

**FOR AF POWER AMPLIFIER APPLICATIONS**

**8-LEAD SUBMINIATURE**  
**POWER OUTPUT—1 WATT**

**SHOCK, VIBRATION RATINGS**  
**HEATER-CYCLING RATING**

**DESCRIPTION AND RATING**

The 5902 is a subminiature beam power pentode for use as an audio-frequency power amplifier. In this application the tube is capable of delivering an output of approximately one watt.

The 5902 is a special-quality tube 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.

**GENERAL**

**ELECTRICAL**

Cathode—Coated Unipotential

Heater Voltage, AC or DC.....6.3  $\pm$  5% Volts

Heater Current.....0.45 Amperes

Direct Interelectrode Capacitances

|                             | With<br>Shield* | Without<br>Shield |
|-----------------------------|-----------------|-------------------|
| Grid-Number 1 to Plate..... | 0.11            | 0.15 $\mu$ f      |
| Input.....                  | 6.5             | 6.5 $\mu$ f       |
| Output.....                 | 7.5             | 4.5 $\mu$ f       |

\*With external shield of 0.405-inch inside diameter connected to cathode.

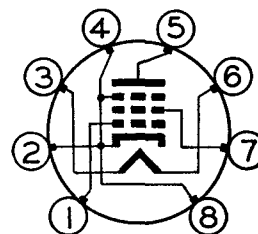
**MECHANICAL**

Mounting Position—Any

Envelope—T-3, Glass

Base—E8-10, Subminiature Button 8-Lead

**BASING DIAGRAM**

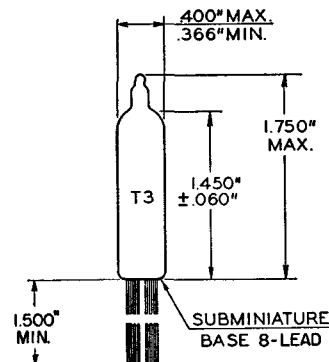


RETMA 8DL

**TERMINAL CONNECTIONS**

- Lead 1—Grid Number 1
- Lead 2—Cathode and Beam Plates
- Lead 3—Heater
- Lead 4—Cathode and Beam Plates
- Lead 5—Plate
- Lead 6—Heater
- Lead 7—Grid Number 2 (Screen)
- Lead 8—Cathode and Beam Plates

**PHYSICAL DIMENSIONS**



RETMA 3-3

## MAXIMUM RATINGS

### ABSOLUTE MAXIMUM VALUES

|                                         |                 |
|-----------------------------------------|-----------------|
| Plate Voltage                           | 165 Volts       |
| Screen Voltage                          | 155 Volts       |
| Positive DC Grid-Number 1 Voltage       | 0 Volts         |
| Negative DC Grid-Number 1 Voltage       | 55 Volts        |
| Plate Dissipation                       | 3.7 Watts       |
| Screen Dissipation                      | 0.4 Watts       |
| DC Cathode Current                      | 50 Milliamperes |
| Heater-Cathode Voltage                  |                 |
| Heater Positive with Respect to Cathode | 200 Volts       |
| Heater Negative with Respect to Cathode | 200 Volts       |
| Bulb Temperature at Hottest Point       | 220 C           |

## CHARACTERISTICS AND TYPICAL OPERATION

### CLASS A<sub>1</sub> AMPLIFIER

|                                           |                  |
|-------------------------------------------|------------------|
| Plate Voltage                             | 110 Volts        |
| Screen Voltage                            | 110 Volts        |
| Cathode-Bias Resistor                     | 270 Ohms         |
| Peak AF Grid-Number 1 Voltage, RMS        | 6.4 Volts        |
| Plate Resistance, approximate             | 15,000 Ohms      |
| Transconductance                          | 4200 Micromhos   |
| Zero-Signal Plate Current                 | 30 Milliamperes  |
| Maximum-Signal Plate Current, approximate | 29 Milliamperes  |
| Zero-Signal Screen Current                | 2.2 Milliamperes |
| Maximum-Signal Screen Current             | 5.5 Milliamperes |
| Load Resistance                           | 3000 Ohms        |
| Total Harmonic Distortion, approximate    | 10 Percent       |
| Maximum-Signal Power Output               | 1.0 Watts        |
| Grid-Number 1 Voltage, approximate        |                  |
| I <sub>b</sub> = 10 Microamperes          | -40 Volts        |

## CHARACTERISTICS LIMITS

|                                                                                                                                                                                             |         | Minimum | Maximum |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|--------------|
| Heater Current                                                                                                                                                                              |         |         |         |              |
| E <sub>f</sub> = 6.3 volts                                                                                                                                                                  | Initial | 420     | 480     | Milliamperes |
|                                                                                                                                                                                             | 500-Hr  | 414     | 492     | Milliamperes |
| Plate Current                                                                                                                                                                               |         |         |         |              |
| E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 110 volts, E <sub>c2</sub> = 110 volts, R <sub>k</sub> = 270 ohms (by-passed)                                                                  | Initial | 23.0    | 37.0    | Milliamperes |
| Screen Current                                                                                                                                                                              |         |         |         |              |
| E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 110 volts, E <sub>c2</sub> = 110 volts, R <sub>k</sub> = 270 ohms (by-passed)                                                                  | Initial | 0       | 4.0     | Milliamperes |
| Transconductance                                                                                                                                                                            |         |         |         |              |
| E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 110 volts, E <sub>c2</sub> = 110 volts, R <sub>k</sub> = 270 ohms (by-passed)                                                                  | Initial | 3500    | 4900    | Micromhos    |
| Plate Resistance                                                                                                                                                                            |         |         |         |              |
| E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 110 volts, E <sub>c2</sub> = 110 volts, R <sub>k</sub> = 270 ohms (by-passed)                                                                  | Initial | 0.01    | ....    | Megohms      |
| Power Output (1)                                                                                                                                                                            |         |         |         |              |
| E <sub>f</sub> = 6.3 volts, E <sub>b</sub> = 110 volts, E <sub>c2</sub> = 110 volts, R <sub>k</sub> = 270 ohms (by-passed),<br>R <sub>L</sub> = 3000 ohms, E <sub>sig</sub> = 6.4 volts RMS | Initial | 0.75    | ....    | Watts        |
| Power Output Change with Heater Voltage                                                                                                                                                     |         |         |         |              |
| Difference between Power Output (1) and Power Output at E <sub>f</sub> = 5.7 volts<br>(other conditions the same) expressed as a percentage of Power Out-<br>put (1)                        | Initial | ....    | 15      | Percent      |
|                                                                                                                                                                                             | 500-Hr  | ....    | 15      | Percent      |
| Power Output Change with Operation                                                                                                                                                          |         |         |         |              |
| Difference between Power Output (1) initially and after operation ex-<br>pressed as a percentage of initial value                                                                           | 500-Hr  | ....    | 20      | Percent      |

## CHARACTERISTICS LIMITS (Cont'd)

|                                                                                                                                                                     |         | Minimum | Maximum |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|--------------|
| <b>Average Power Output Change with Operation</b>                                                                                                                   |         |         |         |              |
| Average of values for "Power Output Change with Operation" . . . . .                                                                                                | 500-Hr  | ....    | 15      | Percent      |
| <b>Plate Current Cutoff</b>                                                                                                                                         |         |         |         |              |
| $E_f = 6.3$ volts, $E_{bb} = 110$ volts, $E_{c2} = 110$ volts, $E_{c1} = -40$ volts . . . . .                                                                       | Initial | ....    | 100     | Microamperes |
| <b>Interelectrode Capacitances</b>                                                                                                                                  |         |         |         |              |
| Grid-Number 1 to Plate ( $g_1$ to $p$ ) . . . . .                                                                                                                   | Initial | ....    | 0.20    | $\mu\mu f$   |
| Input ( $g_1$ to $h$ , $k$ , $g_2$ ) . . . . .                                                                                                                      | Initial | 5.5     | 7.5     | $\mu\mu f$   |
| Output ( $p$ to $h$ , $k$ , $g_2$ ) . . . . .                                                                                                                       | Initial | 6.5     | 8.5     | $\mu\mu f$   |
| Measured with external shield of 0.405-inch inside diameter connected to cathode.                                                                                   |         |         |         |              |
| <b>Negative Grid-Number 1 Current</b>                                                                                                                               |         |         |         |              |
| $E_f = 6.3$ volts, $E_b = 110$ volts, $E_{c2} = 110$ volts, $R_{g1} = 1.0$ meg, $R_k = 270$ ohms . . . . .                                                          | Initial | ....    | 1.0     | Microamperes |
|                                                                                                                                                                     | 500-Hr  | ....    | 2.0     | Microamperes |
| <b>Heater-Cathode Leakage Current</b>                                                                                                                               |         |         |         |              |
| $E_f = 6.3$ volts, $E_{hk} = 100$ volts                                                                                                                             |         |         |         |              |
| Heater Positive with Respect to Cathode . . . . .                                                                                                                   | Initial | ....    | 15      | Microamperes |
|                                                                                                                                                                     | 500-Hr  | ....    | 60      | Microamperes |
| Heater Negative with Respect to Cathode . . . . .                                                                                                                   | Initial | ....    | 15      | Microamperes |
|                                                                                                                                                                     | 500-Hr  | ....    | 60      | Microamperes |
| <b>Interelectrode Leakage Resistance</b>                                                                                                                            |         |         |         |              |
| $E_f = 6.3$ 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 | 50      | ....    | Megohms      |
|                                                                                                                                                                     | 500-Hr  | 25      | ....    | Megohms      |
| Plate to All at 300 Volts DC . . . . .                                                                                                                              | Initial | 50      | ....    | Megohms      |
|                                                                                                                                                                     | 500-Hr  | 25      | ....    | Megohms      |
| <b>Vibrational Noise Output Voltage, RMS</b>                                                                                                                        |         |         |         |              |
| $E_f = 6.3$ volts, $E_{bb} = 110$ volts, $E_{c2} = 110$ volts, $R_k = 270$ ohms (by-passed), $R_L = 2000$ ohms, Vibrational acceleration = 15 G at 40 cps . . . . . | Initial | ....    | 100     | Millivolts   |
| <b>Grid-Number 1 Emission Current</b>                                                                                                                               |         |         |         |              |
| $E_f = 7.5$ volts, $E_b = 110$ volts, $E_{c2} = 110$ volts, $E_{c1} = -40$ volts, $R_{g1} = 1.0$ meg . . . . .                                                      | Initial | ....    | 2.0     | Microamperes |

The indicated 500-hour values are life-test end points for the following conditions of operation:  $E_f = 6.3$  volts,  $E_b = 100$  volts,  $E_{c2} = 100$  volts,  $R_k = 220$  ohms,  $R_{g1} = 0.47$  meg,  $E_{hk} = 200$  volts with heater positive with respect to cathode, and bulb temperature = 220 C minimum.

## **SPECIAL TESTS AND RATINGS**

### **Stability Life Test**

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

### **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 minimum to evaluate and control heater-cathode defects. Conditions of test include  $E_f = 7.0$  volts cycled for one minute on and four minutes off,  $E_b = E_{c2} = E_{c1} = 0$  volts, and  $E_{hk} = 140$  volts RMS.

### **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 25 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.

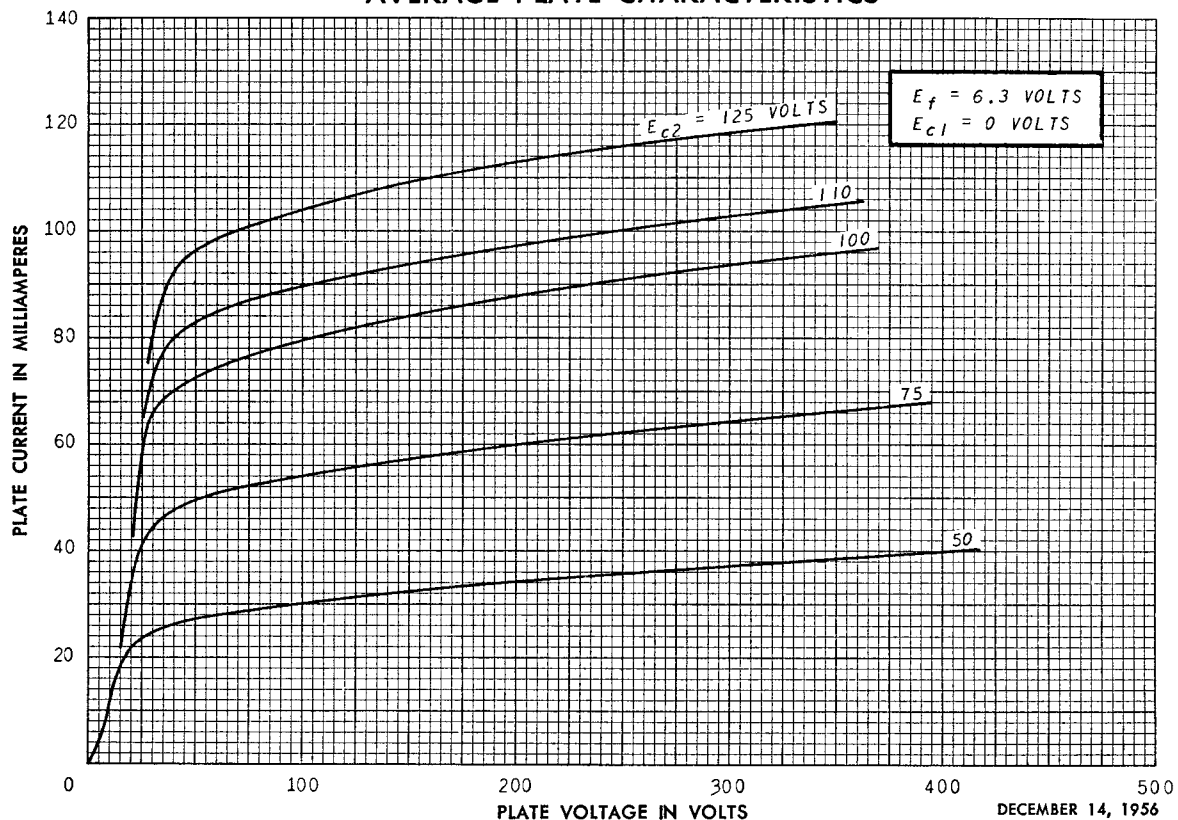
### **Altitude Rating—60,000 Feet**

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

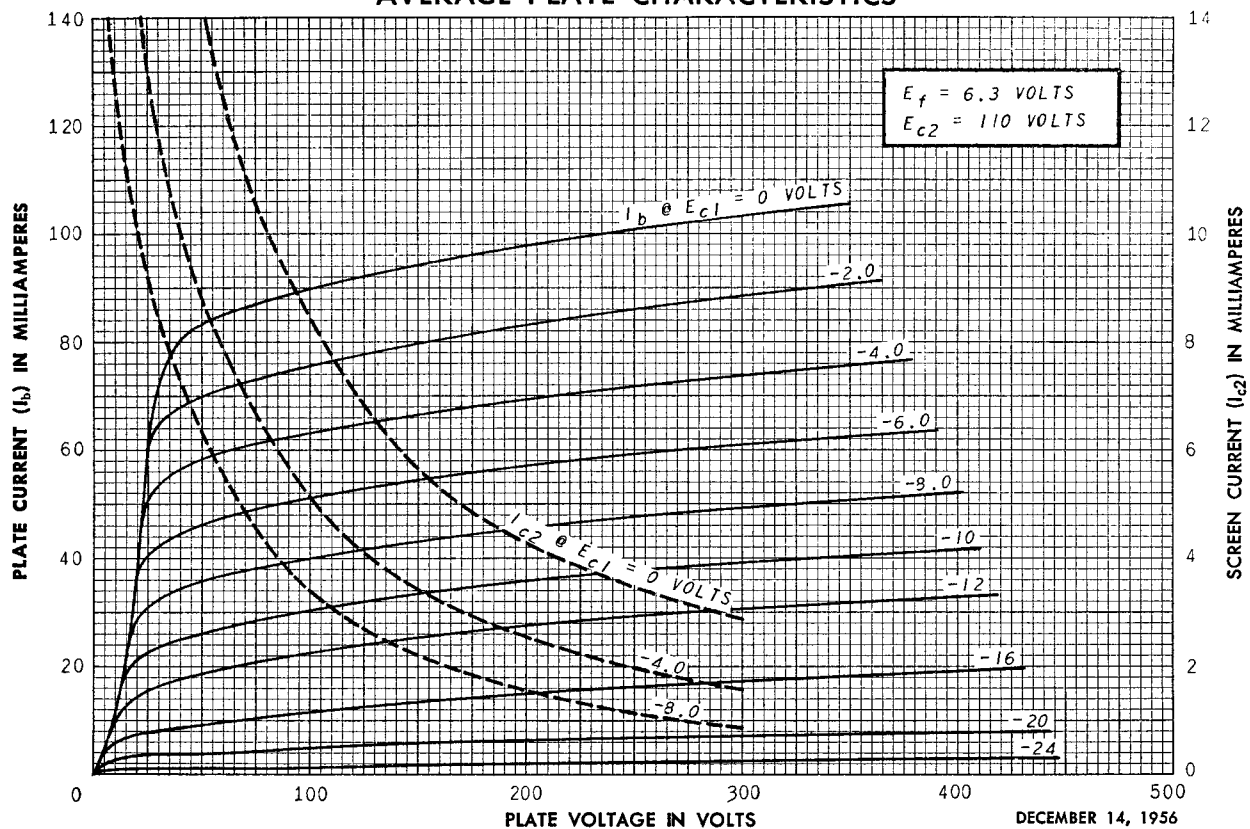
**Note:** The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

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

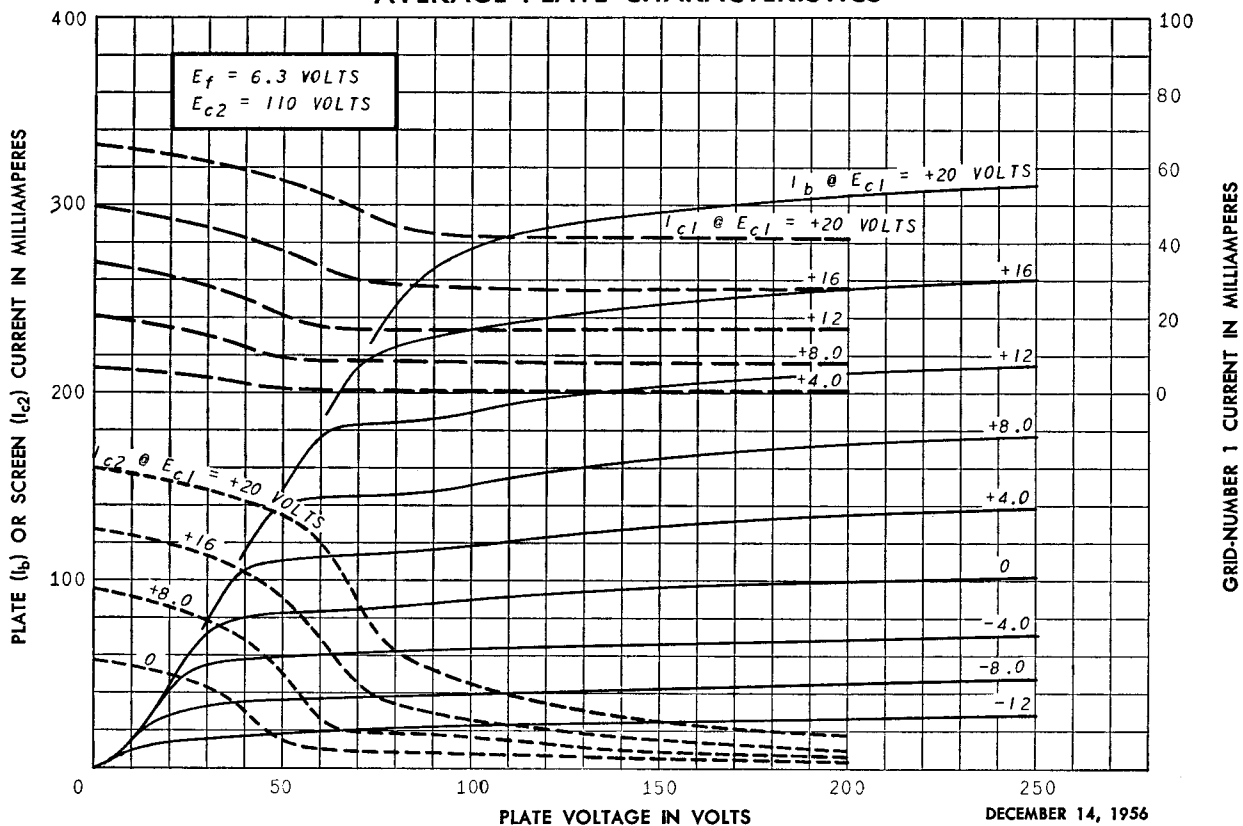
# AVERAGE PLATE CHARACTERISTICS



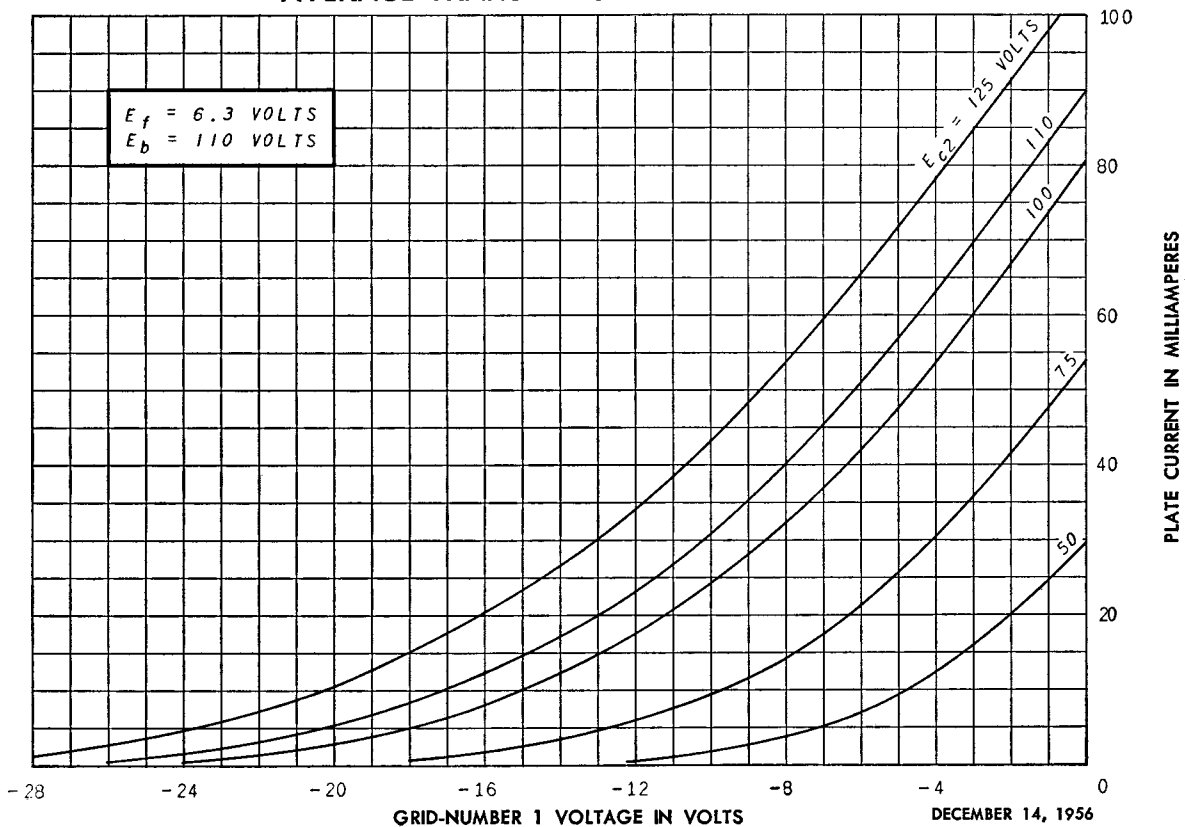
# AVERAGE PLATE CHARACTERISTICS



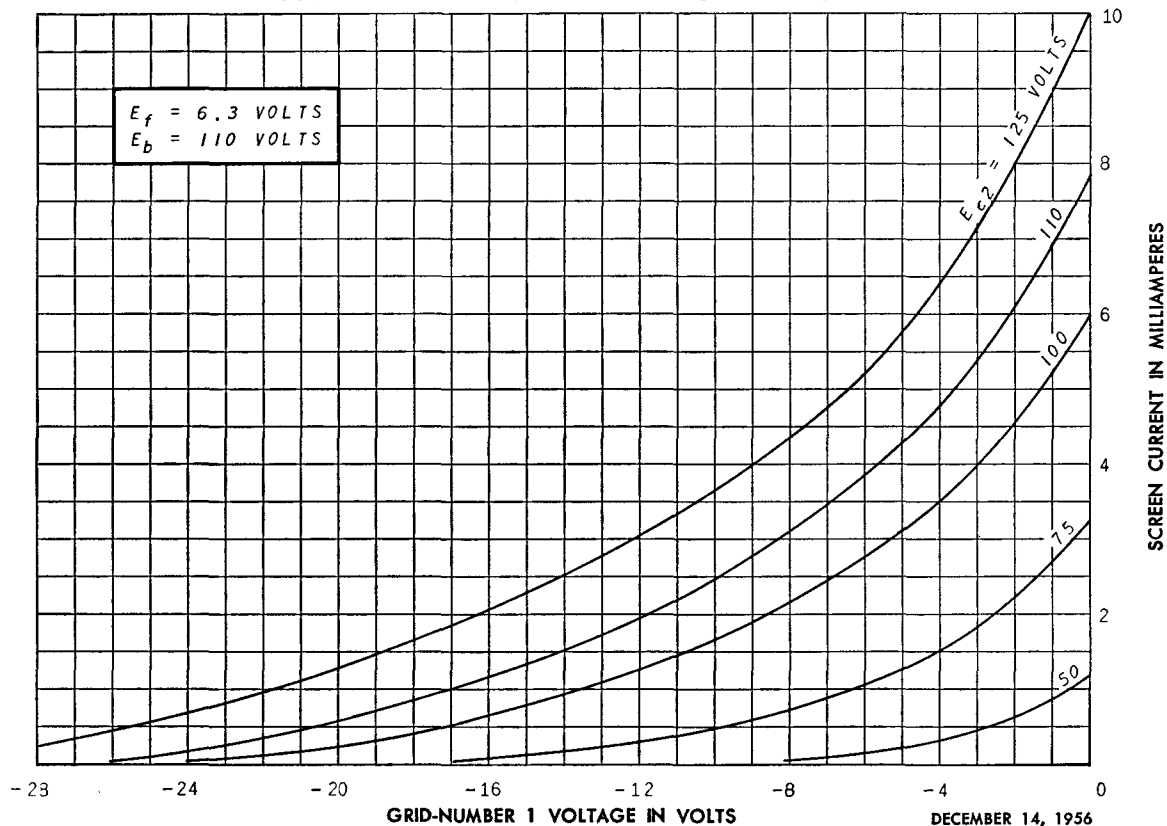
## AVERAGE PLATE CHARACTERISTICS



## AVERAGE TRANSFER CHARACTERISTICS



# AVERAGE TRANSFER CHARACTERISTICS



# AVERAGE TRANSFER CHARACTERISTICS

