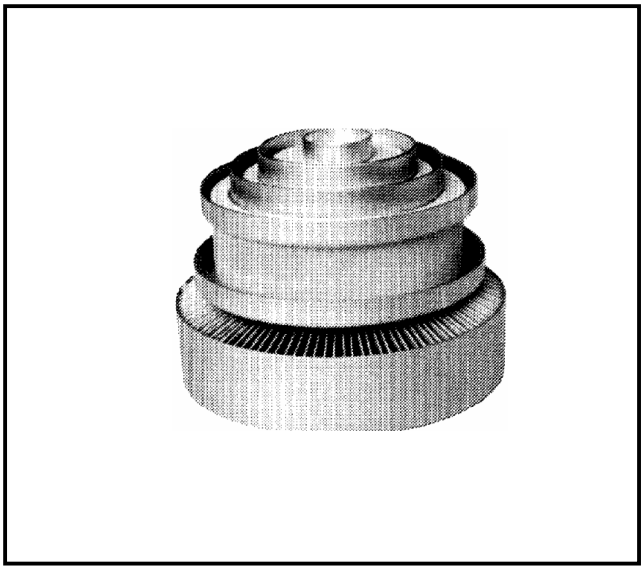
4665

Power Tube
UHF Pulsed Power Amplifier Tube

- **Cermolox®**
- **Forced-Air-Cooled**
- **Coaxial Terminals**
- **Full Input to 1215 MHz**
- **65kW Peak Pulsed Power Output**
- **Controlled Interelectrode Capacity**



The BURLE 4665 is designed for use as a reliable UHF pulsed power amplifier at frequencies up to 1215 MHz. It is well suited for use in compact equipment for airborne, mobile or stationary service. Its design applications include telemetry, which may employ pulsed-amplitude, pulse position, pulse duration, or pulse code modulation, and accelerators which may require unique waveforms. The 4665 and variants of this basic design can also be useful in pulse modulation, CW amplifiers, regulators, and other special services.

The 4665 features sturdy Cermolox® construction and a unipotential cathode of the oxide-coated, matrix type to minimize tube inductance and feed-thru capacitances. Its coaxial, forced-air-cooled radiator with louvered fins, reduces noise to a minimum and insures against spurious outputs.

It features a controlled interelectrode capacity. Its basic design assures high voltage integrity and the thorough tube processing combined with conservative ratings obtains reliable, long life performance.

This data sheet gives application information unique to the BURLE 4665. General information, covering installation and operation of this tube type is given in the “Application Guide for BURLE Power Tubes” TP105. Close attention to the instructions contained therein will assure longer tube life, safer operation, less equipment downtime and fewer tube handling accidents.

General Data

Electrical

Heater-Cathode			
Type……	Unipotential Oxide-Coated Matrix		
Voltage[1]……	5.5	Typ.	V
	5.8	max.	V
Current at 5.5 volts[2]……..	17.3		A
Minimum heating time……..	180		S
Mu Factor[3] (Grid no.2 to Grid no.1)			
Direct Interelectrode Capacitances:			
Grid no.1 to Anode[4]……	0.17	max.	pF
Grid no.1 to Heater-Cathode…..	42		pF
Anode to Heater-Cathode[4,5]…	0.017	max.	pF
Grid no.2 to Anode…….	16.8		pF
Grid no.1 to Grid no.2……..…..	55		pF
Grid no.2 to Heater-Cathode[6]….	1.4	max.	pF

Mechanical

Operating Attitude……..	Any
Maximum Height…….	84.8 mm (3.34 in)
Maximum Diameter…….	95.2 mm (3.75 in)
Socket……	Jettron CD89-095F
Weight……	2.0 lb

Thermal

Maximum Seal Temperature[7] (Anode, Grid no.2, Grid no.1 Heater, Heater-Cathode)……	250 °C
Maximum Anode Core Temperature[7]……..	250 °C

Pulsed RF Power Amplifier[13]

For frequencies up to 1215 MHz.

Maximum Ratings, Absolute-Maximum Values

Peak, Positive-Pulse, Anode Voltage[14]	10000	V
DC Anode Voltage	5000	V
DC or Peak, Positive-Pulse, Grid No.2 Voltage[15]	1200	V
DC Grid No.1 Voltage	-300	V
Peak, Positive-Pulse, Anode Current[16]	18	A
DC Anode Current[16]	1.0	A
Grid No.2 Input (Average)	50	W
Grid No.1 Input (Average)	30	W
Anode Dissipation (Average)	1500	W

Typical Operation

In a Class C, cathode-drive circuit with rectangular wave-shaped pulses, pulse length of 10 microsecond, a duty factor of 0.01 and at 1215 MHz.

Peak, Positive-Pulse, Anode Voltage	10000	-	V
DC Anode Voltage	-	4500	V
Peak, Positive-Pulse, Grid No.2 Voltage[15]	1000	1000	V
DC Grid No.1 Voltage	-80	-80	V
Peak, Positive-Pulse, Anode Current	18	11	A
DC Anode Current	180	110	mA
DC Grid No.2 Current	9	5	mA
DC Grid No.1 Current	16	10	mA
Peak, Positive-Pulse, Driver Power	11	4.5	kW
Useful Power Output at Peak of Pulse	65	20	kW

In a Class AB, cathode drive circuit with DC anode voltage and pulsed grid no.2 voltage, rectangular wave shape pulses, a duty factor of 0.02 and a pulse length of 60[14] microseconds at a frequency of 420 MHz with a bandwidth of 30 MHz at the -3 dB points.

DC Anode Voltage	4300	V
DC Grid No.2 Voltage	1000	V
DC Grid No.1 Voltage	-100	V
Peak Positive-Pulse, Grid No.1 Voltage	+20	V
Peak Positive-Pulse, Anode Current [15]	8.0	A
DC Anode Current[16]	160	mA
DC Grid No.2 Current	10	mA
DC Grid No.1 Current	30	mA
Peak, Positive-Pulse, Driver Power	600	W
Useful Power Output at Peak of Pulse	6000	W

Characteristic Range Values

Parameter	Min. Values	Max. Values	Units
Heater Current[8]	16.3	18.2	A
Direct Interelectrode Capacitance:			
Grid No.1 to Anode[4]		0.17	pF
Grid No.1 to Heater-Cathode	37	46	pF
Anode to Heater-Cathode[4,5]		0.017	pF
Grid No.1 to Grid no.2	46	62	pF
Grid No.2 to Anode	16	17.8	pF
Grid No.2 to Heater-Cathode[6]		1.4	pF
Mu Factor (Grid No.2 to Grid No. 1)[3,8]	8	24	
Cut-off Grid No.1 Voltage[8,9]		-100	V
Peak Grid No.2 Current [8,10]		12	A
Low Frequency Vibration [8,11]		500	mV
High Frequency Vibration [8,12]		See note 12	

Notes

1. Measured at tube terminals. The heater-cathode may be subjected to RF heating when tube is operated at high frequency. For maximum life, it is recommended that the heater be operated at the lowest voltage that will give stable performance.
2. The heater surge current must be limited to 55 A rms or DC.
3. For anode voltage = 2500 V. Grid No.2 voltage = 600 V and anode current = 600mA.
4. With an external flat metal shield 8(200 mm) in diameter having a center hole 3" (76 mm) in diameter. The shield is located in the plane of the grid no.2 terminal, perpendicular to the tube axis, and is connected to Grid No.2.
5. With an external flat metal shield 8"(200 mm) in diameter having a center hole 2-3/8"(60 mm) in diameter. The shield is located in the plane of the Grid No.1 terminal, perpendicular to the tube axis, and is connected to Grid No.1.
6. Socket is available in production quantities as the CD89-095 from Jettron Products Incorporated, 65 Route 10, P. 0. Box 337, East Hanover, NJ 07938.
7. See Dimensional Outline for temperature measurement points.
8. With 5.5 volts AC on heater.
9. With DC anode voltage of 2500 volts, DC Grid No.2 voltage of 1000 volts, and DC Grid No.1 voltage adjusted to give an anode current of 0.015 amperes.
10. With DC anode voltage of 2500 volts, DC Grid No.2 voltage of 1000 volts, and Grid No.1 voltage pulse adjusted to give a peak anode current of 40 amperes. Rectangular pulse duration is 16 microseconds and pulse repetition frequency is 60 cps.
11. As specified in MIL-E-IE Test Method 1031, and with anode voltage of 450 volts, Grid No.2 voltage of 300 volts, Grid No.1 voltage varied to give a anode current of 10 mA, and anode load resistor of 2000 ohms.
12. As specified in MIL-E-IE Test Method 1031.
13. See TP-105
14. See TP-105. ft is recommended that a suitable, high-speed electronic protective device be employed when the pulse duration exceeds ten microseconds at duty factors of 0.01 or higher.
15. Pulsed anode voltage must precede pulsed Grid No.2 voltage.
16. Absolute maximum peak, positive-pulse, anode current for a maximum on time up to 10 microseconds in any 1000 microsecond interval.

Forced Air Cooling

Air Flow

Through radiator - Adequate air flow to limit the anode-core temperature to 250 °C should be delivered by a blower through the radiator before and during the application of heater, anode, grid no.2, and grid no.1 voltages. In typical operation at 1500 watts anode dissipation, and 225 °C anode core temperature, 30 cfm at 0.35 inches of water at 28 °C ambient air temperatures should be sufficient.

To Anode, Grid No.2, Grid No 1, Heater-Cathode and Heater Terminals - A sufficient quantity of air should be allowed to flow past each of these terminals so that their temperature does not exceed the specified maximum value of 250 °C.

During Standby Operation - Cooling air is required when only heater voltage is applied to the tube.

During Shutdown Operation - Air flow should continue for a few minutes after all electrode power is removed.

For further information on forced-air cooling, see TP-105.

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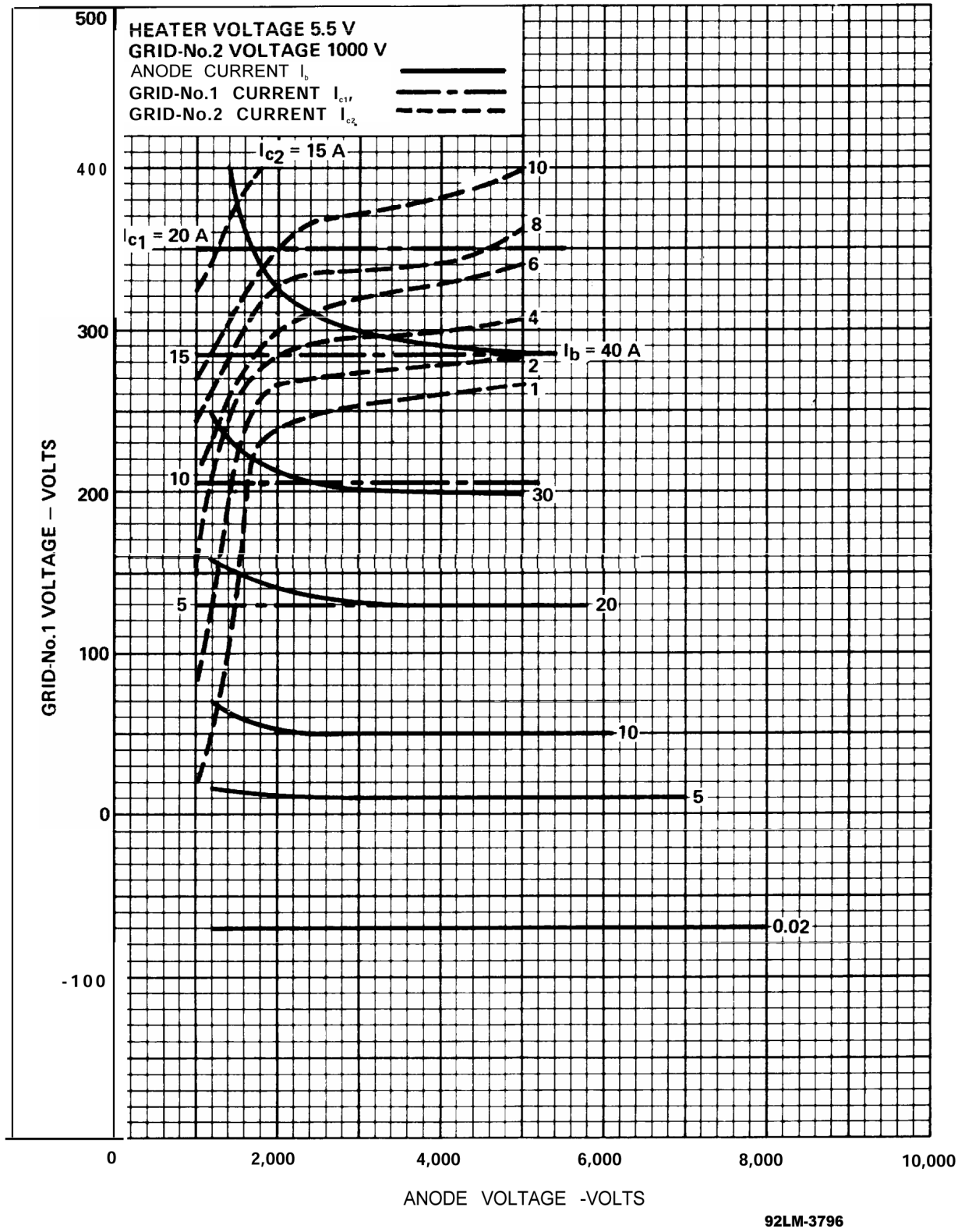

Figure 1 - **Typical Constant Current Characteristics**

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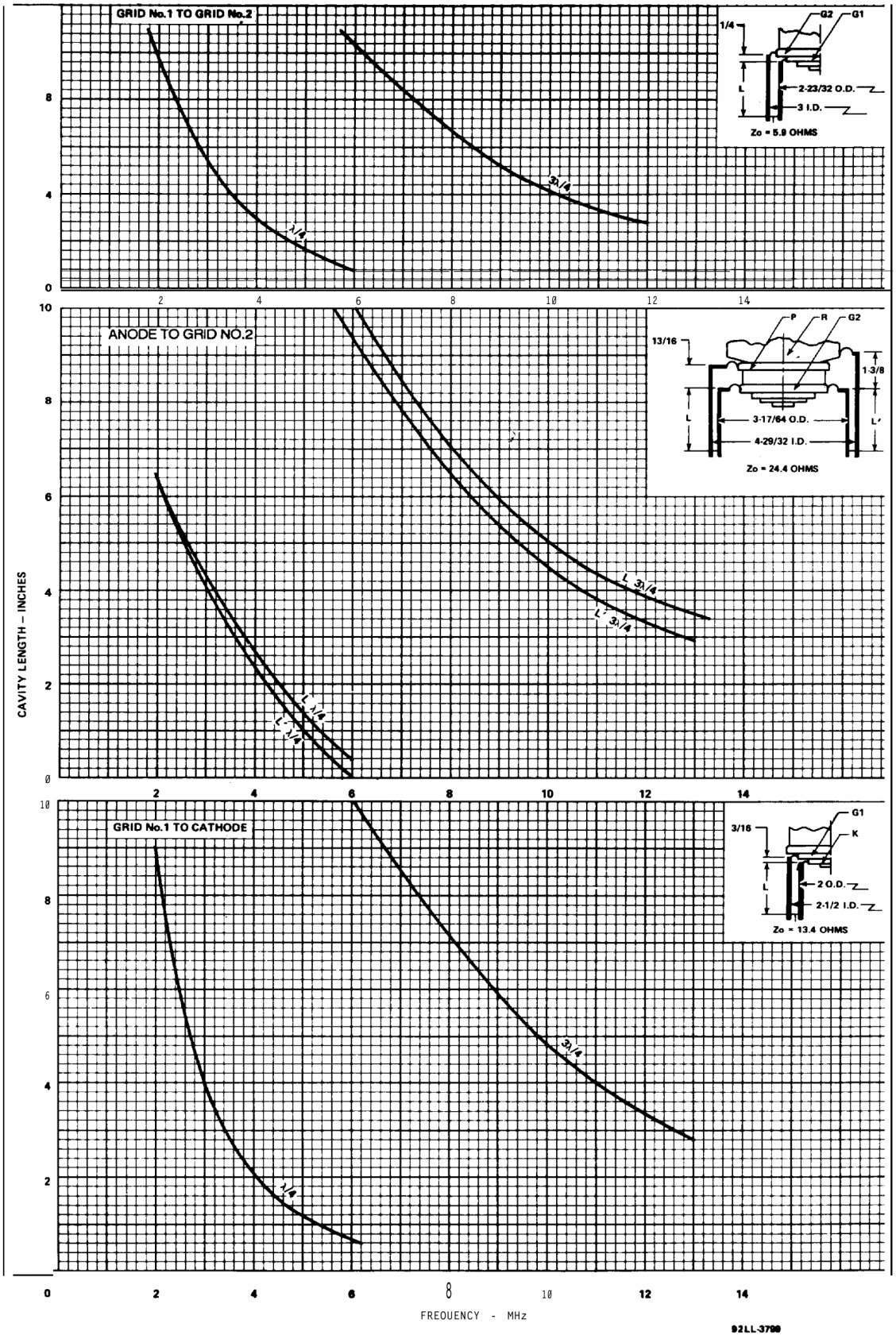
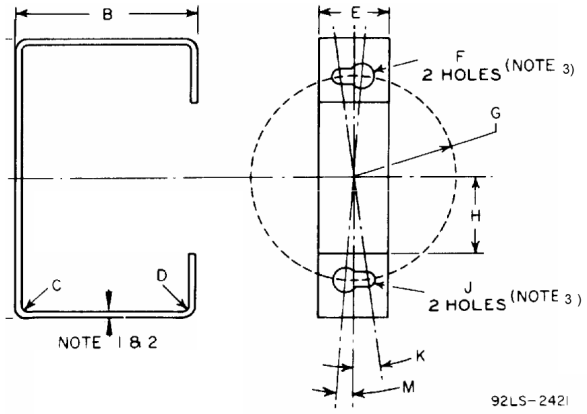


Figure 2 - **Tuning Characteristics**



Note 1 - Material 1/16” thick cold rolled steel
Note 2 - Round all edges
Note 3 - Slot between holes

Tabulated Dimensions

Dimensions	Millimeters	Inches
A	71	2.8
B	46	1.8
C Rad.	1.5	0.06
D Rad.	1.5	0.06
E	18	0.7
F Dia.	6.350	0.250
G Rad.	25.781	1.015
H	19	0.75
J Dia.	3.556	0.140
K		8.3º
M		4.5º

Figure 3 - **Tube Extractor**

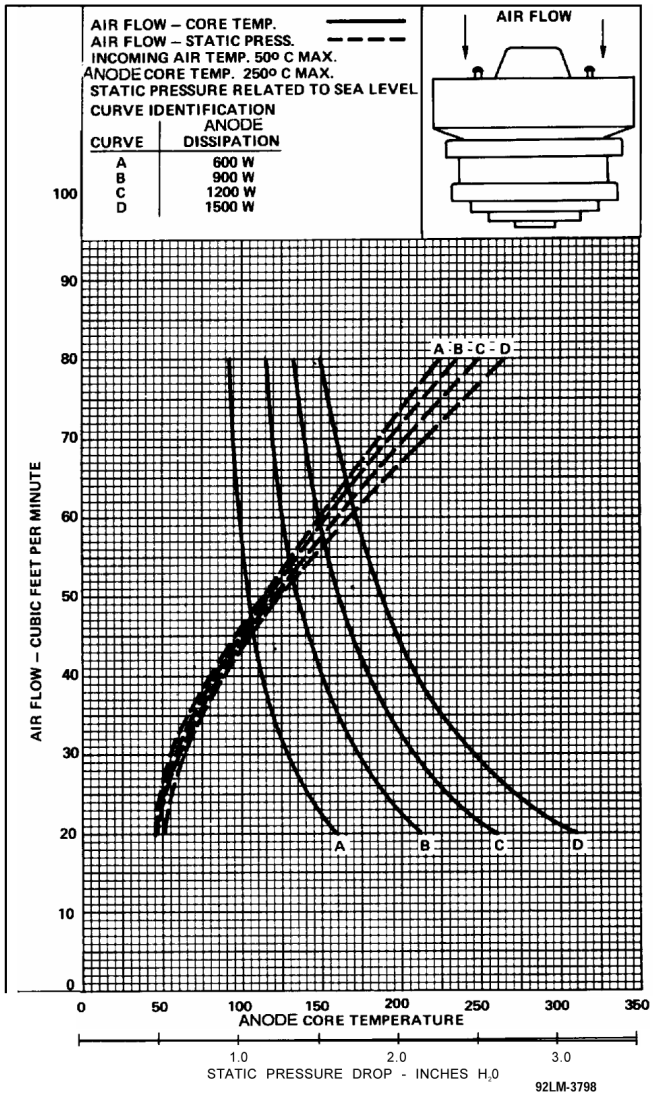


Figure 4 - Typical Cooling Characteristics

Warning - **Personal Safety Hazards**

Electrical Shock - Operating voltages applied to this device present a safety hazard.

X-Ray Warning - This device in operation produces x-rays which can constitute a health hazard unless the device is adequately shielded for radiation.

Radio Frequency Radiation - This device in operation produces radio frequency radiation which may be harmful to personnel.

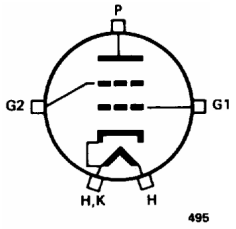


Figure 5 - **Terminal Diagram**

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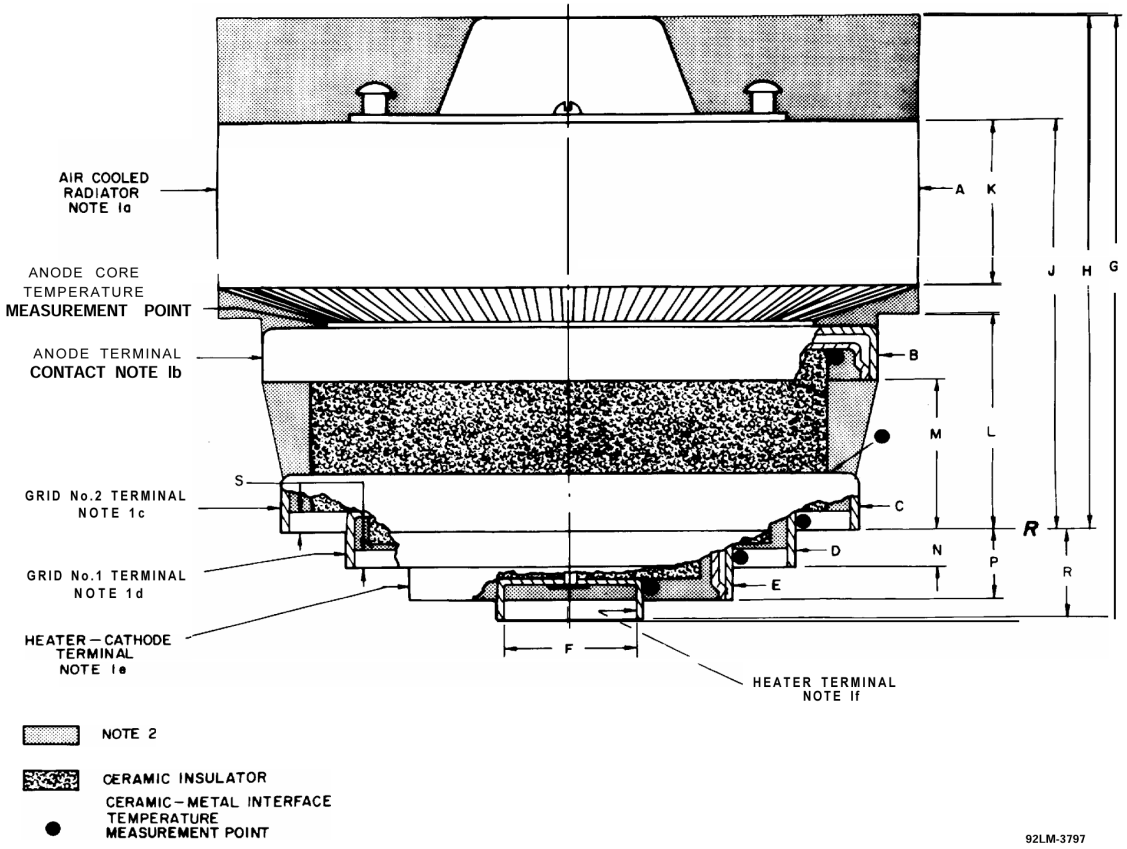

Tabulated Dimensions*

Dim.	Millimeters	Inches
A Dia.	94.52 ±.8	3.72 ±.03
B Dia.	81.53 Min.	3.210 Min.
C Dia.	76.45 Min.	3.010 Min.
D Dia.	58.46 Min.	2.307 Min.
E Dia.	43.43 Min.	1.710 Min.
F Dia.	18.42 Max.	0.725 Max.
G	82.3 ±2.5	3.24 ±.10
H	70.6 ±1.8	2.78 ±.07
J	55.6 ±1.0	2.19 ±.04
K	21.59 Min.	0.85 Min.
L	29.5 Ref.	1.16 Ref.
M	20.8 ±.8	0.82 ±.03
N	5.08 ±.51	0.20 ±.02
P	9.4 ±.8	0.37 ±.03
R	11.7 ±.8	0.46 ±.03
S	2.66 Min.	0.105 Min.

Note 1 - The contact distance* listed is the minimum, uniform, indicated length as measured from the edge of the terminal.

	Contact Distance	
1a. Radiator	0.850	(21.59)
1b. Anode Terminal	0.220	(5.59)
1c. Grid no.2 Terminal	0.220	(5.59)
1d. Grid no.1 Terminal	0.200	(5.08)
1e. Heater-Cathode Terminal	0.115	(2.92)
1f. Heater Terminal	0.135	(3.43)

Note 2 - Keep all stippled regions clear. In general do not allow contacts to protrude into these annular regions. If special connectors are required which may intrude on these regions, contact BURLE Power Tube Application Engineering, Lancaster, PA 17601.

* Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm).

Figure 6: Dimensional Outline