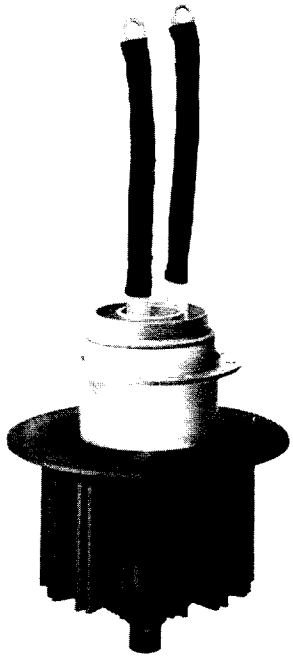
TECHNICAL DATA

3CV30,000H3
MEDIUM-MU
VAPOR-COOLED
POWER TRIODE

The EIMAC 3CV30,000H3 is a vapor-cooled ceramic/metal power triode designed primarily for use in industrial radio-frequency heating service. Its vapor-cooled anode is conservatively rated at 30 kilowatts dissipation capability when mounted in an EIMAC BR-200 boiler.

Full input of 60 kilowatts is permissible up to 100 MHz. Large reserve emission is available from the one kilowatt filament and the grid structure is rated at one ampere making this tube an excellent choice for severe applications.

It is also recommended as an audio amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	6.3 ± 0.3	V
Current @ 6.3V (approximate)	160	A
Amplification Factor (nominal)	20	
Interelectrode Capacitance (Grounded Cathode Connection) [2]		
Cin	53	pF
Cout	1.5	pF
Cgp	35	pF
Maximum Frequency for Full Ratings (CW)	100	MHz

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 EIMAC should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured with no special shielded fixture but otherwise in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base:	Special, with Grid Contact Flange & Filament Flying Leads
Socketing	No Socket Required
Operating Position	Axis Vertical, Base Down
Cooling	Vapor & Forced Air
Net Weight	18 lbs, 8.2 kg
Shipping Weight	36 lbs, 16.4 kg
Maximum Dimensions	
Height (including base flying leads)	17.62 in; 44.75 cm
Diameter (anode flange)	7.75 in; 19.68 cm
Maximum Operating Temperature, Ceramic Metal Seals and Envelope	250°C

RF INDUSTRIAL OSCILLATOR
Class C (Filtered DC Power Supply)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10.0	KILOVOLTS
DC PLATE CURRENT	6.0	AMPERES
DC GRID VOLTAGE	-1.0	KILOVOLT
DC GRID CURRENT	1.0	AMPERE
PLATE INPUT POWER	60	KILOWATTS
PLATE DISSIPATION	30	KILOWATTS

* Approximate value

TYPICAL OPERATION (loaded conditions)

Plate Voltage	7.0	10.0	kVdc
Plate Current	6.0	6.0	Adc
Grid Voltage	-600	-800	Vdc
Grid Current *	660	315	mAdc
Peak Positive Grid Voltage *	440	360	v
Driving Power *	660	365	W
Plate Input Power	42	60	kW
Plate Dissipation *	12	18	kW
Plate Output Power *	30	42	kW
Load Impedance *	600	750	Ohms

(Effective March 1988, superseding 05/68)
VA5029

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER
PLATE MODULATED - Class C

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7.0	KILOVOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION #	20	KILOWATTS
GRID VOLTAGE	-1.0	KILOVOLT
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

Plate Voltage	5.0	7.0	kVdc
Grid Voltage	-600	-820	Vdc
Plate Current	5.0	5.0	Adc
Grid Current *	600	600	mAdc
Driving Power *	600	750	W
Plate Output Power *	17.8	27.5	kW

* Approximate value
# Will rise to 30 kW with 100% sine-wave modulation

AUDIO AMPLIFIER OR MODULATOR - Class AB2

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10	KILOVOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	30	KILOWATTS
DC GRID VOLTAGE	-1.0	KILOVOLT
GRID DISSIPATION	500	WATTS

* Approximate value
# Adjust for specified zero-signal Plate Cur.

TYPICAL OPERATION (2 tubes)

Plate Voltage	6.0	9.6	kVdc
Grid Bias Voltage #	-280	-480	Vdc
Zero-Signal Plate Current	0.5	0.25	Adc
Max.Signal Plate Current	4.2	3.1	Adc
Max.Signal DC Grid Current *	145	42	mAdc
Peak Driving Voltage *	480	590	v
Drive Power *	140	50	W
Plate/Plate Load Resistance	1300	2740	Ohms
Power Output *	31	36	kW

TYPICAL OPERATION values are obtained by calculation from published characteristic curves. In industrial oscillator service adjustment of the rf grid voltage (feedback) to obtain the specified plate current at the specified bias and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced.

RANGE VALUES FOR EQUIPMENT DESIGN:

Filament current at 6.3 volts	152	168	Aac
Interelectrode Capacitance (grounded cathode connection)			
cin	50.0	60.0	pF
Cout	1.30	1.60	pF
Cgp	30.0	38.0	pF

Capacitance values are for a cold tube, measured with no special shielding but otherwise in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The tube must be mounted vertically, base up, in an EIMAC BR200 boiler. It is very important that the boiler tube assembly be mounted vertically, the water be maintained at the suggested level, and that the anode flange of the tube makes a vapor-tight seal against the rubber "O" ring and the boiler. Accessories are available (see COOLING) for control of water level and a condenser system is needed to convert generated steam to water for recirculation. The tube contains a thoriated-tungsten filament and should be protected from shock and vibration.

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 it has not been damaged and operates properly (See FILAMENT OPERATION for recommendations on initial value of filament voltage during this operation period). If the tube is still in storage 6 months later it again 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.

COOLING - Cooling is accomplished by immersing the anode in the water filled EIMAC boiler. The energy dissipated at the anode causes the water to boil at the surface of the anode, to be converted into steam and be carried away to a condenser. This boiling action keeps the anode surface at approximately 100°C at full dissipation ratings.

Water in the boiler must be maintained at a constant level (just below the top of the anode fins; this level is marked on the boiler) which may be accomplished automatically in an EIMAC vapor cooling system with a suitable reservoir and EIMAC Control Box CB202. Condensate from the condenser is returned to the boiler to maintain a constant coolant level. Any losses or drops in the coolant level are sensed by the Control Box and makeup water enters the boiler from the reservoir. When the proper level is reached flow from the reservoir is stopped automatically. A switch is energized when the reservoir water level drops to a low level. This switch may be used to shut down the equipment or activate an alarm. For reliable operation the CB202 must be mounted so the level sensed is the actual level in the boiler.

Air cooling of the tube base is required whenever filament voltage is applied. A minimum air flow of 100 cfm should be ducted toward the center of the socket and around the contact areas from a blower or fan. Seal temperature is the final criteria of effective cooling; temperature sensitive paints are available to an equipment designer for testing before equipment design is finalized. EIMAC Application Bulletin #20, TEMPERATURE MEASUREMENTS WITH EIMAC TUBES, is available on request.

Tube life can be seriously compromised by water condition. If it becomes contaminated, deposits can form on the anode surfaces, interfering with capillary flow and causing localized heating and eventual tube failure. Though water in a vapor-cooled system is continuously being distilled, this does not assure continued high purity. The water resistance at 25°C should always be one megohm per cubic cm. or higher. Relative water resistance can be continuously monitored in the reservoir by readily available instruments.

The entry of any contamination to the system must be prevented. The use of any lead-bearing alloys such as soft solder in fabrication of the cooling system must be avoided since steam leaches out the lead, contaminating the coolant.

Suitable materials for a cooling system are hard solder, copper, and polypropylene or Teflon®. Any contamination of the water causes leakage current to flow through the water supply lines to ground. When the resistivity is low this leakage current power will cause boiling in the lines, interfering with the proper operation of the system.

The user must be prepared to flush the system on initial startup to purge any contamination which may have entered during shipment or assembly.

ELECTRICAL

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 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.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly. Equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. Equipment must include safety enclosures for the 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. The interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Remember HIGH VOLTAGE CAN KILL.

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 it is recommended the user contact Application Engineering at Varian EIMAC for additional information.

With a new tube, or one which has been in storage for some period of time, operation with filament voltage only (cooling air must be on) applied for a period of 30 to 60 minutes is recommended before full operation begins. This allows the active getter material mounted within the filament structure to absorb any residual gas molecules which have accumulated during storage. Once normal operation has been established a minimum filament warmup time of ten seconds is normally sufficient.

At rated (nominal) filament voltage the peak emission capability is many times that needed for communication service. A reduction in voltage will lower filament temperature, which will substantially increase life expectancy; the correct value should be determined for the particular application. It is recommended the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. Then voltage should gradually be reduced until there is a slight degradation in performance (such as power output or distortion). Voltage should then be increased a few tenths of a volt above the value where performance degradation was noted. The operating point should be rechecked after 24 hours.

Filament voltage should be closely regulated when voltage is to be reduced below nominal in this manner, to avoid any adverse influence by normal line voltage variations.

Filament voltage should be measured at the tube filament lead terminals, using an accurate rms-responding meter. Periodically throughout the life of the tube the procedure outlined above for reduction of voltage should be repeated, with voltage reset as required, to assure best tube life. EIMAC Application Bulletin #18 titled "EXTENDING TRANSMITTER TUBE LIFE" contains valuable information and is available on request.

GRID OPERATION - The maximum grid current rating is 1.0 ampere dc, which should not be exceeded for more than short periods such as during tuning. Over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.4 to 0.6 amperes of grid current to obtain reasonable efficiency. In industrial heating service with varying loads, grid current should be monitored continuously with a dc current meter. The maximum grid dissipation rating is 500 watts.

PLATE OPERATION - The maximum plate input power rating is 60 kilowatts at 10 kVdc and 6 amperes dc. This rating applies for Class C amplifier or oscillator service and for Class AB applications. When used as a plate-modulated rf amplifier the input is reduced 7 kVdc and 5 amperes dc. Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition, current-limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variatin in loading. Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during a fault condition.

LOAD FAULTS - In self-excited oscillators large load variations or faults can cause potentially dangerous changes in tube efficiency, which in turn can increase anode dissipation to a very high level. If this occurs tube damage can result even though anode current is near the normal operating value. The circuit designer is therefore cautioned to suitably proportion the circuit constants to minimize this effect, and to be sure anode cooling is adequate to handle worst-case dissipation.

FAULT PROTECTION - In addition to the normal coolant and over-current interlocks, the tube must be protected from damage caused by an internal arc which may occur at high plate voltage. A protective resistance should be connected in series with the tube anode, to help absorb power supply stored energy if an internal arc occurs. An electronic crowbar, which will discharge power supply capacitors in a few microseconds after the start of an arc, may be required. The test for each electrode supply is to short each electrode to ground, one at a time, through a vacuum relay switch and a 6-inch length of #30 AWG copper wire. The wire will remain intact if protection is adequate.

EIMAC Application Bulletin #17 titled FAULT PROTECTION is available on request.

RADIO-FREQUENCY RADIATION - Exposure to strong rf fields should be avoided, 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 even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation be limited to 10 milliwatts per square centimeter.

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 between tube terminals, and wiring effects. To control capacitance values within the tube [as the key component involved] industry and the Military Services use a standard test procedure described in Electronic Industries Association Standard RS-191. With the 3CV30,000H3 no special shielded fixture is used. The test is performed on a cold tube. Other factors being equal, controlling internal capacitance in this way normally assures good interchangeability of tubes.

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

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; attn: Applications Engineering; 301 Industrial Way; San Carlos, CA 94070 U.S.A.

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 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, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

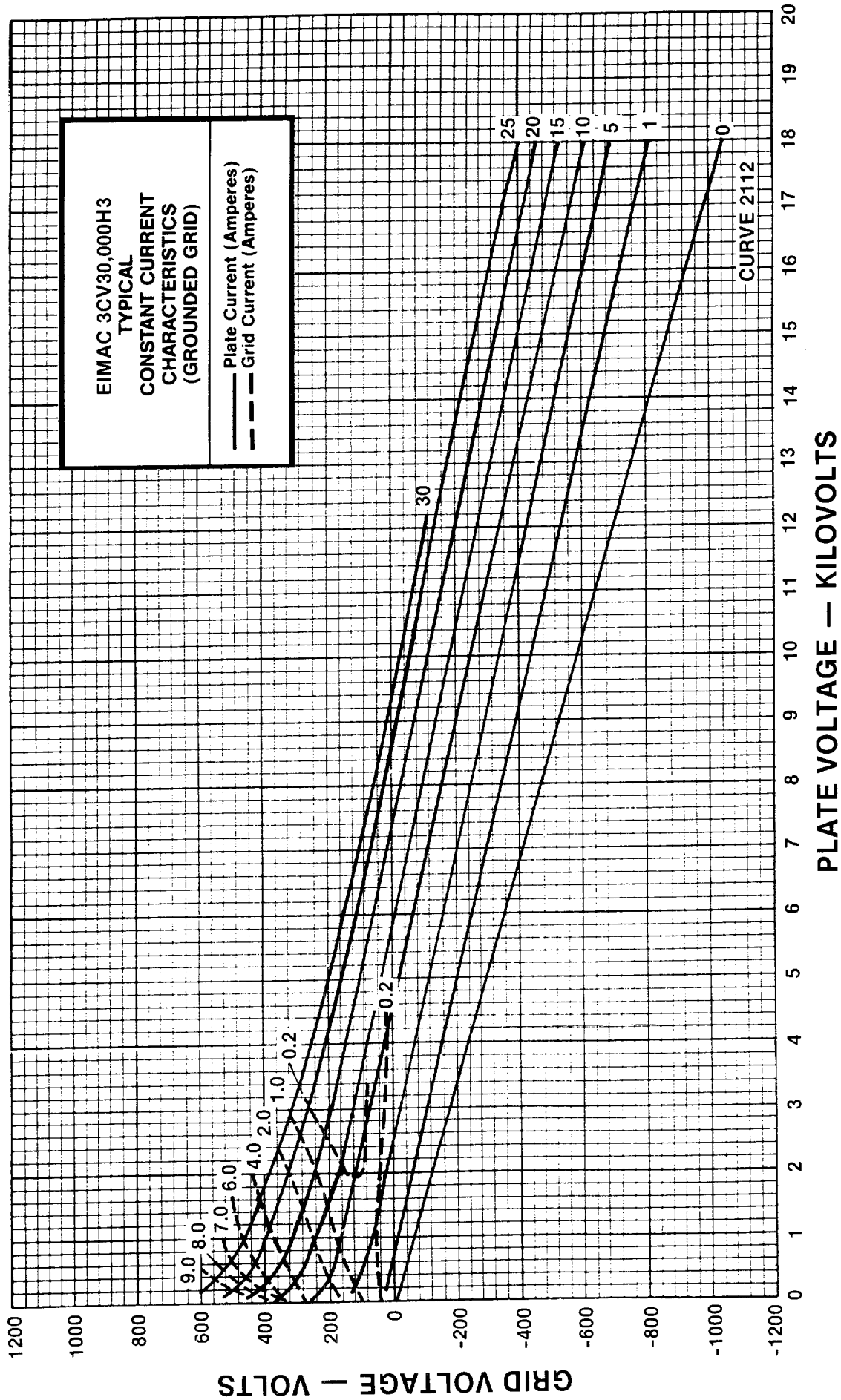
b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

c. 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.

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

e. 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.

Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.


EIMAC 3CV30,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
CURVE 2112
25
20
15
10
5
1
0
30
0.2
1.0
2.0
4.0
6.0
7.0
8.0
9.0
1200
1000
800
600
400
200
0
-200
-400
-600
-800
-1000
-1200
0
1
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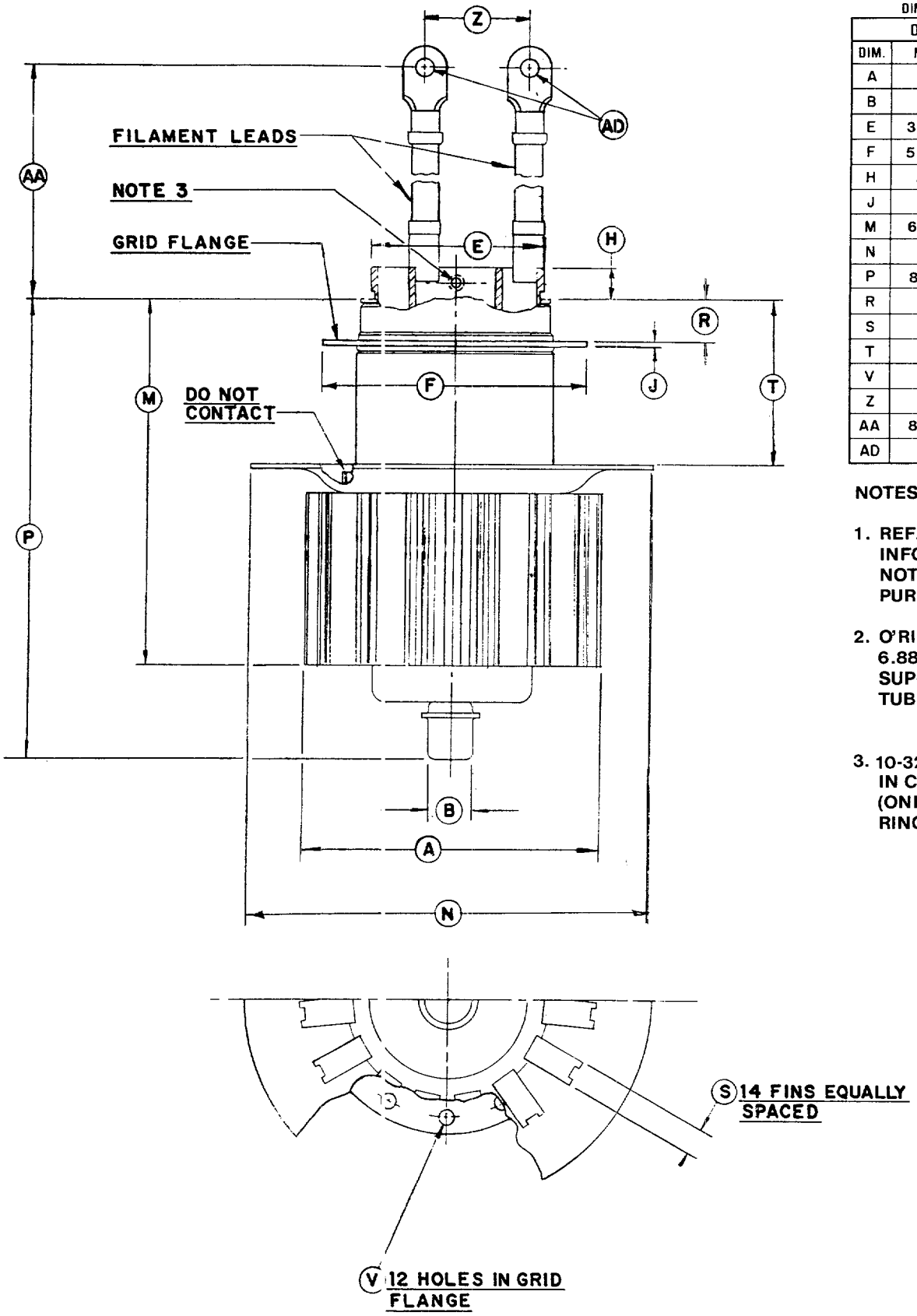
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — KILOVOLTS



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A			5.812
B	.885	.895	
E	3.230	3.270	
F	5.030	5.090	
H	.530	.700	
J			.125
M	6.743	6.875	
N			7.750
P	8.400	8.625	
R	.700	.860	
S			.510
T			2.906
V			.265
Z			2.000
AA	8.500	9.000	
AD			.390

NOTES:

1. REF. DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.
2. O'RING P/N 119772, 6.885 I.D. x 1/4 WALL, SUPPLIED WITH TUBE.
3. 10-32 TAPPED HOLES IN CONTACT RINGS, (ONE HOLE EACH RING, IN LINE.