

8794 Power Tube

Linear Beam Power Tube

- CERMOLOX[®]
- 3000 Watts Peak Sync in Translator Service
- 10,000 Watts PEP Output in SSB Service
- Full Input to 400 MHz

The BURLE 8794 is intended specifically to meet the high linearity, high gain requirements of modern, reliable, SSB and translator linear amplifier equipments.

In a BURLE Y1266 (high-band) or Y1277 (low-band) VHF Amplifier Circuit, the 8794 can deliver 3000 watts of synchronizing peak-power output and 300 watts of aural power as a translator amplifier with a minimum of intermodulation product distortion with a 6 MHz bandwidth and 13 dB gain.

As a linear RF power amplifier in Single-Sideband Suppressed-Carrier Service, the tube can deliver 10 kW of peak-envelope power. Its sturdy, CERMOLOX construction and thoriated tungsten, mesh filament minimize tube inductances and feed-thru capacitances. Its coaxial, forced-air-cooled radiator reduces noise to a minimum and insures against spurious outputs. These features make possible the use of simple, economical, broadband circuit techniques in HF and VHF operation.

This data sheet gives application information unique to the BURLE 8794. It is to be used in conjunction with the publication, "Application Guide for BURLE Power Tubes", TP-105, for general application information for tubes of this type.

Additional information of a general nature applicable to tubes of this type is given in the following publications:

- TP-122 Screen-Grid Current, Loading, and Bleeder Considerations
- TP-117 Handling and Operating Considerations When Using BURLE Tetrodes
- TP-118 Application Guide for Forced Air Cooling of BURLE Power Tubes



Close attention to the instructions contained in these publications will assure longer tube life, safer operation, less equipment downtime and fewer tube handling accidents. For copies of these publications, contact your BURLE Representative or write BURLE INDUSTRIES INC., 1000 New Holland Avenue, Lancaster, PA 17601 -5688.

General Data Electrical

All voltages referenced to cathode, unless otherwise specified.
Filamentary Cathode:

Type	Thoriated-Tungsten Mesh	
Voltage ¹ (AC or DC)	5.7 typ.	V
	6.0 max.	V

Caution: For long-life expectancy, the filament voltage must be adjusted initially and throughout life as described in the procedure under **Operating Considerations, Filament Voltage Adjustment.**

Current:		
Typical value at 5.7 volts ²	116	A
Maximum value for starting even momentarily ¹⁹	300	A
Cold resistance	0.005	ohm
Recommended heating time		See Note 3
Mu-Factor ⁴ :		
Grid No.2 to grid No.1	10	
Direct Interelectrode Capacitances:		
Grid No.1 to plate ⁵	0.60	max. pF
Grid No.1 to filament	60	pF
Plate to filament ⁵	0.11	max. pF
Grid No.1 to grid No.2	85	pF
GridNo.2 to plate	13	pF
Grid No.2 to filament ⁶	3.3	max. pF



General Data (Cont'd)

Mechanical

Operating Attitude	Vertical, either end up
Overall Length	138.43 mm (5.45 in) max.
Greatest Diameter	156.72 mm (6.17 in) max.
Terminal Connections	See Dimensional Outline
Cavity:	
TV, low-band VHF	BURLE Y1277, or equivalent
TV, high-band VHF	BURLE Y1266, or equivalent
Socket	CD 89-088 ⁷ or equivalent
Chimney	8823 ⁷ or equivalent
Radiator	Integral part of tube
Weight (Approx.)	4.54 kg (10 lbs)

Thermal

Seal Temperature ⁸ (Plate, grid No.2, grid No.1, filament-cathode and filament)	250 max. °C
Plate-Core Temperature ^{8,9}	250 max. °C

Characteristic Range Values

Parameter	Min.	Max.	
Filament Current ¹⁰	106	126	A
Direct Interelectrode Capacitance:			
G ₁ to plate ⁵	-	0.60	pF
Plate to filament ⁵	-	0.11	pF
G ₂ to filament ⁶	-	3.3	pF
Cut-off G ₁ Voltage ^{10,11}	-	340	V
Grid-No.1 Voltage ^{10,12}	131	225	V

Linear RF Power Amplifier¹³

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:

	Up to 400 Mhz	
DC Plate Voltage ¹⁴	8000	V
DC Grid-No.2 Voltage ¹⁵	1650	V
DC Plate Current at Peak of Envelope	4.0	A
DC Grid-No.1 Current	500	mA
Grid-No.1 Input	50	W
Grid-No.2 Input ¹⁵	150	W
Plate Dissipation ¹⁸	10	kW

Maximum Circuit Values

Grid No. 1 Circuit Resistance Under Any Condition:	
With fixed bias	5000 ohms
With fixed bias (In Class AB ₁ operation)	25,000 ohms
With cathode bias	Not Recommended
Grid No.2 Circuit Impedance	See Note 15
Plate Circuit Impedance	See Note 14

Calculated Class AB, CCS Operation with "Two-Tone" Modulation

In a grid-drive circuit at 30 MHz		
DC Plate Voltage	7000	V
DC Grid-No.2 Voltage	1500	V
DC Grid-No.1 Voltage	-185	V
Zero-Signal DC Plate Current	1.3	A
Effective RF Load Resistance	960	ohms

DC Plate Current at Peak of Envelope	3.0	A
Average DC Plate Current	2.1	A
DC Grid-No.2 Current at Peak of Envelope	100	mA
Average DC Grid-No.2 Current	70	mA
Peak Envelope Drive Power	See Note 17	
Output Circuit Efficiency (Approx.)	95	%
Useful Power Output (Approx.):		
Average	5000	W
Peak envelope	10	kW

RF Power Amplifier-Class AB₁ Translator Service¹³

Synchronizing-level conditions per tube unless otherwise specified.

Maximum CCS Ratings, Absolute-Maximum Values

DC Plate Voltage ¹⁴	8000	V
DC Grid-No.2 Voltage ¹⁵	1650	V
DC Grid-No.1 Voltage ¹⁶	-450	V
DC Plate Current	4	A
Plate Dissipation ¹⁸	10,000	W
Grid-No.2 Input	150	W
Grid-No.1 Input	50	W

Typical Operation

VHF Translator Service

In a cathode-drive circuit with video RF drive at 80 MHz and a 1.0 dB bandwidth of 6.0 MHz min.

DC Plate Voltage	5500	V
DC Grid-No.2 Voltage	1000	V
DC Grid-No.1 Voltage	-150	V
DC Plate Current:		
Zero-signal	1.0	A
Full signal	2.0	A
DC Grid-No.2 Current (Approx.):		
Full signal	20	mA
DC Grid-No.1 Current (Approx.):		
Full signal	0	mA
RF Drive Power	150	W
RF Power Output:		
Sync peak level	3000	W
Aural	300	W
Power Gain, Including Circuit Losses	13	dB
Intermodulation:		
Product distortion	-52	dB
Harmonic content	-30	dB

1. Measured at the tube terminals. For accurate data the AC filament voltage should be measured using an accurate RMS type meter such as an iron-vane or thermocouple type meter. The DC voltage should be measured using a high input impedance type meter. For high-current, low-voltage filaments such as are used in this tube, it is recommended that the filament current be monitored, since very small changes in resistance can produce misleading changes in voltage. For maximum life, the filament power should be regulated at the lowest value that will give stable performance. If the tube is operated below maximum rated conditions, the

filament can safely be operated as low as 5.4 volts. For those applications where hum is a critical consideration, DC filament or hum-bucking circuits are recommended. See also Application Note TP-117.

2. The characteristic range of current at 5.7 volts is from 106 to 126 amperes. It is recommended that an additional six amperes be available to allow for the normal reduction of filament resistance with life. Thus, the filament supply should be designed for a mean value of 132 amperes at 5.7 volts.
3. The recommended heating time for maximum stability and longest life is 2 minutes or greater. The sequence of voltage application after filament warm-up is as follows: Grid No.1, Plate, Grid No.2, and RF drive.

Whenever turn on time is an important consideration and slightly shorter life is not objectionable, heating times as short as 15 seconds may be considered if the above voltage sequence is followed. Emergency filament heating time of 4 seconds followed by grid No.1, plate, grid No.2, RF drive may be considered; however, continued use of this mode of start-up will shorten the tube's life. In addition, grid No.1 voltage and RF drive must be changed proportionally to reduce plate current to 75% of its normal value for the first 15 seconds to prevent tripping the plate over current devices.

4. For plate voltage = 2000 V, grid-No.2 voltage = 1375V, peak plate current = 9.0 A.
5. With external flat metal shield 200 mm (8 in) in diameter having a center hole 76 mm (3 in) in diameter. Shield is located in plane of the grid-No.2 terminal, perpendicular to the tube axis, and is connected to grid No.2.
6. With external flat metal shield 200 mm (8 in) in diameter having a center hole 60mm (2-3/8 in) in diameter. Shield is located in plane of the grid-No.1 terminal, perpendicular to the tube axis, and is connected to grid No.1.
7. As manufactured by: Jettron Products Inc., 65 Route Ten, P.O. Box 337, East Hanover, NJ 07938.
8. See Dimensional Outline for Temperature Measurement Points. For good contact-finger life, a maximum temperature of 180° C at the terminal is recommended when using commercially-available beryllium-copper socket contacts.
9. The value of 250° C is the average of three readings taken 120° apart around the anode core. No one reading may exceed 300° C.
10. With 5.7 AC applied to the filament.

11. With DC plate voltage = 8000 V, DC grid-No.2 voltage = 1000 V, and the DC grid-No.1 voltage adjusted to 20 milliamperes plate current.
12. With DC plate voltage = 2000 V, DC grid-No.2 voltage = 1250 V, and the DC grid-No.1 voltage adjusted for a DC plate current = 1.0 A.
13. See TP-105. At the 3dB points, the maximum recommended θ is
50. A typical Q value for the BURLE Y1266 or Y1277 cavities would be 35.
14. See TP-105.

The maximum voltage ratings must be modified for operation at altitudes higher than sea level and for temperatures in excess of 22° C in accordance with the curves of Figure 1. For altitude derating of the plate voltage, use the voltage difference between plate and grid No.2.

The maximum fault energy that can be dissipated within the tube is approximately 20 joules. Therefore, the energy available for a high-voltage arc or fault must be limited to this value by means of current limiting resistors or fault-protection circuitry such as spark gaps and electronic "crow bars". This is especially important where high, stored energy and large capacitors are used. In typical 10 kW transmitters, the series resistors used are:

Plate -- Thirty ohm minimum is required in high capacitance power supplies for video service.

Grid No.2 -- Fifty ohms minimum.

Grid No.1 -- Fifty ohms.

For additional information see TP-105, "Application Guide for BURLE Power Tubes".

15. See TP-105 and TP-122. Protection devices such as spark gaps should be used.
16. See TP-105. Protection devices such as spark gaps or positive clamping diodes should be used.
17. Driver power output represents circuit losses and is the actual power measured at the input to grid-No.1 circuit. The actual power required depends on the operating frequency and the circuits used. The tube driving power is approximately zero watts.
18. Permitted plate dissipation is a function of cooling. For specific ratings see Forced Air Cooling information in this data sheet.
19. To limit filament surge current, a series resistor is recommended; the resistor can then be shorted after 15 seconds.

Operating Considerations

Safety Precautions

Protection circuits serve a threefold purpose: safety of personnel, protection of the tube in the event of abnormal circuit operation, and protection of the tube circuits in the event of abnormal tube operation.

Power tubes require mechanical protective devices such as interlocks, relays, and circuit breakers. Circuit breakers alone may not provide adequate protection in certain power-tube circuits when the power-supply, ripple filter, modulator, or pulse-forming network stores much energy. Additional protection may be achieved by the use of high-speed electronic circuits to bypass the fault current until mechanical circuit breakers are opened. These circuits may employ a spark gap or controlled gas tube, such as a thyratron or ignitron, depending on the amount of energy to be handled.

Great care should be taken during the adjustment of circuits. The tube and its associated apparatus, especially all parts which may be at high potential above ground, should be housed in a protective enclosure. The protective housing should be designed with interlocks so that personnel can not possibly come in contact with any high-potential point in the electrical system. The interlock devices should function to break the primary circuit of the high-voltage supplies and

discharge high-voltage capacitors when any gate or door on the protective housing is opened, and should prevent the closing of this primary circuit until the door is again locked.

The screen circuit requires special attention because the heating power of the current and voltage on this electrode is not the algebraic product of the current and voltage elements as observed at the terminal. For analysis of the circuit, review TP-122.

A time-delay relay should be provided in the grid-No.1 supply circuit to delay application of this voltage until the filament has reached normal operating temperature.

An interlocking relay system should be provided to prevent application of plate voltage prior to the application of sufficient bias voltage otherwise, with insufficient bias, the resultant high plate current may cause excessive plate dissipation with consequent damage to the tube. RF load shorts or other causes of high output VSWR may also cause high dissipations, excessive voltage gradients, or insulator flash-over. The load VSWR should be monitored and the detected signal used to actuate the interlock system to remove the plate voltage in less than 10 milliseconds after the fault occurs.

Filament-Voltage Adjustment

The life of the filament can be conserved by adjusting to the lowest filament supply voltage that will give the desired performance. Follow the filament voltage adjustment procedure below.

1. Before the application of any other voltages to a new tube, the filament voltage should be adjusted to 5.7 volts at the tube socket. A true RMS voltmeter should be used for accurate measurement. It may be more convenient to make the measurement at other contacts in the equipment, but the value will be higher because of increased impedance such as wire loss or contact resistance.
2. Apply voltages and adjust tuning controls as necessary for proper operation as described in the appropriate instruction manual.
3. Reduce the filament voltage in 0.1-volt increments repeating the procedures in Steps 1 and 2 until performance degradation is noted. Then increase the heater voltage 0.1 volt above this point. Typically depending upon the application, this voltage will be in the range of 5.5 to 5.7 volts.

During life when evidence is observed that a tube is becoming emission limited, increasing the filament voltage may extend the useful life of the tube. However, never increase filament voltage to compensate for a decrease in other circuit parameters such as RF drive or video modulating voltage.

Forced Air Cooling

Cooling air flow is necessary to limit the anode-core and terminal-seal temperatures to values that will assure long reliable life. A sufficient quantity of air should be directed past each of these terminals so that its temperature does not approach the absolute-maximum limit. The absolute-maximum temperature rating for this tube is 250° C. It is recommended that a safety factor of 25° to 50° be applied, to compensate for all probable system and component variations throughout life.

The cooling air must be delivered by the blower through the radiator and at the terminal seals during the application of power and for a minimum of three minutes after the power has been removed.

To Cathode-Filament and Filament Terminals A sufficient quantity of air should be blown directly at these terminals so that their temperature does not approach the absolute-maximum limit of 250° C. A value of at least 60 cfm is recommended.

The Cooling Characteristic Curve, **Figure 5**, indicates the air flow and pressure requirements of a system sufficient to limit the core temperature to specific values for various levels of plate dissipation.

Because the cooling capacity of air varies with its density, factors must be applied to the air flow to compensate for operation at altitude or in high temperature environments.

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

For further information on forced air cooling, see TP-105 and also TP-118, "Application Guide for Forced Air Cooling of BURLE Power Tubes".

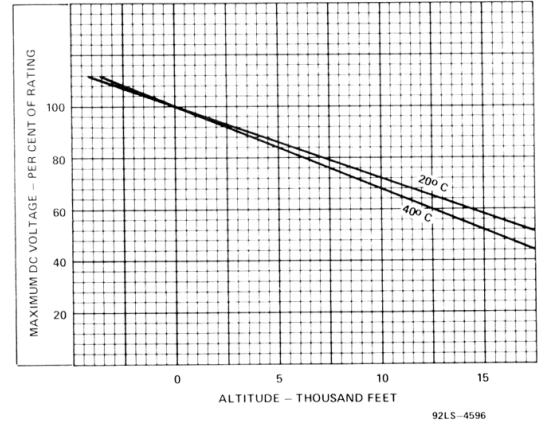


Figure 1 - Maximum DC Voltage vs Altitude

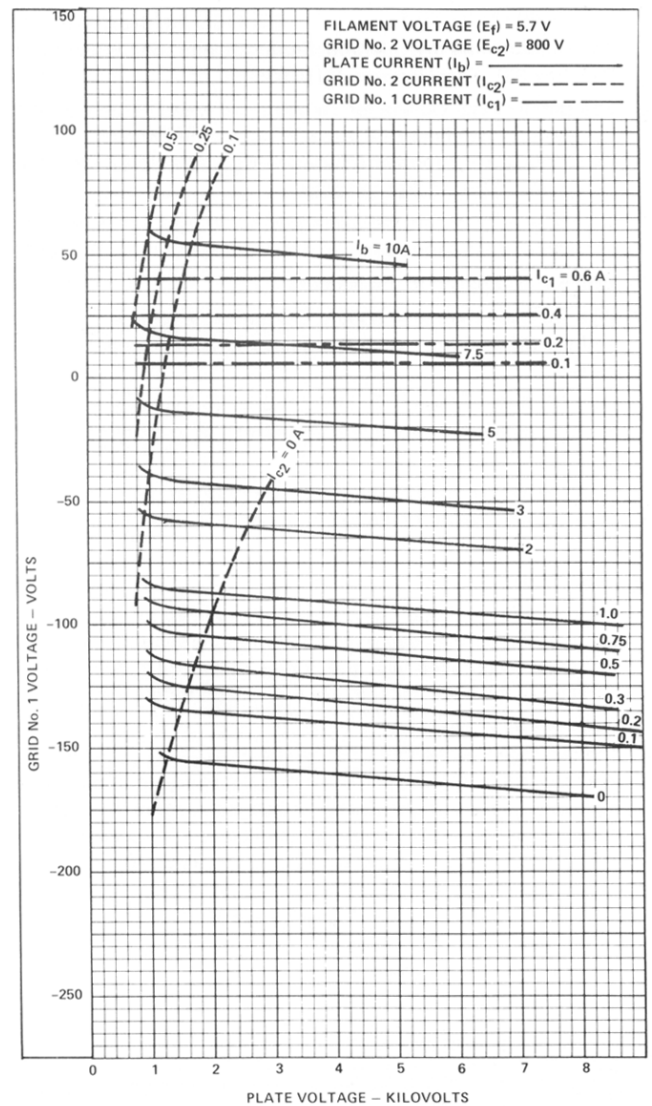


Figure 2 - Typical Constant Current Characteristics
Grid-No.2 Voltage = 800 V

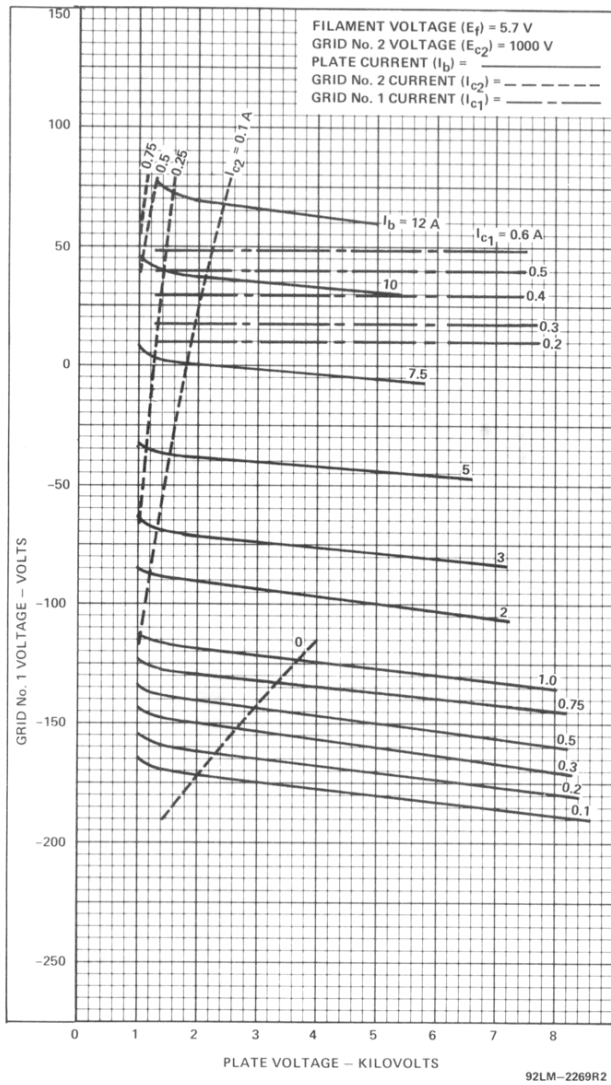


Figure 3 - Typical Constant Current Characteristics
Grid-No.2 Voltage = 1000 V

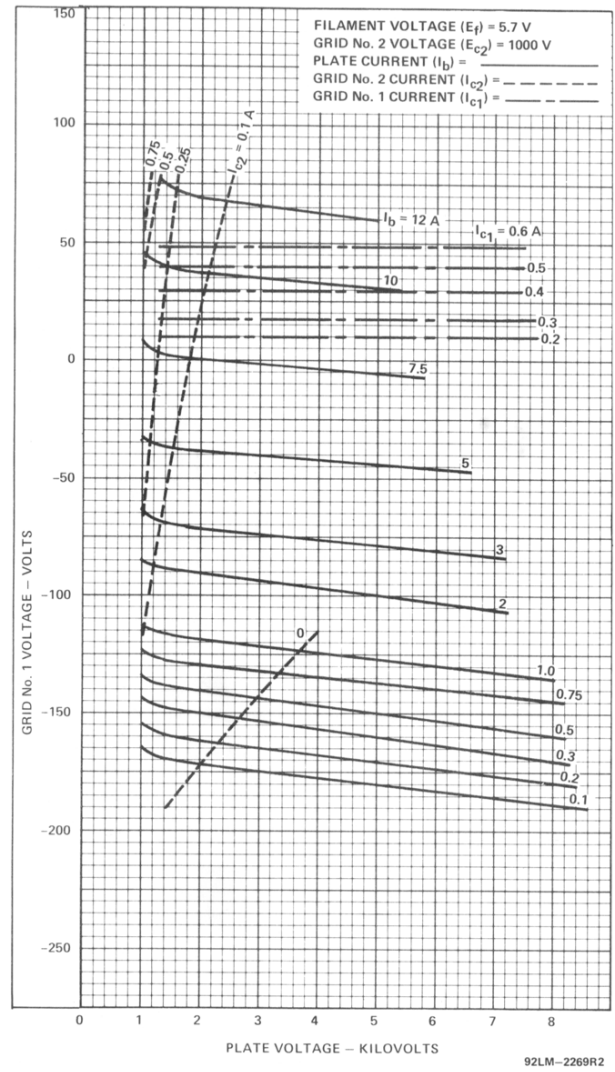


Figure 4 - Typical Constant Current Characteristics Grid-No.2
Voltage = 1500 V

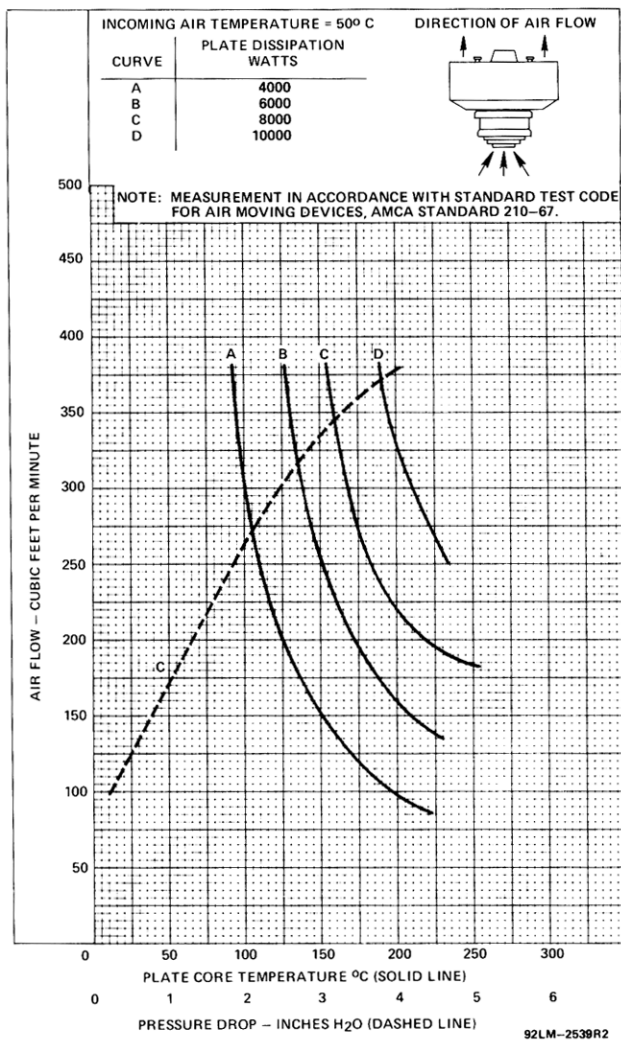


Figure 5 - Typical Cooling Characteristics

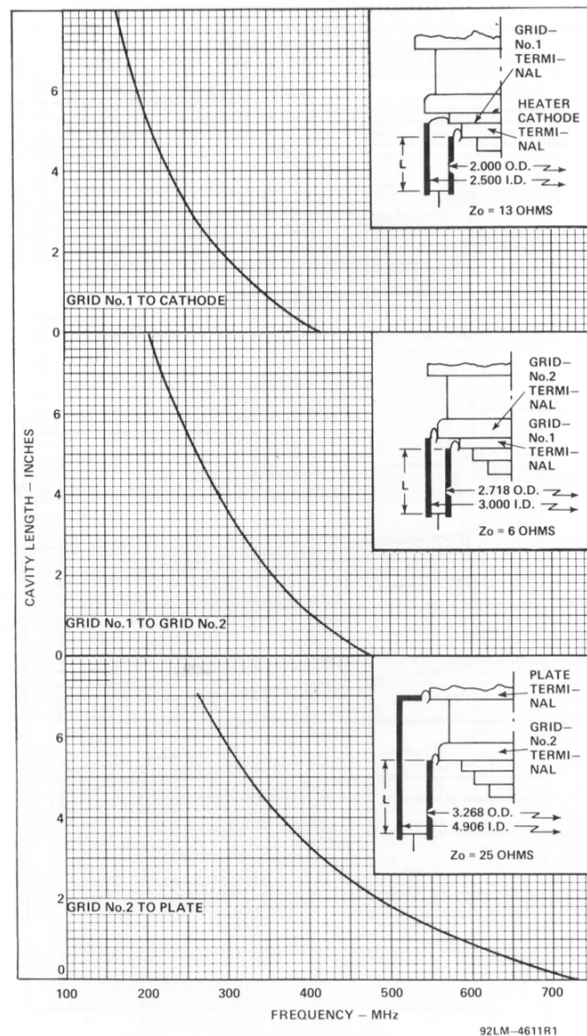


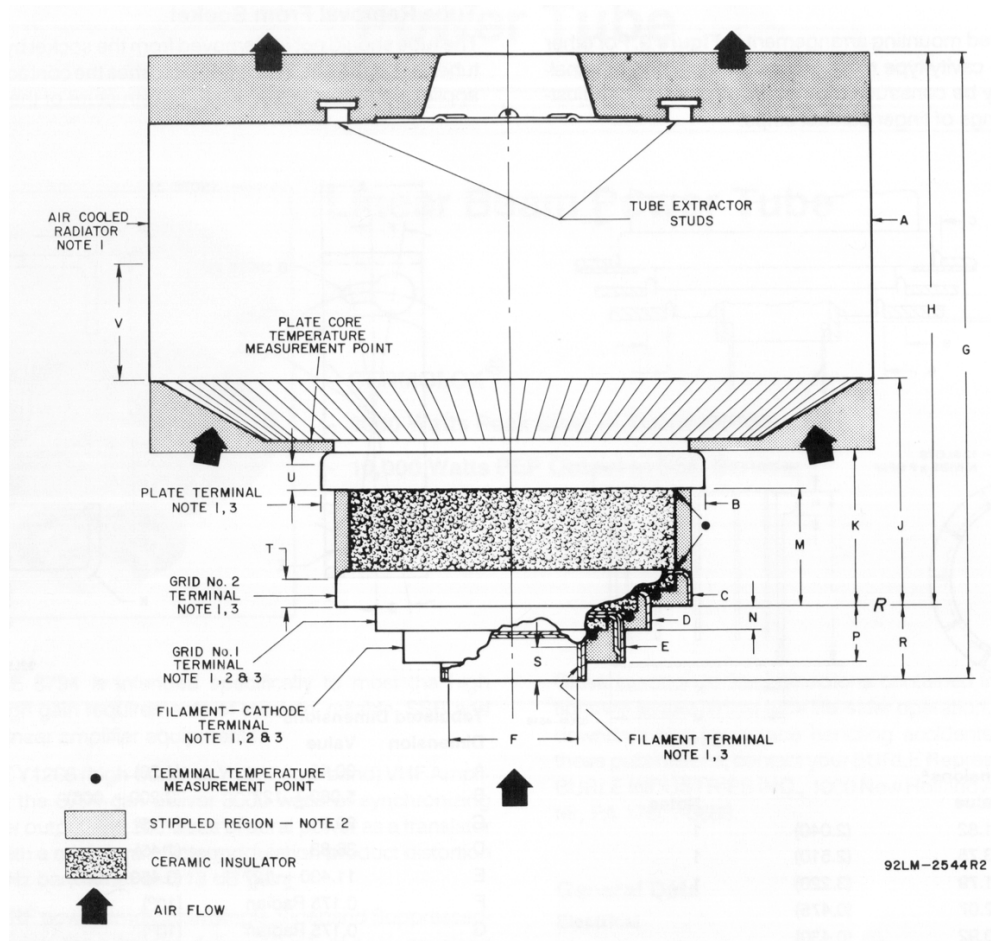
Figure 6 - Tuning Characteristics

Warning - Personal Safety Hazards

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

RF Radiation - This device in operation produces RF radiation which may be harmful to personnel.



92LM-2544R2

Tabulated Dimensions*

Dimension	Millimeters	Inches	Notes
A Dia.	155.83±88	6.135±.035	1,3
B Dia.	82.30±.25	3.240±.010	1,3
C Dia.	76.91±.36	3.028 ±.014	1,3
D Dia.	58.90±.30	2.319±.012	1,3
E Dia.	46.99±.25	1.850 ±.010	1,3
F Dia.	30.48±25	1.200±.010	1,3
G	136.4± 2.0	5.370±.080	
H	118.6±1.2	4.670±.050	
J	50.55± 1.01	1.990±.040	
K	35.05±.76	1.380+.030	
M	25.53+.51	1.005+.020	
N	5.08±.63	0.200+.025	
P	12.06±.76	0.475±.030	
R	16.51±.76	0.650+.030	
S	5.59 min.	0.220 min.	1
T	5.59 min.	0.220 min.	1
U	4.95 min.	0.195 min.	1
V	50.8 ref	2.000 ref	1

Note 1 - The diameter of each terminal is maintained only over the indicated minimum length of the contact surface.

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.

Note 3 - With the plate terminal and the cathode-filament terminal used as reference, the other terminals will measure less than 1.02mm (0.040 in) total indicator run-out (TIR).

Figure 7 - Dimensional Outline

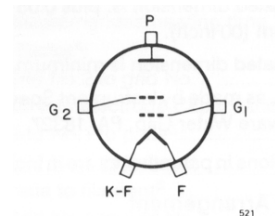
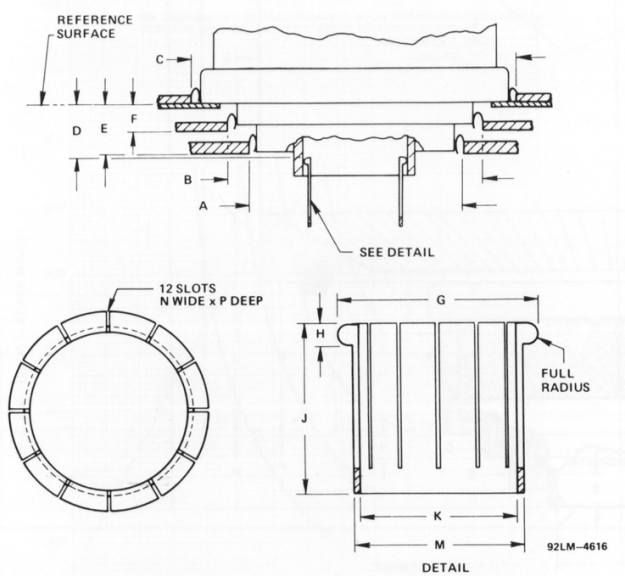


Figure 8 - Terminal Diagram

Mounting

See the preferred mounting arrangement in Figure 9. For other arrangements, cavity-type mounting for multiple-ring terminal-type tubes may be constructed by using either fixed or adjustable contact rings of finger contact strips.



Tabulated Dimensions*

Dimension	Value	Notes
A Dia.	51.82 (2.040)	1
B Dia.	63.75 (2.510)	1
C Dia.	81.79 (3.220)	1
D	12.07 (0.475)	
E	10.92 (0.430)	
F	5.46 (0.215)	
G Dia.	30.99 (1.220)	2
H	3.18 (0.125)	
J	25.40 (1.000)	3
K	20.32 (0.800)	
M	25.40 (1.000)	
N	1.58 (0.062)	
P	19.05 (0.750)	

Note 1 - The tolerance for the indicated dimension is: plus 0.25 mm (0.010 inch) -- minus 00 mm (00 inch).

Note 2 - The tolerance for the indicated dimension is: plus 0.05 mm (0.002 inch) -- minus 00 mm (00 inch).

Note 3 - The tolerance for the indicated dimension is minimum.

Note 4 - Finger stock is No.97-135A, as made by Instrument Specialities Co., P.O. Box A, Delaware Water Gap, PA 18327.

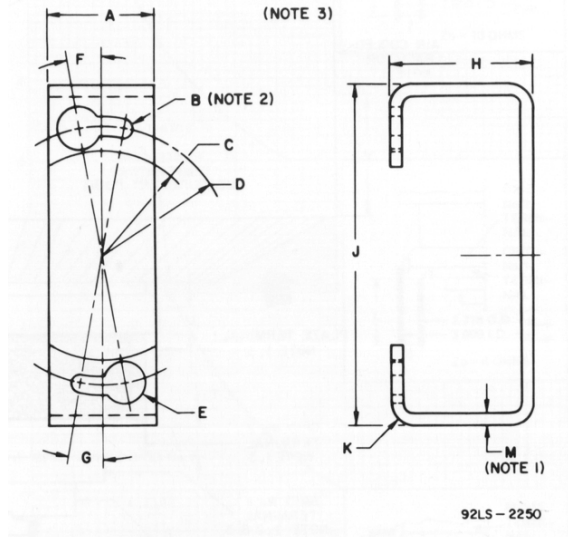
* Dimensions in millimeters. Dimensions in parentheses are in inches.

Figure 9 - Preferred Mounting Arrangement

Tube Removal From Socket

The tube should not be removed from the socket by rocking the

tube back and forth. This motion crushes the contact fingers and applies undue force to the internal structure of the tube.



Tabulated Dimensions*

Dimension	Value	Notes
A	30.48 (1.20)	
B	5.080 ± .127 (0.200 ± .005)	Dia.
C	29.21 (1.15)	Radius
D	36.83 (1.45)	Radius
E	11.430 ± .127 (0.450 ± .005)	Dia.
F	0.175 Radian (10°)	
G	0.175 Radian (10°)	
H	40.64 (1.60)	
J	96.52 (3.80)	
K	6.4 (1/4)	Radius
M	3.2 (1/8)	Radius

Note 1 - Material 1/8" thick cold rolled steel

Note 2 - Round all edges

Note 3 - Slot between holes

* Dimensions in millimeters. Dimensions in parentheses are in inches.

Figure 10 - Tube Extractor (Suggested Design)