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\text{1}
- 570 Watts PEP Output at 30 MHz AB\text{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 Tubes 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)\text{1} 13.5 \pm 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:\text{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

\text{1} Voltage AC or DC refers to voltage applied to the tube under test after the heater has reached 13.5 volts.\text{2} \mu-Factor and direct capacitance refer to tests made using the recommended circuit and test procedures.
**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: \(300\) 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 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:**
  - 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: 10,000 ohms
- **Anode Circuit Impedance:** See Notes 4 and 6

### Typical CCS Operation at 30 MHz with “Two-Tone Modulation”:

<table>
<thead>
<tr>
<th>AB₁</th>
<th>AB₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2500</td>
</tr>
<tr>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>-35</td>
<td>-35</td>
</tr>
<tr>
<td>100</td>
<td>115</td>
</tr>
<tr>
<td>3050</td>
<td>3500</td>
</tr>
</tbody>
</table>

### Typical CCS Operation at Peak of Envelope:

- **DC Anode Current at Peak of Envelope:** 335 mA
- **Average DC Anode Current:** 250 mA

### 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:

<table>
<thead>
<tr>
<th>In Grid-Drive Circuit at 50 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DC Anode Voltage</strong></td>
</tr>
<tr>
<td><strong>DC Grid-No. 2 Voltage</strong></td>
</tr>
<tr>
<td><strong>DC Grid-No. 1 Voltage</strong></td>
</tr>
<tr>
<td><strong>DC Anode Current</strong></td>
</tr>
<tr>
<td><strong>DC Grid-No. 2 Current</strong></td>
</tr>
<tr>
<td><strong>DC Grid-No. 1 Current</strong></td>
</tr>
<tr>
<td><strong>Driver Power Output (Approx.)</strong></td>
</tr>
<tr>
<td><strong>Useful Power Output</strong></td>
</tr>
</tbody>
</table>

### 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 |

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b. Erie Specialty Products, 645 W. 11th St., Erie, PA 16512.
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

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Current</td>
<td>1.15</td>
<td>1.45</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No. 1 to plate</td>
<td>0.15</td>
<td>pF</td>
</tr>
<tr>
<td>Grid-No. 1 to cathode</td>
<td>14.8</td>
<td>pF</td>
</tr>
<tr>
<td>Plate to cathode</td>
<td>0.004</td>
<td>pF</td>
</tr>
<tr>
<td>Grid-No. 1 to grid-No. 2</td>
<td>20.0</td>
<td>pF</td>
</tr>
<tr>
<td>Grid-No. 2 to plate</td>
<td>6.3</td>
<td>pF</td>
</tr>
<tr>
<td>Grid-No. 2 to cathode</td>
<td>2.1</td>
<td>pF</td>
</tr>
<tr>
<td>Cathode to heater</td>
<td>2.5</td>
<td>pF</td>
</tr>
<tr>
<td>Grid-No. 1 Voltage</td>
<td>-8</td>
<td>volts</td>
</tr>
<tr>
<td>Reverse Grid-No. 1 Current</td>
<td>-25</td>
<td>mA</td>
</tr>
<tr>
<td>Grid-No. 2 Current</td>
<td>-5</td>
<td>+6</td>
</tr>
<tr>
<td>Peak Emission</td>
<td>13</td>
<td>- peak A</td>
</tr>
<tr>
<td>Interelectrode Leakage</td>
<td>0.50</td>
<td>* megohm</td>
</tr>
<tr>
<td>Zero Bias Anode Current</td>
<td>1.0</td>
<td>1.8</td>
</tr>
</tbody>
</table>

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.)


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°C 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 450°C 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
2. Screen-Grid Current Loading and Bleeder Considerations, TP-122

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

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

Figure 9 - Gauge Drawing JEDEC No. GE11 -1

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