PLANAR TRIODE
Y-690 / 8941

The Eimac Y-690/8941 is a ceramic/metal planar triode designed for airborne, ground or space applications as a grid/plate pulsed oscillator or amplifier up to 2.0 GHz, series regulator or modulator. The elongated grid-to-anode insulator assures reliable operation, in some applications to 12KV[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 a radiator. Cooling may be accomplished by conduction, convection, heat sink or liquid 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 Y-690 is an 8941 which has been specially processed for series regulator and switch tube (modulator) service and will operate in some applications up to 15 kV[1]. Solder tabs are available on the Y-690A permitting attachment of flying leads for grid, cathode and heater connections.

CHARACTERISTICS[1]

ELECTRICAL:

Cathode (Oxide Coated, Unipotential)
- Heater Voltage ..... 6.3 ± 5% Volts
- Heater Current at 6.3 Volts ..... 2.25 Amps
- Transconductance (Average):
  - Ib = 160 mA ..... 75 mmhos
- Amplification Factor (Average) 200
- Direct Interelectrode Capacitances[2] (grounded cathode):
  - Cin ..... 14.0 pF
  - Cout ..... 0.11 pF
  - Cgp ..... 2.8 pF
- Cut-off Bias[3] ..... -20 Volts Max.

Frequency for Maximum Ratings:
- CW ..... 2 GHz
- Plate or Grid-Pulsed ..... 2 GHz

MECHANICAL:

Overall Dimensions:
- Length ..... 2.235 in; 56.77 mm
- Diameter ..... 1.365 in; 34.67 mm

Weight (approx.) ..... 1.96 oz; 56 gm

Operating Position ..... Any

Maximum Operating Temperature:
- Ceramic/Metal Seals & Envelope ..... 250° C
- Cooling ..... Conduction, convection, liquid or forced air

ENVIRONMENTAL:

Shock, 11 ms, non-operating ..... 60 G

Vibration, operating, all axis ..... 10 G

Altitude, max., in suitably designed circuit ..... 60,000 ft

[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. CPI MPP, Eimac Operation 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 in accordance with Electronic Industries Association Standard RS-191. When the cathode is heated to the proper temperature, the grid/cathode capacitance will increase from the cold value of approximately 2 pF due to thermal expansion of the cathode.

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

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.		
Heater Current @ 6.3 Volts	**2.05**	**2.50**	**Amps**	
Cathode Warm-up Time	**90**	**---**	**Seconds**	
Interelectrode Capacitances (grounded cathode connection)[1]:				
Cin		**12.5**	**16.5**	**pF**
Cout		**---**	**.005**	**pF**
Cgp		**2.4**	**3.3**	**pF**

[1]Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

The values listed above represent specified limits for the product and are subject to change. The data should be used for basic information only. Formal, controlled specifications may be obtained from CPI for use in equipment design.

For information on this and other CPI products, visit our website at: **www.cpii.com**, or contact: CPI MPP, Eimac Operation, 811 Hansen Way, Palo Alto, CA 94304

TELEPHONE: 1(800) 414-8823. **FAX:** (650) 856-0705 | **EMAIL:** powergrid@cpii.com

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GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC Plate Voltage (Grid Pulsed)	10	kVolts
Peak Plate Pulsed Voltage	12	kVolts
DC Grid Voltage	-350	Volts

INSTANTANEOUS GRID TO CATHODE VOLTAGE

Grid Negative to Cathode	-750	Volts
Grid Positive to Cathode	175	Volts
Pulsed Cathode Current	12	Amps
Pulsed Grid Current	3	Amps
DC Grid Current	45	mA

AVERAGE PLATE DISSIPATION

Forced Air Cooling[1]	750	Watts
Grid Dissipation	2.0	Watts
Pulse Duration	6.0	µs
Frequency	2.0	GHz
Duty	0.0033	

Operating Conditions for Y-690/8941 in Representative Applications

	Cathode Biased RF Pulsed Amplifier	Grid Pulsed Amplifier	
Frequency	1850	1090	MHz
Heater Voltage	6.32	6.3	Volts
DC Plate Voltage	4500	5000	Volts
DC Grid Voltage	-40	-60	Volts
Peak Video Plate Current	3.1	4.0	A
Peak Video Grid Current	0.6	0.75	A
Useful Power Output	4.2	10.0	KW
Pulse Duration	3.0	3.0	µs
Duty Cycle	0.04	0.001	
Gain	11.5	12.0	dB
Bandwidth	20	---	MHz

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

(Y-690 or Y-690A)

ABSOLUTE MAXIMUM RATINGS:

DC Plate Voltage	15	kVolts
Peak Plate Voltage	18	kVolts
DC Grid Voltage	-350	Volts

INSTANTANEOUS GRID TO CATHODE VOLTAGE

Grid Negative to Cathode	-750	Volts
Grid Positive to Cathode	100	Volts
Pulse Cathode Current	16	Amps
DC Plate Current	600	mA

AVERAGE PLATE DISSIPATION

Forced Air Cooling[1]	750	Watts
Grid Dissipation (Average)	2.0	Watts
Pulse Duration	6.0	µs
Duty	0.0033	
Cut-Off Mu	90	

[1]Using Eimac radiator PN 158096, or equivalent

APPLICATION

MECHANICAL

The cathode and grid flanges should not be altered by machining or filing. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

Soldered connections may be made to the anode stud, grid or cathode flanges or heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and seals. 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.

STORAGE – If a tube is to be stored as a spare it should be kept in its original shipping carton, with the original packing material, to minimize the possibility of handling damage. Before storage a new tube should be operated in the equipment for 100 to 200 hours to establish that it has not been damaged and operates properly. If the tube is still in storage 6 months later it should be operated in the equipment for 100 to 200 hours to make sure there has been no degradation. If operation is satisfactory the tube can again be stored with great assurance of being a known-good spare.

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ELECTRICAL

X-RAY RADIATION HAZARD – High vacuum tubes operating at voltages higher than about 15 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The Y-690/8941, operating at its rated voltages and currents, is a potential X-ray hazard, with only limited shielding afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made and the tube should never be operated without adequate shielding in place. 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 able to 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 the 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 possibly tube life. When the heater of a planar triode is energized by a DC source, its useful life is always shorter than with equivalent AC operation. Heater life under DC 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 DC conditions can be achieved by operating the heater at a negative potential with respect to the cathode. The tube's initial cold heater resistance is such that damaging filament current in excess of 25 amps can occur without current limiting. When operated after the 300 second warm-up period, the heater current is within the noted range values. To eliminate possible damage to the tube, a maximum of 20 amps peak for 500 milliseconds is recommended. A commercial soft-start thermistor, or equivalent current limiting device, is recommended.

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 serviceability of the tube may be impaired. In order not to 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, load variation, or manufacturing variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

RF RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with the hazard, and the published OSHA (Occupational Safety and Health Administration) or other local recommendations to limit prolonged exposure of rf radiation should be followed.

INTERLOCKS - An interlock device should be provided to ensure that cooling water and air flow is established before application of electrical power, include the heater. The circuit should be so arranged that rf drive cannot be applied in the absence of normal plate voltage.

INTERELECTRODE CAPACITANCE – The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by a socket, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This normally requires the use of specially constructed test fixtures, which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground" but since this tube does not use a socket no capacitance fixture is required. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers.

The equipment designer is cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with mounting which represents approximate final layout if capacitance values are highly significant in the design.

FAULT PROTECTION - It is good practice to protect the tube from internal damage caused by an internal arc which may occur at high anode voltage. Use of a series current limiting resistor in the high voltage lead is highly recommended.

HIGH VOLTAGE - The Y-690/8941 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 supplies 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 APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, contact the Application Engineering Dept., CPI MPP Eimac Operation, Palo Alto, Calif. 94304 for information and recommendations.

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OPERATING HAZARDS

Proper use and safe operating practices with respect to power tubes are the responsibility of equipment manufacturers and users of such tubes. All persons who work with and are exposed to power tubes, or equipment that utilizes such tubes, must take precautions to protect themselves against possible serious bodily injury. DO NOT BE CARELESS AROUND SUCH PRODUCTS.

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel.

HIGH VOLTAGE – Normal operating voltages can be deadly. Remember the HIGH VOLTAGE CAN KILL.

LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

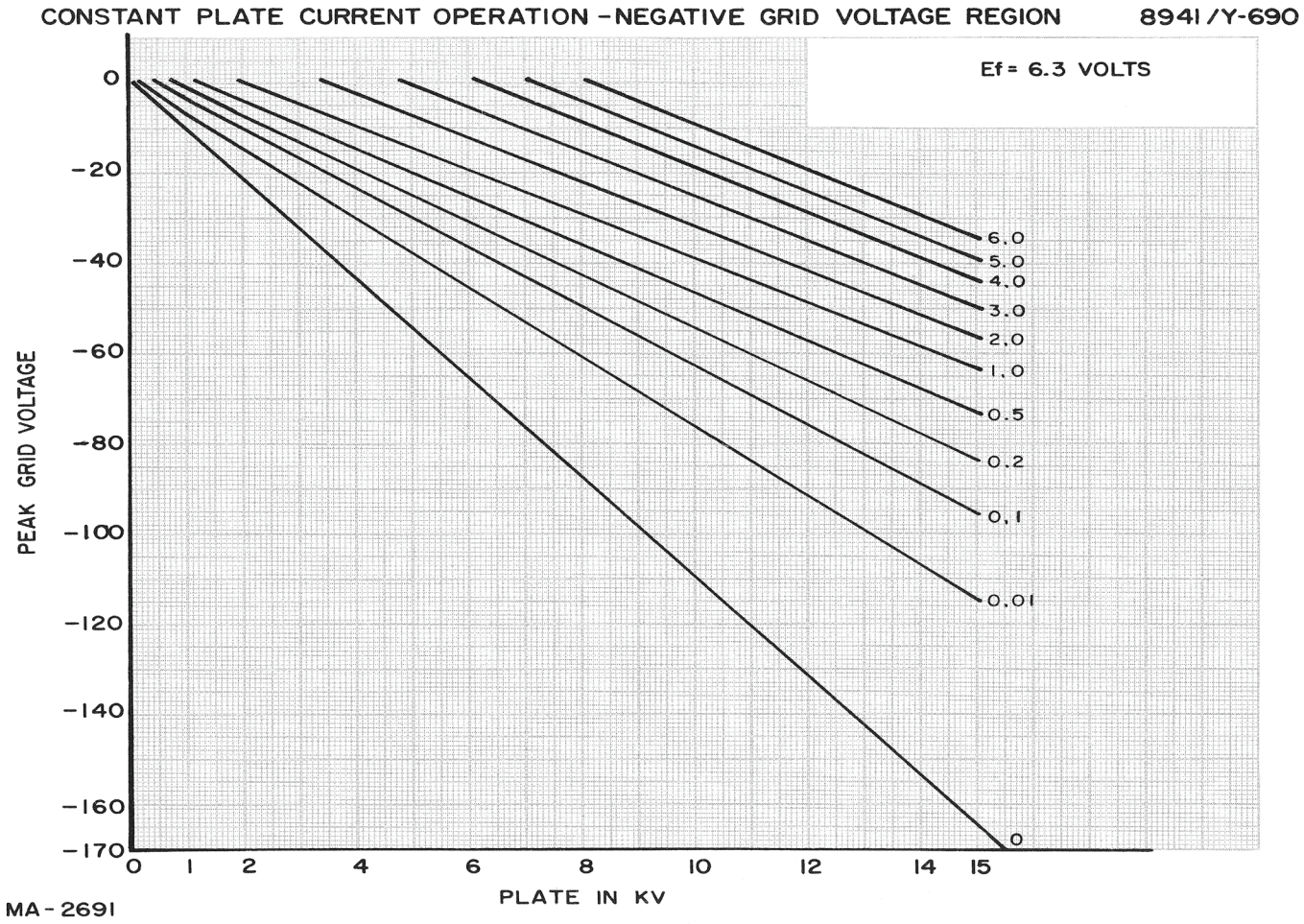
RF RADIATION – Exposure to strong rf fields should be avoided, even at relatively low frequencies. CARDIAC PACEMAKERS MAY BE AFFECTED.

HOT WATER - Water used to cool tubes may reach scalding temperatures. Touching or rupture of the cooling system can cause serious burns.

HOT SURFACES – Surfaces of tubes can reach temperatures of several hundred°C and cause serious burns if touched for several minutes after all power is removed.

MATERIAL COMPLIANCE - This product and package conforms to the conditions and limitations specified in 49CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910. In addition, this product and package contains no beryllium oxide (BeO).

Please review the detailed Operating Hazards sheet enclosed with each tube, or request a copy from CPI MPP, Eimac Operation Application Engineering at (800) 414-8823, Opt. #1.



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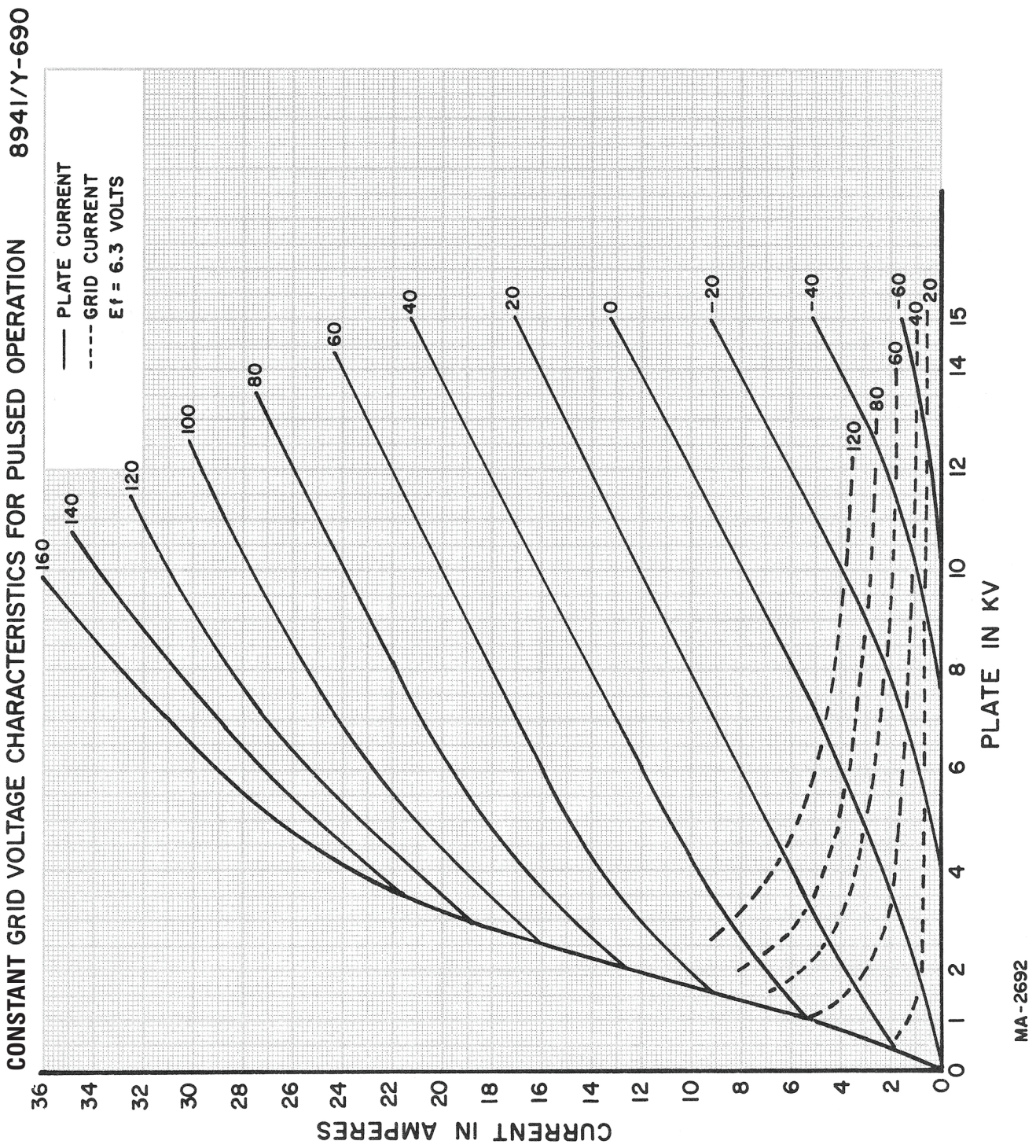

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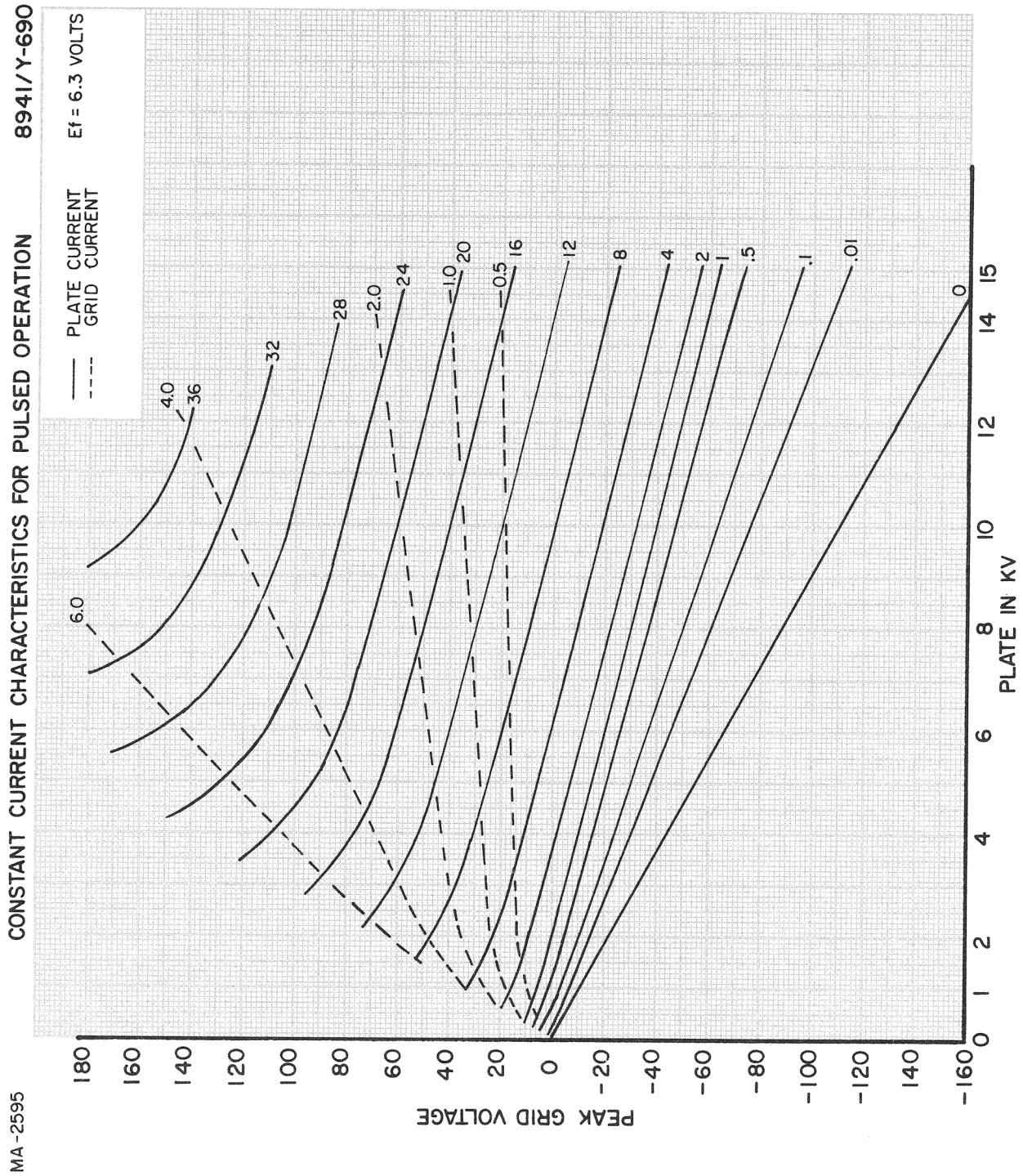
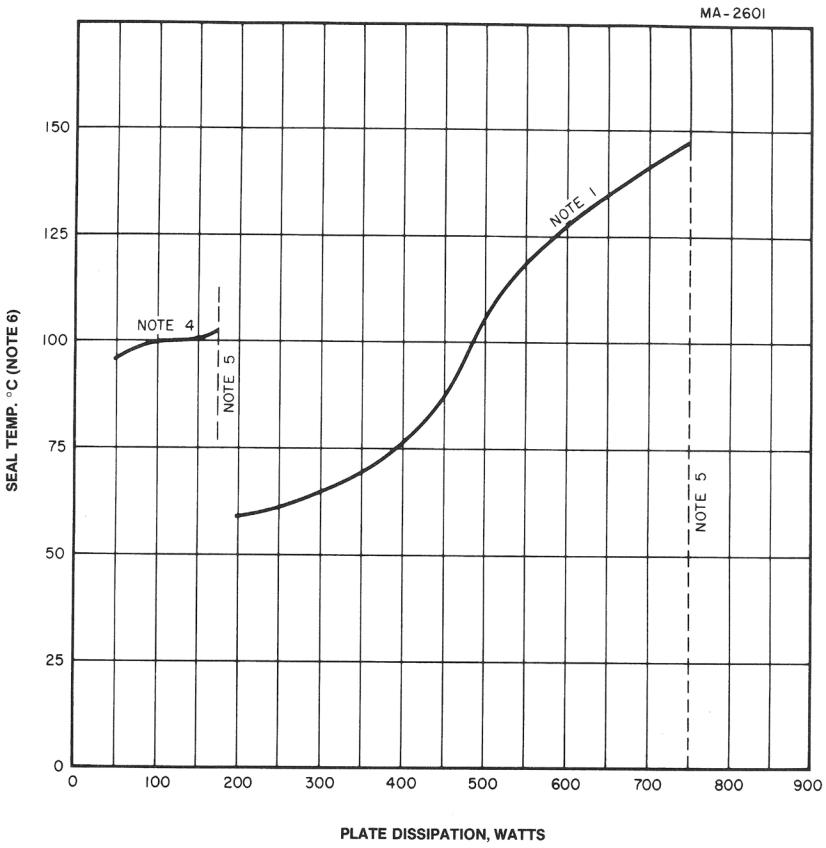


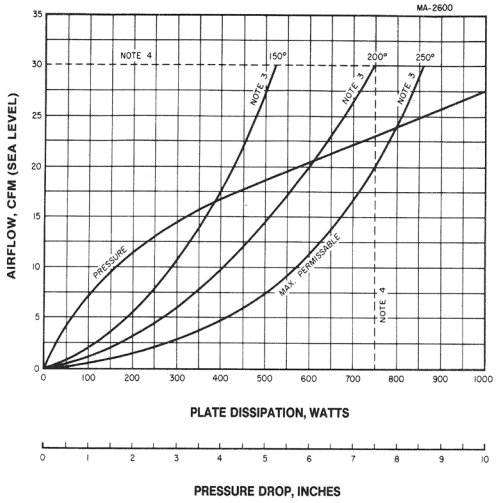
COOLING DATA FOR 8941/Y690 IN FC 77 DIELECTRIC COOLANT

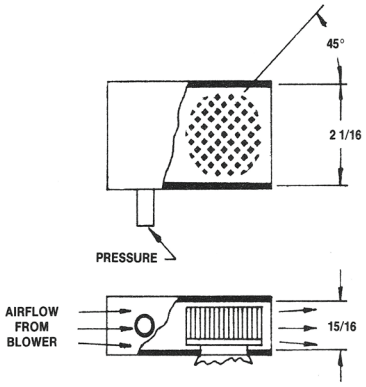


NOTES:

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.)

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.

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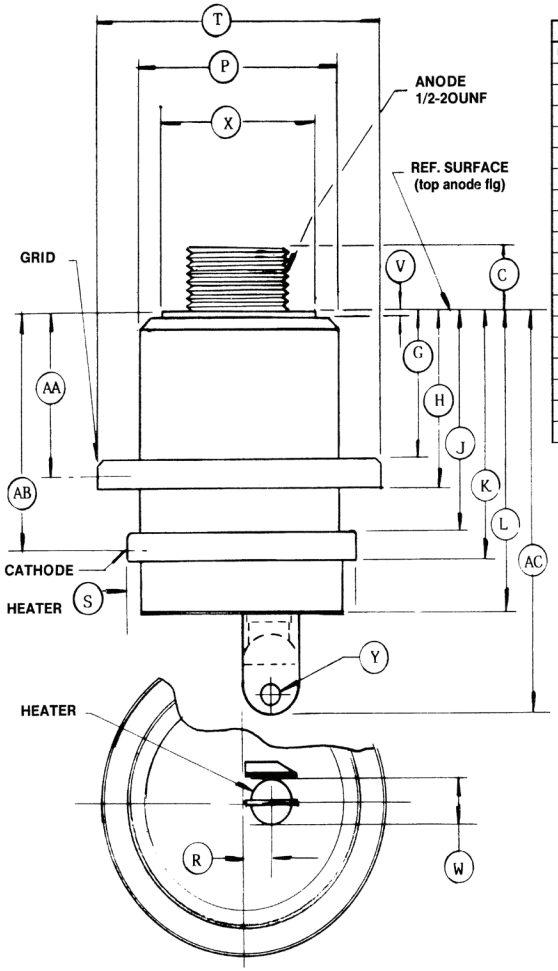


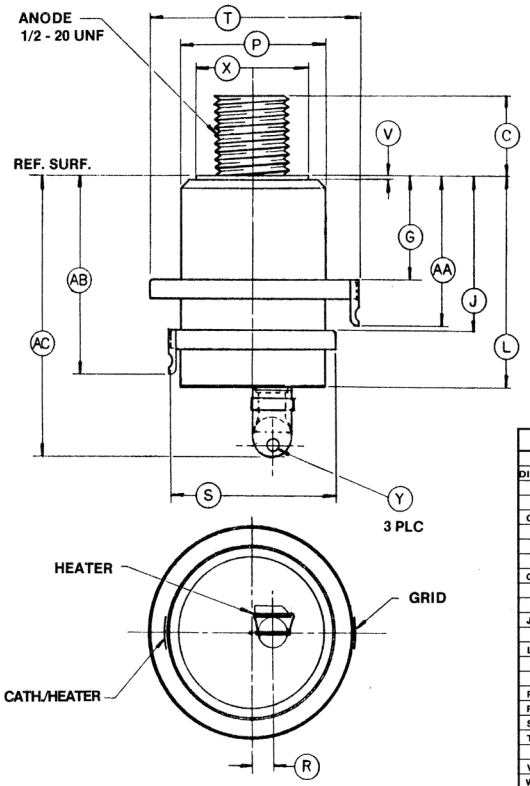
DIMENSIONS IN INCHES

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.

8941/Y690



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	

Y690A

Communications & Power Industries

Eimac®