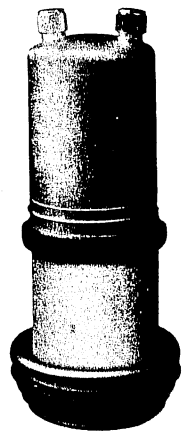
TECHNICAL DATA

Y-647
Liquid Cooled Power Tetrode

The EIMAC Y-647 is a ceramic/metal, liquid-cooled power tetrode intended for us at the 100 to 200 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The Y-647 is also useful as a plate and screen modulated Class-C rf amplifier, and in pulse modulator-generator service.

The liquid-cooled anode is rated at 100 kilowatts maximum plate dissipation.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 V
Current	295 A
Amplification Factor (Grid-Screen)(average)	4.5
Interelectrode Capacitances, Grounded Cathode: [2]	
Cin	440 pF
Cout	55 pF
Cgp	2.4 pF
Interelectrode Capacitances, Grounded Grid: [2]	
Cin	175 pF
Cout	57 pF
Cpk	0.5 pF
Frequency for Maximum Ratings	30 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. CPI Eimac Division 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.

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250°C
Maximum Envelope Temperature	250°C
Recommended Socket	EIMAC SK-1510
Operating Position	Vertical, base up or down

Communications & Power Industries
Eimac division

301 Industrial Road
San Carlos, CA 94070
(650) 592-1221

Printed in U.S.A.

Maximum Dimensions:
- Height ..... 18.0 In.; 457.2 mm
- Diameter ..... 8.0 In.; 203.2 mm

Cooling ..... Liquid and Forced Air
Net Weight (Approximate) ..... 60 lbs; 27.3 kg
Shipping Weight (Approximate) ..... 85 lbs; 38.6 kg

PULSED REGULATOR SERVICE & SWITCH TUBE

DC Plate Voltage	60	KV	DC Grid Bias	-2	KV
DC Screen Voltage	2500	V	Plate Dissipation	100	KW
DC Plate Current	15	A	Grid Dissipation	500	W
Peak Cathode Current	100	A	Screen Dissipation	1750	W

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 10.0 volts	280	310	A
Interelectrode Capacitances (grounded cathode connection) [2]			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF

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

APPLICATION

MECHANICAL

MOUNTING - The Y-647 must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the circuit designer.

SOCKET - The EIMAC sockets, type SK-1500 and SK-1510 are recommended for use with the Y-647.

COOLING - Anode cooling is accomplished by circulating water through the integral anode water jacket. The table below lists minimum cooling water requirements at various dissipation levels.

Plate Dissipation* (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
50	10	10
75	15	25
100	20	40

*Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The cooling table above assumes a water temperature rise of 20°C. Under no circumstances should the outlet water temperature exceed 70°C. Inlet water pressure should not exceed 80 PSI.

A major factor affecting long life of water cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 K ohms/cm^3, and preferably above 250 k ohms/cm^3. A relative water resistance check can be made continuously by measuring the leakage current which will by-pass a short section of the insulating hose column if metal nipples or fittings are used as electrodes.

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 cfm of air directed through the center of the socket is sufficient for this purpose.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC Y-647 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the Y-647 by a substantial percentage. It is a good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the Y-647. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked to maintain proper operation.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of the tube, and SK-1500 socket, must not exceed 100 volts.

CONTROL GRID OPERATION - The Y-647 control grid is rated at 500 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power dissipated by the screen grid must not exceed 1750 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on RMS screen voltage, and RMS screen current. Plate voltage, plate load or bias voltage must never be

removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

PLATE DISSIPATION - The plate dissipation of 100 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the Y-647 is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 66,500 watts.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment 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 primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operating with access doors open. Always remember that **HIGH VOLTAGE CAN KILL!**

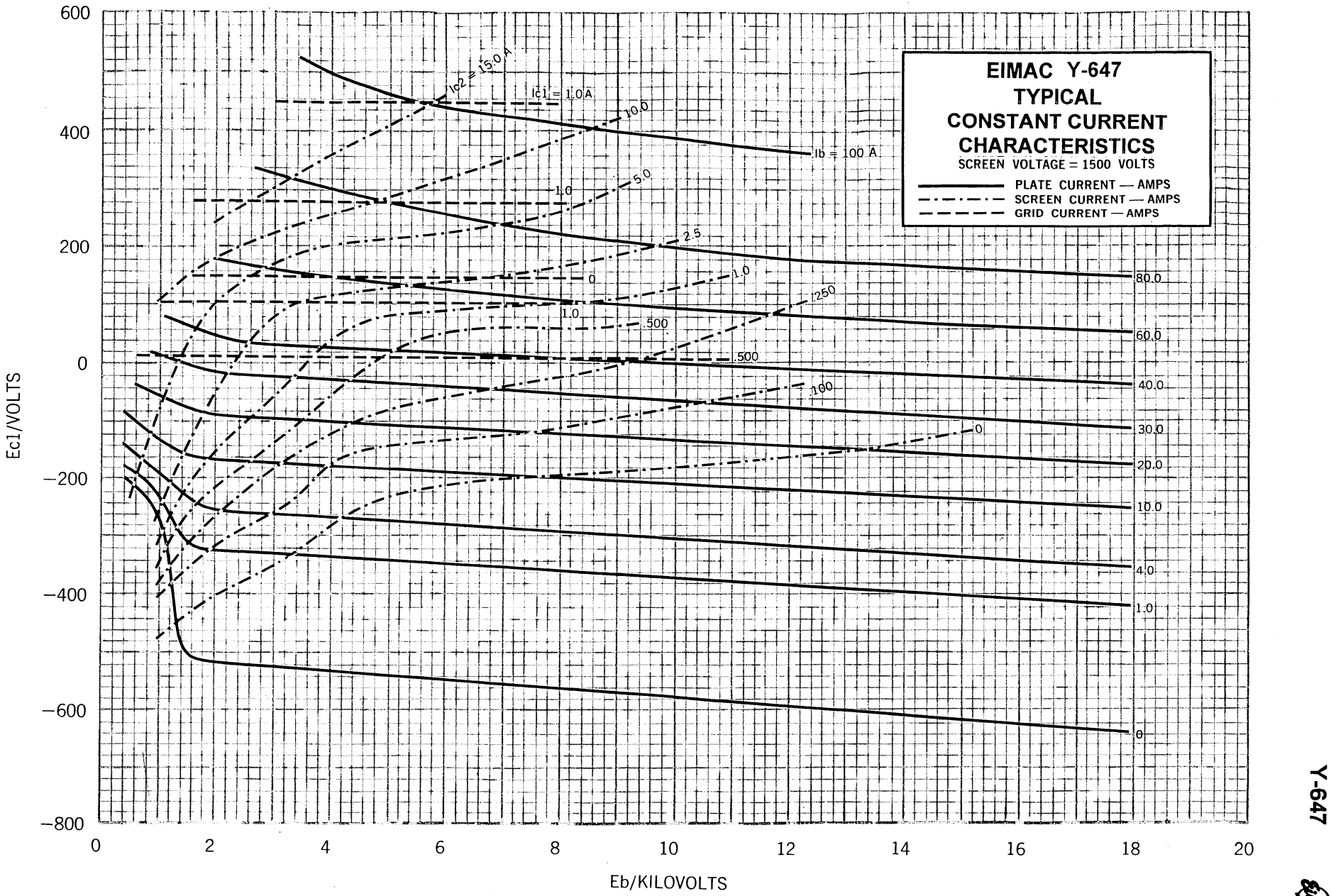
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage 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 when voltages above 10 kilovolts 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 be better able to locate an equipment malfunction can result in serious X-ray exposure.

FAULT PROTECTION - In addition to normal plate overcurrent interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

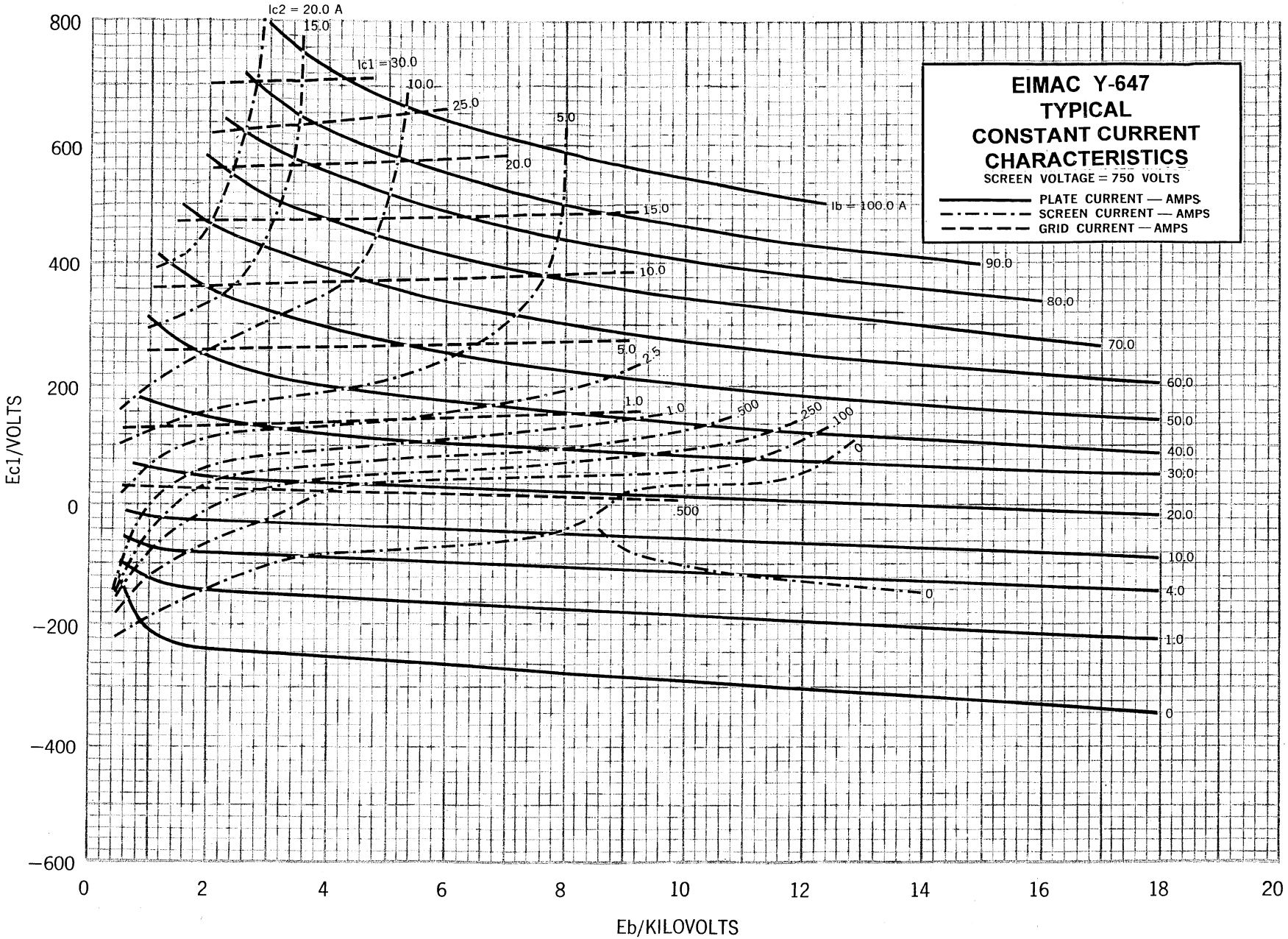
In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to CPI Eimac Division at 301 Industrial Way, San Carlos, CA 94070 or call 650/592-1221.

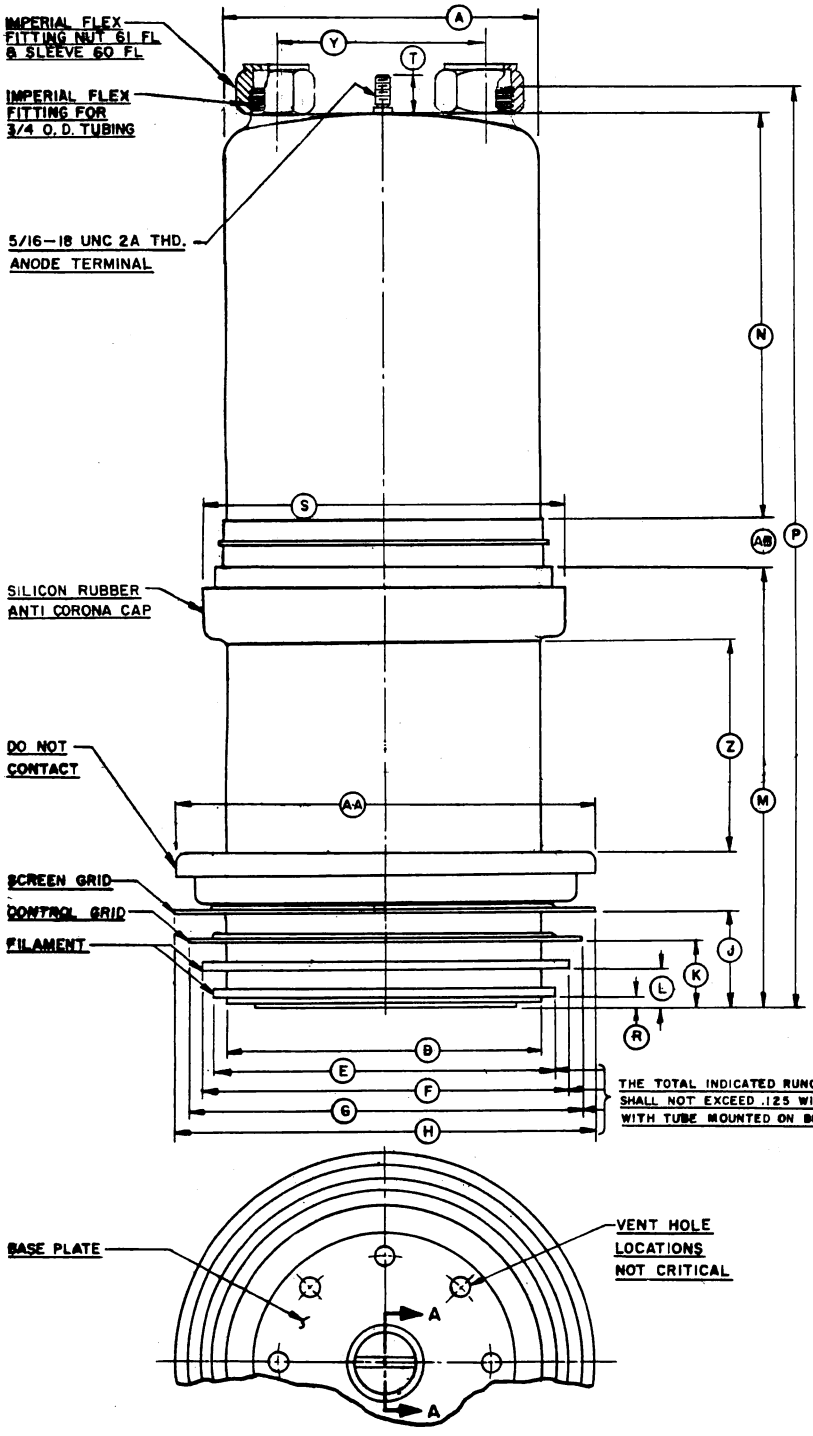


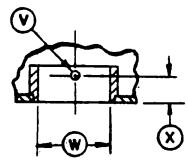
CURVE #2621

Y-647


EIMAC Y-647
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ic2 = 20.0 A
15.0
Ic1 = 30.0
10.0
25.0
5.0
20.0
15.0
10.0
5.0
2.5
1.0
1.0
500
250
100
0
500
0
Ib = 100.0 A
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
4.0
1.0
0
800
600
400
200
0
−200
−400
−600
Ec1/VOLTS
0
2
4
6
8
10
12
14
16
18
20
Eb/KILOVOLTS

CURVE #2623





SECTION A-A
ROTATED 180°

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.875	6.125	- -	149.2	155.6	- -
D	5.980	6.020	- -	151.9	152.9	- -
E	6.510	6.560	- -	165.3	166.6	- -
F	6.980	7.020	- -	177.3	178.3	- -
G	7.480	7.520	- -	190.0	191.0	- -
H	7.975	8.015	- -	202.6	203.6	- -
J	1.750	1.800	- -	44.4	45.7	- -
K	1.220	1.270	- -	31.0	32.3	- -
L	0.690	0.740	- -	17.5	18.8	- -
M	8.600	8.800	- -	218.4	223.5	- -
N	7.000	7.500	- -	177.8	190.5	- -
P	17.250	18.000	- -	438.1	457.2	- -
R	0.173	0.213	- -	4.39	5.41	- -
S	- -	- -	6.950	- -	- -	176.5
T	- -	- -	0.718	- -	- -	18.2
V	- -	0.135	- -	- -	3.43	- -
W	1.250	1.270	- -	31.7	32.2	- -
X	0.490	0.530	- -	12.4	13.5	- -
Y	3.940	4.060	- -	100.1	103.1	- -
Z	- -	- -	4.200	- -	- -	106.7
AA	- -	- -	8.000	- -	- -	203.2
AB	- -	- -	1.080	- -	- -	27.4

NOTES:
1. THE LATERAL AXES OF THE WATER FITTINGS & BASE LOCKING PIN ARE TO BE WITHIN 10°
2. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.