



5654
PENTODE
Five-Star Tube
★ ★ ★ ★ ★

FOR WIDE-BAND HIGH-FREQUENCY AMPLIFIER APPLICATIONS
SHARP-CUTOFF CHARACTERISTIC **SHOCK, VIBRATION RATINGS**
7-PIN MINIATURE **HEATER-CYCLING RATING**
HIGH TRANSCONDUCTANCE

DESCRIPTION AND RATING

The 5654 is a miniature sharp-cutoff pentode for use as a wide-band, high-frequency amplifier. It is also useful in video and audio amplifiers, oscillators, mixers, frequency multipliers, and cathode followers.

The 5654 is a special-quality tube intended for use in critical industrial and military applications in which operational dependability is of primary importance. Features of the tube include a high degree of mechanical strength and a heater-cathode construction capable of withstanding many-thousand cycles of intermittent operation. When used in on-off control applications, the tube will maintain its emission capabilities after long periods of operation under cutoff conditions.

Analysis of the electrical characteristics of this tube with those of the 6AK5 will indicate that the 5654 is essentially similar.

GENERAL

ELECTRICAL

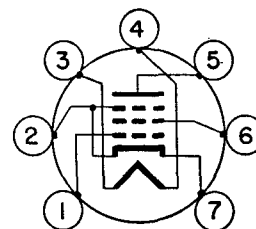
Cathode—Coated Unipotential	
Heater Voltage, AC or DC	6.3 ± 10% Volts
Heater Current	0.175 Amperes
Direct Interelectrode Capacitances*	
Grid-Number 1 to Plate, maximum	0.02 μf
Input	4.0 μf
Output	2.85 μf

*With external shield (RETMA 316) connected to cathode.

MECHANICAL

Mounting Position—Any
Envelope—T-5½, Glass
Base—E7-1, Miniature Button 7-Pin

BASING DIAGRAM

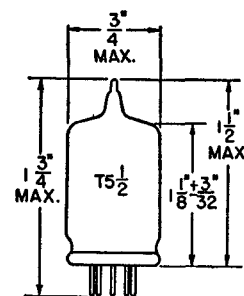


RETMA 7BD

TERMINAL CONNECTIONS

- Pin 1—Grid Number 1
- Pin 2—Cathode, Internal Shield, and Grid Number 3
- Pin 3—Heater
- Pin 4—Heater
- Pin 5—Plate
- Pin 6—Grid Number 2 (Screen)
- Pin 7—Cathode, Internal Shield, and Grid Number 3

PHYSICAL DIMENSIONS



RETMA 5-1

GENERAL ELECTRIC

Supersedes ET-T1082 dated 8-54

MAXIMUM RATINGS

ABSOLUTE MAXIMUM VALUES

Plate Voltage	200 Volts
Screen Voltage	155 Volts
Positive DC Grid-Number 1 Voltage	0 Volts
Negative DC Grid-Number 1 Voltage	50 Volts
Plate Dissipation	1.65 Watts
Screen Dissipation	0.55 Watts
DC Grid-Number 1 Current	1.0 Milliampere
DC Cathode Current	20 Milliampere
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	135 Volts
Heater Negative with Respect to Cathode	135 Volts
Grid-Number 1 Circuit Resistance	0.1 Megohms
Bulb Temperature at Hottest Point	165 C

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A₁ AMPLIFIER

Plate Voltage	120 Volts
Screen Voltage	120 Volts
Grid-Number 1 Voltage	-2.0 Volts
Plate Resistance, approximate	0.34 Megohms
Transconductance	5000 Micromhos
Plate Current	7.5 Milliampere
Screen Current	2.5 Milliampere
Grid-Number 1 Voltage, approximate	
I _b = 10 Microampere	-8.5 Volts

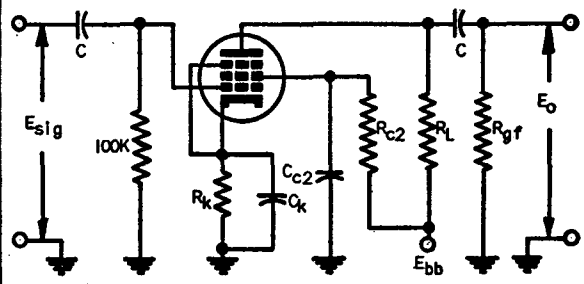
CLASS A RESISTANCE-COUPLED AMPLIFIER

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)													
R _L	R _{gf}	E _{bb} = 90 Volts				E _{bb} = 180 Volts				E _{bb} = 300 Volts			
		R _k	R _{c2}	E _o	Gain	R _k	R _{c2}	E _o	Gain	R _k	R _{c2}	E _o	Gain
0.10	0.10	700	0.2	12	62	400	0.3	21	120	200	0.4	38	170
0.10	0.24	800	0.2	16	85	400	0.3	28	170	300	0.4	51	260
0.24	0.24	4100	0.3	13	53	900	0.7	22	160	500	0.9	35	250
0.24	0.51	4800	0.3	15	68	1000	0.8	26	200	500	1.0	40	300
0.51	0.51	7100	0.9	11	73	2000	1.5	22	170	1200	1.8	34	290
0.51	1.0	7500	1.0	14	93	2500	1.6	26	220	1400	1.9	42	390

HIGH IMPEDANCE DRIVE (APPROXIMATELY 100K OHMS)													
R _L	R _{gf}	E _{bb} = 90 Volts				E _{bb} = 180 Volts				E _{bb} = 300 Volts			
		R _k	R _{c2}	E _o	Gain	R _k	R _{c2}	E _o	Gain	R _k	R _{c2}	E _o	Gain
0.10	0.10	1600	0.1	13	42	300	0.4	23	120	200	0.4	41	160
0.10	0.24	1800	0.1	16	64	400	0.4	31	160	200	0.4	53	290
0.24	0.24	5300	0.2	14	43	700	1.0	26	160	400	1.1	44	240
0.24	0.51	5500	0.3	15	65	700	1.2	33	200	500	1.2	54	310
0.51	0.51	11000	0.5	12	50	2000	1.6	23	180	800	2.5	47	290
0.51	1.0	11000	0.7	13	72	2000	1.7	27	250	900	2.8	58	370

Notes:

1. E_o is maximum RMS voltage output for approximately five percent total harmonic distortion.
2. Gain is measured for an output voltage of two volts RMS.
3. R_k is in ohms; R_{c2}, R_L, and R_{gf} are in megohms.
4. Coupling capacitors (C) should be selected to give desired frequency response. R_k and R_{c2} should be adequately by-passed.



CHARACTERISTICS LIMITS

		Minimum	Maximum	
Heater Current				
Ef = 6.3 volts	Initial	160	190	Milliamperes
	500 Hr	160	190	Milliamperes
	1000 Hr	160	190	Milliamperes
Plate Current				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ec1 = -2.0 volts	Initial	5.0	11.0	Milliamperes
Screen Current				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ec1 = -2.0 volts	Initial	0.8	4.0	Milliamperes
Transconductance (1)				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ec1 = -2.0 volts	Initial	3800	6200	Micromhos
Transconductance Change with Heater Voltage				
Difference between Transconductance (1) and Transconductance at Ef = 5.7 volts (other conditions the same) expressed as a percentage of Transconductance (1)				
	Initial	....	15	Percent
	500 Hr	....	15	Percent
Transconductance Change with Operation				
Difference between Transconductance (1) initially and after operation expressed as a percentage of initial value				
	500 Hr	....	20	Percent
	1000 Hr	....	25	Percent
Average Transconductance Change with Operation				
Average of values for "Transconductance Change with Operation"	500 Hr	....	15	Percent
Plate Resistance				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ec1 = -2.0 volts	Initial	0.25	....	Megohms
Plate Current Cutoff (1)				
Ef = 6.3 volts, Ebb = 120 volts, Ec2 = 120 volts, Ec1 = -10 volts, RL = 0.1 meg	Initial	....	200	Microamperes
Plate Current Cutoff (2)				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ec1 = -5.5 volts	Initial	5.0	....	Microamperes
Interelectrode Capacitances				
Grid-Number 1 to Plate (g1 to p)	Initial	....	0.02	μf
Input (g1 to h, k, g2, g3)	Initial	3.4	4.6	μf
Output (p to h, k, g2, g3)	Initial	2.45	3.25	μf
Measured with external shield (RETMA 316) connected to cathode.				
Negative Grid-Number 1 Current				
Ef = 6.3 volts, Eb = 120 volts, Ec2 = 120 volts, Ecc1 = -2.0 volts, Rg1 = 0.5 meg	Initial	0	0.1	Microamperes
	500 Hr	0	0.1	Microamperes
	1000 Hr	0	0.1	Microamperes
Heater-Cathode Leakage Current				
Ef = 6.3 volts, Ehk = 100 volts				
Heater Positive with Respect to Cathode	Initial	....	10	Microamperes
	500 Hr	....	10	Microamperes
	1000 Hr	....	10	Microamperes
Heater Negative with Respect to Cathode	Initial	....	10	Microamperes
	500 Hr	....	10	Microamperes
	1000 Hr	....	10	Microamperes
Interelectrode Leakage Resistance				
Ef = 6.3 volts. Polarity of applied d-c interelectrode voltage is such that no cathode emission results.				
Grid-Number 1 to All at 100 Volts DC	Initial	100	....	Megohms
	500 Hr	50	....	Megohms
Plate to All at 300 Volts DC	Initial	100	....	Megohms
	500 Hr	50	....	Megohms
Vibrational Noise Output Voltage, RMS				
Ef = 6.3 volts, Ebb = 120 volts, Ec2 = 120 volts, Ec1 = -2.0 volts, RL = 10,000 ohms, vibrational acceleration = 2.5 G at 25 cps	Initial	....	150	Millivolts
Grid-Number 1 Emission Current				
Ef = 7.5 volts, Eb = 120 volts, Ec2 = 120 volts, Ecc1 = -45 volts, Rg1 = 0.1 meg	Initial	....	0.5	Microamperes

The indicated 500-hour and 1000-hour values are life-test end points for the following conditions of operation: Ef = 6.3 volts, Eb = 150 volts, Ec2 = 125 volts, Rk = 130 ohms, Rg1 = 0.1 meg, Ehk = 135 volts with heater positive with respect to Cathode, and bulb temperature = 165 C minimum.

†Supersedes pages 3 and 4 only dated 8-56

SPECIAL TESTS AND RATINGS

Stability Life Test

Statistical sample operated for one hour to evaluate and control initial variations in transconductance.

Survival Rate Life Test

Statistical sample operated for one hundred hours to evaluate and control early-life electrical and mechanical in-operatives.

Heater-Cycling Life Test

Statistical sample operated for 2000 cycles to evaluate and control heater-cathode defects. Conditions of test include $E_f = 7.5$ volts cycled for one minute on and one minute off, $E_b = E_{c2} = E_{c1} = 0$ volts, and $E_{hk} = 135$ volts with heater positive with respect to cathode.

Shock Rating—450 G

Statistical sample subjected to five impact accelerations of 450 G in each of four different positions. The accelerating forces are applied by the Navy-type, High Impact (flyweight) Shock Machine for Electronic Devices or its equivalent.

Fatigue Rating—2.5 G

Statistical sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

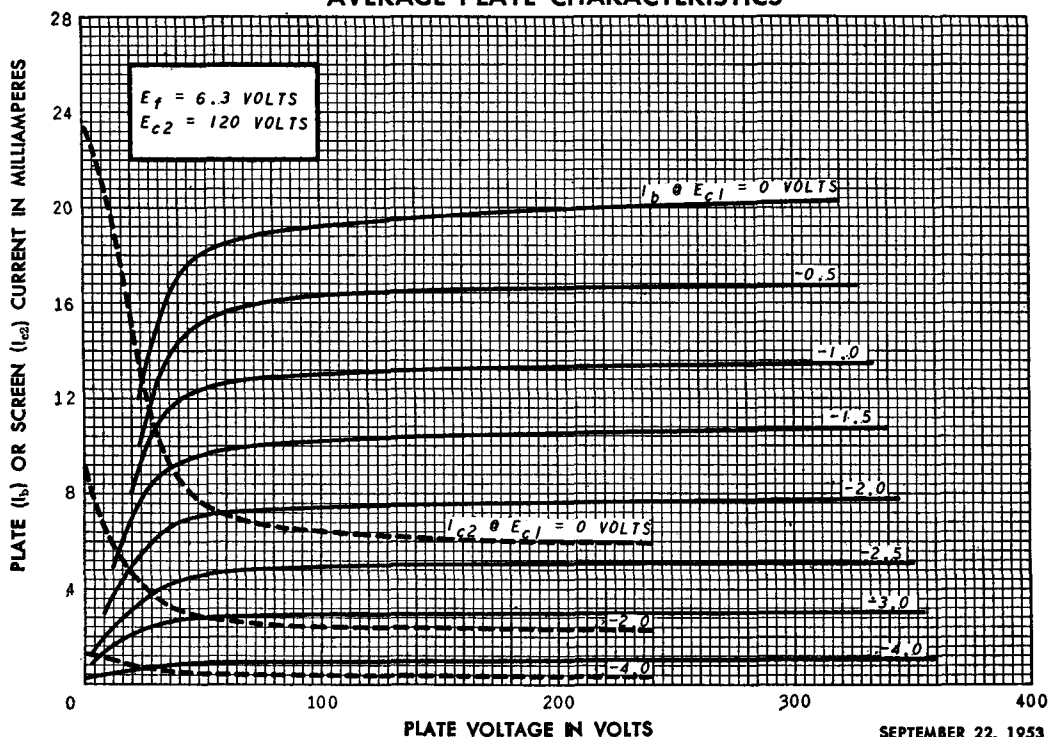
Altitude Rating—60,000 Feet

Statistical sample subjected to pressure of 55 millimeters of mercury to evaluate and control arcing and corona.

Note: The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

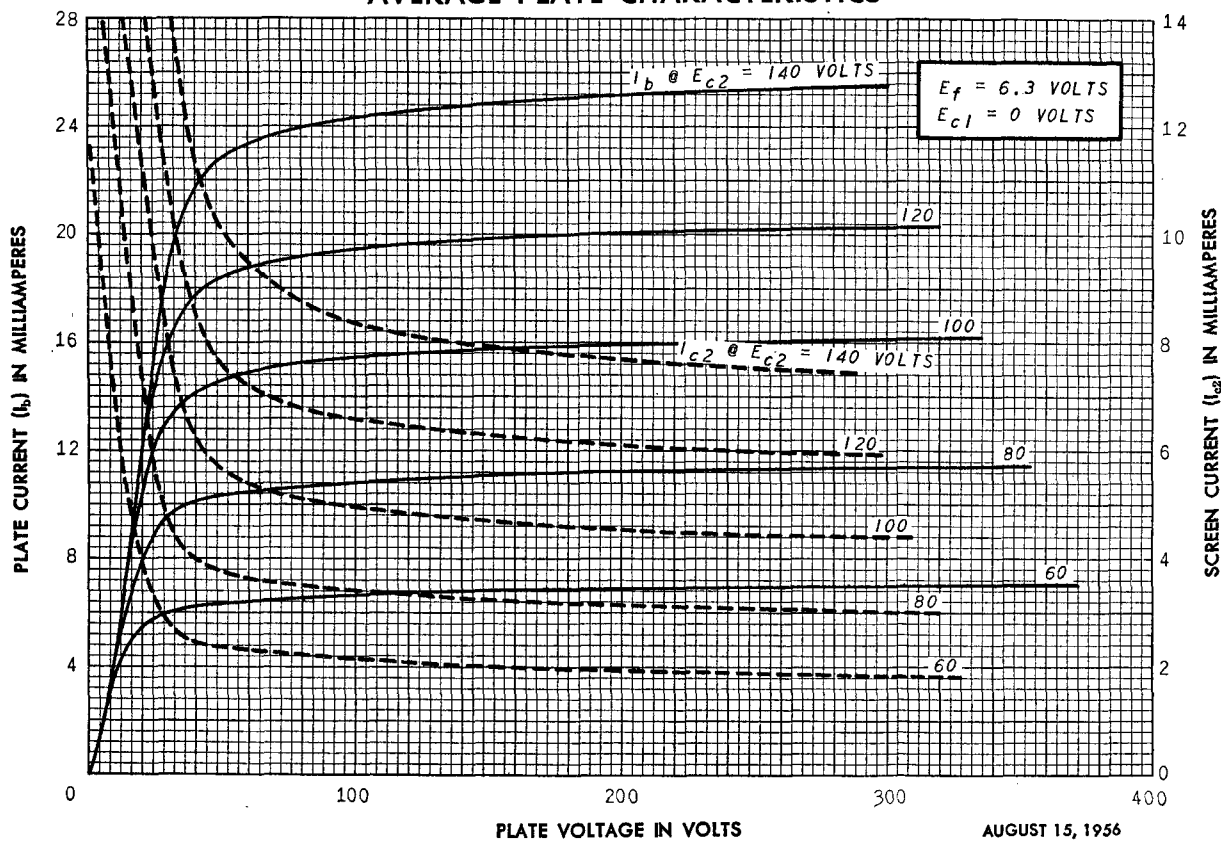
In the design of military equipment employing this tube, reference should be made to the appropriate MIL-E-1C specification.

AVERAGE PLATE CHARACTERISTICS

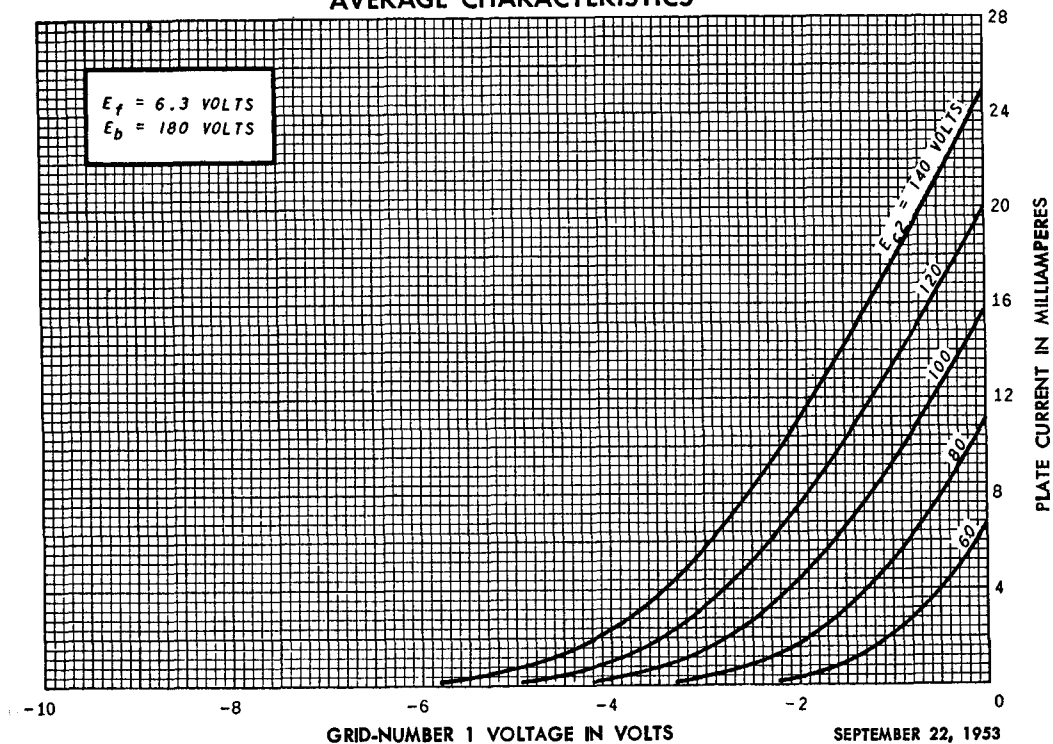


SEPTEMBER 22, 1953

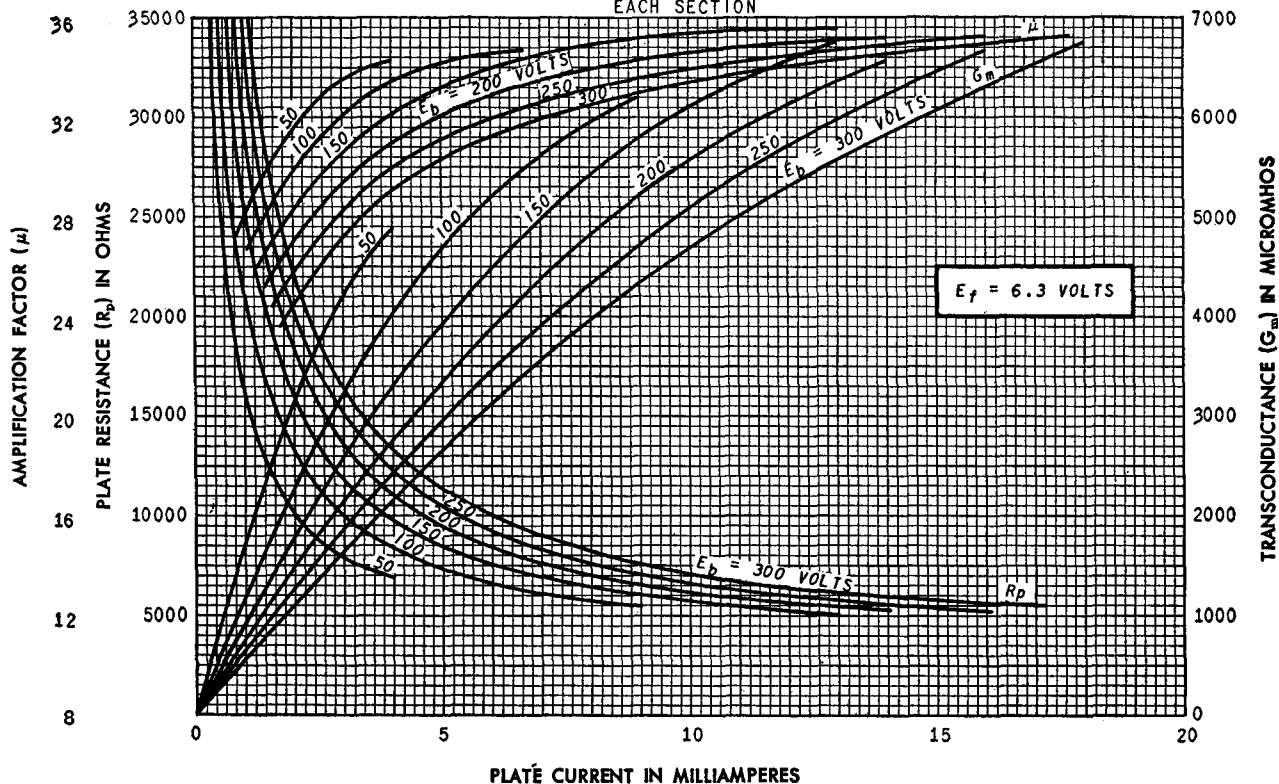
AVERAGE PLATE CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS
 EACH SECTION



OCTOBER 9, 1953

