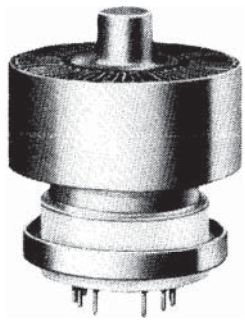
8122
Power Tube



Linear Beam Power Tube

- **Coaxial-Electrode Structure**
- **Ceramic Metal Seals**
- **Full Ratings up to 500 MHz**
- **Forced-Air Cooled**
- **380 Watts PEP Output at 30 MHz AB_1**
- **570 Watts PEP Output at 30 MHz AB_2**
- **300 Watts CW Output at 470 MHz**
- **Matched Pair Available**

BURLE-8122 is a very small, low-cost, forced-air-cooled beam power tube designed for use as an RF power amplifier, oscillator, regulator, distributed amplifier, or linear RF power amplifier in mobile or fixed equipment.

The 8122 features a light-weight, cantilever-supported cylindrical electrode structure within a ceramic-metal envelope. This construction provides a very sturdy tube and permits high-temperature operation.

The terminal arrangement of the 8122 facilitates use of the tube with tank circuits of the coaxial or stripline type. Effective isolation of the output circuit from the input circuit is provided at the higher frequencies by the low-inductance ring terminal for grid-No. 2. A base-pin termination for grid-No. 2 is also available for operation of the 8122 at the lower frequencies.

The tripod arrangement of both the cathode and the grid-No. 1 leads not only simplifies construction, but enhances electrical characteristics. The three cathode leads reduce the inductance path to RF ground and reduce the input admittance at high frequencies.

This data sheet gives application information unique to the BURLE 8122. It is to be used in conjunction with the publication, "Application Guide for BURLE Power Tubes", TP-105, for general application information.

The three grid-No.1 leads to separate pins accommodate a split-input circuit for distributed amplifier service.

The BURLE 8122/V1 is the designation for a matched pair of Type 8122 Beam Power Tu bes for use in equipments not having individual bias adjustment. This pair is matched to assure balanced operation within a bias range of 28 to 40 volts, so that each tube will have an approximately equal anode current during zero-signal and signal operation. Such matching also assures efficient, full system operation and gives optimum life expectancy.

General Data

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)[1]	13.5 ±. 10%	volts
Current at 13.5 volts	1.3	A
Minimum heating time	60	s
Mu-Factor, Grid No. 2 to Grid No. 1 for Anode Volts = 450, Grid-No. 2 Volts = 325, and Anode Amperes = 1.2	12	
Direct Interelectrode Capacitances:[2]		
Grid No. 1 to anode	0.15 max.	pF
Grid No. 1 to cathode	16.3	pF
Anode to cathode	0.01	pF
Grid No. 1 to grid No. 2	23.3	pF
Grid No. 2 to anode	7.0	pF
Grid No. 2 to cathode	2.7	pF
Cathode to heater	3.3	pF

BURLE Electron Tubes

Mechanical:

Operating Position	Any
Maximum Overall Length	2.26"
Seated Length	1.920" ± 0.065"
Greatest Diameter	1.625" ± 0.015"
Base	Large-Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)
Socket	Jettron[c] No. CD77-030, Johnson[a] No. 124-311-100, Erie[b] No. 9813-000, or equivalent
Grid No. 2 Bypass Capacitor	Johnson[a] No. 124-0113-001, Erie[b] No. 9812-000, or equivalent
Weight (Approx.)	**3.5 oz**

Thermal:

Terminal Temperature (All terminals)	250	max.	°C
Radiator Core Tern erature (See Dimensional Outline)	250	max.	°C

Air Flow:

See Figure 1 - Typical Cooling Requirements

Linear RF Power Amplifier Single-Sideband Suppressed-Carrier Service

Peak envelope conditions for a signal having a minimum peak-to-average power ratio of 2

Maximum CCS Ratings, Absolute-Maximum Values:

DC Anode Voltage:		
Up to 30 MHz	3000[4]	volts
Up to 500 MHz	2200	volts
	Up to 500 MHz	
DC Grid-No. 2 Voltage	400	volts
DC Grid-No. 1 Voltage	-100	volts
DC Anode Current at Peak of Envelope	450[5]	mA
DC Grid-No. 1 Current	100	mA
Anode Dissipation	400	watts
Grid-No. 2 Dissipation	8	watts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	150	volts
Heater positive with respect to cathode	150	volts

Maximum Circuit Values:

Grid-No. 1 Circuit Resistance Under Any Condition:[9]		
With fixed bias	25,000	ohms
With fixed bias (In Class AB, operation)	100,000	ohms
With cathode bias	Not recommended	
Grid-No. 2 Circuit Impedance[8]	10,000	ohms
Anode Circuit Impedance	See Notes 4 and 6	

Typical CCS Operation at 30 MHz with "Two-Tone Modulation":

	AB_1	AB_2	
DC Anode Voltage	2000	2500	volts
DC Grid-No. 2 Voltage	400	400	volts
DC Grid-No. 1 Voltage	-35	-35	volts
Zero-Signal DC Anode Current	100	115	mA
Effective RF Load Resistance	3050	3500	ohms
DC Anode Current at Peak of Envelope	335	400	mA
Average DC Anode Current	250	275	mA
DC Grid-No. 2 Current at Peak of Envelope	10	6	mA
Average DC Grid-No. 2 Current	7	4	mA
DC Grid-No. 1 Current at Peak of Envelope	0.05[7]	3	mA
Peak-Envelope Driver Power Output (Approx.)	0.3	0.5	watt
Output-Circuit Efficiency (Approx.)	90	90	%
Distortion Products Level:			
Third order	29[10]	28	dB
Fifth order	32	32	dB
Useful Power Output (Approx.)			
Average	190	285	watts
Peak envelope	380	570	watts

RF Power Amplifier & Oscillator - Class C Telegraphy and RF Power Amplifier - Class C FM Telephony

Maximum CCS Ratings, Absolute-Maximum Values:

	Up to 500 MHz	
DC Anode Voltage	2200	volts
DC Grid-No. 2 Voltage	400	volts
DC Grid-No. 1 Voltage	-100	volts
DC Anode Current	300	mA
DC Grid-No. 1 Current	100	mA
Grid-No. 2 Dissipation	8	watts
Anode Dissipation	400	watts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	150	volts
Heater positive with respect to cathode	150	volts

Maximum Circuit Values:

Grid-No. 1 Circuit Resistance Under Any Condition:		
With fixed bias	25,000	ohms
Grid-No. 2 Circuit Impedance	10,000	ohms
Anode Circuit Impedance	See Note 6	

Typical CCS Operation:

In Grid-Drive Circuit at 50 MHz

DC Anode Voltage	700	1000	1500	2000	volts
DC Grid-No. 2 Voltage	175	200	200	200	volts
DC Grid-No. 1 Voltage	-10	-30	-30	-30	volts
DC Anode Current	300	300	300	300	mA
DC Grid-No. 2 Current	25	20	20	20	mA
DC Grid-No. 1 Current	50	40	40	30	mA
Driver Power Output (Approx.)	1.2	2	2	2	watts
Useful Power Output	120	175	275	375	watts

In Grid-Drive Circuit at 470 MHz

DC Anode Voltage	700	1000	1500	2000	volts
DC Grid-No. 2 Voltage	200	200	200	200	volts
DC Grid-No. 1 Voltage	-30	-30	-30	-30	volts
DC Anode Current	300	300	300	300	mA
DC Grid-No. 2 Current	10	10	5	5	mA
DC Grid No. 1 Current	30	30	30	30	mA
Driver Power Output (Approx.)	5	5	5	5	watts
Useful Power Output	100	165	235	300	watts

a. E. F. Johnson Co., 299 Johnson Ave., Waseca, MN 56093.
b. Erie Specialty Products, 645 W. 11th St., Erie, PA 16512.
c. Jettron Products, Inc., 56 Route 10, Hanover, NJ 07936

Plate-Modulated RF Power Amplifier - Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1 .0

Maximum CCS Ratings, Absolute-Maximum Values:

	Up to 500 MHz	
DC Anode Voltage	1800	volts
DC Grid-No. 2 Voltage	400	volts
DC Grid-No. 1 Voltage	-100	volts
DC Anode Current	250	mA
DC Grid-No.1 Current	100	mA
Grid-No. 2 Input	5	watts
Anode Dissipation	280	watts

Characteristics Range Values

	Min.	Max.	
Heater Current[1] [11]	1.15	1.45	A
Direct Interelectrode Capacitances:			
Grid-No. 1 to plate[2]	-	0.15	pF
Grid-No. 1 to cathode[2]	14.6	18.0	pF
Plate to cathode[2]	0.004	0.016	pF
Grid-No. 1 to grid-No. 2[2]	20.0	26.5	pF
Grid-No. 2 to plate[2]	6.3	7.7	pF
Grid-No. 2 to cathode[2]	2.1	3.3	pF
Cathode to heater[2]	2.5	4.1	pF
Grid-No. 1 Voltage[11,12]	-8	-19	volts
Reverse Grid-No. 1 Current[11,12]	-	-25	mA
Grid-No. 2 Current[11,12]	-5	+6	mA
Peak Emission[11,13]	13	-	peak A
Interelectrode Leakage Resistance[14]	50	-	megohm
Zero Bias Anode Current[11,15]	1.0	1.8	A

1. Because the cathode is subjected to back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should, for optimum life, be reduced to a value such that at the heater voltage obtained at minimum supply voltage conditions (all other voltages constant) the tube performance just starts to show some degradation; e.g., at 470 MHz heater volts = 12.5 (approx.)
2. Measured with special shield adapter.
3. See TP-105
4. For operation above 2200 anode volts, the tube shall see an effective anode-supply impedance of no less than 750 ohms. A fault current limiting resistor of no less than 15 ohms is to be used between the output filter capacitance and the tube anode. The anode-supply-output-filter capacitance is to be no greater than 10 microfarads.
5. The maximum rating for a signal having a minimum peak-to-average power ratio less than 2, such as is obtained in "Single-Tone" operation, is 300 mA. During short periods of circuit adjustment under "Single-Tone" conditions, the average anode current may be as high as 450 mA.
6. The tube should see an effective anode supply impedance which limits the peak current through the tube under surge conditions to 15 amperes.
7. This value represents the approximate grid-No. 1 current obtained due to initial electron velocities and contact-potential effects when grid-No. 1 is driven to zero volts at maximum signal.
8. A fault current limiting resistor of no less than 320 ohms is to be used between the screen output filter capacitance and the tube screen. The screen supply output filter capacitance is to be no greater than 80 microfarads.
9. A fault current limiting resistor of no less than 20 ohms is to be used between the bias supply output filter capacitance and the tube grid-No. 1. The bias supply output filter capacitance is to be no greater than 150 microfarads.
10. The value of third order distortion product level shown may be improved by approximately 5dB by utilizing an unbypassed, non-inductive 20-ohm resistor between the cathode and ground; a slight increase in drive power will be required.
11. With 13.5 volts ac or dc on heater.
12. With dc plate voltage at 700 volts, dc grid-No. 2 voltage of 250 volts, and dc grid-No. 1 voltage adjusted to give a dc anode current of 185 mA.
13. For conditions with grid-No. 1, grid No. 2, and anode tied together; and pulse voltage source connected between anode and cathode. Pulse duration is 2.5 microseconds and pulse repetition frequency is 60 pps. The voltage-pulse amplitude is 200 volts peak. After 1 minute at this value, the current-pulse amplitude will not be less than the value specified.
14. Under conditions with tube at 20° to 30°C for at least 30 minutes without any voltages applied to the tube. The minimum resistance between any two electrodes as measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1 .0 megohm, will be no less than the value specified.
15. With dc anode voltage of 450 volts, dc grid-No. 2 voltage of 400 volts, dc grid-No. 1 voltage of -100 volts, grid drive voltage to zero. With pulse duration of 4500 to 5000 microseconds and pulse repetition frequency of 10 to 12 pps.

Operating Considerations for Type 8122/V1-Matched Pair

Follow all of the recommendations and instructions outlined by the equipment manufacturers with special emphasis on the following precautions:

1. Always allow at least three minutes for the tube heaters to warm up before any other voltages are applied or before any current is drawn.
2. During CW tune-up procedure, the total screen current for both tubes should never exceed 15 milliamperes.
3. During CW tune-up procedure the total anode current for both tubes should never exceed 550 milliamperes.
4. In the SSB mode, the total anode current for both tubes should not exceed 400 milliamperes during voice peaks. A sustained tone like a whistle should not be permitted.
5. Check the socket wiring to assure that each of the three pins provided for the cathode, grid and screen electrodes are interconnected rather than using one pin for each electrode. (See basing diagram of tube bulletin.)
6. Use only 8122/V1 for "matched pair" performance.

   If an unmatched pair is used in a parallel circuit not having individual bias adjustment for each tube, one tube will carry most of the load current and, consequently, will be operated out of ratings.
7. Never rap a tube or equipment. Each tube of the 8122/V1 set has closely spaced electrodes which control the tube's electrical characteristics. Bumping or rapping the tubes or the equipment may change the spacings, thereby destroying the matched characteristics of the tubes.
8. The operating voltages applied to these devices presents an electrical shock hazard. The tubes and associated apparatus should be housed in a protective enclosure to keep all personnel from coming in contact with high voltage. The protective enclosure should be designed with interlocks to break the primary circuit of the high-voltage supplies, discharging high-voltage capacitors when any door or gate on the protective housing is opened, and should prevent the closing of the primary circuit until the door or gate is again closed.
9. DO NOT use the remaining tube of a matched pair with any other remaining or new tube. The tubes will be unbalanced and will fail prematurely.

References

1. Application Guide for BURLE Power Tubes, TP-105.
2. Screen-Grid Current Loading and Bleeder Considerations, TP-122
3. Application Guide for Forced Air Cooling of BURLE Power Tubes, TP-118.

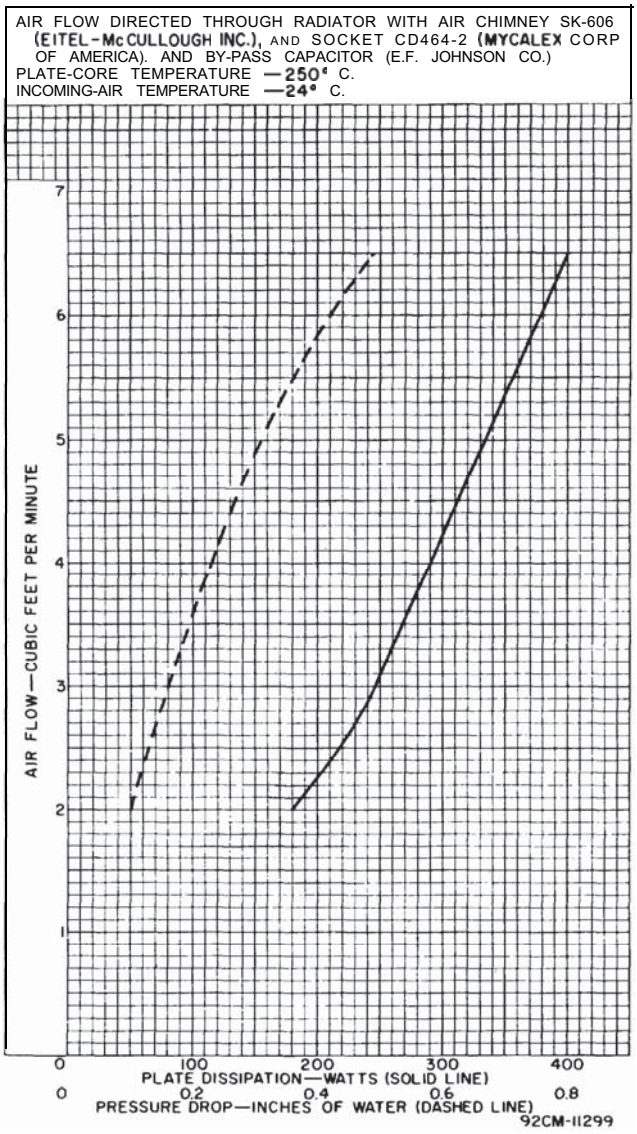


Figure 1 - Typical Cooling Requirements

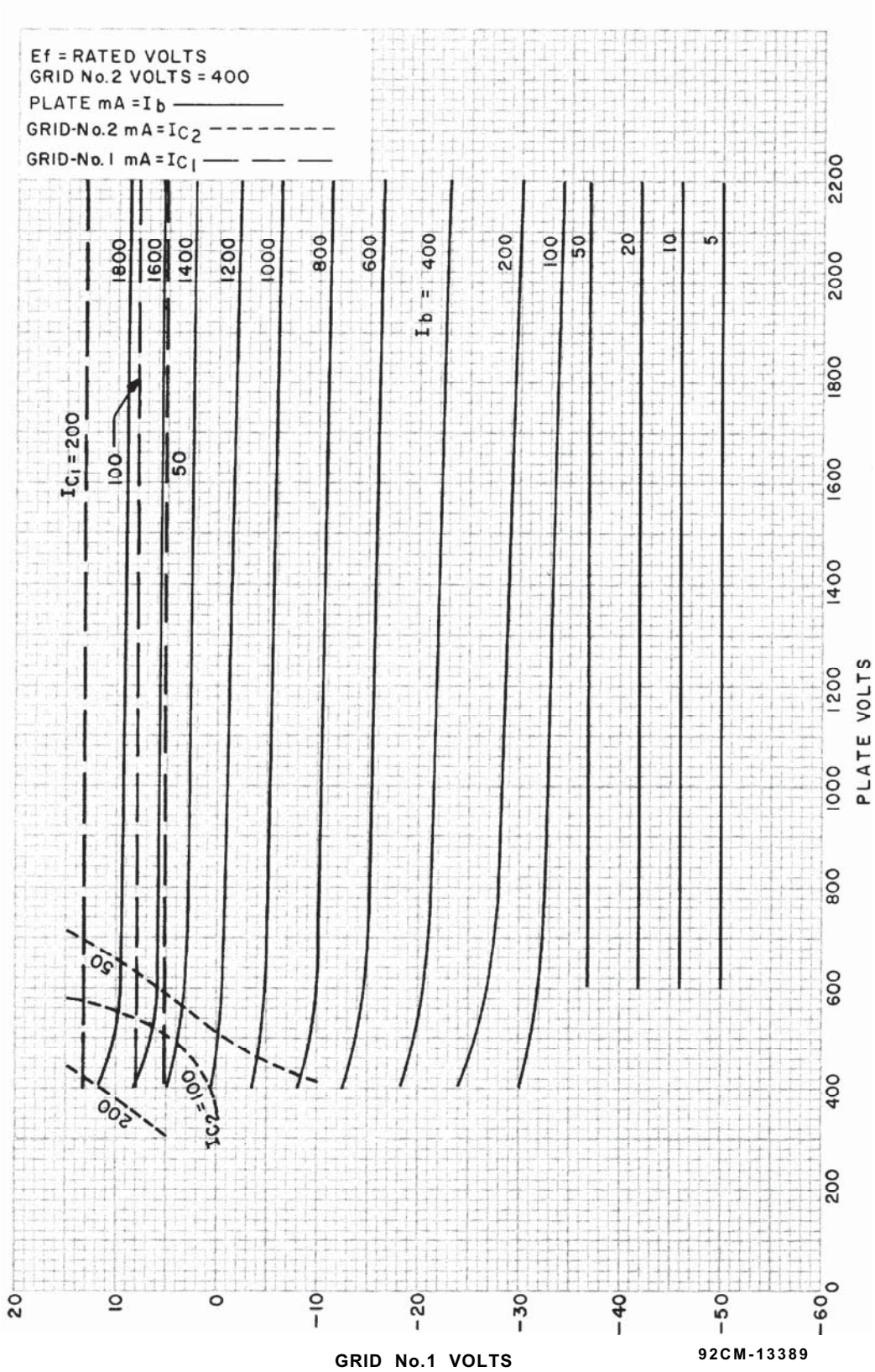


Figure 2 - Typical Constant-Current Characteristics - For Grid-No. 2 Voltage = 400 Volts

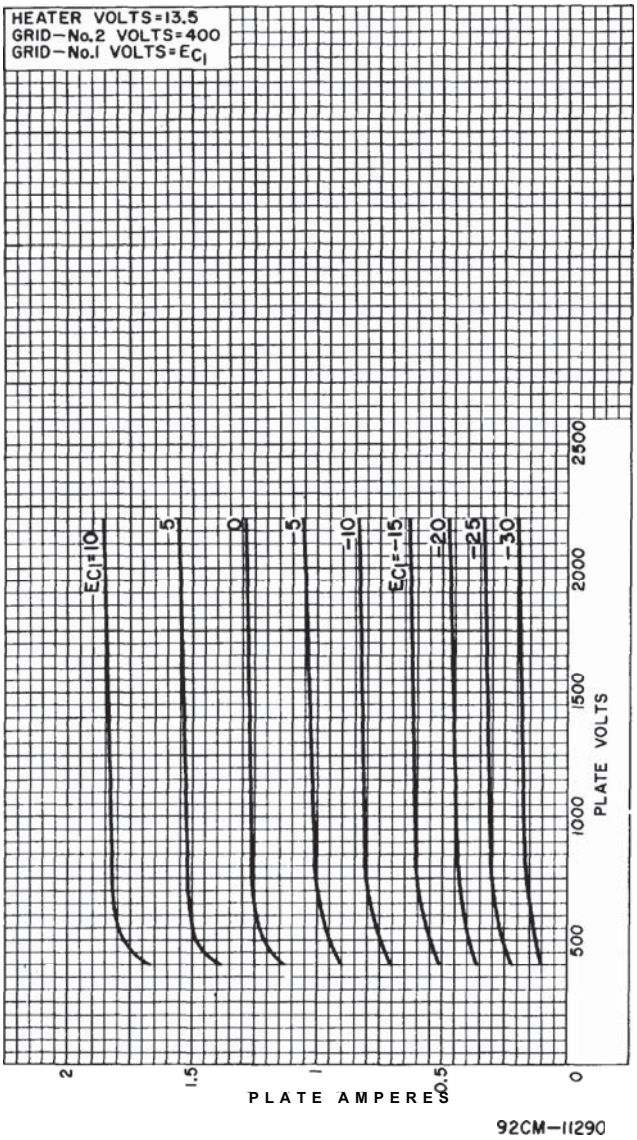


Figure 3 - Typical Anode Characteristics - For Grid-No. 2 Voltage = 400 Volts

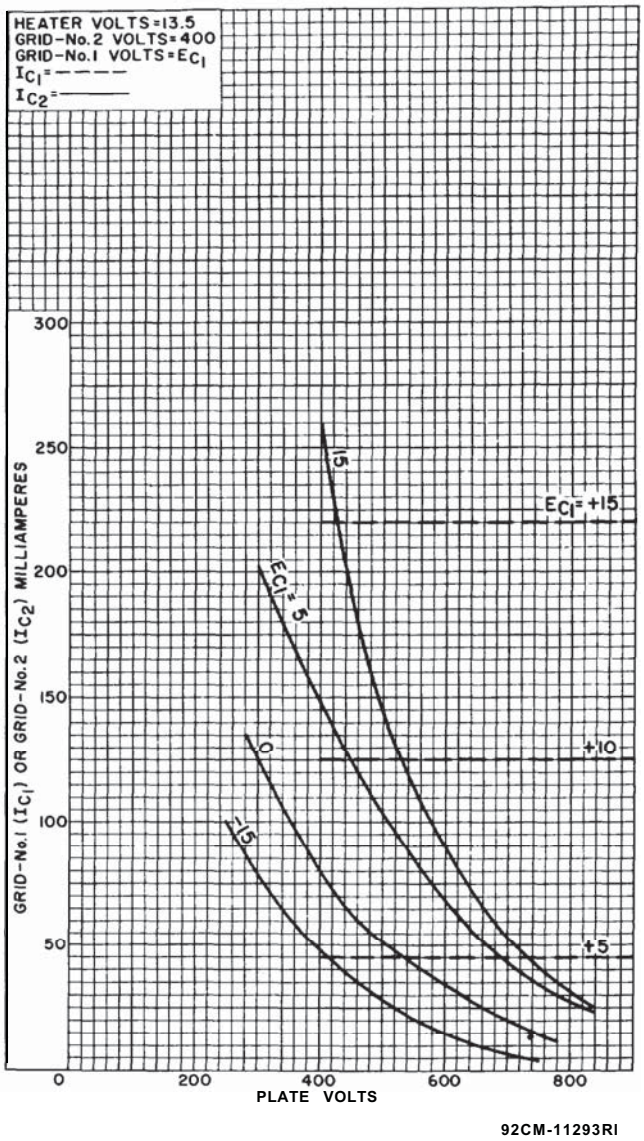


Figure 4 - Typical Characteristics - For Grid-No. 2 Voltage = 400 Volts

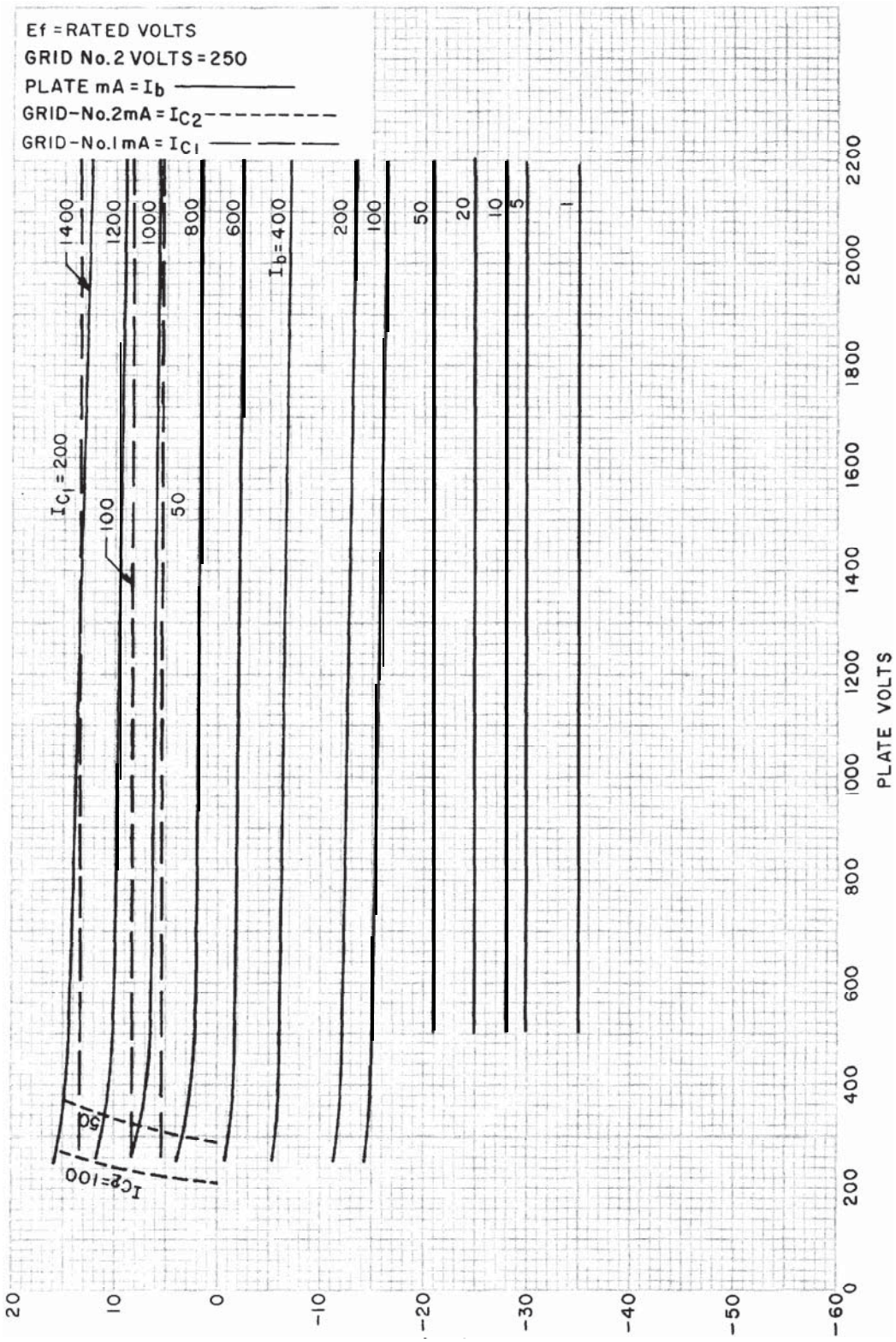
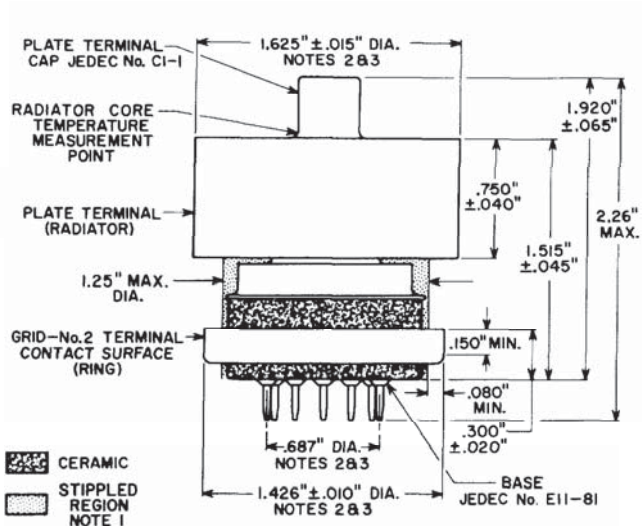


Figure 5 - Typical Constant-Current Characteristics - For Grid-No. 2 Voltage = 250 Volts



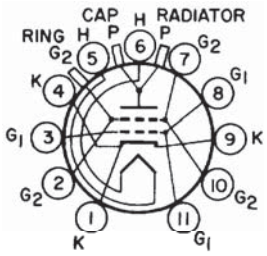
Note 1: Keep all stippled regions clear. Do not allow contacts or circuit components to protrude into these annular volumes.

Note 2: The diameters of the radiator, grid-No. 2 terminal contact surface, and pin circle to be concentric within the following values of maximum full indicator reading:

Radiator to Grid-No. 2 Terminal Contact Surface	0.030" max.
Radiator to Pin Circle	0.040" max.
Grid-No. 2 Terminal Contact Surface to Pin Circle	0.030" max.

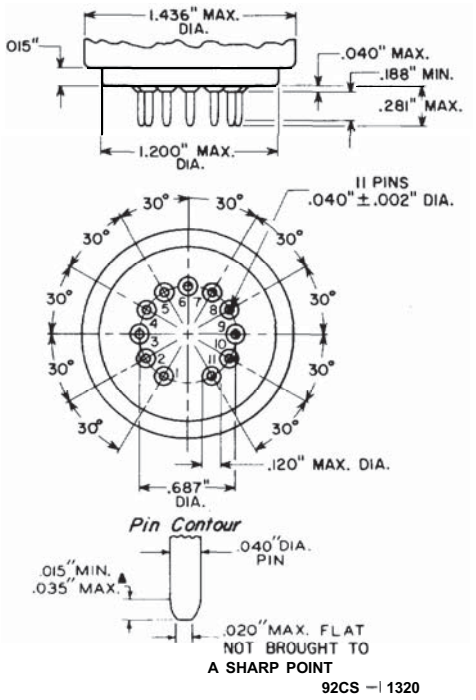
Note 3: The full indicator reading is the maximum deviation in radial position of a surface when the tube is completely rotated about the center of the reference surface. It is a measure of the total effect of run-out and ellipticity.

Figure 6 - Dimensional Outline



Pin 1: Cathode
Pin 2: Grid-No.2
Pin 3: Grid-No.1
Pin 4: Cathode
Pin 5: Heater
Pin 6: Heater
Pin 7: Grid-No.2
Pin 8: Grid-No.1
Pin 9: Cathode
Pin 10: Grid-No.2
Pin 11: Grid-No.1
Cap: Anode Terminal
Radiator: Anode Terminal
Ring: Grid-No. 2 Terminal Contact Surface (For use at higher frequencies)

Figure 8 - Basing Diagram - Bottom View



* This dimension around the periphery of any individual pin may vary within the limits shown.

Figure 7 - Base Drawing Large-Wafer Elevenar 11 -Pin With Ring JEDEC No. El I-81

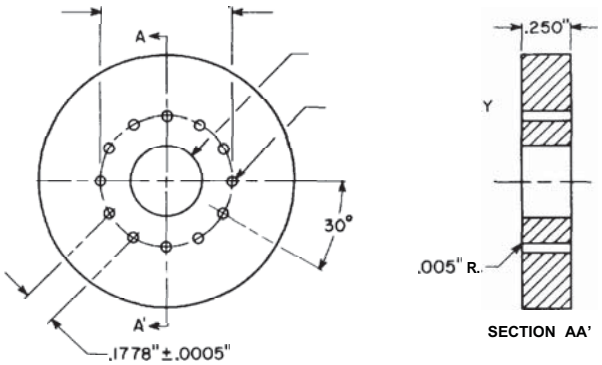


Figure 9 - Gauge Drawing JEDEC No. GE11 -1

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