TECHNICAL DATA

8321 / 4CX350A
8322 / 4CX350F

RADIAL-BEAM POWER TETRODES

The Eimac 8321/4CX350A and 8322/4CX350F are compact radial beam tetrodes with maximum plate dissipation of 350 watts and are intended for Class-AB, audio or rf amplifier service. These tubes are externally identical to the 4CX250B but contain rugged internal construction features. Amplification factor and cathode area have been increased over the 4CX250B to give higher transconductance and figure of merit.

The 8321/4CX350A and 8322/4CX350F differ only in heater voltage and current; the 8321/4CX350A is used at 6.0 volts while the 8322/4CX350F is rated at 26.5 volts. Both types are of ceramic and metal construction and are recommended for new equipment design.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30		60	secs
	Cathode-to-Heater Potential			±150	volts
Heater:	4CX350A Voltage		6.0		volts
	4CX350A Current	2.9		3.6	amps
	4CX350F Voltage		26.5		volts
	4CX350F Current	0.66		0.81	amps

	Min.	Nom.	Max.	
Amplification Factor (Grid-to-Screen)		13		
Transconductance (I_b = 150 mA)		22,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	22.2		26.2	uuf
Output	5.0		6.0	uuf
Feedback			0.05	uuf
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input	17.9		21.9	uuf
Output	5.0		6.0	uuf
Feedback			0.01	uuf

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
Height	2.464 inch
Seated Height	1.910 inch
Diameter	1.640 inch
Cooling	Forced air
Net Weight	4 ounces
Shipping Weight (approximate)	1.6 pounds

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Printed in U.S.A.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	2500 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	300 MAX. MA
PLATE DISSIPATION	350 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID CURRENT	2 MAX. MA

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2200	volts
DC Screen Voltage	400	400	400	volts
DC Grid Voltage[1]	—27	—27	—27	volts
Zero-Signal DC Plate Current	200	200	200	mA
Max-Signal DC Plate Current	520	530	580	mA
Max-Signal DC Screen Current	—8	—10	—6	mA
Effective Load, Plate to Plate	2600	5000	7800	ohms
Peak AF Grid Input Voltage (per tube)*	21	21	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Input Power	560	800	1260	watts
Max Signal Plate Output Power	190	400	770	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	300 MAX. MA
PLATE DISSIPATION	350 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS
GRID CURRENT	2 MAX. MA

*Approximate values

[1]Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2200	volts
DC Screen Voltage	400	400	400	volts
DC Grid Voltage[1]	—27	—27	—27	volts
Zero-Signal DC Plate Current	100	100	100	mA
Peak RF Grid Voltage*	21	21	25	volts
DC Plate Current	260	265	290	mA
DC Screen Current*	—4	—5	—3	mA
Plate Input Power	260	400	630	watts
Plate Output Power	95	200	385	watts
Two-Tone Average DC Plate Current	210	215	195	mA
Two-Tone Average DC Screen Current*	—7	—8	—3	mA
Resonant Load Impedance	1300	2500	3900	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause 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 driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CX350A and 4CX350F may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen by-pass capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING — Sufficient cooling must be provided for the anode, base seals and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated on page 3. These requirements apply when the Eimac SK-600 or SK-610 socket is used with the SK-606 chimney and air-flow in the base-to-anode direction.

At 500 mc or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which might interfere with effective cooling.

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 below, plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

MINIMUM COOLING AIR-FLOW REQUIREMENTS				
	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air-Flow (CFM)	Pressure Drop (Inches of water)	Air-Flow (CFM)	Pressure Drop (Inches of water)
250	5.3	0.6	7.7	0.85
300	6.5	0.9	9.5	1.25
350	7.8	1.2	12.0	1.9

If cooling methods other than forced air are used, if the recommended air-flow rates are not supplied or if there is any doubt that the cooling is adequate, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperatures is by the use of a temperature-sensitive lacquer. When temperature-sensitive materials are used, extremely thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

VIBRATION — These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments.

ELECTRICAL

HEATER — The rated heater voltages for the 4CX350A and 4CX350F are 6.0 volts and 26.5 volts respectively and these voltages should be maintained as closely as practicable. Short-time variations of the voltage of ±10% of the rated value will not damage the tube, but variations in performance must be expected. The heater voltage should be maintained within ±5% of its rated value to minimize variations in performance and to obtain maximum tube life.

CATHODE OPERATION — The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

CONTROL-GRID OPERATION — The grid dissipation rating of the 4CX350A and 4CX350F is zero watt. The design features which make the tubes capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive grid operation. The grid current rating of 2.0 milliamperes allows the flow of positive grid current for peak-signal monitoring purposes.

SCREEN-GRID OPERATION — The maximum rated power dissipation for the screen grid is 8 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen can be provided by an overcurrent relay and by interlocking the screen supply so that the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions, and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

PLATE OPERATION — The maximum rated plate-dissipation power is 350 watts. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 megacycles the top cap on the anode cooler may be used for a plate terminal. At higher frequencies a circular clamp or spring-finger collect encircling the cylindrical outer surface of the anode cooler should be used.

MULTIPLE OPERATION — Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

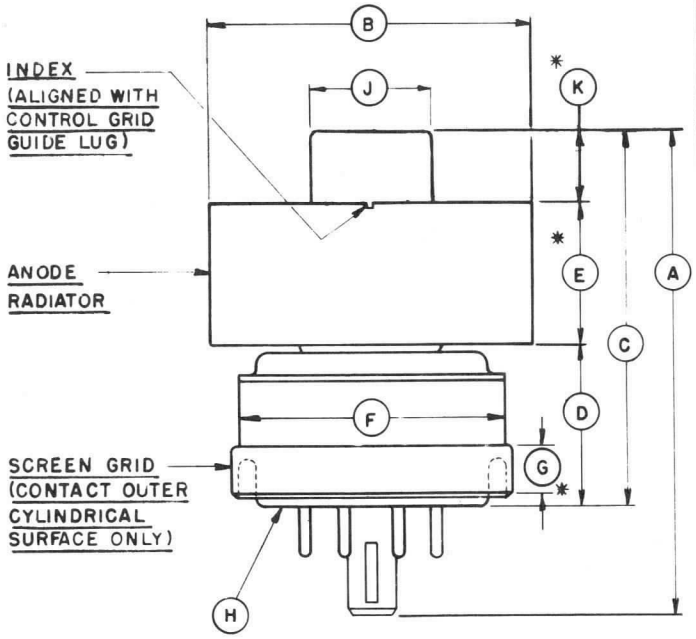
UHF OPERATION — The 4CX350A and 4CX350F are useful in the UHF region. UHF operation should be conducted with heavy plate loading, minimum bias and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Some of the added circuit loss observed in UHF operation is in the base insulator of the tube. It is sometimes necessary to use more than the recommended minimum air-flow rates to maintain safe operating base temperatures at UHF.

These tubes may be used in frequency multiplier applications. Such operation results in low plate efficiency and requires high driving voltages. If the frequency multiplier is used as an output power stage, it is preferable to operate the final tube as a frequency doubler rather than a frequency tripler.

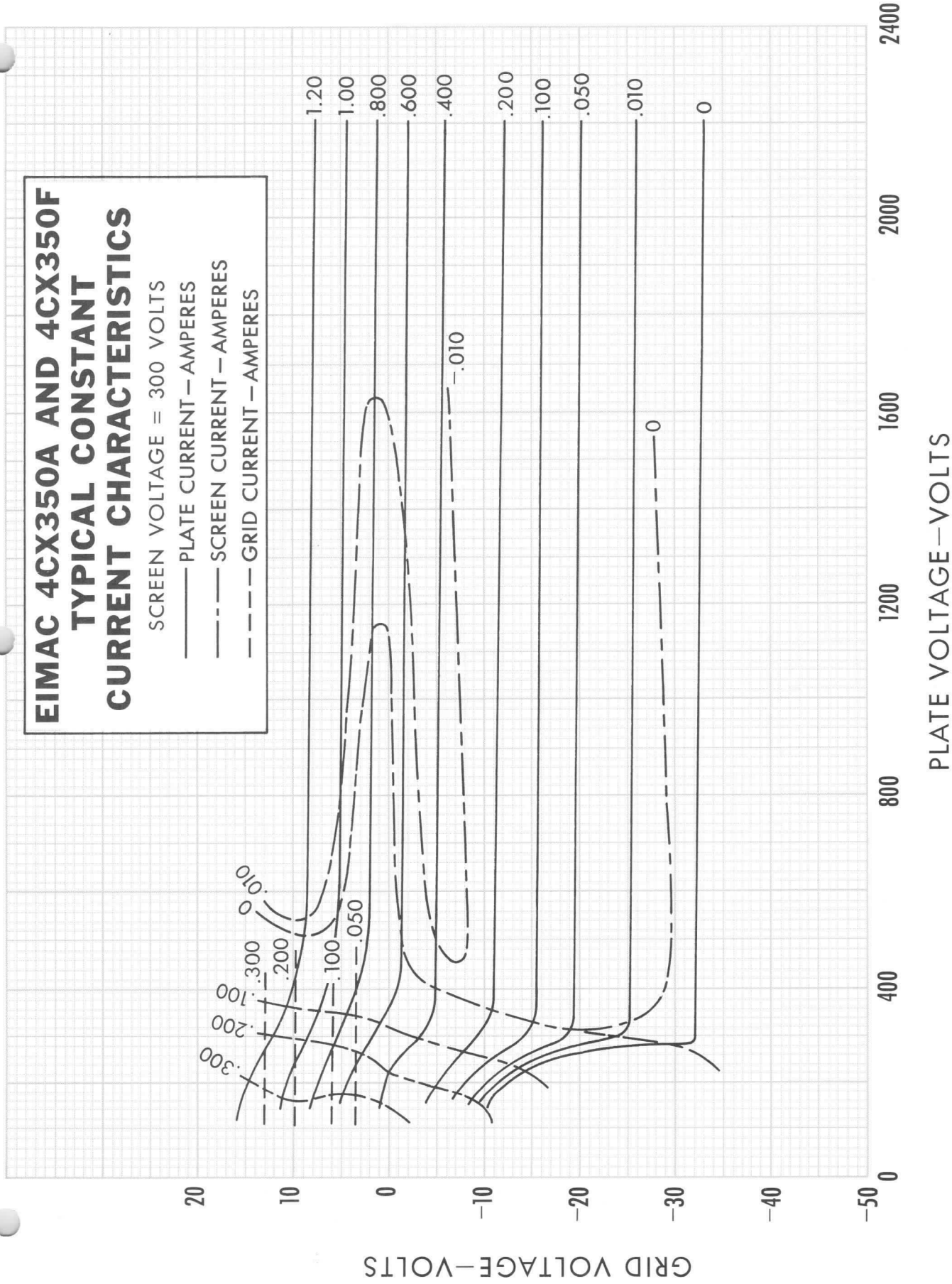
SPECIAL APPLICATIONS — If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Department, Eimac, Division of Varian, San Carlos, California for information and recommendations.

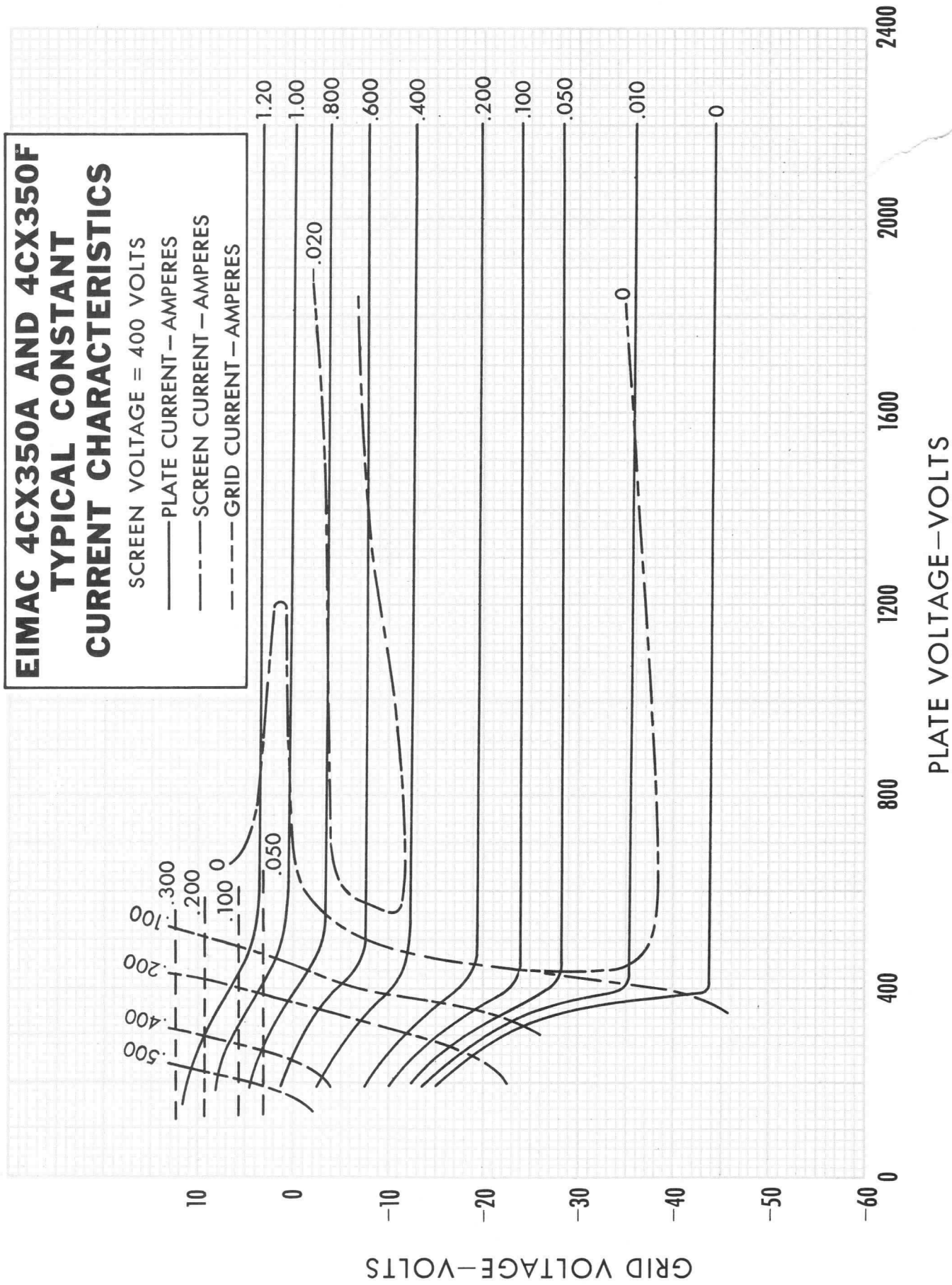
PIN NO. 1. SCREEN GRID
PIN NO. 2. CATHODE
PIN NO. 3. HEATER
PIN NO. 4. CATHODE
PIN NO. 5. I.C. DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6. CATHODE
PIN NO. 7. HEATER
PIN NO. 8. CATHODE
CENTER PIN - CONTROL GRID



DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	2.324	2.464	
B	1.610	1.640	
C	1.810	1.910	
D	.750	.810	
E	.710	.790	
F		1.406	
G	.187		
H	BASE:	B8-236	
	(JEDEC DESIGNATION)		
J	.559	.573	
K	.240		

NOTES
1. * CONTACT SURFACE
2. REF. DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSP PURPOSES.


EIMAC 4CX350A AND 4CX350F
TYPICAL CONSTANT
CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 300 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.300
.200
.100
.050
.010
0
.300
.200
.100
0
.010
0
PLATE VOLTAGE—VOLTS
0
400
800
1200
1600
2000
2400
GRID VOLTAGE—VOLTS
20
10
0
−10
−20
−30
−40
−50


EIMAC 4CX350A AND 4CX350F
TYPICAL CONSTANT
CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 400 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.020
0
.300
.200
.100
0
.050
.100
.200
.400
.500
10
0
-10
-20
-30
-40
-50
-60
0
400
800
1200
1600
2000
2400
PLATE VOLTAGE—VOLTS
GRID VOLTAGE—VOLTS