

# 8791 Power Tube

## Linear Beam Power Amplifier Tube

- Ruggedized, Reliable
- 80 Watt Average-Noise-Power Output with White Noise Loading
- 250 Watt Power Output in VHF-Linear Translator Service
- 500 Watt PEP Output in SSB Suppressed-Carrier Service
- CERMOLOX® Power Tube
- Full Input to 400 MHz



The BURLE 8791 is designed specifically to meet the high linearity and low noise requirements of modern data transmission and communication systems. Its ruggedized construction makes it ideal for use in portable or mobile equipments.

The design linearity has been evaluated using Method 2206 of MIL-STD-1311. This method employs white noise with a Gaussian amplitude distribution to check the inherent distortion in power amplifiers over a broad operating spectrum. The 8791 tested better than the -40 dB specified for Government high-performance equipments for data transmission. This test checks the linearity for all methods of modulation both continuous (amplitude, frequency and phase) and also pulse (position, amplitude and duration).

The 8791 is also rated for SSB-suppressed carrier service where it can deliver up to 500 watts of peak envelope power at a third order intermodulation of -38 dB when tested with "Two Tone Modulation". It can also supply in excess of 200 watts of useful power output in linear telephony applications.

This bulletin gives application information unique to the BURLE 8791. General information covering the installation and operation of this tube type is given in the "Application Guide for BURLE Power Tubes", TP-105. 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 Type		
Voltage <sup>1</sup> (ac or dc).....	5.5	typ.	V
	6.6	max	V
Current at 5.5 volts.....	7.2		A
Minimum heating time.....	120		s
Mu-Factor, (Grid No.2 to grid No.1)..	13		
Direct Interelectrode Capacitances:			
Grid No.1 to plate <sup>2</sup> .....	0.11	max	pF
Grid No.1 to cathode & heater.....	30		pF
Plate to cathode & heater <sup>2</sup> .....	0.012	max	pF
Grid No.1 to grid No.2.....	38		pF
Grid No.2 to plate.....	5.5		pF
Grid No.2 to cathode & heater <sup>2</sup> .....	1.1	max	pF

#### Mechanical

Operating Attitude.....	Any
Overall Length.....	62.0 mm (2.44 in) max.
Greatest Diameter... ..	64.8 mm (2.55 in) max.
Terminal Connections.....	See Dimensional Outline
Sockets.....	See Mounting Arrangement
Radiator.....	Integral Part of Tube
Weight (Approx.).....	0.3 kg (3/4 lb)

#### Thermal

Seal Temperature <sup>3</sup> (plate, grid No.2, grid No. 1, cathode-heater and heater).....	250	max.	°C
Plate-Core Temperature <sup>3</sup> .....	250	max.	°C



**Linear RF Power Amplifier<sup>4</sup>**  
**Single-Sideband Suppressed-Carrier Service**  
**Maximum CCS Ratings, Absolute-Maximum Values**

Up to 400 MHz			
DC Plate Voltage <sup>4</sup> .....	3000		V
DC Grid-No.2 Voltage <sup>4</sup> .....	750		V
DC Plate Current at Peak of Envelope <sup>5</sup> .....	700		mA
Grid-No.2 Input <sup>4</sup> .....	25		W
Plate Dissipation.....	1000		W

**Maximum Circuit Values**

Grid-No.1 Circuit Resistance:			
With fixed bias.....	15000	ohms	
With cathode bias .....	Not recommended		
Plate Circuit Impedance.....	See note 4		
Grid-No.2 Circuit Impedance.....	See note 4		

**Typical Class AB<sub>1</sub> CCS Operation with "Two-Tone Modulation"**

At 30 Mc				
DC Plate Voltage.....	2000	2000	2500	V
DC Grid-No.2 Voltage.....	450	450	350	V
DC Grid-No.1 Voltage <sup>6</sup> .....	-34	-32	-26	V
Zero-Signal DC Plate Current...	250	250	200	mA
Effective RF Load Resistance..	1850	1850	2750	ohms
DC Plate Current at Peak of Envelope.....	535	545	430	mA
Average DC Plate Current.....	400	410	320	mA
DC Grid-No.2 Current at Peak of Envelope.....	-1.2	+0.2	-4.0	mA
Average DC Grid No. 2 Current.	-4.0	-4.0	-3.0	mA
Peak RF Grid-No.1 Voltage.....	30	40	22	V
Output-Circuit Efficiency (Approx.)	90	90	90	%
Distortion Products Level: <sup>7</sup>				
Third order.....	38 <sup>8</sup>	42	37 <sup>8</sup>	dB
Fifth order.....	48 <sup>8</sup>	54	53 <sup>8</sup>	dB
Unbypassed Cathode Resistor	0	10	0	ohms
Useful Power Output (Approx.):				
Average.....	250	250	250	W
Peak envelope.....	500	500	500	W

**VHF Power Amplifier**  
**Class B VHF-TV or Translator Service<sup>4</sup>**

Synchronizing level conditions per tube unless otherwise specified.

**Maximum CCS Ratings, Absolute-Maximum Values**

DC Plate Voltage <sup>4</sup> .....	3000		V
DC Grid No.2 Voltage <sup>4</sup> .....	750		V
DC Plate Current .....	0.5		A
Plate Dissipation.....	1000		W
Grid No.2 Input <sup>5</sup> .....	25		W

**Typical CCS Operation for Translator or Video Service**

In a cathode-drive circuit at 216 MHz and a -1.0 dB bandwidth of 6.0 MHz

	Translator	Video	
DC Plate Current:.....	2100	2300	V
DC Grid-No. 2 Voltage.....	450	450	V
DC Grid-No. 1 Voltage.....	-34	-37	V
DC Plate Current:			
Zero-signal .....	0.28	0.20	A
Sync peak level.....	-	0.47	A

**Translator Video**

Composite signal .....	0.5	-	A
DC Grid-No.2 Current (Approx.) <sup>4</sup> .....	0	-1	mA
(Pedestal Level)			
DC Grid-No.1 Current (Approx.) (Sync....	0	0	mA
Peak Level)			
RF Drive Power:			
Sync peak level.....	8	12	W
Typical Linearity.....	-52	-	dB
RF Power Output:			
Sync peak level.....	250	500	W
Power Gain, Including			
Circuit Losses.....	15	15	dB

**RF Power Amplifier & Oscillator - Class C**  
**Telegraphy<sup>4</sup> and RF Power Amplifier - Class C FM**  
**Telephony<sup>4</sup>**

**Maximum CCS Ratings, Absolute-Maximum Values**

Up to 400 MHz			
DC Plate Voltage <sup>4</sup> .....	2500		V
DC Grid-No.2 Voltage <sup>4</sup> .....	750		V
DC Grid-No.1 Voltage <sup>4</sup> .....	-250		V
DC Plate Current.....	500		mA
DC Grid-No.1 Current.....	100		mA
Grid-No.2 Input <sup>4</sup> .....	25		W
Plate Dissipation.....	700		W
Maximum Circuit Values			
Grid-No.1-Circuit Resistance.....	15000		ohms
Plate-Circuit Impedance.....			See note 4
Grid-No.2-Circuit Impedance.....			See note 4

**Typical CCS Operation in a Cathode Drive Circuit**

At 400 MHz			
DC Plate Voltage.....	2250	2500	V
DC Grid-No.2 Voltage.....	400	400	V
DC Grid-No.1 Voltage.....	-45	-35	V
DC Plate Current.....	450	500	mA
DC Grid No. 2 Current.....	1	8	mA
DC Grid No.1 Current.....	10	12	mA
Drive Power (Approx.) .....	30	35	W
Output Circuit Efficiency (Approx.).....	80	80	%
Useful Power Output.....	650	800	W

**Characteristic Range Values**

	Min.	Max.	Unit
Heater Current <sup>12</sup> .....	6.9	8.3	A
Direct Interelectrode Capacitances:			
Grid-No.1 to plate <sup>2</sup> .....	-	0.11	pF
Grid No.1 to cathode and heater..	27.5	31.6	pF
Plate to cathode and heater <sup>2</sup> .....		0.012	pF
Grid No.1 to grid No.2.....	34	41	pF
Grid No.2 to plate.....	4.5	6.0	pF
Grid No.2 to cathode and heater <sup>2</sup> .	-	1.1	
Reverse Grid-No.1 Current <sup>12,13</sup> .....	-	-50	uA
Peak Emission <sup>3,14</sup> .....	80	-	A
Interelectrode Leakage.....	8.0	-	Mohms
Resistance <sup>15</sup>			
Cutoff Grid-No.1 Voltage <sup>12,16</sup> .....	-	70	V

1. For maximum life expectancy, the heater-voltage must be adjusted initially and throughout life to the lowest value that will give the desired performance.
  - a. Before the application of any other voltages to a new tube, the heater voltage should be adjusted to 5.5 volts at the tube socket. A true RMS voltmeter should be used for accurate measurement.
  - b. Apply voltages and adjust tuning controls as necessary for proper operation as described in the appropriate instruction manual.
  - c. Reduce the heater voltage in 0.1-volt increments - repeating Step 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 4.8 to 5.5 volts.

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

2. With special shield adapter.
3. See Dimensional Outline for Temperature Measurement points.
4. See TP-105.
5. During short periods of circuit adjustment, under "Single Tone" conditions, the average plate current may be as high as 750 mA.
6. Adjust to specified zero-signal dc plate current.
7. Referenced to two equal tones.
8. Measured during open loop operation (no feedback or neutralization employed to enhance performance).
9. Measured across a 50 ohm grid-swamping resistor.
10. Third order IM, with three tone input signal which includes the aural carrier at -10 dB, the color sub-carrier at -17 dB, and the visual carrier at -8dB below the reference peak power level.
11. .Adjust for zero-signal dc plate current of 200 mA.
12. With 6.3 V ac or dc on heater.
13. With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a plate current of 240 mA.
14. For conditions with grid-No.1, grid-No.2, and plate tied together, and pulse voltage source of 850 peak volts, between plate and cathode. Pulse duration is 2 microseconds, pulse repetition frequency is 60 pps, and duty factor is 0.0012. Peak emission current is read after 1 minute.
15. 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 (except across heater terminals) is measured with a 200-volt Megger-type ohmmeter having an internal impedance of 1.0 megohm.

16. With dc plate voltage of 2500 volts, dc grid-No.2 voltage of 400 volts, and dc grid-No.1 voltage adjusted to give a plate current of 5 mA.

### Forced-Air Cooling

#### Air Flow:

Through radiator - Adequate air flow to limit the plate-core temperature 250° C should be delivered by a blower through the radiator before and during the application of heater, plate, grid-No.2, and grid-No.1 voltages. In typical operation at 750 watts plate dissipation and 200° C plate core temperature 12 cfm at 0.36 inch of water at 22° C ambient air temperature should be sufficient as shown on Air Flow Chart.

To Plate, 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.

**Figure 1 – Typical Cooling Characteristics**





