Beam Power Tube

FORCED-AIR COOLED HIGH GAIN-BANDWIDTH PRODUCTS
INTEGRAL RADIATOR 10000 WATS CW POWER OUTPUT
THORIATED-TUNGSTEN MESH FILAMENT AT 400 Mc

For Compact Aircraft, Mobile, and Stationary Equipment Applications in the UHF Frequency Range

Electrical:

Filamentary Cathode, Thoriated-Tungsten Cylindrical-Mesh Type:
Voltage (AC or DC) ................ 8.5 typ. volts
........................................ 9.0 max. volts

Current:
  Typical value at 8.5 volts .......... 88 amp
  Maximum value for start-
ing, even momentarily .......... 300 amp
  Minimum heating time .......... 15 sec

Mu-Factor, Grid No.2 to
  Grid No.1 for plate volts
  = 7000, grid-No.2 volts
  = 1350, and plate ma. = 500 .... 30

Direct Interelectrode Capacitances:
  Grid No.1 to plate a .......... 0.4 max. pf
  Grid No.1 to filament .......... 86 pf
  Plate to filament a .......... 0.07 max. pf
  Grid No.1 to grid No.2 .......... 88 pf
  Grid No.2 to plate .......... 20 pf
  Grid No.2 to filament a .......... 1.5 max. pf

Mechanical:

Operating Position ................ Any
Maximum Overall Length .............. 6.188"
Maximum Diameter .................. (See Dimensional Outline) 6.170"
Weight (Approx.) .................. 12 lbs.
Radiator ................................ Integral part of tube

Terminal Connections (See Dimensional Outline):

G1 = Grid-No.1-
  Terminal
  Contact
  Surface
G2 = Grid-No.2-
  Terminal
  Contact
  Surface
F = Filament-
  Terminal
  Contact
  Surface
K = Cathode-
  Filament
  Terminal
  Contact
  Surface
P = Plate-
  Terminal
  Contact
  Surface
Thermal:
Terminal Temperature (Plate, grid No.2, grid No.1, cathode-filament, and filament) ........ 250 max. °C
Plate-Core Temperature ................ 250 max. °C
Air Flow:
Through radiator — Adequate air flow to limit the plate-core temperature to 250° C should be delivered by a blower through the radiator before and during the application of filament, plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator are shown in accompanying Typical-Cooling-Requirements curve as a function of plate dissipation.

To Plate, Grid-No.2, Grid-No.1, Cathode-Filament, and Filament 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 to the Cathode-Filament and Filament Terminals when only filament voltage is applied to the tube.

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

At Sea Level — Cooling requirements as shown in accompanying Typical-Cooling-Requirements curve, may be met by use of the following blowers and associated motors manufactured by Rotron Mfg. Co., Inc., Woodstock, N.Y., or equivalent:

For 100% Plate Dissipation:
Blower Model No. AS-704 KS-704 - PS-606
Motor Model No. 255JS 452AS - 209JS
Phase (φ) 3 1 3
Frequency (cps) 60 60 400
Voltage (v) 208 115 -

For 80% Plate Dissipation:
Blower Model No. AS-601 KS-601 PS-4502 PS-4502
Motor Model No. 266JS 413AS 358AS 209JS
Phase (φ) 3 1 1 3
Frequency (cps) 60 60 400 400
Voltage (v) 208 115 115 115

For 60% Plate Dissipation:
Blower Model No. AS-4506 KS-4506 PS-3503 NS-301
Motor Model No. 139JS 364AS 450AS 587JS
Phase (φ) 3 1 1 3
Frequency (cps) 60 60 400 400
Voltage (v) 208 115 115 115

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy

RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCSb Ratings, Absolute-Maximum Values:
For frequencies up to 500 Mc
DC Plate Voltage ............... 7000 max. volts
DC Grid-No.2 Voltage ............ 1500 max. volts
<table>
<thead>
<tr>
<th>DC Grid-No.1 Voltage</th>
<th>-150 max. volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Current</td>
<td>4 max. amp</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>1.2 max. amp</td>
</tr>
<tr>
<td>Grid-No.1 Input&lt;sup&gt;c&lt;/sup&gt;</td>
<td>150 max. watts</td>
</tr>
<tr>
<td>Grid-No.2 Input&lt;sup&gt;c&lt;/sup&gt;</td>
<td>300 max. watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>10000 max. watts</td>
</tr>
</tbody>
</table>

**Typical CCS Operation:**

*In Cathode-Drive Circuit at 400 Mc*

<table>
<thead>
<tr>
<th>DC Plate Voltage</th>
<th>6500 volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Grid-No.2 Voltage&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1200 volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-90 volts</td>
</tr>
<tr>
<td>DC Grid Current</td>
<td>3.5 amp</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>0.05 amp</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>0.53 amp</td>
</tr>
<tr>
<td>Driver Power Output&lt;sup&gt;f&lt;/sup&gt; (Approx.)</td>
<td>600 watts</td>
</tr>
<tr>
<td>Output-Circuit Efficiency</td>
<td>78 %</td>
</tr>
<tr>
<td>Useful Power Output</td>
<td>10000 watts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

<table>
<thead>
<tr>
<th>Grid-No.1-Circuit Resistance</th>
<th>5000 max. ohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.2-Circuit Impedance g</td>
<td>h</td>
</tr>
<tr>
<td>Plate-Circuit Impedance</td>
<td>h</td>
</tr>
</tbody>
</table>

<sup>a</sup> See Characteristics Range Values, Test No.2.

<sup>b</sup> Continuous Commercial Service.

<sup>c</sup> Grid Input represents the power dissipated in the grid electrode. The grid input is not necessarily the product of the dc grid voltage and the "metered" grid current. For example, see Grid No.2 under Operating Considerations.

<sup>d</sup> Obtained from a fixed supply.

<sup>e</sup> Obtained from a grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

<sup>f</sup> The driver stage is required to supply tube losses and rf circuit losses. It should be designed to provide an excess of power above the indicated values to take care of variations in line voltage, components, initial tube characteristics, and tube characteristics during life.

<sup>g</sup> See Grid No.2 under Operating Considerations.

<sup>h</sup> See Plate under Operating Considerations.

### CHARACTERISTICS RANGE VALUES

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Note</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Filament Current</td>
<td></td>
<td>1</td>
<td>84</td>
</tr>
<tr>
<td>2. Direct Interelectrode Capacitances</td>
<td></td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Grid No.1 to plate</td>
<td></td>
<td>-</td>
<td>78</td>
</tr>
<tr>
<td>Grid No.1 to filament</td>
<td></td>
<td>2,3</td>
<td>-</td>
</tr>
<tr>
<td>Plate to filament</td>
<td></td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td>Grid No.1 to grid No.2</td>
<td></td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td>Grid No.2 to plate</td>
<td></td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Grid No.2 to filament</td>
<td></td>
<td>1,4</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note 1:** With 8.5 ac volts on filament.

**Note 2:** With external flat metal shield 8" in diameter having a center hole 4" 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.
Note 3: With external flat metal shield 8" in diameter having a center hole 3-3/8" 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.

Note 4: With dc plate voltage of 3750 volts, dc grid-No.2 voltage of 1200 volts, and instantaneous grid-No.1 voltage adjusted to give peak plate current of 10 amperes.

OPERATING CONSIDERATIONS

Filament

The rated filament voltage of 9.5 volts should be applied for 15 seconds to allow the cathode to reach normal operating temperature before voltages are applied to other electrodes.

The life of the cathode can then be conserved by adjusting to the lowest nominal filament supply voltage which will give the desired performance. Good regulation of the filament supply voltage about this value is, in general, economically advantageous from the viewpoint of tube life. The supply regulation should not exceed ±5%. This recommendation is particularly applicable at the higher operating frequencies.

Temperature

The maximum plate core or terminal temperature of 250° C is a tube rating and is to be observed in the same manner as other ratings. The temperature may be measured with temperature-sensitive paint, such as Tempilag. This paint is manufactured in the form of liquid or stick by the Tempil Corporation, 132 W. 22nd Street, New York 11, N.Y.

Grid No.2

Grid-No.2 current is composed of a positive-current component resulting from cathode emission to grid No.2 and a negative-current component resulting from secondary-emission phenomena. Because it is the net result of these component currents which is read on a meter in the grid-No.2 circuit, grid-No.2 dissipation can not be accurately determined. Operation similar to conditions given under Typical Operation in the tabulated data section will minimize the possibility of exceeding maximum grid-No.2 input rating.

The grid-No.2 circuit must be capable of maintaining the proper grid-No.2 voltage in the presence of moderate negative dc current as well as normal values of positive current. Complete protection can be achieved by the use of a well-regulated power supply, a grid-No.2-to-ground impedance that is low enough to prevent gradual build-up of grid-No.2 voltage and/or catastrophic build-up in runaways under negative-current conditions, and a current-overload relay to protect the grid No.2 against positive or negative currents of the order of one-tenth the required plate current.

Plate

In beam power tubes with closely spaced electrodes, such as the 8437, extremely high voltage gradients occur even with moderate tube operating voltages. Any arc-over between elec-
neurodes may be destructive. A series impedance in the plate lead is recommended. The resultant plate impedance giving a plate-voltage-supply regulation of no better than 10% is usually sufficient.

Standby Operation

During long or frequent standby periods, the 8437 may be operated at decreased filament voltage to conserve life. It is recommended that the filament voltage be reduced to 80% of normal during standby periods up to 2 hours. For longer periods, the filament voltage should be turned off.

Precautions

Protective devices should be used to protect the plate and grid No.2 against overload. Excessive plate-current flow and resultant over-heating of the tube can be prevented by connection of the common ground lead of the plate circuit in series with the coil of an instantaneous overload relay. This relay should be adjusted to remove the dc plate voltage and dc grid-No.2 voltage when the average value of plate current reaches a value slightly higher than normal plate current. A protective device in the grid-No.2 supply should remove the grid-No.2 voltage when the dc grid-No.2 current reaches a value slightly higher than normal.

The rated plate and grid-No.2 voltages of this tube are extremely dangerous. 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 device should function to break the primary circuit of the high-voltage supplies when any gate or door of the protective housing is opened, and should prevent the closing of the primary circuit until the door is again locked.
NOTE 1: SEE SKETCH G1 FOR THE MAXIMUM DIAMETRICAL SPACE REQUIRED BY THE 8437 BASED UPON THE DIAMETER AND ECCENTRICITY OF RADIATOR BAND AND OF EACH RING TERMINAL.


NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR REGIONS.
SKETCH GI

OPENING FOR:

RADIATOR
6.240 DIA.

PLATE TERMINAL
4.238 DIA.

GRID-No. 2 TERMINAL
3.960 DIA.

GRID-No. 1 TERMINAL
3.335 DIA.

FILAMENT-CATHODE TERMINAL
2.730 DIA.

FILAMENT TERMINAL (INNER)
1.935 DIA.

FILAMENT TERMINAL (OUTER)
2.130 DIA.

DIMENSIONS IN INCHES
NOTE 1: FINGER STOCK No.97-310.
NOTE 2: FINGER STOCK No.97-139.
NOTE 3: SPECIFIED FINGER STOCK IS MADE BY INSTRUMENT SPECIALTIES CO., LITTLE FALLS, N.J.
TYPICAL COOLING REQUIREMENTS

INCOMING AIR TEMPERATURE — 24°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>PLATE DISSIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4000</td>
</tr>
<tr>
<td>B</td>
<td>6000</td>
</tr>
<tr>
<td>C</td>
<td>8000</td>
</tr>
<tr>
<td>D</td>
<td>10000</td>
</tr>
</tbody>
</table>

DIRECTION OF AIR FLOW

AIR FLOW — CUBIC FEET PER MINUTE

ANODE CORE TEMPERATURE °C (SOLID LINE)

PRESSURE DROP IN INCHES OF WATER (DASHED LINE)

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.

DATA 5
10-63
TYPICAL PLATE CHARACTERISTICS

FILAMENT VOLTS = 8.5
GRID-No.2 VOLTS=1200
GRID-No.1 VOLTS=$E_C$
TYPICAL CHARACTERISTICS

FILAMENT VOLTS = 8.5
GRID-No.2 VOLTS = 1200
GRID-No.1 VOLTS = EC1
IC1
IC2

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

PLATE VOLTS

92CM-12/01R1
TYPICAL CONSTANT-CURRENT CHARACTERISTICS

FILAMENT VOLTS = 8.5
GRID-No. 2 VOLTS = 1200
IC1 = GRID-No. 1 AMPERES
IC2 = GRID-No. 2 AMPERES
IB = PLATE AMPERES

GRID-No. 1 VOLTS

PLATE VOLTS

92CM-12/03R1