Beam Power Tube

LESS THAN 1-SECOND WARM-UP FOR USE IN LOW-VOLTAGE MOBILE EQUIPMENT UP TO 500 Mc

COAXIAL-ELECTRODE STRUCTURE CERAMIC-METAL SEALS CONDUCTION COOLED

For Use as an RF Power Amplifier, Oscillator, Regulator, Distributed Amplifier, or Linear RF Power Amplifier in Mobile or Stationary Equipment

Electrical:

Filamentary Cathode, Woven-Wire-Mesh Type, Oxide-Coated:
Voltage (AC or DC) .................. 2.9 volts
Current at 2.9 volts .................. 4.6 amp
Minimum heating time ................ less than 1 sec
Mu-Factor, Grid No.2 to Grid No.1
for plate volts = 250, grid-No.2 -volts = 200, and plate amperes = 1.2 11

Direct Interelectrode Capacitances:
Grid No.1 to plate .................. 0.13 max. pf
Grid No.1 to cathode ................. 16 pf
Plate to cathode ................... 0.03 max. pf
Grid No.1 to grid No.2 .............. 22 pf
Grid No.2 to plate .................. 7 pf
Grid No.2 to cathode ................. 3 pf

Mechanical:
Operating Position .................. Any
Maximum Overall Length ................ 2.26"
Seated Length ...................... 1.920" ± 0.005"
Diameter ................................ 1.426" ± 0.010"
Weight (Approx.) ..................... 2 oz
Socket ............................. E. F. Johnson Co. No.124-311-100, Mycalex No.CP464-2, or equivalent
Grid-No.2 Bypass Capacitor .............................. E. F. Johnson Co. No.124-113-1, or equivalent
Base .......................... Large-Wafer Elevenar 11-Pin with Ring
(JEDEC No.E11-81)

Terminal Connections (See Dimensional Outline):
BOTTOM VIEW

Pin 1-Filament-Cathode
Pin 2-Grid No.2
Pin 3-Grid No.1
Pin 4-Same as Pin 1
Pin 5-No Internal Connection
Pin 6-No Internal Connection
Pin 7-Grid No.2
Pin 8-Grid No.1
Pin 9-Same as Pin 1
Pin 10-Grid No.2
Pin 11-Filament
Cap-Plate-Terminal Connection
Cylinder-Plate-Terminal Contact Surface
Ring* -Grid No.2 Terminal Contact Surface

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Harrison, N. J.

DATA 1
6-64
**Thermal:**

Terminal Temperature  
(All Terminals) . . . . . . . . . . . . . . . . 250 max. °C

Plate Core Temperature (See  

dimensional outline) . . . . . . . . . . . . . . 250 max. °C

Cooling, Conduction:

The plate terminal must be thermally coupled to a constant  
temperature device (heat sink—solid or liquid) to limit  
the plate terminal temperature to the specified maximum  
value of 250° C. The grid-No.2, grid-No.1, and filament  
terminals may also require coupling to the heat sink to  
limit their respective terminal temperature to the specified  
maximum value of 250° C.

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**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:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>2200 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>400 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-100 max. volts</td>
</tr>
<tr>
<td>DC Plate Current at Peak of Envelope</td>
<td>450 f max. ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>100 max. ma</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>1009 max. watts</td>
</tr>
<tr>
<td>Grid No.2 Input</td>
<td>8 max. watts</td>
</tr>
</tbody>
</table>

**Typical CCS Operation with "Two-Tone Modulation":**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>700 volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>250 volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-20 volts</td>
</tr>
<tr>
<td>Zero-Signal DC Plate Current</td>
<td>100 ma</td>
</tr>
<tr>
<td>Effective RF Load Resistance</td>
<td>1420 ohms</td>
</tr>
<tr>
<td>DC Plate Current at Peak of Envelope</td>
<td>205 ma</td>
</tr>
<tr>
<td>Average DC Plate Current</td>
<td>150 ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current at Peak of Envelope</td>
<td>16 ma</td>
</tr>
<tr>
<td>Average DC Grid-No.2 Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>Average DC Grid-No.1 Current</td>
<td>1.0j ma</td>
</tr>
<tr>
<td>Peak-Envelope Driver Power Output (Approx.)</td>
<td>0.3 watt</td>
</tr>
<tr>
<td>Output-Circuit Efficiency (Approx.)</td>
<td>95 %</td>
</tr>
<tr>
<td>Distortion Products Level:</td>
<td></td>
</tr>
<tr>
<td>Third order</td>
<td>30 db</td>
</tr>
<tr>
<td>Fifth order</td>
<td>35 db</td>
</tr>
<tr>
<td>Useful Power Output (Approx.):</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>40n watts</td>
</tr>
<tr>
<td>Peak envelope</td>
<td>80n watts</td>
</tr>
</tbody>
</table>
**Maximum Circuit Values:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Circuit Resistance Under Any Condition</td>
<td>25000 max. ohms</td>
</tr>
<tr>
<td>With fixed bias</td>
<td>25000 max. ohms</td>
</tr>
<tr>
<td>With fixed bias (in Class AB1 operation)</td>
<td>100000 max. ohms</td>
</tr>
<tr>
<td>With cathode bias</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Grid-No.2 Circuit Impedance</td>
<td>100 ohms</td>
</tr>
<tr>
<td>Plate Circuit Impedance</td>
<td></td>
</tr>
</tbody>
</table>

**RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy**

**RF POWER AMPLIFIER — Class C FM Telephony**

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>2200 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>400 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-100 max. volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>300 max. ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>100 max. ma</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>8 max. watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>100* max. watts</td>
</tr>
</tbody>
</table>

**Typical CCS Operation:**

**In Grid-Drive Circuit at 50 Mc**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>500 700 volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>160 175 volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-10 -10 volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>300 300 ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>25 25 ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>50 50 ma</td>
</tr>
<tr>
<td>Driver Power Output (Approx.)</td>
<td>1.2 1.2 watts</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>85n 110n watts</td>
</tr>
</tbody>
</table>

**In Grid-Drive Circuit at 175 Mc**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>500 700 volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>200 200 volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-30 -30 volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>300 300 ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>30 20 ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>40 40 ma</td>
</tr>
<tr>
<td>Driver Power Output (Approx.)</td>
<td>3 3 watts</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>70n 105n watts</td>
</tr>
</tbody>
</table>

**In Grid-Drive Circuit at 470 Mc**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>700 volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>200 volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-30 volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>300 ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>10 ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>20 ma</td>
</tr>
</tbody>
</table>
In Grid-Drive Circuit at 470 Mc

Driver Power Output (Approx.)... 5 watts
Useful Power Output ... 85 watts

Maximum Circuit Values:

Grid-No.1 Circuit Resistance
Under Any Condition:
  With fixed bias ... 25000 max. ohms
  Grid-No.2 Circuit Impedance ... 10000 max. ohms
  Plate Circuit Impedance ... p

The heating time required for adequate cathode emission is a function of the filament voltage and the impedance of the filament-voltage supply. It may be drastically reduced by employing a suitably designed overvoltage control circuit.

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 plate current may be as high as 450 ma.

Maximum plate dissipation is limited by the maximum plate core temperature and the cooling system to maintain tube operation below the specified maximum plate core temperature. With simple low-cost cooling techniques, maximum plate dissipation may be only about 100 watts; with more sophisticated cooling techniques, maximum plate dissipation may be as high as 300 watts.

Obtained preferably from a separate well-regulated source.

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.

Driver power output represents circuit losses and is the actual power measured at input to grid-No.1 circuit. The actual power required depends on the operating frequency and the circuit used. The tube driving power is approximately zero watts.

Referenced to either of the two tones, and without the use of feedback to enhance linearity.

This value of useful power is measured at load of output circuit.

The tube should see an effective plate supply impedance which limits the peak-current through the tube under surge conditions to 15 amperes.

Driver power output includes circuit losses and is the actual power measured at the input to the grid circuit. It will vary depending upon the frequency of operation and the circuit used.

<table>
<thead>
<tr>
<th>CHARACTERISTICS RANGE VALUES</th>
<th>Note</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Filament Current. ... 1</td>
<td>3.6</td>
<td>5.6</td>
<td>amp</td>
</tr>
<tr>
<td>2. Direct Interelectrode Capacitance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to plate. ... 2</td>
<td>0.13</td>
<td></td>
<td>pf</td>
</tr>
<tr>
<td>Grid No.1 to cathode. ... 2</td>
<td>14</td>
<td>18.5</td>
<td>pf</td>
</tr>
<tr>
<td>Plate to cathode. ... 2</td>
<td>0.03</td>
<td></td>
<td>pf</td>
</tr>
<tr>
<td>Grid No.1 to grid No.2. ... 2</td>
<td>18</td>
<td>24</td>
<td>pf</td>
</tr>
<tr>
<td>Grid No.2 to plate. ... 2</td>
<td>5.7</td>
<td>8.0</td>
<td>pf</td>
</tr>
<tr>
<td>Grid No.2 to cathode. ... 2</td>
<td>2.0</td>
<td>4.0</td>
<td>pf</td>
</tr>
<tr>
<td>3. Grid-No.1 Voltage ... 1,3</td>
<td>6</td>
<td>24</td>
<td>volts</td>
</tr>
<tr>
<td>4. Grid-No.2 Current ... 1,3</td>
<td>7</td>
<td>8</td>
<td>ma</td>
</tr>
</tbody>
</table>
Note 1: With 2.9 volts (AC or DC) on filament.
Note 2: Measured with special shield adapter.
Note 3: With dc plate voltage of 700 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 185 ma.

Dimensions in inches

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

- Plate terminal contact surface to grid-No.2 terminal contact surface: 0.030"
- Plate terminal contact surface to pin circle: 0.040"
- Grid-No.2 terminal contact surface to pin circle: 0.030"

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.
TYPICAL PLATE CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 400 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 400
GRID-No.1 VOLTS = $E_{C1}$

PLATE AMPERES

PLATE VOLTS

92CM-12225
TYPICAL PLATE CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 250 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 250
GRID-No.1 VOLTS = E_c1

PLATE AMPERES

PLATE VOLTS
2000
1500
1000
500

20
16
12
10
8
6
4
0

92CM-12228

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TYPICAL PLATE CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 150 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 150
GRID-No.1 VOLTS = EC1
TYPICAL CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 400 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 400
GRID-No.1 VOLTS = EC1
IC1 =
IC2 =

PLATE VOLTS

GRID-No.1 (IC1) OR GRID-No.2 (IC2) MILLIAMPERES

0 200 400 600 800

100 200 300 400 500

+5 +10 +15 +20

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TYPICAL CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 250 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 250
GRID-No.1 VOLTS = E_G1
I_C1 = ——
I_C2 = ——

GRID-No.1(I_C1) OR GRID-No.2 (I_C2) MILLIAMPERES

PLATE VOLTS

92CM-12229
TYPICAL CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 150 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 150
GRID-No.1 VOLTS = ECI
IC1 =
IC2 =
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 400 Volts

FILAMENT VOLTS=2.9
GRID-No.2 VOLTS=400
PLATE AMPERES=$I_b$
GRID-No.2 AMPERES=$I_{C2}$
GRID-No.1 AMPERES=$I_{C1}$
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 250 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 250
PLATE AMPERES = I_p =
GRID-No.2 AMPERES = I_c2 =
GRID-No.1 AMPERES = I_c1 =

GRID-No.1 VOLTS

PLATE VOLTS

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TYPICAL CONSTANT-CURRENT CHARACTERISTICS
At a Constant Grid-No.2 Voltage of 150 Volts

FILAMENT VOLTS = 2.9
GRID-No.2 VOLTS = 150
PLATE AMPERES = I_p
GRID-No.2 AMPERES = I_c2
GRID-No.1 AMPERES = I_c1