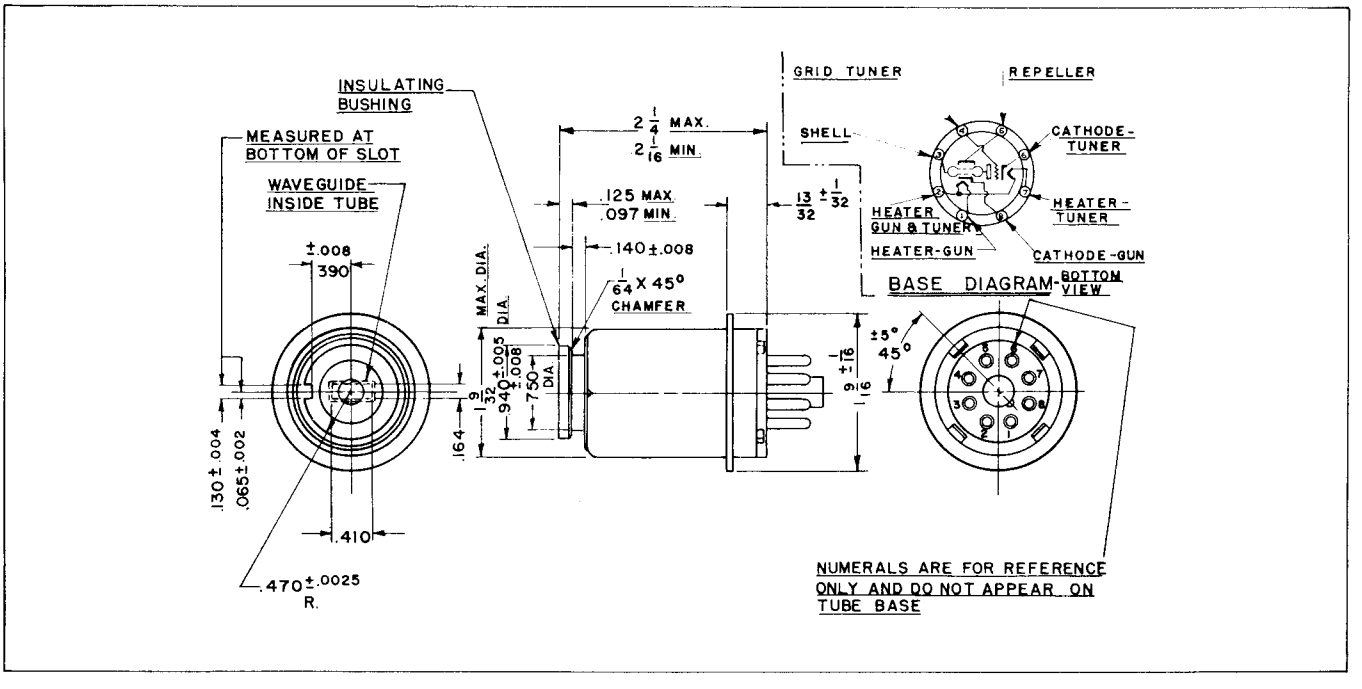
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

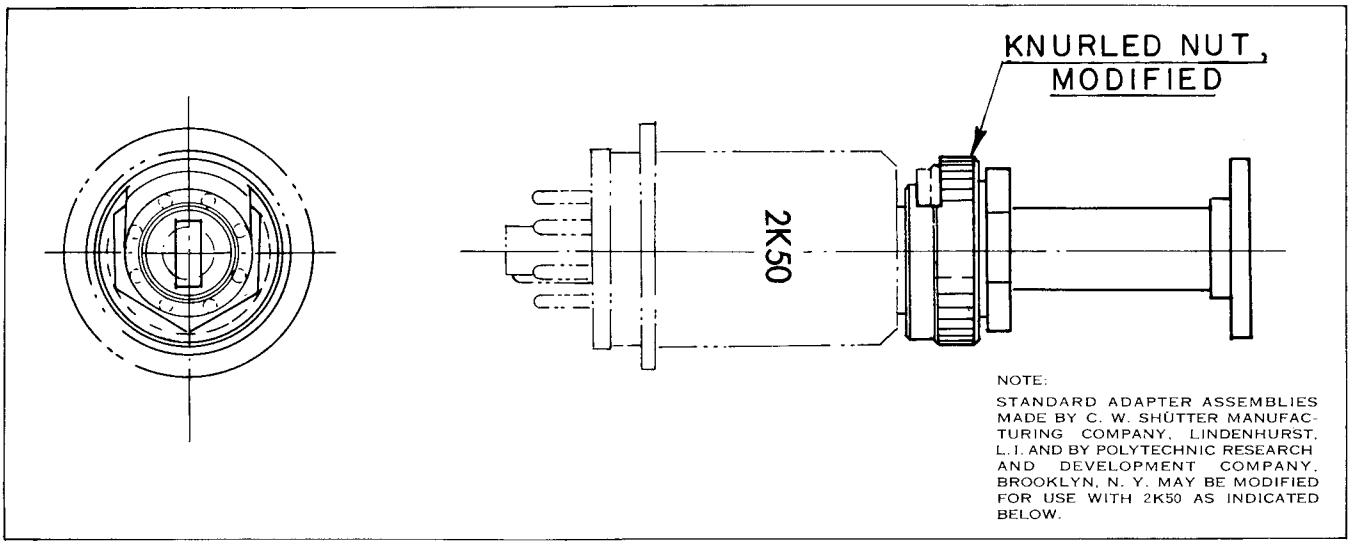
TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS					
Reflector Leakage Current	Er = —100 Vdc	Ir	—	5	uAdc
Reflector Gas Current	Er = —100 Vdc	Ir	—	2	uAdc
Grid Current	Ec = —10 Vdc	Ic	—	2	uAdc
Gun Cathode Current	Er = —50 to —100 Vdc Tube Non-Oscillating	Ik_1	—	22	mAdc
Tuner Cathode Current	Ec = 0 Vdc	Ik_2	—	10	mAdc
Thermal Tuning Range (1)	Er/Max. Po; Ec = 0 Vdc	F_1	—	23216	Mc
Thermal Tuning Range (2)	Er/Max. Po; Ec = — 30 Vdc	F_2	24751	—	Mc
Bump	Er/Max. Po	△Po/Po	—	10%	
Power Output	F = 23504 Mc } VSWR = 1.2 max.	Po	8.5	—	mW
	F = 23984 Mc } VSWR = 1.2 max.	Po	10	—	mW
	F = 24464 Mc } VSWR = 1.2 max.	Po	8.5	—	mW
Tuner Grid Voltage	Er/Max. Po	Ec	—3	—16	Vdc
Thermal Tuning	F = 23504 to 24,464 Mc	△Ec	—3	—10	Vdc
	Er/Max. Po				
Reflector Voltage		Er	—40	—110	Vdc
Emission Activity (Gun)	Ef = 5.8 V	$△Ik_1/Ik_1$	—	15%	
Emission Activity (Tuner)	Ef = 5.8 V	$△Ik_2/Ik_2$	—	15%	
DESIGN TESTS					
Electrode Insulation	500 v; Tube Cold	$R(k_1\text{-Res.})$	20	—	Meg.
		$R(k_2\text{-Res.})$	20	—	Meg.
		R(f-Res.)	20	—	Meg.
Heater Cathode Leakage	Ehk_1 = ± 45 Vdc.	Ihk_1	—	100	uAdc
	Ehk_2 = ± 45 Vdc	Ihk_2	—	100	uAdc
Heater Current		$If_1 + If_2$	705	805	mA
Thermal Tuning Time		t	1.2	2.6	sec.
Electronic Tuning	Er/50% Max. Po	F	55	125	Mc
Hysteresis			—	5%	

GENERAL TEST CONDITIONS:

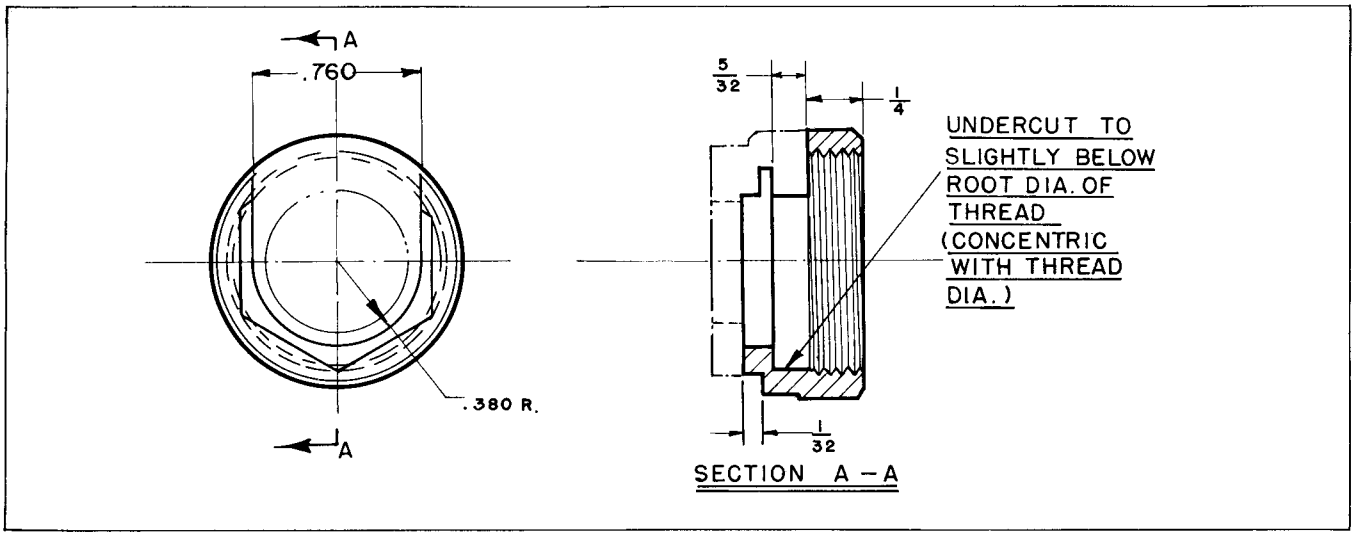
Ef.	Eres.	Er	Ec	F
6.3 volts	+300 Vdc	—20 to —130 Vdc	0 to —30 Vdc	23984 ± .3% Mc



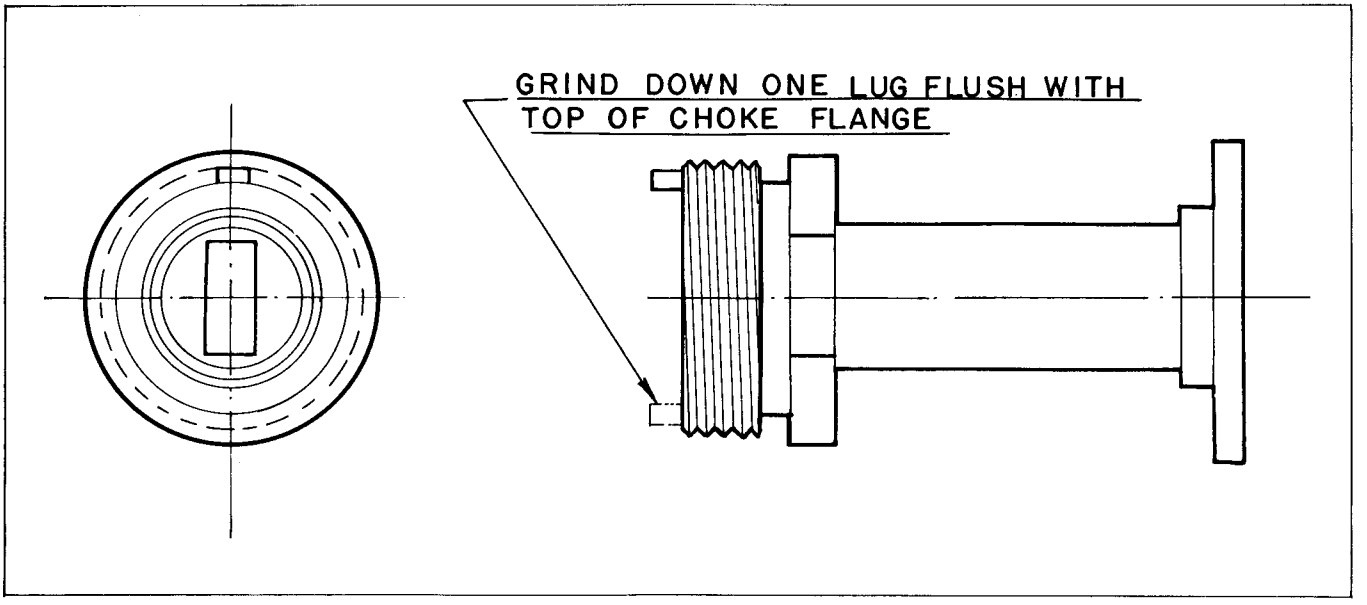
OUTLINE DRAWING



TYPICAL ADAPTER ASSEMBLY FOR COUPLING THE 2K50 TO RG-53/U WAVEGUIDE



STANDARD KNURLED NUT — MODIFIED AS SHOWN



STANDARD WAVEGUIDE ADAPTER — MODIFIED AS SHOWN

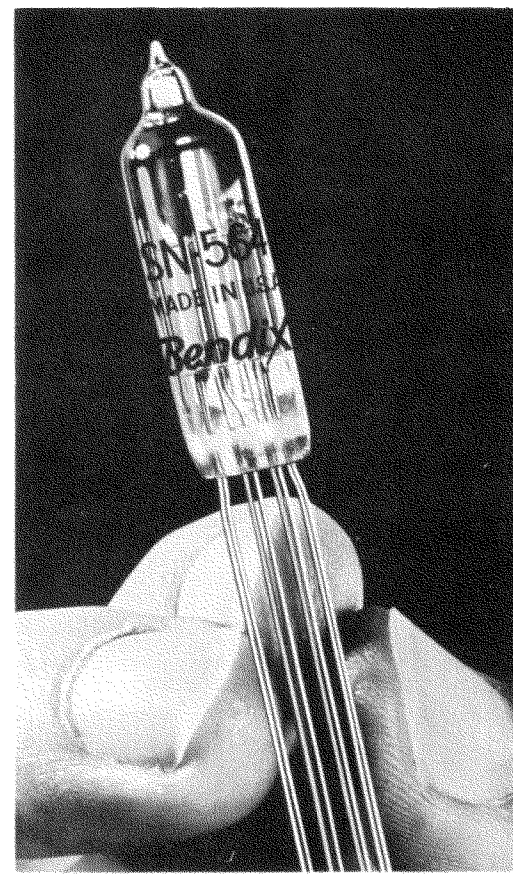
5643
Bendix Type TD-17

SUBMINIATURE TETRODE THYRATRON

DESCRIPTION

This reliable subminiature xenon tetrode thyratron is from the Bendix Red Bank line of reliable gas tubes. It is specifically designed for use in counters, grid control rectifiers, and other control circuits such as Gyro erection systems, missile systems and automatic flight control applications where freedom from early failures, long average service life and uniform operating characteristics are extremely important. In addition, this tube is designed for use in equipment where high levels of shock, vibration and other accelerations are to be encountered. Each tube is given a 24-hour run-in under various conditions of overload comparable to those to be encountered in service. This run-in period serves to reduce early failures by eliminating tubes that may have minor defects which could possibly lead to failure under operating conditions.

The mechanical and electrical design, combined with a program of 100% microscopic inspection during manufacture, assures a high degree of reliability in all applications where severe mechanical shock and vibration may be encountered. Careful exhaust to a high degree of vacuum is employed before xenon is put into the envelope to ensure a long life expectancy. The large cathode area operating at moderate temperatures gives long service life. Small mass of the tube elements and electrode spacing provide increased ability of the tube to withstand shock and vibration. This tube has a control characteristic which is virtually independent of ambient temperature over a comparatively wide range. (Refer to the enlarged view on the last page for the many improved features of this tube.)



ELECTRICAL RATINGS

Heater Voltage	6.3 volts
Heater Current	0.15 amperes
Peak Plate Inverse Voltage	500 volts
Peak Forward Plate Voltage	500 volts
Maximum Negative Grid 1 Voltage (Before Conduction)	−200 volts
Maximum Negative Grid 2 Voltage (Before Conduction)	−100 volts
Average Cathode Current	16 mAdc
Peak Cathode Current	100 mA
Heater-Cathode Voltage:	
Maximum	+25 Vdc
Minimum	−100 Vdc
Cathode Warm-up Time	10 sec
Maximum Negative Grid 1 or Grid 2 Voltage During Conduction	−10 volts

MECHANICAL DATA

Base	Button: Subminiature 8-pin long leads
Envelope	T-3 (8-1)
Bulb Length (Max)	1.375 in.
Diameter (Max)	0.400 in.
Mounting Position	Any
Altitude Rating (Max)	60,000 ft.
Bulb Temperature (Max)	125°C
Ambient Temperature (Min)	−55°C
Cathode	Coated Unipotential

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 62-6 (Supersedes No. R 511-12)

Printed in U.S.A.

SUBMINIATURE TETRODE THYRATRON

5643
Bendix Type TD-17

ELECTRICAL CHARACTERISTICS AND TEST DATA

END OF LIFE
TEST CONDITIONS AND CHARACTERISTICS LIMITS

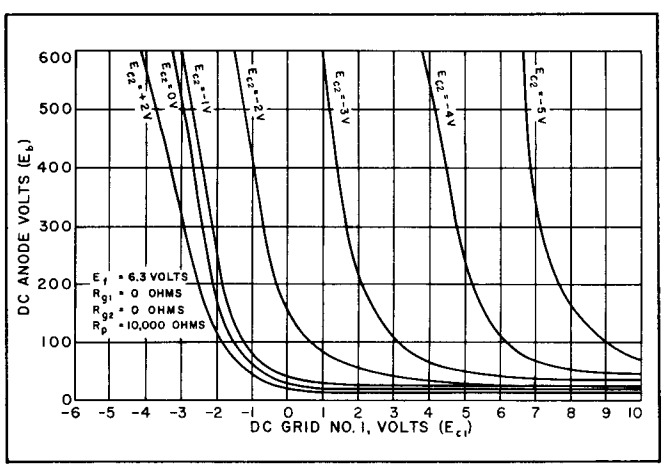
CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Heater Current	If	138	150	164	mA
Heater-Cathode Leakage	Ihk	—	—	±20	μAdc
Grid Voltage (1)	Eg1	—0.8	—	—5.0	Vdc
Grid Voltage (2)	Eg1	—	—	—	Vdc
Anode Voltage	Ebb	—	—	70	Vdc
Pulse Emission	td	—	—	100	Vac
Short and Continuity					

ELECTRODE:	Ef	Ec2	Ehk
TEST CONDITIONS:	6.3 volts	0	+25 Vdc
			—100 Vdc

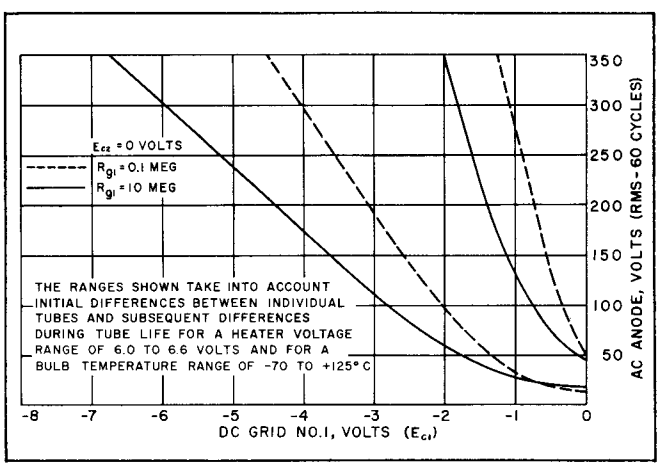
ADDITIONAL TESTS

In addition to the production and design tests shown other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

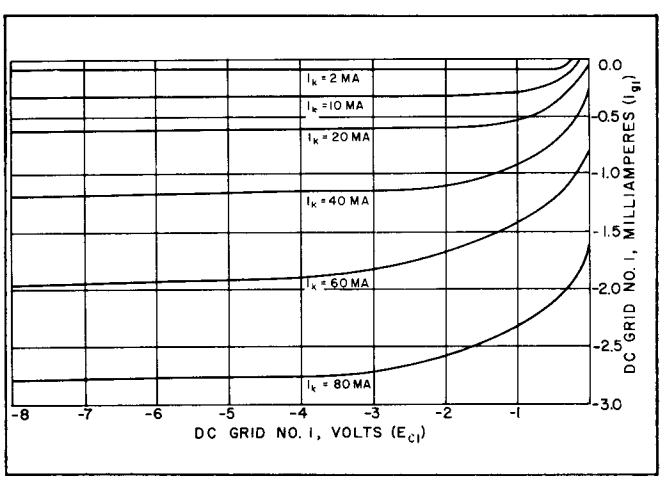
TEST	CONDITIONS	DURATION
Heater cycling Life Test	On 1 Min. Off 4 Min. Ef=7.0 Ehk=18	2500 on-off cycles
High Temp. Life Test	Under "Test Conditions" Bulb Temp. 125° C	600 Hours
Survival Rate Life Test	Under "Test Conditions"	100 Hours
High Level Fatigue Test	2.5G Excitation 60/sec. rep. rate	96 Hours
Shock	500 G	
Altitude Test	60,000 Feet	
Glass Strain Test	Boiling Water to Ice Water	15 sec. hot 5 sec. cold
Lead Fatigue	1 Pound	4 Arcs
Mount Inspection	100% Test—Microscopic Inspection	



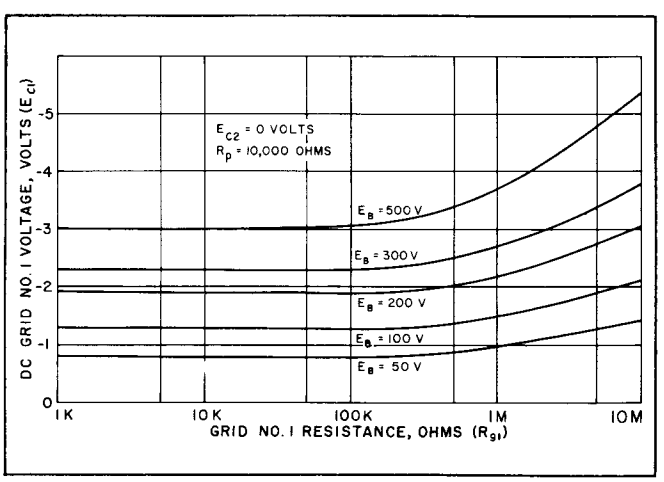
AVERAGE CONTROL CHARACTERISTICS



OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE



AVERAGE GRID CHARACTERISTICS DURING ANODE CONDUCTION

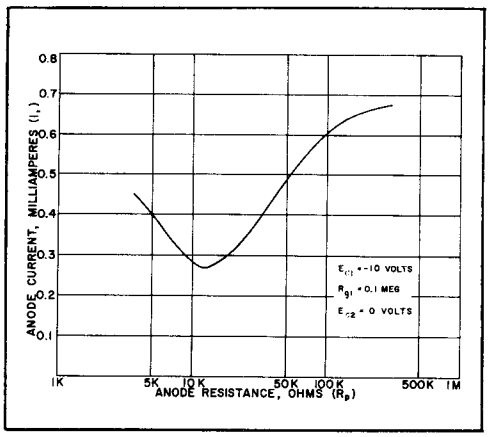


AVERAGE GRID VOLTAGES vs. GRID RESISTANCE

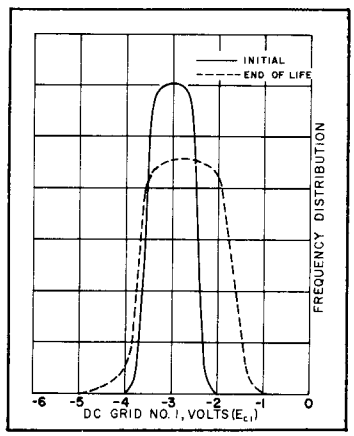
SUBMINIATURE TETRODE THYRATRON

Bendix Type TD-17

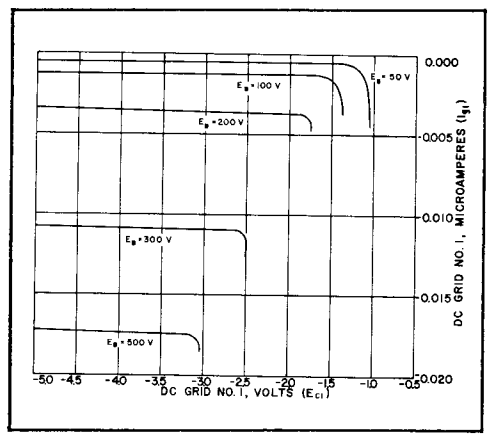
5643



AVERAGE ANODE CURRENT REQUIRED TO MAINTAIN CONDUCTION



AVERAGE GRID FIRING DISTRIBUTION



AVERAGE GRID CHARACTERISTICS BEFORE ANODE CONDUCTION

APPLICATION NOTES

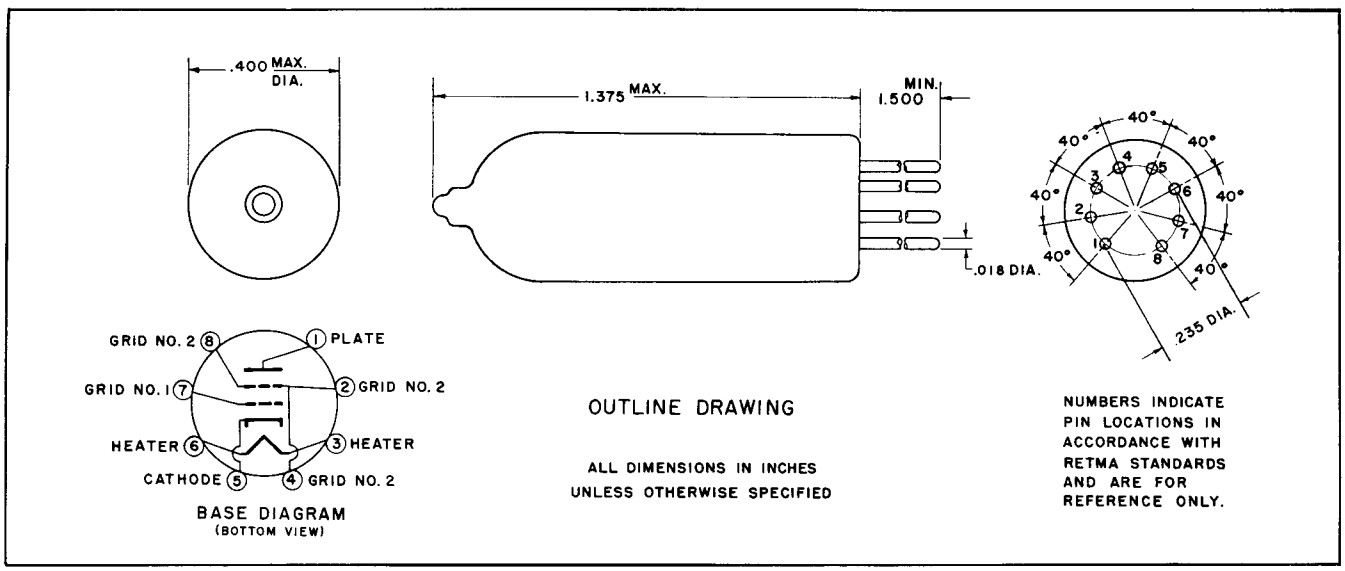
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability.

Typical use of this subminiature thyratron is in grid-controlled rectifiers, counter circuits and various control circuits where a high degree of reliability is required. When conservatively used, this tube has a life expectancy of over 1000 hours.

EFFECT ON LIFE OF INCREASED RATINGS

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3V ± 2%	6.3V ± 3%	6.3V ± 5%
Plate Voltage (dc)	350 Vdc	400 Vdc	500 Vdc
Plate Voltage (ac)	275 Vac	300 Vac	350 Vac
Peak Plate Voltage Inv.	350 V	400 V	500 V
Plate Current (Av.)	12mA	14mA	16mA
Cathode Current (Peak)	50mA	65mA	100mA
H-K Voltage	±10V	+20; —90V	+25; —100V
Grid Resistance	100,000 ohms	1,000,000 ohms	10,000,000 ohms
Bulb Temperature	85°C	100°C	125°C
Altitude	0—50,000 ft	50,000 ft.	60,000 ft.
Vibration	0 G	2.5 G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

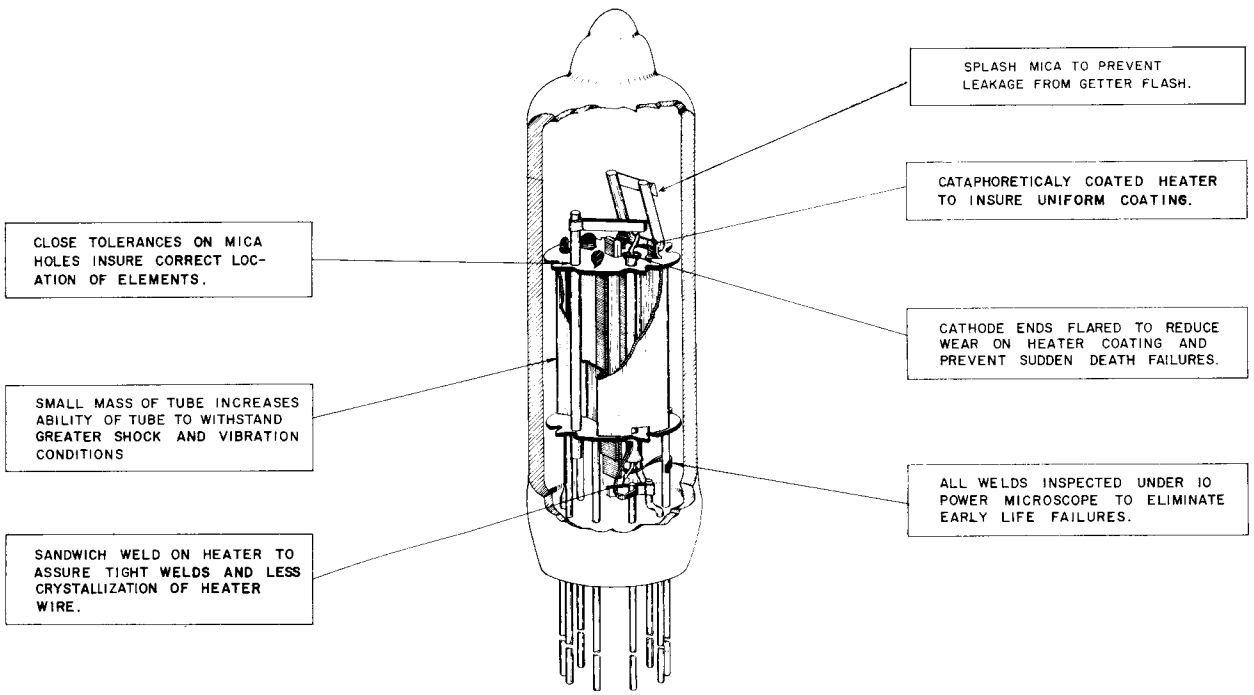


OUTLINE DRAWING

SUBMINIATURE TETRODE THYRATRON

5643

Bendix Type TD-17



STRUCTURAL FEATURES OF 5643 PROVIDE HIGH RELIABILITY AND LONG LIFE.

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

5787 WA
Bendix Type TD-63

RELIABLE SUB-MINIATURE VOLTAGE REGULATOR



DESCRIPTION

This tube is a gas filled, cold cathode, subminiature voltage regulator, Type 5787 WA. The construction of this tube is such that it will withstand conditions of severe shock and vibration. The tube is characterized by long life and is designed to operate under conditions of high temperature. This tube may be soldered directly into any circuit and is particularly adaptable where space is of prime importance.

ELECTRICAL RATINGS

Anode Supply Voltage	140 Vdc min.
Ionization Voltage	135 Vdc max.
(For Ionization Voltage Distributions, See Fig. 2)	
Operating Voltage Range	95 - 103 Vdc
(For Operating Voltage Distributions, See Fig. 1)	
Operating Current Range	5 - 25 mAdc
Vibration Output (40 cps, 15G)	50 mVac max.
Shock (30° Hammer Angle)	
Fatigue (96 hrs., 2.5G, 25-60 cps)	
Ambient Temperature Range	−55°C to +150°C
Maximum Bulb Temperature	+225°C

OPERATING NOTES

Attention should be given to the bulb temperature at which the tubes are to be operated. Reliability will be impaired if the maximum bulb temperature is exceeded. There are several requirements in the operation of a glow discharge tube, like the 5787 WA/TD-63, which must be adhered to carefully. The first is that the supply voltage must always be greater than the anode breakdown voltage. The second condition is that sufficient resistance must always be in series with the tube to limit the current to the minimum and maximum values specified in the ratings.

PHYSICAL CHARACTERISTICS

- *Envelope:* T-3.
- *Base:* Pressed Stem: (.016" tinned flexible leads. Spacing 0.096" center to center. Length 1.5" minimum)
- *Terminal Connections:* Lead 1, Cathode; Lead 3, anode, Lead 5, cathode.
- *Maximum Bulb Dia.:* 0.400".
- *Maximum Sealed Bulb Height:* 2.063".
- *Mounting Position:* Any.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R06-3

Printed in U.S.A.

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

RATINGS	Total Darkness Ionization Voltage	Ambient Light Ionization Voltage	Operating Voltage	Operating Current	T Envelope	Alt	TA
Absolute	Vdc	Vdc	Vdc	mAdc	°C	ft	°C
Maximum	—	—	98	25	+225	60,000	+150
Minimum:	141	141	—	5	—	—	−55
Test Cond.:	—	—	—	—	—	—	—

Cathode: Glow Discharge
Base: Subminiature 5 Pin with Long Leads

Pin No.:	1	2	3	4	5
Element:	k	nc	p	nc	k

The following tests shall be performed:

MEASUREMENTS ACCEPTANCE TESTS PART 1 NOTE 1

Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS Min.				LIMITS Max.		Units
4.13.1	†Ionization Voltage(1):	Ebb/Ib = 5 — 25 mAdc: Illumination = 5 — 50 ft. candles	0.65	II	Ez:	—	—	—	—	135	—	Vdc
4.13.2	Tube Voltage Drop(1):	Ebb/Ib = 25 mAdc	0.65	II	Etd:	95	—	—	—	103	—	Vdc
4.13.2	Tube Voltage Drop(2):	Ebb/Ib = 5 mAdc	0.65	II	Etd:	95	—	—	—	103	—	Vdc
4.13.2.1	Regulation:	(1)Etd — (2)Etd	0.65	II	Reg:	—	—	—	—	±3	—	Vdc
4.7.5	Continuity and Shorts: (Inoperatives)		0.4	II		—	—	—	—	—	—	
4.9.1	Mechanical:	Envelope Outline No. 8-7 Except Dimension A = 2.063 max. Dimension B = 1.813 ± 0.100				—	—	—	—	—	—	

MEASUREMENTS ACCEPTANCE TESTS PART 2

4.13.4.3	Noise:	Ebb/Ib = 25 mAdc	1.0	I	Eb:	—	—	—	—	20	—	mVac
4.13.4.2	Oscillation:	Esig = 100 mVac; RL = 500 Ω Ebb/Ib = 5 — 25 mAdc	1.0	I		—	—	—	—	—	—	
4.13.1	Ionization Voltage(2):	Note 2	6.5	Code G	Ez:	—	—	—	—	141	—	Vdc
4.13.3	Leakage:	Eb = 50 Vdc; Rp = 3000 Ω	6.5	Code G	Ilb:	—	—	—	—	5	—	uAdc
—	Repeatability:	Ebb/Ib = 10 mAdc; Note 3	6.5	Code E	△Etd:	—	—	—	—	1.0	—	Vdc
4.9.19.1	Vibration(2):	Rp = 10,000 Ω; Ebb/Ib = 25 mAdc; F = 40 cps; G = 15	6.5	Code G	Ep:	—	—	—	—	50	—	mVac

DEGRADATION RATE ACCEPTANCE TESTS

4.9.5.3	Subminiature Lead Fatigue		2.5	Code G		4	—	—	—	—	—	arcs
4.9.20.5	Shock:	Hammer Angle = 30°;	—	—	—	—	—	—	—	—	—	
4.9.20.6	Fatigue:	G = 2.5; Fixed Frequency; F = 25 min., 60 max.	6.5			—	—	—	—	—	—	
—	Post Shock and Fatigue Test End Points:	Vibration(2)	—	—	Ep:	—	—	—	—	100	—	mVac
		Ionization Voltage(1)	—	—	Ez:	—	—	—	—	141	—	Vdc
		Tube Voltage Drop(1)	—	—	Etd:	95	—	—	—	105	—	Vdc
		Tube Voltage Drop(2)	—	—	Etd:	95	—	—	—	105	—	Vdc
		Regulation	—	—	Reg.	—	—	—	—	±4.0	—	Vdc
—	Glass Strain		2.5	I		—	—	—	—	—	—	

ACCEPTANCE LIFE TESTS

Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defective per Characteristic		Sym.	LIMITS		Units
					1st Sample	Combined Samples		Min.	Max.	
—	Stability Life Test (1 hour)	Ebb/Ib = 25 mAdc; TA = Room	6.5	Code I	—	—		—	—	
4.11.4	Stability Life Test End Points:	Change in Tube Voltage Drop(1) of individual tubes	—	—	—	—	△Etd: t	—	1.0	Vdc
		Change in Tube Voltage Drop(2) of individual tubes	—	—	—	—	△Etd: t	—	1.0	Vdc
—	Survival Rate Life Test: (100 hours)	Stability Life Test Conditions or equivalent	—	II	—	—		—	—	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives)	0.65	—	—	—		—	—	
		Change in Tube Voltage Drop(1) of individual tubes	6.5	—	—	—	△Etd: t	—	1.0	Vdc
		Change in Tube Voltage Drop(2) of individual tubes	6.5	—	—	—	△Etd: t	—	1.0	Vdc
4.11.5	Intermittent Life Test:	Stability Life Test Conditions; T Envelope = 225°C min.	—	—	—	—		—	—	
4.11.4	Intermittent Life Test End Points: (500 hours)	Inoperatives	—	—	1	3		—	—	
		Regulation	—	—	1	3	Reg:	—	±5.0	Vdc
		Tube Voltage Drop(1)	—	—	1	3	Etd:	95	105	Vdc
		Tube Voltage Drop(2)	—	—	1	3	Etd:	95	105	Vdc
		Change in Tube Voltage Drop(1) of individual tubes	—	—	1	3	△Etd: t	—	3	%
		Change in Tube Voltage Drop(2) of Individual tubes	—	—	1	3	△Etd: t	—	3	%
		Ionization Voltage(1)	—	—	1	3	Ez:	—	141	Vdc
		Total Defectives	—	—	4	8		—	—	
4.11.4	Intermittent Life Test End Points: (1000 hours)	Inoperatives	—	—	2	5		—	—	
		Regulation	—	—	2	5	Reg:	—	±6.0	Vdc
		Tube Voltage Drop(1)	—	—	2	5	Etd:	95	105	Vdc
		Tube Voltage Drop(2)	—	—	2	5	Etd:	95	105	Vdc
		Change in Tube Voltage Drop(1) of individual tubes	—	—	2	5	△Etd: t	—	4	%
		Change in Tube Voltage Drop(2) of individual tubes	—	—	2	5	△Etd: t	—	4	%
		Ionization Voltage(1)	—	—	2	5	Ez:	—	141	Vdc
		Total Defectives	—	—	5	10		—	—	

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

Note 2: 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 3: Repeatability shall be defined as the maximum shift in tube voltage drop between successive firings of the tube. The tube shall be tested in the following manner.

a. Etd 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 times. The range of Etd shall be taken as the measure of repeatability.

AVERAGE CHARACTERISTICS

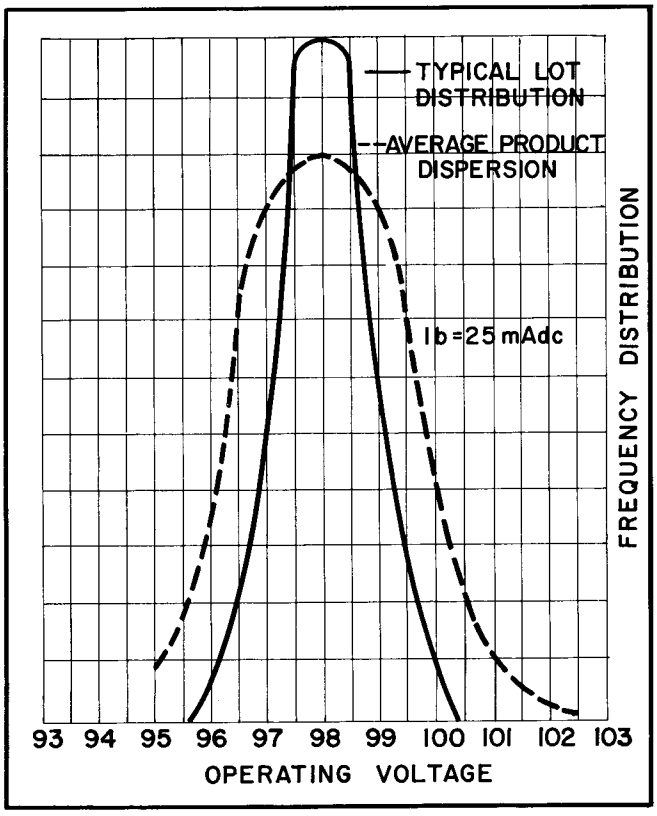


FIG. 1

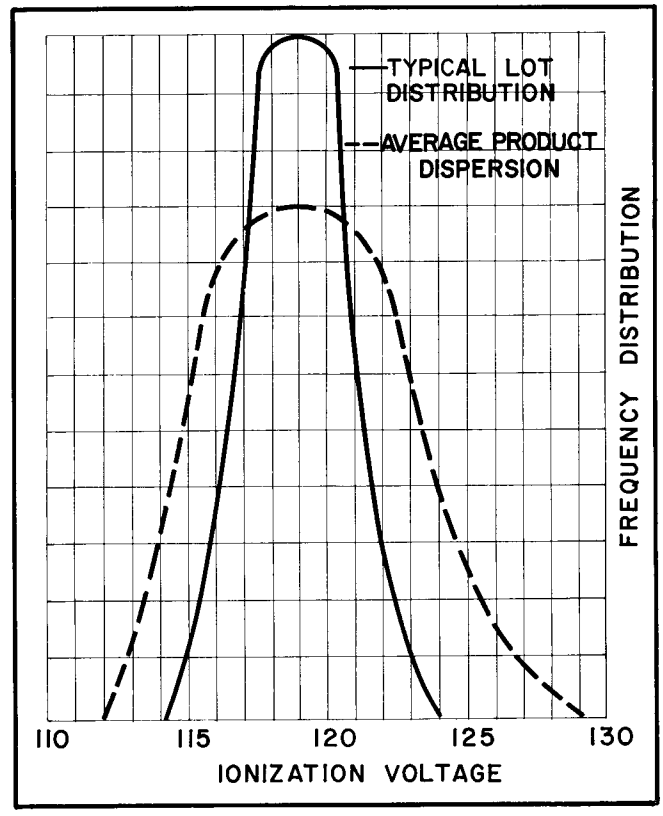


FIG. 2

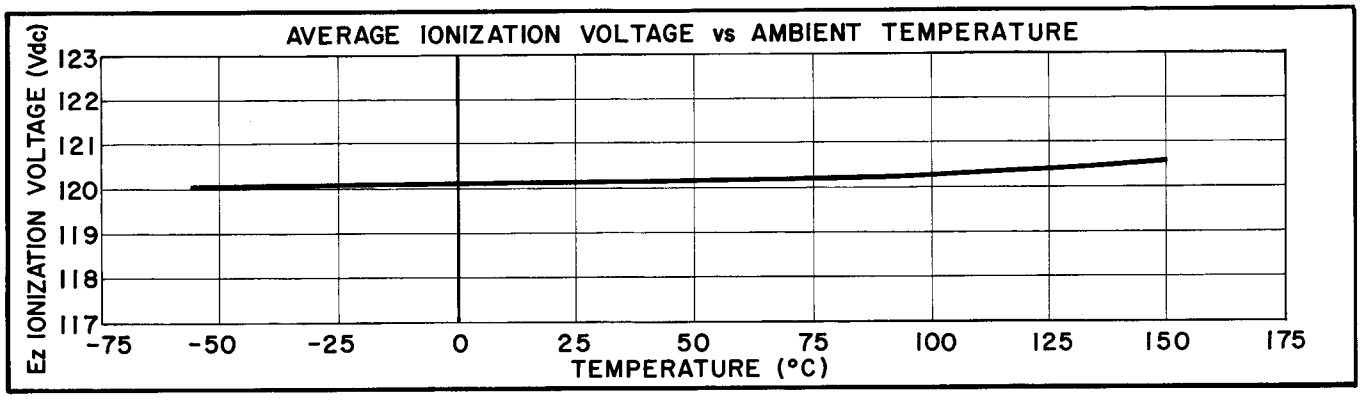


FIG. 3

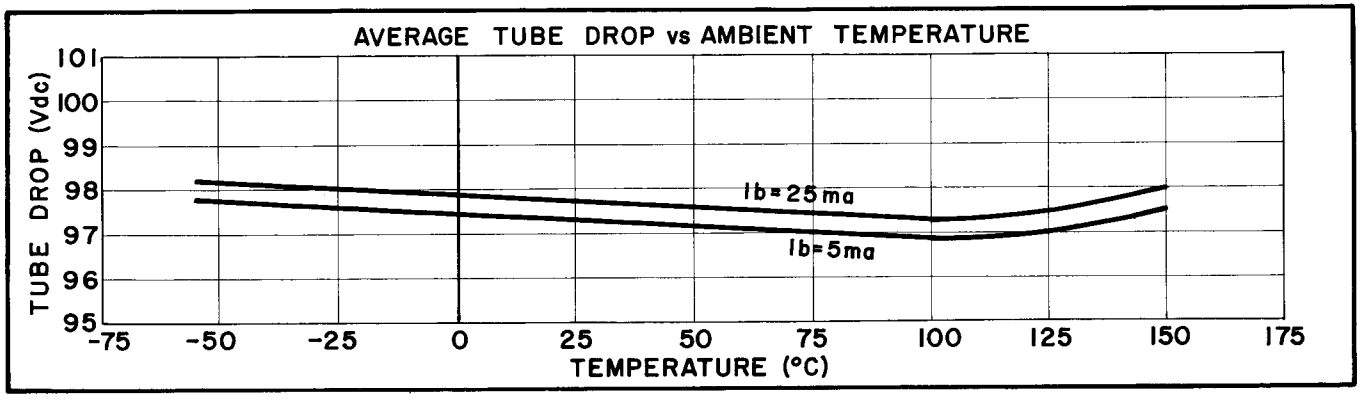


FIG. 4

AVERAGE CHARACTERISTICS

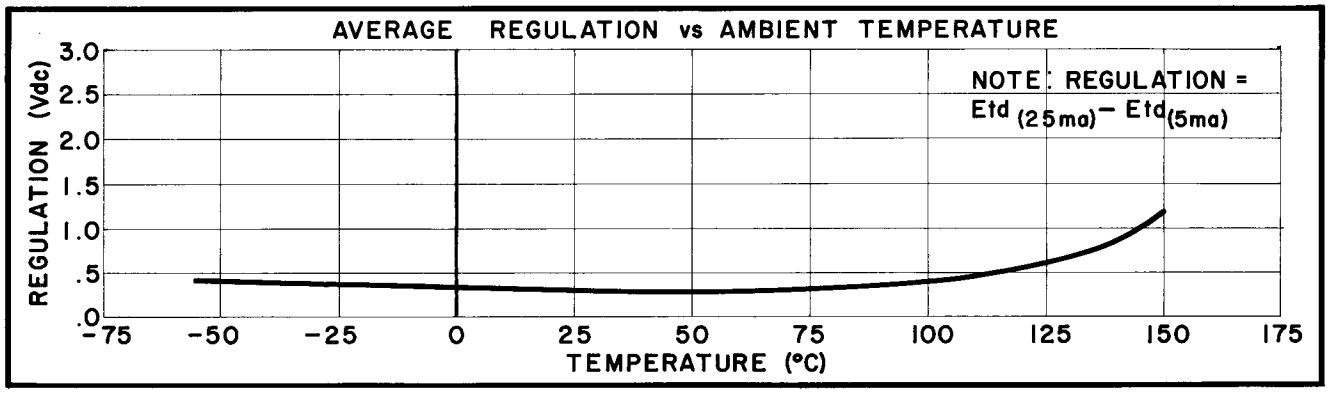
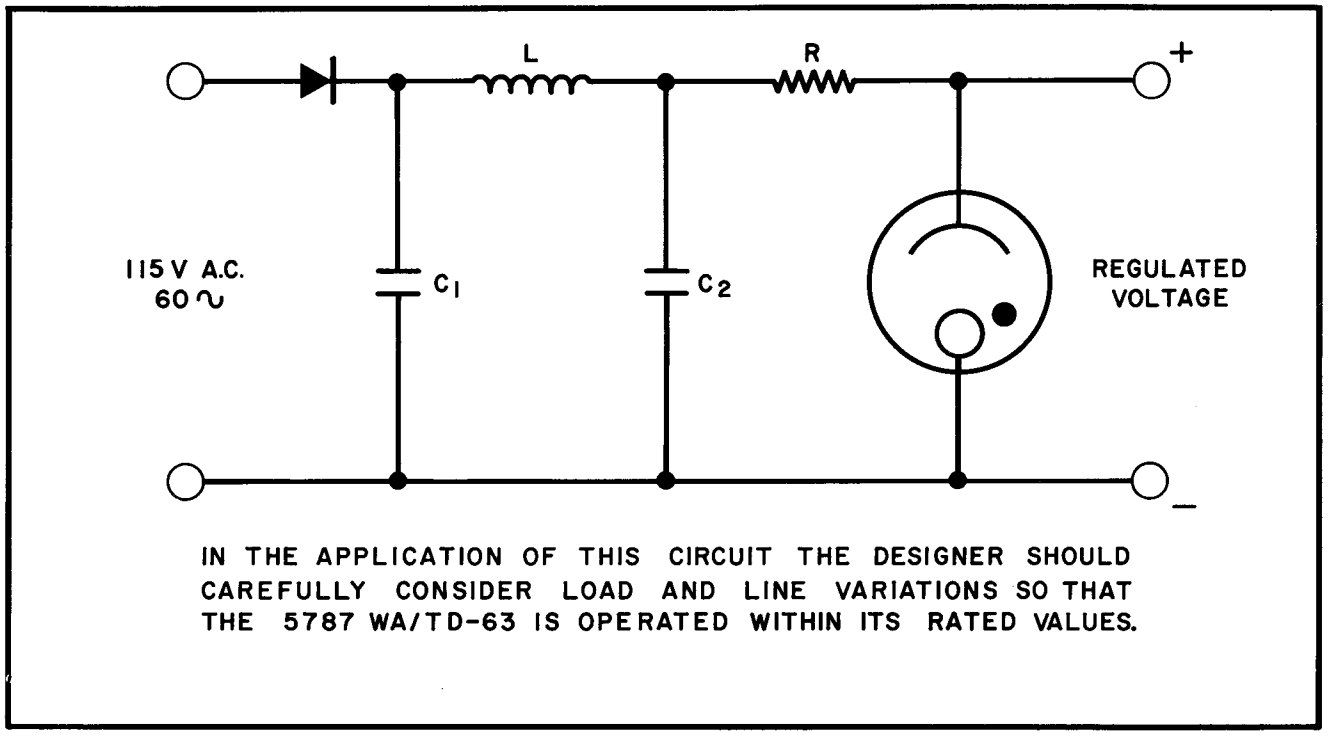


FIG.5



TYPICAL APPLICATION CIRCUIT FOR USE DIRECTLY FROM 110V AC LINE.
FIG.6

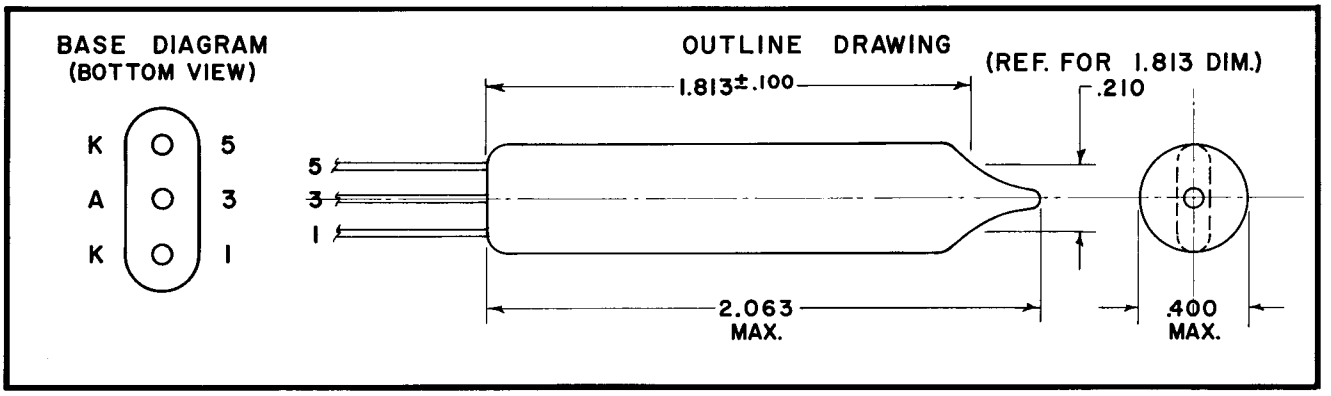


FIG. 7

For Additional Information Write —

ELECTRON TUBE PRODUCTS

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

Cable: **BENDIX-EATONTOWN** Telephone: **LIBERTY 2-2000**

OR

The Bendix Corporation
1701 K Street, N. W.
Washington, D. C.
REpublic 7-3118

The Bendix Corporation
1900 Hulman Building
Dayton, Ohio
BAldwin 6-2341

The Bendix Corporation
2N565 York Road
Elmhurst, Illinois
BRowning 9-5050

The Bendix Corporation
8425 First Ave. South
Seattle 8, Washington
PArkway 5-9100

The Bendix Corporation
P.O. Box 35092
Dallas 35, Texas
FLeetwood 1-5411

The Bendix Corporation
117 East Providencia Ave.
Burbank, California
VIctoria 9-3961

The Bendix Corporation
Bendix International Division
205 East 42nd Street
New York 17, N Y.

Computing Devices of Canada Ltd.
P.O. Box 508
Ottawa, Ontario, Canada

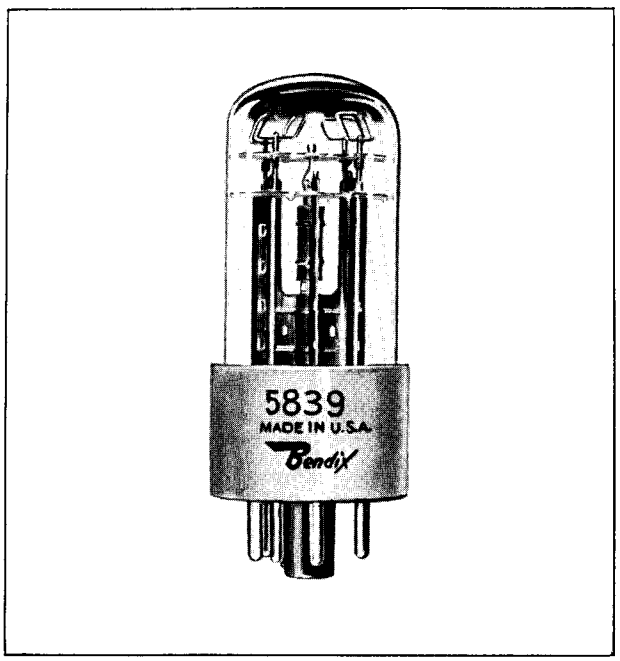
File Catalog: Electron Tube Products
Section: Receiving Tubes

5839
5838
5852

Bendix Types { TE-2, TE-3, TE-5

(Generic Type 6X5)

FULL-WAVE RECTIFIERS



DESCRIPTION

These full-wave, high-vacuum rectifiers are from the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft and industrial applications where freedom from early failures, long average service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions. The three tubes covered on this sheet are identical with the exception of the filament ratings.

The heavy-gage heater construction, together with a pure alumina insulator, permits operation at high heater cathode voltages. The large area cathode operating at moderate temperatures gives long service life and freedom from arc-overs. The eight-pillar mount structure and the button-type stem provide a strong assembly that will stand up under extreme conditions of vibration and shock. The tube requires an 8-pin octal socket and can be mounted in any position. Adequate ventilation should be provided.

RATINGS*

Heater voltage and current**

†JAN 5839 (R.B. Type TE-2)..... 26.5 volts, 0.255 amps.
5838 (R.B. Type TE-3)..... 12.6 volts, 0.6 amps.
JAN 5852 (R.B. Type TE-5)..... 6.3 volts, 1.2 amps.

†Illustrated above.

Peak inverse voltage	1375 volts (max.)
Peak plate current—(per plate)	230 mA (max.)
DC heater-cathode potential	450 volts (max.)
Cathode heating time	45 sec.
Total effective plate supply impedance—per plate	150 ohms (min.)

For maximum current and voltage ratings, refer to the graph at right.

* To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

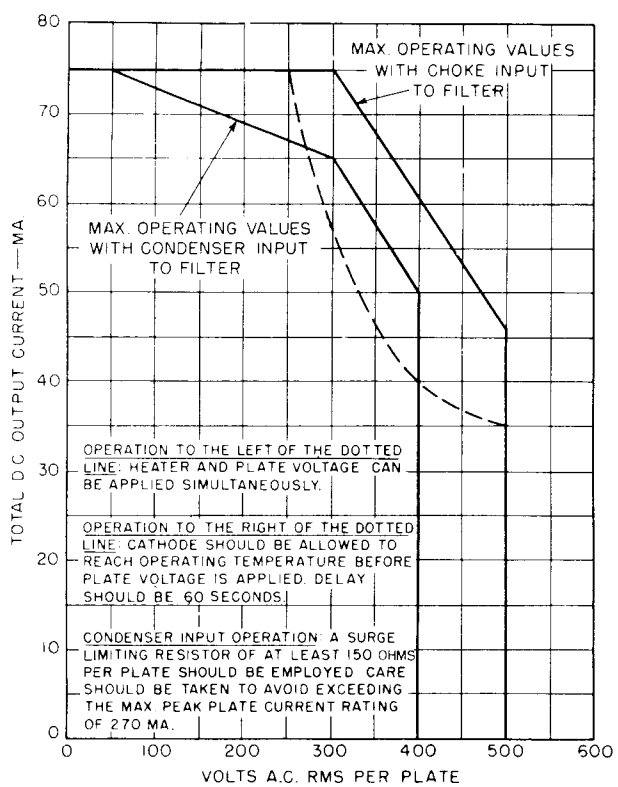
** Voltage should not fluctuate more than ± 5%.

PHYSICAL CHARACTERISTICS

Base	Intermediate shell octal 6-pin (Melamine—with barriers)
Bulb	T-9
Max. overall length	3.320 in.
Max. seated height	2.820 in.
Max. diameter	1.380 in.
Mounting position	Any
Max. altitude***	80,000 ft.
Max. bulb temperature	160°C.

***See chart on reverse side.

RATING CHART



THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

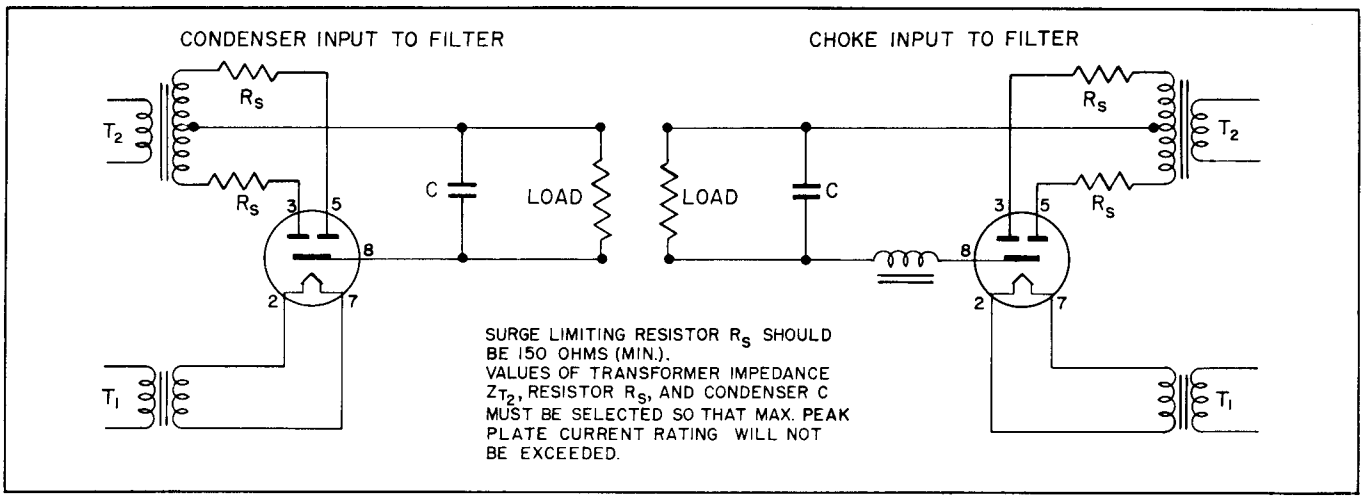
Publication No. R610-25 (Supersedes No. R51-28)

Printed in U.S.A.

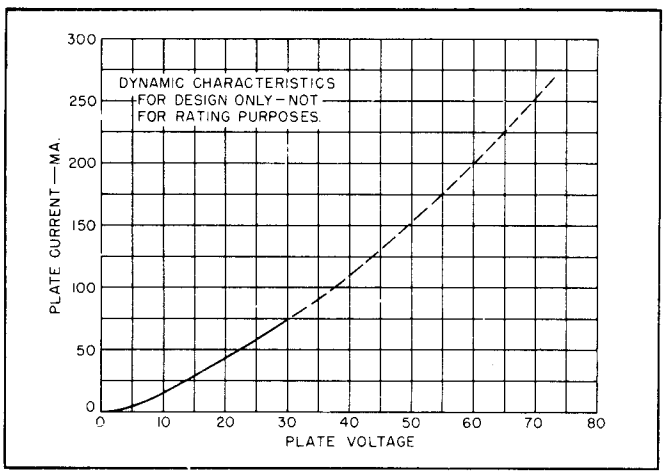
FULL-WAVE RECTIFIERS

5839
5838 Bendix Type TE-2 / TE-3 / TE-5
5852

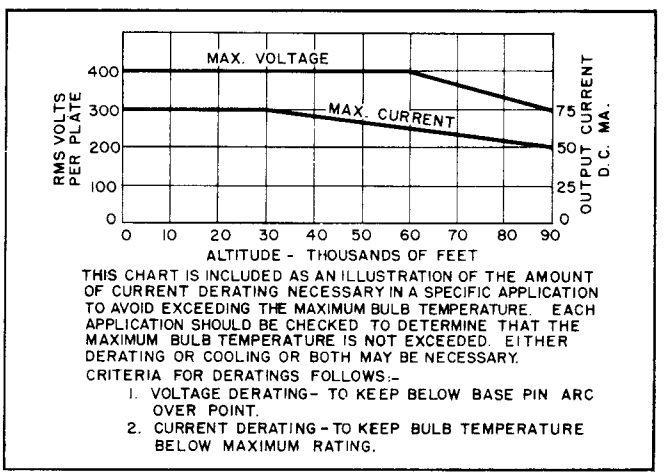
(Generic Type 6X5)



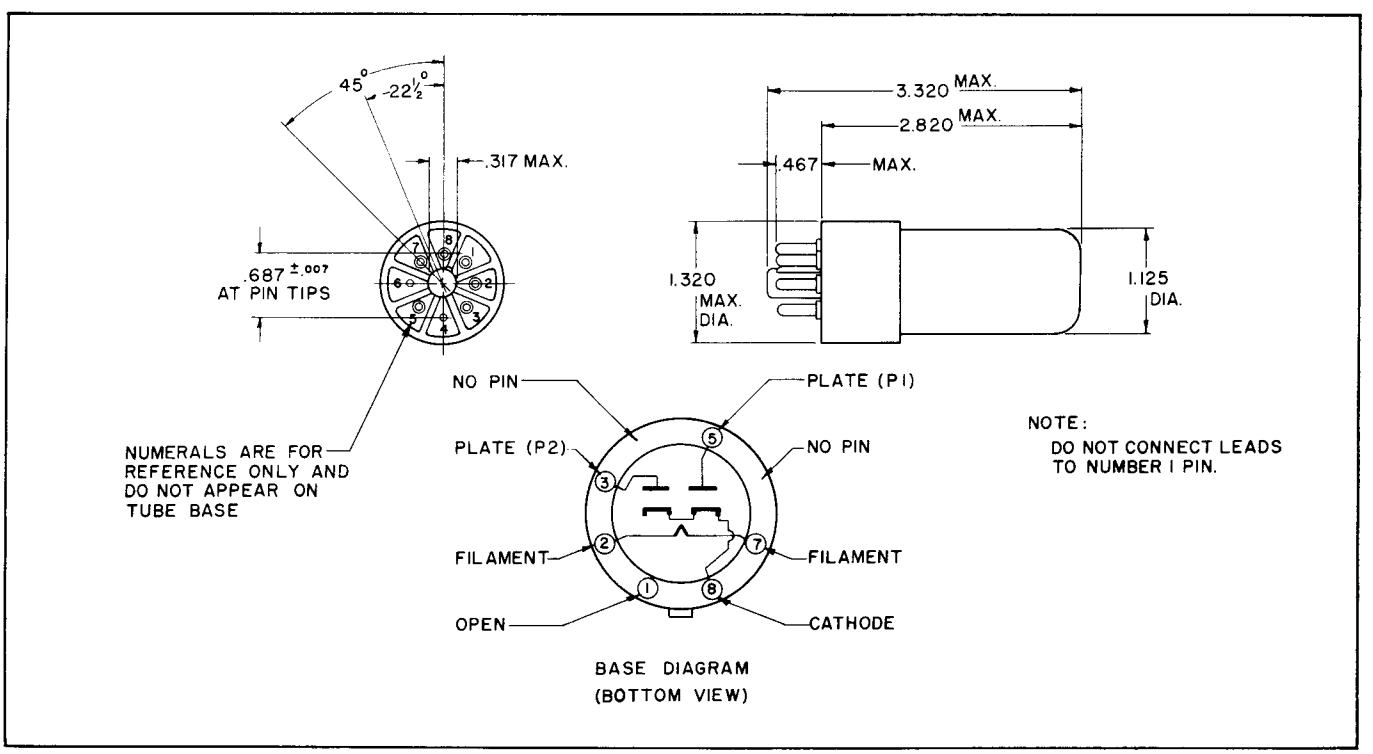
APPLICATION OF FULL-WAVE RECTIFIER



AVERAGE PLATE CHARACTERISTICS



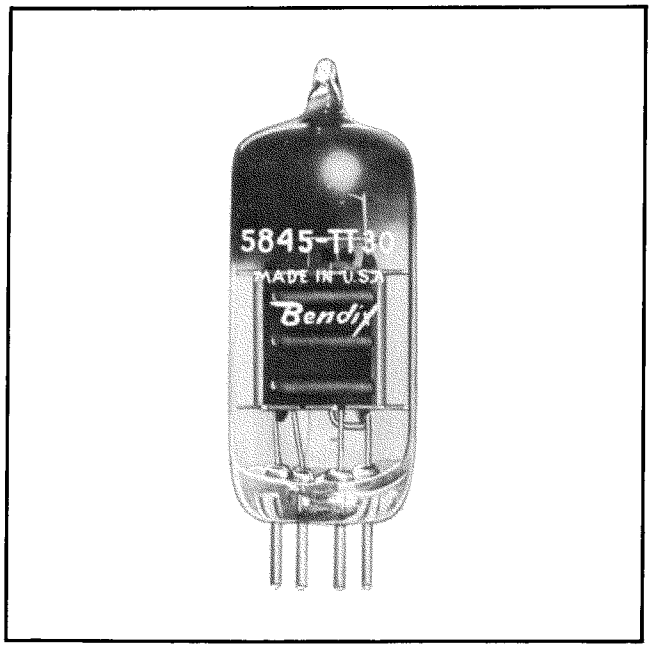
ALTITUDE RATINGS



OUTLINE DRAWING

5845
Bendix Type TT-30

MINIATURE TEMPERATURE LIMITED DIODE



DESCRIPTION

This temperature limited diode is designed for use in voltage regulator applications or for use in circuits requiring a tube with temperature limited emission characteristics. Temperature limited operation of the tube causes anode current to become a direct function of filament voltage, and thus small changes in applied filament voltage will produce relatively large changes in anode current. The use of a pure tungsten filament permits continuous use of the tube in the temperature limited region without change or damage to the filament during the life of the tube. The tube includes a fail safe device which causes a heater to anode short should the heater open.

RATINGS

Anode Voltage	250 Vdc
Anode Current (1)	50 uAdc
Filament Voltage (2)	3Vac or dc
Filament Current	365 mAac or dc
Anode Load Resistor	1 megohm

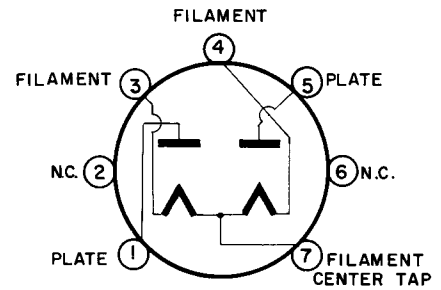
PHYSICAL CHARACTERISTICS

Base	E7-1 (7 Pin miniature)
Bulb	T-5½
Outline	5-2
Max. overall length	2⅛ in.
Max. diameter	¾ in.
Mounting position	
Vertical	Base up or down
Horizontal	Pins 3 and 4 in a vertical plane

MAXIMUM RATINGS (3)

The ratings given above should be closely followed when the tube is used in circuits where stable operating characteristics and long service life are of prime importance. However, the ratings can be increased to the absolute limits specified below with a corresponding reduction in stability of operating characteristics and decrease in service life. (Refer to graphs on the reverse side of this sheet.)

Anode Voltage	300 Vdc
Anode Current (1)	2.0 mAdc
Filament Voltage (2)	5 Vac or dc



BASE DIAGRAM
(BOTTOM VIEW)

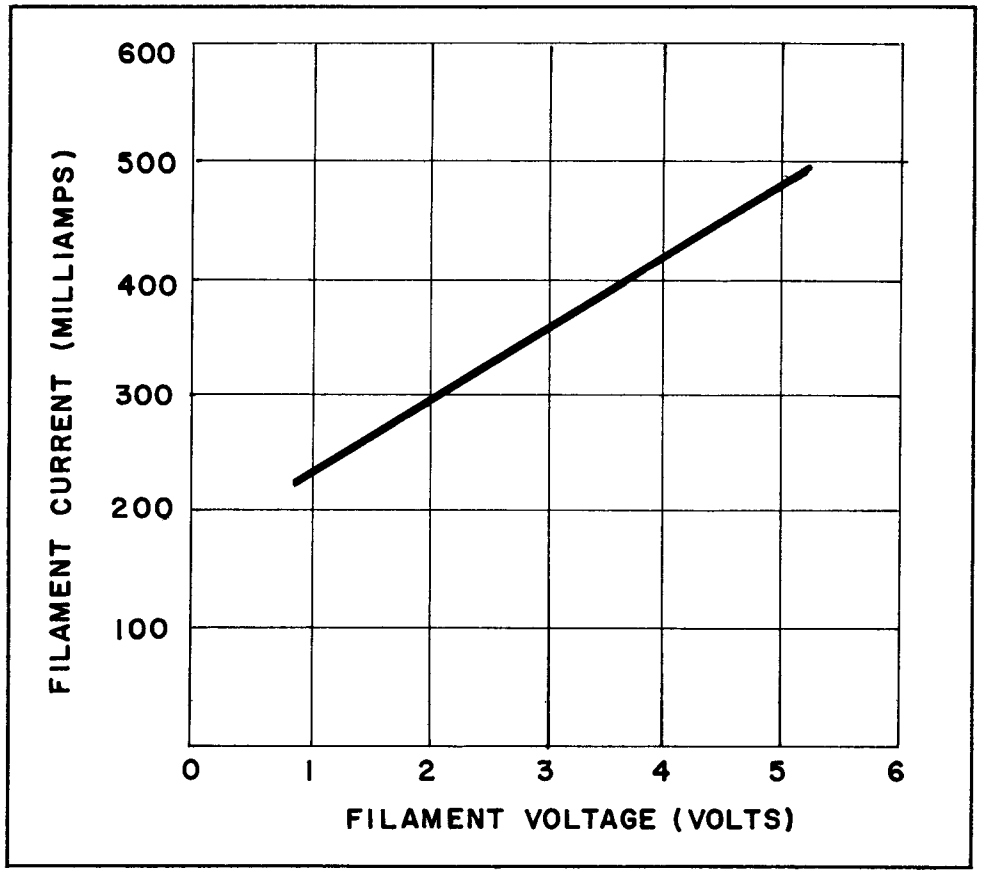
NOTES:

1. Plates connected together at socket.
2. Filaments connected in series.
3. Maximum on time with a 50% duty cycle is 5 minutes.

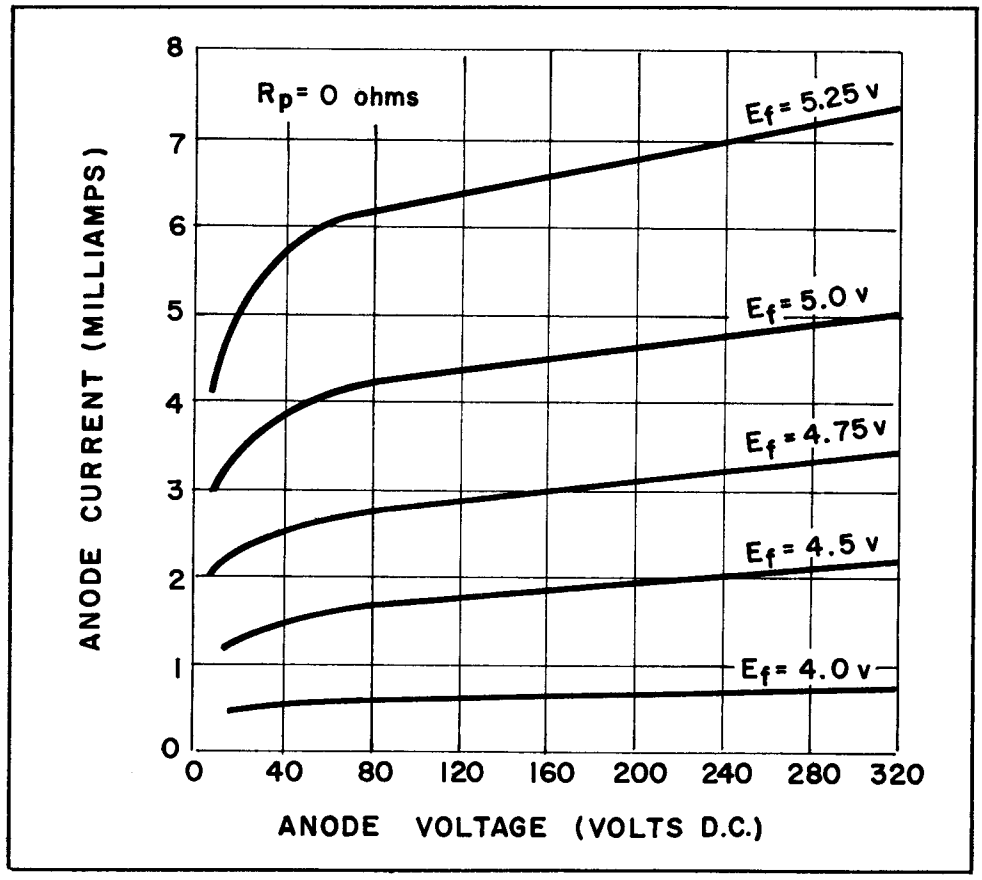
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-27

Printed in U.S.A.



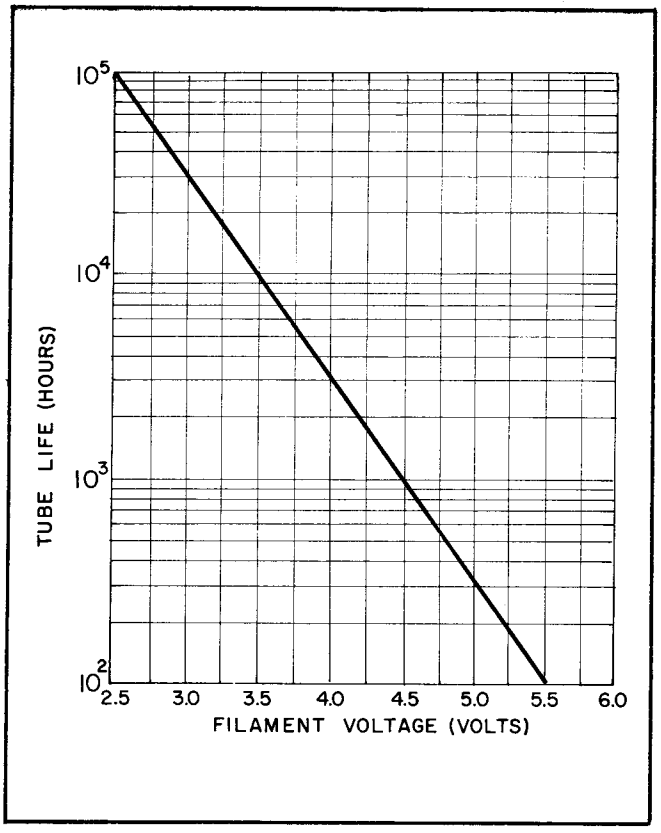
AVERAGE FILAMENT CHARACTERISTICS



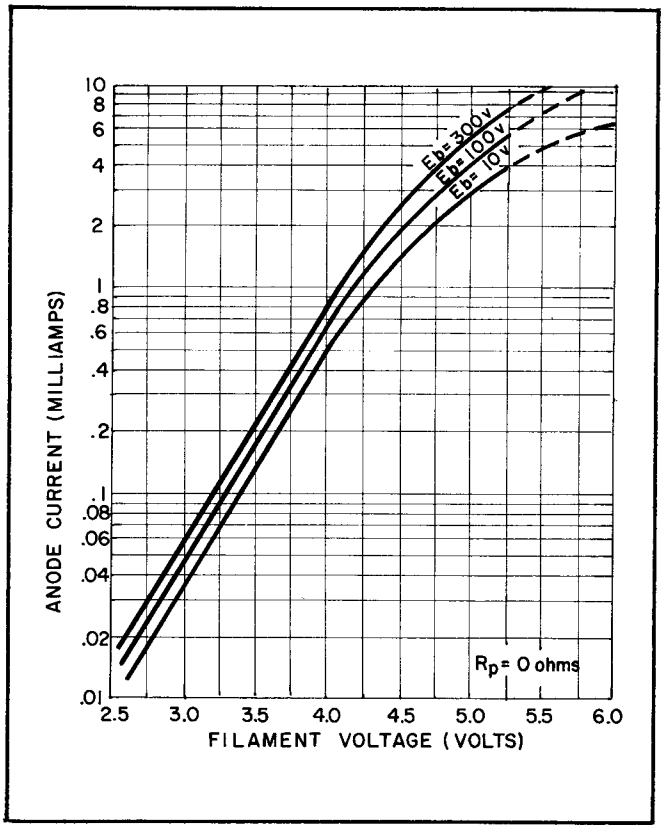
AVERAGE SATURATION CHARACTERISTICS

MINIATURE TEMPERATURE LIMITED DIODE

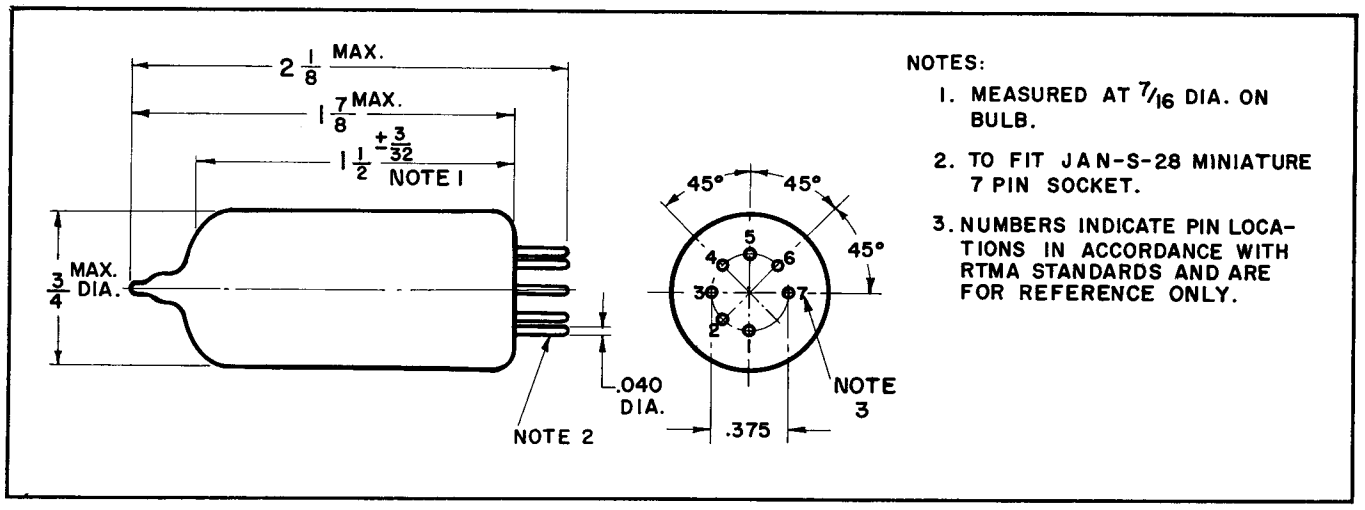
5845
Bendix Type TT-30



NORMAL LIFE EXPECTANCY
VS
APPLIED FILAMENT VOLTAGE



AVERAGE EMISSION CHARACTERISTICS



NOTES:

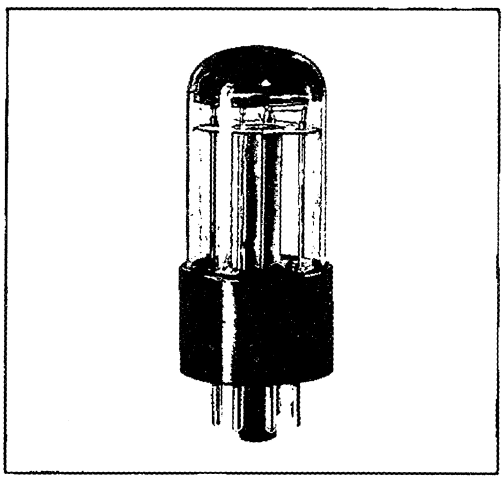
1. MEASURED AT $^7/_{16}$ DIA. ON BULB.
2. TO FIT JAN-S-28 MINIATURE 7 PIN SOCKET.
3. NUMBERS INDICATE PIN LOCATIONS IN ACCORDANCE WITH RTMA STANDARDS AND ARE FOR REFERENCE ONLY.

OUTLINE DRAWING

File Catalog: Special Purpose Electron Tubes
Section: Temperature Tubes

R.M.A. 5947
Eclipse-Pioneer Type TT-2

TEMPERATURE LIMITED DIODE



DESCRIPTION

This temperature limited diode is designed for use as a stable reference source for voltage regulator applications, or for use in circuits requiring a tube with temperature limited emission characteristics. Temperature limited operation of the tube causes anode current to become a direct function of filament voltage, and thus small changes in applied filament voltage will produce relatively large changes in anode current. The use of a pure tungsten filament permits continuous use of the tube in the temperature limited region without change or damage to the filament during the life of the tube. Close control of critical dimensions and a processing schedule designed to eliminate residual gas content, provide a tube with highly stable characteristics held to close tolerances.

RATINGS

Anode voltage	90 volts DC
Anode current	1.5 ma DC
Filament voltage required to give rated anode current	4.44 volts (±2.5%) AC or DC
Filament current	1.75 amp. AC or DC
Long term filament stability	1%

PHYSICAL CHARACTERISTICS

Base	Intermediate shell octal, 8-pin micanol
Bulb	T-9
Max. overall length	3¼ in.
Max. seated height	2 11/16 in.
Max. diameter	1 5/16 in.
Mounting position	Base down or base up

MAXIMUM RATINGS

The ratings given above should be closely followed when the tube is used in circuits where stable operating characteristics and long service life are of prime importance. However, the ratings can be increased to the absolute limits specified below with a corresponding reduction in stability of operating characteristics and decrease in service life. (Refer to graphs on the reverse side of this sheet.)

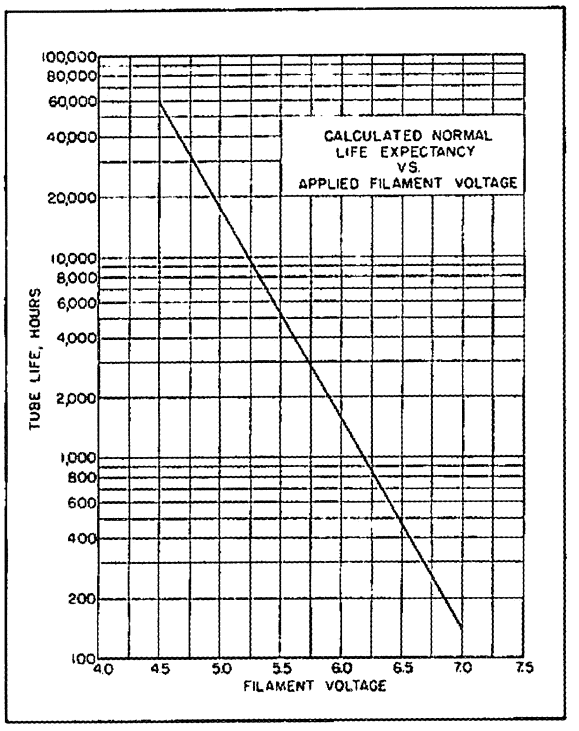
Anode voltage	250 volts DC
Anode current	45 ma. DC
Anode dissipation	7 watts
Filament voltage	6.5 volts AC or DC
Filament current	2.2 amp. AC or DC

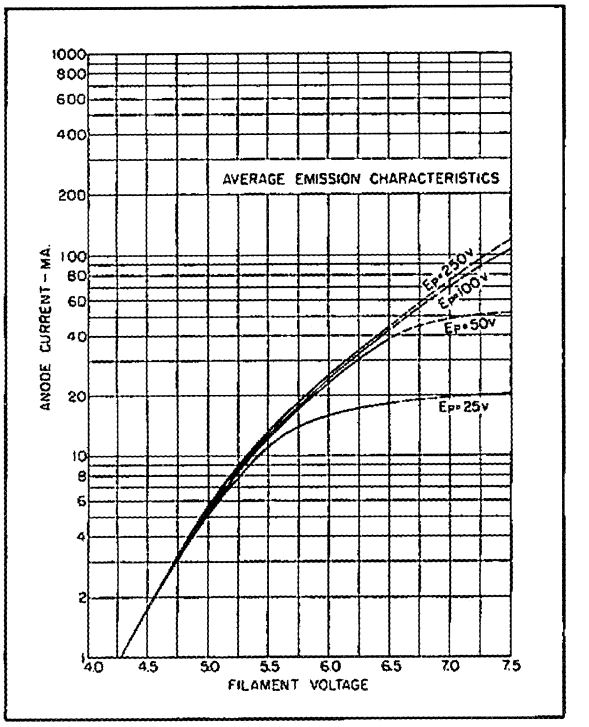
Publication No. 011-24C

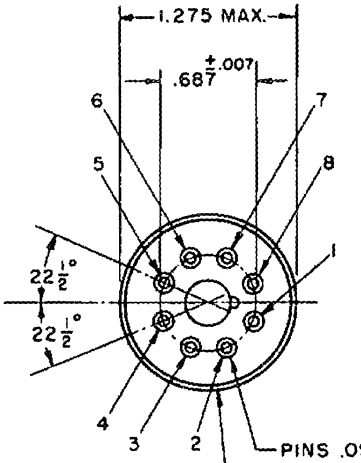
Printed in U.S.A.

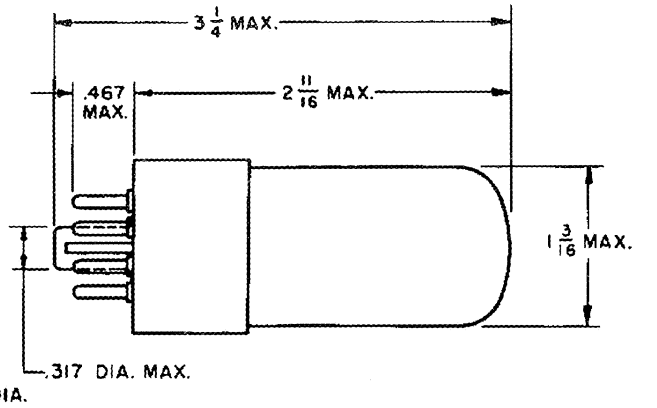
TEMPERATURE LIMITED DIODE

R. M. A. 5947
Eclipse-Pioneer Type TT-2

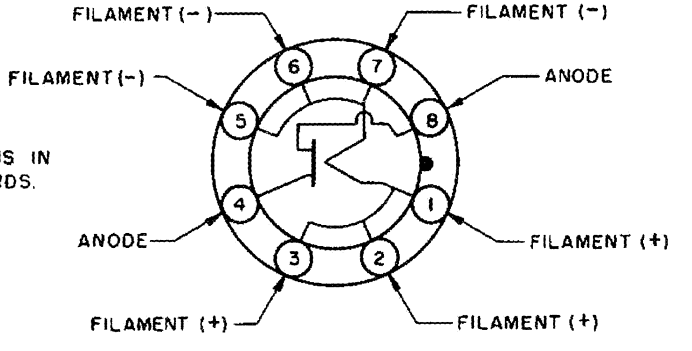








NOTE:
NUMERALS INDICATE PIN LOCATIONS IN ACCORDANCE WITH R.M.A. STANDARDS.



BASE DIAGRAM
(BOTTOM VIEW)

THIS OUTLINE DRAWING APPLIES TO ALL TYPE TT-2 TUBES

5960
Bendix Type TD-1

COLD CATHODE DISCHARGE TUBE



DESCRIPTION

This gaseous discharge tube is designed for use as an electronic relay to control large peak currents at high voltages. It is particularly suited for aircraft and industrial applications where ruggedness, small size, and long service life are important, and where heater power is not available or warm-up time is not permitted.

The tube has a metal envelope and a ceramic base filled with an insulating compound to permit operation at high altitudes with no arc-over. It requires a four-pin socket and can be mounted in any position.

Applications for this tube can be found in ignition systems, capacitor discharge welding circuits, pulsing circuits, and control circuits.

RATINGS

Heater voltage	None
Max. forward plate voltage	1300 volts
Max. average current	90 ma.
Max. peak current	100 amps.
Tube voltage drop	100 volts (approx.)
Max. frequency	500 p.p.s.
Min. trigger voltage	250 volts
Min. anode voltage	325 volts

PHYSICAL CHARACTERISTICS

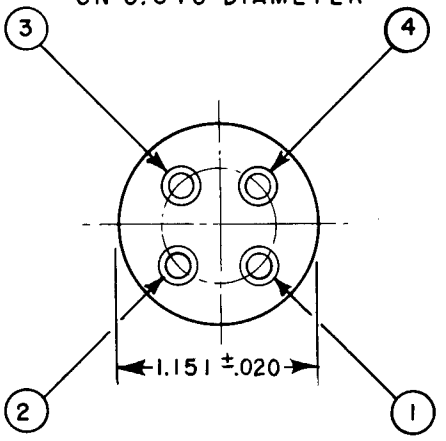
Base	4-pin ceramic
Envelope	MT-8
Max. overall length	2.917 in.
Max. seated height	2.281 in.
Max. diameter	1.171 in.
Mounting position	Any
Ambient temperature	−67° to + 165°F.
Max. altitude	65,000 ft.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

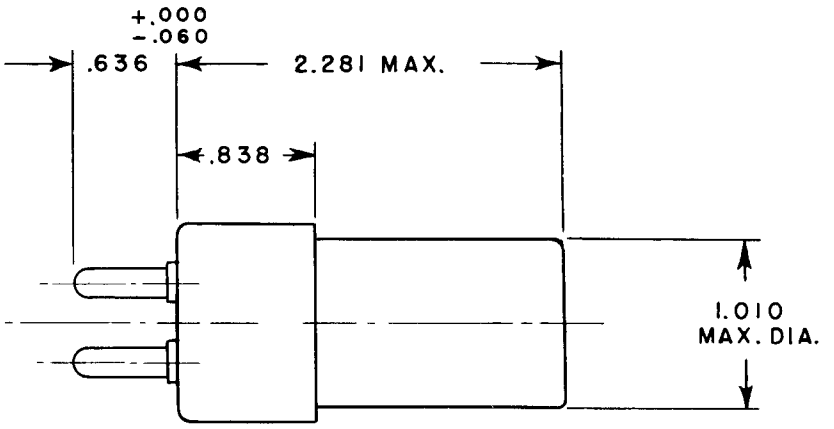
Publication No. R51-29 (Supersedes No. R35-5)

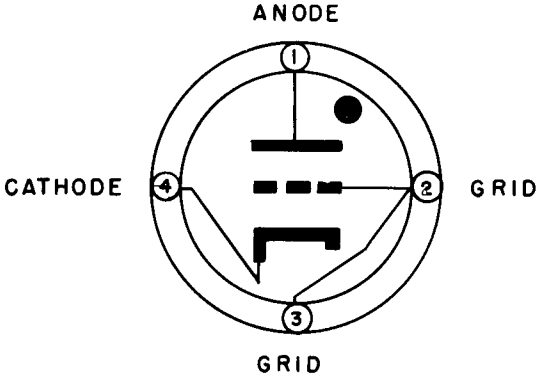
Printed in U.S.A.

COLD CATHODE DISCHARGE TUBE



PINS 1 & 4 — DIAMETER 0.156
PINS 2 & 3 — DIAMETER 0.125





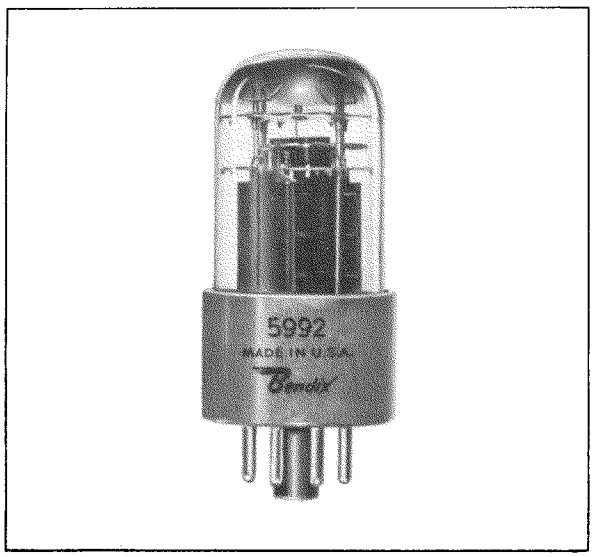
BASE DIAGRAM
(BOTTOM VIEW)

OUTLINE DRAWING

Bendix Type TD-1 5960

5992
Bendix Type TE-8
(Generic Type 6V6)

BEAM POWER AMPLIFIER



DESCRIPTION

This beam power amplifier is from the Bendix Red Bank line of reliable vacuum tubes. It is specifically designed to replace the 6V6 for aircraft and industrial applications where freedom from early failure, long average service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

The use of a coil type heater inside an extruded alumina insulator gives a long life heater structure which stands up well under high heater to cathode voltage. The short mount, the heavy side rods on the grids, and the multiple supports on the cage give an improved structure which maintains rigidity under shock and vibration. The tube requires an 8-pin octal socket and can be mounted in any position.

ELECTRICAL RATINGS*

Heater voltage—(AC or DC)**	6.3 volts
Heater current	0.6 amps
Plate voltage—(max.)	300 volts
Screen voltage—(max.)	275 volts
Peak plate voltage—(max. instantaneous)	600 volts
Plate dissipation—(max.)***	12 watts
Screen dissipation—(max.)***	2 watts
Max. heater-cathode voltage	350 volts
Max. grid resistance	0.1 megohm
Warm-up time	45 sec.

(Plate and heater voltage may be applied simultaneously)

* To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

** Voltage should not fluctuate more than ± 5%.

*** See chart on other side.

PHYSICAL CHARACTERISTICS

Base	Intermediate shell octal 8-pin (Melamine—with barriers)
Bulb	T-9
Max. overall length	3.320 in.
Max. seated height	2.820 in.
Max. diameter	1.320 in.
Mounting position	Any
Max. altitude (See chart on page 3)	80,000 ft.
Max. bulb temperature	180°C.
Life expectancy	10,000 hours

TYPICAL OPERATION

SINGLE-TUBE, CLASS A_1 AMPLIFIER

Plate voltage, volts	180	250	300
Screen voltage, volts	180	250	250
Grid voltage, volts	—8.5	—12.5	—15.0
Peak A-F grid voltage, volts	8.5	12.5	15.0
Zero signal plate current, mA	29	45	34
Max. signal plate current, mA	30	47	35
Zero signal screen current, mA	3.0	4.5	3.0
Max. signal screen current, mA	4.0	7.0	6.0
Plate resistance, ohms	55,000	45,000	55,000
Transconductance, μmhos	3,500	4,000	3,500
Load resistance, ohms	5,500	5,000	6,000
Total harmonic distortion, per cent	8	8	12
Max. signal power output, watts	2.0	4.0	4.5

TYPICAL OPERATION

PUSH-PULL, CLASS AB_1 AMPLIFIER

(Values given are for two tubes)

Plate voltage, volts	250	275
Screen voltage, volts	250	275
Grid voltage, volts	—15	—19
Peak A-F grid-to-grid voltage, volts	30	38
Zero signal plate current, mA	70	70
Max. signal plate current, mA	79	92
Zero signal screen current, mA	5	4
Max. signal screen current, mA	13	13.5
Effective load resistance, ohms (plate-to-plate)	10,000	8,000
Total harmonic distortion, per cent	5	3.5
Max. signal power output, watts	10	14

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 62-4 (Supersedes No. R 54-24)

Printed in U.S.A.

BEAM POWER AMPLIFIER

5992

Bendix Type TE-8
(Generic Type 6V6)

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 cps prior to 100% Testing.

CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Short and Continuity					
Heater Current	If	550	600	650	mA
Heater-Cathode Leakage	Ihk	—	—	± 25	uAdc
Grid Current	Ic1	—	—	-1.0	uAdc
Plate Current	Ib	32	45	57	mAdc
Screen Current	Ic2	0	3.5	6.5	mAdc
Transconductance	Sm	3200	4000	5500	umhos
Trans. Ef = 5.7 V	Sm	—	—	15%	
Power Output	Po	3.0	—	—	watts
Cut Off Plate Current (Ec1 = -60 Vdc)	Ib			200	uAdc
A. F. Noise				17	VU
DESIGN TESTS					
Vibration 30 cps. 2.5 G Ec1 = -25 Vdc Rp = 2,000 ohms Eb = Ec2 = 250 Vdc	Ep	—	—	150	mVac
Grid Emission Test Ef = 7.0 V; Eb = 300; Ec2 = 275; Ec1 = -12.5 Time = 2 minutes	Ic1			-2.0	uAdc

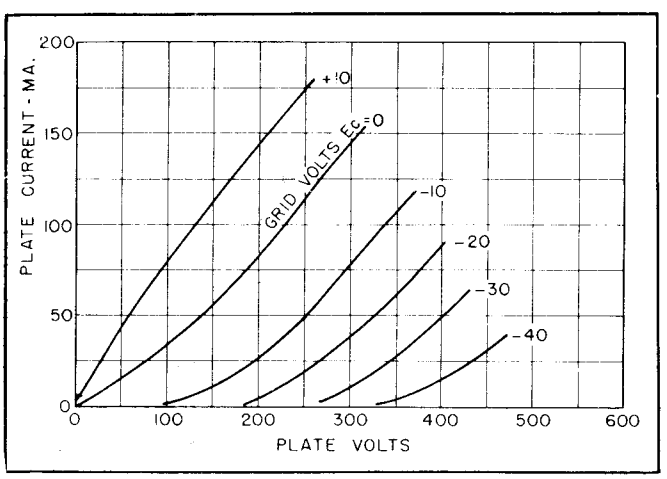
ELECTRODE	Ef	Eb	Ec2	Ec1	Ehk
TEST CONDITIONS:	6.3 volts	250 Vdc	250 Vdc	-12.5 Vdc	± 250 Vdc

SPECIAL TESTS*

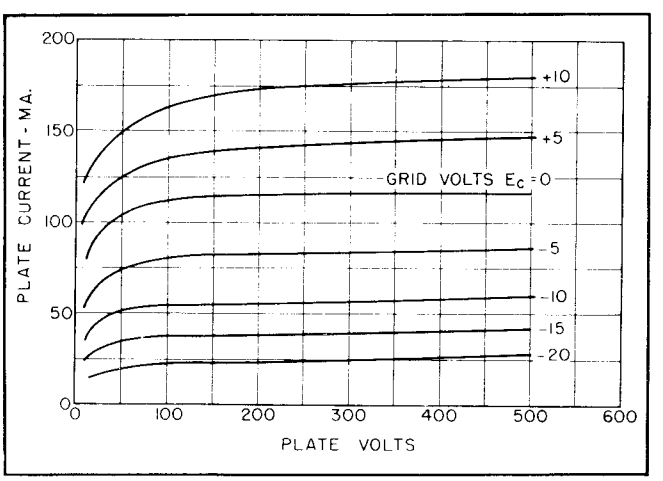
In addition to the production and design tests shown, other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 2½ Min. Off 2½ Min. Ef = 7.0 Ehk = 300	3,000 On-Off Cycles
Intermittent Life Test	Under "Test Conditions"	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	5,000 Hours
High Level Fatigue Test	50G—Shock Excitation 18 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	

*For additional specifications consult MIL-E-1/201 specification for the 5992.



AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION
$E_f = 6.3$ VOLTS



AVERAGE PLATE CHARACTERISTICS
PENTODE CONNECTION
$E_f = 6.3$ VOLTS SCREEN = 250 VOLTS

BEAM POWER AMPLIFIER

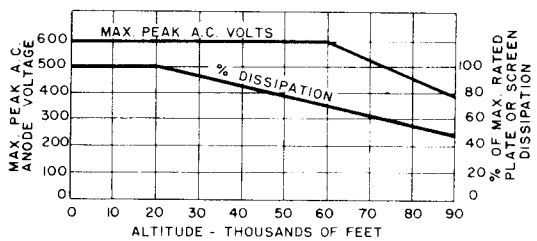
5992

Bendix Type TE-8

(Generic Type 6V6)

EFFECT ON LIFE OF INCREASED RATINGS

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	250 Vdc	300 Vdc	300 Vdc
Screen Voltage	200 Vdc	250 Vdc	275 Vdc
Peak Plate Voltage	400 v	500 v	600 v
Plate Current (Av.)	25 mA	35 mA	40 mA
Screen Current (Av.)	3 mA	4 mA	6 mA
Cathode Current (Peak)	50 mA	65 mA	100 mA
H-K Voltage	200 V	300 V	350 V
Grid Resistance	25,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	120°C	140°C	180°C
Altitude	0-20,000'	60,000'	80,000'
Vibration	1 G	2½ G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF DISSIPATION DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATINGS FOLLOWS:

1. VOLTAGE DERATING - TO KEEP BELOW BASE PIN ARC OVER POINT.
2. DISSIPATION DERATING - TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

ALTITUDE RATINGS

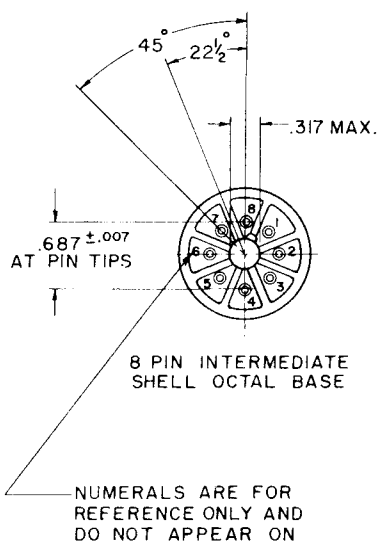
APPLICATION NOTES

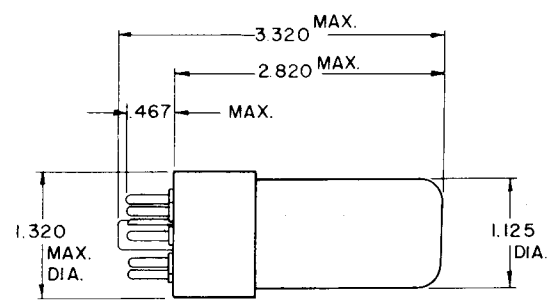
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced 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.

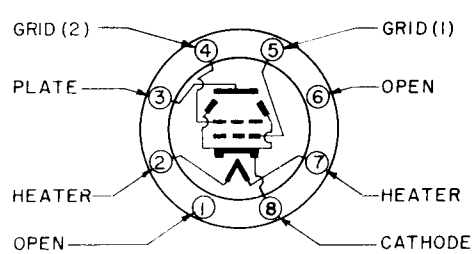
The altitude rating chart shows the correct voltage derating necessary for various altitudes. However, the dissipation derating is only approximate and must be measured for each application because of the additive effects mentioned above.

When used with A.C. on plate and screen with an inductive load such as in servo discriminator circuits, sufficient unshunted resistance in series with the screen should be used to avoid damage to the tube during that portion of the cycle when the plate may be negative with respect to the screen.

The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.







BASE DIAGRAM
(BOTTOM VIEW)

NOTE :
DO NOT MAKE CONNECTIONS TO UNUSED PINS.

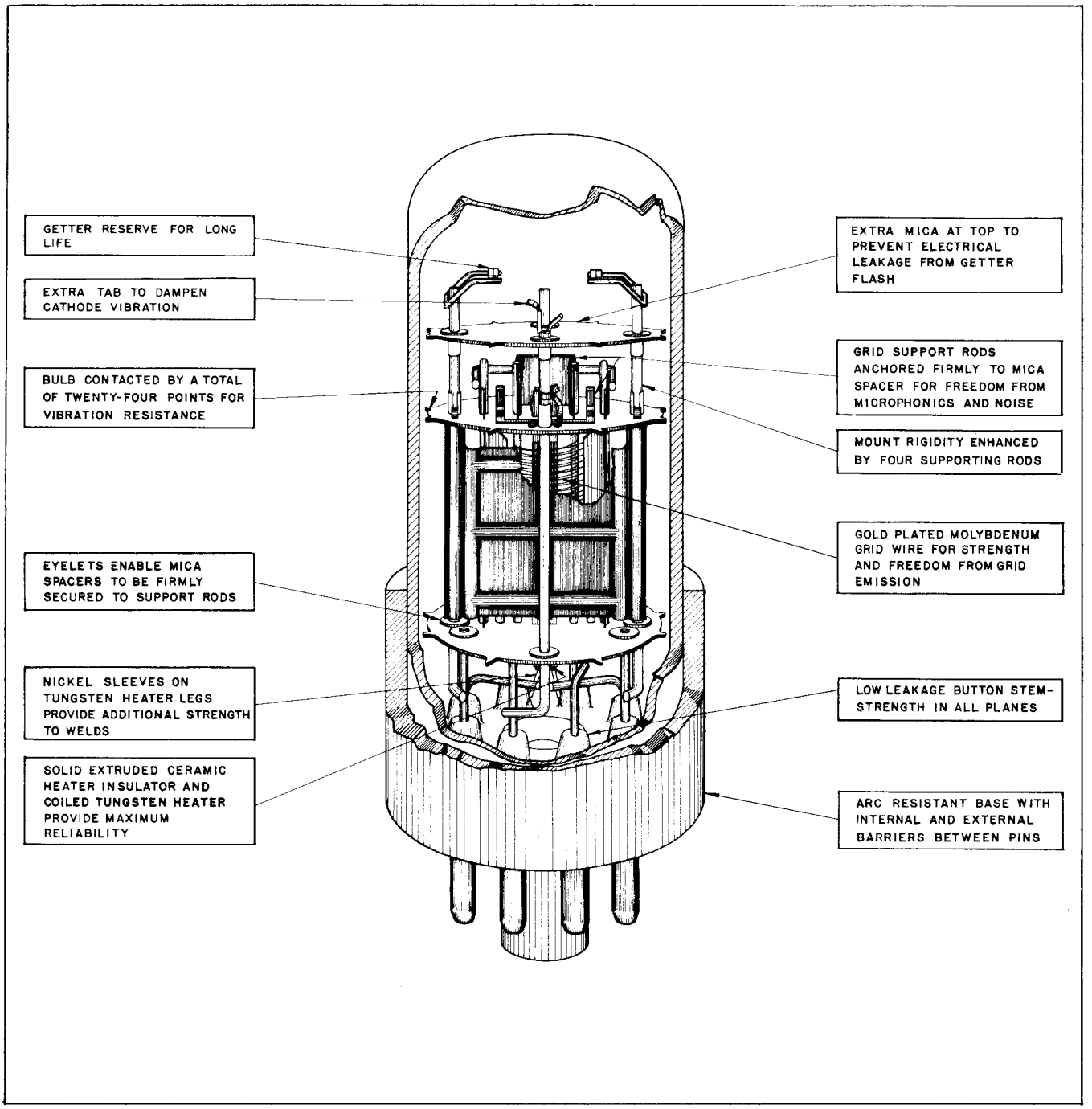
OUTLINE DRAWING

BEAM POWER AMPLIFIER

5992

Bendix Type TE-8

(Generic Type 6V6)



STRUCTURAL FEATURES OF 5992 PROVIDE HIGH RELIABILITY AND LONG LIFE

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.

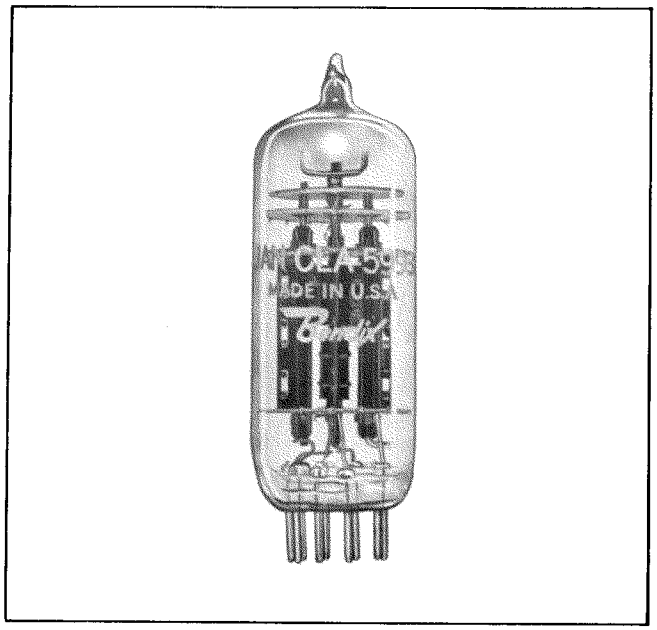
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

File Catalog: Electron Tube Products
Section: Receiving Tubes

5993

Bendix Type TE-10
(Generic Type 6X4)

FULL-WAVE RECTIFIER



DESCRIPTION

This miniature, full-wave, high-vacuum rectifier is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft, military and industrial applications where freedom from early failures, long service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

Heavy gauge heater construction together with a pure alumina insulator reduces the likelihood of heater failure. A large area cathode operating at moderate temperatures gives longer service life and freedom from arc-overs. A four-pillar mount structure provides a strong assembly that will stand up under extreme conditions of vibration and shock. The tube requires a 9-pin miniature socket and can be mounted in any position. Adequate ventilation should be provided.

The tube is designed to replace the 6X4 and similar types in applications where severe environmental conditions are encountered, especially in airborne equipment. The cathode type structure instead of a filament structure insures against filament breakage under shock and vibration. When conservatively used, this tube has a life expectancy of 10,000 hours.

ELECTRICAL RATINGS*

Heater voltage**	6.3 volts
Heater current	0.80 amps.
Peak inverse voltage	1500 volts (max.)
Peak plate current—(per plate)	230 mA. (max.)
Peak surge current—(per plate)	1.6 amps. (max.)
DC heater-cathode potential	500 volts (max.)
Cathode heating time	45 sec.
Total effective plate supply impedance—per plate	See Rating Chart 3

For maximum current and voltage ratings, refer to Rating Chart 1.

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

TYPICAL OPERATION

Input to Filter

	Capacitor	Choke
Heater voltage (volts)	6.3	6.3
Heater current (amperes)	0.8	0.8
RMS plate supply voltage (volts per plate)	325	450
Input capacitor (μf)	8	—
Input choke (henries)	—	10
DC output current (mA)	70	70
DC output voltage (volts)		
At half-load current (35 mA)	375	395
At full-load current (70 mA)	325	385

PHYSICAL CHARACTERISTICS

Base	9-pin miniature
Bulb	T-6½
Max. overall length	2⅝ in.
Max. seated height	2⅜ in.
Max. diameter	⅞ in.
Mounting position	Any
Max. altitude (See chart on page 3)	80,000 ft.
Max. bulb temperature	180°C.
Life expectancy***	10,000 hours

***See application notes.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 62-3 (Supersedes No. R 54-25)

Printed in U.S.A.

FULL-WAVE RECTIFIER

5993
Bendix Type TE-10
(Generic Type 6X4)

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 hours under Test Conditions A & B and 2 G Vibration at 30 cps prior to 100% Testing.

CHARACTERISTIC	TEST CONDITIONS	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS						
Heater Current	A	If	.740	.800	.860	Aac
Heater-Cathode Leakage	A	Ihk	—	—	± 50	uAdc
Operation	B	Io	70	75	—	mAdc
Emission	C	Is	110	—	—	mAdc
Short and Continuity						
DESIGN TESTS						
Vibration 2.5 G, 25 cps						
Insulation of Electrodes	D	R	100	—	—	megohms
Heater-Cathode Leakage	E	Ihk	—	—	± 100	uAdc

TEST CONDITIONS	Ef	Epp/p	Es	Ep	RL	CL	Zpp/p	Ehk
Units	V	Vac	Vdc	Vdc	ohms	uf	ohms	Vdc
A	6.3							± 400
B	6.3	400			5700	8	265	
C	6.3		40					
D	6.3			1500				
E	6.3							1500

SPECIAL TESTS*

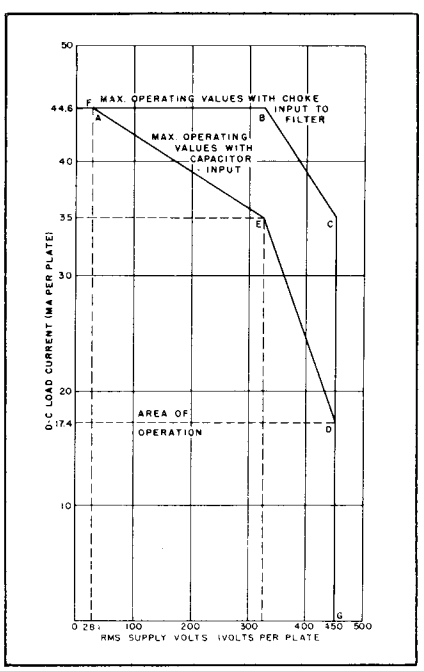
In addition to the production and design tests shown under "Electrical Characteristics and Test Data", other tests are performed on a sampling basis to assure a high out-going quality level. See below:

TEST	CONDITION	DURATION
Heater Cycling Life Test	On 2½ min. Off 2½ min. Ef = 7.0 Vac	3,000 On-Off cycles
Glass Strain Test	Boiling water to Ice water	3 minutes in each
High Level Fatigue Test	50 G Shock Excitation: 18/sec. rep. rate	100 hours
Altitude Test	60,000 Feet	5 minutes
High Temp. Life Test	Under "Test Conditions" Bulb Temp. 160°C	1,000 Hours
Life Expectancy Test	Under Test Conditions	5,000 hours
Mount Inspection	100% Test-Microscopic Inspection of 15 possible Trouble Points	

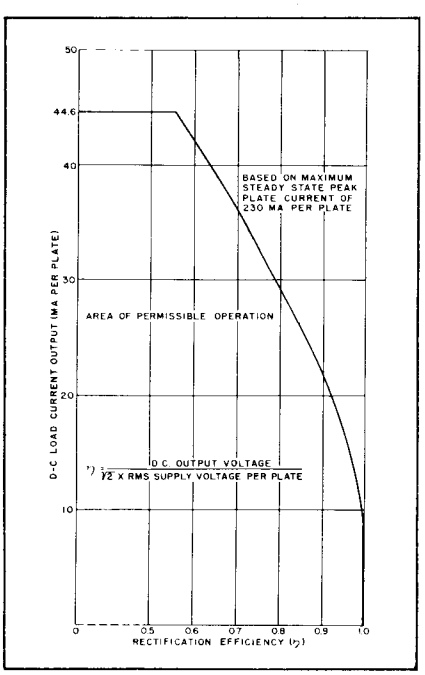
*For additional specifications consult MIL-E-1/202 specification for the 5993.

EFFECT ON LIFE OF INCREASED RATINGS

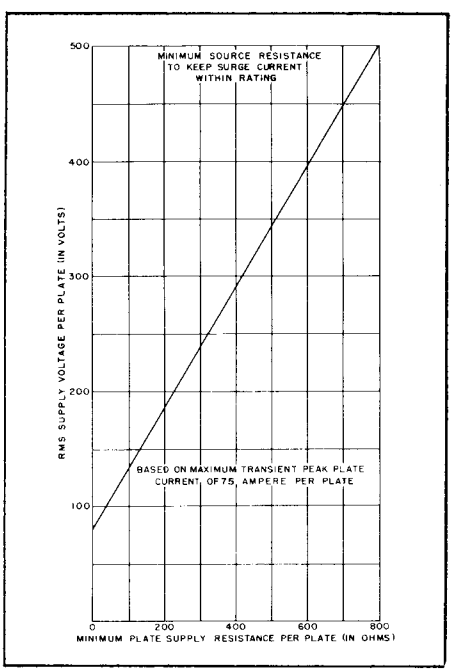
See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
H-K Voltage	425 V	450 V	500 V
Peak Plate Current (per plate)	175 mA	200 mA	250 mA
Peak Plate Inverse Voltage	900 V	1100 V	1250 V
Output Current (per Tube)	55 mA	65 mA	75 mA
Bulb Temperature	100°C	140°C	180°C
Altitude	0-20,000 ft.	60,000 ft.	80,000 ft.
Vibration	1 G	2.5 G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM



RATING CHART 1



RATING CHART 2

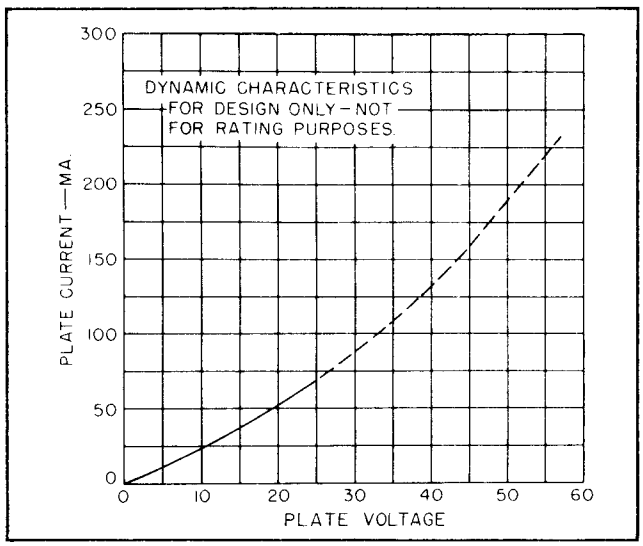


RATING CHART 3

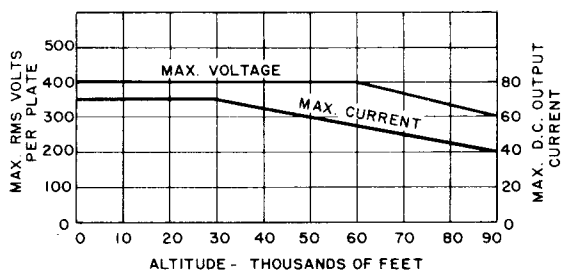
FULL-WAVE RECTIFIER

5993

Bendix Type TE-10
(Generic Type 6X4)



AVERAGE PLATE CHARACTERISTICS



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF CURRENT DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATINGS FOLLOWS:

1. VOLTAGE DERATING – TO KEEP BELOW BASE PIN ARC OVER POINT.
2. CURRENT DERATING – TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

ALTITUDE RATINGS

APPLICATION NOTES

For reliable operation special consideration should be given to the maximum ratings of the 5993. These ratings are limiting absolute values and if exceeded may seriously impair the reliability of the tube. Therefore, the equipment designer should determine an average design value for each rating so that variations in supply voltages, load, and components do not cause the absolute values to be exceeded. The bulb temperature rating is an extremely important characteristic which should not be exceeded if expected life is to be achieved.

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.

From Rating Chart I, operating conditions should be selected to insure usage within the area of permissible operation with choke or capacitor inputs.

To insure that the maximum peak plate current is not exceeded a choice of operating values of d-c output current per plate and rectification efficiency should be made such that they fall within the area of permissible operation of Rating Chart II.

Rating Chart III graphically represents the relationship between the maximum a-c plate supply voltage per plate and the minimum plate supply resistance per plate to prevent maximum transient currents from exceeding the peak surge current rating of the tube. The plate supply resistance $Rs = R(sec) + N^2R(pri) + Ra$, where

R(sec) = d-c resistance of each section of transformer secondary,

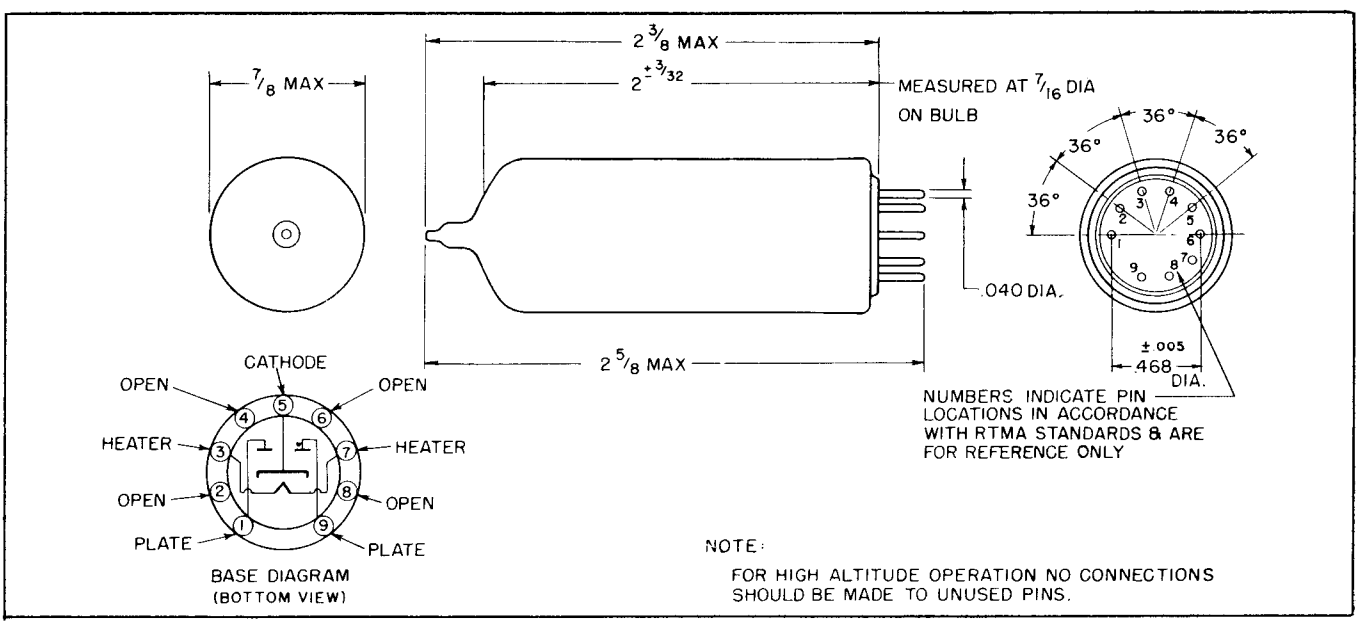
N = Transformer voltage step-up ratio per section,

R(pri) = d-c resistance of transformer primary,

Ra = d-c resistance of added series resistance per plate.

The addition of inductance would allow a reduction of the minimum value specified for Rs provided the reactance added is not too small as to cause the maximum peak surge plate current and maximum steady-state peak plate current ratings to be exceeded.

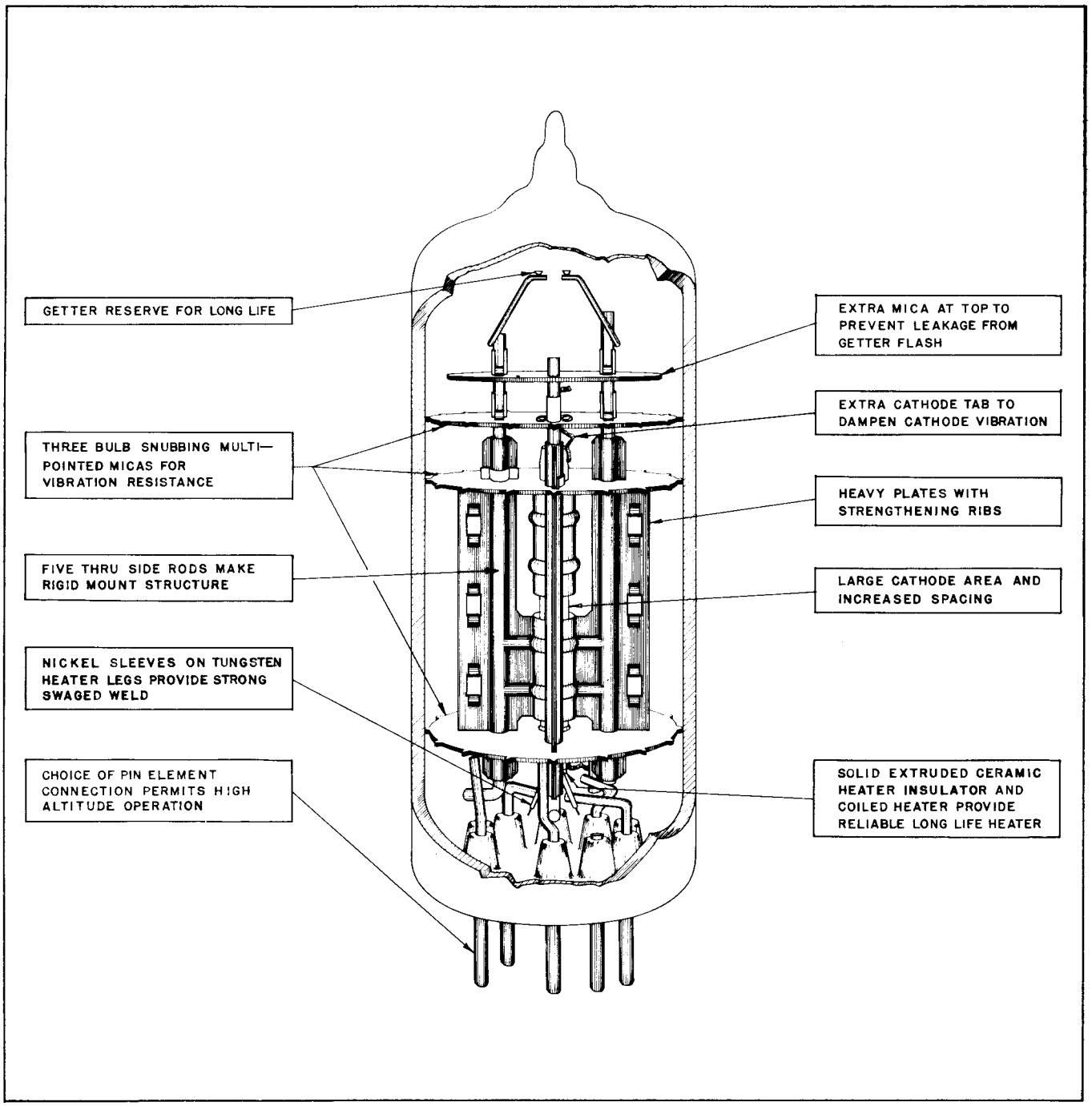
The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.



OUTLINE DRAWING

FULL-WAVE RECTIFIER

5993
Bendix Type TE-10
(Generic Type 6X4)



STRUCTURAL FEATURES OF 5993 PROVIDE HIGH RELIABILITY AND LONG LIFE

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix Aviation Corp.
Red Bank Division
Electron Tube Plant
Eatontown, New Jersey

HY-G-300

TYPE 6082A (Tentative Data)

Reliable Hard Glass Low-Mu Twin Power Triode

MECHANICAL DATA

Coated unipotential cathode

Outline drawing . . . . . Bulb	T-12
Base . . . . . Large wafer octal 8-pin	B8-94
Maximum bulb temperature	300°C
Maximum diameter.	1 23/32
Maximum seated height	3 11/16
Maximum overall length	4 1/4

Pin connections

Pin 1	#2 triode grid	Pin 5	#1 triode plate
Pin 2	#2 triode plate	Pin 6	#1 triode cathode
Pin 3	#2 triode cathode	Pin 7	Heater
Pin 4	#1 triode grid	Pin 8	Heater

Mounting position	any
Life expectancy	10,000 hrs

ELECTRICAL DATA

Ratings

Heater voltage (ac or dc)	26.5	volts
Maximum plate voltage	250	volts
Maximum heater-cathode voltage	450	volts
Maximum d-c plate current (each section)	125	mA
Maximum plate dissipation (each section)	13	watts
Maximum grid resistor (cathode bias)	1.0	meg
Maximum positive d-c grid voltage	0	volts

Typical operating conditions and characteristics

Heater voltage (ac or dc)	26.5	volts
Heater current	0.6	amps
Plate voltage	135	volts
Plate current	125	mA
Transconductance	7000	µmhos
Plate resistance	280	ohms
Amplification factor	2	
Cathode bias resistor	250	ohms
Plate dissipation	13	watts

from JETEC release #1874, March 18, 1957

6094

Bendix Type TE-18
(Generic Type 6AQ5/6005)

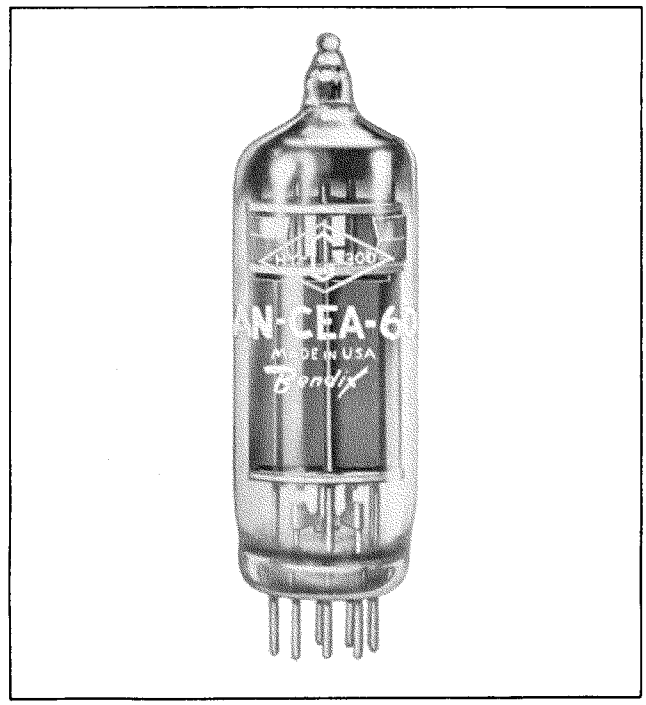
RELIABLE HARD GLASS MINIATURE BEAM POWER AMPLIFIER

DESCRIPTION

This miniature beam power amplifier is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft, military and industrial applications where freedom from early failures, long average service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various vibration and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under operating conditions.

In addition, this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration, shock and other accelerations are encountered. Careful exhaust to a high degree of vacuum with thorough outgassing of all elements with electron bombardment is employed to ensure long life expectancy. A hard glass (nonex) bulb and stem with nickel pins are used. These, together with a conservative design center of cathode temperature, permit operation of these tubes up to bulb temperatures of 300°C, in contrast to an average of 175°C for soft glass bulbs. In addition, because of the lower expansion of the tungsten-nonex seal (about one-third that of conventional lime or lead glass), greater resistance to thermal shock is obtained. The nickel pins are gold plated to assure excellent contact resistance throughout life with freedom from corrosion.

This tube employs pressed ceramic spacers, instead of micas, for element separation. High temperature metal snubbers are used to snub the tube structure with respect to the bulb. Mica when used in contact with the hot cathode, deteriorates rapidly under shock and vibration conditions. Ceramic eleminates this problem and, furthermore, reduces damage caused by fatigue failure of parts.



The heavy-gauge heater construction, together with a pure alumina insulator, permits operation at high heater-cathode voltages. The large area cathode operating at moderate temperatures gives long service life. Small mass of the tube elements, multi-pillar mount locked together with eyelets, and increased electrode spacing provide rigidity, strength, and increased ability of the tube to withstand shock and vibration.

See the enlarged view on last page for the many improved features of this tube.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)**	6.3 volts
Heater Current	0.6 amps
Plate Voltage (Maximum DC)	300 volts
Screen Voltage (Maximum DC)	275 volts
Peak Plate Voltage (Max. Instantaneous)***	550 volts
Plate Dissipation (Absolute Max.)***	14.0 watts
Screen Dissipation (Absolute Max.)***	2.0 watts
Cathode Current (Max. Instantaneous Peak Value)	100.0 mA
Heater-Cathode Voltage (Max.)	±450 volts
Grid Resistance (Max.)	0.1 megohm
Grid Voltage (Max.)	+5.0 volts
(Min.)	−200.0 volts
Cathode Warm-up Time (plate and heater voltage may be applied simultaneously)	45 seconds

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously. See application notes.

CHART 2. MECHANICAL DATA

Base	9-Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6½
Max. Overall Length	3″
Max. Seated Height	2¾″
Max. Diameter	⅞″
Mounting Position	any
Max. Altitude***	80,000 feet
Max. Bulb Temperature	300°C
Max. Impact Shock	500 G
Max. Vibrational Acceleration (100 hour shock excited fatigue test, sample basis)	50 G
Life Expectancy	10,000 hrs.

**Voltage should not fluctuate more than ±5%.
***See altitude chart on page 3.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 610-26 (Supersedes No. R 62-7)

Printed in U.S.A.

MINIATURE BEAM POWER AMPLIFIER

Bendix 6094
Type TE-18
(Generic Type 6AQ5 6005)

ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 3. TEST CONDITIONS AND CHARACTERISTICS LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G. Vibration at 30 Cps. Prior to 100% Testing.

CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Heater Current	If	560	600	640	mA
Heater-Cathode Leakage	Ihk	—	—	± 25	uAdc
Grid Current	Ic1	—	—	0.5	uAdc
Plate Current	Ib	33	45	57	mAdc
Screen Current	Ic2	0	3.0	7.5	mAdc
Transconductance	Sm	3000	4100	5200	umhos
Power Output Ef = 5.7 v.	△ Po	—	—	15%	
Power Output	Po	3.6	45	—	watts
Cut off Plate Current (Ec1 = —60 Vdc)	Ib			200	uAdc
Short and Continuity					
A. F. Noise					
DESIGN TESTS					
Vibration: 25 cps., 2.5 G. Ec1 = —25 v. D.C. Rp = 2,000 ohms Eb = Ec2 = 250 v. D.C.	Ep	—	—	150	mVac
Grid Emission Test Ef = 7.0 v. Time = 2 minutes	Ic1			—2.0	uAdc
Capacitance	Cgp	1.2	1.45	1.6	uufds
	Cin	7.0	8.5	10.0	uufds
	Cout	4.0	5.3	6.0	uufds
Plate Resistance	Rp	32,000	—	—	ohms

ELECTRODE:	Ef	Eb	Ec2	Ec1	Ehk
TEST CONDITIONS:	6.3 volts	250 Vdc	250 Vdc	—12.5 Vdc	± 450 Vdc

CHART 4. SPECIAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 2½ Min. Off 2½ Min. Ef = 7.5 Ehk = 300 Vac	3,000 On-Off Cycles
High Temp. Life Test	Under "Test Conditions" Bulb Temp. 300°C	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 18/sec. rep. rate	100 Hours
Shock	500	20 Impacts
Altitude Test	60,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	

CHART 5

AVERAGE PLATE CHARACTERISTICS
PENTODE CONNECTION
E_F = 6.3 VOLTS SCREEN = 250 VOLTS

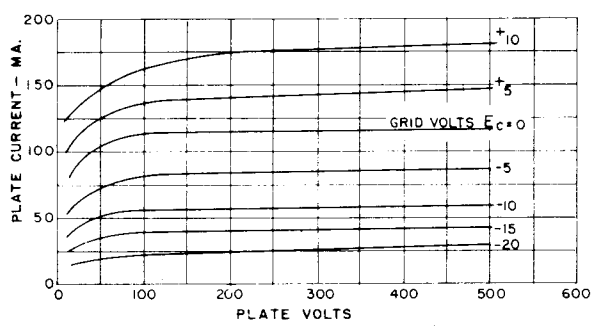
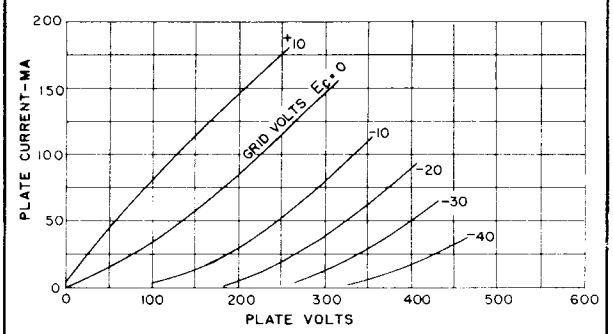


CHART 6

AVERAGE PLATE CHARACTERISTICS
TRIODE CONNECTION
E_F = 6.3 VOLTS

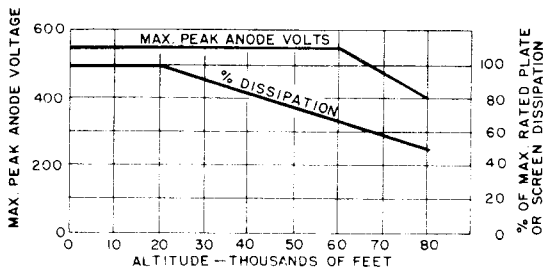


MINIATURE BEAM POWER AMPLIFIER

Bendix 6094
Type TE-18
(Generic Type 6AQ5/6005)

CHART 7

ALTITUDE RATINGS



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF DISSIPATION DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY

CRITERIA FOR DERATING FOLLOWS:

1. VOLTAGE DERATING—TO KEEP BELOW BASE PIN ARC OVER POINT.
2. DISSIPATION DERATING—TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

CHART 8. EFFECT ON LIFE OF INCREASED RATINGS

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	200 Vdc	250 Vdc	300 Vdc
Screen Voltage	200 Vdc	250 Vdc	275 Vdc
Peak Plate Voltage	400 v	500 v	550 v
Plate Current (Av.)	25 mA	40 mA	45 mA
Screen Current (Av.)	3 mA	4 mA	6 mA
Cathode Current (Peak)	50 mA	65 mA	100 mA
H-K Voltage	200 V	300 V	450 V
Grid Resistance	25,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	200°C	250°C	300°C
Altitude	0-20,000′	60,000′	80,000′
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

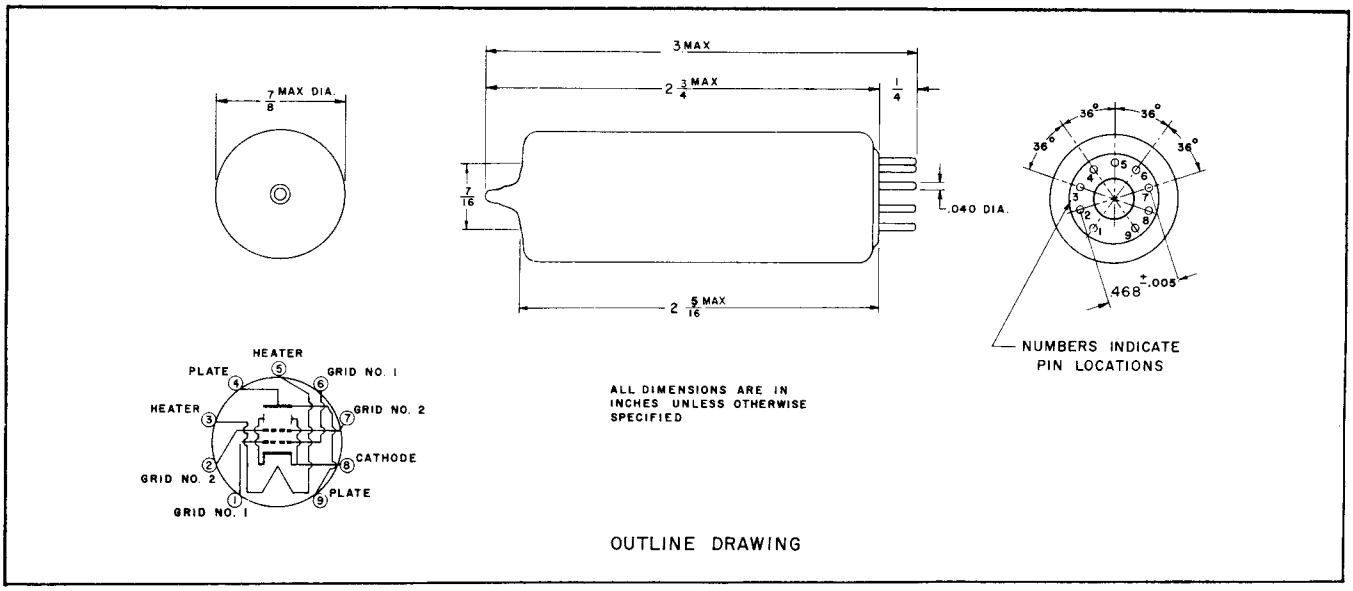
APPLICATION NOTES

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 will 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.

This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment. The altitude rating chart shows the correct voltage derating necessary for various altitudes. However, the dissipation derating is only approximate and must be measured for each application because of the additive effects mentioned above.

When used with A.C. on plate and screen with an inductive load such as in servo discriminator circuits, sufficient unshunted resistance in series with the screen should be used to avoid damage to the tube during that portion of the cycle when the plate may be negative with respect to the screen.

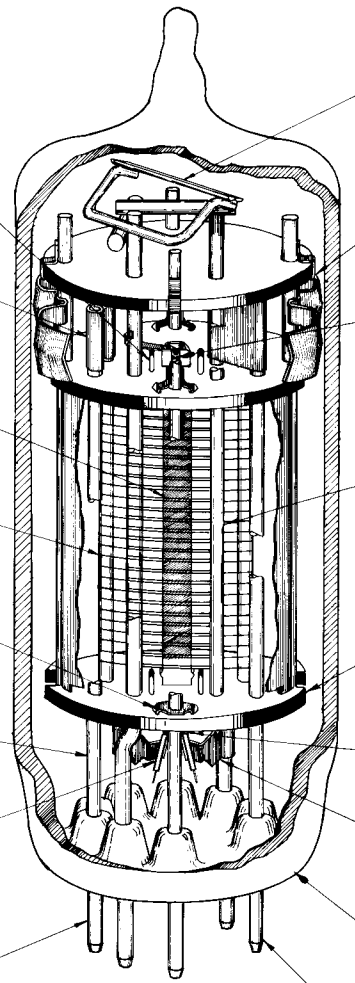
Chart 8 is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.



OUTLINE DRAWING

MINIATURE BEAM POWER AMPLIFIER

6094
Bendix Type TE-18
(Generic Type 6AQ5/6005)



SLOTS BETWEEN CATHODE AND GRID TO REDUCE LIKELIHOOD OF LEAKAGE.

HEAVY RADIATORS CONNECT GRIDS TO THROUGH SUPPORTS-MULTIPLE WELDS.

LARGER CATHODE AREA & INCREASED ELECTRODE SPACING

HEAVY GRID SIDE RODS

EYELETS LOCK STRUCTURE TOGETHER.

STEM LEADS EXTEND THROUGH MOUNT STRUCTURE TO PROVIDE STRENGTH.

NICKEL SLEEVES ON TUNGSTEN HEATER-LEGS PROVIDE STRONG SWAGED WELD.

NICKEL PINS-GOLD PLATED FOR LOW CONTACT RESISTANCE AND FREEDOM FROM COROSION.

GETTER RESERVE FOR LONG LIFE.

HIGH TEMPERATURE METAL SNUBBERS USED TO SUPPORT MOUNT IN BULB.

CATHODE TAB-HEAVY AS POSSIBLE CONSISTANT WITH NEED TO PREVENT HEAT LOSS FROM CATHODE-ONLY TAB IN STRUCTURE.

BEAM RODS GIVE PROPER "BEAM" ACTION & REDUCE SECONDARY GRID EMISSION EFFECT.

PRESSED & PUNCHED CERAMIC SPACERS PROVIDE STABLE ELEMENT SEPARATORS & REDUCE GAS RELEASE AT HIGH TEMPERATURE.

SOLID EXTRUDED CERAMIC HEATER INSULATOR & COILED HEATER PROVIDE RELIABLE LONG LIFE.

HEAVY HEATER BUS-PROVIDES FIRM ANCHORING.

HIGH TEMPERATURE GLASS USED FOR STEM & BULB- FREEDOM FROM GAS RELEASE & ELECTROLYSIS AT HIGH TEMPERATURE.

BUTTON STEMS-STRENGTH IN ALL PLANES.

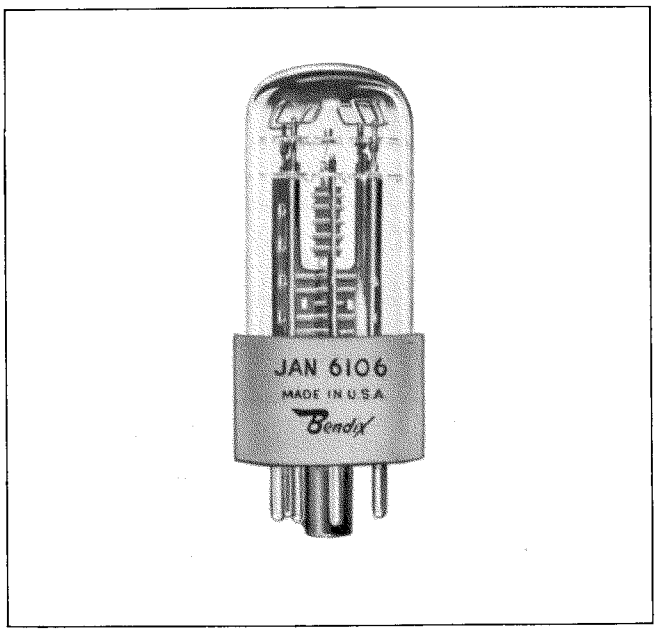
STRUCTURAL FEATURES OF 6094 PROVIDE HIGH RELIABILITY AND LONG LIFE.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6106
Bendix Type TE-22
(Generic Type 5Y3GT)

FULL-WAVE RECTIFIER



ELECTRICAL RATINGS*

Heater voltage**	5.0 volts
Heater current	1.7 amps.
Peak inverse voltage	1550 volts (max.)
Peak plate current (per plate)	415 mA (max.)
Peak surge current (per plate)	1.4 amps. (max.)
AC plate supply voltage and DC output currents	See Rating Chart I
Cathode warm-up time	45 seconds
Total effective plate supply impedance —per plate	See Rating Chart III

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

TYPICAL OPERATION

Input to Filter

	Capacitor	Choke
Heater voltage (volts)	5.0	5.0
Heater current (amperes)	1.7	1.7
RMS plate supply voltage (volts per plate)	350	500
Input condenser (μf)	4	—
Input choke (henries)	—	10
DC output current (mA)	125	125
DC output voltage (volts)	350	390

DESCRIPTION

This full-wave, high-vacuum rectifier is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft, military and industrial applications where freedom from early failures, long service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

Heavy gauge heater construction together with a pure alumina insulator reduces the likelihood of heater failure. A large area cathode operating at moderate temperatures gives longer service life and freedom from arc-overs. An eight-pillar mount structure and the button-type stem provide a strong assembly that will stand up under extreme conditions of vibration and shock. The tube requires an 8-pin octal socket and can be mounted in any position. Adequate ventilation should be provided.

The tube is designed to replace the 5Y3-GT and similar types in applications where severe environmental conditions are encountered, especially in airborne equipment. The cathode type structure instead of a filament structure insures against filament breakage under shock and vibration. The arc-resistant, compound-filled, melamine base with inter-pin barriers permits operation to an altitude of 80,000 feet. (See Altitude Ratings, Page 3)

PHYSICAL CHARACTERISTICS*

Base	Intermediate shell octal 5-pin (Melamine—with barriers)
Bulb	T-9
Max. overall length	3.375 in.
Max. seated height	2.880 in.
Max. diameter	1.320 in.
Mounting position	Any
Max. altitude***	80,000 ft.
Max. bulb temperature****	200° C.
Life expectancy	10,000 hrs.

***See "Altitude Ratings" Page 3

****Temperature measurement made with "Tempilaq"

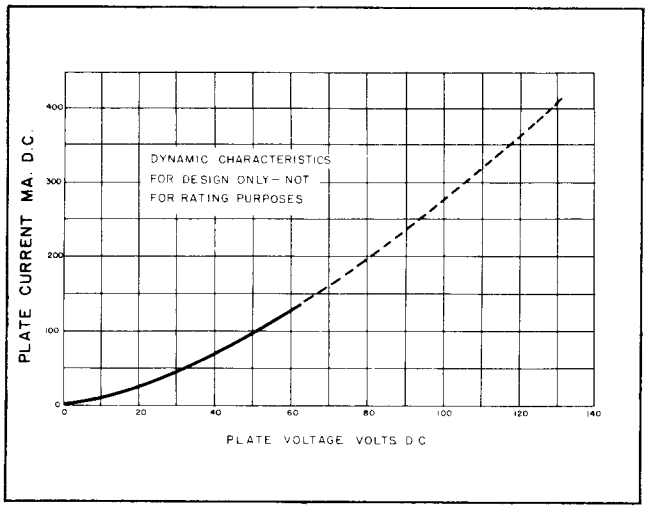
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 62-1 (Supersedes No. R 54-26)

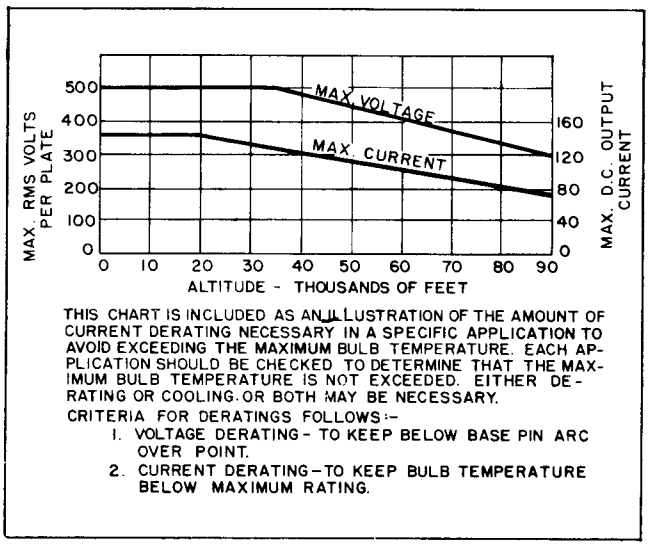
Printed in U.S.A.

FULL-WAVE RECTIFIER

6106
Bendix Type TE-22
(Generic Type 5Y3GT)



AVERAGE PLATE CHARACTERISTICS



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF CURRENT DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATINGS FOLLOWS:–

1. VOLTAGE DERATING – TO KEEP BELOW BASE PIN ARC OVER POINT.
2. CURRENT DERATING – TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

ALTITUDE RATINGS

APPLICATION NOTES

For reliable operation special consideration should be given to the maximum ratings of the 6106. These ratings are limiting absolute values and if exceeded may seriously impair the reliability of the tube. Therefore, the equipment designer should determine an average design value for each rating so that variations in supply voltages, load, and components do not cause the absolute values to be exceeded. The bulb temperature rating is an extremely important characteristic which should not be exceeded if expected life is to be achieved.

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.

From Rating Chart I, operating conditions should be selected to insure usage within the area of permissible operation with choke or capacitor inputs.

To insure that the maximum peak plate current is not exceeded a choice of operating values of d-c output current per plate and rectification efficiency should be made such that they fall within the area of permissible operation of Rating Chart II.

Rating Chart III graphically represents the relationship between the maximum a-c plate supply voltage per plate and the minimum plate supply resistance per plate to prevent maximum transient currents from exceeding the peak surge current rating of the tube. The plate supply resistance $Rs = R(sec) + N^2R(pri) + Ra$, where

R(sec) = d-c resistance of each section of transformer secondary,

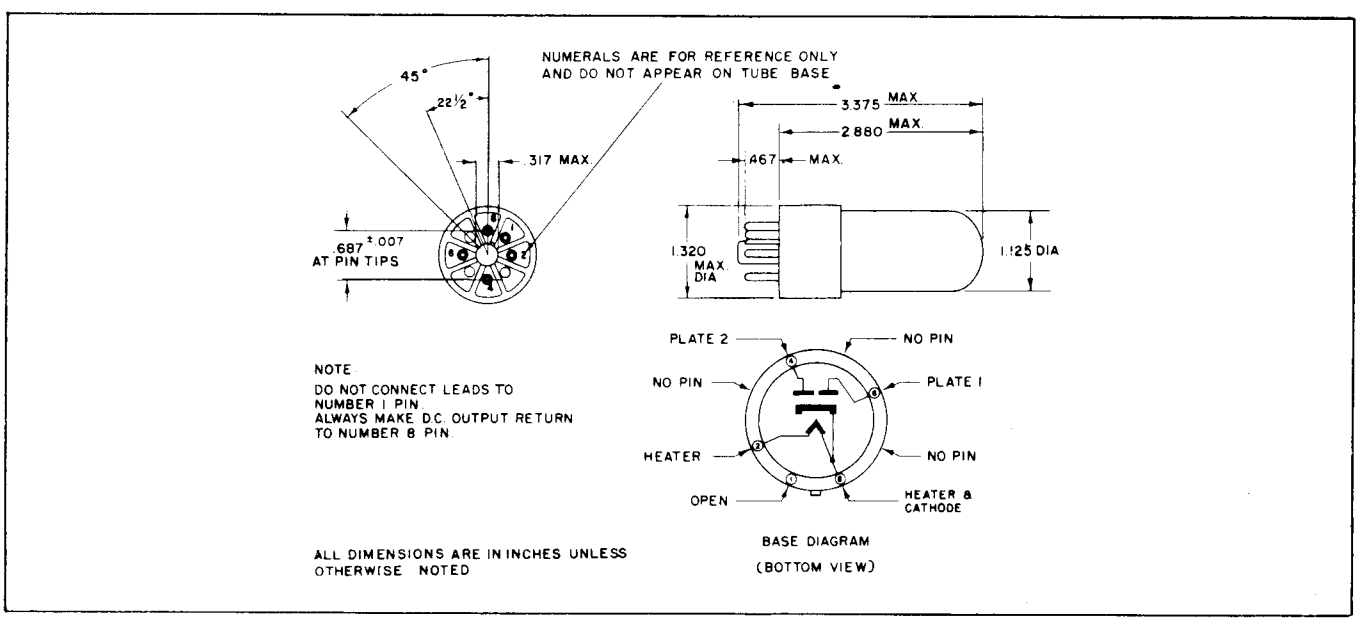
N = Transformer voltage step-up ratio per section,

R(pri) = d-c resistance of transformer primary,

Ra = d-c resistance of added series resistance per plate.

The addition of inductance would allow a reduction of the minimum value specified for Rs provided the reactance added is not too small as to cause the maximum peak surge plate current and maximum steady-state peak plate current ratings to be exceeded.

The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.



OUTLINE DRAWING

FULL-WAVE RECTIFIER

6106
Bendix Type TE-22
(Generic Type 5Y3GT)

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 hours under Test Conditions and 2G Vibration at 30 cps prior to 100% Testing.

CHARACTERISTICS	TEST CONDITIONS	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS	
PRODUCTION TESTS							
Heater Current	A	If	1.6	1.7	1.8	Aac	
Operation	B	Io	130	140	—	mAdc	
Emission (1)	C	Ils	145	—	—	mAdc	
Emission (2)	C	I2s	145	—	—	mAdc	
Short and Continuity							
DESIGN TESTS							
Vibration: 2.5 G, 25 cps							
Insulation of Electrodes	D	R	100	—	—	megohms	
TEST CONDITIONS	Ef	Epp/p	Es	Ep	RL	CL	Zpp/p
Units	Vdc	Vac	Vdc	Vdc	ohms	uf	ohms
A	5.0						
B	5.0	400			2750	4	*
C	5.0		75				
D	5.0			1500			

*Adjust with tube having Etd = 60 Vdc @ 125 mA dc per plate to give Io = 140 mA

SPECIAL TESTS*

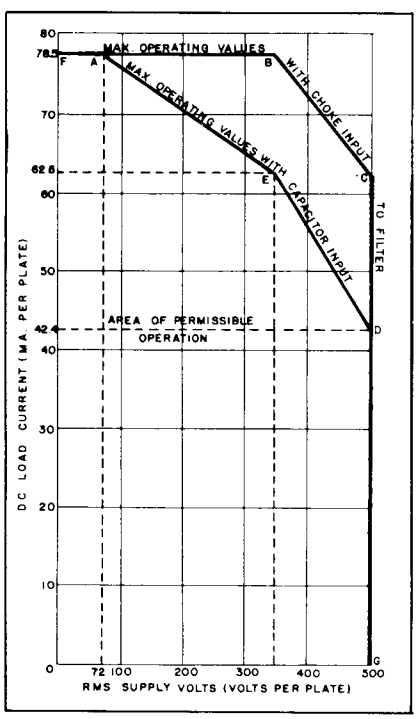
In addition to the production and design tests shown under "Electrical Characteristics and Test Data", other tests are performed on a sampling basis to assure a high out-going quality level. See below:

TEST	CONDITION	DURATION
Heater Cycling Life Test	On 2½ min. Off 2½ min. Ef = 5.5 Vac	3,000 On-Off cycles
Glass Strain Test	Boiling water to Ice water	3 minutes in each
Life Test	Under Test Conditions	1,000 hours
High Level Fatigue Test	50 g Shock Excitation: 18/sec. rep. rate	100 hours
Altitude Test	60,000 Feet	5 minutes
Life Expectancy Test	Under Test Conditions	5,000 hours
Mount Inspection	100% Test-Microscopic Inspection of 15 possible Trouble Points	

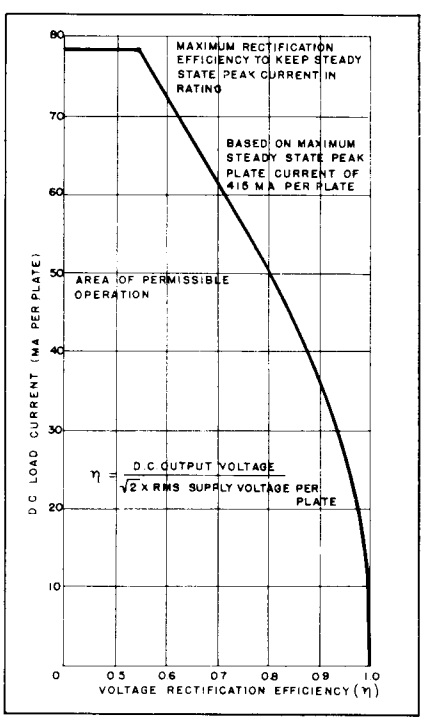
*For additional specifications consult MIL-E-1/203 specification for the 6106.

EFFECT ON LIFE OF INCREASED RATINGS

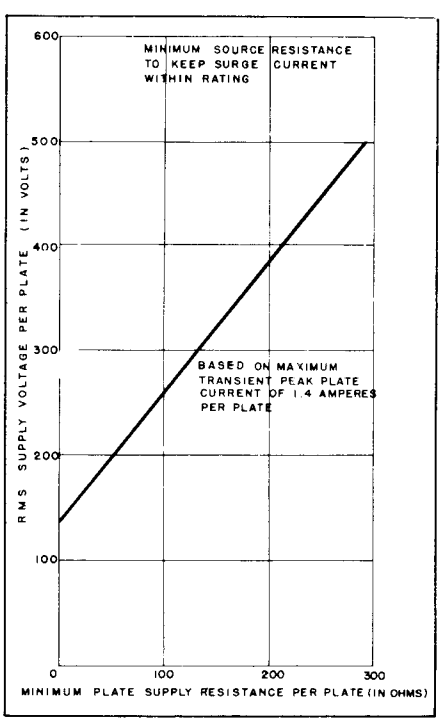
See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	5.0 V ± 2%	5.0 V ± 5%	5.0 V ± 10%
Plate Supply Voltage	300 Vac	350 Vac	450 Vac
Peak Plate Current	300 mA	350 mA	415 mA
D-C Output Current	110 mA	125 mA	150 mA
Bulb Temperature	150° C	175° C	200° C
Altitude	0-20,000′	60,000′	80,000′
Vibration	1 G	2½ G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM



RATING CHART 1



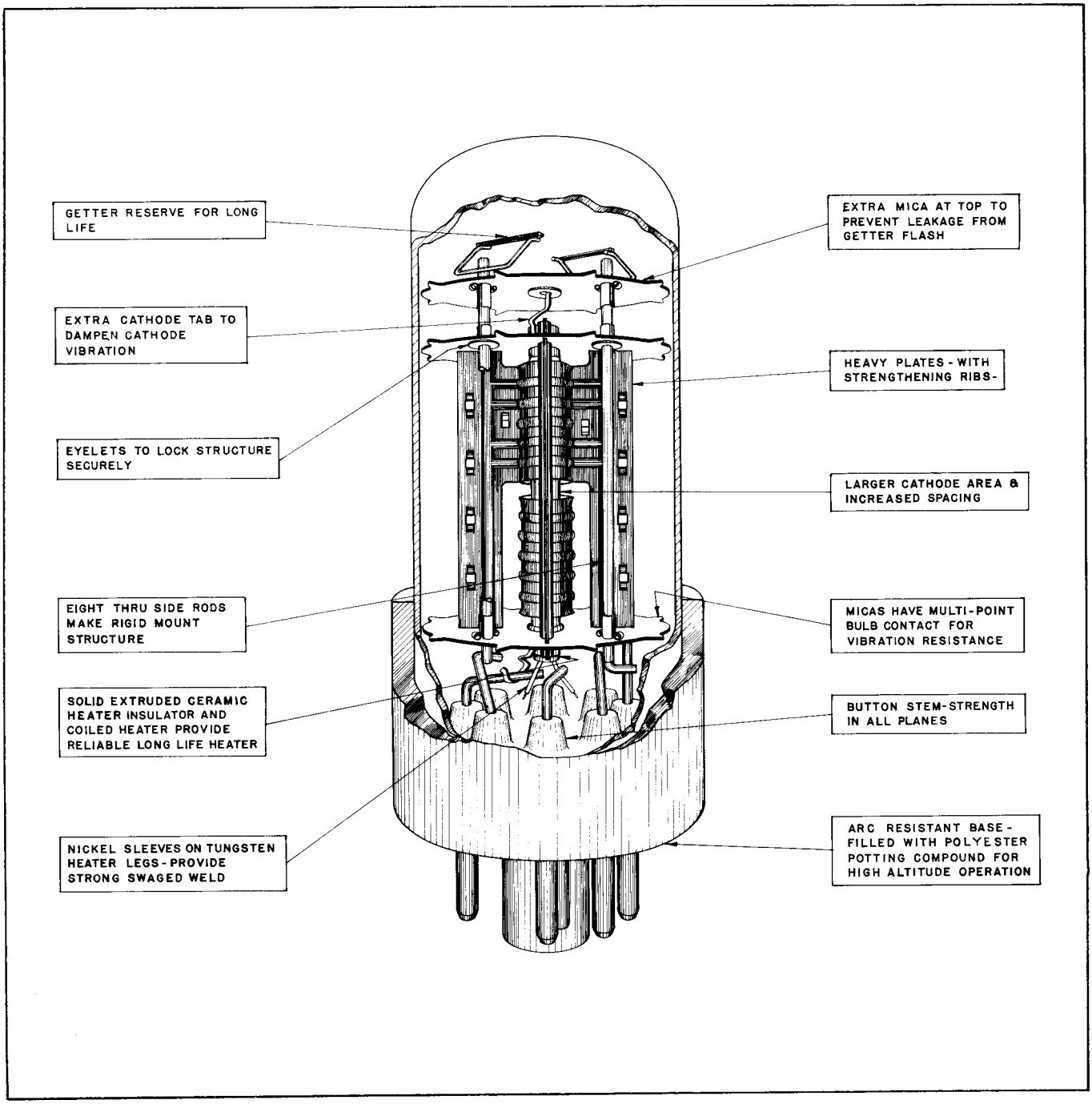
RATING CHART 2



RATING CHART 3

FULL-WAVE RECTIFIER

6106
Bendix Type TE-22
(Generic Type 5Y3GT)



STRUCTURAL FEATURES OF 6106 PROVIDE HIGH RELIABILITY AND LONG LIFE

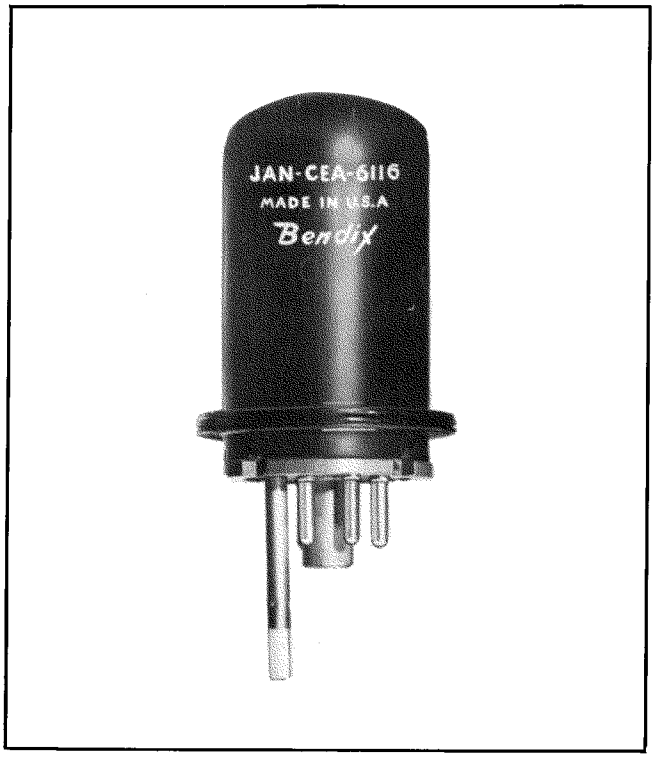
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6116
Bendix Type TK-62

REFLEX KLYSTRON

(THERMALLY TUNED)



DESCRIPTION

The 6116 (Bendix® Type TK-62) tube is a ruggedized low voltage thermally tuned X-band reflex klystron, designed for use as a CW power source over the frequency range of 8500 to 9660 Mc./sec. Thermal tuning of the klystron is accomplished by means of a diode included within the vacuum envelope, the plate of which comprises one wall of the klystron cavity. As diode voltage, and hence current, is increased, expansion of the plate results in corresponding changes in the klystron cavity gap spacing causing the tube to tune. The tuning speed over the required frequency range is .7 to 3 seconds.

With the exception of the diode tuner, the 6116 may be considered a ruggedized version of the 2K45 with equivalent outline dimensions and electrical characteristics.

The ruggedization feature of the tube permits it to be operated under severe vibration environments without sacrifice of frequency stability. Under vibration conditions of 10g acceleration at 50 cycles, the maximum frequency variation is ± 1.3 Mc./sec.

The tube has coaxial output as shown in the accompanying photograph and outline drawing, and is coupled to the waveguide circuit through a transducer identical to that used for the type 2K45 and 2K25 klystrons. Details of this transducer can be found in the Military Number 227 JAN specification sheet.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	350 volts D.C.
Reflector Voltage	—350 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 ma. D.C.
Diode Plate Dissipation	*see note below
Diode Voltage	—350 volts D.C.
Heater-Cathode Voltage	±100 volts D.C.

*Note: Power inputs as high as 16.5 watts may be applied to the diode when the frequency of the klystron is above 8500. Tuner power in excess of 10 watts may permanently damage the tuning structure, if applied when the tube is tuned below 8500 Mc.

TYPICAL OPERATING CONDITIONS

Frequency	8500 to 9660 Mc./sec.
Resonator Voltage	300 volts D.C.
Reflector Voltage @ 9660 Mc./sec.	—95 to —145 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 mA D.C. (max.)
Tuner Diode Current	5 to 36 ma (D.C.)
Tuner Diode Voltage	170 to 275 volts D.C.

PHYSICAL CHARACTERISTICS

- *Base:* Small octal 8-pin, B8-21, Low Loss Phenolic Wafer, Modified for coaxial output lead as shown on outline drawing.
- *Coupling to Wave Guide:* Coaxial output fits standard transducer per 227 JAN.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Integral with tube.
- *Bulb:* Metal.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-25

Printed in U.S.A.

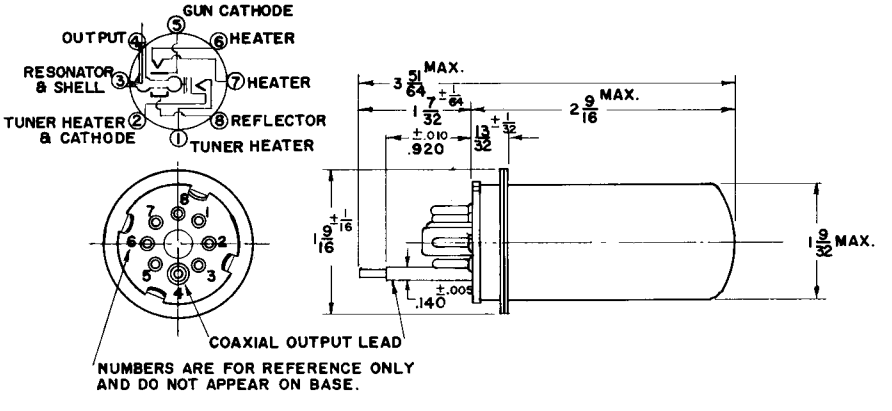
REFLEX KLYSTRON
(THERMALLY TUNED)

6116
Bendix Type TK-62

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

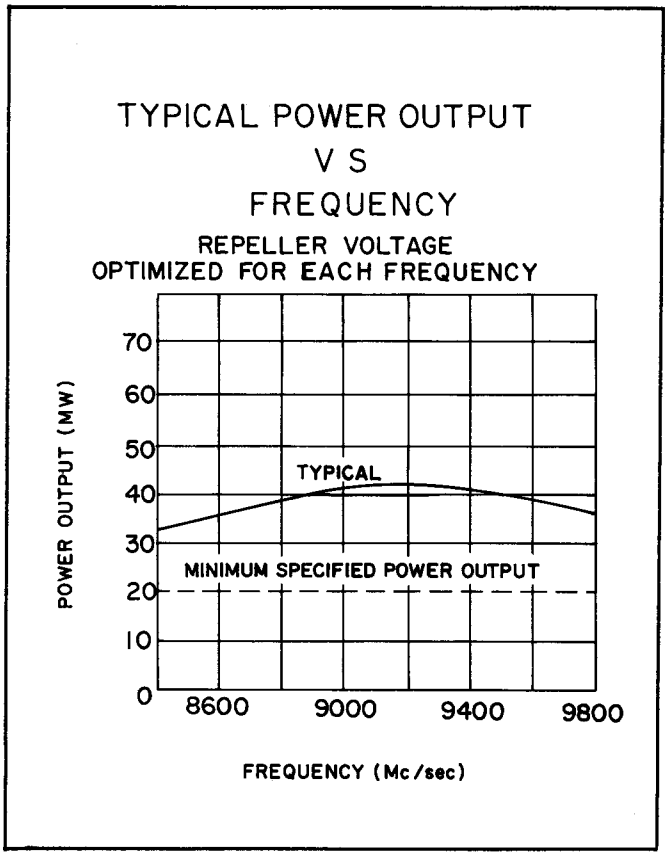
Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS:					
Total Reflector Current:	Er = −150 Vdc; t = 120 sec.(min)	Ir:	—	5.0	μAdc
Reflector Leakage:	Er = −150 Vdc	Ir:	—	3.0	μAdc
Reflector Gas Current:	Er = −150 Vdc	Ir:	—	1.0	μAdc
Cathode Current (1):	Er = −150 Vdc	Ik1:	—	32	mAdc
Reflector Voltage:	Er (Mode A)/Max. Po @ 9660 ±0.3% Mc.	Er:	−95	−145	Vdc
Emission (1):	Ef = 5.8; Er = −150 Vdc	△Ik1/Ik1:	—	0.15	
Emission (2):	Ef = 5.8; Ik2 = 20 mA	△Ik2/Ik2:	—	0.10	
Thermal Tuning Time (1):	F = 9660 to 8500 Mc.	t:	0.7	3.0	sec.
Thermal Tuning Time (2):	F = 8500 to 9660 Mc.	t:	0.7	3.0	sec.
Power Output:	Ef = 5.8; F from 8500 to 9660 Mc.	Po:	20	—	mW
DESIGN TESTS:					
Electrode Insulation:	300 Vdc Tube Cold	Rk1-rs:	2.0	—	Meg.
		Rk2-rs:	2.0	—	Meg.
		RF1-rs:	2.0	—	Meg.
Heater Current (1):		If1:	465	570	mA
Heater Current (2):		If2:	720	880	mA
Insulation:	Eh-K1 = ±100 Vdc	IhK1:	—	100	μAdc
Bump:	Ef = 5.8; Er (Mode A)/Max. Po @ 9660 ±0.3% Mc.	△Po/Po:	—	0.10	
Thermal Tuning Range:	Ef = 5.8 V; Er (Mode A)/Max. Po Pp = 1.0 to 9.0 watts	Max. F:	9660	—	Mc
		Min. F:	—	8500	Mc
Tuner Diode Voltage Drop (1):	Ik2 = 10 mAdc	ED:	170	218	Vdc
Tuner Diode Voltage Drop (2):	Ik2 = 28 mAdc	ED:	225	274	Vdc
Tuner Diode Voltage (1):	F = 9660 ±0.03% Mc. Er (Mode A)/Max. Po	ED:	170	230	Vdc
Tuner Diode Voltage (2):	F = 9080 ±0.3% Mc. Er (Mode A)/Max. Po	ED:	200	260	Vdc
Tuner Diode Voltage (3):	F = 8500 ±0.3% Mc. Er (Mode A)/Max. Po	ED:	220	275	Vdc
Tuner Diode Current (1):	F = 9660 ±0.03% Mc. Er (Mode A)/Max. Po	Ik2:	5	19	mA
Tuner Diode Current (2):	F = 9080 ±0.3% Mc. Er (Mode A)/Max. Po	Ik2:	13	28	mA
Tuner Diode Current (3):	F = 8500 ±0.3% Mc. Er (Mode A)/Max. Po	Ik2:	20	36	mA
Electrical Tuning Range:	Er (Mode A)/50% Max. Po: F from 8500 to 9660 Mc.	F:	45	—	Mc
Vibration:	Er (Mode A)/Max. Po at 9080 Mc; Total Displacement = 0.080" F = 50 cps, Position X1 and Y1	△F:	—	±1300	Kc

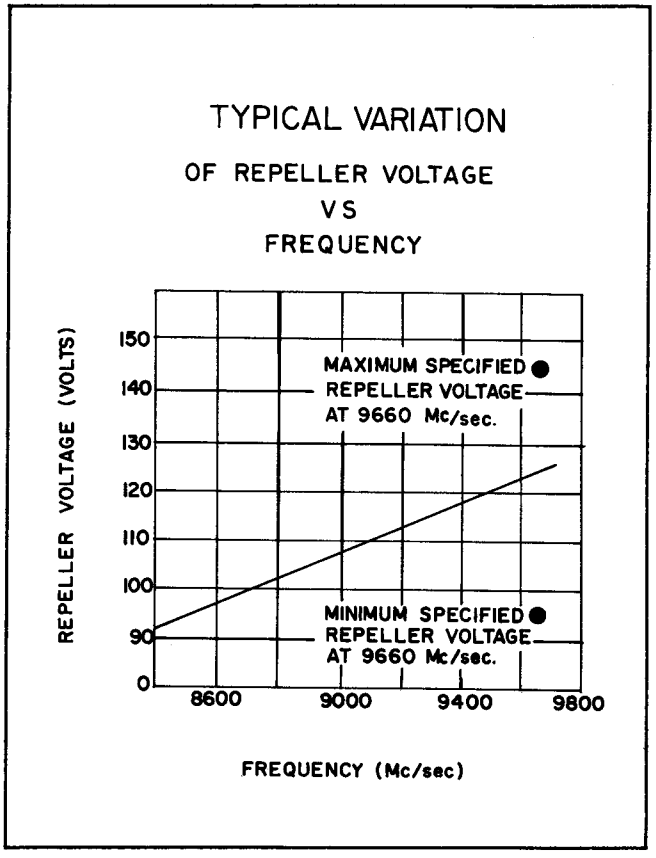


OUTLINE DRAWING

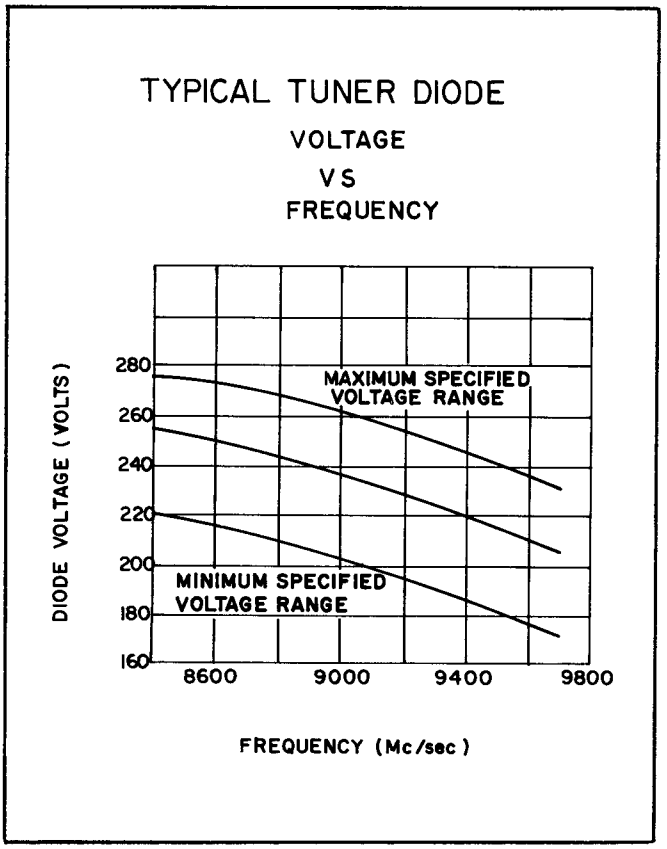
AVERAGE CHARACTERISTICS



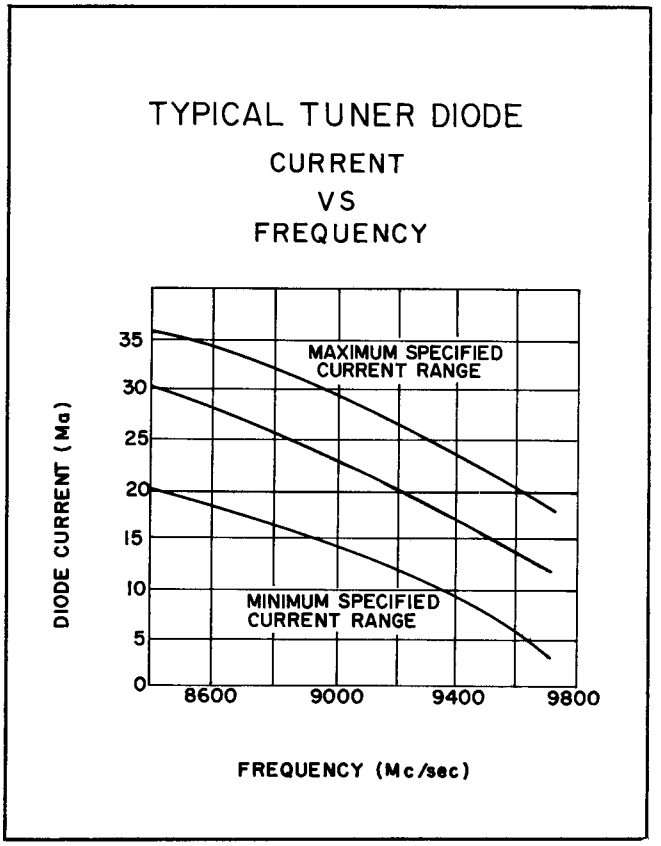
POWER OUTPUT VS FREQUENCY
(REPELLER VOLTAGE OPTIMIZED FOR EACH FREQUENCY)



REPELLER VOLTAGE VS FREQUENCY

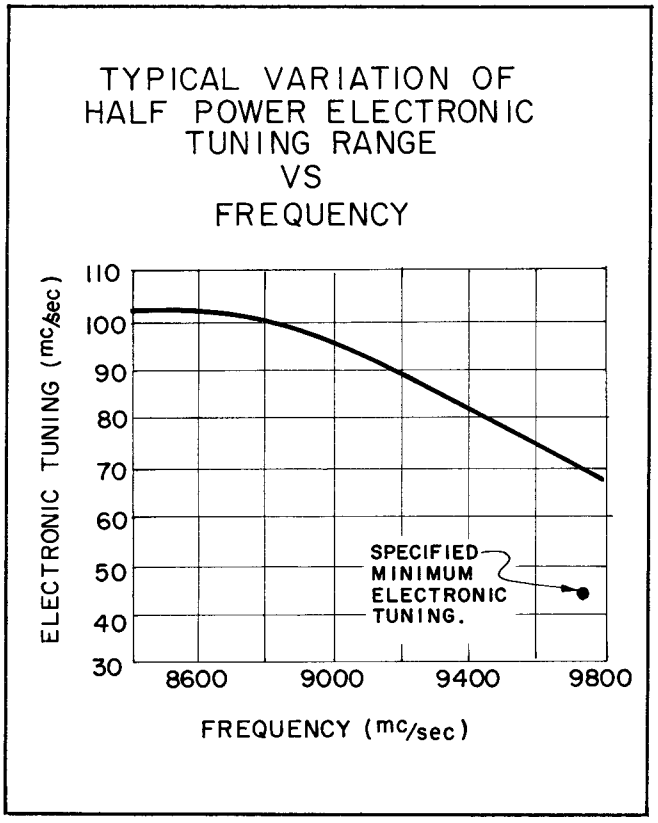


TUNER DIODE VOLTAGE VS FREQUENCY

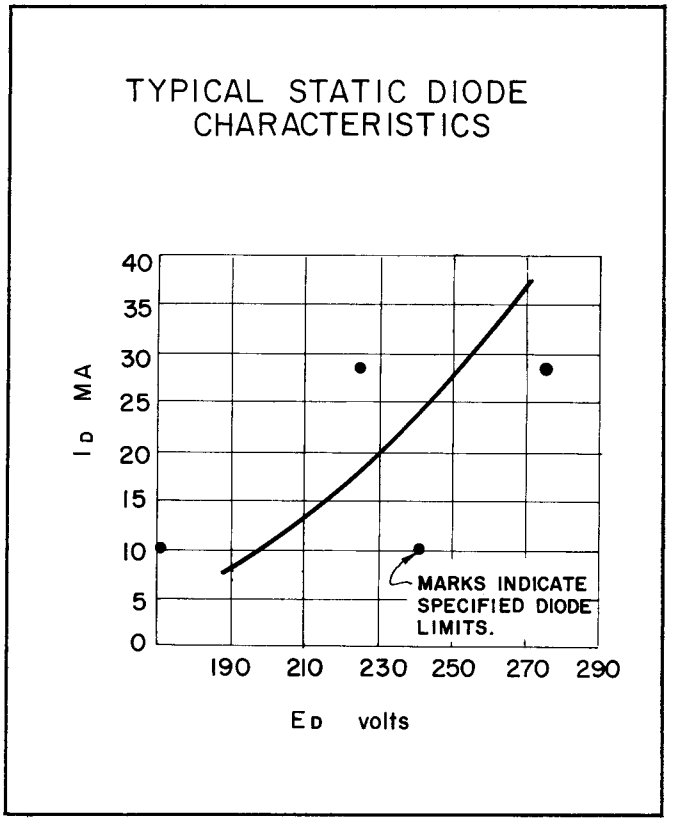


TUNER DIODE CURRENT VS FREQUENCY

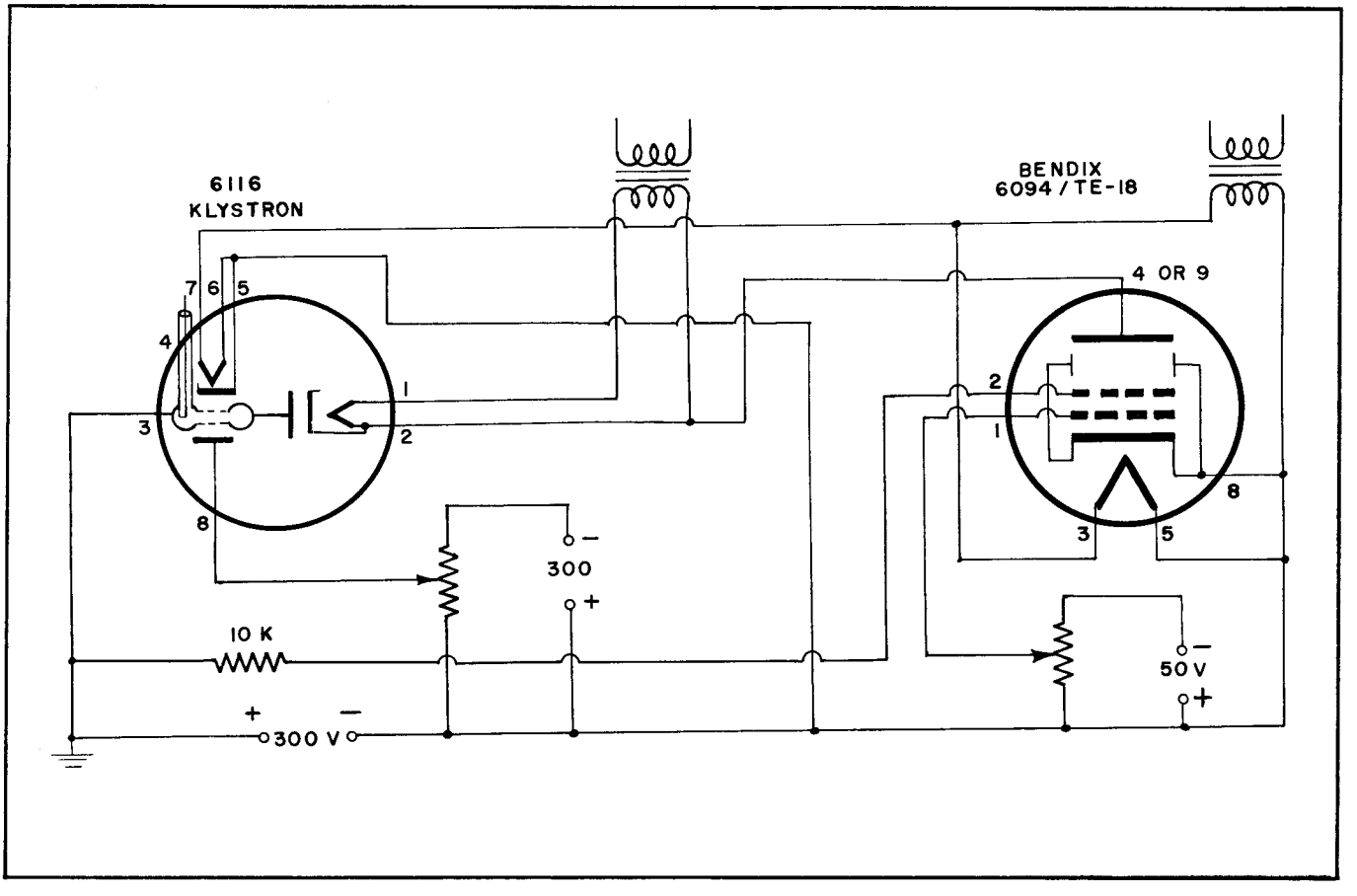
AVERAGE CHARACTERISTICS



HALF POWER ELECTRONIC TUNING RANGE VS FREQUENCY



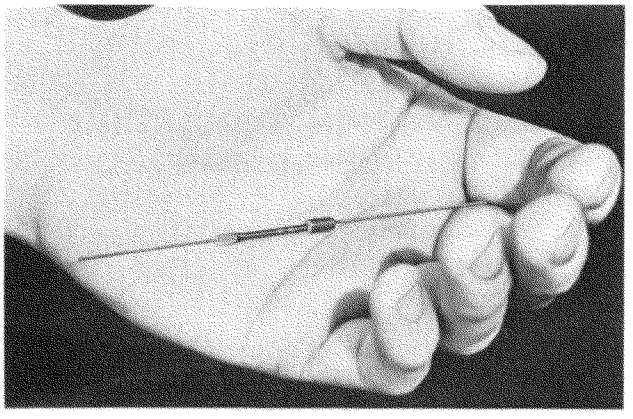
STATIC DIODE CHARACTERISTICS



CONTROL CIRCUIT FOR TUNING DIODE

6142
Bendix Type TD-9A

GAS DIODE VOLTAGE REGULATOR



DESCRIPTION

This tube is a sub-miniature voltage regulator of the cold cathode type. It is designed for use as a voltage reference source or a voltage stabilizing element in low current applications where space conservation is a primary consideration. Its small size and wire lead terminals permit it to be incorporated directly into the electrical circuit in the same manner as small condensers or resistors, thereby eliminating the need for any tube socket.

RATINGS

Anode supply voltage	300 volts DC
Ionization voltage*	250 volts DC (max.)
Regulation voltage**	150 volt DC
Operating current range	75 to 400 microamps.
Regulation over current range	± 5%
Ambient temperature range	−55°C. to +85°C.
Regulation over ambient range***	± 5%

*With anode circuit resistances adjusted to give anode current of 250 microamperes.

**With anode circuit resistance adjusted to give anode current of 250 microamperes as center value at room temperature.

***With anode circuit resistance adjusted to give anode current of 250 microamperes at room temperature.

PHYSICAL CHARACTERISTICS

Connections	Tinned wire leads
Maximum diameter	0.150-in. (max.)
Length — without leads	1.187-in. (max.)
Mounting position	Any
Lead length	1.25-in.

OPERATION NOTES

Sufficient resistance must be inserted in series with the tube to limit the current passing through the tube to 400 microamperes (steady state). Maximum starting or surge current should be limited to one milliampere. Tube regulating characteristics will be impaired by excessive current during starting or by current surges. High circuit capacity across the tube may cause the tube to oscillate leading to unstable operation with consequent poor or erratic regulation characteristics.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

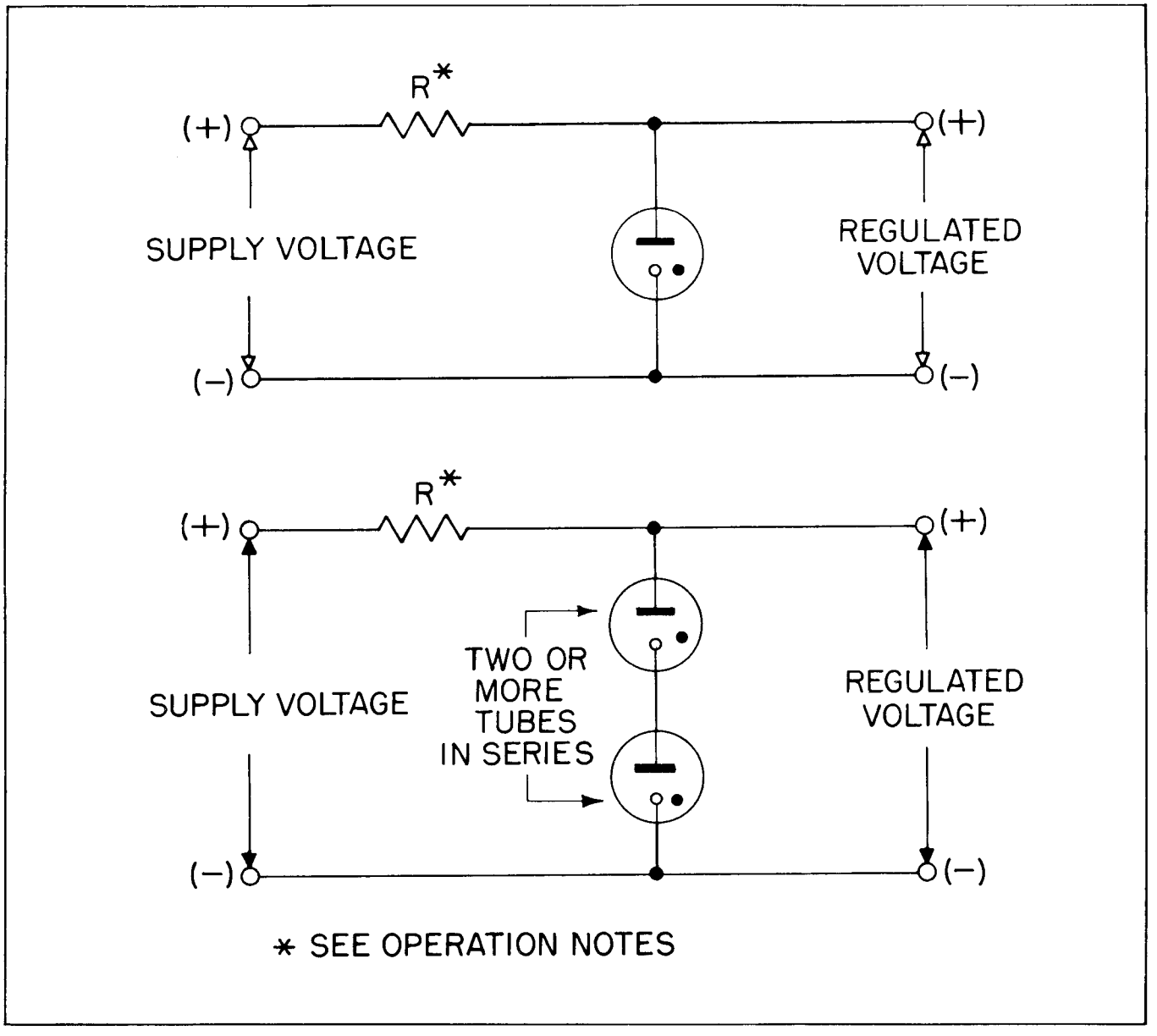
Publication No. R51-30 (Supersedes No. R35-6)

Printed in U.S.A.

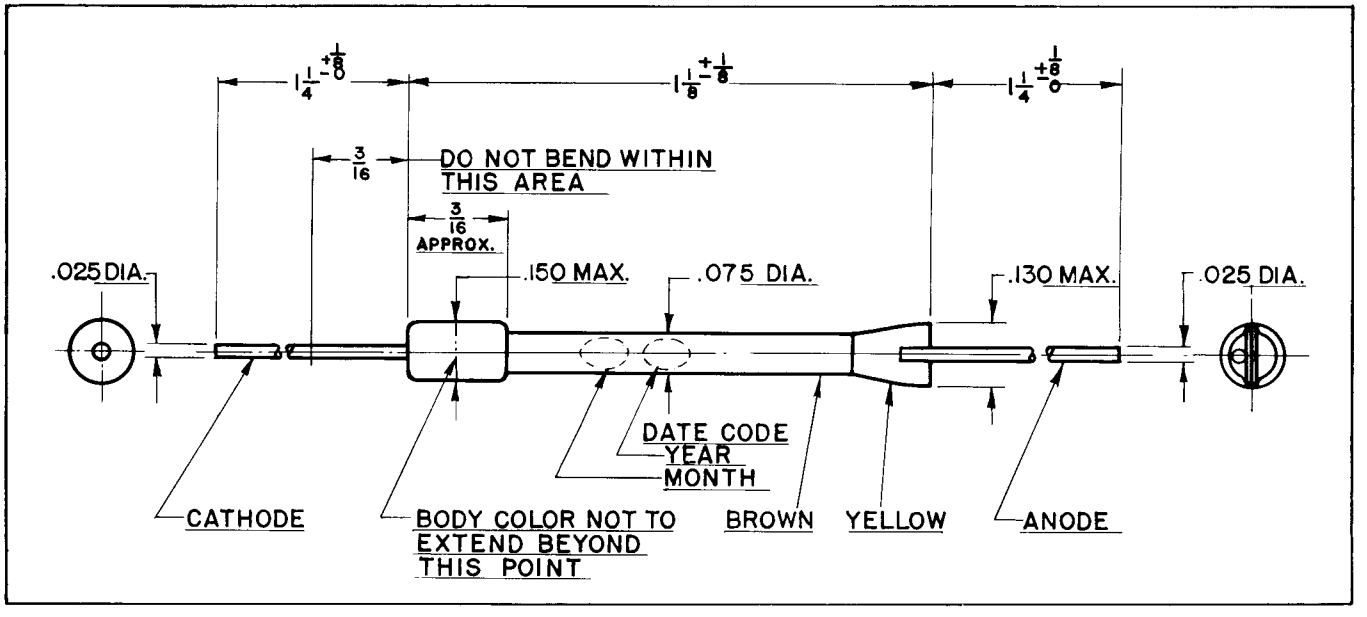
GAS DIODE VOLTAGE REGULATOR

6142

Bendix Type TD-9A



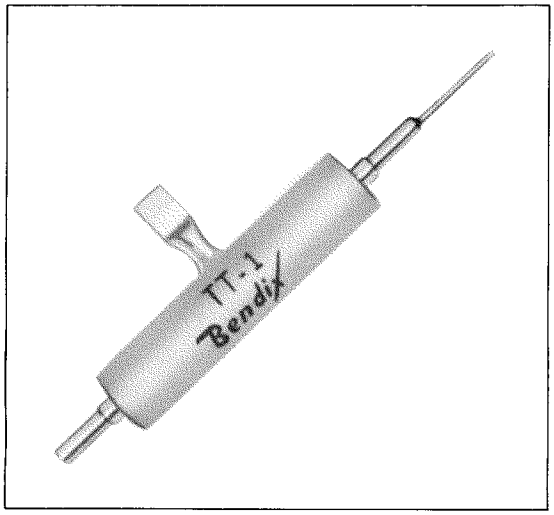
CIRCUIT APPLICATIONS



OUTLINE DRAWING

Bendix 6144 Type TT-1

NOISE DIODE



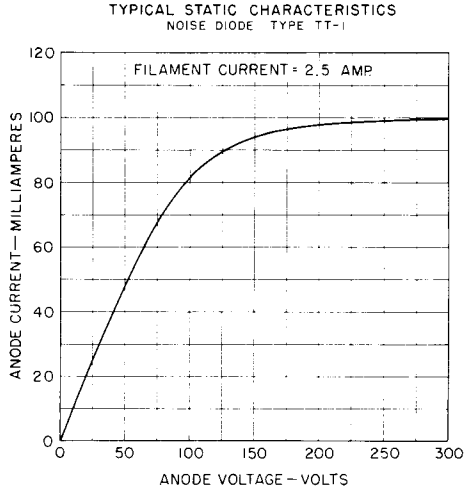
DESCRIPTION

This tube is designed for use as a noise source in HF and UHF measurements. It is constructed to match the characteristic impedance of a 50-ohm coaxial line. The noise output is a direct function of anode current and is controlled by varying the applied filament voltage. The coaxial construction gives wide band operation thus permitting use with any type of circuit — tuned or untuned. Correct matching of impedances and a termination is required to keep the VSWR of the overall circuit to a minimum.

RATINGS

Anode voltage	300 volts D-C (max.)
Anode current	100 ma. D-C (max.)
Filament voltage	3.2 volts A-C or D-C
Filament current	2.5 amp.
Anode dissipation	30 watts (max.)
Characteristic coaxial impedance	50 ohms
Frequency range	3000 megacycles (max.)
Dynamic impedance	16,000 ohms (min.)

TYPICAL STATIC CHARACTERISTICS



OPERATING CHARACTERISTICS

Since the tube operates under temperature limited emission conditions, anode current is controlled by holding the anode voltage constant and varying the filament supply voltage or current. Maximum operating conditions with an anode dissipation of 30 watts will require supplementary cooling of the anode. This can be accomplished by heat conduction through the radio frequency plumbing, by air jet or by thermal conduction through a mounting block. Anode dissipation should be limited to 18 watts unless cooling means are provided. Maximum anode hot spot temperature should not exceed 400°F.

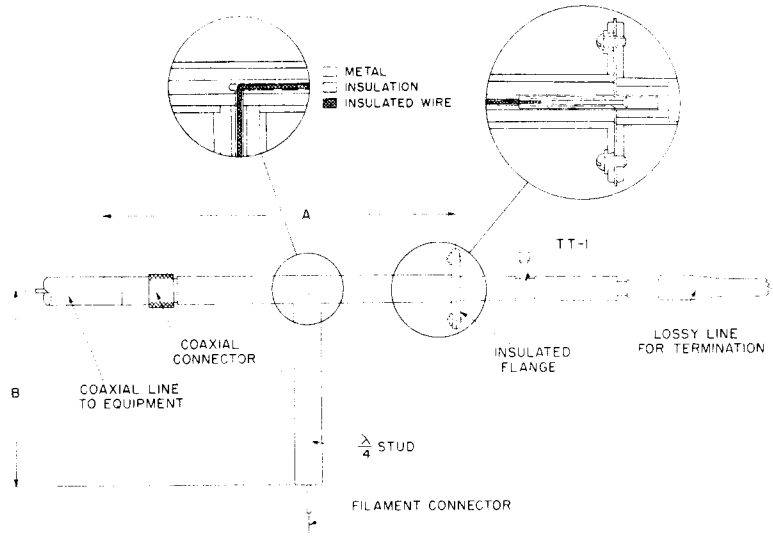
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R34-7 (Supersedes No. 518-30C)

Printed in U.S.A

NOISE DIODE

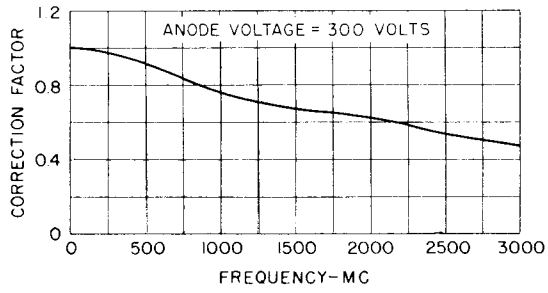
6144
Bendix Type TT-1



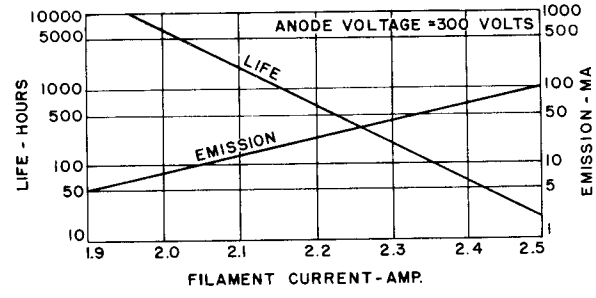
FREQUENCY	A	B
2000 MEGACYCLES	2.401	1.725
750 MEGACYCLES	3.178	3.632

"A" AND "B" DIMENSIONS VARY WITH THE CENTER FREQUENCY OF EQUIPMENT UNDER TEST.

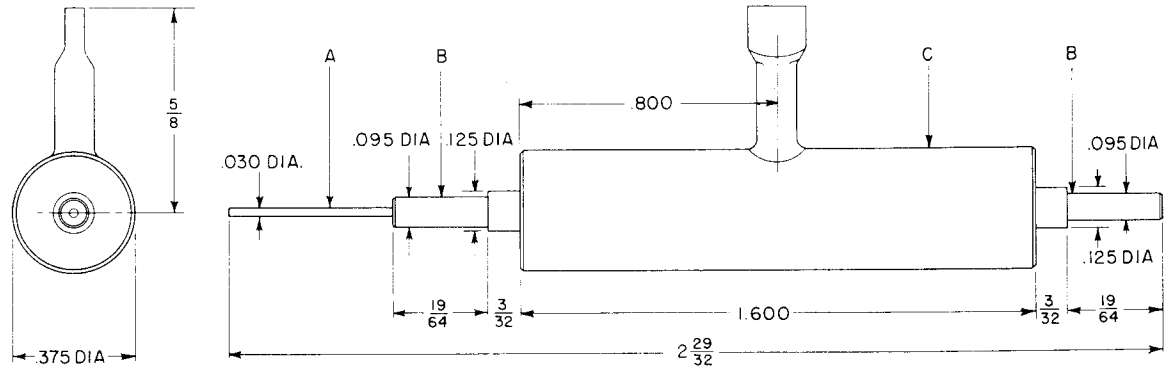
TUBE MOUNT



CALCULATED TRANSIT TIME REDUCTION OF NOISE



CALCULATED MINIMUM LIFE EXPECTANCY AND EMISSION CURVES



FILAMENT PAIR	A-B′ OR A-B
ANODE	C
ANODE RETURN	B OR B′
50 OHM COAX	B, B′-C

OUTLINE DRAWING

6356
Bendix Type TD-10

GAS NOISE SOURCE



RATINGS

Filament Voltage	12 Volts
Anode Current	250 Ma D.C.
Filament Current	170 Ma D.C.
Tube Dissipation	20 Watts
Tube Voltage Drop	80 Volts
Ambient Temp. Range	−40°F to +165°F

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-49/U and RG-50/U waveguides to provide noise in the 3.7 - 7.6 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performnce of the tube is non-critical with respect to variations in the discharge current.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.07 with a maximum of about 1.13. The noise temperature is 16 $\pm$ 1 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

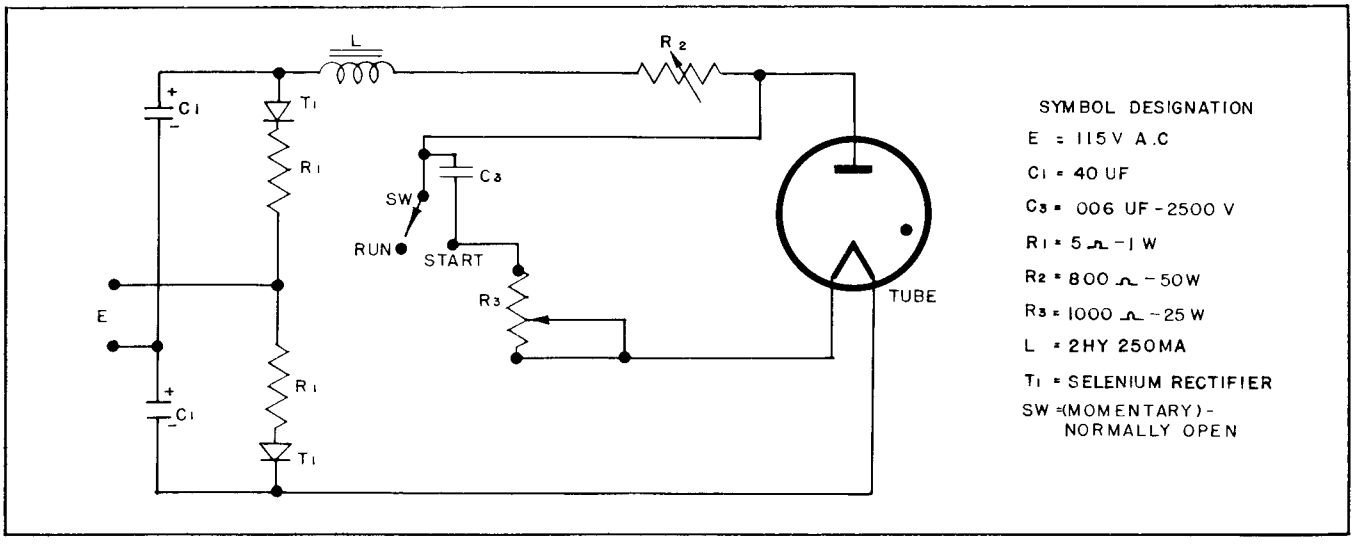
Publication No. R610-31 (supersedes R51-13)

Printed in U.S.A.

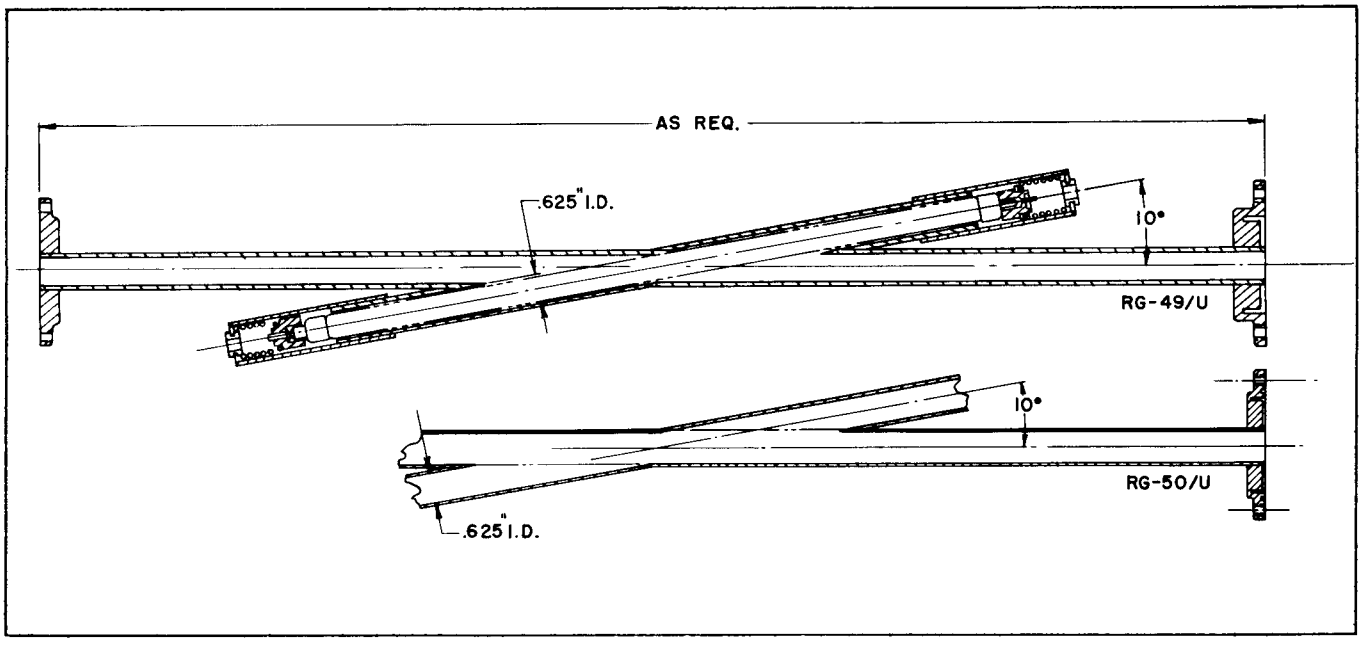
GAS NOISE SOURCE

6356

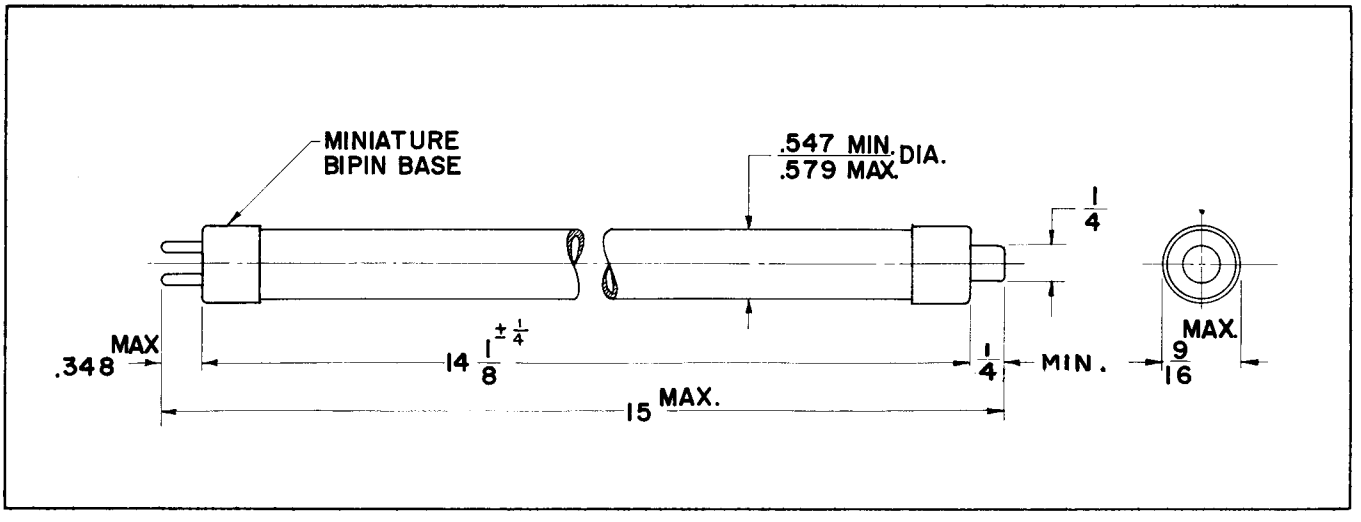
Bendix Type TD-10



TYPICAL STARTING AND OPERATING CIRCUIT



WAVEGUIDE MOUNT ASSEMBLIES RG-49/U & RG-50/U



OUTLINE DRAWING

Bendix 6357 Type TD-11

GAS NOISE SOURCE



RATINGS

Filament Voltage	12 Volts
Anode Current	200 Ma D.C.
Filament Current	170 Ma D.C.
Tube Dissipation	17 Watts
Tube Voltage Drop	85 Volts
Ambient Temp. Range	−40°F to +165°F

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-52/U waveguide to provide noise in the 2.4 - 3.6 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recomended transmission bandwidth of the guide.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.07 with a maximum of about 1.13. The noise temperature is 16 ± 1 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

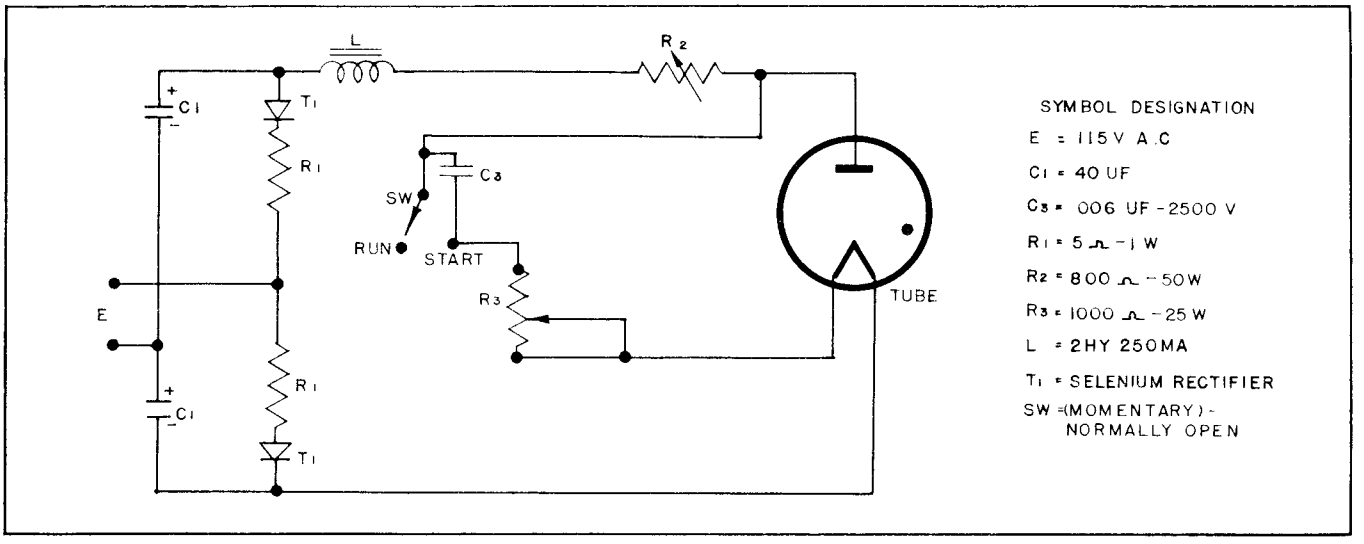
Publication No. R611-1 (supersedes R51-14)

Printed in U.S.A.

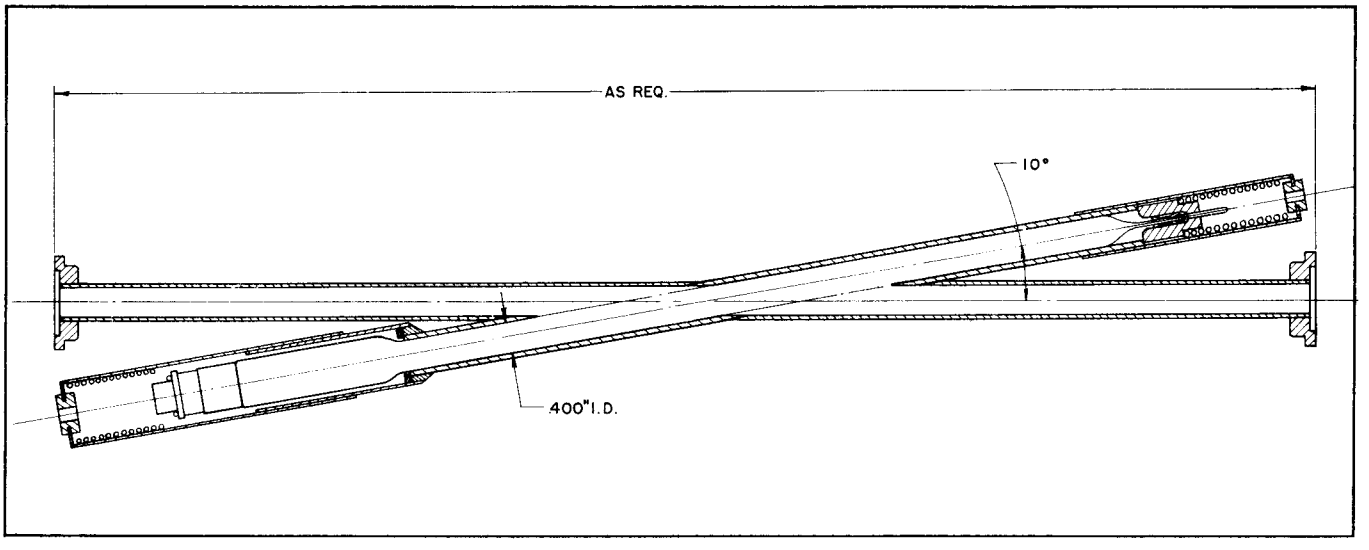
GAS NOISE SOURCE

6357

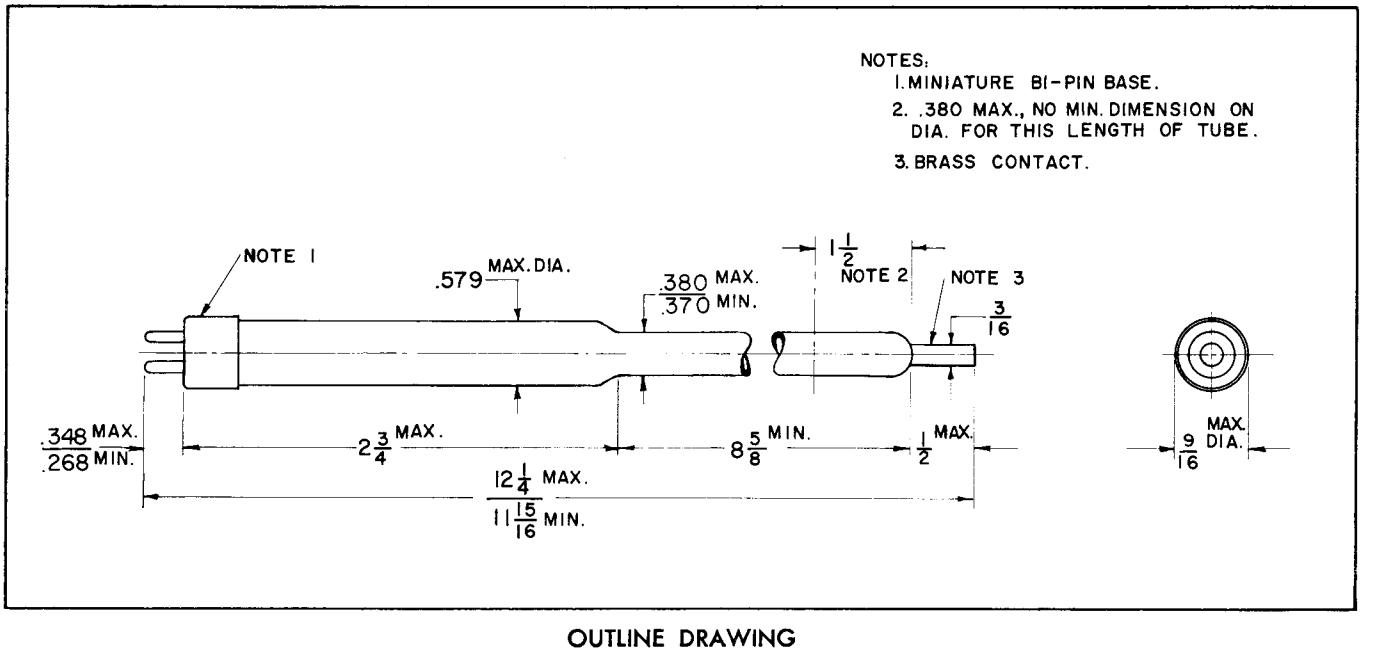
Bendix Type TD-11



TYPICAL STARTING AND OPERATING CIRCUIT



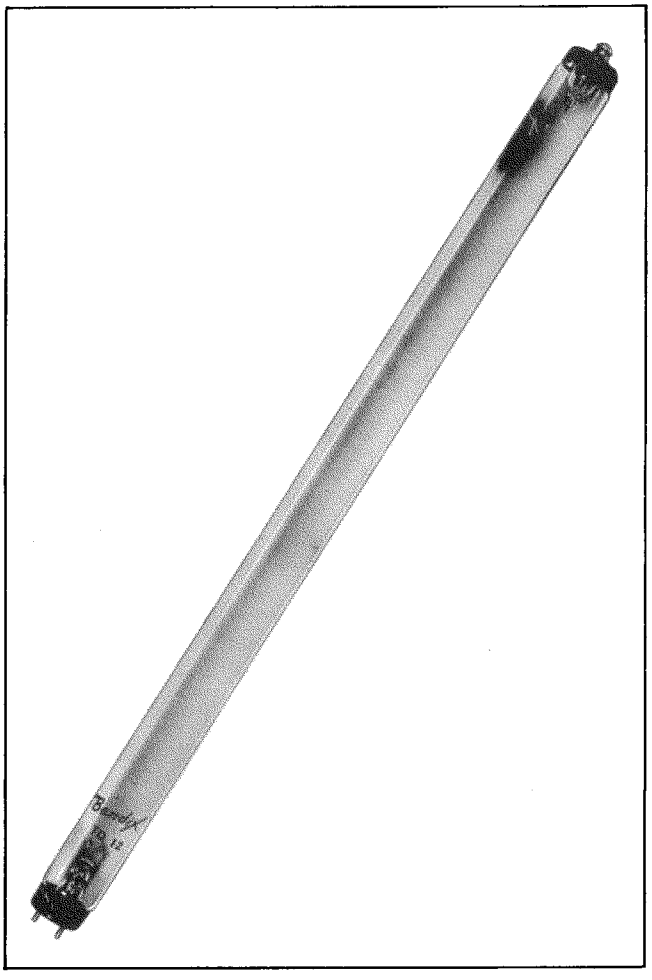
WAVEGUIDE MOUNT ASSEMBLY RG-52/U



OUTLINE DRAWING

6358
Bendix Type TD-12

GAS NOISE SOURCE



RATINGS

Filament Voltage	10 Volts
Anode Current	250 Ma D.C.
Filament Current	300 Ma D.C.
Tube Dissipation	22 Watts
Tube Voltage Drop	90 Volts
Ambient Temp. Range	−40°F to +165°F

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-48/U waveguide to provide noise in the 7.6 - 11.5 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.07 with a maximum of about 1.13. The noise temperature is 15.25 $\pm$ 0.2 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

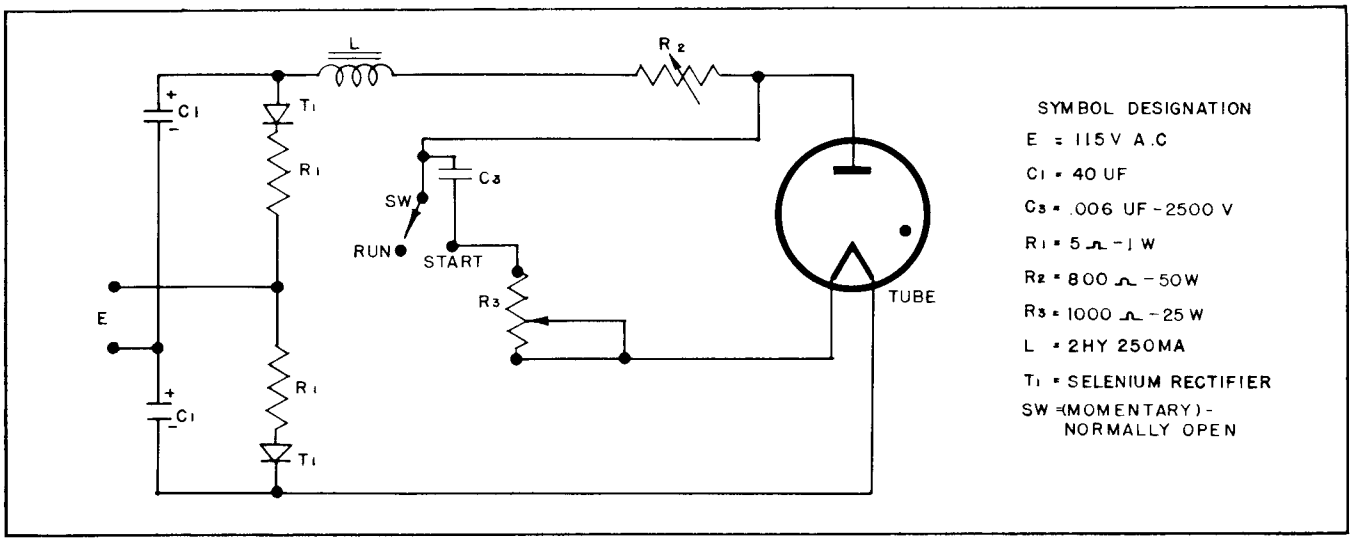
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R611-2 (supersedes R51-15)

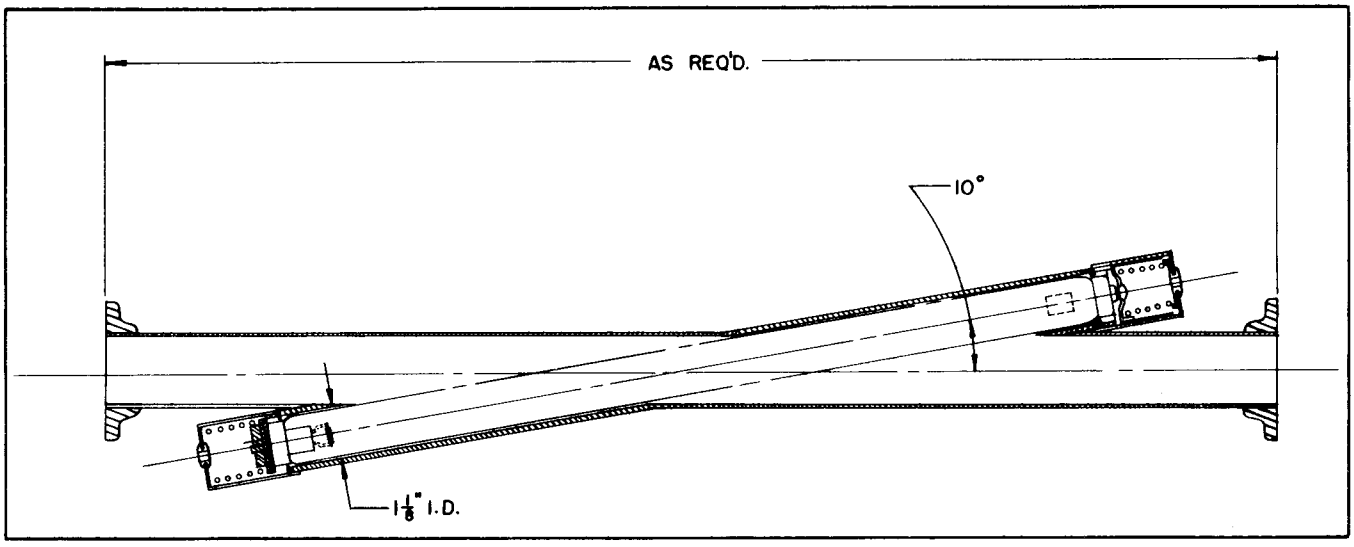
Printed in U.S.A.

GAS NOISE SOURCE

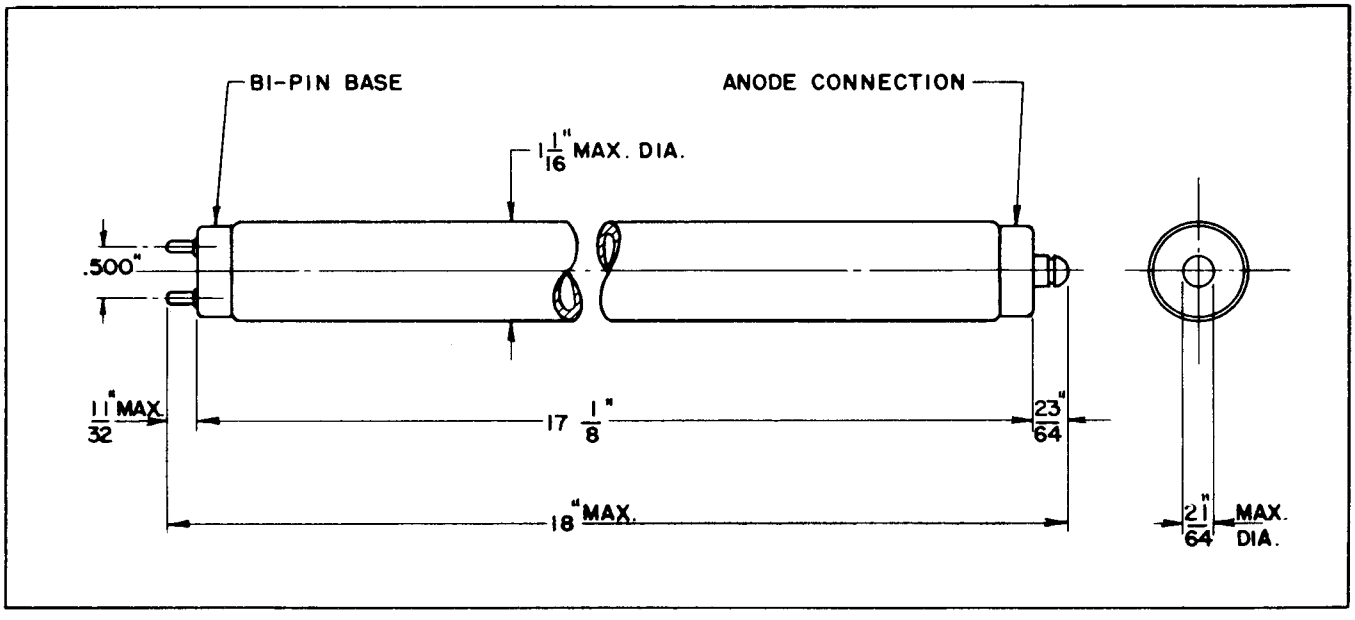
6358
Bendix Type TD-12



TYPICAL STARTING AND OPERATING CIRCUIT



WAVEGUIDE MOUNT ASSEMBLY RG-48/U



OUTLINE DRAWING

6359
Bendix Type TD-13

GAS NOISE SOURCE



RATINGS

Filament Voltage	12 Volts
Anode Current	200 Ma D.C.
Filament Current	170 Ma D.C.
Tube Dissipation	13 Watts
Tube Voltage Drop	65 Volts
Ambient Temp. Range	−40°F to +165°F

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-53/U waveguide to provide noise in the 1.2 - 1.5 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide.

To secure good transmission performance at the frequencies involved, this tube is fabricated from low loss 707 glass.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.07 with a maximum of about 1.13. The noise temperature is 16 $\pm$ 1 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

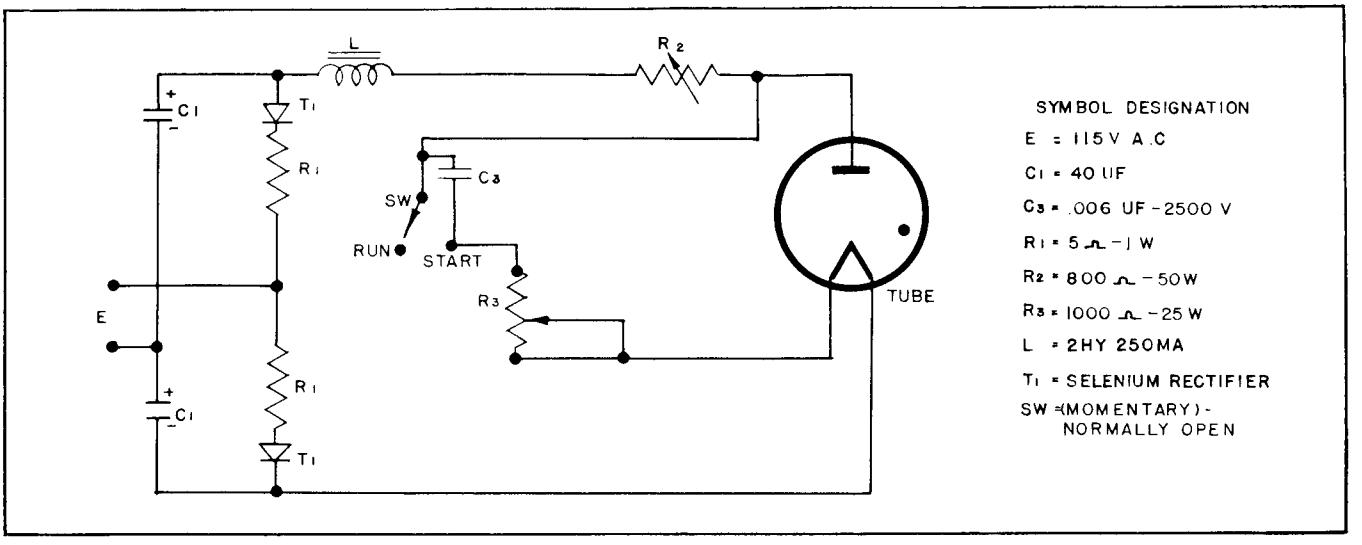
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R611-3 (supersedes R51-16)

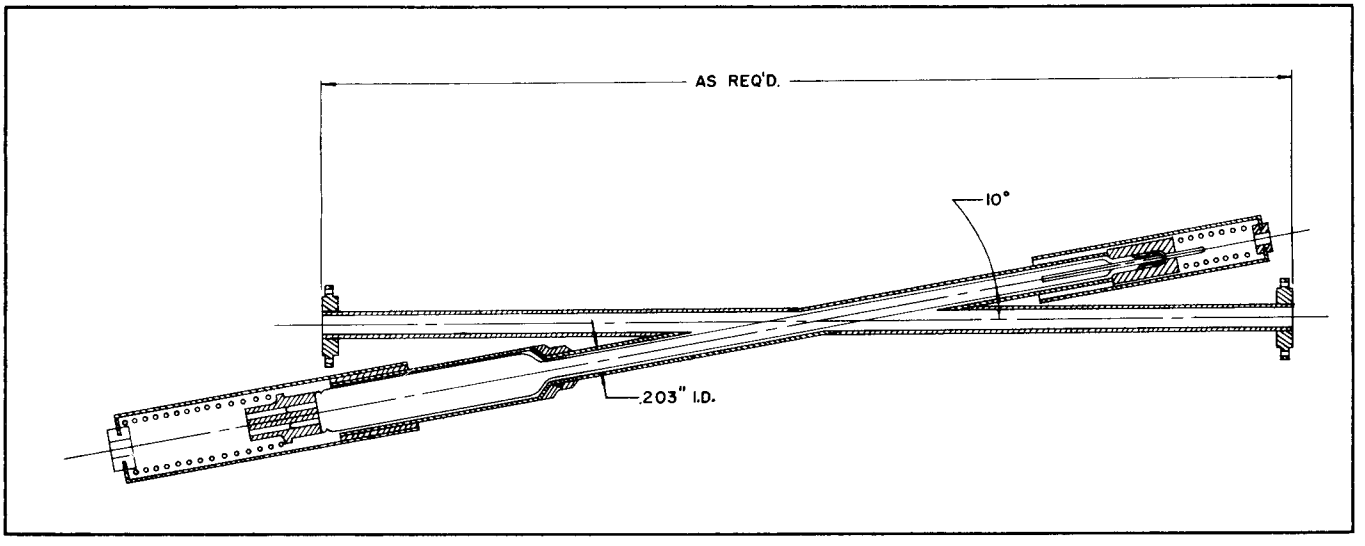
Printed in U.S.A.

GAS NOISE SOURCE

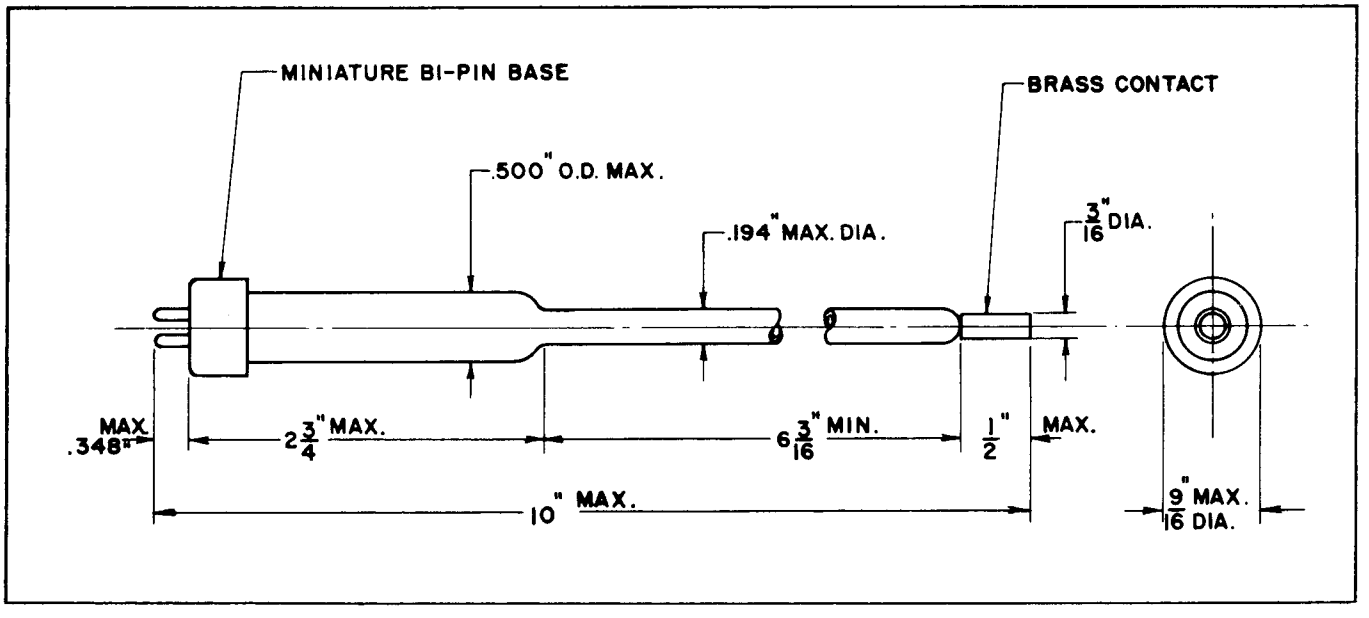
6359
Bendix Type TD-13



TYPICAL STARTING AND OPERATING CIRCUIT



WAVEGUIDE MOUNT ASSEMBLY RG-53/U



OUTLINE DRAWING

6361
Bendix Type TT-25

SINGLE CONVECTRON



RATINGS (2 UNITS AT 90°)

Supply Voltage	8 volts
Sensitivity	10 Mv./Deg.
Null—A.C. supply	0.75 Mv. Max.
Time Constant	0.1 sec.

PHYSICAL CHARACTERISTICS

Connections	Small Cap RTMA C1-1
Overall length	3⅛" Nom.
Max. diameter, less tip	¾"

DESCRIPTION

The introduction of ihe Type-TT-25 Single Convectron Unit marks an important advance in the technique of determining and correcting deviations from a vertical reference position wholly by electronic means. This tube consists of a fine wire sensing element supported in a gaseous atmosphere within a glass envelope. Connections to the sensing element are made to external metal caps at both ends of the tube.

Two Type TT-25 tubes are required for the installation. These are mounted so that their axes form an angle of 90 degrees and they are connected electrically to form a bridge circuit as illustrated in the drawing on the reverse side of this sheet.

The filaments carry sufficient current to heat them to an average temperature of about 400° C. The heat leaves the filaments by (1) metal conduction (2) gas conduction (3) radiation and (4) gas convection. The percentage of heat leaving by the first three means is comparatively small, while that leaving by convection is large. Gas convection currents rise along the vertical and so pass the filament at whatever angle it happens to be relative to the vertical.

The relative rate at which each filament loses its heat to these convection currents and, consequently, the filament temperature, depends on this angle. Since the filament material is nickel which changes its electrical resistivity with temperature, the bridge is thrown out of balance as the tubes are moved from the vertical reference.

The vertical or null position is any position where the two sensing elements form equal angles with the vertical and produce electrical zero. This permits using the tubes to control servo mechanisms or instruments because the signal has sense as to whether the displacement is to the right or to the left of null.

With the axes of the tubes set at an angle of 90 degrees, a plot of the output voltage against angular deflection will approximate a sine wave. An increase in sensitivity can be obtained for the indication of small angles by decreasing the angle between the tubes to approximately 60 degrees.

A deviation in the indication from the true vertical may occur if the tube is accelerated or subjected to a magnetic field. The effect of the magnetic field may be reduced by magnetic shielding. Sometimes a slight shift in the null position occurs in the earlier convectron type. This shift in null position is minimized when a pair of TT-25 units are used. Hysteresis effect is also decreased by the use of TT-25 tubes.

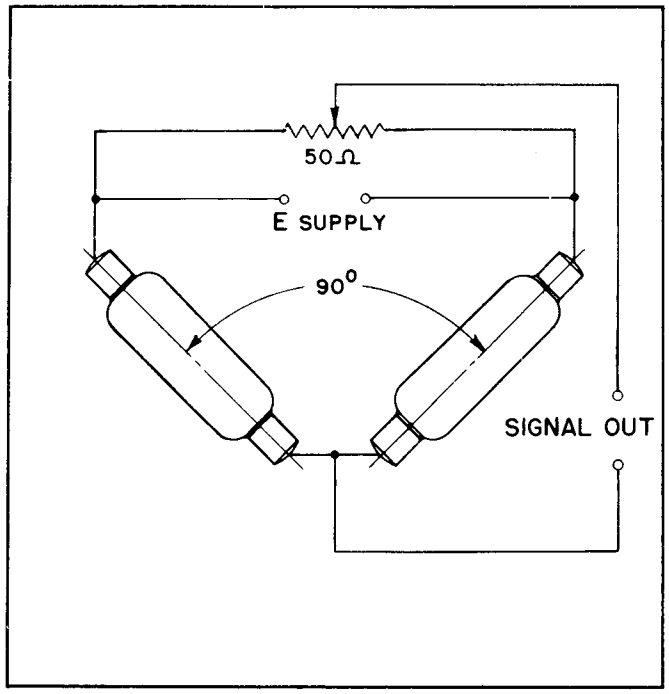
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R33-13

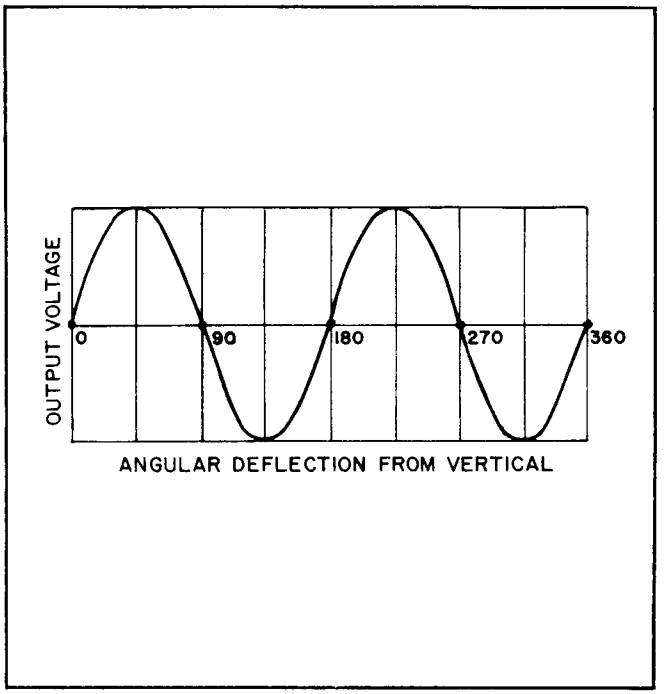
Printed in U.S.A.

SINGLE CONVECTRON

6361
Bendix Type TT-25

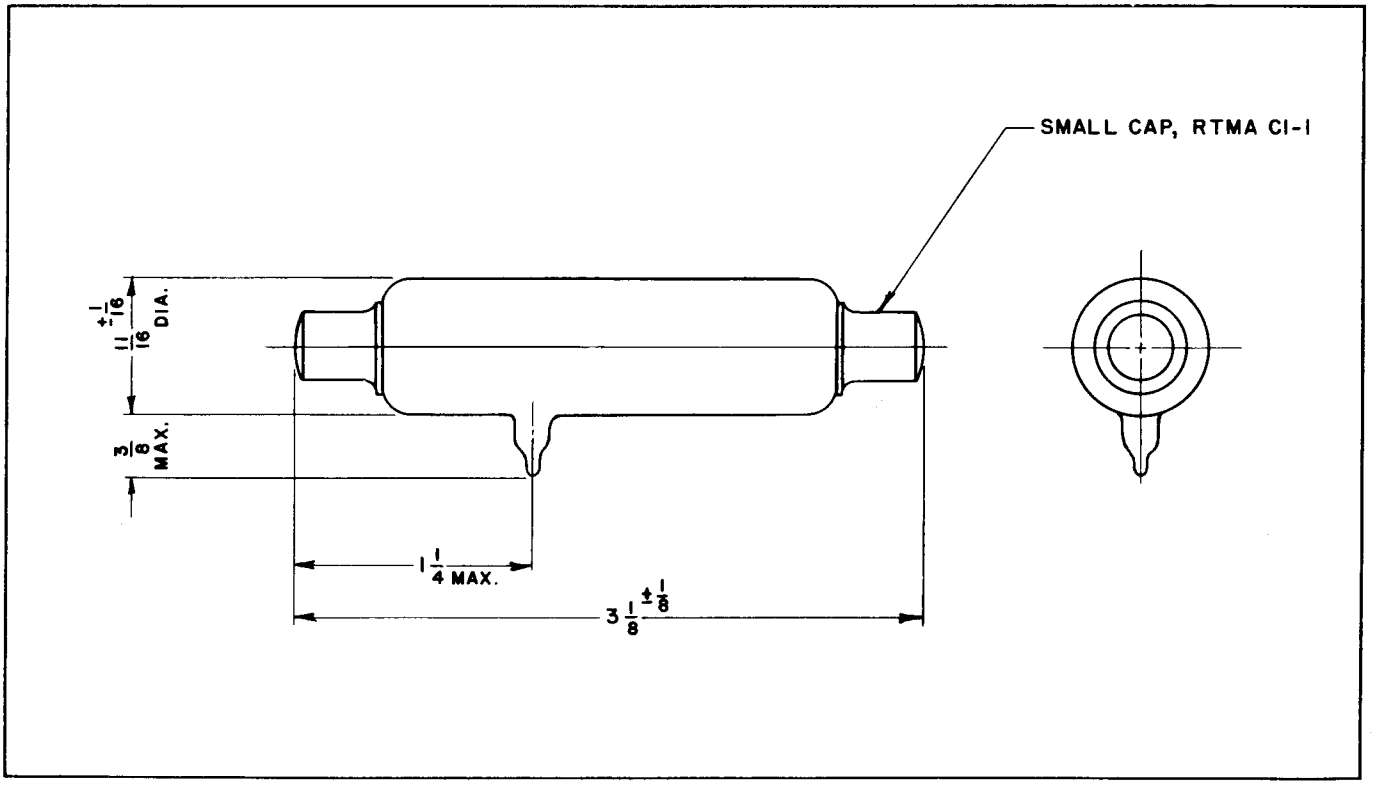


TUBES ELECTRICALLY CONNECTED
TO FORM TYPICAL BRIDGE CIRCUIT



CONVECTRON BRIDGE OUTPUT SIGNAL

Note: With a pair of tubes set at a 90° angle to each other, a plot of the output voltage against angular deflection will approximate a sine wave.
An increase in sensitivity can be obtained for the indication of small angles by decreasing the angle between tubes to 60°.



OUTLINE DRAWING

6384

Bendix Type TE-27
(Generic Type 6AR6-6098)

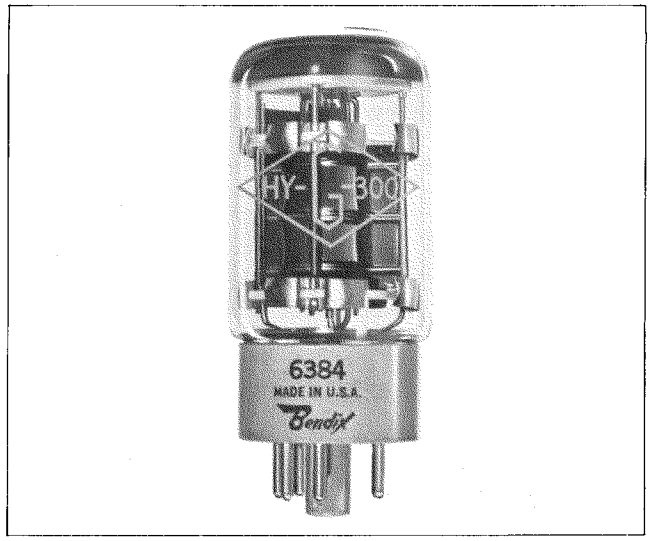
RELIABLE HARD GLASS BEAM POWER AMPLIFIER

DESCRIPTION

One of the Bendix line of HY-G-300 tubes, this high-perveance beam power amplifier has been designed as a direct retrofit for the 6AR6 or 6098 in aircraft, military and industrial applications where freedom from early failures, long average service life and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under overload, vibration and shock conditions. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under operating conditions.

Since this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration and shock are encountered, special materials and techniques are employed. The hard glass bulb and tungsten stem seal construction are features similar to those found on many high-powered transmitting tubes. Careful exhaust to a high degree of vacuum, with thorough outgassing of all elements by means of electron bombardment, as well as the usual RF induction heating, insures maximum life expectancy. These factors, as well as a conservative design center of cathode temperature, permit operation of the 6384 at bulb temperatures up to 300°C as compared to the 225°C rating of the 6AR6. Moreover, because of the lower expansion (about ⅓ that of conventional receiving tube "soft glass"), greater resistance to thermal shock is attained.

This tube is constructed with ceramic spacers rather than the usual mica. Therefore, one of the most prevalent causes of tube failure is eliminated, namely, gas evolution under vibration (from deteriorated mica) and subsequent loss of cathode emission. In addition, ceramic spacers contribute to a much sturdier structure, which is further strengthened by multi-pillar supports locked together with 18 welded eyelets. Bulb snubbers are made with an alloy which retains its spring properties at the high



temperatures under which this tube can operate. These snubbers contact the bulb at 32 separate points and thus effectively cushion the mount structure from shock accelerations as high as 500G.

Other special features include a rugged, pure tungsten, helical heater which is used with a high purity aluminum oxide insulator, enabling reliable operation at high heater-cathode voltages. Also featured is a ceramic shield which prevents getter flash from forming inter-electrode leakage paths. In addition, the ceramic spacers have slots between cathode and grid holes to prevent the development of any leakage during the service life of the tube.

The design of this tube is a result of extensive engineering evaluation on special impact vibration equipment in which the accelerations equal or exceed those encountered in severe aircraft applications. The shake table used for these studies shock excites the tubes at a repetition rate of 15 cycles per second with a minimum peak acceleration of 50G. These tests indicate that the Bendix 6384 will survive thousands of hours longer, under adverse conditions, than the prototype 6AR6 and 6098 tubes.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)**	6.3 volts
Heater Current	1.20 amps
Plate Voltage (Max DC)	750 volts
Screen Voltage (Max DC)	325 volts
Peak Plate Voltage (Max Instantaneous)	1500 volts
Plate Dissipation (Absolute Max)	30 watts
Screen Dissipation (Absolute Max)	3.5 watts
Cathode Current (Max DC Value)	125 mA
Cathode Current (Max Inst. peak value—of continuous sine wave)	250 mA
Cathode Current (Max Inst. Peak Value) Pulse***	1000 mA
Heater-Cathode Voltage (Max)	±450 volts
Grid Resistance (Max)	0.1 megohm
Grid Voltage (Max DC)	+5.0 volts
(Min DC)	−200 volts
Cathode Warm-up Time	45 seconds

(plate and heater voltage may be applied simultaneously)

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously. See application notes.

**Voltage should not fluctuate more than ±5%.

***See pulse rating chart.

CHART 2. MECHANICAL DATA

Base	Intermediate (short) Shell Octal (6-pin) (Glass filled Mica)
Bulb	Nonex Glass—T-11
Max Overall Length	3-15/32"
Max Seated Height	2-15/16"
Max Diameter	1-7/16"
Mounting Position	Any
Max Altitude****	80,000 feet
Max Bulb Temperature	300°C
Max Impact Shock	500G
Max Vibrational Acceleration (100-hour shock excited fatigue test, sample basis)	50G
Life Expectancy	10,000 hours

****See altitude chart on page 3.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R610-27 (Supersedes No. R61-4)

Printed in U.S.A.

BEAM POWER AMPLIFIER

HY-G-300

6384

Bendix Type TE-27

(Generic Type 6AR6-6098)

ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 3.

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps Prior to 100% Testing.

CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX	UNITS
PRODUCTION TESTS:					
Short and Continuity					
Heater Current	If	1.14	1.20	1.26	A
Heater Cathode Leakage (Ehk = ± 450 Vdc)	Ihk	—	—	10	μAdc
Grid Current	Ic1	—	—	−0.2	μAdc
Plate Current	Ib	66	77	88	mAdc
Screen Grid Current	Ic2	0.5	3.5	6.5	mAdc
Transconductance (1)	Sm	4800	5400	6000	μmhos
Cut off Plate Current (Ec1 = −60 Vdc)	Ib			0.5	mAdc
DESIGN TESTS					
Transconductance (2) (Ef = 5.7 V)	△Sm	—	—	5%	
Accelerated Grid Current (Ef = 7.0 V)	Ic1			−0.3	μAdc
Primary Screen Grid Emission (Eg2 = 150 Vac)	Ic2			−750	μAdc

ELECTRODE:	Ef	Eb	Ec2	Ec1	Ehk
TEST CONDITIONS:	6.3 volts	250 Vdc	250 Vdc	−22.5 Vdc	0 Vdc

CHART 4.

ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min Off 4 Min Ef = 7.0 Ehk = 300	2,000 On-Off Cycles
High Temp Life Test	Under "Test Conditions" at 30 W Plate Dis. Bulb Temp. 300°C	1,000 Hours
Pulse Life Test	ib = 1.0 A	500 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 15 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	
Swept Freq Fatigue	5G—F = 16—512 CPS	96 Hours

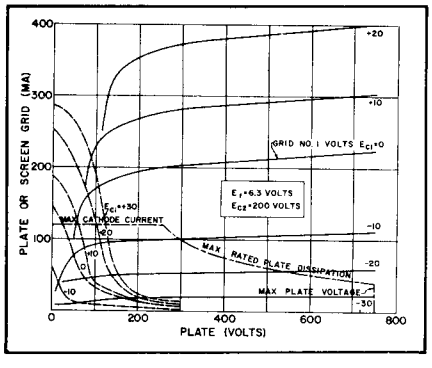


CHART 5.

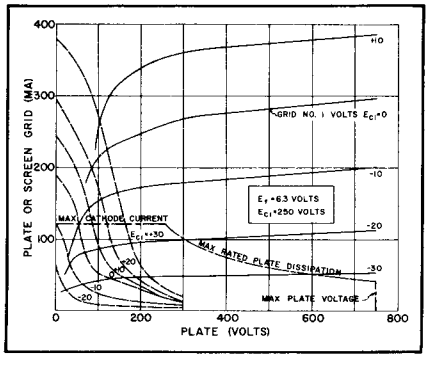


CHART 6.

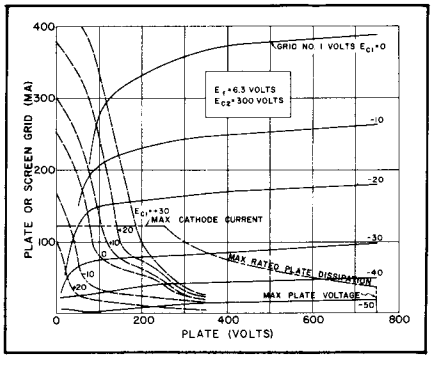


CHART 7.

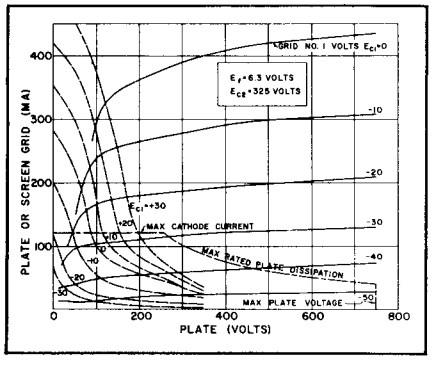


CHART 8.

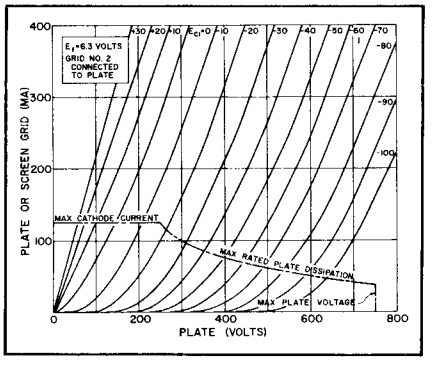


CHART 9.

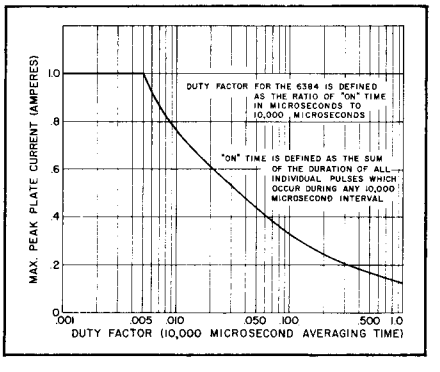


CHART 10.

BEAM POWER AMPLIFIER

HY-G-300

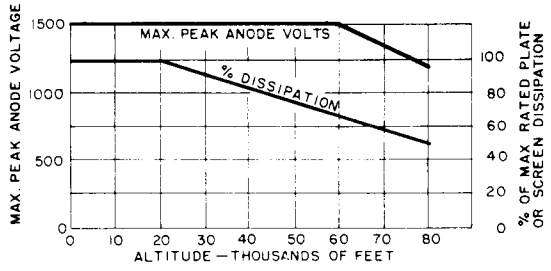
6384

Bendix Type TE-27

(Generic Type 6AR6-6098)

CHART 11.

ALTITUDE RATINGS



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF DISSIPATION DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATING FOLLOWS:

1. VOLTAGE DERATING—TO KEEP BELOW BASE PIN ARC OVER POINT.
2. DISSIPATION DERATING—TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

CHART 12.

EFFECT ON LIFE OF INCREASED RATINGS

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3V ± 2%	6.3V ± 5%	6.3V ± 10%
Plate Voltage	300 Vdc	500 Vdc	750 Vdc
Screen Voltage	200 Vdc	275 Vdc	375 Vdc
Peak Plate Voltage	600 V	1000 V	1500 V
Plate Current (Av.)	70 mA	50 mA	40 mA
Screen Current (Av.)	3 mA	4 mA	6 mA
Power Dissipation	21 W	25 W	30 W
H-K Voltage	200 V	300 V	450 V
Grid Resistance	25,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	200°C	250°C	300°C
Altitude	0-20,000′	60,000′	80,000′
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

APPLICATION NOTES

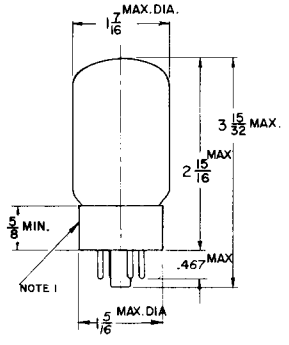
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced 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.

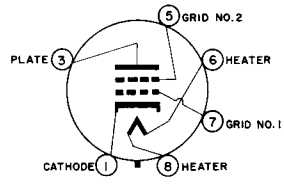
This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment. The altitude rating chart shows the correct voltage derating necessary for various altitudes. However, the dissipation derating is only approximate and must be measured for each application because of the additive effects mentioned above.

When used with A.C. on plate and screen with an inductive load such as in servo discriminator circuits, sufficient unshunted resistance in series with the screen should be used to avoid damage to the tube during that portion of the cycle when the plate may be negative with respect to the screen.

The plate voltage rating and high-perveance of the 6384 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak plate current should not exceed the value shown in Chart 10 for the required duty factor.

Chart 12 is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.





BASE DIAGRAM
(BOTTOM VIEW)

NOTES:

1. SHORT INTERMEDIATE SHELL OCTAL 6-PIN BASE.
2. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
3. NUMERALS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON TUBE BASE.

OUTLINE DRAWING

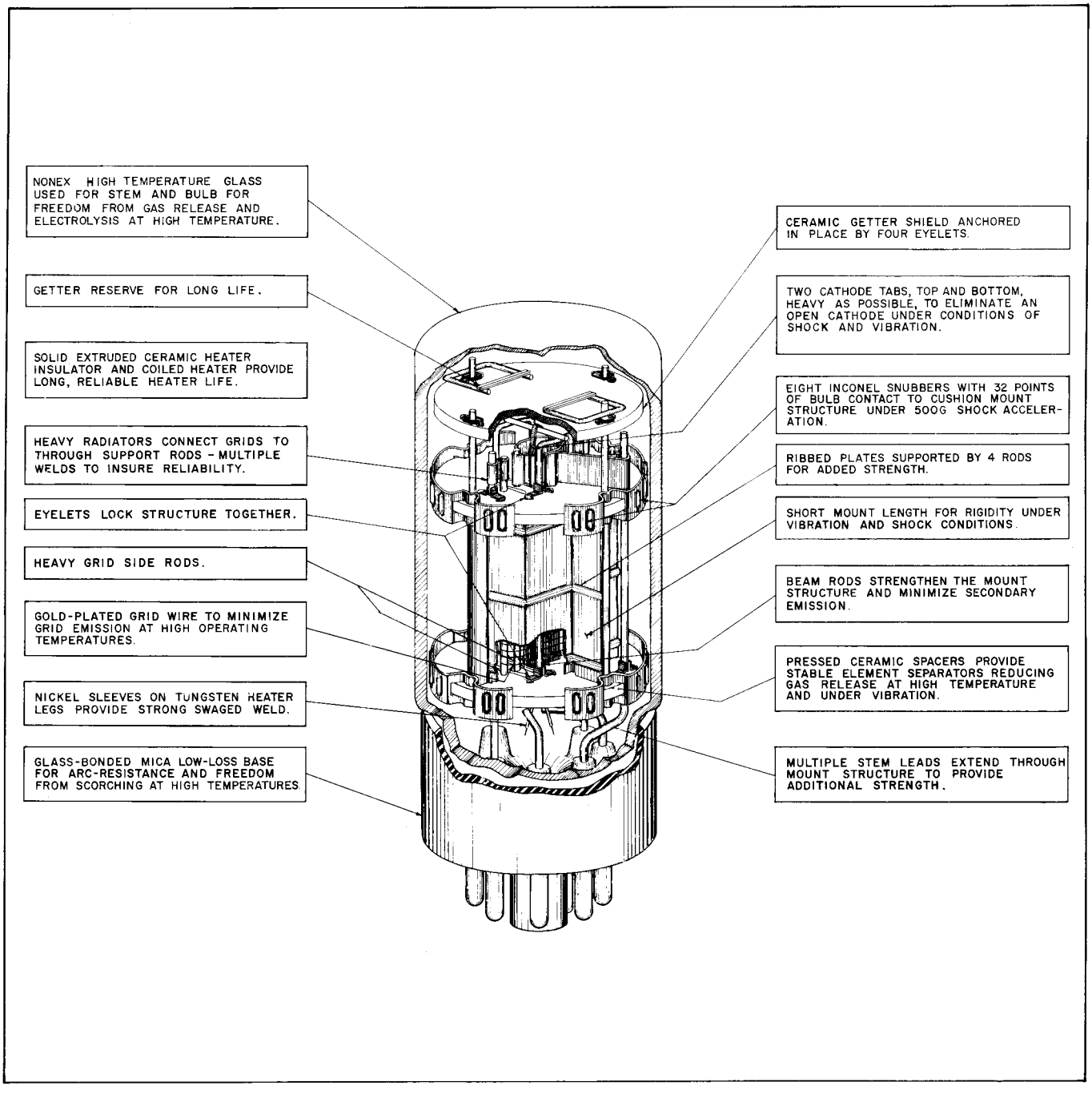
BEAM POWER AMPLIFIER

HY-G-300

6384

Bendix Type TE-27

(Generic Type 6AR6-6098)



STRUCTURAL FEATURES OF 6384 PROVIDE HIGH RELIABILITY AND LONG LIFE

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

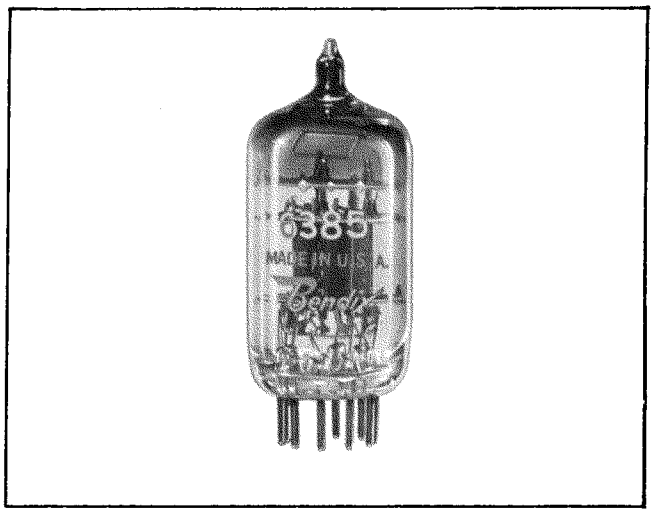
West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.

Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.

Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6385
Bendix Type TE-21
(Generic Type 5670)

RELIABLE MINIATURE DOUBLE TRIODE



RATINGS*

Heater voltage—(AC or DC)**	6.3 volts
Heater current	0.50 amps
Plate voltage—(max.)	300 volts
Max. peak plate current (per plate)	25 mA
Max. plate dissipation (per plate)	1.5 watts
Max. peak grid voltage	+0 volts —100 volts
Max. heater-cathode voltage	300 volts
Max. grid resistance	1.0 megohm
Warm-up time	25 sec.
Life expectancy***	10,000 hrs.

(Plate and heater voltage may be applied simultaneously)

*To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ± 5%.

***See application notes.

PHYSICAL CHARACTERISTICS

Base	Miniature button 9-pin
Bulb	T-6½
Max. overall length	2 3/16 in.
Max. seated height	1 15/16 in.
Max. diameter	⅞ in.
Mounting position	Any
Max. bulb temp.	160°C
Max. altitude****	80,000 ft.

****See Altitude Rating Chart on page 3.

DESCRIPTION

This miniature nine-pin double triode is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft and industrial applications where freedom from early failure, long average service life, and uniform operating characteristics are extremely important. It is intended to replace the 2C51 or the 5670 in applications where reliability is the primary consideration. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

The use of a coil type heater inside an extruded alumina insulator gives a long life heater structure which stands up well under high heater to cathode voltage. The mount structure is so designed that the tube is capable of withstanding severe shock and vibration.

The tube is intended for use as an amplifier—to increase or control alternating voltages or power; as a mixer—to change electrical energy at one frequency to electrical energy at another frequency; or as an oscillator—to generate an alternating voltage. It can also be used in control equipment as part of a multivibrator or clamp circuit. When used as an oscillator, the upper limit of its frequency range is approximately 500 Mc.

This tube has been designed to minimize noise and microphonic effects.

AVERAGE ELECTRICAL CHARACTERISTICS

Heater voltage, E_f	6.3 volts
Heater current, I_f	0.50 amps.
Plate voltage, E_b	150 volts
Grid voltage, E_c	—2.0 volts
Plate current, I_b	8.0 mA
Mutual conductance, g_m	5000 μmhos
Amplification factor, μ	35
Cut-off voltage	—10 volts
Direct interelectrode capacitances (no shield)	
Plate-grid (per section)	1.7 μμf
Plate-cathode (per section)	1.1 μμf
Grid-cathode (per section)	2.4 μμf
Plate-plate	0.1 μμf

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 610-28 (Supersedes No. R 51-9)

Printed in U.S.A.

DOUBLE TRIODE

6385
Bendix Type TE-21
(Generic Type 5670)

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G. Vibration at 30 cps Prior to 100% Testing

CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX.	UNITS
PRODUCTION ON TESTS					
Heater Current	If	460	500	540	mA
Heater-Cathode Leakage	Ihk	—	—	±10	μAdc
Grid Current	Ic	—	—	—0.3	μAdc
Plate Current	Ib	5.5	8.0	11.5	mAdc
Transconductance	Sm	4000	5000	6500	μmhos
Trans. Ef = 5.7 v.	Sm	—	—	15%	
Cut Off Plate Current (Ecl = — 10 v. D.C.)	Ib	—	—	45	uAdc
DESIGN TESTS					
Short and Continuity					
Noise and Microphonics Ehk = 0 Ebb = 250 Ecl = 0 Ecal = 200 mVac Rp = 10,000 V	Ep			200	mVac
R. F. Noise				3.0	mWac
Electrode Insulation Eg-all = — 100 V Ep-all = — 300 V		500	—	—	Meg
Vibration 30 cps 2.5 g. Ecl = — 3 v. D.C. Rp = 2000 ohms Eb = 150 v. D.C.	Ep	—	—	100	mVac
Grid Emission Test Ef = 7.0 v.	Ic			—0.5	μAdc
Time = 5 minutes @ Ef = 7.5 V.	Cgp	1.4	1.7	2.0	μμfds
Capacitance	Cin	1.9	2.4	2.9	μμfds
	Cout	0.8	1.1	1.4	μμfds
	Cpp	—	—	0.15	μμfds

ELECTRODE:	Ef	Eb	Ec	Ehk
TEST CONDITIONS:	6.3 Volts	150 Vdc	—2.0 Vdc	±250 Vdc

SPECIAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 2½ Min. Off 2½ Min. Ef = 7.5 Ehk = 250	3,000 On-Off Cycles
Life Test	Under "Test Conditions"	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 18/sec. rep. rate	100 Hours
Shock	500 g.	20 Impacts
Altitude Test	60,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	15 Seconds in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	

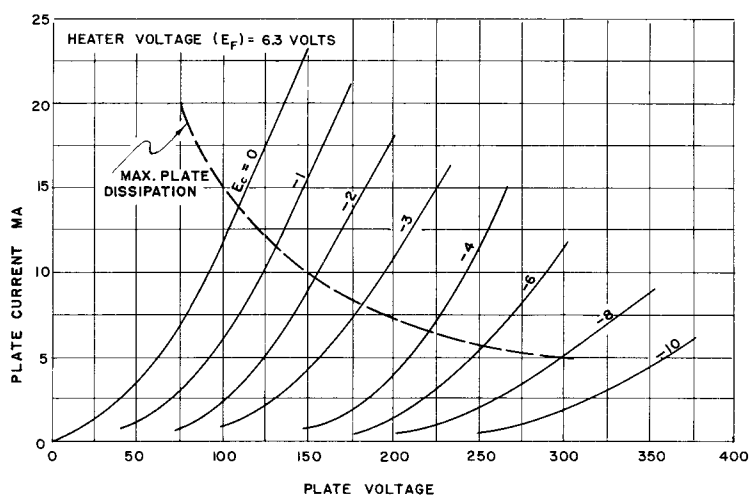
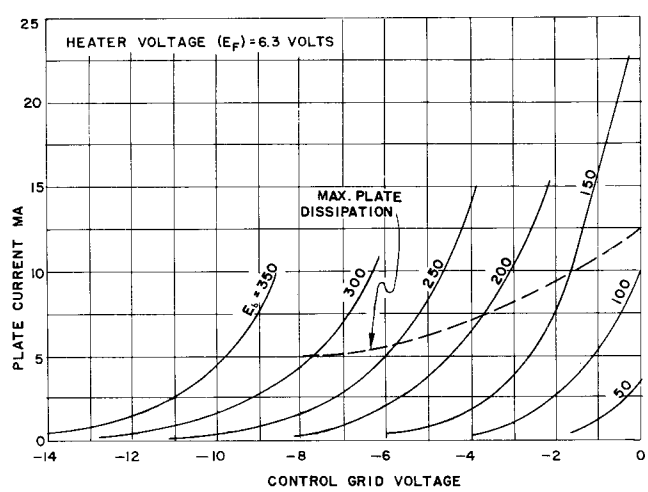


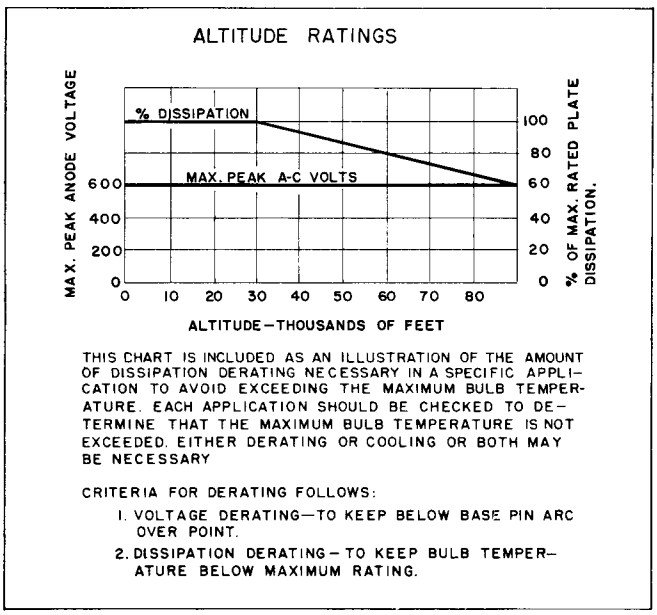
PLATE CHARACTERISTICS



TRANSFER CHARACTERISTICS

DOUBLE TRIODE

Bendix Type TE-21 **6385**
(Generic Type 5670)



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF DISSIPATION DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY

CRITERIA FOR DERATING FOLLOWS:

1. VOLTAGE DERATING—TO KEEP BELOW BASE PIN ARC OVER POINT.
2. DISSIPATION DERATING—TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

EFFECT ON LIFE OF INCREASED RATINGS

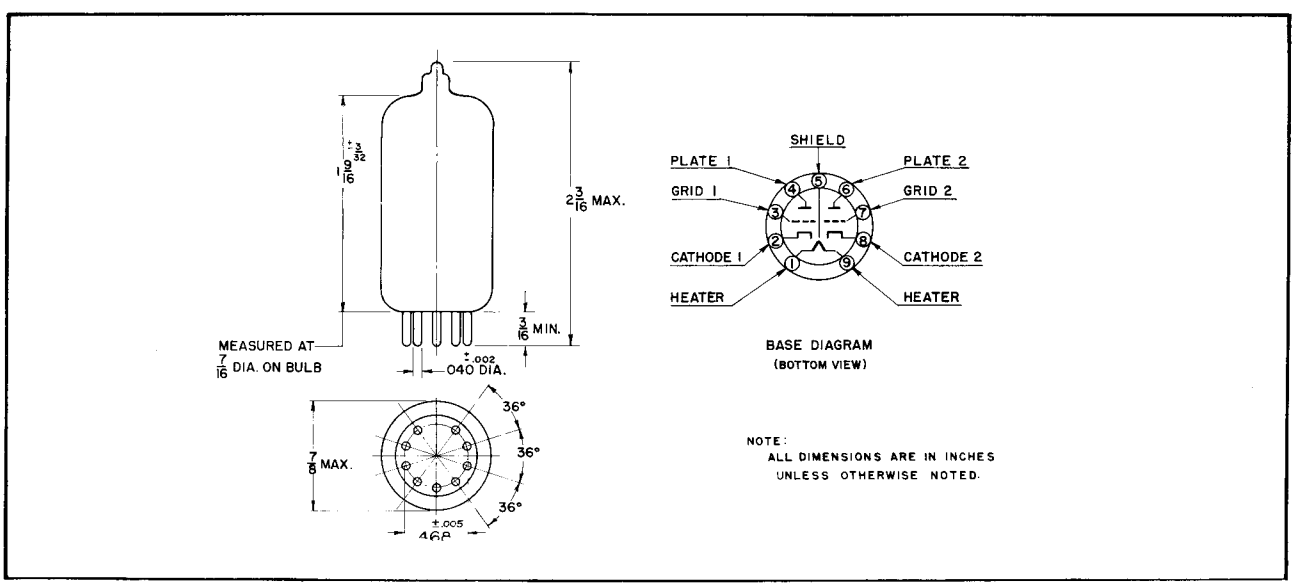
See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 ± 2%	6.3 ± 5%	6.3 ± 10%
Plate Voltage	130 Vdc	150 Vdc	180 Vdc
Peak Plate Voltage	200 V	250 V	300 V
Plate Current (Av.)	6 mA	7 mA	8 mA
Cathode Current (Peak)	15 mA	20 mA	25 mA
H-K Voltage	200 V	250 V	300 V
Grid Resistance	250,000 ohms	750,000 ohms	1,000,000 ohms
Bulb Temperature	120°C	140°C	160°C
Altitude	0-20,000 ft	60,000 ft	80,000 ft
Vibration	1 G	2½ G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

APPLICATION NOTES

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 will 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.

The altitude rating chart shows the correct voltage derating necessary for various altitudes. However, the dissipation derating is only approximate and must be measured for each application because of the additive effects mentioned above.

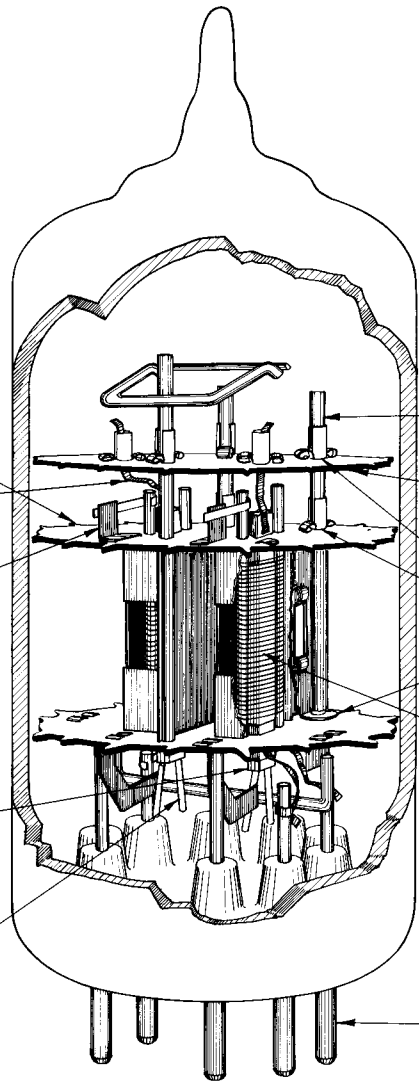
The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on the life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.



OUTLINE DRAWING

DOUBLE TRIODE

6385
Bendix Type TE-21
(Generic Type 5670)



MULTI-POINT MICA SPACERS FOR INCREASED VIBRATION RESISTANCE

EXTRA CATHODE TABS TO DAMPEN CATHODE VIBRATION

GRID ANCHORS REDUCE MICROPHONISM

SOLID EXTRUDED CERAMIC HEATER INSULATORS AND COILED HEATERS PROVIDE RELIABLE LONG LIFE HEATER AND IMPROVED HEATER–CATHODE INSULATION

NICKEL SLEEVES ON TUNGSTEN HEATER LEGS PROVIDE STRONG SWAGED WELD

THREE SIDE RODS FOR INCREASED RIGIDITY OF MOUNT STUCTURE

GETTER SHIELD TO MINIMIZE INTERELECTRODE LEAKAGE

EYELETS LOCK STRUCTURE TOGETHER

LARGER CATHODE AREA AND INCREASED ELECTRODE SPACINGS

BUTTON STEM — STRENGTH IN ALL PLANES

STRUCTURAL FEATURES OF 6385 PROVIDE HIGH RELIABILITY AND LONG LIFE.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

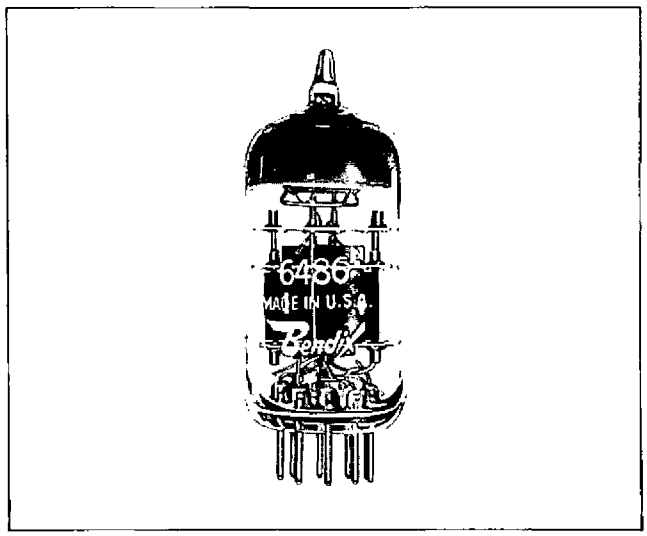
West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6486

Bendix Red Bank Type TE-11

from JETEC release #1626, April 9, 1956

RELIABLE MINIATURE DUAL CONTROL PENTODE



DESCRIPTION

This miniature nine-pin dual control sharp cut-off, R.F. pentode is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft and industrial applications where freedom from early failure, long average service life and uniform operating characteristics are extremely important. It is intended to replace the 6AS6 in applications where reliability is the primary consideration. Each tube is given a 45-hour run-in under various overload, vibration and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

The use of a coil type heater inside an extruded alumina insulator gives a long life heater structure which stands up well under high heater to cathode voltage. The mount structure is so designed that the tube is capable of withstanding severe shock and vibration.

The control grid (Grid #1) and the suppressor grid (Grid #3) may be used as independent control electrodes for such circuits as mixers, gated amplifiers, delay circuits and gain controlled amplifiers.

CHART 1. DESIGN CENTER MAXIMUM RATINGS*

Heater Voltage (ac or dc)**	6.3 volts
Plate Voltage	180 volts
Grid #2 Voltage	140 volts
Grid #3 Voltage	30 volts
Plate Dissipation	2.0 watts
Grid #2 Dissipation	0.75 watt
Cathode Current	18 mA
Heater-Cathode Voltage	300 volts
Cathode Warm-up Time	25 seconds
Bulb Temperature (at hottest point on bulb surface)	160°C

* To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously. See application notes.

** Voltage should not fluctuate more than ±5%.

CHART 2.

PHYSICAL CHARACTERISTICS

Base	Miniature button 9-pin
Bulb	T-6½
Max. overall length	2 3/16 in.
Max. seated height	1 15/16 in.
Max. diameter	⅞ in.
Mounting position	Any
Max. bulb temp.	160°C

CHART 3. AVERAGE ELECTRICAL CHARACTERISTICS

Heater Current, If	0.25	0.25 amp
Plate Voltage, Eb	120	120 volts
Grid #2 Voltage, Ec2	120	120 volts
Grid #1 Voltage, Ec1	—2	—2 volts
Grid #3 Voltage, Ec3	—3	0 volts
Plate Current, Ib	4.2	3.5 mA
Grid #2 Current, Ic2	5.1	3.3 mA
Mutual conductance, Grid #1—plate	2100	3250 μmhos
Mutual conductance, Grid #3—plate	710	450 μmhos
Grid #1 Voltage for Ib = 10 μA (approx.)	—	—7 volts
Grid #3 Voltage for Ib = 10 μA (approx.)	—15	0 volts

Direct Inter-electrode Capacitances	(no shield)	(with shield)
Grid #1 to plate	0.04 max.	0.035 max. μμf
Input	4.4	4.5 max. μμf
Output	3.7	3.3 μμf
Grid #1 to Grid #3	0.16 max.	1.6 μμf
Grid #3 to all other electrodes	3.5	3.6 μμf

RED BANK DIVISION
BENDIX AVIATION CORPORATION
EATONTOWN, NEW JERSEY

Publication No. R 62-2 (Supersedes No. R 511-11)

Printed in U.S.A.

MINIATURE DUAL CONTROL PENTODE

6486

Bendix Red Bank Type TE-11

ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 4. TEST CONDITIONS AND CHARACTERISTICS LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps. Prior to 100% Testing

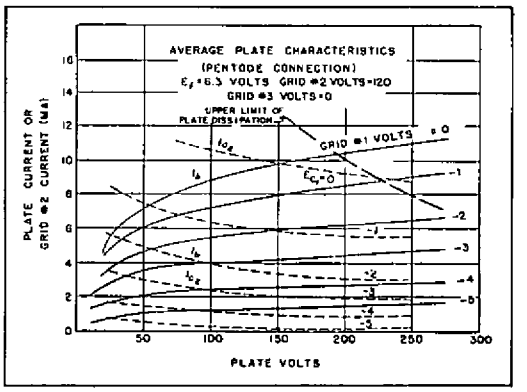
CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Heater Current	If	235	250	265	mA
Heater-Cathode Leakage	Ihk	—	—	10	μAdc
Grid Current	Ic1	—	—	0.1	μAdc
Plate Current	Ib	2.5	5.5	9.0	mAdc
Screen Grid Current	Ic2	1.0	2.5	6.0	mAdc
Transconductance (1) g1-p	Sm	2250	3250	4500	μmhos
Short and Continuity					
DESIGN TESTS					
Insulation of Electrodes					
Eg1-all = −100 Vdc	R	100	—	—	meg
Ep-all = −300 Vdc	R	100	—	—	meg
Cut Off Plate Current					
Ec1 = 8 Vdc Ec3 = 0	Ib	—	—	200	μAdc
Ec1 = −6 Vdc Ec3 = 0	Ib	5	—	—	μAdc
Cut Off Plate Current					
Ec1 = −3 Vdc Ec3 = −10 Vdc	Ib	—	—	200	μAdc
Ec1 = −3 Vdc Ec3 = −6 Vdc	Ib	5	—	—	μAdc
Transconductance (2) g1-p Ec = 5.7	ΔSm	—	—	15	%
Transconductance (3) g3-p Ec3 = −3	Sm	400	710	1300	μmhos
Transconductance (4) g1-p Ec3 = −5	Sm	500	1150	1700	μmhos
RF Noise Ecat = 15 mV		—	—	3	mW
Noise and Microphonics Ebb = Ecc2 = 250 Vdc Ec1 = 0 RK = 1000 ohm Rg2 = 0.5 Meg. Rp = 0.1 Meg. Cg2 = 2 μf RK = 1000 μf Ecat = 200 mVac	—	—	—	200	mVac
Capacitance (with shield)					
	Cg1-p	—	—	0.035	μμf
	Cin	4.0	4.5	5.0	μμf
	Cout	2.9	3.3	3.7	μμf
	Cg1g3	—	—	0.16	μμf
	Cg3-all	3.2	3.6	4.0	μμf

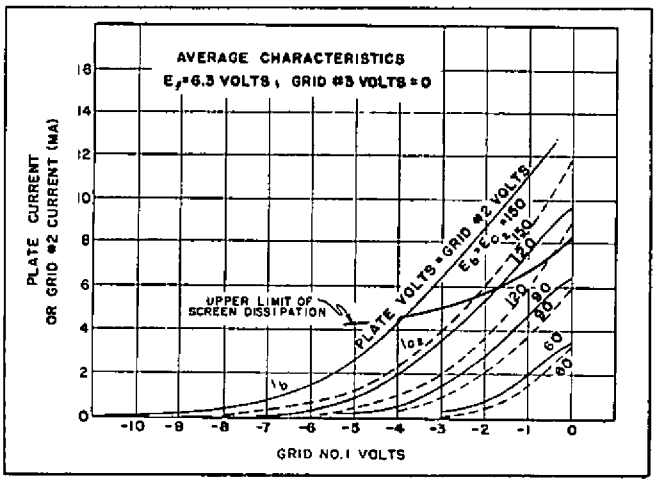
ELECTRODE:	Ef	Eb	Ec1	Ec2	Ec3	Ehk
TEST CONDITIONS:	6.3 Volts	120 Vdc	−2 Vdc	120 Vdc	0	±250 Vdc

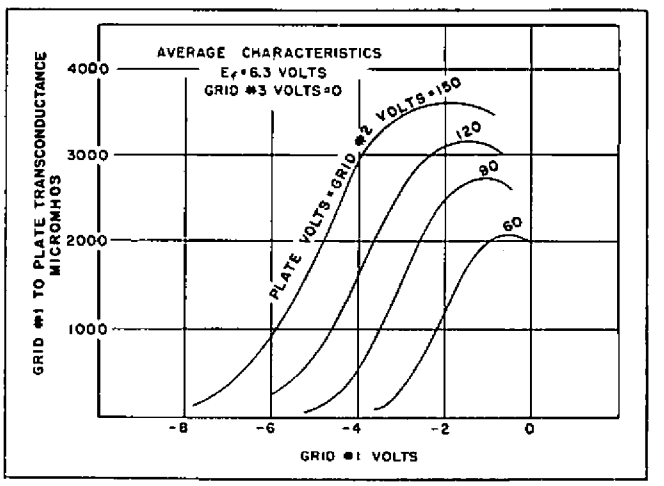
CHART 5. ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 2½ Min. Off 2½ Min. Ef = 7.5 Ehk = 250	3,000 On-Off Cycles
Life Test	Under "Test Conditions"	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	5,000 Hours
High Level Fatigue Test	50G—Shock Excitation 18 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	15 Seconds in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	



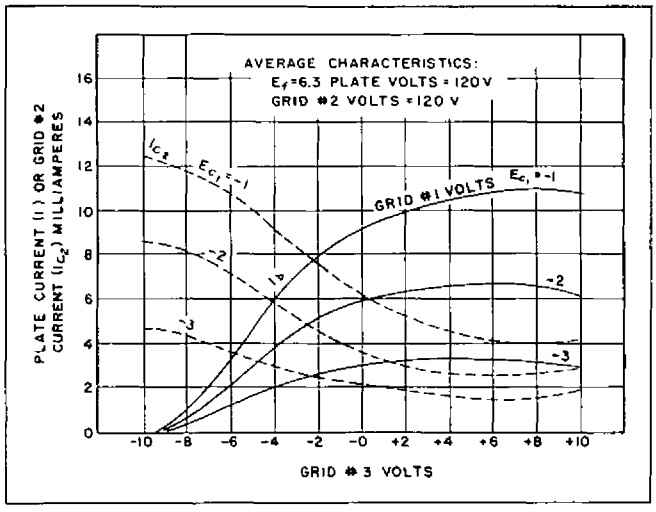


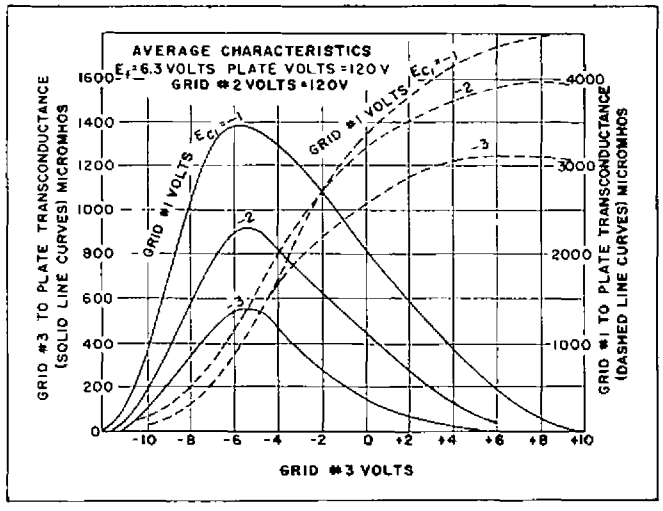


MINIATURE DUAL CONTROL PENTODE

6486

Bendix Red Bank Type TE-11





APPLICATION NOTES

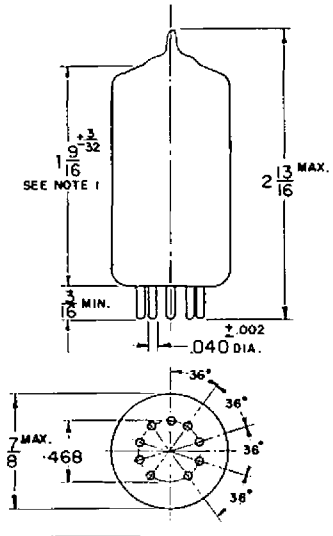
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced 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.

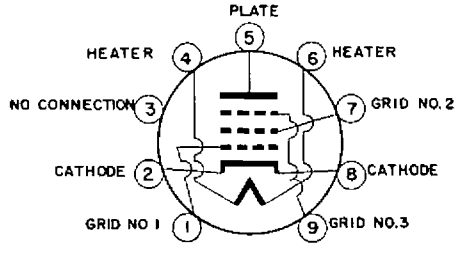
The bulb temperature should never exceed the maximum rated value at the hottest point and cooling should be employed if necessitated by the additive effects of operation at higher altitudes and high dissipation simultaneously or by other sources of heat in the equipment. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability.

Chart 11 is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.

CHART 11. **EFFECT ON LIFE OF INCREASED RATINGS**

See Also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	120 Vdc	150 Vdc	180 Vdc
Screen Voltage	100 Vdc	120 Vdc	140 Vdc
Plate Current (Av.)	2.5 mA	5.5 mA	9 mA
Screen Current (Av.)	1.0 mA	3.5 mA	6 mA
Cathode Current (Peak)	8 mA	10 mA	18 mA
H-K Voltage	200 V	250 V	300 V
Bulb Temperature	100°C	120°C	160°C
Altitude	0-20,000 ft	60,000 ft	80,000 ft
Vibration	1 G	2.5 G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM





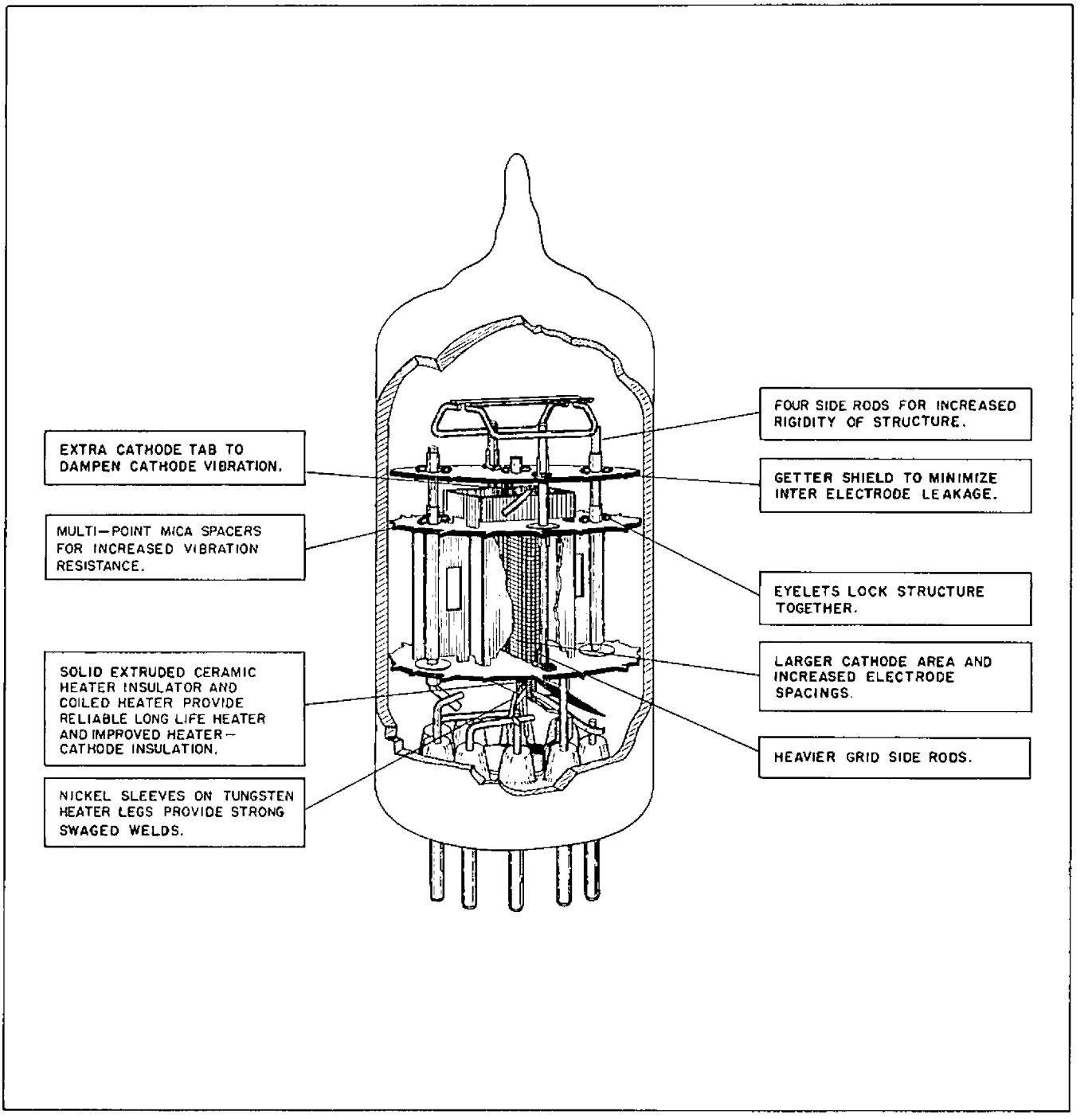
BASE DIAGRAM
(BOTTOM VIEW)

NOTES:
1. MEASURED AT 7/16 DIA. ON BULB.
2. ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED.

MINIATURE BEAM POWER AMPLIFIER

6486

Bendix Red Bank Type TE-11



STRUCTURAL FEATURES OF 6486 PROVIDE HIGH RELIABILITY AND LONG LIFE.

RED BANK DIVISION
BENDIX AVIATION CORPORATION
EATONTOWN, NEW JERSEY

Bendix Red Bank

West Coast Sales and Service: 117 E. Providencia, Burbank, Calif.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.

Bendix Aviation Corp.
Red Bank Division
Electron Tube Plant
Eatontown, New Jersey

HY-G-300

TYPE 6486A (Tentative Data)

Reliable Hard Glass Miniature Dual Control Pentode

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	6-2	Bulb	T-6 1/2
Base	E9-1 miniature button, 9-Pin		
Maximum bulb temperature	300°C		
Maximum diameter	7/8		
Maximum seated height	1-15/16		
Maximum overall length	2-3/16		

Pin connections

9DV

Pin 1	Grid #1	Pin 6	Heater
Pin 2	Cathode	Pin 7	Grid #2
Pin 3	No connection	Pin 8	Cathode
Pin 4	Heater	Pin 9	Grid #3
Pin 5	Plate		

Mounting position	any
Life expectancy	10,000 hrs

ELECTRICAL DATA

Direct Interelectrode Capacitances	With shield	Without shield	
Grid to plate (g1 to p) max	0.04	0.035	µµf
Input max	4.4	4.5	µµf
Output	3.7	3.3	µµf
Grid #1 to grid #3 max	0.16	0.16	µµf
Grid #3 to (h+k+g1+g2+p+i.s.)	3.5	3.6	µµf

Ratings		
Heater voltage (ac or dc)	6.3	volts
Maximum heater-cathode voltage	300	volts
Maximum plate voltage	200	volts
Maximum grid #2 voltage	155	volts
Maximum positive grid #3 voltage	30	volts
Maximum plate dissipation	2.0	watts
Maximum grid #2 dissipation	0.85	watts

Typical operating conditions and characteristics			
Heater Voltage (ac or dc)	6.3	6.3	volts
Heater Current, If	0.25	0.25	amp
Plate Voltage, Ib	120	120	volts
Grid #2 Voltage, Ec2	120	120	volts
Grid #1 Voltage, Ec1	-2	-2	volts
Grid #3 Voltage, Ec3	-3	0	volts
Plate Current, Ib	4.2	3.5	mA
Grid #2 Current, Ic2	5.1	3.3	mA
Mutual conductance, Grid #1-plate	2100	3250	µmhos
Mutual conductance, Grid #3-plate	710	450	µmhos
Grid #1 Voltage for Ib=10µA(approx.)	---	-7	volts
Grid #3 Voltage for Ib=10µA(approx.)	-15	0	volts

from JETEC release #1874, March 18, 1957

6541

Bendix Red Bank Type TE-30

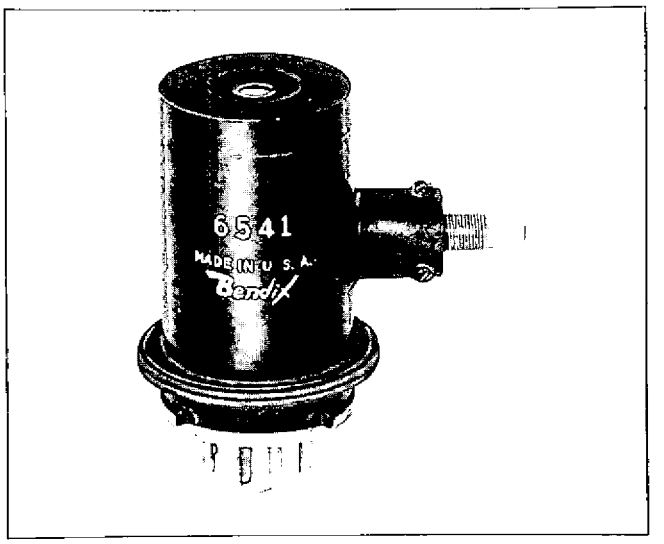
from JETEC release
#1627, April 9, 1956

REFLEX KLYSTRON

(MECHANICALLY TUNED)

DESCRIPTION

The 6541 reflex klystron (Bendix Type TE-30) is a ruggedized, low voltage, mechanically tuned K-band reflex oscillator designed for use as a CW power source over the frequency range of 23.25 KMC/sec. to 24.75 KMC/sec. This tube incorporates an improved method of tuning the cavity resonator which permits the achievement of a relatively flat power output and electronic tuning characteristic with variation of the operating frequency. Unlike the conventional capacitive type tuners wherein the interaction gap spacing of the resonant cavity is varied to control the operating frequency, the interaction gap of the type 6541 is fixed at optimum spacing. Tuning is accomplished by moving a dielectric rod into the electric field surrounding the interaction gap. The tuner rod is moved by a spring loaded differential screw acting through bellows in the wall of the vacuum envelope. This screw is designed to receive an allen wrench for tuning purposes and can be locked in position with an external lock nut. Since a flexible diaphragm is no longer necessary as a cavity wall for tuning purposes, the cavity is designed as a rigid structure which is stable under acceleration, shock, and vibration environments. The electron gun and repeller structures are mounted rigidly on ceramics in order to ruggedize these assemblies and to eliminate the use of all mica insulators which are subject to decomposition and flaking under severe environmental conditions. The output coupling is accomplished by means of an internal tapered section of waveguide which couples radio frequency energy from the cavity resonator through a non-resonant iris. This waveguide section tapers in the narrow dimension only from the iris to a terminating choke abutting a circular low loss glass output window. The output fitting of the tube is designed to match and fasten directly to a standard UG-596/U waveguide choke flange. The bulb is of steel construction and hence provides protection from external magnetic fields for the internal electron optics structure.



APPLICATION NOTES

Insulation The bulb of the 6541 is designed to operate at resonator voltage potential hence requiring a resonator voltage supply having its positive polarity grounded when the tube is to be mounted directly on the waveguide flange. If the desired application requires that the tube shall be operated above ground or "hot" with respect to ground, the tube and the waveguide flange may be insulated by means of a mica sheet and four insulating bushings between the mounting screws, tube and waveguide flange.

Cooling The maximum bulb temperature should not exceed 130°C in applications where long tube life is important. At room temperature without a tube enclosure no forced cooling is required. If the tube is to be operated in an enclosure, care should be taken to insure that adequate cooling is provided in order that the maximum bulb temperature is not exceeded since impairment of tube life may result.

Environment The type 6541 has been designed to provide stable frequency and power output under severe acceleration, shock, and vibration environments. Under constant acceleration up to 50G, impact shocks of 5 milliseconds duration to 100G, and vibration environments at 10 to 1200 cycles/sec. with accelerations of 3 to 10G, the tube displays maximum variations in power output of 10%, maximum frequency modulation of 2 Mc/sec., and maximum frequency variations of 5 Mc/sec.

Output Load The tube has been designed for operation into a matched waveguide load. When operation into a reactive load is necessary, adequate attenuation should be inserted in the load circuit between the tube and the load to limit the voltage standing wave ratio at the tube to a value less than 2 to 1 in order to prevent impairment of tube performance.

Repeller Modes The tube should be operated in the repeller voltage mode defined in this data sheet. However, modes do exist at lower repeller voltages than that specified which should be considered when the design of AFC circuits is undertaken to prevent lock-in on one of these lower modes. The 6541 has been designd to provide a minimum mode separation of 40 volts between the operating repeller voltage mode and the next lower mode.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Filament Voltage	6.3 ± 8% volts
Resonator Voltage	330 volts D.C.
Reflector Voltage	−300 volts D.C.
Resonator Current	30 mAdc
Heater-Cathode Voltage	± 45 volts

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Weight:* 4.3 ounces.
- *Base:* Small Octal 8-Pin, B8-21, Low Loss Phenolic Wafer.
- *Coupling to Wave Guide:* Direct. Fastens to UG-596/U choke flange.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Silver Plated Steel.
- *Bulb:* Metal.
- *Output Window:* Low Loss Glass.

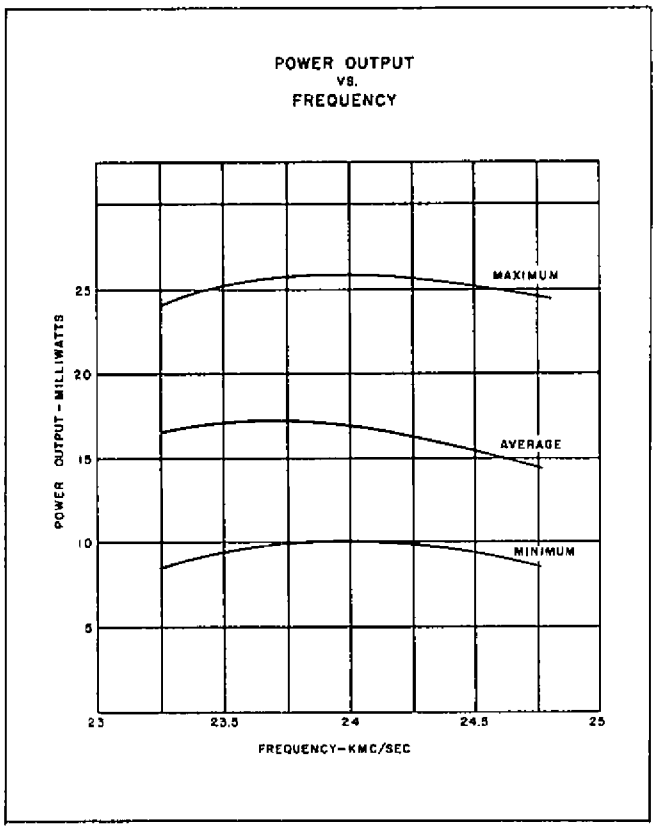
RED BANK DIVISION
BENDIX AVIATION CORPORATION
EATONTOWN, NEW JERSEY

Bendix Red Bank

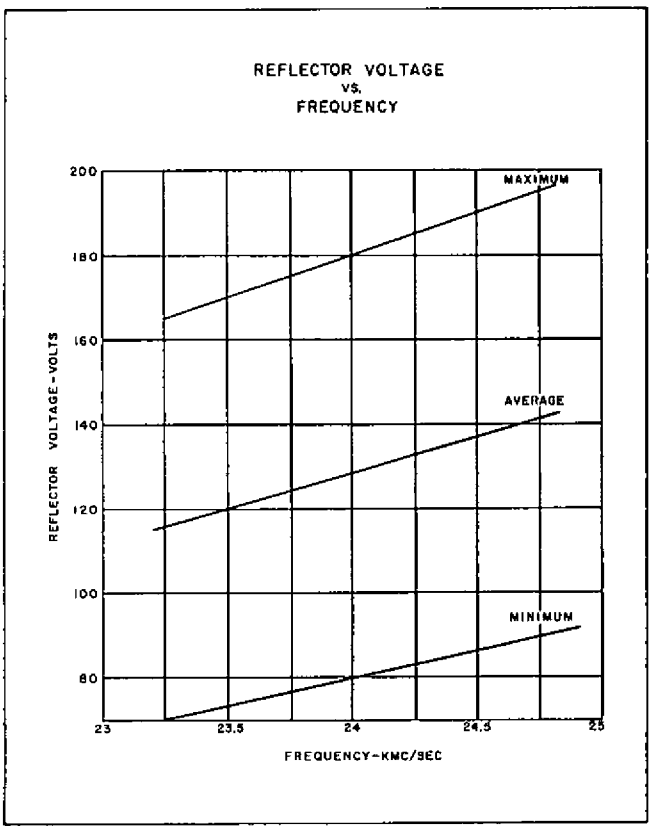
Publication No. R61-10

Printed in U.S.A.

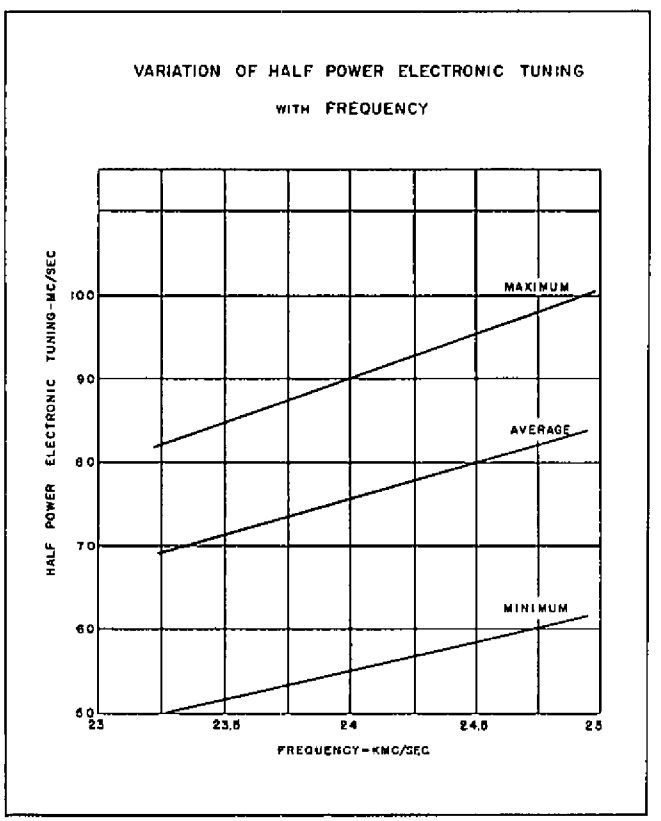
AVERAGE CHARACTERISTICS



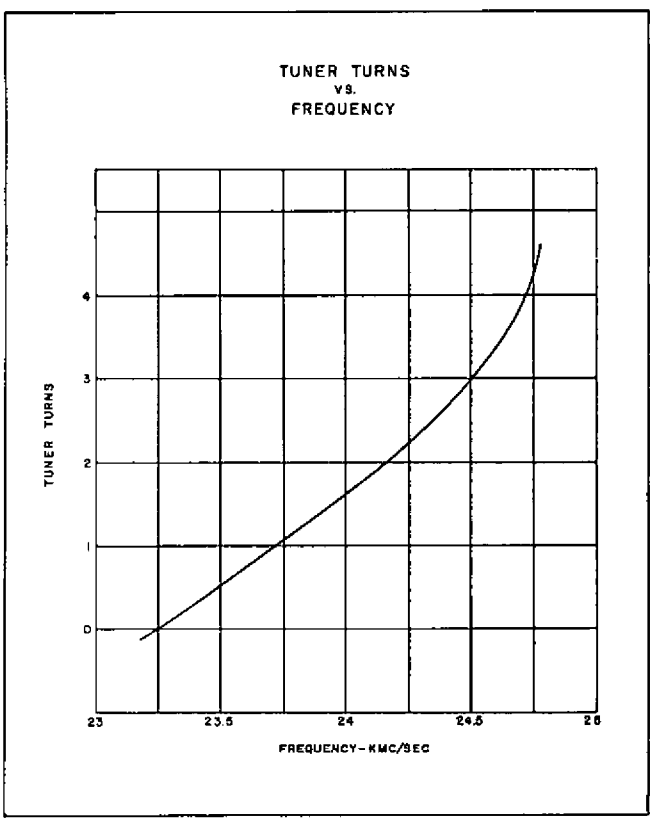
POWER OUTPUT VS. FREQUENCY



REFLECTOR VOLTAGE VS. FREQUENCY



ELECTRONIC TUNING VS. FREQUENCY



TUNER TURNS VS. FREQUENCY

REFLEX KLYSTRON
(MECHANICALLY TUNED)

6541
Bendix Red Bank Type TE-30

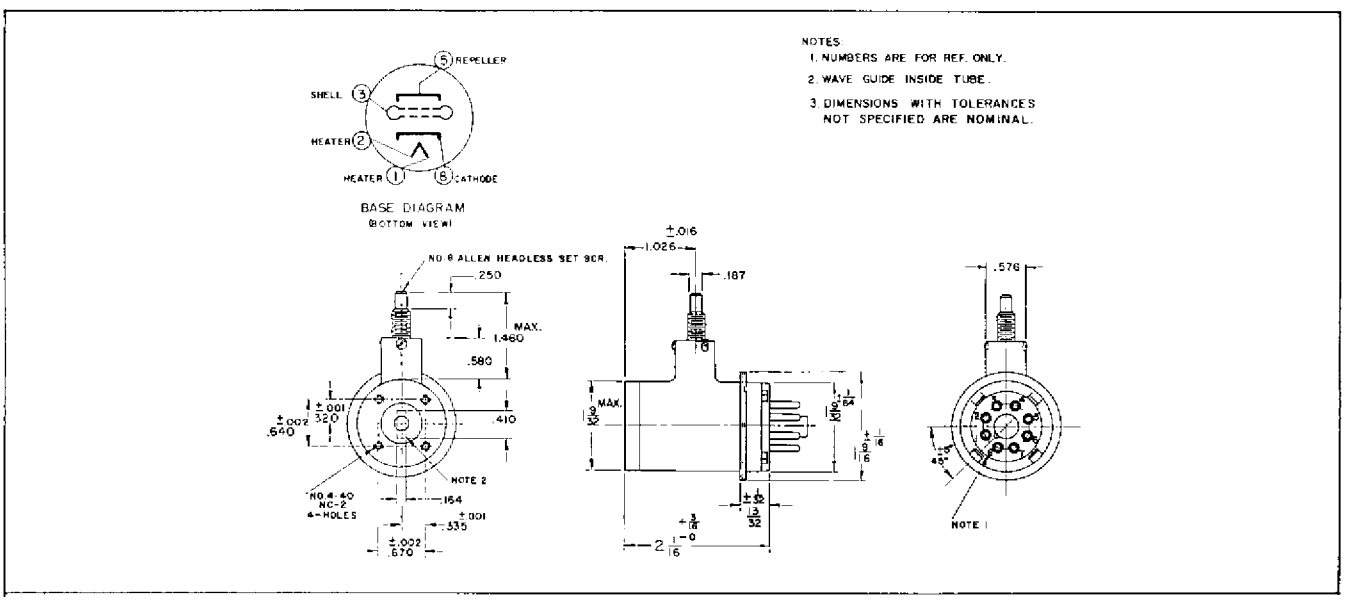
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current	Er = −100 Vdc	Ir	—	7.0	μAdc
Reflector Leakage Current	Er = −100 Vdc		—	5.0	μAdc
Reflector Gas Current	Er = −100 Vdc		—	2.0	μAdc
Resonator Current	Test Conditions; Er = −100 Vdc	Irs	—	30	mAdc
Mechanical Tuning Range	Er/max Po	F	23250	24750	Mc
Power Output (1)	Test Conditions	Po	10	—	mW
Power Output (2)	Er/max Po; F = 23250 ± .3%; F = 24750 ± .3%	Po	8.5		mW
Reflector Voltage	Test Conditions; Er/max Po	Er	−80	−180	Vdc
Electronic Tuning (1)	Test Conditions; Er/50% max Po		55		Mc
Emission	Ef = 5.8 v	△Ik/Ik		15	%
Hysteresis	Test Conditions; Er/max Po	Ratio		5	%
DESIGN TESTS:					
Insulation	Ehk = ±45 Vdc	Ihk		100	μAdc
Heater Current	Test Conditions	If	475	555	mA
Bump	Test Conditions; Er/max Po	△Po/Po		0.10	
Electronic Tuning (2)	F = 23250 ± .3%; F = 24750 ± .3%; Er/50% max Po		55		Mc
Modulation Sensitivity Resonator	Test Conditions; △Ers = 20 Vac	△f/△Ers	1.0	1.6	Mc/v
Modulation Sensitivity Repeller	Test Conditions; △Erp = ±3 v	△f/△Erp	2.0	4.0	Mc/v
Life Test	Test Conditions	t	500		hrs
Life Test End Points	Test Conditions	Po	8		mW

GENERAL TEST CONDITIONS:

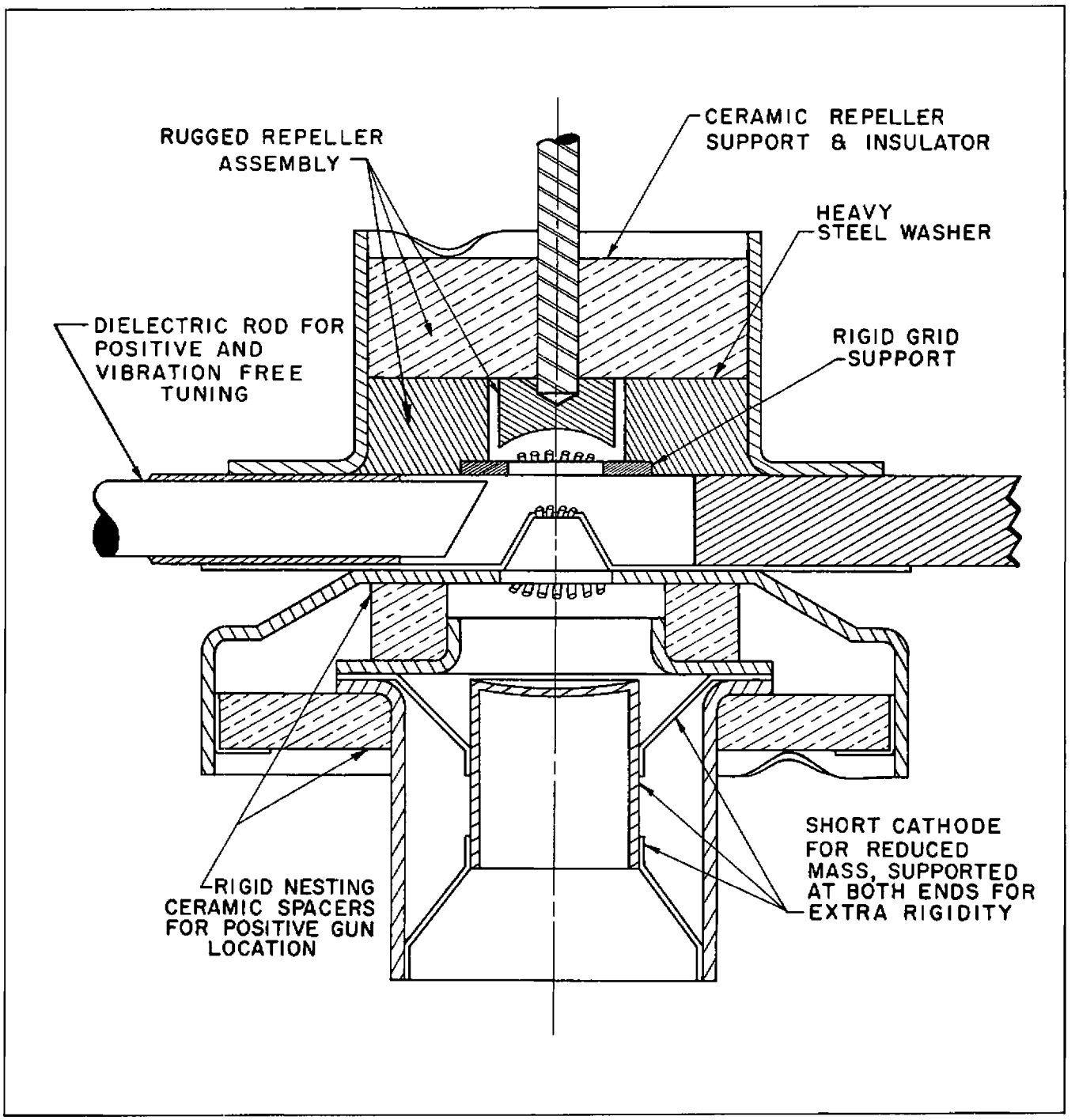
Ef	Eres	Er	F
6.3 volts	+300 Vdc	Adjust	24000 ± 0.3% Mc



OUTLINE DRAWING

REFLEX KLYSTRON
(MECHANICALLY TUNED)

6541
Bendix Red Bank Type TE-30



STRUCTURAL FEATURES OF THE 6541

RED BANK DIVISION
BENDIX AVIATION CORPORATION
EATONTOWN, NEW JERSEY

Printed in U.S.A.

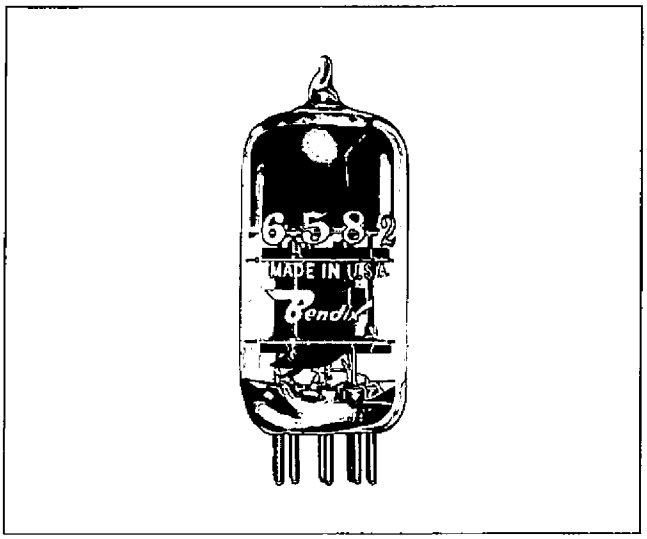
West Coast Sales and Service: 117 E. Providencia, Burbank, Calif.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

from JEDEC release #4135, Feb. 11, 1963

6582

Bendix Red Bank Type TE-35

RELIABLE MINIATURE RF SHARP CUT-OFF PENTODE



DESCRIPTION

This miniature nine-pin dual control sharp cut-off, rf pentode is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft and industrial applications where freedom from early failure, long average service life and uniform operating characteristics are extremely important. It is intended to replace the 6AK5 in applications where reliability is the primary consideration. Each tube is given a 45-hour run-in under overload vibration and shock conditions. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

In order to keep the lead length as short as possible for use in rf circuits the cathode and grid 1 are brought out to both sides of the tube.

The use of a coil type heater inside an extruded alumina insulator gives a long life heater structure which stands up well under high heater to cathode voltage. The mount structure is so designed that the tube is capable of withstanding severe shock and vibration.

CHART 1. DESIGN CENTER MAXIMUM RATINGS*

Heater Voltage (ac or dc)**	6.3 volts
Plate Voltage	200 volts
Grid #2 Voltage	155 volts
Grid #1 Voltage (max.)	−100 Vdc
Plate Dissipation	2.0 W
Grid #2 Dissipation	0.85 W
Cathode Current	20 mAdc
Heater-Cathode Voltage	250 V
Cathode Warm-up Time	25 sec.
Bulb Temperature (at hottest point on bulb)	165°C

* To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously. See application notes.

** Voltage should not fluctuate more than ±5%.

CHART 2.
PHYSICAL CHARACTERISTICS

Base	Miniature button 9-pin
Bulb	T-6½
Max. overall length	2 3/16 in.
Max. seated height	1 15/16 in.
Max. diameter	⅞ in.
Mounting position	Any
Max. bulb temp.	165°C

CHART 3. AVERAGE ELECTRICAL CHARACTERISTICS

Heater Current, If	.25 A	
Plate Voltage, Eb	120 Vdc	
Grid #2 Voltage, Ec2	120 Vdc	
Grid #1 Voltage, Ec1	−2 Vdc	
Plate Current, Ib	7.5 mAdc	
Grid #2 Current, Ic2	2.5 mAdc	
Mutual conductance	4500 μmhos	
Direct Inter-electrode Capacitances	(no shield)	(with shield)
Grid #1 to plate	.046	.030 max. μμf
Input	5.0	5.0 max. μμf
Output	3.3	3.4 max. μμf
Life Expectancy		10,000 hrs.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 610-29

Printed in U.S.A.

SHARP CUT-OFF PENTODE

6582

Bendix Red Bank Type TE-35

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTICS LIMITS

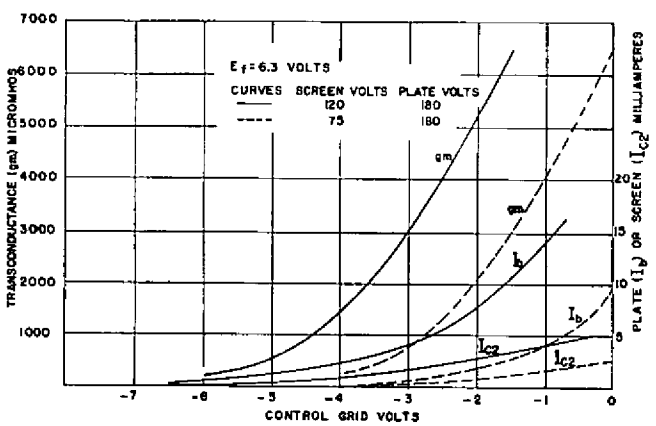
All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps. Prior to 100% Testing

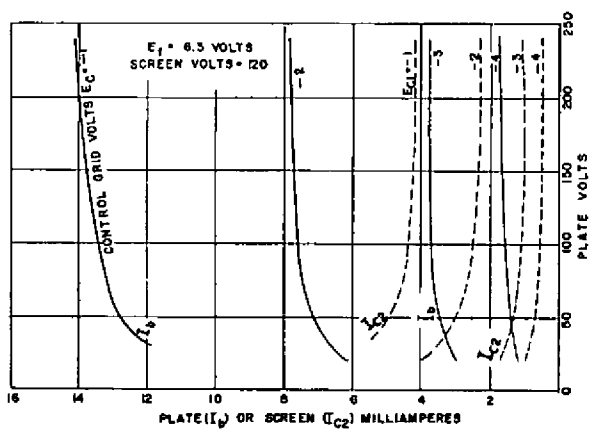
CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Short and Continuity					
Heater Current	If	235	250	265	mA
Heater-Cathode Leakage	Ihk	—	—	10	μAdc
Grid Current (1)	Ic1	—	—	0.1	μAdc
Plate Current (1)	Ib	5.0	7.5	11.0	mAdc
Screen Grid Current	Ic2	0.8	2.5	4.0	mAdc
Tranconductance (1)	Sm	3500	4500	5500	μmhos
DESIGN TESTS					
Transconductance (2) Ef = 5.7 V.	△Sm	—	—	15	%
Plate Current (2) Ec1 = −10 Vdc	Ib	—	—	200	μAdc
Plate Current (3) Ec1 = −5.5 Vdc	Ib	5	—	—	μAdc
Grid Current (2) Ef = 7.0 V	Ic1	0	—	0.3	μAdc
RF Noise Eca1 = 15 mVac	—	—	—	3.0	Mw
AF Noise	Ep	—	—	100	mVac
ELECTRODE:	Ef	Eb	Ec1	Ec2	Ehk
TEST CONDITIONS:	6.3 Volts	120 Vdc	−2 Vdc	120 Vdc	±250 Vdc

ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 2½ Min. Off 2½ Min. Ef = 7.5 Ehk = 250	3,000 On-Off Cycles
Life Test	Under "Test Conditions"	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	5,000 Hours
High Level Fatigue Test	50G—Shock Excitation 18 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	15 Seconds in Each
Mount Inspection	100% Test—Microscopic Inspection of 30 Possible Trouble Points	

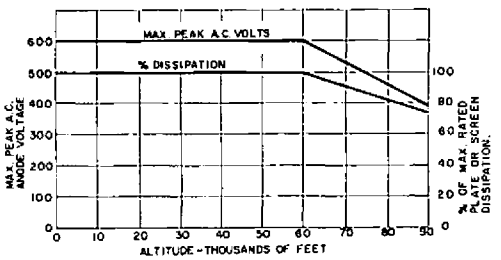




SHARP CUT-OFF PENTODE

6582

Bendix Red Bank Type TE-35



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF DISSIPATION DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATINGS FOLLOWS:

1. VOLTAGE DERATING - TO KEEP BELOW BASE PIN ARC OVER POINT.
2. DISSIPATION DERATING - TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

ALTITUDE RATINGS

EFFECT ON LIFE OF INCREASED RATINGS

See Also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	150 Vdc	185 Vdc	200 Vdc
Screen Voltage	100 Vdc	120 Vdc	155 Vdc
Plate Current (Av.)	2.5 mA	7.5 mA	10 mA
Screen Current (Av.)	1.0 mA	2.5 mA	4.5 mA
Cathode Current (Peak)	8 mA	12 mA	20 mA
H-K Voltage	200 V	250 V	300 V
Bulb Temperature	100°C	140°C	180°C
Altitude	0-20,000 ft	60,000 ft	80,000 ft
Vibration	1 G	2.5 G	5 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

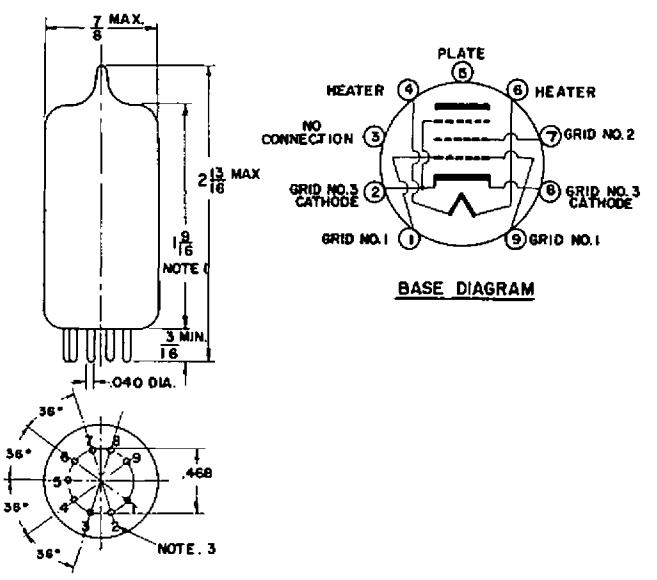
APPLICATION NOTES

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 will 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.

The bulb temperature should never exceed the maximum rated value at the hottest point and cooling should be employed if necessitated by the additive effects of operation at higher altitudes and high dissipation simultaneously or by other sources of heat in the equipment. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability.

The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.

The altitude rating chart shows the correct voltage derating necessary for various altitude. However, the dissipation derating is only approximate and must be measured for each application because of the additive effects mentioned above.



BASE DIAGRAM

NOTES:

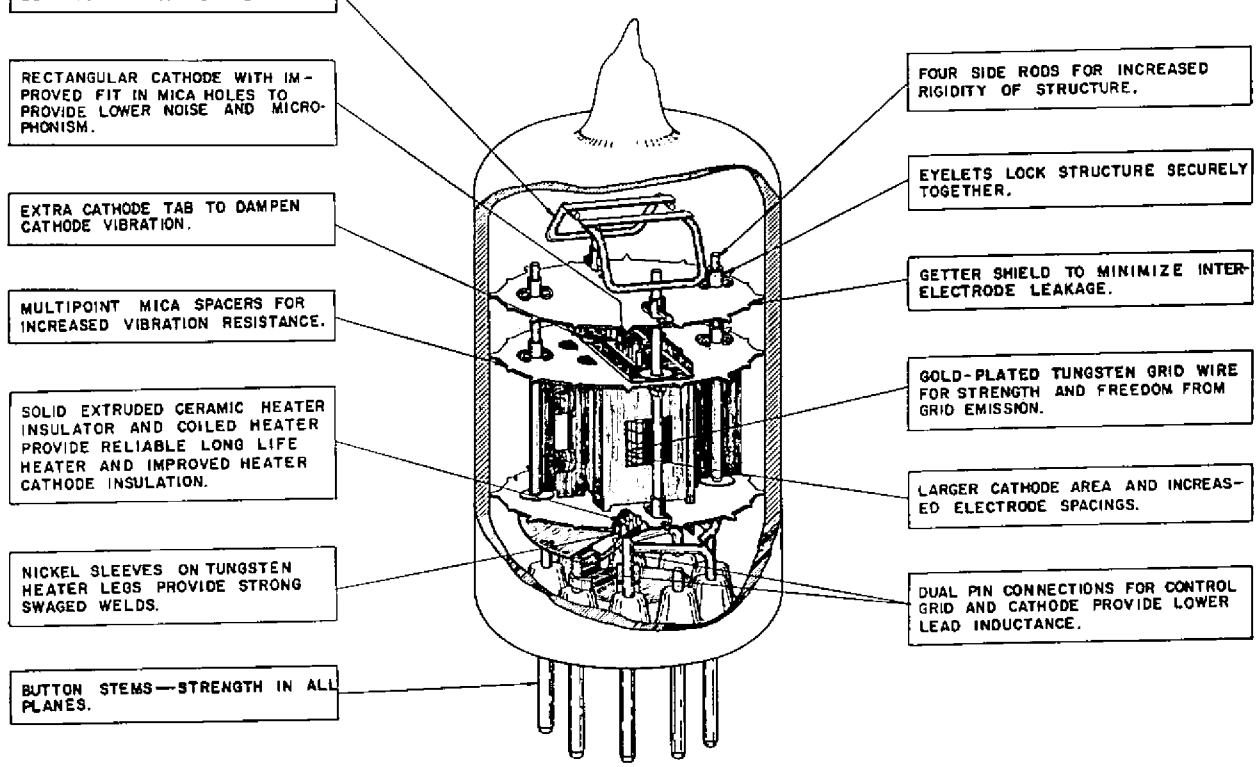
1. MEASURED AT 7/16 DIA. ON BULB.
2. ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED.
3. NUMBERS INDICATE PIN LOCATIONS AND ARE FOR REFERENCE ONLY.

OUTLINE DRAWING

SHARP CUT-OFF PENTODE

6582

Bendix Red Bank Type TE-35



STRUCTURAL FEATURES OF 6582 PROVIDE HIGH RELIABILITY AND LONG LIFE.

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales and Service: 117 E. Providencia, Burbank, Calif.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.

Printed in U.S.A.

Bendix Aviation Corp.
Red Bank Division
Electron Tube Plant
Eatontown, New Jersey

TYPE 6582A (Tentative Data)

Miniature Hard Glass Pentode, RF, Sharp Cut-off

MECHANICAL DATA

Coated unipotential cathode

Outline drawing . . . . . Bulb	T-6 1/2
Base	E9-1 miniature button, 9-pin
Maximum bulb temperature	300°C
Maximum diameter	7/8
Maximum seated height	1 15/16
Maximum overall length	2 3/16

Pin connections

9EJ

Pin 1	Grid #1	Pin 6	Heater
Pin 2	Cathode and grid #3	Pin 7	Grid #2
Pin 3	No connection	Pin 8	Cathode and Grid #3
Pin 4	Heater	Pin 9	Grid #1
Pin 5	Plate		

Mounting position	any
Life expectancy	10,000 hrs

ELECTRICAL DATA

Direct interelectrode capacitances	With #315 Shield	
Grid #1 to plate (max)	0.03	µµf
Input (g1 to all)	4.5	µµf
Output (p to all)	3.0	µµf

Ratings		
Heater voltage (ac or dc)	6.3	volts
Maximum heater-cathode voltage	300	volts
Maximum plate voltage	200	volts
Maximum grid #2 voltage	155	volts
Maximum plate dissipation	2.0	watts
Maximum grid #2 dissipation	0.85	watts
Maximum positive d-c grid #1 voltage	0	volts
Maximum cathode current	20	mAdc

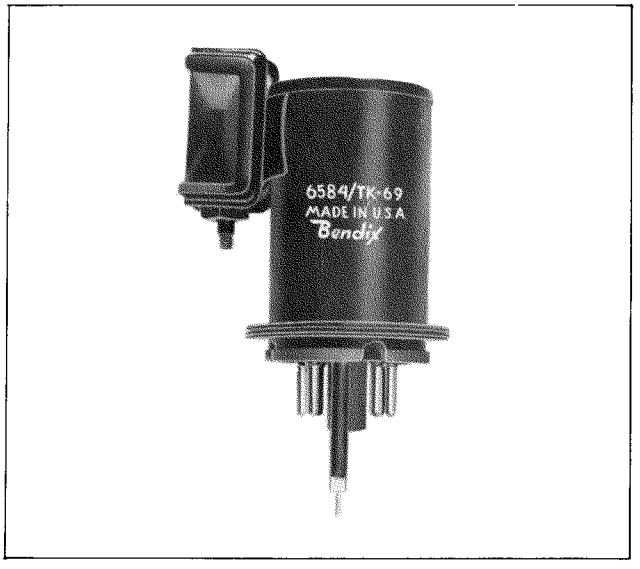
Typical operating conditions and characteristics, class A1 amplifier		
Heater voltage (ac or dc)	6.3	volts
Heater current	250	mA
Plate voltage	120	volts
Grid #2 voltage	120	volts
Cathode resistor	180	ohms
Plate resistance (approx)	0.5	meg
Transconductance	4500	µmhos
Plate current	7.5	mA
Grid #2 current	2.5	mA
Grid #1 voltage (approx) for Ib=10 µA	-8.5	volts

from JETEC release #1874, March 18, 1957

Bendix 6584 Type TK-69

REFLEX KLYSTRON

(MECHANICALLY TUNED)



MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	330 Vdc
Reflector Voltage	— 300 Vdc
Filament Voltage	6.3 ± 8% volts
Resonator Current	35 mAdc
Heater — Cathode Voltage	± 50 Vdc

PHYSICAL CHARACTERISTICS

- *Dimensions*: Refer to the outline drawing.
- *Base*: Modified Small Octal 8-Pin, B8-21, Low Loss Phenolic.
- *Output Coupling*: Coaxial. (See Typical Adapter Assembly Drawing.)
- *Cooling*: Convection.
- *Mounting Position*: Any.
- *Bulb*: Metal.
- *Tuner*: Allen Socket Screw for #8 Allen Wrench.

DESCRIPTION

The 6584 (Bendix® Red Bank Type TK-69) Tube is a mechanically tuned C band reflex oscillator. The electrical characteristics of the 6584 have been designed to be similar to the type 6115, with the exception that the repeller voltage variation with frequency has been reduced. The tube is designed for use as a CW oscillator over the range of 5100 Mc./sec. to 5900 Mc./sec. The tube is capacitively tuned over this frequency range by changing the interaction gap spacing.

The design is such as to exhibit no spurious oscillation modes when the output connecter is properly terminated.

The electron optics of the tube have been designed to reduce electrical hysteresis to a minimum.

The mechanical tuner design eliminates long mechanical and thermal paths external to the tube structure as well as the use of overstressed diaphragms; hence, mechanical tuning hysteresis is virtually eliminated. In addition, the cavity diaphragm is completely contained within the vacuum enclosure thus eliminating frequency sensitivity to atmospheric pressure as present in tubes having the diaphragm as a part of the vacuum enclosure.

Output coupling is accomplished by means of a coaxial output lead. The output line may be coupled into a coaxial system or directly into a waveguide mount by means of the Typical Adaptor Assembly drawing shown on the last page. This adaptor is the same as the one used for the JAN-2K29.

APPLICATION NOTES

This tube is designed to have improved temperature and altitude characteristics, fast warm-up, stabilized warm-up frequency drift, and reduced repeller voltage variation with frequency. The tube is applicable for use in equipments operating in widely varying ambient temperatures, varying atmospheric pressures and in intermittent operation. Such applications include airborne radar systems, telemetering and microwave relay links. In addition, the reduced repeller voltage vs. frequency characteristic makes possible savings in components for an afc system with given characteristics.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-20 (Supersedes No. R58-3)

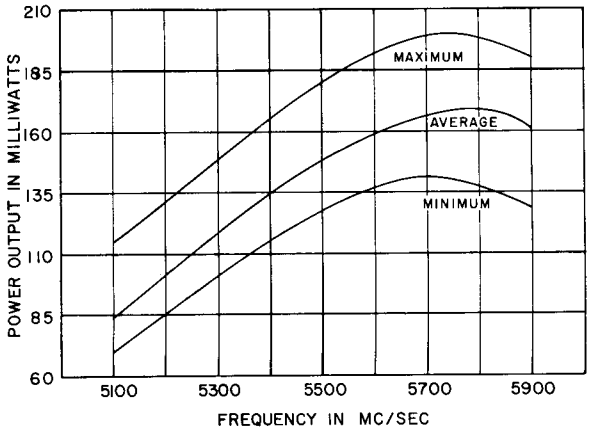
Printed in U.S.A.

REFLEX KLYSTRON
(MECHANICALLY. TUNED)

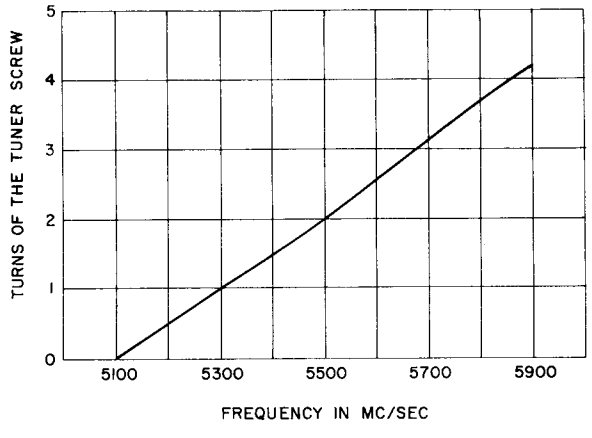
6584
Bendix Type TK-69

AVERAGE CHARACTERISTICS

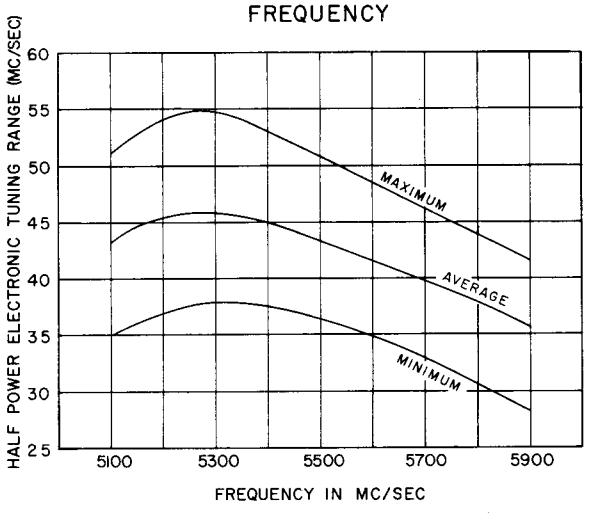
TYPICAL POWER OUTPUT
VS
FREQUENCY
(REPELLER VOLTAGE
OPTIMIZED FOR EACH FREQUENCY)



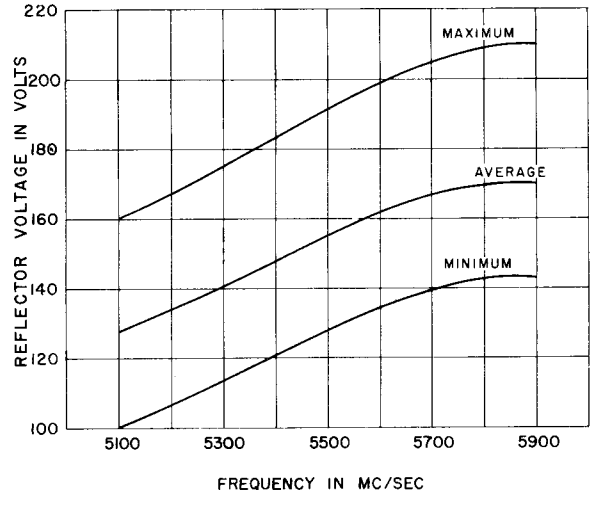
TURNS OF TUNER SCREW
VS
FREQUENCY



TYPICAL VARIATION OF HALF POWER
ELECTRONIC TUNING RANGE
WITH
FREQUENCY



TYPICAL VARIATION
OF REPELLER VOLTAGE
WITH FREQUENCY



ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS					
Total Reflector Current	Er = −100 Vdc	Ir	—	7	uAdc
Reflector Leakage Current	Er = −100 Vdc	Ir	—	5	uAdc
Reflector Gas Current	Er = −100 Vdc	Ir	—	2	uAdc
Bump	Test Conditions; Er/max Po	△Po/Po	—	0.10	
Resonator Current	Test Conditions; Er = −100 Vdc	Irs	—	32	mAdc
Mechanical Tuning Range	Er/max Po	F min	—	5100	Mc
		F max	5900	—	Mc
Power Output (1)	F = 5100 Mc; Er/max Po	Po	70	—	mW
Reflector Voltage (1)	F = 5100 Mc; Er/max Po	Er	−100	−160	Vdc
Reflector Voltage (2)	F = 5900 Mc; Er/max Po	Er	−140	−210	Vdc
Electronic Tuning (2)	F = 5900 Mc; Er/50% Po	△F	28	—	Mc
Emission	Ef = 5.8 V	△Ik/Ik	—	0.15	
Life Test	Test Conditions	t	500	—	hrs
Life Test End Points	Power Output; F = 5900; Er/max Po	Po	100	—	mW
DESIGN TESTS:					
Insulation	Ehk ±45 Vdc		—	100	uAdc
Electrode Insulation	500 Vdc; Tube Cold	Rk-rs	2	—	Meg
		Rk-rs	2	—	Meg
Vibration Operating*	F = 25 cps, Peak to Peak Excursion .080" t = 60 sec	Fm		±1.5	Mc
Heater Current	Test Conditions		450	550	mA
Power Output (2)	F = 5900 Mc; Er/max Po	Po	120	—	mW
Electronic Tuning (1)	F = 5100 Mc; Er/50% Po	△F	34	—	Mc
Hysteresis	Test Conditions; Er/max Po	Ratio	—	0.05	
Modulation Sensitivity	Test Conditions; Er/max Po; △ Er = ±3 V	△F/△Er	0.61	1.2	Mc/V
Resonator Voltage Sensitivity	Test Conditions; Er/max Po; △ Ers = 20v p to p ac	△F/△Ers	—	0.320	Mc/V

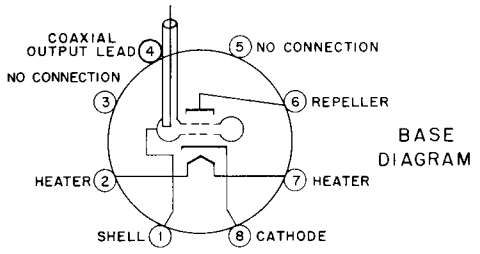
TEST CONDITIONS:

	Ef.	Eres.	Er	Irs	Ehk	F
	6.3 volts	300 Vdc	Adjust Vdc	25 mAdc	0	5500 Mc

*Tube is mechanically pretuned to 5100 Mc. Vibration tests are conducted on a cyclic basis for nine five minute periods in each of three mutually perpendicular planes. The tube must be capable of meeting all production tests after completion of the vibration tests.

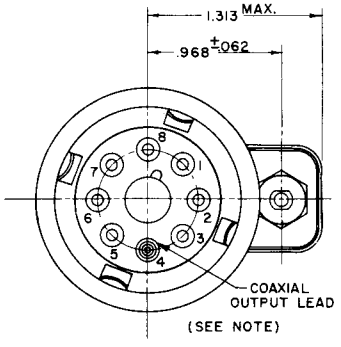
REFLEX KLYSTRON
(MECHANICALLY TUNED)

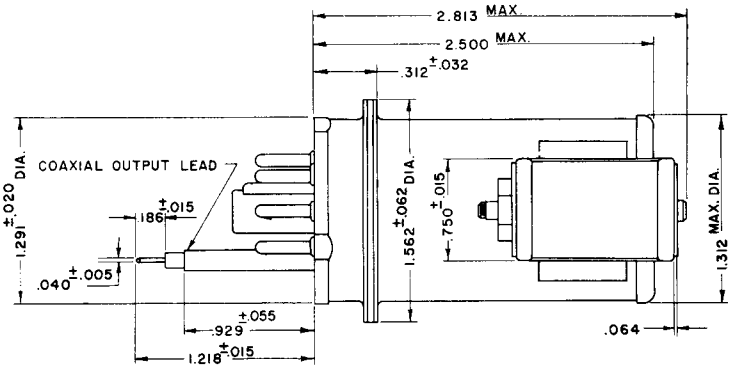
6584
Bendix Type TK-69



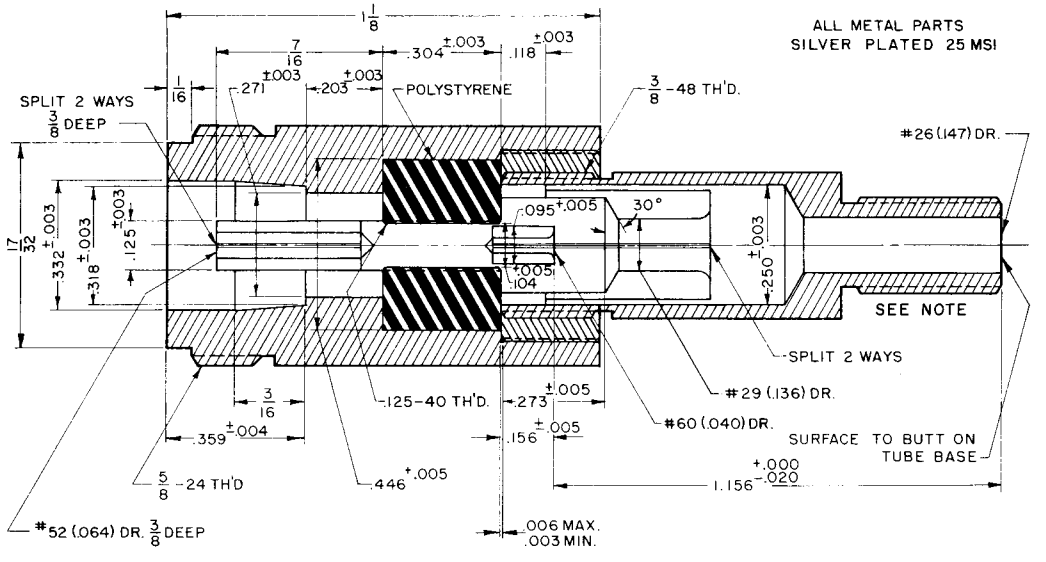
BASE DIAGRAM

NOTE:
NUMERALS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON TUBE BASE.





NOTE: SAME AS BENDIX RED BANK PART NO. RT-1738



ALL METAL PARTS SILVER PLATED 25 MSI

COAXIAL OUTPUT ADAPTOR

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6684
Bendix Type TD-18

GAS NOISE SOURCE



RATINGS

Filament Voltage	12 Volts
Anode Current	200 Ma D.C.
Filament Current	170 Ma D.C.
Tube Dissipation	15 Watts
Tube Voltage Drop	75 Volts
Ambient Temp. Range	−40°F to +165°F

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-91/U waveguide to provide noise in the 1.67 - 2.42 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide.

To secure good transmission performance at the frequencies involved, this tube is fabricated from low loss 707 glass.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.07 with a maximum of about 1.13. The noise temperature is 16 ± 1 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

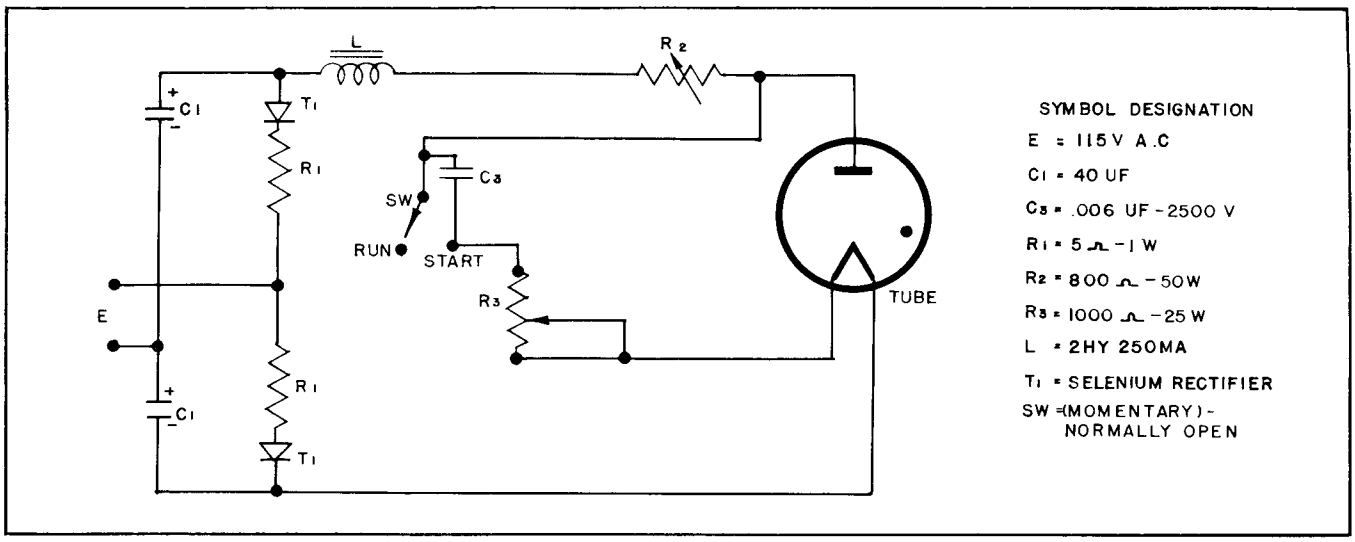
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R611-4 (Supersedes R53-14)

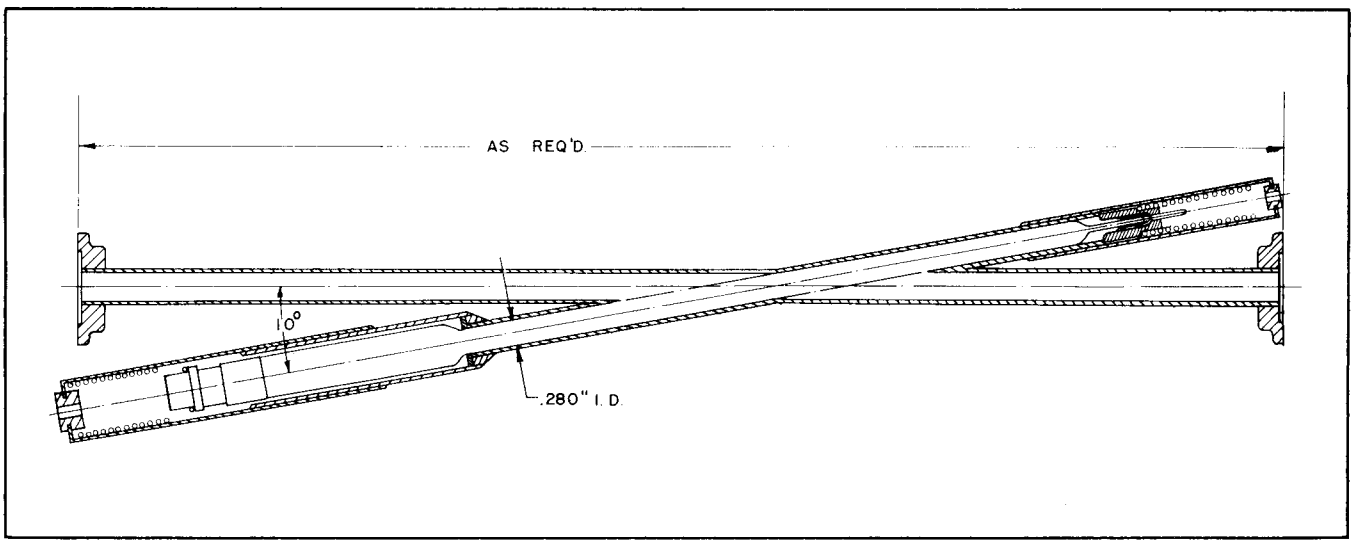
Printed in U.S.A.

GAS NOISE SOURCE

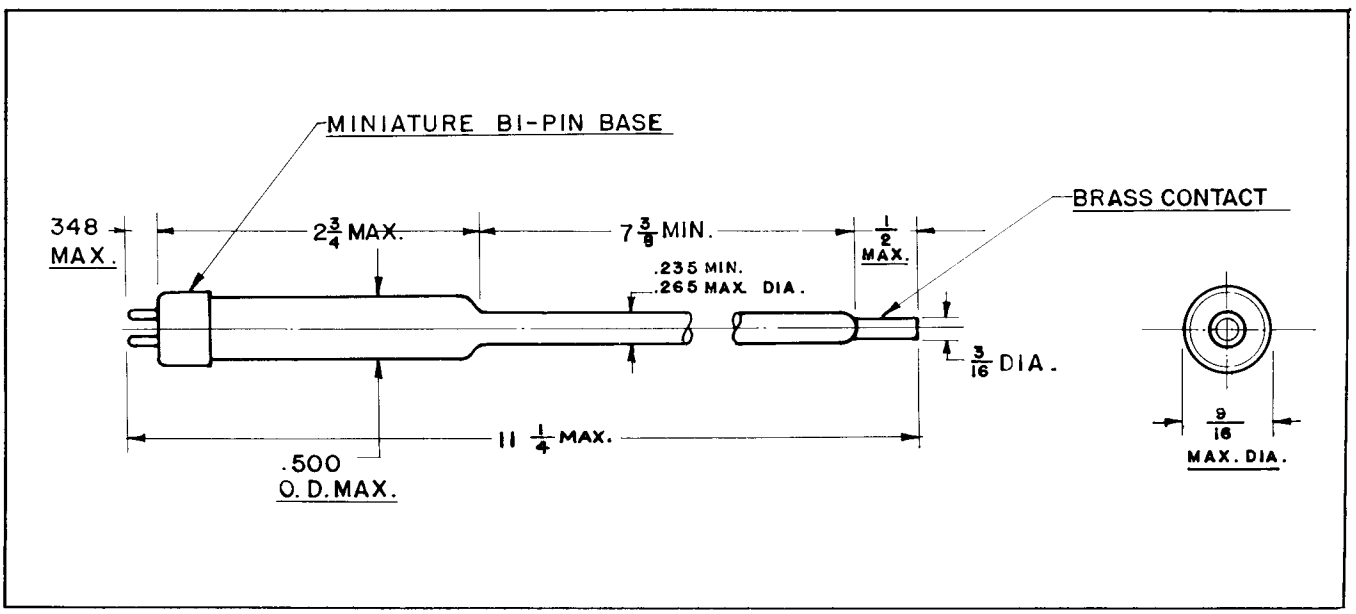
6684
Bendix Type TD-18



TYPICAL STARTING AND OPERATING CIRCUIT



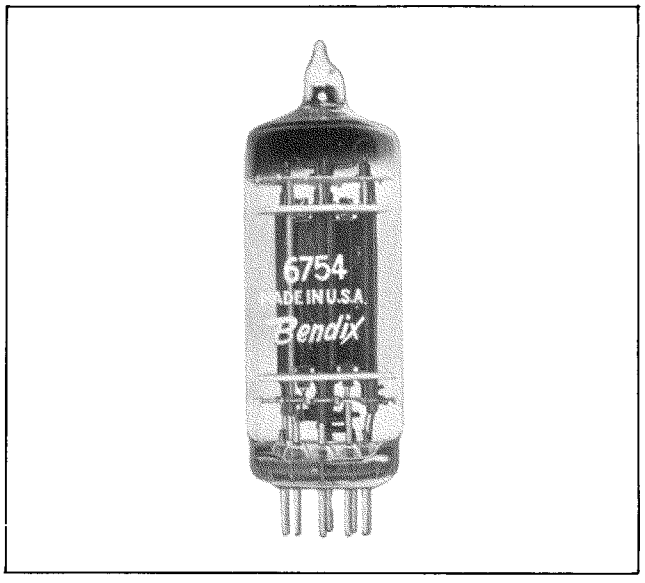
WAVEGUIDE MOUNT ASSEMBLY RG-91/U



OUTLINE DRAWING

6754
Bendix Type TE-36
(Generic Type 412A)

RELIABLE HARD GLASS MINIATURE FULL-WAVE RECTIFIER



ELECTRICAL RATINGS*

Heater voltage**	6.3 volts
Heater current	1.0 amp
Peak inverse voltage	1450 volts
Peak plate current—(per plate)	330 mA
Peak surge current—(per plate)	1.1 amps
DC heater-cathode potential	500 volts (max.)
Cathode heating time	45 sec.
Total effective plate supply impedance—(per plate)	See Rating Chart 3

For maximum current and voltage ratings, refer to Rating Chart 1.

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

TYPICAL OPERATION

Input to Filter

	Capacitor	Choke
Heater voltage (volts)	6.3	6.3
Heater current (amperes)	1.0	1.0
RMS plate supply voltage (volts per plate)	325	450
Input capacitor (μf)	4	—
Input choke (henries)	—	10
DC output current (mA)	100	100
DC output voltage (volts)		
At half-load current (50 mA)	375	395
At full-load current (100 mA)	325	385

DESCRIPTION

This miniature, full-wave, high-vacuum rectifier is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft, military and industrial applications where freedom from early failures, long service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

In addition, this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration, shock and other accelerations are encountered. Careful exhaust to a high degree of vacuum with thorough outgassing of all elements with electron bombardment is employed to ensure long life expectancy. A hard glass (nonex) bulb and stem with nickel pins are used. These, together with a conservative design center of cathode temperature, permit operation of these tubes up to bulb temperatures of 300°C, in contrast to an average of 175°C for soft glass bulbs. In addition, because of the lower expansion of the tungsten-nonex seal (about one-third that of conventional lime or lead glass), greater resistance to thermal shock is obtained. The nickel pins are gold plated to assure excellent contact resistance throughout life with freedom from corrosion.

This tube employs pressed ceramic spacers, instead of micas, for element separation. Conventional micas are used to snub the tube structure with respect to the bulb. These micas do not touch the hot elements of the tube which avoids deterioration of the mica and consequent loss of emission. Mica in contact with the hot cathode deteriorates even more rapidly under shock and vibration. Ceramic eliminates this problem and, furthermore, reduces damage caused by fatigue failure of parts.

MECHANICAL DATA

Base	9 Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6½
Max. Overall Length	2¾"
Max. Seated Height	2½"
Max. Diameter	⅞"
Mounting Position	any
Max. Altitude***	80,000 feet
Max. Bulb Temperature	300°C
Max. Impact Shock	500 G
Max. Vibrational Acceleration (100 hour shock excited fatigue test, sample basis)	50 G
Life Expectancy	10,000 hrs.

***See altitude chart on page 3.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R61-11

Printed in U.S.A.

FULL-WAVE RECTIFIER

6754

Bendix Type TE-36
(Generic Type 412A)

ELECTRICAL CHARACTERISTICS AND TEST DATA

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 hours under Test Conditions A & B and 2 G Vibration at 30 cps prior to 100% Testing.

CHARACTERISTIC	TEST CONDITIONS	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS						
Heater Current	A	If	.90	1.0	1.1	Aac
Heater-Cathode Leakage	A	Ihk	—	—	± 50	μAdc
Operation	B	Io	95	100	—	mAdc
Emission	C	Is	75	—	—	mAdc
Short and Continuity						
DESIGN TESTS						
Vibration 2.5 G, 25 cps						
Insulation of Electrodes	D	R	100	—	—	megohms
Heater-Cathode Leakage	E	Ihk	—	—	100	μAdc

TEST CONDITIONS	Ef	Epp/p	Es	Ep	RL	CL	Zpp/p	Ehk
Units	V	Vac	Vdc	Vdc	ohms	uf	ohms	Vdc
A	6.3							± 500
B	6.3	350			3890	4	Adjust	
C	6.3		15					
D	6.3			1500				
E	6.3							1500

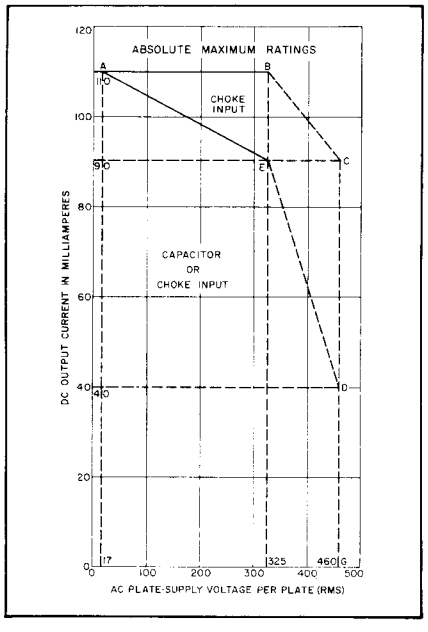
SPECIAL TESTS

In addition to the production and design tests shown under "Electrical Characteristics and Test Data", other tests are performed on a sampling basis to assure a high out-going quality level. See below:

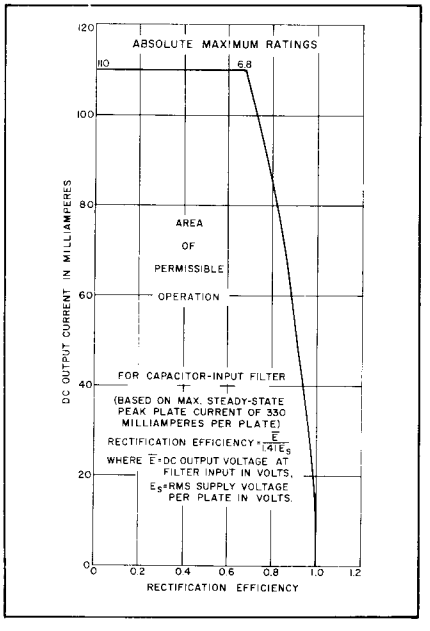
TEST	CONDITION	DURATION
Heater Cycling Life Test	On 2½ min. Off 2½ min. Ef = 7.0 Vac	3,000 On-Off cycles
Glass Strain Test	Boiling water to Ice water	3 minutes in each
High Level Fatigue Test	50 G Shock Excitation: 18/sec. rep. rate	100 hours
Altitude Test	60,000 Feet	5 minutes
High Temp. Life Test	Under "Test Conditions" Bulb Temp. 300°C	1,000 hours
Life Expectancy Test	Under Test Conditions	5,000 hours
Mount Inspection	100% Test-Microscopic Inspection of 15 possible Trouble Points	

EFFECT ON LIFE OF INCREASED RATINGS

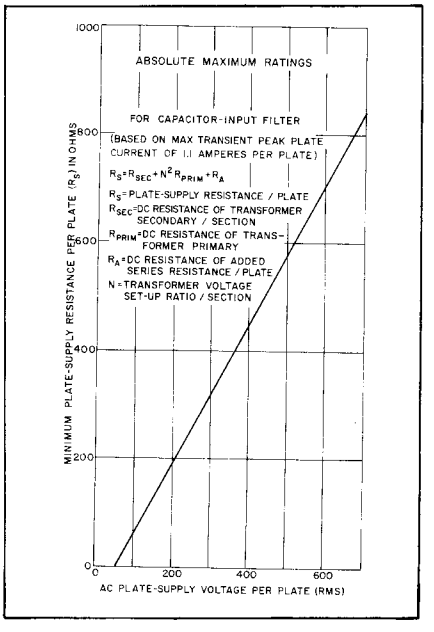
See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
H-K Voltage	425 V	450 V	500 V
Peak Plate Current (per plate)	225 mA	300 mA	330 mA
Peak Plate Inverse Voltage	1000 V	1250 V	1450 V
Output Current (per Tube)	85 mA	90 mA	100 mA
Bulb Temperature	175°C	225°C	300°C
Altitude	0-20,000 ft.	60,000 ft.	80,000 ft.
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM



RATING CHART 1



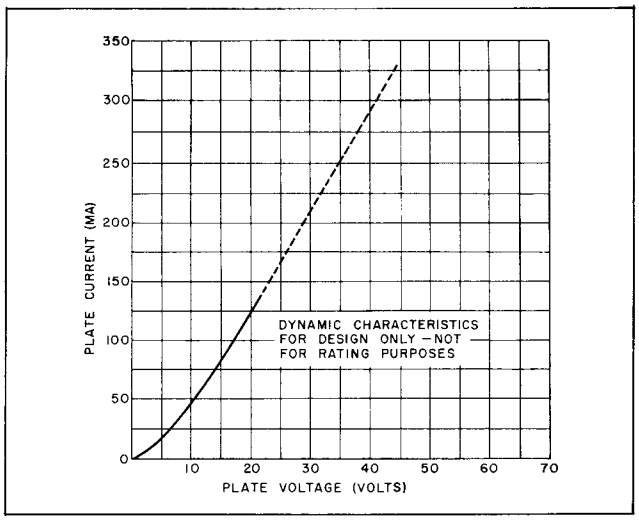
RATING CHART 2



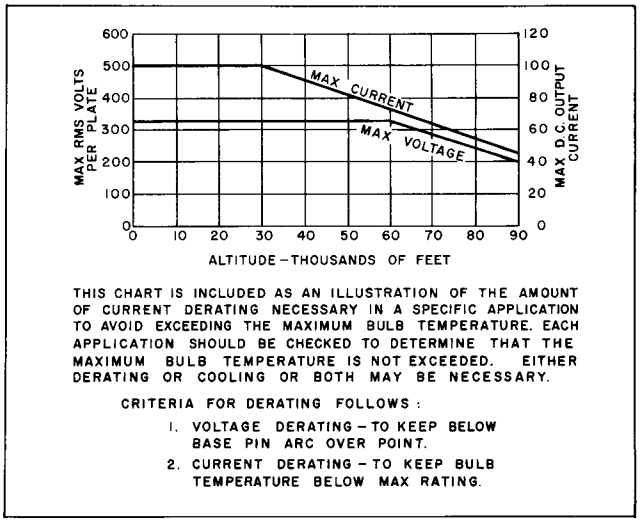
RATING CHART 3

FULL-WAVE RECTIFIER

6754
Bendix Type TE-36
(Generic Type 412A)



AVERAGE PLATE CHARACTERISTICS



THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF CURRENT DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

CRITERIA FOR DERATING FOLLOWS:

1. VOLTAGE DERATING – TO KEEP BELOW BASE PIN ARC OVER POINT.
2. CURRENT DERATING – TO KEEP BULB TEMPERATURE BELOW MAX RATING.

ALTITUDE RATINGS

APPLICATION NOTES

For reliable operation special consideration should be given to the maximum ratings of the 6754. These ratings are limiting absolute values and if exceeded may seriously impair the reliability of the tube. Therefore, the equipment designer should determine an average design value for each rating so that variations in supply voltages, load, and components do not cause the absolute values to be exceeded. The bulb temperature rating is an extremely important characteristic which should not be exceeded if expected life is to be achieved.

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.

From Rating Chart 1, operating conditions should be selected to insure usage within the area of permissible operation with choke or capacitor inputs.

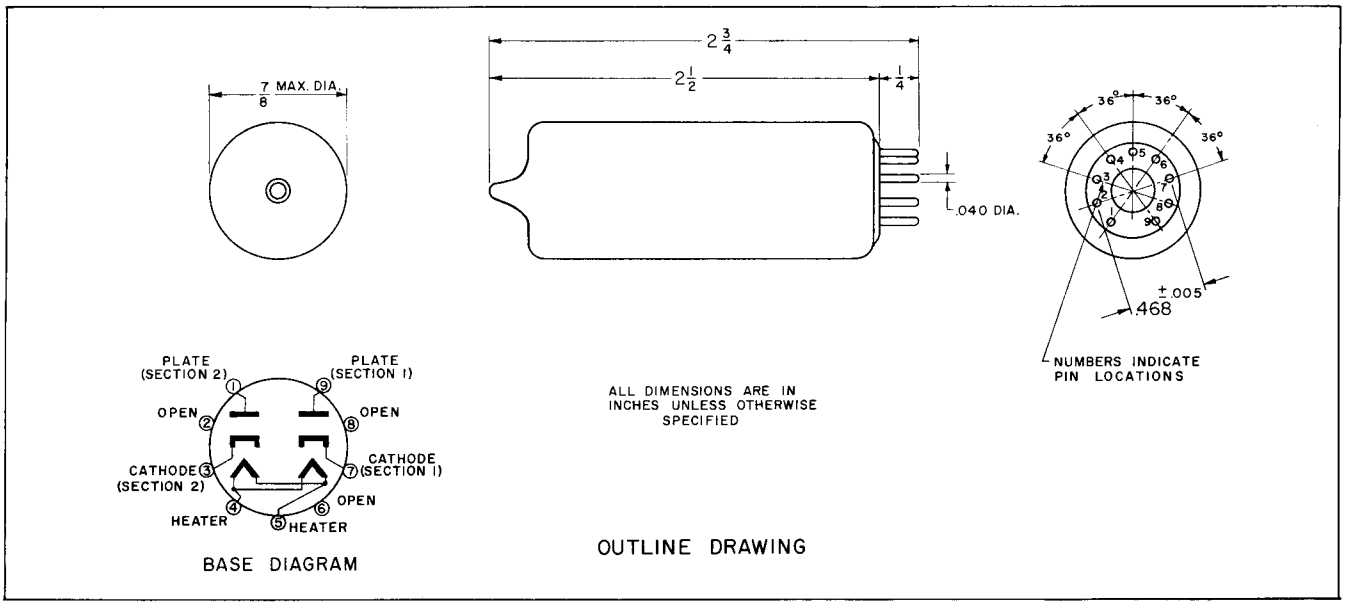
To insure that the maximum peak plate current is not exceeded a choice of operating values of d-c output current per plate and rectification efficiency should be made such that they fall within the area of permissible operation of Rating Chart 2.

Rating Chart 3 graphically represents the relationship between the maximum a-c plate supply voltage per plate and the minimum plate supply resistance per plate to prevent maximum transient currents from exceeding the peak surge current rating of the tube. The plate supply resistance $Rs = R(sec) + N^2R(pri) + Ra$, where

R(sec) = d-c resistance of each section of transformer secondary,
N = Transformer voltage step-up ratio per section,
R(pri) = d-c resistance of transformer primary,
Ra = d-c resistance of added series resistance per plate.

The addition of inductance would allow a reduction of the minimum value specified for Rs provided the reactance added is not too small as to cause the maximum peak surge plate current and maximum steady-state peak plate current ratings to be exceeded.

The increased rating chart is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditons in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.

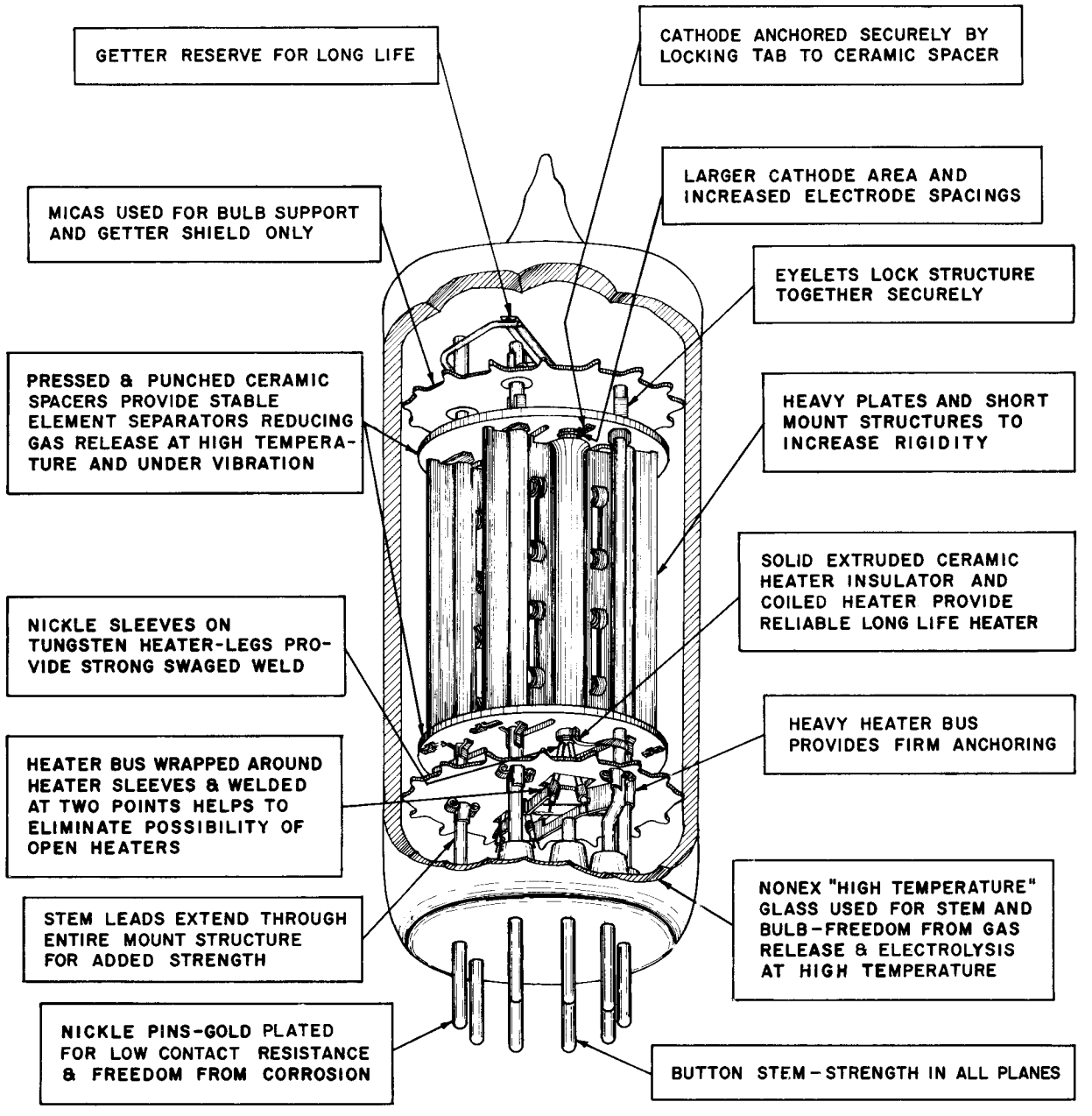


OUTLINE DRAWING

FULL-WAVE RECTIFIER

6754

Bendix Type TE-36
(Generic Type 412A)



STRUCTURAL FEATURES OF 6754 PROVIDE HIGH RELIABILITY AND LONG LIFE

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

GAS NOISE SOURCE, ARGON



DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with a 90° H-plane mount in RG/48U waveguide to provide noise in the 7.6-11.5 cm waveband. When used in the suggested mount assembly it functions essentially as an untuned noise generator over the recommended transmission bandwidth of the mount.

RATINGS

DC

Filament Voltage	12 Vdc
Anode Current	250 mAdc
Filament Current	170 mAdc
Tube Dissipation	11 watts
Tube Voltage Drop	44 Vdc

AC

Anode Current*	250 mAac
Anode Current Striking Voltage	2000 Vac max.
Tube Dissipation	16 watts max.
Tube Voltage Drop*	65 Vac

* These values are those read on RMS reading meters.

ENVIRONMENTAL

Ambient Temp. Range	−55°C to +85°C
Bulb Temp.	+125°C max.

PHYSICAL CHARACTERISTICS

Max. overall length	$9\frac{3}{16}$"
Max. diameter	.565
Mounting position	Refer to Page 4

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

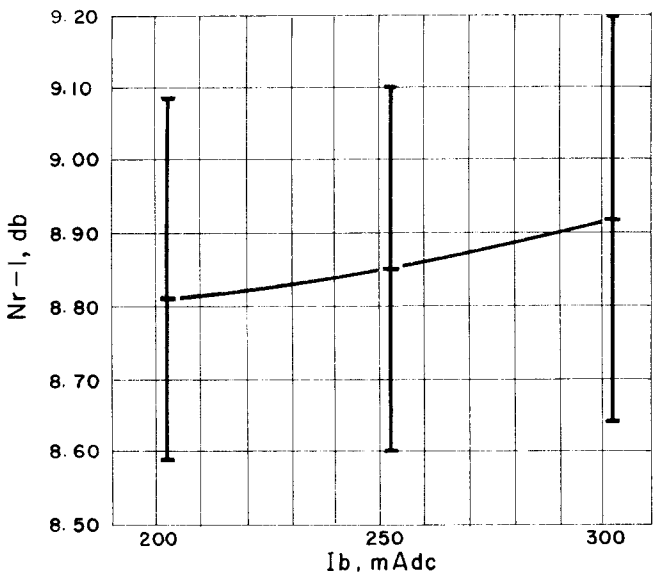
Publication No. R612-11

Printed in U.S.A.

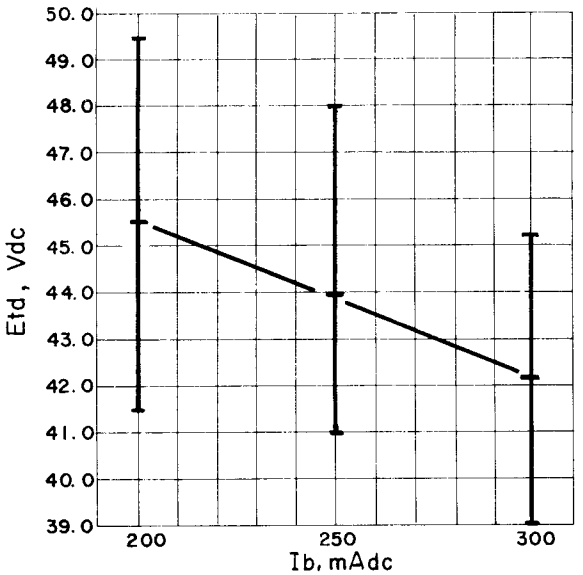
GAS NOISE SOURCE, ARGON

6782
Bendix Type TD-22

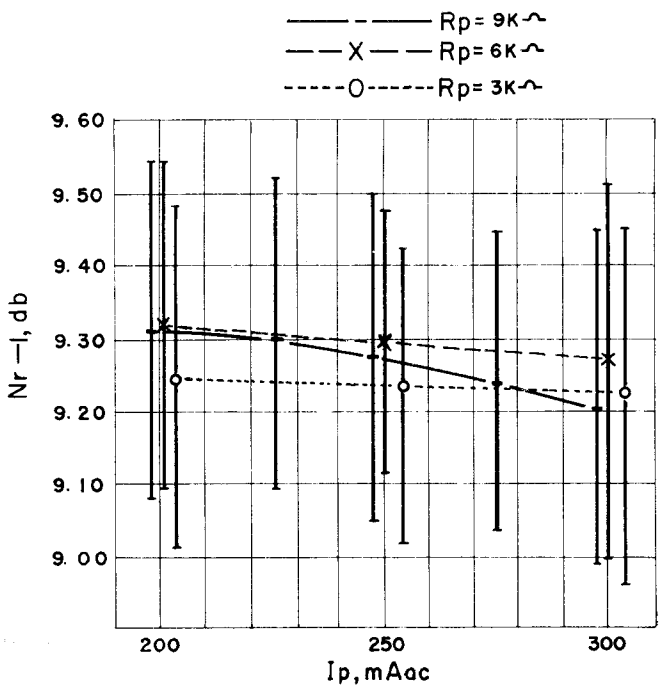
EXCESS NOISE RATIO VS.
D-C TUBE CURRENT



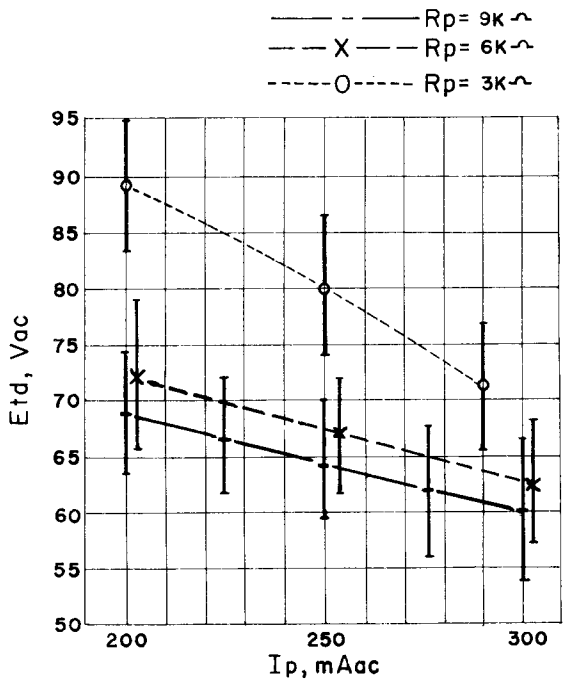
TUBE DROP VS.
D-C TUBE CURRENT



EXCESS NOISE RATIO VS.
A-C (60 CYCLES) TUBE CURRENT

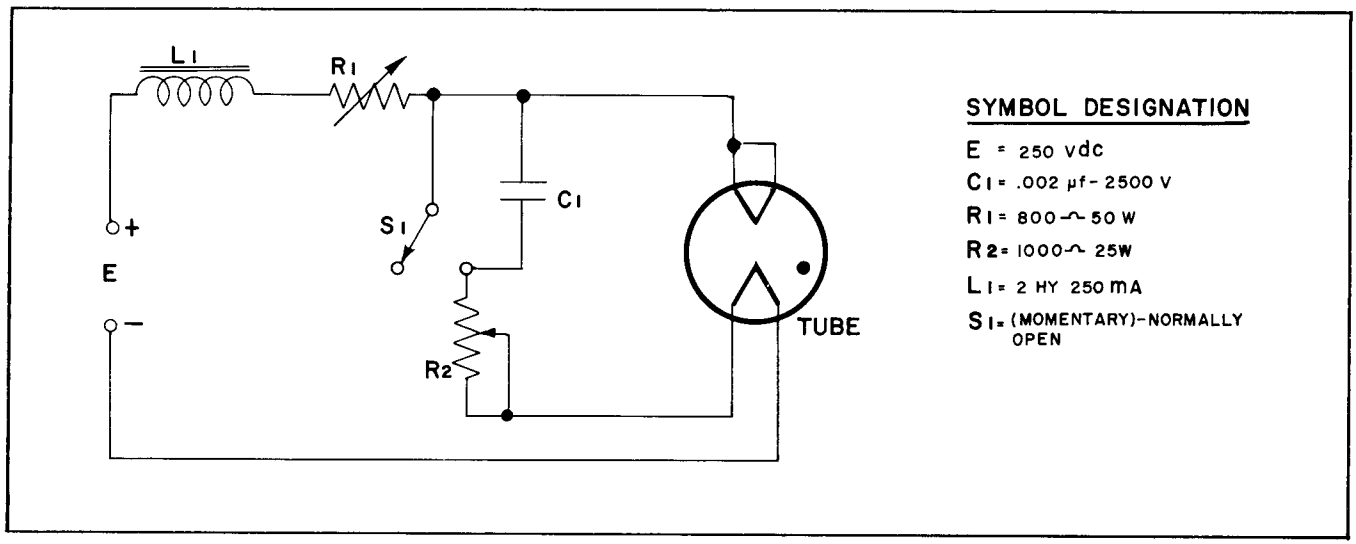


TUBE DROP VS.
A-C (60 CYCLES) TUBE CURRENT

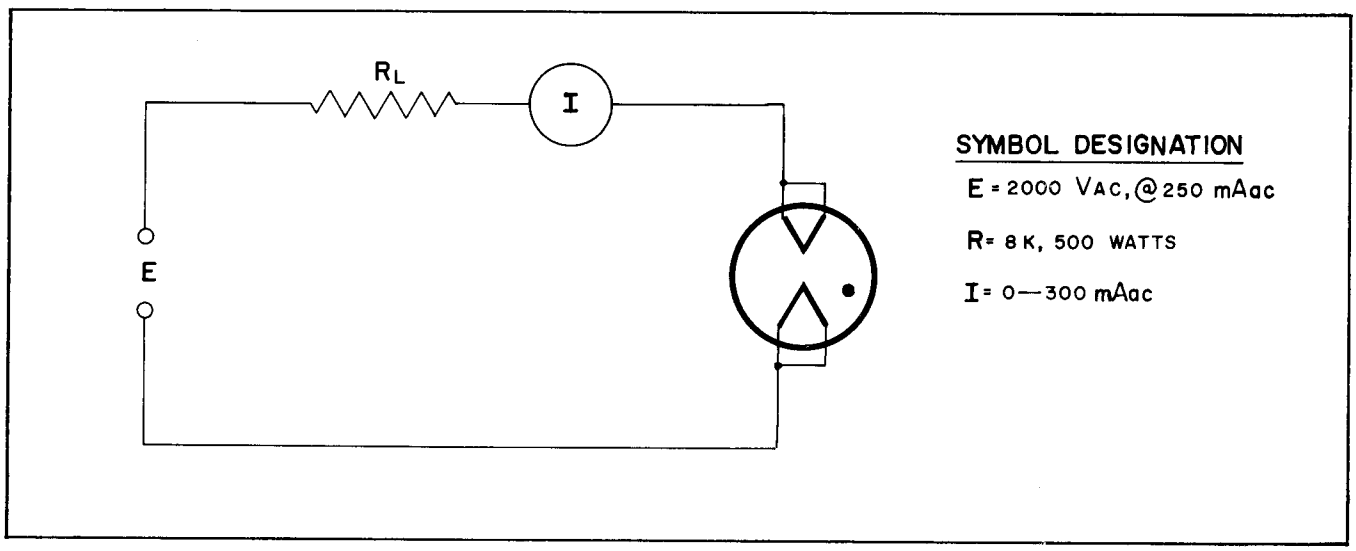


GAS NOISE SOURCE, ARGON

6782
Bendix Type TD-22



TYPICAL STARTING AND OPERATING CIRCUIT (DC)



TYPICAL STARTING AND OPERATING CIRCUIT (AC)

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

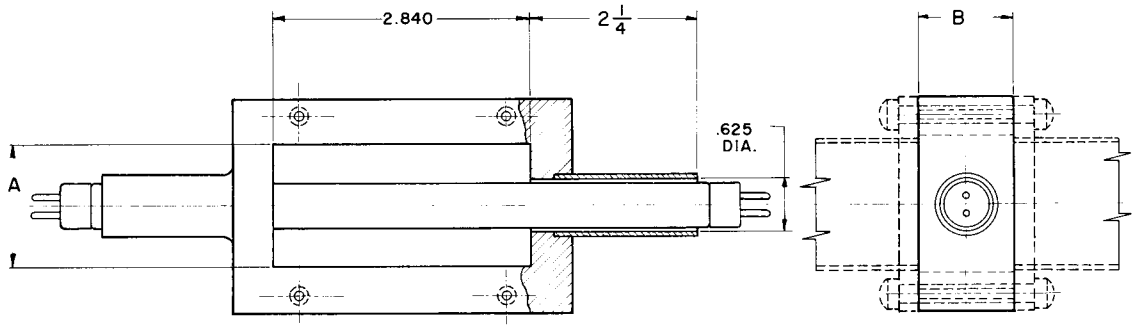
This tube may be operated either in a d-c circuit which provides a starting filament current or in an a-c circuit without initial filament operation. In either case the operating circuit should have sufficient series resistance to limit the current through the tube to the rated value during operation.

When used in the suggested mount assembly, the average operating voltage standing wave ratio (VSWR) at the design center frequency of the mount is 2.50 (±0.5) db. In such a mount when the tube is operated at the rated d-c current, ±20%, the excess noise coupled into the wave guide over the recommended transmission bandwidth of the mount is 8.85 (±0.25)db above 290°K. When the tube is operated in an a-c circuit, there is a small correction to the available excess noise depending on the circuit components and the a-c frequency.

When used in a 90° H-plane mount which is terminated by a piston adjusted to match the susceptance of the tube and mount, the excess noise coupled into the guide is 15.3 (±0.3)db above 290°K.

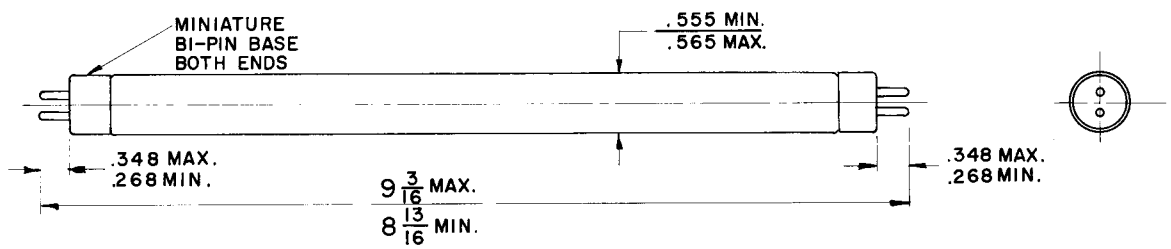
GAS NOISE SOURCE, ARGON

6782
Bendix Type TD-22



NOTE:
DIMENSIONS "A" & "B" ARE DETERMINED BY THE DESIGN CENTER FREQUENCY OF OPERATION.

SUGGESTED TYPE OF WAVEGUIDE MOUNT ASSEMBLY, RG-48/U



OUTLINE DRAWING

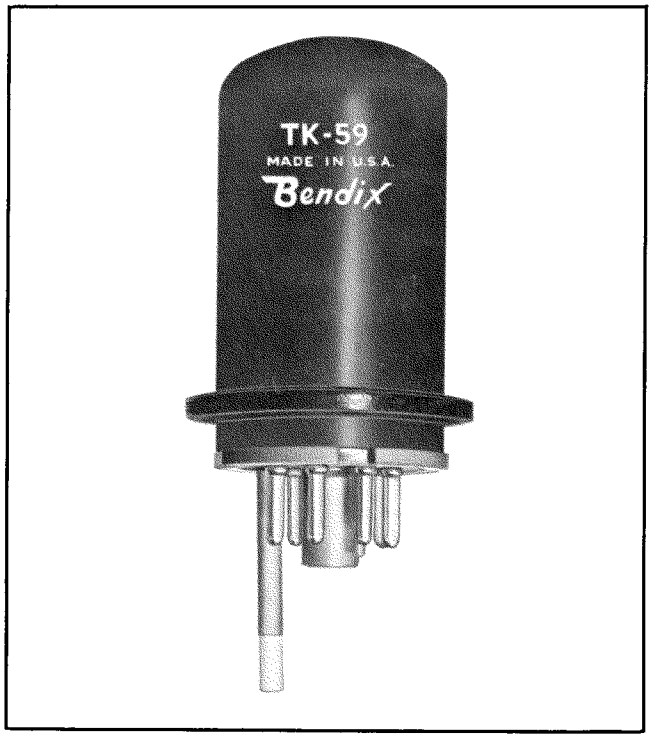
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

6845
Bendix Type TK-59

REFLEX KLYSTRON

(THERMALLY TUNED)



MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	350 volts D.C.
Reflector Voltage	—350 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 ma. D.C.
Diode Plate Dissipation	*see note below
Diode Voltage	—350 volts D.C.

*Note: Power inputs as high as 16.5 watts may be applied to the diode when the frequency of the klystron is above 8500. Tuner power in excess of 10 watts may permanently damage the tuning structure, if applied when the tube is tuned below 8500 Mc.

PHYSICAL CHARACTERISTICS

- *Base:* Small octal 8-pin, B8-21, Low Loss Phenolic Wafer, Modified for coaxial output lead as shown on outline drawing.
- *Coupling to Wave Guide:* Fits standard JAN 2K25 transducer.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Integral with tube.
- *Bulb:* Metal.
- Externally biased reflector shield allowing tube to be pulsed with minimum frequency modulation.

DESCRIPTION

The 6845 (Bendix® Type TK-59) tube is a ruggedized, low voltage, thermally tuned X-band reflex klystron, designed for use over a frequency range of 8500 to 9660 Mc/sec. Thermal tuning of the klystron is accomplished by means of a diode included within the vacuum envelope, the plate of which comprises one wall of the klystron cavity. As diode voltage, and hence current, is increased, expansion of the plate results in corresponding changes in the klystron cavity gap space causing the tube to tune.

With the exception of the diode tuner, the 6845 may be considered as a ruggedized version of the 2K45. It is also similar in electrical characteristics to the type 6116 (Bendix Type TK-39) with the exception that it is capable of pulse operation with minimum frequency modulation. Physical dimensions are comparable to those of the 6116 and 2K45.

The ruggedization feature of the tube permits it to be operated under severe vibration environments without sacrifice of frequency stability. Under vibration conditions of 10g acceleration at 50 cycles, the maximum frequency variation is ± 1.3 Mc./sec.

The tube has coaxial output as shown in the accompanying photograph and outline drawing, and is coupled to the waveguide circuit through a transducer identical to that used for the type 2K45, 2K25 and 6116 klystrons. Details of this transducer can be found in the Military Number 227 JAN specification sheet.

TYPICAL OPERATING CONDITIONS

Frequency	8500 to 9660 Mc./sec.
Resonator Voltage	300 volts D.C.
Reflector Voltage @ 9660 Mc./sec.	—95 to —145 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 mA D.C. (max.)
Tuner Diode Current	5 to 36 ma (D.C.)
Tuner Diode Voltage	170 to 275 volts D.C.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-24

Printed in U.S.A.

REFLEX KLYSTRON
(THERMALLY TUNED)

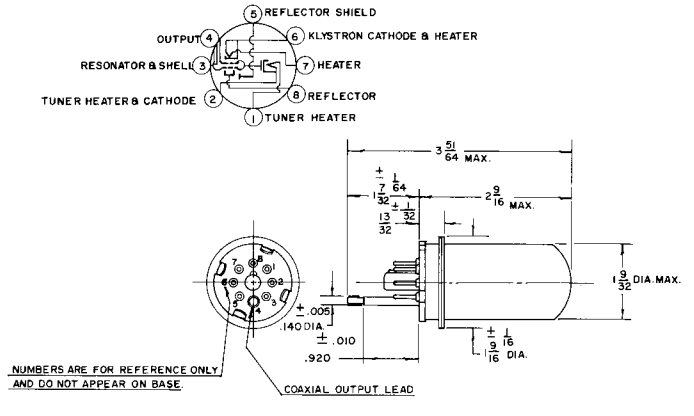
Bendix Type TK-59

6845

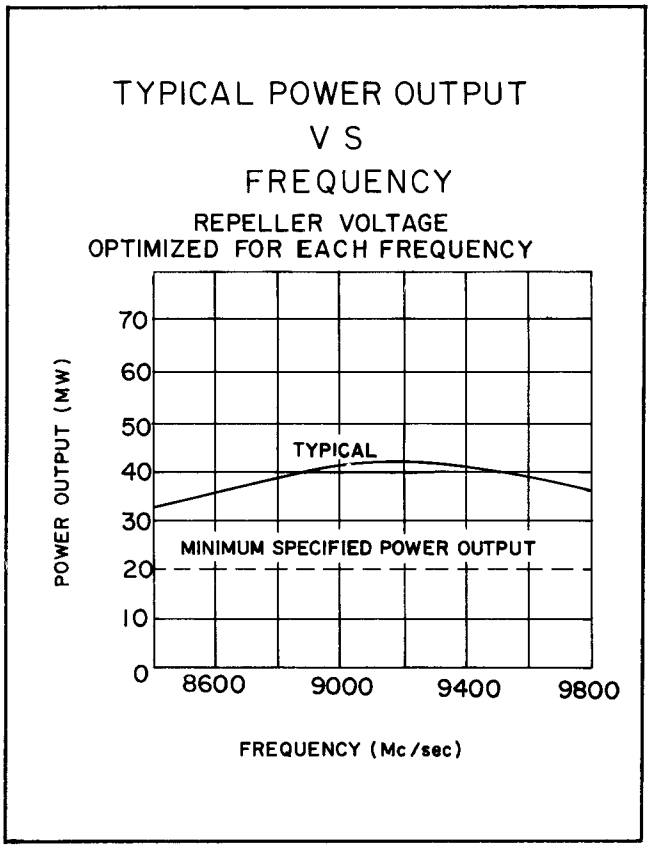
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

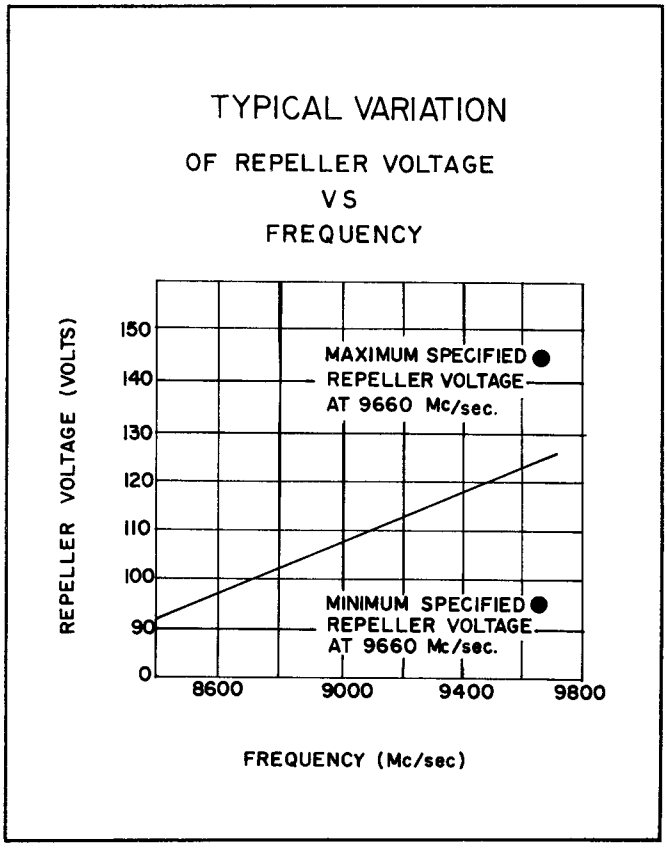
TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS:					
Total Reflector Current	Er = −150 Vdc t = 120 sec. (min)	Ir:	—	5.0	μAdc
Reflector Leakage:	Er = −150 Vdc	Ir:	—	3.0	μAdc
Reflector Gas Current:	Er = −150 Vdc	Ir:	—	2.0	μAdc
Cathode Current (1):	Er = −150 Vdc	Ikl:	—	32	mAdc
Reflector Voltage:	Er (Mode A)/Max. Po @ 9660 ± 0.3% Mc.	Er:	−95	−145	Vdc
Thermal Tuning Range:	Ef = 5.8 V				
	Er (Mode A)/Max. Po	Max. F:	9660	—	Mc
	Pp = 1.0 to 9.0 watts	Min. F:	—	8500	Mc
Bump:	Ef = 5.8; Er (Mode A)/Max. Po @ 9660 ± 0.3% Mc.	△Po/Po:	—	0.10	
Emission (1):	Ef = 5.8; Er = −150 Vdc	△Ik1/Ik1:	—	0.15	
Emission (2):	Ef = 5.8; Ik2 = 20 mA	△Ik2/Ik2:	—	0.10	
Thermal Tuning Time (1):	F = 9660 to 8500 Mc.	t:	0.7	3.0	sec.
Thermal Tuning Time (2):	F = 8500 to 9660 Mc.	t:	0.7	3.0	sec.
Vibration:	Er (Mode A)/Max. Po at 9080 Mc; Total displacement = 0.080" F = 50 cps, Position Y1 only	F:	—	±1300	Kc
Power Output:	Ef = 5.8; F from 8500 to 9660 Mc.	Po:	20	—	mW
DESIGN TESTS:					
Electrode Insulation:	300 Vdc Tube Cold	Rk1-rs:	2.0	—	Meg.
		Rk2-rs:	2.0	—	Meg.
Heater Current (1):		If1:	465	570	mA
Heater Current (2):		If2:	720	880	mA
Tuner Diode Voltage Drop (1):	Ik2 = 10 mAdc	ED:	170	218	Vdc
Tuner Diode Voltage Drop (2):	Ik2 = 28 mAdc	ED:	225	274	Vdc
Tuner Diode Voltage (1):	F = 9660 ±0.3% Mc. Er (Mode A)/Max. Po	ED:	170	230	Vdc
Tuner Diode Voltage (2):	F = 9080 ±0.3% Mc. Er (Mode A)/Max. Po	ED:	200	260	Vdc
Tuner Diode Voltage (3):	F = 8500 ±0.3% Mc. Er (Mode A)/Max. Po	ED:	220	275	Vdc
Tuner Diode Current (1):	F = 9660 ±0.3% Mc. Er (Mode A)/Max. Po	Ik2:	5	19	mA
Tuner Diode Current (2):	F = 9080 ±0.3% Mc. Er (Mode A)/Max. Po	Ik2:	13	28	mA
Tuner Diode Current (3):	F = 8500 ±0.3% Mc. Er (Mode A)/Max. Po	Ik2:	20	36	mA
Electrical Tuning Range:	Er (Mode A)/50% Max. Po: F from 8500 to 9660 Mc.	F:	45	—	Mc.



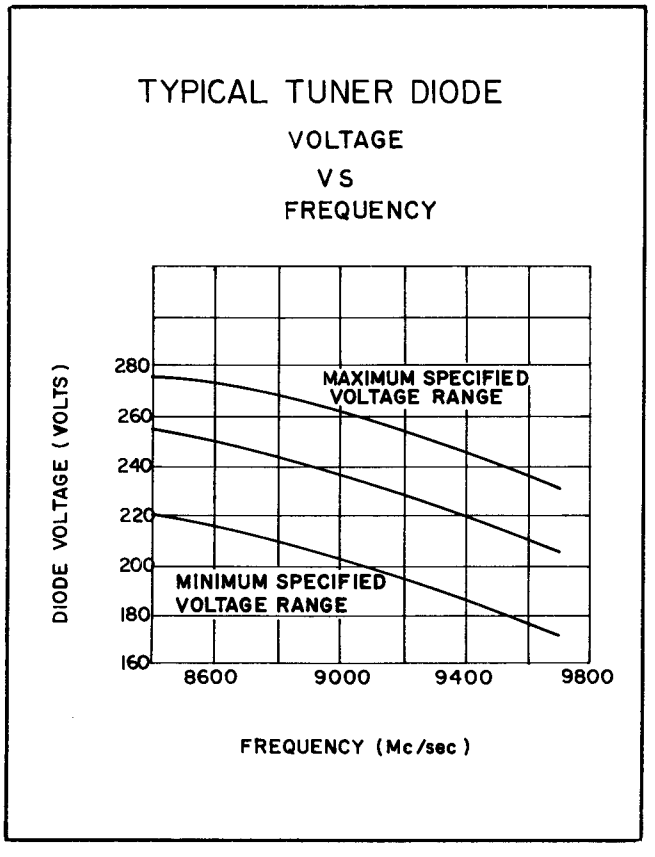
AVERAGE CHARACTERISTICS



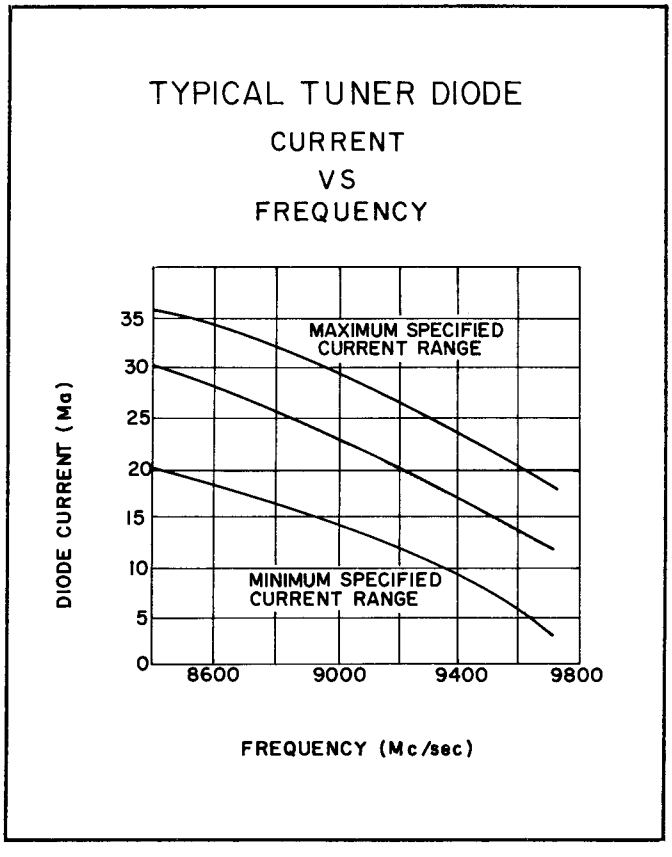
POWER OUTPUT VS FREQUENCY
REPELLER VOLTAGE OPTIMIZED FOR EACH FREQUENCY



REPELLER VOLTAGE VS FREQUENCY

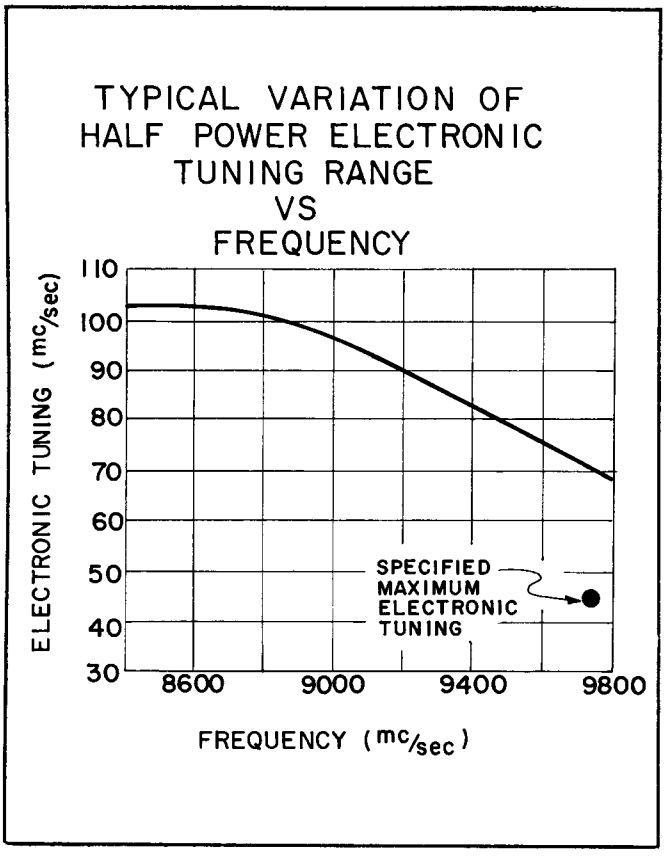


TUNER DIODE VOLTAGE VS FREQUENCY

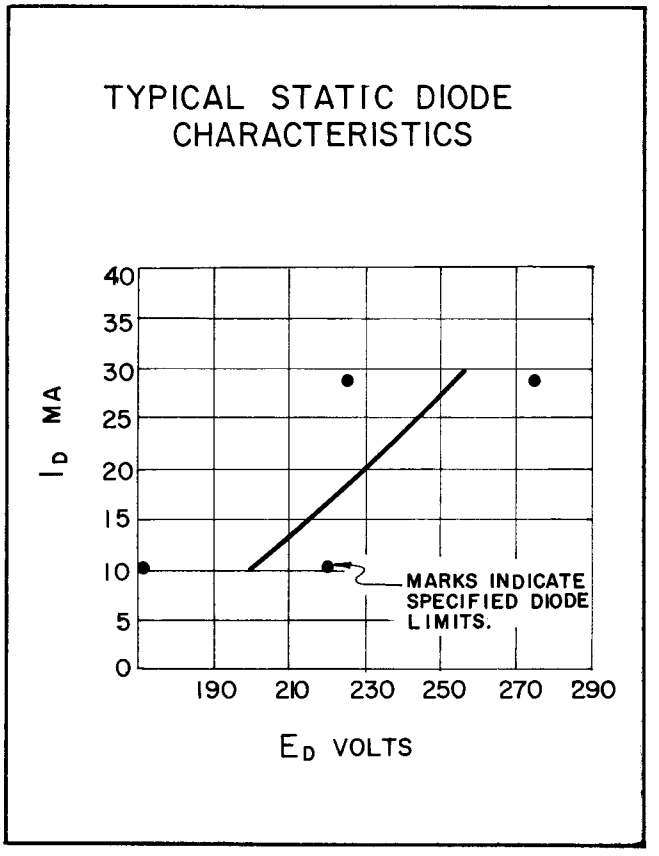


TUNER DIODE CURRENT VS FREQUENCY

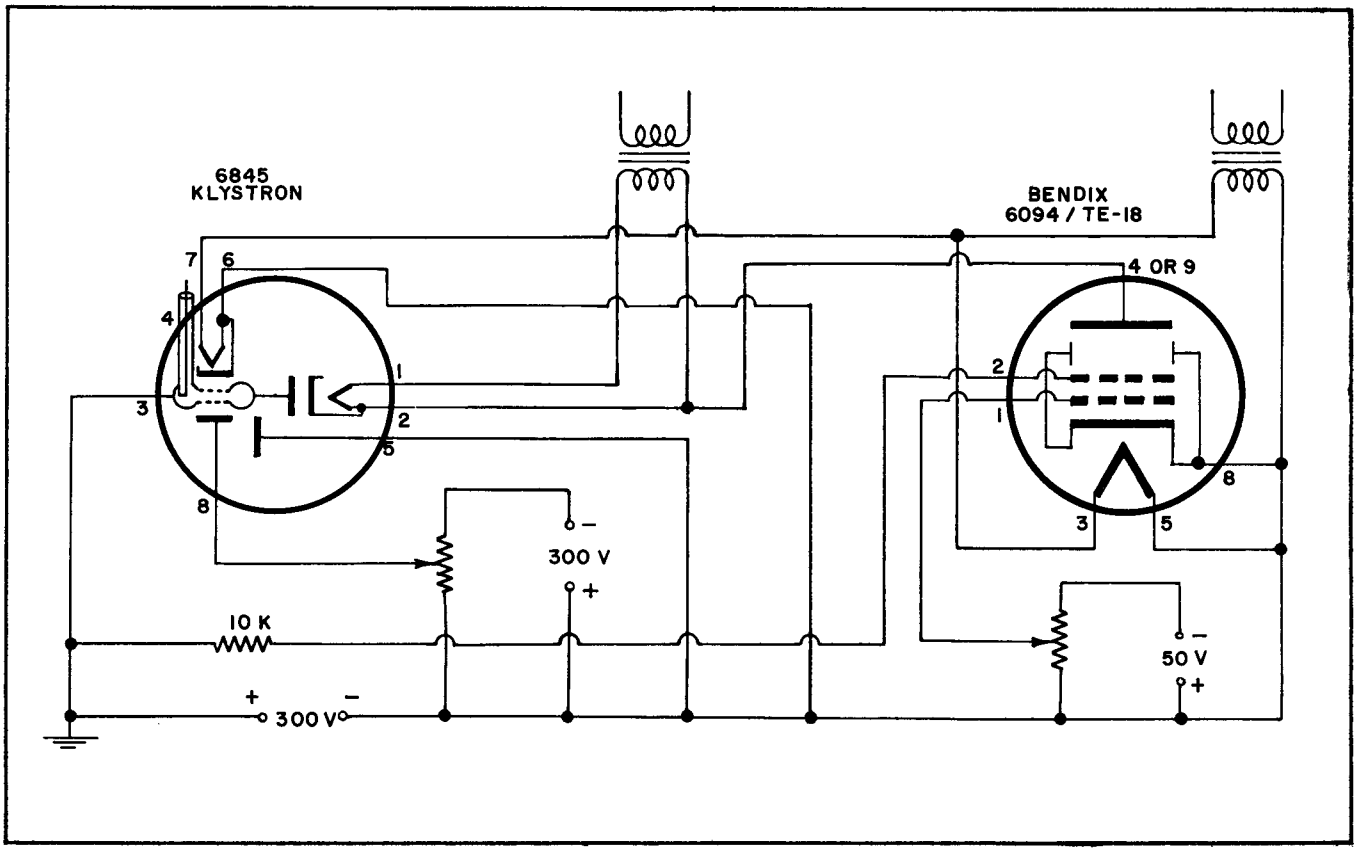
AVERAGE CHARACTERISTICS



HALF POWER ELECTRONIC TUNING RANGE VS FREQUENCY



STATIC DIODE CHARACTERISTICS



CONTROL CIRCUIT FOR TUNING DIODE

Bendix Aviation Corporation
Red Bank Division
Electron Tube Plant
Eatontown, New Jersey

TYPE 6851 (Tentative Data)
Miniature Hard Glass High Mu Double Triode

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	6-2
Bulb	T-6 1/2
Base	E9-1 miniature button, 9-Pin
Maximum bulb temperature	300°C
Maximum diameter	7/8
Maximum seated height	1-15/16
Maximum overall length	2-3/16

Pin connections

9A

Pin 1	#2 triode plate	Pin 6	#1 triode plate
Pin 2	#2 triode grid	Pin 7	#1 triode grid
Pin 3	#2 triode cathode	Pin 8	#1 triode cathode
Pin 4	Heater	Pin 9	Heater center tap
Pin 5	Heater		

Mounting position	any
Life expectancy	10,000 hrs

ELECTRICAL DATA

Direct interelectrode capacitances	#1 Triode	#2 Triode	
Grid to plate	1.4	1.4	μμf
Input	1.5	1.6	μμf
Output	0.36	0.36	μμf

Ratings

Heater voltage (ac or dc)	6.3	volts
Maximum heater-cathode voltage	300	volts
Maximum plate voltage	330	volts
Maximum plate dissipation	1.0	watts
Maximum cathode current	8	mA
Maximum grid circuit resistance	1.0	meg

Typical operating conditions and characteristics, class A1 amplifier

(each triode)		
Heater voltage (ac or dc)	6.3	volts
Heater current	250	mA
Plate voltage	250	volts
Cathode resistor	3100	ohms
Plate resistance	60,000	ohms
Transconductance	1200	μmhos
Amplification factor	70	
Plate current	1.0	mA

from JETEC release #1874, March 18, 1957

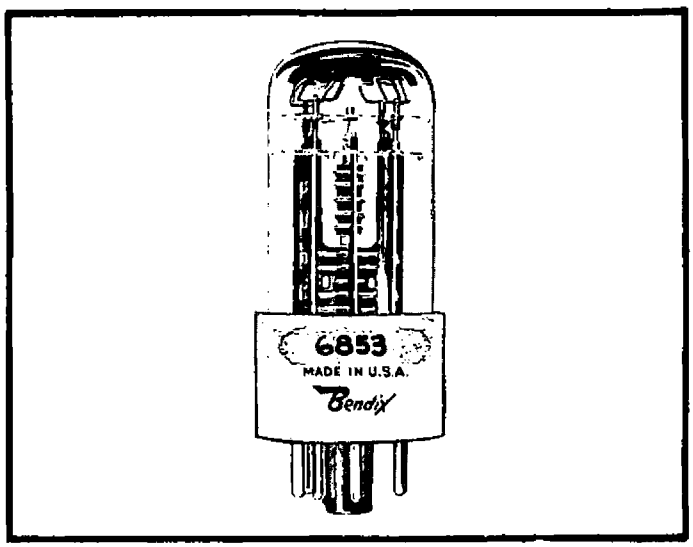
File Catalog: Special Purpose Electron Tubes
Section: Receiving Tubes

from JEDEC release #4135, Feb. 11, 1963

6853

Bendix Red Bank Type TE-45
(Generic Type 5Y3GT)

RELIABLE HARD GLASS FULL-WAVE RECTIFIER



ELECTRICAL RATINGS *

Heater voltage**	5.0 volts
Heater current	1.7 amps
Peak inverse voltage	1550 volts (max.)
Peak plate current (per plate)	415 mA (max.)
Peak surge current (per plate)	1.4 amps. (max.)
AC plate supply voltage and DC output currents	See Rating Chart 1
Cathode warm-up time	45 seconds
Total effective plate supply impedance – per plate	See Rating Chart 2

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

TYPICAL OPERATION

INPUT TO FILTER

	Capacitor	Choke
Heater voltage (volts)	5.0	5.0
Heater current (amperes)	1.7	1.7
RMS plate supply voltage (volts per plate)	350	500
Input condenser (μf)	4	–
Input choke (henries)	–	10
DC output current (mA)	125	125
DC output voltage (volts)	350	390

DESCRIPTION

This full-wave, high-vacuum rectifier is one of the Bendix Red Bank line of reliable vacuum tubes specifically designed for aircraft, military and industrial applications where freedom from early failures, long service life, and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under various overload, vibration, and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under actual operating conditions.

In addition, this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration, shock and other accelerations are encountered. Careful exhaust to a high degree of vacuum with thorough outgassing of all elements with electron bombardment is employed to ensure long life expectancy. A hard glass (nonex) bulb and stem with nickel pins are used. These, together with a conservative design center of cathode temperature, permit operation of these tubes up to bulb temperatures of 300° C, in contrast to an average of 175° C for soft glass bulbs.

The tube is designed to replace the 5Y3-GT and similar types in applications where severe environmental conditions are encountered, especially in airborne equipment. The cathode type structure instead of a filament structure insures against filament breakage under shock and vibration. The arc-resistant, compound-filled, glass bonded mica base with inter-pin barriers permits operation to an altitude of 80,000 feet. (See Altitude Ratings).

PHYSICAL CHARACTERISTICS

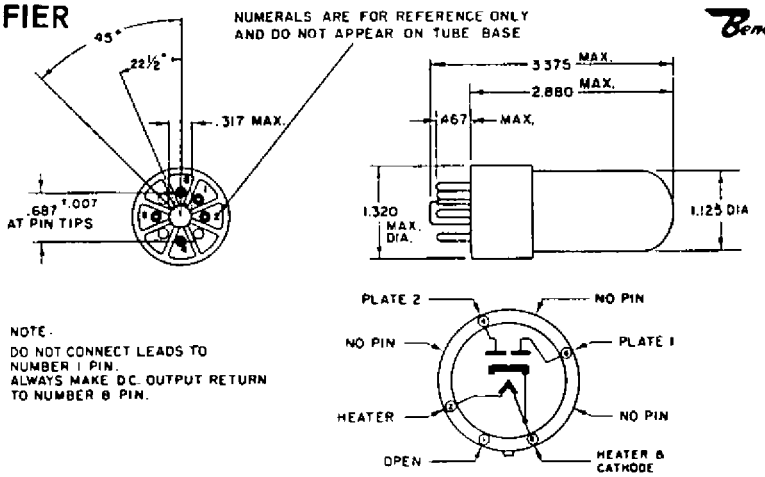
Base	Intermediate shell octal 5-pin (Glass bonded mica – with barriers)
Bulb	T-9
Max. overall length	3.375 in.
Max. seated height	2.880 in.
Max. diameter	1.320 in.
Mounting position	Any
Max. altitude***	80,000 ft.
Max. bulb temperature	300° C.
Life expectancy	10,000 hrs.

***See "Altitude Ratings"

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

FULL WAVE RECTIFIER

Bendix Red Bank Type TE-45
(Generic Type 5Y3GT)

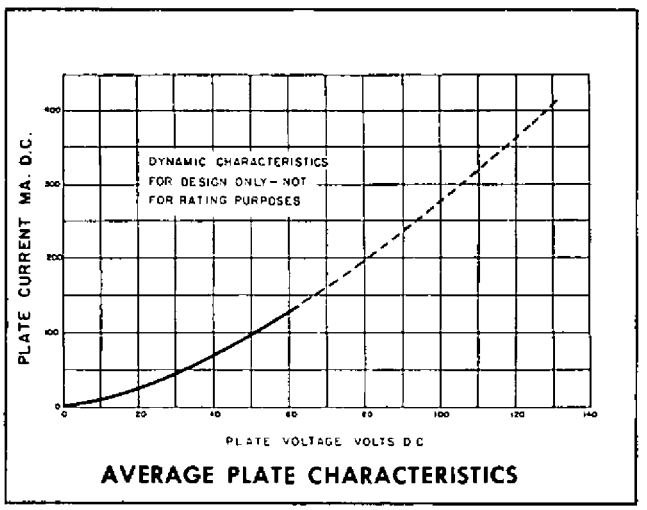


NOTE:
DO NOT CONNECT LEADS TO NUMBER 1 PIN.
ALWAYS MAKE D.C. OUTPUT RETURN TO NUMBER 8 PIN.

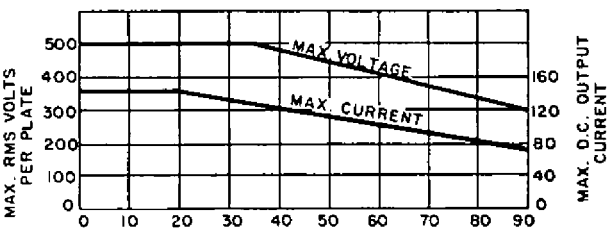
BASE DIAGRAM
(BOTTOM VIEW)

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

OUTLINE DRAWING



AVERAGE PLATE CHARACTERISTICS

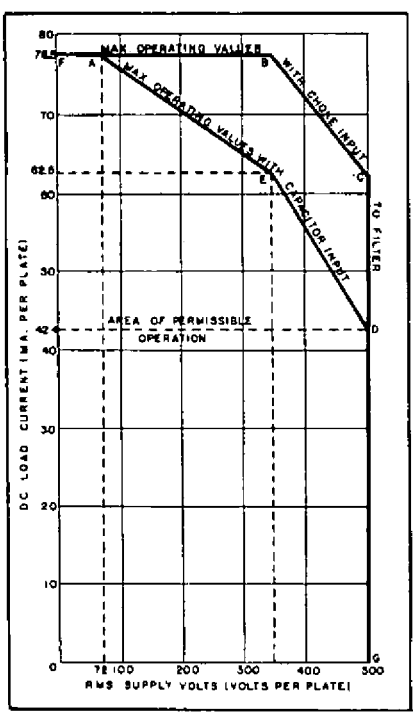


THIS CHART IS INCLUDED AS AN ILLUSTRATION OF THE AMOUNT OF CURRENT DERATING NECESSARY IN A SPECIFIC APPLICATION TO AVOID EXCEEDING THE MAXIMUM BULB TEMPERATURE. EACH APPLICATION SHOULD BE CHECKED TO DETERMINE THAT THE MAXIMUM BULB TEMPERATURE IS NOT EXCEEDED. EITHER DERATING OR COOLING OR BOTH MAY BE NECESSARY.

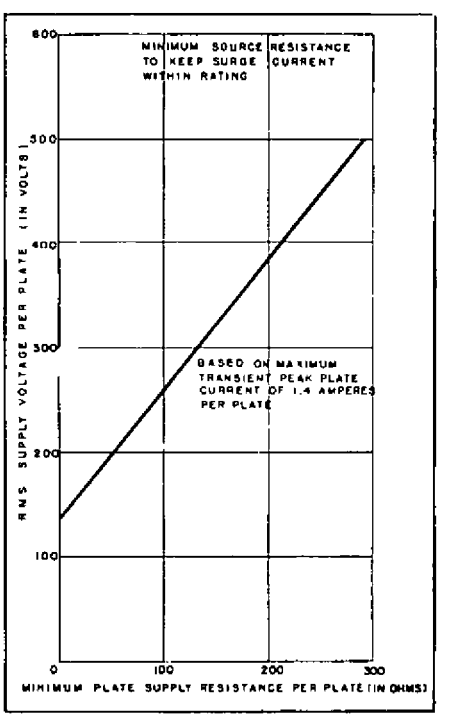
CRITERIA FOR DERATINGS FOLLOWS:-

1. VOLTAGE DERATING - TO KEEP BELOW BASE PIN ARC OVER POINT.
2. CURRENT DERATING – TO KEEP BULB TEMPERATURE BELOW MAXIMUM RATING.

ALTITUDE RATINGS



RATING CHART 1



RATING CHART 2

Publication No. RT21-11
Supersedes Pub. No. R01-11

Printed in U.S.A

Bendix Aviation Corp.
Red Bank Division
Electron Tube Plant
Eatontown, New Jersey

TYPE 6854 (Tentative Data)
Reliable Hard Glass Double Triode

MECHANICAL DATA

Coated unipotential cathode

Outline drawing	6-2	Bulb	T-6 1/2
Base	E9-1 miniature button, 9-Pin		
Maximum bulb temperature	300°C		
Maximum diameter	7/8		
Maximum seated height	1-15/16		
Maximum overall length	2-3/16		

Pin connections

9FV

Pin 1	Heater	Pin 6	#1 triode plate
Pin 2	#2 triode cathode	Pin 7	#1 triode grid
Pin 3	#2 triode grid	Pin 8	#1 triode cathode
Pin 4	#2 triode plate	Pin 9	Heater
Pin 5	Shield, internal		

Mounting position	any
Life expectancy	10,000 hrs

ELECTRICAL DATA

Direct interelectrode capacitances (each section)	Without Shield	
Grid to plate: (g to p)	1.7	µµf
Input: g to (h+k+i.s.)	2.4	µµf
Output: p to (h+k+i.s.)	1.1	µµf
Plate to plate	0.10	µµf
Ratings (each section)		
Heater voltage (ac or dc)	6.3	volts
Maximum plate voltage	300	volts
Maximum positive d-c grid voltage	0	volts
Maximum plate dissipation	1.5	watts
Maximum cathode current	20	mA
Maximum heater-cathode voltage	300	volts
Maximum grid circuit resistance	1.0	meg
Typical operating conditions and characteristics, class A1 amplifier (per section except where noted)		
Heater voltage (ac or dc)	6.3	volts
Heater current (both sections)	500	mA
Plate voltage	150	volts
Cathode bias resistor	240	ohms
Plate current	8.2	mA
Plate resistance (approximate)	6500	ohms
Transconductance	5225	µmhos
Amplification factor	35	
Grid #1 voltage for Ib=10µA	-8	volts

HY-G-300®

Bendix **6877** Type TE-48

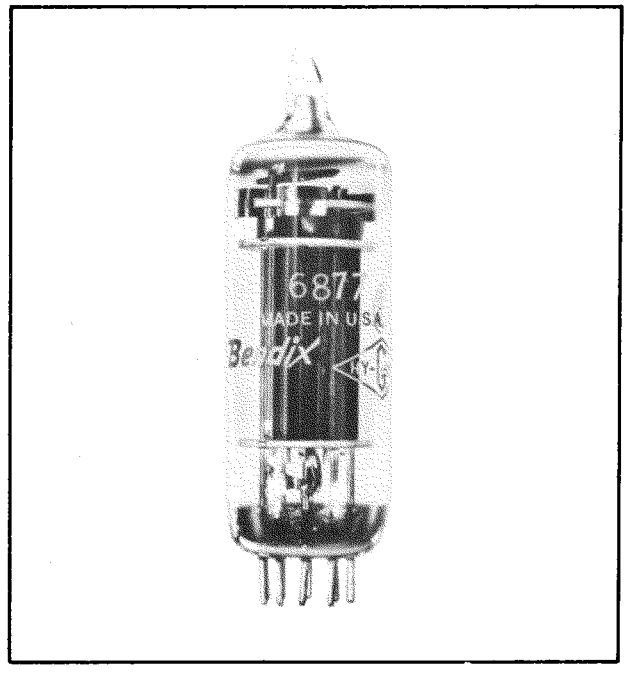
RELIABLE HARD GLASS MINIATURE LOW MU TRIODE

DESCRIPTION

One of the Bendix Red Bank line of HY-G-300 tubes, this miniature reliable hard glass, low Mu triode has been designed for use in voltage regulator circuits in aircraft, military and industrial applications where freedom from early failures, long average service life, uniform operating characteristics and minimum space requirements are extremely important. Each tube is given a 45 hour run-in under overload, vibration and shock conditions likely to be encountered in service. This run-in serves to reduce early failures by eliminating tubes with any minor defects that might lead to failure under operating conditions.

Since this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration and shock are encountered, special materials and techniques are employed. The hard glass bulb and tungsten stem seal construction are features similar to those found on many high-powered transmitting tubes. Careful exhaust to a high degree of vacuum, with thorough outgassing of all elements by means of electron bombardment, as well as the usual RF induction heating, insures maximum life expectancy. These factors, as well as a conservative design center of cathode temperature, permit operation of the 6877 at bulb temperatures up to 300°C. Moreover, because of the lower expansion (about 1/3 that of conventional receiving tube "soft glass"), greater resistance to thermal shock is attained.

This tube is constructed with ceramic spacers rather than the usual mica. Therefore, one of the most prevalent causes of tube failure is eliminated, namely, gas



evolution under vibration (from deteriorated mica) and subsequent loss of cathode emission. In addition, ceramic spacers contribute to a much sturdier structure, which is further strengthened by multi-pillar supports locked together with welded eyelets. Bulb snubbers are made with an alloy which retains its spring properties at the high temperatures under which this tube can operate.

The heavy-gauge heater construction, together with a pure alumina insulator, permits operation at high heater-cathode voltages. The large area cathode operating at moderate temperatures gives long service life. Small mass of the tube elements, multi-pillar mount locked together with eyelets, and increased electrode spacing provide rigidity, strength, and increased ability of the tube to withstand shock and vibration.

See the enlarged view on last page for the many improved features of this tube.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)**	6.3 volts
Heater Current	0.8 amp.
Plate Voltage (Maximum DC)	200 volts
Peak Plate Voltage (Max instantaneous)	400 volts
Plate Dissipation (Absolute Max)	12.0 watts
Cathode Current (Max DC Value)	100 mA
Cathode Current (Max Inst. Peak Value of continuous sine wave)	200 mA
Cathode Current (Max Inst. Peak Value) Pulse***	750 mA
Heater-Cathode Voltage (Max)	±450 volts
Grid Resistance (Max)	
Cathode Bias	1.0 Meg
Fixed Bias	0.1 Meg
Any combination of fixed and cathode bias	0.1 Meg
Grid Voltage (Max DC)****	+5.0 volts
(Min DC)	−150 volts
Cathode Warm-up time	45 seconds
(plate and heater voltage may be applied simultaneously)	

*To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously. See application notes.

**Voltage should not fluctuate more than ±5%.

***Short duration pulses only.

****Limit grid current to 5 mA max.

CHART 2. MECHANICAL DATA

Base	9-Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6½
Max Overall Length	3"
Max Seated Height	2¾"
Max Diameter	⅞"
Mounting Position	any
Max Altitude	80,000 feet
Max Bulb Temperature	300°C
Max Impact Shock	500G
Max Vibrational Acceleration	50G
(100 hour shock excited fatigue test, sample basis)	
Life Expectancy	10,000 hrs.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R710-9

Printed in U.S.A.

MINIATURE LOW MU TRIODE

6877

Bendix Type TE-48

ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 3.

TEST CONDITIONS AND CHARACTERISTIC LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps Prior to 100% Testing.

CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX	UNITS
PRODUCTION TESTS:					
Short and Continuity					
Heater Current	If	0.74	0.80	0.86	A
Heater Cathode Leakage (Ehk = ± 450 Vdc)	Ihk	—	—	25	μAdc
Grid Current	Ic1	—	—	—1.0	μAdc
Plate Current	Ib	60	75	90	mAdc
Transconductance (1)	Sm	5500	6500	7500	μmhos
Cut off Plate Current (Ec1 = — 100 Vdc)	Ib			2.0	mAdc
DESIGN TESTS					
Transconductance (2) (Ef = 5.7 V)	△ Sm			10%	
Grid Emission (Ef = 7.5 V)	Ic1	—	—	—5.0	μAdc
ELECTRODE: Ef	Eb		Ec1		Ehk
TEST CONDITIONS: 6.3 volts	100 Vdc		—12 Vdc		0 Vdc

CHART 4.

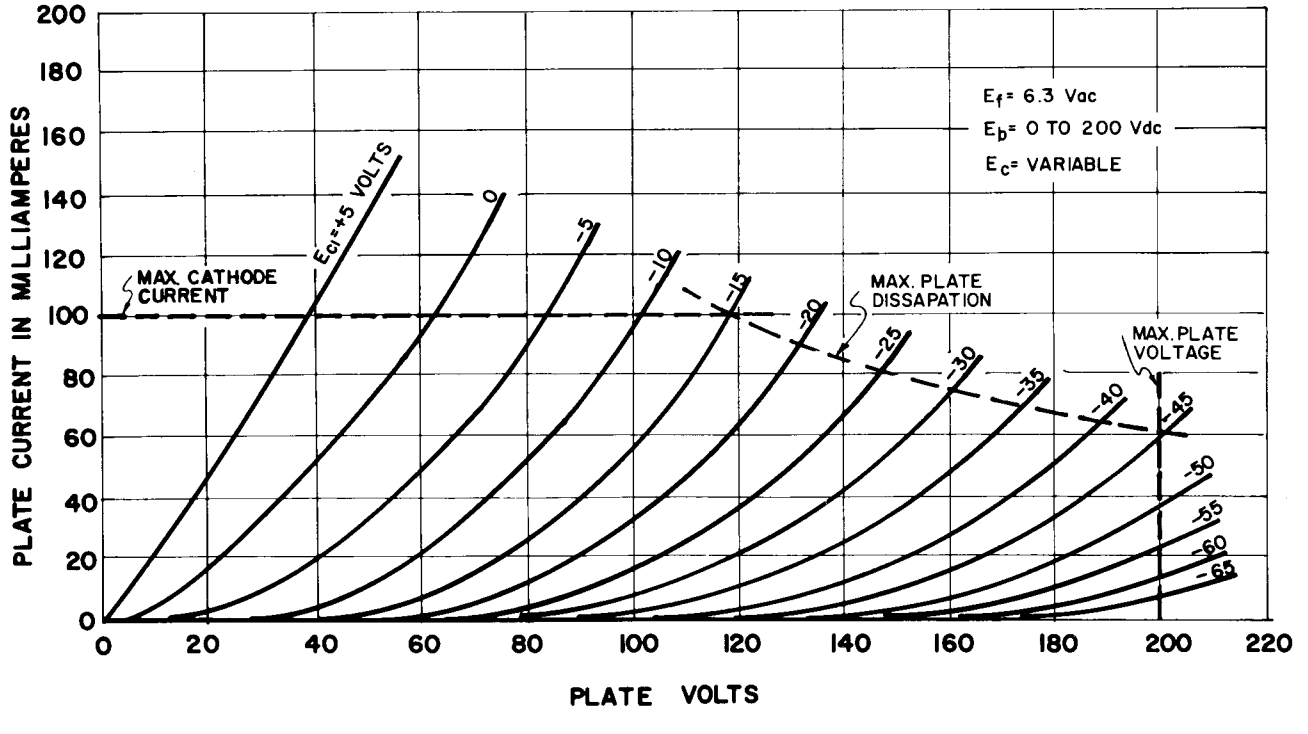
ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min Off 4 Min Ef = 7.5V Ehk = 300 Vac	2,000 On-Off Cycles
High Temp Life Test	Under "Test Conditions" at 12W Plate Dis. Bulb Temp. 300°C	1,000 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 15 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Mount Inspection	100% Test-Microscopic Inspection of 30 Possible Trouble Points	
Swept Freq Fatigue	2.5G—F = 50—500—50 CPS in two minutes	32 Hours in each of three planes

CHART 5.

AVERAGE PLATE CHARACTERISTICS



MINIATURE LOW MU TRIODE

6877

Bendix Type TE-48

APPLICATION NOTES

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 will 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.

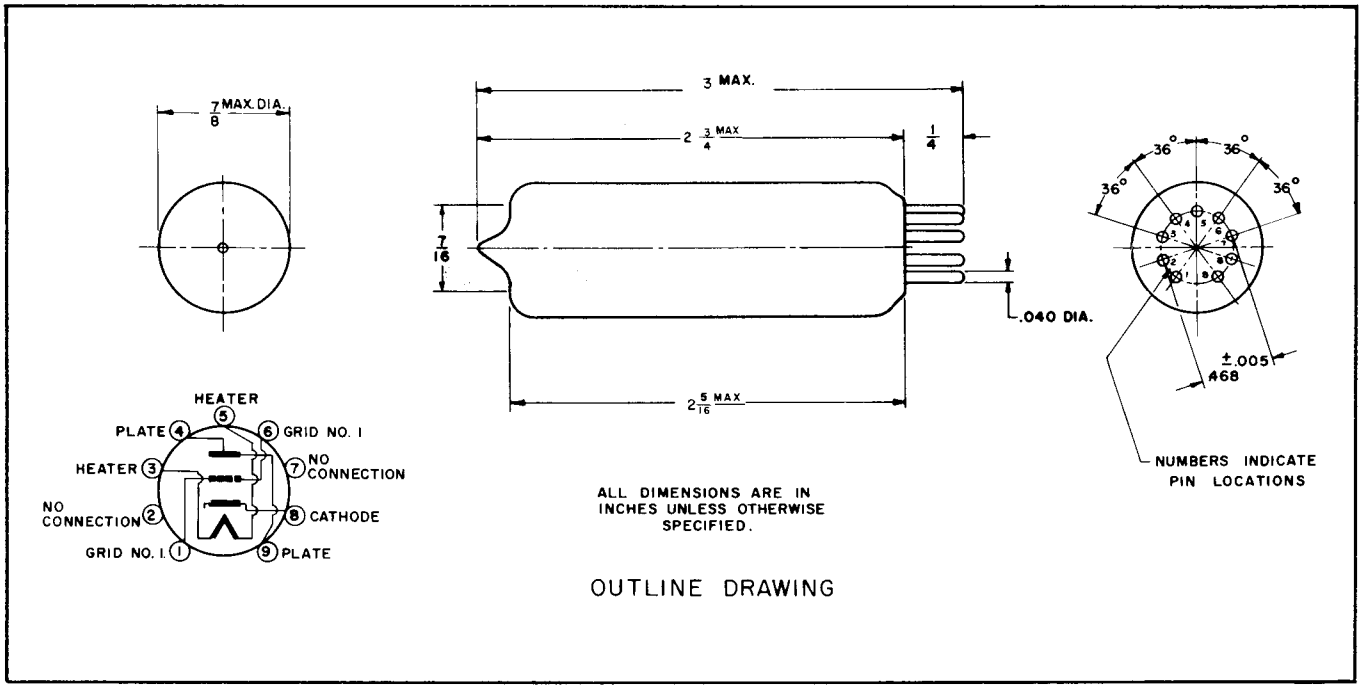
This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment or dissipation derating must be applied. The dissipation derating must be measured for each application because of the additive effects mentioned above.

Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 10,000 hours.

CHART 6.

EFFECT ON LIFE OF INCREASED RATINGS

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTIC	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	100 Vdc	150 Vdc	200 Vdc
Peak Plate Voltage	200 V	300 V	400 V
Plate Current (Av.)	50 mA	75 mA	100 mA
Cathode Current (Peak)	100 mA	150 mA	200 mA
H-K Voltage	200 V	300 V	450 V
Grid Resistance (Fixed Bias)	50,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	200°C	250°C	300°C
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

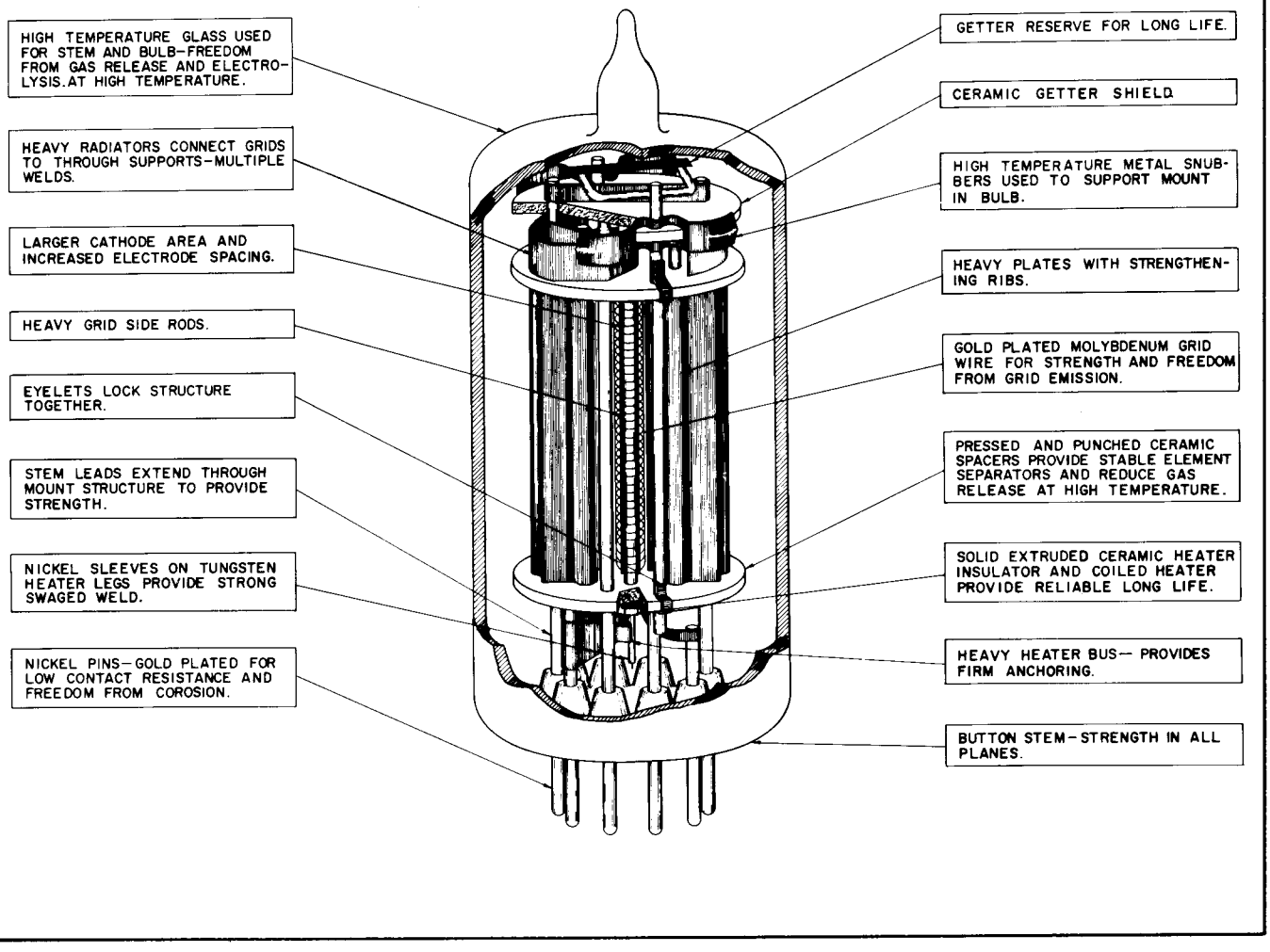


OUTLINE DRAWING

MINIATURE LOW MU TRIODE

6877

Bendix Type TE-48



STRUCTURAL FEATURES OF 6877 PROVIDE HIGH RELIABILITY AND LONG LIFE

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.

Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

BENDIX AVIATION CORPORATION
RED BANK DIVISION
ELECTRON TUBE PLANT
EATONTOWN, NEW JERSEY

September 20, 1957

TYPE 6881
Red Bank Type TD21

SUBJECT: TECHNICAL DATA

DESCRIPTION: GAS NOISE SOURCE - ARGON

This tube is designed for use as a noise source in UHF measurements. It is constructed for use with a 90° H plane mount in RG-69U waveguide or equivalent to provide noise in the 1.12 to 1.70 KMC frequency range. When used in a properly matched mount it functions essentially as an untuned noise generator over the recommended transmission bandwidth of the mount. When used in a 90° H plane mount which is terminated by a piston adjusted to match the susceptance of the tube and mount, the excess noise coupled into the guide is 15.2 Db above 290°K.

This tube may be operated in a D.C. circuit which provides a starting filament current. The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value during operation.

The use of pure inert gas eliminates any dependence of noise output on operating temperature. The noise source is available for measurement at practically zero warm-up time. The performance of the tube is non-critical with respect to variations in the discharge current.

Mechanical Data

Coated filamentary cathode	-	ionically heated
Maximum diameter	-	1.55"
Maximum overall length	-	15"
Base - Cathode End	-	Bipin
Base - Anode End	-	Single pin
Mounting Position	-	any

Electrical Data

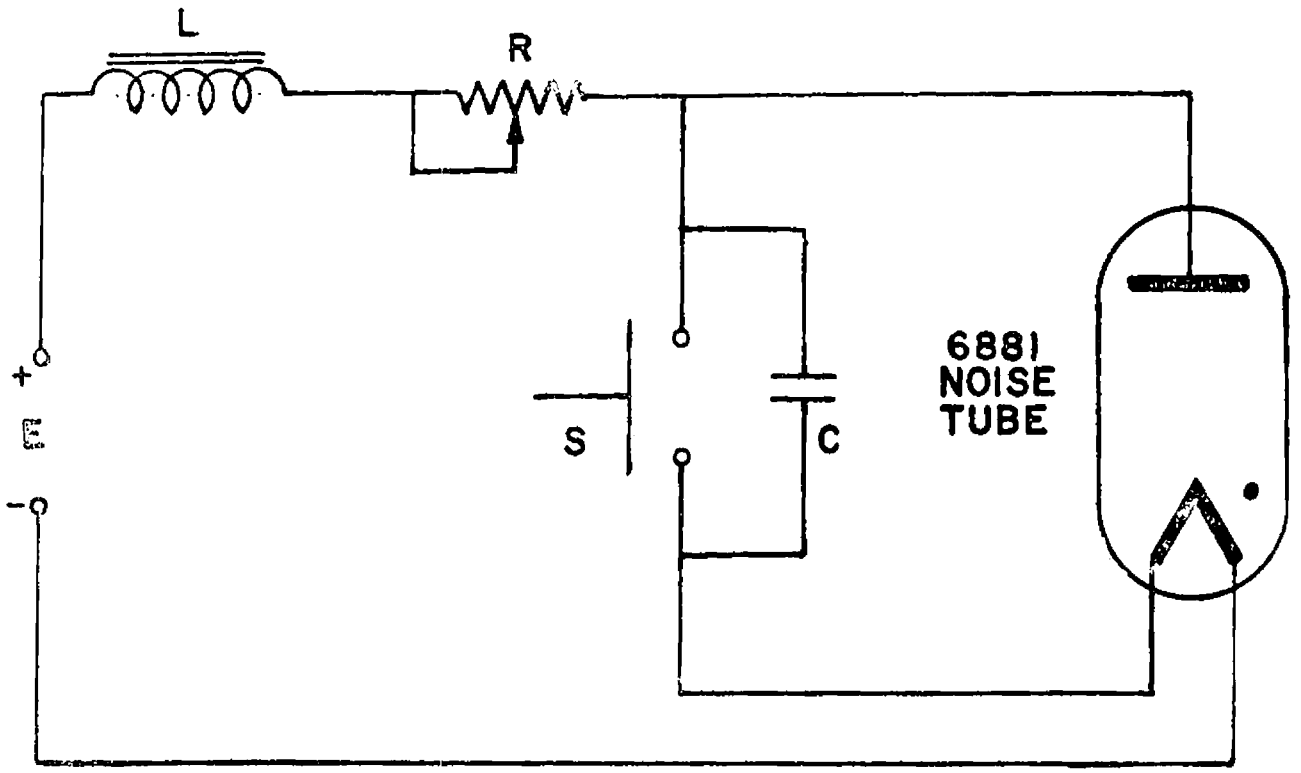
Anode Current	-	250 mAdc
Filament Current	-	350 mAdc
Tube Drop	-	65 Vdc
Tube Dissipation	-	16 watts
Ambient Temperature	-	(-)55°C min.
Bulb Temperature	-	(+)125°C max.

from JETEC release #2029, Oct. 28, 1957

GAS NOISE SOURCE, ARGON

TYPE 6881
RED BANK TYPE TD2I

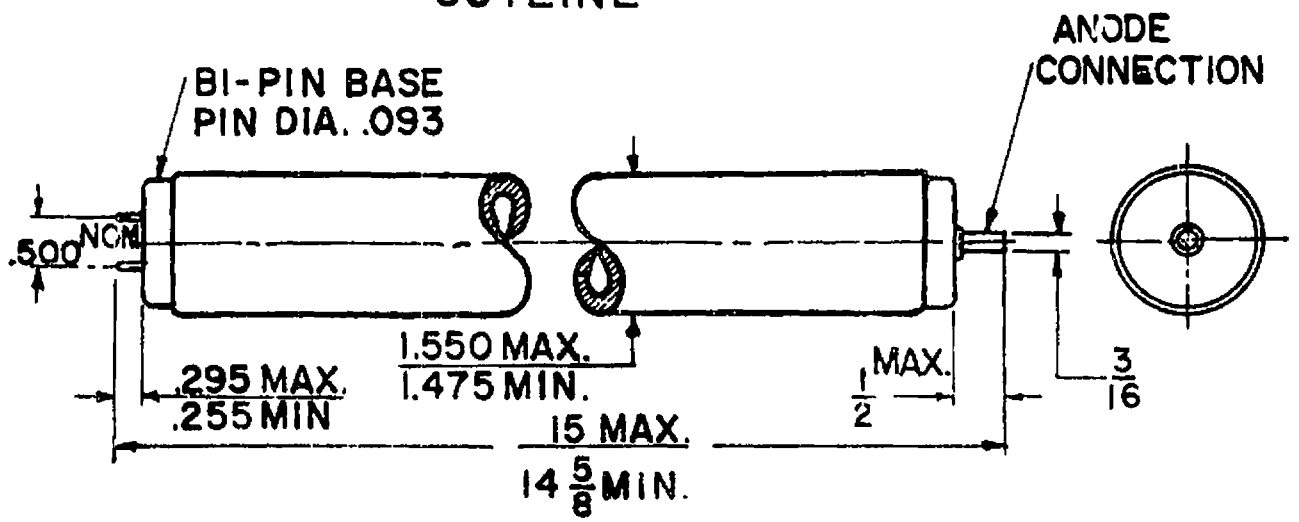
TYPICAL OPERATING CIRCUIT



E= 250 VDC
L= 2 HY - 250 MA
C= .002 MFD - 2500 V

S= N.O. MOMENTARY
R= 750 ~ 50W ADJUST
FOR 250 MA

OUTLINE



Bendix* 6882
Type TD-23

GAS NOISE SOURCE, NEON



RATINGS

Anode Current	200 mAdc
Filament Voltage	9-15 Vdc
Filament Current	170 mAdc
Tube Dissipation	23 Watts
Tube Voltage Drop	115 Volts
Ambient Temp. Range	−40°F to +165°F

* Trademark

DESCRIPTION

This tube is designed for use as a noise source in super high frequency (SHF) measurements. It is constructed for use with the RG-52/U waveguide to provide noise in the 2.4 - 3.6 cm waveband. When used in the standard mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement at zero warm-up time with little change due to ambient temperature variations.

The performance of the tube is non-critical with respect to variations in the discharge current.

The maximum voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is about 1.15. The noise temperature is 18 ± 0.5 db above 290° K.

The operating circuit should have sufficient series resistance to limit the current through the tube to the rated value after the starting period.

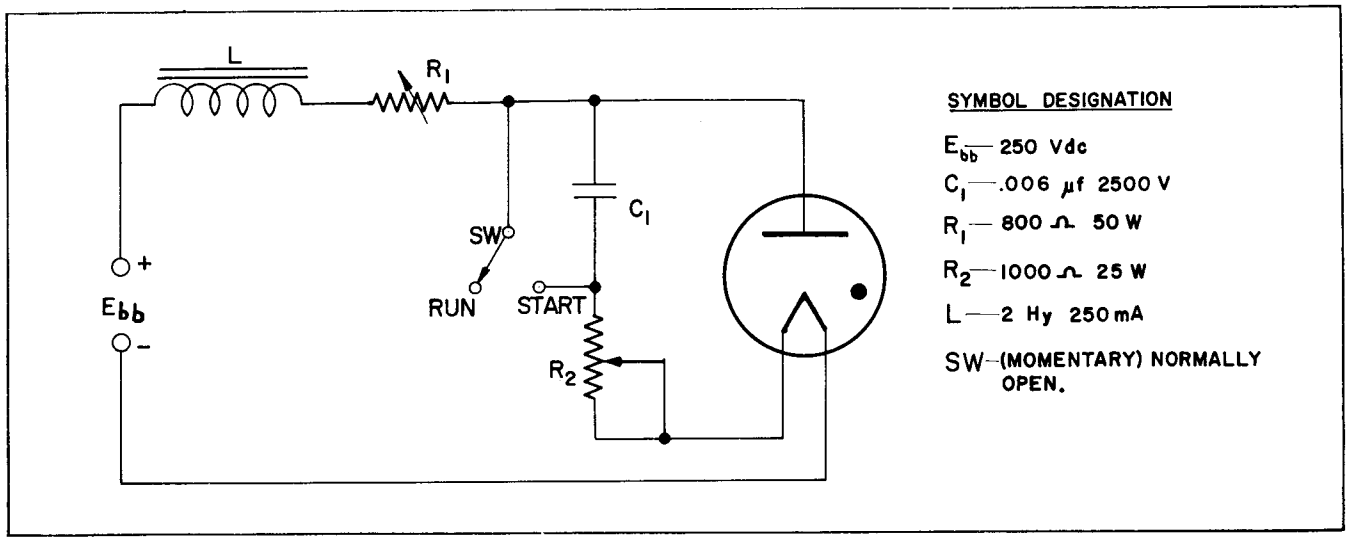
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 611-6

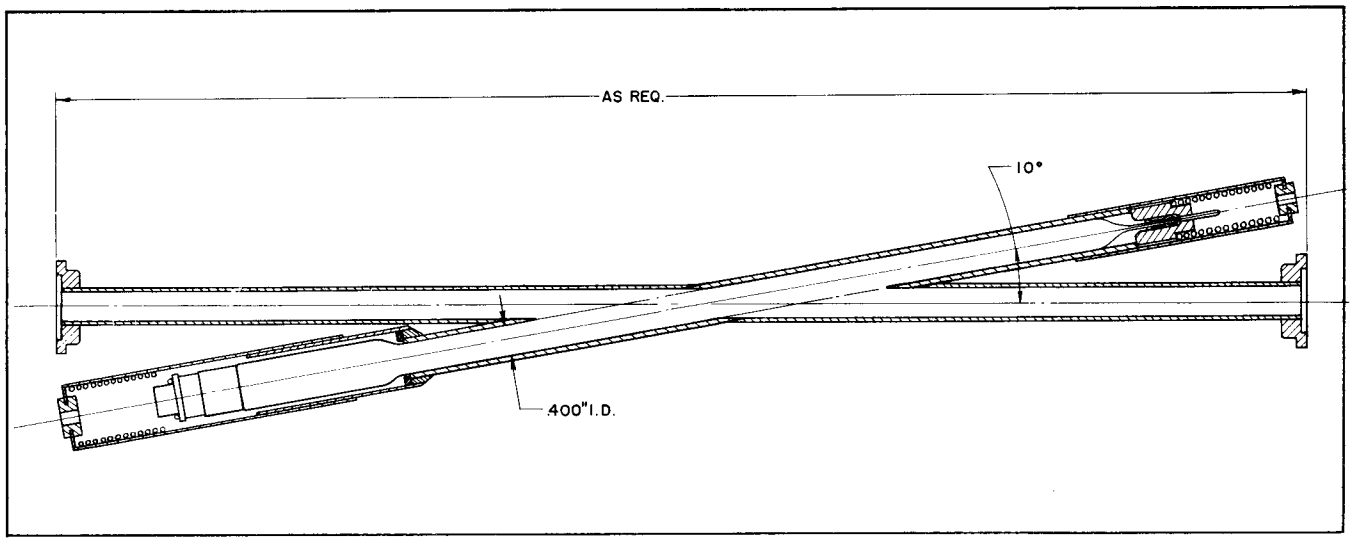
Printed in U.S.A.

GAS NOISE SOURCE

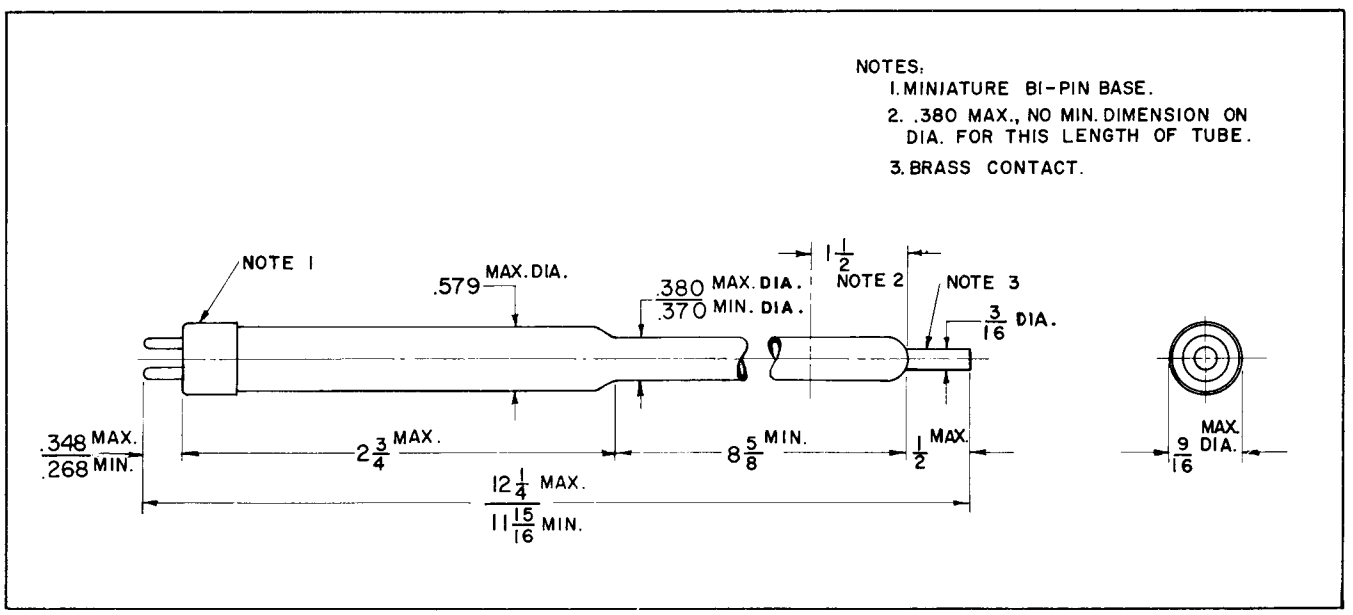
6882
Bendix Type TD-23



TYPICAL STARTING AND OPERATING CIRCUIT



WAVEGUIDE MOUNT ASSEMBLY RG-52/U



OUTLINE DRAWING

HY-G-300®

6889

Bendix® Type TE-52

RELIABLE HARD GLASS BEAM POWER AMPLIFIER FOR PULSE AND HIGH VOLTAGE REGULATOR SERVICE

DESCRIPTION

One of the Bendix line of HY-G-300 tubes, this high-perveance beam power amplifier has been designed for use in aircraft, military and industrial applications where freedom from early failures, long average service life and uniform operating characteristics are extremely important. Each tube is given a 45-hour run-in under overload. This run-in serves to reduce early failures that might lead to failure under operating conditions. These tubes are also conditioned to operate in high voltage circuits such as high-voltage regulators, and pulse applications.

Since this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration and shock are encountered, special materials and techniques are employed. The hard glass bulb and tungsten stem seal construction are features similar to those found on many high-powered transmitting tubes. Careful exhaust to a high degree of vacuum, with thorough outgassing of all elements by means of electron bombardment, as well as the usual RF induction heating, insures maximum life expectancy. These factors, as well as a conservative design center of cathode temperature, permit operation of the 6889 at bulb temperatures up to 300°C. Moreover, because of the lower expansion of the hard glass bulb (about ⅓ that of conventional receiving tube "soft glass"), greater resistance to thermal shock is attained.

The use of more refractory materials such as ceramics and hard glass, together with proper material treatment and high vacuum exhausting, provides a tube free from transient outgassing and contaminants likely to cause difficulty at high voltages in applications subject to unusual shock and vibration environments.



Other special features include a rugged, pure tungsten, helical heater which is used with a high purity aluminum oxide insulator, enabling reliable operation at high heater-cathode voltages. Also featured is a ceramic shield which prevents getter flash from forming inter-electrode leakage paths.

The design of this tube is a result of extensive engineering evaluation on special impact vibration equipment in which the accelerations equal or exceed those encountered in severe aircraft applications. The shake table used for these studies shock excites the tubes at a repetition rate of 15 cycles per second with a minimum peak acceleration of 50G. These tests indicate that the Bendix 6889 will survive thousands of hours longer, under extremely adverse conditions.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)	6.3 volts
Heater Current	1.20 amps
Plate Voltage (Max DC)	3000 volts
Screen Voltage (Max DC)	850 volts
Plate Dissipation (Absolute Max)	30 watts
Screen Dissipation (Absolute Max)	3.5 watts
Cathode Current (Max DC Value)	125 mA
Cathode Current (Max Inst. Peak value—of continuous sine wave)	250 mA
Cathode Current (Max Inst. Peak Value) Pulse***	4.5 amps
Heater-Cathode Voltage (Max)	±450 volts
Grid Resistance (Max)	0.1 megohm
Grid Voltage (Max DC)	+5.0 volts
(Min DC)	—200 volts
(Max Inst. Peak Value) Pulse***	+220 volts
Cathode Warm-up Time	45 seconds

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously. See application notes.

**Voltage should not fluctuate more than ±5%.

***See pulse rating chart.

CHART 2. MECHANICAL DATA

Base	Intermediate (short) Shell Octal (6-pin) (Glass filled Mica)
Bulb	Nonex Glass—T-11
Max Overall Length	3-29/32"
Max Seated Height	3-3/8"
Max Diameter	1-7/16"
Mounting Position	Any
Max Altitude	80,000 feet
Max Bulb Temperature	300°C
Max Impact Shock	500G
Max Vibration Acceleration (100-hour shock excited fatigue test, sample basis)	50G
Life Expectancy	10,000 hours

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. RO6-27

Printed in U.S.A.

BEAM POWER AMPLIFIER
(PULSE)

MY-G-300

6889
Bendix Type TE-52

ELECTRICAL CHARACTERISTICS AND ENVIRONMENTAL TESTS

CHARACTERISTIC TESTS

CHART 3.

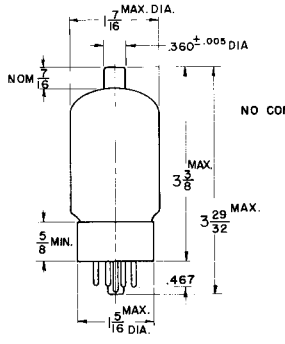
CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX	UNITS
PRODUCTION TESTS					
Short and Continuity					
Heater Current	If	1.12	1.20	1.28	A
Heater Cathode Leakage (Ehk = ± 450 Vdc)	Ihk	—	—	50	μAdc
Grid Current	Ic1	—	—	−0.5	μAdc
Plate Current	Ib	60	77	94	mAdc
Screen Grid Current	Ic2	0.5	3.5	6.5	mAdc
Transconductance (1)	Sm	4500	5400	6300	μmhos
Cut off Plate Current (Ec1 = −185, Eb = 3000)	Ib	—	—	1.0	mAdc
DESIGN TESTS					
Transconductance (2) (Ef = 5.7 V)	△Sm	—	—	10%	
Accelerated Grid Current (Ef = 7.0 V)	Ic1			−1.0	μAdc
Pulsed Operation	ib	4.0	—	—	a

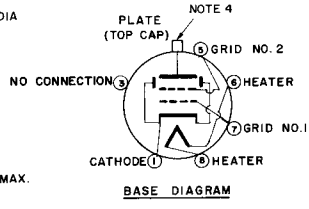
ELECTRODE	Ef	Eb	Ec2	Ec1	Ehk
TEST CONDITIONS	6.3 volts	250 Vdc	250 Vdc	−22.5 Vdc	0 Vdc
PULSE TEST CONDITIONS	6.3 volts	1200 Vdc	750 Vdc	−200 Vdc	0 Vdc

ENVIRONMENTAL TESTS

CHART 4.

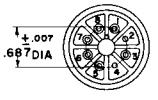
TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min Off 4 Min Ef = 7.0 Ehk = 300	2,000 On-Off Cycles
Survival Rate Life Test	Under "Test Conditions" at 30 W Plate Dis.	100 Hours
Pulse Life Test	ib = 4.0 A	500 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 15 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Swept Freq Fatigue	5G—F = 50—500 CPS	96 Hours





BASE DIAGRAM

NOTES:
1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. SHORT INTERMEDIATE SHELL OCTAL 6-PIN BASE.
3. NUMBERS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON BASE.
4. CAP: SMALL CI-1



OUTLINE DRAWING

CHART 5.

AVERAGE PLATE CHARACTERISTICS

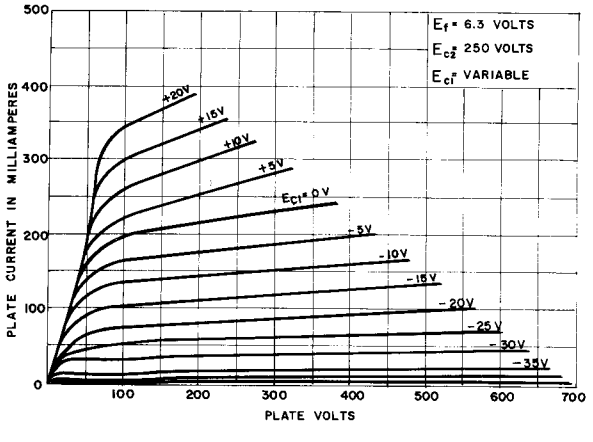
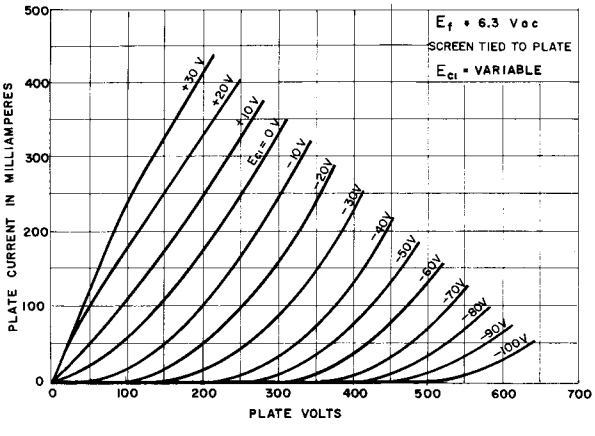


CHART 6.

TYPICAL TRIODE CHARACTERISTICS



BEAM POWER AMPLIFIER
(PULSE)

MV-G-300

6889
Bendix Type TE-52

ADDITIONAL PENTODE CHARACTERISTICS

CHART 7.

TYPICAL PLATE CHARACTERISTICS

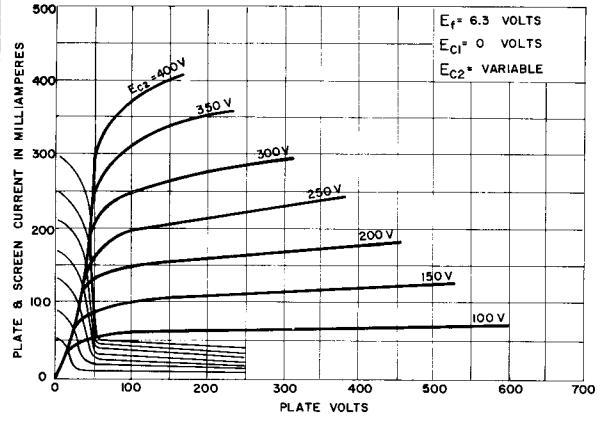


CHART 8.

TYPICAL PLATE CHARACTERISTICS

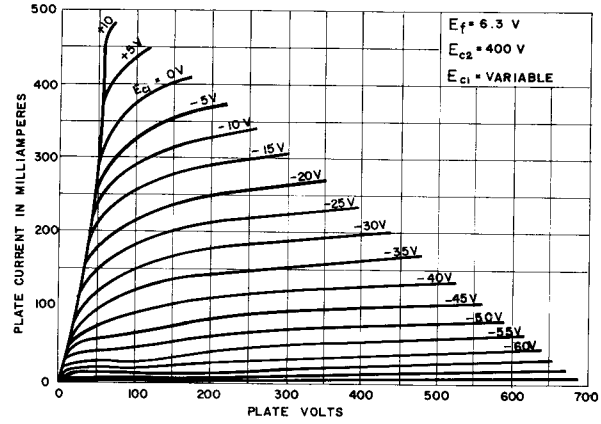
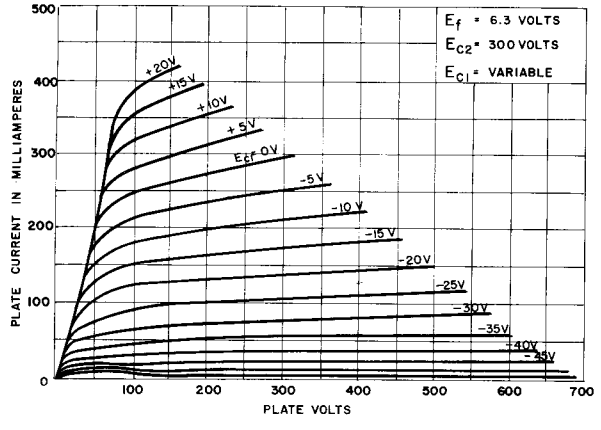


CHART 9.

TYPICAL PLATE CHARACTERISTICS



PULSE CHARACTERISTICS

See CHART 13 page 4 (Pulse Ratings)

CHART 10.

TYPICAL PULSE CHARACTERISTICS

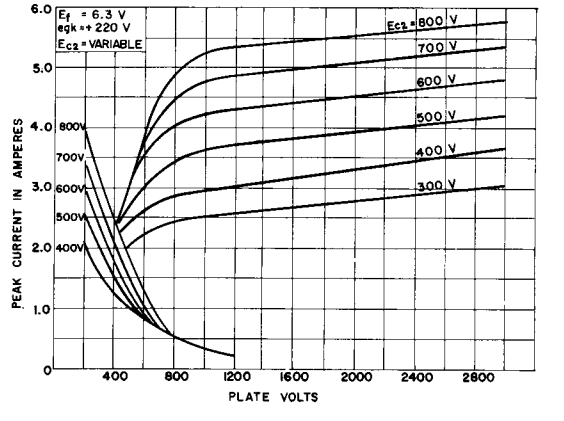


CHART 11.

TYPICAL PULSE CHARACTERISTICS

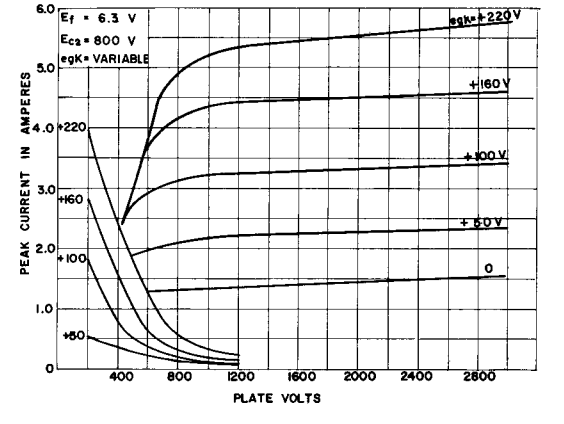
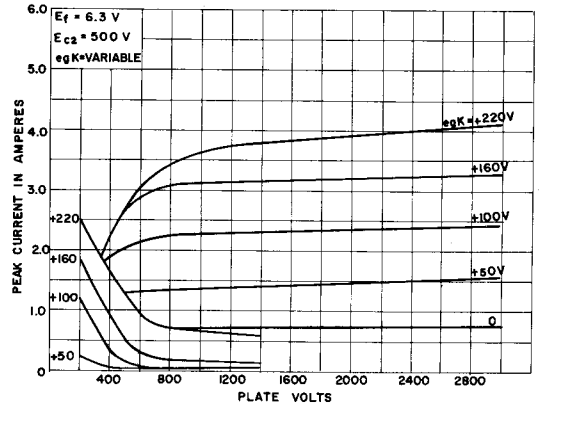


CHART 12.

TYPICAL PULSE CHARACTERISTICS

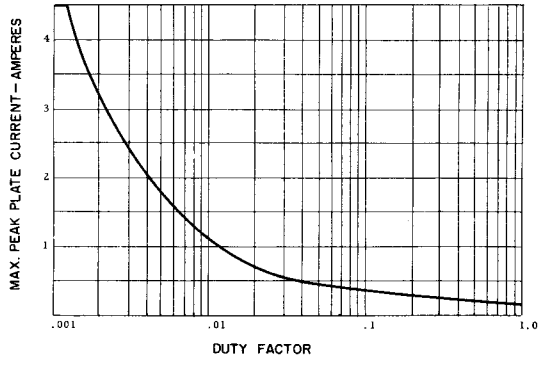


BEAM POWER AMPLIFIER
(PULSE)

MY-G-300

6889
Bendix Type TE-52

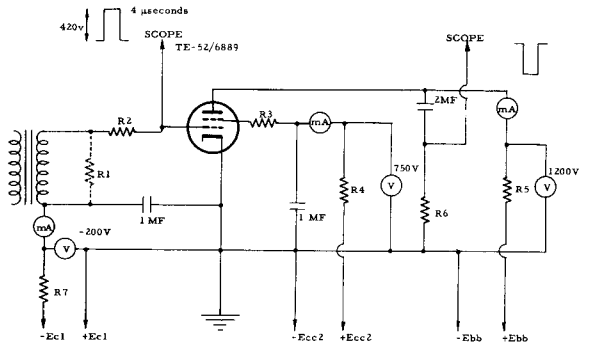
CHART 13. PULSE RATING



Duty factor (10,000 microsecond averaging time) for the 6889 is defined as the ratio of "ON" time in microseconds to 10,000 microseconds.

"ON" TIME is defined as the sum of the duration of all individual pulses which occur during any 10,000 microsecond interval.

CHART 14. PULSE TEST CIRCUIT



R1=Adjust for minimum ringing and overshoot.
R2=1 2Ω (approximately), 1 watt (Parasitic suppressor).
R3=1 2Ω (approximately), 1 watt (Parasitic suppressor)
R4=15000Ω 100 watt wire wound.
R5=15000Ω 100 watt wire wound.
R6=2Ω, 1/2%, 10 watts, carbon.
R7=1500Ω, 10 watts

SCOPE = TEKTRONIX TYPE 535 OR EQUIVALENT

APPLICATION NOTES

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 will 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.

This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment.

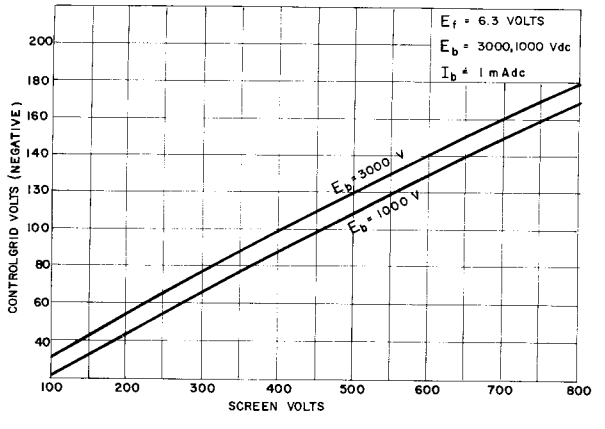
The plate voltage rating and high-perveance of the 6889 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak plate current should not exceed the value shown in Chart 13 for the required duty factor.

CUT-OFF CHARACTERISTICS

For Ib = 1.0 ma

CHART 15.

TYPICAL CURRENT CUT-OFF CHARACTERISTICS



THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508, Ottawa 4, Ontario

6900
Bendix Type TE-54
(Generic Type 5687)

RELIABLE HARD GLASS MEDIUM MU TWIN TRIODE

(For Pulse Application)

DESCRIPTION

This miniature medium-mu twin triode is one of Bendix Red Bank HY-G-300* reliable vacuum tubes specifically designed for Pulse applications in missiles, aircraft and other military and industrial installations. Freedom from early failures, long average service life and uniform operating characteristics are considered prime requisites for such tubes. In addition to a 45-hour run-in under various overload, vibration and shock conditions, likely to be encountered in service, each tube is tested for its Pulse capabilities under maximum grid-drive and duty-cycle conditions.

Since this tube is designed for use in equipment with high ambient temperatures and where high levels of vibration and shock are encountered, special materials and manufacturing techniques are employed. The hard glass bulb and Tungsten stem seal construction are features found on many high-powered transmitting tubes. Careful exhaust to a high degree of vacuum, with complete out-gassing of all the elements by means of electron bombardment, as well as the usual induction heating, insures maximum life expectancy. These factors, as well as a conservative design center for cathode temperature, permit operation of the 6900 at bulb temperatures up to 300° Centigrade.

The use of ceramic spacers eliminates one of the most common sources of tube failure, which is the evolution of gas from other less costly materials, such as mica. Moreover, ceramic spacers contribute to a much sturdier structure with the use of multi-pillar supports locked together by 12 welded eyelets. Special alloy snubbers, which maintain the mount in position, retain their spring properties at high temperatures, resulting in a structure resistant to shock accelerations as high as 500 G. The rugged pure Tungsten heater is supported in a high density aluminum oxide insulator which permits operation at high Heater-Cathode voltages.

*Registered Trademark.

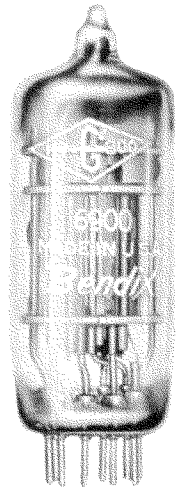


CHART 1. RATINGS*

Heater Voltage—(AC or DC)**	6.3 volts
Heater Current	1.00 amp.
Plate Voltage—(max.)	600 volts
Max. Peak Cathode Current***	4.5 amps.
Max. Plate Dissipation (per plate)	4.25 watts
Max. Peak Grid Voltage	±100 volts
Max. Heater-Cathode Voltage	100 ±500 volts
Max. Grid Resistance	1.0 megohm
Warm-up Time	45 sec.

(Plate and heater voltage may be applied simultaneously)

*To obtain greatest life expectancy from tube, avoid designs where the tube is subject to all maximum ratings simultaneously.

**Voltage should not fluctuate more than ±5%.

***See Chart 5.

CHART 2. MECHANICAL DATA

Base	9 Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6 ½
Max. Overall Length	2 5/8"
Max. Seated Height	1 15/16" Nom
Max. Diameter	7/8"
Mounting Position	any
Max. Altitude	80,000 feet
Max. Bulb Temperature	300°C
Max. Impact Shock	500 G
Max. Vibrational Acceleration (100 hour shock excited fatigue test, sample basis)	50 G
Life Expectancy	5,000 hrs.

CHART 3. PULSE TEST CONDITIONS AND AVERAGE CHARACTERISTICS

Heater Voltage	6.3 volts
Heater Current	1.00 amp.
Plate Voltage	500 volts
Grid Pulse	+50 volts
Grid Voltage	—100 volts
*Plate Current	4.25 amps.
*Grid Current	.25 amp.
Pulse Time	10 μ sec.
Pulse Repetition Rate	250 pp sec.

*Both sections paralleled (Chart 10)

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R83-14

Printed in U.S.A.

RELIABLE MEDIUM MU TWIN TRIODE

HY-G-300

6900

Bendix Type TE-54
(Generic Type 5687)

ELECTRICAL CHARACTERISTICS AND TEST DATA

CHART 4. TEST CONDITIONS AND CHARACTERISTICS LIMITS

All Tubes are Stabilized for 45 Hours Under Test Conditions and 2 G Vibration at 30 Cps. Prior to 100% Testing

Heater voltage, E_f ..... 6.3 volts
Plate voltage, E_b ..... 120 volts
Grid voltage, E_c ..... —2.0 volts

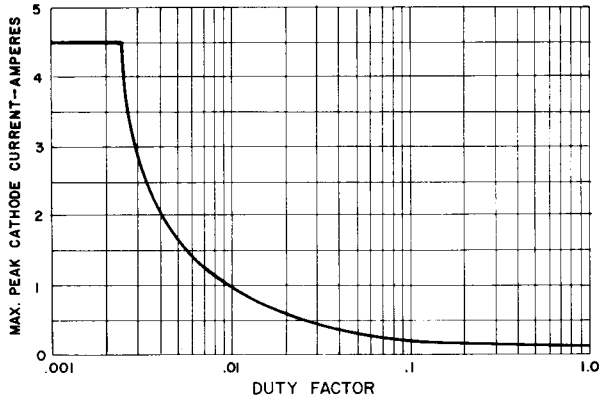
CHARACTERISTIC	SYMBOL	MIN.	DESIGN CENTER	MAX.	UNITS
PRODUCTION TESTS					
Heater Current	If	.950	1.000	1.050	A
Heater-Cathode Leakage	Ihk	—	—	25	μAdc
Grid Current	Ic1	—	—	1.0	μAdc
Plate Current	Ib	25	36	47	mAdc
Transconductance (1)	Sm	8000	11500	15000	μmhos
Transconductance (2) Ec = 5.7	▲Sm	—	—	15	%
Short and Continuity					
DESIGN TESTS					
Insulation of Electrodes					
Eg1-all = —100 Vdc	R	100	—	—	meg
Ep-all = —300 Vdc	R	100	—	—	meg
Cut Off Plate Current					
Ec1 = —25 Vdc Eb = 300	Ib	—	—	2000	μAdc
Ec1 = —55 Vdc Eb = 500	Ib	5	—	500	μAdc
Accelerated Grid Current (Ef = 7.0 V)	Ic1			5.0	μAdc
Primary Plate Emission (Eb = 195 Vdc)	Ib			25	μAdc
Amplification Factor	MU	16.0	18.5	21.0	
Vibration Noise Output Ebb = 120 Vdc Ec1 = —2 Vdc Rp = 2000 Swept Frequency = 60-500~ Constant Acceleration = 2.5 G	Ep	—	—	500	mVac
Capicitance (without shield)					
	Cg1-p	2.8	—	5.2	μμf
	Cin	5.0	—	8.0	μμf
	$Cout_1$	0.62	—	0.98	μμf
	$Cout_2$	0.45	—	0.77	μμf
	CHK	2.0	—	4.0	μμf

CHART 6. ADDITIONAL TESTS

In addition to the production and design tests shown in Chart 3 other tests are performed on a sampling basis to assure a high outgoing quality level. See below.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min. Off 4 Min. Ef = 7.5 Ehk = 300	2,000 On-Off Cycles
Life Test	Under "Pulse Test Conditions"	500 Hours
Life "Expectancy" Test	Under "Pulse Test Conditions"	5,000 Hours
High Level Fatigue Test	2.5 G 60-500 Cycles Swept Frequency	96 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	15 Seconds in Each
Mount Inspection	100% Test—Miscroscopic Inspection of 30 Possible Trouble Points	

CHART 5. PULSE RATING



DUTY FACTOR (10,000 MICROSECOND AVERAGING TIME) FOR THE 6900 IS DEFINED AS THE RATIO OF "ON" TIME IN MICROSECONDS TO 10,000 MICROSECONDS.

ON TIME IS DEFINED AS THE SUM OF THE DURATION OF ALL INDIVIDUAL PULSES WHICH OCCUR DURING ANY 10,000 MICROSECOND INTERVAL.

CHART 7. AVERAGE CHARACTERISTICS

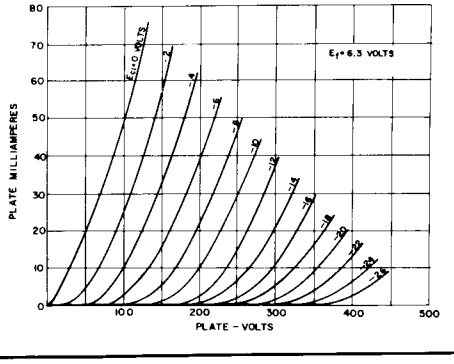
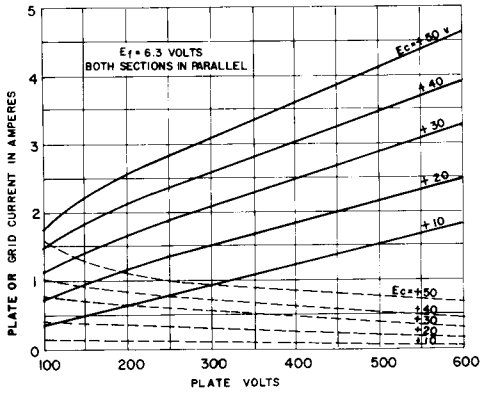


CHART 8. AVERAGE CHARACTERISTICS (PULSE)



RELIABLE MEDIUM MU TWIN TRIODE

HY-G-300

6900
Bendix Type TE-54
(Generic Type 5687)

CHART 9.

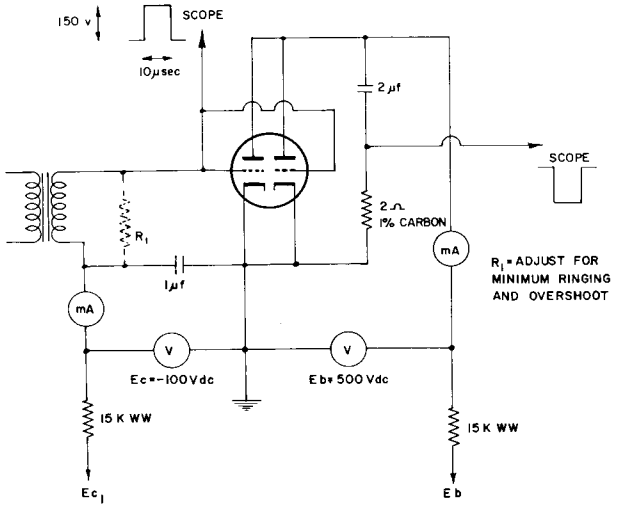
EFFECT ON LIFE OF INCREASED RATINGS (PULSE)

See also Application Notes	OPERATING CONDITIONS		
RATING OR CHARACTERISTICS	CONSERVATIVE	TYPICAL	MAXIMUM
Heater Voltage	6.3 V ± 2%	6.3 V ± 5%	6.3 V ± 10%
Plate Voltage	400 Vdc	500 Vdc	600 Vdc
Plate Current (Av.)*	10 mA	11 mA	14 mA
Plate Dissipation*	4.0 W	5.5 W	8.5 W
H-K Voltage	200 V	350 V	500 V
Grid Resistance	25,000 ohms	75,000 ohms	100,000 ohms
Bulb Temperature	200°C	250°C	300°C
Altitude	0-20,000'	60,000'	80,000'
Vibration	2 G	5 G	10 G
LIFE EXPECTANCY	MAXIMUM	HIGH	MEDIUM

*See Chart 5.

CHART 10.

PULSE TEST CIRCUIT



APPLICATION NOTES

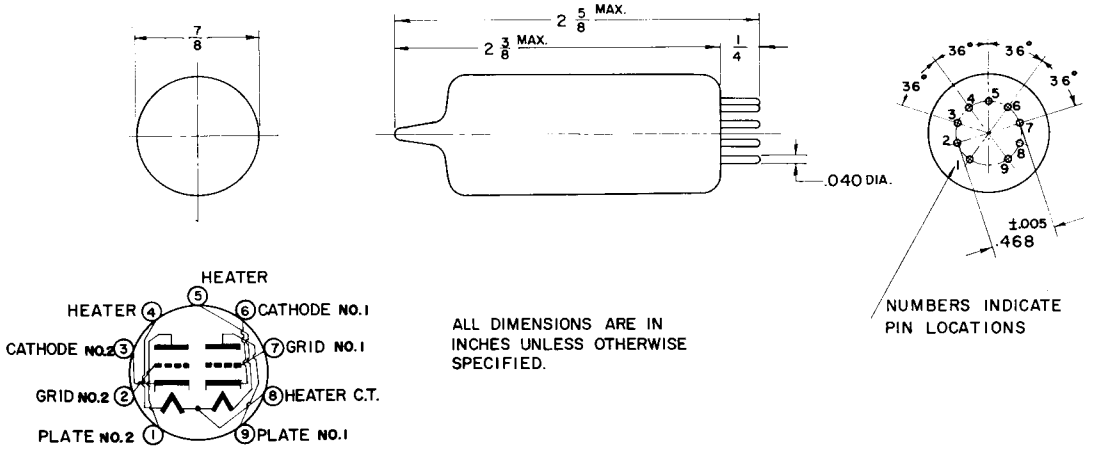
Special attention should be given to the temperatures at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy will be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced 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.

This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment.

The plate voltage rating and high-perveance of the 6900 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak cathode current should not exceed the value shown in Chart 5 for the required duty factor.

Chart 9 is presented to emphasize the dangers of operating simultaneously at or near all maxima. In general, the effect on life of operation at increased ratings is additive and cumulative. Interpolation within this chart will give the designer a general idea of the life expectancy and reliability of his application. Each proposed application should be life tested under maximum environmental conditions in order to check that the design gives the desired reliability. When conservatively used this tube has a life expectancy of 5,000 hours.

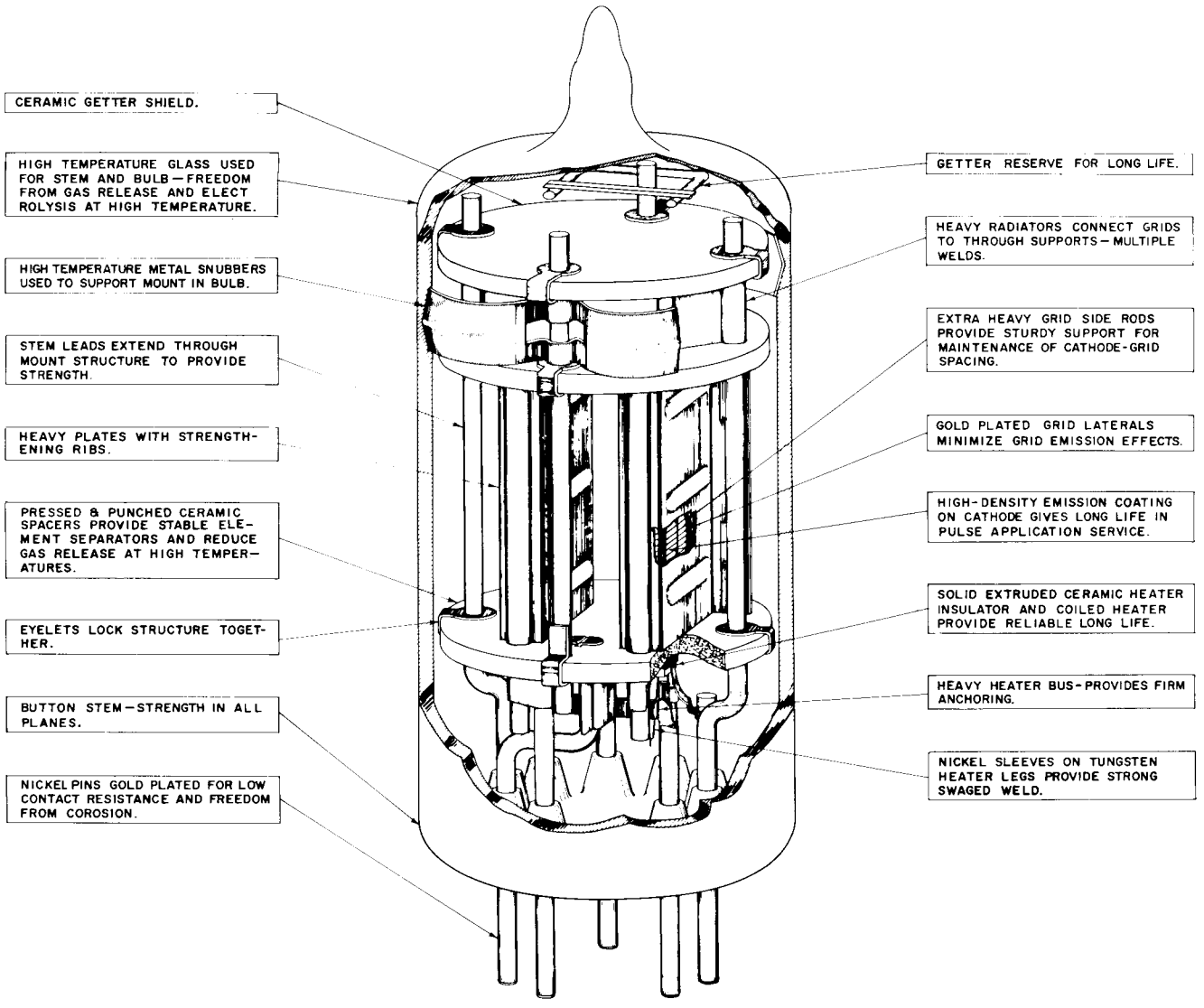
Chart 10 shows a typical Pulse Test circuit in which every 6900 is tested before shipment. Special exhaust procedures and cathode activation bring the relatively dense emission coating to a high degree of activity to maintain cathode currents under Pulse conditions with practically no "slump" during the life of the tube. The Bendix 6900 can be used with the confident expectation of superior performance in every application now using the 5687.



RELIABLE MEDIUM MU TWIN TRIODE

HY-G-300

6900
Bendix Type TE-54
(Generic Type 5687)



STRUCTURAL FEATURES OF 6900 PROVIDE HIGH RELIABILITY AND LONG LIFE.

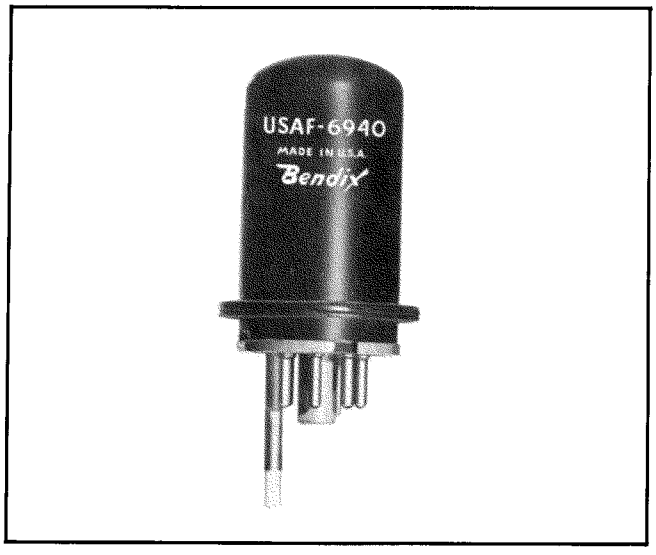
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

6940
Bendix Type TK-58

REFLEX KLYSTRON

(THERMALLY TUNED)



MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	350 volts D.C.
Reflector Voltage	—350 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 ma. D.C.
Diode Plate Dissipation	*see note below
Diode Voltage	—350 volts D.C.
Heater-Cathode Voltage	±100 volts D.C.

*Note: Power inputs as high as 16.5 watts may be applied to the diode when the frequency of the klystron is above 8500. Tuner power in excess of 10 watts may permanently damage the tuning structure, if applied when the tube is tuned below 8500 Mc.

TYPICAL OPERATING CONDITIONS

Frequency	8500 to 9660 Mc./sec.
Resonator Voltage	300 volts D.C.
Reflector Voltage @ 9660 Mc./sec.	—95 to —145 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 mA D.C. (max.)
Tuner Diode Current	5 to 36 ma (D.C.)
Tuner Diode Voltage	170 to 275 volts D.C.

DESCRIPTION

The 6940 (Bendix® Type TK-58) Tube is a ruggedized low voltage thermally tuned X-band reflex klystron, designed for use as a CW power-source over the frequency range of 8500 to 9660 Mc./sec. Thermal tuning of the klystron is accomplished by means of a diode included within the vacuum envelope, the plate of which comprises one wall of the klystron cavity. As diode voltage, and hence current, is increased, expansion of the plate results in corresponding changes in the klystron cavity gap spacing causing the tube to tune. The tuning speed over the required frequency range does not exceed a maximum of 3 seconds. The 6940 is similar to the 6116, but has special characteristics limiting spectrum width and spectrum continuity under adverse load conditions.

With the exception of the diode tuner, the 6940 may be considered a ruggedized version of the 2K45 with equivalent outline dimensions and electrical characteristics.

The ruggedization feature of the tube permits it to be operated under severe vibration environments without sacrifice of frequency stability. Under vibration conditions of 10g acceleration at 50 cycles, the maximum frequency variation is ±1.3 Mc./sec.

The tube has coaxial output as shown in the accompanying photograph and outline drawing, and is coupled to the waveguide circuit through a transducer identical to that used for the type 2K45 and 2K25 klystrons. Details of this transducer can be found in the Military Number 227-JAN specification sheet.

PHYSICAL CHARACTERISTICS

- *Base:* Small octal 8-pin, B8-21, Low Loss Phenolic Wafer, Modified for coaxial output lead as shown on outline drawing.
- *Coupling to Wave Guide:* Coaxial output fits standard transducer per 227 JAN.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Integral with tube.
- *Bulb:* Metal.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-26

Printed in U.S.A.

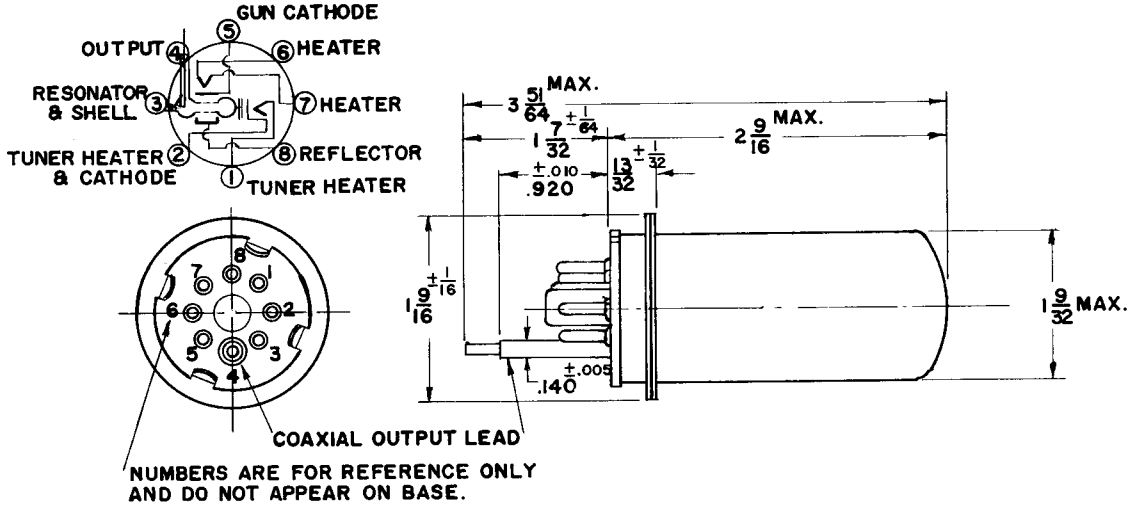
REFLEX KLYSTRON
(THERMALLY TUNED)

Bendix Type TK-58 — 6940

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

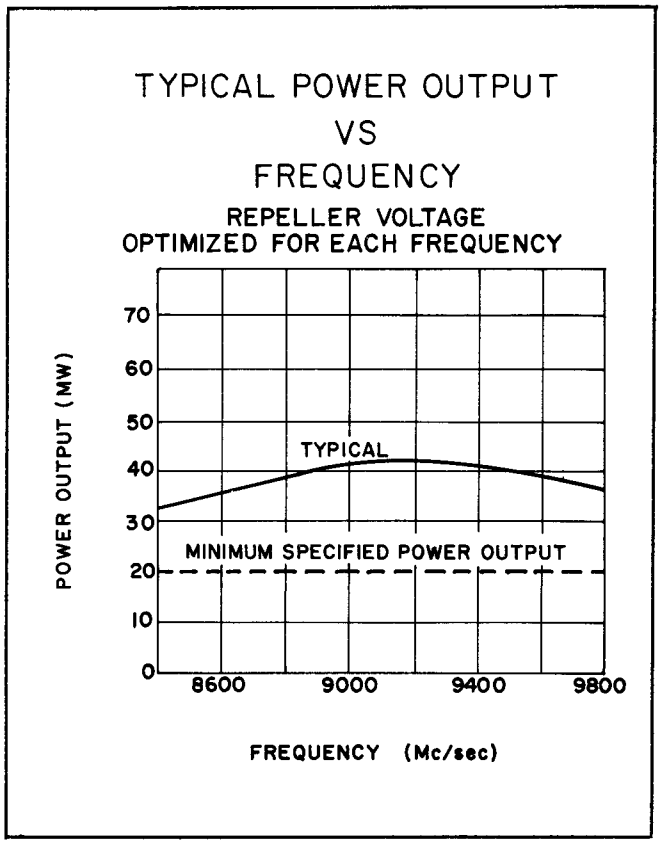
Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS:					
Total Reflector Current:	Er = −150 Vdc t = 120 sec. (min)	Ir:	—	5.0	μAdc
Reflector Leakage:	Er = −150 Vdc	Ir:	—	3.0	μAdc
Reflector Gas Current:	Er = −150 Vdc	Ir:	—	1.0	μAdc
Cathode Current (1):	Er = −150 Vdc	Ikl:	—	32	mAdc
Reflector Voltage:	Er (Mode A)/Max. Po @ 9660 ±0.3% Mc.	Er:	−95	−145	Vdc
Thermal Tuning Range:	Ef_1 and Ef_2 = 5.8 V Er (Mode A) Thermal Tuning (1)	Max. F:	9660	—	Mc
	Thermal Tuning (2)	Min. F:	—	8500	Mc
Bump:	Ef = 5.8; Er (Mode A)/Max. Po @ 9660 ±0.3% Mc.	Po/Po	—	0.10	
Emission (1):	Ef = 5.8; Er = −150 Vdc	Ik1/Ik1:	—	0.15	
Emission (2):	Ef = 5.8; Ik2 = 20 mA	Ik2/Ik2:	—	0.10	
Thermal Tuning Time (1):	F = 9660 to 8500 Mc.	t:	1.0	3.0	sec.
Thermal Tuning Time (2):	F = 8500 to 9660 Mc.	t:	1.0	3.0	sec.
Power Output:	Ef = 5.8; F from 8500 to 9660 Mc.	Po:	20	—	mW
Spectrum Width:	F = 9265 ±5 Mc.; Mod. Volt. = 0.3 ±0.02 volts pk to pk 1350 ±20 cps	sw	.65	1.5	Mc
Mode Breakup:	F = 9280 Mc.; Volt. = 10 v pk to pk (approx.)			Mode to be continuous	
DESIGN TESTS:					
Electrode Insulation:	300 Vdc Tube Cold	Rk1-rs:	2.0	—	Meg.
		Rk2-rs:	2.0	—	Meg.
		RF1-rs:	2.0	—	Meg.
Heater Current (1):		If1:	465	570	mA
Heater Current (2):		If2:	720	880	mA
Insulation:	Eh-Kl = ±45 Vdc	IhK1:	—	100	μAdc
Tuner Diode Voltage:	@ 8500 ±0.3% Mc. 9660 ±0.3% Mc.	ED:	See Graph	—	—
Tuner Diode Current:	@ 8500 ±0.3% Mc. 9660 ±0.3% Mc.	Ik2:	See Graph	—	—
Vibration:	No Voltage 10g; t = 120 sec.; F = 50 cps	—	—	—	—

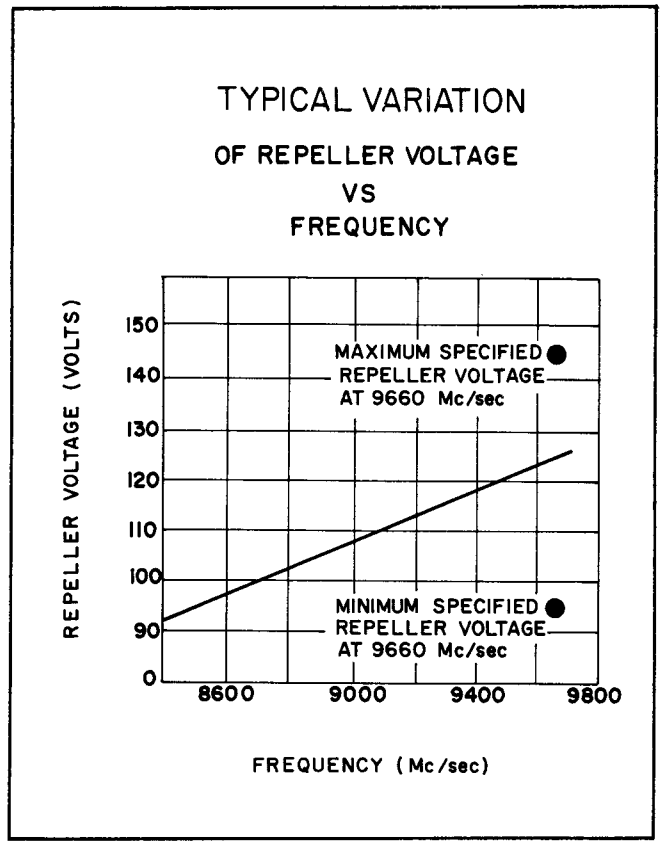


OUTLINE DRAWING

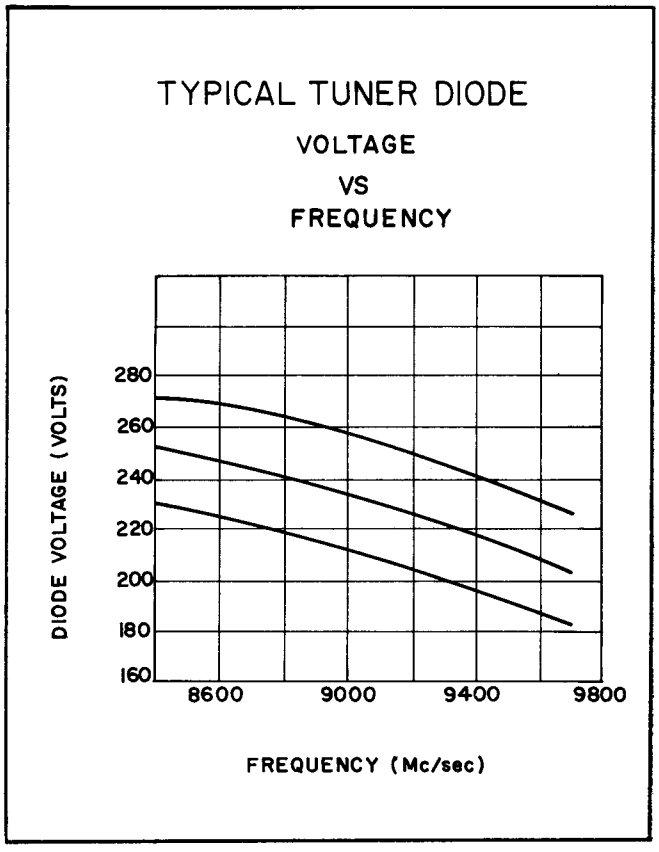
AVERAGE CHARACTERISTICS



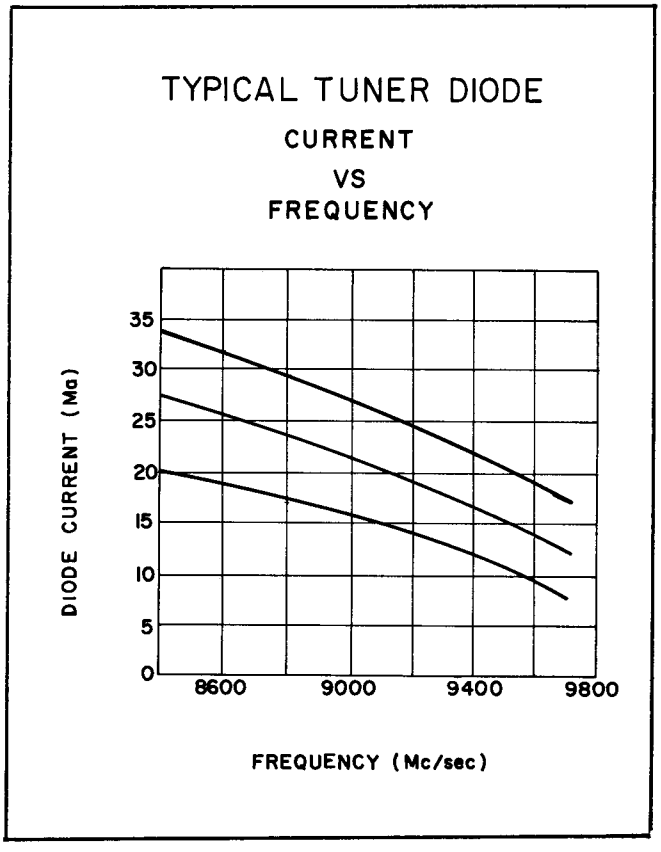
POWER OUTPUT VS FREQUENCY
REPELLER VOLTAGE OPTIMIZED FOR EACH FREQUENCY



REPELLER VOLTAGE VS FREQUENCY

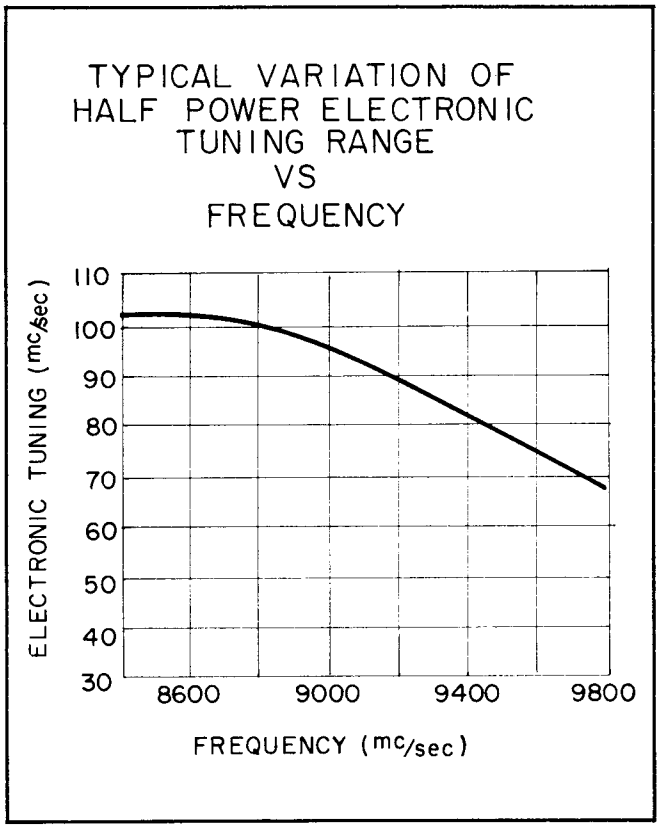


TUNER DIODE VOLTAGE VS FREQUENCY

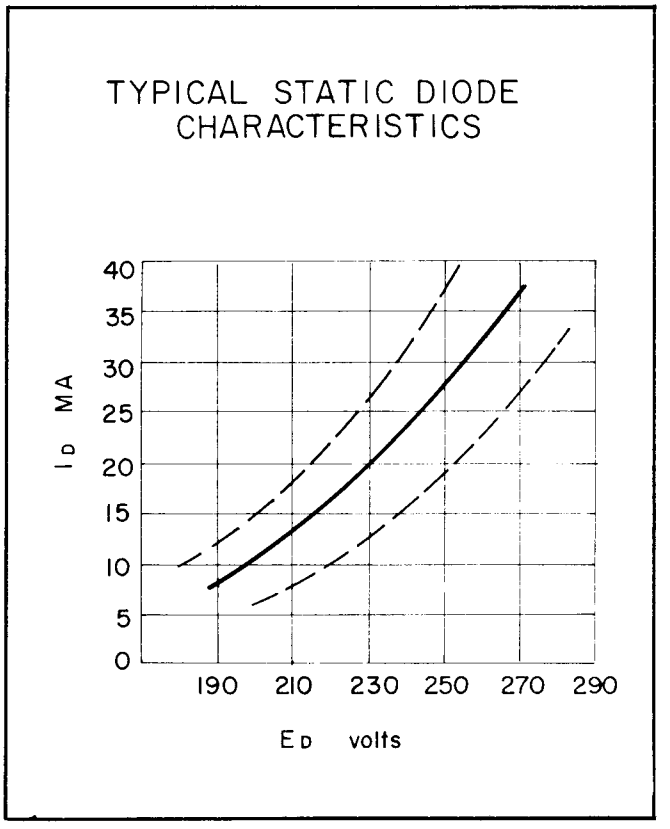


TUNER DIODE CURRENT VS FREQUENCY

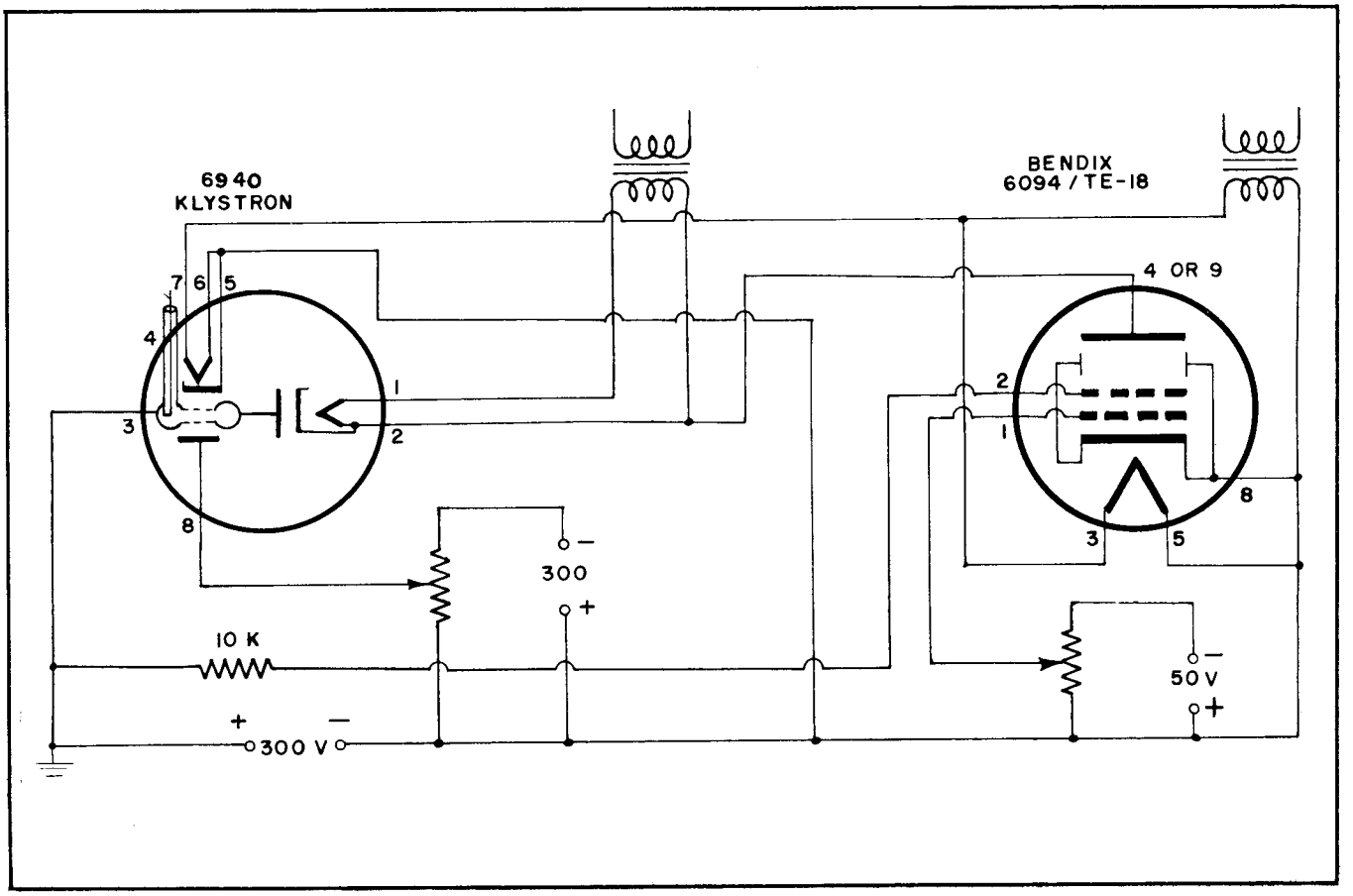
AVERAGE CHARACTERISTICS



HALF POWER ELECTRONIC TUNING RANGE VS FREQUENCY



STATIC DIODE CHARACTERISTICS



CONTROL CIRCUIT FOR TUNING DIODE

BENDIX AVIATION CORPORATION
RED BANK DIVISION
ELECTRON TUBE PLANT
EATONTOWN, NEW JERSEY

September 19, 1957

SUBJECT: TECHNICAL DATA

TYPE 7101
Red Bank Type TD-29

DESCRIPTION: GAS NOISE SOURCE - NEON

This tube is designed for use as a noise source in UHF measurements. It is constructed for use with a 90° H plane mount in RG-69U waveguide or equivalent to provide noise in the 1.12 to 1.70 KMC frequency range. When used in a properly matched mount it functions essentially as an untuned noise generator over the recommended transmission bandwidth of the mount. When used in a 90° H plane mount which is terminated by a piston adjusted to match the susceptance of the tube and mount, the excess noise coupled into the guide is 18 Db above 290°K.

This tube may be operated either in a D.C. circuit which provides a starting filament current or in an A.C. circuit without initial filament operation. In either case the operating circuit should have sufficient series resistance to limit the current through the tube to the rated value during operation.

The use of pure inert gas eliminates any dependence of noise output on operating temperature. The noise source is available for measurement at practically zero warm-up time. The performance of the tube is non-critical with respect to variations in the discharge current. When operated in an A.C. circuit there is a small correction to the available excess noise depending upon circuit components and the A.C. frequency. When operated in a D.C. circuit, only one cathode is active, the other serving as the anode.

Mechanical Data

Coated filamentary cathodes	- ionically heated
Maximum diameter	- 1.55"
Maximum overall length	- 14 3/4"
Bases	- Bipin each end
Mounting position	- any

Electrical Data

D.C.		A.C.	
Anode Current	250 mAdc	Anode Current	250 mAac
Filament Current	350 mAdc	Filament Current *	350 mAac
Tube Drop	125 Vdc	Tube Drop *	155 Vac
Tube Dissipation	31 watts	Anode Striking Voltage	2500 Vac max.
Ambient Temperature	(-) 55°C min.		
Bulb Temperature	(+) 125°C max.	*As read on RMS meter	

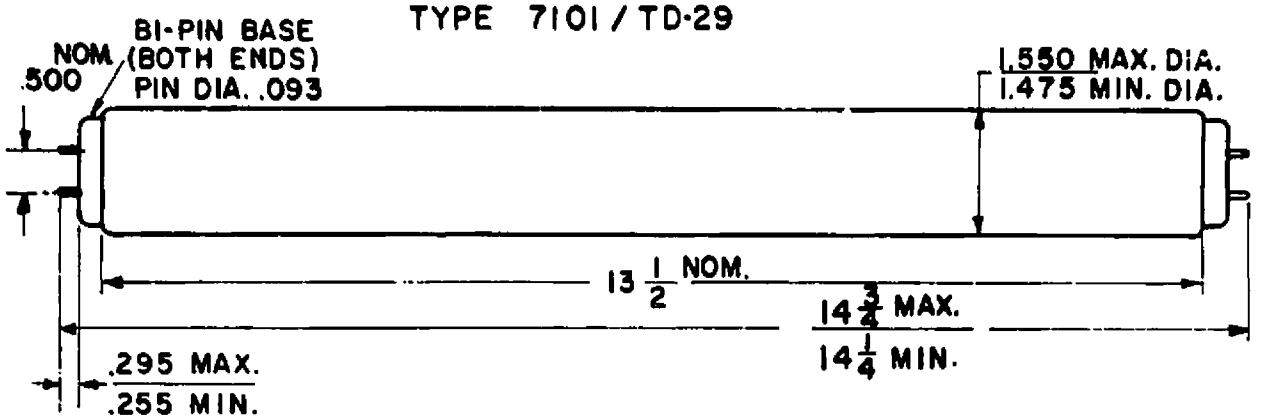
Publication No. R79-7

Printed in U.S.A.

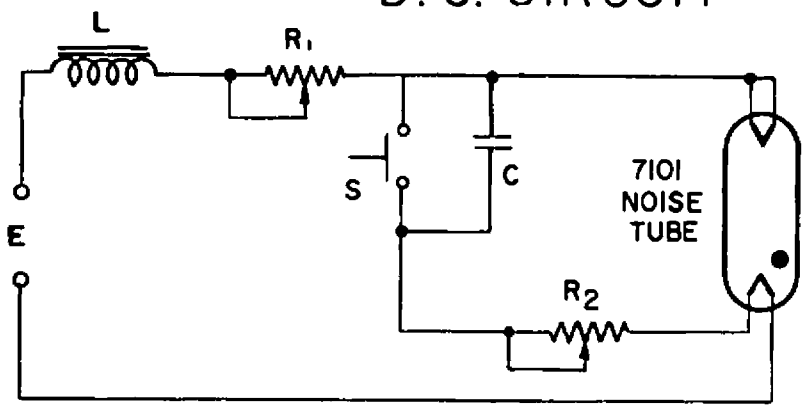
from RMA release #2025, Oct. 21, 1957

OUTLINE

TYPE 7101 / TD-29



D. C. CIRCUIT



E = 250 vdc

R_1 = 500 Ω 50 w

R_2 = 500 Ω 50 w

L = 2 HY 250 mA

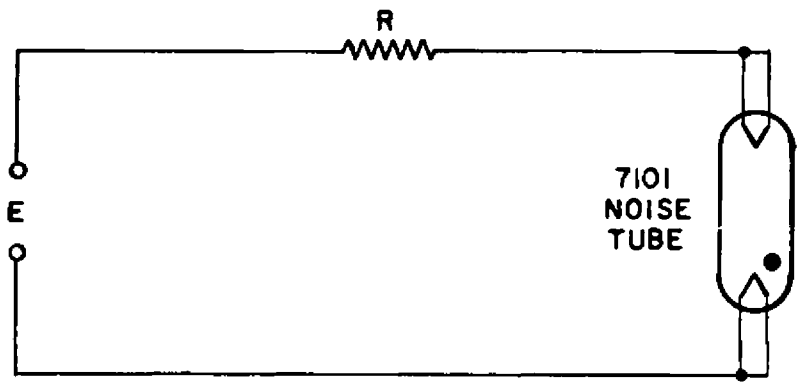
C = .002 μfd 2500 v

S = N.O. MOMENTARY

ADJUST R_1 FOR 250 mA

ADJUST R_2 FOR 350 mA WITH S CLOSED

A. C. CIRCUIT



E = 2500 V

R = 9500 Ω 600 W

NOTE:

R MAY BE INCLUDED IN SUPPLY AS REACTANCE

6881 7101
7992 8401
7147 8402

Bendix Red Bank

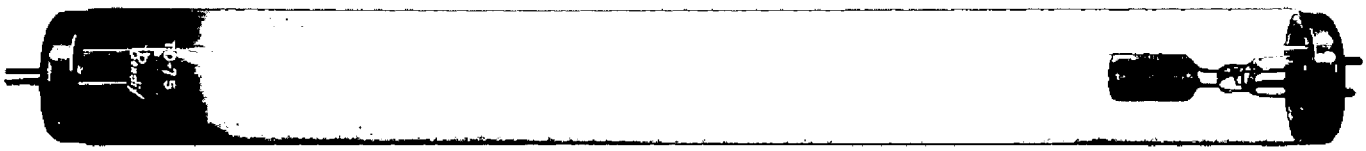
GAS NOISE SOURCES, 1.12-1.70 KMC



6881/TD-21 , 7992/TD-62



7147/TD-33 , 7101/TD-29



8401/TD-49 , 8402/TD-75

DESCRIPTION

These tubes are designed for use as noise sources in microwave measurements. They are constructed for use with 90° H-plane mounts in RG-69U waveguide, or equivalent, to provide noise in the 1.12 to 1.70 kMc frequency range. When used in properly matched mounts they function essentially as untuned noise generators over most of the recommended transmission bandwidth of the mount. When used in a 90° H-plane mount which is terminated by a piston adjusted to match the susceptance of the tube and mount, the excess noise coupled into the guide is approximately 15.2 db for the Argon types, 6881, 7147 and 8401, and approximately 18 db for the Neon types, 7992, 7101 and 8402. The excess noise ratio in db is defined as 10 log $(\frac{Te}{290} - 1)$.

All of these types may be operated in a DC circuit which provides a starting voltage spike, although the 8401 and 8402 are recommended primarily for pulse operation at duty cycles of less than 50%. The 7147 and 7101 further may be operated in a high voltage AC circuit without provision of an initial starting spike. In all cases the operating circuits must have sufficient series resistance to limit the tube currents to the rated values.

In the cases of the 7147 and 7101 when operated in an AC circuit there is a small correction to the available excess noise depending upon circuit components and the AC frequency. When operated in a DC circuit, only one cathode is active, the other serving as the anode.

The use of pure inert gases eliminates any dependence of noise output on operating temperature. The noise sources are available for measurement at practically zero warm up time.

from JEDEC release #4296, June 10, 1963

Publication No. RT-33-22

Printed in U. S. A.

Bendix Red Bank

GAS NOISE SOURCES, 1.12-1.70 K M C

RATINGS							
Characteristic	Unit	6881/TD21	7992/TD62	7147/TD33	7101/TD29	8401/TD49	8402/TD75
Recommended Mode of Operation		DC	DC	DC or AC	DC or AC	Pulse	Pulse
Anode Current (Peak)	ma	250	250	250	250	200	200
Anode Current (Average)	mAdc	250max	250max	250 max	250 max	200 max	200 max
Tube Voltage drop (Average)	Vdc	65	145	75	130	125	235
Tube Dissipation (Average)	Watts	16	36	19	33	25	47
Starting Voltage (Note 1, 3)	KV	2.0-4.0	2.5-4.5	2.0-4.0 (Fig 1) 2.5 max (Fig 2)	2.5-4.5 (Fig 1) 2.5 max (Fig 2)	2.0-4.0	2.5-4.5
Starting Current (Note 2, 3)	mAdc	300	350	300	350	300	350
Ambient Temp. Range	°C	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°	-55°to85°	-55°to+85°
Nr-1 Tube in Mount @ Rated Current (Notes 4, 5)	db	15.20±.50	18.0±.50	15.20±.50 (Note 6)	18.0±.50 (Note 6)	15.2±.50	18.0±.50

Note 1: With the noise source in a case grounded mount, starting voltages were measured in Figures 1, 2, or 3 where appropriate.

Note 2: With the noise source in a case grounded mount and the starting current (I_{start}) through the choke of Figure I adjusted to the value stated, the noise source will start within three attempts of closing and opening switch SW.

Note 3: In general the starting voltage for DC or pulse operation will decrease with a starting pulse of either a faster rise time or longer pulse width.

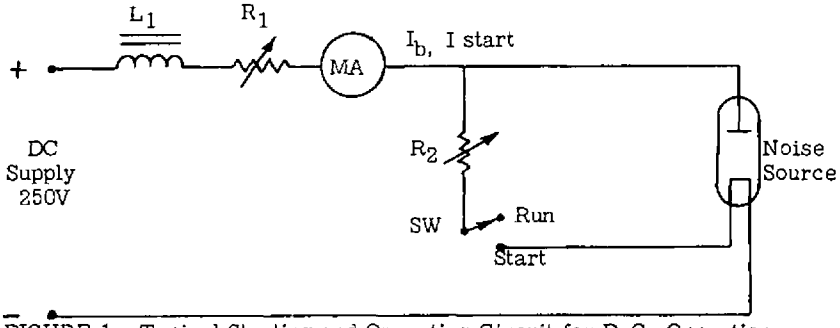
Note 4: The excess noise ratio (Nr-1) is defined in db as $(Nr-1) = 10 \log \left(\frac{Te}{290} - 1 \right)$ where Te is the effective electron temperature.

Note 5: The values of (Nr-1) are given for the tubes mounted in a 90° H plane mount which is terminated by a piston adjusted to match susceptance of the tube and mount.

Note 6: When operated in an AC circuit there is a small correction to the available excess noise depending upon circuit components and the AC frequency.

Bendix Red Bank

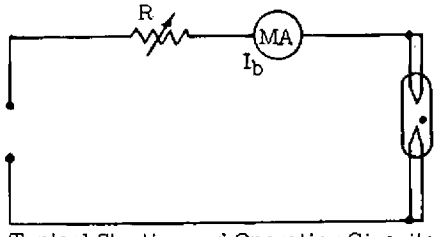
GAS NOISE SOURCES, 1.12-1.70 K M C



L_1 - 2 Hy, 250 mA
R_1 - 900Ω - 50W
R_2 - 500Ω - 50W
SW - (Momentary) normally open

FIGURE 1 : Typical Starting and Operating Circuit for D. C. Operation

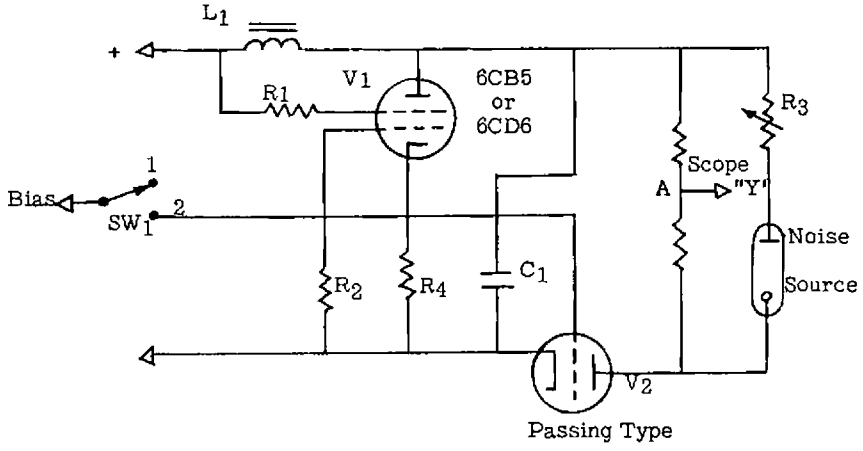
The run start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the choke. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L_1". This high voltage initiates the discharge in the noise source which is then sustained by the power supply voltage and stabilized by the resistance R_1.



E = 2500 Vac
R = 9500Ω 600 W

NOTE:
R MAY BE INCLUDED IN SUPPLY AS REACTANCE

FIGURE 2 : Typical Starting and Operating Circuits for AC Operation



L_1 - 2 Hy
R_1 - 5 K
R_2 - 10 K - adjusted for required pulse amplitude
R_3 - 1.5 K - adjusted for rated I_b
R_4 - Start-run or on-off switch
C_1 - surge capacitor
V_1 - turn-on tube
V_2 - turn-off tube

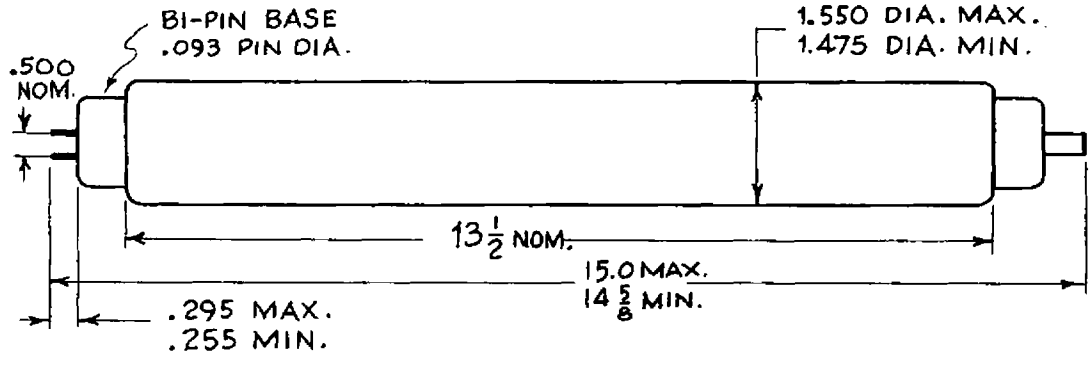
FIGURE 3 : Typical Starting and Operating Circuit for Pulse Operation

The pentode or beam tube, V_1, acts as a switch interrupting the current flow in L_1 when the bias switch, SW 1 is in position 1. The resultant voltage spike developed is impressed across the noise source. The current limited by R3 to rated value. The noise source is turned off when the bias switch, SW_1, is in position 2, causing the current through the passing tube, V_2, to be interrupted. The circuit can be modified to drive the grids of the switch tube and passing tube with pulses, thus pulsing the noise output.

Bendix Red Bank

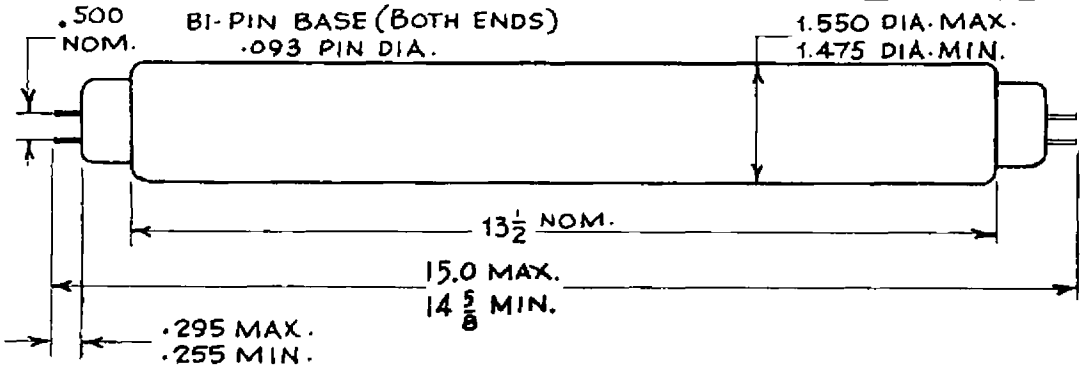
GAS NOISE SOURCES, 1.12-1.70 KMC

OUTLINE DRAWINGS



DC AND PULSE TYPES

6881/TD21, 7992/TD62, 8401/TD49, 8402/TD75

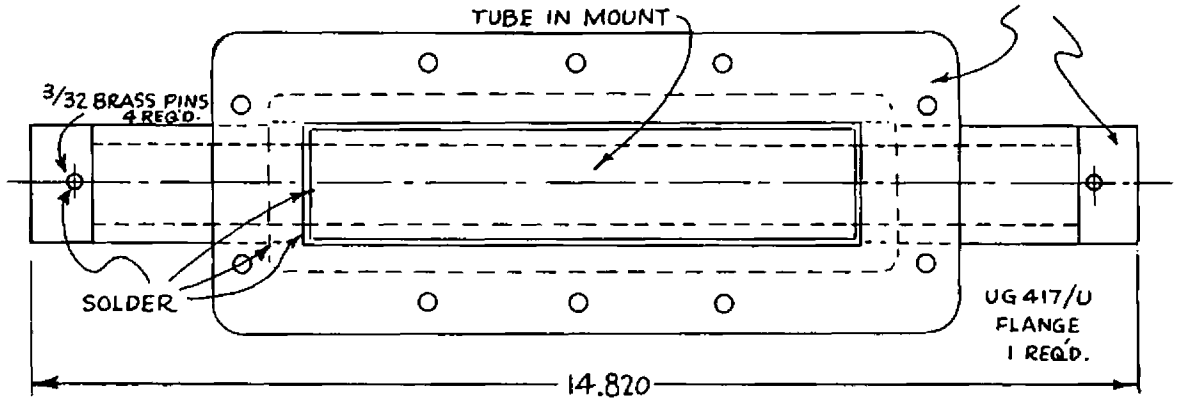


AC-DC TYPES

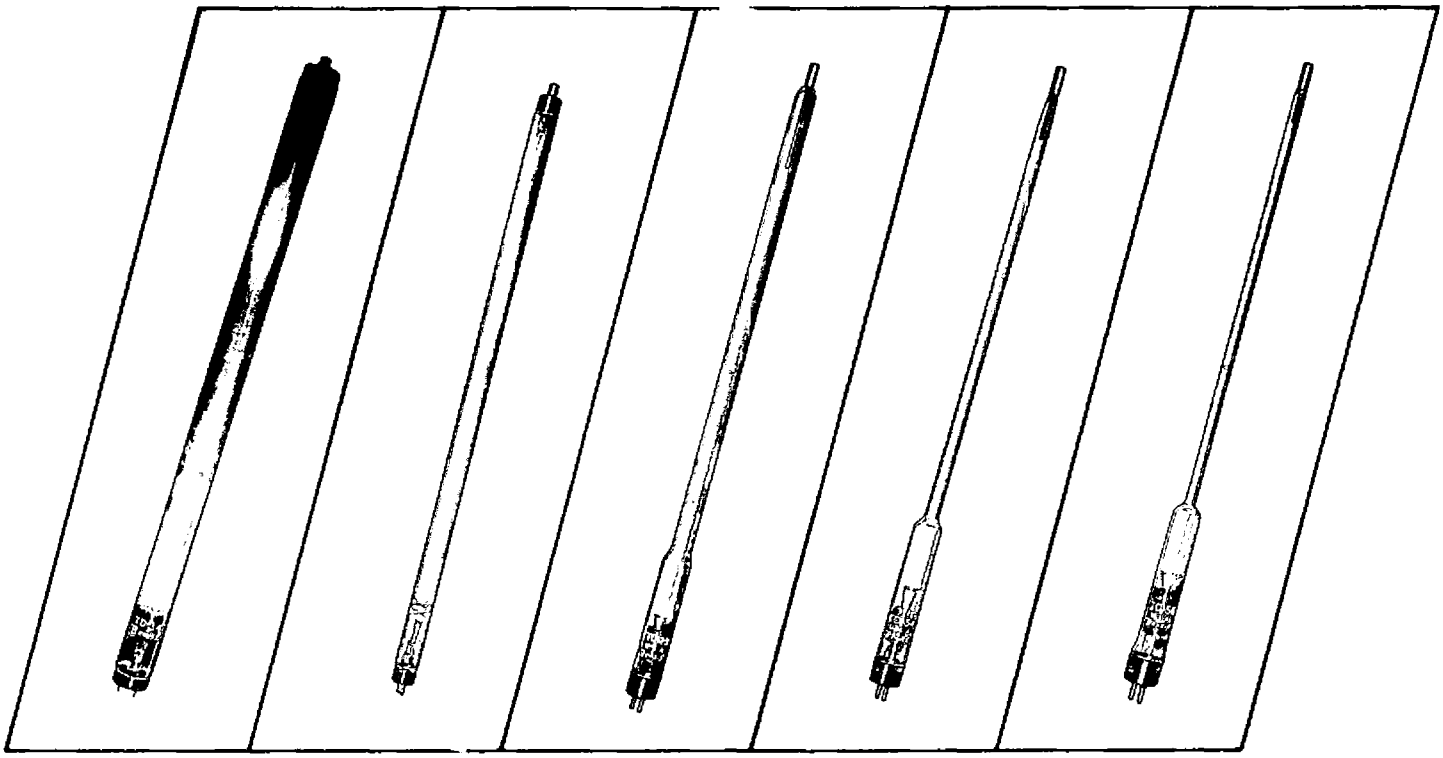
7147/TD33, 7101/TD29

MOUNT

NOTE: SILVER PLATE MASK TOP OF FLANGE AND BOTH ENDS BEFORE PAINTING SMOOTH GRAY.



GAS NOISE SOURCES, NEON



7148 TD-34 | 7989 TD-48 | 6882 TD-23 | 7991 TD-54 | 7990 TD-50

DESCRIPTION

These tubes are designed for use as DC operated noise sources in super high frequency (SHF) measurements. When used in standard mount assemblies, they function as untuned terminations over the entire recommended transmission bandwidths of the guides.

	7148/TD-34	7989/TD-48	6882/TD-23	7991/TD-54	7990/TD-50
Waveguide	RG-48/U	RG-49/U RG-50/U	RG-52/U	RG-91/U	RG-53/U
Frequency kMc	2.60 - 3.95	3.95 - 5.85 5.85 - 8.20	8.20 - 12.40	12.40 - 18.00	18.00 - 26.50
Insertion Angle	10° E	10° E	10° E	10° E	10° E

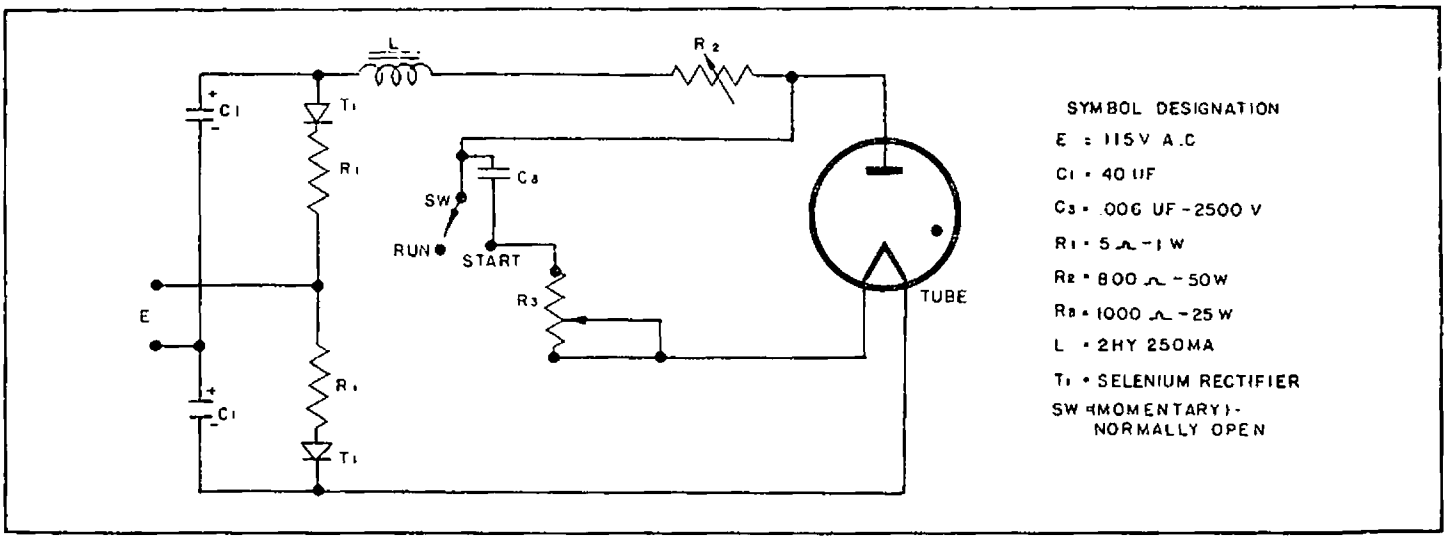
ELECTRON TUBE PRODUCTS
Red Bank Division
EATONTOWN, N. J.
THE Bendix CORPORATION

from JEDEC release #3327, July 3, 1961

RATINGS

Characteristic	Unit	7148/TD-34	7989/TD-48	6882/TD-23	7991/TD-54	7990/TD-50
Anode Current	mAdc	250	250	200	200	200
Filament Voltage	Vdc	10 max.	20 max.	20 max.	20 max.	20 max.
Filament Current*	mAdc	300	170	170	170	170
Tube Dissipation	Watts	41	28	23	27	30
Tube Voltage Drop	Vdc	165	110	115	135	150
Ambient Temp. Range	°C	-55° to +85°	-55° to +85°	-55° to +85°	-55° to+85°	-55° to +85°
VSWR (Cold)		1.15 max.	1.20 max.	1.20 max.	1.20 max.	1.20 max.
VSWR (Hot)		1.15 max.	1.15 max.	1.15 max.	1.15 max.	1.15 max.
NR-1	db	17.75 ± .3	18.00 ± .5	18.00 ± .3	18.20 ± .5	18.40 ± .5

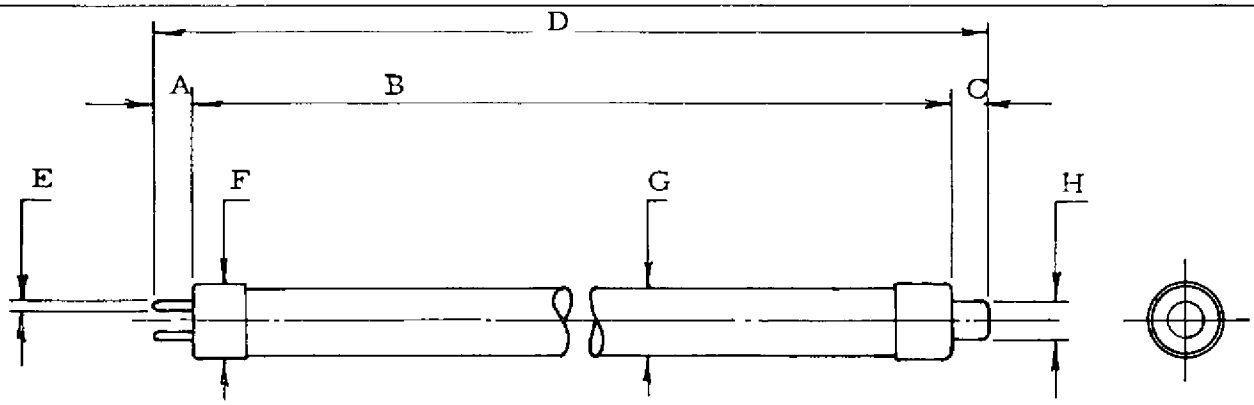
* Filament current used during starting only.



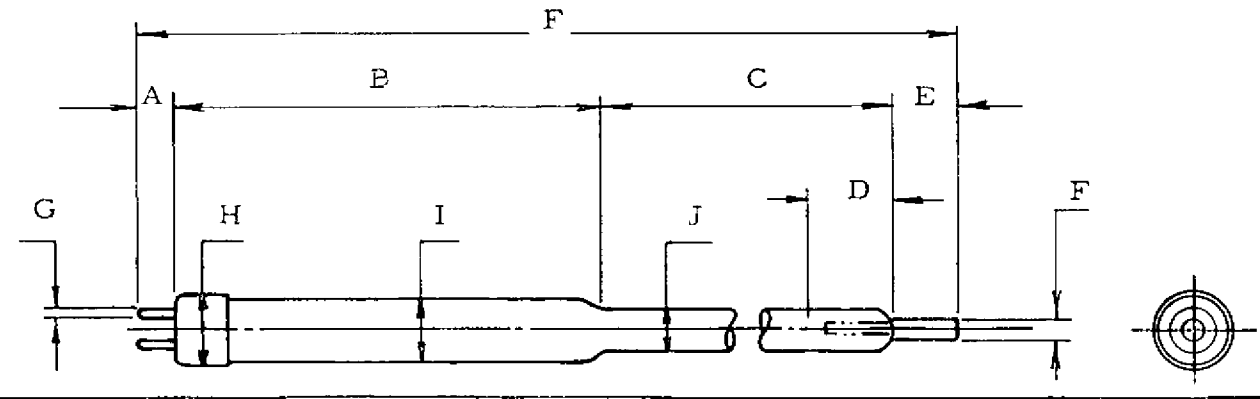
TYPICAL STARTING AND OPERATING CIRCUIT

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the filament at the cathode end of the tube preheating the filament and assisting in starting the discharge. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L". This high voltage initiates the discharge in the tube which is then sustained by the power supply voltage and stabilized by the resistance R2. External power is no longer supplied to the filament once the discharge is established. Filament temperature is maintained by the tube current and is evidenced by a hot spot on the filament structure.

OUTLINE DRAWINGS

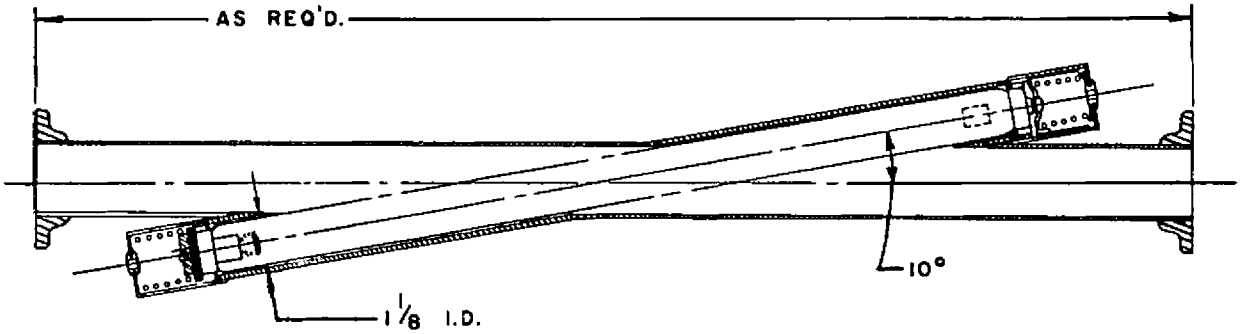


DIM.	7148/TD-34		7989/TD-48		DIM.	7148/TD-34		7989/TD-48	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	E	.090	.105	.090	1.05
B	16.937	17.437	13.875	14.375	F		.990		.555
C	.310	.360	.270	.320	G	.975	1.050	.547	.579
D	17.625	18.000	14.375	15.000	H	.305	.325	.245	.265

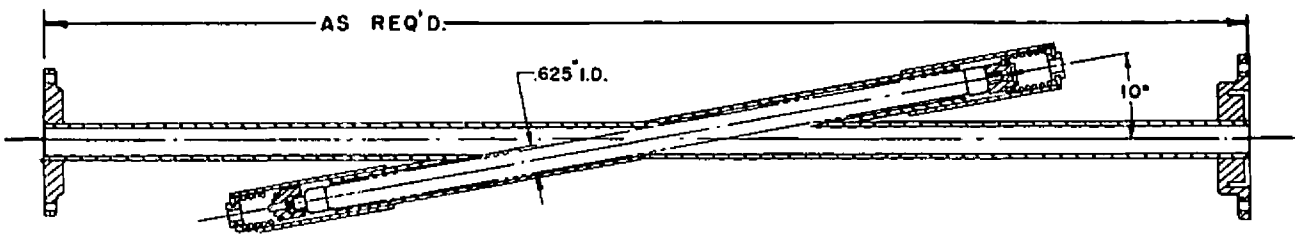


DIM.	6882/TD-23		7991/TD-54		7990/TD-50		DIM.	6882/TD-23		7991/TD-54		7990/TD-50	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	.260	.325	G	.090	.105	.090	.105	.090	.105
B		2.750		2.750		2.750	H		.555		.555		.555
C	8.625		7.375		6.187		I		.579		.500		.500
D (See Note)		* 1.500	N.A.	N.A.	N.A.	N.A.	J	.370	.380	.235	.265	.160	.194
E		.500		.500		.500	K		.187		.187		.187
F	11.937	12.250	10.875	11.250	9.687	10.000							

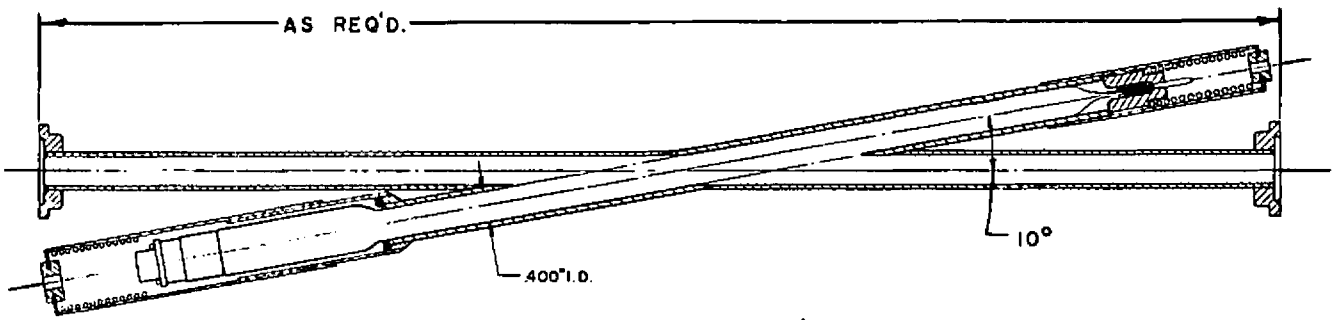
* = .380 max., No min, Dim. on Dia. for this Lgth. of tube.



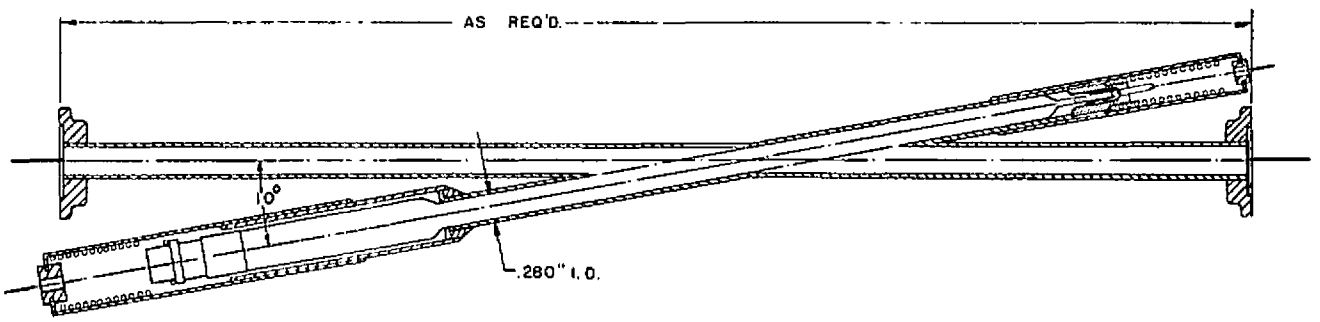
WAVEGUIDE MOUNT ASS'Y. RG-48/U



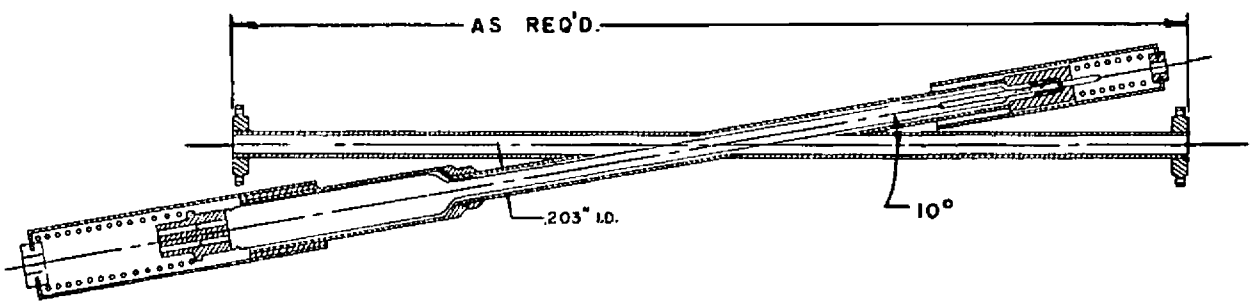
WAVEGUIDE MOUNT ASS'YS. RG-49/U OR RG-50/U



WAVEGUIDE MOUNT ASS'Y. RG-52/U



WAVEGUIDE MOUNT ASS'Y. RG-91/U



WAVEGUIDE MOUNT ASS'Y. RG-53/U

File Catalog: Special Purpose Electron Tubes
Section: Receiving Tubes

Bendix

Red Bank Type TE-31
(Generic Type 6L6)

METAL-CERAMIC MINIATURE BEAM POWER AMPLIFIER

RATINGS

Heater Voltage (AC or DC)	6.3 Volts
Heater Current	0.80 Amperes
Plate Voltage (Maximum DC)	300 Volts
Screen Voltage (Maximum DC)	300 Volts
Plate Dissipation (Absolute Max.)	21 Watts
Screen Dissipation (Absolute Max.)	2.75 Watts
Cathode Current (Maximum DC)	0.10 Amperes
Heater-Cathode Voltage (Max.)	±450 Volts
Grid Number 1 Circuit Resistance	
With Fixed Bias (Max.)	0.1 Megohm
With Cathode Bias (Max.)	0.5 Megohm

PIN CONNECTIONS

Pin	Element
1	Cathode and Beam Plates
2	Heater
3	Grid Number 2 (Screen)
4	No Connection
5	Cathode and Beam Plates
6	Heater
7	Grid Number 1
Bulb	Plate

DESCRIPTION

The Bendix 7311 is a beam power amplifier and is one of the Bendix HY-G-500 line of receiving tubes. It is in the miniature tube size and features an external anode, metal-ceramic construction. It is specifically designed to replace type 6L6 for aircraft, missile and industrial applications where limited space requirements and/or envelope temperatures up to 500° C are encountered.

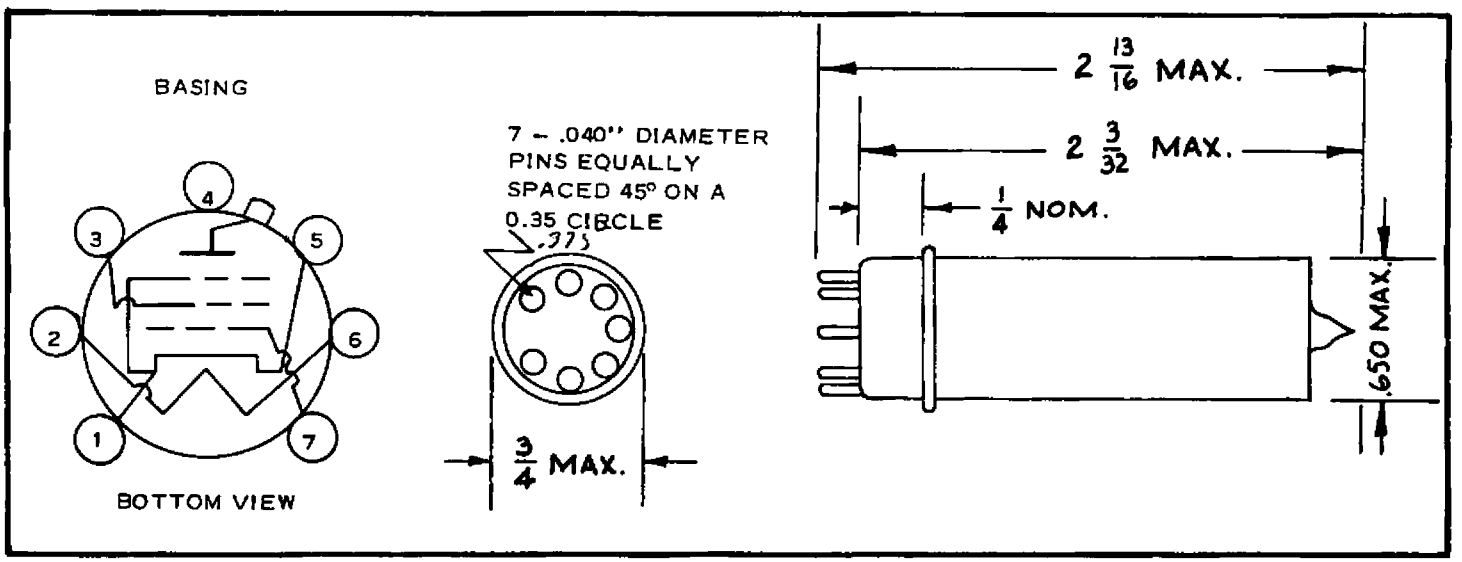
The external metal anode construction permits operation in which auxiliary cooling may be used. This may be by immersion in oil or by clamping to a suitable heat sink.

The electrical connections for the remaining elements are by means of the conventional seven pin miniature tube base and the tube may be operated in any position.

The internal structure employs ceramic element spacers and the much smaller size and mass of the tube elements greatly increase resistance to damage by vibration and shock. A pure alumina heater insulator permits operation at high heater-cathode voltages.

MECHANICAL DATA

Bulb Temperature	500° C Max.
Overall Length	2-13/16 inches Max.
Seated Height	2-3/32 inches Max.
Diameter	3/4 inches Max.
Base	Seven pin miniature
Mounting Position	Any



METAL-CERAMIC MINIATURE BEAM POWER AMPLIFIER

Bendix

Red Bank Type TE-31
(Generic Type 6L6)

TYPICAL OPERATION

Class A Amplifier (Pentode Connection)

Plate Voltage	250	300	Volts
Screen Voltage	250	200	Volts
Grid No. 1 Voltage	-14	-12.5	Volts
Peak AF Grid Number 1 Voltage	14	12.5	Volts
Plate Resistance, Approximate	22500	35000	Ohms
Transconductance	6000	5300	Microhmos
Zero Signal Plate Current	72	48	Milliamperes
Maximum Signal Plate Current	79	55	Milliamperes
Zero Signal Screen Current	5.0	2.5	Milliamperes
Maximum Signal Screen Current	7.3	4.7	Milliamperes
Load Resistance	2500	4500	Ohms
Total Harmonic Distortion, Approximate	10	11	Percent
Maximum Signal Output	6.5	6.5	Watts

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

from JEDEC release #4117, Feb. 4, 1963

File Catalog: Special Purpose Electron Tubes
Section: Receiving Tubes

7312

Red Bank Type TE-32
(Generic Type One
Section of 6080)

METAL-CERAMIC MINIATURE LOW MU TRIODE

MECHANICAL DATA

Bulb Temperature	500° C Max.
Overall Length	2-13/16 inches Max.
Overall Height	2-3/32 inches Max.
Diameter	3/4 inches Max.
Base	Seven pin miniature
Mounting Position	Any

PIN CONNECTIONS

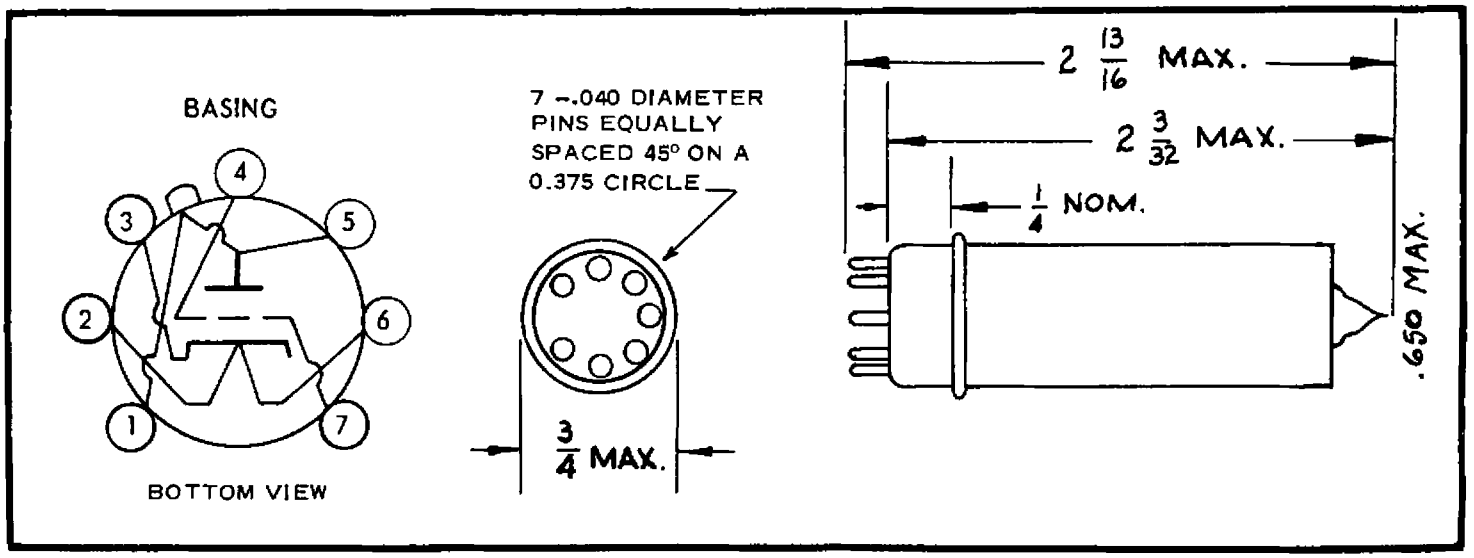
Pin	Element
1	Plate
2	Heater
3	Cathode
4	Grid
5	Plate
6	Heater
7	Grid
Bulb	Plate

DESCRIPTION

The Bendix 7312, one of the Bendix HY-G-500 line of receiving tubes, is a low mu triode, designed for use in voltage regulator circuits in aircraft, missile and industrial applications where limited space and high ambient temperatures up to 500° C are extremely important. The tube features an external anode with metal-ceramic construction which permits operation in which auxiliary cooling may be used, either by immersion in oil or by clamping of the bulb to a suitable heat sink.

The electrical connections for the remaining elements are by means of the seven pin miniature tube base and the tube may be operated in any position.

The internal structure employs ceramic element spacers and the much smaller size and mass of the tube elements greatly increase resistance to damage by vibration and shock. A pure alumina heater insulator permits operation at high heater-cathode voltages.



Publication No. RT22-17

Printed in U.S.A.

METAL-CERAMIC MINIATURE LOW MU TRIODE

Bendix Red Bank Type TE-32

RATINGS

Heater Voltage (AC or DC)	6.3	Volts
Heater Current	1.25	Amps
Plate Voltage (Maximum DC)	275	Volts
Plate Dissipation (Absolute Max.)	20	Watts
Grid Current (Absolute Max.)	5.0	Milliamperes
Grid Circuit Resistance		
With Fixed Bias (Max.)	0.05	Megohm
With Cathode Bias (Max.)	0.10	Megohm
With any combination of fixed and cathode bias	0.05	Megohm
Heater-Cathode Voltage (Absolute Max.)	±450	Volts

TYPICAL OPERATION

Class A_1 Amplifier

Plate Supply Voltage	135	Volts
Cathode Bias Resistor	250	Ohms
Amplification Factor	2	
Plate Resistance	280	Ohms
Transconductance	7000	Micromhos
Plate Current	125	Milliamperes

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

from JEDEC release #4117, Feb. 4, 1963

7313

File Catalog: Special Purpose Electron Tubes
Section: Receiving Tubes

Bendix

Red Bank Type TE-33
(Generic Type one
Section of 5R4)

METAL-CERAMIC MINIATURE HALF-WAVE RECTIFIER

MECHANICAL DATA

Bulb Temperature	500°C max.
Overall Length	2-15/16 inches max.
Seated Height	2-11/16 inches max.
Diameter	3/4 inches max.
Base	Seven-pin miniature
Mounting Position	Any
Cathode Warm-up Time (plate and heater voltages simultaneously)	45 Seconds
Maximum altitude*	60,000 feet

*Derating or cooling may be necessary to meet maximum bulb temperature requirement.

PIN CONNECTIONS

Pin	Element
1	No Connection
2	Heater
3	No Connection
4	Cathode
5	No Connection
6	Heater
7	No Connection
Bulb	Plate

DESCRIPTION

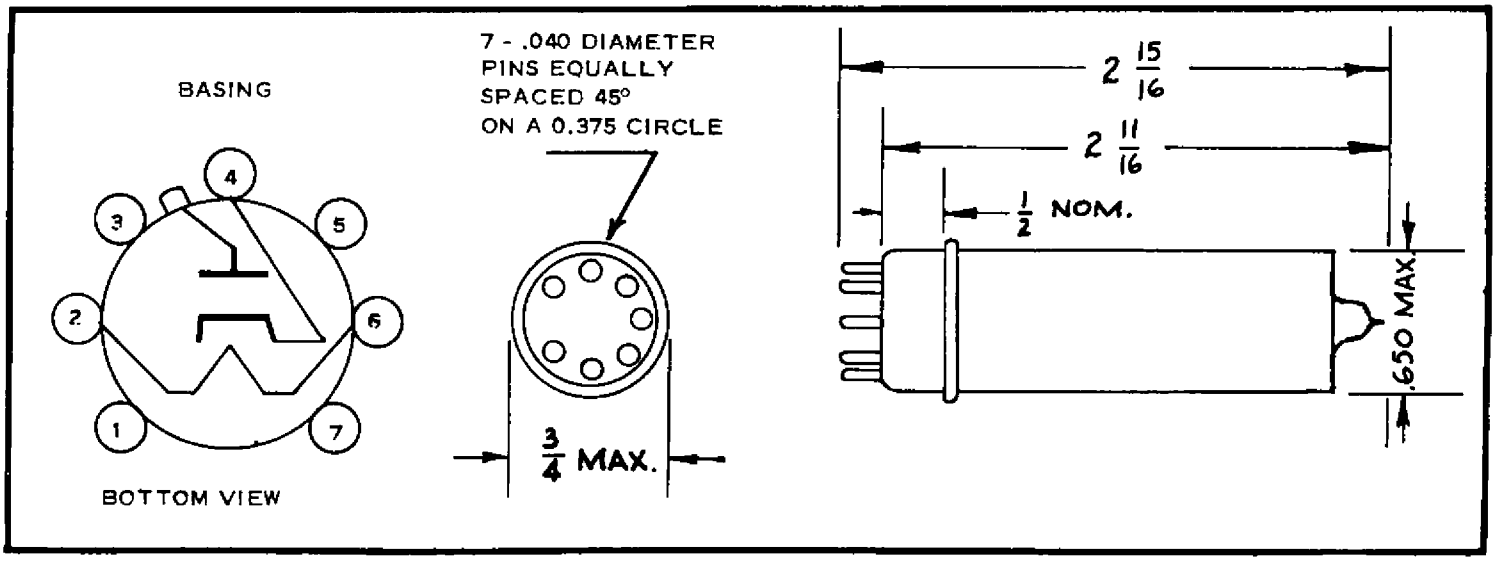
The Bendix 7313 is a half-wave rectifier and is one of the Bendix HY-G-500 line of receiving tubes. It is in the miniature tube size and features an external anode, metal-ceramic construction. It is specifically designed for aircraft, missile and industrial applications where limited space requirements and/or envelope temperatures up to 500° C are encountered.

The external metal anode construction permits operation in which auxiliary cooling may be used by immersion in oil or by clamping in a suitable heat sink.

The other electrical connections for the elements are by means of base pins in the standard seven-pin miniature configuration and the tube may be operated in any position.

Pure alumina element spacers are employed. An indirectly heated unipotential cathode provides low internal tube drop. The much smaller size and lower mass of the tube elements in comparison with equivalent glass rectifier types, greatly increase resistance to damage by vibration and shock.

A pure, alumina heater insulator permits operation at high heater-cathode voltages.



Publication No. RT22-15

Printed in U.S.A.

HALF-WAVE RECTIFIER

7313

Red Bank Type TE-33

RATINGS

Heater Voltage	6.3 Volts
Heater Current	1.55 Amperes
Peak Inverse Voltage	2800 Volts
Peak Plate Current	1000 Milliamperes
DC Heater-Cathode Potential (max)	500 Volts

TYPICAL OPERATION

Input to Filter

	Capacitor	Choke	
Heater Voltage	6.3	6.3	Volts
Heater Current	1.55	1.55	Amperes
RMS Plate Supply Voltage	700	700	Volts
Input Capacitor	4	--	Microfarads
Input Choke	--	10	Henries
Supply Impedance	100	--	Ohms
Output Current (DC)	140	85	Milliamperes
Output Voltage (full load) (DC)	755	865	Volts
Output Voltage (half load) (DC)	815	875	Volts

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

from JEDEC release #4117, Feb. 4, 1963

7314

File Catalog: Special Purpose Electron Tubes
Section: Receiving Tubes

Bendix Red Bank Type TE-34
(Generic Type 6AG7)

METAL CERAMIC MINIATURE BEAM POWER AMPLIFIER

MECHANICAL DATA

Bulb Temperature	500° max.
Overall Length	2-13/16 inches max.
Seated Height	2-3/32 inches max.
Diameter	3/4 inches max.
Base	Seven-pin miniature
Mounting Position	Any

Pin Connections

Pin	Element
1	Cathode and Grid Number 3
2	Heater
3	Grid Number 2 (Screen)
4	No connection
5	Cathode and Grid Number 3
6	Heater
7	Grid Number 1
Bulb	Plate

DESCRIPTION

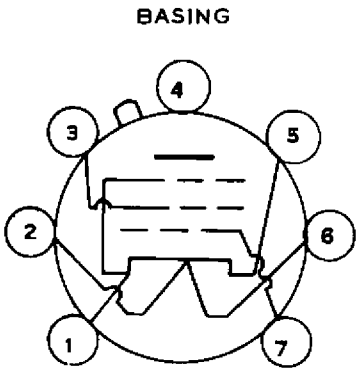
The Bendix 7314 is a beam power amplifier and is one of the Bendix HY-G-500 Line of Receiving Tubes. It is in the miniature tube size and features an external anode, metal-ceramic construction. It is specifically designed to replace type 6AG7 for aircraft, missile and industrial applications where limited space requirements and/or envelope temperatures up to 500° C are encountered.

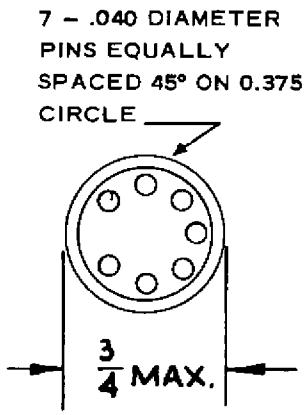
The external anode construction permits operation in which auxiliary cooling may be used, either by immersion in oil or clamping to a suitable heat sink.

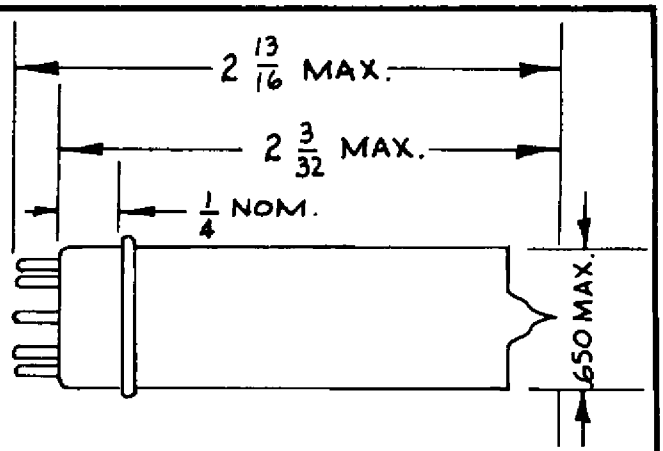
The 7314 is designed primarily for use in the output stage of video amplifiers, being capable of operating at high plate current levels and having high transconductance.

Electrical connections for the other tube elements are by means of base pins in the standard seven-pin miniature configuration and the tube may be operated in any position.

The internal structure employs ceramic element spacers and the much smaller size and mass of the tube elements greatly increase resistance to damage by vibration and shock. A pure alumina heater insulator permits operation at high heater-cathode voltages.







METAL CERAMIC MINIATURE BEAM POWER AMPLIFIER

7314

Bendix Red Bank Type TE-34

RATINGS

Heater Voltage (AC or DC)	6.3	Volts
Heater Current	0.60	Amperes
Plate Voltage (maximum DC)	300	Volts
Screen Voltage (maximum DC)	300	Volts
Plate Dissipation (Absolute maximum)	10	Watts
Heater - Cathode Voltage (maximum)	± 450	Volts

TYPICAL OPERATION

CLASS A, AMPLIFIER

Plate Voltage	300	Volts
Screen Voltage	150	Volts
Grid Number 1 Voltage	-3.0	Volts
Peak AF Grid Number 1 Voltage	3.0	Volts
Plate Resistance (Approx.)	0.13	Megohm
Transconductance	11000	Micromhos
Zero Signal Plate Current	30	Milliamperes
Maximum Signal Plate Current	30.5	Milliamperes
Zero Signal Screen Current	7.0	Milliamperes
Maximum Signal Screen Current	9.0	Milliamperes
Load Resistance	10,000	Ohms
Total Harmonic Distortion	7.0	Percent
Power Output	3.0	Watts

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. RT21-14

Printed in U.S.A.

HY-G-300®

7403
Bendix Type TE-74

RELIABLE HARD GLASS BEAM TETRODE FOR HIGH VOLTAGE PULSE AND REGULATOR SERVICE

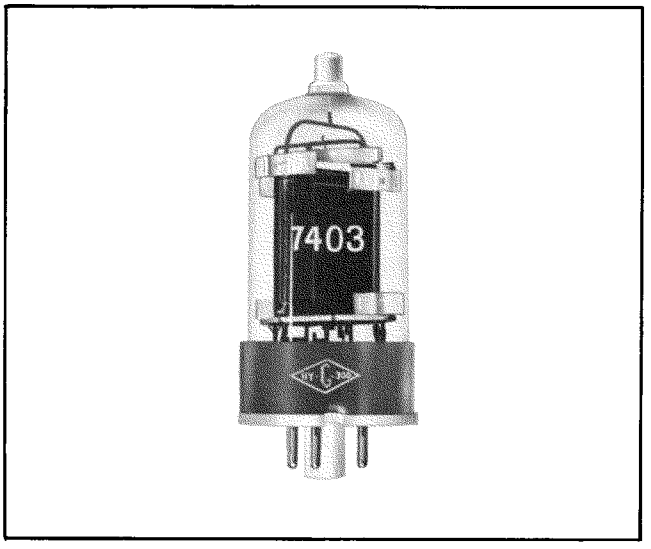
DESCRIPTION

This high perveance beam power amplifier tube is one of the Bendix line of HY-G-300 tubes. It has been designed for high voltage pulse modulator use in aircraft, military, and industrial applications where long pulse life, reliable operation at high voltages during vibration and shock, and freedom from internal arcing are important. Its ability to operate at 4000 volts without arcing and to deliver 10 ampere peaks of cathode current make it ideal for use in such applications or pulse modulators, blocking oscillators, high voltage regulators, switching, deflection amplifiers, etc. The reliable design and processing techniques provide the above characteristics in a package that will operate reliably in military environments.

Each tube is subjected to a high voltage, high energy lint and particle elimination process, and a minimum of 24 hours of pulse operation run-in at high peak cathode currents. This run-in serves to eliminate early failure under operating conditions and to stabilize tubes under pulse operating conditions.

Since this tube is designed for use in equipment with high voltage and where high levels of vibration and shock are encountered, special materials, and processing techniques are employed. Inasmuch as destructive internal arcing usually culminates in ionization, it is important that tubes used at high voltages be extremely well evacuated at high temperatures to remove residual gases which may ionize. The transmitting tube type materials and processing utilized in the Bendix HY-G-300® line result in tubes that are inherently gas free and capable of high dissipation.

The addition of a titanium insert to the anode structure performs a dual function: (1) the gettering capability of



titanium permits the elimination of gettering by conventional barium flash which may induce arcing by coating various insulating surfaces; (2) titanium has the advantage of absorbing contaminatives on its surface which may otherwise dissociate during operation to cause emission slump.

The barrier type glass bonded mica base used on the 7403 not only provides greater arc resistance, but also will not carbonize during a possible arc preventing the build up of a permanently conductive path.

Other special features include a rugged, pure tungsten, helical heater which is used with a high purity aluminum oxide insulator, enabling reliable operation at high heater-cathode voltages.

The design of this tube is a result of extensive engineering evaluation on special impact vibration equipment in which the accelerations equal or exceed those encountered in severe aircraft applications. The shake table used for these studies shock excites the tubes at a repetition rate of 15 cycles per second with a minimum peak acceleration of 50G. These tests indicate that the Bendix 7403 will survive many hours longer, under extremely adverse conditions.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)	6.3 volts
Heater Current	1.7 amps
Plate Voltage (Max DC)	4000 volts
Screen Voltage (Max DC)	850 volts
Plate Dissipation (Absolute Max)	40 watts
Screen Dissipation (Absolute Max)	3.5 watts
Cathode Current (Max DC Value)	175 mA
Cathode Current (Max Inst. Peak value—of continuous sine wave)	350mA
Cathode Current (Max Inst. Peak Value) Pulse***	10 amps
Heater-Cathode Voltage (Max)	±450 volts
Grid Resistance (Max)	0.1 megohm
Grid Voltage (Max DC)	+5.0 volts
(Min DC)	—200 volts
(Max Inst. Peak Value) Pulse***	+220 volts
Cathode Warm-up Time	45 seconds

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously. See application notes.

**Voltage should not fluctuate more than ±5%.

***See pulse rating chart.

CHART 2. MECHANICAL DATA

Base	Large wafer octal, with metal sleeve, 6 pin Glass bonded mica
Bulb	Nonex Glass—T-12
Max Overall Length	4-9/32"
Max Seated Height	3-3/4"
Max Diameter	1-23/32"
Mounting Position	Any
Max Altitude	80,000 feet
Max Bulb Temperature	300°C
Max Impact Shock	500G
Max Vibration Acceleration (100-hour shock excited fatigue test, sample basis)	50G
Life Expectancy	5,000 Hours

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R01-11

Printed in U.S.A.

BEAM POWER AMPLIFIER
(PULSE)

HY-G-300

7403
Bendix Type TE-74

ELECTRICAL CHARACTERISTICS AND ENVIRONMENTAL TESTS

CHARACTERISTIC TESTS

CHART 3.

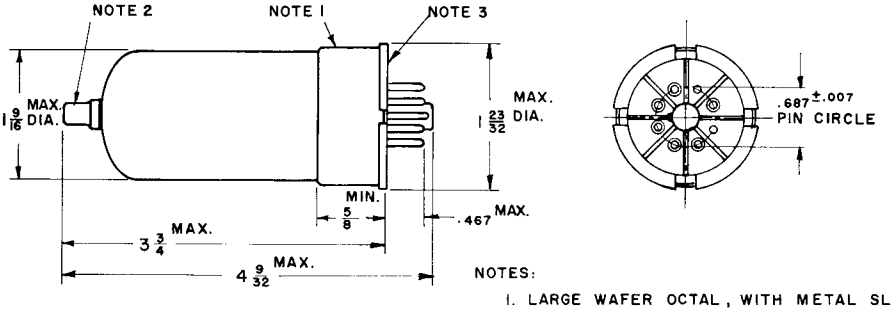
CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX	UNITS
PRODUCTION TESTS					
Short and Continuity					
Heater Current	If	1.55	1.70	1.85	A
Heater Cathode Leakage (Ehk = ± 450 Vdc)	Ihk	—	—	50	μAdc
Grid Current	Ic1	—	—	—5.0	μAdc
Plate Current	Ib	28	32.5	37	mAdc
Screen Grid Current	Ic2	—	1.5	3.0	mAdc
Transconductance (1)	Sm	5000	6000	7000	μmhos
Cut off Plate Current (Ec1 = — 180 Vdc, Eb = 4000 Vdc, Ec2 = 800 Vdc)	Ib	—	—	300	μAdc
Pulsed Operation	ib	6.0	—	—	a
Pulsed Operation	ic2	—	—	3	a
Pulsed Operation	ic1	—	—	2	a

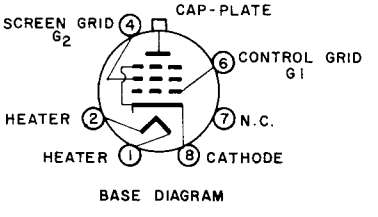
ELECTRODE	Ef	Eb	Ec2	Ec1	Rk	Egk
TEST CONDITIONS	6.3 volts	600 Vdc	300 Vdc	0	825 ohms	—
PULSE TEST CONDITIONS	6.3 volts	600 Vdc	800 Vdc	—180 Vdc	0	+150 v

ENVIRONMENTAL TESTS

CHART 4.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min Off 4 Min Ef = 7.0 Ehk = 300	2,000 On-Off Cycles
Pulse Life Test	ib = 6.5	500 Hours
Life "Expectancy" Test	Under "Test Conditions"	5,000 Hours
High Level Fatigue Test	50G—Shock Excitation 15 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	80,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Swept Freq Fatigue	5G—F = 50—500 CPS	96 Hours





BASE DIAGRAM

NOTES:
1. LARGE WAFER OCTAL, WITH METAL SLEEVE.
2. CAP IS JEDEC C1-2(MODIFIED)
3. WAFER IS GLASS BONDED MICA.
4. ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED.

OUTLINE DRAWING

CHART 5. AVERAGE PLATE CHARACTERISTICS

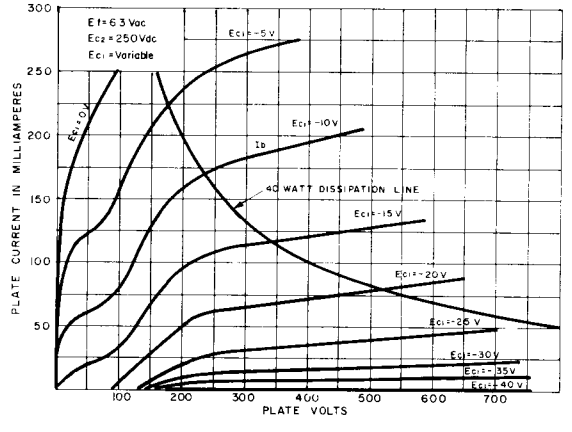
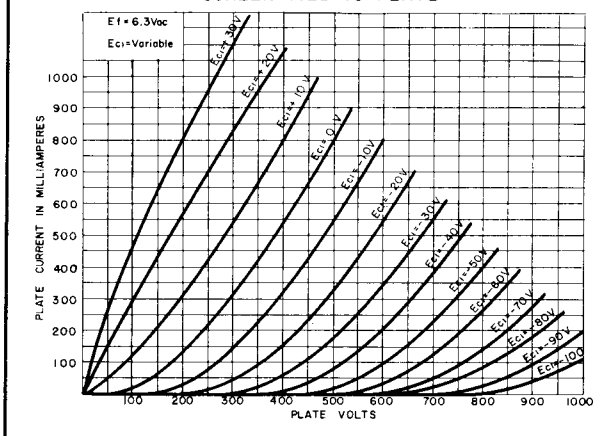


CHART 6. TYPICAL TRIODE CHARACTERISTICS SCREEN TIED TO PLATE



BEAM POWER AMPLIFIER
(PULSE)

MV-G-300

7403
Bendix Type TE-74

ADDITIONAL CHARACTERISTICS

PULSE CHARACTERISTICS

See CHART 13 page 4 (Pulse Ratings)

CHART 7.

TYPICAL PLATE CHARACTERISTICS

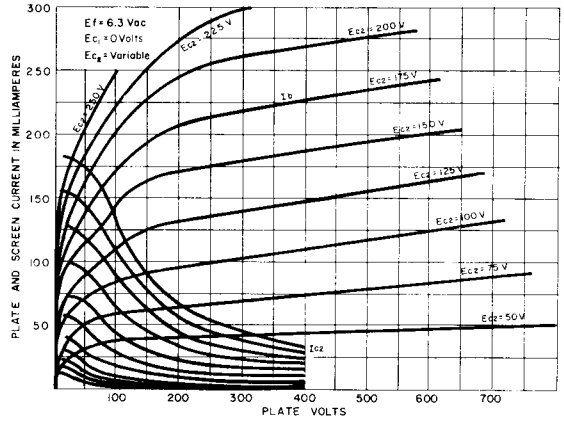


CHART 8. TYPICAL PLATE CHARACTERISTICS
SCREEN TIED TO CATHODE

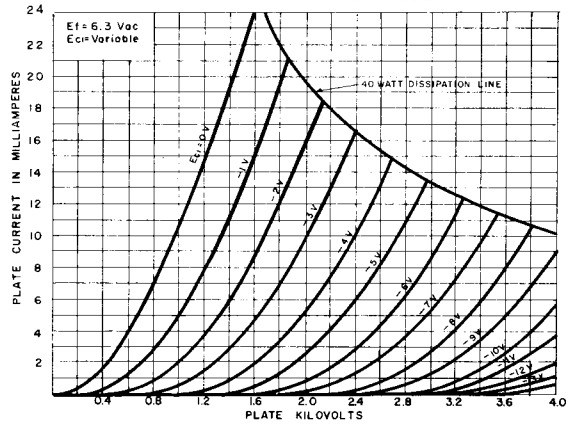


CHART 9. TYPICAL PULSE CHARACTERISTICS

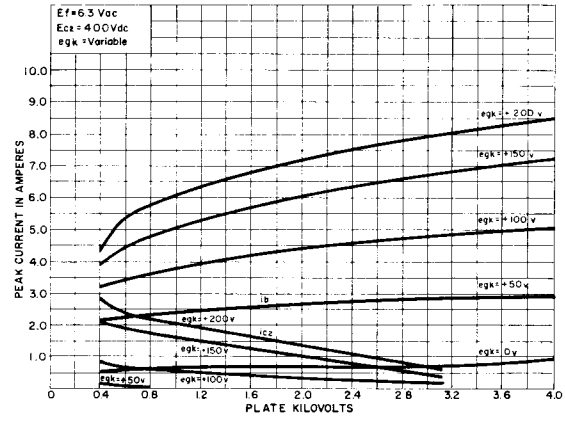


CHART 10.

TYPICAL PULSE CHARACTERISTICS

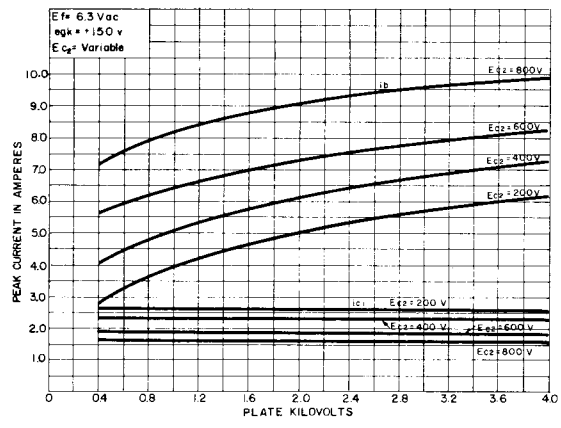


CHART 11.

TYPICAL PULSE CHARACTERISTICS

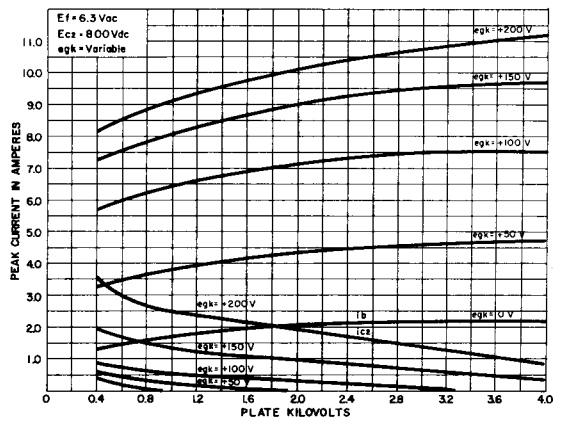
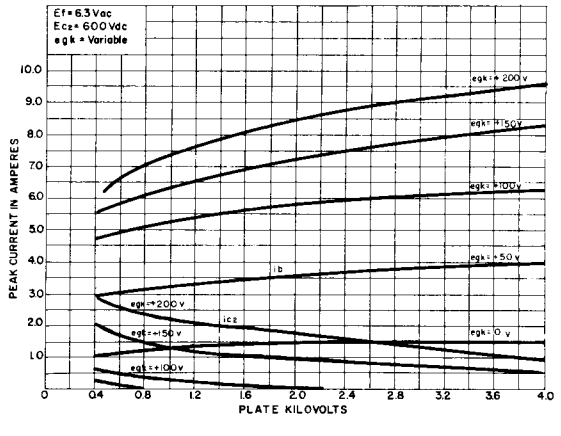


CHART 12.

TYPICAL PULSE CHARACTERISTICS

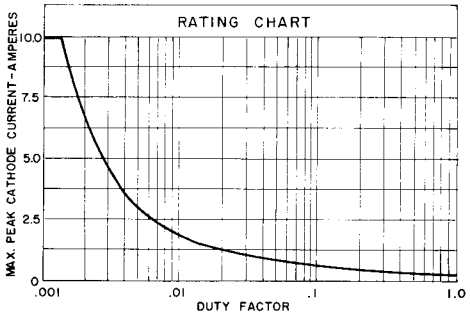


BEAM POWER AMPLIFIER
(PULSE)

MY-G-300

7403
Bendix Type TE-74

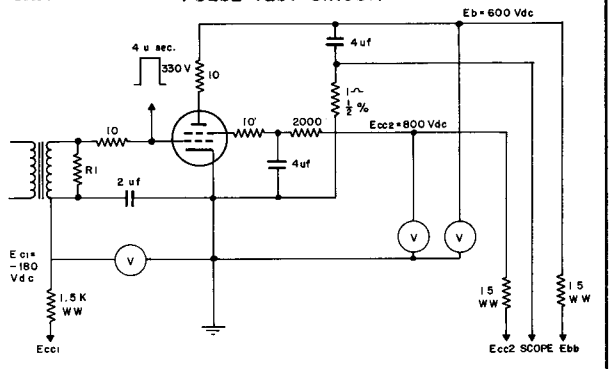
CHART 13. PULSE RATING



DUTY FACTOR (10,000 MICROSECOND AVERAGING TIME) FOR THE 7403 IS DEFINED AS THE RATIO OF "ON" TIME IN MICROSECONDS TO 10,000 MICROSECONDS.

"ON" TIME IS DEFINED AS THE SUM OF THE DURATION OF ALL INDIVIDUAL PULSES WHICH OCCUR DURING ANY 10,000 MICROSECOND INTERVAL.

CHART 14. PULSE TEST CIRCUIT



NOTES:

1. ADJUST R1 FOR MINIMUM RINGING AND OVERSHOOT.
2. PULSE REPETITION RATE = 250 PULSES PER SECOND. DUTY CYCLE = .001

APPLICATION NOTES

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 will 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.

This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment.

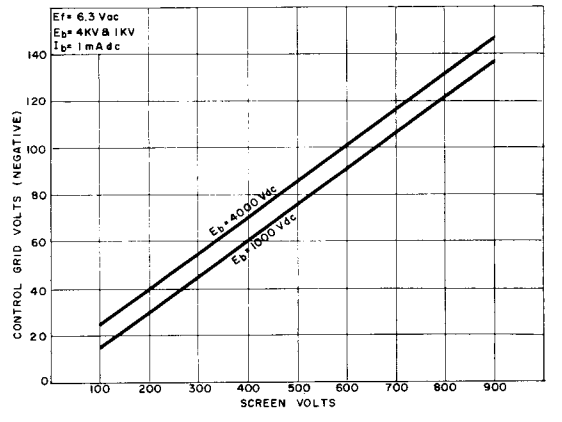
The plate voltage rating and high-perveance of the 7403 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak plate current should not exceed the value shown in Chart 13 for the required duty factor.

CUT-OFF CHARACTERISTICS

For Ib = 1.0 ma

CHART 15.

TYPICAL CURRENT CUT-OFF CHARACTERISTICS



THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

from JEDEC release #2414A, March 14, 1959

File Catalog: Special Purpose Electron Tubes

7414

TENTATIVE

Bendix Red Bank Type TD–70

SUBMINIATURE TIME TOTALIZER



MECHANICAL DATA

Envelope	T–3
Base	Button-subminiature 8 pin long leads
Bulb length	1.70 in. max.
Diameter	0.400 in. max.
Mounting position	Any
Ambient Temperature	–55°C. to +55°C.

ELECTRICAL DATA

Cathode	Cold
Tube drop	118 Vdc nominal
Cathode current	0.36 mAdc
Supply voltage	See Figure 3
Operating time	1000 hours
Accuracy at rated current	±20% to 1000 hours
Collector Dissipation	Average 50 mw max.
	Peak 100 mw max.

DESCRIPTION

This subminiature gas filled tube is designed for use as a cumulative time measuring device. Total nominal operating time is 1000 hours at rated current.

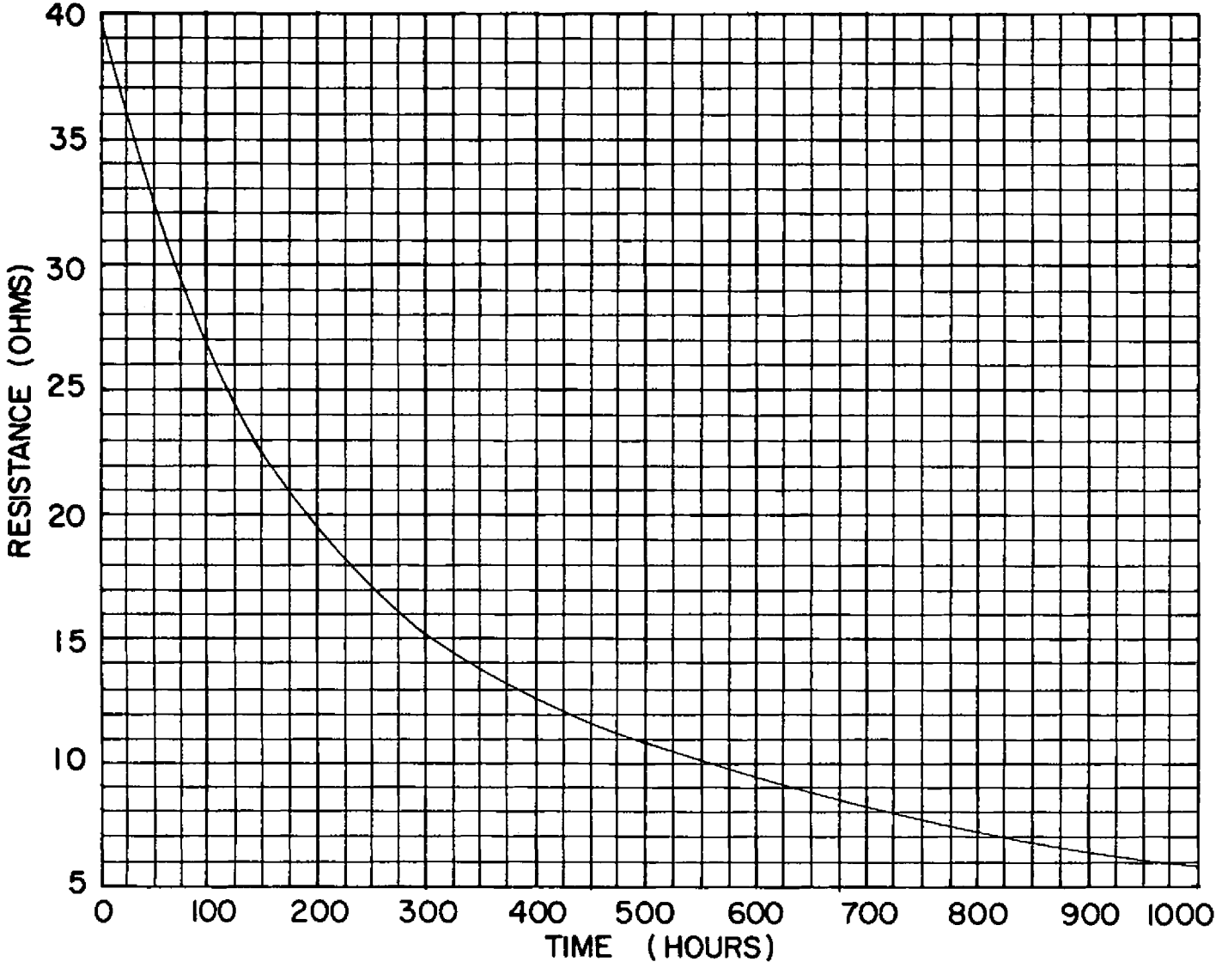
The tube consists of an anode, a cathode and a collector element. The tube operates by passage of a current between anode and cathode. This part of the tube has essentially the same characteristics as any cold cathode gas diode. Operation is accomplished by drawing current from a DC source through a limiting resistor in series with the anode as shown in Figure 2. Adjustment of the load resistance should be made to provide a current of 0.36 milliamperes for a nominal tube drop of 118 volts. Tubes having anode voltage different from this value will draw a correspondingly different current which will be correct for the particular tube. A graph showing recommended load resistance values for various supply voltages is shown in Figure 3.

During operation metallic vapor from the cathode is deposited on the collector thereby changing the resistance across the collector contacts. Resistance measurements made between pins 1 and 8, collector contacts, determine the operating time of the tube. Conversion from ohms to hours can be made by referring to the graph in Figure 1 of this data sheet. Diode current must be off during resistance measurements to prevent diode current leakage into the resistance measuring circuit with resultant error in measured elapsed time. No potentials should be applied to the collector during operation of the diode circuit; furthermore, collector contacts must not be grounded during operation of the tube.

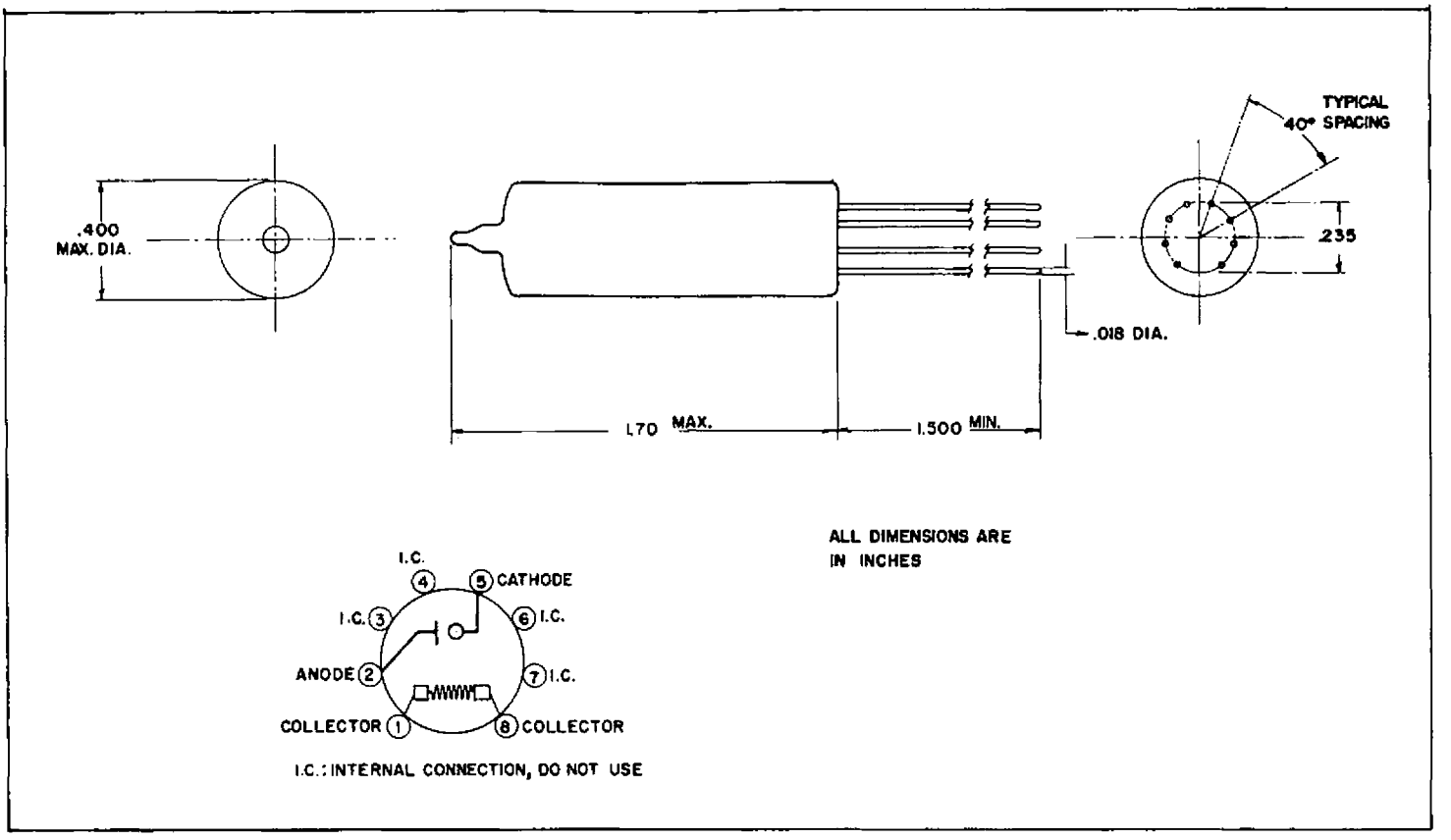
BASE CONNECTIONS

No. 1 – Collector contact
No. 2 – Anode
No. 3 – I.C. – Do not use
No. 4 – I.C. – Do not use
No. 5 – Cathode
No. 6 – I.C. – Do not use
No. 7 – I.C. – Do not use
No. 8 – Collector contact

Bendix AVIATION CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY



COLLECTOR RESISTANCE vs OPERATING TIME
FIG. 1



OUTLINE DRAWING

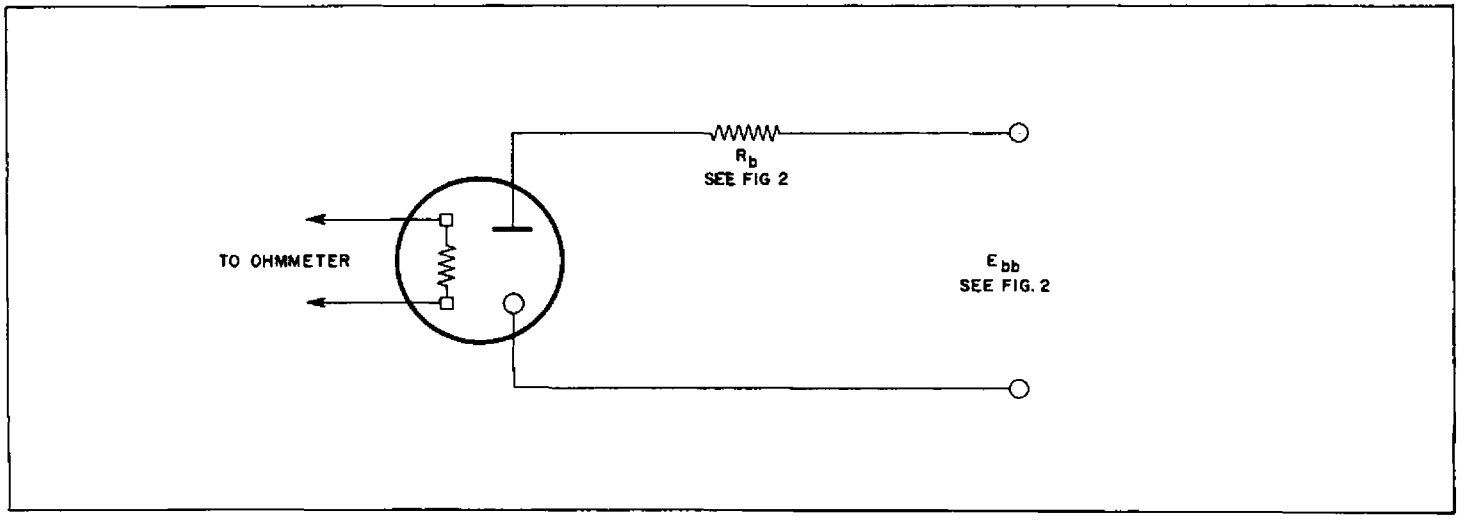


FIG. 2 OPERATING CIRCUIT

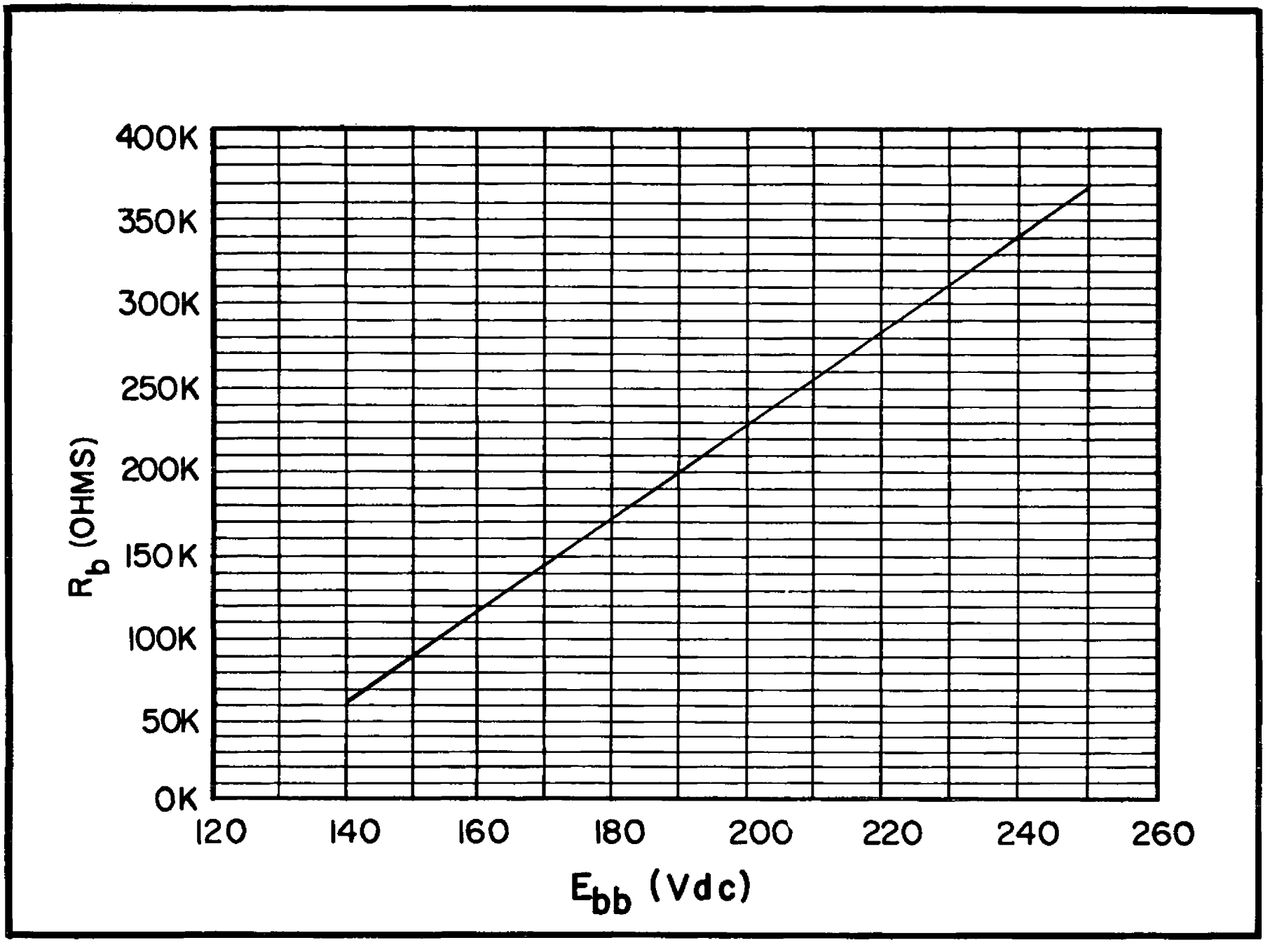
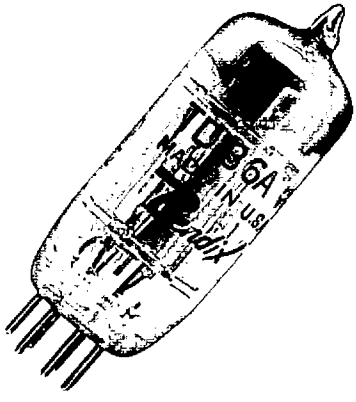


FIG. 3 PLATE SUPPLY - LOAD RESISTANCE

CONSTANT FIRING DIODE



DESCRIPTION

The TD-36A is a miniature cold cathode inert gas filled diode. It is designed for use as a firing diode in RC timing circuits, energy transfer circuits and as a protective device. It is specifically designed for circuits in which a very stable breakdown voltage is required from -55° C to +135° C and for applications where the tube must operate with minimum deviation from initial characteristics after long periods of off time over the above temperature range. Its large, bare metal cathode is capable of supplying high peak currents under condenser discharge conditions and adequate average currents during steady state operations.

PHYSICAL CHARACTERISTICS

Base	Button: 7-pin miniature (E7-1)
Envelope	T-5 1/2 (5-2)
Overall length (Max.)	2 1/8"
Diameter (Max.)	3/4"
Seated Height (Max.)	1 7/8"
Mounting position	Any

ELECTRICAL RATINGS

Ionization Voltage E_z	133 Vdc, nom. (Note 1)
Ambient temperature	-55° C to +135° C
Total ΔE_z over above temperature range	2 Vdc, max. (Note 2)
Life (Fig. 6)	10,000 pulses, min.
Life test end point: Total ΔE_z	2 Vdc, max.
Operating voltage, E_b, (at 20 mAdc)	95 Vdc, max. (Note 3)
$E_z - E_b$	43 Vdc, min. (Note 4)
Instantaneous peak i_k	100 ma, max.
Average cathode current	20 mAdc
Maximum temperature for extended storage	+135° C
Vibration	10 g's

Note 1: 95% of the tubes break down between 130 Vdc and 135 Vdc. (see Figure 1)

Note 2: A tube is tested 10 times at -55° C, at +25° C, and at +135° C. The total ΔE_z for all thirty readings is less than 2V. 95% of the tubes change less than 1.5 Vdc. (see Figure 3)

Note 3: 95% of the tubes have an operating voltage of 86 to 88 Vdc (see Figure 2)

Note 4: 95% of the tubes have a difference, $E_z - E_b$, of 43 to 51 Vdc (see Figure 4)

OPERATION

This tube was designed to operate continuously in a glow discharge. Consequently sufficient resistance must be inserted in series with the tube to limit the current passing through the tube to the rated values.

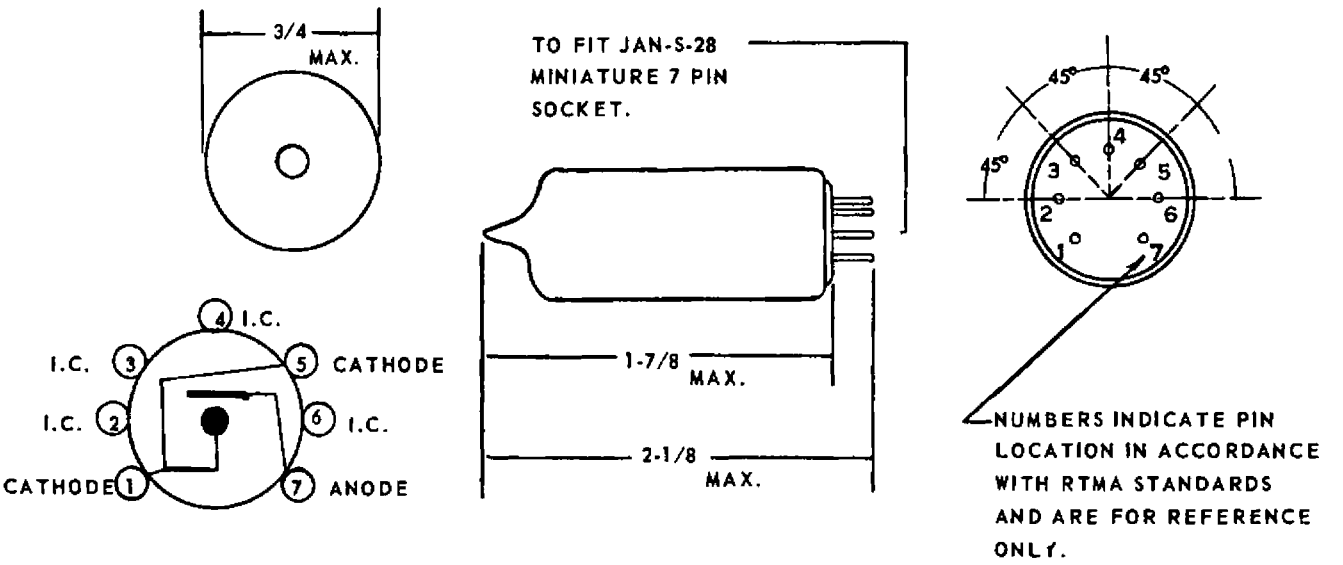


FIGURE 5
OUTLINE DRAWING OF CONSTANT FIRING DIODE, 7416/TD-36A

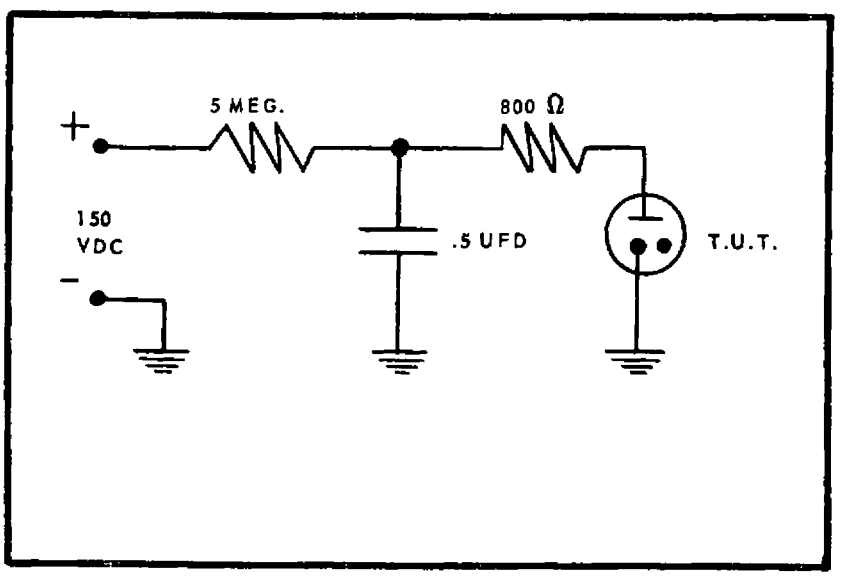


FIGURE 6
LIFE TEST CIRCUIT OF TD-36 A

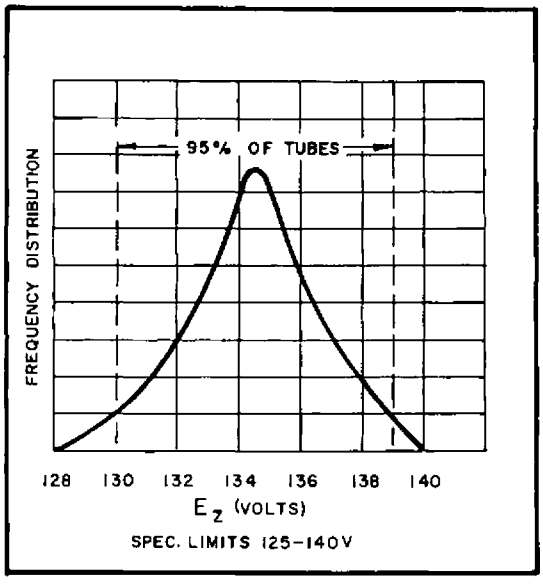


FIG. 1

TYPICAL DISTRIBUTION OF
IONIZATION VOLTAGES
OF PRODUCTION LOTS

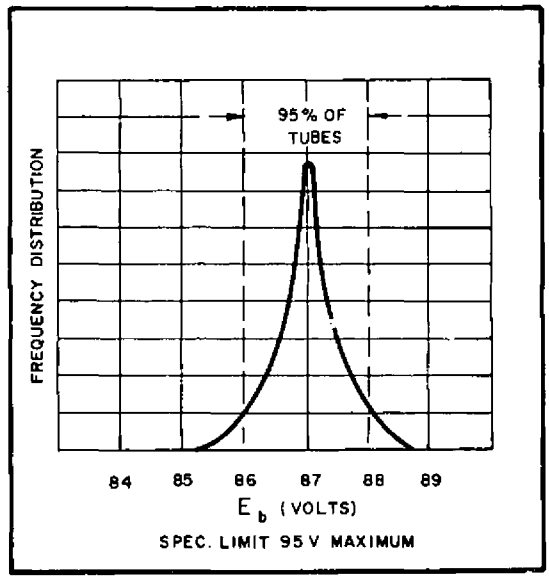


FIG. 2

TYPICAL DISTRIBUTION OF
OPERATING VOLTAGES
OF PRODUCTION LOTS

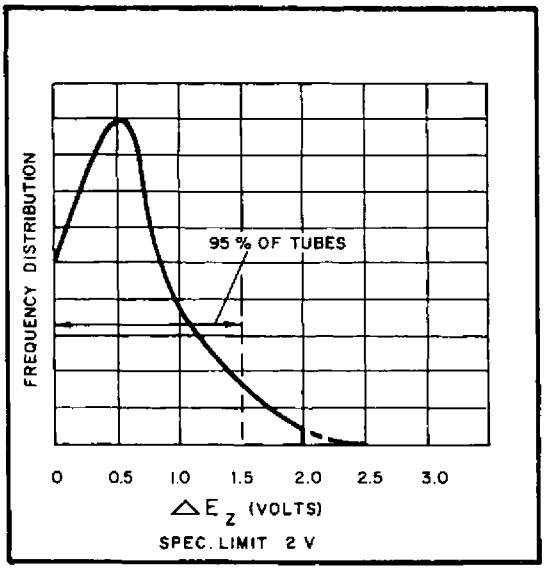


FIG. 3

TYPICAL DISTRIBUTION OF
CHANGE IN IONIZATION VOLTAGES
FROM −55°C TO +135°C
OF PRODUCTION LOTS

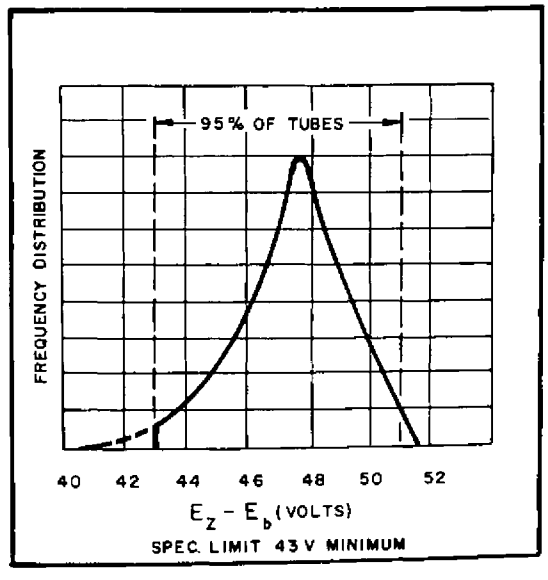


FIG. 4

TYPICAL DISTRIBUTION OF
THE DIFFERENCE BETWEEN
IONIZATION AND OPERATING VOLTAGES
OF PRODUCTION LOTS

Bendix makes a complete family of gas and special tubes: xenon and cold cathode thyratrons, gas diode voltage regulators, chronotrons, convectrons, spark gaps, etc...

For more information on any of these tubes - or information on our other electron tube products, contact:

Market Manager
Electron Tube Products
Red Bank Division
The Bendix Corporation
Eatontown, New Jersey

Or, contact any of our sales offices:

The Bendix Corporation
1730 "K" Street, N.W.
Washington 6, D.C.
FEderal 3-8200

The Bendix Corporation
6444 North Central Avenue
Chicago, Illinois
SPring 5-4636

The Bendix Corporation
Dallas, Texas
FLeetwood 1-5411

The Bendix Corporation
Bendix International Division
205 East 42nd Street
New York 17, New York

The Bendix Corporation
1900 Hulman Building
Dayton, Ohio
BAldwin 6-2341

The Bendix Corporation
117 East Providencia Avenue
Burbank, California
VIctoria 9-3961

The Bendix Corporation
128 El Camino Real
San Carlos, California
LYtell 3-7845

Computing Devices of Canada, Ltd.
P.O. Box 508
Ottawa, Ontario, Canada

Publication No. RT11-1
Supersedes Pub. No. R93-5

Printed in U.S.A.

HY-G-300®

7757

Bendix® Type TE-81

RELIABLE HARD GLASS MINIATURE BEAM POWER AMPLIFIER FOR PULSE AND HIGH VOLTAGE REGULATOR SERVICE

DESCRIPTION

This high perveance beam power amplifier tube is one of the Bendix line of HY-G-300 tubes. It has been designed for high voltage pulse modulator and deflection amplifier use in aircraft, military, and industrial applications where reliable operations at high voltages during vibration and shock, and freedom from internal arcing are important. Its ability to operate at 3000 volts without arcing and to deliver 2 ampere peaks of cathode current make it ideal for use in such applications as pulse modulators, blocking oscillators, high voltage regulators, switching, deflection amplifiers, etc. The reliable design and processing techniques provide the above characteristics in a package that will operate reliably in military environments.

Each tube is subjected to a high voltage, high energy, lint and particle elimination process, and a minimum of 24 hours of pulse operation run-in at high peak cathode currents. This run-in serves to eliminate early failure under operating conditions and to stabilize tubes under pulse operating conditions.

Since this tube is designed for use in equipment with high voltage and where high levels of vibration and shock are encountered, special materials, and processing techniques are employed. Inasmuch as destructive internal arcing usually culminates in ionization, it is important that tubes used at high voltages be extremely well evacuated at high temperatures to remove residual gases which may ionize. The transmitting tube type materials and processing utilized in the Bendix HY-G300® line result in tubes that are inherently gas free and capable of high dissipation.

The addition of a titanium anode structure performs a dual function: (1) The gettering capability of titanium permits the elimination of gettering by conventional barium flash which may induce arcing by coating various insulating surfaces; (2) Titanium has the advantage of absorbing contaminants on its surface which may otherwise dissociate during operation to cause emission slump.



Other special features include a rugged, pure tungsten, helical heater which is used with a high purity aluminum oxide insulator, enabling reliable operation at high heater-cathode voltages.

The design of this tube is a result of extensive engineering evaluation on special impact vibration equipment in which the accelerations equal or exceed those encountered in severe aircraft applications. The shake table used for these studies shock excites the tubes at a repetition rate of 15 cycles per second with a minimum peak acceleration of 50G. These tests indicate that the Bendix 7757 will survive thousands of hours longer, under extremely adverse conditions.

CHART 1. ELECTRICAL RATINGS*

Heater Voltage (AC or DC)	6.3 volts
Heater Current	0.6 amps
Plate Voltage (Max DC)	3000 volts
Screen Voltage (Max DC)	700 volts
Plate Dissipation (Absolute Max)	14 watts
Screen Dissipation (Absolute Max)	3 watts
Cathode Current (Max DC Value)	75 mA
Cathode Current (Max Inst. Peak value—of continuous sine wave)	150 mA
Cathode Current (Max Inst. Peak Value) Pulse***	2 amps
Heater-Cathode Voltage (Max)	±450 volts
Grid Resistance (Max)	0.1 megohm
Grid Voltage (Max DC)	+5.0 volts
(Min DC)	−200 volts
(Max Inst. Peak Value) Pulse***	+220 volts
Cathode Warm-up Time	45 seconds

*To obtain greatest life expectancy from tube, avoid designs where the tube is subjected to all maximum ratings simultaneously. See application notes.
**Voltage should not fluctuate more than ±5%.
***See pulse rating chart.

CHART 2. MECHANICAL DATA

Base	9-Pin Miniature Nonex Glass—Gold Plated Pins
Bulb	Nonex Glass—T6 ½
Max. Overall Length	3"
Max. Seated Height	2 ¾"
Max. Diameter	⅞"
Mounting Position	any
Max. Altitude***	70,000 feet
Max. Bulb Temperature	300°C
Max. Impact Shock	500 G
Max. Vibrational Acceleration (100 hour shock excited fatigue test, sample basis)	50 G
Life Expectancy	10,000 hrs.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. RO6-13

Printed in U.S.A.

BEAM POWER AMPLIFIER
(PULSE)

HY-G-300

7757
Bendix Type TE-81

ELECTRICAL CHARACTERISTICS AND ENVIRONMENTAL TESTS

CHARACTERISTICS TESTS

CHART 3.

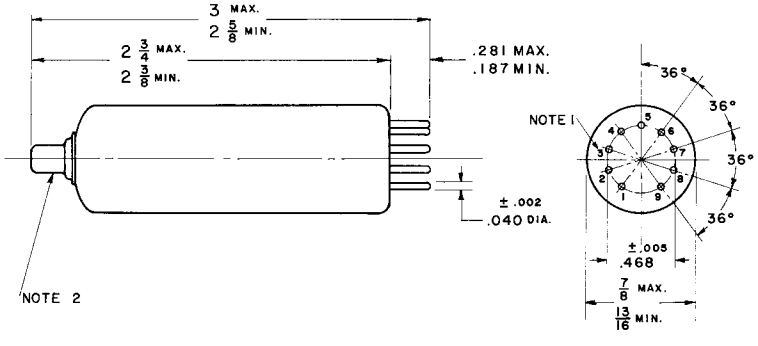
CHARACTERISTIC	SYMBOL	MIN	DESIGN CENTER	MAX	UNITS
PRODUCTION TESTS					
Short and Continuity					
Heater Current	If	0.560	0.600	0.640	A
Heater Cathode Leakage (Ehk = ± 450 Vdc)	Ihk	—	—	50	μAdc
Grid Current	Ic1	—	—	—5.0	μAdc
Plate Current	Ib	33	45	57	mAdc
Screen Grid Current	Ic2	0.5	3.5	7.5	mAdc
Transconductance (1)	Sm	3000	4100	5200	μmhos
Cut off Plate Current (Ec1 = —100, Eb = 3000, Ec_2 = 325)	Ib	—	—	100	μAdc
Pulsed Operation	ib	0.7	—	—	a

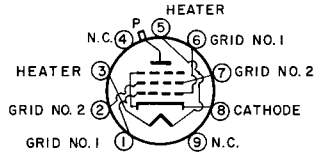
ELECTRODE	Ef	Eb	Ec2	Ec1	egk
TEST CONDITIONS	6.3 volts	250 Vdc	250 Vdc	—12.5 Vdc	—
PULSE TEST CONDITIONS	6.3 volts	750 Vdc	325 Vdc	—200 Vdc	+100 v

ENVIRONMENTAL TESTS

CHART 4.

TEST	CONDITIONS	DURATION
Heater Cycling Life Test	On 1 Min Off 4 Min Ef = 7.0 Ehk = 300	2,000 On-Off Cycles
Survival Rate Life Test	Under "Test Conditions" at 14 W Plate Dis.	100 Hours
Pulse Life Test	ib = 1.0 a	500 Hours
Life "Expectancy" Test	Under "Test Conditions"	10,000 Hours
High Level Fatigue Test	50G—Shock Excitation 15 Cycles/Sec.	100 Hours
Shock	500 G	20 Impacts
Altitude Test	70,000 Feet	5 Minutes
Glass Strain Test	Boiling Water to Ice Water	3 Minutes in Each
Swept Freq. Fatigue	5G—F = 50—500 CPS	96 Hours





BASE DIAGRAM

NOTES

1. NUMERALS DO NOT APPEAR ON BASE, SHOWN FOR REFERENCE ONLY.
2. CAP IS JEDEC C1-2
3. ALL DIMENSIONS ARE IN INCHES UNLESS SHOWN OTHERWISE.

OUTLINE

CHART 5.

AVERAGE PLATE CHARACTERISTICS

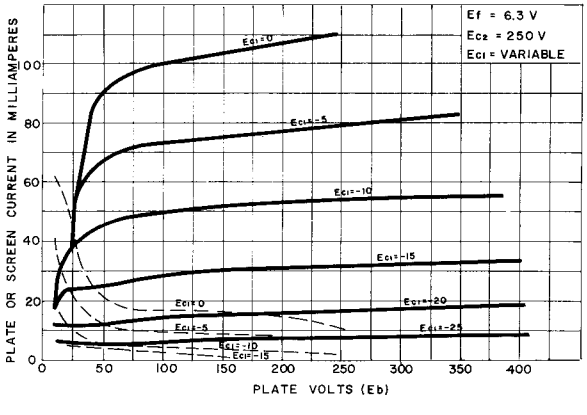
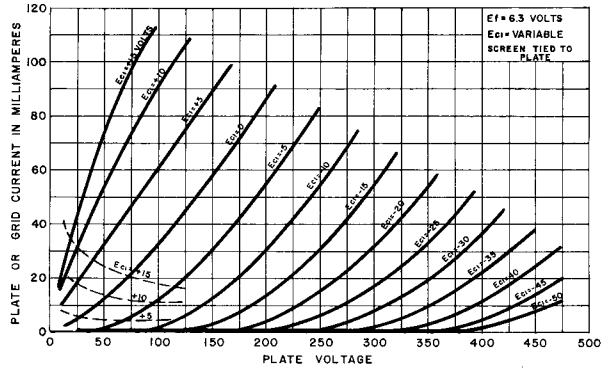


CHART 6.

TYPICAL TRIODE CHARACTERISTICS



BEAM POWER AMPLIFIER
(PULSE)

HY-G-300

7757

Bendix Type TE-81

ADDITIONAL PENTODE CHARACTERISTICS

CHART 7.

TYPICAL PLATE CHARACTERISTICS

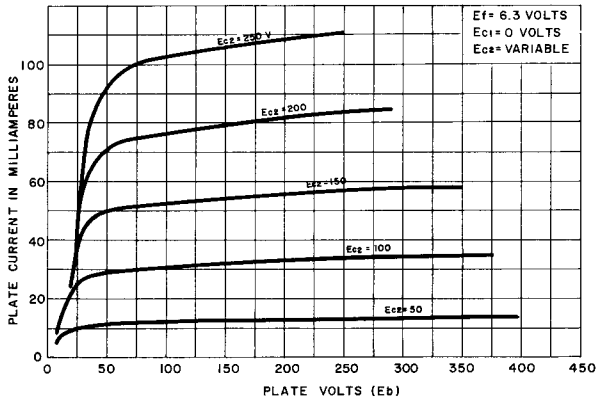


CHART 8.

TYPICAL TRANSFER CHARACTERISTICS

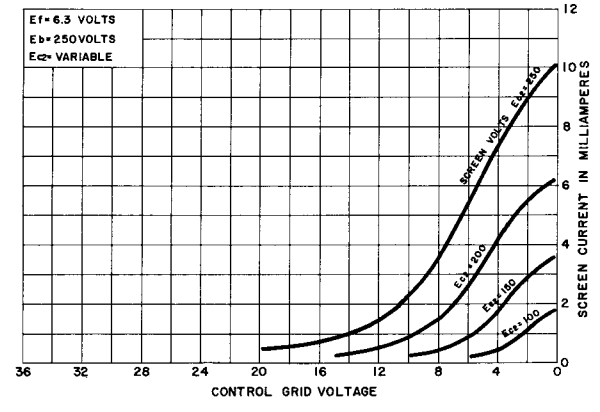
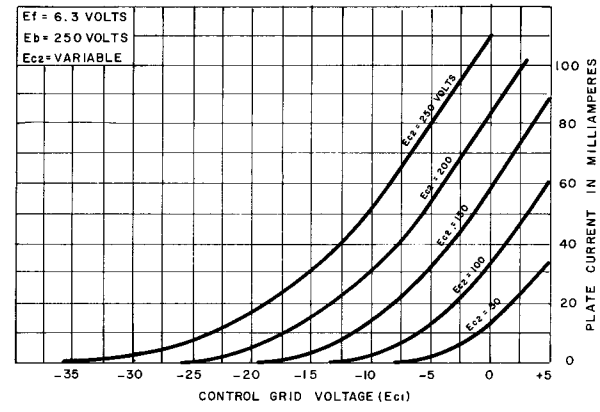


CHART 9.

AVERAGE TRANSFER CHARACTERISTICS



PULSE CHARACTERISTICS

See CHART 13 page 4 (Pulse Ratings)

CHART 10.

TYPICAL PULSE CHARACTERISTICS

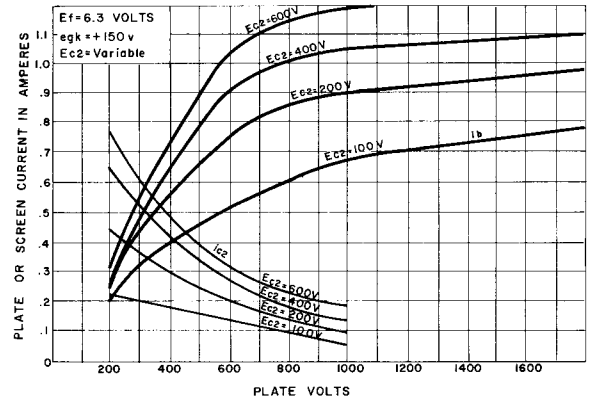


CHART 11.

TYPICAL PULSE CHARACTERISTICS

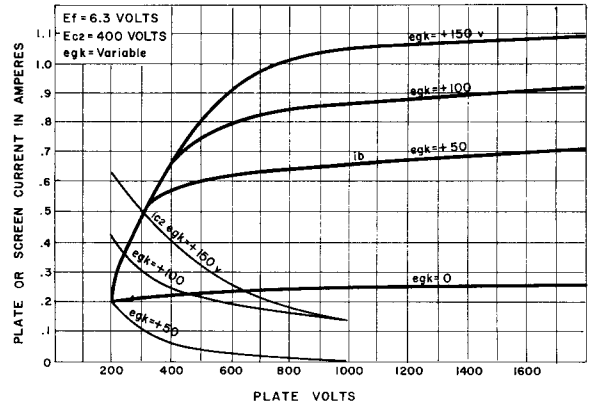
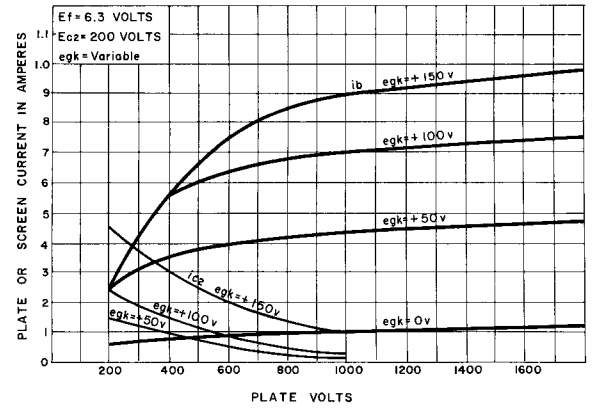


CHART 12.

TYPICAL PULSE CHARACTERISTICS

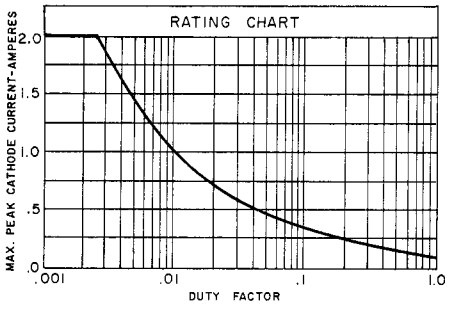


BEAM POWER AMPLIFIER
(PULSE)

HY-G-300

7757
Bendix Type TE-81

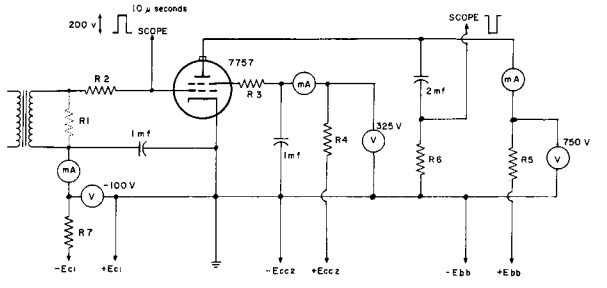
CHART 13. PULSE RATING



DUTY FACTOR (10,000 MICROSECOND AVERAGING TIME) FOR THE 7757 IS DEFINED AS THE RATIO OF "ON" TIME IN MICROSECONDS TO 10,000 MICROSECONDS.

"ON" TIME IS DEFINED AS THE SUM OF THE DURATION OF ALL INDIVIDUAL PULSES WHICH OCCUR DURING ANY 10,000 MICROSECOND INTERVAL.

CHART 14. PULSE TEST CIRCUIT



R1 = ADJUST FOR MINIMUM RINGING AND OVERSHOOT
R2 = 12Ω (APPROX.), 1 WATT (PARASITIC SUPPRESSOR).
R3 = 12Ω (APPROX.), 1 WATT (PARASITIC SUPPRESSOR).
R4 = 5000Ω 100 WATT WIRE WOUND
R5 = 2500Ω 100 WATT WIRE WOUND
R6 = 1Ω 1/2% 10 WATT CARBON
R7 = 1500Ω 10 WATTS

SCOPE = TEKTRONIX TYPE 535 OR EQUIVALENT.

APPLICATION NOTES

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 will 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.

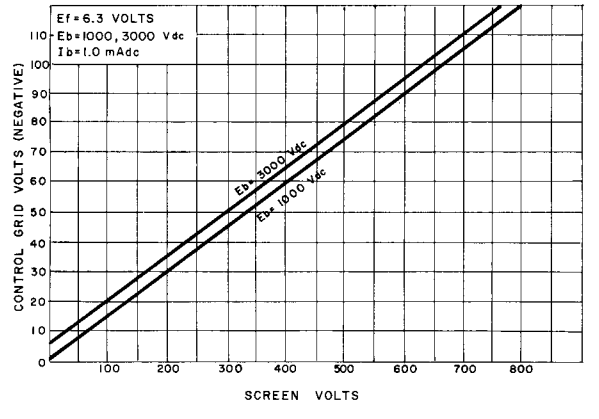
This tube is constructed using nonex glass and thus can withstand higher ambient temperatures in operation. However, the bulb temperature should never exceed 300°C at its hottest point and cooling should be employed if necessitated by the additive effects of operation at high altitudes and high dissipation simultaneously or by other sources of heat in the equipment.

The plate voltage rating and high-perveance of the 7757 make it readily adaptable to varied pulse applications. In order to insure maximum reliability in pulse service the peak plate current should not exceed the value shown in Chart 13 for the required duty factor.

CUT-OFF CHARACTERISTICS

For Ib = 1mA

CHART 15.
TYPICAL CURRENT CUT-OFF CHARACTERISTICS



THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

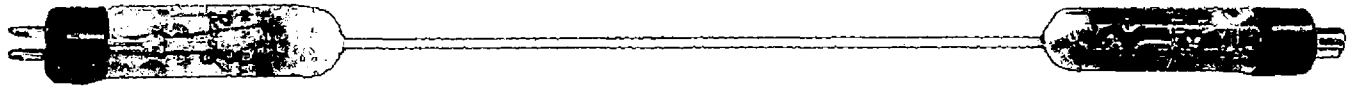
from JEDEC release #4296, June 10, 1963

7993

8292

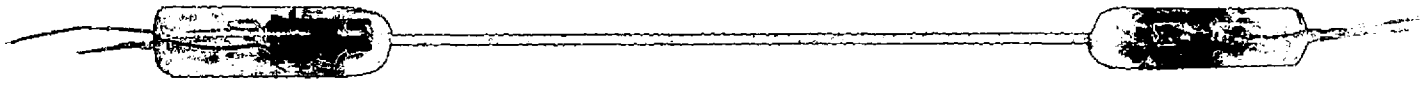
Bendix Red Bank

GAS NOISE SOURCES - ARGON, K_a BAND (26.5 40.0 G.C.)



TD 76

(7993)



TD 77

(8292)

DESCRIPTION

These tubes are designed primarily for use as noise sources in milli-wave measurements. When used in standard mount assemblies, they function as untuned terminations over the entire recommended transmission bandwidths of the guide.

	OPR.	Anode Current (Peak) ma	Anode Current (Av.) mAdc	Tube Voltage drop (Av.) Vdc	Tube Dissipation (Av.) WATTS	Starting Voltage K.V.	Starting Current mAdc	VSWR (Cold)	VSWR (Hot)	Ambient Temp. Range °C	Nr-1 Tube in Mount @ Rated Current
7993 TD76	DC	125	125	130	16	1.3 - 2.7	170	1.15	1.15	-55 to +85	16.0 ± 1db
8292 TD77	Pulse	150	100	175	18	2.0 - 3.0	170	1.15	1.15	-55 to +85	16.0± 1db

Electron Tube Products
Red Bank Division
Eatontown, New Jersey.

Publication No. RT32-19

Printed in U.S.A.

GAS NOISE SOURCES - ARGON, K_a BAND

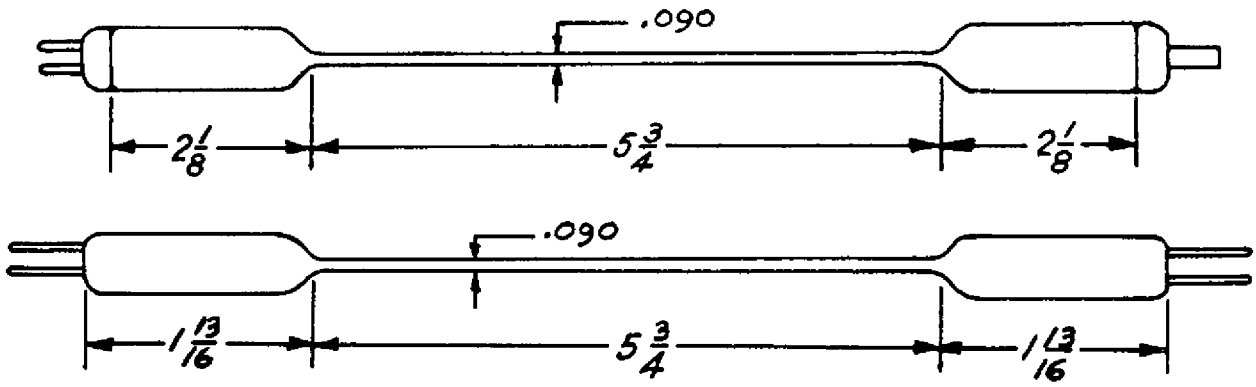


FIGURE 1: Outline Dimensions

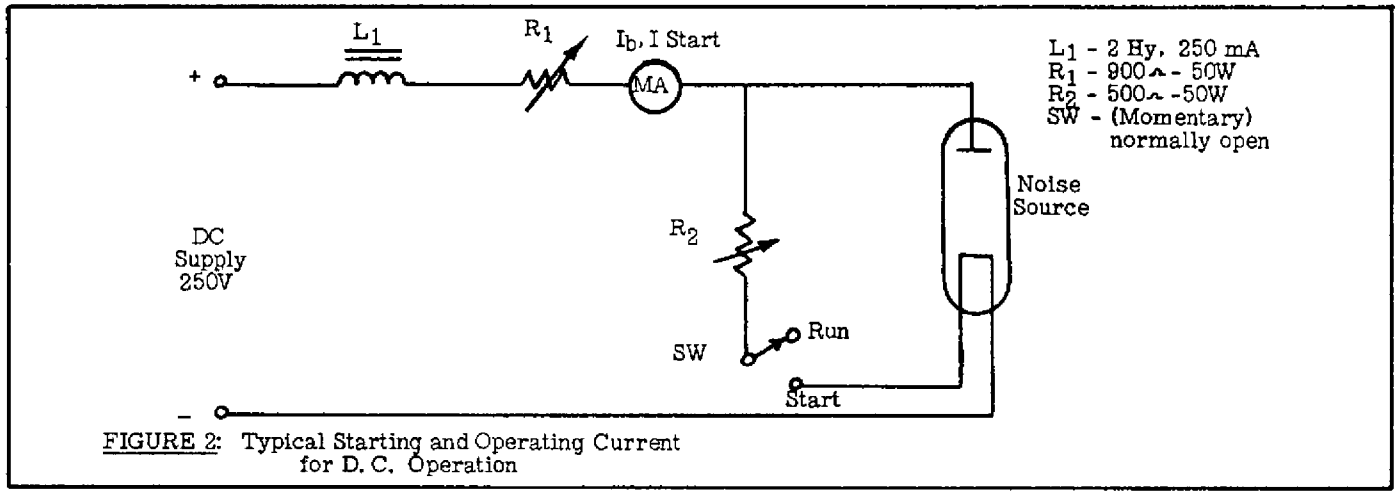


FIGURE 2: Typical Starting and Operating Current for D. C. Operation

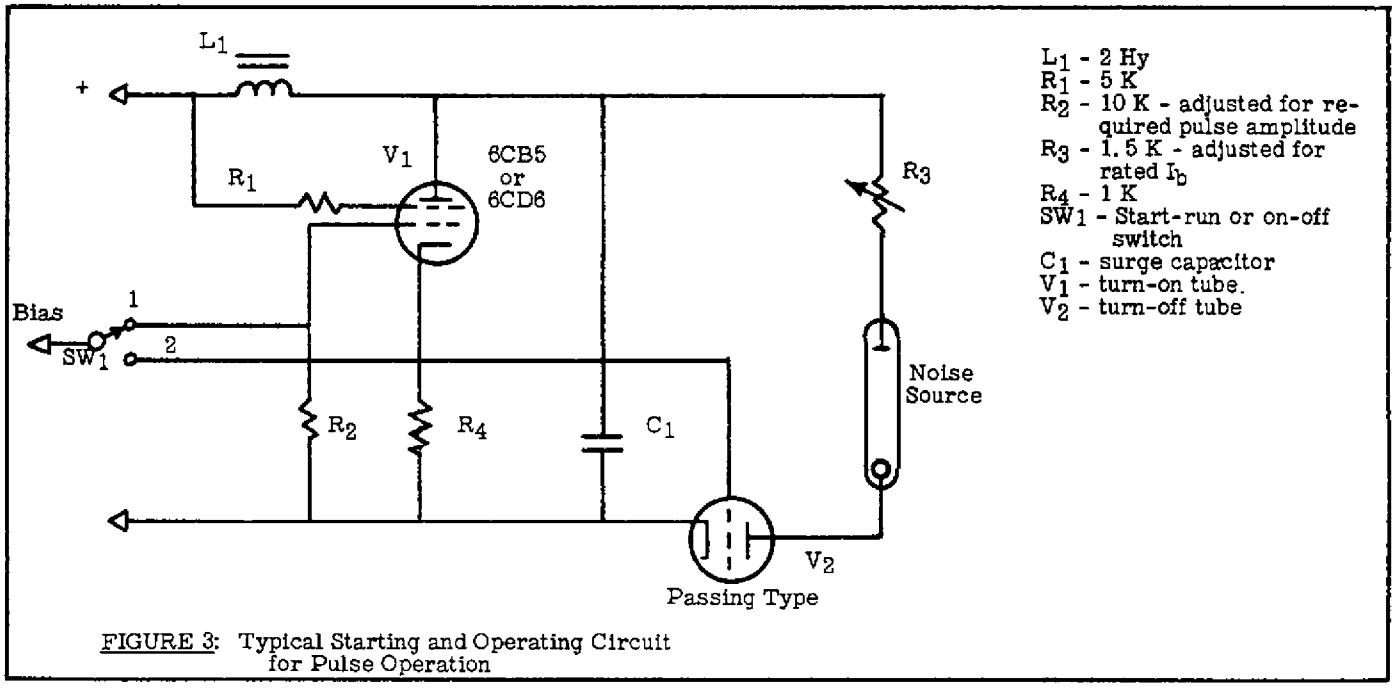
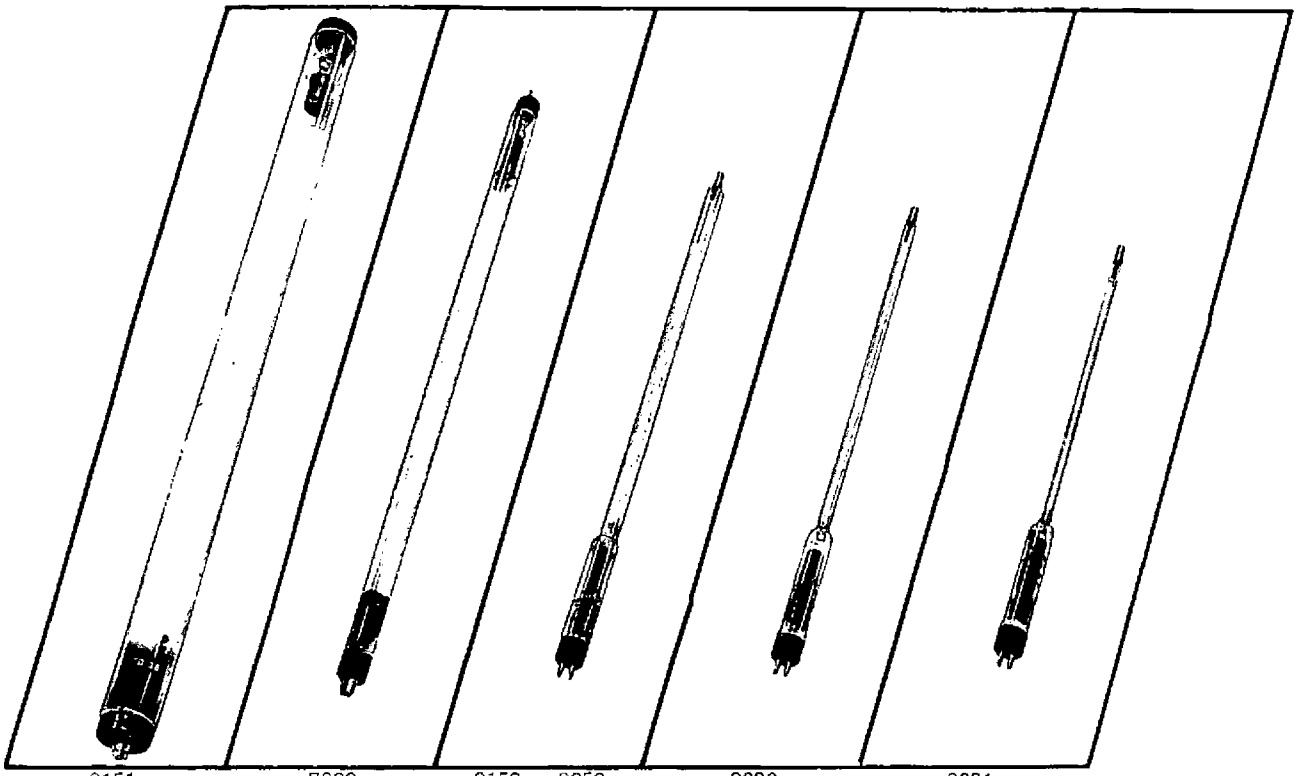


FIGURE 3: Typical Starting and Operating Circuit for Pulse Operation

Bendix Red Bank

GAS NOISE SOURCES. ARGON. PULSE

8151 7999
8030 8031
8152-8059



8151 TD-38 | 7999 TD-39 | 8152 _ 8059 TD-40 TD-72 | 8030 TD-41 | 8031 TD-42

DESCRIPTION

These tubes are designed primarily for use as pulse-operated noise sources in super high frequency (SHF) measurements. They may be used also in DC operation. When used in standard mount assemblies, they function as untuned terminations over the entire recommended transmission bandwidths of the guides.

	8151/TD-38	7999/TD-39	8152/TD-40 8059/TD-72	8030/TD-41	8031/TD-42
Waveguide	RG-48/U	RG-49/U RG-50/U	RG-52/U	RG-91/U	RG-53/U
Frequency kMc	2.60 - 3.95	3.95 - 5.85 5.85 - 8.20	8.20 - 12.40	12.40 - 18.00	18.00 - 26.50
Insertion Angle	10°E	10°E	10°E	10°E	10°E

Electron Tube Products
Red Bank Division
Eatontown, N. J.

Publication No. RT21-4

from JEDEC release #3850, Aug. 20, 1962

Bendix Red Bank

GAS NOISE SOURCES. ARGON. PULSE

RATINGS							
Characteristic	Unit	8151/TD-38	7999/TD-39	8152/TD-40	8059/TD-72**	8030/TD-41	8031/TD-42
Anode Current (Peak)	ma	225	200	200	200	200	200
Anode Current (Average)	mAdc	200 max.	175 max.	175 max.	175 max.	175 max.	175 max.
Tube Voltage drop (Average)	Vdc	145	130	125	128	125	125
Tube Dissipation (Average)	Watts	28	23	21	21	21	22
Starting Voltage for Pulse Operation (Note 1, 3)	KV	2.0-3.3	2.0-3.5	2.0-3.3	2.0-3.3	2.0-3.3	2.0-3.3
Starting Current for D. C. Operation (Note 2, 3)	mAdc	190	170	170	170	300	300
Ambient Temp. Range	°C	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°
VSWR (Cold)		1.10 max	1.10 max	2.10 max	1.10 max	1.10 max	1.25 max
VSWR (Hot)		1.10 max	1.10 max	1.15 max	1.10 max	1.10 max	1.15 max
Nr-1 Tube in Mount @ Rated Current (Note 4, 5)	db	15.27 ± .20	15.20 ± .20 for RG-49/ 15.28 ± .20 for RG-50/	15.62 ± .20	15.65 ± .20	15.91 ± .25	16.00 ± .25

Note 1: With the noise source in a case grounded mount, starting voltages were measured as shown in Figures 1 and 2.

Note 2: With the noise source in a case grounded mount and the starting current through the choke (I_{start}) of Figure 3 adjusted to the value stated, the noise source will start within three attempts of closing and opening switch SW_1.

Note 3: In general the starting voltage will decrease with a starting pulse of either a faster rise time or longer pulse width.

Note 4: The excess noise ratio (Nr-1) is defined in db as Nr-1 = 10 log $(\frac{Te}{290} - 1)$ where Te is the effective electron temperature.

Note 5: For values of Nr-1 at other than rated currents, contact The Bendix Corporation, Red Bank Division, Eatontown, New Jersey.

Note 6: The values of Nr-1 are traceable to the National Bureau of Standards.

** The TD-72 is a low loss glass version of the TD-40.

GAS NOISE SOURCES. ARGON. PULSE

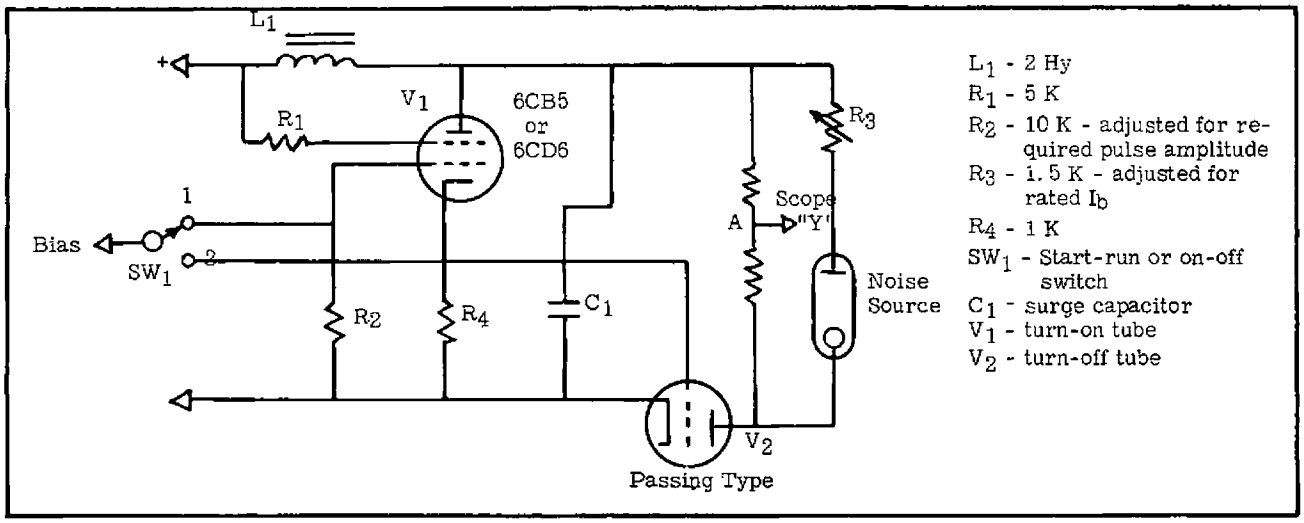


FIGURE 1: Typical Starting and Operating Circuit for Pulse Operation

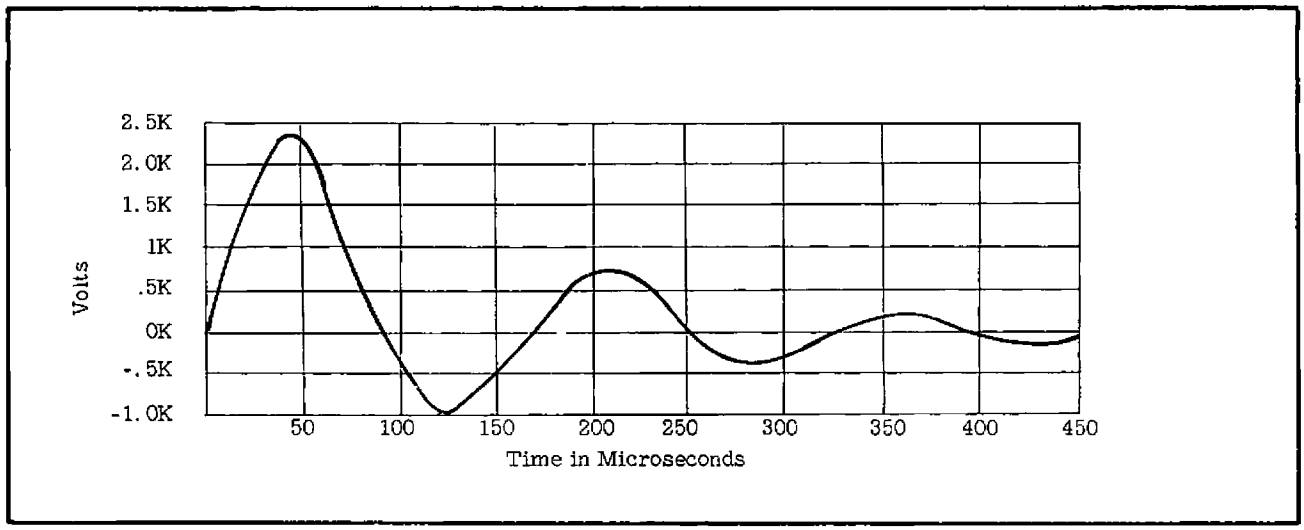


FIGURE 2: Typical Starting Pulse Appearing at A of Figure 1

The pentode or beam tube, V_1, acts as a switch interrupting the current flow in L_1 when the bias switch, SW_1, is in position 1. The resultant voltage spike developed is impressed across the noise source. The current limited by R_3 to rated value. The noise source is turned off when the bias switch, SW_1, is in position 2, causing the current through the passing tube, V_2, to be interrupted. The circuit can be modified to drive the grids of the switch tube and passing tube with pulses, thus pulsing the noise output.

GAS NOISE SOURCES. ARGON, PULSE

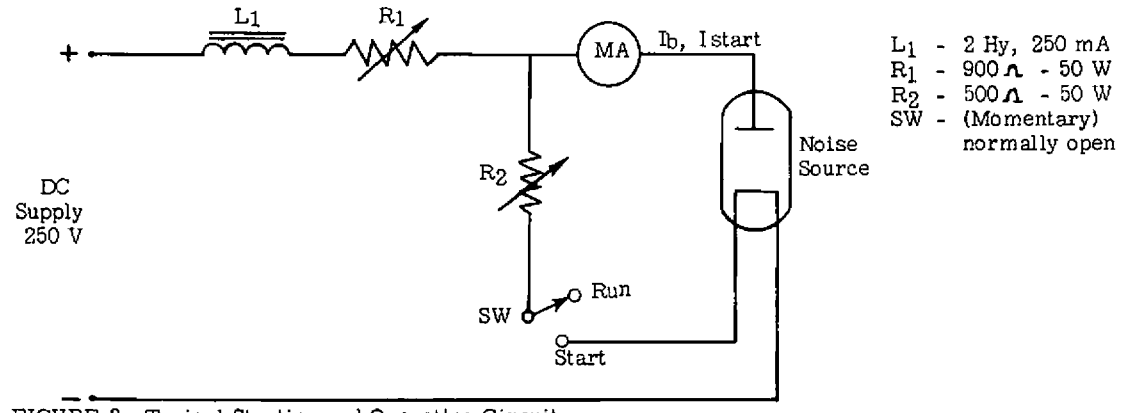


FIGURE 3: Typical Starting and Operating Circuit for D.C. Operation

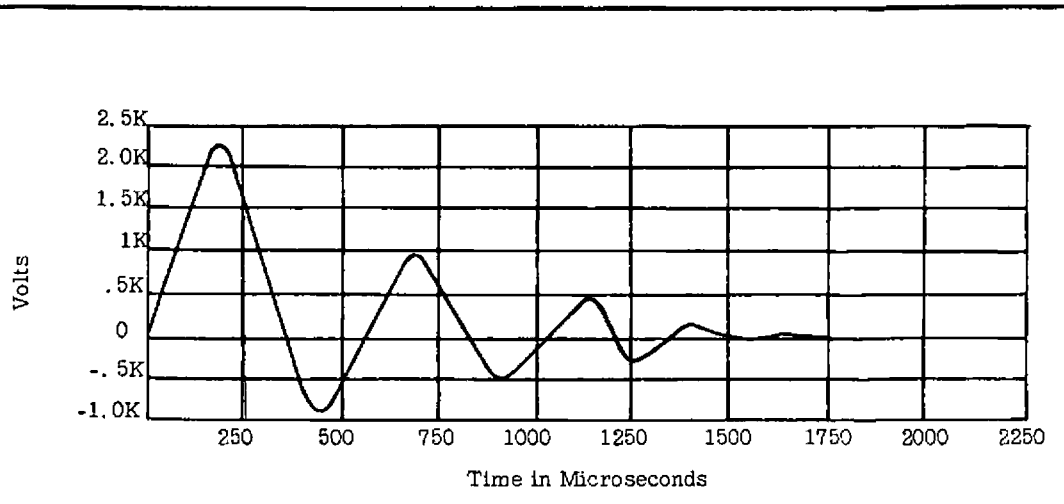
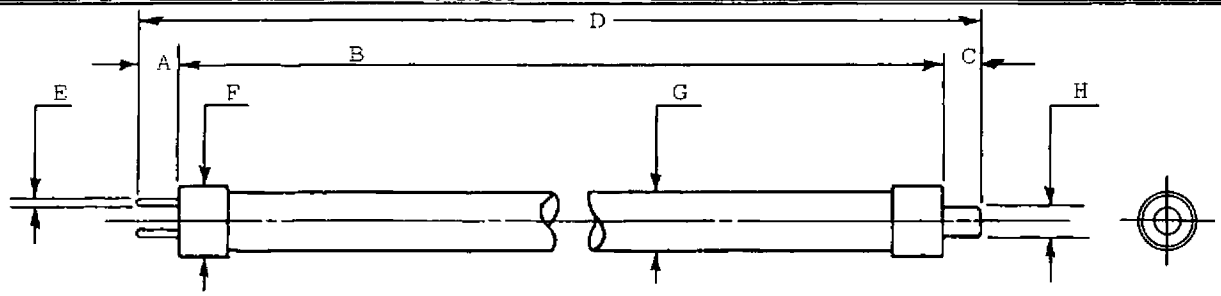


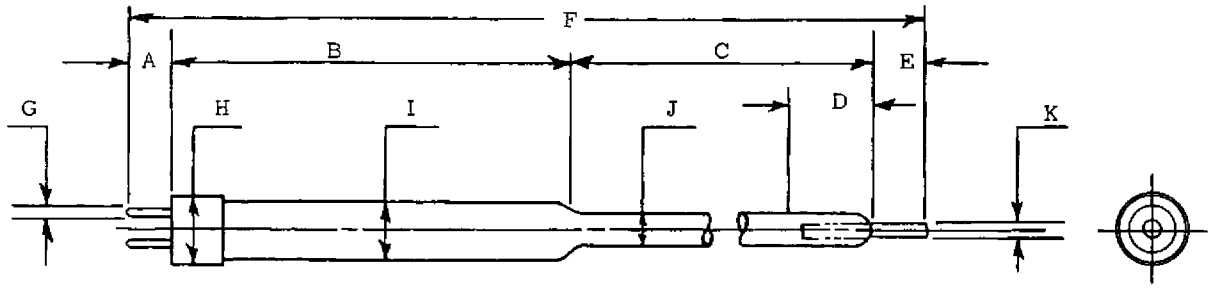
FIGURE 4: Typical Starting Pulse of Figure 3.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the choke. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L_1". This high voltage initiates the discharge in the noise source which is then sustained by the power supply voltage and stabilized by the resistance R_1.

OUTLINE DRAWINGS

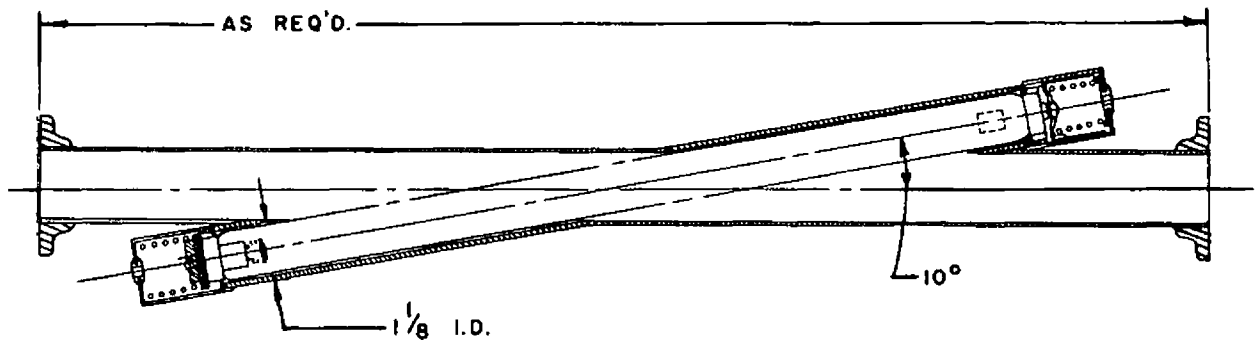


DIM.	8151/TD-38		7999/TD-39		DIM.	8151/TD-38		7999/TD-39	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	E	.090	.105	.090	1.05
B	16.937	17.437	13.875	14.375	F		.990		.555
C	.310	.360	.270	.320	G	.975	1.050	.547	.579
D	17.625	18.000	14.375	15.000	H	.305	.325	.245	.265

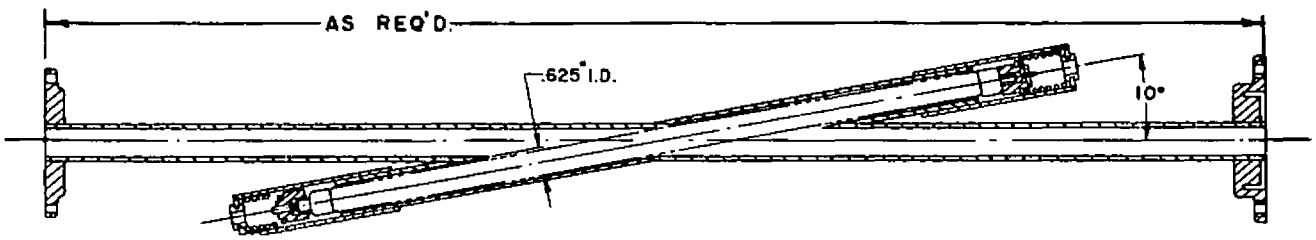


DIM.	8152/TD-40 8059/TD-72		8030/TD-41		8031/TD-42		DIM.	8152/TD-40 8059/TD-72		8030/TD-41		8031/TD-42	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	.260	.325	G	.090	.105	.090	.105	.090	.105
B		2.750		2.750		2.750	H		.555		.555		.555
C	8.625		7.375		6.187		I		.579		.500		.500
D (see note)		1.500*	N.A.	N.A.	N.A.	N.A.	J	.370	.380	.235	.265	.160	.194
E		.500		.500		.500	K		.187		.187		.187
F	11.937	12.250	10.875	11.250	9.687	10.000							

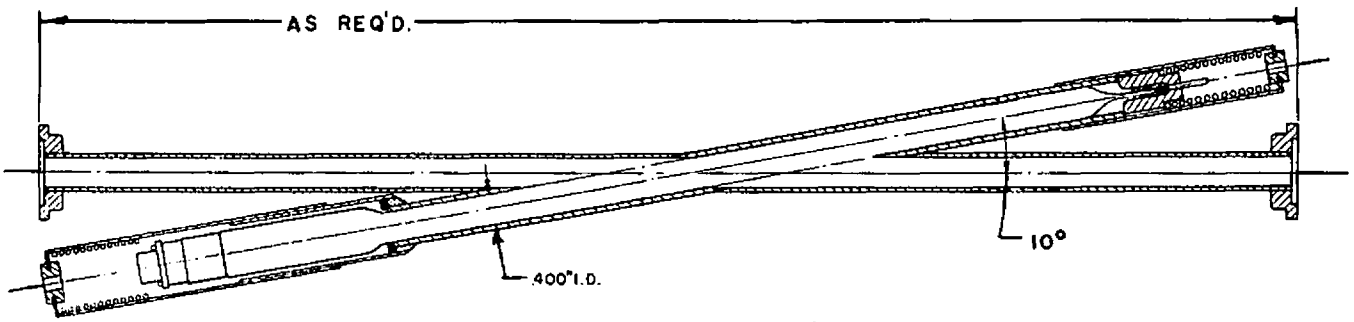
* = .380 max., No min., Dim. on Dia. for this Lgth. of tube.



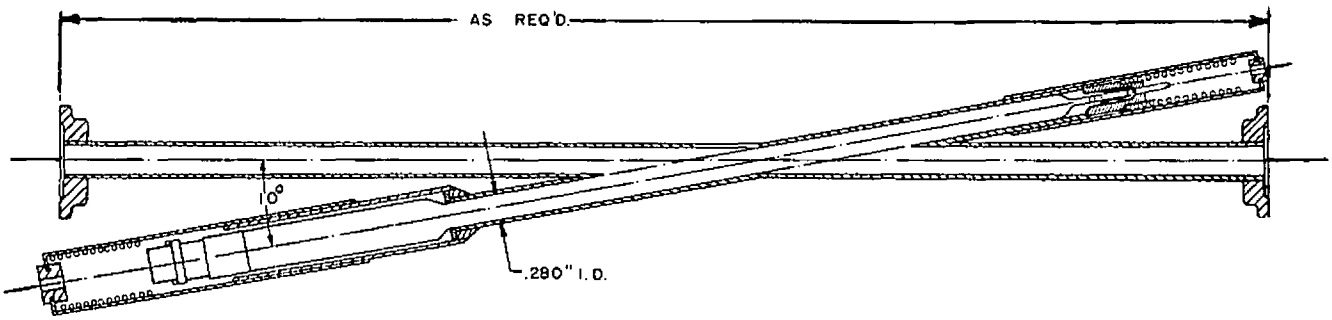
WAVEGUIDE MOUNT ASS'Y. RG-48/U



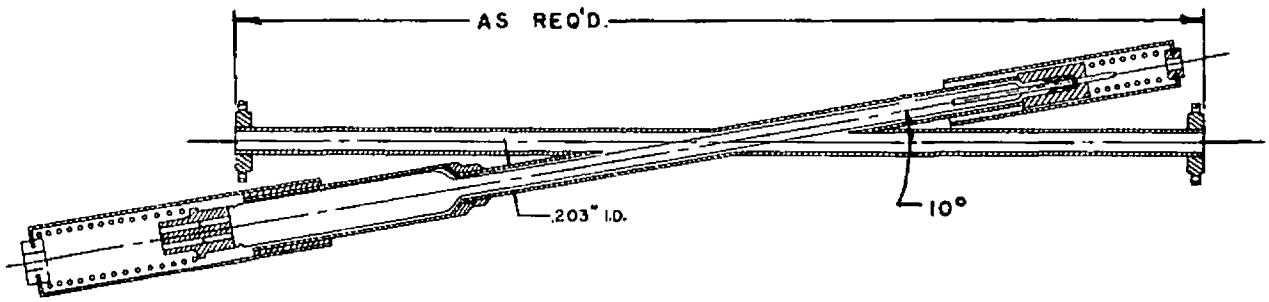
WAVEGUIDE MOUNT ASS'YS. RG-49/U OR RG-50/U



WAVEGUIDE MOUNT ASS'Y. RG-52/U



WAVEGUIDE MOUNT ASS'Y. RG-91/U



WAVEGUIDE MOUNT ASS'Y. RG-53/U

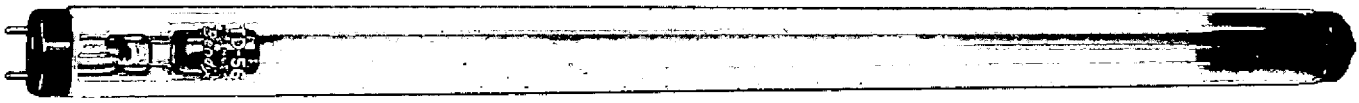
Printed in U. S. A.

from JEDEC release #4138, Feb. 11, 1963

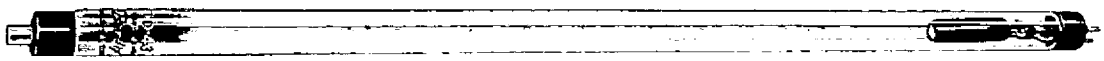
Bendix Red Bank

GAS NOISE SOURCES - NEON, PULSE

8286 8293
8287 8290
7988 8291



8286
TD-56



8287
TD-43



7988 8293
TD-44 TD-58



8290
TD-55



8291
TD-51

DESCRIPTION

These tubes are designed primarily for use as pulse-operated noise sources in microwave measurements. They may be used also in DC operation. When used in standard mount assemblies, they function as untuned terminations over the entire recommended transmission bandwidths of the guides.

	8286/TD-56	8287/TD-43	7988/TD-44 8293/TD-58	8290/TD-55	8291/TD-51
Waveguide	RG-48/U	RG-49/U RG-50/U	RG-52/U	RG-91/U	RG-53/U
Frequency kMc	2.60 - 3.95	3.95 - 5.85 5.85 - 8.20	8.20 - 12.40	12.40 - 18.00	18.00 - 26.50
Insertion Angle	10°E	10°E	10°E	10°E	10°E

Electron Tube Products
Red Bank Division
Eatontown, N. J.

The Bendix Corporation

Publication No. RT31-18
(Supersedes Pub. No. RT21-4)

Printed in U.S.A.

Bendix Red Bank

GAS NOISE SOURCES - NEON, PULSE

RATINGS							
Characteristic	Unit	8286/TD-56	8287/TD-43	7988/TD-44	8293/TD-58*	8290/TD-55	8291/TD-51
Anode Current (Peak)	ma	225	200	200	200	200	200
Anode Current (Average)	mAdc	200 max.	175 max	175 max	175 max	175 max	175 max
Tube Voltage drop (Average)	Vdc	265	210	205	208	230	260
Tube Dissipation (Average)	Watts	53	42	41	42	46	52
Starting Voltage (Note 1, 3)	KV	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5
Starting Current (Note 2, 3)	mAdc	190	190	190	190	300	300
Ambient Temp. Range	°C	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°	-55°to+85°
VSWR (Cold)		1.15 max	1.20 max	2.10 max	1.10 max	1.15 max	1.20 max
VSWR (Hot)		1.10 max	1.35 max	1.20 max	1.20 max	1.15 max	1.15 max
Nr-1 Tube in Mount @ Rated Average Current (Notes 4, 5, 6)	db	17.90±.25	17.81±.30 for RG-49/u 17.86±.30 for RG-50/u	17.95±.30	18.00±.25	17.85±.30	17.94±.35

Note 1: With the noise source in a case grounded mount, starting voltages were measured as shown in Figures 1 and 2.

Note 2: With the noise source in a case grounded mount and the starting current through the choke (I_{start}) of Figure 3 adjusted to the value stated, the noise source will start within three attempts of closing and opening switch SW.

Note 3: In general the starting voltage will decrease with a starting pulse of either a faster rise time or longer pulse width.

Note 4: The excess noise ratio (Nr-1) is defined in db as $Nr\text{-}1 = 10 \log \left(\frac{Te}{290} - 1\right)$ where Te is the effective electron temperature.

Note 5: For values of Nr-1 at other than rated currents, contact The Bendix Corporation, Red Bank Division, Eatontown, New Jersey.

Note 6: The values of Nr-1 for the comparison standards are traceable to the National Bureau of Standards.

* The TD-58 is a low loss glass version of the TD-44.

GAS NOISE SOURCES - NEON, PULSE

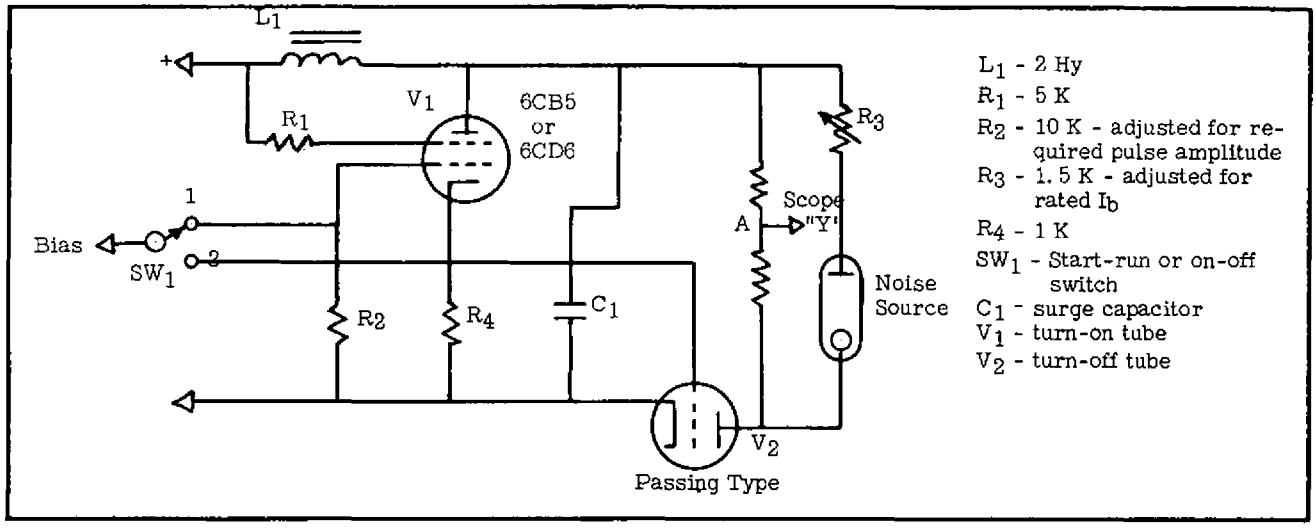


FIGURE 1: Typical Starting and Operating Circuit for Pulse Operation

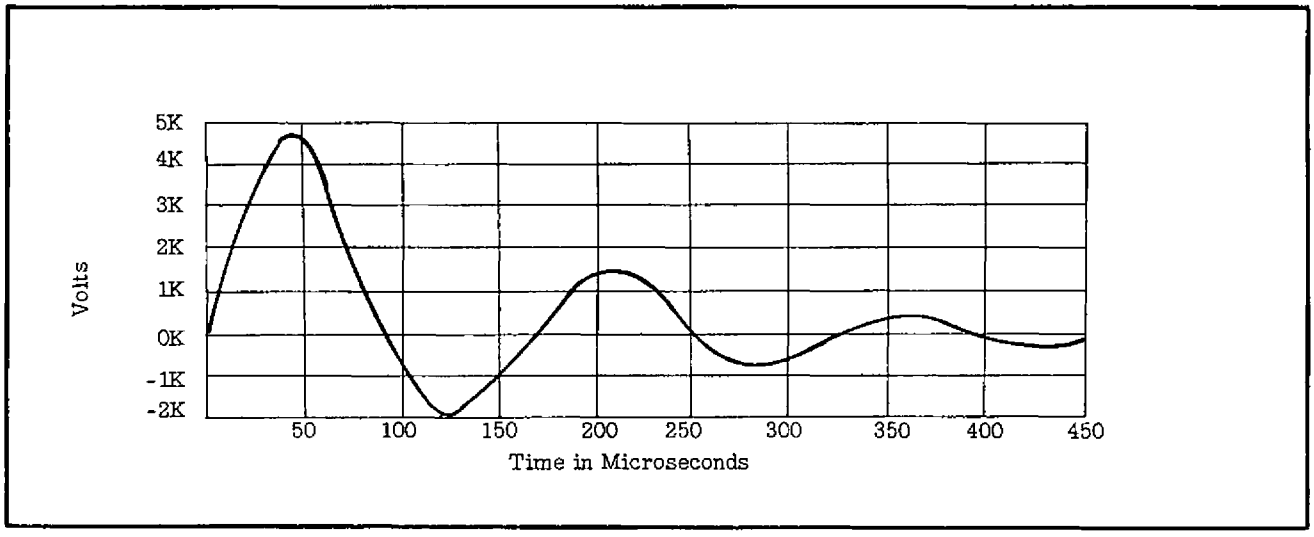


FIGURE 2: Typical Starting Pulse Appearing at A of Figure 1

The pentode or beam tube, V_1, acts as a switch interrupting the current flow in L_1 when the bias switch, SW_1, is in position 1. The resultant voltage spike developed is impressed across the noise source. The current limited by R_3 to rated value. The noise source is turned off when the bias switch, SW_1, is in position 2, causing the current through the passing tube, V_2, to be interrupted. The circuit can be modified to drive the grids of the switch tube and passing tube with pulses, thus pulsing the noise output.

GAS NOISE SOURCES - NEON, PULSE

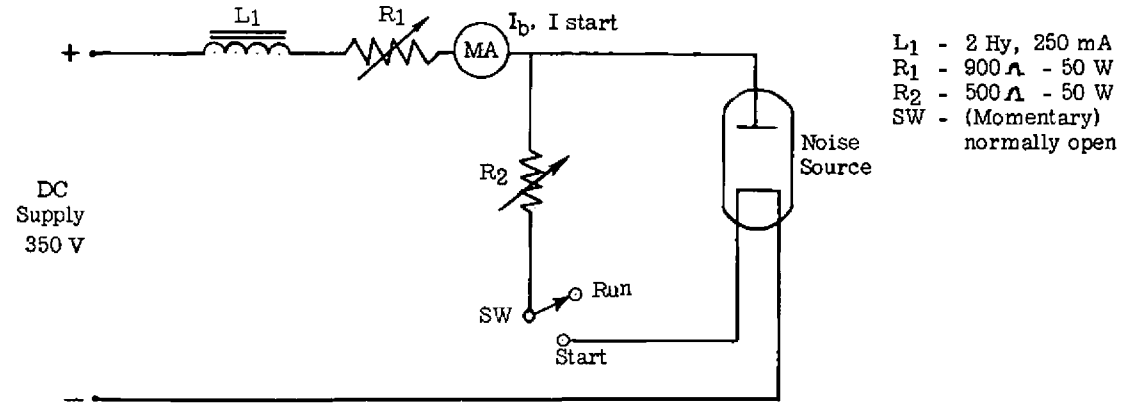


FIGURE 3: Typical Starting and Operating Circuit for D.C. Operation

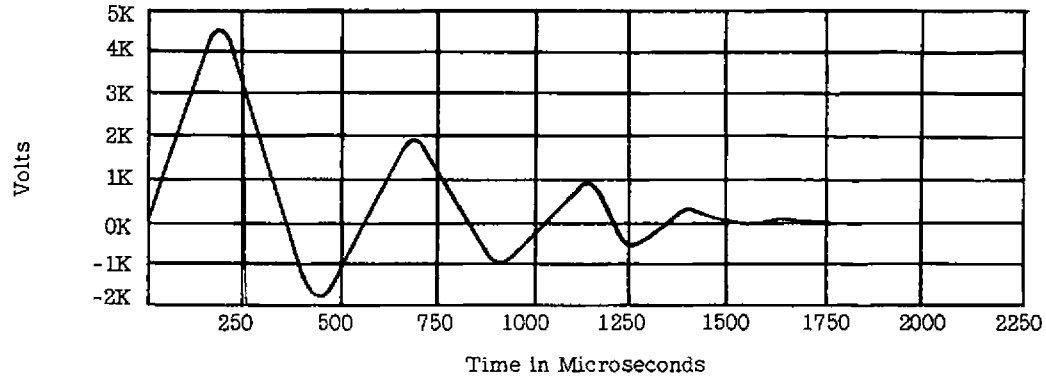
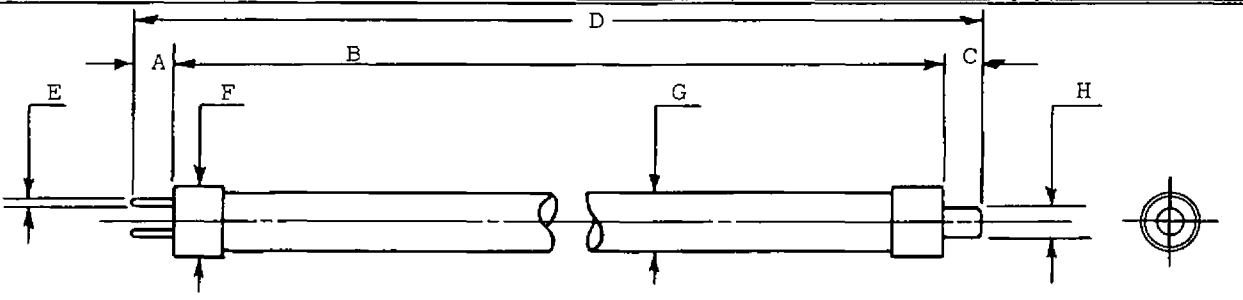


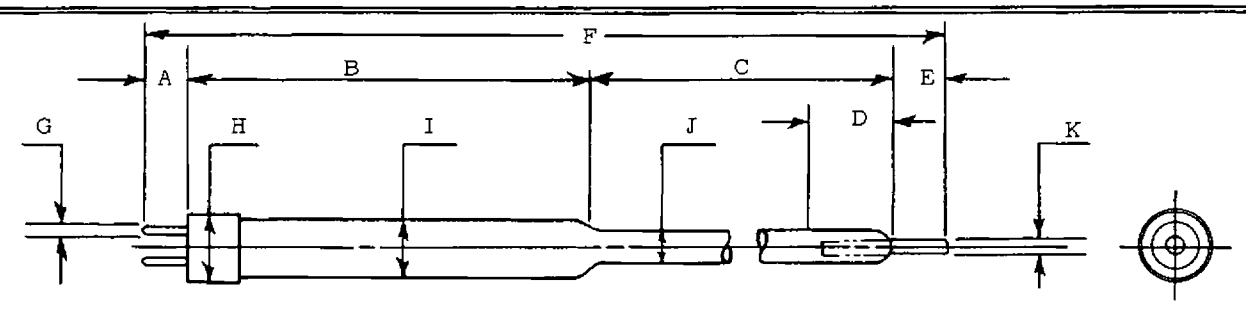
FIGURE 4: Typical Starting Pulse of Figure 3.

The run-start switch shown in the typical circuit provides the high voltage surge or spike necessary to initiate the discharge. In the start position, current passes through the choke. As the switch is released to the run position, a high surge voltage appears momentarily across the tube, caused by the collapse of the magnetic field in choke "L_1". This high voltage initiates the discharge in the noise source which is then sustained by the power supply voltage and stabilized by the resistance R_1.

OUTLINE DRAWINGS

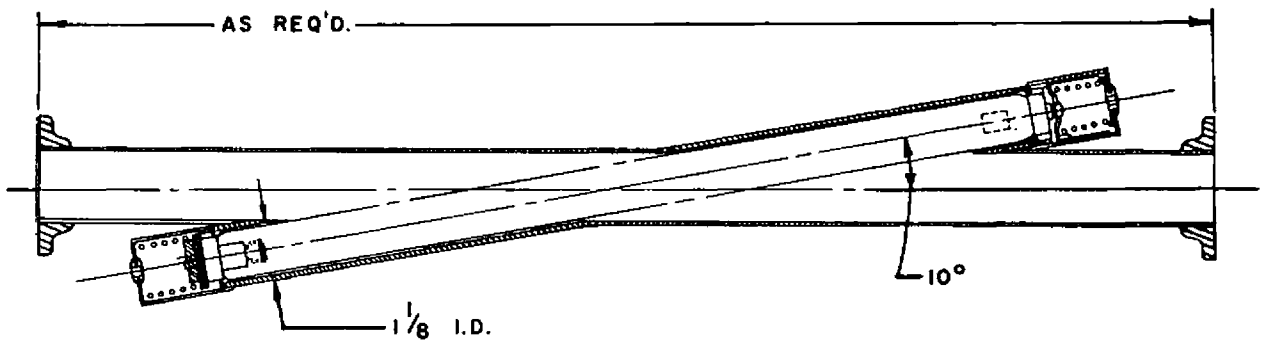


DIM.	8286/TD-56		8287/TD-43		DIM.	8286/TD-56		8287/TD-43	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	E	.090	.105	.090	1.05
B	16.937	17.437	13.875	14.375	F		.990		.555
C	.310	.360	.270	.320	G	.975	1.050	.547	.579
D	17.625	18.000	14.375	15.000	H	.305	.325	.245	.265

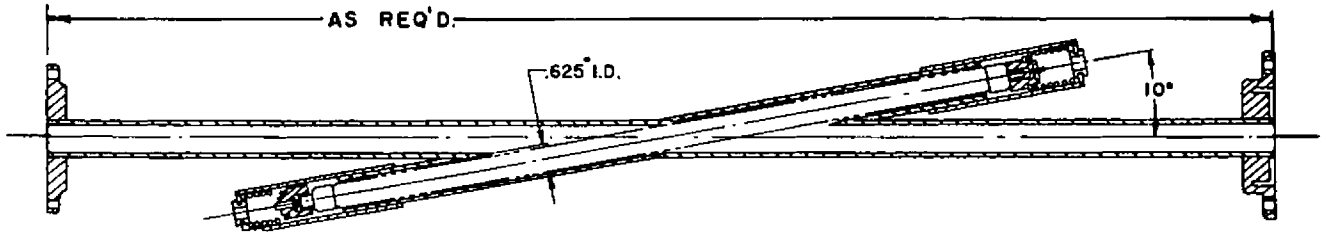


DIM.	7988/TD-44 8293/TD-58		8290/TD-55		8291/TD-51		DIM.	7988/TD-44 8293/TD-58		8290/TD-55		8291/TD-51	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
A	.260	.325	.260	.325	.260	.325	G	.090	.105	.090	.105	.090	.105
B		2.750		2.750		2.750	H		.555		.555		.555
C	8.625		7.375		6.187		I		.579		.500		.500
D (see note)		1.500*	N.A.	N.A.	N.A.	N.A.	J	.370	.380	.235	.265	.160	.194
E		.500		.500		.500	K		.187		.187		.187
F	11.937	12.250	10.875	11.250	9.687	10.000							

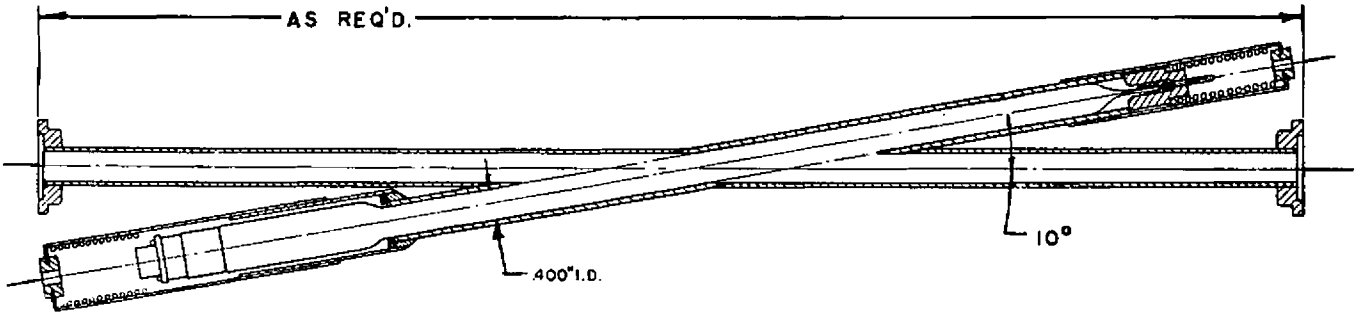
* = .380 max., No min., Dim. on Dia. for this Lgth. of tube.



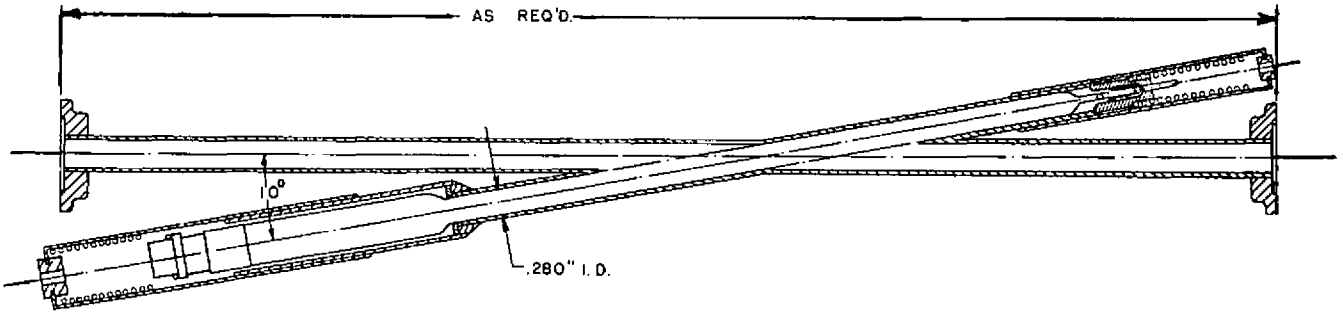
WAVE GUIDE MOUNT ASS'Y. RG-48/U



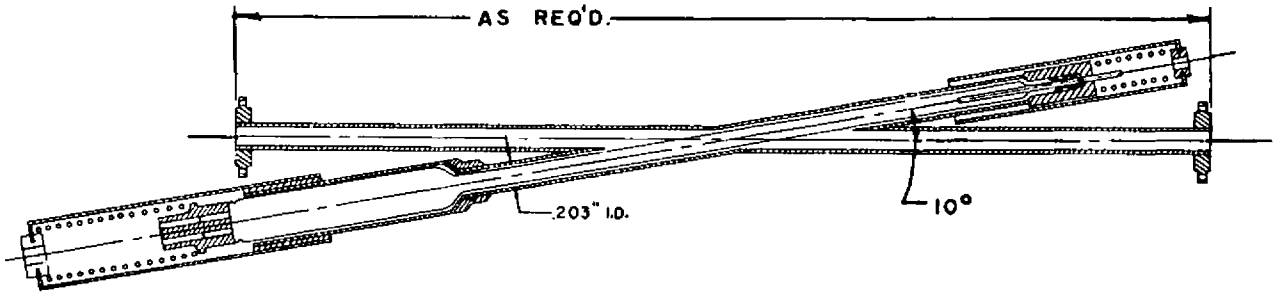
WAVEGUIDE MOUNT ASS'YS. RG-49/U OR RG-50/U



WAVEGUIDE MOUNT ASS'Y. RG-52/U



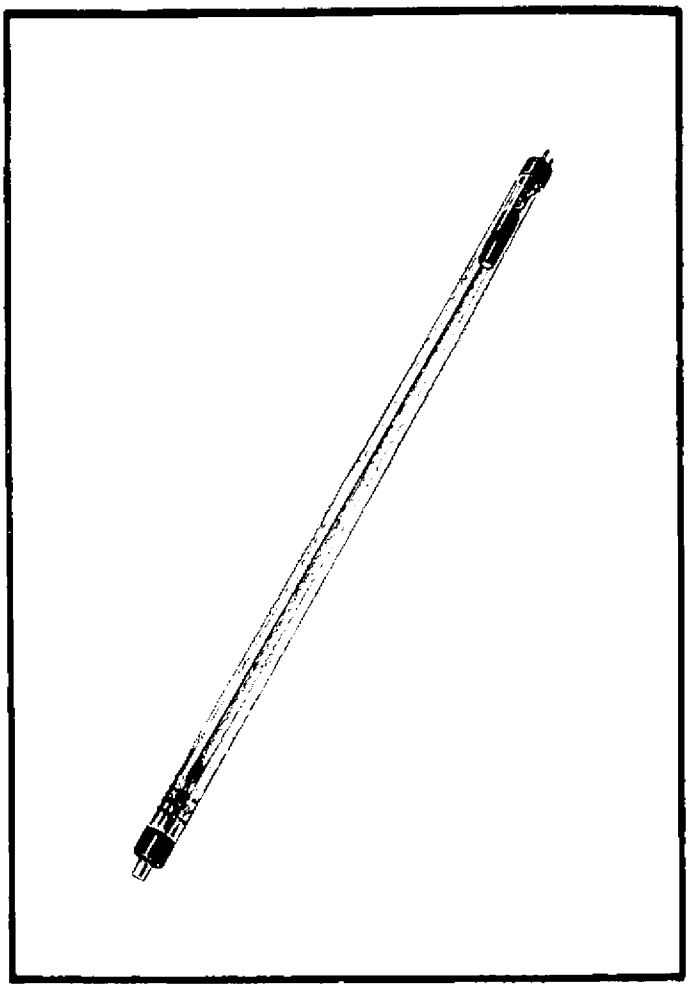
WAVEGUIDE MOUNT ASS'Y. RG-91/U



WAVEGUIDE MOUNT ASS'Y. RG-53/U

8288
Bendix Type TD-67

GAS NOISE SOURCE, NEON, PULSE



RATINGS

Anode Current, pulse	150 mA max.
Anode Current, Avg	150 mA max.
Starting Current (Ckt Fig. 1)	190 mA
Tube Dissipation	34 watts
Tube Voltage Drop	225 Vdc (note)
Ambient Temp. Range	−55° C to +85° C

Note: If the anode current during the "on time" of a square pulse (of greater than 100 microsec duration) is nominally the same as the rated D.C. anode current, the tube drop during this period will be approximately the same as the rated D.C. tube drop.

DESCRIPTION

This tube is designed for use as a noise source in microwave measurements. It is constructed for use with the RG-50/U waveguide to provide noise in the 5.85-8.20 kMc waveband. When used in a 10° or 15° E-plane mount assembly, it functions as an untuned termination over the entire recommended transmission bandwidth of the guide. It is a cold cathode type noise source designed primarily for pulse operation but may be used for continuous service with somewhat reduced life.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement instantaneously with little change due to ambient temperature variations. The performance of the tube is non-critical with respect to variations in the discharge current over a wide range.

The average voltage standing wave ratio (VSWR) over the recommended transmission bandwidths of the guides is a maximum of 1.15. The excess noise ratio, 10 log $\left(\frac{Teff}{290} - 1\right)$, is 17.98 ± .3db.

The circuit of Figure 1 is a basic starting and operating circuit. The pentode or beam tube acts as a switch interrupting the current flow in L_1 when the cut-off bias switch is closed. The resultant voltage spike developed is impressed across the noise tube. The current is limited by R_3 to rated value. Capacitor C_1 flattens the pulse peak and assists in initiating the noise tube discharge. C_1 must not be large enough to lower the voltage spike below the firing voltage of the noise tube and must be of high voltage rating. Current through the beam tube is adjusted by R_4 to provide rated choke current. If the application requires only infrequent starting, the hard tube may be replaced by a mercury switch.

For most normal pulse applications, this basic circuit can be modified to drive the grid of the switch tube with pulses, thus pulsing the noise output. For high repetition rates or for control of pulse shape, a circuit, similar to that shown in Figure 2, which insures extinguishing of the noise tube current, is necessary.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. RT21-13
Supersedes Pub. No. RT13-8

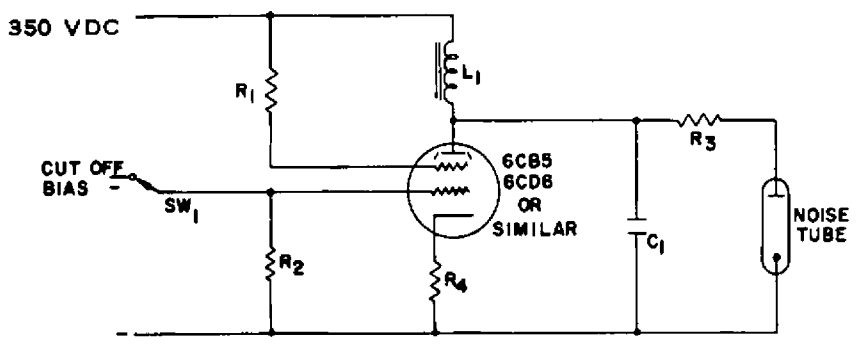
from JEDEC release 4204, April 1, 1963

Printed in U.S.A.

GAS NOISE SOURCE, NEON, PULSE

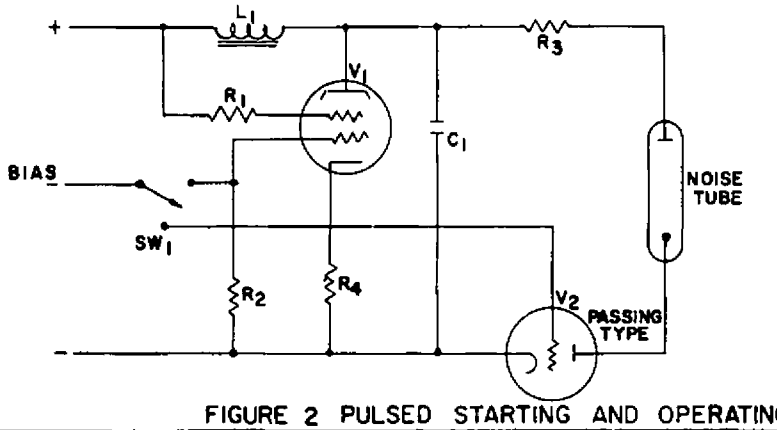
8288

Bendix Type TD-67



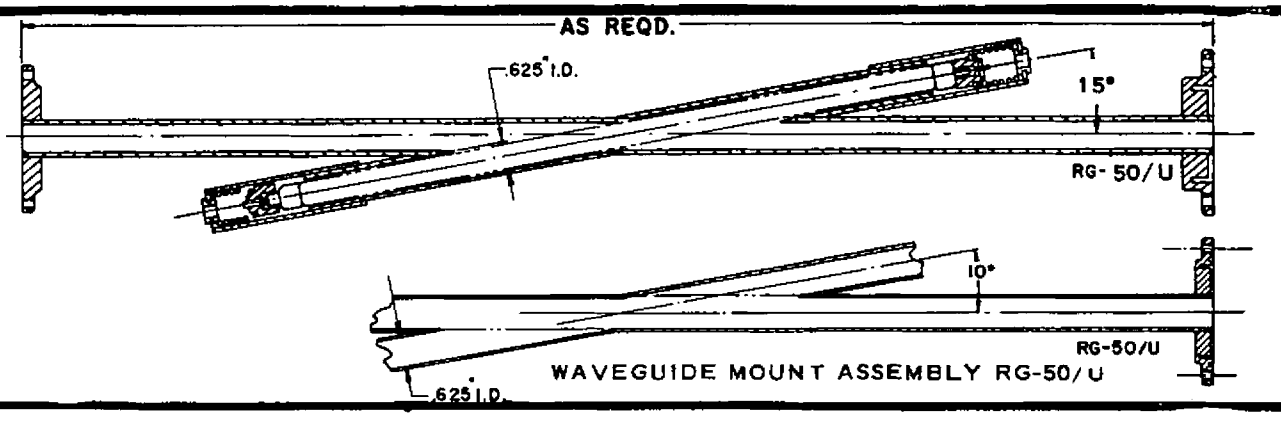
L_1 - INDUCTANCE
R_1 - SCREEN DROPPING RESISTOR
R_2 - GRID RESISTOR
R_3 - NOISE TUBE CURRENT LIMITING RESISTOR
R_4 - NORMAL BIAS RESISTOR
SW_1 - START - RUN SWITCH
C_1 - SURGE CAPACITOR

FIGURE 1. BASIC STARTING AND OPERATING CIRCUIT

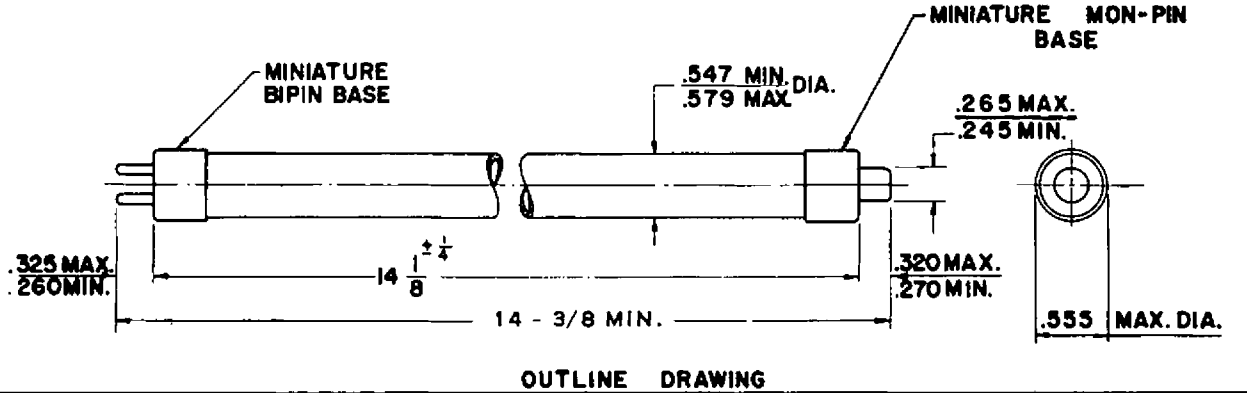


L_1 - INDUCTANCE
R_1 - SCREEN DROPPING RESISTOR
R_2 - GRID RESISTOR
R_3 - NOISE TUBE CURRENT LIMITING RESISTOR
R_4 - NORMAL BIAS RESISTOR
SW_1 - START - RUN OR ON-OFF SWITCH
C_1 - SURGE CAPACITOR
V_1 - TURN - ON TUBE
V_2 - TURN - OFF TUBE

FIGURE 2 PULSED STARTING AND OPERATING CIRCUIT



WAVEGUIDE MOUNT ASSEMBLY RG-50/U

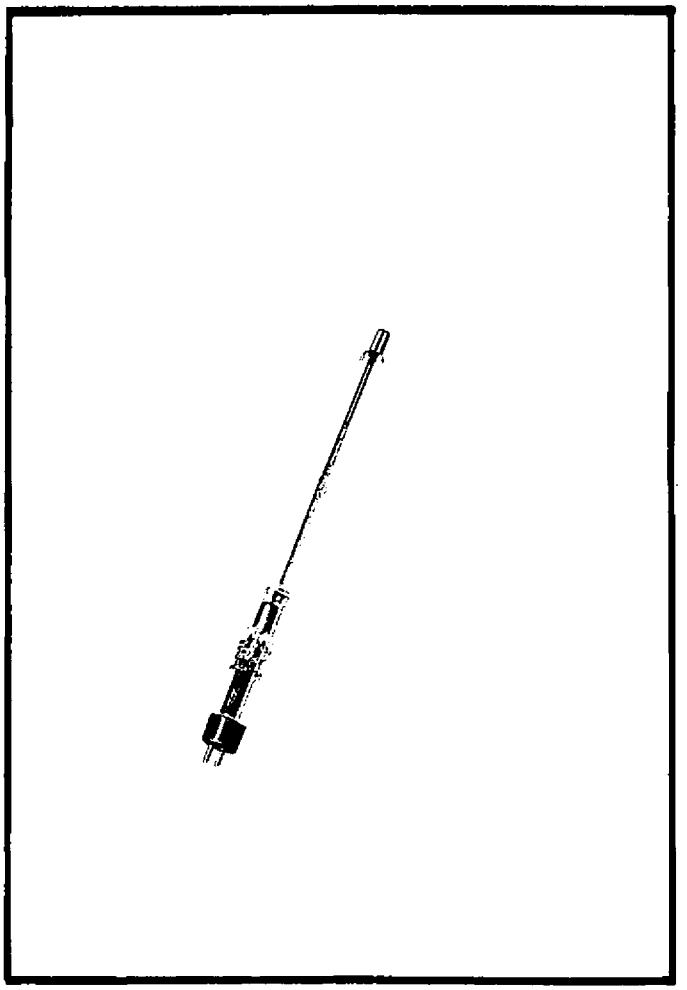


OUTLINE DRAWING

8289

Bendix Type TD-66

GAS NOISE SOURCE, NEON, PULSE



RATINGS

Anode Current, pulse	150 mA max.
Anode Current, Avg	150 mA max.
Starting Current (Ckt Fig. 1)	170 mA
Tube Dissipation	28 watts
Tube Voltage Drop	185 Vdc (note)
Ambient Temp. Range	−55° C to +85° C

Note: If the anode current during the "on time" of a square pulse (of greater than 100 microsec duration) is nominally the same as the rated D.C. anode current, the tube during this period will be approximately the same as the rated D.C. tube drop.

DESCRIPTION

This tube is designed for use as a noise source in microwave measurements. It is constructed for use with the RG 52/u waveguide to provide noise in the 8.20 - 12.40 kMc waveband. When used in a terminated 15° E-plane mount assembly, such as Hewlett Packard HC02 347A or equivalent, it functions as a broadband noise generator. It is a cold cathode type noise source designed primarily for pulse operation but may be used for continuous service with somewhat reduced life.

OPERATING CHARACTERISTICS

The use of pure inert gas eliminates the dependence of noise output on the operating temperature. The noise source is available for measurement instantaneously with little change due to ambient temperature variations. The performance of the tube is non-critical with respect to variations in the discharge current over a wide range.

The operating voltage standing wave ratio (VSWR) over the recommended transmission bandwidth of the guide is typically 1.07 with a maximum of 1.15. The excess noise ratio, 10 log $(\frac{Teff}{290} - 1)$, is 17.60 ± .3db.

The circuit of Figure 1 is a basic starting and operating circuit. The pentode or beam tube acts as a switch interrupting the current flow in L_1 when the cut-off bias switch is closed. The resultant voltage spike developed is impressed across the noise tube. The current is limited by R_3 to rated value. Capacitor C_1 flattens the pulse peak and assists in initiating the noise tube discharge. C_1 must not be large enough to lower the voltage spike below the firing voltage of the noise tube and must be of high voltage rating. Current through the beam tube is adjusted by R_4 to provide rated choke current. If the application requires only infrequent starting, the hard tube may be replaced by a mercury switch.

For most normal pulse applications, this basic circuit can be modified to drive the grid of the switch tube with pulses, thus pulsing the noise output. For high repetition rates or for control of pulse shape, a circuit, similar to that shown in Figure 2, which insures extinguishing of the noise tube current, is necessary.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

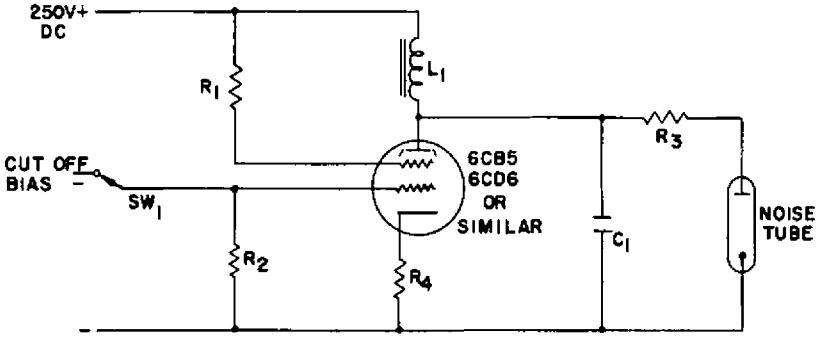
Publication No. RT21-12
Superseded Pub. No. RT13-12

from JEDEC release #4124, Feb. 4, 1963

Printed in U.S.A.

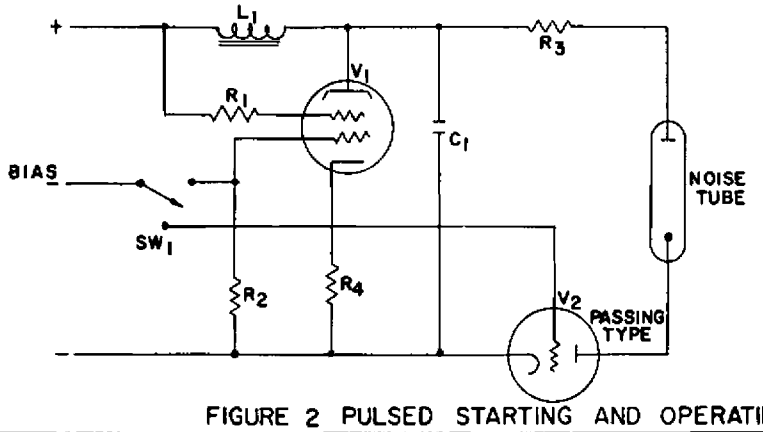
GAS NOISE SOURCE, NEON, PULSE

Bendix 8289 Type TD-66



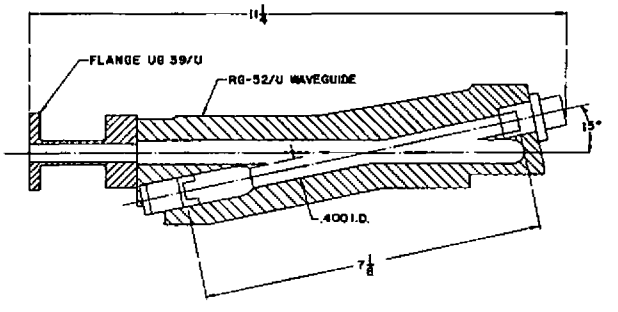
L_1 - INDUCTANCE
R_1 - SCREEN DROPPING RESISTOR
R_2 - GRID RESISTOR
R_3 - NOISE TUBE CURRENT LIMITING RESISTOR
R_4 - NORMAL BIAS RESISTOR
SW_1 - START - RUN SWITCH
C_1 - SURGE CAPACITOR

FIGURE 1. BASIC STARTING AND OPERATING CIRCUIT

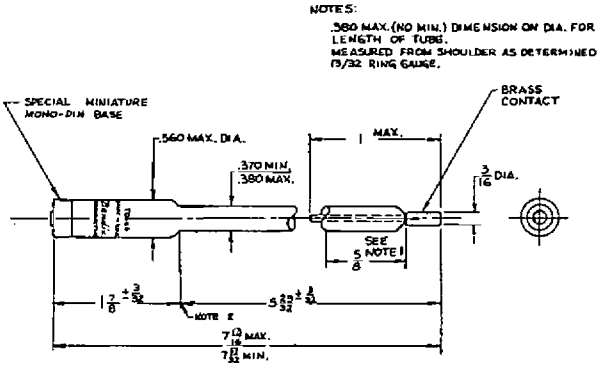


L_1 - INDUCTANCE
R_1 - SCREEN DROPPING RESISTOR
R_2 - GRID RESISTOR
R_3 - NOISE TUBE CURRENT LIMITING RESISTOR
R_4 - NORMAL BIAS RESISTOR
SW_1 - START - RUN OR ON-OFF SWITCH
C_1 - SURGE CAPACITOR
V_1 - TURN - ON TUBE
V_2 - TURN - OFF TUBE

FIGURE 2 PULSED STARTING AND OPERATING CIRCUIT



TERMINATED 15° WAVEGUIDE MOUNT ASSEMBLY



OUTLINE DRAWING

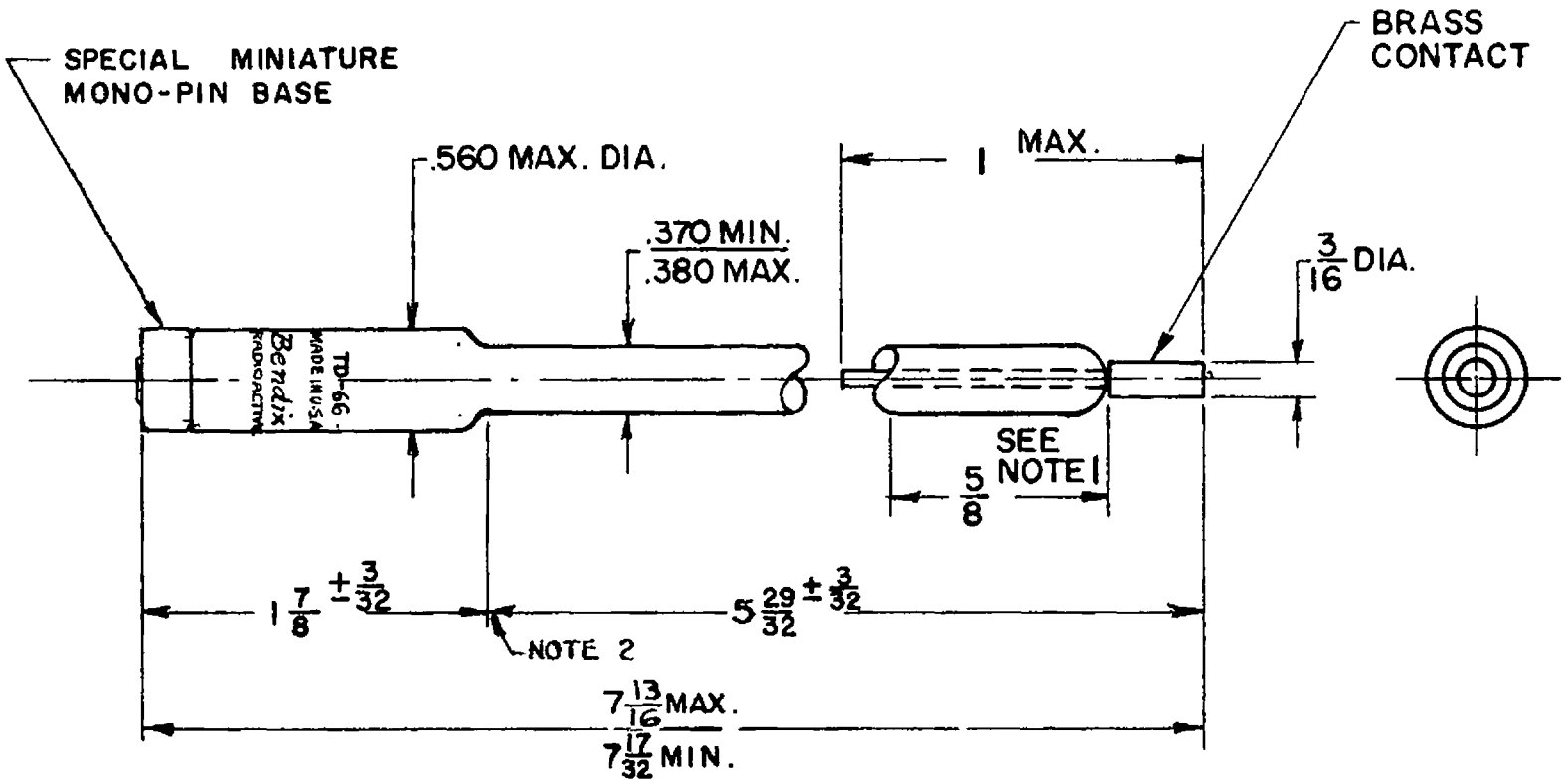
THIS DRAWING IS FURNISHED FOR ENGINEERING INFORMATION AND REFERENCE ONLY. THE FURNISHING OF THIS DRAWING DOES NOT CONVEY ANY REPRODUCTION OR MANUFACTURING RIGHTS.

REMOVE ALL BURRS

ISSUE
RB-TD-66-0-

NOTES:

1. .380 MAX. (NO MIN.) DIMENSION ON DIA. FOR THIS LENGTH OF TUBE.
2. MEASURED FROM SHOULDER AS DETERMINED BY 13/32 RING GAUGE.



LET.	C. O. NO.	DATE	CKR.	USED ON
				TD-66

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES ON FRACTIONS ± 1/64
DECIMALS ± .003
SCALE 4/1
DRWN. W.T. 9-18-59
CKR.
APPVD.

TITLE
OUTLINE

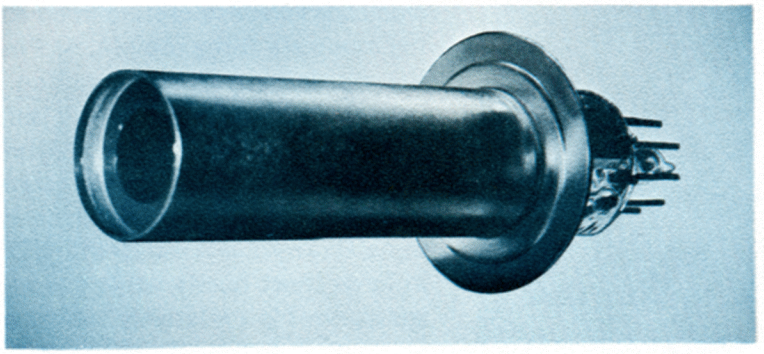
MATERIAL
WEIGHT FINISH
SEE PARTS LIST FOR LATEST ISSUE OF ALL PARTS

RED BANK DIVISION
BENDIX AVIATION CORPORATION
EATONTOWN, N. J.
ELECTRON TUBES

ISSUE
RB-TD-66-0-

Channeltron® Ultraviolet Photon Counter Tube

Model No. BX 760



DESCRIPTION

The Bendix BX 760 Ultraviolet Photon Counter Tube* is a small high gain, very low-noise Bendix photomultiplier tube which employs a Channeltron® electron multiplier to provide electron gain. This tube has been especially designed for counting single photoelectron events resulting from far ultraviolet radiation; it is unique in that it exhibits a typical dark count rate of less than one count per ten seconds at room temperature when care is taken to minimize extraneous noise sources. The noise from the channel electron multiplier which amplifies the photoelectron current is extremely low. (1—3) This factor coupled with the very low thermionic emission from cesium iodide results in a noise count of the magnitude one would expect from cosmic background radiation.

FEATURES

The tube employs a front-surface (opaque) cesium iodide photocathode deposited on the inner surface of the extended cone Channeltron electron multiplier. The photocathode surface is externally processed; thus, the possibility of cesium contaminating the tube is eliminated, assuring a solar blind characteristic. A bias potential applied to the cone results in a unity collection coefficient when the tube is operated in the pulse counting mode. The combined characteristics of the sapphire window and cesium iodide photocathode give the tube a useful working range from 1900 Å to 1450 Å. The capped anode connection reduces the number of electrical leads required.

APPLICATIONS

The combination of high gain, narrow pulse height distribution, very low dark count rate, and the cesium iodide photocathode make the Bendix BX760 ideal for detecting weak ultraviolet fluxes in the presence of high visible radiation; e.g., such sources as flames, corona discharges, rocket exhaust, explosions, and other UV generators in a high ambient background. The BX 760 is also an excellent atomic absorption line detector in the 1450 Å to 1900 Å range, and it can serve as a secondary standard in this range for measuring weak ultraviolet fluxes. The minimum measurable photon flux (photons per second) of the Bendix BX 760 is better by two orders of magnitude than any other known device sensitive to these wavelengths. Operated as a pulse counter, the measured count is practically insensitive to applied voltage variations and delivers an unambiguous high level pulse using simple post-electronics.

SPECIAL FEATURES

- **CsI Front Surface Photocathode**
- **Sapphire Window**
- **Channeltron® Electron Multiplier**
- **Solar Blind**
- **Very Low Dark Noise Without Cooling**
- **Insensitive To Voltage**
- **Narrow Pulse Height Distribution**
- **Only Three Active Terminals**
- **Relatively Insensitive To Magnetic and Electrostatic Fields**

*Patent No. 3128408

Bendix Research Laboratories

Typical Operation

FIG. 1

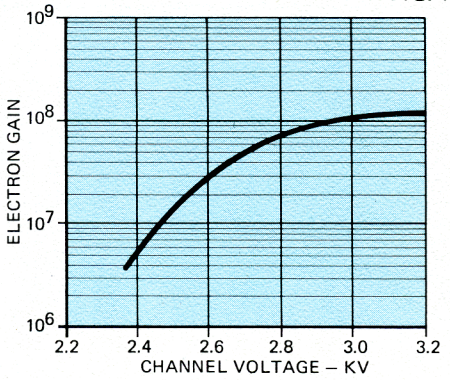


FIG. 2

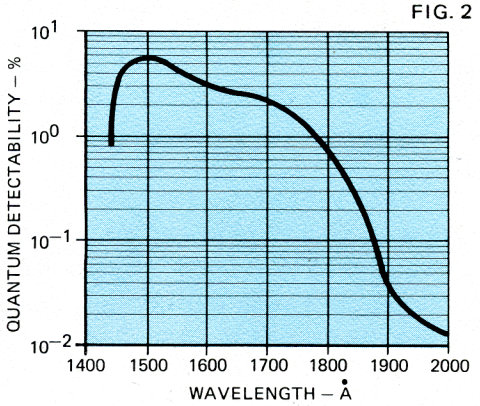


FIG. 3

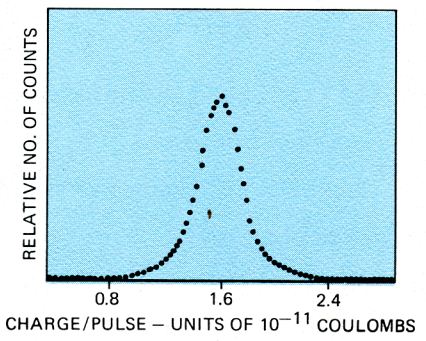
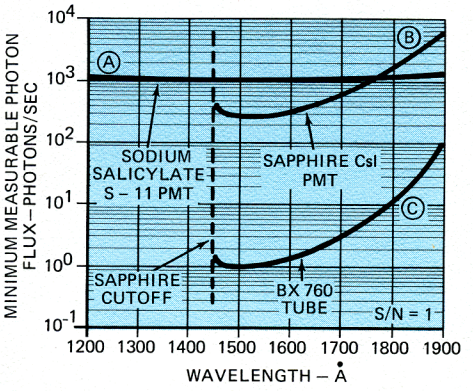


FIG. 4



The advantages of counting photoelectrons versus operating in an analog mode are three fold: (4, 5) First, the multiplier gain as a function of voltage is very stable once a sufficient gain level is attained. Second, leakage current can be separated from true signal current, since the signal current arrives at the anode in large short bursts while the leakage current is a relatively steady signal. Third, extremely low level signals can be conveniently counted over an extended period of time, in contrast with other electrometer-type instruments which are cumbersome and inflexible.

When the BX 760 tube is operated at high gain in the "uniform mode," the distribution of output pulse charge amplitudes for individual input photoelectron events departs from the quasiexponential curve characteristic of an ordinary photomultiplier and becomes a narrow peaked distribution centered at about 10^{-11} coulomb (Figure 3). Such a charge pulse, when detected with ordinary pulse counting circuitry, will insure output counts for over 99 percent of all pulses at an output discrimination threshold of 10^{-12} coulomb. The graphs show the extremely high count efficiency and stability this mode of operation provides, even for large changes in electron multiplier voltage.

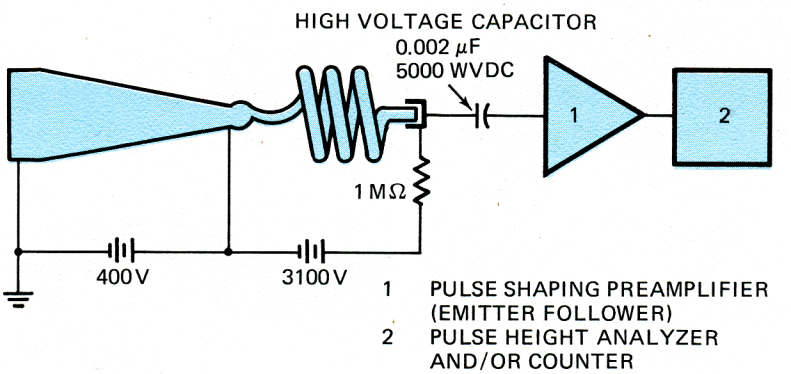
In Figure 4, the minimum detectable photon flux of the BX 760 tube is compared to those of two other common detectors used at these wavelengths. Typical values of dark count and sensitivity were used in this calculation—gain is not relevant since all calculations are referred to the photocathode. Since there is a degree of arbitrariness about setting discrimination levels in discrete dynode photomultiplier tubes (curves A and B), the typical D-C dark current was divided by the D-C gain to obtain equivalent dark electrons per second from the photocathode. Using a typical value of sensitivity, these can be converted to an equivalent number of photons per second at each wavelength. These are the values plotted in Figure 4.

An important point to note in using the BX 760 is that high sensitivity is obtained at the expense of the high count rate capability. When operated at a high gain, the tube should not be exposed to count rates in excess of 10^5 per second for long periods of time, although it will stand momentary exposures of 10^6 counts per second.

AVAILABILITY

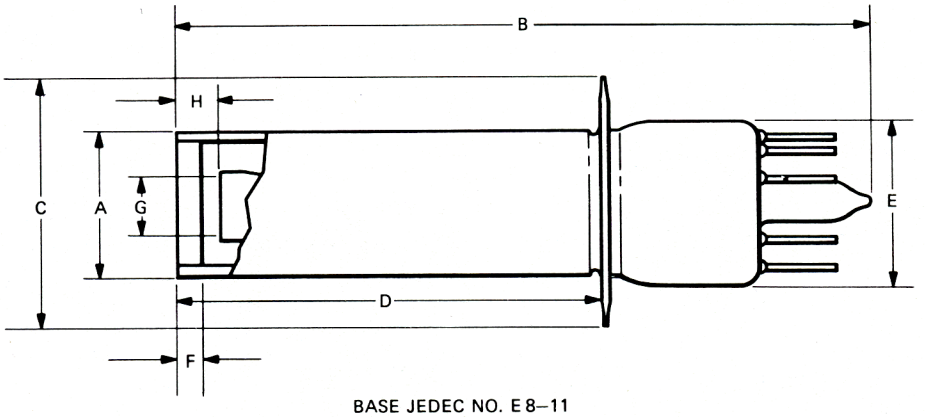
At this time, the tube is in pilot production and is currently available from Bendix Research Laboratories. Delivery is available from stock to 60 days.

FIG. 5



1 PULSE SHAPING PREAMPLIFIER (EMITTER FOLLOWER)
2 PULSE HEIGHT ANALYZER AND/OR COUNTER

Specifications



BASE JEDEC NO. E 8–11

BX 760 DIMENSIONS

A = 0.900 ± 0.005″
B = 4.55 ± 0.10″
C = 1.60 + 0.010″
– 0.150″
D = 2.76 ± 0.04″
E = 1.00 ± 0.040″
F = 0.125″ (Nominal)
G = 0.500 ± 0.005″
H = 0.225 ± 0.025″

INPUT WINDOW

Material	Sapphire
Thickness	0.125″ (Nominal)

PHOTOCATHODE

Material	CsI
Usable Diameter	0.500 ± 0.005″
Spectral Response (With Sapphire Window)	1450 Å to 1900 Å

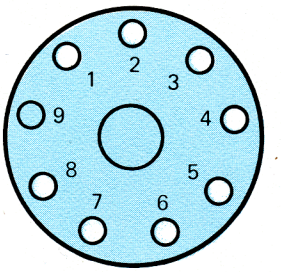
GENERAL

Weight	55 ± 10 Grams
Typical Operating Voltages:	
Cone Bias	400 Volts
Channeltron Multiplier	3100 Volts

TYPICAL PERFORMANCE CHARACTERISTICS

Wavelength of Maximum Response	1500 Å
Quantum Efficiency at Maximum Response Wavelength	5%
Quantum Efficiency at 2537 Å	3×10^{-6}
Quantum Efficiency at 3160 Å	Less Than 4×10^{-7}
Luminous Sensitivity (Tungsten Lamp at 2870°K)	Less Than 9000 Counts/Second-Lumen
	(Less Than 2 Counts/Second-Lumen With 4000 Å Cutoff Corning No. 3341 Visible-Pass Filter)
Dark Counts at 3100 Volts	Less Than 1 Count per 10 Seconds
Output Charge per Photoelectron at 3100 Volts	10^{-11} Coulomb

BASING DESIGNATION



1. CHANNEL OUTPUT
2. DO NOT USE
3. DO NOT USE
4. CONE INPUT
5. CHANNEL BIAS
6. DO NOT USE
7. DO NOT USE
8. DO NOT USE
9. SHORT PIN

SOCKET – CINCH TYPE 8VT OR EQUIVALENT

ACCESSORY EQUIPMENT

Miniature electronic circuitry designed to optimize the special advantages of the BX 760 ultraviolet Photon Counter Tube is available from the Bendix Research Laboratories. The following circuitry is available packaged for various environments, including space applications:

FOR PHOTON COUNTING APPLICATIONS

- **Power Supplies**
- **Charge Pulse Amplifiers**
- **Gating Circuits**

A complete capability for supplying custom optical assemblies is also available. Your inquiries are invited regarding these products, as well as specific electro-optical packages tailored to your needs.

For additional information contact:

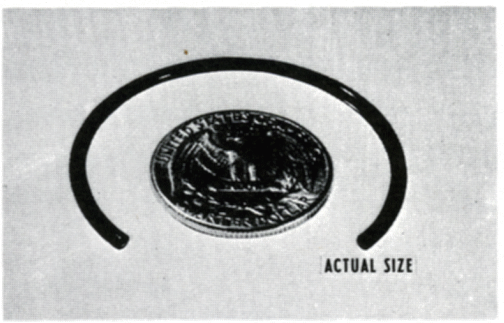
Manager Program Planning
General Science and Technology Laboratory
Bendix Research Laboratories
20800 10½ Mile Road
Southfield, Michigan 48075
(Area Code 313: 353–3500)

REFERENCES

1. D. S. Evans, "Low Energy Charged-Particle Detection Using Continuous Electron Multiplier," Rev. Sci. Instr., Vol. 36, No. 3, p. 375, March 1965
2. W. C. Wiley and C. F. Hendee, "Electron Multipliers Utilizing Continuous Strip Surfaces," IRE Trans. Nucl. Sci., Vol. NS–9, 3, p. 103, June 1962
3. G. W. Goodrich and W. C. Wiley, "Continuous Channel Electron Multiplier," Rev. Sci. Instr., Vol. 33, No. 7, pp 761–762, July 1962
4. W. A. Baum, "Magnetic Focusing of Image Tubes," Advances in Electronics and Physics, Vol. 22, Photoelectronic Image Devices, Third Symposium
5. G. A. Morton, "Photon Counting," Appl. Opt., Vol. 7, No. 1, pp 1–10, January 1968

Bendix Research Laboratories

MODEL CEM-4010 CHANNELTRON® ELECTRON MULTIPLIER



DESCRIPTION:

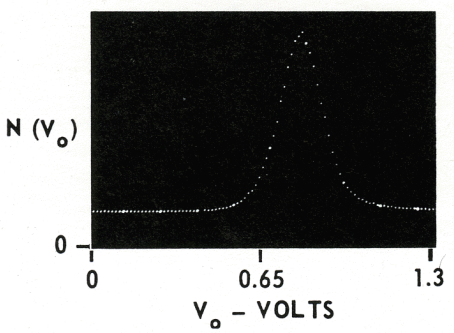
The curved Channeltron Electron Multiplier (CEM) is the most recent of the windowless multipliers developed at the Bendix Research Laboratories Division. It was designed specifically for rocket-probe investigations of the auroral plasma, but is also well suited for satellite experiments and other applications where small size, light weight, low power consumption, and an exposed cathode are important considerations.

As opposed to the conventional discrete dynode electron multipliers, the Bendix CEM* is an electrostatic device which employs a continuous dynode surface -- only two electrical connections are required to establish the necessary voltage distribution for electron multiplication. Because of the stability of the dynode surface on exposure to normal atmospheric conditions and its complete lack of photosensitivity to visible and near ultraviolet radiation, CEM's have found wide application as windowless solar blind detectors for the ultraviolet and soft X-ray region of the spectrum and for energetic charged particles. Principles of operation of Bendix CEM's are described in the literature.**

Forming the CEM into a circular arc makes stable electron gains of greater than 10^8 realizable. The output pulse height distribution is approximately Gaussian with a FWHM of 50 percent at an electron gain of 10^8, and dark count rate is normally less than five per minute. This combination of high gain, narrow pulse height distribution, and low dark count rate makes the curved CEM ideal for photon and particle counting applications where simplicity of electronic circuitry is required.

DETECTS

- XUV AND X-RAY PHOTONS
- β PARTICLES
- LOW ENERGY ELECTRONS
- LOW ENERGY PROTONS
- POSITIVE IONS
- NEGATIVE IONS



TYPICAL PULSE HEIGHT DISTRIBUTION

Other configurations of the CEM (helix, spiral, cone, etc.) can be made to suit special applications.

Miniaturized high voltage power supplies, capable of extreme environmental operation, are available from the Bendix Electro-Optics Division.

*PATENT NO. 3128408

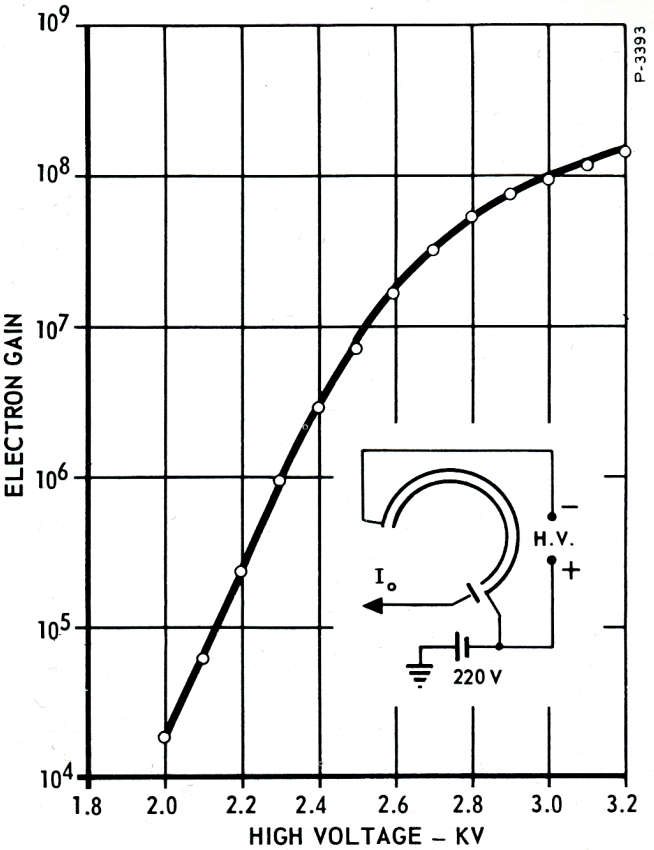
**WILEY, W. C. AND HENDEE, C. F., IRE TRANS. NUCLEAR SCI., NS-9, APRIL 1962
GOODRICH, G. W. AND WILEY, W. C., REV. SCI. INST., 33, 761, 1962
EVANS, D. S., REV. SCI. INST., 36, 375, MARCH 1965

CHANNELTRON IS A REGISTERED TRADEMARK OF THE BENDIX CORPORATION

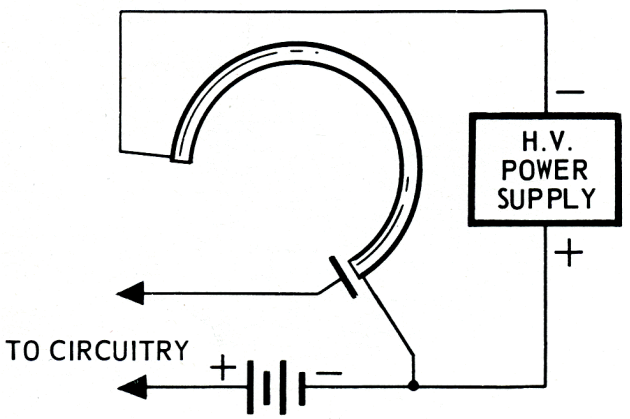
SPECIFICATIONS

SPECTRAL RESPONSE	1500°A TO BELOW 2°A
DARK PULSE COUNT RATE	FIVE COUNTS PER MINUTE OR LESS
TYPICAL ELECTRON GAIN	SEE GAIN CURVE
FULL WIDTH HALF MAXIMUM (FWHM) AT GAIN OF 1 X 10^8	50% OR LESS
MAXIMUM D-C ANODE CURRENT FOR LINEAR ANALOG RESPONSE	10% OF BIAS * CURRENT
MAXIMUM OPERATING HIGH VOLTAGE	4 KV
DYNODE SURFACE RESISTANCE	1 X 10^9 Ω (NOMINAL)
INNER DIAMETER	0.040" (1 mm)
OUTER DIAMETER	0.080" (NOMINAL)
LENGTH OF ARC	4.00"
RADIUS OF CURVATURE	0.85"
SUBTENDED ARC	270°
WEIGHT	1/42 OZ.
ELECTRICAL CONNECTIONS	SUPPLIED BY USER
ANODE	SUPPLIED BY USER

MEASURED GAIN CURVE



TYPICAL ELECTRICAL CONNECTIONS



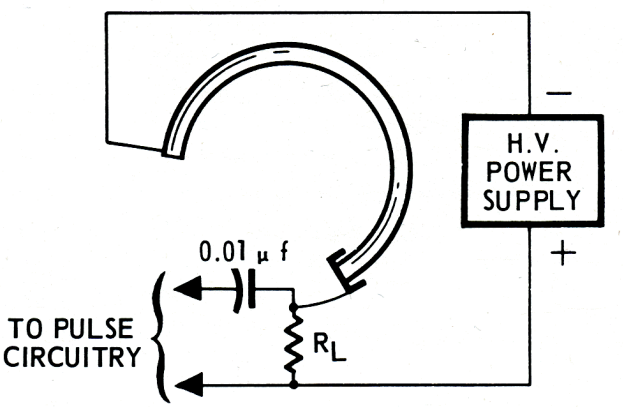
SEPARATE COLLECTOR

NOTE:

(1) POINT OF GROUNDING OPTIONAL

(2) COLLECTOR SPACING NOMINALLY ONE MILLIMETER

(3) COLLECTOR VOLTAGE TYPICALLY 200–300 VOLTS



CAP COLLECTOR

NOTE:

(1) POINT OF GROUNDING OPTIONAL

(2) COLLECTOR CAN BE METAL FOIL BONDED TO CEM WITH CONDUCTIVE ADHESIVE

(3) R_L TYPICALLY 100 K Ω

P-3393

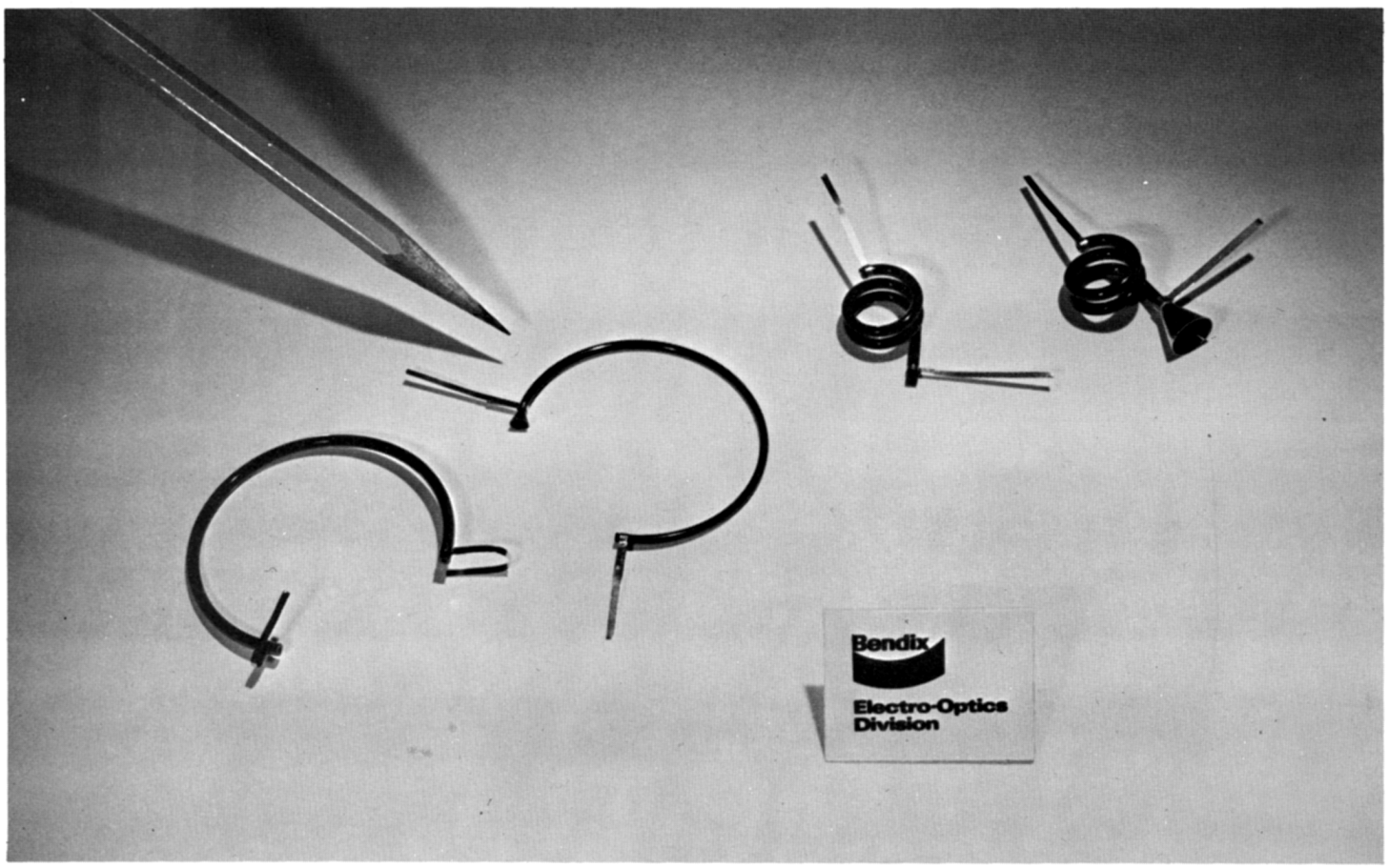
*BIAS CURRENT IS EQUAL TO THE OPERATING VOLTAGE DIVIDED BY THE DYNODE SURFACE RESISTANCE

FOR FURTHER INFORMATION CONTACT: MARKETING DEPARTMENT

THE BENDIX CORPORATION
ELECTRO-OPTICS DIVISION
1975 GREEN ROAD
ANN ARBOR, MICHIGAN 48107

TELEPHONE (313) 663-3311

CHANNELTRON®
ELECTRON MULTIPLIERS



MODELS: CEM-4010, CEM-4013, CEM-4020, CEM-4028

FOR FURTHER INFORMATION CONTACT: MARKETING DEPARTMENT

THE BENDIX CORPORATION
ELECTRO-OPTICS DIVISION
1975 GREEN ROAD
ANN ARBOR, MICHIGAN 48107

TELEPHONE (313) 663-3311

SPECIFICATIONS

CHANNELTRON® ELECTRON MULTIPLIERS

CHARACTERISTIC	MODEL			
	4010	4013	4020	4028
MECHANICAL:				
SHAPE	CIRCULAR	CIRCULAR	HELIX	HELIX
SUBTENDED ARC	270°	270°	840°	840°
CONE DIAMETER*	None	3mm	None	8mm
CONE ANGLE	—	45°	—	45°
CHANNEL I.D.	0.040"	0.040"	0.040"	0.040"
CHANNEL O.D.	0.080"	0.080"	0.080"	0.080"
RADIUS OF CURVATURE	0.85"	0.85"	0.24"	0.24"
ELECTRICAL:				
SPECTRAL RESPONSE	1500 Å to below 2 Å			
MINIMUM GAIN	5×10^7 with 3000 vdc applied			
OUTPUT PULSE HEIGHT DISTRIBUTION	Full width half maximum 50%			
OUTPUT CURRENT PULSE WIDTH	20 nanoseconds (nominal) at 5×10^7 gain			
BACKGROUND COUNT RATE** (avg) at 3000 vdc	< 0.5/sec	< 1.5/sec	< 0.5/sec	< 4.0/sec
DYNODE SURFACE RESISTANCE	$1 \times 10^9 \Omega$	$1 \times 10^9 \Omega$	$1 \times 10^9 \Omega$	$1 \times 10^9 \Omega$
MAX. OPERATING PRESSURE	1×10^{-4} Torr	1×10^{-4} Torr	1×10^{-4} Torr	1×10^{-4} Torr
MAX. OPERATING VOLTAGE	4 kv	4 kv	4 kv	4 kv
MAX. DC ANODE CURRENT FOR LINEAR ANALOG RESPONSE	10% OF BIAS CURRENT SEE NOTE 2	10% OF BIAS CURRENT SEE NOTE 2	10% OF BIAS CURRENT SEE NOTE 2	10% OF BIAS CURRENT SEE NOTE 2

NOTE: 1. ALL SPECIFICATIONS ARE NOMINAL UNLESS OTHERWISE NOTED.
2. BIAS CURRENT IS EQUAL TO THE OPERATING VOLTAGE DIVIDED BY THE DYNODE SURFACE RESISTANCE.

* MODEL CEM-4010 WITH 10MM CONE AVAILABLE AS CEM-4019. MODEL CEM 4020 WITH 10MM AXIAL CONE AVAILABLE AS CEM 4039

**<4.0/SEC FOR MODELS CEM-4019 & CEM-4039

FOR FURTHER INFORMATION CONTACT: MARKETING DEPARTMENT
THE BENDIX CORPORATION
ELECTRO-OPTICS DIVISION
1975 GREEN ROAD
ANN ARBOR, MICHIGAN 48107
TELEPHONE (313) 663-3311

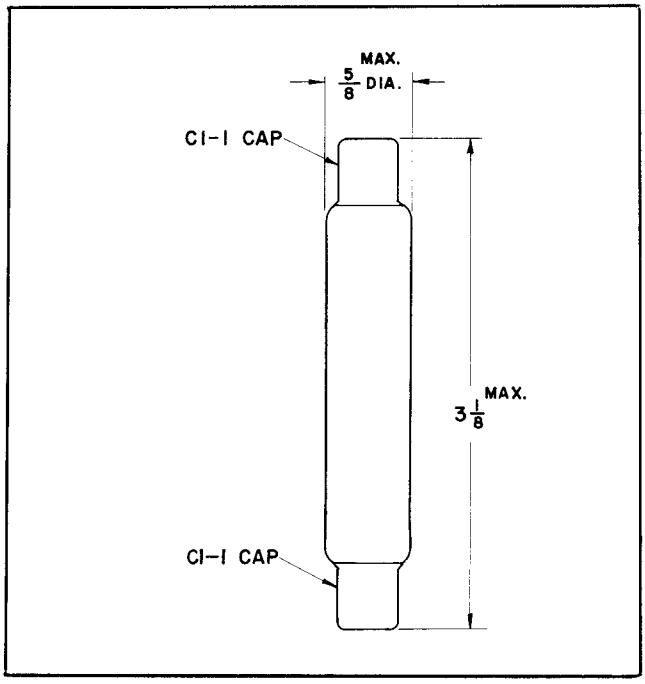
Bendix Type TG-14

SPARK GAP

OVERVOLTAGE PROTECTION SERVICE

COLD CATHODE
SEALED
AMBIENT FREE

SPARK DISCHARGE
NON-POLARIZED
TWO-ELECTRODE



RATINGS & CHARACTERISTICS

Initial Pulse Breakdown*	28 Kv. Max.
Repetitive Pulse Breakdown*	17 Kv. Min.
Ambient Temp.	(—) 55°C
	(+) 85°C

DESCRIPTION

This gap is designed to be used as a protective device in high voltage circuits, primarily for use in a line type modulator. It prevents failure of the pulse transformer and associated components through insulation breakdown. Its characteristics are not affected by changes in ambient conditions within its ratings.

*Peak voltage breakdown will vary as shape of applied pulse varies, in general, decreasing as rise time increases, as pulse width increases, and as repetition rate increases.

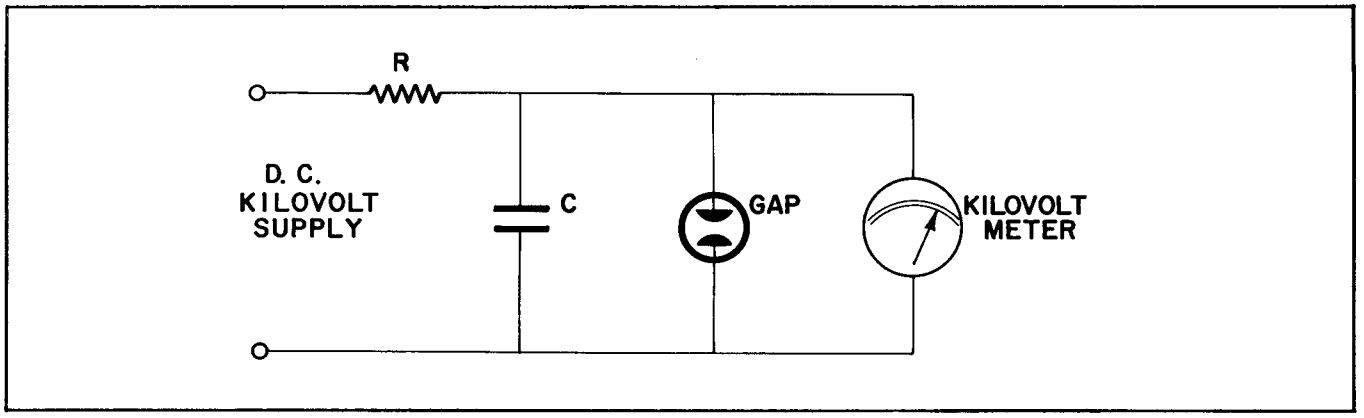
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R612-9

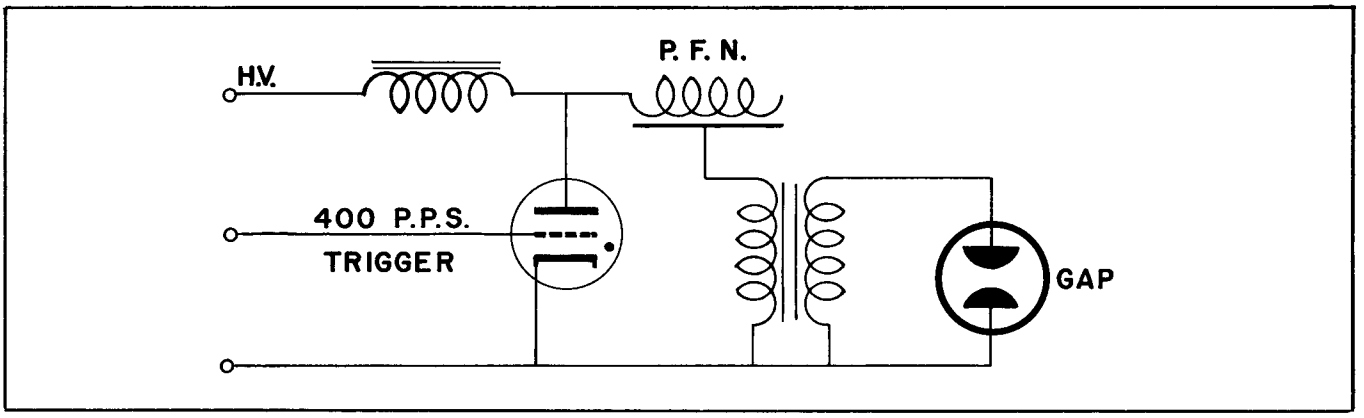
Printed in U.S.A.

SPARK GAP

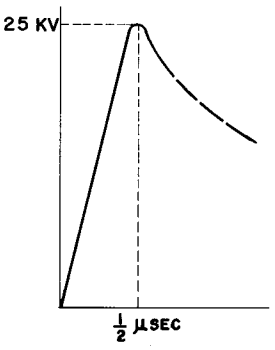
Bendix Type TG-14



TEST CIRCUIT — STATIC BREAKDOWN



TEST CIRCUIT — PULSE BREAKDOWN



Amplitude will vary as H.V. changes but peak occurs at about 0.5 microsecond.

APPROXIMATE PULSE SHAPE

Spark Gaps are made in a wide variety for a great many applications: DC Puse, AC, Stand-by, Repetitive operation, Surge protection, and Switching according to customer requirements.

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix Type TG-20

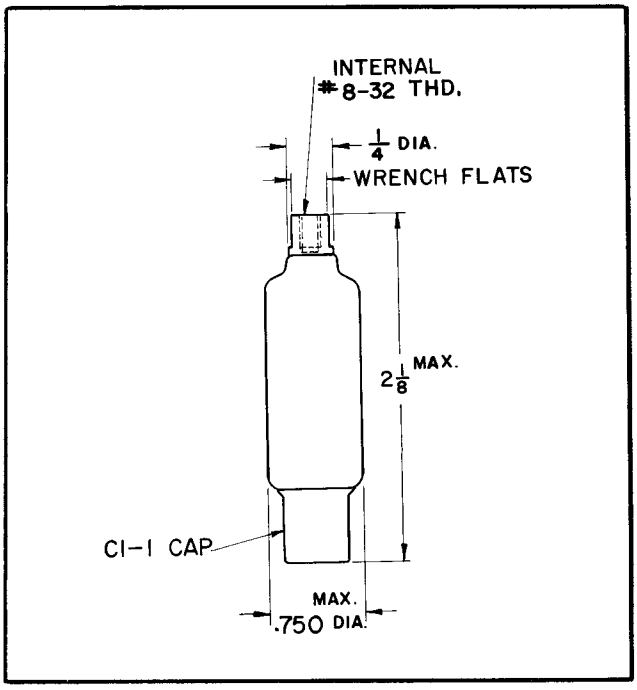
SPARK GAP

OVERVOLTAGE PROTECTION SERVICE

COLD CATHODE
SEALED

AMBIENT FREE

SPARK DISCHARGE
TWO-ELECTRODE



RATINGS & CHARACTERISTICS

Initial Pulse Breakdown*	17 Kv. Min.
Repetitive Pulse Breakdown*	17 Kv. Min.
Ambient Temp.	(—) 55°C
	(+) 85°C
Vibration	10G

DESCRIPTION

This gap is designed to be used as a protective device in high voltage circuits, primarily for use in a line type modulator. It prevents failure of the pulse transformer and associated components through insulation breakdown. Its characteristics are not affected by changes in ambient conditions within its ratings. An internal 8-32 thread at one end permits mounting directly to chassis or to a threaded stud. Normal operation of the gap should be with threaded end at positive polarity.

* Peak voltage breakdown will vary as shape of applied pulse varies, in general, decreasing as rise time increases, as pulse width increases, and as repetition rate increases.

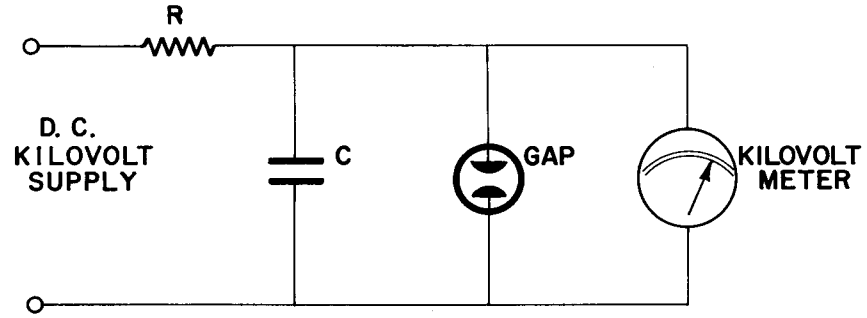
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R612-10

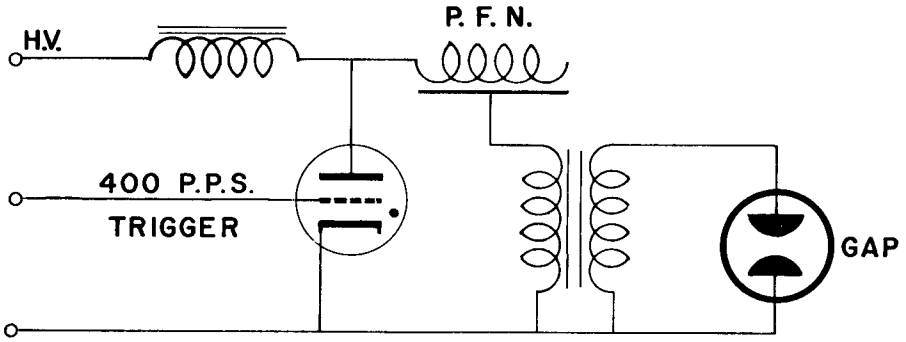
Printed in U.S.A.

SPARK GAP

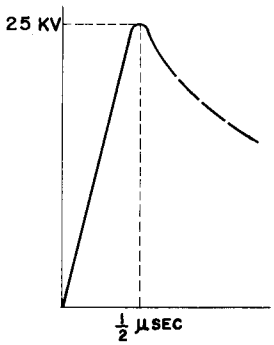
Bendix Type TG-20



TEST CIRCUIT — STATIC BREAKDOWN



TEST CIRCUIT — PULSE BREAKDOWN



Amplitude will vary as H.V. changes but peak always occurs at about 0.5 microsecond.

APPROXIMATE PULSE SHAPE

Spark Gaps are made in a wide variety for a great many applications: DC Puse, AC, Stand-by, Repetitive operation, Surge protection, and Switching according to customer requirements.

THE Bendix CORPORATION

Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

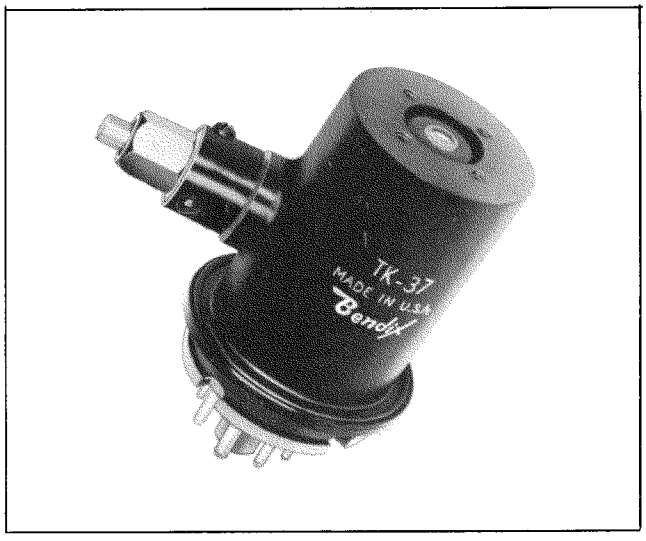
Bendix® Type TK-37
(Generic Type SRV-38)

REFLEX KLYSTRON

(MECHANICALLY TUNED)

DESCRIPTION

The Bendix® Type TK-37 is a ruggedized, low voltage, mechanically tuned Ka band reflex oscillator designed for use as a CW power source over a frequency range of 34.0 to 35.6 Kmc/sec. This tube incorporates a unique method of tuning the cavity resonator which permits the achievement of a relatively flat power output and electronic tuning characteristic with variation of the operating frequency. Unlike the conventional capacitive type tuners wherein the interaction gap spacing of the resonant cavity is varied to control the operating frequency, the interaction gap of the TK-37 is fixed at optimum spacing. Tuning is accomplished by moving a dielectric rod into the electric field surrounding the interaction gap. The tuner rod is moved by a spring loaded differential screw acting through a bellows in the wall of the vacuum envelope. This screw is designed to receive an allen wrench for tuning purposes. Since a flexible diaphragm is no longer necessary as a cavity wall for tuning purposes, the cavity is designed as a rigid structure. The electron gun and repeller structures are mounted rigidly on ceramics in order to ruggedize these assemblies and to eliminate the use of all mica insulators which are subject to decomposition and flaking under some environmental conditions. The output coupling is accomplished by means of an internal tapered section of waveguide which couples radio frequency energy from the cavity resonator through a non-resonant iris. This waveguide section tapers in the narrow dimension only from the iris to a terminating choke abutting a circular low loss glass output window. The output fitting of the tube is designed to match and fasten directly to a standard UG-600/U waveguide flange. The bulb is of steel construction and hence provides protection from external magnetic fields for the internal electron optics structure.



APPLICATION NOTES

Insulation The bulb of the TK-37 is designed to operate at resonator voltage potential hence requiring a resonator voltage supply having its positive polarity grounded when the tube is to be mounted directly on the waveguide flange. If the desired application requires that the tube shall be operated above ground or "hot" with respect to ground, the tube and the waveguide flange may be insulated by means of a mica sheet and four insulating bushings between the mounting screws, tube and waveguide flange.

Cooling At room temperature without a tube enclosure no forced cooling is required. If the tube is to be operated in an enclosure, care should be taken to insure that adequate cooling is provided in order that the bulb temperature does not become excessive since impairment of tube life may result.

Output Load The tube has been designed for operation into a matched waveguide load. When operation into a reactive load is necessary, adequate attenuation should be inserted in the load circuit between the tube and the load to limit the voltage standing wave ratio at the tube in order to prevent impairment of tube performance.

Repeller Modes The tube should be operated in the repeller voltage mode defined in this data sheet. However, modes do exist at other repeller voltages than that specified which should be considered when the design of AFC circuits is undertaken to prevent lock-in on one of these other modes.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Filament Voltage	6.3 ± 8% volts
Resonator Voltage	425 volts D.C.
Reflector Voltage	−400 volts D.C.
Resonator Current	40 mAdc
Heater-Cathode Voltage	±50 volts

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Weight:* 4.3 ounces.
- *Base:* Small wafer octal 8 pin, B8-21, low loss phenolic.
- *Coupling to Wave Guide:* Direct. Fastens to UG-600/U choke flange.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Copper.
- *Bulb:* Metal.
- *Output Window:* Low Loss Glass.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

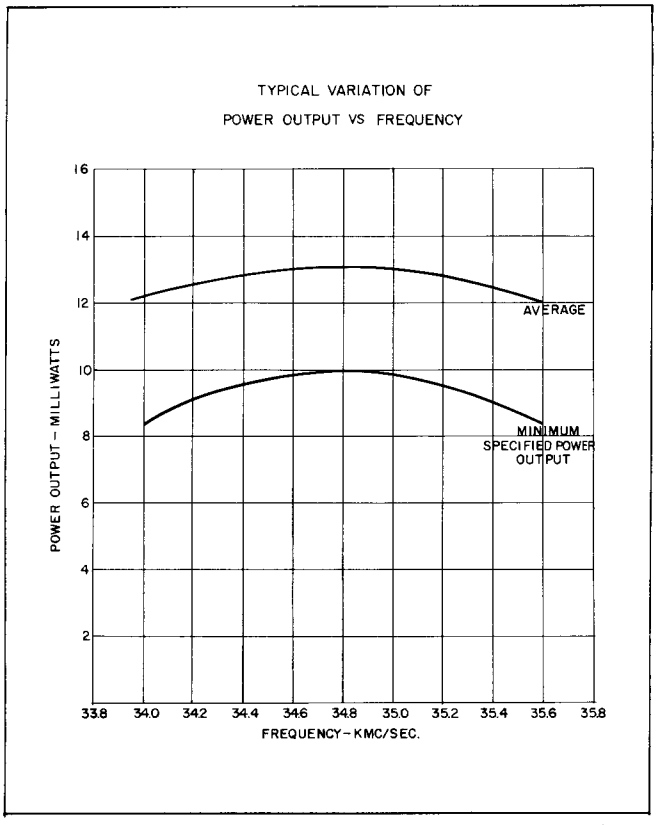
Publication No. R01-8

Printed in U.S.A.

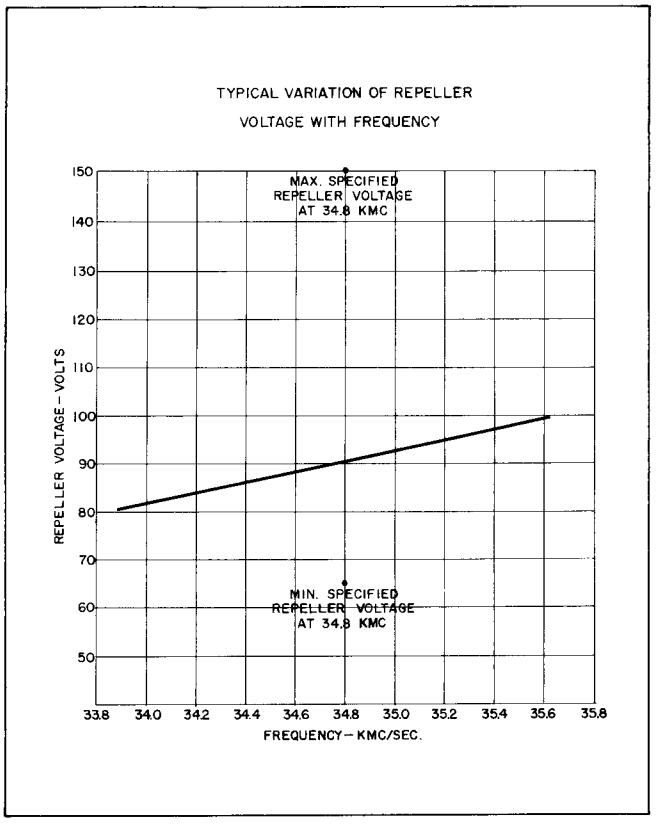
REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-37
(Generic Type SRV-38)

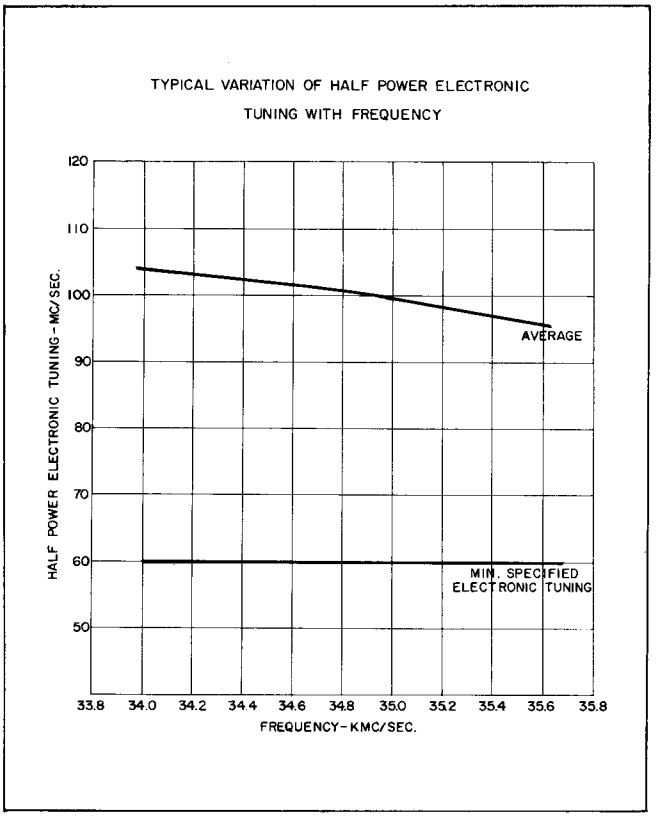
AVERAGE CHARACTERISTICS



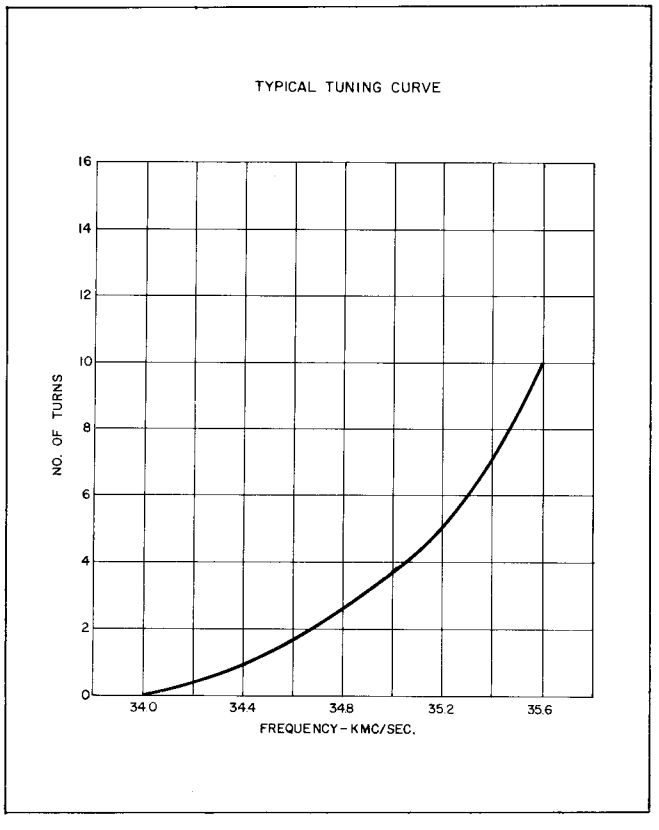
POWER OUTPUT VS. FREQUENCY



REFLECTOR VOLTAGE VS. FREQUENCY



ELECTRONIC TUNING VS. FREQUENCY



TUNER TURNS VS. FREQUENCY

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-37
(Generic Type SRV-38)

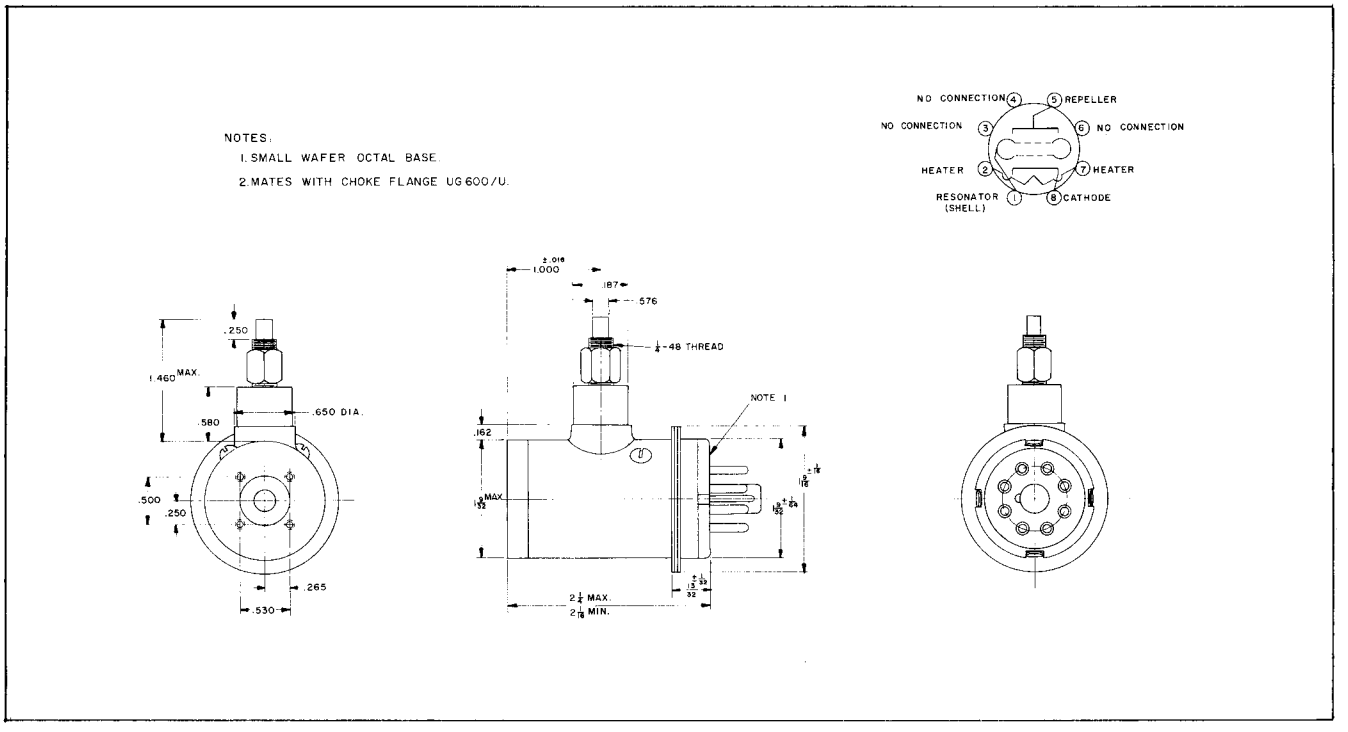
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Leakage Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Gas Current	Er = −150 Vdc	Ir	—	5.0	μAdc
Resonator Current	Er = −75 to −260 Vdc Tube in non oscillating state	Ik	—	60	mAdc
Mechanical Tuning Range	Er/max Po	F	34,000	35,600	Mc
Power Output (1)	Test Conditions	Po	10.0	—	mW
Power Output (2)	Er/max Po; F = 34,000 ± 0.3% Mc; F = 35,600 ± 0.3% Mc.	Po	8.5	—	mW
Reflector Voltage	Test Conditions; Er/max Po	Er	−75	−260	Vdc
Electronic Tuning	Er/50% max Po		60	—	Mc
Emission	Ef = 5.8 v	△Ik/Ik	—	10	%
Bump	Test Conditions; Er/max Po	△Po/Po	—	10	%
DESIGN TESTS:					
Electrode Insulation	400 Vdc, tube cold	Rk-rs	2.0	—	Megohms
Heater Current	Test Conditions	If	0.54	0.66	Amps
Insulation	Ehk = ±45 Vdc	Ihk	—	100	μAdc
Hysteresis	Test Conditions		—	5	%

GENERAL TEST CONDITIONS:

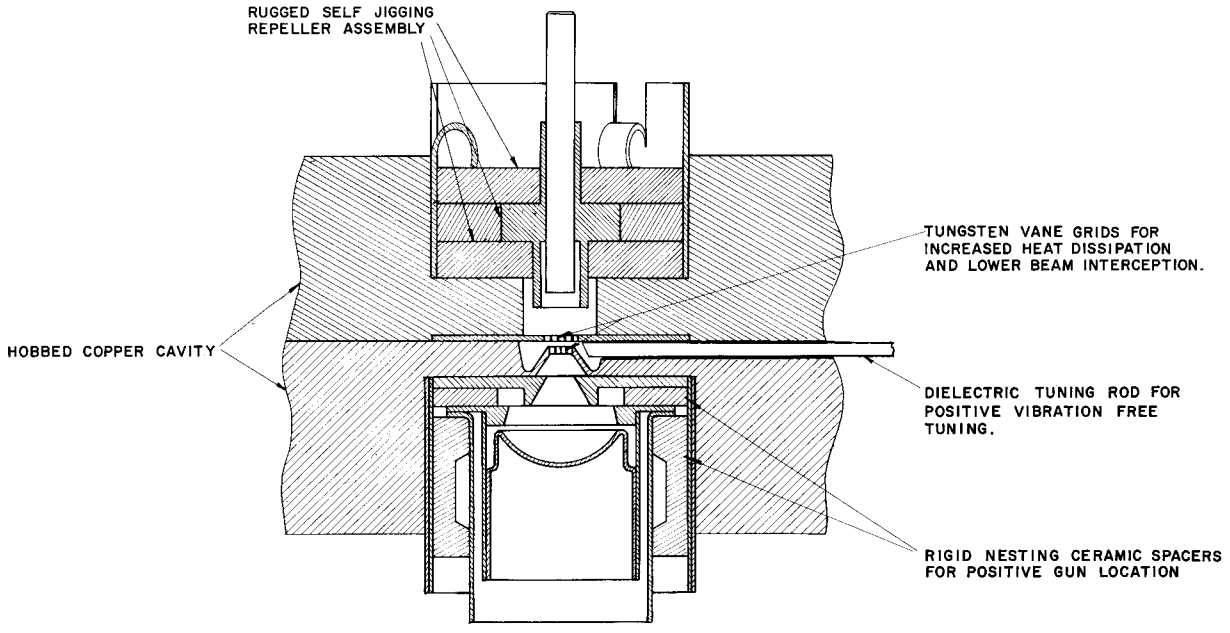
Ef	Eres	Er	F
6.3 volts	+400 Vdc	Adjust −60 to −300 Vdc	34,800 ± 0.3% Mc



OUTLINE DRAWING

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-37
(Generic Type SRV-38)



STRUCTURAL FEATURES OF THE TK-37

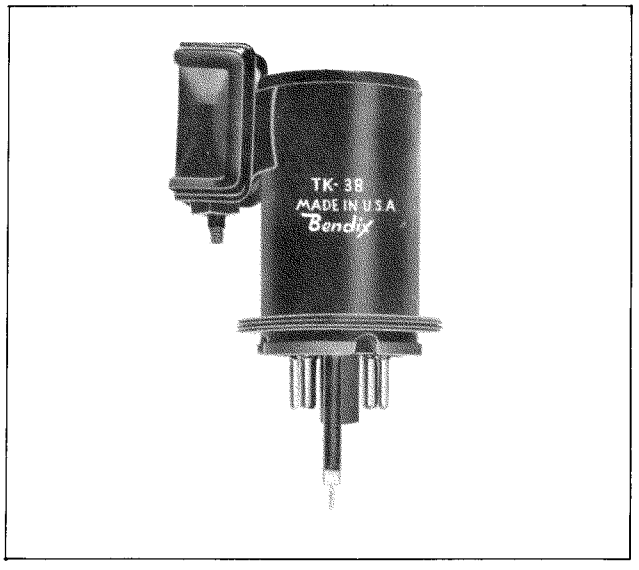
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 17 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix Type TK-38

REFLEX KLYSTRON

(MECHANICALLY TUNED)



MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	330 Vdc
Reflector Voltage	— 300 Vdc
Filament Voltage	6.3 ± 8% volts
Resonator Current	35 mAdc
Heater — Cathode Voltage	± 50 Vdc

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Base:* Modified Small Octal 8-Pin, B8-21, Low Loss Phenolic.
- *Output Coupling:* Coaxial. (See Typical Adapter Assembly Drawing.)
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Bulb:* Metal.
- *Tuner:* Allen Socket Screw for #8 Allen Wrench.

DESCRIPTION

The Bendix® Red Bank Type TK-38 Tube is a mechanically tuned C band reflex oscillator. The electrical characteristics of the TK-38 have been designed to be similar to the type 6115, with the exception that the repeller voltage variation with frequency has been reduced. The tube is designed for use as a CW oscillator over the range of 5100 Mc./sec. to 5900 Mc./sec. The tube is capacitively tuned over this frequency range by changing the interaction gap spacing.

The design is such as to exhibit no spurious oscillation modes when the output connecter is properly terminated.

The electron optics of the tube have been designed to reduce electrical hysteresis to a minimum.

The mechanical tuner design eliminates long mechanical and thermal paths external to the tube structure as well as the use of overstressed diaphragms; hence, mechanical tuning hysteresis is virtually eliminated. In addition, the cavity diaphragm is completely contained within the vacuum enclosure thus eliminating frequency sensitivity to atmospheric pressure as present in tubes having the diaphragm as a part of the vacuum enclosure.

Output coupling is accomplished by means of a coaxial output lead. The output line may be coupled into a coaxial system or directly into a waveguide mount by means of the Typical Adaptor Assembly drawing shown on the last page. This adaptor is the same as the one used for the JAN-2K29.

APPLICATION NOTES

This tube is designed to have improved temperature and altitude characteristics, fast warm-up, stabilized warm-up frequency drift, and reduced repeller voltage variation with frequency. The tube is applicable for use in equipments operating in widely varying ambient temperatures, varying atmospheric pressures and in intermittent operation. Such applications include airborne radar systems, telemetering and microwave relay links. In addition, the reduced repeller voltage vs. frequency characteristic makes possible savings in components for an afc system with given characteristics.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-19 (Supersedes No. R58-3)

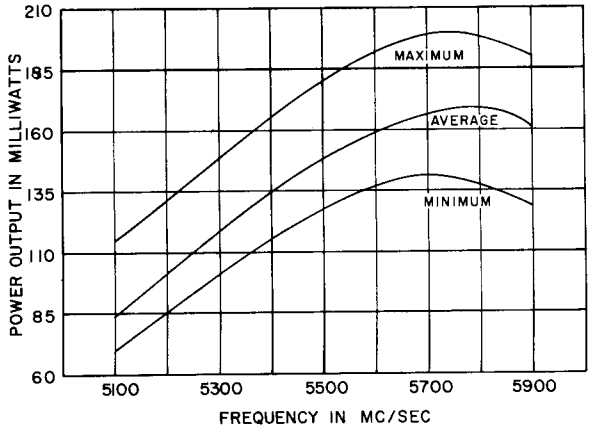
Printed in U.S.A.

REFLEX KLYSTRON
(MECHANICALLY TUNED)

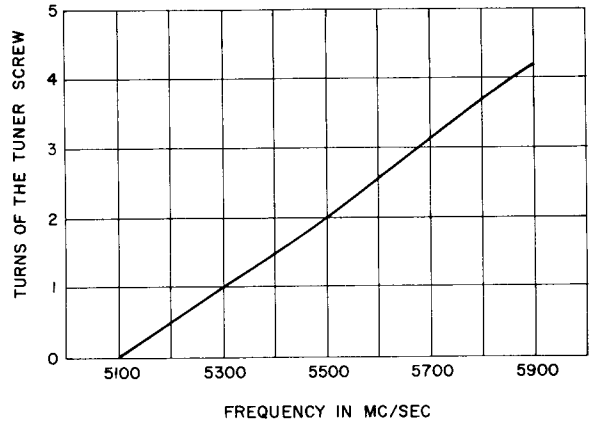
Bendix Type TK-38

AVERAGE CHARACTERISTICS

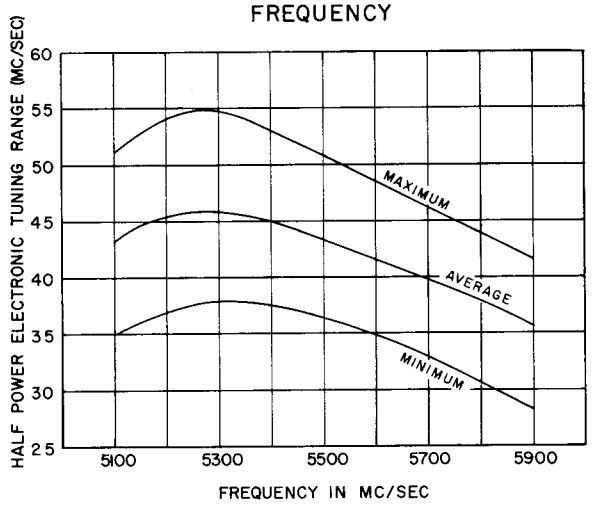
TYPICAL POWER OUTPUT
VS
FREQUENCY
(REPELLER VOLTAGE
OPTIMIZED FOR EACH FREQUENCY)



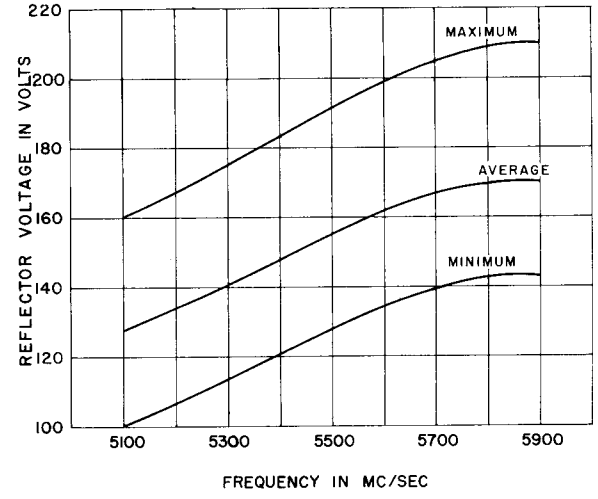
TURNS OF TUNER SCREW
VS
FREQUENCY



TYPICAL VARIATION OF HALF POWER
ELECTRONIC TUNING RANGE
WITH
FREQUENCY



TYPICAL VARIATION
OF REPELLER VOLTAGE
WITH FREQUENCY



REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-38

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS					
Total Reflector Current	Er = −100 Vdc	Ir	—	7	uAdc
Reflector Leakage Current	Er = −100 Vdc	Ir	—	5	uAdc
Reflector Gas Current	Er = −100 Vdc	Ir	—	2	uAdc
Bump	Test Conditions; Er/max Po	△ Po/Po	—	0.10	
Resonator Current	Test Conditions; Er = −100 Vdc	Irs	—	32	mAdc
Mechanical Tuning Range	Er/max Po	F min	—	5100	Mc
		F max	5900	—	Mc
Power Output (1)	F = 5100 Mc; Er/max Po	Po	70	—	mW
Reflector Voltage (1)	F = 5100 Mc; Er/max Po	Er	−100	−160	Vdc
Reflector Voltage (2)	F = 5900 Mc; Er/max Po	Er	−140	−210	Vdc
Electronic Tuning (2)	F = 5900 Mc; Er/50% Po	△ F	28	—	Mc
Emission	Ef = 5.8 V	△ Ik/Ik	—	0.15	
Life Test	Test Conditions	t	500	—	hrs
Life Test End Points	Power Output; F = 5900; Er/max Po	Po	80	—	mW
DESIGN TESTS:					
Insulation	Ehk ±45 Vdc		—	100	uAdc
Electrode Insulation	500 Vdc; Tube Cold	Rk-rs	2	—	Meg
		Rk-rs	2	—	Meg
Vibration Non-Operating*	F = 10 −55 −10, Peak to Peak Excursion .065"				
	F = 55 −300 −55, G = 10				
Heater Current	Test Conditions		450	550	mA
Power Output (2)	F = 5900 Mc; Er/max Po	Po	120	—	mW
Electronic Tuning (1)	F = 5100 Mc; Er/50% Po	△ F	34	—	Mc
Hysteresis	Test Conditions; Er/max Po	Ratio	—	0.05	
Modulation Sensitivity	Test Conditions; Er/max Po; △ Er = ±3 V	△ F/△ Er	0.61	1.2	Mc/V
Resonator Voltage Sensitivity	Test Conditions; Er/max Po; △ Ers = 20v p to p ac	△ F/△ Ers	—	0.320	Mc/V

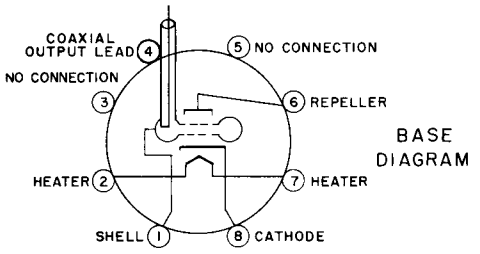
TEST CONDITIONS:

	Ef.	Eres.	Er	Irs	Ehk	F
	6.3 volts	300 Vdc	Adjust Vdc	25 mAdc	0	5500 Mc

*Tube is mechanically pretuned to 5100 Mc. Vibration tests are conducted on a cyclic basis for nine five minute periods in each of three mutually perpendicular planes. The tube must be capable of meeting all production tests after completion of the vibration tests.

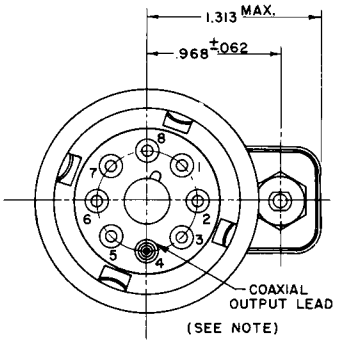
REFLEX KLYSTRON
(MECHANICALLY TUNED)

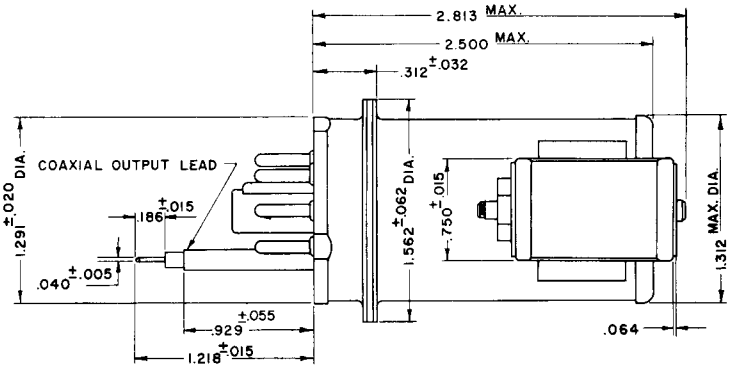
Bendix Type TK-38



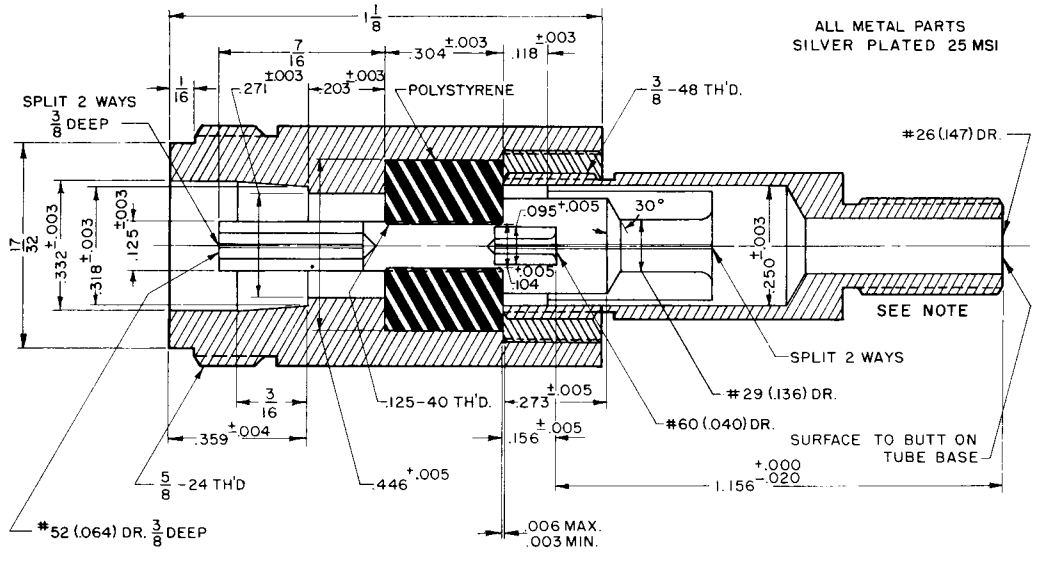
BASE DIAGRAM

NOTE:
NUMERALS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON TUBE BASE.





NOTE: SAME AS BENDIX RED BANK PART NO. RT-1738



ALL METAL PARTS
SILVER PLATED 25 MSI

COAXIAL OUTPUT ADAPTOR

THE **Bendix** CORPORATION
Red Bank Division, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix® Type TK-53
(Retrofit for Type SRV-38)

REFLEX KLYSTRON

(MECHANICALLY TUNED)

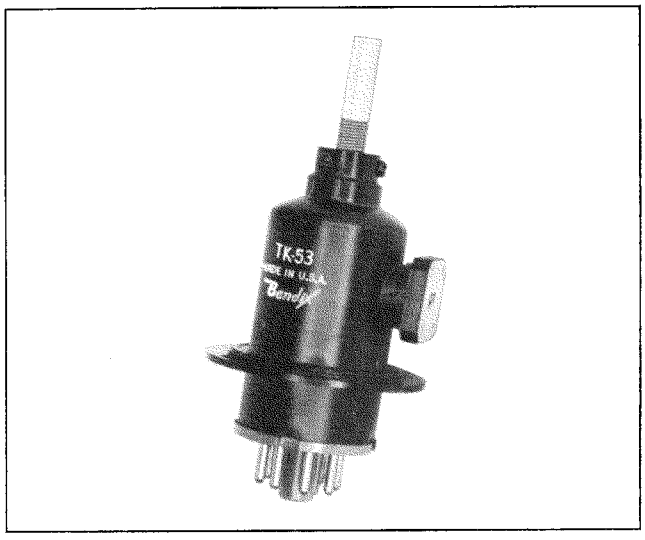
DESCRIPTION

The Bendix® Type TK-53 is a ruggedized, low voltage, mechanically tuned Ka band reflex oscillator designed for use as a CW power source over a frequency range of 34.0 to 35.6 Kmc/sec. This tube incorporates a unique method of tuning the cavity resonator which permits the achievement of a relatively flat power output and electronic tuning characteristic with variation of the operating frequency. Unlike the conventional capacitive type tuners wherein the interaction gap spacing of the resonant cavity is varied to control the operating frequency, the interaction gap of the TK-53 is fixed at optimum spacing. Tuning is accomplished by moving a dielectric rod into the electric field surrounding the interaction gap. The tuner rod is moved by a spring loaded differential screw acting through a bellows in the wall of the vacuum envelope. This screw is designed to receive an allen wrench for tuning purposes. Since a flexible diaphragm is no longer necessary as a cavity wall for tuning purposes, the cavity is designed as a rigid structure. The electron gun and repeller structures are mounted rigidly on ceramics in order to ruggedize these assemblies and to eliminate the use of all mica insulators which are subject to decomposition and flaking under some environmental conditions. The output coupling is accomplished by means of an internal tapered section of waveguide which couples radio frequency energy from the cavity resonator through a non-resonant iris. This waveguide section tapers in the narrow dimension only from the iris to a terminating choke abutting a circular low loss glass output window. The output fitting of the tube is designed to match and fasten directly to a standard UG-599/U or UG-600/U waveguide flange. The bulb is of steel construction and hence provides protection from external magnetic fields for the internal electron optics structure.

APPLICATION NOTES

Insulation The bulb of the TK-53 is designed to operate at resonator voltage potential hence requiring a resonator voltage supply having its positive polarity grounded when the tube is to be mounted directly on the waveguide flange. If the desired application requires that the tube shall be operated above ground or "hot" with respect to ground, the tube and the waveguide flange may be insulated by means of a mica sheet and four insulating bushings between the mounting screws, tube and waveguide flange.

Cooling At room temperature without a tube enclosure no forced cooling is required. If the tube is to be operated in an enclosure, care should be taken to insure that adequate cooling is provided in order that the bulb temperature does not become excessive since impairment of tube life may result.



Output Load The tube has been designed for operation into a matched waveguide load. When operation into a reactive load is necessary, adequate attenuation should be inserted in the load circuit between the tube and the load to limit the voltage standing wave ratio at the tube in order to prevent impairment of tube performance.

Repeller Modes The tube should be operated in the repeller voltage mode defined in this data sheet. However, modes do exist at other repeller voltages than that specified which should be considered when the design of AFC circuits is undertaken to prevent lock-in on one of these other modes.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Filament Voltage	6.3 ± 8% volts
Resonator Voltage	425 volts D.C.
Reflector Voltage	—400 volts D.C.
Resonator Current	40 mAdc
Heater-Cathode Voltage	±50 volts

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Weight:* 4.3 ounces.
- *Base:* Small wafer octal 8 pin, B8-21, low loss phenolic.
- *Coupling to Wave Guide:* Direct. Fastens to UG-599/U or UG-600/U flange.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Copper.
- *Bulb:* Metal.
- *Output Window:* Low Loss Glass.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

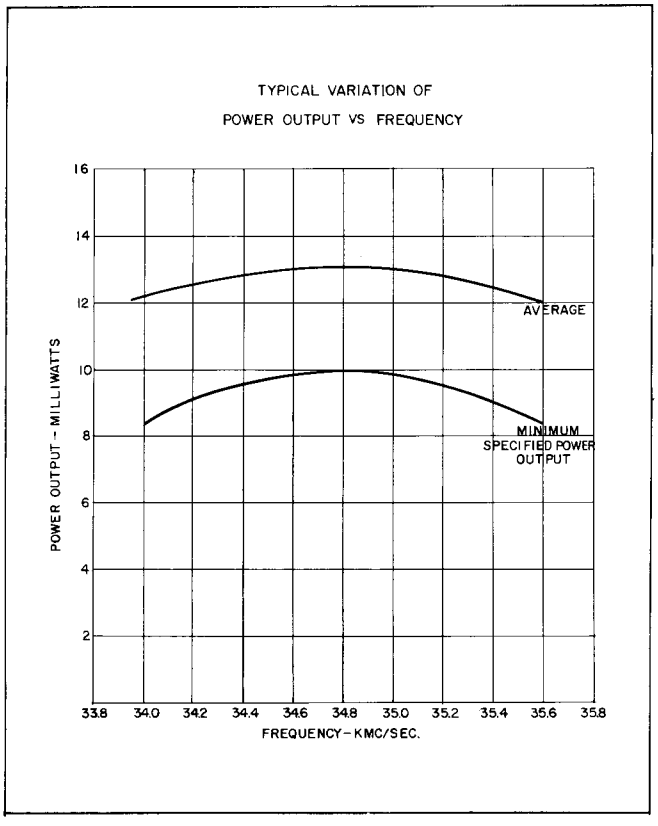
Publication No. R01-12

Printed in U.S.A.

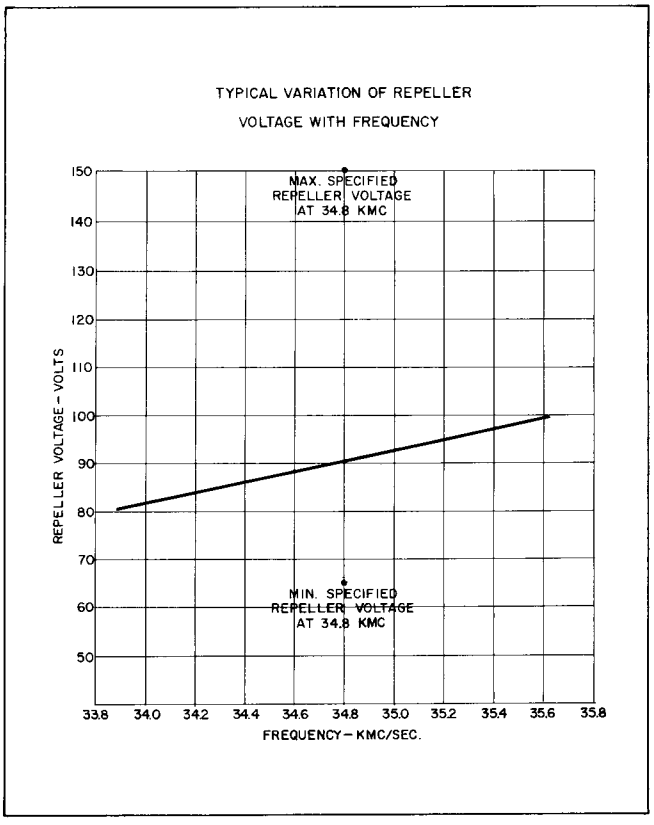
REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-53
(Retrofit for Type SRV-38)

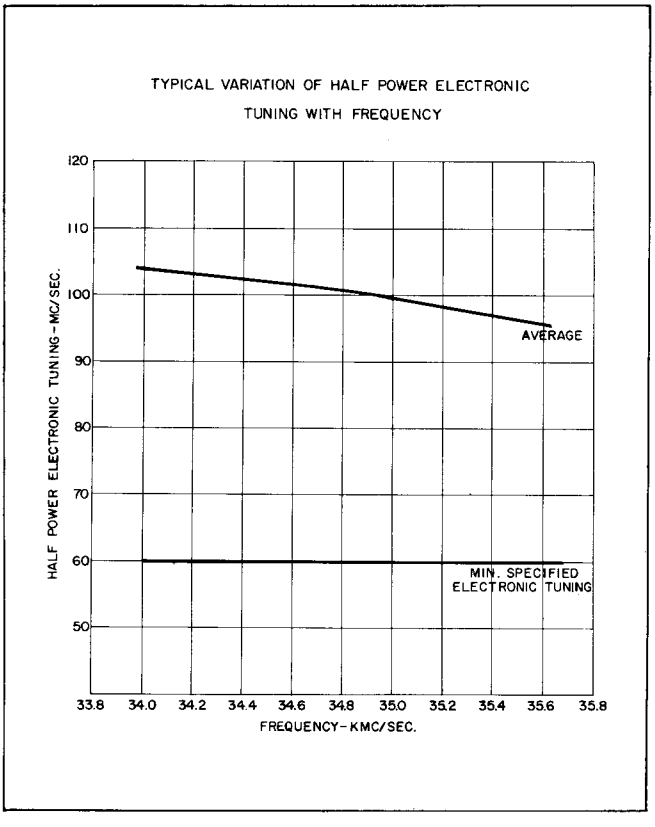
AVERAGE CHARACTERISTICS



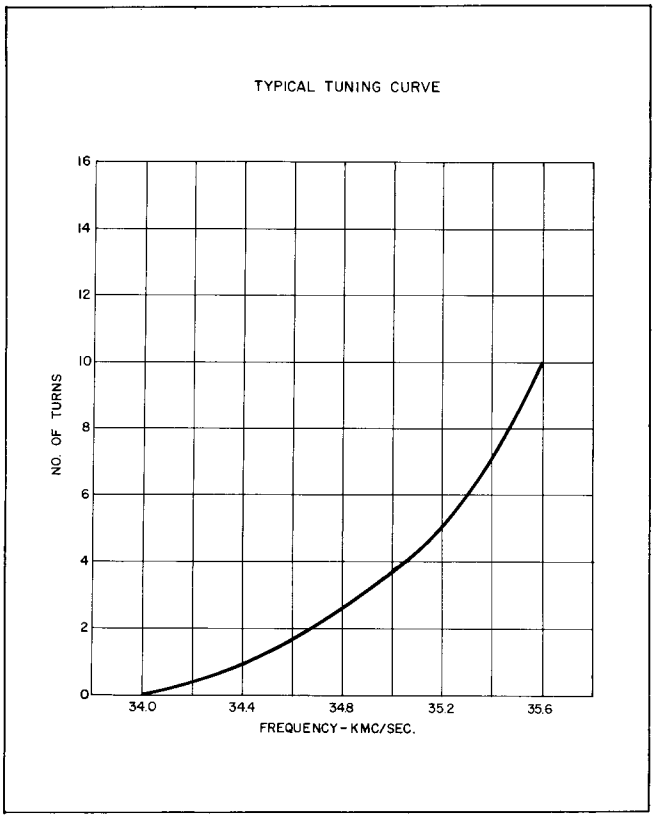
POWER OUTPUT VS. FREQUENCY



REFLECTOR VOLTAGE VS. FREQUENCY



ELECTRONIC TUNING VS. FREQUENCY



TUNER TURNS VS. FREQUENCY

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-53
(Retrofit for Type SRV-38)

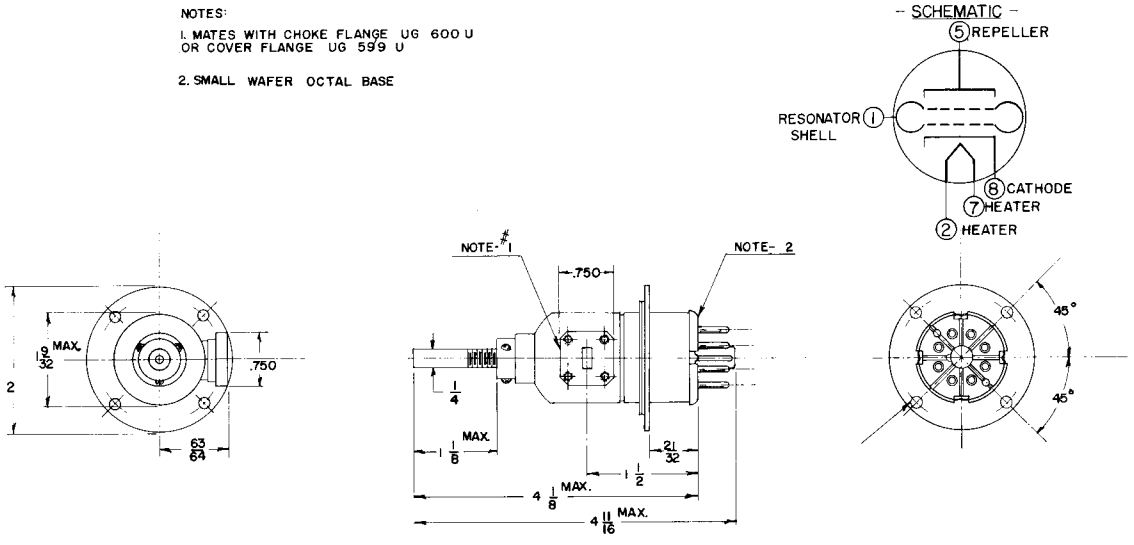
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Leakage Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Gas Current	Er = −150 Vdc	Ir	—	5.0	μAdc
Resonator Current	Er = −75 to −260 Vdc Tube in non oscillating state	Ik	—	60	mAdc
Mechanical Tuning Range	Er/max Po	F	34,000	35,600	Mc
Power Output (1)	Test Conditions	Po	10.0	—	mW
Power Output (2)	Er/max Po; F = 34,000 ± 0.3% Mc; F = 35,600 ± 0.3% Mc	Po	8.5	—	mW
Reflector Voltage	Test Conditions; Er/max Po	Er	−75	−260	Vdc
Electronic Tuning	Er/50% max Po		60	—	Mc
Emission	Ef = 5.8 v	△Ik/Ik	—	10	%
Bump	Test Conditions; Er/max Po	△Po/Po	—	10	%
DESIGN TESTS:					
Electrode Insulation	400 Vdc, tube cold	Rk-rs	2.0	—	Megohms
Heater Current	Test Conditions	If	0.54	0.66	Amps
Insulation	Ehk = ±45 Vdc	Ihk	—	100	μAdc
Hysteresis	Test Conditions		—	5	%

GENERAL TEST CONDITIONS:

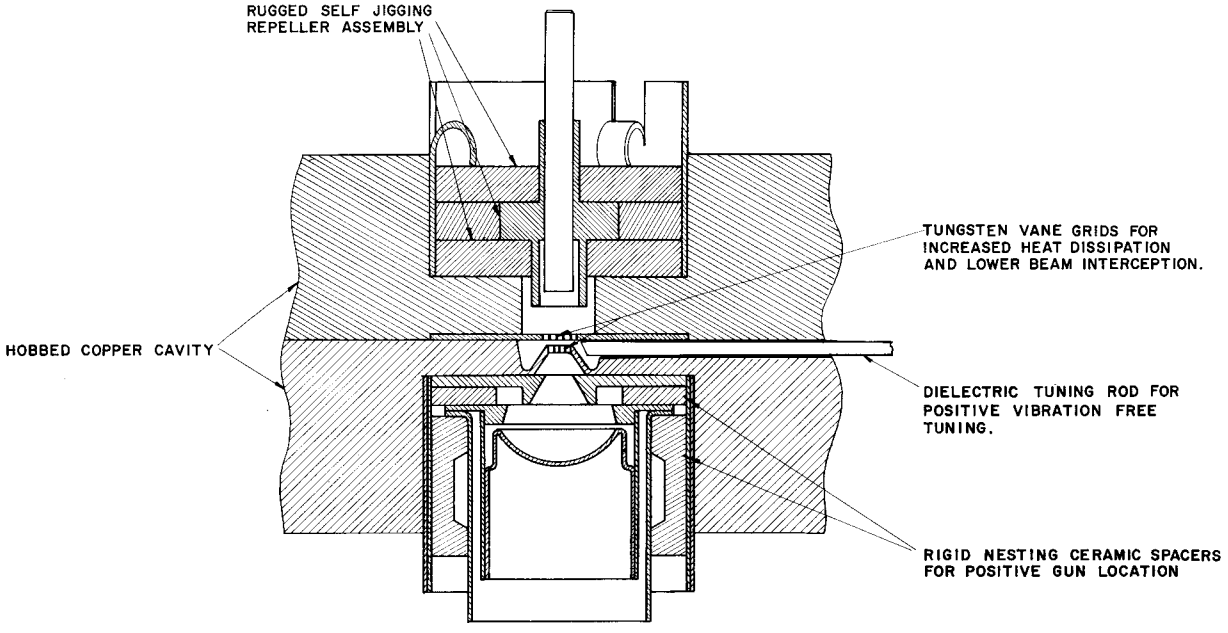
Ef	Eres	Er	F
6.3 volts	+400 Vdc	Adjust −60 to −300 Vdc	34,800 ± 0.3% Mc



OUTLINE DRAWING

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-53
(Retrofit for Type SRV-38)



STRUCTURAL FEATURES OF THE TK-53

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 17 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

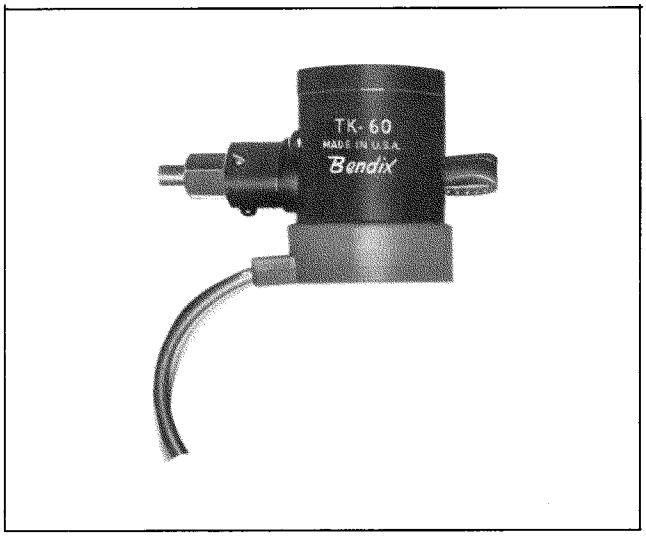
Bendix Type TK-60

REFLEX KLYSTRON

(MECHANICALLY TUNED)

DESCRIPTION

The Bendix® Type TK-60 reflex klystron is a ruggedized, low voltage, mechanically tuned K-band reflex oscillator designed for use as a CW power source over the frequency range of 23.25 KMC/sec. to 24.75 KMC/sec. This tube incorporates an improved method of tuning the cavity resonator which permits the achievement of a relatively flat power output and electronic tuning characteristic with variation of the operating frequency. Unlike the conventional capacitive type tuners wherein the interaction gap spacing of the resonant cavity is varied to control the operating frequency, the interaction gap of the type TK-60 is fixed at optimum spacing. Tuning is accomplished by moving a dielectric rod into the electric field surrounding the interaction gap. The tuner rod is moved by a spring loaded differential screw acting through bellows in the wall of the vacuum envelope. This screw is designed to receive an allen wrench for tuning purposes and can be locked in position with an external lock nut. Since a flexible diaphragm is no longer necessary as a cavity wall for tuning purposes, the cavity is designed as a rigid structure-which is stable under acceleration, shock, and vibration environments. The electron gun and repeller structures are mounted rigidly on ceramics in order to ruggedize these assemblies and to eliminate the use of all mica insulators which are subject to decomposition and flaking under severe environmental conditions. The output coupling is accomplished by means of an internal tapered section of waveguide which couples radio frequency energy from the cavity resonator through a non-resonant iris. This waveguide section tapers in the narrow dimension only from the iris to a terminating choke abutting a circular low loss glass output window. The output fitting of the tube is designed to match and fasten directly to a standard UG-596/U waveguide choke flange. The bulb is of steel construction and hence provides protection from external magnetic fields for the internal electron optics structure.



APPLICATION NOTES

Insulation The bulb of the TK-60 is designed to operate at resonator voltage potential hence requiring a resonator voltage supply having its positive polarity grounded when the tube is to be mounted directly on the waveguide flange. If the desired application requires that the tube shall be operated above ground or "hot" with respect to ground, the tube and the waveguide flange may be insulated by means of a mica sheet and four insulating bushings between the mounting screws, tube and waveguide flange.

Cooling The maximum bulb temperature should not exceed 130°C in applications where long tube life is important. At room temperature without a tube enclosure no forced cooling is required. If the tube is to be operated in an enclosure, care should be taken to insure that adequate cooling is provided in order that the maximum bulb temperature is not exceeded since impairment of tube life may result.

Environment The type TK-60 has been designed to provide stable frequency and power output under severe acceleration, shock, and vibration environments. Under constant acceleration up to 50G, impact shocks of 5 milliseconds duration to 100G, and vibration environments at 10 to 1200 cycles/sec. with accelerations of 3 to 10G, the tube displays maximum variations in power output of 10%, maximum frequency modulation of 2 Mc/sec., and maximum frequency variations of 5 Mc/sec.

Output Load The tube has been designed for operation into a matched waveguide load. When operation into a reactive load is necessary, adequate attenuation should be inserted in the load circuit between the tube and the load to limit the voltage standing wave ratio at the tube to a value less than 2 to 1 in order to prevent impairment of tube performance.

Repeller Modes The tube should be operated in the repeller voltage mode defined in this data sheet. However, modes do exist at lower repeller voltages than that specified which should be considered when the design of AFC circuits is undertaken to prevent lock-in on one of these lower modes. The TK-60 has been designd to provide a minimum mode separation of 40 volts between the operating repeller voltage mode and the next lower mode.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Filament Voltage	6.3 ± 8% volts
Resonator Voltage	330 volts D.C.
Reflector Voltage	−300 volts D.C.
Resonator Current	30 mAdc
Heater-Cathode Voltage	± 45 volts

PHYSICAL CHARACTERISTICS

- *Dimensions*: Refer to the outline drawing.
- *Weight*: 4.3 ounces.
- *Base*: Molded Silastic Boot with Flying Leads.
- *Coupling to Wave Guide*: Direct. Fastens to UG-596/U choke flange.
- *Cooling*: Convection.
- *Mounting Position*: Any.
- *Cavity*: Silver Plated Steel.
- *Bulb*: Metal.
- *Output Window*: Low Loss Glass.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

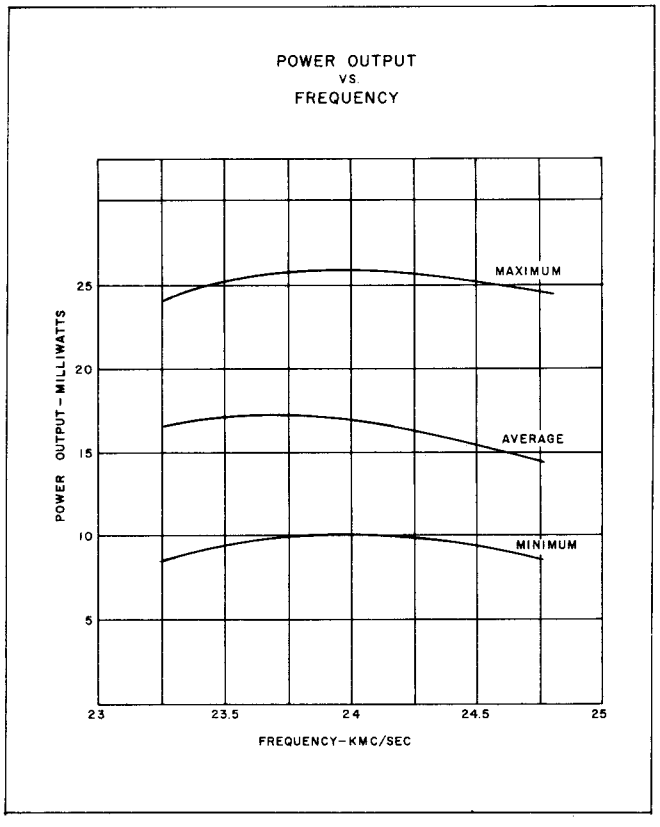
Publication No. R811-21

Printed in U.S.A.

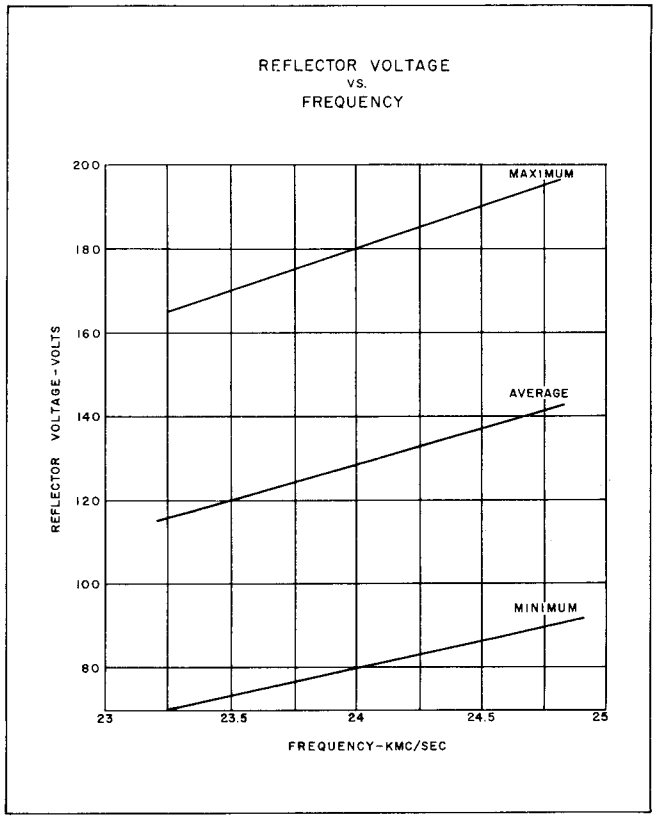
REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-60

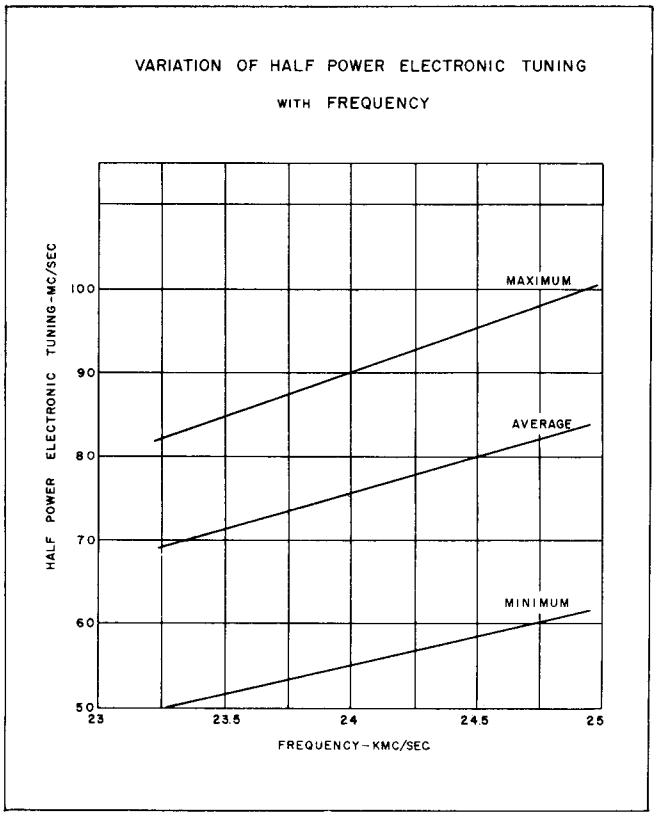
AVERAGE CHARACTERISTICS



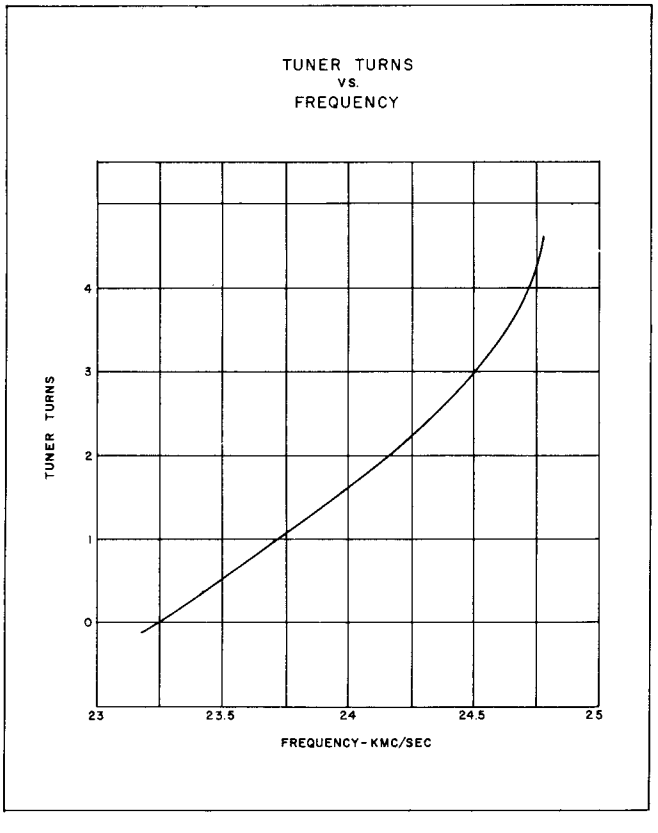
POWER OUTPUT VS. FREQUENCY



REFLECTOR VOLTAGE VS. FREQUENCY



ELECTRONIC TUNING VS. FREQUENCY



TUNER TURNS VS. FREQUENCY

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-60

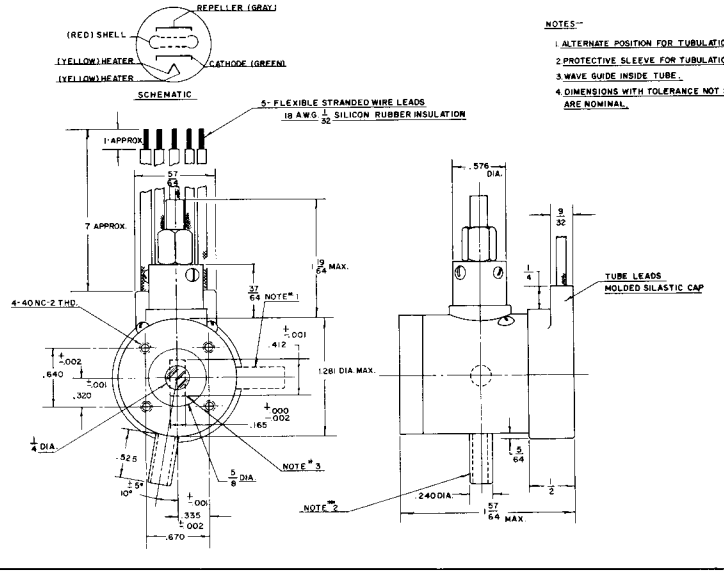
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current	Er = −100 Vdc	Ir	—	7.0	μAdc
Reflector Leakage Current	Er = −100 Vdc		—	5.0	μAdc
Reflector Gas Current	Er = −100 Vdc		—	2.0	μAdc
Resonator Current	Test Conditions; Er = −100 Vdc	Irs	—	30	mAdc
Mechanical Tuning Range	Er/max Po	F	23250	24750	Mc
Power Output (1)	Test Conditions	Po	10	—	mW
Power Output (2)	Er/max Po; F = 23250 ± .3%; F = 24750 ± .3%	Po	8.5		mW
Reflector Voltage	Test Conditions; Er/max Po	Er	−80	−180	Vdc
Electronic Tuning (1)	Test Conditions; Er/50% max Po		55		Mc
Emission	Ef = 5.8 v	△Ik/Ik		15	%
Hysteresis	Test Conditions; Er/max Po	Ratio		5	%
DESIGN TESTS:					
Insulation	Ehk = ±45 Vdc	Ihk		100	μAdc
Heater Current	Test Conditions	If	700	800	mA
Bump	Test Conditions; Er/max Po	△Po/Po		0.10	
Electronic Tuning (2)	F = 23250 ± .3%; F = 24750 ± .3%; Er/50% max Po		55		Mc
Modulation Sensitivity Resonator	Test Conditions; △Ers = 20 Vac	△f/△Ers	1.0	1.6	Mc/v
Modulation Sensitivity Repeller	Test Conditions; △Erp = ±3 v	△f/△Erp	2.0	4.0	Mc/v
Life Test	Test Conditions	t	500		hrs
Life Test End Points	Test Conditions	Po	8		mW

GENERAL TEST CONDITIONS:

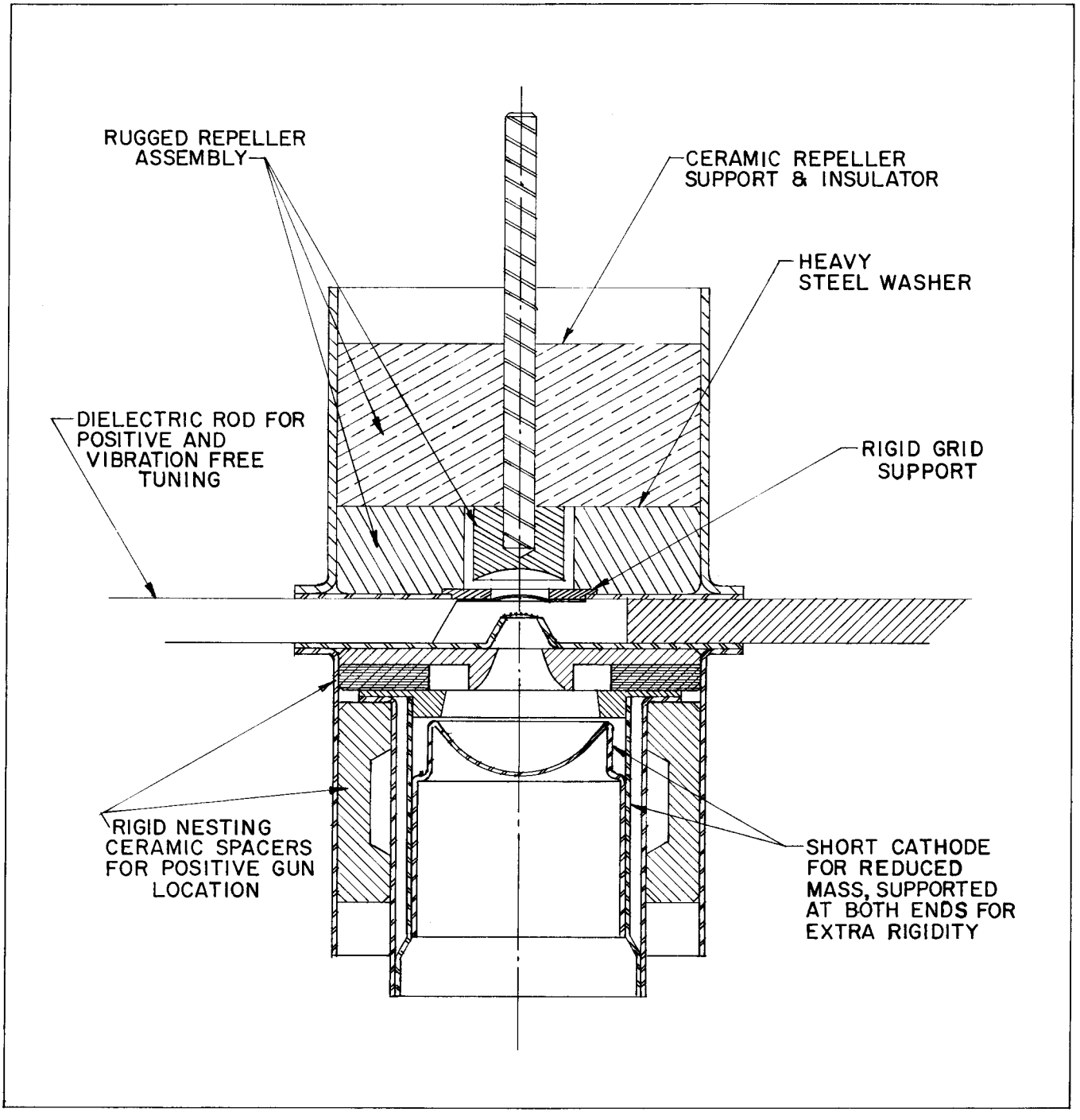
Ef	Eres	Er	F
6.3 volts	+300 Vdc	Adjust	24000 ± 0.3% Mc



OUTLINE DRAWING

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-60



STRUCTURAL FEATURES OF THE TK-60

THE Bendix CORPORATION

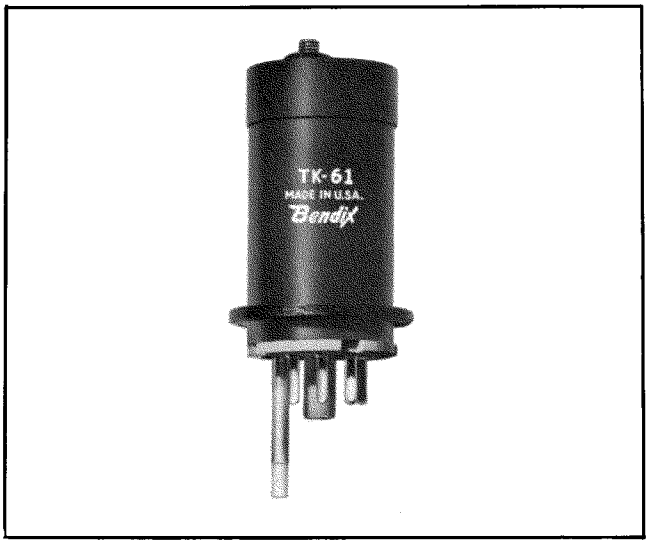
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 17 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix Type TK-61

REFLEX KLYSTRON

(MECHANICALLY TUNED)



PHYSICAL CHARACTERISTICS

- *Base:* Small octal 8-pin, B8-21, Low Loss Phenolic Wafer, Modified for coaxial output lead as shown on outline drawing.
- *Coupling to Wave Guide:* Coaxial output fits standard transducer per 227-JAN.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Integral with tube.
- *Bulb:* Metal.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	350 volts D.C.
Reflector Voltage	—350 volts D.C.
Filament Voltage	6.3 ±8% volts
Gun Cathode Current	32 ma. D.C.
Heater-Cathode Voltage	±100 volts D.C.

DESCRIPTION

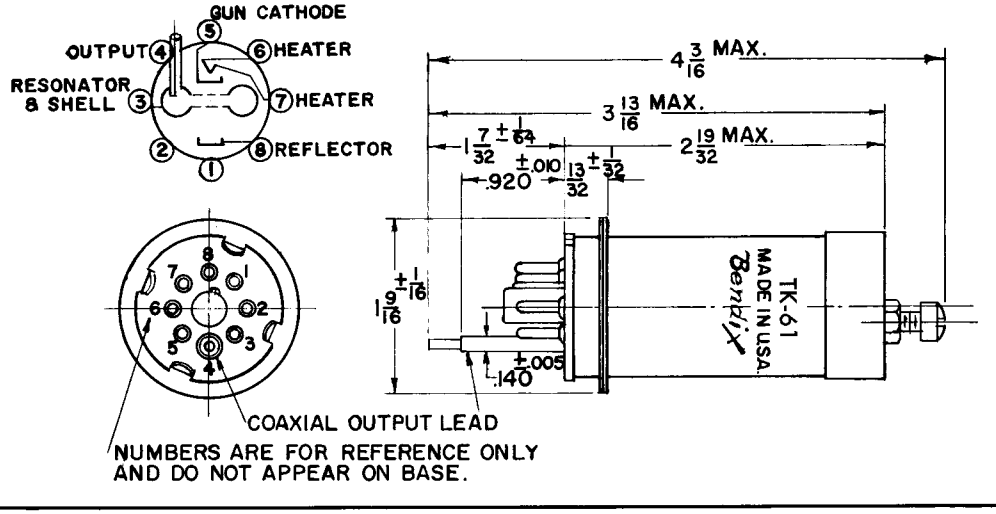
The Bendix® Type TK-61 Tube is a ruggedized, low voltage, reflex oscillator designed for use as a CW power source at a frequency of 10,525 ±25 Mc./sec. A trimming screw for limited frequency adjustment is located at the top of the envelope. This screw is set and locked at the factory, but may be adjusted by the user for small frequency changes, should this be desired. The tube is ideally suited for application in speed control Doppler radar systems. The tube has relatively excellent frequency stability with respect to ambient temperature changes. In addition, the power output shows only minor variation when cavity tuning is changed throughout its assigned band.

The ruggedization feature of the tube permits it to be operated under severe vibration environments without sacrifice of frequency stability. Under vibration conditions of 10g acceleration at 50 cycles, the maximum frequency variation is ±1.3 Mc./sec.

The tube has coaxial output and is coupled to the waveguide circuit through a transducer identical to that used for type 2K45, 2K25, and 6116 klystrons. Details of this transducer are covered in Military Drawing Number 227-JAN.

TYPICAL OPERATING CONDITIONS

Frequency	10,525 Mc./sec. ±25 Mc./sec.
Resonator Voltage	300 volts D.C.
Reflector Voltage @ 10,525 Mc./sec.	—70 to —145 volts D.C.
Filament Voltage	6.3 ±8% volts
Gun Cathode Current	32 mA D.C. (max.)



THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R811-23

Printed in U.S.A.

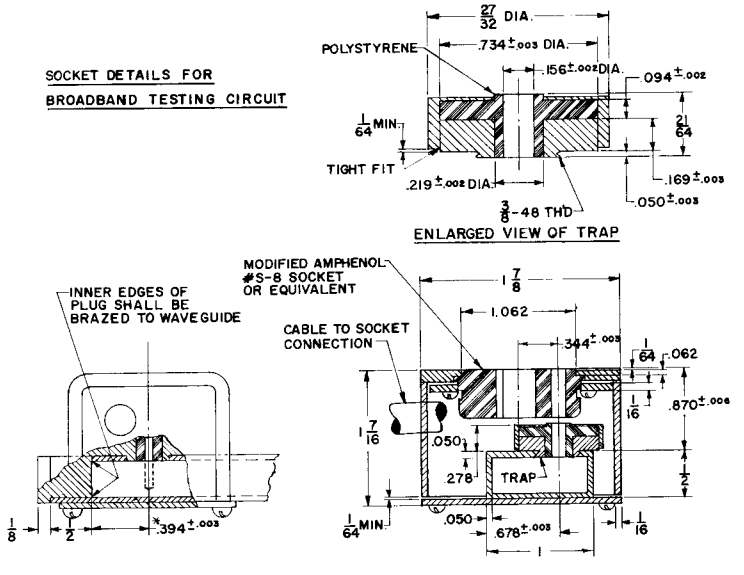
REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-61

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
PRODUCTION TESTS:					
Total Reflector Current:	Er = −150 Vdc t = 120 sec. (min)	Ir:	—	5.0	μAdc
Reflector Leakage:	Er = −150 Vdc	Ir:	—	3.0	μAdc
Reflector Gas Current:	Er = −150 Vdc	Ir:	—	2.0	μAdc
Cathode Current:	Er = −150 Vdc	Ik:	—	32	mAdc
Reflector Voltage:	Er Max. Po @ 10,525 ±0.3% Mc./sec.	Er:	−70	−130	Vdc
Mechanical Tuning Range:	Er Max. Po	Max. F: Min. F:	10,550 —	— 10,500	Mc Mc
Bump:	Ef = 5.8; Er Max. Po @ 10,525 ±0.3% Mc./sec.	△Po/Po:	—	0.15	
Emission:	Ef = 5.8; Er = −150 Vdc	△Ik/Ik:	—	0.15	
Vibration:	Er Max. Po at 10,525 Mc./sec. Total Displacement = 0.080" F = 50 cps, Position Y1 and X1	F:	—	±1300	Kc
Power Output:	Ef = 5.8; F 10,525 ±25 Mc./sec.	Po:	20	—	mW
DESIGN TESTS:					
Electrode Insulation:	300 Vdc Tube Cold	Rk-rs: RF-rs:	2.0 2.0	— —	Meg. Meg.
Heater Current:		If:	465	570	mA
Insulation:	Eh-K = ±45 Vdc	IhK:	—	100	μAdc
Electrical Tuning Range:	Er (Mode)/50% Max. Po: F 10,525 ±25 Mc./sec.	F:	35	—	Mc.

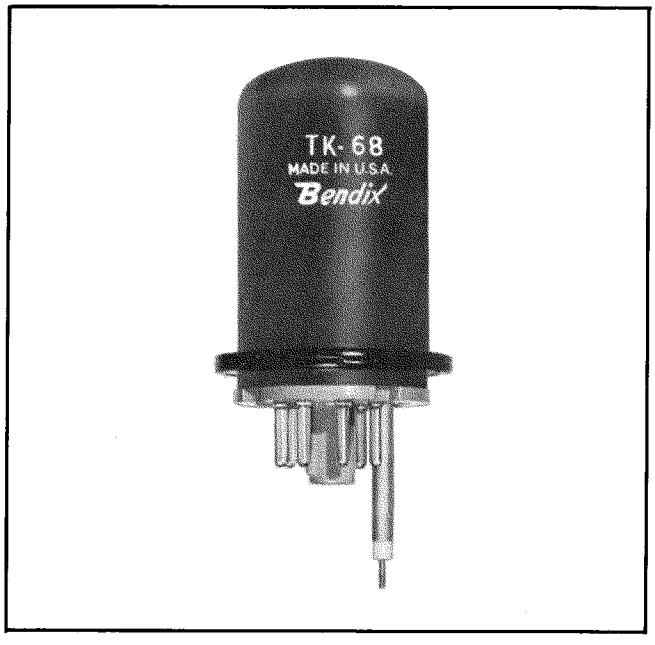


SOCKET DETAIL

Bendix Type TK-68
(Tentative Data)

REFLEX KLYSTRON

(THERMALLY TUNED)



DESCRIPTION

The Bendix® Type TK-68 Tube is a thermally tuned C band reflex oscillator. It is of the same ruggedized construction as the Bendix 6116/TK-62 The tube is designed for use as a CW power source, over the frequency range of 5120 Mc./sec. to 5430 Mc./sec. Thermal tuning of the klystron is accomplished by means of a diode included within the vacuum envelope, the plate of which comprises one wall of the klystron cavity. Increasing diode voltage, and hence current, causes the plate of the diode to expand thus changing the gap spacing of the klystron; which in turn tunes the tube over the desired frequency range.

Output coupling is accomplished by means of a coaxial output lead. The output line may be coupled into a coaxial system or directly into a waveguide mount by means of the typical adaptor assembly used by the Bendix Types TK-38 and 6584/TK-69.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Resonator Voltage	330 volts D.C.
Reflector Voltage	—400 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	35 ma. D.C.
Diode Voltage	—330 volts D.C.
Diode Plate Dissipation	*see note below

*Note: Power inputs as high as 16.5 watts may be applied to the diode when the frequency of the klystron is above 5430. Tuner Power in excess of 10 watts may permanently damage the tuning structure, if applied when the tube is tuned below 5120 Mc.

PHYSICAL CHARACTERISTICS

- *Base:* Small octal 8-pin, B8-21, Low Loss Phenolic Wafer, Modified for coaxial output lead as shown on outline drawing.
- *Dimensions:* Refer to the outline drawing.
- *Output Coupling:* Coaxial.
- *Mounting Position:* Any.
- *Bulb:* Metal.
- *Cavity:* Integral with tube.
- *Cooling:* Convection.

TYPICAL OPERATING CONDITIONS

Frequency	5120 to 5430 Mc./sec.
Resonator Voltage	300 volts D.C.
Reflector Voltage	—80 to —160 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	32 mA D.C. (max.)
Tuner Diode Current	5 to 36 ma (D.C.)
Tuner Diode Voltage	170 to 275 volts D.C.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. 811-22

Printed in U.S.A.

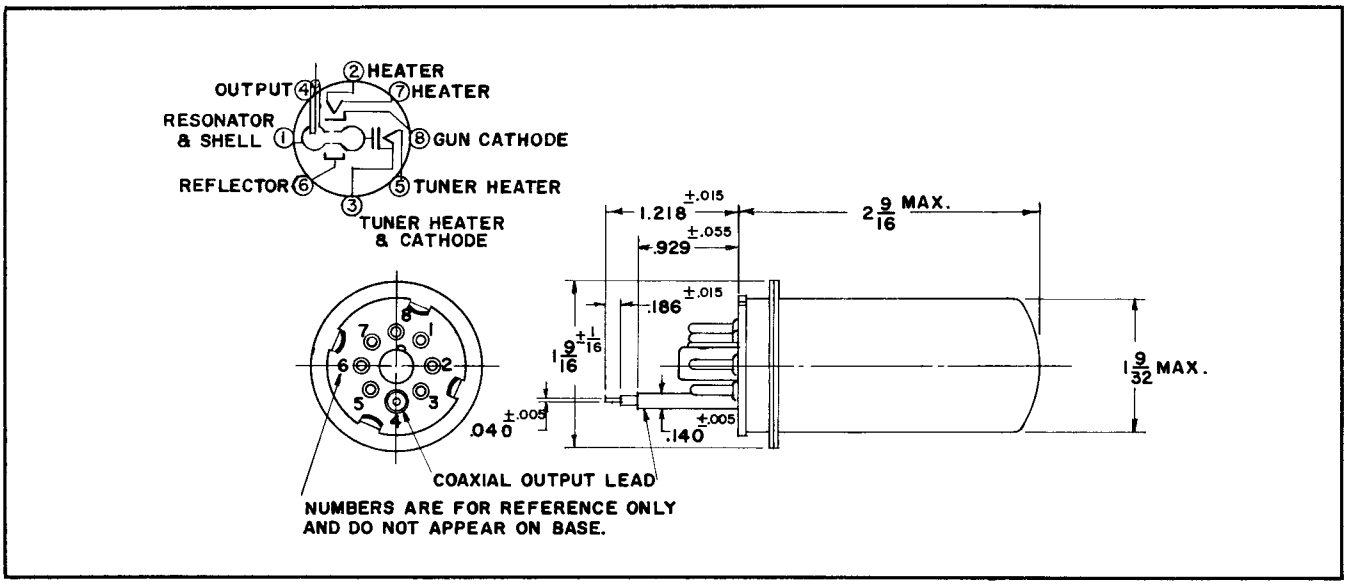
REFLEX KLYSTRON
(THERMALLY TUNED)

Bendix Type TK-68

ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current:	Er = −250 Vdc, 2 min.	Ir:	—	5.0	μA
Reflector Leakage Current:	Er = −250 Vdc	Ir:	—	3.0	μA
Reflector Gas Current:	Er = −250 Vdc	Ir:	—	2.0	μA
Cathode 1 Current:	Er/Max. Po	Ik1:	—	32	mAdc
Reflector Voltage:	Er/Max. Po	Er:	−80	−160	Vdc
Thermal Tuning Range:	Er/Max. Po				
	Thermal Tuning	Max. F:	5430	—	Mc
	Thermal Tuning	Min. F:	—	5120	Mc
Speed (1):	F = 5170 to 5370	t:	—	3.0	sec.
Speed (2):	F = 5370 to 5170	t:	—	2.5	sec.
Power Output:	Er/Max. Po; F = 5120 to 5430	Po:	80	—	mW
Emission:	Ef = 5.8	Ik1/Ik1:	—	.15	
DESIGN TESTS:					
Electrode Insulation:	300 Vdc Tube Cold	Rk1-rs:	2.0	—	Meg.
		Rk2-rs:	2.0	—	Meg.
		RF1-rs:	2.0	—	Meg.
Heater Current (1):		If1:	465	570	mA
Heater Current (2):		If2:	720	880	mA
Insulation:	Eh-K1 = ±100 Vdc	IhK1:	—	100	μAdc
Electronic Tuning:	Er/50% Max. Po	E.T.	30	—	Mc



OUTLINE DRAWING

Bendix® Type TK-78
(Generic Type SRV-38)

REFLEX KLYSTRON

(MECHANICALLY TUNED)

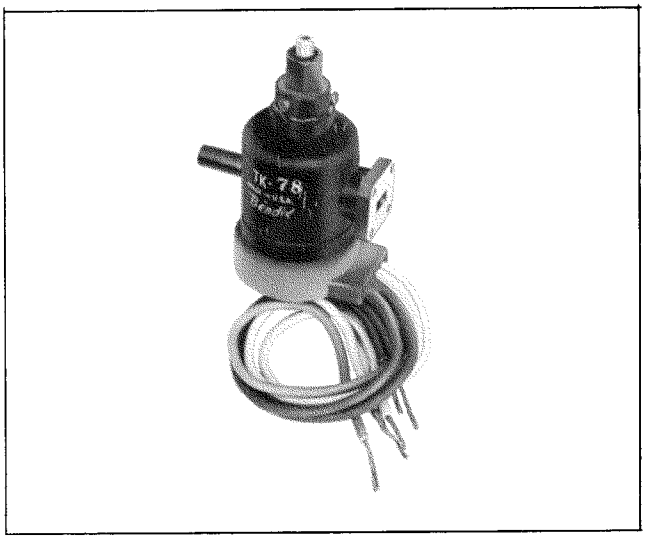
DESCRIPTION

The Bendix® Type TK-78 is a ruggedized, low voltage, mechanically tuned Ka band reflex oscillator designed for use as a CW power source over a frequency range of 34.0 to 35.6 Kmc/sec. This tube incorporates a unique method of tuning the cavity resonator which permits the achievement of a relatively flat power output and electronic tuning characteristic with variation of the operating frequency. Unlike the conventional capacitive type tuners wherein the interaction gap spacing of the resonant cavity is varied to control the operating frequency, the interaction gap of the TK-78 is fixed at optimum spacing. Tuning is accomplished by moving a dielectric rod into the electric field surrounding the interaction gap. The tuner rod is moved by a spring loaded differential screw acting through a bellows in the wall of the vacuum envelope. This screw is designed to receive an allen wrench for tuning purposes. Since a flexible diaphragm is no longer necessary as a cavity wall for tuning purposes, the cavity is designed as a rigid structure. The electron gun and repeller structures are mounted rigidly on ceramics in order to ruggedize these assemblies and to eliminate the use of all mica insulators which are subject to decomposition and flaking under some environmental conditions. The output coupling is accomplished by means of an internal tapered section of waveguide which couples radio frequency energy from the cavity resonator through a non-resonant iris. This waveguide section tapers in the narrow dimension only from the iris to a terminating choke abutting a circular low loss glass output window. The output fitting of the tube is designed to match and fasten directly to a standard UG-599/U or UG-600/U waveguide flange. The bulb is of steel construction and hence provides protection from external magnetic fields for the internal electron optics structure.

APPLICATION NOTES

Insulation The bulb of the TK-78 is designed to operate at resonator voltage potential hence requiring a resonator voltage supply having its positive polarity grounded when the tube is to be mounted directly on the waveguide flange. If the desired application requires that the tube shall be operated above ground or "hot" with respect to ground, the tube and the waveguide flange may be insulated by means of a mica sheet and four insulating bushings between the mounting screws, tube and waveguide flange.

Cooling At room temperature without a tube enclosure no forced cooling is required. If the tube is to be operated in an enclosure, care should be taken to insure that adequate cooling is provided in order that the bulb temperature does not become excessive since impairment of tube life may result.



Output Load The tube has been designed for operation into a matched waveguide load. When operation into a reactive load is necessary, adequate attenuation should be inserted in the load circuit between the tube and the load to limit the voltage standing wave ratio at the tube in order to prevent impairment of tube performance.

Repeller Modes The tube should be operated in the repeller voltage mode defined in this data sheet. However, modes do exist at other repeller voltages than that specified which should be considered when the design of AFC circuits is undertaken to prevent lock-in on one of these other modes.

MAXIMUM RATINGS

(ABSOLUTE VALUES)

Filament Voltage	6.3 ± 8% volts
Resonator Voltage	425 volts D.C.
Reflector Voltage	—400 volts D.C.
Resonator Current	40 mAdc
Heater-Cathode Voltage	±50 volts

PHYSICAL CHARACTERISTICS

- *Dimensions:* Refer to the outline drawing.
- *Weight:* 4.3 ounces.
- Molded Rubber Boot and flexible leads.
- *Coupling to Wave Guide:* Direct. Fastens to UG-599/U or UG-600/U flange.
- *Cooling:* Convection.
- *Mounting Position:* Any.
- *Cavity:* Copper.
- *Bulb:* Metal.
- *Output Window:* Low Loss Glass.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

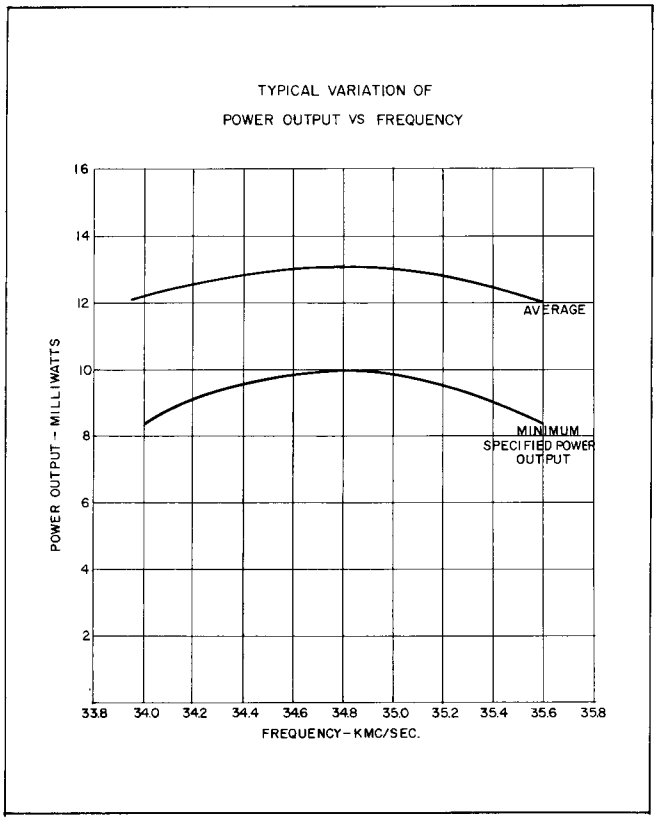
Publication No. RO1-13

Printed in U.S.A.

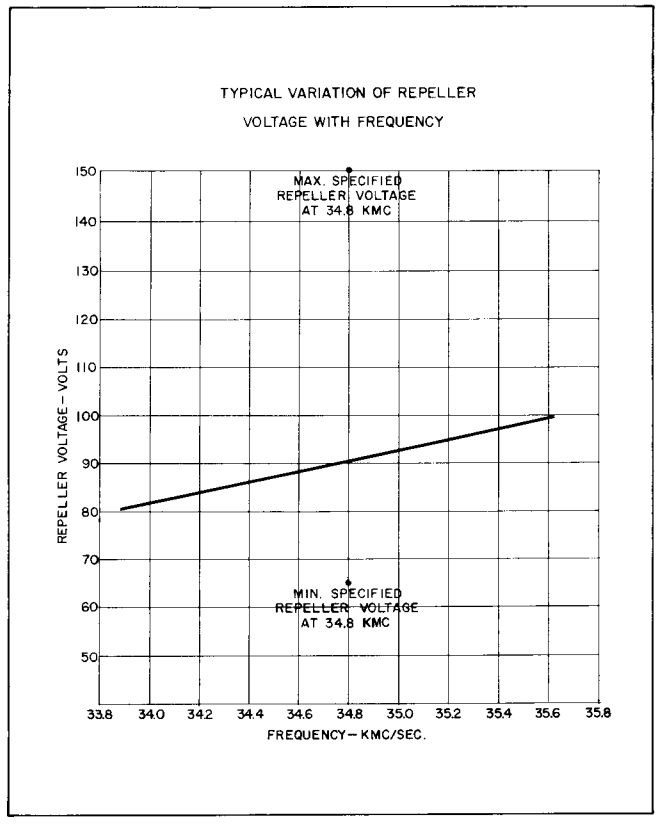
REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-78
(Generic Type SRV-38)

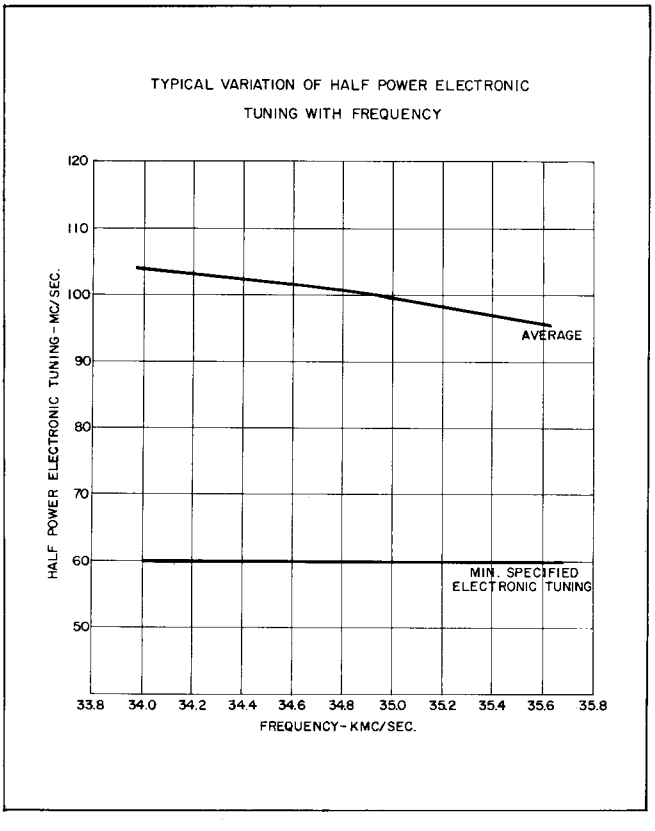
AVERAGE CHARACTERISTICS



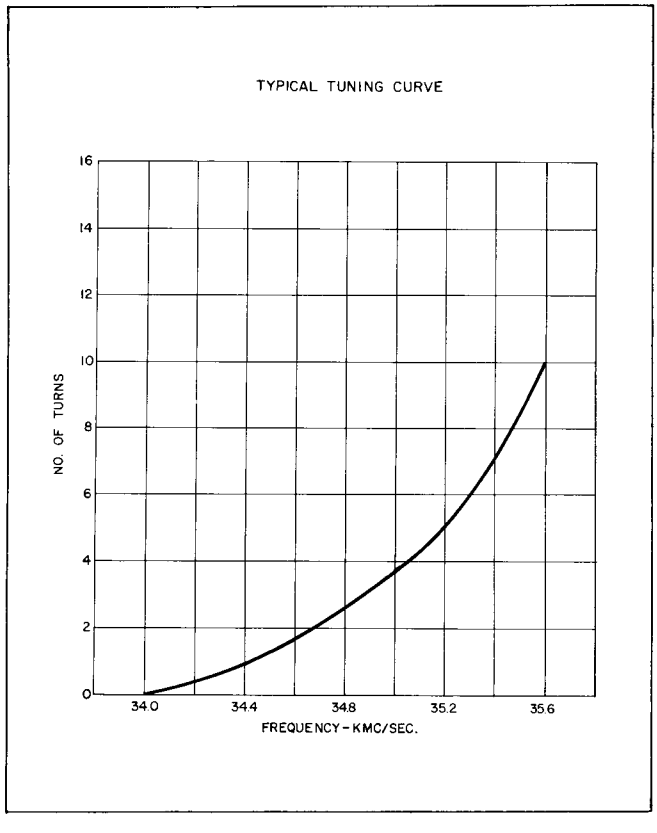
POWER OUTPUT VS. FREQUENCY



REFLECTOR VOLTAGE VS. FREQUENCY



ELECTRONIC TUNING VS. FREQUENCY



TUNER TURNS VS. FREQUENCY

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-78
(Generic Type SRV-38)

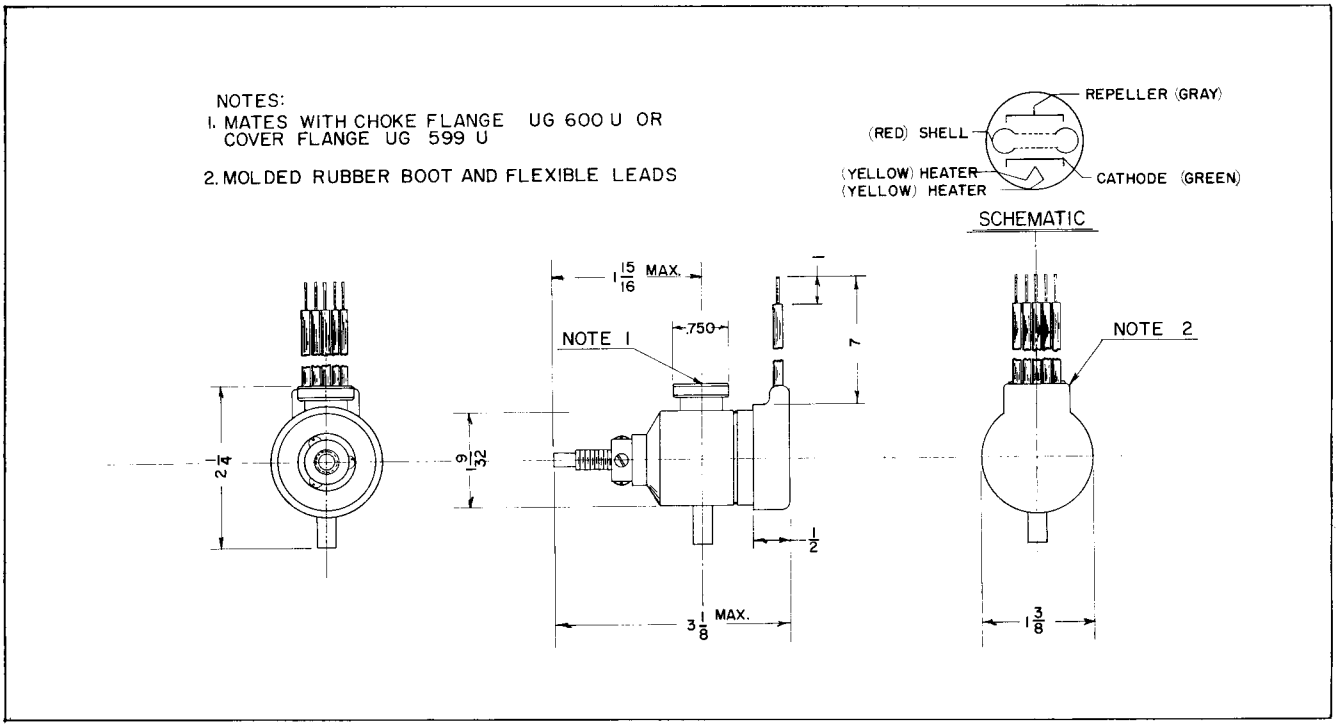
ELECTRICAL CHARACTERISTICS & TEST CONDITIONS

Test Conditions and Specification Limits

TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
			MIN.	MAX.	
PRODUCTION TESTS:					
Total Reflector Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Leakage Current	Er = −150 Vdc	Ir	—	10.0	μAdc
Reflector Gas Current	Er = −150 Vdc	Ir	—	5.0	μAdc
Resonator Current	Er = −75 to −260 Vdc Tube in non oscillating state	Ik	—	60	mAdc
Mechanical Tuning Range	Er/max Po	F	34,000	35,600	Mc
Power Output (1)	Test Conditions	Po	10.0	—	mW
Power Output (2)	Er/max Po; F = 34,000 ± 0.3% Mc; F = 35,600 ± 0.3% Mc	Po	8.5	—	mW
Reflector Voltage	Test Conditions; Er/max Po	Er	−75	−260	Vdc
Electronic Tuning	Er/50% max Po		60	—	Mc
Emission	Ef = 5.8 v	△Ik/Ik	—	10	%
Bump	Test Conditions; Er/max Po	△Po/Po	—	10	%
DESIGN TESTS:					
Electrode Insulation	400 Vdc, tube cold	Rk-rs	2.0	—	Megohms
Heater Current	Test Conditions	If	0.54	0.66	Amps
Insulation	Ehk = ±45 Vdc	Ihk	—	100	μAdc
Hysteresis	Test Conditions		—	5	%

GENERAL TEST CONDITIONS:

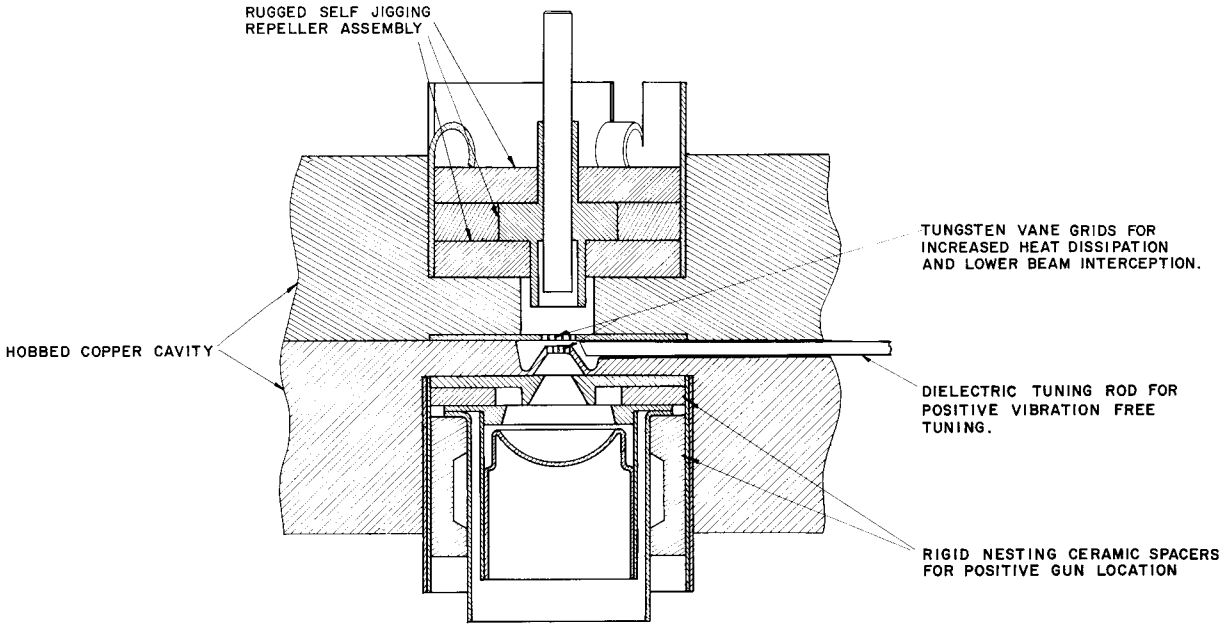
Ef	Eres	Er	F
6.3 volts	+400 Vdc	Adjust −60 to −300 Vdc	34,800 ± 0.3% Mc



OUTLINE DRAWING

REFLEX KLYSTRON
(MECHANICALLY TUNED)

Bendix Type TK-78
(Generic Type SRV-38)



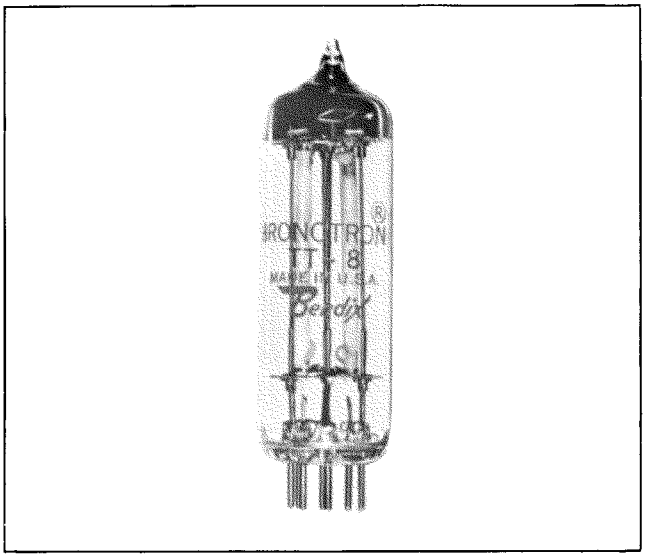
STRUCTURAL FEATURES OF THE TK-78

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

West Coast Sales & Service: 17 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division,
205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Computing Devices of Canada, Ltd., P.O. Box 508,
Ottawa 4, Ontario

Bendix Types { TT-8*, TT-9, TT-13
TT-15, TT-17, TT-18
TT-20, TT-21, TT-22

CHRONOTRONS



DESCRIPTION

These tubes are designed for use in electronic control circuits to provide a time delay in a manner similar to an integrating device. They are temperature-resistance devices with two heaters and two secondaries mounted in a miniature-size vacuum tube. The secondaries are resistance windings used in a balanced bridge circuit. A variation in one heater current changes the temperature of the corresponding secondary resistance winding. A temperature change will cause the secondary wire which has a positive temperature coefficient of resistivity to unbalance the secondary bridge giving rise to an output voltage. After a heater is energized, the rate of increase in output voltage is determined by the time constant of the tube, which is the time required for the output voltage to reach 63% of its maximum value.

Time constants contained in the rating chart on the reverse side of this sheet have been compiled using the tube in a static bridge circuit. Other time constant readings may be obtained when using the tube in other types of circuits.

OPERATING CHARACTERISTICS

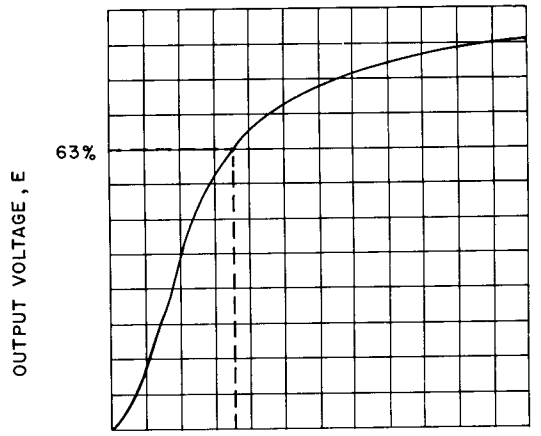
Since heaters and secondaries are electrically isolated, any type of heater voltage may be used, a-c, d-c, or any wave form. The secondary bridge may also be excited with a voltage of any desired wave form. If heater currents, for example, come from a vacuum tube amplifier and contain undesirable harmonics, the secondary bridge can be excited with a pure sine wave voltage resulting in an output voltage almost free from distortion or undesirable harmonics.

The working parts of the Chronotron have virtually an indefinite life. Enclosed in a sealed envelope they operate at moderate temperatures and have no electron emission.

PHYSICAL CHARACTERISTICS

Base	7 pin miniature
Bulb	T 5½
Max. overall length	2⅝ inch
Max. seated height	2⅜ inch
Max. diameter	¾ inch
Ambient temperature limit	−40° to +60°C.
Mounting position	vertical or horizontal

TYPICAL OUTPUT CHARACTERISTIC



NOTE: TIME CONSTANT OF EXPONENTIAL CURVE VARIES FOR EACH TYPE OF TUBE (SEE TUBE RATING CHART ON REVERSE SIDE)

*Illustrated.

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R 62-5 (Supersedes No. R54-27)

Printed in U.S.A.

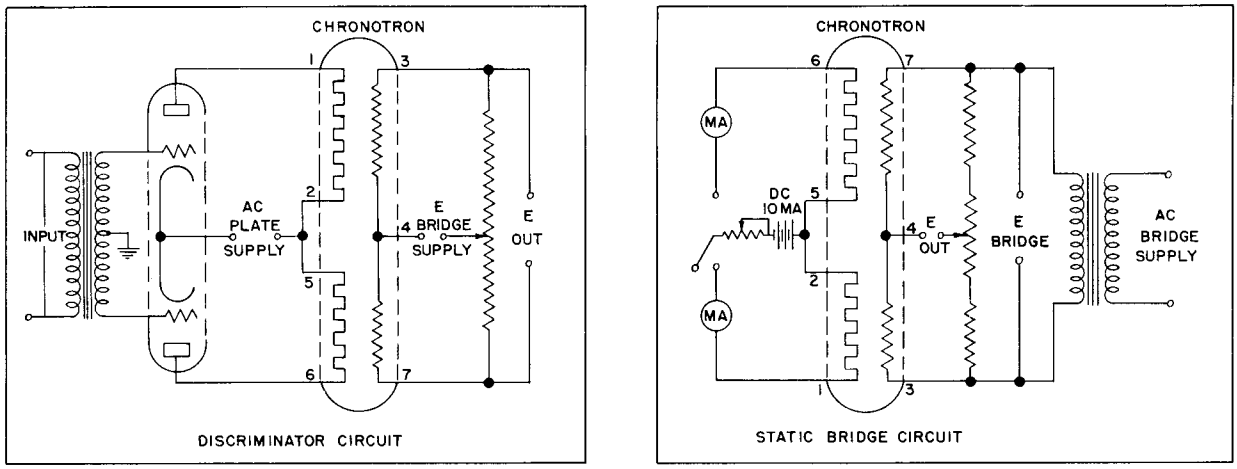
CHRONOTRONS

Bendix Types { TT-8*, TT-9, TT-13 / TT-15, TT-17, TT-18 / TT-20, TT-21, TT-22

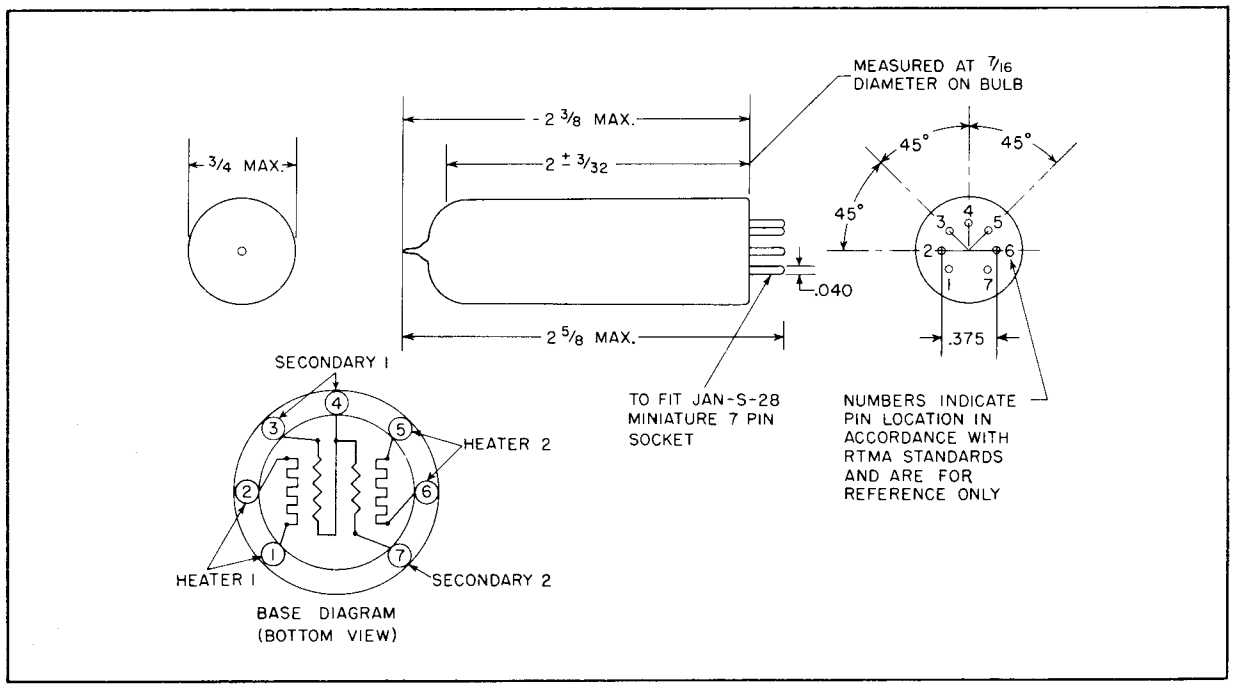
Red Bank Type Number	Heater Resistance Ohms	Secondary Resistance Ohms	Heater Input Ma.	Bridge Voltage	Bridge Output Volts	Time Constant Sec.
TT-8	1000	450	10	20	.080	10
TT-9	300	125	10	10	.150	19
TT-13	500	265	10	20	.050	15
TT-15	1000	500	10	20	.250	130
TT-17	2000	500	10	20	.250	2
TT-18	1000	500	10	20	.350	50
TT-20	2000	500	10	20	.100	18
TT-21	1000	500	10	20	.080	4
TT-22	1000	500	10	20	.050	22

RATING CHART

Chronotrons having other heater resistances, secondary resistances or time constants can be made on special order.

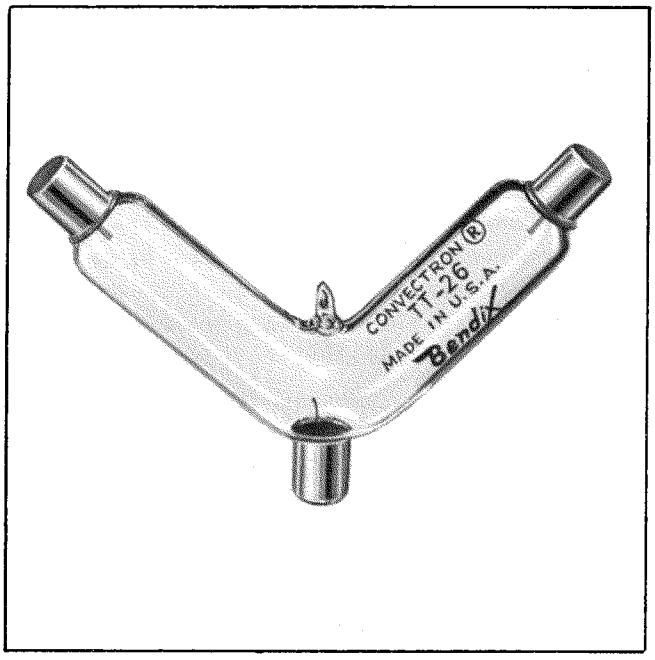


TYPICAL CIRCUIT APPLICATIONS



OUTLINE DRAWING

Y-TYPE D-C CONVECTRON



RATINGS

Nominal Supply Voltage	8 volts
Maximum Supply Voltage	10 volts
Nominal Sensitivity (within 1° of null)	10 Mv./Deg.
Time Constant	0.1 sec.

PHYSICAL CHARACTERISTICS

Connections	Small Cap RETMA C1-1
Dimensions	See outline drawing on reverse side

OPERATION DATA

Bridge Supply Voltage	Resistance per Arm
2 Volts	31 Ohms
4 Volts	41 Ohms
8 Volts	67 Ohms
12 Volts	95 Ohms

DESCRIPTION

In order to overcome the drawbacks inherent in other devices for determining a vertical reference, Bendix Red Bank has developed an electric device known as the Y-Type D-C Convectron which offers new possibilities as a vertical sensitive element. It is a non-emission type tube, operating on direct current, and is capable of giving an appreciable electrical signal relative to its position about the vertical. It consists of a sealed glass bulb with grid caps mounted at the end of each arm and at the base of the tube. The envelope is filled with a gas, such as argon, and contains a single nickel filament running centrally through each arm to a spring support in the base which serves as a center tap for the filament.

When the tube is used in a bridge circuit as illustrated, (see over), the filament carries sufficient current to heat it to an average temperature of about 400° C. This heat leaves the filament by (1) metallic conduction, (2) gaseous conduction, (3) radiation, and (4) gaseous convection. The percentage of heat leaving by the first three means is comparatively small, while that leaving by convection is large. Convection currents rise along the vertical and so pass the filament at whatever angle it happens to be relative to the vertical. The relative rate at which the filament loses its heat because of these convection currents, and consequently the filament temperature, depends on this angle.

Since the filament material is nickel which changes its resistivity with temperature, the bridge is thrown out of balance as the tube is moved from the vertical position. The vertical, or null position is any position where the two sensing elements form approximately equal angles with the vertical and produce a zero output signal. This condition is satisfied at each quadrant so the tube will have a sinusoidal output with rotation, the signal reversing polarity at null. This permits using the tube to control servo mechanisms or instruments because the signal has sense as to whether the displacement is to the right or to the left of null.

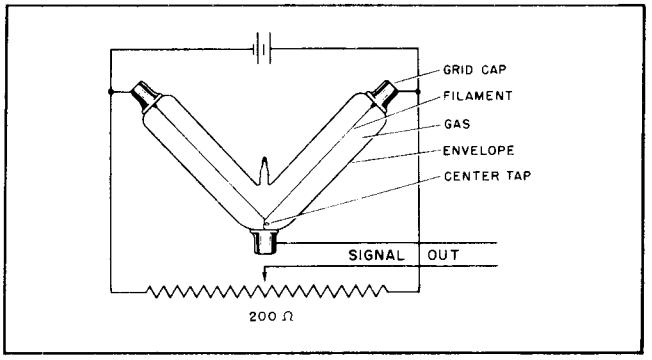
The Y-Type D-C Convectron overcomes the problems inherent in the old methods for obtaining vertical refer-

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R39-28

Printed in U.S.A.

ence. It has no moving parts and gives an electric signal directly without oscillation. The time constant of the tube is about 1/10 of a second. It draws less than 1 watt for a bridge supply voltage of 10 volts. The displacement signal is about 10 mv per degree at null. The noise level is zero. As the supply voltage to the bridge circuit is increased, the tube sensitivity is increased until the bridge supply voltage becomes about 8 volts. Further voltage increase may reduce sensitivity and null stability. With a bridge supply of 8 volts, a change of ± 5% in supply voltage will not cause the null to shift more than 1 millivolt.



TYPICAL BRIDGE CIRCUIT

It is possible to obtain a stronger signal by using two tubes to complete the bridge. However, this procedure is recommended only if the two tubes used are matched so as to provide the best results.

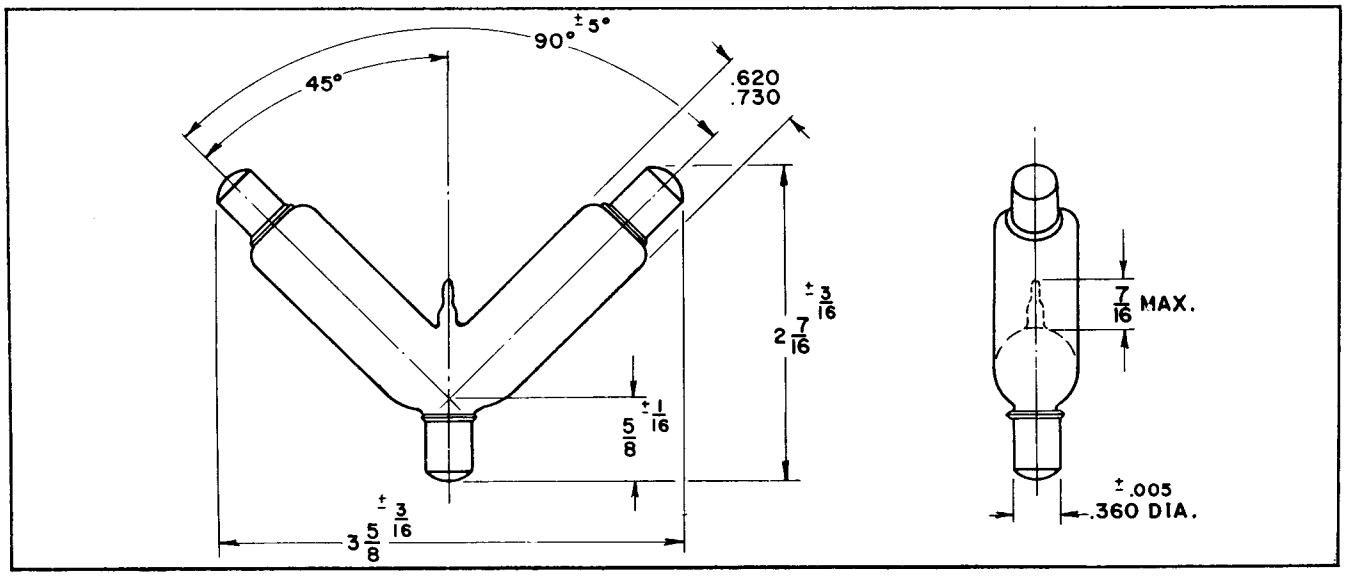
The null is affected by the ambient temperature and bridge supply voltage, and is likely to shift during an extended period of time. If suitable precautions are taken to prevent random air currents from striking the tube and to maintain close regulation of ambient temperature and supply voltage, a null shift of less than six minutes of arc may be expected during continuous operation.

Like the plumb line and liquid level, the convectron tube locates the accelerating forces acting upon it. For stationary installations this force is the force of gravity alone and, hence along the true vertical. When two different accelerating forces are acting on the tube, it will locate their vector component. If the plumb line, liquid level, or the convectron, for example, were spun in a centrifuge in a horizontal plane so that the centrifugal force was equal to the force of gravity, the vector component would be 45 degrees off the vertical and would be so located by each of these mechanisms. The Y-Type D-C Convectron does not replace the self-erecting gyroscope but can be used to monitor the gyroscope because its time constant is much less than that of the gyroscope. The difference between these two devices is made clear by considering the Y-Type Convectron as acting much like a short arm pendulum while the self-erecting gyroscope acts like an extremely long arm pendulum.

In addition to the operational differences already mentioned, the Y-Type Convectron is sensitive to changes in magnitude as well as direction of the acceleration. One of these tubes displaced 10 degrees from vertical, giving a signal of 50 mv under an accelerating force of 1 g, will give a signal of 80 mv under an accelerating force of 2 g.

During free fall the output signal from the convectron is zero because thermal convection currents no longer exist within the tube and, in the absence of thermal convection, the filament temperature is not affected by the position of the tube. (Under this condition other vertical indicating devices are inoperative as well.) But, should the tube be accelerated toward the earth faster than 32 feet/sec/sec, it will again become operative. In other words, the tube is sensitive to vertical forces because essentially it is an accelerometer.

The performance characteristics of these tubes make them adaptable to numerous applications in the instrument and industrial control fields.



OUTLINE DRAWING

SINGLE D-C CONVECTRON



RATINGS (2 UNITS AT 90°)

Nominal Supply Voltage	8 volts
Maximum Supply Voltage	10 volts
Nominal Sensitivity (within 1° of null)	10 Mv./Deg.
Time Constant	0.1 sec.

PHYSICAL CHARACTERISTICS

Connections	Small Cap RETMA C1-1
Overall length	3⅛" Nom.
Max. diameter, less tip	¾"

DESCRIPTION

The introduction of the Type-TT-27 Single Convectron Unit marks an important advance in the technique of determining and correcting deviations from a vertical reference position wholly by electronic means. This tube consists of a fine wire sensing element supported in a gaseous atmosphere within a glass envelope. Connections to the sensing element are made to external metal caps at both ends of the tube.

Two Type TT-27 tubes are required for the installation. These are mounted so that their axes form an angle of 90 degrees and they are connected electrically to form a bridge circuit as illustrated in the drawing on the reverse side of this sheet.

The filaments carry sufficient current to heat them to an average temperature of about 400° C. The heat leaves the filaments by (1) metal conduction (2) gas conduction (3) radiation and (4) gas convection. The percentage of heat leaving by the first three means is comparatively small, while that leaving by convection is large. Gas convection currents rise along the vertical and so pass the filament at whatever angle it happens to be relative to the vertical.

The relative rate at which each filament loses its heat to these convection currents and, consequently, the filament temperature, depends on this angle. Since the filament material is nickel which changes its electrical resistivity with temperature, the bridge is thrown out of balance as the tubes are moved from the vertical reference.

The vertical or null position is any position where the two sensing elements form equal angles with the vertical and produce electrical zero. This permits using the tubes to control servo mechanisms or instruments because the signal has sense as to whether the displacement is to the right or to the left of null.

With the axes of the tubes set at an angle of 90 degrees, a plot of the output voltage against angular deflection will approximate a sine wave. An increase in sensitivity can be obtained for the indication of small angles by decreasing the angle between the tubes to approximately 60 degrees.

A deviation in the indication from the true vertical may occur if the tube is accelerated or subjected to a magnetic field. The effect of the magnetic field may be reduced by magnetic shielding. Sometimes a slight shift in the null position occurs in the earlier convectron type. This shift in null position is minimized when a pair of TT-27 units are used. Hysteresis effect is also decreased by the use of TT-27 tubes.

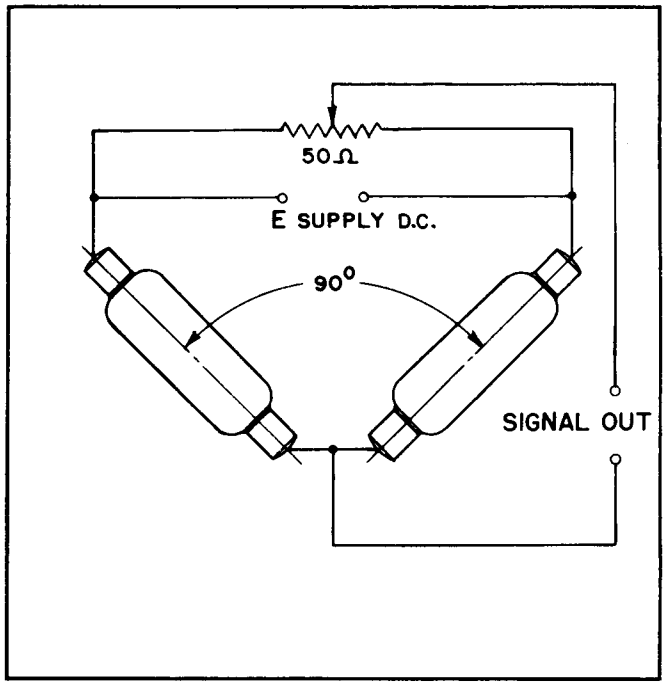
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R310-7

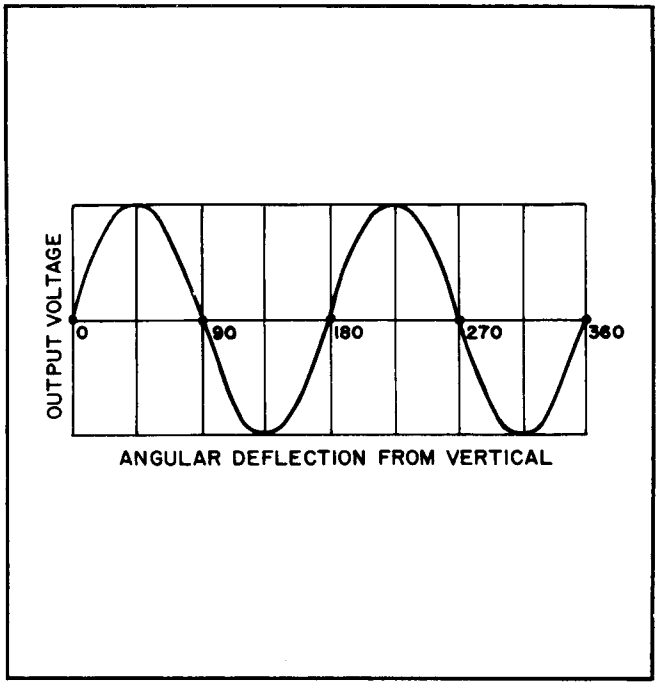
Printed in U.S.A.

SINGLE D-C CONVECTRON

Bendix Type TT-27

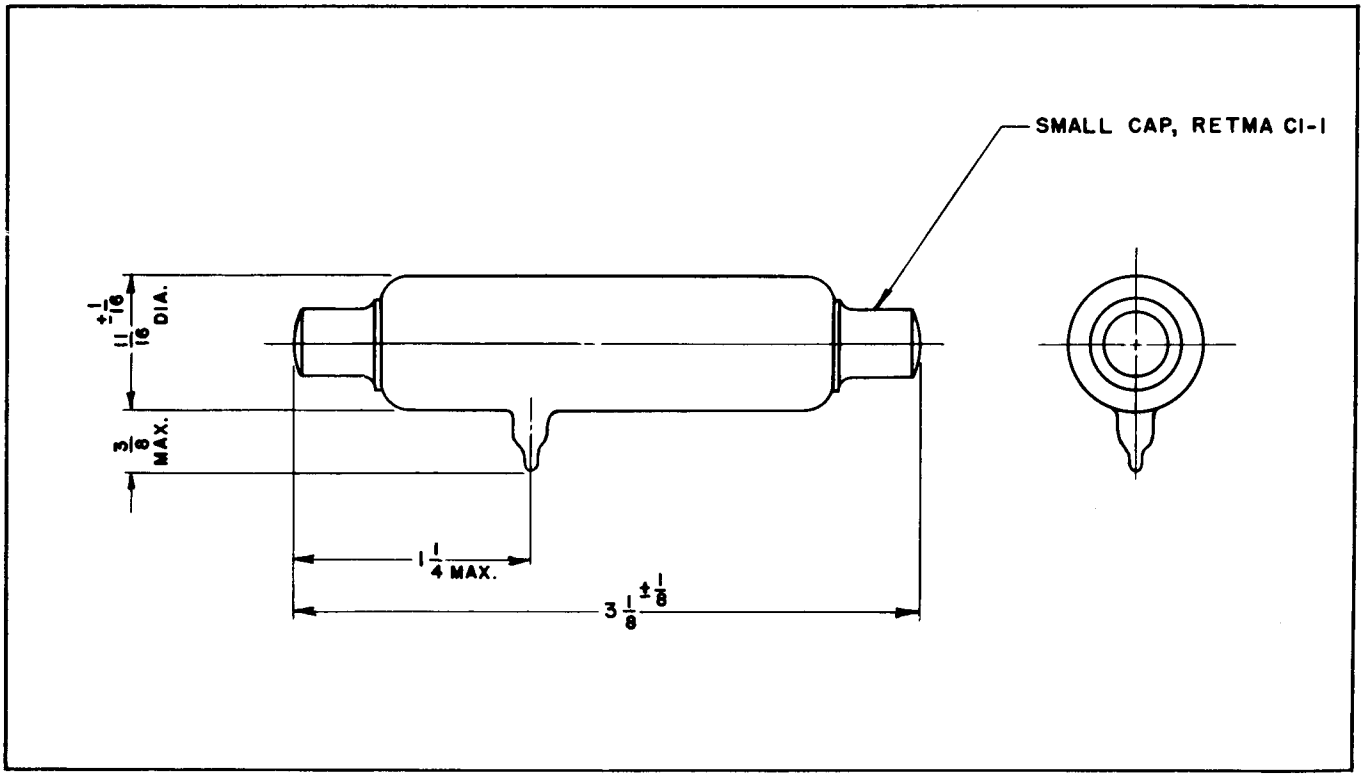


TUBES ELECTRICALLY CONNECTED
TO FORM TYPICAL BRIDGE CIRCUIT



CONVECTRON BRIDGE OUTPUT SIGNAL

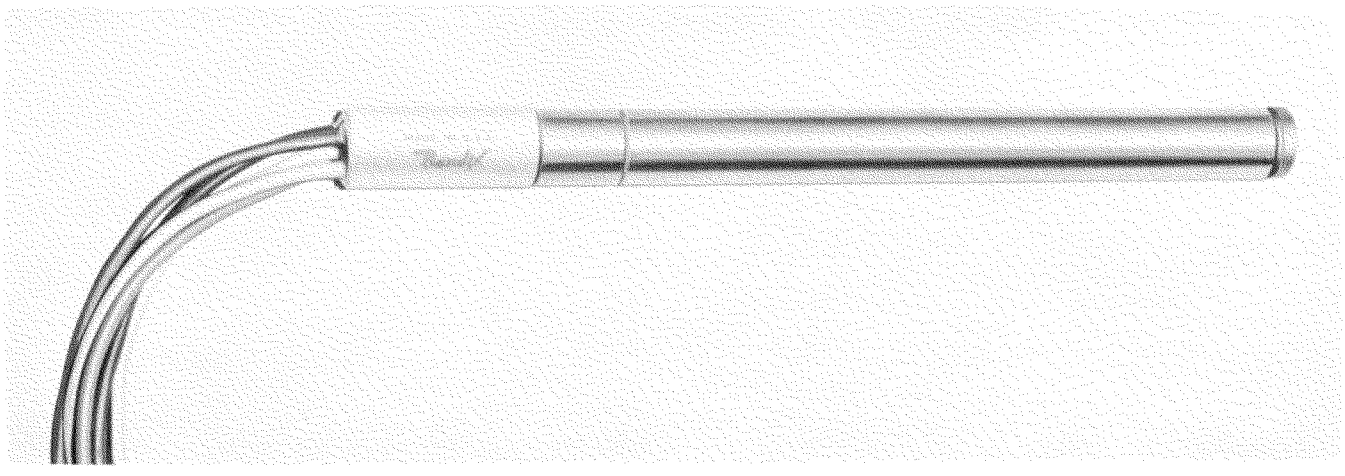
Note: With a pair of tubes set at a 90° angle to each other, a plot of the output voltage against angular deflection will approximate a sine wave.
An increase in sensitivity can be obtained for the indication of small angles by decreasing the angle between tubes to 60°.



OUTLINE DRAWING

Backward-Wave Oscillator

Tentative Data



ELECTRICAL DATA

Frequency Range	61 KMC - 71 KMC
Anode Voltage	1000 - 2500 volts
Power Output	2 mw average power
Beam Current	8 ma
*Magnetic Field	2000 gauss (minimum)
Heater Voltage	6.3 ± 10%
*Power Input	15 watts (maximum)

MECHANICAL DATA

Output Flange	Special adapter to RG-98/U
Maximum Diameter	.625"
Length	9"
Lead Wire Length	7½"
Mounting Position	Any
Weight (tube only, without magnet)	5 oz.

Magnets available

DESCRIPTION

The Bendix Red Bank Backward Wave Oscillator Type TWO-66 has many applications where low power, voltage tuned millimeter wavelength radio frequency energy is required. These tubes require parts machined to very precise dimensions in such difficult to work materials as steatite, molybdenum and kovar. Hence, the most advanced techniques of engraving, hubbing, and precision grinding are employed in their fabrication. This tube, a type of Traveling Wave Tube, has application in advanced types of multi-channel telephone and television systems using circular waveguide for transmission, high definition short range radar, highly directive communications, microwave spectroscopy, and as signal sources in the millimeter wavelength region.

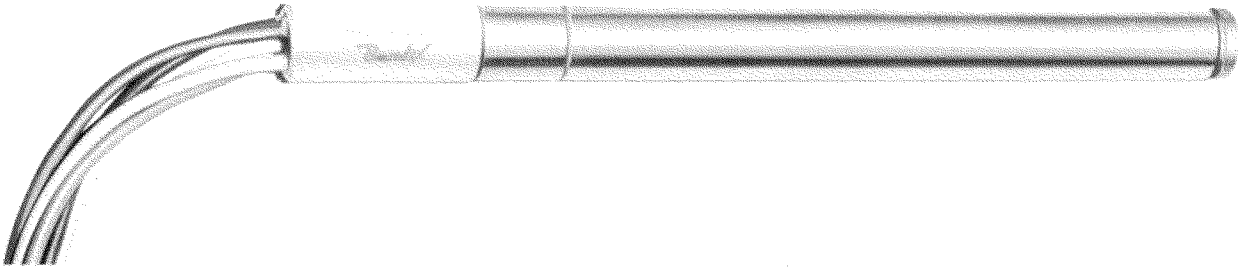
THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R810-9

Printed in U. S. A.

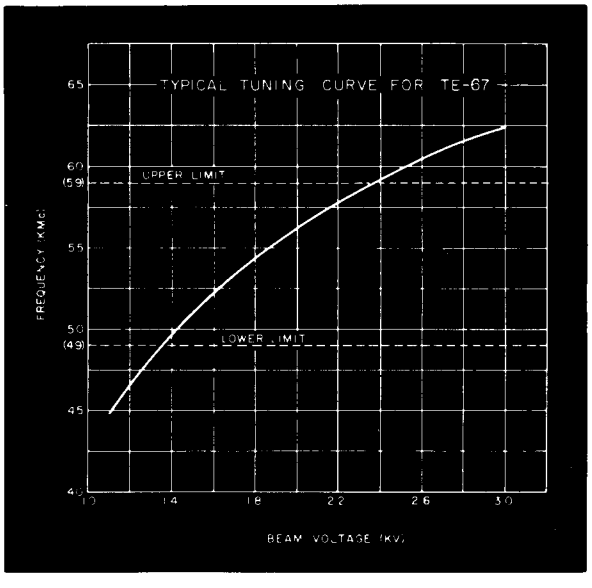
Backward-Wave Oscillator

Tentative Data



ELECTRICAL DATA

Frequency Range	49 KMC - 59 KMC
Anode Voltage	1000 - 3000 volts
Power Output	5 mw average power
Beam Current	5 ma
Magnetic Field	1300 gauss (minimum)
Heater Voltage	6.3 ± 10%



Typical Tuning Curve

DESCRIPTION

The Bendix Red Bank Backward Wave Oscillator Type TWO-67 has many applications where low power, voltage tuned millimeter wavelength radio frequency energy is required. These tubes require parts machined to very precise dimensions in such difficult to work materials as steatite, molybdenum and kovar. Hence, the most advanced techniques of engraving, hubbing, and precision grinding are employed in their fabrication. This tube, a type of Traveling Wave Tube, has application in advanced types of multi-channel telephone and television systems using circular waveguide for transmission, high definition short range radar, highly directive communications, microwave spectroscopy, and as signal sources in the millimeter wavelength region.

MECHANICAL DATA

Output Flange	Special adapter to RG-98/U
Maximum Diameter	.625"
Length	9"
Lead Wire Length	7½"
Mounting Position	Any
Weight (tube only, without magnet)	5 oz.

Magnets available

THE Bendix CORPORATION
Red Bank DIVISION, EATONTOWN, NEW JERSEY

Publication No. R88-22

Printed in U. S. A.