



EITEL-McCULLOUGH, INC.  
SAN CARLOS, CALIFORNIA

2C39A

HIGH-MU  
UHF  
TRIODE

The Eimac 2C39A is a ceramic-metal high-mu planar triode with a plate-dissipation rating of 100 watts, designed for use as a power amplifier, oscillator, or frequency multiplier at frequencies to above 2500 megacycles. The new ceramic-metal construction results in extreme ruggedness, mechanical uniformity, reliable operation at seal temperatures up to 250°C, and longer life expectancy than its glass prototypes.

The 2C39A in a class-C r-f grounded grid circuit at 500 megacycles will typically deliver 27 watts useful power output with 6 watts driving power. As an r-f oscillator at 2500 megacycles the 2C39A will deliver a minimum of 12 watts useful power output.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

|   | Min.   | Nom. | Max.   |         |
|---|--------|------|--------|---------|
| Cathode: Oxide-Coated, Unipotential                       |        |      |        |         |
| Heating Time  | -      | 60   | -      | seconds |
| Heater: Voltage (See "Applications")                      | -      | 6.3  | -      | volts   |
| Current   | 0.95   | -    | 1.10   | amperes |
| Amplification Factor                                      | -      | 100  | -      |         |
| Direct Interelectrode Capacitances (In Shielded Fixture): |        |      |        |         |
| Grid-Plate  | 1.86   | -    | 2.16   | uuf     |
| Grid-Cathode  | 5.60   | -    | 7.60   | uuf     |
| Plate-Cathode   | -      | -    | 0.035  | uuf     |
| Transconductance ( $I_b = 70$ ma.)                        | 20,000 | -    | 30,000 | umhos   |
| Frequency for Maximum Ratings                             | -      | -    | 2,500  | mc      |

**MECHANICAL**

|                                 |             |
|---------------------------------|-------------|
| Base, Socket and Connections    | See drawing |
| Operating Position              | Any         |
| Cooling                         | Forced Air  |
| Maximum Operating Temperatures: |             |
| Ceramic-to-Metal Seals          | 250° C      |
| Anode Core                      | 250° C      |

|  |             |
|--|-------------|
| Maximum Over-all Dimensions:           |             |
| Length                                 | 2.75 inches |
| Diameter                               | 1.27 inches |
| Net Weight                             | 2.5 ounces  |
| Shipping Weight (Single Tube, Approx.) | 7.0 ounces  |



**RADIO-FREQUENCY POWER AMPLIFIER, OR OSCILLATOR**

MAXIMUM RATINGS (Per tube)

|  |                       |
|--|-----------------------|
| D-C PLATE VOLTAGE                        | 1000 MAX. VOLTS       |
| D-C CATHODE CURRENT                      | 125 MAX. MA           |
| D-C GRID VOLTAGE                         | -150 MAX. VOLTS       |
| D-C GRID CURRENT                         | 50 MAX. MA            |
| HEATER VOLTAGE                           | SEE APPLICATION NOTES |
| INSTANTANEOUS PEAK POSITIVE GRID VOLTAGE | 30 MAX. VOLTS         |
| INSTANTANEOUS PEAK NEGATIVE GRID VOLTAGE | 400 MAX. VOLTS        |
| PLATE DISSIPATION                        | 100 MAX. WATTS        |
| GRID DISSIPATION                         | 2 MAX. WATTS          |

TYPICAL OPERATION (Key-down conditions, per tube)  
(Power-Amplifier Grid-Isolation Circuit, CW Operation, 500 Mc.)

|                                      |           |
|--------------------------------------|-----------|
| D-C Plate Voltage                    | 800 volts |
| D-C Grid Voltage                     | -20 volts |
| D-C Plate Current                    | 80 ma     |
| D-C Grid Current                     | 32 ma     |
| Driving Power (approx.) <sup>1</sup> | 6 watts   |
| Useful Power Output                  | 27 watts  |

TYPICAL OPERATION  
(R-F Oscillator, 2500 Mc.)<sup>2</sup>

|                     |           |
|---------------------|-----------|
| D-C Plate Voltage   | 900 volts |
| D-C Grid Voltage    | -22 volts |
| D-C Plate Current   | 90 ma     |
| D-C Grid Current    | 27 ma     |
| Useful Power Output | 12 watts  |

**PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER OR OSCILLATOR**

MAXIMUM RATINGS (Carrier conditions, per tube)

|  |                 |
|--|-----------------|
| D-C PLATE VOLTAGE <sup>3</sup>           | 600 MAX. VOLTS  |
| D-C GRID VOLTAGE                         | -150 MAX. VOLTS |
| D-C GRID CURRENT                         | 50 MAX. MA      |
| D-C CATHODE CURRENT                      | 100 MAX. MA     |
| PEAK INSTANTANEOUS POSITIVE GRID VOLTAGE | 30 MAX. VOLTS   |
| PEAK INSTANTANEOUS NEGATIVE GRID VOLTAGE | 400 MAX. VOLTS  |
| PLATE DISSIPATION                        | 70 MAX. WATTS   |
| GRID DISSIPATION                         | 2 MAX. WATTS    |

TYPICAL OPERATION  
(Plate-Modulated Radio-Frequency Power Amplifier  
Grid-Isolation Circuit, 500 Mc., Per Tube)

|                                      |           |
|--------------------------------------|-----------|
| D-C Plate Voltage                    | 600 volts |
| D-C Grid Voltage                     | -16 volts |
| D-C Plate Current                    | 65 ma     |
| D-C Grid Current                     | 35 ma     |
| Driving Power (approx.) <sup>1</sup> | 5 watts   |
| Useful Carrier Power Output          | 16 watts  |

<sup>1</sup>Driving power listed is the total power which must be supplied to a practical grid circuit at the frequency shown.

<sup>2</sup>These 2500-megacycle conditions conform to the minimum requirements of the MIL-E-1 specifications for the 2C39A.

<sup>3</sup>For less than 100% modulation, higher d-c plate voltage may be used if the sum of the peak positive modulating voltage and the d-c plate voltage does not exceed 1200 volts.



## APPLICATION

### MECHANICAL

**Mounting**—The 2C39A may be operated in any position. It should be firmly held in place by spring-finger collets bearing on the terminal surfaces. The tube should seat against the under side of the "anode flange" (see outline drawing). In applications involving severe shock and vibration, the tube may be clamped in place by applying a suitable clamping device to the anode flange. It is recommended that no other portion of the tube be subjected to clamping forces.

**Connections**—The tube terminals are in the form of concentric cylinders of graduated diameters so that the 2C39A may be conveniently used with coaxial tuning devices. Spring-finger collets should be used to make contact with the anode, grid, cathode, and heater terminals. Adequate contact area and spring pressure should be provided to minimize heating and to prevent erratic circuit performance at the higher frequencies. Non-contacting or intermittently-contacting collet fingers will cause troublesome circuit behavior, especially at very-high and ultra-high frequencies. Electrode contact surfaces should be kept clean and free of oxide coatings.

**Cooling**—Sufficient cooling must be provided for the anode and body seals to maintain operating temperatures below the rated maximum values:

|                        |       |
|------------------------|-------|
| Ceramic to Metal Seals | 250°C |
| Anode Core             | 250°C |

At sea level, with an inlet air temperature of 25°C, 13.0 cubic feet per minute of air flow is required to cool the anode at 100 watts plate dissipation when the air cowling as illustrated is used. Pressure across the anode under these conditions is 0.6 inches of water. Operation at higher altitudes or with higher inlet temperatures requires increased volumes of flow to obtain equivalent cooling. When using the anode cowling as illustrated here, it is necessary to provide additional facilities for seal cooling.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness, regardless of the coolant type, flow rate or coolant temperature.

### ELECTRICAL

**Heater Operation**—The rated heater voltage for the 2C39A is 6.3 volts and the working voltage should be determined from the table below. The heater voltage should be maintained within plus or minus 10% of its intended value to minimize variations in circuit performance and to obtain maximum tube life.

At ultra-high frequencies transit-time effects can influence the cathode temperature. The amount of r-f driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, and the r-f driving power being supplied to the tube. The following table is intended as a general guide.

| Frequency (Mc.) | $E_r$ (Volts) |
|-----------------|---------------|
| Up to 400       | 6.3           |
| 400 to 1000     | 6.0           |
| 1000 to 1500    | 5.5           |
| 1500 to 2000    | 5.0           |
| 2000 and above  | 4.5           |

If the conditions of operation result in extreme cathode back-heating, it may be necessary to start dynamic tube operation at normal heater voltage followed by a reduction of heater voltage to the proper value.

**Cathode Operation**—The oxide-coated unipotential cathode in the 2C39A and one side of the heater are connected internally. The absolute maximum rated d-c current is 125 milliamperes.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Tube performance will become stabilized approximately 60 seconds after the heater voltage is applied.

**Control-Grid Operation**—The maximum rated grid dissipation is 2.0 watts.

At operating frequencies near 500 megacycles, the driving power necessary for maximum output of a typical grounded-grid amplifier is in the order of 6 watts and as the operating frequency is increased, the driving power requirements increase. Most of this additional driving power is absorbed in circuit losses other than grid dissipation, however, and the actual grid dissipation will increase very little.

The grid bias required by various 2C39A tubes may vary between limits approximately 50% above and below the nominal value and means should be provided in the equipment to accommodate such variations.

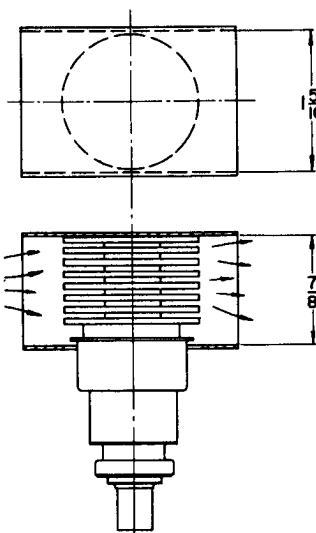
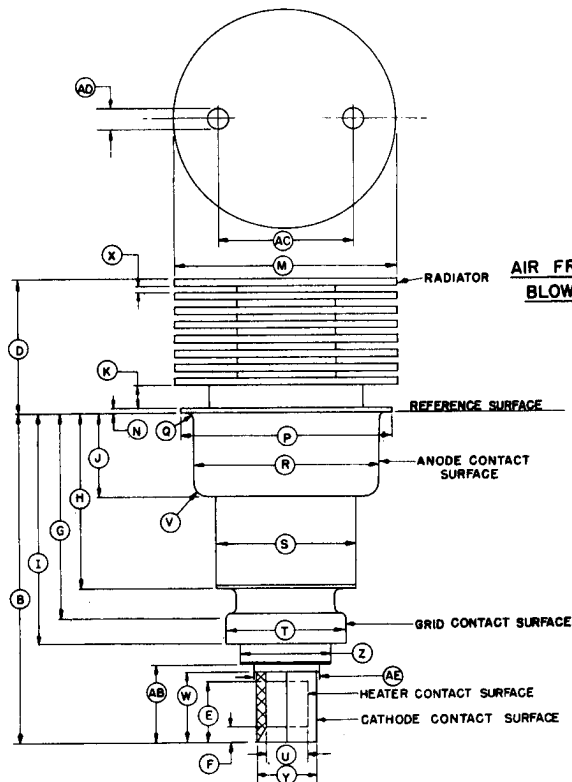
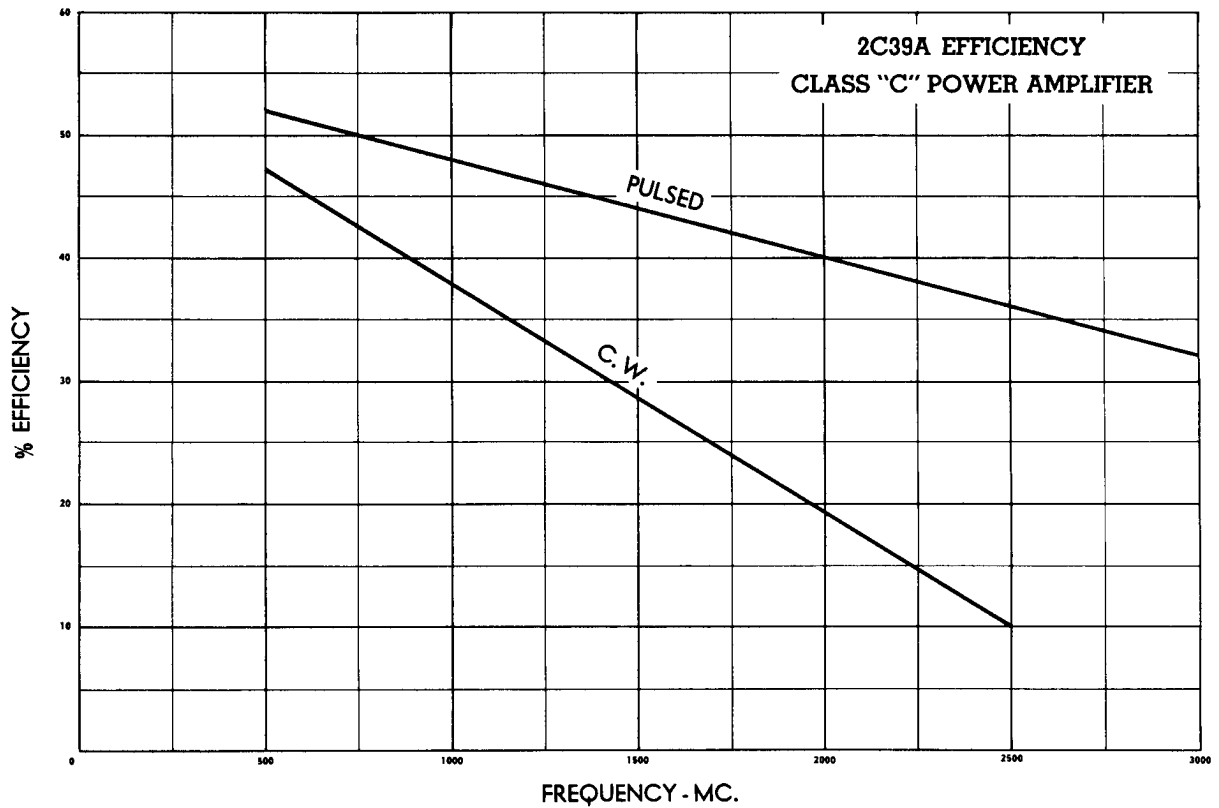
When grid-leak bias is used, suitable means must be provided to protect the tube against loss of excitation at plate voltages above 600 volts and the grid-leak resistor should be made variable to facilitate maintaining the bias voltage and plate current at the desired values when tubes are changed in the equipment.

**Plate Operation**—The maximum rated plate dissipation is 100 watts. In plate-modulated applications, the plate dissipation under carrier conditions must be limited to 70 watts to avoid exceeding the plate-dissipation rating with 100% sine-wave modulation.

In general, low-voltage high-current operation is preferable to high-voltage low-current operation from the standpoint of optimum life.

An excellent indication of operating conditions is the ratio of grid current to plate current; when the 2C39A is operated with grid-current values greater than half those of the plate current, either the drive is excessive or the plate loading is too light for the excitation present. The tube should never be operated unloaded, even for short periods of time. Drive should be held to the lowest value consistent with reasonable efficiency.

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



**RECOMMENDED COWLING  
FOR  
FORCED-AIR COOLING  
OF ANODE**

| REF. | NOM. | MIN.  | MAX.  |
|------|------|-------|-------|
| B    |      | 1.815 | 1.875 |
| D    |      | .766  | .826  |
| E    |      | .341  | .401  |
| F    |      | .026  | .086  |
| G    |      | 1.095 | 1.135 |
| H    |      | .880  | .920  |
| I    |      | 1.281 | 1.329 |
| J    |      | .462  | .477  |
| K    |      | .125  | .185  |
| M    |      | 1.234 | 1.264 |
| N    | .031 |       |       |
| P    |      | 1.180 | 1.195 |
| Q    | .031 |       |       |
| R    |      | 1.024 | 1.039 |
| S    |      | .752  | .792  |
| T    |      | .653  | .668  |
| U    |      | .213  | .223  |
| V    | .094 |       |       |
| W    |      | .400  | .460  |
| X    |      | .016  | .046  |
| Y    |      | .313  | .328  |
| Z    |      | .455  | .470  |
| AB   |      | .420  | .480  |
| AC   | .750 |       |       |
| AD   | .125 |       |       |
| AE   |      | .333  | .348  |

**NOTES:**

1. The total indicated runout of the anode contact surface and the grid contact surface with respect to the cathode contact surface shall not exceed .020.
2. The total indicated runout of the cathode contact surface with respect to the heater contact surface shall not exceed .012.



**EIMAC 2C39A**

**TYPICAL  
CONSTANT CURRENT  
CHARACTERISTICS**

— PLATE CURRENT — AMPERES  
- - - GRID CURRENT — AMPERES

