

# Super-Power Klystron

FIVE-RESONATOR, FIXED-TUNED, MAGNETICALLY-FOCUSED  
WATER-COOLED TYPE

21-MEGAWATT PEAK PULSE OUTPUT AT 2856 Mc/s

For RF-Pulsed Amplifier in S-Band Linear  
Accelerator Service

## ELECTRICAL

### Heater, for Matrix-Type Oxide-Coated

#### Unipotential Cathode

Voltage (AC or DC) . . . . . 15 V

See accompanying *Electrical Considerations*

#### Current:

Typical value at 15 volts . . . . . 14 A

Starting value, even momentarily . . . . . 30 max A

Cold resistance . . . . . 0.15  $\Omega$

Heating time (Minimum) . . . . . 20 min

At normal operating current before applying  
beam voltage

Pump . . . . . Sputter Ion Type

See accompanying *Electrical Considerations*

### Direct Interelectrode Capacitances

Anode to cathode . . . . . 42 pF

Anode to cathode . . . . . 50 pF

With corona shield and in permanent magnet

Frequency (Center) . . . . . 2856 Mc/s

Phase Sensitivity to Beam Voltage . . 6 deg/per cent of beam-  
voltage change

## MECHANICAL

Operating Position . . . . . Vertical, cathode end down

Maximum Overall Length . . . . . 49.7 in

Maximum Diameter . . . . . See accompanying *Dimensional Outline*

### Cooling Connections

Inlet . . . . . 1/2 in — 14MPT

Outlet . . . . . 1/2 in — 14MPT

### Circuit Connections

Beam and heater voltage terminals . . . . . See accompanying  
*Dimensional Outline*

RF input . . . . . Mates with UG-573/U male

RF output . . . . . Mates to Waveguide WR284 with  
RCA-AJ2121 Male Waveguide Flange

Sputter ion pump voltage . . . . . Mates with No.924-0715<sup>a</sup>  
High Voltage Connector

### Weight (Approx.)

Without magnets . . . . . 150 lb

With electromagnet and lead X-radiation  
shields attached . . . . . 1100 lb

With permanent magnet and lead X-radiation  
shields attached . . . . . 1625 lb



## THERMAL

### Metal Surface Temperature

At O-ring groove on cathode cylinder. . . . . 100 max °C  
 All other metal surfaces. . . . . 150 max °C

### Ambient Oil Temperature . . . . . 100 max °C

Electron-gun-assembly bath

### Window Band Temperature . . . . . 90 max °C

Through 10-32 NF tapped hole in window cover to accommodate thermocouple

Temperature-Measurement Points. . . . . See accompanying *Dimensional Outline*

### Oil Immersion

Oil immersion of the electron gun assembly is required. The tube must be lowered into an oil bath to the level shown on the *Dimensional Outline*. The oil bath must be of sufficient volume to limit the surface of the electron gun assembly to a temperature below 100° C. Transformer oil with high insulating properties, such as GE10C<sup>b</sup> or equivalent, must be used.

### Water Cooling<sup>f</sup>

Water cooling of the internal structure is required. The water flow must start before application of any voltage in order to purge the system of bubbles and should continue for several minutes after removal of voltage. Interlocking of the water flow with the power supply is recommended to prevent tube damage in case of failure of adequate water flow.

### Water Flow

For Collector Dissipation	Typ. Flow	Absolute Min. Flow	Max. Pressure Differential for Typ. Flow
kw	gpm	gpm	psi
of 78	11	10	30

Resistivity of water at 25° C . . . . . 1 min MΩ-cm  
 Water temperature at outlet . . . . . 70 max °C  
 Max. water pressure at inlet. . . . . 100 max psi

## PULSED RF AMPLIFIER<sup>g</sup>

### Absolute-Maximum Ratings

*For a maximum dc pulse "ON" time of 3.2 micro-seconds in any 2700-microsecond interval, and rf load vacuum pressure of 10<sup>-7</sup> Torr.*

Peak Beam Voltage <sup>c</sup> . . . . .	260	kV
Peak Inverse Beam Voltage . . . . .	50	kV
Peak Beam Current . . . . .	270	A
Peak Input Beam Power . . . . .	68	MW
Average Input Beam Power. . . . .	78	kW



### Typical Operation

With rectangular waveshape pulses, rfpulse duty factor of 0.0009, rf pulse duration of 2.5  $\mu$ s centered within a dc pulse duration of 3.2  $\mu$ s, and at a frequency of 2856 Mc/s.

Peak Beam Voltage . . . . .	250	200	kV
Peak Beam Current . . . . .	250	170	A
Driving Power Output . . . . .	105	150	W
At peak of pulse <sup>d</sup> . . . . .			
Useful Power Output . . . . .	21 <sup>e</sup>	12 <sup>e</sup>	MW
At peak of pulse . . . . .			
Power Gain . . . . .	53	49	dB
Phase Modulation			
By heater magnetic field . . . . .	0.14	0.1	deg
By change in beam voltage . . . . .	6	5.5	deg/%
Amplitude Modulation . . . . .	0.12	0.05	%
By noise and heater magnetic field . . . . .			

### Maximum Circuit Value

Load VSWR . . . . . 1.5:1

<sup>a</sup> Varian Associates, 611 Hansen Way, Palo Alto 2, Calif.

<sup>b</sup> Manufactured by General Electric Co.

<sup>c</sup> The magnitude of any spike on the beam voltage pulse should not exceed its peak value by more than 5%, and the duration of the spike when measured at the peak value level should not exceed 0.15  $\mu$ s.

<sup>d</sup> Input VSWR at the tube input connection must not exceed 1.5:1.

<sup>e</sup> At a load VSWR not exceeding 1.2:1.

The following footnotes apply to the RCA Transmitting Tube Operating Considerations given at front of this section.

<sup>f</sup> See *Cooling Considerations — Liquid Cooling*. For more detailed information on cooling systems see *Application Guide for RCA Super Power Tubes, 1CE-279A*. A copy of this guide may be obtained by writing to RCA, Commercial Engineering, Harrison, N.J.

<sup>g</sup> See *Classes of Service*.

### CHARACTERISTICS RANGE VALUES

	Note	Min	Max	
Heater Current . . . . .	1	13	15	A
Peak Beam Current . . . . .	1,2	237	263	A

Note 1: With 15 volts ac or dc on heater.

Note 2: With beam voltage of 250 kilovolts.

### ACCESSORIES

#### For RCA-8568 SUPER-POWER KLYSTRON

The following tabulated accessories are shown in position on the accompanying Assembly Drawing

RCA Type No.	Description
AJ2106	Set of X-radiation Shields (Includes AJ2107 through AJ2113)
AJ2107	Upper Collector X-radiation Shield
AJ2108	Lower Collector X-radiation Shield
AJ2109	Outlet Water Pipe X-radiation Shield



RCA Type No.	Description
AJ2110	Window X-radiation Shield
AJ2111	Waveguide X-radiation Shield
AJ2112	Inlet Water Pipe X-radiation Shield
AJ2113	Aluminium "Spool" Casting X-radiation Shield
AJ2114	Permanent Magnet
AJ2115	Corona Shield
AJ2116	Sputter-Ion-Pump Magnet and Bracket Assembly
AJ2117	Electromagnet
AJ2119	Aluminum Waveguide-Flange Gasket
AJ2120	Copper Waveguide-Flange Gasket
AJ2121	Male Waveguide Flange
AJ2122	O-ring, uniform dash number 441 Buna N
AJ2123	Waveguide-Flange Hardware (Includes 10 sets of 3/8-16 x 2-1/4 hex head bolts, 3/8-16 nuts, and 0.625 OD x 0.390 ID x 1/16 washers)

### OPERATING CONSIDERATIONS ELECTRICAL

#### X-Radiation Warning

Because the 8568 is designed to be operated at peak voltages as high as 260 kilovolts, shielding of the tube for X-radiation is necessary to protect against possible injury to operating personnel.

A set of X-radiation shields to reduce X-radiation to a level not to exceed 3 milliroentgens/hour at a distance of 36 inches from the major tube axis is available as an accessory, RCA-AJ2106. The shields are available individually or in a set.

#### Heater Voltage

The life of the cathode can be conserved by adjusting to the lowest heater supply voltage that will give the desired performance. In a klystron, however, the heater voltage must not be reduced to a level that will cause an excessive reduction in beam current; otherwise, the cathode may be damaged.

A recommended procedure for adjusting heater voltage during life for maximum life expectancy is as follows:

1. Set the heater voltage at the recommended value.
2. Set the beam voltage at the maximum operating voltage during adjustment.
3. Reduce the heater voltage in 0.5-volt steps with 20-minute stabilization periods between each step.
4. Monitor the beam current continually.



**CAUTION**

With the beam voltage held constant, the beam current must never drop more than three amperes. If the three-ampere drop is exceeded, TURN OFF BEAM VOLTAGE IMMEDIATELY.

5. Lower the heater voltage until the beam current is reduced two amperes.
6. Increase heater voltage approximately ten percent of the minimum value of heater voltage noted in step 5 above. If the heater voltage supply is regulated, increase heater voltage approximately five percent of the minimum value of heater voltage noted in step 5 above.

**Sputter Ion Pump**

The sputter ion pump on the 8568 is a variant of the RCA-VC2119; the only difference is in the vacuum system connection.

The RCA-VX2201 Control Unit is a power supply designed especially for the VC2119 Series sputter ion pumps.

**PM Magnetic Field**

For applications using permanent-magnet-focused 8568's, care must be taken that the magnetic field is not distorted by effects of other ferromagnetic materials. In general, such materials should be located at least three feet from the magnet.

**MECHANICAL****Handling**

Raise the tube and magnet by using a hoist attached to three eyebolts on the top flange of the magnet, or by three eyebolts which can be screwed into the 1/2"-13 tapped holes located on the top flange of the aluminum "spool" casting. See *Dimensional Outline* for eyebolt locations.

**CAUTION**

Do not rest the tube on the corona shield or heater contact.

Rest the tube in an appropriate stand on the lower side of the bottom flange of the aluminum "spool" casting. The tube can also rest on the three locating "buttons" when so equipped.

**Mounting**

For equipment design, the tube is mounted by resting the lower side of the bottom flange of the aluminum "spool" casting on the focusing magnet.

**Connections**

The output waveguide of the 8568 contains an rf window to close the vacuum envelope of the tube.



## CAUTION

External pressure (load side) applied to the rf window must not exceed  $10^{-7}$  Torr during operation, otherwise the tube may be damaged.

In certain cases, it may be desirable to pressurize rather than evacuate to load side of the window to prevent damage to the tube.

The window must be kept clean of any foreign material. When the load waveguide is not connected to the tube, the plastic cover supplied for shipping should be used to cover the tube waveguide flange.

A male waveguide flange, RCA-AJ2121, a non-reusable gasket, RCA-AJ2119 (aluminum) or RCA-AJ2120 (copper), and ten sets of nuts, bolts, and washers, RCA-AJ2123, can be used to provide a vacuum-tight waveguide seal. The nuts should be evenly tightened, with a torque wrench in increments of 1/8 to 1/4 turn each cycle. The final torque must not exceed 100 pound-inches. The copper gasket should be selected if the oxidation rate of the aluminum is excessive. Power supply voltage connections to the tube are made with a corona shield, RCA-AJ2115.

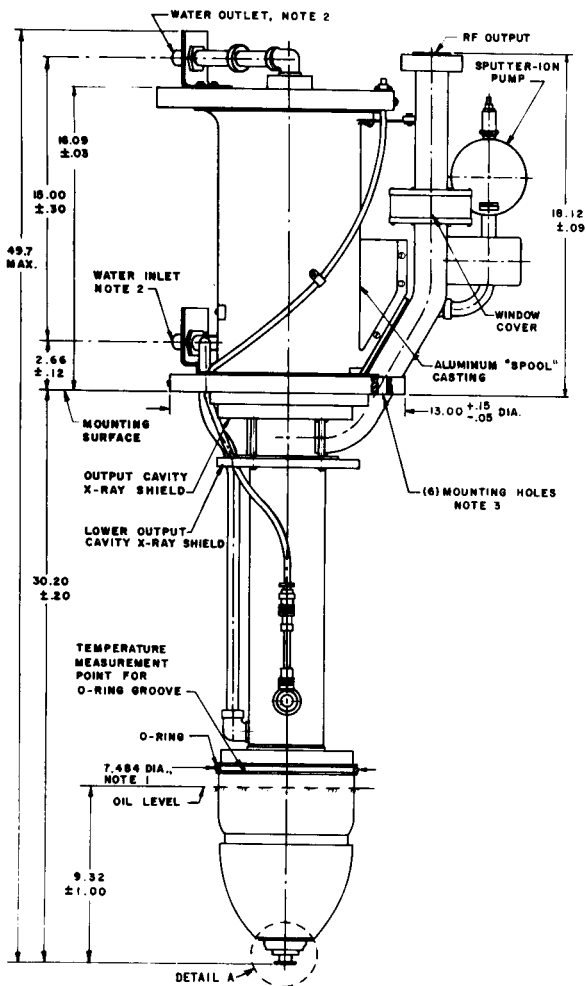
FOR ADDITIONAL INFORMATION ON THIS TYPE, WRITE FOR TECHNICAL BULLETIN AND APPLICATION GUIDE FOR RCA SUPER POWER TUBES, ICE-279A AVAILABLE FROM:

Commercial Engineering  
Electronic Components and Devices  
Radio Corporation of America  
Harrison, New Jersey



## DIMENSIONAL OUTLINE

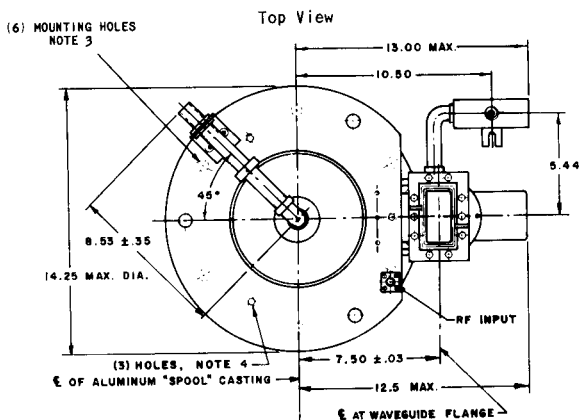
Side View



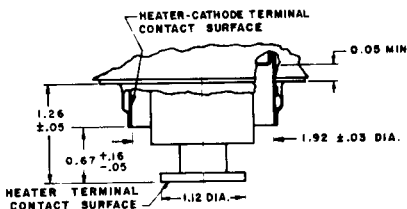
DIMENSIONS IN INCHES



## DIMENSIONAL OUTLINE



## Detail A



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DIMENSIONS IN INCHES

Note 1: Recommended diameter of O-ring sealing surface.

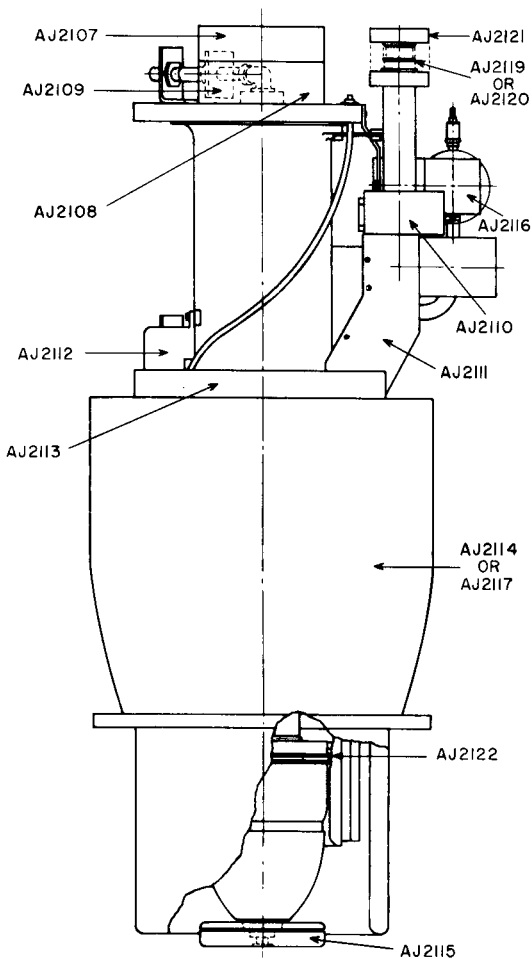
Note 2: 1/2-14 external American Standard taper pipe thread (Male).

Note 3: Six (6) mounting holes, 9/16 inch diameter through the 13.00-inch diameter flange. Equally spaced on a bolt circle of 11.56 inch diameter.

Note 4: Three (3) holes, 1/2-13 NC, equally spaced on a bolt circle of 10.00 inches for lifting eyebolts.



## ASSEMBLY DRAWING



92LL-1012

