

EITEL-McCULLOUGH, Inc.

SAN BRUNO, CALIFORNIA

2000T

MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The 2000T is a medium-mu, high-vacuum transmitting triode intended for amplifier, oscillator and modulator service. It has a maximum plate dissipation rating of 2000 watts. Cooling of the 2000T is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by means of forced air circulation around the envelope and at the seals.

GENERAL CHARACTERISTICS

ELECTRICAL

| | |
|------------------------------|--------------|
| Filament: Thoriated Tungsten | |
| Voltage | 10.0 volts |
| Current | 23.5 amperes |

Note: Dual connections for each filament lead are provided within the base of the tube (see basing diagram). Corresponding socket terminals must be connected in parallel to provide proper distribution of filament and R-F charging currents.

| | |
|---|-------------------------|
| Amplification Factor (Average) | 23 |
| Direct Interelectrode Capacitances (Average) | |
| Grid-Plate | 8.5 $\mu\text{mfd.}$ |
| Grid-Filament | 12.7 $\mu\text{mfd.}$ |
| Plate-Filament | 1.7 $\mu\text{mfd.}$ |
| Transconductance ($i_b = 1.75 \text{ amp.}, E_b = 6000 \text{ v.}$) | 11,000 μmhos |
| Frequency for Maximum Ratings | 40 Mc. |

MECHANICAL

| | |
|----------|---------------------------|
| Base | Special 4-pin, No. 5006B |
| Basing | RMA type 48D |
| Mounting | Vertical, base down or up |
| Cooling | Radiation and forced air |

Recommended Heat Dissipating Connectors:

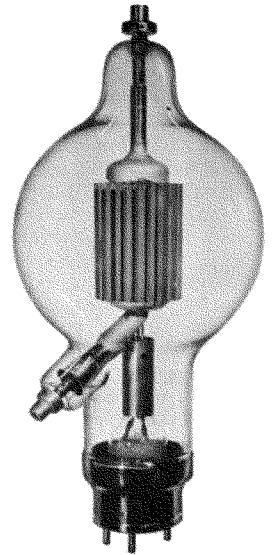
| | |
|-------|------------|
| Plate | Eimac HR-8 |
| Grid | Eimac HR-8 |

Maximum Overall Dimensions:

| | |
|----------|--------------|
| Length | 17.75 inches |
| Diameter | 8.125 inches |

Net weight 3.5 pounds

Shipping weight (Average) 13 pounds



AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB₂ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

| | |
|--|-----------------|
| D-C PLATE VOLTAGE | 8000 MAX. VOLTS |
| MAX-SIGNAL D-C PLATE CURRENT, PER TUBE | 1.75 MAX. AMPS. |
| PLATE DISSIPATION, PER TUBE | 2000 MAX. WATTS |

TYPICAL OPERATION—2 TUBES

| | | | | | |
|--|------|------|------|------|-------|
| D-C Plate Voltage | 4000 | 5000 | 6000 | 7000 | Volts |
| D-C Grid Voltage (approx)* | -140 | -180 | -230 | -280 | Volts |
| Zero-Signal D-C Plate Current | 400 | 400 | 400 | 300 | Ma. |
| Max-Signal D-C Plate Current | 2.30 | 2.20 | 2.00 | 1.80 | Amps |
| Effective Load, Plate-to-Plate | 3400 | 5000 | 7000 | 9200 | Ohms |
| Peak A-F Grid Input Voltage (per tube) | 500 | 520 | 580 | 600 | Volts |
| Max-Signal Peak Driving Power | 300 | 280 | 380 | 350 | Watts |
| Max-Signal Nominal Driving Power (approx.) | 150 | 140 | 190 | 175 | Watts |
| Max-Signal Plate Power Output | 5200 | 7000 | 8000 | 8600 | Watts |

*Adjust to give stated zero-signal plate current

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telephony or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS (Frequencies below 40 Mc.)

| | |
|-------------------|-----------------|
| D-C PLATE VOLTAGE | 8000 MAX. VOLTS |
| D-C PLATE CURRENT | 1.75 MAX. AMPS. |
| PLATE DISSIPATION | 2000 MAX. WATTS |
| GRID DISSIPATION | 150 MAX. WATTS |

TYPICAL OPERATION, PER TUBE* (Frequencies below 40 Mc.)

| | | | | |
|-----------------------------|------|------|------|-------|
| D-C Plate Voltage | 5000 | 6000 | 7000 | Volts |
| D-C Grid Voltage | -350 | -500 | -600 | Volts |
| D-C Plate Current | 1.35 | 1.35 | 1.15 | Amps. |
| D-C Grid Current | 175 | 165 | 120 | Ma. |
| Peak R-F Grid Input Voltage | 840 | 1000 | 1060 | Volts |
| Driving Power (approx.) | 140 | 160 | 115 | Watts |
| Grid Dissipation | 85 | 82 | 55 | Watts |
| Plate Power Input | 6750 | 8000 | 8000 | Watts |
| Plate Dissipation | 2000 | 2000 | 2000 | Watts |
| Plate Power Output | 4750 | 6000 | 6000 | Watts |

*The performance figures listed under Typical Operation are for radio frequencies up to the VHF region and are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power given includes power taken by the tube grid and the bias circuit. The driving power and output power do not allow for losses in the associated resonant circuits. These losses are not included because they depend principally upon the design and choice of the circuit components.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies below 40 Mc.)

| | |
|-------------------|-----------------|
| D-C PLATE VOLTAGE | 6000 MAX. VOLTS |
| D-C PLATE CURRENT | 1.4 MAX. AMPS. |
| PLATE DISSIPATION | 1350 MAX. WATTS |
| GRID DISSIPATION | 150 MAX. WATTS |

TYPICAL OPERATION, PER TUBE* (Frequencies below 40 Mc.)

| | | | | |
|---------------------------------------|------|------|------|-------|
| D-C Plate Voltage | 4000 | 5000 | 6000 | Volts |
| D-C Plate Current | 1.25 | 1.20 | 1.13 | Amps. |
| Total Bias Voltage | -600 | -700 | -800 | Volts |
| Fixed Bias Voltage | -300 | -330 | -375 | Volts |
| Grid Resistor | 1500 | 2000 | 2500 | Ohms |
| D-C Grid Current | 200 | 185 | 170 | Ma. |
| Peak R-F Grid Input Voltage (approx.) | 1140 | 1240 | 1320 | Volts |
| Driving Power (approx.) | 228 | 230 | 225 | Watts |
| Grid Dissipation | 108 | 100 | 88 | Watts |
| Plate Power Input | 5000 | 6000 | 6750 | Watts |
| Plate Dissipation | 1350 | 1350 | 1350 | Watts |
| Plate Power Output | 3650 | 4650 | 5400 | Watts |

*The performance figures listed under Typical Operation are for radio frequencies up to the VHF region and are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power given includes power taken by the tube grid and the bias circuit. The driving power and output power do not allow for losses in the associated resonant circuits. These losses are not included because they depend principally upon the design and choice of the circuit components.

APPLICATION

MECHANICAL

Mounting—The 2000T must be mounted vertically, base up or base down. Flexible connecting straps should be provided between the grid and plate terminals and the external grid and plate circuits. The tube must be protected from severe vibration and shock.

► **Cooling**—Forced-air cooling is required on the envelope and also in the base of the tube. Envelope cooling may be accomplished by locating an ordinary 8- or 10-inch fan about one foot from the tube and directing the air at the middle of the envelope.

Base cooling requires an air flow of $2\frac{1}{2}$ cu. ft. per min. directed up through the bottom of the base toward the filament press. The base of the tube is provided with a 1-inch diameter hole for this purpose. If a socket is used with a 1-inch diameter matching hole and the manifold is of the same diameter, a static pressure of less than 0.1 inch of water is required at the manifold to provide the $2\frac{1}{2}$ cu. ft. per min.

One type of socket provides a $\frac{1}{4}$ inch diameter pipe for the air inlet to the base. With this type of socket a static pressure of $5\frac{1}{2}$ inches of water is required at the pipe to obtain the necessary $2\frac{1}{2}$ cu. ft. per min. volume.

Suitable electrical interlocks should be provided to remove the plate and filament voltages in the event that the supply of cooling air is interrupted.

ELECTRICAL

► **Filament Voltage**—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 10 volts. Unavoidable variations in filament voltage must be kept within the range from 9.5 to 10.5 volts. All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 2000T there is

little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Plate Voltage—The plate supply voltage for the 2000T should not exceed 8000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—The power dissipated by the grid of the 2000T must not exceed 150 watts. Grid dissipation may be calculated from the following expression:

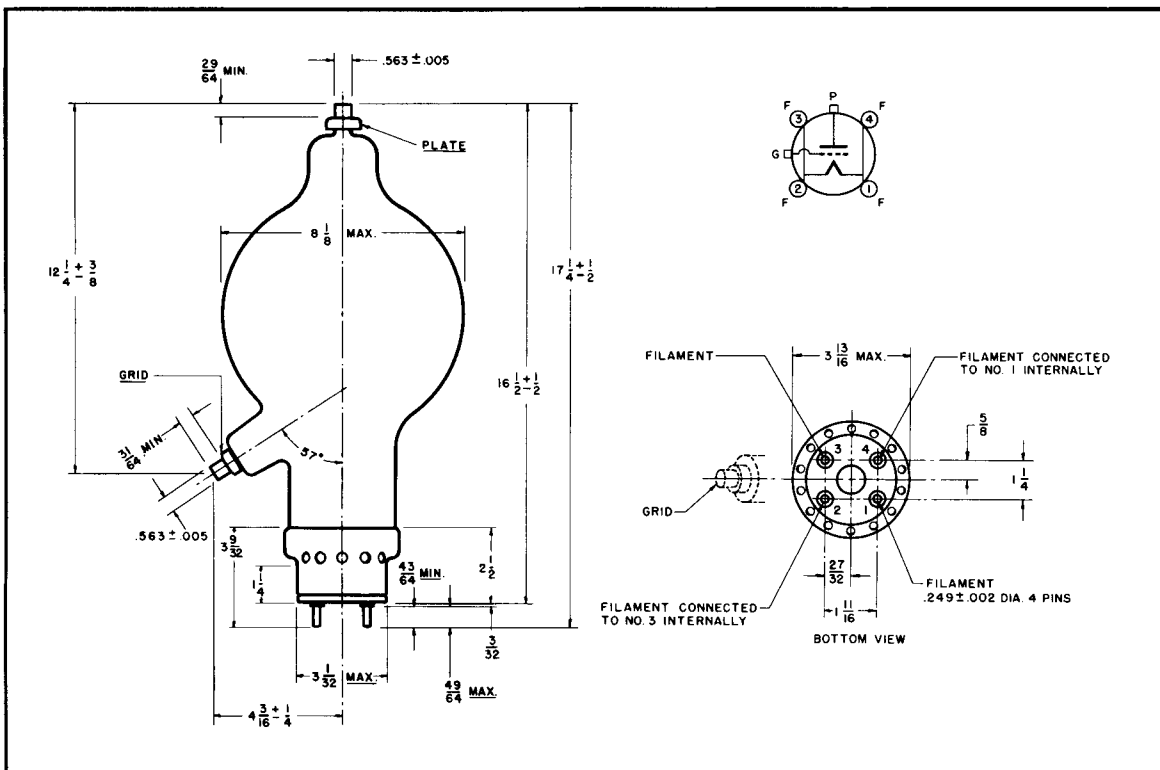
$$P_g = e_{emp} I_c$$

where P_g = Grid dissipation,
 e_{emp} = Peak positive grid voltage, and
 I_c = D-c grid current.

e_{emp} may be measured by means of a suitable peak voltmeter connected between filament and grid.¹ In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 2000T should not be allowed to exceed 2000 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

¹For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," Eimac News, January, 1945. This article is available in reprint form on request.



DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 5000, 6000, and 7000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p .

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 5000, 6000, and 7000 volts respectively.

