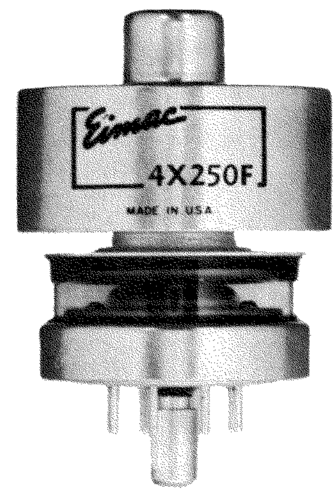
TENTATIVE DATA

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4X250F

RADIAL-BEAM POWER TETRODE



The Eimac 4X250F is a compact, oxide-cathode, external-anode power tetrode, unilaterally interchangeable with the 4X150D in most applications, and is intended for use as an amplifier, oscillator or frequency multiplier over a wide range of frequencies extending into the UHF region. It is cooled by convection and forced air.

A single 4X250F in a coaxial-cavity amplifier circuit will deliver up to 300 watts of useful power output at 400 megacycles although this is not the upper frequency limit of the tube.

Outstanding features of the 4X250F are: 1. Simple air-cooling requirements. 2. A maximum plate dissipation rating of 250 watts available for low-efficiency applications. 3. A maximum d-c plate voltage rating of 2000 volts at frequencies up to 400 Mc. The high transconductance of the 4X250F makes the tube useful at relatively low plate voltages. The high ratio of transconductance to inter-electrode capacitance and the 250-watt plate dissipation make the tube very useful for wide-band amplifier applications.

The use of an Eimac Air-System Socket or a socket providing equivalent air cooling characteristics, is required.

GENERAL CHARACTERISTICS

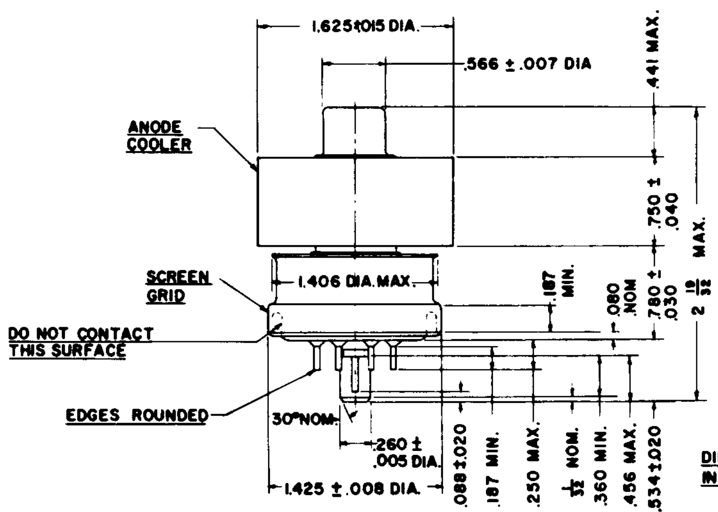
ELECTRICAL

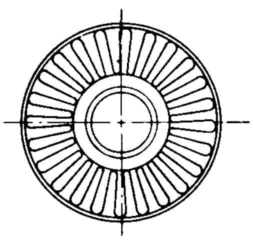
Cathode: Oxide Coated, Unipotential		
Minimum Heating Time	30	seconds
Cathode-to-Heater Voltage	150	max. volts
Heater: Voltage	26.5	volts
Current	0.50	amperes
Grid-Screen Amplification Factor (Average)	5	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.04	μμf
Input	18.5	μμf
Output	4.7	μμf
Transconductance (E_b=500v., E_{c2}=250v., I_b=200 ma)	12,000	μmhos
Frequency for Maximum Plate Voltage Ratings	400	Mc

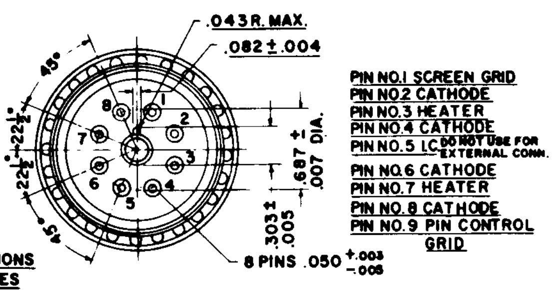
(All other Maximum Ratings applicable to 500 Mc)

MECHANICAL

Base	9-pin, special	
Recommended Socket	Eimac Air-System Socket	
Base Connections	See outline drawing	
Mounting	Any position	
Cooling	Convection and Forced air	
Maximum Over-all Dimensions		
Length	2.59	inches
Diameter	1.65	inches
Seated Height	2.03	inches
Net Weight	4.0	ounces
Shipping Weight	1.6	pounds







DIMENSIONS IN INCHES

BOTTOM VIEW

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

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

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000	MAX. VOLTS
D-C SCREEN VOLTAGE	300	MAX. VOLTS
D-C GRID VOLTAGE	—250	MAX. VOLTS
D-C PLATE CURRENT	250	MAX. MA
PLATE DISSIPATION	250	MAX. WATTS
SCREEN DISSIPATION	12	MAX. WATTS
GRID DISSIPATION	2	MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, per tube)

D-C Plate Voltage	500	1000	1500	2000	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	ma
D-C Screen Current	45	35	30	25	ma
D-C Grid Current	32	28	28	27	ma
Peak R-F Grid Voltage (approx.)	118	116	116	115	volts
Driving Power	3.6	3.2	3.2	2.8	watts
Plate Power Input	125	250	375	500	watts
Plate Power Output	85	195	300	410	watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500	MAX. VOLTS
D-C SCREEN VOLTAGE	300	MAX. VOLTS
D-C GRID VOLTAGE	—250	MAX. VOLTS
D-C PLATE CURRENT	200	MAX. MA
PLATE DISSIPATION	165	MAX. WATTS
SCREEN DISSIPATION	12	MAX. WATTS
GRID DISSIPATION	2	MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175Mc, per tube)

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current	45	35	25	ma
D-C Grid Current	22	19	17	ma
Peak R-F Grid Input Voltage	124	122	121	volts
Driving Power	2.7	2.3	2.1	watts
Plate Power Input	100	200	300	watts
Plate Power Output	75	160	250	watts

CLASS-AB POWER AMPLIFIER OR MODULATOR

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000	MAX. VOLTS
D-C SCREEN VOLTAGE	400	MAX. VOLTS
D-C PLATE CURRENT	250	MAX. MA
PLATE DISSIPATION	250	MAX. WATTS
SCREEN DISSIPATION	12	MAX. WATTS
GRID DISSIPATION	2	MAX. WATTS

TYPICAL OPERATION
Class-AB_1 Audio Amplifier (Sinusoidal wave, two tubes unless otherwise noted)

D-C Plate Voltage	1000	1500	2000	volts,
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage (approx.)*	—50	—50	—50	volts
Zero-Signal D-C Plate Current	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	ma
Max-Signal D-C Screen Current	50	40	30	ma
Effective Load, Plate-to-Plate	3260	5760	8260	ohms
Peak A-F Grid Input Voltage (per tube)	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	125	150	175	watts
Max-Signal Plate Power Output	250	450	650	watts
Third-Harmonic Distortion	4.5	4.5	4.5	pct

*Adjust grid voltage to obtain specified zero-signal plate current

TYPICAL OPERATION
Class-AB_1 R-F Linear Amplifier (Frequencies to 175 Mc, per tube)

D-C Plate Voltage	1000	1500	2000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage (approx.)*	—50	—50	—50	volts
Zero-Signal D-C Plate Current	100	100	100	ma
Max-Signal D-C Plate Current	250	250	250	ma
Max-Signal D-C Screen Current	25	20	15	ma
Peak R-F Grid Voltage	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation	125	150	175	watts
Max-Signal Plate Power Output	125	225	325	watts

*Adjust grid voltage to obtain specified zero-signal plate current

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

APPLICATION

MECHANICAL

Mounting—The 4X250F may be mounted in any position. Use of an Eimac Air -System Socket, or its equivalent, is recommended.

The tube will fit a standard "loktal" socket, but the use of such a socket in the usual way prevents adequate air-cooling of the base of the tube. Use of the "loktal" socket is not recommended.

Connections to the terminals of all the electrodes except the plate are provided by the Air-System Socket. The anode-cooler assembly provides a terminal surface for the plate connection. For high-frequency applications a metal band or a spring-finger collet should be used to make good electrical contact with the cylindrical outer surface of the anode cooler. Points of electrical contact should be kept clean and free of oxidation to minimize r-f losses.

Cooling—The 4X250F requires sufficient cooling air to prevent the temperature of the metal part of the metal-to-glass seals exceeding a maximum of 175°C. The temperature of the anode as measured at the base of the cooling fins must be maintained below its maximum of 250°C.

Under conditions of normal room temperatures and installation in the Eimac Air-System Socket, the 4X250F requires no forced air during stand-by periods where only the heater power is on. Anode cooling air may be started and stopped simultaneously with the power on the anode. A quantity of 3.8 cubic feet per minute is required to cool the tube when operating at maximum-rated plate dissipation at 500 Mc. At this quantity of air the pressure drop across the cooler and the Air-System Socket is equal to approximately 0.25 inches of water column. At frequencies below 175 Mc and at 250 watts plate dissipation the quantity of air flow may be reduced to 3.6 cubic feet per minute, at which quantity the pressure drop is 0.23 inches of water column.

The air requirements stated above are based on operation at sea level and an ambient temperature of 20°C. Operation at high altitude or at high ambient temperatures requires a greater volume of air flow. The necessary design information for such conditions is contained in an article entitled "Blower Selection for Forced-Air-Cooled Tubes," by A. G. Nekut, in the August, 1950, issue of "Electronics."

One method of measuring temperature is provided by the use of "Tempilaq", a temperature-sensitive lacquer, which melts when a given temperature is reached. Where forced-air cooling is employed, very thin applications of the lacquer must be used. This product is obtainable from the Tempil Corporation, 11 West 25th St. New York 10, N. Y.

ELECTRICAL

Heater—The heater should be operated as close to 26.5 volts as possible, but it will withstand heater-voltage variations as great as 10% for short durations without injury. Some variations in power output must be expected to occur with variations of the heater voltage.

Cathode—The cathode is internally connected to the four even-numbered base pins. All four corresponding socket terminals should be used for connection to the external circuit. The leads should be of large cross-section and as short and direct as possible to minimize cathode-lead inductance.

Grid Dissipation—Grid-circuit driving-power requirements increase with frequency because of circuit losses other than grid dissipation. This becomes noticeable at frequencies near 100 Mc., and increases until at 500 Mc. as much as 20-25 watts driving power may be required in ordinary circuits.

Despite the increased driving power required by the circuit as a whole at higher frequencies, the power actually dissipated at the tube grid does not increase greatly. Satisfactory operation in stable amplifier circuits is indicated by d-c grid-current values below approximately 20 milliamperes.

Screen Dissipation—Bias- or plate-supply failure or unloaded-plate-circuit operation can cause the screen current and dissipation to rise to excessive values. Protection for the screen can be provided by an overload relay in the screen circuit, in addition to the usual plate-circuit overload relay. Use of a screen-current milliammeter is recommended.

Plate Dissipation—The maximum-rated plate dissipation is 250 watts. The maximum-rated plate dissipation for plate modulated applications is 165 watts under carrier conditions, which permits the plate dissipation to rise to 250 watts under 100% sinusoidal modulation.

Plate dissipation may be permitted to exceed the maximum rating momentarily, as, for instance, during tuning.

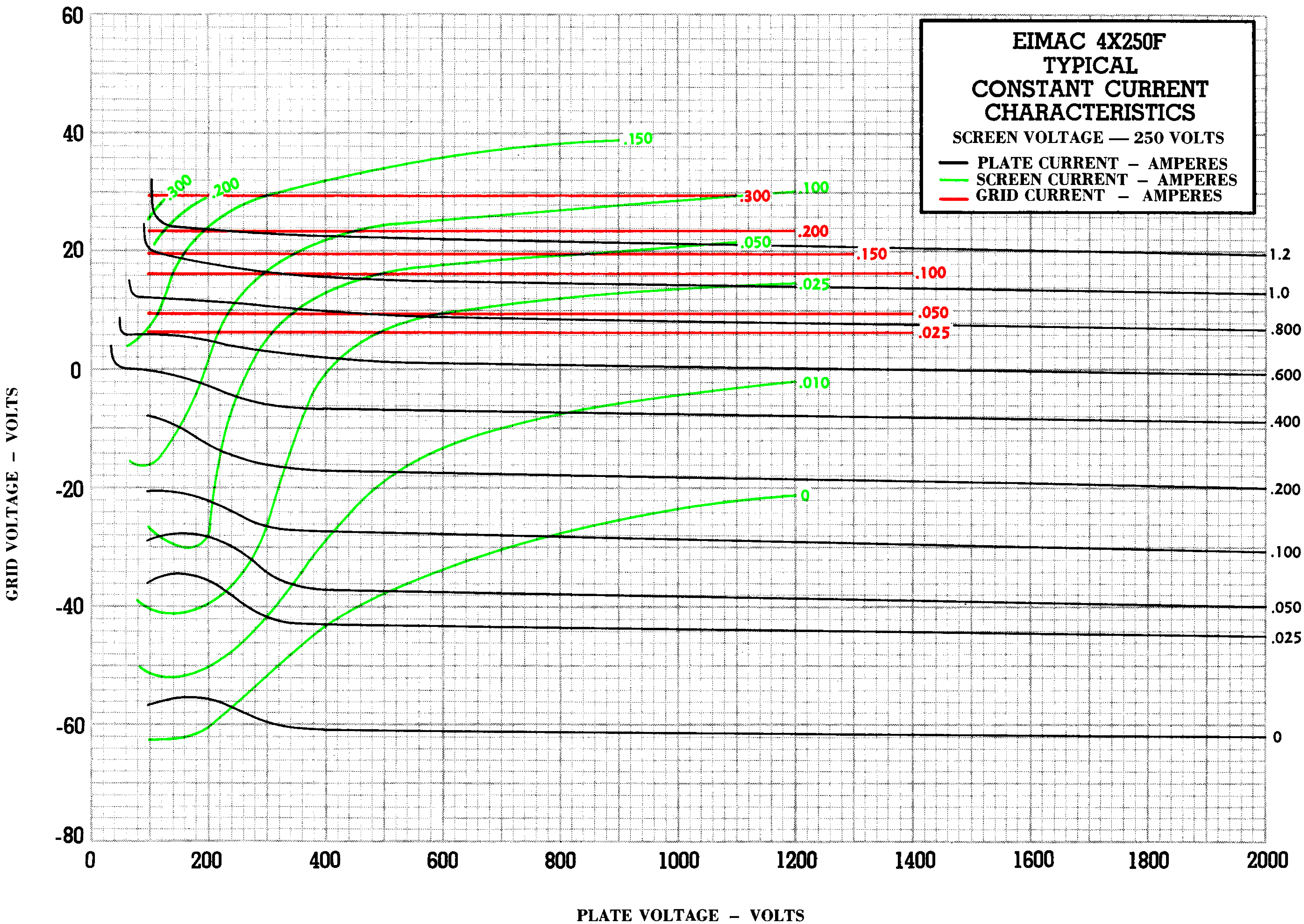
UHF Operation—Transit time and other effects, which occur at ultra-high-frequencies in the 4X250F, can be reduced to minimum values by compliance with the following suggested operating conditions:

1. Use a minimum value of d-c grid bias voltage.
2. Apply only enough grid drive to obtain satisfactory plate efficiency.
3. Operate the screen at reasonably high voltage, but do not exceed the screen dissipation rating.
4. Fairly heavy plate loading is required. In general, low-voltage, high-current operation is preferable to operation at high voltage and low current. If conditions require a change to lighter plate loading, the drive should also be reduced to the minimum value for satisfactory operation at the new output level.
5. Parasitic oscillations are usually associated with excessive grid and screen current and are injurious to vacuum tubes. Similarly, tuned-plate circuits which accidentally become simultaneously resonant to harmonics and the fundamental frequency may also cause low efficiency and damage tubes.

Plate Modulation—Plate modulation can be applied to the 4X250F when it is operated as a class-C radio-frequency amplifier. To obtain 100% modulation, the d-c screen voltage must be modulated in phase with the plate modulation. Self-modulation of the screen by means of a series resistor or reactor may not be satisfactory in this particular tetrode due to the screen-voltage, screen-current characteristics.

Special Applications—If it is desired to operate this tube under conditions widely different than those given here, write to Eitel-McCullough, Inc., San Bruno, California, for information and recommendations.

Eimac 4X250F



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