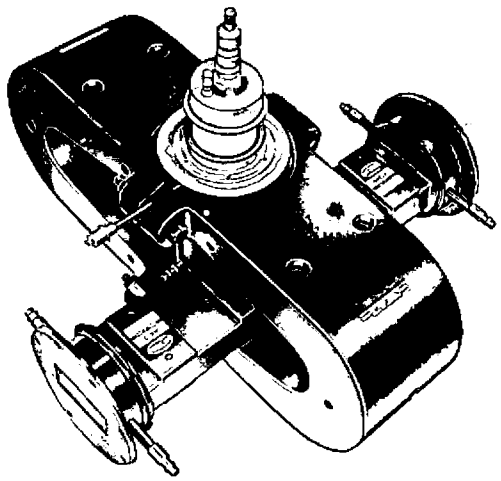
RAYTHEON

TECHNICAL INFORMATION

Excellence in Electronics

TYPE 8129

GENERAL DESCRIPTION



The 8129 is a pulsed-type Amplitron capable of producing a minimum peak power output of 3 megawatts when an rf drive power no less than 550 kilowatts is applied to its input. When used with a modulator having proper load line characteristics, such as a "line type" modulator, it will cover the frequency band 2900 Mc to 3100 Mc without mechanical or electrical adjustment. It is an integral magnet type tube with waveguide input and output and requires forced liquid cooling.

Detailed information necessary for specific applications may be obtained by contacting the Product Programs Department, Microwave and Power Tube Division, Raytheon Company, Spencer Laboratory, Burlington, Massachusetts.

PULSED-TYPE AMPLITRON

GENERAL CHARACTERISTICS

ELECTRICAL

Heater Characteristics

No Heater Power Required For Most Applications

Typical Operation

Pulse Duration	11	10 usec
Duty Cycle	.0055	.0050
Peak Anode Voltage @ 2900 Mc	48	50 kv
Peak Anode Voltage @ 3100 Mc	52	54 kv
Peak Anode Current	20	66 a
Average Anode Current	110	330 mAdc
Peak Power Output	600 kw	3.0 Mw
Average Power Output	3300	15,000 W
Frequency Band	2900-3100	2900-3100 Mc
RF Driver Characteristics		
Peak Drive Power	48 kw	550 kw min.
Frequency Band	2900-3100	2900-3100 Mc

The driver rf pulse must coincide with or overlap the Amplitron current pulse.

Cold Insertion Loss	0.5 db

Printed in U.S.A.

MECHANICAL

Over-all Dimensions	20" x 16.8" x 16.7"
Net Weight	110 lbs.
Mounting	Cathode Axis Vertical
Output Coupling	Mates with UG54A/U type flange
Input Coupling	Mates with UG54A/U type flange
Input Pressurization	35 psia
Output Pressurization	45 psia
Cooling	Forced Liquid
Magnet Protection	12"

DETAILED ELECTRICAL INFORMATION

HEATER-CATHODE

This tube does not require heater power for most applications. Satisfactory starting and operation will occur whenever the pulse voltage is applied in the presence of normal rf drive power.

TYPICAL OPERATION

Figure 1 illustrates a typical Amplitron circuit. The driver tube may be a magnetron, Amplitron, traveling wave tube, or other device capable of supplying at least the minimum required rf input power. An isolator will normally be required between the Amplitron and its driver because reverse directed power reflected from the load mismatch is practically unattenuated by the Amplitron. The amount of isolation necessary will depend upon the gain of the Amplitron, the VSWR of the load and the amount of mismatch the driver can withstand.

The relationship $|\Gamma_i| |\Gamma_o| G < 1$ must be maintained to eliminate oscillation, where G is the power gain of the Amplitron and Γ_i and Γ_o are the input and output reflection coefficients measured at the input and output terminals looking away from the tube.

TYPICAL OPERATION

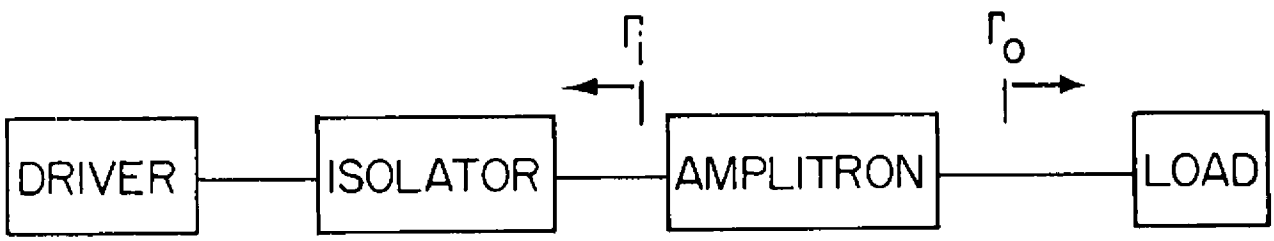


Figure 1

OPERATING CHARACTERISTICS

The operating characteristics of the 8129 for high power operation is shown in Figure 2 below. With peak current and driver power held constant the output power, gain, efficiency and peak voltage are plotted versus frequency. Gain and efficiency are defined as follows:

$$\text{Gain} = \frac{\text{rf power output}}{\text{rf power input}}$$

$$\text{Efficiency} = \frac{\text{rf power output} - \text{rf power input}}{\text{Modulator power input to Amplitron}}$$

8129 TYPICAL OPERATING CHARACTERISTICS

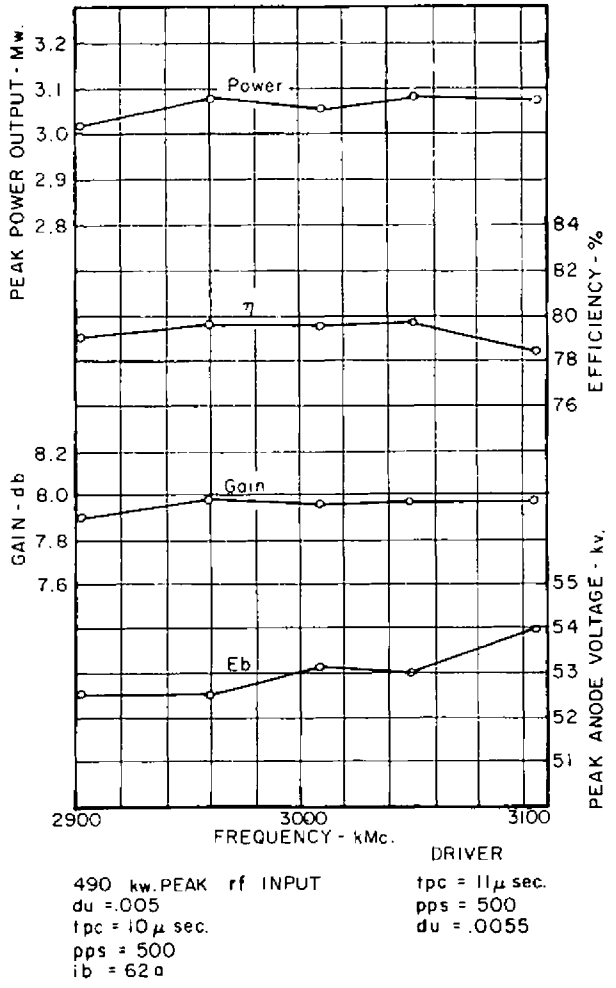


Figure 2

LOAD MISMATCH

The nature of the 8129 is such that output power is less sensitive to load mismatch than is common in magnetrons. Power is a maximum with a matched load and decreases as the load mismatch becomes greater causing more power to be reflected back through the Amplitron into the input circuit.

PHASE SHIFT CHARACTERISTICS

In many applications, MTI operation in particular, it is desirable that the phase delay in a given tube be as independent as possible of variations of voltage or current pulse amplitude. Phase pushing in the 8129 is on the order of 0.5 degrees per 1% change in peak current. The total phase change occurring in the 8129 during the pulse rise and fall is only a few degrees and takes place during the last small part of the voltage rise as well as during the first small part of the voltage fall.

DRIVER REQUIREMENTS

Amplitrons must have a driving signal applied to them for proper operation. The driving signal may be applied either before or at the same instant the Amplitron is turned on and may be removed either after or at the same time the Amplitron is turned off. The magnitude of the rf output is insensitive to rf input but dependent on the pulsed dc input. If the rf drive for a given level of pulsed dc input is reduced to too low a value, the tube ceases to operate properly. Moreover, the consequent instability can damage the tube.

VOLTAGE-CURRENT CHARACTERISTICS

The voltage-current characteristic of an Amplitron is non-linear, resembling that of a magnetron oscillator. A representative value for the dynamic impedance of an 8129 would be 160 ohms.

COOLING

The 8129 is a forced liquid cooled tube. The coolant to be used will depend on the average power level and ambient temperature requirements which will determine the coolant flow rate. Figure 3 is a plot of water coolant flow rate as a function of pressure drop.

CATHODE BUSHING PROTECTION

It is recommended that the ceramic cathode bushing be immersed in a fluid insulating medium of "Univolt 35" transformer oil or equivalent. A minimum distance of 1½" must be maintained through the oil from high voltage to ground. No sharp-edged objects should be in the vicinity of the cathode bushing.

If the 8129 is mounted with the cathode bushing vertically downward, the oil vent pipe provided on the tube must be used to remove all air trapped in the Amplitron oil flange area. A puncture and loss of the vacuum seal may result from arcing near the ceramic cathode bushing.

PRESSURIZATION

Output waveguide pressurization to 45 psia is required. An input waveguide pressure of 35 psia is satisfactory. Pressures lower than those recommended may result in waveguide breakdown If sustained arcing in the waveguide occurs, failure of the output window may result. To minimize the possibility of arcing in the guide, and to achieve optimum performance, the load VSWR should be kept as low as possible.

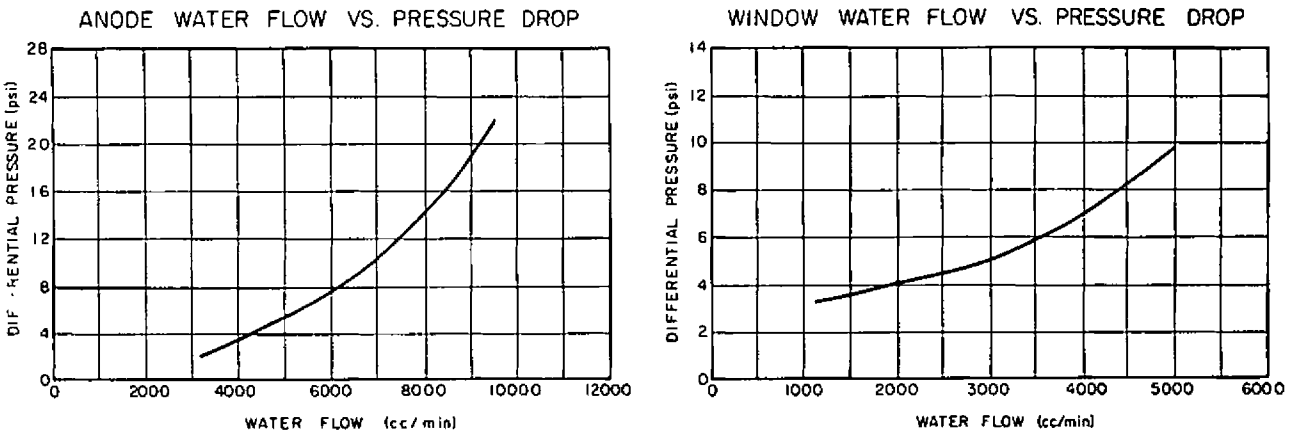


Figure 3

GENERAL PRECAUTIONS

Damage to the Amplitron will be avoided if the following installation and handling precautions are carefully observed:

1. Avoid setting up mechanical strains on input and output windows and cathode bushing when handling or mounting.
2. If the Amplitron has been operated with water as a coolant, be sure to drain the water from the coolant jacket before storing in a freezing environment.
3. If an Amplitron has been stored in a freezing environment, examine it closely for traces of frost or moisture on the rf windows and wipe dry before application of high voltage.
4. Avoid unnecessary jarring or rough handling.
5. Do not place tube in closer proximity to magnetic materials than is specified.

8129 ELECTRON TUBE OUTLINE DRAWING

REFERENCE PLANE "A" IS DEFINED AS A PLANE PASSING ALONG THE MOUNTING SURFACE OF THE MAGNET AS SHOWN.

REFERENCE PLANE "B" IS DEFINED AS A PLANE PERPENDICULAR TO REFERENCE PLANE "A" PASSING THRU THE ℄ OF HOLES AT REFERENCE PLANE "A" AS SHOWN.

REFERENCE PLANE "C" IS DEFINED AS A PLANE MUTUALLY PERPENDICULAR TO REFERENCE PLANES "A" & "B" PASSING THRU THE ℄ OF "Y" HOLE AT REFERENCE PLANE "A" AS SHOWN.

1. THIS FLANGE TO MATE WITH UG-54 A/U WITH CLEARANCE HOLES.
2. MATES WITH HANSEN SERIES #3000 SOCKET OR EQUIVALENT.
3. ANODE TEMPERATURE POINT.
4. MATES WITH WIGGINS #P1700 SERIES OR EQUIVALENT.
5. THIS DIMENSION APPLIES TO THE ℄ OF 5.300 - 5.325 DIAMETER.
6. COMMON CATHODE CONNECTION.
7. THESE SURFACES TO BE COPLANER WITHIN .032.
8. RF OUTPUT.
9. RF INPUT.
10. THESE HOLES WILL ACCEPT A GAGE CONSISTING OF FOUR .385 DIAMETER PINS, 7.125 LONG, 3.000 APART x 10.500 APART.
11. THIS DIMENSION APPLIES TO THE AXIS OF DIAMETER "X".

REFERENCES

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The Amplitron: Raytheon Technical Information Bulletin, June, 1958.

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Description and Operating Characteristics of the Platinotron — A New Microwave Tube Device: W. C. Brown, Proceedings of the IRE, September, 1957.

QKS622 Final Engineering Report, BuShips Contract No. NObsr-72589.

A 3-Megawatt, 15 Kilowatt S-Band Amplitron — Smith and Zawada, Microwave Journal, October 1959.

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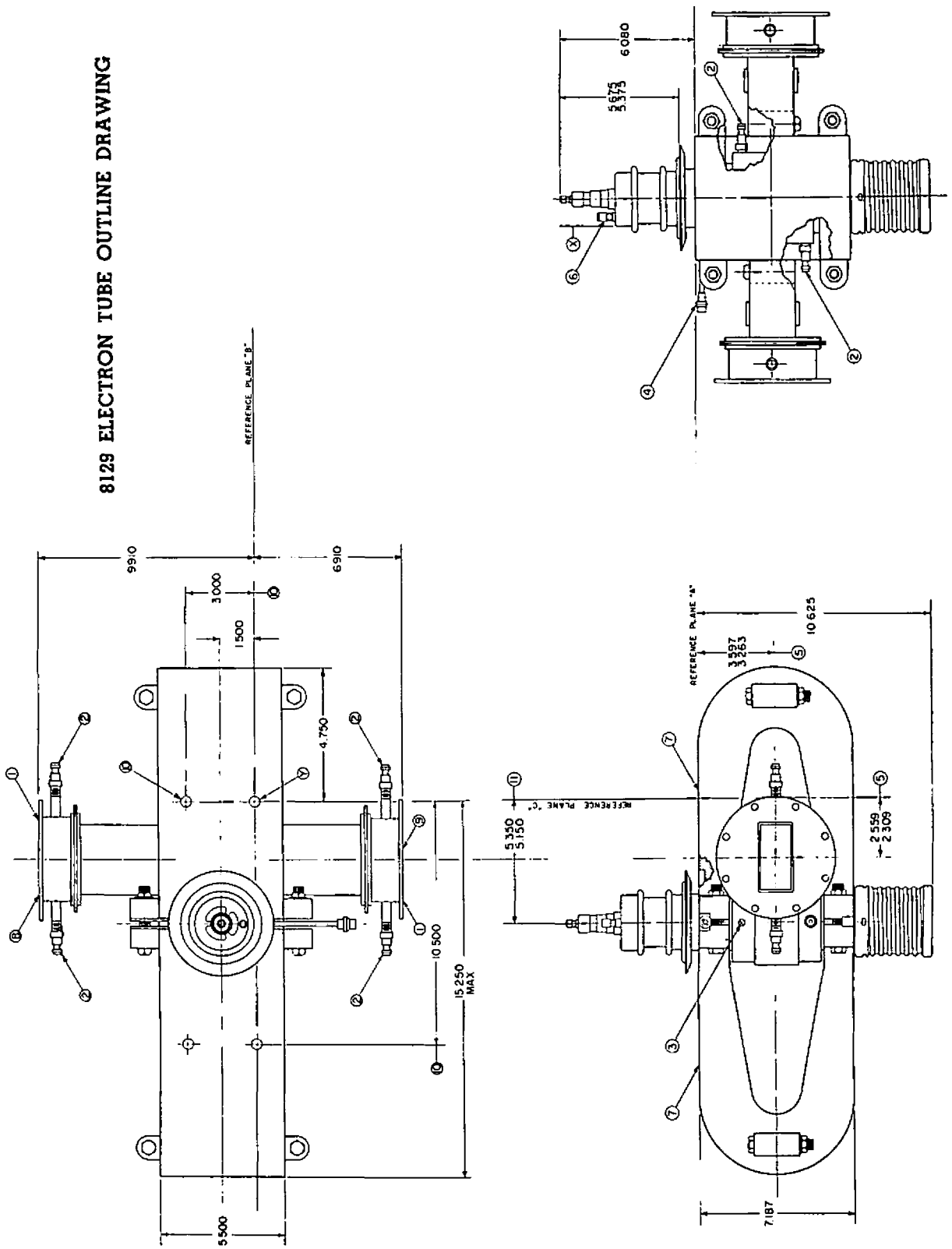

MICROWAVE AND POWER TUBE DIVISION

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