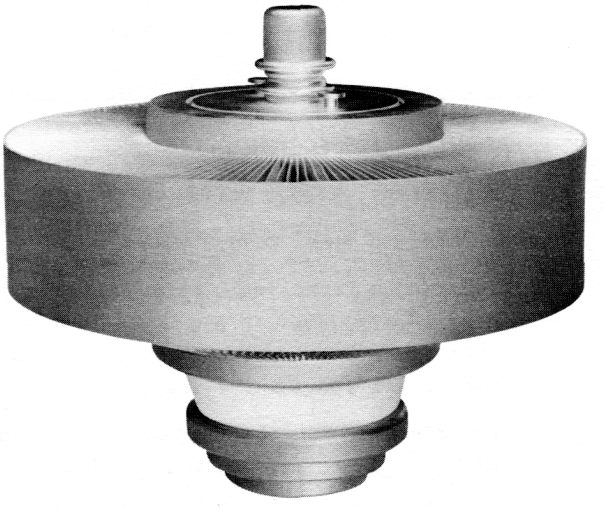
TECHNICAL DATA

3CX10,000U7
HIGH-MU VHF TRANSMITTING TRIODE

The EIMAC 3CX10,000U7 is a ceramic/metal high-mu power triode designed especially for use in the VHF and UHF spectrum as a cathode-driven Class AB rf amplifier or Class C power amplifier, and for pulsed rf amplifier service. It is forced-air cooled, with an anode dissipation rating of 10,000 watts. Cavity amplifier assemblies are available for the tube from EIMAC.

The 3CX10,000U7 makes use of a beam-forming cathode and control grid geometry to produce high gain, low grid interception, and outstanding intermodulation performance in linear amplifier service. These attributes make the tube well suited for cathode-driven circuitry, which reduces equipment complexity.

The tube has coaxial terminals for which contact collets are available from EIMAC.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated Unipotential

Heater Voltage	15.0 ± 0.5	V
Heater Current, @ 15.0 Volts	13.5	A
Cathode Warmup Time, @ 15.0 Volts (minimum)[2]	300	Sec
Amplification Factor (average)	200	
Direct Interelectrode Capacitance (grid grounded)[3]		
Cin	86.5	pF
Cout	23.2	pF
Cpk	0.25	pF
Frequency of Maximum Rating:		
CW	260	MHz
Pulsed	500	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. Before high voltage and rf drive voltage are applied.
3. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:

Length	7.30 in; 185 mm
Diameter	8.30 in; 211 mm

359150 (Effective 1 Sept 82; supersedes 1 Jan 81)
VA4533
Printed in U.S.A.

VARIAN EIMAC / 301 Industrial Way / San Carlos, CA 94070 / USA

Cooling . . . . . Forced Air

Base . . . . . Special Coaxial

Recommended Contact Collets:

TUBE ELEMENT	EIMAC P/N	TUBE ELEMENT	EIMAC P/N
Heater	720638	Grid	720636
Heater-Cathode	720637	Anode	720635

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	Units
Heater Current, @ 15.0 Volts	12.5	14.5	Aac
Cathode Warmup Time, @ 15.0 Volts	300	---	Sec
Interelectrode Capacitance (grounded grid) [1]			
Cin	83.0	90.0	pF
Cout	22.7	23.7	pF
Cpk	---	0.5	pF
Interelectrode Capacitance (grounded cathode) [1]			
Cin	83.0	90.0	pF
Cout	---	0.5	pF
Cgp	22.7	23.7	pF

1 Values are for a cold tube as measured in a special shielded fixture in accordance with Electronics Industries Association Standard RS-191.

RADIO FREQUENCY POWER AMPLIFIER
CATHODE DRIVEN

Class AB Television Service

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	6500	VOLTS	PLATE DISSIPATION	10	KILOWATTS
DC PLATE CURRENT	4.0	AMPERES	GRID DISSIPATION	100	WATTS

TV TRANSLATOR SERVICE:

Measurements made in EIMAC cavities under CW conditions.

	Channel	f_o (MHz)	Gain (dB)	± 1 dB BW (MHz)	
LOW BAND: EIMAC Cavity CV-2240	4	69	15.3	6.26	Typical data taken at 2.5 kW single-tone output @ Eb = 4800 Vdc, Ibo = 1.9 Adc, Ib = 2.4 Adc
HIGH BAND: EIMAC Cavity CV-2250	11	201	16.7	6.27	Typical data taken at 2.5 kW single-tone output @ Eb = 4800 Vdc, Ibo = 1.9 Adc, Ib = 2.25 Adc
	E2	227.75	16.8	7.08	

Three-tone test under CCIR loading: Video -8 dB (below 2.5 kW peak output)
Sound -7 dB
Color -17 dB

Third order intermodulation products: -52 dB or better

LOW BAND TV VISUAL SERVICE

Measurements made in EIMAC CV-2240 Cavity
(CW Conditions)

f_o = 79 MHz BW = 6 MHz Min. ± 0.25 dB
BW = 7 MHz Min. ± 1.0 dB

Plate Voltage	5.0	5.5	kVdc
Zero Signal Plate Current	1.0	1.0	Adc
Max.Signal Plate Current .	3.72	3.60	Adc
Cathode Voltage (bias) **	+25	+29	Vdc
Grid Current *	53	39	mAdc
Driving Power *	398	389	W
Useful Power Output . . .	10	10	kW
Efficiency *	53.2	50.5	%
Gain *	14.0	14.1	dB

HIGH BAND TV VISUAL SERVICE

Measurements made in EIMAC CV-2250 Cavity
(CW Conditions)

f_o = 177 MHz BW = 6 MHz Min. ± 0.25 dB
BW = 7 MHz Min. ± 1.0 dB

Plate Voltage	5.0	5.5	kVdc
Zero Signal Plate Current	1.0	1.0	Adc
Max.Signal Plate Current .	4.0	3.6	Adc
Cathode Voltage (bias) **	+25	+29	Vdc
Grid Current *	41	16	mAdc
Driving Power *	407	407	W
Useful Power Output . . .	10	10	kW
Efficiency *	50.0	50.5	%
Gain *	13.9	13.9	dB

* May vary with particular installation.
** Cathode bias voltage is adjusted to produce specified Zero Signal (idling) Plate Current.

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN - Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	6.5	KILOVOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10	KILOWATTS
GRID DISSIPATION	100	WATTS

* May vary with particular installation.
** Adjust for specified Zero-Signal Plate Current.
\# Measured at the load.
The intermodulation distortion products are referenced against one tone of a two-equal-tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB, Cathode Driven, Peak Envelope or Modulation Crest Conditions; Data Measured at 2.0 MHz.

Plate Voltage	6.0	kVdc
Cathode Voltage (bias) ** .	+42.9	Vdc
Zero-Signal Plate Current .	0.5	Adc
Single-Tone Plate Current .	2.58	Adc
Two-Tone Plate Current . . .	1.7	Adc
Single-Tone Grid Current * .	15	mAdc
Two-Tone Grid Current * . .	9.5	Madc
Peak rf Driving Voltage * .	120	v
Driving Power *	240	W
Single-Tone Useful Power Out #	10	kW
Resonant Load Impedance . .	1100	Ohms
Intermodulation Distortion ##		
3rd Order	-45	dB
5th Order	-50	dB

TYPICAL OPERATION values are obtained by measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage 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 ouput power when the tube is replaced, even though there may be some variation in grid current. The grid current which occurs when the desired plate current is obtained is incidental and may vary from tube to tube. This current variation causes no performance degradation providing the circuit maintains the correct voltage in the presence of the current variation.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The 3CX10,000U7 must be operated vertically, base up or down, and should be protected from shock and vibration. Collets are available from EIMAC (see page 2) for use in contacing the heater, heater-cathode, grid and anode terminals of the tube.

COOLING - The maximum temperature rating for the external surfaces of the tube is 250 Deg.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 temperature of the ceramic/metal seals comfortably below this rated maximum.

The cooling data shown is for cooling air at 50°C with air flowing in a base-to-anode direction, and represents minimum anode cooling requirements. The pressure drop values shown are approximate and do not allow for any system losses, such as ducting or filters. (CFM = cubic feet per minute; CMM = cubic meters per minute)

Altitude: Sea Level

Plate Diss. Watts	Flow Rate CFM	Press.Drop In. Water	Flow Rate CMM	Press.Drop Millibars
2000	117	0.18	3.3	0.70
4000	117	0.19	3.3	0.74
6000	190	0.39	5.4	1.64
8000	318	0.84	9.0	3.97
10000	462	1.52	13.1	7.75

Altitude: 5000 Feet, 1524 Meters

Plate Diss. Watts	Flow Rate CFM	Press.Drop In. Water	Flow Rate CMM	Press.Drop Millibars
2000	141	0.21	4.0	0.84
4000	141	0.23	4.0	0.89
6000	229	0.47	6.5	1.97
8000	383	1.01	10.9	4.79
10000	558	1.83	15.8	9.35

Altitude: 10000 Feet, 3048 Meters

Plate Diss. Watts	Flow Rate CFM	Press.Drop In. Water	Flow Rate CMM	Press.Drop Millibars
2000	170	0.26	4.8	1.01
4000	170	0.28	4.8	1.07
6000	276	0.57	7.8	2.38
8000	462	1.22	13.1	5.77
10000	672	2.21	19.0	11.28

It is considered good engineering practice to design for a maximum anode core temperature of 225 °C, and temperature-sensitive paints are available for checking base and seal temperatures before any design is finalized. It is also considered good practice to allow for variables such as dirty air filters, rf seal heating, and the fact that the anode cooling fins may not be clean if the tube has been in service for some length of time.

The pressure drop in a typical installation will be higher because of system losses. Typical data for a VHF cavity assembly is shown in the EIMAC Technical Data for the CV-2240 and CV-2250 cavities, which are available on request.

Forced air cooling of the base is also required, with air directed past the seal areas. Special attention may be required in cooling the center of the stem (base), by means of special directors or some other provision. An air interlock system should be incorporated in the design to automatically remove all voltages from the tube in case of even partial failure of the tube cooling air.

Air flow must be applied before or simultaneously with the application of power, including the tube heater, and should normally be maintained for a short period of time after all power is removed to allow for tube cooldown.

ELECTRICAL

HEATER-CATHODE OPERATION - The rated heater voltage for the 3CX10,000U7 is 15.0 volts and should be maintained within plus or minus 0.5 volt when good life and consistent performance are factors. Voltage should be measured with a known-accurate (preferably plus or minus one percent) rms-responding voltmeter.

Heater voltage should be applied for five minutes (minimum) before high voltage is applied to the tube and any operation is attempted, to allow for cathode warmup to full temperature.

ABSOLUTE MAXIMUM RATINGS - The 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 the 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 that the abso-

lute values will never be exceeded under any usual conditions of supply voltage variation in the equipment. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

INPUT CIRCUIT - When this tube is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

INTERMODULATION DISTORTION - Typical Operating Conditions, with distortion values included, are the result of data taken during actual operation at 2 MHz. Intermodulation values listed are those measured at the full peak envelope power noted and are referenced against one tone of a two-equal-tone signal.

UHF OPERATION - This tube is useful in the UHF region. High cathode emission makes it especially useful in pulse applications. Operation at UHF under CW conditions should be conducted with heavy plate loading and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

FAULT PROTECTION - All power tubes operate at voltages which can cause severe damage in the event of an internal arc, especially in those cases where large amounts of stored energy or follow-on current are involved. Some means of protection is advised in all cases, and it is recommended that a series resistor be used in the anode circuit to limit peak current and help dissipate the energy in the event of a tube or circuit arc. A resistance of 10 ohms in the positive plate power supply lead, together with a protective spark gap such as the Siemens #B1-C145 connected between the cathode and grid will help protect the tube in the event of an internal arc. A maximum of four (4) joules total energy may be permitted to dissipate into a grid-to-cathode arc. Amounts in excess of this will permanently damage the cathode or the grid structure. Additional information is found in EIMAC Application Bulletin #17 "FAULT PROTECTION". Copies are available on request.

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 capacitors 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, especially at frequencies above 300 MHz, where energy absorption by the human body is significant. The human eye is particularly sensitive. Prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter (Occupational Safety & Health Administration (OSHA) standard). It is generally accepted that exposure to "high levels" of rf radiation can result in severe bodily injury, including blindness. **CARDIAC PACEMEAKERS MAY BE AFFECTED.**

INTERELECTRODE CAPACITANCE - The interelectrode capacitance of a tube in a typical circuit is influenced by many variables, 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 Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of a specially constructed test fixture 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. The capacitance values shown in the manufacturer technical data 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 appliction. Measurements should be taken with the mounting which represent 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: Product Manager; 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.

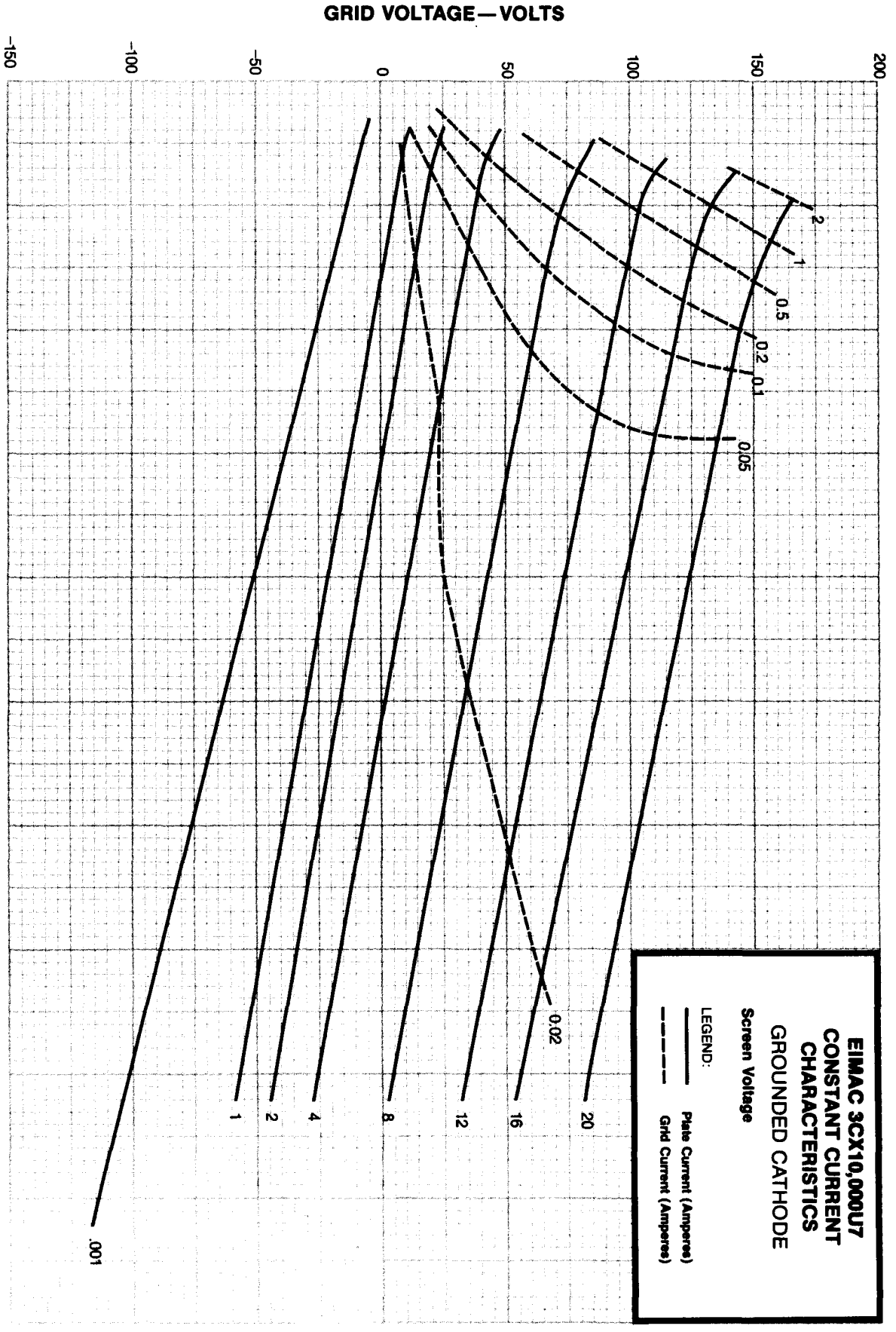
The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

a. HIGH VOLTAGE - Normal operating voltages can be deadly.

b. 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 EFFECTED.

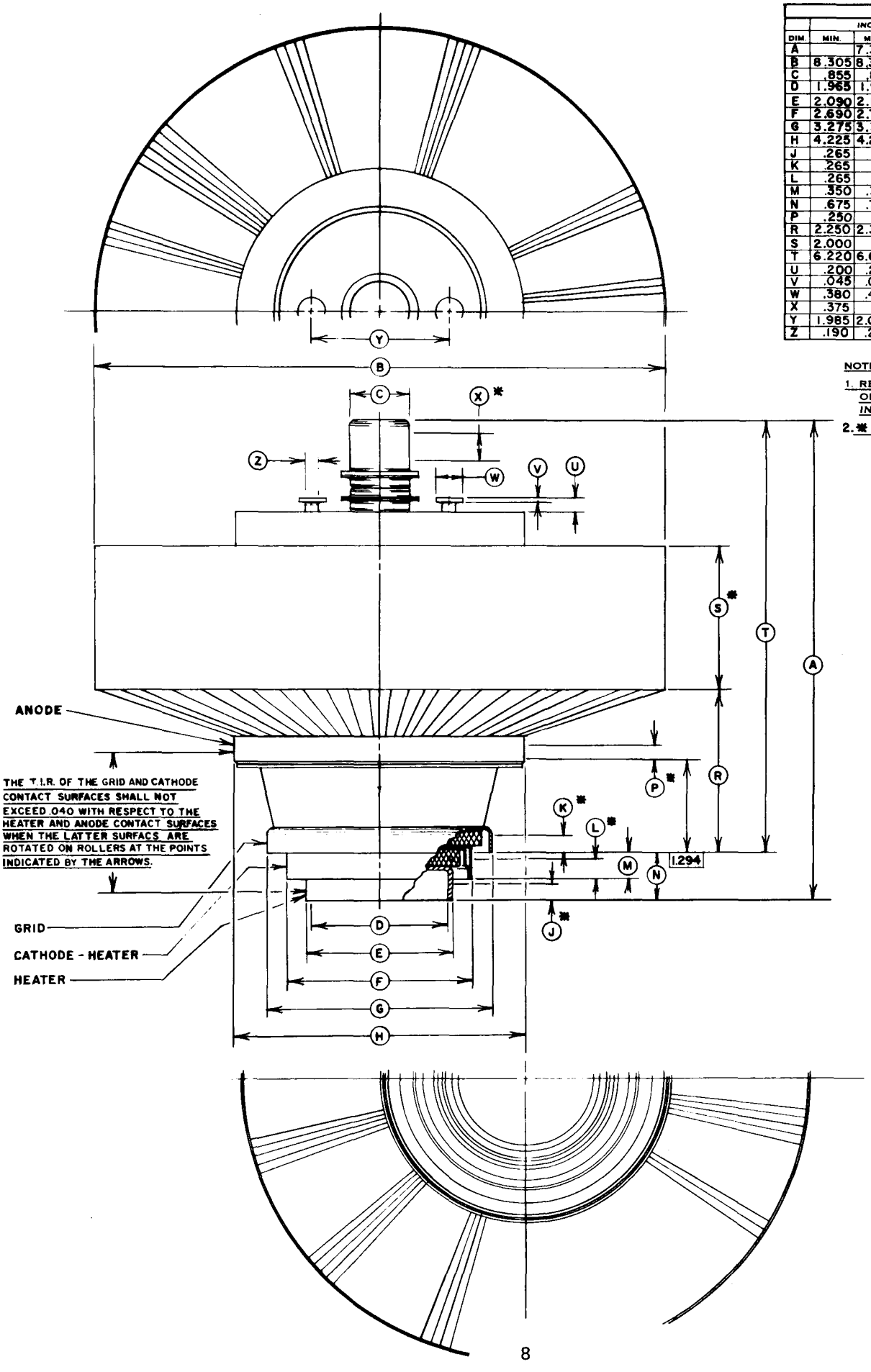
c. HOT SURFACES - Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred Degrees C and cause serious burns if touched for several minutes after all power is remove.

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


EIMAC 3CX10,000U7
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
Screen Voltage
LEGEND:
Plate Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—KILOVOLTS
200
150
100
50
0
-50
-100
-150
0
1
2
3
4
5
6
7
8
9
10
2
1
0.5
0.2
0.1
0.05
0.02
.001
20
16
12
8
4
2
1

CURVE 4924

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		7.300				
B	8.305	8.355				
C	.855	.895				
D	1.965	1.985				
E	2.090	2.110				
F	2.690	2.720				
G	3.275	3.310				
H	4.225	4.245				
J	.265					
K	.265					
L	.265					
M	.350	.385				
N	.675	.715				
P	.250					
R	2.250	2.340				
S	2.000					
T	6.220	6.600				
U	.200	.240				
V	.045	.075				
W	.380	.430				
X	.375					
Y	1.985	2.015				
Z	.190	.200				

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE