Electronic TUBES

# 5654
# PENTODE
**Five-Star Tube**
★ ★ ★ ★ ★

**FOR WIDE-BAND HIGH-FREQUENCY AMPLIFIER APPLICATIONS**

**SHARP-CUTOFF CHARACTERISTIC**
**7-PIN MINIATURE**
**SHOCK, VIBRATION RATINGS**
**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**

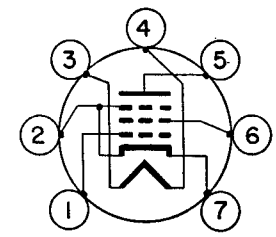
| | | |
|---|---|---|
| Cathode—Coated Unipotential | | |
| Heater Voltage, AC or DC | 6.3 ± 10% | Volts |
| Heater Current | 0.175 | Amperes |
| Direct Interelectrode Capacitances* | | |
| Grid-Number 1 to Plate, maximum | 0.02 | μμf |
| Input | 4.0 | μμf |
| Output | 2.85 | μμf |

*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**

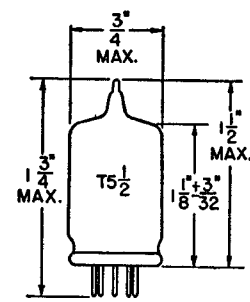



RETMA 7BD

**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 Milliamperes |
| DC Cathode Current | 20 Milliamperes |
| 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 $A_1$ 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 Milliamperes |
| Screen Current | 2.5 Milliamperes |
| Grid-Number 1 Voltage, approximate Ib = 10 Microamperes | −8.5 Volts |

## CLASS A RESISTANCE-COUPLED AMPLIFIER

LOW IMPEDANCE DRIVE (APPROXIMATELY 200 OHMS)

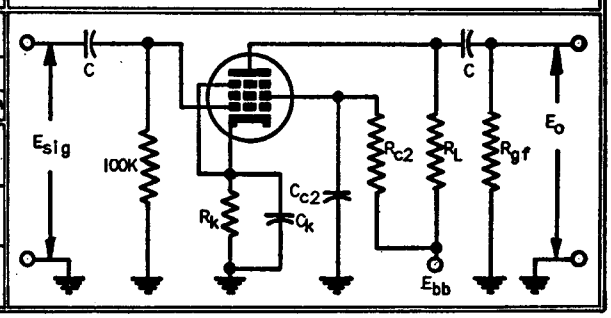
| $R_L$ | $R_{gf}$ | Ebb = 90 Volts | | | | Ebb = 180 Volts | | | | Ebb = 300 Volts | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $R_k$ | $R_{c2}$ | $E_o$ | Gain | $R_k$ | $R_{c2}$ | $E_o$ | Gain | $R_k$ | $R_{c2}$ | $E_o$ | Gain |
| 0.10 | 0.10 | 700 | 0.2 | 12 | 62 | 400 | 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)

| $R_L$ | $R_{gf}$ | Ebb = 90 Volts | | | | Ebb = 180 Volts | | | | Ebb = 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, $R_L$ = 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 | μμf |
| Input (g1 to h, k, g2, g3) | Initial | 3.4 | 4.6 | μμf |
| Output (p to h, k, g2, g3) | Initial | 2.45 | 3.25 | μμf |
| 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 |
| **Heater-Cathode Leakage Current** | 1000 Hr | 0 | 0.1 | Microamperes |
| 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, $R_L$ = 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, Rgl = 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 inoperatives.

Heater-Cycling Life Test

Statistical sample operated for 2000 cycles to evaluate and control heater-cathode defects. Conditions of test include Ef = 7.5 volts cycled for one minute on and one minute off, Eb = Ec2 = Ec1 = 0 volts, and Ehk = 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.

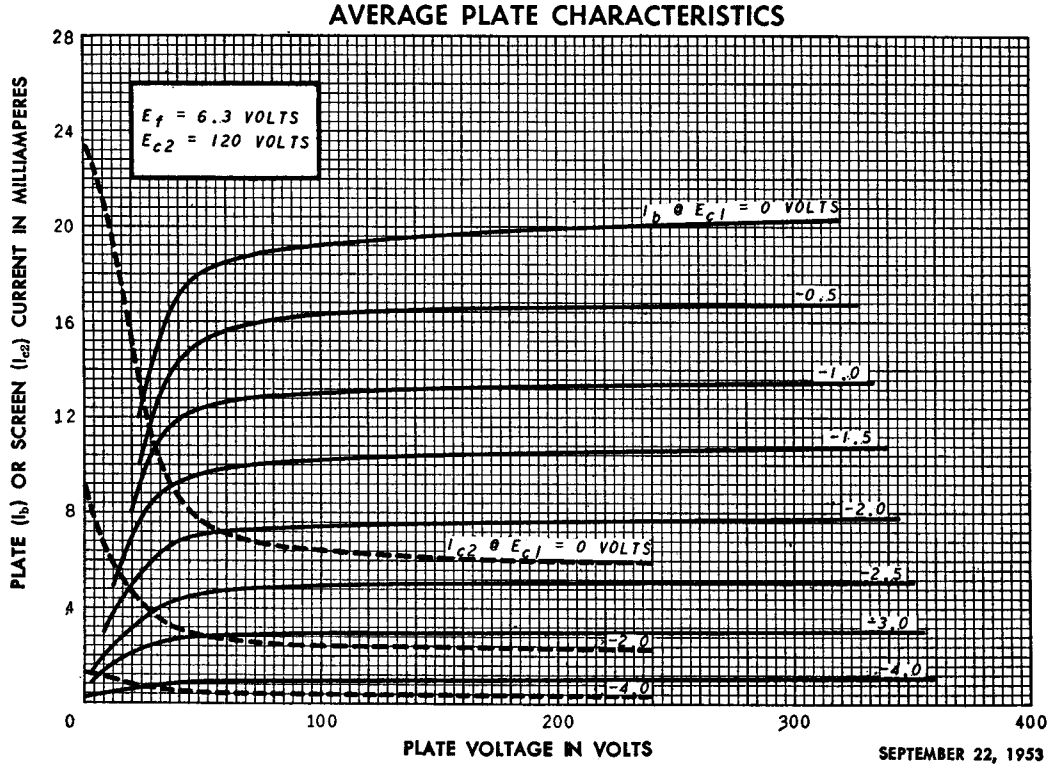
Altitude Rating—60,000 Feet

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

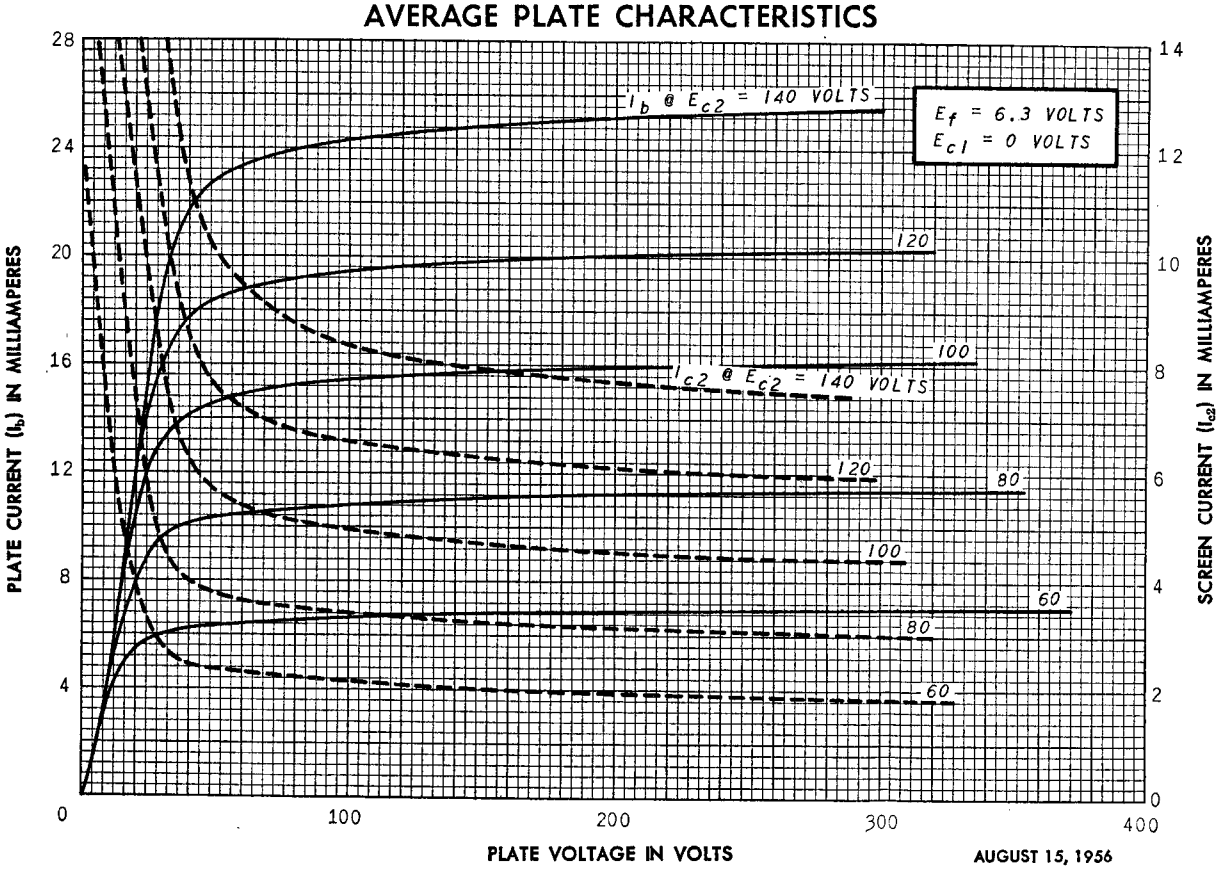
Note: The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

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

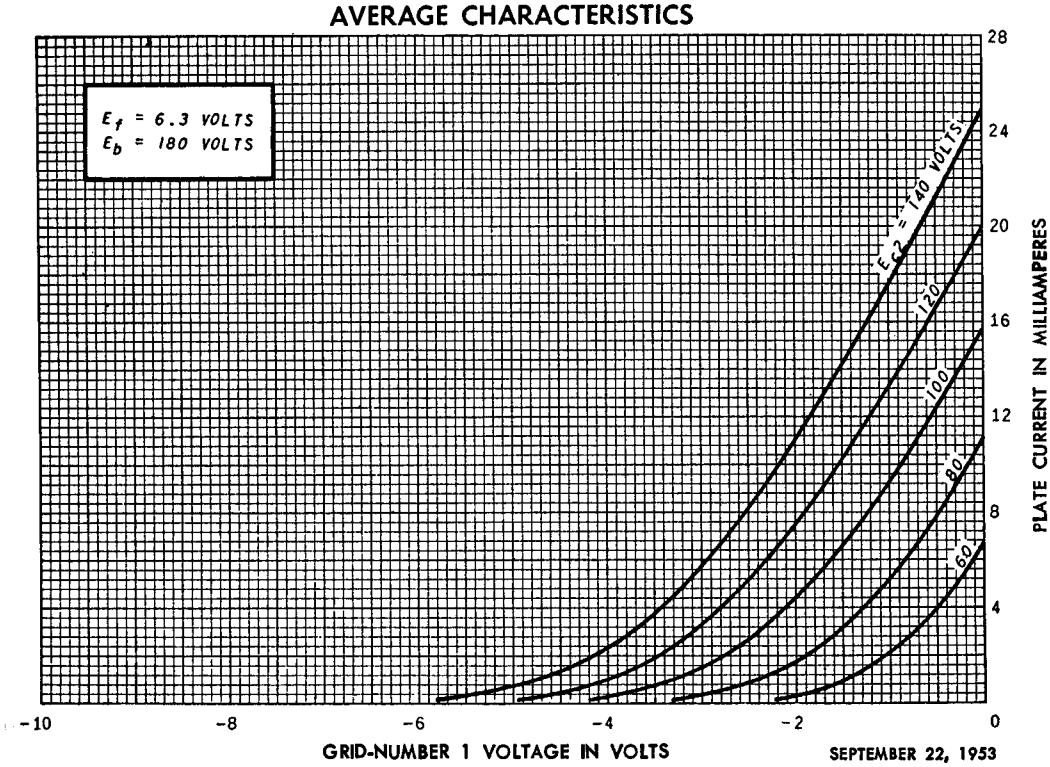
AVERAGE PLATE CHARACTERISTICS



## AVERAGE PLATE CHARACTERISTICS

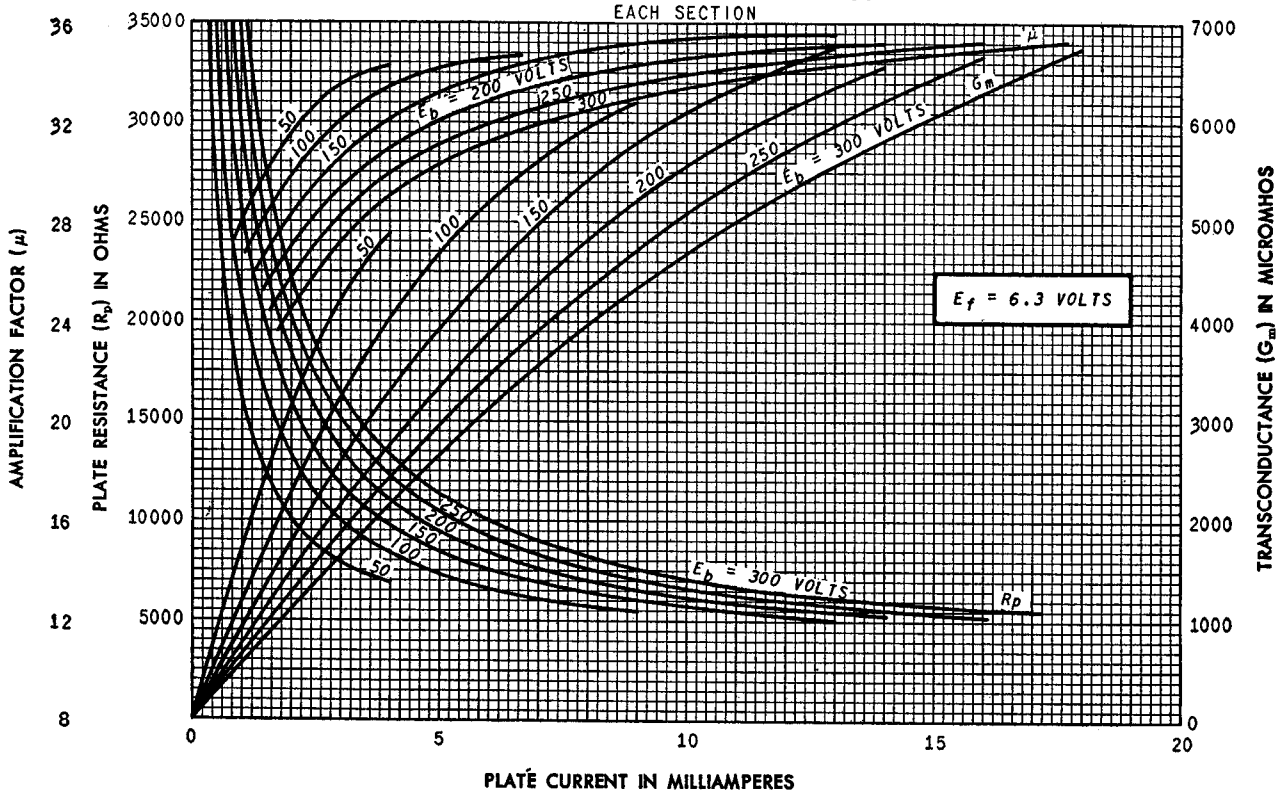



## AVERAGE CHARACTERISTICS



## AVERAGE CHARACTERISTICS

EACH SECTION




OCTOBER 9, 1953