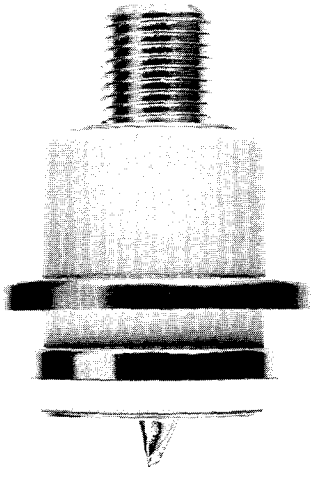
# 8941/Y690

## TECHNICAL DATA

**PLANAR TRIODE**



The 8941 is a planar triode of ceramic/metal construction designed for use in airborne, ground and space applications as a grid/plate pulsed oscillator or amplifier at frequencies up to 2.0 GHz, series regulator or modulator. The elongated grid-to-anode insulator assures reliable operation; in some applications to 12 kV[1]. The other special features of this tube include high transconductance, high mu and high current capability from an arc-resistant, extended interface matrix cathode.

The tube is normally supplied without radiator and may be conduction, convection, heat sink or liquid cooled such as immersion in an insulating medium (e.g. FC-77). Radiators for forced-air cooling as well as heat sink adapters permitting anode dissipation up to 750 watts are available as separate items.

The Y690 is an 8941 which has been specially processed for series/shunt regulator and switch tube (modulator) service and will operate in some applications up to 15 kV[1]. Solder tabs are available on the Y690A permitting attachment of flying leads for grid, cathode and heater connections.

## GENERAL CHARACTERISTICS[1]

### ELECTRICAL

| | |
|---|---|
| Cathode: Oxide Coated, Unipotential | |
| Heater: Voltage | 6.3 ±0.3 V |
| Current, at 6.3 Volts | 2.25 A |
| Transconductance (average): | |
| $I_b$ = 160 mA | 75 mmhos |
| Amplification Factor (average): | 200 |
| (Cut-off)[3] | 400 |
| Direct Interelectrode Capacitance (grounded cathode)[2] | |
| $C_{in}$ | 14 pF |
| $C_{out}$ | 0.11 pF |
| $C_{gp}$ | 2.8 pF |
| Cut-off Bias[3] | -20 V max |
| Frequency of Maximum Rating: | |
| CW | 2000 MHz |
| Plate or Grid-Pulsed | 2000 MHz |

[1] Characteristics and operating values are based upon performance tests and environmental conditions. These figures may change without notice as the result of additional data or product refinement. Varian EIMAC should be consulted before using this information for final equipment design.

[2] Capacitance values are for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid/cathode capacitance will increase from the cold value by approximately 2 pF due to thermal expansion of the cathode.

[3] Measured with one milliampere plate current and a plate voltage of 1 kVdc.



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## MECHANICAL

| | | | |
|---|---|---|---|
| Maximum Overall Dimensions: | | | |
| Length | 2.235 in; | 56.77 | mm |
| Diameter | 1.365 in; | 34.67 | mm |
| Net Weight | 1.96 oz; | 56 | gm |
| Operating Position | | | Any |
| Maximum Operating Temperature: | | | |
| Ceramic/Metal Seals | | | 250°C |
| Cooling | Conduction, convection, liquid or forced air | | |

## ENVIRONMENTAL

| | |
|---|---|
| Shock: 11 ms, non-operating | 60 G |
| Vibration: Operating, All Axes | 10 G |
| Altitude: max., in suitably designed circuit | 60,000 ft. |

## RANGE VALUES FOR EQUIPMENT DESIGN

| | Min. | Max. | |
|---|---|---|---|
| Heater: Current at 6.3 volts | 2.05 | 2.50 | A |
| Cathode Warm-up Time | 90 | — | sec. |
| Interelectrode Capacitance* (grounded cathode connection) | | | |
| $C_{in}$ | 12.5 | 16.5 | pF |
| $C_{out}$ | — | 0.11 | pF |
| $C_{gp}$ | 2.4 | 3.3 | pF |

* Capacitance values are for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid/cathode capacitance will increase from the cold value by approximately 2 pF due to thermal expansion of the cathode.

## GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

### ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE (grid pulsed) | 10,000 V |
| PEAK PULSE PLATE VOLTAGE (plate pulsed) | 12,000 V |
| DC GRID VOLTAGE | -350 V |
| INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE | |
| Grid negative to cathode | -750 V |
| Grid positive to cathode | 175 V |
| PULSE PLATE CURRENT | 12 A |
| PULSE GRID CURRENT | 3.0 A |
| DC GRID CURRENT | 45 mA |
| AVERAGE PLATE DISSIPATION | |
| Forced Air Cooling[1] | 750 W |
| GRID DISSIPATION (average) | 2.0 W |
| FREQUENCY | 2.0 GHz |
| PULSE DURATION[2] | 6.0 $\mu$s |
| DUTY FACTOR[2] | 0.0033 |

[1] Using EIMAC radiator PN 158096, or equivalent

Operating Conditions for 8941/Y690 in representative applications:

| | Cathode Biased, rf Pulsed Amplifier[3] | Grid Pulsed Amplifier | |
|---|---|---|---|
| Frequency | 1850 | 1090 | MHz |
| Heater Voltage | 6.3 | 6.3 | V |
| DC Plate Voltage | 4500 | 5000 | Vdc |
| DC Grid Voltage | -40 | -60 | Vdc |
| Peak Video Plate Current | 3.1 | 4.0 | a |
| Peak Video Grid Current | .6 | .75 | a |
| Useful Power Output | 4.2 | 10.0 | kw (peak) |
| Pulse Duration | 3.0 | 3.0 | $\mu$s |
| Duty Cycle | 0.04 | 0.001 | |
| Gain | 11.5 | 12.0 | dB |
| Bandwidth | 20 | — | MHz |

[2] For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Device Sales Office, or the Product Manager, Varian EIMAC, Salt Lake City, Utah.

[3] No gate pulse used.

**PULSE MODULATOR AND PULSE AMPLIFIER SERVICE**
(Type Y690 or Y690A)

**ABSOLUTE MAXIMUM RATINGS:**

| | |
|---|---|
| DC PLATE VOLTAGE | 15,000 V* |
| PEAK PLATE VOLTAGE | 18,000 V |
| DC GRID VOLTAGE | -350 V |
| INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE | |
| Grid negative to cathode | -750 V |
| Grid positive to cathode | 100 V |
| PULSE CATHODE CURRENT | 16 A |
| DC PLATE CURRENT | 600 mA |

* In suitably designed circuit

| | |
|---|---|
| AVERAGE PLATE DISSIPATION | |
| Forced Air Cooling [1] | 750 W |
| GRID DISSIPATION (average) | 2 W |
| PULSE DURATION[2] | 6.0 $\mu$s |
| DUTY FACTOR[2] | 0.0033 |
| CUT-OFF MU | 90 |

[1] Using EIMAC radiator PN 158096, or equivalent.

[2] For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Device Sales Office, or the Product Manager, Varian EIMAC, Salt Lake City, Utah.

# APPLICATION

## MECHANICAL

The cathode and grid flanges should not be altered in any way such as by machining or filing, since the final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

For optimum rf performance, the anode line should make good contact with the anode area indicated on the outline drawing.

Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal-to-ceramic brazed areas. If forced air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C.

## X-RAY RADIATION

High voltage tubes operating at voltages higher than 15kV produce progressively more dangerous x-ray radiation as the voltages increase. The 8941/Y690 operating at its rated voltages and currents is a potential x-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the x-ray radiation level can increase significantly with aging and gradual deterioration due to leakage path or emission characteristics as they are affected by the high voltage.

X-ray shielding must be provided on all sides of the tubes operating at these voltages to provide adequate protection throughout the life of the tubes. Periodic checks on the x-ray level should be made and the tube should never be operated without adequate shielding in place at voltages above 15kV. When voltages above 15kV are in use, lead glass (which attenuates x-rays) is available for viewing windows.

If there is any doubt as to the requirement for, or the adequacy of shielding, an expert in this field should be contacted to perform an x-ray survey of the equipment. Operation of high voltage equipment with interlock switches cheated and cabinet doors open in order to better locate an equipment malfunction, can result in serious x-ray exposure.

## HEATER VOLTAGE

One of the most important factors affecting planar tube life and ultimate performance is heater voltage. The heater voltage value indicated under GENERAL CHARACTERISTICS/ELECTRICAL is the nominal value used when evaluating the tube during the manufacturing process. Optimum heater voltage for a specific use may, or may not be, the same value. Due to the many possible applications, no general definition of optimum heater voltage can be given. Many applications require lower heater voltage to assure the longest possible tube life. When the heater of a planar triode is energized by a d-c source, its useful life is always shorter than with equivalent a-c operation. Heater life under d-c conditions is extended by connecting the common heater/cathode terminal to the positive side of the heater supply. If the heater is electrically insulated from the cathode circuit, optimum heater life under d-c conditions can be achieved by operating the heater at a negative potential with respect to the cathode.

## ABSOLUTE MAXIMUM RATINGS

Values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. To not exceed absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

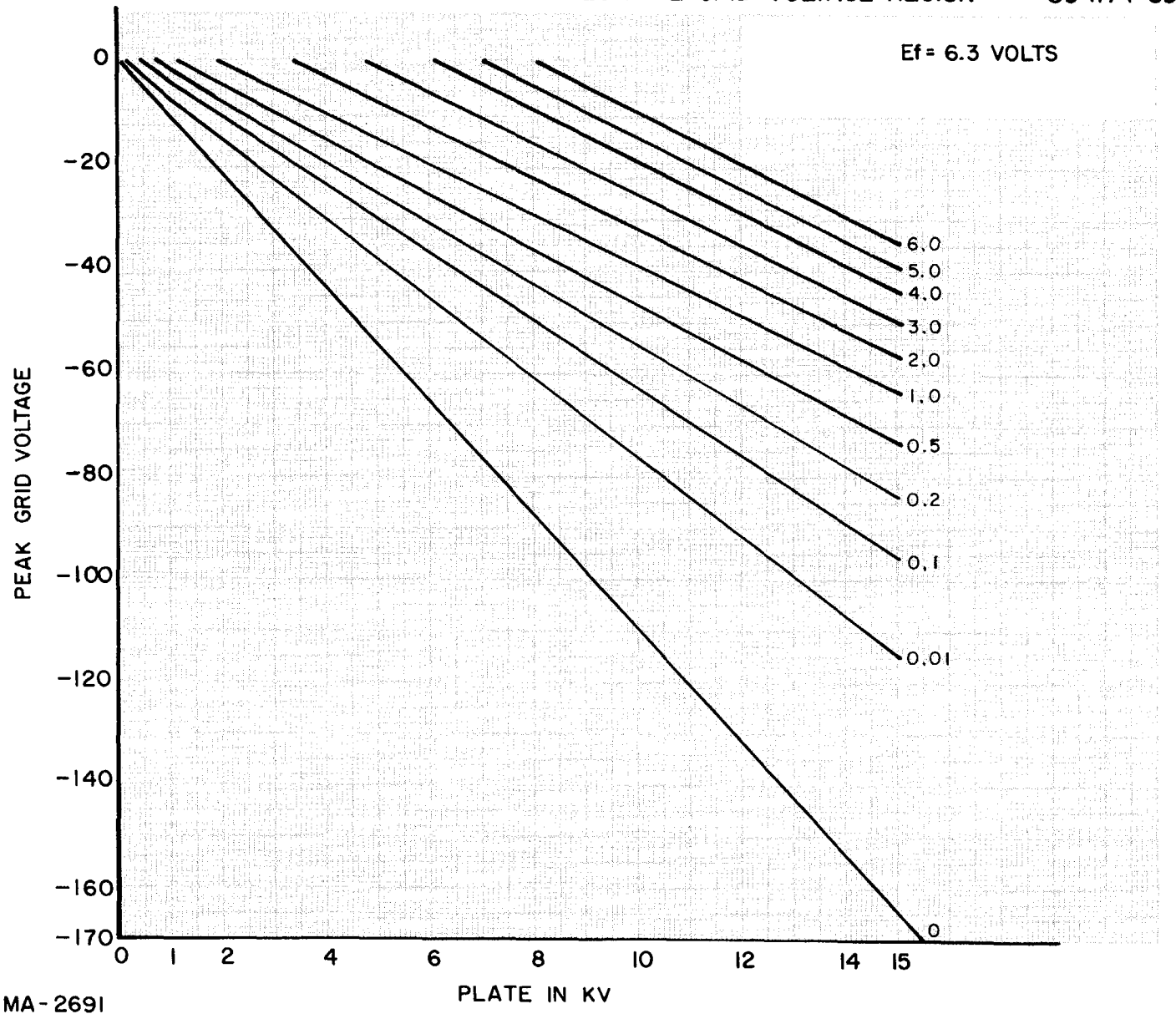
## HIGH VOLTAGE

Normal operating voltages used with this tube are deadly. Equipment must be designed properly and operating precautions must be followed. Design all equipment so 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 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.

## GENERAL

For general application information please refer to the Planar Triode Operating Instruction Booklet. The operating instructions should be consulted prior to the designing of new requirements around the 8941/Y690 tube type. For unusual and special applications consult the nearest Varian Electron Device Group Sales Office, or the Product Manager, Varian EIMAC, Salt Lake City, Utah.

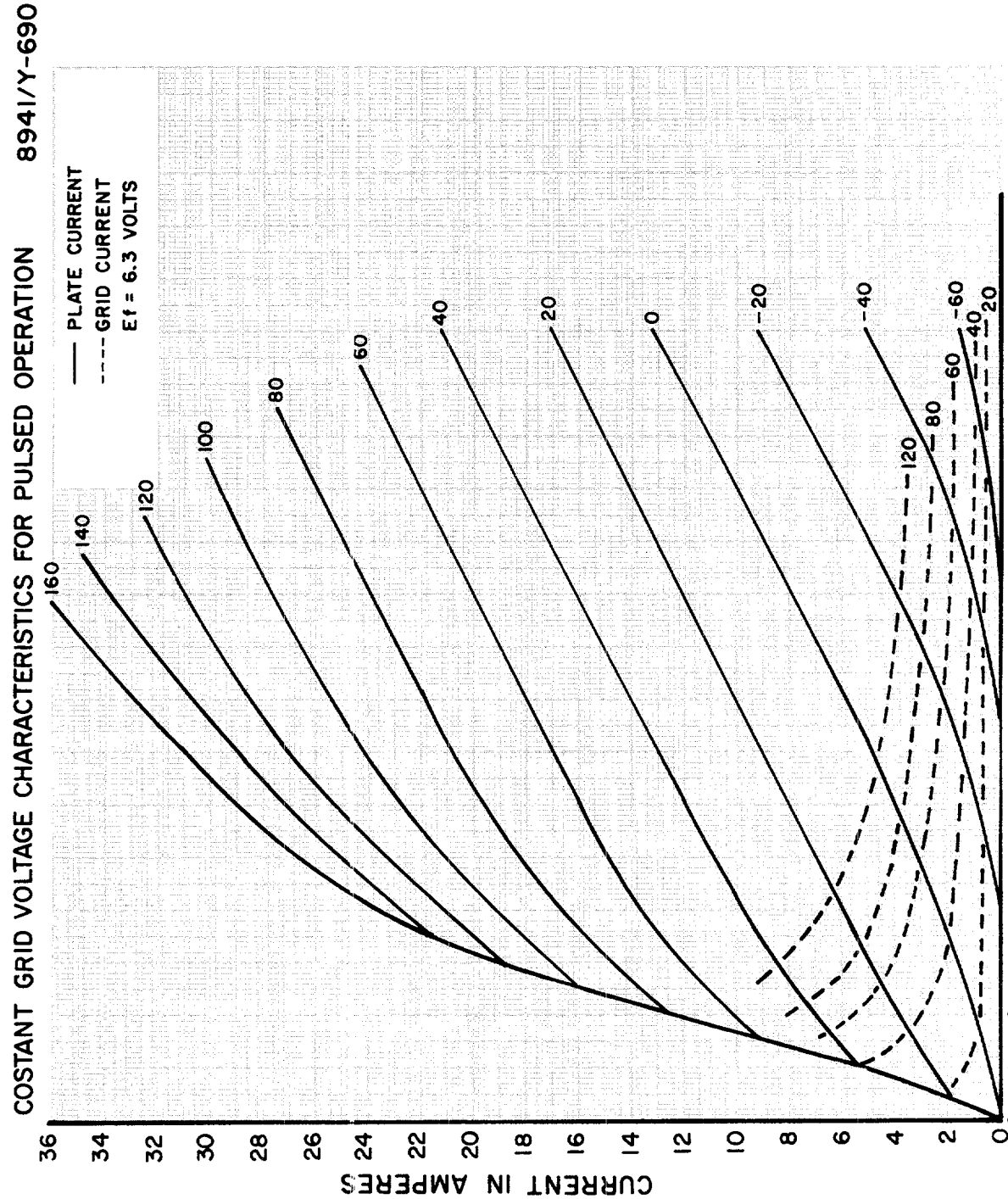
CONSTANT PLATE CURRENT OPERATION - NEGATIVE GRID VOLTAGE REGION 8941/Y-690




MA-2691

8941/Y690

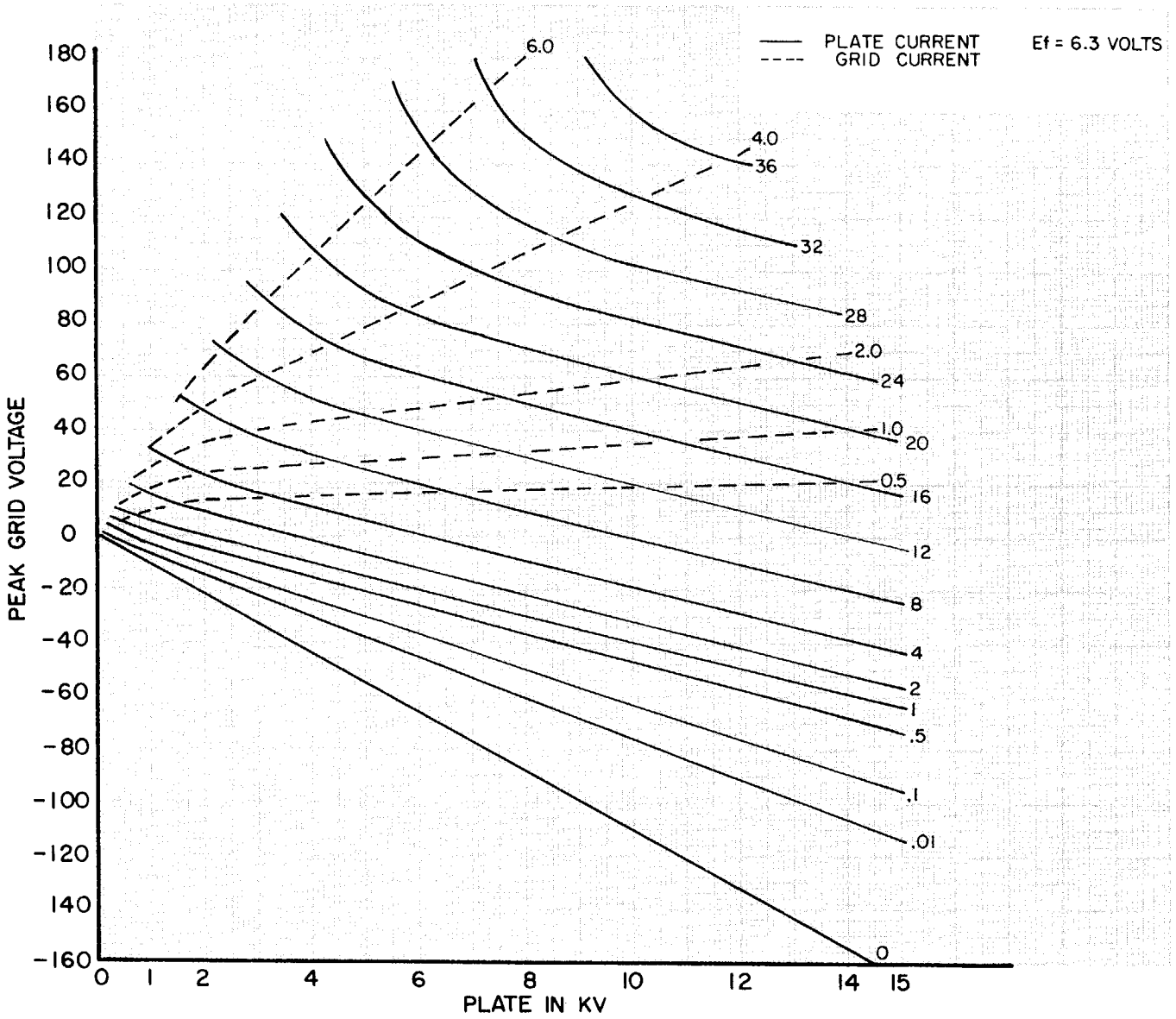
Eimac


COSTANT GRID VOLTAGE CHARACTERISTICS FOR PULSED OPERATION 8941/Y-690
PLATE CURRENT
GRID CURRENT
Ef = 6.3 VOLTS
CURRENT IN AMPERES
PLATE IN KV
160
140
120
100
80
60
40
20
0
-20
-40
-60
MA-2692

MA-2595

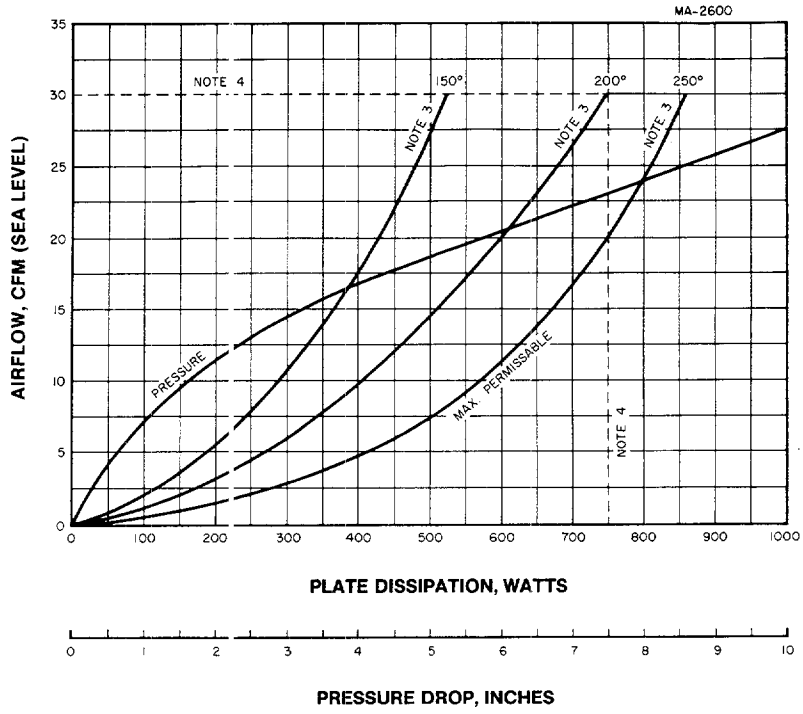
## CONSTANT CURRENT CHARACTERISTICS FOR PULSED OPERATION

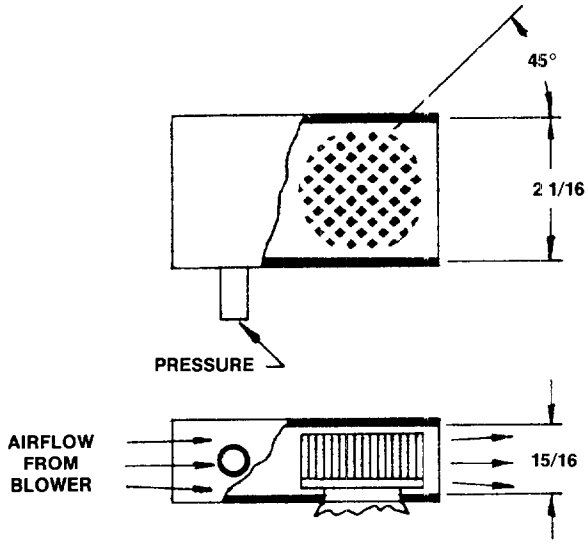
8941/Y-690




8941/Y690

# AIR COOLING DATA FOR 8941/Y690

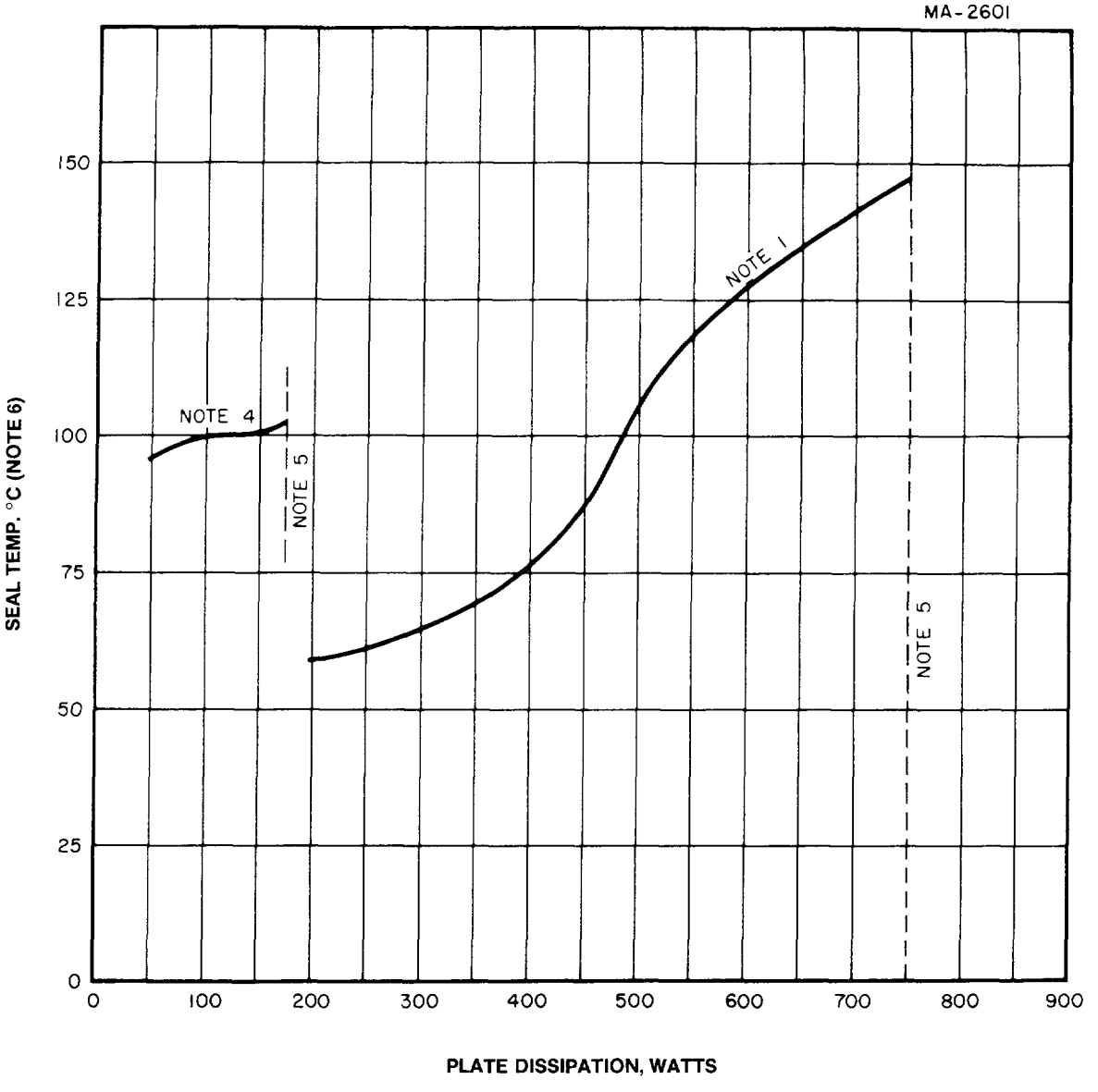



COWLING DETAIL

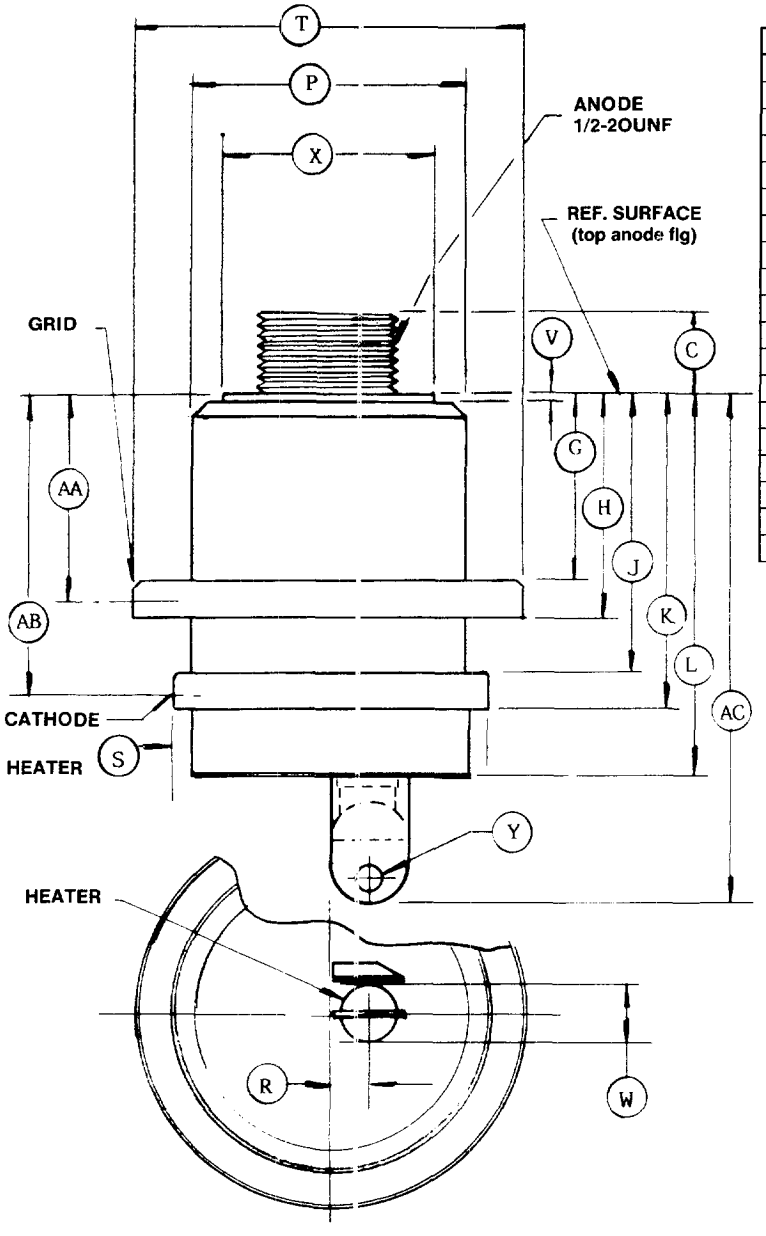
1. INLET AIR AT 20°C.
2. USE RADIATOR NO. 158096 (COPPER-PIN) IN COWLING AS SHOWN.
3. TEMP. MEASURED AT ANODE CUP-PLATE INSULATOR SEAL.
4. DESCRIBES TYPICAL MAX. CW OPERATING POINT.

# COOLING DATA FOR 8941/Y690 IN FC 77 DIELECTRIC COOLANT




**NOTES:**

1. USE RADIATOR 158096 (COPPER-PIN)
2. TUBE AXIS VERTICAL IN LIQUID.
3. LIQUID AMBIENT TEMPERATURE 40°C.
4. TUBE W/O COOLER STUD COOLING ONLY.
5. MAX. CW RATING—CONTACT PLANAR MGR. EIMAC, SLC ON INTERMEDIATE OR HIGHER POWERS THAN SHOWN.
6. SEAL TEMPERATURE IS MEASURED AT PLATE TO ANODE INSULATOR FLANGE (SEE 'V' ON OUTLINE DWG.)

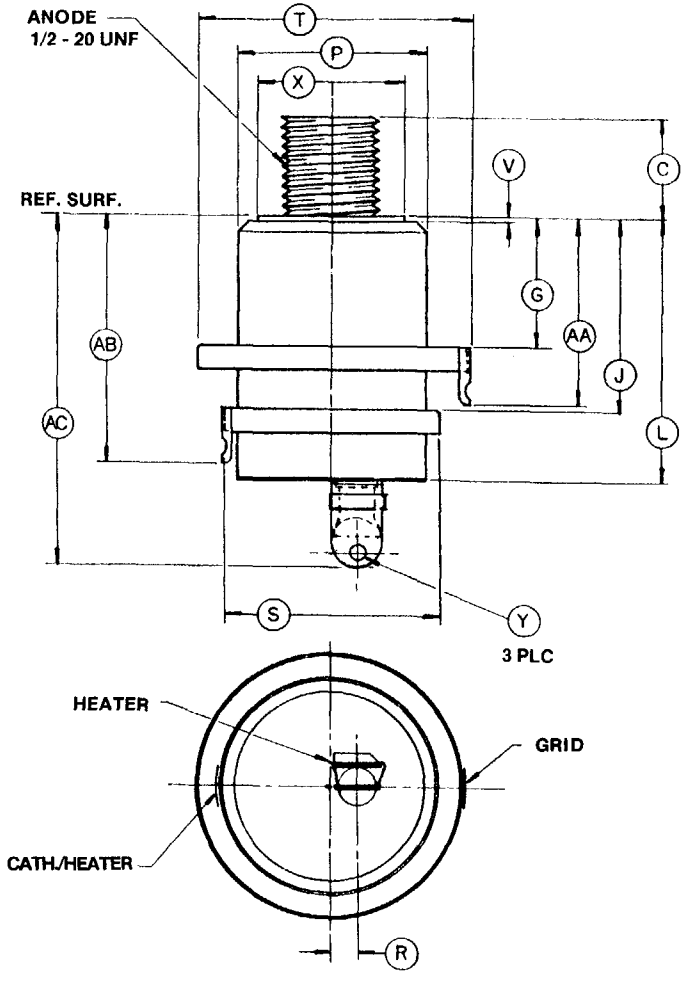



DIMENSIONS IN INCHES

| DIMENSIONAL DATA | | | |
|---|---|---|---|
| REF. | MIN. | MAX. | NOM. |
| C | .500 | .600 | |
| G | .635 | .660 | |
| H | .760 | .795 | |
| J | .905 | .960 | |
| K | | 1.095 | |
| L | 1.180 | 1.260 | |
| P | .940 | .965 | |
| R | .090 | .110 | |
| S | 1.065 | 1.085 | |
| T | 1.345 | 1.365 | |
| V | | .050 | |
| W | | | 190 |
| X | .760 | .815 | |
| Y | .060 | .090 | |
| | | | |
| AA | SEE NOTES 2 & 3 | | .710 |
| AB | SEE NOTES 2 & 3 | | 1.000 |
| AC | | 1.625 | |

**NOTES:**

1. REF. DIMS. ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. CONTACT SURFACE DIMS. AA & AB ARE FOR CAVITY DESIGN PURPOSES ONLY & ARE NOT INTENDED AS INSPECTION CRITERIA.
3. CONTACT SURFACES ARE ± .030 AROUND DIM. INDICATED.
4. T.I.R. OF CONTACT SURFACES ARE SPECIFIED IN INDIVIDUAL TUBE ELECTRICAL SPECS.




**NOTES:**

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES
2. METRIC EQUIVALENTS TO THE NEAREST .01mm, ARE GIVEN FOR GENERAL INFO ONLY & ARE BASED ON 1 INCH=25.4mm.
3. NO. T.I.R. SPECIFIED FOR CONTACT SURFACES BECAUSE OF THE TABS.

**DIMENSIONAL DATA**

| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| DIM. | MIN. | MAX. | REF. | MIN. | MAX. | REF. |
| C | .500 | .600 | | 12.7 | 15.24 | |
| G | .635 | .660 | | 16.13 | 16.76 | |
| J | .905 | .960 | | 24.13 | 24.38 | |
| L | 1.180 | 1.260 | | 29.97 | 32.0 | |
| P | .940 | .965 | | 23.87 | 24.51 | |
| R | .090 | .110 | | 2.28 | 2.79 | |
| S | 1.065 | 1.100 | | 27.05 | 27.94 | |
| T | 1.345 | 1.380 | | 34.16 | 35.05 | |
| V | | .035 | | | .89 | |
| W | | | .190 | | | 4.82 |
| X | .740 | .815 | | 18.78 | 20.70 | |
| Y | .060 | .090 | | 1.52 | 2.28 | |
| AA | | .965 | | | 24.51 | |
| AB | | 1.265 | | | 32.13 | |
| AC | | 1.625 | | | 41.27 | |

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**Y690A**