TECHNICAL DATA

9007/4CX26,000A VHF POWER TETRODE

The EIMAC 9007/4CX26,000A is a ceramic/metal power tetrode for use in VHF linear amplifier service. This product is a replacement for the 9007 in VHF-TV transmitters, delivering up to 33 kW peak-sync in visual service. The anode is rated for 26 kW dissipation with forced-air cooling.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten Mesh

Voltage	9.5 +0.5% V
Current at 9.5 Volts	147 A
Maximum Cold Start Inrush Current	300 A
Amplification Factor (average) Grid to Screen	12

Direct Interelectrode Capacitances (cathode grounded)[2]

C_{in}	225 pF
C_{out}	18.3 pF
C_{gp}	0.4

Direct Interelectrode Capacitances (grids grounded)[2]

C_{in}	119 pF
C_{out}	18.6 pF
C_{pk}	0.15 pF

Maximum Frequency for Full Ratings (CW) ...... 400 MHz

MECHANICAL

Maximum Overall Dimensions:

Length	8.31 in; 21 mm
Diameter	8.35 in; 212 mm
Net Weight (approximate)	22 lbs; 10.0 kg
Operating position	Axis Vertical, Base Up or Down
Cooling	Forced Air

Operating Temperature, Absolute Maximum

Ceramic/Metal Seals and Anode Core	250 °C
Base	Special, Coaxial

RANGE VALUES FOR EQUIPMENT DESIGN

Filament Current, at 9.5 Volts

Minimum	135 A
Maximum	156 A

[1] Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. Varian Power Grid Tube Products 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 the Electronic Industries Association Standard RS-191.

9007/4CX26,000A

RF POWER AMPLIFIER - CLASS B TELEVISION SERVICE
Channels 7-13, Cathode Driven

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	13.0 kV
DC Screen Voltage	2.0 kV
DC Grid Voltage	-600 V
DC Plate Current	7 A
Plate Dissipation	26 kW
Screen Dissipation	250 W
Grid Dissipation	150 W

TYPICAL OPERATION
In a cathode-driven circuit at 216 MHz and bandwidth of 6.3 MHz.

DC Plate Voltage	8.4 kV
DC Screen Voltage	1.5 kV
DC Grid Voltage	-190 V
DC Plate Current:	
Synchronizing Level	6.45 A
Blanking Level	4.9 A
DC Screen Current:	
Synchronizing Level	0.18 A
Blanking Level	0.03 A
DC Grid Current:	
Synchronizing level	0.22 A
Blanking Level	0.01 A
Driver Power Output:	
Synchronizing Level	1250 W
Blanking Level	750 W
Useful Power Output:	
Synchronizing Level	33 kW
Blanking Level	18.5 kW
Power Gain	14.2 dB

Typical operation values are obtained by measurement or by calculation from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation, providing the circuit maintains the correct voltage in the presence of these current variations.

APPLICATION

MECHANICAL

MECHANICAL STORAGE - If a tube is to be stored as a spare, it should be kept in the original packing material and shipping carton to minimize the possibility of damage.

Before storage, a new tube should be operated in the equipment for 100 to 200 hours to ensure that it operates properly. See the "Filament Operation" section for recommendations on filament voltage during this initial operation period. After 6 months of storage, the tube should be operated again for 100 to 200 hours to make sure there has been no degradation.

MOUNTING - The 9007/4CX26,000A must be operated with its axis vertical. The base of the tube may be placed up or down.

COOLING - The maximum temperature rating for the external surfaces of the tube is 250°C, and sufficient forced-air cooling must be used in all applications to keep the temperature of the anode (at the base of the cooling fins) and the ceramic/metal seals below this maximum. It is considered good engineering practice to design for a maximum anode core temperature of 225°C. Temperature-sensitive paints are available for checking base and seal temperatures before any design is finalized.

For more detailed information, Application Bulletin #20, "Temperature Measurements With EIMAC Tubes," is available upon request.

The following cooling guidelines should be noted and followed:

- It is good practice to allow for variables such as dirty air filters, rf seal heating, and unclean anode cooling fins if the tube has been in service for a length of time.
- Special attention should be given to ensure cooling of the center of the stem (base).
- An air interlock system should be incorporated into the design to automatically remove all voltages from the tube in case of even partial failure of the tube cooling system.

- The contact fingers used in the contact collet assemblies (inner and outer filament, control grid, and screen grid) are made of beryllium copper. If operated above 150°C for any appreciable length of time, this material will lose its springy characteristic, and will no longer make good contact with the base of the tube. This can lead to arcing, which can melt a contact area—primarily the inner or outer filament contacts—and the tube's vacuum integrity will be destroyed.

- Movement of air around the base of the tube keeps both the tube base and socket contact fingers at a safe operating temperature. If all cooling air is not passed around the base of the tube and through the socket, then arrangements must be made for adequate cooling of these areas.

- Air flow must be applied before or simultaneously with the application of power, including that of the tube filament, and should be maintained for a short period of time after all power is removed to allow the tube to cool down.

- For longer life and consistent performance, exceed the minimum cooling requirements.

- Minimum air flow requirements for a maximum anode temperature of 225°C at various altitudes and dissipation levels are listed below. The pressure drop values are approximate and are for the tube anode cooler only. Pressure drop in a typical installation will be higher due to system loss.

ELECTRICAL

HIGH VOLTAGE - This tube's operating voltages reach deadly levels. Design all equipment so that no one can come into 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 to allow operation with access doors open. Always remember that high voltage can kill.

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 condition. To avoid exceeding these ratings, the equipment designer should determine, for each rating, an average design value below the absolute value 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.

FILAMENT WARM-UP - The filament inrush current should be limited to 300 amperes. A suitable step-start procedure can accomplish this, or an impedance-limited transformer designed for this purpose can be used. The filament should be allowed to heat for a minimum of 15 seconds before any high voltage is applied, including the grid bias voltage.

In case of a power failure of less than 15 seconds, filament warm-up time can be as short as 5 seconds, but the inrush current limitation must be observed.

FILAMENT OPERATION - This tube is designed for commercial service with no more than one normal off/on filament cycle per day. If additional cycling is anticipated, the Varian Power Grid Tube Products Application Engineering department should be contacted for additional information.

New tubes and tubes that have been in storage should be operated with only filament voltage applied for 30 to 60 minutes before operation begins. This allows the active getter material mounted within the filament structure to absorb any residual gas molecules which might have accumulated during storage.

At rated or nominal filament voltage, the tube's peak emission capability is many times that needed for communication service. A reduction in filament voltage will lower the filament temperature and substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application.

The tube should be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before it is operated at reduced voltage. The voltage should then be gradually reduced until there is a slight degradation in performance, such as decreased power output or distortion. The voltage should then be increased a few tenths of a volt above the value where the performance degradation was noted. The operating point should be rechecked after 24 hours. Filament voltage should be closely regulated when voltage is reduced below nominal to avoid any adverse influence by nominal line voltage variations.

Filament voltage should always be measured at the tube base or socket using an accurate rms-responding meter.

For detailed information, Application Bulletin #18, "Extending Transmitter Tube Life," is available upon request.

To ensure maximum tube life, the procedure for voltage reduction described in Application Bulletin #18 should be repeated periodically to reset voltage as required.

DISSIPATION RATINGS - Maximum dissipation ratings must be respected to avoid tube damage. An exception is plate dissipation, which may be permitted to rise above the rated maximum for up to 10 seconds, such as during tuning.

GRID OPERATION - The maximum control grid dissipation is 150 watts, which is approximately determined by the product of the dc grid current and the peak positive grid voltage. A protective spark-gap device should be connected between the control grid and cathode to guard against excessive voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 250 watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and dc screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, as screen dissipation ratings will be exceeded. Energy limiting circuitry, which will activate if there is a fault condition, and spark-gap over-voltage protection are recommended.

Constant screen supply voltage must be maintained for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization with a bleeder resistor connected from screen to cathode assures that net screen current is always positive. This is essential if a series electronic regulator is used.

FAULT PROTECTION - In addition to using the normal plate over-current interlock, screen current interlock, and coolant interlock, the tube must be protected from damage caused by an internal arc which may occur at high plate voltage. **No more than 50 joules of energy may be dissipated in the tube structure.**

A protective resistance of 10 ohms should be connected in series with the tube anode (in the B+ lines) to absorb power supply stored energy if an internal arc should occur. If the power supply's stored energy is high, it is recommended that an electronic crowbar be utilized in the circuitry design. This circuit will discharge power supply capacitors in a few microseconds after the start of an arc.

To conduct a protection test for each electrode supply which will verify adequate tube protection, short circuit each HV power supply to ground, one at a time, through a vacuum relay switch or other suitable high-speed, high-voltage switch and a 6-inch (15.24 cm) length of #30 AWG (0.255 mm) soft copper wire. If the total energy delivered is less than 50 joules, the wire will remain intact, verifying adequate protection.

For more detailed information, Application Bulletin #17, "Fault Protection," is available upon request.

RADIO-FREQUENCY 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 effect. However, public health agencies are concerned with the hazard even at these frequencies. The Occupational Safety and Health Administration recommends that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

INTERELECTRODE CAPACITANCE - In most applications, the internal interelectrode capacitance of a tube is influenced by many variables, such as stray capacitance to the chassis, stray capacitance added by the socket, stray capacitance between the tube terminals, and wiring effects. To control the capacitance values within the tube as the key component involved, the industry and military services use a standard test procedure that is described in Electronic Industries Association Standard RS-191.

The test is performed on a cold tube, and requires a specially constructed test fixture that shields all external tube leads or contacts from each other and eliminates any capacitance reading to "ground." Other factors being equal, controlling internal tube capacitance in this way assures good interchangeability of tubes over time. The capacitance values shown in the technical data are taken in accordance with Standard RS-191. The equipment designer is cautioned to make allowance for the capacitance values which will exist in the application. Measurements should be taken with the mounting which represents approximate final layout if capacitance values are significant in the design.

SPECIAL APPLICATIONS - To operate this tube under conditions different from those listed here, contact the Power Grid Tube Marketing Department at Varian in San Carlos, 415-592-1221 or fax 415-592-9988.

OPERATING HAZARDS

Proper use and safe operating practices are the responsibility of equipment manufacturers and users of such tubes. All persons who work with or are exposed to power tubes or equipment which utilizes such tubes must take precautions to protect themselves against possible serious bodily injury. Do not be careless around such products.

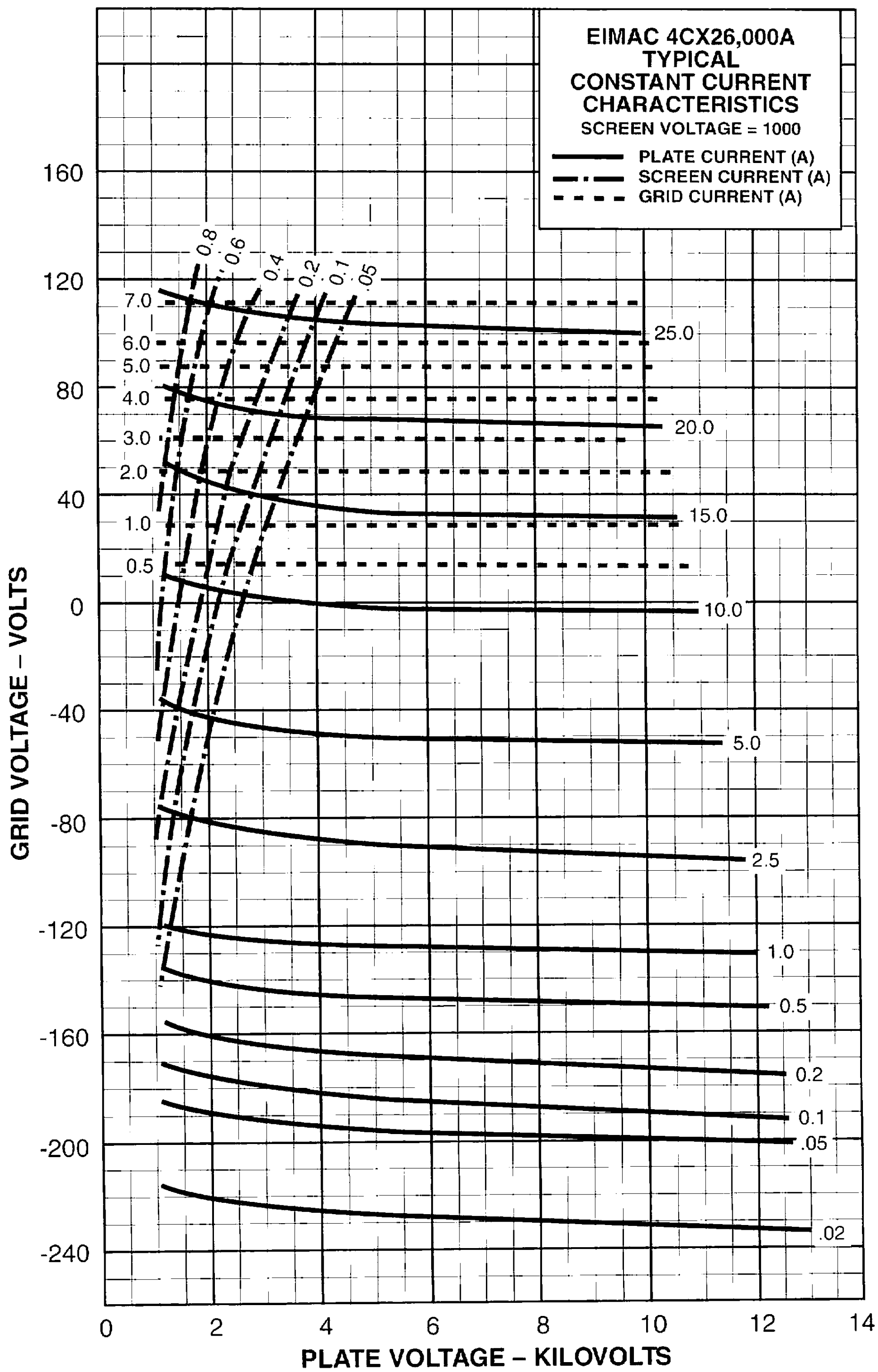
The operation of this tube may involve the following hazards, which, in the absence of safe operating practices and precautions, could result in serious harm to personnel. Please review the following hazards as well as the detailed operating hazards sheet enclosed with each tube, or request a copy from Varian.

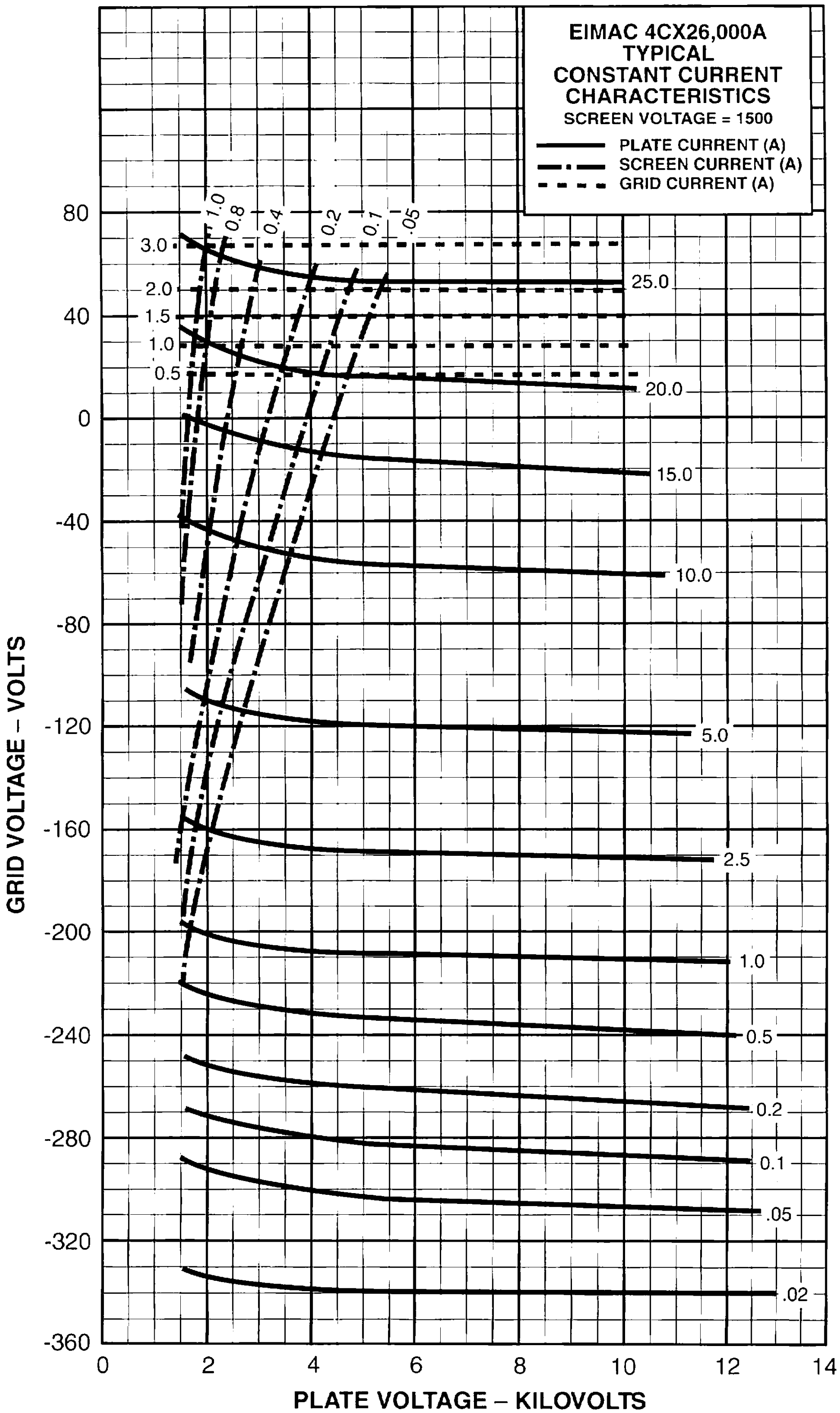
HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that high voltage can kill.

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

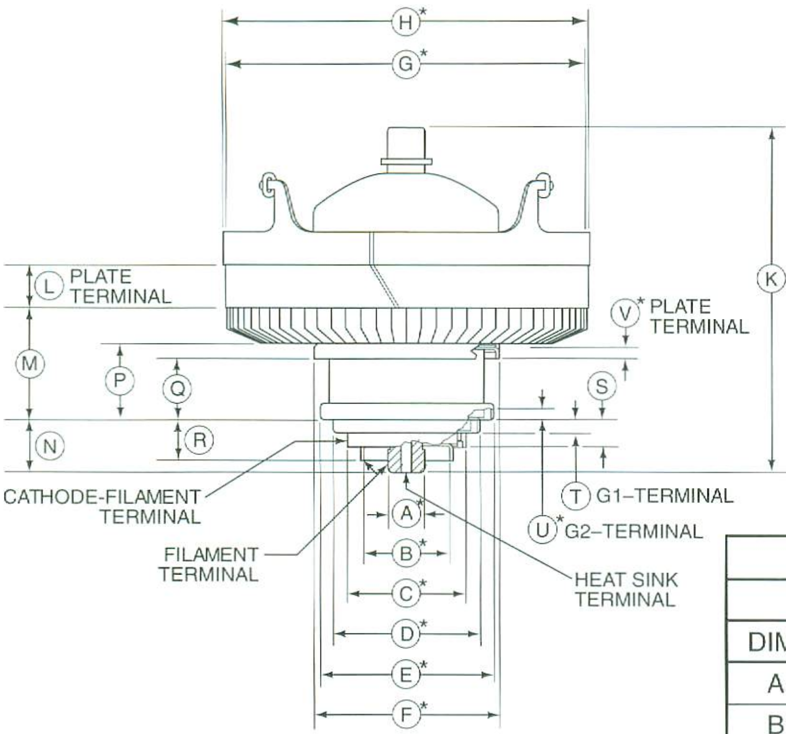
RF RADIATION - Exposure to strong rf fields should be avoided. even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. Cardiac pacemakers may be affected.

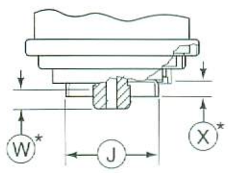
HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C, and they can cause serious burns even several minutes after all power has been removed.


EIMAC 4CX26,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1000
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
0.8
0.6
0.4
0.2
0.1
.05
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
25.0
20.0
15.0
10.0
5.0
2.5
1.0
0.5
0.2
0.1
.05
.02
160
120
80
40
0
-40
-80
-120
-160
-200
-240
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
12
14
PLATE VOLTAGE – KILOVOLTS


EIMAC 4CX26,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
80
40
0
-40
-80
-120
-160
-200
-240
-280
-320
-360
0
2
4
6
8
10
12
14
3.0
2.0
1.5
1.0
0.5
1.0
0.8
0.4
0.2
0.1
.05
25.0
20.0
15.0
10.0
5.0
2.5
1.0
0.5
0.2
0.1
.05
.02

9007/4CX26,000A





DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		.810			20.57	
B	1.945	1.975		49.40	50.16	
C	2.681	2.711		68.10	68.86	
D	3.300	3.330		83.82	84.58	
E	3.900	3.930		99.06	99.82	
F	4.168	4.208		105.87	106.89	
G	8.215	8.285		208.66	210.44	
H	8.279	8.349		210.29	212.07	
J			2.07			52.68
K		8.31			211.07	
L	.950	1.050		24.10	26.70	
M	2.620	2.760		66.53	70.13	
N			1.24			31.50
P	1.775			45.08		
Q	1.390	1.450		35.31	36.83	
R	.910	1.010		23.10	25.70	
S	.610	.690		15.51	17.51	
T	.300	.360		7.62	9.14	
U	.265			6.73		
V	.265			6.73		
W	.450			11.43		
X	.265			6.73		

1. Reference dimensions are for information only and are not required for inspection.
2. (*) Contact surfaces.
3. The diameter of each terminal is maintained only over the indicated minimum length of its contact surface.
4. With the plate and cathode terminals used as reference the other terminals will have a maximum T.I.R. of .040.

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