



7008

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MAGNETRON

SERVO-TUNABLE TYPE

FORCED-AIR COOLED

INTEGRAL MAGNET

*For use as a pulsed oscillator
at frequencies between 8500 and 9600 Mc*

GENERAL DATA**Electrical:**

Heater, for Unipotential Cathode:

Voltage 13.75 $\pm$ 10% ac or dc volts

Current at 13.75 volts 3.15 amp

Starting current The maximum instantaneous starting current must never exceed 12 amperes, even momentarily

Minimum Cathode Heating Time 2.5 minutes

Frequency 8500 to 9600 Mc

Maximum Frequency Pulling at

VSWR of 1.5 15 Mc

Mechanical:

Operating Position Any

Dimensions See Dimensional Outline

Air Flow:

Through Ducts--An air stream should be directed through each of the cooling ducts provided on the tube. Adequate flow should be provided so that the temperature of the anode block does not exceed 150° C.

To Heater-Cathode Terminal--Adequate flow should be provided to maintain the temperature of the heater-cathode terminal below 165° C.

Waveguide Output Flange Mates with Modified JAN UG-52A/U Flange

Servo-Drive Shaft with Associated Calibrated Indicator:

Revolutions (Approx.) to cover full range of 8500 to 9600 Mc 160

Maximum Torque (Absolute) at tuning-range stops 192 oz-in.

Typical Torque between -55° and +150° C (Approx.) 6 oz-in.

Weight (Approx.) 13 lbs

PULSED-OSCILLATOR SERVICE**Maximum and Minimum Ratings, Absolute Values:***For duty cycle up to 0.0011 maximum*

PEAK ANODE VOLTAGE	25 max.	kv
PEAK ANODE CURRENT	27.5 max.	amp
PEAK POWER INPUT	630 max.	kw
AVERAGE POWER INPUT	0.63 max.	kw
PULSE DURATION	2.75 max.	μ sec

• See next page.



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RATE OF RISE OF VOLTAGE PULSE:

For pulse duration of
1 μ sec or less { 225 max. kv/ μ sec
70 min. kv/ μ sec

For pulse duration greater
than 1 μ sec. { 200 max. kv/ μ sec
70 min. kv/ μ sec

ANODE-BLOCK TEMPERATURE. 150 max. $^{\circ}$ C

HEATER-CATHODE-TERMINAL TEMPERATURE. 165 max. $^{\circ}$ C

LOAD-VOLTAGE STANDING-WAVE RATIO 1.5 max.

**Typical Operation[#] with Load-Voltage Standing-Wave Ratio
Equal to or Less than 1.05, Except as Noted:**

With duty cycle of 0.001

Heater Voltage	See Operating Considerations		
Peak Anode Voltage	22	22	kv
Peak Anode Current	27.5	27.5	amp
Pulse-Repetition Rate.	400	4000	cps
Pulse Duration	2.5	0.25	μ sec
RF Bandwidth with worst phasing of 1.5 VSWR.	0.5	5	Mc
Side Lobes with worst phasing of 1.5 VSWR.	8	10	db
Pulling Figure at VSWR of 1.5.	10	10	Mc
Pushing Figure	0.2	0.2	Mc/amp
Thermal Factor for any 30 $^{\circ}$ range of anode-block temperature between -55 $^{\circ}$ C and 150 $^{\circ}$ C.	0.2	0.2	Mc/ $^{\circ}$ C
Servo-Drive-Shaft Torque	6	6	oz-in.
Frequency Deviation due to tuning backlash.	8	8	Mc
Peak Power Output (Approx.).	220	220	kw

* For atmospheric pressure greater than 600 millimeters of mercury in the vicinity of the heater-cathode stem. Operation at pressures lower than 600 millimeters of mercury may result in arc-over across the stem with consequent damage to the tube. The waveguide must always be pressurized to a minimum of 15 psi absolute to prevent arcing, especially when there is a mismatched load. Arcing in the waveguide due to lack of pressure can damage the tube.

It is essential that the input circuit be designed so that if arcing occurs the energy per pulse delivered to the tube cannot greatly exceed the normal energy per pulse. To satisfy this requirement, it is recommended that pulsers of the discharging-network type be used.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	Min.	Max.	
Heater Current	1	2.8	3.5	amp
Peak Anode Voltage	2	20	23	kv
Peak Power Output.	3	180	-	kw
Pulses Missing from Total.	4,5	-	0.25	%

Notes 1 to 5: See next page.



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- Note 1: With 13.75 volts ac or dc on heater.
- Note 2: With peak anode current of 27.5 amperes. For heater voltage, see *Operating Considerations*.
- Note 3: With peak anode current of 27.5 amperes corresponding to a peak anode voltage in the order of 22 kv, anode-block temperature of 115° C approx., pulse duration of 2.5 microseconds, and maximum load-voltage standing-wave ratio equal to or less than 1.05. For heater voltage, see *Operating Considerations*.
- Note 4: Pulses are considered to be missing if the energy level at the operating frequency is less than 70 per cent of the normal value.
- Note 5: With peak anode current of 27.5 amperes corresponding to a peak anode voltage in the order of 22 kv, anode-block temperature of 115° C approx., pulse duration of 0.25 microsecond, load-voltage standing-wave ratio of 1.5 adjusted in phase to produce maximum instability. For heater voltage, see *Operating Considerations*.

DEFINITIONS

Smooth Peak Value. The maximum value of a smooth curve drawn through the average of the fluctuation over the top of a voltage or current pulse.

Pulse Width. The time interval between the two points of the current pulse at which the current is 50 per cent of the smooth peak value.

Rate of Rise of Voltage Pulse. The steepest slope of the voltage-pulse leading edge above 50 per cent of the smooth peak value. Measurement of the rate of rise of voltage should be made using a capacitance divider with an input capacitance not exceeding 6 μmf . An oscilloscope of sufficient bandpass, such as the Tektronix 517 or equivalent, should be used.

OPERATING CONSIDERATIONS

Mounting of the 7008 should be accomplished by means of the mounting flange which may be positioned to operate the tube in any orientation. This flange is made to permit use of the 7008 in applications requiring a pressure seal. Care should be taken by the equipment designer to insure that the tube is mounted on a surface having adequate flatness so as to avoid possible distortion of the mounting flange when it is bolted to the mounting surface. Captive 1/4" - 20 bolts are provided at the corners of the mounting flange for mounting the magnetron. These four mounting bolts are held in position during shipment of the 7008 by plastic sleeving which also serves to protect the bolt threads.

Fastening the JAN RG-51/U waveguide to the waveguide output flange of the tube is accomplished in the following manner. A JAN UG-52A/U choke flange or equivalent should be modified by drilling out the screw threads from the four mounting holes in the choke flange using a No. 15 drill. This operation will permit four size 8-32 bolts inserted through the flange mounting holes, to engage the threaded waveguide output flange of the tube. It is recommended that the choke flange be sufficiently tight to avoid arcing and other contact effects. Before the choke flange is fastened to the waveguide output flange of the tube, the user should make certain that the waveguide window is entirely free of dust to prevent possible arcing with consequent damage to the tube.



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A conduit should be attached to each of the inlet-air duct flanges provided on the tube. The conduits should be made of flexible, non-magnetic material. Rubber hose or stainless-steel hose is suitable. Fastening of the conduits requires two non-magnetic 6-32 screws at each duct. Adequate flow of cooling air should be provided through the ducts to maintain the temperature of the anode block below 150°C under any condition of operation. Failure to provide adequate cooling will impair tube life. Cooling of the heater-cathode terminal may be required under some conditions to maintain the temperature of this terminal below 165°C .

A mechanical drive may be connected to the drive shaft of the 7008 by using a flexible coupling drilled for a $3/16$ "-diameter shaft and held in place by a setscrew. When the magnetron is installed in radar equipment which has a frequency index dependent upon rotation of the drive shaft, both the index and the 7008 tuner indicator should be adjusted to the same frequency before the drive coupling is connected to the drive shaft.

The heater terminal and the heater-cathode terminal require the use of a connector with flexible leads such as the Ucinite* No. 115364 with built-in capacitor, or equivalent. Unless flexible leads are used, the heater and heater-cathode seals may be damaged.

A heater starter should be used to raise the voltage gradually and to limit the instantaneous starting current through the heater when the circuit is first closed. The starter may be either a system of time-delay relays cutting resistance out of the circuit, a high-reactance heater transformer, or a simple rheostat. Regardless of the method of control, it is important that the maximum instantaneous starting current never exceed, even momentarily, a value of 12 amperes. Exceeding this value may damage the heater.

After the heater voltage is raised to its rated value of 13.75 volts, allow the cathode to warm up for at least 2-1/2 minutes to make sure that the cathode reaches operating temperature. When the cathode has reached full operating temperature, high-voltage pulses, negative with respect to anode (ground), can be applied to the heater-cathode terminal. As soon as the 7008 begins to oscillate, the heater voltage (E_f) should be reduced in accordance with the following formulas, depending on the average power input (P_i) to the tube:

$$P_i \text{ up to 450 watts: } E_f = 13.75 \left(1 - \frac{P_i}{450} \right) \text{ volts}$$

$$P_i \text{ greater than 450 watts: } E_f = 0 \text{ volts}$$

When the 7008 is oscillating, the cathode is subjected to considerable electron bombardment which raises the temperature of the cathode. The magnitude of such heating is a

* Manufactured by Ucinite Division of United-Carr Fastener Corporation, Newtonville 60, Massachusetts.



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function of the total dissipation and must be compensated by reduction of heater voltage in order to prevent overheating of the cathode. Failure to start the tube at rated heater voltage and to reduce the heater voltage as soon as oscillation starts may adversely affect tube life.

The heater should be protected against input pulse power by placing a suitable capacitor in shunt with the heater leads as near the heater-cathode stem as possible in order to limit the magnitude of the transient voltages which may develop across the heater. This capacitor may be incorporated in the design of the connector for the heater terminal and heater-cathode terminal.

The *anode-circuit return* should be made to the *heater-cathode terminal*. If the anode-circuit return is made to the heater terminal, all of the anode current will flow through the heater and may cause heater burnout.

The *frequency of the 7008 may be preset* by turning the drive shaft until the setting of the indicator is reached corresponding to the desired frequency. For precise tuning adjustment, the final indicator setting should be approached using a counterclockwise direction of rotation which is the direction of increasing frequency.

Revolutions of the servo-drive shaft are not indicated directly by the indicator. Approximately 160 revolutions of the drive shaft are required to tune through the 8500-to-9600-Mc range. A tuning rate of 200 megacycles per second can be achieved. Typical servo-drive-shaft torque is 6 ounce-inches throughout the temperature range of -55° to 150° C. Mechanical stops are provided at each end of the tuning range. Torque applied to these stops and the starting torque must not exceed 192 ounce-inches (1 foot-pound) including inertial effects.

Our engineers are ready to assist you in circuit applications of the RCA-7008. For further information, write to Commercial Engineering, RCA, Harrison, New Jersey, giving complete details as to the proposed service.

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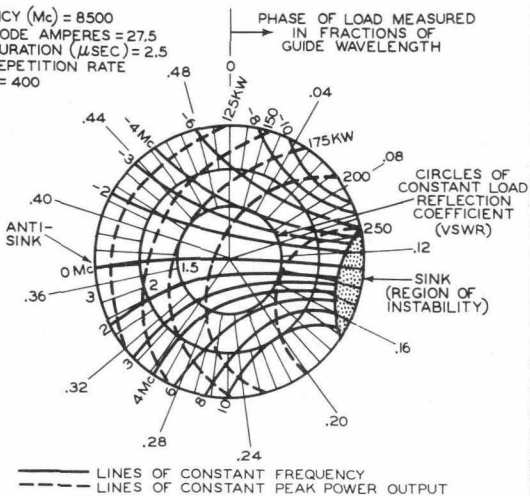


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RIEKE DIAGRAM

FREQUENCY (Mc) = 8500
 PEAK ANODE AMPERES = 27.5
 PULSE DURATION (μ SEC) = 2.5
 PULSE-REPETITION RATE
 (PPS) = 400



92CM-9629



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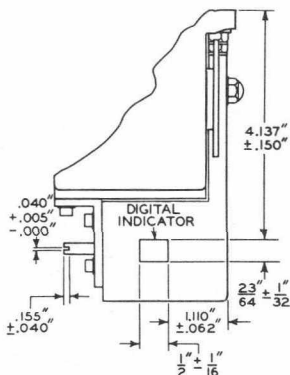
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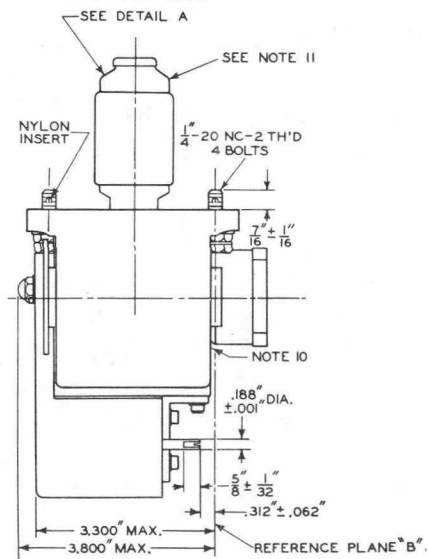
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PARTIAL RIGHT-SIDE VIEW



LEFT-SIDE VIEW



92CJ-9470

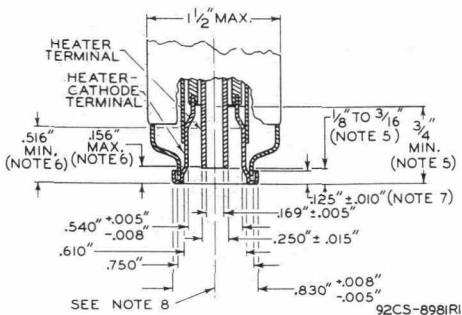


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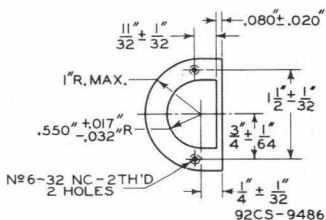
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DETAIL A



DETAIL B





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REFERENCE PLANE A IS DEFINED AS THE PLANE THROUGH THAT PORTION OF THE MOUNTING FLANGE DESIGNATED AS ANNULAR SURFACE D.

REFERENCE PLANE B IS DEFINED AS THE PLANE WHICH IS PERPENDICULAR TO PLANE A AND PASSES THROUGH THE EXACT CENTERS OF MOUNTING-FLANGE HOLES No.2 & No.3 WHICH HAVE THE SPECIFIED BOLTS INSERTED THROUGH THEM.

REFERENCE PLANE C IS DEFINED AS THE PLANE WHICH IS PERPENDICULAR TO PLANE A & PLANE B AND PASSES THROUGH THE EXACT CENTER OF MOUNTING-FLANGE HOLES No.3 & No.4 WHICH HAVE THE SPECIFIED BOLTS INSERTED THROUGH THEM.

NOTE 1: SURFACE E OF THE WAVEGUIDE OUTPUT FLANGE, AND THE ENTIRE MOUNTING FLANGE ARE MADE SO THAT THEY MAY BE USED TO PROVIDE A HERMETIC SEAL.

NOTE 2: THE AXIS OF THE HEATER-CATHODE TERMINAL WILL BE WITHIN THE CONFINES OF A CYLINDER WHOSE RADIUS IS $3/64$ " AND WHOSE AXIS IS PERPENDICULAR TO REFERENCE PLANE A AT THE SPECIFIED LOCATION.

NOTE 3: ALL POINTS ON MOUNTING FLANGE WILL LIE WITHIN 0.015" ABOVE OR BELOW REFERENCE PLANE A.

NOTE 4: THE LIMITS INCLUDE ANNULAR AS WELL AS LATERAL DEVIATIONS.

NOTE 5: THESE DIMENSIONS DEFINE EXTREMITIES OF THE 0.169" INTERNAL DIAMETER OF THE CYLINDRICAL HEATER TERMINAL.

NOTE 6: THESE DIMENSIONS DEFINE EXTREMITIES OF THE 0.540" INTERNAL DIAMETER OF THE CYLINDRICAL HEATER-CATHODE TERMINAL.

NOTE 7: NO PART OF THE CONNECTOR DEVICE FOR THE HEATER AND HEATER-CATHODE TERMINALS SHOULD BEAR AGAINST THE UNDERSIDE OF THIS LIP.

NOTE 8: THE HEATER TERMINAL AND THE HEATER-CATHODE TERMINAL ARE CONCENTRIC WITH 0.010".

NOTE 9: CLOCKWISE ROTATION OF DRIVE SHAFT DECREASES FREQUENCY.

NOTE 10: ANODE TEMPERATURE MEASURED AT JUNCTION OF WAVEGUIDE AND ANODE BLOCK.

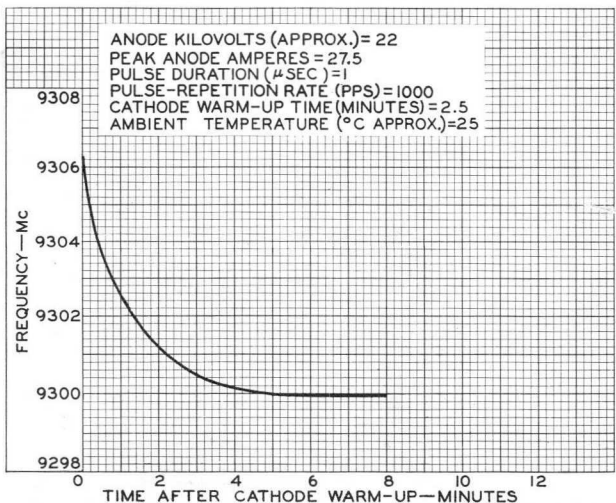
NOTE 11: TEMPERATURE OF HEATER-CATHODE TERMINAL MEASURED HERE.



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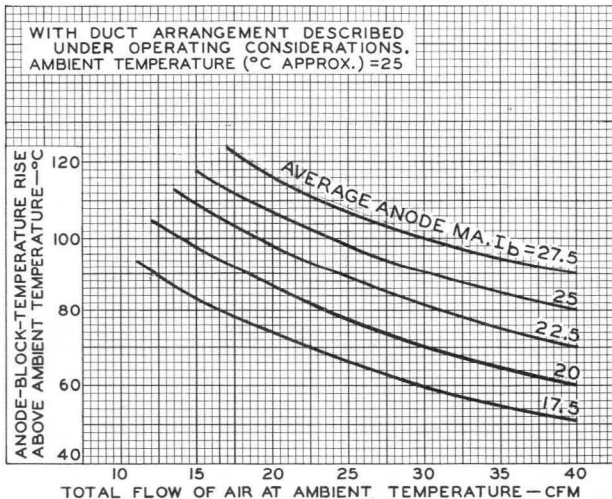
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TYPICAL STABILIZATION CHARACTERISTIC



92CS-8941RI

TYPICAL COOLING REQUIREMENTS



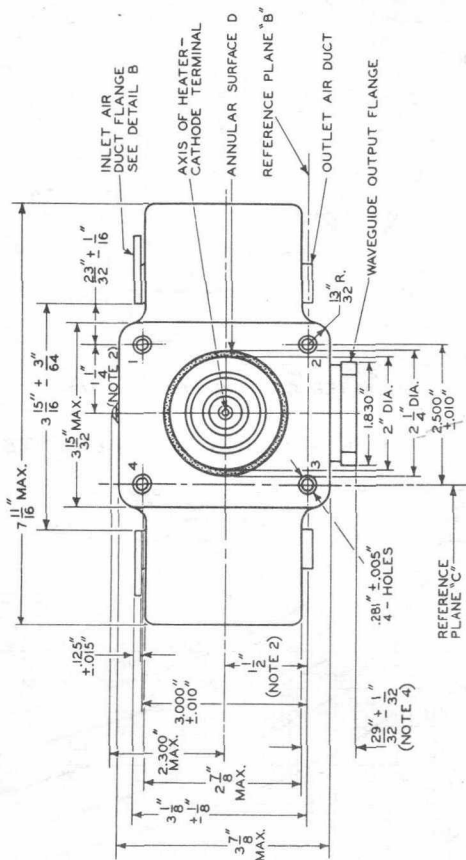
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92CS-9472RI

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TOP VIEW

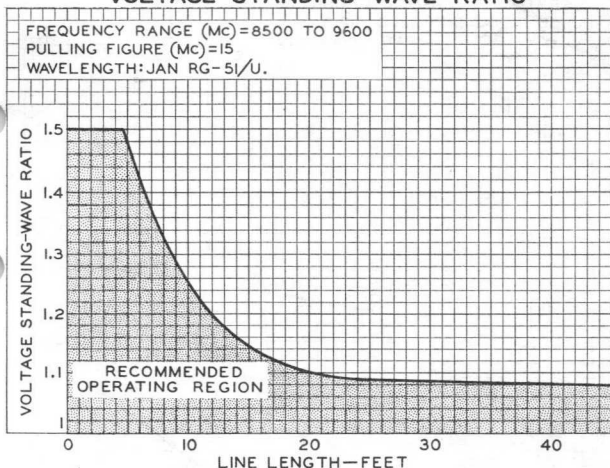




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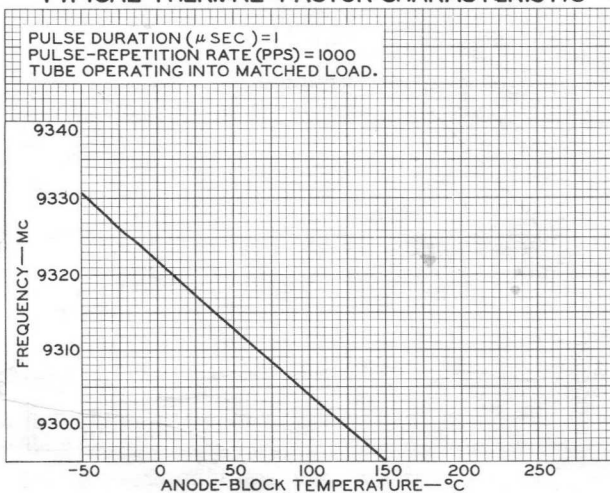
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EFFECT OF LENGTH OF TRANSMISSION LINE BETWEEN OUTPUT FLANGE AND LOAD ON ALLOWABLE VOLTAGE STANDING-WAVE RATIO



92CS-9469R1

TYPICAL THERMAL-FACTOR CHARACTERISTIC

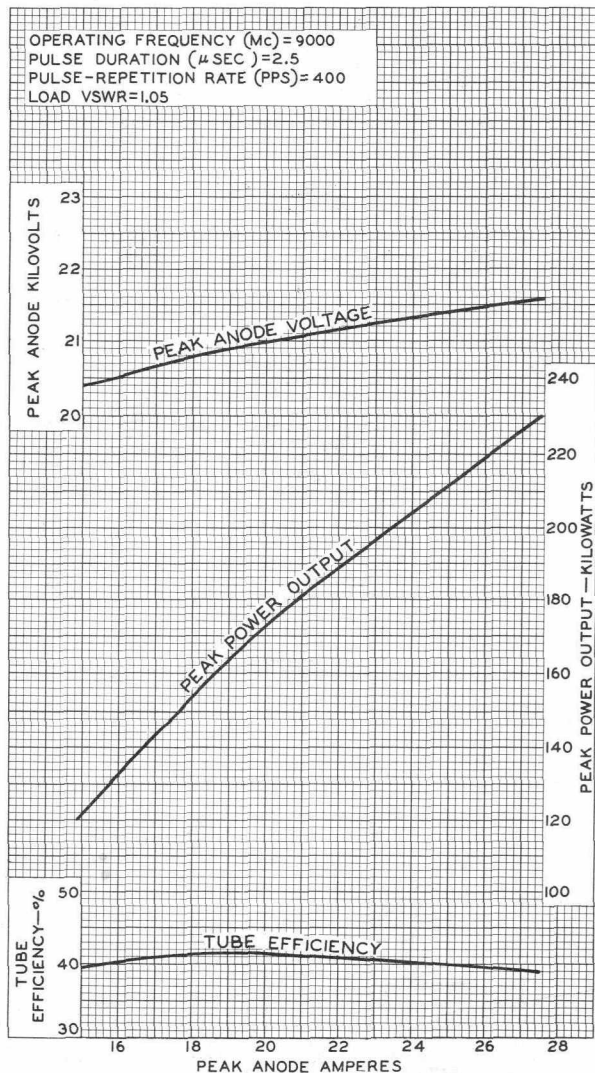


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TYPICAL PERFORMANCE CURVES



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92CM-9468RI

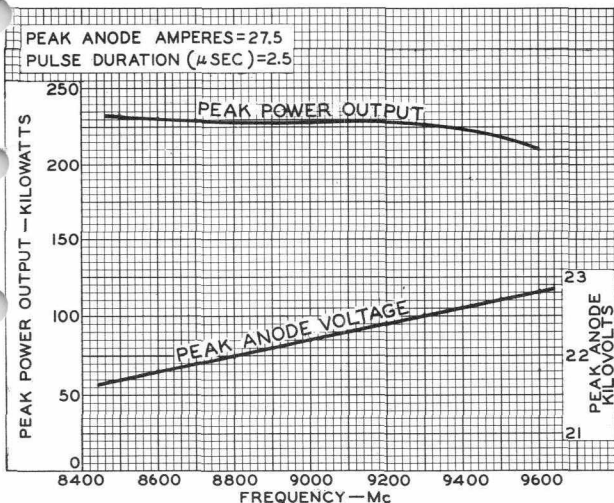
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TYPICAL PERFORMANCE CURVES



92CS-9471R1

REPRESENTATIVE TUNING CHARACTERISTIC

