MG5222
X-Band Magnetron

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The data should be read in conjunction with the Magnetron Preamble.

ABRIDGED DATA

Fixed frequency pulse magnetron. Direct replacement for the M5039, being mechanically and electrically interchangeable and tested to the same electrical specification. Under most conditions it offers enhanced operating life.

Operating frequency	9375 ± 30	MHz
Typical peak output power	25	kW
Magnet		integral
Output		no. 16 waveguide (22.86 x 10.16 mm internal)
Coupler		UG-40B/U (NATO S.N. 5985-99-083-0051)
Cooling		natural or forced-air

GENERAL

Electrical

Cathode		indirectly heated
Heater voltage (see note 1)	6.3	V
Heater current at 6.3 V	0.55	A
Heater starting current, peak value, not to be exceeded	3.0	A max
Cathode pre-heating time (minimum) (see note 2)	60	s

Mechanical

Overall dimensions	see outline
Net weight	1.5 kg approx
Mounting position	any

A minimum clearance of 50 mm must be maintained between the magnet and any magnetic materials.

Cooling . . . . natural or forced-air

MAXIMUM AND MINIMUM RATINGS
(Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating should be exceeded.

	Min	Max	
Heater voltage (see note 1)	5.7	6.9	V
Heater starting current (peak)	–	3.0	A
Anode voltage (peak)	7.5	8.5	kV
Anode current (peak)	6.0	10	A
Input power (peak)	–	75	kW
Input power (mean) (see note 3)	–	85	W
Duty cycle	–	0.0015	
Pulse duration	–	2.0	μs
Rate of rise of voltage pulse (see notes 4 and 5)	–	200	kV/μs
Anode temperature (see note 6)	–	120	°C
VSWR at the output coupler	–	1.5:1	

TYPICAL OPERATION
Operating Conditions

	1	2	
Heater voltage	6.3	6.3	V
Anode current (peak)	8.0	8.0	A
Pulse duration	1.0	0.1	μs
Pulse repetition rate	1000	1000	pps
Rate of rise of voltage pulse	170	170	kV/μs

Typical Performance

Anode voltage (peak)	8.2	8.2	kV
Output power (peak)	25	25	kW
Output power (mean)	25	2.5	W

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TEST CONDITIONS AND LIMITS

The magnetron is tested to comply with the following electrical specification.

Test Conditions

	Oscillation 1	Oscillation 2	Oscillation 3	
Heater voltage (for test)	6.3	4.0	4.0	V
Anode current (mean)	1.6	8.0	8.0	mA
Duty cycle	0.0002	0.001	0.001	
Pulse duration (see note 7)	0.05	0.5	1.0	μs
VSWR at the output coupler	1.15:1	1.15:1	1.5:1	max
Rate of rise of voltage pulse (see note 4):				
using hard tube pulser	200	200	200	kV/μs min
alternatively using line type pulser	120	120	120	kV/μs min

Limits

	Min	Max	Min	Max	Min	Max	
Anode voltage (peak)	-	-	7.5	8.5	7.5	8.5	kV
Output power (mean)	4.0	-	20	-	-	-	W
Frequency (see note 8)	-	-	9345	9405	-	-	MHz
RF bandwidth at $^1/_4$ power	-	-	-	5.0	-	2.5	MHz
Frequency pulling (VSWR not less than 1.5:1)	-	-	-	18	-	-	MHz
Stability (see note 9)	-	-	-	0.25	-	0.25	%
Moding							see note 10
Heater current							see note 11
Temperature coefficient of frequency							see note 12

LIFE TEST

The quality of all production is monitored by the random selection of tubes which are then life-tested under Test Conditions Oscillation 2. If the tube is to be operated under conditions other than those specified herein, e2v technologies should be consulted to verify that the life of the magnetron will not be impaired.

End of Life Criteria (under Test Conditions Oscillation 2)

Anode voltage (peak)	7.5 to 8.5	kV
Output power (peak)	16	kW min
RF bandwidth at $^1/_4$ power	5.0	MHz max
Frequency	9345 to 9405	MHz
Stability (see note 9)	1.0	% max

NOTES

1. With no anode input power.

   For average values of pulse input power greater than 40 W the heater voltage must be reduced within 3 seconds after the application of HT according to the following schedule:

   $$V_h = 0.08\,(110 - Pi) \text{ volts}$$

   where Pi = average input power in watts.

   The magnetron heater must be protected against arcing by the use of a minimum capacitance of 4000 pF shunted across the heater directly at the input terminals; in some cases a capacitance as high as 2 μF may be necessary depending on the equipment design. For further details see the Magnetron Preamble.

2. For ambient temperatures above 0 °C. For ambient temperatures between 0 and −55 °C the cathode pre-heating time is 90 seconds.

3. The various parameters are related by the following formula:

   $$Pi = i_{apk} \times v_{apk} \times Du$$

   where Pi = mean input power in watts
   i_{apk} = peak anode current in amperes
   v_{apk} = peak anode voltage in volts
   and Du = duty cycle.

4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance in the viewing system must not exceed 6.0 pF.

5. The maximum rate of rise of voltage for stable operation depends upon detailed characteristics of the applied pulse and the pulser design. The specified maximum rating applies to typical hard tube pulsers. For minimum starting jitter and optimum operation, the recommended rate of rise of voltage for most line type pulsers is from 70 to 120 kV/μs.

6. The anode temperature measured at the point indicated on the outline drawing must be kept below the limit specified by means of a suitable flow of air over the anode body and waveguide attachment brackets which serve as cooling fins.

7. Tolerance ± 40%.

8. Other frequency ranges can be supplied on request.

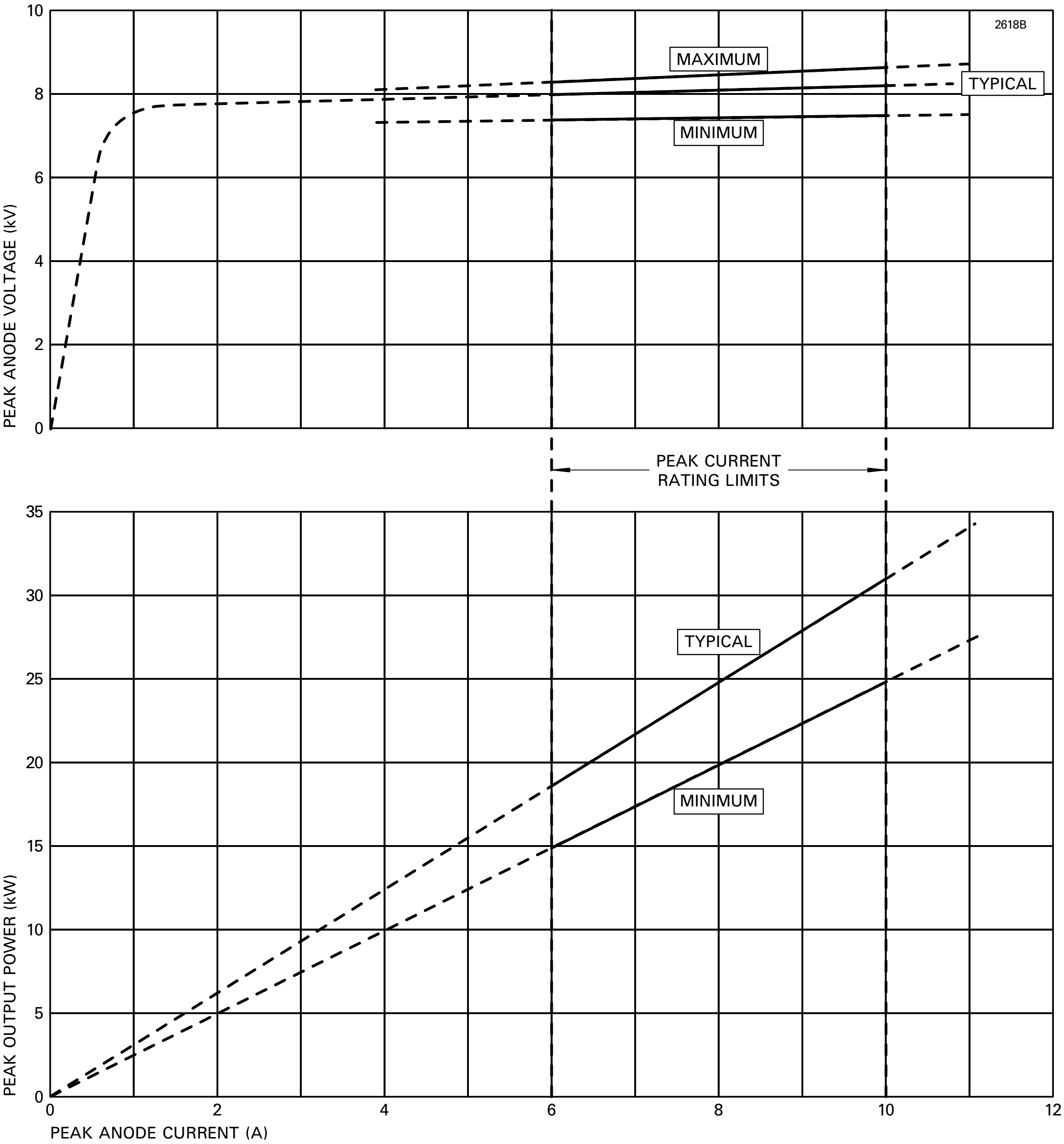
9. With the magnetron operating into a VSWR of 1.15:1. Pulses are defined as missing when the RF energy level is less than 70% of the normal energy level in a 0.5% frequency range. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of 10 minutes operation.

10. In addition to missing pulse count measurements, the tube is checked for possible moding using a monitor diode.

11. Measured with heater voltage of 6.3 V and no anode input power, the heater current limits are 0.43 A minimum, 0.60 A maximum.

12. Design test only. The maximum frequency change with anode temperature change (after warming) is −0.25 MHz/°C.

TYPICAL PERFORMANCE CHART



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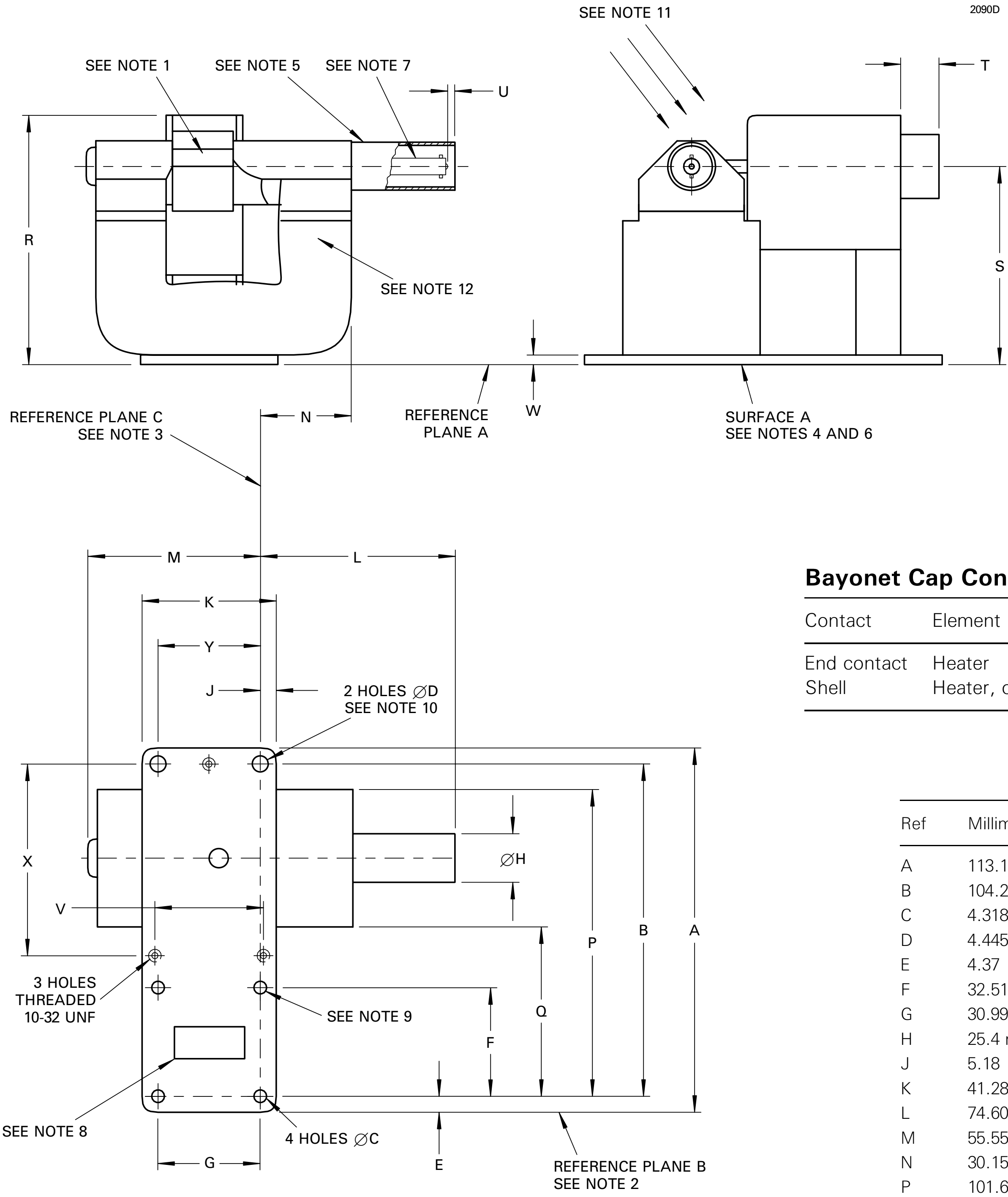
OUTLINE
(All dimensions without limits are nominal)



Bayonet Cap Connections

Contact	Element
End contact	Heater
Shell	Heater, cathode

Ref	Millimetres
A	113.11 ± 0.38
B	104.22 ± 0.10
C	4.318 ± 0.076
D	4.445 ± 0.076
E	4.37 ± 0.41
F	32.51 ± 0.10
G	30.99 ± 0.10
H	25.4 max
J	5.18 ± 0.38
K	41.28 ± 0.41
L	74.60 ± 3.18
M	55.55 max
N	30.15 max
P	101.6 max
Q	48.01 min
R	84.12 max
S	63.5
T	12.7
U	3.18 max
V	31.75
W	3.18
X	60.78
Y	30.99 ± 0.10

Outline Notes

1. Anode temperature measured at this point. Paint should be removed from this point before temperature measurement is made.
2. Reference plane B passes through the centres of the two holes of the mounting plate as shown and is perpendicular to reference plane A.
3. Reference plane C intersects plane B at the centre of the mounting plate hole as shown and is mutually perpendicular to reference planes A and B.
4. With surface A resting on a flat surface plate, a feeler gauge 0.51 mm thick and 3.18 mm wide will not enter more than 3.18 mm at any point.
5. The axis of the heater lead protector will be within 5° of a normal to reference plane C.
6. Surface A and interior surfaces of the waveguide will be plated with 1.55 mg/cm^2 of gold or 4.65 mg/cm^2 of silver, but will not be plated if the parts are made of monel or equivalent corrosion resistant materials. All other metal surfaces will be painted with heat resistant paint or otherwise treated to prevent corrosion.
7. The clearance between the inside surface of the protector and the 9.53 mm diameter cylindrical surface of the standard single contact miniature bayonet lamp base (B.S.52 (1952) Type BA9s/14) will not be less than 3.18 mm.
8. The position of the waveguide hole is not specified on this drawing since tubes are tested and used with coupler UG-40B/U (NATO S.N. 5985-99-083-0051).
9. The centre of this hole will lie within 0.102 mm of reference plane C.
10. These holes will lie within 0.127 mm of the indicated centres. A cylinder of 8.38 mm diameter and centred on these holes will clear the side of the magnet.
11. Recommended direction of air flow.
12. The north seeking pole of the magnet will be adjacent to the cathode sidearm.

HEALTH AND SAFETY HAZARDS

e2v technologies magnetrons are safe to handle and operate, provided that the relevant precautions stated herein are observed. e2v technologies does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipments incorporating e2v technologies devices and in operating manuals.

High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed and fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and other stored charges before allowing access. Interlock switches must not be bypassed to allow operation with access doors open.

RF Radiation

Personnel must not be exposed to excessive RF radiation. All RF connectors must be correctly fitted before operation so that no leakage of RF energy can occur and the RF output must be coupled efficiently to the load. It is particularly dangerous to look into open waveguide or coaxial feeders while the device is energised. Screening of the cathode sidearm of high power magnetrons may be necessary.

X-Ray Radiation

High voltage magnetrons emit a significant intensity of X-rays not only from the cathode sidearm but also from the output waveguide. These rays can constitute a health hazard unless adequate shielding for X-ray radiation is provided. This is a characteristic of all magnetrons and the X-rays emitted correspond to a voltage much higher than that of the anode.