PRODUCT INFORMATION FROM EMI-VARIAN

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Cables : EMIVAR LONDON

A member of the EMI Group of companies.
International leaders in Electronics, Records and Entertainment

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EMI-Varian Limited

EMI-Varian market a wide range of microwave tubes and associated devices for use in radar, communications and broadcasting systems.

The range includes,

Reflex klystrons.
2-Cavity klystron oscillators.
Backward wave oscillators.
Magnetron oscillators.
Travelling wave tubes.
High and low power klystron amplifiers.
Solid state products.
Microwave components.
Microwave mixer pre-amplifiers.
R.F. amplifiers, converters and components.
I.F. amplifiers and components.
Microstrip circuits.
Strip transmission line components.
Pulse modulation receivers.
Xenon lamps.
Communication transistors.
Power Grid Tubes.

Details of all these components and advice on their application and installation are readily available from EMI-Varian's team of specialist marketing engineers. For further information telephone either EMI-Varian or your nearest sales office, a list of which appears on the inside back cover.

Brochures available from EMI-Varian Ltd include :

Reflex Klystrons and Cavities.
Ceramics in Electronics.
Microwave Products and Ceramic Components.
High-power Microwave Tubes.
Low Noise Travelling Wave Amplifiers.
Introduction to Dither Tuned Magnetrons.
Introduction to Coaxial Magnetrons.
Introduction to Pulsed Crossed-field Amplifiers.
Solid State Microwave Products.
Gunn-Effect Oscillators.
The Coaxial Magnetron.

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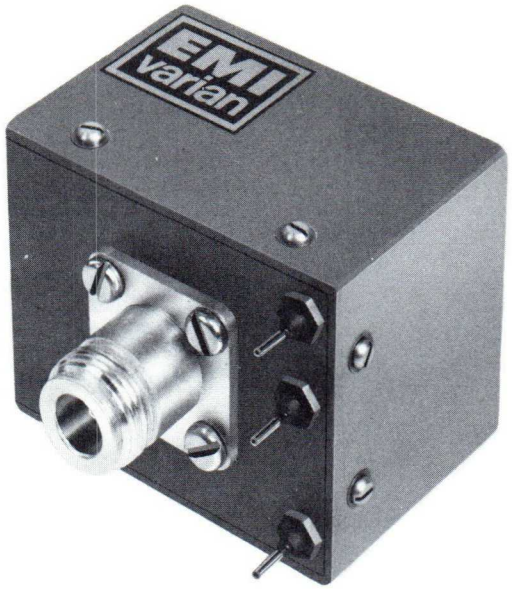
U.H.F. Oscillator type S30,006

This transistor oscillator which gives a power output of 500 mW operates at discrete frequencies in the 600–900 MHz band. A varactor diode is used to provide electronic tuning.



Specification

Input voltage	– 28V
Input current	120 mA
Frequency range	600 – 900 MHz
Electronic tuning	40 MHz
Power output (min)	500 mW

Higher power levels can be provided to special order.

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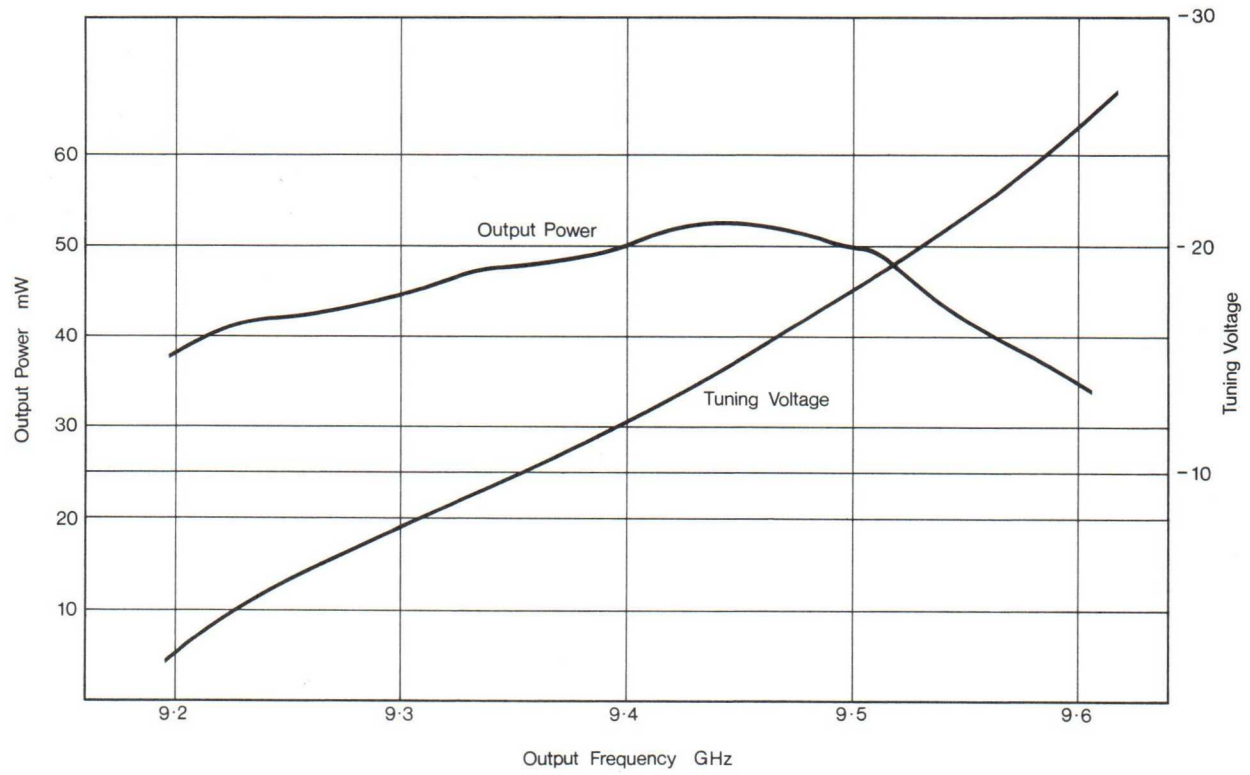
Typical performance of S30,003/3

Power output	
mid band (fo)	50 mW at room temperature
band ends (fo ± 200 MHz)	30 mW at room temperature
Tuning voltage range for 400 MHz tuning	−5 to −24V

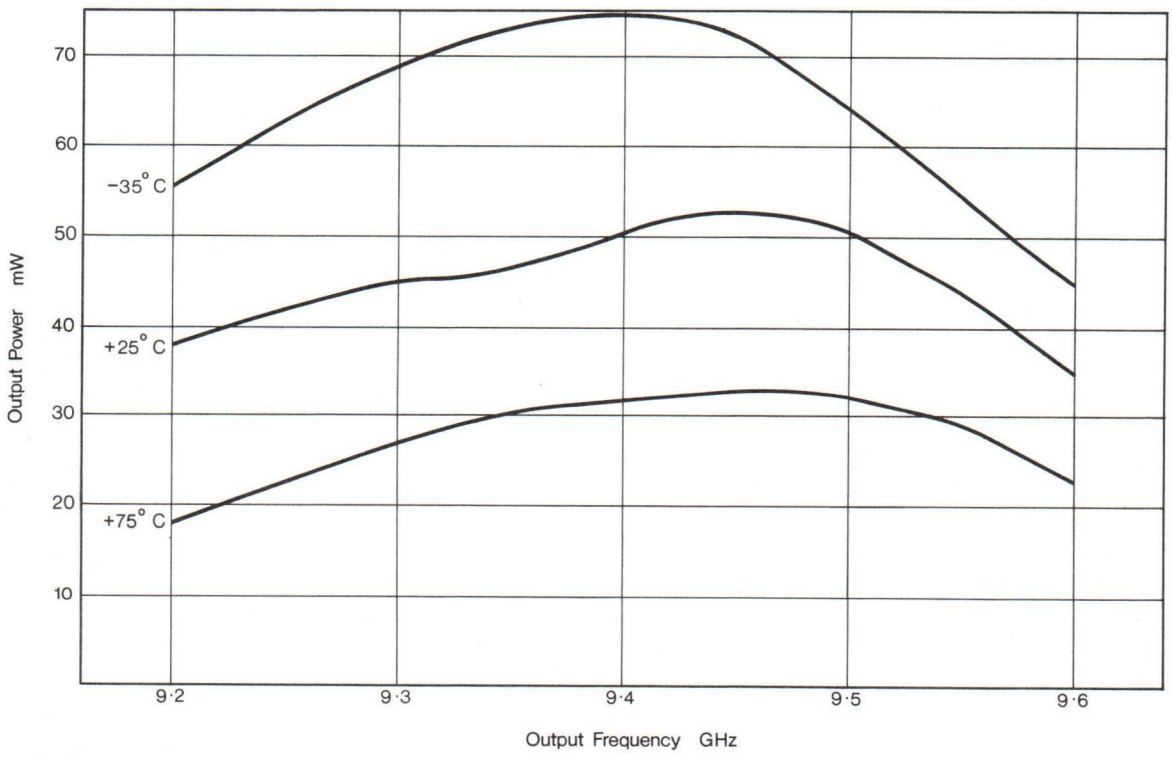
Variants may be obtained on special order for other X-band frequencies and for higher power levels as required.

Power output variation over −35 °C to + 75 °C	±2 dB
Frequency variation over −35 °C to +75 °C at fixed tuning voltage	± 30 MHz
Typical efficiency — D.C. to X-band	1.55%

Power Output/Tuning Characteristics (room temperature)



Power Output / Temperature Characteristics

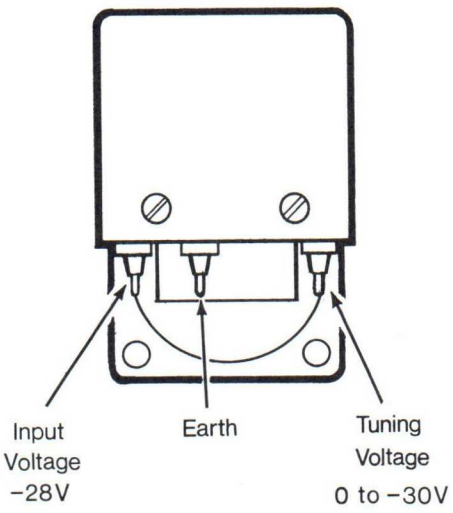


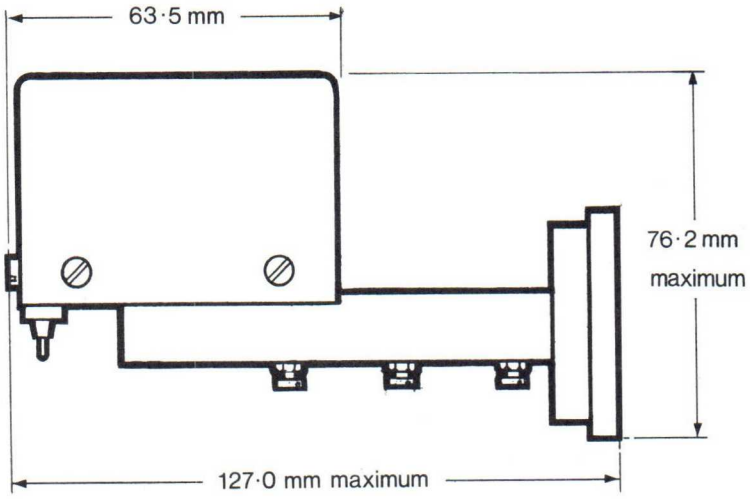
X-Band Solid State Source type S30,003

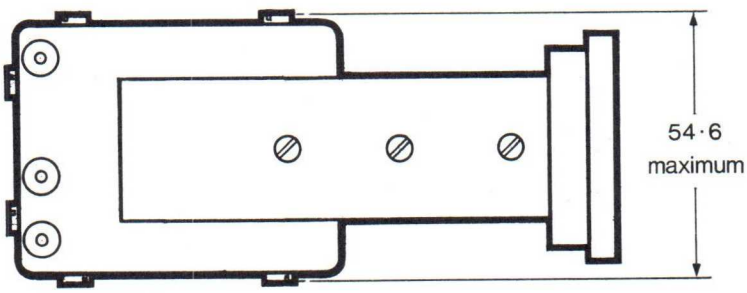
This voltage-tuned solid state source of rugged construction consists of a varactor-tuned transistor oscillator operating at U.H.F., coupled to a step-recovery diode harmonic generator and waveguide filter.
Three frequency variants are available in the range 8.5 GHz to 9.6 GHz, each electronically tunable over 400 MHz.

Specification

Input voltage	−28V d.c. −30V d.c. max.
Input current	120 mA typical at − 28V d.c. (max d.c. input power 4.5W)
Tuning voltage	0 to − 30V
Tuning range **S30.003/1** **S30.003/2** **S30.003/3**	400 MHz to 3 dB points 8.5 GHz to 8.9 GHz 8.85 GHz to 9.25 GHz 9.2 GHz to 9.6 GHz
Power output	15 mW min. over operating temperature range. 25 mW min. at room temperature
Temperature range	− 35°C to + 75°C operational − 55°C to + 90° storage





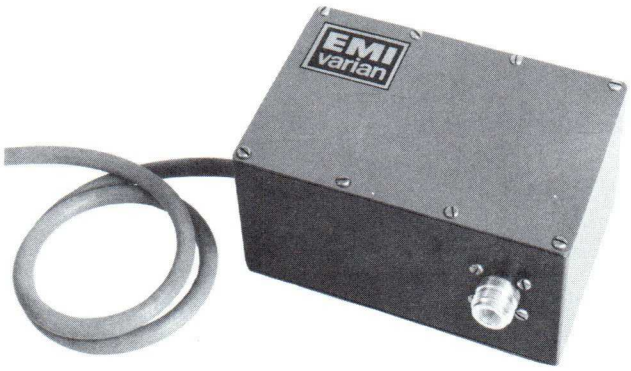


Weight Brass Aluminium	 0.68 Kg (1.5 lb) 0.23 Kg (0.5 lb)
Output	Waveguide WG16 (RG52/U)
Flange	Square plain. 5985–99–083–0052 (UG–39/U)

Solid-State Microwave Sources

EMI-Varian Ltd. are able to offer a range of solid state sources and frequency multipliers in the frequency range 600 MHz to 12 GHz.
The devices described in this leaflet are those produced for particular applications, but a widely-based technology imparts a capability from which variants and special designs can meet most engineering needs.

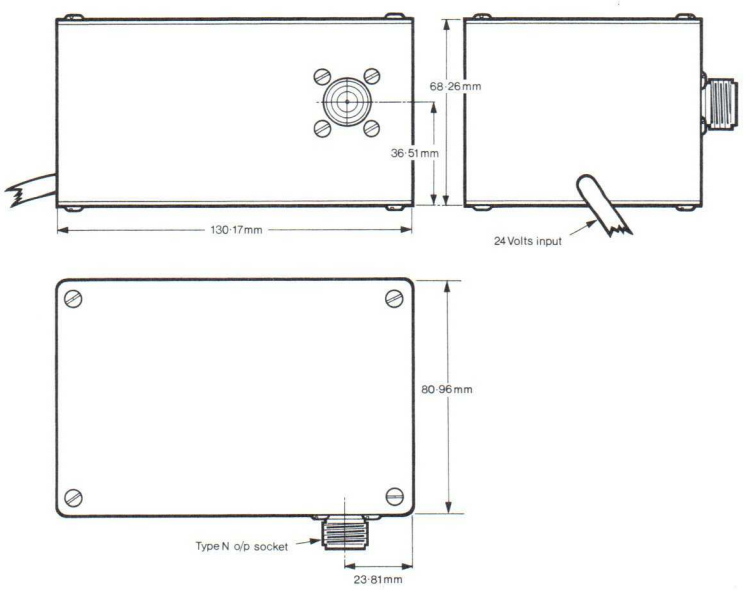
S-Band Crystal Controlled Oscillator type S30,000



This solid state source of high frequency stability and rugged construction consists of a crystal controlled oscillator operating in the 100–150 MHz range, followed by stages of amplification and frequency multiplication. A step-recovery diode is used to give a typical power output of 500 mW at discrete frequencies in the S-band. Variants type S30.000A can be made for the range 3.0 to 3.5 GHz giving very low f.m. noise.

Specification

Power output	300 mW min. at room temperature 200 mW min. over temperature range
Frequency stability **temperature range** **temperature range**	 −10 °C to +60 °C ± 25 p.p.m. −35 °C to + 70 °C ± 50 p.p.m.
Input voltage	+ 24 volts
Input current	0.45A typical
Harmonic Rejection	25 dB min.
Output connector	Type N (female)
Size	133.35 mm x 88.90 mm x 69.85 mm (5¼ in. x 3½ in. x 2¾ in.)
Weight	1.134 Kg (2½ lbs)



Marine Radar Magnetrons

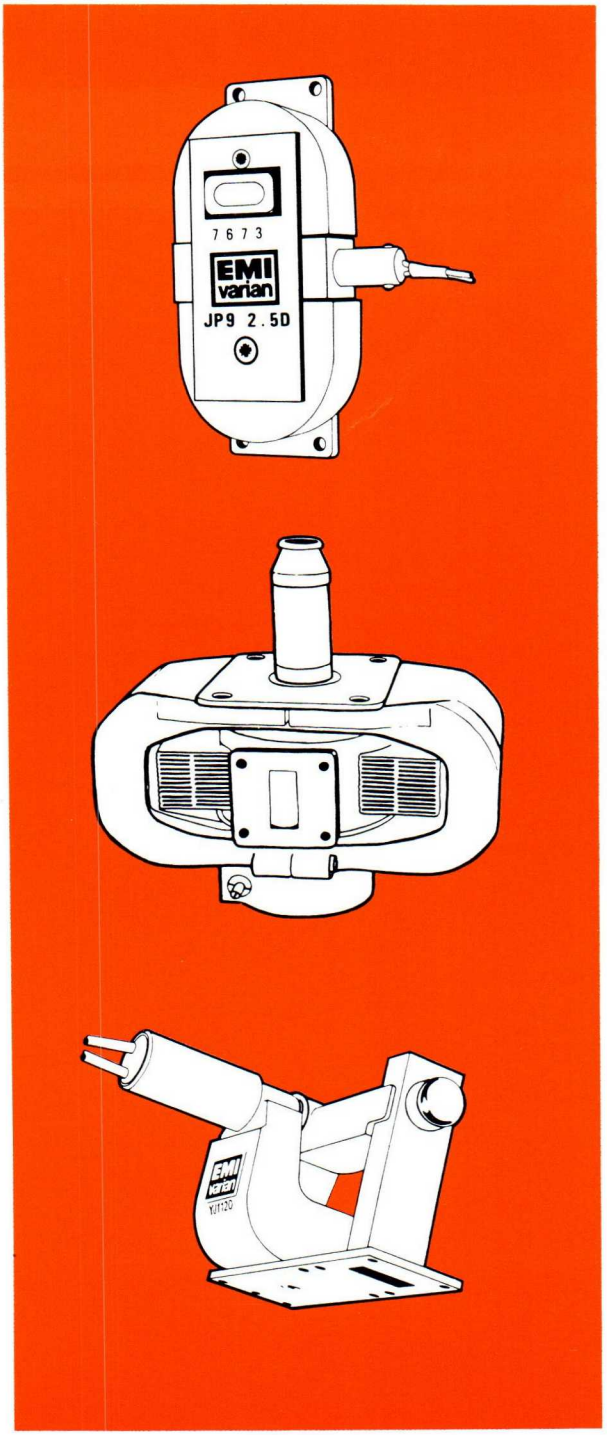
EMI-Varian manufactures magnetrons designed for commercial and small boat radars. These long-established designs of proven reliability have a fixed operating frequency.

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.375 ± 0.03	10	0.0025	2.5	2J42
9.375 ± 0.03	20	0.001	1.5	YJ1110
9.41 ± 0.065	3	0.0005	0.5	JP9-2.5
9.41 ± 0.03	21	0.001	2.5	JP9-18
9.41 ± 0.03	25	0.001	1.0	YJ1120
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5D
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5E
9.445 ± 0.03	26	0.001	1.0	YJ1121

Airborne Radar Magnetrons

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.24 ± 0.03	22	0.001	1.0	PT5036
9.375 ± 0.03	20	0.0015	1.5	YJ1112
TUNABLE COAXIAL MAGNETRONS				
9.1 – 9.5	100	0.001	2.5	PT5017
8.5 – 9.6	200	0.001	1.5	PT5016
16.6 – 16.8	40	0.001	2.0	PT5060
SPIN TUNED MAGNETRON				
8.7 – 9.7+	100	0.001	1.0	PT5024

+ SPIN TUNED OVER ANY 200 MHz band



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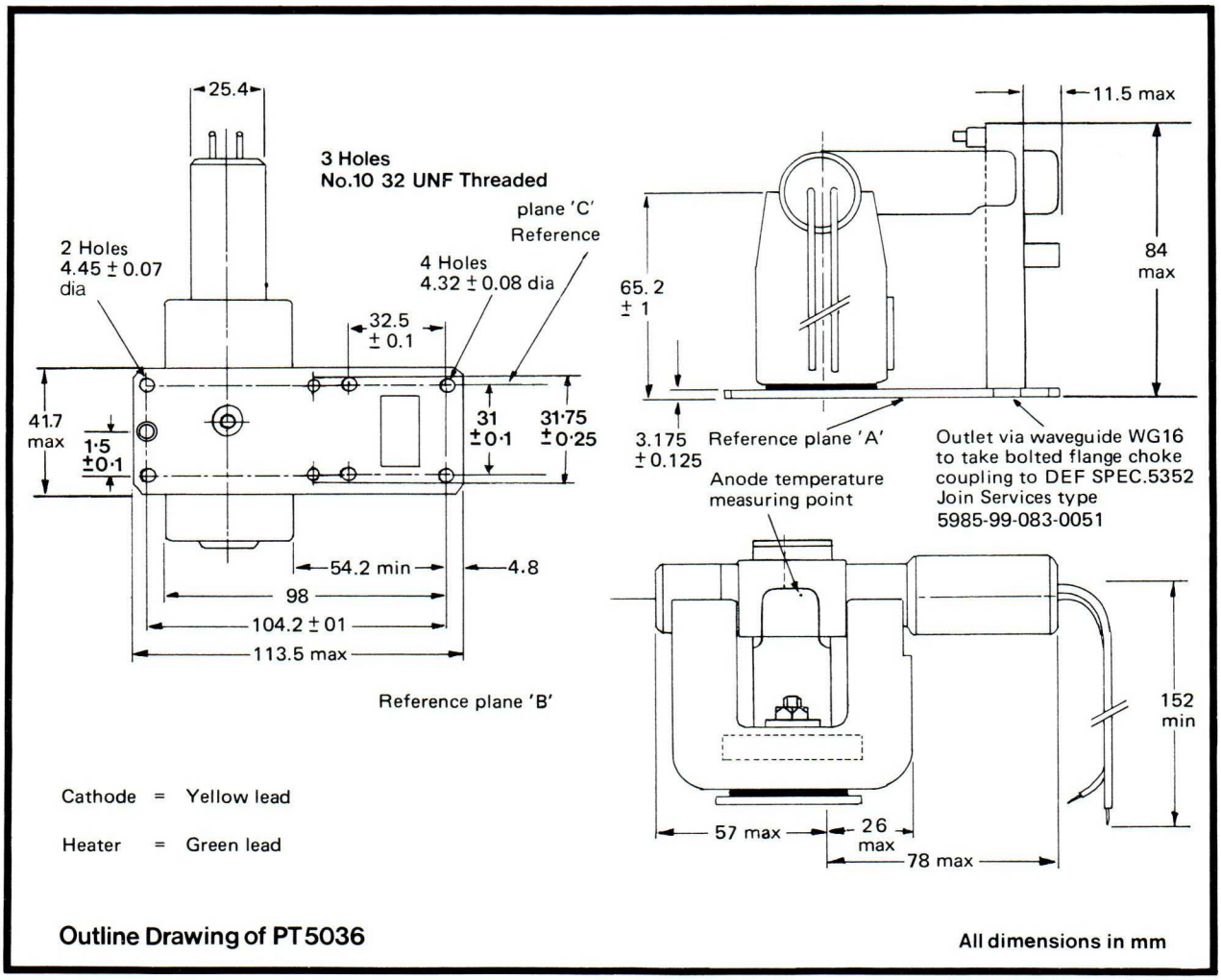
Notes

1. For ambient temperatures between 0°C and −40°C.
2. The tolerance on pulse current duration at the 50% amplitude points is ± 10%.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude. For calculating the rate of rise of anode voltage the 100% valve must be taken as 7.6kV. The capacitance of any system used to measure this parameter must not exceed 6.0 pF.
4. A peak anode current of 7.5 A is set under matched conditions. A mismatch with a v.s.w.r. of 1.5:1 is then introduced and varied through all phases.
5. Measured with the magnetron operating into a v.s.w.r. of 1.5:1 varied through all phases over the anode current range of 6.0 to 9.0 A peak.
6. Measured with the conditions described in Note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in a 0.5% frequency band. 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 has elapsed.
7. Design test only.
8. Measured over the anode current range 6.0 to 9.0 A peak.
9. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.43 to 0.6 A.
10. The maximum frequency change with anode temperature change after thermal equilibrium is reached between the magnetron and ambient temperature is −0.25 MHz/°C.
11. The maximum input capacitance is 9 pF.
12. Measured at the point indicated on the outline drawing.
13. The magnetron is normally tested with a sine-wave heater supply of 50 Hz and is suitable for operation from 50 Hz to 1 kHz sine or square-wave supply. EMI-Varian Limited should be consulted if the magnetron is to be operated with a heater supply having different frequency or waveform conditions.



Outline Drawing of PT5036

All dimensions in mm

Test Conditions and Limits

Test conditions

Heater voltage (test)	6.3 V
Anode current (mean)	3.75 mA
Pulse duration t_p (note 2)	0.5 us
Duty factor	0.0005
v.s.w.r. at output coupler	1.05:1
Rate of rise of voltage pulse (see note 3)	105 kV/μs

Test limits	min.	max.
Anode voltage (peak)	7.0	7.7 kV
Power output (mean)	9.0	W
Frequency	9.210	9.270 GHz
r.f. bandwidth at ¼ power		$\frac{2.5}{t_p}$ MHz
Frequency pulling (see note 4)		25.0 MHz
Frequency pushing (see notes 7 & 8)		1.5 MHz/A
Stability (see note 5)		0.5 %
Heater current (see note 9)		
Frequency temperature coefficient (see notes 7 & 10)		
Input capacitance (see notes 7 & 11)		

Operating Altitude

The magnetron is constructed with a vacuum tight window sealed to the output waveguide to permit operation up to 20,000 ft provided a choke coupling type UG-40B/U (5985-99-083-0051) is used.

Under no circumstances should the output window be pressurised. During storage the window should be protected by the cover supplied.

Maximum and Minimum Ratings

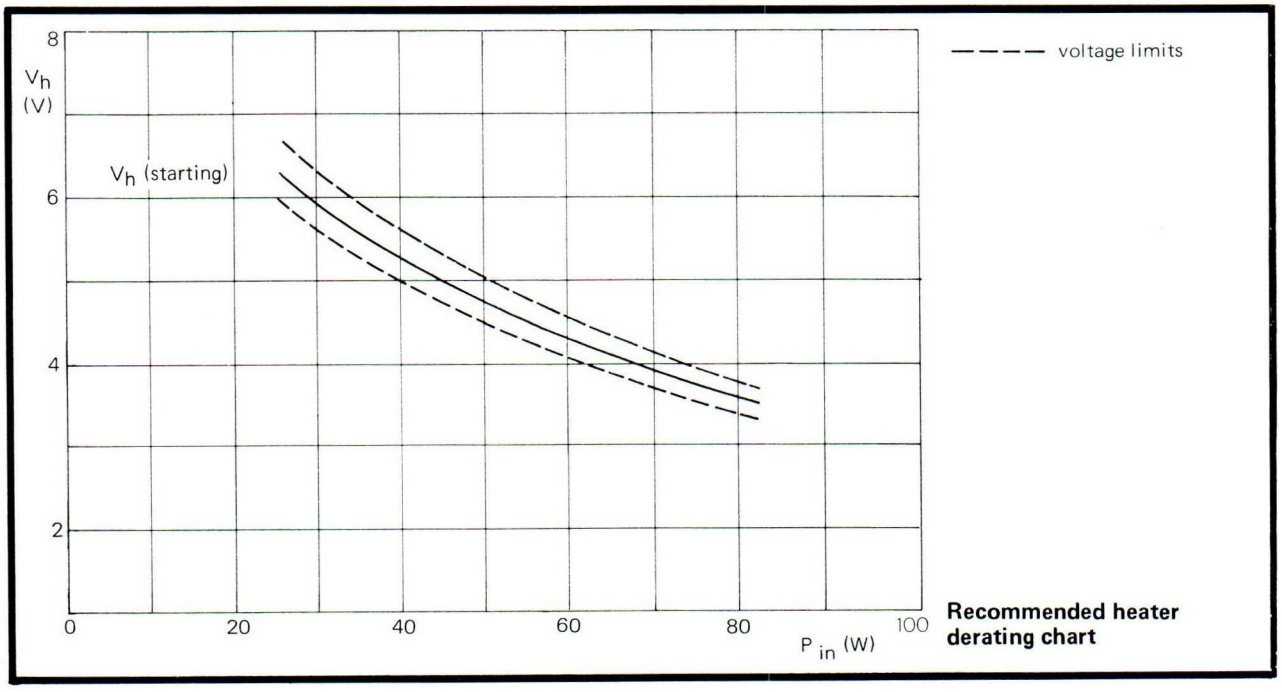
These ratings cannot necessarily be used simultaneously and no individual rating should be exceeded.

	Min.	Max.
Heater voltage (see note 13)	5.7	6.9 V
Heater starting current (peak)		5.0 A
Anode voltage (peak)	7.0	7.7 kV
Anode current (peak)	6.0	9.0 A
Power input (peak)		71 kW
Power input (mean)		71 W
Duty factor		0.0015
Pulse duration (see note 2)		1.0 us
Rate of rise of voltage pulse (see note 3)		100 kV/us
Anode temperature (see note 12)		120 °C
v.s.w.r. at output connection		1.5:1
Altitude	See note on operating altitude below	

End of Life Performance

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated conditions. If the magnetron is to be operated under different conditions from those specified above, EMI-Varian Limited should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of its life when it fails to meet the following limits when operated as specified in test conditions above.

Anode voltage (peak)	7.0	7.7 kV
Power output (peak)	14.0	kW
r.f. bandwidth at ¼ power		$\frac{3.0}{t_p}$ MHz
Stability (note 6)		1.0 %
Frequency	9.210	9.270 GHz



Recommended heater derating chart

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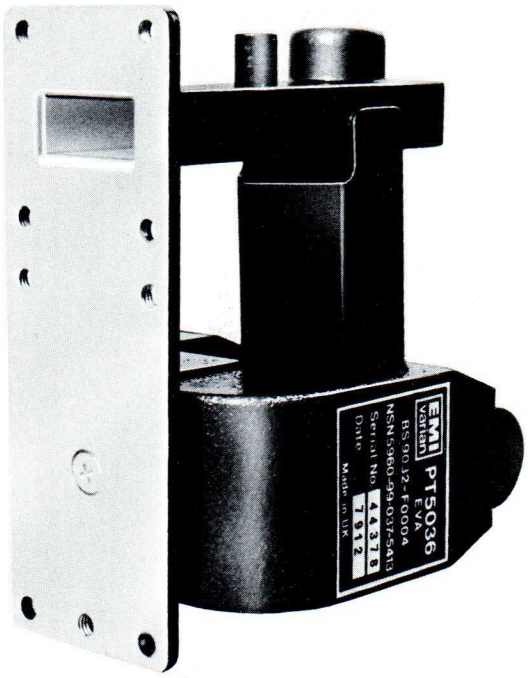
Magnetron
Fixed Frequency
PT5036

APPROVED TO BS 9031-F0008 & BS 9032-F0004
SERVICE TYPE CV6199 5960-99-037-5413

FOR AIRBORNE RADAR APPLICATIONS



Quick Reference

X-band fixed frequency pulsed magnetron

Frequency (fixed within the band)	9.210 to 9.270 GHz
Power output (peak)	22 kW
Output coupler	WG 16 waveguide UG-40B/U (5985-99-083-0051)
Construction	Packaged

Typical Operation

Operational Conditions

Heater voltage	6.3 V
Anode current (peak)	7.5 A
Pulse duration	0.5 µs
Pulse repetition rate	800 p.p.s.
Rate of rise of voltage pulse	75 kV/µs

Typical Performance

Anode voltage (peak)	7.5 kV
Power output (peak)	22 kW
Power output (mean)	8.8 W

General Data

ELECTRICAL

Cathode	indirectly heated
Heater voltage	6.3 V
Heater current	0.5 A
Cathode heating time (minimum) (see note 1)	120 Sec

PHYSICAL

Mounting position	any
Weight of magnetron	1.3 kg
Weight of magnetron in storage carton	2.4 kg
Dimension of storage carton	205 x 195 x 240 mm

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

Cooling	forced air

Marine Radar Magnetrons

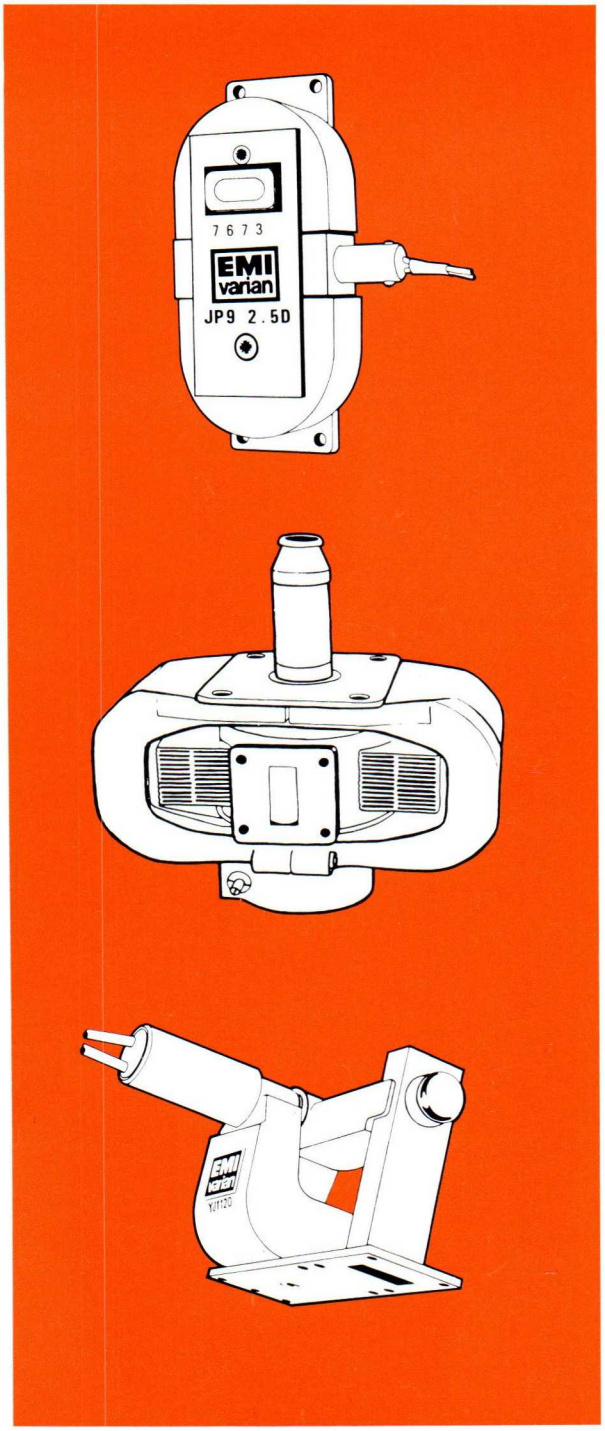
EMI-Varian manufactures magnetrons designed for commercial and small boat radars. These long-established designs of proven reliability have a fixed operating frequency.

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.375 ± 0.03	10	0.0025	2.5	2J42
9.375 ± 0.03	20	0.001	1.5	YJ1110
9.41 ± 0.065	3	0.0005	0.5	JP9-2.5
9.41 ± 0.03	21	0.001	2.5	JP9-18
9.41 ± 0.03	25	0.001	1.0	YJ1120
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5D
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5E
9.445 ± 0.03	26	0.001	1.0	YJ1121

Airborne Radar Magnetrons

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.24 ± 0.03	22	0.001	1.0	PT5036
9.375 ± 0.03	20	0.0015	1.5	YJ1112
TUNABLE COAXIAL MAGNETRONS				
9.1 – 9.5	100	0.001	2.5	PT5017
8.5 – 9.6	200	0.001	1.5	PT5016
16.6 – 16.8	40	0.001	2.0	PT5060
SPIN TUNED MAGNETRON				
8.7 – 9.7+	100	0.001	1.0	PT5024

+ SPIN TUNED OVER ANY 200 MHz band



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Notes

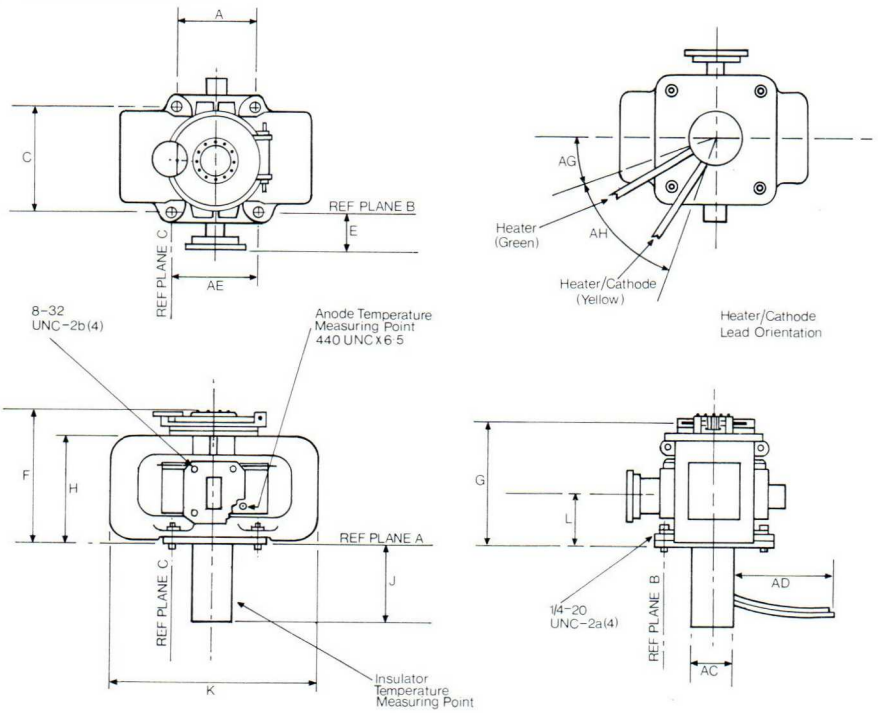
1. With no anode power. When tube is operating the heater voltage must be reduced to the appropriate value determined by the formula.

   $V_h = 12.6 - 0.021\ P_{in} \pm 10\%$

   Where P_{in} = mean anode current (mA) x peak anode voltage (kV)

   V_h = Heater voltage

2. For ambient temperatures between 0°C and −40°C the heating time is 180 seconds.
3. The tolerance on the pulse current duration at the 50% amplitude point is ± 10%.
4. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude measured with an anode voltage of 15 kV. The capacitance of any system used to measure this parameter must not exceed 6.0 pF.
5. A peak anode current of 16A is set under matched conditions. A mismatch with a v.s.w.r. of 1:5:1 is then introduced and varied through all phases.
6. Measured with the magnetron operating into a v.s.w.r. of 1:5:1 varied through all phases over the anode current range of 15 to 17A peak.
7. Measured with the conditions described in Note 6. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in a 0.5% frequency band. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of ten minutes has elapsed.
8. Design test only.
9. Measured with a heater voltage of 12.5 volts and no anode input power, the heater current limits are 2.0 to 2.4A.
10. The maximum frequency change with anode temperature change after thermal equilibrium is reached between the magnetron and ambient temperature is −0.25MHz/°C.
11. Measured at the point indicated on the outline drawing.
12. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 400 Hz sine or square-wave supply. EMI-Varian Limited should be consulted if the magnetron is to be operated with a heater supply having different frequency or wave-form conditons.



PT5017 Dimensions

Letters	Dimensions +−	Letters	Dimensions +−
A	64·29 ± ·38	AG	20 ± ·5
E	25·78 ± ·64	AH	50 max
G	92 ± 3	C	70·64 ± 0·38
K	157 max	F	104 max
L	35·7 ± ·5	H	77 max
AD	305 min	J	90 max
AE	63·8 ± ·5	AC	40·6 max

Magnetron PT5017 Specification

Test Conditions and Limits

Test conditions	Cond. 1	Cond. 2	
Heater voltage (test)	7.6	11.8	V
Anode current (mean)	16.0	2.6	mA
Pulse duration (t_p) (note 3)	2.5	0.4	μs
Duty factor	0.001	0.00016	
v.s.w.r. at output coupler	1.05:1	1.05:1	
Rate of rise of voltage pulse (note 4)	115	115	kV/μs

Test limits	Cond. 1		Cond. 2		
	Min.	Max.	Min.	Max.	
Anode voltage (peak)	14.0	16.0	14.0	16.0	kV
Output power (mean)	80		13		W
Frequency range	9.100	9.500	9.500	9.500	GHz
r.f. bandwidth at ¼ power	$\frac{2.5}{t_p}$		$\frac{2.5}{t_p}$		
Frequency pulling (note 5)		5		5	MHz
Frequency pushing (notes 6 & 8)		100		100	kHz/A
Stability (note 7)		0.1		0.1%	
Heater current (note 9)					
Frequency temperature coefficient (notes 8 & 10)					
Side lobes	10		10		dB
Tuner turns	40	60	40	60	

Maximum & Minimum Ratings

These ratings are absolute values and cannot necessarily be used simultaneously. No individual rating should be exceeded.

	Min.	Max.	
Heater voltage (notes 1 & 12)		13	V
Heater starting current (peak)		10	A
Anode voltage (peak)	14	16	kV
Anode current (peak)	5	18	A
Input power (peak)		280	kW
Input power (mean)		280	W
Duty factor		0.0012	
Pulse duration (note 3)	0.15	2.7	μs
Rate of rise of voltage pulse (note 4)	40	180	kV/μs
Anode temperature (note 11)		150	°C
v.s.w.r. at output connection		1.5:1	
Tuner Shaft rotation rate		800	RPM
Dynamic torque		0.85	Nm
Backlash		3	MHz

End of Life Performance

(Under test conditions)

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, EMI-Varian Limited should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of its life when it fails to meet the following limits when operated as specified in test condition 2.

	Min.	Max.	
Anode voltage (peak)	14	16	kV
Output power (peak)	60		W
r.f. bandwidth at ¼ power		$\frac{3.0}{t_p}$	MHz
Stability (note 7)		0.5%	

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Magnetron

Tunable - Coaxial Construction

PT5017

APPROVED TO BS 9031-F0006
and BS 9032-F0003
SERVICE TYPE 5960-99-038-2201

FOR AIRBORNE RADAR APPLICATIONS

Quick Reference

X-band tunable frequency magnetron

Frequency tunable over the band	9.100 to 9.500 GHz
Output power (peak)	100 kW
Output	WG 15 waveguide
Coupler	Modified UG-52B/U
Construction	Packaged

Typical Operation

Operation conditions	Cond. 1	Cond. 2	
Heater voltage	11.8	7.5	V
Anode current (mean)	2.6	16	mA
Pulse duration	0.4	2.5	µs
Pulse repetition rate	400	400	pulse/s
Rate of rise of voltage pulse	110	110	kV/µsec

Typical Performance

Anode voltage (peak)	15	15	Kv
Output power (peak)	100	100	kW
Output power (mean)	16	100	W

General Data

ELECTRICAL

Cathode	indirectly heated
Heater voltage (note 1)	12.6 V
Heater current	2.2 A
Cathode heating time (minimum) (note 2)	120 S

PHYSICAL

Mounting position	any
Weight of magnetron	4 kg
Weight of magnetron in storage carton	6kg
Dimension of storage carton	350x350x350mm

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

Cooling	natural or forced air

4. To avoid damage to the amplifier and potentially hazardous microwave radiation it is essential that the r.f. input and output connections are correctly terminated during operation.
5. X-radiation can occur when the EHT voltage is applied. Appropriate caution signs should be attached to the operating equipments and the recommended safety precautions followed.
6. Interlocks for the protection of the amplifier and of maintenance personnel are recommended below. Interlocks should prevent the application of EHT voltages or r.f. input (when indicated). Advice on the provision of suitable interlocks is available on request.

   a) Protection of personnel against contact with high voltage.
   b) Correct coolant flow. All circuits.
   c) Correct focusing magnet current.
   d) Correct heater voltage and minimum heater warm-up time.
   e) Excess beam voltage.
   f) Excess ion pump current.
   g) Excess coolant temperature (inlet and outlet).
   h) Power reflected from output termination exceeds 600 Watts Mean. The r.f. drive should be removed within 10μsecs of this occurrence, but in this case it is not necessary to remove the beam voltage.

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Notes

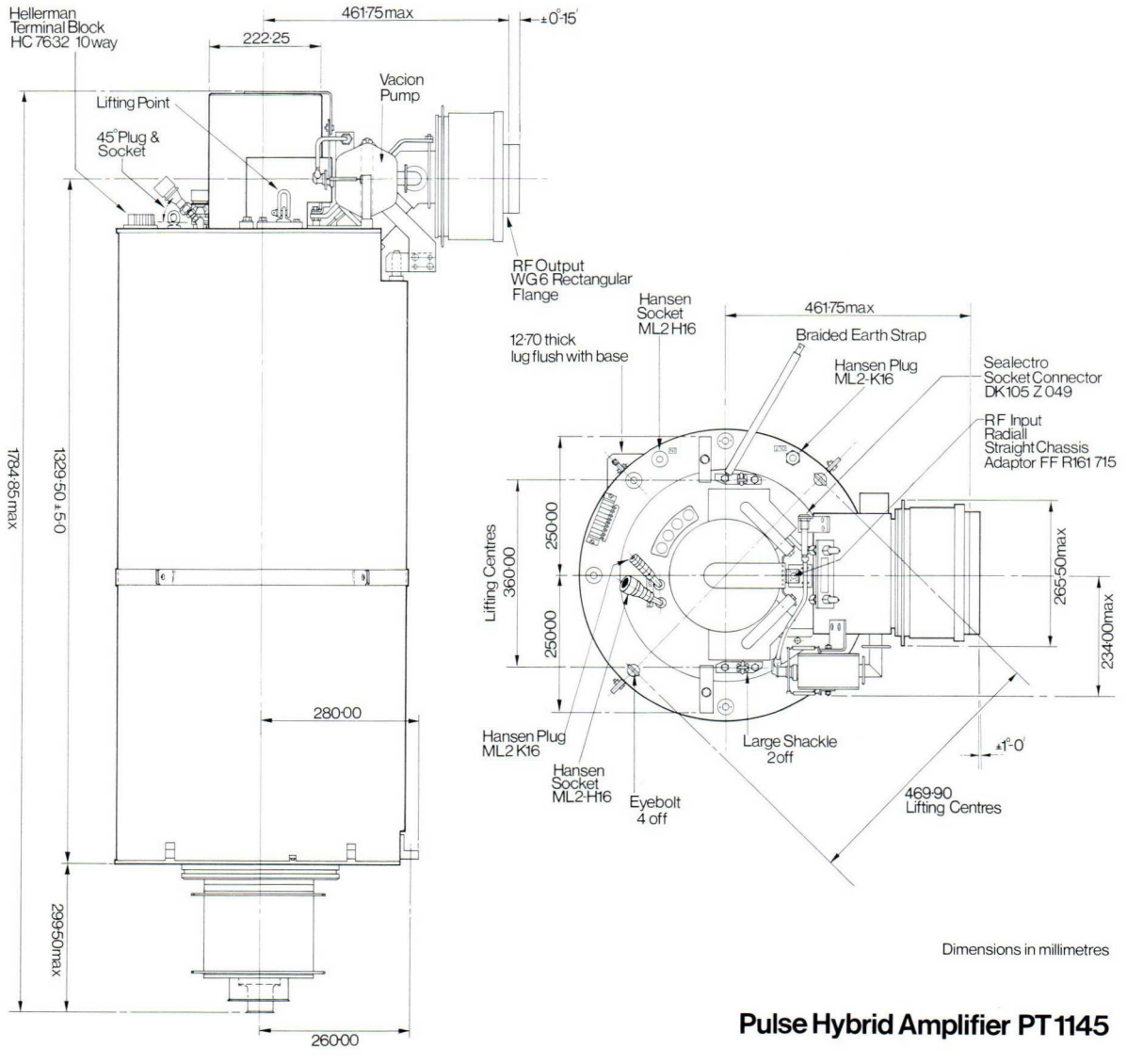
1. The PT 1145 is a hybrid amplifier which combines Klystron and Travelling Ware Tube techniques to maximise bandwidth and gain. A tuned 4 cavity Klystron buncher precedes a broadband slow wave structure of the "Centipede" type.

2. The performance indicated opposite represents one method of operation providing 100 MHz of instantaneous bandwidth. Amplifiers may be adjusted during manufacture to provide alternative characteristics, including peak power output in excess of 5 MW.

3. **Cooling Requirements**
   Cooling of the collector, amplifier body, and electromagnet is required. The requirements when water is used as the coolant are indicated below. Corresponding requirements for glycol-water mixtures are available on request.

	Flow rate (litres–min.)	Max. Pressure Drop (PSI)
Collector	40	90
Body	10	90
Electromagnet	7	40

A closed circuit cooling system designed to minimise scaling and corrosion should be used to obtain the maximum operating life. Any metal in the system should be close to copper on the Galvanic Scale. Oxygen, carbon dioxide, and other impurities should be continuously removed.



Pulse Hybrid Amplifier PT 1145

Test Conditions and Limits

The amplifier is tested typically to comply with the following specification (but see Note 2).

TEST CONDITIONS

	Min.	Max.	Unit
Heater voltage	15	20	Volts
Heater current	35	45	Amps
Beam voltage (peak)	130	145	kV
Beam current (peak)	87	100	Amps
Pulse length (r.f.)	—	10	μsec.
Duty cycle (beam)	—	0.0033	
Frequency range	1.250	1.350	GHz
Electromagnet voltage*	—	100	Volts
Electromagnet current*	—	15	Amps

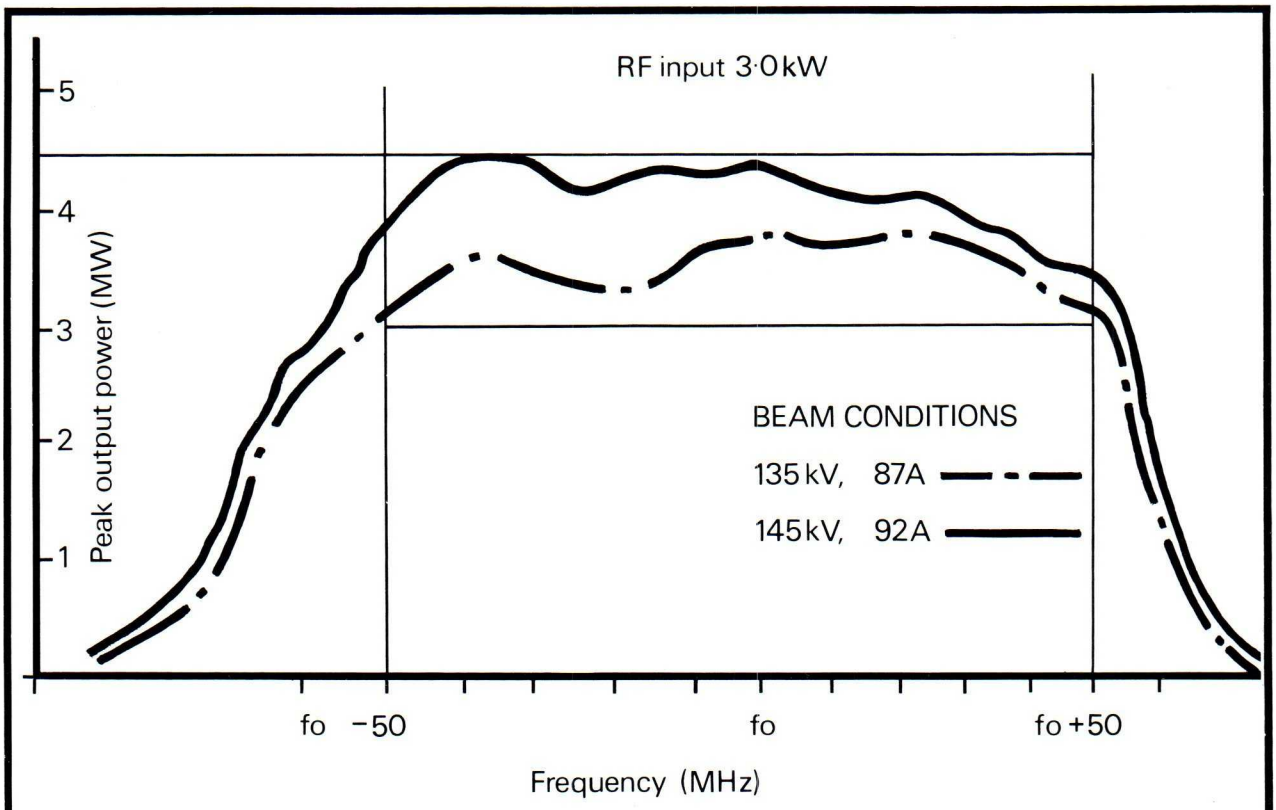
*Each of 4 supplies

TEST LIMITS

Output power (Pk)	3	5	MW
r.f. input power (Pk)	—	4	kW
Beam input power (Pk)	—	12.5	MW
Beam input power (mean)	—	42	kW
Instantaneous bandwidth	100	—	MHz
Noise output relative to central spectral line	—	100	dB/Hz

Maximum and Minimum Ratings

	Min.	Max.	Unit
Heater voltage	15	20	Volts
Heater current	—	50	Amps
Heater current surge	—	60	Amps
Heater warm-up time	15	—	Mins.
Collector voltage (peak)	—	160	kV
Cathode current (peak)	—	125	Amps
Collector dissipation	—	42	kW
Beam duty cycle	—	0.0033	
Ion pump current at application of EHT	—	15	μA
Ion pump current (surge)	—	50	μA
Load VSWR			
In operating band	—	1.5:1	
Outside operating band between 1.12 and 1.44 GHz	—	2.0:1	
Ambient temperature (operating)	0	55	°C
Storage temperature	−40	70	°C
Coolant inlet temperature		65	°C
Coolant outlet temperature		80	°C



Typical Output power Characteristic: Hybrid Amplifier Type PT1145

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Pulsed Hybrid Amplifier

PT 1145

1.235 - 1.365 GHz
5 MW Peak

Quick Reference

L-band pulsed high power amplifier

Centre frequency	1.3 GHz
Instantaneous bandwidth	100 MHz
Peak output power	3–5 MW
Gain	30 dB
Cathode modulated	
Solenoid focused	
Liquid cooled	
Input r.f. connector	Type N
Output r.f. connector	WG6

Typical Operation

Heater voltage	18 Volts
Heater current	40 Amps
Beam voltage (peak)	140 kV
Beam current (peak)	95 Amps
Beam duty factor	0.0033
Efficiency (minimum)	24%

Typical Performance

Frequency range	1.25–1.35 GHz
Peak output power	3–5 MW
Bandwidth	100 MHz
Gain	30 dB
r.f. pulse length	10 μsecs.
Beam duty factor	0.0033
Noise output (relative to central spectral line)	Below 100 dB/Hz

General Data

ADDITIONAL ELECTRICAL REQUIREMENTS

Appendage pump voltage	3.5 kV
Appendage pump current	50 μA
Electromagnet voltage	100 Volts*
Electromagnet current	15 Amps*

*Each of 4 isolated coils

MECHANICAL FEATURES

Dimensions		See drawing
Weight	Amplifier	230 kg
	Electromagnet	320 kg
Electromagnet type		PTE 5028
Mounting position		Vertical (cathode down)

COOLING

Preferred coolant (normal temperatures)	De-ionised water
Preferred coolant (down to −40°C)	Ethylene Glycol and water mixture

Marine Radar Magnetrons

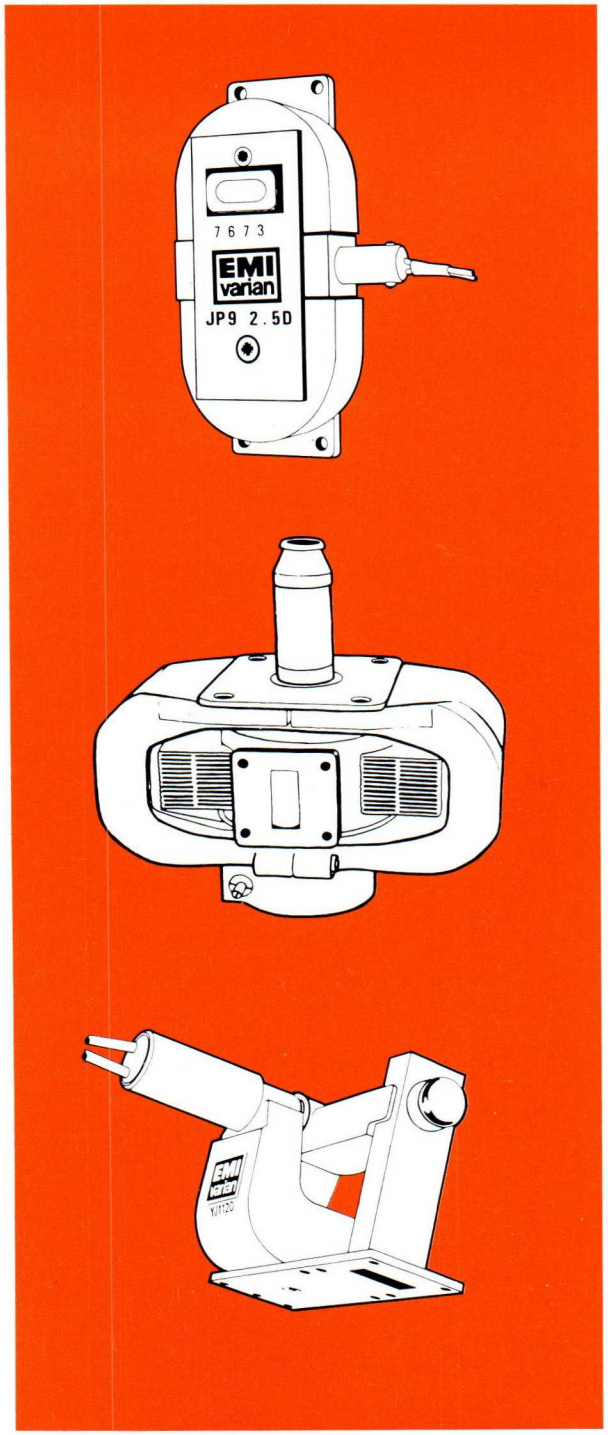
EMI-Varian manufactures magnetrons designed for commercial and small boat radars. These long-established designs of proven reliability have a fixed operating frequency.

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.375 ± 0.03	10	0.0025	2.5	2J42
9.375 ± 0.03	20	0.001	1.5	YJ1110
9.41 ± 0.065	3	0.0005	0.5	JP9-2.5
9.41 ± 0.03	21	0.001	2.5	JP9-18
9.41 ± 0.03	25	0.001	1.0	YJ1120
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5D
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5E
9.445 ± 0.03	26	0.001	1.0	YJ1121

Airborne Radar Magnetrons

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.24 ± 0.03	22	0.001	1.0	PT5036
9.375 ± 0.03	20	0.0015	1.5	YJ1112
TUNABLE COAXIAL MAGNETRONS				
9.1 – 9.5	100	0.001	2.5	PT5017
8.5 – 9.6	200	0.001	1.5	PT5016
16.6 – 16.8	40	0.001	2.0	PT5060
SPIN TUNED MAGNETRON				
8.7 – 9.7+	100	0.001	1.0	PT5024

+ SPIN TUNED OVER ANY 200 MHz band



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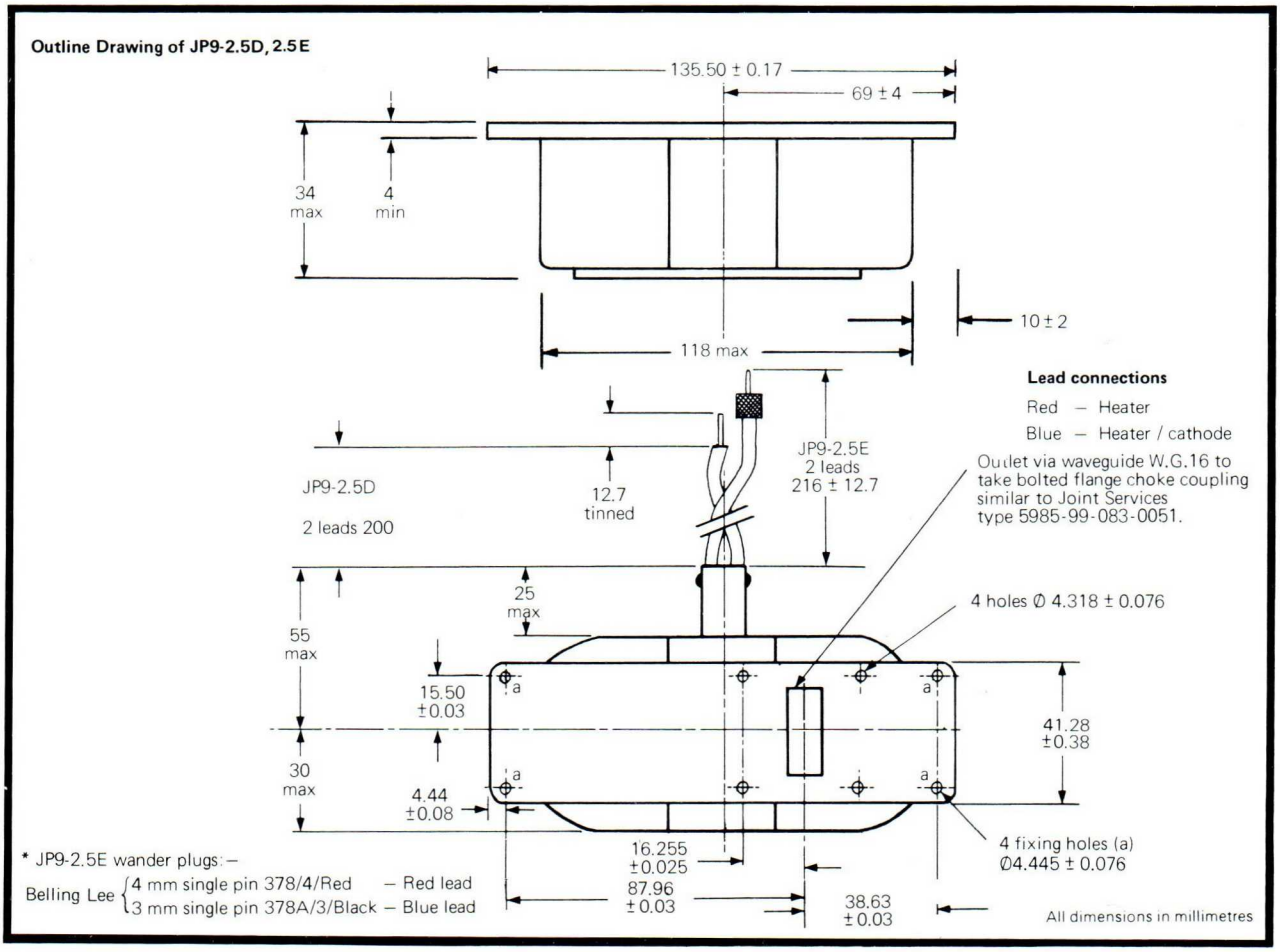
electronics and leisure.

Notes

1. For ambient temperatures above 0°C. For ambient temperature between 0°C and −55°C the heating time is 180 seconds.
2. The tolerance on the pulse current duration at the 50% amplitude point is ± 10%.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude measured with an anode voltage of 3.7 kV. The capacitance of any system used to measure this parameter must not exceed 6.0 pF.
4. A peak anode current of 3A is set under matched conditions. A mismatch with a v.s.w.r. of 1:5:1 is then introduced and varied through all phases.
5. Measured with the magnetron operating into a v.s.w.r. of 1:5:1 varied through all phases over the anode current range of 2.5 to 3.5A peak.
6. Measured with the conditions described in Note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in a 0.5% frequency band. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of ten minutes has elapsed.
7. Design test only.
8. Measured over the anode current range 2.5 to 3.5A peak.
9. The cold impedance of the magnetron is measured at the operating frequency and will be such as to give a v.s.w.r. of at least 6:1. The position of voltage minimum from the face of the output flange into the magnetron is 3 to 9mm for JP9-2.5D and 0 to 6mm for the JP9-2.5E.
10. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.5 to 0.6A.
11. The maximum frequency change with anode temperature change after thermal equilibrium is reached between the magnetron and ambient temperature is −0.25MHz/°C.
12. The maximum input capacitance is 9pF.
13. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 1kHz sine or square-wave supply. EMI-Varian Limited should be consulted if the magnetron is to be operated with a heater supply having different frequency or wave-form conditons.

Outline Drawing of JP9-2.5D, 2.5E



Test Conditions and Limits

Test conditions

Heater voltage (test)	6.3 V
Anode current (mean)	3.0 mA
Pulse duration (t_p) (note 2)	1.0 μs
Duty factor	0.001
v.s.w.r. at output coupler	1.05:1
Rate of rise of voltage pulse (note 3)	75 kV/μs

Test limits	Min.	Max.
Anode voltage (peak)	3.2	3.8 kV
Output power (mean)	3.0	W
Frequency	9.415	9.475 GHz
r.f. bandwidth at ¼ power		$\frac{2.5}{t_p}$ MHz
Frequency pulling (note 4)		18.0 MHz
Frequency pushing (notes 7 & 9)		2.5 MHz/A
Stability (note 6)		0.25%
Cold impedance (note 9)		
Heater current (note 10)		
Frequency temperature coefficient (notes 7 & 11)		
Input capacitance (notes 7 & 12)		

Maximum and Minimum Ratings

These ratings are absolute values and cannot necessarily be used simultaneously. No individual rating should be exceeded.

	Min.	Max.
Heater voltage (note 13)	5.7	6.9 V
Heater starting current (peak)		5.0 A
Anode voltage (peak)	3.2	3.8 kV
Anode current (peak)	2.5	3.5 A
Input power (peak)		13.0 kW
Input power (mean)		13.0 W
Duty factor		0.001
Pulse duration (note 2)	0.02	1.0 μs
Rate of rise of voltage		70 kV/us
Anode temperature		120°C
v.s.w.r. at output connection		1.5:1

End of Life Performance

(Under test conditions)

The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, EMI-Varian Limited should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of its life when it fails to meet the following limits when operated as specified in test condition 2.

	Min.	Max.
Anode voltage (peak)	3.2	3.6 kV
Output power (peak)	2.5 W	
r.f. bandwidth at ¼ power		$\frac{3.0}{t_p}$ MHz
Frequency	9.415	9.475 GHz
Stability (note 6)		2.0%

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Magnetron

X-band fixed frequency

JP9-2·5D JP9-2·5E

SERVICE TYPE No CV10758

FOR MARINE RADAR APPLICATIONS

Quick Reference

X-band fixed frequency pulsed magentron

Frequency (fixed within the band)	9.415 to 9.475
Output power (peak)	4.0 kW
Output	WG 16 waveguide
Coupler	UG-40B/U (5985-99-083-0051)
Construction	Packaged

To be read in conjunction with General operating recommendations-Magnetrons.

Typical Operation

Operational conditions	Cond. 1	Cond. 2	
Heater voltage	6.3	6.3	V
Anode current (peak)	3.0	3.0	A
Pulse duration	0.1	0.5	us
Pulse repetition rate	2000	1000	pulse/s
Rate of rise of voltage pulse	60	60	kV/us

Typical Performance

Anode voltage (peak)	3.6	3.0 kV
Output power (peak)	4.0	4.0 kW
Output power (mean)	0.8	2.0 W

General Data

ELECTRICAL

Cathode	indirectly heated
Heater voltage	6.3 V
Heater current	0.55 A
Cathode heating time (minimum)	120 S

PHYSICAL

Mounting position	any
Weight of magnetron	1.02 kg
Weight of magnetron in storage carton	1.82 kg

Dimension of storage carton

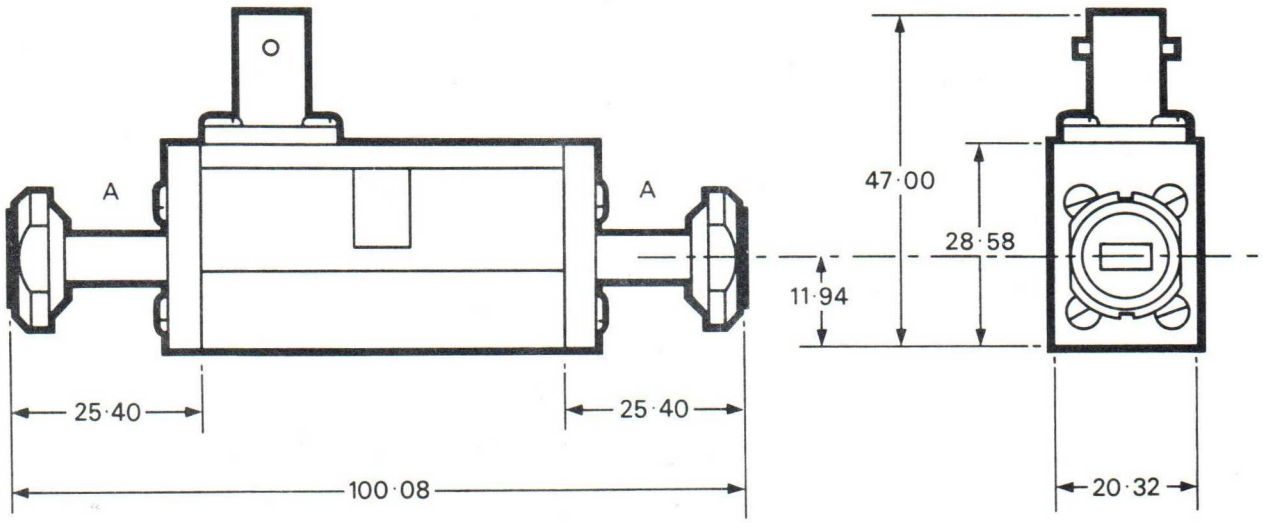
A minimum clearance of 50 mm must be maintained between the magnet and any magnetic materials.

Cooling — Natural or forced air

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

P-I-N Diode Attenuator Type 2640

Dimensions are shown in millimetres



BIAS INPUT SOCKET: **B.N.C. 50 (5935-99-911-6872)**

FLANGES: **Flange type 5985-99-083-0018 is fitted as standard, but the device will mate with a square flange (type 5985-99-012-4834 or UG599/U) if the adaptor ends "A" are removed.**

DS.1028/2

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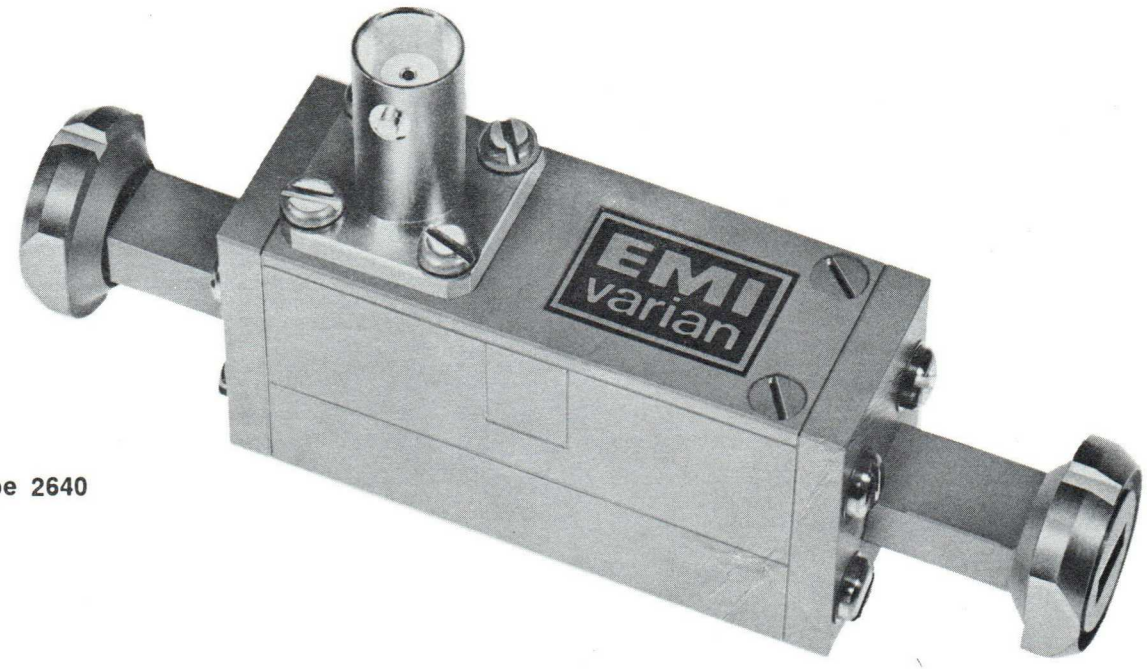
EMI-Varian Ltd

Provisional data sheet

P-I-N Diode Attenuators



Type 2640

A p-i-n diode attenuator comprises an array of diodes mounted as shunt elements in a transmission line. At microwave frequencies a p-i-n diode behaves as a resistor whose value is determined by its d.c. bias current. By incorporation in an appropriate microwave circuit a broad-band electronically controlled attenuator can be produced having a modest control power requirement.

In the designs described on this data sheet the frequency of operation of p-i-n diode attenuators has been extended to 40 GHz and a unique range of components for J, K, and Q bands has been developed. A typical application is the control of pump power for a low noise parametric amplifier.

Electrical Specifications (typical values)

	Type 1218 J-Band (Ku Band)	Type 1826 K-Band	Type 2640 Q-Band (Ka Band)
Frequency Range	11 to 18 GHz	18 to 26 GHz	26 to 40 GHz
Insertion Loss at 0mA bias	0.6dB	0.6dB	0.6dB (26 to 35 GHz) 1.5dB (35 to 40 GHz)
Attenuation at 10mA bias	11.5dB	11.0dB	10.5dB
Input v.s.w.r. at 0mA bias	0.7	0.8	0.7

EMI varian news

From EMI-Varian Limited Hayes Middlesex England Telephone 01-573 3888 One of the EMI group of companies

65/73

HIGH EFFICIENCY INTEGRAL CAVITY KLYSTRON AMPLIFIERS FOR UHF TV TRANSMITTERS

As the result of a recently completed development programme, EMI-Varian now offers a new, high efficiency "H" series of integral cavity power klystron amplifiers for UHF-TV service. The higher operating efficiency of these tubes allows broadcasting transmitter operators the choice of achieving a significant reduction in transmitter prime power costs without sacrificing the performance quality or increasing transmitter output power. "H" model tubes are direct replacements for the following standard "A" type tubes:

VA 943A/944A/945A
VA 946A/947A/948A
VA 950A/951A/952A
VA 953A/954A/955A

These klystrons are now available in the 10kW and 25kW ranges and will be available in the 40kW and 55kW ranges by the end of 1973.

Advantages of "H" series klystron amplifiers

The operating efficiency of "H" series klystrons is typically 42 percent compared with 35 percent for standard "A" series tubes. This enables the rated transmitter output power to be obtained with reduced beam input power. By switching from "A" tubes to "H" tubes, a saving of from 9 to 13 percent in transmitter prime power cost may be obtained.

Alternatively, if, one wishes to take advantage of the higher output power available for the same beam input power, an "H" tube can be installed in the vision socket without equipment modifications. With the tube operating at "A" tube beam and heater conditions, three significant differences in performance occur.

1. Vision output power increases about 12 per cent.

2. Body current reduces to between 5 and 10 milliampere compared with the 50 to 70 milliampere range for "A" tubes.

3. Magnet current is less critical and can vary over a wider range without affecting the output power or body current.

When converting to "H" series tubes, no hardware changes are required, only beam or modulating anode voltages.

If output power is to be kept the same, the beam voltage may be reduced by selecting a lower power transformer tap, or the modulating anode voltage reduced by tapping lower on the biasing resistor chain, or by some combination of both.

To take advantage of the higher r. f. output power capability, the only adjustments required are in sync stretch and in linearity correction at the driver.

When using "H" tubes for sound, the beam current can be reduced somewhat by selecting a lower tap on the modulating anode biasing resistor.

ENDS

Press enquiries and photographs

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or

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EMI

PHOTO NEWS

from EMI Electronics and Industrial Operations, Hayes, Middlesex, England. Telephone: 01-573 3888

65/73

Neg. No. 12726

HIGH EFFICIENCY INTEGRAL CAVITY KLYSTRON AMPLIFIERS FOR UHF TV TRANSMITTERS

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ENDS

Press enquiries

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high efficiency integral cavity klystrons for UHF TV transmitters

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EMI PHOTO NEWS

from EMI Limited, 135 Blyth Road, Hayes, Middlesex UB3-1BP, England. Telephone: 01-573 3888

21. November 1974

EMI-VARIAN ÜBERNIMMT HERSTELLUNG UND MARKETING VON SCHIFFS- UND RADARMAGNETRONEN DES MULLARD-PROGRAMMS

EMI-Varian erweitert seine Position auf dem internationalen Markt durch Vertragsabschluss

EMI-Varian Limited, Hayes, Middlesex, England, gab heute den Abschluss eines Vertrages bekannt, nach dem das Unternehmen die gesamte Herstellung und den Vertrieb von mehr als 50 Schiffs-, Flugzeug- und Spezialradarmagnetronen der Mullard-Serie übernimmt.

Mit diesem Schritt sichert sich EMI-Varian - als Hauptzulieferer von hochentwickelten Mikrowellenbauelementen und -baugruppen auf internationaler Ebene bereits bestens eingeführt - eine noch stärkere Marktposition für den Absatz seiner bewährten Serie von Radar-megnetronen.

Darüber hinaus wurde EMI-Varian die Herstellung und der Vertrieb von bestimmten Mullard-Reflex-Klystronen vertraglich übertragen.

Eine Auswahl dieser neu in das EMI-Varian-Programm aufgenommenen Geräte wird neben den anderen Erzeugnissen des Unternahmens an Stand Nr. 5208 auf der Electronica '74 in München vom 21. bis 27. November 1974 vorgestellt.

ENDE

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or Colin Woodley - Publicity Manager
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zu Hause: Hemel Hempstead (0442) 55128


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from EMI Electronics and Industrial Operations, Hayes, Middlesex, England. Telephone: 01-573 3888

Neg. no. 52365

65/73

15-MINUTE TOTAL INSTALLATION TIME IS A FEATURE OF EMI-VARIAN INTEGRAL-CAVITY PRE-TUNED TELEVISION KLYSTRONS

Loading an EMI-Varian integral-cavity television klystron into its electromagnet, at an IBA transmitting station near Birmingham. One of these pre-tuned UHF tubes can be installed, including making the required electrical and cooling connections, within 15 minutes.

EMI-Varian Ltd., of Hayes, Middlesex, manufactures a comprehensive range of CW klystrons for use as the final stage for both sound and vision amplifiers of UHF television transmitters. The company is the leading supplier of these tubes to Britain's Independent Broadcasting Authority.

ENDS

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EMI varian news

From EMI-Varian Limited Hayes Middlesex England Telephone 01-573 3888 One of the EMI group of companies

65/73 31st May 1973

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/contd.....

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EMI-Varian

Magnetron

YJ1301

FOR MARINE RADAR APPLICATIONS

Quick Reference

X-band fixed frequency pulsed magnetron

Frequency (fixed within the band)	9.415 to 9.475 GHz
Output power (peak)	7.0 kW
Output	WG 10 waveguide
Coupler	UG-40B/U (5985-99-083-0051)
Construction	Packaged

Typical Operation

Operational conditions	Cond. 1	Cond. 2
Heater voltage	6.3	6.3 V
Anode current (peak)	5.0	5.0 A
Pulse duration	0.1	1.0 μs
Pulse repetition rate	2000	1000 pulse/s
Rate of rise of voltage pulse	6.0	6.0 kV/μs

Typical Performance

Anode voltage (peak)	4.25	4.25 kV
Output power (peak)	7.0	7.0 kW
Output power (mean)	1.4	7.0 W

General Data

ELECTRICAL

Cathode	indirectly heated
Heater voltage	6.3 V
Heater current	0.55 A
Cathode heating time (minimum) (Note 1)	120 S

PHYSICAL

Mounting position	any
Weight of magnetron	1.25 kg
Weight of magnetron in storage carton	1.82 kg
Dimension of storage carton	190 x 190 x 288 mm

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

Cooling	noted for forced air

Test Conditions and Limits

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

Test conditions

Heater voltage (test)	6.3 V
Anode current (mean)	5.0 mA
Pulse duration (t_p) (note 2)	1.0 μs
Duty factor	0.001
v.s.w.r. at output coupler	1.05:1
Rate of rise of voltage pulse (note 3)	75 kV/us

Test limits	Min.	Max.
Anode voltage (peak)	4.0	4.5 kV
Output power (mean)	6.0	W
Frequency	9.415	9.475 GHz
r.f. bandwidth at ¼ power		$\frac{2.5 \text{ MHz}}{t_p}$
Frequency pulling (note 4)		18 MHz
Frequency pushing (notes 7 & 9)		2.5 MHz
Stability (note 6)		0.25%
Cold impedance (note 9)		
Heater current (note 10)		
Frequency temperature coefficient (notes 7 & 11)		
Input capacitance (notes 7 & 12)		

Maximum and Minimum Ratings

These ratings are absolute values and cannot necessarily be used simultaneously. No individual rating should be exceeded.

	Min.	Max.
Heater voltage (note 13)	5.7	6.9 V
Heater starting current (peak)		5.0 A
Anode voltage (peak)	4.0	4.5 kV
Anode current (peak)	4.0	6.0 A
Input power (peak)		27.0 kW
Input power (mean)		27.0 W
Duty factor		0.001
Pulse duration (note 2)		1.0 μs
Rate of rise of voltage pulse (note 3)		75 kV/μs
Anode temperature		120°C
v.s.w.r. at output connection		1.5:1

End of Life Performance

(Under test conditions)

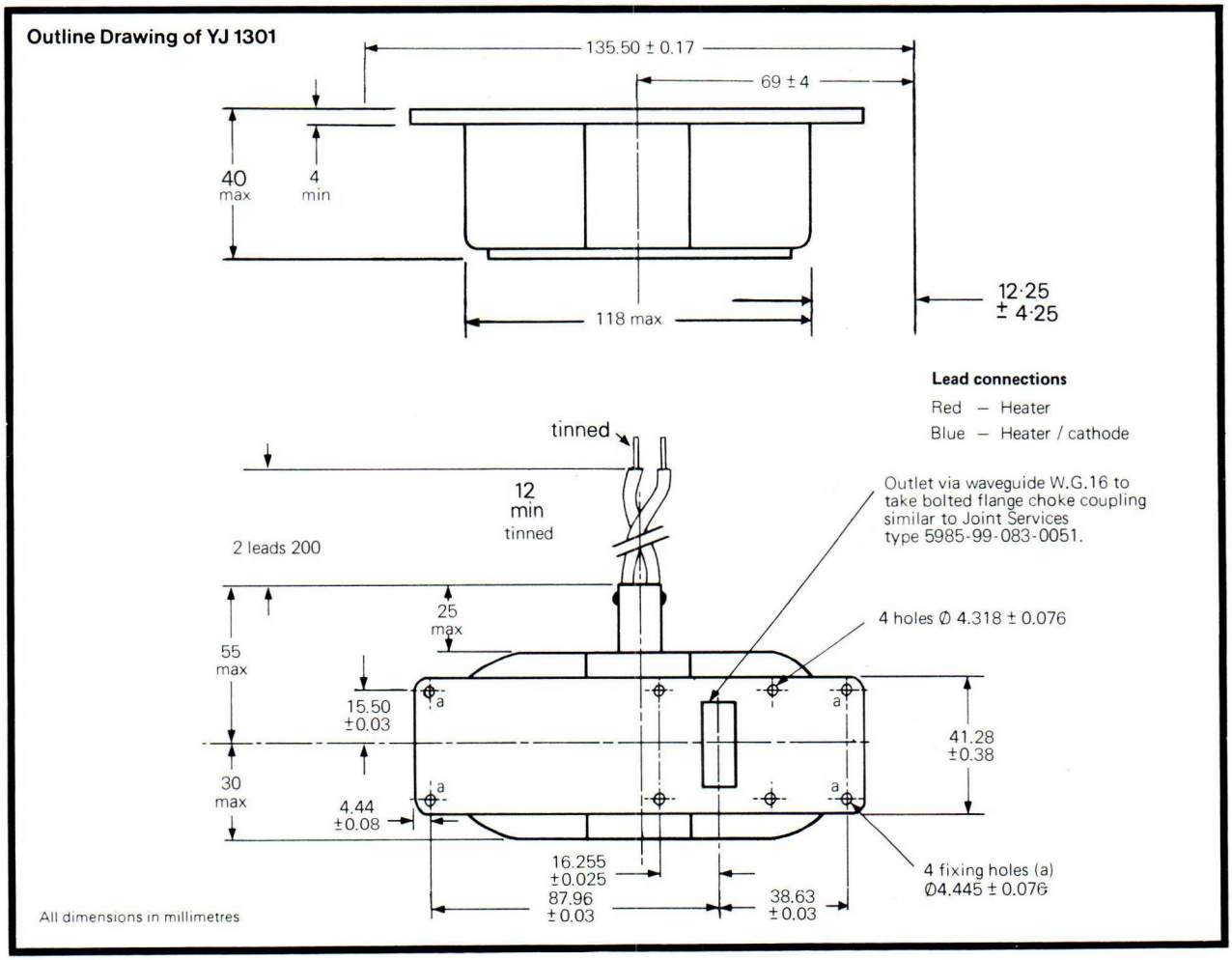
The quality of all production is monitored by the random selection of magnetrons which are then life tested under the stated test conditions. If the magnetron is to be operated under different conditions from those specified above, EMI-Varian Limited should be consulted to verify that the life will not be affected. The magnetron is considered to have reached the end of its life when it fails to meet the following limits when operated as specified in test condition 2.

	Min.	Max.
Anode voltage (peak)	4.0	4.5 kV
Output power (peak)	5.0 W	
r.f. bandwidth at ¼ power		3.0/tp MHz
Frequency	9.415	9.475 GHz
Stability (note 6)		2.0%

Notes

1. For ambient temperatures above 0°C. For ambient temperature between 0°C and −55°C the heating time is 180 seconds.
2. The tolerance on the pulse current duration at the 50% amplitude points is ± 10%.
3. Defined as the steepest tangent to the leading edge of the voltage pulse above 80% amplitude measured with an anode voltage of 4.4 kV. The capacitance of any system used to measure this parameter must not exceed 6.0 pF.
4. A peak anode current of 5A is set under matched conditions. A mismatch with a v.s.w.r. of 1:5:1 is then introduced and varied through all phases.
5. Measured with the magnetron operating into a v.s.w.r. of 1:5:1 varied through all phases over the anode current range of 4 to 6A peak.
6. Measured with the conditions described in Note 5. Pulses are defined as missing when the r.f. energy level is less than 70% of the normal level in a 0.5% frequency band. Missing pulses are expressed as a percentage of the number of input pulses applied during the period of observation after a period of ten minutes has elapsed.
7. Design test only.
8. Measured over the anode current range 4 to 6A peak.
9. The cold impedance of the magnetron is measured at the operating frequency and will be such as to give a v.s.w.r. of at least 6:1. The position of voltage minimum from the face of the output flange into the magnetron is 3 to 9mm.
10. Measured with a heater voltage of 6.3 volts and no anode input power, the heater current limits are 0.5 to 0.6A.
11. The maximum frequency change with anode temperature change after thermal equilibrium is reached between the magnetron and ambient temperature is −0.25MHz/°C.
12. The maximum input capacitance is 9pF.
13. The magnetron is normally tested with a sinewave heater supply of 50Hz and is suitable for operation from 50Hz to 1kHz sine or square-wave supply. EMI-Varian Limited should be consulted if the magnetron is to be operated with a heater supply having different frequency or wave-form conditons.

Outline Drawing of YJ 1301



Marine Radar Magnetrons

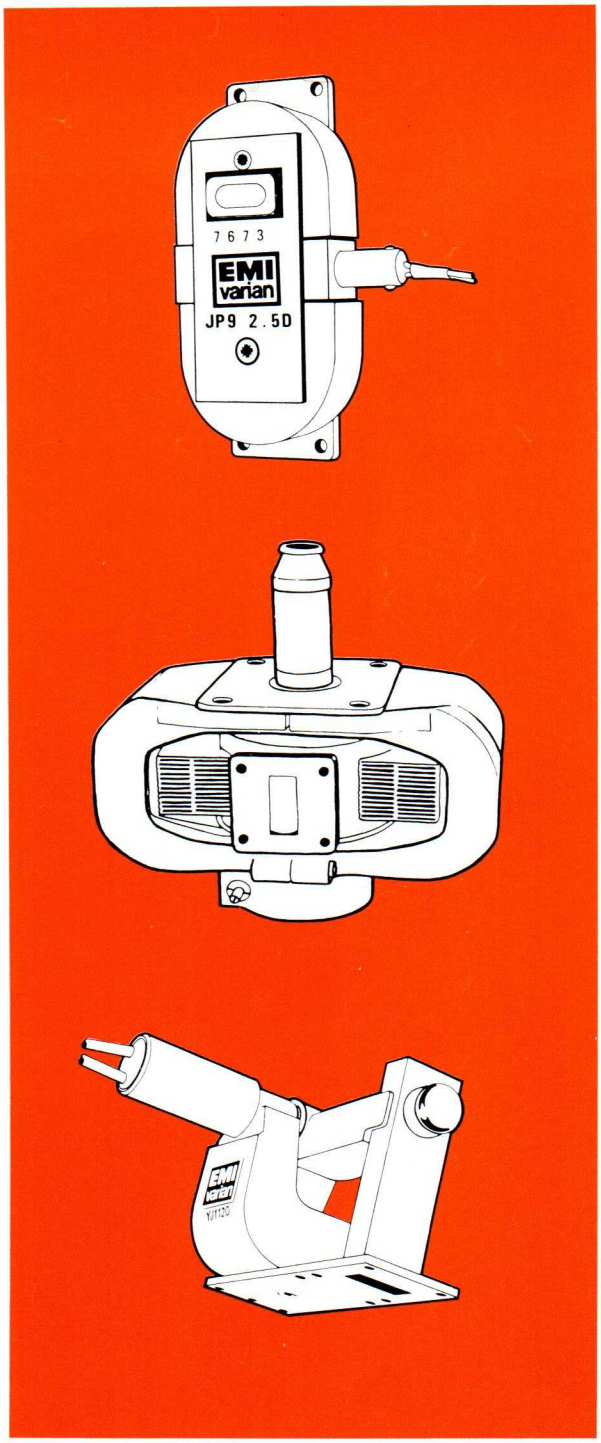
EMI-Varian manufactures magnetrons designed for commercial and small boat radars. These long-established designs of proven reliability have a fixed operating frequency.

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.375 ± 0.03	10	0.0025	2.5	2J42
9.375 ± 0.03	20	0.001	1.5	YJ1110
9.41 ± 0.065	3	0.0005	0.5	JP9-2.5
9.41 ± 0.03	21	0.001	2.5	JP9-18
9.41 ± 0.03	25	0.001	1.0	YJ1120
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5D
9.445 ± 0.03	3	0.0005	0.5	JP9-2.5E
9.445 ± 0.03	26	0.001	1.0	YJ1121

Airborne Radar Magnetrons

Frequency (GHz)	Output power (kW)	Duty Cycle	Pulse length (uS)	Type Number
9.24 ± 0.03	22	0.001	1.0	PT5036
9.375 ± 0.03	20	0.0015	1.5	YJ1112
TUNABLE COAXIAL MAGNETRONS				
9.1 – 9.5	100	0.001	2.5	PT5017
8.5 – 9.6	200	0.001	1.5	PT5016
16.6 – 16.8	40	0.001	2.0	PT5060
SPIN TUNED MAGNETRON				
8.7 – 9.7+	100	0.001	1.0	PT5024

+ SPIN TUNED OVER ANY 200 MHz band



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