



TECHNICAL DATA

3CX3000H7

HIGH-MU  
AIR-COOLED  
POWER TRIODE

The EIMAC 3CX3000H7 is a ceramic/metal, forced-air cooled, external anode high-mu power triode for use as an amplifier, oscillator, or modulator, or in voltage regulator applications.

The tube has flexible leads on the base for the filament connections, and a flange on the grid terminal so the tube may be mounted and used with no socket.

Operation with zero grid bias in many applications offers circuit simplicity by eliminating the bias supply. Grounded-grid operation is attractive, since a power gain of over 20 times can be obtained.

The anode is rated for up to 4000 watts of dissipation, with a grid dissipation rating of 225 watts.



GENERAL CHARACTERISTICS<sup>1</sup>

ELECTRICAL

Filament: Thoriated Tungsten

Voltage .....	7.5 ± 0.37 V
Current, at 7.5 volts .....	50.5 A
Amplification Factor (Average) .....	160

Direct Interelectrode Capacitance (grounded cathode)<sup>2</sup>

Cin .....	38 pF
Cout .....	0.6 pF
Cgp .....	24 pF

Frequency of Maximum Rating:

CW .....	30 MHz
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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. EIMAC Division of Varian 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.

MECHANICAL

Maximum Overall Dimensions:

Length (excluding leads) .....	9.000 in; 228.60 mm
Diameter .....	4.250 in; 107.95 mm
Net Weight .....	7.0 lb; 3.2 kg
Operating Position .....	Vertical, base up or down

Maximum Operating Temperature:

Ceramic/Metal Seals & Anode Core .....	250°C
Filament Lead/Tube Base Junctions .....	150°C

Cooling .....	Forced Air
Base .....	See Outline



3CX3000H7

**RADIO FREQUENCY LINEAR AMPLIFIER  
CATHODE DRIVEN**

Class AB<sub>2</sub>

**ABSOLUTE MAXIMUM RATINGS:**

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	4000	WATTS
GRID DISSIPATION	225	WATTS

1. Approximate value.

**TYPICAL OPERATION (Frequencies to 30 MHz)  
Class AB<sub>2</sub>, Peak Envelope or Modulation  
Crest Conditions**

Plate Voltage	4000	4800	4800	Vdc
Zero-Signal Plate Current <sup>1</sup>	0.25	0.35	0.35	Adc
Single-Tone Plate Current	2.00	1.68	2.00	Adc
Single-Tone Grid Current <sup>1</sup>	0.61	0.46	0.60	Adc
Peak Driving Power	420	293	410	w
Plate Dissipation	2285	2275	2775	W
Single-Tone Plate Output Power	6030	6000	7266	W
Resonant Load Impedance	1210	1720	1425	Ω
Driving Impedance	47.5	50.0	46.3	Ω

**RADIO FREQUENCY LINEAR AMPLIFIER  
GRID DRIVEN**

Class AB<sub>2</sub>

**ABSOLUTE MAXIMUM RATINGS:**

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	4000	WATTS
GRID DISSIPATION	225	WATTS

1. Approximate value.

**TYPICAL OPERATION (Frequencies to 30 MHz)  
Class AB<sub>2</sub>, Grid Driven, Carrier Conditions**

Plate Voltage	4000	Vdc
Zero-Signal Plate Current <sup>1</sup>	0.25	Adc
DC Plate Current	0.74	Adc
DC Grid Current <sup>1</sup>	0.13	Adc
Peak rf Grid Voltage <sup>1</sup>	85.0	v
Peak Driving Power <sup>1</sup>	11.5	w
Plate Dissipation	1830	W
Single-Tone Plate Output Power	1130	W
Resonant Load Impedance	1750	Ω
Peak rf Plate Voltage	2000	v

**RADIO FREQUENCY POWER AMPLIFIER**

Class C Telegraphy or FM, Cathode Driven  
(Key-Down Conditions)

**ABSOLUTE MAXIMUM RATINGS:**

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	4000	WATTS
GRID DISSIPATION	225	WATTS

**TYPICAL OPERATION (Frequencies to 30 MHz)**

Plate Voltage	3500	4800	Vdc
Grid Voltage	-50	-60	Vdc
Plate Current	1.30	1.54	Adc
Grid Current <sup>1</sup>	0.42	0.48	Adc
Peak rf Cathode Voltage <sup>1</sup>	220	267	v
Calculated Driving Power <sup>1</sup>	310	435	W
Plate Dissipation	985	1480	W
Useful Output Power <sup>2</sup>	3300	5500	W

1. Approximate value.

2. Output circuit and filter loss of 10% assumed.

**AUDIO FREQUENCY POWER AMPLIFIER OR  
MODULATOR**

Class AB<sub>2</sub>, Grid Driven (Sinusoidal Wave)

**ABSOLUTE MAXIMUM RATINGS (per tube)**

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	4000	WATTS
GRID DISSIPATION	225	WATTS

1. Approximate value.

2. Per tube.

**TYPICAL OPERATION (Two Tubes)**

Plate Voltage	4000	Vdc
Zero-Signal Plate Current <sup>1</sup>	0.50	Adc
Max. Signal Plate Current	3.58	Adc
Max. Signal Grid Current <sup>1</sup>	0.58	Adc
Peak af Grid Voltage <sup>2</sup>	190	v
Peak Driving Power <sup>3</sup>	115	w
Max. Signal Plate Dissipation	3700	W
Plate Output Power	10,500	W
Load Resistance (plate to plate)	2720	Ω

3. Nominal drive power is one-half peak power.



## VOLTAGE REGULATOR SERVICE

### ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE . . . . .	10,000 Vdc
DC PLATE CURRENT . . . . .	4.0 Adc
PULSED PLATE CURRENT . . . . .	10.0 a
PLATE DISSIPATION <sup>1</sup> . . . . .	4,000 W
GRID DISSIPATION <sup>1</sup> . . . . .	225 W

<sup>1</sup> The equipment designer or user must assure that the rated dissipation values are not exceeded. In continuous operation (Class A) element dissipation is simply the product of voltage and current at the operation condition. In pulsed operation the element dissipation is basically the product of voltage, current, and duty factor, though pulse shape and circuit conditions may effect actual dissipation values.

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

### RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.
Filament: Current @ 7.5 volts . . . . .	48.0	53.0 A
Interelectrode Capacitances <sup>1</sup> (grounded filament connection)		
Cin . . . . .	30.0	45.0 pF
Cout . . . . .	---	1.0 pF
Cgp . . . . .	20.0	28.0 pF
Interelectrode Capacitances <sup>1</sup> (grounded grid connection)		
Cin . . . . .	30.0	45.0 pF
Cout . . . . .	20.0	28.0 pF
Cpk . . . . .	---	1.0 pF
Zero Bias Plate Current ( $E_b = 5000$ volts) . . . . .	0.36	0.52 A
Cut-off Bias ( $E_b = 5000$ volts, $I_b = 1.0$ mA dc) . . . . .	---	-45.0 V

1. Capacitance values are for a cold tube as measured in a shielded fixture.



## APPLICATION

## MECHANICAL

**MOUNTING** - The 3CX3000H7 must be mounted vertically, base down or up at the convenience of the circuit designer.

**COOLING** - The maximum temperature rating for the anode core and the ceramic/metal seal areas of the tube is 250°C, and sufficient forced-air cooling must be provided to assure operation at safe tube temperatures. Tube life is usually prolonged if cooling in excess of absolute minimum requirements is provided for cooler tube temperatures.

The filament leads of the 3CX3000H7 are attached to the tube with soft solder, and care must therefore be taken to supply sufficient cooling to this area of the tube to maintain temperatures below 150°C to avoid melting or loosening of these leads.

Minimum air flow requirements to maintain anode core and ceramic/metal seal areas below 225°C at sea level with an inlet-air temperature of 50°C are tabulated for air-flow in the base-to-anode and anode-to-base directions. At higher ambient temperatures, frequencies above 30 MHz, or at higher altitudes, a greater quantity of air will be required.

With air flowing in a base-to-anode direction, and with the specified air also flowing past the base section of the tube, no additional base cooling of the tube is normally required. With air flowing in an anode-to-base direction, the tube requires additional cooling air directed into the filament stem structure, between the inner and outer filament terminals, in the amount of 5 cfm minimum, directed by an appropriate air nozzle or pipe.

It is suggested that temperatures, especially in the base area of the tube, be monitored in any new installation to insure proper cooling. Temperatures may be measured with any of the available temperature-sensing paint or crayon materials.

Anode-to-Base Air Flow				
Anode Dissipation watts	Sea Level		10,000 Feet	
	Air Flow CFM	Pressure Drop Inches water	Air Flow CFM	Pressure Drop Inches water
2000	49	0.31	71	0.45
3000	85	0.72	124	1.40
4000	127	1.40	185	2.55
Base-to-Anode Air Flow				
2000	46	0.3	67	0.44
3000	72	0.6	105	0.88
4000	99	1.0	145	1.46

## ELECTRICAL

**FILAMENT OPERATION** - The filament voltage, as measured at the filament terminals, should be 7.5 volts, with maximum allowable variations due to line fluctuations of from 7.12 to 7.87 volts.

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

**INPUT CIRCUIT** - When operated as a grounded-grid rf amplifier, the use of a matching network in the cathode circuit is recommended. For best results with a single-ended amplifier, and depending on the application, it is suggested the cathode tank circuit operate with a Q of five or more.

**HIGH FREQUENCY OPERATION** - The 3CX3000H7 is usable to 110 MHz, with a plate voltage reduction to 4000 volts for rf service, if the rf connections to the filament contacts are properly made directly at the base of the tube.



**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 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as these, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

**FAULT PROTECTION** - In addition to normal cooling airflow interlock and plate over-current interlock it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high plate voltage.

In all cases some protective resistance, at least 10 ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur.

**HIGH VOLTAGE** - Normal operating voltages used with these tubes 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 operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

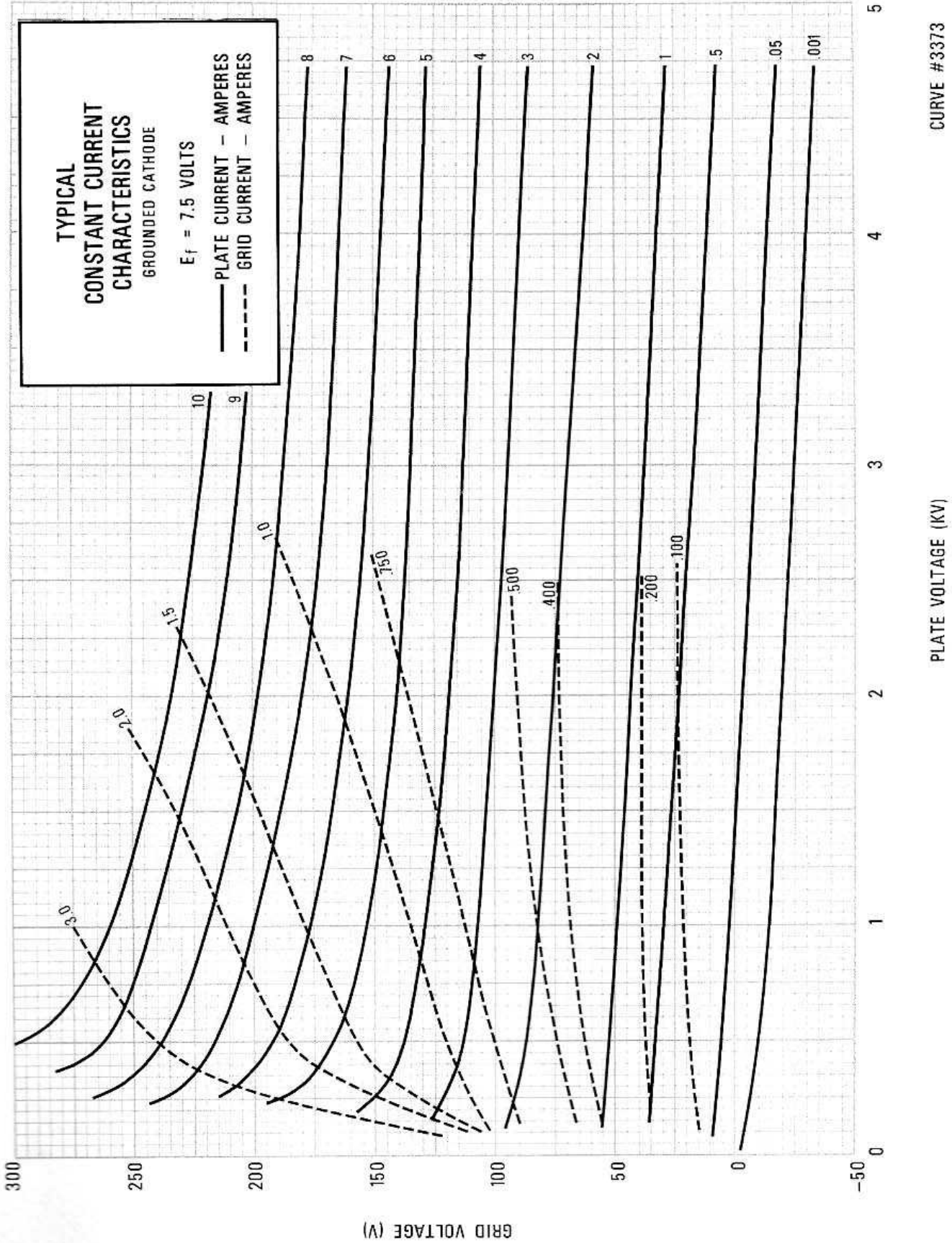
**INTERELECTRODE CAPACITANCE** - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the 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 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". The test is performed on a cold tube. 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 capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

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

**SPECIAL APPLICATION** - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



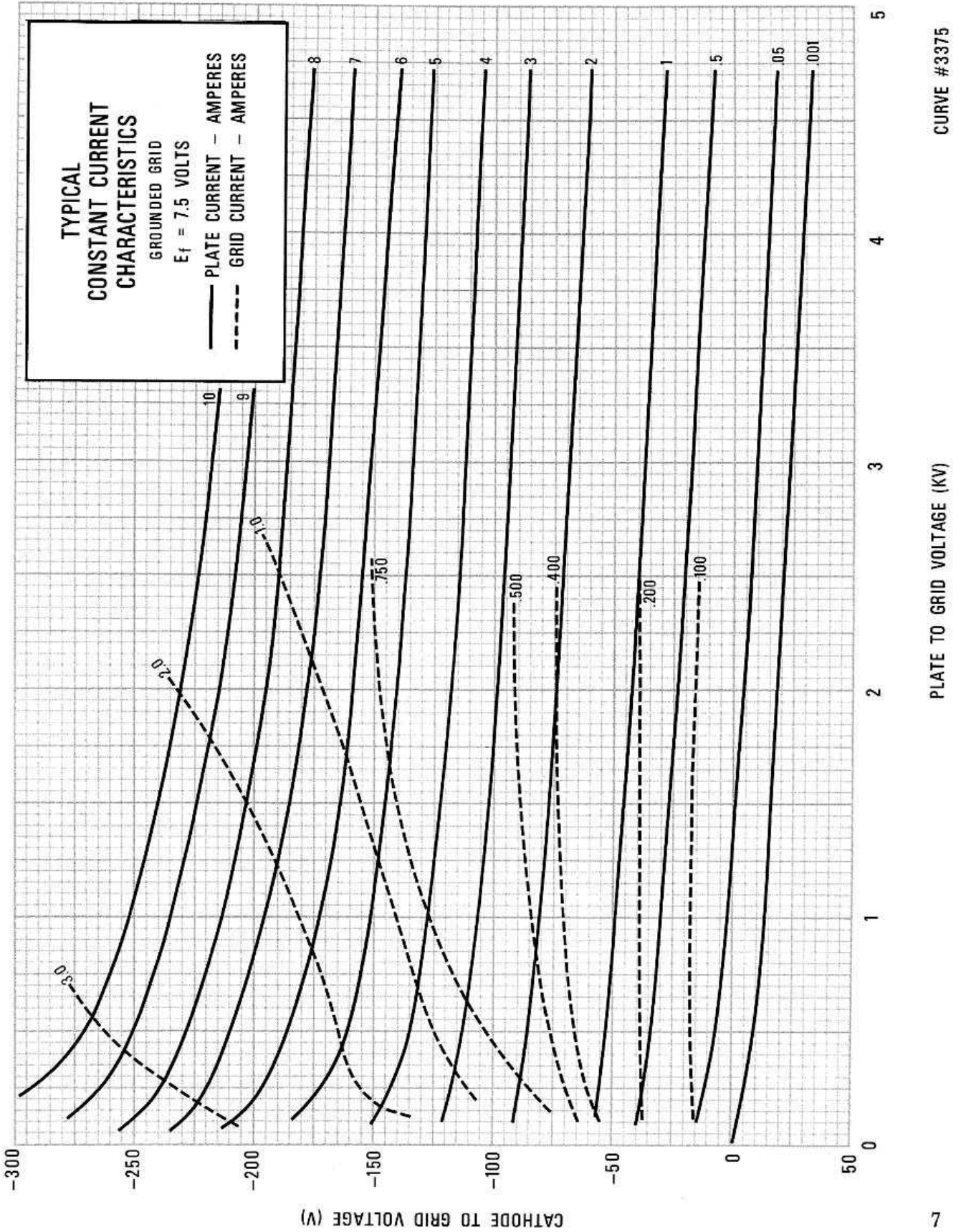
3CX3000H7



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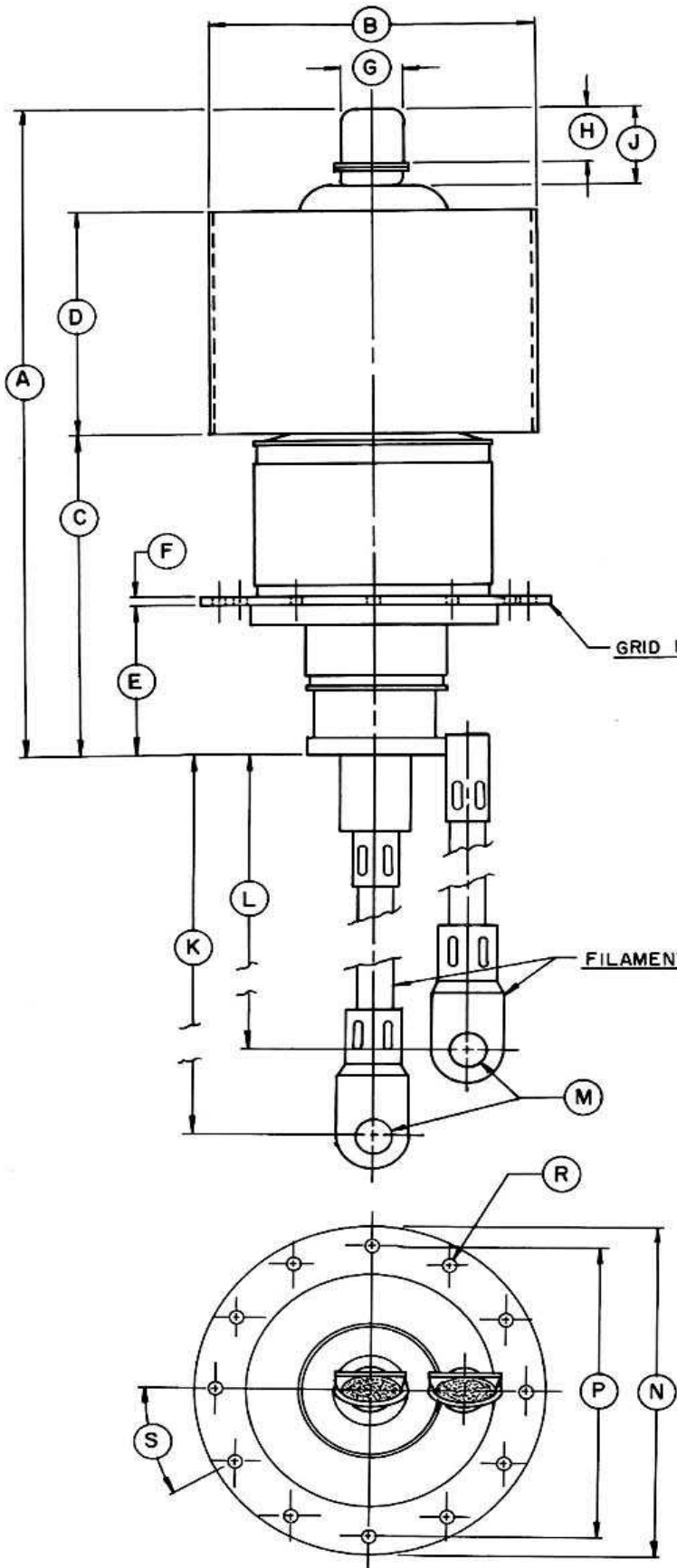
PLATE VOLTAGE (KV)

GRID VOLTAGE (V)





3CX3000H7



DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	8.000	9.000	--	203.20	228.60	--
B	4.093	4.156	--	103.96	105.56	--
C	3.875	4.250	--	98.43	107.95	--
D	2.937	3.062	--	74.60	77.77	--
E	1.703	1.953	--	43.26	49.61	--
F	--	--	0.125	--	--	3.18
G	0.781	0.843	--	19.84	21.41	--
H	0.687	0.812	--	17.45	20.62	--
J	1.000	1.125	--	25.40	28.58	--
K	8.937	9.437	--	227.00	239.70	--
L	7.937	8.437	--	201.60	214.30	--
M	--	--	0.390	--	--	9.91
N	4.230	4.250	--	107.44	107.95	--
P	3.855	3.885	--	97.92	98.68	--
R	--	--	0.250	--	--	6.35
S	29°	31°	--	29°	31°	--

**NOTES:**

1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. THERE ARE 12 HOLES IN GRID FLANGE.
3. GRID FLANGE AND FILAMENT LEADS ARE TO BE ORIENTED AS SHOWN