



TECHNICAL DATA

4CW800B  
4CW800F

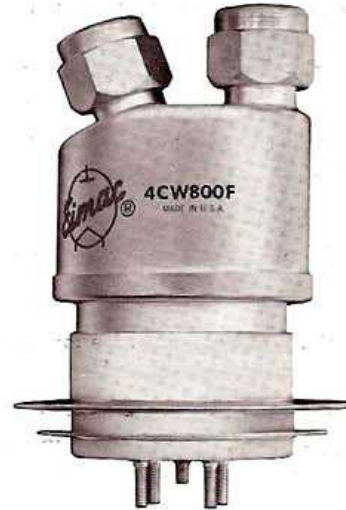
RADIAL BEAM  
POWER TETRODE

The EIMAC 4CW800B and 4CW800F are ceramic/metal, liquid cooled radial-beam tetrodes designed for use in distributed amplifiers and VHF/UHF power amplifiers.

The mechanical and electrical features of these tubes are compatible with distributed amplifier circuit requirements, i.e., low lead inductance, low input and output capacitance and small size.

Ruggedized construction consisting of a unitized electrode structure and direct mounting to the chassis, combine to make the 4CW800B and 4CW800F suitable for environments of severe shock and vibration.

The maximum rated plate dissipation is 800 watts for both types.



GENERAL CHARACTERISTICS<sup>1</sup>

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: 4CW800B

Voltage .....	6.0 V
Current .....	4.4 A

Heater: 4CW800F

Voltage .....	26.5 V
Current .....	1.1 A

Transconductance: ( $I_b = 600 \text{ mA}_{dc}$ ) ..... 40,000  $\mu\text{mhos}$

Input Conductance: ( $I_b = 600 \text{ mA}_{dc}$ )  
( $F = 30 \text{ MHz}$ ) .....  $0.1 \times 10^{-3} \text{ mhos}$

Frequency for Maximum Ratings ..... 800 MHz

Direct Interelectrode Capacitance: (Grounded Cathode)<sup>2</sup>

$C_{in}$  ..... 45 pF

$C_{out}$  ..... 5.8 pF

$C_{gp}$  ..... 0.15 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

Base ..... Special

Operating Position ..... Any

Maximum Operating Temperatures:

Ceramic-to-Metal Seals ..... 250°C

Base Plate ..... 150°C

Cooling ..... Liquid

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# 4CW800B/4CW800F

## Maximum Over-all Dimensions:

Length .....	3.00 In; 76.20 mm
Diameter .....	2.03 In; 51.56 mm
Net Weight .....	7 oz; 198 gm

## RANGE VALUES FOR EQUIPMENT DESIGN

Heater: 4CW800B - Current at 6.0 volts .....	4.0	4.7 A
4CW800F - Current at 26.5 volts .....	0.85	1.25 A
Cathode Warmup Time - both types .....	180	--- sec.
Interelectrode Capacitances (grounded cathode circuit) <sup>1</sup>		
Cin .....	42.0	48.0 pF
Cout .....	5.3	6.3 pF
Cgp .....	---	0.20 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.

## BROADBAND RF LINEAR AMPLIFIER

Class AB, Grid Driven

## TYPICAL OPERATION

### ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE .....	3000 VOLTS
DC SCREEN VOLTAGE .....	500 VOLTS
DC PLATE CURRENT .....	0.6 AMPERE
PLATE DISSIPATION .....	800 WATTS
SCREEN DISSIPATION .....	15 WATTS
GRID DISSIPATION .....	3 WATTS

Plate Voltage .....	1000	1500	2500 Vdc
Screen Voltage .....	275	275	275 Vdc
Grid Voltage <sup>1</sup> .....	-40	-40	-40 Vdc
Zero Signal Plate Current ..	100	100	100 mAdc
Plate Current .....	570	580	585 mAdc
Screen Current <sup>2</sup> .....	32	29	17 mAdc
Peak rf Grid Voltage <sup>2</sup> .....	44	43	42 v
Plate Output Power <sup>2</sup> .....	320	590	1000 W
Plate Dissipation <sup>2</sup> .....	250	280	460 W
rf Load Impedance .....	765	1225	2325 Ω

1. Adjust for specified zero-signal plate current.
2. Approximate value.

## RADIO FREQUENCY POWER AMPLIFIER

Class B, Grid Driven

## TYPICAL OPERATION

### ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE .....	3000 VOLTS
DC SCREEN VOLTAGE .....	500 VOLTS
DC PLATE CURRENT .....	0.6 AMPERE
PLATE DISSIPATION .....	800 WATTS
SCREEN DISSIPATION .....	15 WATTS
GRID DISSIPATION .....	3 WATTS

	140-250 MHz Strip-line amp			432 MHz Cavity	865 MHz Cavity
Plate Voltage .....	1650	1950	2500	2000	2000 Vdc
Screen Voltage .....	400	300	300	300	300 Vdc
Grid Voltage <sup>1</sup> .....	-75	-60	-60	-54	-60 Vdc
Zero Signal Plate Current .....	15	15	15	20	15 mAdc
Maximum Signal Plate Current .....	600	530	600	600	600 mAdc
Screen Current <sup>2</sup> .....	14	11	11	7	8 mAdc
Grid Current <sup>2</sup> .....	-6	-2	+8	+14	0 mAdc
Useful Power Output <sup>3</sup> ..	540	555	820	770	550 W
Bandwith (3dB) of Amplifier .....	6	6	4.5	---	9 MHz
Power Gain <sup>2</sup> .....	---	---	---	15.3	10.4 dB

1. Adjust for specified zero-signal plate current.
2. Approximate value.
3. Delivered to the load.



## APPLICATION

### MECHANICAL

**MOUNTING** - These tubes may be mounted in any position. No socket is required. The tube may be mounted directly on the SK-680 Screen Bypass Capacitor which in turn is mounted to the chassis with four 6-32 screws. The chassis thickness should be 0.062 inch to insure adequate space for connections to the base of the tube and care should be exercised to insure a flat mounting surface to minimize cathode lead inductance.

**COOLING** - Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-metal seals	250°C
Base and flanges	150°C

Anode cooling is accomplished by circulating liquid through the integral water jacket.

At ambient temperatures of 25°C or less, no base cooling is required.

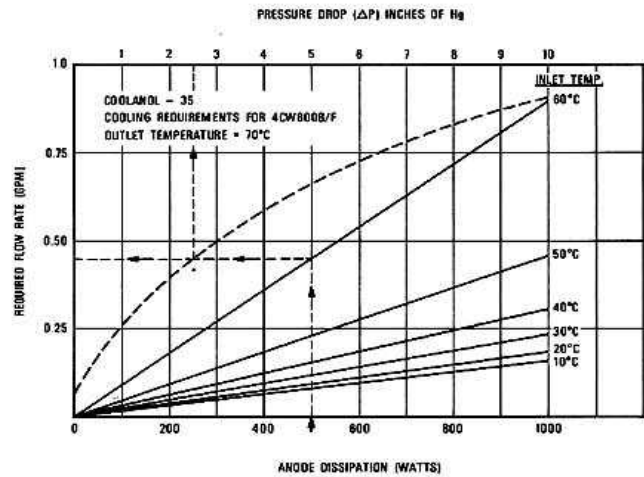
At higher temperatures, base cooling may be required to maintain base temperatures below 150°C. This can be accomplished by mounting the tube to a cold plate cooled by the inlet liquid.

**WATER COOLING** - The tabulation below lists the minimum water flow requirements for 25°C inlet water temperature with a temperature rise of 15°C from inlet to outlet.

Plate Dissipation (Watts)	Water Flow (GPM)	Pressure Drop (psi)
200	.050	.025
400	.100	.050
600	.156	.075
800	.202	.100

Water pressure should never exceed 200 psi and outlet temperature must be limited to 70°C.

**OIL COOLING** - The cooling jacket was specifically designed for oil coolant such as Coolanol 35. The minimum flow requirement and pressure drop can be derived from the following graph:



\* Sample Calculation: For an inlet temperature of 60°C at 500 watts anode dissipation, the required flow rate is .45 GPM. The pressure drop will be .25 inches of Hg.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness.

### ELECTRICAL

**HEATER** - The rated heater voltage is 6.0 volts for the 4CW800B and 26.5 volts for the 4CW800F. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than three minutes before current is drawn from the cathode. Tube operation will stabilize after a period of approximately five minutes from a cold start.

**CONTROL-GRID OPERATION** - The control-grid has a maximum dissipation of 3.0 watts and precautions should be observed to avoid exceeding this rating. Derating of the control grid dissipation will be necessary if the base flange temperature exceeds 150°C.

There are four threaded grid pins on the base of the tube. These pins can be used separately or in parallel to control the amount of grid lead in-



ductance to suit the requirements of the circuit. The grid lead inductance for one pin is 2.4 nanohenries.

**SCREEN GRID OPERATION** - The maximum rated screen dissipation for the 4CW800B or 4CW800F is 15 watts.

Under certain operating conditions the screen current of a tetrode may reverse as indicated on the screen current meter. This condition is the result of secondary emission from the screen and is normal for a power tetrode. If the impedance of the screen power supply is high, negative screen current will cause the screen voltage to approach the anode voltage, and the results will be a runaway condition which could lead to a catastrophic failure. This condition can be avoided if sufficient bleeder current is drawn from the screen supply by an appropriate bleeder or regulator tube. The recommended bleeder current for these tubes is 20 mA for each tube connected to a common screen power supply.

A low inductance screen bypass capacitor, EIMAC SK-680, is available for either tube. This capacitor is easily installed with six 0-80 screws. With the SK-680 capacitor installed, the screen self-resonant frequency of either tube is in excess of 900 MHz.

**PLATE OPERATION** - The maximum rated plate dissipation power for either tube is 800 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded. Connection to the anode is accomplished by a clamp around the anode.

**DISTRIBUTED AMPLIFIER SERVICE** - The mechanical and electrical features of the 4CW800B and 4CW800F are compatible with distributed amplifier circuit requirements, combining the qualities of low lead inductance, low input and output capacitances, high transconductance, and small size. Connection is made to the control grid by means of four threaded studs. By using the correct number of connections, the designer has available a choice of several values of grid lead inductance. This feature is quite useful in design of VHF/UHF distributed amplifiers. In addition, rugged internal tube construction, consisting of a unitized electrode structure and a solid direct-chassis flange mount, are features which make these tubes suitable for environments exhibiting severe shock and vibration, such as encountered in mobile or airborne service.

A distributed amplifier is a wideband, cascade device, employing vacuum tubes placed along an artificial transmission line, the tube capacitances appearing as the shunt elements of the line. In a properly designed distributed amplifier, the driving impedance is virtually independent of the number of tubes. The amplifier may make use of the characteristics of the low pass, the band pass, or the high pass filter configuration.

The 4CW800B and 4CW800F are ideal tubes for distributed amplifier service, as anode heat may be readily disposed of by a compact, external cooling system. An amplifier using one of these types is an advantage in instantaneous bandwidth rf systems as it eliminates the need of complex and slow tuning and tracking equipment necessary for a tuned amplifier.

**EIMAC APPLICATION BULLETIN NUMBER FOURTEEN** - This 23-page booklet is available from EIMAC and contains additional information on the use of these tubes (or similar types of the same tube family), including some constructional details, in strip-line amplifier circuitry in the 140-250 MHz range, distributed amplifier service, and cavity amplifier operation at 432 MHz and 865 MHz.

**HIGH VOLTAGE** - The 4CW800B and 4CW800F 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**.

**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, 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 inter-

changeability 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 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.



4CW800B/F

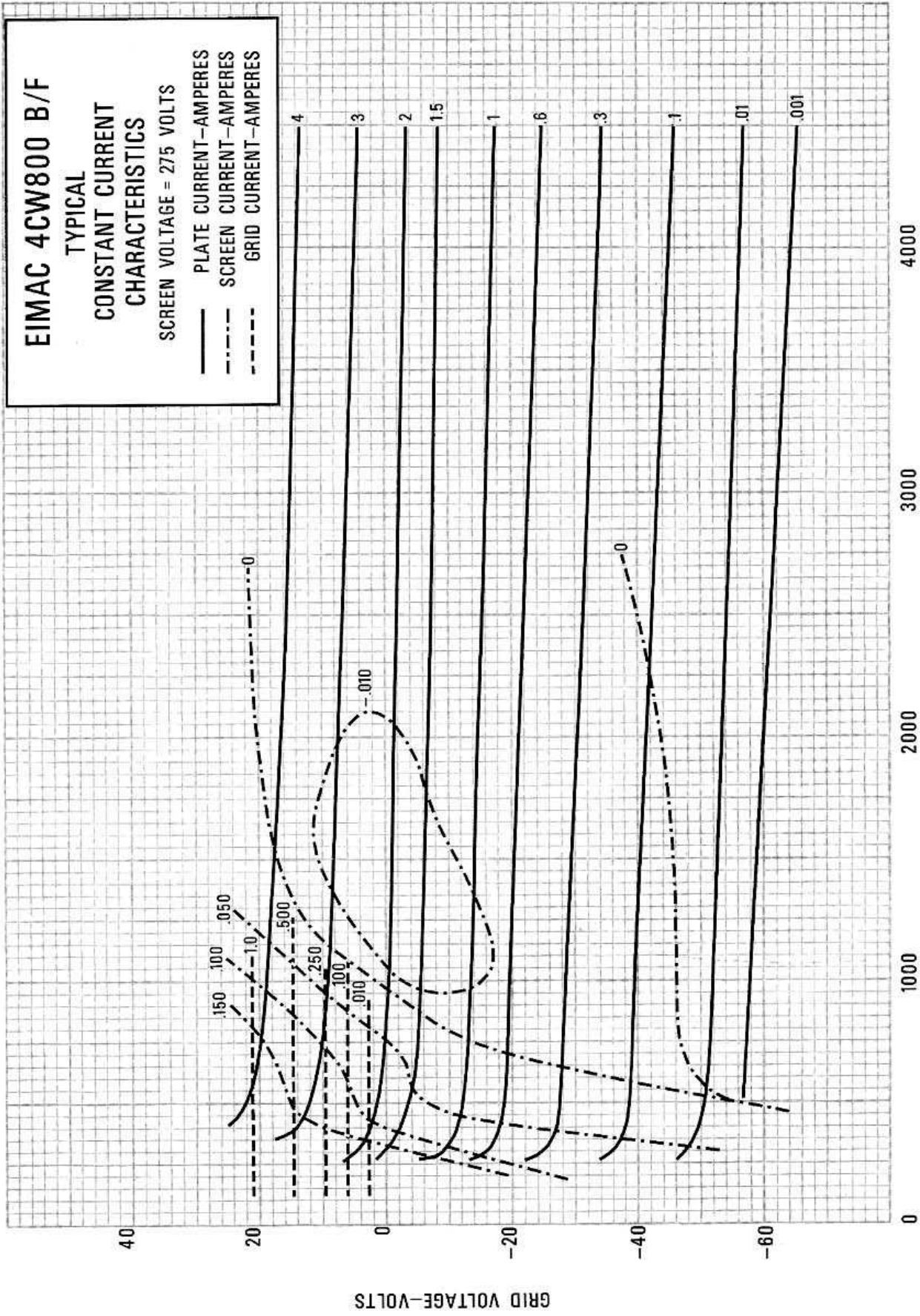
# EIMAC 4CW800 B/F

TYPICAL

CONSTANT CURRENT  
CHARACTERISTICS

SCREEN VOLTAGE = 275 VOLTS

- PLATE CURRENT—AMPERES
- - - SCREEN CURRENT—AMPERES
- - - GRID CURRENT—AMPERES



CURVE #3371



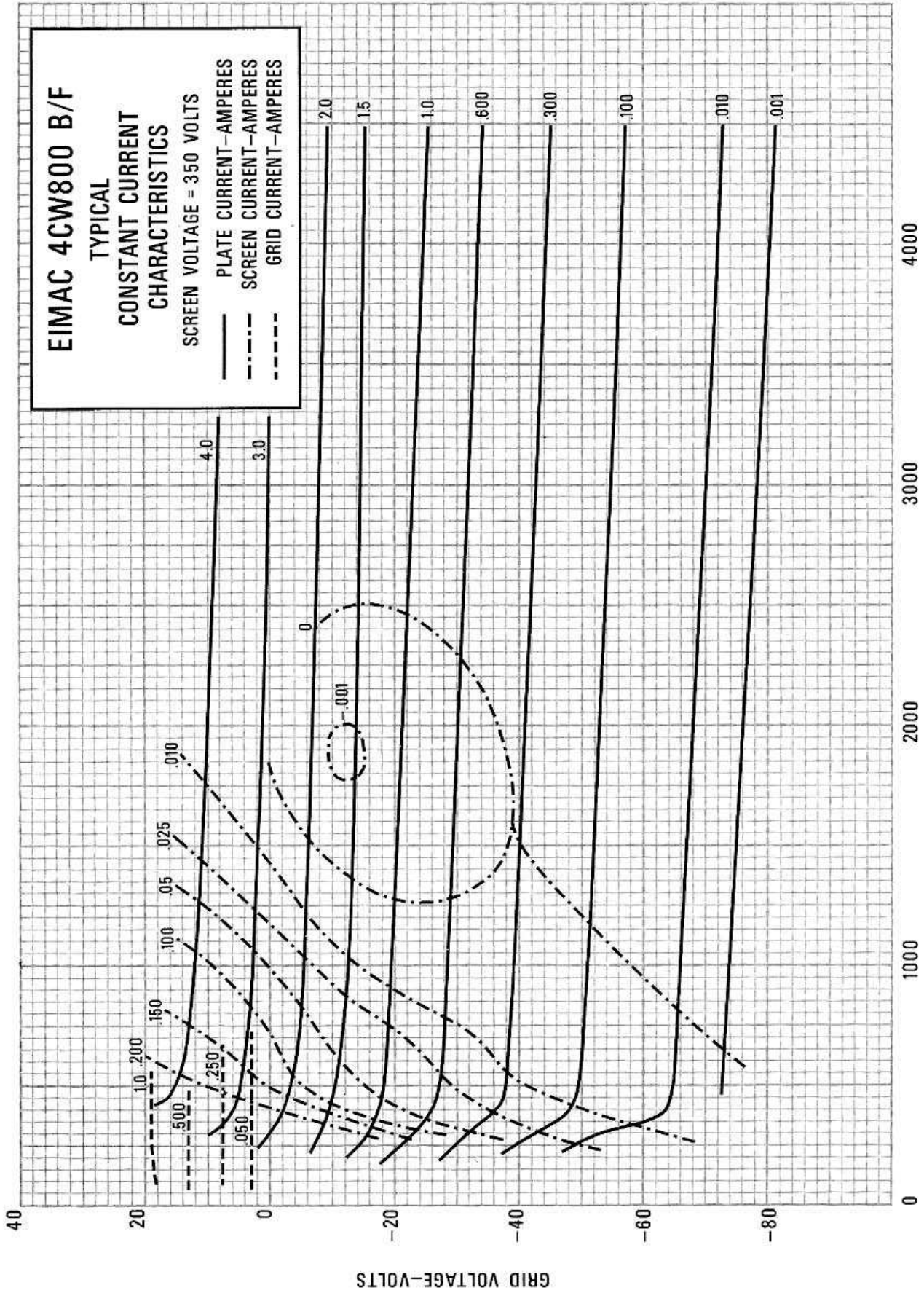
# EIMAC 4CW800 B/F

## TYPICAL

### CONSTANT CURRENT CHARACTERISTICS

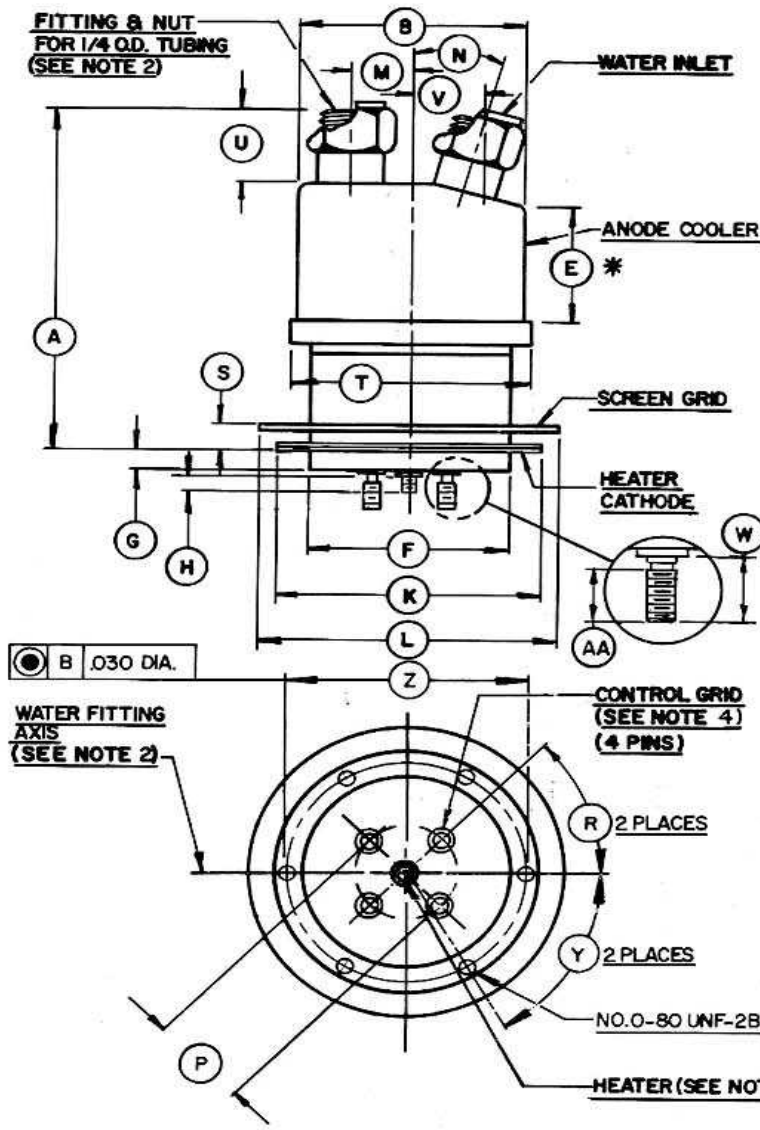
SCREEN VOLTAGE = 350 VOLTS

- PLATE CURRENT—AMPERES
- - - - SCREEN CURRENT—AMPERES
- - - - GRID CURRENT—AMPERES



CURVE # 3342

PLATE VOLTAGE—VOLTS



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	-	2.515	-	-	63.88	-
B	1.485	1.515	-	37.35	38.10	-
E	0.650	-	-	16.35	-	-
F	1.305	1.325	-	32.82	33.32	-
G	0.130	0.155	-	3.27	3.90	-
H	0.130	0.180	-	3.27	4.53	-
K	1.710	1.750	-	43.01	44.01	-
L	1.930	2.025	-	48.54	50.93	-
M	0.435	0.475	-	10.94	11.95	-
N	15°	25°	-	15°	25°	-
P	0.550	0.600	-	13.97	15.24	-
R	44°	46°	-	44°	46°	-
S	0.180	0.220	-	4.53	5.53	-
T	1.550	1.610	-	38.98	40.48	-
U	0.400	-	-	10.06	-	-
V	0.440	0.520	-	11.07	13.08	-
W	0.250	0.300	-	6.29	7.54	-
Y	59°	61°	-	59°	61°	-
Z	1.608	1.628	-	40.84	41.35	-

- NOTES:**
1. REF DIMS. ARE FOR INFO ONLY AND ARE NOT REQD FOR INSP PURPOSES.
  2. WATER FITTINGS ARE DIA - METRICALLY OPPOSED & AXIS IS LOCATED BETWEEN AXES OF PINS.
  3. (\*) CONTACT SURFACE.
  4. 2-56 UNC-2A.