Eimac®

TUBE MANUAL

EIMAC division of varian

SAN CARLOS, CALIFORNIA

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

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(Revised 3/15/76)

Printed in U.S.A.

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EIMAC
Division of Varian
301 INDUSTRIAL WAY • SAN CARLOS, CALIF. 94070
PHONE: (415) 592-1221 • CABLE: "EIMAC" SAN CARLOS

15 March 1976

TO EIMAC TUBE MANUAL HOLDERS

The enclosed new or revised data sheets, along with an updated Table of Contents and list of sales offices, are to be inserted in the appropriate section of your EIMAC tube manual, volumes I & II. Please use your Table of Contents as a guide.

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Pentodes	INSERT	REMOVE
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William I. Orr

William I. Orr, Manager
Technical Data

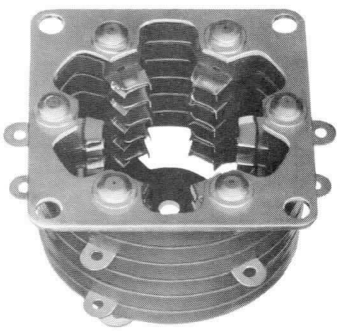
WIO/a
Enclosures

TECHNICAL DATA

SK-740

AIR-SYSTEM SOCKET

The EIMAC SK-740 Air-System Socket is recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. This socket is not intended for use with an Air-Chimney, but is particularly useful in applications where transverse air cooling, heat-sink or immersion cooling is intended. When this socket is used, connection is made to each of the tube electrodes except the anode.



BASE CONNECTIONS

The SK-740 socket consists of five sets of ring contacts: they are from top to bottom: 1.screen-grid, 2.control-grid, 3.cathode, 4.heater, 5.heater. Each set of contacts consist of six separate contacting tabs. The tube elements are connected to their external circuits by two diametrically-opposed solder tabs. The SK-740 has no grounded contacts.

MATERIALS AND FINISHES

The mounting plate of the socket is fabricated of nickel-plated brass. The contact rings and tabs are of beryllium copper, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the socket are molded of a flameproof diallyl meta-phthalate.

INSTALLATION

The SK-740 Air-System Socket is designed for under-chassis mounting and requires a 1.593 inches diameter hole through the chassis deck. Four screw holes are provided for fastening as shown in the outline drawing.

THE SK-740 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBE TYPES:

4N15A	4CX300A/8167
4CX125C	4CX300Y/8561
4CX125F	

Note: A separate means of directing air is required when using the SK-740 with the 4CX300A and 4CX300Y. For applications using these two tubes, the SK-760 and SK-770 Air-System Sockets are recommended. These contain an integral chimney.

NET WEIGHT (Approximate) . . . . 1.5 Oz.; (42.5 gm)

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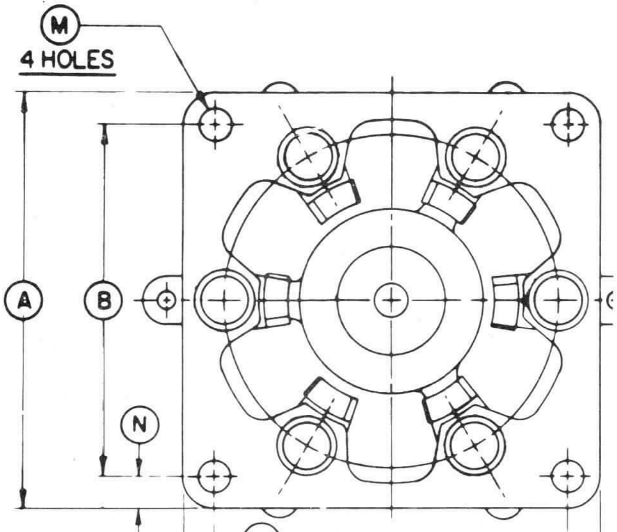
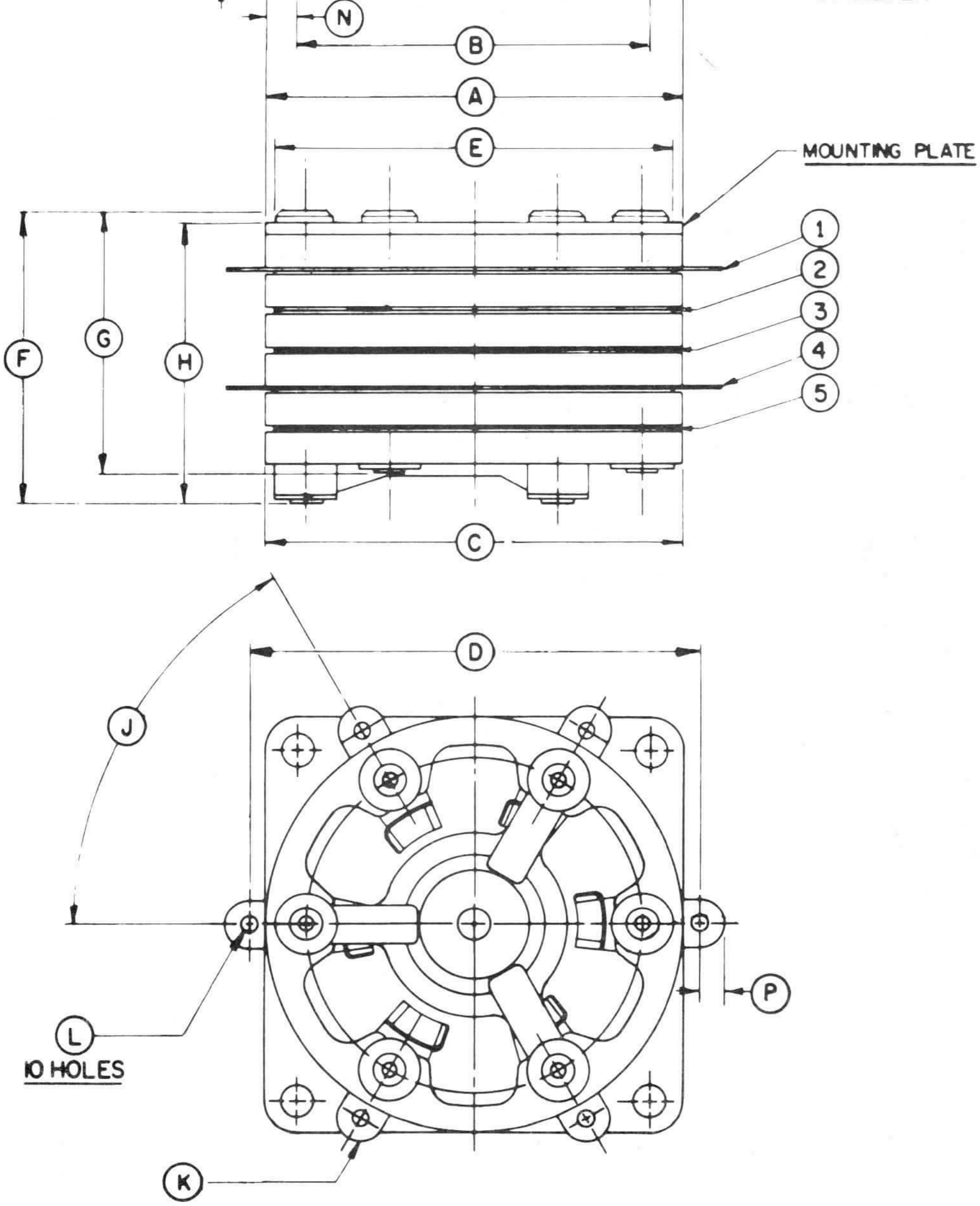




DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.615	1.635	- -	41.02	41.53	- -
B	1.360	1.390	- -	34.54	35.31	- -
C	1.615*	1.635*	- -	41.02*	41.53*	- -
D	1.735	1.765	- -	44.07	44.83	- -
E	1.485	1.575	- -	37.72	40.00	- -
F	1.070	1.110	- -	27.18	28.19	- -
G	0.925	0.965	- -	23.49	24.51	- -
H	1.020	1.060	- -	25.91	26.92	- -
J	- -	- -	60°	- -	- -	60°
K	- -	- -	3/32R	- -	- -	2.34R
L	- -	- -	1/16 *	- -	- -	1.57*
M	0.134*	0.154*	- -	3.40*	3.91*	- -
N	0.120	0.130	- -	3.05	3.30	- -
P	0.078	0.109	- -	1.98	2.77	- -

* DIAMETER

CONNECTIONS

1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER

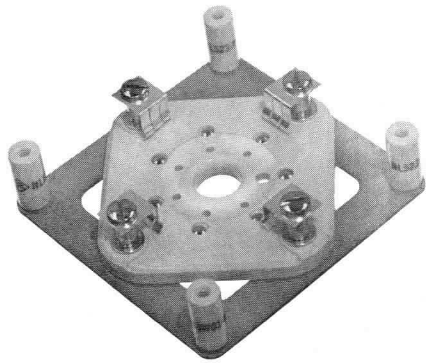
TECHNICAL DATA

SK-2200
SK-2210
AIR SYSTEM SOCKET
SK-2216
AIR CHIMNEY

The EIMAC SK-2200 and SK-2210 are air-system sockets recommended for use with the EIMAC 8877/3CX1500A7 triode. A companion chimney is available, which will operate with either socket.

With these sockets, connection is made to each tube element except the anode.

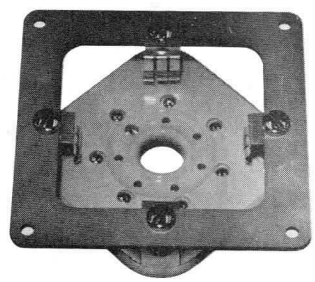
No contacts are grounded on the SK-2200, while the SK-2210 has the grid contacts grounded to the equipment chassis when installed.



SK-2200

INSTALLATION

The SK-2200 and SK-2210 are designed for under-chassis mounting, and require a 3¼ inch hole through the chassis deck. Each socket is held in place by four 6-32 screws.



SK-2210

AIR CHIMNEY

The SK-2216 chimney is made of low-loss teflon. It is held in place with four toe clamps which are supplied with the chimney.

SK-2216

NET WEIGHTS

SK-2200 Socket	4.5oz; 128 gm
SK-2210 Socket	4.0 oz; 113 gm
SK-2216 Chimney	2.0 oz; 56.7 gm

(Effective 3-1-76)

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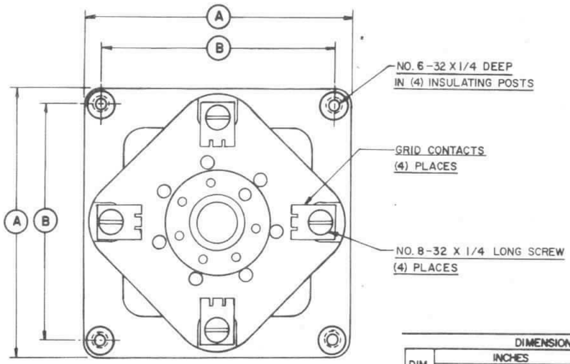
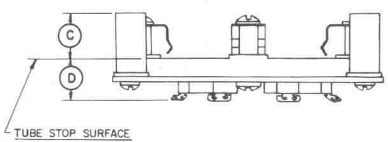
SK-2200/SK-2210

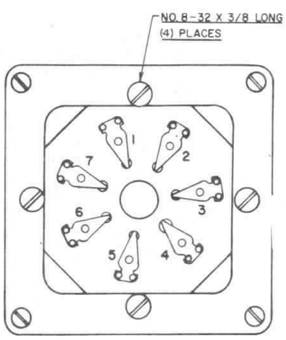


DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	3.373	3.413	- -	85.67	86.70	- -
B	2.953	2.983	- -	75.01	75.77	- -
C	0.500	0.550	- -	12.70	13.97	- -
D	- -	0.630	- -	- -	16.00	- -

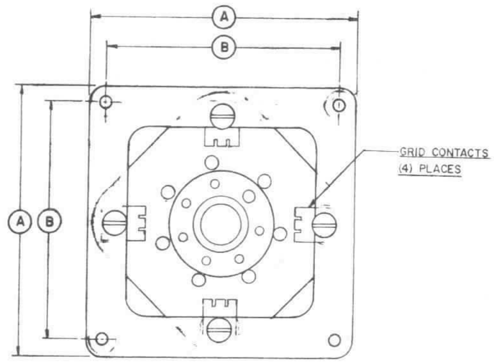
DIMENSIONAL DATA

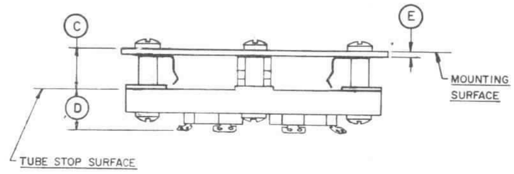


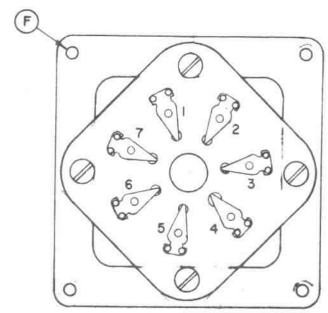
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. CONNECTIONS:
   1-HEATER
   2-CATHODE
   3-CATHODE
   4-CATHODE
   5-HEATER
   6-CATHODE
   7-CATHODE
3. GRID CONTACTS INSULATED FROM GROUND & OTHER ELEMENTS.



SK-2200 Socket





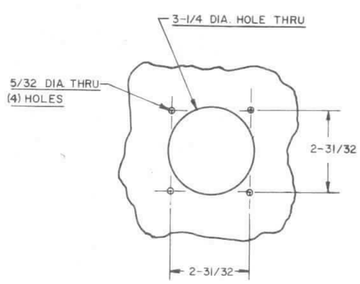


SK-2210 Socket

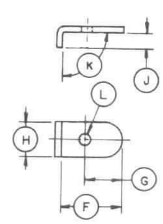
DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	3.373	3.413	- -	85.67	86.70	- -
B	2.953	2.983	- -	75.01	75.77	- -
C	0.474	0.553	- -	12.04	14.05	- -
D	- -	0.630	- -	- -	16.00	- -
E	- -	- -	0.063	- -	- -	1.60
F	0.140	0.149	- -	3.56	3.78	- -

DIMENSIONAL DATA

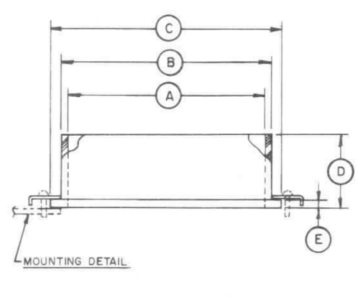
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. CONNECTIONS:
   1-HEATER
   2-CATHODE
   3-CATHODE
   4-CATHODE
   5-HEATER
   6-CATHODE
   7-CATHODE
3. GRID CONTACTS GROUNDED TO MOUNTING PLATE.



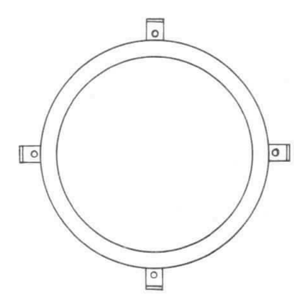
CHASSIS CUT OUT
FOR MOUNTING & REQUIRED COOLING AIR FLOW.



TOE CLAMP DETAIL
(4) SUPPLIED
P/N 889901



SK-2216 Chimney



DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	3.385	3.415	- -	85.98	86.74	- -
B	3.532	3.592	- -	89.71	91.24	- -
C	3.907	3.967	- -	99.24	100.76	- -
D	1.220	1.280	- -	30.99	32.51	- -
E	0.110	0.140	- -	2.79	3.56	- -
F	0.417	0.457	- -	10.59	11.61	- -
G	0.292	0.332	- -	7.42	8.43	- -
H	0.292	0.332	- -	7.42	8.43	- -
J	0.105	0.145	- -	2.67	3.68	- -
K	80°	100°	- -	80°	100°	- -
L	0.142	0.146	- -	3.61	3.71	- -

DIMENSIONAL DATA

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. MATERIALS:
   a. CHIMNEY: TEFLON TFE
   b. TOE CLAMP: BRASS-SILVER PLATED

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

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(Revised 10-15-76)

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4CX1000K/8352	8-20-66
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4CX5000A/8170	4-15-69
4CX5000J/8909	10-1-71
4CX5000R/8170W	5-1-76
4CX10,000D/8171	1-1-72
4CX10,000J	2-1-72
4CX15,000A/8281	12-15-73
4CX15,000J/8910	10-15-71
4CX35,000C/8349	9-1-75
4W300B/8249	11-1-73
4X150A/7034 & 7609	8-1-74
4X150G/8172	10-15-73
4X500A	1-1-64
6816,6884,7843	11-15-71
7609	see 4X150A/7034
8560A	7-15-71
8876	6-15-71
8930	12-1-73
8954	6-1-74
8959	11-1-74
X2159	7-1-73

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5CX1500A	11-15-75
5CX3000A	8-1-67
264/8576	6-5-70
290	5-5-70
8295A	1-15-73

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4PR250C/8248	9-1-70
4PR400A/8188	9-15-65
4PR1000A/8189	12-15-65
6C21	12-15-65

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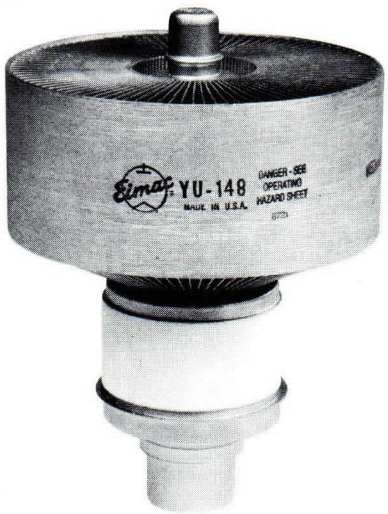
SK-300A	4-15-69
SK-306, SK-316	3-1-76
SK-400	4-1-56
SK-406, SK-416, SK-426	12-1-73

(Cont'd)

OTHER PRODUCTS

TECHNICAL DATA

YU-148
HIGH-MU TRIODE



The EIMAC YU-148 high mu, forced air cooled, power triode provides relatively high power output as an amplifier, oscillator or modulator at low plate voltages. The tube has a low inductance cylindrical filament stem structure which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides good shielding between the input and output circuits for grounded grid applications and conveniently terminates in a ring between the plate and filament terminals.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	7.0 ± 0.35 Volts
Current @ 7 Volts	78 Amperes
Amplification Factor (Average)	200

Direct Interelectrode Capacitance (Grounded Filament)[2]

Cin	42 pF
Cout	0.28 pF
Cgp	24.5 pF

Direct Interelectrode Capacitance (Grounded Grid)[2]

Cin	42 pF
Cout	24.5 pF
Cgp	0.28 pF

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

(Effective 3/91) 2208

Printed in U.S.A.

varian
power grid & x-ray tube products
1678 South Pioneer Road / Salt Lake City, Utah 84104 / U.S.A. / (801) 972-5000

RADIO-FREQUENCY POWER AMPLIFIER
Class C Telegraphy or FM, Cathode Driven

TYPICAL OPERATION AT 108 MHZ

Plate Voltage	4800	5700	6000	Vdc
Grid Voltage	0	0	-100	Vdc
Plate Current	2.30	2.50	2.56	Adc
Grid Current	.32	.33	.48	Adc
Peak RF Cathode Voltage[1]	215	224	340	Volts
Plate Dissipation	3200	4100	3900	Watts
Useful Output Power[1]	8,000	10,000	12,000	Watts
Driving Power[1]	500	600	800	Watts
Load Impedance	1200	1300	1200	Ohms
Drive Impedance	50	49	77	Ohms

[1]Approximate Values

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	7,000 Volts
DC Plate Current	3.5 Amperes
Plate Dissipation	6,000 Watts
Grid Dissipation	225 Watts

MECHANICAL

Maximum Overall Dimensions:

Length	8.50 in; 21.59 cm
Diameter	6.70 in; 17.018 cm
Net Weight	8.01 lbs; 3.64 kg
Operating Position	Vertical, base down or up
Cooling	Forced Air

APPLICATION

MECHANICAL

COOLING - The maximum temperature rating for the anode core and the ceramic/metal seal area of this 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.

Minimum air flow requirements to maintain anode core and ceramic/metal seal areas below 225°C at sea level with an air inlet temperature of 40°C are tabulated for air flow in the base-to-anode and anode-to-base directions. At higher ambient temperatures, frequencies above 40 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 either type is normally required. With air flowing in an anode-to-base direction, 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 is required.

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

Cooling 50 C Ambient

	Anode to Base Air Flow	
Watt	CFM	In of Water
4500	250	1.0
5000	300	1.2
	Base to Anode Air Flow	
Watt	CFM	In of Water
5000	142	0.22
6000	205	0.4

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage, as measured at the filament terminals, should be 7.0 Volts, with maximum allowable variation due to line fluctuations of from 6.65 to 7.35 Volts.

INTERLOCKS - An interlock device should be provided to ensure that cooling air flow is established before application of electrical power, including the heater. 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 network have a "Q" of at least 5, and higher if possible.

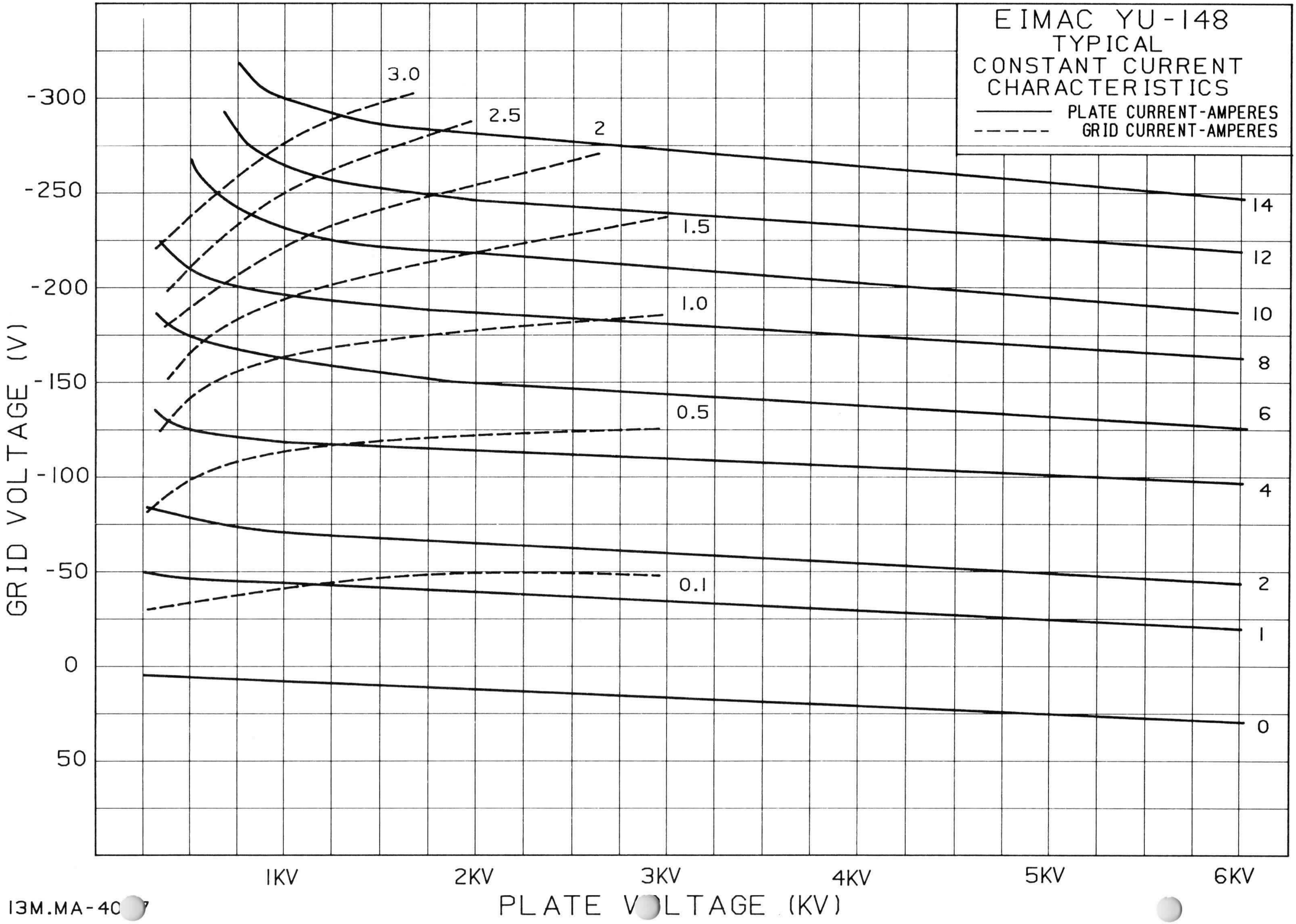
FAULT PROTECTION - It is good practice to protect the tube from internal damage caused by an internal arc which may occur at high anode voltage.

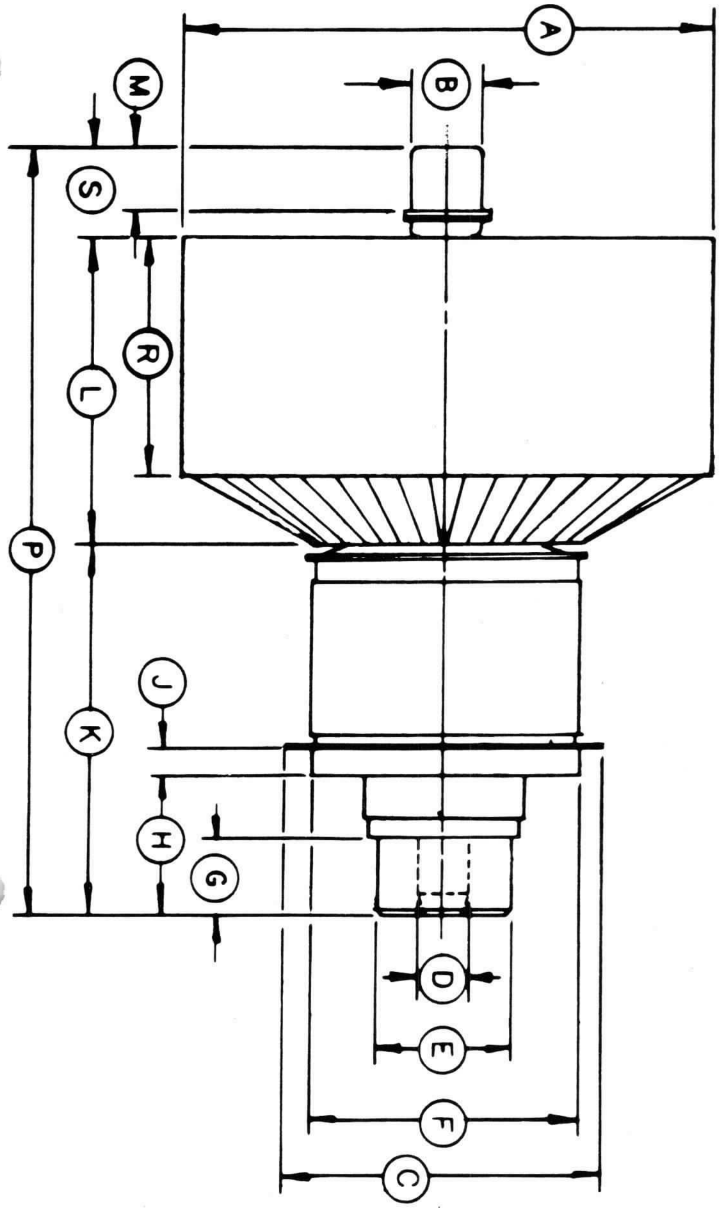
RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE AFFECTED.

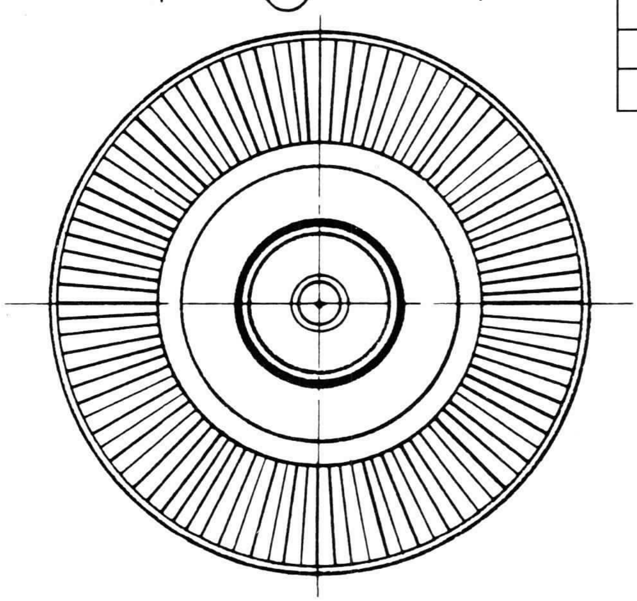
HOT SURFACES - When the tube is used in air and air cooled, external surfaces of the tube may reach temperatures up to 200 degrees C and higher. In addition to the anode, the cathode insulator and cathode/heater surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns, take care to avoid any bodily contact with these surfaces both during, and for a reasonable cool down period after, tube operation.

CAUTION - HIGH VOLTAGE - *Operating voltage for the YU-148 can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design 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 the 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.***

SPECIAL APPLICATIONS - If it desired to operate this tube under conditions different from those given here write to the Power Grid Tube Marketing Department, Varian Power Grid & X-Ray Tube Products, 1678 South Pioneer Road, Salt Lake City, UT 84104, for information and recommendations.


EIMAC YU-148
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT-AMPERES
GRID CURRENT-AMPERES
3.0
2.5
2
1.5
1.0
0.5
0.1
14
12
10
8
6
4
2
1
0
-300
-250
-200
-150
-100
-50
0
50
GRID VOLTAGE (V)
1KV
2KV
3KV
4KV
5KV
6KV
PLATE VOLTAGE (KV)
13M.MA-40





DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.000	6.125		152.4	155.58	
B	.781	.843		19.8	21.4	
C		3.625			92.1	
D	.615	.635		15.6	16.1	
E	1.490	1.510		37.8	38.4	
F	2.990	3.010		75.9	76.4	
G	.812	.937		20.6	23.8	
H	1.375	1.625		34.9	41.3	
J	.375	.437		9.5	11.1	
K	3.875	4.250		98.4	107.9	
L		3.325			84.5	
M	.687	.812		17.5	20.6	
P	8.000	9.000		203.2	228.6	
R					65.1	65.1
S	1.000	1.125		25.4	28.6	

general

volume 1

general

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

TECHNICAL DATA

Eimac Tube Type Numbering System

EIMAC tube types are identified by either a non-descriptive, sequentially-assigned 4-digit type number, standardized and registered with the ELECTRONIC INDUSTRIES ASSOCIATION (EIA) for non-duplication throughout the world, or by an EIMAC-originated coded numbering system, designed to convey descriptive information about the tube. Many tube types can be identified with either number, and are branded with both.

In general, the EIMAC type number consists of: a numeral indicating the number of electrodes, one or more letters denoting special characteristics, a numeral representing the plate dissipation rating, and a final letter to distinguish the tube from others which may bear similar or preceding letters and numerals. Triode types carry an additional number to indicate their approximate amplification factor.

To illustrate the system, a typical 1500-watt, ceramic, external-anode, forced-air cooled EIMAC triode is broken down as follows:

8877/3CX1500A7

EIA Type Number

Number of Electrodes

- 2 - Diode
- 3 - Triode
- 4 - Tetrode
- 5 - Pentode

Description

- C - Ceramic Envelope (No Glass)
- L - External Anode, Liquid Convection Cooling
- N - External Anode, Natural Convection Air Cooling
- P - Primarily for Pulse Applications
- *R - Internal Anode, Radiation Cooled
- S - External Anode, Conduction Cooled
- V - External Anode, Vapor Cooled
- W - External Anode, Water Cooled
- X - External Anode, Forced-Air Cooled

* In older types, the dash, as in the case of the 4-250A, carries the meaning of "R" given above.

Plate Dissipation (Watts)

Version

Distinguishes tubes which, although alike as to number of electrodes and plate dissipation, are not necessarily interchangeable physically or electrically.

Amplification Factor

- 1-0 to 10
- 2-11 to 20
- 3-21 to 30
- 4-31 to 50
- 5-51 to 100
- 6-101 to 200
- 7-201 to 500
- 8-501 to 1000

(Effective 6-1-73)

TECHNICAL DATA

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DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

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301 Industrial Way
San Carlos, California
94070

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Printed in U.S.A.

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4CX250K/8245	TET
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5-500A	PE
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PL - Planar Triode
PM - Pulse Modulator
OP - Other Products
R - Rectifier
T - Triode
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8911	PL
8912	PL
8921 see 4CX600J/JA	TET
8930	TET
8933	PL
8938	T
8954	TET
8959	TET
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HR Heat Dissipating Connectors	OP
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SK-2200	OP
SK-2210 see SK-2200	OP
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Y572AL see 8906AL	PL

D - Diode
PE - Pentode
PL - Planar Triode
PM - Pulse Modulator

OP - Other Products
R - Rectifier
T - Triode
TET - Tetrode

EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC CROSS-REFERENCE LIST

FEBRUARY 15, 1975

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC to JEDEC

EIMAC No.	JEDEC No.
2-01C	—
2-25A	—
2-50A	—
2-150D	—
2-240A	—
2-2000A	—
2C39A	2C39A
2C39WA	2C39WA
2X1000A	—
2X3000F	—
3C24	3C24
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3-500Z	—
3-1000Z	8164
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3CPX100A5	7815R
3CPX1500A7	—
3CV1500A7	—
3CV30,000A1	—
3CV30,000A3	—
3CV30,000H3	—
3CV50,000A7	—
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3CW5000F3	8243
3CW5000H3	—
3CW10,000A3	—
3CW10,000H3	—
3CW20,000A1	—
3CW20,000A3	—
3CW20,000A7	—
3CW20,000H3	—
3CW20,000H7	—
3CW30,000H3	—
3CW30,000H7	—
3CW40,000H3	—
3CX100A5	7289
3CX100F5	8250
3CX400U7	8961
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	—
3CX3000A1	8238
3CX3000A7	—
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	—
3CX5000H3	—
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	—
3CX15,000A3	—
3CX15,000A7	—
3CX15,000H3	—
3CX20,000A3	—
3CX20,000A7	—
3CX20,000H3	—
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	—
4-1000A	8166
4CN15A	—
4CPX250K	8590
4CS250R	—
4CV1500B	—
4CV8000A	—
4CV20,000A	—
4CV35,000A	—
4CV50,000E	—
4CV50,000J	—
4CV100,000C	8351
4CV250,000A	—
4CW800B	—
4CW800F	—
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	—
4CW50,000E	—
4CW50,000J	—
4CW100,000D	—
4CW100,000E	—
4CW250,000A	—
4CX125C	—
4CX125F	—
4CX250B	7203
4CX250BC	8957
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	—
4CX600F	—
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	—
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	—
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	—
4W300B	8249
4X150A	7034
4X150G	8172
4X500A	—
5-125B	4E27A
5-500A	—
5CX1500A	—
5CX3000A	—
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	—
177A	—
177WA	6549W
250R	—
250TH	250TH
250TL	250TL
253	253
254W	—
264	8576
279	—
284	—
290	—
294	—
304TH	304TH
304TL	304TL
322	—
450TH	450TH
450TL	450TL
750TL	750TL
826	826
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8295A	8295A
8403	8403
8432	8432
8533W	8533W
8560A	8560A
8560AS	8560AS
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8892	8892
8893	8893
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8911	8911
8912	8912
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8959	8959
8960	8960
8962	8962
8963	8963
8964	8964
8965	8965

JEDEC/EIMAC CROSS-REFERENCE LIST

JEDEC to EIMAC

JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
592	3-200A3
750TL	750TL
826	826
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549W	177WA
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	4-400C
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7203	4CX250B
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7815X	7815X
7815XAL	7815XAL
7843	7843
7855	7855
7855AL	7855AL
7855K	7855K
7855KAL	7855KAL
8020	100R
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533W	8533W
8560A	8560A
8560AS	8560AS
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8906AL	8906AL
8906BAL	8906BAL
8906X	8906X
8906XAL	8906XAL
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912
8921	4CX600JA
8930	8930
8933	8933
8938	8938
8940	8940
8941	8941
8942	8942
8944	8944
8954	8954
8957	4CX250BC
8959	8959
8960	8960
8961	3CX400U7
8962	8962
8963	8963
8964	8964
8965	8965

Eimac®

DIVISION OF VARIAN
301 Industrial Way
San Carlos, California

POWER GRID TUBE SELECTION GUIDE

Printed in U.S.A.

POWER GRID TUBE SELECTION GUIDE

The EIMAC Power Grid Tube Selection Guide is arranged for ease in making type selections by use rather than tube type. The Guide is applications-oriented.

Tube types are listed according to the principle modes of service for which they are rated. Under each mode of service, EIMAC tube types suitable for the application are tabulated in descending order of the most significant tube parameter in the left hand column. For example, in the POWER AMPLIFIER tabulation, tube types are listed in descending order of typical rf power output; PULSE REGULATOR tubes are listed in descending order of peak current capability. This format places emphasis on tube application and facilitates comparison in terms of the significant ratings of the EIMAC types available for a given application.

After preliminary selection of a tube type (or types) from the Guide, the final choice should be based upon the complete ratings from the EIMAC data sheet for the tube in question and consultation with the EIMAC Application Engineering Department.

RADIO FREQUENCY POWER AMPLIFIER

Linear Service

Peak Env. Power‡ Typical (kW)	Rated Anode Diss. (kW)	Frequency* F1 / upper useful (MHz)	Inter-Mod. Distortion Typical† 3rd (dB)	5th (dB)	Cooling	EIMAC Type Number	Tube Type
1180	1250	30 / 50	—	—	water	X-2159	Tetrode
600	650	50 / 100	—	—	water	X-2170	Tetrode
230	250	30 / 50	-31	-43	vapor	4CV250,000A	Tetrode
230	250	30 / 50	-31	-43	water	4CW250,000A	Tetrode
168	100	108 / 150	—	—	water	4CW100,000E	Tetrode
123	100	30 / 50	-26	-40	vapor	4CV100,000C	Tetrode
105	50	110 / 220	—	—	vapor	3CV50,000A7	Triode[1]
55	35	30 / 50	-30	-40	air	4CX35,000C	Tetrode
45	50	110 / 200	-46	-60	vapor	4CV50,000J	Tetrode
45	50	110 / 200	-46	-60	water	4CW50,000J	Tetrode
27.5	20	250 / 500	—	—	air	8963	Triode[2]
27.5	20	110 / 220	—	—	air	3CX20,000A7	Triode[1]
17	15	110 / 220	-40	-39	air	3CX15,000A7	Triode[1]
17	20	140 / 220	-40	-39	water	3CW20,000A7	Triode[1]
17	10	140 / 220	-40	-39	air	3CX10,000A7	Triode[1]
14	10	100 / 220	-30	-36	air	4CX10,000D	Tetrode
12	15	110 / 220	-41	-41	air	4CX15,000J	Tetrode
10.5	10	100 / 220	-35	-40	air	4CX10,000J	Tetrode
10	5	100 / 220	-30	-38	air	4CX5000A	Tetrode
10	5	100 / 220	-30	-38	air	4CX5000R	Tetrode
5.8	3	150 / 220	-40	-43	air	5CX3000A	Pentode
5.3	5	30 / —	-26	-40	air	290	Pentode
5.5	3	110 / —	-51	-45	air	3CX3000A7	Triode[1]
5.3	3	150 / 220	-32	-36	air	4CX3000A	Tetrode
5.8	3	30 / —	-26	-41	air	264/8576	Pentode
3.3	5	100 / 220	-41	-44	air	4CX5000J	Tetrode
2.06	1	220 / 400	-31	-39	air	3CX1000A7	Triode[1]

‡ Plate power output, calculated or measured at low frequency.

* F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

† Calculated or measured by two-tone method at 2.0 MHz.

1. Grounded grid 2. VHF TV

RADIO FREQUENCY POWER AMPLIFIER—LINEAR, CONTINUED

Peak Env. Power‡ Typical (Watts)	Rated Anode Diss. (Watts)	Frequency* F1/ upper useful (MHz)	Inter-Mod. Distortion Typical† 3rd (dB)	5th (dB)	Cooling	EIMAC Type Number	Tube Type
2050	1500	220 / 400	−38	−44	air	3CX1500A7	Triode[1]
2030	1500	500 / —	−44	−44	air	8938	Triode[1]
1785	1500	110 / 220	−33	−42	air	5CX1500A	Pentode
1160	1000	110 / 220	−43	−47	air	4CX1500B	Tetrode
1080	1000	110 / —	−29	−37	air	3-1000Z	Triode[1]
940	500	110 / —	−40	−45	air	3-500Z	Triode[1]
645	500	110 / —	−33	−41	air	5-500A	Pentode
590	200	500 / 900	−35	−36	conduction	8873	Triode[1]
590	400	500 / 900	−35	−36	air	8874	Triode[1]
590	300	500 / 900	−35	−36	air	8875	Triode[1]
590	400	110 / —	−28	−35	air	3-400Z	Triode[1]
580	600	30 / —	−43	−43	air	4CX600J	Tetrode
495	400	110 / —	—	—	air	4-400C	Tetrode
350	350	500 / —	−27	−50	air	8930	Tetrode
295	250	500 / —	−25	−30	air	4CX250R	Tetrode
295	250	500 / —	−25	−30	conduction	4CS250R	Tetrode
263	350	30 / 220	−30	−35	air	4CX350A	Tetrode
263	350	30 / 220	−30	−35	air	4CX350F	Tetrode
263	350	30 / 220	−40	−45	air	4CX350FJ	Tetrode
226	200	500 / —	—	—	conduction	8560A	Tetrode

‡ Plate power output, calculated or measured at low frequency.
* F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.
† Calculated or measured by two-tone method at 2.0 MHz.
1. Grounded grid

RF POWER AMPLIFIER

Class C, CW or FM Service

Plate Pwr. Output Typical* (kW)	Rated Plate Diss. (kW)	Freq.† F1/ upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
1650	1250	30 / 50	x200	water	X-2159	Tetrode
1050	650	50 / 100	x300	water	X-2170	Tetrode
460	250	30 / 50	x150	vapor	4CV250,000A	Tetrode
460	250	30 / 50	x150	water	4CW250,000A	Tetrode
220	100	108 / 150	x1800	water	4CW100,000E	Tetrode
168	100	30 / 50	x1350	vapor	4CV100,000C	Tetrode
165	100	30 / 50	x140	water	4CW100,000D	Tetrode
137	50	110 / 220	x900	vapor	4CV50,000E	Tetrode
137	50	110 / 220	x900	water	4CW50,000E	Tetrode
110	35	30 / 50	x425	air	4CX35,000C	Tetrode
80	60	40 / 80	x130	water	6696A	Triode
80	80	40 / 80	x130	vapor	7480	Triode
80	35	40 / 80	x130	air	6697A	Triode
64	20	90 / 150	x66	air	3CX20,000A3	Triode
64	20	90 / 150	x66	air	3CX20,000H3	Triode
42	25	100 / 150	x37	water	3CW25,000A3	Triode
36.5	15	110 / 225	x166	air	4CX15,000A	Tetrode
30.0	15	100 / 150	x45	air	3CX15,000A3	Triode
25.0	15	110 / 160	x50	air	3CX15,000A7	Triode
24.5	10	140 / 200	x6	air	3CX10,000A3	Triode[1]
24.5	20	140 / 200	x6	water	3CW20,000A3	Triode[1]
16	5	100 / 220	x1050	air	4CX5000A	Tetrode

* Power output and power gain are calculated or measured at low frequency.
† FI is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.
1. Grounded grid

RF FREQUENCY POWER AMPLIFIER — CLASS C, CW or FM, CONTINUED

Plate Pwr. Output Typical* (Watts)	Rated Plate Diss. (Watts)	Frequency† F1/ upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
16,000	10,000	100 / 220	x1050	air	4CX10,000D	Tetrode
16,000	10,000	100 / 220	x1050	water	4CW10,000A	Tetrode
16,000	5000	100 / 220	x1050	air	4CX5000R	Tetrode
11,000	3000	150 / 220	x260	air	4CX3000A	Tetrode
10,000	4000	75 / 150	x73	air	3CX2500A3	Triode
10,000	4000	75 / 150	x73	air	3CX2500F3	Triode
10,000	5000	75 / 150	x73	water	3CW5000A3	Triode
10,000	5000	75 / 150	x73	water	3CW5000F3	Triode
8500	3000	150 / 220	x160	air	5CX3000A	Pentode
3400	1000	110 / —	x225	air	4-1000A	Tetrode
3200	1500	110 / 220	x350	air	4CX1500A	Tetrode
3180	1500	110 / 220	x350	air	5CX1500A	Pentode
2600§	1500	250 / —	x33	air	3CX1500A7	Triode[1]
1500§§	1500	500 / —	x30	air	8938	Triode[1]
1265	500	110 / —	x140	air	4-500A	Pentode
1100	400	110 / —	x190	air	4-400C	Tetrode
1000	250	110 / —	x190	air	4-250A	Tetrode
840	350	100 / 150	x31	air	5867A	Triode
805	250	60 / —	x9	air	6569	Triode[1]
805	500	110 / —	x67	air	4-500A	Tetrode
745	400	60 / —	x8	air	6580	Triode[1]
680	1500	— / 900	x10	air	8962	Triode[2]
600	300	110 / 220	x158	air	4CX300Y	Tetrode
500	300	500 / —	x177	air	4CX300A	Tetrode
450	350	500 / —	—	air	8930	Tetrode
380	250	500 / —	x190	conduction	4CS250R	Tetrode
380	250	500 / —	x130	air	4CX250BC	Tetrode
380	250	500 / —	x130	air	4CX250FG	Tetrode
380	250	500 / 1500	x130	air	4CX250K	Tetrode
380	250	500 / 1500	x130	air	4CX250M	Tetrode
380	250	500 / —	x190	air	4CX250R	Tetrode
380	250	150 / 500	x130	air	4X150A	Tetrode
380	250	150 / 500	x130	air	7609	Tetrode
380	250	500 / —	x130	conduction	8560A	Tetrode
375	125	120 / —	x150	air	4-125A	Tetrode
320	200	500 / —	x35	conduction	8873	Triode
320	400	500 / —	x35	air	8874	Triode
320	300	500 / —	x35	air	8875	Triode
270	65	150 / —	x160	convection	4-65A	Tetrode
216	400	1000 / —	11.5	air	3CX400U7	Triode[2]
100	115	1215 / —	x27 @ 400 MHz	air	6816	Tetrode
100	115	1215 / —	x27 @ 400 MHz	air	6884	Tetrode
100	115	1215 / —	x27 @ 400 MHz	air	7457	Tetrode
100	115	1215 / —	x27 @ 400 MHz	conduction	7843	Tetrode

* Power output and power gain are calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

§ Power output shown is measured useful, delivered to load, at 104 MHz. §§ Useful power output, measured at 430 MHz

1. Grounded grid 2. 900 MHz

RF POWER AMPLIFIER

Class C – Plate Modulated Service

Carrier Pwr. Output Typical* (kW - W)	Plate Diss. at Typical Conditions (kW - W)	Frequency† F1 / upper useful (MHz)	Power Gain*	Cooling	EIMAC Type Number	Tube Type
1375 kW	800 kW	30 / 50	x200	water	X-2159	Tetrode
700 kW	160 kW	50 / 100	x290	water	X-2170	Tetrode
285 kW	119 kW	30 / 50	x120	vapor	4CV250,000A	Tetrode
285 kW	119 kW	30 / 50	x120	water	4CW250,000A	Tetrode
140 kW	47 kW	30 / 50	x110	vapor	4CV100,000C	Tetrode
140 kW	35 kW	108 / 150	x260	water	4CW100,000E	Tetrode
138 kW	22 kW	30 / 50	x160	water	4CW100,000D	Tetrode
110 kW	22 kW	110 / 220	x160	water	4CW50,000E	Tetrode
110 kW	22 kW	110 / 220	x160	vapor	4CV50,000E	Tetrode
60 kW	20 kW	40 / 80	x30	water	6696A	Triode
60 kW	20 kW	40 / 80	x30	air	6697A	Triode
60 kW	20 kW	40 / 80	x30	vapor	7480	Triode
55 kW	13 kW	30 / 50	x440	air	4CX35,000C	Tetrode
27.5 kW	7.5 kW	90 / 150	x18	air	3CX20,000A3	Triode
27.5 kW	7.5 kW	90 / 150	x18	air	3CX20,000H3	Triode
23.5 kW	5.8 kW	110 / 225	x155	air	4CX15,000A	Tetrode
23.5 kW	5.8 kW	110 / 225	x155	vapor	4CV35,000A	Tetrode
18.0 kW	5.4 kW	100 / 150	x37	air	3CX15,000A3	Triode
12.4 kW	2.6 kW	140 / 200	x24	air	3CX10,000A3	Triode
8500 W	3500 W	100 / 220	x230	air	4CX10,000D	Tetrode
8500 W	3500 W	100 / 220	x230	air	4CX5000A	Tetrode
8500 W	3500 W	100 / 220	x230	air	4CX5000R	Tetrode
5750 W	1250 W	150 / 220	x190	air	4CX3000A	Tetrode
5300 W	950 W	75 / 150	x45	air	3CX2500A3	Triode
5300 W	950 W	75 / 150	x45	air	3CX2500F3	Triode
2630 W	670 W	110 / —	x290	air	4-1000A	Tetrode
2320 W	780 W	110 / 220	x230	air	4CX1500A	Tetrode
1960 W	575 W	110 / 220	x195	air	5CX1500A	Pentode
1765 W	485 W	110 / —	x50	air	3-1000Z	Triode
830 W	245 W	110 / —	x140	air	4-500A	Tetrode
785 W	280 W	110 / —	x110	air	5-500A	Pentode
640 W	185 W	110 / —	x25	air	3-500Z	Triode
630 W	195 W	110 / —	x190	air	4-400C	Tetrode
510 W	165 W	110 / —	x160	air	4-250A	Tetrode
300 W	80 W	120 / —	x90	air	4-125A	Tetrode
300 W	200 W	110 / 220	x175	air	4CX300 Y	Tetrode
270 W	280 W	500 / —	—	air	8930	Tetrode
235 W	65 W	500 / —	x160	conduction	4CS250R	Tetrode
235 W	65 W	500 / —	x135	air	4CX250BC	Tetrode
235 W	65 W	500 / —	x135	air	4CX250F	Tetrode
235 W	65 W	500 / 1500	x135	air	4CX250K	Tetrode
235 W	65 W	500 / 1500	x135	air	4CX250M	Tetrode
235 W	65 W	500 / —	x160	air	4CX250R	Tetrode
235 W	65 W	500 / —	x135	air	4CX300A	Tetrode
235 W	65 W	150 / 500	x135	air	4X150A	Tetrode
235 W	65 W	150 / 500	x135	air	7609	Tetrode
235 W	65 W	500 / —	x135	conduction	8560A	Tetrode
210 W	45 W	150 / —	x65	convection	4-65A	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	air	6884	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	air	7457	Tetrode
45 W	45 W	1215 / —	x15 @ 400 MHz	conduction	7843	Tetrode

* Power output and power gain are calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operating at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

RF POWER AMPLIFIER

Grid Pulsed Service

Peak RF Pwr. Output Typical β (kW)	Rated Anode Diss. (kW)	Frequency† F1 / upper useful (MHz)	Maximum Anode Voltage (kVdc)	Maximum Anode Current β (A)	Cooling	EIMAC Type Number	Tube Type
3900	1250	30 / 50	30	195	water	X-2159	Tetrode
2000	650	50 / 100	30	100	water	X-2170	Tetrode
1000	100	108 / 150	30	50	water	4CW100,000E	Tetrode
500	50	110 / 220	30	33	vapor	4CV50,000E	Tetrode
500	50	110 / 220	30	33	water	4CW50,000E	Tetrode
160	15	110 / 225	12	20	air	4CX15,000A	Tetrode
80	10	110 / 220	10	13	air	4CX10,000D	Tetrode
80	10	110 / 220	10	13	air	4CX5000A	Tetrode
80	10	100 / 220	10	13	air	4CX5000R	Tetrode
35	1.5	— / 500	20	8	air	3CPX1500A7	Triode
34	1.0	110 / —	15	3.5	air	4PR1000A	Tetrode
28*	0.25	500 / 1500	7	6.0	air	4CPX250K	Tetrode
28*	0.25	500 / 1500	7	6.0	air	4CX250K	Tetrode
28*	0.25	500 / 1500	7.0	6.0	air	4CX250M	Tetrode
26	1500	500 / —	5	8	air	8938	Triode
11	0.40	110 / —	10	1.7	air	4PR400A	Tetrode
10‡	0.25	500 / 1500	5.5	0.8	air	4CPX250K	Tetrode
4.0	0.125	120 / —	9.0	0.7	air	4PR125A	Tetrode
2.6	0.300	110 / 220	3.0	1.3	air	4CX300Y	Tetrode
2.0	0.065	150 / —	7.5	0.4	convection	4PR65A	Tetrode
1.6	0.20	500 / —	3.0	0.8	conduction	8873	Triode
1.6	0.40	500 / —	3.0	0.8	air	8874	Triode
1.6	0.30	500 / —	3.0	0.8	air	8875	Triode
1.6	0.25	500 / —	3.0	0.8	air	4CX250B }	Tetrode
1.6	0.25	500 / —	3.0	0.8	air	4CX250F }	Tetrode
1.6	0.25	500 / 1500	3.0	0.8	air	4CX250K }	Tetrode
1.6	0.25	500 / 1500	3.0	0.8	air	4CX250M }	Tetrode

β Average during the pulse. Power output data is anode power (does not include circuit losses), calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced anode power input.

* Anode and screen-grid pulsed

‡ Cathode driven, screen pulsed

OSCILLATOR OR AMPLIFIER

Class C — Industrial Service

Plate Pwr. Output Typical* (kW)	Rated Plate Diss. (kW)	Filament Heating Power (Watts)	Frequency† F1 / upper useful (MHz)	Cooling	EIMAC Type Number	Tube Type
1800	1000	26640	30 / 60	water	X-2176	Triode
900	500	13320	30 / 60	water	X-2177	Triode
80	60	2665	40 / 80	water	6696A	Triode
80	35	2665	40 / 80	air	6697A	Triode
80	80	2665	40 / 80	vapor	7480	Triode
70	40	1600	90 / —	water	3CW40,000H3	Triode
60	20	1600	90 / —	air	3CX20,000H3	Triode
42	30	1020	90 / —	water	3CW30,000H3	Triode
42	30	1020	100 / —	vapor	3CV30,000H3	Triode
41.2	15	1020	90 / —	air	3CX15,000H3	Triode
29	10	742	90 / —	air	3CX10,000H3	Triode
28	20	742	90 / —	water	3CW20,000H3	Triode
20.6	10	566	90 / —	water	3CW10,000H3	Triode
18.6	5	566	90 / —	air	3CX5000H3	Triode
10	5	379	75 / 150	water	3CW5000H3	Triode
5	2.5	379	75 / 150	air	3CX2500A3/F3/H3	Triode
1.2	0.3	125	40 / 80	air	304TL	Triode
0.68	0.35	70	100 / —	air	5867A	Triode

* Calculated or measured at low frequency.

† F1 is the maximum frequency at which maximum ratings apply. Operation at the upper useful frequency normally involves operation at reduced anode voltage and reduced plate input power.

AF POWER AMPLIFIER

OR

MODULATOR SERVICE

AF Pwr. Output Typical* (2 tubes) (kW - W)	Typical* Plate Diss. Per Tube (kW - W)	Class of Service	Driving Power (2 tubes)	Cooling	EIMAC Type Number	Tube Type
1900 kW	420 kW	AB1	0	water	X-2159	Tetrode
950 kW	210 kW	AB1	0	water	X-2170	Tetrode
660 kW	260 kW	AB1	0	vapor	4CV250,000A	Tetrode
660 kW	260 kW	AB1	0	water	4CW250,000A	Tetrode
246 kW	57 kW	AB1	0	vapor	4CV100,000C	Tetrode
246 kW	57 kW	AB1	0	water	4CW100,000D	Tetrode
200 kW	46 kW	AB1	0	water	4CW100,000E	Tetrode
195 kW	42 kW	AB1	0	water	4CW50,000E	Tetrode
195 kW	42 kW	AB1	0	vapor	4CV50,000E	Tetrode
195 kW	42 kW	AB1	0	vapor	4CV50,000J	Tetrode
195 kW	42 kW	AB1	0	water	4CW50,000J	Tetrode
152 kW	44 kW	AB2	600	water	6696A	Triode
152 kW	44 kW	AB2	600	air	6697A	Triode
152 kW	44 kW	AB2	600	vapor	7480	Triode
70 kW	20 kW	AB1	0	air	4CX35,000C	Tetrode
66 kW	20.5 kW	AB1	0	vapor	4CV35,000A	Tetrode
57 kW	14 kW	AB1	0	water	4CW25,000A	Tetrode
57 kW	14 kW	AB1	0	air	4CX15,000A	Tetrode
31.9 kW	9 kW	AB1	0	air	4CX10,000D	Tetrode
29.1 kW	10 kW	AB1	0	air	3CX10,000A1	Triode
29.1 kW	10 kW	AB1	0	water	3CW20,000A1	Triode
17.5 kW	4.2 kW	AB1	0	air	4CX5000A	Tetrode
17.5 kW	4.2 kW	AB1	0	air	4CX5000R	Tetrode
1.45 kW	4.75 kW	AB1	0	vapor	4CV8000A	Tetrode
13.0 kW	2.5 kW	B	113	water	3CW5000A3	Triode
13.0 kW	2.5 kW	B	113	air	3CX2500A3	Triode
13.0 kW	2.5 kW	B	113	air	3CX2500F3	Triode
13.0 kW	2.5 kW	B	113	water	3CW5000F3	Triode
11.4 kW	3.3 kW	AB1	0	air	4CX3000A	Tetrode
10.0 kW	2.95 kW	AB1	0	water	3CW5000A1	Triode
10.0 kW	2.95 kW	AB1	0	water	3CW5000F1	Triode
10.0 kW	2.95 kW	AB1	0	air	3CX3000A1	Triode
10.0 kW	2.95 kW	AB1	0	air	3CX3000F1	Triode
3.9 kW	900 W	AB2	4.7	air	4-1000A	Tetrode
3.22 kW	920 W	AB1	0	air	5CX1500A	Pentode
3.2 kW	920 W	AB1	0	air	4CX1500A	Tetrode
1.72 kW	500 W	AB1	0	air	4-500A	Tetrode
1.66 kW	458 W	AB1	0	air	5-500A	Pentode
1.75 kW	400 W	AB2	3.5	air	4-400C	Tetrode
1.42 kW	445 W	AB2	25	air	3-500Z	Triode
1.31 kW	340 W	B	26	air	3-400Z	Triode
1.04 kW	190 W	AB2	1.9	air	4-250A	Tetrode
800 W	225 W	AB1	0	air	4CX300A	Tetrode
780 W	350 W	AB1	0	air	8930	Tetrode
600 W	200 W	AB1	0	air	4CX250BC 4CX250F 4X150A 7609	Tetrode
400 W	125 W	AB2	1.0	air	4-125A	Tetrode
270 W	63 W	AB2	1.3	air	4-65A	Tetrode

* Measured in watts, unless otherwise specified.

VOLTAGE OR CURRENT

REGULATOR SERVICE

Maximum Pass Current (Adc)	Maximum Hold-off Voltage (kVdc)	Minimum Tube Drop (Vdc)	Rated Anode Diss. (kW)	Cooling	EIMAC Type Number	Tube Type
300	40	3000	1250	water	X-2159	Tetrode
150	40	2500	650	water	X-2170	Tetrode
50	40	4400	250	water	4CW250,000A	Tetrode
35	40	2700	100	water	4CW100,000E	Tetrode
30	40	3300	100	water	4CW100,000D	Tetrode
15	35	3000	50	water	4CW50,000E	Tetrode
15	40	2200	35	air	4CX35,000C	Tetrode
7.5	10	1500	20	water	3CW20,000A1	Triode
7.5	20	1200	20	water	3CW20,000A7	Triode
7	10	1300	12	air	3CX10,000A1	Triode
6	20	800	25	water	4CW25,000A	Tetrode
4	20	500	15	air	3CX15,000A7	Triode
4	15	2000	10	water	4CW10,000A	Tetrode
3	12	1300	5	water	3CW5000A1	Triode
2	12	1000	3	air	3CX3000F1	Triode
2	6	1000	2	water	4CW2000A	Tetrode
1	8	250	1.5	air	3CX1500A7	Triode
1	6	500	1	air	4CX1000A	Tetrode
1	6	500	0.8	water	4CW800B	Tetrode
1	6	500	0.8	water	4CW800F	Tetrode
0.8	4.5	300	0.4	air	8874	Triode
0.8	4.5	300	0.3	air	8875	Triode
0.8	4.5	300	0.2	convection	8873	Triode
0.6	30	500	1	air	4PR1000A	Tetrode
0.6	8	400	0.5	air	3-500Z	Triode
0.2	20	1800	0.4	air	4PR400A	Tetrode
0.2	50	1000	0.25	air	4PR250C	Tetrode
0.1	18	1200	0.125	air	4PR125A	Tetrode
0.1	15	500	0.065	convection	4PR65A	Tetrode

SWITCH TUBE OR

PULSED REGULATOR SERVICE

Peak Anode Current (A)	Maximum Hold-off Voltage (kVdc)	Rated Anode Diss. (kW)	Cooling	EIMAC Type Number	Tube Type
780	60	1250	water	X-2159	Tetrode
400	60	650	water	X-2170	Tetrode
300	40	250	water	4CW250,000A	Tetrode
150	75	35	air	Y-546	Tetrode[1]
150	75	100	water	Y-647	Tetrode[2]
150	40	100	water	4CW100,000D	Tetrode
150	75	100	water	Y-676	Tetrode[3]
150	40	100	water	4CW100,000E	Tetrode
150	40	35	air	4CX35,000C	Tetrode
130	25	60	water	6696A	Triode
130	25	35	air	6697A	Triode
100	50	5	air	X-2187	Triode[4]
100	35	50	water	4CW50,000E	Tetrode
100	35	50	vapor	4CV50,000E	Tetrode
70	20	25	water	4CW25,000A	Tetrode
60	20	15	air	4CX15,000A	Tetrode
60	30	15	air	Y-456	Tetrode[5]
50	30	25	water	Y-569	Tetrode[6]
40	15	10	air	4CX10,000D	Tetrode
40	18	5	air	Y-573	Pentode[7]
40	18	3	air	Y-574	Pentode[8]
40	20	6.0	water	Y-633	Tetrode[9]
40	20	20	water	3CW20,000A7	Triode
40	15	5	air	4CX5000A	Tetrode
40	15	5	air	4CX5000R	Tetrode
40	25	10	water	Y-442	Tetrode[10]
25	20	3	air	4CX3000A	Tetrode
25	20	1.5	air	3CPX1500A7	Triode
18	20	0.06	air	4PR60C	Tetrode
15	10	3	air	3CX3000F7	Triode
12	12	1	air	Y-575	Pentode[11]
12	4	0.6	air	4CX600B/F	Tetrode
12	4	0.8	water	4CW800B/F	Tetrode
12	25	0.75	air	8941	Planar Triode
12	20	0.75	air	8942	Planar Triode
12	6.5	0.75	air	8940	Planar Triode
10	50	1.0	air	8960	Tetrode
10	7	1.5	air	4CX1500A	Tetrode
8	30	1.0	air	4PR1000A	Tetrode
8	40	1.0	air	Y-364	Tetrode[12]
8	7.5 (oil)	0.6	air or oil	8954	Tetrode
6	12	0.15	air	Y-518	Planar Triode
6	7	0.25	air	4CPX250K	Tetrode
6	4	0.15	air	Y-519	Planar Triode
5	12	0.15	air	Y-540	Planar Triode

1. Specially processed 4CX35,000C
2. Specially processed 4CW100,000D
3. Specially processed 4CW100,000E
4. Focused oxide cathode
5. Specially processed 4CX15,000A
6. Prototype: 4CW25,000A
7. Specially processed Type 290
8. Specially processed Type 8576/264
9. Prototype: 4CX5000R
10. Specially processed 4CX5000R
11. Specially processed 8295A
12. Specially processed 4PR1000A

SWITCH TUBE OR PULSED REGULATOR SERVICE, CONTINUED

Peak Anode Current (A)	Maximum Hold-off Voltage (kVdc)	Rated Anode Diss. (Watts)	Cooling	EIMAC Type Number	Tube Type
5	10	150	air	8755	Planar Triode
5	4	150	air	8847	Planar Triode
5	3.5	100	air	7211	Planar Triode
5	3.5	150	air	8757	Planar Triode
5	3.5	100	air	8403	Planar Triode
4	50	250	air	4PR250C	Tetrode
4	20	400	air	4PR400A	Tetrode
3	10	400	air	Y-504	Triode[13]
3	4.5	100	air	7815RAL	Planar Triode
3	3.5	100	air	7815R	Planar Triode
3	3.5	100	air	7855	Planar Triode
3	3.5	150	air		Planar Triode
2.1	18	125	air	4PR125A	Tetrode
1.5	4.5	100	air	8745	Planar Triode
1.2	15	65	convection	4PR65A	Tetrode

13. Specially processed 3-400Z

varian sales office locations

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6650 Powers Ferry Rd., N.W.
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Los Altos, California 94022
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2065 Australia
TEL: 411-1277

Varian Pty. Ltd.
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North Springvale, VICT. 3171
Australia
TEL: 560-7133

Benelux
Varian Benelux N.V.
Maassluisstraat 100
P.O. Box 9158
Amsterdam, Holland
TEL: (020) 15 94 10

Brazil
Varian Indústria e Comércio Ltda.
Avenida DR Cardoso De Melo, 1644
V. Olimpia
Caixa Postal 19010-Pinheiros
04548 Sao Paulo, Brazil
TEL: 240-1622

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Georgetown, Ontario, Canada
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91401 Orsay
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TEL: 907.78.26

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Varian GmbH
Allacher Strasse 230E
D-8 München 50
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TWX: 522523

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1-10040 Leini (Torino)
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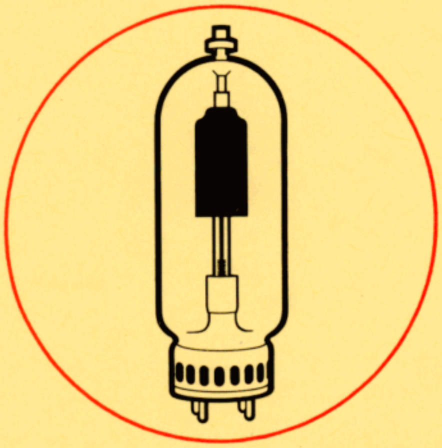


diodes • rectifiers

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–
A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

TECHNICAL DATA

2-01C
INSTRUMENT DIODE

The Eimac 2-01C is a small, closely-spaced, low-capacitance, high-vacuum diode designed for use through ultra-high frequencies. In measurement work, it is well suited to mounting in a probe and will maintain accuracy in the order of ± 1 decibel up to 700 megacycles. It is useful as an indicator at frequencies as high as 3000 megacycles.

The 2-01C has a maximum d-c current rating of 1.0 milliampere and a maximum peak inverse voltage rating of 1000 volts. Cooling is by convection and radiation.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode—Oxide-Coated, Unipotential

	Min.	Nom.	Max.	
Heating Time	30	60		seconds
Heater Voltage		5.0		volts
Heater Current	0.31		0.39	amperes
Direct Interelectrode Capacitance			0.7	pF
Zero Signal Voltage (110 Megohm Load)	0.6		1.4	volts
Resonant Frequency		2800		MHz
Plate Resistance (E_b = 12 volts)		8000	24,000	ohms

Actual Size

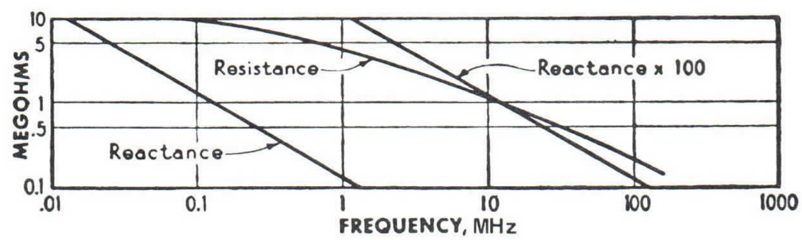
MAXIMUM RATINGS

PEAK INVERSE ANODE VOLTAGE	1000 MAX.	VOLTS
D-C PLATE CURRENT	1.0 MAX.	MA
PLATE DISSIPATION	0.1 MAX.	WATT
SEAL TEMPERATURE	175°C MAX.	

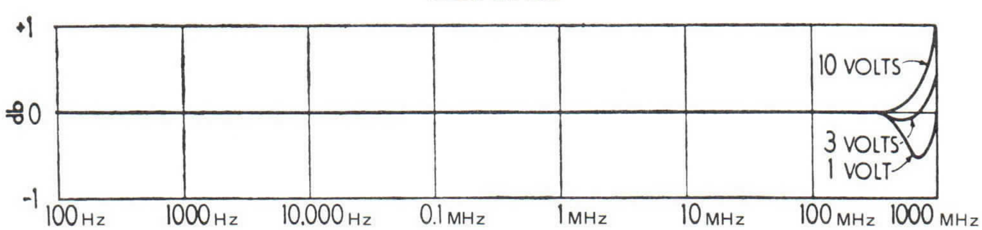
MECHANICAL

Length	1.813 inches	Net Weight	0.2 ounce
Diameter	0.563 inches	Shipping Weight (Approx.)	1.0 pound

INPUT CHARACTERISTICS

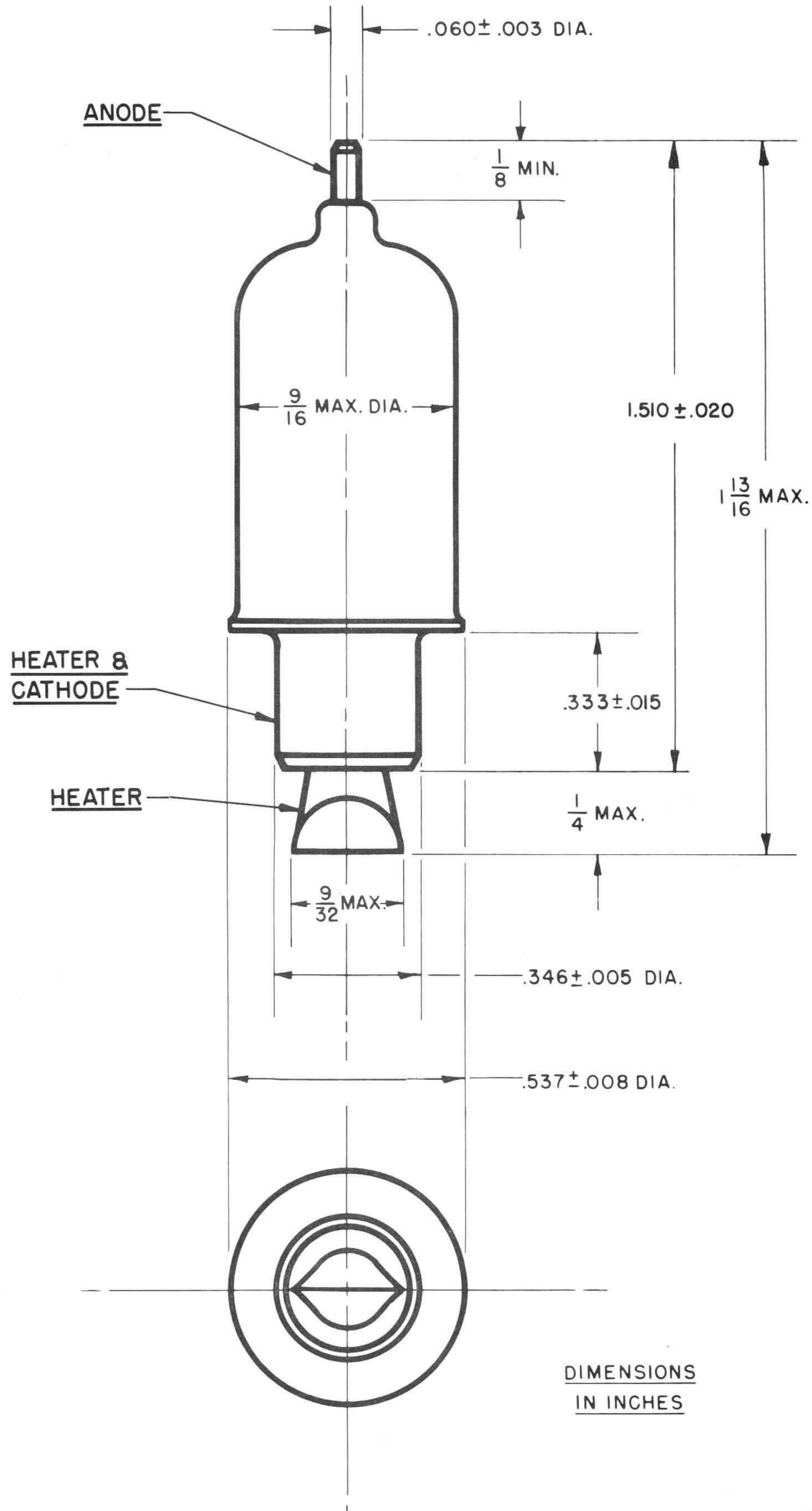


RESPONSE



Input Impedance and Frequency Response of an Eimac 2-01C operating in a Hewlett-Packard Model 410B Vacuum Tube Voltmeter. Reproduced from Hewlett-Packard Catalog No. 21-A, 1952.

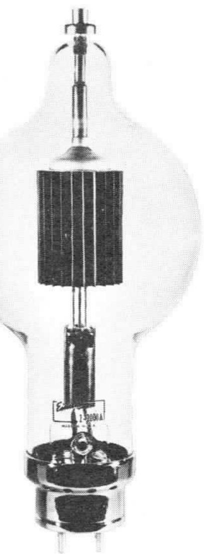
▶ Indicates change from sheet dated 11-14-58


.060± .003 DIA.
ANODE
1/8 MIN.
9/16 MAX. DIA.
1.510 ±.020
1 13/16 MAX.
HEATER & CATHODE
.333±.015
HEATER
1/4 MAX.
9/32 MAX.
.346±.005 DIA.
.537±.008 DIA.
DIMENSIONS IN INCHES

2-2000A

HIGH-VACUUM RECTIFIER

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA



The Eimac 2-2000A is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-2000A has a maximum d-c current rating of 750 milliamperes and a maximum peak inverse voltage rating of 75,000 volts. Cooling is by forced air, convection, and radiation.

A single 2-2000A will deliver 600 milliamperes at 31,500 volts to a capacitor-input filter with 26,500 volts single-phase supply. Four 2-2000A's in a bridge circuit will deliver 1.50 amperes at 47,600 volts to a choke-input filter with 53,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	10.0 volts
Current	25.0 amperes

MECHANICAL

Base	Special 4-pin
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Forced air, convection, and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	17.8 inches
Diameter	8.13 inches
Net Weight	3 pounds
Shipping Weight (approx.)	13 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	75,000 MAX. VOLTS
PLATE DISSIPATION	1200 MAX. WATTS
D-C PLATE CURRENT[1]	750 MAX. MA
PEAK PLATE CURRENT	12 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-2000A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The special 4-pin base fits an E. F. Johnson Co. No. 124-214 or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-2000A is cooled by forced air, convection, and radiation. Forced air is required for cooling of the filament seals. If an E. F. Johnson Co. No. 124-214 socket is used, air at a static pressure of 4 inches of water measured at the inlet of the 1/4-inch cooling tube in the socket will provide sufficient base cooling. The base of the tube is provided with a 1-inch diameter hole. If a socket is used with a 1-inch diameter matching hole and the manifold is of the same diameter, a static pressure of less than 0.1 inch of water will be required. Clearance should be provided around the glass envelope adequate

APPLICATION (Continued)

for the free circulation of air. An Eimac HR-8 heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St, New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 10.0 volts. Variations must be kept within the range from 9.5 to 10.5 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value. All four socket terminals should be used, putting two in parallel for each filament connection.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-2000A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—The plate of the 2-2000A operates at dull red color at the maximum plate dissipation rating of 1200 watts. The maximum peak-inverse-voltage rating of 75,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-2000A when used as a power-supply rectifier.

2-2000A MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter D-C Output Voltage (volts)	Capacitor-Input Filter D-C Output Current (amperes)	Choke-Input Filter D-C Output Voltage (volts)	Choke-Input Filter D-C Output Current (amperes)
Single-Phase, Half-Wave	26,500	31,500	0.600	....	....
Single-Phase, Full-Wave	26,500[1]	31,500	1.20	23,800	1.50
Single-Phase, Bridge	53,000	63,000	1.20	47,600	1.50

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-2000A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-2000A is 750 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_I in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-2000A is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-2000A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-2000A, which may be taken as 400 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak-inverse-voltage rating of the 2-2000A is 75,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications— The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-2000A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-2000A is 1500 milliamperes.

The plate characteristic curve for the 2-2000A serves as a guide to special applications. The maximum plate dissipation rating of 1200 watts, the maximum peak-inverse-voltage rating of 75,000 volts, and the maximum peak plate current of 12 amperes must not be exceeded.

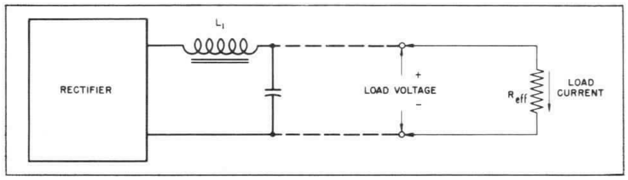
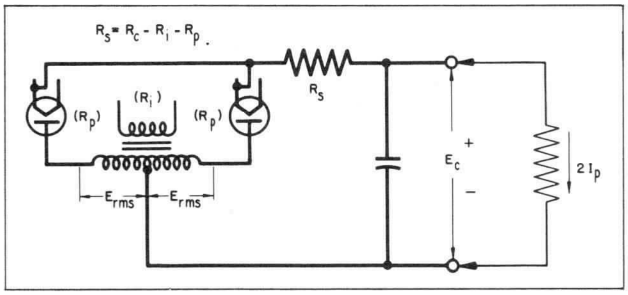
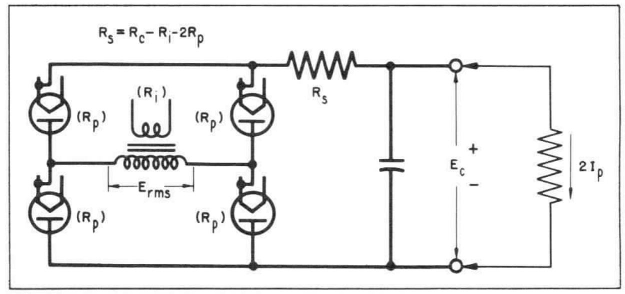


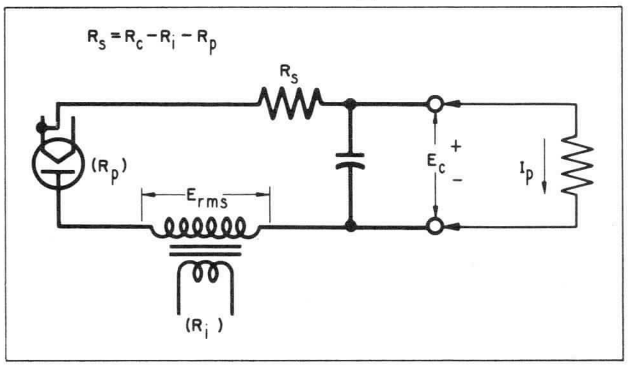
Fig. 1. Rectifier with Choke-Input Filter



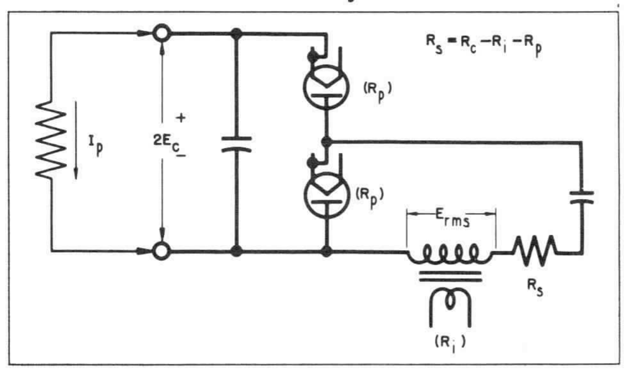
a. Full-Wave Center-Tapped Rectifier



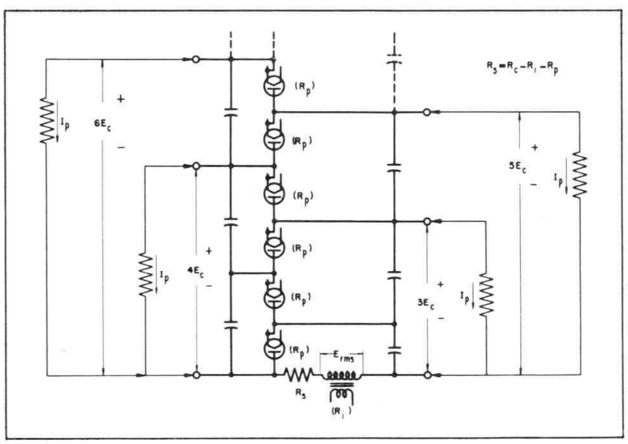
b. Full-Wave Bridge Rectifier



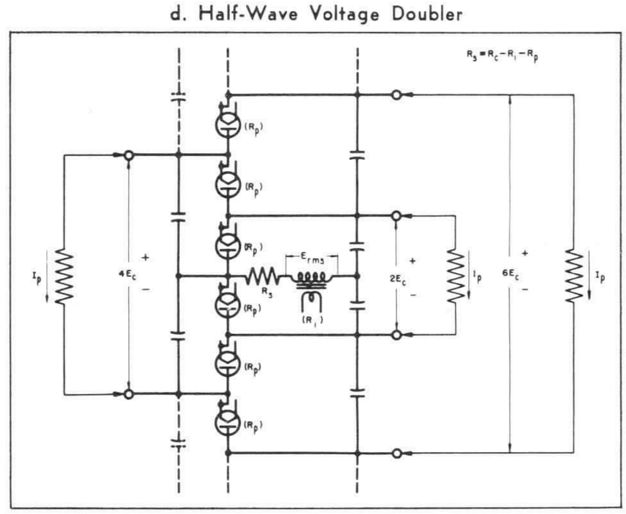
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



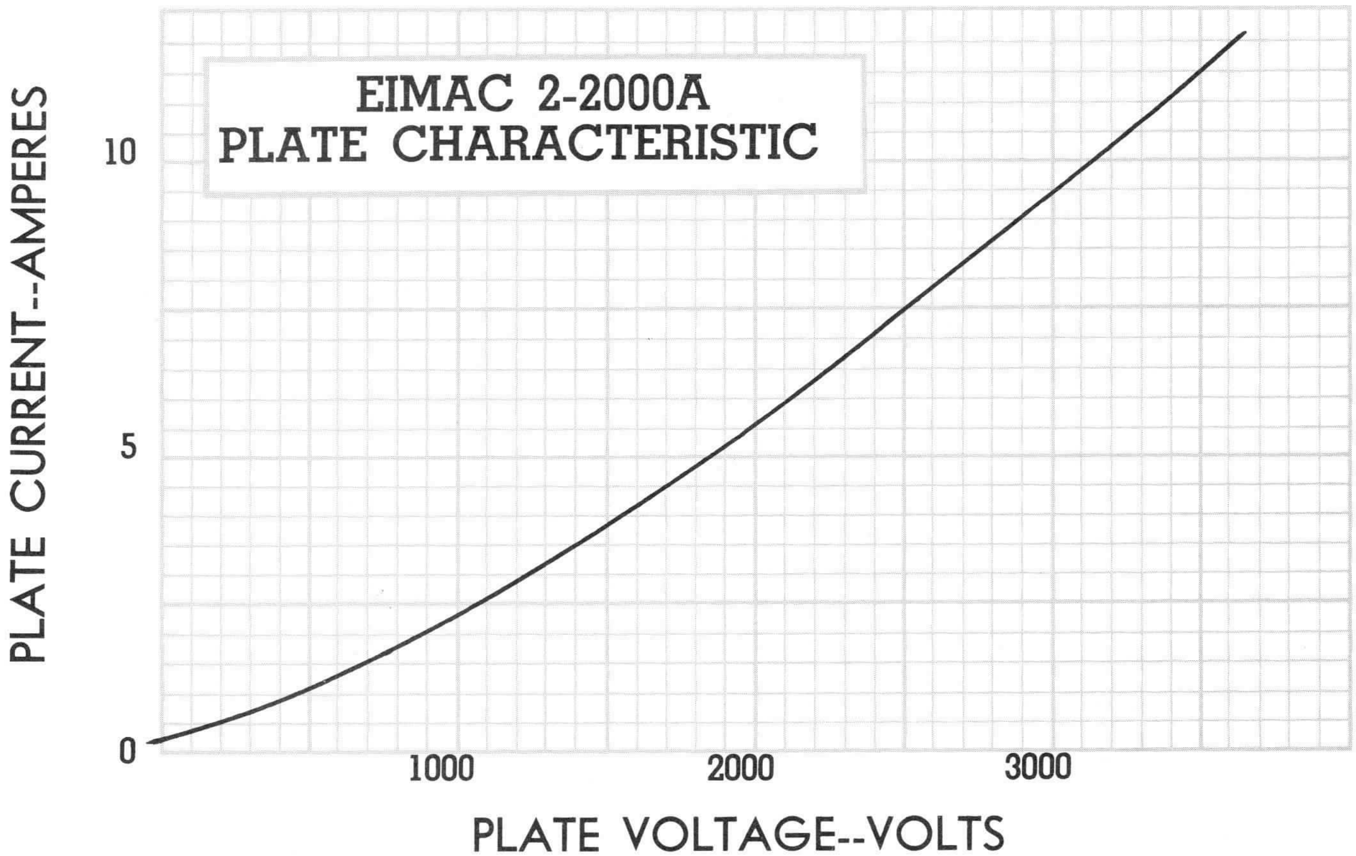
f. Full-Wave Voltage Multiplier

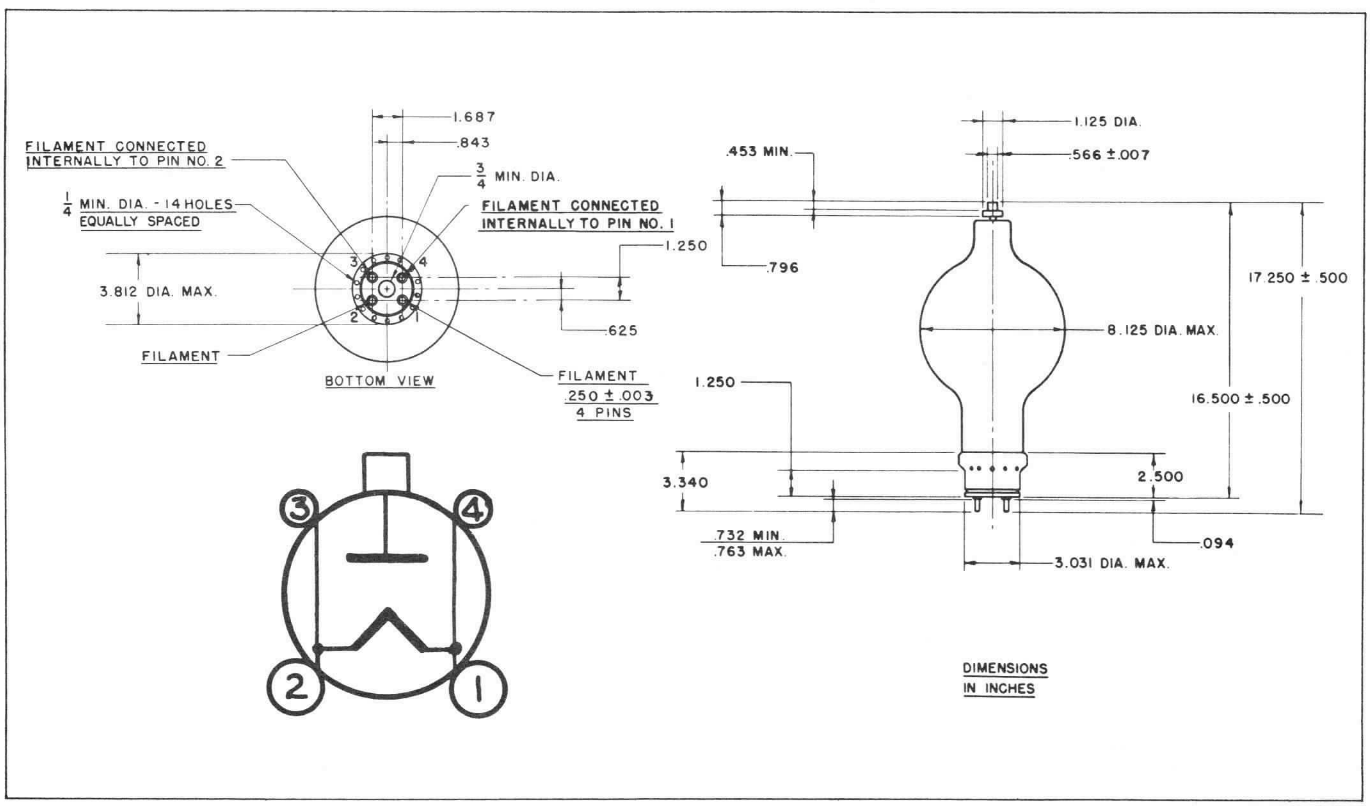
Eimac 2-2000A Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	550	600	650	700	750	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.1	2.1	3.8	7.0	13	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.84	0.90	1.00	1.16	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.6	2.8	3.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 2-2000A basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 400 ohms (200 ohms for two tubes in parallel)





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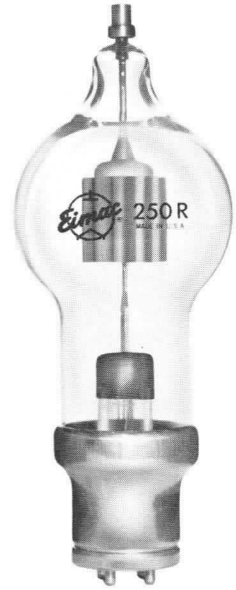
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

250R
HIGH-VACUUM RECTIFIER



The Eimac 250R is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 250R has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 60,000 volts. Cooling is by convection and radiation.

A single 250R will deliver 160 milliamperes at 24,000 volts to a capacitor-input filter with 21,000 volts single-phase supply. Four 250R's in a bridge circuit will deliver 500 milliamperes at 38,000 volts to a choke-input filter with 42,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0 volts
Current	10.5 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.82 inches
Net Weight	10 ounces
Shipping Weight (approx.)	3 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	60,000 MAX. VOLTS
PLATE DISSIPATION	150 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 250R must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 250R is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 250R reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 250R begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 60,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 250R when used as a power-supply rectifier.

250R MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	21,000	24,000	160	....	....
Single-Phase, Full-Wave	21,000[1]	24,000	320	19,000	500
Single-Phase, Bridge	42,000	48,000	320	38,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 250R is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 250R is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 250R is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 250R when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 250R, which may be taken as 750 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply experssed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 250R is 60,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 250R is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 250R is 400 milliamperes.

The plate characteristic curve for the 250R serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 60,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

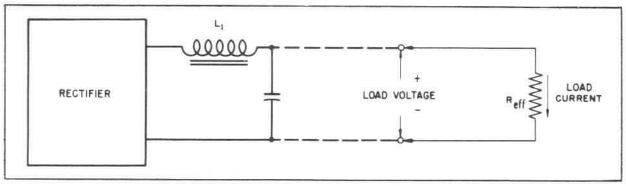
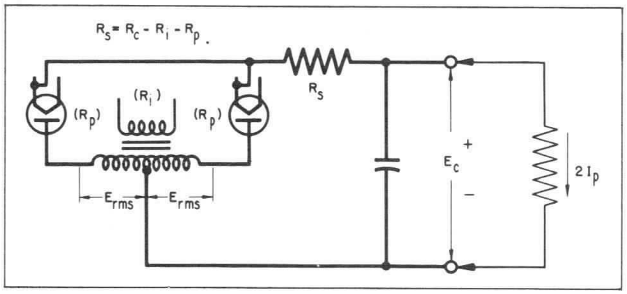
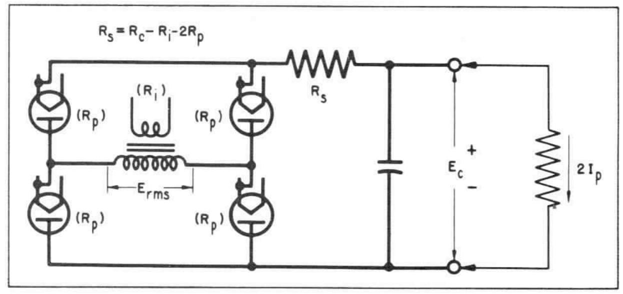


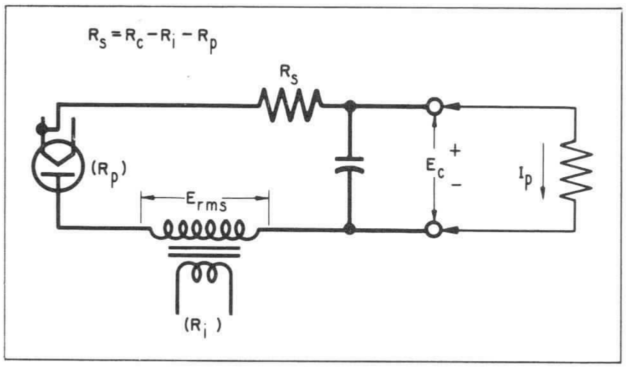
Fig. 1. Rectifier with Choke-Input Filter



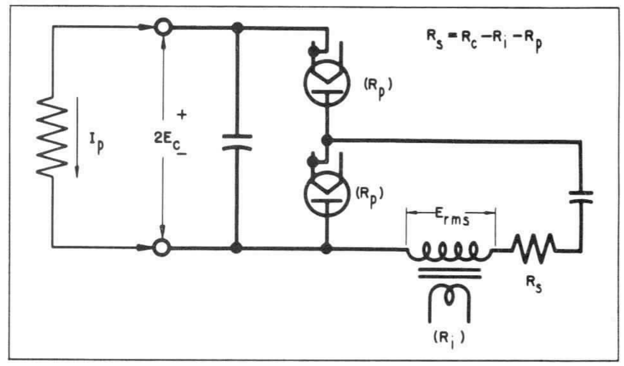
a. Full-Wave Center-Tapped Rectifier



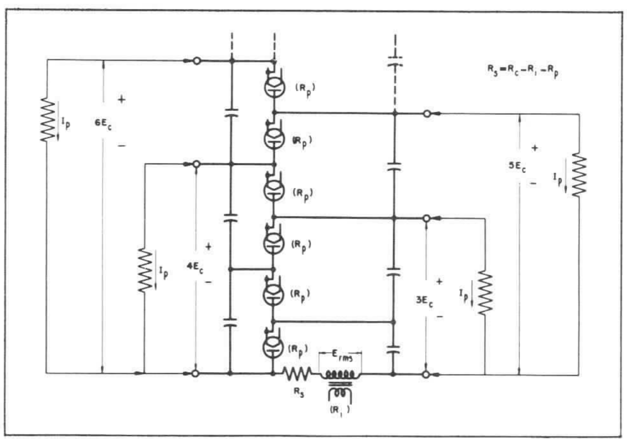
b. Full-Wave Bridge Rectifier



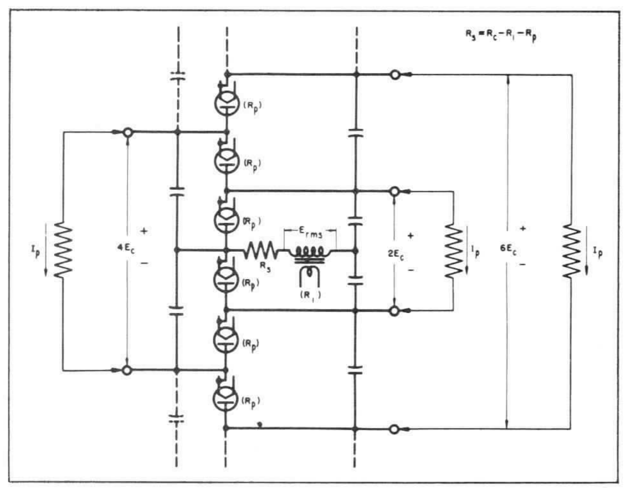
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



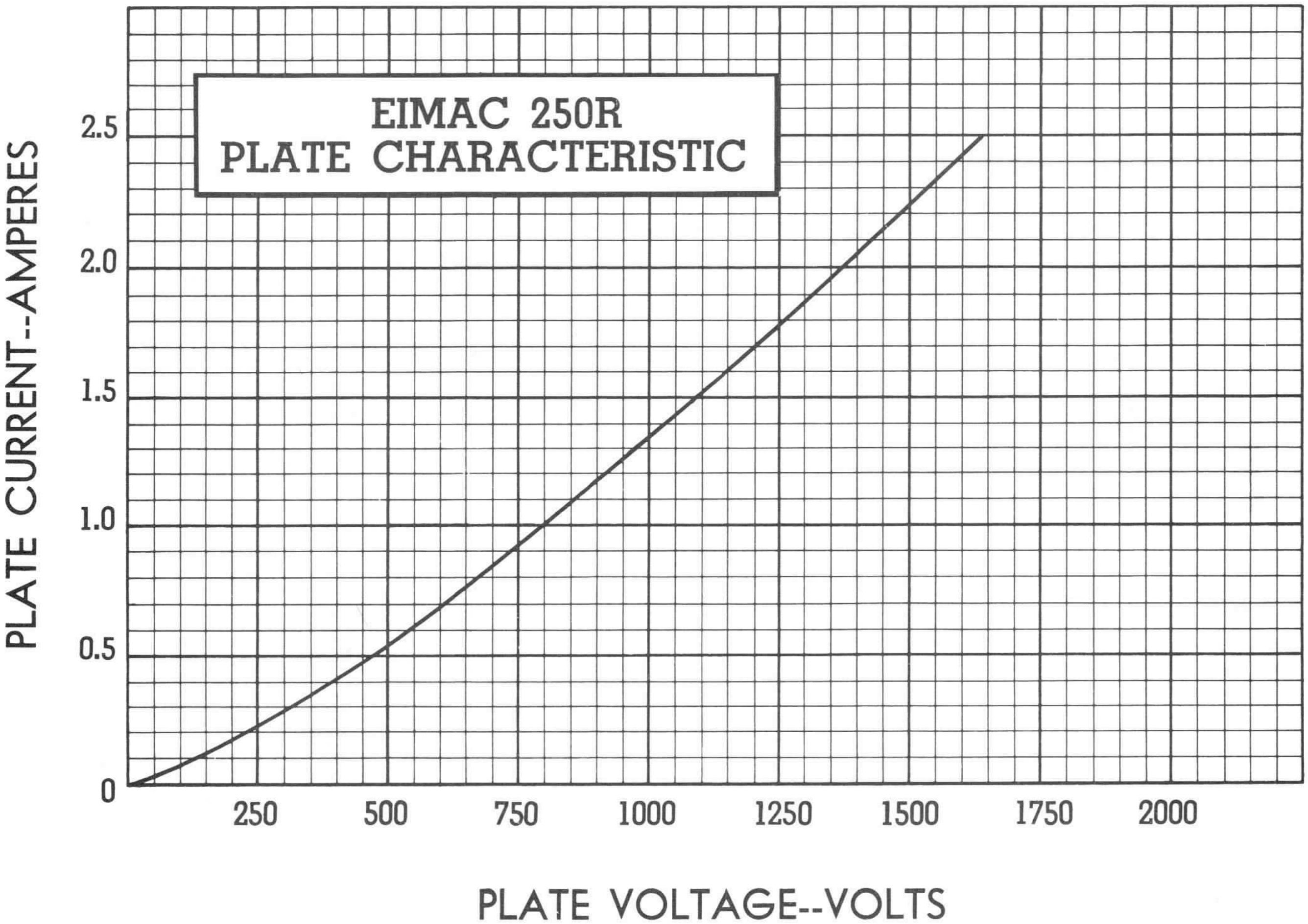
f. Full-Wave Voltage Multiplier

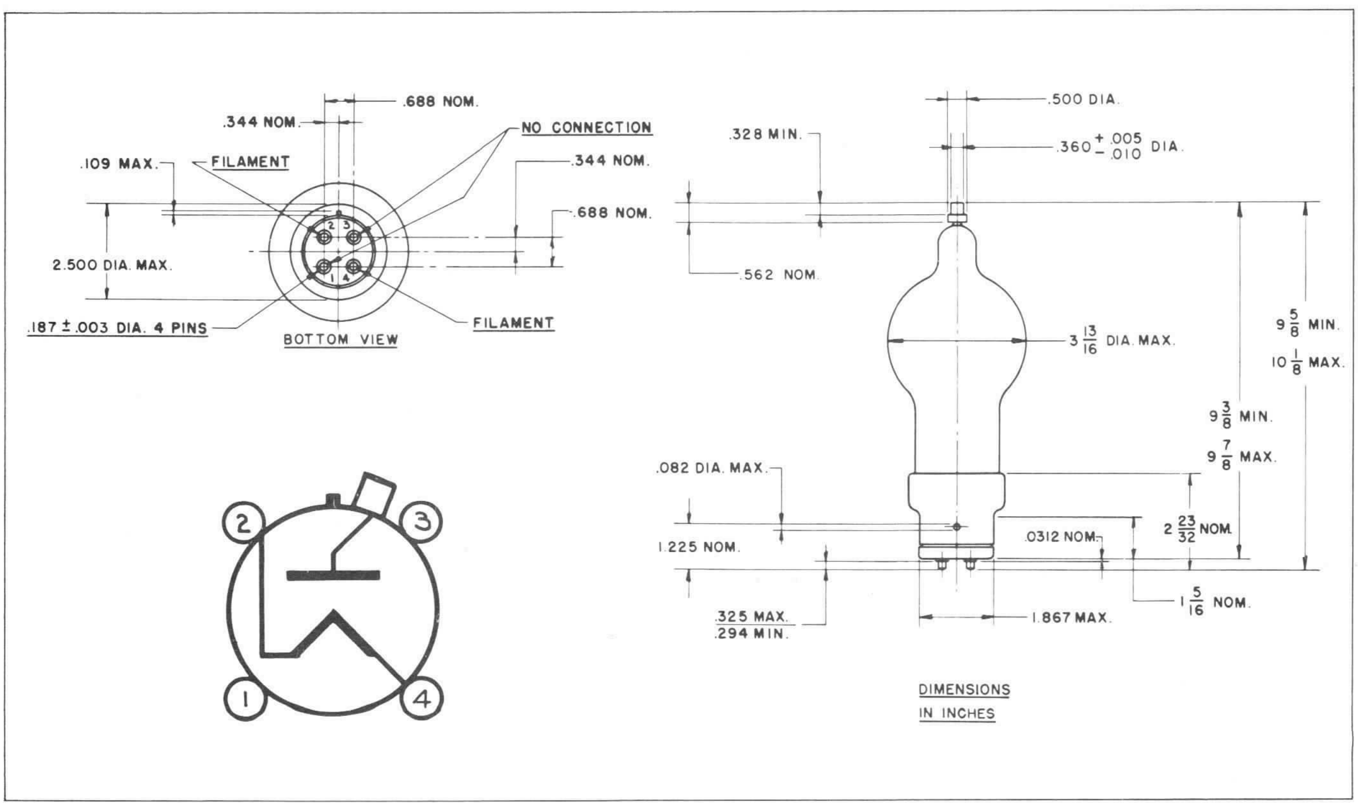
Eimac 250R Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	140	150	160	170	180	190	200	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.2	1.9	3.0	4.8	7.6	12	19	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.87	0.93	1.01	1.14	1.33	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (1/2 these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.7	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 250R Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 750 ohms (375 ohms for two tubes in parallel)





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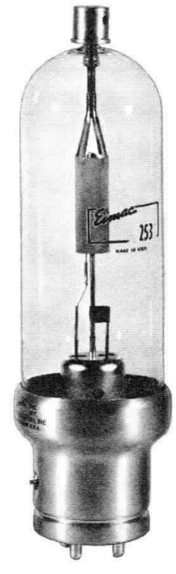
Eimac®

E I M A C
Division of Varian
S A N C A R L O S
C A L I F O R N I A

253
HIGH-VACUUM RECTIFIER



The Eimac 253 is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 253 has a maximum d-c current rating of 350 milliamperes and a maximum peak inverse voltage rating of 15,000 volts. Cooling is by convection and radiation.

A single 253 will deliver 210 milliamperes at 5640 volts to a capacitor-input filter with 5300 volts single-phase supply. Four 253's in a bridge circuit will deliver 700 milliamperes at 9500 volts to a choke-input filter with 10,600 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0 volts
Current	10.0 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	8.75 inches
Diameter	2.50 inches
Net Weight	7 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per Tube)

PEAK INVERSE PLATE VOLTAGE	15,000 MAX. VOLTS
PLATE DISSIPATION	100 MAX. WATTS
D-C PLATE CURRENT[1]	350 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 253 must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 253 is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-8 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this tem-

Printed in U.S.A.

perature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 253 reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 253 begins to show color as the maximum plate dissipation rating of 100 watts is approached. The maximum peak inverse voltage rating of 15,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 253 when used as a power-supply rectifier.

253 MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter D-C Output Voltage (volts)	Capacitor-Input Filter D-C Output Current (ma)	Choke-Input Filter D-C Output Voltage (volts)	Choke-Input Filter D-C Output Current (ma)
Single-Phase, Half-Wave	5300	5640	210	....	....
Single-Phase, Full-Wave	5300[1]	5640	420	4750	700
Single-Phase, Bridge	10,600	11,280	420	9500	700

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 253 is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 253 is 350 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),

f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 253 is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 253 when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 253, which may be taken as 300 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 253 is 15,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 253 is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 253 is 500 milliamperes.

The plate characteristic curve for the 253 serves as a guide to special applications. The maximum plate dissipation rating of 100 watts, the maximum peak inverse voltage rating of 15,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

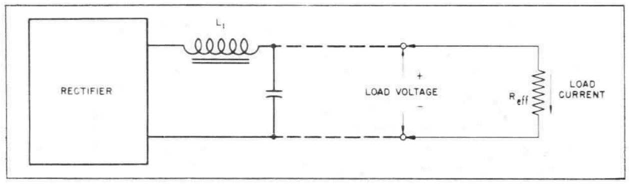
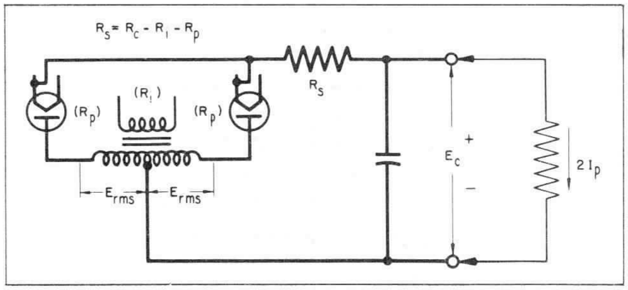
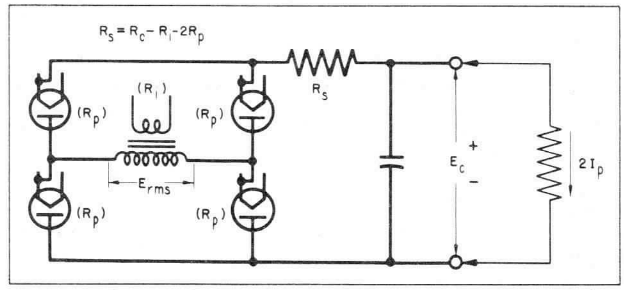


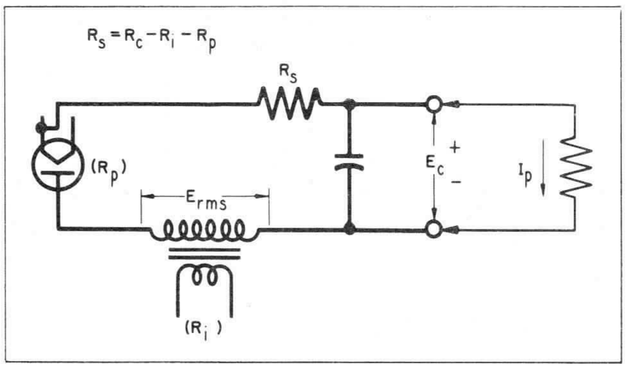
Fig. 1. Rectifier with Choke-Input Filter



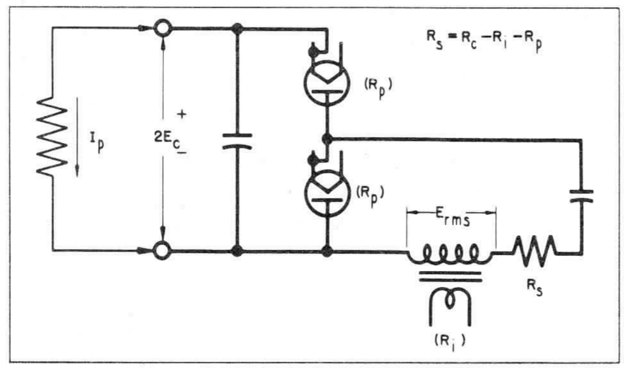
a. Full-Wave Center-Tapped Rectifier



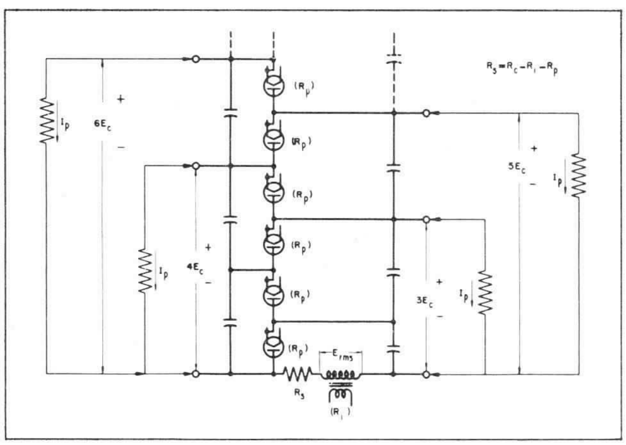
b. Full-Wave Bridge Rectifier



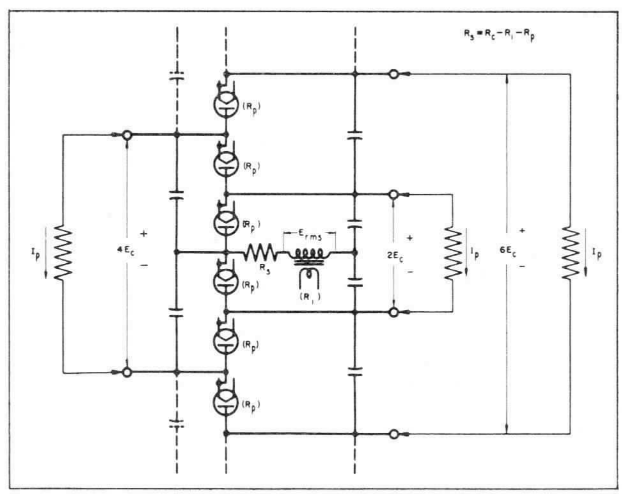
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



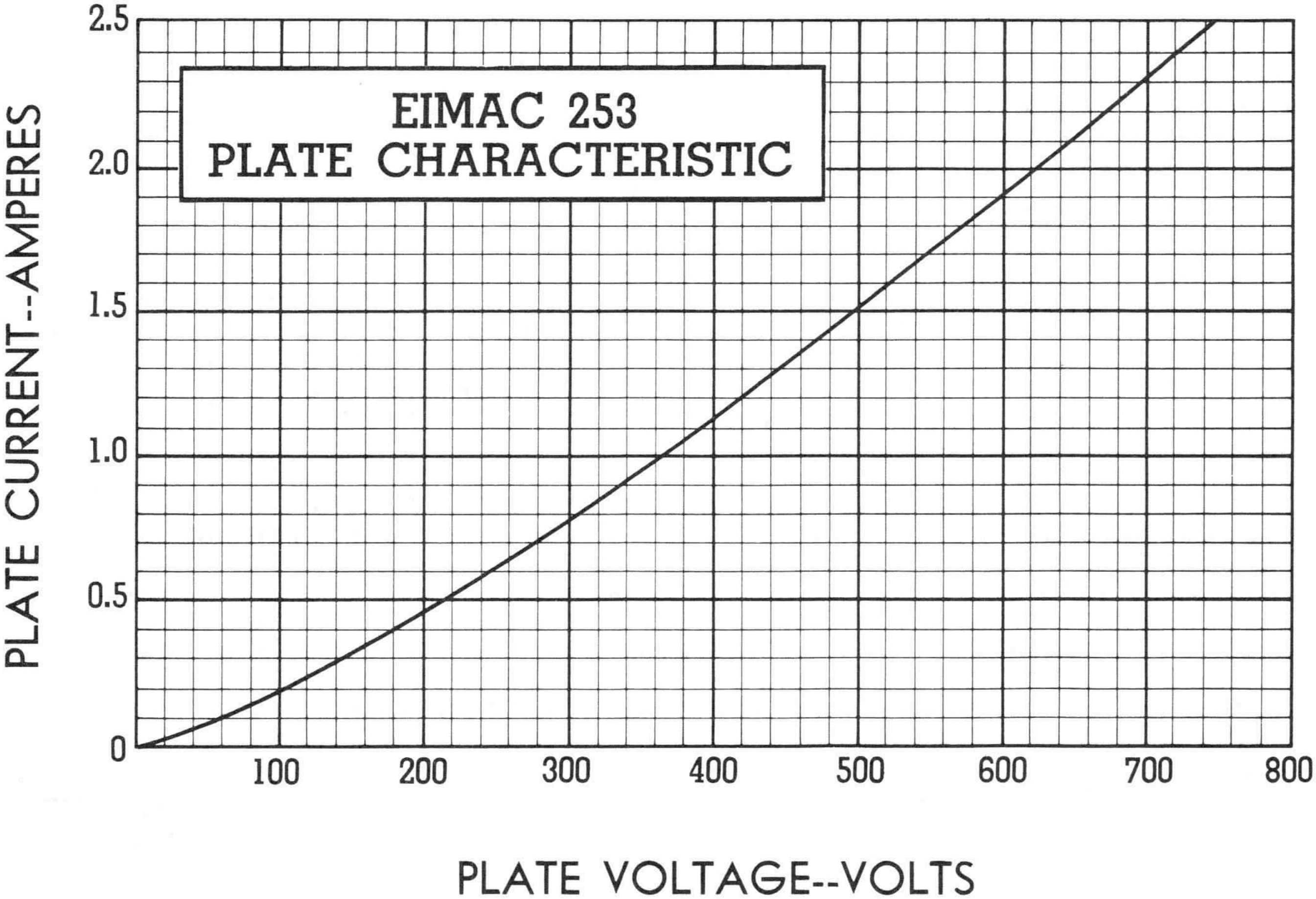
e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



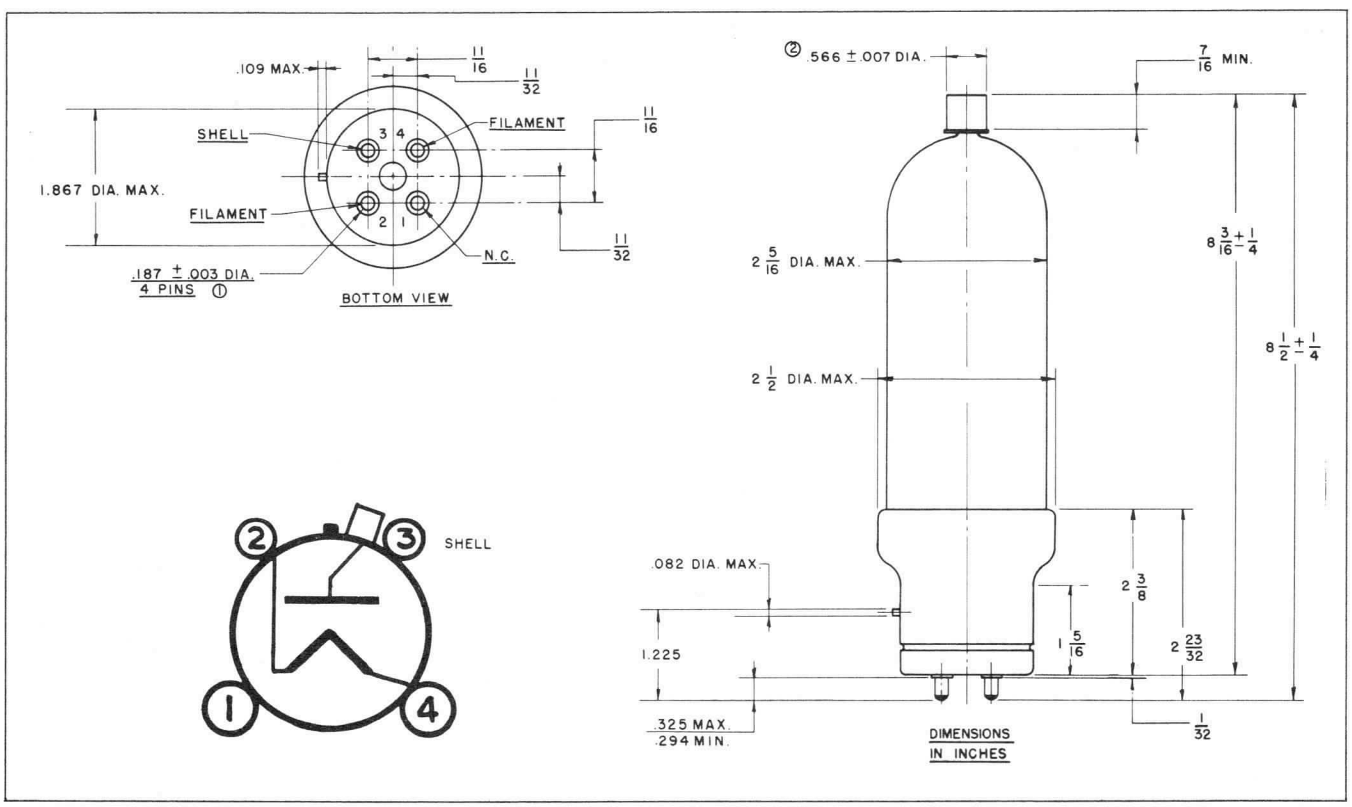
f. Full-Wave Voltage Multiplier

Eimac 253 Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	170	190	210	230	250	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.1	2.3	5.0	10	27	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.85	0.94	1.08	1.50	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (1/2 these values for circuit b.)	2.3	2.4	2.7	3.1	4.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 253 Basic R-C Circuits (for any one of the indicated loads)
R_i = Equivalent resistance of voltage source
R_p = 300 ohms (150 ohms for two tubes in parallel)



EIMAC 253
PLATE CHARACTERISTIC
PLATE CURRENT--AMPERES
2.5
2.0
1.5
1.0
0.5
0
100
200
300
400
500
600
700
800
PLATE VOLTAGE--VOLTS

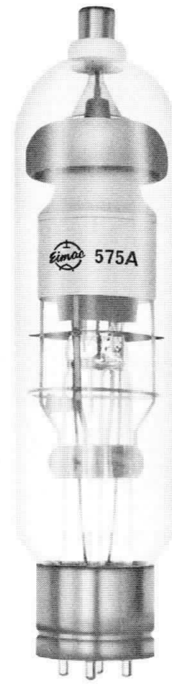


.109 MAX.
11/16
11/32
SHELL
FILAMENT
11/16
1.867 DIA. MAX.
FILAMENT
N.C.
11/32
3 4
2 1
.187 ± .003 DIA.
4 PINS ①
BOTTOM VIEW
② .566 ± .007 DIA.
7/16 MIN.
8 3/16 + 1/4
2 5/16 DIA. MAX.
8 1/2 + 1/4
2 1/2 DIA. MAX.
2
3
SHELL
1
4
.082 DIA. MAX.
2 3/8
1.225
1 5/16
2 23/32
.325 MAX.
.294 MIN.
DIMENSIONS
IN INCHES
1/32

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

575A
673
MERCURY-VAPOR RECTIFIERS

The EIMAC 575A and 673 are half-wave mercury vapor-rectifiers incorporating features which enable them to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The tubes differ only in basing.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage	5.0	volts
Current	9.0 to 11.5	amperes
Filament Heating Time	30	seconds
Anode Starting Voltage (approx.)	20	volts

MECHANICAL

Base	575A	50 watt, A4-29
	673	Industrial, A4-18
Recommended Socket	575A	E. F. Johnson #123-211
	673	E. F. Johnson #123-206
Maximum Overall Dimensions:		
Length	575A	11-1/8 inches
	673	11-7/16 inches
Diameter		2-9/16 inches
Net Weight		12 ounces

MAXIMUM RATINGS (per tube)

CONDENSED MERCURY TEMPERATURE LIMITS*	20-50	20-60	°C
PEAK INVERSE ANODE VOLTAGE	15	10	kV
PEAK ANODE CURRENT:			
Quadrature Filament Excitation**	10	10	Amps
In-Phase Filament Excitation	6	7	Amps
AVERAGE ANODE CURRENT: (Maximum averaging time - 20 seconds)			
Quadrature Filament Excitation**	2.5	2.5	Amps
In-Phase Filament Excitation	1.5	1.75	Amps
MAXIMUM AC SHORT CIRCUIT CURRENT***	100	100	Amps

*Condensed Mercury temperature rises approximately 18°C above ambient.
**Quadrature excitation refers to filament voltage 90°±30° out of phase with anode voltage.
***Max. duration 100 milliseconds.

APPLICATION

MECHANICAL

Mounting: The 575A and 673 must be mounted vertically base down.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury should be kept within the ranges given under "MAXIMUM RATINGS." This temperature should be maintained at 40°±5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube. The approximate condensed-mercury temperature rise above ambient is 18°C.

ELECTRICAL

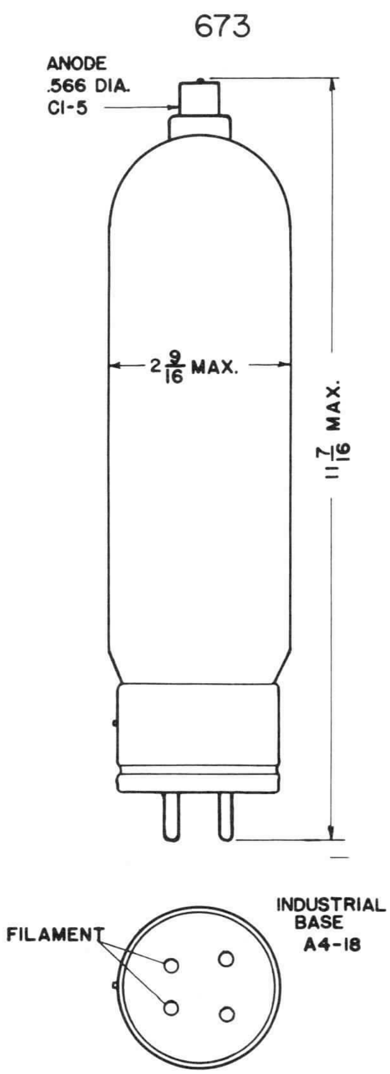
Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range of 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

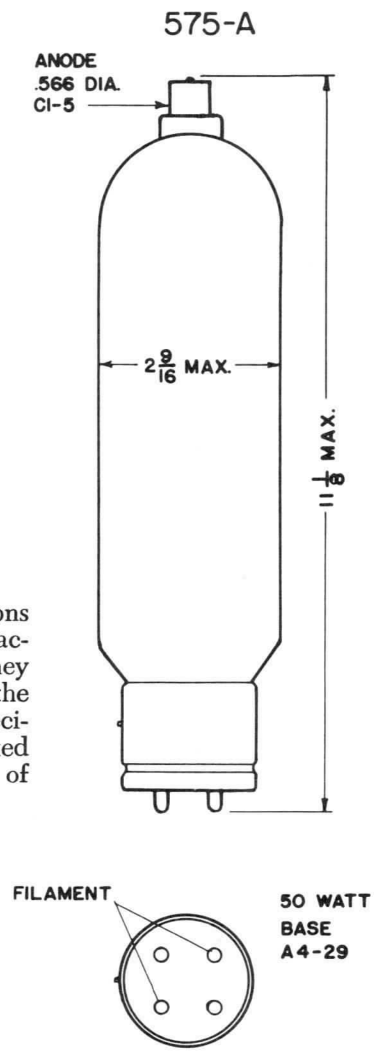
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the tube should be isolated from such fields as exist around a transmitter or other similar equipment.





NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with EIMAC, Division of Varian.

TECHNICAL DATA

869B
869BL
MERCURY-VAPOR RECTIFIERS

The EIMAC 869B and 869BL are half-wave mercury-vapor rectifiers incorporating features which enable them to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The 869B and 869BL carry maximum ratings of 20 kV peak inverse voltage, 5 amperes dc and 20 amperes peak cathode current.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated	
Voltage	5.0 V
Current	17 to 21 A
Filament Heating Time	60 Sec
Anode Starting Voltage (approx.)	30 V

MECHANICAL

Base	See Drawing
Maximum Overall Dimensions:	
Length	14-7/16 in.
Diameter	3 in.
Net Weight	20 oz.

MAXIMUM RATINGS (Single Tube)

CONDENSED MERCURY TEMPERATURE RANGE*	30-60	30-50	30-40° C	
PEAK INVERSE ANODE VOLTAGE	10	15	20	MAX KV
PEAK ANODE CURRENT:				
Quadrature Excitation**	20	20	20	MAX AMPS
In-Phase Excitation	10	10	10	MAX AMPS
AVERAGE ANODE CURRENT: (30 second maximum averaging time)				
Quadrature Excitation	5.0	5.0	5.0	MAX AMPS
In-Phase Excitation	2.5	2.5	2.5	MAX AMPS
MAXIMUM AC SHORT-CIRCUIT CURRENT***	100	100	100	MAX AMPS

*Condensed Mercury rises approximately 20°C above ambient.

**Quadrature excitation refers to anode current and filament current 90°±30° out of phase.

***Maximum duration 100 milliseconds.

Data based on load return to center tap on filament transformer.

APPLICATION

MECHANICAL

Mounting: The 869B and 869BL must be mounted vertically, base down. The 869BL includes 3 inch insulated flexible leads with lugs.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury in the 869B and 869BL should be kept within the ranges given under "MAXIMUM RATINGS."

This temperature should be maintained at 40° ±5° C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

In some installations a blast of air must be directed at the base of the tube to insure adequate cooling.

ELECTRICAL

Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range of 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

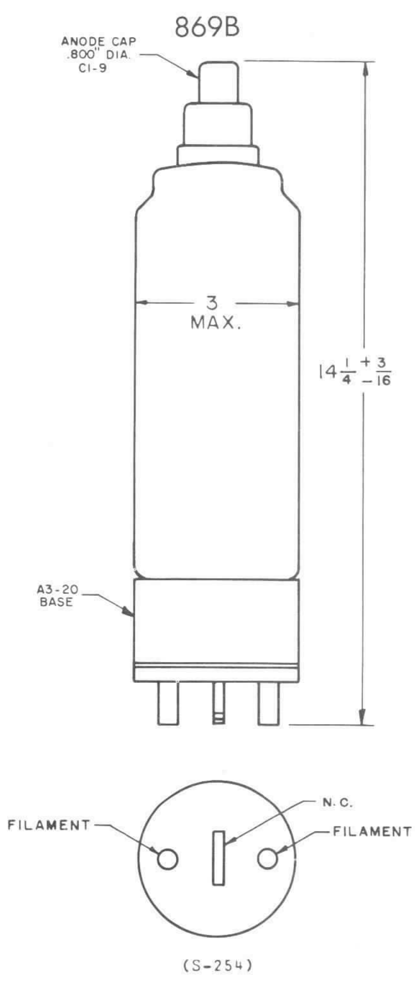
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament should be allowed to reach operating temperature before the plate voltage is applied Under normal conditions, a delay of approximately 60 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

X-Ray Radiation: Above approximately 16,000 peak inverse voltage, a rectifier will produce X-Rays. In most equipment, there is adequate shielding so that this does not constitute a health hazard, however, this should be checked in any new equipment. A standard reference on this subject is "X-Ray Protection, Handbook No. 93," National Bureau of Standards.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the 869B and 869BL should be isolated from such fields as exist around a transmitter or other similar equipment.



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070.

869BL has 3 inch insulated flexible filament leads with spade terminals for #10 screw instead of pins shown on the 869B outline.

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

6894
6895
MERCURY-VAPOR RECTIFIERS

The EIMAC 6894 and 6895 are half-wave mercury-vapor rectifiers especially designed for high voltage power rectifier applications. They are mercury filled for high efficiency, long life and the ability to operate at high peak inverse voltage.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage	5.0	V
Current	9.0 to 11.0	A
Filament Heating Time	30	Sec
Anode Starting Voltage (approx.)	20	V

MECHANICAL

Base	6894	50 watt, A4-29
	6895	Industrial A4-18
Recommended Socket	6894	E.F. Johnson #123-211
	6895	E.F. Johnson #123-206
Maximum Overall Dimensions:		
Length	6894	10-17/32 in.
	6895	10-13/32 in.
Diameter		2-9/16 in.
Net Weight		4 oz.

MAXIMUM RATINGS (per tube)

PEAK INVERSE ANODE VOLTAGE	
20° -50°C Condensed Mercury Temperature Range*	20 MAX KV
20° -55°C Condensed Mercury Temperature Range	15 MAX KV
20° -60°C Condensed Mercury Temperature Range	10 MAX KV
PEAK ANODE CURRENT:	
Quadrature Filament Excitation**	11.5 MAX AMPS
In-Phase Filament Excitation	8.3 MAX AMPS
AVERAGE ANODE CURRENT	
Quadrature Filament Excitation	2.5 MAX AMPS
In-Phase Filament Excitation	1.8 MAX AMPS
MAXIMUM AC SHORT CIRCUIT CURRENT***	100 MAX AMPS

*Condensed Mercury Temperature rises approximately 20°C above ambient.
**Quadrature Excitation refers to filament voltage $90° \pm 30°$ out of phase with anode voltage.
***Max. duration 100 milliseconds.
All data based on load return to center tap of filament transformer.

APPLICATION

MECHANICAL

Mounting: The 6894 and 6895 must be mounted vertically, base down. These two tubes differ only in their basing and socketry.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury should be kept within the ranges given under "MAXIMUM RATINGS."

This temperature should be maintained at 40° ± 5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

ELECTRICAL

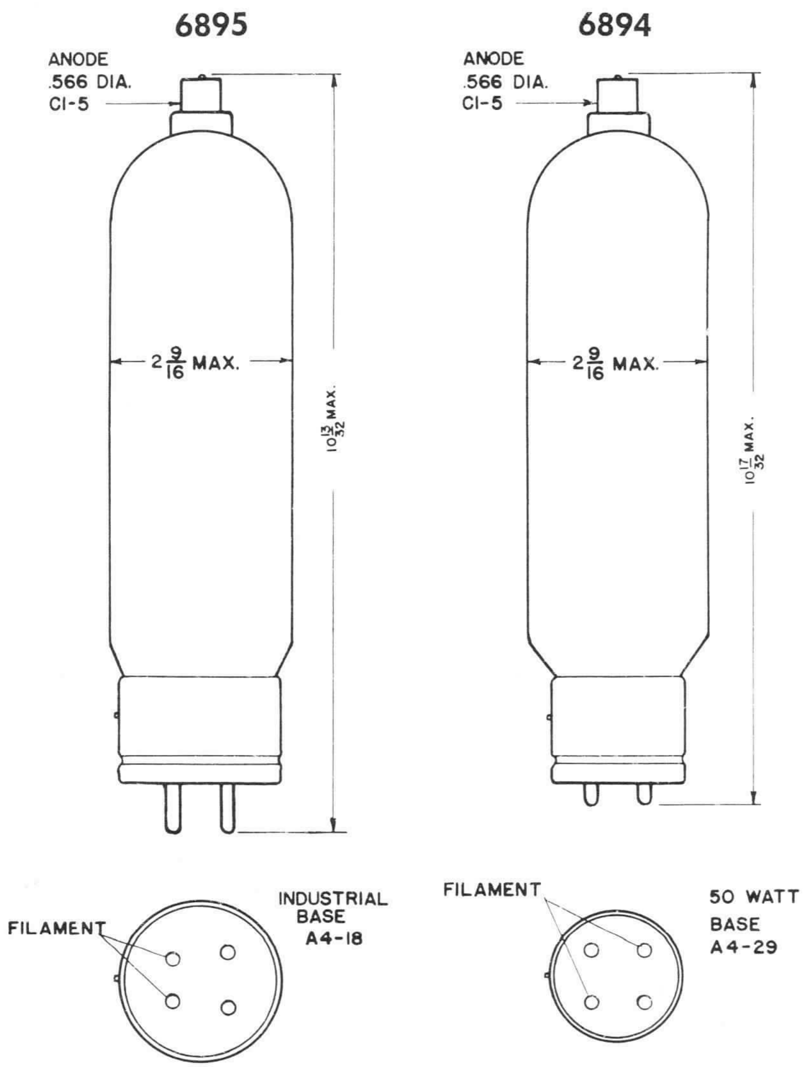
Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range 4.8 to 5.2 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

When it is necessary to use a shield around the tube care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a mercury-vapor rectifier is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the tube should be isolated from such fields as exist around transmitter or other similar equipment.

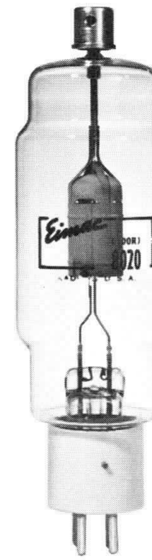


NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with EIMAC Division of Varian, 301 Industrial Way, San Carlos, Calif. 94070.

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8020

HIGH-VACUUM RECTIFIER



The EIMAC 8020 diode is a high-vacuum rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 8020 has a maximum dc current rating of 100 milliamperes and a maximum peak inverse voltage rating of 40,000 volts. Cooling is by convection and radiation.

A single 8020 will deliver 80 milliamperes at 17,000 volts to a capacitor-input filter with 14,000 volts single-phase supply. Four 8020's in a bridge circuit will deliver 200 milliamperes at 25,000 volts to a choke-input filter with 28,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0	volts
Current	6.5	amperes

MECHANICAL

Base	Medium 4-pin bayonet	
Basing	Refer to outline drawing	
Socket	Refer to discussion under "Application"	
Mounting Position	Vertical, base down or up	
Cooling	Convection and radiation	
Maximum Temperature of Plate Seal	225°C	
Recommended Heat Dissipating Plate Connector	EIMAC HR-8	
Maximum Overall Dimensions:		
Length	8.00	inches
Diameter	2.32	inches
Net Weight	4	ounces
Shipping Weight (approx.)	1	pound

MAXIMUM RATINGS (Per Tube)

Peak Inverse Plate Voltage	40,000	volts
Plate Dissipation	60	watts
DC Plate Current[1]	100	ma
Peak Plate Current	1.5	ampere

[1] Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum dc current ratings under this and other load conditions see discussion under "Application."

APPLICATION

MECHANICAL

Mounting—The 8020 must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The medium 4-pin bayonet base fits an E. F. Johnson Co. No. 122-124, a National Co. No. XC-4 or CIR-4, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 8020 is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for free circulation of air. An EIMAC HR-8 Heat Dissipating Connector or equivalent is required on the plate terminal.

APPLICATION (Continued)

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq," a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

Caution should be observed when measuring rectifier filament voltage. The filament circuit may be at high potential.

The thoriated-tungsten filament of the 8020 reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 8020 begins to show color as the maximum plate dissipation rating of 60 watts is approached. The maximum peak inverse voltage rating of 40,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 8020 when used as a power-supply rectifier.

8020 MAXIMUM PERFORMANCE CAPABILITIES

Circuit Type	AC Input Voltage (volts rms)	Capacitor-Input Filter: DC Output Voltage (volts)	Capacitor-Input Filter: DC Output Current (ma)	Choke-Input Filter: DC Output Voltage (volts)	Choke-Input Filter: DC Output Current (ma)
Single-Phase, Half-Wave	14,000	17,000	80	.....	...
Single-Phase, Full-Wave	14,000[1]	17,000	160	12,500	200
Single-Phase, Bridge	28,000	34,000	160	25,000	200

[1] One-half the transformer secondary voltage.

Maximum DC Current Ratings—Plate dissipation rather than peak current usually limits the dc current which the 8020 is capable of delivering to the load. Because the plate dissipation associated with a given dc current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum dc current rating of the tube.

Choke-Input Filter—The maximum dc current rating of the 8020 is 100 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),
$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 8020 is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum dc current rating of the 8020 when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input dc voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the dc current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the dc current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube $\left(\frac{E_c}{I_p}\right)$. The total charging circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the ac voltage supply, R_i.

R_p is the plate resistance of the 8020, which may be taken as 1000 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 8020 is 40,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak ac supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- or full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a large percent ripple is tolerable and filter capacitance is low, the 8020 is capable of larger dc output currents.

As a unidirectional conductor in dc circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 8020 is 200 milliamperes.

The plate characteristic curve for the 8020 serves as a guide to special applications. The maximum plate dissipation rating of 60 watts, the maximum peak inverse voltage rating of 40,000 volts, and the maximum peak plate current of 1.5 amperes must not be exceeded.

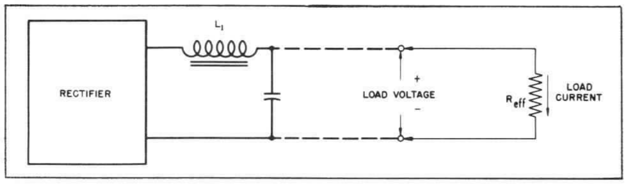
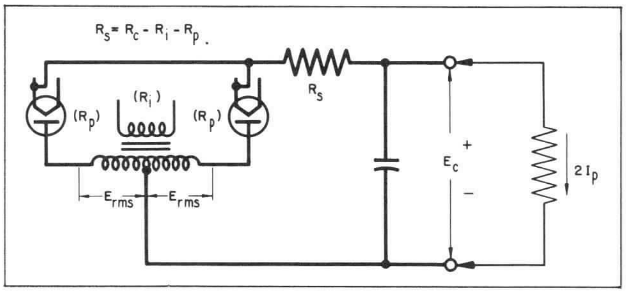
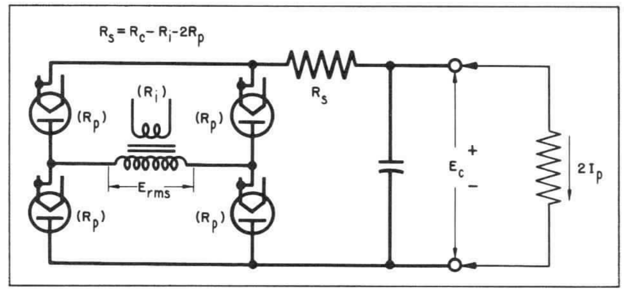


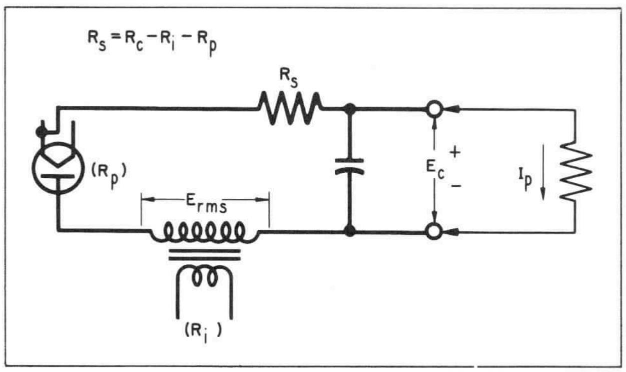
Fig. 1. Rectifier with Choke-Input Filter



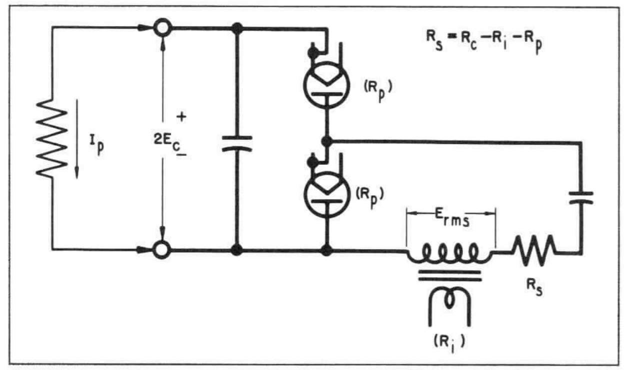
a. Full-Wave Center-Tapped Rectifier



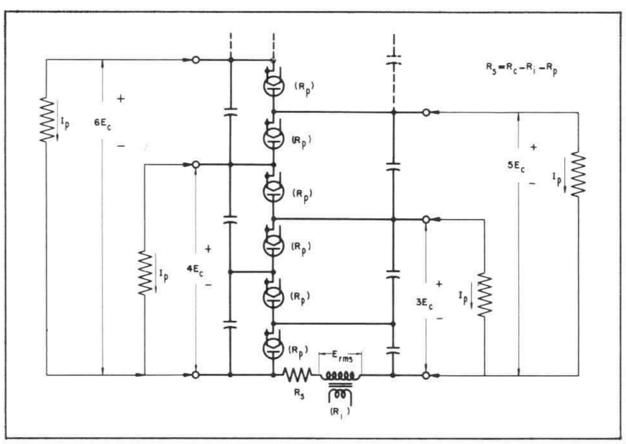
b. Full-Wave Bridge Rectifier



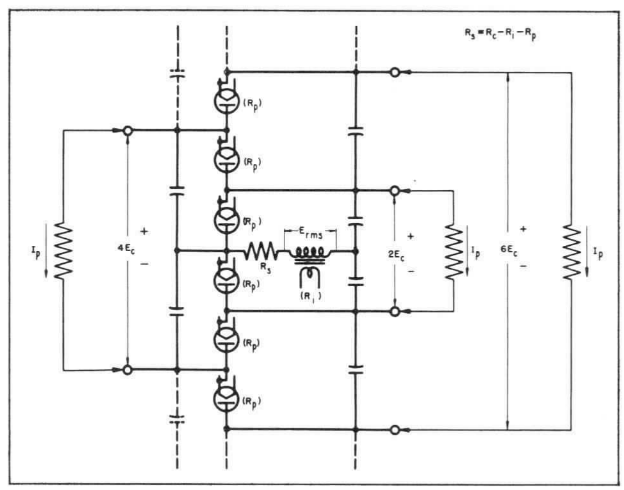
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



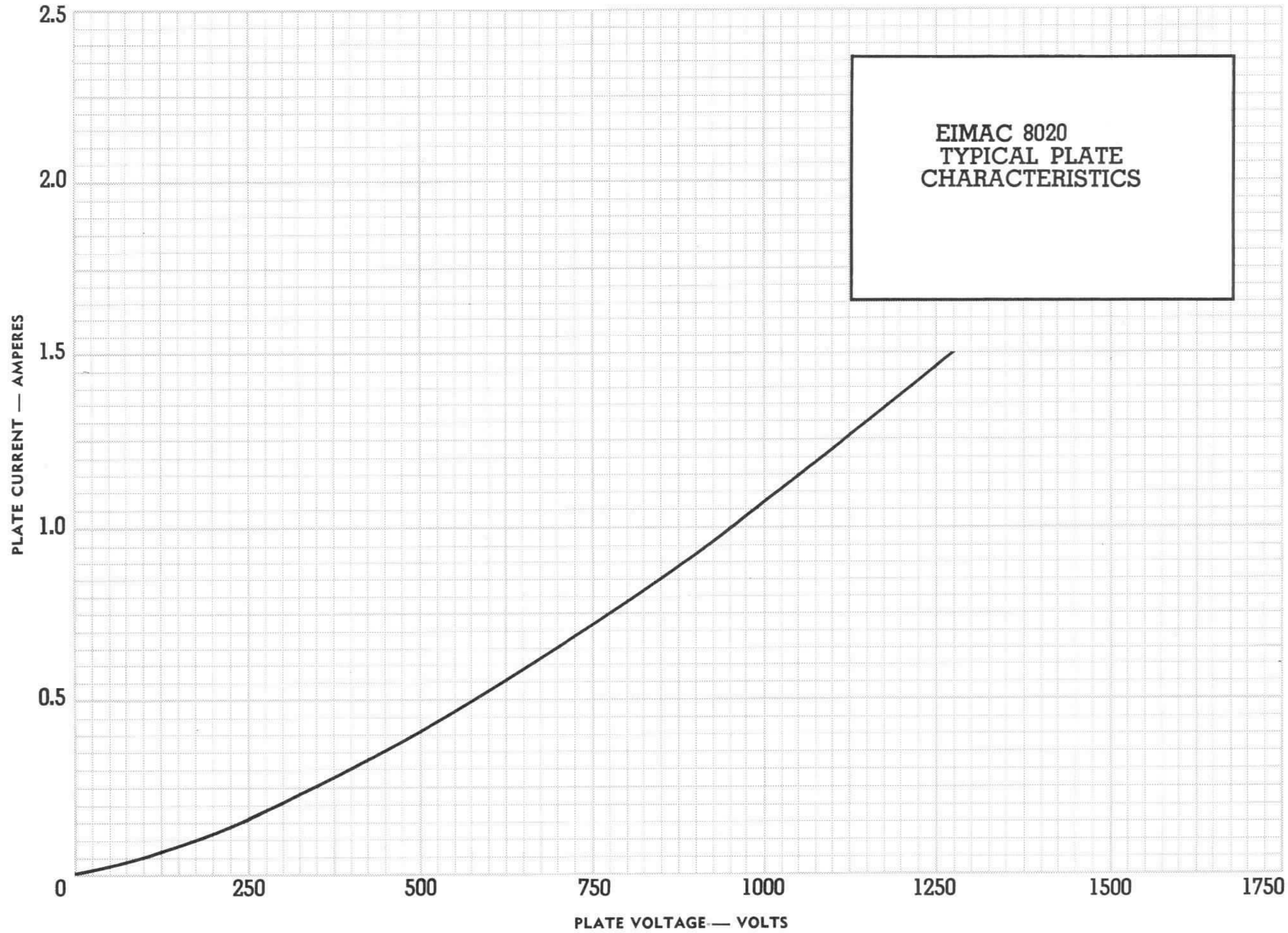
e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})

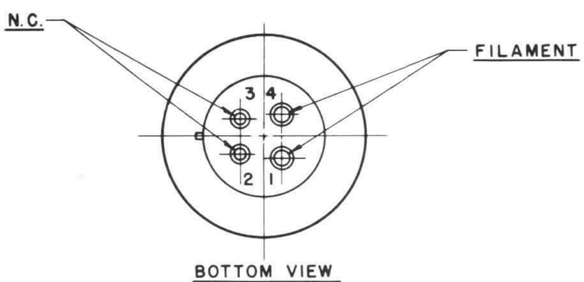


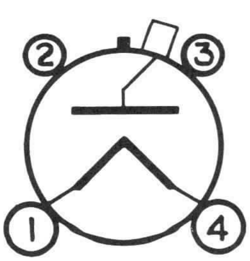
f. Full-Wave Voltage Multiplier

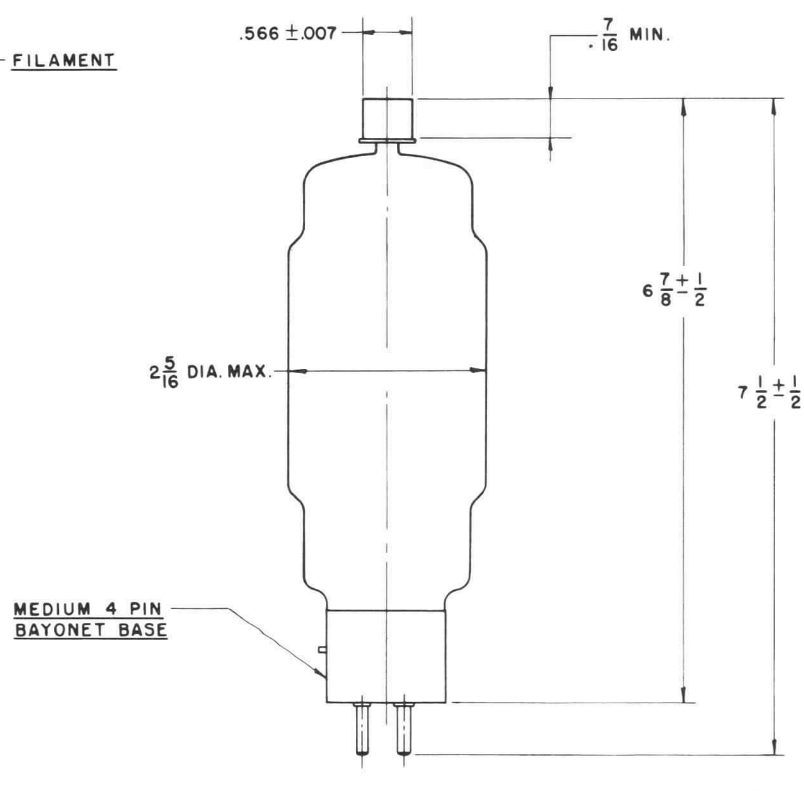
Eimac 8020 Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	70	75	80	85	90	95	100	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	0.8	1.2	1.8	3.0	4.7	7.6	12	percent of Effective Load Resistance per Tube $\left(\frac{E_c}{I_p}\right)$
A-C Supply Voltage (E_{rms})	0.78	0.80	0.83	0.87	0.92	1.01	1.14	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values in circuit "b".)	2.2	2.3	2.4	2.5	2.6	2.9	3.2	times Filter-Input D-C Voltage (E_c)

Fig. 2. EIMAC 8020 Basic R-C Circuits (for any one of the indicated loads)
R_i = Equivalent resistance of voltage source
R_p = 1000 ohms (500 ohms for two tubes in parallel)

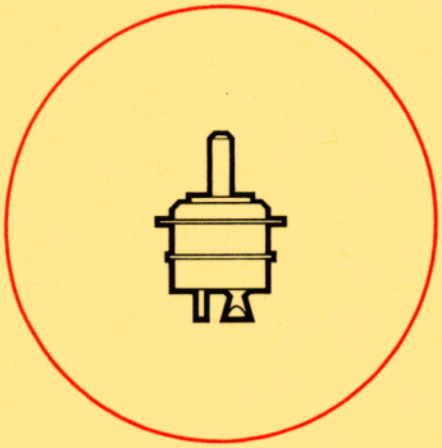








DIMENSIONS
IN INCHES



planar triodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–
A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

TECHNICAL DATA

7289
3CX100A5

PLANAR TRIODE

The EIMAC Type 7289/3CX100A5 is a rugged ceramic/metal planar triode designed for use in CW, grid- or plate-pulsed oscillator, amplifier or frequency multiplier service up to 3 GHz. The tube may also be used in pulse modulator or voltage regulator service. The 7289 is supplied with an air cooled radiator for forced air cooling.

The 7289 features high mu, high transconductance, great mechanical strength and low interelectrode capacitance.

Note: The data for the 7289/3CX100A5 also apply to the 2C39A and 2C39WA in all respects, except that filament voltage for 2C39A is 6.3 volts.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	1.0 A
Transconductance (Average):	
$I_b = 70$ mA, $E_b = 600$ Vdc	25 mmhos
Amplification Factor (Average)	100
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	6.30 pF
Cout	.035 pF
Cgp	2.00 pF
Cut-off bias[3]	-25 V max

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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Revision 11-1-71) Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions	
Length	2.701 in; 68.60 mm
Diameter	1.264 in; 32.11 mm
Net Weight	2.2 oz; 63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axis, 55 to 500 Hz	10 G
Altitude, max (in suitably designed circuit)	60,000 ft.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	0.90	1.05	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	5.60	7.00	pF
Cout	---	0.95	pF
Cgp	1.95	2.15	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	1000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	100	MILLIAMPERES
DC GRID CURRENT	50	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced air cooling[1]	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	2.5	GHz

1. Using EIMAC radiator PN 014224.

OPERATING CONDITIONS FOR 7289 IN REPRESENTATIVE APPLICATION

GROUNDED GRID CW POWER AMPLIFIER

Frequency	500	MHz
Heater Voltage	6.0	V
DC Plate Voltage	900	Vdc
DC Grid Voltage (approx.)	-40	Vdc
DC Cathode Current	90	mAdc
DC Grid Current	25	mAdc
Drive Power (approx.)	6	W
Useful CW Power Output	40	W

GROUNDED GRID CW OSCILLATOR

Frequency	2.5	GHz
Heater Voltage	5.0	V
DC Plate Voltage	900	Vdc
DC Grid Voltage (approx.)	-20	Vdc
DC Plate Current	90	mAdc
DC Grid Current	10	mAdc
Useful CW Power Output	17	W

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE		
(grid pulsed)	1000	VOLTS
PEAK PULSE PLATE VOLTAGE		
(plate pulsed)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	3.0	AMPERES
PULSE GRID CURRENT	1.8	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[2]	3	μs
DUTY FACTOR[2]	.0025	

Operating Conditions for 7289 in Representative Application.

PLATE PULSED OSCILLATOR

Frequency	3.0	GHz
Heater Voltage	5.8	V
Peak Plate Voltage	3500	v
Peak Video Plate Current	3.0	a
Peak Video Grid Current	1.8	a
Useful Power output (approx.)	1600	w
Pulse Duration	3	μs
Duty Factor	.0025	

1. Using EIMAC radiator PN 014224.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS

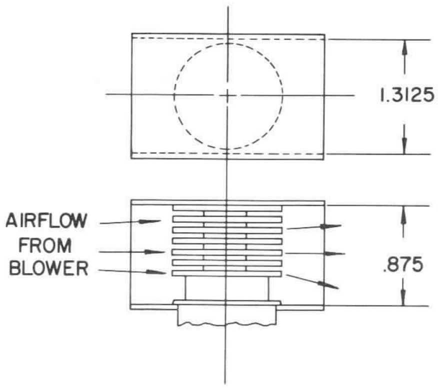
DC PLATE VOLTAGE	1000	VOLTS
PEAK PLATE VOLTAGE	1200	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	4.8	AMPERES
DC PLATE CURRENT	100	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
PULSE DURATION[2]	3.0	μs
CUT-OFF Mu	70	
DUTY FACTOR	.0025	

1. Using EIMAC radiator PN 014224.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

APPLICATION

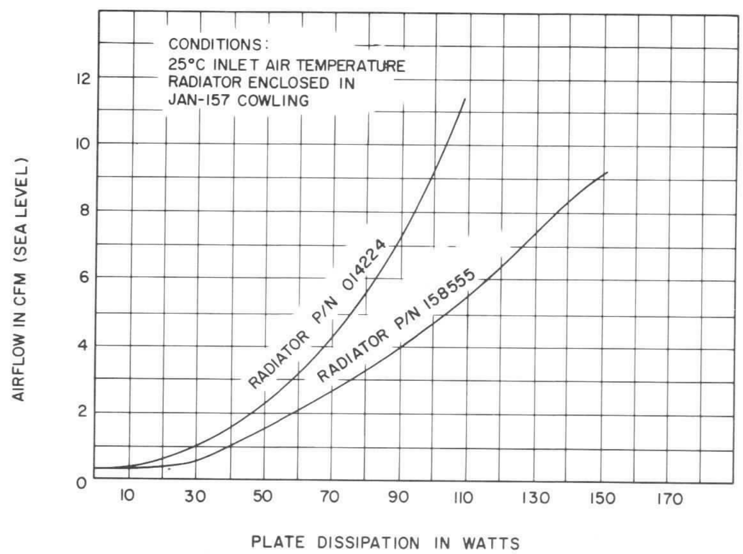
For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. Plate dissipation of up to 150 watts is possible with the 7289 tube type when using radiator P/N 158555. If this is required the tube order should include reference to the different radiator part number. For unusual and special application consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

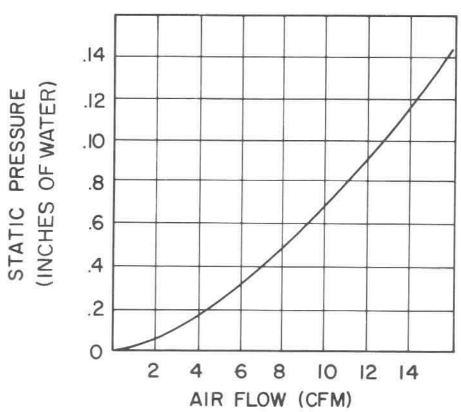
AIRFLOW vs STATIC PRESSURE WITH STANDARD COWLING JAN-157



- STANDARD COWLING -

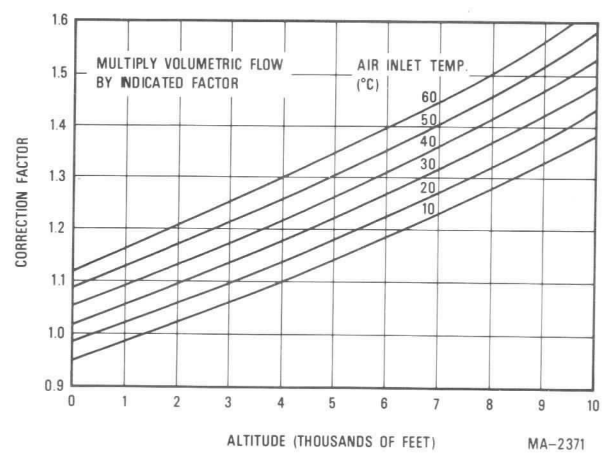
MAXIMUM PLATE DISSIPATION vs COOLING AIRFLOW

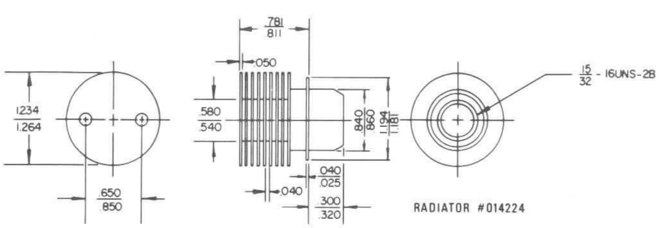




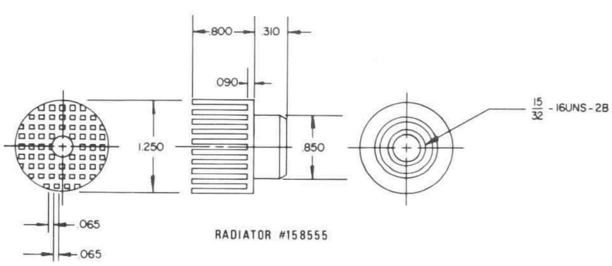
COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

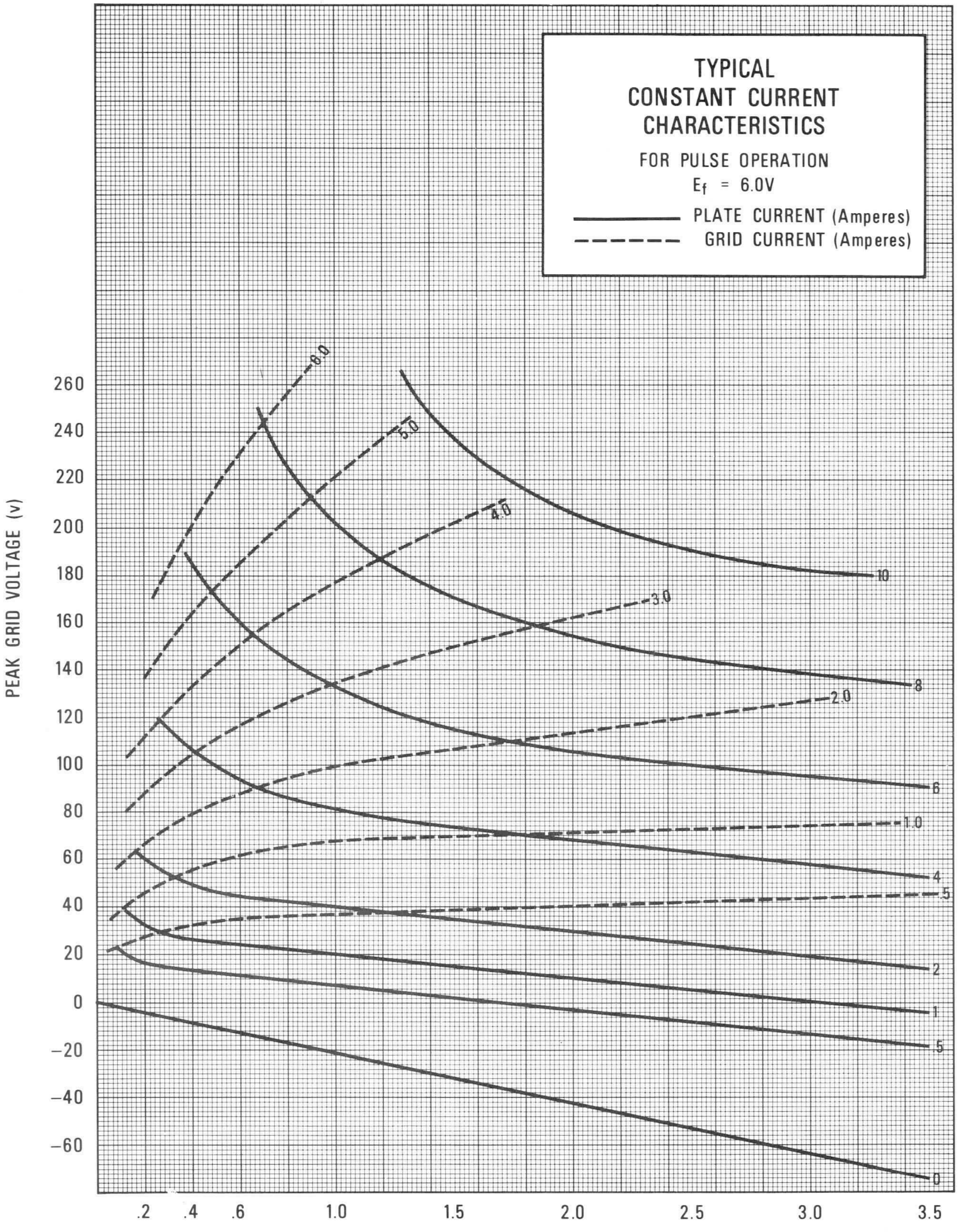




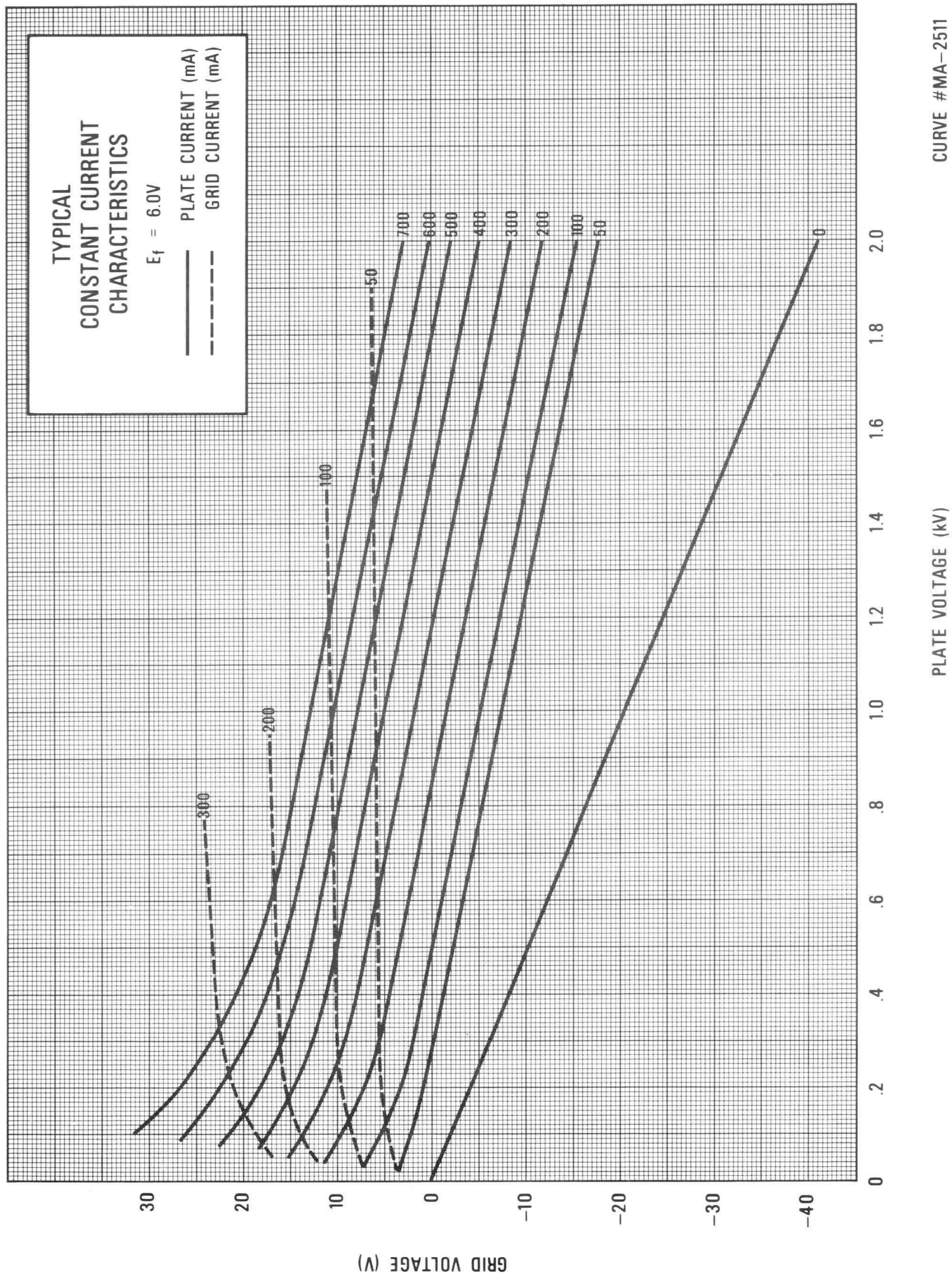
RADIATOR #014224

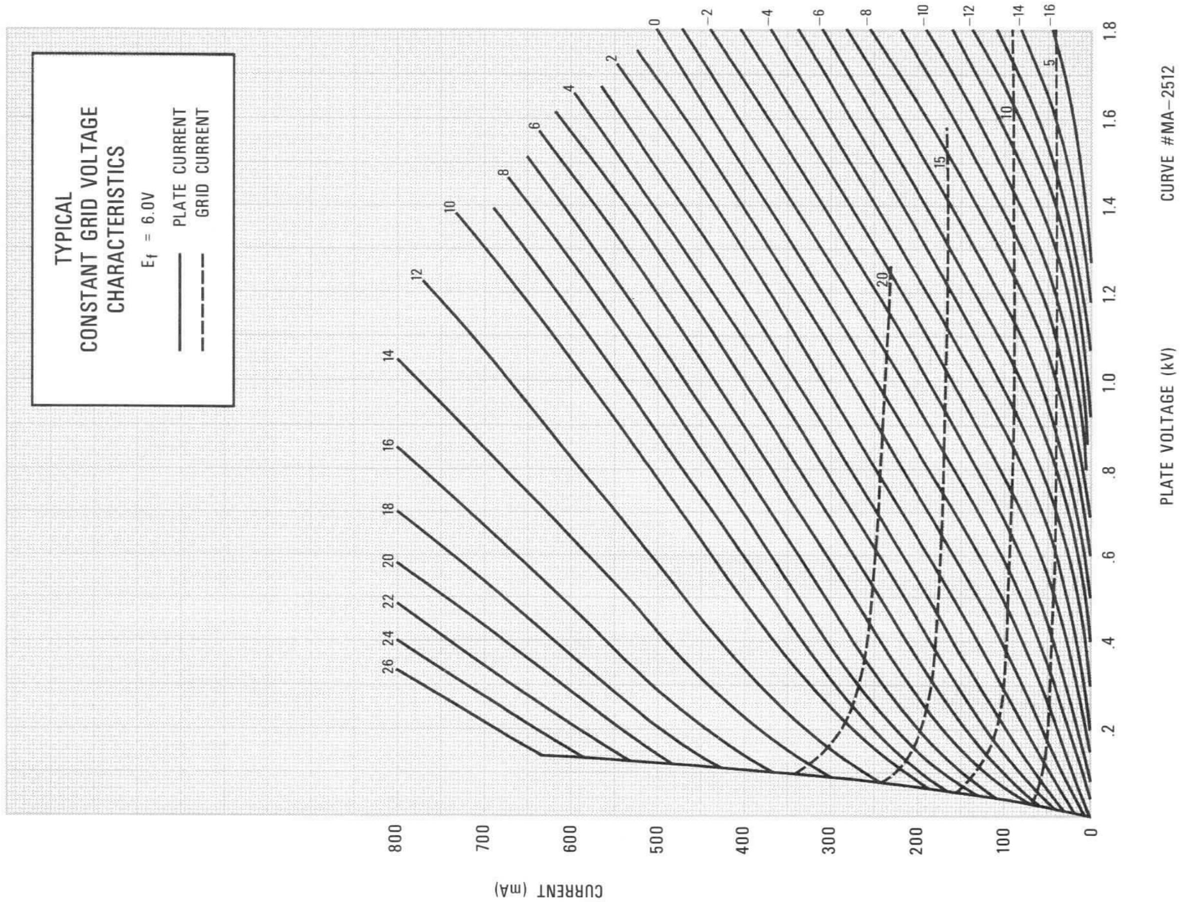


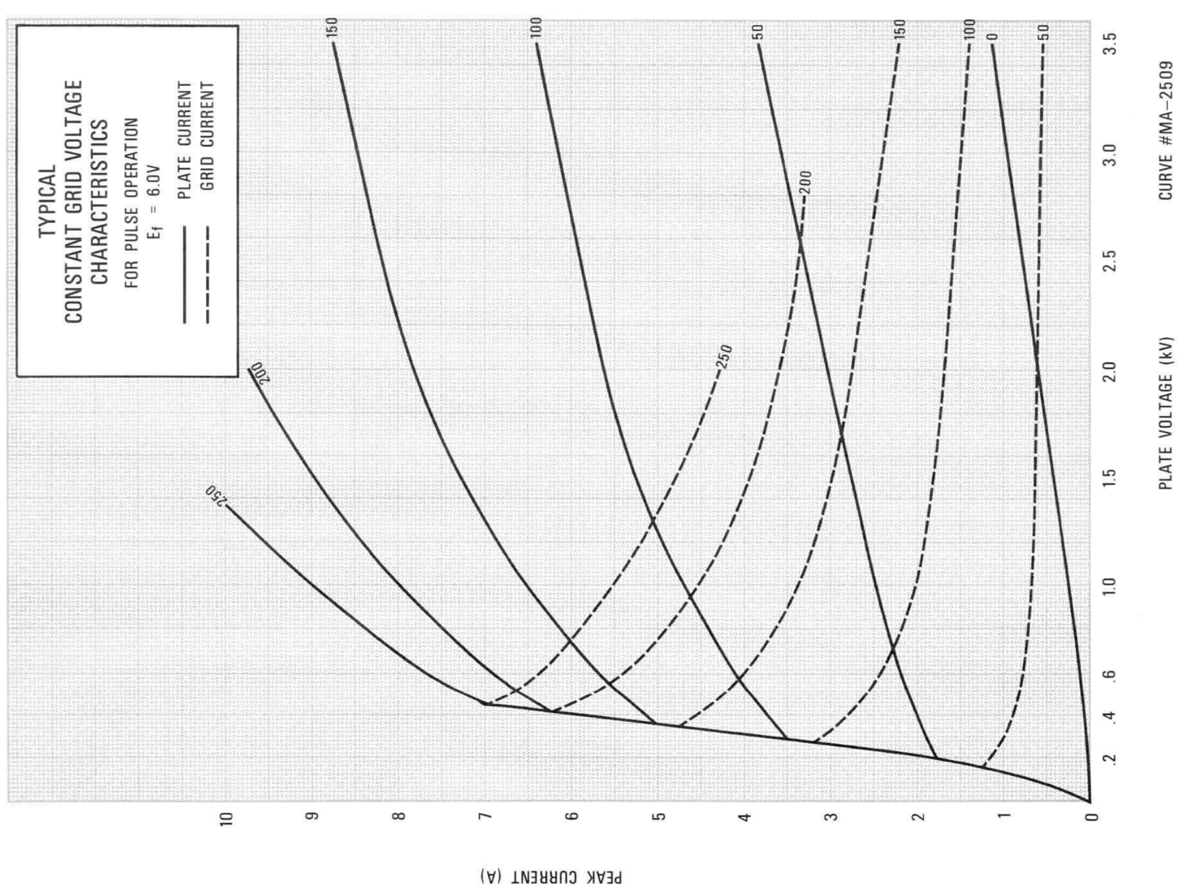
RADIATOR #158555

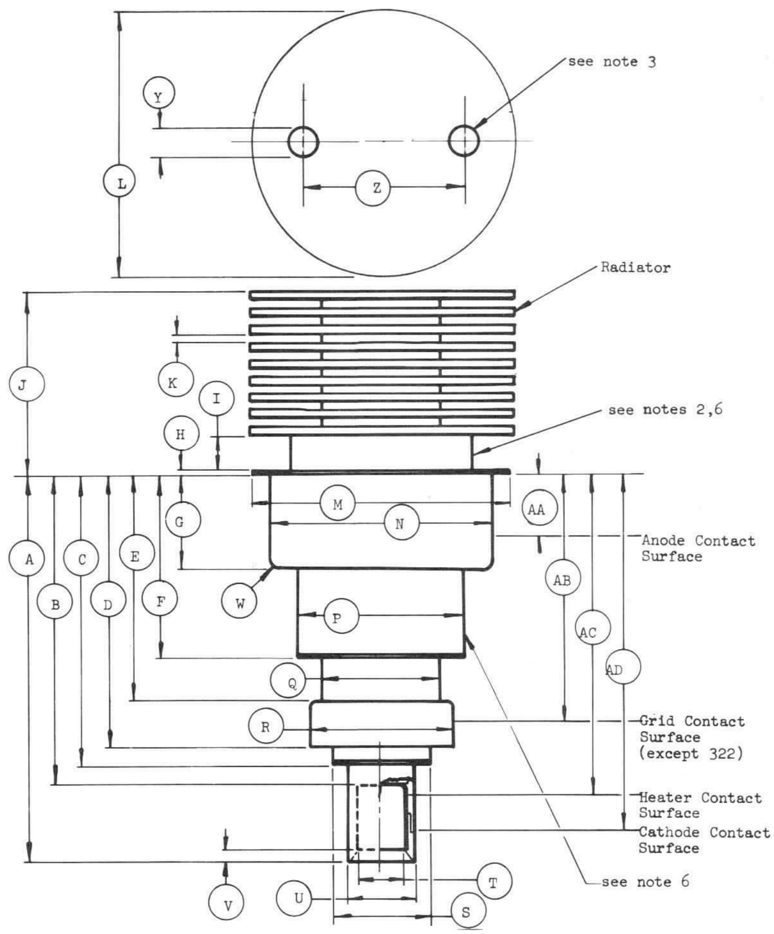


CURVE #MA-2510


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0V
PLATE CURRENT (mA)
GRID CURRENT (mA)
700
600
500
400
300
200
100
50
0
50
100
200
300
PLATE VOLTAGE (kV)
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
GRID VOLTAGE (V)
30
20
10
0
-10
-20
-30
-40
CURVE #MA-2511


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
E_f = 6.0V
PLATE CURRENT
GRID CURRENT
CURRENT (mA)
PLATE VOLTAGE (kV)
CURVE #MA–2512


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.0V
PLATE CURRENT
GRID CURRENT
PEAK CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #MA–2509



ELECTRODE CONTACT AREA

Dim. in Inches Min.	Dim. in Inches Max.	Dim.	Dim. in Millim. Min.	Dim. in Millim. Max.
.035	.361	AA	.89	9.17
1.185	1.265	AB	30.10	32.14
1.534	1.728	AC	38.96	43.89
1.475	1.815	AD	37.47	46.10

DIMENSIONAL DATA

Dim. in Inches Min.	Dim. in Inches Max.	Ref.	Dim.	Dim. in Millimeters MIN.	Dim. in Millimeters MAX.	Ref.
1.815	1.875		A	46.10	47.62	
	1.534		B		38.96	
	1.475		C		37.46	
1.289	1.329		D	32.74	33.76	
1.085	1.135		E	27.56	28.83	
.880	.920		F	22.35	23.37	
.462	.477		G	11:73	12.12	
	.040		H		1.02	
.125	.185		I	3.18	4.70	
.766	.826		J	19.46	20.98	
.025	.046		K	.64	1.17	
1.234	1.264		L	31.34	32.11	
1.180	1.195		M	29.97	30.35	
1.025	1.035		N	26.04	26.29	
.752	.792		P	19.20	20.12	
.541	.561		Q	13.74	14.25	
.655	.665		R	16.64	16.89	
	.545		S		.13.84	
.213	.223		T	5.41	5.66	
.315	.325		U	8.00	8.26	
	.100		W		2.54	
.105	.145		Y	2.67	3.68	
.650	.850		Z	16.51	21.59	
	.086		V		2.18	

NOTES:

1. Metric equivalents to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.
2. This surface shall be used to measure Anode shank temperatire.
3. Holes for extractor thru top fin only.
4. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

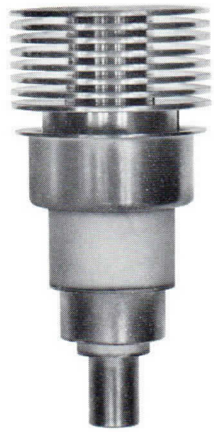
Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

5. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC & AD respectively.
6. This surface shall not be used for clamping or locating.
7. Electrode Contact dims. are given for socket design purposes & are not intended for inspection purposes.

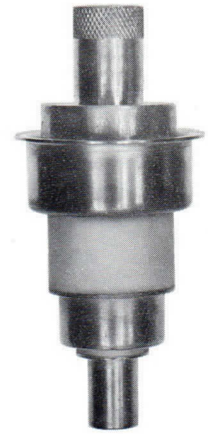
TECHNICAL DATA

7211 / 7698

PLANAR TRIODES



7211



7698

The EIMAC 7211 and 7698 are rugged ceramic/metal planar triodes designed for use in CW, grid- or plate-pulsed oscillator, amplifier or frequency multiplier service up to 3 GHz. The tubes may also be used in pulse modulator or voltage regulator service. The 7211 is normally supplied with an air cooled radiator for forced air cooling, while the 7698 is supplied without radiator and is intended for conduction-convection cooling as found in many pulsed type applications. Except for the plate dissipation ratings and outline, the characteristics of both tube types are identical.

The 7211 and 7698 feature high mu, high transconductance, great mechanical strength and low interelectrode capacitances, as well as high current capability and increased grid-anode insulator length. Both tubes have an arc-resistant, extended interface cathode, well proven in airline applications, assuring reliable and long life operation under adverse conditions.

Note: The data for the 7211 also applies to the EIMAC 7698R in all respects.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b= 160 mAdc, (200mA/cm^2)	38	mmhos
Amplification Factor (Average)	80	
Direct Interelectrode Capacitance (grounded cathode)[2], without heater voltage:		
Grid-Cathode	8.0	pF
Grid-Plate	2.25	pF
Plate-Cathode (maximum)	0.06	pF
Cut-off Bias[3] (maximum)	-30	V

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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.701 in; 68.60 mm
Diameter (7698)	1.195 in; 30.35 mm
Diameter (7211)	1.264 in; 32.11 mm
Net Weight (7698)	1.8 oz; 48 gm
Net Weight (7211)	2.2 oz; 63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling (7698)	Conduction and Convection
Cooling (7211)	Forced Air
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	70,000 ft.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	150	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7698)	10	WATTS
Forced Air Cooling[1](7211)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	2.5	GHz

1. Using EIMAC radiator PN 014224.

OPERATING CONDITIONS FOR 7211 AND 7698 IN REPRESENTATIVE APPLICATION

Grounded Grid CW Power Amplifier

Frequency	700	MHz
Heater Voltage	6.3	V
DC Plate Voltage	630	Vdc
DC Grid Voltage (approx)	-5	Vdc
DC Cathode Current	140	mAdc
DC Grid Current	25	mAdc
Drive Power (approx)	4	W
Useful CW Power Output	45	W

Grounded Grid CW Oscillator

Frequency	2.5	GHz
Heater Voltage	5.0	V
DC Plate Voltage	1000	Vdc
DC Grid Voltage (approx)	-20	Vdc
DC Plate Current	140	mAdc
DC Grid Current	30	mAdc
Useful CW Power Output	30	W

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE (GRID PULSED)	2500	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7698)	10	WATTS
Forced Air Cooling[1](7211)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION [2]	6	μs
DUTY FACTOR [2]	.0033	

OPERATING CONDITIONS FOR 7211 AND 7698 IN REPRESENTATIVE APPLICATION

Grid Pulsed Amplifier

Frequency	1.1	GHz
Heater Voltage	6.3	V
DC Plate Voltage	2200	Vdc
DC Grid Voltage	-50	Vdc
Peak Video Plate Current	2.5	a
Peak Video Grid Current	1.0	a
Pulse Drive Power (approx)	400	w
Useful Power Output (approx)	2500	w
Pulse Duration	3	µs
Duty Factor	.002	

Plate Pulsed Oscillator

Frequency	3.0	GHz
Heater Voltage	5.8	V
Peak Plate Voltage	3500	v
Peak Video Plate Current	4.8	a
Peak Video Grid Current	1.5	a
Useful Power Output (approx)	3000	w
Pulse Duration	3	µs
Duty Factor	.0025	

1. Using Eimac radiator PN 014224.

2. For application requiring longer pulse duration and/ or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2500	VOLTS
PEAK PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7698)	.10	WATTS
Forced Air Cooling[1] (7211)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
PULSE DURATION[2]	6	µs
DUTY FACTOR[2]	.0033	
CUT-OFF MU	60	

1. Using EIMAC radiator PN 014224.

2. For application requiring long pulse duration and/ or higher dury cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

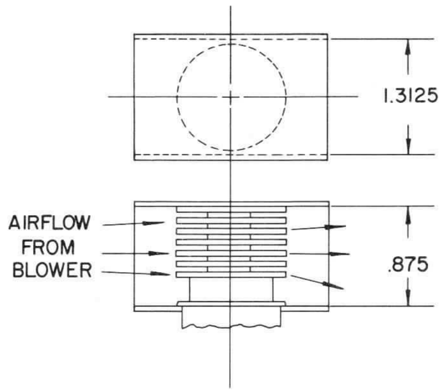
	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Grid-Cathode	7.0	9.0	pF
Plate-Cathode	---	0.06	pF
Grid-Plate	2.10	2.40	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

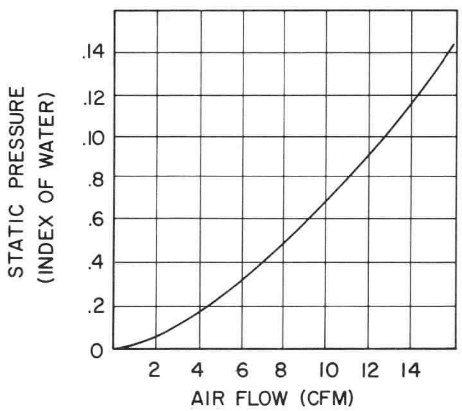
APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube types. Plate dissipation of up to 150 watts is possible with the 7211/7698 tube type when using radiator P/N 158555. If this is required the tube order should include a reference to the different radiator part number. For unusual and special application consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake, City, Utah.

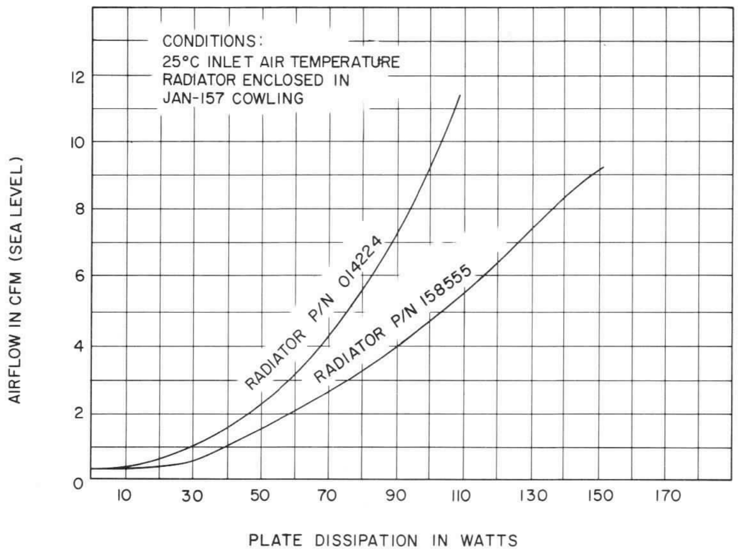
AIRFLOW vs STATIC PRESSURE WITH
STANDARD COWLING JAN-157



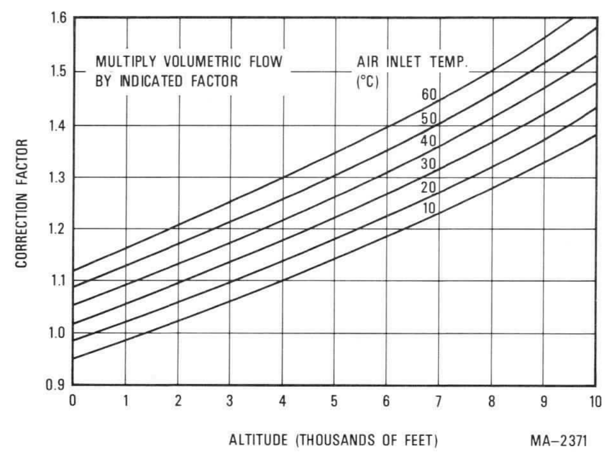
-STANDARD COWLING-

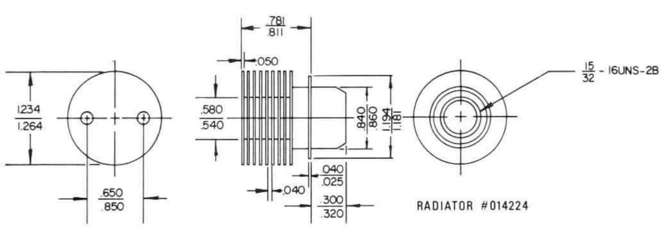


MAXIMUM PLATE DISSIPATION vs COOLING AIRFLOW

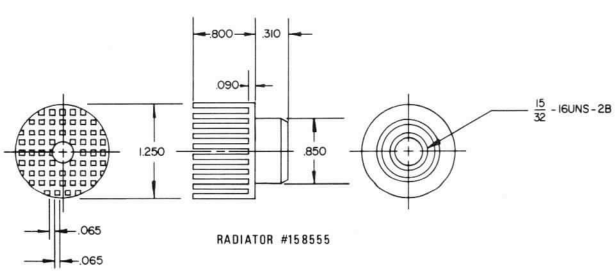


COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE
AND ALTITUDE
(RELATIVE TO 25°C AND SEA LEVEL)

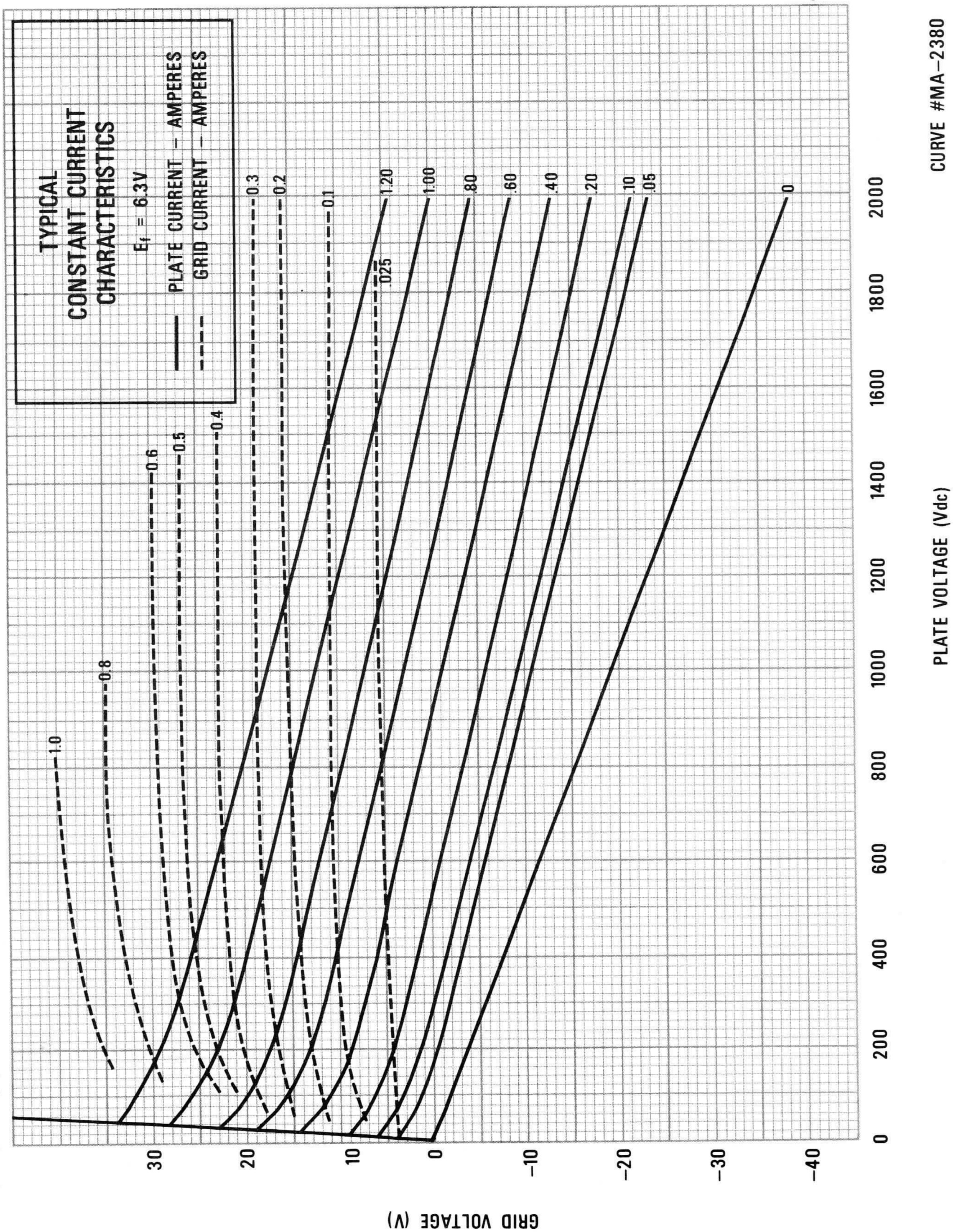




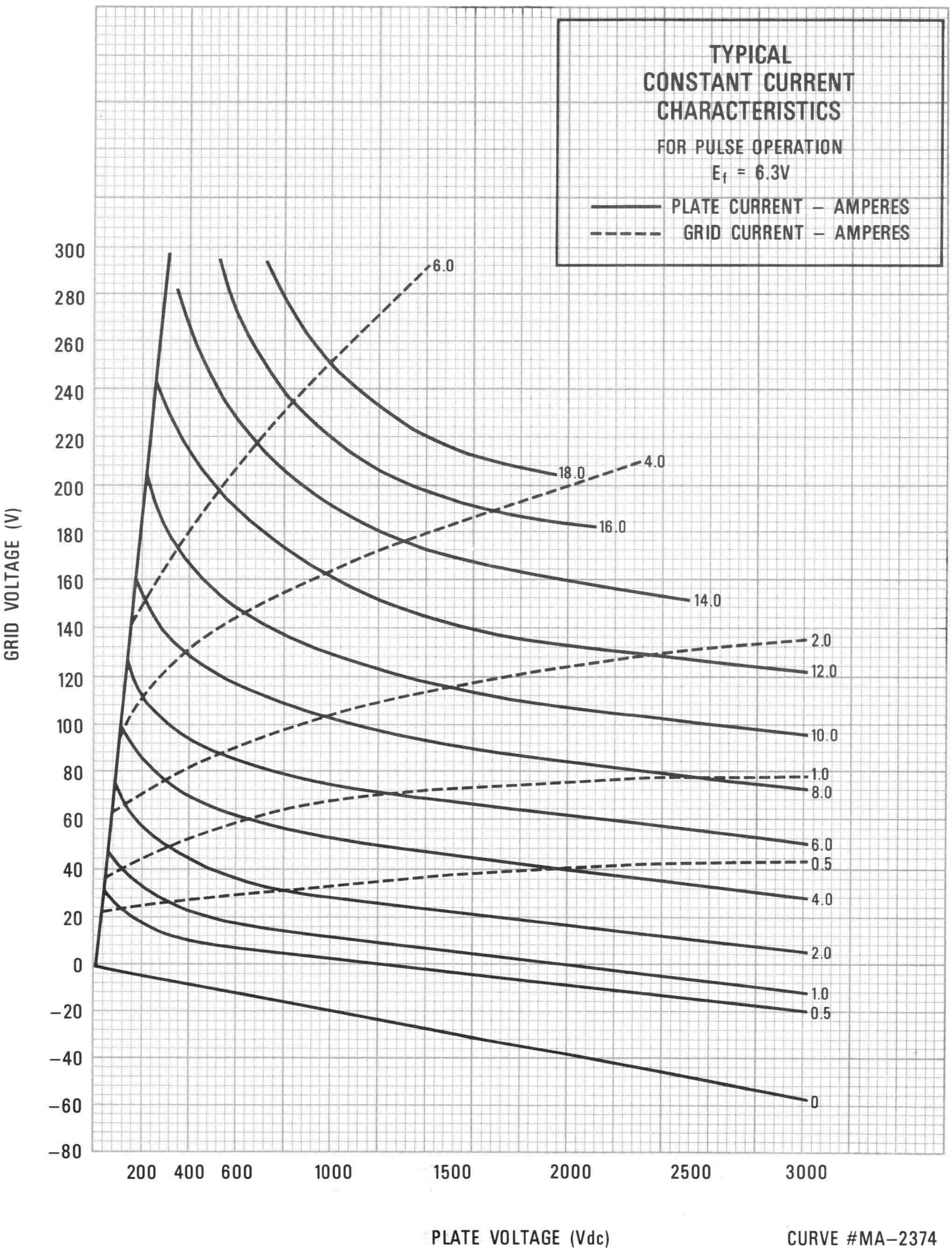
RADIATOR #014224

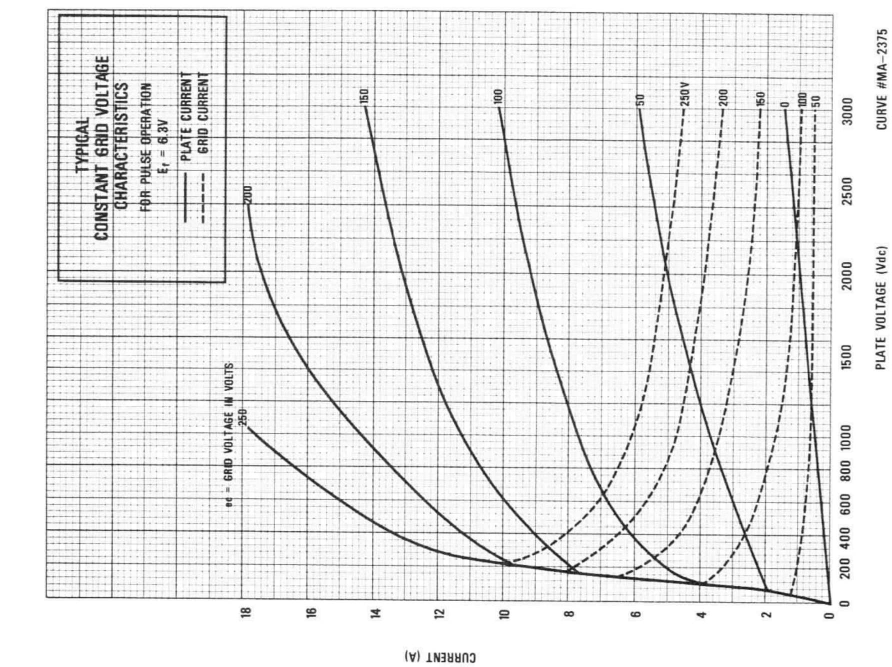


RADIATOR #158555

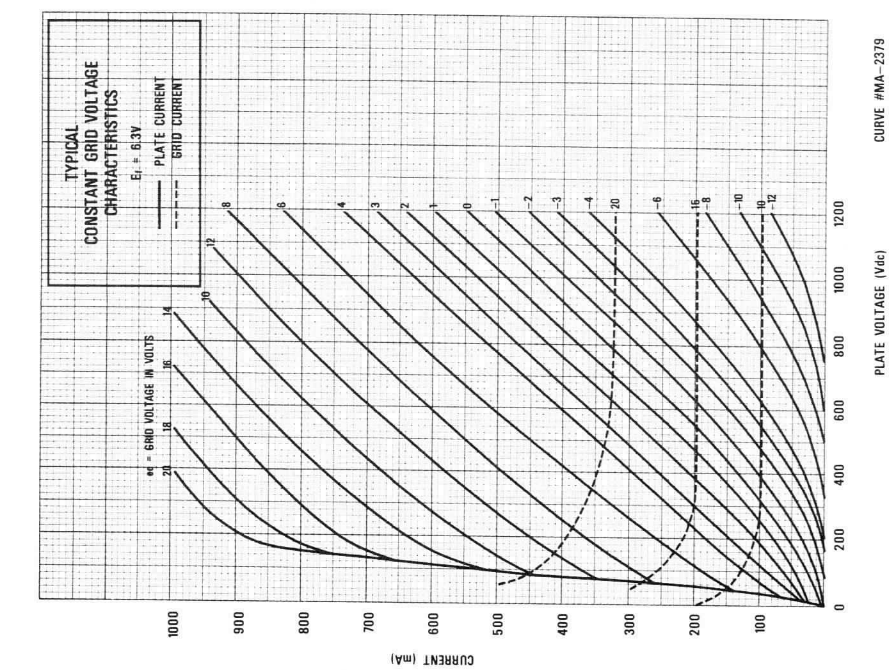


CURVE #MA-2380


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
−20
−40
−60
−80
200
400
600
1000
1500
2000
2500
3000
6.0
18.0
4.0
16.0
14.0
2.0
12.0
10.0
1.0
8.0
6.0
0.5
4.0
2.0
1.0
0.5
0
PLATE VOLTAGE (Vdc)
CURVE #MA–2374



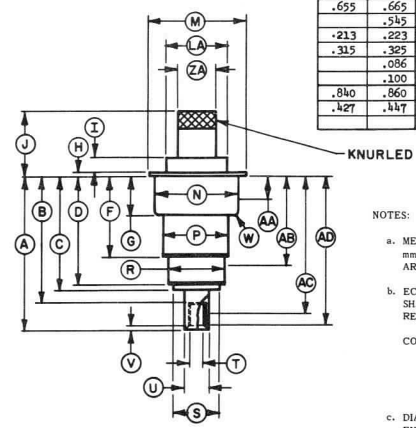
TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
ed = GRID VOLTAGE IN VOLTS
CURRENT (A)
PLATE VOLTAGE (Vdc)
CURVE #MA-2375



TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
ed = GRID VOLTAGE IN VOLTS
CURRENT (mA)
PLATE VOLTAGE (Vdc)
CURVE #MA-2379

ELECTRODE CONTACT AREA				
DIM	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA					
DIM. IN INCHES			DIM. IN MILLIMETERS		
MIN.	MAX.	DIM	MIN.	MAX.	NOTES
1.185	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
	.185	I		4.70	
.766	.826	J	19.46	20.98	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	c
.752	.792	P	19.10	20.12	d
.655	.665	R	16.64	16.89	c
	.545	S		13.84	
.213	.223	T	5.41	5.66	c
.315	.325	U	8.00	8.26	c
	.086	V		2.18	
	.100	W		2.54	
.840	.860	LA	21.34	21.84	
.427	.447	ZA	10.75	11.35	



NOTES:

a. METRIC EQUIVALENTS, TO THE NEAREST .01 mm, ARE FOR GENERAL INFORMATION ONLY & ARE BASED UPON 1 inch = 25.4 mm.

b. ECCENTRICITY OF CONTACT SURFACES SHALL BE GAGED FROM CENTER LINE OR REFERENCE & SHALL BE AS FOLLOWS:

CONTACT SURFACE	TIR(MAX)	REFERENCE
ANODE	.020	CATHODE
GRID	.020	CATHODE
HEATER	.012	CATHODE

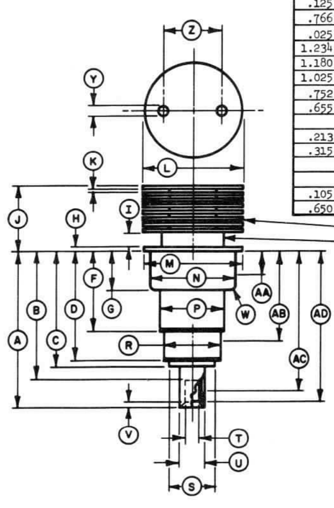
c. DIA'S N, R, T, & U SHALL APPLY THROUGHOUT ENTIRE LENGTH AS DEFINED BY DIM'S AA, AB, AC & AD RESPECTIVELY.

d. THIS SURFACE SHALL NOT BE USED FOR CLAMPING OR LOCATING.

7698

ELECTRODE CONTACT DIMENSION				
DIM	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA					
DIM. IN INCHES			DIM. IN MILLIMETERS		
MIN.	MAX.	DIM	MIN.	MAX.	NOTES
1.185	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.046	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	e
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	
	.545	S		13.84	
.213	.223	T	5.41	5.66	e
.315	.325	U	8.00	8.26	e
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	c
.650	.850	Z	16.51	21.59	



NOTES:

a. METRIC EQUIVALENTS, TO THE NEAREST .01 mm, ARE GIVEN FOR GENERAL INFORMATION ONLY & ARE BASED ON 1 inch = 25.4 mm.

b. THIS SURFACE SHALL BE USED TO MEASURE ANODE SHANK TEMPERATURE.

c. HOLES FOR EXTRACTOR THROUGH TOP FIN ONLY.

d. ECCENTRICITY OF CONTACT SURFACES SHALL BE GAGED FROM CENTER LINE OF REFERENCE & SHALL BE AS FOLLOWS:

CONTACT SURFACE	TIR(MAX)	REFERENCE
ANODE	.020	CATHODE
GRID	.020	CATHODE
HEATER	.012	CATHODE

e. DIA'S N, R, T & U SHALL APPLY THROUGHOUT ENTIRE LENGTH AS DEFINED BY DIM'S AA, AB, AC & AD RESPECTIVELY.

f. THIS SURFACE SHALL NOT BE USED FOR CLAMPING OR LOCATING.

7211

TECHNICAL DATA

7815 / 7815R

PLANAR TRIODES

The EIMAC 7815 and 7815R are rugged ceramic/metal planar triodes designed for use in CW, grid- or plate-pulsed oscillator, amplifier or frequency multiplier service up to 3 GHz. The tubes may also be used in pulse modulator or voltage regulator service. The 7815R is normally supplied with an air cooled radiator for forced air cooling, while the 7815 is supplied without radiator and is intended for conduction-convection cooling as found in many pulsed type applications. Except for the plate dissipation ratings and outline, the characteristics of both tube types are identical.

7815 7815R

The 7815 and 7815R feature high mu, high transconductance, great mechanical strength and low interelectrode capacitances, as well as high current capability and increased grid-anode insulator length. Both tubes have an arc-resistant, extended interface cathode, well proven in airline applications, assuring reliable and long life operation under adverse conditions.

Note: This data sheet also covers the 3CPN10A5 (same as 7815) and 3CPX100A5 (same as 7815R).

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	1.00 A
Transconductance (Average):	
I_b = 70 mAdc, (E_b = 600 Vdc)	25 mmhos
Amplification Factor (Average)	100
Direct Interelectrode Capacitance (grounded cathode)[2], without heater voltage:	
Cin	6.3 pF
Cgp	1.98 pF
Cout	0.035 pF
Cut-off Bias[3] (maximum)	-25 V

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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

 Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.701 in; 68.60 mm
Diameter (7815)	1.195 in; 30.35 mm
Diameter (7815R)	1.264 in; 32.11 mm
Net Weight (7815)	1.8 oz; 48 gm
Net Weight (7815R)	2.2 oz; 63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling (7815)	Conduction and Convection
Cooling (7815R)	Forced Air
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	70,000 ft.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	100	MILLIAMPERES
DC GRID CURRENT	50	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7815)	10	WATTS
Forced Air Cooling (7815R)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	2.5	GHz

OPERATING CONDITIONS FOR 7815 AND 7815R IN REPRESENTATIVE APPLICATION

Grounded Grid CW Power Amplifier

Frequency	500	MHz
Heater Voltage	6.0	V
DC Plate Voltage	900	Vdc
DC Grid Voltage (approx)	-40	Vdc
DC Cathode Current	90	mAdc
DC Grid Current	25	mAdc
Drive Power (approx)	6	W
Useful CW Power Output	40	W

Grounded Grid CW Oscillator

Frequency	2.5	GHz
Heater Voltage	5.0	V
DC Plate Voltage	900	Vdc
DC Grid Voltage (approx)	-20	Vdc
DC Plate Current	90	mAdc
DC Grid Current	10	mAdc
Useful CW Power Output	17	W

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE (GRID PULSED)	2500	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	3.0	AMPERES
PULSE GRID CURRENT	1.8	AMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7815)	10	WATTS
Forced Air Cooling (7815R)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[1]	6	μs
DUTY FACTOR[1]	.0033	

OPERATING CONDITIONS FOR 7815 AND 7815R IN REPRESENTATIVE APPLICATION

Grid Pulsed Amplifier

Frequency	1.1	GHz
Heater Voltage	6.0	V
DC Plate Voltage	2200	Vdc
DC Grid Voltage	-45	Vdc
Peak Video Plate Current	1.9	a
Peak Video Grid Current	1.1	a
Pulse Drive Power (approx)	400	w
Useful Power Output (approx)	2000	w
Pulse Duration	3	μs
Duty Factor	.002	

Plate Pulsed Oscillator

Frequency	3.0	GHz
Heater Voltage	5.8	V
Peak Plate Voltage	3500	v
Peak Video Plate Current	3.0	a
Peak Video Grid Current	1.8	a
Useful Power Output (approx)	1600	w
Pulse Duration	3	μs
Duty Factor	.0025	

1. For application requiring longer pulse duration and/ or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2500	VOLTS
PEAK PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	4.8	AMPERES
DC PLATE CURRENT	100	MILLIAMPERES

AVERAGE PLATE DISSIPATION		
Conduction and Convection (7815)	10	WATTS
Forced Air Cooling (7815R)	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
PULSE DURATION [1]	6	μs
DUTY FACTOR [1]	.0033	
CUT-OFF MU	70	

1. For application requiring long pulse duration and/ or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

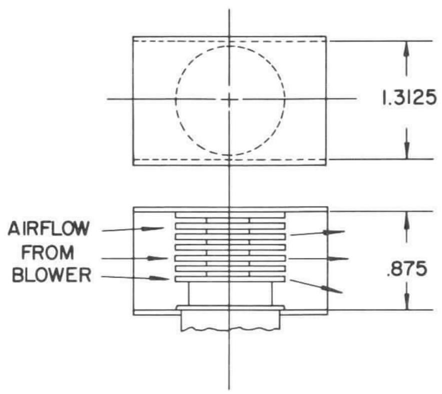
	Min.	Max.	
Heater: Current at 6.0 volts	0.90	1.05	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	5.60	7.00	pF
Cout	---	0.035	pF
Cgp	1.85	2.10	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

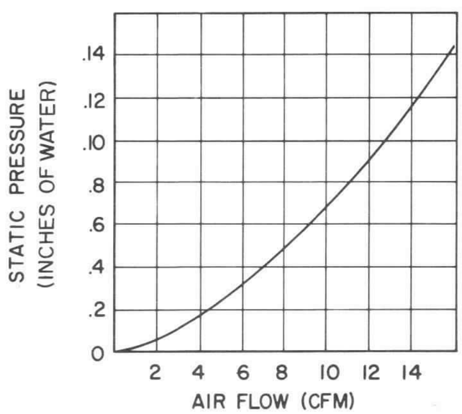
APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube types. Plate dissipation of up to 150 watts is possible with the 7815/7815R tube type when using radiator P/N 158555. If this is required the tube order should include a reference the different radiator part number. For unusual and special application consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake, City, Utah.

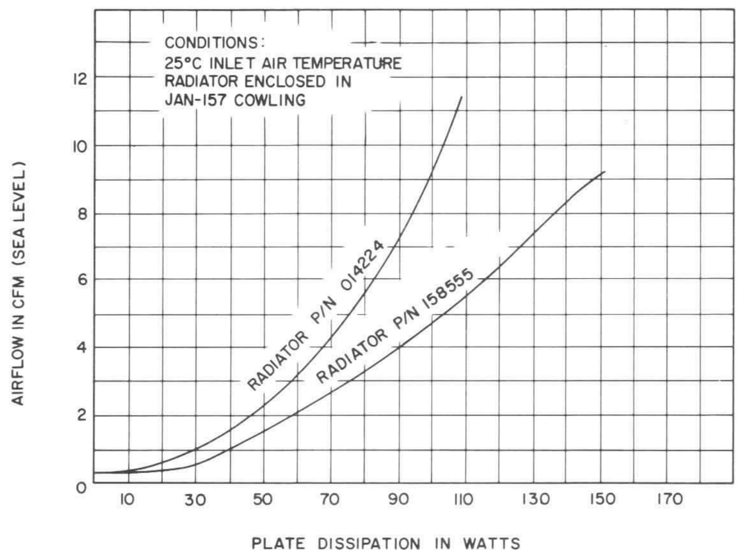
AIRFLOW vs STATIC PRESSURE WITH STANDARD COWLING JAN-157



- STANDARD COWLING -

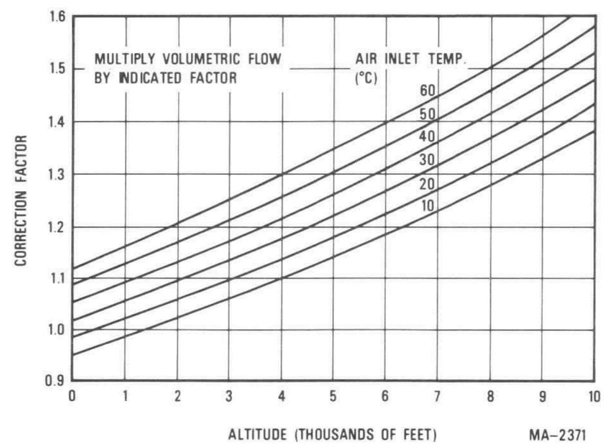


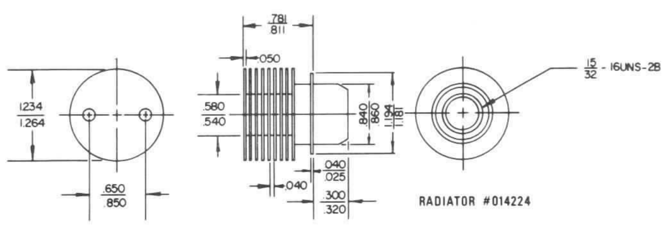
MAXIMUM PLATE DISSIPATION vs COOLING AIRFLOW



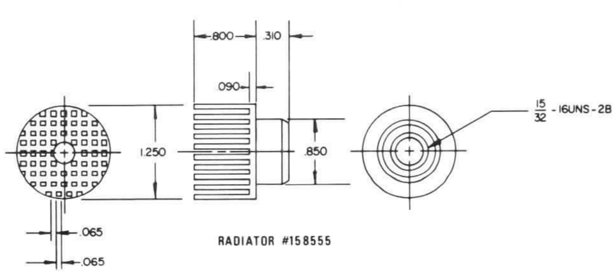
COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

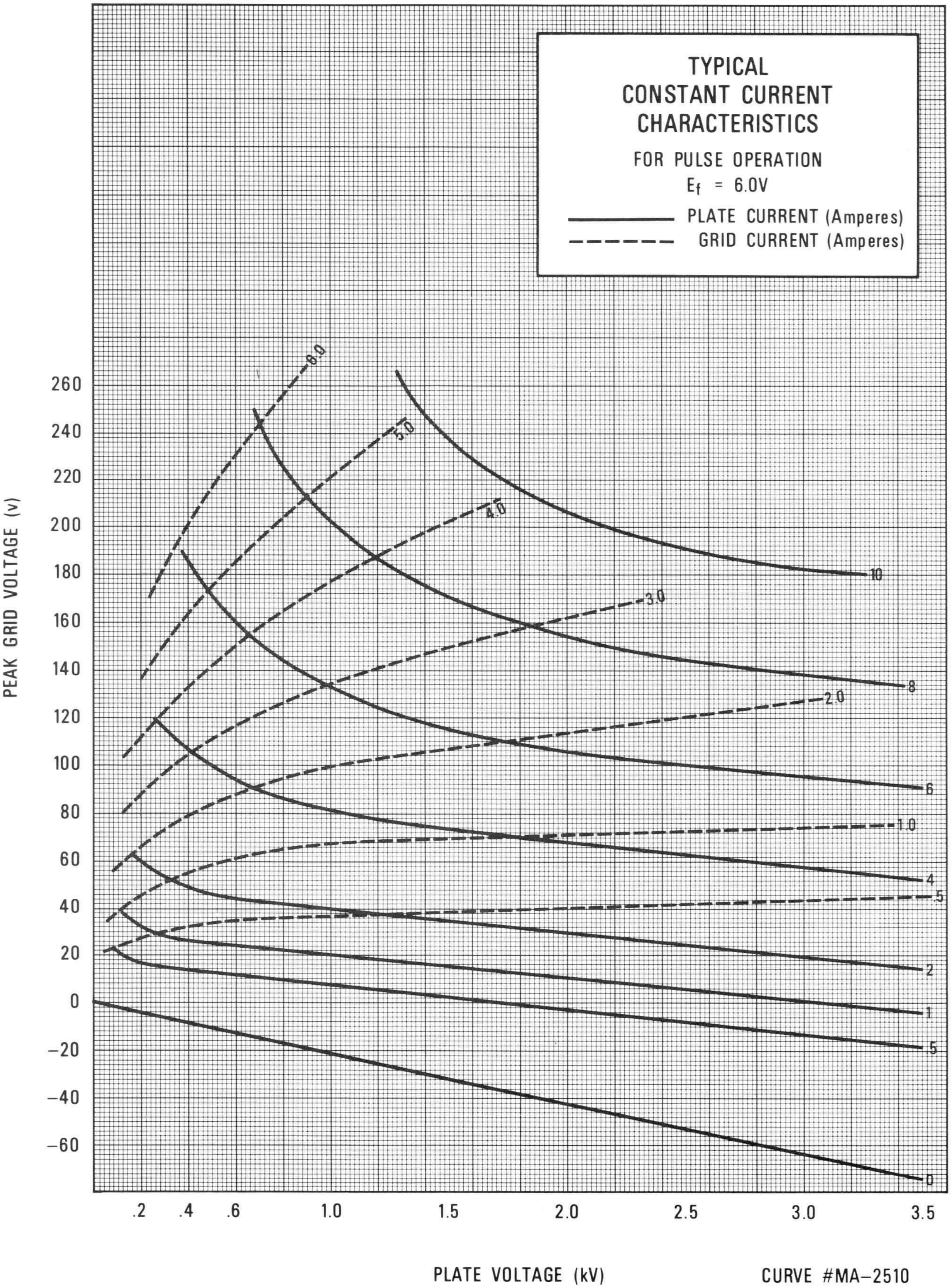




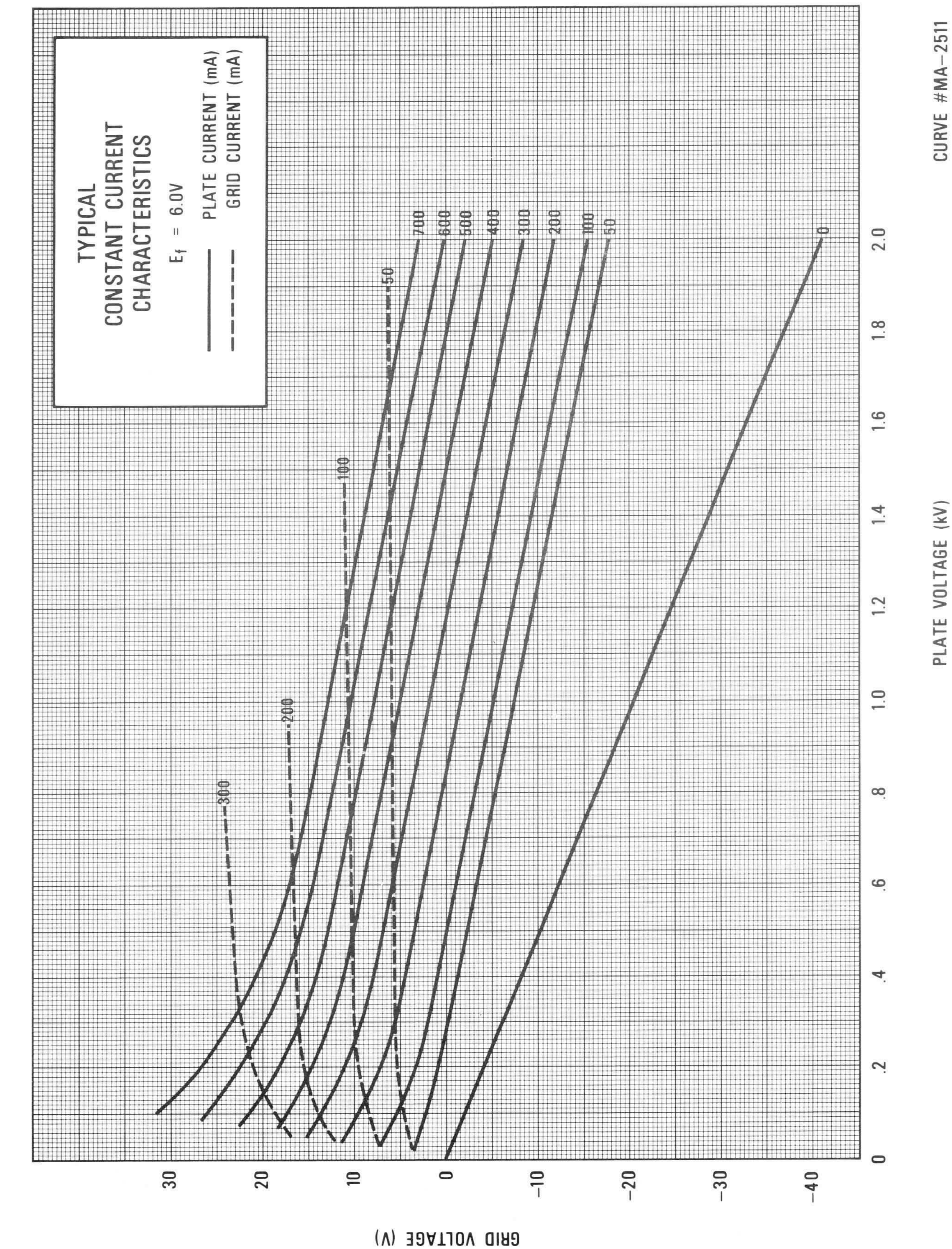
RADIATOR #014224



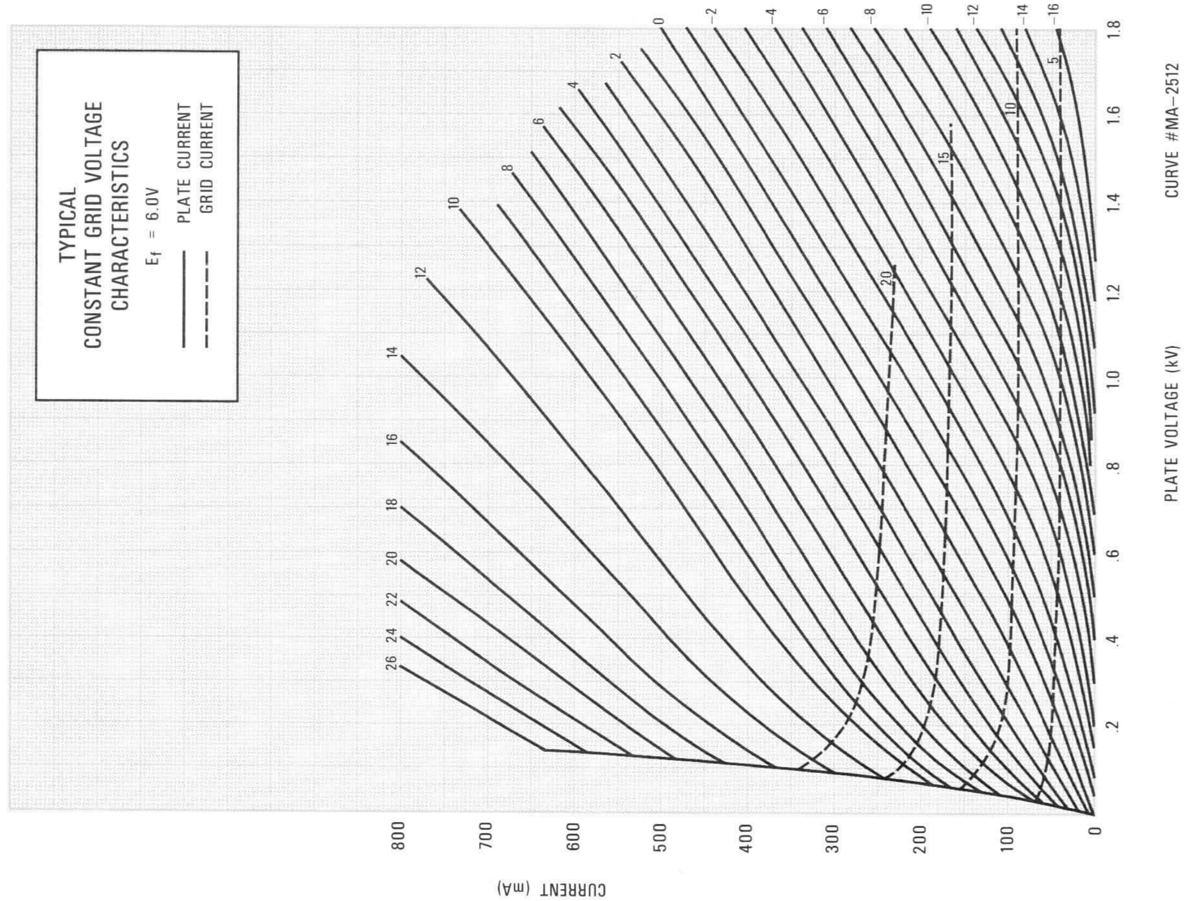
RADIATOR #158555



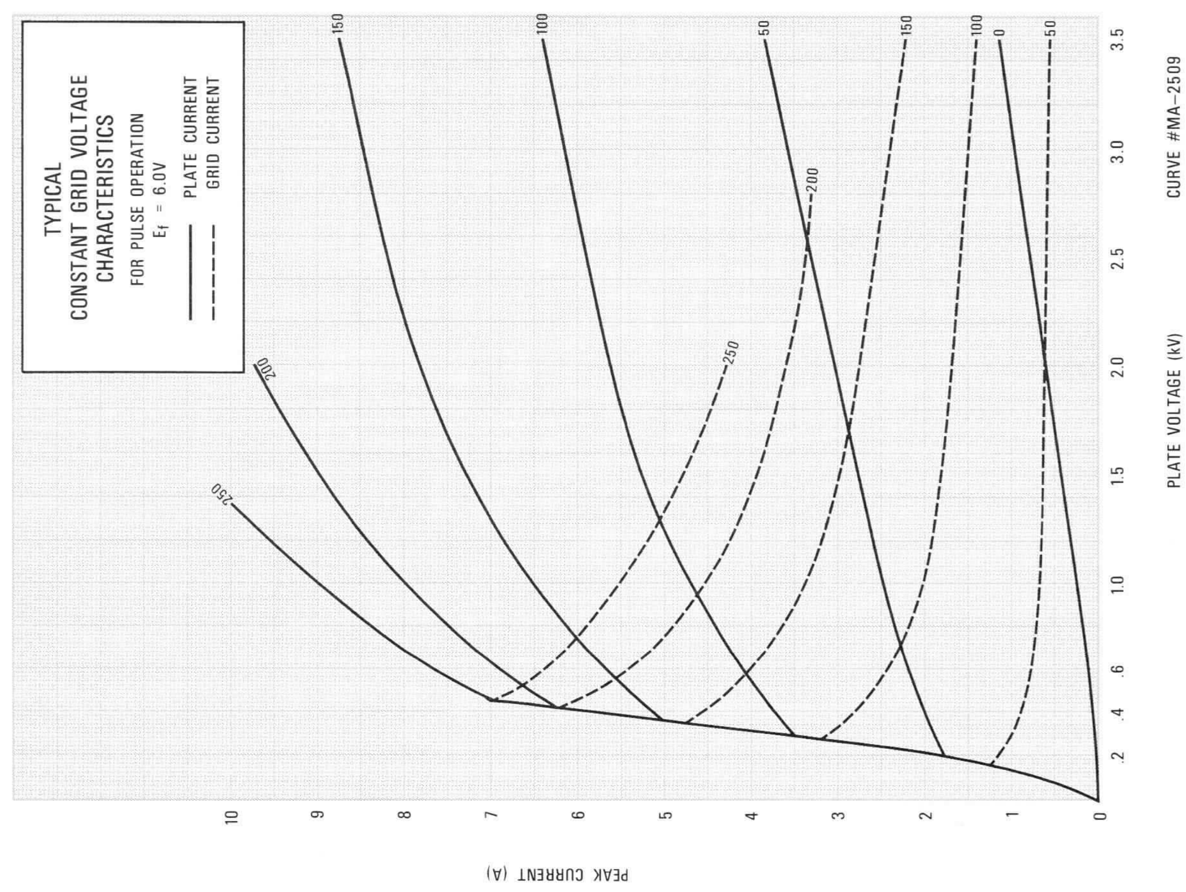
CURVE #MA–2510



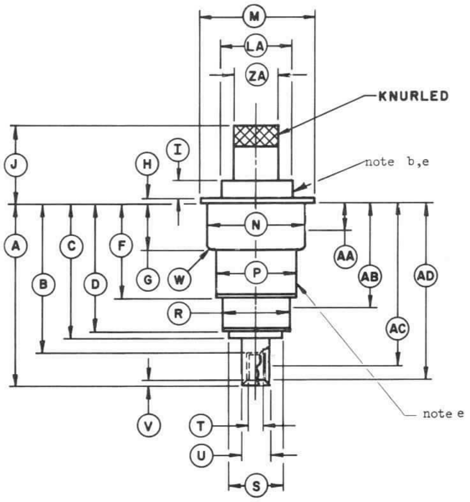
TYPICAL CONSTANT CURRENT CHARACTERISTICS
E_f = 6.0V
PLATE CURRENT (mA)
GRID CURRENT (mA)
700
600
500
400
300
200
100
50
0
50
100
200
300
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #MA-2511



TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
E_f = 6.0V
PLATE CURRENT
GRID CURRENT
CURRENT (mA)
PLATE VOLTAGE (kV)
CURVE #MA-2512



TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.0V
PLATE CURRENT
GRID CURRENT
PEAK CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #MA-2509



7815

ELECTRODE CONTACT AREA(see note a,f)				
DIM.	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA (Note a)					
DIM. IN INCHES		DIM. IN MILLIMETERS			
MIN.	MAX.	DIM.	MIN.	MAX.	NOTES
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
	.185	I		4.70	
.766	.826	J	19.46	20.98	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	d
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	d
	.545	S		13.84	
.213	.223	T	5.41	5.66	d
.315	.325	U	8.00	8.26	d
	.086	V		2.18	
	.100	W		2.54	
.840	.860	LA	21.34	21.84	
.427	.447	ZA	10.85	11.35	

NOTES:

a.. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.

b. This surface shall be used to measure Anode Shank temperature.

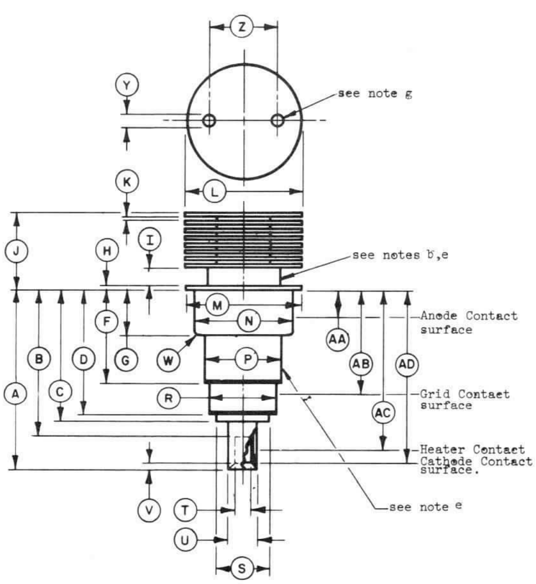
c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows; note 2 shall apply:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

d. Dias. N,R,T,U shall apply throughout entire contact area as defined by dims. AA,AB, AC,AD respectively.

e. This surface shall not be used for clamping or locating.

f. . Electrode Contact Dims. are given for socket design purposes & are not intended foo inspection purposes.



7815R

ELECTRODE CONTACT AREA (Note a,f)				
	Dim. in Inches		Dim. in Millimeter	
Dim.	Min.	Max.	Min.	Max.
AA	.035	.361	.89	, 9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10

DIMENSION DATA (Note a)					
Dim. in Inches		Dim. in **Millimeters.**			
Min.	Max	Dim.	MIN.	MAX.	Notes
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.040	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	c,d
.752	.792	P	19.20	20.12	
.655	.665	R	16.64	16.89	c,d
	.545	S		13.84	
.213	.223	T	5.41	5.66	c,d
.315	.325	U	8.00	8.26	c,d
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	
.650	.850	Z	16.51	21.59	

Notes:

a. Metric equivalents to the nearest .01 mm, are given for general information only & are based on 1 inch= 25.4 mm.

b. This surface shall be used to measure anode shank temp.

c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	**Reference**
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

d. Dias. N,R,T & U shall apply throughout entire lenght as defined be dims. AA,AB,AC & AD respectively.

e. This surface shall not be used for clamping or locating.

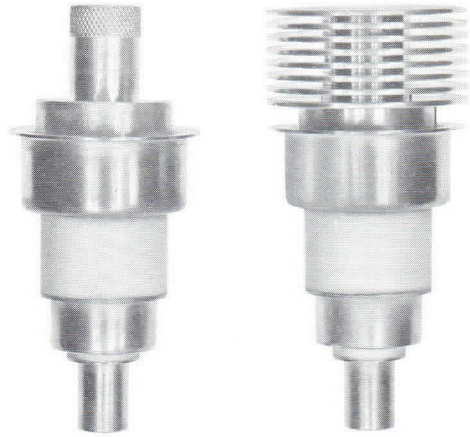
f. Electrode Contact dims. are given for socket design purposes & are not intended for inspection purposes.

g. Holes for Tube Extractor thru top fin only.

TECHNICAL DATA

7815AL
7815RAL

PLANAR TRIODES



7815AL 7815RAL

The EIMAC 7815AL and 7815RAL are ceramic/metal planar triodes specially processed and tested to assure high reliability in airborne service. Evaluation of these tubes is based upon operating conditions in grid- or plate-pulsed oscillator service (transponder) and in grid- or plate-pulsed amplifier service in distance measuring equipment (DME). The testing emphasizes cathode emission capability at reduced heater voltage and high voltage hold-off, both features which are demanded in airline service.

The 7815AL is derived from the 7815/3CPN10A5 and the 7815RAL from the 7815R/3CPX100A5. These new improved tubes also contain the features of the original types, including rugged ceramic/metal construction, low interelectrode capacitance, high transconductance and high mu. The longer grid-anode ceramic insulator of the earlier type is used, making the 7815AL and 7815RAL tubes especially suited for high altitude airborne operation.

In addition to these features, these tubes also incorporate the arc-resistant cathode which assures stable operation under adverse conditions and which minimizes catastrophic failure due to arc-over during circuit malfunction. Both tubes are useable from dc to 3 GHz.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	5.7 (±2%) V
Current, at 5.7 volts	0.95 A
Transconductance (Average):	
I_b = 70 mAdc, E_b = 600 Vdc	25 mmhos
Amplification Factor (Average)	100
Direct Interelectrode Capacitance (grounded cathode)[2], without heater voltage:	
Grid-Cathode	6.30 pF
Grid-Plate	1.98 pF
Plate-Cathode (maximum)	0.035 pF

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	2.701 in; 68.60 mm
Diameter (7815AL)	1.195 in; 30.35 mm
Diameter (7815RAL)	1.264 in; 32.11 mm
Net Weight (7815AL)	1.8 oz; 48 gm
Net Weight (7815RAL)	2.2 oz; 63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling (7815AL)	Conduction and Convection
Cooling (7815RAL)	Forced Air
Terminals	Special

RF POWER AMPLIFIER OR OSCILLATOR

Grid- or Plate-Pulsed

MAXIMUM RATINGS, ABSOLUTE VALUES

DC PLATE VOLTAGE	3500	VOLTS
PEAK PULSE PLATE VOLTAGE		
PLATE PULSED	4500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	3.0	AMPERE
PULSE GRID CURRENT	1.8	AMPERE
DC CATHODE CURRENT	125	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection (7815AL)	10	WATTS
Forced Air Cooling(7815RAL)	45	WATTS
GRID DISSIPATION (Average)	2	WATTS
DUTY FACTOR 1	.0033	
PULSE DURATION 1	6	μs
FREQUENCY	3	GHz

1. For longer pulse duration or higher duty cycle, consult the nearest Varian Electron Tube and Device Group Sales Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah, or San Carlos, California.

OPERATING CONDITIONS FOR THE 7815AL and 7815RAL in REPRESENTATIVE APPLICATION.

Grid-Pulsed Oscillator

Frequency	1.090	GHz
Heater Voltage	5.7	V
DC Plate Voltage	2000	Vdc
DC Grid Voltage	-75	Vdc
Peak Plate Current	1.1	a
Peak Grid Current	0.8	a
Pulse Duration	0.5	μs
Duty	0.001	
Useful Power Output (Approx.)	750	w

Plate-Pulsed Amplifier

Frequency	1.1	GHz
Heater Voltage	5.7	V
Peak Plate Pulse Voltage	2000	Vdc
DC Grid Voltage	-45	Vdc
Peak Plate Current	1.8	a
Peak Grid Current	1.0	a
Pulse Duration	3.5	μs
Duty	0.001	
Driving Power	300	w
Useful Power Output (Approx.)	1800	w
Gain	8	db
Plate Efficiency	50%	

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at 5.7 volts	0.87	1.02	A
Cut-off Bias 1	---	-25	V
Grid-Plate Capacitance2	1.85	2.10	pF
Grid-Cathode Capacitance2	5.60	7.00	pF
Plate-Cathode Capacitance	---	0.035	pF

1. Measured with 1 mA plate current and a plate voltage of 1000 Vdc.
2. Capacitance values as measured with a cold tube and in a shielded socket. When the cathode is heated to the proper temperature the grid-cathode capacitance will increase by approximately 1 pF due to thermal expansion of the cathode support.

APPLICATION

MECHANICAL

MOUNTING - The important dimensions of the tube are carefully controlled with respect to the reference surface as shown on the outline drawing. The reference surface is intended to serve as a tube stop and the location of the tube in the circuit should therefore be determined by this surface coming in positive contact with a precisely positioned member of the socket or cavity. Adherence to this practice will assure both mechanical and electrical interchangeability of all tubes of a given type. If a non-designated surface is used as a tube stop, faulty positioning of the tube in the cavity and possible incomplete electrical contact can result in improper tuning, reduced power output and damage to the cavity, tube or both. Contact surfaces, with reference to the designated tube stop are shown in the outline drawing. Electrical contact to the cathode, grid, anode and also the heater should be restricted to these designated contact areas.

Dimensions should never be taken from sample tubes. Dimensional changes due to normal variations in undimensioned surfaces may occur within the limits specified on the outline drawing. Use of nondesignated electrical contact surfaces might therefore result in incomplete contact or mechanical interference, causing changes in cavity tuning.

Electrical contact should be made by spring finger collets bearing against the previously described contact areas. If connections are employed which do not provide multiple contacts to the designated contact areas, concentration of RF current will result in loss of output power, especially at higher frequencies. The spring contacts used should exert a firm pressure without gouging the plated contact surface. This latter phenomena can result in loose particles of material which can cause arcing or unstable operation of the cavity.

If the tubes are used in applications which call for severe shock or vibration the tube may be clamped in place by the knob or radiator, exerting pressure only on this part of the tube and against the tube stop. No other portion of the tube should be subject to any clamping force. In particular, electrical contacts which utilize setscrews or rigid clamps should be avoided. Such contact schemes can distort the contact surfaces causing undue stress in the metal-to-ceramic seal area which may result in a vacuum leak. Soldered electrical connections can be made, however great care should be taken during the solder operation to avoid fracture of the seal area due to thermal shock. All contact surfaces should be kept clean to minimize losses.

COOLING - The EIMAC planar triodes are designed to operate at envelope and anode temperatures of up to the maximum rated value of 250°C. However, performance and long-term reliability of any component are improved when it is kept as cool as technically feasible. Therefore, it is recommended that sufficient cooling be provided to keep the anode and seal areas well below the specified maximum temperature, where long tube life and high reliability are of great importance.

The maximum plate dissipation of the 7815AL is 10 watts average power. This can be accomplished by conduction, natural convection or forced air convection cooling. The maximum plate dissipation of the 7815RAL in pulse service is 45 watts average and forced air cooling must be employed at that level. When forced air cooling is used, it is recommended that additional airflow, apart from that flowing through the radiator be used to cool the tube envelope and other tube terminals. A certain amount of conduction cooling is usually inherent in the contact finger configuration. It should be noted, however, that spring fingers provide poor heat conduction and measurements have shown a temperature difference as much as 50°C between the contact finger and contact area.

It is suggested that in all new applications the envelope temperature be measured, especially if the tube is used close to the upper temperature limit. The temperature can easily be determined by the use of Tempilaq paint (Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield N.J. 07080) or Temp-Plate stickers (Pydrodyne, Inc., 1001 Colorado, Santa Monica, Calif. 90404)

ELECTRICAL

HEATER VOLTAGE - The rated heater voltage for either tube type is 5.7 volts and should be controlled within ±2% to obtain maximum tube life and to minimize variations in circuit performance.

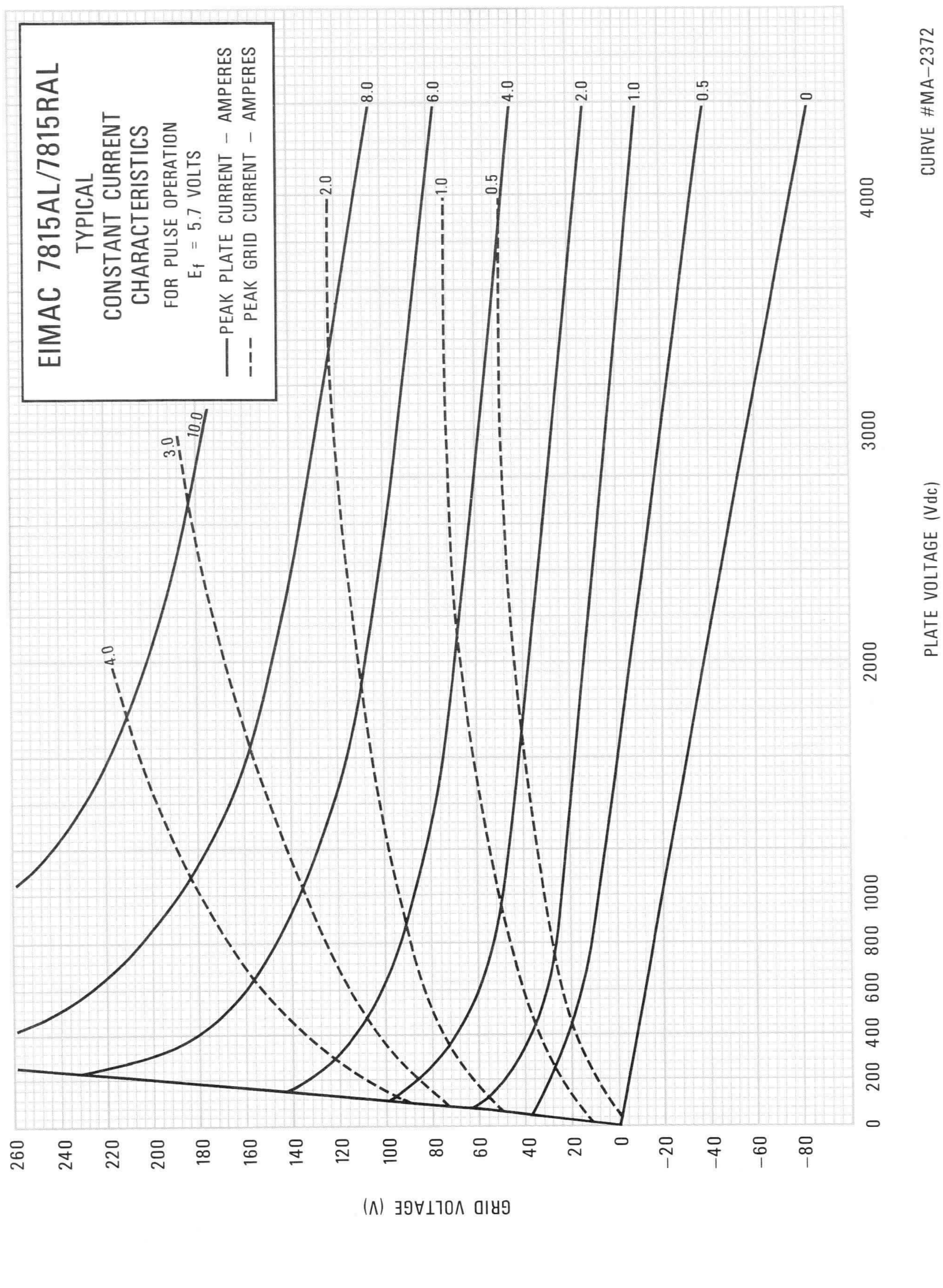
The rated heater voltage is optimum for most existing airborne applications such as DME and transponder systems. However, there are other applications where a different heater voltage than the nominal should be used to obtain the longest possible tube life. Depending on pulse width, power output and frequency of oscillation used a different heater voltage may be better for long reliable. life. Electron transit time is not necessarily small with respect to the period of oscillation and the amount of driving power diverted will contribute to the cathode heating by electron bombardment.

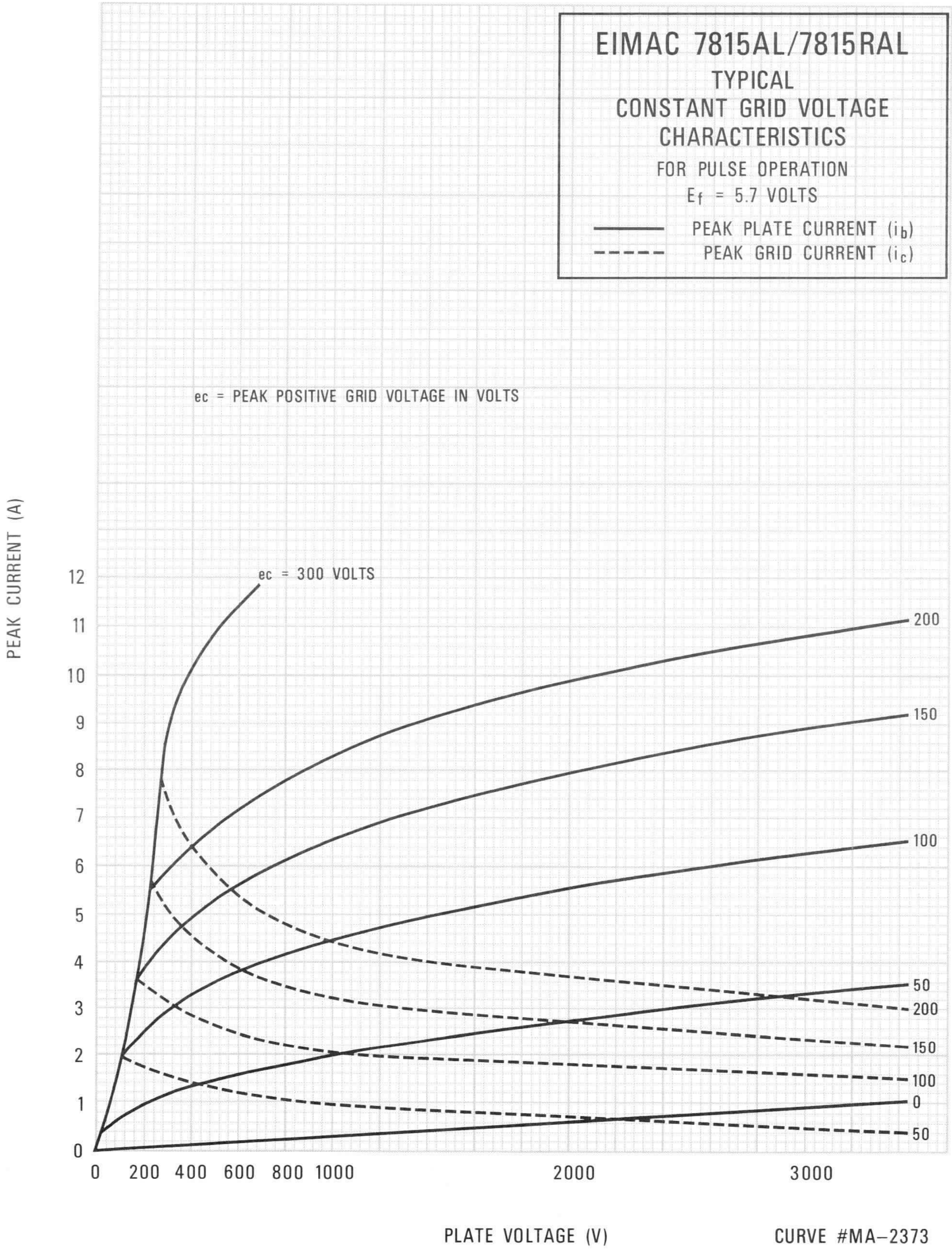
The proper adjustment of the heater voltage must be made to compensate for this additional heating, which depends on operating frequency and duty cycle employed.

INTERELECTRODE CAPACITANCES - As indicated, the capacitance values are shown for measurements made with no heater voltage. The cathode to grid and cathode to plate capacitance will increase with the application of the heater voltage, due to the thermal expansion of the cathode support. Typically, the increase in the grid to cathode capacitance will be 15%, or more, depending on the heater voltage. Since the heater voltage can vary depending on use, data taken without heater voltage is more useful for control of tube-to-tube uniformity. The grid to anode capacitance is not effected by the application of the heater voltage.

CIRCUIT TUNING - Especially under grid pulse conditions, it is important that the tube does not lose bias or momentarily go into a CW mode. Either of these events may result in tube failure. It is suggested that provision be made for initial circuit tune-up at reduced anode voltage and for extra tube protection when the circuit adjustment is critical. The average grid dissipation capability of these tubes is 2.0 watts. For many applications the limiting factor is often not anode dissipation or cathode emission capability, but grid dissipation. If pulse width control is lost in pulse applications the grid can exceed safe operating temperatures in 50 ms or less. Appropriate circuit protection during tune up is therefore recommended.

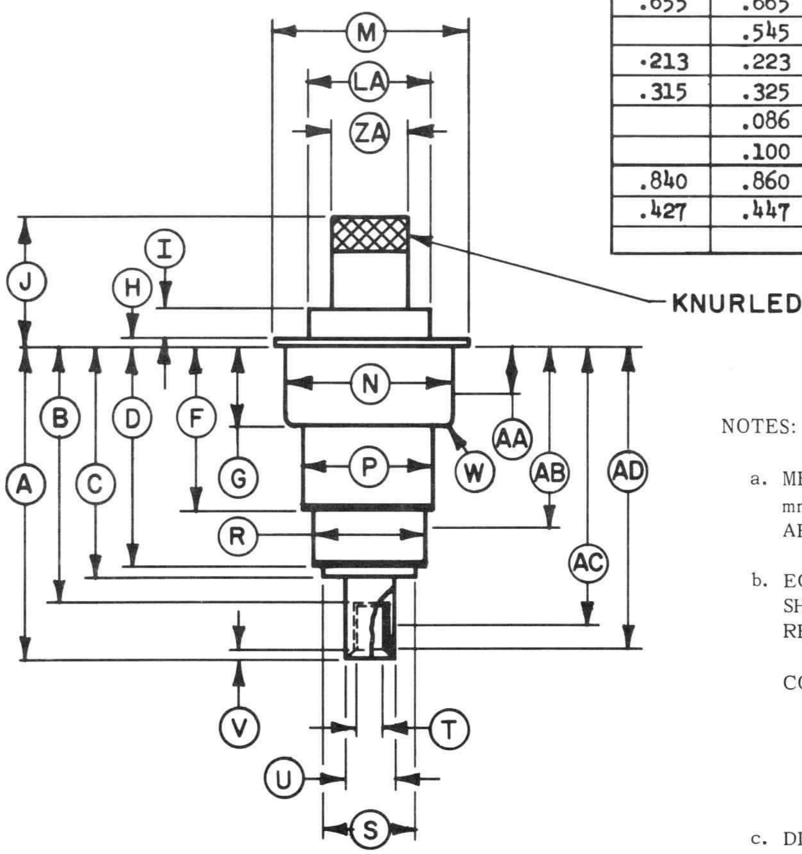
CATHODE OPERATION - The 7815AL and 7815RAL contain an arc-resistant cathode. Performance in the field and laboratory indicates these tubes are capable of withstanding some abuse due to high voltage arcs, however, poor circuit adjustment in the field may result in shortened tube life. It is, therefore, suggested that wherever feasible, the plate supply be designed such that its impedance limits the short circuit current to within five to ten times the maximum forward current. For pulse service the peak current should be limited to the values listed. Higher pulse width and duty cycles than given can be obtained with proper derating of the current. For this and special applications it is recommended that the user request additional information pertaining to his special application from the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah or San Carlos, California.


EIMAC 7815AL/7815RAL
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 5.7 VOLTS
—— PEAK PLATE CURRENT – AMPERES
– – – PEAK GRID CURRENT – AMPERES
PLATE VOLTAGE (Vdc)
GRID VOLTAGE (V)
CURVE #MA-2372


EIMAC 7815AL/7815RAL
TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 5.7 VOLTS
PEAK PLATE CURRENT (i_b)
PEAK GRID CURRENT (i_c)
ec = PEAK POSITIVE GRID VOLTAGE IN VOLTS
ec = 300 VOLTS
200
150
100
50
200
150
100
0
50
PEAK CURRENT (A)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
200
400
600
800
1000
2000
3000
PLATE VOLTAGE (V)
CURVE #MA-2373

ELECTRODE CONTACT AREA				
DIM	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA					
DIM. IN INCHES			DIM. IN MILLIMETERS		
MIN.	MAX.	DIM	MIN.	MAX.	NOTES
1.185	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
	.185	I		4.70	
.766	.826	J	19.46	20.98	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	c
.752	.792	P	19.10	20.12	d
.655	.665	R	16.64	16.89	c
	.545	S		13.84	
.213	.223	T	5.41	5.66	c
.315	.325	U	8.00	8.26	c
	.086	V		2.18	
	.100	W		2.54	
.840	.860	LA	21.34	21.84	
.427	.447	ZA	10.75	11.35	



7815 AL –

NOTES:

a. METRIC EQUIVALENTS, TO THE NEAREST .01 mm, ARE FOR GENERAL INFORMATION ONLY & ARE BASED UPON 1 inch = 25.4 mm.

b. ECCENTRICITY OF CONTACT SURFACES SHALL BE GAGED FROM CENTER LINE OR REFERENCE & SHALL BE AS FOLLOWS:

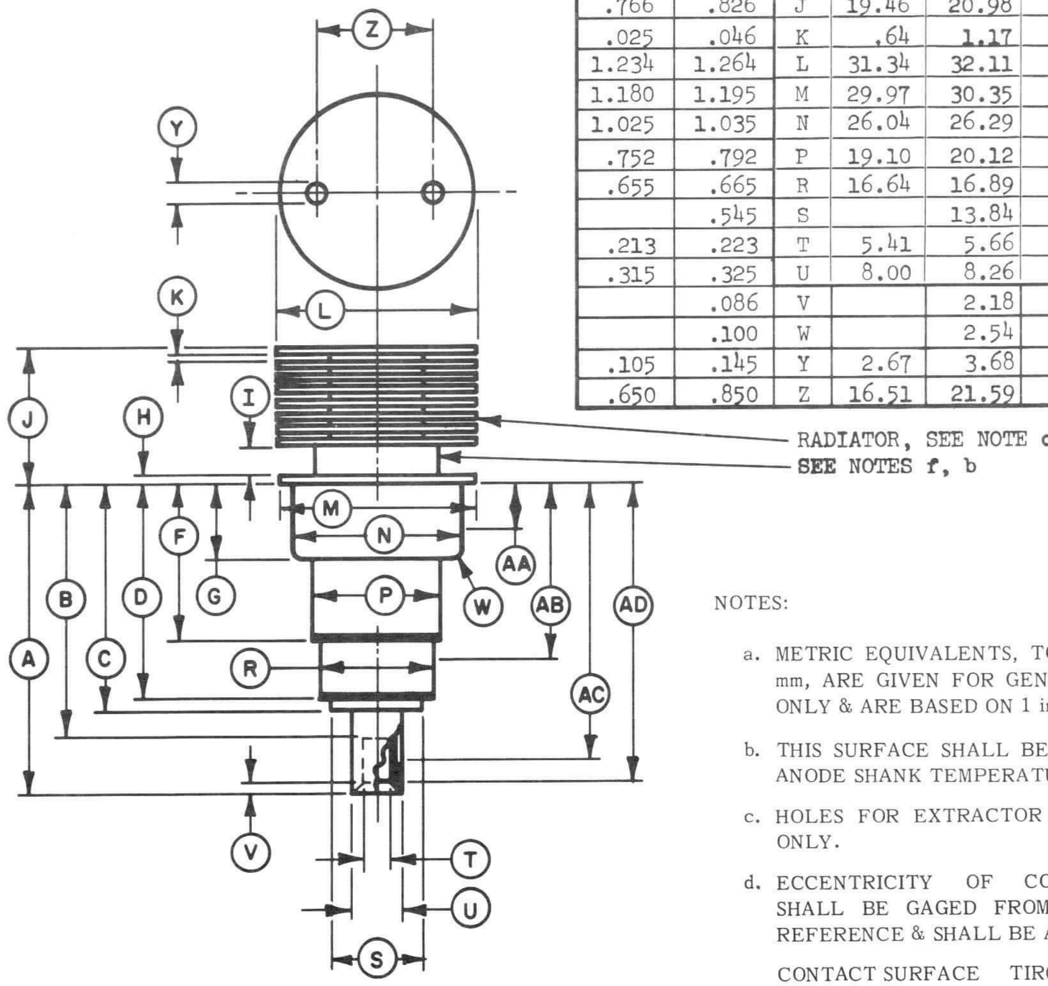
CONTACT SURFACE	TIR(MAX)	REFERENCE
ANODE	.020	CATHODE
GRID	.020	CATHODE
HEATER	.012	CATHODE

c. DIA'S N, R, T, & U SHALL APPLY THROUGHOUT ENTIRE LENGTH AS DEFINED BY DIM'S AA, AB, AC & AD RESPECTIVELY.

d. THIS SURFACE SHALL NOT BE USED FOR CLAMPING OR LOCATING.

ELECTRODE CONTACT DIMENSION				
DIM	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA					
DIM. IN INCHES			DIM. IN MILLIMETERS		
MIN.	MAX.	DIM	MIN.	MAX.	NOTES
1.185	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.046	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	e
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	
	.545	S		13.84	
.213	.223	T	5.41	5.66	e
.315	.325	U	8.00	8.26	e
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	c
.650	.850	Z	16.51	21.59	



7815 RAL

NOTES:

a. METRIC EQUIVALENTS, TO THE NEAREST .01 mm, ARE GIVEN FOR GENERAL INFORMATION ONLY & ARE BASED ON 1 inch = 25.4 mm.

b. THIS SURFACE SHALL BE USED TO MEASURE ANODE SHANK TEMPERATURE.

c. HOLES FOR EXTRACTOR THROUGH TOP FIN ONLY.

d. ECCENTRICITY OF CONTACT SURFACES SHALL BE GAGED FROM CENTER LINE OF REFERENCE & SHALL BE AS FOLLOWS:

CONTACT SURFACE	TIR(MAX)	REFERENCE
ANODE	.020	CATHODE
GRID	.020	CATHODE
HEATER	.012	CATHODE

e. DIA'S N, R, T & U SHALL APPLY THROUGHOUT ENTIRE LENGTH AS DEFINED BY DIM'S AA, AB, AC & AD RESPECTIVELY.

f. THIS SURFACE SHALL NOT BE USED FOR CLAMPING OR LOCATING.

EIMAC®

TECHNICAL DATA

7855 / 7855K

HIGH-MU PLANAR TRIODE

The EIMAC 7855 and 7855K are ruggedized high-mu planar triodes of ceramic/metal construction, designed for grid pulsed, plate pulsed and CW operation in amplifiers, oscillators and frequency multipliers from low frequency to 3 GHz. The 7855 is supplied with a radiator for forced air cooling and the 7855K without radiator for conduction and convection cooling. Except for plate dissipation ratings, the characteristics of the two tubes are the same. In addition to the low interelectrode capacitances and high transconductance these tubes exhibit special design features such as a frequency stable anode and an arc resistant cathode to assure stable operation under adverse conditions and to minimize catastrophic failure due to arc over during a circuit malfunction.

7855K   7855

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	1.00 A
Transconductance (Average):	
I_b = 70 mA	25 mmhos
Amplification Factor (Average):	80
Direct Interelectrode Capacitances (Grounded Cathode)[2]	
Cin	6.8 pF
Cout	0.04 pF
Cgp	2.50 pF
Cut-off Bias[3]	-30 V max.

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 for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.39 in; 60.60 mm
Diameter	1.27 in; 32.20 mm
Net Weight (7855)	57 gm
(7855K)	40 gm
Operating Position	Any

(Effective 8-1-71)   Printed in U.S.A.

Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling (7855)	Forced air
(7855K)	Conduction, convection
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	50,000 ft.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (grid pulsed)	2500	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	3.0	AMPERES
PULSE GRID CURRENT	1.8	AMPERES
PLATE DISSIPATION (7855)	100	WATTS
(7855K)	10	WATTS
GRID DISSIPATION	2.0	WATTS
FREQUENCY	3.0	GIGAHERTZ
PULSE DURATION[1]	6	μsec
DUTY FACTOR[1]	.0033	

TYPICAL OPERATION Grid Pulsed Oscillator, Representative Application

Plate Voltage	2000	Vdc
Grid Voltage	-75	Vdc
Heater Voltage	5.7	V
Peak Video Plate Current	1.3	a
Peak Video Grid Current	0.8	a
Useful Power Output (approx.)	750	w
Frequency	1.090	GHz
Pulse Duration	0.5	μs
Duty Factor	.001	

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	2500	VOLTS
PEAK PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	4.8	AMPERES
DC PLATE CURRENT	100	MILLIAMPERES
PLATE DISSIPATION (7855)	100	WATTS
(7855K)	10	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION[1]	6	μs
DUTY FACTOR[1]	.0033	
CUT-OFF MU	60	

1. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager Eimac-Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	0.90	1.05	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	6.00	7.50	pF
Cout	---	0.04	pF
Cgp	2.35	2.65	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

APPLICATION

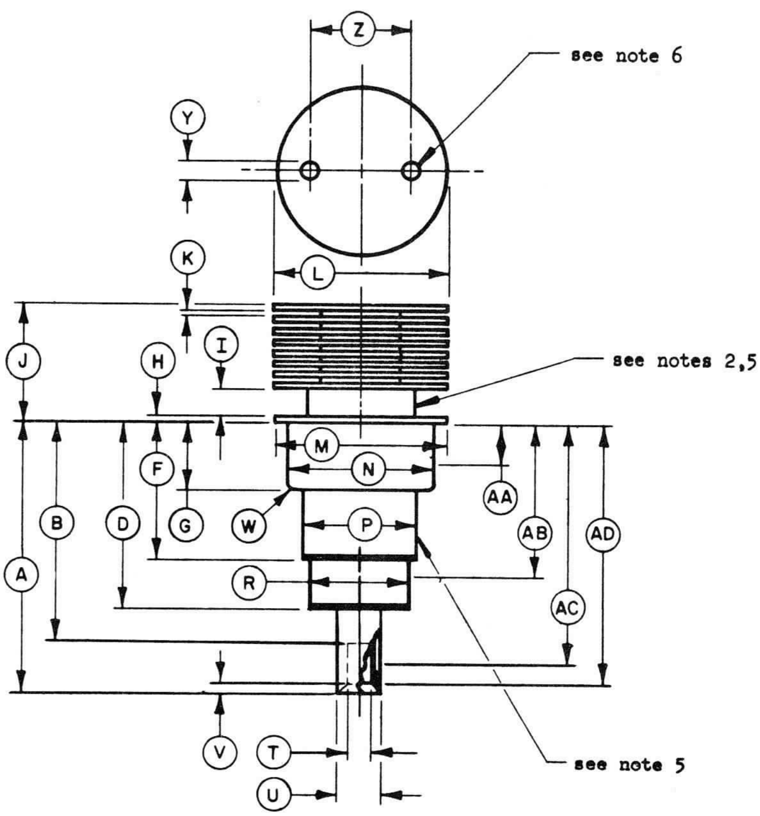
For operating information refer to EIMAC bulletin #15, "Operating Instruction for Planar Triodes."

ELECTRODE CONTACT DIMS. (see note 7)

Dim. in Inches		Dim.	Dim. in Millim.	
Min.	Max.		Min.	Max.
.035	.361	AA	.89	9.17
1.021	1.101	AB	25.93	27.97
1.219	1.413	AC	30.96	35.89
1.160	1.500	AD	29.46	38.10

DIMENSIONAL DATA

Dim. in Inches			Dim. in Millimeters	
Min.	Max.	Dim.	MIN.	MAX.
1.500	1.560	A	38.10	39.62
	1.214	B		30.84
1.125	1.165	D	28.58	29.59
.800	.840	F	20.32	21.34
.462	.477	G	11.73	12.12
	.040	H		1.02
.125	.185	I	3.18	4.70
.766	.826	J	19.46	20.98
.025	.046	K	.64	1.17
1.234	1.264	L	31.34	32.11
1.180	1.195	M	29.97	30.35
1.025	1.035	N	26.04	26.29
.752	.792	P	19.10	20.12
.655	.665	R	16.64	16.89
.213	.223	T	5.41	5.66
.315	.325	U	8.00	8.26
	.086	V		2.18
	.100	W		2.54
.105	.145	Y	2.67	3.68
.650	.850	Z	16.51	21.59



7855

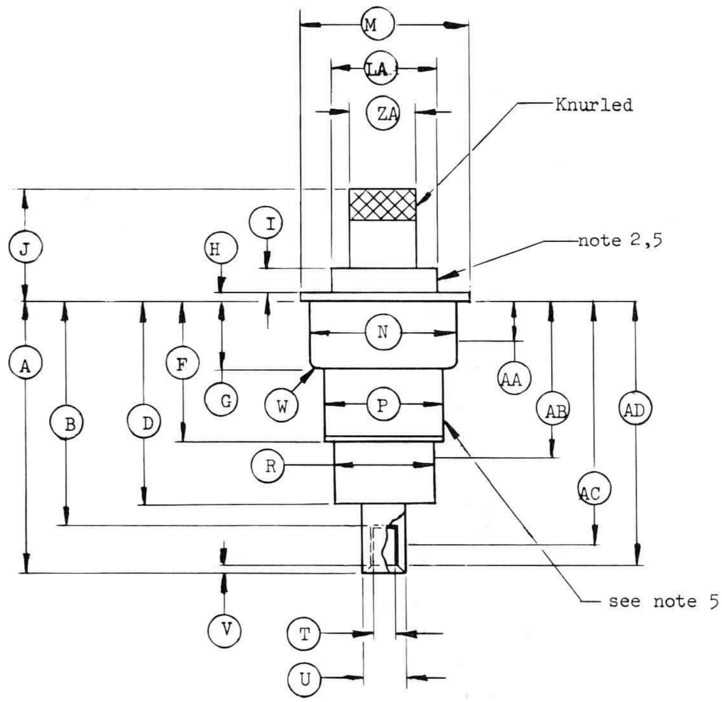
NOTES:
1. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.
2. This surface to be used to measure anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Holes for extractor thru top fin only.
7. Electrode Contact dims. are for socket design purposes & are not intended for inspection purposes.

ELECTRODE CONTACT AREA (see note 6)				
Dim. in Millimeters		Dim.	Dim. in Inches	
Min.	Max.		Min.	Max.
.89	9.17	AA	.035	.361
25.93	27.97	AB	1.021	1.101
30.96	35.89	AC	1.219	1.413
29.46	38.10	AD	1.160	1.500

DIMENSIONAL DATA				
Dim. in Inches			Dim. in Millimetres	
Min.	Max.	Dim.	MIN.	MAX.
1.500	1.560	A	38.10	39.62
	1.215	B		30.84
1.125	1.165	D	28.58	29.59
.800	.840	F	20.32	21.34
.462	.477	G	11.73	12.12
	.040	H		1.02
	.185	I		4.70
.766	.826	J	19.46	20.98
.025	.046	K	.64	1.17
1.234	1.264	L	31.34	32.11
1.180	1.195	M	29.97	30.35
1.025	1.035	N	26.04	26.29
.752	.792	P	19.10	20.12
.655	.665	R	16.64	16.89
.213	.223	T	5.41	5.66
.315	.325	U	8.00	8.26
	.086	V		2.18
	.100	W		2.54
.840	.860	LA	21.34	21.84
.427	.447	ZA	10.85	11.35



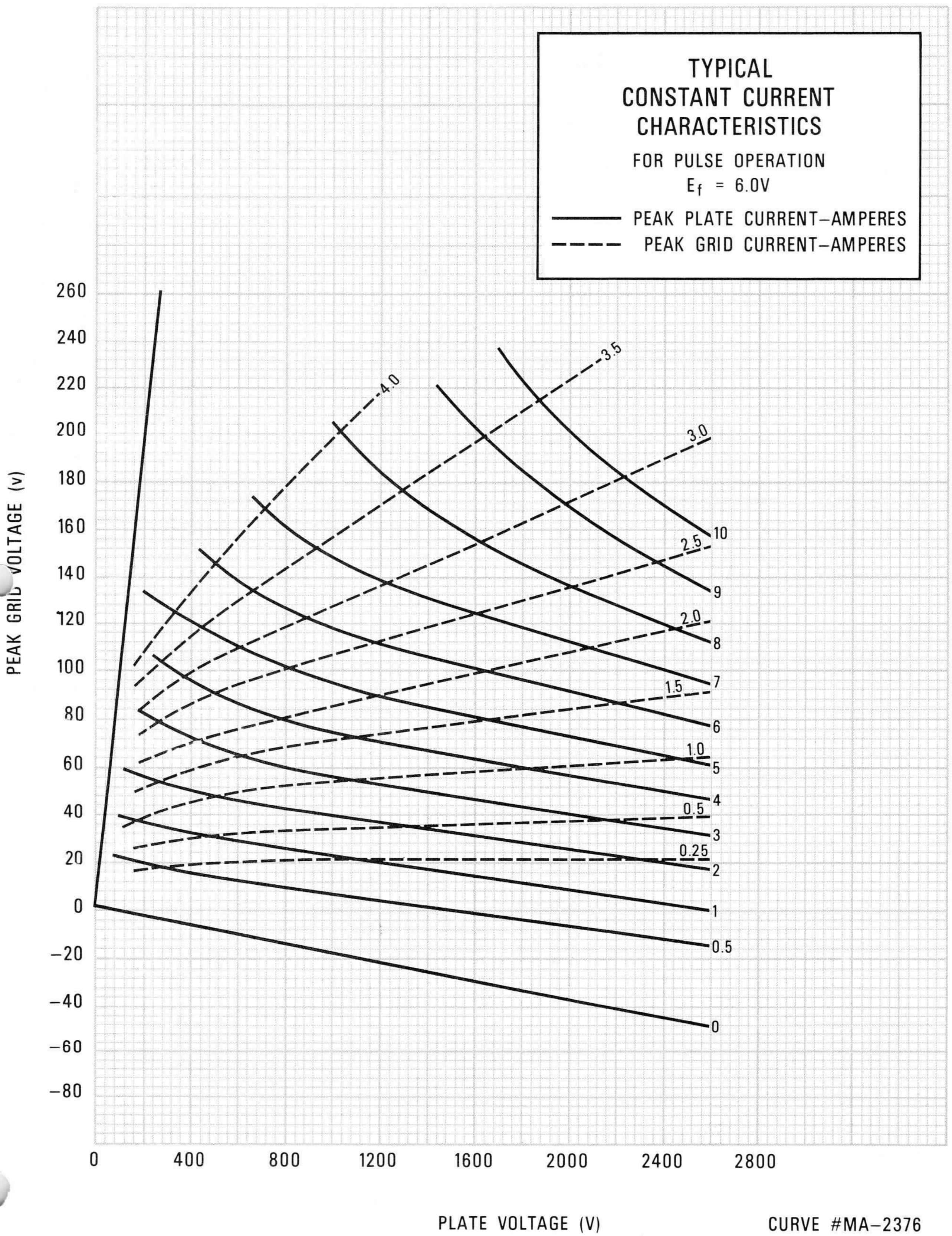
7855K

NOTES:

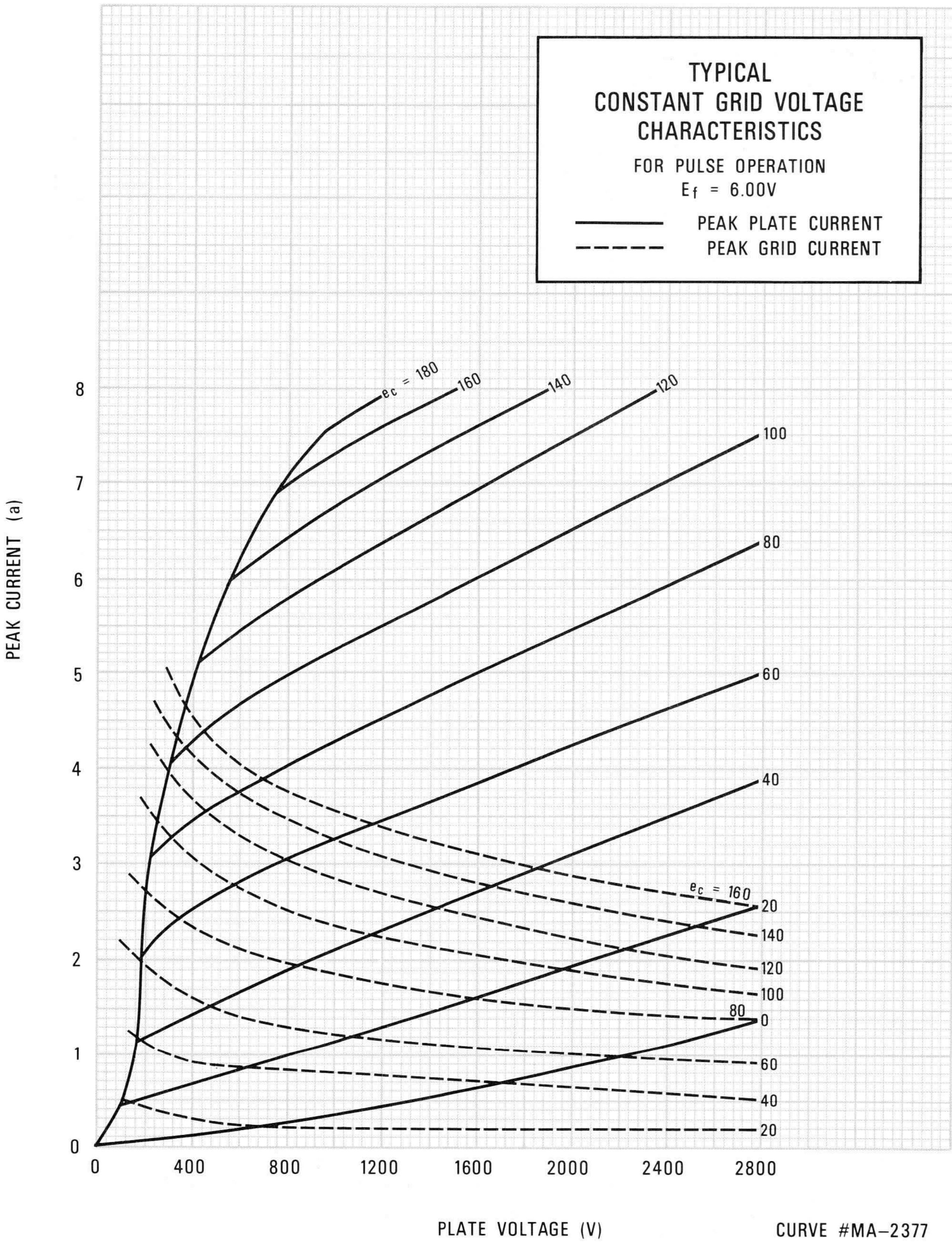
1. Metric equivalents to the nearest .01mm, are given for general information only & are based on 1 inch= 25.4 mm.
2. This surface shall be used to measure Anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T,U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Electrode Contact Dims. are intended for socket design only & are not intended for inspection purposes.



CURVE #MA–2376



CURVE #MA–2377

TECHNICAL DATA

7855AL
7855KAL

PLANAR TRIODE

The EIMAC 7855AL and 7855KAL are ceramic/metal planar triodes specially processed and tested to assure high reliability in airborne service. Evaluation of these tubes is based upon operating conditions found in commercial airborne applications such as transponders. The testing emphasizes cathode emission capability at reduced heater voltage and high voltage hold-off, both features which are demanded in airline service.

The 7855AL is derived from the 7855, the 7855KAL from the 7855K. These new improved tubes also contain features of the original types such as a frequency stable anode, rugged ceramic/metal construction, low interelectrode capacitance, high transconductance and high mu.

7855AL 7855KAL

In addition to these features, these tubes also incorporate the arc-resistant cathode which assures stable operation under adverse conditions and which minimizes catastrophic failures due to arc-over during circuit malfunction. These tubes are useable from dc to 3 GHz.

The 7855KAL utilizes conduction-convection cooling. The 7855AL is supplied with a radiator for forced-air cooling. Except for the plate dissipation ratings, the two tubes have identical electrical characteristics.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.7 ± 2%	V
Current, at 5.7 volts	0.95	A
Transconductance (Average):		
I_b = 70 mAdc, E_b = 600 Vdc	25	mmhos
Amplification Factor (Average)	100	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	6.80	pF
Cout	0.04	pF max.
Cgp	2.50	pF
Cut-off Bias[3]	-30	V
Frequency of Maximum Rating:		
Plate or Grid-Pulsed	3000	MHz

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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pf due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length (7855AL)	2.386 in; 60.60 mm
(7855KAL)	2.386 in; 60.60 mm
Diameter (7855AL)	1.264 in; 32.11 mm
(7855KAL)	1.195 in; 30.35 mm
Net Weight (7855AL)	2.01 oz; 57 gm
(7855KAL)	1.41 oz; 40 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling - 7855AL (With Radiator)	Forced Air
- 7855KAL (Without Radiator)	Conduction and Convection
Terminals	Coaxial special

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.7 volts	0.87	1.02	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	6.00	7.50	pF
Cout	---	0.40	pF
Cgp	2.35	2.65	pF

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

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	2500	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	3.0	AMPERES
PULSE GRID CURRENT	1.8	AMPERES
AVERAGE PLATE DISSIPATION		
Conduction and convection (7855KAL)	10	WATTS
Forced Air (7855AL)[1]	35	WATTS
GRID DISSIPATION (Average)	2.0	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	

1. Using EIMAC radiator PN 158601.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City,

OPERATING CONDITIONS

GRID PULSED OSCILLATOR

Frequency	1.090	GHz
Heater Voltage	5.7	V
DC Plate Voltage	2000	Vdc
DC Grid Voltage	-75	Vdc
Peak Video Plate Current	1.3	a
Peak Video Grid Current	0.8	a
Useful Power Output (approx.)	750	w
Pulse Duration	0.5	μs
Duty Factor	0.001	

PLATE PULSED AMPLIFIER

Frequency	1.1	GHz
Heater Voltage	5.7	V
Peak Plate Voltage	2000	v
Peak Video Plate Current	1.8	a
Peak Video Grid Current	1.0	a
Useful Power Output (approx.)	1800	w
Pulse Duration	3.5	μs
Duty Factor	0.001	
Gain	8	db
Plate Efficiency	50	%

APPLICATION

MECHANICAL

MOUNTING - The important dimensions of the tube are carefully controlled with respect to the reference surface as shown on the outline drawing. The reference surface is intended to serve as a tube stop and the location of the tube in the circuit should therefore be determined by this surface coming in positive contact with a precisely positioned member of the socket or cavity. Adherence to this practice will assure both mechanical and electrical interchangeability of all tubes of a given type. If a non-designated surface is used as a tube stop, faulty positioning of the tube in the cavity and possible incomplete electrical contact can result in improper tuning, reduced power output and damage to the cavity, tube or both. Contact surfaces, with reference to the designated tube stop are shown in the outline drawing. Electrical contact to the cathode, grid, anode and also the heater should be restricted to these designated contact areas.

Dimensions should never be taken from sample tubes. Dimensional changes due to normal variations in undimensioned surfaces may occur within the limits specified on the outline drawing. Use of nondesignated electrical contact surfaces might therefore result in incomplete contact or mechanical interference, causing changes in cavity tuning.

Electrical contact should be made by spring finger collets bearing against the previously described contact areas. If connections are employed which do not provide multiple contacts to the designated contact areas, concentration of RF current will result in loss of output power, especially at higher frequencies. The spring contacts used should exert a firm pressure without gouging the plated contact surface. This latter phenomena can result in loose particles of material which can cause arcing or unstable operation of the cavity.

If the tubes are used in applications which call for severe shock or vibration the tube may be clamped in place by the knob or radiator, exerting pressure only on this part of the tube and against the tube stop. No other portion of the tube should be subject to any clamping force. In particular, electrical contacts which utilize setscrews or rigid clamps should be avoided. Such contact schemes can distort the contact surfaces causing undue stress in the metal-to-ceramic seal area which may result in a vacuum leak. Soldered electrical connections can be made, however great care should be taken during the solder operation to avoid fracture of the seal area due to thermal shock. All contact surfaces should be kept clean to minimize losses.

COOLING - The EIMAC planar triodes are designed to operate at envelope and anode temperatures of up to the maximum rated value of 250°C. However, performance and long-term reliability of any component are improved when it is kept as cool as technically feasible. Therefore, it is recommended that sufficient cooling be provided to keep the anode and seal areas well below the specified maximum temperature, where long tube life and high reliability are of great importance.

The maximum plate dissipation of the 7855KAL is 10 watts average power. This can be accomplished by conduction, natural convection or forced air convection cooling. The maximum plate dissipation of the 7855AL in pulse service is 35 watts average and forced air cooling must be employed at that level. When forced air cooling is used, it is recommended that additional airflow, apart from that flowing through the radiator be used to cool the tube envelope and other tube terminals. A certain amount of conduction cooling is usually inherent in the contact finger configuration. It should be noted, however, that spring fingers provide poor heat conduction and measurements have shown a temperature difference as much as 50°C between the contact finger and contact area.

It is suggested that in all new applications the envelope temperature be measured, especially if the tube is used close to the upper temperature limit. The temperature can easily be determined by the use of Tempilaq paint (Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield N.J. 07080) or Temp-Plate stickers (Pydrodyne, Inc., 1001 Colorado, Santa Monica, Calif. 90404).

ELECTRICAL

HEATER VOLTAGE - The rated heater voltage for either tube type is 5.7 volts and should be controlled within ±2% to obtain maximum tube life and to minimize variations in circuit performance. The rated heater voltage is optimum for most existing airborne applications such as DME and transponder systems. However, there are other applications where a different heater voltage than the nominal should be used to obtain the longest possible tube life. Depending on pulse width, power output and frequency of oscillation used a different heater voltage may be better for long reliable life. Electron transit time is not necessarily small with respect to the period of oscillation and the amount of driving power diverted will contribute to the cathode heating by electron bombardment.

The proper adjustment of the heater voltage must be made to compensate for this additional heating, which depends on operating frequency and duty cycle employed.

INTERELECTRODE CAPACITANCES - As indicated, the capacitance values are shown for measurements made with no heater voltage. The cathode to grid and cathode to plate capacitance will increase with the application of the heater voltage, due to the thermal expansion of the cathode support. Typically, the increase in the grid to cathode capacitance will be 15%, or more, depending on the heater voltage. Since the heater voltage can vary depending on use, data taken without heater voltage is more useful for control of tube-to-tube uniformity. The grid to anode capacitance is not effected by the application of the heater voltage.

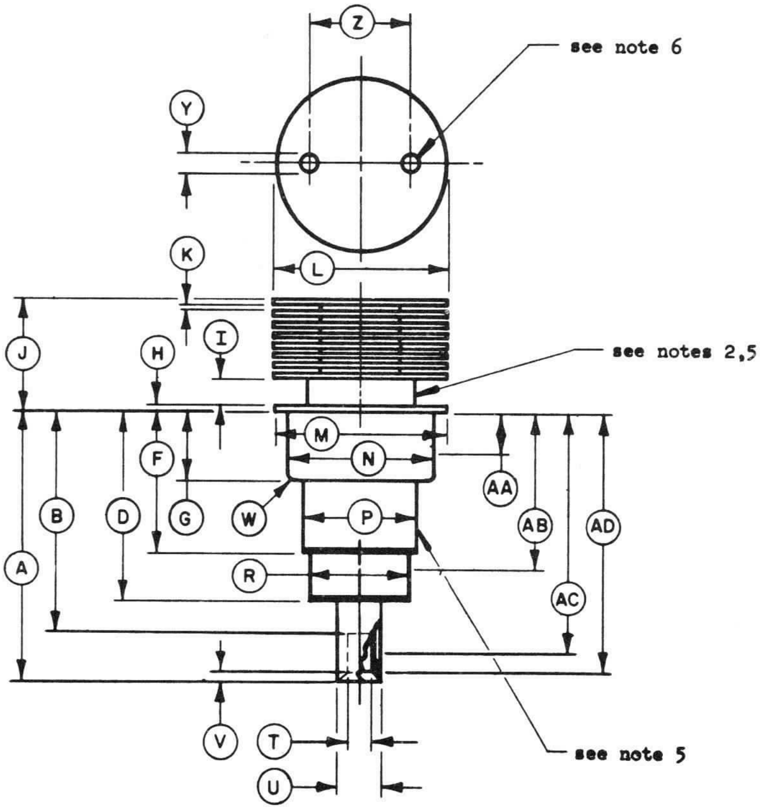
CIRCUIT TUNING - Especially under grid pulse conditions, it is important that the tube does not lose bias or momentarily go into a CW mode. Either of these events may result in tube failure. It is suggested that provision be made for initial circuit tune-up at reduced anode voltage and for extra tube protection when the circuit adjustment is critical. The average grid dissipation capability of these tubes is 2.0 watts. For many applications the limiting factor is often not anode dissipation or cathode emission capability, but grid dissipation. If pulse width control is lost in pulse applications the grid can exceed safe operating temperatures in 50 ms or less. Appropriate circuit protection during tune up is therefore recommended.

CATHODE OPERATION - The 7855AL and 7855KAL contain an arc-resistant cathode. Performance in the field and laboratory indicates these tubes are capable of withstanding some abuse due to high voltage arcs, however, poor circuit adjustment in the field may result in shortened tube life. It is, therefore, suggested that wherever feasible, the plate supply be designed such that its impedance limits the short circuit current to within five to ten times the maximum forward current. For pulse service the peak current should be limited to the values listed. Higher pulse width and duty cycles than given can be obtained with proper derating of the current. For this and special applications it is recommended that the user request additional information pertaining to his special application from the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

SPECIAL APPLICATION - For further operating information refer to EIMAC bulletin #15 "Operating Instructions for Planar Triodes".

ELECTRODE CONTACT DIMS. (see note 7)				
Dim. in Inches		Dim.	Dim. in Millim.	
Min.	Max.		Min.	Max.
.035	.361	AA	.89	9.17
1.021	1.101	AB	25.93	27.97
1.219	1.413	AC	30.96	35.89
1.160	1.500	AD	29.46	38.10

DIMENSIONAL DATA				
Dim. in Inches			Dim. in Millimeters	
Min.	Max.	Dim.	MIN.	MAX.
1.500	1.560	A	38.10	39.62
	1.214	B		30.84
1.125	1.165	D	28.58	29.59
.800	.840	F	20.32	21.34
.462	.477	G	11.73	12.12
	.040	H		1.02
.125	.185	I	3.18	4.70
.766	.826	J	19.46	20.98
.025	.046	K	.64	1.17
1.234	1.264	L	31.34	32.11
1.180	1.195	M	29.97	30.35
1.025	1.035	N	26.04	26.29
.752	.792	P	19.10	20.12
.655	.665	R	16.64	16.89
.213	.223	T	5.41	5.66
.315	.325	U	8.00	8.26
	.086	V		2.18
	.100	W		2.54
.105	.145	Y	2.67	3.68
.650	.850	Z	16.51	21.59



NOTES:

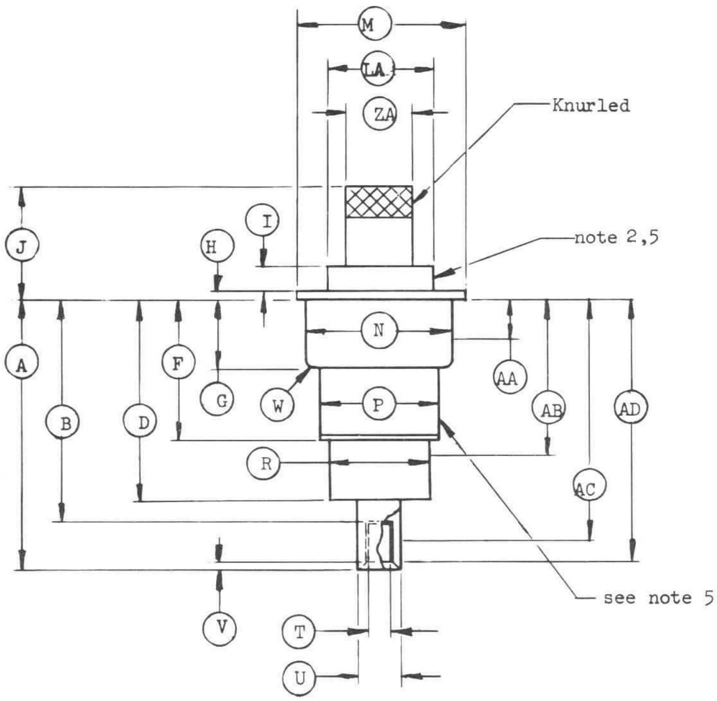
1. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.
2. This surface to be used to measure anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Holes for extractor thru top fin only.
7. Electrode Contact dims. are for socket design purposes & are not intended for inspection purposes.

ELECTRODE CONTACT AREA (see note 6)				
Dim. in Millimeters		Dim.	Dim. in Inches	
Min.	Max.		Min.	Max.
.89	9.17	AA	.035	.361
25.93	27.97	AB	1.021	1.101
30.96	35.89	AC	1.219	1.413
29.46	38.10	AD	1.160	1.500

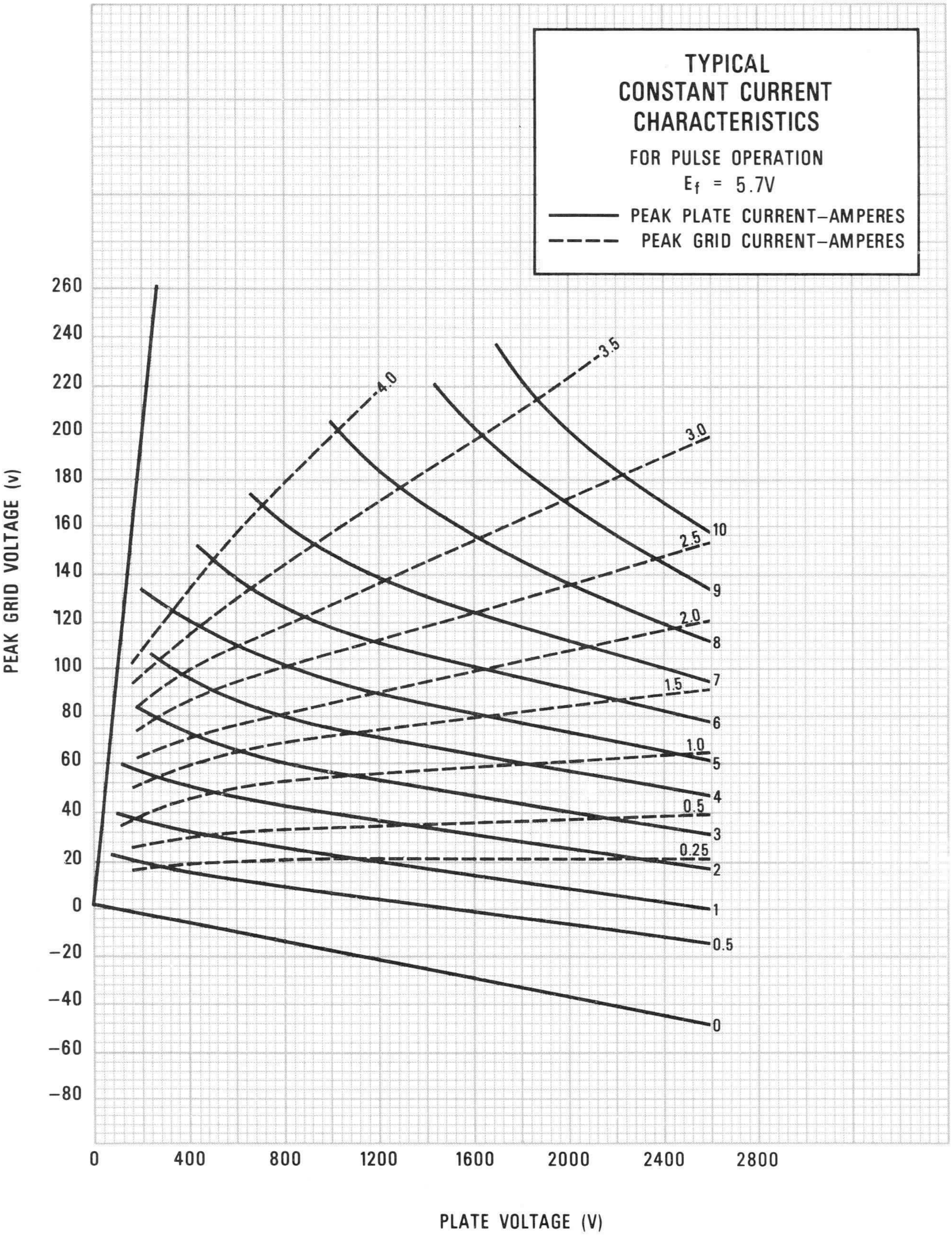
DIMENSIONAL DATA				
Dim. in Inches		Dim. in Millimetres		
Min.	Max.	Dim.	MIN.	MAX.
1.500	1.560	A	38.10	39.62
	1.214	B		30.84
1.125	1.165	D	28.58	29.59
.800	.840	F	20.32	21.34
.462	.477	G	11.73	12.12
	.040	H		1.02
	.185	I		4.70
.766	.826	J	19.46	20.98
.025	.046	K	.64	1.17
1.234	1.264	L	31.34	32.11
1.180	1.195	M	29.97	30.35
1.025	1.035	N	26.04	26.29
.752	.792	P	19.10	20.12
.655	.665	R	16.64	16.89
.213	.223	T	5.41	5.66
.315	.325	U	8.00	8.26
	.086	V		2.18
	.100	W		2.54
.840	.860	LA	21.34	21.84
.427	.447	ZA	10.85	11.35



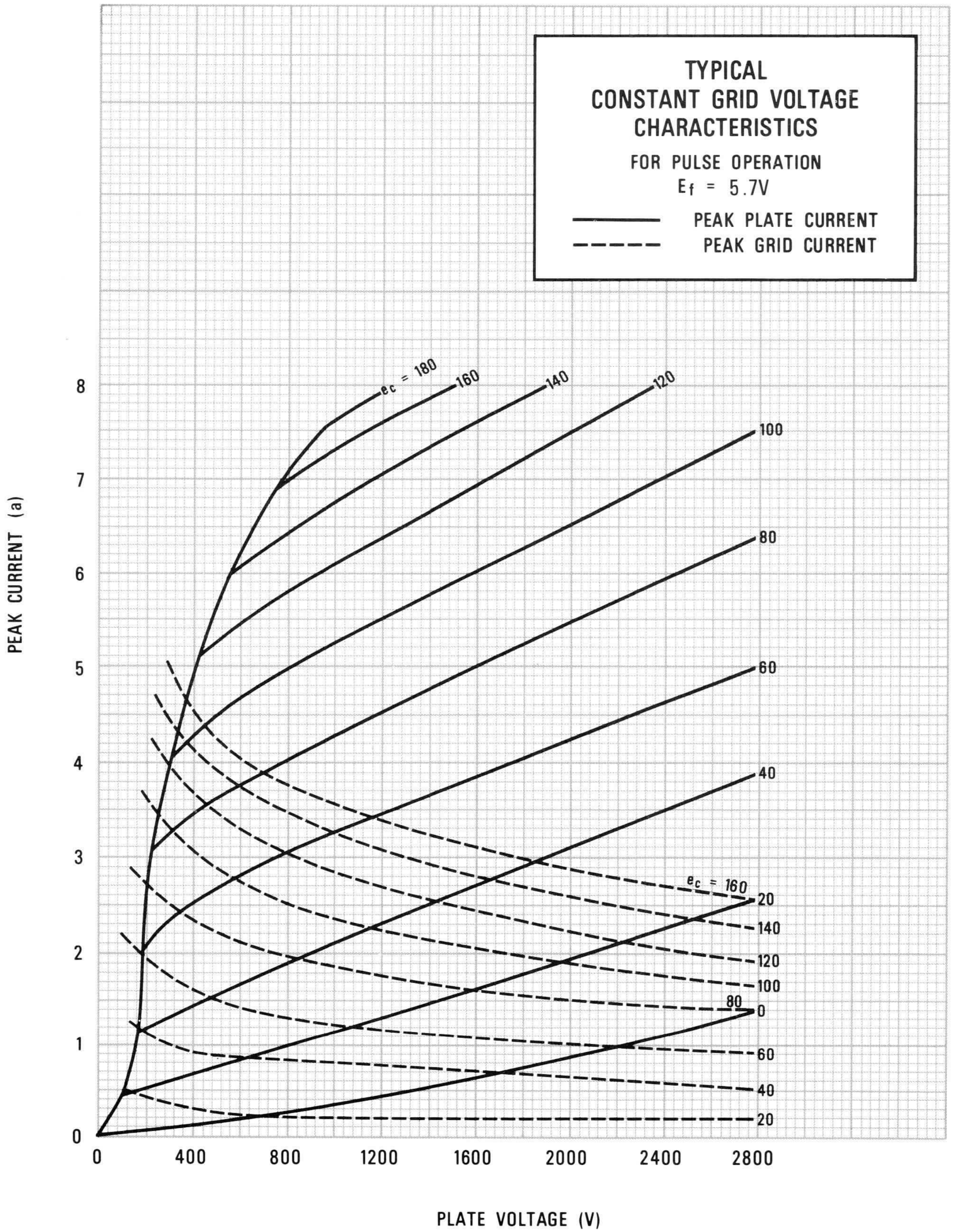
NOTES:
1. Metric equivalents to the nearest .01mm, are given for general information only & are based on 1 inch= 25.4 mm.
2. This surface shall be used to measure Anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

4. Dias. N,R,T,U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Electrode Contact Dims. are intended for socket design only & are not intended for inspection purposes.



TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 5.7V
PEAK PLATE CURRENT–AMPERES
PEAK GRID CURRENT–AMPERES
PEAK GRID VOLTAGE (v)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
−20
−40
−60
−80
0
400
800
1200
1600
2000
2400
2800
PLATE VOLTAGE (V)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
10
9
8
7
6
5
4
3
2
1
0.5
0

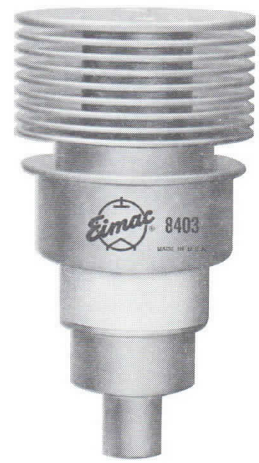

TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
Ef = 5.7V
PEAK PLATE CURRENT
PEAK GRID CURRENT
ec = 180
160
140
120
100
80
60
40
20
ec = 160
140
120
100
80
60
40
20
PEAK CURRENT (a)
PLATE VOLTAGE (V)
0
400
800
1200
1600
2000
2400
2800
1
2
3
4
5
6
7
8

8403

TECHNICAL DATA

PLANAR TRIODE

The EIMAC Type 8403 is a planar triode featuring frequency stability and an arc resistant cathode of high emission capability assuring stable operation under adverse conditions involving a wide ambient temperature range and varying plate dissipation. This construction, in combination with the proper plate series impedance, reduces to a minimum the possibility of cathode failures due to voltage surges. Other features of this type include high transconductance, high mu, and low interelectrode capacitances coupled with the great mechanical strength of metal/ceramic construction. The cathode is an indirectly heated disc requiring only minimal heater power. The design of the tube permits operation from low frequencies up to 3.0 GHz as a grid-pulsed, plate-pulsed, or CW oscillator, amplifier, or frequency multiplier.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	1.3 A
Transconductance (Average):	
I_b = 160 mA (200 mA/cm^2)	30 mmhos
Amplification Factor (Average):	80
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	8.0 pF
Cout (maximum)	0.065 pF
Cgp	3.1 pF
Cut-off Bias (maximum)[3]	-30 V max
Frequency of Maximum Rating:	
CW	2500 MHz
Plate or Grid-Pulsed	3000 MHz

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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Effective 12-1-71) Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.386 in; 60.60 mm
Diameter	1.264 in; 32.11 mm
Net Weight	2.04 oz; 58 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axis	10 G
Altitude	60,000 ft.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance [1]			
Cin	7.5	9.0	pF
Cout	---	0.065	pF
Cgp	2.95	3.25	pF

1. Capacitance value for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE (grid pulsed)	2500	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.0	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling [1]	100	WATTS
GRID DISSIPATION (Average)	2.0	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION [2]	6.0	μs
DUTY FACTOR [2]	.0033	

OPERATING CONDITIONS for 8403 in Representative Application

GRID PULSED OSCILLATOR

Frequency	1.09	GHz
Heater Voltage	6.3	V
DC Plate Voltage	2000	Vdc
DC Grid Voltage	-150	Vdc
Peak Video Plate Current	4.0	a
Peak Video Grid Current	1.0	a
Useful Power Output (Approx.)	1000	w
Pulse Duration	0.5	μs
Duty Factor	.005	

1. Using EIMAC radiator PN 158601.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake, City, Utah.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	150	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced air cooling[1]	100	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	2.5	GHz

OPERATING CONDITIONS for 8403 in Representative Application

GROUNDED GRID CW OSCILLATOR

Frequency	2500	GHz
Heater Voltage	6.0	V
DC Plate Voltage	900	Vdc
DC Grid Voltage (Approx.)	-20	Vdc
DC Plate Current	140	mAdc
DC Grid Current	15	mAdc
Useful CW Power Output	25	W

1. Using EIMAC radiator PN 158601.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

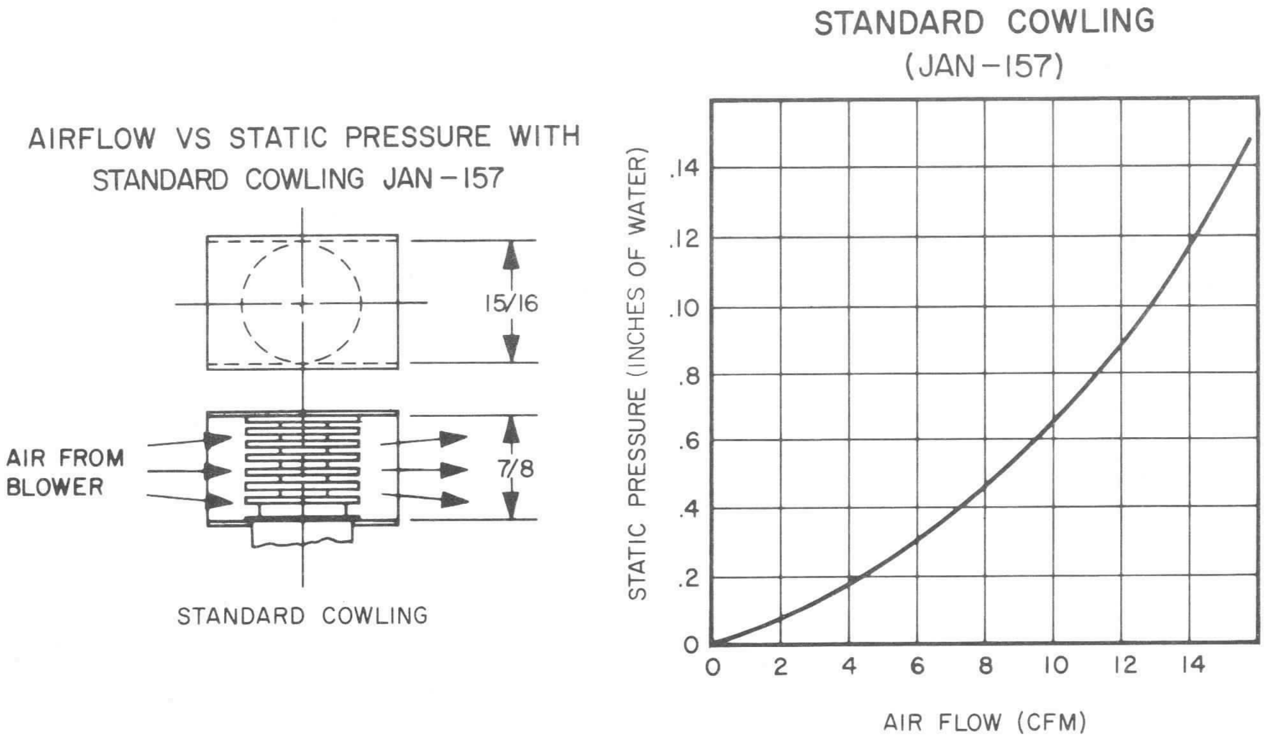
ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
PEAK PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	+150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	100	WATTS
GRID DISSIPATION (average)	1.5	WATTS
PULSE DURATION[2]	6.0	μs
CUT-OFF MU	60	
DUTY	.0033	

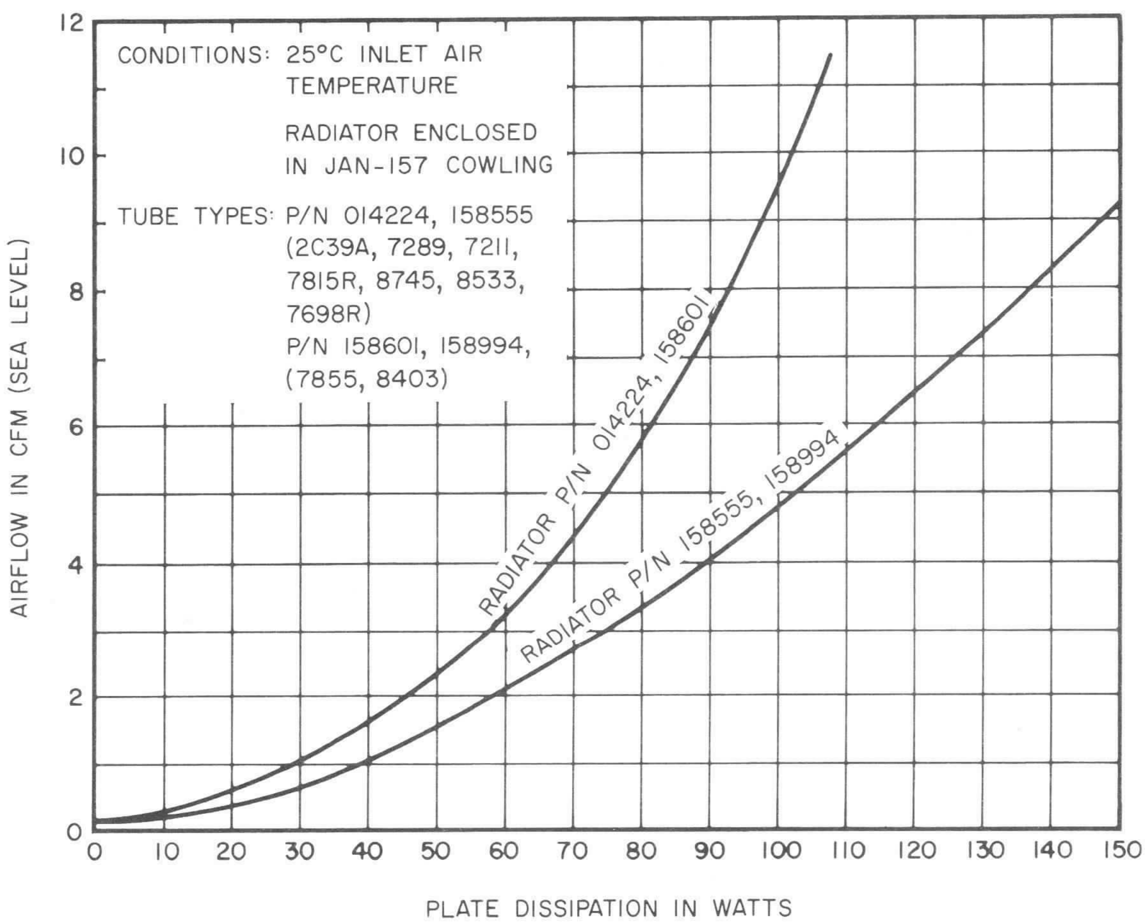
1. Using EIMAC radiator PN 158601.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

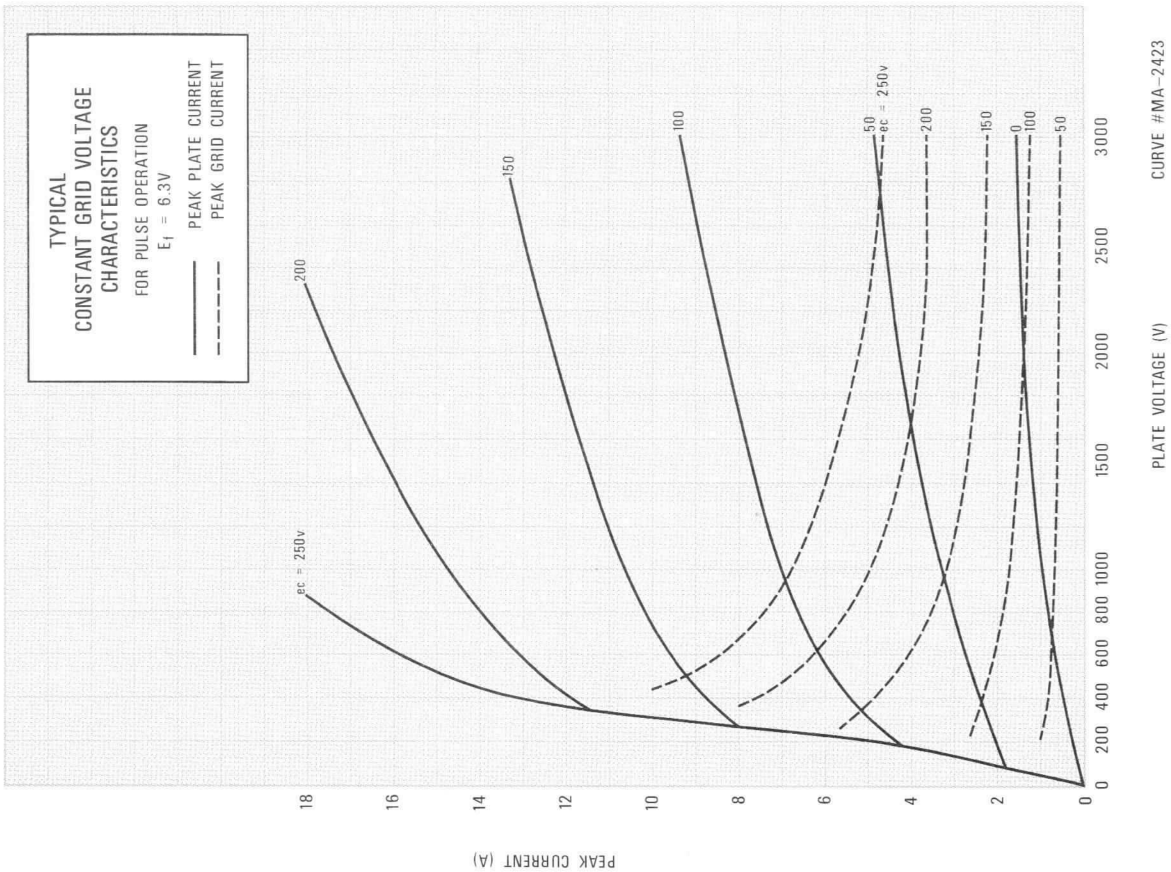
APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

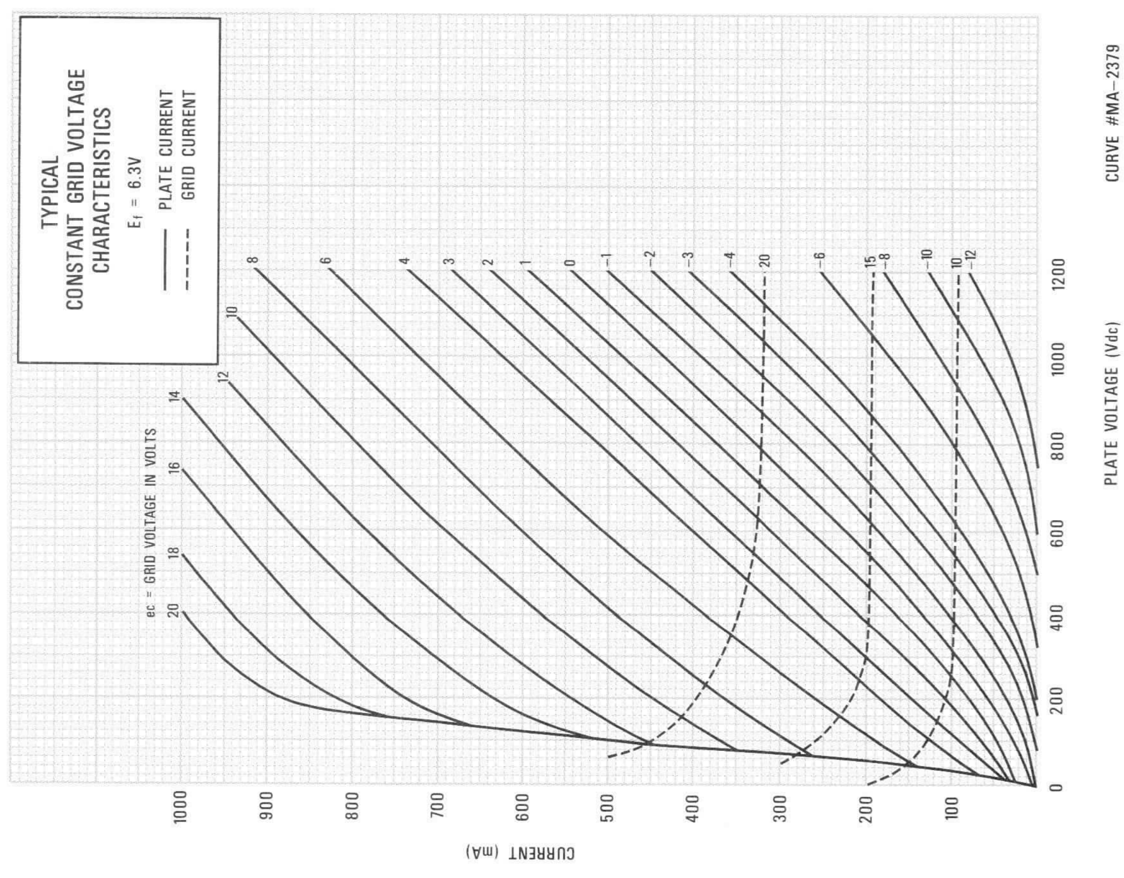


MAXIMUM PLATE DISSIPATION VS COOLING AIRFLOW

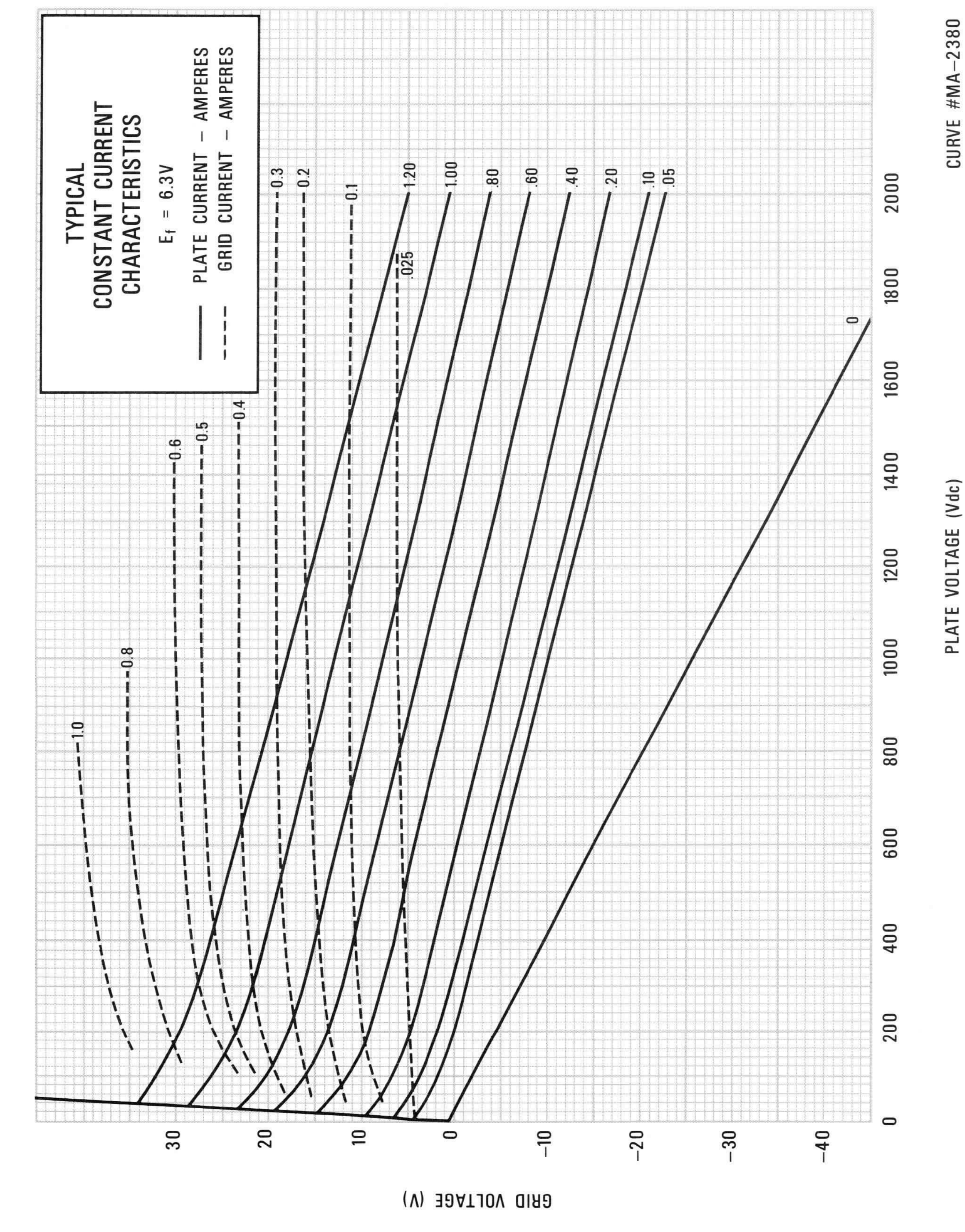




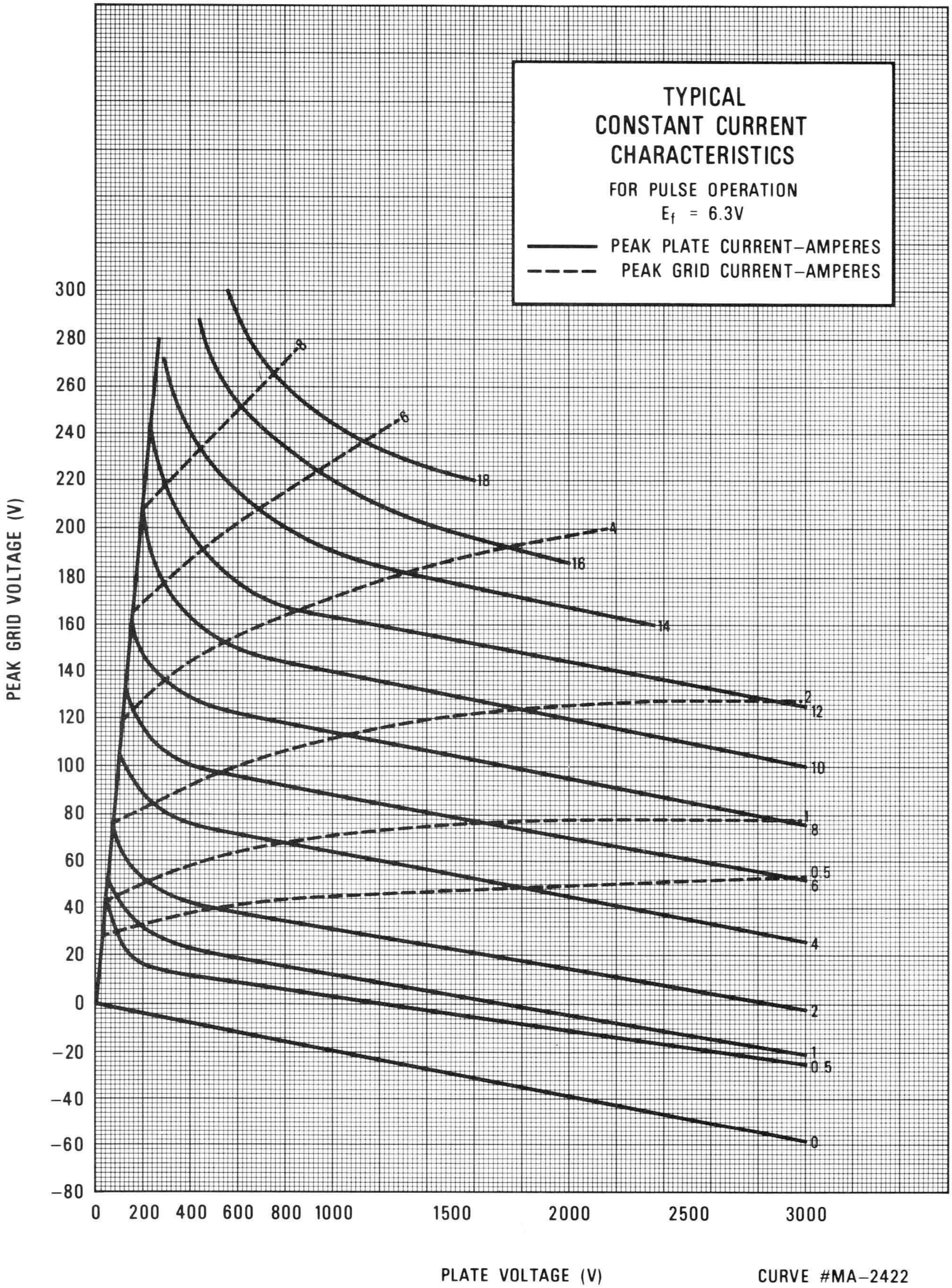
TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
Ef = 6.3V
PEAK PLATE CURRENT
PEAK GRID CURRENT
ec = 250v
200
150
100
50
0
PEAK CURRENT (A)
PLATE VOLTAGE (V)
CURVE #MA-2423



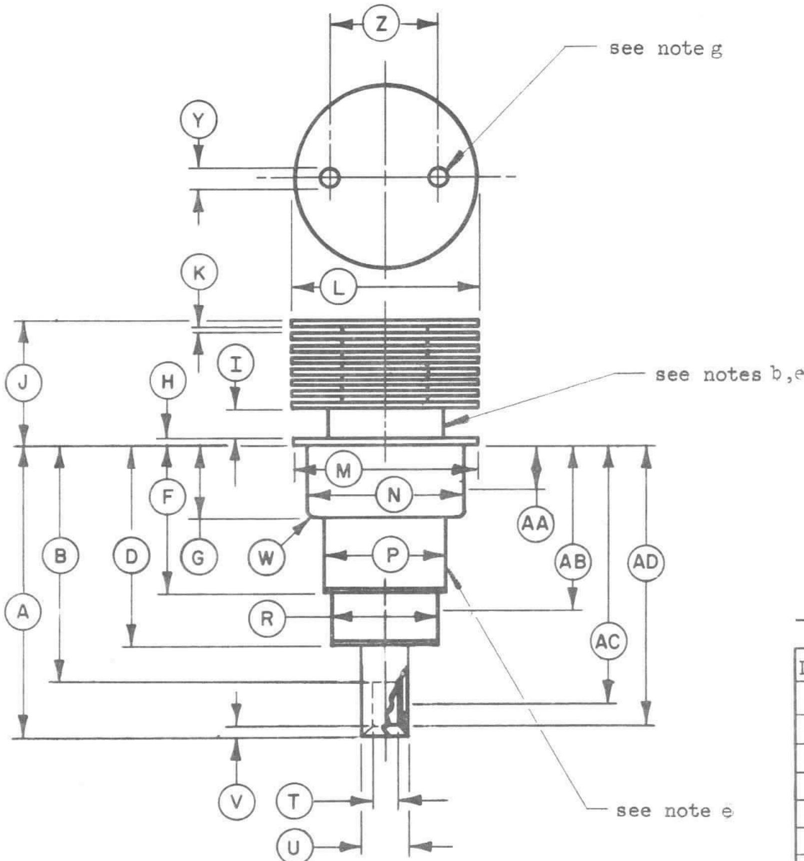
TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
Ef = 6.3V
PLATE CURRENT
GRID CURRENT
ec = GRID VOLTAGE IN VOLTS
CURRENT (mA)
PLATE VOLTAGE (Vdc)
CURVE #MA-2379



TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 6.3V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
1.20
1.00
.80
.60
.40
.20
.10
.05
0
1.0
0.8
0.6
0.5
0.4
0.3
0.2
0.1
.025
30
20
10
0
–10
–20
–30
–40
GRID VOLTAGE (V)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
PLATE VOLTAGE (Vdc)
CURVE #MA–2380



CURVE #MA–2422



ELECTRODE CONTACT DIMS. (see note a,f)				
Dim. in Inches		Dim.	Dim. in Millim.	
Min.	Max.		Min.	Max.
.035	.361	AA	.89	9.17
1.021	1.101	AB	25.93	27.97
1.219	1.413	AC	30.96	35.89
1.160	1.500	AD	29.46	38.10

DIMENSIONAL DATA (Note a)					
Dim. in Inches			Dim. in Millimeters		
Min.	Max.	Dim.	MIN.	MAX.	
1.500	1.560	A	38.10	39.62	
	1.214	B		30.84	
1.125	1.165	D	28.58	29.59	
.800	.840	F	20.32	21.34	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.046	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	
.213	.223	T	5.41	5.66	
.315	.325	U	8.00	8.26	
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	
.650	.850	Z	16.51	21.59	

NOTES:

a. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.

b. This surface to be used to measure anode shank temperature.

c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

d. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.

e. This surface shall not be used for clamping or locating.

f. Electrode Contact dims. are for socket design purposes & are not intended for inspection purposes.

g. Holes for tube extractor thru top fin only

TECHNICAL DATA

PLANAR TRIODE

The EIMAC Type 8533 is a planar triode designed for use as a grid- or plate-pulsed oscillator, amplifier, frequency multiplier, or switch tube at high plate voltages. The tube will operate from low frequencies up to 3.0 GHz. The extended grid-to-anode insulator and a matrix cathode of the arc resistant extended interface type permit reliable operation up to 8 kVdc in RF applications. Other features of this tube type include high transconductance, high mu, and high current capability coupled with great mechanical strength permitting operation at elevated temperatures. The compact metal and ceramic coaxial construction coupled with low interelectrode capacitances make this tube well suited for operation in line type circuits at lower frequencies as well as in cavity resonators at the higher frequencies. The cathode is an indirectly heated disc requiring only minimal heater power.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	1.3 A
Transconductance (Average):	
I_b = 160 mA (200 mA/cm^2)	30 mmhos
Amplification Factor (Average):	145
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	8.0 pF
Cout	0.06 pF
Cgp	1.65 pF
Cut-off Bias[3]	-30 V max.
Frequency of Maximum Rating:	
CW	3000 MHz
Plate or Grid-Pulsed	3000 MHz

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. When the cathode is heated to the proper temperature,the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

 Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.701 in; 68.60 mm
Diameter	1.264 in; 32.11 mm
Net Weight	63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Terminals	Coaxial, special

ENVIRONMENTAL

Shock: 11 ms, non-operating	60 G
Vibration: Operating, All Axis	10 G
Altitude: max., in suitably designed circuit	60,000 ft.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	7.00	9.00	pF
Cout	---	0.06	pF
Cgp	1.50	1.80	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	8000	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	10,000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	100	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	

1. Using EIMAC radiator PN 014224.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000	VOLTS
PEAK PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode . .	-750	VOLTS
Grid positive to cathode . .	150	VOLTS
PULSE CATHODE CURRENT . .	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	100	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	
CUT-OFF MU	90	

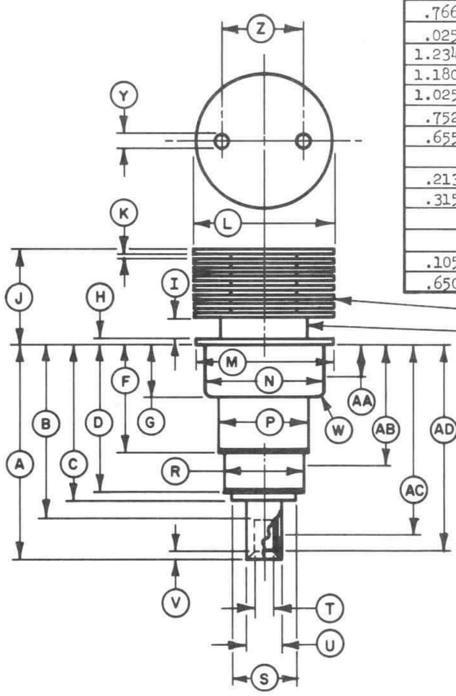
1. Using EIMAC radiator PN 014224.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

ELECTRODE CONTACT DIMENSION				
DIM	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA					
DIM. IN INCHES			DIM. IN MILLIMETERS		
MIN.	MAX.	DIM	MIN.	MAX.	NOTES
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.046	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	e
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	
	.545	S		13.84	
.213	.223	T	5.41	5.66	e
.315	.325	U	8.00	8.26	e
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	c
.650	.850	Z	16.51	21.59	



RADIATOR, SEE NOTE c
SEE NOTES f, b

NOTES:

a. METRIC EQUIVALENTS, TO THE NEAREST .01 mm, ARE GIVEN FOR GENERAL INFORMATION ONLY & ARE BASED ON 1 inch = 25.4 mm.

b. THIS SURFACE SHALL BE USED TO MEASURE ANODE SHANK TEMPERATURE.

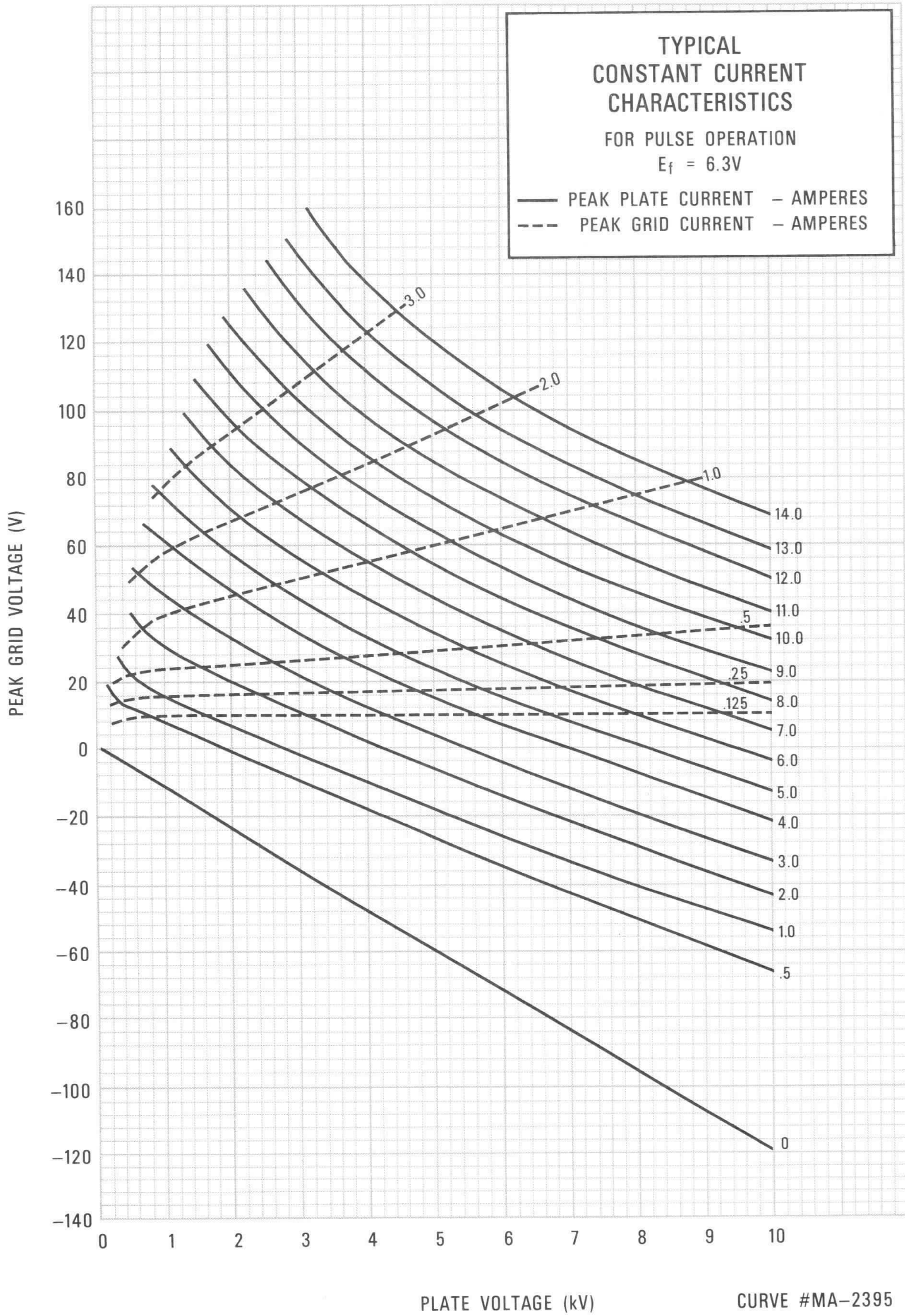
c. HOLES FOR EXTRACTOR THROUGH TOP FIN ONLY.

d. ECCENTRICITY OF CONTACT SURFACES SHALL BE GAGED FROM CENTER LINE OF REFERENCE & SHALL BE AS FOLLOWS:

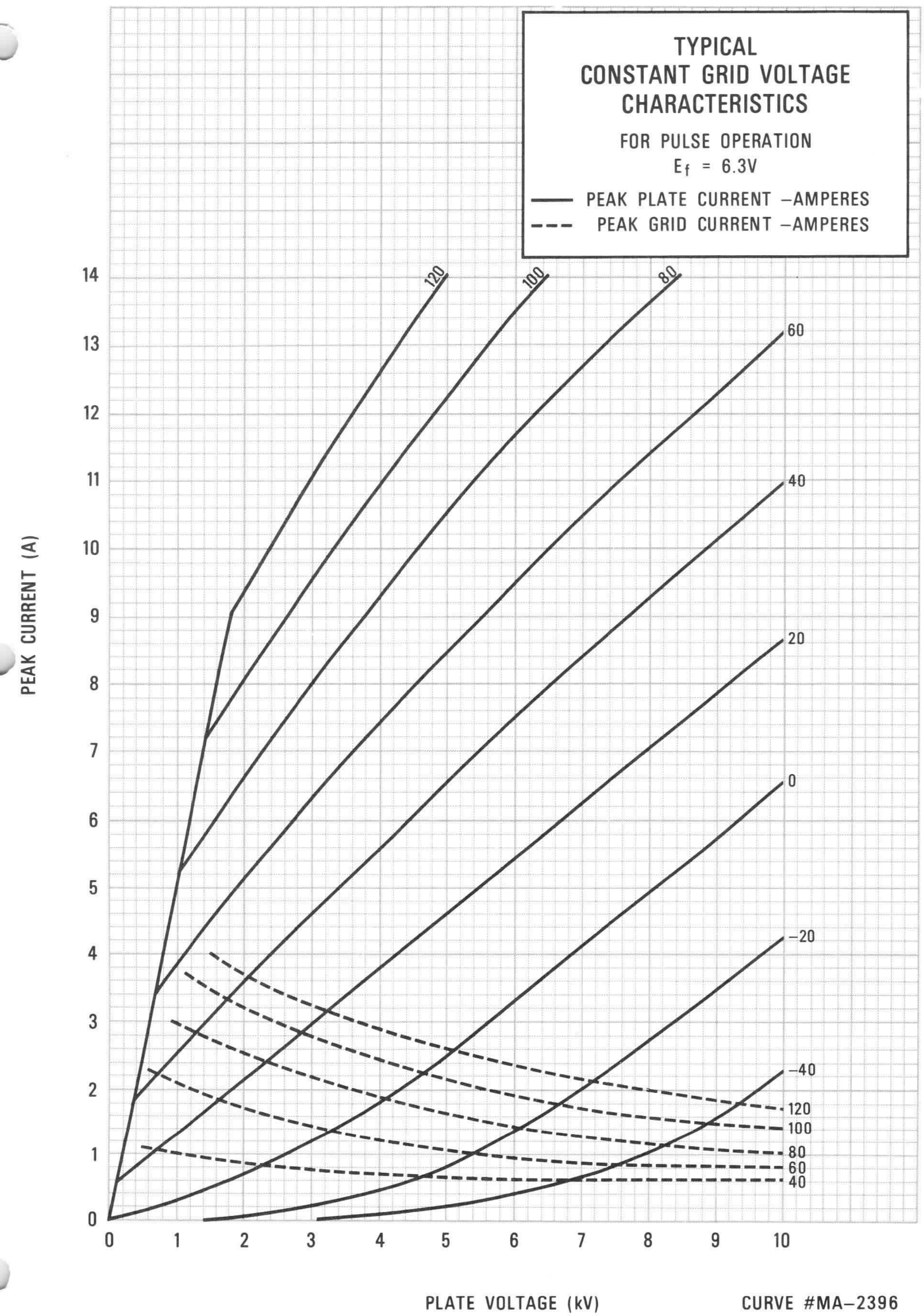
CONTACT SURFACE	TIR(MAX)	REFERENCE
ANODE	.020	CATHODE
GRID	.020	CATHODE
HEATER	.012	CATHODE

e. DIA'S N, R, T & U SHALL APPLY THROUGHOUT ENTIRE LENGTH AS DEFINED BY DIM'S AA, AB, AC & AD RESPECTIVELY.

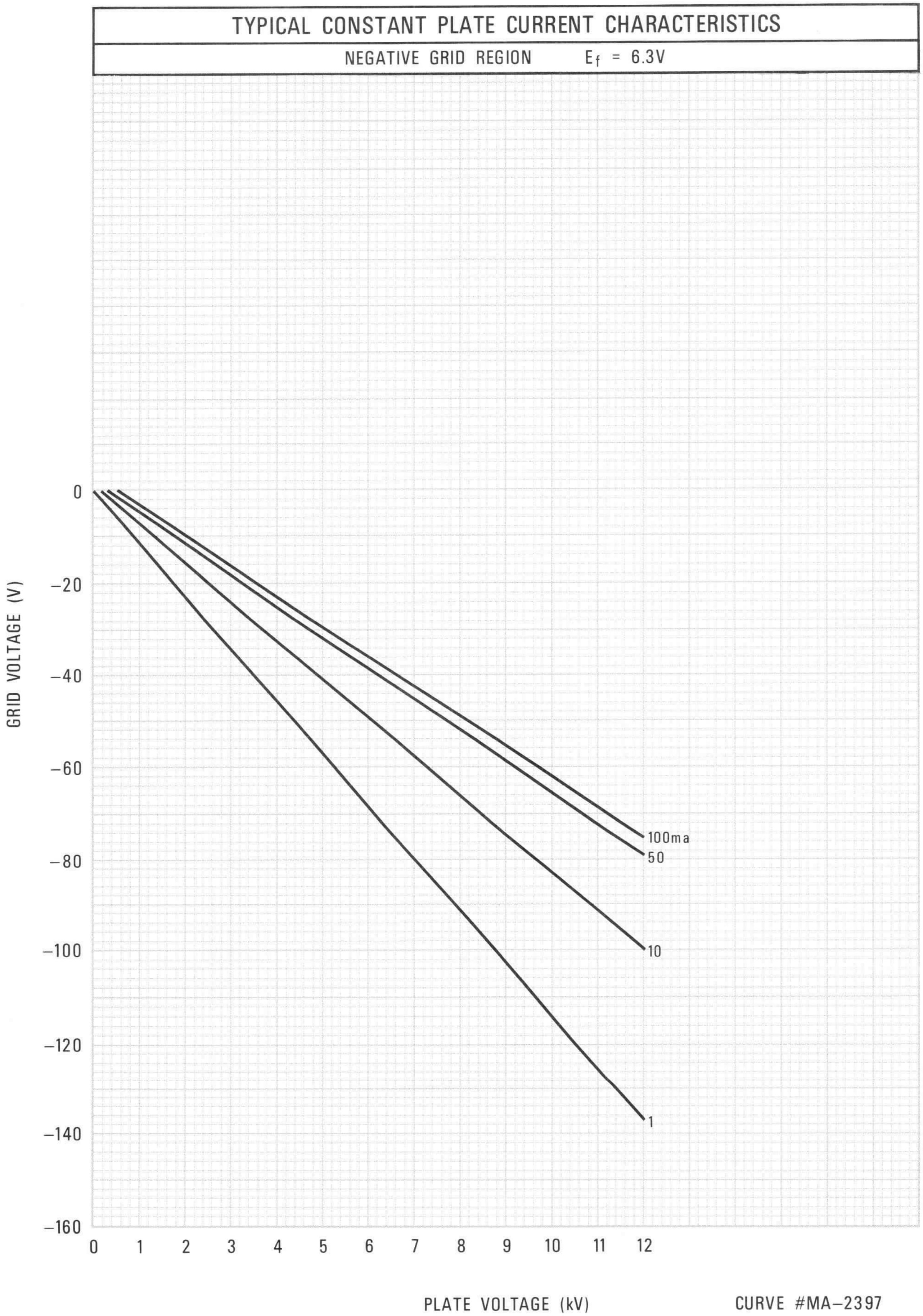
f. THIS SURFACE SHALL NOT BE USED FOR CLAMPING OR LOCATING.



CURVE #MA–2395



CURVE #MA–2396



CURVE #MA–2397

TECHNICAL DATA

8755/8755A

HIGH-MU
PLANAR TRIODE

The 8755/8755A is a miniature, ceramic/metal, rugged planar triode for advanced airborne and space applications up to 3.0 GHz.

The 8755/8755A may be used as an amplifier, oscillator, or frequency multiplier in the grid- or plate-pulsed mode, as well as a modulator or regulator tube. In addition to low interelectrode capacitances, high transconductance and amplification factor, the 8755/8755A has an anode designed to produce frequency stability, and an arc-resistant cathode, both assuring stable, reliable and long-life operation under adverse conditions.

The 8755/8755A is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced-air cooling, permitting an anode dissipation up to 150 watts, can be furnished on separate order.

The 8755/8755A is especially designed for applications where high rf pulse power is required. It can also be readily used in switch tube applications up to 8 kV dc.

The 8755A is identical to the 8755 in all respects except that the 8755A is furnished with a spewing shield. With this, this tube will exhibit longer life in the same applications and should be used where long tube life is of major concern.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b = 160 mA (200 mA/cm^2)	38	mmhos
Amplification Factor (Average):	135	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Cgk	9.5	pF
Cpk	0.06	pF
Cgp	1.05	pF
Cut-off Bias[3]	-20	V max.

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

2. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.37 in; 34.75 mm
Diameter	0.785 in; 19.94 mm
Net Weight	0.56 oz; 16 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction, convection, forced-air[1] or liquid
Terminals	Coaxial, special

1. Using one of the EIMAC radiators shown on the cooling curves.

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	70,000 ft.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (GRID PULSED)	8000	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	10,000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	150	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.0	GIGAHERTZ
PULSE DURATION[2]	6	μsec
DUTY FACTOR[2]	.0033	

TYPICAL OPERATION
Grid-Pulsed rf Power Amplifier (1182 MHz)

DC Plate Voltage	1750	Vdc
Peak Plate Current	1.0	a
DC Grid Voltage Approx.	-20	V
Peak Grid Current	1.7	a
Filament Voltage	5.6	V
Useful Power Output (Approx.)	650	w
Plate Efficiency	37%	
RF Input Power	65	w
Gain	10	db

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	8000	VOLTS
PEAK PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION[2]	6	μs
DUTY FACTOR[2]	.0033	
CUT-OFF MU	90	

1. Using one of the EIMAC radiators shown on the cooling curves.
2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager EIMAC Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

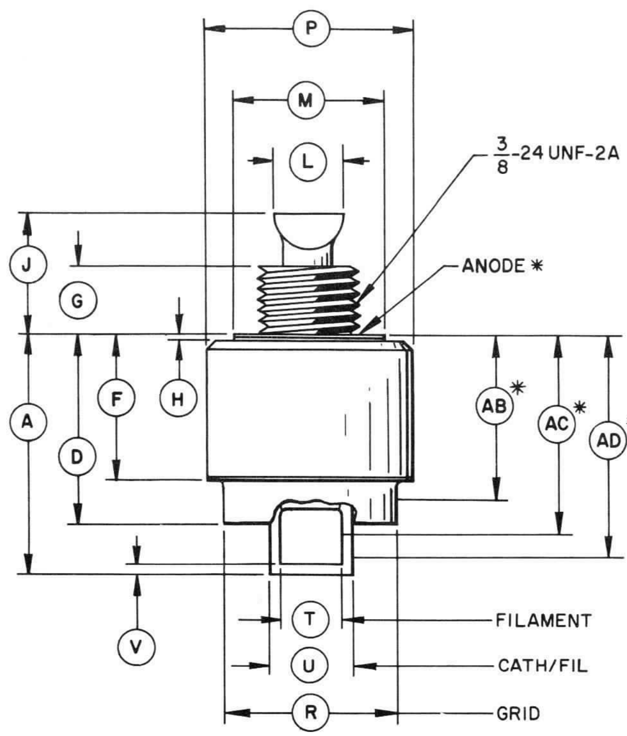
	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Cgk	8.5	10.5	pF
Cpk	---	0.06	pF
Cgp	0.9	1.2	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

APPLICATION

COOLING - The 8755/8755A can be cooled by conduction, convection, forced-air or liquid cooling. The tube is designed to permit high-temperature operation up to the limit indicated. However, if long life is the prime objective, tube terminal and seal temperatures should be kept well below 250°C. If forced-air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C. Cooling curves are given for the three radiators which are suitable for use with the 8755/8755A.

For further details on cooling or other aspects of tube operation, refer to EIMAC bulletin #15, "Operating Data for Planar Triodes."

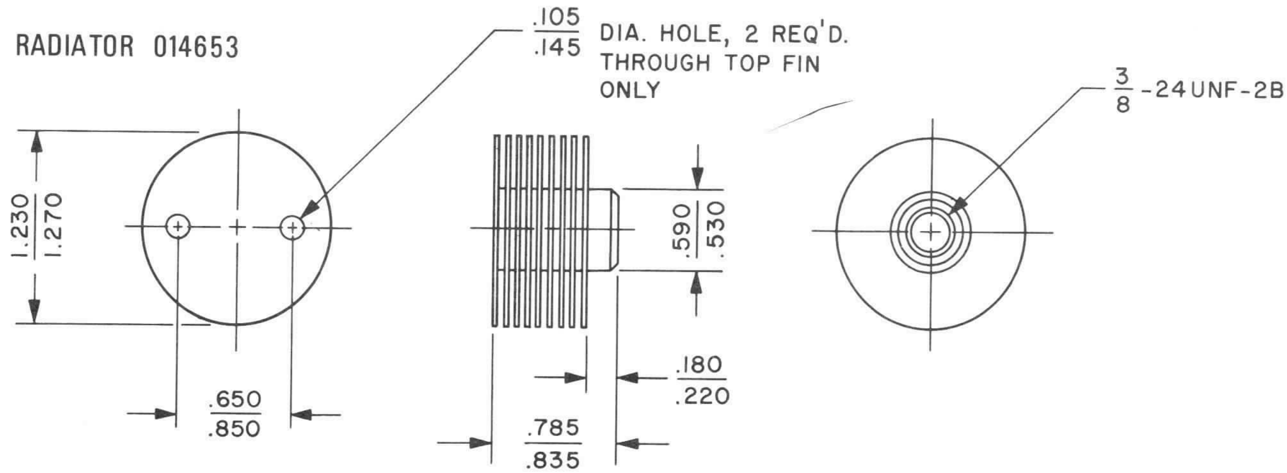


DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	1.020	- -	- -	25.91	- -
D	0.740	0.800	- -	18.80	20.32	- -
F	- -	0.570	- -	- -	14.48	- -
G	0.150	0.170	- -	3.81	4.32	- -
H	- -	0.040	- -	- -	1.02	- -
J	- -	0.350	- -	- -	8.89	- -
L	- -	0.260	- -	- -	6.60	- -
M	0.545	0.570	- -	13.84	14.48	- -
P	0.775	0.785	- -	19.69	19.94	- -
R	0.650	0.670	- -	16.51	17.02	- -
T	0.210	0.225	- -	5.33	5.72	- -
U	0.310	0.330	- -	7.87	8.38	- -
V	- -	0.040	- -	- -	1.02	- -
AB	0.590	0.740	- -	14.99	18.80	- -
AC	0.760	0.885	- -	19.30	22.48	- -
AD	0.800	0.975	- -	20.32	24.77	- -

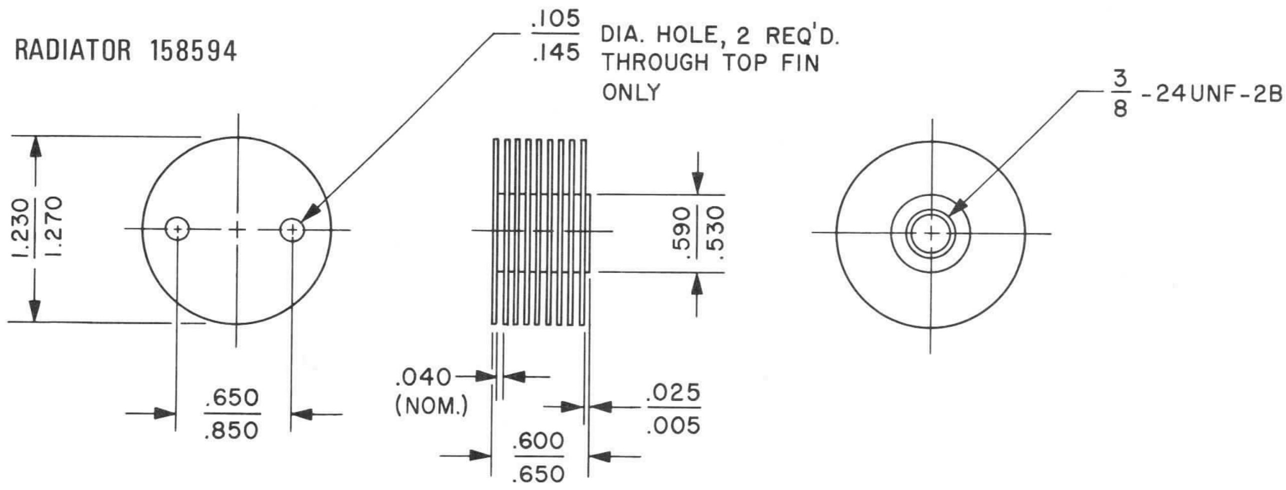
NOTES
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. ANODE FLANGE IS ELECTRICAL CONTACT. STUD IS FOR HEAT TRANSFER.

EIMAC RADIATORS

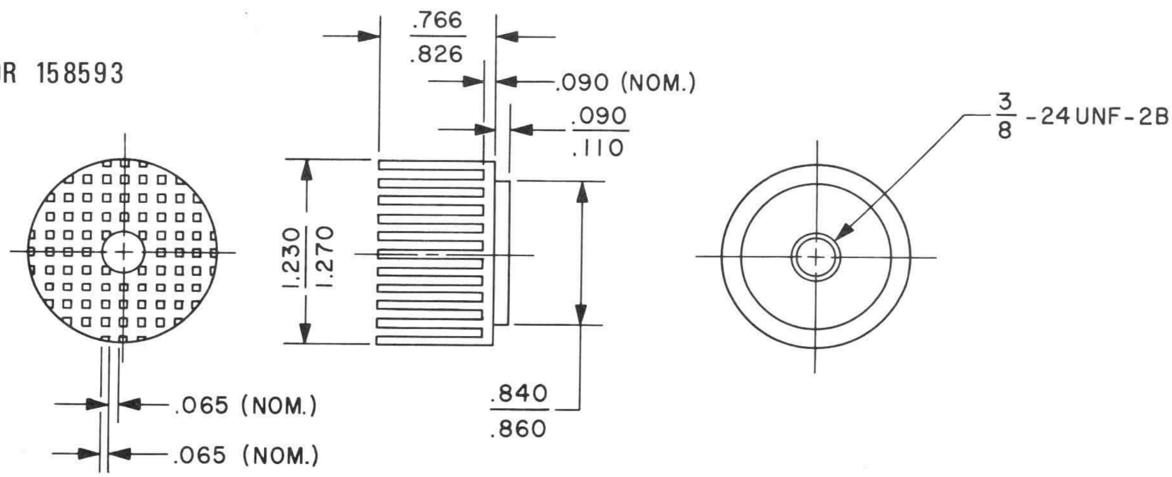
RADIATOR 014653



RADIATOR 158594



RADIATOR 158593



COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

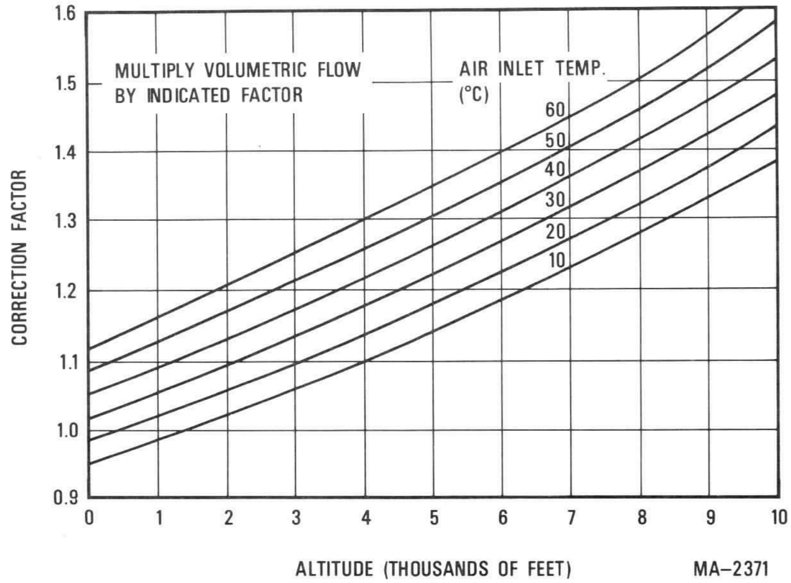
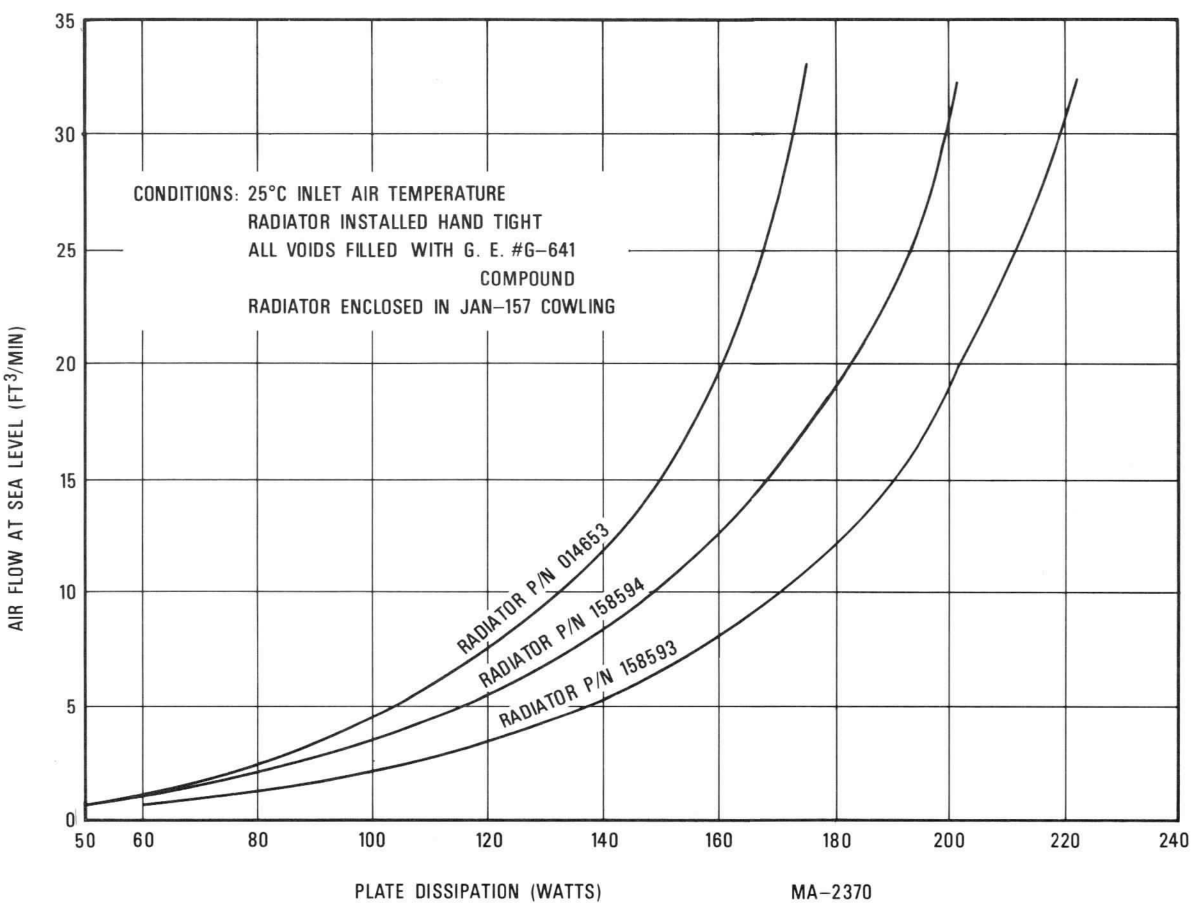
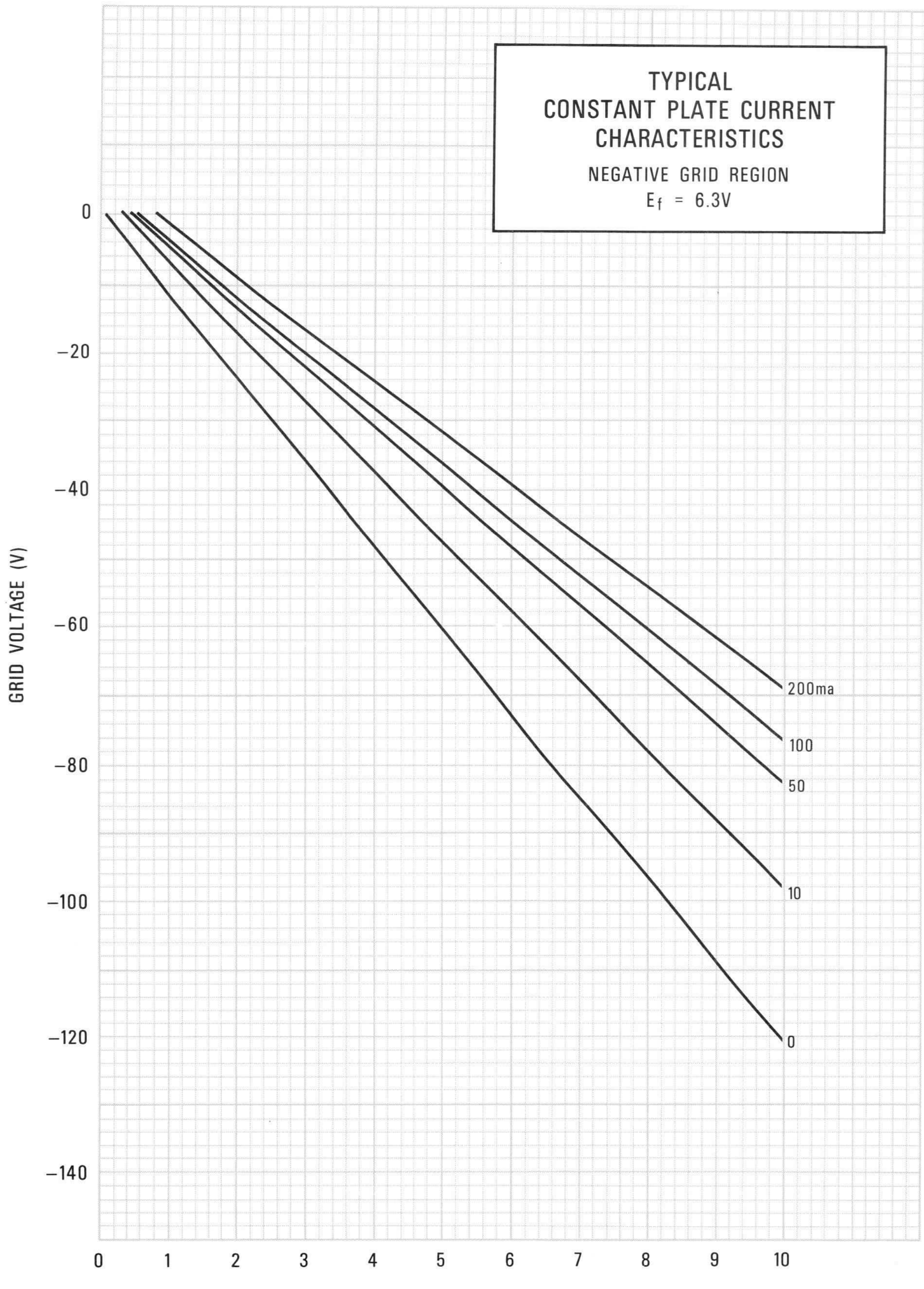
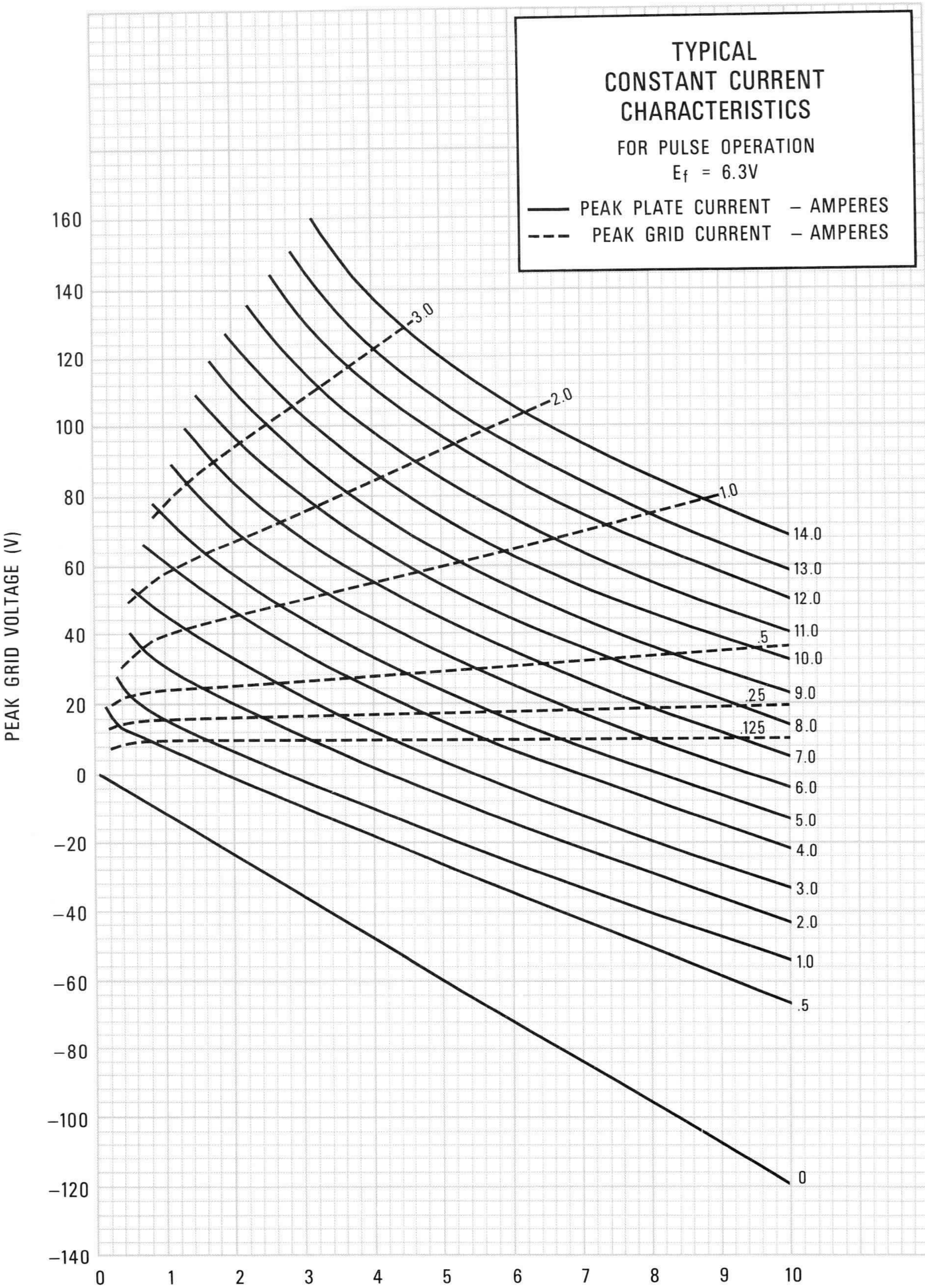


PLATE DISSIPATION VARIATION WITH COOLING AIR FLOW

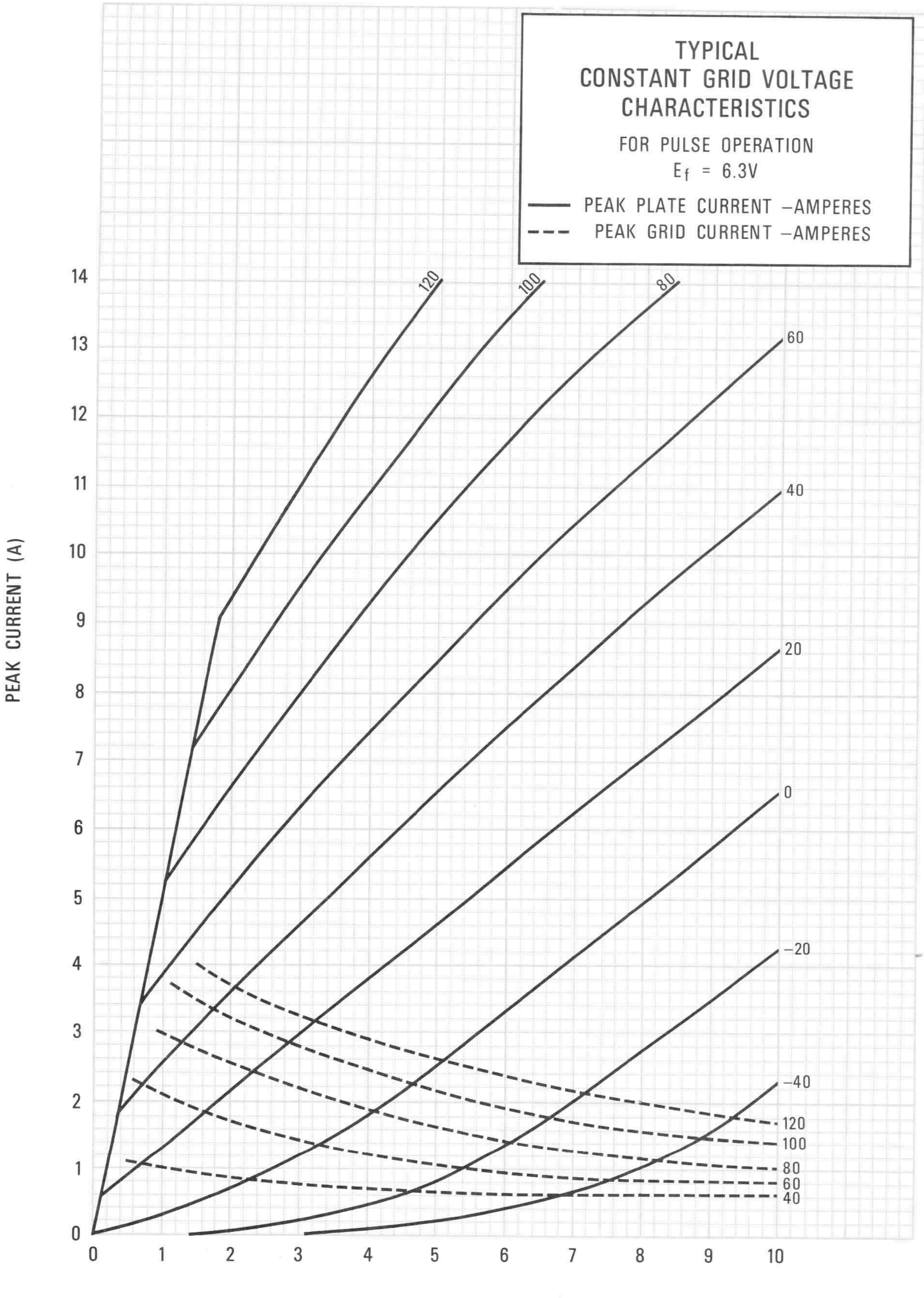




CURVE #MA−2482



CURVE #MA–2395



CURVE #MA–2396

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8757

HIGH-MU PLANAR TRIODE

The 8757 is a miniature, frequency-stable, ceramic/metal, rugged planar triode for advanced airborne and space applications up to 3.5 GHz.

The 8757 may be used as an amplifier, oscillator, or frequency multiplier in the CW, grid- or plate-pulsed mode, as well as a modulator or regulator tube. In addition to low interelectrode capacitances, high transconductance and amplification factor, the 8757 has an anode designed to produce exceptional frequency stability and an arc-resistant cathode, both assuring stable, reliable and long-life operation under adverse conditions.

The 8757 is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced-air cooling permitting an anode dissipation up to 150 watts, can be furnished on separate order.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b = 160 mA (200 mA/cm^2)	38	mmhos
Amplification Factor (Average):	75	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Grid-Cathode	9.0	pF
Plate-Cathode	0.06	pF
Grid-Plate	1.65	pF
Cut-off Bias[3]	-30	V max.

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

2. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Effective 3-3-70) Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:

Length	1.30 in; 33.02 mm
Diameter	0.785 in; 19.94 mm
Net Weight	0.56 oz; 16 gm
Operating Position	Any

Maximum Operating Temperature:

Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Conduction, convection, forced-air[1] or liquid
Terminals	Coaxial, special

1. Using one of the EIMAC radiators shown on the cooling curves.

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitable designed circuit)	70,000 ft.

CW RF POWER AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	250	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.0	GIGAHERTZ

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, Eimac-Division of Varian, Salt Lake City, Utah.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (GRID PULSED)	3000	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID CATHODE VOLTAGE		
GRID NEGATIVE TO CATHODE	-700	VOLTS
GRID POSITIVE TO CATHODE	175	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.5	GIGAHERTZ
PULSE DURATION[2]	6	μsec
DUTY FACTOR[2]	.0033	

TYPICAL OPERATION

Grid-Pulsed r-f Power Oscillator (3.5 GHz)

DC Plate Voltage	2500 Vdc
Peak Plate Current	5.0 a
DC Grid Voltage Approx.	-70 V
Peak Grid Current	1.7 a
Filament Voltage	6.0 V
Useful Power Output Approx.	3000 w
Plate Efficiency	25%

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	3000	VOLTS
PEAK PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION[2]	6	μs
DUTY FACTOR[2]	.0033	
CUT-OFF MU	60	

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager Eimac-Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Grid-Cathode	8.5	9.5	pF
Plate-Cathode	---	0.06	pF
Grid-Plate	1.5	1.8	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

APPLICATION

COOLING - The 8757 can be cooled by conduction, convection, forced-air or liquid cooling. The tube is designed to permit high-temperature operation up to the limit indicated. However, if long life is the prime objective, tube terminal and seal temperatures should be kept well below 250°C. If forced-air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50° C. Cooling curves are given for the three radiators which are suitable for use with the 8757.

For operating information refer to EIMAC bulletin #15, "Operating Data for Planar Triodes."

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A		.950		24.13
D	.690	.730	17.53	18.54
F		.500		12.70
G	.150	.170	3.81	4.32
H		.040		1.02
J		.350		8.89
L		.260		6.04
M	.545	.570	13.84	14.48
P	.775	.785	19.69	19.94
R	.650	.670	16.51	17.02
T	.210	.225	5.33	5.72
U	.310	.330	7.87	8.38
V		.040		1.02
(*) CONTACT SURFACES				
AB	.595* ±.075		15.11* ±1.91	
AC	.752* ±.062		19.10* ±1.57	
AD	.817* ±.087		20.75* ±2.21	

NOTES:

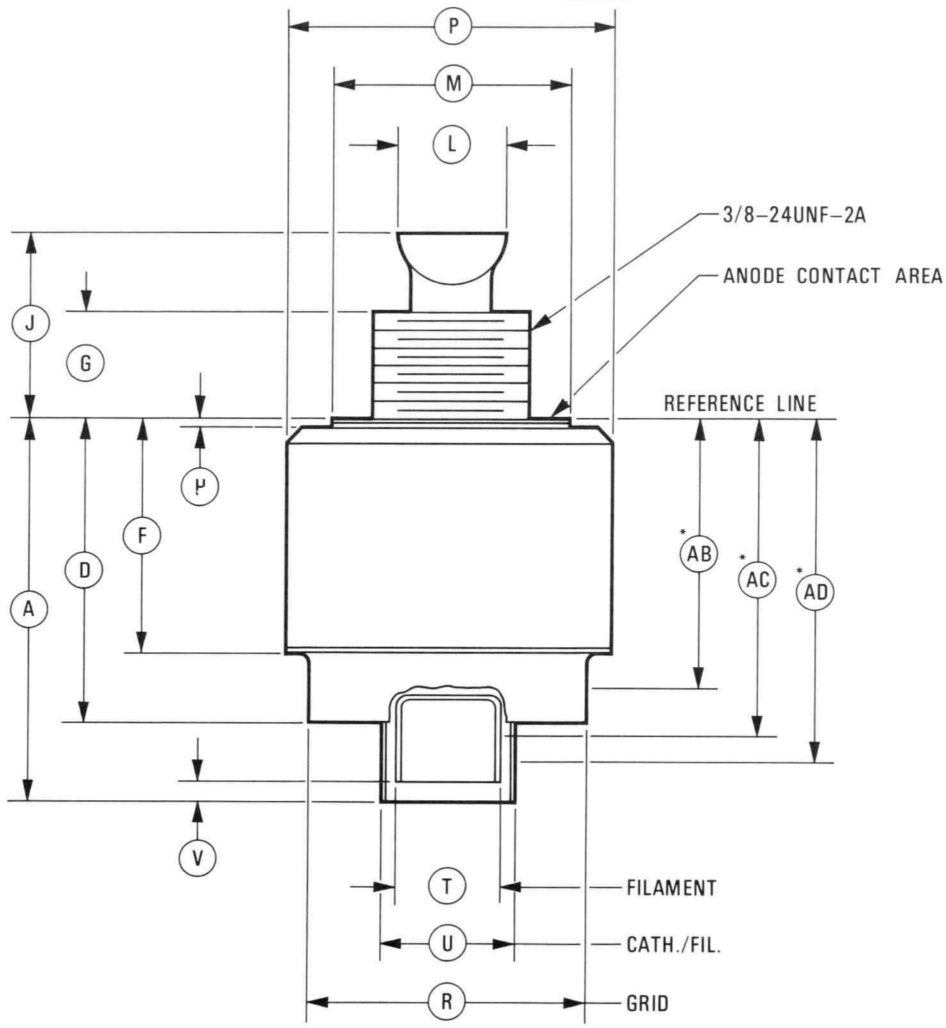
1. ANODE FLANGE IS ELECTRICAL CONTACT. STUD IS FOR HEAT TRANSFER.

2. (*) DISTANCE FROM REFERENCE SURFACE TO THE CENTER OF CONTACT AREA.

3. METRIC EQUIVALENTS ARE TO THE NEAREST .01 mm, ARE GIVEN FOR GENERAL INFORMATION ONLY, AND ARE BASED ON 1 INCH = 25.4 mm.

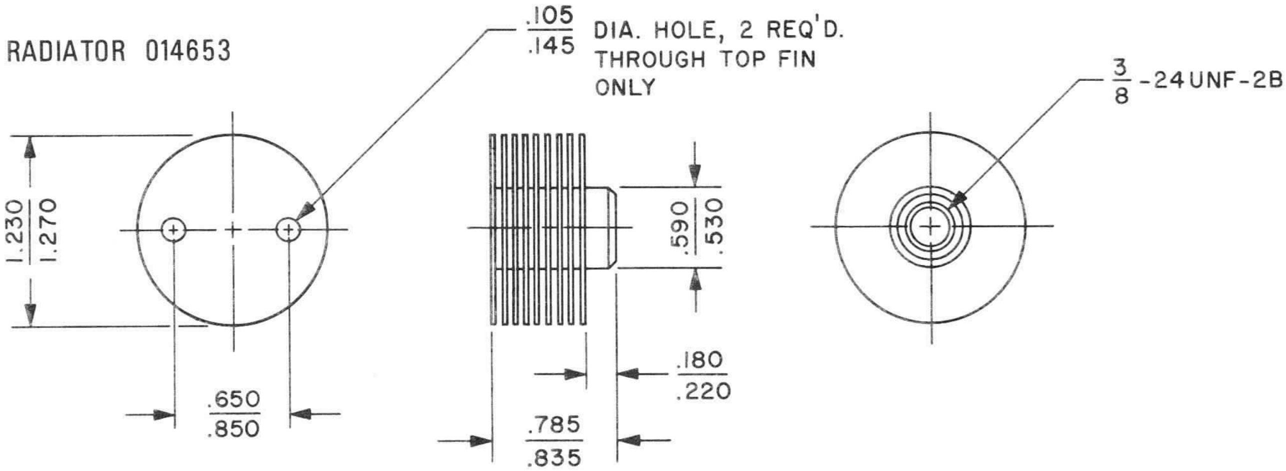
4. CONCENTRICITY BETWEEN GRID TERMINAL AND CATHODE/HEATER TERMINAL RESPECTIVELY TO THE ANODE STUD TO BE 0.020 TIR MAX. MEASUREMENT TO BE MADE WITH EIMAC GAGE JA-21685G WHICH MUST SEAT AGAINST THE ANODE FLANGE.

FIGURE 1

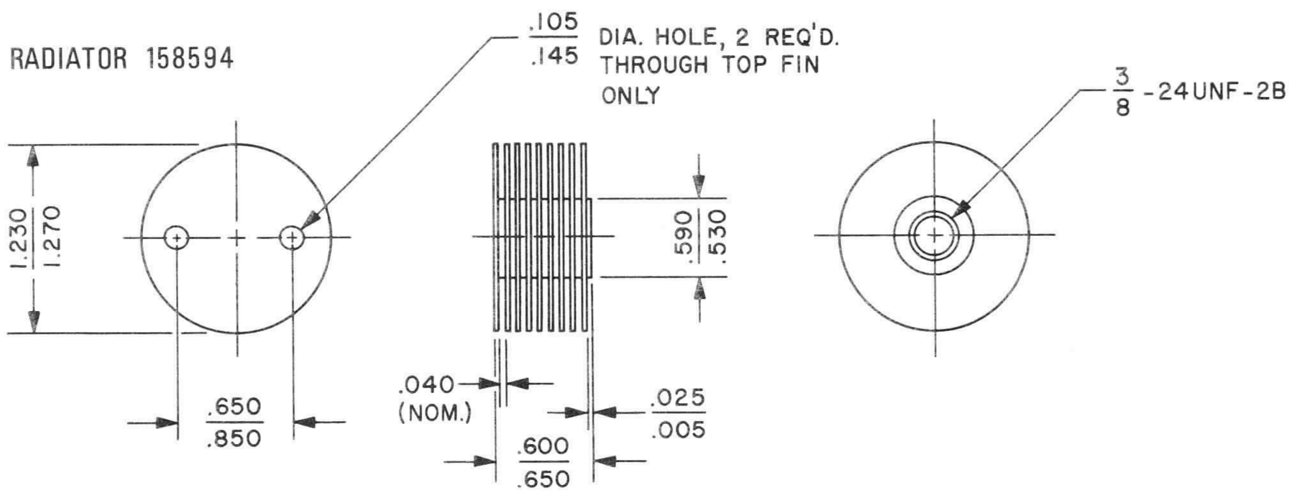


EIMAC RADIATORS

RADIATOR 014653



RADIATOR 158594



RADIATOR 158593

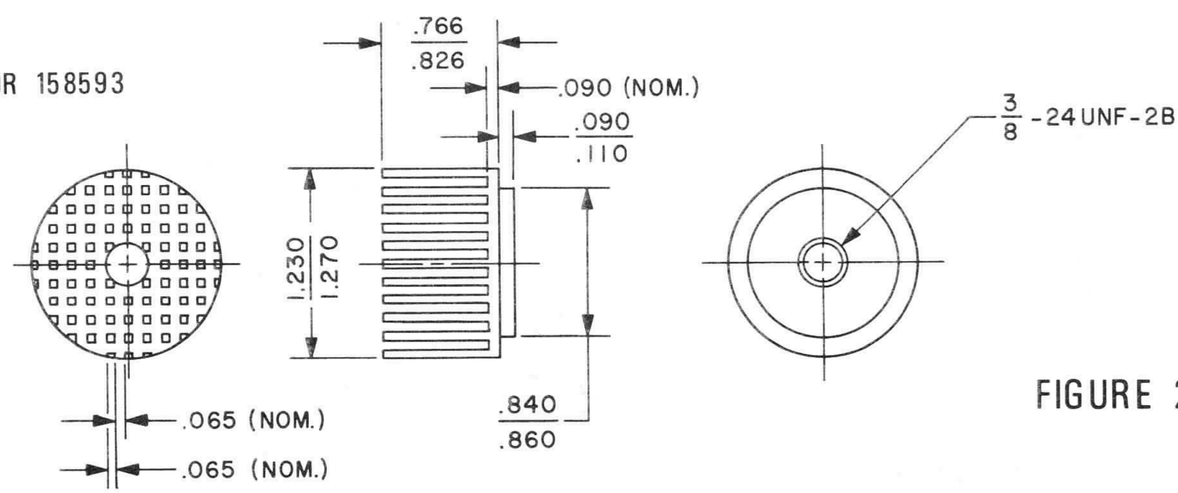


FIGURE 2

FIGURE 3

COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

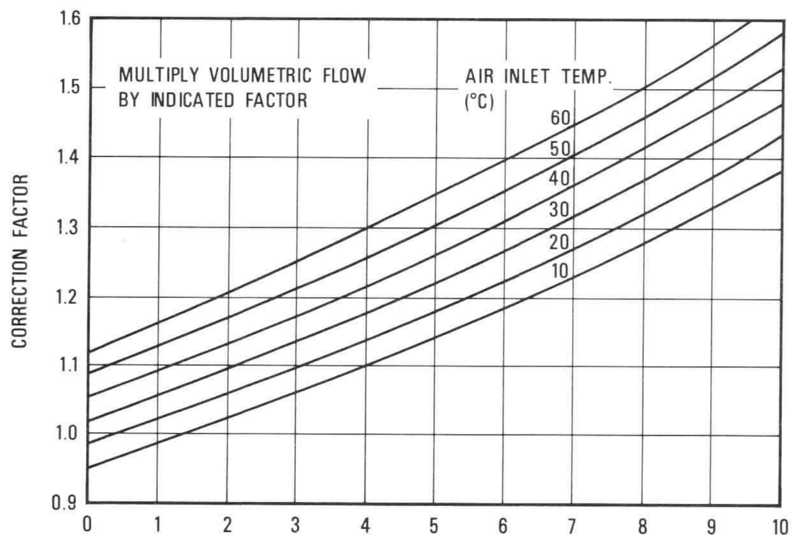
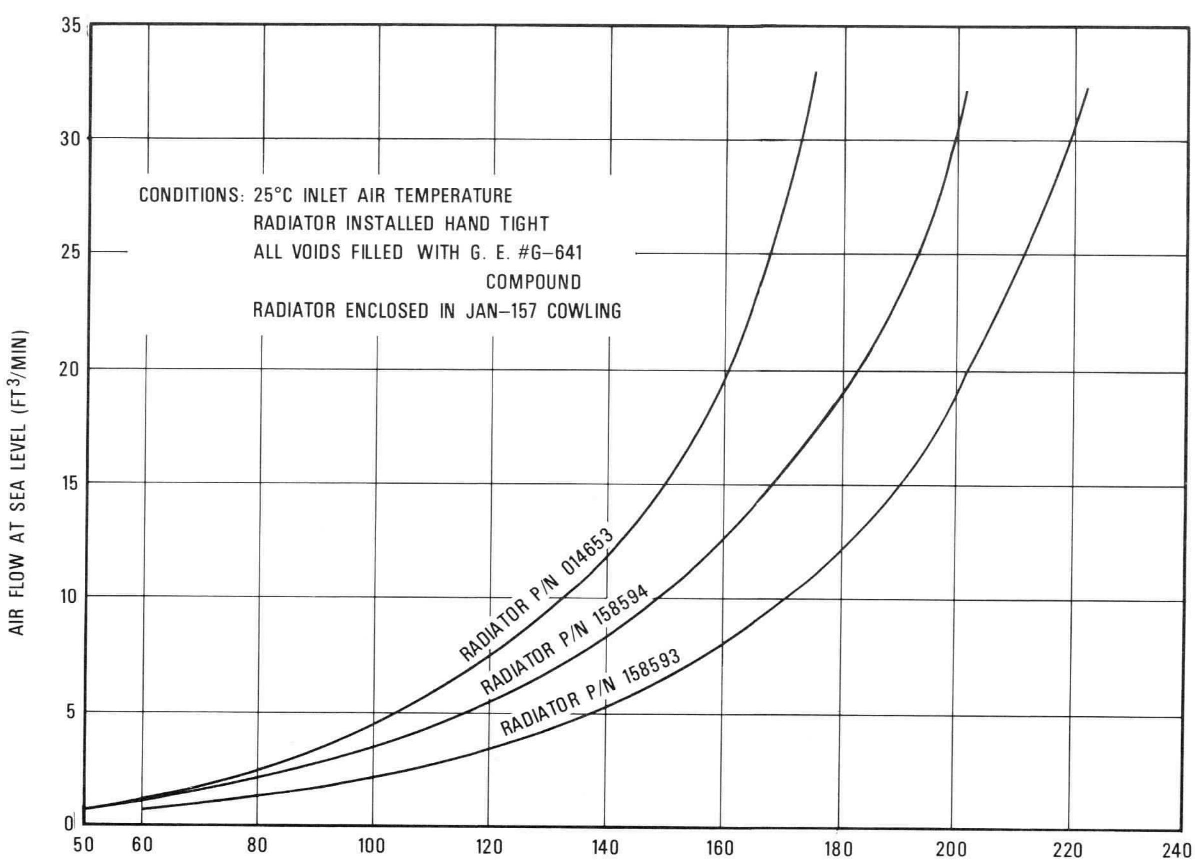
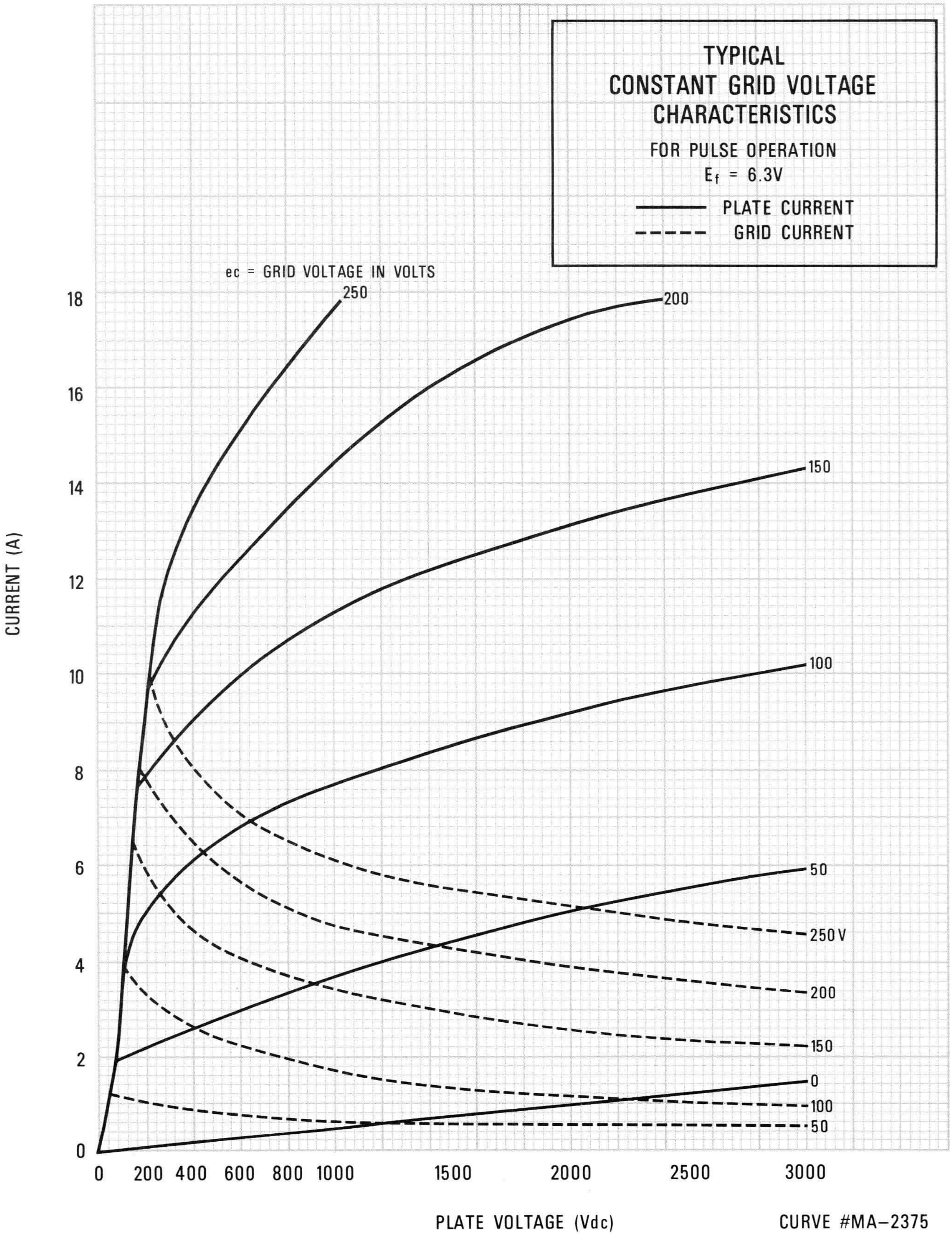


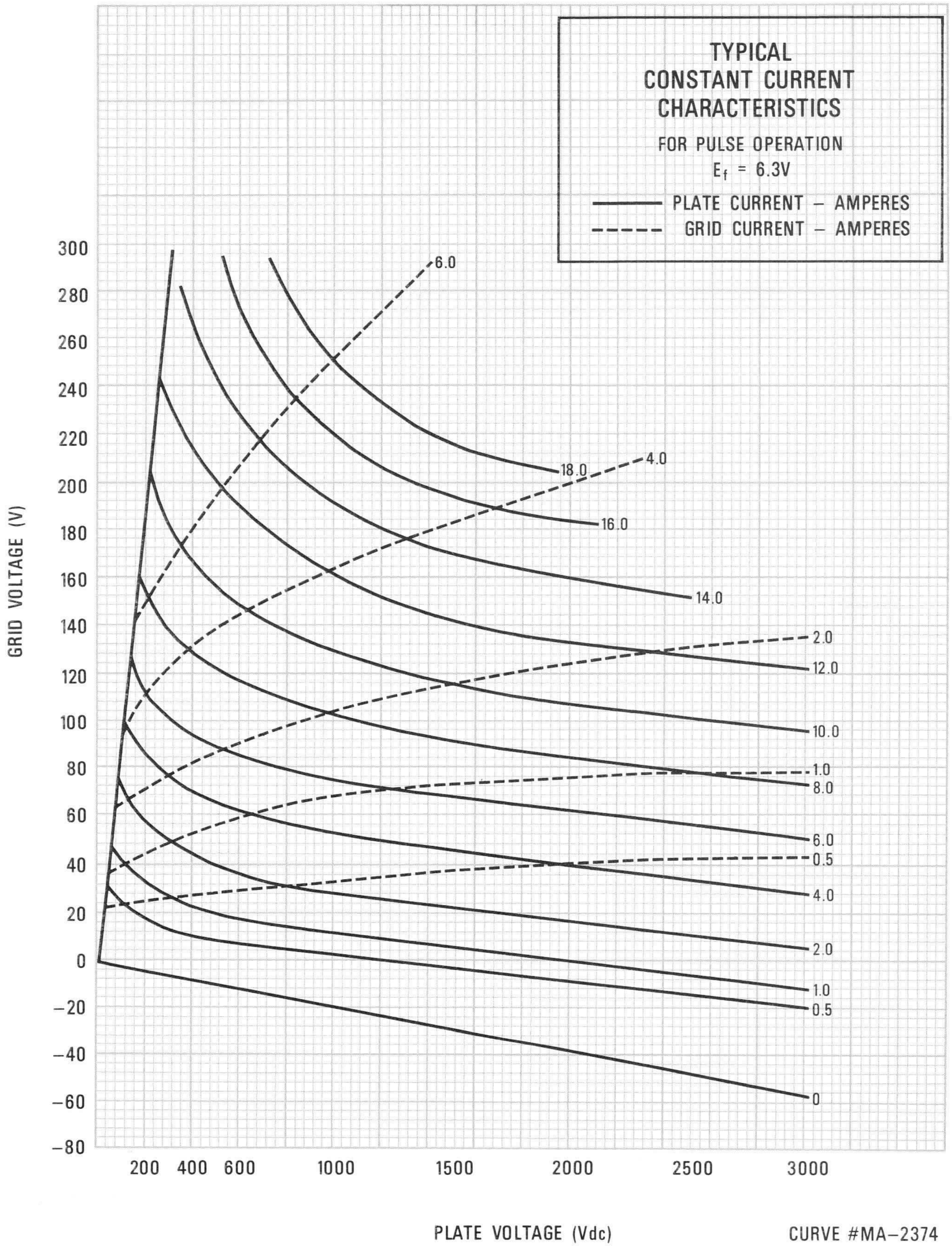
FIGURE 4

PLATE DISSIPATION VARIATION WITH COOLING AIR FLOW

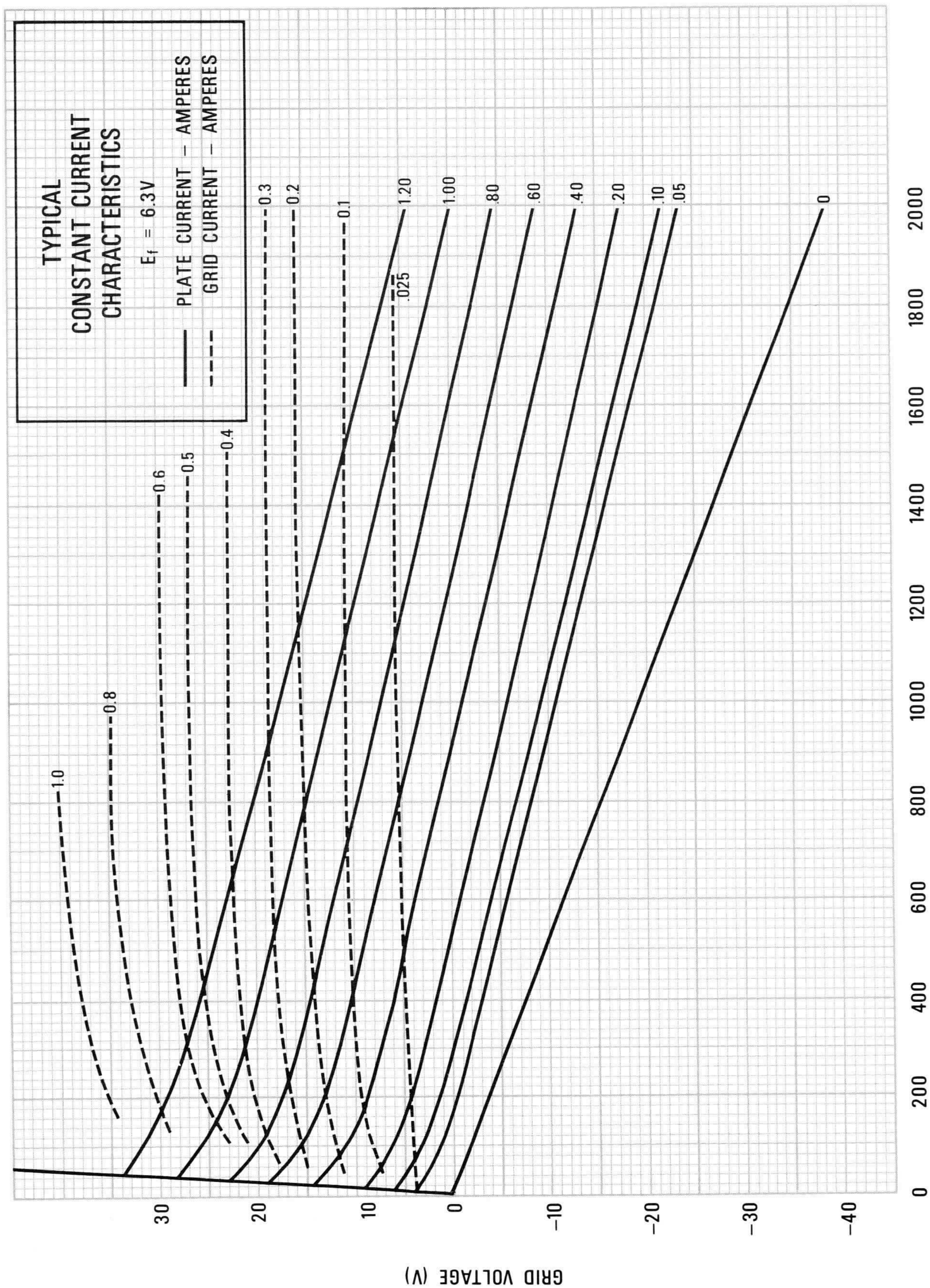




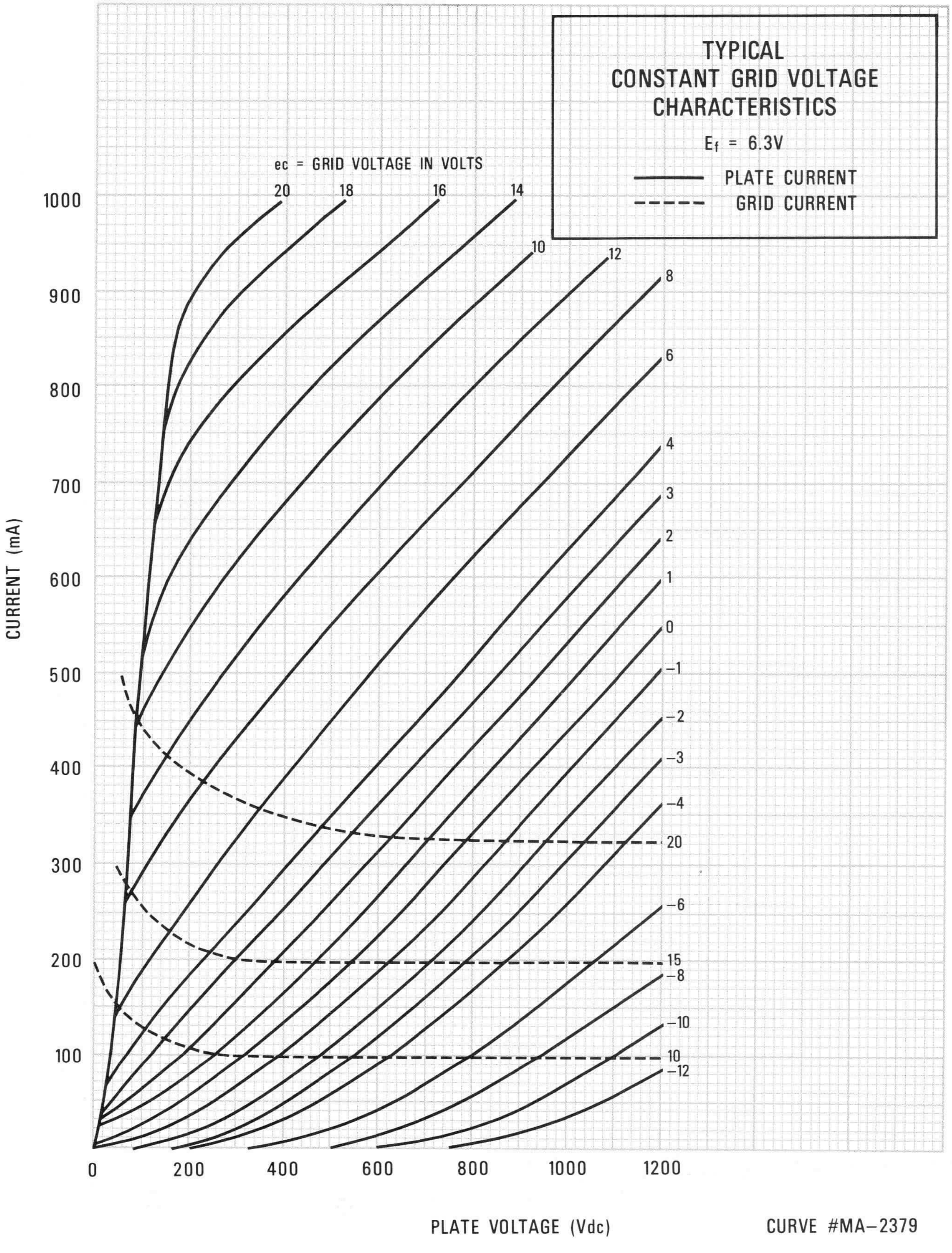
CURVE #MA–2375



CURVE #MA–2374



CURVE #MA-2380



CURVE #MA–2379

TECHNICAL DATA

8847
8847A

HIGH-MU PLANAR TRIODES

The 8847 and 8847A are miniature, ceramic/metal, rugged planar triodes for advanced airborne and space applications up to 3.5 GHz.

The 8847A is identical to the 8847 in all respects except that the required heater power is reduced by 25%. The tube should be used where input power consumption and heat dissipation are of major concern.

Either tube may be used as an amplifier, oscillator, or frequency multiplier in the CW, grid- or plate-pulsed mode, as well as a modulator or regulator tube. In addition to low interelectrode capacitances, high transconductance and amplification factor, the 8847 and 8847A have an anode designed to enhance frequency stability and an arc-resistant cathode, both assuring stable, reliable and long-life operation under adverse conditions.

The 8847 and 8847A are supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced-air cooling permitting an anode dissipation up to 150 watts, can be furnished on separate order.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
8847 Current, at 6.3 volts	1.30	A
8847A Current, at 6.0 volts	0.95	A
Transconductance (Average):		
I_b = 160 mA (200 mA/cm^2)	38	mmhos
Amplification Factor (Average):	75	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Grid-Cathode	9.5	pF
Plate-Cathode	0.06	pF
Grid-Plate	1.40	pF
Cut-off Bias[3]	-30	V max.

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.

2. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.370 in; 34.75 mm
Diameter	0.785 in; 19.94 mm
Net Weight	0.56 oz; 16.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction, convection, forced-air[1] or liquid
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in suitable designed circuit)	70,000 ft.

CW RF POWER AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	250	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.0	GIGAHERTZ

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, Eimac-Division of Varian, Salt Lake City, Utah.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (GRID PULSED)	3000	VOLTS
PEAK PULSE PLATE VOLTAGE (PLATE PULSED)	3500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-700	VOLTS
Grid positive to cathode	175	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PUSLE GRID CURRENT	2.5	AMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.5	GIGAHERTZ
PULSE DURATION[2]	6	μsec
DUTY FACTOR[2]	.0033	

REPRESENTATIVE OPERATION

Grid-Pulsed rf Power Oscillator (1.6 GHz)

DC Plate Voltage	3000	Vdc
Peak Plate Current	3.0	a
DC Grid Voltage (Approx.)	-90	V
Peak Grid Current	1.0	a
Filament Voltage	6.3	V
Useful Power Output (Approx.)	3000	w
Bandwidth (1db)	40	MHz
Plate Efficiency	33%	

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE	3500	VOLTS
PEAK PLATE VOLTAGE	4000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
PLATE DISSIPATION[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION	6	μs
DUTY FACTOR	.0033	
CUT-OFF MU	60	

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager Eimac-Division of Varian, Salt Lake City, Utah.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater current at 6.3 volts (8847)	1.20	1.40	A
Heater current at 6.0 volts (8847A)	0.85	1.05	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Grid-Cathode	8.5	10.5	pF
Plate-Cathode	---	0.06	pF
Grid-Plate	1.2	1.6	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

APPLICATION

COOLING - The 8847 and 8847A can be cooled by conduction, convection, forced-air or liquid cooling. The tubes are designed to permit high-temperature operation up to the limit indicated. However, if long life is the prime objective, tube terminal and seal temperatures should be kept well below 250°C. If forced-air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C. Cooling curves are given for the three radiators which are suitable for use with the 8847 and 8847A.

For further details on cooling or other aspects of tube operation, refer to the "Application Notes for Planar Triodes" bulletin which can be obtained on request.

DIMENSIONAL DATA

DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	--	1.020	--	--	25.91	--
D	0.740	0.800	--	18.80	20.32	--
F	--	0.570	--	--	14.48	--
G	0.150	0.170	--	3.81	4.32	--
H	--	0.040	--	--	1.02	--
J	--	0.350	--	--	8.90	--
L	--	0.260	--	--	6.60	--
M	0.545	0.570	--	13.84	14.48	--
P	0.775	0.785	--	19.69	19.94	--
R	0.650	0.670	--	16.51	17.02	--
T	0.210	0.225	--	5.33	5.72	--
U	0.310	0.330	--	7.87	8.38	--
V	--	0.040	--	--	1.07	--
AB	0.590	0.740	--	14.99	18.80	--
AC	0.760	0.885	--	19.30	22.48	--
AD	0.800	0.975	--	20.32	24.77	--

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

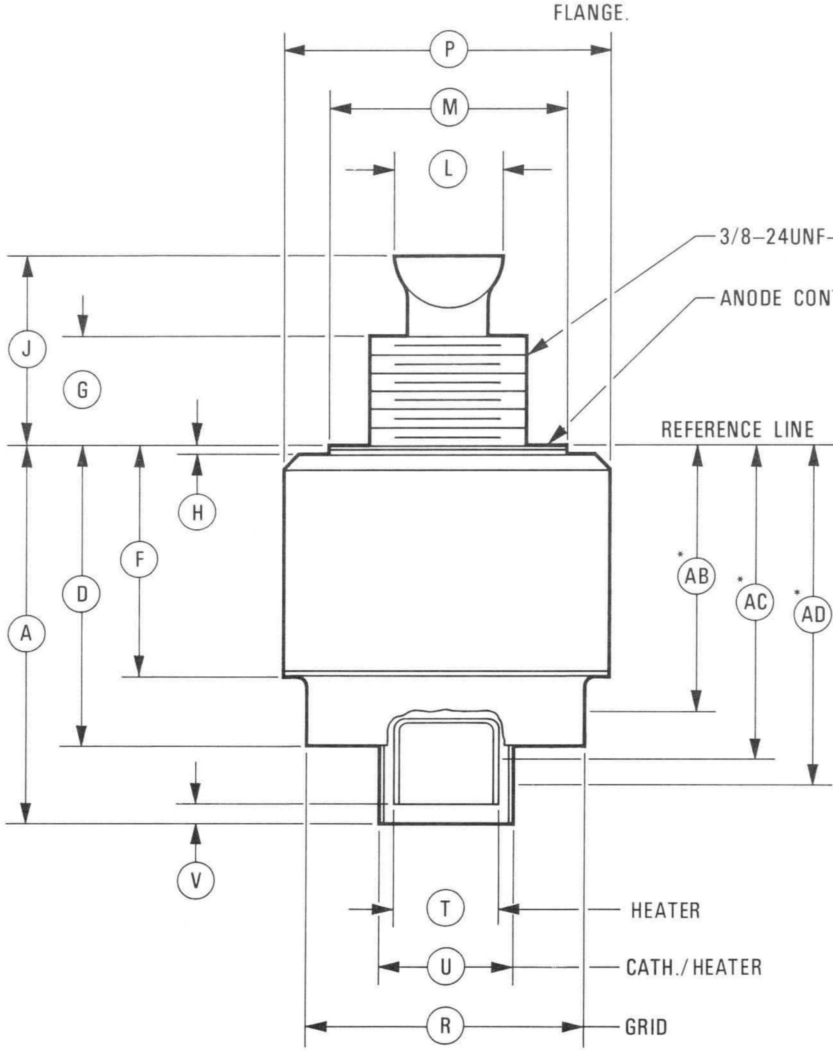
NOTES:

1. ANODE FLANGE IS ELECTRICAL CONTACT. STUD IS FOR HEAT TRANSFER.

2. (*) DISTANCE FROM REFERENCE SURFACE TO THE CENTER OF CONTACT AREA.

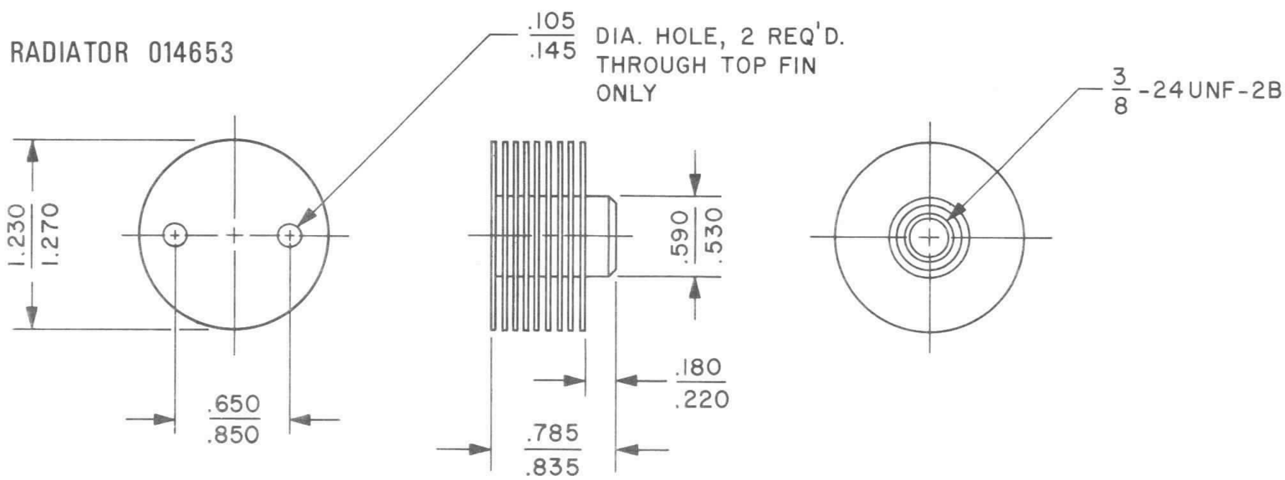
3. METRIC EQUIVALENTS ARE TO THE NEAREST .01 mm, ARE GIVEN FOR GENERAL INFORMATION ONLY, AND ARE BASED ON 1 INCH = 25.4 mm.

4. CONCENTRICITY BETWEEN GRID TERMINAL AND CATHODE/HEATER TERMINAL RESPECTIVELY TO THE ANODE STUD TO BE 0.020 TIR MAX. MEASUREMENT TO BE MADE WITH EIMAC GAGE JA-21685G WHICH MUST SEAT AGAINST THE ANODE FLANGE.

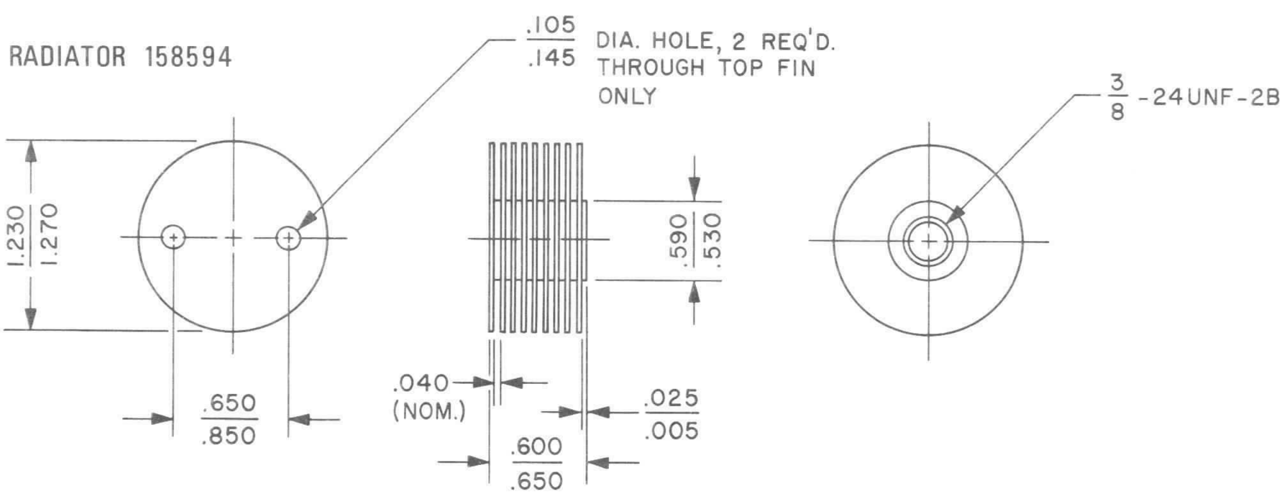


EIMAC RADIATORS

RADIATOR 014653



RADIATOR 158594



RADIATOR 158593

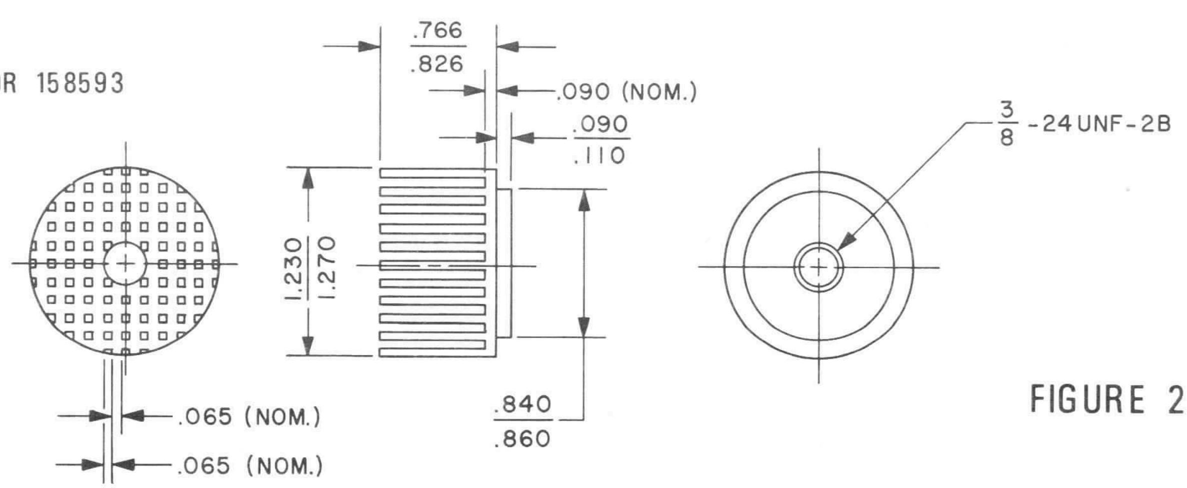
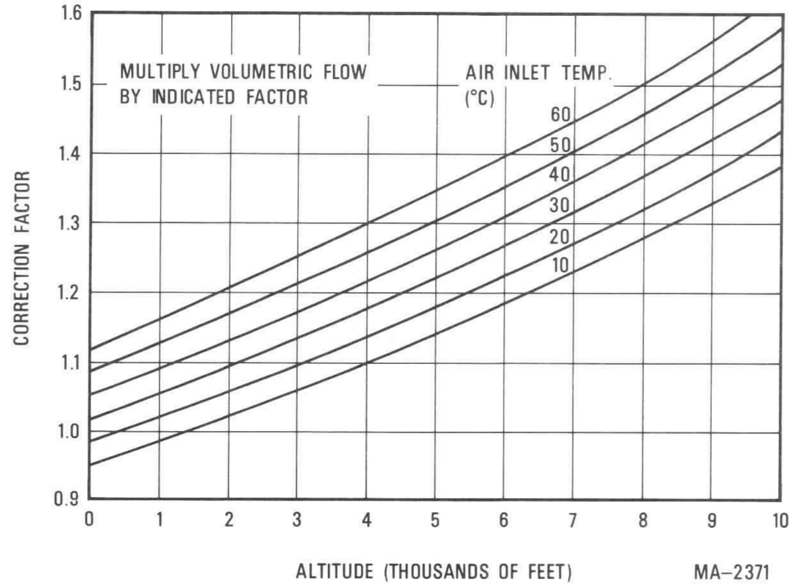


FIGURE 2

FIGURE 3

COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

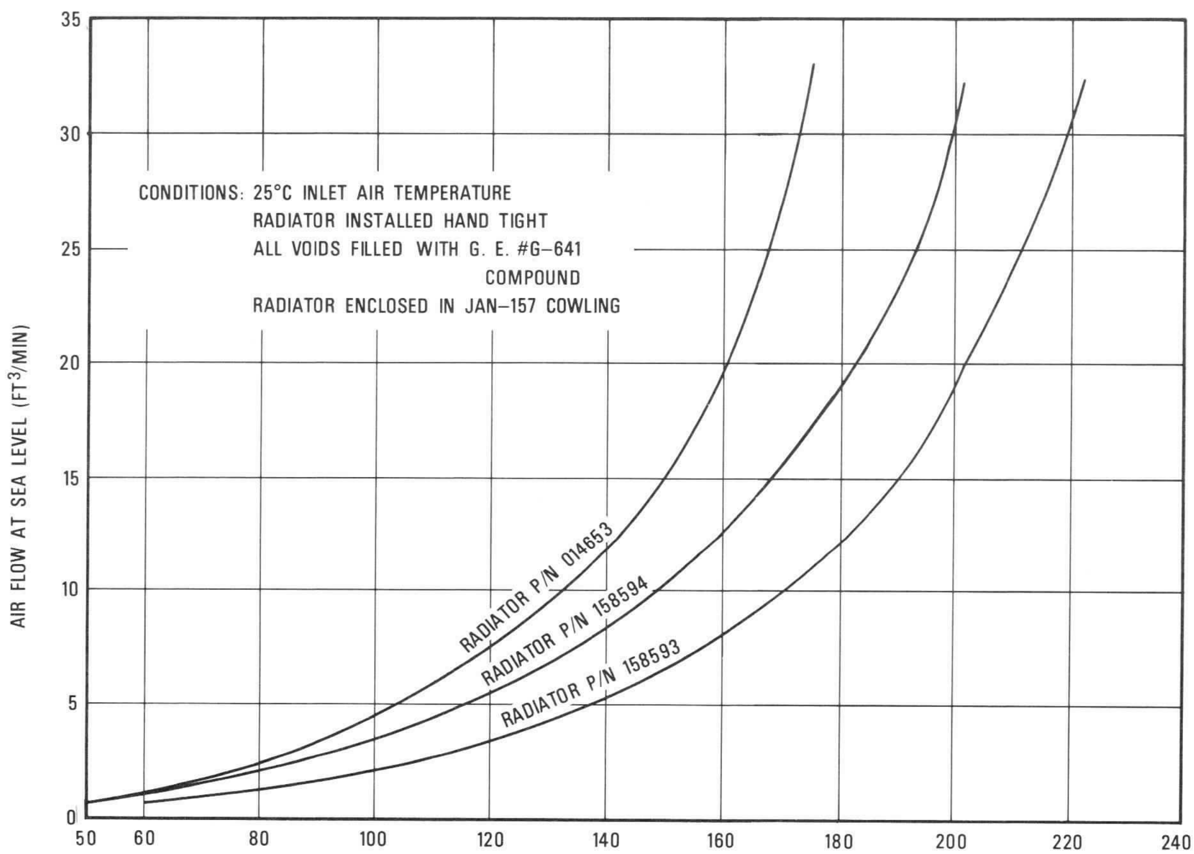
(RELATIVE TO 25°C AND SEA LEVEL)



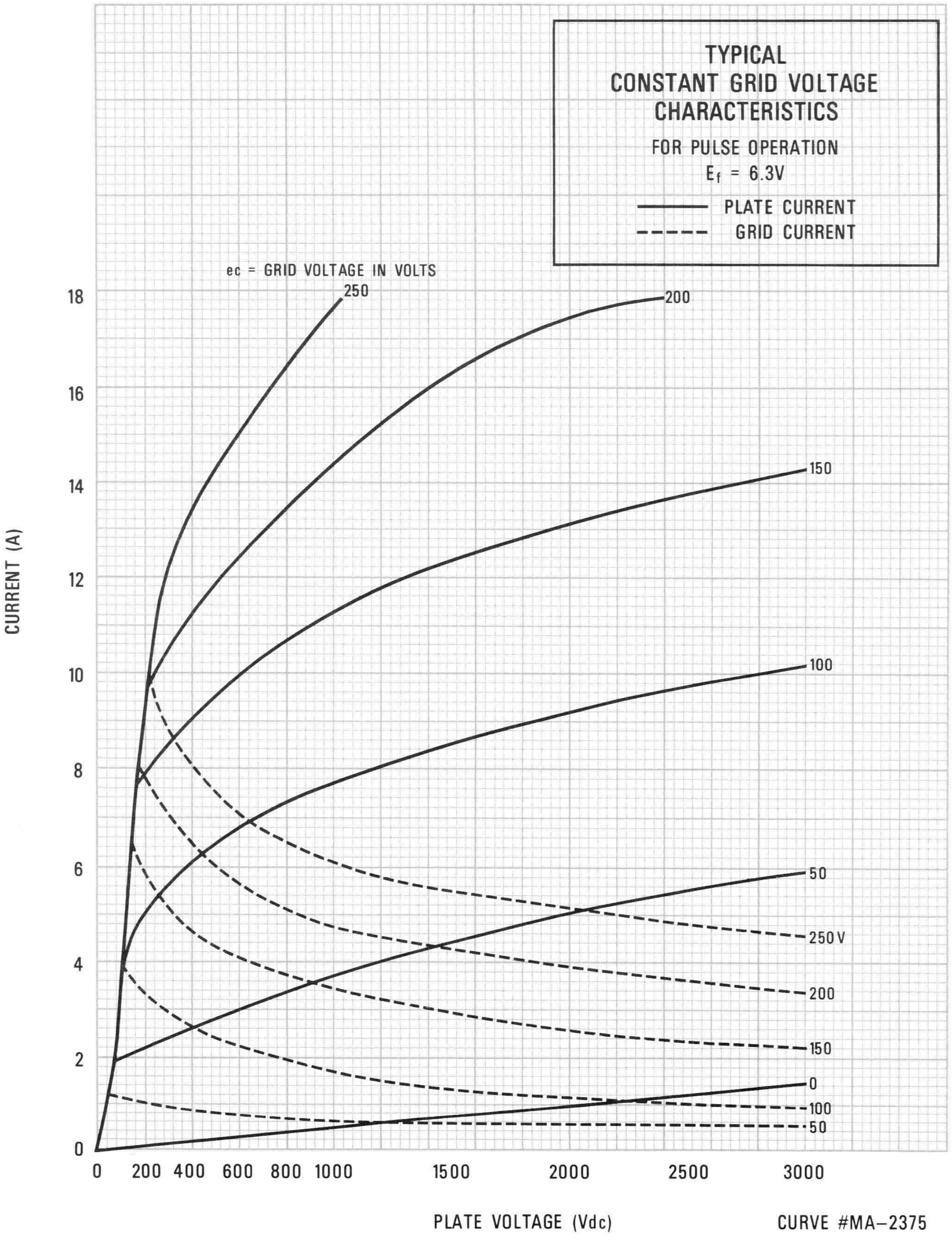
MA–2371

FIGURE 4

PLATE DISSIPATION VARIATION WITH COOLING AIR FLOW



MA–2370


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
Ef = 6.3V
PLATE CURRENT
GRID CURRENT
ec = GRID VOLTAGE IN VOLTS
250
200
150
100
50
250 V
200
150
0
100
50
CURRENT (A)
0
2
4
6
8
10
12
14
16
18
0
200
400
600
800
1000
1500
2000
2500
3000
PLATE VOLTAGE (Vdc)
CURVE #MA-2375

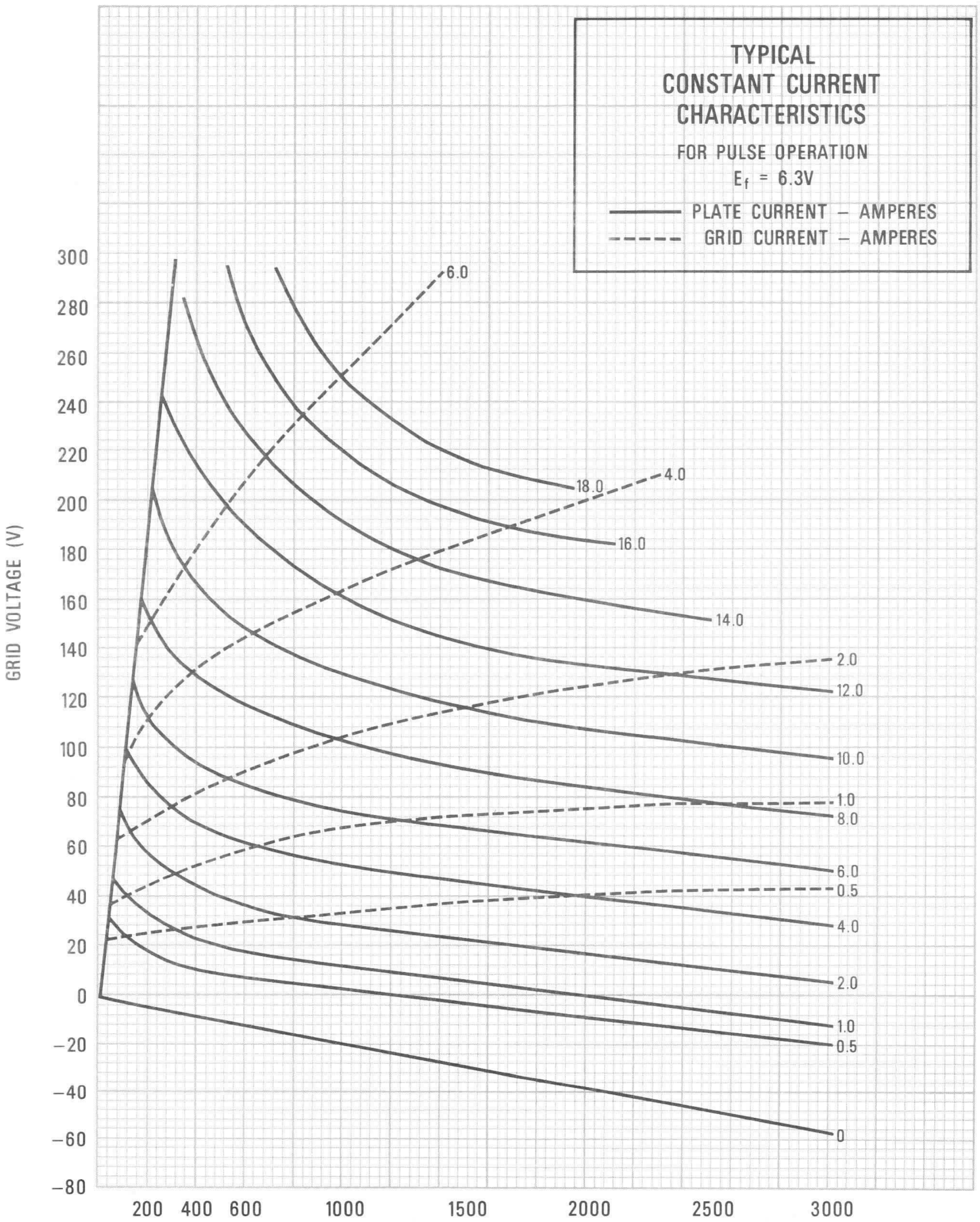
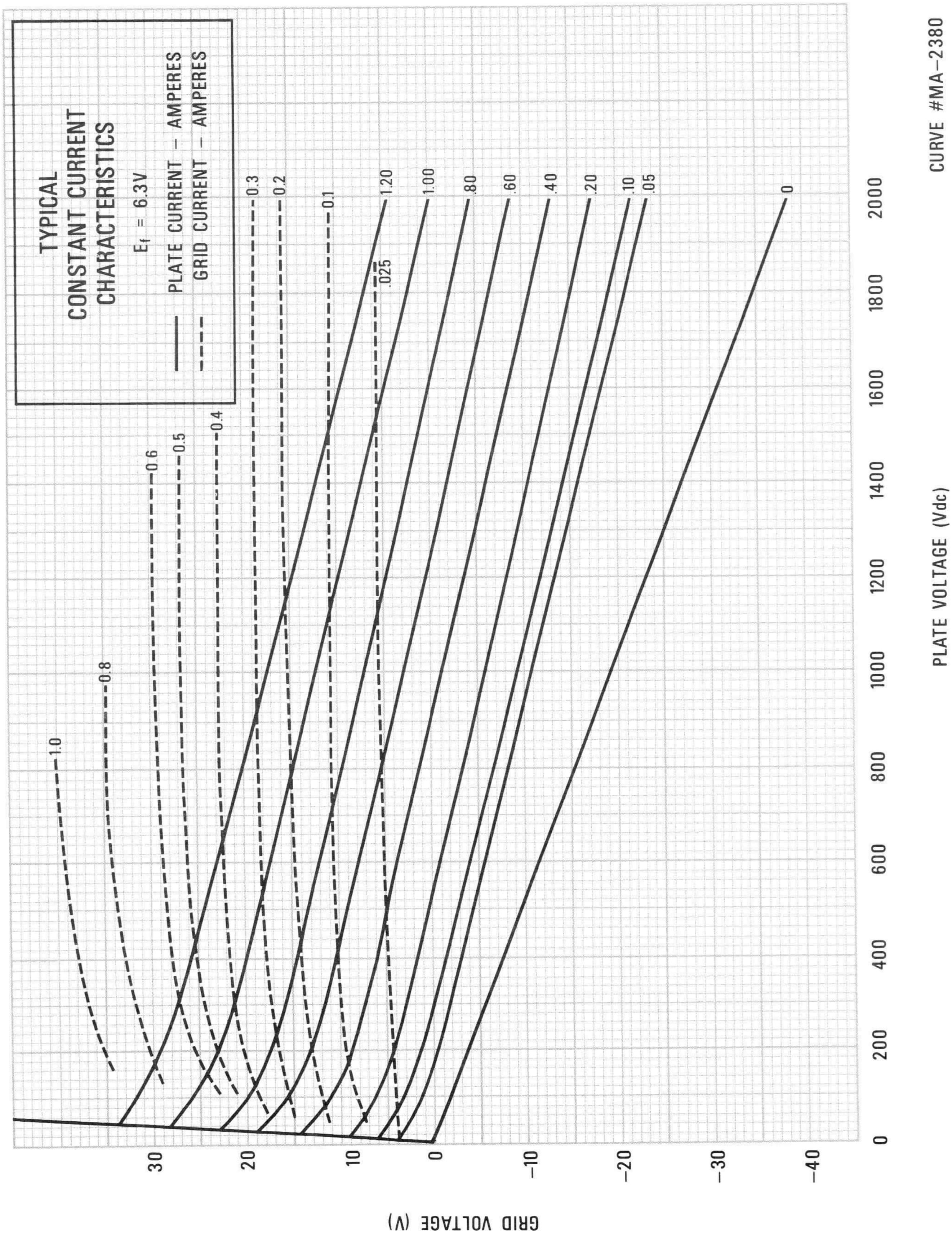
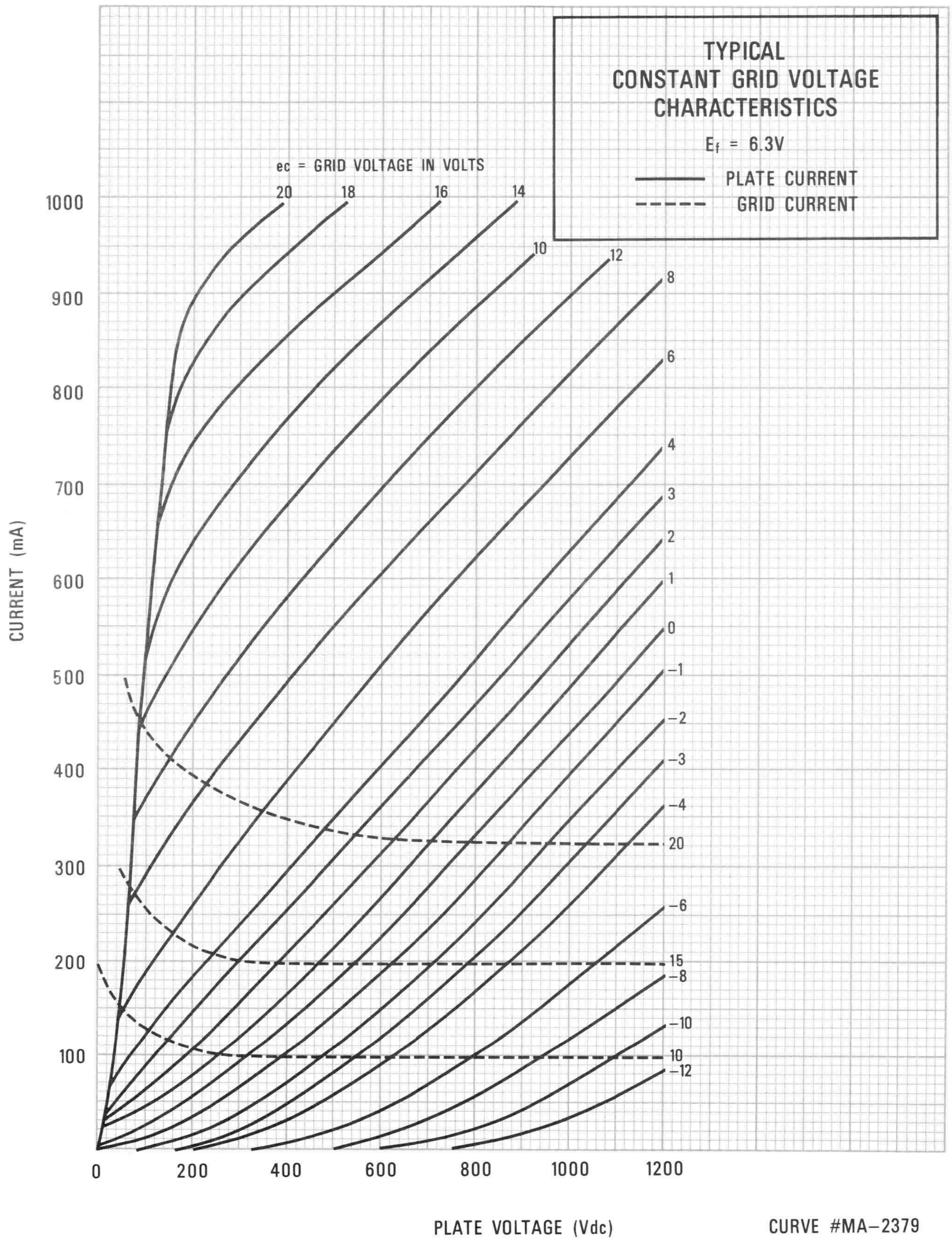


PLATE VOLTAGE (Vdc)

CURVE #MA-2374



CURVE #MA-2380



CURVE #MA–2379

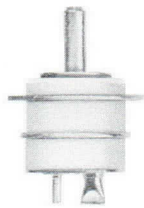
TECHNICAL DATA

PRELIMINARY DATA

8892

PLANAR TRIODE

The 8892 is a compact, rugged ceramic/metal planar triode intended for CW use or as a plate- or grid-pulsed oscillator or amplifier. It features high power output, high plate efficiency and excellent frequency stability under severe environmental conditions. The construction of the 8892 readily lends itself to cavity circuit operation resulting in an extremely compact rf source. The 8892 is capable of providing in excess of 1 kW peak power at 6 GHz.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 (±5%) V
Current, at 6.3 volts	0.65 A
Cathode Heating Time	60 sec.
Transconductance (Average)	30 mmhos
Amplification Factor (Average)	60
Direct Interelectrode Capacitance, without heater voltage	
Grid-Cathode	5.00 pF
Grid-Plate	1.60 pF
Plate-Cathode (maximum)	0.06 pF
Plate Dissipation (maximum)[2]	50 W
Grid Dissipation (maximum)	1.5 W

1. The data presents the nominal design objectives for this product and the characteristics and specifications of this type are subject to change. The device is now under development and is made available for experimental purposes only. For the most recent information concerning the status of this development, please contact your nearest Varian Electron Tube and Device Field Office or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah.

2. With forced air cooling or appropriate conduction and/or convection cooling.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.059 in; 26.90 mm
Diameter	0.758 in; 19.3 mm
Net Weight	0.25 oz; 7.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Conduction and Forced Air

 Printed in U.S.A.

8892

RF OSCILLATOR
Class C, Pulsed

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2.0 kVdc
PEAK PLATE VOLTAGE	2.5 kv
DC PLATE CURRENT	100 mAdc
DC GRID CURRENT	30 mAdc
PEAK PLATE CURRENT	3.0 a
PEAK GRID CURRENT	1.2 a
DC GRID VOLTAGE	-100 Vdc
PULSE DURATION[1]	3.0 μs
DUTY FACTOR[1]	.0025
PEAK HEATER-CATHODE VOLTAGE[2] . . .	±50 V
FREQUENCY	6.0 GHz

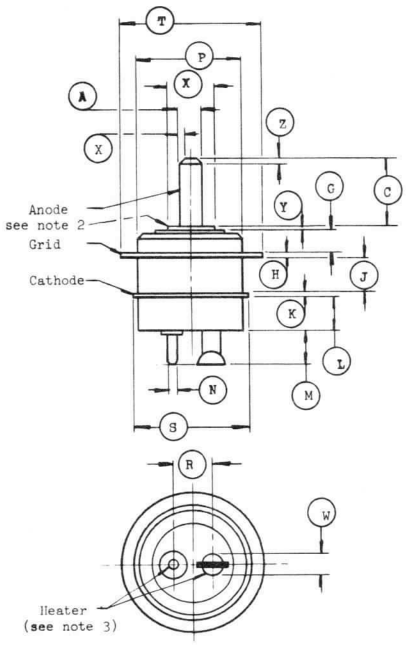
1. For applications requiring longer pulse duration and/or higher duty factor, please consult the Product Manager, EIMAC-Division of Varian, Salt Lake City, Utah.
2. The heater is electrically isolated from the cathode.

APPLICATION

The cathode and grid flanges should not be altered in any way such as by machining or filing, since final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

For optimum rf performance, the anode line should make good rf contact on the anode area indicated in the outline drawing.

Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas.



DIMENSIONAL DATA

DIM.	INCHES MIN.	INCHES MAX.	INCHES REF	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF
A	0.122	0.128	--	3.10	3.25	--
C	0.325	0.335	--	8.26	8.51	--
G	0.120	0.130	--	3.05	3.30	--
H	0.025	0.031	--	0.64	0.79	--
J	0.167	0.177		4.24	4.50	
K	0.025	0.031	--	0.64	0.79	--
L	0.170	0.185	--	4.32	4.70	--
M	0.170	0.190	--	4.32	4.83	--
N	0.047	0.053	--	1.19	1.35	--
P	0.535	0.565	--	13.59	14.35	--
R	0.185	0.215	--	4.70	5.46	--
S	0.598	0.608	--	15.19	15.44	--
T	0.748	0.758	--	19.00	19.25	--
W	--	--	0.100	--	--	2.54
X	0.250	0.260	--	6.35	6.60	--
Y	--	0.020	--	--	0.51	--

Note:
1. Ref. Dims. are for info. only & are not req'd. for inspection purposes.
2. For optimum rf performance the Anode line should make rf contact at this point on the Anode Cup.
3. Heater is electrically isolated from cathode.

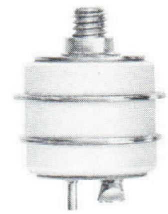
TECHNICAL DATA

PRELIMINARY DATA

8893

PLANAR TRIODE

The 8893 is a compact, rugged ceramic/metal planar triode intended for CW use or as a plate- or grid-pulsed oscillator or amplifier. It features high power output, high plate efficiency and excellent frequency stability under severe environmental conditions. The construction of the 8893 readily lends itself to cavity circuit operation resulting in an extremely compact rf source.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 (±5%) V
Current, at 6.3 volts	1.3 A
Cathode Heating Time	60 sec.
Transconductance (Average)	30 mmhos
Amplification Factor (Average)	60
Direct Interelectrode Capacitance, without heater voltage	
Grid-Cathode	8.00 pF
Grid-Plate	2.35 pF
Plate-Cathode (maximum)	0.10 pF
Plate Dissipation (maximum)[2]	100 W
Grid Dissipation (maximum)	1.5 W

1. The data presents the design objectives for this product and the characteristics and specifications of this type are subject to change. The device is now under development and is made available for experimental purposes only. For the most recent information concerning the status of this development, please contact your nearest Varian Electron Tube and Device Field Office or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah.

2. With forced air cooling or appropriate conduction and/or convection cooling.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.074 in; 27.30 mm
Diameter	0.758 in; 19.30 mm
Net Weight	0.35 oz; 10.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Forced Air

RF OSCILLATOR
Class C, Pulsed

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2.0	kVdc
PEAK PLATE VOLTAGE	3.5	kv
DC PLATE CURRENT	150	mAdc
DC GRID CURRENT	45	mAdc
PEAK PLATE CURRENT	5.0	a
PEAK GRID CURRENT	1.5	a
DC GRID VOLTAGE	-100	Vdc
PULSE DURATION 1	6.0	μs
DUTY FACTOR 1	.004	
PEAK HEATER-CATHODE VOLTAGE 2	±50	V
FREQUENCY	4.0	GHz

1. For applications requiring longer pulse duration and/or higher duty factor, please consult the Product Manager, EIMAC-Division of Varian, Salt Lake City, Utah.
2. The heater is electrically isolated from the cathode.

REPRESENTITIVE OPERATION (Grid-Pulsed Oscillator)

Frequency	2.5	GHz
Heater Voltage	6.3	V
Heater Current	1.3	A
Duty Factor	0.01	maximum
Pulse Width	30	microseconds maximum
Peak Plate Voltage	1.5	kv
Peak Plate Current	3a	maximum
Power Output (useful)	1	kw, minimum

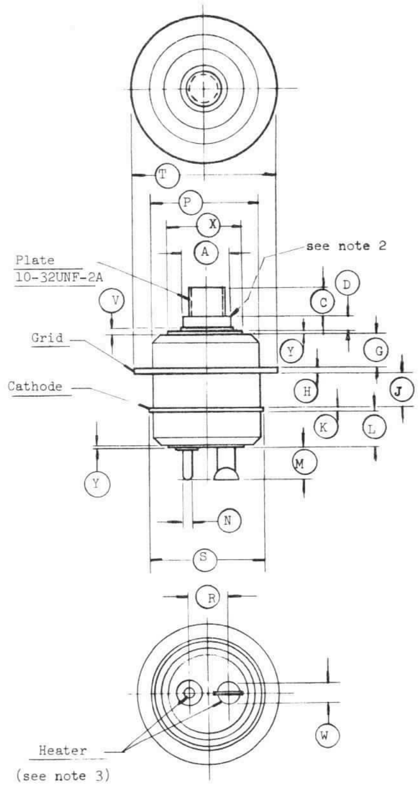
APPLICATION

The cathode and grid flanges should not be altered in any way such as by machining or filing, since final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

For optimum rf performance, the anode line should make good rf contact on the anode area indicated in the outline drawing.

For further details on cooling or other aspects of tube operation, refer to the "Application Notes for Planar Triodes" bulletin which can be obtained on request.

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX	REF	MIN	MAX.	REF
A	0.247	0.253	- -	6.27	6.43	- -
C	0.120	0.160	- -	3.05	4.06	- -
D	0.070	0.090	- -	1.78	2.29	- -
G	0.182	0.192	- -	4.62	4.88	- -
H	0.025	0.031	- -	0.64	0.79	- -
J	0.170	0.180	- -	4.32	4.57	- -
K	0.025	0.031	- -	0.64	0.79	- -
L	0.170	0.180	- -	4.32	4.57	- -
M	0.170	0.190	- -	4.32	4.83	- -
N	0.047	0.053	- -	1.19	1.35	- -
P	0.635	0.665	- -	16.13	16.89	- -
R	0.186	0.214	- -	4.72	5.44	- -
S	0.698	0.708	- -	17.73	17.98	- -
T	0.748	0.758	- -	19.00	19.25	- -
V	- -	0.040	- -	- -	1.02	- -
W	- -	- -	0.100	- -	- -	2.54
X	0.545	0.570	- -	13.84	14.48	- -
Y	- -	0.020	- -	- -	0.51	- -



Notes: 1. Ref Dims. are for info. only and are not reqd for insp. purposes.
2. For optimum rf performance the Anode line should make rf contact at this point on the Anode Cup.
3. Heater is electrically isolated from cathode.

TECHNICAL DATA

8906 / 8907

PLANAR TRIODES

8906

8907

The EIMAC 8906 (formerly Y-572) and 8907 (formerly Y-581) are rugged ceramic/metal planar triodes designed for use as a CW, grid- or plate-pulsed oscillator or frequency multiplier up to 3 GHz, as well as for pulse modulator or voltage regulator service. The 8906 is supplied with a knob intended for conduction-convection cooling and the 8907 is supplied with radiator (P/N 014224) for forced air cooling. Except for the plate dissipation ratings, the characteristics of both tube types are identical.

An outstanding feature of these tubes is the low heater power requirement for such high current capability. Either type can normally be used in place of the 7815, 7815R and 8745 at the same heater voltage where higher current capability and/or longer life is desired. Replacement of the above tube types with either the 8906 or 8907 is possible in most cases. The tubes can also replace the 7211/7698 (or 7698R) when a 25% lower heater power requirement is desired. In addition, the 8906 and 8907 have the preferred features of the 7815 and 7211 type family: high-Mu, high transconductance, great mechanical strength, low interelectrode capacitance, high current capability and increased grid-to-anode insulator length. The cathode is of the arc resistant extended interface type, well proven in airline type applications, assuring reliable, long-life operation under adverse conditions.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	1.00	A
Transconductance (Average):		
I_b = 160 mA (200 mA/cm^2)	38	mmhos
Amplification Factor (Average)	80	
Direct Interelectrode Capacitances (grounded cathode)[2]		
Grid-Cathode	8.00	pF
Grid-Plate	1.98	pF
Plate-Cathode	0.06	pF
Cut-off Bias[3]	-30	V max.

(Revised 11-1-71) Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.701 in; 68.60 mm
Diameter (8906)	1.195 in; 30.35 mm
Diameter (8907)	1.264 in; 32.11 mm
Net Weight (8906)	1.8 oz; 48 gm
Net Weight (8907)	2.2 oz; 63 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling:	
8906	Conduction and Convection
8907	Forced Air
Terminals	Coaxial, Special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes, 55 to 500 Hz	10 G
Altitude, max (in a suitable designed circuit)	70,000 ft

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 for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
GRID NEGATIVE TO CATHODE	-400	VOLTS
GRID POSITIVE TO CATHODE	30	VOLTS
DC PLATE CURRENT	150	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
PLATE DISSIPATION		
8906	10	WATTS
8907	100	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	2.5	GIGAHERTZ

REPRESENTATIVE OPERATION

Grounded Grid CW r-f Power Amplifier

DC Plate Voltage	630	Vdc
DC Cathode Current	140	mAdc
DC Grid Voltage (Approx.)	-5	Vdc
DC Grid Current	25	mAdc
Drive Power (Approx.)	4	W
Useful CW Power Output	45	W
Heater Voltage	6.0	V
Frequency	700	MHz

Grounded Grid CW r-f Oscillator

DC Plate Voltage	1000	Vdc
DC Plate Current	140	mAdc
DC Grid Voltage (Approx.)	-20	Vdc
DC Grid Current (Approx.)	30	mAdc
Useful CW Power Output	30	W
Heater Voltage	5.0	V
Frequency	2.5	GHz

RF POWER AMPLIFIER OR OSCILLATOR
Grid- or Plate-Pulsed

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE (Grid-Pulsed)	3500	VOLTS
PEAK PULSE PLATE VOLTAGE		
(Plate-Pulsed)	4500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
GRID NEGATIVE TO CATHODE	-700	VOLTS
GRID POSITIVE TO CATHODE	200	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
PLATE DISSIPATION		
8906	10	WATTS
8907	100	WATTS
GRID DISSIPATION	1.5	WATTS
FREQUENCY	3.0	GIGAHERTZ
PULSE DURATION [1]	6	μs
DUTY FACTOR [1]	0033	

REPRESENTATIVE OPERATION
Grid-Pulsed r-f Amplifier

DC Plate Voltage	2200	Vdc
Peak Video Plate Current	2.5	a
DC Grid Voltage	-50	Vdc
Peak Video Grid Current	1.0	a
Pulse Drive Power	400	w
Useful Power Output (Approx.)	2500	w
Duty Factor	.002	
Pulse Width	3	μs
Heater Voltage	6.0	V
Frequency	1.1	GHz

Plate-Pulsed r-f Oscillator

Peak Plate Voltage	3500	v
Peak Video Plate Current	4.8	a
Peak Video Grid Current	1.5	a
Useful Power Output	3000	w
Duty Factor	.0025	
Pulse Width	3	μs
Heater Voltage	5.8	V
Frequency	3.0	GHz

PULSE MODULATOR OR PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3500	VOLTS
PEAK PLATE VOLTAGE	4500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
GRID NEGATIVE TO CATHODE	-750	VOLTS
GRID POSITIVE TO CATHODE	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
PLATE DISSIPATION		
8906	10	WATTS
8907	100	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION	6	μs
DUTY FACTOR [1]	0033	
CUT-OFF MU [1]	60	

1. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

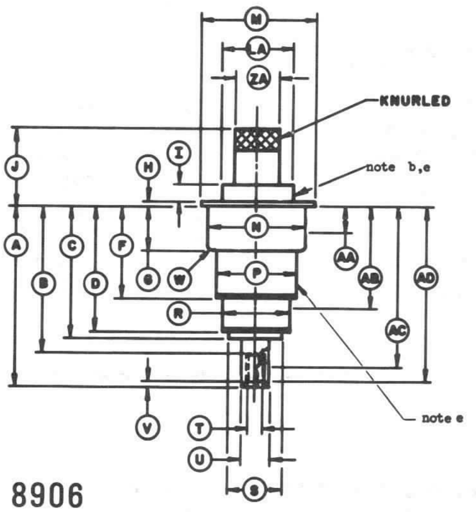
RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	0.90	1.05	A
Cathode Heating Time	60	---	sec
Interelectrode Capacitances [1] (grounded cathode connection)			
Grid-Cathode	7.0	9.0	pF
Plate-Cathode	---	0.06	pF
Grid-Plate	1.86	2.10	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

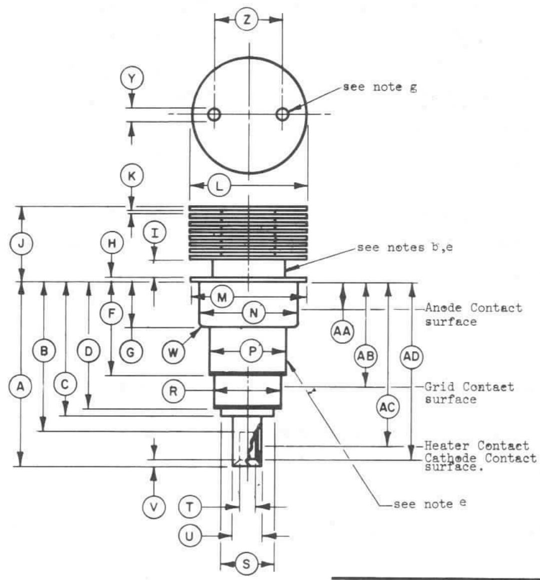
APPLICATION

For general application information please refer to the bulletin "Operating Instructions for Planar Triodes". The operating instructions should be consulted prior to the designing of new requirements around the above tube types. Higher plate dissipation of up to 150 watts is possible with the 8906 and 8907 tube type when using radiator P/N 158555. If this is required the tube order should call for the tube type Y-602. For unusual and special application consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.



8906

DIMENSION DATA (Note a)					
Dim. in Inches		Dim. in Millimeters.			
Min.	Max	Dim.	MIN.	MAX.	Notes
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
.125	.185	I	3.18	4.70	
.766	.826	J	19.46	20.98	
.025	.040	K	.64	1.17	
1.234	1.264	L	31.34	32.11	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	c,d
.752	.792	P	19.20	20.12	
.655	.665	R	16.64	16.89	c,d
	.545	S		13.84	
.213	.223	T	5.41	5.66	c,d
.315	.325	U	8.00	8.26	c,d
	.086	V		2.18	
	.100	W		2.54	
.105	.145	Y	2.67	3.68	
.650	.850	Z	16.51	21.59	



8907

ELECTRODE CONTACT AREA (Note a,f)				
	Dim. in Inches		Dim. in Millimeters	
Dim.	Min.	Max.	Min.	Max.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10

DIMENSION DATA (Note a)					
DIM. IN INCHES		DIM. IN MILLIMETERS			
MIN.	MAX.	DIM.	MIN.	MAX.	NOTES
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
	.185	I		4.70	
.766	.826	J	19.46	20.98	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	d
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	d
	.545	S		13.84	
.213	.223	T	5.41	5.66	d
.315	.325	U	8.00	8.26	d
	.086	V		2.18	
	.100	W		2.54	
.840	.860	LA	21.34	21.84	
.427	.447	ZA	10.85	11.35	

NOTES:

a.. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.

b. This surface shall be used to measure Anode Shank temperature.

c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows; note 2 shall apply:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

d. Dias. N,R,T,U shall apply throughout entire contact area as defined by dims. AA,AB, AC,AD respectively.

e. This surface shall not be used for clamping or locating.

f. . Electrode Contact Dims. are given for socket design purposes & are not intended for inspection purposes.

Notes:

a. Metric equivalents to the nearest .01 mm, are given for general information only & are based on 1 inch= 25.4 mm.

b. This surface shall be used to measure anode shank temp.

c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

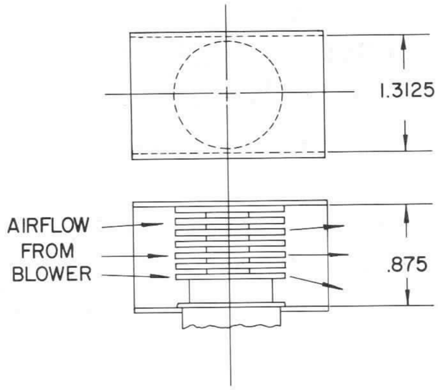
d. Dias. N,R,T & U shall apply throughout entire lenght as defined be dims. AA,AB,AC & AD respectively.

e. This surface shall not be used for clamping or locating.

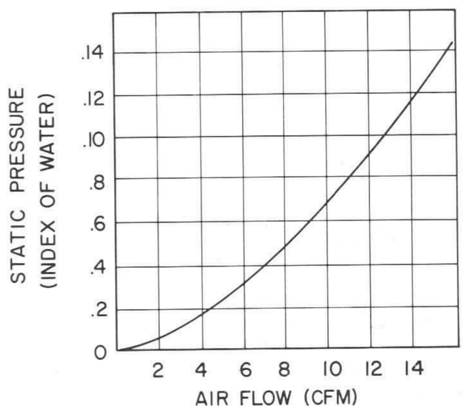
f. Electrode Contact dims. are given for socket design purposes & are not intended for inspection purposes.

g. Holes for Tube Extractor thru top fin only.

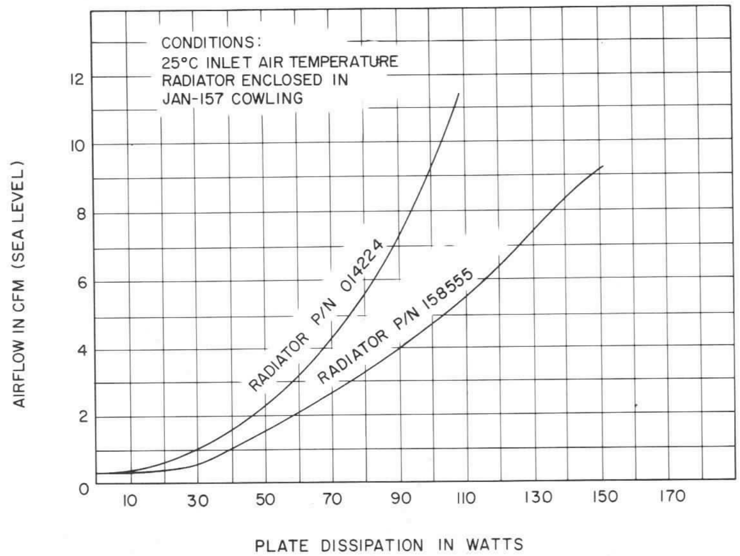
AIRFLOW vs STATIC PRESSURE WITH STANDARD COWLING JAN-157



-STANDARD COWLING-

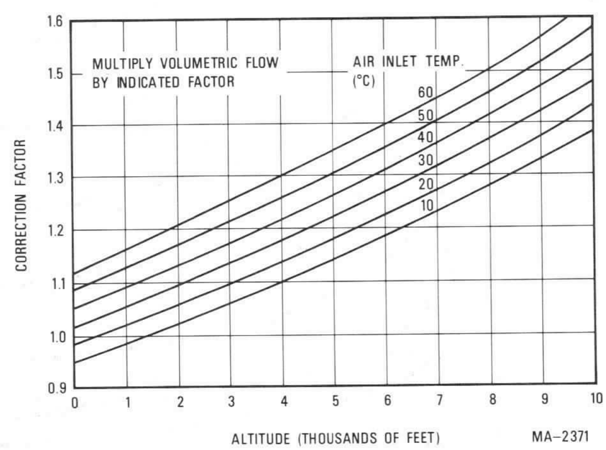


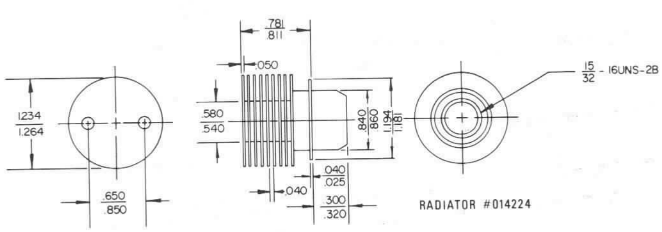
MAXIMUM PLATE DISSIPATION vs COOLING AIRFLOW



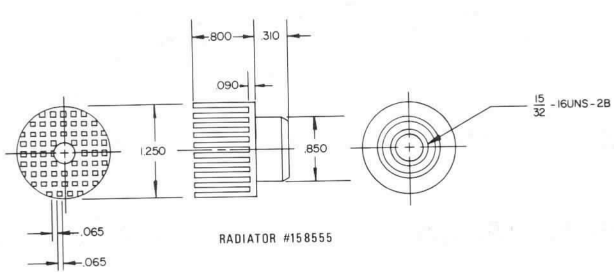
COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

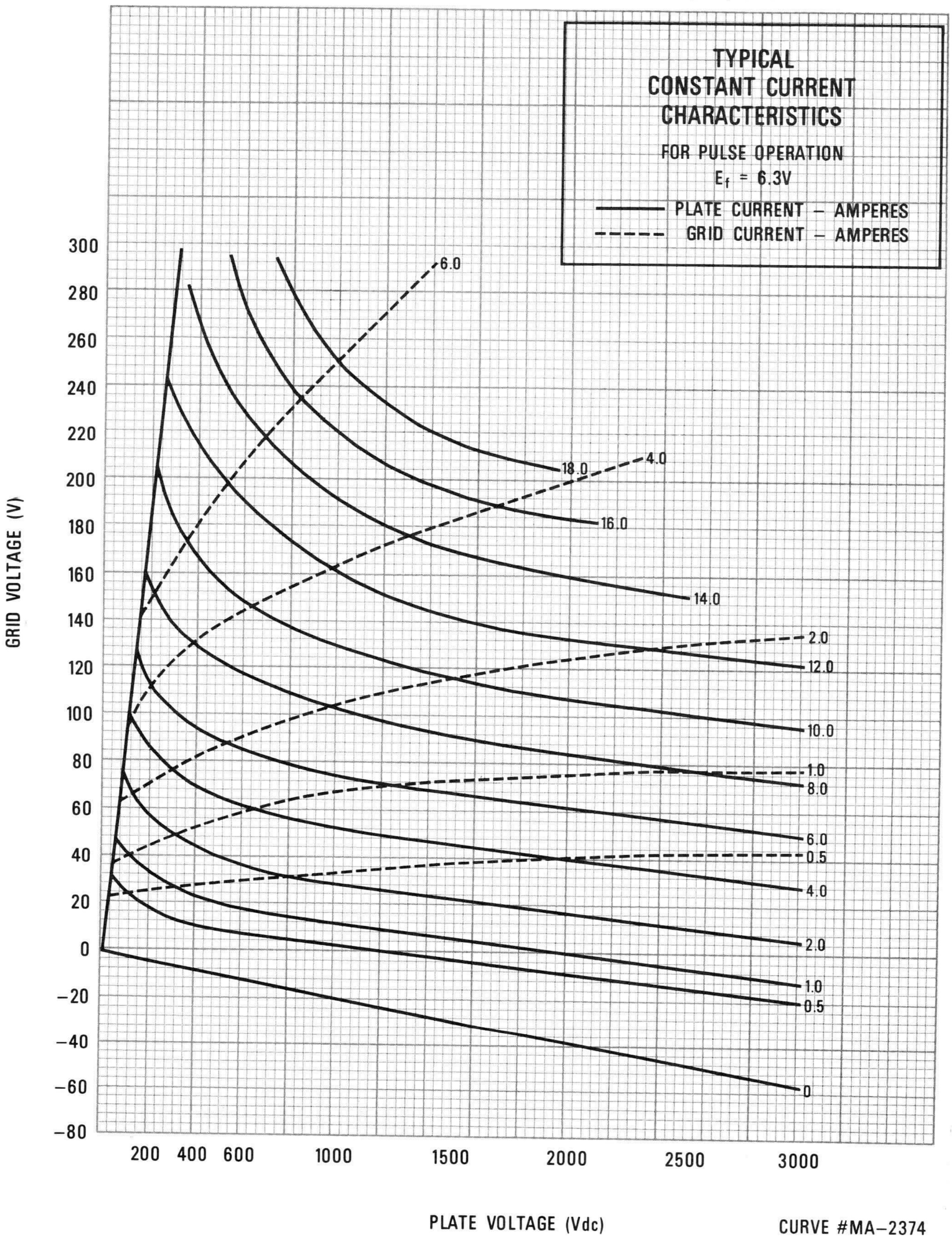




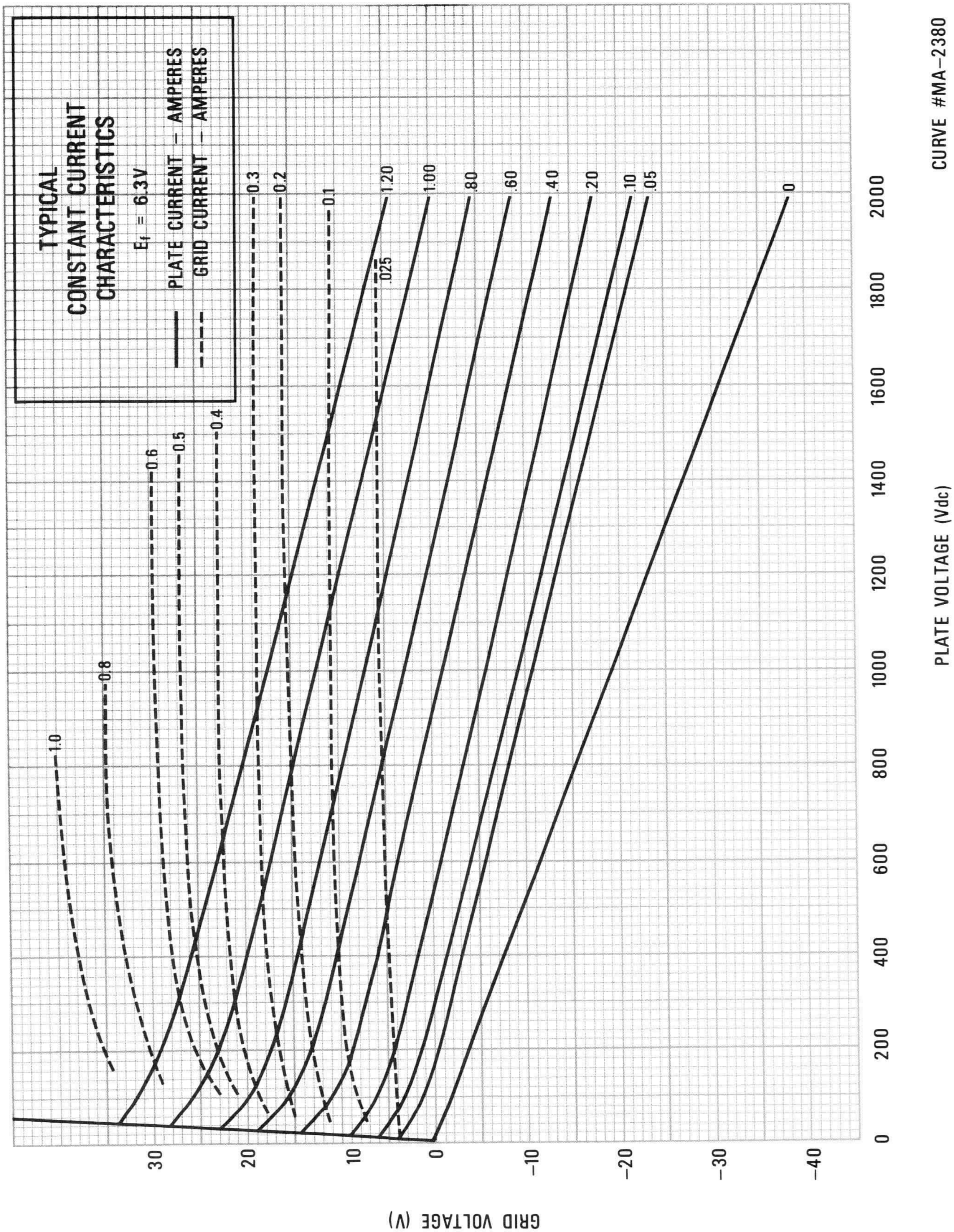
RADIATOR #014224

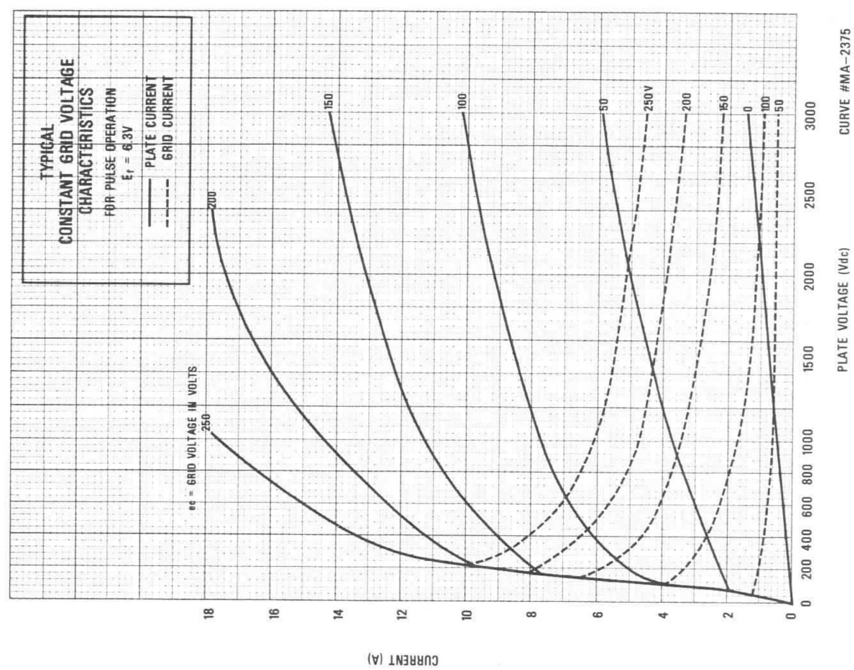


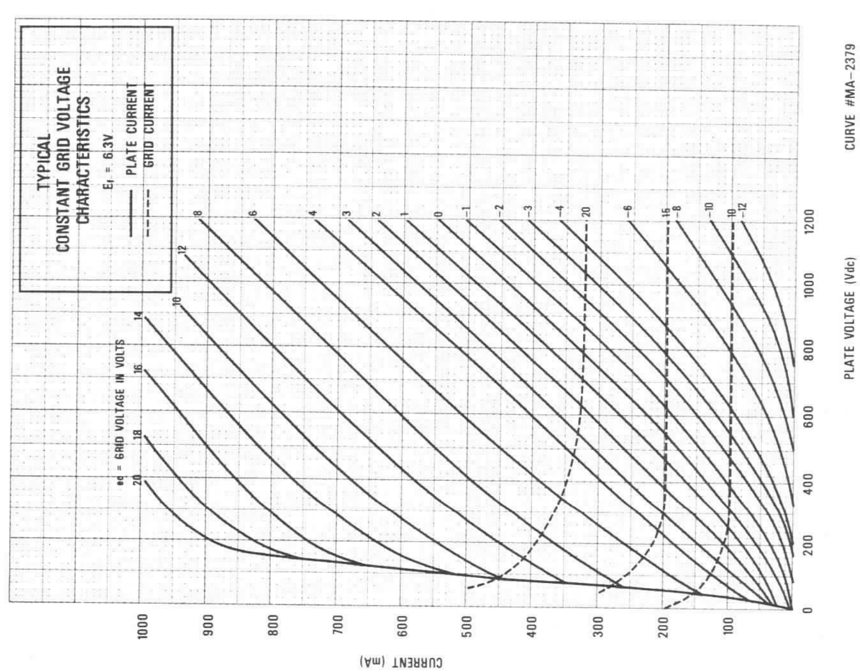
RADIATOR #158555



CURVE #MA-2374


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.3V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
1.20
1.00
.80
.60
.40
.20
.10
.05
0
.025
1.0
0.8
0.6
0.5
0.4
0.3
0.2
0.1
GRID VOLTAGE (V)
30
20
10
0
–10
–20
–30
–40
PLATE VOLTAGE (Vdc)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
CURVE #MA–2380


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
ec = GRID VOLTAGE IN VOLTS
CURRENT (A)
PLATE VOLTAGE (Vdc)
CURVE #MA-2375


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
ec = GRID VOLTAGE IN VOLTS
CURRENT (mA)
PLATE VOLTAGE (Vdc)
CURVE #MA-2379

TECHNICAL DATA

8906AL
Y572AL

PLANAR TRIODE

The EIMAC 8906AL/Y572AL is a ceramic/metal planar triode specially processed and tested to assure high reliability in airborne service. Evaluation of this tube is based upon operating conditions in grid- or plate-pulsed oscillator service (transponder) and in grid- or plate-pulsed amplifier service in distance measuring equipment (DME). The testing emphasizes cathode emission capability at reduced heater voltage and high voltage hold-off, both features which are demanded in airline service.

The 8906AL/Y572AL is derived from the 7815AL/7211/7698 family. This new improved tube also contains the features of the original types, including rugged ceramic/metal construction, low interelectrode capacitance, high transconductance and high mu. The longer grid-anode ceramic insulator of the earlier type is used, making the 8906AL/Y572AL especially suited for high altitude airborne operation. The 8906AL/Y572AL has a 60% larger cathode area than the 7815/7815AL thus lowering cathode current loading per unit area yet maintaining as high or higher current capability.

In addition to these features, this tube also incorporates the arc-resistant cathode which assures stable operation under adverse conditions and which minimizes catastrophic failure due to arc-over during circuit malfunction. The tube is useable from dc to 3 GHz.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.7 (±2%)	V
Current, at 5.7 volts	0.95	A
Transconductance (Average):		
I_b = 100 mAdc, E_b = 600 Vdc	30	mmhos
Amplification Factor (Average)	80	
Direct Interelectrode Capacitance (grounded cathode)[2], without heater voltage:		
Grid-Cathode	8.00	pF
Grid-Plate	1.98	pF
Plate-Cathode (maximum)	0.060	pF

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	2.701 in; 68.60 mm
Diameter	1.195 in; 30.35 mm
Net Weight	1.8 oz; 48 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction and Convection
Terminals	Special

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at 5.7 volts	0.87	1.02	A
Cut-off Bias[1]	---	-25	V
Grid-Plate Capacitance[2]	1.85	2.10	pF
Grid-Cathode Capacitance[2]	7.00	9.00	pF
Plate-Cathode Capacitance	---	0.060	pF

1. Measured with 1 mA plate current and a plate voltage of 1000 Vdc.
2. Capacitance values as measured with a cold tube and in a shielded socket. When the cathode is heated to the proper temperature the grid-cathode capacitance will increase by approximately 1 pF due to thermal expansion of the cathode support.

RF POWER AMPLIFIER OR OSCILLATOR

Grid- or Plate-Pulsed

MAXIMUM RATINGS, ABSOLUTE VALUES

DC PLATE VOLTAGE	3500	VOLTS
PEAK PULSE PLATE VOLTAGE		
PLATE PULSED	4500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	750	VOLTS
Grid positive to cathode	250	VOLTS
PULSE PLATE CURRENT	5.0	AMPERE
PULSE GRID CURRENT	2.5	AMPERE
DC CATHODE CURRENT	200	MILLIAMPERES
AVERAGE PLATE DISSIPATION[1]		
Conduction and Convection	10	WATTS
GRID DISSIPATION (Average)	2	WATTS
DUTY FACTOR[2]	.0033	
PULSE DURATION[2]	6	μs
FREQUENCY	3	GHz

1. Higher plate dissipation is permissible when EIMAC radiator (P/N 014224) is used.
2. For longer pulse duration or higher duty cycle, consult the nearest Varian Electron Tube and Device Group Sales Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

OPERATING CONDITIONS FOR THE 8906AL/Y572AL in REPRESENTATIVE APPLICATION.

Grid-Pulsed Oscillator

Frequency	1.090	GHz
Heater Voltage	5.7	V
DC Plate Voltage	2000	Vdc
DC Grid Voltage	-75	Vdc
Peak Plate Current	1.1	a
Peak Grid Current	0.8	a
Pulse Duration	0.5	μs
Duty	0.001	
Useful Power Output (Approx.)	850	w

Plate-Pulsed Amplifier

Frequency	1.1	GHz
Heater Voltage	5.7	V
Peak Plate Pulse Voltage	2000	v
DC Grid Voltage	-45	Vdc
Peak Plate Current	2.0	a
Peak Grid Current	1.0	a
Pulse Duration	3.5	μs
Duty	0.001	
Driving Power	300	w
Useful Power Output (Approx.)	2000	w
Gain	8	db
Plate Efficiency	50%	

APPLICATION

MECHANICAL

MOUNTING - The important dimensions of the tube are carefully controlled with respect to the reference surface as shown on the outline drawing. The reference surface is intended to serve as a tube stop and the location of the tube in the circuit should therefore be determined by this surface coming in positive contact with a precisely positioned member of the socket or cavity. Adherence to this practice will assure both mechanical and electrical interchangeability of all tubes of a given type. If a non-designated surface is used as a tube stop, faulty positioning of the tube in the cavity and possible imcomplete electrical contact can result in improper tuning, reduced power output and damage to the cavity, tube or both. Contact surfaces, with reference to the designated tube stop are shown in the outline drawing. Electrical contact to the cathode, grid, anode and also the heater should be restricted to these designated contact areas.

Dimensions should never be taken from sample tubes. Dimensional changes due to normal variations in undimensioned surfaces may occur within the limits specified on the outline drawing. Use of nondesignated electrical contact surfaces might therefore result in incomplete contact or mechanical interference, causing changes in cavity tuning.

Electrical contact should be made by spring finger collets bearing against the previously described contact areas. If connections are employed which do not provide multiple contacts to the designated contact areas, concentration of RF current will result in loss of output power, especially at higher frequencies. The spring contacts used should exert a firm pressure without gouging the plated contact surface. This latter phenomena can result in loose particles of material which can cause arcing or unstable operation of the cavity.

If the tubes are used in applications which call for severe shock or vibration the tube may be clamped in place by the knob or radiator, exerting pressure only on this part of the tube and against the tube stop. No other portion of the tube should be subject to any clamping force. In particular, electrical contacts which utilize setscrews or rigid clamps should be avoided. Such contact schemes can distort the contact surfaces causing undue stress in the metal-to-ceramic seal area which may result in a vacuum leak. Soldered electrical connections can be made, however great care should be taken during the solder operation to avoid fracture of the seal area due to thermal shock. All contact surfaces should be kept clean to minimize losses.

COOLING - The EIMAC planar triodes are designed to operate at envelope and anode temperatures of up to the maximum rated value of 250°C. However, performance and long-term reliability of any component are improved when it is kept as cool as technically feasible. Therefore, it is recommended that sufficient cooling be provided to keep the anode and seal areas well below the specified maximum temperature, where long tube life and high reliability are of great importance.

The maximum plate dissipation of the 8906AL/Y572AL is 10 watts average power. This can be accomplished by conduction, natural convection or forced air convection cooling. The maximum plate dissipation in pulse service is 45 watts average when furnished with EIMAC radiator (P/N 014224) and forced air cooling is employed at that level. When forced air cooling is used, it is recommended that additional airflow, apart from that flowing through the radiator be used to cool the tube envelope and other tube terminals. A certain amount of conduction cooling is usually inherent in the contact finger configuration. It should be noted, however, that spring fingers provide poor heat conduction and measurements have shown a temperature difference as much as 50°C between the contact finger and contact area.

It is suggested that in all new applications the envelope temperature be measured, especially if the tube is used close to the upper temperature limit. The temperature can easily be determined by the use of Tempilaq paint (Tempil Division, Big Three Industrial Gas & Equipment Co. Hamilton Blvd., So. Plainfield, N.J. 07080. or Temp-Plate stickers (Pydrodyne, Inc., 1001 Colorado St., Santa Monica, California 90404.)

ELECTRICAL

HEATER VOLTAGE - The rated heater voltage for the 8906AL/Y572AL is 5.7 volts and should be controlled within ±2% to obtain maximum tube life and to minimize variations in circuit performance. The rated heater voltage is optimum for most existing airborne applications such as DME and transponder systems. However, there are other applications where a different heater voltage than the nominal should be used to obtain the longest possible tube life. Depending on pulse width, power output and frequency of oscillation used a different heater voltage may be better for long reliable life. Electron transit time is not necessarily small with respect to the period of oscillation and the amount of driving power diverted will contribute to the cathode heating by electron bombardment.

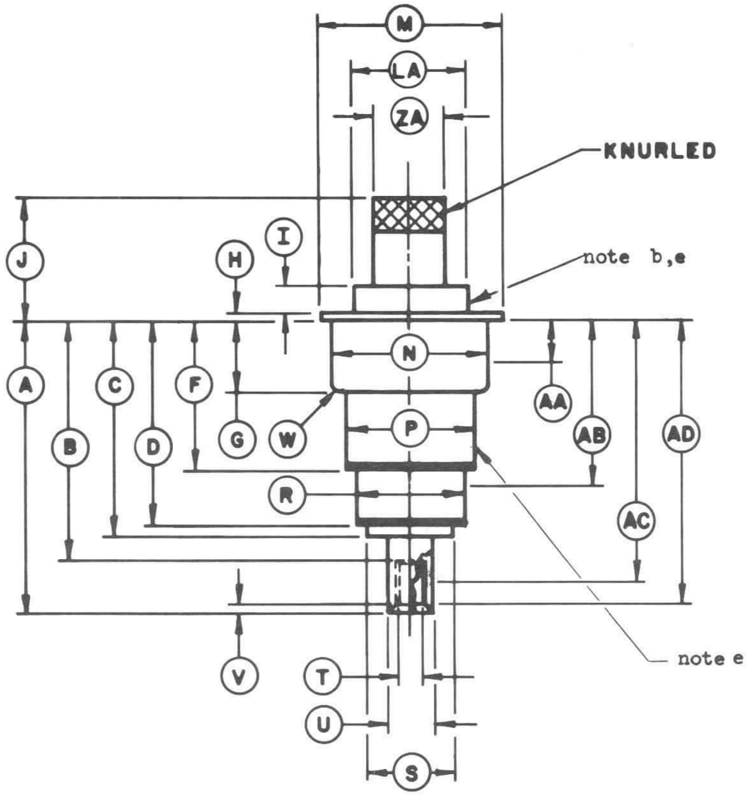
The proper adjustment of the heater voltage must be made to compensate for this additional heating, which depends on operating frequency and duty cycle employed.

INTERELECTRODE CAPACITANCES - As indicated, the capacitance values are shown for measurements made with no heater voltage. The cathode to grid and cathode to plate capacitance will increase with the application of the heater voltage, due to the thermal expansion of the cathode support. Typically, the increase in the grid to cathode capacitance will be 15%, or more, depending on the heater voltage. Since the heater voltage can vary depending on use, data taken without heater voltage is more useful for control of tube-to-tube uniformity. The grid to anode capacitance is not effected by the application of the heater voltage.

CIRCUIT TUNING - Especially under grid pulse conditions, it is important that the tube does not lose bias or momentarily go into a CW mode. Either of these events may result in tube failure. It is suggested that provision be made for initial circuit tune-up at reduced anode voltage and for extra tube protection when the circuit adjustment is critical. The average grid dissipation capability for this tube is 2.0 watts. For many applications the limiting factor is often not anode dissipation or cathode emission capability, but grid dissipation. If pulse width control is lost in pulse applications the grid can exceed safe operating temperatures in 50 ms or less. Appropriate circuit protection during tune up is therefore recommended.

CATHODE OPERATION - The 8906AL/Y572AL contains an arc-resistant cathode. Performance in the field and laboratory indicates this tube is capable of withstanding some abuse due to high voltage arcs, however, poor circuit adjustment in the field may result in shortened tube life. It is, therefore, suggested that wherever feasible, the plate supply be designed such that its impedance limits the short circuit current to within five to ten times the maximum forward current. For pulse service the peak current should be limited to the values listed. Higher pulse width and duty cycles than given can be obtained with proper derating of the current. For this and special applications it is recommended that the user request additional information pertaining to his special application from the nearest Varian Electron Tube and Devices Field Office, or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah.

For general application information please refer to the Planar Triode Operating Instructions.



ELECTRODE CONTACT AREA (see note a,f)				
DIM.	MIN.	MAX.	MIN.	MAX.
AA	.035	.361	.89	9.17
AB	1.185	1.265	30.10	32.14
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10
	DIM. IN INCHES		DIM. IN MILLIMETERS	

DIMENSION DATA (Note a)					
DIM. IN INCHES		DIM. IN MILLIMETERS			
MIN.	MAX.	DIM.	MIN.	MAX.	NOTES
1.815	1.875	A	46.10	47.62	
	1.534	B		38.96	
	1.475	C		37.46	
1.289	1.329	D	32.74	33.76	
.970	1.010	F	24.64	25.65	
.462	.477	G	11.73	12.12	
	.040	H		1.02	
	.185	I		4.70	
.766	.826	J	19.46	20.98	
1.180	1.195	M	29.97	30.35	
1.025	1.035	N	26.04	26.29	d
.752	.792	P	19.10	20.12	
.655	.665	R	16.64	16.89	d
	.545	S		13.84	
.213	.223	T	5.41	5.66	d
.315	.325	U	8.00	8.26	d
	.086	V		2.18	
	.100	W		2.54	
.840	.860	LA	21.34	21.84	
.427	.447	ZA	10.85	11.35	

NOTES:

a.. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.

b. This surface shall be used to measure Anode Shank temperature.

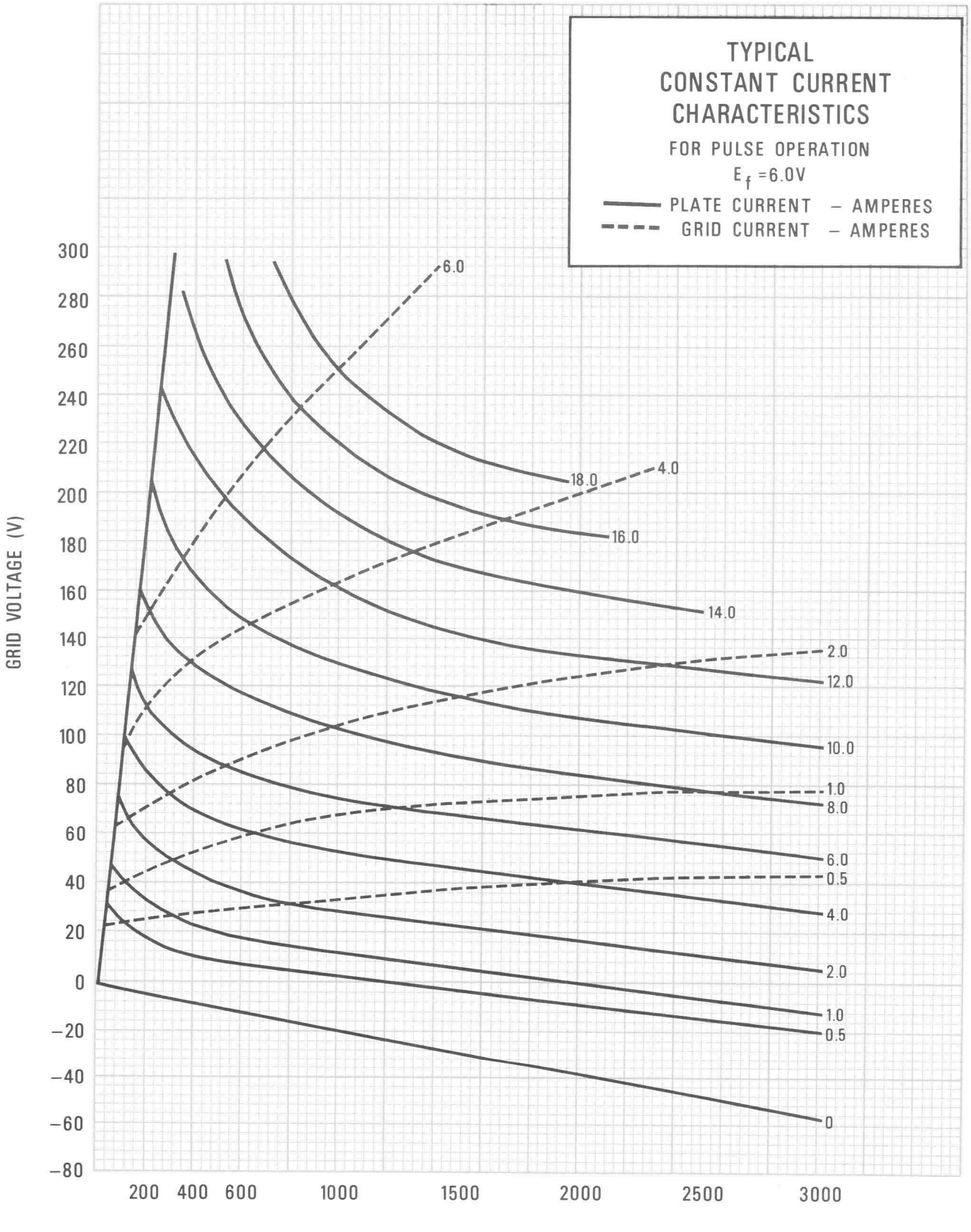
c. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows; note 2 shall apply:

Contact Surface	TIR Max.	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

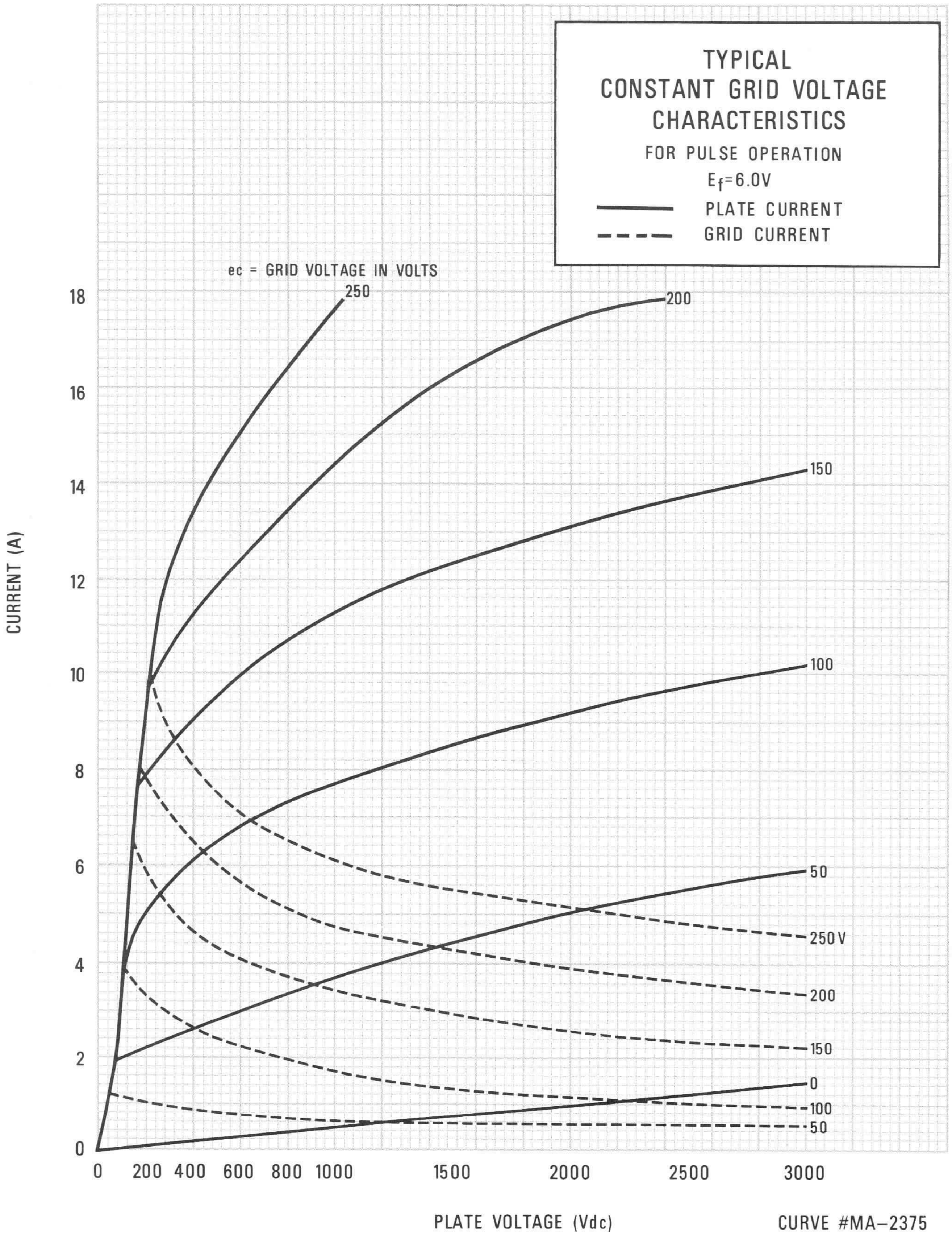
d. Dias. N,R,T,U shall apply throughout entire contact area as defined by dims. AA,AB, AC,AD respectively.

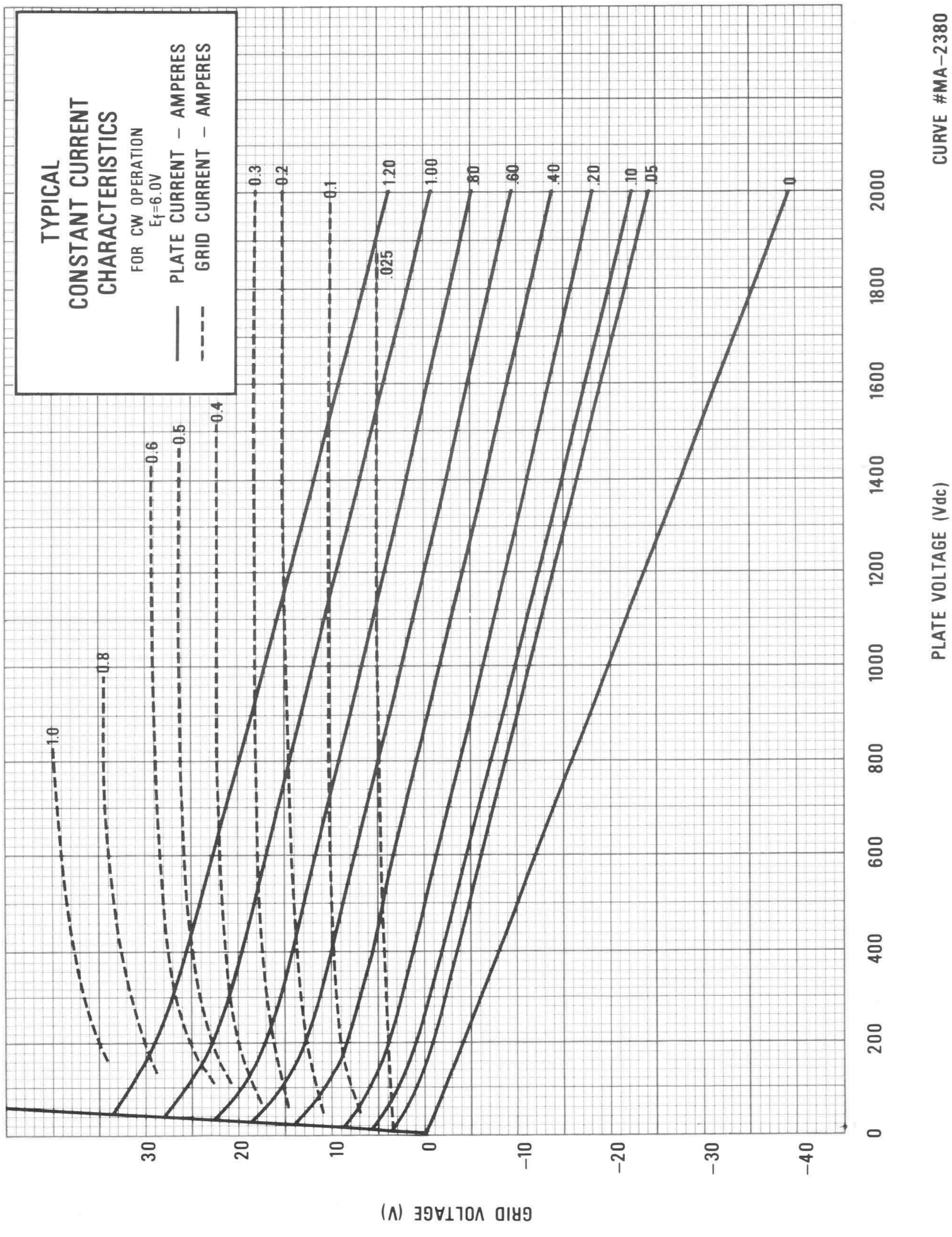
e. This surface shall not be used for clamping or locating.

f. . Electrode Contact Dims. are given for socket design purposes & are not intended for inspection purposes.



CURVE #MA–2374


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
Ef=6.0V
PLATE CURRENT
GRID CURRENT
ec = GRID VOLTAGE IN VOLTS
250
200
150
100
50
0
250 V
200
150
100
50
CURRENT (A)
0
2
4
6
8
10
12
14
16
18
0
200
400
600
800
1000
1500
2000
2500
3000
PLATE VOLTAGE (Vdc)
CURVE #MA–2375


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR CW OPERATION
Ef=6.0V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (Vdc)
CURVE #MA-2380

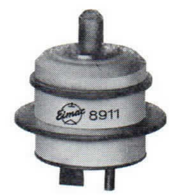
TECHNICAL DATA

PRELIMINARY DATA

8911

PLANAR TRIODE

The 8911 (formerly X2153) is a compact, rugged ceramic/metal planar triode intended for CW plate- or grid-pulsed oscillator, amplifier, or frequency multiplier use. It features high power output, high plate dissipation and excellent frequency stability under severe environmental conditions. The construction of the 8911 readily lends itself to cavity circuit operation resulting in an extremely compact rf source. The 8911 is capable of providing in excess of 1 kw peak power at 6 GHz.



Actual Size

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 5% V
Current, at 6.3 volts	0.65 A
Cathode Heating Time	60 sec.
Transconductance (Average)	30 mmhos
Amplification Factor (Average)	60
Direct Interelectrode Capacitance, without heater voltage	
Grid-Cathode	5.00 pF
Grid-Plate	1.50 pF
Plate-Cathode (maximum)	0.06 pF
Plate Dissipation (maximum)[2]	50 W
Grid Dissipation (maximum)	1.5 W

1. The data presents the nominal design objectives for this product and the characteristics and specifications of this type are subject to change. The device is now under development and is made available for experimental purposes only. For the most recent information concerning the status of this development, please contact your nearest Varian Electron Tube and Device Field Office or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah.

2. With forced air cooling or appropriate conduction and/or convection cooling.

MECHANICAL

Maximum Overall Dimensions:	
Length	0.943 in; 23.95 mm
Diameter	0.758 in; 19.25 mm
Net Weight	0.25 oz; 7.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Conduction and Forced Air

Printed in U.S.A.

EIMAC division of varian / 301 industrial way / san carlos / california 94070

RF OSCILLATOR
Class C, Pulsed

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2.0	kVdc
PEAK PLATE VOLTAGE	3.0	kv
DC PLATE CURRENT	100	mAdc
DC GRID CURRENT	30	mAdc
PEAK PLATE CURRENT	3.0	a
PEAK GRID CURRENT	1.2	a
DC GRID VOLTAGE	-100	Vdc
PULSE DURATION[1]	3.0	μs
DUTY FACTOR[1]	.0025	
PEAK HEATER-CATHODE VOLTAGE[2]	±50	v
FREQUENCY	6.0	GHz

1. For applications requiring longer pulse duration and/or higher duty factor, please consult the Product Manager, EIMAC-Division of Varian, Salt Lake City, Utah.

2. The heater is electrically isolated from the cathode.

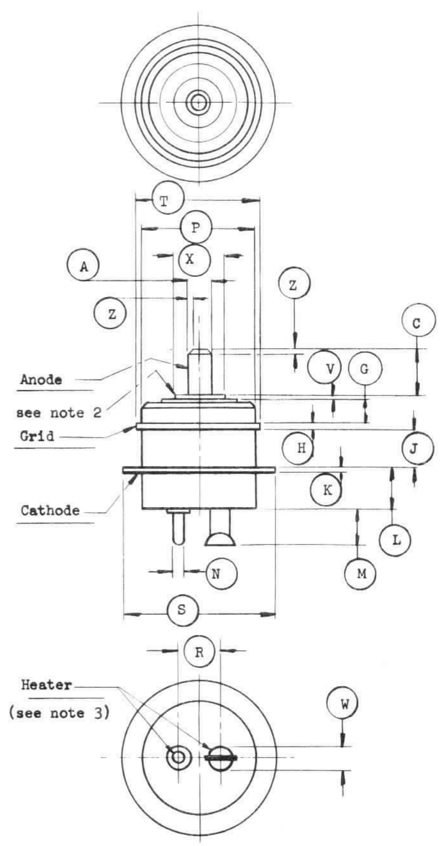
APPLICATION

The cathode and grid flanges should not be altered in any way such as by machining or filing, since final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

For optimum rf performance, the anode line should make good rf contact on the anode area indicated in the outline drawing.

Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas.

For operating information refer to EIMAC bulletin #15, "Operating Instructions for Planar Triodes".



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	0.122	0.128	--	3.10	3.25	--
B	0.200	0.210	--	5.08	5.33	--
C	0.120	0.130	--	3.05	3.30	--
H	0.025	0.031	--	0.64	0.79	--
J	0.167	0.177	--	4.24	4.50	--
K	0.025	0.031	--	0.64	0.79	--
L	0.170	0.185	--	4.32	4.70	--
M	0.170	0.190	--	4.32	4.83	--
N	0.047	0.053	--	1.19	1.35	--
P	0.535	0.565	--	13.59	14.35	--
R	0.185	0.215	--	4.70	5.46	--
S	0.748	0.758	--	19.00	19.30	--
T	0.598	0.608	--	15.19	15.44	--
V	--	0.020	--	--	0.51	--
W	--	--	0.100	--	--	2.54
X	0.250	0.260	--	6.35	6.60	--
Z	--	--	0.030	--	--	0.76

Notes:
1. Ref. dims. are for info. only & are not required for insp. purposes.
2. For optimum rf performance the Anode Line should contact the Anode Cup at this point.
3. Heater is electrically isolated from Cathode.

PRELIMINARY DATA

8912

PLANAR TRIODE

TECHNICAL DATA

The 8912 (formerly X2154) is a compact, rugged ceramic/metal planar triode intended for CW plate- or grid-pulsed oscillator, amplifier, or frequency multiplier use. It features high power output, high plate dissipation and excellent frequency stability under severe environmental conditions. The construction of the 8912 readily lends itself to cavity circuit operation resulting in an extremely compact rf source. The 8912 is capable of providing in excess of 1 kw peak power at 6 GHz.

Actual Size

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 5% V
Current, at 6.3 volts	0.65 A
Cathode Heating Time	60 sec.
Transconductance (Average)	30 mmhos
Amplification Factor (Average)	85
Direct Interelectrode Capacitance, without heater voltage	
Grid-Cathode	5.00 pF
Grid-Plate	1.50 pF
Plate-Cathode (maximum)	0.06 pF
Plate Dissipation (maximum)[2]	50 W
Grid Dissipation (maximum)	1.5 W

1. The data presents the nominal design objectives for this product and the characteristics and specifications of this type are subject to change. The device is now under development and is made available for experimental purposes only. For the most recent information concerning the status of this development, please contact your nearest Varian Electron Tube and Device Field Office or the Product Manager, Eimac Division of Varian, Salt Lake City, Utah.

2. With forced air cooling or appropriate conduction and/or convection cooling.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.013 in; 25.73 mm
Diameter	0.608 in; 15.44 mm
Net Weight	0.25 oz; 7.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Conduction and Forced Air

(Effective 2-1-71) Printed in U.S.A.

RF OSCILLATOR
Class C, Pulsed

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2.0 kVdc
PEAK PLATE VOLTAGE	2.5 kv
DC PLATE CURRENT	100 mAdc
DC GRID CURRENT	30 mAdc
PEAK PLATE CURRENT	3.0 a at .0025 DUTY
	1.5 a at .01 DUTY
PEAK GRID CURRENT	1.2 a at .0025 DUTY
	0.7 a at .01 DUTY
DC GRID VOLTAGE	-100 Vdc
PULSE DURATION[1]	3.0 μs
DUTY FACTOR[1]	.01
PEAK HEATER-CATHODE VOLTAGE[2]	±50 v
FREQUENCY	6.0 GHz

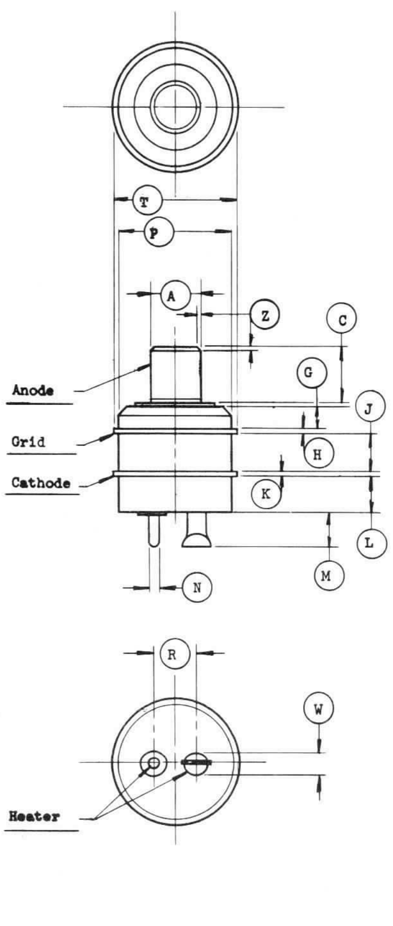
1. For applications requiring longer pulse duration and/or higher duty factor, please consult the Product Manager, EIMAC-Division of Varian, Salt Lake City, Utah.

2. The heater is electrically isolated from the cathode.

APPLICATION

The cathode and grid flanges should not be altered in any way such as by machining or filing, since final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.
For optimum rf performance, the anode line should make good rf contact on the anode area indicated in the outline drawing.

Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas. For operating information refer to EIMAC bulletin #15, "Operating Instructions for Planar Triodes".



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	0.245	0.260	--	6.22	6.60	--
C	0.240	0.255	--	6.10	6.48	--
G	0.120	0.155	--	3.05	3.93	--
H	0.025	0.031	--	0.64	0.79	--
J	0.167	0.177	--	4.24	4.50	--
K	0.025	0.031	--	0.64	0.79	--
L	0.170	0.185	--	4.32	4.70	--
M	0.170	0.190	--	4.32	4.83	--
N	0.047	0.053	--	1.19	1.35	--
P	0.535	0.565	--	13.59	14.35	--
R	0.185	0.215	--	4.70	5.46	--
T	0.598	0.608	--	15.19	15.44	--
W	--	--	0.100	--	--	2.54

Note;
1. Ref. Dims. are for info. only and are not req'd. for inspection purposes.

TECHNICAL DATA

8933

PLANAR TRIODE

The 8933 is a miniature, ceramic/metal, rugged planar triode for advanced airborne and space applications up to 3.0 GHz.

The 8933 may be used as an amplifier, oscillator, or frequency multiplier in the grid- or plate-pulsed mode as well as a modulator or regulator tube. In addition to low interelectrode capacitance, high transconductance and amplification factor, the 8933 has an arc-resistant cathode, and a spewing shield, assuring stable, reliable, and long-life operation under adverse conditions.

The 8933 is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced air cooling permitting an anode dissipation up to 150 watts can be furnished on separate order.

The 8933 is especially designed for applications where high RF pulse power is required. It can also be readily used in switch tube applications up to 8 kV dc.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	1.30	A
Transconductance (Average):		
I_b = 160 mA	38	mmhos
Amplification Factor (Average):	120	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	9.5	pF
Cout	0.06	pF
Cgp	1.40	pF
Cut-off Bias[3]	-30	V max
Frequency of Maximum Rating:		
Plate or Grid-Pulsed	3.0	GHz

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 a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

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MECHANICAL

Maximum Overall Dimensions:	
Length	1.50 in; 38.10 mm
Diameter	.950 in; 24.13 mm
Net Weight	0.7 oz; 19.3 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Cooling	Conduction, convection, forced air, or liquid

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	8.5	11.0	pF
Cout	---	0.06	pF
Cgp	1.30	1.55	pF

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

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	8000	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	10,000	VOLTS
DC GRID VOLTAGE	-300	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	175	VOLTS
PULSE PLATE CURRENT	5.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	150	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	

OPERATING CONDITIONS for 8933 in Representative Application

GRID PULSED AMPLIFIER	Driver	Amp	
Frequency	1030	1030	GHz
Heater Voltage	5.8	5.8	V
DC Plate Voltage	4700	5000	Vdc
DC Grid Voltage	-70	-70	Vdc
Peak Video Plate Current	1.5	3.3	a
Peak Video Grid Current	0.25	1.1	a
Pulse Drive Power (approx.)	300	2000	w
Useful Power Output (approx.)	3250	8000	w
Gain	10.4	6.0	dB
Plate Efficiency	46	48	%

1. Using proper EIMAC radiator.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000	VOLTS
PEAK PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	100	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	150	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
PULSE DURATION[2]	6.0	μs
CUT-OFF MU	85	

1. Using proper EIMAC radiator.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	1.160	- -	- -	29.46	- -
B	- -	0.960	- -	- -	24.38	- -
C	- -	0.895	- -	- -	22.73	- -
D	0.825	0.875	- -	20.96	22.23	- -
E	0.702	0.740	- -	17.83	18.80	- -
F	0.655	0.684	- -	16.64	17.37	- -
G	0.150	0.190	- -	3.81	4.83	- -
H	- -	0.040	- -	- -	1.02	- -
J	- -	0.340	- -	- -	8.64	- -
K	0.537	0.554	- -	13.64	14.07	- -
L	- -	0.260	- -	- -	6.60	- -
M	0.545	0.570	- -	13.84	14.48	- -
N	- -	0.200	- -	- -	5.08	- -
P	0.775	0.785	- -	19.69	19.94	- -
R	0.595	0.607	- -	15.11	15.42	- -
S	0.935	0.950	- -	23.75	24.13	- -
T	0.235	0.265	- -	5.97	6.73	- -
U	0.440	0.460	- -	11.18	11.68	- -
AA	- -	- -	0.925	- -	- -	23.50
AB	- -	- -	0.778	- -	- -	19.76
AC	- -	- -	0.598	- -	- -	15.19

Notes:

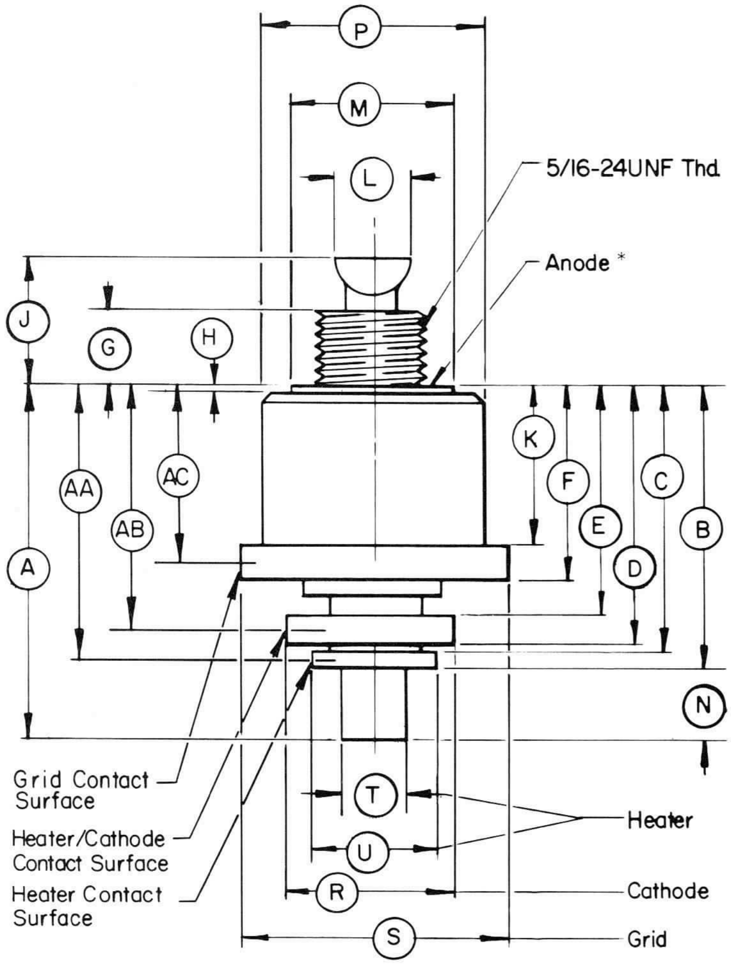
A. Reference Dimensions are for information only and are not required for inspection purposes.

B. Anode Flange is for electrical contact; Stud is for heat transfer.

C.* Total indicated runout (TIR) of Contact Surfaces shall be gaged from centerline of reference & shall be as follows:

CONTACT SURF.	TIR(Max.)	Ref.
Grid	.020	Anode
Heater	.020	Anode
Cathode	.020	Anode

D. Electrode Contact Dimensions are given for socket design purposes & are not intended for inspection purposes.



TYPICAL CONSTANT PLATE CURRENT CHARACTERISTICS

NEGATIVE GRID REGION $E_f = 6.3V$

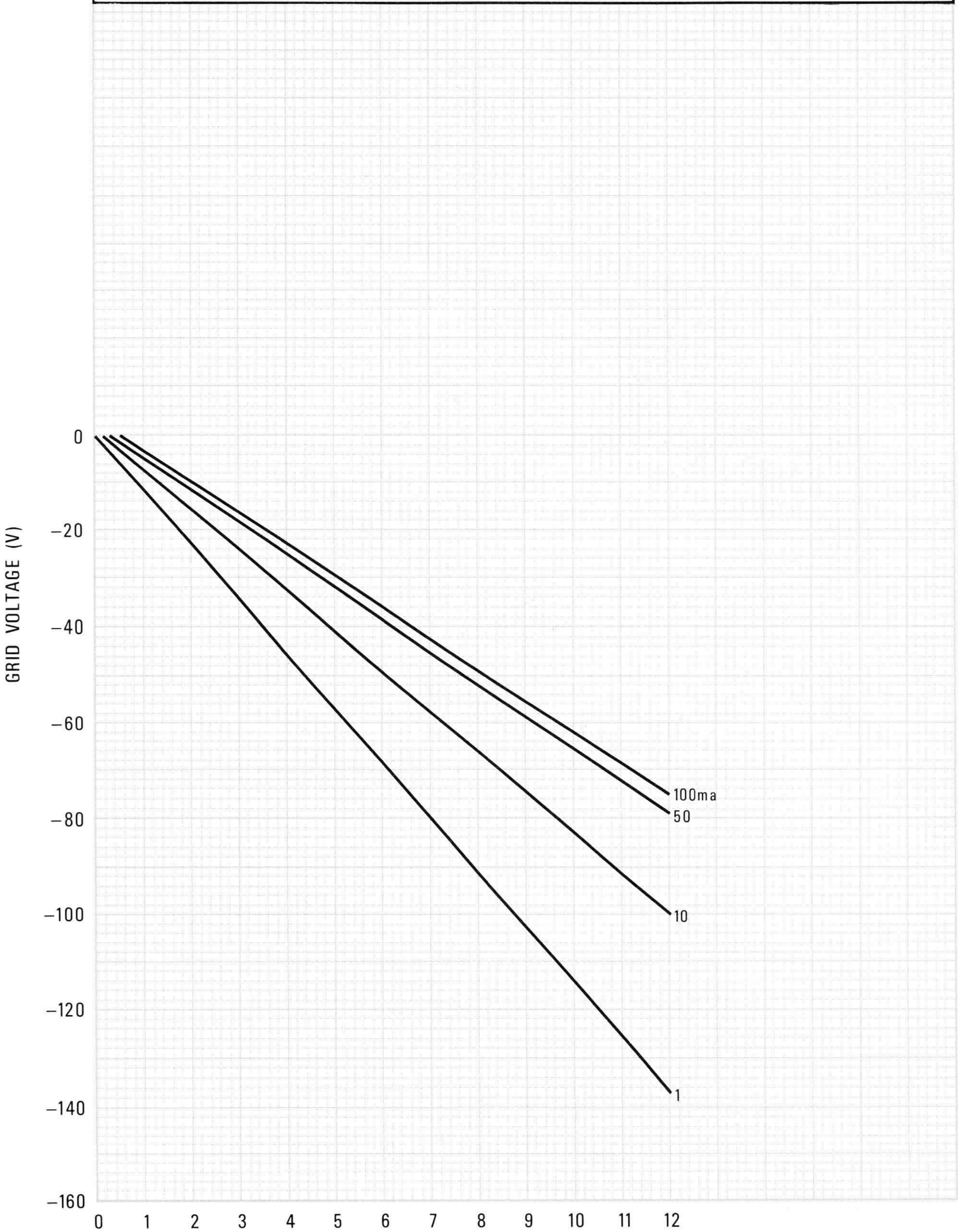
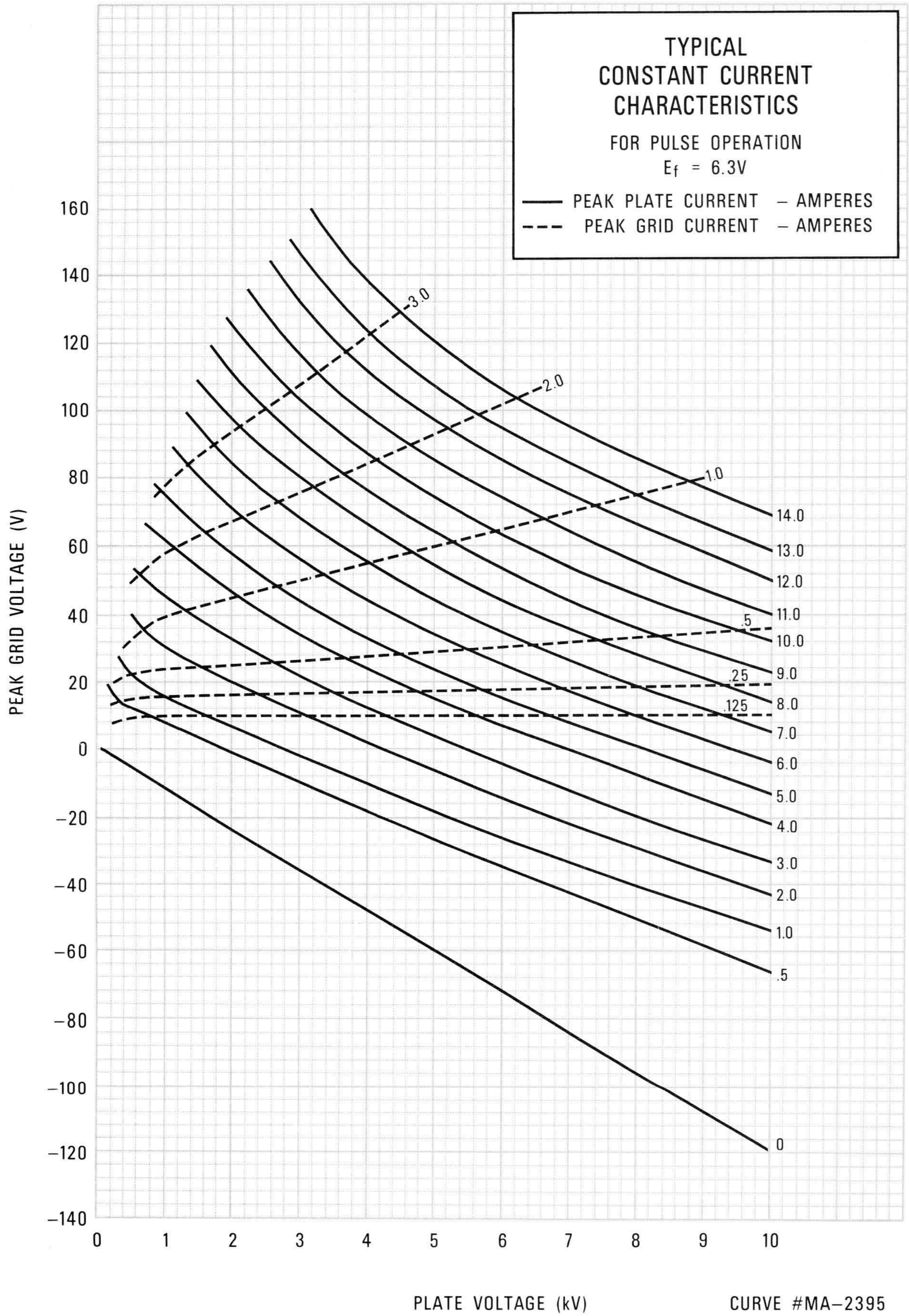
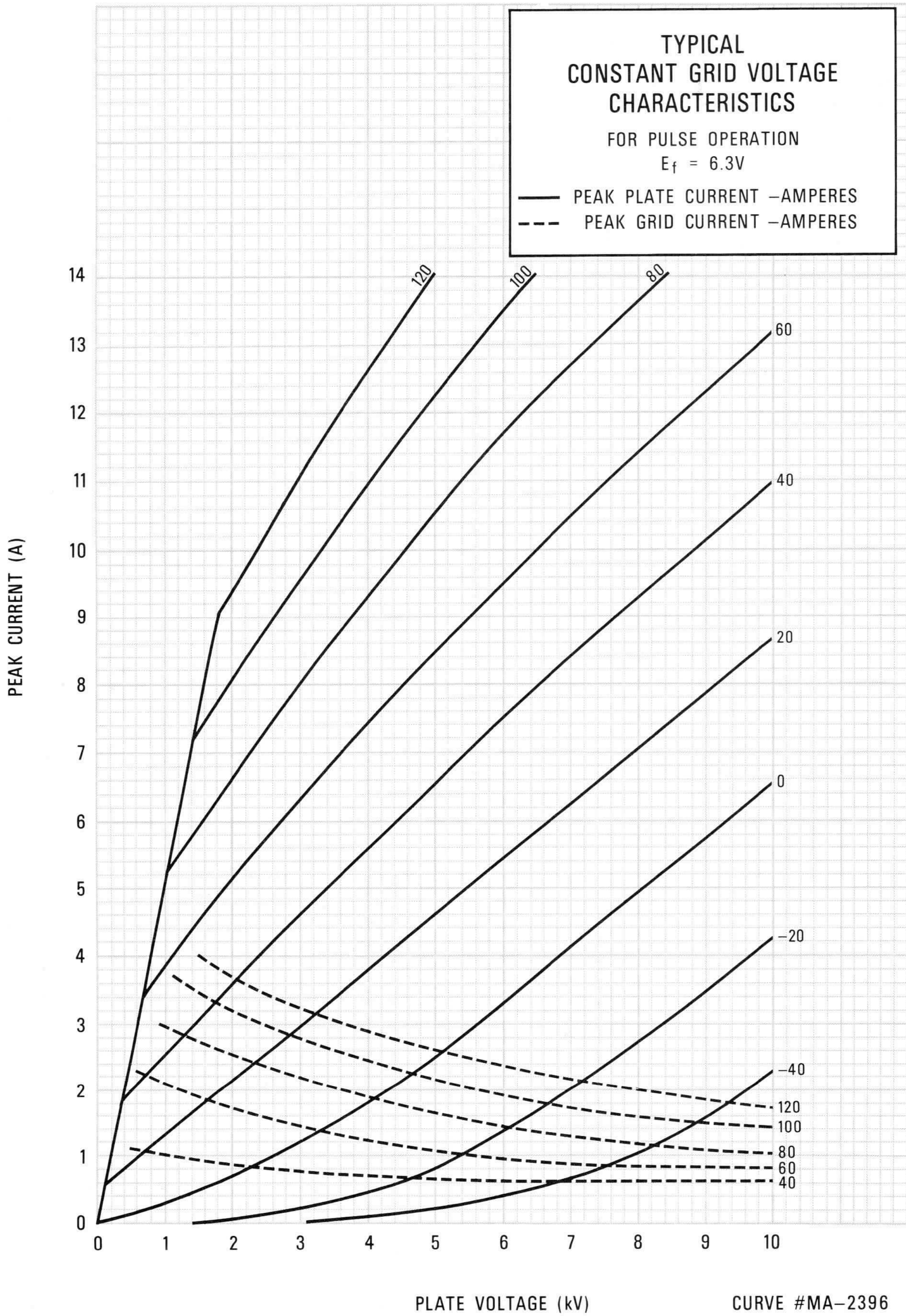


PLATE VOLTAGE (kV)

CURVE #MA-2397



CURVE #MA–2395



CURVE #MA–2396

TECHNICAL DATA

8940

PLANAR TRIODE

The 8940 is a planar triode of ceramic/metal construction and rugged design to be used in advanced airborne, ground, and space applications up to 2.5 GHz.

The 8940 may be used as an amplifier, oscillator, or frequency multiplier in the CW as well as the grid or plate-pulsed mode, or as a modulator or series regulator tube. In addition to the low inter-electrode capacitance, high transconductance and amplification factor, the tube has an arc-resistant cathode and a vaporization shield to assure stable and reliable long life operation under adverse conditions.

The 8940 is normally supplied without a radiator and may be conduction, convection, heat-sink, or liquid cooled. Liquid cooling can be done by submersion of the tube in an insulating medium such as FC-75. Radiators for forced-air cooling as well as heat-sink adaptors permitting anode dissipation up to 750 watts are available as separate items.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	2.25 A
Transconductance (Average):	
I_b = 160 mA	100 mmhos
Amplification Factor (Average):	65
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	16.0 pF
Cout	0.11 pF
Cgp	3.8 pF
Cut-off Bias[3]	-50 V max
Frequency of Maximum Rating:	
Plate or Grid-Pulsed	2.5 GHz
CW	2.0 GHz

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 a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 2 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

 Printed in U.S.A.

8940

MECHANICAL

Maximum Overall Dimensions:	
Length	1.985 in; 50.4 mm
Diameter	1.365 in; 34.6 mm
Net Weight	1.96 oz; 56 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Conduction, convection, forced air, or liquid

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	2.05	2.50	A
Cathode Warmup Time	90	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	13.5	17.0	pF
Cout	---	0.11	pF
Cgp	3.3	4.2	pF

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

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE(grid pulsed)	4000	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	6500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	500	VOLTS
Grid positive to cathode	200	VOLTS
PULSE PLATE CURRENT	12	AMPERES
PULSE GRID CURRENT	4	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	750	WATTS
GRID DISSIPATION (Average)	2	WATTS
FREQUENCY	2.5	GHz
PULSE DURATION[2]	6	μs
DUTY FACTOR[2]	.0033	

OPERATING CONDITIONS for 8940 in Respresentative Application

	Grid Pulsed Amplifier		Grid Pulsed OSC	Plate Pulsed OSC	
Frequency	1.3	1.2	1.03	1.65	GHz
Heater Voltage	6.3	6.3	6.3	6.3	V
DC Plate Voltage	4000	3500	3850	5000	Vdc
DC Grid Voltage	-50	-75	-80	- -	Vdc
Peak Video Plate Current	3.0	3.0	6.0	6.0	a
Peak Video Grid Current	0.7	0.5	1.8	2.0	a
Pulse Drive Power(approx.)	600	600	- -	- -	w
Useful Power Output(")	6000	4000	11,500	10,000	w
Pulse Duration	500	3.5	5.0	5.0	μs
Duty Factor	0.01	0.04	.001	.001	
Bandwidth	75	10	- -	- -	MHz

1. Using EIMAC Radiator Part No. 158096.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
PEAK PLATE VOLTAGE	6500	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	500	VOLTS
Grid positive to cathode	100	VOLTS
PULSE CATHODE CURRENT	16	AMPERES
DC PLATE CURRENT	600	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	750	WATTS
GRID DISSIPATION (Average)	2.0	WATTS
PULSE DURATION[2]	6	μs
CUT-OFF MU	35	

1. Using EIMAC Radiator Part No. 158096.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	350	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	0.6	AMPERE
DC GRID CURRENT	0.07	AMPERE
AVERAGE PLATE DISSIPATION		
Forced-Air Cooling [1]	750	WATTS
GRID DISSIPATION (Average)	2.0	WATTS

1. Using EIMAC Radiator Part No. 158096.

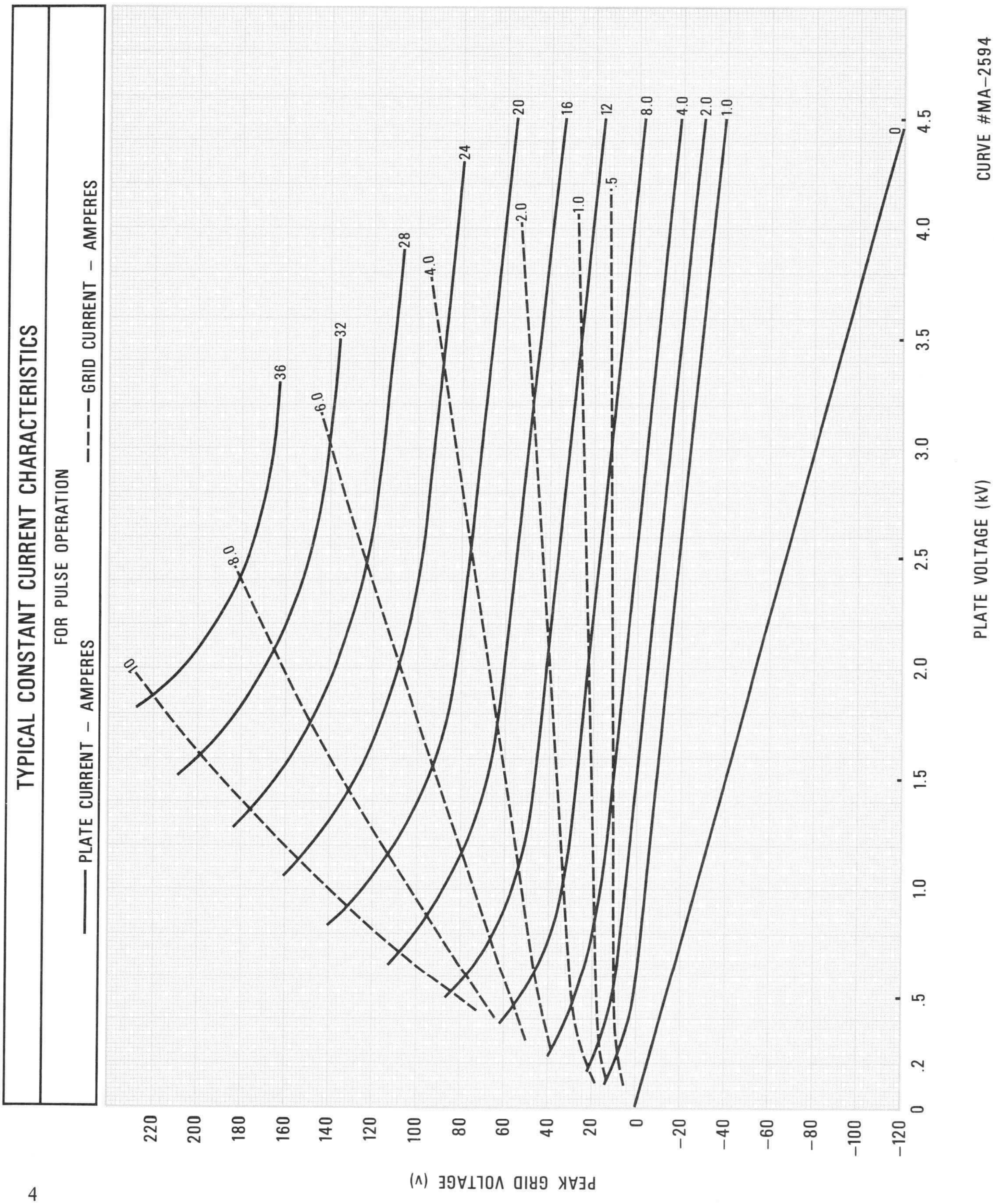
APPLICATION

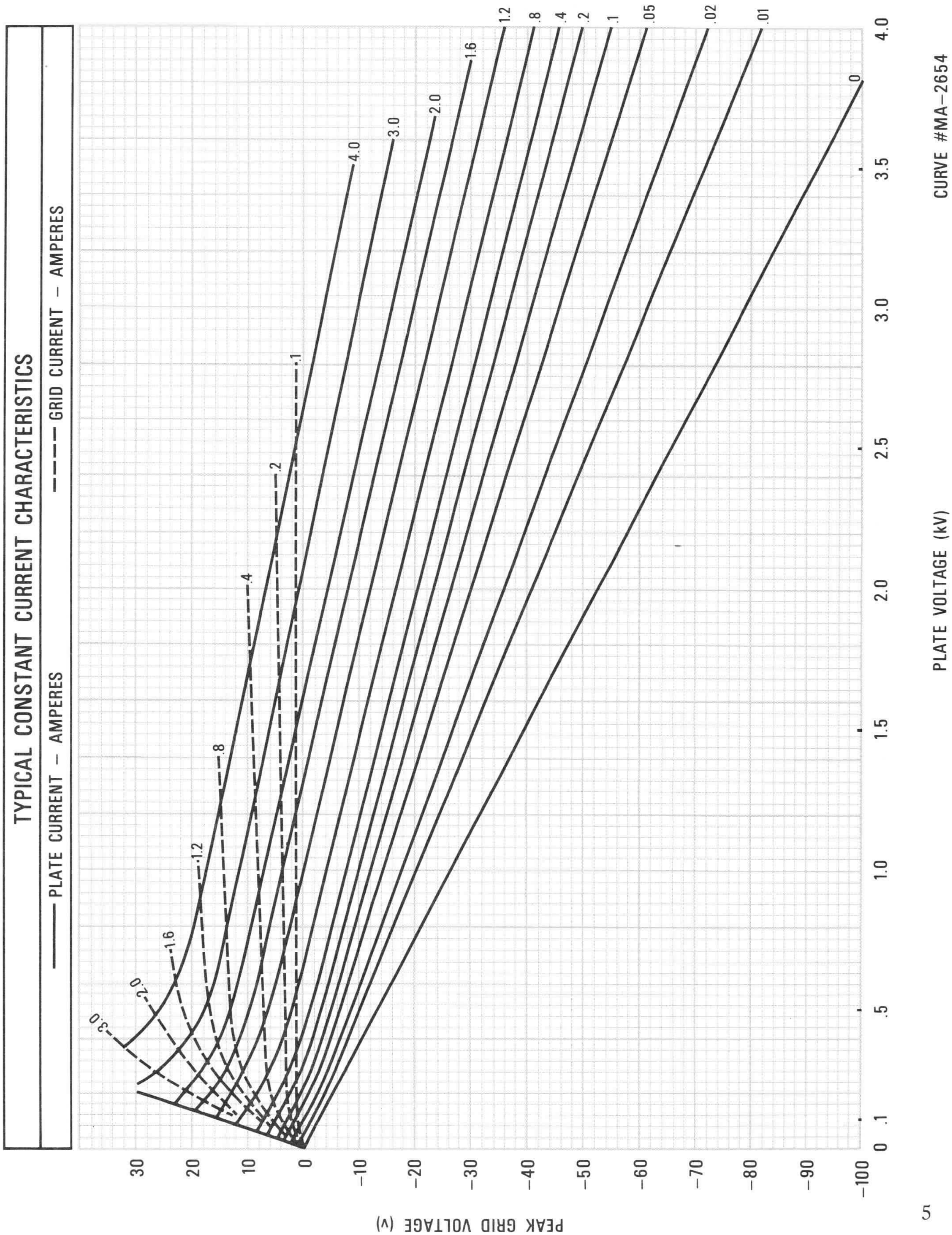
For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

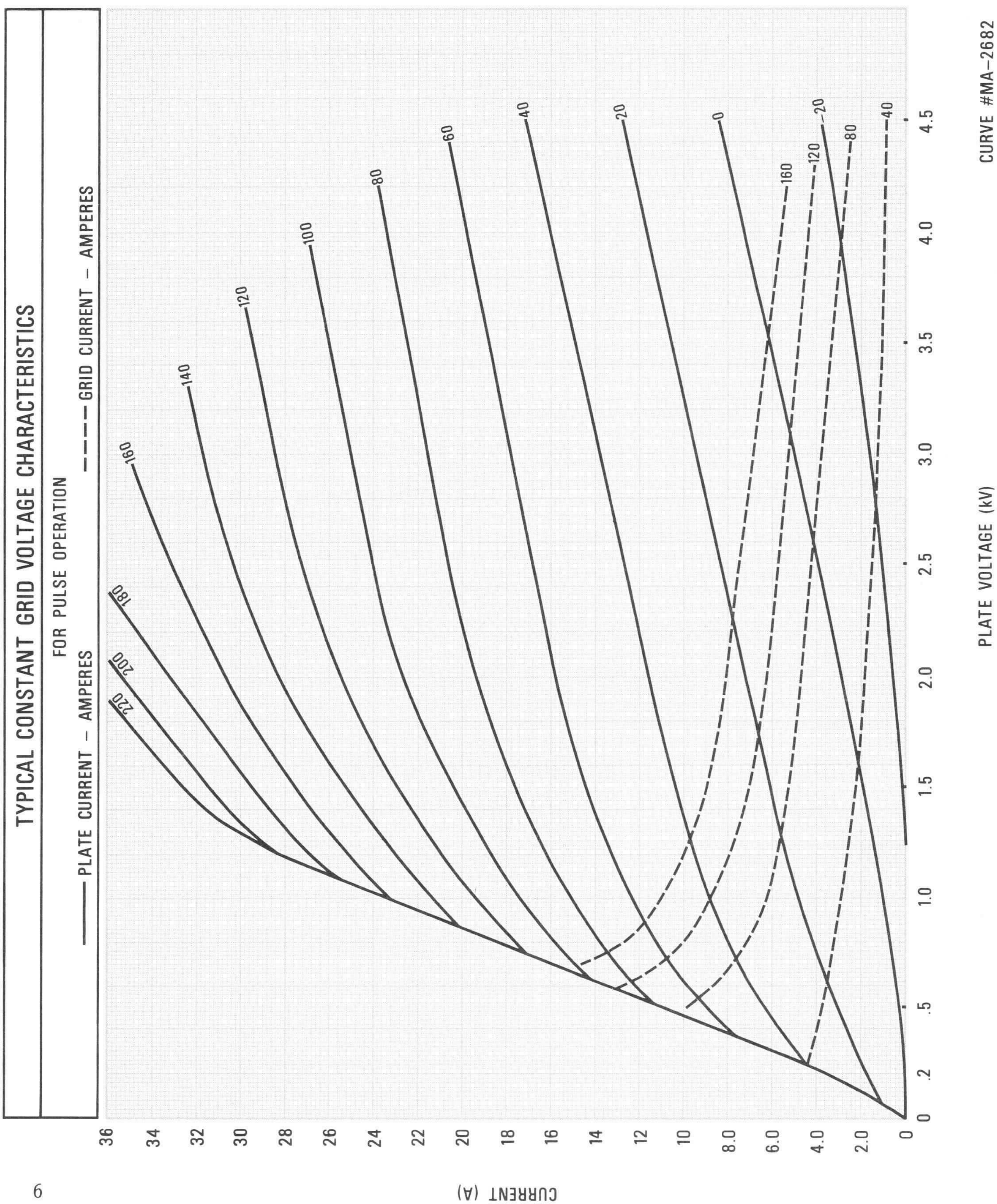
The cathode and grid flanges should not be altered in any way such as by machining or filing, since the final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

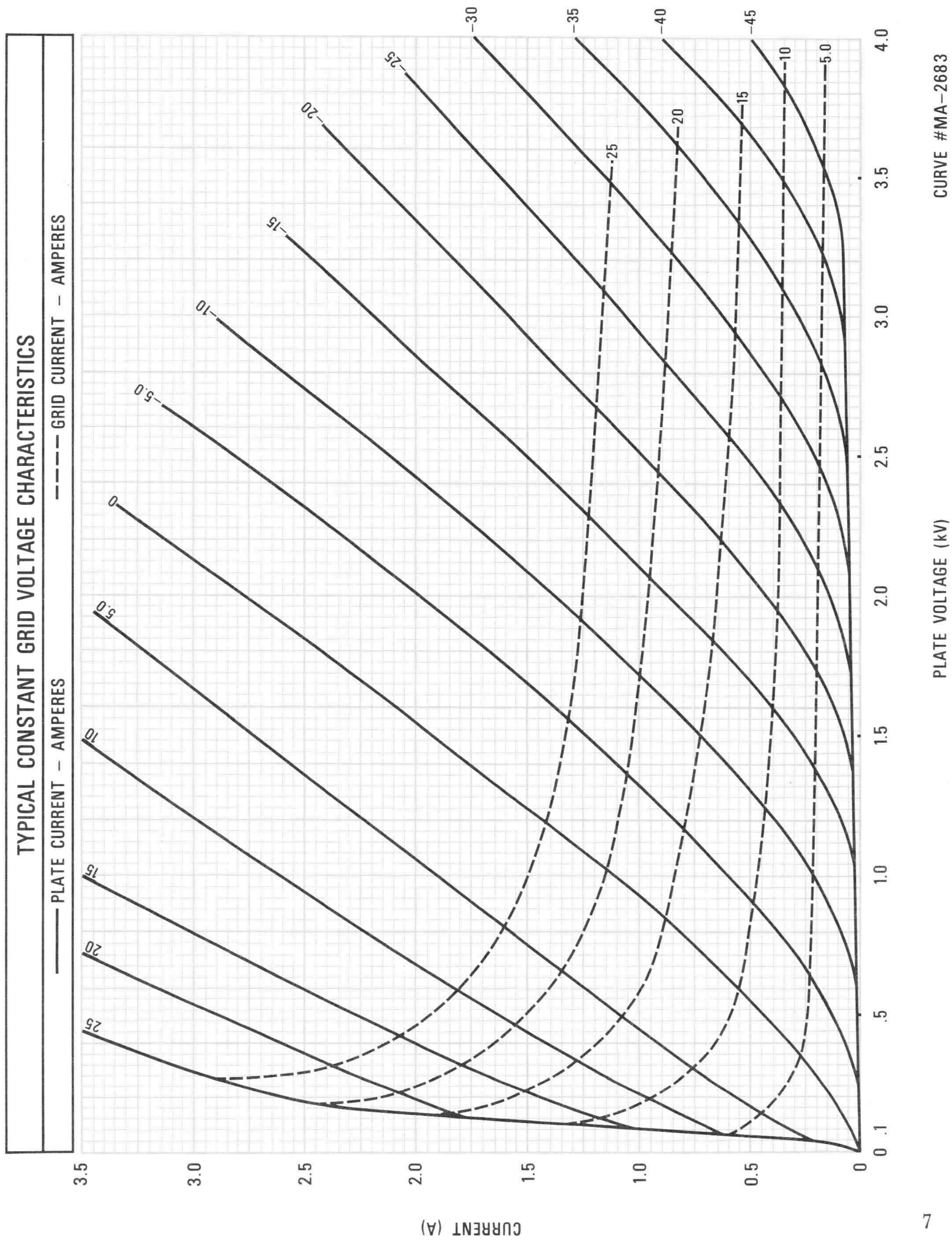
For optimum RF performance, the anode line should make good contact on the anode area indicated on the outline drawing.

Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas. If forced air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C.

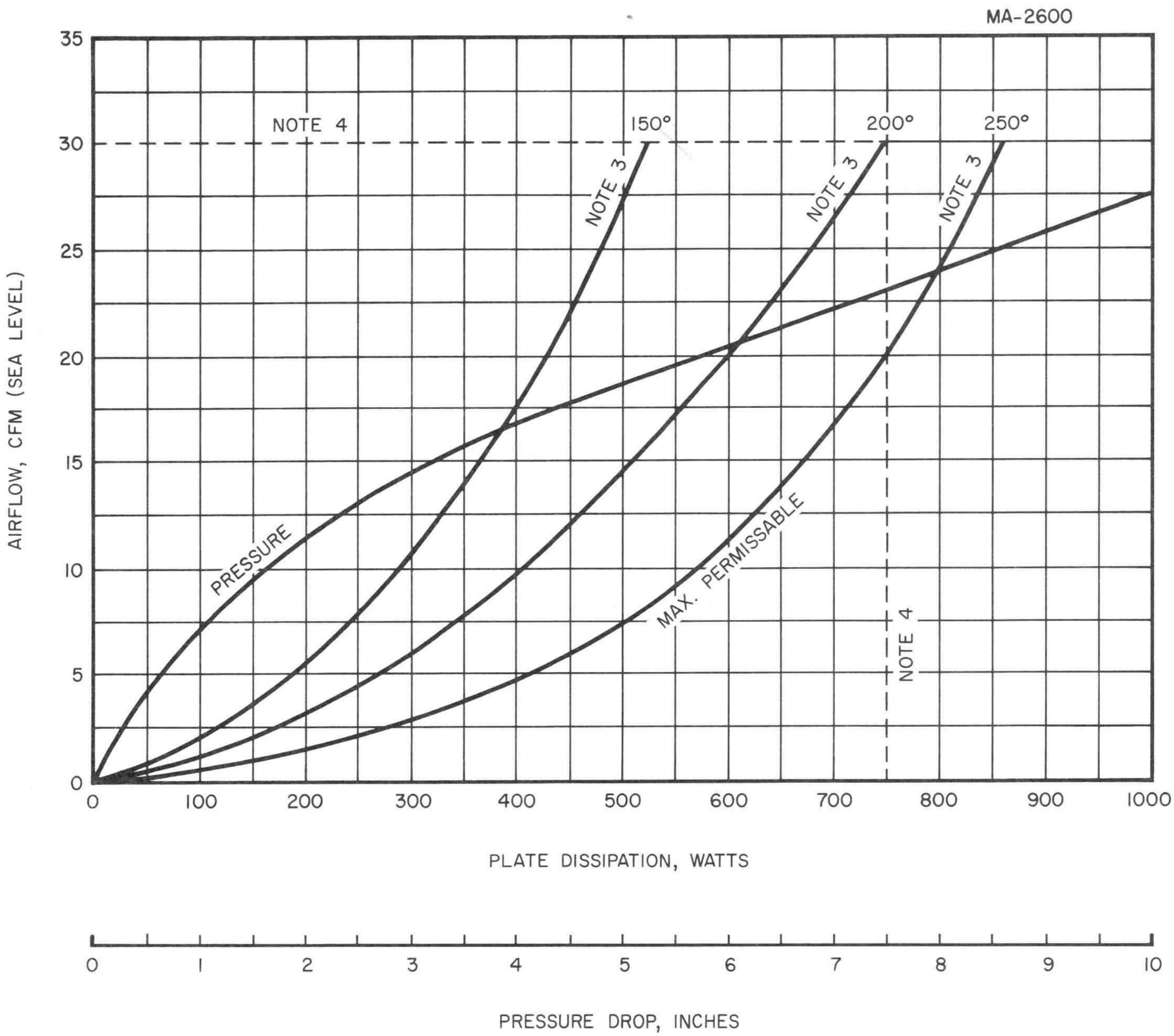

TYPICAL CONSTANT CURRENT CHARACTERISTICS
FOR PULSE OPERATION
—— PLATE CURRENT - AMPERES
- - - - GRID CURRENT - AMPERES
PEAK GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #MA-2594
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
0
.2
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
36
32
28
24
20
16
12
8.0
4.0
2.0
1.0
0
10
8.0
6.0
4.0
2.0
1.0
.5

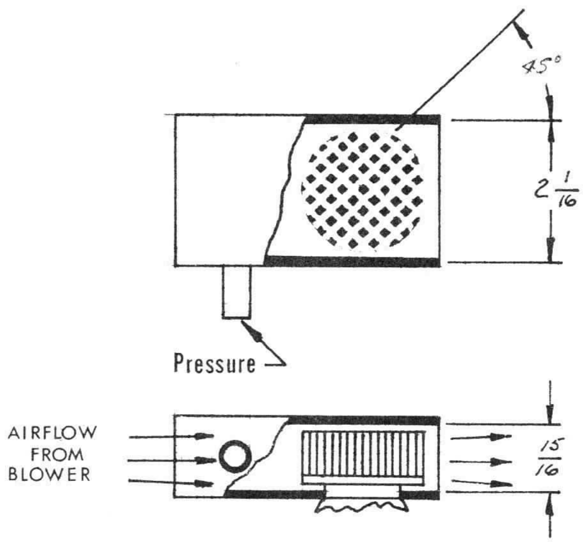

TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
PEAK GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #MA-2654
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
.1
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.0
3.0
2.0
1.6
1.2
.8
.4
.2
.1
.05
.02
.01
0


TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
FOR PULSE OPERATION
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
PLATE VOLTAGE (kV)
CURRENT (A)
CURVE #MA-2682
0
.2
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
0
2.0
4.0
6.0
8.0
10
12
14
16
18
20
22
24
26
28
30
32
34
36
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
160
120
80


TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
—— PLATE CURRENT - AMPERES
- - - - GRID CURRENT - AMPERES
PLATE VOLTAGE (kV)
CURRENT (A)
CURVE #MA-2683
0 .1 .5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
25 20 15 10 5.0 0 -5.0 -10 -15 -20 -25 -30 -35 -40 -45
25 20 15 10 5.0

AIR COOLING DATA FOR 8940





– COWLING DETAIL –

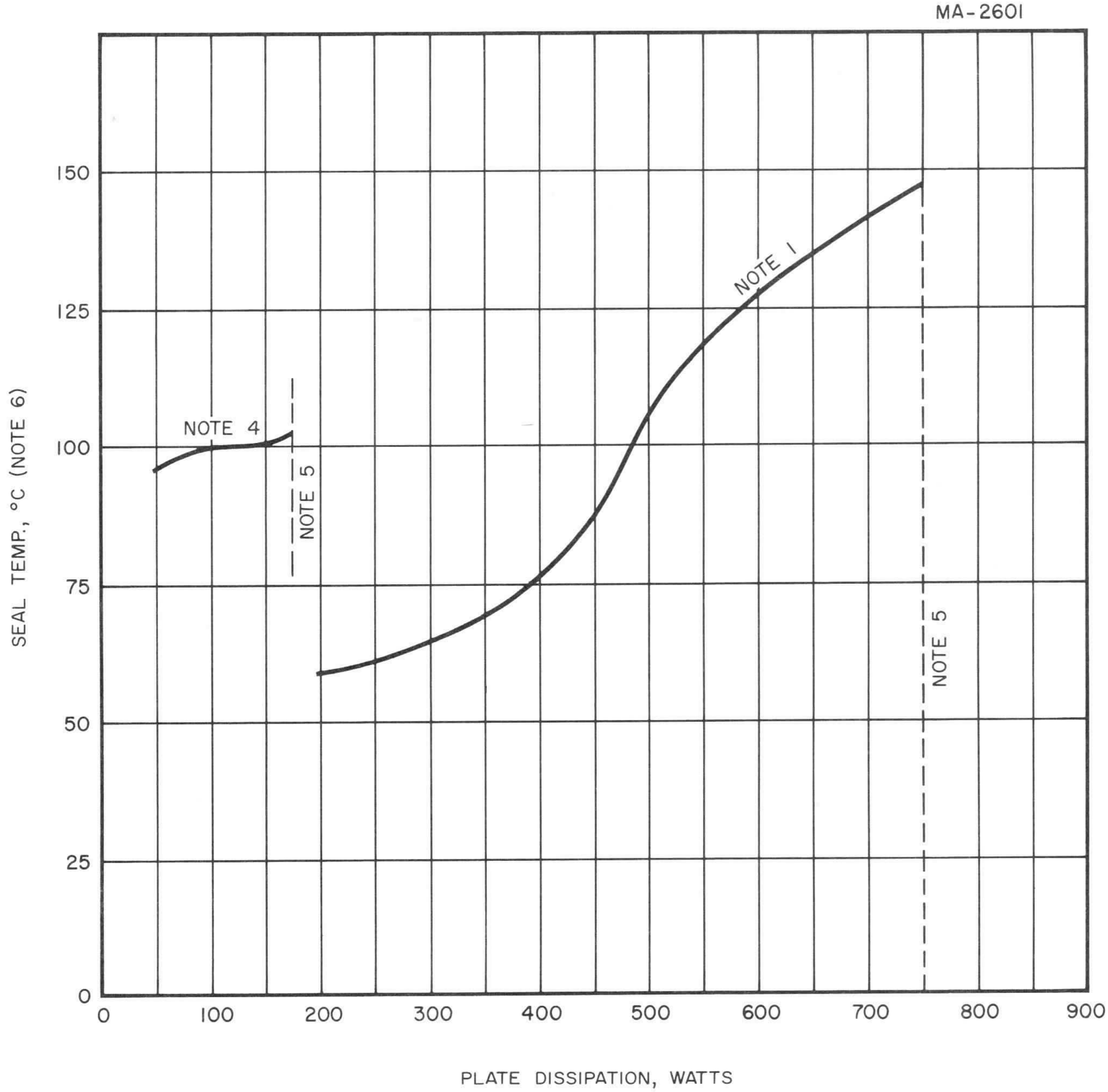
1. Inlet Air at 20° C

2. Use Radiator No. 158096 (Copper–Pin) in Cowling as shown.

3. Temp. measured at Anode Cup–Plate Insulator Seal.

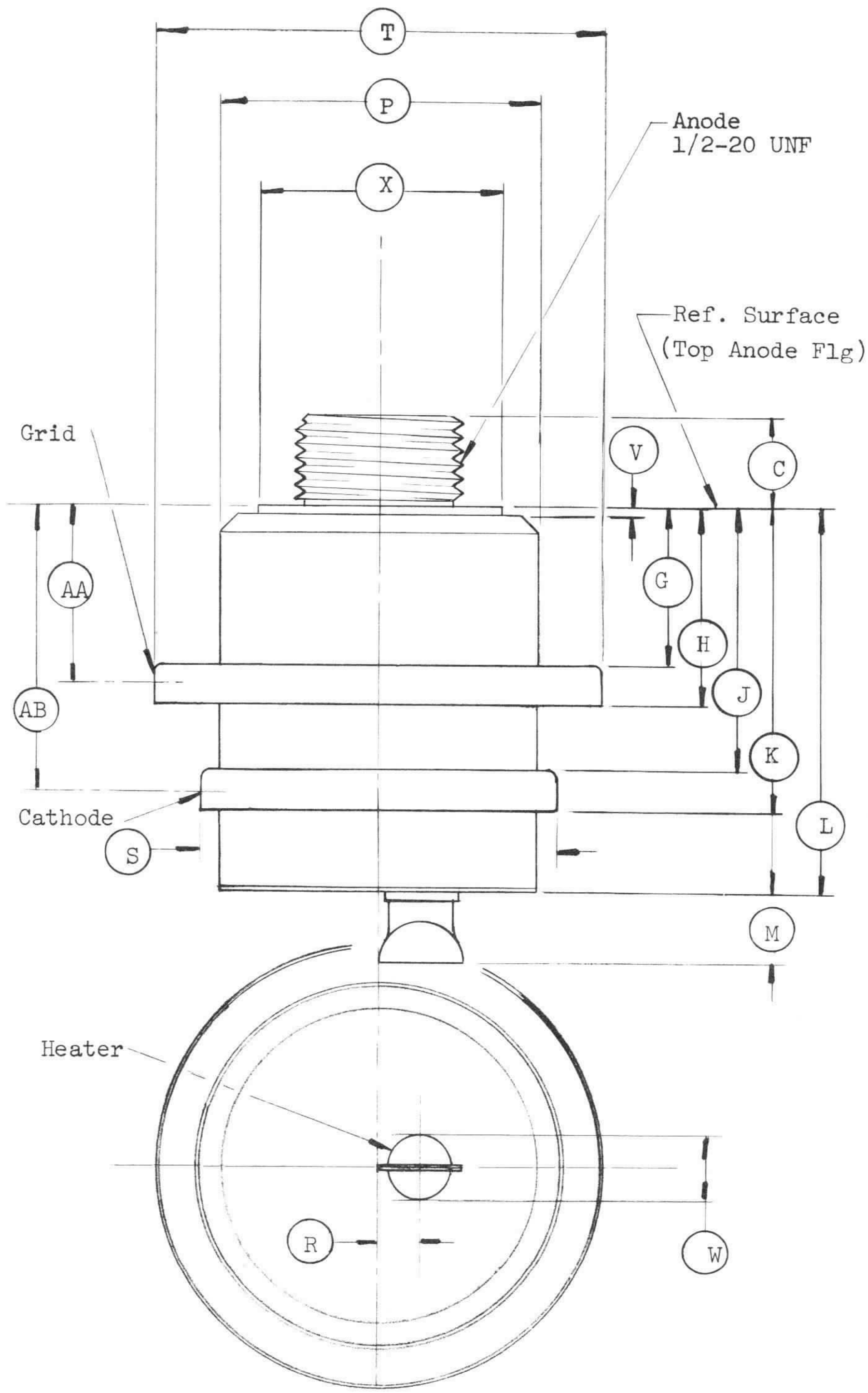
4. Describes Typical MAX. CW Operating Point.

COOLING DATA FOR 8940 IN FC 75 DIELECTRIC COOLANT



NOTES:

1. USE RADIATOR 158096 (Copper - Pin)
2. TUBE AXIS VERTICAL IN LIQUID.
3. LIQUID AMBIENT TEMPERATURE 40°C.
4. TUBE W/O COOLER STUD COOLING ONLY.
5. MAX. CW RATING - CONTACT PLANAR MGR. EIMAC, SLC ON INTERMEDIATE OR HIGHER POWERS THAN SHOWN.
6. SEAL TEMPERATURE IS MEASURED AT PLATE TO ANODE INSULATOR FLANGE (SEE 'V' ON OUTLINE DWG.)



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
C	0.500	0.600	- -	12.70	15.24	- -
G	0.385	0.410	- -	9.78	10.41	- -
H	0.510	0.545	- -	12.95	13.84	- -
J	0.655	0.710	- -	16.64	18.03	- -
K	- -	0.845	- -	- -	21.46	- -
L	0.930	1.010	- -	23.62	25.65	- -
M	0.300	0.375	- -	7.62	9.52	- -
P	0.940	0.965	- -	23.88	24.51	- -
R	0.090	0.110	- -	2.29	2.79	- -
S	1.065	1.085	- -	27.05	27.56	- -
T	1.345	1.365	- -	34.19	34.67	- -
V	- -	0.035	- -	- -	0.89	- -
W	- -	- -	0.190	- -	- -	4.83
X	0.740	0.770	- -	18.80	19.56	- -
AA	(see note 2,3)		0.460	- -	- -	11.68
AB	(see note 2,3)		0.750	- -	- -	19.05

NOTES:

1. Ref. Dims. are for info. only & are not req'd for inspection purposes.
2. Contact Surface dims. AA & AB are for cavity design purposes only & are not intended as inspection criteria
3. Contact surfaces are ± .030 around dim. indicated.
4. TIR of Contact Surfaces are specified in individual Tube Electrical Specs.

TECHNICAL DATA

Y503

HIGH-MU PLANAR TRIODE

The EIMAC Y503 is a small frequency stable rugged planar triode which has been specially processed and tested to assure the high reliability demanded and required in airborne service. The tube is supplied without radiator for conduction and/or convection or heat sink cooling.

The tube may be used as an amplifier, oscillator, or frequency multiplier in grid or plate pulsed applications. In addition to the low interelectrode capacitances, high transconductance and Mu, the tube exhibits such special design features as a frequency-stable anode and an arc-resistant cathode to assure stable operation under adverse conditions and minimize catastrophic failure due to arcover if it should occur due to circuit malfunction.

The tube is usable from low frequency to 3 GHz.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	1.00 A
Transconductance (Average):	
I_b = 70 mA	25 mmhos
Amplification Factor (Average):	80
Direct Interelectrode Capacitances (Grounded Cathode)[2]	
Cin	6.8 pF
Cout	0.04 pF
Cgp	2.50 pF
Cut-off Bias[3]	-30 V max.

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 for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.810 in; 45.97 mm
Diameter	0.792 in; 20.12 mm

Printed in U.S.A.

Net Weight	18 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction, convection
Terminals	Coaxial, special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	50,000 ft.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS/ABSOLUTE VALUES

DC PLATE VOLTAGE (grid pulsed)	2500 VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	3500 VOLTS
DC GRID VOLTAGE	-150 VOLTS
INSTANTANEOUS PEAK GRID CATHODE VOLTAGE	
Grid negative to cathode	-700 VOLTS
Grid positive to cathode	250 VOLTS
PULSE PLATE CURRENT	3.0 AMPERES
PULSE GRID CURRENT	1.5 AMPERES
PLATE DISSIPATION (Average)	
Conduction & Convection	10 WATTS *
GRID DISSIPATION	2.0 WATTS
FREQUENCY	3.0 GIGAHERTZ
PULSE DURATION [1]	6 μsec
DUTY FACTOR [1]	.0033

TYPICAL OPERATION Grid Pulsed Oscillator, Representative Application

Plate Voltage	2000 Vdc
Grid Voltage	-75 Vdc
Heater Voltage	5.7 V
Peak Video Plate Current	1.3 a
Peak Video Grid Current	0.8 a
Useful Power Output (approx.)	750 w
Frequency	1.090 GHz
Pulse Duration	0.5 μs
Duty Factor	.001

1. For application requiring longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube and Device Field Office, or the Product Manager EIMAC Division of Varian, Salt Lake City, Utah.

* Plate dissipation of up to 100 Watts is permissable with adequate cooling.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	0.90	1.05	A
Cathode Heating Time	60	---	sec.
Interelectrode Capacitances [1] (grounded cathode connection)			
Cin	6.00	7.50	pF
Cout	---	0.04	pF
Cgp	2.25	2.60	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

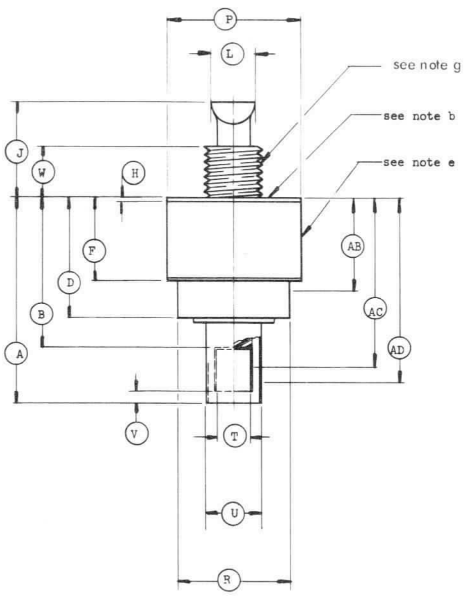
APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

The cathode and grid terminals should not be altered such as by machining or filing, since final seal could be damaged. Maximum torque applied to the tube during installation should not exceed 15 inch pounds.

For optimum performance, the anode line should make good rf contact on the anode area.

Soldered connections may be made to the anode stud, grid or cathode terminals, and heater contact where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas.



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.125	1.210	- -	28.58	30.73	- -
B	- -	0.865	- -	- -	21.97	- -
D	0.782	0.822	- -	19.86	20.88	- -
F	- -	0.475	- -	- -	12.07	- -
H	- -	- -	0.030	- -	- -	0.762
I	0.345	0.375	- -	8.76	9.53	- -
J	- -	0.600	- -	- -	15.24	- -
L	- -	0.260	NOTE e	- -	6.60	NOTE e
P	0.752	0.792	NOTE e	19.10	20.12	NOTE e
R	0.655	0.665	NOTE d,b	16.64	16.89	NOTE d,b
T	0.213	0.223	NOTE d,b	5.41	5.66	NOTE d,b
U	0.315	0.325	NOTE d,b	8.00	8.26	NOTE d,b
V	- -	0.086	- -	- -	2.18	- -
ELECTRODE CONTACT AREA DIMENSIONS						
AB	0.695	0.775	NOTE b	17.65	19.68	NOTE b
AC	0.860	1.046	NOTE b	21.84	26.57	NOTE b
AD	0.800	1.090	NOTE b	20.32	27.69	NOTE b

NOTES:

a. Metric equivalents to the nearest .01mm are given for general information only & are based on 1 inch = 25.4 mm.

b. This surface shall be used to measure Anode shank temperature.

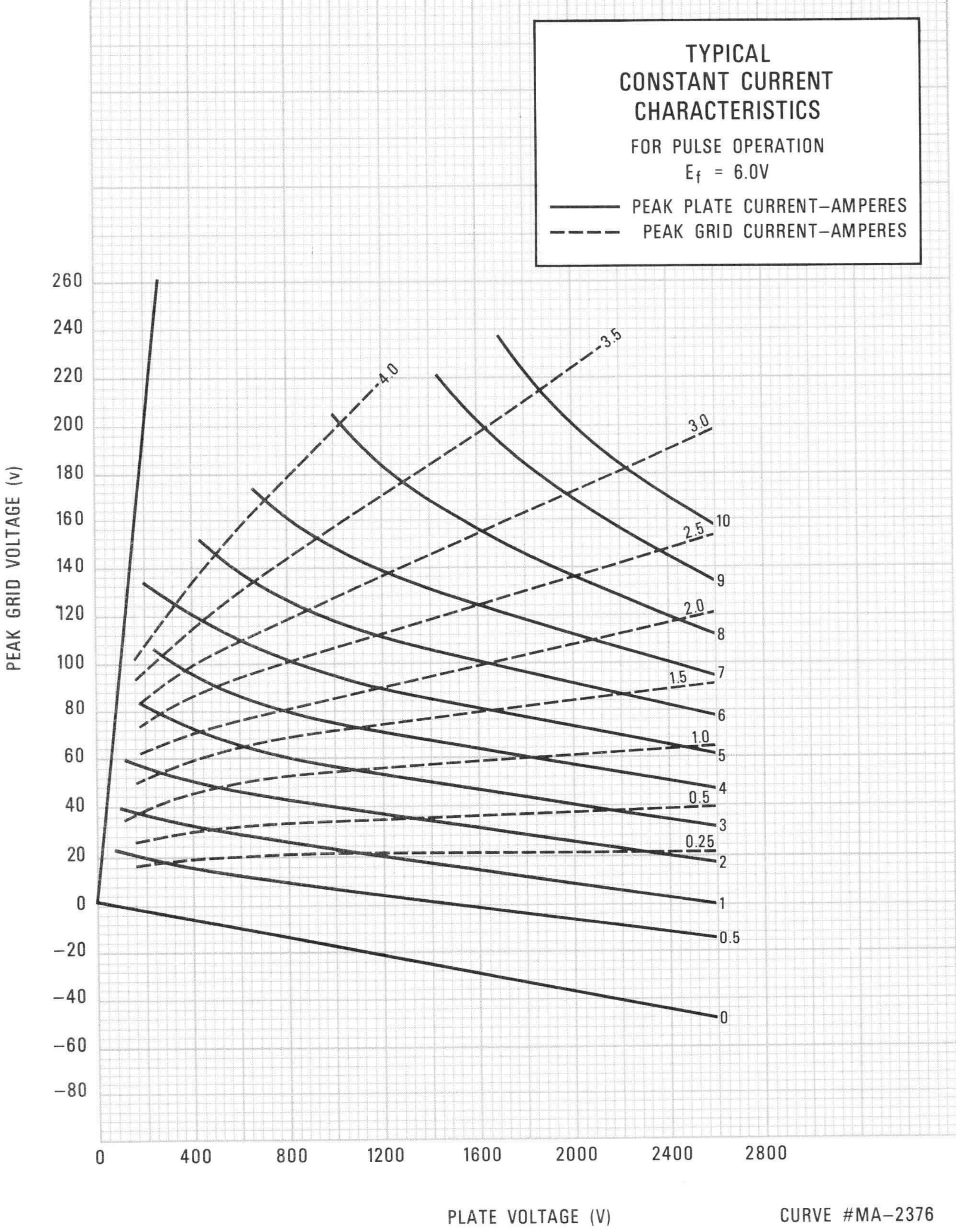
c. The total indicated runout of the Grid contact surface (DIMS AB & R) and Cathode contact surface (DIMS AC & U) will not exceed .020. This measurement is made with the gage (J-21685) screwed on the Anode thread so that the face of the gage makes full contact with the Anode contact surface. Runout is then measured by the O.D. of the gage as the reference surface. The total indicated runout of the Cathode contact surface using the Heater contact surface as the reference will not exceed .012.

d. Dias. R, T, U shall apply throughout entire contact area as defined by dims. AB, AC, AD.

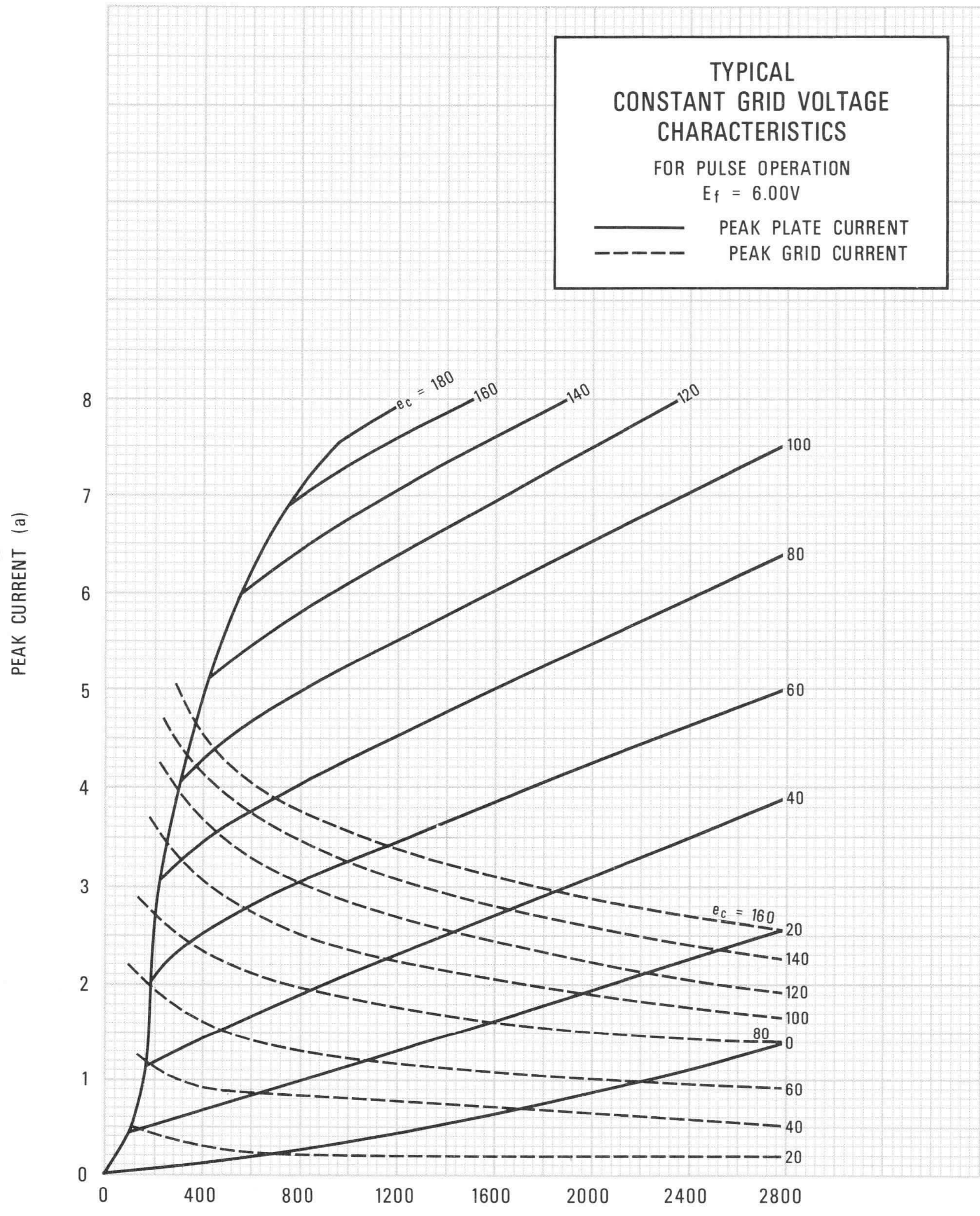
e. This surface shall not be used for clamping or locating.

f. Electrode Contact Dims. are given for socket design & are not intended for inspection purposes.

g. Thread 3/8-16 UNC-2A.



CURVE #MA-2376



CURVE #MA-2377

The Y-540 is a high voltage planar triode especially designed for switch or series regulator service,for general purpose as well as radar applications. Being essentially a UHF triode, the tube capacitances and inductances are small, which enhances operation in the nanosecond region. Other note-worthy features include an extended grid-anode insulator making 10 kV operation at sea level possible, and a matrix cathode of the arc-resistant, extended interface type. The tube exhibits the standard features of a planar triode, such as high transconductance, high mu, and high cathode current capability, coupled with great mechanical strength, permitting reliable operation at elevated temperatures.

The compact ceramic/metal construction and solder tabs provided on grid, cathode-heater, and heater terminals make this tube especially suited for ECM and other switch applications. The tube is small in size and light-weight. The cathode is an indirectly heated disc requiring minimal heater power. These are all factors of great importance in airborne applications.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.3 ± 5%	V
Current, at 6.3 volts	1.3	A
Cathode Heating Time	60	Sec
Transconductance (Average):		
I_b = 100 mA	30	mmhos
Amplification Factor (Average):	145	
(Cut-off)[3]	110	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	9.5	pF
Cout	0.06	pF
Cgp	1.00	pF

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 (Eimac Dwg. #EC-043-919-0002). When the cathode is heated to the proper temperature the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.56 in; 39.62 mm
Diameter	0.785 in; 19.94 mm
Net Weight	0.56 oz; 16.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Conduction, Forced Air with appropriate heat sink adaptor or radiator (Rad. P/N 157254. H.S.P/N SK-3020)

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Maximum Inrush Current	---	10.0	A
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	---	10.5	pF
Cout	---	0.06	pF
Cgp	---	1.65	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture (P/N EC-043-919-0002) in accordance with Electronic Industries Association Standard RS-191.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10	KILOVOLTS
PEAK PLATE VOLTAGE	12	KILOVOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE CATHODE CURRENT	7.5	AMPERES
DC PLATE CURRENT	150	MILLAMPERES
DC GRID CURRENT	45	MILLAMPERES
AVERAGE PLATE DISSIPATION		
Conduction and Convection Cooling	10	WATTS
Forced Air Cooling[1]	150	WATTS
GRID DISSIPATION	1.5	WATTS
PULSE DURATION[2]	6.0	μs
CUT-OFF Mu	110	
DUTY[2]	.0033	

1. Only with Radiator #157271 attached with heat conducting grease such as Insulgrease S-641 (G.E.).
2. For applications using longer plus duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

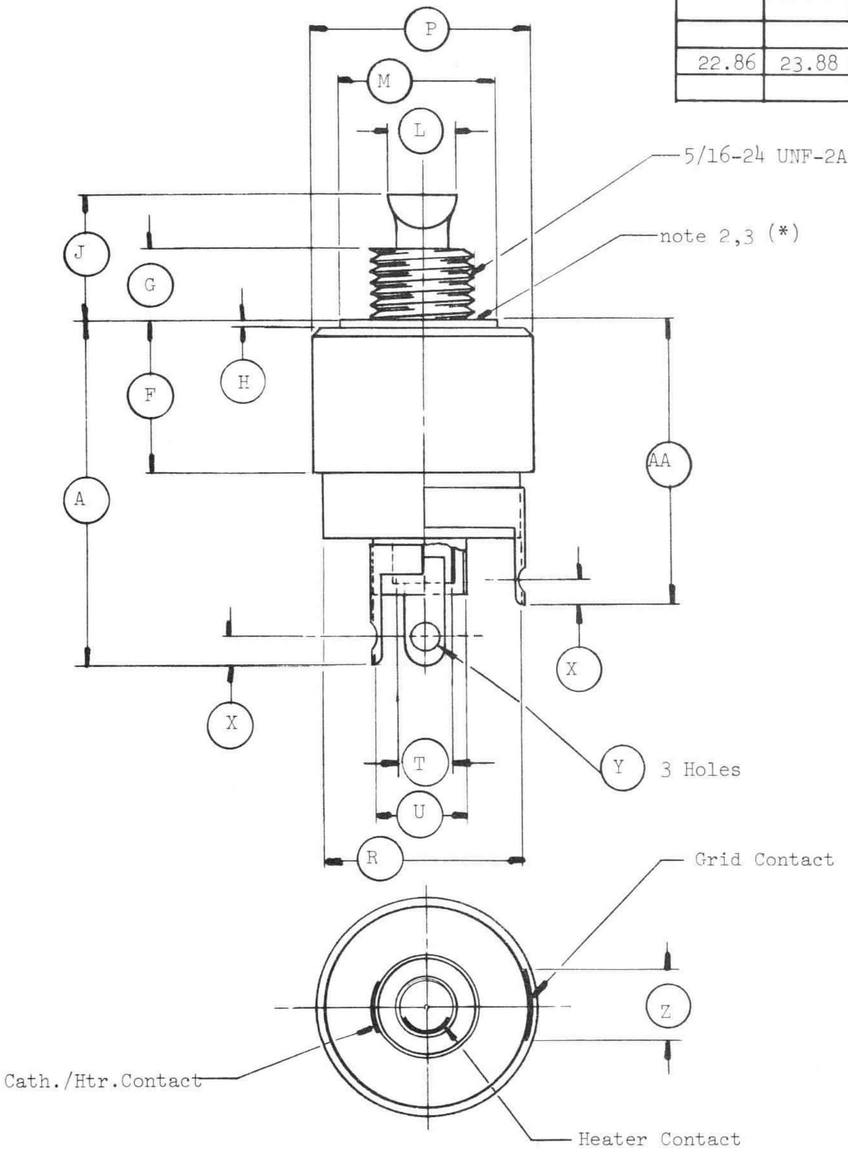
APPLICATION

For general application information please refer to the Planar Triode Operating Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

NOTES:

1. Ref. dimensions are for information only & are not req'd for inspection purposes.
2. (*) contact surface
3. Anode flange is for electrical contact. Stud is for heat transfer.
4. Metric equivalents to the nearest mm. are for information only & are based on 1 inch= 25.4mm.

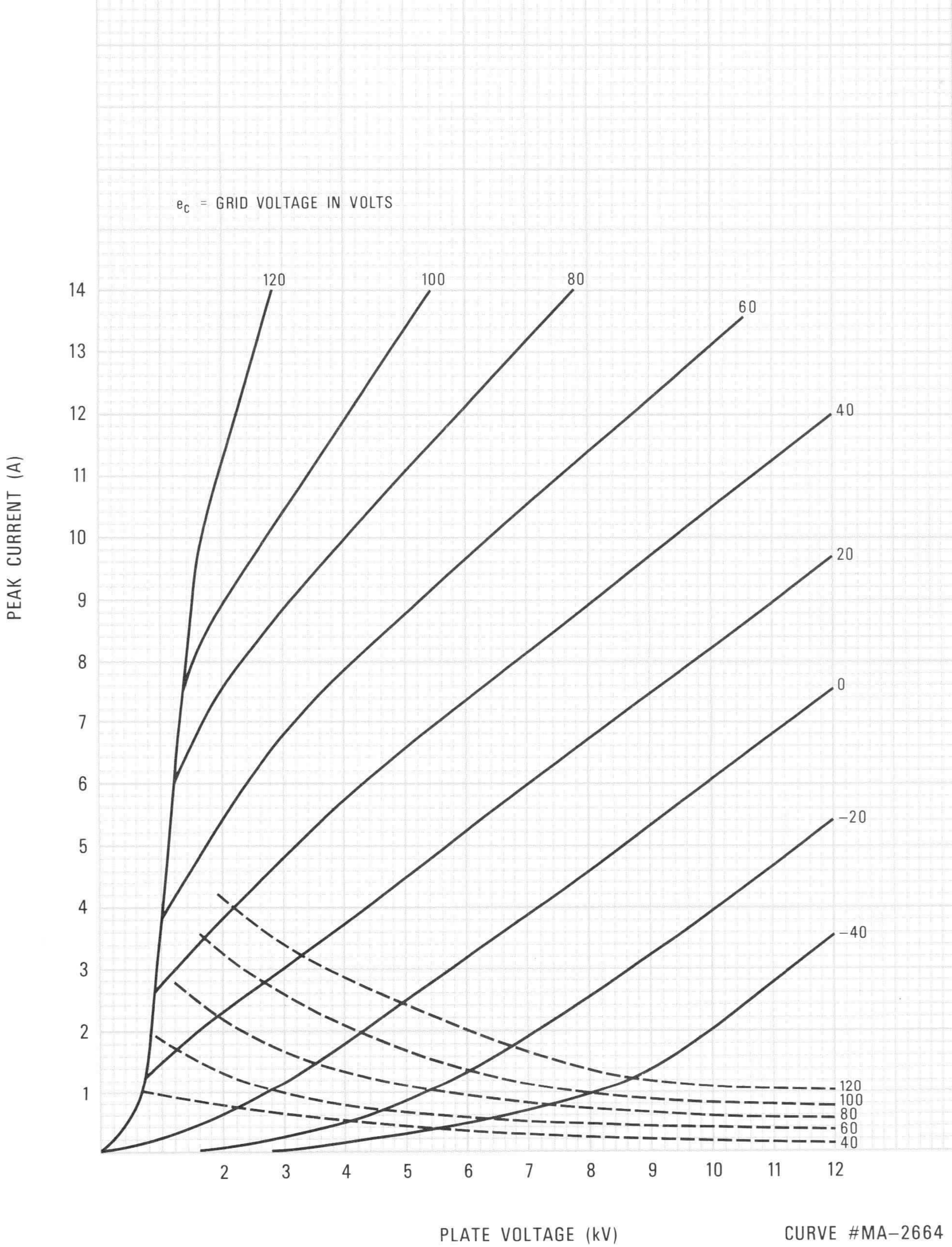
DIMENSIONS IN MILLIMETERS				DIMENSIONS IN INCHES		
MIN.	MAX.	REF.	DIM.	MIN.	MAX.	REF.
28.45	29.46		A	1.120	1.160	
	14.48		F		.570	
6.10	6.86		G	.240	.270	
	1.02		H		.040	
	10.16		J		.400	
	6.60		L		.260	
13.84	14.48		M	.545	.570	
19.69	19.94		P	.775	.785	
		16.76	R			.660
		5.54	T			.218
		8.13	U			.320
1.78	2.79		X	.070	.110	
		2.29	Y			.090
6.10	8.18		Z	.240	.322	(flat)
22.86	23.88		AA	.900	.940	



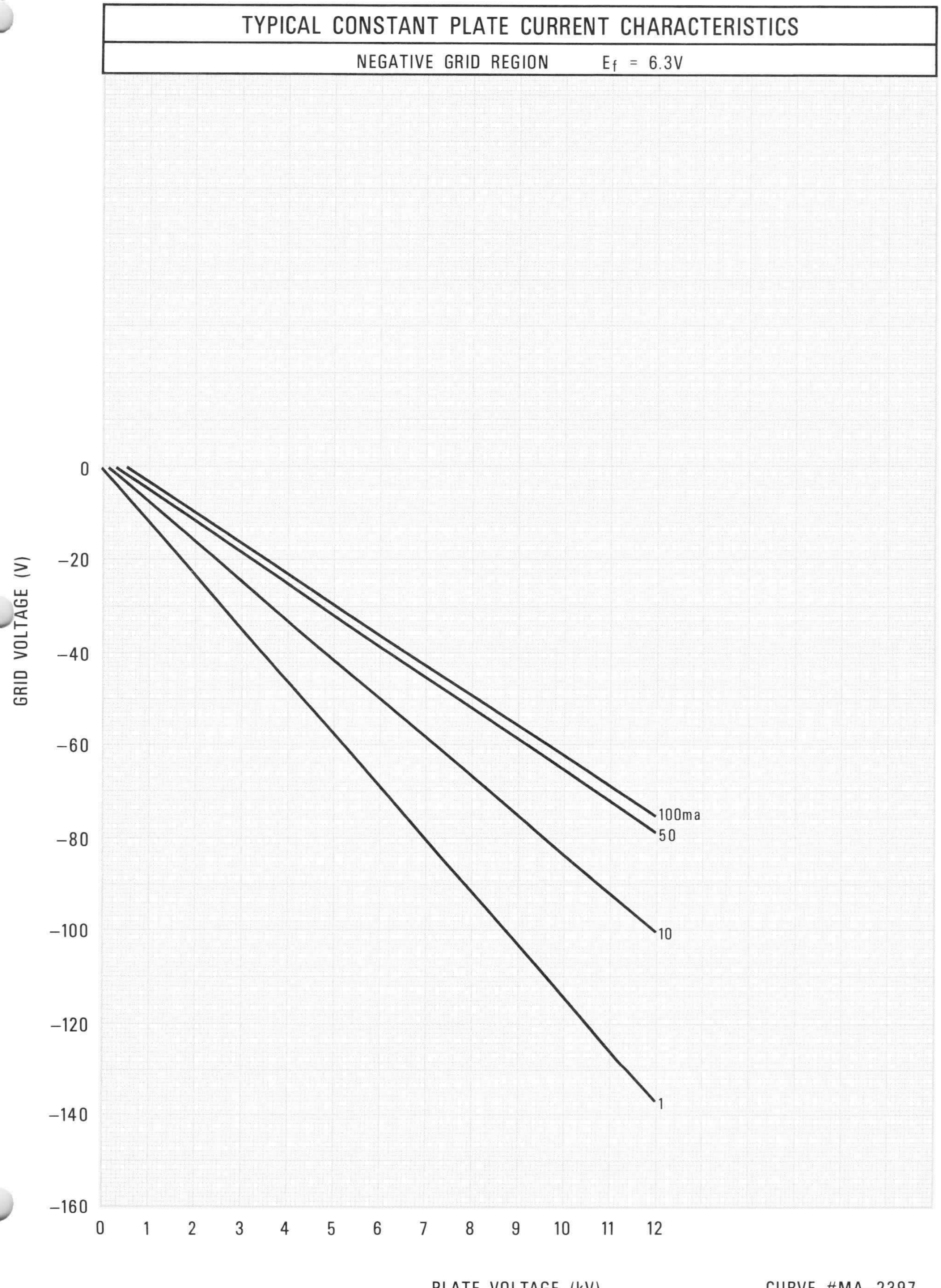
TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS

FOR PULSE OPERATION $E_f = 6.3V$

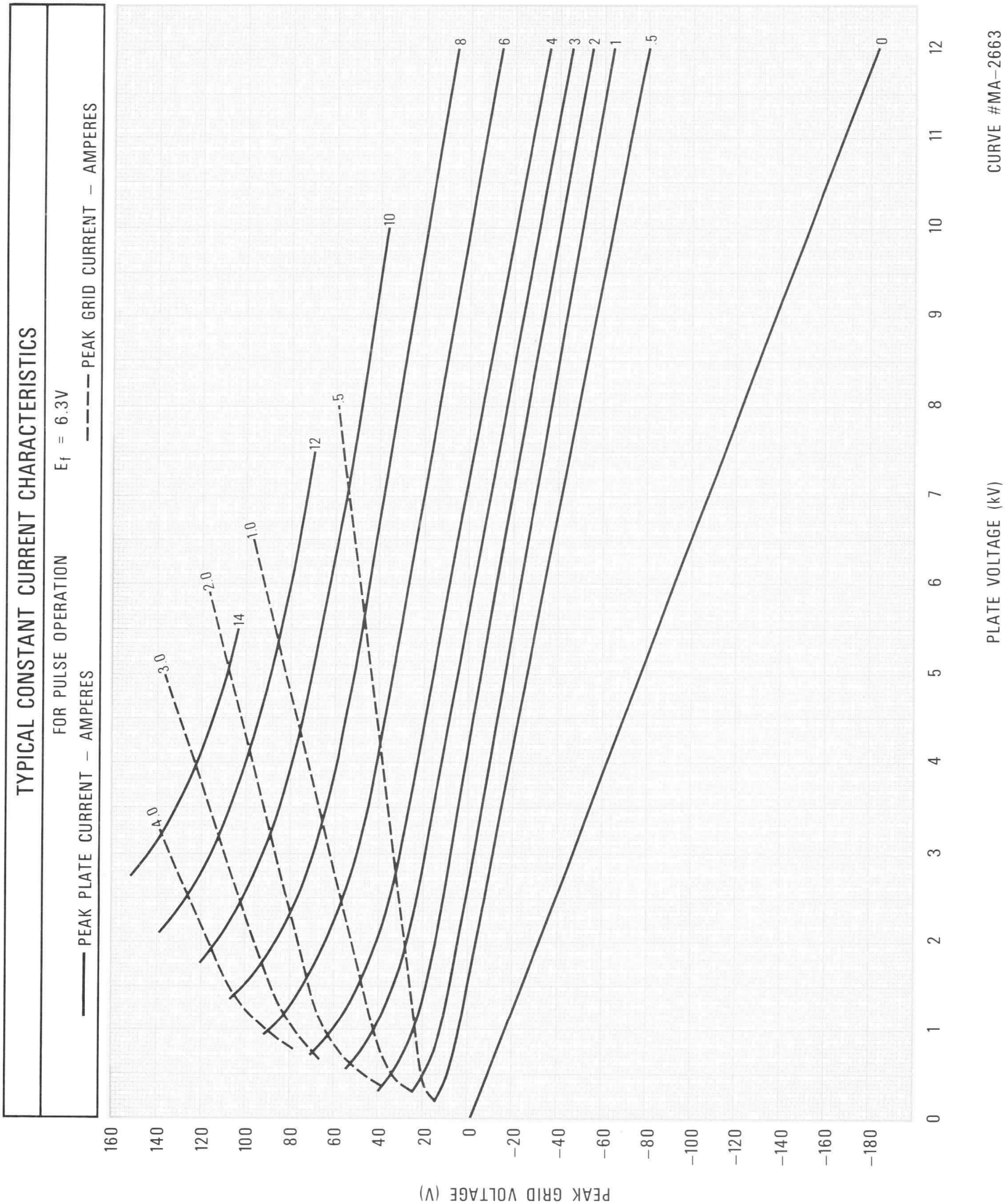
——— PEAK PLATE CURRENT – AMPERES ---- PEAK GRID CURRENT – AMPERES



CURVE #MA–2664



CURVE #MA–2397


TYPICAL CONSTANT CURRENT CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PEAK PLATE CURRENT - AMPERES
PEAK GRID CURRENT - AMPERES
PLATE VOLTAGE (kV)
PEAK GRID VOLTAGE (V)
CURVE #MA-2663
0
1
2
3
4
5
6
7
8
9
10
11
12
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
.5
1
2
3
4
6
8
10
12
14
.5
1.0
2.0
3.0
4.0

Eimac®

TECHNICAL DATA

Y654

PLANAR TRIODE
HIGH MU

The Y654 is a miniature ceramic/metal rugged planar triode for advanced airborne, ground, and space applications up to 3.0 GHz.

The Y654 may be used as an amplifier, oscillator, or frequency multiplier in the C-W mode, grid- or plate-pulsed mode, as well as a modulator or regulator tube. In addition to the low interelectrode capacitance, high transconductance and amplification factor the Y654 has an arc-resistant cathode to assure stable, reliable, and long-life operation under adverse conditions, and a specially supported grid structure.

The Y654 is supplied without radiator and may be conduction, convection, heat sink, or liquid cooled. Radiators for forced air cooling, as well as heat sink adaptors, permitting an anode dissipation up to 300 watts, can be furnished on separate order.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	1.30 A
Transconductance (Average):	
(200 mA/cm^2)	50
Amplification Factor (Average)	135
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	9.75 pF
Cout	0.065 pF max.
Cgp	1.05 pF
Cut-off Bias[3]	-20 V
Frequency of Maximum Rating:	
CW	2500 MHz
Plate or Grid-Pulsed	3000 MHz

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 for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pF due to thermal expansion of the cathode.
3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

MECHANICAL

Maximum Overall Dimensions:	
Length	1.370 in; 34.75 mm
Diameter	0.785 in; 19.94 mm

EIMAC division of varian / 301 industrial way / san carlos / california 94070

Net Weight	0.56 oz; 16.0 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250° C
Anode Core	250° C
Cooling	Conduction, convection, forced air, or liquid
Terminals	Coaxial special

ENVIRONMENTAL

Shock, 11 ms, non-operating	60 G
Vibration, operating, all axes 55 to 500 Hz	10 G
Altitude, max (in a suitably designed circuit)	70,000 ft.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at 6.3 volts	1.20	1.40	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	8.5	11.0	pF
Cout	---	0.065	pF
Cgp	0.90	1.20	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pf due to the thermal expansion of the cathode.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	8000	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	10,000	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	150	VOLTS
PULSE PLATE CURRENT	6.0	AMPERES
PULSE GRID CURRENT	2.5	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	300	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
FREQUENCY	3.0	GHz
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	

OPERATING CONDITIONS IN REPRESENTATIVE APPLICATION

GRID PULSED AMPLIFIER

Frequency	1.1	GHz
Heater Voltage	6.3	V
DC Plate Voltage	4000	Vdc
DC Grid Voltage	-80	Vdc
Peak Video Plate Current	1.8	a
Plate Efficiency	35	%
Pulse Drive Power (approx.)	200	w
Useful Power Output (approx.)	2500	w
Gain	11	db
Duty Factor	0.02	

1. Using one of the EIMAC radiators shown on the cooling curves.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
PEAK PLATE VOLTAGE	12,000	VOLTS
DC GRID VOLTAGE	-150	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	100	VOLTS
PULSE CATHODE CURRENT	9.0	AMPERES
DC PLATE CURRENT	190	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	300	WATTS
GRID DISSIPATION (Average)	1.5	WATTS
PULSE DURATION[2]	6.0	μs
CUT-OFF Mu	90	

1. Using one of the EIMAC radiators shown on the cooling curves.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

CW RF POWER AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500	VOLTS
DC GRID VOLTAGE	-200	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-400	VOLTS
Grid positive to cathode	30	VOLTS
DC PLATE CURRENT	300	MILLIAMPERES
DC GRID CURRENT	45	MILLIAMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	300	WATTS
GRID DISSIPATION (Average)	1.5	WATTS

1. Using one of the EIMAC radiators shown on the cooling curves.

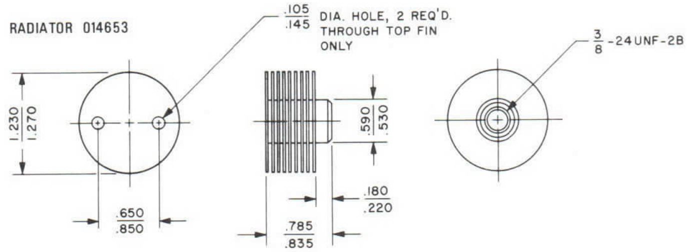
APPLICATION

COOLING - The Y654 can be cooled by conduction, convection, forced air, or liquid cooling. The tube is designed to permit high-temperature operation up to the limit indicated. However, if long life is the prime objective, tube terminal and seal temperatures should be kept well below 250°C. If forced air cooling is provided, auxiliary air flow, apart from the air flowing thru the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided thru the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C. Cooling curves are given for four standard radiators which are suitable for use with the Y654. Special cooling designs are available upon request.

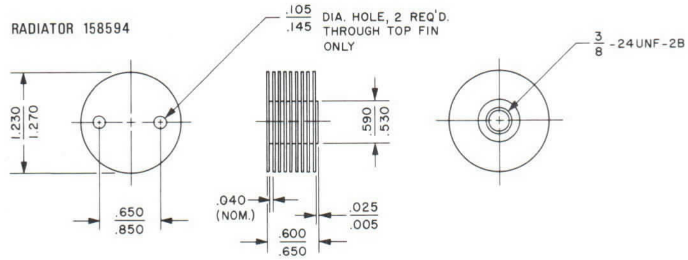
For unusual operating conditions contact the nearest Varian Electron Tube and Devices Field Office or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

For general operating information refer to EIMAC bulletin #15, "Operating Data for Planar Triodes."

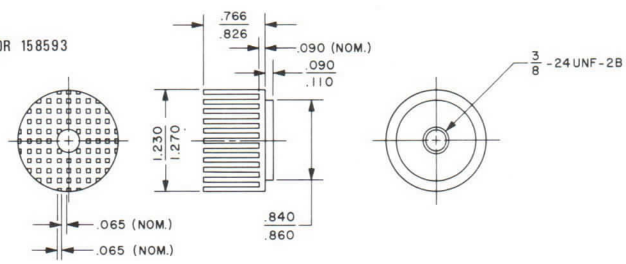
RADIATOR 014653



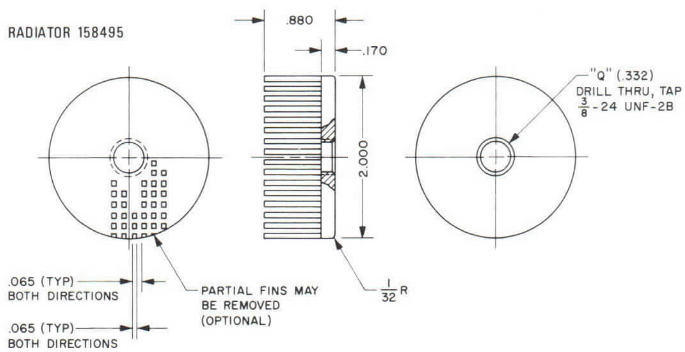
RADIATOR 158594



RADIATOR 158593



RADIATOR 158495



COMBINED CORRECTION FACTORS FOR INLET AIR TEMPERATURE AND ALTITUDE

(RELATIVE TO 25°C AND SEA LEVEL)

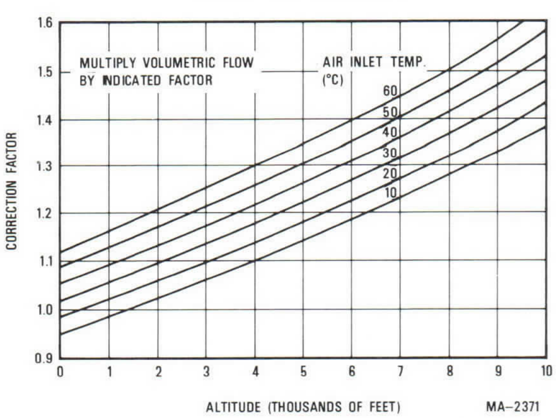
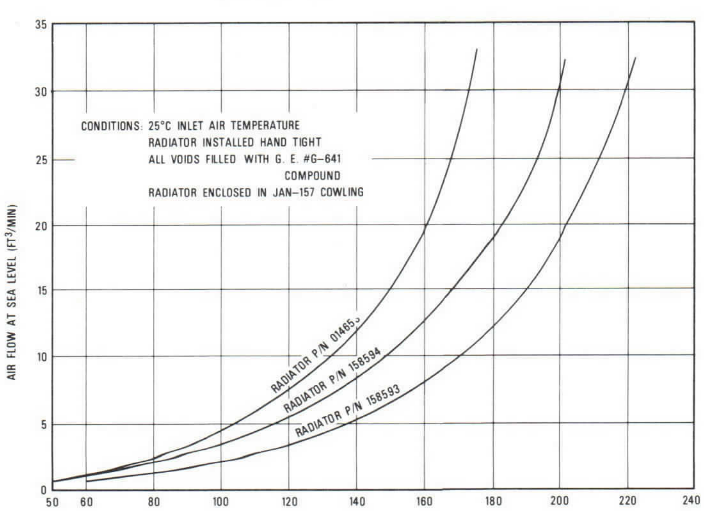
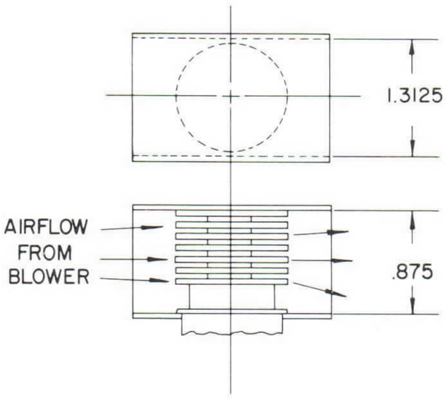


PLATE DISSIPATION VARIATION WITH COOLING AIR FLOW

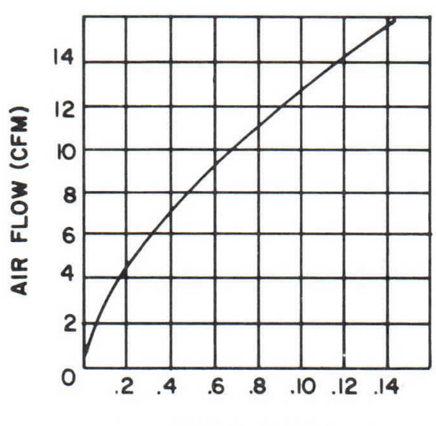


AIRFLOW vs STATIC PRESSURE WITH
STANDARD COWLING JAN-157



- STANDARD COWLING -

FOR 014653, 158594, 158593
RADIATORS



AIRFLOW COWLING FOR EIMAC
"PIN" RADIATOR PART #158495

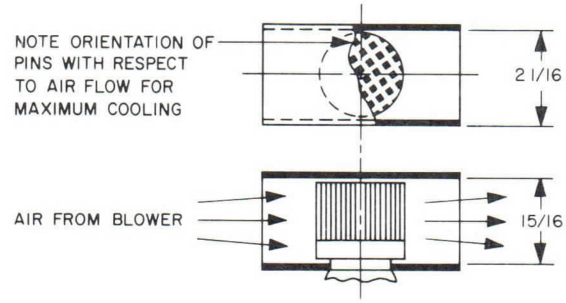
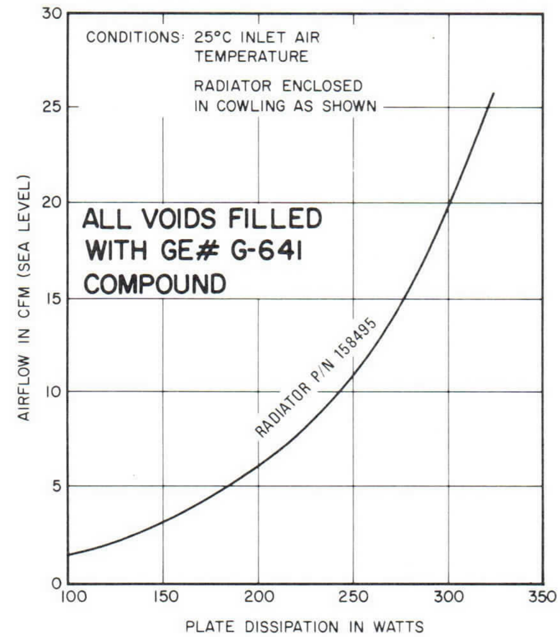
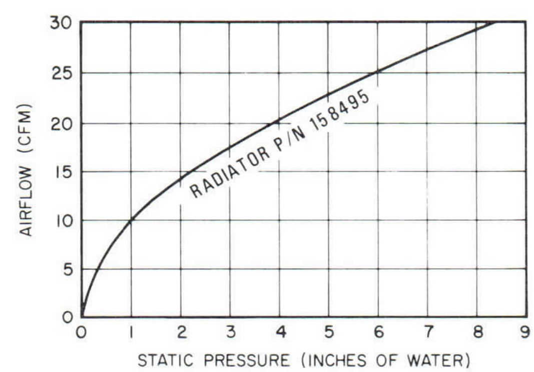
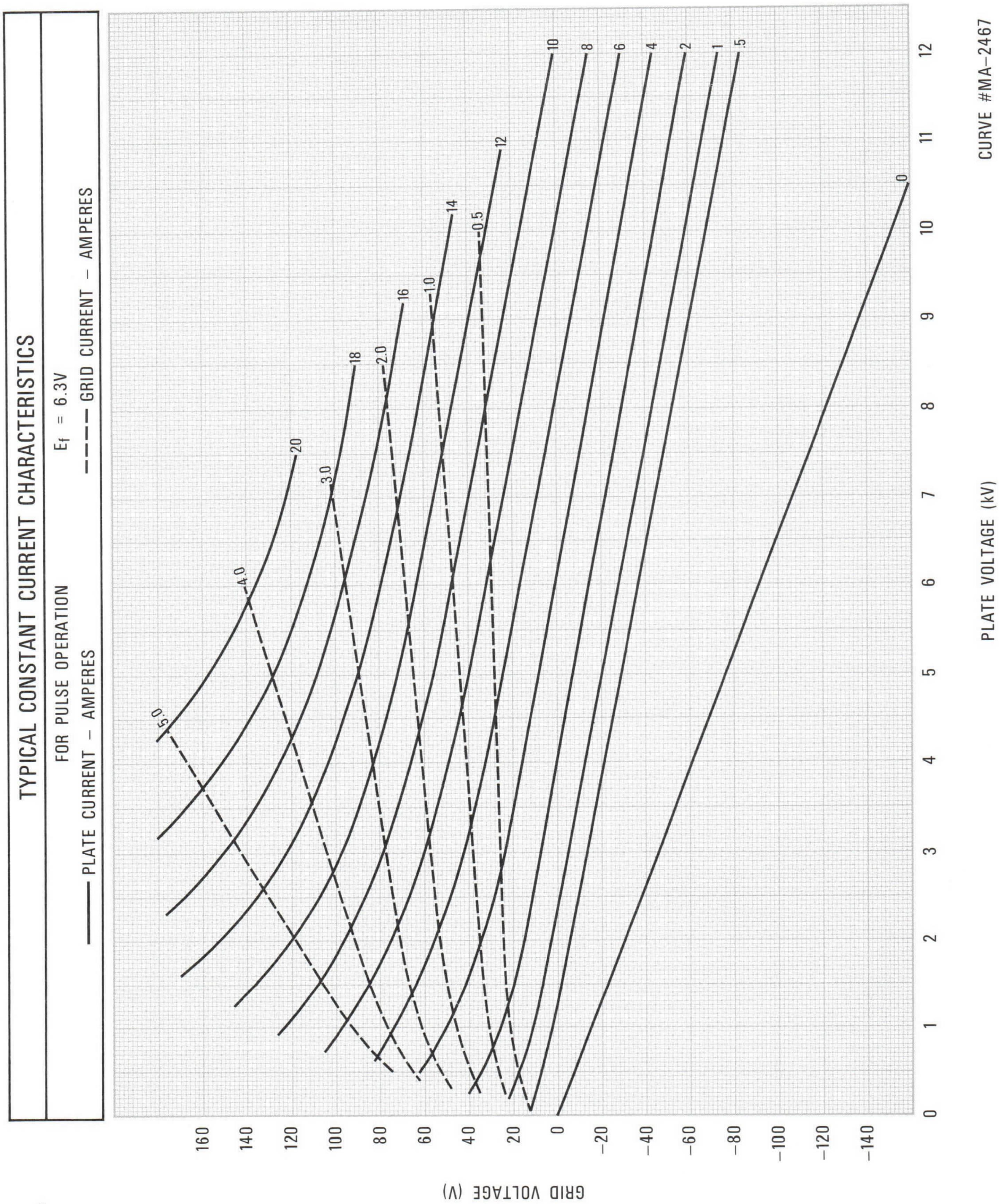
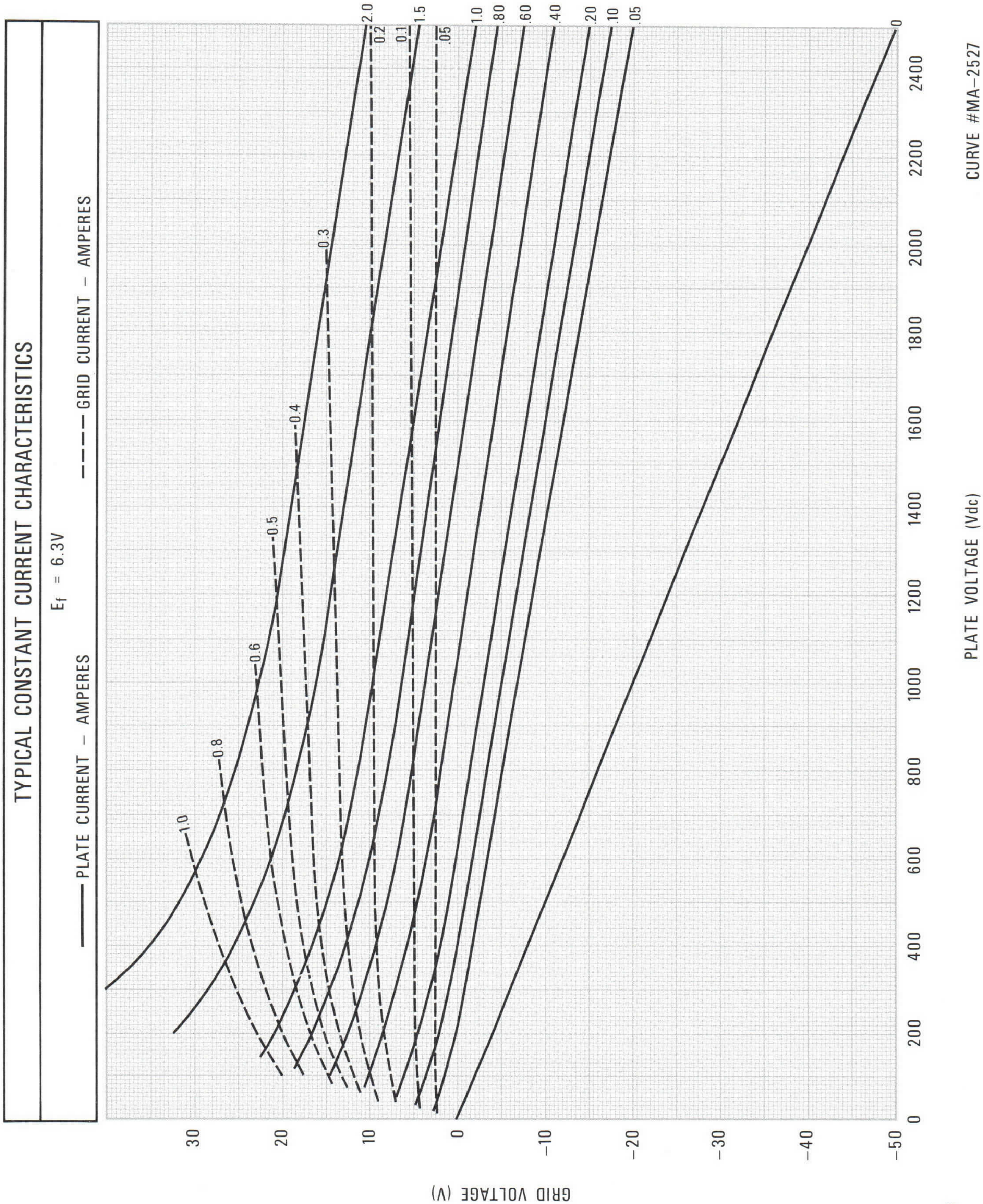


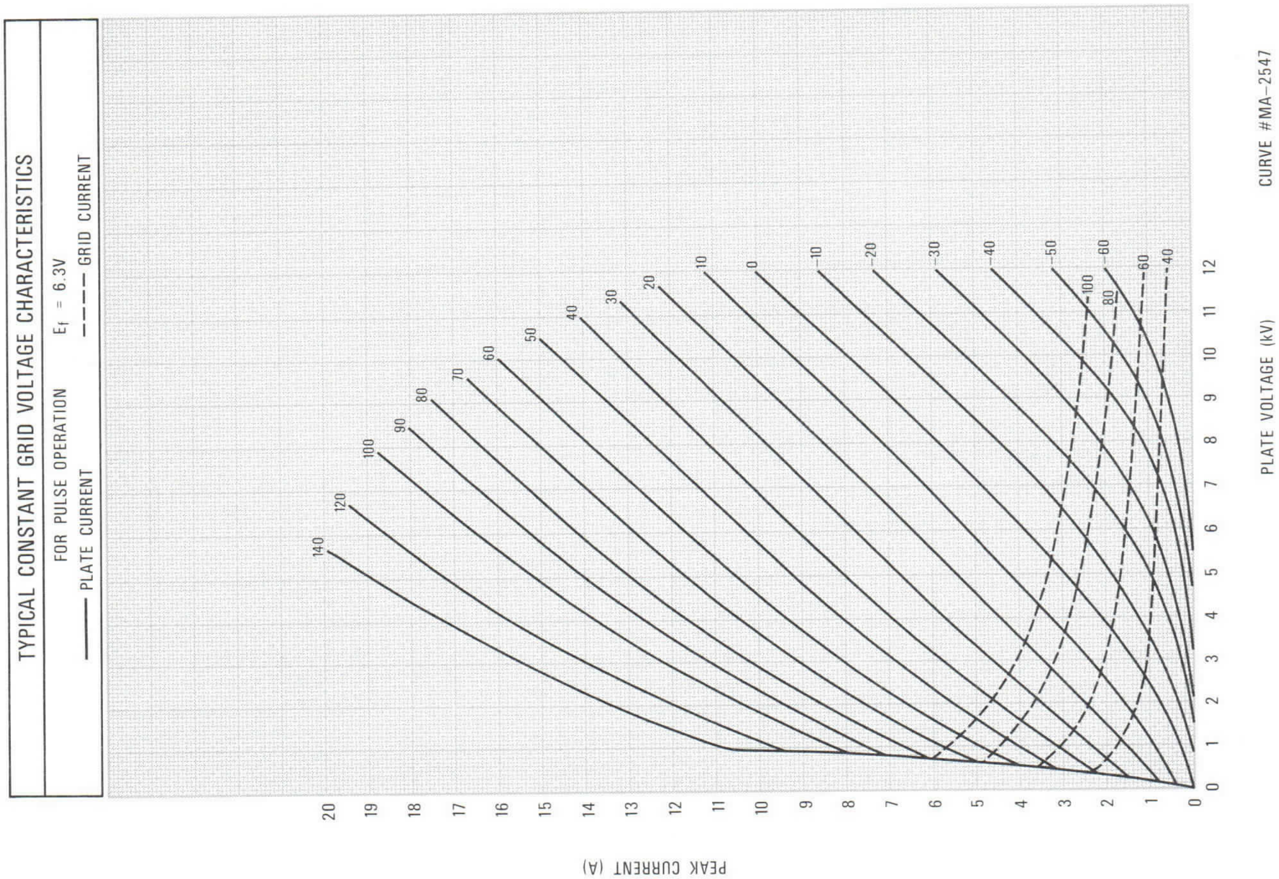
PLATE DISSIPATION VARIATION WITH
COOLING AIRFLOW

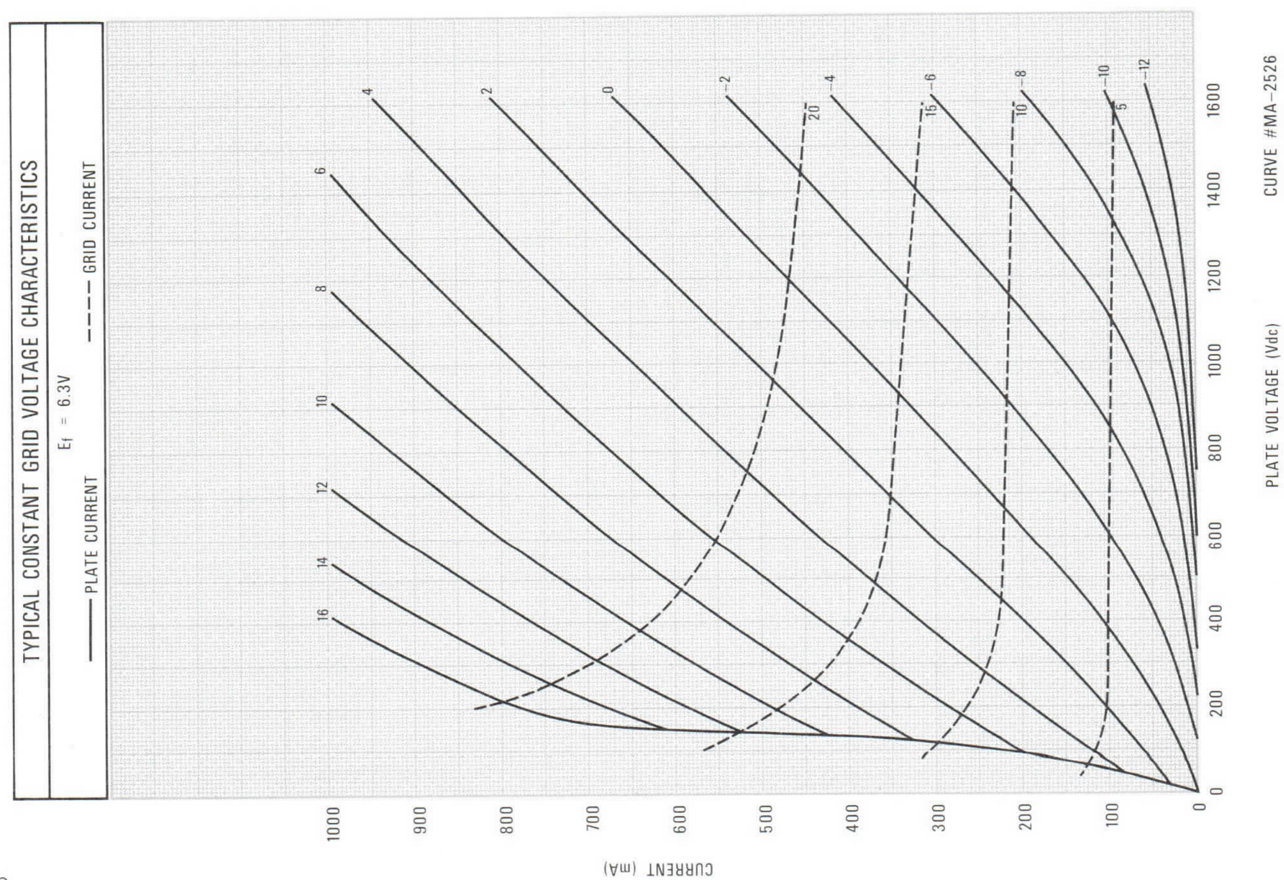





TYPICAL CONSTANT CURRENT CHARACTERISTICS
FOR PULSE OPERATION
Ef = 6.3V
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #MA-2467
0 1 2 3 4 5 6 7 8 9 10 11 12
160 140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140
20 18 16 14 12 10 8 6 4 2 1 .5 0
5.0 4.0 3.0 2.0 1.0 0.5


TYPICAL CONSTANT CURRENT CHARACTERISTICS
E_f = 6.3V
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
PLATE VOLTAGE (Vdc)
GRID VOLTAGE (V)
CURVE #MA-2527
2.0
1.5
1.0
.80
.60
.40
.20
.10
.05
0
0.2
0.1
.05
0.3
0.4
0.5
0.6
0.8
1.0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
30
20
10
0
-10
-20
-30
-40
-50


TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
FOR PULSE OPERATION
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
PEAK CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #MA-2547

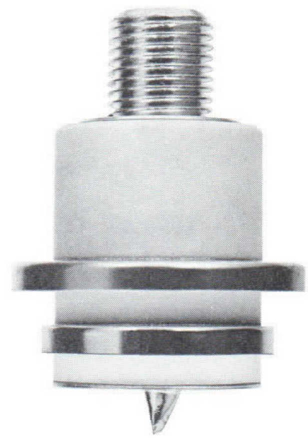

TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
E_f = 6.3V
PLATE CURRENT
GRID CURRENT
CURRENT (mA)
PLATE VOLTAGE (Vdc)
CURVE #MA-2526

8941/Y690

TECHNICAL DATA

PLANAR TRIODE

The 8941 is a planar triode of ceramic/metal construction designed for use in airborne, ground and space applications as a grid or plate pulsed oscillator, amplifier, or frequency multiplier at frequencies up to 2.0 GHz. The extended grid to cathode insulator permits reliable operation in some applications to 12 KV[1]. The other special features of this tube include high transconductance, high mu and high current capability from an arc-resistant, extended interface matrix cathode.



The tube is normally supplied without radiator and may be conduction, convection, heat sink or liquid cooled such as immersion in an insulating medium (eg. FC-75). Radiators for forced-air cooling as well as heat sink adapters permitting anode dissipations up to 750 watts are available as separate items.

The Y-690 is an 8941 which has been specially processed for series regulator and switch tube service and will operate in some applications to 15 KV[1]. Solder tabs are available on special request permitting attachment of flying leads for grid, cathode and heater connections.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	2.25 A
Transconductance (Average):	
I_b = 160 mA	75 mmhos
Amplification Factor (Average):	200
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	14.0 pF
Cout	0.11 pF
Cgp	2.5 pF
Cut-off Bias[3]	-20 V max.
Frequency of Maximum Rating:	
CW	2000 MHz
Plate or Grid-Pulsed	2000 MHz

1. Characteristics and operating values are based upon performance tests and environmental conditions. 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. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 2 pF due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

(Effective 10-15-75) Printed in U.S.A.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.235 in; 56.77 mm
Diameter	1.365 in; 34.60 mm
Net Weight	1.96 oz; 56 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Conduction, convection, liquid or forced air

ENVIRONMENTAL

Shock: 11 ms, non-operating	60 G
Vibration: Operating, All Axis	10 G
Altitude; max., in suitably designed circuit	60,000 ft.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.3 volts	2.05	2.50	A
Cathode Warmup Time	90	---	sec.
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	12.5	16.5	pF
Cout	---	0.11	pF
Cgp	2.0	3.0	pF

1. Capacitance values for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 2 pF due to thermal expansion of the cathode.

GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (grid pulsed)	10,000	VOLTS
PEAK PULSE PLATE VOLTAGE (plate pulsed)	12,000	VOLTS
DC GRID VOLTAGE	-350	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode	-750	VOLTS
Grid positive to cathode	175	VOLTS
PULSE PLATE CURRENT	12	AMPERES
PULSE GRID CURRENT	3.0	AMPERES
AVERAGE PLATE DISSIPATION		
Forced Air Cooling[1]	750	WATTS
GRID DISSIPATION (Average)	2.0	WATTS
FREQUENCY	2.0	GHz
PULSE DURATION[2]	6.0	μs
DUTY FACTOR[2]	.0033	

1. Using EIMAC radiator PN 158096.

Operating Conditions for 8941 in representative applications:

	Cathode Biased, rf Pulsed Amplifier[3]	Grid Pulsed Amplifier	
Frequency	1850	1090	MHz
Heater Voltage	6.3	6.3	V
DC Plate Voltage	4500	5000	Vdc
DC Grid Voltage	-40	-60	Vdc
Peak Video Plate Current	3.1	4.0	a
Peak Video Grid Current	.6	.75	a
Useful Power Output	4.2	10.0	kw(peak)
Pulse Duration	3.0	3.0	μs
Duty Cycle	0.04	0.001	
Gain	11.5	12.0	dB
Bandwidth	20	---	MHz

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

3. No gate pulse used.

PULSE MODULATOR AND PULSE AMPLIFIER SERVICE (Type Y-690)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
PEAK PLATE VOLTAGE	18,000	VOLTS
DC GRID VOLTAGE	-350	VOLTS
INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE		
Grid negative to cathode . .	-750	VOLTS
Grid positive to cathode . .	100	VOLTS
PULSE CATHODE CURRENT . .	16	AMPERES
DC PLATE CURRENT	600	MILLIAMPERES

AVERAGE PLATE DISSIPATION		
Forced Air Cooling 1	750	WATTS
GRID DISSIPATION (Average)	2	WATTS
PULSE DURATION 2	6.0	μs
DUTY FACTOR2	.0033	
CUT-OFF MU	90	

1. Using EIMAC radiator PN 158096.
2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Device Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

APPLICATION

For general application information please refer to the Planar Triode Operazing Instruction Sheet. The operating instructions should be consulted prior to the designing of new requirements around the above tube type. For unusual and special applications consult the nearest Varian Electron Tube Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

The cathode and grid flanges should not be altered in any way such as be machining or filing, since the final seal could be damaged. Maximum torque applied to flanges during installation should not exceed 15 inch pounds.

For optimum RF performance, the anode line should make good contact on the anode area indicated on the outline drawing.

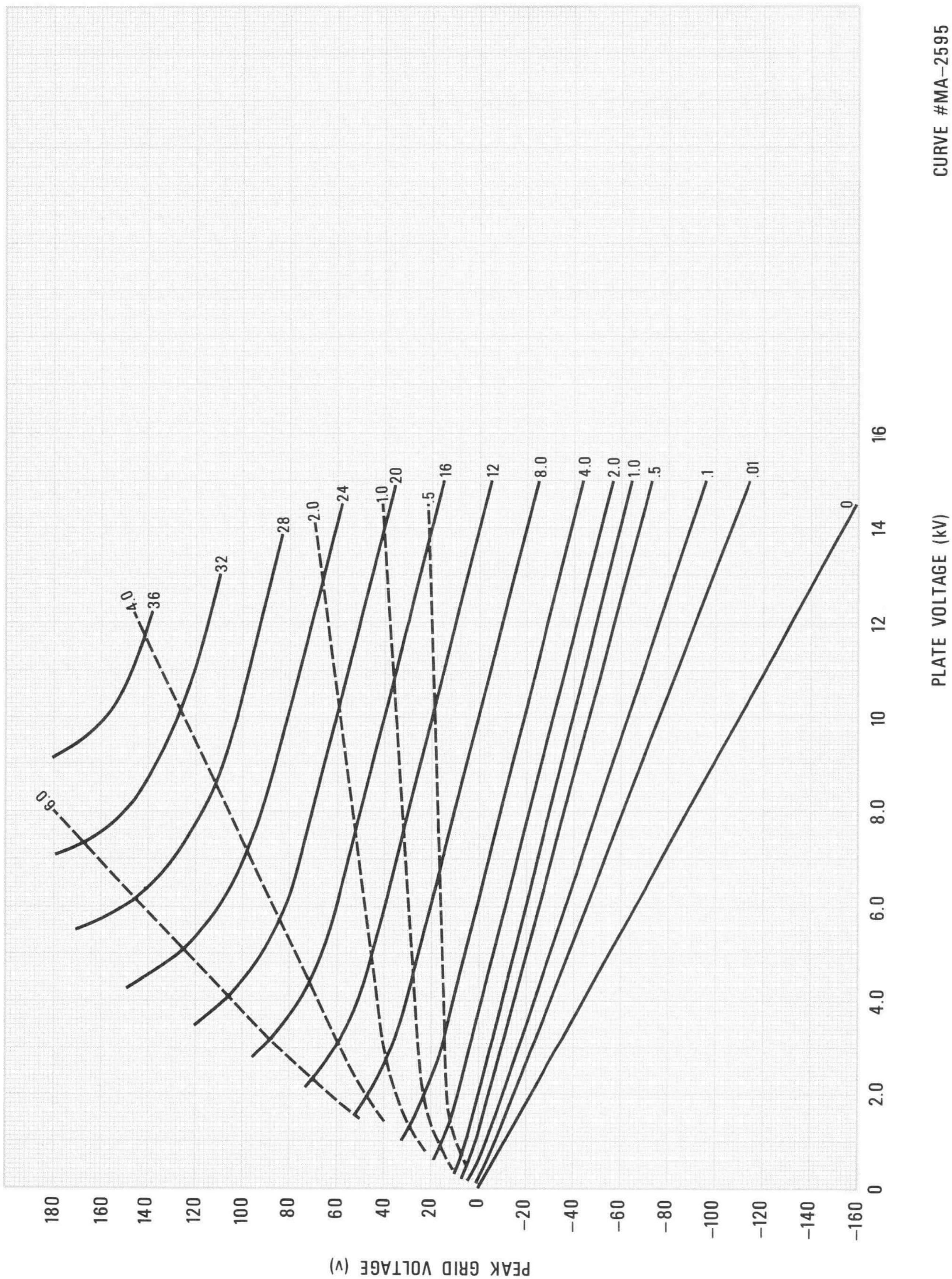
Soldered connections may be made to the anode stud, grid or cathode flanges, and heater contacts where adequate heat sinking and good soldering practices are followed to minimize the heat applied to the tube and the thermal gradient across the metal to ceramic brazed areas. If forced air cooling is provided, auxiliary air flow, apart from the air flowing through the radiator, should be provided to cool the tube envelope and other tube terminals. Some conduction cooling is always provided through the contact terminals. However, these terminals usually exhibit poor heat transfer, often having a temperature gradient across them as high as 50°C.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

FOR PULSE OPERATION

—— PLATE CURRENT - AMPERES

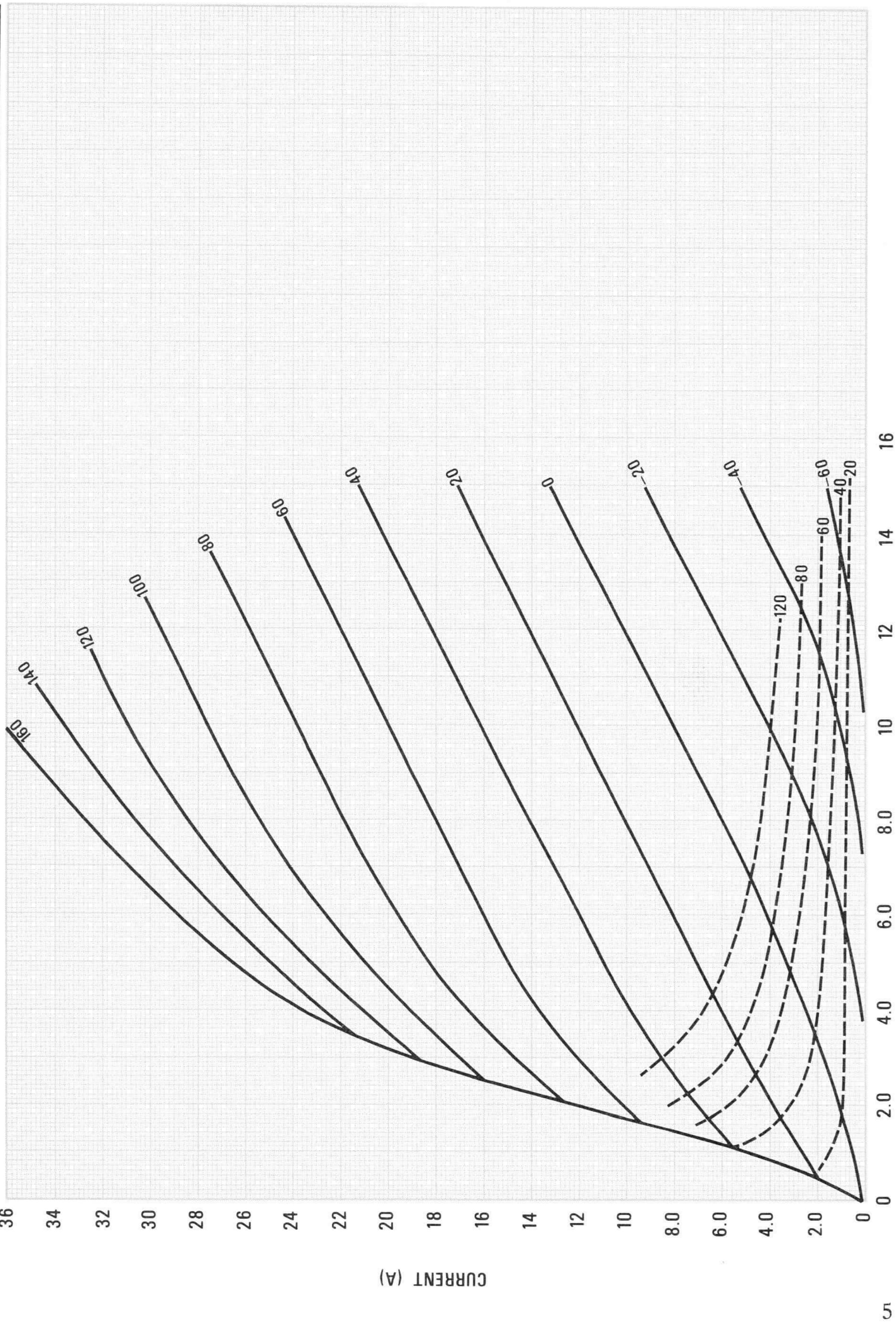
- - - - GRID CURRENT - AMPERES



TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS

FOR PULSE OPERATION

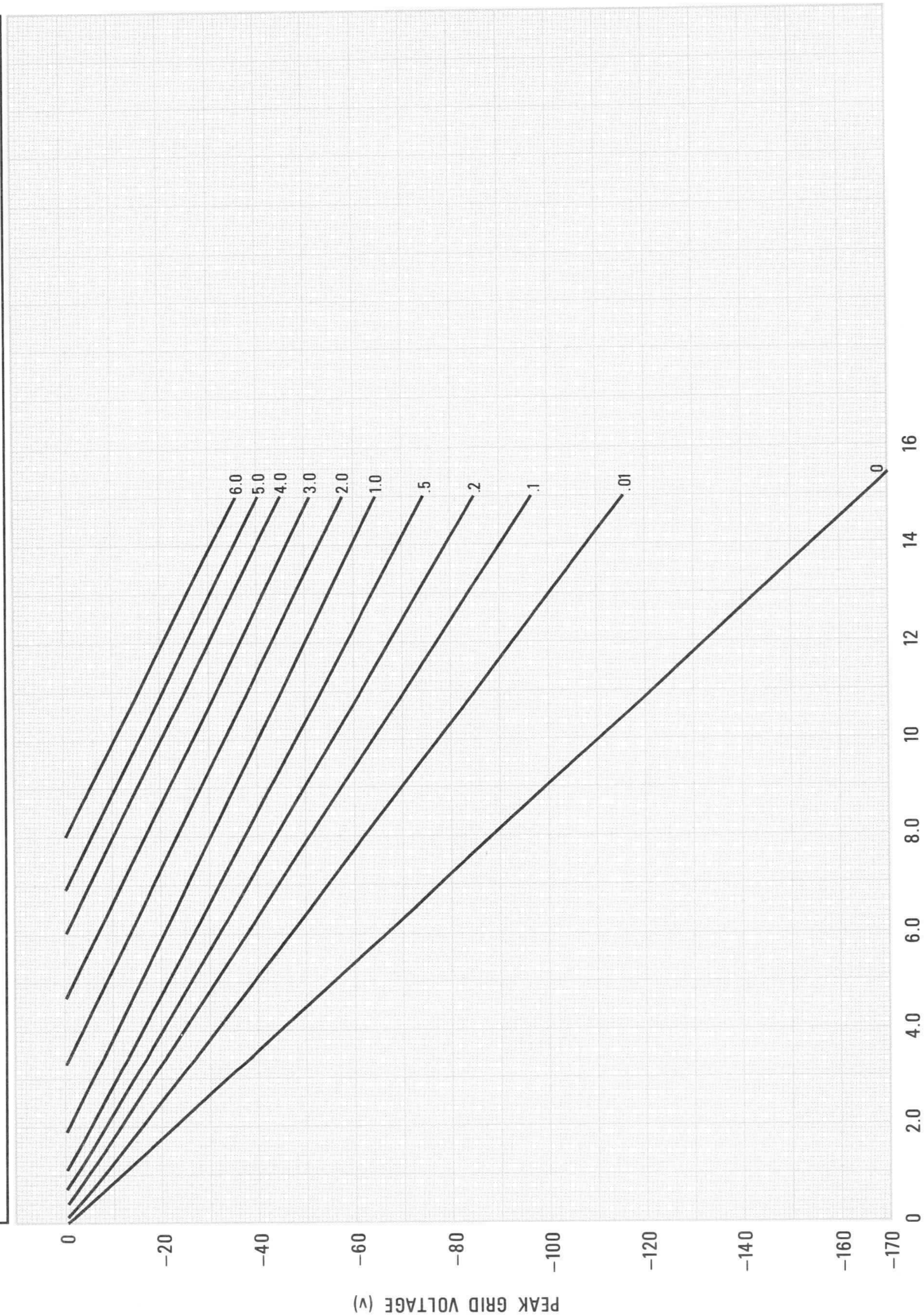
——— PLATE CURRENT - AMPERES
- - - - GRID CURRENT - AMPERES



CURVE #MA-2692

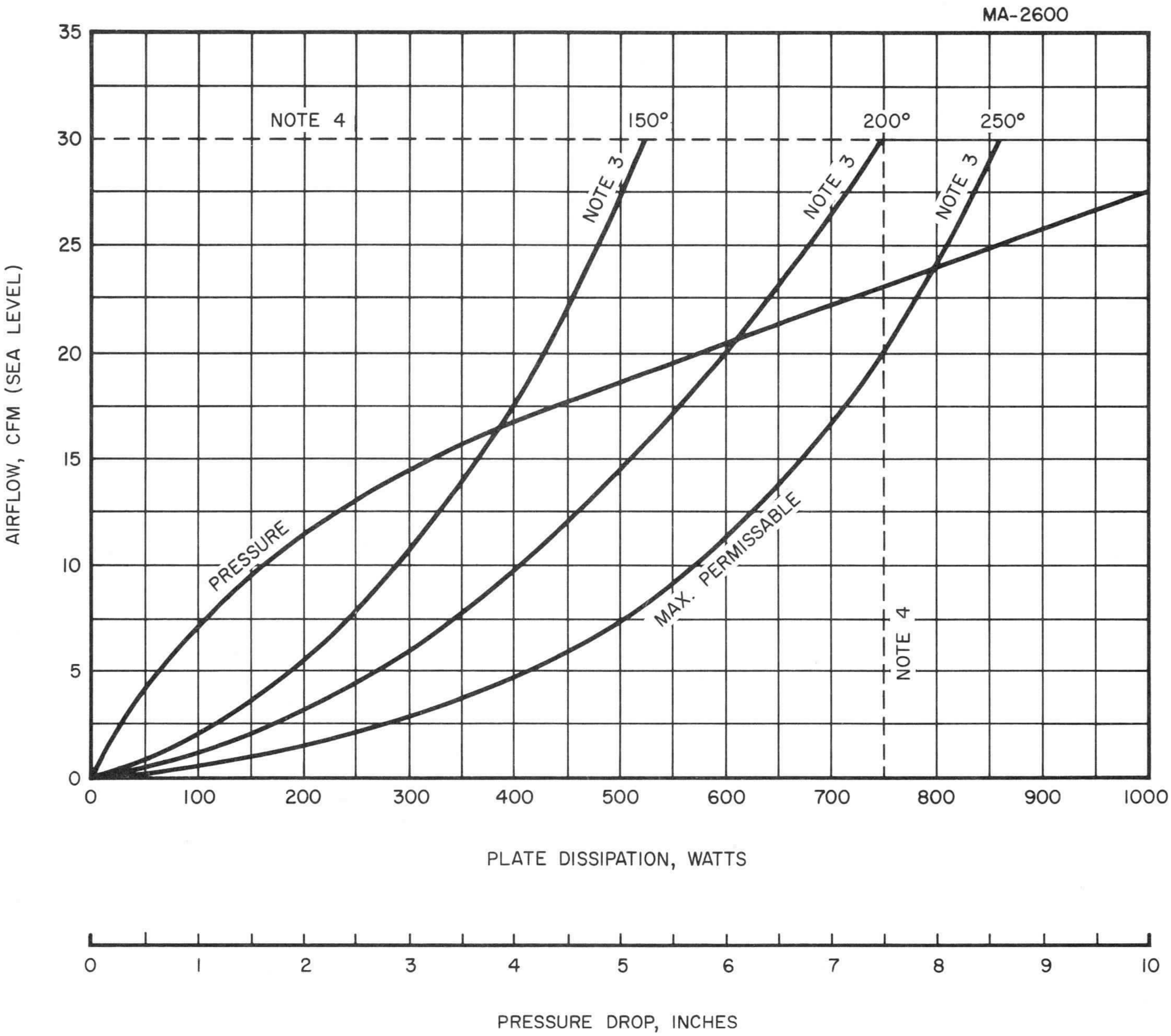
TYPICAL CONSTANT PLATE CURRENT CHARACTERISTICS

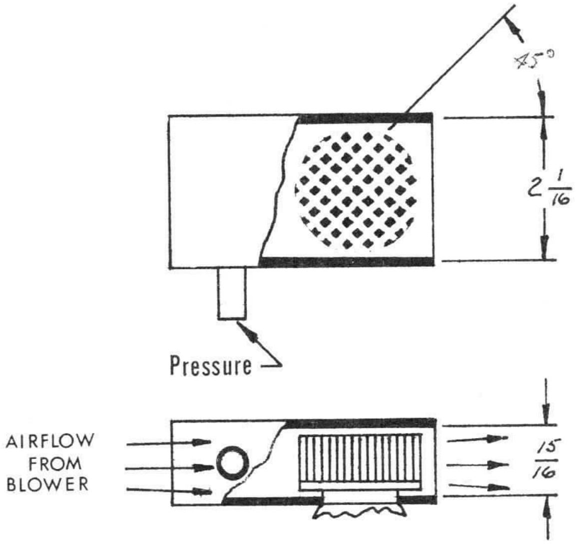
NEGATIVE GRID VOLTAGE REGION



CURVE #MA-2691

AIR COOLING DATA FOR 8941





- COWLING DETAIL -

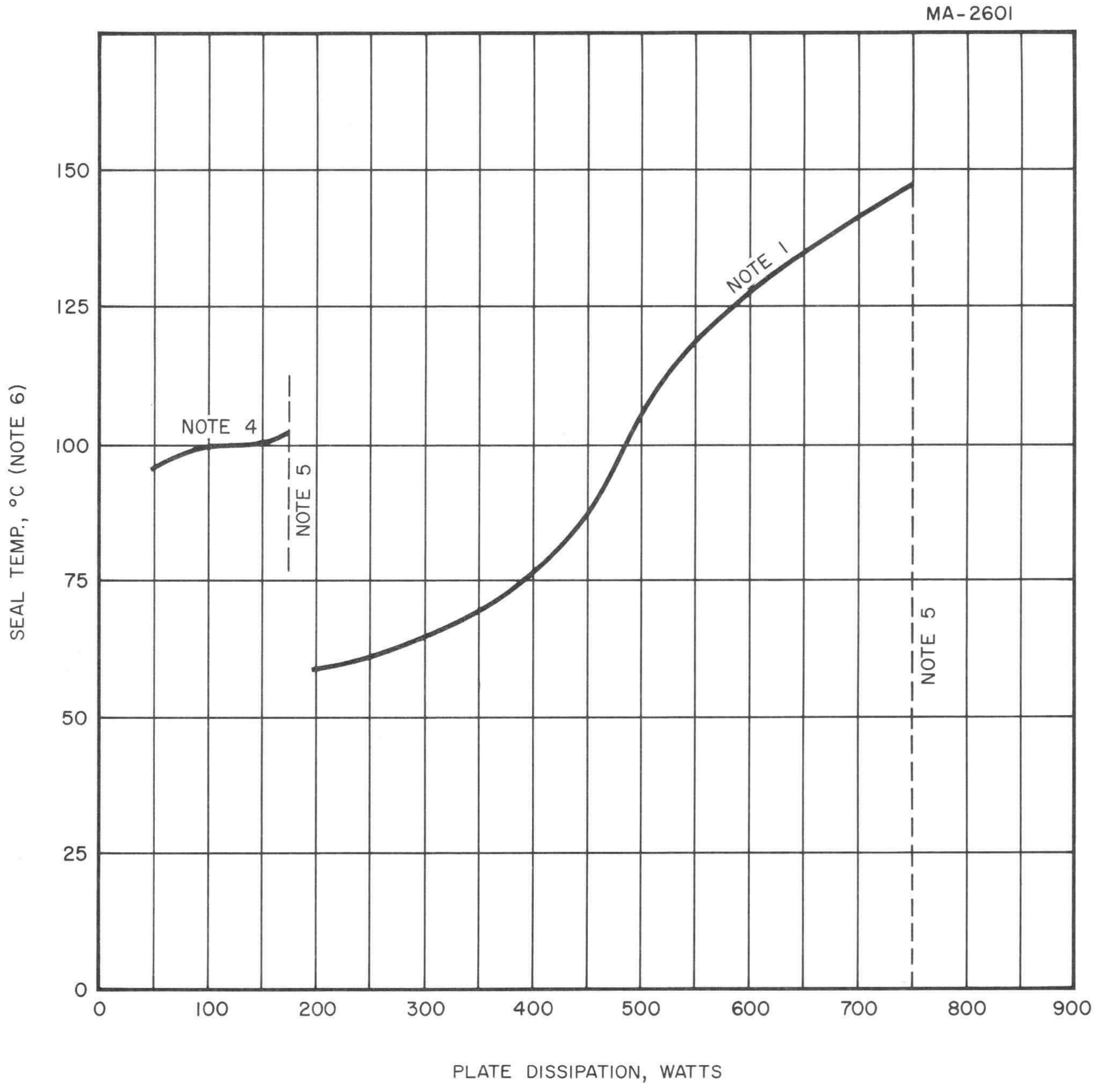
1. Inlet Air at 20°C

2. Use Radiator No. 158096 (Copper–Pin) in Cowling as shown.

3. Temp. measured at Anode Cup–Plate Insulator Seal.

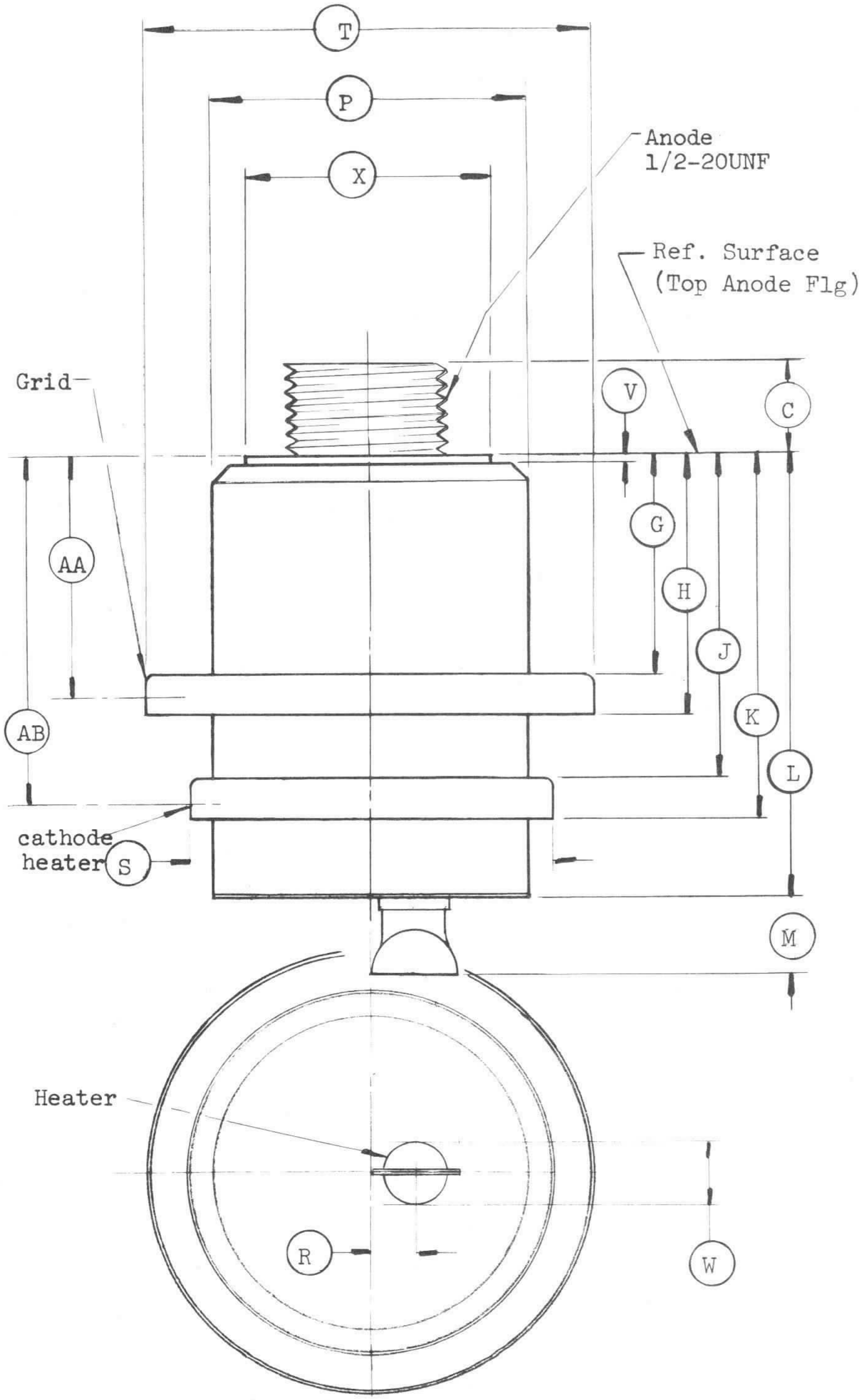
4. Describes Typical MAX. CW Operating Point.

COOLING DATA FOR 8941 IN FC 75 DIELECTRIC COOLANT



NOTES:

1. USE RADIATOR 158096 (Copper - Pin)
2. TUBE AXIS VERTICAL IN LIQUID.
3. LIQUID AMBIENT TEMPERATURE 40°C.
4. TUBE W/O COOLER STUD COOLING ONLY.
5. MAX. CW RATING - CONTACT PLANAR MGR. EIMAC, SLC ON INTERMEDIATE OR HIGHER POWERS THAN SHOWN.
6. SEAL TEMPERATURE IS MEASURED AT PLATE TO ANODE INSULATOR FLANGE (SEE 'V' ON OUTLINE DWG.)

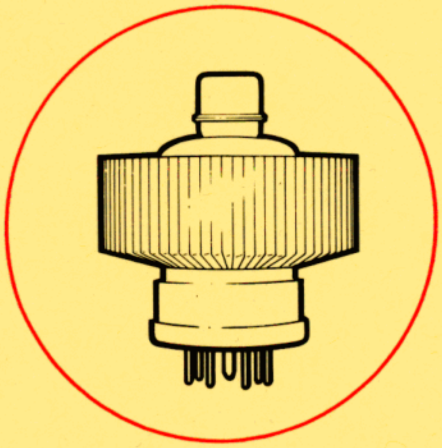


DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
C	0.500	0.600	- -	12.70	15.24	- -
G	0.635	0.660	- -	16.13	16.76	- -
H	0.760	0.795	- -	19.30	20.19	- -
J	0.905	0.960	- -	22.99	24.38	- -
K	- -	1.095	- -	- -	27.81	- -
L	1.180	1.260	- -	29.97	32.00	- -
M	0.300	0.375	- -	7.62	9.52	- -
P	0.940	0.965	- -	23.88	24.51	- -
R	0.090	0.110	- -	2.29	2.79	- -
S	1.065	1.085	- -	27.05	27.56	- -
T	1.345	1.365	- -	34.16	34.67	- -
V	- -	0.035	- -	- -	0.89	- -
W	- -	- -	0.190	- -	- -	4.83
X	0.760	0.815	- -	19.30	20.70	- -
AA	(see note 2,3)		0.710	- -	- -	18.03
AB	(see note 2,3)		1.000	- -	- -	25.40

DIMENSIONAL DATA

NOTES:

1. Ref. Dims .are for info only & are not req'd for inspection purposes.
2. Contact Surface Dims. AA & AB are for cavity design purposes only & are not intended as inspection criteria
3. Contact Surfaces are ± .030 around dim. indicated.
4. TIR of Contact Surfaces are specified in individual Tube Electrical Specs.



triodes

EIMAC division of Varian

Main office: 301 Industrial Way, San Carlos, CA 94070

Look in the general section for–
A quick guide to EIMAC products and services offered in this catalog.

Including . . .

- Your nearest distributor of modern, fully guaranteed EIMAC electron tubes and accessories.
- Your nearest Varian/EIMAC Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or to provide other information not found in this catalog.
- EIMAC tube type numbering system.
- EIMAC/JEDEC cross-reference list.

Important EIMAC extras...

APPLICATION ENGINEERING. The EIMAC Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proven by EIMAC engineers, whose combined knowledge and experience are at your service. EIMAC Application Bulletins covering various uses of EIMAC products are available upon request.

FIELD ENGINEERING. Serving as an extension of the Varian/EIMAC Application Engineering Department outside the EIMAC Division plant, the Field Engineers cover the United States, and numerous foreign countries, operating out of offices in major cities. They will help you personally with experimental work, circuits, technique, etc. Engineers from the EIMAC plant are available, too, for field consultation. As EIMAC tubes are world renowned, the same services extend to countries overseas through the Varian/EIMAC export operations and overseas offices.

TECHNICAL DATA

8163
3-400Z

HIGH-MU
POWER TRIODE

The EIMAC 8163/3-400Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8163/3-400Z in a cathode-driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0	V
Current	14.1	A
Amplification Factor (Average)	200	

Interelectrode Capacitances (Average),[2] Grounded-Grid Connection:

Cin	7.1	pF
Cout	4.1	pF
Cpk	0.1	pF
Frequency for Maximum Ratings	110	MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	5 Pin Special
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-All Dimensions:	
Height	5.375 In; 136.5 mm
Diameter	3.562 In; 90.47 mm
Net Weight (approximate)	7 Oz; 198 gm

RADIO FREQUENCY LINEAR AMPLIFIER GROUNDED-GRID, Class B

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Single-Tone Conditions)

Plate Voltage	3000	Vdc
Zero Sig. Plate Current[1]	100	mAdc
Max. Sig. Plate Current	333	mAdc
Max. Sig. Grid Current [1]	120	mAdc
Driving Impedance	122	Ω
Resonant Load Impedance	4750	Ω
Max. Sig. Driving Power [1]	32	W
Peak Envelope Plate Output Power	655	W

TYPICAL OPERATION (Minimum Distortion Products)

Plate Voltage	2000	Vdc
Zero Sig. Plate Current[1]	62	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current [1]	148	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current[1]	87	mAdc
Driving Impedance	112	Ω
Resonant Load Impedance	2750	Ω
Max. Sig. Driving Power[1]	45	W
Peak Envelope Useful Output Power[1]	445	W
Intermodulation Distortion Products[2]	-40	dB

TYPICAL OPERATION (Minimum Distortion Products at 1 kW PEP Input)

Plate Voltage	2500	Vdc
Zero Sig. Plate Current[1]	73	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current [1]	142	mAdc
Two Tone Plate Current	274	mAdc
Two Tone Grid Current[1]	82	mAdc
Driving Impedance	114	Ω
Resonant Load Impedance	3450	Ω
Peak Envelope Useful Output Power [1]	560	W
Max. Sig. Driving Power [1]	44	W
Intermodulation Distortion Products [2]	-35	dB

TYPICAL OPERATION (Minimum Distortion Products with E_b = 1500 Vdc)

Plate Voltage	1500	Vdc
Zero Sig. Plate Current[1]	46	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current [1]	163	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current [1]	92	mAdc
Driving Impedance	109	Ω
Resonant Load Impedance	1620	Ω
Peak Envelope Useful Output Power [1]	300	W
Max. Sig. Driving Power[1]	46	W
Intermodulation Distortion Products[2]	-37	dB

1. Approximate value.

2. Approximate value; referenced against one tone of a two equal-tone signal.

AUDIO FREQUENCY AMPLIFIER OR MODULATOR
Class B

MAXIMUM RATINGS (PER TUBE):

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

TYPICAL OPERATION (Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero Sig. Plate Current[1]	200	mAdc
Max. Sig. Plate Current	666	mAdc
Max. Sig. Grid Current[1]	240	mAdc
Driving Power[1]	26	W
Peak af Driving Voltage(per tube)[1]	88	v
Load Resistance, Plate/Plate	9500	Ω
Max. Sig. Plate Output Power [1]	1310	W

RADIO FREQUENCY AMPLIFIER OR OSCILLATOR
Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000	Vdc
Plate Current	333	mAdc
Grid Voltage	-75	Vdc
Grid Current [1]	130	mAdc
Peak rf Grid Voltage[1]	187	v
Grid Driving Power[1]	25	W
Plate Output Power[1]	730	W

RADIO FREQUENCY AMPLIFIER[1]
Plate Modulated, Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION	270	WATTS
GRID DISSIPATION	20	WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000	Vdc
Plate Current	245	mAdc
Grid Voltage	-90	Vdc
Grid Current[2]	100	mAdc
Peak rf Grid Voltage[2]	185	v
Grid Driving Power[2]	18	W
Plate Output Power[2]	550	W

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Max.	
Filament Current, at 5.0 volts	13.5	14.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	80	115	mAdc
Cut-Off Voltage (E_b = 3000 Vdc, I_b = 1.0 mAdc)	---	-25	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	6.0	9.0	pF
Cout	---	0.15	pF
Cgp	3.4	4.8	pF
Interelectrode Capacitance (Grounded Grid Connection)[1]			
Cin	6.0	9.0	pF
Cout	3.4	4.8	pF
Cpk	---	0.15	pF

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

APPLICATION

MOUNTING - The 3-400Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit, and the tube should be protected from severe vibration and shock.

The EIMAC SK-410 Air-System Socket is especially recommended for mounting, as the contacting clips are made with considerable flexibility in order to avoid applying undue lateral pressure on the tube pins, to avoid the possibility of damage to the base of the tube. The tube should always be inserted or removed from the socket with a straight-in or straight-out motion, and "rocking" the tube in or out of the socket should be avoided.

If a socket other than the EIMAC SK-410 is used, it should be ascertained that the contacts are flexible enough so they do not apply any significant lateral force against the tube base pins, as installed or during insertion or removal, to avoid the possibility of catastrophic damage to the glass tube base.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an air temperature of 55°C. At higher inlet air temperatures, higher altitudes, or at frequencies above 30 MHz,the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

FILAMENT OPERATION - The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

INTERMODULATION DISTORTION - Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

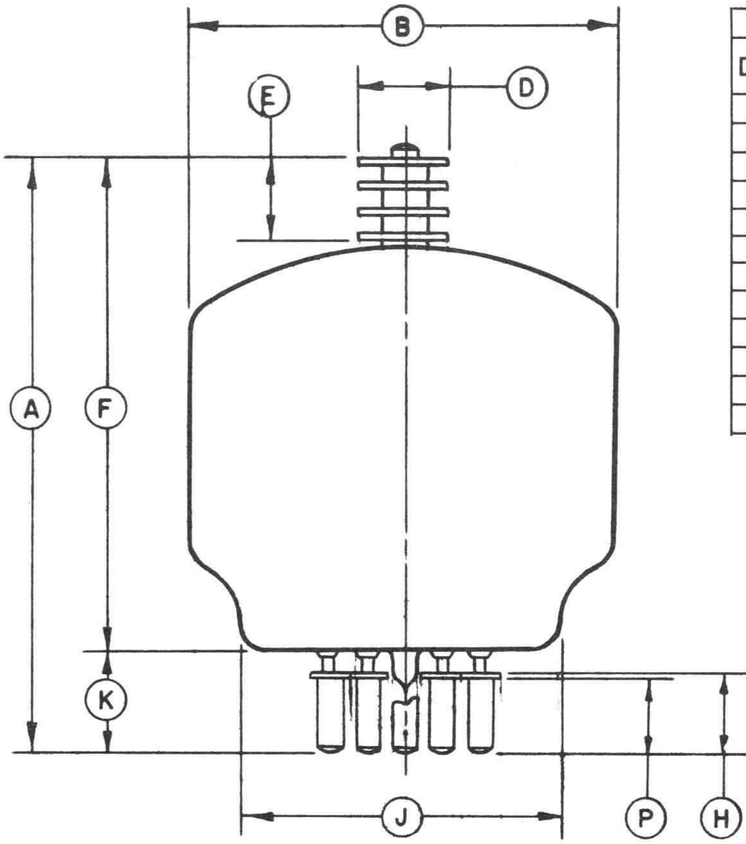
INPUT CIRCUIT - When the 3-400Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a ''Q'' of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 8163/3-400Z 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 APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

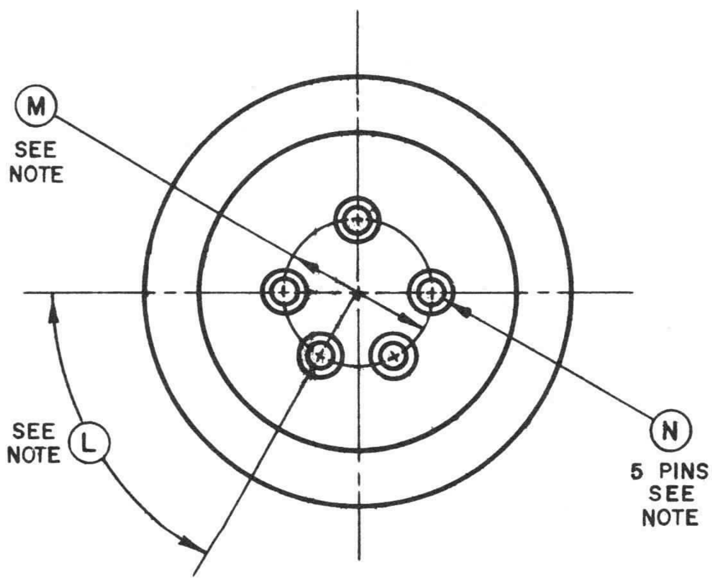


DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.875	5.375	- -	123.8	136.5	- -
B	- -	3.562	- -	- -	90.47	- -
D	0.740	0.760	- -	18.80	19.30	- -
E	0.635	0.665	- -	16.13	16.89	- -
F	3.937	4.437	- -	100.0	112.7	- -
H	0.688	0.813	- -	17.47	20.65	- -
J	- -	2.500	- -	- -	63.50	- -
K	- -	- -	0.937	- -	- -	23.80
L	- -	- -	60°	- -	- -	60°
M	- -	- -	1.250	- -	- -	31.75
N	0.185	0.191	- -	4.70	4.85	- -
P	0.625	0.750	- -	15.87	19.05	- -

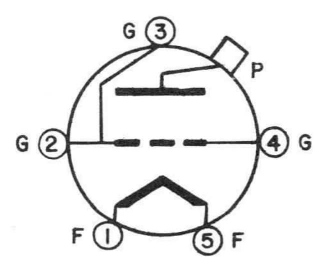
NOTES:

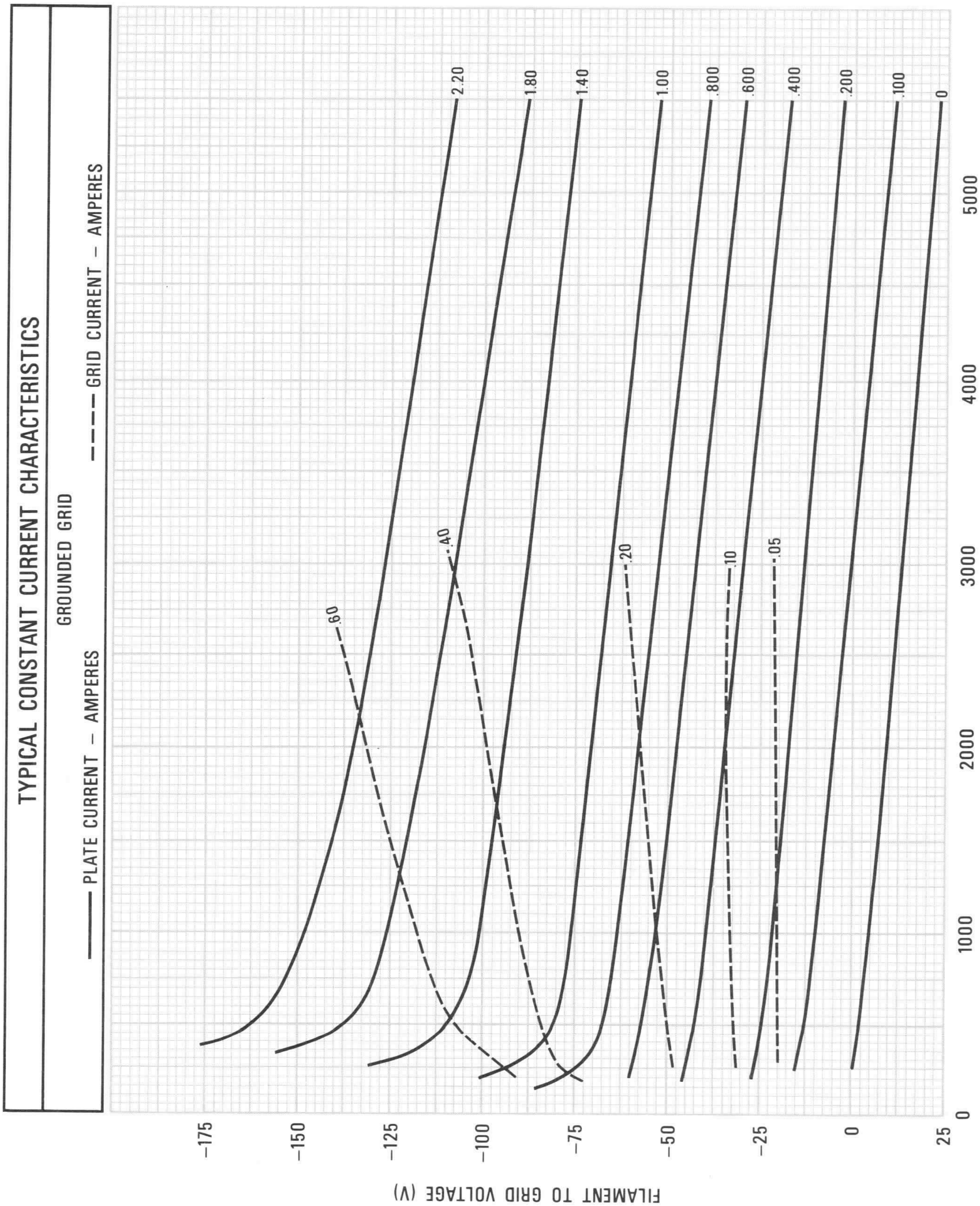
1. BASE PINS N ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THICK WITH HOLE DIAMETERS OF 0.204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS L & M.

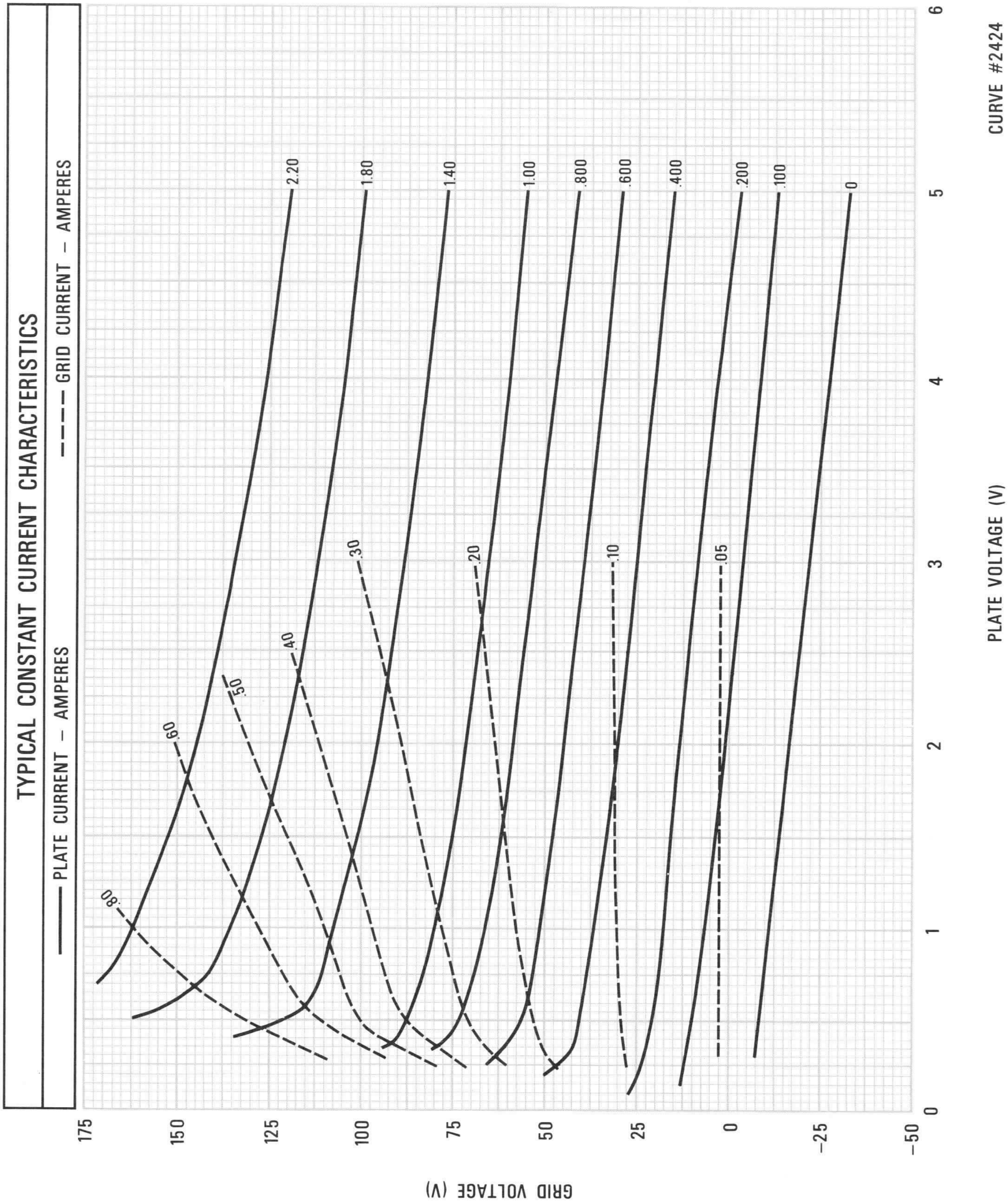
2. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.



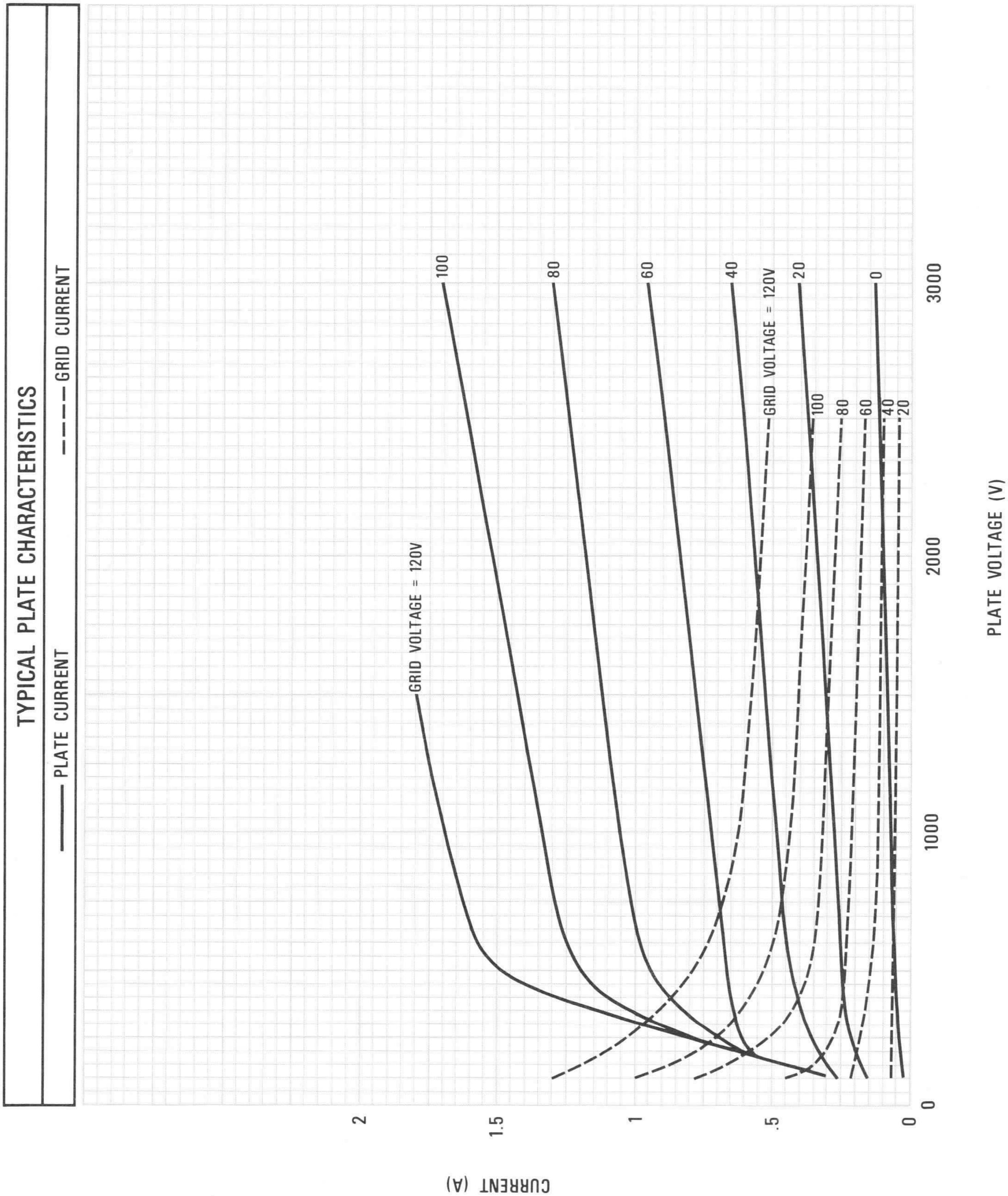
BOTTOM VIEW




TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0
.60
.40
.20
.10
.05
PLATE TO GRID VOLTAGE (V)
0
1000
2000
3000
4000
5000
FILAMENT TO GRID VOLTAGE (V)
-175
-150
-125
-100
-75
-50
-25
0
25



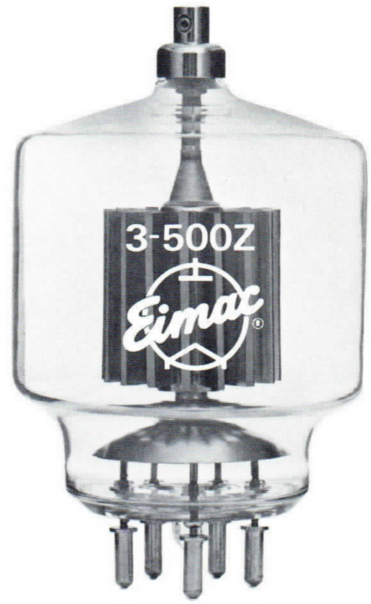
TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0
.80
.60
.50
.40
.30
.20
.10
.05
GRID VOLTAGE (V)
175
150
125
100
75
50
25
0
-25
-50
PLATE VOLTAGE (V)
0
1
2
3
4
5
6
CURVE #2424


TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 120V
100
80
60
40
20
0
GRID VOLTAGE = 120V
100
80
60
40
20
PLATE VOLTAGE (V)
0
1000
2000
3000
CURRENT (A)
0
.5
1
1.5
2

3-500Z

TECHNICAL DATA

HIGH-MU POWER TRIODE



The EIMAC 3-500Z is a compact power triode intended to be used as a zero-bias Class-AB2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3-500Z in a cathode-driven circuit.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.2 A
Amplification Factor (Average)	130
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	8.3 pF
Output	0.07 pF
Feedback	4.7 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Input	8.3 pF
Output	4.7 pF
Feedback	0.07 pF
Frequency of Maximum Rating:	
CW	110 MHz

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. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.00 in; 152.40 mm
Diameter	3.44 in; 87.33 mm
Net Weight	7.0 oz; 198.5 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	5 Pin Special

 Printed in U.S.A.

Recommended Socket . . . . EIMAC SK-410
Recommended Chimney . . . . EIMAC SK-406
Recommended Heat-Dissipating Connector:
Plate HR-6

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[3/4]	400	400	400	400	400	mAdc
Two-Tone Plate Current	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	Ω
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	---	---	---	-46	-45	db

1. Zener diode positive bias used at plate potentials of 3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of circuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two equal tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR GRID DRIVEN, CATHODE DRIVEN

Class AB_2 and C Telegraphy or FM
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	0	-75	0	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	---	187	215	215	v
Measured Driving Power	30	22	87	98	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	250	305	W
Useful Output Power	720	850	750	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	330	WATTS
GRID DISSIPATION[2]	20	WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	3000	Vdc
Grid Voltage	-100	Vdc
Plate Current	275	mAdc
Grid Current[1]	120	mAdc
Peak rf Grid Voltage[1]	200	v
Calculated Driving Power	25	W
Plate Input Power	825	W
Plate Dissipation	185	W
Plate Output Power	640	W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_2, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE[1]	4000	VOLTS
DC PLATE CURRENT	0.4	AMPERE
PLATE DISSIPATION	500	WATTS
GRID DISSIPATION	20	WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per Tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[2]	300	mAdc
Max. Signal Plate Current	770	mAdc
Max. Signal Grid Current[2]	244	mAdc
Peak af Grid Voltage[3]	100	v
Peak Driving Power[4]	25	w
Plate Input Power	2310	W
Max. Signal Plate Dissipation	890	W
Plate Output Power	1420	W
Load Resistance (plate to plate)	8600	Ω

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurment. 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 at 5.0 volts	13.5	14.7	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	6.5	10.0	pF
Output	---	0.18	pF
Feedback	4.2	5.2	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	6.5	10.0	pF
Output	4.2	5.2	pF
Feedback	---	0.18	pF
Zero Signal Plate Current:			
(E_c = 0Vdc, E_b = 2500 Vdc)	90	180	mAdc

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 3-500Z must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

SOCKET - The EIMAC SK-410 air system socket and SK-406 chimney are recommended for use with the 3-500Z. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the EIMAC SK-410 is employed, the user must assure himself that lateral pressure is not applied to the tube pins and base seal. Otherwise damage to the tube may result.

CAUTION-GLASS IMPLOSION - The EIMAC 3-500Z is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. Air-flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches-WC)
300	6.6	.023
400	10.3	.052
500	13.0	.082

The anode of the 3-500Z operates at a visibly red color at its maximum rated dissipation of 500 watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500Z tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3-inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon. Suitable products are manufactured by the Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate voltages over 3000 since plate dissipation may be exceeded. A zener diode placing positive bias on the cathode or other constant voltage source may be used to reduce zero signal plate current at plate potentials over 2500 volts.

CLASS-C OPERATION - Although specifically designed for linear amplifier service, the 3-500Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-500Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-resistor bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 3-500Z is 5.0 volts. Filament voltage, as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

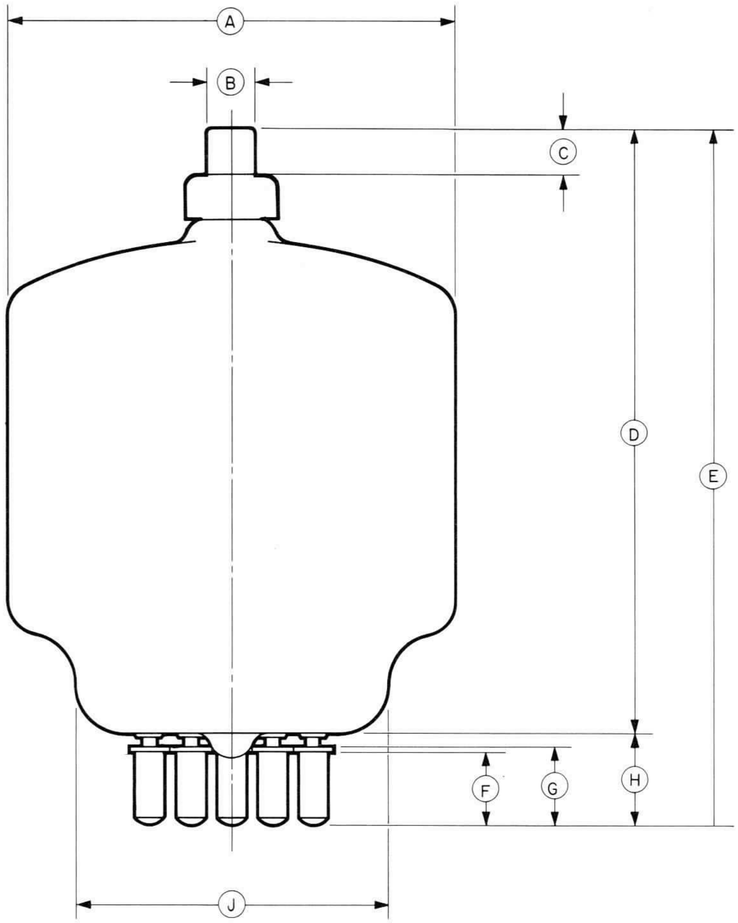
CAUTION-HIGH VOLTAGE - Operating voltage for the 3-500Z can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the 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.

INTERMODULATION DISTORTION - Typical operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted.

INPUT CIRCUIT - When the 3-500Z 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 two or more.

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

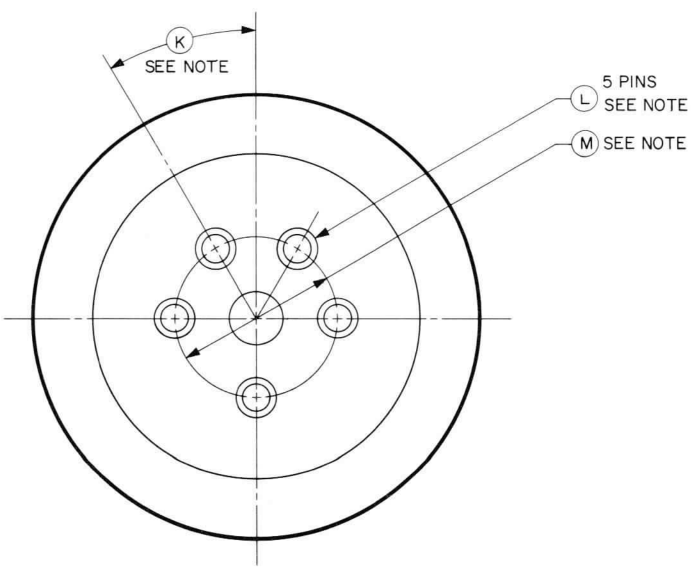
3-500Z OUTLINE DRAWING AND PIN CONNECTIONS

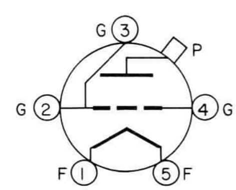


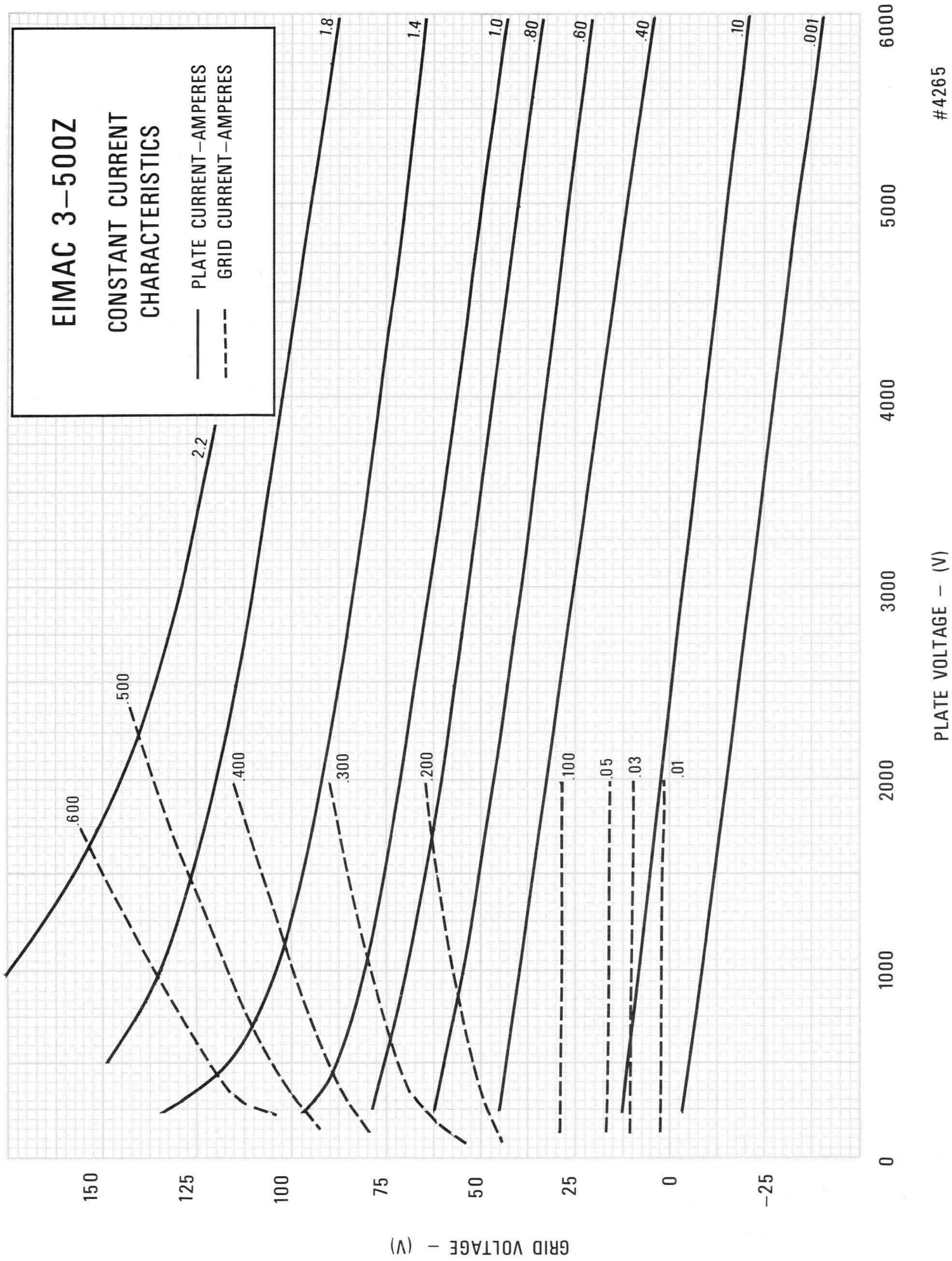
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	3.438	- -	- -	87.33	- -
B	0.350	0.365	- -	8.87	9.27	- -
C	0.328	0.359	- -	8.33	9.12	- -
D	- -	- -	4.844	- -	- -	123.04
E	5.500	6.000	- -	139.70	152.40	- -
F	0.625	0.750	- -	15.87	19.05	- -
G	0.688	0.812	- -	17.48	20.62	- -
H	- -	- -	0.906	- -	- -	23.01
J	- -	2.500D	- -	- -	63.50	- -
K	- -	- -	30°TYP.	- -	- -	30°TYP.
L	0.185D	0.191D	- -	4.70	4.85	- -
M	- -	- -	1.250D	- -	- -	31.75D

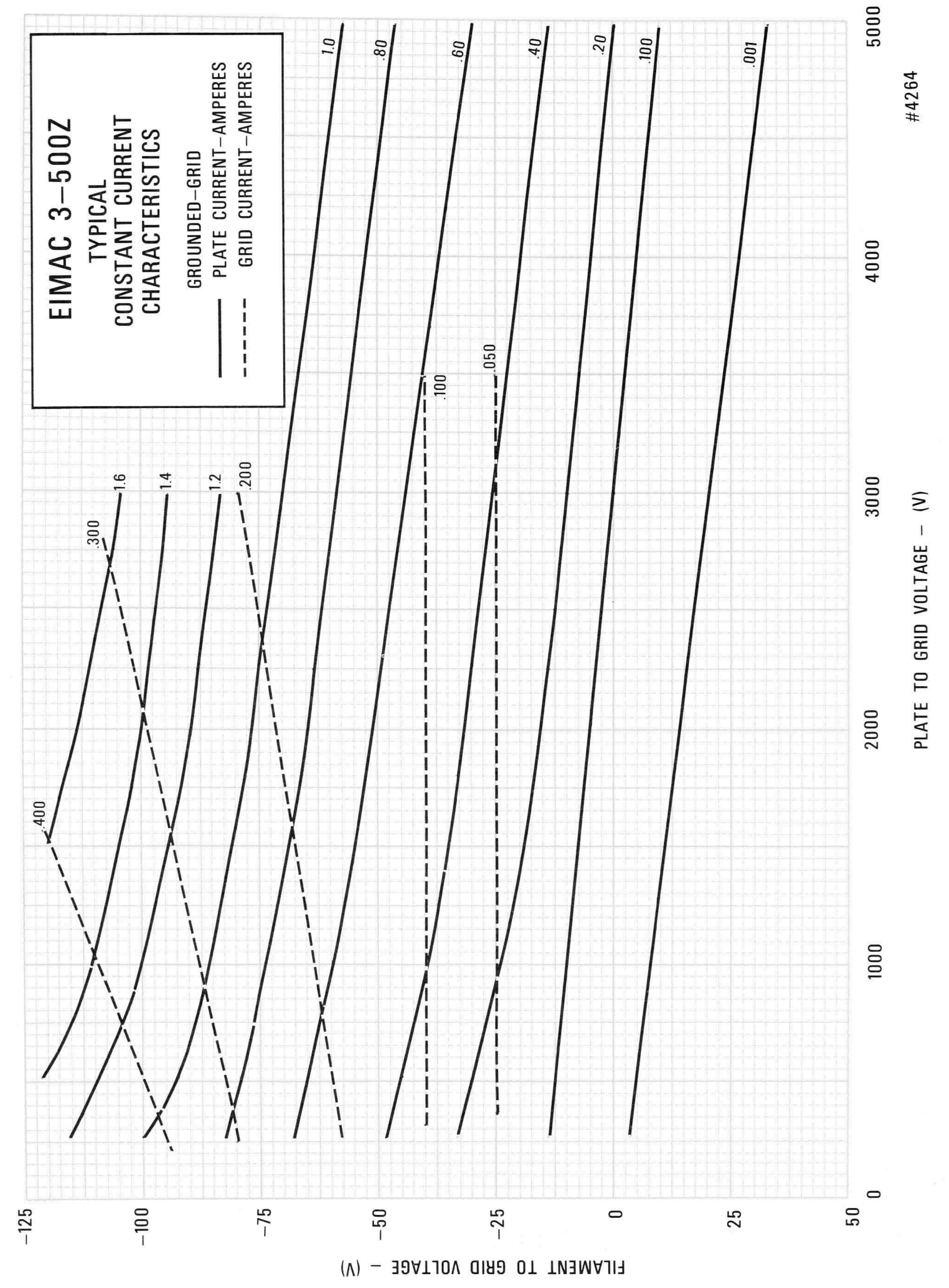
NOTE

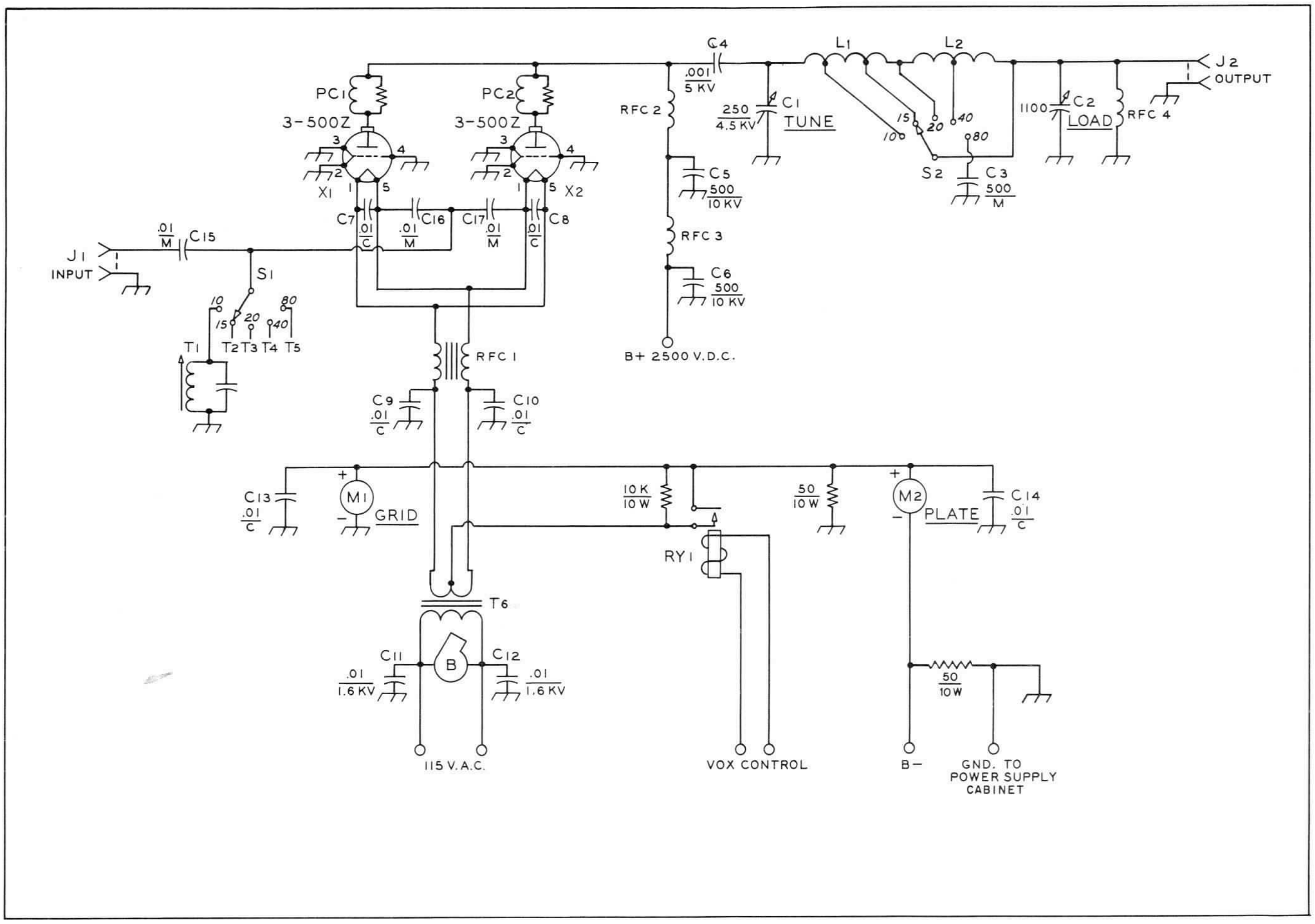
BASE PINS (L)
THEY CAN BE FREELY INSERTED INTO A GAUGE ¼" THICK WITH HOLE DIA'S OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMENSIONS (K) & (M).






EIMAC 3–500Z
CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
PLATE VOLTAGE – (V)
GRID VOLTAGE – (V)
#4265


EIMAC 3–500Z
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
1.0
.80
.60
.40
.20
.100
.001
1.6
1.4
1.2
.300
.400
.200
.100
.050
PLATE TO GRID VOLTAGE – (V)
FILAMENT TO GRID VOLTAGE – (V)
0
1000
2000
3000
4000
5000
–125
–100
–75
–50
–25
0
25
50
#4264



TYPICAL CATHODE DRIVEN (GROUNDED GRID) AMPLIFIER CIRCUIT FOR TWO 3-500Z TUBES

C-1--250 pF, 4.5 kV (Johnson 154-16).

C-2--1100 pF, 3 section. Jackson Bros. LE-3-4595-380. (M. Swedgal, 258 Broadway, N.Y. 10007).

C-3--500 pF, 2.5 kV mica. Sangamo H-5347.

C-4--.001 μF, 5 kV. Centralab 858S-1000.

C-5, C-6--500 pF, 10 kV, TV "door knob" capacitor.

C-7 thru C-10--.01 μF, 600V ceramic capacitor (Centralab DD-103).

C-11, C-12--.01 μF, 1.6 kV ceramic capacitor (Centralab DD16-103).

C-13, C-14--.01 pF, 600V ceramic capacitor (Centralab DD-103).

C-15 thru C-17--.01 μF, 1 kV mica capacitor (Sangamo H-2210).

M-1--500 mAdc.

M-2--1000 mAdc.

RFC-1--50 μH. 14 bifilar turns #10 AWG enamelled wire wound on ferrite core, 5 inches long, ½ inch diameter. (Indiana General CF-503. Newark Electronics Co. catalog number 59F-1521). Notch core with file and break to length.

RFC-2--100 μH, 1 Adc. 112 turns #26 AWG, spacewound wire diameter on 1" diam., 6" long ceramic form (Centralab X-3022H insulator). Series resonant with terminals shorted to 24.5 MHz.

RFC-3--1.7 μH, 1 Adc. 20 turns #26 AWG wound on 100K, 2W resistor (J.W. Miller RFC-144).

RY-1--VOX operated SPST relay. Energized when transmit.

PC-1, PC-2--Three 100 ohm, 2W carbon resistors in parallel. Three turns #14 AWG, ½" diam., ¾" long in parallel with resistors. (Equivalent: Ohmite P-300 reduced to 3 turns).

J-1, J-2--Coaxial receptacle. UG-58A/U, for type N connector.

T-6--5 v at 30 amp. Chicago-Stancor P-4648.

X-1, X-2--EIMAC SK-410 socket and EIMAC SK-406 chimney.

B-Blower--13 cubic feet at 0.2 inch back pressure. Use #3 impeller at 3100 rpm. (Ripley 8472, Dayton 1C-180 or Redmond AK-2H-01AX).

CATHODE CIRCUIT COMPONENTS:

T-1 (10 meters)--0.15 μH. 4 turns #14 AWG on ½-inch form, ½-inch long. Parallel capacitance: 200 pF, 1 kV silver mica capacitor. Resonant at 28.7 MHz.

T-2 (15 meters)--0.15 μH, same as T-1. Resonant at 21.3 MHz with 470 pF, 1 kV silver mica capacitor.

T-3 (20 meters)--0.31 μH. 6 turns #14 AWG on ½-inch form, ½-inch long, slug tuned (National XR-50). Resonant at 14.2 MHz with 470 pF, 1 kV silver mica capacitor.

T-4 (40 meters)--0.31 μH, same as T-3. Resonant at 7.2 MHz with 940 pF. (Two 470 pF, 1 kV silver mica capacitors in parallel).

T-5 (80 meters)--1.3 μH. 13 turns #18 AWG on ½-inch diameter form, ½-inch long, slug tuned (National XR-50). Resonant at 3.8 MHz with 940 pF, same as T-4.

PLATE CIRCUIT COMPONENTS (for plate potential of 2500 Vdc), $R_L = 1725\Omega$:

The 10, 15 and 20 meter inductor (L_1) may be 10½ turns #8 AWG copper wire (or 3/16" tubing) 2" diam., 3" long. Ten meter tap is 5¼ turns from plate end; 15 meter tap is 7¼ turns from plate end. The 40-80 meter coil (L_2) may be 16 turns #10 AWG, 2½" diam., 4" long. Forty meter tap is 8 turns from junction with coil L-1.

S-2--Single pole ceramic switch, high voltage, 30° index. Radio Switch Corp. Model 86-A.

NOTE: For additional data on plate circuit design, write for Amateur Service Bulletin #30, "Pi and Pi-L Networks for Linear Amplifier Service"

NOTE: B- of power supply is floating and grounded only through plate meter M_2 and the 50 ohm safety resistor. Cabinet of power supply should be grounded to amplifier cabinet as safety measure.

8164
3-1000Z

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 8164/3-1000Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8164/3-1000Z in a cathode driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	7.5 ± 0.37 V
Current	20 A
Amplification Factor (Average)	200

Interelectrode Capacitance (Grounded Cathode)[2]

Cin	17.0 pF
Cout	0.2 pF
Cgp	7.5 pF

Interelectrode Capacitance (Grounded Grid)[2]

Cin	17.0 pF
Cout	7.5 pF
Cpk	0.2 pF
Frequency of Maximum Rating (CW)	110 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	5-Pin Special
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-8
Recommended Air-System Socket	EIMAC SK-510
Recommended Air-System Chimney	EIMAC SK-516

Maximum Operating Temperatures:

Plate Seal	225°C
Base Seals	200°C

 Printed in U.S.A.

Maximum Overall Dimensions:

Height	7.875 In; 200.02 mm
Diameter	5.250 In; 133.35 mm
Net Weight	1.2 lb; 0.55 kg

RADIO FREQUENCY POWER AMPLIFIER
Class C, Grid Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	700	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

TYPICAL OPERATION

Plate Voltage	3000	4500	6000	Vdc
Grid Voltage	-30[1]	-75	-100	Vdc
Plate Current	700	700	700	mAdc
Grid Current [2]	230	240	250	mAdc
Peak RF Grid Voltage [2]	107	200	230	v
Grid Driving Power [2]	27	48	57	W
Output Power [2]	1300	2250	3200	W

1. Operating bias may be wholly derived from grid current flowing through 130 ohm, 25 watt resistor.
2. Approximate value.

PLATE MODULATED RF AMPLIFIER
Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4500	VOLTS
DC PLATE CURRENT	550	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	670	WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION [1]

Plate Voltage	4500	Vdc
Grid Voltage	-100	Vdc
Plate Current	500	mAdc
Grid Current [2]	170	mAdc
Drive Power [2]	35	W
Output Power (carrier) [2]	1765	W

RADIO-FREQUENCY LINEAR AMPLIFIER
Class B, Zero Bias, Cathode Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

1. Approximate value.
2. Referenced against one tone of a two-equal tone signal.

TYPICAL OPERATION

Plate Voltage	2500	3000	Vdc
Zero-Signal Plate Current [1]	162	240	mAdc
Max. Signal Plate Current	800	670	mAdc
Max. Signal Grid Current [1]	260	220	mAdc
Max. Signal Drive Power [1]	100	47	W
Plate Load Impedance	1760	2650	ohms
Nominal Cathode Impedance	65	67	ohms
Plate Output Power [1]	1050	1080	W
Intermodulation Distortion [2]			
Products: 3rd Order	-32	-29	dB
5th Order	-39	-37	dB

AUDIO FREQUENCY AMPLIFIER OR MODULATOR
Class B

MAXIMUM RATINGS (per tube):

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	50	WATTS

1. Approximate Value. Adjust to provide stated zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
(Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000	5000	Vdc
Grid Voltage [1]	0	-13	Vdc
Zero-Signal Plate Current	350	200	mAdc
Max. Signal Plate Current	1450	1000	mAdc
Max. Signal Grid Current [2]	485	310	mAdc
Driving Power [2]	48	28	W
Peak AF Driving Voltage [2]	100	90	v
Load Resistance Plate to Plate	3940	10,200	ohms
Max. Sig. Plate Output Power [2]	2540	3560	W

RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Max.	
Filament Current, at 7.5 volts	20.0	22.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	160	260	mAdc
Cut-Off Voltage (E_b = 3000 Vdc; I_b = 1.0 mAdc)	---	-24.0	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	15.0	19.0	pF
Cout	---	0.30	pF
Cgp	6.0	9.0	pF
Interelectrode Capacitance (Grounded Grid Connection)[1]			
Cin	15.0	19.0	pF
Cout	6.0	9.0	pF
Cpk	---	0.30	pF

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

APPLICATION

MOUNTING - The 3-1000Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the EIMAC HR-8 Heat Dissipating Connector on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock. The EIMAC SK-510 socket or equivalent must be employed to prevent excess lateral pressure on base pins and seal of the tube.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-510 Air-System Socket and SK-516 Chimney, a minimum air flow rate of 25 cubic feet per minute at a static pressure of approximately 0.43 inch of water, as measured at the socket at sea level, is required to provide adequate cooling at an inlet air temperature of 50°C. Above 30 megahertz the required air flow is increased to 35 cubic feet per minute at a static pressure of approximately 0.8 inch of water, as measured at the SK-510 socket. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-510 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate seal. In all cases air flow rates in excess of the minimum requirements will prolong tube life.

FILAMENT OPERATION - The rated filament voltage for the 3-1000Z is 7.5 volts. Filament voltage, as measured at the socket, must be maintained within the range of 7.13 to 7.87 volts to obtain maximum tube life. Operation at reduced voltage decreases emission capability, but increases life expectancy.

INTERMODULATION DISTORTION - Typical Operating Conditions and Intermodulation Distortion Product values are derived from measurements made at 2 MHz and are referred to one tone of a two-tone test signal. As the driving signal is reduced below full peak envelope power, distortion products remain at, or better than, the indicated value.

CLASS C OPERATION - Although designed for Class B service, the 3-1000Z may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristics can be used to advantage in Class C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

ZERO-BIAS OPERATION - Operating at zero-bias is not recommended with plate voltages over 3500 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias operation as mentioned above under "Class-C Operation" is not available at plate voltages above 3500 volts. Straight Class-C or Class-B operation is, of course, permissible up to 6000 volts where other ratings are not exceeded.

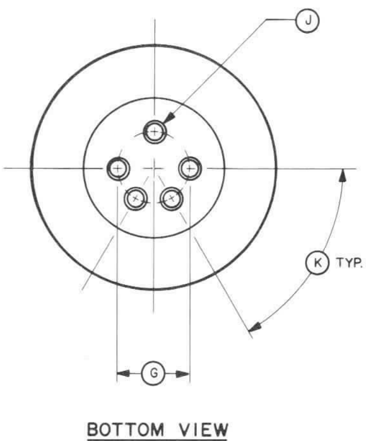
INPUT CIRCUIT - When the 3-1000Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 3-1000Z 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.

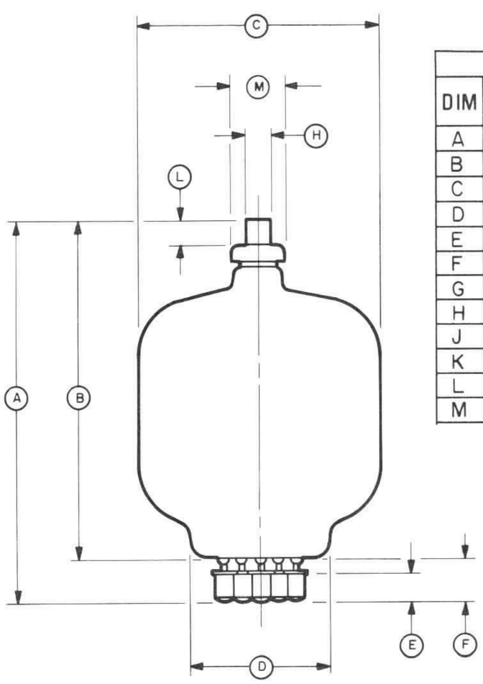
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual 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 APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

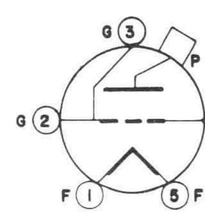


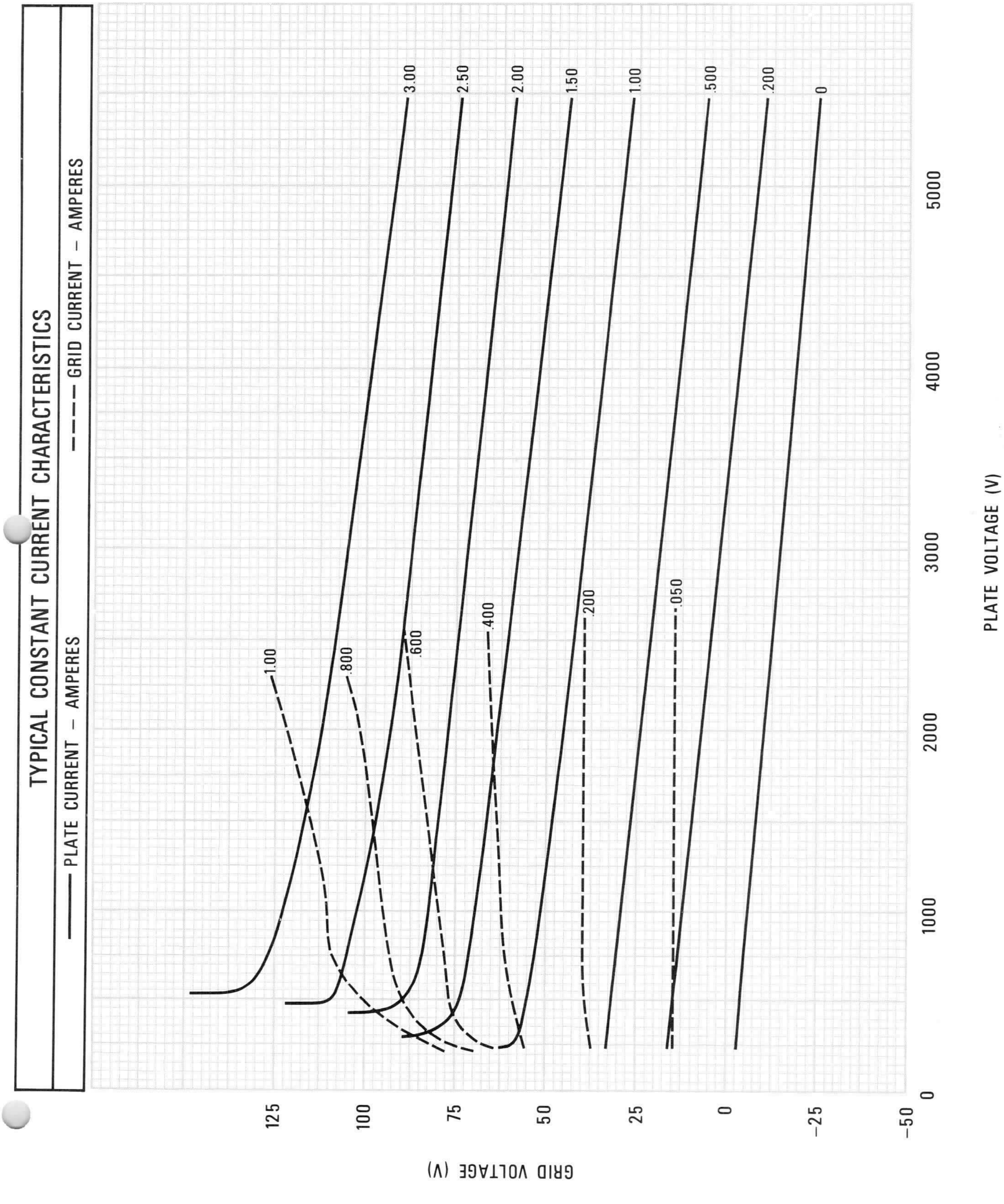
BOTTOM VIEW

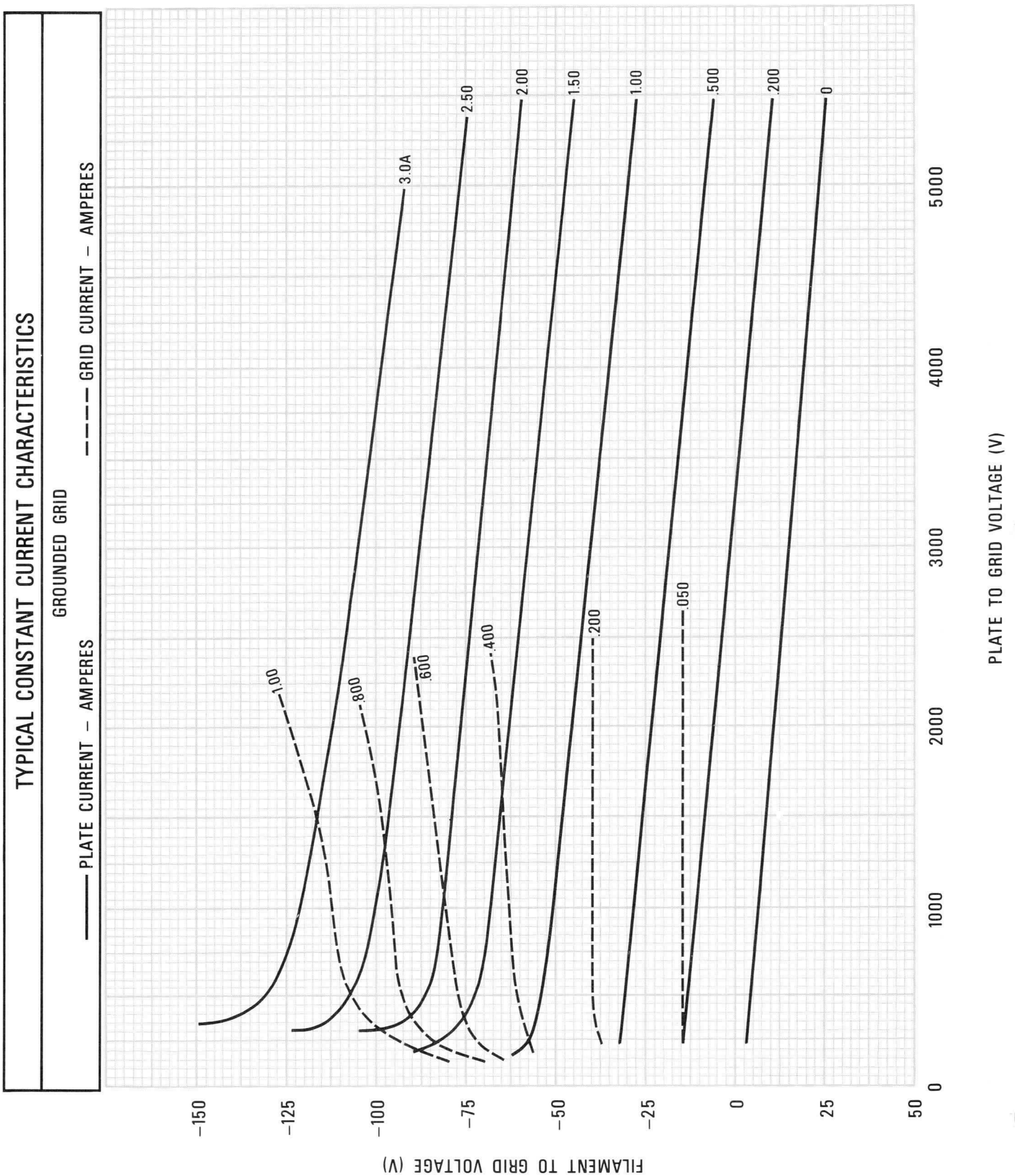


DIMENSIONAL DATA

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.500	7.875	- -	190.5	200.0	- -
B	6.812	7.187	- -	173.0	182.5	- -
C	- -	5.250	- -	- -	133.3	- -
D	3.062	3.187	- -	77.77	80.95	- -
E	0.531	0.656	- -	13.49	16.66	- -
F	0.718	0.843	- -	18.24	21.41	- -
G	- -	- -	1.500	- -	- -	38.10
H	0.559	0.573	- -	14.20	14.55	- -
J	0.371	0.377	- -	9.42	9.57	- -
K	- -	- -	60°	- -	- -	60°
L	0.484	- -	- -	12.29	- -	- -
M	- -	- -	1.125	- -	- -	28.57




TYPICAL CONSTANT CURRENT CHARACTERISTICS
—— PLATE CURRENT - AMPERES
- - - - GRID CURRENT - AMPERES
3.00
2.50
2.00
1.50
1.00
.500
.200
0
1.00
.800
.600
.400
.200
.050
PLATE VOLTAGE (V)
0
1000
2000
3000
4000
5000
GRID VOLTAGE (V)
125
100
75
50
25
0
-25
-50


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
3.0A
2.50
2.00
1.50
1.00
.500
.200
0
1.00
.800
.600
.400
.200
.050
PLATE TO GRID VOLTAGE (V)
0
1000
2000
3000
4000
5000
FILAMENT TO GRID VOLTAGE (V)
-150
-125
-100
-75
-50
-25
0
25
50

EIMAC

Division of Varian

SAN CARLOS

CALIFORNIA

3C24

MEDIUM-MU TRIODE

•

MODULATOR

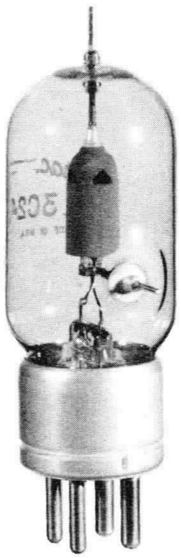
OSCILLATOR

AMPLIFIER

The Eimac 3C24 is a medium-mu, power triode intended for use as an amplifier, oscillator or modulator. It has a maximum plate dissipation rating of 25 watts and can be operated at its maximum ratings at frequencies up to 60 megacycles.

The 3C24 is cooled by radiation from the plate and by air circulation around the envelope. The plate operates at a visible red color at maximum rated dissipation.

This tube is identical to the 25T except that the grid terminal is located at the side of the envelope instead of the base.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten

Voltage	6.3 volts
Current	3.0 amperes
Amplification Factor (Average)	24
Direct Interelectrode Capacitances (Average)	
Grid-Plate	1.6 $\mu\mu$f
Grid-Filament	1.7 $\mu\mu$f
Plate-Filament	0.2 $\mu\mu$f
Transconductance (i_b=25 ma., E_b=1000 v.)	2500 μmhos
Frequency for Maximum Ratings	60 Mc.

MECHANICAL

Base	UX Small 4-pin
Basing - Fits E. F. Johnson Co. No. 122-224, National Co. No. XC-4 or CIR-4, or equivalent socket	
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connector:	
Plate	HR-1
Grid	HR-1
Maximum Over-all Dimensions:	
Length	4.38 inches
Diameter	1.44 inches
Net Weight	1.5 ounces
Shipping Weight (Average)	1.0 pound

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-B and AB

MAXIMUM RATINGS, PER TUBE

D-C PLATE VOLTAGE	2000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	75 MAX. MA.
PLATE DISSIPATION	25 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

TYPICAL OPERATION, CLASS AB_2

Sinusoidal wave, two tubes unless otherwise specified

D-C Plate Voltage	750	1000	1250	Volts
D-C Grid Voltage (approx.)*	—20	—30	—42	Volts
Zero-Signal D-C Plate Current	43	32	24	Ma.
Max-Signal D-C Plate Current	127	127	130	Ma.
Effective Load, Plate-to-Plate	12,000	17,000	21,400	Ohms
Peak A-F Grid Input Voltage (per tube)	110	120	135	Volts
Max-Signal Peak Driving Power	5.5	6.0	6.8	Watts
Max-Signal Nominal Driving Power (approx.)	2.8	3.0	3.4	Watts
Max-Signal Plate Power Output	60	85	112	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1600 MAX. VOLTS
D-C PLATE CURRENT	60 MAX. MA.
PLATE DISSIPATION	17 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1000	1250	1600	Volts
D-C Plate Current	60	60	53	Ma.
D-C Grid Voltage	—120	—140	—170	Volts
D-C Grid Current	14	13	11	Ma.
Peak R-F Grid Input Voltage	235	255	280	Volts
Driving Power	3.3	3.3	3.1	Watts
Grid Dissipation	1.6	1.5	1.2	Watts
Plate Power Input	60	75	85	Watts
Plate Dissipation	13	15	17	Watts
Plate Power Output	47	60	68	Watts

The above figures show actual measured tube performance and do not allow for variations in circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS

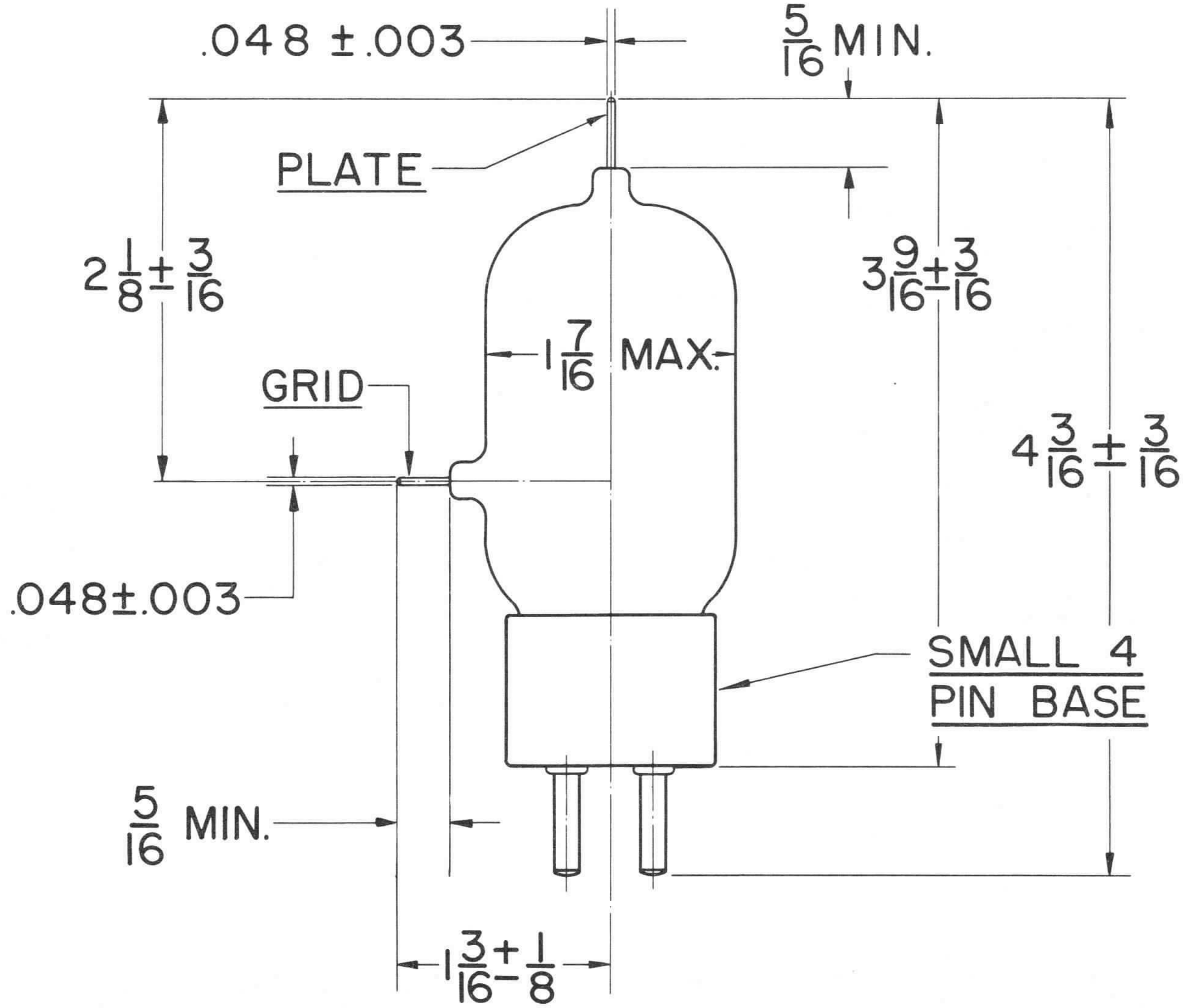
D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C PLATE CURRENT	75 MAX. MA.
PLATE DISSIPATION	25 MAX. WATTS
GRID DISSIPATION	7 MAX. WATTS

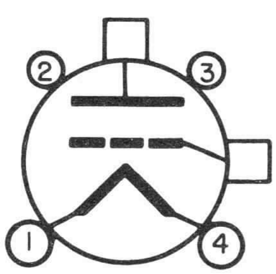
TYPICAL OPERATION

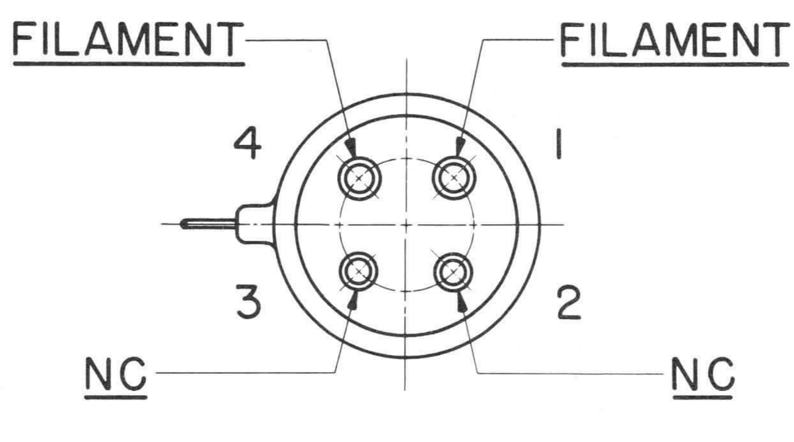
D-C Plate Voltage	1000	1500	2000	Volts
D-C Plate Current	72	67	63	Ma.
D-C Grid Voltage	—70	—95	—130	Volts
D-C Grid Current	9	13	18	Ma.
Peak R-F Grid Input Voltage	170	195	245	Volts
Driving Power	1.3	2.2	4.0	Watts
Grid Dissipation	.9	1.3	2.1	Watts
Plate Power Input	72	100	125	Watts
Plate Dissipation	25	25	25	Watts
Plate Power Output	47	75	100	Watts

The above figures show actual measured tube performance and do not allow for variations in circuit losses.

Printed in U.S.A.


.048 ±.003
5/16 MIN.
PLATE
2 1/8 ± 3/16
3 9/16 ± 3/16
1 7/16 MAX.
GRID
4 3/16 ± 3/16
.048±.003
SMALL 4 PIN BASE
5/16 MIN.
1 3/16 ± 1/8


2
3
1
4

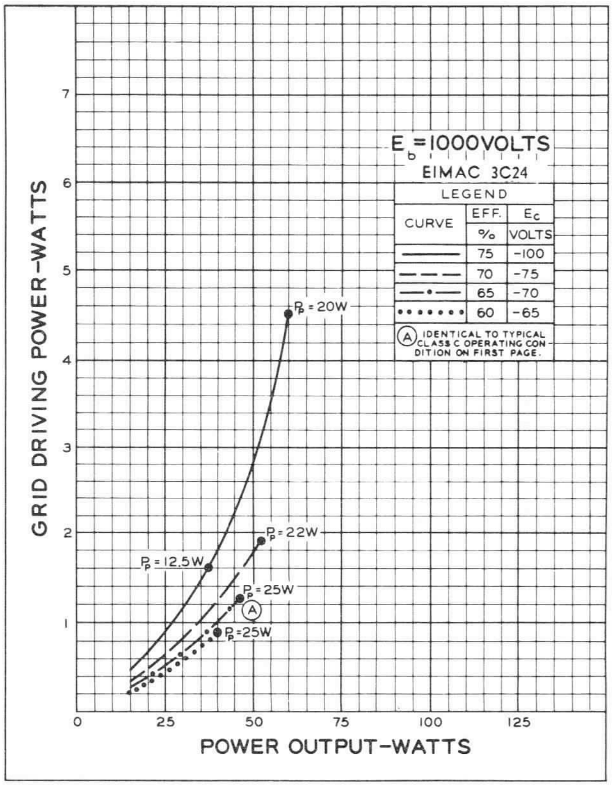

FILAMENT
FILAMENT
4
1
3
2
NC
NC

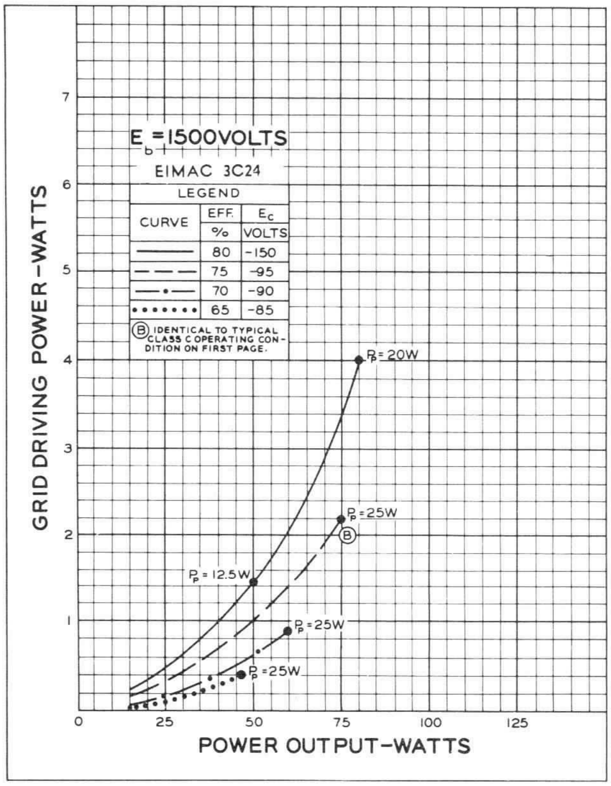
BOTTOM VIEW

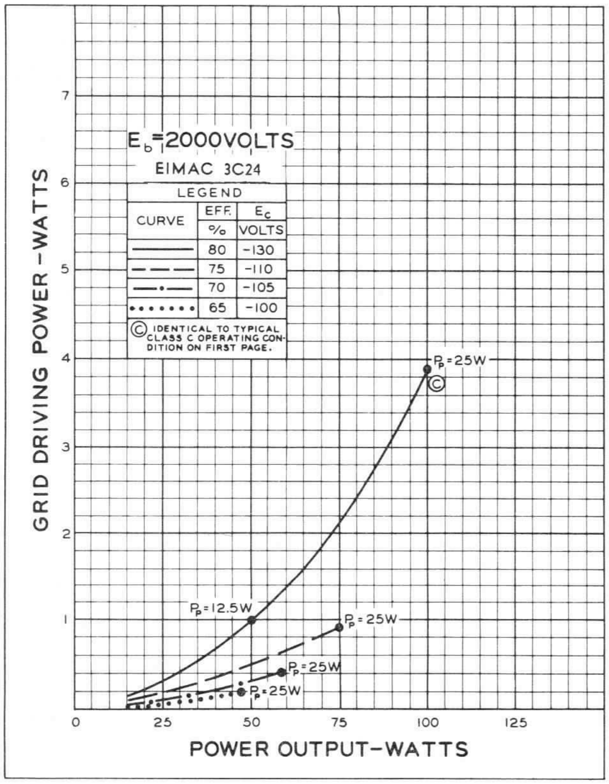
DRIVING POWER vs. POWER OUTPUT

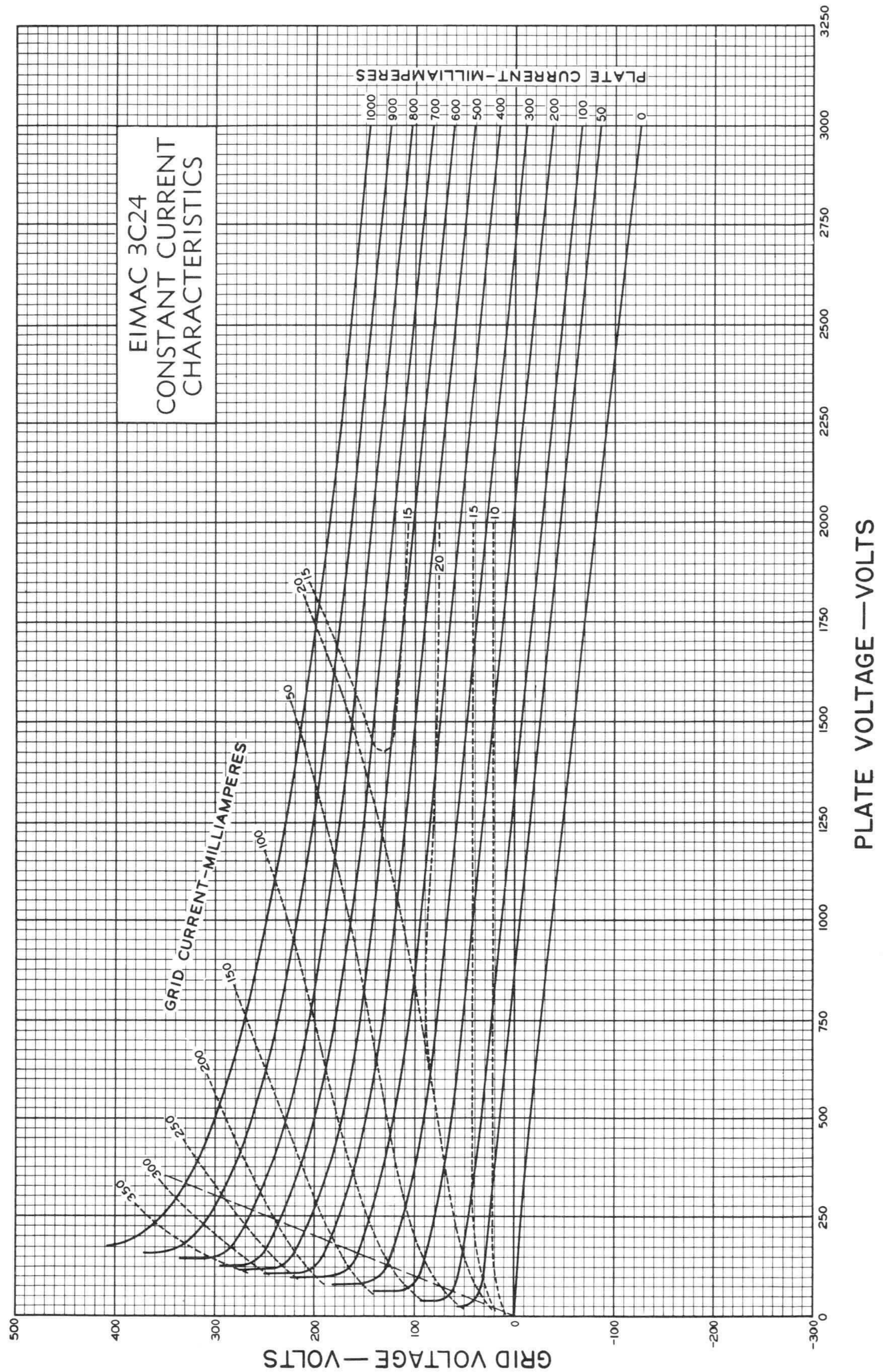
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.





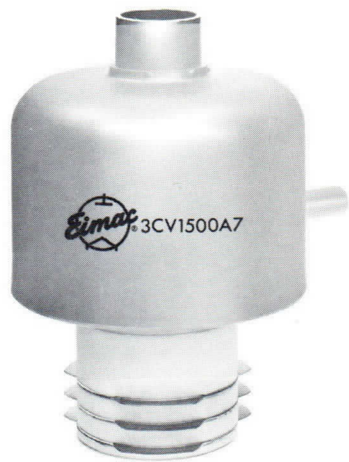



EIMAC 3C24
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT-MILLIAMPERES
1000
900
800
700
600
500
400
300
200
100
50
0
GRID CURRENT-MILLIAMPERES
350
300
250
200
150
100
50
20
15
10
PLATE VOLTAGE — VOLTS
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
GRID VOLTAGE — VOLTS
500
400
300
200
100
0
-100
-200
-300

3CV1500A7

TECHNICAL DATA

HIGH-MU POWER TRIODE



The 3CV1500A7 is an integral-boiler, ceramic/metal, vapor cooled zero-bias triode, intended for Class AB2 linear amplifier service in either grid driven or cathode driven configuration. Except for the anode dissipation rating, the 3CV1500A7 is electrically identical to the EIMAC 8283/3CX-1000A7.

The 3CV1500A7 is especially recommended when the ambient noise level must be reduced to a minimum, since high-pressure/high-volume forced-air cooling is not required.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten Mesh	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	30 A
Amplification Factor (average)	200
Direct Interelectrode Capacitances (grounded filament) [2]	
Cin	32.0 pF
Cout	0.15 pF
Cgp	14.0 pF
Direct Interelectrode Capacitances (grounded grid) [2]	
Cin	32.0 pF
Cout	14.0 pF
Cpk	0.15 pF
Frequency of Maximum Rating:	
CW	220 MHz

1. Characteristics and operating values are based upon 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.

2. Capacitance values are for a cold tube, as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	5.110 in; 129.8 mm
Diameter	3.355 in; 85.2 mm
Net Weight	2.38 lb; 1.08 kg
Operating Position	Vertical, base down
Maximum Operating Temperature:	
Ceramic/metal seals	250°C
Cooling	Vapor and Forced Air
Base	Special Breechlock
Recommended Socket	EIMAC SK-861

(Effective 6-15-71) Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	45	WATTS

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2 Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	2500	3500	Vdc
Grid Voltage[1]	0	0	-12	Vdc
Zero-Signal Plate Current	238	305	129	mAdc
Single Tone Plate Current	875	800	857	mAdc
Two-Tone Plate Current	600	585	590	mAdc
Single-Tone Grid Current[3]	230	205	225	mAdc
Two-Tone Grid Current[3]	130	120	120	mAdc
Peak rf Drive Voltage[3]	80	74	110	v
Peak Driving Power	80	60	100	w
Plate Dissipation	800	830	940	W
Useful Output Power	940	1170	2060	W
Resonant Load Impedance	1100	1670	2300	Ω
Intermodulation Distortion Products[2]				
3rd Order	-29	-31	-31	db
5th Order	-37	-40	-39	db

AUDIO FREQUENCY POWER AMPLIFIER OR
MODULATOR Class AB_2, Grid Driven(Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE[1]	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	45	WATTS

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per Tube.
4. Nominal drive power is one-half peak power.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	2000	2500	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current	400	500	mAdc
Max. Signal Plate Current	2.0	2.0	Adc
Max. Signal Grid Current[2]	590	480	mAdc
Peak af Grid Voltage[3]	95	90	v
Peak Driving Power[4]	25	44	w
Plate Input Power	4000	5000	W
Max. Signal Plate Dissipation	1650	1900	W
Plate Output Power	2350	3100	W
Load Resistance (plate to plate)	1900	2580	Ω

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.	
Heater: Current at 5.0 volts	28.0	33.0	A
Cathode Warmup Time	5	---	sec.
Interelectrode Capacitance[1] (grounded grid connection)			
Cin	29.0	35.0	pF
Cout	12.0	16.0	pF
Cpk	---	0.2	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CV1500A7 must be mounted with its axis vertical, base down, with sufficient clearance for an insulated makeup water line to connect to the side of the integral anode boiler and an outlet steam line to attach to the top of the boiler. The use of the EIMAC socket SK-861 is recommended.

COOLING - Cooling is accomplished by the presence of distilled water at a controlled level in the integral anode boiler. The energy dissipated by the anode causes the water to boil at the anode surface, to be converted into steam and carried away to a condenser. This boiling action keeps the anode surface at approximately 100°C.

The water in the boiler must be maintained at the correct level, as shown on the outline drawing for the tube. This is normally accomplished with a special control unit, mounted with the correct relationship to the tube so as to maintain the water level in the tube boiler at the specified level. A condenser unit is used to convert the steam back to water, which is then returned to reservoir/control-box/boiler system.

Forced-air cooling of the tube base is required, with 15 cfm minimum directed across and through the socket and base of the tube. Air flow should be applied simultaneously with the application of electrode voltages, including the filament, and may be removed simultaneously with the removal of filament voltage.

ELECTRICAL

FILAMENT - Rated filament voltage for the 3CV1500A7 is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 3CV1500A7 is operated as grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended 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.

CLASS-C OPERATION - Although designed for Class-AB2 service, the 3CV1500A7 may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

ZERO-BIAS OPERATION - Operating at zero-bias is not recommended with plate voltages over 2500 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias operation as mentioned above under "Class-C Operation" is not available at plate voltages above 2500 volts. Straight Class-C or Class-AB2 operation is, of course, permissible up to 3500 volts where other ratings are not exceeded. Higher plate voltage may be used with the proper bias.

PLATE DISSIPATION - The plate dissipation of 1500 watts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded during tuning for brief periods.

Since the tube anode is usually at high potential to ground, water and steam connections to the anode are made through insulating tubing. These insulating sections should be long enough so that column resistance is above 100,000 ohms per 1000 supply volts. It is essential that high purity water be used to minimize power loss and corrosion of metal fittings. Good distilled or deionized water will have a resistance of 1 to 2 megohms per cm3. Water should be discarded if resistivity falls to 50,000 ohms cm3.

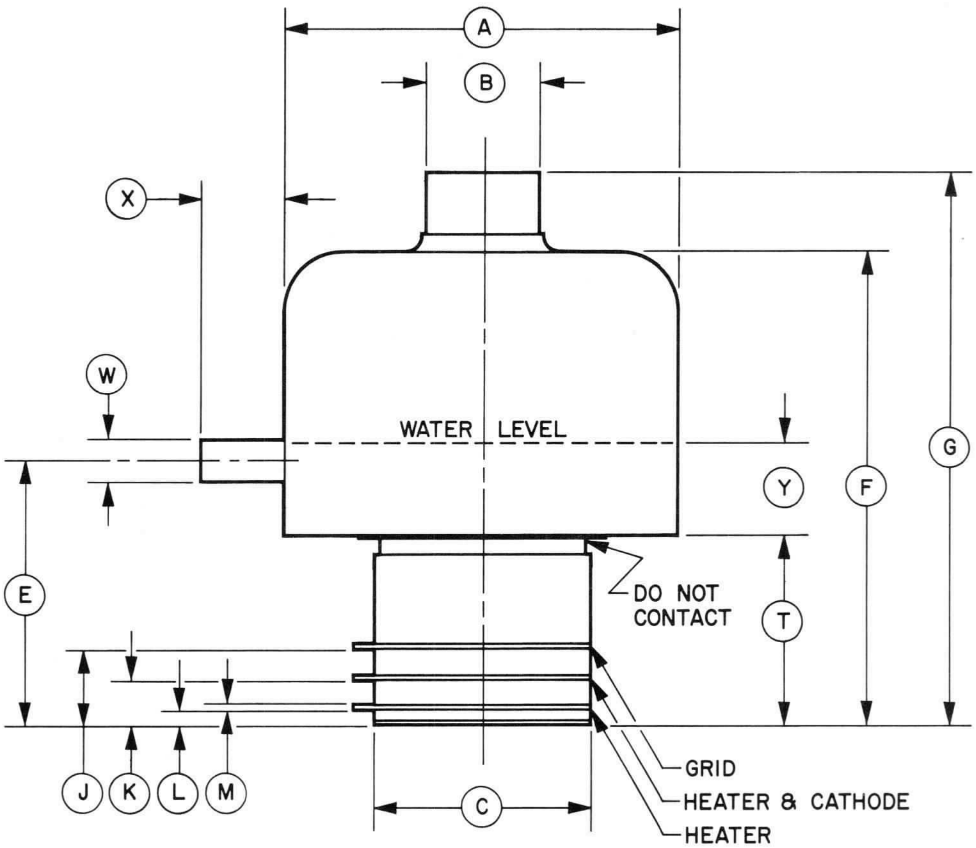
HIGH VOLTAGE - Normal operating voltages used with the 3CV1500A7 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage 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.

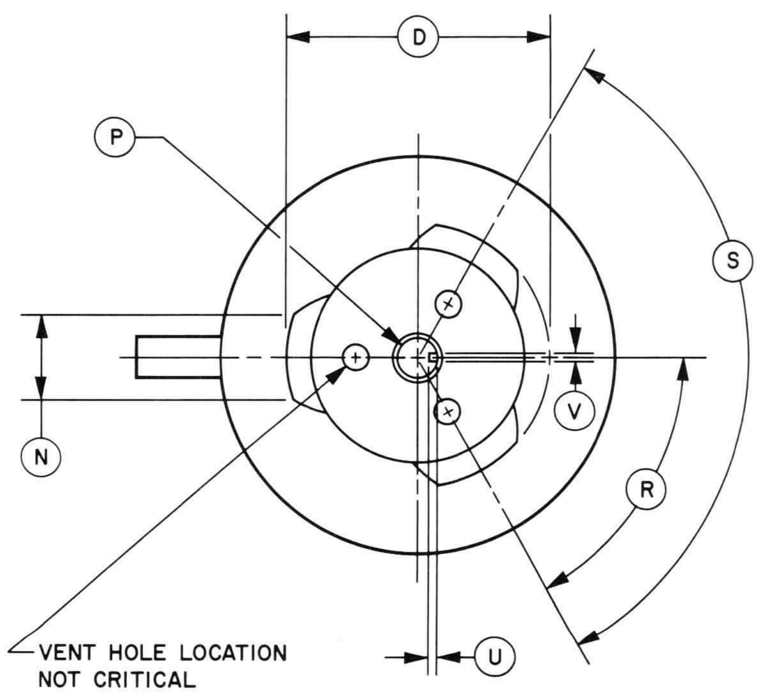
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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.

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.

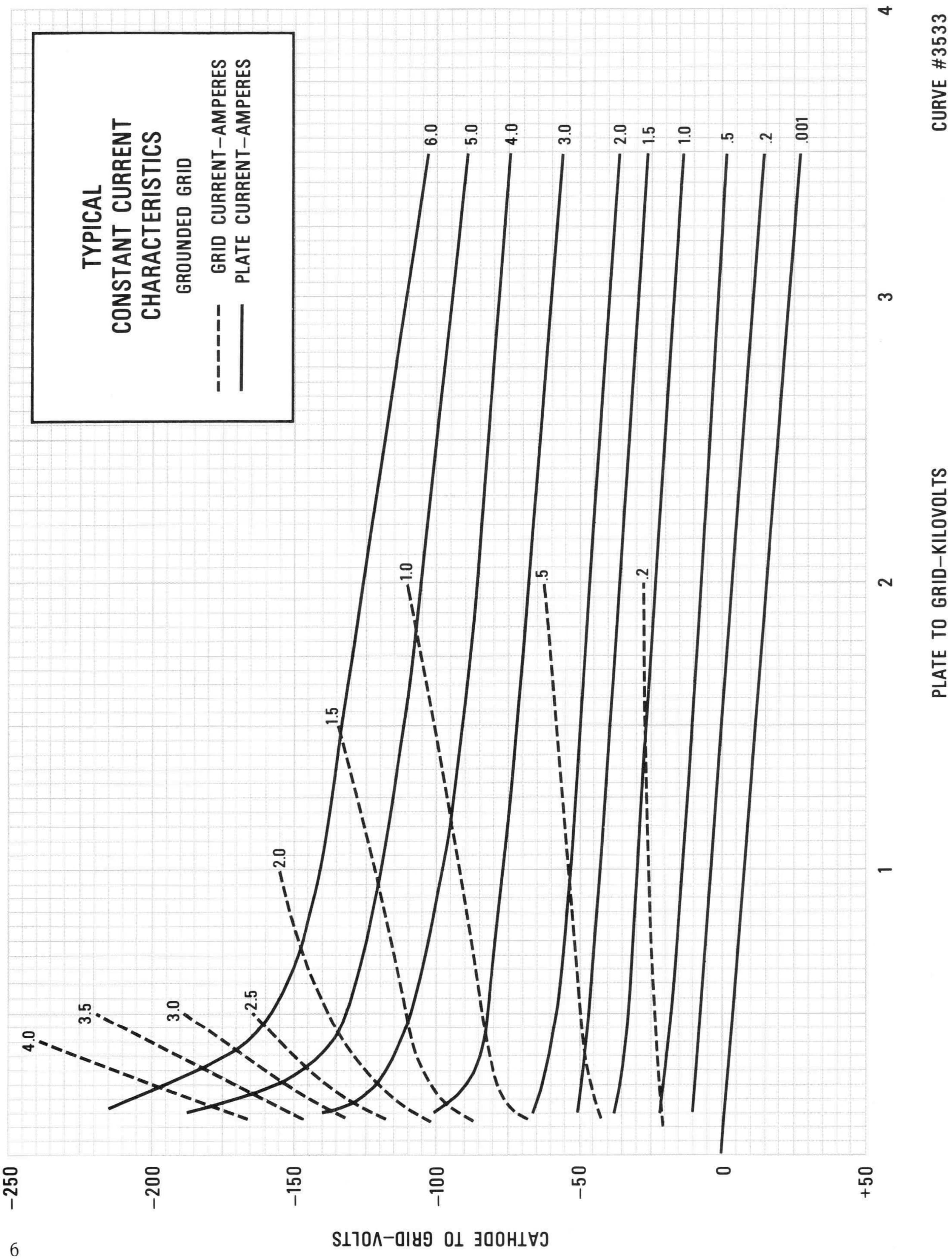
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.





DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	3.355	- -	- -	85.22
B	- -	- -	1.000	- -	- -	25.40
C	1.870	1.900	- -	47.50	48.26	- -
D	2.250	2.300	- -	57.15	58.42	- -
E	- -	- -	2.400	- -	- -	60.96
F	4.190	4.315	- -	106.43	109.60	- -
G	4.850	5.110	- -	123.19	129.79	- -
J	0.690	0.710	- -	17.53	18.03	- -
K	0.415	0.435	- -	10.54	11.05	- -
L	0.140	0.165	- -	3.57	4.19	- -
M	0.020	0.030	- -	0.50	0.76	- -
N	0.700	0.800	- -	17.78	20.32	- -
P	0.314	0.316	- -	7.98	8.03	- -
R	55°	65°	- -	55°	65°	- -
S	115°	125°	- -	115°	125°	- -
T	- -	- -	1.720	- -	- -	43.69
U	0.025	0.048	- -	0.64	1.22	- -
V	0.045	0.070	- -	1.14	1.78	- -
W	- -	- -	0.375	- -	- -	9.53
X	- -	- -	0.750	- -	- -	19.05
Y	0.500	1.000	- -	- -	- -	- -

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


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
GRID CURRENT–AMPERES
PLATE CURRENT–AMPERES
6.0
5.0
4.0
3.0
2.0
1.5
1.0
.5
.2
.001
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
.2
−250
−200
−150
−100
−50
0
+50
CATHODE TO GRID–VOLTS
1
2
3
4
PLATE TO GRID–KILOVOLTS
CURVE #3533

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

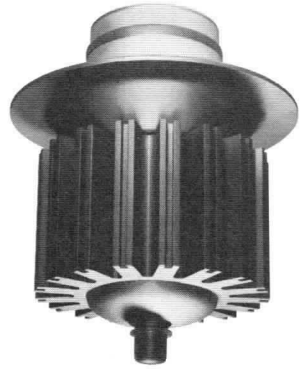
3CV30,000A3

MEDIUM-MU VAPOR-COOLED POWER TRIODE

The EIMAC 3CV30,000A3 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 of plate dissipation when mounted in an EIMAC BR-200 boiler.

Full input of 60 kilowatts is permissible up to 100 megahertz. Large reserve emission is available from its 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 a grounded grid FM amplifier, a conventional plate-modulated amplifier or as a linear amplifier in new equipment designs.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		6.3		volts
Current	152		172	amperes
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF

Frequency for Maximum Ratings - - - - - 100 MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1310
Recommended Boiler	EIMAC BR-200
Operating Position	Vertical, base up
Cooling	Vapor and Forced air
Maximum Operating Temperatures:	
Anode Flange	200°C
Ceramic-to-metal Seals	250°C
Maximum Dimensions:	
Height	8.75 inches
Diameter	7.5 inches
Net Weight	18 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION	30 KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Plate Current	6.0	6.0	amps
DC Grid Voltage	—600	—800	volts
DC Grid Current	.66	.315	amps
Peak Positive Grid Voltage	440	360	volts
Driving Power	660	365	watts
Plate Input Power	42	60	kW
Plate Dissipation	12	18	kW
Plate Output Power	30	42	kW
Approximate Load Impedance	600	750	ohms

RADIO-FREQUENCY POWER AMPLIFIER PLATE-MODULATED
Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	20	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	—600	—820	volts
DC Plate Current	5.0	5.0	amps
DC Grid Current	600	600	mA
Driving Power	600	750	watts
Plate Output Power	17.8	27.5	kW

RADIO-FREQUENCY LINEAR AMPLIFIER
Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
PLATE DISSIPATION	30	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Grid Voltage*	—250	—400	volts
Zero-Sig Plate Current	2.0	2.0	amps
Max-Sig DC Plate Current	6.0	6.0	amps
Max-Sig DC Grid Current	375	333	mA
Peak RF Grid Voltage	530	700	volts
Driving Power	200	240	watts
Plate Output Power	26.4	41	kW

*Adjust to give specified zero-signal dc plate current.

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament—The rated filament voltage for the 3CV30,000A3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation — The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and 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 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 10,000 volts and 6.0 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, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

Special Application—If it is desired to operate this tube under conditions widely different from these given here, write to Power Grid Tube Marketing Department, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

MECHANICAL

Mounting — The 3CV30,000A3 must be mounted vertically, base up in an EIMAC BR-200 boiler. It is very important that the boiler tube assembly be mounted vertically, the water be maintained at the suggested level, and that the flange of the tube makes a vapor-tight seal against the rubber "O" ring and boiler.

Sockets—The EIMAC SK-1310 socket is available for use with the 3CV30,000A3. Filament and grid connection are made to this socket.

Cooling — Cooling is accomplished by immersion of the anode in a distilled water-filled BR-200 boiler. The energy dissipated at the anode causes the water to boil and be converted into steam. Steam is carried away by convection to the condenser where it is cooled and condenses into water. Condensate is then returned to the boiler.

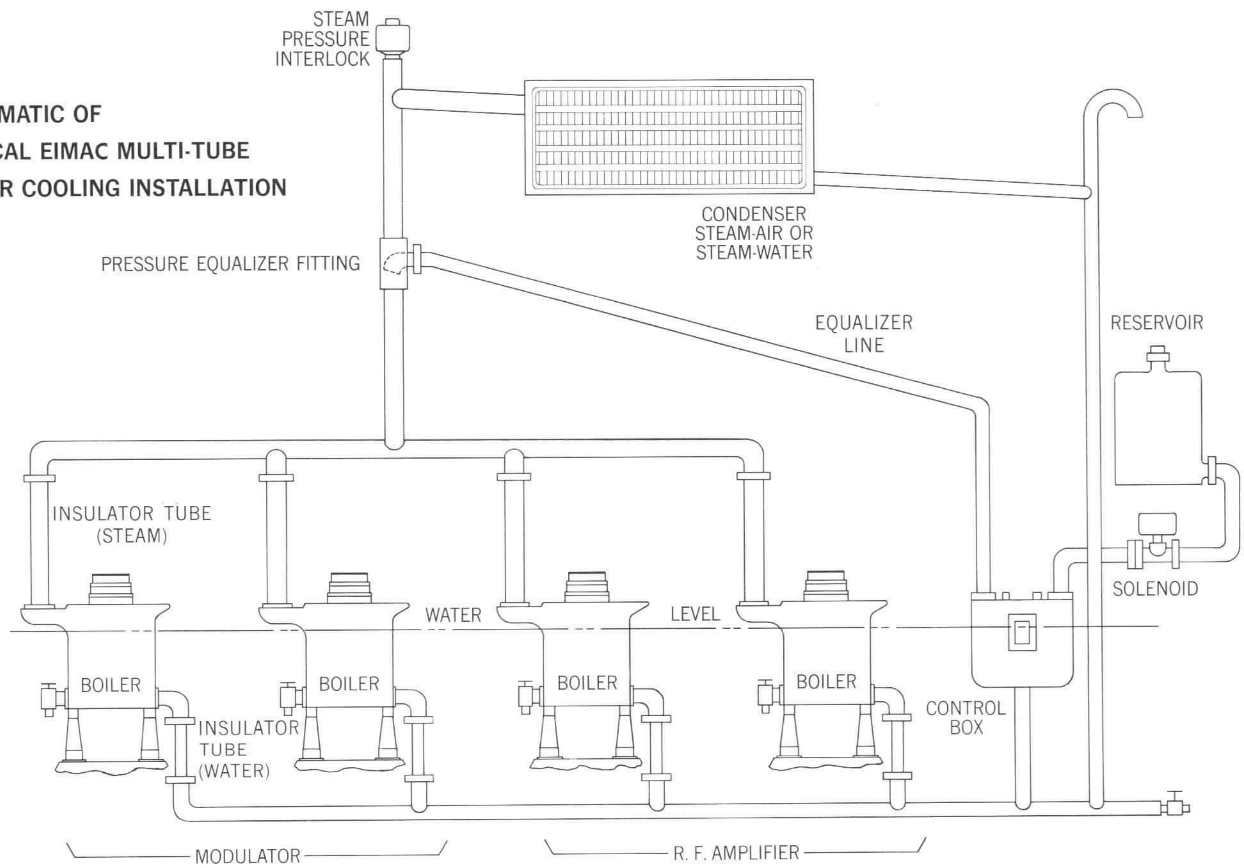
The boiling action maintains the anode surface temperature at approximately 100°C. In a properly designed system (such as the 3CV30,000A3 and BR-200) it unlikely that anode surface temperature will ever exceed 125°C — well below the rated maximum for the tube — even at full plate dissipation levels.

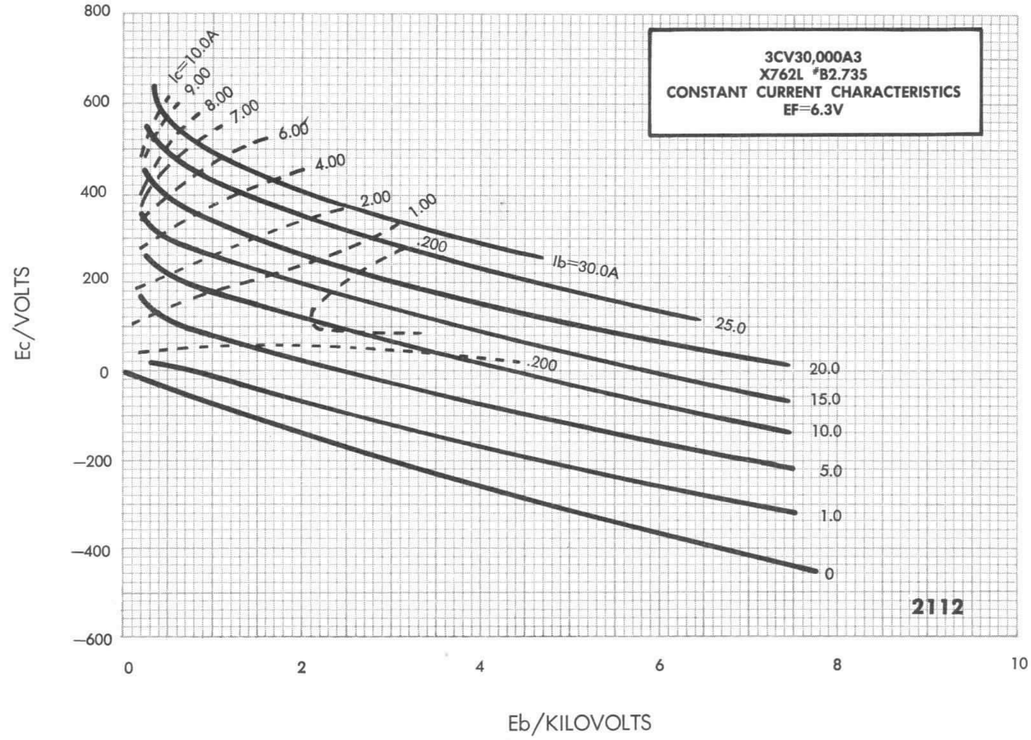
The water in the boiler must be maintained at a constant level, just below the top of the anode fins. This level is marked on the boiler. A recommended system for assuring constant water level is shown in the system diagram below. This system incorporates an EIMAC CB-202 Control Box to sense water level and a small reservoir to supply make-up water on demand. In the event of a drop in system water level, a switch is closed in the control box, energizing a solenoid water valve in the line from the reservoir. When the make-up water brings the system back to the proper level, the switch is opened, de-energizing the solenoid valve. A second switch in the CB-202 Control Box senses a lower, danger level and can be used to actuate an alarm or shut down the system.

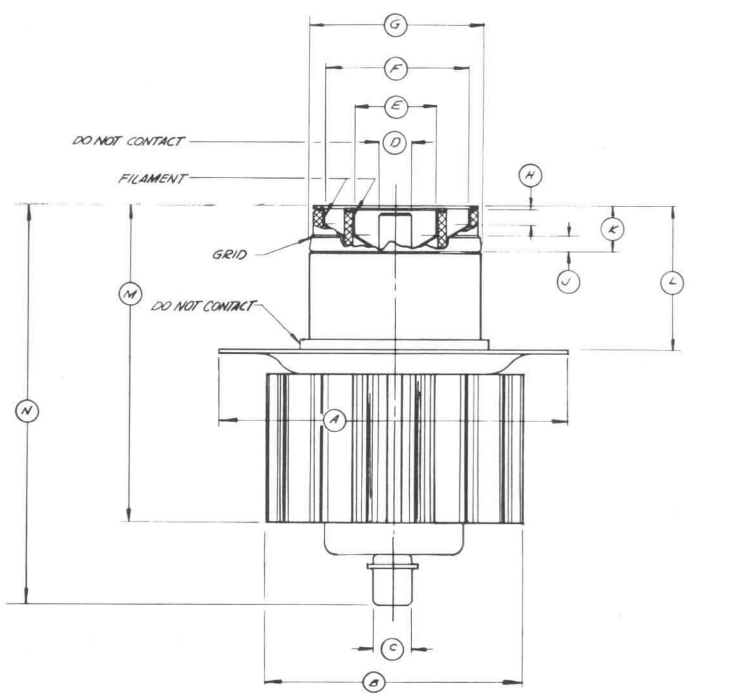
For reliable operation, it is essential that the Control Box be mounted so that the level sensed is the actual level in the boiler.

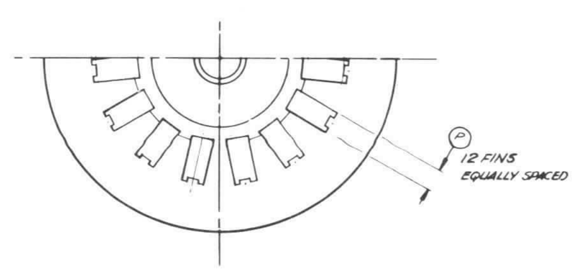
Separate cooling of the tube base is required and is accomplished by directing 100 CFM of cooling air into the base structure from the top of the socket.

SCHEMATIC OF TYPICAL EIMAC MULTI-TUBE VAPOR COOLING INSTALLATION









DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A			7.750
B			5.812
C	.855	.895	
D	.720	.760	
E	1.896	1.936	
F	3.133	3.173	
G	3.792	3.832	
H	.188		
J	.188		
K	.986	1.050	
L			3.062
M	6.920	6.990	
N	8.250	8.750	
P			.510

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

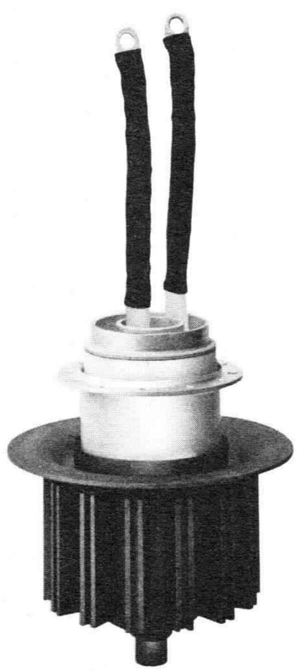
3CV30,000H3

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 of plate dissipation when mounted in an EIMAC BR-200 boiler.

Full input of 60 kilowatts is permissible up to 100 megahertz. Large reserve emission is available from its 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

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		6.3		V
Current	152		172	A
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF
Frequency for Maximum Ratings			100	MHz

MECHANICAL

Filament Connections	Flexible Leads
Grid Connection	Terminal Ring
Recommended Boiler	EIMAC BR-200
Operating Position	Vertical, Base up
Cooling	Vapor and Forced air
Maximum Operating Temperatures:	
Ceramic-to-metal Seals	250°C
Maximum Dimensions:	See Outline
Net Weight	18 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
DC GRID CURRENT	1.0	AMPS
PLATE INPUT POWER	60	KW
PLATE DISSIPATION	30	KW

TYPICAL OPERATION

DC Plate Voltage	7000	10,000	volts
DC Plate Current	6.0	6.0	amps
DC Grid Voltage	-600	-800	volts
DC Grid Current	.66	.315	amps
Peak Positive Grid Voltage	440	360	volts
Driving Power	660	365	watts
Plate Input Power	42	60	kW
Plate Dissipation	12	18	kW
Plate Output Power	30	42	kW
Approximate Load Impedance	600	750	ohms

RADIO-FREQUENCY POWER AMPLIFIER
PLATE-MODULATED

Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	20	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	-600	-820	volts
DC Plate Current	5.0	5.0	amps
DC Grid Current	600	600	mA
Driving Power	600	750	watts
Plate Output Power	17.8	27.5	kW

AUDIO AMPLIFIER
OR MODULATOR

Class-AB_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	6.0	AMPS
PLATE DISSIPATION	30	KW
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (two tubes)

DC Plate Voltage	6000	9600	volts
DC Grid Voltage*	-280	-480	volts
Zero-Sig Plate Current	.5	.25	amps
Max-Sig DC Plate Current	4.2	3.1	amps
Max-Sig DC Grid Current	145	42	mA
Peak Driving Voltage	480	590	volts
Drive Power	140	50	watts
Plate-to-Plate Load Resistance	1300	2740	ohms
Power Output	31	36	kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament The rated filament voltage for the 3CV30,000H3 is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and 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 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 10,000 volts and 6.0 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, input is reduced to 7000 volts at 5.0 amperes dc. Maximum input may be exceeded for short periods during tuning without exceeding plate dissipation ratings.

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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

Special Application If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

MECHANICAL

Mounting The 3CV30,000H3 must be mounted vertically, base up in an EIMAC BR-200 boiler. It is very important that the boiler tube assembly be mounted vertically, the water be maintained at the suggested level, and that the flange of the tube makes a vapor-tight seal against the rubber "O" ring and boiler.

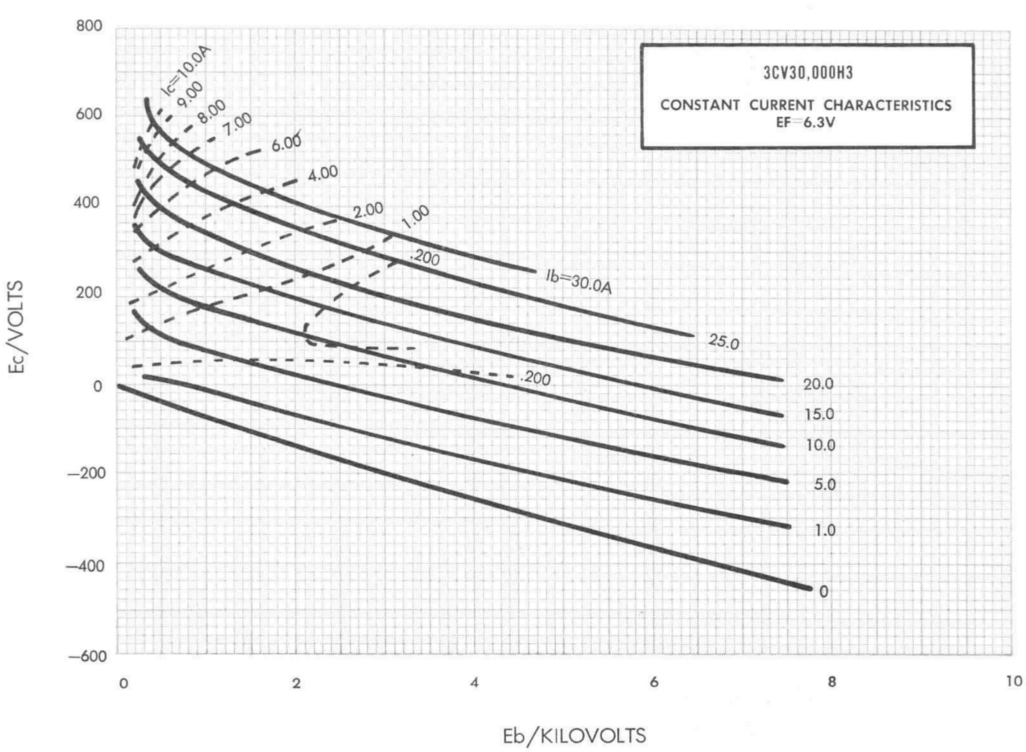
Cooling Cooling is accomplished by immersion of the anode in a distilled water-filled BR-200 boiler. The energy dissipated at the anode causes the water to boil and be converted into steam. Steam is carried away by convection to the condenser where it is cooled and condenses into water. Condensate is then returned to the boiler.

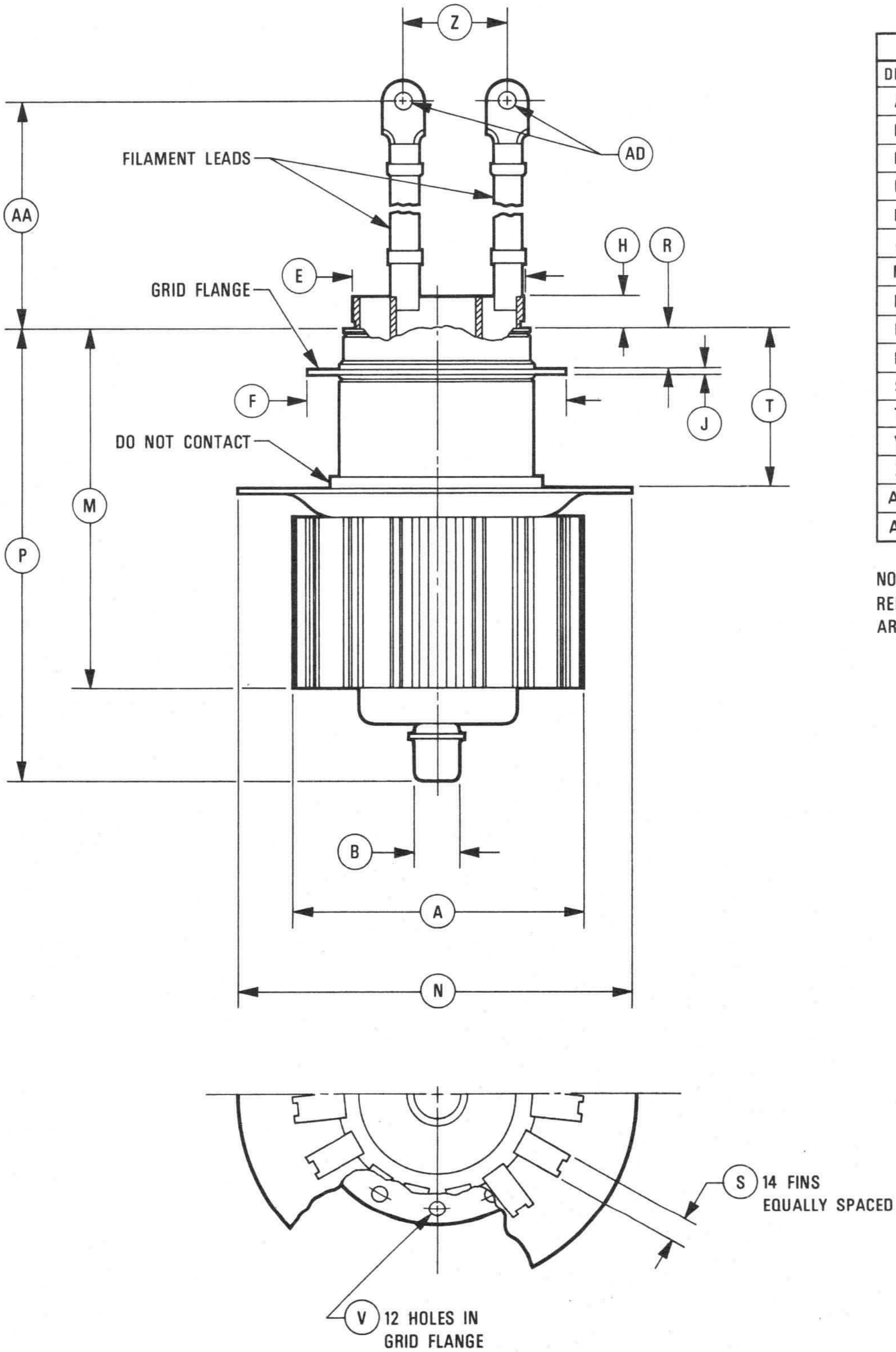
The boiling action maintains the anode surface temperature at approximately 100°C. In a properly designed system (such as the 3CV30,000H3 and BR-200) it is unlikely that anode surface temperature will ever exceed 125°C — well below the rated maximum for the tube — even at full plate dissipation levels.

The 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. A recommended system for assuring constant water level is shown in the system diagram below. This system incorporates an EIMAC CB-202 Control Box to sense water level and a small reservoir to supply make-up water on demand. In the event of a drop in system water level, a switch is closed in the control box, energizing a solenoid water valve in the line from the reservoir. When the make-up water brings the system back to the proper level, the switch is opened, de-energizing the solenoid valve. A second switch in the CB-202 Control Box senses a lower, danger level and can be used to actuate an alarm or shut down the system.

For reliable operation, it is essential that the Control Box be mounted so that the level sensed is the actual level in the boiler.

Separate cooling of the tube base is required and is accomplished by directing 100 CFM of cooling air into the base structure from the top of the socket.





DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A			5.812
B	.855	.895	
E	3.230	3.270	
F	5.030	5.090	
H	.530	.700	
J			.125
M	6.643	6.775	
N			7.750
P	8.400	8.625	
R	.700	.860	
S			.510
T			2.806
V			.265
Z			2.000
AA	8.500	9.000	
AD			.390

NOTE:
REF. DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D. FOR INSP. PURPOSES.

TECHNICAL DATA

8240 / 3CW5000A1
8241 / 3CW5000F1

LOW-MU WATER-COOLED TRIODES

The EIMAC 8240/3CW5000A1 and 8241/3CW5000F1 are low-mu water-cooled power triodes intended for use as audio amplifiers or modulators. Their maximum rated plate dissipation is 5000 watts. The two types are identical except for the addition of flexible leads for the grid and filament terminals on the 8241/3CW5000F1.

Two of these tubes, in Class AB_1 audio service, will deliver more than 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

These two types are electrically identical to the air-cooled EIMAC 8238/3CX3000A1 except for the plate dissipation rating.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage . . . . 7.5 ± 0.37 V

Current, at 7.5 volts

8240/3CW5000A1 . . . . 51.5 A

8241/3CW5000F1 . . . . 50.5 A

Transconductance (Average)

$I_b = 1.0$ Adc, $E_b = 3000$ Vdc . 11,000 μmhos

Amplification Factor (Average) 4.9

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

MECHANICAL

Maximum Overall Dimensions:

Length (excluding leads on 8241/3CW5000F1) . . . . 12.625 in; 321 mm

Diameter . . . . 3.255 in;86.2 mm

Net Weight (Approximate) . . . . 3.5 lbs; 1.6 kg

Operating Position . . . . Axis vertical, base down or up

Maximum Operating Temperature:

Ceramic/Metal Seals or Envelope . . . . 250°C

Cooling:

Seals and Envelope . . . . Forced Air

Plate . . . . Water

Base . . . . .See Outline Drawings

(Effective 5-15-71) Printed in U.S.A.

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

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5000	WATTS
GRID DISSIPATION	50	WATTS

1. Approximate value; adjust to give stated zero-signal plate current.

2. Per tube.

TYPICAL OPERATION (Class AB_1, Sinusoidal Wave, Two Tubes)

Plate Voltage	4000	5000	6000	Vdc
Grid Voltage [1]	-860	-1080	-1300	Vdc
Zero-Signal Plate Current	500	400	335	mAdc
Max. Signal Plate Current	3.00	2.80	2.65	Adc
Peak af Grid Voltage [2]	760	995	1250	v
Peak Driving Power	0	0	0	w
Max. Signal Plate Input Power	12,000	14,000	16,000	W
Max. Signal Plate Dissipation [2]	3000	3000	3000	W
Max. Signal Plate Output Power	6000	8000	10,000	W
Load Resistance (plate to plate)	2160	3320	4560	Ω

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the 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.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts (8240/3CW5000A1)	49.0	54.0	A
(8241/3CW5000F1)	48.0	53.0	A
Amplification Factor	4.3	5.6	

APPLICATION

MECHANICAL

MOUNTING - The 3CW5000A1 and 3CW5000F1 must be mounted vertically, base down or up at the convenience of the circuit designer. The filament connections to the 3CW5000A1 should be made through spring collets. These are available from EIMAC with the following part numbers: 149575 Inner line collet;
149576 Outer line collet
Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - With an anode dissipation of 5000 watts and with an incoming water temperature of 50°C maximum, 7.7 gpm of cooling water must be supplied to the anode cooling jacket. Outlet water temperature from the cooling jacket should never exceed 70°C, and water pressure on the jacket should not exceed 60 psi. The pressure drop across the anode cooling jacket itself, with a water flow of 7.7 gpm, will be approximately 6 psi.

The grid-terminal contact surface and adjacent ceramic must be cooled by forced air, with quantity, velocity, and direction adjusted to limit the maximum seal temperature to less than 250°C.

The filament stem structure also requires forced-air cooling. A minimum of 6 cfm should be directed into the space between the inner and outer filament contacting surfaces.

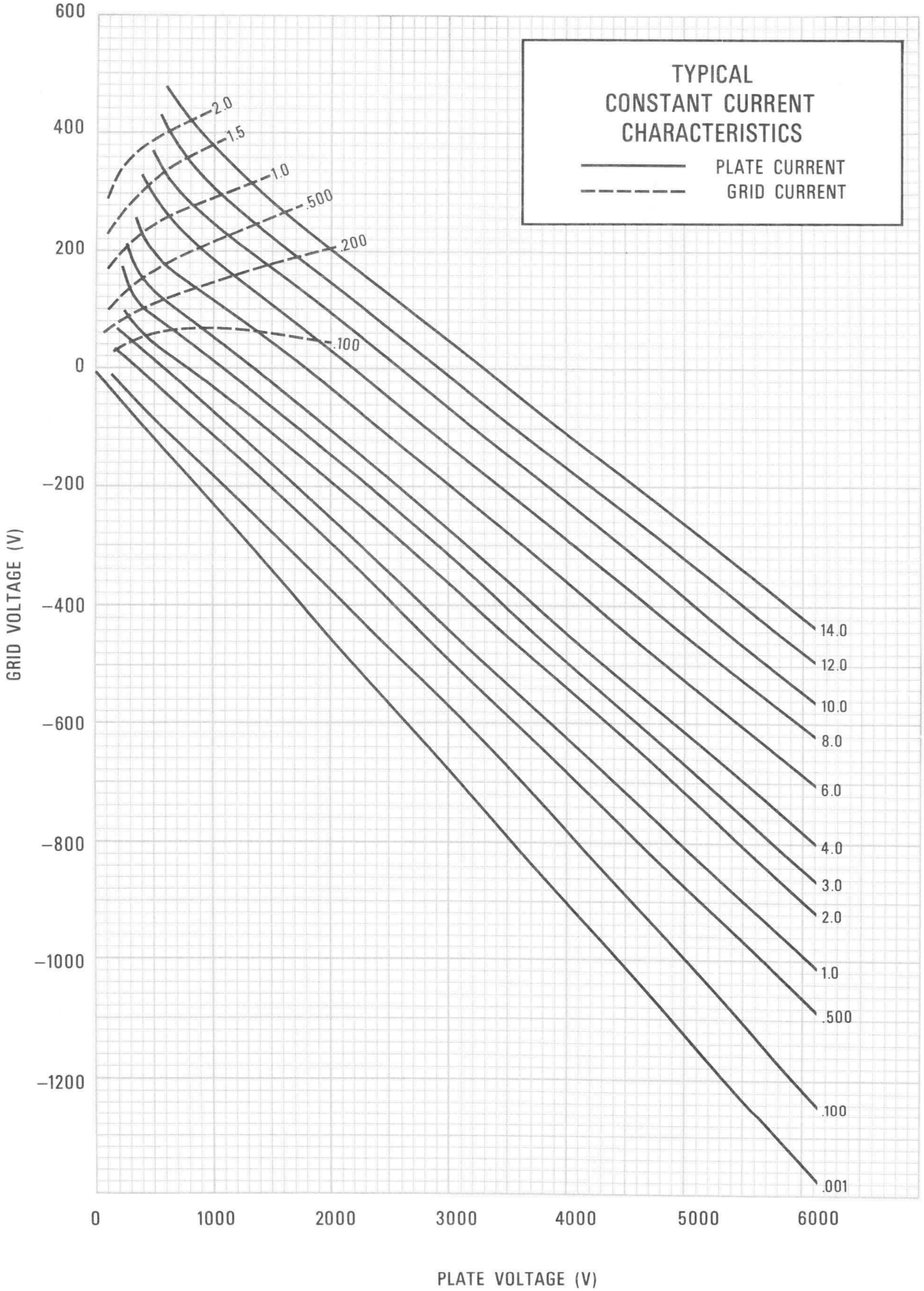
Both air and water flow must be supplied before or simultaneously with the application of electrode voltages, including the filament, and may be removed simultaneously with them. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

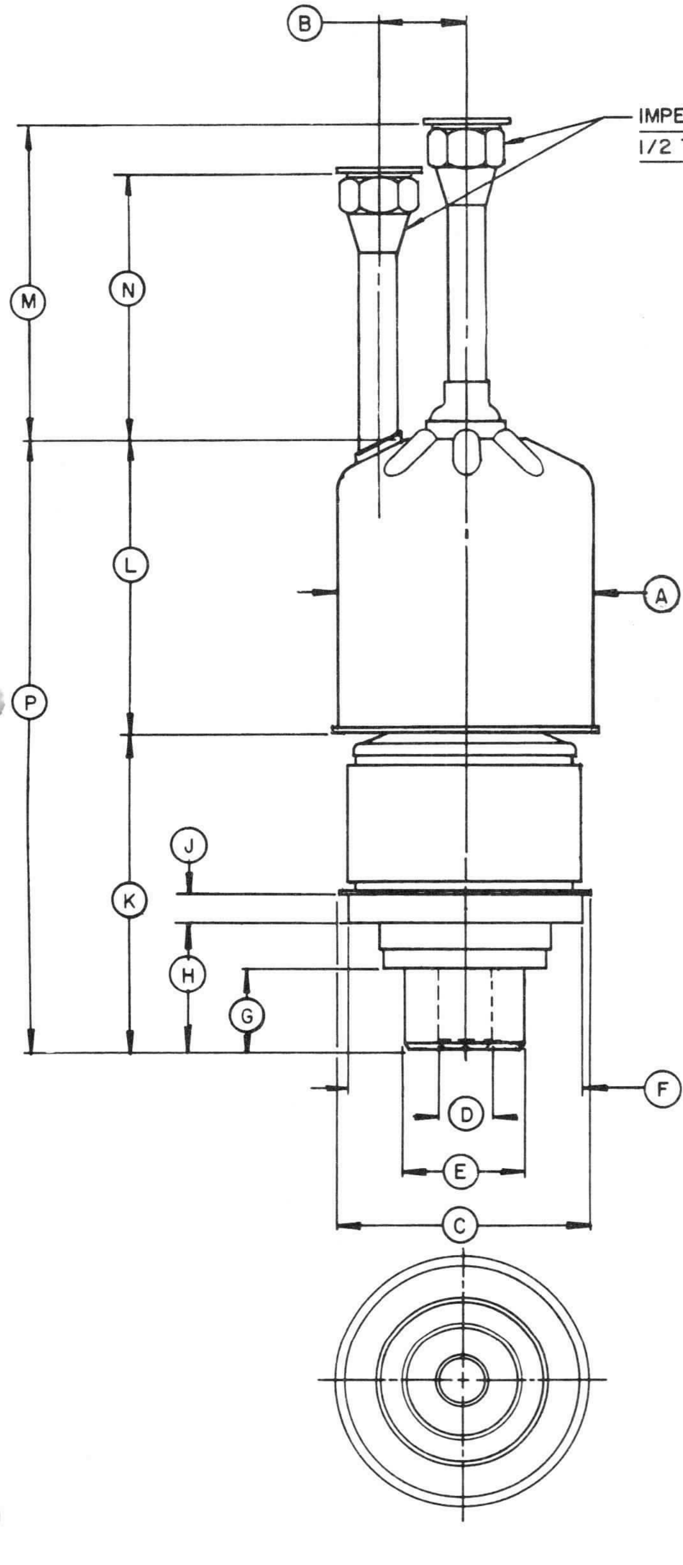
ELECTRICAL

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.

HIGH VOLTAGE - The 3CW5000A1 and 3CW-5000F1 operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies and to discharge high-voltage condensers when 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.

SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA. 94070, for information and recommendations.

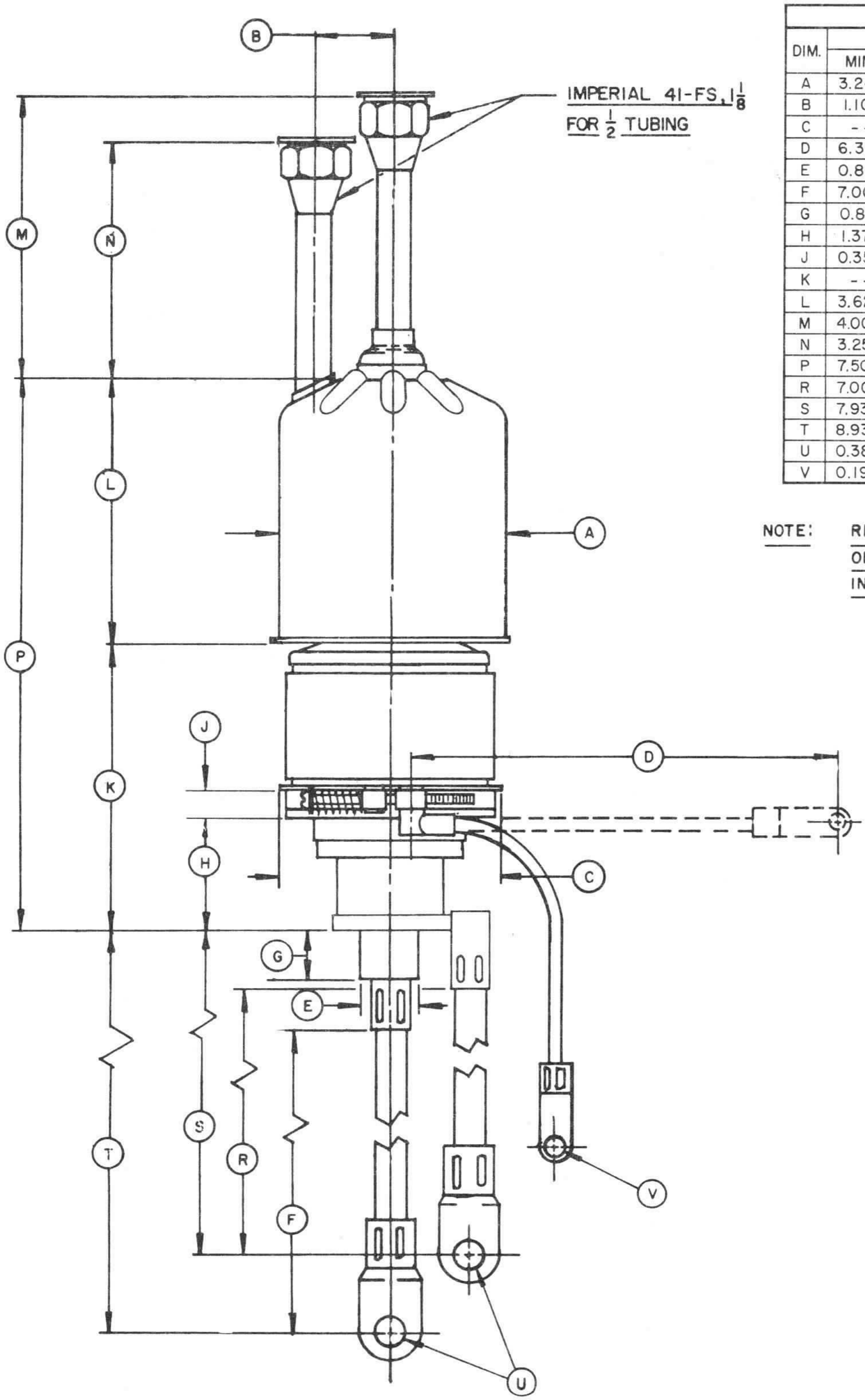

TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
600
400
200
0
−200
−400
−600
−800
−1000
−1200
GRID VOLTAGE (V)
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE (V)
2.0
1.5
1.0
.500
.200
.100
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.500
.100
.001



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	--	82.42	82.68	--
B	1.109	1.141	--	28.17	28.98	--
C	--	3.625	--	--	92.08	--
D	0.615	0.635	--	15.62	16.13	--
E	1.490	1.510	--	37.85	38.35	--
F	2.990	3.010	--	75.95	76.45	--
G	0.812	0.938	--	20.62	23.83	--
H	1.375	1.625	--	34.93	41.28	--
J	0.359	0.422	--	9.12	10.72	--
K	--	--	3.599	--	--	91.41
L	3.625	3.875	--	92.08	98.43	--
M	4.000	4.500	--	101.60	114.30	--
N	3.250	3.750	--	82.55	95.25	--
P	7.500	8.125	--	190.50	206.38	--

Table title: DIMENSIONAL DATA

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	- -	82.42	82.68	- -
B	1.109	1.141	- -	28.17	28.98	- -
C	- -	3.625	- -	- -	92.08	- -
D	6.375	6.625	- -	161.93	168.28	- -
E	0.859	0.890	- -	21.82	22.61	- -
F	7.000	7.500	- -	177.80	190.50	- -
G	0.812	0.938	- -	20.62	23.83	- -
H	1.375	1.625	- -	34.93	41.28	- -
J	0.359	0.422	- -	9.12	10.72	- -
K	- -	- -	3.599	- -	- -	91.41
L	3.625	3.875	- -	92.08	98.43	- -
M	4.000	4.500	- -	101.60	114.30	- -
N	3.250	3.750	- -	82.55	95.25	- -
P	7.500	8.125	- -	190.50	206.38	- -
R	7.000	7.500	- -	177.80	190.50	- -
S	7.937	8.437	- -	201.60	214.30	- -
T	8.937	9.437	- -	226.99	239.70	- -
U	0.385	0.395	- -	9.78	10.03	- -
V	0.194	0.200	- -	4.93	5.08	- -

Caption: DIMENSIONAL DATA

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.

3CW5000H3

INDUSTRIAL MEDIUM-MU

WATER-COOLED POWER TRIODE

TECHNICAL DATA

The EIMAC 3CW5000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 5 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 12.5 kilowatts is permissible up to 75 megahertz. Plentiful reserve emission is available from its 375 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten	*Min.*	*Nom.*	*Max.*	
Voltage		7.5		Volts
Current	48		53	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Grid-Filament	29.2		40.2	$\mu\mu$f
Plate-Filament	0.60		1.20	$\mu\mu$f
Grid-Plate	17.8		24.2	$\mu\mu$f
Frequency for Maximum Ratings			75	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	7.5 Pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000 volts
DC PLATE CURRENT	2.5 amps
DC GRID VOLTAGE	—1000 volts
DC GRID CURRENT	0.4 amp
PLATE INPUT POWER	12.5 kW
PLATE DISSIPATION (NOMINAL)	5 kW

TYPICAL OPERATION*

DC Plate Voltage	4000	6000 volts
DC Plate Current	2.5	2.08 amps
DC Grid Voltage	—300	—500 volts
DC Grid Current	.245	.180 amps
Peak Positive Grid Voltage	280	265 volts
Driving Power	142	136 watts
Plate Input Power	10,000	12,500 kW
Plate Dissipation	2,500	2,500 kW
Plate Output Power	7,500	10,000 kW
Approximate Load Impedance	910	1,625 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW5000H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.4 ampere dc. This value should not be exceeded for more than very 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 0.275 amperes 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 150 watts.

Plate Operation

Maximum plate voltage rating of 6000 volts and maximum plate current of 2.5 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 12.5 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW5000H3 is usable to 110 MHz. At this frequency, plate voltage must be reduced to 4000 volts in Class C service.

MECHANICAL

Mounting

The 3CW5000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 15°C temperature rise inlet to outlet water.

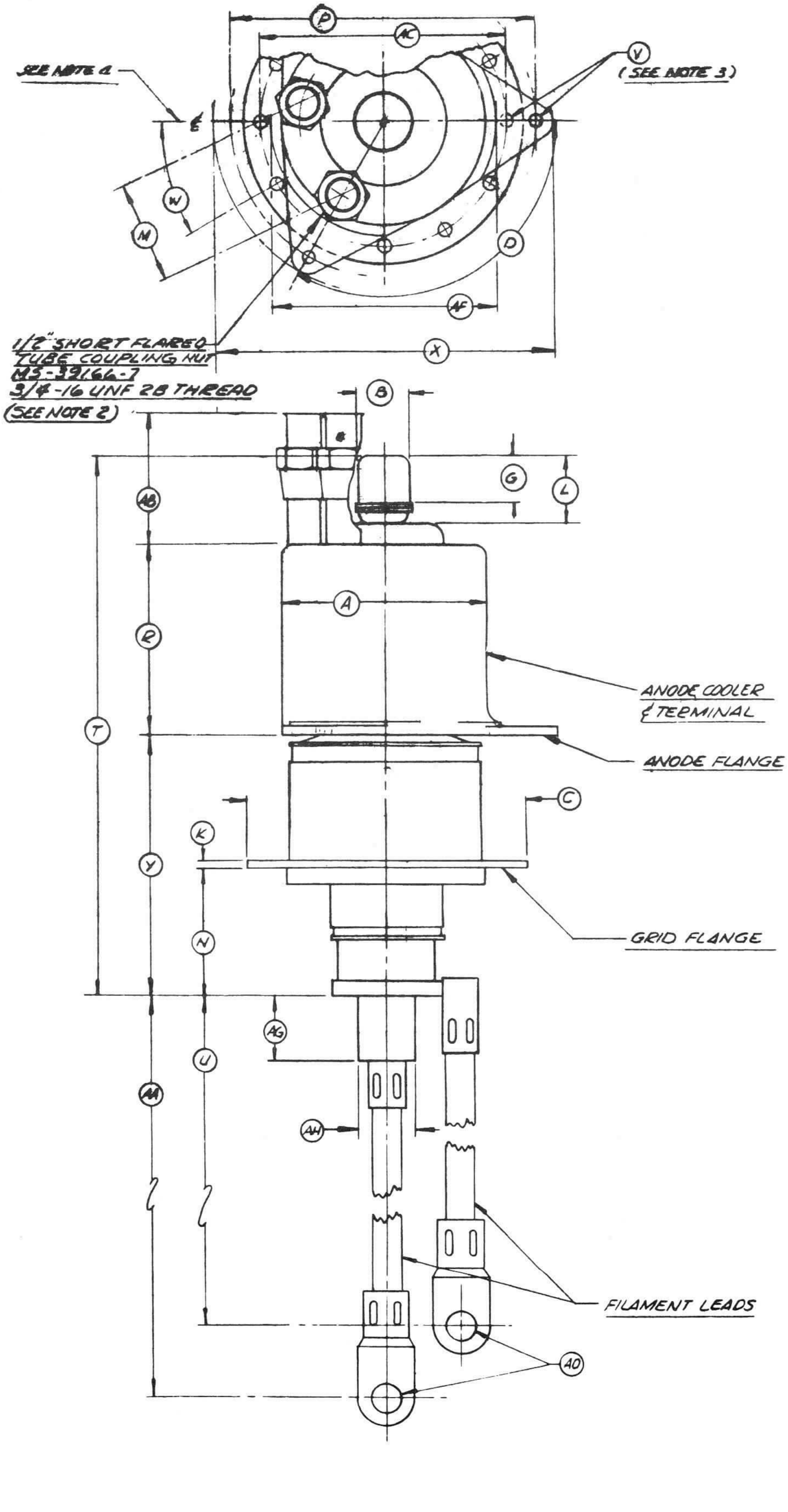
MINIMUM WATER-COOLING REQUIREMENT

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
3.0	0.65	0.27
5.0	1.10	0.70
7.0	1.75	1.75

Additional stem cooling air must be provided. 13 CFM of air directed against the center filament contact ring ½″ below the outer filament contact ring by a 1½″ I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

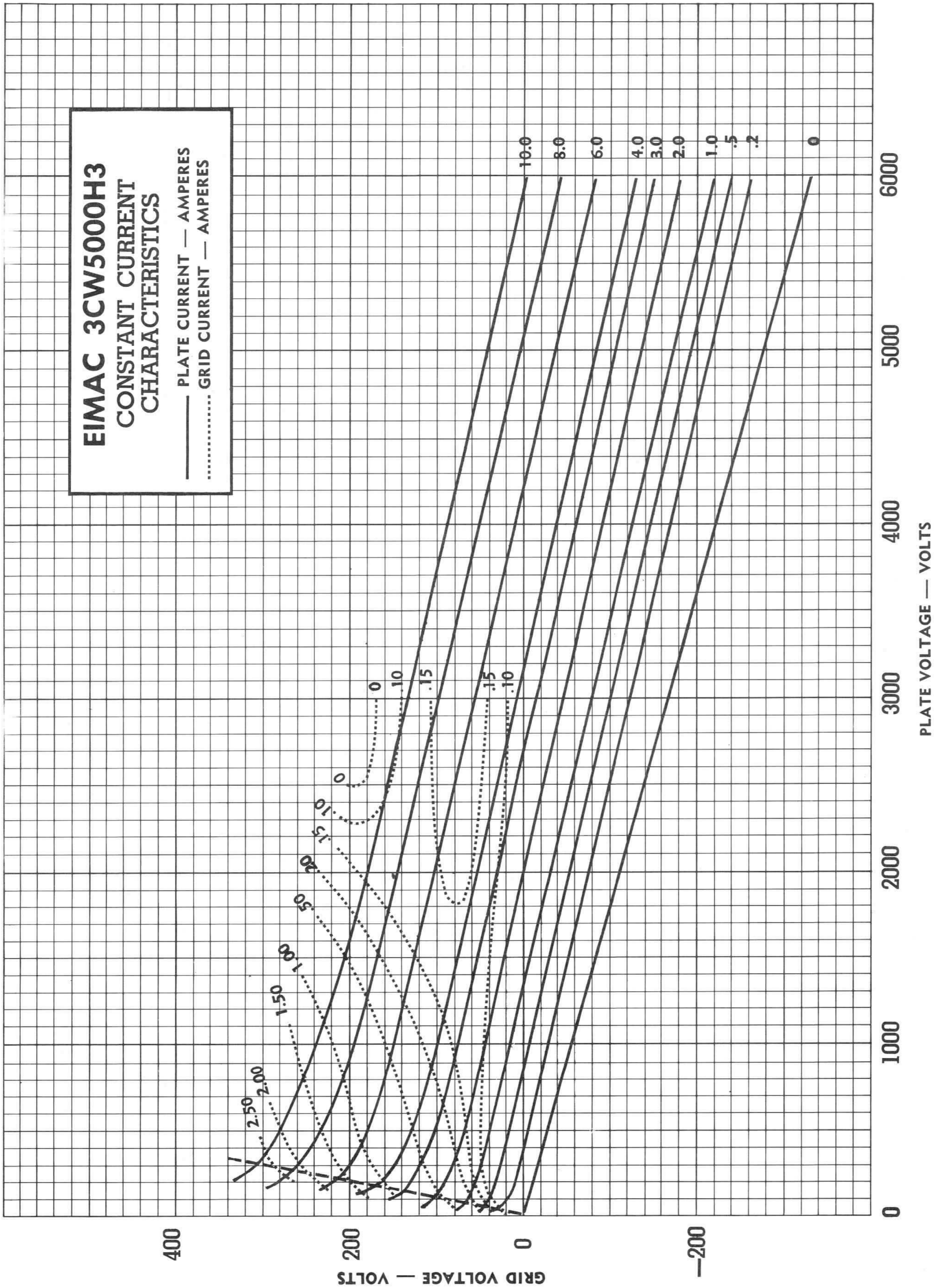
Special Application

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



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	3.300	3.400	
B	.780	.843	
C	4.230	4.250	
D	118°	122°	
G	.687	.812	
K			.125
L	1.000	1.125	
M			1.500
② N	1.703	1.953	
P	4.615	4.635	
R	2.625	2.875	
T	8.000	9.000	
U	7.937	8.437	
V			.250
W	29°	31°	
X	5.330	5.420	
Y	3.875	4.250	
AA	8.937	9.437	
AB			2.000
AC	3.855	3.885	
AD			.390
AF			3.625
AG	.812	.937	
AH	.859	.890	

NOTE:
1. REF. DIM. ARE FOR INFO ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.
2. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
3. 3 HOLES IN ANODE FLANGE, 12 HOLES IN GRID FLANGE.
4. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW5000H3
CONSTANT CURRENT
CHARACTERISTICS
——— PLATE CURRENT — AMPERES
.... GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
0
.10
.15
.15
.10
0
.10
.15
.20
.50
1.00
1.50
2.00
2.50
PLATE VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE — VOLTS
400
200
0
−200

TECHNICAL DATA

8242
3CW5000A3
8243
3CW5000F3
MEDIUM-MU WATER-COOLED POWER TRIODES

The EIMAC 8242/3CW5000A3 and 8243/3CW5000F3 are medium-mu water-cooled power triodes intended for use in amplifier, oscillator, or modulator service. Their maximum rated anode dissipation is 5000 watts. The two types are identical except for the addition of flexible leads for the grid and filament terminals of the 8243/3CW5000F3.

These tubes are water-cooled versions of the air-cooled 8161/3CX2500A3 and 8251/3CX2500F3.

The water-cooled tubes are recommended for industrial applications or installations where reserve anode dissipation is required.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten

Voltage	7.5	V
Current @ 7.5 V (3CW5000A3)	51.5	A
(3CW5000F3)	50.5	A
Amplification Factor (Average)	22	
Transconductance (Average)	20,000	μmhos

(E_b = 3000 Vdc; I_b = 830 mAdc)

Direct Interelectrode Capacitances (Cathode grounded)[2]

Cin	35	pF
Cout	0.9	pF
Cgp	20	pF

Frequency of Maximum Ratings (CW)

3CW5000A3	F1	75	MHz
	F2	110	MHz
3CW5000F3	F1	30	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. 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, in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length (excluding leads on 3CW5000F3)	12.56 In; 31.9 Cm
Diameter	3.63 In; 9.22 Cm
Net Weight (Approximate) 3CW5000A3	4.8 lb; 2.2 kg
3CW5000F3	5.5 lb; 2.5 kg
Operating Position (both types)	Axis Vertical, Base Down or Up
Maximum Operating Temperatures:	
Ceramic/Metal Seals or Envelope	250°C
3CW5000F3 Filament Lead/Tube Base junctions	150°C
Cooling: Anode	Water or Equivalent Liquid
Envelope, Seals, Base Areas	Forced Air
Base: 3CW5000A3	Special Coaxial
3CW5000F3	Special with Flying Leads

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current @ 7.5 volts (3CW5000A3)	49.0	54.0	A
(3CW5000F3)	48.0	53.0	A
Interelectrode Capacitance (Grounded cathode) [1]			
Cin	29.2	40.2	pF
Cout	0.60	1.20	pF
Cgp	16.8	23.2	pF
Amplification Factor	19	26	

1. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association standard RS-191.

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 voltage 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. This current variation causes 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.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM - Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (up to F1)	6000	VOLTS
DC PLATE VOLTAGE (F1 to F2)	4000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5000	WATTS
GRID DISSIPATION	150	WATTS

1. Approximate value.
2. Approximate; useful power delivered to the load will be lower because of circuit losses.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	4000	5000	6000	Vdc
Plate Current	2.5	2.5	2.1	Adc
Grid Voltage	-300	-450	-500	Vdc
Grid Current [1]	245	265	180	mAdc
Peak rf Grid Voltage [1]	580	750	765	v
Driving Power [1]	142	197	136	W
Grid Dissipation [1]	68	78	46	W
Plate Power Input	10	12.5	12.5	kW
Plate Dissipation	2.5	2.5	2.5	kW
Plate Power Output [2]	7.5	10	10	kW

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class C Telephony - Carrier Conditions

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (up to F1)	5000	VOLTS
DC PLATE VOLTAGE (F1 to F2)	3500	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	3350	WATTS
GRID DISSIPATION	150	WATTS

1. Approximate value.
2. Approximate; useful power delivered to the load will be lower because of circuit losses.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	4000	4500	5000	Vdc
Plate Current	1.67	1.55	1.45	Adc
Total Bias Voltage	-450	-500	-550	Vdc
Fixed Bias Voltage	-230	-325	-410	Vdc
Grid Resistor	1500	1500	1400	Ω
Grid Current	150	120	100	mAdc
Peak rf Grid Voltage[1]	680	720	760	v
Driving Power [1]	102	86	76	W
Grid Dissipation[1]	35	26	21	W
Plate Dissipation [1]	1.67	1.67	1.67	kW
Plate Power Output[2]	5.0	5.3	5.6	kW

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5000	WATTS
GRID DISSIPATION	150	WATTS

1. Approx. Adjust for specified zero-signal plate current.
2. Approximate.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	4000	5000	5000	6000	Vdc
Grid Voltage [1]	-145	-190	-190	-240	Vdc
Zero Signal Plate Current	0.6	0.5	0.5	0.4	Adc
Max. Signal Plate Current	2.70	2.26	3.2	3.0	Adc
Effective Load, plate-to-plate	3300	5000	3600	4650	Ω
Peak af Grid Voltage (per tube) [2]	285	310	360	390	v
Max. Signal Peak Driving Power [2]	134	118	230	225	W
Max. Signal Nom. Driving Power [2]	67	59	115	113	W
Max. Signal Plate Output Power [2]	7.4	8.0	11.0	13.0	kW

APPLICATION

MECHANICAL

MOUNTING - The 3CW5000A3 and 3CW5000F3 must be mounted vertically, base down or up at the convenience of the circuit designer. The filament connections to the 3CW5000A3 should be made through spring collets. These are available from EIMAC with the following part numbers:

149575 Inner line collet;
149576 Outer line collet

Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - With an anode dissipation of 5000 watts and with an incoming water temperature of 50°C maximum, 7.7 gpm of cooling water must be supplied to the anode cooling jacket. Outlet water temperature from the cooling jacket should never exceed 70°C, and water pressure on the jacket should not exceed 60 psi. The pressure drop across the anode cooling jacket itself, with a water flow of 7.7 gpm, will be approximately 6 psi. The grid-terminal contact surface and adjacent ceramic must be cooled by forced air, with quantity, velocity, and direction adjusted to limit the maximum seal temperature to less than 250°C.

The filament stem structure also requires forced-air cooling. A minimum of 6 cfm should be directed into the space between the inner and outer filament contacting surfaces.

Both air and water flow must be supplied before or simultaneously with the application of electrode voltages, including the filament, and may be removed simultaneously with them. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

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.

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.

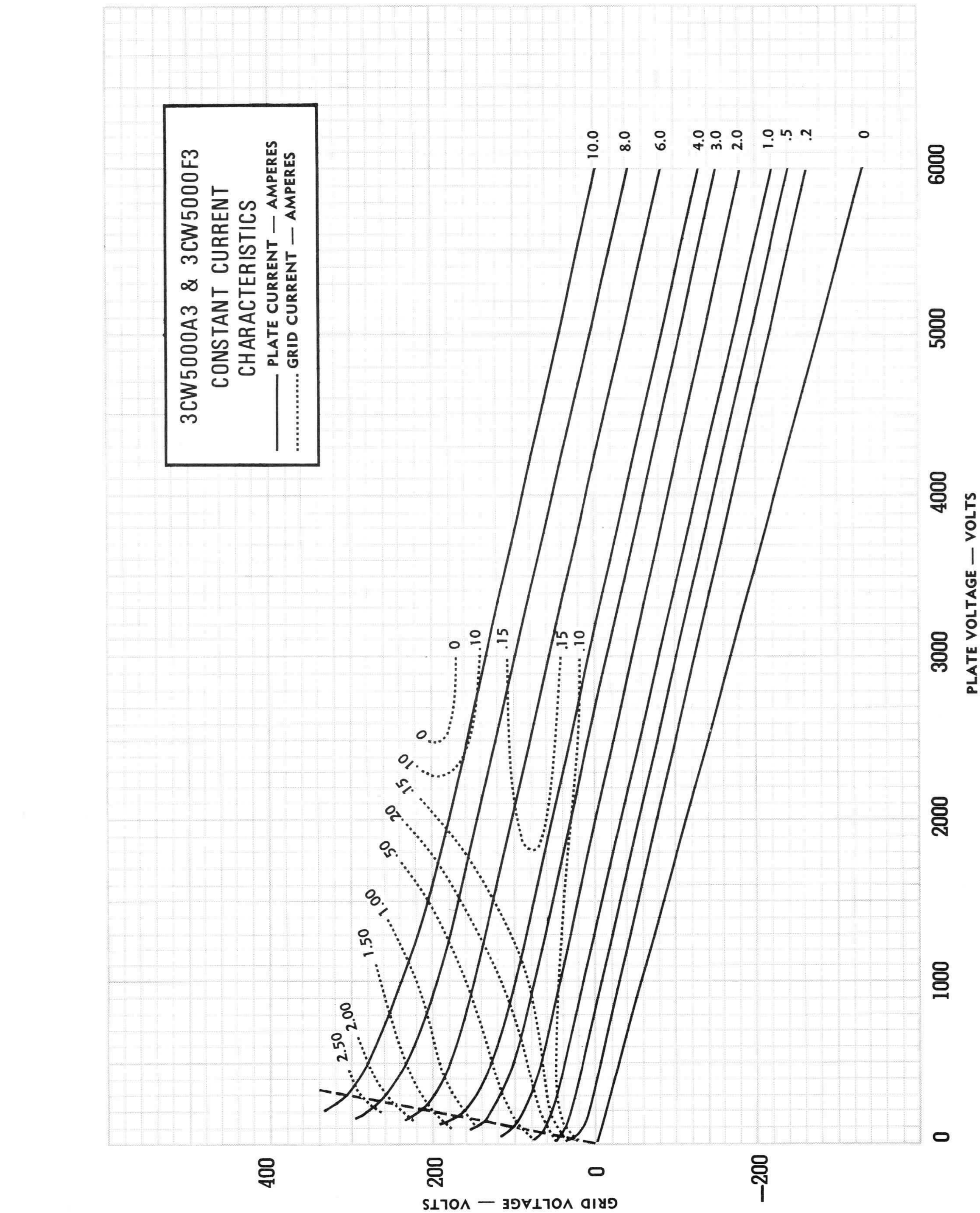
Many EIMAC power tubes, such as these, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--the more power involved, the stronger the rf field. Proper enclosure design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

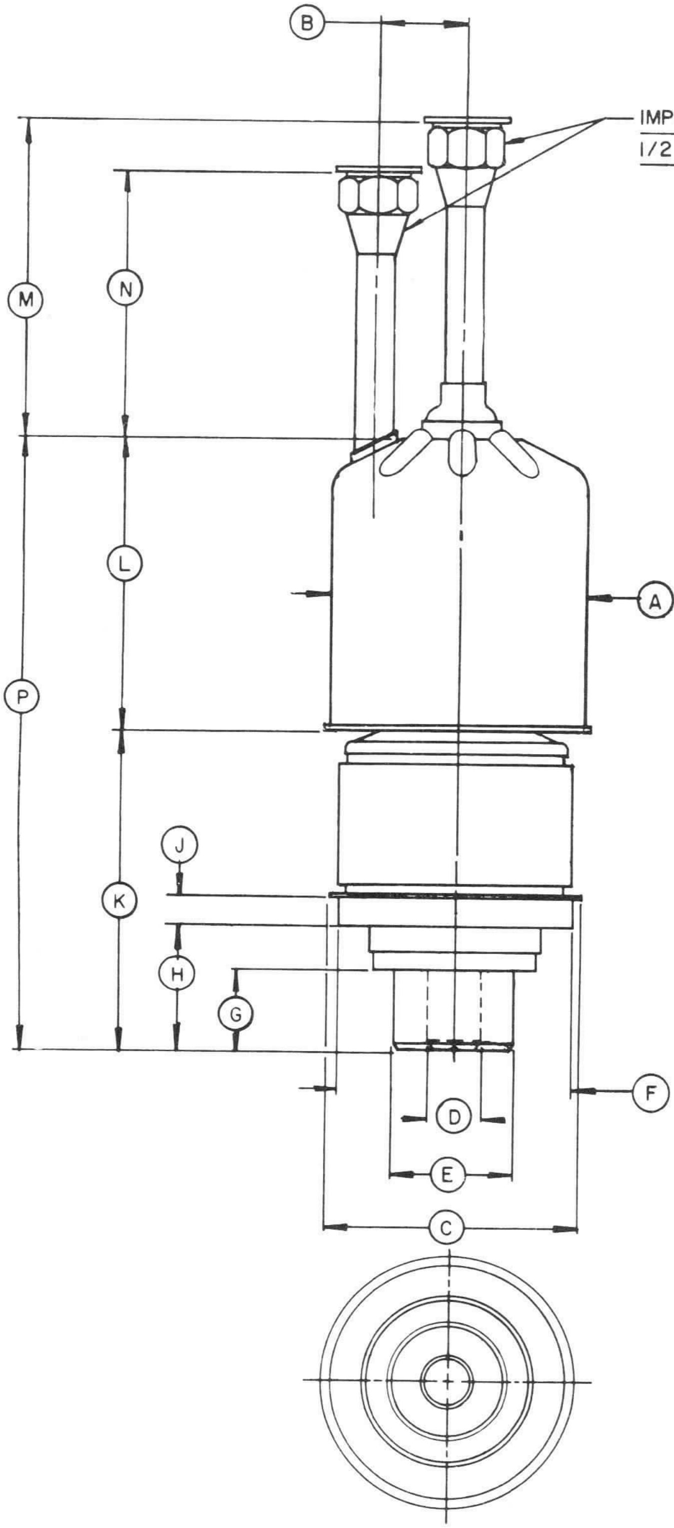
HIGH VOLTAGE - Normal operating voltages used with these tubes are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage 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.

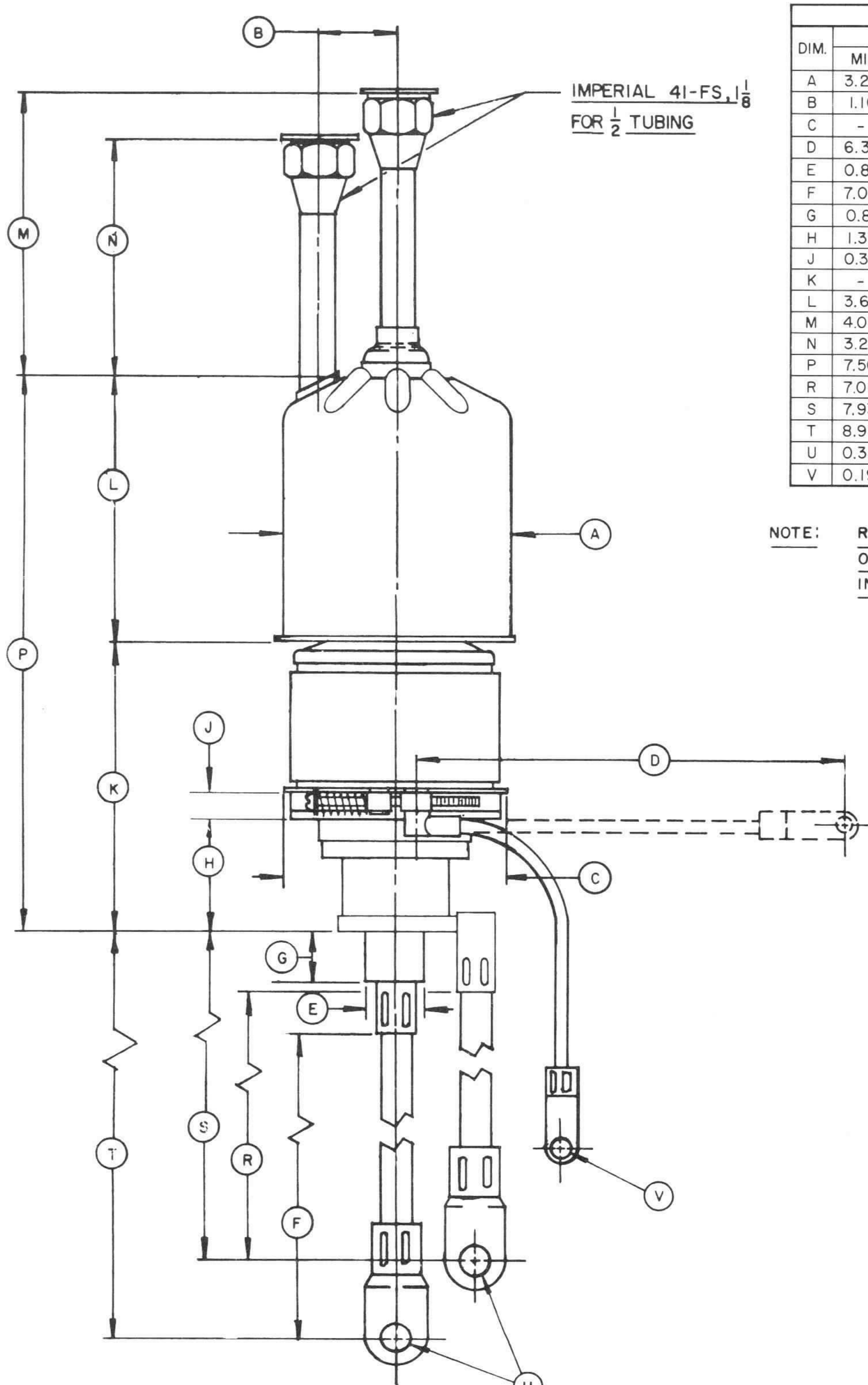
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


3CW5000A3 & 3CW5000F3
CONSTANT CURRENT
CHARACTERISTICS
——— PLATE CURRENT — AMPERES
.... GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
PLATE VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE — VOLTS
400
200
0
−200



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	- -	82.42	82.68	- -
B	1.109	1.141	- -	28.17	28.98	- -
C	- -	3.625	- -	- -	92.08	- -
D	0.615	0.635	- -	15.62	16.13	- -
E	1.490	1.510	- -	37.85	38.35	- -
F	2.990	3.010	- -	75.95	76.45	- -
G	0.812	0.938	- -	20.62	23.83	- -
H	1.375	1.625	- -	34.93	41.28	- -
J	0.359	0.422	- -	9.12	10.72	- -
K	- -	- -	3.599	- -	- -	91.41
L	3.625	3.875	- -	92.08	98.43	- -
M	4.000	4.500	- -	101.60	114.30	- -
N	3.250	3.750	- -	82.55	95.25	- -
P	7.500	8.125	- -	190.50	206.38	- -

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.245	3.255	- -	82.42	82.68	- -
B	1.109	1.141	- -	28.17	28.98	- -
C	- -	3.625	- -	- -	92.08	- -
D	6.375	6.625	- -	161.93	168.28	- -
E	0.859	0.890	- -	21.82	22.61	- -
F	7.000	7.500	- -	177.80	190.50	- -
G	0.812	0.938	- -	20.62	23.83	- -
H	1.375	1.625	- -	34.93	41.28	- -
J	0.359	0.422	- -	9.12	10.72	- -
K	- -	- -	3.599	- -	- -	91.41
L	3.625	3.875	- -	92.08	98.43	- -
M	4.000	4.500	- -	101.60	114.30	- -
N	3.250	3.750	- -	82.55	95.25	- -
P	7.500	8.125	- -	190.50	206.38	- -
R	7.000	7.500	- -	177.80	190.50	- -
S	7.937	8.437	- -	201.60	214.30	- -
T	8.937	9.437	- -	226.99	239.70	- -
U	0.385	0.395	- -	9.78	10.03	- -
V	0.194	0.200	- -	4.93	5.08	- -

DIMENSIONAL DATA

NOTE: REF. DIMS ARE FOR INFO ONLY AND NOT REQ. FOR INSPECTION PURPOSES.

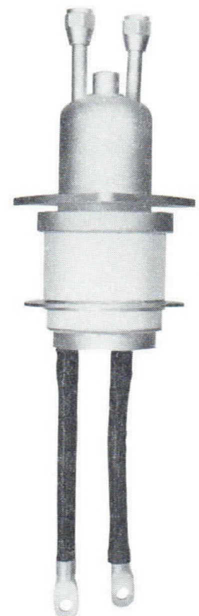
3CW10,000H3

INDUSTRIAL
MEDIUM-MU

WATER-COOLED
POWER TRIODE

TECHNICAL DATA

The EIMAC 3CW10,000H3 is a water-cooled, ceramic/metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 10 kilowatts of plate dissipation with low water flow and pressure drop.



Input of 30 kilowatts is permissible up to 90 Megahertz. Plentiful reserve emission is available from its 560 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 ± 0.37 V
Current, at 7.5 volts	75 A
Amplification Factor (Average):	20
Direct Interelectrode Capacitance (grounded cathode)[2]	
Input	53.0 pF
Output	1.5 pF
Feedback	25.0 pF
Frequency of Maximum Rating:	
CW	90 MHz

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)	10.450 in; 265.43 mm
Diameter	5.090 in; 129.29 mm
Net Weight	10 lb; 4.54 kg
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Cooling	Water and Forced Air
Base	See Outline

(Revised 10-15-70) Printed in U.S.A.

RADIO FREQUENCY INDUSTRIAL OSCILLATOR
Class C (Filtered DC Power Supply)
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000	VOLTS
DC GRID VOLTAGE	-1000	VOLTS
DC PLATE CURRENT	3.0	AMPERES
DC GRID CURRENT	0.5	AMPERE
PLATE INPUT POWER	30,000	WATTS
PLATE DISSIPATION	10,000	WATTS

TYPICAL OPERATION (Frequencies to 90 MHz)[2]

Plate Voltage	7000	9000	Vdc
Grid Voltage	-700	-900	Vdc
Plate Current	2.88	2.90	Adc
Grid Current [1]	0.18	0.18	Adc
Peak rf Grid Voltage[1]	250	250	v
Calculated Driving Power	170	215	W
Plate Input Power	20.15	26.10	kW
Plate Dissipation	5.15	5.50	kW
Plate Output Power	15.0	20.6	kW
Resonant Load Impedance	1120	1470	Ω

1. Approximate value.
2. Loaded Conditions

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurment. 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 at 7.5 volts	72	77	A
Interelectrode Capacitances[1] (grounded filament connection)			
Input	46.0	56.0	pF
Output	1.35	1.65	pF
Feedback	22.0	28.0	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CW10,000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

COOLING - Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 15°C temperature rise of water from inlet to outlet.

MINIMUM WATER-COOLING REQUIREMENT		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
8	3.2	5.5
10	4.4	8.1
12	5.8	13.4

Additional stem cooling air must be provided. 8 CFM of air directed against the center filament contact ring ½ inch below the outer filament contact ring by a 1½ inch I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

ELECTRICAL

FILAMENT - The rated filament voltage for the 3CW10,000H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

GRID OPERATION - The grid current rating is 0.5 ampere dc. This value should not be exceeded for more than very 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 0.25 ampere 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 150 watts.

PLATE OPERATION - 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 variations in loading.

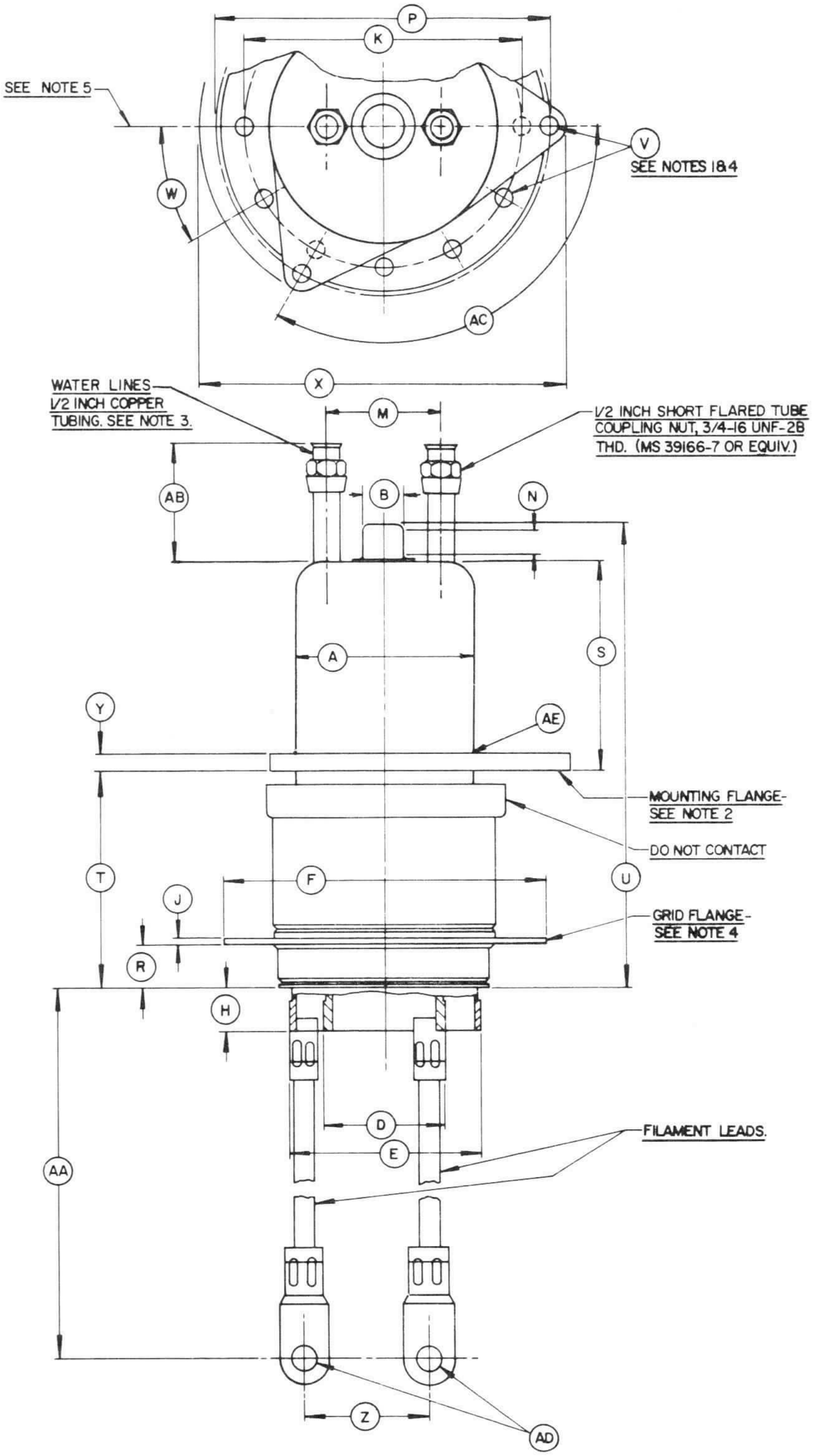
HIGH VOLTAGE - The 3CW10,000H3 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies 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.

X-RAY RADIATION - The 3CW10,000H3, operating at its maximum rated voltage and current, as an industrial oscillator is a potential X-ray hazard. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to changes in leakage paths or emission characteristics as they are affected by high voltage. Only limited shielding is afforded by the tube envelope. Additional X-ray shielding must be provided on all sides of the tube to provide adequate protection to operating personnel throughout the tube's life. X-ray caution signs or labels must be permanently attached to equipment using this tube directing operating personnel never to operate this device without X-ray shielding in place.

RADIO FREQUENCY RADIATION - Exposure of the human body to rf radiation becomes increasingly more hazardous as the power level and/or frequency are increased. Exposure to high-power rf radiation must be strictly prevented at any frequency.

Equipment must be designed to fully safeguard all personnel from these hazards. Labels and caution notices must be provided on equipment and in manuals clearly warning of these hazards.

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

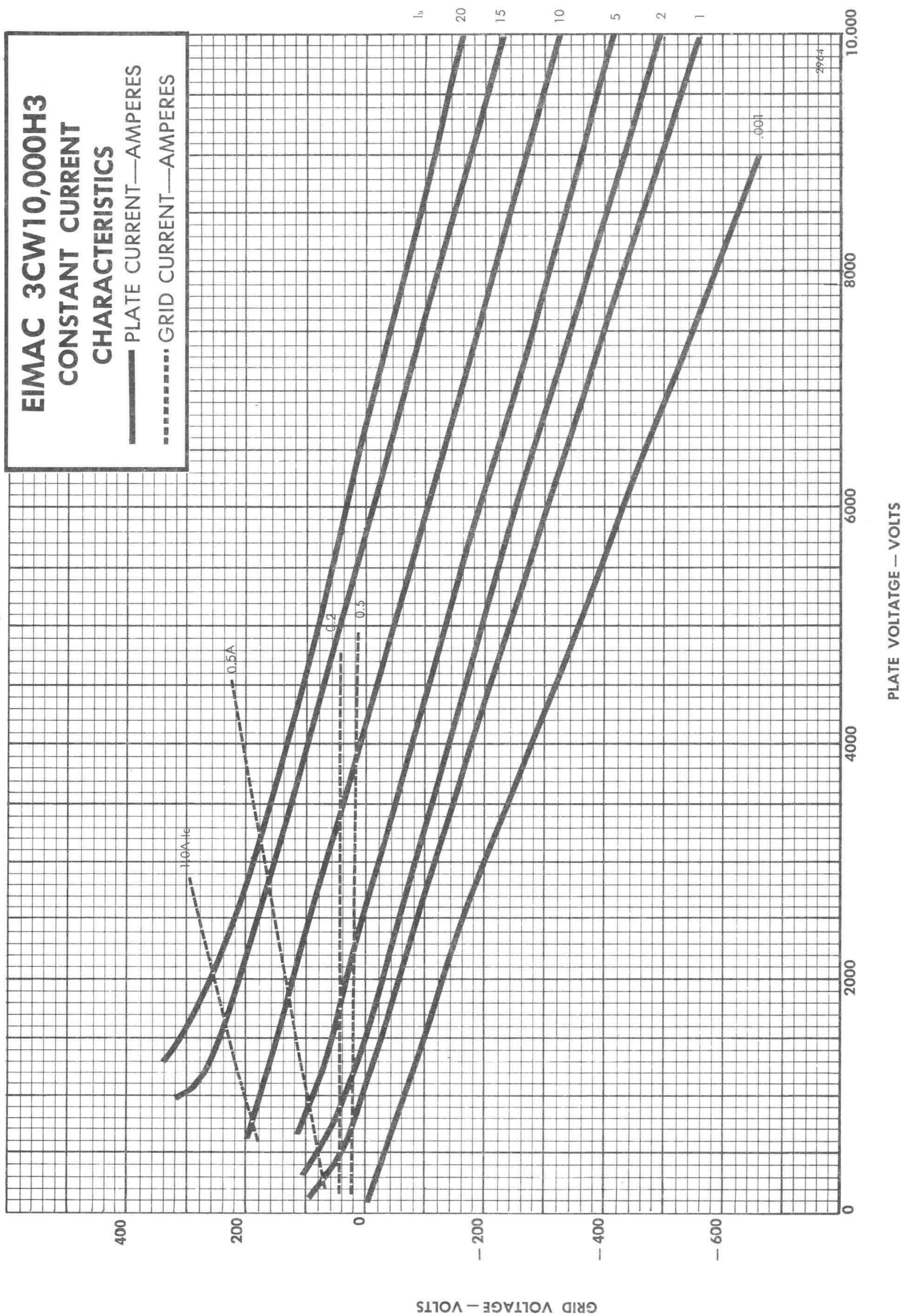


DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.830	3.030	- -	71.88	76.96	- -
B	0.860	0.890	- -	21.84	22.61	- -
D	- -	- -	1.875	- -	- -	47.63
E	- -	- -	3.250	- -	- -	82.55
F	5.030	5.090	- -	127.76	129.29	- -
H	0.530	0.700	- -	13.46	17.78	- -
J	- -	- -	0.125	- -	- -	3.18
K	4.425	4.445	- -	112.40	112.90	- -
M	- -	- -	1.900	- -	- -	48.26
N	0.375	- -	- -	9.53	- -	- -
P	5.990	6.010	- -	152.15	152.65	- -
R	0.700	0.860	- -	17.78	21.84	- -
S	- -	- -	3.350	- -	- -	85.09
T	4.000	4.150	- -	101.60	105.41	- -
U	8.000	8.400	- -	203.20	213.36	- -
V	- -	- -	0.265	- -	- -	6.73
W	29°	31°	- -	29°	31°	- -
X	6.700	6.800	- -	170.18	172.72	- -
Y	- -	- -	0.250	- -	- -	6.35
Z	- -	- -	2.000	- -	- -	50.80
AA	8.500	9.000	- -	215.90	228.60	- -
AB	- -	- -	2.250	- -	- -	57.15
AC	118°	122°	- -	118°	122°	- -
AD	- -	- -	0.390	- -	- -	9.91
AE	- -	- -	0.062R	- -	- -	1.57R

NOTES:

1. REF. DIMS. ARE FOR INFO. ONLY & ARE NOT FOR INSPECTION PURPOSES.
2. 3 MOUNTING HOLES IN MTG. FLANGE.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. 12 HOLES IN GRID FLANGE.
5. MTG. FLANGE, FIL. LEADS & WATER FITTING ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW10,000H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT—AMPERES
GRID CURRENT—AMPERES
PLATE VOLTATGE — VOLTS
GRID VOLTAGE — VOLTS
Ib
20
15
10
5
2
1
.001
1.0A Ic
0.5A
0.2
0.5
0
2000
4000
6000
8000
10,000
400
200
0
-200
-400
-600
2964

3CW20,000A1

TECHNICAL DATA

WATER-COOLED
LOW-MU
POWER TRIODE

The EIMAC 3CW20,000A1 is a ceramic/metal power triode intended primarily for use as an audio amplifier or modulator. This tube is also recommended for voltage-regulator applications where high current capability and low tube drop are important. Up to 20 kilowatts of plate power can be dissipated on its water-cooled anode. Except for plate dissipation, the tube is electrically identical to the 8158/3CX10,000A1.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten	
Voltage	7.5 ± 0.37 V
Current, at 7.5 volts	100 A
Amplification Factor (average)	6.2
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	51.0 pF
Cout	4.1 pF
Cgp	28.5 pF
Transconductance (I_b = 2.0 Adc, E_b = 3000 Vdc)	20,000 μmhos
Frequency of Maximum Rating (CW)	110 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	11.22 In; 28.49 cm
Diameter	4.66 In; 11.83 cm
Net Weight	12 lbs; 5.5 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Envelope & Ceramic/Metal Seals	250°C
Cooling	Water and Forced Air
Base	Coaxial
Recommended Socket	EIMAC SK-1300

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR
Class AB_1

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	100	WATTS

1. Adjust for Zero-Signal plate current.
2. Approximate value.

Effective grid circuit resistance must not exceed 20,000 ohms.

TYPICAL OPERATION, Two Tubes
Sinusoidal Wave

Plate Voltage	7000	7000	Vdc
Grid Voltage [1]	-1300	-1300	Vdc
Zero-Sig Plate Current	1.5	1.5	Adc
Max-Sig Plate Current	5.8	7.0	Adc
Load Res. Plate-to-Plate	2460	1720	Ω
Peak af Drive Voltage [2] (per tube)	1300	1300	v
Max-Sig Driving Power	0	0	W
Max-Sig Plate Output Power	24.4	29.1	kW
Total Harmonic Distortion [2]	2.9	3.6	%

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR
Class A

MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	See Class A derating table on P. 3.	
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	100	WATTS

TYPICAL OPERATION

Plate Voltage	2500	Vdc
Grid Voltage [1]	-290	Vdc
Plate Current	4.0	Adc
Peak af Driving Voltage [2]	290	v
Load Resistance	212	Ω
Max. Sig. Plate Output Power [2]	1800	W
Second Harmonic Distortion [2]	6.75	%

1. Adjust for specified dc plate current.
2. Approximate value.

VOLTAGE REGULATOR SERVICE
Class A

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	See Class A derating table on P. 3.	
PLATE DISSIPATION	12,000	WATTS
GRID DISSIPATION	100	WATTS

TYPICAL OPERATION

Plate Voltage (Tube drop)	5000	Vdc
Plate Current	0-2.0	Adc

(These values are chosen according to the Class A derating table on Page 3).

NOTE: TYPICAL OPERATION data are obtained by measurement or calculation from published characteristic curves. Adjustment of the 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.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	94.0	104.0	A
Amplification Factor	4.8	6.8	
Interelectrode Capacitances (grounded cathode connection) [1]			
Cin	45.0	57.0	pF
Cout	3.6	4.5	pF
Cgp	25.0	32.0	pF

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

APPLICATIONS

MECHANICAL

MOUNTING - The 3CW20,000A1 must be operated vertically, anode down or up, and should be protected from shock and vibration. The EIMAC SK-1300 socket is available and recommended for simultaneously holding the tube in position and making all base contacts.

COOLING - The anode of the 3CW20,000A1 is cooled by circulating water through the integral water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes a temperature rise for the water of 10°C. Inlet water temperature should never exceed 55°C and outlet water temperature should never exceed 70°C. Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure should not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Dissipation (watts)	Water Flow (gpm)	Press. Drop Approx. psi
10,000	11	11.5
15,000	12	13.5
20,000	14	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 $K\Omega/cm^3$, and preferably above 250 $K\Omega/cm^3$. A relative water resistance check can be made by continuously measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with 30 to 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the filament and grid contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

VOLTAGE REGULATOR OR CLASS A SERVICE - Maximum dc plate current and voltage are restricted according to the following table:

CLASS A DERATING TABLE	
DC Plate Voltage (Volts)	Max. DC Plate Current (mA)
0 - 2400	5000
3000	4000
4000	3000
5000	2000
6000	1500
7000	1000
8000	700
9000	500
10,000	350

FILAMENT OPERATION - Filament voltage should be measured at the socket with a one percent accuracy, rms responding meter. The peak emission capability of the tube at rated filament voltage is normally many times that required for for communication or regulator service, and a small decrease in filament temperature due to a reduction in filament voltage can increase the life of the tube by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect the equipment operation. This is done by measuring some important parameter of performance, such as plate current or power output, while filament voltage is slowly reduced. At some point in filament voltage there will be a noticeable reduction in plate current or power output, and operation must be at a filament voltage slightly higher than the point at which performance appeared to deteriorate. This point should be periodically checked to maintain proper operation, and line or filament voltage regulation must be such that this procedure for operating at slightly reduced voltage is feasible.

STANDBY OPERATION - Both anode and base cooling must be applied whenever filament power is applied even though no other voltages are present, since sixty to eighty percent of the filament power appears as heat at the anode. In the absence of cooling, temperatures will rise to levels which are detrimental to long life, and if the anode coolant lines are obstructed the cooling jacket may rupture from generated steam pressure.

HIGH VOLTAGE - Normal operating voltages used with the 3CW20,000A1 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.

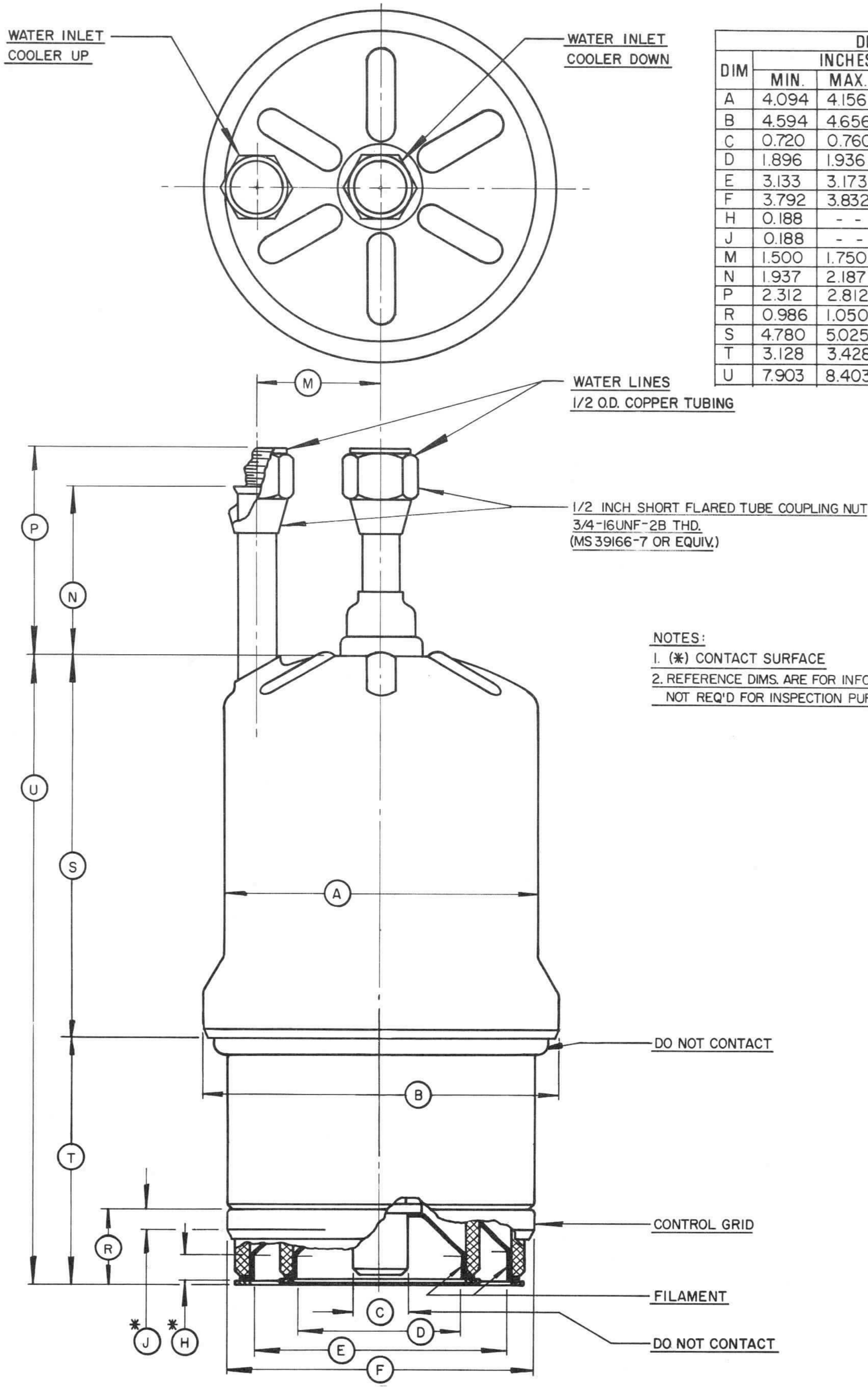
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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 the 3CW-20,000A1, 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.

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.

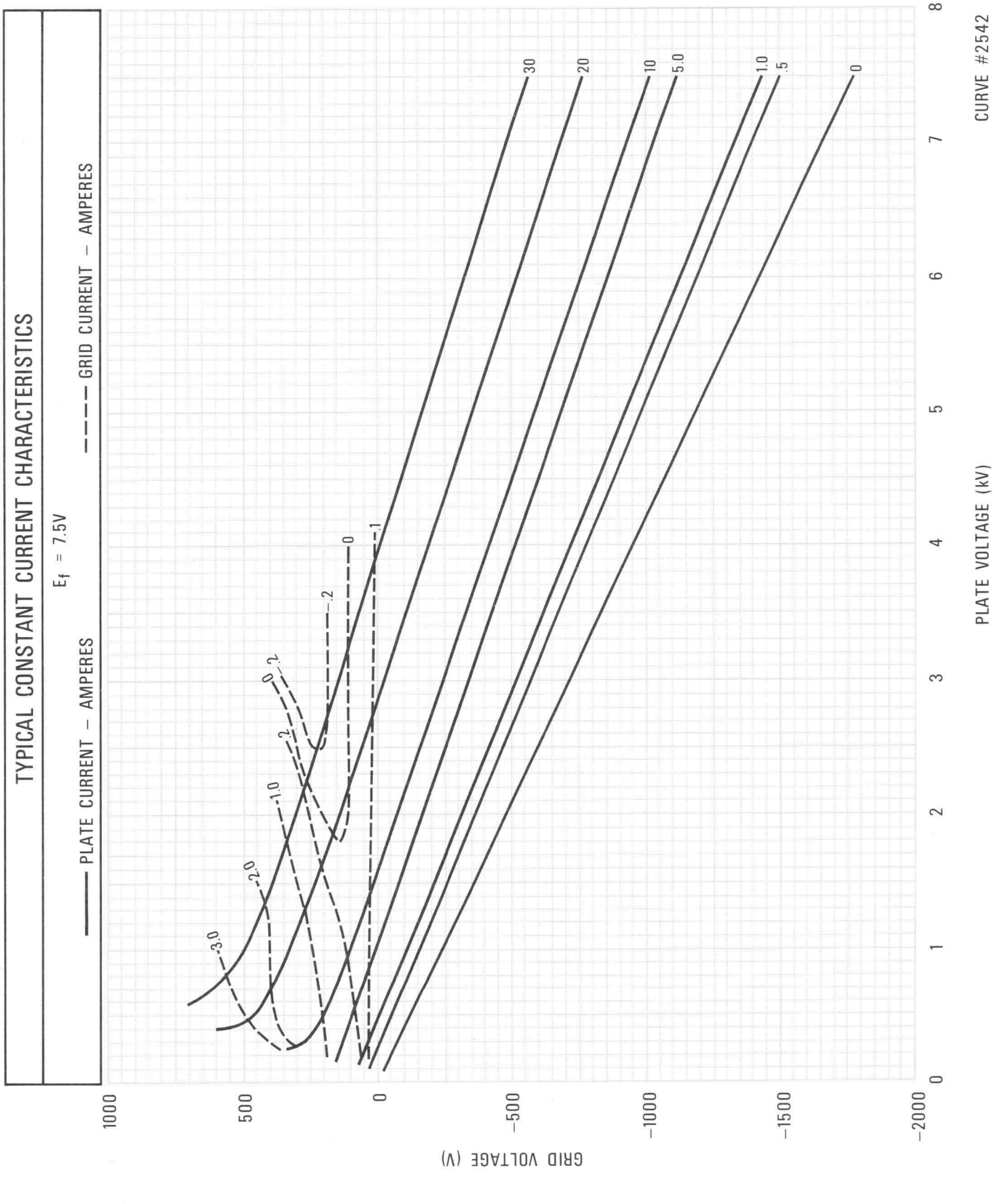
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for information and recommendations.

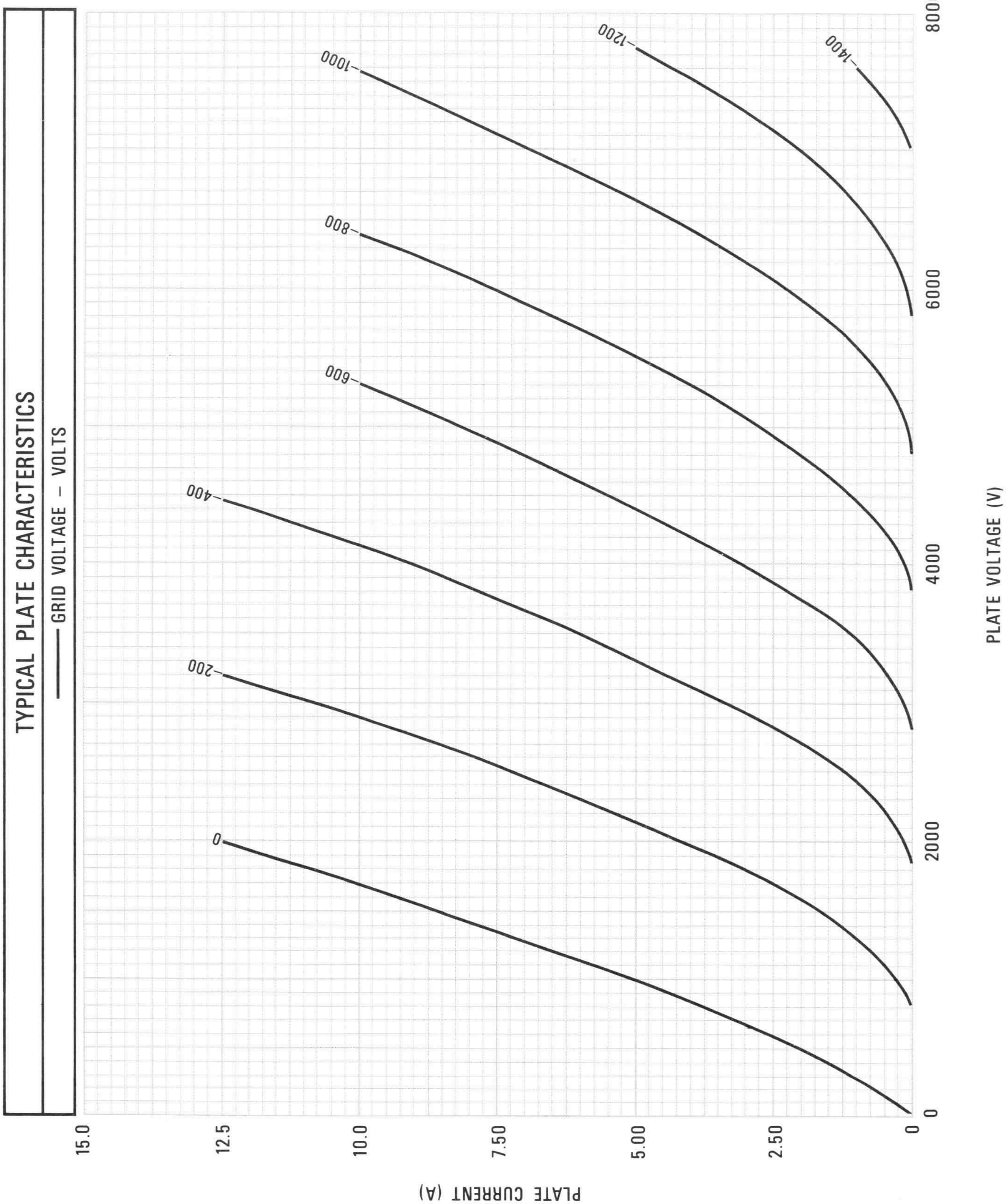


DIM	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	4.594	4.656	- -	116.69	118.26	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
M	1.500	1.750	- -	38.10	44.45	- -
N	1.937	2.187	- -	49.20	55.55	- -
P	2.312	2.812	- -	58.72	71.42	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	4.780	5.025	- -	121.41	127.64	- -
T	3.128	3.428	- -	79.45	87.07	- -
U	7.903	8.403	- -	200.74	213.44	- -

DIMENSIONAL DATA

NOTES:
1. (*) CONTACT SURFACE
2. REFERENCE DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
E_f = 7.5V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
CURVE #2542
30
20
10
5.0
1.0
.5
0
.1
.2
1.0
2.0
3.0
0
1
2
3
4
5
6
7
8
1000
500
-500
-1000
-1500
-2000


TYPICAL PLATE CHARACTERISTICS
GRID VOLTAGE – VOLTS
0
-200
-400
-600
-800
-1000
-1200
-1400
PLATE VOLTAGE (V)
0
2000
4000
6000
8000
PLATE CURRENT (A)
0
2.50
5.00
7.50
10.0
12.5
15.0

TECHNICAL DATA

3CW20,000A3

WATER-COOLED MEDIUM-MU POWER TRIODE

The EIMAC 3CW20,000A3 is a ceramic/metal power triode intended primarily for use as a power oscillator in industrial-heating applications. It is also recommended for use as a grounded-grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier.

The anode dissipation rating is 20,000 watts with water cooling.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.4	V
Current, at 7.5 V	100	A
Amplification Factor (Average)	20	
Direct Interelectrode Capacitances [2]		
Cin	53	pF
Cout	1.35	pF
Cgp	34	pF
Frequency of Maximum Ratings (CW)	140	MHz

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.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special, Coaxial
Recommended Air System Socket	EIMAC SK-1300
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperature:	
Envelope and Ceramic/Metal Seals	250°C
Maximum Overall Dimensions:	
Length	10.21 in; 259.3 mm
Diameter	4.65 in; 118.1 mm
Net Weight	12 lbs; 5.5 kg

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER PLATE-MODULATED

Class C

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	13.5	KILOWATTS
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

DC Plate Voltage	4000	5000	Vdc
DC Grid Voltage	-480	-600	Vdc
DC Plate Current	3.0	3.0	Adc
DC Grid Current	660	550	mAdc
Driving Power	530	515	W
Plate Output Power	9.7	12.4	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Grounded-Grid, Class AB2

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20	KILOWATTS
GRID DISSIPATION	250	WATTS

1. Adjust to give specified zero-signal dc plate current.

TYPICAL OPERATION

DC Plate Voltage	6000	7000	Vdc
DC Grid Voltage[1]	-270	-325	Vdc
Zero-Sig. Plate Current	500	500	mAdc
Max-Sig DC Plate Current	4.0	4.0	Adc
Max-Sig DC Grid Current	300	250	mAdc
Peak RF Grid Voltage	540	585	v
Driving Power	1900	2050	W
Plate Output Power	18	20	kW

RADIO-FREQUENCY INDUSTRIAL OSCILLATOR

Class C

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	20	KILOWATTS
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION, Optimum Load

DC Plate Voltage	6000	7000	Vdc
DC Grid Voltage	-575	-670	Vdc
DC Plate Current	4.0	4.0	Adc
DC Grid Current	610	670	mAdc
Plate Input Power	24	28	kW
Plate Output Power	18.9	22.4	kW

RADIO-FREQUENCY POWER AMPLIFIER

Grounded-Grid, Class C

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	20	KILOWATTS
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

DC Plate Voltage	6000	7000	Vdc
DC Grid Voltage	-535	-625	Vdc
DC Plate Current	4.0	4.0	Adc
DC Grid Current	545	530	mAdc
Driving Power	3700	4100	W
Plate Output Power	20.5	24.5	kW

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurement. 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 at 7.5 Volts	94.0	104.0	A
Interelectrode Capacitance (grounded cathode connection)[1]			
Cin	48.0	58.0	pF
Cout	1.2	1.5	pF
Cgp	30.0	38.0	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CW20,000A3 must be operated vertically, anode down or up, and should be protected from shock and vibration.

COOLING - The anode of the 3CW20,000A3 is cooled by circulating water through the integral anode water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes a temperature rise for the water of 10°C. Inlet water temperature should never exceed 55°C and outlet water temperature should never exceed 70°C. Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure must not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop Approx. psi
10	11.0	11.5
15	12.0	13.5
20	14.0	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 $K\Omega/cm^3$, and preferably above 250 $K\Omega/cm^3$. A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with 30 to 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the grid and filament contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the terminals with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 3CW20,000A3 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 3CW20,000A3 by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate.

INPUT CIRCUIT - When the 3CW20,000A3 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 two or more.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

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 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.

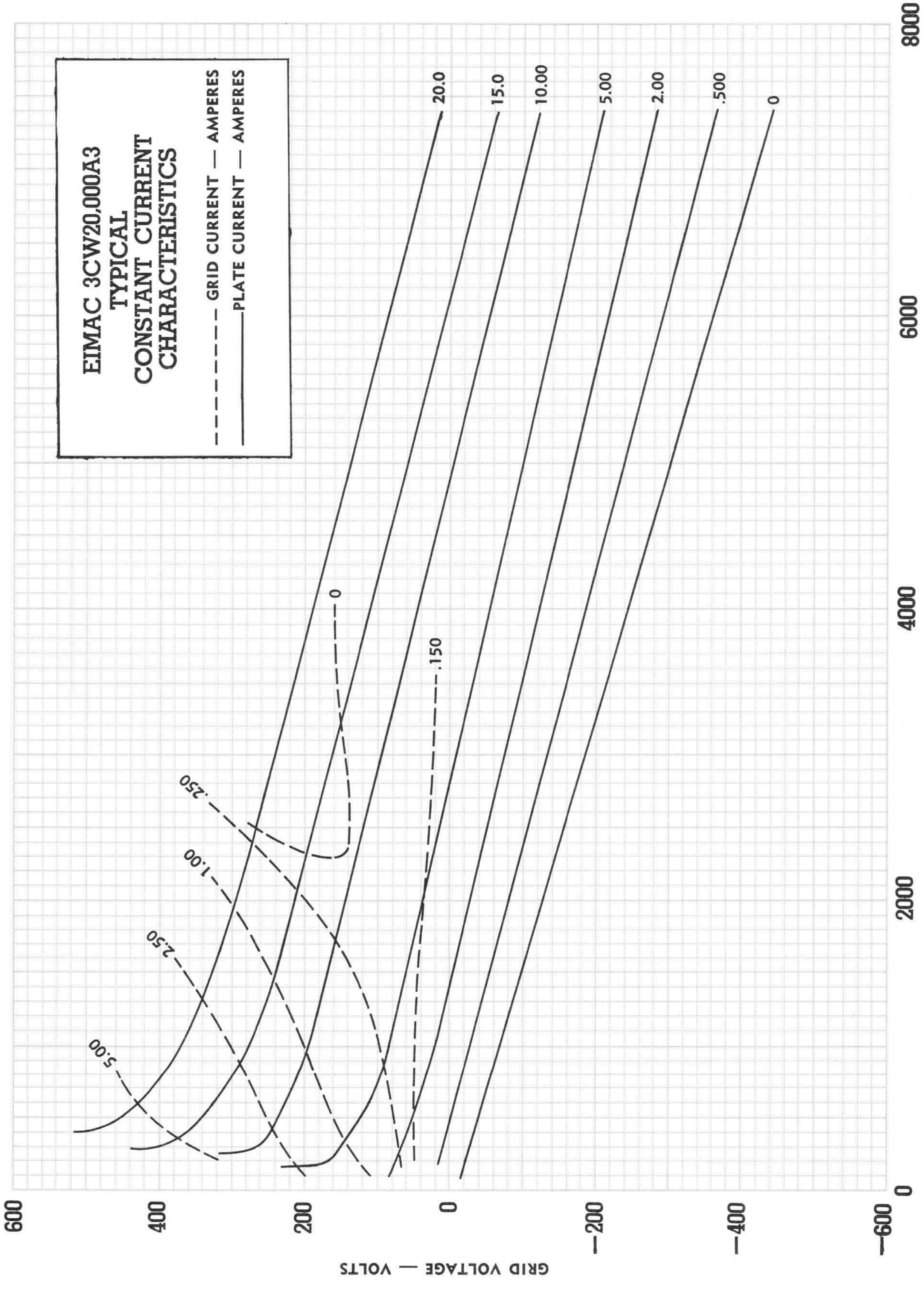
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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 the 3CW-20,000A3, 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 invloved, 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.

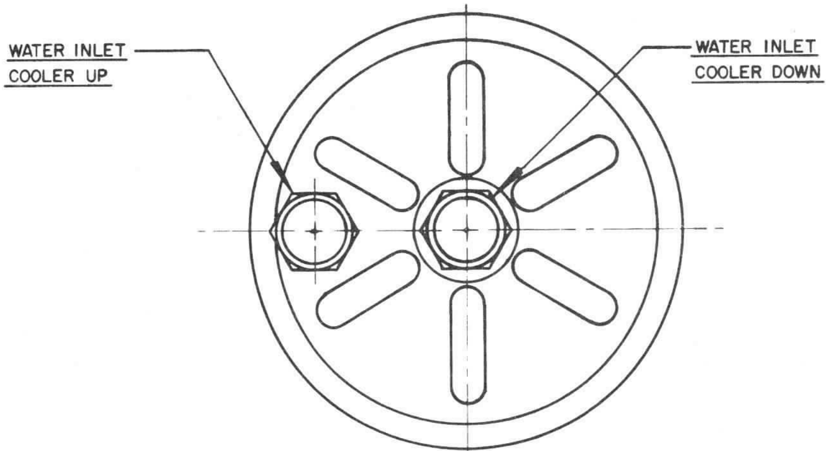
FAULT PROTECTION - In addition to normal plate over-current interlock and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

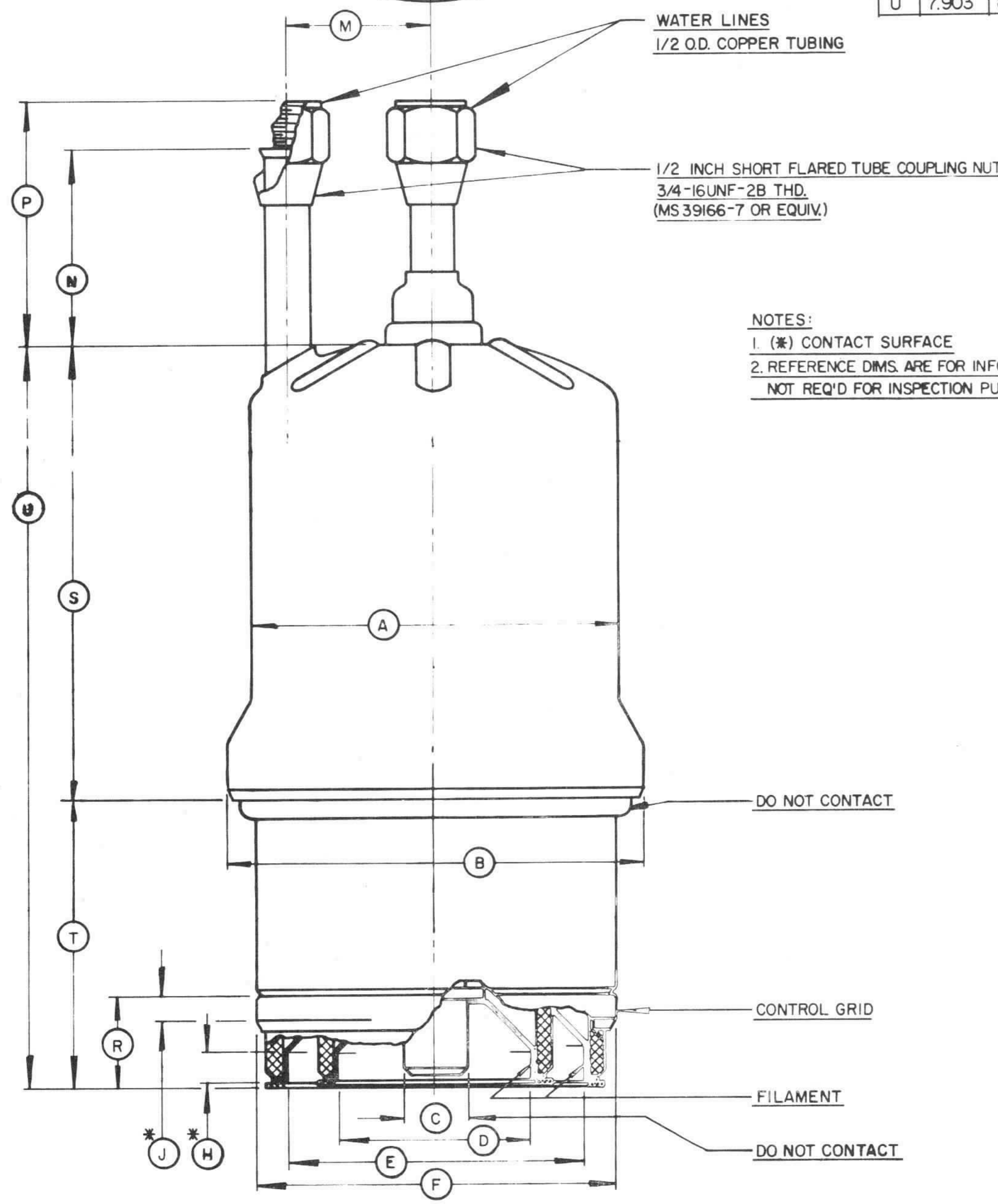
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


EIMAC 3CW20,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
20.0
15.0
10.00
5.00
2.00
.500
0
0
.150
.250
1.00
2.50
5.00
PLATE VOLTAGE — VOLTS
0
2000
4000
6000
8000
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600

3CW20,000A3



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	104.0	105.6	- -
B	4.594	4.656	- -	116.7	118.3	- -
C	0.600	0.760	- -	15.2	19.3	- -
D	1.896	1.936	- -	48.2	49.2	- -
E	3.133	3.173	- -	79.6	80.6	- -
F	3.792	3.832	- -	96.3	97.3	- -
H	0.188	- -	- -	4.8	- -	- -
J	0.188	- -	- -	4.8	- -	- -
M	1.500	1.750	- -	38.1	44.4	- -
N	1.937	2.187	- -	49.2	55.5	- -
P	2.312	2.812	- -	58.7	71.4	- -
R	0.986	1.050	- -	25.0	26.7	- -
S	4.780	5.025	- -	121.4	127.6	- -
T	3.128	3.428	- -	79.4	87.1	- -
U	7.903	8.403	- -	200.7	213.4	- -



NOTES:
1. (*) CONTACT SURFACE
2. REFERENCE DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.

TECHNICAL DATA

3CW20,000A7

WATER-COOLED HIGH-MU POWER TRIODE

The Eimac 3CW20,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3CW20,000A7.

The 3CW20,000A7 is electrically identical to the air-cooled 3CX10,000A7 except for its 20kW plate dissipation rating.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amperes
Amplification Factor		200		

Direct Interelectrode Capacitances:	Min.	Max.
Grid-Filament	50.0	62.0 uuf
Grid-Plate	32.0	40.0 uuf
Plate-Filament		0.3 uuf
Frequency for Maximum Ratings		140 Mc

MECHANICAL

Base	Coaxial
Recommended Socket	Eimac SK-1300
Operating Position	Vertical, base up or down
Cooling	Water and Forced air
Maximum Operating Temperatures:	
Anode Core	250° C
Ceramic-to-Metal Seals	250° C
Maximum Dimensions:	
Height	11.4 inches
Diameter	4.7 inches
Net Weight	12 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Grounded Grid, Class-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENTS	5.0 MAX. AMPS
PLATE DISSIPATION	20 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Values

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000 volts
Zero-Sig DC Plate Current*	0.60	0.60 amps
Max-Sig DC Plate Current	3.72	5.00 amps
Max-Sig DC Grid Current	0.71	1.00 amp
Driving Impedance	35	32 ohms
Resonant Load Impedance	1020	745 ohms
Max-Sig Driving Power	885	1540 watts
Peak Envelope Plate Output Power	17,700	24,200 watts
Power Gain	20.0	15.7 times

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-B, Grid Driven

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	20 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Values

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	5000	7000	volts
DC Grid Voltage	0	0	volts
Zero-Sig DC Plate Current*	1.2	1.2	amps
Max-Sig DC Plate Current	10.0	10.0	amps
Max-Sig DC Grid Current	1.2	2.1	amps
Driving Power	290	560	watts
Peak AF Driving Voltage (Per Tube)	240	310	volts
Load Resistance, Plate-to-Plate	1030	1520	ohms
Max-Sig Plate Output Power	31,000	47,700	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Carrier Conditions, Grounded-Grid, Class-B_2

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	20 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

*Approximate Values
†Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000	volts
DC Grid Voltage	0	volts
Zero-Sig DC Plate Current*	0.6	amp
DC Plate Current	2.4	amps
DC Grid Current	0.25	amp
Driving Impedance†	32	ohms
Peak Driving Voltage†	310	volts
Driving Power	330	watts
Plate Output Power	5650	watts

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR, Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX.VOLTS
DC PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	20 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Plate Current	4.0	4.0	amps
DC Grid Voltage	-210	-230	volts
DC Grid Current	840	775	mA
Peak RF Grid Voltage	510	555	volts
Grid Driving Power	420	530	watts
Plate Output Power	14	21.3	kW

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER, Class-C

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500 MAX. VOLTS
DC PLATE CURRENT	3.0 MAX. AMPS
PLATE DISSIPATION†	13.5 MAX. KW
GRID DISSIPATION	500 MAX. WATTS

†Corresponds to 20 kW at 100% sine-wave modulation

TYPICAL OPERATION

DC Plate Voltage	5000	volts
DC Plate Current	3.0	amps
DC Grid Voltage	-200	volts
DC Grid Current	775	mA
Peak RF Grid Voltage	490	volts
Grid Driving Power	380	watts
Plate Output Power	11.9	kW

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Adjustment of the rf grid drive to obtain the specified zero-signal plate current at the specified bias and plate voltage is assumed.

APPLICATION

MECHANICAL

Mounting—The 3CW20,000A7 must be operated vertically, base down or up. The tube must be protected from severe vibration and shock.

Socket—The SK-1300 socket is available for use with the 3CW20,000A7. Base cooling is accomplished by directing approximately 30 cfm of air at a static pressure of 0.1 inch through the socket and over the base seals.

Cooling—The anode of the 3CW20,000A7 is cooled by circulating water through the integral anode-water jacket. The table below lists minimum water-flow rates at various plate dissipation levels

Minimum Cooling Water-Flow Requirements

Plate Dissipation (kW))	Water Flow (gpm)	Pressure Drop (psi)
10	6.3	4.9
15	9.0	9.2
20	12.0	15.0

°Since power dissipated by the filament represents 750 watts and grid dissipation can reach 500 watts, 1250 watts has been added to anode dissipation in preparing this tabulation.

The cooling table assumes that the maximum outlet-water temperature will be below 70°C to preclude "spot" boiling. Further, inlet-water temperature must not exceed 60°C. In all cases, maximum system water pressure must not exceed 50 pounds per square inch. Water flow and air flow must be started before applying any voltages to the tube and may be stopped simultaneously with the removal of tube voltages. Suitable flow and temperature interlocks should be provided to protect the tube from inadequate flow rates.

ELECTRICAL

Filament—The rated filament voltage for the 3CW20,-000A7 is 7.5 volts Filament voltage, as measured at the socket, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

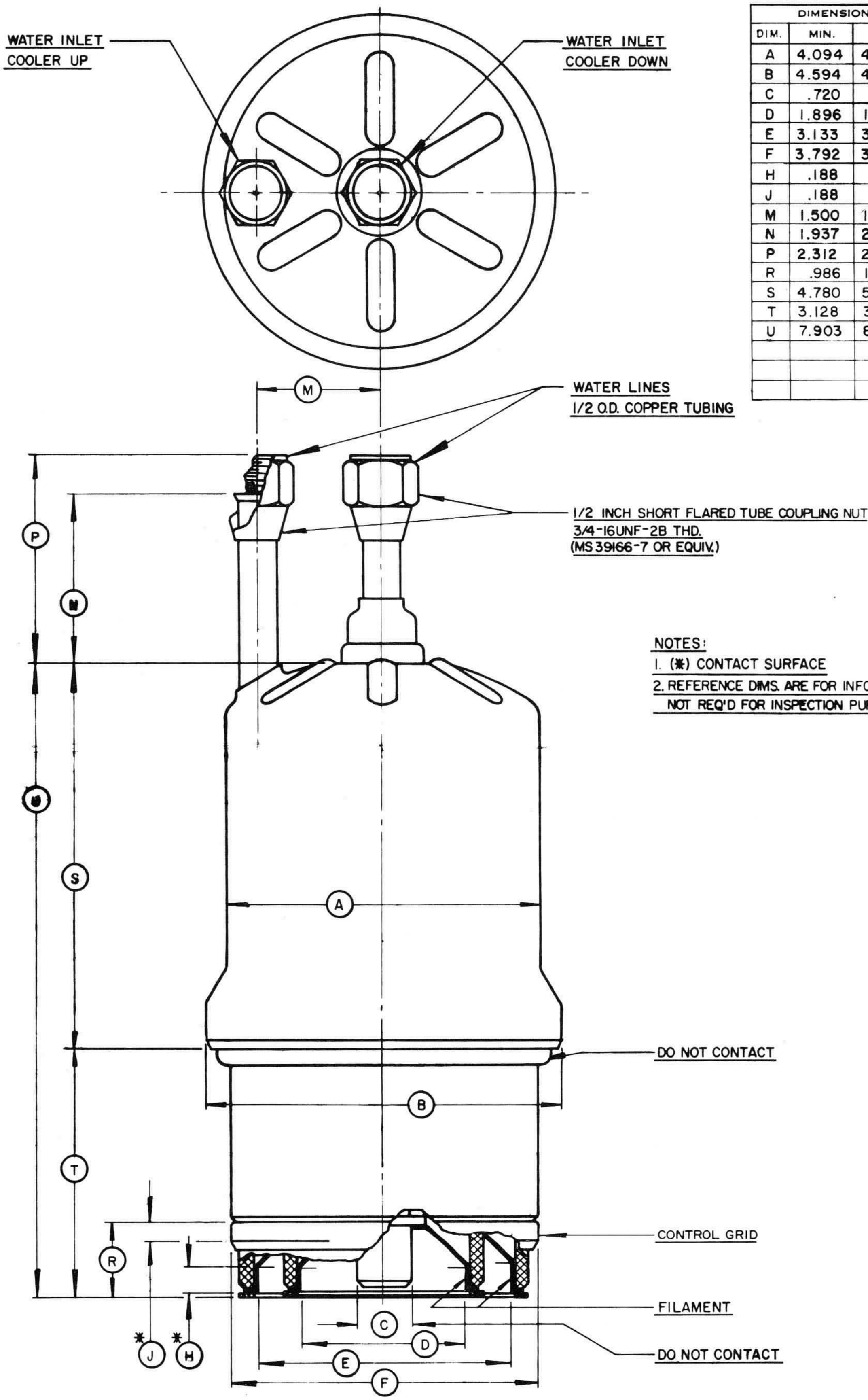
Input Circuit—When the 3CW20,000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank line in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a "Q" of two or more.

Class-C Operation—Although designed specifically for Class-B service, the 3CW20,000A7 may be operated as a Class-C amplifier or oscillator or as a plate-modulated radio-frequency amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power should fail, plate dissipation is then kept to a low value because the tube will be operating at normal, static, zero-bias conditions.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

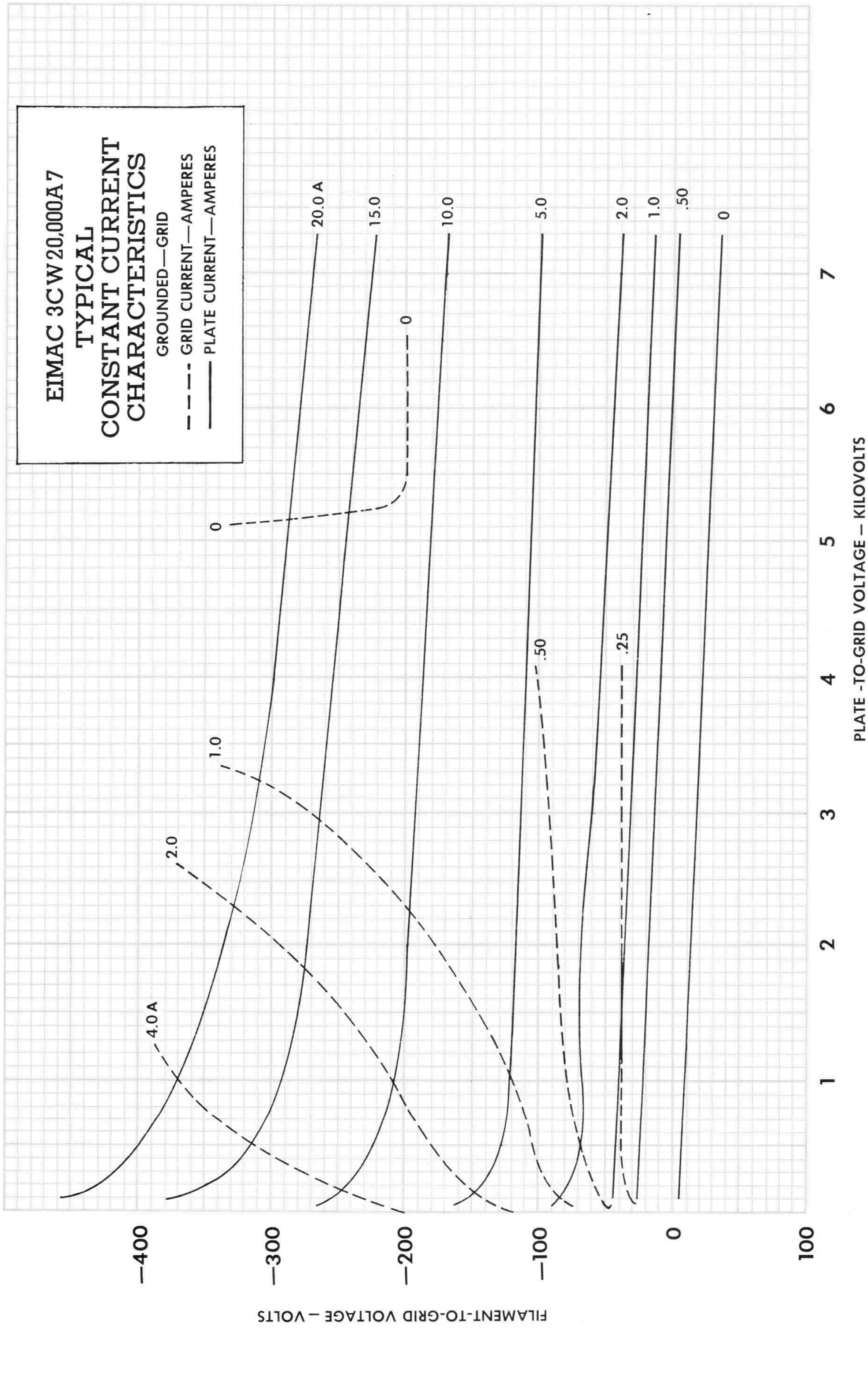
DIMENSIONS IN INCHES

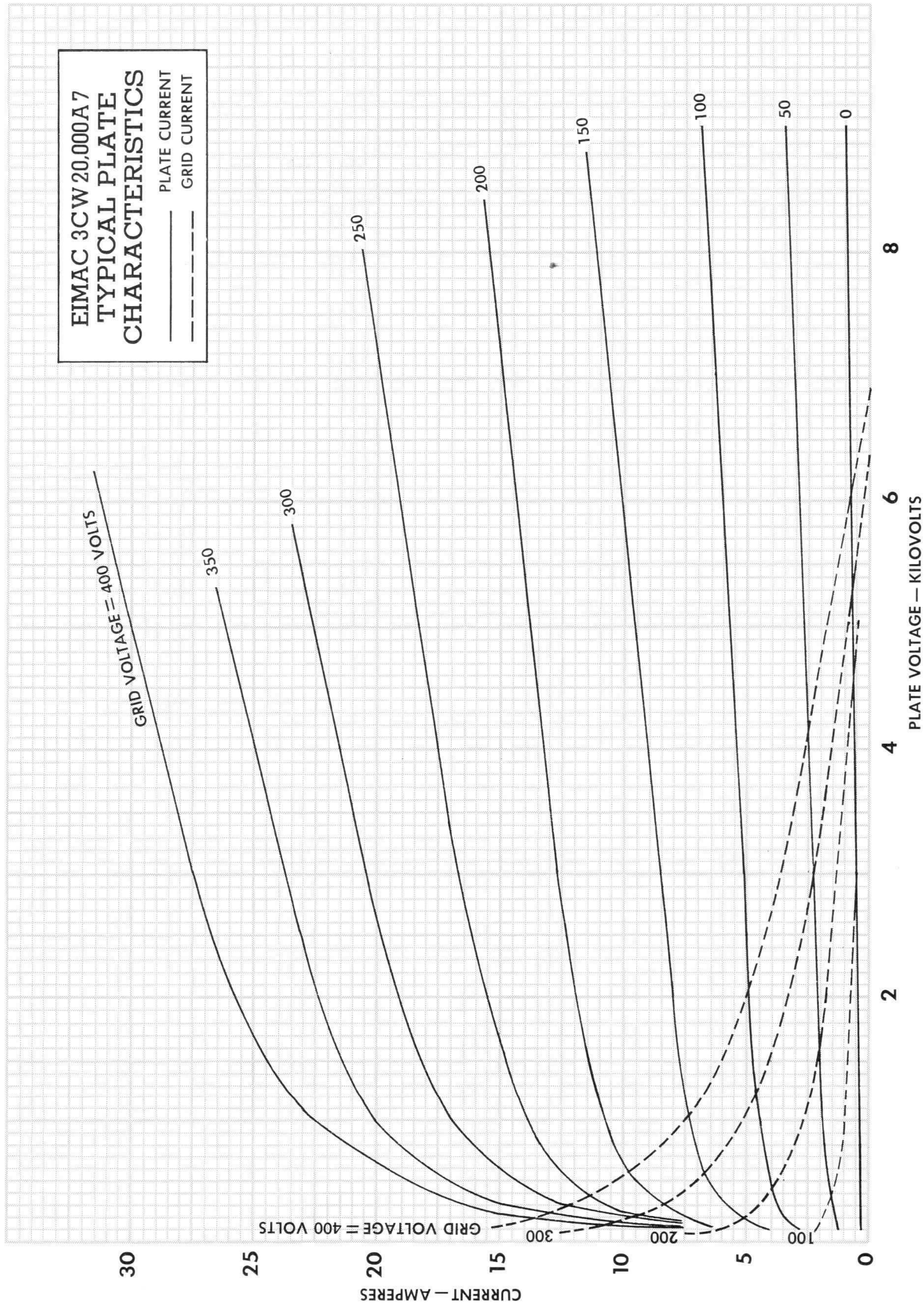
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.094	4.156	
B	4.594	4.656	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
H	.188		
J	.188		
M	1.500	1.750	
N	1.937	2.187	
P	2.312	2.812	
R	.986	1.050	
S	4.780	5.025	
T	3.128	3.428	
U	7.903	8.403	



NOTES:

1. (*) CONTACT SURFACE
2. REFERENCE DIMS. ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


EIMAC 3CW20,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
20.0 A
15.0
10.0
5.0
2.0
1.0
.50
0
0
1.0
2.0
4.0 A
.50
.25
1
2
3
4
5
6
7
PLATE -TO-GRID VOLTAGE — KILOVOLTS
−400
−300
−200
−100
0
100
FILAMENT-TO-GRID VOLTAGE — VOLTS


EIMAC 3CW20,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE = 400 VOLTS
300
200
100
CURRENT — AMPERES
0
5
10
15
20
25
30
PLATE VOLTAGE — KILOVOLTS
2
4
6
8

EIMAC

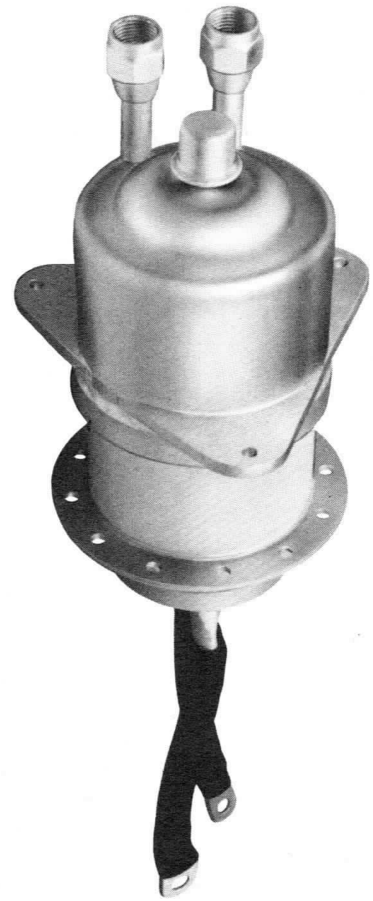
Division of Varian

SAN CARLOS CALIFORNIA

3CW20,000H3

MEDIUM-MU

WATER-COOLED POWER TRIODE



The Eimac 3CW20,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 20 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 40 kilowatts is permissable up to 90 megacycles. Plentiful reserve emission is available from its 750 watt filament. The grid structure is rated at 250 watts, making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated-Tungsten				
Voltage		7.5		volts
Current	94		104	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	$\mu\mu$f
Plate-Filament	1.2		1.5	$\mu\mu$f
Grid-Plate	30		38	$\mu\mu$f
Frequency for Maximum Ratings			90	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,000 VOLTS
DC PLATE CURRENT	4.0 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	0.6 AMP
PLATE INPUT POWER	40 KW
PLATE DISSIPATION (NOMINAL)	20 KW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000 volts
DC Plate Current	4.0	4.0 amps
DC Grid Voltage	—670	—800 volts
DC Grid Current	.275	.315 amps
Peak Positive Grid Voltage	340	340 volts
Driving Power	260	340 watts
Plate Input Power	28	40 kW
Plate Dissipation	9	12 kW
Plate Output Power	19	28 kW
Approximate Load Impedance	720	1270 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW20,000H3 is 7.5 volts. Filament voltage, as measured at the tube, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

Control Grid Operation

The grid current rating is 0.6 ampere dc. This value should not be exceeded for more than very short periods such as during tuning and overcurrent protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.2 to 0.4 amp 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 250 watts.

Plate Operation

Maximum plate voltage rating of 12,000 volts and maximum plate current of 4.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded. The 40 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load 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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW20,000H3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting

The 3CW20,000H3 must be mounted vertically, either base up or down.

Cooling

The anode of the 3CW20,000H3 is cooled by circulating water through the integral anode-water jacket. The table below lists minimum water-flow rates at various plate dissipation levels. The table is based upon a water temperature rise of 20°C.

MINIMUM COOLING WATER-FLOW REQUIREMENTS

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
10	2	2.5
15	3	3.0
20	4	3.5
25	5	4.0

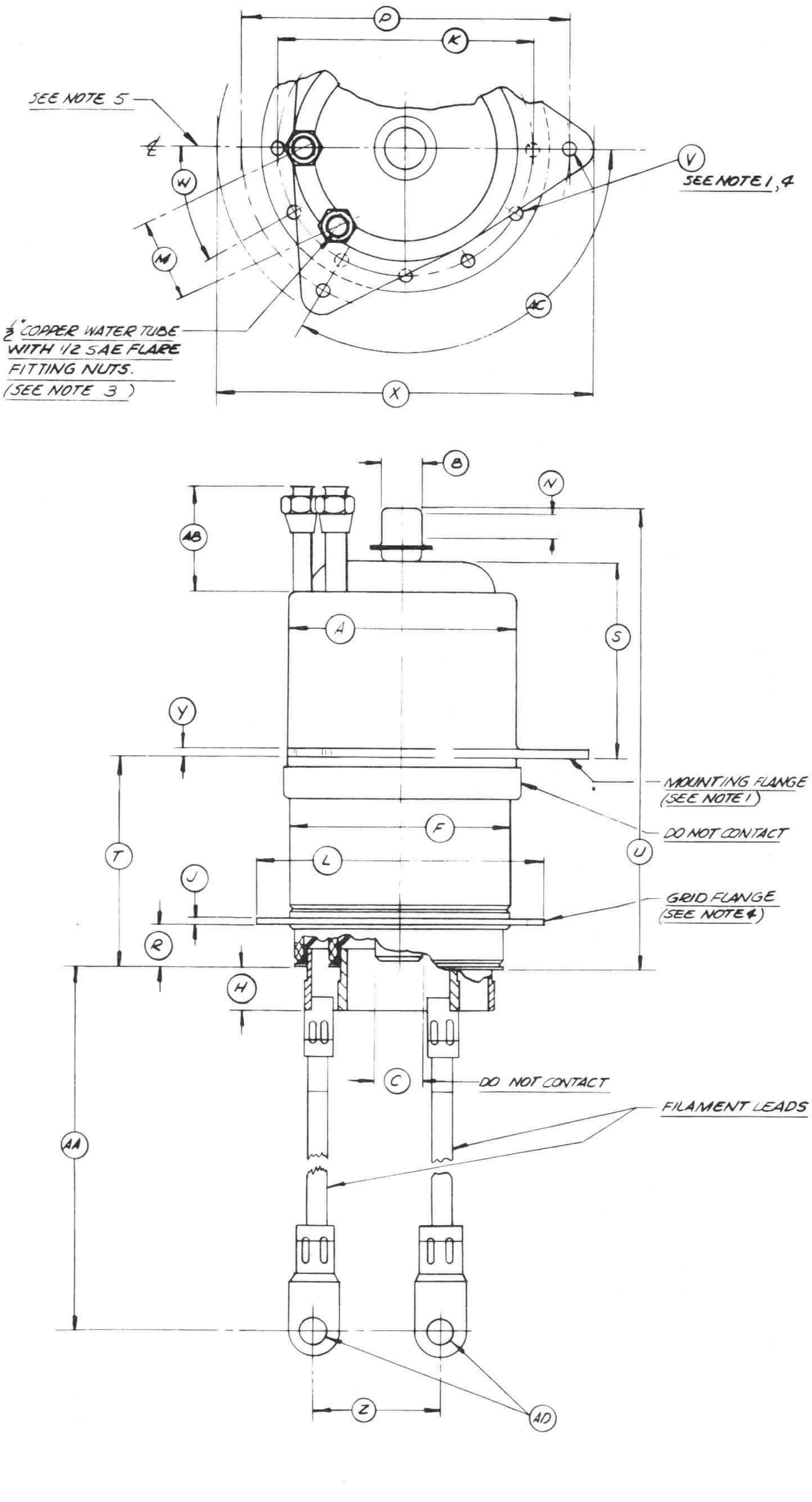
Since power dissipated by the filament represents 750 watts and grid dissipation can reach 250 watts, 1000 watts has been added to anode dissipation in preparing this tabulation.

The cooling table assumes that the maximum outlet-water temperature will be below 70°C to preclude "spot" boiling.

Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 40 cfm of cooling air directed into the base structure will generally satisfy this requirement.

Special Application

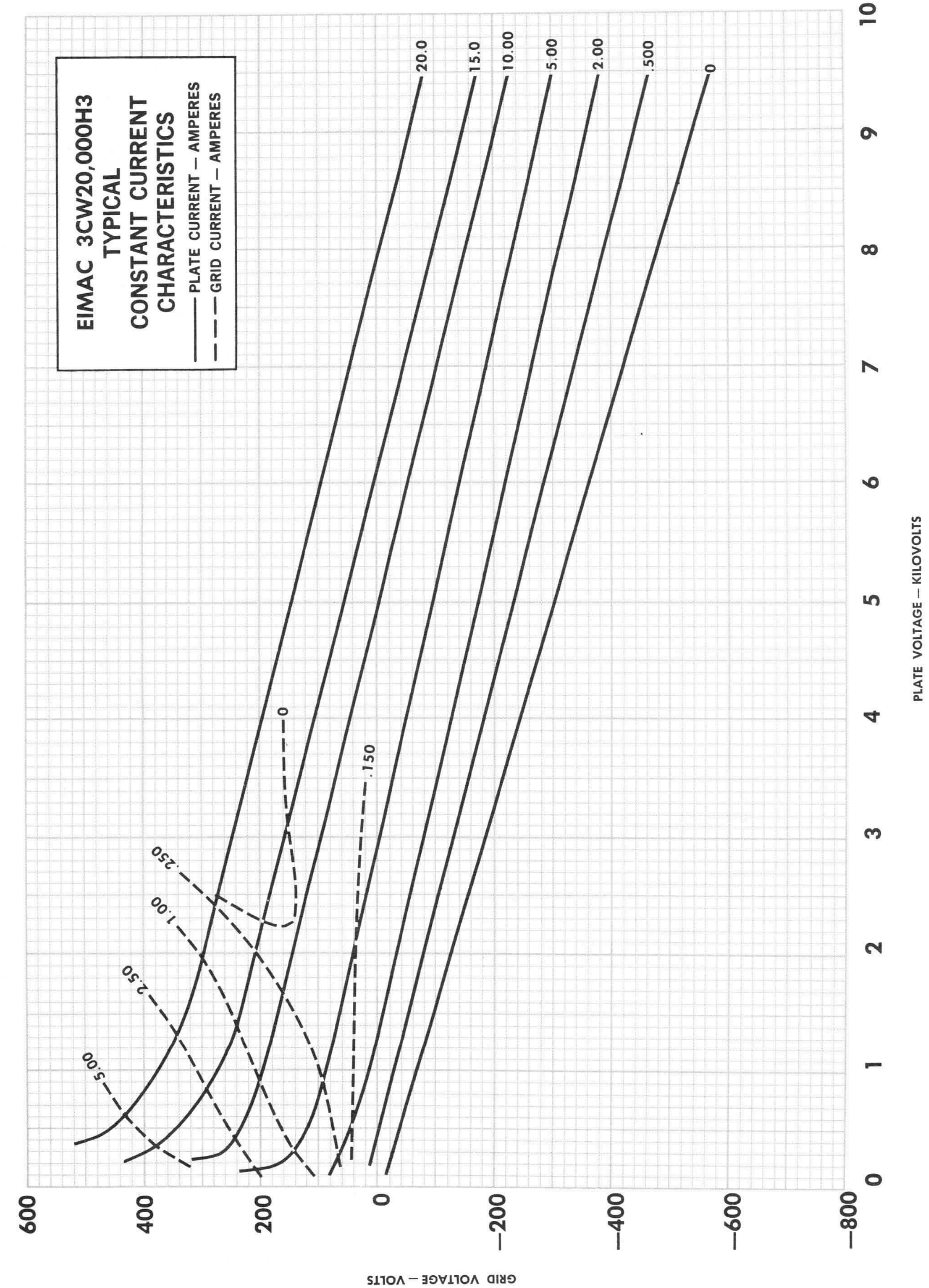
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., Eimac Division of Varian, 301 Industrial Way, San Carlos, Calif. for information and recommendations.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.050	4.250	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.990	6.010	
R	.800	.860	
S	3.300	3.500	
T	3.950	4.100	
U	8.250	8.750	
V			.250
W	29°	31°	
X			6.750
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390

NOTES:

1. 3 MOUNTING HOLES IN MTG FLANGE.
2. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. 12 HOLES IN GRID FLANGE.
5. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW20,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
—— PLATE CURRENT — AMPERES
– – – GRID CURRENT — AMPERES
20.0
15.0
10.00
5.00
2.00
.500
0
.150
.250
1.00
2.50
5.00
PLATE VOLTAGE — KILOVOLTS
0
1
2
3
4
5
6
7
8
9
10
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800

3CW20,000H7

WATER-COOLED HIGH-MU POWER TRIODE

The EIMAC 3CW20,000H7 is a ceramic/metal power triode intended for use as a dc voltage or current regulator, or in high-voltage switch tube or pulsed regulator service.

In addition, since the tube is identical to the EIMAC 3CW20,000A7 except for the anode and grid flanges and the addition of the filament flying leads, the tube is useful as a zero-bias Class B amplifier in audio or rf applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the tube.

The anode dissipation rating is 20,000 watts with water cooling.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 ± 0.4 V
Current, at 7.5 V	100 A
Amplification Factor (Average)	200
Direct Interelectrode Capacitances[2]	
Cin	59 pF
Cout	0.2 pF
Cgp	36 pF
Frequency of Maximum Rating (CW)	110 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. 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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special, with grid contact flange & filament flying leads
Operating Position	Vertical, Anode up or down
Cooling	Water or equivalent liquid & forced air

 Printed in U.S.A.

Maximum Overall Dimensions:

Length (including filament leads)	20.7 in; 52.2 cm
Diameter (anode mounting flange pitch circle)	6.75 in; 17.1 cm

Maximum Operating Temperature:

Envelope & Ceramic/Metal Seals	250°C
Net Weight (Approximate)	10.6 lbs: 4.8 kg

DC VOLTAGE OR CURRENT REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20 KILOVOLTS	PLATE DISSIPATION	20 KILOWATTS
DC PLATE CURRENT	7.5 AMPERES	GRID DISSIPATION	500 WATTS

SWITCH TUBE OR PULSED REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20 KILOVOLTS	PLATE DISSIPATION	20 KILOWATTS
PULSE PLATE CURRENT	40 AMPERES	GRID DISSIPATION	500 WATTS

RADIO FREQUENCY LINEAR AMPLIFIER

Grounded Grid, Class B

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION, Single-Tone Conditions

Plate Voltage	7000	7000	Vdc
Zero-Signal Plate Current[1]	0.60	0.60	Adc
Max. Signal Plate Current	3.72	5.00	Adc
Max. Signal Grid Current[1]	0.71	1.00	Adc
Driving Impedance	35	32	Ω
Resonant Load Impedance	1020	745	Ω
Max. Signal Driving Power[1]	885	1540	W
Peak Envelope Plate Output Power	17.7	24.2	kW
Power Gain[1]	20.0	15.7	times

AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Class B, Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.

TYPICAL OPERATION
Two Tubes, Sinusoidal Wave

Plate Voltage	5000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current[1]	0.8	1.2	Adc
Max. Signal Plate Current	10.0	10.0	Adc
Max. Signal Grid Current[1]	1.2	2.1	Adc
Driving Power[1]	290	560	W
Peak Audio Driving[1] Voltage (per tube)	240	310	v
Load Resistance, plate-to-plate	1030	1520	Ω
Max. Signal Plate Output Power[1]	31.0	47.7	kW

RADIO FREQUENCY LINEAR AMPLIFIER (AM DOUBLE SIDEBAND)

Carrier Conditions, Grounded-Grid Class B

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7000 VOLTS
DC PLATE CURRENT	5.0 AMPERES
PLATE DISSIPATION	20 KILOWATTS
GRID DISSIPATION	500 WATTS

1. Approximate value.
2. Modulation Crest Conditions.

TYPICAL OPERATION

Plate Voltage	7000	Vdc
Grid Voltage	0	Vdc
Zero-Signal Plate Current[1]	0.6	Adc
Plate Current	2.4	Adc
Grid Current[1]	0.25	Adc
Driving Impedance[2]	32	Ω
Peak Driving Voltage[2]	310	v
Driving Power[1]	330	W
Plate Output Power[1]	5650	W

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	7000	VOLTS
PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	20	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	5000	7000	Vdc
Plate Current	4.0	4.0	Adc
Grid Voltage	-210	-230	Vdc
Grid Current [1]	840	775	mAdc
Peak rf Grid Voltage	510	555	v
Grid Driving Power	420	530	W
Plate Output Power [1]	14	21.3	kW

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current @ 7.5 Volts	94.0	104.0	A
Interelectrode Capacitance[1] (grounded cathode connection)			
Cin	53.0	65.0	pF
Cout	---	0.30	pF
Cgp	32.0	40.0	pF
Interelectrode Capacitance[1] (grounded grid connection)			
Cin	53.0	65.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.30	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CW20,000H7 must be operated vertically, anode down or up, and should be protected from shock and vibration. The anode mounting flange provides a convenient mounting means, and the grid is also provided with a flange for mating with a simple contact assembly. Both filament connections are made with flying leads approximately nine inches long with heavy lugs attached at the ends.

COOLING - The anode of the 3CW20,000H7 is cooled by circulating water through the integral anode water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes a temperature rise for the water of 10°C. Inlet water temperature should never exceed 55°C and outlet water temperature should never exceed 70°C. Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure must not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop Approx. psi
10	11.0	11.5
15	12.0	13.5
20	14.0	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 $K\Omega/cm^3$, and preferably above 250 $K\Omega/cm^3$. A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with 30 to 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the grid and filament contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the terminals with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 3CW20,000H7 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 3CW20,000H7 by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate.

INPUT CIRCUIT - When the 3CW20,000H7 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 two or more.

CLASS-C OPERATION - Although designed specifically for Class-B service,the 3CW20,000H7 may be operated as a Class-C amplifier or oscillator or as a plate-modulated radio-frequency amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power should fail, plate dissipation is then kept to a low value because the tube will be operating at normal, static, zero-bias conditions.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

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 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.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, 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 effected 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.

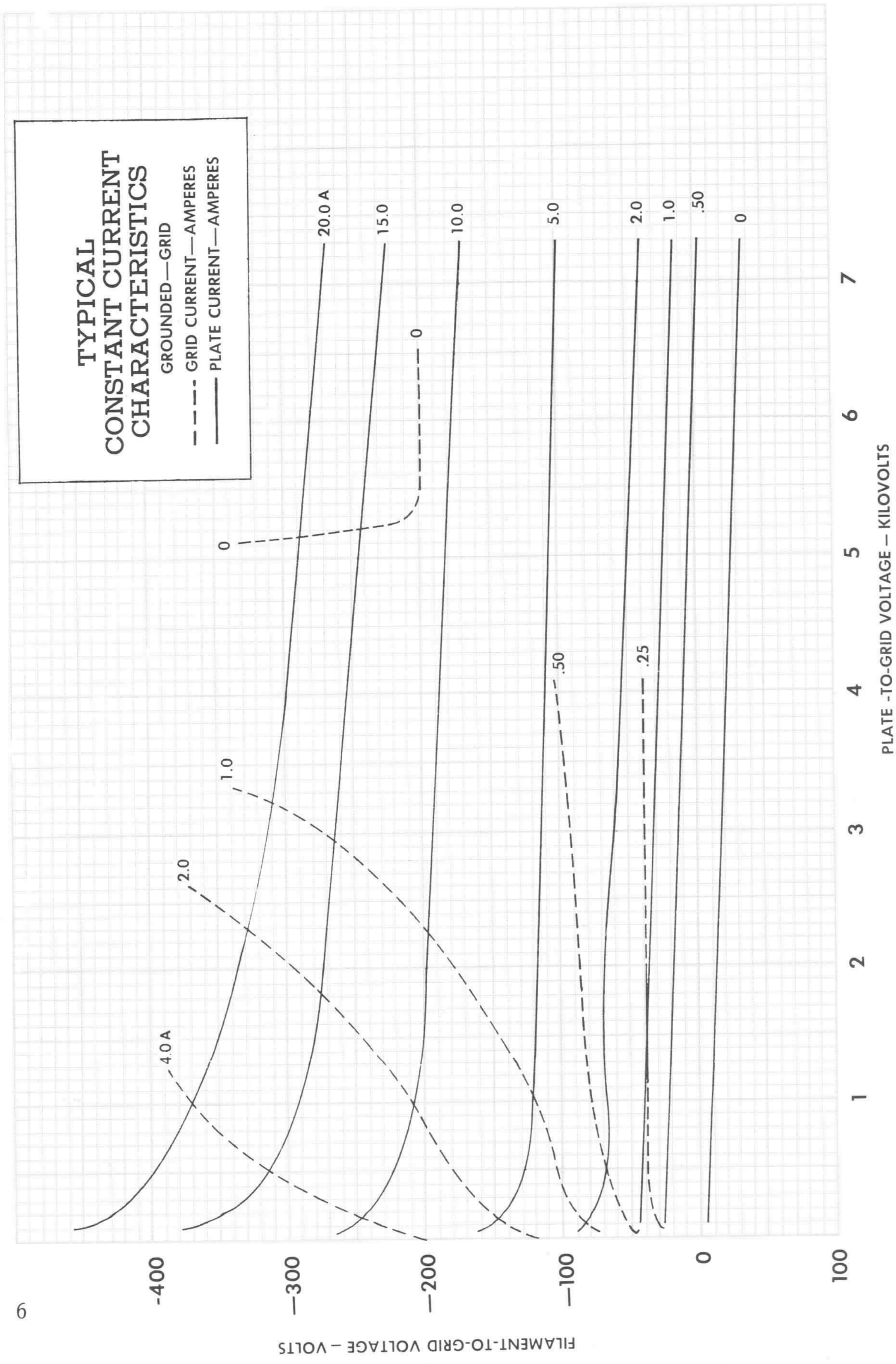
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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.

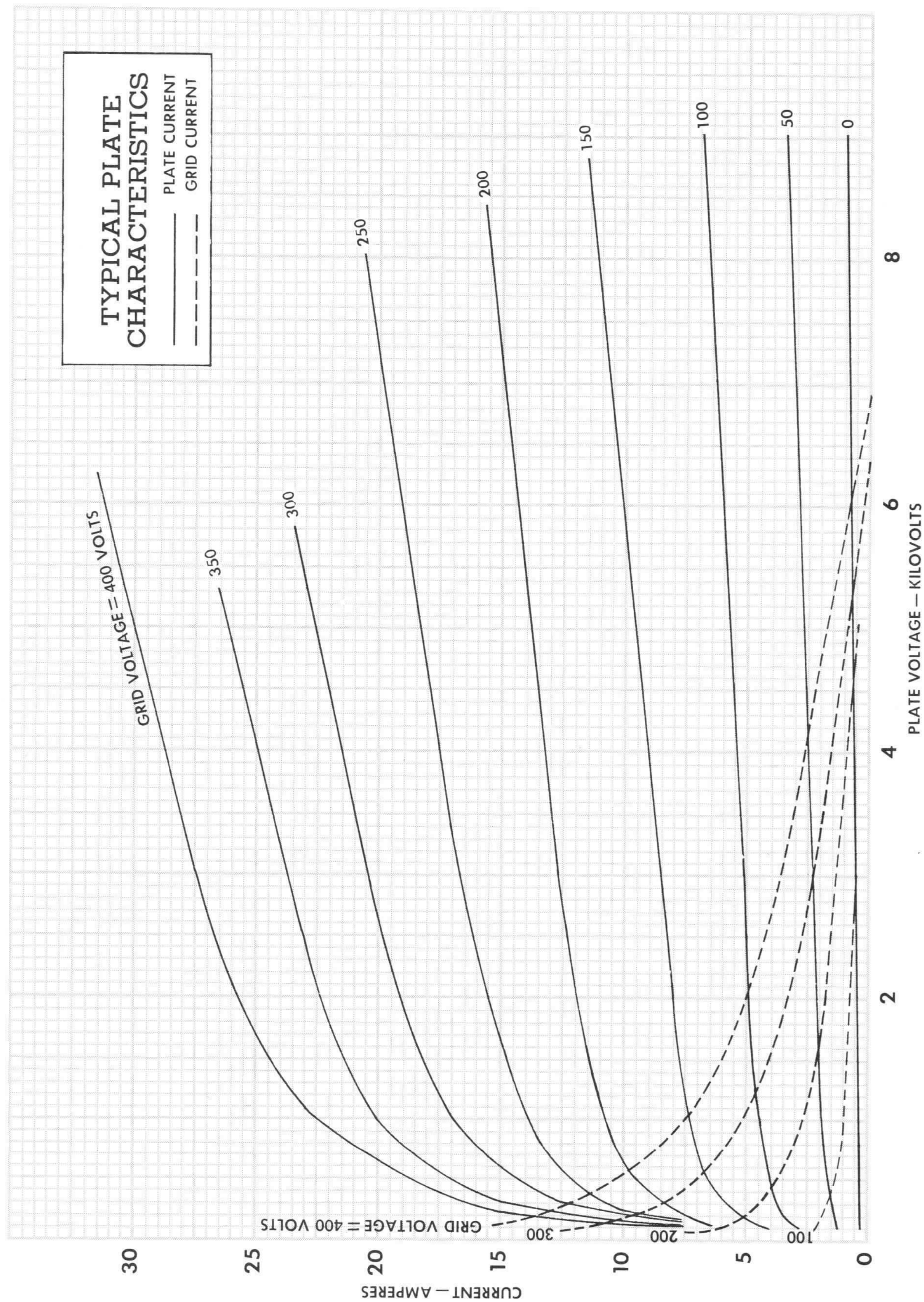
Many EIMAC power tubes, such as the 3CW-20,000H7, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--- the more power invloved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

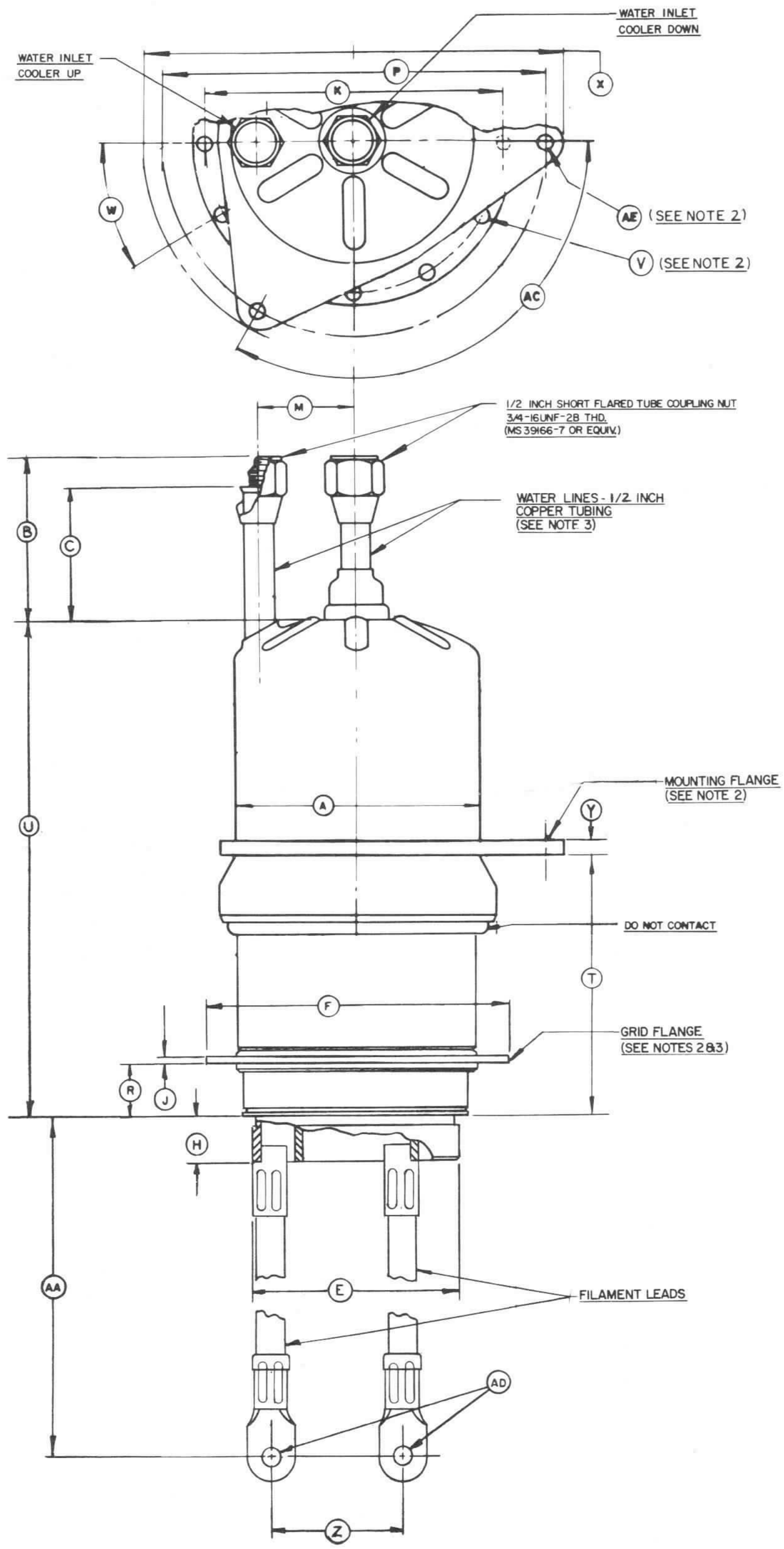
FAULT PROTECTION - In addition to normal plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

SPECIAL APPLICATION - Where 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
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
20.0 A
15.0
10.0
5.0
2.0
1.0
.50
0
4.0 A
2.0
1.0
.50
.25
0
PLATE -TO-GRID VOLTAGE – KILOVOLTS
1
2
3
4
5
6
7
FILAMENT-TO-GRID VOLTAGE – VOLTS
-400
-300
-200
-100
0
100


TYPICAL PLATE CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE = 400 VOLTS
350
300
250
200
150
100
50
0
PLATE VOLTAGE — KILOVOLTS
CURRENT — AMPERES
2
4
6
8
5
10
15
20
25
30



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	2.312	2.812	- -	56.72	71.42	- -
C	1.937	2.187	- -	49.20	55.55	- -
E	3.230	3.270	- -	82.04	83.06	- -
F	5.030	5.090	- -	127.76	129.29	- -
H	0.530	0.700	- -	13.46	17.78	- -
J	- -	- -	0.125	- -	- -	3.18
K	4.425	4.445	- -	112.40	112.90	- -
M	1.500	1.750	- -	38.10	44.45	- -
P	5.957	6.025	- -	151.31	153.04	- -
R	0.700	0.860	- -	17.78	21.84	- -
T	4.350	4.450	- -	110.49	113.03	- -
U	7.903	8.403	- -	200.74	213.44	- -
V	- -	- -	0.250	- -	- -	6.35
W	29°	31°	- -	29°	31°	- -
X	- -	- -	6.750	- -	- -	171.45
Y	- -	- -	0.250	- -	- -	6.35
Z	- -	- -	2.000	- -	- -	50.80
AA	8.500	9.000	- -	215.90	228.60	- -
AC	118°	122°	- -	118°	122°	- -
AD	- -	- -	0.390	- -	- -	9.91
AE	- -	- -	0.265	- -	- -	6.73

NOTES:

1. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQ'D FOR INSPECTION PURPOSES.
2. 3 MTG. HOLES IN MTG FLANGE AND 12 IN THE GRID FLANGE.
3. GRID FLANGE, WATER FITTINGS, AND FIL. LEADS ORIENTED AS SHOWN.

EIMAC

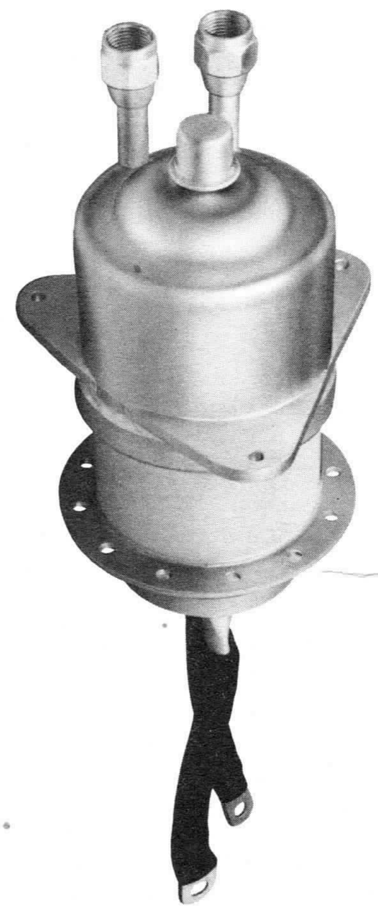
Division of Varian

SAN CARLOS
CALIFORNIA

3CW30,000H3

MEDIUM-MU

WATER-COOLED
POWER TRIODE



The Eimac 3CW30,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 30 kilowatts of plate dissipation with low water flow and pressure drop.

Input of 60 kilowatts is permissable up to 90 megahertz. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten	*Min.*	*Nom.*	*Max.*	
Voltage		6.3		V
Current	152		172	A
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament	48		58	pF
Plate-Filament	1.2		1.5	pF
Grid-Plate	30		38	pF
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Water and Forced Air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 pounds

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,000 VOLTS
DC PLATE CURRENT	6.0 AMPS
DC GRID VOLTAGE	—1000 VOLTS
DC GRID CURRENT	1.0 AMP
PLATE INPUT POWER	60 KW
PLATE DISSIPATION (NOMINAL)	30 KW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000 volts
DC Plate Current	6.0	6.0 amps
DC Grid Voltage	—600	—800 volts
DC Grid Current	.66	.315 amps
Peak Positive Grid Voltage	440	360 volts
Driving Power	660	365 watts
Plate Input Power	42	60 kW
Plate Dissipation	12	18 kW
Plate Output Power	30	42 kW
Approximate Load Impedance	600	750 ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CW30,000H3 is 6.3 volts. Filament voltage, as measured at the tube, must be maintained at 6.3 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning and 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 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

Maximum plate voltage rating of 12,000 volts and maximum plate current of 6.0 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 60 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation

The 3CW30,000H3 is usable to 140 MHz. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting

The 3CW30,000H3 must be mounted vertically, either base up or down.

Cooling

Anode cooling is accomplished by circulating water through the integral anode-water jacket.

The table below lists the minimum water flow requirement for adequate anode cooling at various plate dissipation levels. In all cases, the outlet water temperature must not exceed 70°C nor should inlet water pressure exceed 60 psi. This table is based upon 20°C temperature rise.

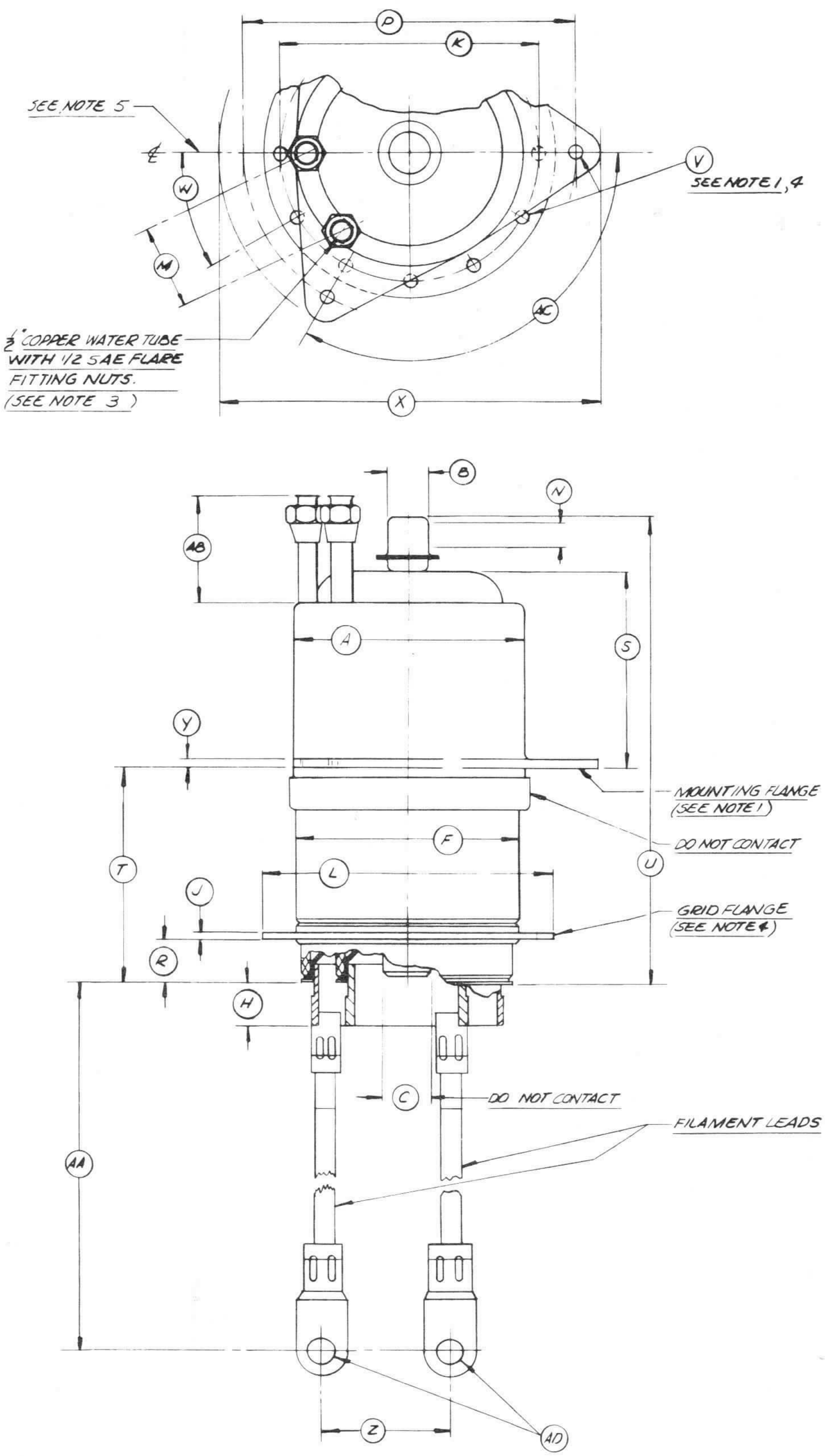
MINIMUM WATER-COOLING REQUIREMENT

Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
20	4	3.5
25	5	4.0
30	6	4.5
35	7	5.0

Additional forced-air cooling of the tube's base is also required to maintain ceramic-to-metal seal temperatures below the 250°C maximum. Approximately 50 cfm of cooling air directed into the base structure will generally satisfy this requirement.

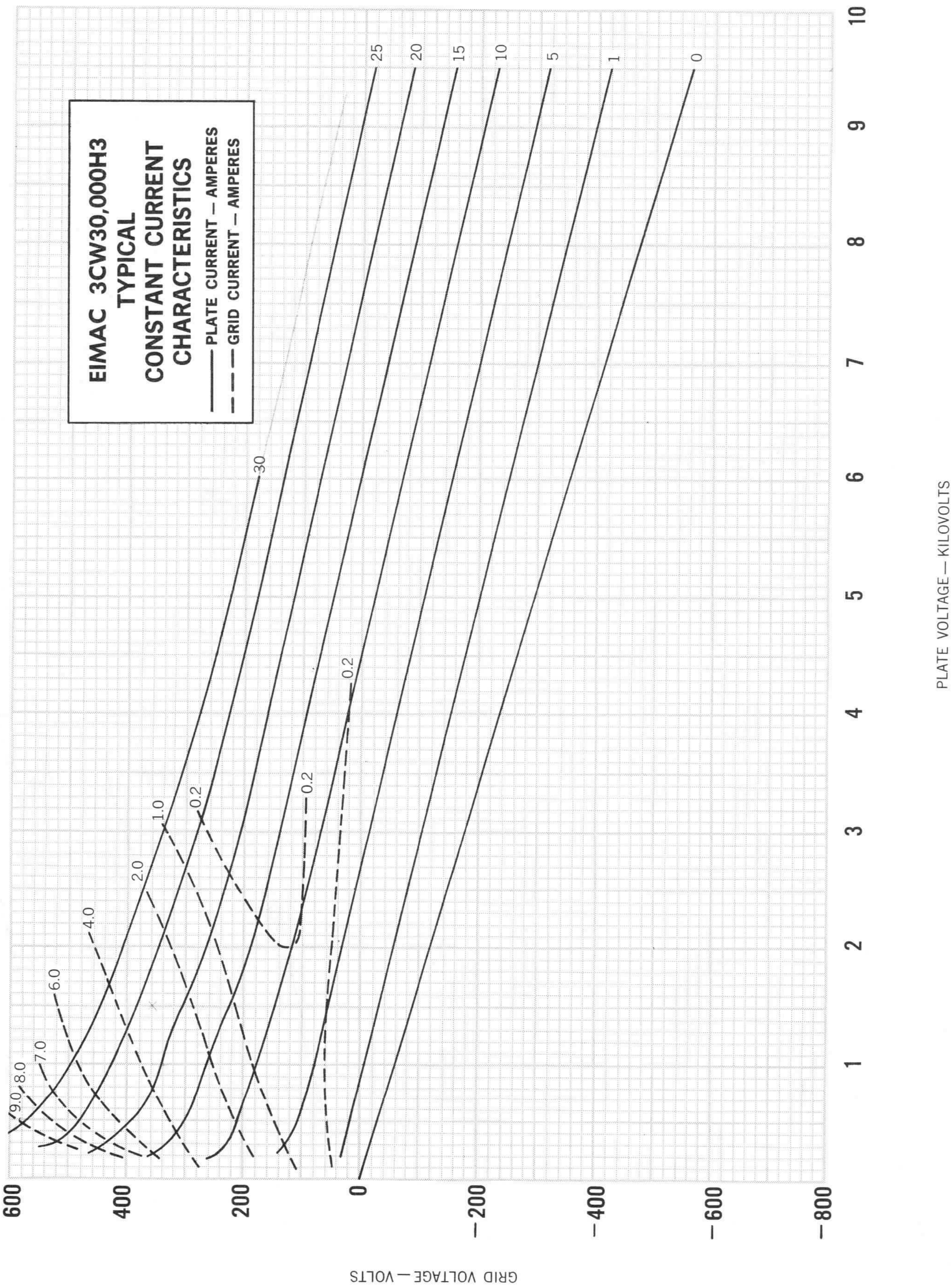
Special Application

If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., EIMAC, Division of Varian, 301 Industrial Way, San Carlos, Calif. for information and recommendations.



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.050	4.250	
B	.860	.890	
C	.720	.760	
F	3.792	3.832	
H	.530	.700	
J			.125
K	4.425	4.445	
L	5.030	5.090	
M			1.500
N	.375		
P	5.990	6.010	
R	.800	.860	
S	3.300	3.500	
T	3.950	4.100	
U	8.250	8.750	
V			.250
W	29°	31°	
X			6.750
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.000
AC	118°	122°	
AD			.390

NOTES:
1. 3 MOUNTING HOLES IN MTG FLANGE.
2. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQ'D FOR INSP. PURPOSES.
3. EITHER FITTING CAN BE USED AS INLET OR OUTLET.
4. 12 HOLES IN GRID FLANGE.
5. MTG. FLANGE, FIL. LEADS & WATER FITTINGS ARE TO BE ORIENTED AS SHOWN.


EIMAC 3CW30,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
—— PLATE CURRENT — AMPERES
– – – GRID CURRENT — AMPERES
PLATE VOLTAGE — KILOVOLTS
GRID VOLTAGE — VOLTS
0
1
5
10
15
20
25
30
0.2
0.2
0.2
1.0
2.0
4.0
6.0
7.0
8.0
9.0
600
400
200
0
−200
−400
−600
−800
1
2
3
4
5
6
7
8
9
10

3CW30,000H7

TECHNICAL DATA

HIGH-MU
WATER-COOLED
POWER TRIODE

The EIMAC 3CW30,000H7 is a ceramic/metal water-cooled high-mu power triode intended for use as a Class C power amplifier or for zero-bias Class B or AB linear amplifier service, and also intended for use as a dc voltage or current regulator, or in high-voltage switch tube or pulsed regulator service.

Internally the tube is identical to the 3CX15,000A7, and except for anode dissipation capability, all ratings are the same.

Class B amplifier operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded grid operation is attractive since a power gain as high as twenty times can be obtained.

The anode power dissipation rating is 30,000 watts with water cooling. No socket is required for the tube because of the mounting flanges attached to the anode and grid and the flexible filament leads on the base.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor (Average):	200
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	61 pF
Cout	0.2 pF
Cgp	36 pF
Direct Interelectrode Capacitance (grounded grid)[2]	
Cin	61 pF
Cout	36 pF
Cpk	0.2 pF
Frequency of Maximum Rating:	
CW	110 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

Printed In U.S.A.

MECHANICAL

Base . . . . Special, with grid contact flange & filament flying leads
Operating Position . . . . Vertical, Anode up or down
Cooling . . . . Water or equivalent liquid & forced air
Maximum Overall Dimensions:
Length (including filament leads) . . . . 20.5 in; 52.1 cm
Diameter (anode mounting flange pitch circle) . . . . 6.75 in; 17.1 cm
Maximum Operating Temperature:
Envelope & Ceramic/Metal Seals . . . . 250°C
Net Weight (Approximate) . . . . 10.6 lbs; 4.8 kg

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	30,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate values
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_2

Plate Voltage	7000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current [1]	.6	.6	Adc
Single-Tone Plate Current [2]	5.92	5.0	Adc
Single-Tone Grid Current [1]	1.22	1.0	Adc
Driving Power [1]	1750	1540	W
Plate Dissipation	13.4	10.8	kW
Single-Tone Plate Output Power	29.6	24.2	kW
Resonant Load Impedance	693	745	Ω
Drive Impedance	27	32	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	30,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	7000	Vdc
Grid Voltage	-230	Vdc
Plate Current	4.0	Adc
Grid Current [1]	775	mAdc
Peak rf Grid Voltage [1]	555	v
Calculated Driving Power [1]	430	W
Plate Input Power	28	kW
Plate Dissipation	6.7	kW
Plate Output Power	21.3	kW
Resonant Load Impedance	963	Ω

DC VOLTAGE OR CURRENT REGULATOR SWITCH TUBE OR PULSED REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	28	KILOVOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT [1]	6	AMPERES
PULSE PLATE CURRENT	40	AMPERES

DUTY, PULSE SERVICE [2]	0.1	
PLATE DISSIPATION [2]	30	KILOWATTS
GRID DISSIPATION [2]	500	WATTS

1. Steady-state value in voltage or current regulator service.
2. With duty in excess of approximately 0.1 excessive element heating may occur during the pulse and consequent element dissipation derating may be required.

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.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid) [1]			
Cin	55.0	67.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode) [1]			
Cin	55.0	67.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitances values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 3CW30,000H7 must be operated vertically, anode down or up, and should be protected from shock and vibration. The anode mounting flange provides a convenient mounting means, and the grid is also provided with a flange for mating with a simple contact assembly. Both filament connections are made with flying leads approximately nine inches long with heavy lugs attached at the ends.

COOLING - The anode of the 3CW30,000H7 is cooled by circulating water through the integral anode water jacket. The cooling table shows minimum water-flow rates at various plate dissipation levels and assumes an inlet water temperature of 50°C with the anode mounted either up or down. Care should be taken to use the correct cooling water connector for inlet water, which is dependent on the tube orientation (base up or down), and these are shown on the tube outline drawing.

Where a liquid coolant other than water is used, the difference in cooling characteristics should be carefully considered and taken into account. Maximum system pressure must not exceed 50 psi.

Minimum Cooling Water-Flow Requirements		
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop Approx. psi.
15	12	13.5
20	13	15.0
30	14	17.0

A major factor effecting long life of water-cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 KΩ/cm , and preferably above 250 KΩ/cm . A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of insulating hose column if metal nipples or fittings are used as electrodes.

Forced-air cooling of the base is also required, with a minimum of 50 cfm of air at 50°C maximum directed up into and around the base of the tube to cool the grid and filament contact areas.

Both anode and base cooling should be applied before or simultaneously with electrode voltages, including the filament, and should normally be maintained for a short period of time after all voltages are removed to allow for tube cooldown.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the terminals with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 3CW30,000H7 is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 3CW30,000H7 by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate. For pulsed regulator or switch tube service full nominal filament voltage is recommended.

INPUT CIRCUIT - When the 3CW30,000H7 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 5 or more.

CLASS-C OPERATION - Although designed specifically for Class-B service, the 3CW30,000H7 may be operated as a Class-C amplifier or oscillator or as a plate-modulated radio-frequency amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias. If driving power should fail, plate dissipation is then kept to a low value because the tube will be operating at normal, static, zero-bias conditions.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

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 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.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, 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 effected 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.

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.

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 the 3CW-30,000H7, 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 plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

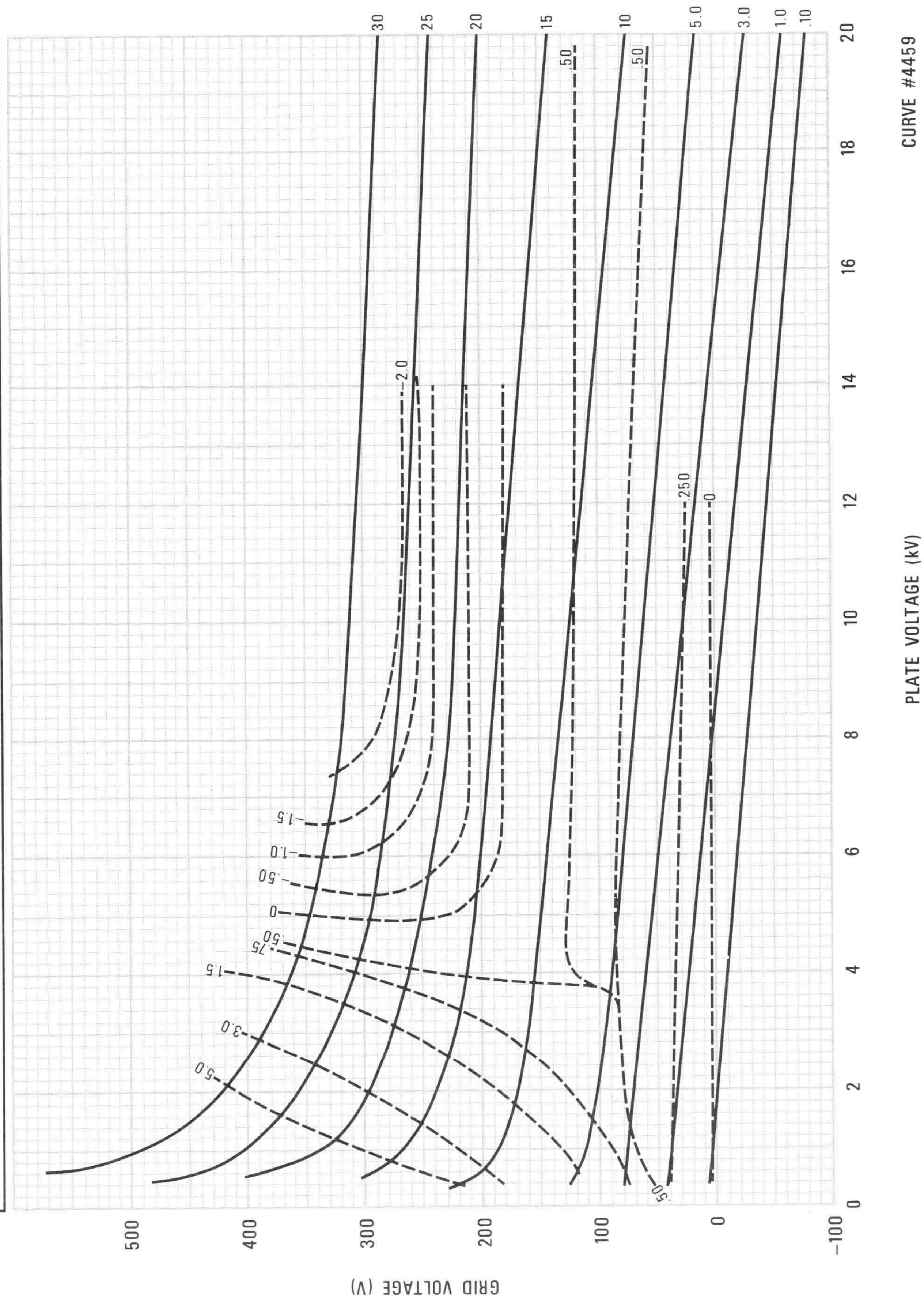
In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

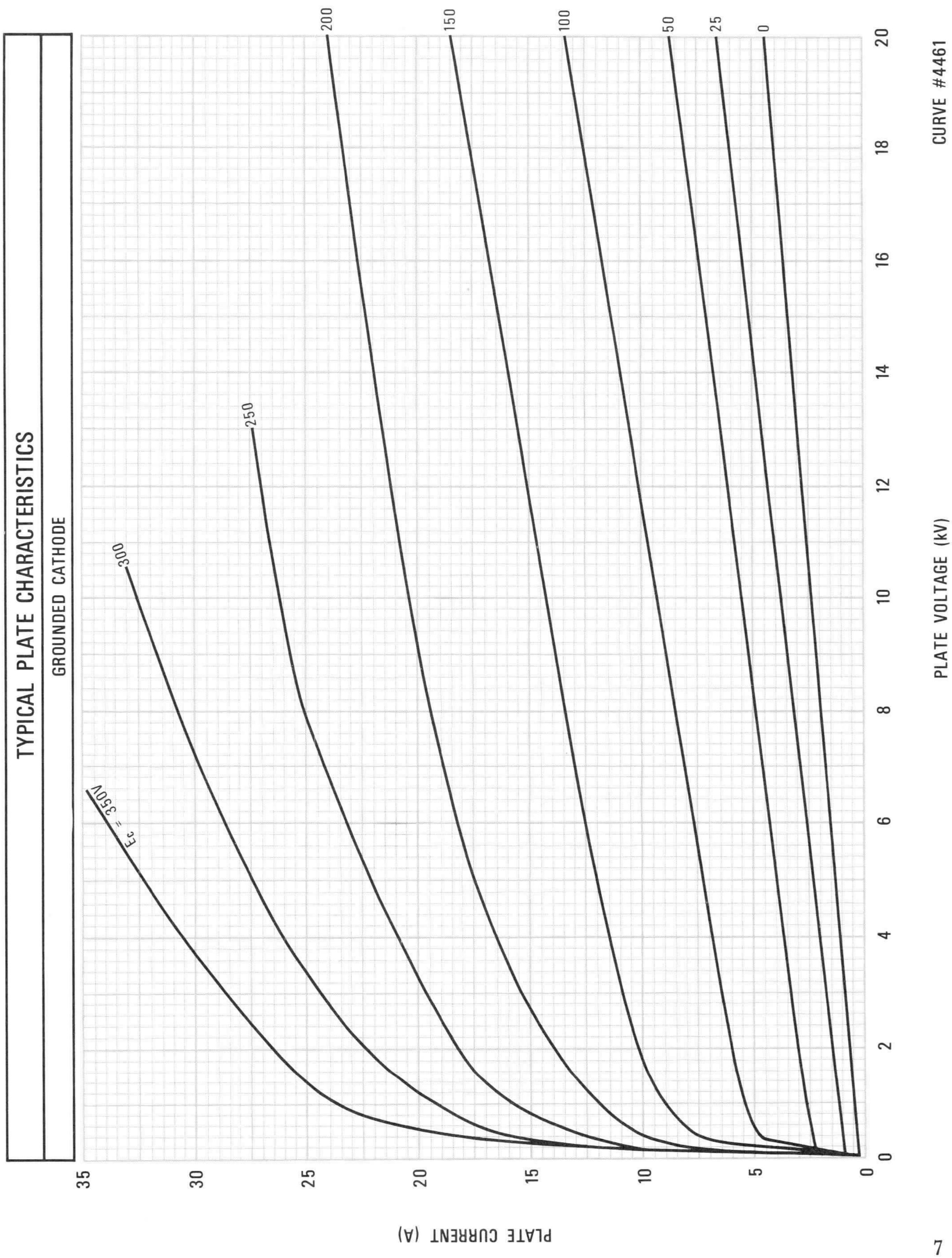
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

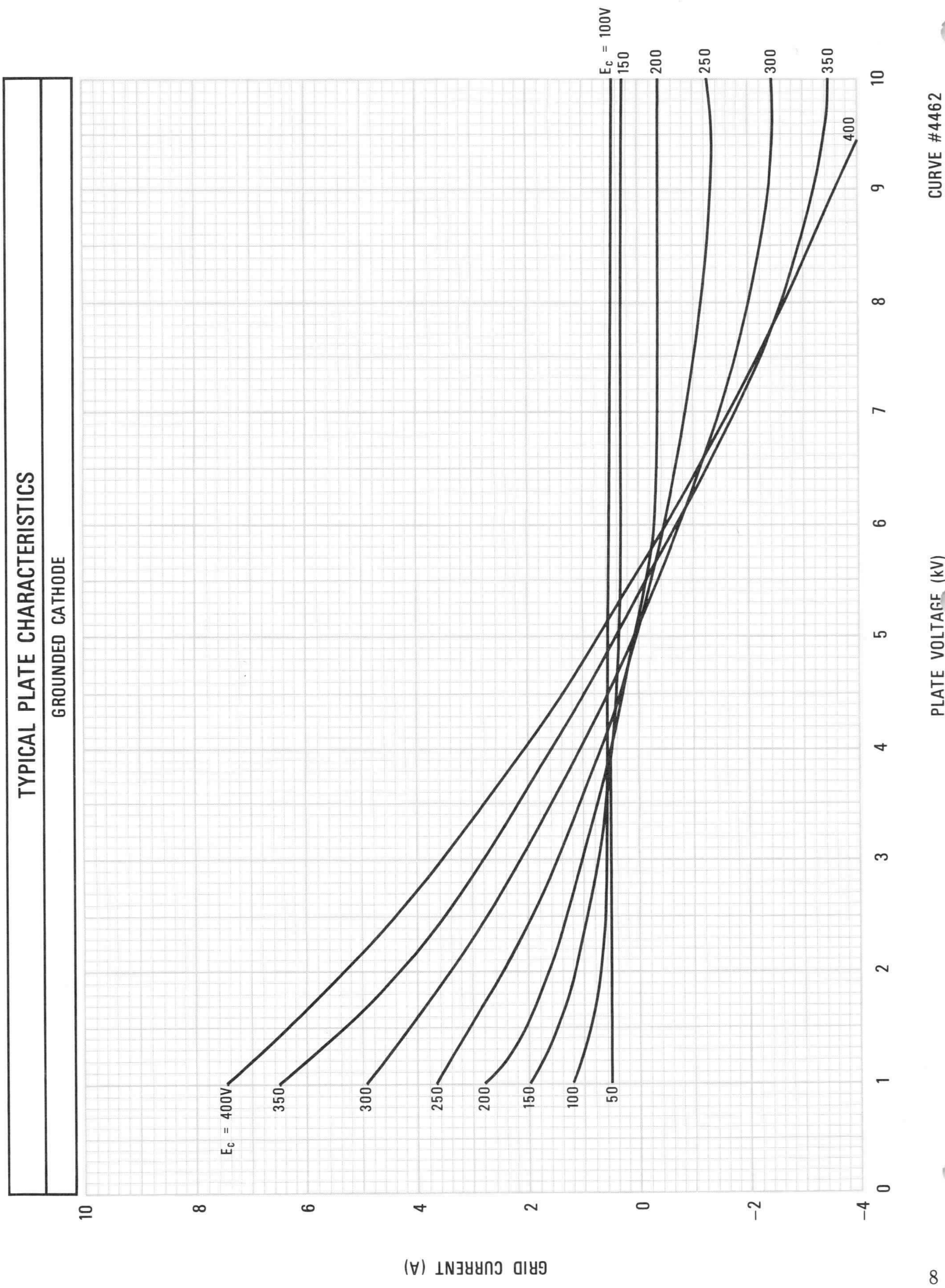
GROUNDED CATHODE

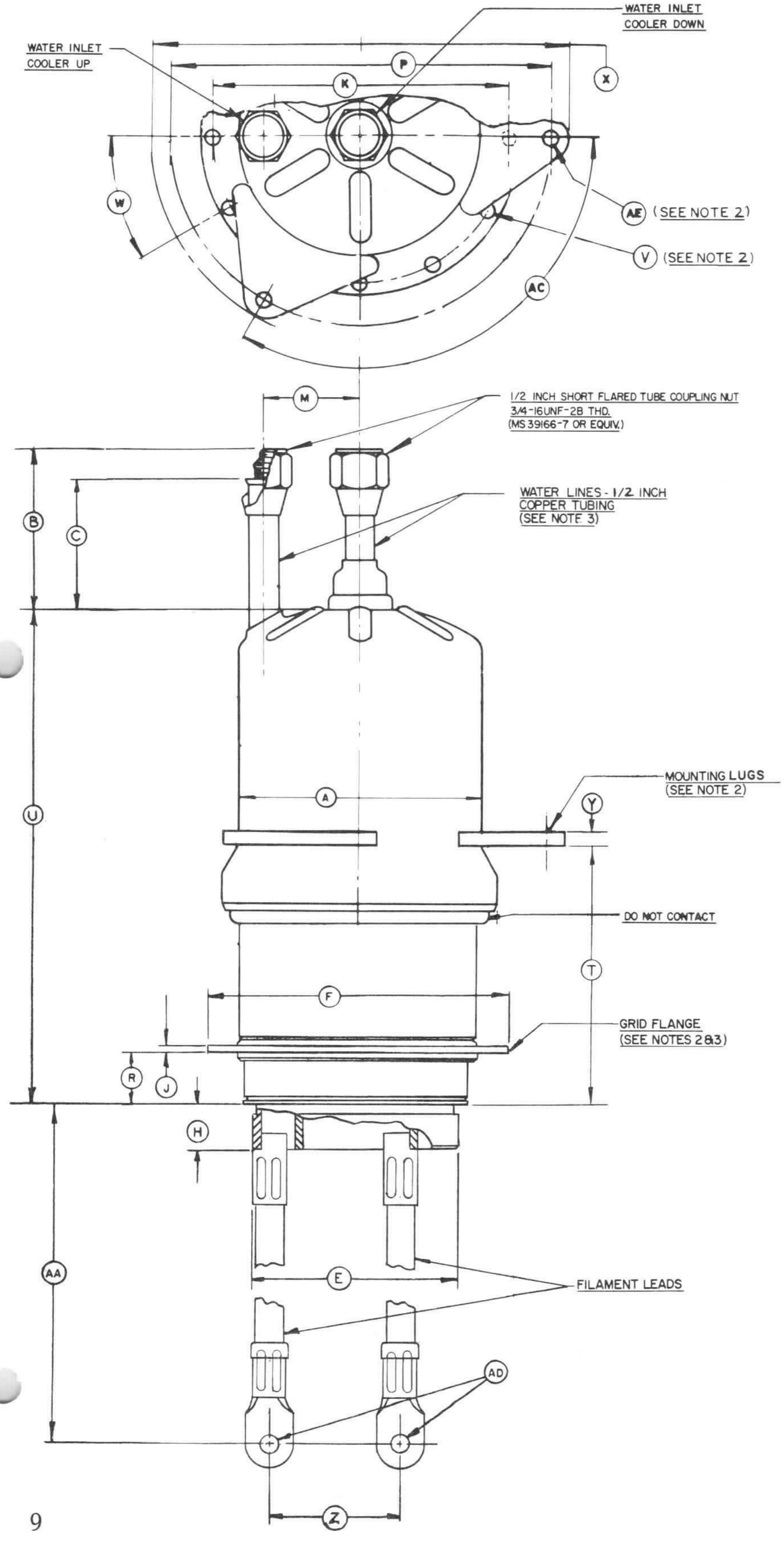
—— PLATE CURRENT – AMPERES   - - - - GRID CURRENT – AMPERES





TYPICAL PLATE CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #4461
Ec = 350V
300
250
200
150
100
50
25
0
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12
14
16
18
20


TYPICAL PLATE CHARACTERISTICS
GROUNDED CATHODE
GRID CURRENT (A)
PLATE VOLTAGE (kV)
CURVE #4462
E_c = 400V
350
300
250
200
150
100
50
E_c = 100V
150
200
250
300
350
400
10
8
6
4
2
0
−2
−4
0
1
2
3
4
5
6
7
8
9
10



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	2.312	2.812	- -	56.72	71.42	- -
C	1.937	2.187	- -	49.20	55.55	- -
E	3.230	3.270	- -	82.04	83.06	- -
F	5.030	5.090	- -	127.76	129.29	- -
H	0.530	0.700	- -	13.46	17.78	- -
J	- -	- -	0.125	- -	- -	3.18
K	4.425	4.445	- -	112.40	112.90	- -
M	1.500	1.750	- -	38.10	44.45	- -
P	5.957	6.025	- -	151.31	153.04	- -
R	0.700	0.860	- -	17.78	21.84	- -
T	4.350	4.450	- -	110.49	113.03	- -
U	7.903	8.403	- -	200.74	213.44	- -
V	- -	- -	0.250	- -	- -	6.35
W	29°	31°	- -	29°	31°	- -
X	- -	- -	6.750	- -	- -	171.45
Y	- -	- -	0.250	- -	- -	6.35
Z	- -	- -	2.000	- -	- -	50.80
AA	8.500	9.000	- -	215.90	228.60	- -
AC	118°	122°	- -	118°	122°	- -
AD	- -	- -	0.390	- -	- -	9.91
AE	- -	- -	0.265	- -	- -	6.73

NOTES:
1. REF DIMS ARE FOR INFO. ONLY AND ARE NOT REQD FOR INSPECTION PURPOSES.
2. 3 MTG. HOLES IN MTG. LUGS & 12 IN THE GRID FLANGE.
3. GRID FLANGE, WATER FITTINGS, & FIL. LEADS ORIENTED AS SHOWN.

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

3CW40,000H3

MEDIUM-MU

WATER-COOLED POWER TRIODE

The EIMAC 3CW40,000H3 is a water-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its water-cooled anode is conservatively rated at 40 kilowatts of plate dissipation with low waterflow and pressure drop.

Input of 80 kilowatts is permissible up to 90 megahertz. Plentiful reserve emission is available from its 1500 watt filament. The grid structure is rated at 750 watts, making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage - - - - - - -		10		volts
Current - - - - - - -	152		168	amps
Amplification Factor - - - - -		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament - - - - -	65		75	pF
Plate-Filament - - - - -	2.0		2.6	pF
Grid Plate - - - - - -	38		48	pF
Frequency for Maximum Ratings - - - - - -			90	MHz

MECHANICAL

Base -	See Outline
Operating Position - - - - - - - - - - - - -	Vertical, base up or down
Cooling - - - - - - - - - - - - - - - - -	Water and Forced Air
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals - - - - - - - - - - - - -	250°C
Maximum Dimensions:	
Height - - - - - - - - - - - - - - - - -	See Outline
Diameter - - - - - - - - - - - - - - - -	See Outline
Net Weight - - - - - - - - - - - - - - - - -	14 pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS

DC PLATE VOLTAGE	12,000 VOLTS
DC PLATE CURRENT	9.0 AMPS
DC GRID VOLTAGE	-1200 VOLTS
DC GRID CURRENT	1.2 AMPS
PLATE INPUT POWER	100 KW
PLATE DISSIPATION	40 KW

TYPICAL OPERATION*

DC Plate Voltage	7000	10,000	volts
DC Plate Current	7.7	9.0	amps
DC Grid Voltage	-700	-850	volts
DC Grid Current	.53	.742	amps
Peak Positive Grid Voltage	440	550	volts
Driving Power	600	1040	watts
Plate Input Power	54	90	kW
Plate Dissipation	16	20	kW
Plate Output Power	37.7	70	kW
Approximate Load Impedance	408	526	ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

ELECTRICAL

Filament — The rated filament voltage for the 3CW40,000H3 is 10.0 volts. Filament voltage, as measured at the tube, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 10.0 volts by more than plus or minus five percent.

Control Grid Operation — The grid current rating is 1.2 ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.3 to 0.6 amp 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 750 watts.

Plate Operation — Maximum plate voltage rating of 12,000 volts and maximum plate current of 9.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded. The 100 kilowatts input rating applies for Class-C amplifier or oscillator service with no modulation.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load 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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation — The 3CW40,000H3 is usable to 120 MHz. At this frequency, plate voltage must be reduced to 7000 volts in Class-C service.

MECHANICAL

Mounting — The 3CW40,000H3 must be mounted vertically, either base up or down.

Cooling — The anode of the 3CW40,000H3 is cooled by circulating water through the integral anode-water jacket. The table below lists minimum water-flow rates at various plate dissipation levels. The table is based on a water temperature rise of 15°C.

MINIMUM COOLING WATER-FLOW REQUIREMENTS

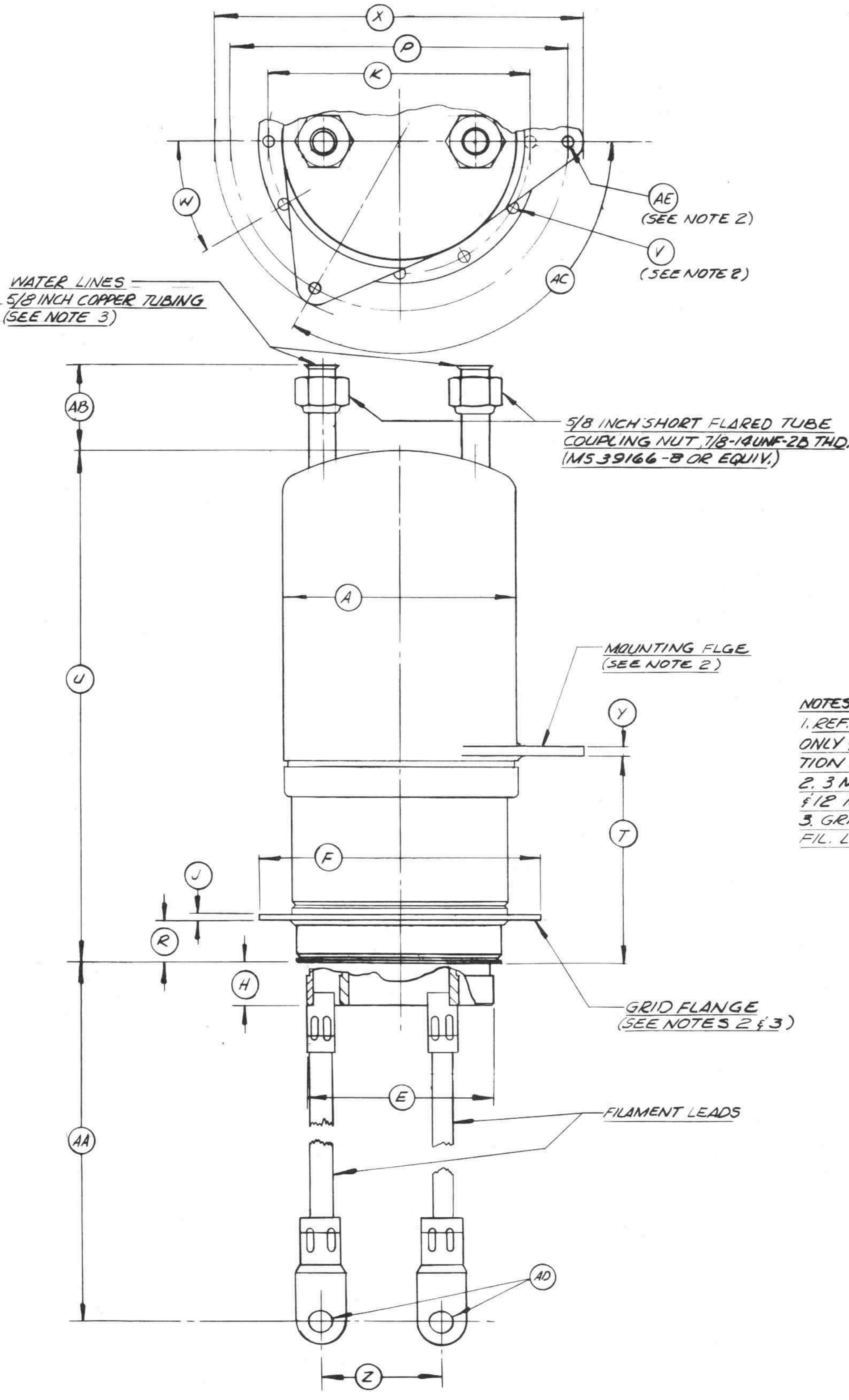
Plate Dissipation (kW)	Water Flow (gpm)	Pressure Drop (psi)
20	5.25	4.0
30	7.6	6.5
40	10.2	13.0
50	12.6	21.0

Since power dissipated by the filament represents 1500 watts and grid dissipation can reach 750 watts, 2250 watts has been added to anode dissipation in preparing this tabulation.

The cooling table assumes that the maximum outlet-water temperature will be below 70°C to preclude "spot" boiling.

Additional stem cooling air must be provided. 20 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by a 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling for maximum frequency of 30 MHz, 50°C ambient, and 5000 ft. altitude.

Special Application — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

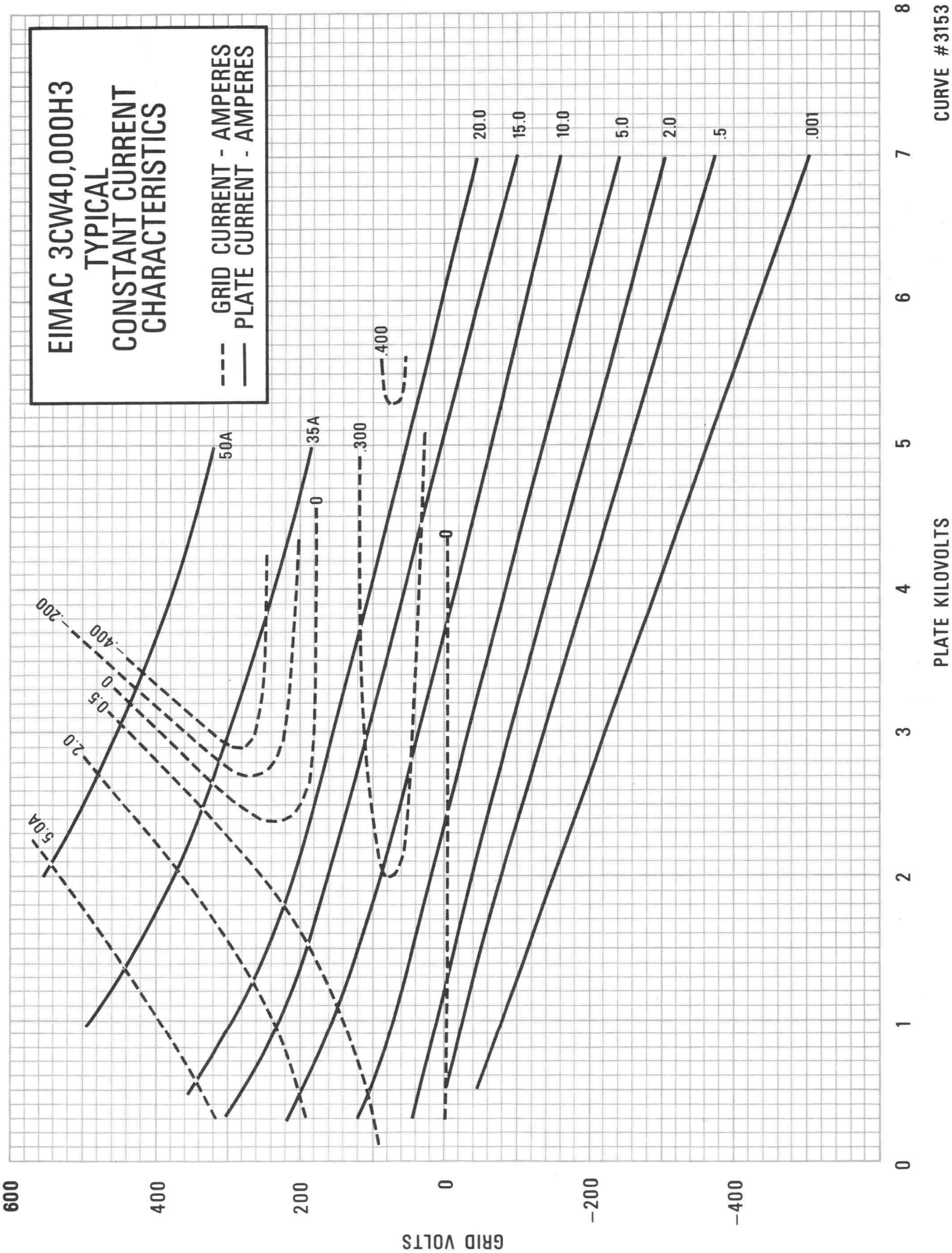


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM	MIN.	MAX.	REF
A	4.250	4.375	
E	3.230	3.270	
F	5.030	5.090	
H	.530	.700	
J			.325
K	4.425	4.445	
M			2.750
P	5.850	5.900	
R	.700	.860	
T	4.050	4.160	
U	9.800	10.050	
V			.250
W	29°	31°	
X			6.750
Y			.250
Z			2.000
AA	8.500	9.000	
AB			2.625
AC	118°	122°	
AD			.390
AE			.312

NOTES:

1. REF. DIMS. ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.
2. 3 MTG. HOLES IN MTG. FLANGE & 12 IN THE GRID FLANGE
3. GRID FLGE, WATER FITTINGS & FIL. LEADS ORIENTED AS SHOWN.


EIMAC 3CW40,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT - AMPERES
PLATE CURRENT - AMPERES
50A
35A
.300
.400
0
0
.200
.400
0
0.5
2.0
5.0A
20.0
15.0
10.0
5.0
2.0
.5
.001
600
400
200
0
−200
−400
GRID VOLTS
0
1
2
3
4
5
6
7
8
PLATE KILOVOLTS
CURVE #3153

3CX400U7

Eimac

TECHNICAL DATA

HIGH-MU UHF TRANSMITTING TRIODE

The EIMAC 3CX400U7 is designed for use above 200 MHz as a CW, pulse, or linear rf amplifier, particularly in the 806 to 950 MHz portion of the spectrum allocated to land mobile services.

The 3CX400U7 is a high-mu triode designed with beam-forming cathode and control grid geometry, of all metal/ceramic construction, and an external anode rated for 400 watts of dissipation with forced-air cooling.

The combination of an amplification factor of over 200 and minimum current interception by the control grid provides good power gain in cathode-driven (grounded grid) amplifiers. Coaxial terminals and continuous cone-shaped conductors for the grid and cathode allow the lowest possible inductance between these tube elements and the cavity. The heater terminals are separate from the cathode.

200 watts of useful CW rf power may be obtained with better than 33% efficiency, and better than 10 dB of gain. At frequencies near 900 MHz the amplifier circuit may be essentially a quarter-wave radial or rectangular resonator for the anode, and a three-quarter wave coaxial line section between ground and cathode. The amplifier is described in this data sheet. Terminal collets are available and are listed.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-Coated, Unipotential		
Heater Voltage, Nominal (see derating table for UHF use)	6.3 ± 0.3	V
Heater Current, at 6.3 volts	3.0	A
Cathode-Heater Potential, Maximum	±150	V
Transconductance, average (I_b = 250 mAdc)	29,000	μmhos
Amplification Factor, average	240	
Direct Interelectrode Capacitances (grid grounded)[2]		
Cin	18.4	pF
Cout	6.1	pF
Cpk	0.07	pF
Ck-htr	6.0	pF
Frequency of Maximum Rating:		
CW	1000	MHz

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 in accordance with Electronic Industries Association Standard RS-191.

 Printed in U.S.A.

MECHANICAL

Maximum Operating Temperature:

Ceramic/Metal Seals and Anode Core . . . . 250°C

Cooling . . . . Forced Air

Base . . . . Special Coaxial

Recommended Contact Collets:

Tube Element	EIMAC Part No.
Inner Heater	008290
Outer Heater	008291
Cathode	008292
Grid	882931
Anode	154418

Maximum Overall Dimensions:

Length . . . . 2.51 in; 63.75 mm

Diameter . . . . 2.08 in; 52.83 mm

Net Weight (approximate) . . . . 5.5 oz; 155 gms

RADIO FREQUENCY POWER AMPLIFIER CLASS C TELEGRAPHY OR FM

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.400	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION, Cathode Driven, 850 MHz

Plate Voltage	1500	Vdc
Plate Current	400	mAdc
Grid Current	-5	mAdc
Measured Driving Power	13.0	W
Useful Output Power	225	W
Efficiency	37	%
Power Gain	12	dB

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	2.8	3.4	A
Cathode Warmup Time	60	---	Sec
Interelectrode Capacitances (grid grounded)[1]			
Cin	16.0	21.0	pF
Cout	5.0	7.0	pF
Cpk	---	0.1	pF

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

APPLICATION

MOUNTING & SOCKETING - Part numbers of available EIMAC collets are listed under MECHANICAL. These collets may be soft-soldered to the appropriate UHF line or cavity elements. The collets provide low-inductance connections between tube and circuitry and serve to draw off a portion of the heat released during normal operation.

HEATER-CATHODE OPERATION - The nominal heater voltage for the 3CX400U7 is 6.3 volts. For CW operation at frequencies above 300 MHz the heater voltage should be reduced as the cathode receives additional heat from rf charging currents and a transit-time effect. The following table gives approximate values of heater voltage recommended versus operating frequency for CW power levels at, or near, the typical operating conditions shown on Page 2. It is recommended that a mechanical relay, or other type of switching device, be provided so that near-nominal heater voltage will be provided during warmup and standby periods, and then dropped to the recommended level when rf drive is applied to the amplifier.

Frequency (MHz)	Heater Volts
300 or lower	6.3
300 to 400	6.1
400 to 500	5.7
500 to 600	5.3
600 to 700	4.9
700 to 800	4.5
800 to 900	4.0
900 to 1000	3.6

The heater voltage should be operated at nominal voltage of 6.3 volts for a minimum of 60 seconds before application of plate voltage or rf driving voltage.

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

COOLING - Forced-air cooling of the tube is required, with 11.5 cfm of air directed through the anode cooler when operating at full rated (400 W) dissipation. The pressure drop across the anode cooler only at this flow rate is approximately 0.2 inch of water, and these figures are based on an incoming air temperature of 50°C and a maximum tube anode temperature of 225°, at sea level, and with air flowing in a base-to-anode direction. When air is flowing in this direction, and the base contacting arrangement does not restrict flow in and around the base seals, additional base cooling provisions may not be required, but the designer is cautioned to verify whether base cooling is adequate before a circuit design is finalized, by means of temperature-sensitive paints which are available for this purpose, or other equivalent means.

Depending on the circuit or cavity design, allowance must also be made for other losses in the air system, in order to always assure sufficient flow for tube cooling. The designer is also cautioned that it is not good practice to operate at, or very close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined is normally beneficial.

UHF CAVITY AMPLIFIER - Included in this data sheet is an exploded view of a typical cavity amplifier of simple construction requiring little precise machine work. The dimensions shown are for an amplifier to be operated near 900 MHz. The typical operating conditions for 850 MHz, shown on Page 2, were obtained with this cavity.

The output circuit is essentially a quarter-wave rectangular cavity forming the tuned circuit between anode and grid. Output coupling is magnetic. A loop is formed by a post *F* which terminates at one end in the center conductor of the coaxial fitting, and at the other end it is solidly in contact with the opposite plate (or wall) of the cavity.

The input circuit, while simple mechanically, is not as easily visualized as an electrical circuit. Starting with the small inner conductor *A*, this is a heater conductor and rf choke. The next tube, *B*, is the second heater conductor and rf choke. The third tube, *C*, is the cathode line which may be considered as a broadly tuned three-quarter wave line. The next diameter of tubing, *D*, is a sleeve tuned to an electrical three-quarter wave-length by an adjustable capacity probe, *E*. The sleeve is excited by the input capacity probe, *F*. Current flows on the inside as well as on the outside wall of the three-quarter wave sleeve, thereby coupling energy to the cathode line. Sleeve *D* is electrically three-quarter wavelength because there is approximately a loaded quarter wavelength within the vacuum tube itself, *E*.

Suitable cowling (not shown) should be provided to introduce cooling air through three short tubes on each side of the output cavity for anode cooling. The air then exhausts through the anode cooling fins of the 3CX400U7. The three short tubes on each side of the cavity are dimensioned to serve as waveguide-above-cutoff frequency filters in the air openings.

HIGH VOLTAGE - Normal operating voltages used with the 3CX400U7 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.

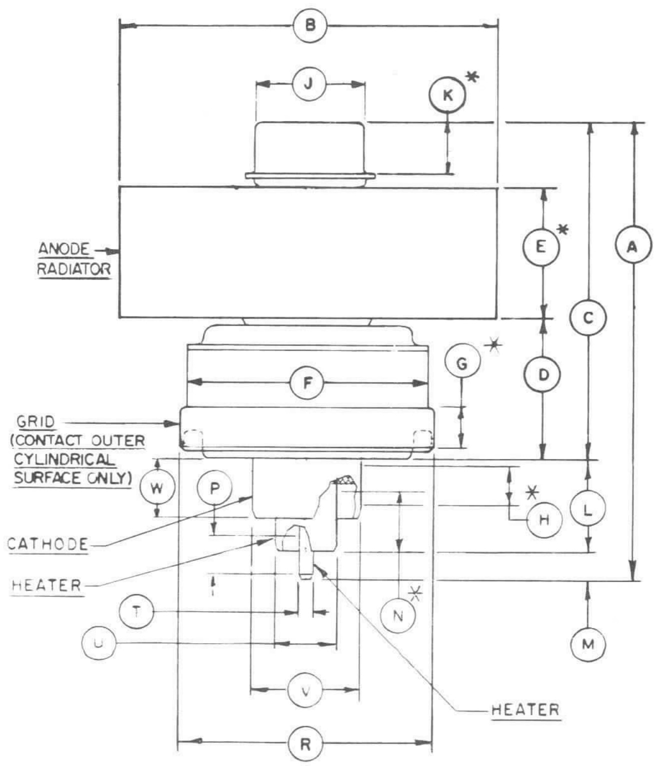
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

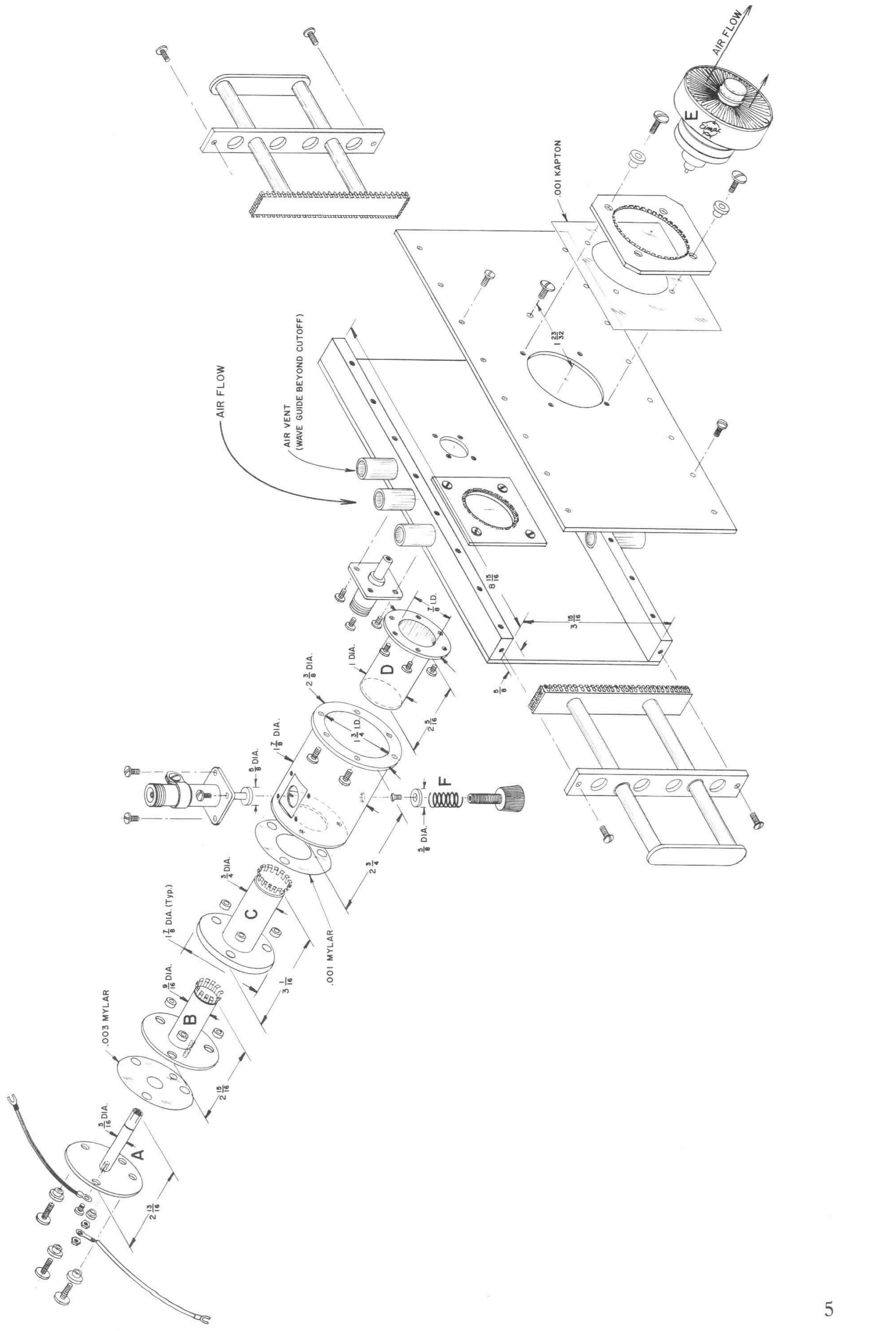
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

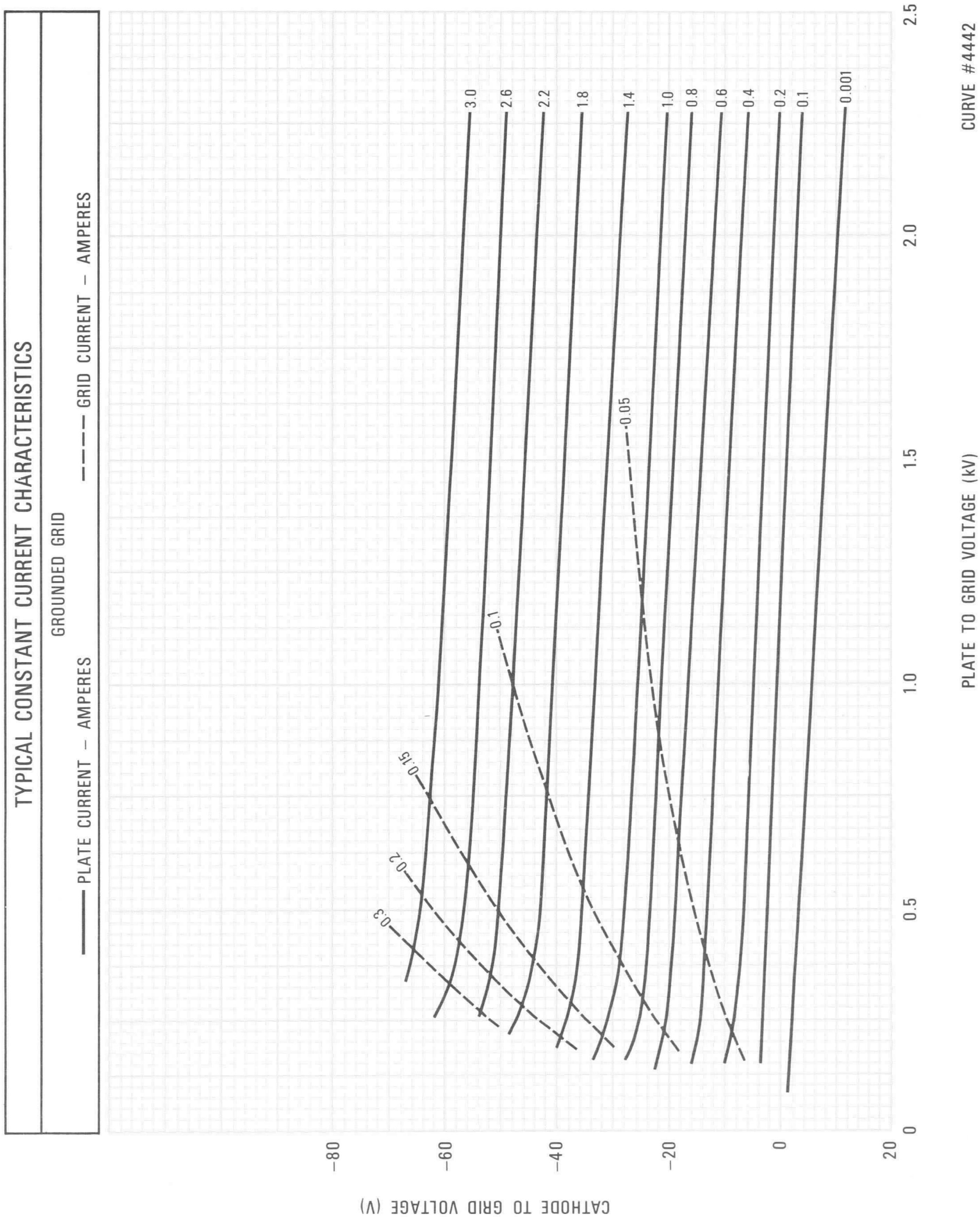
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	2.510	- -	- -	63.75
B	2.050	2.080	- -	52.07	52.83	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	0.200	- -	- -	5.08	- -	- -
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.500	- -	- -	12.70
M	- -	- -	0.150	- -	- -	3.81
N	0.330	- -	- -	8.38	- -	- -
P	0.230	- -	- -	5.84	- -	- -
R	1.417	1.433	- -	35.99	36.40	- -
T	0.091	0.095	- -	2.31	2.41	- -
U	0.318	0.325	- -	8.08	8.25	- -
V	0.588	0.597	- -	14.93	15.16	- -
W	- -	- -	0.325	- -	- -	8.25

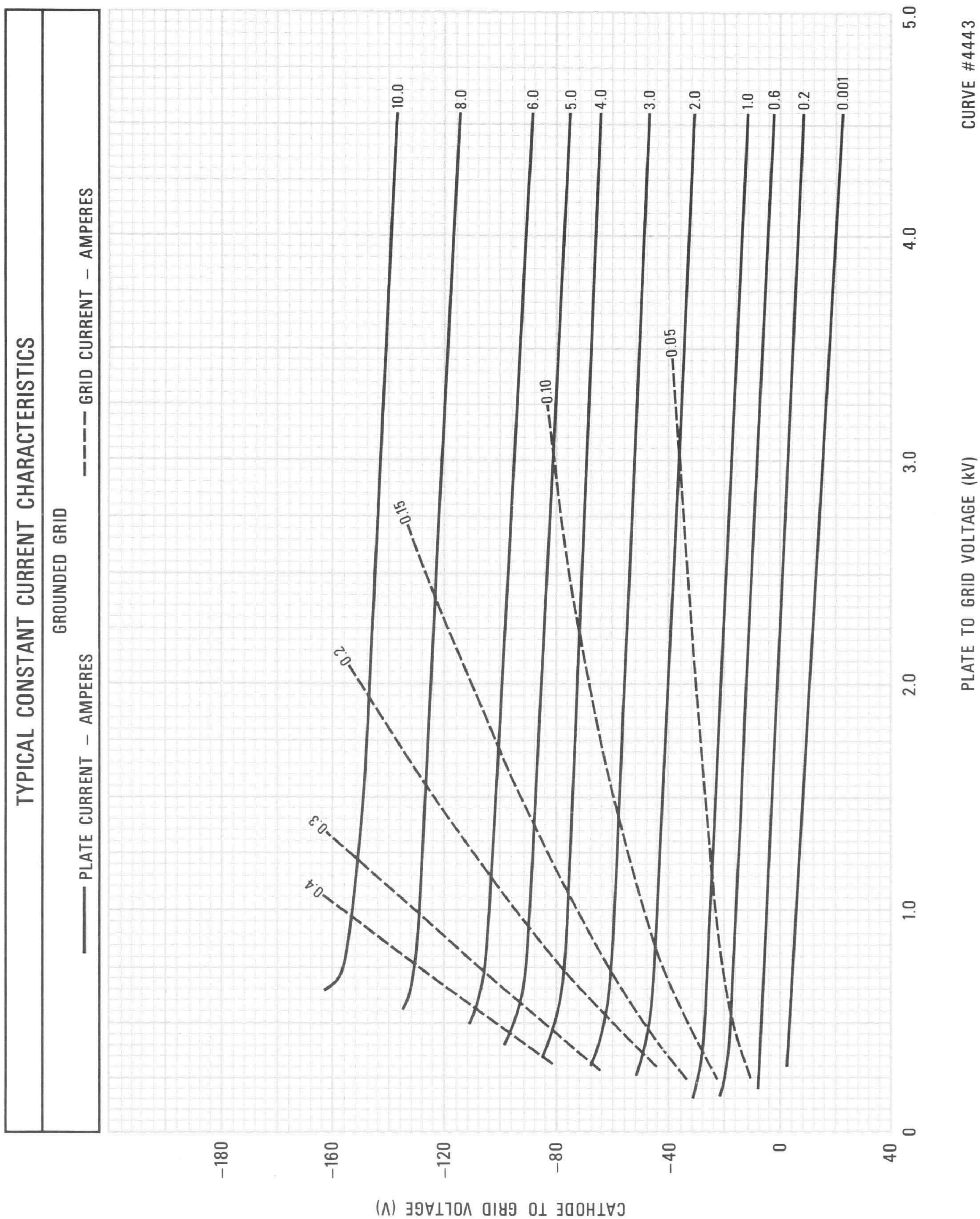
NOTES:

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




AIR FLOW
AIR FLOW
AIR VENT
(WAVE GUIDE BEYOND CUTOFF)
.001 KAPTON
.003 MYLAR
.001 MYLAR
A
B
C
D
E
F


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
3.0
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0.001
0.3
0.2
0.15
0.1
0.05
-80
-60
-40
-20
0
20
0
0.5
1.0
1.5
2.0
2.5
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (kV)
CURVE #4442



TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
0.05
0.10
0.15
0.2
0.3
0.4
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
CURVE #4443
-180
-160
-120
-80
-40
0
40
CATHODE TO GRID VOLTAGE (V)

TECHNICAL DATA

3CX800A7
HIGH - MU
POWER TRIODE

The EIMAC 3CX800A7 is a compact power triode intended for use as a cathode-driven Class AB2 or Class B amplifier in rf applications including the VHF band. As a linear amplifier, high power gain may be obtained without sacrifice of low intermodulation distortion characteristics. Low grid interception and high amplification factor combine to make the 3CX800A7 drive power low for a tube of this power capacity. A single 3CX800A7 will deliver 750 watts PEP and 750 watts key-down CW output power to 350 MHz. The 3CX800A7 is useful to 600 MHz. (For typical cavity operation see page 10) A pulse rated version (3CPX800A7) is also available.

The anode is forced-air cooled for 800 watts of dissipation.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater Voltage	13.5 ± 0.6	V
Heater Current, at 13.5 volts	1.5	A
Cathode-Heater Potential (maximum)	± 150	V
Minimum Warmup Time (before application of rf drive and high voltage)	3	Min
Amplification Factor (approximate)	200	
Direct Interelectrode Capacitance (grid grounded)[2]		
Cin	26.0	pF
Cout	6.1	pF
Cpk	0.05	pF
Highest Frequency for Maximum Ratings	350	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 in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions	
Length	2.52 in; 64.01 mm
Diameter	2.53 in; 64.26 mm
Net Weight	11.5 oz; 326 gm
Operating Position	Any
Cooling	Forced Air
Maximum Operating Temperature:	
Ceramic/Metal Seals or Anode Core	250°C
Base	Large Wafer Elevenar 11-Pin with Ring (EIA No. E11-81)
Recommended Socket	EIMAC SK-1900
Recommended Air Chimney	EIMAC SK-1906
Available Chimney Clamp for SK-1906 (needed if mounting is not vertical, anode up)	EIMAC SK-1916
Available Grid Collet with grounding flange to fit SK-1900 (for VHF operation)	EIMAC P/N 720359
Available Grid Bypass Capacitor Ring (1100 pF @ 1000 DCWV)	EIMAC SK-655
Available Anode Connector Clip	EIMAC ACC-1

VA5131 (Effective August 1989, Supersedes April 1987) Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN Class AB2

ABSOLUTE MAXIMUM RATINGS (to 350 MHz):

DC PLATE VOLTAGE #	2250	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	800	WATTS
GRID CURRENT	0.06	AMPERE
GRID DISSIPATION	4.0	WATTS

* Approximate value.

** Ref. against 1 tone of a 2-equal-tone signal.

\# Plate voltage may rise to 2500 volts maximum under no-signal conditions to account for power supply regulation.

\## Measured at the load.

§ Value will be lower with voice modulation for the same PEP level.

TYPICAL OPERATION - Measured Data (to 150 MHz)
Class AB2 Cathode Driven

	CW/SSB	
Plate Voltage	2200	Vdc
Cathode Bias Voltage	+8.2	Vdc
Zero-Signal Plate Current *	15	mAdc
CW Plate Current	500	mAdc
CW Power Input	1100	W
Peak Envelope Power Input	1100	w
Two-Tone Plate Current §	313	mAdc
CW Grid Current *	36	mAdc
Two-Tone Grid Current * §	16	mAdc
Peak rf Cathode Voltage *	64	v
Peak Driving Power *	23	w
Useful Power Output ##	750	W
Useful Power Output, PEP ##	750	w
Cathode Input Impedance	54	Ohms
Resonant Load Impedance	2700	Ohms
Intermodulation Distortion **		
3rd Order Products	-36	dB
5th Order Products	-32	dB

PULSE MODULATOR OR REGULATOR

ABSOLUTE MAXIMUM RATINGS: (See Figure 2 PULSE DERATING CHART for pulse durations over 100 microseconds)

DC PLATE VOLTAGE	3500	VOLTS
AVERAGE PLATE DISSIPATION	800	WATTS
PEAK PLATE CURRENT (average during pulse)	8	AMPERES
AVERAGE PLATE CURRENT	0.6	AMPERE
AVERAGE GRID CURRENT	0.06	AMPERE
GRID DISSIPATION (average)	4	WATTS

TYPICAL OPERATION values are obtained by actual measurement or by calculation from published characteristic curves. Adjustment of the rf drive 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 output 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 grid/cathode voltage in the presence of the current variation.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The tube may be mounted in any position. If it is to be operated in an inverted (anode down) or horizontal position the SK-1916 clamp assembly should be used for reliable retention. The SK-1906 chimney is provided with four 4-40 tapped holes at one end for chassis mounting and four more 4-40 tapped holes at the other end for optional SK-1916 mounting. The combination of the SK-1906 with the optional SK-1916 clamp makes a rigid mounting assembly for the 3CX800A7. Outline drawings of the SK-1906 air chimney and the clamp assembly are shown in Fig.1.

COOLING - Forced-air cooling must be provided to maintain the anode core and seal temperatues at a safe operating temperature. Cooling data are shown for incoming cooling air at 25°C and 50°C, and represent the minimum requirements to limit tube temperatures to 225°C. The pressure drop figures are approximate and are for the mounting-plate (shown in Fig. 1), socket, tube and chimney combination as would be the case with pressurized-compartment mounting, where air is required to pass through the chassis slots and the anode cooler to the outside of the cabinet.

Cooling Air at 25°C

	SEA LEVEL		5000 FEET	
Anode Diss. W	Flow Rate cfm	Press. Drop In.Water	Flow Rate cfm	Press. Drop In.Water
400	6	0.09	7	0.10
600	11	0.20	14	0.23
800	19	0.50	23	0.57

Cooling Air at 50°C

	SEA LEVEL		5000 FEET	
Anode Diss. W	Flow Rate cfm	Press. Drop In.Water	Flow Rate cfm	Press. Drop In.Water
400	8	0.10	10	0.12
600	16	0.31	19	0.35
800	27	0.79	33	0.88

Some air from the pressurized compartment passes by the socket for base cooling. This mounting technique is effective in the HF region but rf leakage through the slots may cause amplifier instability or regeneration in the VHF region. Screening the holes or use of "wave-guide-beyond-cutoff" (honeycomb) air vents may be required in the VHF region.

Cooling must be applied before or simultaneously with electrode voltages, including the heater, and may be removed simultaneously with them. In all cases temperature of the anode and the ceramic/metal seals is the limiting factor, and the designer is encouraged to use temperature-sensitive paint or other temperature sensing devices in connection with any equipment design before the layout is finalized. It should also be noted that it is not good practice to operate at, or close to, the absolute maximum temperature rating for the metal/ceramic seals. Where long life and consistent performance are factors cooling in excess of minimum requirements is normally beneficial.

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.

HEATER/CATHODE OPERATION - The rated heater voltage for the 3CX800A7 is 13.5 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.6 volt for long life and consistent performance.

CATHODE WARMUP TIME - In normal service it is recommended the heater voltage be applied for a minimum of three minutes before anode voltage and rf drive voltage are applied, to allow for proper conditioning of the cathode surface.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly. 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.**

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 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 two or more.

GRID AND PLATE CURRENT LIMITATIONS - Note that grid current is a function of drive power and amplifier loading and can vary widely during tuning and loading. Under no circumstances should grid current exceed 60 mAdc during tuning or operation of the tube.
The maximum plate current rating is 600 mAdc. Drive level should be restricted during tuning periods so this rating is not exceeded. For monitoring purposes, peak meter readings on voice (taking into account inertia of the meter) will be approximately 200 mAdc. Under no circumstances is the plate current meter reading to exceed the maximum plate current rating of 600 mAdc.

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.

FAULT PROTECTION - All power tubes operate at voltages which can cause severe damage in the event of an arc, especially in cases where large amounts of power supply stored energy are involved. Some means of protection is advised in all cases, and it is recommended that a series resistor be used in the lead from the power supply to the anode circuit to limit peak current and help dissipate the energy in the event of a tube or circuit arc. A resistance of 50 ohms, with at least a 25W rating, in the positive plate power supply lead will help protect the tube in the event of an arc.

VHF OPERATION - The base pin connections to the grid may be used at frequencies to 30 MHz. Above 30 MHz the available contact collets or grid by-pass capacitor assembly (see Page 1) are recommended. VHF driving power will be greater than the typical values shown on page 2 because of higher circuit losses.

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 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 shields all external tube leads or contacts 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. The capacitance values shown in the 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 his application. Measurements should be taken with the mounting which represents the approximate final layout if capacitance values are highly significant in the design.

RADIO-FREQUENCY RADIATION - Exposure to strong rf fields should be avoided, 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 injury, including blindness. **CARDIAC PACEMEAKERS MAY BE EFFECTED.**

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.

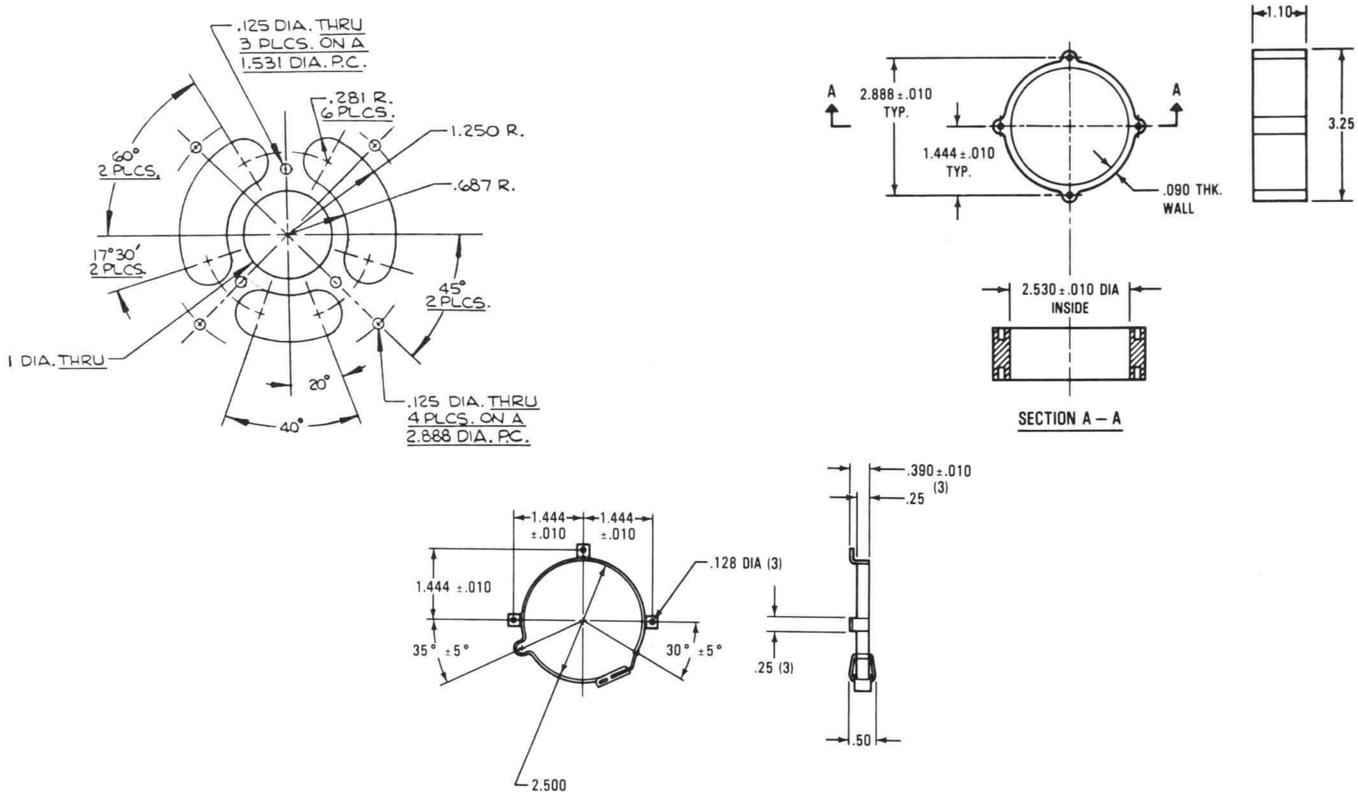


Figure 1 - Mounting Plate, Chimney SK-1906 and Clamp SK-1916, for SK-1900 Socket Assembly

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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:

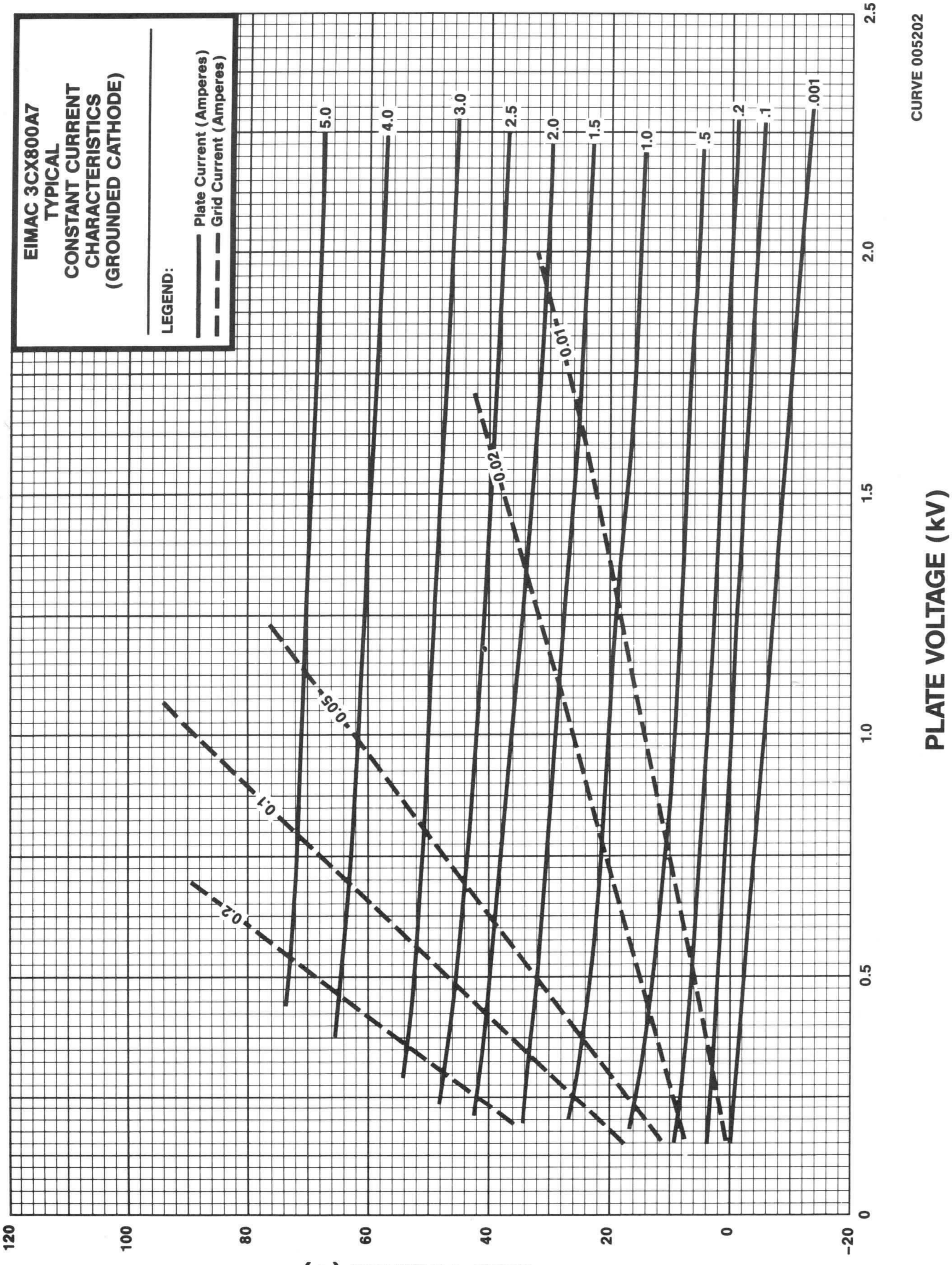
a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that **HIGH VOLTAGE CAN KILL.**

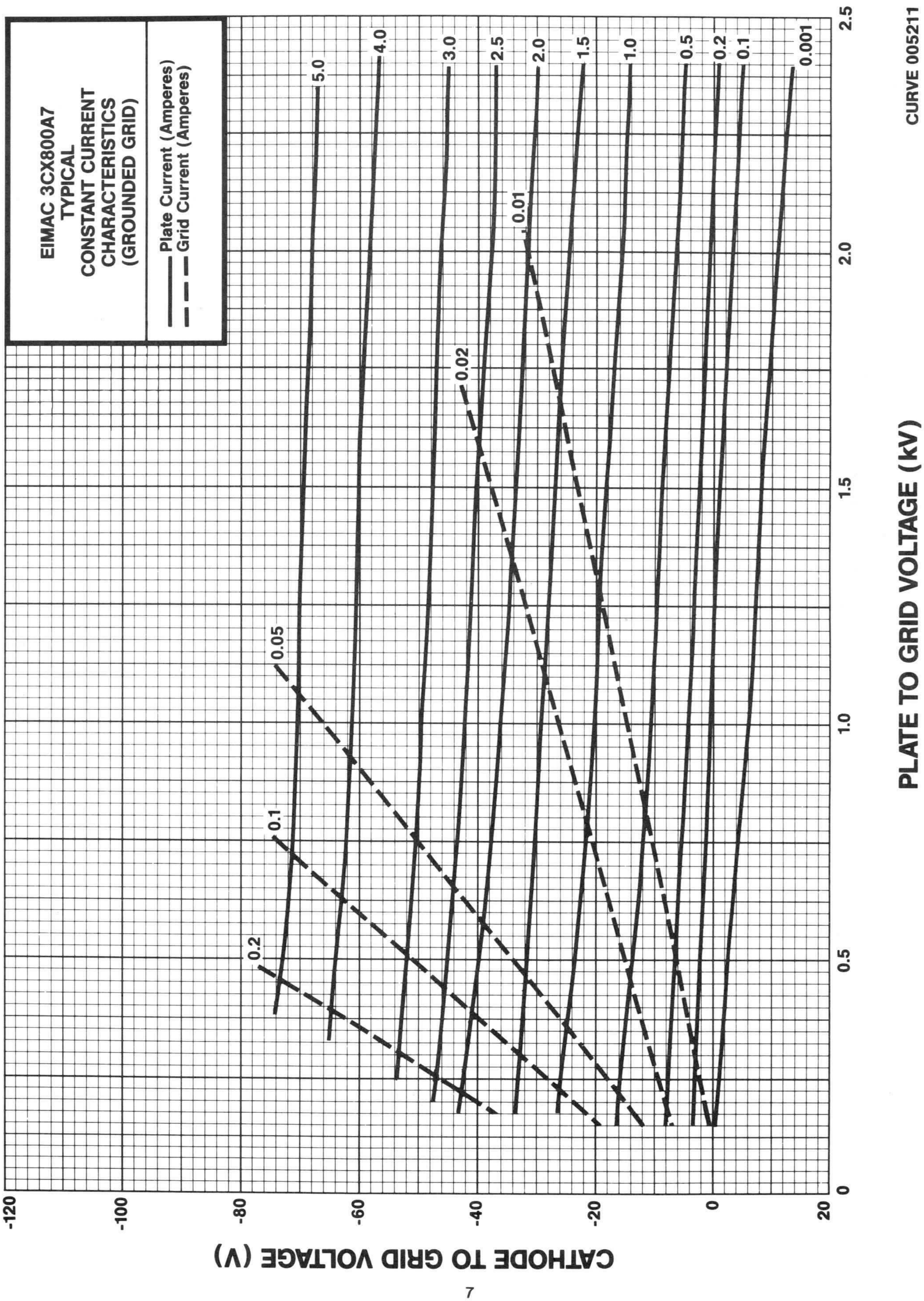
b. LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

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 EFFECTED.**

d. 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 3CX800A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
LEGEND:
Plate Current (Amperes)
Grid Current (Amperes)
5.0
4.0
3.0
2.5
2.0
1.5
1.0
.5
.2
.1
.001
0.01
0.02
0.05
0.1
0.2
GRID VOLTAGE (V)
120
100
80
60
40
20
0
−20
PLATE VOLTAGE (kV)
0
0.5
1.0
1.5
2.0
2.5
CURVE 005202


EIMAC 3CX800A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
5.0
4.0
3.0
2.5
2.0
1.5
1.0
0.5
0.2
0.1
0.001
0.01
0.02
0.05
0.1
0.2
PLATE TO GRID VOLTAGE (kV)
0
0.5
1.0
1.5
2.0
2.5
CATHODE TO GRID VOLTAGE (V)
-120
-100
-80
-60
-40
-20
0
20
CURVE 005211

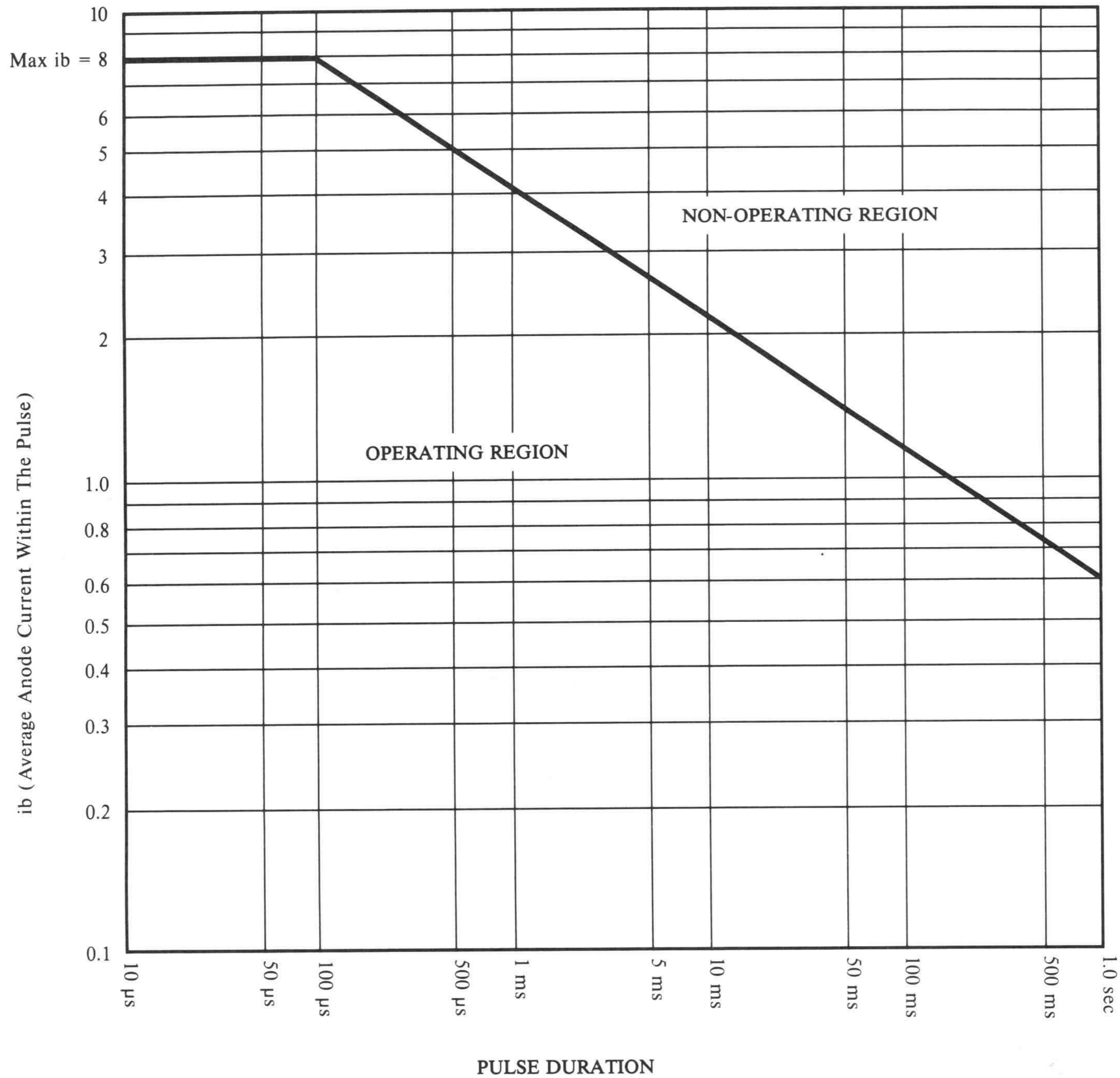


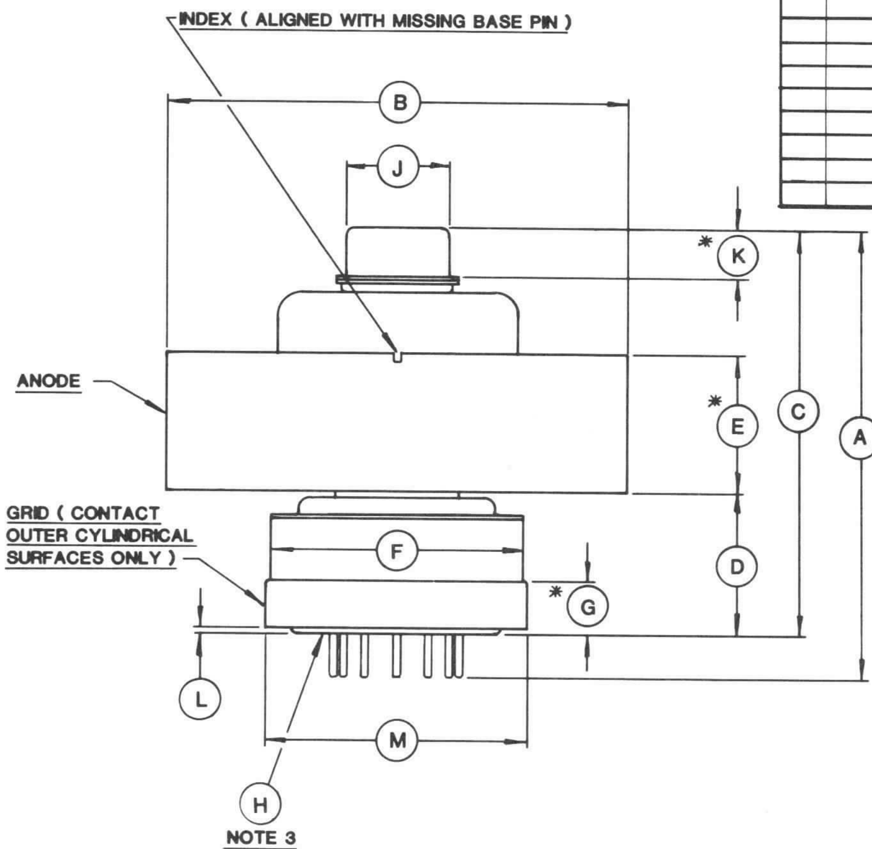
Figure 2 - Pulse Derating Chart, 3CX800A7

Pulse Modulator or Regulator Service

Pulse anode current (ib) capability is dependent on pulse duration (tp) and duty factor (Du). Maximum ib for a given tp is shown; maximum Du may then be derived from the relationship:

$$0.6 = ib\sqrt{Du}$$

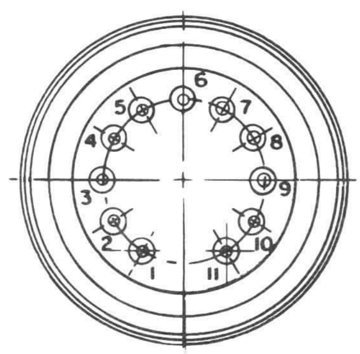
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.326	2.526		59.080	64.160	
B	2.485	2.515		63.119	63.881	
C	2.084	2.284		52.934	58.014	
D	.718	.838		18.237	21.285	
E	.710	.790		18.034	20.066	
F		1.406			35.712	
G	.187			4.750		
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	.559	.573		14.199	14.554	
K	.240			6.096		
L			.027			.686
M	1.417	1.433		35.992	36.398	



NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES
3. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL

PIN No. 1 CATHODE
PIN No. 2 CATHODE
PIN No. 3 CATHODE
PIN No. 4 GRID
PIN No. 5 HEATER
PIN No. 6 HEATER
PIN No. 7 GRID
PIN No. 8 CATHODE
PIN No. 9 CATHODE
PIN No. 10 CATHODE
PIN No. 11 GRID



EIMAC UHF CAVITY AMPLIFIERS

EIMAC UHF CV-2400 series cavity amplifiers cover the range of 180 to 530 MHz. They are useful for communications service in the CW or FM mode. The designs incorporate the 3CX800A7 high-mu power triode for CW applications or the 3CPX800A7 in pulse applications.

Detailed information is shown for the CV-2401. Similar cavities available for other frequency ranges are listed.

CV-2407	180-200 MHz
CV-2403	280-300 MHz
CV-2405	330-370 MHz
CV-2402	375-420 MHz
CV-2406	450-470 MHz
CV-2404	470-530 MHz
CV-2408	585-615 MHz

Similar cavites can be adapted to specific requirements, including pulsed applications.

CV-2401 400 W POWER OUTPUT
390-450 MHZ

The CV-2401 is designed for use in the 390-450 MHz frequency range. It is designed for FM, CW or SSB linear amplifier service.

The amplifier tube is the EIMAC 3CX800A7, a high-mu triode designed with beam-forming cathode and control grid geometry. The tube is cathode driven for good linearity and high stage gain.

The triode design eliminates many cavity and equipment design complications associated with tetrode cavities.

CHARACTERISTICS

Tuning Range	390-450 MHz
Tube Type Used (not supplied	3CX800A7
Input rf Connector	Type N
Output rf Connector	Type N
Cooling Required	Forced Air
Mounting Position	Optional: normally mounts to fit 19-in Rack Panel
Overall Dimensions (nominal):	
Height	5.0 in; 12.7 cm
Width	8.5 in; 21.6 cm
Depth	8.25 in; 20.9 cm
Net Weight, approx. (tube not installed) .	13 lbs; 6.0 kg

TYPICAL OPERATION (450 MHZ)

Heater Voltage	13.5	Vac
Heater Current *	1.5	Aac
Anode Voltage	1800	Vdc
Grid Bias Voltage	-8.0	Vdc
Anode Current	0.48	Adc
Grid Current *	10	mAdc
Driving Power *	15	W
Useful Power Output * #	400	W
Power Gain *	14.2	dB
Efficiency	46	%

* Approximate value # Power delivered to the load

TECHNICAL DATA

8283
3CX1000A7

HIGH-MU
POWER TRIODE

The EIMAC 8283/3CX1000A7 is a ceramic-metal zero-bias triode intended for Class-AB_2 linear amplifier service in either grid-driven or cathode-driven configuration. It is recommended for use as a grid driven, push-pull audio amplifier or modulator and as a cathode driven linear amplifier through the VHF-TV bands.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-Tungsten Mesh	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	30.5 A
Amplification Factor (Average)	200
Direct Interelectrode Capacitance (Grounded Cathode)[2]	
Cin	32.0 pF
Cgp	14.0 pF
Cout	0.15 pF
Direct Interelectrode Capacitance (Grounded Grid)[2]	
Cin	32.0 pF
Cpk	0.15 pF
Cout	14.0 pF
Frequency of Maximum Ratings	220 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or produce 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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.80 in; 121.9 mm
Diameter	3.38 in; 85.8 mm
Net Weight	2 lb; 0.91 kg
Operating Position	Vertical, base up or down
Cooling	Forced Air
Base	Special Breechlock
Recommended Air-System Socket	EIMAC SK-860 or SK-870
Recommended Air Chimney	EIMAC SK-816
Maximum Temperature, Anode Core & Ceramic/Metal Seals	250°C

 Printed in U.S.A.

EIMAC division of varian / 301 industrial way / san carlos / california 94070

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_2 Grid Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	45	WATTS

TYPICAL OPERATION, (Two tubes)

Plate Voltage	2000	2500	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current	400	500	mAdc
Max-Signal Plate Current	2.0	2.0	Adc
Max-Signal Grid Current	590	480	mAdc
Peak AF driving Voltage (per tube)	95	90	v
Driving Power	25	44	W
Load Resistance (plate-to-plate)	1900	2580	Ω
Max-Signal Plate Output Power	2350	3100	W

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_2, Grounded-Grid

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	45	WATTS

TYPICAL OPERATION

Plate Voltage	2000	2500	3500	Vdc
Grid Voltage [1]	0	0	-12	Vdc
Zero-Signal Plate Current	238	305	129	mAdc
Single-Tone Plate Current	875	800	857	mAdc
Two-Tone Plate Current	600	585	590	mAdc
Single-Tone Grid Current	230	205	225	mAdc
Two-Tone Grid Current	130	120	120	mAdc
Peak RF Driving Voltage	80	74	110	v
Driving Power	80	60	100	W
Peak Envelope Power Output	940	1170	2060	W
Resonant Load Impedance	1100	1670	2300	Ω
RF Driving Impedance	40	45	60	Ω
Third Order IM Distortion [2]	-29	-31	-31	dB
Fifth Order IM Distortion [2]	-37	-40	-39	dB

1. The bias voltage in this set of typical operating conditions was obtained by means of a -12 volt 50 watt Zener diode in the negative return to the center-tap of the filament transformer.

2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.

RADIO-FREQUENCY AMPLIFIER OR OSCILLATOR - Class C.

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.7	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	45	WATTS

PLATE MODULATED RADIO-FREQUENCY AMPLIFIER - Class C.

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.55	AMPERE
PLATE DISSIPATION	670	WATTS
GRID DISSIPATION	45	WATTS

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current, at 5.0 volts	28.0	33.0	A
Zero Bias Plate Current, with E_b = 2500 Vdc	250	350	mA
Cut-off Grid Voltage (E_b = 2500 Vdc; I_b = 1.0 mA)	---	-25	V
Interelectrode Capacitances (Grounded Cathode) [1]			
Cin	29.0	35.0	pF
Cout	---	0.2	pF
Cgp	12.0	16.0	pF
Interelectrode Capacitances (Grounded Grid) [1]			
Cin	29.0	35.0	pF
Cout	12.0	16.0	pF
Cpk	---	0.2	pF

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

APPLICATION

MOUNTING & SOCKETING - The 3CX1000A7 must be operated with its axis vertical, base up or down. The EIMAC SK-860 and SK-870 air-system sockets are available for use with the tube. The SK-870 has its grid contacts grounded to the socket frame. No contacts are grounded with the SK-860. The EIMAC SK-816 air-chimney is also available to direct cooling air from the socket through the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces and the anode core of the 3CX1000A7 is 250°C. Tube life is prolonged if these areas are maintained at somewhat lower temperatures. The table lists air-flow requirements to maintain tube temperatures below 225°C with 50°C inlet air and base-to-anode air flow.

SEA LEVEL		
Plate Diss. (watts)	Air Flow (cfm)	Press. Drop (In. H_2O)
600	12	0.12
800	16	0.19
1000	20.5	0.30
1500	33	0.65
10,000 FEET		
600	18	0.18
800	24	0.28
1000	31	0.45
1500	50	0.97

FILAMENT - Rated filament voltage for the 3CX1000A7 is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 3CX1000A7 is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended 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.

CLASS-C OPERATION - Although designed for Class-AB_2 service, the 3CX1000A7 may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristic can be used to advantage in Class-C amplifiers by employing only grid leak bias, provided the anode voltage is not over 2500 Vdc. If driving power fails under these circumstances, plate dissipation will be kept within the maximum rating since the tube will operate at normal static zero-bias conditions.

For Class C operation with anode voltage in excess of 2500 Vdc additional protective bias voltage is required.

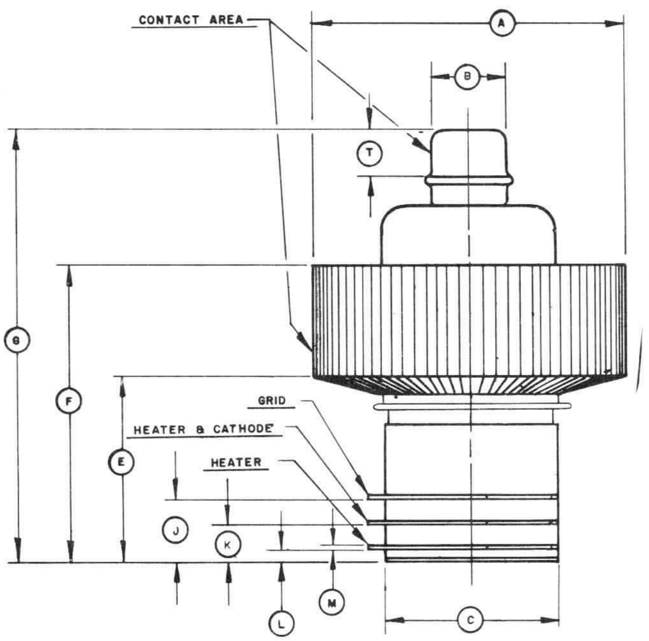
INTERLOCKS - An interlock device should be provided to insure that cooling air is established before application of electrical power, including the filament voltage. The circuit should be so arranged that rf drive cannot be applied in the absence of normal anode voltage.

HIGH VOLTAGE - The 3CX1000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be by-passed 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 the 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 specially constructed test fixtures with effectively shield all external tube terminals or 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.

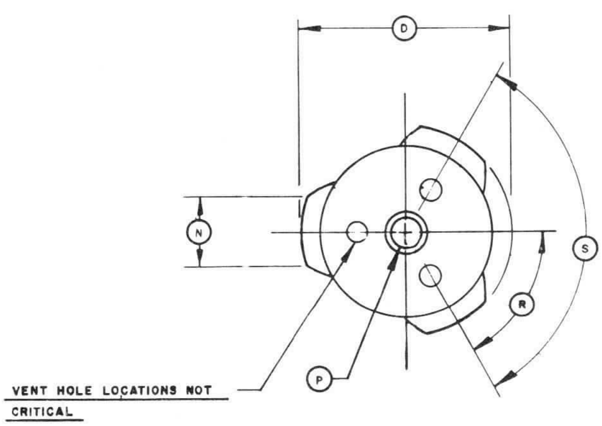
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

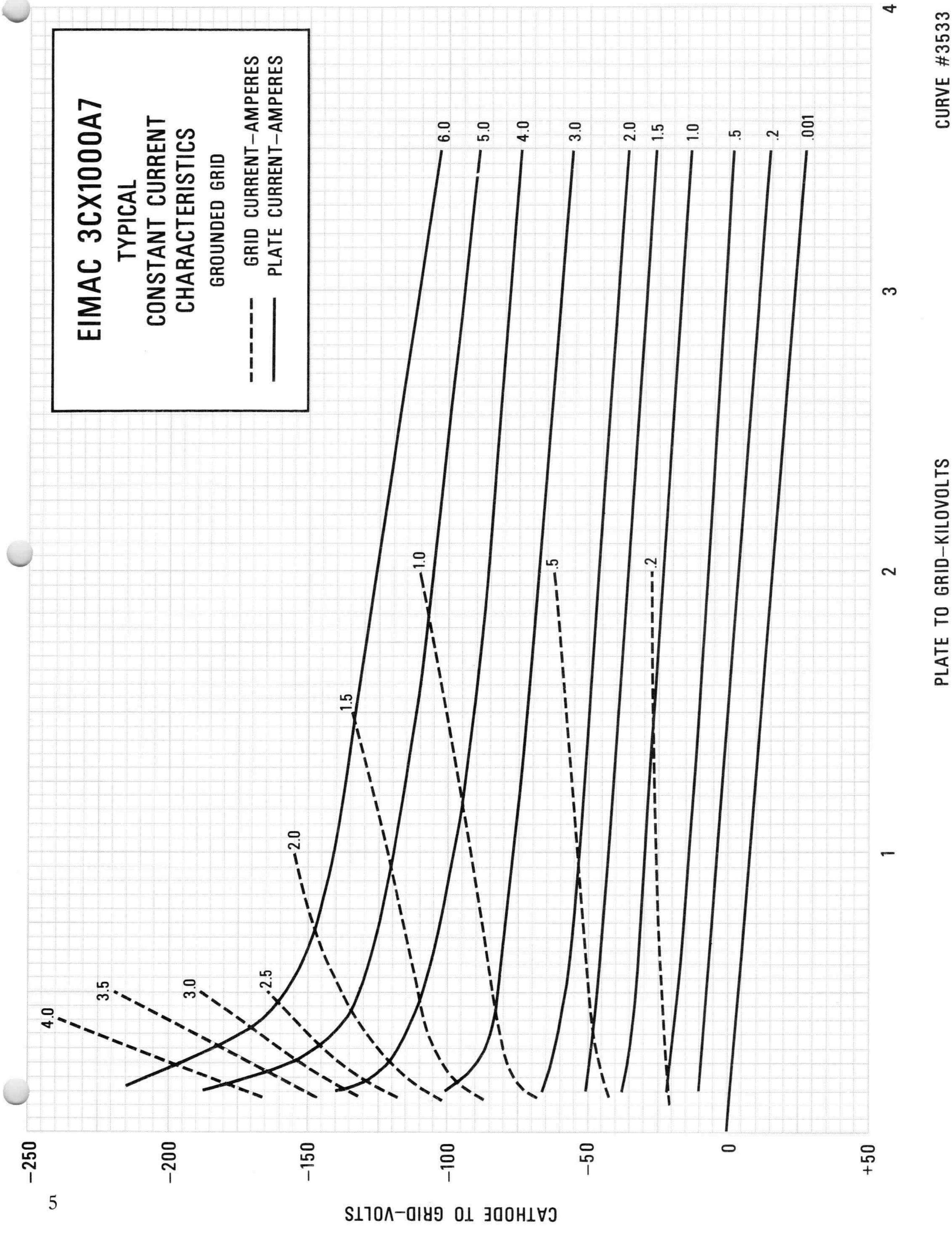
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.325	3.375	- -	84.45	85.72	- -
B	0.807	0.817	- -	20.50	20.75	- -
C	1.870	1.900	- -	47.50	48.26	- -
D	2.250	2.300	- -	57.15	58.42	- -
E	2.000	2.194	- -	50.80	55.73	- -
F	3.175	3.375	- -	80.64	85.72	- -
G	4600	4.800	- -	116.8	121.9	- -
J	0.690	0.710	- -	17.53	18.03	- -
K	0.415	0.435	- -	10.54	11.04	- -
L	0.140	0.165	- -	3.56	4.19	- -
M	0.020	0.030	- -	0.508	0.762	- -
N	0.700	0.800	- -	17.78	20.32	- -
P	0.314	0.316	- -	7.97	8.03	- -
R	55°	65°	- -	55°	65°	- -
S	115°	125°	- -	115°	125°	- -
T	0.470	0.530	- -	11.94	13.46	- -

NOTE:
REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.




EIMAC 3CX1000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
6.0
5.0
4.0
3.0
2.0
1.5
1.0
.5
.2
.001
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
.2
-250
-200
-150
-100
-50
0
+50
1
2
3
4
PLATE TO GRID—KILOVOLTS
CATHODE TO GRID—VOLTS
CURVE #3533

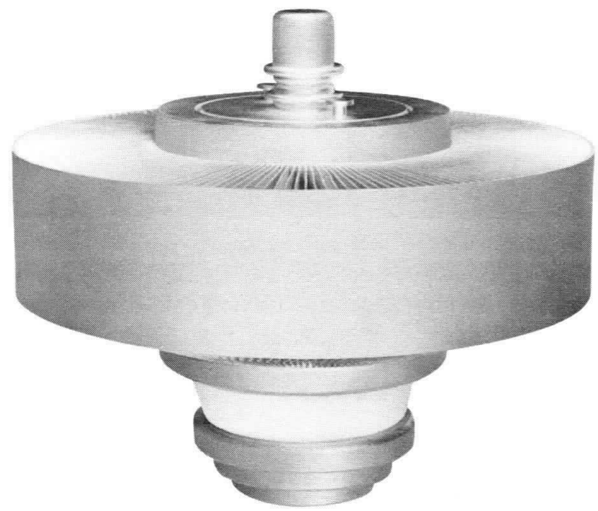
TECHNICAL DATA

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) Printed in U.S.A.
VA4533

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)	$\pm$ 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 absolute 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.

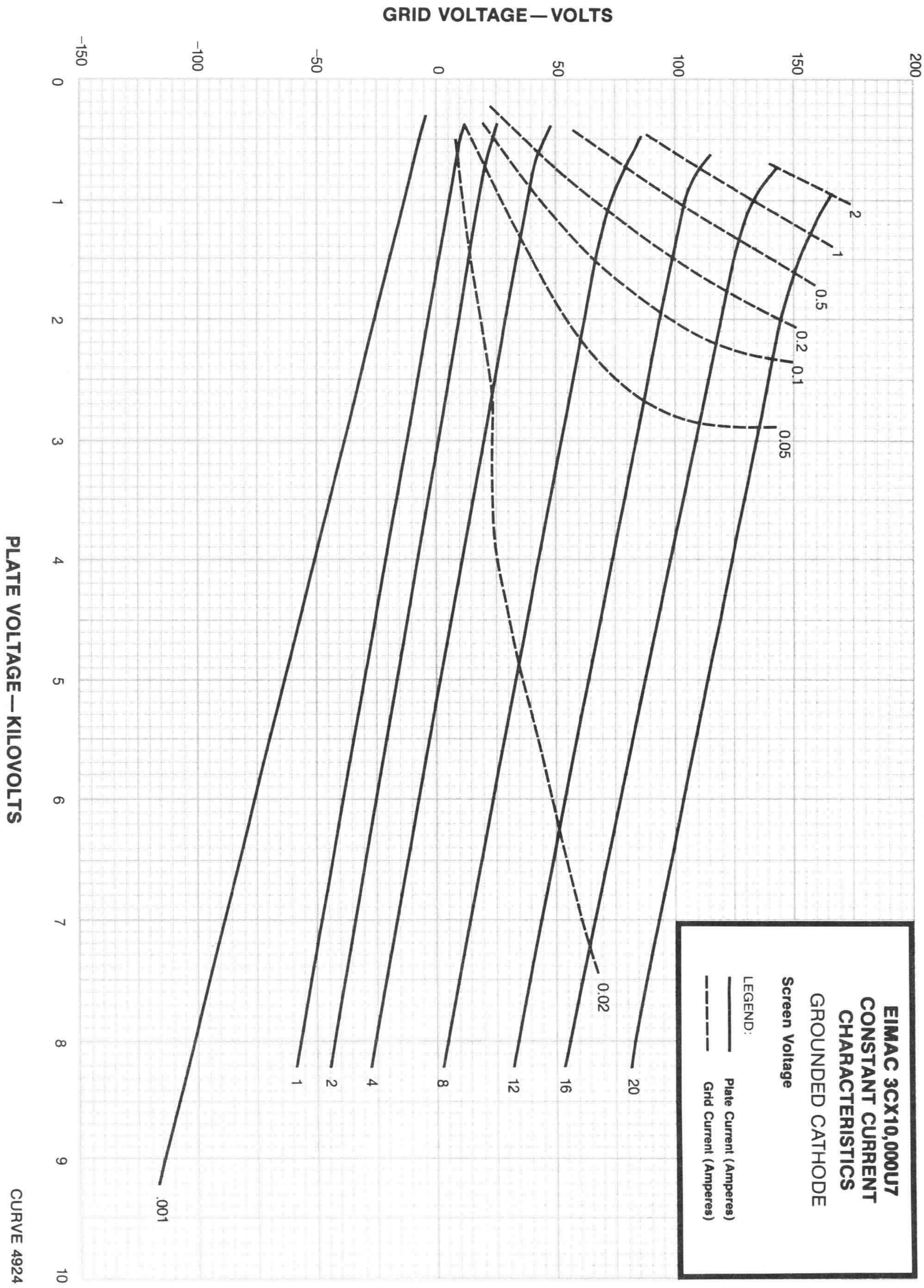
The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

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.



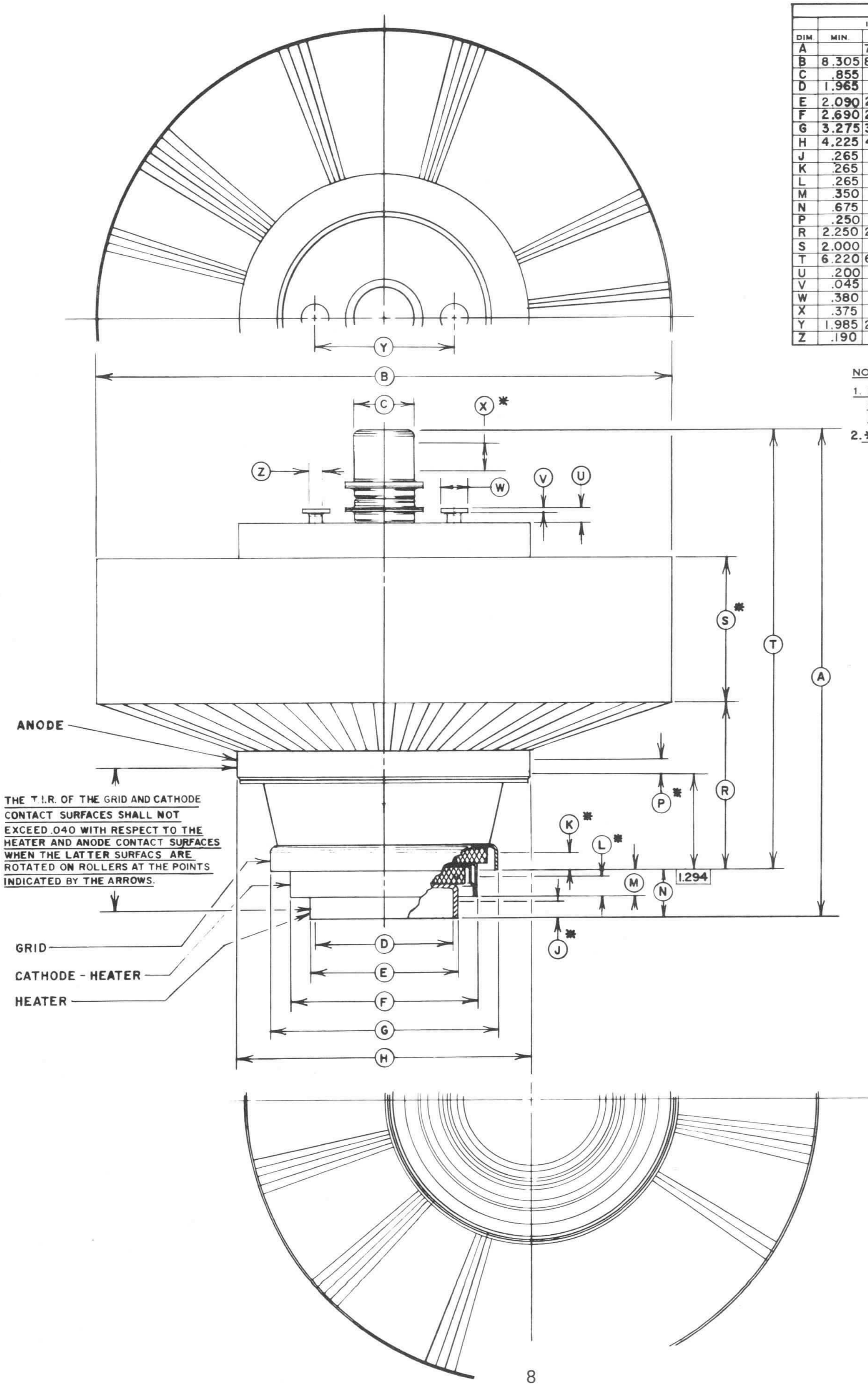
EIMAC 3CX10,000U7
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
Screen Voltage
LEGEND:
Plate Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE—VOLTS
-150
-100
-50
0
50
100
150
200
PLATE VOLTAGE—KILOVOLTS
0
1
2
3
4
5
6
7
8
9
10
2
1
0.5
0.2
0.1
0.05
0.02
20
16
12
8
4
2
1
.001

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



TECHNICAL DATA

8877
3CX1500A7

HIGH-MU
POWER TRIODE

The EIMAC 8877/3CX1500A7 is a rugged ceramic/metal power triode designed for use as a cathode driven Class AB_2 or Class B amplifier, in audio or rf applications including the UHF band, or as a cathode driven plate modulated Class C rf amplifier. As a linear amplifier, high power gain may be obtained without sacrifice of low intermodulation characteristics.

Low grid interception and high amplification factor combine to make the 8877/3CX1500A7 drive power requirements exceptionally low for a tube of this power capacity.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	5.0 ± 0.25	V
Current, at 5.0 volts	10.5	A
Transconductance (Average):		
I_b = 1.0 Adc	55,000	μmhos
Amplification Factor (Average)	200	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	38.5	pF
Cout	0.1	pF
Cgp	10	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	38.5	pF
Cout	10	pF
Cpk	0.1	pF
Ck-htr	9.7	pF
Frequency of Maximum Rating:		
CW	250	MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.02 in;102.16 mm
Diameter	3.38 in; 85.85 mm
Net Weight	25.0 oz; 708.8 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals, Anode Core	250°C
Cooling	Forced Air
Base	Special 7-pin
Recommended Air System Socket	
(Grounded Grid)	SK-2210
(Grounded Cathode)	SK-2200
Recommended Air Chimney	
(Teflon)	SK 2216

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 5.0 volts	9.5	11.5	A
Cathode Warmup Time	90	---	sec
Interelectrode Capacitance (grounded grid circuit)[1]			
Cin	36.0	41.0	pF
Cout	9.2	11.2	pF
Cpk	---	0.2	pF

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

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN Class AB_2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB2 Cathode Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2700	3500	Vdc
Cathode Voltage[1]	+8.2	+8.2	Vdc
Zero-Signal Plate Current[3]	92	182	mAdc
Single-Tone Plate Current	740	1000	mAdc
Two-Tone Plate Current	480	675	mAdc
Single-Tone Grid Current[3]	40	74	mAdc
Two-Tone Grid Current[3]	16	25	mAdc
Peak rf Cathode Voltage[3]	68	81	v
Peak Driving Power[3]	40	64	w
Single-Tone Useful Output Power[3]	1085	2075	W
Resonant Load Impedance	1820	2000	Ω
Intermodulation Distortion Products[2]			
3rd Order	-40	-38	dB
5th Order	-41	-41	dB

1. Positive cathode bias provided by zener diode.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (220 MHz)
Class AB2 Cathode Driven

Plate Voltage	2500	Vdc
Cathode Voltage[1]	+8.2	Vdc
Plate Current	1000	mAdc
Grid Current[2]	10	mAdc
Useful Output Power[2]	1520	W
Driving Power[2]	57	W
Power Gain[2]	14	dB

1. Positive cathode bias provided by zener diode.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER
Class B Telegraphy or FM
(Continuous Operating Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (88-108 MHz) Measured Values
Class B, Cathode Driven

Plate Voltage	2000	2500	3000	4000	Vdc
Cathode Voltage[1, 2]	+9	+12	+15	+20	Vdc
Plate Current	1.0	1.0	1.0	1.0	Adc
Grid Current[2]	60	58	42	25	mAdc
Driving Power[2]	64	54	65	78	W
Useful Power Output[3]	1330	1670	1960	2600	W
Efficiency[4]	66.5	66.7	65.5	65.2	%
Power Gain[4]	13.2	14.2	14.8	15.3	dB

1. For measured case, idling anode current was set for 10 mAdc.
2. Approximate.
3. Approximate, delivered to the load.
4. For the measured case; may vary from tube to tube.

RADIO FREQUENCY POWER AMPLIFIER
Class C - Cathode Driven, Plate Modulated

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3200	VOLTS
DC PLATE CURRENT	0.8	AMPERE
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION Carrier Conditions, Frequencies to 30 MHz, Cathode Driven

Plate Voltage	2400	Vdc
Cathode Voltage[1]	+22	Vdc
Plate Current	600	mAdc
Grid Current[2]	45	mAdc
Plate Load Resistance	2000	Ω
Driving Power[3]	41	W
Plate Output Power	1000	W
Power Gain	14	dB

1. Bias may be obtained from a fixed supply of 15.8 volts in series with a 9.5 ohm resistor. The resistor & supply should be bypassed for audio frequencies.
2. Approximate.
3. Approximate, and driver must be modulated approximately 83%.

APPLICATION

MECHANICAL

MOUNTING - The 8877/3CX1500A7 may be mounted in any position.

SOCKET - The grid of the 8877/3CX1500A7 terminates in the cylindrical grid ring about the base of the tube. This may be contacted by multiple clips or flexible finger stock. Connections to the heater and cathode are made via the 7-pin base.

COOLING - The maximum temperature limit for external tube surfaces and the anode core is 250°C. Tube life is prolonged if these areas are maintained at lower temperatures. For full 1500 watt anode dissipation 38.0 cfm of air is required at a back pressure of 0.60 inches to hold tube temperature below 225°C with 50°C ambient temperature at sea level. At frequencies higher than 30 MHz, or at high altitudes, the air quantity must be increased.

Base-to-Anode Air Flow (sea level)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H_2O
500	7.5	0.10
1000	22.5	0.20
1500	35.0	0.41
Base-to-Anode Air Flow (10,000 ft.)		
Anode Dissipation (watts)	Air Flow (CFM)	Pressure Drop In./H_2O
500	11.0	0.15
1000	32.5	0.29
1500	51.0	0.60

Note: 1) Tube mounted in SK-2200 Socket with SK-2216 Chimney.
2) An allowance of 25 watts has been made for grid dissipation and 50 watts for filament power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8877/3CX1500A7 is 5.0 volts. Filament voltage, as measured at the socket optimum performance and maximum tube life. In no case should it be allowed to deviate from 5.0 volts by more than plus or minus five per cent.

INPUT CIRCUIT - When the 8877/3CX1500A7 is operated as a cathode driven rf amplifier, the use of a resonant circuit in the cathode is recommended. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a Q of two or more.

ZERO-BIAS OPERATION - Operation at zero-bias is not recommended with plate potentials over 3000 volts, since plate dissipation may be exceeded. Higher plate voltage may be used with the proper protective bias.

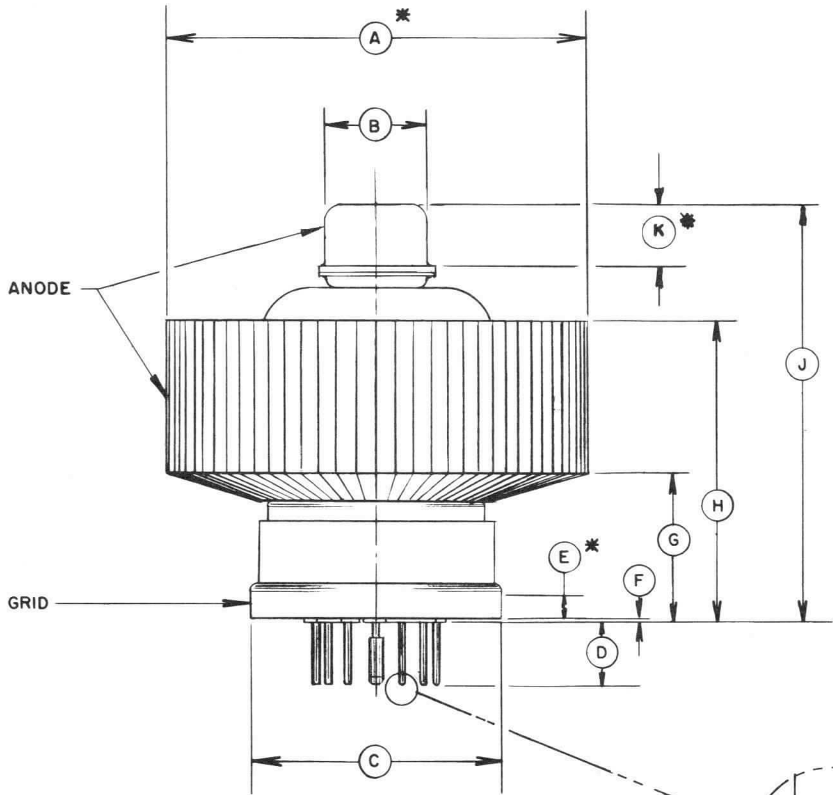
HIGH VOLTAGE - The 3CX1500A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies 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.

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.

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, 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.

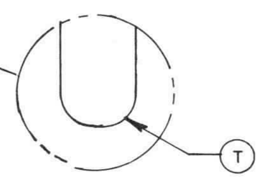
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

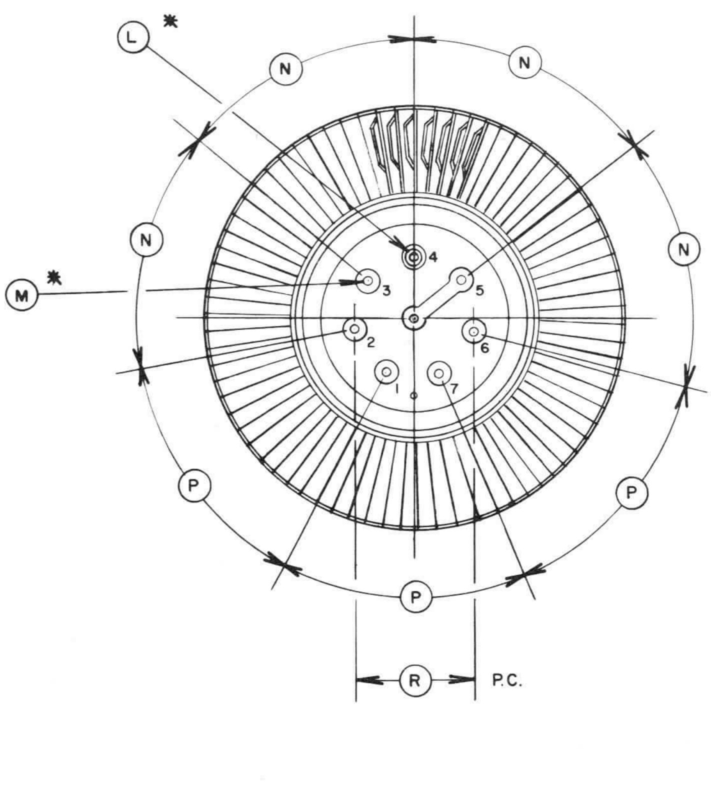


DIM.	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	3.350	3.380	— —	85.09	85.85	— —
B	0.810	0.820	— —	20.57	20.83	— —
C	1.995	2.015	— —	50.67	51.18	— —
D	0.438	0.562	— —	11.13	14.27	— —
E	0.235	— —	— —	5.97	— —	— —
F	0.000	0.040	— —	0.00	1.02	— —
G	1.100	1.225	— —	27.94	31.12	— —
H	2.300	2.425	— —	58.42	61.60	— —
J	3.250	3.420	— —	82.55	86.87	— —
K	0.470	0.530	— —	11.94	13.46	— —
L	0.120	0.127	— —	3.05	3.23	— —
M	0.056	0.062	— —	1.42	1.57	— —
N	— —	— —	51°	— —	— —	51°
P	— —	— —	52°	— —	— —	52°
R	— —	— —	1.000	— —	— —	25.40
T	0.020R	— —	— —	0.51R	— —	— —

NOTES:

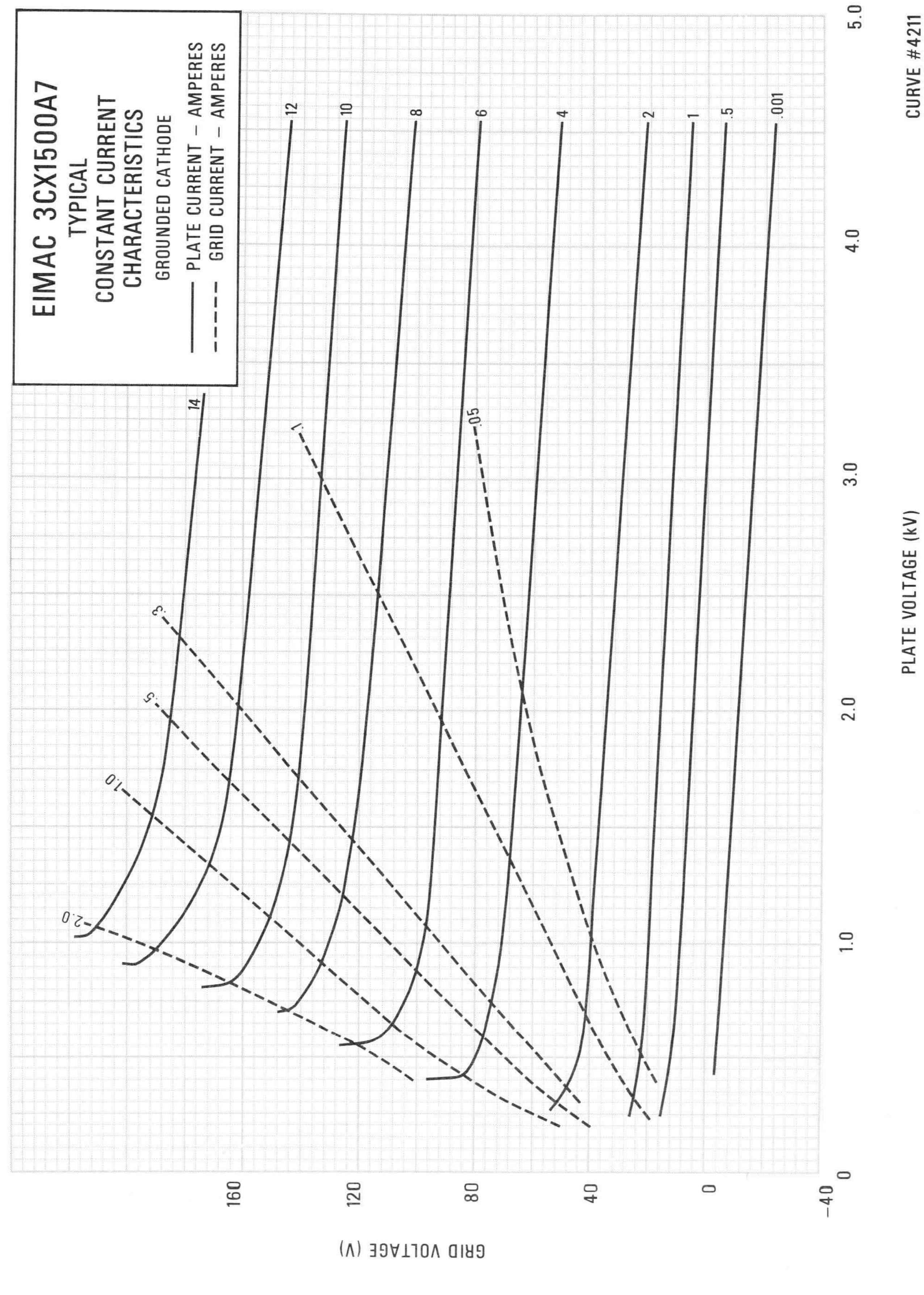
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE
3. DIMENSION T APPLIES TO ALL BUT CENTER PIN.

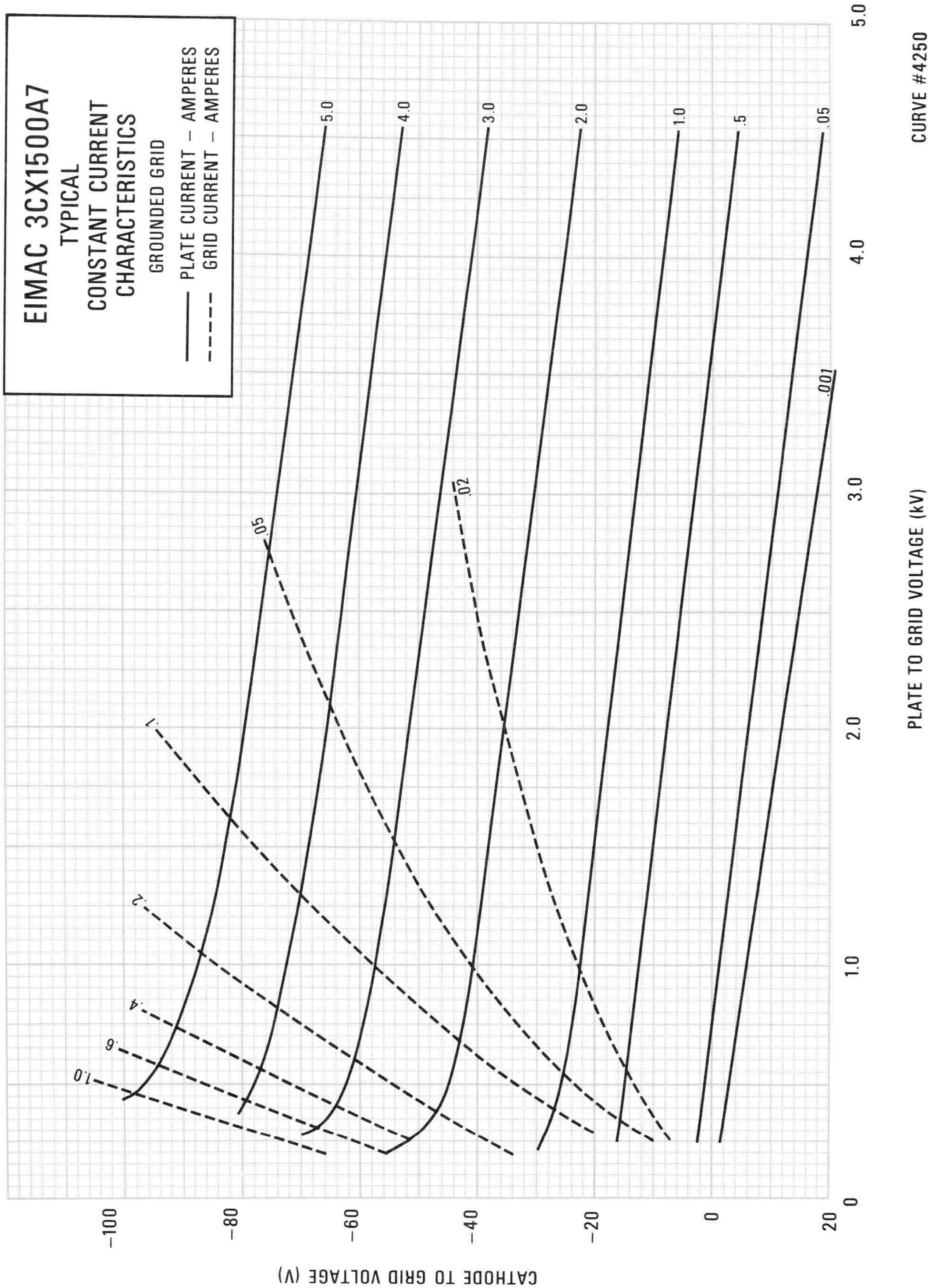




PIN CONNECTIONS

1 - HEATER
5 - HEATER
2 - 3 - 4 - 6 - 7 CATHODE


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
14
12
10
8
6
4
2
1
.5
.001
2.0
1.0
.5
.3
.1
.05
GRID VOLTAGE (V)
−40
0
40
80
120
160
PLATE VOLTAGE (kV)
0
1.0
2.0
3.0
4.0
5.0
CURVE #4211


EIMAC 3CX1500A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
5.0
4.0
3.0
2.0
1.0
.5
.05
.001
.02
.05
.1
.2
.4
.6
1.0
–100
–80
–60
–40
–20
0
20
0
1.0
2.0
3.0
4.0
5.0
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (kV)
CURVE #4250

Eimac®

TECHNICAL DATA

8161

3CX2500A3

MEDIUM MU TRIODE

The EIMAC 3CX2500A3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500A3 is an exact replacement for the EIMAC 3X2500A3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube has a rugged, low-inductance cylindrical filament-stem structure, which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides thorough shielding between the input and output circuits for grounded-grid applications and is conveniently terminated in a ring between the plate and filament terminals. The 3CX2500A3 may be installed or removed without the aid of tools.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	49		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	pF
Grid-Filament	29.2		40.2	pF
Plate-Filament	0.6		1.2	pF
Tranconductance (Ib=830 ma., Eb=3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			75	MHz

MECHANICAL

Base	See drawing
Mounting	Vertical, base down or up
Cooling	Forced Air
Maximum Anode Core and Seal Temperatures	250°C
Maximum Over-all Dimensions:	
Length	8.6 inches
Diameter	4.16 inches
Net Weight	6.25 pounds
Shipping Weight (Average)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier, (Frequencies below 75 MHz.)

Class-C FM or Telegraphy (Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	2500 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION (Frequencies below 75 MHz per tube)

DC Plate Voltage	4000	5000	6000	volts
DC Plate Current	2.5	2.5	2.08	amps
DC Grid Voltage	—300	—450	—500	volts
DC Grid Current*	245	265	180	ma
Peak RF Grid Input Voltage*	580	750	765	volts
Driving Power*	142	197	136	watts
Grid Dissipation*	68	78	46	watts
Plate Power Input	10,000	12,500	12,500	watts
Plate Dissipation	2500	2500	2500	watts
Plate Power Output	7500	10,000	10,000	watts

*Approximate values.

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier, (Frequencies below 75 MHz.)

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC PLATE CURRENT	2.0	AMPS
PLATE DISSIPATION	1670	VOLTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Frequencies below 75 MHz per tube)

DC Plate Voltage	4000	4500	5000	volts
DC Plate Current	1.67	1.47	1.25	amps
DC Grid Voltage	—450	—500	—550	volts
DC Grid Current*	180	140	150	ma
Peak RF Grid Input Voltage*	685	715	760	volts
Driving Power*	125	100	115	watts
Grid Dissipation*	43	30	32	watts
Plate Power Input	6670	6615	6250	watts
Plate Dissipation	1670	1315	950	watts
Plate Power Output	5000	5300	5300	watts

*Approximate values.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPS
PLATE DISSIPATION	2500	WATTS
GRID DISSIPATION	150	WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage[1]	—150	—190	—240	volts
Zero-Signal DC Plate Current	0.6	0.5	0.4	amps
Max-Signal DC Plate Current	4.0	3.2	3.0	amps
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390	volts
Max-Signal Peak Driving Power*	340	230	225	watts
Max-Signal Nominal Driving Power*	170	115	113	watts
Max-Signal Plate Output Power	11,000	11,000	13,000	watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDNG THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Cooling—Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 MHz, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Anode-to-Base Air Flow[1]				
	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air Flow				
	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1] When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

Simultaneous removal of all power and air (as in the case of a power failure) will not ordinarily injure the tube, but it is recommended that cooling airflow continue for at least three minutes after filament power has been removed.

Filament Voltage — The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts.

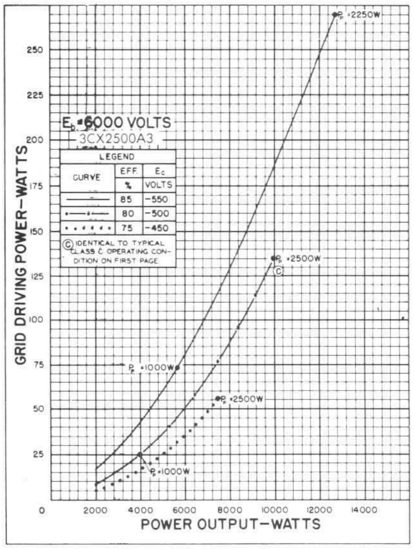
Bias Voltage — There is little advantage in using bias voltages in excess of those given under "TYPICAL OPERATION" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

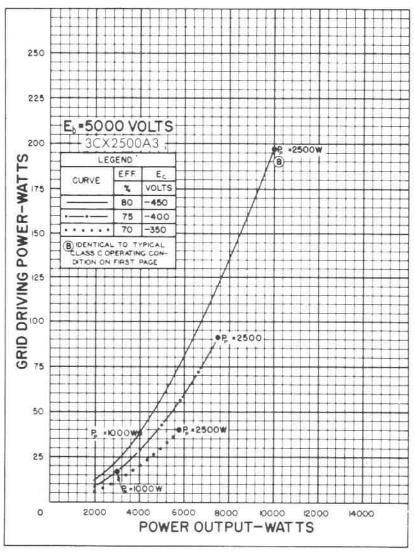
Plate Voltage — The plate-supply voltage for the 3CX2500A3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "TYPICAL OPERATION" for the power output desired.

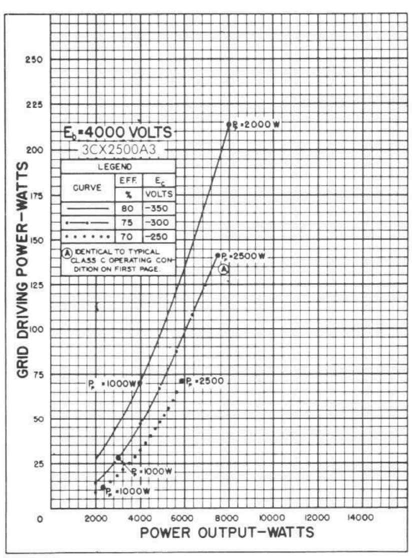
Grid Dissipation — The power dissipated by the grid of the 3CX2500A3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

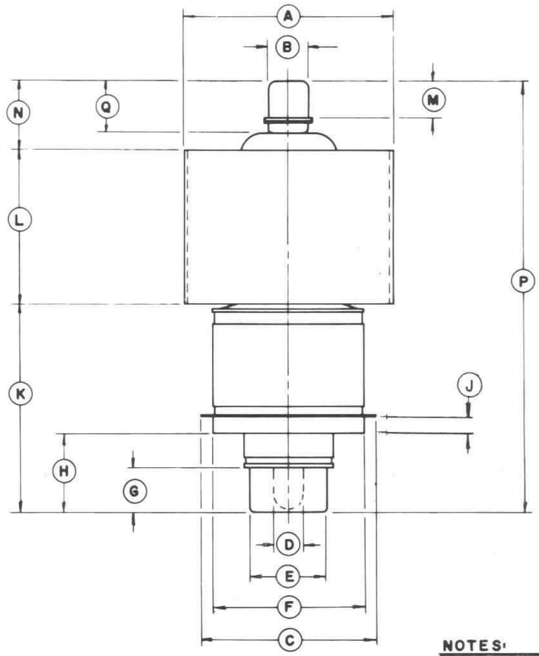
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

In VHF operation, particularly above 75 MHz the dc grid current must not exceed 200 ma under any conditions of plate loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





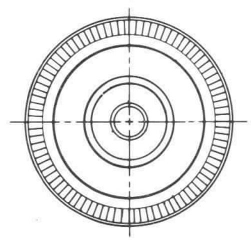




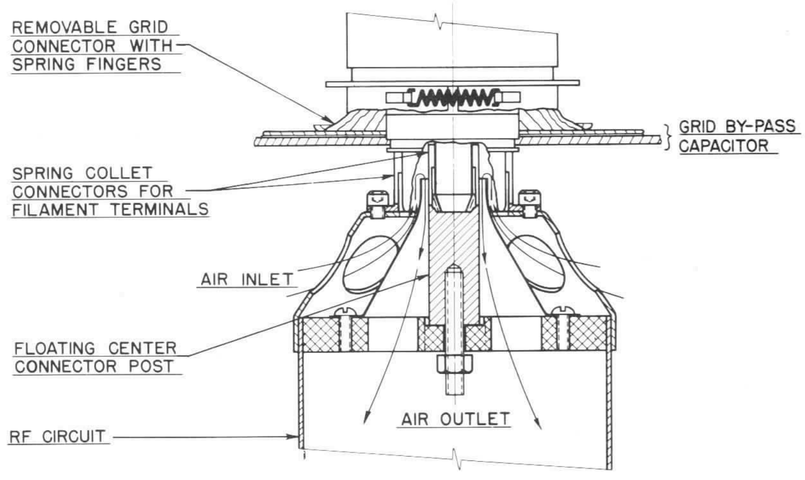
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	.615	.635	
E	1 .490	1 .510	
F	2 .990	3 .010	
G	13/16	15/16	
H	1 3/8	1 5/8	
J	3/8	7/16	
K	3 7/8	4 1/4	
L	2 15/16	3 1/16	
M	11/16	13/16	
N	1 3/16	1 11/16	
P	8	9	
Q	1	1 1/8	

NOTES:

1. .040 MAXIUM RUNOUT OF GRID CONTACT SURFACE WITH RESPECT TO AXIS DETERMINED BY ANODE AND OUTER FILAMENT CONTACT SURFACE.
2. .025 MAXIUM RUNOUT OF INNER FILAMENT CONTACT SURFACE WITH RESPECT TO OUTER FILAMENT CONTACT SURFACE.
3. DIMENSIONS IN INCHES.



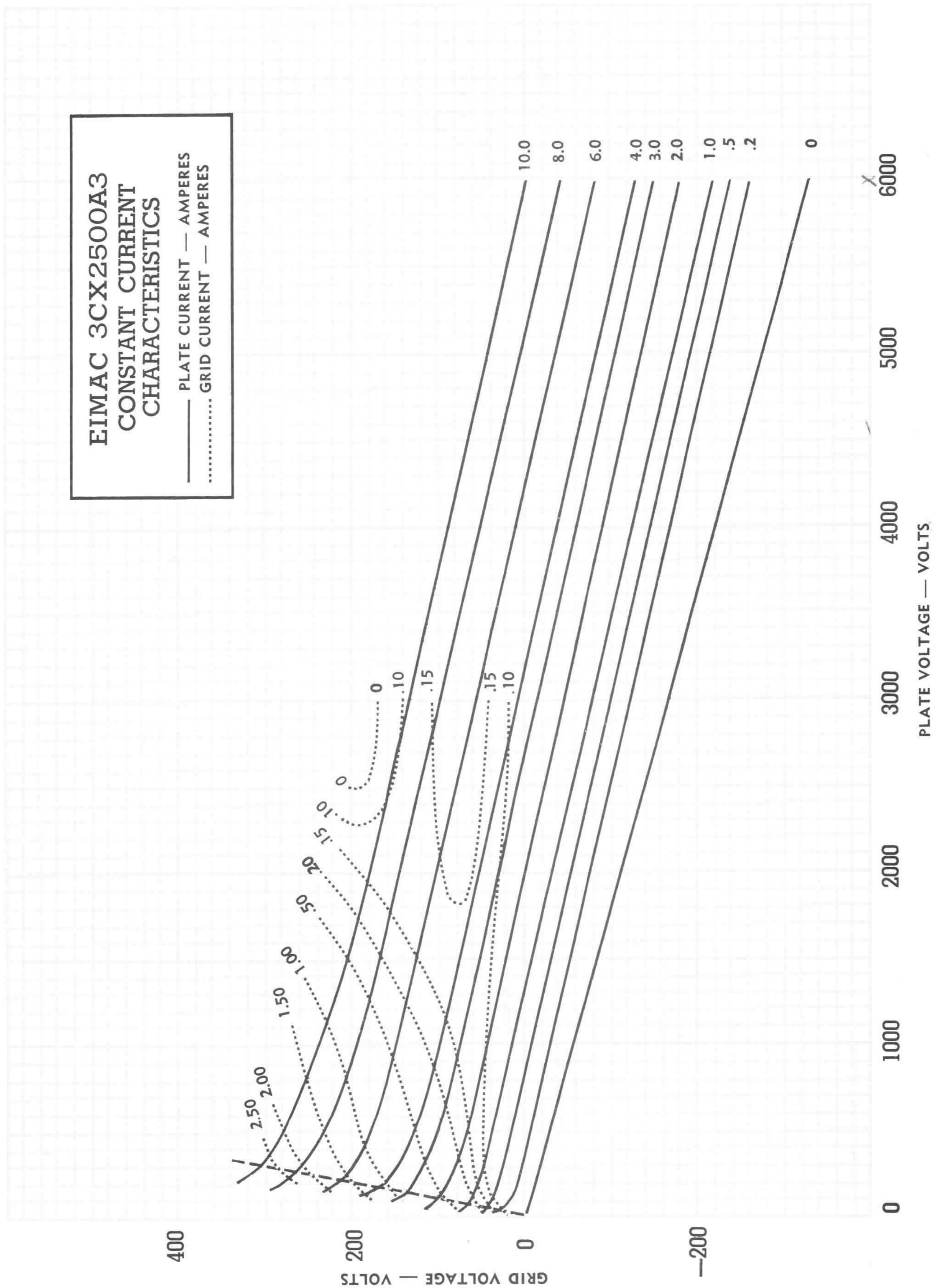
BOTTOM VIEW



TYPICAL TUBE CONNECTORS AND STEM COOLING

DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000 and 6000 volts respectively.


EIMAC 3CX2500A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
PLATE VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE — VOLTS
400
200
0
−200

E I M A C
Division of Varian
SAN CARLOS
CALIFORNIA

8251
3CX2500F3

MEDIUM MU TRIODE

The EIMAC 3CX2500F3 is an all ceramic and metal, medium-mu, forced-air cooled, external anode transmitting triode with a maximum plate dissipation rating of 2500 watts. Relatively high power output as an amplifier, oscillator, or modulator may be obtained from this tube at low plate voltages. The 3CX2500F3 is an exact replacement for the EIMAC 3X2500F3 and is suggested for use where higher ambient temperatures are to be expected or greater reliability is required. The all ceramic and metal construction allows a greater margin of safety with respect to tube operating temperatures while permitting higher processing temperatures to insure longer life.

The tube is equipped with flexible filament and grid leads which simplify socketing and equipment design for industrial and communication frequencies below 30 megahertz.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	48		53	amperes
Amplification Factor	19		26	
Direct Interelectrode Capacitances				
Grid-Plate	16.8		23.2	pF
Grid-Filament	29.2		40.2	pF
Plate-Filament	0.6		1.2	pF
Tranconductance (Ib=830 ma., Eb=3000 v.)		20,000		umhos
Highest Frequency for Maximum Ratings			30	MHz

MECHANICAL

Base	See outline drawing
Mounting	Vertical, base down or up
Maximum Anode Core and Seal Temperatures	250°C
Cooling	Forced Air
Maximum Over-all Dimensions:	
Length (Does not include filament connectors)	8.6 inches
Diameter	4.16 inches
Length of filament Connectors (Approximate)	9.5 inches
Net Weight	7.5 pounds
Shipping Weight (Approximate)	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Conventional Neutralized Amplifier, Class-C FM or Telegraphy (Key-down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 VOLTS
DC PLATE CURRENT	2.5 AMPS
PLATE DISSIPATION	2500 WATTS
GRID DISSIPATION	150 WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	4000	5000	6000	volts
DC Plate Current	2.5	2.5	2.08	amps
DC Grid Voltage	—300	—450	—500	volts
DC Grid Current	245	265	180	ma
Peak RF Grid Input Voltage*	580	750	765	volts
Driving Power*	142	197	136	watts
Grid Dissipation*	68	78	46	watts
Plate Input Power	10,000	12,500	12,500	watts
Plate Dissipation	2500	2500	2500	watts
Plate Output Power	7500	10,000	10,000	watts

*Approximate values.

Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Conventional Neutralized Amplifier, Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE -	5500	VOLTS
DC PLATE CURRENT -	2.0	AMPS
PLATE DISSIPATION -	1670	VOLTS
GRID DISSIPATION -	150	WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	4000	4500	5000	volts
DC Plate Current	1.67	1.47	1.25	amps
DC Grid Voltage	—450	—500	—550	volts
DC Grid Current*	180	140	150	ma
Peak RF Grid Input Voltage*	685	715	760	volts
Driving Power*	125	100	115	watts
Grid Dissipation*	43	30	32	watts
Plate Input Power	6670	6615	6250	watts
Plate Dissipation	1670	1315	950	watts
Plate Output Power	5000	5300	5300	watts

*Approximate values.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB or B

MAXIMUM RATINGS

DC PLATE VOLTAGE -	6000	VOLTS
DC PLATE CURRENT -	2.5	AMPS
PLATE DISSIPATION -	2500	WATTS
GRID DISSIPATION -	150	WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	4000	5000	6000	volts
DC Grid Voltage[1]	—150	—190	—240	volts
Zero-Signal DC Plate Current	0.6	0.5	0.4	amps
Max-Signal DC Plate Current	4.0	3.2	3.0	amps
Effective Load, Plate to Plate	2200	3600	4650	ohms
Peak AF Grid Input Voltage (per tube)*	340	360	390	volts
Max-Signal Peak Driving Power*	340	230	225	watts
Max-Signal Nominal Driving Power*	170	115	113	watts
Max-Signal Plate Output Power	11,000	11,000	13,000	watts

*Approximate values.
[1]Adjust to give listed zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDNG THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Cooling—Forced-air cooling must be provided to hold the ceramic-to-metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 MHz, additional air flow must be provided. Sea level and 10,000 foot altitude air-flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Anode-to-Base Air Flow[1]

	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	.6	48	.9
2500	66	1.25	96	1.82

Base-to-Anode Air Flow

	Sea Level		10,000 Feet	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	.6	47	.9
2500	57	1.0	83	1.5

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 550 watts.

[1] When air is supplied in the anode-to-base direction, a minimum of 3 cfm must be directed into the filament-stem structure between the inner and outer filament terminals to maintain the base seals below 250°C. No separate air is required with base-to-anode airflow.

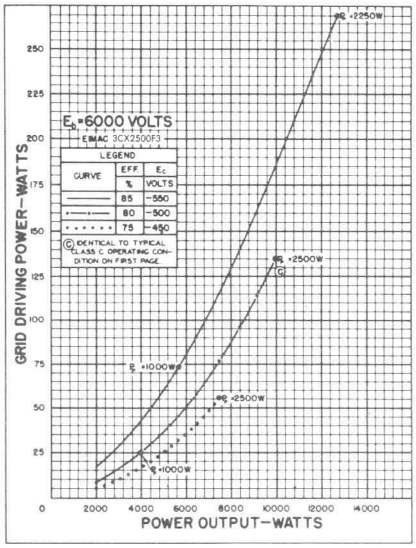
Filament Voltage — The filament voltage, as measured directly at the tube, should be 7.5 volts with maximum allowable variations due to line fluctuation of from 7.12 to 7.87 volts. Tube life may be extended by operation at the lower end of this range.

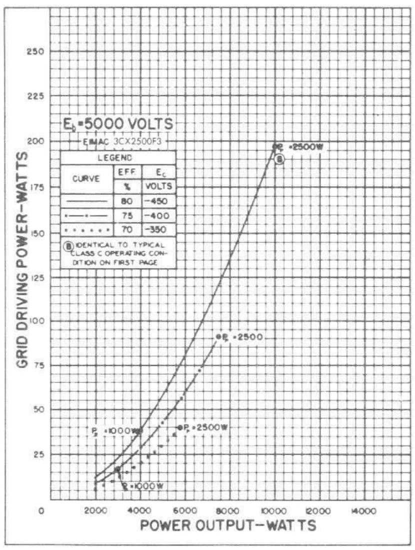
Bias Voltage — There is little advantage in using bias voltages in excess of those given under "TYPICAL OPERATION" except in certain very specialized applications. Where bias is obtained from a grid resistor, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

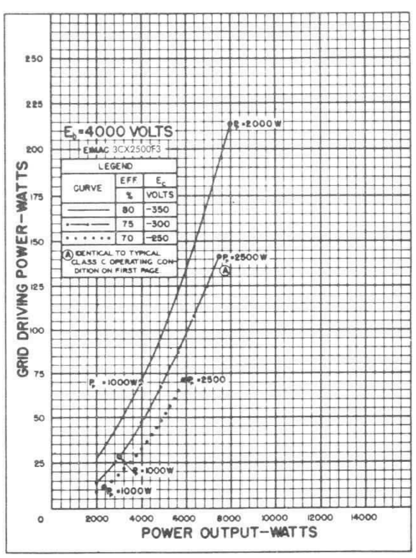
Plate Voltage — The plate-supply voltage for the 3CX2500F3 should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "TYPICAL OPERATION" for the power output desired.

Grid Dissipation — The power dissipated by the grid of the 3CX2500F3 must never exceed 150 watts. Grid dissipation is the product of dc current and peak positive grid voltage.

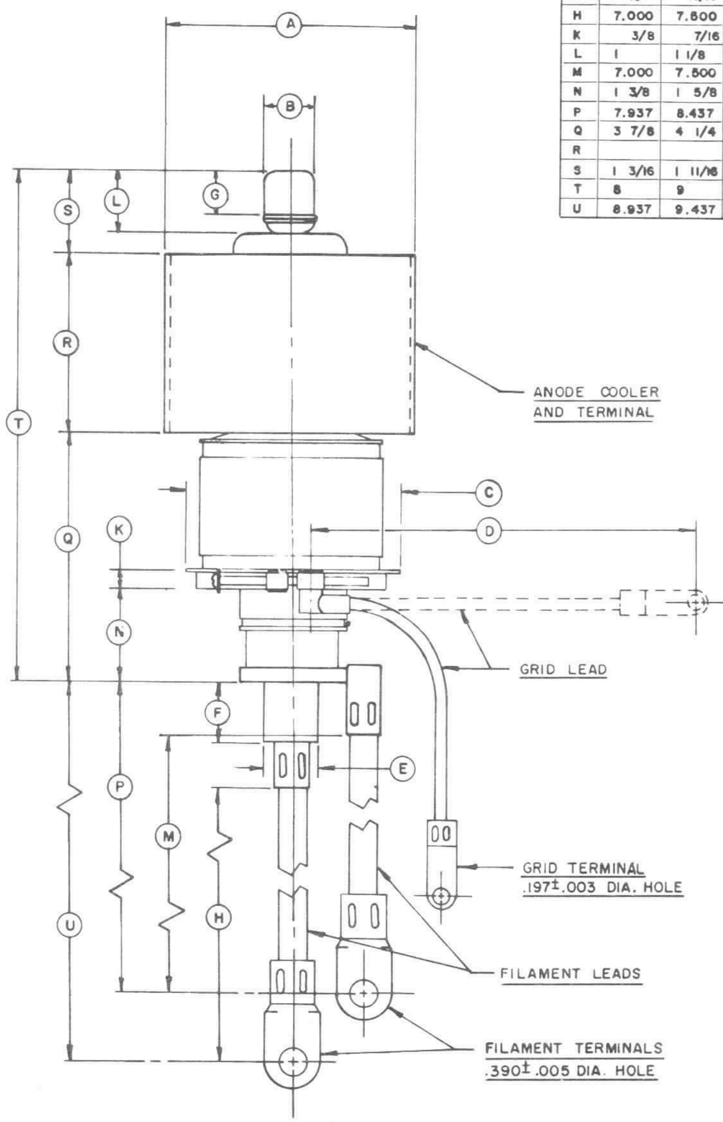
In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading. With lightly loaded conditions the grid driving power should be reduced so that the grid current does not exceed one-tenth of the plate current.





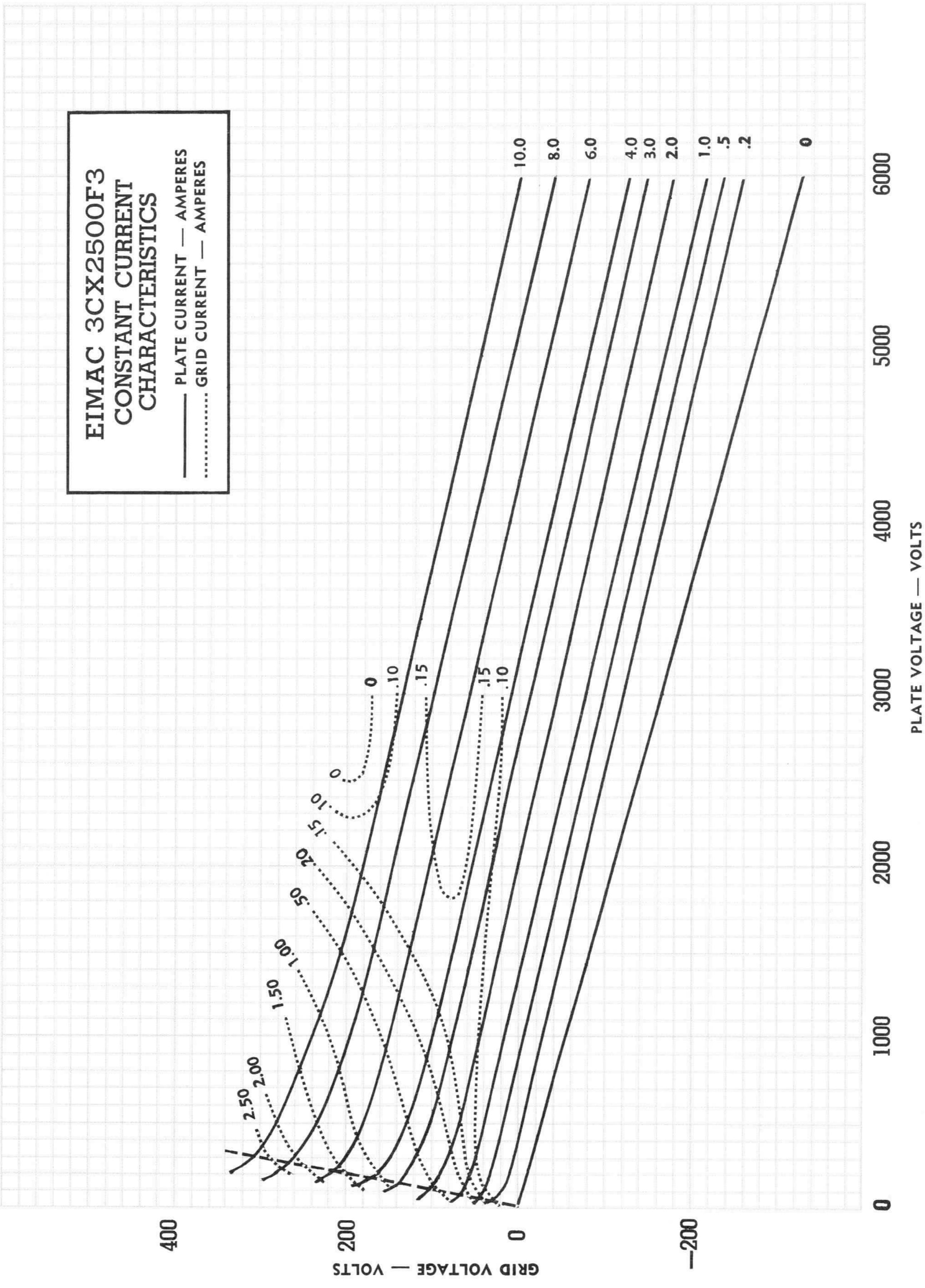


DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	11/16	13/16	
H	7.000	7.500	
K	3/8	7/16	
L	1	1 1/8	
M	7.000	7.500	
N	1 3/8	1 5/8	
P	7.937	8.437	
Q	3 7/8	4 1/4	
R			
S	1 3/16	1 11/16	
T	8	9	
U	8.937	9.437	



DRIVING POWER vs. POWER OUTPUT

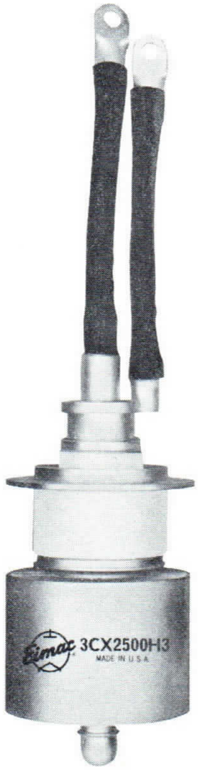
The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving-power and power-output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4,000, 5000 and 6000 volts respectively.


EIMAC 3CX2500F3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
2.50
2.00
1.50
1.00
.50
.20
.15
.10
0
PLATE VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE — VOLTS
400
200
0
−200

3CX2500H3

MEDIUM-MU
AIR-COOLED
POWER TRIODE

TECHNICAL DATA



The EIMAC 3CX2500H3 is a ceramic/metal, forced air cooled, external anode power triode designed primarily for use in industrial radio-frequency heating services. Its anode is conservatively rated at 2.5 kilowatts of plate dissipation with low air flow and pressure drop.

Input of 12.5 kilowatts is permissable up to 75 megahertz. Plentiful reserve emission is available from its 390 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	7.5 ± 0.37 V
Current, at 7.5 volts	50 A
Amplification Factor (Average)	20

Direct Interelectrode Capacitance (grounded cathode)[2]

Input	35.0 pF
Output	0.9 pF
Feedback	20.0 pF

Frequency of Maximum Rating:

CW	75 MHz

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	6.5 lb; 14.3 kg
Operating Position	Vertical, base up or down

Maximum Operating Temperature:

Ceramic/Metal Seals	250°C
Cooling	Forced Air
Base	See Outline

(Effective 2-1-71) Printed in U.S.A.

RADIO FREQUENCY INDUSTRIAL OSCILLATOR
Class C (Filtered DC Power Supply)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	6000	VOLTS
DC GRID VOLTAGE	-1000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	2500	WATTS
PLATE INPUT POWER	12.5	kW
DC GRID CURRENT	0.4	AMPERE

TYPICAL OPERATION (Frequencies to 75 MHz)[2]

Plate Voltage	4000	6000	Vdc
Grid Voltage	-300	-500	Vdc
Plate Current	2.50	2.08	Adc
Grid Current[1]	0.245	0.180	mAdc
Peak rf Grid Voltage[1]	280	265	v
Calculated Driving Power[1]	142	136	W
Plate Input Power	10.0	12.5	kW
Plate Dissipation	2.5	2.5	W
Plate Output Power	7.5	10.0	W
Resonant Load Impedance	910	1625	Ω

1. Approximate value.
2. Loaded Conditions

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.	
Filament: Current at 7.5 volts	48	53	A
Interelectrode Capacitance[1] (grounded filament connection)			
Input	29.2	40.2	pF
Output	0.6	1.2	pF
Feedback	16.8	23.2	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CX2500H3 must be mounted vertically either base up or down. A mounting flange is provided on the grid terminal to allow bolting the tube to a grid deck or a strap. Filament voltage is applied through two heavy flexible leads.

COOLING - Forced-air cooling must be provided to hold the ceramic/metal seals and anode core temperature below the maximum rating of 250°C. At ambient temperatures above 50°C, at higher altitudes and at operating temperatures above 30 MHz, additional air flow must be provided. Sea level and 5000 foot altitude air flow requirements to maintain seal temperatures below 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Anode-to-Base Air Flow				
	Sea Level		5000 Feet	
Anode Dissipation watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	33	0.6	40	0.74
2500	66	1.25	79	1.49

Base-to-Anode Air Flow				
	Sea Level		5000 Feet	
Anode Dissi-pation watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
1500	32	0.6	39	0.74
2500	57	1.0	68	1.23

*Since the power dissipated by the filament represents about 400 watts and since grid dissipation can, under some conditions represent another 150 watts, allowance has been made in preparing this tabulation for an additional 500 watts.

Additional stem cooling air must be provided. 14 CFM of air directed against the center rod ½'' below the outer filament contact ring by a 1½'' I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

ELECTRICAL

FILAMENT - The rated filament voltage for the 3CX2500H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

GRID OPERATION - The grid current rating is 0.4 ampere dc. This value should not be exceeded for more than very 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 0.275 ampere 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 150 watts.

PLATE OPERATION - Maximum plate voltage rating of 6000 volts and maximum plate current of 2.5 amperes dc should not be applied simultaneously as rated plate dissipation may be exceeded. The 12.5 kilowatts input rating applies for Class C amplifier or oscillator service with no modulation.

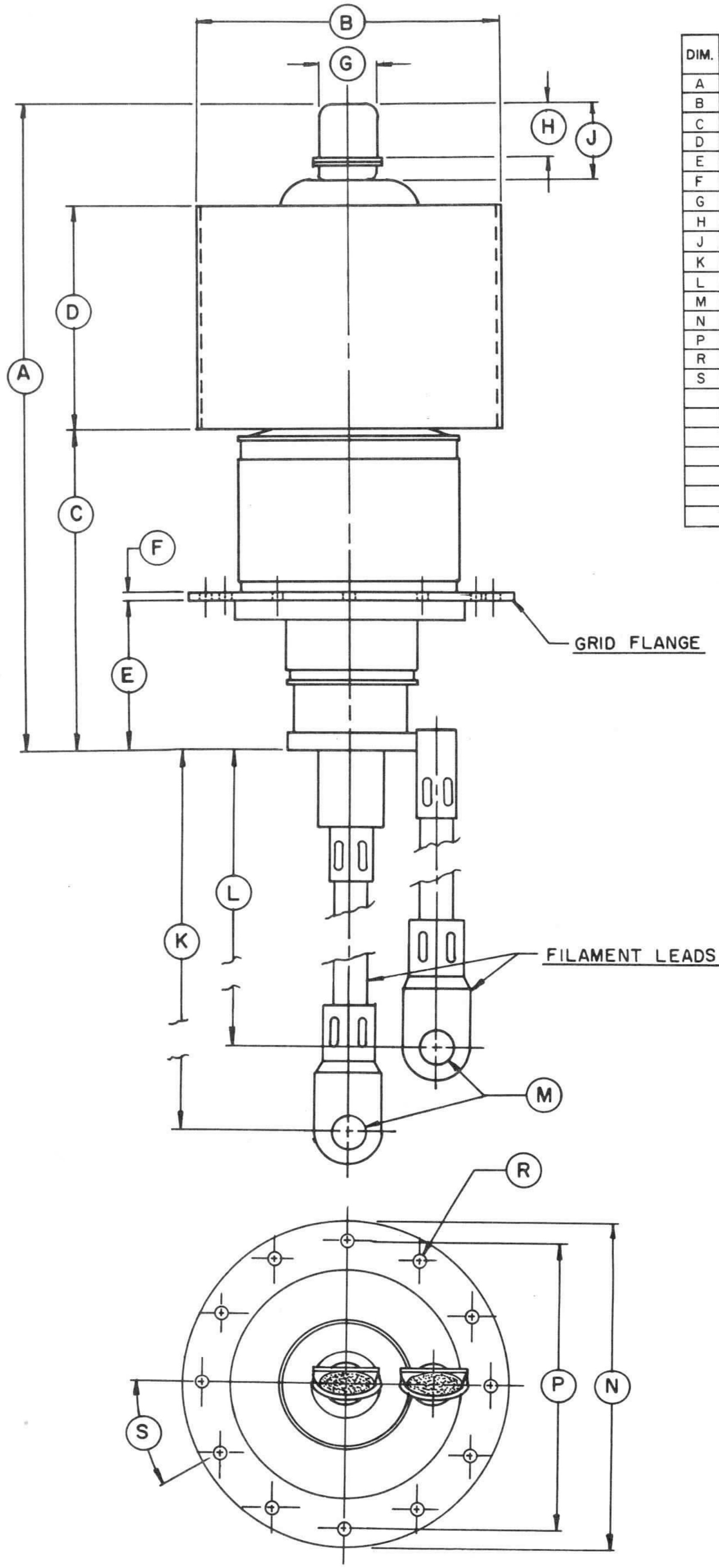
Plate over-current protection should be provided to remove plate voltage quickly in the event of an overload or an arc-over at the load. In addition current limiting power supply resistors should be used. These precautions are especially important in industrial service with its wide variations in loading.

Spark gaps from plate to ground should be used to prevent voltages from flashing across the tube envelope during any fault conditions.

HIGH FREQUENCY OPERATION - The 3CX-2500H3 is usable to 110 MHz. At this frequency, plate voltage must be reduced to 4000 volts in Class C service.

HIGH VOLTAGE - The 3CX2500H3 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies 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.

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

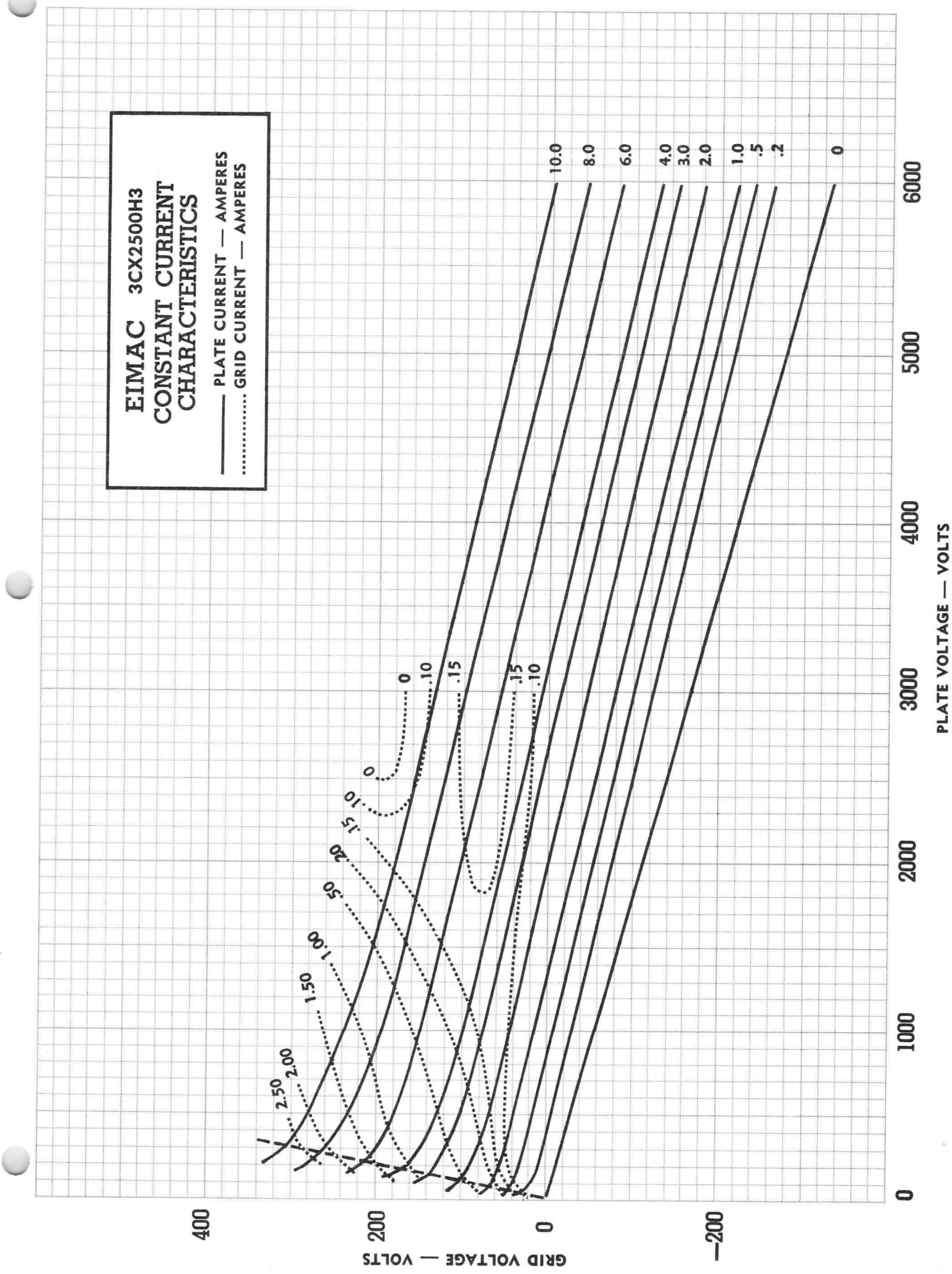


DIMENSIONAL DATA

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


EIMAC 3CX2500H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.5
.2
0
.10
.15
.20
.50
1.00
1.50
2.00
2.50
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE — VOLTS
400
200
0
−200
GRID VOLTAGE — VOLTS

TECHNICAL DATA

8238
3CX3000A1

LOW-MU TRIODE

The Eimac 8238/3CX3000A1 is a low-mu forced-air cooled power triode intended for use as an audio amplifier or modulator. The maximum rated plate dissipation is 3000 watts.

Available high plate current under Class AB_1 operating conditions permits high power gain with a minimum of distortion.

The ceramic envelope is rugged and permits high temperature processing leading to reliable service.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	*Min.*	*Nom.*	*Max.*	
Voltage		7.5		V
Current	49		54	A
Amplification Factor	4.3		5.6	
Direct Interelectrode Capacitances (Average)				
Grid-Plate		17		pF
Grid-Filament		29		pF
Plate-Filament		2.5		pF
Transconductance $_b = 1.0$ A, $E_b = 3000$V)		11,000		umhos

MECHANICAL

Base	See outline drawing
Mounting Position	Vertical, base down or up
Cooling	Forced Air
Maximum Temperatures:	
Grid and Filament Seals	250°C
Anode Cooler Core	250°C
Maximum Diameter	4.16 in.
Maximum Height	8.59 in.
Net Weight	6.25 lbs.
Shipping Weight	16 lbs.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	50	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ±15%. Effective grid-current resistance must not exceed 200,000 ohms.

TYPICAL OPERATION (Sinusoidal wave, two tubes)

Class AB_1

DC Plate Voltage	4.0	5.5	kV
DC Grid Voltage (Approx)*	-750	-1070	Volts
Zero-Signal DC Plate Current	500	500	mA
Max-Signal DC Plate Current	2.75	2.2	Amps
Effective Load, Plate-to-Plate	2120	4000	Ohms
Peak AF Grid Input Voltage (per tube)	750	1070	Volts
Max-Signal Driving Power	0	0	Watts
Max-Signal Plate Input Power	11.0	13.1	kW
Max-Signal Plate Dissipation (per tube)	2.75	2.55	kW
Max-Signal Plate Output Power	5.5	8.25	kW

Printed in U.S.A.

APPLICATION

MECHANICAL

Mounting: The 3CX3000A1 must be mounted vertically with its base up or down at the convenience of the designer. The filament connections should be made through spring collets and care must be taken not to impart strain to the terminals or base assembly.

The tube must be protected from severe shock and vibration during shipment and operation.

Cooling: Sufficient forced air cooling must be provided to maintain seal and anode core temperature at 250°C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

The table below lists minimum air-flow requirements to maintain tube temperatures below 250°C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 50°C and sea level. A separate supply of approximately 3 cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

	MINIMUM COOLING AIR-FLOW REQUIREMENTS			
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)
1000	32	0.49	39	0.65
2000	67.5	1.52	85	2.16
3000	106	3.15	138	4.55

NOTE:
An extra 450 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for grid and filament dissipation.

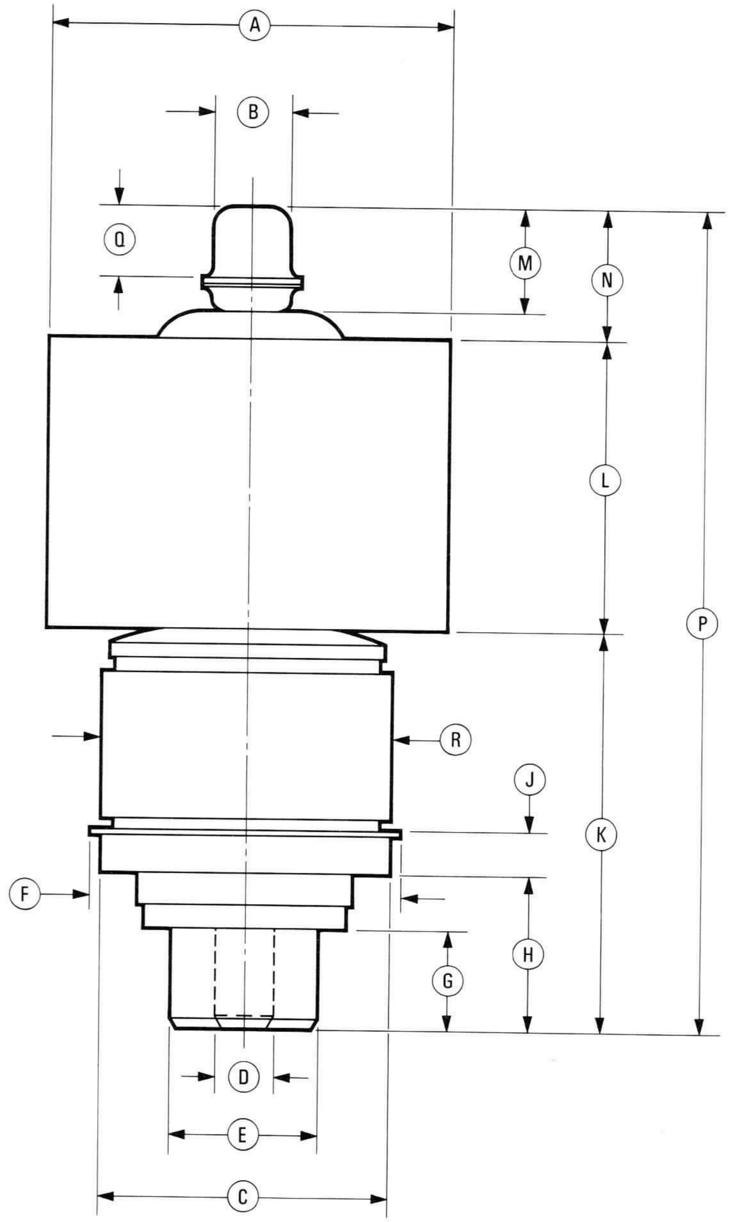
For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

ELECTRICAL

Filament: The rated filament voltage for the 3CX3000A1 is 7.5 volts and should not be exceeded by more than five percent if maximum tube life is to be realized. Reduction of filament voltage to about 7.2 volts will actually enhance tube life and provision should be made for this adjustment where the lower emission can be tolerated.

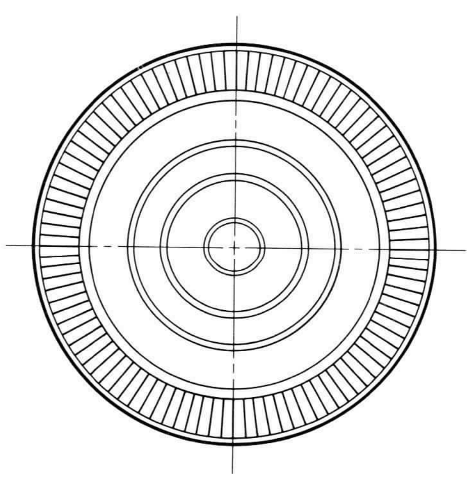
Grid Operation: The grid dissipation rating of the 3CX3000A1 is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service, provision should be made for individual adjustment of bias voltage, in order to match the tubes.

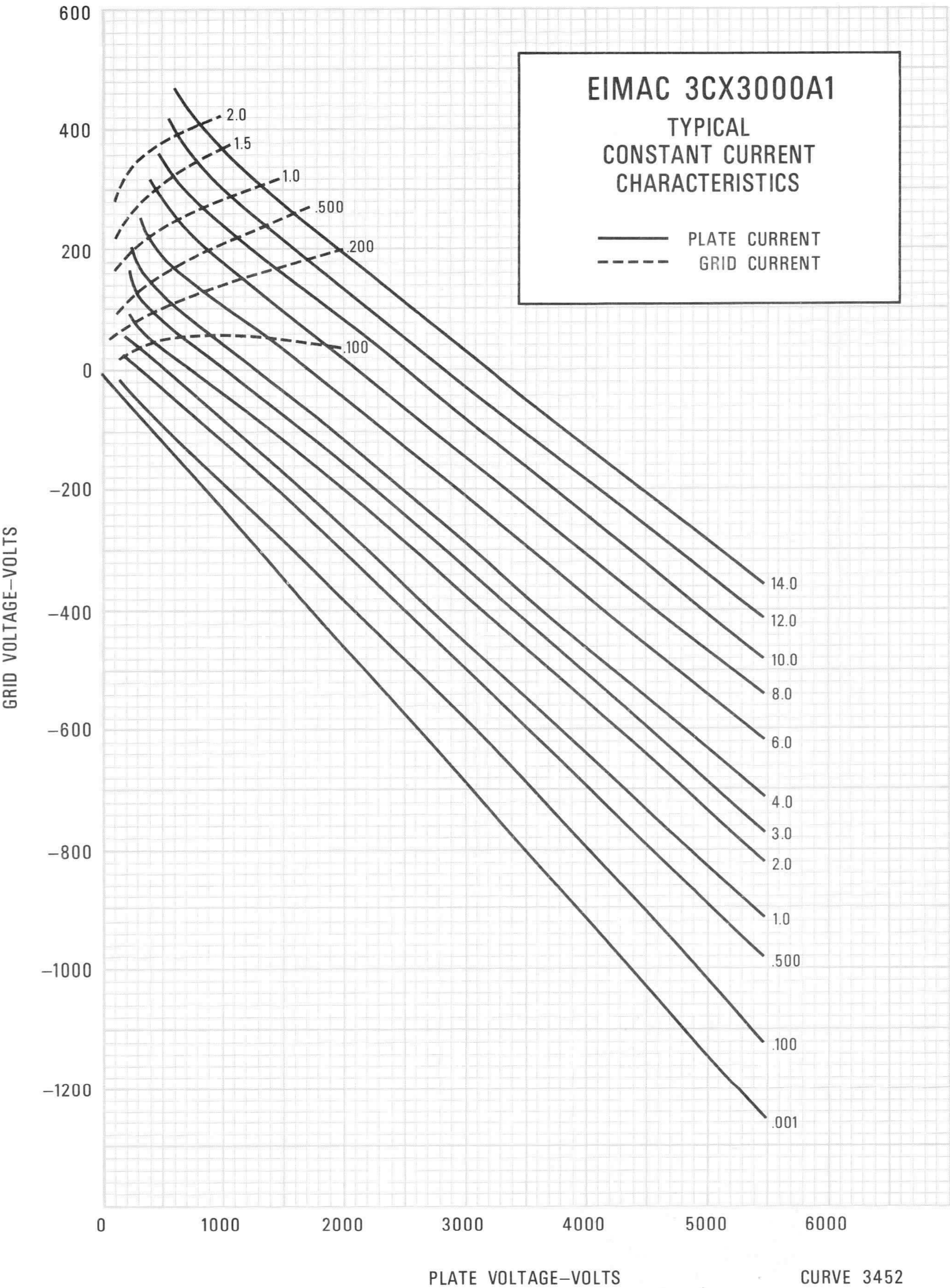
Special Applications: If it is desired to operate the tube under conditions widely different from those given here, write to Eimac Division of Varian Assoc., 301 Industrial Way, San Carlos, California, for information and recommendations.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C	2.990	3.010	
D	.615	.635	
E	1.490	1.510	
F		3 5/8	
G	13/16	15/16	
H	1 3/8	1 5/8	
J	25/64	27/64	
K	3 7/8	4 1/4	
L	2 15/16	3 1/16	
M	1	1 1/8	
N	1 3/16	1 11/16	
P	8	9	
Q	11/16	13/16	
R	2.998	3.002	




EIMAC 3CX3000A1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
600
400
200
0
-200
-400
-600
-800
-1000
-1200
GRID VOLTAGE–VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE–VOLTS
2.0
1.5
1.0
.500
.200
.100
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.500
.100
.001

CURVE 3452

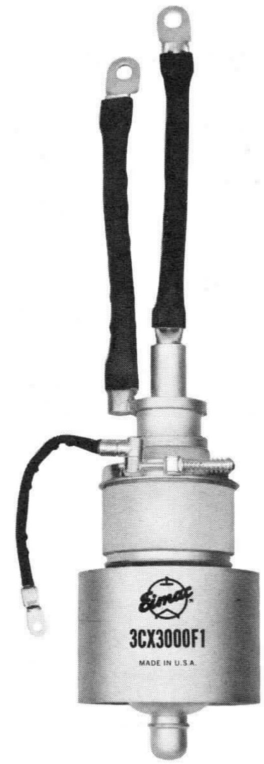
EIMAC

Division of Varian

SAN CARLOS CALIFORNIA

8239
3CX3000F1

LOW-MU TRIODE



The Eimac 8239/3CX3000F1 is a low-mu forced-air cooled power triode intended for use as an audio amplifier or modulator. The maximum rated plate dissipation is 3000 watts.

Two 3CX3000F1s in class-AB_1 audio service will deliver up to 10 kilowatts maximum-signal plate output power at 6000 plate volts without drawing grid current.

The 3CX3000F1 is provided with "flying leads" for filament and grid connections.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten				
Voltage		7.5		V
Current	48		53	A
Amplification Factor	4.3		5.6	
Direct Interelectrode Capacitances (Average)				
Grid-Plate		17		pF
Grid-Filament		29		pF
Plate-Filament		2.5		pF
Transconductance (I_b=1.0A, E_b=3000V)		11,000		umhos

MECHANICAL

Base	See outline drawing
Mounting Position	Vertical, base down or up
Cooling	Forced Air
Maximum Temperatures:	
Grid and Filament Seals	250°C
Anode Cooler Core	250°C
Maximum Diameter	4.16 in.
Net Weight	7.5 lbs.
Shipping Weight	17 lbs.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	3000	WATTS
GRID DISSIPATION	50	WATTS

*Adjust to stated Zero-Signal DC Plate Current. Can be expected to vary ±15%. Effective grid-current resistance must not exceed 200,000 ohms.

TYPICAL OPERATION (Sinusoidal wave, two tubes)

Class AB_1

DC Plate Voltage	4.0	5.5	kV
DC Grid Voltage (Approx)*	-750	-1070	Volts
Zero-Signal DC Plate Current	500	500	mA
Max-Signal DC Plate Current	2.75	2.2	Amps
Effective Load, Plate-to-Plate	2120	4000	Ohms
Peak AF Grid Input Voltage (per tube)	750	1070	Volts
Max-Signal Driving Power	0	0	Watts
Max-Signal Plate Input Power	11.0	13.1	kW
Max-Signal Plate Dissipation (per tube)	2.75	2.55	kW
Max-Signal Plate Output Power	5.5	8.25	kW

Printed in U.S.A.

APPLICATION

MECHANICAL

Mounting: The 3CX3000F1 must be mounted vertically with its base up or down at the convenience of the designer. The base is fitted with heavy filament leads to facilitate connections. These leads should be arranged to prevent mechanical stress on the filament structure. The grid is also fitted with a flying lead.

The tube must be protected from severe shock and vibration during shipment and operation.

Cooling: Sufficient forced air cooling must be provided to maintain seal temperature at 250°C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

The table below lists minimum air-flow requirements to maintain tube temperatures below 250°C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 50°C and sea level. A separate supply of approximately 3 cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

	MINIMUM COOLING AIR-FLOW REQUIREMENTS			
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)
1000	32	0.49	39	0.65
2000	67.5	1.52	85	2.16
3000	106	3.15	138	4.55

NOTE:
An extra 450 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for grid and filament dissipation.

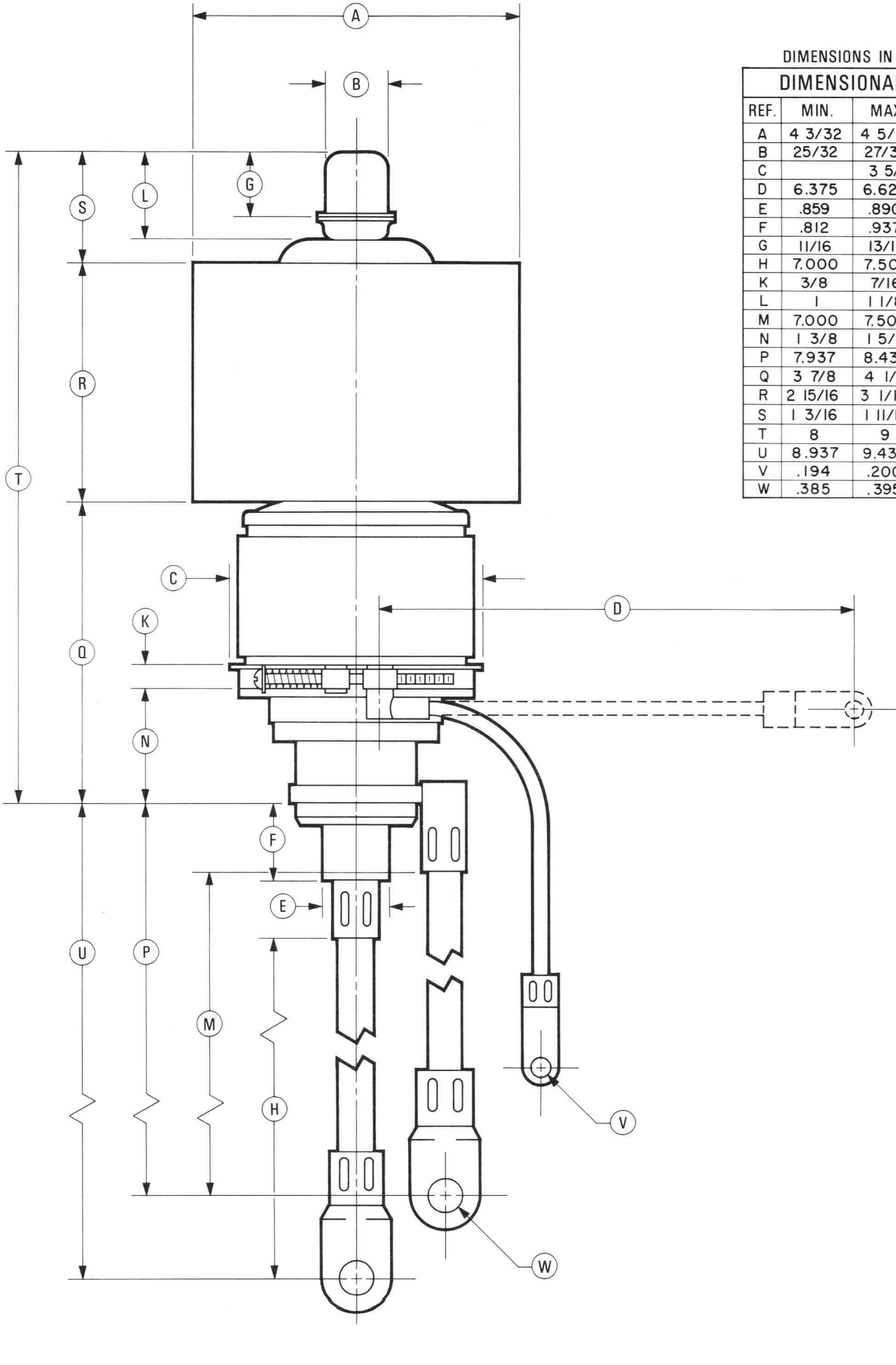
For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

ELECTRICAL

Filament: The rated filament voltage for the 3CX3000F1 is 7.5 volts and should not be exceeded by more than five percent if maximum tube life is to be realized. Reduction of filament voltage to about 7.2 volts will actually enhance tube life and provision should be made for this adjustment where the lower emission can be tolerated.

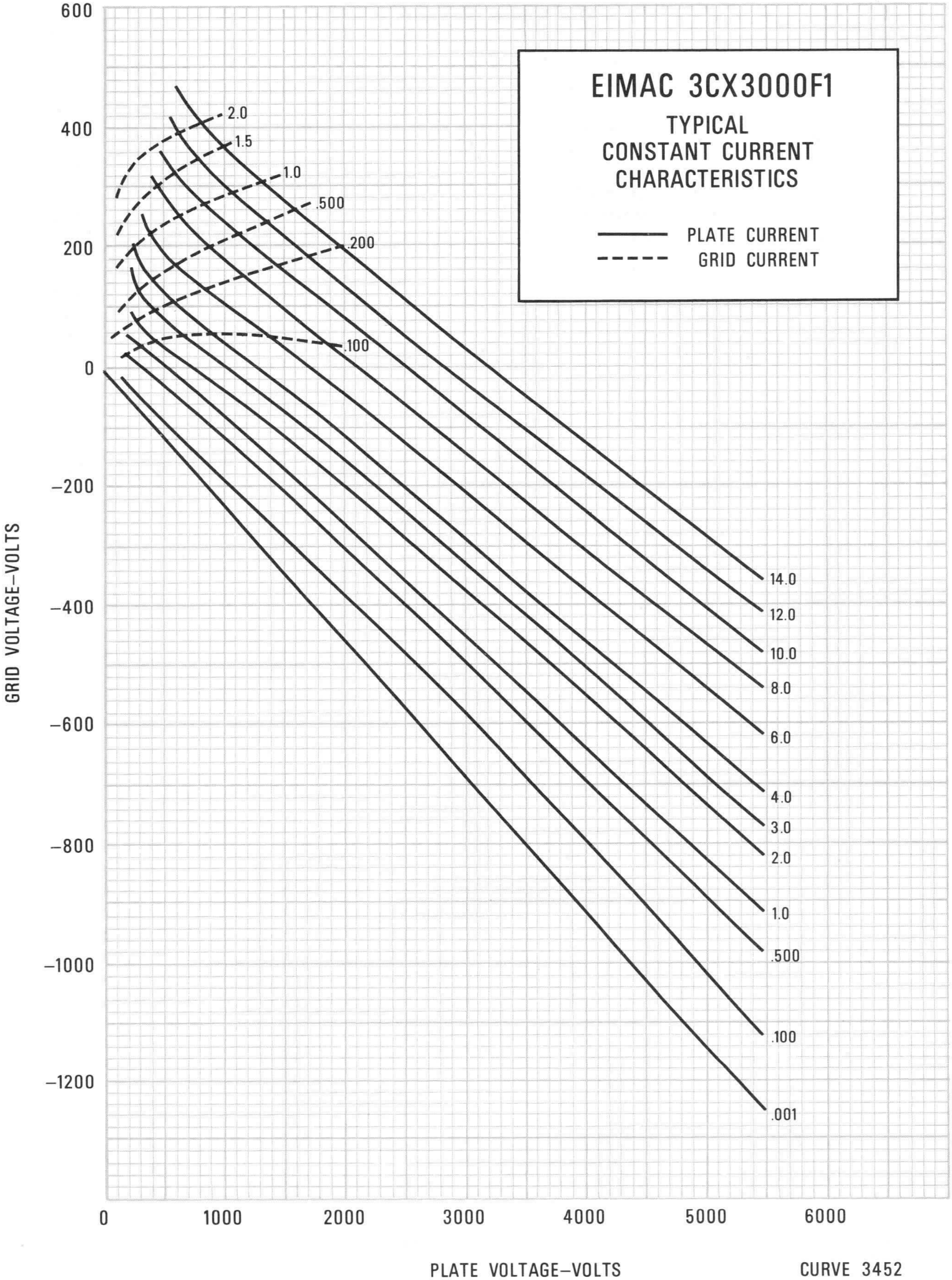
Grid Operation: The grid dissipation rating of the 3CX3000F1 is 50 watts. This is the product of the peak positive grid voltage and average dc grid current. When tubes are used in parallel in amplifier or modulator service, provision should be made for individual adjustment of bias voltage, in order to match the tubes.

Special Applications: If it is desired to operate the tube under conditions widely different from those given here, write to Eimac Division of Varian Assoc., 301 Industrial Way, San Carlos, California, for information and recommendations.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4 3/32	4 5/32	
B	25/32	27/32	
C		3 5/8	
D	6.375	6.625	
E	.859	.890	
F	.812	.937	
G	11/16	13/16	
H	7.000	7.500	
K	3/8	7/16	
L	1	1 1/8	
M	7.000	7.500	
N	1 3/8	1 5/8	
P	7.937	8.437	
Q	3 7/8	4 1/4	
R	2 15/16	3 1/16	
S	1 3/16	1 11/16	
T	8	9	
U	8.937	9.437	
V	.194	.200	
W	.385	.395	


EIMAC 3CX3000F1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
600
400
200
0
-200
-400
-600
-800
-1000
-1200
GRID VOLTAGE-VOLTS
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE-VOLTS
2.0
1.5
1.0
.500
.200
.100
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.500
.100
.001

CURVE 3452

3CX3000A7
8162
3CX3000F7
HIGH-MU
AIR COOLED
POWER TRIODES

TECHNICAL DATA

The EIMAC 3CX3000A7 high-mu forced-air cooled power triode provides relatively high power output as an amplifier, oscillator, or modulator at low plate voltages. The tube has a low inductance cylindrical filament-stem structure which readily becomes part of a linear filament tank circuit for VHF operation. The grid provides good shielding between the input and output circuits for grounded-grid applications and conveniently terminates in a ring between the plate and filament terminals.

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 8162/3CX3000F7 tube is identical except for the addition of flexible leads on the base for grid and filament connections which can simplify socketing in low-frequency applications.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten	
Voltage	7.5 V
Current @ 7.5 V (3CX3000A7)	51.5 A
(3CX3000F7)	50.5 A
Amplification Factor (Average)	160
Direct Interelectrode Capacitances (grounded filament)[2]	
Cin	38.0 pF
Cout	0.6 pF
Cgp	24.0 pF
Direct Interelectrode Capacitances (grounded grid)[2]	
Cin	38.0 pF
Cout	24.0 pF
Cpk	0.6 pF

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. 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, in accordance with Electronic Industries Association Standard RS-191.

Printed in U.S.A.

Frequency of Maximum Rating:	3CX3000A7	110 MHz
	3CX3000F7	30 MHz

MECHANICAL

Maximum Overall Dimensions:	
Length (3CX3000A7)	9.000 in; 227.60 mm
(3CX3000F7, incl. fil. leads)	18.437 in; 468.30 mm
Diameter (both types)	4.156 in; 105.56 mm
Operating Position	Vertical, base up or down
Net Weight: (3CX3000A7) (Approx.)	6.2 lb; 2.8 kg
(3CX3000F7) (Approx.)	7.0 lb; 3.2 kg
Cooling	Forced Air
Base (3CX3000A7)	Special Coaxial
(3CX3000F7)	Special with Flying Leads
Maximum Operating Temperature:	
Anode Core and Ceramic/Metal Seals	250°C
3CX3000F7 Filament Lead/Tube Base Junctions	150°C

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB_2

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_2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	4000	4800	4800	Vdc
Zero-Signal Plate Current[1]	0.25	0.35	0.35	Adc
Single-Tone Plate Current	2.00	1.68	2.00	Adc
Single-Tone Grid Current[1]	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_2

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_2, Grid Driven, Carrier Conditions

Plate Voltage	4000	Vdc
Zero-Signal Plate Current[1]	0.25	Adc
DC Plate Current	0.74	Adc
DC Grid Current[1]	0.13	Adc
Peak rf Grid Voltage[1]	85.0	v
Peak Driving Power[1]	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 110 MHz for 3CX3000A7, to 30 MHz for 3CX3000F7)

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

1. Approximate value.
2. Output circuit and filter loss of 10% assumed.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_2, 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[1]	0.50	Adc
Max. Signal Plate Current	3.58	Adc
Max. Signal Grid Current[1]	0.58	Adc
Peak af Grid Voltage[2]	190	v
Peak Driving Power[3]	115	w
Max. Signal Plate Dissipation	1850	W
Plate Output Power	10,500	W
Load Resistance (plate to plate)	2720	Ω

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

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 (3CX3000A7)	49.0	54.0	A
(3CX3000F7)	48.0	53.0	A
Interelectrode Capacitances[1] (grounded filament connection)			
Cin	30.0	45.0	pF
Cout	---	1.0	pF
Cgp	20.0	28.0	pF
Interelectrode Capacitances[1] (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 mAdc)	---	-45.0	V

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

APPLICATION

MECHANICAL

MOUNTING - The 3CX3000A7 and 3CX3000F7 must be mounted vertically, base down or up at the convenience of the circuit designer. The filament connections to the 3CX3000A7 should be made through spring collets. These are available from EIMAC with the following part numbers:

149575 Inner line collet
149576 Outer line collet

Reasonable care should be taken that these collets do not impart undue strain to the terminals or the base of the tube.

COOLING - The maximum temperature rating for the anode core and the ceramic/metal seal areas of either 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 3CX3000F7 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 either type is normally required. With air flowing in an anode-to-base direction, both types require 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.

Base-to-Anode Air Flow				
	Sea Level		10,000 Feet	
Anode Dissipation watts	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
Anode-to-Base Air Flow				
2000	54	0.37	79	0.68
3000	106	1.1	155	1.90
4000	178	2.50	260	4.50

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 heater. 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 network have a "Q" of at least 2, and higher if possible.

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.

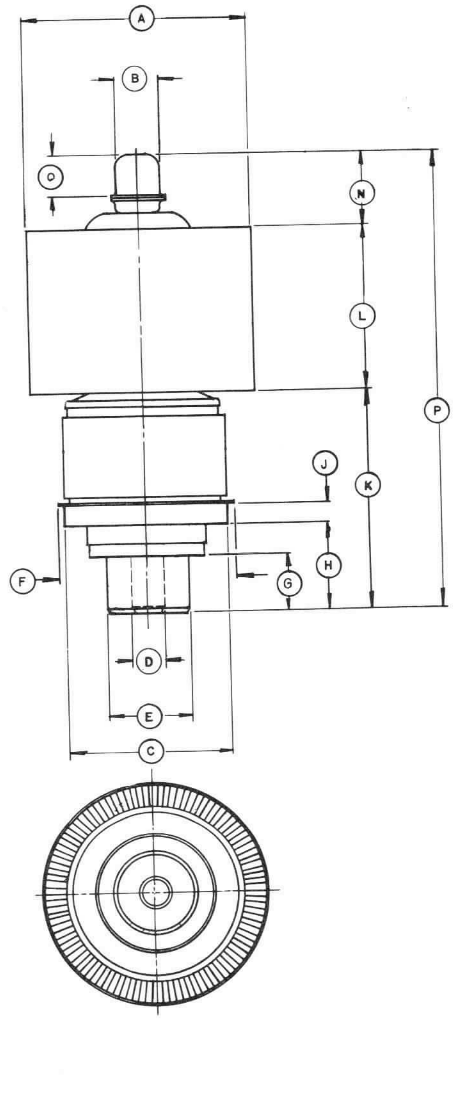
HIGH VOLTAGE - Normal operating voltages used with these tubes are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage 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.



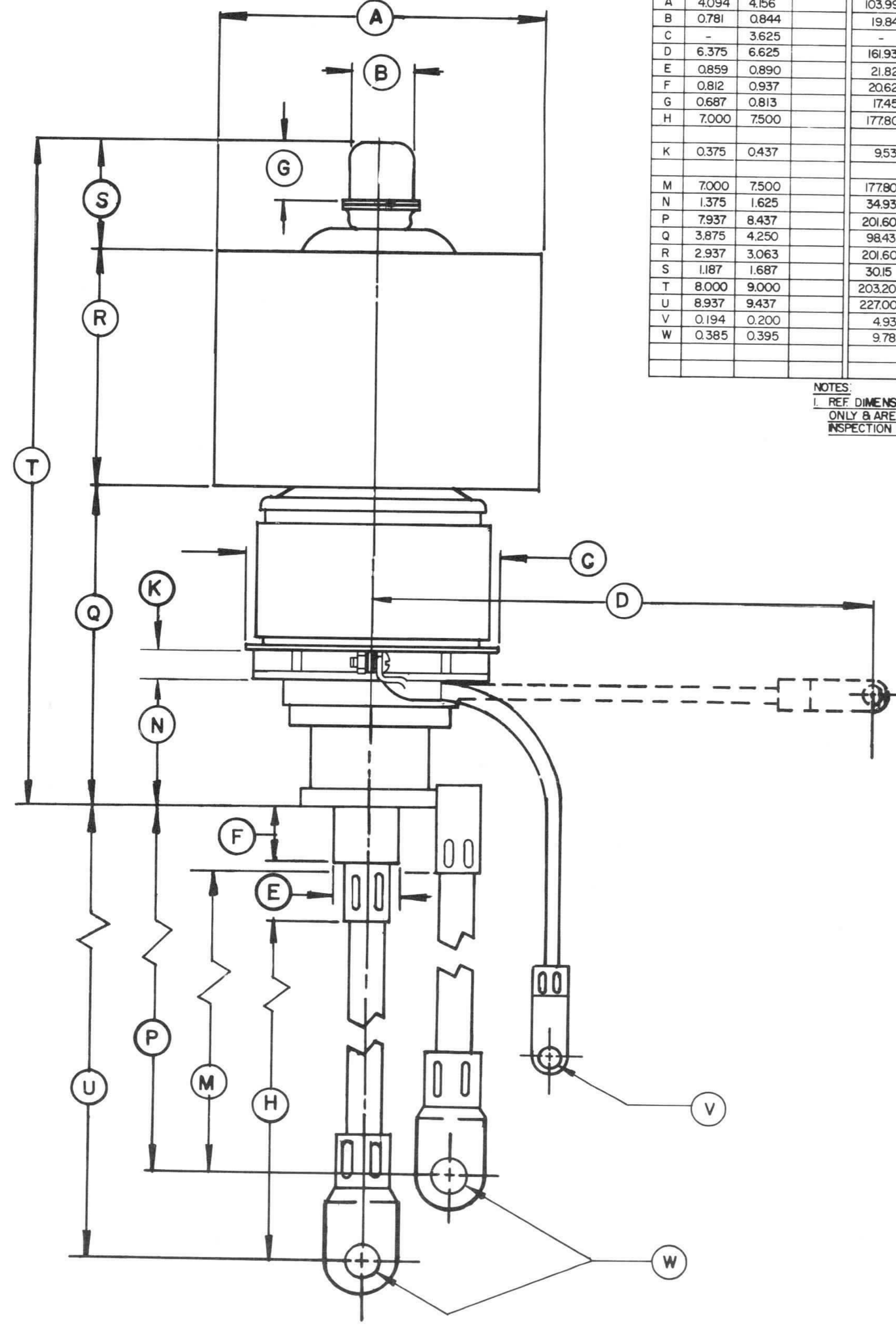
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156	- -	103.99	105.56	- -
B	0.781	0.844	- -	19.83	21.44	- -
C	2.990	3.010	- -	75.95	76.45	- -
D	0.615	0.635	- -	15.62	16.13	- -
E	1.490	1.510	- -	37.85	38.35	- -
F	- -	3.625	- -	- -	92.08	- -
G	0.813	0.937	- -	20.65	23.80	- -
H	1.375	1.625	- -	34.92	41.28	- -
J	0.391	0.422	- -	9.93	10.72	- -
K	3.875	4.250	- -	98.43	107.95	- -
L	2.937	3.063	- -	74.60	77.80	- -
N	1.187	1.687	- -	30.15	42.85	- -
P	8.000	9.000	- -	203.20	228.60	- -
Q	0.687	0.813	- -	17.45	20.65	- -

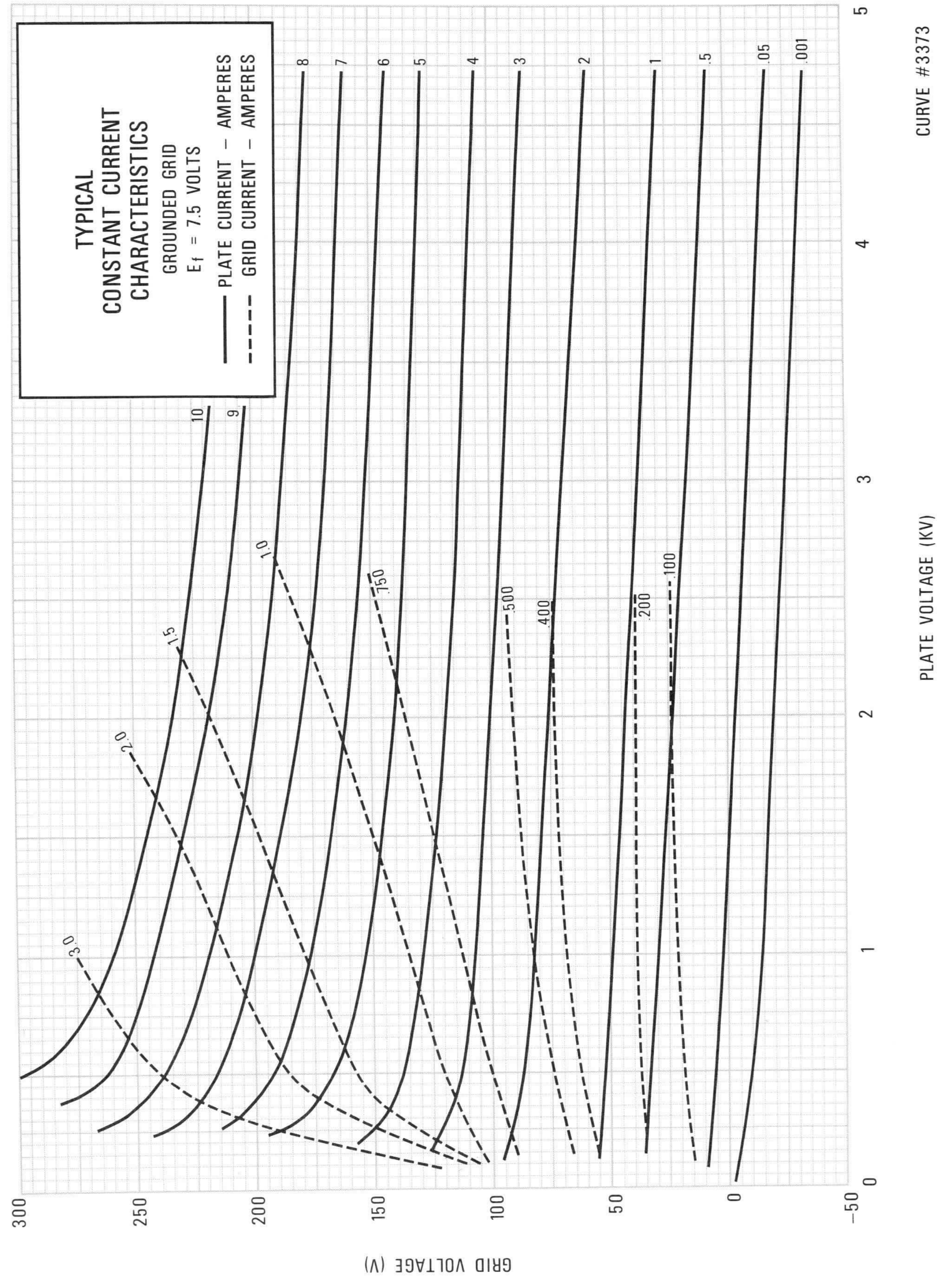
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

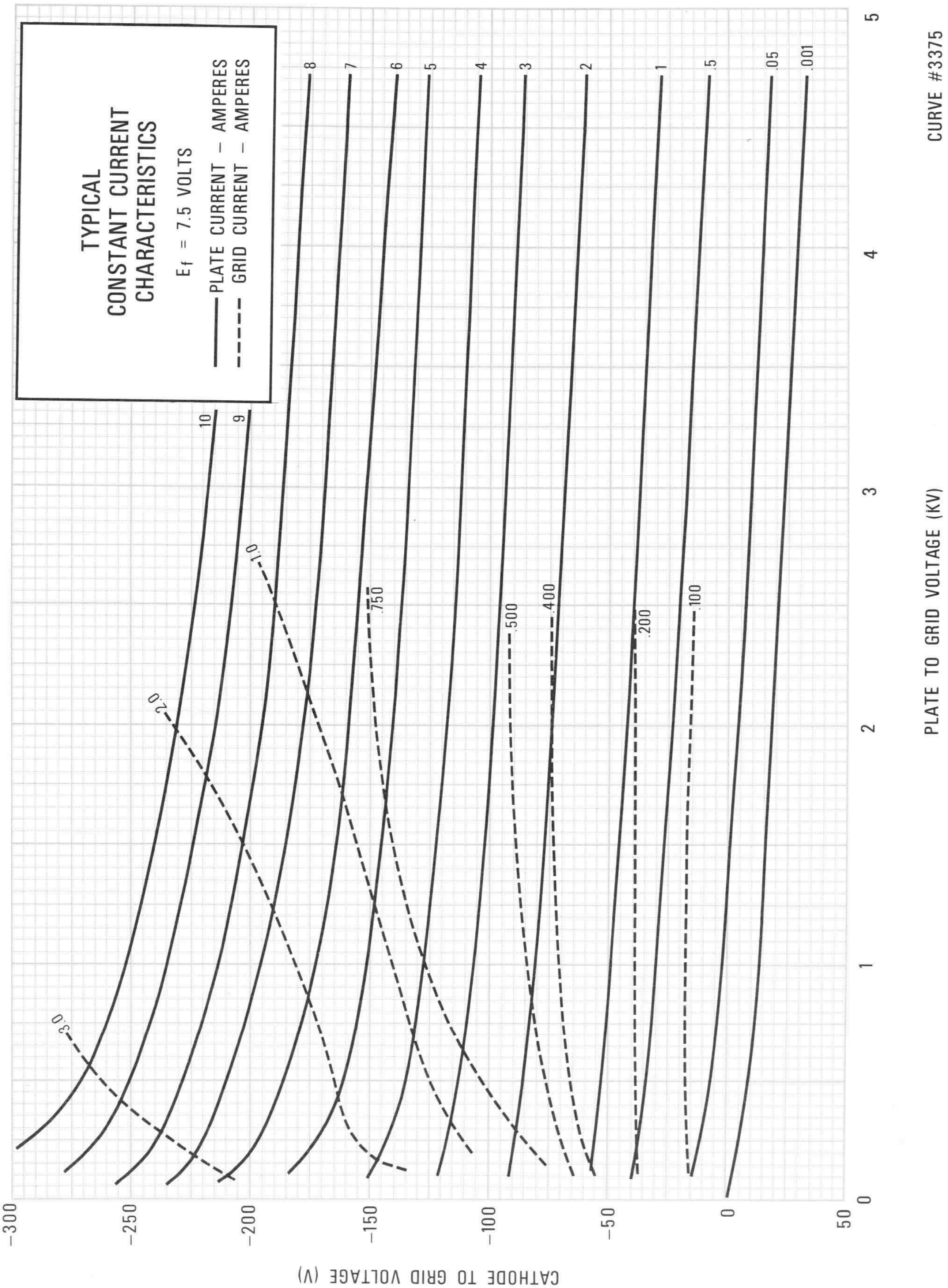
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF
A	4.094	4.156		103.99	105.56	
B	0.781	0.844		19.84	21.44	
C	-	3.625		-	92.08	
D	6.375	6.625		161.93	168.28	
E	0.859	0.890		21.82	22.61	
F	0.812	0.937		20.62	23.80	
G	0.687	0.813		17.45	20.65	
H	7.000	7.500		177.80	190.50	
K	0.375	0.437		9.53	11.10	
M	7.000	7.500		177.80	190.50	
N	1.375	1.625		34.93	41.28	
P	7.937	8.437		201.60	214.30	
Q	3.875	4.250		98.43	107.95	
R	2.937	3.063		201.60	214.30	
S	1.187	1.687		30.15	42.85	
T	8.000	9.000		203.20	228.60	
U	8.937	9.437		227.00	239.70	
V	0.194	0.200		4.93	5.08	
W	0.385	0.395		9.78	10.03	

DIMENSIONAL DATA

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




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
E_f = 7.5 VOLTS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
PLATE VOLTAGE (KV)
GRID VOLTAGE (V)
CURVE #3373

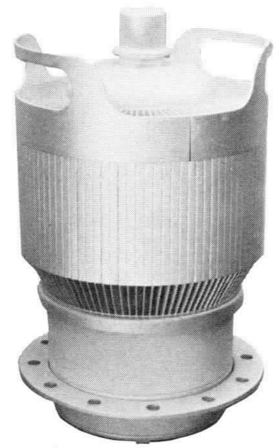

TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 7.5 VOLTS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
PLATE TO GRID VOLTAGE (KV)
CATHODE TO GRID VOLTAGE (V)
CURVE #3375

3CX5000A7 HIGH-MU POWER TRIODE

The EIMAC 3CX5000A7 is a ceramic/metal high-mu power triode designed especially for use as a cathode-driven Class AB rf amplifier or Class C power amplifier. It is forced-air cooled, with an anode dissipation rating of 5000 watts.

The 3CX5000A7 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 cost and complexity.

The tube does not require a socket. It is designed to be bolted directly to the chassis by the grid flange. Cathode and heater connections are also made by bolting directly to the amplifier circuitry. This feature further reduces equipment cost and complexity.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated Unipotential		
Heater Voltage	10.0 ± 0.5	V
Heater Current, at 10.0 Volts	17.5	A
Minimum Cathode Warmup Time, at 10.0 Volts[2]	5	Min
Amplification Factor	200	
Maximum Frequency For Full Ratings	110	MHz
Direct Interelectrode Capacitance (grounded cathode connection)[3]		
Cin	56.5	pF
Cout	0.42	pF
Cgp	34.0	pF
Direct Interelectrode Capacitance (grounded grid connectio-)[3]		
Cin	56.5	pF
Cout	34.0	pF
Cpk	0.42	pF

1. Characteristics and operating values are estimated. 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 accordance with EIA Standard RS-191 except no special shielding is used.

MECHANICAL

Overall Dimensions:	
Length	8.25 In; 20.96 mm
Diameter	4.94 In; 12.55 mm
Cooling	Forced Air
Net Weight (approximate)	9.5 lb; 4.3 kg
Recommended Air-System Chimney	EIMAC SK-306
Base	Designed for Direct Chassis Mounting

RADIO FREQUENCY POWER AMPLIFIER
CATHODE DRIVEN - Class AB Service

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	6500	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION	5.0	KILOWATTS
GRID DISSIPATION	50	WATTS

* Will vary from tube to tube
\# Delivered to the load
§ Referenced aginst 1 tone of a 2-equal-tone signal

Typical Performance, to 30 MHz (measured data)

Plate Voltage	4.0	5.0	6.0	kVdc
Zero Sig.Plate Current	0.4	0.4	0.4	Adc
Max.Sig.Plate Current	1.25	1.45	1.55	Adc
Cathode Bias *	+9.0	+11.0	+12.0	Vdc
Grid Current *	50	35	25	mAdc
Driving Power *	120	160	190	W
Useful Power Output #	3000	4000	5000	W
Power Gain *	14.0	14.0	14.2	dB
Cathode Input Impedance	33	33	33	Ohms
Resonant Load Impedance	1800	1800	1800	Ohms
Intermod. Distortion * §				
3rd Order Products	-37	-35	-38	dB
5th Order Products	-45	-45	-46	dB

358690(Effective Sept 1984)
VA4741

Printed in U.S.A.

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

APPLICATION

MECHANICAL

MOUNTING - The 3CX5000A7 may be mounted in any position and should be protected from shock and vibration. The tube is designed to be bolted directly to the chassis in equipment designed for dc and rf grounded grid circuit configuration. The mounting may be insulated for other circuitry. A flange with threaded holes is provided for a low-inductance cathode connection. Similar provisions are made for the heater connections.

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.
Cooling data shown is for air flow in a base-to-anode direction, and represents minimum anode cooling requirements. Pressure drop values are approximate.

Inlet Air Temperature = 25°C

Sea Level	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	29	0.1
	3000	63	0.3
	4000	114	0.8
	5000	209	2.2

5000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	35	0.1
	3000	77	0.3
	4000	138	0.9
	5000	218	2.0

10,000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	43	0.1
	3000	93	0.4
	4000	167	1.0
	5000	264	2.3

Inlet Air Temperature = 35°C

Sea Level	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	33	0.1
	3000	73	0.3
	4000	131	0.9
	5000	181	1.7

5000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	40	0.1
	3000	88	0.4
	4000	159	1.1
	5000	253	2.5

10,000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	48	0.1
	3000	107	0.4
	4000	192	1.3
	5000	306	3.0

Inlet Air Temperature = 50°C

Sea Level	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	41	0.1
	3000	92	0.5
	4000	165	1.3
	5000	262	3.1

5000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	50	0.1
	3000	111	0.5
	4000	200	1.6
	5000	317	3.7

10,000 Feet	Plate Diss. Watts	Flow Rate CFM	Press. Drop In.Water
	2000	60	0.2
	3000	134	0.6
	4000	242	1.8
	5000	384	4.3

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.
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.

ELECTRICAL

HEATER-CATHODE OPERATION - The rated heater voltage for the 3CX5000A7 is 10.0 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 - 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 absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself. <u>It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously</u>.

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.

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 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 grid structure.

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 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 should be limited to 10 milliwatts per square centimeter.

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:

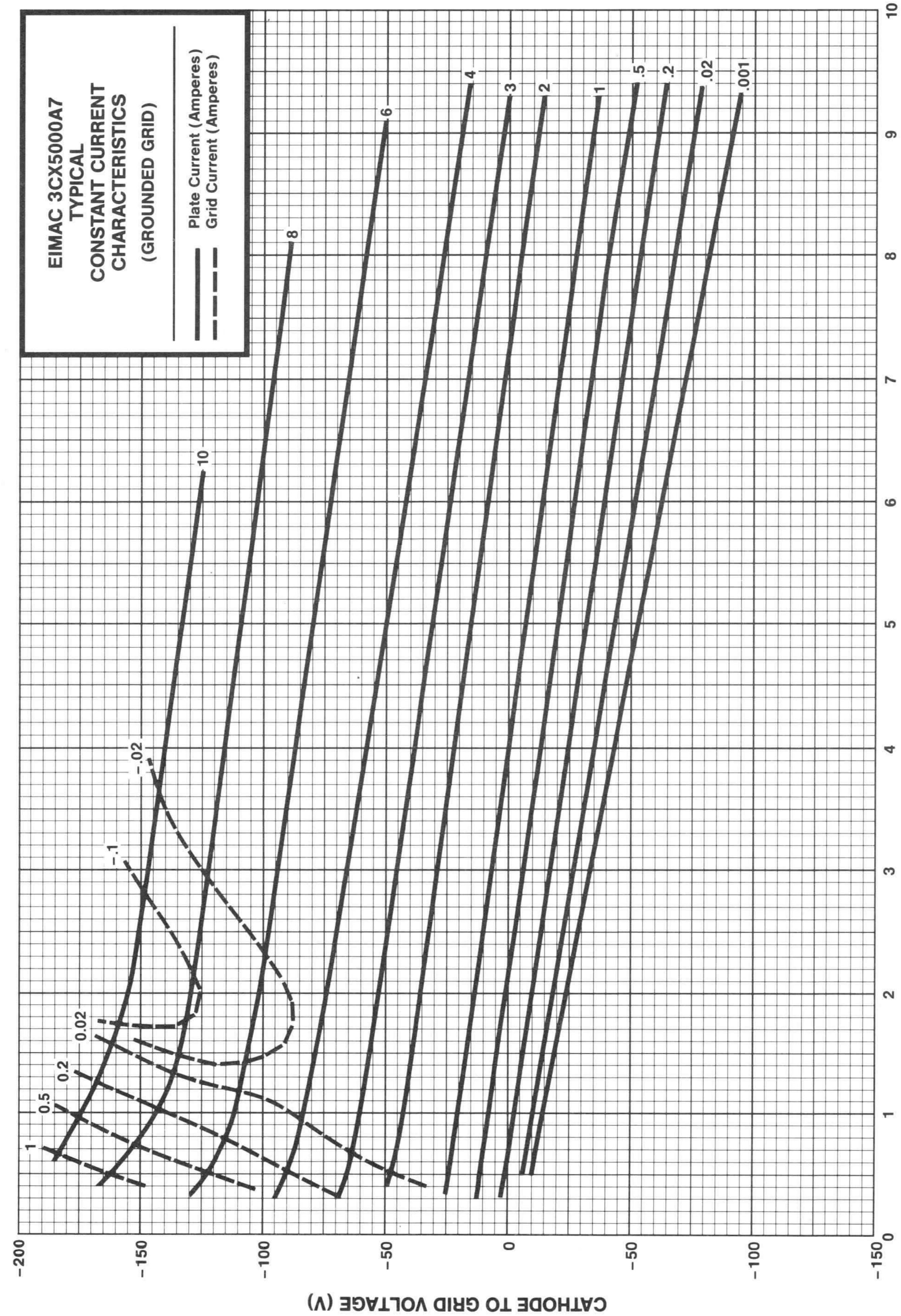
a. HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

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.

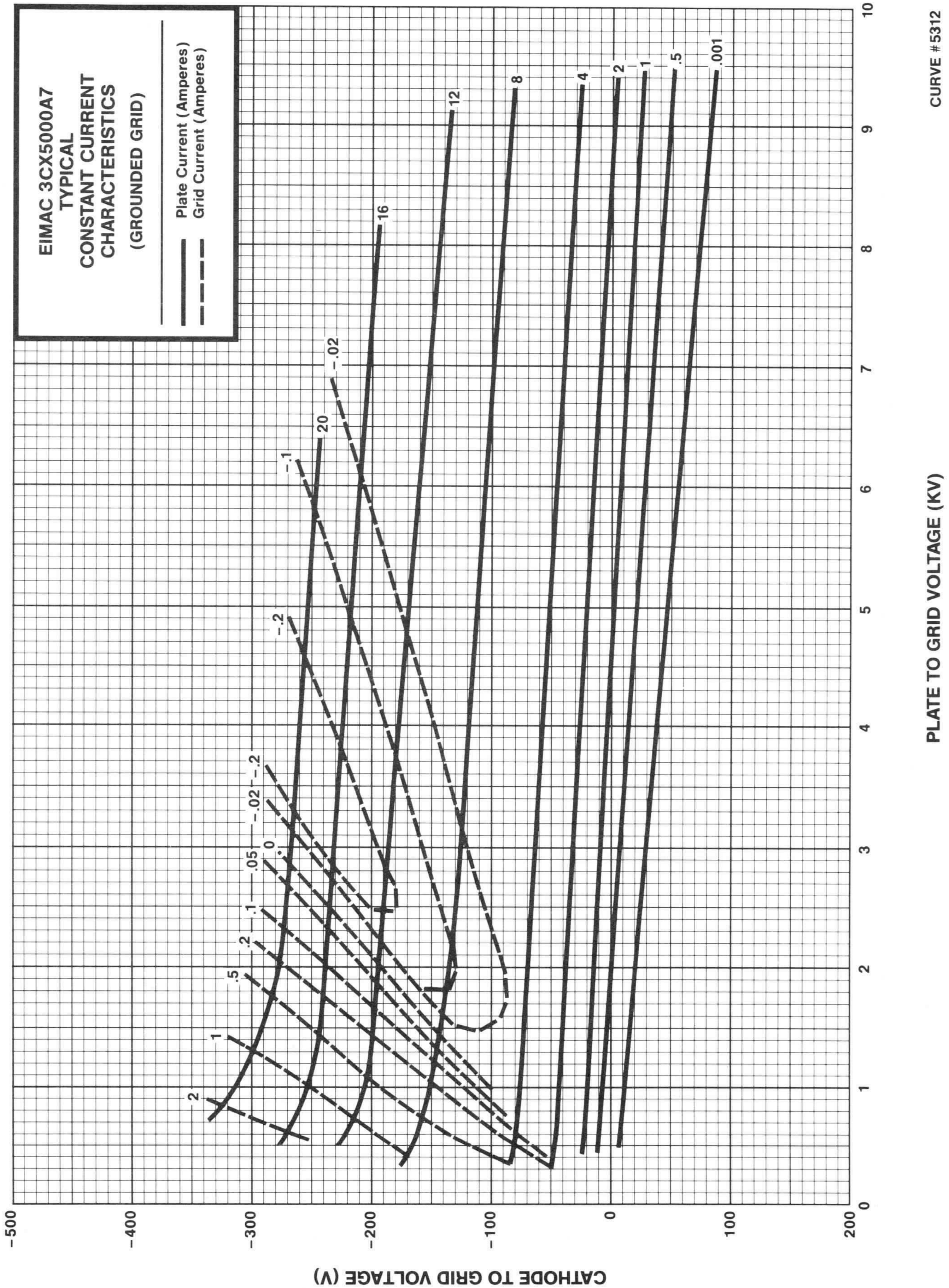
c. RF RADIATION - Avoid exposure to strong rf fields even at relatively low frequencies. The danger is more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE EFFECTED.

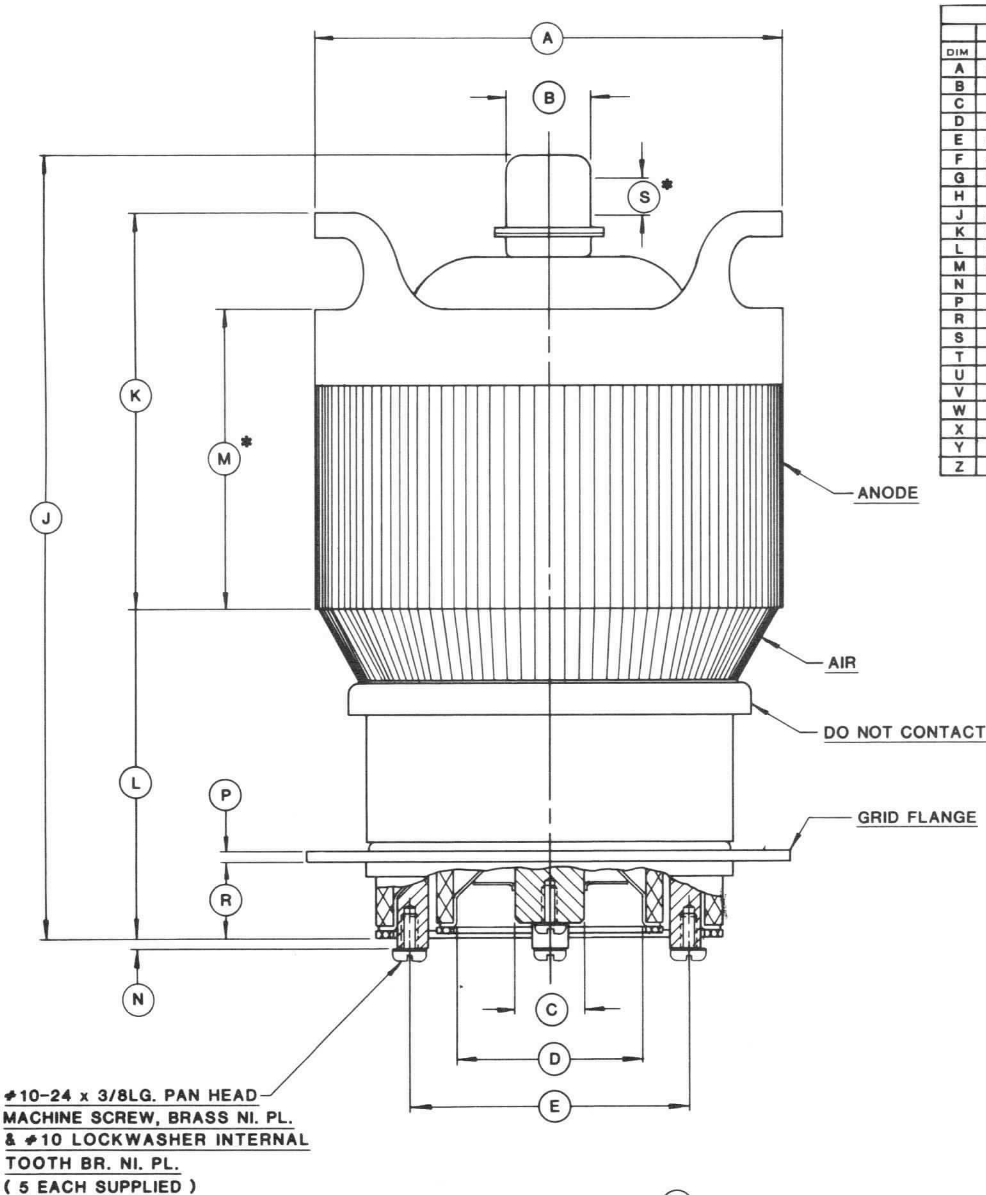
d. HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C and cause serious burns if touched for several minutes after all power is removed.

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 3CX5000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
10
8
6
4
3
2
1
.5
.2
.02
.001
-.02
-.1
0.02
0.2
0.5
1
PLATE TO GRID VOLTAGE (KV)
0
1
2
3
4
5
6
7
8
9
10
CATHODE TO GRID VOLTAGE (V)
-200
-150
-100
-50
0
-50
-100
-150

CURVE #5311

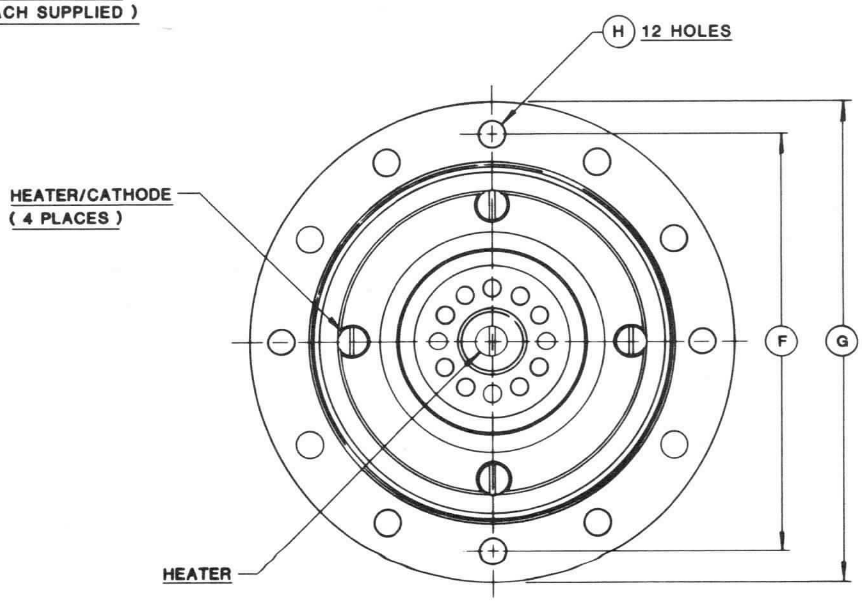

EIMAC 3CX5000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
PLATE TO GRID VOLTAGE (KV)
CATHODE TO GRID VOLTAGE (V)
CURVE #5312



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF.	MIN.	MAX	REF
A	4.812	4.938		122.22	125.43	
B	.855	.895		21.72	22.73	
C	.600	.760		15.24	19.30	
D	1.896	1.936		48.16	49.17	
E	3.326	3.450		84.48	87.63	
F	4.425	4.445		112.40	122.90	
G	5.030	5.090		127.76	129.29	
H			.265			6.73
J	8.017	8.267		203.63	209.98	
K	3.925	4.299		99.70	109.19	
L	3.223	3.597		81.86	91.36	
M	2.925	3.299		74.30	83.79	
N	.093	.156		2.36	3.96	
P			.125			3.18
R	.721	.845		18.31	21.46	
S	.375			9.53		
T						
U						
V						
W						
X						
Y						
Z						

NOTES:

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



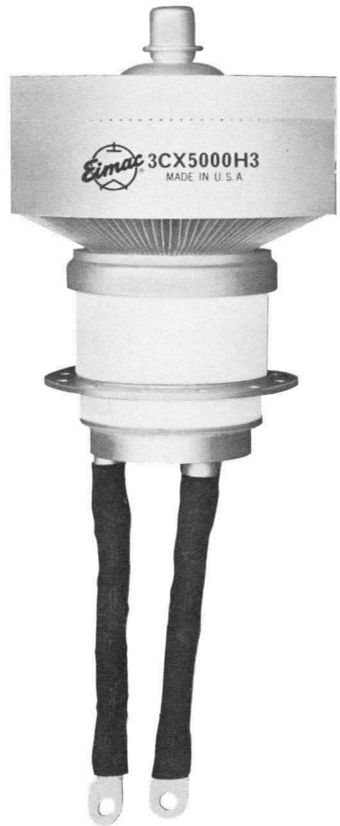
EIMAC

A Division of Varian Associates

SAN CARLOS, CALIFORNIA

3CX5000H3

INDUSTRIAL MEDIUM-MU AIR-COOLED POWER TRIODE



The EIMAC 3CX5000H3 is an air-cooled ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is conservatively rated at 5 kilowatts maximum plate dissipation with low pressure drop.

Input of 25 kilowatts is permissible up to 90 megahertz. Plentiful reserve emission is available from its 560 watt filament. The grid structure is rated at 150 watts making this tube an excellent choice for severe application.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten	*Min.*	*Nom.*	*Max.*	
Voltage - - - - - -		7.5		Volts
Current - - - - - -	73		78	amps
Amplification Factor - - - -		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Input - - - - - - -			53	$\mu\mu f$
Output - - - - - -			1.5	$\mu\mu f$
Grid-Plate - - - - -			25	$\mu\mu f$
Frequency for Maximum Ratings -			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	10 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

(Effective 4-1-66)

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000 Volts
DC PLATE CURRENT	3.0 Amps
DC GRID VOLTAGE	—1000 Volts
DC GRID CURRENT	0.5 Amp
PLATE INPUT POWER	25 kW
PLATE DISSIPATION	5 kW

TYPICAL OPERATION*

DC Plate Voltage	7000	9000 Volts
DC Plate Current	2.65	2.52 Amps
DC Grid Voltage	—700	—900 Volts
DC Grid Current	0.192	0.184 Amps
Peak Positive Grid Voltage	230	230 Volts
Driving Power	179	208 Watts
Plate Input Power	18.55	22.7 kW
Plate Dissipation	4.1	4.1 kW
Plate Output Power	14.45	18.6 kW
Approximate Load Impedance	1245	1725 Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

The rated filament voltage for the 3CX5000H3 is 7.5 volts. Filament voltage, as measured at the tube, must be maintained at 7.5 volts plus or minus five percent for maximum tube life and consistent performance.

Control Grid Operation

The grid current rating is 0.5 ampere dc. This value should not be exceeded for more than very 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 0.25 amperes 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 150 watts.

Plate Operation

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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CX5000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

The maximum temperature rating for the external surfaces of the 3CX5000H3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated for frequencies below 30 MHz.

MINIMUM AIR FLOW REQUIREMENTS (Anode-to-Base Air Flow)

	Sea Level		5000 Feet	
Plate** Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
4000	98	0.24	118	0.29
5000	152	0.49	182	0.59
6000	236	1.00	283	1.2

**Since the power dissipated by the filament is about 560 watts and since grid dissipation can, under some circumstances, represent another 150 watts, allowance has been made in preparing this tabulation for an additional 710 watts dissipation.

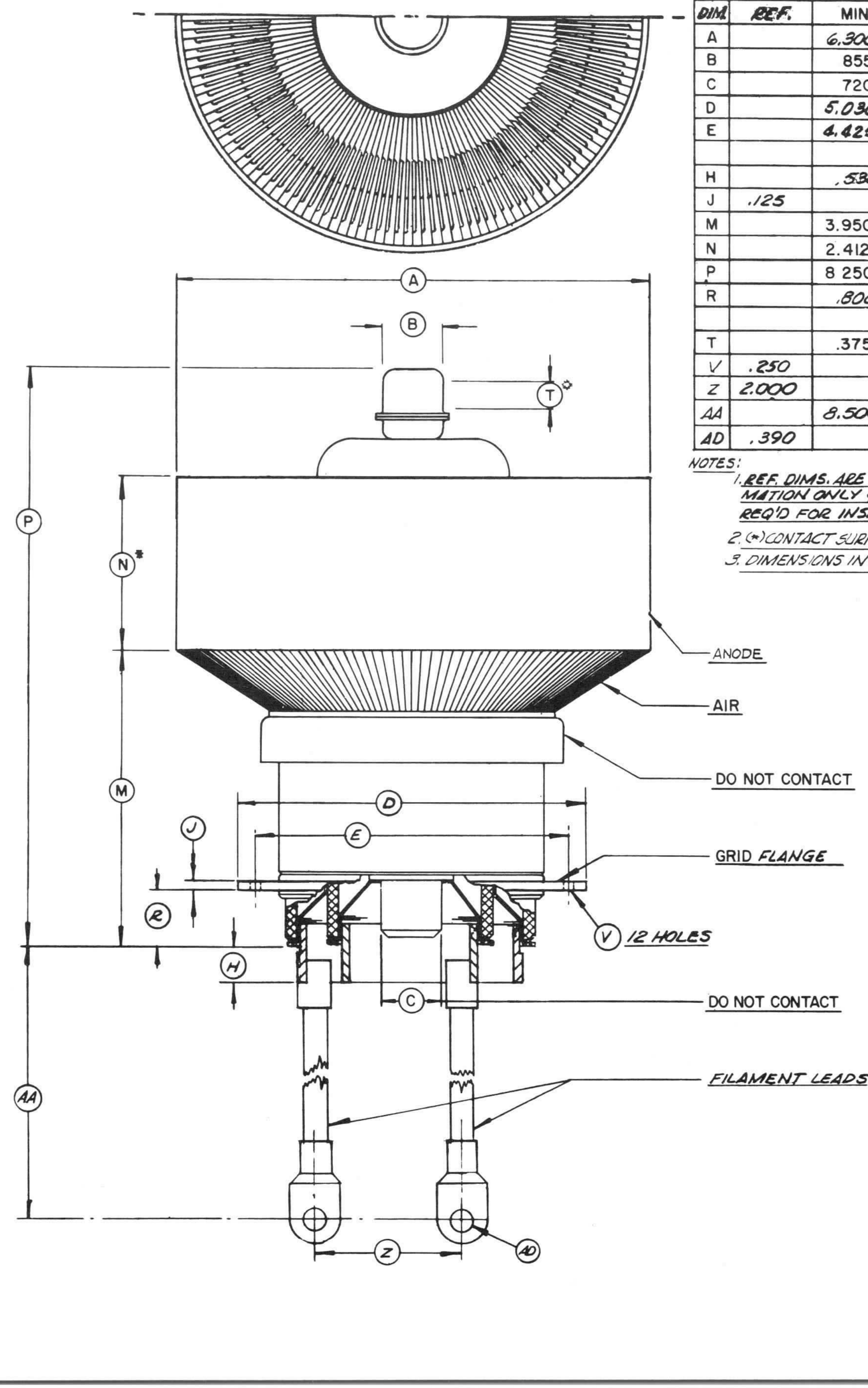
Additional stem cooling air must be provided. 8 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by an 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling for 50°C ambient, 5000 ft. altitude, and 30 MHz or less.

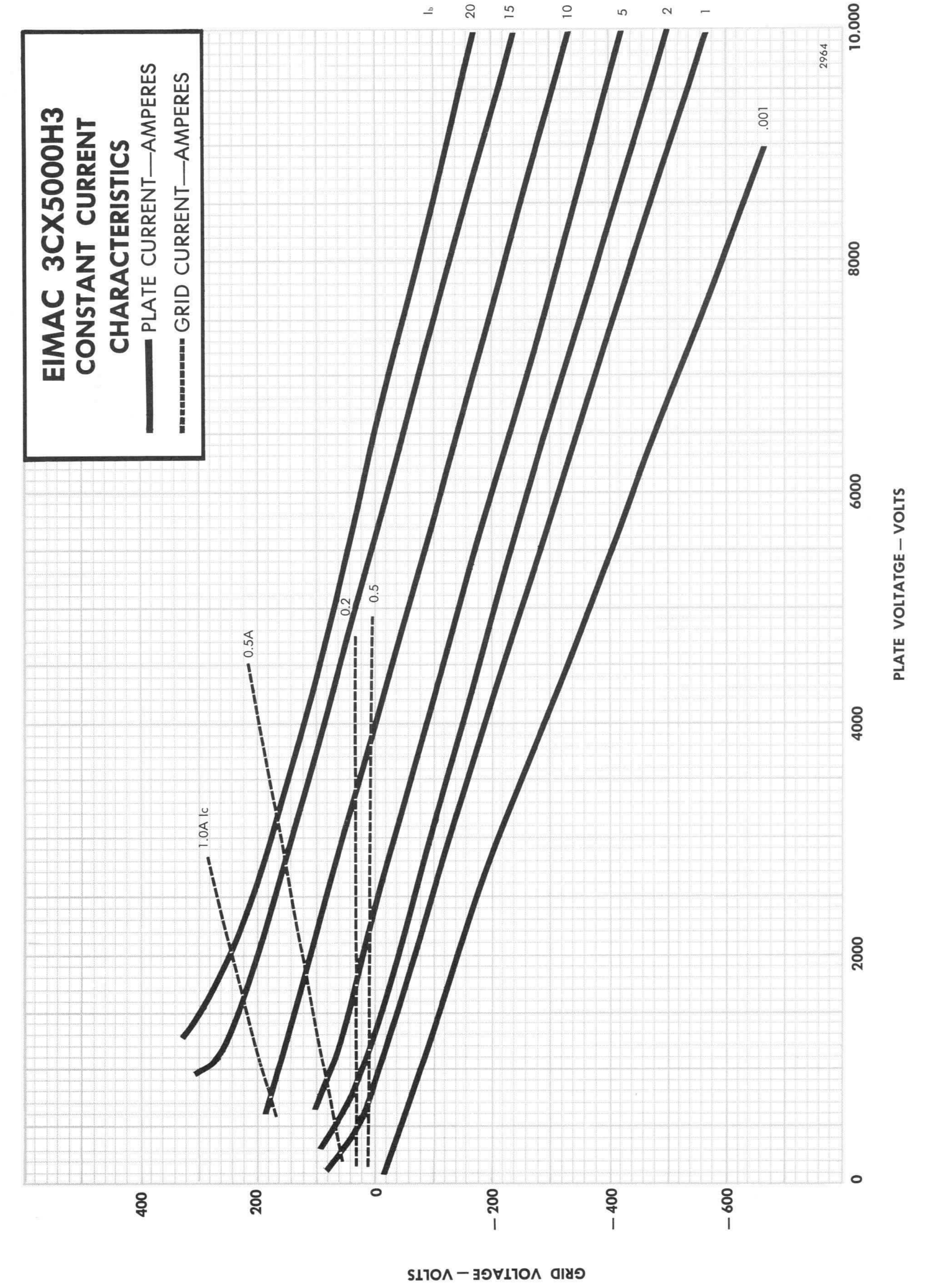
Special Applications

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

DIMENSION DATA			
DIM	REF.	MIN.	MAX.
A		6.300	6.400
B		855	895
C		720	760
D		5.030	5.090
E		4.425	4.445
H		.530	.700
J	.125		
M		3.950	4.300
N		2.412	2.788
P		8 250	8.750
R		.800	.860
T		.375	
V	.250		
Z	2.000		
AA		8.500	9.000
AD	.390		

NOTES:
1. REF. DIMS. ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.
2. (*) CONTACT SURFACE
3. DIMENSIONS IN INCHES




EIMAC 3CX5000H3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT—AMPERES
GRID CURRENT—AMPERES
I_b
20
15
10
5
2
1
.001
1.0A Ic
0.5A
0.2
0.5
2964
PLATE VOLTATGE — VOLTS
0
2000
4000
6000
8000
10,000
GRID VOLTAGE — VOLTS
400
200
0
− 200
− 400
− 600

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8158
3CX10,000A1

LOW-MU POWER TRIODE

The Eimac 8158/3CX10,000A1 is a ceramic and metal power triode intended primarily for use as an audio amplifier or modulator. This tube is also recommended for voltage-regulator applications where high current capability and low tube drop are important. Up to 12 kilowatts of plate power can be dissipated on its air-cooled anode. A water-cooled version, the 3CW20,000A1, is available with a 20 kw dissipation rating.

CHARACTERISTICS

ELECTRICAL

Filament: Thoriated-Tungsten	Min.	Nom.	Max.	
Voltage		7.5		V
Current	94		104	A
Amplification Factor	5.5		7.0	
Interelectrode Capacitances:				
Grid-Filament	45		57	pF
Output	3.4		4.2	pF
Grid-Plate	25		32	
Transconductance (Ib = 2.0 amps, Eb = 3000 volts)	20,000			umhos

MECHANICAL

Base	Coaxial
Recommended Socket	Eimac SK-1300
Recommended Chimney	Eimac SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250 °C
Ceramic-to-Metal Seals	250 °C
Maximum Dimensions:	
Height	8.75 in
Diameter	7.0 in
Net Weight	12 lbs

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR CLASS-AB₁

MAXIMUM RATINGS (Per Tube)

DC Plate Voltage	7000	volts
DC Plate Current	5.0	amps
Plate Dissipation	12	kW
Grid Dissipation	100	watts

*Adjust for zero-signal plate current
**At max-signal without negative feedback

Effective grid circuit resistance must not exceed 200,000 ohms

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000	volts
DC Grid Voltage*	−1300	−1300	volts
Zero-Sig DC Plate Current	1.5	1.5	amps
Max-Sig DC Plate Current	5.8	7.0	amps
Load Resistance, Plate-to-Plate	2460	1720	ohms
Peak AF Grid Driving Voltage (Per Tube)	1300	1300	volts
Max-Sig Driving Power	0	0	watts
Max-Sig Plate Output Power	24,400	29,100	watts
Total Harmonic Distortion**	2.9	3.6	percent

 Printed in U.S.A.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR Class-A

MAXIMUM RATINGS

DC Plate Voltage	7000	volts
DC Plate Current	See Class-A derating table on Page 3	
Plate Dissipation	12,000	watts

*Adjust to give listed zero-signal DC plate current

TYPICAL OPERATION

DC Plate Voltage	2500	volts
DC Grid Voltage *	–290	volts
DC Plate Current	4.0	amps
Peak AF Grid Driving Voltage	290	volts
Load Resistance	2120	ohms
Plate Output Power	1800	watts

VOLTAGE REGULATOR SERVICE
Class-A

MAXIMUM RATINGS

DC Plate Voltage	10,000	volts
DC Plate Current	See Class-A derating table on Page 3	
Plate Dissipation	12,000	watts
Grid Dissipation	100	watts

TYPICAL OPERATION

DC Plate Voltage (tube drop)	0-5000	volts
DC Plate Current	0-5	amps

(These values are chosen according to Class-A derating table on Page 3)

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses, either input or output, has been made.

APPLICATION

Cooling — The maximum temperature rating for the external surfaces of the 3CX10, 000A1 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate** Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	85	0.18	125	0.25
6000	145	0.38	210	0.55
8000	215	0.68	315	0.99
10,000	295	1.08	430	1.60
12,000	390	1.62	565	2.35

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 100 watts, allowance has been made in preparing this tabulation for an additional 850 watts dissipation.

APPLICATION

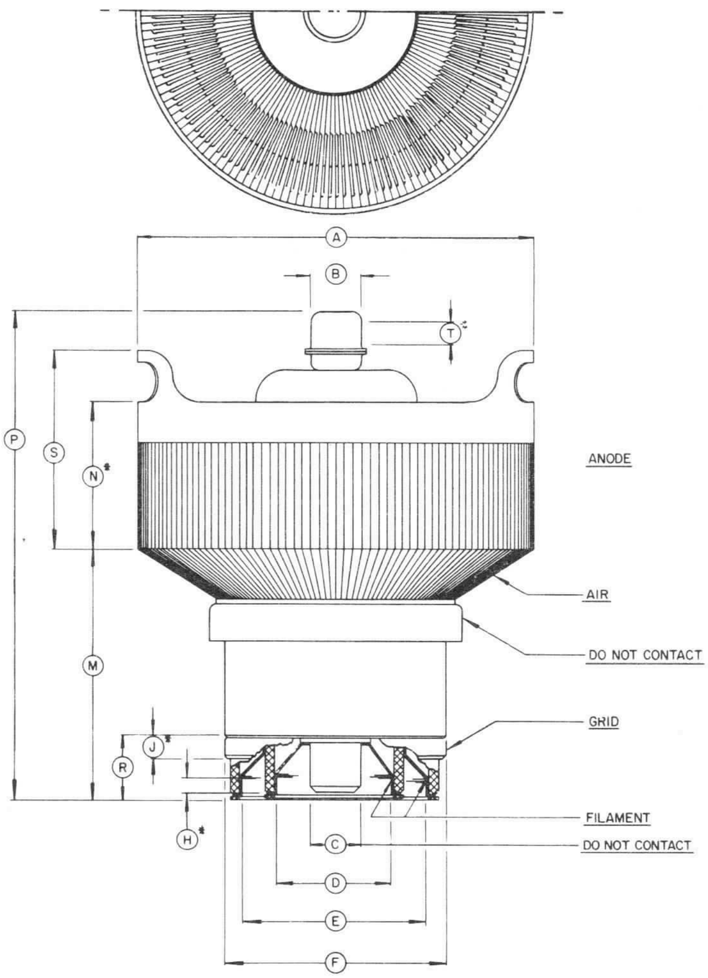
Voltage-Regulator Service — Maximum DC plate current and voltage are restricted according to the following table.

CLASS-A DERATING TABLE	
DC Plate Voltage (Volts)	Max. DC Plate Current (mA)
0 - 2400	5000
3000	4000
4000	3000
5000	2000
6000	1500
7000	1000
8000	700
9000	500
10,000	350

Filament Operation—The rated filament voltage for the 3CX10,000A1 is 7.5 volts. Filament voltage, as measured at the socket, should not be allowed to deviate from the rated value by more than plus or minus five percent.

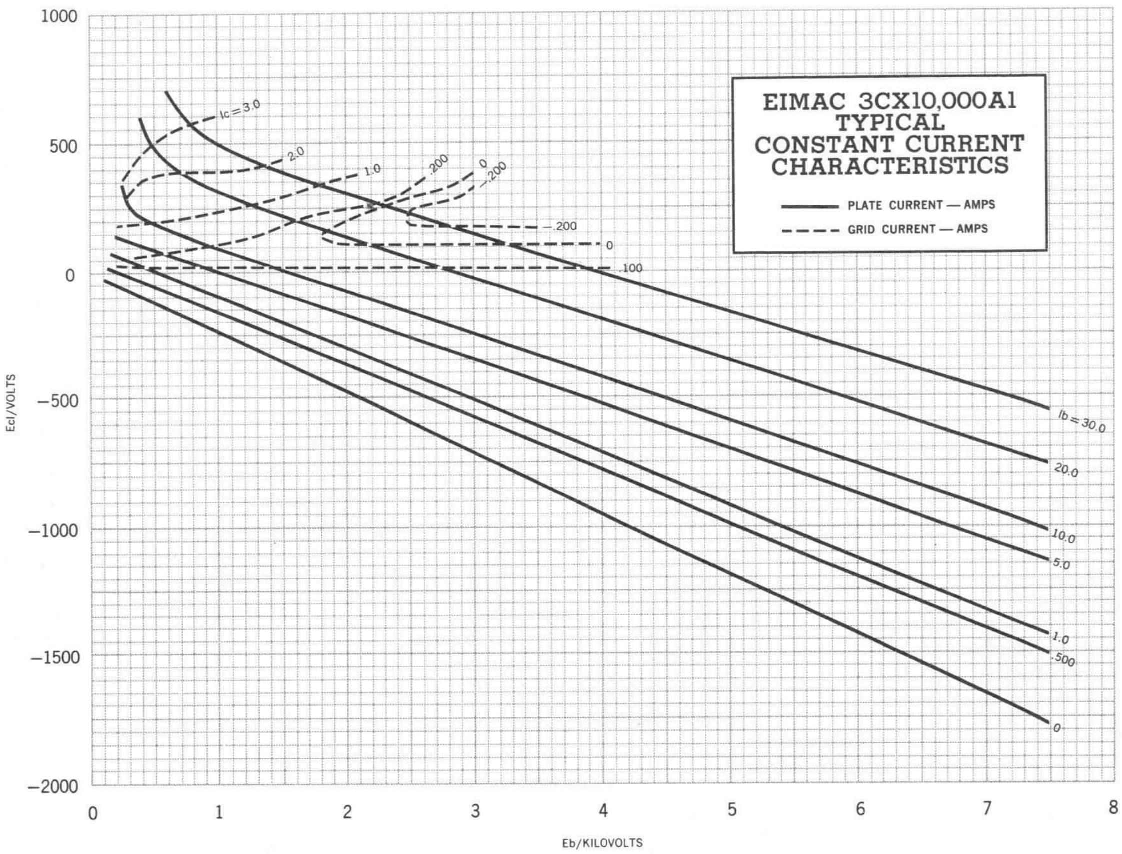
Cooling—The maximum temperature rating for the external surfaces of the 3CX10,000A1 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the ceramic-metal seals and anode core below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates provides effective cooling of the tube. When air-flow is in the anode-to-base direction, special care must be taken to insure adequate cooling of the filament stem structure. A separate supply of air may have to be directed into the area between the filament contact areas to maintain safe seal temperatures.

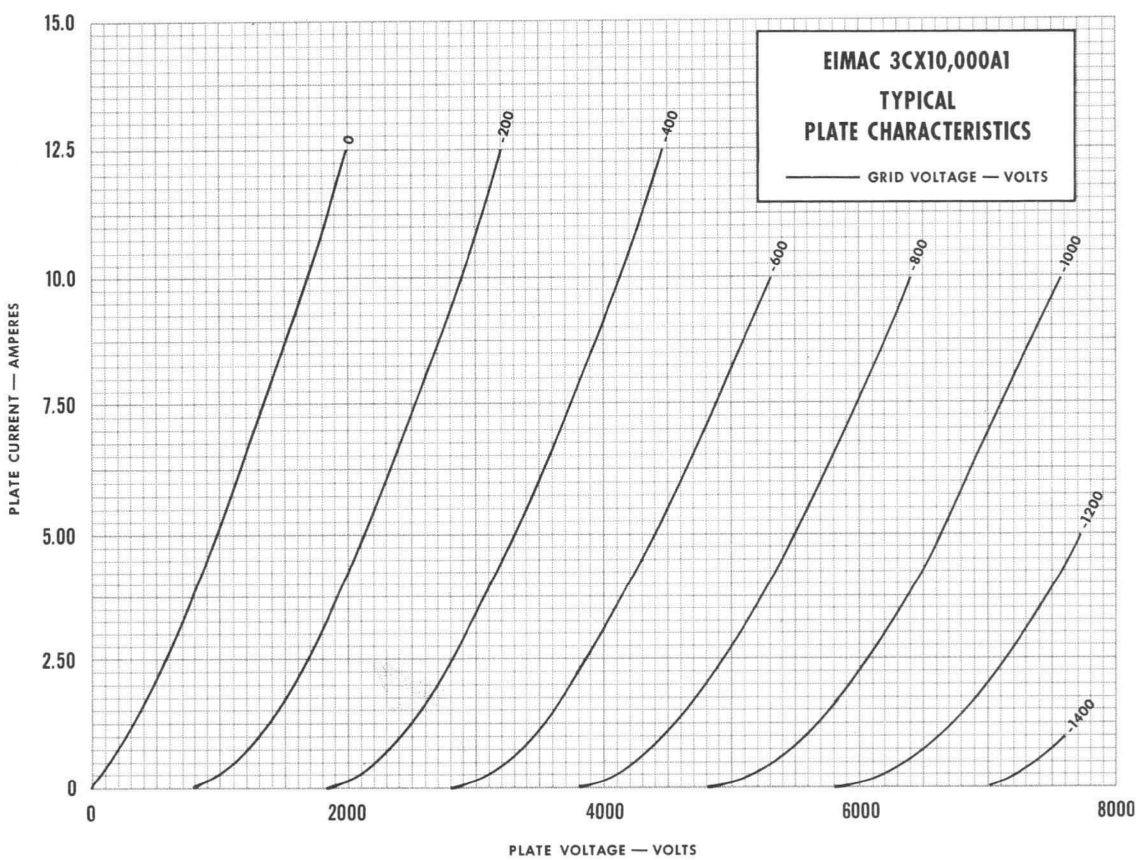
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, Calif., for information and recommendations.



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3 133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	


EIMAC 3CX10,000A1
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPS
GRID CURRENT — AMPS
Ecl/VOLTS
Eb/KILOVOLTS
Ib = 30.0
20.0
10.0
5.0
1.0
.500
0
Ic = 3.0
2.0
1.0
.200
.100


EIMAC 3CX10,000A1
TYPICAL
PLATE CHARACTERISTICS
GRID VOLTAGE — VOLTS
PLATE CURRENT — AMPERES
PLATE VOLTAGE — VOLTS
0
-200
-400
-600
-800
-1000
-1200
-1400

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8159
3CX10,000A3
MEDIUM-MU POWER TRIODE

The EIMAC 3CX10,000A3 is a ceramic and metal power triode intended primarily for use as a power oscillator in industrial-heating applications. It is also recommended for use as a grounded-grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		7.5		V
Current	94		104	A
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode:				
Input	48		58	pF
Output	1.2		1.5	pF
Feedback	30		38	pF

Frequency for Maximum Ratings - 140 MHz

MECHANICAL

Base	Coaxial
Recommended Socket	EIMAC SK-1300
Recommended Chimney	EIMAC SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal Seals	250°C
Maximum Dimensions:	
Height	8.5 in
Diameter	7.0 in
Net Weight	12 lb

R-F INDUSTRIAL OSCILLATOR
CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	4.0	AMPS
PLATE DISSIPATION	10	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION, Optimum Load

D-C Plate Voltage	6000	7000	volts
D-C Grid Voltage	-575	-670	volts
D-C Plate Current	4.0	4.0	amps
D-C Grid Current	610	670	mA
Plate Input Power	24	28	kW
Plate Output Power	18.9	22.4	kW

R-F POWER AMPLIFIER
GROUNDED-GRID, CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	4.0	AMPS
PLATE DISSIPATION	10	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000	volts
D-C Grid Voltage	-535	-625	volts
D-C Plate Current	4.0	4.0	amps
D-C Grid Current	545	530	mA
Driving Power	3700	4100	watts
Plate Output Power	20.5	24.5	kW

R-F POWER AMPLIFIER
PLATE-MODULATED, CLASS-C

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5500	VOLTS
D-C PLATE CURRENT	3.0	AMPS
PLATE DISSIPATION	6.5	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	4000	5000	volts
D-C Grid Voltage	-480	-600	volts
D-C Plate Current	3.0	3.0	amps
D-C Grid Current	660	550	mA
Driving Power	530	515	watts
Plate Output Power	9.7	12.4	kW

R-F LINEAR AMPLIFIER
GROUNDED-GRID, CLASS-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7000	VOLTS
D-C PLATE CURRENT	5.0	AMPS
PLATE DISSIPATION	12	KW
GRID DISSIPATION	250	WATTS

TYPICAL OPERATION

D-C Plate Voltage	6000	7000	volts
Zero-Sig Grid Voltage*	-270	-325	volts
Max-Sig D-C Plate Current	4.0	4.0	amps
Max-Sig D-C Grid Current	300	250	mA
Driving Power	1900	2050	watts
Plate Output Power	18	20	kW

*Adjust to give 500 milliamperes zero-signal d-c plate current.

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristics curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

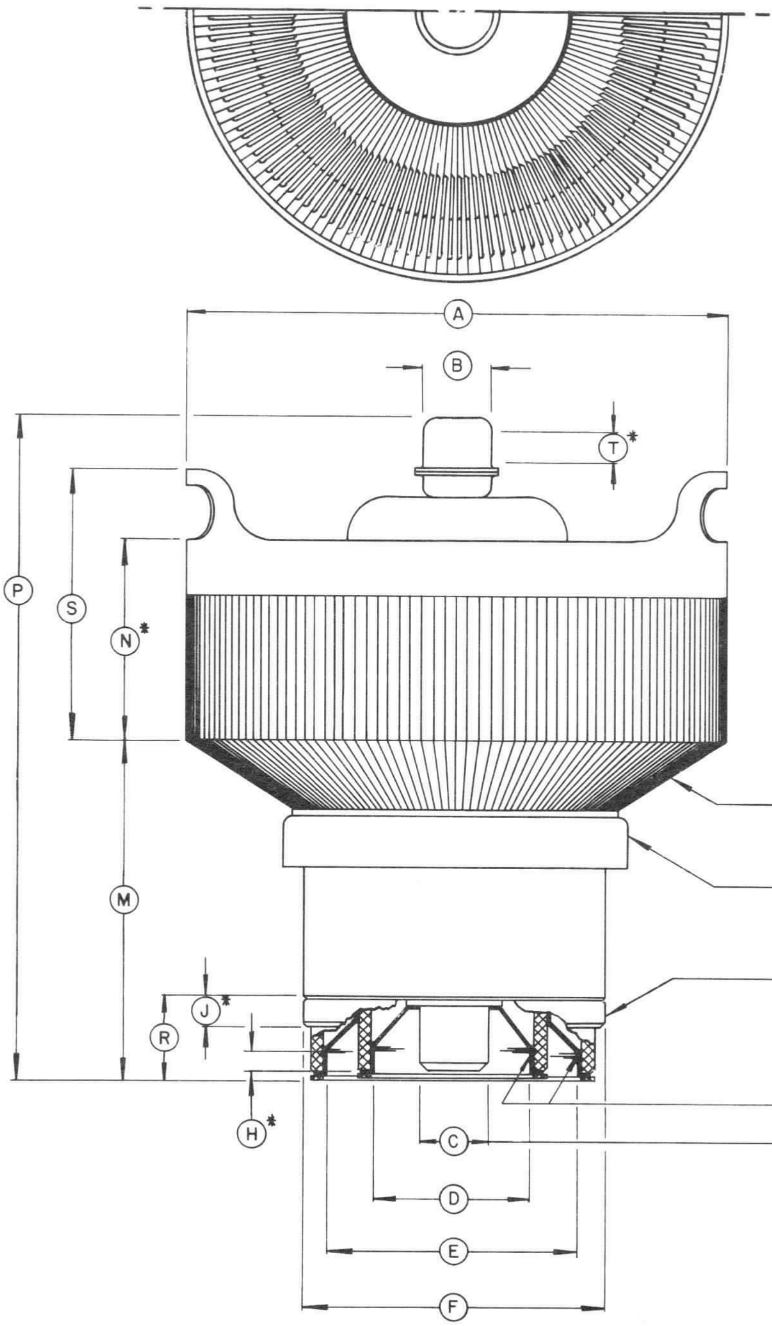
Cooling - The maximum temperature rating for the external surfaces of the 3CX10,000A3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

	Sea Level		10,000 Feet	
Plate** Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
4000	110	.25	160	.36
6000	180	.53	260	.78
8000	270	.95	390	1.4
10,000	373	1.55	545	2.25
12,000	448	2.00	650	2.9

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 250 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

Filament Operation - The rated filament voltage for the 3CX10,000A3 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than five percent.

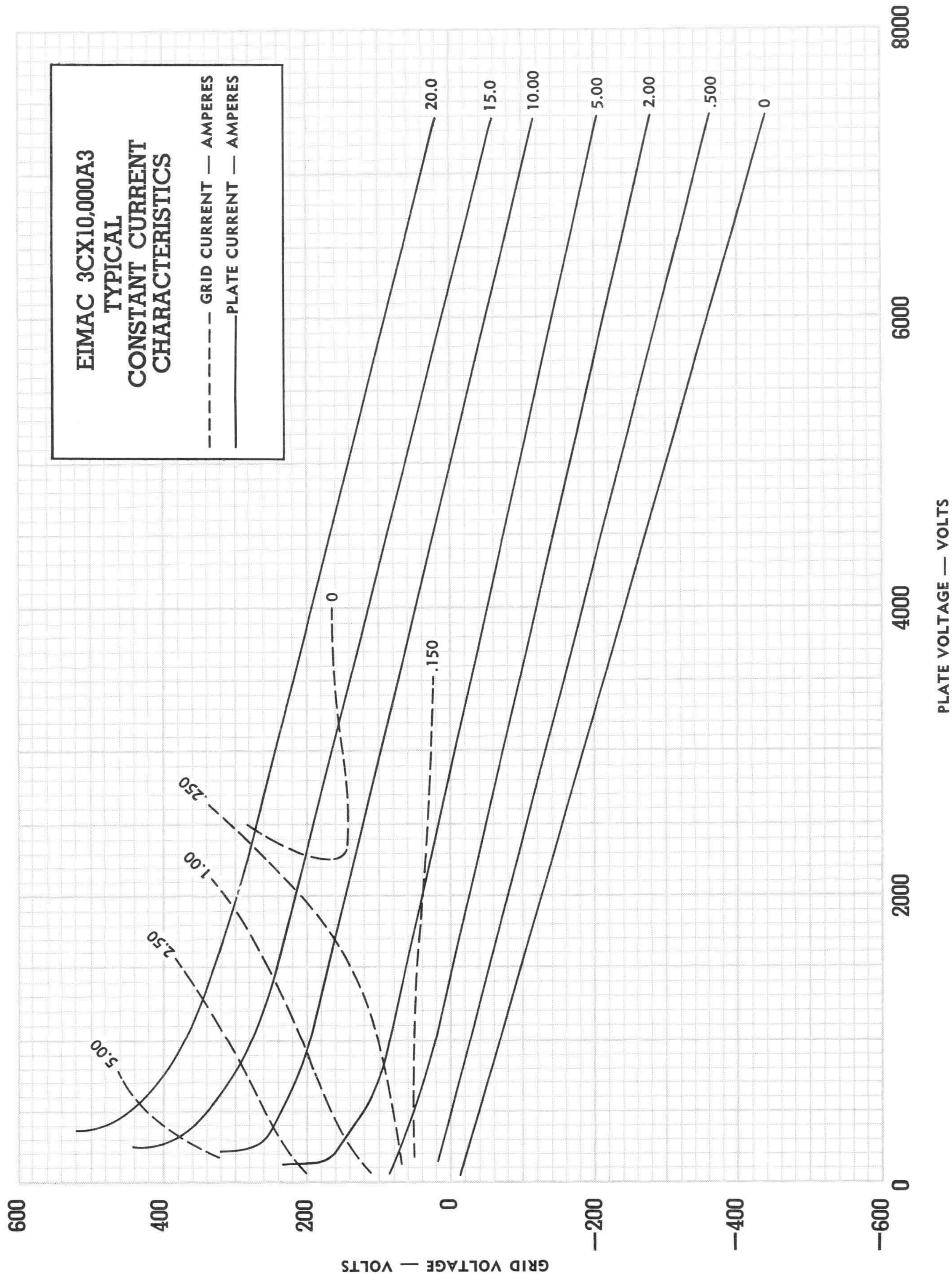
Special Applications - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	

*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

Indicates change from sheet dated 7-1-61


EIMAC 3CX10,000A3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
20.0
15.0
10.00
5.00
2.00
.500
0
.150
0
.250
1.00
2.50
5.00
600
400
200
0
−200
−400
−600
GRID VOLTAGE — VOLTS
0
2000
4000
6000
8000
PLATE VOLTAGE — VOLTS

TECHNICAL DATA

8160
3CX10,000A7

HIGH-MU
POWER TRIODE

The EIMAC 8160/3CX10,000A7 is a ceramic and metal power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8160/3CX10,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-Tungsten	
Voltage	7.5 V
Current	100 A
Amplification Factor (Nominal)	200
Direct Interelectrode Capacitances:[2]	
Grid-Filament	59.0 pF
Grid-Plate	36.0 pF
Plate-Filament	0.2 pF
Frequency for Maximum Ratings	160 MHz

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 shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Coaxial
Recommended Air-System Socket	EIMAC SK-1300
Recommended Air Chimney	EIMAC SK-1306
Operating Position	Vertical, base up or down
Cooling	Forced air
Maximum Operating Temperatures:	
Anode Core	250 °C
Ceramic/Metal Seals	250 °C
Maximum Dimensions:	
Height	8.75 in; 222.25 mm
Diameter	7.05 in; 179.07 mm
Net Weight	12 lbs; 5.45 kg

(Revised 2-1-73) Printed in U.S.A.

RADIO-FREQUENCY LINEAR AMPLIFIER
Grounded Grid, Class-B

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Single-Tone Conditions

DC Plate Voltage	7000	7000	V
Zero-Signal DC Plate Current[1]	0.60	0.60	A
Max-Signal DC Plate Current	3.72	5.00	A
Max-Signal DC Grid Current	0.71	1.00	A
Driving Impedance	35	32	Ω
Resonant Load Impedance	1020	745	Ω
Max-Signal Driving Power	885	1540	w
Peak Envelope Plate Output Power.	17.7	24.2	kW
Power Gain	13	12	dB

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR
Class B, Grid Driven

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION, Two Tubes, Sinusoidal Wave

DC Plate Voltage	7000	7000	V
DC Grid Voltage	0	0	V
Zero-Signal DC Plate Current[1]	1.20	1.20	A
Max-Signal DC Plate Current	7.50	10.0	A
Max-Signal DC Grid Current	1.50	2.06	A
Driving Power	315	560	W
Peak AF Driving Voltage (Per Tube)	250	310	v
Load Resistance, Plate-to-Plate	2000	1520	Ω
Max-Signal Plate Output Power	35.6	47.7	kW

RADIO-FREQUENCY LINEAR AMPLIFIER
Carrier Conditions, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	12	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.
2. Modulation Crest Conditions

TYPICAL OPERATION

DC Plate Voltage	7000	V
DC Grid Voltage	0	V
Zero-Signal DC Plate Current[1]	0.60	A
DC Plate Current	2.40	A
DC Grid Current	0.25	A
Driving Impedance[2]	32	Ω
Peak Driving Voltage[2]	310	v
Driving Power	330	W
Plate Output Power	5650	W

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class-C, Grounded-Grid

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	10	KILOWATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

DC Plate Voltage	7600	V
DC Plate Current	3.68	A
DC Grid Voltage	-110	V
DC Grid Current	775	mA
Peak RF Cathode Voltage	400	v
Cathode Driving Power[1]	1510	W
Plate Output Power	22.5	kW

1. Approximate value.

PLATE-MODULATED RF POWER AMPLIFIER

MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	6.5	KILOWATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION

DC Plate Voltage	5000	V
DC Plate Current	3.0	A
DC Grid Voltage	-200	V
DC Grid Current	775	mA
Peak RF Grid Voltage	490	v
Grid Driving Power[1]	380	W
Plate Output Power	11.9	kW

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.

MOUNTING - The 3CX10,000A7 must be operated vertically base up or down. The tube must be protected from severe vibration and shock.

COOLING - The maximum temperature rating for the external surfaces of the 3CX10,000A7 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic/metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney and tube combination in the base-to-anode direction provides effective cooling of the tube.

Plate ** Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop(Inches of Water)	Air Flow (CFM)	Pressure Drop(Inches of Water)
4000	105	.24	154	.35
6000	178	.50	275	.80
8000	253	.90	370	1.45
10,000	345	1.4	500	2.30
12,000	483	2.25	710	3.40

** Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1250 watts dissipation.

INPUT CIRCUIT - When the 3CX10,000A7 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 two of more.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3CX10,000A7 may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier.

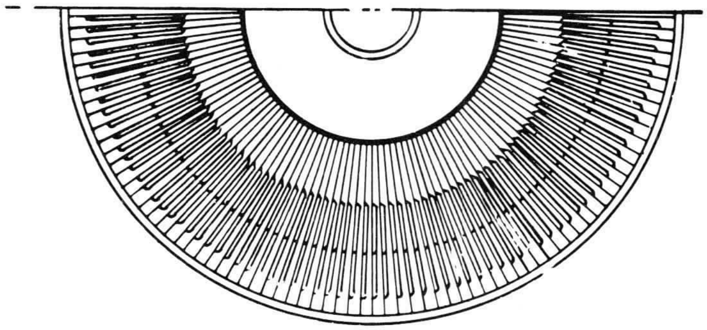
FILAMENT OPERATION - The rated filament voltage for the 3CX10,000A7 is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

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.

HIGH VOLTAGE - The 3CX10,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies 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.

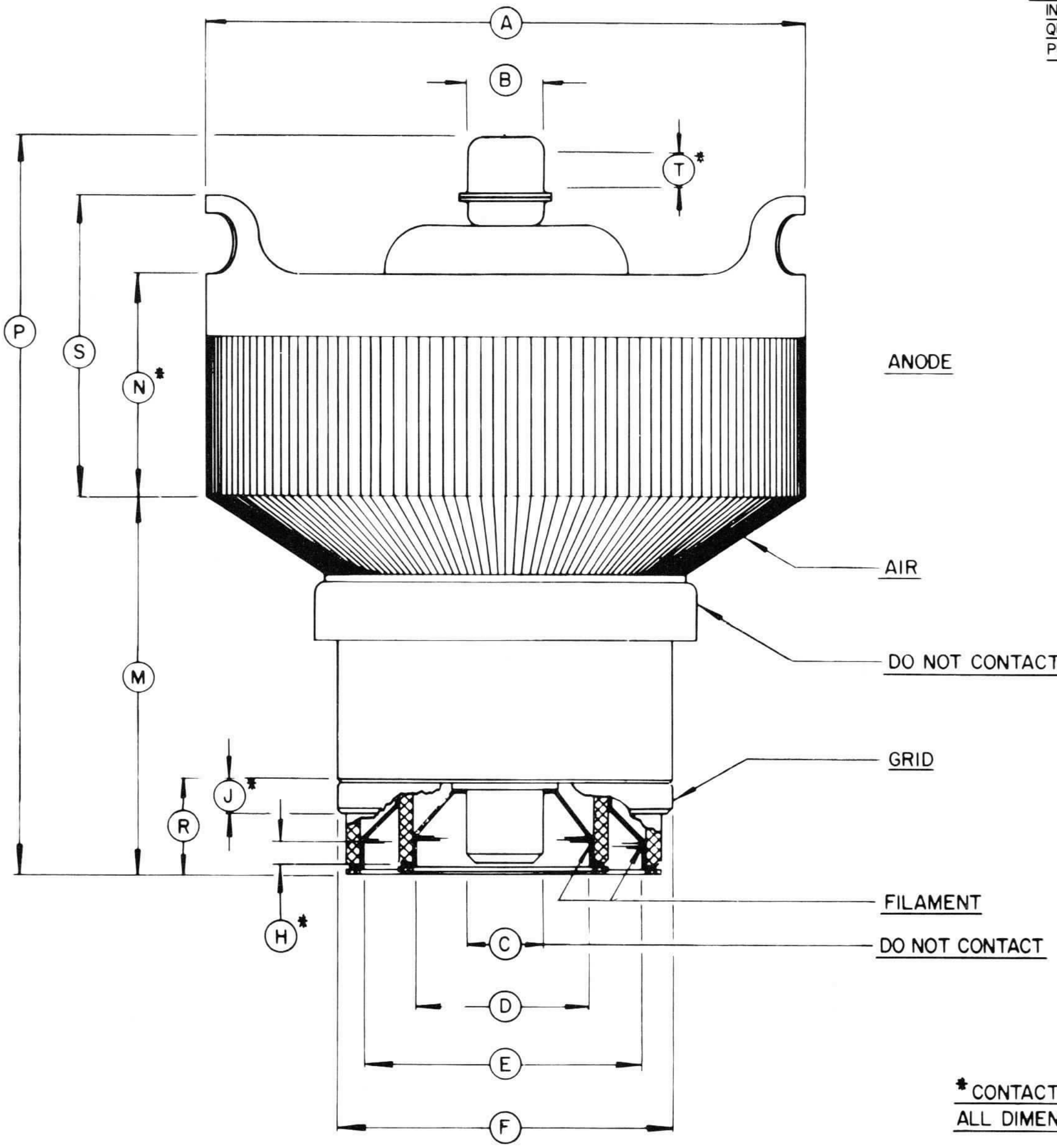
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid **Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070, for information and recommendations.**



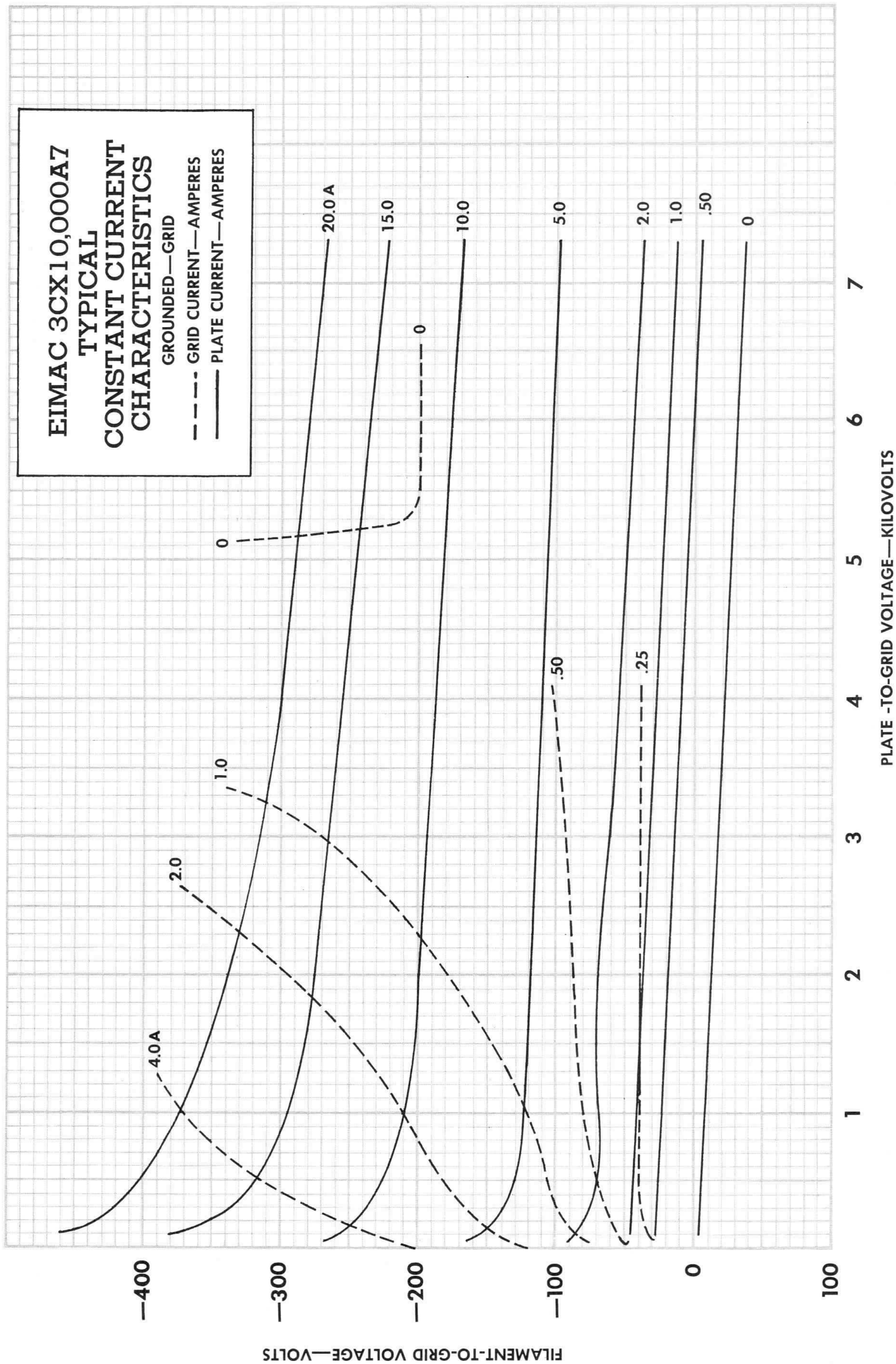
DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.928	7.050	- -	175.97	179.07	- -
B	0.855	0.895	- -	21.72	25.49	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	3.950	4.300	- -	100.33	109.22	- -
N	2.412	2.788	- -	61.26	70.81	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.21	- -
T	0.375	- -	- -	9.52	- -	- -

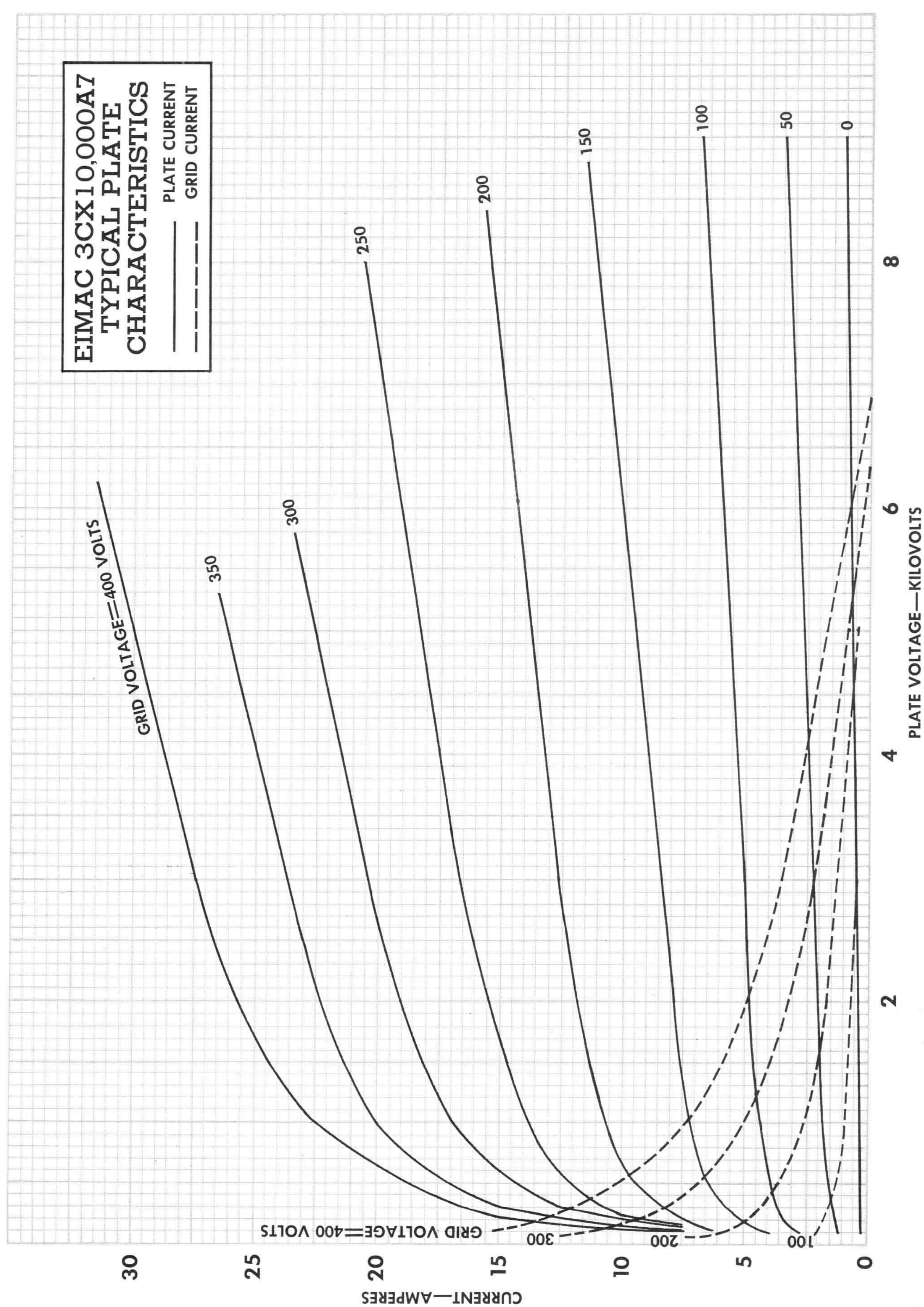
NOTES:

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



* CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED—GRID
GRID CURRENT—AMPERES
PLATE CURRENT—AMPERES
20.0 A
15.0
10.0
5.0
2.0
1.0
.50
0
4.0 A
2.0
1.0
.50
.25
0
PLATE -TO-GRID VOLTAGE—KILOVOLTS
1
2
3
4
5
6
7
FILAMENT-TO-GRID VOLTAGE—VOLTS
−400
−300
−200
−100
0
100


EIMAC 3CX10,000A7
TYPICAL PLATE
CHARACTERISTICS
PLATE CURRENT
GRID CURRENT
GRID VOLTAGE=400 VOLTS
350
300
250
200
150
100
50
0
GRID VOLTAGE=400 VOLTS
300
200
100
0
5
10
15
20
25
30
CURRENT—AMPERES
2
4
6
8
PLATE VOLTAGE—KILOVOLTS

3CX10,000H3

MEDIUM-MU AIR-COOLED POWER TRIODE

TECHNICAL DATA

The Eimac 3CX10,000H3 is an air-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air-cooled anode is conservatively rated at 10 kilowatts of plate dissipation.

Input of 40 kilowatts is permissable up to 90 megacycles. Plentiful reserve emission is available from its 750 watt filament. The grid structure is rated at 250 watts, making this tube an excellent choice for severe applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage - - - - - - -		7.5		Volts
Current - - - - - - -	94		104	Amps
Amplification Factor - - - - - - -		20		
Interelectrode Capacitances, Grounded Cathode:				
Grid-Filament - - - - - -	48		58	$\mu\mu f$
Plate-Filament - - - - - -	1.2		1.5	$\mu\mu f$
Grid-Plate - - - - - - -	30		38	$\mu\mu f$
Frequency for Maximum Ratings - - -			90	Mc

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperature	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	12 Pounds

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	10,000	VOLTS
DC PLATE CURRENT	4.0	AMPS
DC GRID VOLTAGE	—1000	VOLTS
DC GRID CURRENT	0.6	AMP
PLATE INPUT POWER	40	KW
PLATE DISSIPATION	10	KW

*Loaded Conditions

TYPICAL OPERATION*

DC Plate Voltage	7000	9000 Volts
DC Plate Current	4.0	4.0 Amps
DC Grid Voltage	—670	—930 Volts
DC Grid Current	.275	.430 Amps
Peak Positive Grid Voltage	340	390 Volts
Driving Power	260	570 Watts
Plate Input Power	28	36 kW
Plate Dissipation	9	7 kW
Plate Output Power	19	29 kW
Approximate Load Impedance	720	1100 Ohms

NOTE: "Typical Operation" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

ELECTRICAL

Filament — The rated filament voltage for the 3CX10,000H3 is 7.5 volts. Filament voltage, as measured at the tube, should be maintained at this value for consistent performance and maximum tube life. In no case should it be allowed to vary from 7.5 volts by more than plus or minus five percent.

Control Grid Operation — The grid current rating is 0.6 ampere dc. This value should not be exceeded for more than very short periods such as during tuning and over-current protection in the grid circuit should be provided. Ordinarily it will not be necessary to operate with more than 0.2 to 0.4 amp 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 250 watts.

Plate Operation — Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load 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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

High Frequency Operation—The 3CX10,000H3 is usable to 140 Mc. At this frequency, plate voltage must be reduced to 7000 volts in Class C service.

MECHANICAL

Mounting —The 3CX10,000H3 must be mounted vertically, either base up or down. A grid flange is provided for bolting to a grid strap or a grid deck. Heavy flexible leads are provided for the filament voltage connection.

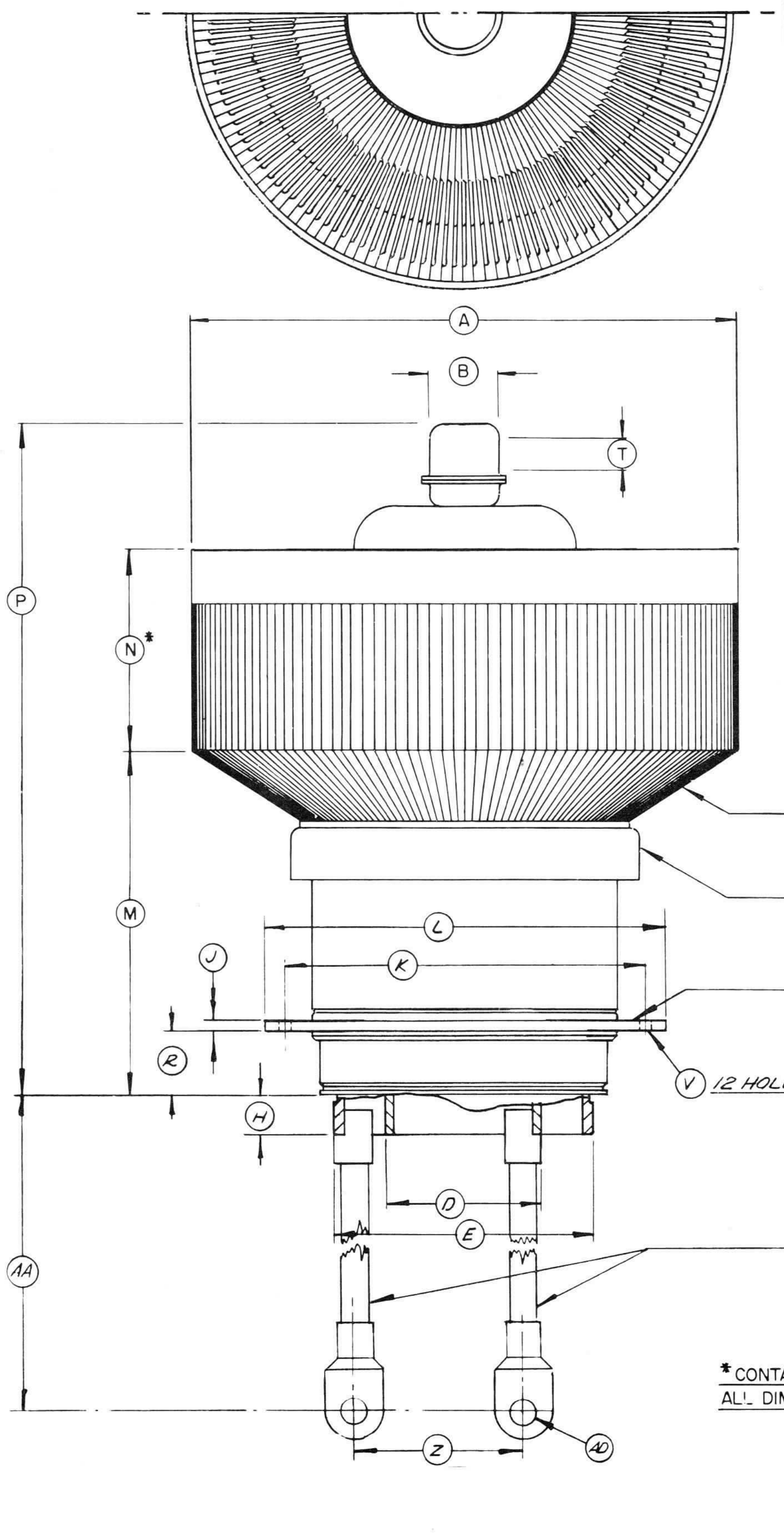
Cooling — The maximum temperature rating for the external surfaces of the 3CX10,000H3 is 250°C. Sufficient forced-air cooling must be provided to keep the temperature of the anode core and the temperature of the ceramic-metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below this maximum rating. Minimum air-flow requirements to maintain anode-core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated.

	Sea Level		5000 Feet	
Plate** Dissipation Watts	Air Flow CFM	Pressure Drop Inches Water	Air Flow CFM	Pressure Drop Inches Water
4000	85	0.18	105	0.21
6000	145	0.38	175	0.46
8000	215	0.68	260	0.82
10,000	295	1.08	360	1.32
12,000	390	1.62	470	1.95

**Since the power dissipated by the filament is about 750 watts and since grid dissipation can, under some circumstances, represent another 25 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

Additional stem cooling air must be provided. 10 CFM of air directed against the center filament contact ¾″ below the outer filament contact ring by a 1½″ I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling.

Special Application — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Div., Eimac, A Division of Varian Associates Inc., 301 Industrial Way, San Carlos, Calif. for information and recommendations.

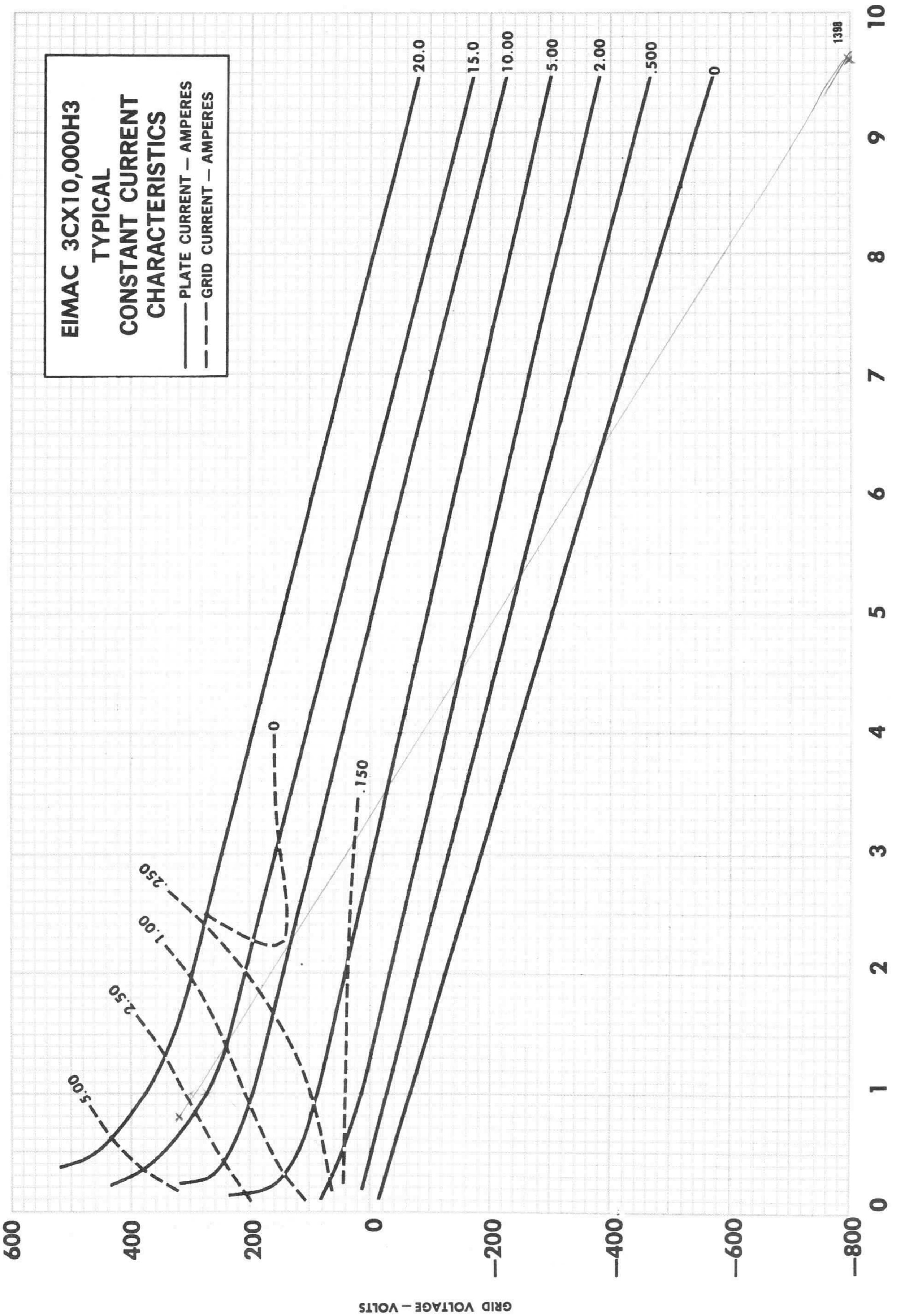


DIMENSION DATA			
DIM.	REF.	MIN.	MAX.
A		6.928	7.050
B		855	895
D	1.875		
E	3.250		
H		.530	.700
J	.125		
K		4.425	4.445
L		5.030	5.090
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.800	.860
T		.375	
V	.250		
Z	2.000		
AA		8.500	9.000
AD	.390		

NOTE: REF. DIMS. ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSP. PURPOSES.

ANODE

*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 3CX10,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
20.0
15.0
10.00
5.00
2.00
.500
0
5.00
2.50
1.00
.250
.150
0
1398
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE — KILOVOLTS
600
400
200
0
−200
−400
−600
−800
GRID VOLTAGE — VOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

3CX15,000A3
MEDIUM-MU
AIR-COOLED POWER TRIODE

The EIMAC 3CX15,000A3 is an air-cooled, ceramic/metal power triode designed primarily for use as a power oscillator in industrial radio frequency heating applications. It is also recommended for use as a grounded grid FM amplifier, as a conventional plate-modulated amplifier, or as a linear amplifier. The one kilowatt filament and rugged 500 watt grid structure make this tube especially suitable for heavy duty service.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated-Tungsten

Voltage	6.3V ±0.3	V
Current, at 6.3 volts	160	A
Amplification Factor	20	

Interelectrode Capacitance (Grounded Cathode)[2]

Grid-Filament	55	pF
Plate-Filament, max.	1.4	pF
Grid-Plate	34	pF
Frequency for Maximum Ratings	100	MHz

MECHANICAL

Dimensions

Height	8.5 in (216 mm)
Diameter	7.0 in (178 mm)
Net Weight	12 lb (5.54 kg)
Operating Position	Vertical, base up or down
Recommended Socket	EIMAC SK-1300
Recommended Chimney	EIMAC SK-1306

Maximum Operating Temperatures

Ceramic-to-Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced Air
Base	Coaxial

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. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values for a cold tube as measured in a special shielded fixture.

3. Adjust to give specified zero-signal DC plate current.

APPLICATION

FILAMENT - The rated filament voltage for the 3CX15,000A3 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at 6.3 volts plus or minus 0.3 volts for long tube life and consistent performance.

GRID OPERATION - A recommended maximum grid current is 1.0 Adc, This value should not be exceeded for more than very 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 A 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 absolute maximum grid dissipation rating is 500 watts.

PLATE OPERATION - Absolute maximum plate voltage rating of 8 kV and maximum plate current of 6.0 A should not be applied simultaneously as rated plate dissipation may be exceeded. When used as a plate modulated RF amplifier, absolute maximum input is reduced to 6500 V at 5.0 Adc. Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load 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 having wide variations in plate current loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

HIGH FREQUENCY OPERATION - The 3CX15,000-A3 is usable to 140 MHz. At this frequency, absolute maximum plate voltage must be reduced to 7000 Vdc A, B, or C service. For plate-modulated application at 140 MHz, absolute maximum plate voltage is reduced to 5500 Vdc.

COOLING - Forced-air cooling is required to adequately maintain the rated ceramic/metal seal and anode temperature at 250° C or below. The table lists minimum air-flow requirements to maintain tube temperatures at 225° C in 40° C ambient air using the EIMAC SK-1300 socket and SK-1306 chimney. Air-flow in the base-to-anode direction is recommended; reverse air-flow may be used, but users should contact the nearest Varian Field Office or EIMAC Division of Varian, San Carlos, California 94070, for specific recommendations.

MINIMUM AIR-FLOW REQUIREMENTS

*Plate Dissipation (kW)	Air-Flow (CFM)	Pressure Drop (Inches water)
5.0	85	0.2
7.5	195	0.7
10.0	360	2.0
12.5	590	4.9
15.0	970	10.5

*An additional 1500 watts has been included in preparing this tabulation to compensate for grid and filament power.

RF POWER AMPLIFIER OR OSILLATOR INDUSTRIAL

Class C Telegraphy or FM Telephony
(Key Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	V
DC PLATE CURRENT	6.0	A
PLATE DISSIPATION	15	kW
GRID DISSIPATION	500	W

TYPICAL OPERATING CONDITIONS

DC Plate Voltage	7000	Vdc
DC Plate Current	6.0	A
DC Grid Voltage	-600	Vdc
DC Grid Current	660	mAdc
Peak RF Grid Voltage	1040	V
Driving Power	660	W
Plate Input Power	42	kW
Plate Dissipation	12	kW
Plate Output Power	30	kW
Resonant Load Impedance	600	ohms

RF POWER AMPLIFIER PLATE-MODULATED

Class C

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	V
DC PLATE CURRENT	5.0	A
PLATE DISSIPATION	10	kW
GRID DISSIPATION	500	W

TYPICAL OPERATING CONDITIONS

DC Plate Voltage	5000	6000	Vdc
DC Plate Current	2.9	3.9	A
DC Grid Voltage	550	600	Vdc
DC Grid Current	450	520	mAdc
Driving Power	375	490	W
Plate Output Power	13.0	18.0	kW

RF LINEAR AMPLIFIER

Class AB or B

ABSOLUTE MAXIMUM RATINGS

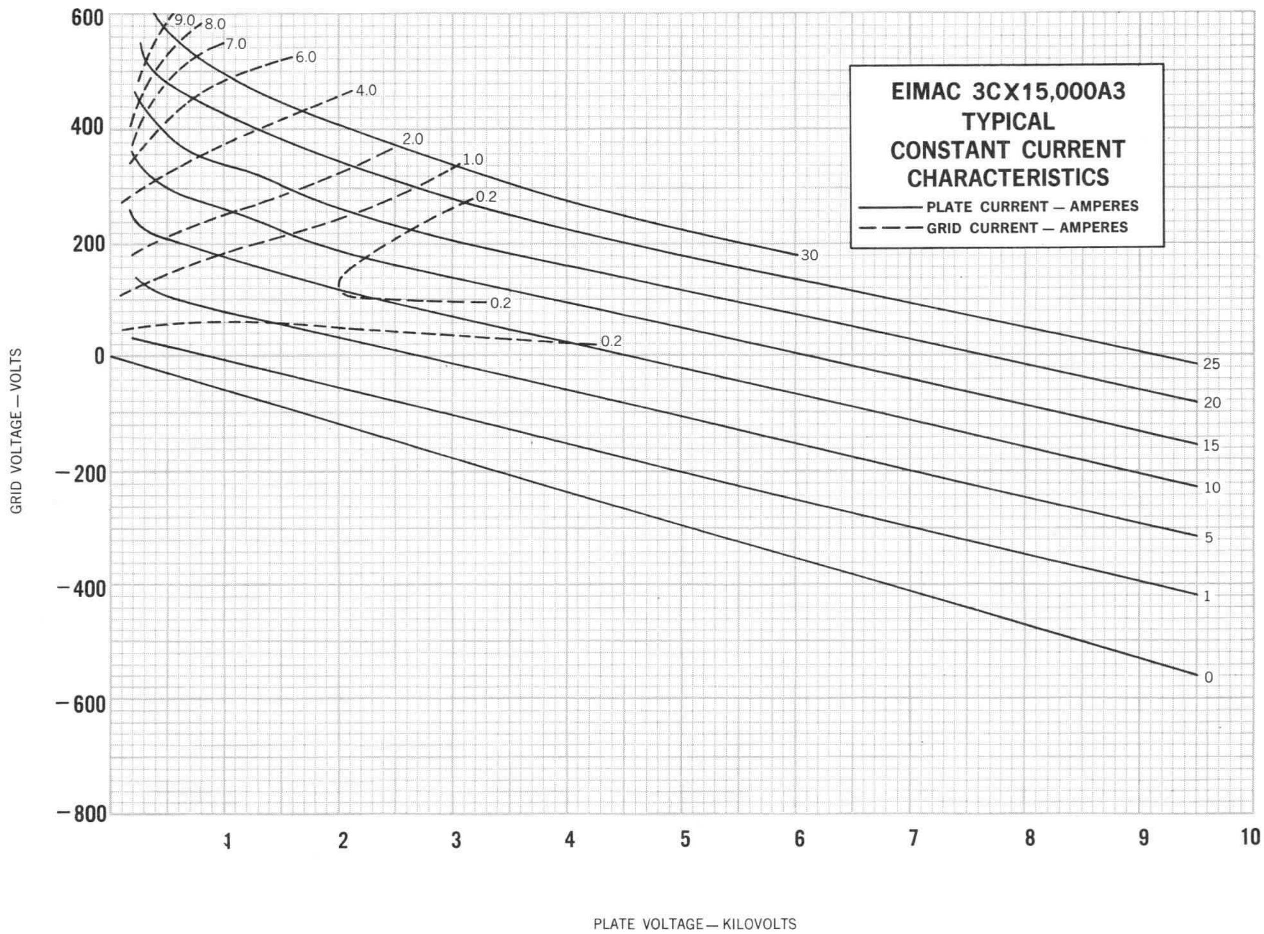
DC PLATE VOLTAGE	8000	V
DC PLATE CURRENT	6.0	A
PLATE DISSIPATION	15	kW
GRID DISSIPATION	500	W

TYPICAL OPERATING CONDITIONS
Class AB_2

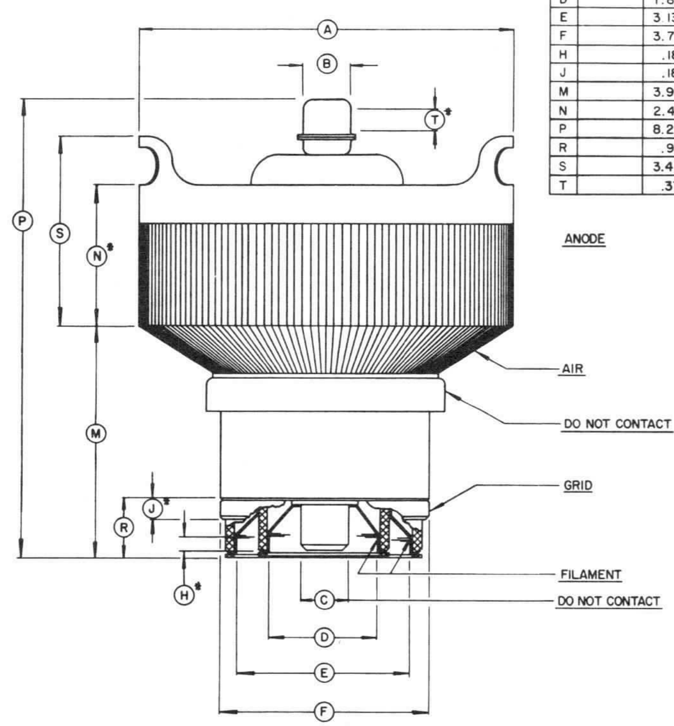
DC Plate Voltage	7000	Vdc
DC Grid Voltage	-270	Vdc
Zero-Sig Plate Current[3]	1.5	A
Max-Sig DC Plate Current	4.8	A
Max-Sig DC Grid Current	400	mAdc
Peak RF Grid Voltage	540	V
Driving Power	215	W
Plate Output Power	23	kW
Resonant Load Impedance	730	ohms

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current, at 6.3 volts	152	168	A
Interelectrode Capacitances[2]			
Grid-Filament	50	60	pF
Plate-Filament	1.3	1.6	pF
Grid-Plate	30	38	pF



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
H		.188	
J		.188	
M		3.950	4.300
N		2.412	2.788
P		8.250	8.750
R		.986	1.050
S		3.412	3.788
T		.375	



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES

3CX15,000A7

TECHNICAL DATA

HIGH-MU POWER TRIODE

The EIMAC 3CX15,000A7 is a ceramic/metal power triode intended for use as a zero-bias Class B rf amplifier or Class C power amplifier or oscillator. Class B operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3CX15,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor (Average):	200

Direct Interelectrode Capacitance (grounded cathode)[2]

Cin	56 pF
Cout	0.2 pF
Cgp	36 pF

Direct Interelectrode Capacitance (grounded grid)[2]

Cin	56 pF
Cout	36 pF
Cpk	0.2 pF

Frequency of Maximum Rating:

CW	110 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:

Length	8.75 in; 222.3 mm
Diameter	7.05 in; 179.1 mm
Net Weight	12 lb; 5.5 kg
Operating Position	Vertical base up or down

Maximum Operating Temperature:

Ceramic/Metal Seals	250°C
Anode Core	250°C

(Effective 4-15-71)

Printed in U.S.A.

Cooling	Forced air
Base	Coaxial
Recommended Air System Socket	SK-1300 or SK-1320
Recommended Air Chimney	SK-1306

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate values.

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB_2

Plate Voltage	7000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current[1]	.6	.6	Adc
Single-Tone Plate Current[2]	5.92	5.0	Adc
Single-Tone Grid Current[1]	1.22	1.0	Adc
Driving Power[1]	1750	1540	W
Plate Dissipation	13.4	10.8	kW
Single-Tone Plate Output Power	29.6	24.2	kW
Resonant Load Impedance	693	745	Ω
Drive Impedance	27	32	Ω

2. Adjust to obtain specified value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	15,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7000	Vdc
Grid Voltage	-230	Vdc
Plate Current	4.0	Adc
Grid Current[1]	775	mAdc
Peak rf Grid Voltage[1]	555	v
Calculated Driving Power[1]	430	W
Plate Input Power	28	kW
Plate Dissipation	6.7	kW
Plate Output Power	21.3	kW
Resonant Load Impedance	963	Ω

1. Approximate value.

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.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid)[1]			
Cin	50.0	62.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode)[1]			
Cin	50.0	62.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - The 3CX15,000A7 must be operated vertically, base up or down, and should be protected from severe shock and vibration. The use of an EIMAC air-system socket is recommended. For grid-driven applications, the SK-1300 is used; for cathode-driven circuits, the SK-1320 should be used, as the grid is grounded to the socket frame in this unit. The SK-1306 air chimney is designed to fit around the tube's anode cooler and mount with either socket.

COOLING - The maximum temperature rating for the external surfaces of the 3CX15,000A7 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the anode core and the ceramic/metal seals below 250°C. Tube life is usually prolonged if these areas are maintained at temperatures below the maximum rating. Minimum air flow requirements (for air flowing in a base-to-anode direction) to maintain anode core and seal temperatures below 225°C with an inlet-air temperature of 50°C are tabulated below. The use of these air-flow rates through the recommended socket/chimney combination will provide effective cooling of the tube. Air flow should be applied before or simultaneously with the application of electrode voltages (including the filament) and should normally be maintained for a short period of time after all voltages are removed to allow for tube cool-down.

	SEA LEVEL		10,000 FEET	
Anode Diss. (watts) *	Air Flow (cfm)	Approx.Press. drop (In.H_2O)	Air Flow (cfm)	Approx.Press. drop(In.H_2O)
5,000	242	0.8	350	1.3
7,500	325	1.7	470	2.4
10,000	475	2.8	690	4.1
12,500	640	4.3	930	6.3
15,000	840	6.2	1220	9.7

* Since the power dissipated by the filament is about 1000 watts, and since the grid dissipation can represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1500 watts of dissipation.

FILAMENT OPERATION - The rated filament voltage for the 3CX15,000A7 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INPUT CIRCUIT - When the 3CX15,000A7 is operated as a ground-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 two or more.

CLASS-C OPERATION - Although specifically designed for Class-B service, the 3CX15,000A7 may be operated as a Class-C power amplifier or oscillator. The zero-bias characteristic of the 3CX15,000A7 can be used to advantage in Class-C amplifiers by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

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.

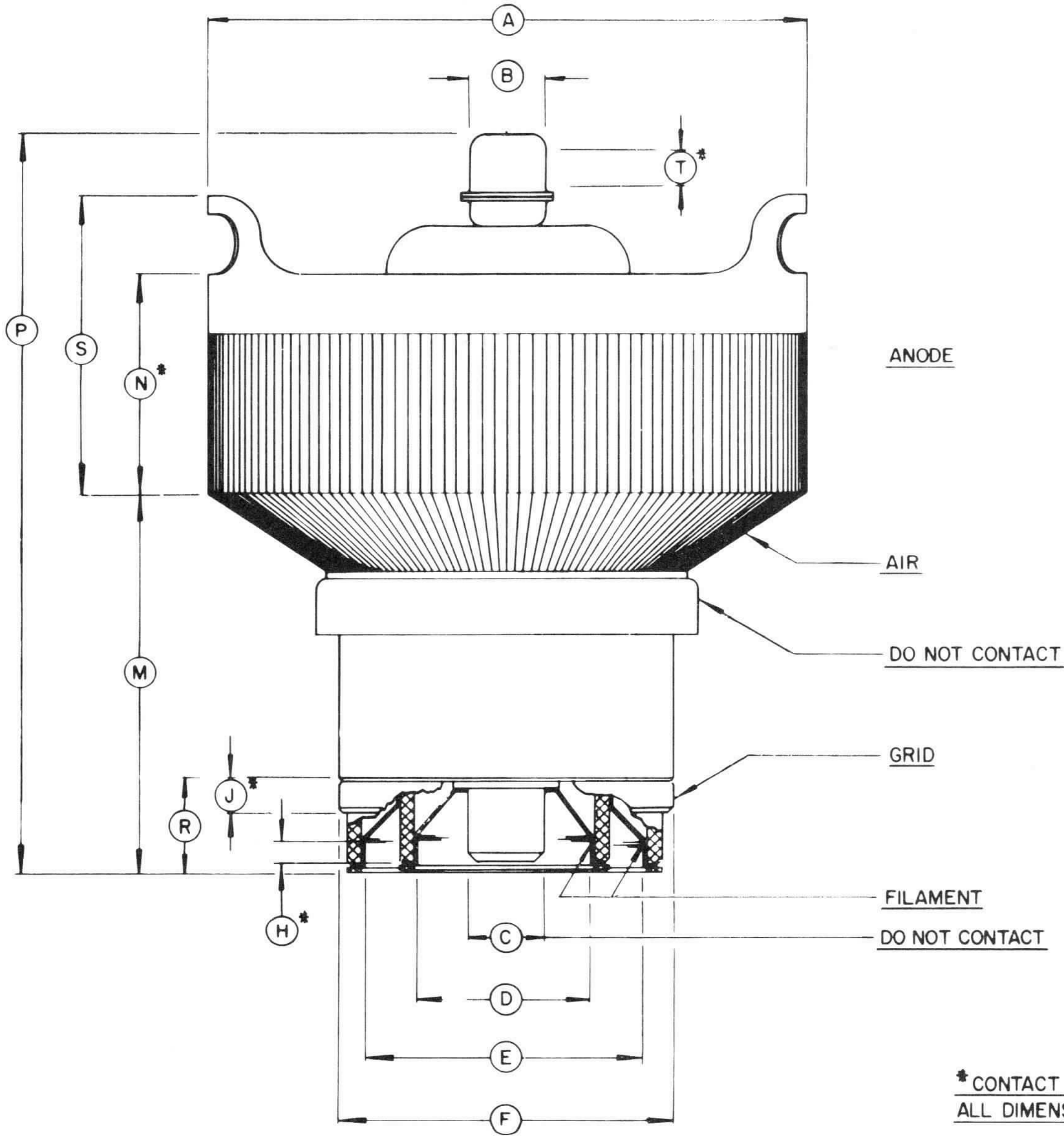
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 3CX15,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies 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.

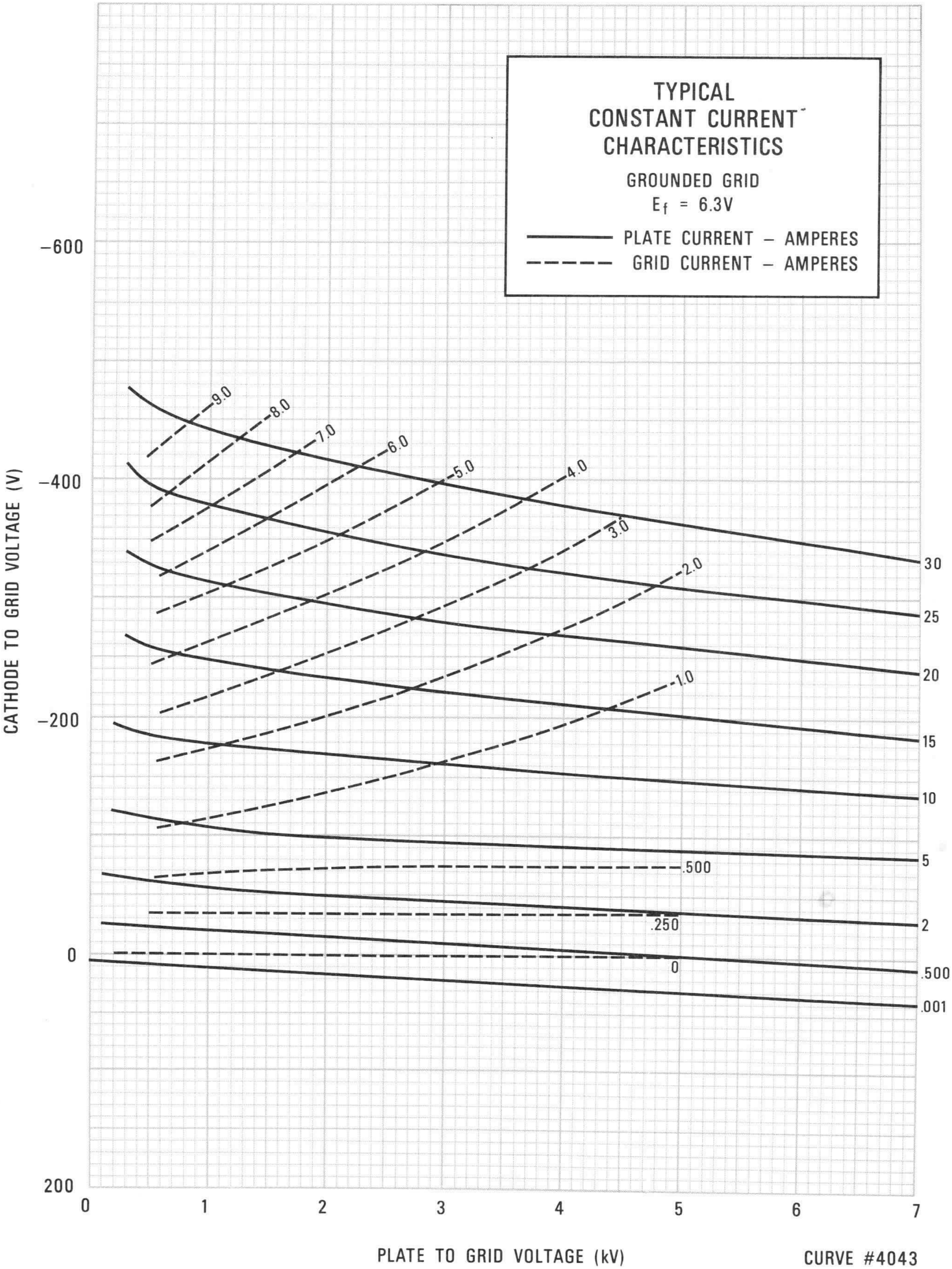
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

3CX15,000A7

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.928	7.050	- -	175.97	179.07	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	98.86	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
M	3.950	4.300	- -	100.33	109.22	- -
N	2.412	2.788	- -	61.26	70.82	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.22	- -
T	0.375	- -	- -	9.53	- -	- -



*CONTACT SURFACE
ALL DIMENSIONS IN INCHES


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED GRID
E_f = 6.3V
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CATHODE TO GRID VOLTAGE (V)
-600
-400
-200
0
200
PLATE TO GRID VOLTAGE (kV)
0
1
2
3
4
5
6
7
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
30
25
20
15
10
5
2
.500
.001

CURVE #4043

3CX15,000H3

INDUSTRIAL
MEDIUM-MU
AIR-COOLED
POWER TRIODE

TECHNICAL DATA

The EIMAC 3CX15,000H3 is an air-cooled, ceramic-metal power triode designed primarily for use in industrial radio-frequency heating services. Its air- cooled anode is rated at 15 kilowatts of plate dissipation.

Full ratings apply up to 90 megacycles. Plentiful reserve emission is available from its one kilowatt filament. The grid structure is rated at 500 watts making this tube an excellent choice for severe application.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated-Tungsten				
Voltage		6.3		Volts
Current	152		172	amps
Amplification Factor		20		
Interelectrode Capacitances, Grounded Cathode Connection:				
Grid-Filament	50		60	$\mu\mu$f
Plate-Filament	1.3		1.6	$\mu\mu$f
Grid-Plate	30		38	$\mu\mu$f
Frequency for Maximum Ratings			90	MHz

MECHANICAL

Base	See Outline
Operating Position	Vertical, base up or down
Cooling	Forced Air
Maximum Operating Temperatures	250°C
Maximum Dimensions:	
Height	See Outline
Diameter	See Outline
Net Weight	13 Pounds

THESE SPECIFICATIONS ARE BASED ON DATA APPLICABLE AT PRINTING DATE. SINCE EIMAC HAS A POLICY OF CONTINUING PRODUCT IMPROVEMENT, SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Printed in U.S.A.

RF INDUSTRIAL OSCILLATOR

Class-C (Filtered DC Power Supply)

MAXIMUM RATINGS:

DC PLATE VOLTAGE - - - - - -	12,000 Volts
DC PLATE CURRENT - - - - - -	6.0 Amps
DC GRID VOLTAGE - - - - - -	—1000 Volts
DC GRID CURRENT - - - - - -	1.0 Amps
PLATE INPUT POWER - - - -	60 kW
PLATE DISSIPATION - - - - - -	15 kW

TYPICAL OPERATION*

DC Plate Voltage - - - - -	7000	10,000	Volts
DC Plate Current - - - - -	6.0	5.0	Amps
DC Grid Voltage - - - - -	—600	—800	Volts
DC Grid Current - - - - -	660	542	mA
Peak Positive Grid Voltage - -	440	400	Volts
Driving Power - - - - - -	660	650	Watts
Plate Input Power - - - -	42	50	kW
Plate Dissipation - - - - -	12	8.8	kW
Plate Output Power - - - -	30	41.2	kW
Approximate Load Impedance -	600	1025	Ohms

*Loaded Conditions

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

ELECTRICAL

Filament

For the 3CX15,000H3 the rated filament voltage is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at 6.3 volts plus or minus five percent for long tube life and consistent performance. Maximum life will be obtained by operation at minus 5 percent.

Control Grid Operation

The grid current rating is one ampere dc. This value should not be exceeded for more than very short periods such as during tuning. Overcurrent 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 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

Maximum plate voltage rating of 12,000 volts and maximum plate current of 6.0 amps should not be applied simultaneously as rated plate dissipation may be exceeded.

Plate over-current protection should be provided to remove plate voltage quickly in the event of an over-load 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 variations in loading.

Spark gaps from plate to ground should be used to prevent transient voltages from flashing across the tube envelope during any fault conditions.

MECHANICAL

Mounting

The 3CX15,000H3 must be mounted vertically, either base up or down. A grid contact flange is provided for bolting to a strap or a grid deck. Heavy flexible leads are provided for applying the filament voltage.

Cooling

The maximum temperature rating for the 3CX15,000H3 is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megacycles.)

MINIMUM AIR FLOW REQUIREMENTS (Anode-to-Base Air Flow)

	Sea Level		5000 Feet	
Plate* Dissipation watts	Air Flow CFM	Pressure Drop inches water	Air Flow CFM	Pressure Drop inches water
7500	361	1.63	433	1.96
10,000	606	3.26	728	3.92
15,000	1260	10.00	1510	12.00

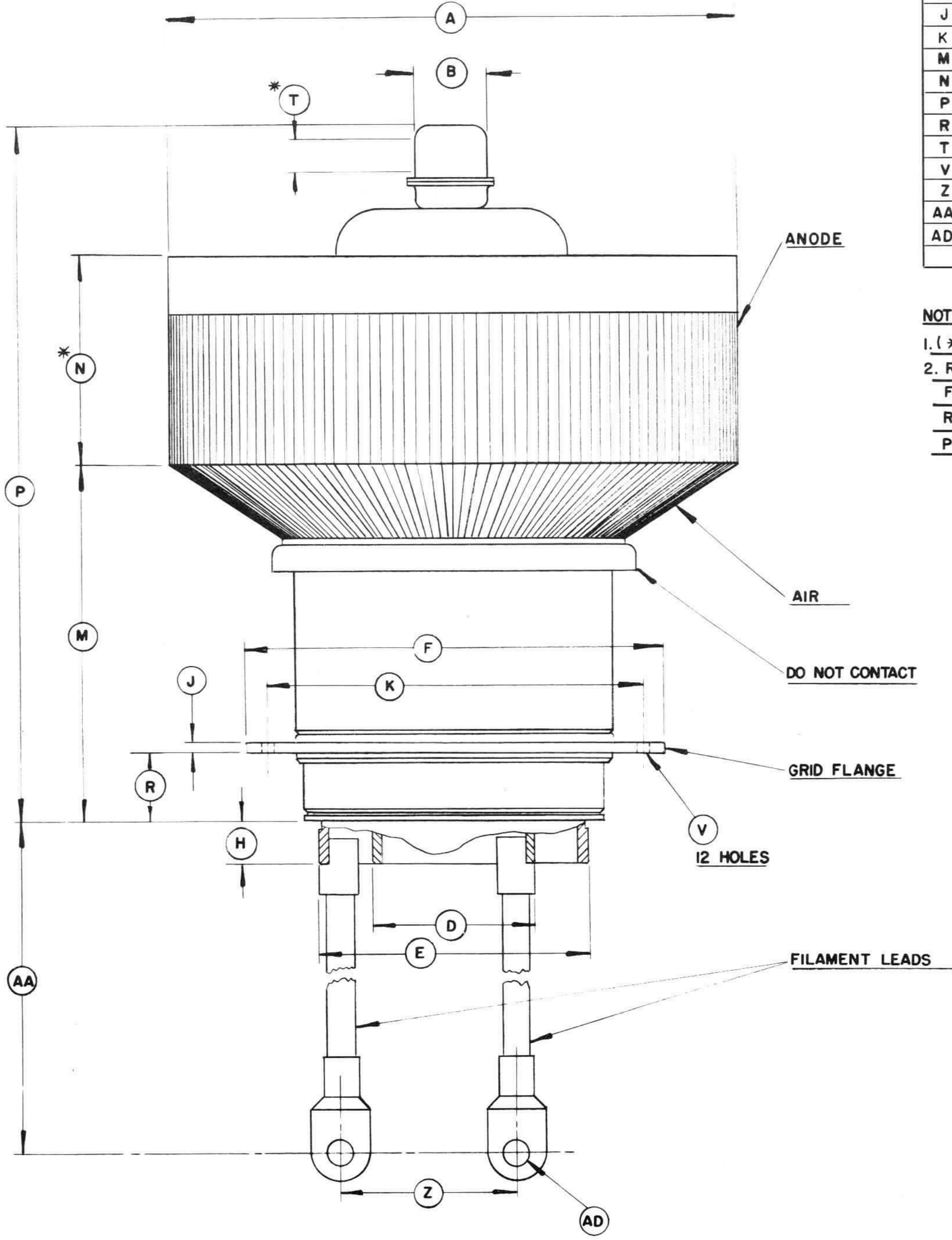
*Since the power dissipated by the filament represents about 1100 watts and since grid dissipation can, under some conditions represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1600 watts.

Additional stem cooling air must be provided. 16 CFM of air directed against the center filament contact ring ½" below the outer filament contact ring by a 1½" I.D. air duct arranged at a 45° angle with the center line of the tube will provide adequate cooling for maximum frequency of 30 MHz, 50°C ambient, and 5000 ft. altitude.

Special Application

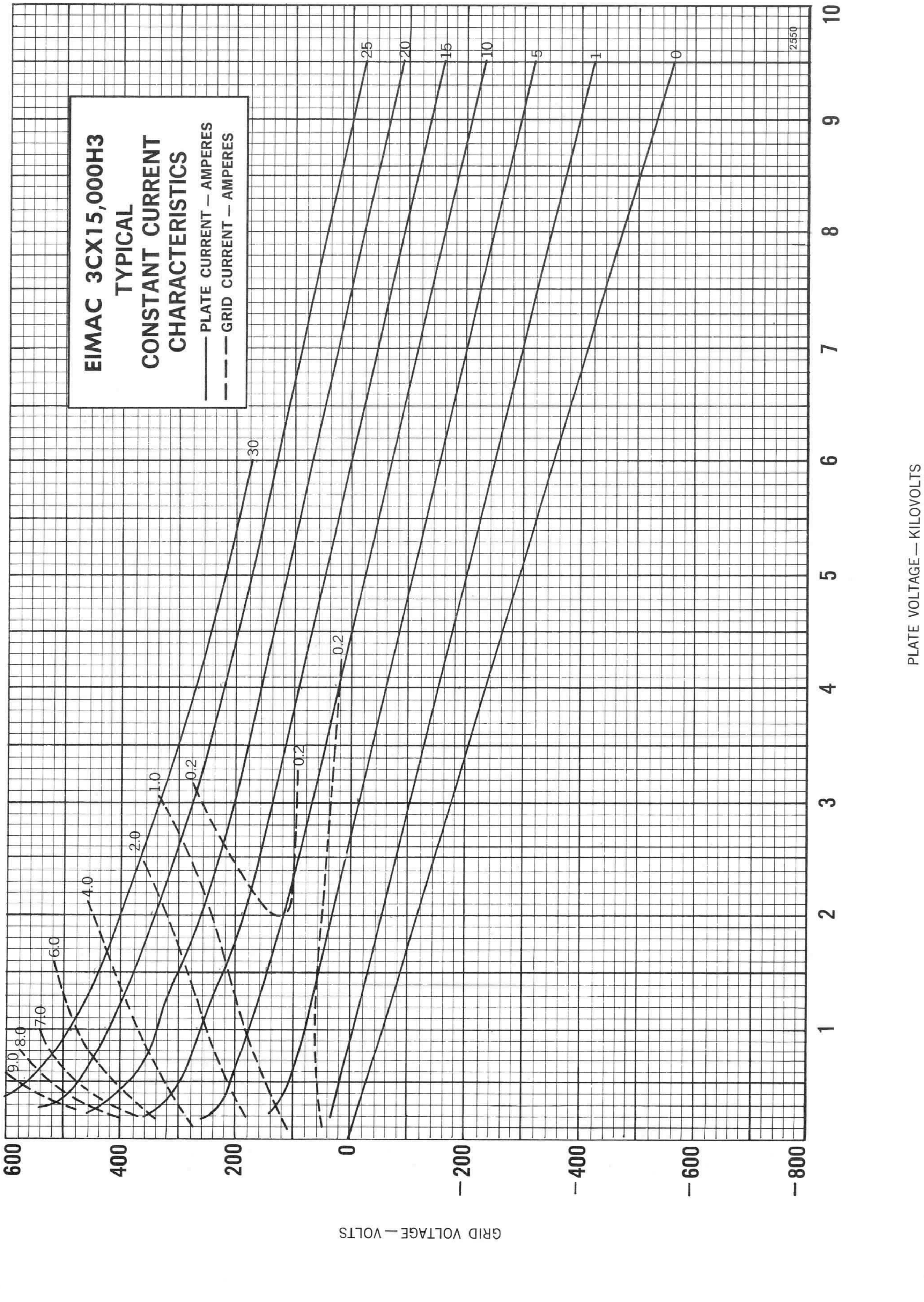
If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Product Manager, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	6.928	7.050	
B	.855	.895	
D			1.875
E	3.230	3.270	3.250
F	5.030	5.090	
H	.530	.700	
J			.125
K	4.425	4.445	
M	3.950	4.300	
N	2.412	2.788	
P	8.250	8.750	
R	.700	.860	
T	.375		
V			.250
Z			2.000
AA	8.500	9.000	
AD			.390



NOTES:

1. (✱) CONTACT SURFACE
2. REFERENCE DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


EIMAC 3CX15,000H3
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
PLATE VOLTAGE — KILOVOLTS
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600
−800
1
2
3
4
5
6
7
8
9
10
30
25
20
15
10
5
1
0
9.0
8.0
7.0
6.0
4.0
2.0
1.0
0.2
0.2
0.2
2550

3CX20,000A3

TECHNICAL DATA

MEDIUM-MU
INDUSTRIAL
TRIODE

The EIMAC 3CX20,000A3 is a ceramic insulated power triode for industrial oscillator or general communications service. It is recommended for Class C amplifier service, or Class B radio frequency and audio frequency amplifier use.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	10.0 ± 0.5 V
Current, at 10.0 volts	160 A

Direct Interelectrode Capacitance (grounded cathode)[2]

Cin	70.0 pF
Cout	2.3 pF
Cgp	43.0 pF

Frequency of Maximum Rating:

CW	90 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:

Length	10.00 in; 254.0 mm
Diameter	8.00 in; 203.0 mm
Net Weight	19.5 lb; 8.8 kg
Operating Position	Vertical

Maximum Operating Temperature:

Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced air
Base	Coaxial
Recommended Air System Socket	SK-1300

(Effective 4-15-71)

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB or B

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	8.0	AMPERES
PLATE DISSIPATION	20.0	KILOWATTS
GRID DISSIPATION	750	WATTS

TYPICAL OPERATION Class AB_2, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	6500	7500	Vdc
Grid Voltage[1]	-320	-380	Vdc
Zero-Signal Plate Current	1.0	1.0	Adc
Single-Tone Plate Current	6.0	7.4	Adc
Single-Tone Grid Current[2]	460	630	mAdc
Peak rf Grid Voltage[2]	545	640	v
Driving Power	520	400	W
Plate Dissipation	11.5	15.1	kW
Single-Tone Plate Output Power	27.5	40.0	kW
Resonant Load Impedance	580	570	Ω

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

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy, Industrial Oscillator (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	12,000	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC GRID CURRENT	1.5	AMPERES
DC PLATE CURRENT	8.0	AMPERES
PLATE DISSIPATION	20.0	KILOWATTS
GRID DISSIPATION	750	WATTS

TYPICAL OPERATION

Plate Voltage	7500	10,000	Vdc
Grid Voltage	-800	-900	Vdc
Plate Current	8.0	7.9	Adc
Grid Resistor	575	1180	Ω
Grid Current[1]	1.4	.75	Adc
Peak rf Grid Voltage[1]	1200	1270	v
Calculated Driving Power[1]	1670	960	W
Plate Input Power	60.0	78	kW
Plate Dissipation	9.0	14	kW
Plate Output Power	51.0	64	kW
Resonant Load Impedance	480.0	640	Ω

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	VOLTS
DC PLATE CURRENT	5.5	AMPERES
PLATE DISSIPATION[1]	13.0	KILOWATTS
GRID DISSIPATION[2]	750	WATTS

1. Corresponds to 20 kW at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION

Plate Voltage	6500	Vdc
Grid Voltage	-1300	Vdc
Plate Current	5.0	Adc
Grid Current[1]	900	mAdc
Peak rf Grid Voltage[1]	1660	v
Calculated Driving Power	1500	W
Plate Input Power	32.5	kW
Plate Dissipation	5.0	kW
Plate Output Power	27.5	kW
Resonant Load Impedance	610	Ω

1. Approximate value.

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

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	8.0	AMPERES
PLATE DISSIPATION	20.0	KILOWATTS
GRID DISSIPATION	750	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	7500	Vdc
Grid Voltage[1/3]	-380	Vdc
Zero-Signal Plate Current	2.0	Adc
Max. Signal Plate Current	14.8	Adc
Max. Signal Grid Current[1]	1.26	Adc
Peak af Grid Voltage[2]	640	v
Driving Power	800	W
Max. Signal Plate Dissipation	30.2	kW
Plate Output Power	80.0	kW
Load Resistance (plate to plate)	1140	Ω

1. Approximate value.
2. Per Tube.
3. Adjust to give stated zero-signal plate current.

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

Heater: Current at 10.0 volts	152	168	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	65.0	75.0	pF
Cout	2.00	2.60	pF
Cgp	38.0	48.0	pF

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

APPLICATION

MECHANICAL

COOLING - The maximum temperature rating for the external surfaces of the 3CX20,000A3 is 250°C. Sufficient forced-air flow must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air flow requirements to maintain core temperature at 225°C in 50°C ambient air are tabulated below. These data are for air flowing in the base-to-anode direction, and the pressure drop figures shown are for the tube/socket/chimney combination.

BASE-TO-ANODE AIR FLOW				
	Sea Level		10,000 Feet	
Plate * Dissipation (watts)	Air Flow (CFM)	Pressure Drop In. H_2O	Air Flow (CFM)	Pressure Drop In. H_2O
10,000	320	1.0	464	1.6
15,000	625	3.0	910	4.4
20,000	1010	6.0	1475	8.7

* Since the power dissipated by the filament represents about 1680 watts and since the grid dissipation can, under some conditions, represent another 750 watts, allowance has been made in preparing this tabulation for an additional 2430 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures, the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT/CATHODE OPERATION - The filament voltage should be maintained within 5% of the nominal 10.0 V value, and for consistent tube life even closer control is advised. For most services the filament voltage may be less than the nominal 10.0 V for extended life. The exact value about which to control should be determined by experiment in any given service.

GRID OPERATION - The grid dissipation rating of 750 watts must not be exceeded. For the convenience of industrial heating operators a maximum grid current of 1.5 amperes is specified. This provides reasonable assurance that the 750 watt rating is not exceeded.

PLATE OPERATION - Allowable anode dissipation depends on provision of sufficient cooling air for the temperature and altitude environment. Anode dissipation will vary widely with load changes in industrial heating service. It is important that the power level be adjusted so that under no condition of the load cycle does the anode dissipation exceed the level established by the available cooling air. When power tubes are operated in parallel, provision should be made to meter plate and grid currents individually. It is good practice also to provide separate plate current or cathode current overload relays when tubes are operated in parallel.

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 the 3CX-20,000A3, 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.

HIGH VOLTAGE - Normal operating voltages used with the 3CX20,000A3 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 circuitx 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.

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 3CX20,000A3, 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.

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.

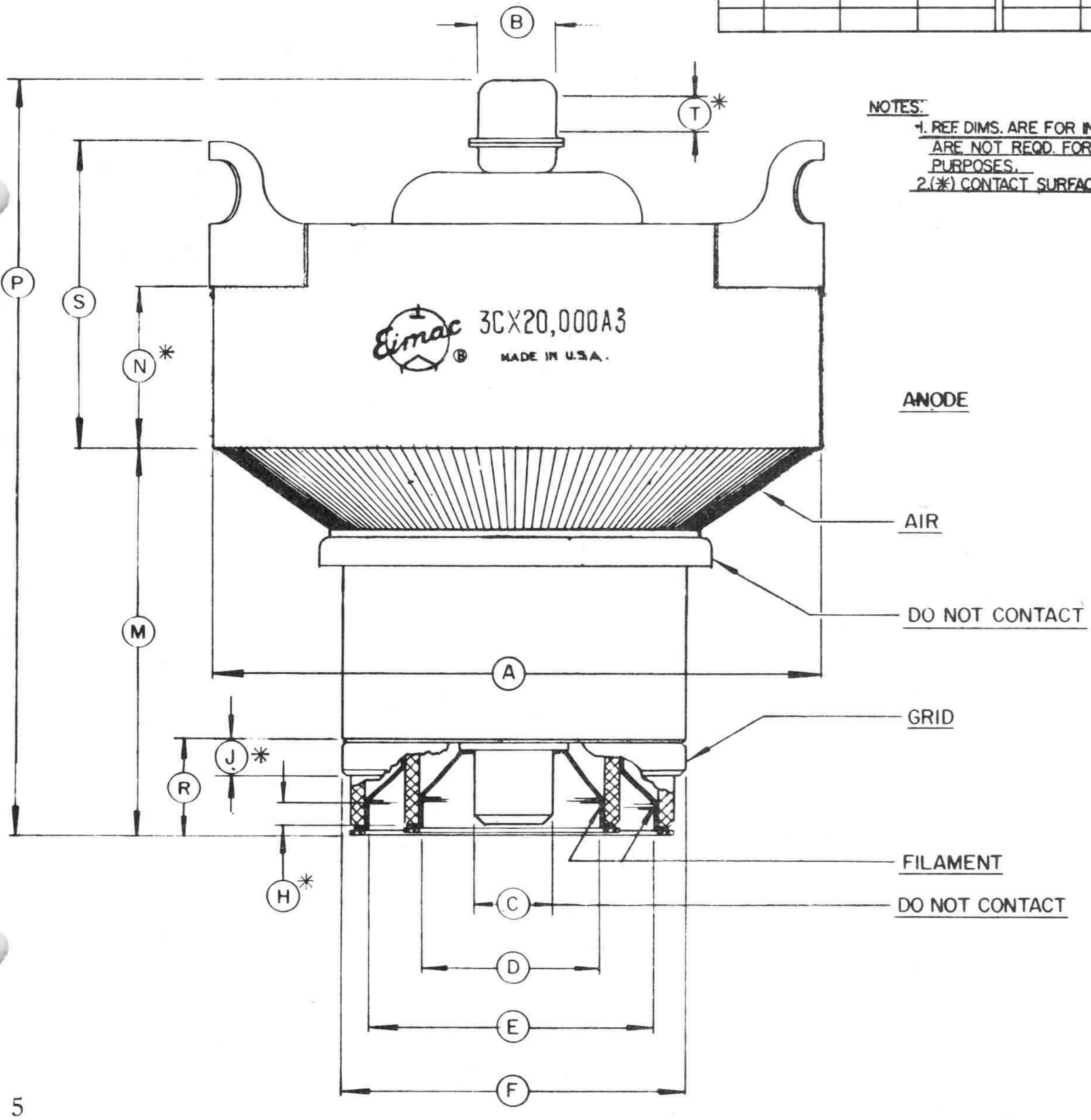
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

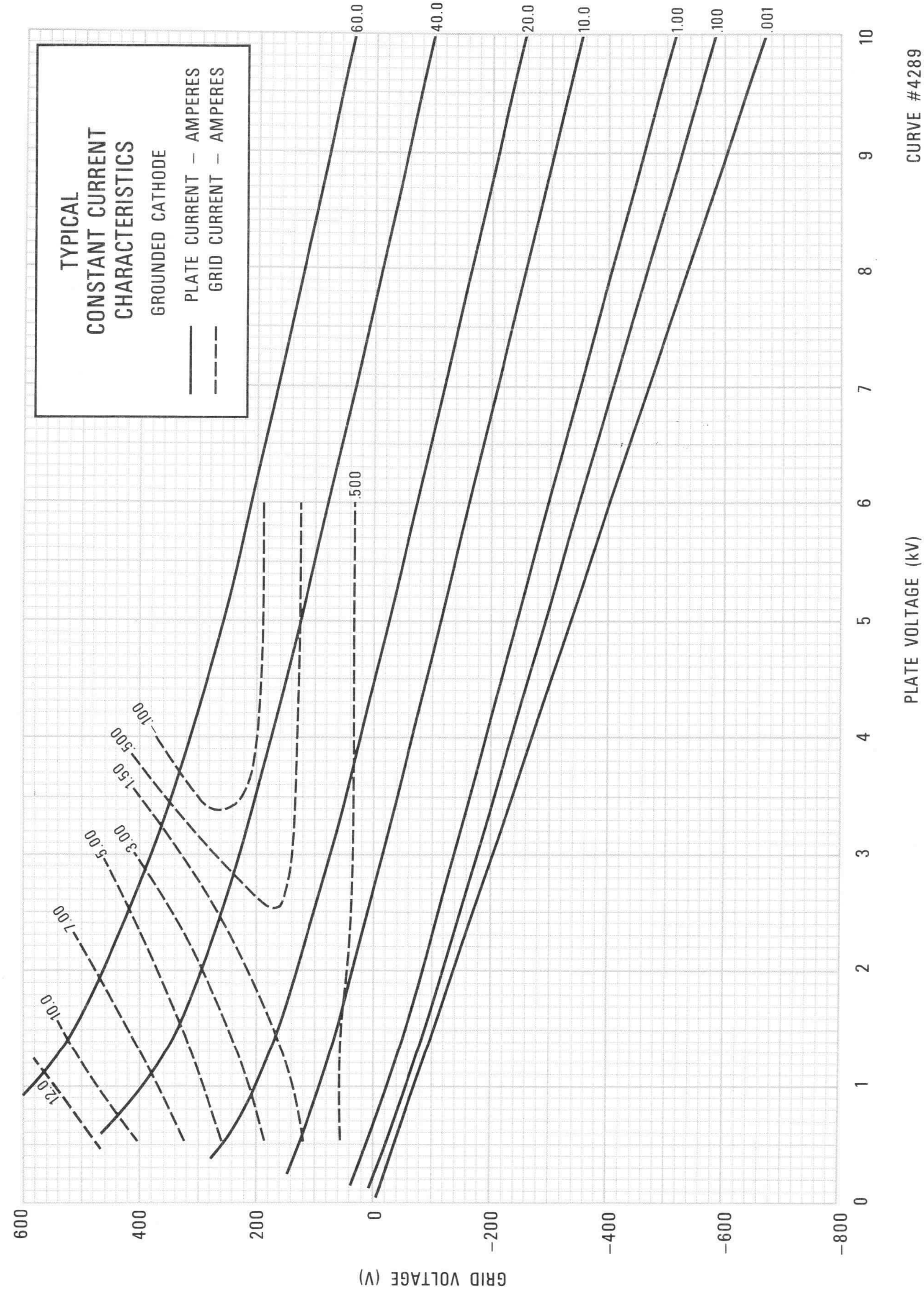
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	8.000	- -	- -	204.00
B	0.855	0.895	- -	21.70	22.70	- -
C	0.720	0.760	- -	18.30	19.30	- -
D	1.896	1.936	- -	- -	- -	98.67
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	3.800	4.150	- -	96.50	105.00	- -
N	- -	- -	3.200	- -	- -	81.28
P	- -	- -	10.000	- -	- -	254.00
R	0.986	1.050	- -	25.10	26.70	- -
S	- -	- -	5.000	- -	- -	127.00
T	0.375	- -	- -	9.50	- -	- -

NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
60.0
40.0
20.0
10.0
1.00
.100
.001
.500
12.0
10.0
7.00
5.00
3.00
1.50
.500
.100
PLATE VOLTAGE (kV)
0
1
2
3
4
5
6
7
8
9
10
CURVE #4289
GRID VOLTAGE (V)
600
400
200
0
-200
-400
-600
-800

3CX20,000A7

TECHNICAL DATA

HIGH-MU
POWER TRIODE

The EIMAC 3CX20,000A7 is a ceramic/metal power triode intended for use as a zero-bias Class B rf amplifier or Class C power amplifier or oscillator. Class B operation with zero grid bias offers circuit simplicity by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 3CX20,000A7.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	6.3 ± 0.3	V
Current, at 6.3 volts	160	A
Amplification Factor (Average):	200	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	61.0	pF
Cout	0.2	pF
Cgp	36	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	61.0	pF
Cout	36	pF
Cpk	0.2	pF
Frequency of Maximum Rating:		
CW	110	MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:	
Length	8.50 in; 215.9 mm
Diameter	8.25 in; 209.6 mm
Net Weight	13.5 lb; 6.15 kg
Operating Position	Vertical base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C

Cooling	Forced air
Base	Coaxial
Recommended Air System Socket	SK-1300 or SK-1320

RADIO FREQUENCY LINEAR AMPLIFIER
CATHODE DRIVEN
Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate values.
2. Adjust to obtain specified value.

TYPICAL OPERATION (Frequencies to 110 MHz)
Class AB_2

Plate Voltage	7000	7000	Vdc
Grid Voltage	0	0	Vdc
Zero-Signal Plate Current[1]	.6	.6	Adc
Single-Tone Plate Current[2]	5.92	5.0	Adc
Single-Tone Grid Current[1]	1.22	1.0	Adc
Driving Power[1]	1750	1540	W
Plate Dissipation	13.4	10.8	kW
Single-Tone Plate Output Power	29.6	24.2	kW
Resonant Load Impedance	693	745	Ω
Drive Impedance	27	32	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM
Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7000	Vdc
Grid Voltage	-230	Vdc
Plate Current	4.0	Adc
Grid Current[1]	775	mAdc
Peak rf Grid Voltage[1]	555	v
Calculated Driving Power[1]	430	W
Plate Input Power	28	kW
Plate Dissipation	6.7	kW
Plate Output Power	21.3	kW
Resonant Load Impedance	963	Ω

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER
Class C Cathode Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	8000	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	5.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION

Plate Voltage	7200	7800	Vdc
Grid to Cathode Voltage	-200	-200	Vdc
Plate Current	3.7	4.2	Adc
Grid Current[1]	92	98	mAdc
Peak rf Cathode Voltage[1]	480	500	v
Cathode Driving Power[1]	1900	2300	W
Plate Dissipation	4500	5000	kW
Plate Load Resistance	1080	1020	Ω
Plate Output Power	22.0	27.5	kW

1. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER
Class B Television Service, Cathode Driven

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	8000	VOLTS
DC PLATE CURRENT	6.0	AMPERES
PLATE DISSIPATION	20,000	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 216 MHz)
Class B

Plate Voltage	7200	Vdc
Grid Voltage	0	Vdc
Zero Signal Plate Current[1]	1.2	Adc
Effective rf Load Resistance	605	Ω
Plate Current: Blanking Level	4.8	Adc
Sync. Peak Level	5.8	Adc
Grid Current: Blanking Level[1]	0.47	Adc
Sync. Peak Level[1]	1.14	Adc
rf Cathode Voltage Peak:		
Blanking Level[1]	230	v
Sync. Peak Level[1]	300	v
Driving Power: Blanking Level[1]	690	w
Sync. Peak Level[1]	1700	w
Plate Power Output: Blanking Level	16.5	kw
Sync. Peak Level	27.5	kw

1. Approximate value.

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.	
Heater: Current at 6.3 volts	152	168	A
Cathode Warmup Time	5.0	---	sec.
Interelectrode Capacitances (grounded grid) [1]			
Cin	55.0	67.0	pF
Cout	32.0	40.0	pF
Cpk	---	0.3	pF
Interelectrode Capacitances (grounded cathode) [1]			
Cin	55.0	67.0	pF
Cout	---	0.3	pF
Cgp	32.0	40.0	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MOUNTING & SOCKETING - The 3CX20,000A7 must be operated vertically, base up or down, and should be protected from severe shock and vibration. The use of an EIMAC air-system socket is recommended. For grid-driven applications, the SK-1300 is used; for cathode-driven circuits, the SK-1320 should be used, as the grid is grounded to the socket frame in this unit.

COOLING - The maximum temperature rating for the external surfaces of the 3CX20,000A7 is 250°C. Sufficient forced-air cooling must be provided to maintain the temperature of the anode core and the ceramic/metal seals below the maximum rating. Air flow should be applied before or simultaneously with the application of electrode voltages (including the filament) and should normally be maintained for a short period of time after all voltages are removed to allow for tube cool-down.

Minimum air flow requirements (for air flowing in a base to anode direction) to maintain core and seal temperatures below 225°C with an inlet temperature of 50°C are tabulated here. Pressure drop for this tabulation is measured across the anode cooler and does not include drop across a socket or chimney. In cases where the tube base is not directly in the anode cooling air stream, provision should be made to direct an air stream of at least 50 CFM at the base from a 1-1/2 inch nozzle, or make other provision to conduct heat from the filament and grid terminals.

Anode Dissipation * kW	Sea Level		10,000 Feet Alt.	
	Air Flow CFM	Pressure Drop In. Water	Air Flow CFM	Pressure Drop In. Water
7.5	122	.25	203	.45
10.0	241	.70	350	1.00
12.5	400	1.40	580	2.25
15.0	590	2.45	940	3.90
17.5	840	4.25	1320	6.70
20.0	1180	6.90	1710	10.00

* Since the power dissipated by the filament is about 1000 watts, and since the grid dissipation can represent another 500 watts, allowance has been made in preparing this tabulation for an additional 1500 watts of dissipation.

FILAMENT OPERATION - The rated filament voltage for the 3CX20,000A7 is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate from the rated value by more than plus or minus five percent.

INPUT CIRCUIT - When the 3CX20,000A7 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 two or more.

CLASS-C OPERATION - Although specifically designed for Class-B service, the 3CX20,000A7 may be operated as a Class-C power amplifier or oscillator. The zero-bias characteristic of the 3CX20,000A7 can be used to advantage in Class-C amplifiers by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

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.

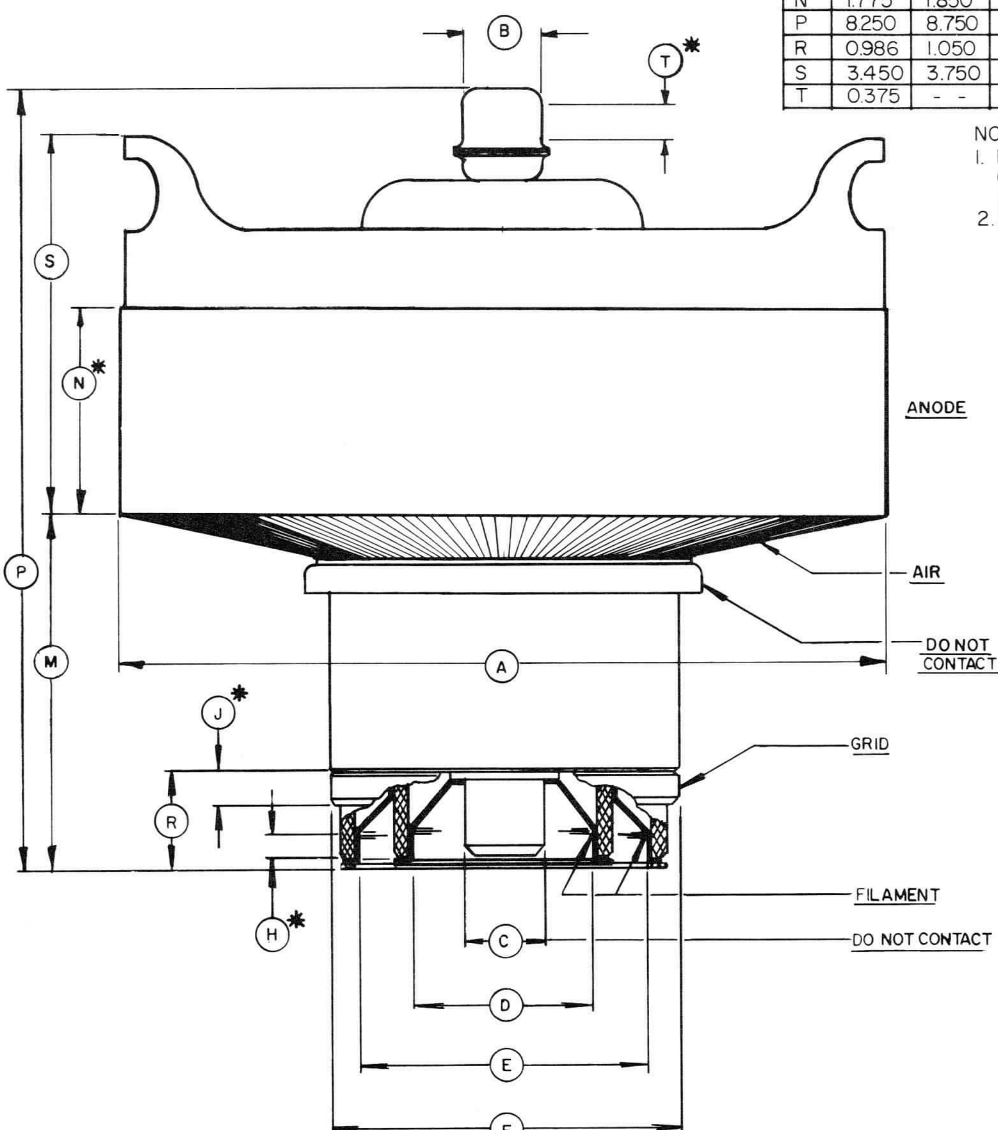
HIGH VOLTAGE - The 3CX20,000A7 operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies 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.

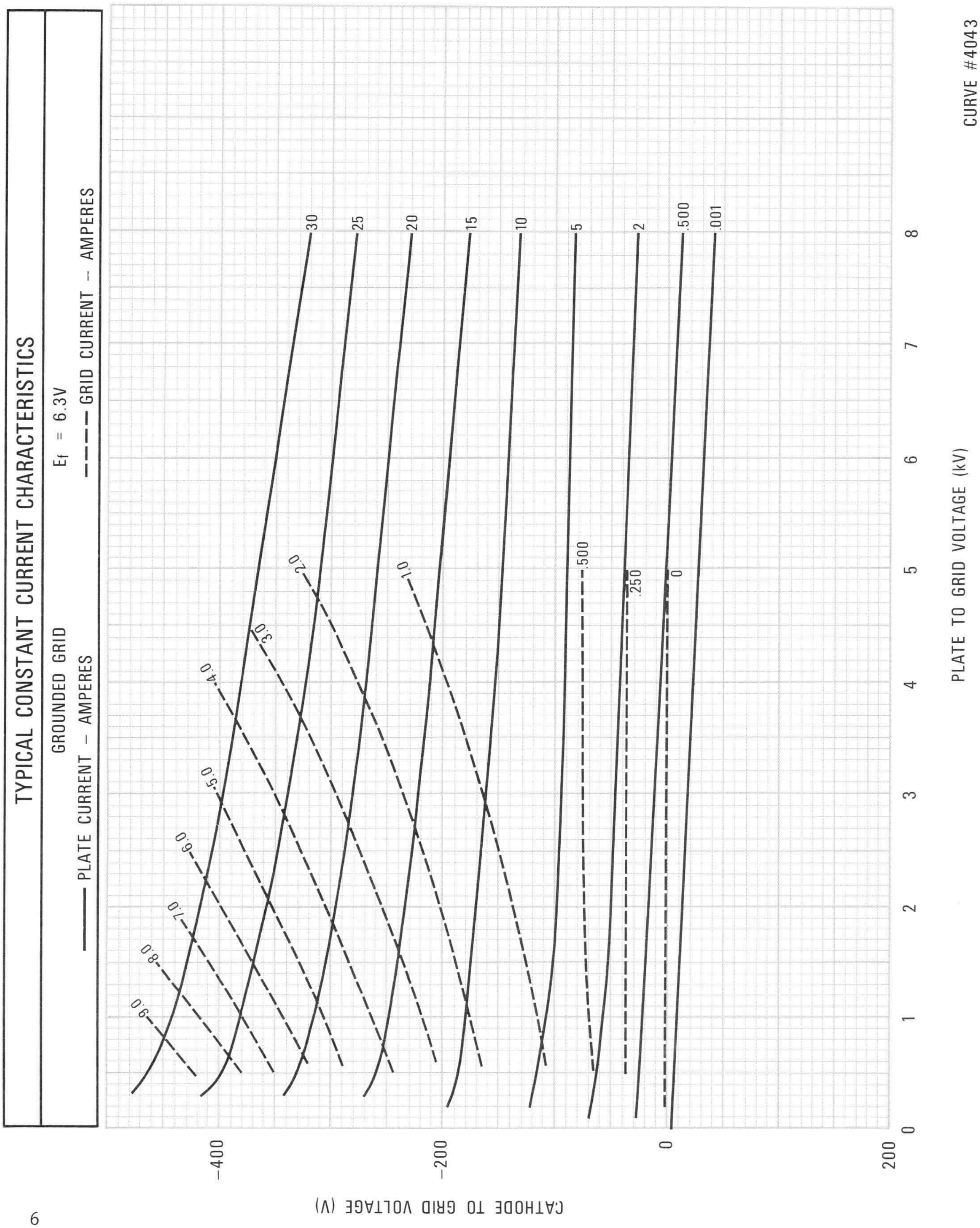
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

DIM	INCHES MIN.	INCHES MAX.	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF.
A	8.190	8.310	- -	208.03	211.07	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
M	4.125	4.375	- -	104.77	111.12	- -
N	1.775	1.850	- -	45.08	46.99	- -
P	8.250	8.750	- -	209.55	222.25	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.450	3.750	- -	87.63	95.25	- -
T	0.375	- -	- -	9.52	- -	- -

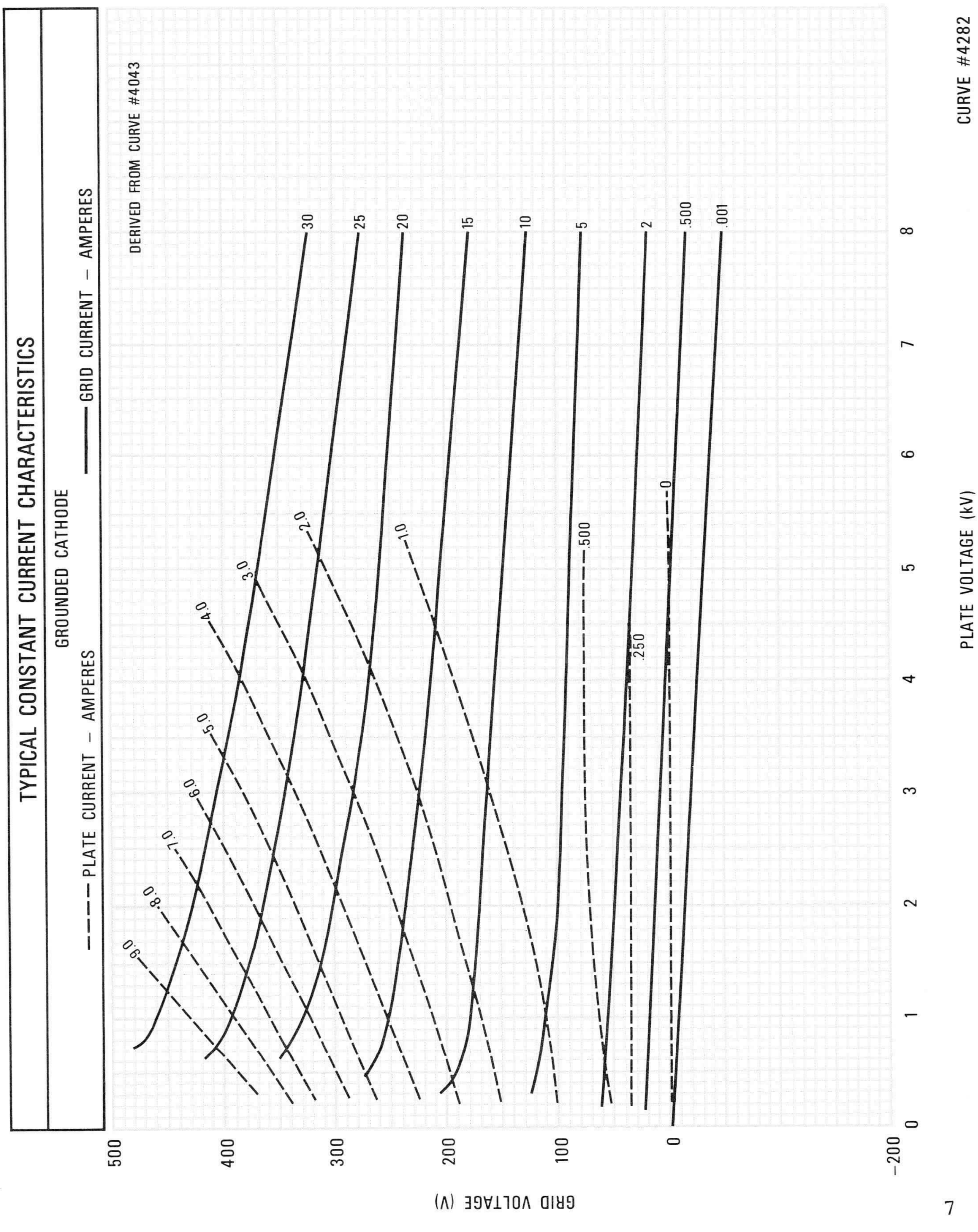
DIMENSIONAL DATA

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (✱) CONTACT SURFACES





TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
E_f = 6.3V
PLATE CURRENT - AMPERES
GRID CURRENT -- AMPERES
30
25
20
15
10
5
2
.500
.001
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
PLATE TO GRID VOLTAGE (kV)
0
1
2
3
4
5
6
7
8
CATHODE TO GRID VOLTAGE (V)
-400
-200
0
200
CURVE #4043



TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
DERIVED FROM CURVE #4043
30
25
20
15
10
5
2
.500
.001
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.250
0
500
400
300
200
100
0
–200
GRID VOLTAGE (V)
0
1
2
3
4
5
6
7
8
PLATE VOLTAGE (kV)
CURVE #4282

3CX20,000H3

TECHNICAL DATA

MEDIUM-MU
INDUSTRIAL TRIODE

The 3CX20,000H3 is a ceramic insulated medium-mu power triode with terminals arranged for direct mounting in industrial heating equipment without the use of a socket. The 3CX20,000H3 is recommended for use as an industrial oscillator in the LF to lower VHF range (30 KHz to 90 MHz). This triode is also recommended for the AM broadcast service as a modulator, modulated rf stage, or as a linear amplifier.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	10.0 ± 0.5 V
Current, at 10.0 volts	160 A

Direct Interelectrode Capacitance (grounded cathode)[2]

Cin	70.0 pF
Cout	2.3 pF
Cgp	43.0 pF

Frequency of Maximum Rating:

CW	90 MHz

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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Overall Dimensions:

Length (Not including filament leads)	10.60 in: 269.2 mm
Diameter	8.00 in; 203.2 mm
Net Weight	20.0 lb; 9.1 kg
Operating Position	Vertical, anode up or down

Maximum Operating Temperature:

Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced air
Base	Flexible filament leads

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy, or Industrial Oscillator
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	12,000	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC GRID CURRENT	1.5	AMPERES
DC PLATE CURRENT	8.0	AMPERES
PLATE DISSIPATION	20.0	KILOWATTS
GRID DISSIPATION	750	WATTS

TYPICAL OPERATION

Plate Voltage	7500	10,000	Vdc
Grid Voltage	-800	-900	Vdc
Plate Current	8.0	7.9	Adc
Grid Current[1]	1.4	.75	Adc
Peak rf Grid Voltage[1]	1200	1270	v
Calculated Driving Power[1]	1670	960	W
Plate Input Power	60	78	kW
Plate Dissipation	9.0	14.0	kW
Plate Output Power	51.0	64.0	kW
Resonant Load Impedance	480	640	Ω

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	6500	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	5.5	AMPERES
PLATE DISSIPATION[1]	13.0	KILOWATTS
GRID DISSIPATION[2]	750	WATTS

1. Corresponds to 20,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION

Plate Voltage	6500	Vdc
Grid Voltage	-1300	Vdc
Plate Current	5.0	mAdc
Grid Current[1]	900	mAdc
Peak rf Grid Voltage[1]	1660	v
Calculated Driving Power	1500	W
Plate Input Power	32.5	kW
Plate Dissipation	5.0	kW
Plate Output Power	27.5	kW
Resonant Load Impedance	610	Ω

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE[1]	8000	VOLTS
DC PLATE CURRENT	8.0	AMPERES
PLATE DISSIPATION	20.0	KILOWATTS
GRID DISSIPATION	750	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	7500	Vdc
Grid Voltage[1/3]	-380	Vdc
Zero-Signal Plate Current	2.0	Adc
Max. Signal Plate Current	14.8	Adc
Max. Signal Grid Current[1]	1.26	Adc
Peak af Grid Voltage[2]	640	v
Driving Power[1]	800	W
Max. Signal Plate Dissipation	30.2	kW
Plate Output Power	80.0	kW
Load Resistance (plate to plate)	1140	Ω

2. Per Tube.
3. Adjust to give stated zero-signal plate current

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.	
Heater: Current at 10.0 volts	152	168	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	65.0	75.0	pF
Cout	2.00	2.60	pF
Cgp	38.0	48.0	pF

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

APPLICATION

MECHANICAL

MOUNTING - The 3CX20,000H3 is intended for direct mounting in the equipment. It may be supported by the anode cooler or by the grid terminal flange. It must be mounted vertically, base up, or base down. The filament terminals are flexible leads approximately eight and three quarter inches in length. At higher operating frequencies it is suggested that the RF return to the filament be made to one or both of the heavy filament rings by suitable clamps. In circuits where circulating current may be large it is possible to make the grid connection through a wide strap bolted to one or more of the ¼ inch holes in the grid flange.

COOLING - The maximum temperature rating for the external surfaces of the 3CX20,000H3 is 250°C. Sufficient forced-air flow must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air flow requirements to maintain core temperature at 225°C in 50°C ambient air are tabulated below. These data are for air flowing in the base-to-anode direction.

The anode cooling air table assumes that the 3CX20,000H3 will be mounted in an enclosure with cooling air flowing into the enclosure and being exhausted through the anode cooler. If the air flow is reversed, that is, flow from the anode toward the base, approximately 20% additional air flow should be provided as indicated by 33% higher pressure drop across the anode cooler.

Approximately 100 CFM of air should be directed from a 1-½ inch diameter nozzle into the base of the tube to cool the filament terminals.

BASE TO ANODE AIR FLOW				
	Sea Level		10,000 Feet	
Plate * Dissipation (watts)	Air Flow (CFM)	Pressure Drop In. W.C.	Air Flow (CFM)	Pressure Drop In. W.C.
10,000	320	0.9	464	1.1
15,000	625	2.1	910	2.8
20,000	1010	4.3	1475	5.8

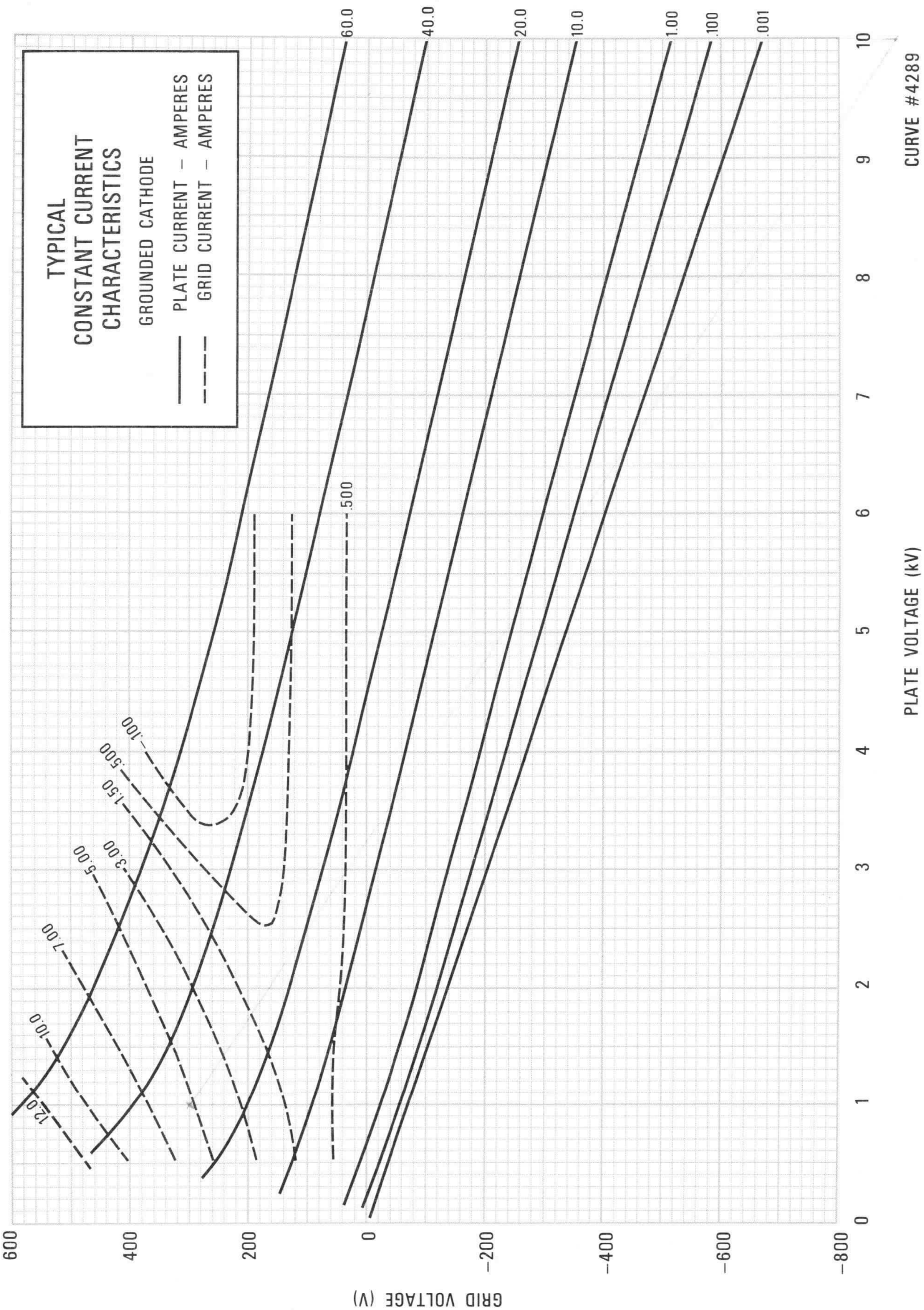
* Since the power dissipated by the filament represents about 1680 watts and since the grid dissipation can, under some conditions, represent another 750 watts, allowance has been made in preparing this tabulation for an additional 2430 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures, the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT/CATHODE OPERATION - The filament voltage should be maintained within 5% of the nominal 10.0 V value, and for consistent tube life even closer control is advised. For most services the filament voltage may be less than the nominal 10.0 V for extended life.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
CURVE #4289
PLATE VOLTAGE (kV)
GRID VOLTAGE (V)
60.0
40.0
20.0
10.0
1.00
.100
.001
.500
.100
.500
1.50
3.00
5.00
7.00
10.0
12.0
600
400
200
0
−200
−400
−600
−800
0
1
2
3
4
5
6
7
8
9
10

The exact value about which to control should be determined by experiment in any given service.

GRID OPERATION - The grid dissipation rating of 750 watts must not be exceeded. For the convenience of industrial heating operators a maximum grid current of 1.5 amperes is specified. This provides reasonable assurance that the 750 watt rating is not exceeded.

PLATE OPERATION - Allowable anode dissipation depends on provision of sufficient cooling air for the temperature and altitude environment.

Anode dissipation will vary widely with load changes in industrial heating service. It is important that the power level be adjusted so that under no condition of the load cycle does the anode dissipation exceed the level established by the available cooling air.

When power tubes are operated in parallel, provision should be made to meter plate and grid currents individually. It is good practice also to provide separate plate current or cathode current overload relays when tubes are operated in parallel.

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.

HIGH VOLTAGE - Normal operating voltages used with the 3CX20,000H3 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.

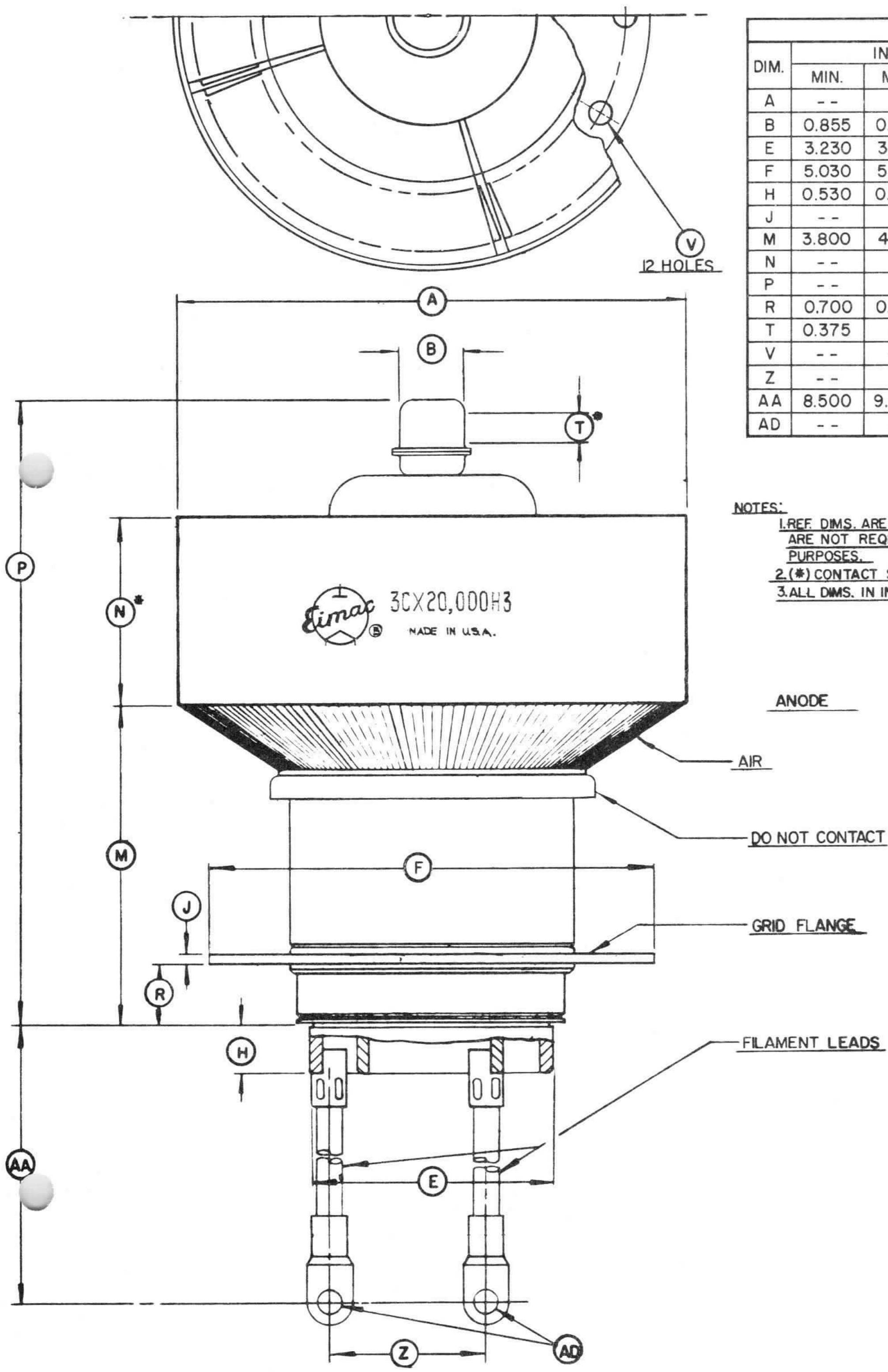
X-RADIATION - High-vacuum tubes operating at voltages higher than 10kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 3CX20,000H3, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. 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 whenvoltages 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.

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 the 3CX-20,000H3 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.

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



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	--	--	8.00	--	--	203.0
B	0.855	0.895	--	21.70	22.70	--
E	3.230	3.270	--	82.00	83.00	--
F	5.030	5.090	--	128.00	128.70	--
H	0.530	0.700	--	13.50	17.70	--
J	--	--	0.125	--	--	3.20
M	3.800	4.150	--	96.50	105.00	--
N	--	--	4.000	--	--	115.00
P	--		10.000	--	--	254.00
R	0.700	0.860	--	17.80	21.80	--
T	0.375	--	--	9.50	--	--
V	--	--	0.265	--	--	6.70
Z	--	--	2.000	--	--	51.00
AA	8.500	9.000	--	215.00	228.00	--
AD	--	--	0.390	--	--	9.90

NOTES:

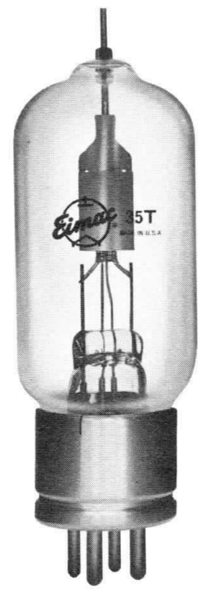
1. REF. DIMS. ARE FOR INFO. ONLY & ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES
3. ALL DIMS. IN INCHES

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

35 T
HIGH-MU TRIODE

The EIMAC 35T is a high-mu triode having a maximum plate dissipation of 50 watts. It is intended for use as an amplifier, oscillator or modulator, and can be used at its maximum ratings at frequencies up to 100 MHz.

The 35T is cooled by radiation and by free circulation of air around the envelope. The plate operates at a visible red color at full dissipation.



CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	Min.	Nom.	Max.	
Voltage		5.0		volts
Current	3.6		4.2	amperes
Amplification Factor	35		43	
Direct Interelectrode Capacitances:				
Grid-Plate	1.4		2.2	pF
Grid-Filament	3.0		5.0	pF
Plate-Filament	0.08		0.23	pF
Transconductance (I_b =100 ma.)		2850		umhos
Frequency for Maximum Ratings			100	MHz

MECHANICAL

Base: UX Medium 4-pin. Fits E.F. Johnson Co. 122-224, or National XC-4 or CIR-4 sockets.

Basing	See outline drawing
Mounting	Vertical, base down or up.
Cooling	Convection and radiation.
Recommended Heat-Dissipating Plate Connector	Eimac HR-3
Maximum Overall Dimensions:	
Length	5.5 in
Diameter	1.8 in
Net Weight	2.5 oz
Shipping Weight (Average)	1.25 lbs

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000	VOLTS
D-C PLATE CUTTENT	150	MA.
PLATE DISSIPATION	50	WATTS
GRID DISSIPATION	15	WATTS

TYPICAL OPERATION

D-C Plate Voltage	600	1000	1500	2000	Volts
D-C Grid Voltage (approx.)*	0	-8	-25	-40	Volts
Zero-signal D-C Plate Current	90	67	45	34	Ma.
Max-signal D-C Plate Current	300	240	200	167	Ma.
Effective Load Plate-to-Plate	4250	7900	16,200	27,500	Ohms
Peak A-F Input Voltage (per tube)	130	240	250	255	Volts
Peak Driving Power (approx.)	18	14	10	8	Watts
Nominal Driving Power (approx.)	9	7	5	4	Watts
Max-signal Plate Power Output	95	140	200	235	Watts

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

(Key-down conditions, per tube)[1]

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000	VOLTS
D-C PLATE CURRENT	150	MA.
PLATE DISSIPATION	50	WATTS
GRID DISSIPATION	15	WATTS

TYPICAL OPERATION

D-C Plate Voltage	1000	1500	2000	Volts
D-C Grid Voltage	-60	-120	-135	Volts
D-C Plate Current	125	125	125	Ma.
D-C Grid Current	40	40	45	Ma.
Peak R-F Grid Input Voltage	165	250	285	Volts
Driving Power (approx.)	7	9	13	Watts
Grid Dissipation	4.2	5.0	6.8	Watts
Plate Power Input	125	188	250	Watts
Plate Dissipation	38	47	50	Watts
Plate Power Output	87	141	200	Watts

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)[1]

MAXIMUM RATINGS

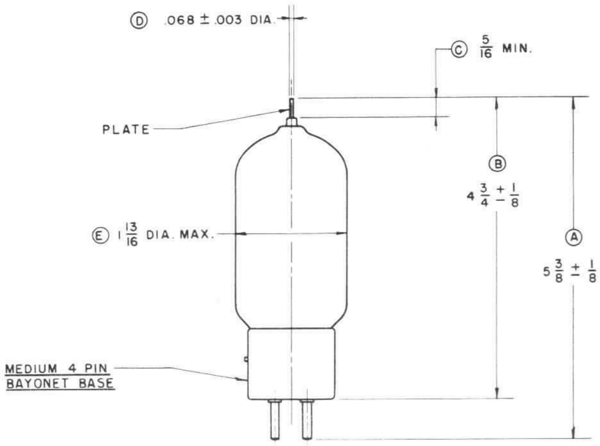
D-C PLATE VOLTAGE	1600	VOLTS
D-C PLATE CURRENT	120	MA.
PLATE DISSIPATION	33	WATTS
GRID DISSIPATION	15	WATTS

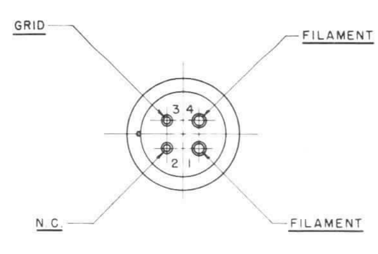
TYPICAL OPERATION

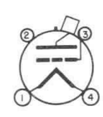
D-C Plate Voltage	750	1000	1500	Volts
D-C Grid Voltage	-100	-125	-150	Volts
D-C Plate Current	95	100	90	Ma.
D-C Grid Current	40	40	40	Ma.
Peak R-F Driving Voltage (approx.)	210	240	270	Volts
Driving Power (approx.)	9	10	11	Watts
Plate Dissipation	20	25	30	Watts
Plate Input	70	100	135	Watts
Plate Power Output	50	75	105	Watts

* Adjust for stated zero-signal plate current.

[1]The performance figures listed under Typical Operation are for radio frequencies up to the VHF region and are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power given includes power taken by the tube grid and the bias circuit. The driving power and output power do not allow for losses in the associated resonant circuits. These losses are not included because they depend principally upon the design and choice of the circuit components.





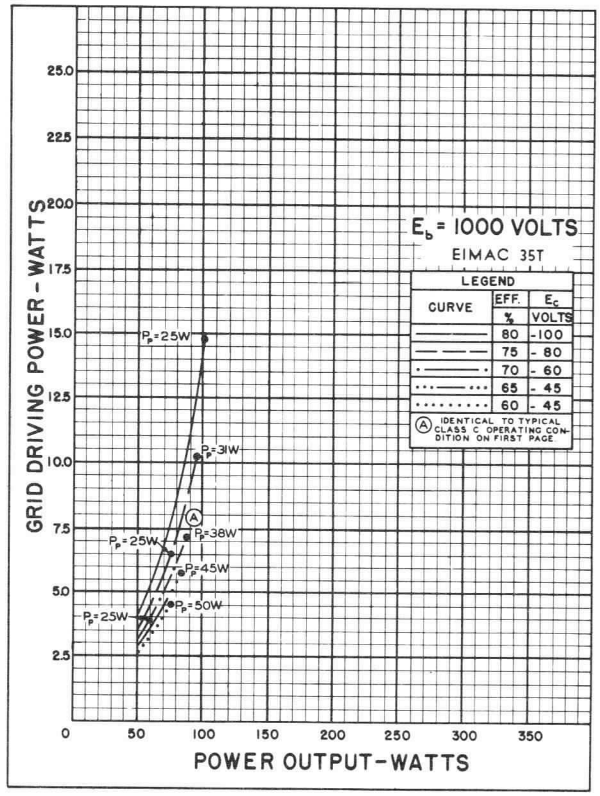


DESIGN TEST MEASUREMENTS: A, E,

TYPE APPROVAL MEASUREMENTS: B, D,

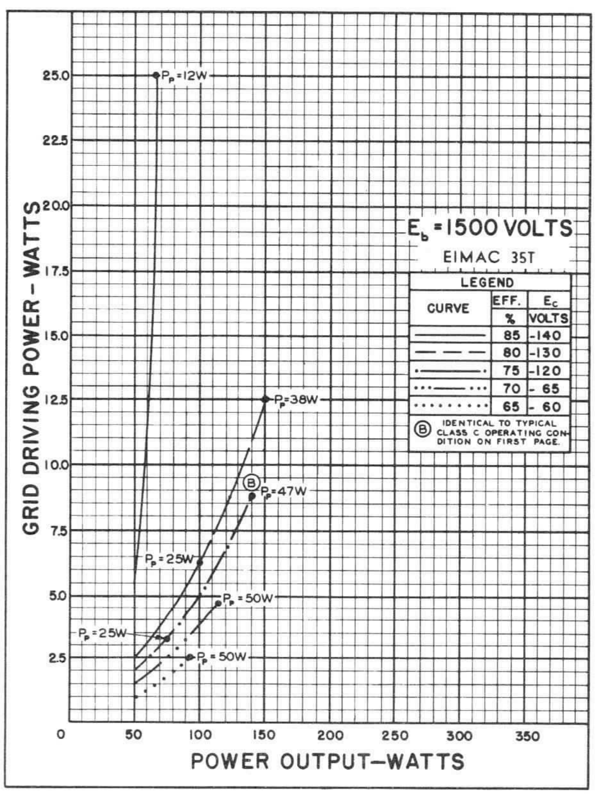
PRODUCTION TEST MEASUREMENTS: C,

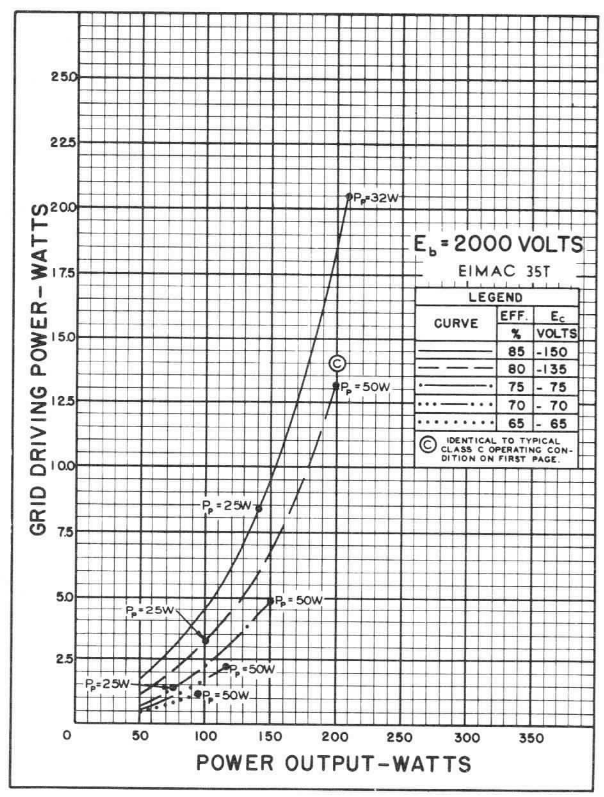
DRIVING POWER vs. POWER OUTPUT

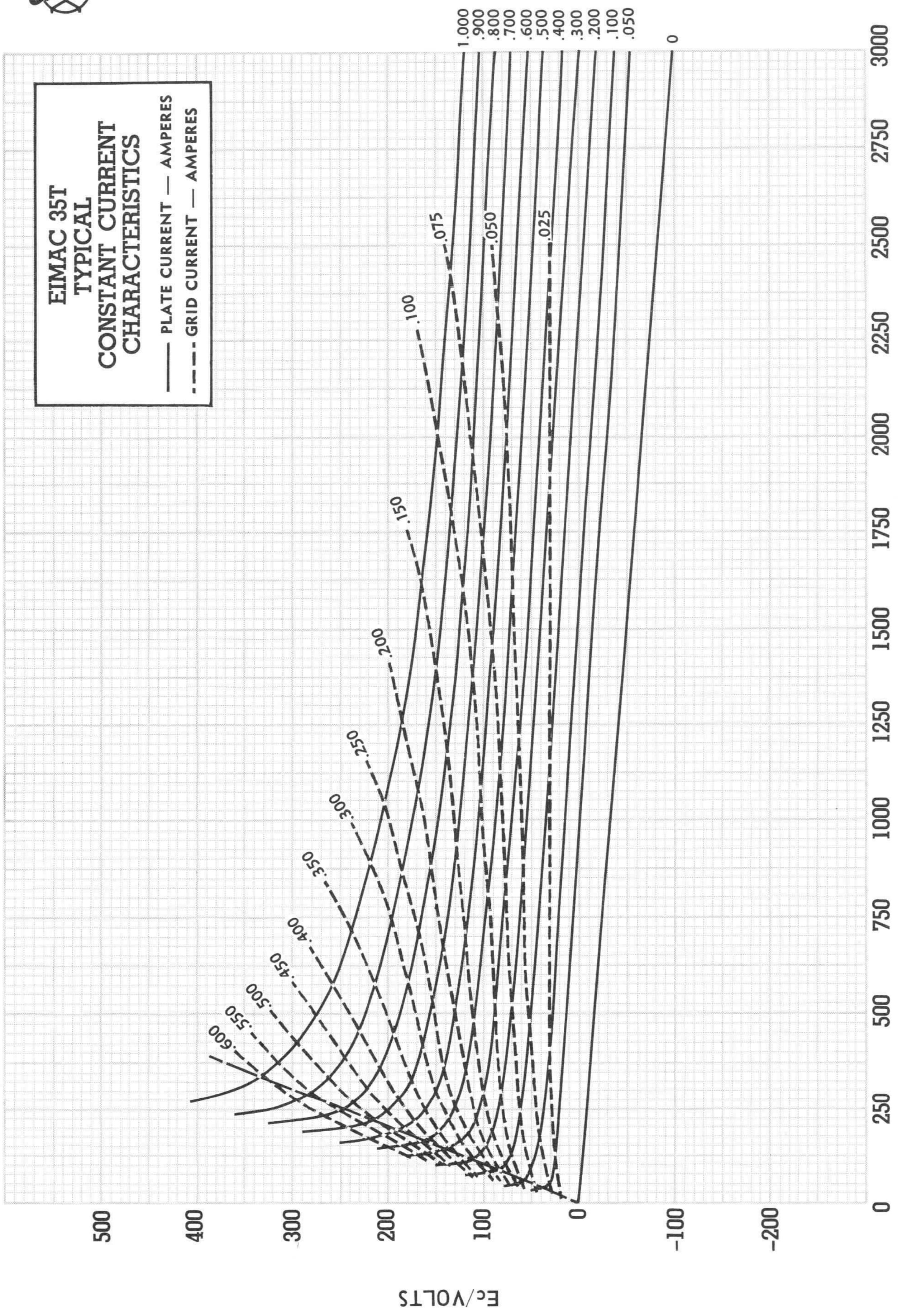


The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1000, 1500 and 2000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A,B, and C are identical to the typical Class C operating conditions shown on the first page under 1000, 1500, and 2000 volts respectively.






EIMAC 35T
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPERES
GRID CURRENT — AMPERES
Eb/VOLTS
Ec/VOLTS

100TL

LOW-MU TRIODE

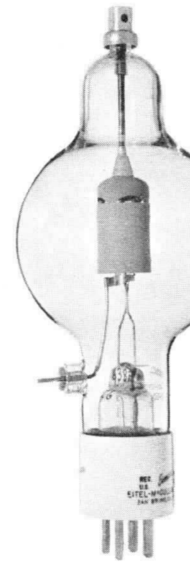
●

MODULATOR
OSCILLATOR
AMPLIFIER

E I M A C
Division of Varian
SAN CARLOS
CALIFORNIA

The Eimac 100TL is a low-mu power triode having a maximum plate dissipation rating of 100 watts, and is intended for use as an amplifier, oscillator or modulator. It can be used at its maximum ratings at frequencies as high as 40-Mc.

Cooling of the 100TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air circulation by convection around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	6.3 amperes
Amplification Factor (Average)	14
Direct Interelectrode Capacitances (Average)	
Grid-Plate	2.0 $\mu\mu$f
Grid-Filament	2.3 $\mu\mu$f
Plate-Filament	0.4 $\mu\mu$f
Transconductance (i_b=225 ma., E_b=3000v., e_c= −90v.)	3000 μmhos
Frequency for Maximum Ratings	40 Mc.

MECHANICAL

Base (Medium 4-pin bayonet, ceramic)	RMA type M8-078
Basing	RMA type 2M
Mounting	Vertical, base down or up.
Cooling	Convection and Radiation.
Recommended Heat Dissipating Connectors:	
Plate	Eimac HR-6
Grid	Eimac HR-2
Maximum Overall Dimensions:	
Length	7.75 inches
Diameter	3.19 inches
Net weight	4 ounces
Shipping weight (Average)	1.5 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB₂ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA.
PLATE DISSIPATION, PER TUBE	100 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	Volts
D-C Grid Voltage (approx.)*	—65	—110	—145	Volts
Zero-Signal D-C Plate Current	80	60	48	Ma.
Max-Signal D-C Plate Current	320	280	250	Ma.
Effective Load, Plate-to-Plate	8800	15,000	22,000	Ohms
Peak A-F Grid Input Voltage (per tube)	235	270	290	Volts
Max-Signal Peak Driving Power	21	22	20	Watts
Max-Signal Nominal Driving Power (approx.)	10.5	11	10	Watts
Max-Signal Plate Power Output	280	360	425	Watts

*Adjust to give stated zero signal plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA.
PLATE DISSIPATION	100 MAX. WATTS
GRID DISSIPATION	15 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	3000	Volts
D-C Grid Voltage	—175	—225	—400	Volts
D-C Plate Current	190	165	165	Ma.
D-C Grid Current	37	28	30	Ma.
Peak R-F Grid Input Voltage	425	450	650	Volts
Driving Power (approx.)	14	11	20	Watts
Grid Dissipation	7.5	5	8	Watts
Plate Power Input	285	335	500	Watts
Plate Dissipation	100	100	100	Watts
Plate Power Output	185	235	400	Watts

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C PLATE CURRENT	180 MAX. MA.
PLATE DISSIPATION	65 MAX. WATTS
GRID DISSIPATION	15 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	Volts
D-C Grid Voltage	—300	—400	—500	Volts
D-C Plate Current	160	150	140	Ma.
D-C Grid Current	32	31	31	Ma.
Peak R-F Grid Input Voltage	530	655	750	Volts
Driving Power (approx.)	17	20	23	Watts
Grid Dissipation	8	7.5	7.5	Watts
Plate Power Input	240	300	350	Watts
Plate Dissipation	65	65	65	Watts
Plate Power Output	175	235	285	Watts

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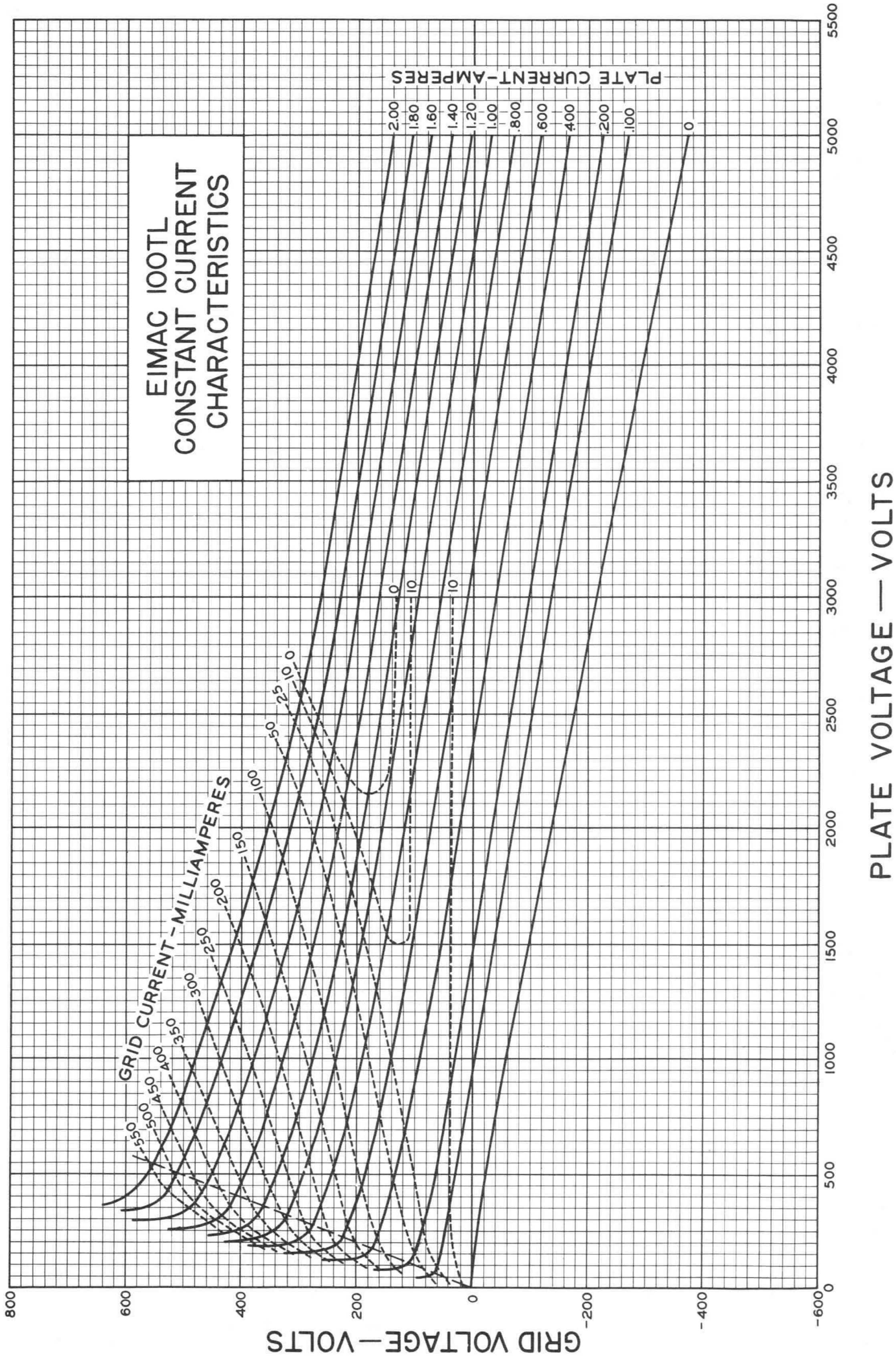
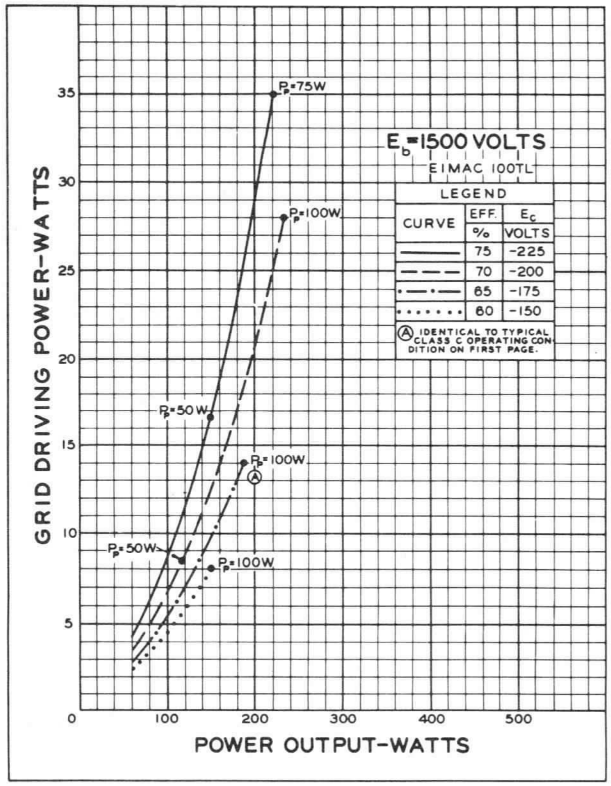
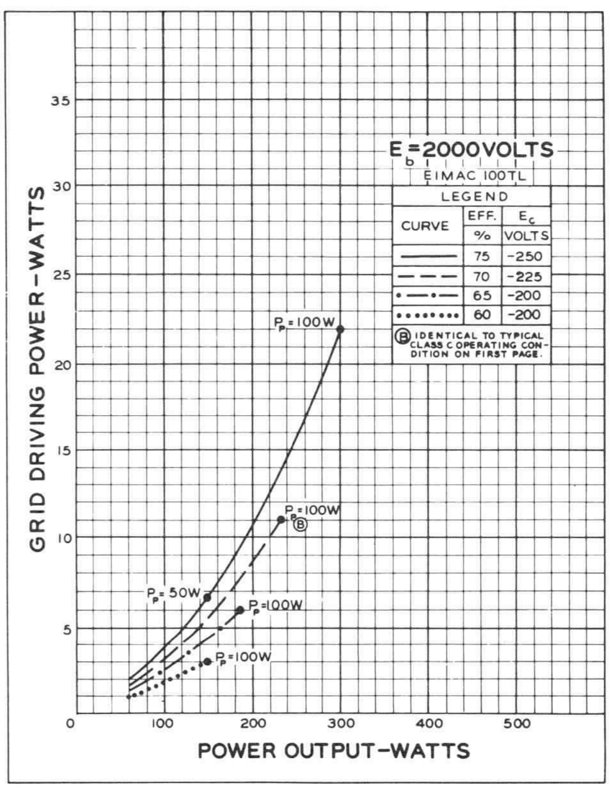

EIMAC 100TL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT-AMPERES
2.00
1.80
1.60
1.40
1.20
1.00
.800
.600
.400
.200
.100
0
GRID CURRENT-MILLIAMPERES
550
500
450
400
350
300
250
200
150
100
50
25
10
0
PLATE VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
GRID VOLTAGE — VOLTS
800
600
400
200
0
-200
-400
-600

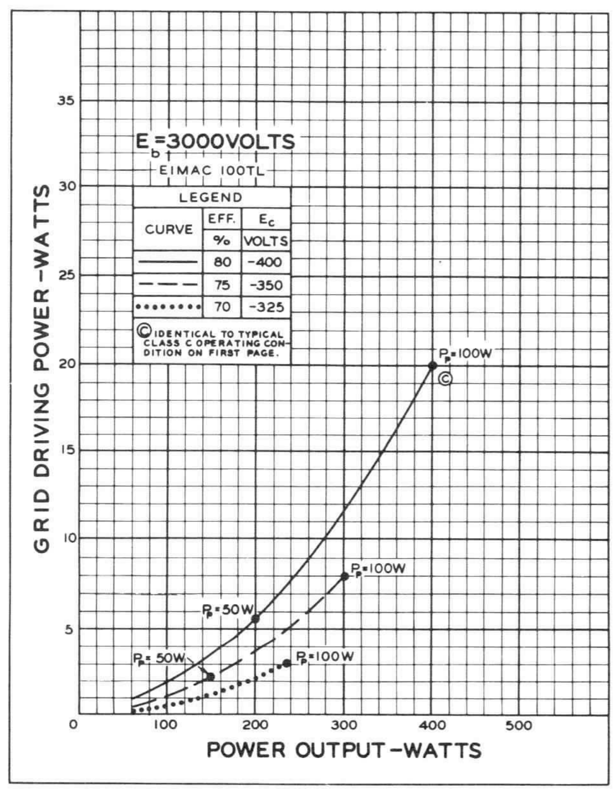
DRIVING POWER vs. POWER OUTPUT

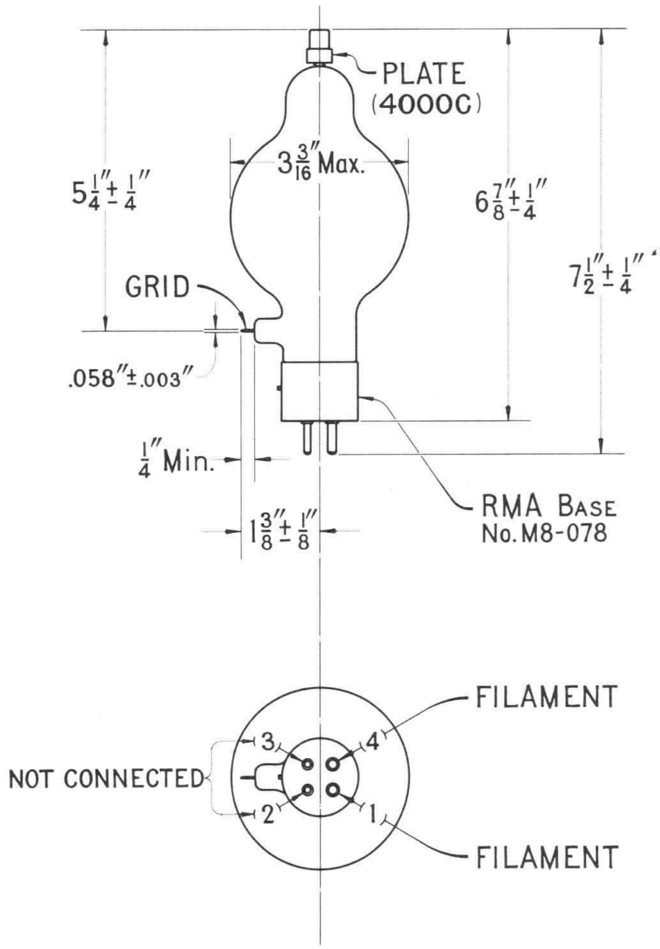
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.









2M

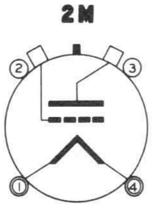
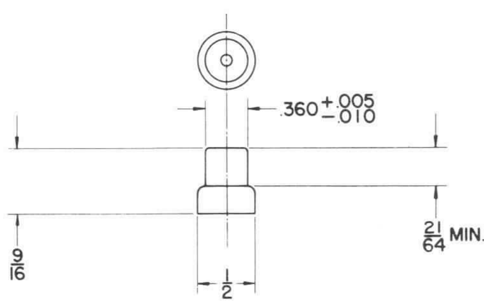


PLATE CAP
NO. 4000C



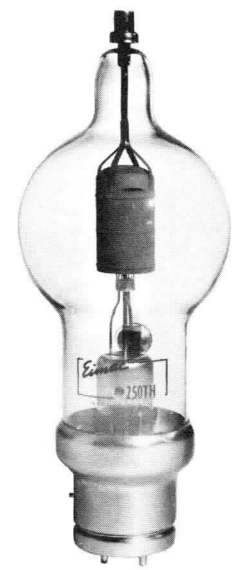
GRID CAP
(SEE TUBE OUTLINE DRAWING)

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

250TH
HIGH-MU TRIODE
MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 250TH is a high-mu power triode intended for use as an amplifier, oscillator or modulator. It has a maximum plate-dissipation rating of 250 watts and a maximum plate-voltage rating of 4000 volts at frequencies up to 40 MHz.

The 250TH in class-C rf service will deliver up to 1000 watts plate power output with 39 watts driving power. Two 250TH's in class-AB_2 modulator service will deliver up to 1180 watts maximum-signal plate power output with 42 watts nominal driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0 volts
Current	10.5 amperes
Amplification Factor (Average)	37
Direct Interelectrode Capacitances (Average)	
Grid-Plate	2.9 $\mu\mu$f
Grid-Filament	4.6 $\mu\mu$f
Plate-Filament	0.5 $\mu\mu$f
Transconductance (I_b=300 ma., E_b=3000 v.)	5600 μmhos
Highest Frequency for Maximum Ratings	40 MHz

MECHANICAL

Base	Special 4-pin
Basing	See outline drawing
Socket	(National No. XM-50 or E. F. Johnson No. 123-211) or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat-Dissipating Connectors:	
Plate	EIMAC HR-6
Grid	EIMAC HR-3
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.81 inches
Net Weight	10 ounces
Shipping Weight	3 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000 VOLTS
DC PLATE CURRENT	350 MA
PLATE DISSIPATION	250 WATTS
GRID DISSIPATION	40 WATTS

TYPICAL OPERATION, per tube (Frequencies up to 40 MHz)

DC Plate Voltage	2000	3000	4000	volts
DC Grid Voltage	—100	—150	—220	volts
DC Plate Current	357	333	313	ma
DC Grid Current*	94	90	93	ma
Peak RF Grid Voltage (approx.)	345	395	470	volts
Driving Power*	29	32	39	watts
Grid Dissipation	20	19	18	watts
Plate Power Input	714	1000	1250	watts
Plate Dissipation	250	250	250	watts
Plate Power Output	464	750	1000	watts

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PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS, PER TUBE
(Frequencies up to 40 MHz)

DC PLATE VOLTAGE	3200	VOLTS
DC PLATE CURRENT	280	MA
PLATE DISSIPATION	165	WATTS
GRID DISSIPATION	40	WATTS

TYPICAL OPERATION, per tube[1] (Frequencies up to 40 MHz)

DC Plate Voltage	2000	2500	3000	volts
DC Grid Voltage	—160	—180	—200	volts
DC Plate Current	250	225	200	ma
DC Grid Current*	60	45	38	ma
Peak RF Grid Voltage	365	365	375	volts
Driving Power*	22	17	14	watts
Grid Dissipation*	12	8	6	watts
Plate Power Input	500	565	600	watts
Plate Dissipation	165	165	165	watts
Plate Power Output	335	400	435	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	350	MA
MAX-SIGNAL PLATE DISSIPATION, PER TUBE	250	WATTS
MAX-SIGNAL GRID DISSIPATION	40	WATTS

TYPICAL OPERATION

DC Plate Voltage	1500	2000	3000	volts
DC Grid Voltage[1]	0	—30	—65	volts
Zero-Signal DC Plate Current	220	140	100	ma
Max-Signal DC Plate Current	700	700	560	ma
Effective Load, Plate-to-Plate	4200	6000	12,200	ohms
Peak AF Grid Voltage (per tube)	230	260	260	volts
Max-Signal Peak Driving Power*	92	104	83	watts
Max-Signal Nominal Driving Power*	46	52	42	watts
Max-Signal Plate Power Input	1050	1400	1680	watts
Max-Signal Plate Power Output	630	900	1180	watts

*Approximate values.
[1]Adjust to give stated Zero-Signal DC Plate Current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, DIVISION OF VARIAN, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting — The 250TH must be mounted vertically, base down or up. The plate and grid leads should be flexible, and the tube must be protected from vibration and shock.

Cooling — Heat Dissipation Connectors (EIMAC HR-6 and HR-3 or equivalent) must be used at the plate and grid terminals of the 250TH. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 MHz. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling.

The temperature of the plate and grid seals must not be allowed to exceed 225°C. One method of measuring these temperatures is by the use of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N.Y.

ELECTRICAL

Filament Voltage — The filament voltage, as measured directly at the tube, should be 5.0 volts with maximum allowable variations due to line fluctuations from 5.25 to 4.75 volts.

Bias Voltage — When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

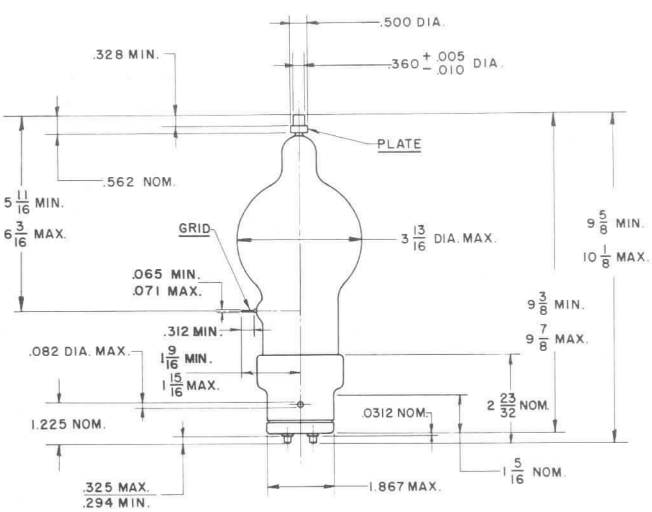
Grid Dissipation — The power dissipated by the grid of the 250TH must not exceed 40 watts. Grid dissipation may be calculated from the following expression:

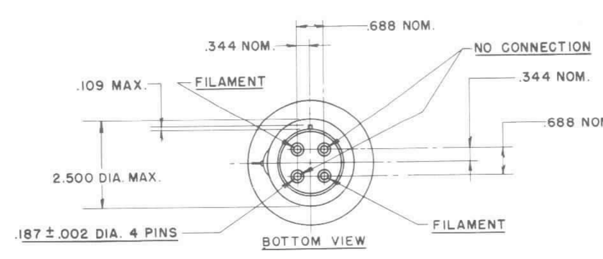
$$P_g = e_{cmp} I_c$$

where P_g = grid dissipation,
e_{mcp} = peak positive grid voltage, and
I_c = dc grid current.

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation — The plates of the 250TH operate at a visibly red color at the maximum rated dissipation of 250 watts. Plate dissipation in excess of the maximum rating is permissible only for short periods of time, such as during tuning procedures.

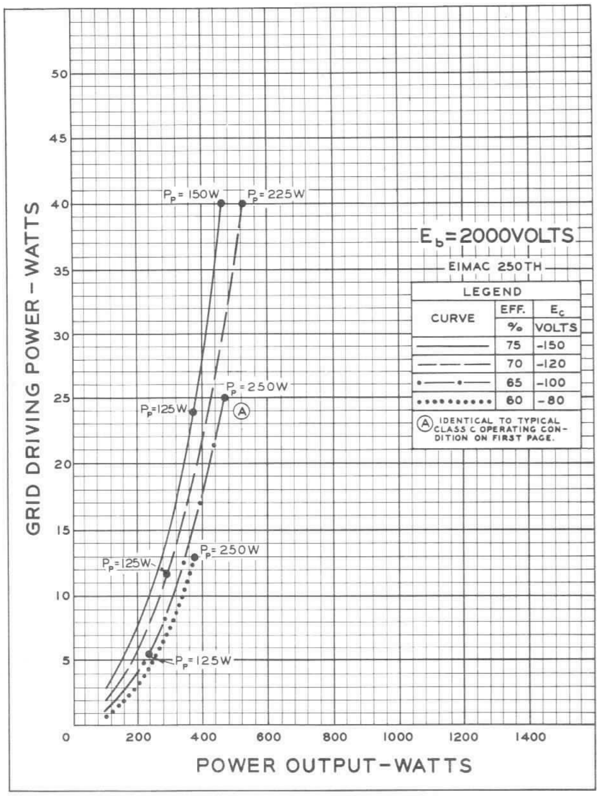


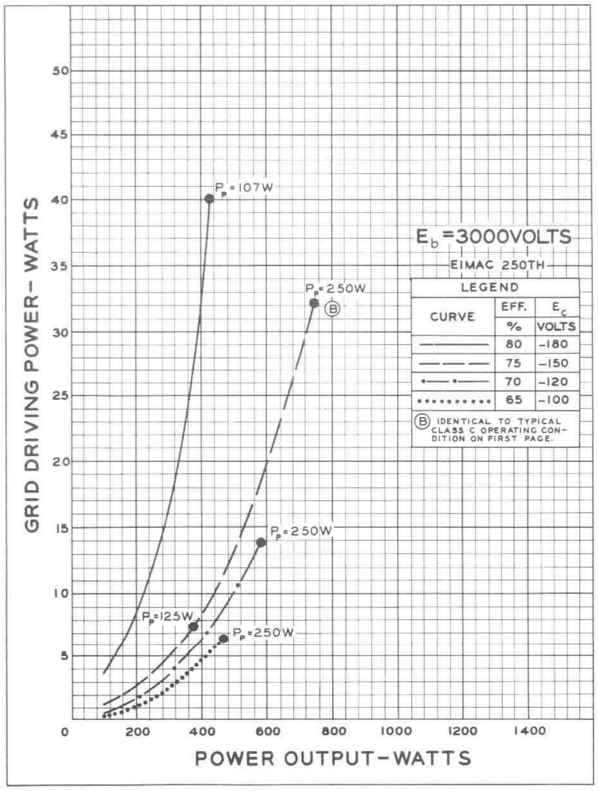


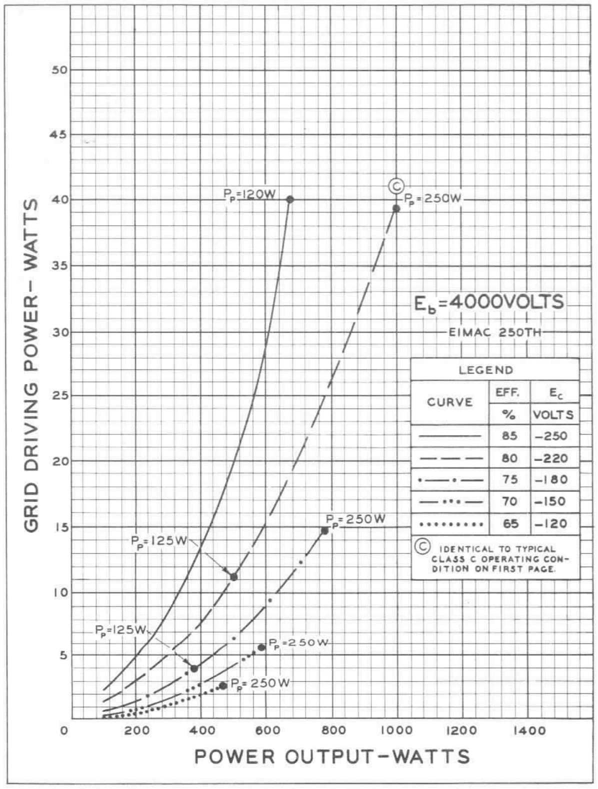
DIMENSIONS IN INCHES

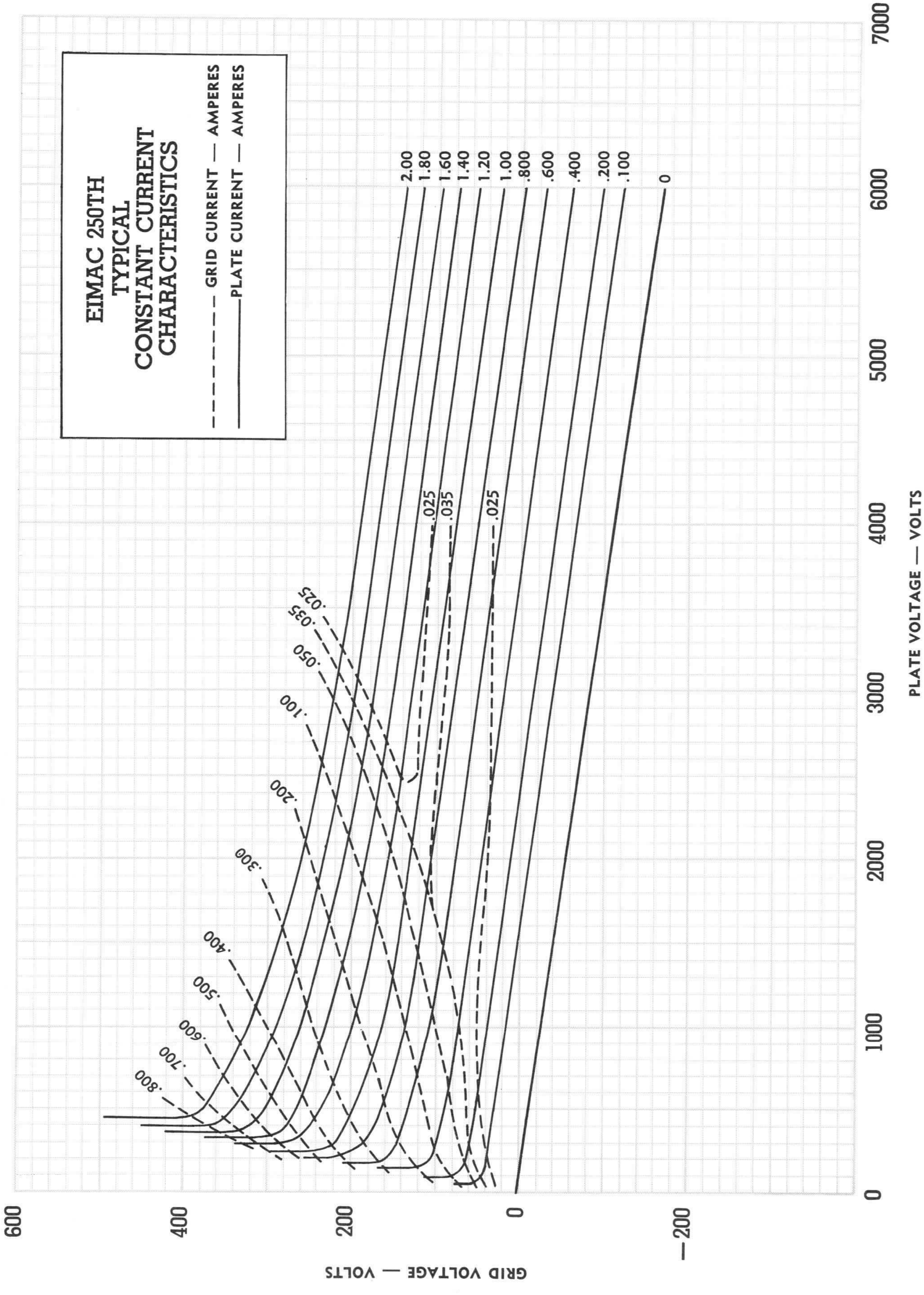
DRIVING POWER vs. POWER OUTPUT

The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 2000, 3000, and 4000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 2000, 3000, and 4000 volts respectively.








EIMAC 250TH
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — AMPERES
PLATE CURRENT — AMPERES
2.00
1.80
1.60
1.40
1.20
1.00
.800
.600
.400
.200
.100
0
.025
.035
.025
.025
.035
.050
.100
.200
.300
.400
.500
.600
.700
.800
PLATE VOLTAGE — VOLTS
0
1000
2000
3000
4000
5000
6000
7000
GRID VOLTAGE — VOLTS
600
400
200
0
−200

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

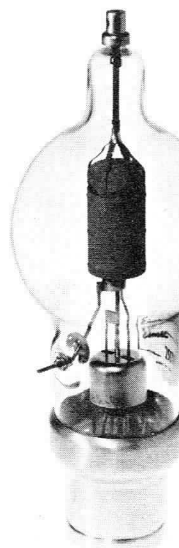
250TL

LOW-MU TRIODE

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 250TL is a low-mu triode having a maximum plate dissipation of 250 watts. It is intended for use as an amplifier, oscillator or modulator, and can be used at its maximum ratings at frequencies up to 40 Mc.

Cooling of the 250TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten

Voltage	5.0 volts
Current	10.5 amperes
Amplification Factor (Average)	14
Direct Interelectrode Capacitances (Average)	
Grid-Plate	3.0 $\mu\mu f$
Grid-Filament	3.7 $\mu\mu f$
Plate-Filament	0.7 $\mu\mu f$
Transconductance ($I_b = 350$ ma., $E_b = 3000V.$)	2650 μmhos
Frequency for Maximum Ratings	40 Mc

MECHANICAL

Base: Medium 4-pin bayonet type, fits E. F. Johnson No. 211 series sockets, National XM-50 socket, or the equivalent.
For pin connections, see outline drawing.

Mounting	Vertical, base down or up.
Cooling	Convection and radiation.
Recommended Heat Dissipating Connectors:	
Plate	Eimac HR-6
Grid	Eimac HR-3
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.81 inches
Net Weight	10 ounces
Shipping Weight	3 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB$_2$ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	350 MAX. MA.
MAX-SIGNAL PLATE DISSIPATION, PER TUBE	250 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	3000	Volts
D-C Grid Voltage (approx.)*	—40	—90	—170	Volts
Zero-Signal D-C Plate Current	200	150	100	Ma.
Max-Signal D-C Plate Current	700	650	500	Ma.
Effective Load, Plate-to-Plate	3800	6150	13,000	Ohms
Peak A-F Grid Input Voltage (per tube)	390	410	400	Volts
Max-Signal Peak Driving Power	76	74	32	Watts
Max-Signal Nominal Driving Power	38	37	16	Watts
Max-Signal Plate Power Output	580	800	1000	Watts

*Adjust for given zero-signal plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	35 MAX. WATTS

TYPICAL OPERATION, per tube* (Frequencies up to 40 Mc.)

D-C Plate Voltage	2000	3000	4000	Volts
D-C Grid Voltage	—200	—350	—500	Volts
D-C Plate Current	350	335	310	Ma.
D-C Grid Current	45	45	40	Ma.
Peak R-F Grid Input Voltage (approx.)	575	720	900	Volts
Driving Power (approx.)	22	29	33	Watts
Grid Dissipation (approx.)	14	15	14	Watts
Power Input	700	1000	1250	Watts
Plate Dissipation	245	250	250	Watts
Plate Power Output	455	750	1000	Watts

*These figures show actual measured tube performance and do not allow for variations in circuit losses.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3200 MAX. VOLTS
D-C PLATE CURRENT	280 MAX. MA.
PLATE DISSIPATION	165 MAX. WATTS
GRID DISSIPATION	35 MAX. WATTS

TYPICAL OPERATION, per tube* (Frequencies up to 40 Mc.)

D-C Plate Voltage	2000	2500	3000	Volts
D-C Plate Current	250	225	200	Ma.
Total D-C Bias Voltage	—520	—520	—520	Volts
Grid Resistor	13,000	15,000	17,500	Ohms
Fixed D-C Bias Supply Voltage	—140	—220	—266	Volts
D-C Grid Current	29	20	14	Ma.
Peak R-F Grid Input Voltage	840	795	795	Volts
Driving Power (approx.)	24	16	11	Watts
Grid Dissipation (approx.)	9	6	5	Watts
Plate Power Input	500	565	600	Watts
Plate Dissipation	165	165	165	Watts
Plate Power Output	335	400	435	Watts

*These figures show actual measured tube performance and do not allow for variations in circuit losses.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 250TL must be mounted vertically, base down or up. The plate and grid leads should be flexible, and the tube must be protected from vibration and shock.

Cooling—Heat Dissipating Connectors (Eimac HR-6 and HR-3 or equivalent) must be used at the plate and grid terminals of the 250TL. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 Mc. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling.

The temperature of the plate and grid seals must not be allowed to exceed 225° C. One method of measuring these temperatures is by the use of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 11 W. 25th St., New York 10, N. Y.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the tube, should be 5.0 volts with maximum allowable variations due to line fluctuations from 5.25 to 4.75 volts.

Bias Voltage—When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

Grid Dissipation—The power dissipated by the grid of the 250TL must not exceed 40 watts. Grid dissipation may be calculated from the following expression.

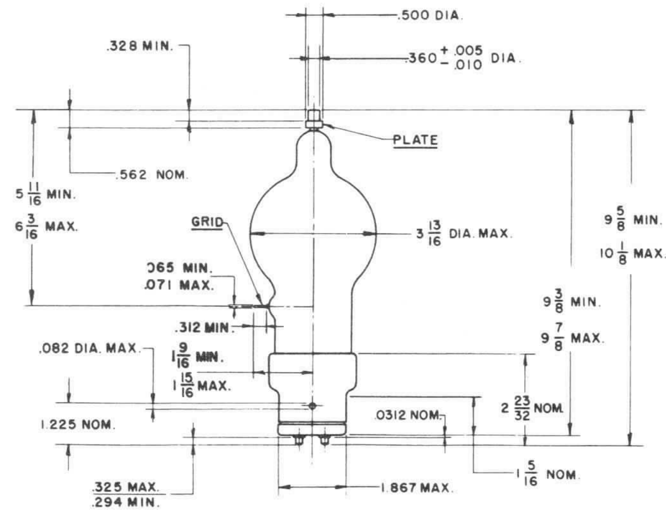
$$P_g = e_{cmp} I_c$$

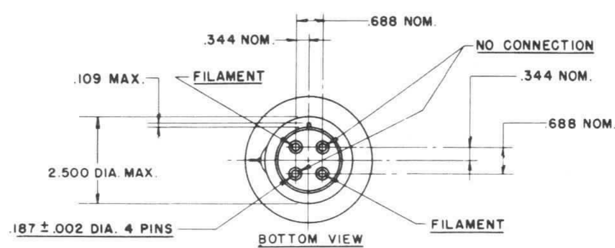
where P_g = grid dissipation,
e_{cmp} = peak positive grid voltage, and
I_c = d-c grid current

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid.[1] In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation—The plates of the 250TL operate at a visibly red color at the maximum rated dissipation of 250 watts. Plate dissipation in excess of the maximum rating is permissible only for short periods of time, such as during tuning procedures.

[1]For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News**, January, 1945. This article is available in reprint form on request.



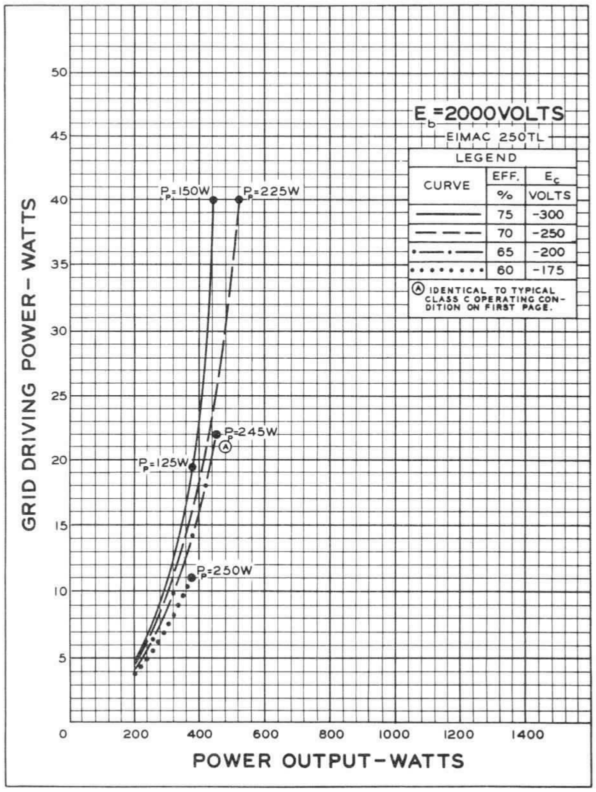


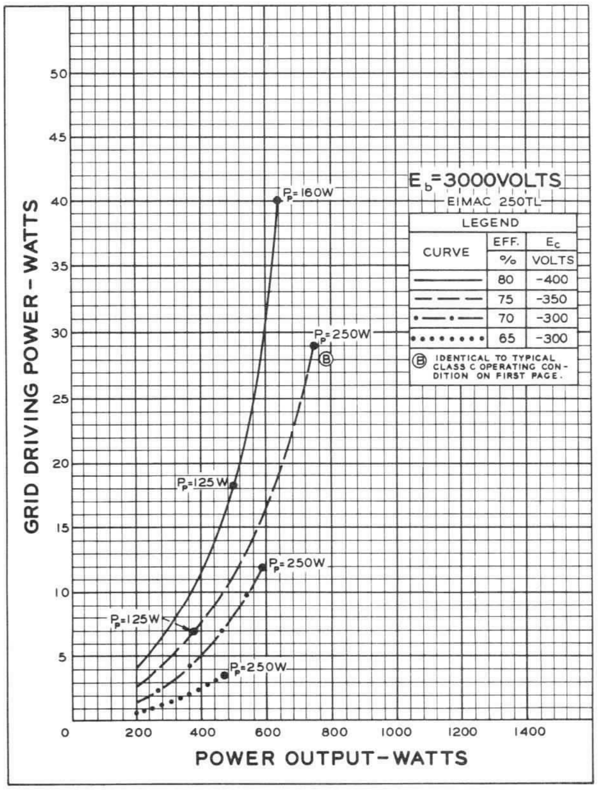
DIMENSIONS IN INCHES

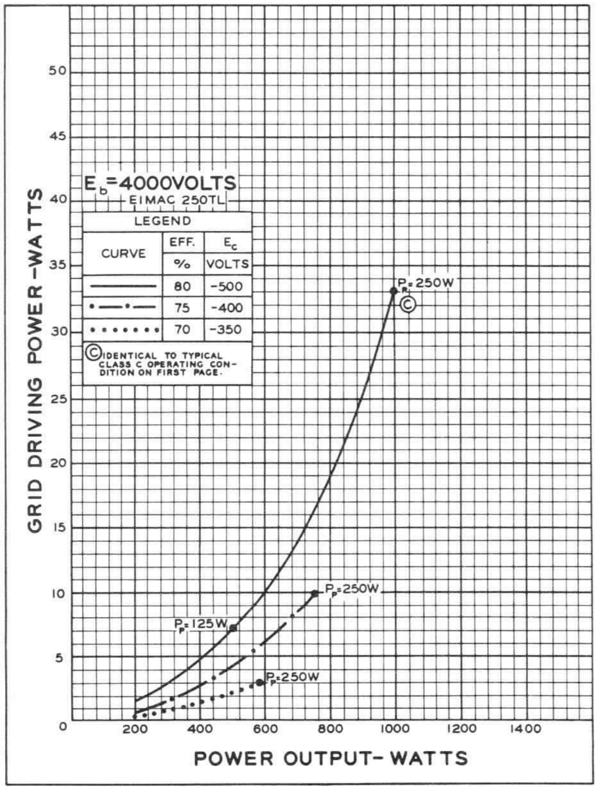
DRIVING POWER vs. POWER OUTPUT

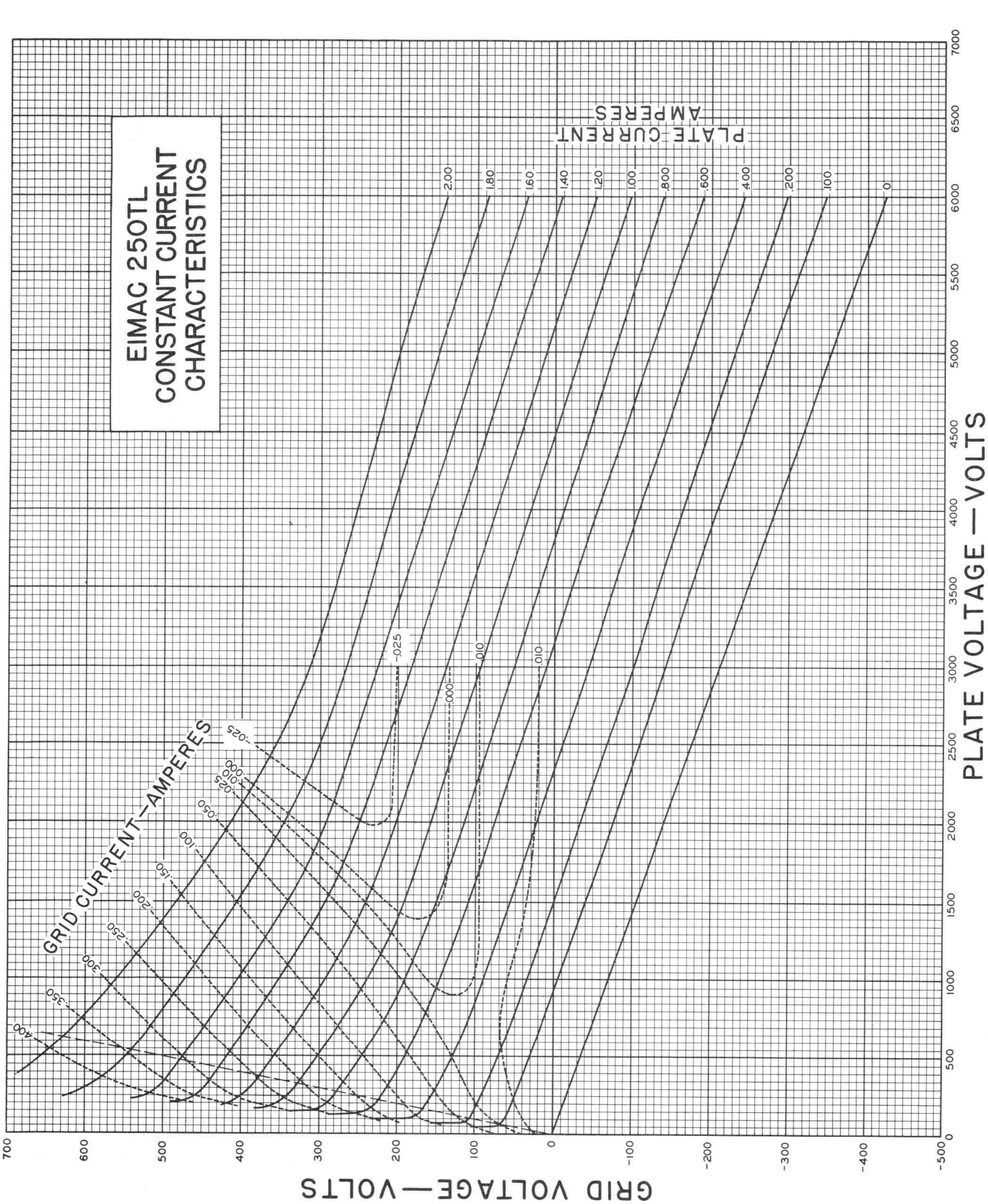
The three charts on this page show the relationship of plate efficiency, power output and approximate grid driving power at plate voltages of 2000, 3000 and 4000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 2000, 3000, and 4000 volts respectively.








EIMAC 250TL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
AMPERES
GRID CURRENT—AMPERES
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS

304TH

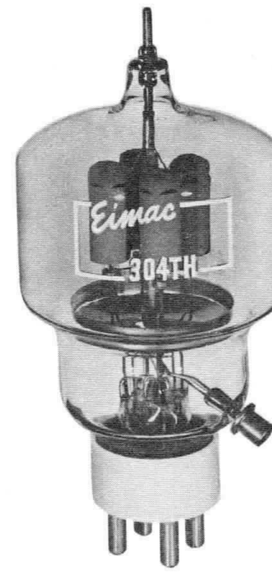
MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

The EIMAC 304TH is a medium-mu power triode intended for use as an amplifier, oscillator or modulator. It has a maximum plate-dissipation rating of 300 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 40 MHz.

The 304TH in Class-C rf service will deliver up to 1200 watts plate power output with 53 watts driving power. Two 304TH's in Class-AB_2 modulator service will deliver up to 1400 watts maximum-signal plate power output with 14 watts nominal driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0 or 10.0	volts
Current	25.0 or 12.5	amperes
Amplification Factor (Average)	20	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	10.2	pF
Grid-Filament	13.5	pF
Plate-Filament	0.7	pF
Transconductance (I_b=1.0 amp., E_b=3000 v.)	16,700	μmhos
Highest Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	Special 4-pin
Basing	See outline drawing
Socket	Johnson type No. 124-213 or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate and Grid Seals	225°C
Recommended Heat-Dissipating Connectors:	
Plate	EIMAC HR-7
Grid	EIMAC HR-6
Maximum Over-all Dimensions:	
Length	7.63 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	3.0 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy (Key-down conditions, one tube)

MAXIMUM RATINGS (Frequencies up to 40 MHz)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS
GRID DISSIPATION	60 WATTS

TYPICAL OPERATION (Frequencies up to 40 MHz)

DC Plate Voltage	1500	2000	3000 volts
DC Grid Voltage	–125	–200	–300 volts
DC Plate Current	665	600	500 ma
DC Grid Current*	115	125	135 ma
Peak RF Grid Voltage	250	325	395 volts
Driving Power*	25	39	53 watts
Grid Dissipation*	16	12	16 watts
Plate Dissipation	300	300	300 watts
Plate Power Input	1000	1200	1500 watts
Plate Power Output	700	900	1200 watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 40 MHz)

DC PLATE VOLTAGE	2500 VOLTS
DC PLATE CURRENT	750 MA
PLATE DISSIPATION	200 WATTS
GRID DISSIPATION	60 WATTS

TYPICAL OPERATION (Frequencies up to 40 MHz)

DC Plate Voltage	1500	2000	2500 volts
DC Grid Voltage	–200	–300	–350 volts
DC Plate Current	420	440	400 ma
DC Grid Current*	55	60	60 ma
Peak RF Grid Voltage	330	440	485 volts
Driving Power*	18	26	29 watts
Grid Dissipation*	7	8	8 watts
Plate Dissipation	200	200	200 watts
Plate Power Input	700	880	1000 watts
Plate Power Output	500	680	800 watts

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_2

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS

*Approximate values.
[1]Adjust to give stated Zero-Signal DC Plate Current.

TYPICAL OPERATION (Sinusoidal wave, two tubes unless otherwise specified)

DC Plate Voltage	1500	2000	3000 volts
DC Grid Voltage[1]	–65	–90	–150 volts
Zero Signal DC Plate Current	265	200	135 ma
Max. Signal DC Plate Current	1065	900	665 ma
Effective Load Plate-to-Plate	2840	4820	10,200 ohms
Peak AF Grid Voltage (per tube)	165	175	210 volts
Max. Signal Peak Driving Power*	50	37	27 watts
Max. Signal Nominal Driving Power*	25	19	14 watts
Max. Signal Plate Power Input	1600	1800	2000 watts
Max. Signal Plate Power Output	1000	1200	1400 watts

If it is desired to operate this tube under conditions widely different from those given under "Typical Operation," possibly exceeding the maximum ratings given for CW service, write Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, Calif. for information and recommendations.

MECHANICAL

Mounting—The 304TH must be mounted vertically, base down or up. The plate and grid leads should be flexible, and the tube must be protected fom vibration and shock.

Cooling—Heat Dissipating Connectors (EIMAC HR-7 and HR-6 or equivalent) must be used at the plate and grid terminals of the 304TH. Forced-air cooling is not required in properly designed equipment operating at frequencies below 40 MHz. If the free circulation of air around the tube is restricted, a small fan or centrifugal blower should be used to provide additional cooling.

The temperature of the plate and grid seals must not be allowed to exceed 225°C. One method of measuring these temperatures is by the use of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N.Y.

ELECTRICAL

Filament Voltage—The filaments of the 304TH may be operated either at 10.0 volts when connected in series or at 5.0 volts when connected in parallel (see basing diagram). For maximum tube life the filament voltage should be maintained at the rated value. Variations must not be allowed to exceed ±5%.

Bias Voltage — When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

Grid Dissipation — The power dissipated by the grid of the 304TH must not exceed 60 watts. Grid dissipation may be calculated from the following expression.

$$P_g = e_{cmp} I_c$$

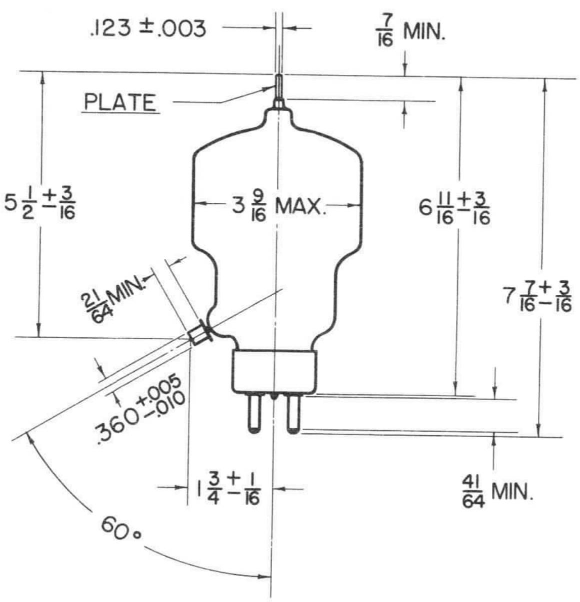
where P_g=grid dissipation,

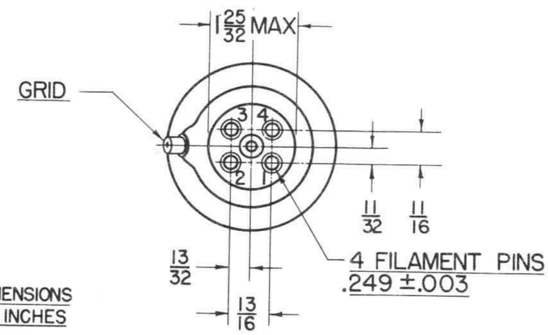
e_{cmp}=peak positive grid voltage, and

I_c=dc grid current.

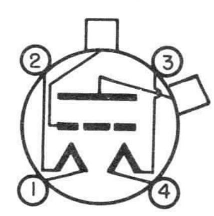
e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any condition of loading.

Plate Dissipation — The plates of the 304TH operate at a visible red color at the maximum rated dissipation of 300 watts. Plate dissipation in excess of the maximum rating is permissable only for short periods of time, such as during tuning procedures.





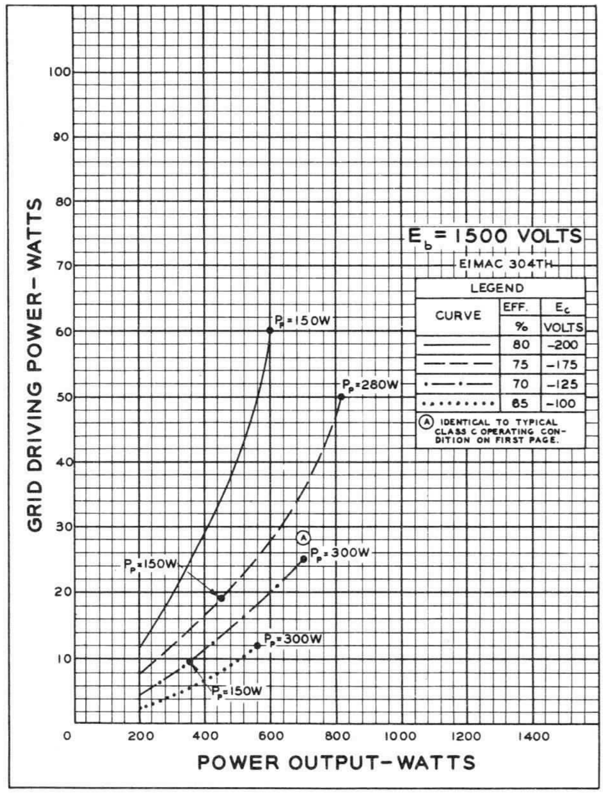
DIMENSIONS IN INCHES

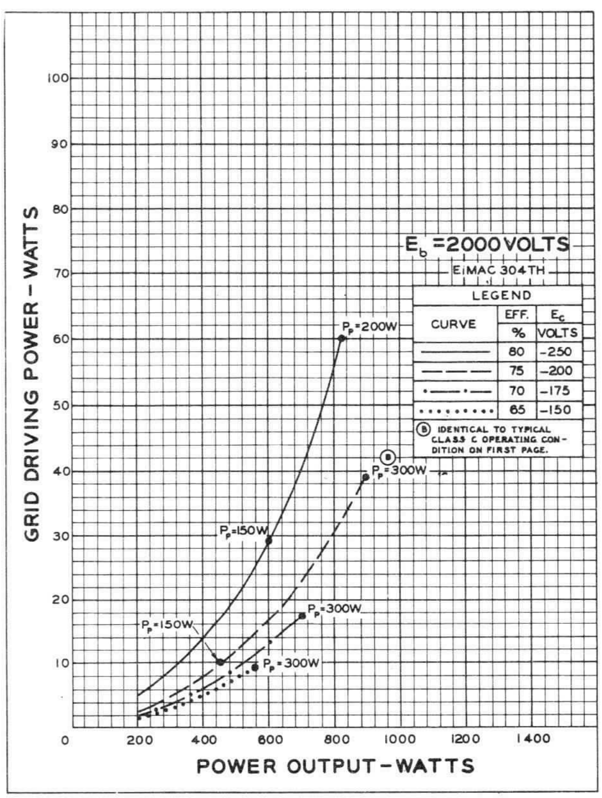


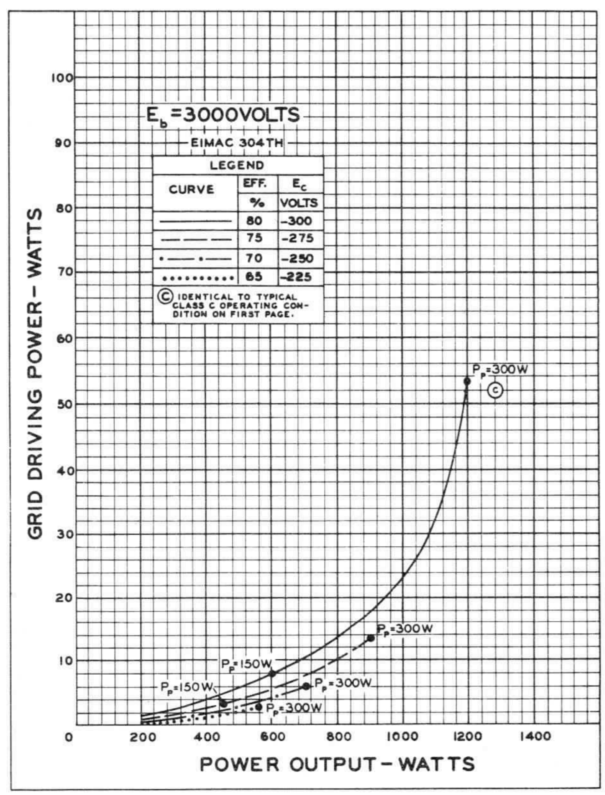
DRIVING POWER vs. POWER OUTPUT

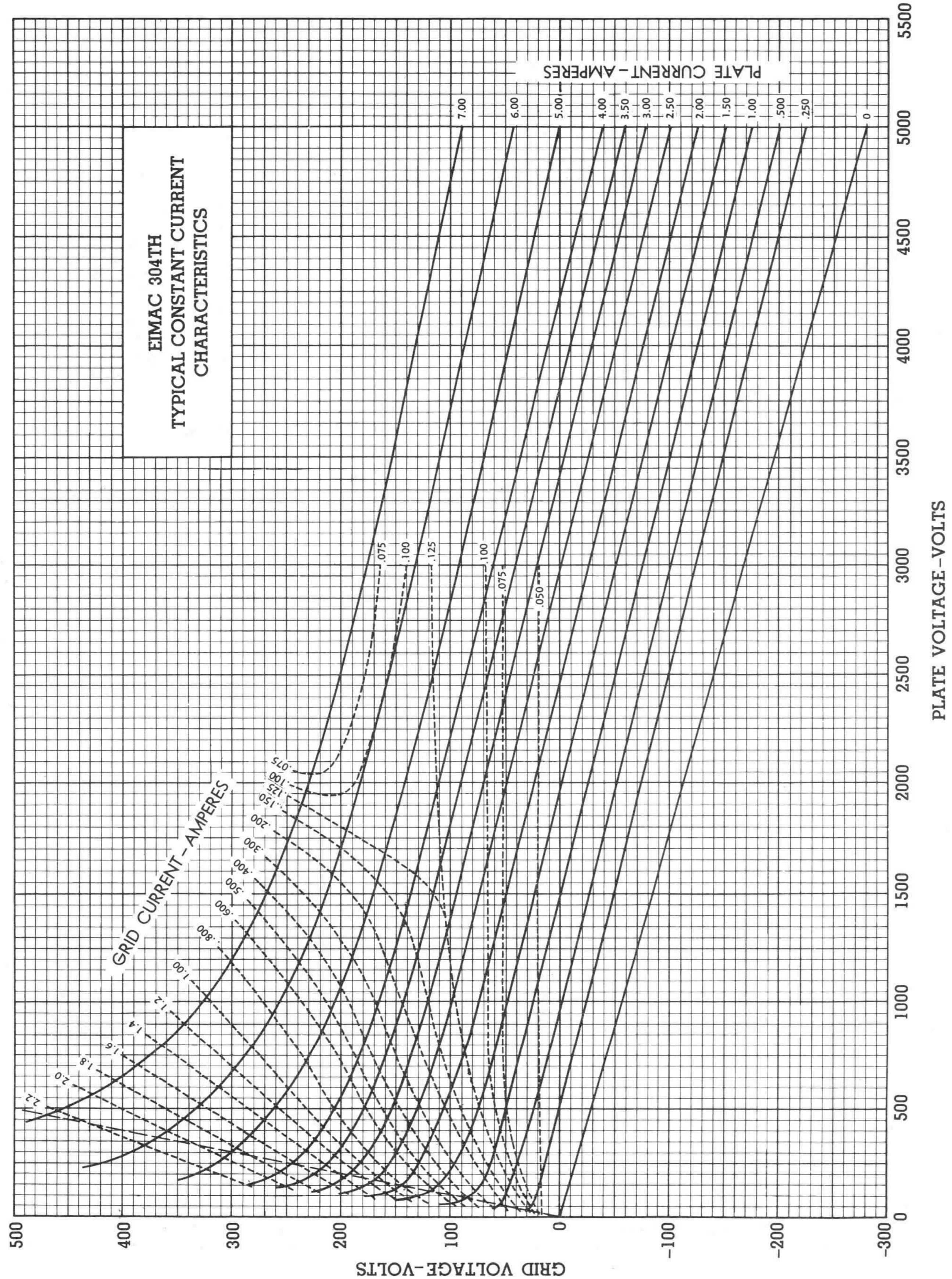
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.








EIMAC 304TH
TYPICAL CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT - AMPERES
7.00
6.00
5.00
4.00
3.50
3.00
2.50
2.00
1.50
1.00
.500
.250
0
GRID CURRENT - AMPERES
.075
.100
.125
.150
.200
.300
.400
.500
.600
.800
1.00
1.2
1.4
1.6
1.8
2.0
2.2
.100
.075
.050
PLATE VOLTAGE-VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
GRID VOLTAGE-VOLTS
500
400
300
200
100
0
-100
-200
-300

TECHNICAL DATA

304TL

LOW-MU TRIODE

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MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 304TL is a low-mu, power triode having a maximum plate dissipation rating of 300 watts, and is intended for use as an amplifier, oscillator or modulator, where maximum performance can be obtained at low plate voltage. It can be used at its maximum ratings at frequencies as high as 40 MHz.

Cooling of the 304TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air convection around the envelope.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten

Voltage	5.0 or 10.0	volts
Current	25.0 or 12.5	amps
Amplification Factor (Average)	12	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	8.6	pF
Grid-Filament	12.1	pF
Plate-Filament	.8	pF
Transconductance (I_b= 1.0 amp, E_b= 3000 V, e_c= —175 V)	16,700	μmhos
Frequency for Maximum Ratings	40	MHz

MECHANICAL

Base	Special 4 pin, No. 5000B
Socket	Johnson No. 124-213 or Equivalent
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connectors:	
Plate	HR-7
Grid	HR-6
Maximum Overall Dimensions:	
Length	7.625 inches
Diameter	3.563 inches
Net Weight	9 ounces
Shipping Weight (Average)	2 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
DC PLATE CURRENT	900 MA
PLATE DISSIPATION	300 WATTS
GRID DISSIPATION	50 WATTS

TYPICAL OPERATION*

DC Plate Voltage	1500	2000	3000 Volts
DC Grid Voltage	—250	—300	—400 Volts
DC Plate Current	665	600	500 mA
DC Grid Current	90	85	80 mA
Peak RF Grid Input Voltage	430	480	575 Volts
Driving Power (approx.)	33	36	40 Watts
Grid Dissipation	11	11	8 Watts
Plate Power Input	1000	1200	1500 Watts
Plate Dissipation	300	300	300 Watts
Plate Power Output	700	900	1200 Watts

*The figures show actual measured tube performance, and do not allow for circuit losses.

Printed in U.S.A.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

DC PLATE VOLTAGE	3000 VOLTS
MAX-SIGNAL DC PLATE CURRENT, PER TUBE	900 MA
PLATE DISSIPATION, PER TUBE	300 WATTS

TYPICAL OPERATION, CLASS AB_1

DC Plate Voltage	1500	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—118	—170	—230	—290 Volts
Zero-signal DC Plate Current	270	200	160	130 mA
Max-Signal DC Plate Current	572	546	483	444 mA
Effective Load, Plate-to-Plate	2540	5300	8500	12,000 Ohms
Peak AF Grid Input Voltage (per tube)	118	170	230	290 Volts
Max-Signal Peak Driving Power	0	0	0	0 Watts
Max-Signal Plate Power Output	256	490	610	730 Watts

*Adjust to give stated zero-signal plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION, CLASS AB_2

DC Plate Voltage	1500	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—118	—170	—230	—290 Volts
Zero-signal DC Plate Current	270	200	160	130 mA
Max-Signal DC Plate Current	1140	1000	900	800 mA
Effective Load, Plate-to-Plate	2750	4500	6600	9100 Ohms
Peak AF Grid Input Voltage (per tube)	245	290	340	390 Volts
Max-Signal Peak Driving Power	78	87	95	110 Watts
Max-Signal Nominal Driving Power (approx.)	39	44	48	55 Watts
Max-Signal Plate Power Output	1100	1400	1650	1800 Watts

*Adjust to give stated zero-signal plate current

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC PLATE CURRENT	700 MA
PLATE DISSIPATION	200 WATTS
GRID DISSIPATION	50 WATTS

TYPICAL OPERATION (Power input limited to 500 and 1000 watts)*

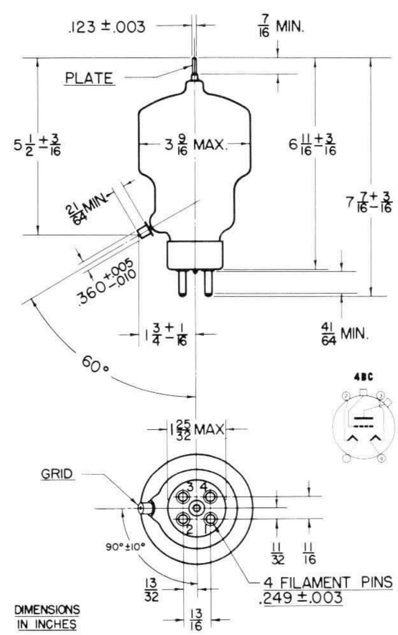
DC Plate Voltage	2000	2000	2500	2500 Volts
DC Plate Current	250	500	200	400 mA
Total Bias Voltage	—500	—500	—525	—550 Volts
Fixed Bias Voltage	—410	—275	—300	—300 Volts
Grid Resistor	3000	3000	12,500	5000 Ohms
DC Grid Current	30	75	18	50 mA
Peak RF Grid Input Voltage	615	690	620	715 Volts
Driving Power	18	52	11	36 Watts
Grid Dissipation	3	15	2	9 Watts
Plate Power Input	500	1000	500	1000 Watts
Plate Dissipation	90	190	75	170 Watts
Plate Power Output	410	810	425	830 Watts

*The figures are for convenience in obtaining a 500 or 1000 Watt carrier input per tube to the modulated amplifier. The output figures do not allow for circuit losses.

TYPICAL OPERATION*

DC Plate Voltage	1500	2000	2500 Volts
DC Plate Current	520	525	450 mA
Total Bias Voltage	—370	—500	—550 Volts
Fixed Bias Voltage	—160	—260	—440 Volts
Grid Resistor	2800	3000	2000 Ohms
DC Grid Current	75	80	55 mA
Peak RF Grid Input Voltage	545	695	720 Volts
Driving Power	41	55	40 Watts
Grid Dissipation	13	15	10 Watts
Plate Power Input	780	1050	1125 Watts
Plate Dissipation	200	200	200 Watts
Power Output	580	850	925 Watts

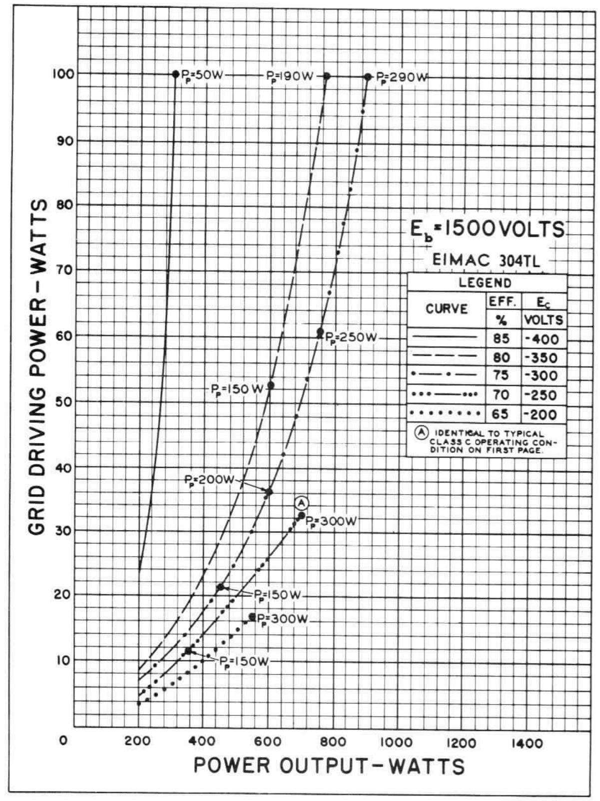
*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class C amplifier. The output figures do not allow for circuit losses.

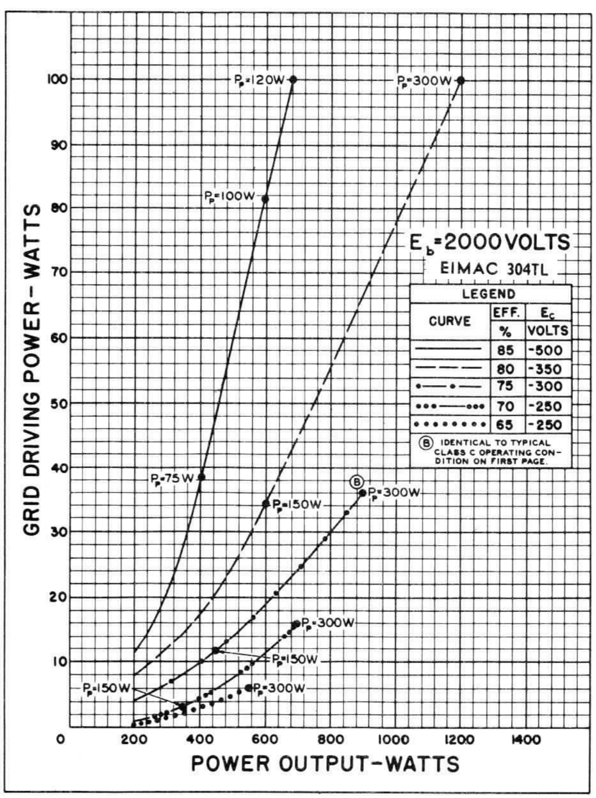


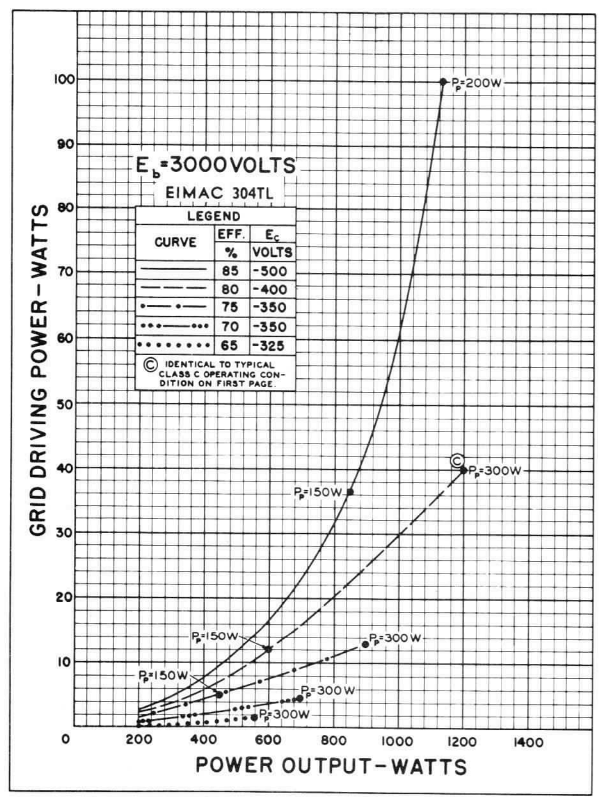
DRIVING POWER vs. POWER OUTPUT

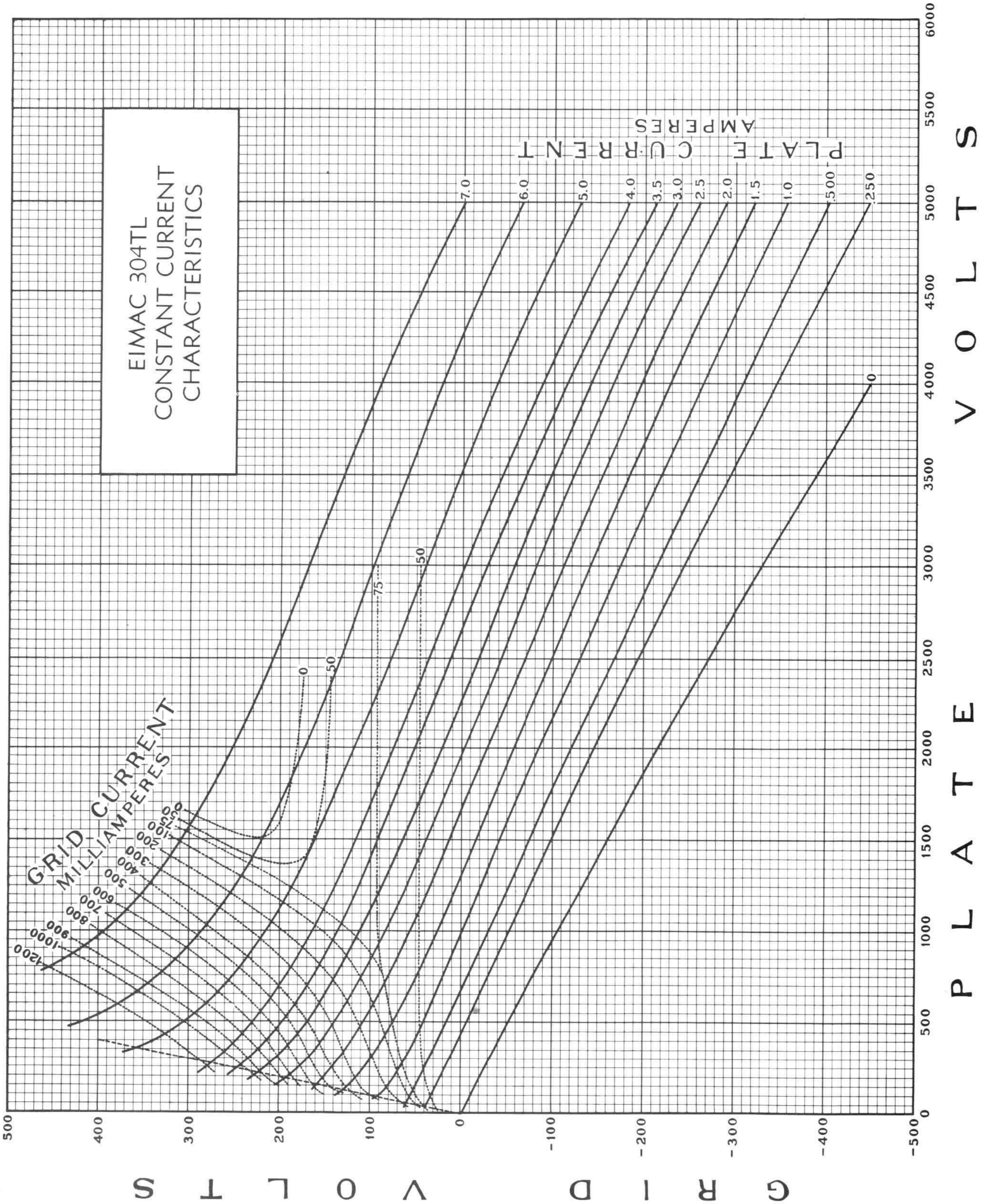
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 1500, 2000 and 3000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by Pp.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 1500, 2000, and 3000 volts respectively.








EIMAC 304TL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT
AMPERES
GRID CURRENT
MILLIAMPERES
PLATE VOLTS
GRID VOLTS

TECHNICAL DATA

450TH

HIGH-MU TRIODE

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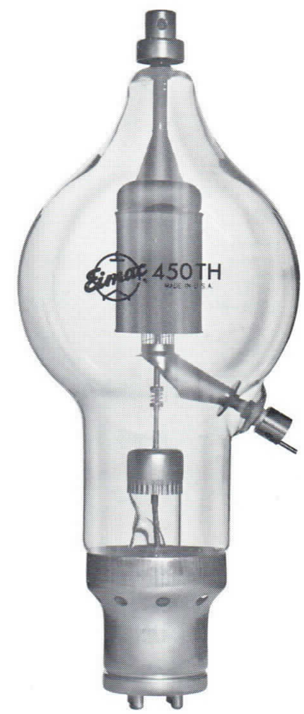
MODULATOR OSCILLATOR AMPLIFIER

The Eimac 450TH is a high-mu power triode having a maximum plate dissipation rating of 450 watts, and is intended for use as an amplifer, oscillator and modulator. It can be used at its maximum ratings at frequencies as high as 40 Mc.

Cooling of the 450TH is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipaton, and by means of air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten

Voltage	7.5 volts
Current	12.0 amperes

Note: Dual connections for each filament lead are provided within the base of the tube (see basing diagram). Corresponding socket terminals must be connected in parallel to provide proper distribution of filament and R-F charging currents.

Amplification Factor (Average)	38
Direct Interelectrode Capacitances (Average)	
Grid-plate	5.0 $\mu\mu$fd.
Grid-Filament	8.8 $\mu\mu$fd.
Plate-Filament	0.8 $\mu\mu$fd.
Transconductance (i_b = 500 ma., E_b = 4000 v.)	6650 μmhos
Frequency for maximum ratings	40 Mc.

MECHANICAL

Base	Special 4 pin, No. 5002B
Basing	RMA type 4AQ
Mounting	Vertical, base down or up
Cooling	Radiation and air circulation

Note: Adequate ventilation or air cooling must be provided so that the seals and envelope do not exceed 200°C under operating conditions.

Socket - - - - Johnson Type No. 211 or National Type No. XM50 or equivalent.

Recommended Heat Dissipating Connectors:

Plate	Eimac HR-8
Grid	Eimac HR-8

Note: The grid terminal of the 450TH is now .560" in diameter. To accommodate existing equipment designed for the older style 450TH having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal, if used, requires an HR-4 heat dissipating connector. (See outline drawing.)

Maximum Overall Dimensions:

Length	12.625 inches
Diameter	5.125 inches
Net weight	1.3 pounds
Shipping weight (Average)	5.6 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT PER TUBE	600 MAX. MA.
PLATE DISSIPATION, PER TUBE	450 MAX. WATTS

TYPICAL OPERATION—2 TUBES

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage (approx.)*	—50	—85	—115	Volts
Zero-Signal D-C Plate Current	200	150	120	Ma.
Max-Signal D-C Plate Current	770	675	620	Ma.
Effective Load, Plate-to-Plate	7800	12,800	18,600	Ohms
Peak A-F Grid Input Voltage (per tube)	225	235	267	Volts
Max-Signal Peak Driving Power	40	34	40	Watts
Max-Signal Nominal Driving Power (approx.)	20	17	20	Watts
Max-Signal Plate Power Output	1400	1800	2200	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4500 MAX. VOLTS
D-C PLATE CURRENT	500 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	4500	Volts
D-C Plate Current	380	340	345	Ma.
Total Bias Voltage	—250	—300	—350	Volts
Fixed Bias Voltage	—100	—150	—175	Volts
Grid Resistor	2500	3500	3500	Ohms
D-C Grid Current	60	43	50	Ma.
Peak R-F Grid Input Voltage	490	525	585	Volts
Driving Power (approx.)	30	23	29	Watts
Grid Dissipation	14	10	12	Watts
Plate Power Input	1150	1360	1550	Watts
Plate Dissipation	300	300	300	Watts
Plate Power Output	850	1060	1250	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class-C amplifier. The output figures do not allow for circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube).

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA.
PLATE DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage	—175	—200	—300	Volts
D-C Plate Current	500	450	450	Ma.
D-C Grid Current	95	85	90	Ma.
Peak R-F Grid Input Voltage	400	410	570	Volts
Driving Power (approx.)	35	35	46	Watts
Grid Dissipation	21	18	24	Watts
Plate Power Input	1500	1800	2250	Watts
Plate Dissipation	450	450	450	Watts
Plate Power Output	1050	1350	1800	Watts

*The figures show actual measured tube performance and do not allow for circuit losses.

APPLICATION

MECHANICAL

Mounting—The 450TH must be mounted vertically, base up or base down. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 450TH. In the event that the design of the equipment restricts natural circulation, the use of a small fan or centrifugal blower to provide additional cooling for the tube will aid in obtaining maximum tube life. Special heat-dissipating connectors (Eimac HR-8) are available for use on the plate and grid terminals. These connectors help to prolong tube life by reducing the temperature of the seals.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Unavoidable variations in fialment voltage must be kept within the range from 7 03 to 7.88 volts. All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 450TH, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 450TH must not exceed 80 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cpm} I_c$$

where P_g = Grid dissipation,

e_{cmp} = Peak positive grid voltage, and

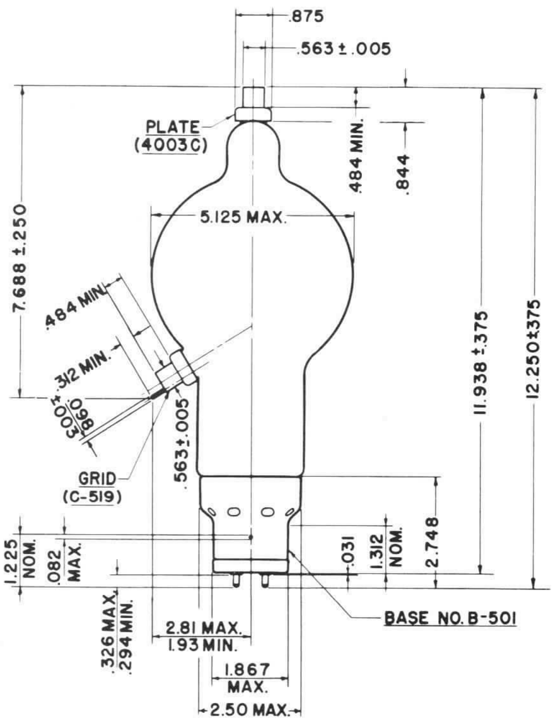
I_c = D-c grid current.

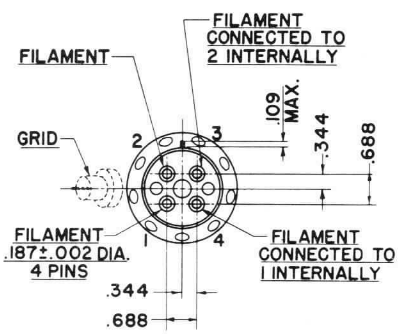
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.[1] In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any conditions of loading.

Plate Voltage—Except in very special applications, the plate supply voltage for the 450TH should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

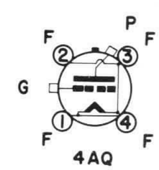
Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 450TH should not be allowed to exceed 450 watts. At this dissipation the brightness temperature of the plate will appear a visible red color. The value of this color is somewhat effected by light from the filament as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

[1]For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News**, January, 1945. This article is available in reprint form on request.





BOTTOM VIEW

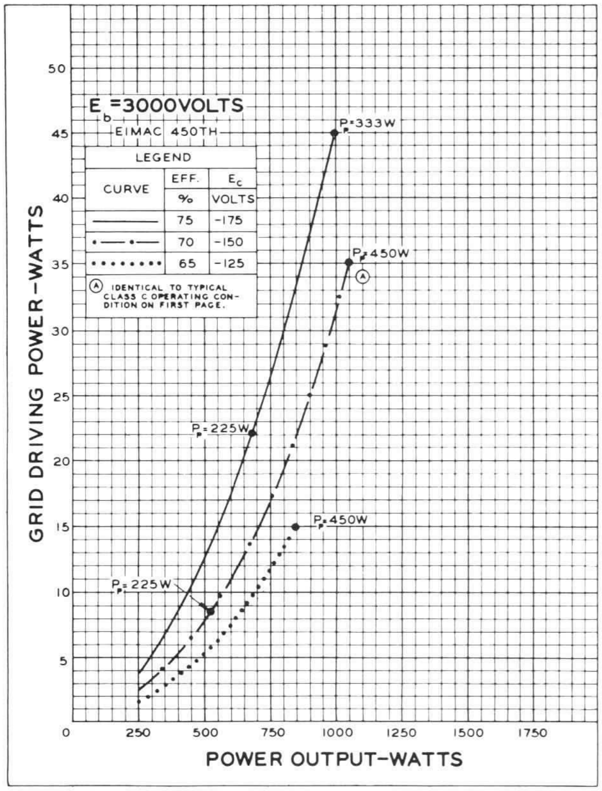


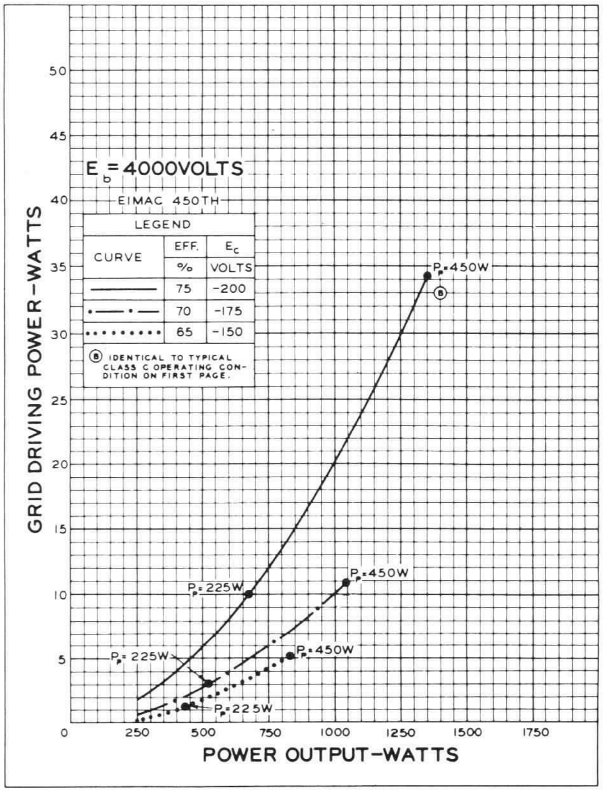
NOTE:—The grid terminal on the new 450TH and TL type tube is now .563" in diameter. To accommodate existing equipment which uses the 450TH or TL tubes with the old style .098" grid terminal, an adapter pin is provided. This adapter pin, if not needed, may be removed by unscrewing.

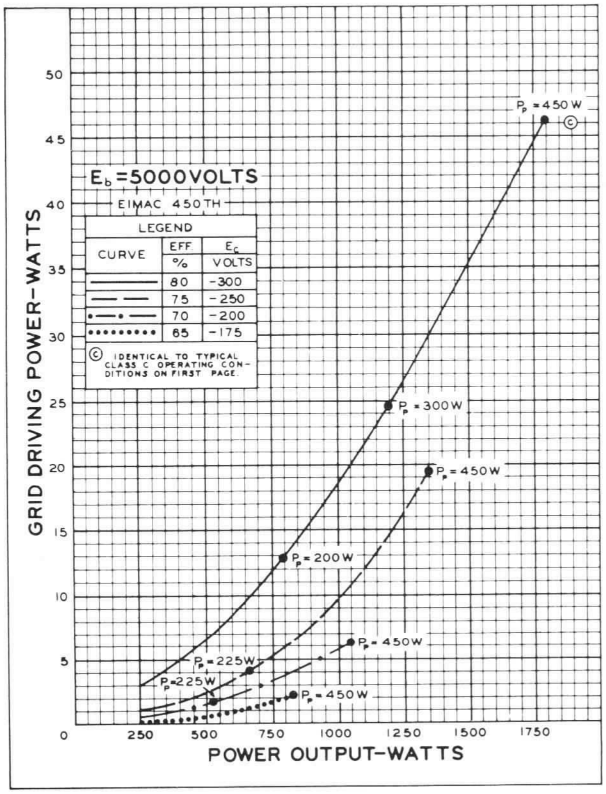
DRIVING POWER vs. POWER OUTPUT

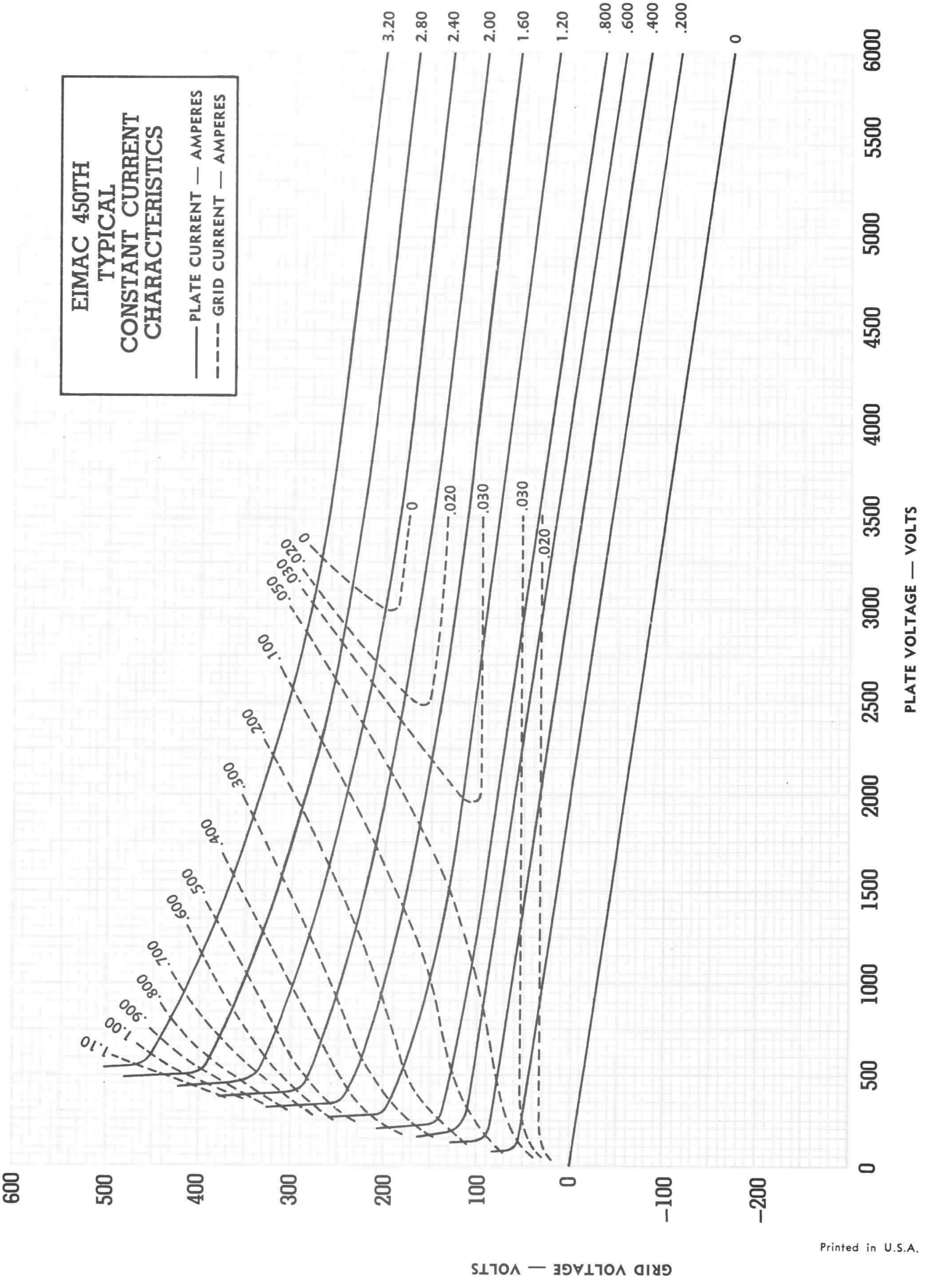
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.









Printed in U.S.A.

EIMAC

Division of Varian

SAN CARLOS

CALIFORNIA

450TL

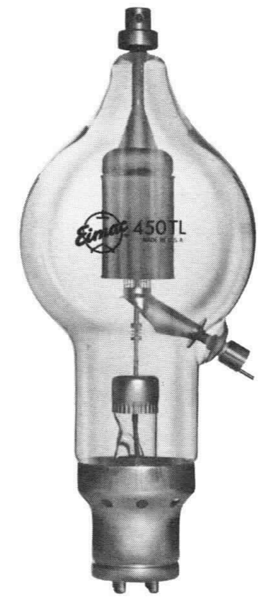
MEDIUM-MU TRIODE

•

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 450TL is a medium-mu power triode having a maximum plate dissipation rating of 450 watts, and is intended for use as an amplifier, oscillator and modulator. It can be used at its maximum ratings at frequencies as high as 40-Mc.

Cooling of the 450TL is accomplished by radiation from the plate, which operates at a visible red color at maximum dissipation, and by means of air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten

Voltage	7.5 volts
Current	12.0 amperes

Note: Dual connections for each filament lead are provided within the base of the tube (see basing diagram). Corresponding socket terminals must be connected in parallel to provide proper distribution of filament and R-F charging currents.

Amplification Factor (Average)	18
Direct Interelectrode Capacitances (Average)	
Grid-Plate	4.5 $\mu\mu$f
Grid-Filament	6.8 $\mu\mu$f
Plate-Filament	0.8 $\mu\mu$f
Transconductance (i_b=500ma, E_b=4000v, e_c= —75v.)	5000 μmhos
Frequency for Maximum Ratings	40-Mc.

MECHANICAL

Base	Special 4 pin, No. 5002B
Basing	RMA type 4AQ
Mounting	Vertical, base down or up
Cooling	Radiation and air circulation

Note: Adequate ventilation or air cooling must be provided so that the seals and envelope do not exceed 200°C under operating conditions.

Socket - - - Johnson Type No. 211 or National Type No. XM50 or equivalent.

Recommended Heat Dissipating Connectors:

Plate	Eimac HR-8
Grid	Eimac HR-8

Note: The grid terminal of the 450TL is now .560" in diameter. To accommodate existing equipment designed for the older style 450TL having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal, if used, requires an HR-4 heat dissipating connector. (See outline drawing.)

Maximum Overall Dimensions:

Length	12.625 inches
Diameter	5.125 inches
Net weight	1.3 pounds
Shipping weight (Average)	5.6 pounds

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT PER TUBE	600 MAX. MA.
PLATE DISSIPATION, PER TUBE	450 MAX. WATTS

TYPICAL OPERATION—2 TUBES

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage (approx.)*	—110	—175	—240	Volts
Zero-Signal D-C Plate Current	200	150	120	Ma.
Max-Signal D-C Plate Current	770	675	620	Ma.
Effective Load, Plate-to-Plate	7700	12,800	18,500	Ohms
Peak A-F Grid Input Voltage (per tube)	325	365	430	Volts
Max-Signal Peak Driving Power	40	33	56	Watts
Max-Signal Nominal Driving Power (approx.)	20	17	28	Watts
Max-Signal Plate Power Output	1400	1800	2200	Watts

*Adjust to give stated zero-signal plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube).

MAXIMUM RATINGS

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA.
PLATE DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	65 MAX. WATTS

TYPICAL OPERATON, PER TUBE*

D-C Plate Voltage	3000	4000	5000	Volts
D-C Grid Voltage	—275	—400	—500	Volts
D-C Plate Current	500	450	450	Ma.
D-C Grid Current	65	53	54	Ma.
Peak R-F Grid Input Voltage	640	740	870	Volts
Driving Power (approx.)	38	35	42	Watts
Grid Dissipation	20	13	15	Watts
Plate Power Input	1500	1800	2250	Watts
Plate Dissipation	450	450	450	Watts
Plate Power Output	1050	1350	1800	Watts

*The figures show actual measured tube performance and do not allow for circuit losses.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4500 MAX. VOLTS
D-C PLATE CURRENT	500 MAX. MA.
PLATE DISSIPATION	300 MAX. WATTS
GRID DISSIPATION	65 MAX. WATTS

TYPICAL OPERATION, PER TUBE*

D-C Plate Voltage	3000	4000	4500	Volts
D-C Plate Current	380	340	345	Ma.
Total Bias Voltage	—400	—500	—550	Volts
Fixed Bias Voltage	—200	—250	—275	Volts
Grid Resistor	5000	7000	7500	Ohms
D-C Grid Current	40	36	36	Ma.
Peak R-F Grid Input Voltage	700	790	850	Volts
Driving Power	28	29	31	Watts
Grid Dissipation	12	11	11	Watts
Plate Power Input	1150	1360	1550	Watts
Plate Dissipation	300	300	300	Watts
Plate Power Output	850	1060	1250	Watts

*The figures are for one tube operating at maximum plate dissipation as a plate modulated Class-C amplifier. The output figures do not allow for circuit losses.

APPLICATION

MECHANICAL

Mounting—The 450TL must be mounted vertically, base up or base down. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—Provision should be made for ample circulation of air around the 450TL. In the event that the design of the equipment restricts natural circulation, the use of a small fan or centrifugal blower to provide additional cooling for the tube will aid in obtaining maximum tube life. Special heat-dissipating connectors (Eimac HR-8) are available for use on the plate and grid terminals. These connectors help to prolong tube life by reducing the temperature of the seals.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 7.5 volts. Unavoidable variations in filament voltage must be kept within the range from 7.03 to 7.88 volts. All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—Although there is no maximum limit on the bias voltage which may be used on the 450TL, there is little advantage in using bias voltages in excess of those given under "Typical Operation," except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 450TL must not exceed 65 watts. Grid dissipation may be calculated from the following expression:

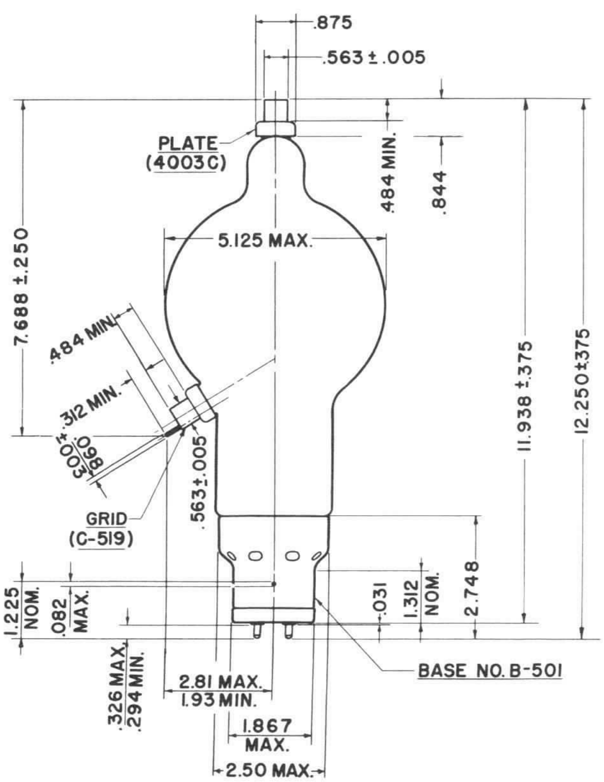
$$P_g = e_{cmp} I_c$$

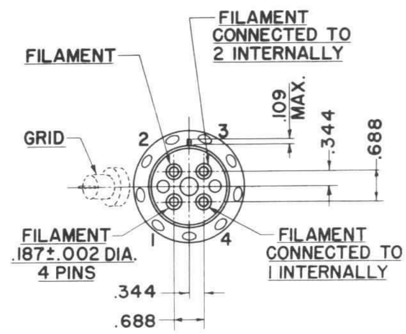
where P_g = Grid dissipation
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

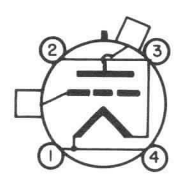
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. In equipment in which the plate loading varies widely, such as oscillators used for radio-frequency heating, care should be taken to make certain that the grid dissipation does not exceed the maximum rating under any conditions of loading.

Plate Voltage—Except in very special applications, the plate supply voltage for the 450TL should not exceed 6000 volts. In most cases there is little advantage in using plate-supply voltages higher than those given under "Typical Operation" for the power output desired.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 450TL should not be allowed to exceed 450 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.





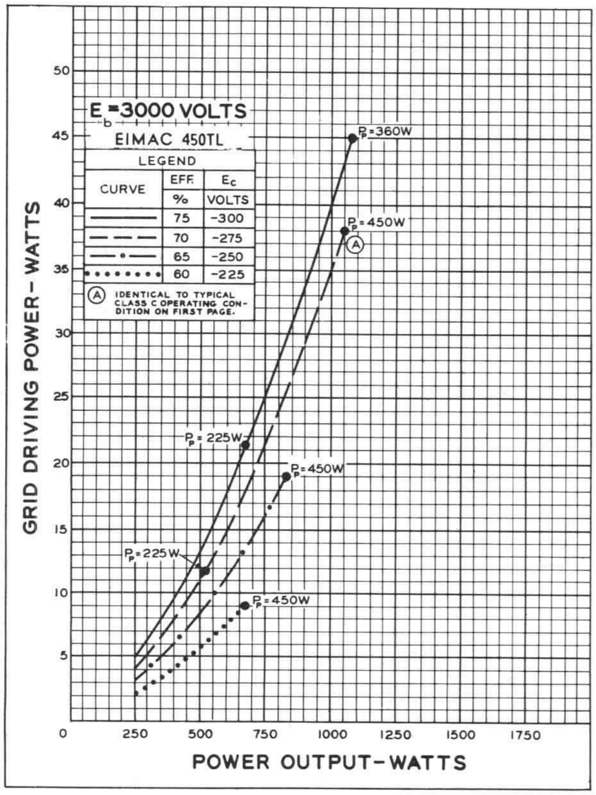


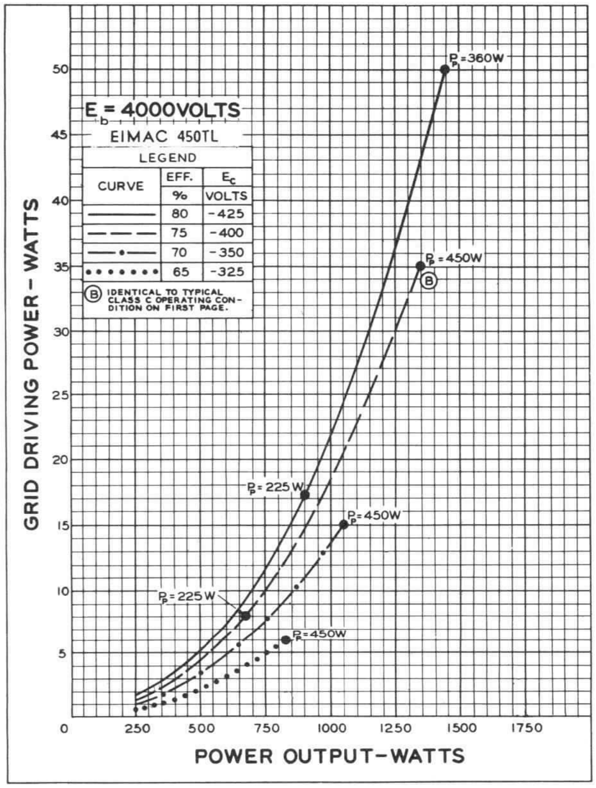
NOTE:—The grid terminal on the new 450TH and TL type tube is now .563" in diameter. To accommodate existing equipment which uses the 450TH or TL tubes with the old style .098" grid terminal, an adaptor pin is provided. This adaptor pin, if not needed, may be removed by unscrewing.

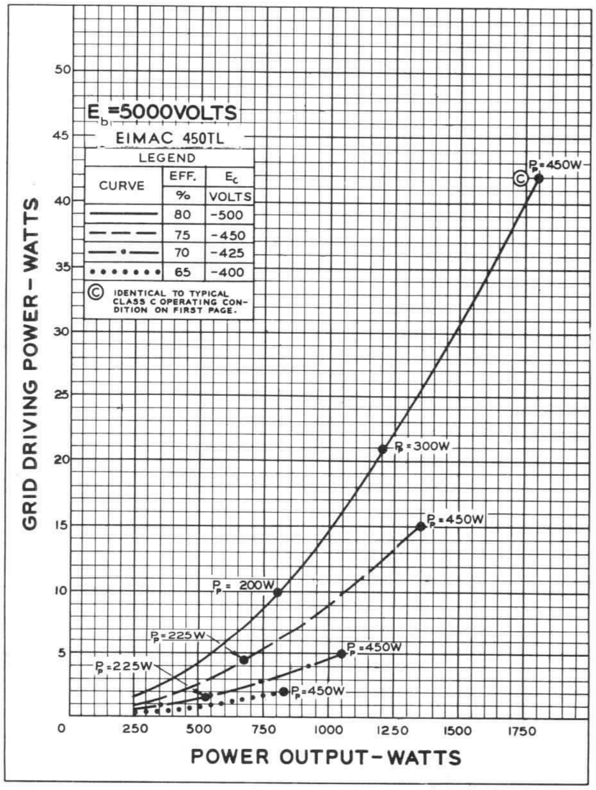
DRIVING POWER vs. POWER OUTPUT

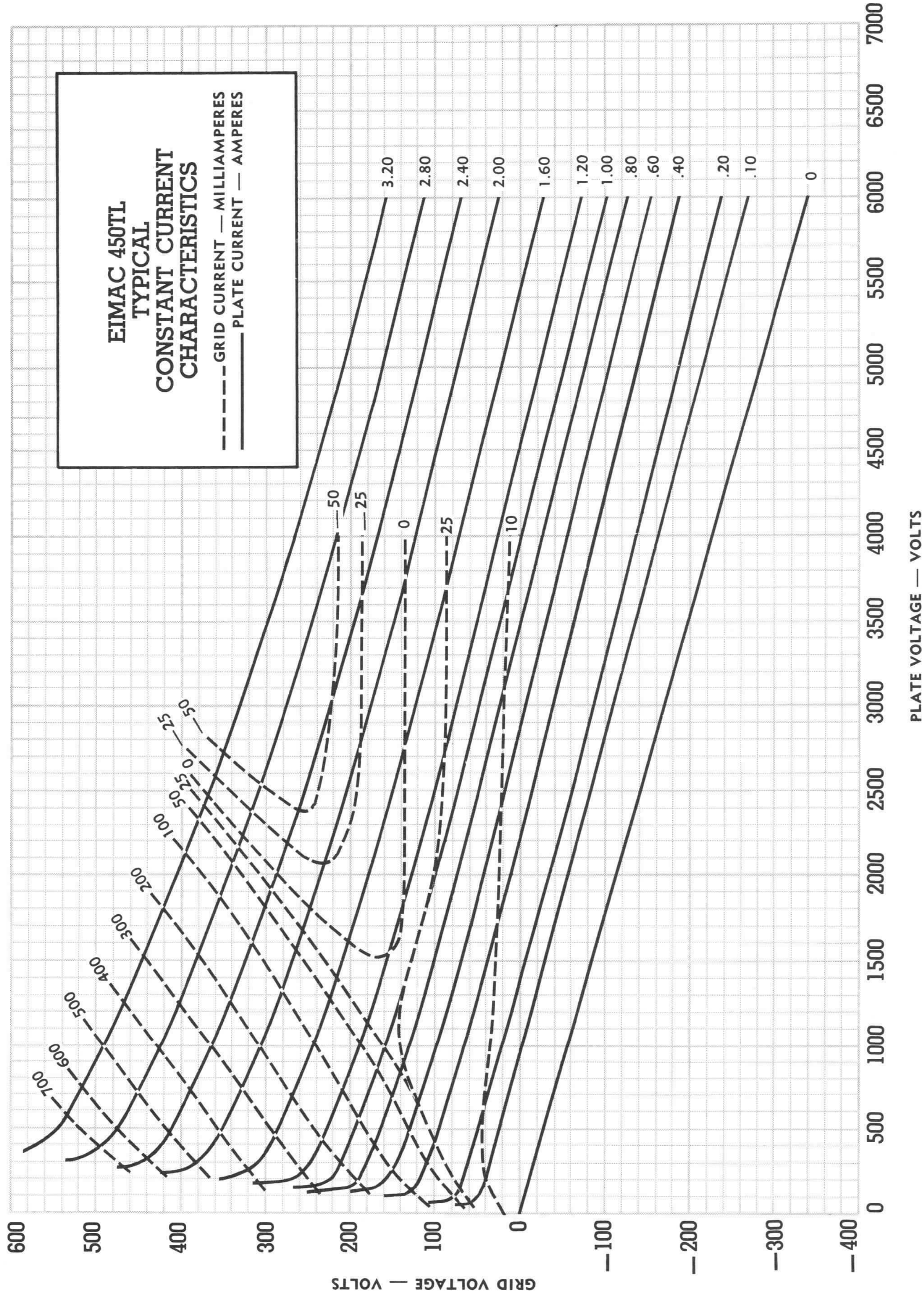
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 3000, 4000, and 5000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 3000, 4000, and 5000 volts respectively.








EIMAC 450TL
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GRID CURRENT — MILLIAMPERES
PLATE CURRENT — AMPERES
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS

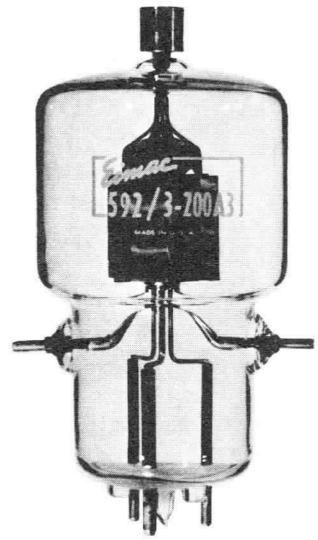
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

592/3-200A3
MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The EIMAC 592/3-200A3 is a medium-mu power triode having a maximum plate dissipation rating of 200 watts, and it is intended for use as a power amplifier, oscillator, or modulator. It can be used at its maximum ratings at frequencies as high as 150 MHz.

Cooling of the 592/3-200A3 is accomplished by radiation from the plate, which operates at a visible red color at maximum plate dissipation, and by means of forced-air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	10.0 volts
Current	5.0 amperes
Amplification Factor (Average)	25
Direct Interelectrode Capacitances (Average)	
Grid-Plate	3.3 $\mu\mu f$
Grid-Filament	3.6 $\mu\mu f$
Plate-Filament	0.29 $\mu\mu f$
Transconductance (I_b=200 ma., E_b=3000 v.)	3600 μmhos
Frequency for Maximum Ratings	150 MHz

MECHANICAL

Mounting	Vertical
Maximum Over-all Dimensions:	
Length	6.0 inches
Diameter	$3\frac{13}{32}$ inches
Net Weight (approx.)	6 ounces
Shipping Weight (approx.)	1½ pounds
Cooling	Radiation and Forced-Air
Recommended Heat Dissipating Connectors:	
Plate	EIMAC HR-10
Grid	EIMAC HR-5
Maximum Bulb Temperature	225°C
Maximum Seal Temperature	175°C

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class B

MAXIMUM RATINGS

DC PLATE VOLTAGE	3500 VOLTS
MAX-SIGNAL DC PLATE CURRENT	250 MA.
DC PLATE CURRENT	200 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION

Sinusoidal wave, two tubes unless otherwise specified.

DC Plate Voltage	2000	2500	3000 Volts
DC Grid Voltage (approx.)*	—50	—70	—90 Volts
Zero-Signal DC Plate Current	120	100	80 Ma.
Max-Signal DC Plate Current	500	450	400 Ma.
Effective Load, Plate-to-Plate	8500	12,600	18,000 Ohms
Peak AF Grid Input Voltage (per tube)	260	270	270 Volts
Max-Signal Peak Driving Power	50	52	40 Watts
Max-Signal Nominal Driving Power (approx.)	25	26	20 Watts
Max-Signal Plate Power Output	600	725	820 Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2600 VOLTS
PLATE DISSIPATION	200 MA.
PLATE DISSIPATION	130 WATTS
GRID DISSIPATION	25 WATTS

TYPICAL OPERATION

DC Plate Voltage	2000	2500 Volts
DC Plate Current	200	200 Ma.
DC Grid Voltage	—250	—300 Volts
DC Grid Current	35	35 Ma.
Peak RF Grid Input Voltage	480	535 Volts
Driving Power	17	19 Watts
Grid Dissipation	8	9 Watts
Plate Power Input	400	500 Watts
Plate Dissipation	115	125 Watts
Plate Power Output	285	375 Watts

The output figures do not allow for circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE - - -	3500 VOLTS
DC PLATE CURRENT - - -	250 MA.
PLATE DISSIPATION - - -	200 WATTS
GRID DISSIPATION - - -	25 WATTS

TYPICAL OPERATION				
DC Plate Voltage - - -	2000	2500	3000	3500 Volts
DC Plate Current - - -	250	228	222	228 Ma.
DC Grid Voltage - - -	−150	−180	−220	−270 Volts
DC Grid Current - - -	32	28	25	30 Ma.
Peak RF Grid Input Voltage	380	400	440	505 Volts
Driving Power - - -	12	11	11	15 Watts
Grid Dissipation - - -	7	6	5.5	7 Watts
Plate Power Input - -	500	570	666	800 Watts
Plate Dissipation - - -	200	200	200	200 Watts
Plate Power Output - -	300	370	466	600 Watts

The output figures do not allow for circuit losses.

APPLICATION

MECHANICAL

Mounting — The 592/3-200A3 must be mounted vertically, base down or base up. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling — An air-flow of approximately 15 cubic feet per minute should be directed at the bulb from a 2 inch diameter nozzle located about three inches from the center line of the tube. The center line of the nozzle should be located about two inches down from the top of the plate terminal. The incoming air temperature should not exceed 50°C. Other methods of cooling may be used provided the maximum bulb and seal temperatures are not exceeded. An 8 inch, household-type fan located about 10 inches from the tube is one alternate method. Special heat-dissipating connectors EIMAC HR-5 and HR-10, or equivalent, for grid and plate terminals respectively) should be used with this tube. These connectors help to prolong tube life by reducing the temperature of the metal-glass seals.

ELECTRICAL

Filament Voltage — For maximum tube life, the filament voltage, as measured directly at the filament pins, should be the rated value of 10.0 volts. Unavoidable variations in filament voltage must be kept within the range of 9.5 to 10.5 volts.

Bias Voltage — There is little advantage in using bias voltages in excess of those given under "Typical Operation" except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation — The power dissipated by the grid of the 592/3-200A3 must not exceed 25 watts. Grid dissipation may be calculated from the following expression:

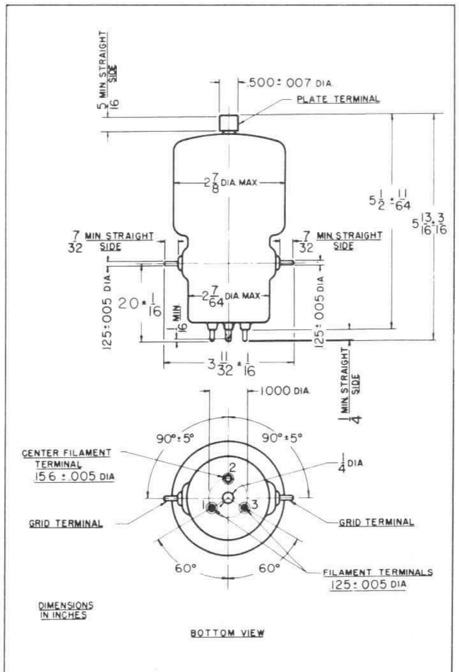
$$P_g = e_{cmp} I_c$$

where P_g=grid dissipation,
e_{cmp}=peak positive grid voltage, and
I_c=dc grid current.

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid.

Plate Voltage—Except for special applications, the plate supply voltage for the 592/3-200A3 should not exceed 3500 volts. In most cases there is little advantage in using plate-supply voltages in excess of those given under "Typical Operation" for the power output desired.

Plate Dissipation — Under normal operating conditions, the power dissipated by the plate of the 592/3-200A3 should not exceed 200 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament, as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

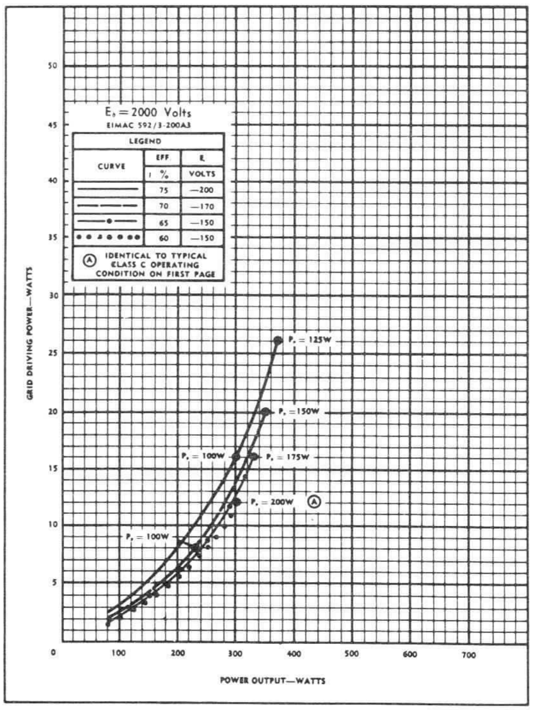


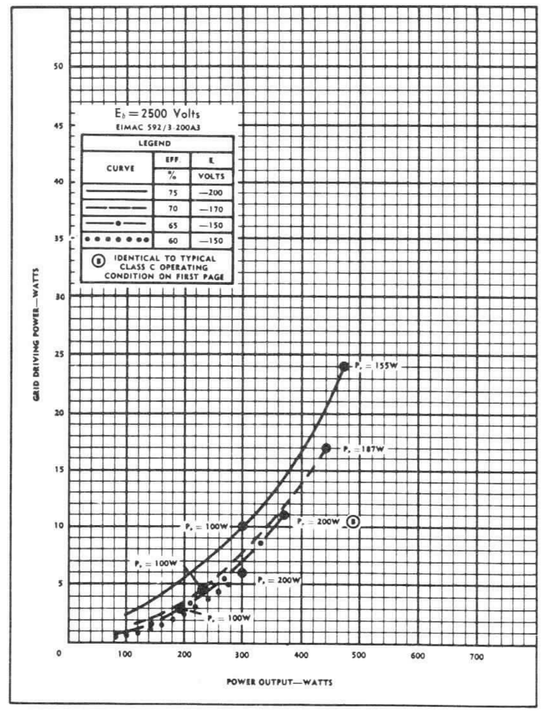
NOTE: CENTER FILAMENT TERMINAL, FILAMENT TERMINALS, AND TUBULATION ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA. .186", .155", AND .350" RESPECTIVELY, LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS.

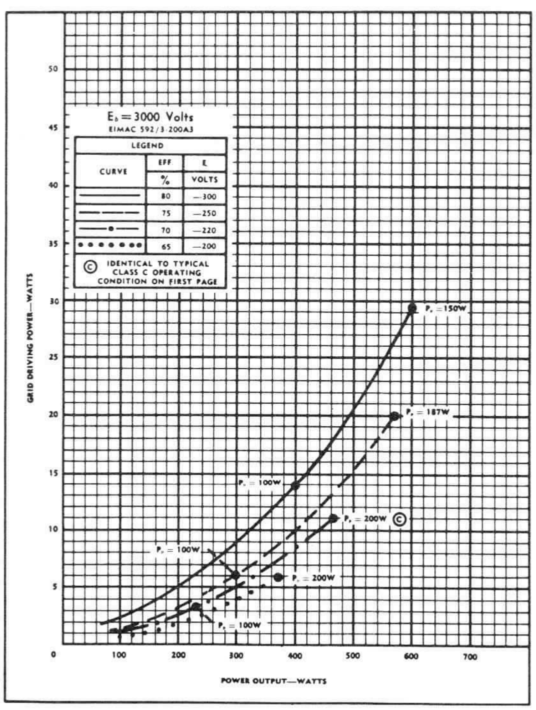
DRIVING POWER vs. POWER OUTPUT

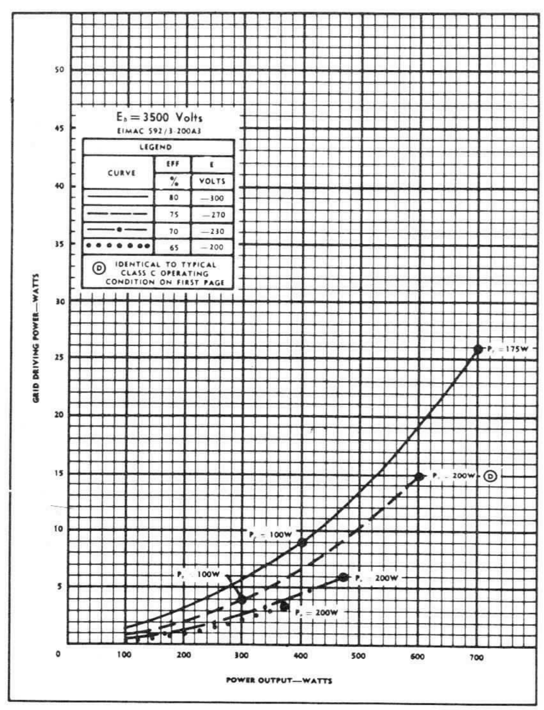
The four charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 2000, 2500, 3000 and 3500 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

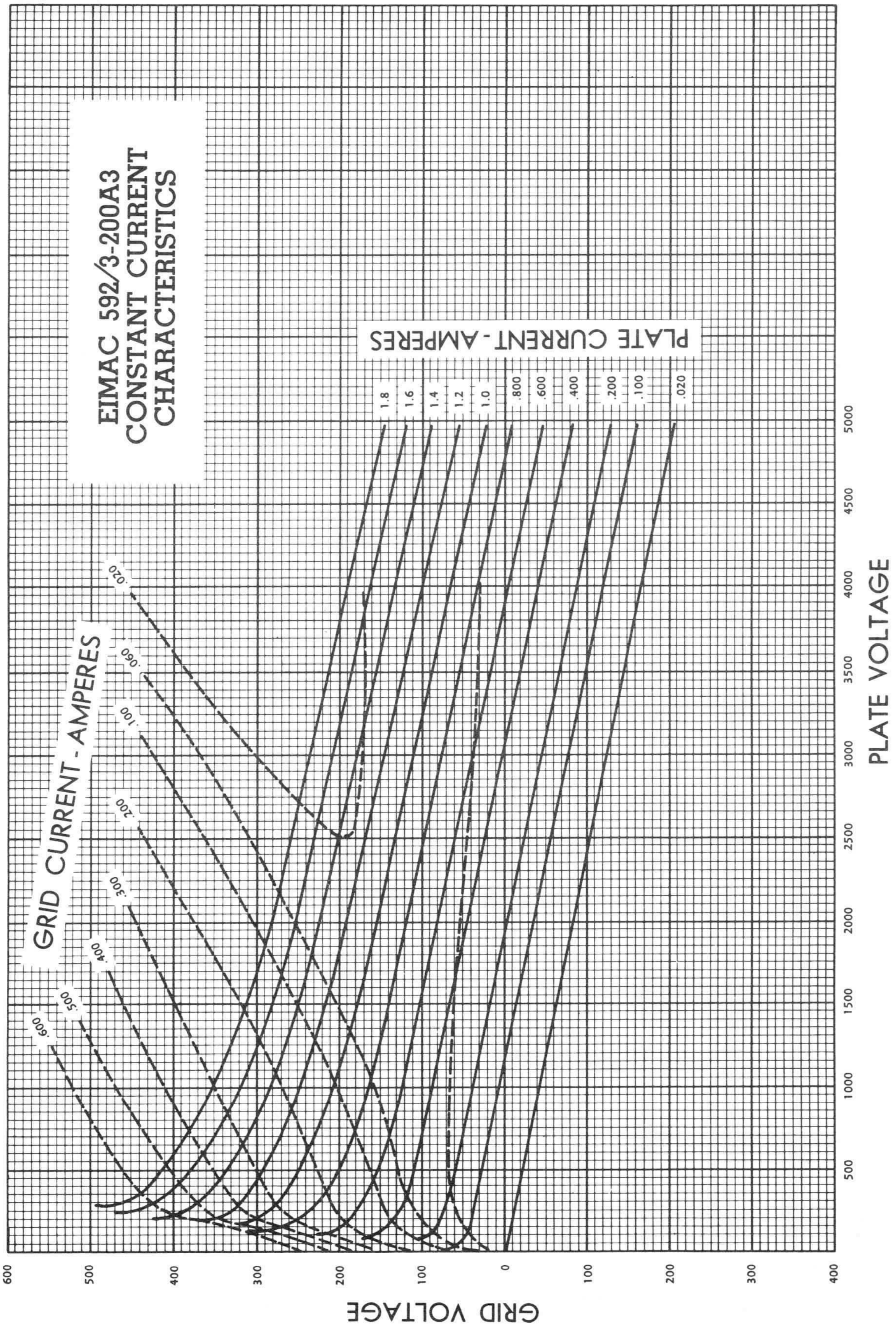
Points A, B, C, and D are identical to the typical Class C operating conditions shown on the first page under 2000, 2500, 3000, and 3500 volts respectively.










EIMAC 592/3-200A3
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT - AMPERES
1.8
1.6
1.4
1.2
1.0
.800
.600
.400
.200
.100
.020
GRID CURRENT - AMPERES
.020
.060
.100
.200
.300
.400
.500
.600
PLATE VOLTAGE
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
GRID VOLTAGE
600
500
400
300
200
100
0
100
200
300
400

TECHNICAL DATA

1000T

HIGH-MU TRIODE

•

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 1000T is a high-mu power triode intended for use as a modulator, oscillator, or amplifier. The tube has a maximum plate dissipation rating of 1000 watts, and a maximum plate voltage rating of 7500 volts at frequencies up to 50 Mc. Cooling is by forced air and radiation.

The 1000T in Class-C r-f service will deliver up to 3000 watts plate power output with 60 watts driving power. Two 1000T's in Class AB_2 modulator service will deliver up to 4600 watts maximum signal plate power output with 60 watts driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 volts ± 5%
Current	15.5 amperes
Amplification Factor (Average)	35
Direct Interelectrode Capacitances (Average)	
Grid-Plate	5.1 $\mu\mu$f
Grid-Filament	9.3 $\mu\mu$f
Plate-Filament	0.5 $\mu\mu$f
Transconductance (I_b=750ma., E_b=6000v.)	9050 μmhos
Highest Frequency for Maximum Ratings	50 Mc

MECHANICAL

Base	50-watt jumbo 4-pin with air-conduction pipe
Connections	See outline drawing
Socket	Johnson type No. 123-211 or equivalent
Mounting Position	Vertical, base down or up
Cooling	Forced air and radiation
Maximum Temperature of Grid and Plate Seals	225°C
Recommended Grid and Plate Heat Dissipating Connectors	Eimac HR-9
Maximum Dimensions:	
Seated Height	12.3 inches
Diameter	5.13 inches
Net Weight	1.25 pounds
Shipping Weight (Average)	6.25 pounds

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_2

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C PLATE CURRENT	750 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Grid Voltage[1]	−85	−125	−160	volts
Zero-Signal D-C Plate Current	335	270	220	ma
Max-Signal D-C Plate Current	1.25	1.14	1.05	amps
Effective Load, Plate-to-Plate	6250	9200	13,300	ohms
Peak A-F Grid Voltage (per tube)	260	290	335	volts
Max-Signal Driving Power*	35	37	60	watts
Max-Signal Plate Power Input	5000	5700	6300	watts
Max-Signal Plate Power Output	3000	3700	4600	watts

[1]Adjust to stated Zero-Signal Plate Current.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 50 Mc.)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C PLATE CURRENT	750 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 50 Mc.)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Grid Voltage	−150	−150	−225	−350	volts
D-C Plate Current	750	713	667	667	ma
D-C Grid Current*	90	100	87	110	ma
Peak R-F Grid Voltage	350	365	420	610	volts
Driving Power*	30	33	33	60	watts
Grid Dissipation*	21	19	14	25	watts
Plate Power Input	2250	2850	3335	4000	watts
Plate Power Output	1350	1850	2335	3000	watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS (Frequencies up to 50 Mc.)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA
PLATE DISSIPATION	665 MAX. WATTS
GRID DISSIPATION	80 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 50 Mc.)

D-C Plate Voltage	4000	5000	6000	volts
D-C Grid Voltage	−300	−400	−500	volts
D-C Plate Current	600	600	600	ma
D-C Grid Current*	80	90	95	ma
Peak R-F Grid Voltage	540	660	775	volts
Driving Power*	45	60	75	watts
Grid Dissipation*	20	24	25	watts
Plate Power Input	2400	3000	3600	watts
Plate Power Output	1735	2335	2935	watts

*Approximate values

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 1000T must be mounted vertically. The base may be either down or up. The leads to the plate and grid terminals should be flexible, and the tube must be protected from vibration and shock.

Cooling—The envelope and seals of the 1000T require forced-air cooling. Air-conduction pipes are provided in the base of the tube and in the HR-9 plate and grid Heat-Dissipating Connectors. Two cubic feet of air per minute supplied to each of these pipes will satisfy the cooling requirements of the seals. An 8- or 10-inch fan located approximately a foot from the tube will provide sufficient cooling air for the envelope. Air must be supplied to the tube when plate and grid voltages are applied, and must be continued until these voltages are removed. In some cases, particularly in locations where the ambient temperature is high, or where the free circulation of air is impeded, cooling air must be supplied when filament voltage is applied, and continued for two or more minutes after all voltages are removed.

The temperature of the grid and plate seals must not be allowed to exceed 225°C. A convenient accessory for the measurements of these temperatures is "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

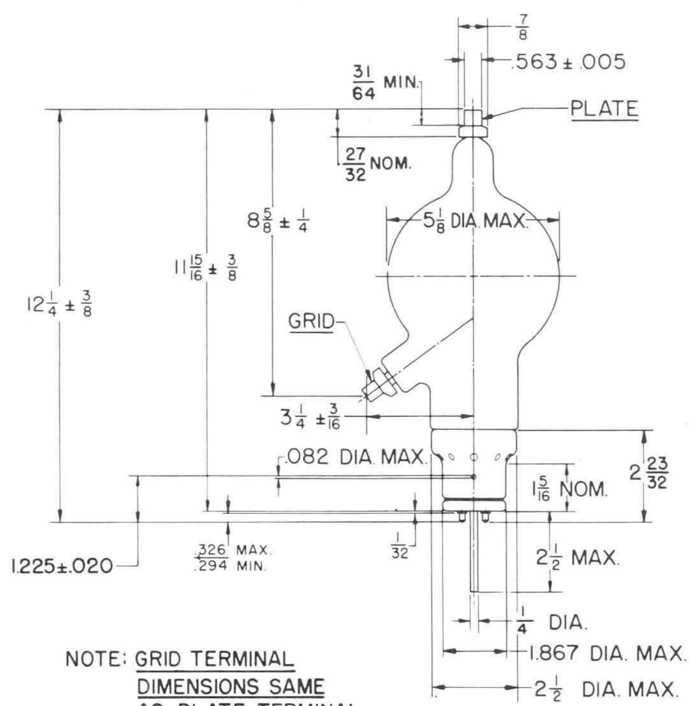
Filament—All four socket terminals should be used, putting two in parallel for each filament connection.

Bias Voltage—The maximum limit on bias voltages which may be used with the 1000T is considerably above those listed in "Typical Operation." Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

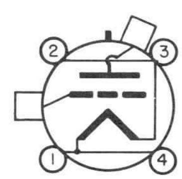
Plate Voltage—The rated maximum d-c plate voltage of 7500 volts applies at frequencies up to 50 Mc. Above that frequency the tube must be operated at lower d-c voltages. In most cases there is little advantage in using plate supply voltages higher than those given under "Typical Operation" for the power output desired.

Grid Dissipation—Grid dissipation may be assumed to be the product of the d-c grid current and the peak positive cathode-to-grid voltage. This assumption is sufficiently accurate for the purpose of determining that the 1000T is operating within its maximum rated grid dissipation of 80 watts.

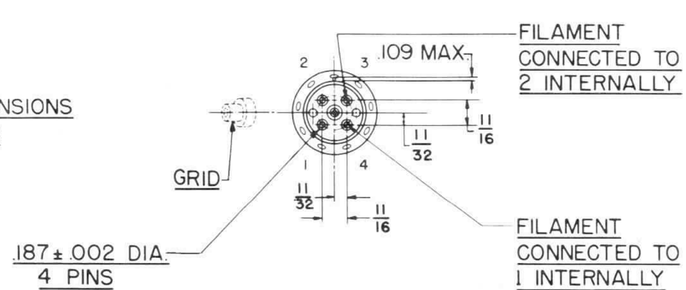
Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 1000T should not be allowed to exceed 1000 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.



NOTE: GRID TERMINAL DIMENSIONS SAME AS PLATE TERMINAL



ALL DIMENSIONS IN INCHES

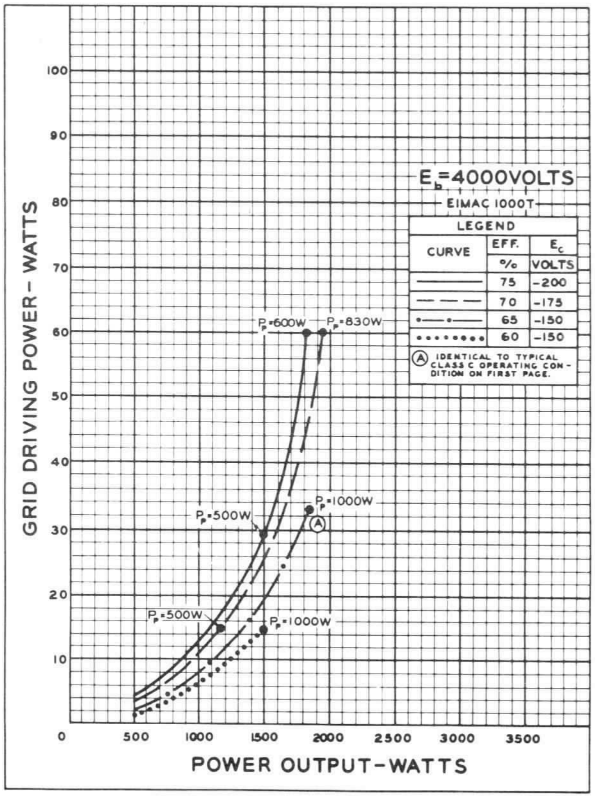


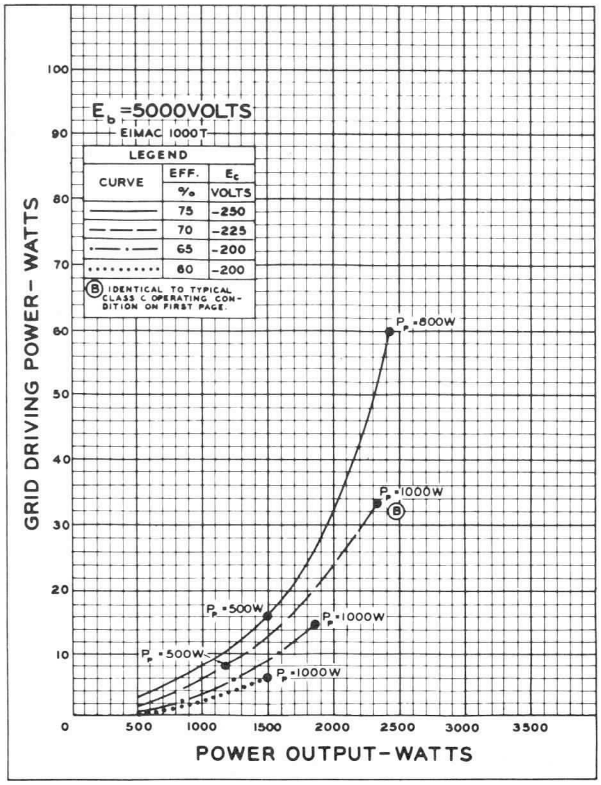
BOTTOM VIEW

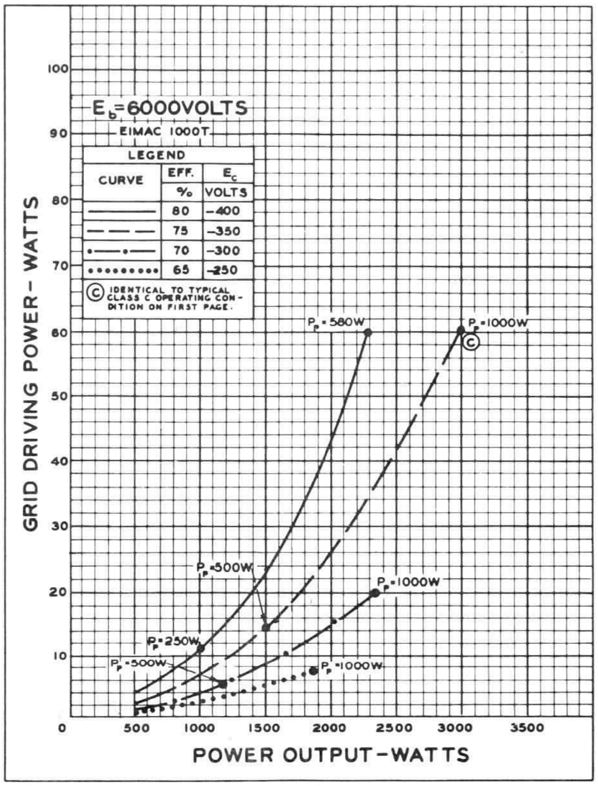
DRIVING POWER vs. POWER OUTPUT

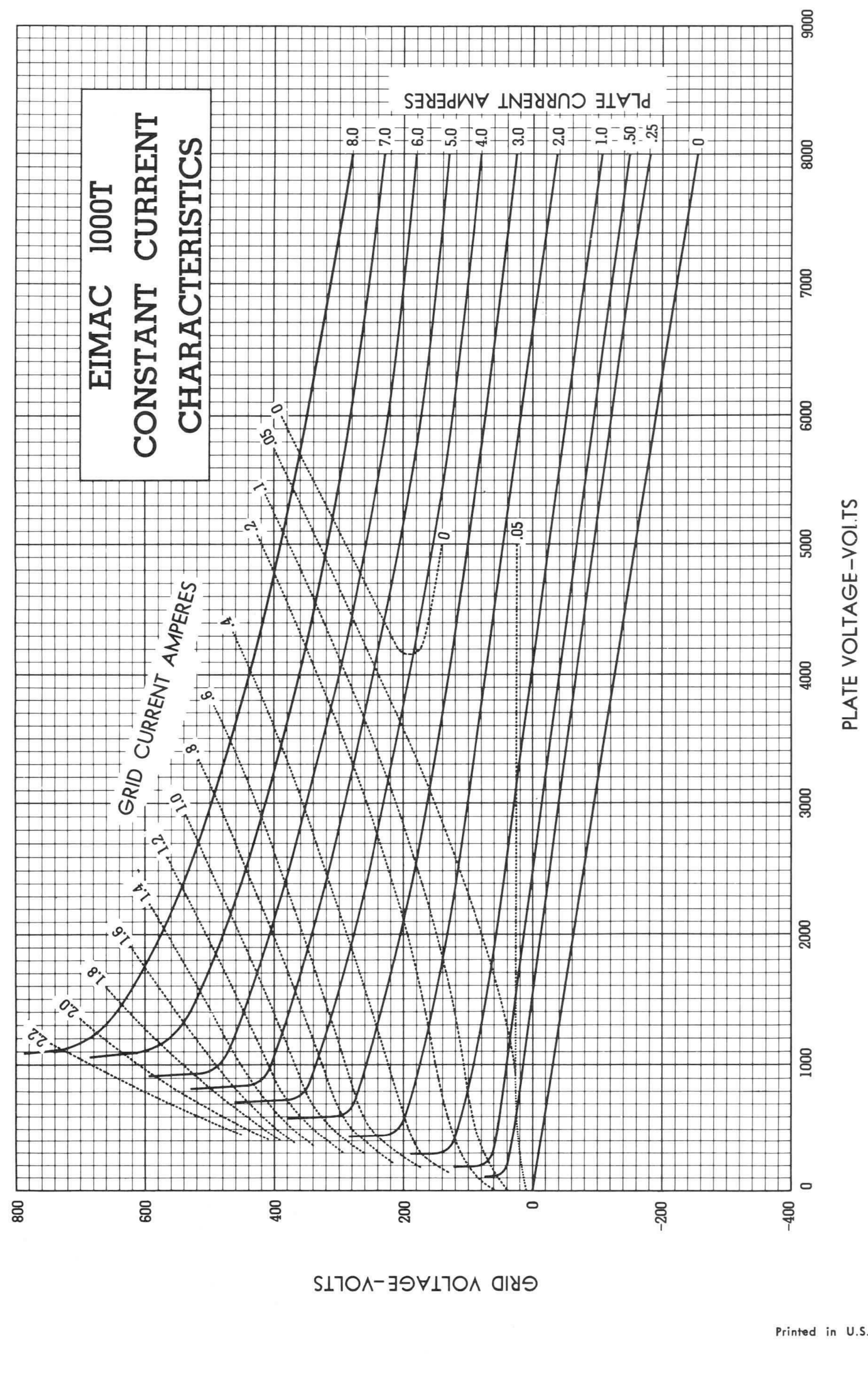
The three charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 4000, 5000 and 6000 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

Points A, B, and C are identical to the typical Class C operating conditions shown on the first page under 4000, 5000, and 6000 volts respectively.









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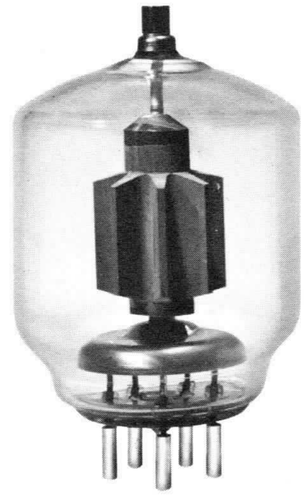
EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

5867A
AIR-COOLED MEDIUM MU POWER TRIODE



The Eimac 5867A is a power triode designed primarily for use in Industrial Heating applications. The large heat storage capacity of the graphite anode aids in compensating for the wide variations in loading generally associated with this type of sevrice. The 5867A is also suitable for use as an RF or AF Power Amplifier or Modulator.

The 5867A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling is greatly simplified by using the Eimac SK-410 Air-System Socket and SK-406 Air Chimney.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*
Filament: Thoriated Tungsten			
Voltage		5.0	volts
Current	13.5		14.7 amperes
Amplification Factor (E_b=2500 V, I_b=100 ma)		25	
Direct Interelectrode Capacitances			
Grid-Plate	5.0		6.2 uuf
Grid-Filament	6.5		8.0 uuf
Plate-Filament			0.5 uuf
Transconductance (I_b=100 ma)		5,000	umhos
Highest Frequency for Maximum Ratings			50 mc

MECHANICAL

Base	see drawing
Mounting	Vertical, base up or down
Cooling	Radiation and forced-air
Maximum Operating Temperatures:	
Plate Seals	220°C
Base Seals	180°C
Maximum Overal Dimensions:	
Height	5.875 inches
Diameter	3.438 inches
Socket	SK-410
Chimney	SK-406
Heat Radiator Connector	HR-6
Net Weight	6 ounces

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

CLASS-C FM or Telegraphy

MAXIMUM RATINGS

DC PLATE VOLTAGE	- - -	4,000 MAX. VOLTS
DC GRID VOLTAGE	- - -	–500 MAX. VOLTS
DC PLATE CURRENT	- - -	400 MAX. Ma.
PLATE DISSIPATION	- - -	350 MAX. WATTS
GRID DISSIPATION	- - -	30 MAX. WATTS

*Approximate Value.

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

DC Plate Voltage	- - -	2,000	3,000	4,000	volts
DC Grid Voltage	- - -	–150	–250	–350	volts
DC Plate Current	- - -	400	365	380	ma
DC Grid Current	- - -	80	70	80	ma
Peak Grid Driving Voltage	-	320	430	535	volts
Driving Power*	- - - -	25	27	40	watts
Plate Input Power	- - -	800	1,090	1,520	watts
Plate Output Power	- - -	585	840	1,200	watts

CLASS-C OSCILLATOR, INDUSTRIAL APPLICATION SINGLE PHASE, FULL WAVE RECTIFIER, UNFILTERED

MAXIMUM RATINGS

DC PLATE VOLTAGE	- - -	3,800 MAX. VOLTS
DC GRID VOLTAGE	- - -	–500 MAX. VOLTS
DC PLATE CURRENT	- - -	360 MAX. Ma.
PLATE DISSIPATION	- - -	350 MAX. WATTS
GRID DISSIPATION	- - -	30 MAX. WATTS
PLATE INPUT POWER	- - -	1,500 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

DC Plate Voltage	- - - -	2,750	3,500	volts
DC Plate Current	- - - -	340	325	ma
DC Grid Current	- - - - -	60	65	ma
Grid Resistor	- - - - -	3,330	4,500	ohms
Plate Input Power	- - - -	935	1,400	watts
Plate Output Power	- - - -	685	1,100	watts

CLASS-C OSCILLATOR, INDUSTRIAL APPLICATION SELF-RECTIFIED

MAXIMUM RATINGS

PLATE VOLTAGE (r.m.s.)	- -	4,500 MAX. VOLTS
DC GRID VOLTAGE	- - -	–500 MAX. VOLTS
DC PLATE CURRENT	- - -	210 MAX. Ma.
PLATE DISSIPATION	- - -	350 MAX. WATTS
GRID DISSIPATION	- - -	30 MAX. WATTS
GRID RESISTOR	- - - -	100,000 MAX. OHMS
PLATE INPUT POWER	- - -	900 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 50 mc., per tube)

Plate Voltage (r.m.s.)	- - -	3,000	4,000	volts
DC Grid Voltage	- - - -	–110	–280	volts
DC Plate Current	- - - -	180	190	ma.
DC Grid Current	- - - - -	32	35	ma.
Plate Input Power	- - - -	600	840	watts
Plate Output Power	- - - -	415	630	watts
Grid Resistor	- - - - -	3,000	5,500	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

APPLICATION

MECHANICAL

Mounting

The 5867A must be operated vertically, base up or down. A flexible strap must be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling

Forced-air cooling is required to maintain base and plate seal temperatures below 180°C and 220°C, respectively. When using the Eimac SK-410 Air system socket and SK-410 Air Chimney, complete with the HR-6 Heat Radiator, a minimum air-flow in the base to anode direction of 12 cfm at sea level is required to provide adequate cooling at an inlet air temperature of 50°C. This flow rate corresponds to a static pressure drop of 0.1 inches of water. At higher inlet air temperatures, higher altitudes, or at frequencies above 50 mc, the air flow rate must be increased to give adequate cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, envelope and plate seals. In all cases, air flow rates in excess of the minimum requirements will prolong tube life.

ELECTRICAL

Filament Voltage

For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated 5.0 volts. Variations in the filament voltage must be kept within the range of 4.75 and 5.25 volts.

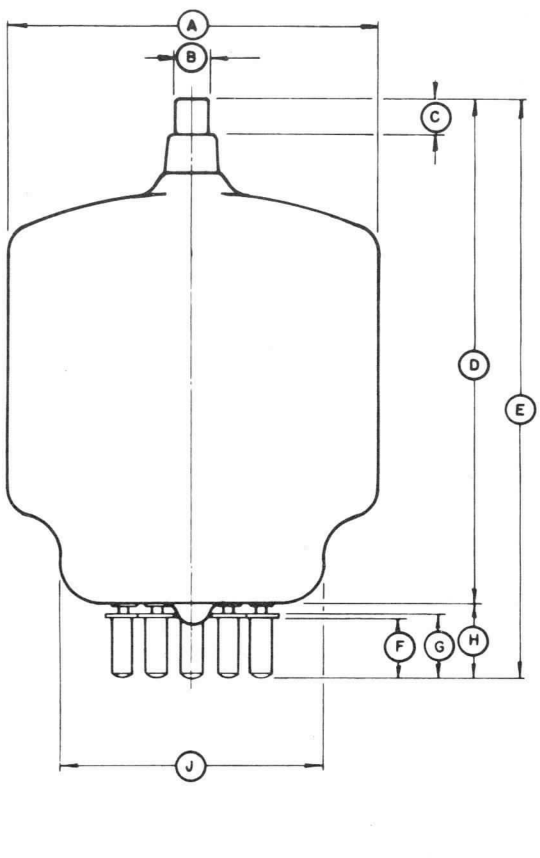
Grid Dissipation

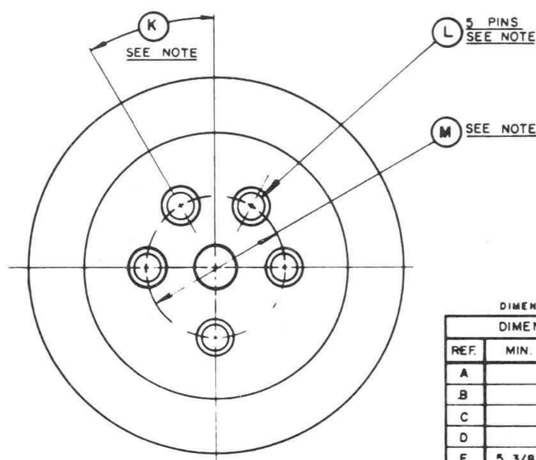
The rated grid dissipation of the Eimac 5867A is 30 watts. Grid dissipation is the approximate product of the dc grid current and the peak positive grid voltage. In equipment where the plate loading varies widely, such as radiofrequency heating oscillators, care should be taken to insure that the grid dissipation does not exceed the 30 watt maximum.

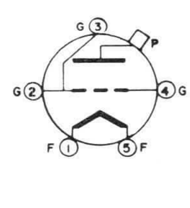
To prevent overheating of a grid pin by RF currents, it is advisable to connect all three grid pins into the circuit.

Special Applications

If it is desired to operate this tube under conditions widely different than those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.





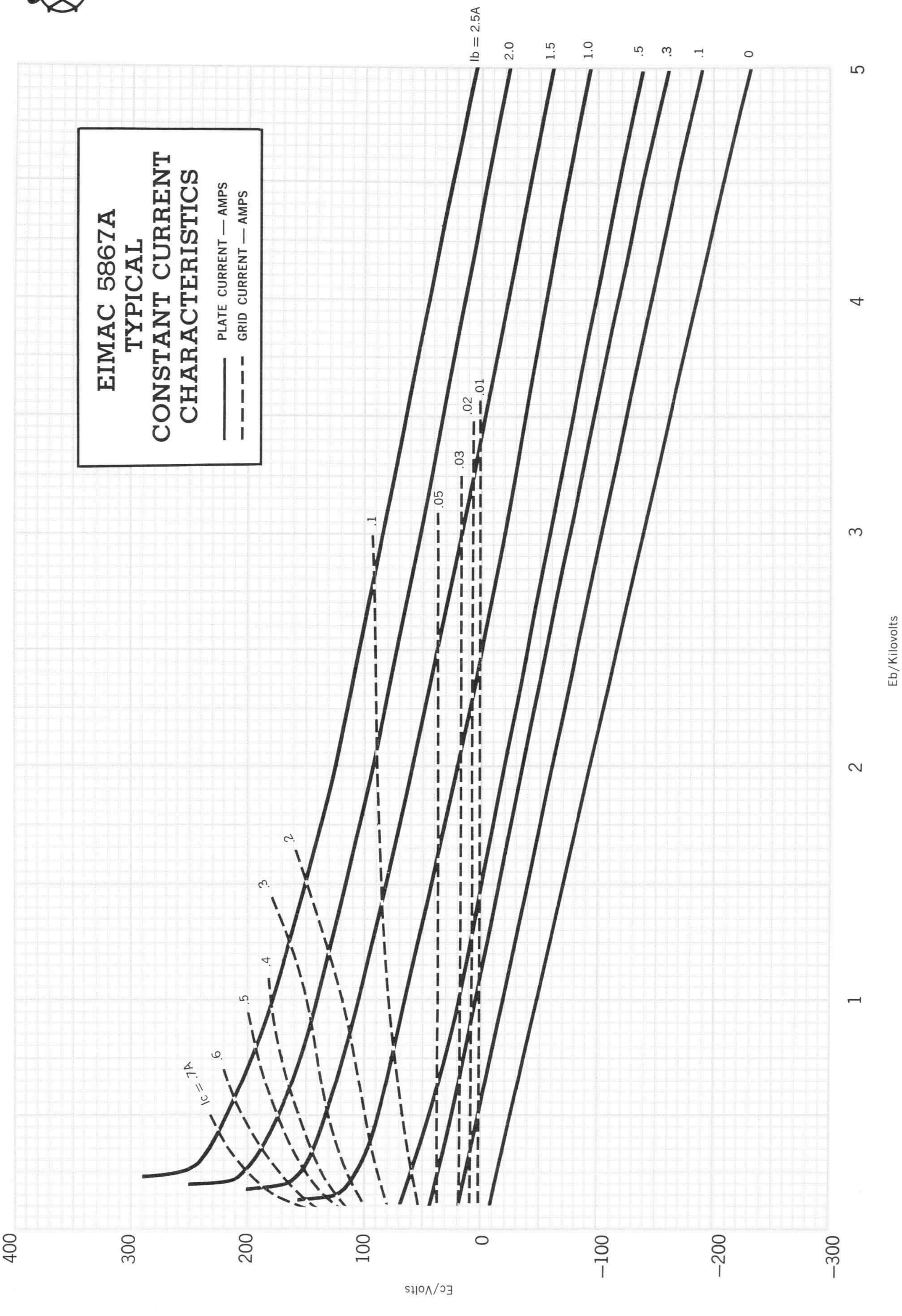


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A		3 7/16 D.	
B			.355 D.
C			.355 D.
D			4 27/32
E	5 3/8	5 7/8	
F	1/2	5/8	
G	9/16	11/16	
H			25/32
J		2 7/16 D.	
K			30° TYP
L	.185 D.	.191 D.	
M			1-1/4 D.P.C.

NOTE

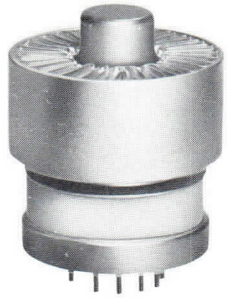
BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA'S OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMENSIONS (K) & (M)


EIMAC 5867A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
PLATE CURRENT — AMPS
GRID CURRENT — AMPS
Ib = 2.5A
2.0
1.5
1.0
.5
.3
.1
0
Ic = .7A
.6
.5
.4
.3
.2
.1
.05
.03
.02
.01
Eb/Kilovolts
Ec/Volts
400
300
200
100
0
−100
−200
−300
1
2
3
4
5

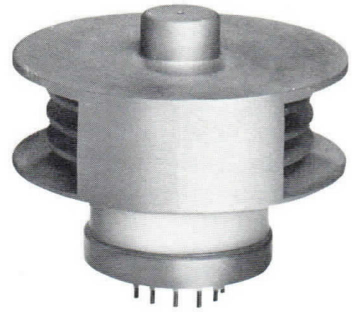
TECHNICAL DATA

8873
8874
8875
HIGH-MU TRIODES

8873



8874



8875

The EIMAC 8873, 8874, and 8875 are compact external-anode ceramic/metal triodes intended for use in Class AB or C amplifiers in radio-frequency applications. The three types differ only in method of cooling and anode dissipation: the anode of the 8873 is designed for conduction cooling and is rated for 200 watts; the 8875 anode has a transverse cooler for forced-air cooling and is rated for 300 watts; and the 8874 requires axial-flow forced-air cooling and is rated for 400 watts. Grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with these types in a cathode-driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater Voltage	6.3 ± 0.3 V
Heater Current, at 6.3 volts	3.0 A
Cathode-Heater Potential (maximum)	±150 V
Tranconductance, average	
Ib = 250 mAdc	29,000 μmhos
Direct Interelectrode Capacitances, (cathode grounded, in shielded fixture)[2]	
Cin	20.5 pF
Cout	0.03 pF
Cgp	6.0 pF
Direct Interelectrode Capacitances, (grid grounded, in shielded fixture)[2]	
Cin	20.5 pF
Cout	6.0 pF
Cpk	0.03 pF
Ck-htr	6.0 pF
Frequency of Maximum Rating:	
CW	500 MHz

1. Characteristics and operating values are based upon peformance tests. These figures may change without notice as the result of additional data or product refinement. Varian, EIMAC Division 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 Electronic Industries Association Standard RS-191.

varian, EIMAC division/301 industrial way/san carlos/california 94070

MECHANICAL

Maximum Overall Dimensions:

	TYPE 8873	TYPE 8874	TYPE 8875
Length	2.14 in. 54.41 mm	2.14 in. 54.41 mm	2.18 in. 55.50 mm
Diameter	1.64 in. 41.66 mm	1.64 in. 41.66 mm	2.52 in. 64.01 mm
Net Weight	8.50 oz. 240.9 gm	4.30 oz. 121.9 gm	8.60 oz. 243.8 gm
Operating Position	Any	Any	Any

Cooling: (Type 8873)

Conduction cooled. Recommended Beryllium Oxide thermal link .... EIMAC SK-1920

(Type 8874)

Air flow at 50°C and sea level .... 8.6 ft^3/Min.

Pressure Drop, across tube anode cooler at 8.6 ft^3/Min .... 0.37 in H_20

(Type 8875)

Air flow at 25°C and sea level, and
Pressure Drop across tube anode cooler } See Application Section, Cooling 8875

Operating Temperature, Maximum, all three types,
Ceramic/Metal seals and Anode Core .... 250°C

Base: (all types) .... Large Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)

Recommended Socket .... E.F. Johnson #124-311-100*

Available grid Collet, for base grid ring contact .... EIMAC Part No. 882931

*NOTE: The E.F. Johnson socket is available from EIMAC as Part No. 154353.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	2.8	3.4	A
Cathode Warmup Time	60	---	sec.
Plate Current (Ef = 6.3 V, Eb = 1000 Vdc, Ec = 0 Vdc)	35	80	mAdc
Grid Cut-off (Ef = 6.3 V, Eb = 2000 Vdc, Ib = 1.0 mAdc)	---	-16	Vdc
Interelectrode Capacitances (cathode grounded, in shielded fixture)[1]			
Cin	18.0	23.0	pF
Cout	---	0.04	pF
Cgp	5.0	7.0	pF
Interelectrode Capacitances (grid grounded, in shielded fixture)[1]			
Cin	18.0	23.0	pF
Cout	5.0	7.0	pF
Cpk	---	0.04	pF

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

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN
Class AB_2

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION
Class AB_2 (Cathode driven) Peak Envelope Modulation Crest or Key-Down Conditions[1]

Frequency	30	150	432	MHz
Plate Voltage	2000	2000	2000	Vdc
Cathode Voltage	8.2	9.8	8.2	Vdc
Zero-Signal Plate Current	22	10	22	mAdc
Single-Tone IVS Plate Current[2]	500	400	500	mAdc
Two-Tone Plate Current[3]	312	245	300	mAdc
Single-Tone Grid Current[4]	30	23	98	mAdc
Two-Tone Grid Current[4]	12	10	39	mAdc
Peak rf Grid/Cathode Voltage[4]	67	50	67	v
Peak Driving Power[4]	26	17.5	27	w
Peak Power Input	1000	800	1000	W
Useful Output Power[4]	587	526	505	W
Resonant Load Impedance	2140	--	--	Ω
Intermodulation Distortion[5]				
3rd Order	-35	--	--	dB
5th Order	-36	--	--	dB

1. Short-term duty should not exceed 50%. During brief test periods, "on" time must be kept as short as possible, with sufficient "off" time to allow for tube cooling.
2. Key down condition. With 50% duty, current will be half the value shown.
3. Two equal-tone modulation. During brief test periods, allow sufficient "off" time for tube cooling. Values will be lower with voice modulation for the same PEP level.
4. Approximate values.
5. The intermodulation distortion products are referenced against one tone of a two equal-tone signal.

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

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION (nominal values)		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	2000	Vdc
Grid Voltage[1]	-10	Vdc
Plate Current	250	mAdc
Grid Current[1]	40	mAdc
Measured Driving Power	9	WATTS
Plate Input Power	500	WATTS
Plate Dissipation	195	WATTS
Useful Output Power	305	WATTS

1. Approximate value.

PULSE MODULATOR OR REGULATOR

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
PEAK ANODE CURRENT	6	AMPERE
GRID DISSIPATION	5	WATTS
PLATE DISSIPATION (nominal values):		
TYPE 8873 (with heat sink)	200	WATTS
TYPE 8874	400	WATTS
TYPE 8875	300	WATTS

APPLICATION

MOUNTING & SOCKETING - The 8873, 8874, and 8875 may be mounted in any position. Sockets such as E.F. Johnson #124-311-100, or equivalent, may be used as long as there are no unusual circumstances which would allow the ceramic/metal anode and base seal temperatures to exceed 250°C. The internal construction of these tubes is such that heat transfer to the tube base is minimized, but in operation there is some heat flow from the tube base to the socket. Mounting should be such that free movement of air past the base by convection is possible, or, if forced-air cooling is being provided for the anode, some of this air may be bled off to provide for some circulation past the tube base.

The 8873 mounting is normally controlled by its heat sink configuration and location. Where possible, the socket can be mounted on a bracket which in turn is mounted to the heat sink so that the one sink will act for removal of heat from the tube anode and also the tube base. The EIMAC SK-1920 beryllium oxide (BeO) thermal link is available for use between the 8873 anode and the heat sink. BeO is a ceramic material which exhibits high thermal conductance, similar to aluminum, and high electrical resistance and low loss typical of ceramics. Properly installed, it provides a low thermal resistance path allowing the anode heat to be transferred to the heat sink, while providing electrical isolation between the anode and the sink.

The 8874 requires forced-air cooling for its anode, which can often be accomplished most easily by means of a pressurized anode-compartment chassis, with air passing through the anode cooler and then exhausting. In such an installation, some air can be bled past the socket mount to provide base cooling if this is required.

The 8875 has a large transverse cooler on its anode, requiring forced-air cooling directed crossways.

HEATER/CATHODE OPERATION - The rated heater voltage for the 8873, 8874, and 8875 is 6.3 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long life and consistent performance. At frequencies above approximately 300 MHz it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid-bias, anode current, duty cycle, and circuit design and adjustment. The following heater operating voltages are recommended:

Frequency (MHz)	Heater Voltage
300 or lower	6.3
301 to 400	6.0
401 to 500	5.7

The potential between the heater and the cathode should be limited to plus or minus 150 Vdc.

CATHODE WARMUP TIME - In normal service it is recommended that the heater voltage be applied for a minimum of 60 seconds before anode voltage and drive boltage are applied, to allow proper conditioning of cathode surface.

If it is desired to apply anode voltage simultaneously with heater voltage, enough bias voltage must also be applied so that no conduction can take place until drive voltage is applied after the full 60 seconds of warmup time.

ANODE CURRENT RATING AND TUNEUP PROCEDURE - The 8873, 8874, and 8875 are rated for 350 mAdc of continuous anode current. In intermittent voice (A3J emission) and interrupted carrier keying (A1 emission) service, which would be normal single-sideband-suppressed-carrier or keyed CW operation, and where short-term duty does not exceed 50%, the dc anode current (per tube) may be 500 mA during the "on" time. With 50% duty, the average current (per tube) would be 250 mA. During very short test periods, the tubes may be operated at full 500 mA value but care must be taken to keep the "on" time as short as possible, with sufficient "off" time to allow for tube cooling.

Initial tuneup should preferable be done with reduced anode voltage and drive, and if done at the correct values, little or no retuning will be necessary when switching to full operating level. For the 2000 volt Intermittent Voice Service (IVS) condition, tuneup is recommended at 1500 volts and reduced grid drive. When anode voltage and drive are then raised, the full one kilowatt PEP IVS condition will be achieved with little or no retuning required.

COOLING - 8873 - This tube is designed for use in a conduction-cooled system by using a beryllium oxide (BeO) thermal link between the anode and the heat sink. The heat sink in turn can be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. The design choice is determined by the tube application, but in all cases the cooling system must maintain the anode and the ceramic-metal seal temperatures below 250°C.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode through the BeO thermal link to the heat sink. A good thermally conductive compound should be used in the interface (between anode and BeO, and between BeO and heat sink) to reduce the thermal resistance of the joint. Examples of commercially available thermal joint compound are:

WAKEFIELD 120 - Wakefield Engineering Co., Wakefield, Mass. 01880
DOW CORNING 340 - Dow Corning Corp., Midland, Michigan 48640
ASTRODYNE THERMAL BOND 312 - Astrodyne Inc., Burlington, Mass 01803
G.E. INSULGREASE G641 - G.E. Company, Cleveland, Ohio 44117

The method of fastening the tube to the heat sink should provide reasonable compression to reduce interface thermal resistance. A device such as the DE-STA-CO toggle clamp, modified by replacing the rubber nose with a ½-inch ceramic insulator, can provide a simple means of holding the tube securely and providing adequate compression.

The EIMAC SK-1920 BeO thermal link is recommended for use between the tube anode and the heat sink, as it is the correct size and thickness to match the physical and electrical characteristics of the 8873 tube.

IMPORTANT - BEFORE HANDLING OR ATTEMPTING TO USE ANY BERYLLIUM OXIDE THERMAL LINK CAREFULLY READ THE MATERIAL ON PAGE 6 REGARDING THIS MA— TERIAL.

A heat sink capable of handling 200 watts of continuous dissipation from the 8873 can be made with a section of finned aluminum alloy extrusion, such as Wakefield A-2494, or equivalent, cut to approximately 8 inches by 4 inches, backed with a ⅛-inch copper plate the same size. Thermal joint compound is used between the copper plate and the flat aluminum surface, with the two secured together at enough points to assure good continuous contact. The backed extrusion is mounted so as to allow for free air convection around the fins. The tube is then mounted, with the EIMAC SK-1920 thermal link, in the approximate center of the copper surface, with thermal joint compound again used between the tube anode and the BeO link, and between the BeO link and the copper. A device such as the modified DE-STA-CO toggle clamp is used to hold the tube securely in place.

Socketing is accomplished with one of the units mentioned earlier, mounted so as to allow for free air convection around the base of the tube and the socket, and on a bracket which returns to the same heat sink if possible. The designer is cautioned to allow for some lateral movement in the socket mount, and to make sure the anode is flat against the BeO thermal link so that good conduction contact exists before the socket mounts are tightened down. If the tube anode, the thermal link, and the heat sink are not making good flat contact, heat transfer will be seriously affected.

If unusually high ambient temperatures are expected, or more than 200 watts capability is required, a small fan can be used to move air past the sink cooling fins. With any conduction-cooled power tube, dissipation capability is almost completely dependent on the ability of the heat-sink system to carry heat away and the temperature limitations of the tube itself. Thus the 200-watt dissipation rating of the 8873 is a nominal value only, as illustrated by the fact that the same tube, with an axial-flow air radiator installed (the 8874) is rated for 400 watts of dissipation under specified cooling conditions.

In all cases, temperature of the tube anode and the ceramic/metal seals is the limiting factor, and the equipment designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

8874 -Forced-air cooling must be provided to maintain the anode core and seal temperatures within maximum rating. The cooling data shown is for sea level, with cooling air at 50°C, and is sufficient to limit tube temperatures to 225°C. The pressure drop figures shown are for the anode cooler only, as would be the case with a pressurized anode compartment of an equipment, where air would be required to pass through the anode cooler and then through an insulated duct to the outside of the cabinet. Some air from the pressurized anode compartment can be bled by the socket for base cooling, either by means of a somewhat oversize socket-mounting hole, or a series of small holes drilled in the chassis near the edges of the socket, in order to provide a small amount of air circulation around the base pins of the tube.

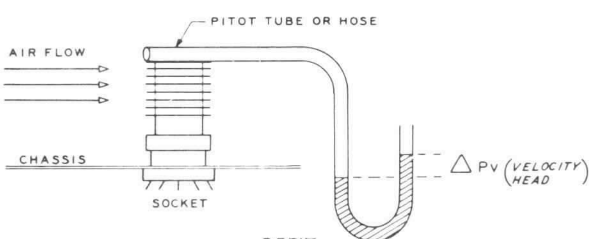
8874

Anode Diss.	Air Flow (CFM)	Approx. Press. Drop (In. H_20)
200W	4.0	0.11
300W	6.0	0.22
400W	8.6	0.37

8875 - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. Cooling data is shown for sea level, with cooling air at 25°C.

These figures are for the case where the cooling air is supplied from a small general-purpose fan in close proximity to the tube and directing air across the tube and through the anode cooler.

The recommended cooling is sufficient to limit tube temperatures to 225°C. The required air velocity can be checked with a simple manometer, as shown in the accompanying figure.



8875

Anode Diss.	Cooling Air Velocity	Vel. Head (Δ Pv) Inches of H_20
200W	870 Ft/Min.	0.045
300W	1600 Ft/Min.	0.16

With all three tube types, the equipment designer is cautioned that it is not good practice to operate at, or close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined here is normally beneficial.

DANGER - BERYLLIUM OXIDE CERAMICS (Be0) Do not alter, grind, lap, fire, chemically clean, or perform any other operation on the SK-1920 Beryllium Oxide thermal link used with the 8873, or any other equivalent section of Be0 used with the 8873. Normal use of Be0 ceramics has never been considered hazardous, but the user should avoid any operation which would create Be0 dust particles in the air, or fumes, which could be breathed, as these are considered dangerous.

It should be noted that none of these three tubes contains any Be0 in the envelope, or internally. Only the SK-1920 thermal link is made of Be0, because of its insulating qualities combined with its high thermal conductivity.

HIGH VOLTAGE - The 8873, 8874, and 8875 operate at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed 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 the primary circuits of the power supplies 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.

OUTPUT CAPACITANCE - The interelectrode capacitance figures given in the General Characteristics are measured in a shielded fixture and do not include additonal external capacitance. Including the stray capacitance between the anode and the heat sink used with the 8873 tube will typically raise the output capacitance to somewhat more than double the measured internal value.

INTERMODULATION DISTORTION - Typical Operating Conditions, with distortion values included, are the result of data taken during actual operation a 2 Megahertz. 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.

INPUT CIRCUIT - When any of these types 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.

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 of 25 to 50 ohms be used in the anode circuit to limit

peak current and provide a means of dissipating the energy in the event of a tube or circuit arc. For an oxide-cathode type such as these tubes are a maximum of 4 joules total energy should be permitted to be dumped into an internal arc. Amounts in excess of this may permanently damage the cathode or the grid structure.

Additional information is found in EIMAC's Application Bulletin #17 titled "FAULT PROTECTION", available on request.

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

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 power tubes involves one or more of 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 AFFECTED.

c. X-RAY RADIATION - High voltage tubes can produce dangerous and possibly fatal x-rays.

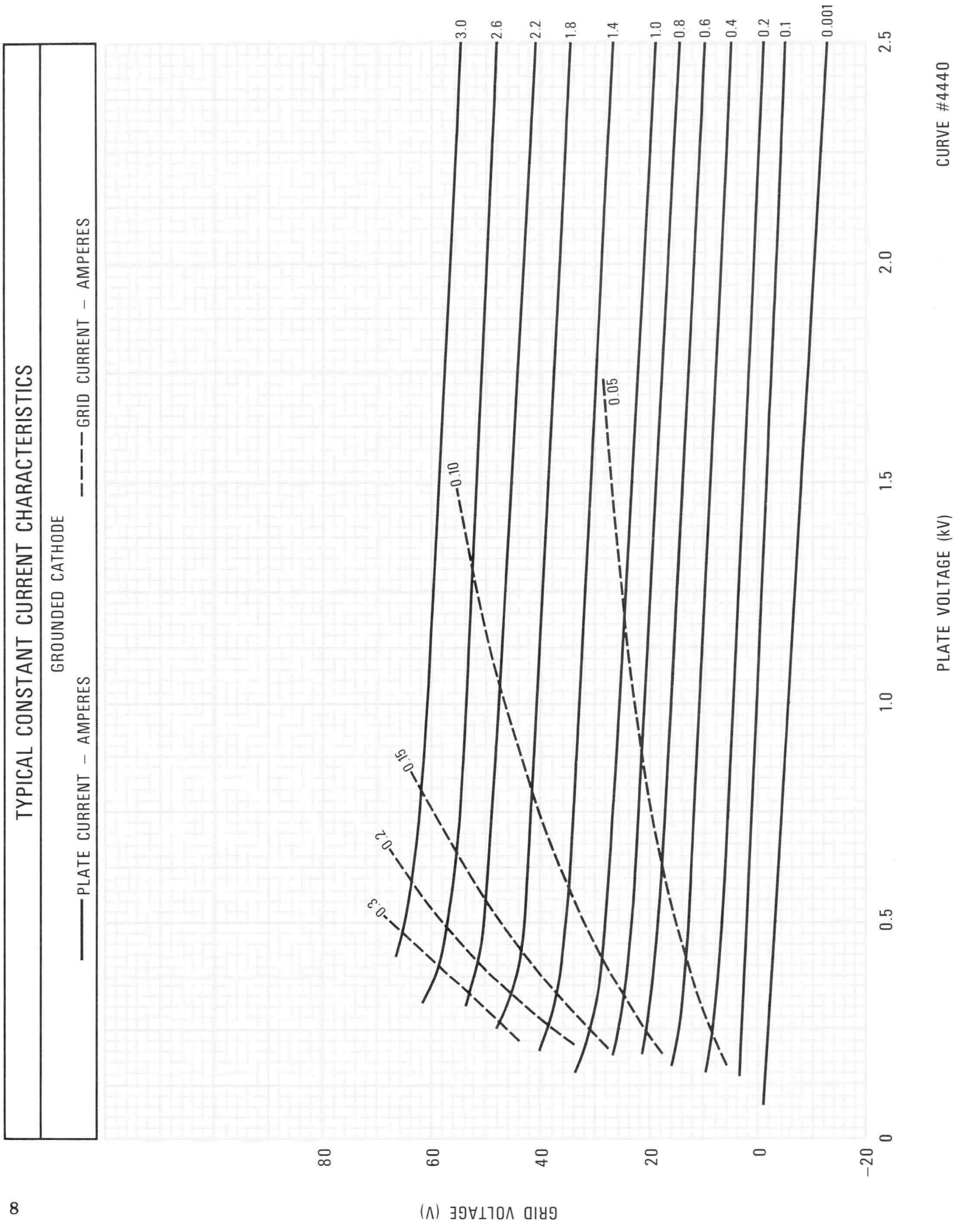
d. BERYLLIUM OXIDE POISONING - Dust or fumes from BeO ceramics used as thermal links with some conduction-cooled power tubes are highly toxic and can cause serious injury or death.

e. GLASS EXPLOSION - Many electron tubes have glass envelopes. Breaking the glass can cause an implosion, which will result in an explosive scattering of glass particles. Handle glass tubes carefully.

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

g. HOT SURFACES - Surfaces of air-cooled radiators and other parts of tubes can reach temperatures of several hundred degrees centigrade and cause serious burns if touched.

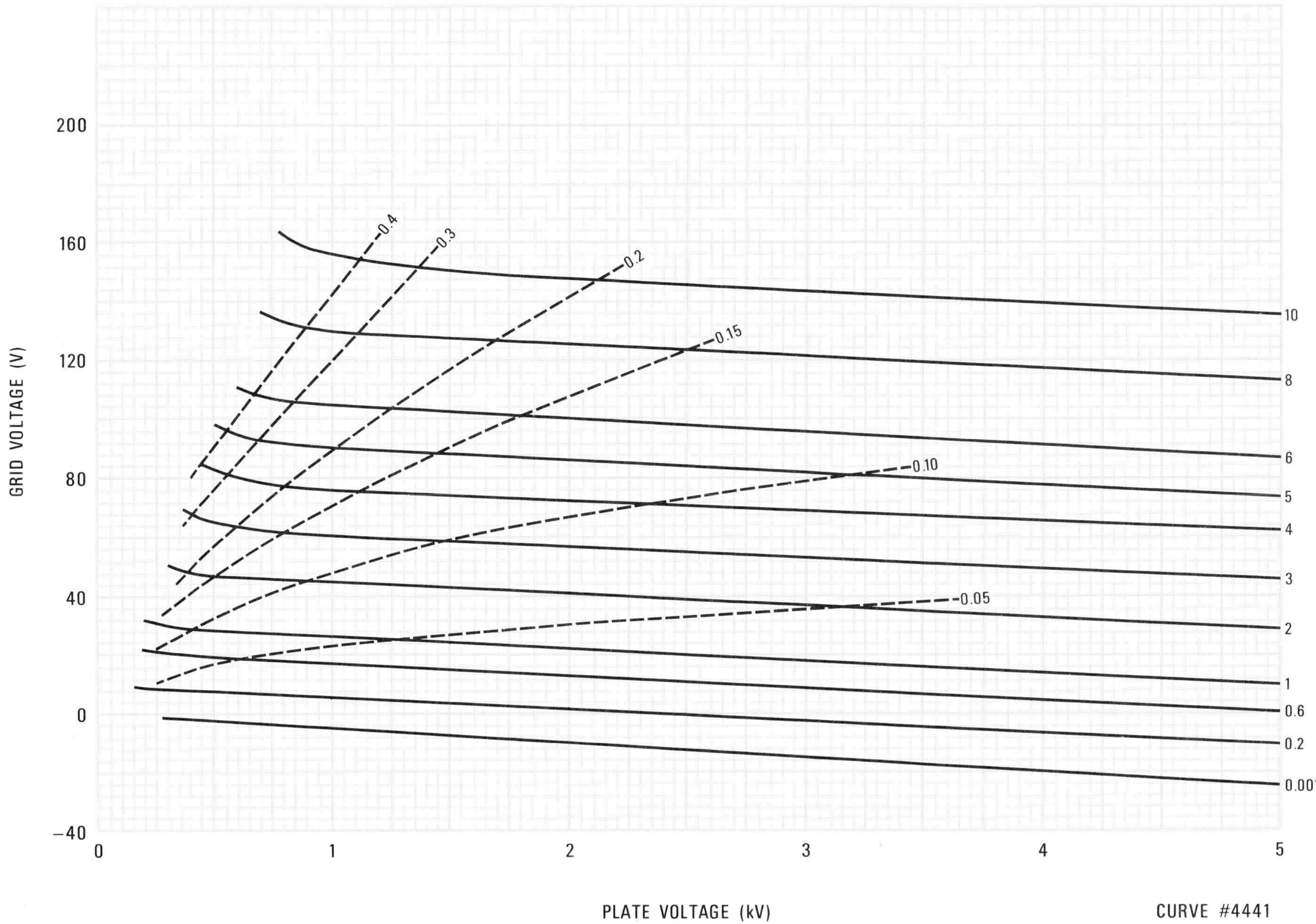
Please review the detailed operating hazards sheet enclosed with each tube or request a copy from the address shown below: Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT - AMPERES
GRID CURRENT - AMPERES
3.0
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0.001
0.05
0.10
0.15
0.2
0.3
0
0.5
1.0
1.5
2.0
2.5
PLATE VOLTAGE (kV)
CURVE #4440
80
60
40
20
0
-20
GRID VOLTAGE (V)

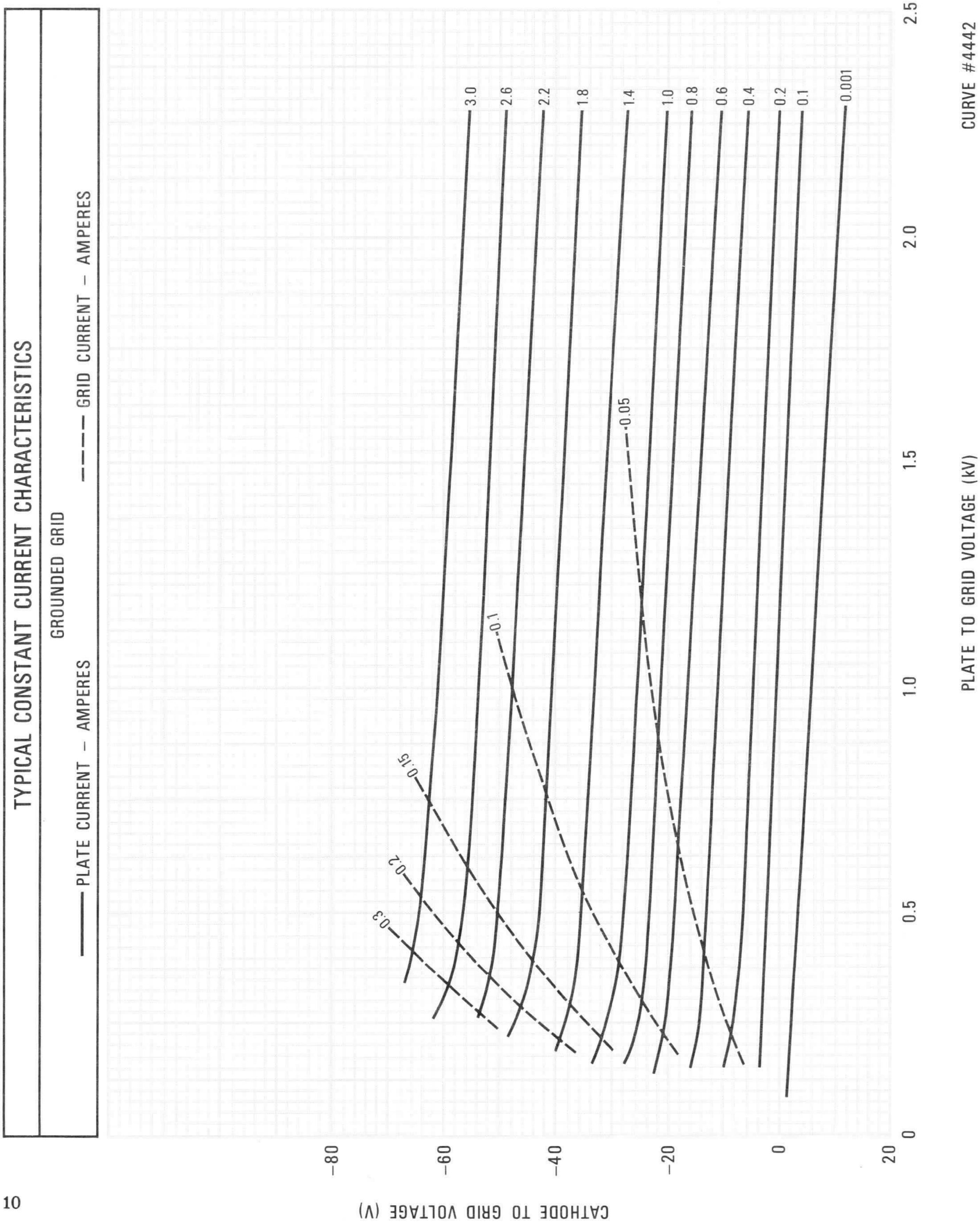
TYPICAL CONSTANT CURRENT CHARACTERISTICS

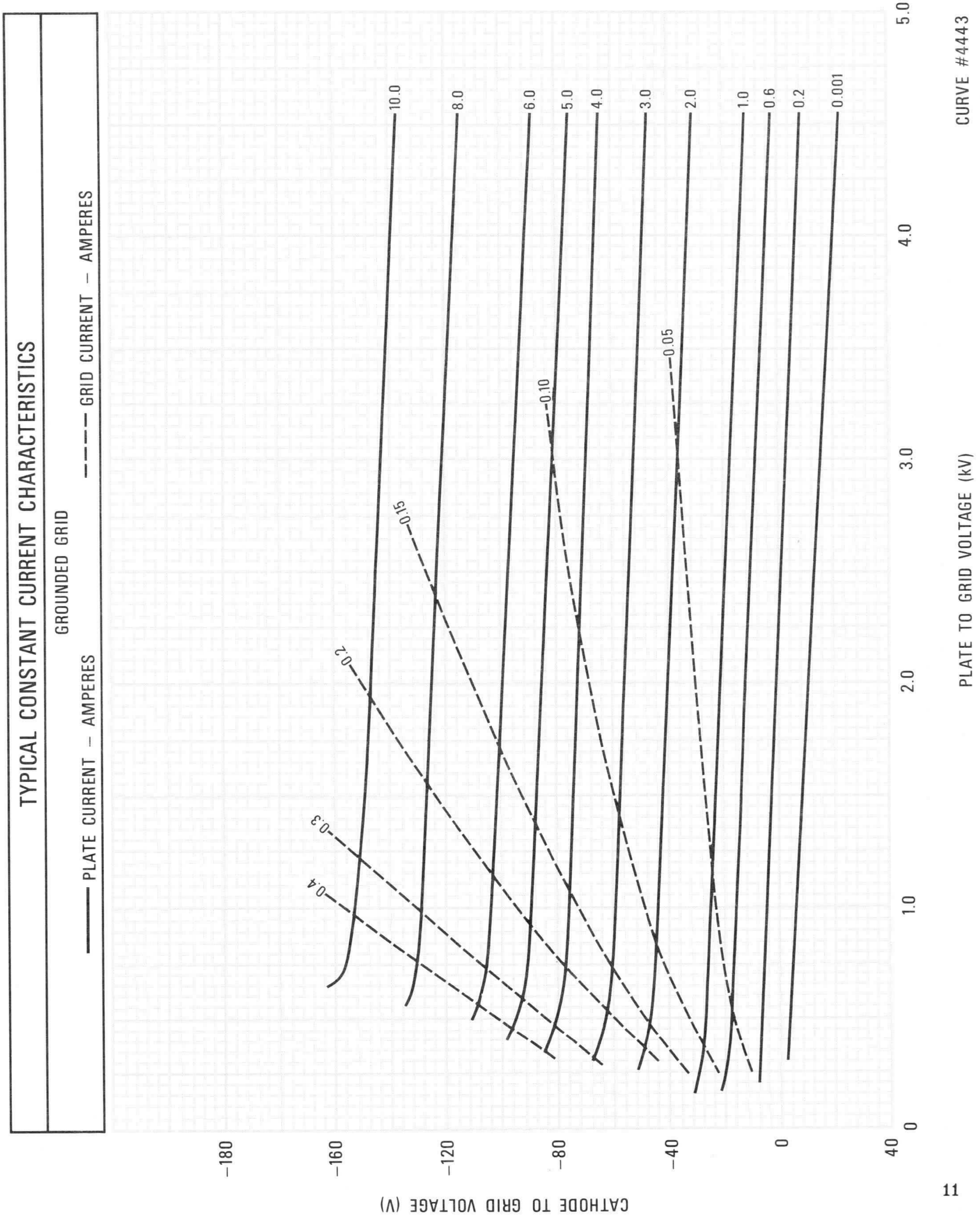
GROUNDED CATHODE

——— PLATE CURRENT – AMPERES   - - - - GRID CURRENT – AMPERES

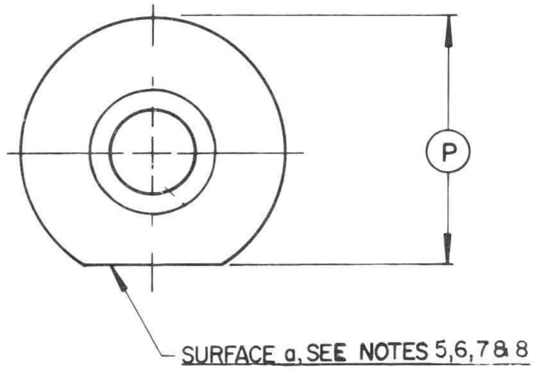


CURVE #4441


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
——— PLATE CURRENT – AMPERES
– – – – GRID CURRENT – AMPERES
3.0
2.6
2.2
1.8
1.4
1.0
0.8
0.6
0.4
0.2
0.1
0.001
0.05
0.1
0.15
0.2
0.3
0
0.5
1.0
1.5
2.0
2.5
PLATE TO GRID VOLTAGE (kV)
-80
-60
-40
-20
0
20
CATHODE TO GRID VOLTAGE (V)
CURVE #4442

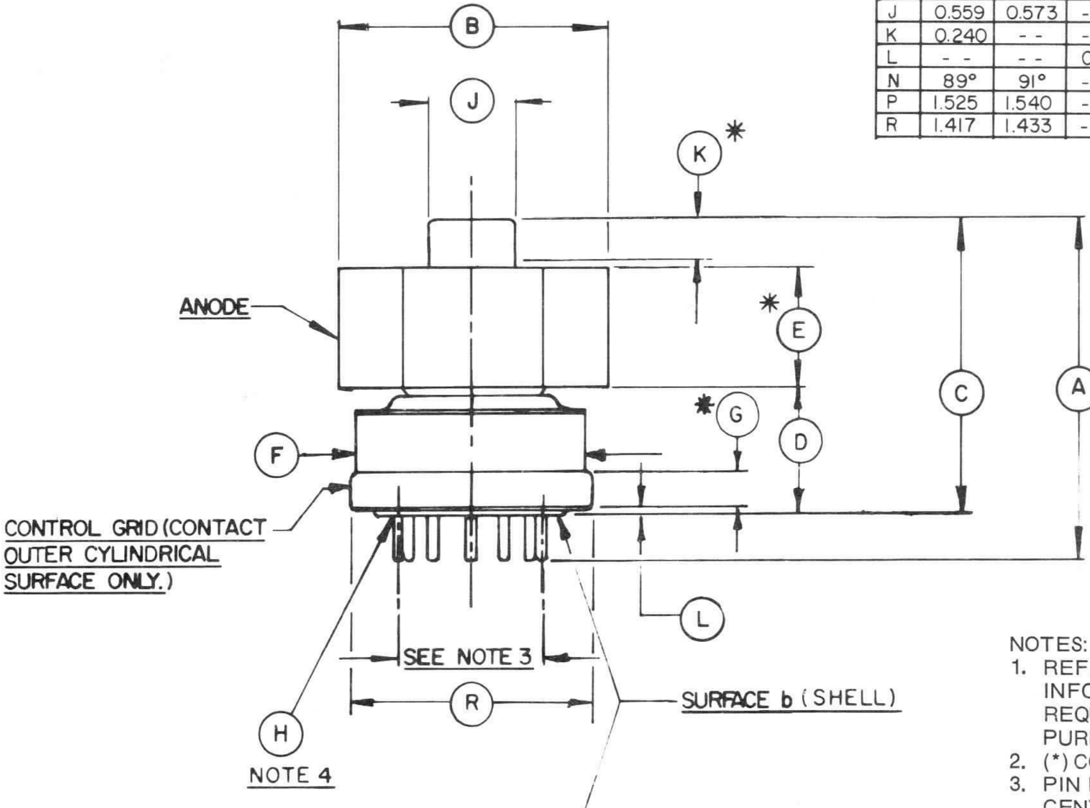


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
0.4
0.3
0.2
0.15
0.10
0.05
-180
-160
-120
-80
-40
0
40
CATHODE TO GRID VOLTAGE (V)
0
1.0
2.0
3.0
4.0
5.0
PLATE TO GRID VOLTAGE (kV)
CURVE #4443



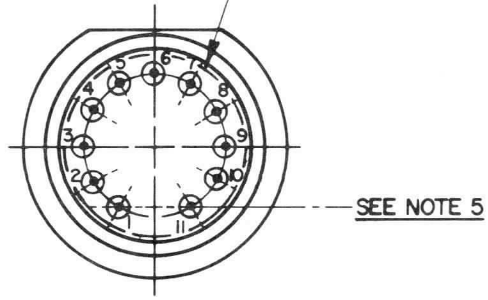
PIN NO. 1 CATHODE
PIN NO. 2 CATHODE
PIN NO. 3 CATHODE
PIN NO. 4 CONTROL GRID
PIN NO. 5 HEATER
PIN NO. 6 HEATER
PIN NO. 7 CONTROL GRID
PIN NO. 8 CATHODE
PIN NO. 9 CATHODE
PIN NO. 10 CATHODE
PIN NO. 11 CONTROL GRID

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
N	89°	91°	- -	89°	91°	- -
P	1.525	1.540	- -	38.73	39.12	- -
R	1.417	1.433	- -	35.99	36.40	- -



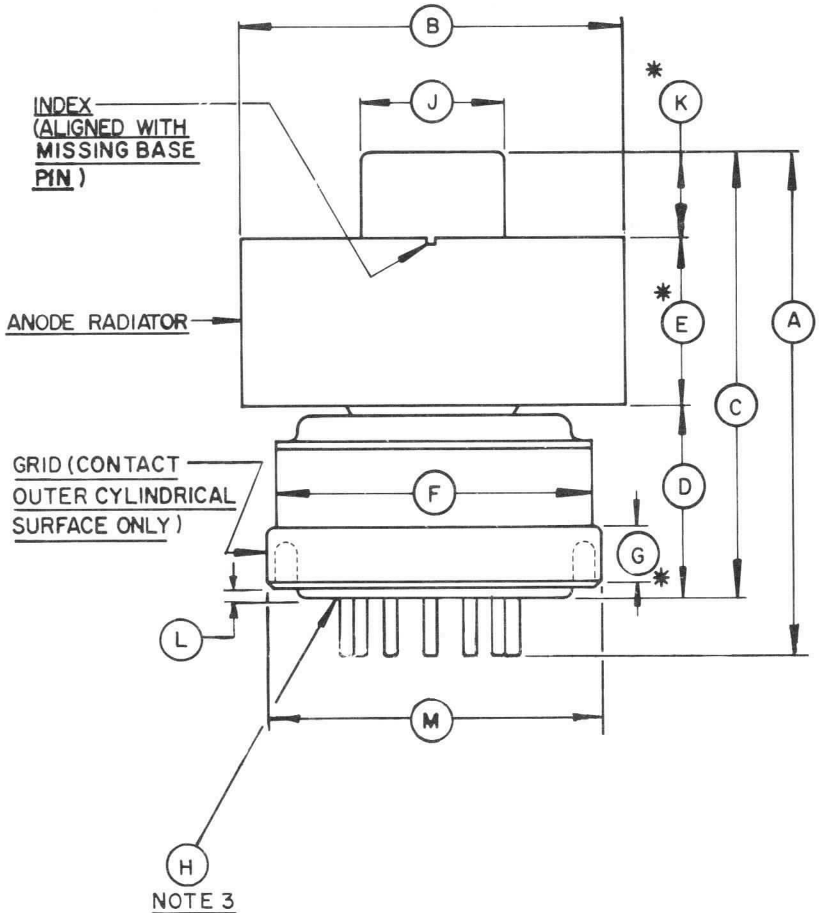
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.
5. SURFACE a TO BE PARALLEL TO PINS I & II AXIS WITHIN 2° & ON OPPOSITE SIDE.
6. SURFACE a MUST BE FLAT WITHIN .001 & PERP. TO SURFACE b WITHIN N LIMITS.
7. SURFACE a TO BE FREE OF ANY CODING OR LABELING.
8. SURFACE a ROUGHNESS (ASA B46.1-1962 OR ISO R468-66) – 32 μin. 6.8 μm.

8873



PIN No.1: CATHODE
PIN No.2: CATHODE
PIN No.3: CATHODE
PIN No.4: GRID
PIN No.5: HEATER
PIN No.6: HEATER
PIN No.7: GRID
PIN No.8: CATHODE
PIN No.9: CATHODE
PIN No.10: CATHODE
PIN No.11: GRID

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.002	2.142	- -	50.85	54.41	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.027	- -	- -	0.69
M	1.417	1.433	- -	35.99	36.40	- -

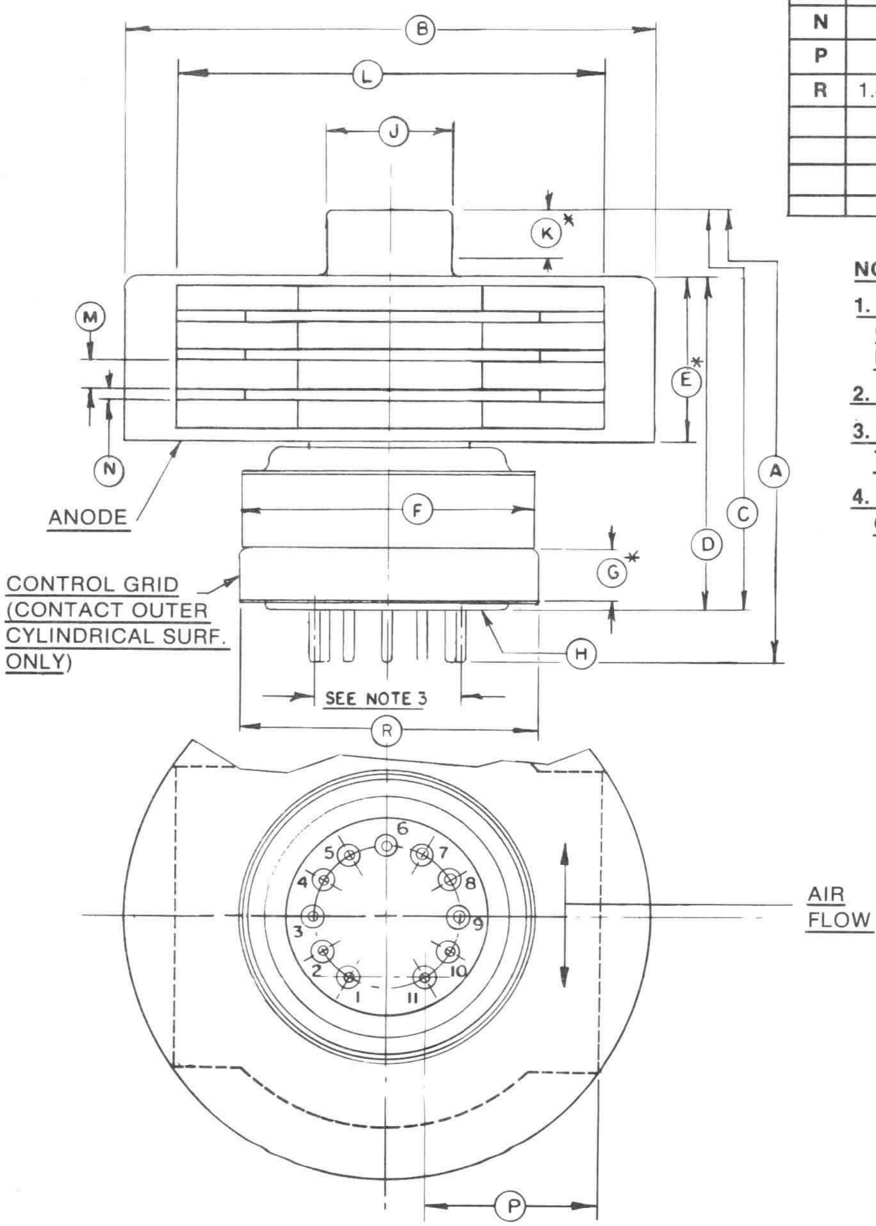


NOTES:
1. REF DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (✱) CONTACT SURFACES.
3. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL

8874

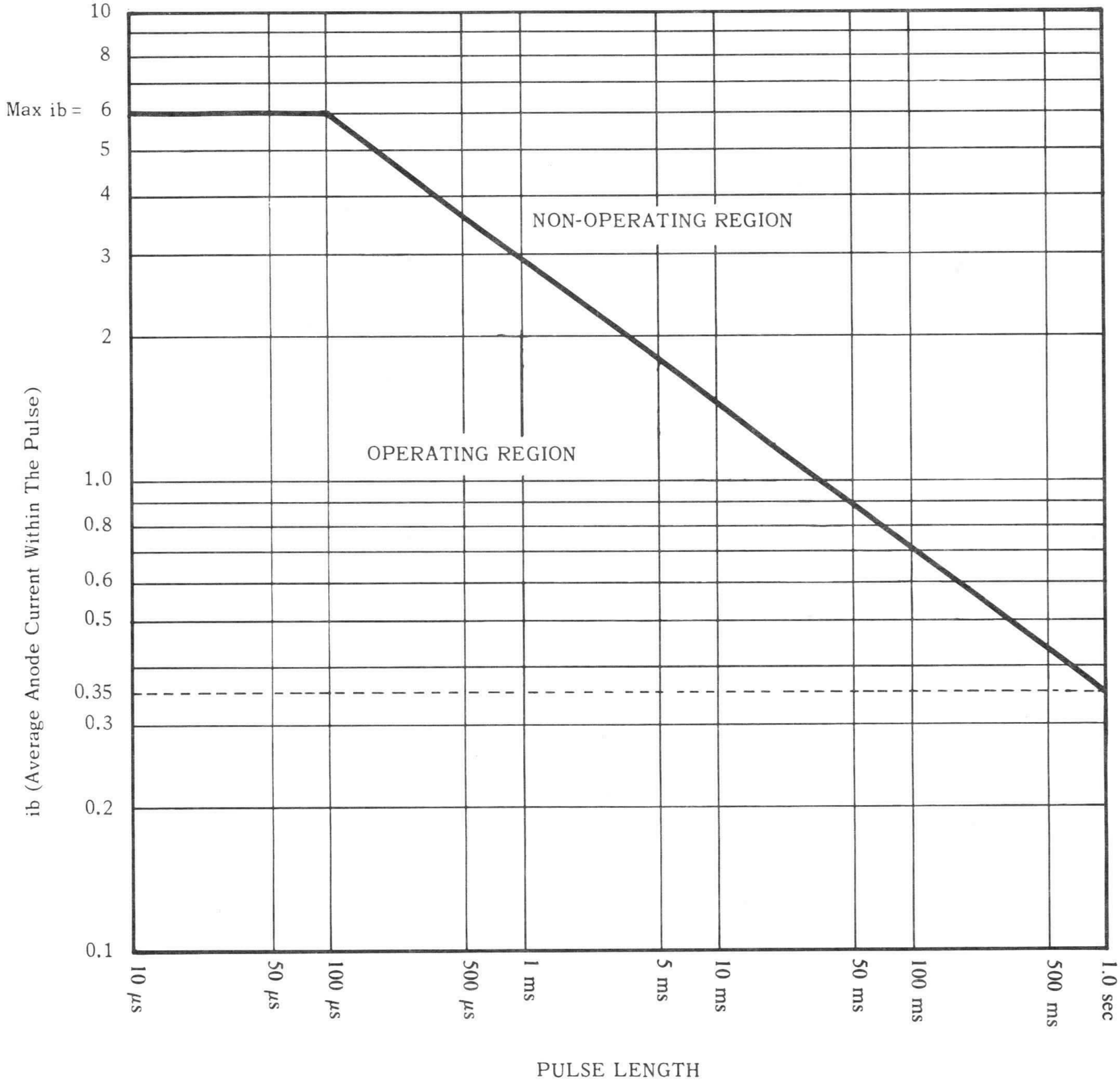
PIN No. 1, 2, 3, 8, 9, 10 CATHODE
PIN No. 4, 7, 11 CONTROL GRID
PIN No. 5, 6 HEATER

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		2.185			55.50	
B	2.480	2.520		62.99	64.01	
C	1.867	1.997		47.42	50.72	
D	1.544	1.674		39.22	42.52	
E	.780	.860		19.81	21.48	
F			1.406			35.71
G	.187			4.75		
H	BASE E11-81 (JEDEC DESIGNATION)					
J	.559	.573		14.20	14.55	
K	.240			6.10		
L		2.050			52.07	
M			.135			3.43
N			.050			1.27
P			.838			21.28
R	1.417	1.433		35.99	36.40	



NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.



Pulse anode current (ib) capability is dependent on pulse length (tp) and duty factor (Du). Maximum ib for a given tp is shown; maximum Du may then be derived from the relationship: $0.350 = ib \sqrt{Du}$

PULSE DERATING CHART, TYPES 8873, 8874, 8875

PULSE MODULATOR OR REGULATOR SERVICE

TECHNICAL DATA

8938
UHF
HIGH-MU
POWER TRIODE

The **EIMAC 8938** is a rugged coaxial-base ceramic and metal power triode designed for use as a cathode driven Class AB_2 or Class C amplifier.

It is recommended for VHF or UHF service as a linear amplifier, power amplifier or pulse amplifier. Linearity and power gain are both excellent due to the low ratio of grid to plate current, and the relatively high amplification factor. Low grid interception of available emission current is due to the beam forming geometry of the special grid and cathode design.

The 8938 is a practical size for use in ground based or mobile equipment in CW or PEP power levels of 1 to 2.5 kW. It is useful at frequencies higher than the upper frequency of maximum ratings, 500 MHz.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	5.0 ± 0.25 Volts
Current @ 5.0 Volts	10.5 Amperes
Transconductance (Average):	
I_b = 1.0 Adc	55,000 μmhos
Amplification Factor (Average)	125
Direct Interelectrode Capacitance (Grounded Grid)[2]	
Cin	39 pF
Cout	13 pF
Cgp	0.14 pF
Ck-htr	12.8 pF
Frequency of Maximum Rating (CW)	500 MHz

[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. **Varian EIMAC** 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.

varian
eimac salt lake division

1678 South Pioneer Road / Salt Lake City, Utah 84104 / (801) 972-5000

Effective 3/15/89

Printed in USA

RADIO FREQUENCY LINEAR AMPLIFIER CATHODE DRIVEN (Class AB_2)

TYPICAL OPERATION
(Frequencies to 30 MHz)
Class AB_2 Cathode Driven, Peak Envelope or
Modulation Crest Conditions

Plate Voltage	3500 Vdc
Grid Voltage[1]	-20 Vdc
Zero-Signal Plate Current	300 mAdc
Single-Tone Plate Current	970 mAdc
Two-Tone Plate Current	715 mAdc
Single-Tone Grid Current[3]	39 mAdc
Two-Tone Grid Current[3]	12 mAdc
Peak rf Cathode Voltage[3]	71 Volts
Driving Power[3]	50 Watts
Useful Output Power[4]	2030 Watts
Resonant Load Impedance	2200 Ohms
Intermodulation Distortion[2]	
3rd Order Products	-44 dB
5th Order Products	-44 dB

[1]Positive cathode bias provided by zener diode.
[2]The intermodulation distortion products are referenced against one tone of a two equal tone signal.
[3]Approximate value.
[4]Delivered to the load.

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	4000 Volts
DC Plate Current	1.0 Ampere
Plate Dissipation	1500 Watts
Grid Dissipation	25 Watts

RADIO FREQUENCY POWER AMPLIFIER (Class B or C)

TYPICAL OPERATION
(Cathode Driven Amplifier)

Frequency of Operation	400 MHz
Heater Voltage	4.3 Volts
DC Plate Voltage	3000 Volts
DC Grid Voltage	-31 Volts
DC Plate Current	1.0 Ampere
DC Grid Current	5 mA
Measured Driving Power	83 Watts
Useful Output Power	1570 Watts
Power Gain	12.8 dB

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	4000 Volts
DC Plate Current	1.0 Ampere
Plate Dissipation	1500 Watts
Grid Dissipation	25 Watts

MECHANICAL

Maximum Overall Dimensions:
- Length .... 3.57 in; 91.00 mm
- Diameter .... 3.38 in; 85.85 mm

Net Weight .... 25 oz.; 709 gm
Operating Position .... Any

Maximum Operating Temperature:
- Ceramic/Metal Seals .... 250°C
- Anode Core .... 250°C

Cooling .... Forced Air
Base .... Coaxial
Socket (Grounded Grid) .... EIMAC SK-2220

APPLICATION

MECHANICAL

MOUNTING - The EIMAC 8938 may be mounted in any position.

SOCKET - The EIMAC SK-2220 socket is designed for use with the 8938 tube, making contact to the two heater terminals, the cathode, and the grid terminal. The grid is grounded to the frame of the socket.

Individual contact collets are also available from EIMAC to fit the 8938 as follows:

TUBE ELEMENT	EIMAC PART NUMBER
Anode	135304
Grid	135305
Cathode	135306
Heater	135307
Heater (Center Pin)	135310

These collets are described by EIMAC drawing SK-2221-60.

COOLING - The maximum temperature limit for all external tube surfaces and the anode core is 250°C. Tube life is prolonged, however, if these areas are maintained at a lower temperature. The cooling data shown is for the anode cooler only and the flow rates indicated will hold tube temperature below 225°C with 50°C ambient temperature at sea level at low frequencies. At frequencies above 30 MHz, or at higher altitudes, the air quantity must be increased. A small amount of additional cooling air is required around the base of the tube to maintain seal and envelope temperatures in this area within ratings.

	SEA LEVEL		10,000 FEET	
Anode Dissipation Watts	Air Flow CFM	Pressure Drop Inches	Air Flow CFM	Pressure Drop Inches
500	12.8	.08	18.7	.11
1000	27.6	.24	40.0	.35
1500	50.0	.70	73.0	1.01

Note: An allowance has been made for 25 watts of grid dissipation and 50 watts of heater power.

ELECTRICAL

FILAMENT OPERATION - Rated filament voltage for the 8938 is 5.0 Volts. For CW operation at the higher end of the frequency range of the 8938, it is advisable to reduce the heater voltage by a small percentage. For a CW or average power output of 1 kW or more at 400 MHz, it is recommended that heater voltage be reduced to 4.3 Volts. At frequencies between 400 and 200 MHz, nominal heater voltage, for the power level above, should be obtained from a straight line curve defined by 4.3 Volts at 400 MHz and 5.0 Volts at 200 MHz.

In equipment intended for a broad range of frequencies, a fixed compromise heater voltage is suggested. This may be the lowest heater voltage which provides adequate cathode emission current at the lower end of the frequency range, and should be between 4.3 and 5.0 Volts.

GRID OR CATHODE BIAS - It is convenient in linear amplifier service to use a zener diode or series of zener diodes in the cathode circuit if bias is required. The power loss is small because linear amplifier bias will generally be less than 25 Volts. Conventional grid bias sources may be used for CW or pulse applications.

UHF OPERATION - The 8938 provides very high gain at UHF with simple cavity designs, as a result of beam focusing action of a series of strip electron guns in the cathode grid region, which produces very high mu with unusually low grid interception.

Use of a high mu triode in the cathode driven configuration at UHF simplifies circuitry in many ways.

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 the 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 specially constructed test fixtures which effectively shield all external tube terminals or 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.

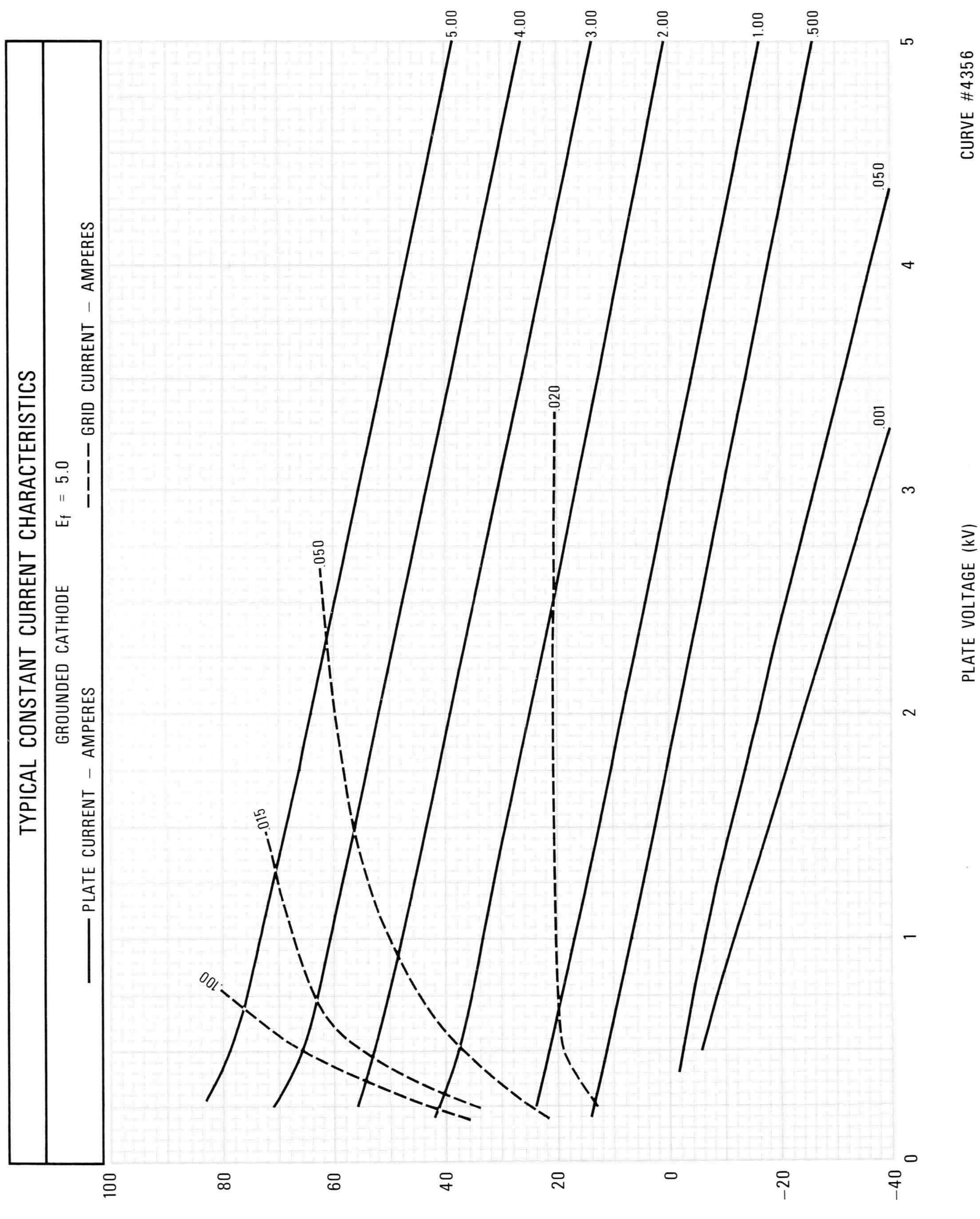
FAULT PROTECTION - It is good practice to protect the tube from internal damage caused by an internal arc which may occur at high anode voltage.

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 - When the tube is used in air and air cooled, external surfaces of the tube may reach temperatures up to 200 degrees C and higher. In addition to the anode, the cathode insulator and cathode/heater surfaces may remain hot for an extended time after the tube is shut off. To prevent serious burns, take care to avoid any bodily contact with these surfaces both during, and for a reasonable cool down period after, tube operation.

CAUTION - HIGH VOLTAGE - *Operating voltage for the 8938 can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design 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 the 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.***

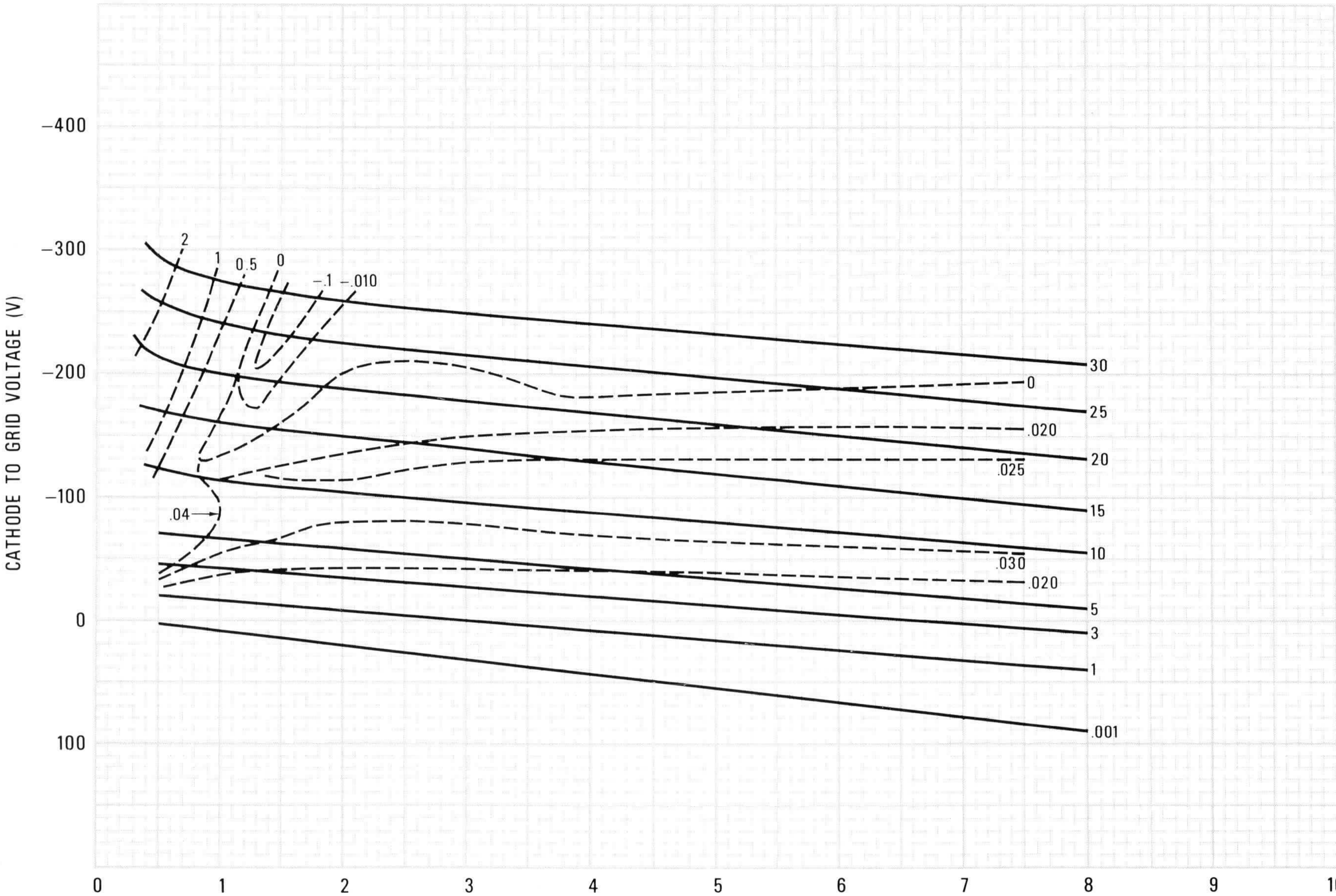
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, Varian EIMAC, 1678 South Pioneer Road, Salt Lake City, UT 84104, for information and recommendations.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
E_f = 5.0
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
5.00
4.00
3.00
2.00
1.00
.500
.050
.001
.020
.050
.015
.100
GRID VOLTAGE (V)
100
80
60
40
20
0
–20
–40
PLATE VOLTAGE (kV)
0
1
2
3
4
5
CURVE #4356

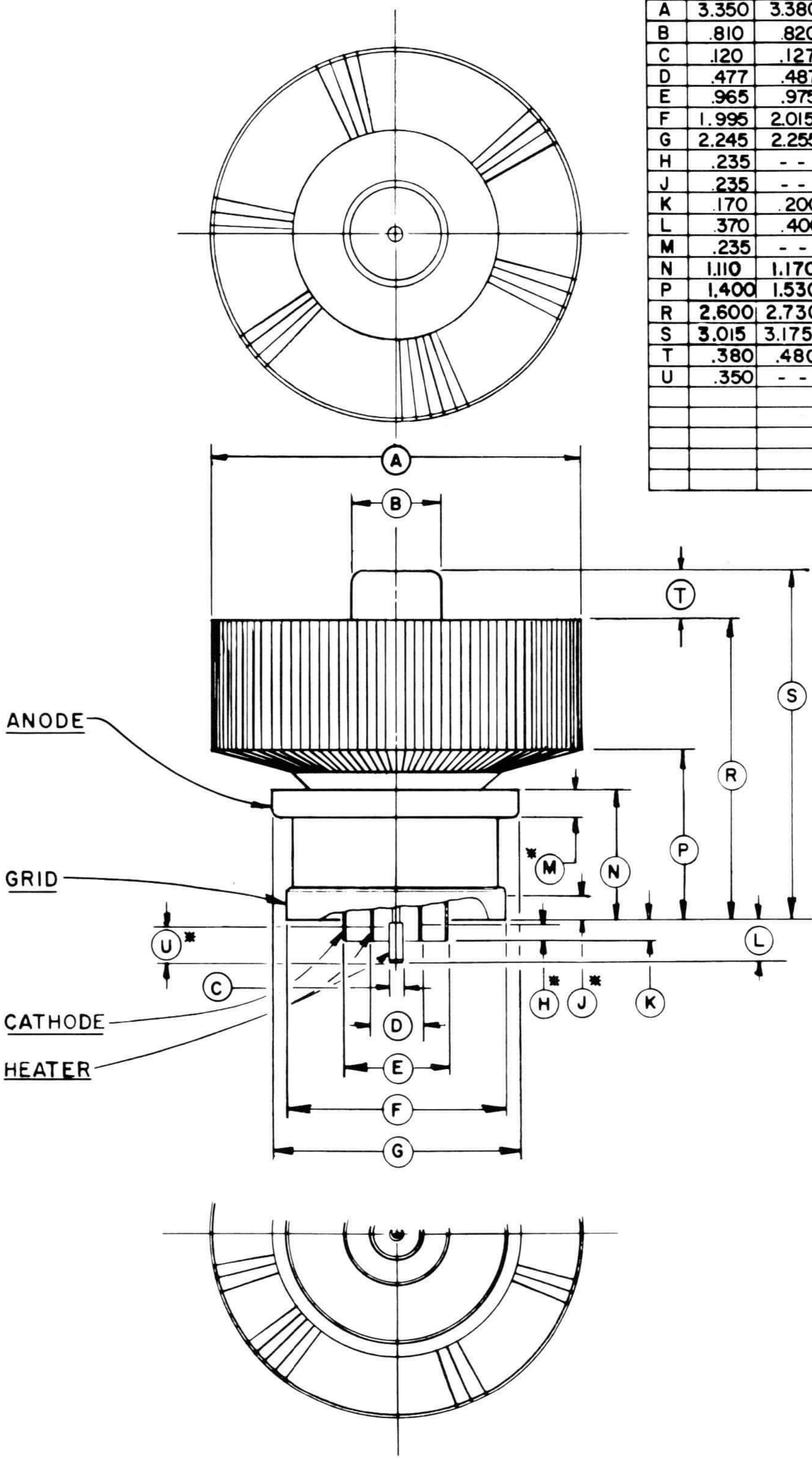
TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED GRID $E_f = 5V$

—— PLATE CURRENT – AMPERES ---- GRID CURRENT – AMPERES



CURVE #4435



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.350	3.380	- -	85.09	85.85	- -
B	.810	.820	- -	20.57	20.83	- -
C	.120	.127	- -	3.05	3.23	- -
D	.477	.487	- -	12.12	12.37	- -
E	.965	.975	- -	24.51	24.76	- -
F	1.995	2.015	- -	50.67	51.18	- -
G	2.245	2.255	- -	57.02	57.28	- -
H	.235	- -	- -	5.97	- -	- -
J	.235	- -	- -	5.97	- -	- -
K	.170	.200	- -	4.32	5.08	- -
L	.370	.400	- -	9.40	10.16	- -
M	.235	- -	- -	5.97	- -	- -
N	1.110	1.170	- -	28.19	29.72	- -
P	1.400	1.530	- -	35.56	38.86	- -
R	2.600	2.730	- -	66.04	69.34	- -
S	3.015	3.175	- -	76.58	80.64	- -
T	.380	.480	- -	9.65	12.19	- -
U	.350	- -	- -	8.89	- -	- -

NOTES:

1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE.
3. DIMENSIONS C, D, E TO BE CONCENTRIC WITH F & G WITHIN .015 DIA.
4. DIMENSIONS A & B TO BE CONCENTRIC WITH F & G WITHIN .040 DIA.

Eimac®

TECHNICAL DATA

3CX400U7

HIGH-MU UHF TRANSMITTING TRIODE

The EIMAC 3CX400U7 is designed for use above 200 MHz as a CW, pulse, or linear rf amplifier, particularly in the 806 to 950 MHz portion of the spectrum allocated to land mobile services.

The 3CX400U7 is a high-mu triode designed with beam-forming cathode and control grid geometry, of all metal/ceramic construction, and an external anode rated for 400 watts of dissipation with forced-air cooling.

The combination of an amplification factor of over 200 and minimum current interception by the control grid provides good power gain in cathode-driven (grounded grid) amplifiers. Coaxial terminals and continuous cone-shaped conductors for the grid and cathode allow the lowest possible inductance between these tube elements and the cavity. The heater terminals are separate from the cathode.

200 watts of useful CW rf power may be obtained with better than 33% efficiency, and better than 10 dB of gain. At frequencies near 900 MHz the amplifier circuit may be essentially a quarter-wave radial or rectangular resonator for the anode, and a three-quarter wave coaxial line section between ground and cathode. The amplifier is described in this data sheet. Terminal collets are available and are listed.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-Coated, Unipotential		
Heater Voltage, Nominal (see derating table for UHF use)	6.3 ± 0.3	V
Heater Current, at 6.3 volts	3.0	A
Cathode-Heater Potential, Maximum	±150	V
Transconductance, average (I_b = 250 mAdc)	29,000	μmhos
Amplification Factor, average	240	
Direct Interelectrode Capacitances (grid grounded)[2]		
Cin	18.4	pF
Cout	6.1	pF
Cpk	0.07	pF
Ck-htr	6.0	pF
Frequency of Maximum Rating:		
CW	1000	MHz

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 in accordance with Electronic Industries Association Standard RS-191.

Printed in U.S.A.

MECHANICAL

Maximum Operating Temperature:
Ceramic/Metal Seals and Anode Core . . . . 250°C
Cooling . . . . Forced Air
Base . . . . Special Coaxial
Recommended Contact Collets:

Tube Element	EIMAC Part No.
Inner Heater	008290
Outer Heater	008291
Cathode	008292
Grid	882931
Anode	154418

Maximum Overall Dimensions:
Length . . . . 2.51 in; 63.75 mm
Diameter . . . . 2.08 in; 52.83 mm
Net Weight (approximate) . . . . 5.5 oz; 155 gms

RADIO FREQUENCY POWER AMPLIFIER CLASS C TELEGRAPHY OR FM

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.400	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	5	WATTS

TYPICAL OPERATION, Cathode Driven, 850 MHz

Plate Voltage	1500	Vdc
Plate Current	400	mAdc
Grid Current	-5	mAdc
Measured Driving Power	13.0	W
Useful Output Power	225	W
Efficiency	37	%
Power Gain	12	dB

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	2.8	3.4	A
Cathode Warmup Time	60	---	Sec
Interelectrode Capacitances (grid grounded)[1]			
Cin	16.0	21.0	pF
Cout	5.0	7.0	pF
Cpk	---	0.1	pF

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

APPLICATION

MOUNTING & SOCKETING - Part numbers of available EIMAC collets are listed under MECHANICAL. These collets may be soft-soldered to the appropriate UHF line or cavity elements. The collets provide low-inductance connections between tube and circuitry and serve to draw off a portion of the heat released during normal operation.

HEATER-CATHODE OPERATION - The nominal heater voltage for the 3CX400U7 is 6.3 volts. For CW operation at frequencies above 300 MHz the heater voltage should be reduced as the cathode receives additional heat from rf charging currents and a transit-time effect. The following table gives approximate values of heater voltage recommended versus operating frequency for CW power levels at, or near, the typical operating conditions shown on Page 2. It is recommended that a mechanical relay, or other type of switching device, be provided so that near-nominal heater voltage will be provided during warmup and standby periods, and then dropped to the recommended level when rf drive is applied to the amplifier.

Frequency (MHz)	Heater Volts
300 or lower	6.3
300 to 400	6.1
400 to 500	5.7
500 to 600	5.3
600 to 700	4.9
700 to 800	4.5
800 to 900	4.0
900 to 1000	3.6

The heater voltage should be operated at nominal voltage of 6.3 volts for a minimum of 60 seconds before application of plate voltage or rf driving voltage.

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

COOLING - Forced-air cooling of the tube is required, with 11.5 cfm of air directed through the anode cooler when operating at full rated (400 W) dissipation. The pressure drop across the anode cooler only at this flow rate is approximately 0.2 inch of water, and these figures are based on an incoming air temperature of 50°C and a maximum tube anode temperature of 225°, at sea level, and with air flowing in a base-to-anode direction. When air is flowing in this direction, and the base contacting arrangement does not restrict flow in and around the base seals, additional base cooling provisions may not be required, but the designer is cautioned to verify whether base cooling is adequate before a circuit design is finalized, by means of temperature-sensitive paints which are available for this purpose, or other equivalent means.

Depending on the circuit or cavity design, allowance must also be made for other losses in the air system, in order to always assure sufficient flow for tube cooling. The designer is also cautioned that it is not good practice to operate at, or very close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements outlined is normally beneficial.

UHF CAVITY AMPLIFIER - Included in this data sheet is an exploded view of a typical cavity amplifier of simple construction requiring little precise machine work. The dimensions shown are for an amplifier to be operated near 900 MHz. The typical operating conditions for 850 MHz, shown on Page 2, were obtained with this cavity.

The output circuit is essentially a quarter-wave rectangular cavity forming the tuned circuit between anode and grid. Output coupling is magnetic. A loop is formed by a post *F* which terminates at one end in the center conductor of the coaxial fitting, and at the other end it is solidly in contact with the opposite plate (or wall) of the cavity.

The input circuit, while simple mechanically, is not as easily visualized as an electrical circuit. Starting with the small inner conductor *A*, this is a heater conductor and rf choke. The next tube, *B*, is the second heater conductor and rf choke. The third tube, *C*, is the cathode line which may be considered as a broadly tuned three-quarter wave line. The next diameter of tubing, *D*, is a sleeve tuned to an electrical three-quarter wave-length by an adjustable capacity probe, *E*. The sleeve is excited by the input capacity probe, *F*. Current flows on the inside as well as on the outside wall of the three-quarter wave sleeve, thereby coupling energy to the cathode line. Sleeve *D* is electrically three-quarter wavelength because there is approximately a loaded quarter wavelength within the vacuum tube itself, *E*.

Suitable cowling (not shown) should be provided to introduce cooling air through three short tubes on each side of the output cavity for anode cooling. The air then exhausts through the anode cooling fins of the 3CX400U7. The three short tubes on each side of the cavity are dimensioned to serve as waveguide-above-cutoff frequency filters in the air openings.

HIGH VOLTAGE - Normal operating voltages used with the 3CX400U7 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.

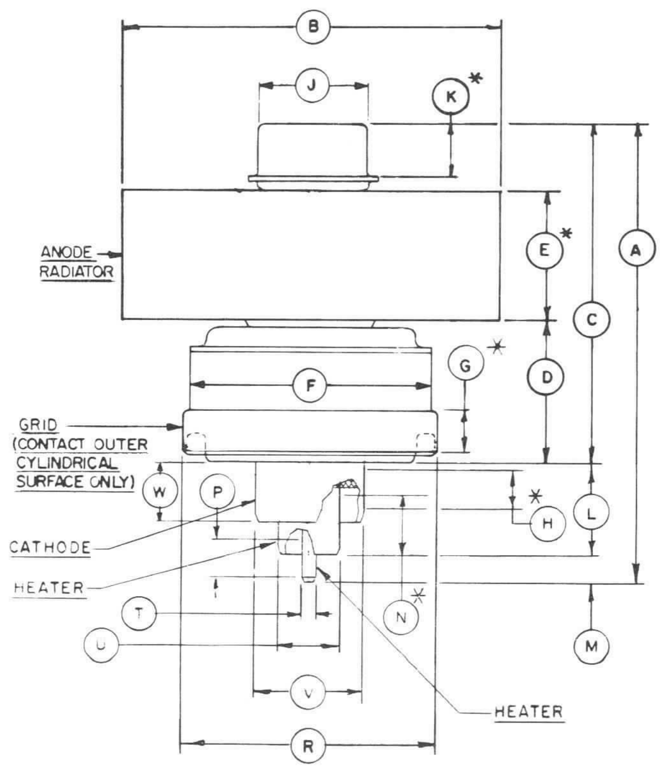
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

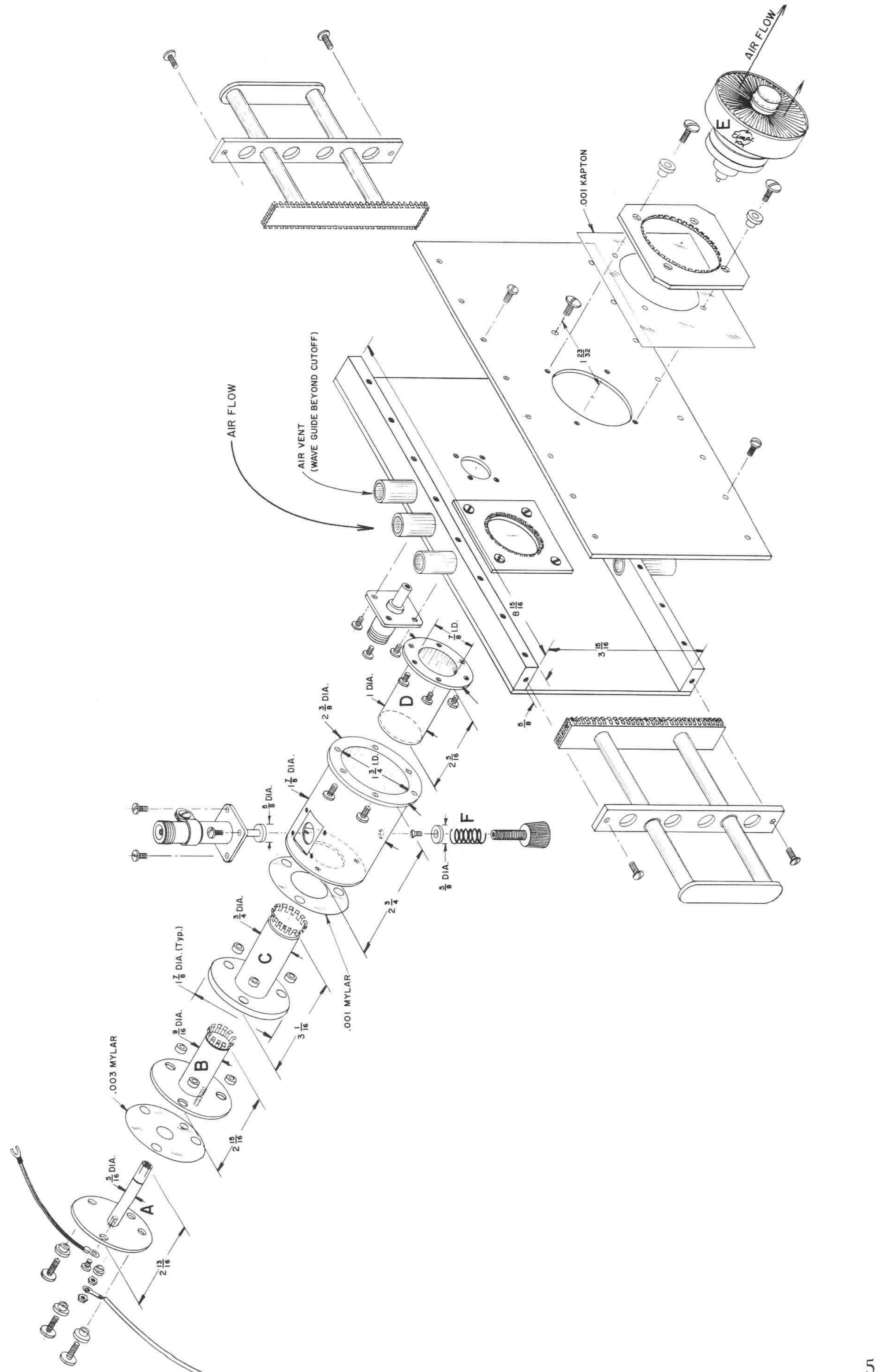
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	- -	2.510	- -	- -	63.75
B	2.050	2.080	- -	52.07	52.83	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	0.200	- -	- -	5.08	- -	- -
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	- -	- -	0.500	- -	- -	12.70
M	- -	- -	0.150	- -	- -	3.81
N	0.330	- -	- -	8.38	- -	- -
P	0.230	- -	- -	5.84	- -	- -
R	1.417	1.433	- -	35.99	36.40	- -
T	0.091	0.095	- -	2.31	2.41	- -
U	0.318	0.325	- -	8.08	8.25	- -
V	0.588	0.597	- -	14.93	15.16	- -
W	- -	- -	0.325	- -	- -	8.25

NOTES:

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

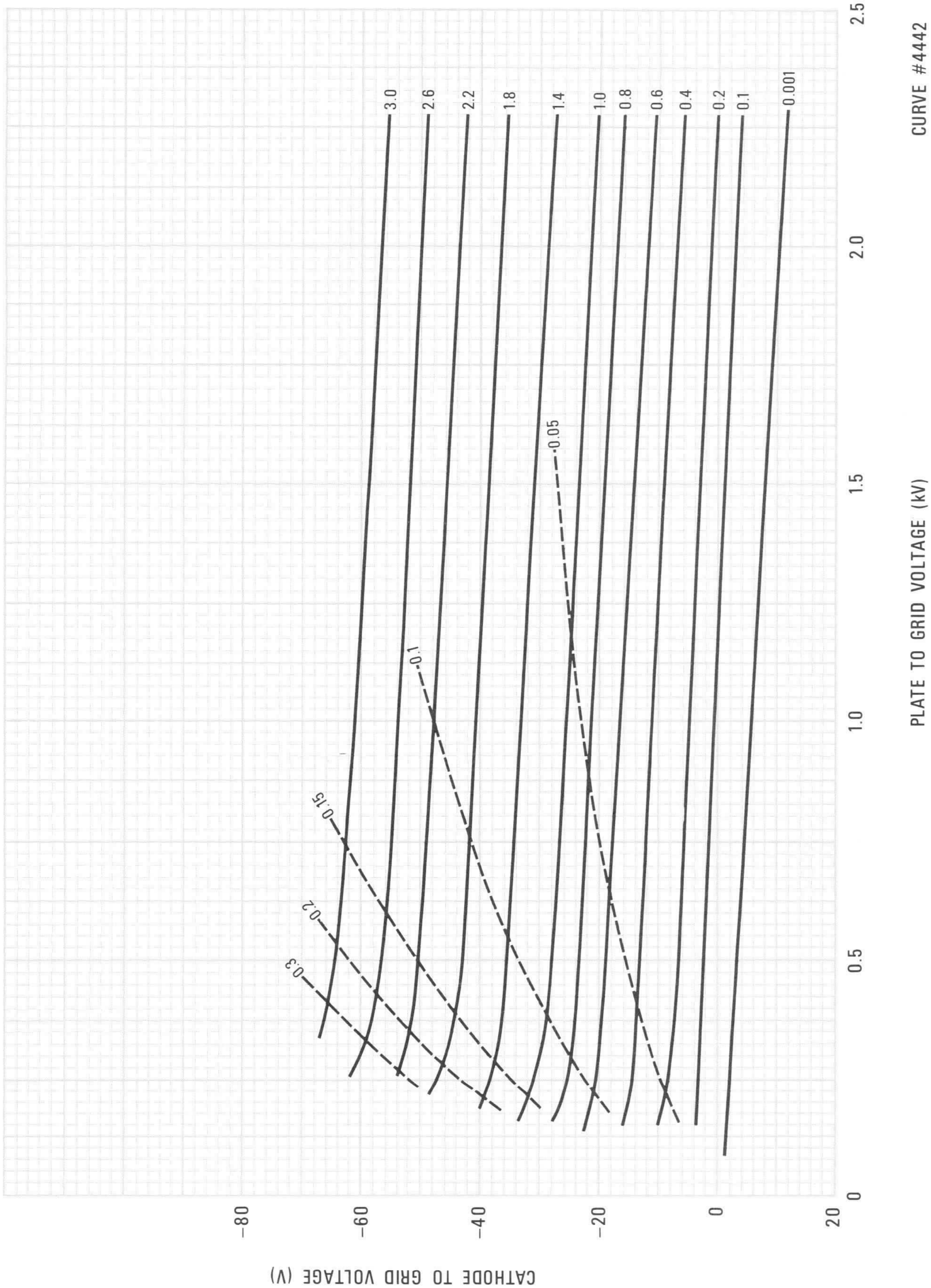


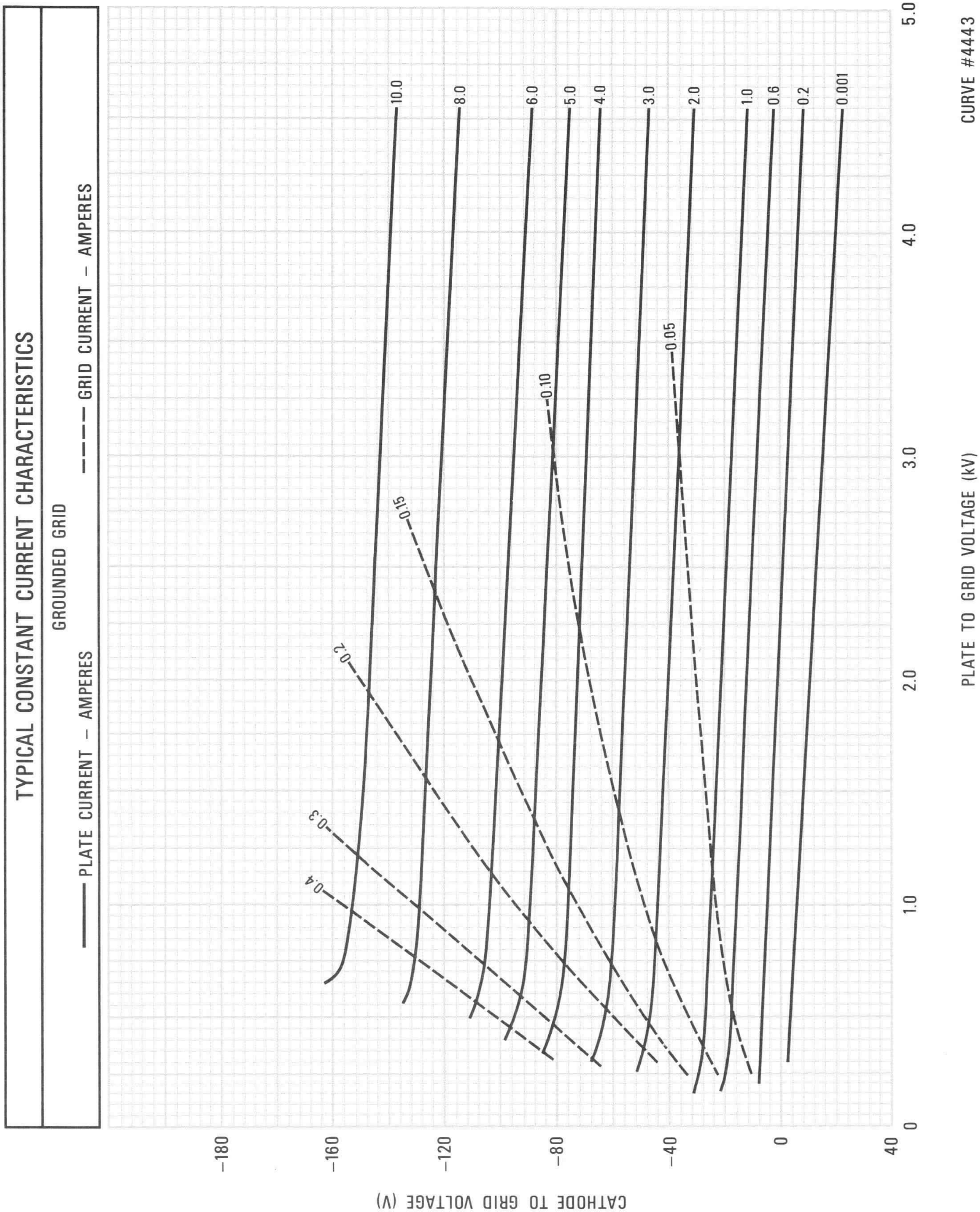

AIR FLOW
AIR VENT
(WAVE GUIDE BEYOND CUTOFF)
AIR FLOW
.001 KAPTON
.001 MYLAR
.003 MYLAR
A
B
C
D
E
F
1 DIA.

TYPICAL CONSTANT CURRENT CHARACTERISTICS

GROUNDED GRID

—— PLATE CURRENT – AMPERES ---- GRID CURRENT – AMPERES




TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.6
0.2
0.001
0.4
0.3
0.2
0.15
0.10
0.05
PLATE TO GRID VOLTAGE (kV)
0
1.0
2.0
3.0
4.0
5.0
CATHODE TO GRID VOLTAGE (V)
-180
-160
-120
-80
-40
0
40
CURVE #4443

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