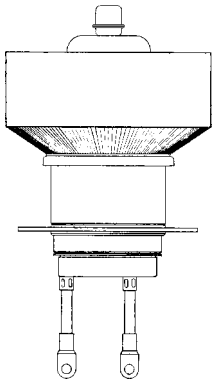

3CX20,000H3

Power Triode

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

Electrical Characteristics

Filament	Thoriated Tungsten	
Filament Voltage	10.0	Volts
Filament Current	160	Amperes
Direct Interelectrode Capacitance (grounded cathode)[1]		
Cin	70.0	pf
Cout	2.3	pf
Cgp	43.0	pf
Frequency of maximum ratings(CW)	90	MHz

1. Capacitance values are for a cold tube as measured in a special sheilded fixture in accordance with EIA Standard RS-191.

Mechanical Characteristics

Overall Dimensions		
Length (not including filament leads)	10.60 (269.2)	Inches (mm)
Diameter	8.00 (203.2)	Inches (mm)
Net Weight	20.0 (9.1)	Lbs (kg)
Maximum Operating Temperature		
Ceramic/Metal Seals	250	°C
Anode Core	250	°C
Cooling	Forced Air	
Base	Flexible Filament Leads	

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P E N T A L A B O R A T O R I E S
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(800) 421-4219 * (818) 882-3872 * FAX: (818) 882-3968

Radio Frequency Power Amplifier or Oscillator

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

Absolute Maximum Ratings

DC Plate Voltage	12,000	Volts
DC Grid Voltage	-2000	Volts
DC Grid Current	1.5	Amperes
DC Plate Current	8.0	Amperes
Plate Dissipation	20.0	Kilowatts
Grid Dissipation	750	Watts

Typical Operation

Plate Voltage	7500	10,000	Volts
Grid Voltage	-800	-900	Vdc
Plate Current	8.0	7.9	Adc
Grid Current[1]	1.4	0.75	Adc
Peak rf Grid Voltage[1]	1200	1270	v
Calculated Driving Power[1]	1670	960	Watts
Plate Input Power	60	78	kW
Plate Dissipation	9.0	14.0	kW
Plate Output Power	51.0	64.0	kW
Resonant Load Impedance	480	640	Ohms

1. Approximate Value

Plate Modulated Radio Frequency Power Amplifier - Grid Driven

Class C Telephony (Carrier Conditions)

Absolute Maximum Ratings

DC Plate Voltage	6500	Volts
DC Grid Voltage	-2000	Volts
DC Plate Current	5.5	Amperes
Plate Dissipation[1]	13.0	kW
Grid Dissipation[2]	750	Watts

1. Corresponds to 20,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

Typical Operation

Plate Voltage	6500	Vdc
Grid Voltage	-1300	Vdc
Plate Current	5.0	Adc
Grid Current[1]	900	mAdc
Peak rf Grid Voltage[1]	1660	v
Calculated Driving Power	1500	Watts

Plate Input Power	32.5	kW
Plate Dissipation	5.0	kW
Plate 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 Plate Voltage[1]	8000	Volts
DC Plate Current	8.0	Amperes
Plate Dissipation	20.0	kW
Grid Dissipation	750	Watts

1. Approximate Value

Typical Operation (Two Tubes)

Plate Voltage	7500	Vdc
Grid Voltage[1,3]	-380	Vdc
Zero-Signal Plate Current	2.0	Amperes
Maximum Signal Plate Current	14.8	Amperes
Maximum Signal Grid Current[1]	1.26	Amperes
Peak af Grid Voltage[2]	640	v
Driving Power[1]	800	Watts
Maximum Signal Plate Dissipation	30.2	kW
Plate Output Power	80.0	kW
Load Resistance (plate to plate)	1140	Ohms

1. Approximate value.
2. Per tube.
3. Adjust to give stated zero-signal plate current.

Range Values for Equipment Design

	Min.	Max.	
Filament Current at 10.0 Volts	152	168	Amperes
Interelectrode Capacitances1 (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 as measured in a special sheilded fixture in accordance with EIA Standard RS-191.

Application Notes

Mechanical

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 base down. The filament terminals are flexible leads approximately eight and three quarter inches in length. At higher operating frequencies it is suggested that the RF return to the filament be made to one of 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 1/4 inch holes in the grid flange.

Cooling - The maximum temperature rating for the external surfaces of the 3CX20,000H3 is 250°C. Sufficient forced-air flow must be provided to keep the temperature of the anode at the base of the cooling fins and the temmperature of the ceramic/metal seals below 250°C. Air flow requirements to maintian core temperature at 225°C in 50°C ambient air are tabulated below. These data are for air flowing in the base to anode direction.
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 whould 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

Plate* Dissipation (watts)	Sea Level		10,000 Feet	
	Air Flow (CFM)	Pressure Drop In. W.C.	Air Flow (CFM)	Pressure Drop In. W.C.
10,000	320	0.9	464	1.1
15,000	625	2.1	910	2.8
20,000	1010	4.3	1475	5.58

* Since the power dissipated by the filament represents about 1680 watts and since the grid dissipation can, under some conditions, represent another 750 watts, allowence has been made in preparing this tabulation for an aditional 2430 watts dissipation.

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 pressure differential must be determined individually in such cases, using rated maximum temperatures as the criterea for satisfactory cooling.

Electrical

Filament/Cathode Operation - The filament voltage should be maintained within 5% of the nominal 10.0 volt value, and for consistent tube life even closer control is advised. For most services the filament voltage may be less that the nominal 10.0 volt for extended life. The exact value about which to control should be determined by experiment in any given service.

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.

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

Interelectrode Capacitance - The actual internal electrode 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 manufactures. The capacitance values shown in the manufacture'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.

High Voltage - Normal operating voltages used with 3CX20,000H3 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 condensors whenever access doors are opened. Interlock switches must not be by-passed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

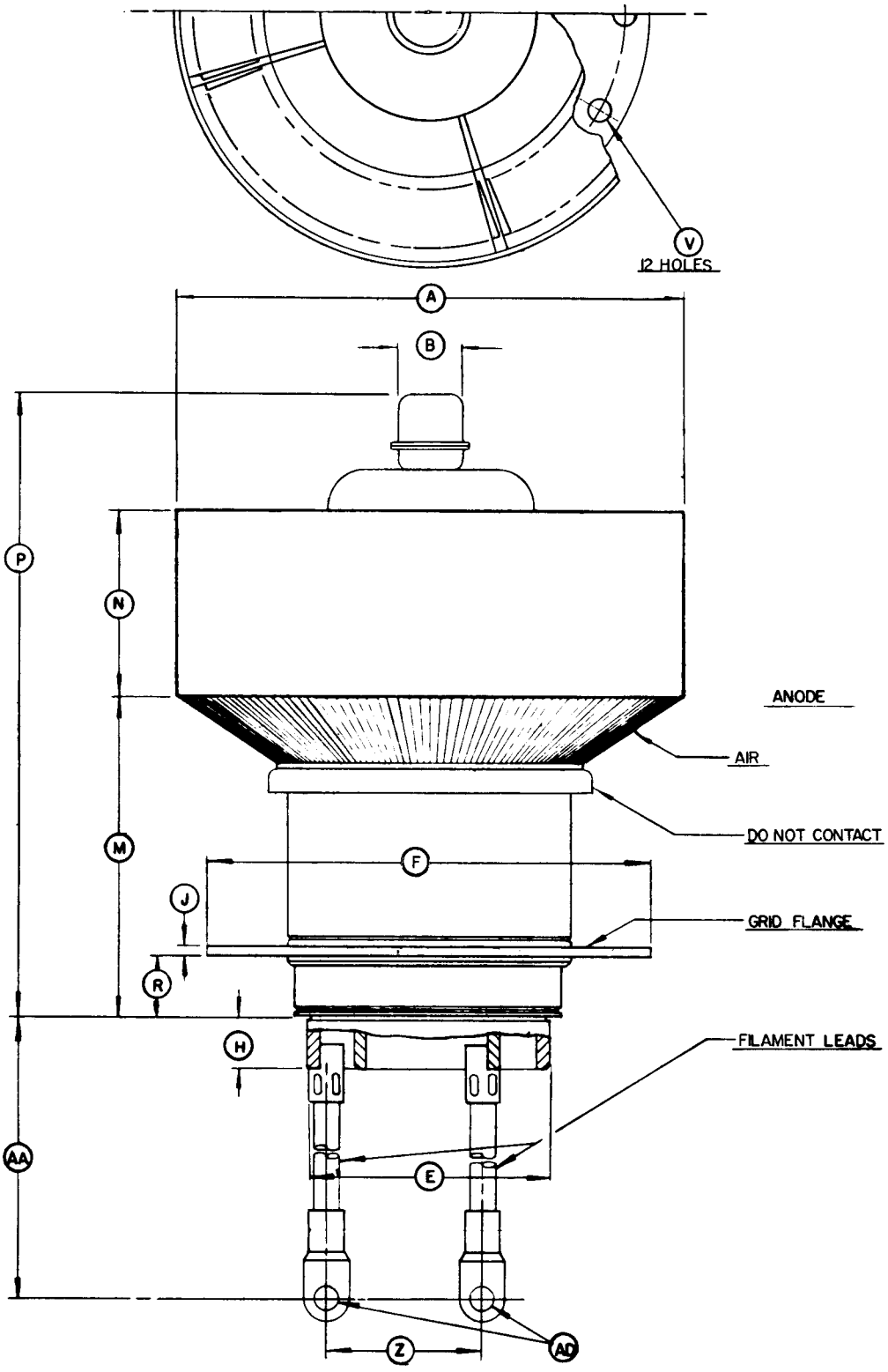
X-Ray Radiation - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 3CX20,000H3, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube 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 sheilding 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.

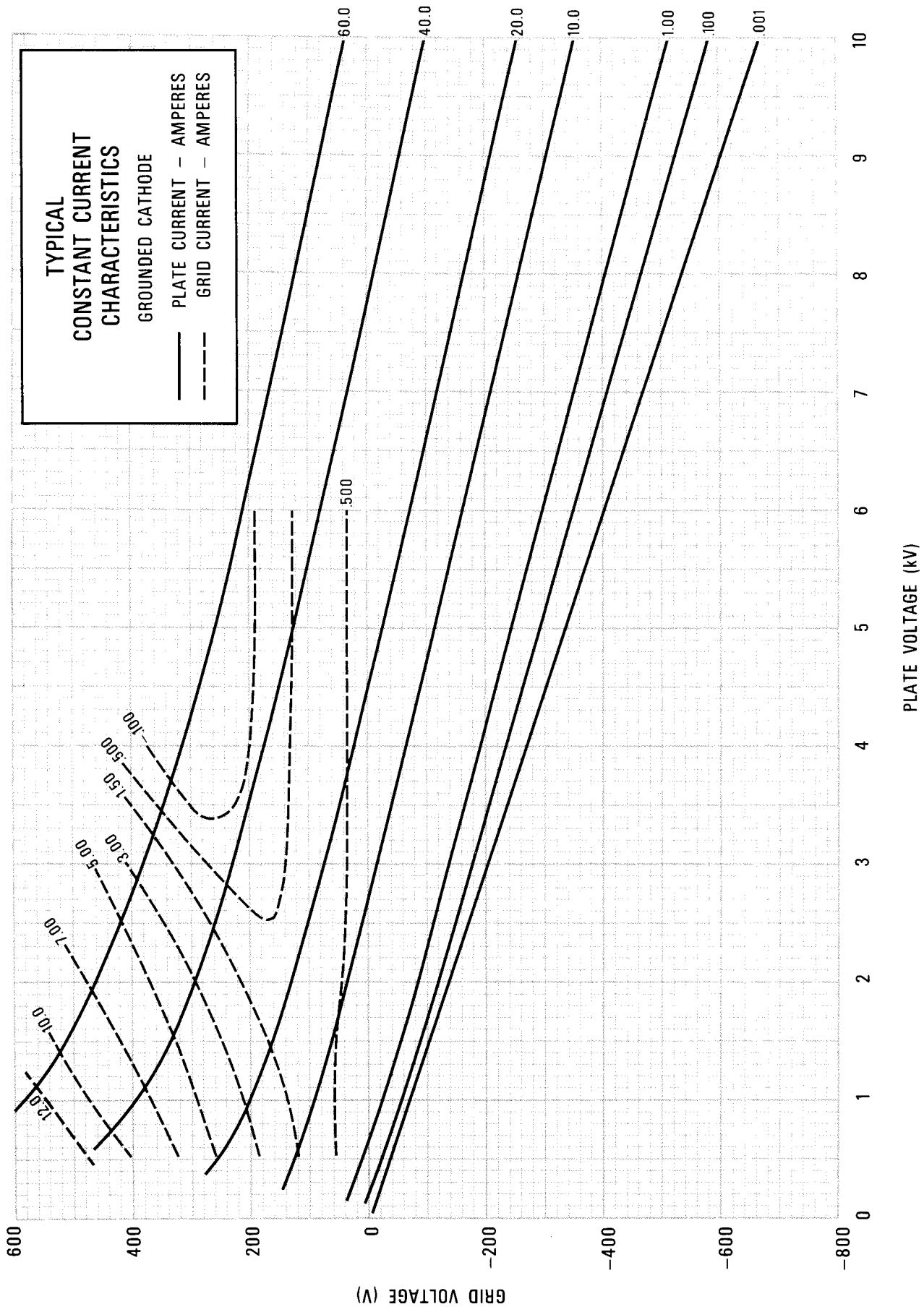
Radio Frequency Radiation - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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 Penta Laboratories 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 this tube under conditions widely different from those given here, contact Penta Laboratories for information and recommendations.

Dimensional Data

	Inches			Millimeters		
Dim.	Min.	Max.	Ref.	Min.	Max.	Ref.
A	---	---	8.00	---	---	203.0
B	---	---	1.260	---	---	32.00
E	3.230	3.270	---	82.00	83.00	---
F	5.030	5.090	---	128.00	128.70	---
H	0.530	0.700	---	13.50	17.70	---
J	---	---	0.125	---	---	3.20
M	3.800	4.150	---	96.50	105.00	---
N	---	---	4.00	---	---	115.00
P	---	---	10.000	---	---	254.00
R	0.700	0.860	---	17.80	21.80	---
V	---	---	0.265	---	---	6.70
Z	---	---	2.000	---	---	51.00
AA	8.500	9.000	---	215.00	228.00	---
AD	---	---	0.390	---	---	9.90


V
12 HOLES
A
B
P
N
M
J
R
H
AA
F
E
Z
AD
ANODE
AIR
DO NOT CONTACT
GRID FLANGE
FILAMENT LEADS


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
60.0
40.0
20.0
10.0
1.00
.100
.001
.500
.100
.500
1.50
3.00
5.00
7.00
10.0
12.0
600
400
200
0
-200
-400
-600
-800
0
1
2
3
4
5
6
7
8
9
10
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)