4CV250,000A

TECHNICAL DATA

VAPOR COOLED
POWER TETRODE

The EIMAC 4CV250,000A is a ceramic/metal, vapor-cooled power tetrode intended for use at the 250 to 500 kilowatt output power level. It is recommended for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier or a Class AB push-pull af amplifier or modulator. The 4CV250,000A is also useful as a plate and screen modulated Class C rf amplifier.

The vapor cooled anode is rated at 250 kilowatts maximum dissipation when used with the EIMAC Y-585 boiler.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	12.0 ± 0.6	V
Current (at 12.0 volts)	660	A
Amplification Factor (Grid-Screen)(Avg.)	4.5	
Direct Interelectrode Capacitance: (Grounded Cathode)[2]		
Cin	765	pF
Cout	124	pF
Cgp	6.0	pF
Frequency for Maximum Ratings	30	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 without any special shielded fixture.

MECHANICAL

Base	Special
Maximum Seal Temperature	200°C
Recommended Boiler	EIMAC Y-585
Operating Position	Vertical, Anode up
Maximum Dimensions:	
Height	28.02 in; 71.17 cm
Diameter	15.062 in; 38.26 cm
Cooling	Vapor and water
Net Weight	180 lb.; 82 kg
Shipping Weight (approximate)	350 lb.; 159 kg

(Revised 3-1-72) Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-down Condition)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	16	19	kV
DC Screen Voltage	800	800	V
DC Grid Voltage	-800	-800	V
DC Plate Current	23.5	32.5	A
DC Screen Current	2.4	3.5	A
DC Grid Current	1.15	2.5	A
Driving Power [1]	2.24	3.0	kW
Plate Output Power	275	460	kW
Plate Dissipation	100	155	kW
RF Load Impedance	300	275	Ω
η	63%	63%	

1. Calculated Driving Power neglects input conductance and rf circuit loss.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class C Telephony (Carrier conditions except where noted)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,000	VOLTS
DC PLATE CURRENT	30	AMPERES
PLATE DISSIPATION [1]	167,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Corresponds to 250,000 watts at 100 per cent sine wave modulation.
2. Approximate Value.

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	15	kV
DC Screen Voltage	800	V
Peak af Screen Voltage(for 100% Mod.)2.	800	V
DC Grid Voltage	-800	V
DC Plate Current	22.8	A
DC Screen Current	4.1	A
DC Grid Current	1.46	A
Peak rf Grid Voltage	1110	v
Grid Driving Power [3]	1630	W
Plate Output Power	280	kW
RF Load Impedance	323	Ω
Plate Dissipation	63	kW
2	66%	

3. Calculated Driving Power neglects input conductance and rf circuit loss.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Approximate Value.
2. Per Tube

TYPICAL OPERATION (Two Tubes Class AB_1)

DC Plate Voltage	15	20	kV
DC Screen Voltage	1.8	1.8	kV
DC Grid Voltage	-500	-500	V
Max-Signal Plate Current	40	46	A
Zero Signal Plate Current[2]	0.2	0.2	A
Max-Signal Screen Current [1]	1.1	1.2	A
Peak af Driving Voltage [2]	500	500	v
Driving Power	0	0	W
Load Impedance (plate to plate)	650	870	Ω
Plate Dissipation	160	260	kW
Max-Signal Output Power	440	660	kW
2	73%	71%	

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Approximate Value.
2. Calculated Driving Power neglects input conductance and rf circuit loss.

TYPICAL OPERATION Class AB_1 Peak-Envelope or Modulation Crest Conditions (Frequencies below 30 MHz)

DC Plate Voltage	15	20	kV
DC Screen Voltage	1.8	1.8	kV
DC Grid Voltage	-500	-500	V
Plate Current	20	23	A
Zero Signal Plate Current	0.2	0.2	A
Maximum Signal Screen Current 1.	1.1	1.2	A
Peak rf Grid Voltage	500	500	v
Driving Power 2.	0	0	W
Plate Dissipation	80	130	kW
Resonant Load Impedance	325	435	Ω
Plate Output Power	220	330	kW
η	73%	71%	

PULSE MODULATOR OR REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	40,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
PEAK CATHODE CURRENT	350 AMPERES
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

APPLICATION

MECHANICAL

MOUNTING - The 4CV250,000A must be mounted vertically, anode up. The tube may be supported by the anode flange or the screen flange.

Care must be exercised to insure that the axis of the tube/boiler combination is vertical and that water in the boiler is at the level indicated. The anode flange on the tube must seat securely against the rubber "O" ring, forming a vapor-tight seal between tube and boiler.

COOLING - Cooling is accomplished by immersing the anode of the 4CV250,000A in a "Boiler" filled with distilled water. Energy dissipated by the anode causes the water to boil at the anode surfaces, be converted into steam and be carried away to an external condenser. The condensate is then returned to the boiler, completing the cycle.

This boiling action maintains the anode surfaces at a fairly constant temperature near 100°C. The vapor-cooled tube has good overload capabilities; excess dissipation for moderate periods only causes more water to boil.

Since the tube anode and boiler are usually at high potential to ground, water and steam connections to the boiler are made through insulated tubing.

The filament supports of the 4CV250,000A are water cooled. Approximately .5 GPM should circulate through each of the filament connectors with a pressure drop of 20 PSI. Filament connector assemblies, SK-1710, provide electrical and water connections. Two sets of SK-1710 are required.

It is recommended that the water cooled control grid connector, SK-1712, be used. Water flow of approximately .5 GPM should circulate through the grid connector. The pressure drop across the grid connector is low. A convenient way to make water connection is to series connect the grid cooling water with the outer filament cooling water path.

The outer filament water path has a lower pressure drop than the inner filament water path making this connection practical.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CV-250,000A 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 4CV250,000A by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked.

Filament starting current must be limited to a maximum of 1800 amperes.

CONTROL GRID OPERATION - The 4CV-250,000A control grid is rated at 1,500 watts of dissipation and protective measures should be included in circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of dc grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power applied to the screen grid must not exceed 3,500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of RMS screen current and RMS screen voltage.

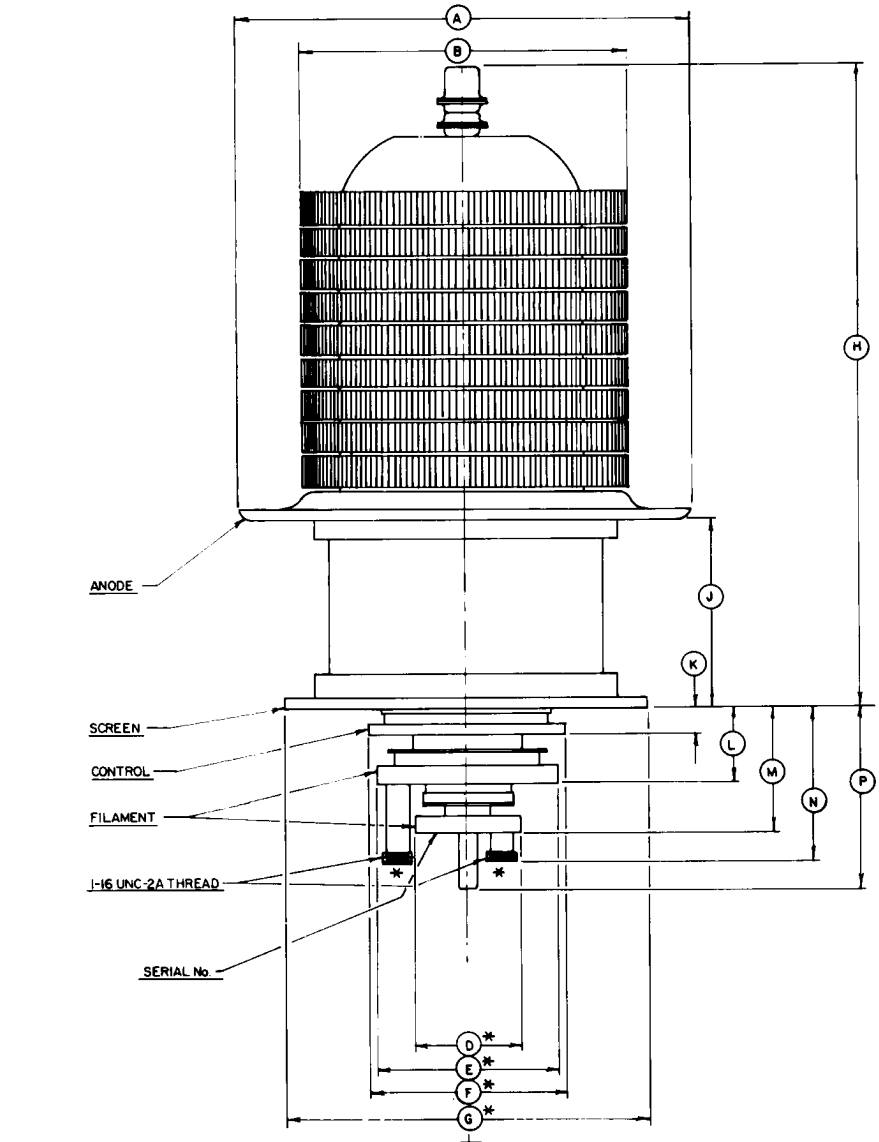
PLATE DISSIPATION - The plate dissipation of 250 kilowatts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV250,000A is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 167,000 watts.

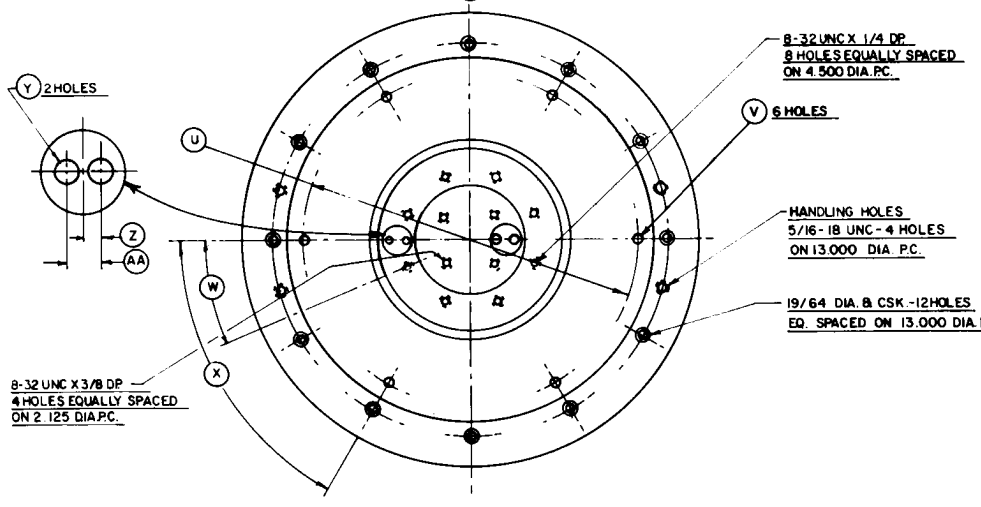
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV250,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. 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.

HIGH VOLTAGE - Normal operating voltages used with the 4CV250,000A 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.

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.

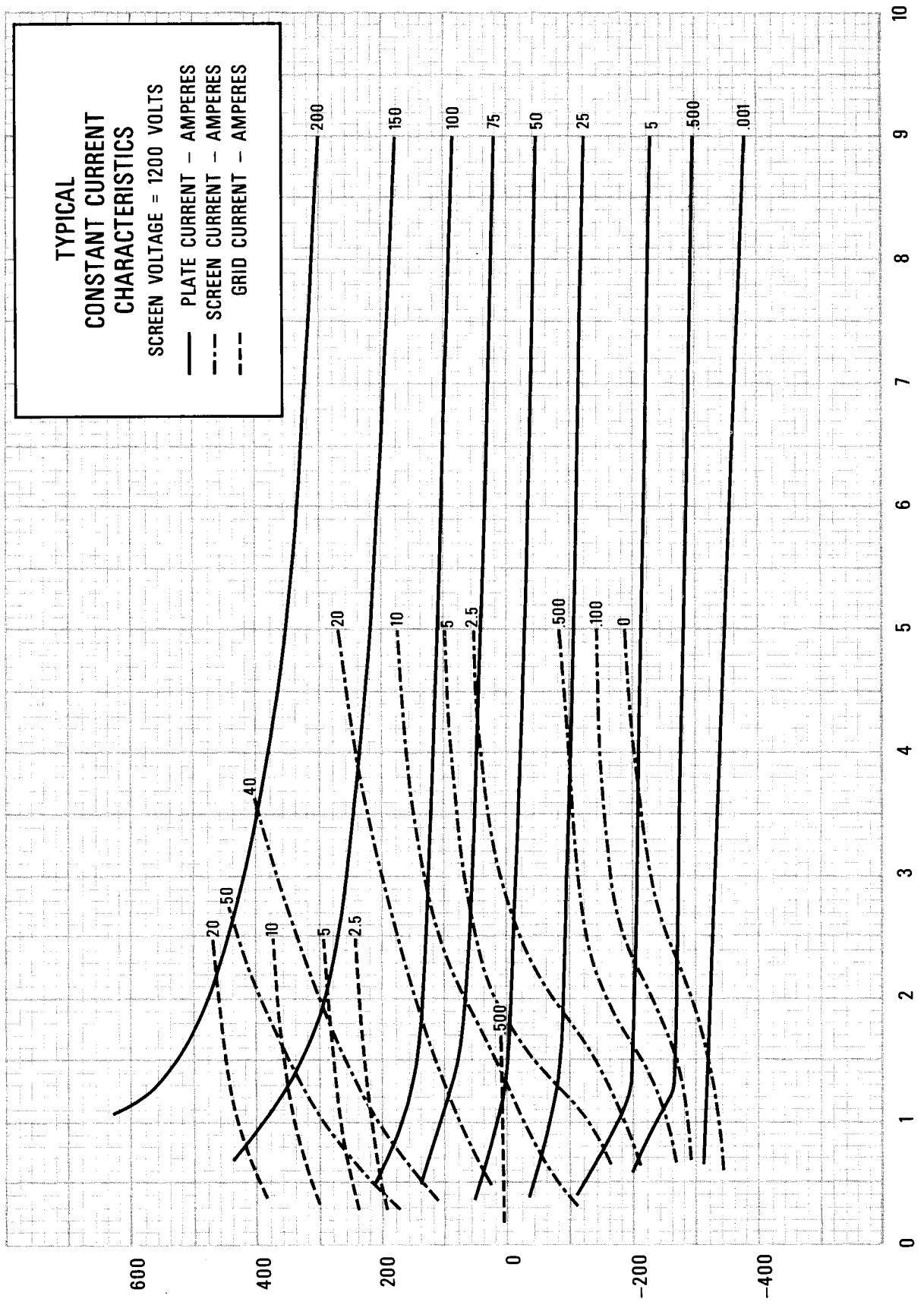


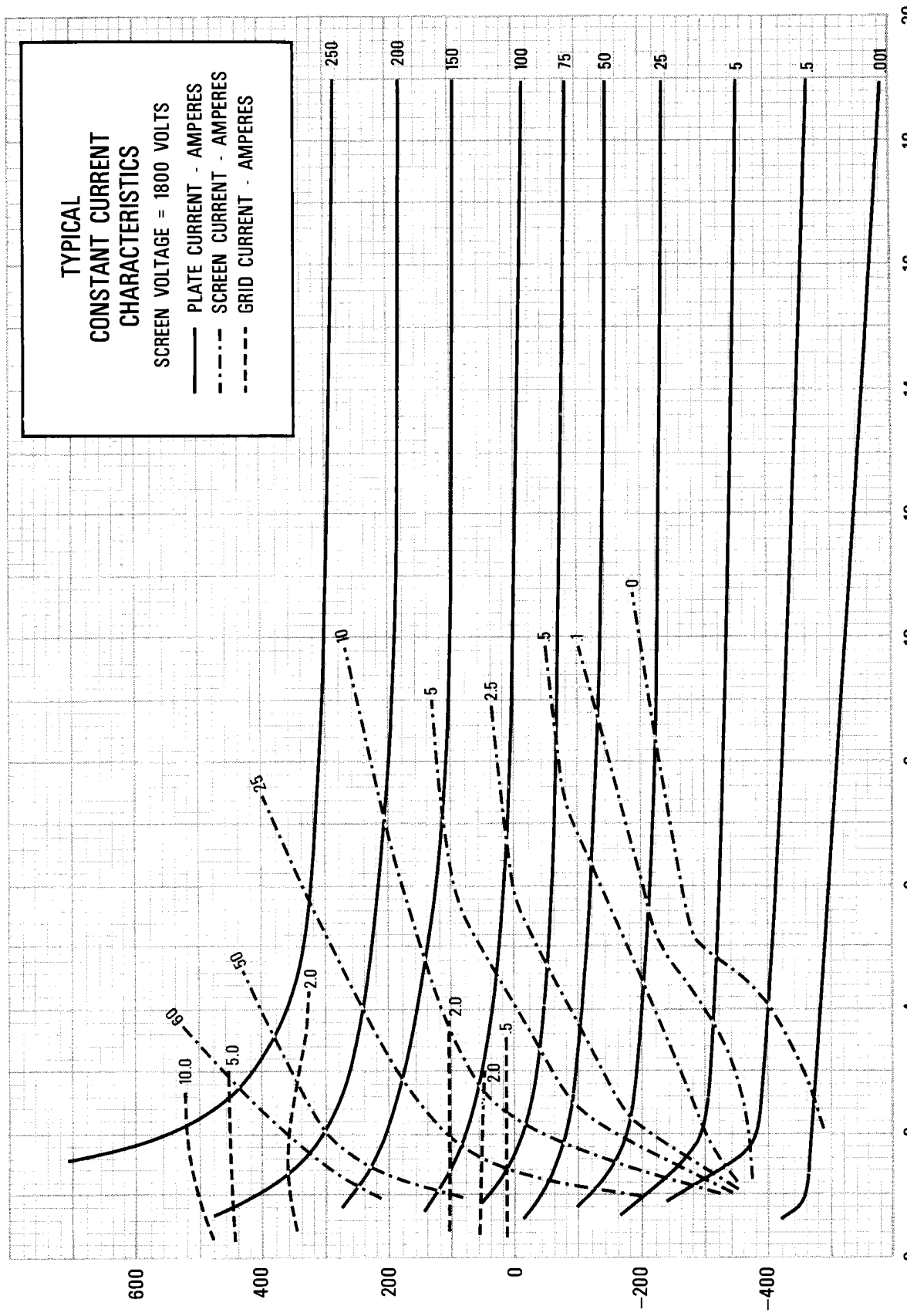


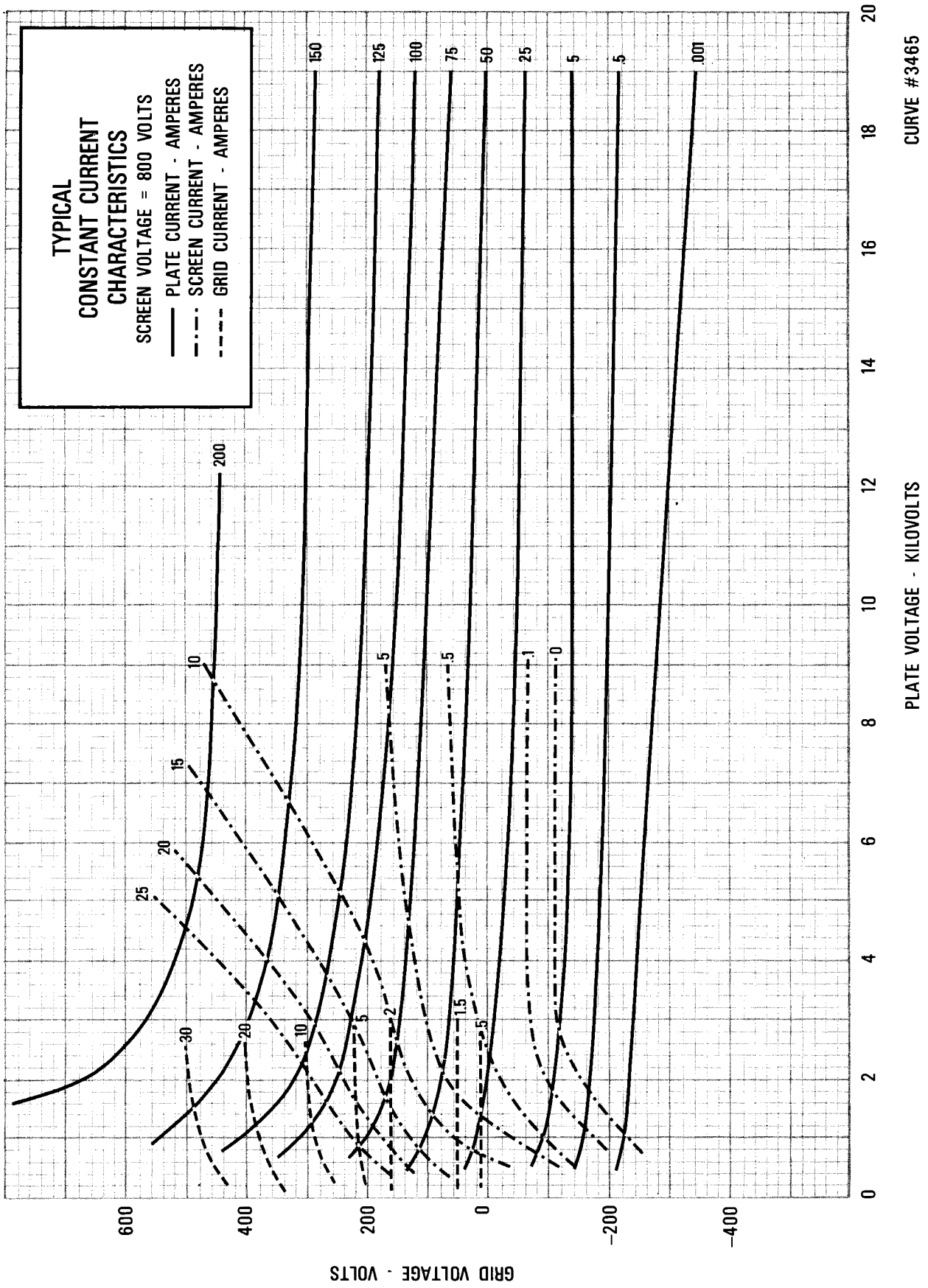
DIM.	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	14.937	15.062	- -	379.40	382.57	- -
B	11.125	11.375	- -	282.57	288.92	- -
D	3.437	3.562	- -	87.30	90.47	- -
E	5.937	6.062	- -	150.80	153.97	- -
F	6.437	6.562	- -	163.50	166.67	- -
G	11.937	12.062	- -	303.20	306.37	- -
H	20.400	21.120	- -	518.16	536.45	- -
J	6.250	6.375	- -	158.75	161.92	- -
K	0.750	0.875	- -	19.05	22.22	- -
L	2.437	2.562	- -	61.90	65.07	- -
M	4.062	4.187	- -	103.17	106.35	- -
N	5.000	5.125	- -	127.00	130.17	- -
U	- -	- -	11.000	- -	- -	279.40
V	- -	- -	0.375	- -	- -	9.52
W	- -	- -	22-1/2°	- -	- -	22-1/2°
X	- -	- -	60°	- -	- -	60°
Y	- -	- -	0.261	- -	- -	6.63
Z	- -	- -	0.219	- -	- -	5.56
AA	- -	- -	0.438	- -	- -	11.12

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

2. (*) CONTACT SURFACES.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1200 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
200
150
100
75
50
25
5
.500
.001
40
20
10
5
2.5
500
20
10
5
2.5
500
100
0
600
400
200
0
−200
−400
GRID VOLTAGE – VOLTS
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE – KILOVOLTS
CURVE #3285


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
250
200
150
100
75
50
25
5
.5
.001
10.0
5.0
2.0
.5
25
10
5
2.5
2.0
.5
.5
.1
0
600
400
200
0
-200
-400
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS
CURVE #3464


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS
CURVE #3465