TECHNICAL DATA

# 6775
# 4-400C

RADIAL BEAM
POWER TETRODE

The EIMAC 6775/4-400C is a compact, ruggedly constructed, broadcast-quality tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator, or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 6775/4-400C is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Series Air-System Socket, and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.[1]

The 6775/4-400C is especially recommended for applications where long life and consistent performance are of prime consideration.[2]


## GENERAL CHARACTERISTICS[3]

### ELECTRICAL

| | | |
|---|---|---|
| Filament: Thoriated Tungsten | | |
| Voltage | 5.0 ± 0.25 | V |
| Current, at 5.0 volts | 14.7 | A |
| Transconductance (Average): | | |
| $I_b$ = 100 mA, $E_{c2}$ = 500 volts | 4000 | μmhos |
| Amplification Factor (Average): | | |
| Grid to Screen | 5.1 | |
| Direct Interelectrode Capacitances (grounded filament)[4] | | |
| Cin | 12.5 | pF |
| Cout | 4.7 | pF |
| Cgp | 0.12 | pF |
| Frequency of Maximum Rating: | | |
| CW | 110 | MHz |

1. Guarantee applies only when the 4-400C is used as specified with adequate cooling air in the SK-400 or SK-410 Air-System Socket and associated chimney, or equivalents.
2. See FILAMENT VOLTAGE section for recommended operating conditions when long life and consistent performance are of prime concern.
3. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
4. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.



Printed in U.S.A.

## MECHANICAL

| | |
|---|---|
| Maximum Overall Dimensions: | |
| Length | 6.375 in; 161.93 mm |
| Diameter | 3.563 in; 90.50 mm |
| Net Weight | 9.0 oz; 255 gm |
| Operating Position | Any |
| Maximum Operating Temperature: | |
| Plate Seal | 225°C |
| Base Seals | 200°C |
| Cooling | Radiation and forced air |
| Base | Special 5-pin |
| Recommended Socket | EIMAC SK-400 Series |
| Recommended Chimney | EIMAC SK-406 |
| Recommended Heat-Dissipating Connectors: | |
| Plate | HR-6 |

## RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class $AB_1$

ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 4000 | VOLTS |
| DC SCREEN VOLTAGE | 800 | VOLTS |
| DC PLATE CURRENT | 0.350 | AMPERE |
| PLATE DISSIPATION | 400 | WATTS |
| SCREEN DISSIPATION | 35 | WATTS |
| GRID DISSIPATION | 10 | WATTS |

TYPICAL OPERATION (Frequencies to 75 MHz)
Class $AB_1$, Grid Driven, Peak Envelope or Modulation Crest Conditions

| | | |
|---|---|---|
| Plate Voltage | 3000 | Vdc |
| Screen Voltage | 750 | Vdc |
| Grid Voltage 1 | -130 | Vdc |
| Zero-Signal Plate Current | 80 | mAdc |
| Single-Tone Plate Current | 290 | mAdc |
| Single-Tone Screen Current 2 | 13 | mAdc |
| Useful Output Power | 470 | w |
| Resonant Load Impedance | 5000 | Ω |

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

## RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 4000 | VOLTS |
| DC SCREEN VOLTAGE | 600 | VOLTS |
| DC PLATE CURRENT | 0.350 | AMPERE |
| PLATE DISSIPATION | 400 | WATTS |
| SCREEN DISSIPATION | 35 | WATTS |
| GRID DISSIPATION | 10 | WATTS |

TYPICAL OPERATION (Frequencies to 75 MHz)

| | | | | |
|---|---|---|---|---|
| Plate Voltage | 2500 | 3000 | 4000 | Vdc |
| Screen Voltage | 500 | 500 | 500 | Vdc |
| Grid Voltage | -200 | -220 | -220 | Vdc |
| Plate Current | 350 | 350 | 350 | mAdc |
| Screen Current 1 | 46 | 46 | 40 | mAdc |
| Screen Dissipation | 23 | 23 | 20 | W |
| Grid Current 1 | 18 | 19 | 18 | mAdc |
| Peak rf Grid Voltage 1 | 300 | 320 | 320 | v |
| Grid Dissipation | 1.8 | 1.9 | 1.8 | W |
| Calculated Driving Power 2 | 5.4 | 6.1 | 5.8 | W |
| Plate Input Power | 875 | 1050 | 1400 | W |
| Plate Dissipation | 235 | 250 | 300 | W |
| Plate Output Power | 640 | 800 | 1100 | W |

1. Approximate value.
2. Driving Power increases with frequency. At 75 MHz driving power is approximately 12 watts.

TYPICAL OPERATION (110 MHz, two tubes)

| | | | |
|---|---|---|---|
| Plate Voltage | 3000 | 4000 | Vdc |
| Screen Voltage | 500 | 500 | Vdc |
| Grid Voltage | -170 | -170 | Vdc |
| Plate Current | 500 | 540 | mAdc |
| Screen Current | 34 | 31 | mAdc |
| Grid Current | 20 | 20 | mAdc |
| Driving Power 1 | 20 | 20 | W |
| Plate Output Power 1 | 1300 | 1600 | W |
| Useful Output Power | 1160 | 1440 | W |

1. Approximate value

**PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN** Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 3200 | VOLTS |
| DC SCREEN VOLTAGE | 600 | VOLTS |
| DC GRID VOLTAGE | -500 | VOLTS |
| DC PLATE CURRENT | 0.275 | AMPERE |
| PLATE DISSIPATION[1] | 270 | WATTS |
| SCREEN DISSIPATION[2] | 35 | WATTS |
| GRID DISSIPATION[2] | 10 | WATTS |

1. Corresponds to 400 watts at 100% sine-wave modulation.

TYPICAL OPERATION (Frequencies to 75 MHz, Continuous Service)

| | | | | |
|---|---|---|---|---|
| Plate Voltage | 2000 | 2500 | 3000 | Vdc |
| Screen Voltage | 500 | 500 | 500 | Vdc |
| Grid Voltage | -220 | -220 | -220 | Vdc |
| Plate Current | 275 | 275 | 275 | mAdc |
| Screen Current[1] | 30 | 28 | 26 | mAdc |
| Screen Dissipation | 15 | 14 | 13 | W |
| Grid Current[1] | 12 | 12 | 12 | mAdc |
| Grid Dissipation | 1.1 | 1.1 | 1.1 | W |
| Peak af Screen Voltage[1] (100% modulation) | 350 | 350 | 350 | v |
| Peak rf Grid Voltage[1] | 290 | 290 | 290 | v |
| Calculated Driving Power[1] | 3.5 | 3.5 | 3.5 | W |
| Plate Input Power | 550 | 688 | 825 | W |
| Plate Dissipation | 170 | 178 | 195 | W |
| Plate Output Power | 380 | 510 | 630 | W |

1. Approximate value.

**MAXIMUM RATINGS** (Frequencies to 30 MHz, Intermittent Service)

ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 4000 | VOLTS |
| DC SCREEN VOLTAGE | 600 | VOLTS |
| DC GRID VOLTAGE | -500 | VOLTS |
| DC PLATE CURRENT | 0.275 | AMPERE |
| PLATE DISSIPATION[1] | 270 | WATTS |
| SCREEN DISSIPATION[2] | 35 | WATTS |
| GRID DISSIPATION[2] | 10 | WATTS |

2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz, Intermittent Service)

| | | | | | |
|---|---|---|---|---|---|
| Plate Voltage | 2000 | 2500 | 3000 | 3650 | Vdc |
| Screen Voltage | 500 | 500 | 500 | 500 | Vdc |
| Grid Voltage | -220 | -220 | -220 | -225 | Vdc |
| Plate Current | 275 | 275 | 275 | 275 | mAdc |
| Screen Current[1] | 30 | 28 | 26 | 23 | mAdc |
| Screen Dissipation | 15 | 14 | 13 | 12 | W |
| Grid Current[1] | 12 | 12 | 12 | 13 | mAdc |
| Grid Dissipation | 1.1 | 1.1 | 1.1 | 1.2 | W |
| Peak Screen Voltage (100% modulation) | 350 | 350 | 350 | 350 | v |
| Peak rf Grid Voltage[1] | 290 | 290 | 290 | 315 | v |
| Calculated Driving Power[1] | 3.5 | 3.5 | 3.5 | 4.0 | W |
| Plate Input Power | 550 | 688 | 825 | 1000 | W |
| Plate Dissipation | 170 | 178 | 195 | 235 | W |
| Plate Output Power | 380 | 510 | 630 | 765 | W |

**AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR** Class AB, Grid Driven
(Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

| | | |
|---|---|---|
| DC PLATE VOLTAGE | 4000 | VOLTS |
| DC SCREEN VOLTAGE | 800 | VOLTS |
| DC PLATE CURRENT | 0.350 | AMPERE |
| PLATE DISSIPATION | 400 | WATTS |
| SCREEN DISSIPATION | 35 | WATTS |
| GRID DISSIPATION | 10 | WATTS |

TYPICAL OPERATION (Two Tubes) Class $AB_1$

| | | | | | |
|---|---|---|---|---|---|
| Plate Voltage | 2500 | 3000 | 3500 | 4000 | Vdc |
| Screen Voltage | 750 | 750 | 750 | 750 | Vdc |
| Grid Voltage[1/4] | -130 | -137 | -145 | -150 | Vdc |
| Zero-Signal Plate Current | 190 | 160 | 140 | 120 | mAdc |
| Max.Signal Plate Current | 635 | 635 | 610 | 585 | mAdc |
| Zero-Signal Screen Current | 0 | 0 | 0 | 0 | mAdc |
| Max.Signal Screen Current[1] | 28 | 26 | 32 | 40 | mAdc |
| Peak af Grid Voltage[2] | 130 | 137 | 145 | 150 | v |
| Peak Driving Power[3] | 0 | 0 | 0 | 0 | w |
| Max Signal Plate Dissipation[2] | 370 | 400 | 400 | 400 | W |
| Plate Output Power | 850 | 1100 | 1330 | 1540 | W |
| Load Resistance (plate to plate) | 6800 | 8900 | 11,500 | 14,000 | Ω |

TYPICAL OPERATION (Two Tubes) Class $AB_2$

| | | | | | |
|---|---|---|---|---|---|
| Plate Voltage | 2500 | 3000 | 3500 | 4000 | Vdc |
| Screen Voltage | 500 | 500 | 500 | 500 | Vdc |
| Grid Voltage[1/4] | -75 | -80 | -85 | -90 | Vdc |
| Zero-Signal Plate Current | 190 | 160 | 140 | 120 | mAdc |
| Max.Signal Plate Current | 700 | 700 | 700 | 638 | mAdc |
| Zero-Signal Screen Current | 0 | 0 | 0 | 0 | mAdc |
| Max.Signal Screen Current | 50 | 40 | 38 | 32 | mAdc |
| Peak af Grid Voltage[2] | 133 | 140 | 145 | 140 | v |
| Peak Driving Power[3] | 8.6 | 9.0 | 10.2 | 7.0 | w |
| Max.Signal Plate Dissipation[2] | 320 | 363 | 400 | 400 | W |
| Plate Output Power | 1110 | 1375 | 1650 | 1750 | W |
| Load Resistance (plate to plate) | 7200 | 9100 | 10,800 | 14,000 | Ω |

1. Approximate value.
2. Per Tube.
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

## RANGE VALUES FOR EQUIPMENT DESIGN

| | Min. | Max. | |
|---|---|---|---|
| Filament: Current at 5.0 volts | 14.0 | 15.3 | A |
| Interelectrode Capacitances [1] (grounded filament connection): | | | |
| Cin | 10.7 | 14.5 | pF |
| Cout | 4.2 | 5.6 | pF |
| Cgp | ---- | 0.17 | pF |

1. In Shielded Fixture, per EIA Standard RS-191.

## APPLICATION

### MECHANICAL

*MOUNTING* - The 4-400C may be operated in any position. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

*COOLING* - Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 or SK-410 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water or less, as measured in the socket or plenum chamber at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

Tube temperatures may be measured with a temperature sensitive paint, spray or crayon, such as manufactured by Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

### ELECTRICAL

*FILAMENT VOLTAGE* - Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal voltage, variations of ±5% are tolerable and should have little effect on electrical performance of the tube. However, when very long life and consistent performance are factors, voltage can often be reduced to a value lower than the nominal voltage, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable, a typical procedure would involve a one-to-one regulating transformer, feeding a variable ratio transformer (such as a POWERSTAT or a VARIAC), which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage applied, and when stable operation is achieved, the voltage is then reduced in small steps (about 0.2 volt at a time) until the point is reached where performance of the tube is clearly affected. The voltage is then

raised to a few tenths of a volt above this level for operation. Periodically (every 500 to 1000 hours) this procedure should be repeated and the operating value of the filament voltage readjusted if necessary.

*BIAS VOLTAGE* - The dc bias voltage for the 4-400C should not exceed 500 volts. If grid resistor bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

*SCREEN VOLTAGE* - The dc screen voltage for the 4-400C should not exceed 800 volts. The screen voltages shown under Typical Operation are representative voltages for the type of operation involved.

*PLATE VOLTAGE* - The plate-supply voltage for the 4-400C should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

*GRID DISSIPATION* - Grid dissipation for the 4-400C should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$Pg = egk \times Ic$$

where $Pg$ = Grid dissipation
$e_{gk}$ = Peak positive grid to cathode voltage, and
$Ic$ = dc grid current

*SCREEN DISSIPATION* - The power dissipated by the screen of the 4-400C must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

*PLATE DISSIPATION* - Under normal operating conditions, the plate dissipation of the 4-400C should not be allowed to exceed 400 watts. The anode operates at a visibly red color at its maximum rated dissipation of 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

*MULTIPLE OPERATION* - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class AB1 operation.

*CAUTION - GLASS IMPLOSION* - The EIMAC 4-400C is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

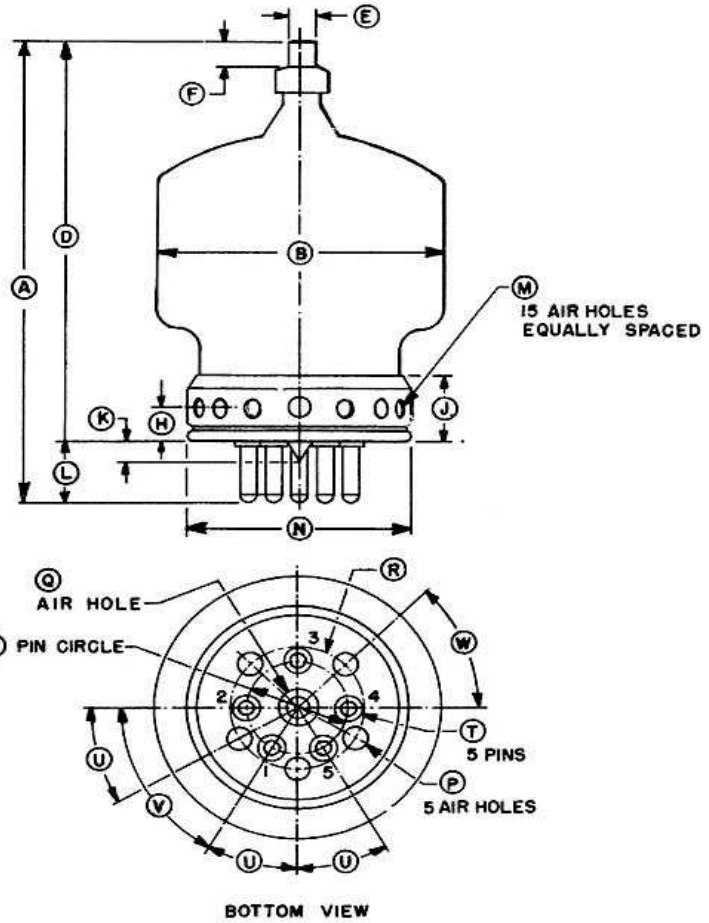
*CAUTION-HIGH VOLTAGE* - Operating voltage for the 4-400C can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

*SPECIAL APPLICATION* - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

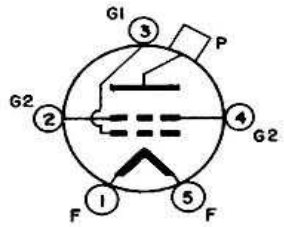
DIMENSIONAL DATA

| DIM. | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN. | MAX. | REF. | MIN. | MAX. | REF. |
| A | 5.875 | 6.375 | -- | 149.23 | 161.93 | -- |
| B | -- | 3.563 | -- | -- | 90.50 | -- |
| | | | | | | |
| D | 5.125 | 5.625 | -- | 130.18 | 142.88 | -- |
| E | 0.350 | 0.365 | -- | 8.89 | 9.27 | -- |
| F | 0.328 | -- | -- | 8.33 | -- | -- |
| | | | | | | |
| H | -- | -- | 0.438 | -- | -- | 11.13 |
| J | -- | 0.969 | -- | -- | 24.61 | -- |
| K | -- | 0.250 | -- | -- | 6.35 | -- |
| L | -- | -- | 0.750 | -- | -- | 19.05 |
| M | -- | -- | 0.250 | -- | -- | 6.35 |
| N | -- | 2.750 | -- | -- | 69.85 | -- |
| P | -- | -- | 0.312 | -- | -- | 7.92 |
| Q | -- | -- | 0.500 | -- | -- | 12.70 |
| R | -- | -- | 1.625 | -- | -- | 41.28 |
| S | -- | -- | 1.250 | -- | -- | 31.75 |
| T | 0.185 | 0.191 | -- | 4.70 | 4.85 | -- |
| U | -- | -- | 30° | -- | -- | 30° |
| V | -- | -- | 60° | -- | -- | 60° |
| W | -- | -- | 45° | -- | -- | 45° |
| | | | | | | |
| | | | | | | |

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

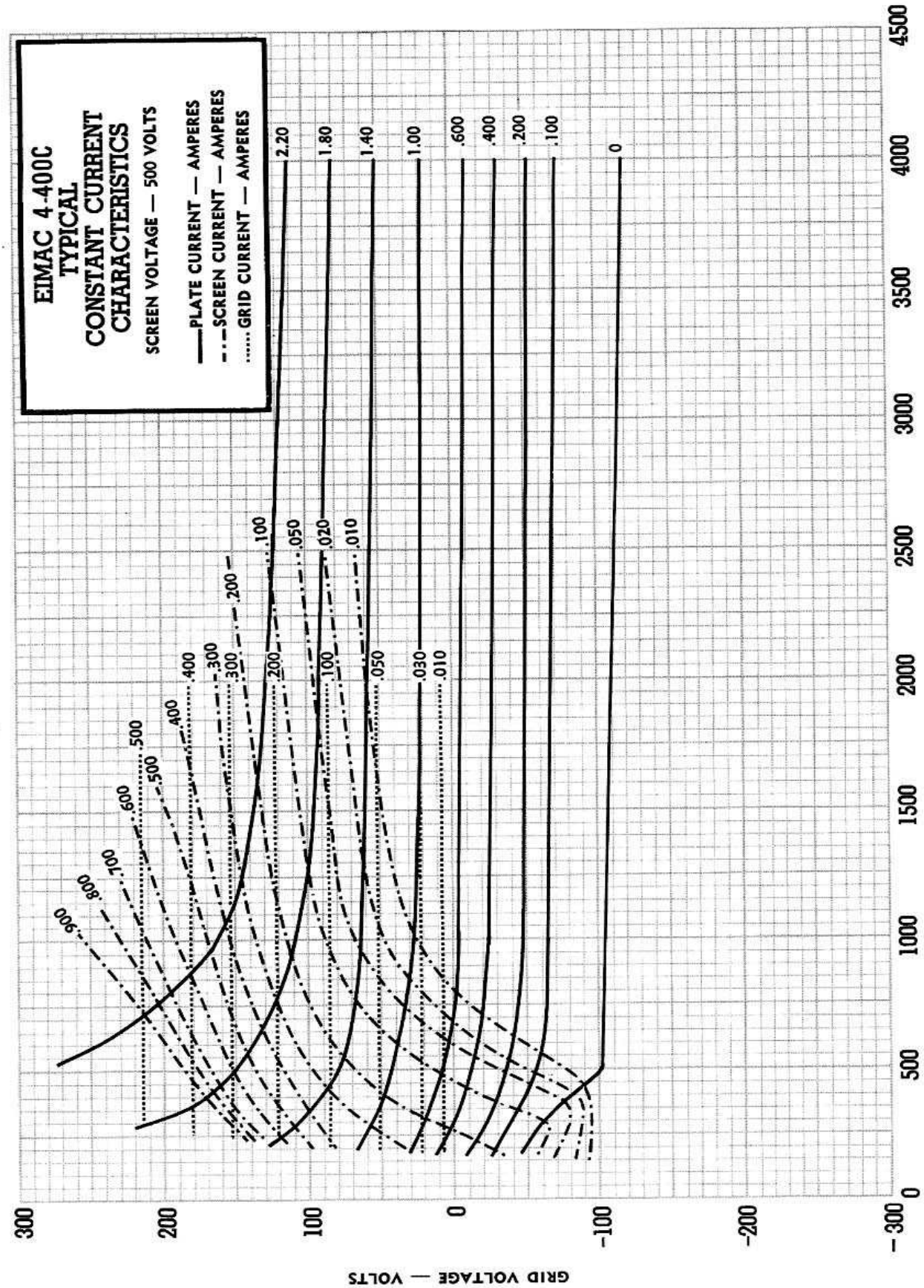



BOTTOM VIEW




**NOTE:**

**Base pins T and tubulation K are so alined that they can be freely inserted in a gage ¼ inch (6.35 mm) thick with hole diameters of .204 (5.18 mm) and .500 (12.70 mm), respectively, located on the true centers by the given dimensions S, U, V.**


EIMAC 4-400C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
2.20
1.80
1.40
1.00
.600
.400
.200
.100
0
.100
.050
.020
.010
.030
.010
.050
.100
.200
.300
.400
.500
.600
.700
.800
.900
300
200
100
0
-100
-200
-300
0
500
1000
1500
2000
2500
3000
3500
4000
4500
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS