M5008 M5009

C-BAND MAGNETRONS

ABRIDGED DATA

Fixed frequency pulse magnetrons

Frequency range:		
M5008	5250 to 5310	MHz
M5009	5450 to 5510	MHz
Typical peak output power	0.84	MW
Magnet and launching section	separate electro-magnet and launching section (see page 7 for dimensions)	
Isolator	use of an isolator is recommended (see note 7 on page 4)	
Output	no. 12 waveguide (1.872 x 0.872 inches internal)	
Cooling	water and forced-air	

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 1)	6.3	V
Heater current	13	A
Heater starting current, peak value, not to be exceeded	40	A max
Cathode heating time (minimum)	3.0	min

Mechanical

Overall dimensions	10.557 x 3.000 x 3.000 inches max 268.1 x 76.20 x 76.20mm max	
Net weight	3.8 pounds (1.73kg) approx	
Mounting position	any	

Cooling

water and forced-air

Water cooling of the anode is incorporated in the electro-magnet; the minimum rate of flow of cooling water is 1 imp. gal/min (4.54 l./min) with a maximum inlet temperature of 60°C.

The output window is cooled by high pressure air in the waveguide; the minimum window cooling air flow is 55g/min (42.5 l./min) with a maximum inlet temperature of 60°C.

Any lubricants used on the anode should be sulphur free.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Max	
Magnetic field (see note 2)	2900	3100	gauss
Heater voltage (see note 1)	5.85	6.75	V
Heater starting current (peak)	–	40	A
Cathode heating time (see note 1)	180	–	s
Anode current (peak)	55	65	A
Input power (mean) (see note 3)	–	3.0	kW
Duty cycle	–	0.0015	
Pulse length (see note 4)	–	3.0	μs
Rate of rise of voltage pulse (see note 5)	170	210	kV/μs
Anode temperature (see note 6)	–	150	°C
Cathode terminal temperature (see note 6)	–	150	°C
V.S.W.R. at the output coupler (see note 7)	–	1.3:1	
Pressurising of waveguide	45	65	lb/in^2
	3.16	4.57	kg/cm^2

TYPICAL OPERATION

Operational Conditions

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (peak)	60	A
Pulse length	2.5	μs
Pulse repetition rate	600	p.p.s.

Typical Performance

Anode voltage (peak)	34	kV
Output power (peak)	0.84	MW
Output power (mean)	1.25	kW

TEST CONDITIONS AND LIMITS

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

Test Conditions (see note 8)

Air flow		see note 9
Magnetic field (see note 10)	3000	gauss
Heater voltage (for test)	0	V
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length (see note 4)	2.5	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse (see note 5)	210	kV/μs min

Limits

	Min	Max	
Anode voltage (peak)	32	36	kV
Output power (mean)	1100	—	W
Frequency:			
M5008	5250	5310	MHz
M5009	5450	5510	MHz
R.F. bandwidth at ¼ power (see note 12)	—	1.0	MHz
Frequency pulling (see note 13)	—	10	MHz
Stability (see note 14)	—	0.25	%
Heater current			see note 15

LIFE TEST

The quality of all production is monitored by the random selection of valves which are then life-tested under the Life Test conditions below. If the valve is to be operated under conditions other than those specified herein, English Electric Valve Company Ltd. should be consulted to verify that the life of the valve will not be impaired.

Heater voltage	0	V
Magnetic field	3000	gauss
Anode current (mean)	90	mA
Duty cycle	0.0015	
Pulse length	2.5	μs
V.S.W.R. at the output coupler		see note 11
Rate of rise of voltage pulse	210	kV/μs min

End of Life Criteria (under Test Conditions above)

Output power (mean)	1.0	kW min
Bandwidth	1.25	MHz max
Stability	0.5	% max

NOTES

1. With no input power.

   Prior to the application of anode voltage, the cathode must be heated for at least 3 minutes by the application of 6.3 volts (±7½%) to the heater. Immediately after the application of anode voltage, the heater voltage must be reduced according to the mean input power as follows:

Mean Input Power (kW)	Heater Voltage ($V_{r.m.s.}$)
0 to 1	6.3 ± 0.45
1 to 2	4.0 ± 0.45
2 to 3	Zero

   The valve heater must be protected against arcing by the use of a minimum capacitance of 1.0μF shunted across the heater directly at the input terminals. A specially designed capacitor with coaxial connectors for mating with the valve input socket is available; details may be obtained from English Electric Valve Company Ltd. The valve is normally tested with a heater supply frequency of 50Hz. English Electric Valve Company Ltd. should be consulted if the valve is to be operated with a heater supply of any other frequency.

2. Measured at the point specified on the electromagnet (see page 7).

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. Tolerance ±10%.

5. The rate of rise of voltage is defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. Any capacitance used in the viewing system must not exceed 6.0pF.

6. Measured at the point specified on the valve outline (see page 6).

7. The magnetron will operate satisfactorily into a load with a v.s.w.r. of 1.3:1, at all phases of the mismatch. It will also operate into a load of v.s.w.r. 1.5:1, at all phases of the mismatch, but the valve characteristics may deteriorate and life may be impaired if such operation is for more than nominally short periods.

   It is recommended that the magnetron should be isolated from the load by means of an isolator of approved design. Information on the characteristics of a suitable isolator may be obtained from English Electric Valve Company Ltd.

8. The modulator must be such that the pulse energy delivered to the magnetron following an arcing pulse cannot greatly exceed the normal pulse energy.

9. During this test the waveguide air pressure must not exceed 45lb/in^2 (3.16kg/cm^2) absolute and the cooling air flow shall not exceed 55g/min. For the purposes of this specification the following conversions and equivalents are to be used:

   1 litre of dry air (normal temperature and pressure) weighs 1.293 gramme.

   1 cubic foot = 28.3 litres

   453.6 grammes = 1 pound

10. The value of the magnetic field must fall monotonically to between 87.5 and 92% of the value at the specified point at ± 1.100 inches (±27.94mm) along the magnetron axis from the specified point. The sense of the field must be such that a north seeking pole at the specified point will move towards the magnetron cathode terminal.

11. The v.s.w.r. of the specified load is that measured at the output flange of the launching section. The load v.s.w.r. for this test will be less than 1.05:1.

12. The v.s.w.r. of the load for this test will be at least 1.3:1 and the phase adjusted for maximum deterioration of spectrum shape.

13. The v.s.w.r. of the load for this test will be at least 1.3:1, varied through all phases of the mismatch.

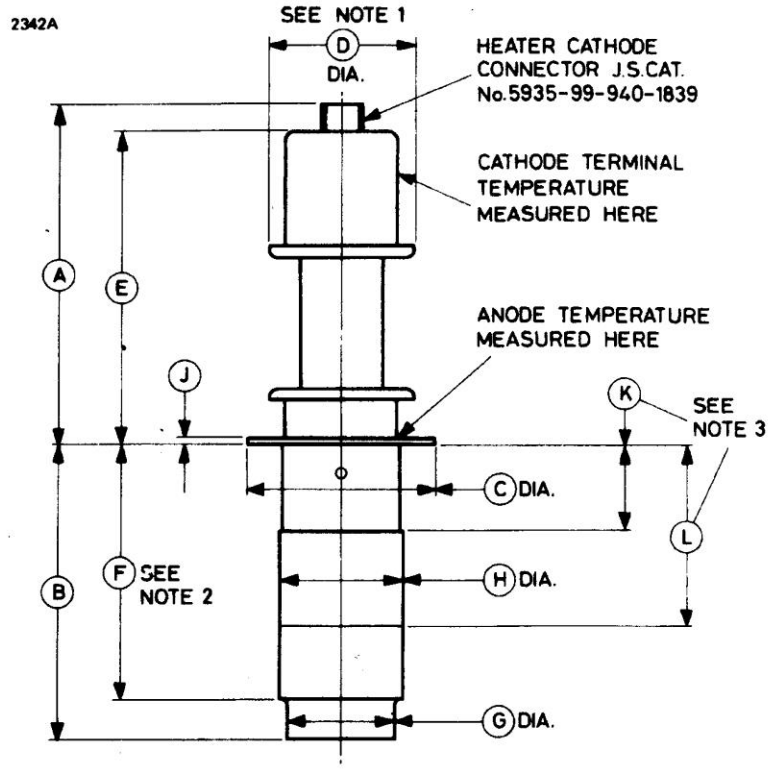
14. Stability is the ratio of missing pulses to the total number of input pulses. A pulse is considered to be missing when its energy is less than 70% of the normal energy level within the frequency band accommodating all the frequency bands plus an extension at each end of twice the pulling figure.

15. Measured with heater voltage of 6.3V and no anode input power, the heater current limits are 12A minimum, 14A maximum.

X-RAY WARNING

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.

OUTLINE



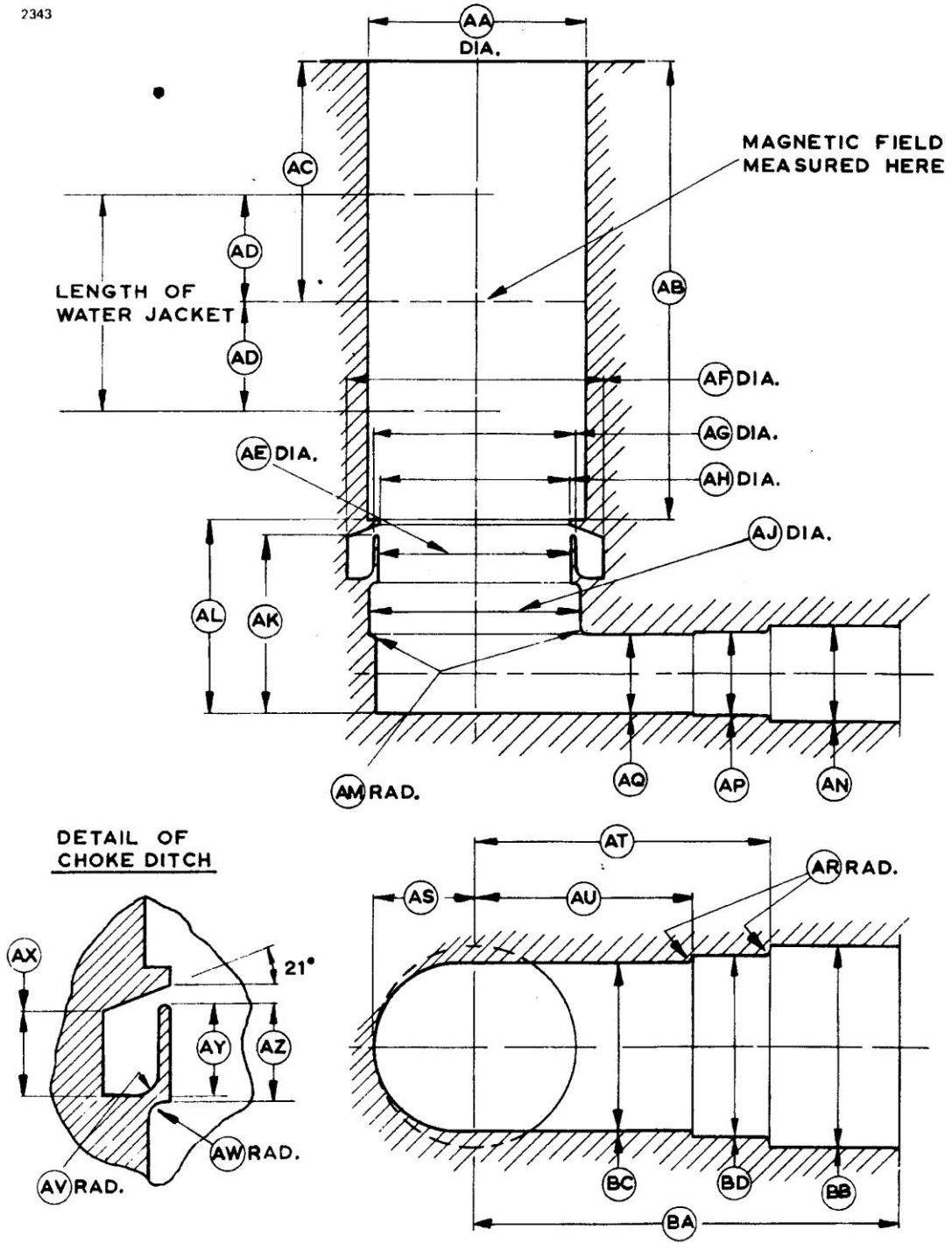
Ref	Inches	Millimetres	Ref	Inches	Millimetres
A	5.800 max	147.3 max	G	1.721 ± 0.010	43.71 ± 0.25
B	4.725 ± 0.032	120.02 ± 0.81	H	2.000 ± 0.001	50.800 ± 0.025
C	2.995 ± 0.005	76.07 ± 0.13	J	0.125 ± 0.005	3.18 ± 0.13
D	2.500 max	63.50 max	K	1.441 max	36.60 max
E	5.225 max	132.7 max	L	2.936 min	74.57 min
F	4.100 ± 0.022	104.14 ± 0.56			

Millimetre dimensions have been derived from inches.

Outline Notes

1. All cathode terminal features will lie within a cylinder of diameter D, concentric with datum diameter H.
2. All features over this length will lie within a cylinder of diameter 2.001 inches (50.825mm), concentric with datum diameter H.
3. Diameter H will be maintained between these dimensions.

ELECTRO-MAGNET AND LAUNCHING SECTION



DIMENSIONS FOR ELECTRO-MAGNET AND LAUNCHING SECTION

Ref	Inches	Millimetres
AA	$2.002^{+0.002}_{-0.000}$	$50.851^{+0.051}_{-0.000}$
AB	4.145 ± 0.010	105.3 ± 0.25
AC	2.200	55.88
AD	1.000 min	25.40 min
AE	1.757	44.63
AF	2.346 ± 0.003	59.588 ± 0.076
AG	1.844	46.84
AH	1.757 ± 0.003	44.627 ± 0.076
AJ	1.959 ± 0.003	49.758 ± 0.076
AK	1.672	42.47
AL	1.812	46.02
AM	0.062	1.57
AN	0.870	22.10
AP	0.772	19.61
AQ	0.725	18.42
AR	0.020	0.51
AS	0.901	22.89
AT	2.687 ± 0.016	68.25 ± 0.41
AU	1.969 ± 0.016	50.01 ± 0.41
AV	0.100	2.54
AW	0.062	1.57
AX	0.392	9.96
AY	0.4215 ± 0.0025	10.706 ± 0.064
AZ	0.4415 ± 0.0025	11.214 ± 0.064
BA	3.875 ± 0.016	98.43 ± 0.41
BB	1.872	47.55
BC	1.536	39.01
BD	1.652	41.96

Millimetre dimensions have been derived from inches.