TECHNICAL DATA

MEDIUM-MU AIR-COOLED POWER TRIODE 3CX20,000H3

The EIMAC 3CX20,000H3 is ceramic insulated medium-mu power triode designed primarily for use in broadcast and industrial heating equipment without the use of a socket.. This triode is recommended for the AM broadcast service as a modulator, modulated rf stage, or as a linear amplifier. It is also recommended for use as an industrial oscillator in the LF to lower VFH range (30 KHz to 90 MHz). Its terminals are arranged for direct mounting in industrial heating equipment without the use of a socket.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	10.0 ± 0.5	V
Current @ 10.0 Volts	160	A

Direct Interelectrode Capacitances (grounded cathode)[2]

Cin	70.0	pF
Cout	2.3	pF
Cgp	43.0	pF

Frequency of Maximum Ratings (CW) ..... 90 MHz

MECHANICAL

Maximum Overall Dimensions:

Length (Excluding Leads)	10.60 in; 269.2 mm
Diameter	8.00 in; 203.2 mm
Net Weight	20.0 lbs; 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

[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. CPI Eimac Operations should be consulted before using this information for final equipment design.

[2] Capacitance values are for a cold tube.

3CX20,000H3

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or Industrial Oscillator (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC ANODE VOLTAGE	12	kV
DC GRID VOLTAGE	-2000	V
DC GRID CURRENT	1.5	A
DC ANODE CURRENT	8.0	A
ANODE DISSIPATION	20	kW
GRID DISSIPATION	750	kW

TYPICAL OPERATION:

DC Anode Voltage	7500	10,000	V
DC Grid Voltage	-800	-900	V
DC Anode Current	8.0	7.9	A
DC Grid Current[1]	1.4	0.75	A
Peak rf Grid Voltage[1]	1200	1270	V
Calculated Driving Power[1]	1670	960	W
Anode Input Power	60	78	kW
Anode Dissipation	9.0	14.0	kW
Anode Output Power	51.0	64.0	kW
Resonant Load Impedance	480	640	Ohms

[1] Approximate value

PLATE MODULATED RF POWER AMPLIFIER

GRID DRIVEN

Class C Telephony (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC ANODE VOLTAGE	6500	V
DC GRID VOLTAGE	-2000	V
DC ANODE CURRENT	5.5	A
ANODE DISSIPATION[1]	13.0	kW
GRID DISSIPATION[2]	750	W

[1] Corresponds to 20,000 watts at 100% sine-wave modulation.

[2] Average, with or without modulation.

TYPICAL OPERATION :

DC Anode Voltage	6500	kV
DC Grid Voltage	-1300	V
DC Anode Current	5.0	mA
DC Grid Current[1]	900	mA
Peak rf Grid Voltage[1]	1660	V
Calculated Driving Power	1500	W
Anode Input Power	32.5	kW
Anode Dissipation	5.0	kW
Anode Output Power*	27.5	kW
Resonant Load Impedance*	610	Ohms

[1] Approximate Value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube):

DC ANODE VOLTAGE[1]	8000	V
DC ANODE CURRENT	8.0	A
ANODE DISSIPATION	20.0	kW
GRID DISSIPATION	750	W

[1] Approximate value.

TYPICAL OPERATION :

DC Anode Voltage	7500	kV
DC Grid Voltage[1/3]	-380	V
Zero-Signal DC Anode Current	2.0	A
Max. Signal DC Anode Current	14.8	A
Max Signal DC Grid Current[1]	1.26	A
Peak af Grid Voltage[2]	640	V
Driving Power[1]	800	W
Max. Signal Anode Dissipation	30.2	kW
Anode Output Power	80.0	kW
Load Resistance (plate to plate)	1140	Ohms

[2] Per Tube

[3] Adjust to give stated zero-signal plate current.

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 anode current at the specified bias and anode 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 anode current is obtained is incidental and may vary 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. 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 @ 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 in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

HANDLING – These product contains a thoriated-tungsten filament and should be protected from shock and vibration. It is recommended that the tube be removed from equipment that is being shipped, to prevent damage that may occur in transit.

STORAGE – If a tube is to be stored as a spare it should be kept in its original shipping carton, with the original packing material, to minimize the possibility of handling damage. Before storage a new tube should be operated in the equipment for 100 to 200 hours to establish it has not been damaged and operates properly (see Filament Operation for recommendations on initial value of filament voltage during this operation period). If the tube is still in storage 6 months later, it again should be operated in the equipment for 100 to 200 hours to make sure there has been no degradation. If operation is satisfactory, the tube can again be stored with great assurance of being a known-good spare.

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 down. The filament terminals are flexible leads approximately 8-3/4" 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 250ºC. 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 250ºC. Air-flow requirements to maintain core temperature at 225ºC in 50ºC ambient air are tabulated below (for operation below 30 MHz.

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 1-1/2 inch diameter nozzle into the base of the tube to cool the filament terminals.

(Base to Anode Air Flow)

Anode* Dissipation (Watts)	SEA LEVEL		5,000 FEET	
	Air Flow (CFM)	Pressure Drop (In. of Water)	Air Flow (CFM)	Pressure Drop (In. of 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 1680 watts and since grid dissipation can, under some conditions represent another 750 watts, allowance has been made in preparing this tabulation for an additional 2430 watts.

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

ELECTRICAL

FILAMENT OPERATION – For the 3CX20,000H3 the rated filament voltage is 10.0 volts. Filament voltage, as measured at the socket, should be maintained at 10.0 volts plus or minus five percent for long tube life and consistent performance. Maximum life will be obtained by operation at minus 5 percent.

This tube is designed for commercial service, with no more than one normal off/on filament cycle per day. If additional cycling is anticipated it is recommended the user contact Application Engineering at CPI/Eimac for additional information.

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.

ANODE 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 anode and grid currents individually. It is good practice also to provide separate anode current or cathode current overload relays when tubes are operated in parallel.

HIGH VOLTAGE - The 3CX20,000H3 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 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.

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 connectors 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; however, in the case of the 3CX20,000H3, no special shielded fixture is used due to the length of the filament leads. 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 represents approximate final layout if capacitance values are highly significant in the design.

X-RADIATION – High-vacuum tubes operating at voltages higher than 10 kilovolts product 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 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 the field should be contacted to perform an x-ray survey of the equipment.

Operating of high voltage equipment with interlock switches ‘cheated’ and cabinet doors open in order to 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 3CX20,000H3 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 these tubes under conditions widely differ from those given here, contact the Application Engineering Dept., CPI Eimac Division, Palo Alto, CA 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 and are exposed to power tubes, or equipment that utilizes such tubes, must take precautions to protect 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.

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

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.

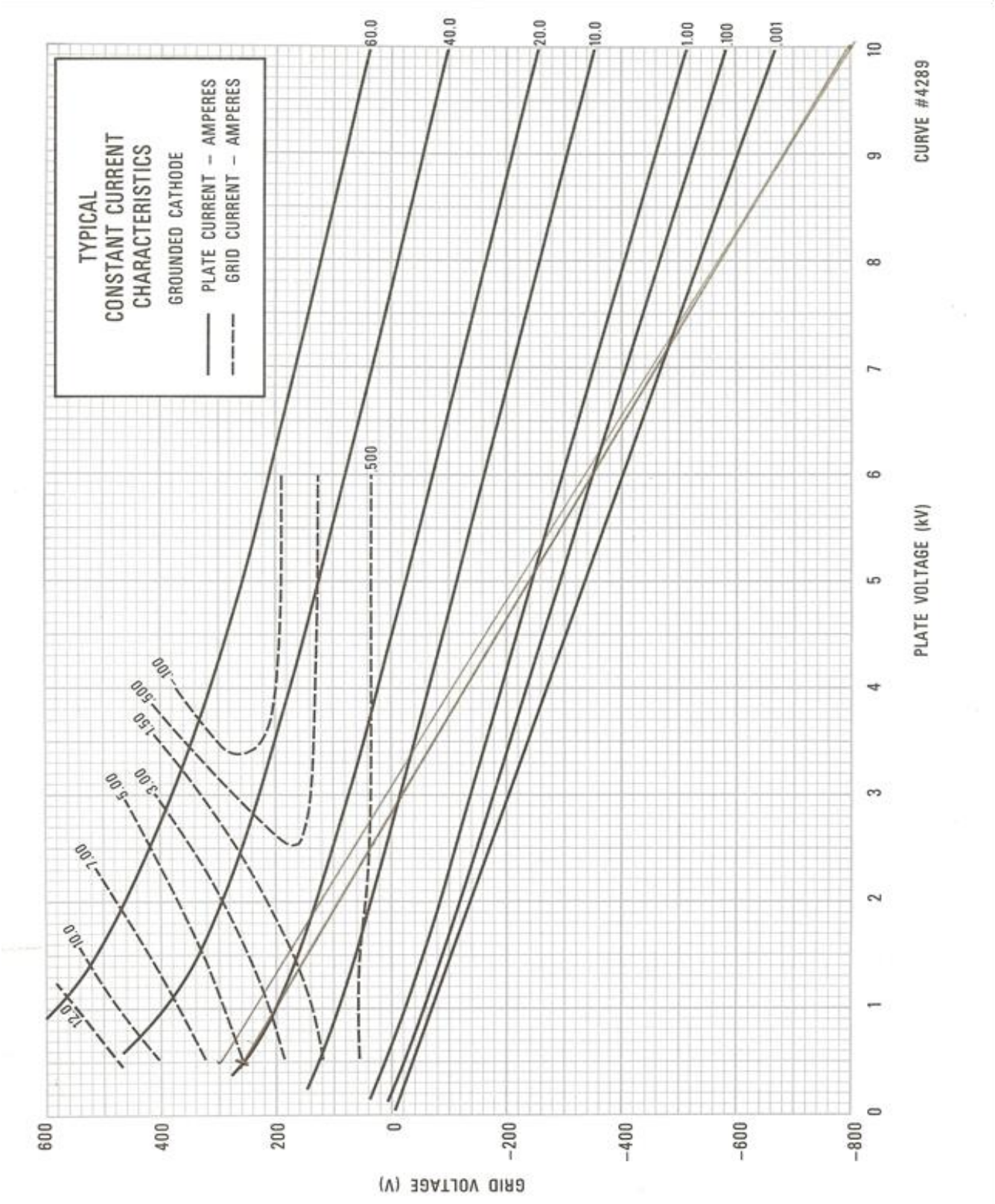
RF RADIATION – Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE AFFECTED.

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

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.

MATERIAL COMPLIANCE - This product and package conforms to the conditions and limitations specified in 49CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910. In addition, this product and package contains no beryllium oxide (BeO).

Please review the detailed Operating Hazards sheet enclosed with each tube, or request a copy from CPI, Eimac Division Application Engineering at (800) 414-8823, #1.



Communications & Power Industries
Eimac division

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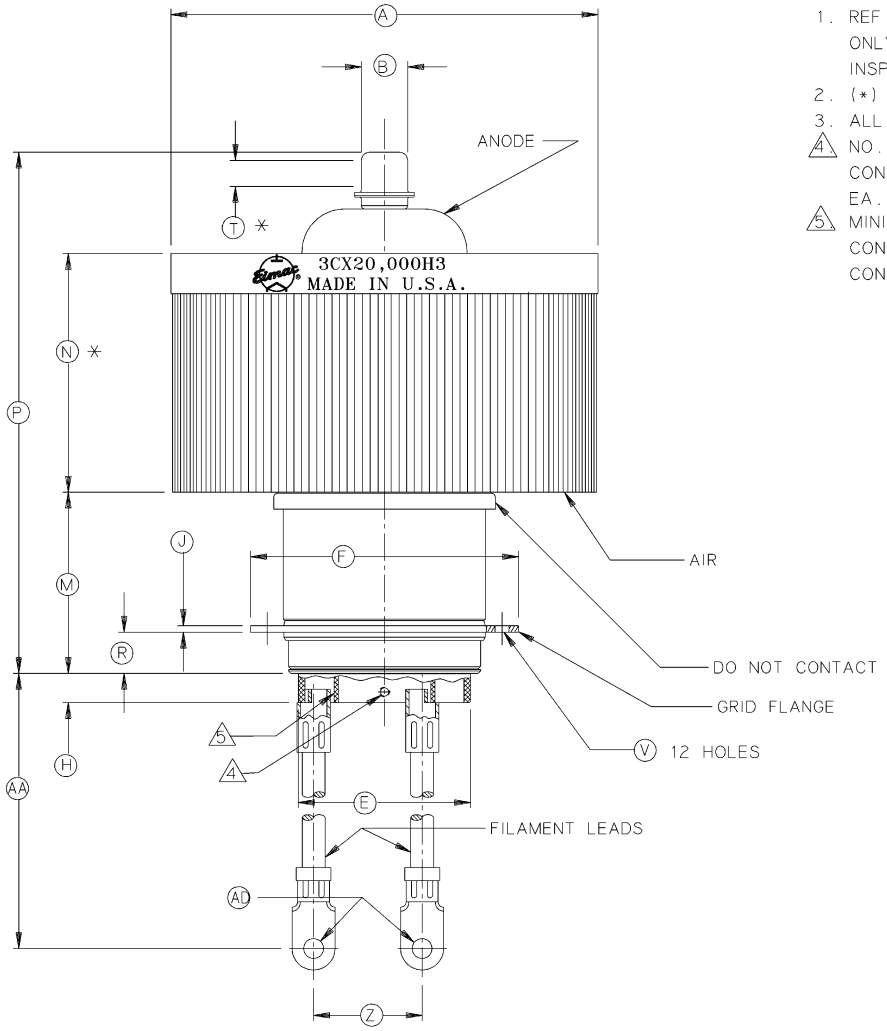
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A			8.000			203.20
B	.855	.895		21.72	22.73	
E	3.230	3.270		82.04	83.06	
F	5.030	5.090		127.76	129.29	
H	.530	.700		13.46	17.78	
J			.125			3.18
M	3.253	3.603		82.63	91.52	
N			4.547			115.49
P			10.000			254.00
R	.700	.860		17.78	21.84	
T	.375			9.53		
V			.265			6.73
Z			2.000			50.80
AA	8.500	9.000		215.90	228.60	
AD			.390			9.91

NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY. AND ARE NOT FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.
3. ALL DIMS. IN INCHES.
4. NO. 10-32 TAPPED HOLES IN CONTACT RINGS, (ONE HOLE EA. RING, IN LINE).
5. MINIMUM GAP BETWEEN CONNECTOR AND INNER CONTACT RING TO BE .05.



LTR	DESCRIPTION OF CHANGE	SCO	DATE	BY
K	REDAWN ON CAD	266006	18/02	SM/KA
L	PICTORIALLY FIXED FIN AND EIMAC AND OUTLINE LABELS	266001	1/18/04	SM/KA
M	ADD NOTE 5	603647	6/11/09	SM/KA

DRAWN: S. SINGH 06/18/02 | ENGR APPR: | SCALE: NONE
CHK'D: K. AUTSEN 06/24/02 | SUPERSEDES: | FILE PATH: L:\OUTLINE\3CX20KH3

Eimac Div of CPI

PART NO. 3CX20,000H3 | CODE IDENT NO. 06550

OUTLINE
ELECTRON DEVICE

NO. 3CX20,000H3 | M

3CX20,000H3

MV: 2 - CPL: 1 - SCL: 0.7