4X150A
4X150D
RADIAL-BEAM POWER TETRODE

EITEL-McCULLOUGH, INC.
SAN CARLOS • CALIFORNIA

The Eimac 4X150A and 4X150D tetrodes are compact power tubes intended for use as amplifiers, oscillators, or frequency multipliers at frequencies up to 500 megacycles. The 4X150A is designed to operate with a heater voltage of 6.0 volts, whereas the 4X150D is designed for operation at a heater potential of 26.5 volts. Otherwise, the two tube types have identical characteristics.

Recent improvements in the 4X150A and 4X150D have allowed an increase in maximum plate-dissipation ratings for all classes of service. Further, the maximum plate-voltage rating has been raised for operation at frequencies below 150 megacycles.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage 4X150A		6.0		
Current 4X150A	2.3		3.8	amperes
Voltage 4X150D		26.5		volts
Current 4X150D	0.5		0.62	ampere
Amplification Factor (Grid-to-Screen)	4		6	

Direct Interelectrode Capacitances, Grounded Cathode:*	Min.	Max.
Input	14.5	17.0 uuf
Output	4.0	4.3 uuf
Feedback		0.05 uuf
Frequency for Maximum Ratings		150 mc
Highest Useful Frequency		500 mc

*In Shielded Fixture

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Base Seals	175° C
Anode Seal	200° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 series
Operating Position	Any
Maximum Dimensions:	
Height	2.404 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

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

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

(Effective 6/15/60) Copyright 1960 by Eitel-McCullough, Inc.

TYPICAL OPERATION

	Frequencies up to 150 Mc.				500 Mc.†
D-C Plate Voltage	500	1000	1500	2000	1250 volts
D-C Screen Voltage	250	250	250	250	250 volts
D-C Grid Voltage	—90	—90	—90	—90	—80 volts
D-C Plate Current	250	250	250	250	200 ma
D-C Screen Current*	45	38	21	19	7 ma
D-C Grid Current*	35	31	28	26	10 ma
Peak R-F Grid Voltage*	114	114	112	112	.... volts
Driving Power	4.0	3.5	3.2	2.9	10 watts
Plate Input Power	125	250	375	500	250 watts
Plate Output Power	70	190	280	390	140 watts

*Approximate values.

†The typical performance figures for 500-megacycle operation were obtained by direct measurement in operating equipment. The output power is *useful* output power measured at the load. The driving power is the total power taken by the tube and a practical resonant circuit.

NOTE: Heater voltage was reduced to 5.5 volts and 24.3 volts for the 4X150A and 4X150D respectively.

Indicates change from sheet dated 5/10/54

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	1600 MAX. VOLTS
150 to 500 megacycles	1000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	500	1000	1600 volts
D-C Screen Voltage	250	250	250 volts
D-C Grid Voltage	—150	—150	—150 volts
D-C Plate Current	200	200	200 ma
D-C Screen Current*	25	20	18 ma
D-C Grid Current*	23	21	21 ma
Peak R-F Grid Input Voltage*	173	172	172 volts
Driving Power	4.0	3.6	3.6 watts
Plate Input Power	100	200	320 watts
Plate Output Power	47	140	250 watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	200	200	200 ma
Max-Signal D-C Plate Current	500	500	500 ma
Max-Signal D-C Screen Current	20	16	10 ma
Effective Load, Plate to Plate	3500	6200	9500 ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	240	430	600 watts

*Approximate values.

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

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 Mc)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
D-C Plate Current	150	150	150 ma
D-C Screen Current*	—3	—4	—4 ma
Peak R-F Grid Voltage*	25	25	25 volts
Plate Output Power	30	50	65 watts

*Approximate values.

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

RADIO-FREQUENCY LINEAR AMPLIFIER, SSB

Class-AB_1 (Single-Tone Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Peak R-F Grid Voltage*	50	50	50 volts
Zero-Signal D-C Plate Current	100	100	100 ma
Single-Tone D-C Plate Current	250	250	250 ma
Two-Tone D-C Plate Current	190	190	190 ma
Single Tone D-C Screen Current*	10	8	5 ma
Two-Tone D-C Screen Current*	2	—1	—2 ma
R-F Load Impedance	1750	3100	4750 ohms
Single-Tone Plate Input Power	250	375	500 watts
Single-Tone Plate Output Power	120	215	300 watts

*Approximate values.

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

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

In class-C operation, adjustment of the r-f grid drive to obtain listed plate current at the listed grid bias, screen voltage, and plate voltage is assumed. Resultant screen and grid currents will vary from tube to tube, but little change in output power will be noted.

In class-AB_1 linear operation, screen current will also vary from tube to tube but is a useful indicator of relative linearity. In general, less screen current means better linearity, providing other conditions are held constant. The same degree of linearity will be obtained from different tubes if loading and drive are adjusted to give the same plate and screen currents, although output power may vary from tube to tube.

APPLICATION

MECHANICAL

Mounting—The 4X150A and 4X150D 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 capacitors and may be obtained with either grounded or ungrounded cathode terminals.

Cooling—Sufficient forced-air 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 anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with air flow in the base to anode direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	3.6	.34	5.25	.5
250	4.8	.55	7.00	.8

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

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.

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. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the Eimac 4CX300A be employed.

ELECTRICAL

Heater—The rated heater voltage for the 4X150A and 4X150D is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 megacycles, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency, Mc	4X150A	4X150D
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode Operation—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated d-c input current is 200 milliamperes for plate-modulated operation and 250 milliamperes for all other types of operation except pulse.

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 maximum rated d-c grid bias voltage is −250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100-megacycle region, driving-power requirements for amplifiers increase noticeably. At 500 megacycles as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500-megacycle operation of the tubes in a stable "straight-through" amplifier is indicated by grid-current values below approximately 15 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated d-c 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 d-c 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 a-c or r-f signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that 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 milliammeter. 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, gaseous voltage regulator tubes, or an electron tube *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.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation or plate-modulated r-f amplifiers using the 4X150A or 4X150D.

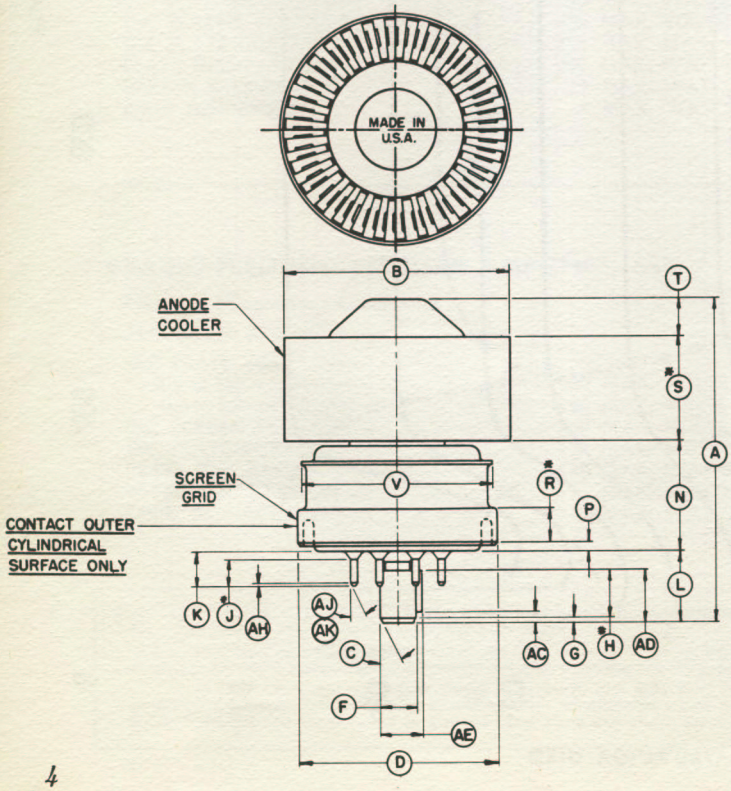
Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

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

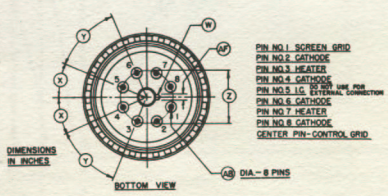
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

UHF Operation—The 4X150A and 4X150D are suitable for use in the UHF region. Such 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.

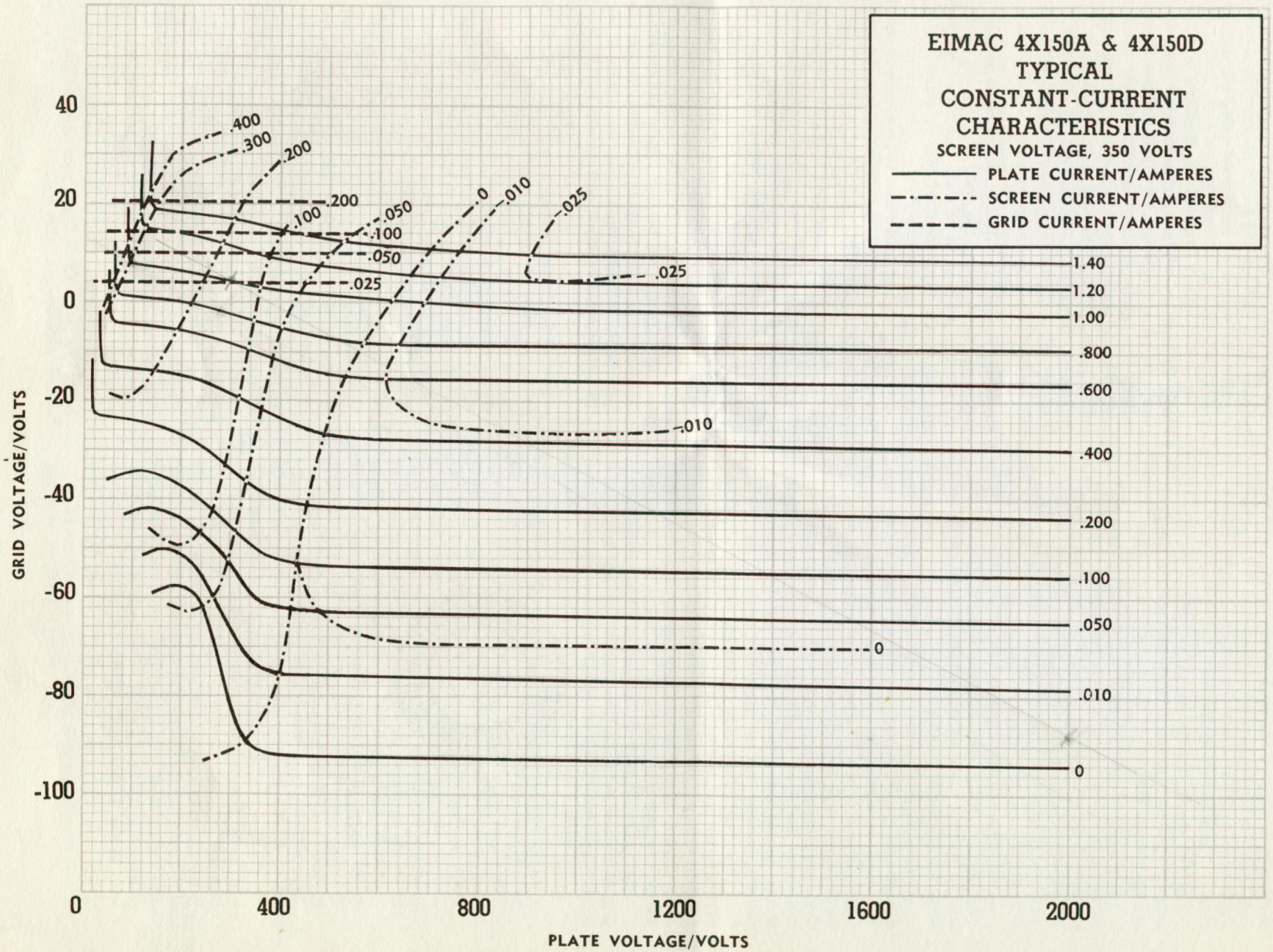
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

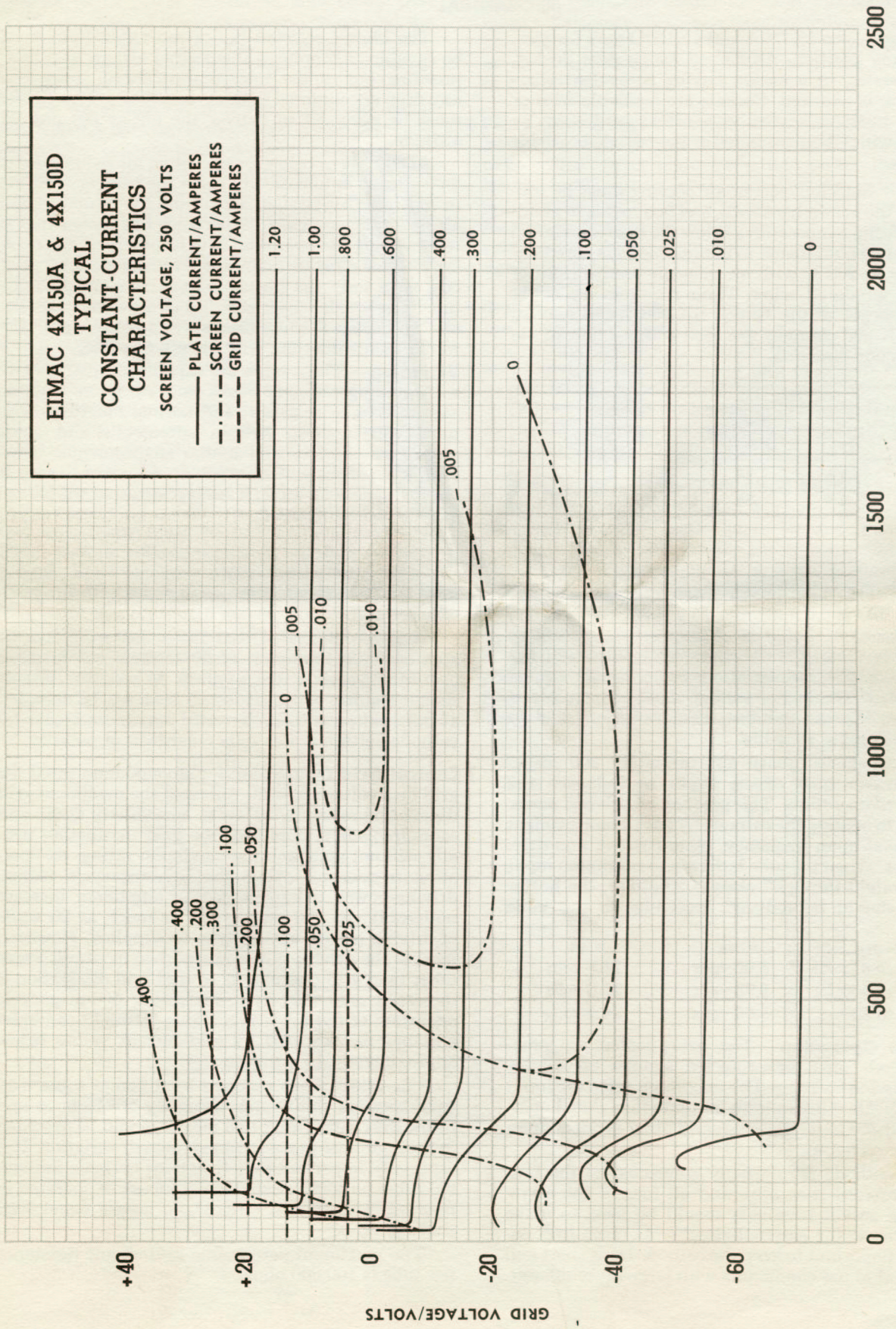


DIMENSION DATA		
REF	MIN.	MAX.
A		2.468
B	1.610	1.640
C	30°	
D	1.417	1.433
F	.255	.265
G	1/32	
H	.360	
J	.187	
K		.250
L	.514	.554
N	.750	.810
P	.080	
R	.187	
S	.710	.790
T		.312
V		1.406
W		.043R
X	22½°	
Y	45°	
Z	.680	.694
AB	.045	.053
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	.086
AH	.035	
AJ	22½°	
AK	.005R	



* CONTACT SURFACE


EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
GRID VOLTAGE/VOLTS
PLATE VOLTAGE/VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
.200
.100
.050
.025
0
.010
.025
.025
.010
0



Printed in U.S.A. 637