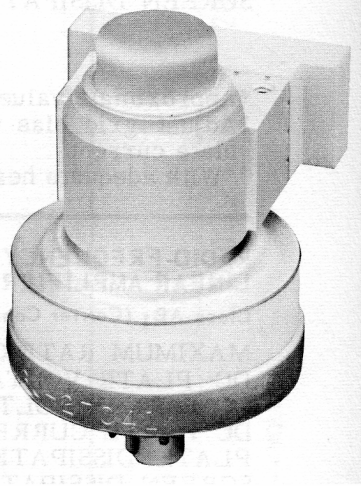
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

4CS100L

QUICK-HEAT POWER TETRODE

The Eimac 4CS100L is a metal-ceramic power tetrode with a quick-heating cylindrical cathode intended for use in portable and mobile transmitters. Power output 3 db down from normal is available within one second after the application of rated heater voltage. Tube operation in approximately 150 milliseconds can be obtained by using a built-in control diode and a minimum amount of additional circuitry.

The conduction cooled 4CS100L has a maximum plate dissipation rating of 100 watts and may be operated at frequencies up to 250 megacycles.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-coated, directly heated				
	Heating time (rated filament voltage)	1	2		seconds
	Heating time (at 6.2 volts)		0.15		second
Heater:	Voltage (See "Application")		2.1		volts
	Current (Ef=2.1 volts)	7.15		8.10	amperes
	Absolute Maximum Filament Voltage for fast warm-up (See "Application")		6.2		volts
Amplification Factor (grid to screen)		10	13		
Transconductance (Ib=150 ma)			20,000		umhos

Direct Interelectrode Capacitances, Grounded Cathode:

Input	26.0 pf
Output*	5.2 pf
Feedback	0.05 pf

*When mounted on a metal chassis, approximately 6.0 pf anode-to-ground capacitance is added to this value.

Frequency for Maximum Ratings - 250 Mc

Control Diode Ratings:

Plate Resistance (Id=0.01A, Ec=0v)	1200 ohms
(Id=0.01A, Ec= —40v)	1600 ohms
Plate Dissipation (Maximum)	0.5 watts
DC Plate Voltage (Maximum)	150 volts
DC Plate Current (Maximum)	20 mA

MECHANICAL

Base	Special 9-pin
Recommended Socket	Eimac, SK-660
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic to Metal Seals	250° C
Anode Core	250° C
Cooling	Conduction
Maximum Over-all dimensions:	
Height	2.464 inches
Width	1.728 inches
Net Weight	4 ounces

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1 (Single Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	**100 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	30	30	30 mA
DC Plate Current	150	150	140 mA
DC Screen Current*	5	4	8 mA
Peak RF Grid Voltage*	24	24	24 volts
Plate Input Power	145	220	280 watts
Plate Output Power	65	125	185 watts
Two-Tone Average DC Plate Current	96	96	96 mA
Two-Tone Average DC Screen Current	3	3	3 mA

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1 (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	**100 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	30	30	30 mA
DC Plate Current	55	55	55 mA
DC Screen Current*	0	0	0
Peak RF Grid Voltage*	12	12	12 volts
Plate Output Power	10	17	30 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	**100 MAX. WATTS
SCREEN DISSIPATION	8 MAX. WATTS

*Approximate values
1Adjust grid bias to obtain listed zero-signal plate current
**With adequate heat sink contact

TYPICAL OPERATION (Sinusoidal wave, two tubes)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	400	400	400 volts
DC Grid Voltage[1]	—33	—33	—33 volts
Zero-Signal DC Plate Current	60	60	60 mA
Max. Signal DC Plate Current	300	300	280 mA
Max. Signal DC Screen Current	10	8	16 mA
Effective Load, Plate to Plate	4700	8600	13800 ohms
Peak AF Grid input voltage* (per tube)	24	24	24 volts
Driving Power	0	0	0 watts
Max. Signal Plate Output Power	130	250	370 watts

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 4CS100L may be mounted in any position provided that the anode beryllium oxide insulator is properly mated to an adequate heat sink. A heat-conducting socket, such as the Eimac SK-660, or a socket having equivalent characteristics, is required. The screen must be by-passed by the Eimac SK-665 capacitor. This capacitor also includes a provision for a dc connection to the tube's screen ring. There is no pin connection on the tube base for a screen connection.

COOLING

Maximum ratings for the 4CS100L depend on adequate conduction cooling to maintain all tube and seal temperatures at 250° C or below. Maximum anode dissipation depends on intimate mating of the BeO anode insulator to an adequate heat-sink. A conductive lubricant is suggested to insure proper seating of the BeO insulator to the heat-sink. Tube temperatures can be expected to run up to 120° C above the beryllia-to-heat-sink surface temperature.

Base cooling is also by conduction through the Eimac SK-660 socket (or equivalent). To insure proper cooling, tube temperatures should be monitored with temperature sensitive lacquer or by some other means in any new installation.

VIBRATION

This tube is capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in normal operation and handling. The tubes will function well in portable, automobile and truck mobile installations or similar environments.

ELECTRICAL

HEATER OPERATION

With the rated heater voltage of 2.1 volts applied, the warm-up time is approximately 1 second for power output 3 db down from normal. Approximately 2 seconds are required for full output power. The heater voltage must be maintained within $\pm 5\%$ of its rated value to minimize variations in performance and to obtain maximum tube life.

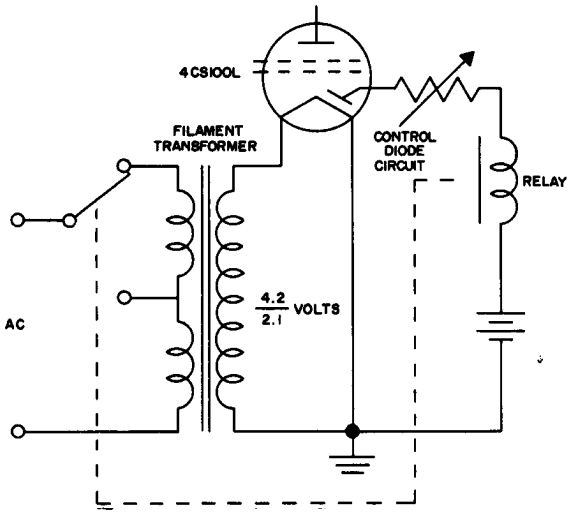
However, the warm-up time may be reduced to approximately 0.15 second by applying overvoltage to the heater for a short period of time, as controlled by the control diode, and then switching to rated heater voltage when the cathode has reached normal operating temperature. Overvoltage must be limited to 3 times nominal (Ef=6.2 volts maximum), for the proper length of time. This feature permits "push-to-talk" operation, of portable and mobile equipment with significant extension of battery life.

CONTROL DIODE OPERATION

Extreme caution must be taken to insure that heater overvoltage is not applied beyond the time at which the cathode reaches operating temperature, since the voltage used is sufficient to destroy the cathode. Proper operation will be insured if overvoltage is removed when control diode anode current reaches 65% of its steady state operating value.

The control diode built into the tube is designed specifically for sensing cathode temperature, and in combination with a properly designed relay circuit will allow overvoltage for a short period followed by a switch to normal voltage. Since the control diode section of the tube is intended for dc switching use only, the control diode anode polarity should not be made negative with respect to the cathode. A typical simplified control circuit is shown; more sophisticated, fail-safe circuits can be used.

In any application, the actual circuit details will depend on such factors as the operating time of the relay used and the degree of overvoltage used initially. It is recommended that the Power Grid Tube Marketing, Eitel-McCullough, Inc., San Carlos, California be contacted for assistance in the use of the Eimac 4CS100L, in applications requiring the use of heater overvoltage.



CONTROL-GRID OPERATION

The grid dissipation rating of the 4CS100L is 0.5 watts and precautions should be observed to avoid exceeding this rating. The 4CS100L is a high transconductance tube requiring low drive voltage for full power output. The design features which make this tube capable of maximum power

operation with low grid drive also make it necessary to avoid drawing significant grid current. Although the tube was designed primarily for Class AB_1 operation, it may be used for Class C applications if the above control grid precautions are carefully observed.

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.

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.

A screen by-pass capacitor such as the Eimac SK-665 may be used. Connection to the screen is made to the contact on the SK-655 or to the screen ring on the tube.

PLATE OPERATION

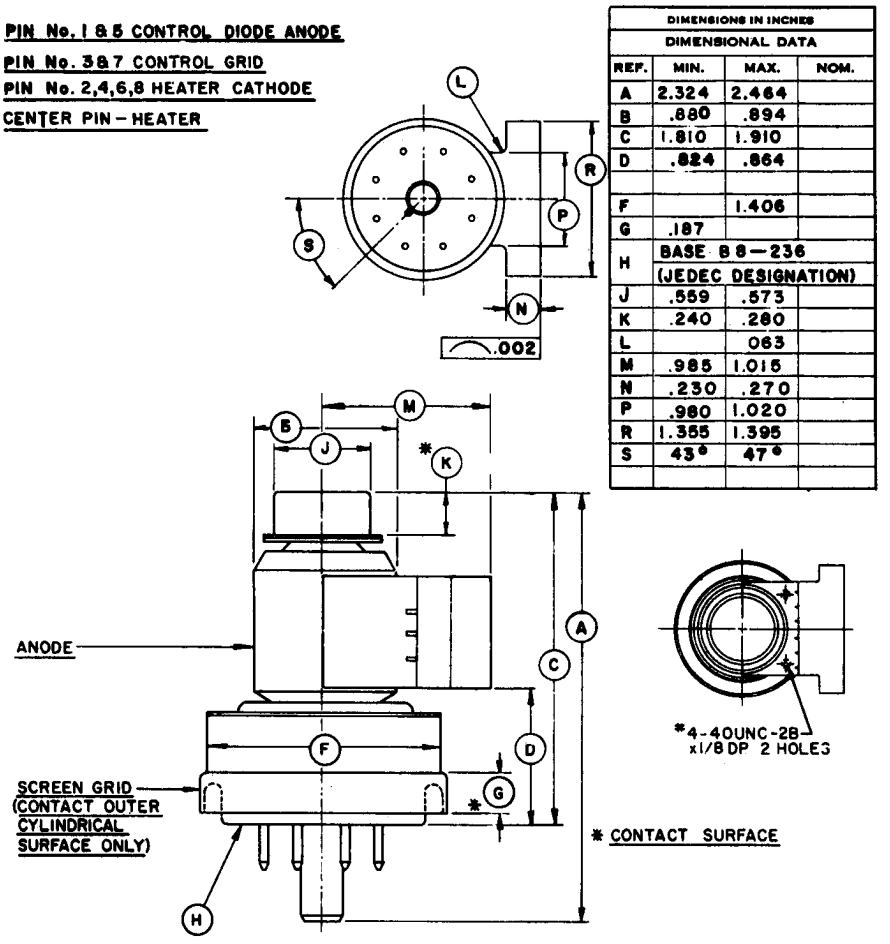
Connection to the anode may be made at the top cap or to the tapped holes on the anode "saddle."

The maximum plate-dissipation rating for the 4CS100L is 100 watts. Plate dissipation may be permitted to exceed the maximum rated value if rated core and seal temperature is maintained.

The maximum rated plate voltage for Class AB_1 operation at frequencies up to 250 megacycles is 2000 volts.

SPECIAL APPLICATIONS

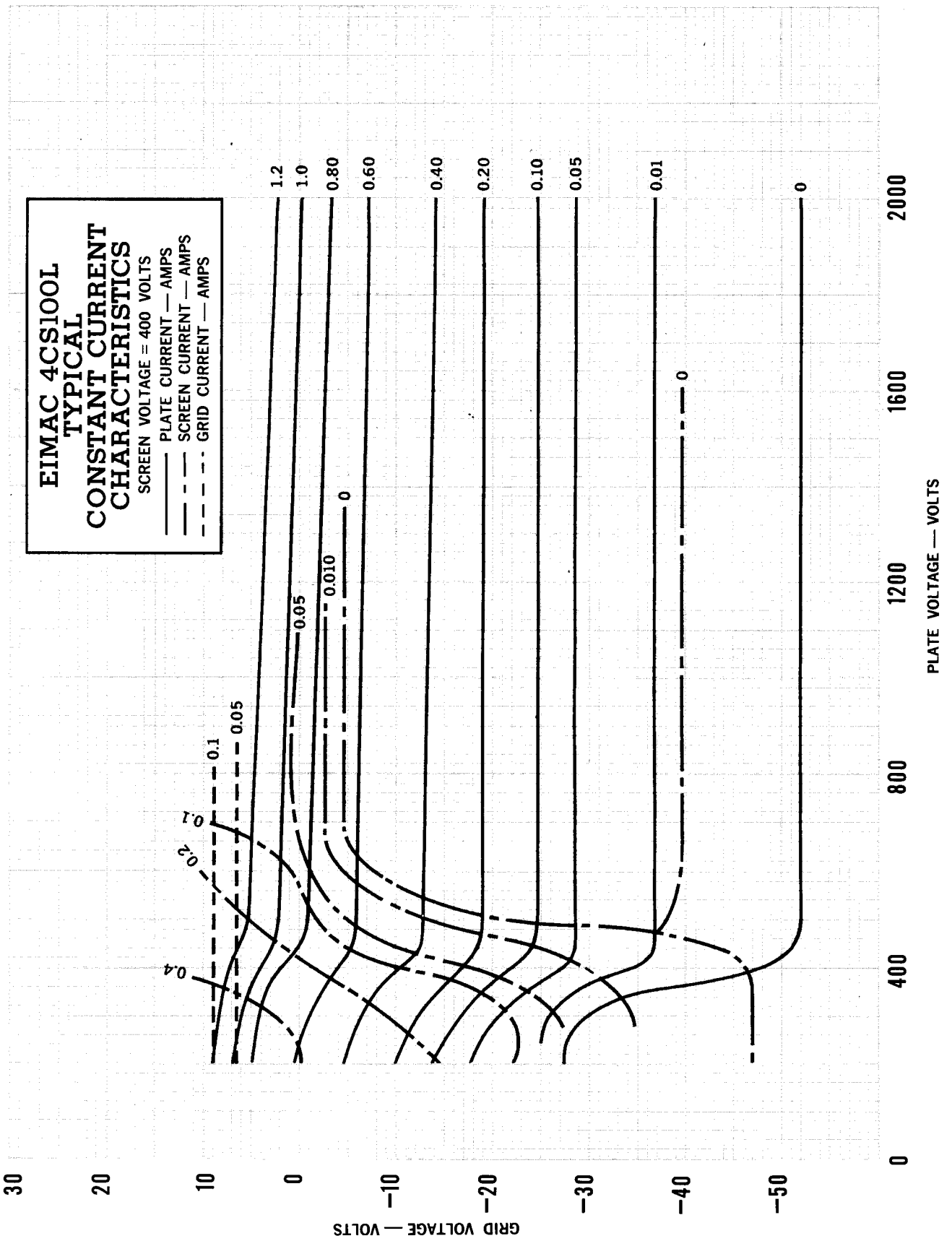
If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

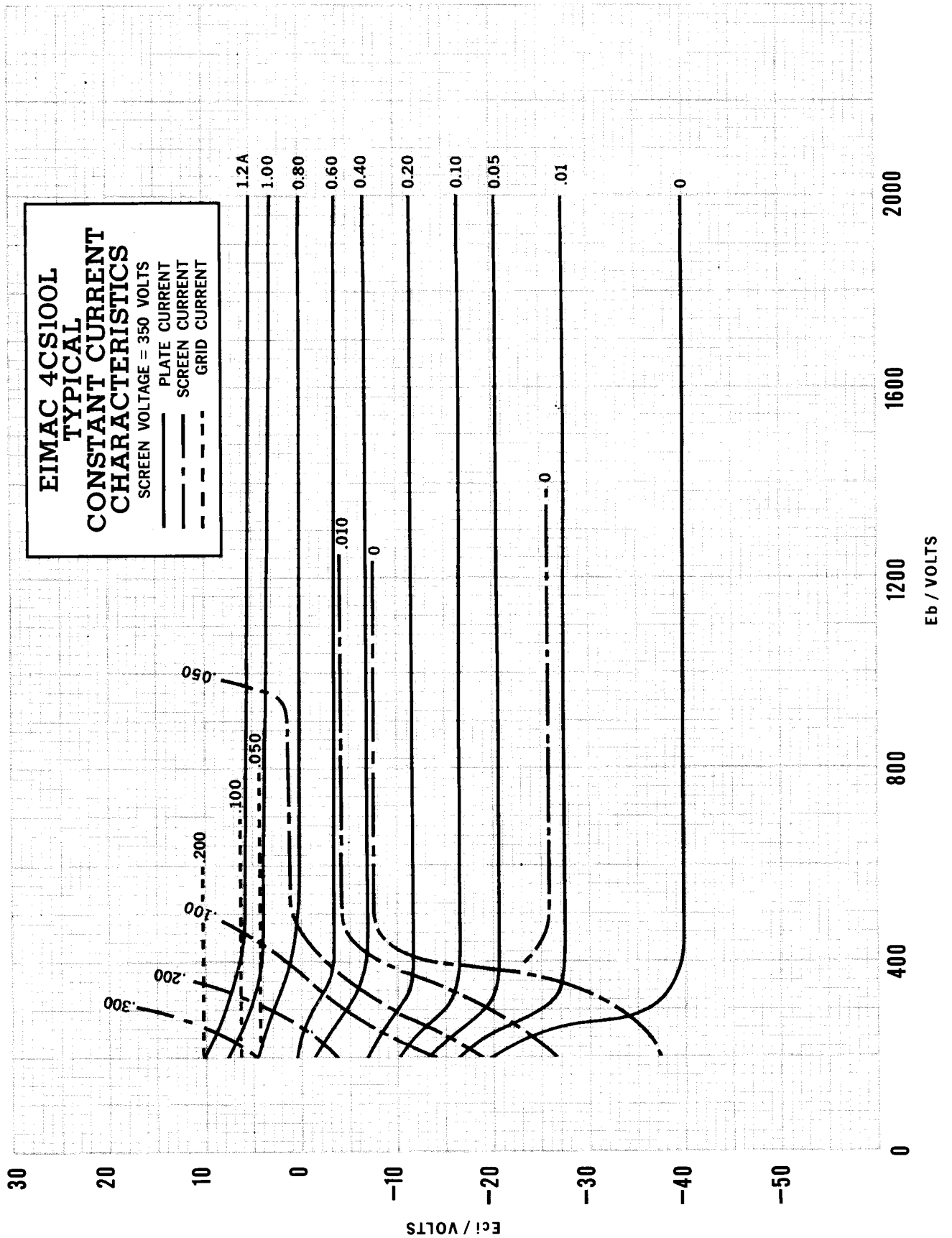


DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.324	2.464	
B	.880	.894	
C	1.810	1.910	
D	.824	.864	
F		1.406	
G	.187		
H	BASE B 8–236 (JEDEC DESIGNATION)		
J	.559	.573	
K	.240	.280	
L		063	
M	.985	1.015	
N	.230	.270	
P	.980	1.020	
R	1.355	1.395	
S	43°	47°	


EIMAC 4CS100L
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 400 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
1.2
1.0
0.80
0.60
0.40
0.20
0.10
0.05
0.01
0
0.05
0.010
0
0.1
0.05
0.1
0.2
0.4
30
20
10
0
−10
−20
−30
−40
−50
GRID VOLTAGE — VOLTS
0
400
800
1200
1600
2000
PLATE VOLTAGE — VOLTS


EIMAC 4CS100L
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 350 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
1.2A
1.00
0.80
0.60
0.40
0.20
0.10
0.05
.01
0
.010
0
.050
.100
.200
.100
.200
.300
30
20
10
0
−10
−20
−30
−40
−50
Ec1 / VOLTS
0
400
800
1200
1600
2000
Eb / VOLTS