3CW4ØØØH

3CW40,000H3

MEDIUM-MU
WATER-COOLED
POWER TRIODE

TECHNICAL DATA

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 100 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[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 (including base leads)	21.22 In; 53.9 cm
Diameter (anode mounting flange)	6.75 In; 17.1 cm
Net weight	14 lb; 6.4 kg
Operating Position	Vertical
Maximum Operating Temperature:	
Ceramic/Metal Seals & Envelope	250°C

Base . . . . . Special, with grid contact flange & filament flying leads

Cooling . . . . . Water or equivalent liquid & forced air

RADIO FREQUENCY INDUSTRIAL OSCILLATOR

Class C (Filtered dc power supply)

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	12.0	KILOVOLTS
PLATE CURRENT	9.0	AMPERES
GRID VOLTAGE	-1.2	KILOVOLTS
GRID CURRENT	1.2	AMPERES
PLATE INPUT POWER	100	KILOWATTS
PLATE DISSIPATION	40	KILOWATTS

TYPICAL OPERATION[1]

Plate Voltage	7.0	10.0	kVdc
Plate Current	7.7	9.0	Adc
Grid Voltage	-700	-850	Vdc
Grid Current[2]	0.53	0.74	Adc
Peak Pos. Grid Voltage[2]	440	550	v
Driving Power[2]	600	1040	W
Plate Input Power	54	90	kW
Plate Dissipation[2]	16	20	kW
Plate Output Power[2]	37.7	70	kW
Approx. Load Impedance	408	526	Ω

1 Loaded conditions.
2 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 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.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 10.0 volts	152	168	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	65.0	75.0	pF
Cout	2.0	2.6	pF
Cgp	38.0	48.0	pF

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

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 good 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 or 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 HMz. 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	15	19
30	16	21
40	17	24
50	18	28

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.

When the tube is mounted with the anode up, the outer cooler pipe should be used as the water inlet. When the tube is mounted anode down, the center cooler pipe should be used as the water inlet.

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^3, and preferably above 250 KΩ/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 50 to 100 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.

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 no be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

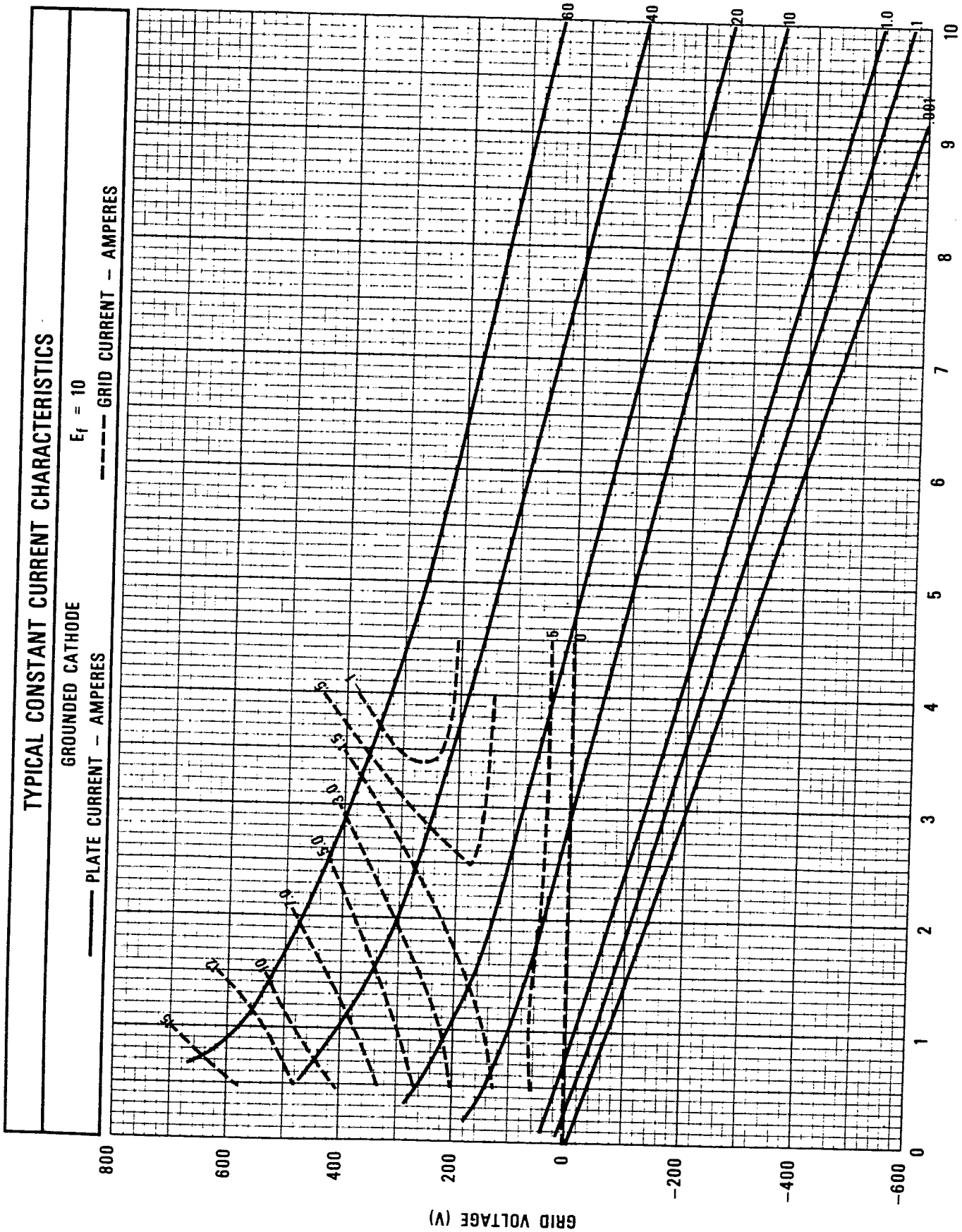
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attentuation or heating effect. Public health agencies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

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, 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
E_f = 10
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
-200
-400
-600
0
1
2
3
4
5
6
7
8
9
10
60
40
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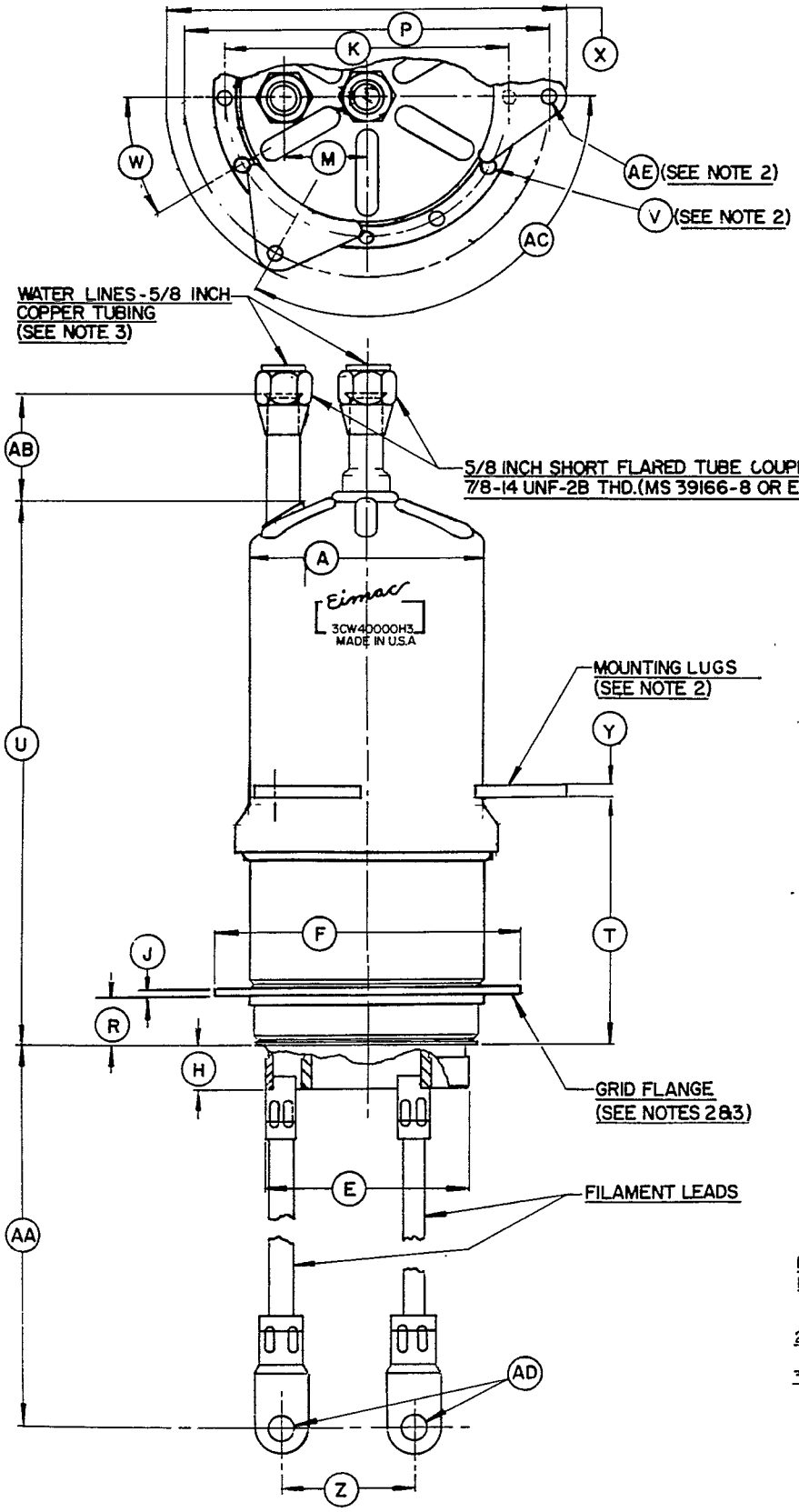

DIM	DIMENSIONAL DATA - INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.062	4.188		103.2	106.4	
E	3.230	3.270		82.0	83.1	
F	5.030	5.090		127.8	129.3	
G						
H	.530	.700		13.5	17.8	
J			.125			3.2
K	4.425	4.445		112.4	112.9	
M			1.625			41.3
P	5.957	6.025		151.3	153.0	
R	.700	.860		17.8	21.8	
T	4.350	4.450		110.5	113.0	
U	9.400	9.600		238.8	243.8	
V			.250			6.4
W	29°	31°		29°	31°	
X			6.750			171.5
Y			.250			6.4
Z			2.000			50.8
AA	8.500	9.000		215.9	228.6	
AB			2.625			66.7
AC	118°	122°		118°	122°	
AD			.390			9.9
AE			.265			6.7

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.