8930

TECHNICAL DATA

RADIAL BEAM
POWER TETRODE

The EIMAC 8930 is a compact, high-perveance tetrode with a maximum plate dissipation of 350 watts. It is electrically identical to the EIMAC 7589W/4CX250R but the larger anode radiator assembly allows higher dissipation with low air flow and pressure drop characteristics.

The tube has rugged internal construction features for reliable operation under heavy shock or vibration conditions.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated, Unipotential	
Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	2.6 A
Frequency of Maximum Rating	500 MHz
Amplification Factor (Average):	
Grid to Screen	5
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	17.5 pF
Cout	4.9 pF
Cgp	0.04 pF

1. Characteristics and operating values are based on 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 in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special 9-pin, JEDEC B8-236
Recommended Air-System Socket	EIMAC SK-600 Series
Recommended Air-System Chimney	EIMAC SK-646
Maximum Overall Dimensions:	
Length	2.46 in; 62.59 mm
Diameter	2.08 in; 52.83 mm
Operating Position	Any
Cooling	Forced Air
Net Weight (Approximate)	5.5 oz; 156 gm
Maximum Operating Temperature:	
Anode Core & Ceramic/Metal Seals	250°C

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB (SSB)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified zero-signal plate current.
2. Approximate; should be held above Absolute Maximum rating of 250 mAdc only for brief periods of tuning.
3. Approximate; rated screen dissipation should not be exceeded.
4. Approximate value.
5. The Intermodulation Distortion Products are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	Vdc
Screen Voltage	350	Vdc
Grid Voltage [1]	-63	Vdc
Zero-Signal Plate Current	90	mAdc
One-Tone Plate Current [2]	290	mAdc
Two-Tone Plate Current [4]	205	mAdc
One-Tone Screen Current [3]	30	mAdc
Two-Tone Screen Current [4]	7	mAdc
One-Tone Useful Output Power	350	W
Resonant Load Impedance	4000	Ω
Intermodulation Distortion Products [5]		
3rd Order	-27	dB
5th Order	-30	dB

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified value of zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Measured data at 400 MHz)
Class AB_1, Grid Driven

Plate Voltage	2000	Vdc
Screen Voltage	400	Vdc
Grid Voltage [1]	-85	Vdc
Zero-Signal Plate Current	70	mAdc
Plate Current, 65 W Carrier [2]	170	mAdc
Plate Current, 65 W Carrier [2] Modulated 90%	200	mAdc
Screen Current, 65 W Carrier	-10	mAdc
Peak Screen Current, 65 W Carrier Modulated 90% [2]	30	mAdc
Driving Power, 65 W Carrier	4	W

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate; adjust for specified value of zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Two Tubes)
Class AB_1

Plate Voltage	2000	Vdc
Screen Voltage	350	Vdc
Grid Voltage [1]	-66	Vdc
Zero Signal Plate Current	140	mAdc
Max. Signal Plate Current	500	mAdc
Zero Signal Screen Current [2]	-4	mAdc
Max. Signal Screen Current [2]	+4	mAdc
Peak Driving Power	0	W
Load Resistance (plate-to-plate)	8000	Ω
Power Output (Trans. Eff. = 95%) [2]	595	W

ABSOLUTE MAXIMUM RATINGS FOR OTHER TYPES OF OPERATION

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM

DC PLATE VOLTAGE	2400	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	350	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER, GRID DRIVEN Class C Telephony (Carrier Conditions)

DC PLATE VOLTAGE	1800	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION	280	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

NOTE: TYPICAL OPERATION data is obtained from direct measurement. Adjustment of the rf grid voltage to obtain the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in screen current, which is incidental and which will vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct screen grid voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater: Current at 6.0 volts	2.3	2.9	A
Interelectrode Capacitances[1](grounded cathode):			
Cin	16.0	18.5	pF
Cout	4.2	5.2	pF
Cgp	---	0.06	pF

1. In a shielded fixture (see INTERELECTRODE CAPACITANCE)

APPLICATION

MECHANICAL

MOUNTING - The 8930 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 bypass capacitors and may be obtained with either grounded or ungrounded cathode terminals. The SK-646 Air Chimney is also available.

When environmental stress (such as shock and/or vibration) is anticipated, special attention should be given to securing the tube, to prevent relative motion between the tube and socket during stress, as such motion could effect both the electrical and mechanical performance.

COOLING - Sufficient cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum value. Air requirements to maintain seal temperatures at 225°C in 50°C ambient air are shown. These values apply when the EIMAC SK-600 or SK-610 socket is used with the SK-646 chimney, with air flowing in the base-to-anode direction.

Minimum Cooling Air Flow Requirements				
Plate Dissipation (watts)	Sea Level		10,000 Feet	
	Air Flow (cfm)	Approx. Press.drop, In. H_2O	Air Flow (cfm)	Approx. Press.drop, In. H_2O
250	4.5	0.35	6.5	0.51
300	5.8	0.56	8.5	0.82
350	7.0	0.85	10.2	1.24

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 may interfere with effective cooling.

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

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperature is by the use of a temperature-sensitive lacquer or paint. When these materials are used, 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.

SHOCK AND VIBRATION - The 8930 is recommended for applications where environmental stress is anticipated and reliable operation must be maintained under these circumstances. The tube structure is routinely tested at a vibration level of 10 G, over the frequency range of 28 to 2000 Hz, with full operating voltages applied, and also tested under 90 G long-duration (11 milliseconds) shock conditions, also with voltages

applied. When shock or vibration stressing is expected, it is extremely important that relative motion between socket and tube be prevented or restricted by clamping the tube into place.

ELECTRICAL

HEATER - The heater voltage for the 8930 is 6.0 volts and should be maintained within ±5% of rated value to minimize variations in performance and maximum life.

Above approximately 300 MHz some transit-time heating of the cathode will occur, and heater voltage should be lowered. For operation in the 300 to 400 MHz range, heater voltage should be 5.75 volts; in the 400 to 500 MHz range, 5.5 volts. Under no circumstances should heater voltage be allowed lower than 5.4 volts.

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

STANDBY OPERATION - When equipment is designed for very low-duty operation, where standby periods of many hours or even days at one time are anticipated, it is good engineering practice to include circuitry for reduction of the heater voltage of an oxide-cathode tube during the standby periods. This will greatly minimize the release of sublimation products within the tube. A reduction in heater voltage of 10% from the nominal value is recommended during such long standby periods, with simultaneous switching to normal voltage when the equipment is switched from STANDBY to OPERATE. A reduction in heater voltage of more than 10% is possible if operation is not attempted for several seconds after switching from the STANDBY to the OPERATE mode.

CONTROL GRID - The grid is rated for a maximum dissipation of 2 watts. The maximum dc bias voltage rating is -250 volts.

SCREEN-GRID OPERATION - The maximum rated power dissipation for the screen grid of the 8930 is 12 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.

If tuning of a linear amplifier circuit is to be done under single-tone conditions, extra care should be exercised to be sure the screen dissipation rating is not exceeded, as this is often the limiting factor during this type of operation.

Protection for the screen can be provided by an over-current relay and by interlocking the screen supply so 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 the 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. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

PLATE OPERATION - The maximum rated plate-dissipation power for the 8930 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 Megahertz the top cap on the anode cooler may be used for a plate terminal. At higher frequencies a circular clamp or spring-finger collet encircling the 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 inputs. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube should fail.

UHF OPERATION - The 8930 is useful in the UHF region. Operation at these frequencies should be conducted with heavy plate loading 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.

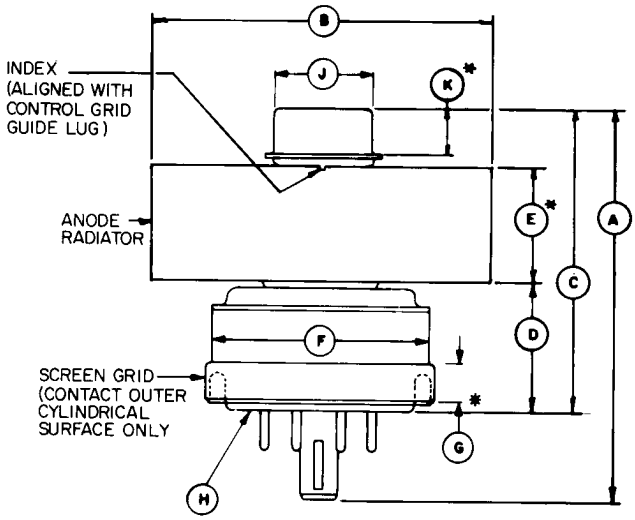
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual 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 manufacturers. The capacitance values shown in the 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 the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 8930 operates 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.

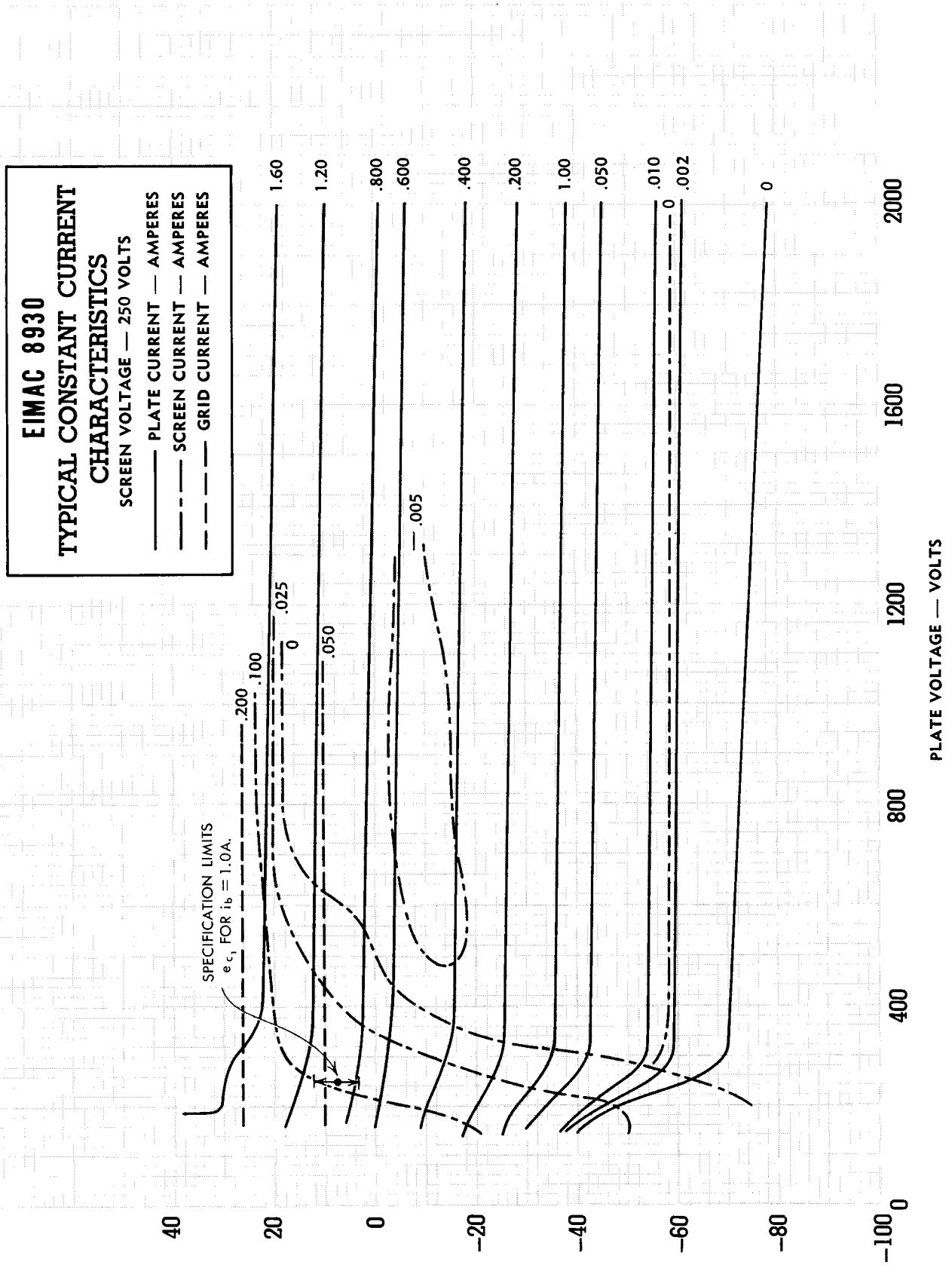
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies 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.

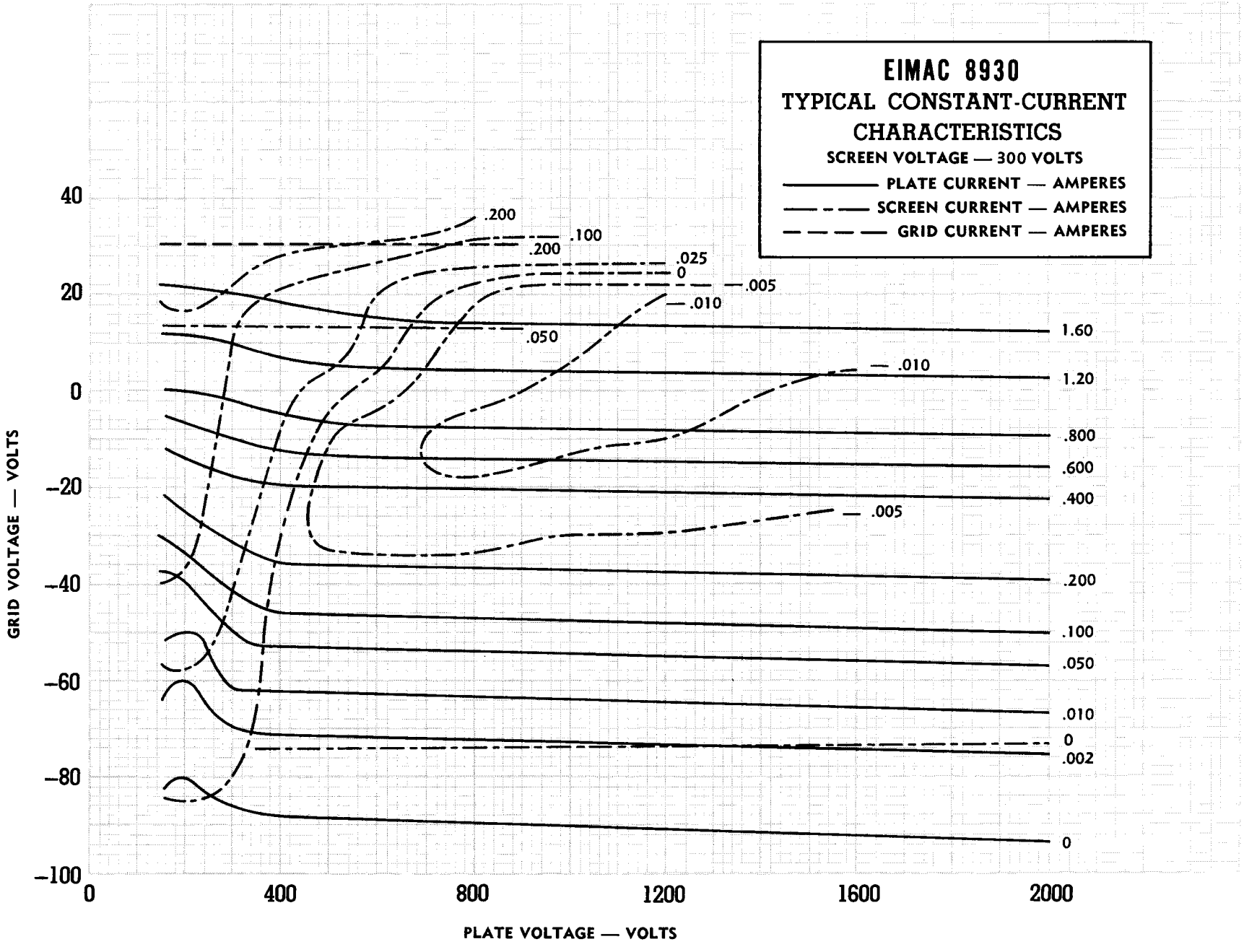
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

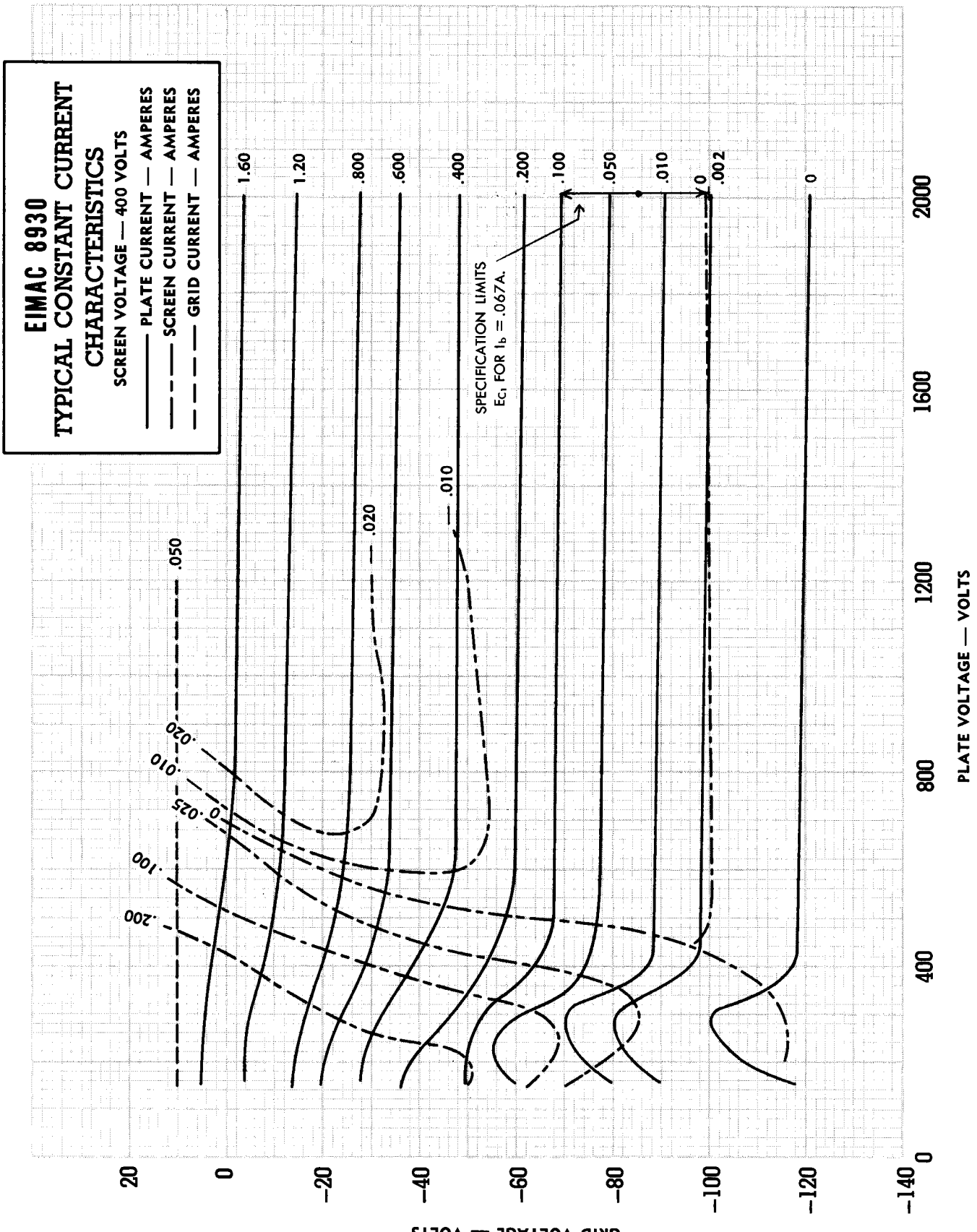


DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.324	2.464	- -	59.03	62.58	- -
B	2.050	2.080	- -	52.07	52.83	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.750	0.810	- -	19.05	20.57	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: B8-236 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -

(*) CONTACT SURFACE


EIMAC 8930
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
.002
0
.005
.025
.100
.200
.050
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS


EIMAC 8930
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 300 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
.200
.100
.200
.025
0
.005
.010
.050
1.60
.010
1.20
.800
.600
.400
.005
.200
.100
.050
.010
0
.002
0


EIMAC 8930
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
0
.050
.020
.010
0
.025
.100
.200
.010
.020
SPECIFICATION LIMITS
Ec1 FOR Ib = .067A.
20
0
-20
-40
-60
-80
-100
-120
-140
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS