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.

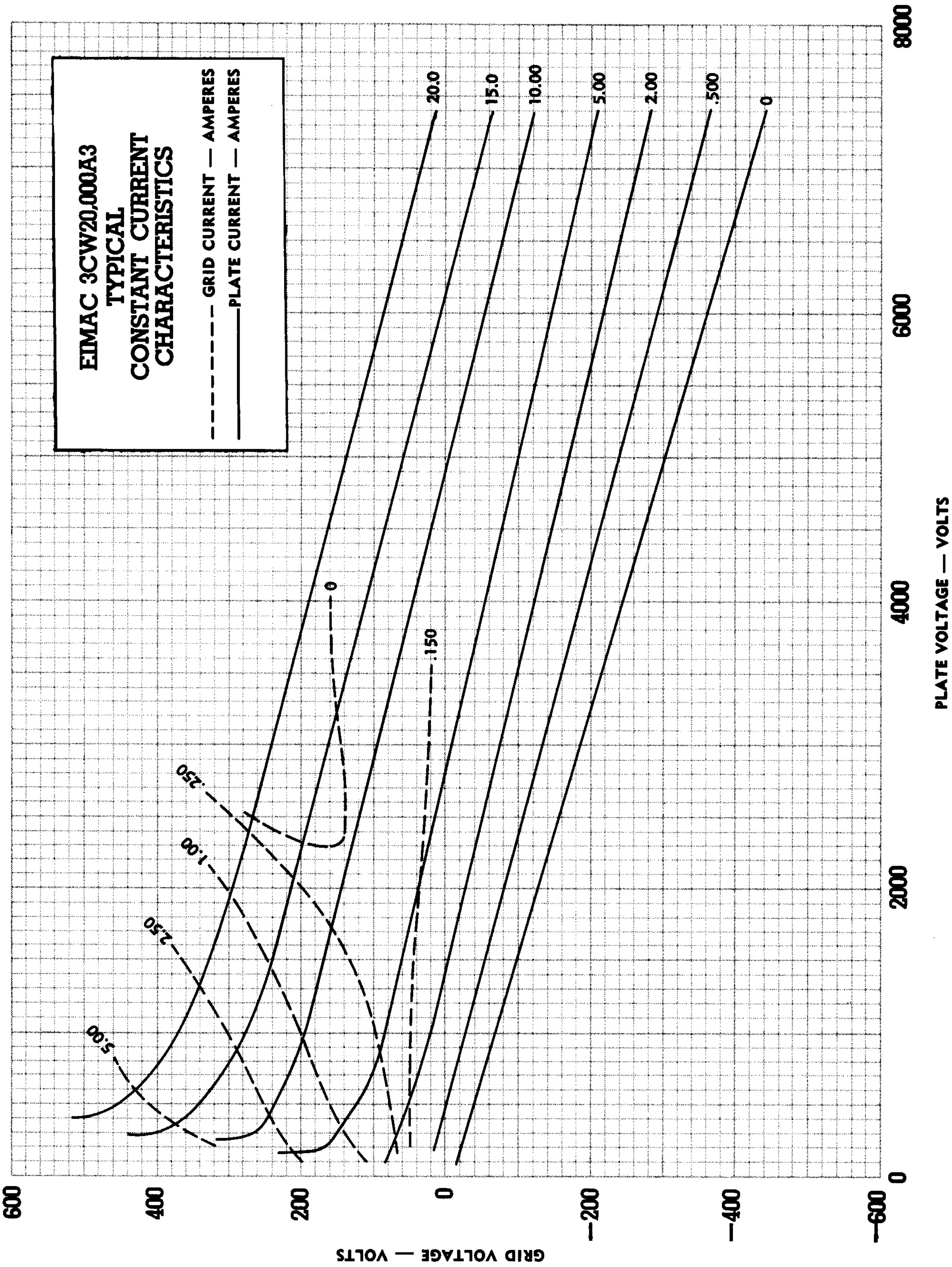
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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.

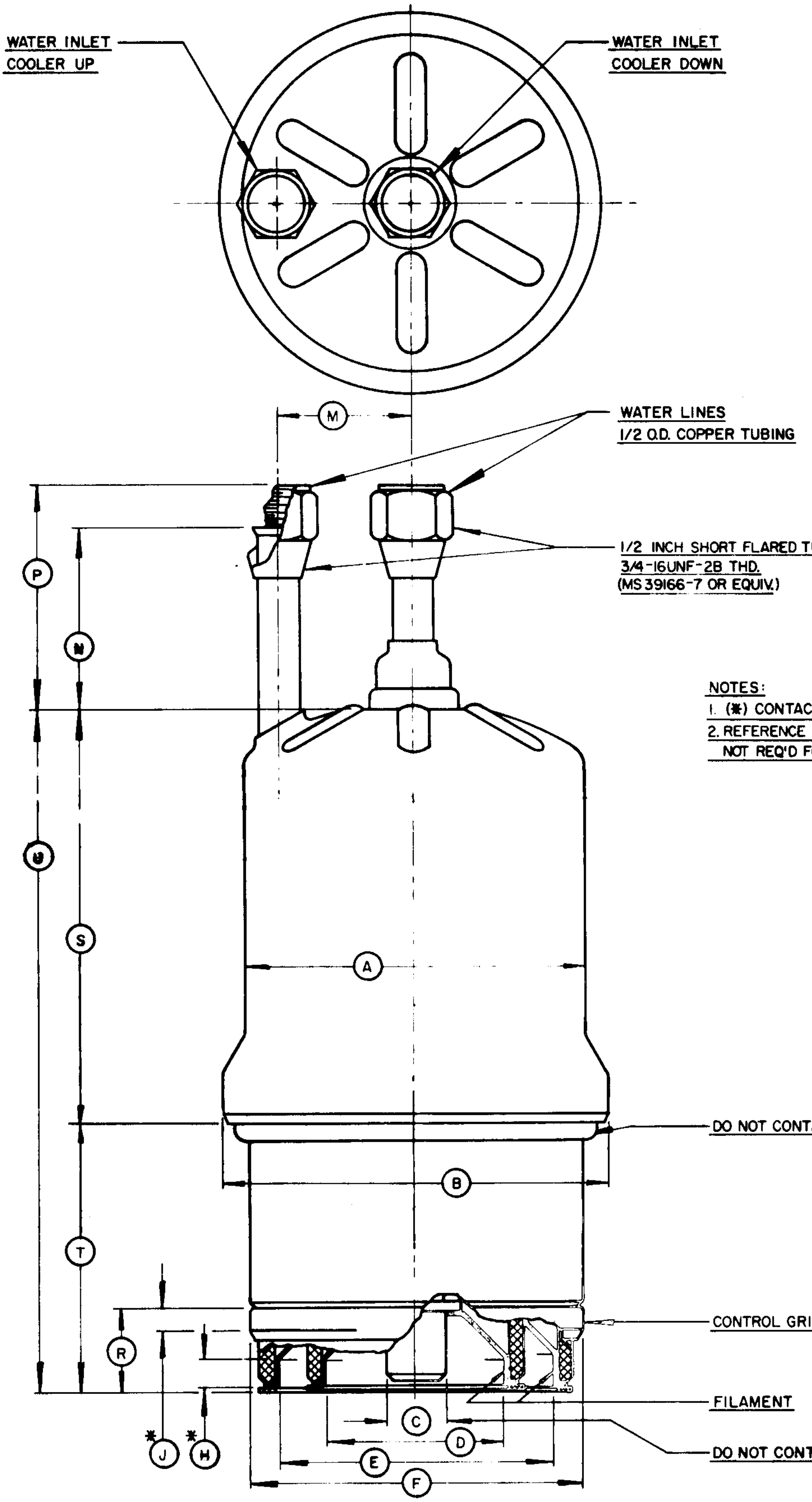
FAULT PROTECTION - In addition to normal plate over-current interlock and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

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
.250
1.00
2.50
5.00
.150
0
PLATE VOLTAGE — VOLTS
0
2000
4000
6000
8000
GRID VOLTAGE — VOLTS
600
400
200
0
−200
−400
−600

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.