TECHNICAL INFORMATION

RAYTHEON

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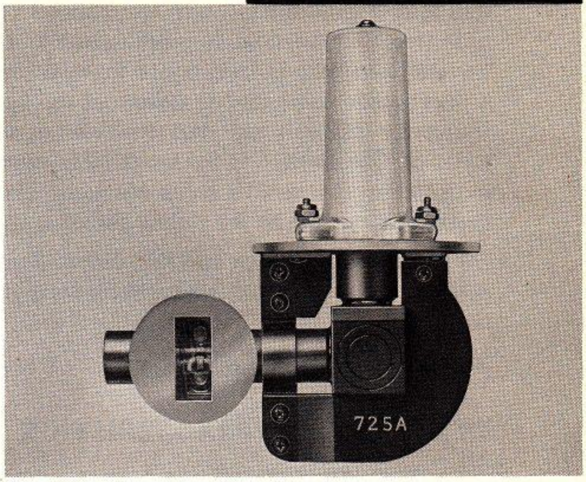
PULSED-TYPE MAGNETRON OSCILLATOR

TYPE 725-A



The type 725-A magnetron tube is a super-high frequency oscillator with internal resonant circuits, designed to operate in the "X Band" and capable of delivering 60 kilowatts of peak power under pulsed conditions.

GENERAL ELECTRICAL CHARACTERISTICS

Heater

Indirectly heated, oxide coated, unipotential cathode.

Heater voltage	6.3 V
Heater current	1.0 A
Minimum heating time	1 Minute

Maximum Ratings

Heater voltage	6.3+10% V
Peak anode voltage	16 kv
Peak anode current	16 a
Maximum duty cycle	.001
Maximum pulse width	2.5 us
Average input power	180 W
Frequency pulling	15 Mc
Anode temperature	100 °C.

The tube should not be operated longer than 5 microseconds in any 100 microsecond interval.

Minimum pressure at which output circuit will pass 50 kw. without breakdown – 0.3 Atmosphere

Typical Operation

Magnetic field intensity	5400 gauss
Recurrence frequency	1000 cycles per second
Pulse width	1 μs
Peak anode voltage	12 kv
Peak anode current	12 a
Peak power output	50 kw
Frequency change due to temperature	.25 mc/°C. Max.
Frequency (fixed frequency in the following range)	9345-9405 Mc

DETAILED MECHANICAL INFORMATION

The outline drawing shows the principal external dimensions, arrangement of heater-cathode terminals, and output coupling flange. The letter "C" etched on the glass protector indicates the common heater-cathode terminal which is connected internally to one end of the heater. It is this cathode terminal which is connected to the pulsating high voltage. No direct connection is made to the output circuit of the tube.

The tube is mounted from the circular flange and may be operated in any orientation. The output circuit of the tube is preplumbed to have a certain frequency pulling figure for operation into a waveguide load and is designed for optimum frequency insensitivity and breakdown characteristics. The coaxial to the waveguide junction is matched so that a little or no electrical reflection exists in any part of the output circuit.

Both mounting flange and R.F. output flange are suitable for application where pressure seals are required.

Net weight of 725-A magnetron 1 Lb. 7 Oz.

OPERATING CHARACTERISTICS

The Rieke Diagram, Figure 1, shows the power and frequency contours for a typical tube operating into a ½"×1⅛" (internal dimensions) waveguide with standing wave ratio and phase angle varied. The pulling figure at 1.5 ratio in voltage is 11.5 megacycles. It should be noted that this data is representative of average tubes and was taken under conditions simulating typical operating characteristics. Slight variations may be expected with different tubes in different systems.

Figure 2 shows the magnetic field, peak power output, frequency and efficiency contours as a function of pulsed voltage and current for a typical tube.

Figure 3 shows the change of frequency as a function of sinusoidal acceleration (G) for a typical tube.

OPERATING NOTES

Satisfactory operation of the tube will depend largely on the waveform characteristics of the input voltage pulse, which should fulfill the following conditions:

Time of rise — 0.1 to 0.2 microsecond.

Time of fall — less than 0.4 microsecond.

Variation of voltage — less than 10% of total at top of pulse.

A poor pulse shape may cause excessive frequency modulation and general instability.

It is recommended that the magnetic field be produced between circular pole tips 0.750±.015 inches in diameter separated by 0.635+.005—.000 inches tapering uniformly from the tips to 1.156 ±.015 inch diameter in .430±.005 inches measured along the axis of each pole tip element. The tube should be operated with the North-seeking pole of the magnet adjacent to the cathode.

Adequate forced air should be provided to keep the anode temperature of the tube less than 100° C.

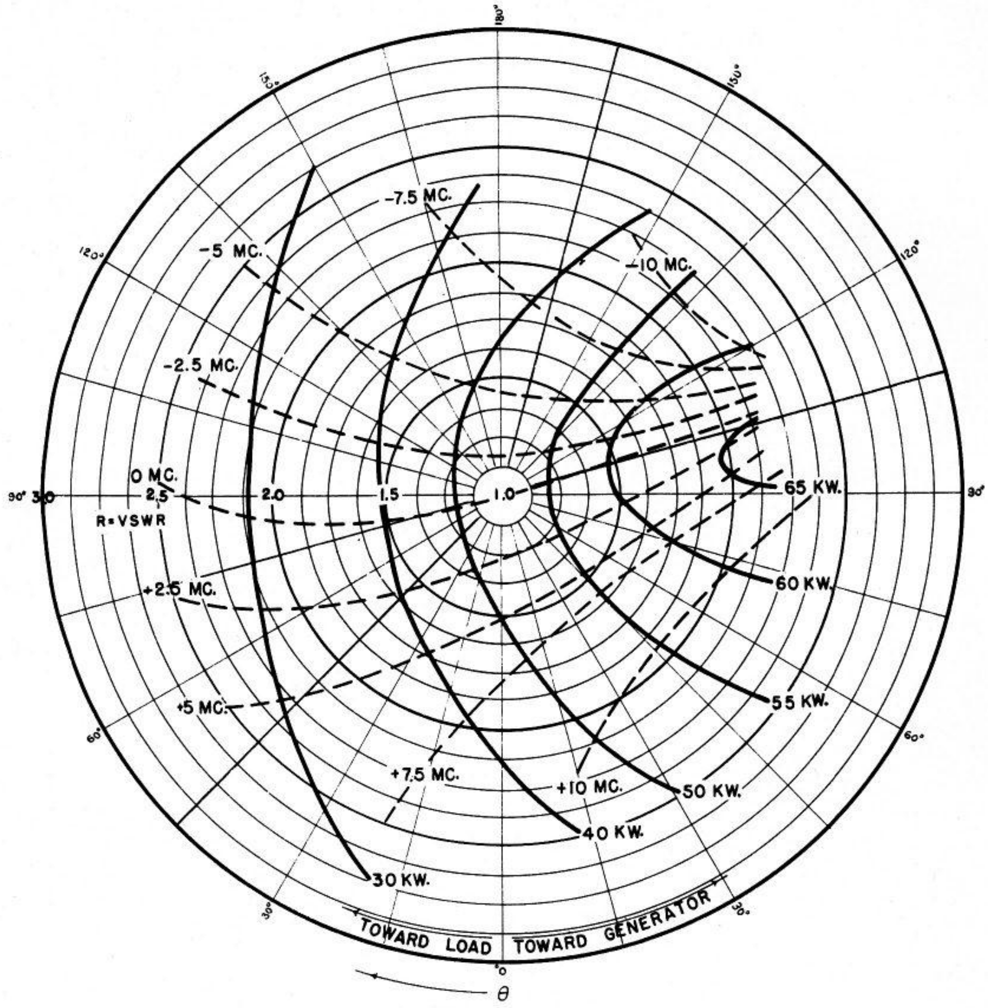
The life of the 725-A magnetron is limited by the usefulness of the cathode. In general, magnetron life is inversely proportional to pulse width and duty cycle. It is therefore recommended that the tube be operated at a low recurrence rate when high peak power is required. The use of a transmission line not properly matched to the magnetron is another factor reducing the life of the magnetron. This is due to excessive cathode heating.

Heater voltage should be turned on one minute before the high voltage pulsations are applied. The tube is to be started at the rated heater power and then reduced in proportion to the average total dissipation such that it becomes zero at 50 watts dissipation. For high voltage pulsed operation at recurrence rates exceeding 500 cycles per second, it is essential to reduce the heater voltage to zero for a duty cycle of 0.001 for average input powers of 100 watts or greater. Reduction of heater voltage to 3.0 volts for duty cycle of 0.0005 for average input powers of 100 watts or greater, and to intermediate values from 0 to 6.3 volts for other duty cycles and power input combinations is recommended. At pulse recurrence rates less than 500 cycles per second, 2.5 volts minimum heater potential should be applied. Failure to start the tube at the rated heater power or to improperly reduce the heater power after oscillation starts may seriously reduce the life of the tube.

In starting a new magnetron, a temporary unsteadiness in its operation may result. It is recommended that the tube be "seasoned" under prevailing conditions of oscillation to the point where it becomes stable and normal operating values are obtained.

AVERAGE PERFORMANCE CHARACTERISTICS

FREQUENCY-POWER CONTOUR DIAGRAM



RIEKE DIAGRAM

FIGURE 1

OPERATING CONDITIONS

Recurrence rate = 1000 cps

Pulse width = 1 microsecond

Magnetic field = 5400 gauss

Average magnetron current = 12.0 mAdc

Recommended load for 725-A at center of diagram.

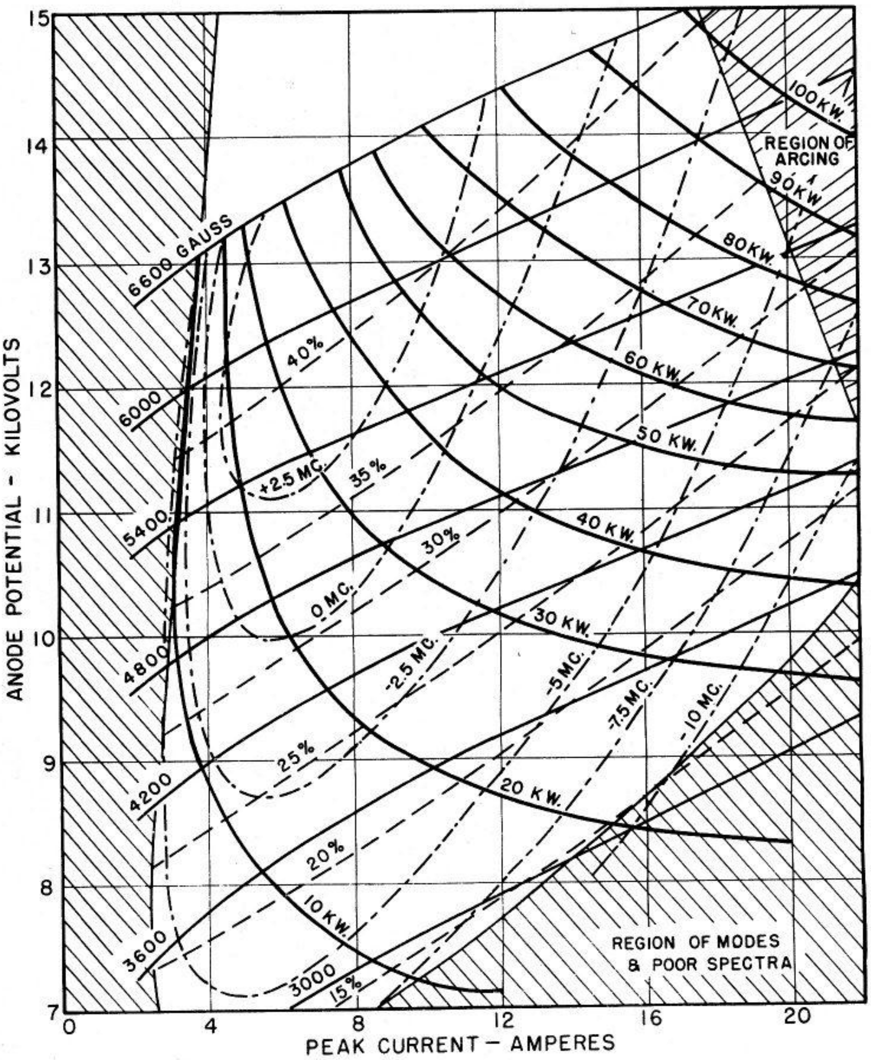
R = Standing wave ratio in voltage.

θ = Distance of standing wave minimum from face of output flange of tube toward load.

——— = Power contours (peak Kw.).

– – – = Frequency contours (megacycles deviations from frequency of magnetron feeding into a matched line).

AVERAGE PERFORMANCE CHARACTERISTICS



OPERATING CHARACTERISTICS

FIGURE 2

Recurrence rate = 1000 cps

Pulse width = 1 microsecond

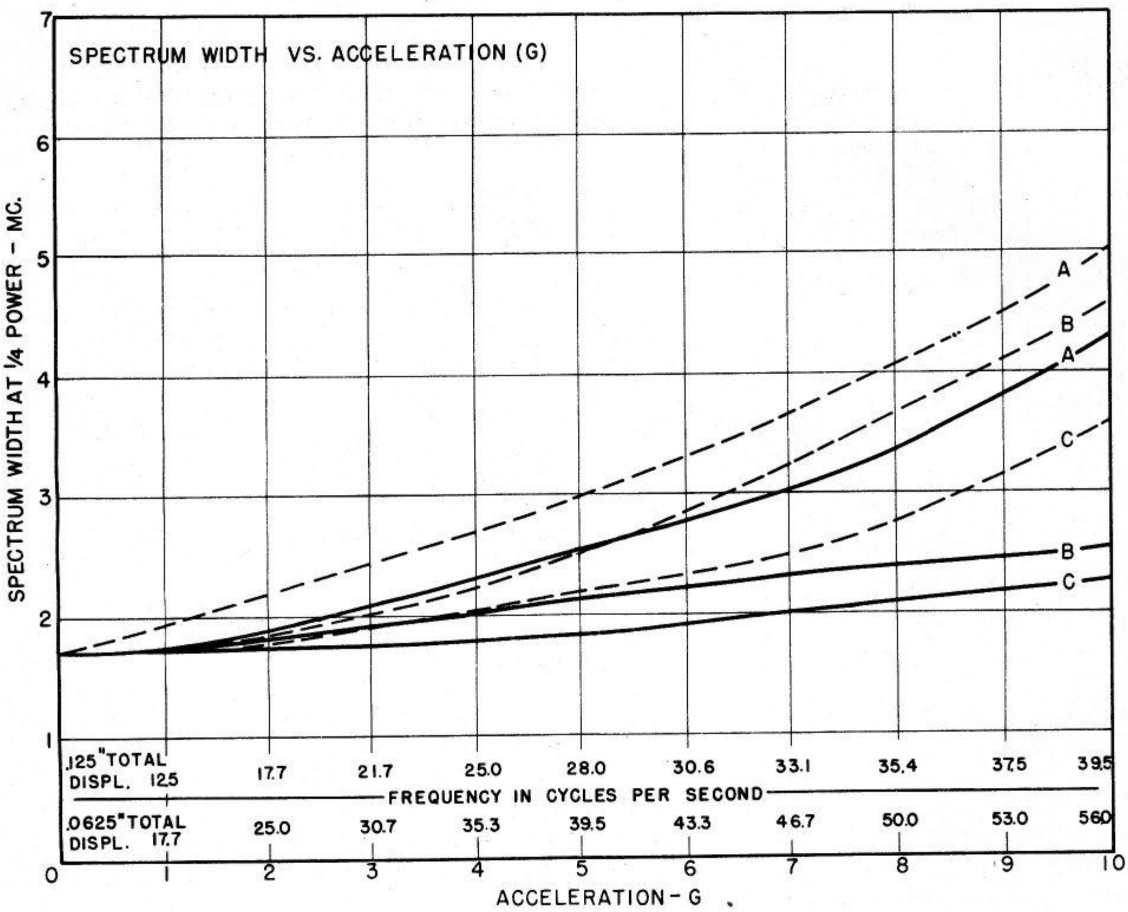
——— = Magnetic field (gauss)

▬▬▬ = Peak power (kilowatts)

— — — = Efficiency

—·— = Frequency contours (megacycles deviation from mean frequency as determined by corresponding Rieke Diagram, and taken under conditions of constant temperature).

AVERAGE PERFORMANCE CHARACTERISTICS



VIBRATION CHARACTERISTICS

FIGURE 3

——— = .125″ Total Displacement

— — — = .0625″ Total Displacement

Recurrence rate = 1000 cps

Average magnetron current = 12 mAdc

Magnetic field = 5400 gauss

Curve A = Displacement perpendicular both to length of cathode and filament leads.

Curve B = Displacement perpendicular to filament leads and along length of cathode.

Curve C = Displacement perpendicular to length of cathode and along length of filament leads.

OUTLINE DRAWING