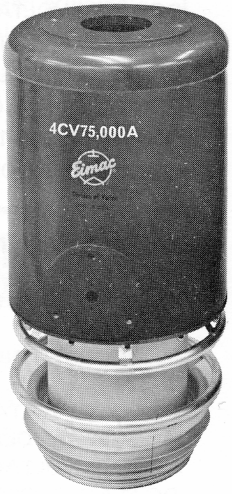
4CV75,000A

TECHNICAL DATA

VAPOR COOLED
POWER TETRODE

The EIMAC 4CV75,000A is a ceramic/metal, vapor-cooled power tetrode intended for use at the 50 to 80 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 4CV-75,000A is also useful as a plate and screen modulated Class C rf amplifier.

The vapor-cooled anode is rated at 75 kilowatts of dissipation when mounted in the EIMAC BR-320 boiler assembly.



BR-320 Boiler installed

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	10 ± 0.5	V
Current, at 10.0 volts	300	A
Amplification Factor (Grid-Screen, average)	4.5	
Direct Interelectrode Capacitances (grounded filament)		
Cin	440	pF
Cout	55	pF
Cgp	2.3	pF
Direct Interelectrode Capacitances (grounded grid)		
Cin	175	pF
Cout	57	pF
Cpk	0.4	pF
Frequency for Maximum Ratings:		
CW	30	MHz

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

MECHANICAL

Maximum Overall Dimensions: (without boiler)	
Length	17.450 in; 443.2 mm
Diameter	9.300 in; 236.2 mm
Net Weight	60 lb; 27.3 kg
Operating Position	Vertical, base down
Maximum Operating Temperature:	
Base and Anode Seals	250°C
Recommended Socket	EIMAC SK-1500 Series
Recommended Boiler	EIMAC BR-320
Cooling	Vapor and Forced Air

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	10.0	15.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage [1]	-290	-340	Vdc
Zero-Signal Plate Current	2.0	1.0	Adc
Single Tone Plate Current	8.7	7.55	Adc
Single-Tone Screen Current[2]	0.385	0.310	Adc
Peak rf Grid Voltage [2]	270	310	v
Plate Dissipation	32	30.5	W
Plate Output Power	55	82.5	kW

1. Adjust to specified zero-signal dc plate current.
2. Approximate value .

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony (Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	10.0	15.0	15.0	kVdc
Screen Voltage	750	750	1500	Vdc
Grid Voltage	-425	-480	-1020	Vdc
Plate Current	6.7	6.45	11.8	Adc
Screen Current[1]	0.925	0.810	1.0	Adc
Grid Current [1]	0.320	0.355	0.100	Adc
Peak rf Grid Voltage[1]	575	640	1220	v
Calculated Driving Power	185	225	120	W
Plate Input Power	67	96.5	177	kW
Plate Dissipation	12	14	38	kW
Plate Output Power	55	82.5	139	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,500	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION [1]	50,000	WATTS
SCREEN DISSIPATION [2]	1750	WATTS
GRID DISSIPATION [2]	500	WATTS

1. Corresponds to 75,000 watts at 10% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	7.5	10.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-460	-520	Vdc
Plate Current	7.0	6.6	Adc
Screen Current[1]	1.2	0.985	Adc
Grid Current [1]	0.375	0.370	mAdc
Peak af Screen Voltage 1 (100% modulation)	640	675	v
Peak rf Grid Voltage[1]	630	680	v
Calculated Driving Power	235	250	W
Plate Input Power	52.5	66	kW
Plate Dissipation	10.5	11	kW
Plate Output Power	42	55	kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB_1, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	10.0	15.0	kVdc
Screen Voltage	1.5	1.5	Vdc
Grid Voltage [1/3]	-290	-340	Vdc
Zero-Signal Plate Current	4.0	2.0	Adc
Max. Signal Plate Current	17.4	15.1	Adc
Zero-Signal Screen Current[1]	0	0	Adc
Max. Signal Screen Current[1]	0.77	0.62	Adc
Max. Signal Grid Current[1]	0	0	Adc
Peak af Grid Voltage [2]	270	310	v
Peak Driving Power	0	0	w
Plate Input Power	143	195.0	kW
Max. Signal Plate Dissipation	33	30.5	kW
Plate Output Power	110	165	kW
Load Resistance(plate to plate)	1150	2560	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen 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 and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary 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. In the case of Class C Service, 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.	
Heater: Current at 10.0 volts	280	310	A
Cathode Warmup Time	10	---	sec.
Interelectrode Capacitances (grounded filament connection)			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF
Interelectrode Capacitances (grounded grid connection)			
Cin	155	195	pF
Cout	52	62	pF
Cpk	---	0.6	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CV75,000A must be mounted vertically, anode up, in an EIMAC BR-320 boiler. Care must be exercised to insure that the axis of the tube/boiler combination is vertical and that the water in the boiler is at the level indicated on the outline drawing of the tube and boiler The anode flange on the tube must seat securely against the rubber "O" ring, forming a liquid-tight seal between the tube and boiler.

SOCKETING - The EIMAC SK-1500 series is available for use with the 4CV75,000A. Filament, control grid, and screen grid connections are made to this socket. Springfinger contacts on the socket are used to make connections to the concentric rings on the tube base.

COOLING - Anode cooling is accomplished by immersion in a "boiler" filled with distilled water. Energy dissipated by the anode causes the water to boil at the anode surface, be converted into steam, and carried away to an external condenser. The condensate is then returned to the boiler, completing the cycle.

This boiling action maintains the anode surface at a fairly constant temperature near 100°C. The vapor-cooled tube has good overload capabilities; excess dissipation for moderate periods only causes more water to boil.

A control box (EIMAC CB-202) is used to sense water level in the boiler and signal for make-up water from a reservoir, and also to shut down the system in case of low water level. In order to perform its function, the control box must be mounted so that its water level mark is at the same elevation as the water level mark on the boiler.

Since the tube anode and boiler are usually at high potential to ground, water and steam connections to the boiler are made through insulated tubing.

A pressure equalizing line is required between the steam side of the system and the top of the control box. Its function is to provide the same pressure in the control box as in the boiler.

Separate cooling of the tube base is required and is accomplished by directing a minimum of 60 cfm of air at 25°C maximum at sea level (rising to 100 cfm of air at 50°C maximum at sea level) into

the socket from the side, in the area of the filament seals. In addition, a minimum of 2 cfm of air should be directed into the base well of the tube, to maintain a safe temperature in this area. Base air cooling should be applied before or simultaneously with the application of electrode voltages, including the filament, and should be maintained for a short period after all voltages are removed to allow for tube cool-down.

ELECTRICAL

FILAMENT - The rated filament voltage for the 4CV75,000A is 10.0 volts and, as measured at the socket or the base of the tube, should be maintained within plus or minus five percent to obtain maximum tube life and consistent performance.

Filament starting (inrush) current should be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of either tube or the SK-1500 socket should not exceed 100 volts.

CONTROL GRID OPERATION - The 4CV75,000A control grid is rated at 500 watts of dissipation. Grid dissipation is the approximate product of a grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power dissipated by the screen grid must not exceed 1750 watts. Where no ac voltage is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the 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 on the tube since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CV75,000A may exhibit reverse screen current, depending on operating conditions. The screen supply voltage must be maintained constant 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 may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be used in the screen supply. A bleeder resistor must be used if a series regulator is employed.

PLATE DISSIPATION - The plate dissipation of 75 kilowatts attainable with vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV75,000A is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 50 kilowatts.

FAULT PROTECTION - In addition to the normal plate-overcurrent interlock, screen-current interlock, and vapor-cooling control box interlock, it is good practice to protect the tube from internal damage caused by an internal plate arc which may occur at high plate voltages.

A protective resistance of 5 to 25 ohms should always be connected in series with the tube anode, to absorb power-supply stored energy if a plate arc should occur. An electronic crowbar, which will discharge power-supply capacitors in a few microseconds after the start of a plate arc, is recommended.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV75,000A, 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.

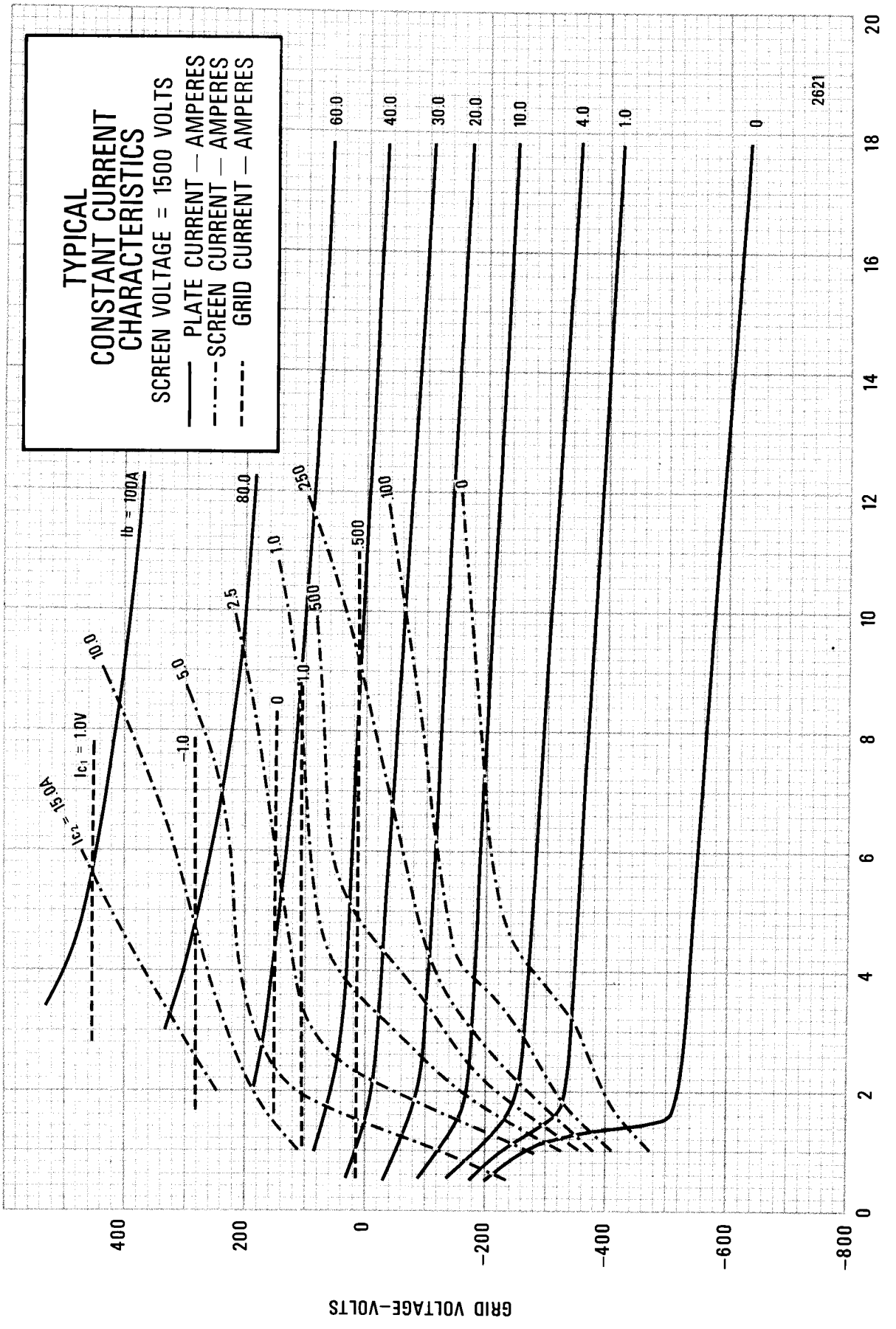
Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

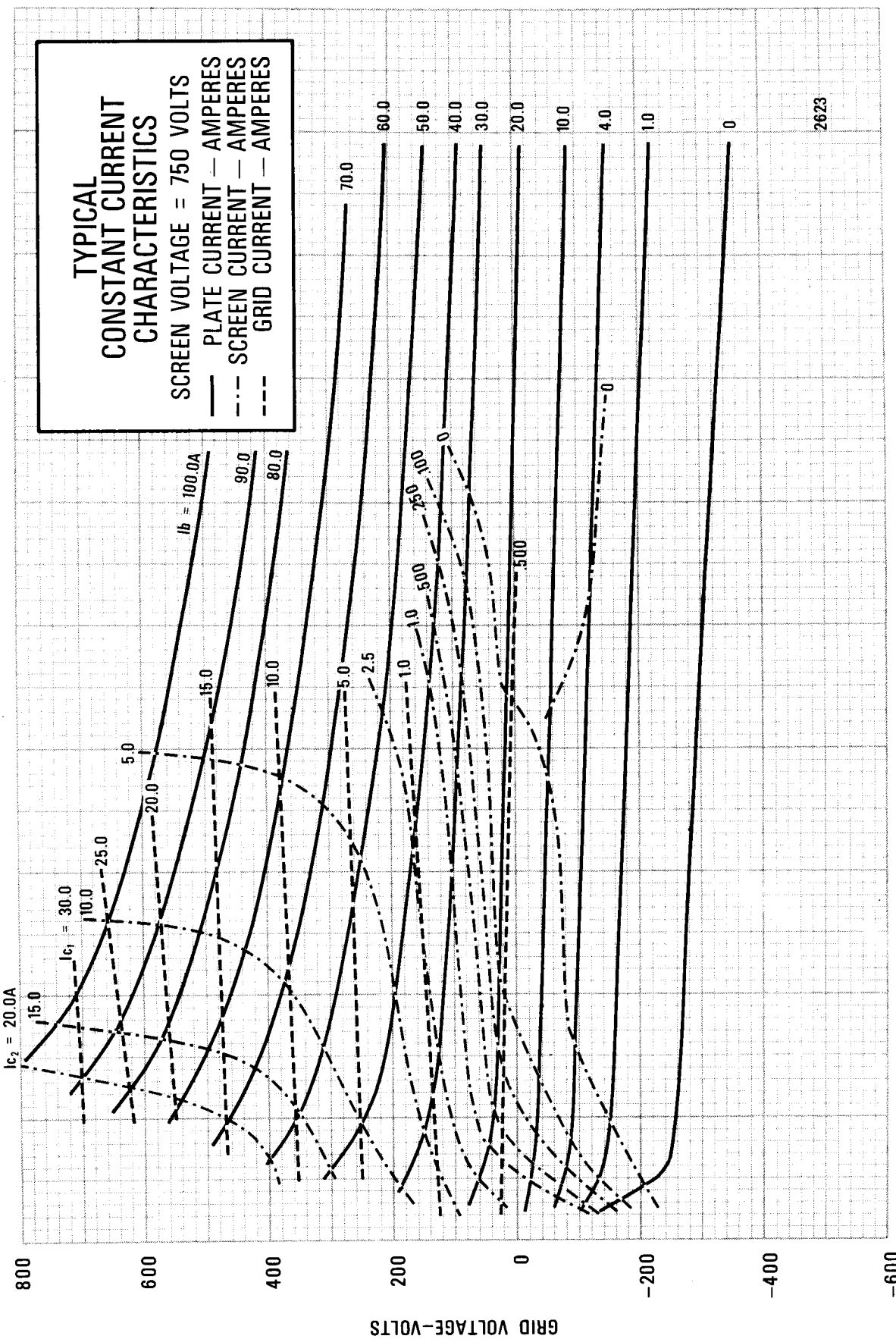
HIGH VOLTAGE - Normal operating voltages used with the 4CV75,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to dis-

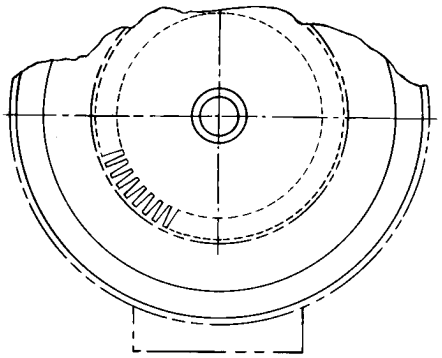
charge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL

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 of 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.

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.

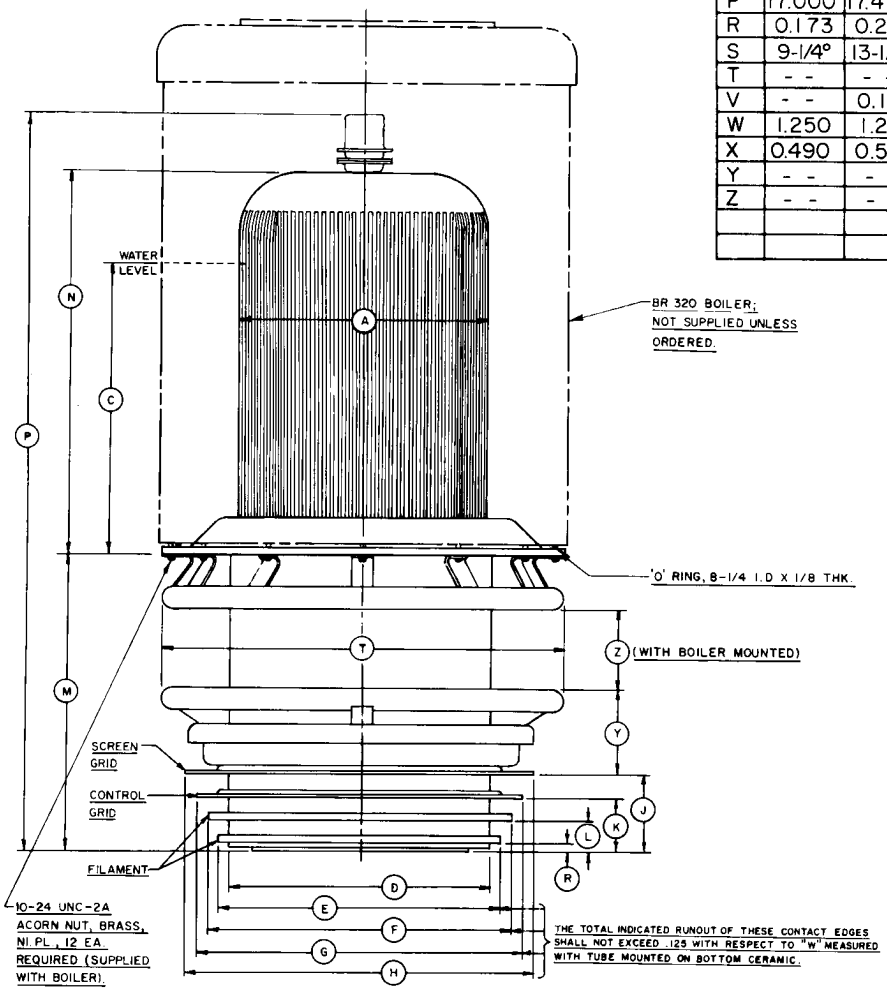

TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
I_{c1} = 15.0A
I_{c1} = 1.0V
I_b = 100A
10.0
5.0
2.5
1.0
0
-1.0
80.0
250
500
1.0
500
100
0
60.0
40.0
30.0
20.0
10.0
4.0
1.0
0
2621
400
200
0
-200
-400
-600
-800
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—KILOVOLTS

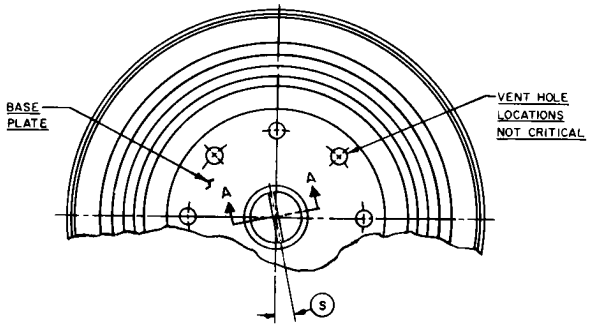

TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
I_b = 100.0A
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
4.0
1.0
0
2623
I_{c_2} = 20.0A
15.0
I_{c_1} = 30.0
10.0
25.0
5.0
20.0
15.0
10.0
5.0
2.5
1.0
.500
.250
.100
0
500
0
GRID VOLTAGE—VOLTS
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE—KILOVOLTS

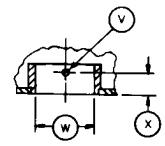


DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.562	5.812	- -	141.28	147.63	- -
C	4.500	7.000	- -	114.30	177.80	- -
D	5.980	6.020	- -	151.89	152.91	- -
E	6.510	6.560	- -	165.35	166.62	- -
F	6.980	7.020	- -	177.29	178.30	- -
G	7.480	7.520	- -	189.99	191.00	- -
H	7.975	8.015	- -	202.56	203.58	- -
J	1.750	1.800	- -	44.45	45.72	- -
K	1.220	1.270	- -	30.99	32.26	- -
L	0.690	0.740	- -	17.53	18.80	- -
M	6.942	7.192	- -	176.33	182.68	- -
N	8.725	8.950	- -	221.62	227.33	- -
P	17.000	17.450	- -	431.80	443.23	- -
R	0.173	0.213	- -	4.39	5.41	- -
S	9-1/4°	13-1/4°	- -	- -	- -	- -
T	- -	- -	9.250	- -	- -	234.95
V	- -	0.135	- -	- -	3.43	- -
W	1.250	1.270	- -	31.75	32.26	- -
X	0.490	0.530	- -	12.45	13.46	- -
Y	- -	- -	2.000	- -	- -	50.80
Z	- -	- -	2.000	- -	- -	50.80

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.







SECTION A-A (ROTATED 11¼°)