Beam Power Tube

CERMOLOX®

FORCED-AIR COOLED  HIGH GAIN-BANDWIDTH PRODUCTS
INTEGRAL RADIATOR  340 WATTS CW POWER OUTPUT AT 400 Mc
MATRIX-TYPE CATHODE  105 WATTS CW POWER OUTPUT AT 1215 Mc

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

GENERAL DATA

Electrical:

Heater, for Matrix-Type, Oxide-Coated, Unipotential Cathode:
Voltage (AC or DC)\textsuperscript{a} .................................. 6.3 volts
Current at heater volts = 6.3 .................................. 3.2 amp
Minimum heating time ........................................... 60 sec

Mu-Factor, Grid No.2 to Grid No.1
for plate volts = 250, grid-No.2
volts = 250, and plate ma. = 100, ........ 18

Direct Interelectrode Capacitances:\textsuperscript{b}
Grid No.1 to plate ............................................. 0.065 max. pf
Grid No.1 to cathode & heater ......................... 15 pf
Plate to cathode & heater ................................. 0.019 max. pf
Grid No.1 to grid No.2 .................................... 20 pf
Grid No.2 to plate ............................................. 3.2 pf
Grid No.2 to cathode & heater ......................... 1.39 max. pf

Mechanical:

Operating Position .............................................. Any
Overall Length .................................................. 2.620" ± 0.090"
Greatest Diameter (See Dimensional Outline) ........... 1.625" ± 0.015"
Weight (Approx.) ................................................ 4 oz

Radiator ........................................................ Integral part of tube

Terminal Connections (See Dimensional Outline):

\begin{align*}
G_1 - \text{Grid-No.1} - & \\
\text{Terminal} & \\
\text{Contact} & \\
\text{Surface} & \\
G_2 - \text{Grid-No.2} - & \\
\text{Terminal} & \\
\text{Contact} & \\
\text{Surface} & \\
H - \text{Heater} - & \\
\text{Terminal} & \\
\text{Contact} & \\
\text{Surface} & \\
\end{align*}

\begin{align*}
H, K - \text{Heater- &} & \\
\text{Cathode-} & \\
\text{Terminal} & \\
\text{Contact} & \\
\text{Surface} & \\
P - \text{Plate-} & \\
\text{Terminal} & \\
\text{Contact} & \\
\text{Surface} & \\
\end{align*}

Thermal:

Plate, Grid No.2, Grid No.1, 
Cathode, and Heater Temperature\textsuperscript{c} ................ 250 max. °C

Radiator Core Temperature\textsuperscript{c} ................ 250 max. °C
Air Flow:

Through radiator — Adequate air flow to limit the radiator core temperature to 250° C should be delivered by a blower through the radiator before and during the application of plate, grid-No.2, and grid-No.1 voltages. Typical values of air flow directed through the radiator versus plate dissipation are shown in accompanying Typical-Cooling-Requirements curve.

To Plate, Grid-No.2, Grid-No.1, Cathode, and Heater Terminals — A sufficient quantity of air should be directed at the heater terminal and 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 not usually required when only heater voltage is applied to the tube.

Plate Power, Grid-No.2 Power, Heater Power, and Air Flow — These may be removed simultaneously.

At Sea Level — Cooling requirements, with air flow directed through the radiator as shown in accompanying Typical-Cooling-Requirements curve, may be met by use of the following blowers and associated motors manufactured by Rotron Manufacturing Company Incorporated, Woodstock, New York, or equivalent:

For 100% Plate Dissipation:

<table>
<thead>
<tr>
<th>Blower Model No.</th>
<th>Motor Model No.</th>
<th>AXIMAX I</th>
<th>AXIMAX I</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS-2501</td>
<td>165AS 323JS</td>
<td>464YS</td>
<td>499JS</td>
</tr>
<tr>
<td>Phase (φ)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Frequency (cps)</td>
<td>60</td>
<td>60</td>
<td>400</td>
</tr>
<tr>
<td>Voltage (v)</td>
<td>115</td>
<td>220</td>
<td>115</td>
</tr>
</tbody>
</table>

For 80% Plate Dissipation:

<table>
<thead>
<tr>
<th>Blower Model No.</th>
<th>Motor Model No.</th>
<th>AXIMAX I</th>
<th>AXIMAX I</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS-201</td>
<td>92AS 323JS</td>
<td>464YS</td>
<td>499JS</td>
</tr>
<tr>
<td>Phase (φ)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Frequency (cps)</td>
<td>60</td>
<td>60</td>
<td>400</td>
</tr>
<tr>
<td>Voltage (v)</td>
<td>115</td>
<td>220</td>
<td>115</td>
</tr>
</tbody>
</table>

For 60% Plate Dissipation:

<table>
<thead>
<tr>
<th>Blower Model No.</th>
<th>Motor Model No.</th>
<th>AXIMAX I</th>
<th>AXIMAX I</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS-1504</td>
<td>92AS 323JS</td>
<td>464YS</td>
<td>499JS</td>
</tr>
<tr>
<td>Phase (φ)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Frequency (cps)</td>
<td>60</td>
<td>60</td>
<td>400</td>
</tr>
<tr>
<td>Voltage (v)</td>
<td>115</td>
<td>220</td>
<td>115</td>
</tr>
</tbody>
</table>

RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy
and

RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCSd Ratings, Absolute-Maximum Values:

- DC PLATE VOLTAGE: 2500 max. volts
- DC GRID-No.2 VOLTAGE: 400 max. volts
- DC GRID-No.1 VOLTAGE: -200 max. volts
- DC PLATE CURRENT: 250 max. ma
- DC GRID-No.1 CURRENT: 30 max. ma
- GRID-No.2 INPUT: 10 max. watts
- PLATE DISSIPATION: 300 max. watts
**Typical CCS Operation:**

*In cathode-drive circuit*

<table>
<thead>
<tr>
<th>Frequency</th>
<th>400</th>
<th>1215</th>
<th>Mc</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>2500</td>
<td>1250</td>
<td>volts</td>
</tr>
<tr>
<td>DC Grid-No.2 Voltage</td>
<td>250</td>
<td>300</td>
<td>volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Voltage</td>
<td>-15</td>
<td>-30</td>
<td>volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>250</td>
<td>250</td>
<td>ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>2</td>
<td>1</td>
<td>ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>15</td>
<td>7</td>
<td>ma</td>
</tr>
<tr>
<td>Driver Power Output (Approx.)&lt;sup&gt;g&lt;/sup&gt;</td>
<td>5</td>
<td>10</td>
<td>watts</td>
</tr>
<tr>
<td>Output-Circuit Efficiency</td>
<td>90</td>
<td>60</td>
<td>%</td>
</tr>
<tr>
<td>Useful Power Output&lt;sup&gt;h&lt;/sup&gt;</td>
<td>340</td>
<td>105</td>
<td>watts</td>
</tr>
</tbody>
</table>

**Maximum Circuit Values:**

| Grid-No.1 Circuit Resistance | 30000 max. | ohms |
| Grid-No.2 Circuit Impedance | 10000 max. | ohms |
| Plate Circuit Impedance | k |

<sup>a</sup> See Operating Considerations under Heater.
<sup>b</sup> Measured with special shield adapter.
<sup>c</sup> See Operating Considerations under Temperature and also Dimensional Outline for temperature measurement points.
<sup>d</sup> Continuous Commercial Service.
<sup>e</sup> See Operating Considerations under Grid No.2.
<sup>f</sup> Obtained preferably from fixed supply and grid-No.1 resistor. Sufficient voltage should be provided from fixed supply to protect the tube in case of drive loss.
<sup>g</sup> 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.
<sup>h</sup> Measured in a typical coaxial-cavity circuit.
<sup>i</sup> For Minimum Useful Power Output value, see Characteristics Range Values, Test No.8.
<sup>j</sup> See Operating Considerations under Precautions.

### 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. Heater Current</td>
<td></td>
<td>2.90</td>
<td>3.55</td>
</tr>
<tr>
<td>2. Direct Interelectrode Capacitances:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to plate</td>
<td>2</td>
<td>-</td>
<td>0.065</td>
</tr>
<tr>
<td>Grid No.1 to cathode &amp; heater</td>
<td>2</td>
<td>13.5</td>
<td>16.5</td>
</tr>
<tr>
<td>Plate to cathode &amp; heater</td>
<td>2</td>
<td>-</td>
<td>0.019</td>
</tr>
<tr>
<td>Grid No.1 to grid No.2</td>
<td>2</td>
<td>16.8</td>
<td>22.2</td>
</tr>
<tr>
<td>Grid No.2 to plate</td>
<td>2</td>
<td>2.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Grid No.2 to cathode &amp; heater</td>
<td>2</td>
<td>-</td>
<td>1.30</td>
</tr>
<tr>
<td>3. Grid-No.1 Voltage</td>
<td>1.3</td>
<td>-6.5</td>
<td>-20.5</td>
</tr>
<tr>
<td>4. Grid-No.1 Cutoff Voltage</td>
<td>1.4</td>
<td>-</td>
<td>-65</td>
</tr>
<tr>
<td>5. Reverse Grid-No.1 Current</td>
<td>1.3</td>
<td>-</td>
<td>-20</td>
</tr>
<tr>
<td>6. Grid-No.2 Current</td>
<td>1.3</td>
<td>-8</td>
<td>+2</td>
</tr>
</tbody>
</table>
Test No.  

7. Interelectrode Leakage
   Resistance:
   Between plate and all
     other electrodes . . . . 5  10  -  megohms
   Between any two elec-
     trodes except plate . . . 5  1  -  megohm

8. Useful Power Output . . . . . 6  300  -  watts

Note 1: With 6.3 volts ac or dc on heater.
Note 2: Measured with special shield adapter.
Note 3: With dc plate voltage of 2500 volts, dc grid-No.2 voltage of
       300 volts, and dc grid-No.1 voltage adjusted to give a dc plate
       current of 120 ma.
Note 4: 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 dc plate
       current of 2.5 ma.
Note 5: Under conditions with tube at 20° to 30° C without any voltages
       applied to the tube, the resistance between the two electrodes
       is measured with a 200-volt Megger-type ohmmeter having an
       internal impedance of 1.0 megohm.
Note 6: In a single-tube, cathode-driven coaxial-cavity class C ampli-
       fier circuit at 400 Mc and for conditions with 5.7 volts ac or
       dc on heater, dc plate voltage of 2500 volts and driver power
       output of 5 watts, dc grid-No.2 voltage of 250 volts, grid-
       No.1 voltage and tuning circuit are adjusted for maximum power
       output with plate current not to exceed 250 ma and grid-No.1
       current not to exceed 20 ma.

OPERATING CONSIDERATIONS

Heater

The heater of the 8226 should be operated at constant
voltage rather than constant current. The rated heater voltage
of 6.3 volts should be applied for 60 seconds to allow the
cathode to reach normal operating temperature before voltages
are applied to other electrodes.

The life of the cathode can be conserved by operating at
the lowest heater supply voltage which will give the desired
performance. Good regulation of the heater supply voltage is,
in general, economically advantageous from the viewpoint of
tube life; in no case should the voltage fluctuations be more
than 5%. This recommendation is particularly applicable at
the higher operating frequencies.

Temperature

The maximum radiator core or electrode 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 Tempilaq. This paint is
manufactured in the form of liquid or stick by the Tempil
Corporation, 132 West 22nd Street, New York 11, N.Y.

Grid No.2

Grid-No.2 current is composed of a positive-current com-
ponent 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 cannot 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 (runaway) 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.

Standby Operation

During long or frequent standby periods, the 8226 may be operated at decreased heater voltage to conserve life. It is recommended that the heater voltage be reduced to 80% of normal during standby periods up to 2 hours. For longer periods, the heater voltage should be turned off.

Precautions

In beam power tubes with closely spaced electrodes, such as the 8226, extremely high voltage gradients occur even with moderate tube operating voltages. Any arc-over between electrodes 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.

Protective devices should be used to protect not only the plate but also grid No.2 against overload. In order to prevent excessive plate current flow and resultant overheating of the tube, the common ground lead of the plate circuit should be connected 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 8226 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 ANULAR REGIONS.
SKETCH GI

OPENING FOR:
RADIATOR
1.675 DIA.

PLATE TERMINAL
1.118 DIA.

GRID-No.2 TERMINAL
1.018 DIA.

GRID-No.1 TERMINAL
0.763 DIA.

HEATER-CATHODE
TERMINAL
0.518 DIA.

HEATER TERMINAL
0.239 DIA.

0.070 DIA.

ALL DIMENSIONS IN INCHES

92CS-12004
PREFERRED MOUNTING ARRANGEMENT & LAYOUT OF ASSOCIATED CONTACTS

SEE DETAIL "A"

NOTE: ALL FINGER STOCK (No. 97-380) MADE BY INSTRUMENT SPECIALTIES COMPANY, LITTLE FALLS, NEW JERSEY.
TYPICAL COOLING REQUIREMENTS

AIR FLOW DIRECTED THROUGH RADIATOR
INCOMING AIR TEMPERATURE — 24°C

AIR FLOW — CUBIC FEET PER MINUTE

RADIATOR CORE TEMPERATURE — °C (SOLID LINE)
0 0.1 0.2 0.3 0.4 0.5 0.6
PRESSURE DROP — INCHES OF WATER (DASHED LINE)

92CM-12005
TYPICAL PLATE CHARACTERISTICS

HEATER VOLTS = 6.3
GRID-No. 2 VOLTS = 250
GRID-No. 1 VOLTS = E_C1

PLATE AMPERES

PLATE VOLTS

92CM-12006
TYPICAL PLATE CHARACTERISTICS

HEATER VOLTS = 6.3
GRID-No. 2 VOLTS = 350
GRID-No. 1 VOLTS = $E_{G1}$

PLATE MILLIAMPERES

PLATE VOLTS

2000 1500 1000 500 0

25 20 15 10 5

92CM-12010

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 6
6-63
TYPICAL CHARACTERISTICS

HEATER VOLTS = 6.3
GRID-No.2 VOLTS = 250
GRID-No.1 VOLTS = $E_C^1$

$E_C^1$ = 0

$E_C^2$ = 0

GRID-No.1 ($I_C^1$) OR GRID-No.2 ($I_C^2$) MA.

PLATE VOLTS

0 500 1000 1500 2000

92CM-12016

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
TYPICAL CHARACTERISTICS

HEATER VOLTS = 6.3
GRID – No.2 VOLTS = 350
GRID – No.1 VOLTS = EC1
IC1 = 
IC2 = 

GRID – No.1(IC1) OR GRID – No.2(ICC) MA.

PLATE VOLTS

92CM-12013

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

DATA 7
6-63
TYPICAL CONSTANT-CURRENT CHARACTERISTICS

HEATER VOLTS = 6.3
GRID-NO. 2 VOLTS = 250
IC1 = GRID-NO. 1 MA.
IC2 = GRID-NO. 2 MA.
IB = PLATE MA.

GRID-NO. 1 VOLTS

PLATE VOLTS

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
TYPICAL CONSTANT-CURRENT CHARACTERISTICS

HEATER VOLTS = 6.3
GRID-No.2 VOLTS = 350
I_C1 = GRID-No.1 MA.
I_C2 = GRID-No.2 MA.
I_b = PLATE MA.