MA-232B

CW X-Band Magnetron

Bulletin 1539

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 710-332-6789

MA-232B CW X-Band Magnetron

DESCRIPTION

A sturdy, lightweight unit incorporating positive anode design. The MA-232B provides efficient fixed-frequency operation for X-band applications requiring a minimum power of 15 watts CW.

APPLICATIONS

Beacon and navigation systems, radar detection systems, missile ground support equipment, transponders, and airborne radar applications.

SPECIFICATIONS

Electrical Characteristics

Frequency Range, Fixed	8800 to 9600 MHz
Power, Output	15 W, CW, min.
Pulling Factor (1.3:1 VSWR)	16 MHz, max.
Pushing Factor	4 MHz (± 10% I_b), max.
Thermal Coefficient[1]	0.2 MHz/°C, max.

Operating Conditions

Heater Voltage[2]	6.3 V
Heater Current	0.7A, max.
Preheat Time	15 sec., min.
Anode Voltage	+900 to +1000 V
Anode Current	0.06 A
Anode-Cathode Capacitance	16 pF, nom.
Duty Cycle (ratio)	CW

Mechanical Characteristics

Size	Refer to Outline drawing
Weight (approx.)	11 oz.
Mounting Position	Any
Output Connector	Mates with UG-39/U

Environmental Characteristics

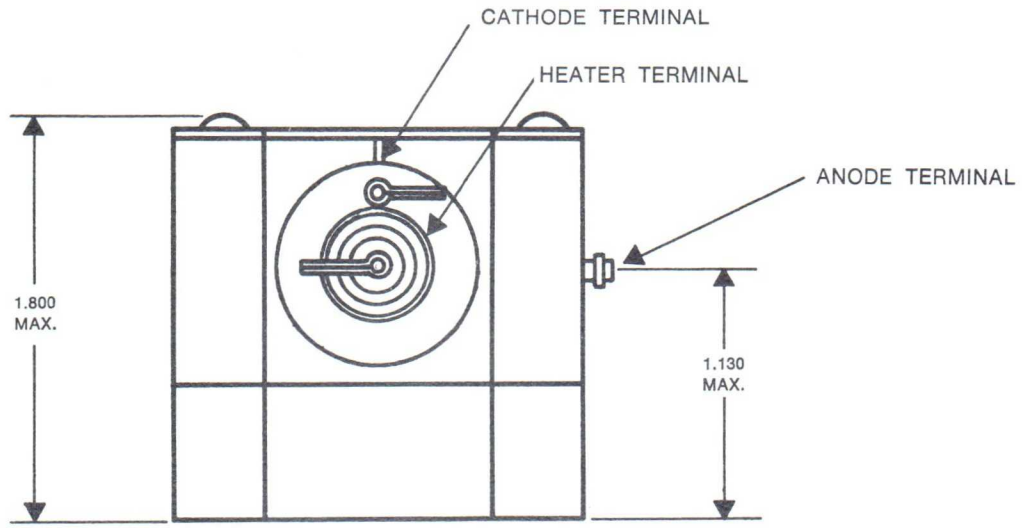
Cooling	Conduction/Convection
Ambient Temperature	−54°C to +85°C
Altitude	40,000 ft.
Vibration (40 to 2,000 cps)	15 G
Shock (11 ±1 ms)	60 G

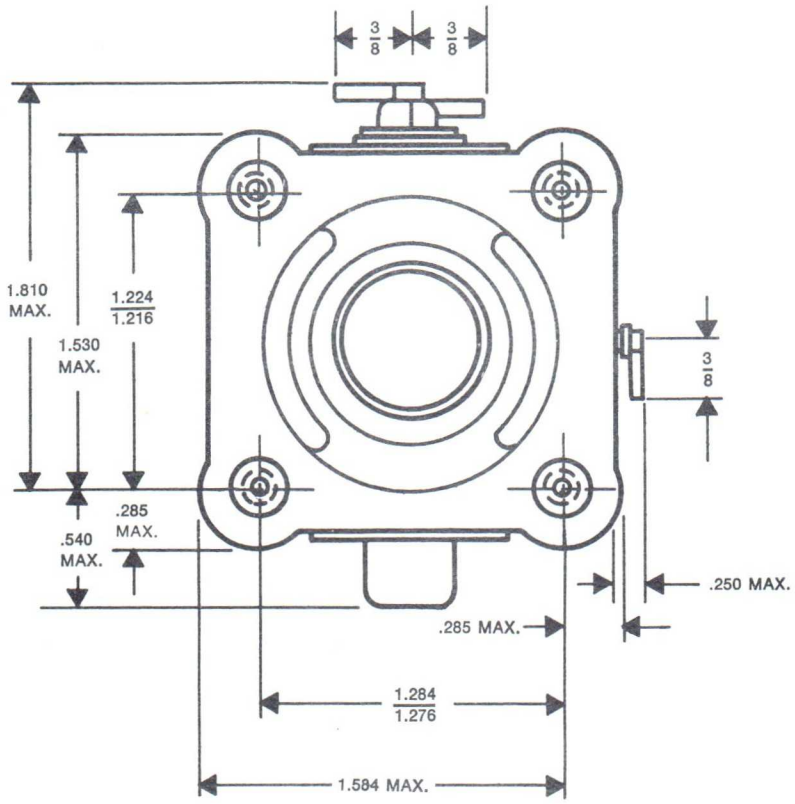
1. Thermal coefficient .050 MHz/°C max. available on special request.
2. Heater voltage is reduced during oscillation to a value specified on each magnetron.

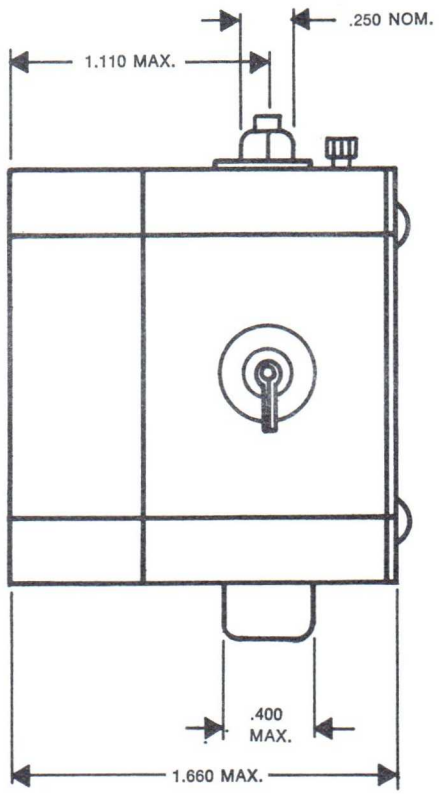
All specifications are subject to change without notice.

3/68 Printed in U.S.A.

OUTLINE DRAWING







MA-270

Tunable X-Band Magnetron

Bulletin 1536

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 710-332-6789

MA-270 Tunable X-Band Magnetron

DESCRIPTION

The MA-270 is a tunable frequency, pulsed, X-band magnetron. This compact, lightweight power tube provides a 150 watt minimum peak power output over the tuning range of 9000 to 9500 MHz. The MA-270 features a rugged design capable of excellent frequency stability.

APPLICATIONS

The MA-270 is designed for use in beacon and transponder systems. It is equally suited for use in airborne, missile and ground support radar equipment.

SPECIFICATIONS

Electrical Characteristics

Frequency Range, Tunable	9000 to 9500 MHz
Peak Power	150 w, min.
Pulling Factor	15 MHz (1.5:1 VSWR), max.
Pushing Factor	4.5 MHz (± 10% ib), max.
Missing Pulse Rate	0.25%, max.
Side Lobes (ratio)	−6 dB, min.
Thermal Coefficient	±0.08 MHz/°C, max.

Operating Conditions

Heater Voltage	5.0 V
Heater Current	0.5 A
Pulse Voltage	1300 to 1500 V
Pulse Current	0.9 A
Anode-Cathode Capacitance	15 pF
Duty Cycle (ratio)	0.002, max.

Mechanical Characteristics

Size	Refer to outline drawing
Weight (approx.)	6.0 oz.
Mounting Position	Any
Output Connector	Mates with TNC female

Environmental Characteristics

Cooling	Conduction/Convection
Ambient Temperature	−55°C to +71°C
Altitude	60,000 ft.
Vibration (60 to 2000 cps)	15 G
Shock (11 ± 1 ms)	60 G

All specifications are subject to change without notice.

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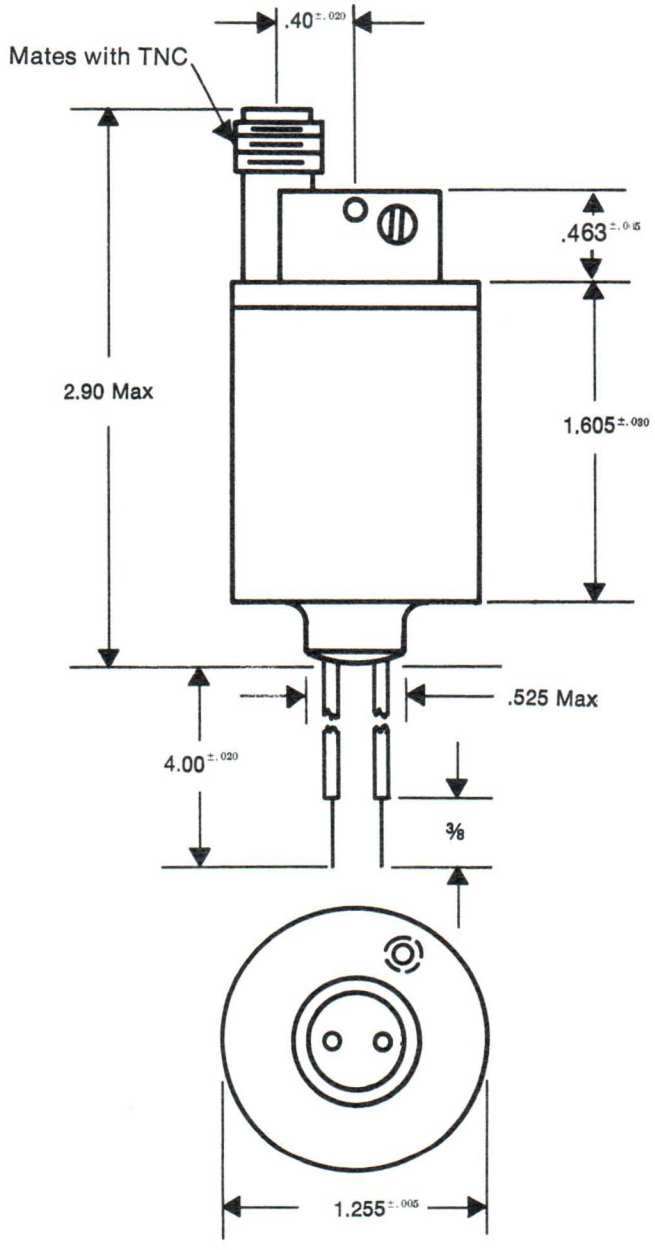
OUTLINE DRAWING



MA-272

7Kw X-Band Miniature Magnetron

Bulletin 1537

Microwave Associates, Inc.
Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 710-332-6789

MA-272 7Kw, X-Band Miniature Magnetron

DESCRIPTION

The MA-272, X-band miniature magnetron features a very small and lightweight package, low voltage and positive anode design.

APPLICATIONS

This miniature magnetron is ideally suited for transponder, beacon and manpack radar systems. It is equally suited for use in missile ground support equipment, missiles, high performance aircraft and battlefield environments.

SPECIFICATIONS

Electrical Characteristics

Frequency Range, Fixed	8500 to 9600 MHz
Peak Power	7kw, min.
Pulling Factor	20 MHz (1.5:1 VSWR), max.
Pushing Factor	3 MHz (±10% max.), max.
Missing Pulse Rate	0.1%, max.
Side Lobes (ratio)	−8dB, min.
Thermal Coefficient	0.1 MHz/°C, max.

Operating Conditions

Heater Voltage	5.5 V
Heater Current	1.0 A, nom.
Preheat Time	10 sec., min.
Pulse Voltage	4300 V to 4700 V
Pulse Current	5.5 A
Anode-Cathode Capacitance	18 pF, nom.
Duty Cycle (ratio)	.002, max.
Pulse Width	1μsec.

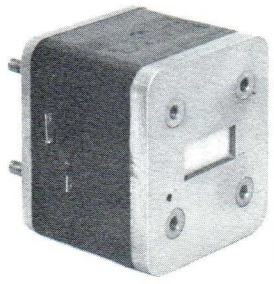
Mechanical Characteristics

Size	Refer to outline drawing
Weight (approx.)	21 oz.
Mounting Position	Any
Output Connector	Mates with UG-39/U Flange

Environmental Characteristics

Cooling	Conduction/Convection to .001 duty
Ambient Temperature	−54°C to +85°C
[1]Vibration (55 to 2000 cps)	20 G
Shock (6 ms)	100 G

[1]100 G provided upon request



All specifications are subject to change without notice.

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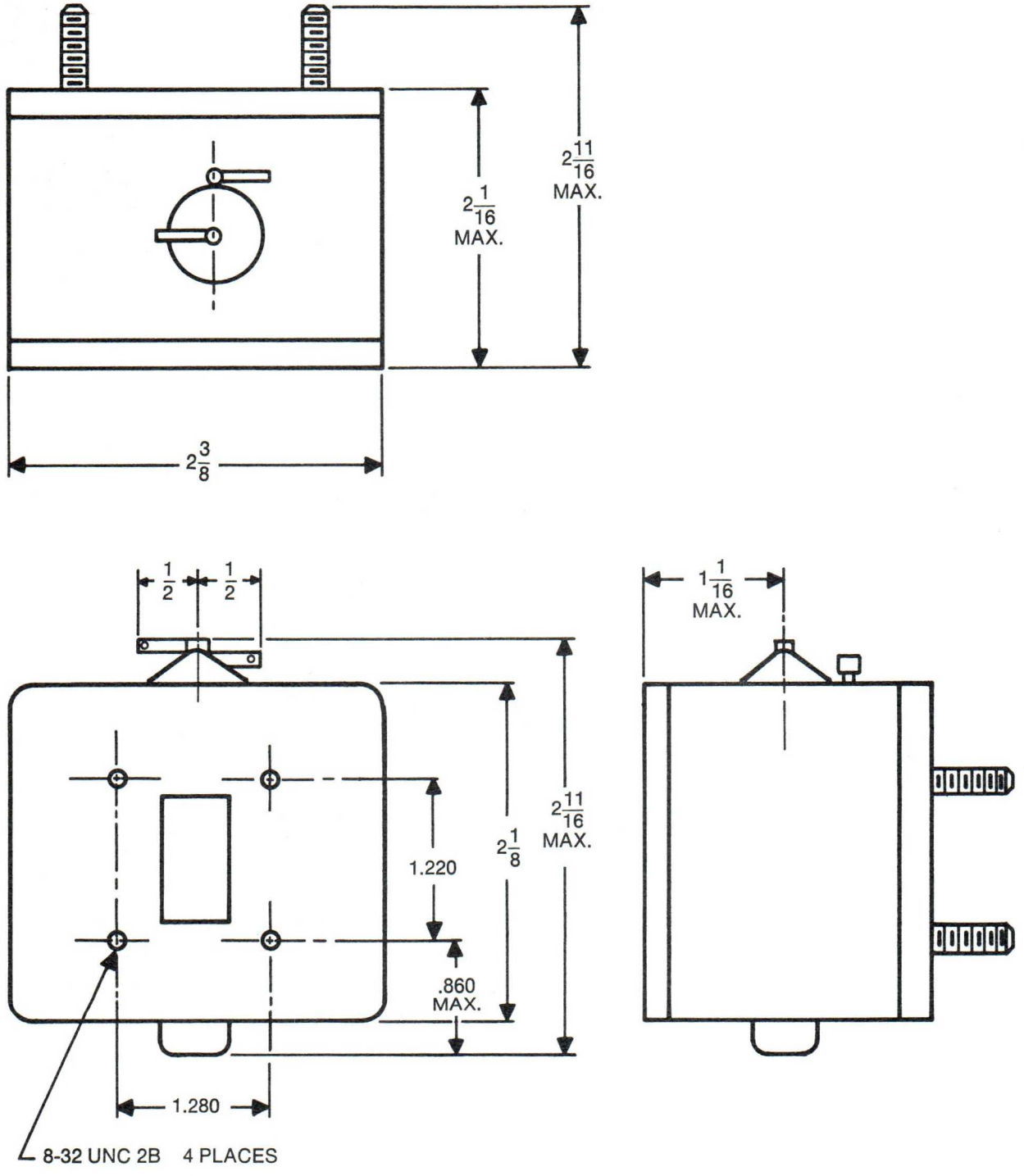
OUTLINE DRAWING



MA-274

KU-Band Tunable Frequency Magnetron

Bulletin 1538

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 710-332-6789

MA-274 KU-Band Tunable Frequency Magnetron

DESCRIPTION

The MA-274 is a tunable frequency Ku-band magnetron. This compact, lightweight power tube provides a 800 watt minimum peak power output over the bandwidth of 15,700 to 16,100 MHz. This power tube also features an integral isolator which makes the tube nearly impervious to load variations.

APPLICATIONS

The MA-274 is suited for use in various types of surface and airborne transmitter and transponder applications.

SPECIFICATIONS

Electrical Characteristics

Frequency Range, Tunable	15,700 to 16,100 MHz
Peak Power	800 w, min.
Pulling Factor	2.5 MHz (1.5:1 VSWR), max.
Pushing Factor	3.0 MHz (±10% ib), max.
Missing Pulse Rate	0.1%, max.
Side Lobes (ratio)	−8dB, min.
Thermal Coefficient	0.1 MHz/°C, max.

Operating Conditions

Heater Voltage	6.3 V
Heater Current	0.85 A, nom.
Pulse Voltage	2300 to 2500 V
Pulse Current	2.0 A
Preheat Time	15 sec. nom.

Anode Cathode Capacitance	20 pF, max.
Duty Cycle (ratio)	.005, max.

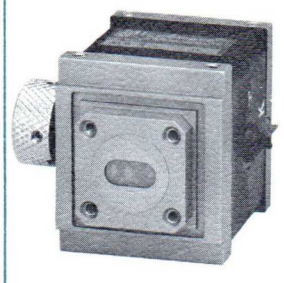
Mechanical Characteristics

Size	Refer to outline drawing
Weight (approx.)	19 oz.
Mounting Position	Any
Output Connector	Mates with UG-419/U

Environmental Characteristics

Cooling	Conduction/Convection
Ambient Temperature	−54°C to +72°C
Vibration (40 to 2000 cps)	15 G
Shock (11±1 ms)	60 G

All specifications are subject to change without notice.



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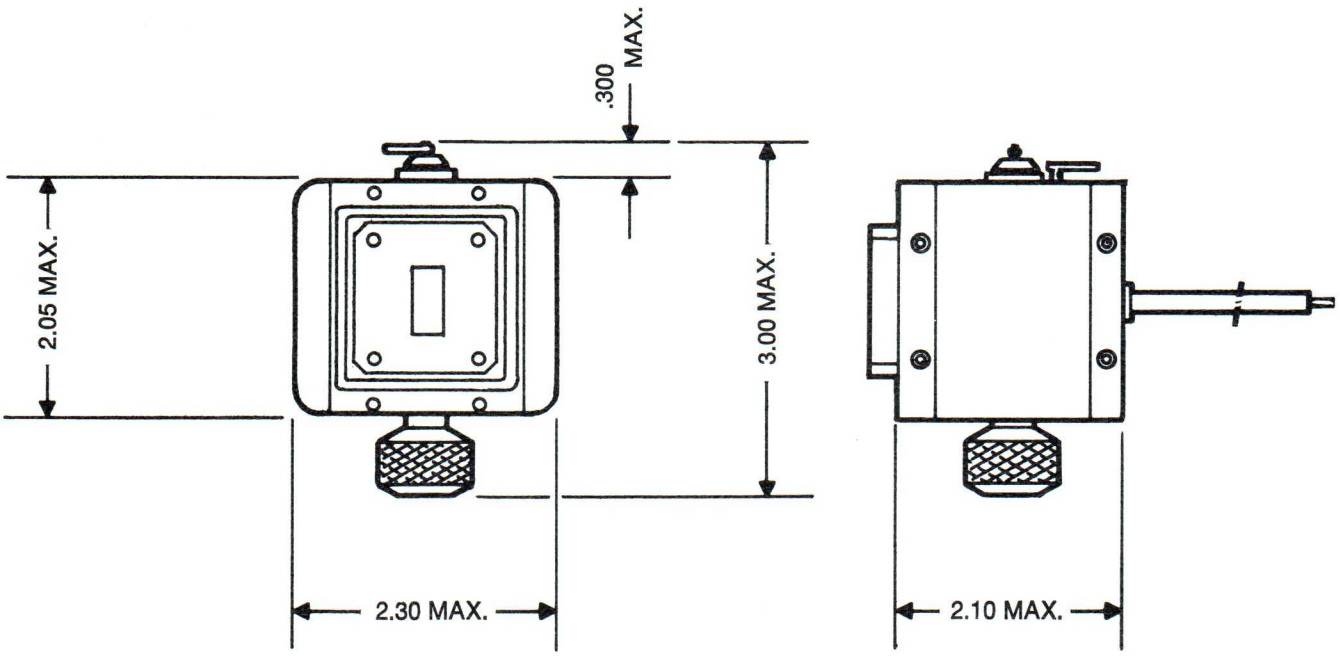
OUTLINE DRAWING



PRELIMINARY

MA-286

Ka-Band Positive Anode Magnetron

Bulletin 1545

Microwave Associates, Inc.
Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 710-332-6789

MA-286 Ka-Band Positive Anode Magnetron

DESCRIPTION

The MA-286 is a positive pulse, tunable frequency magnetron which provides a minimum of 1 kW peak power. This rugged, compact and lightweight power tube features a grounded cathode, isolated-anode design.

APPLICATION

The MA-286 is particularly suited for use in beacon, navigation and radar detection systems. It is equally suited for use in missile ground support equipment, transponders and airborne radar systems.

SPECIFICATIONS

Electrical Characteristics

Frequency Range	+50 to −50 MHz
Peak Power	1.0 kW, min.
Pulling Factor	40 MHz (1.5:1 VSWR)
Missing Pulse Rate	0.1%, max.
Side Lobes (ratio)	−8dB, min.

Mechanical Characteristics

Size	Refer to outline drawing
Weight	16 oz., max.
Mounting Position	Any
Output Connector	Mates with UG-600/U Flange

Operating Conditions

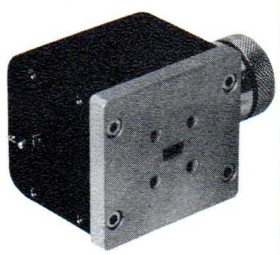
Heater Voltage	6.3V
Heater Current	0.9A
Pulse Voltage	3400 to 3600V
Pulse Current	1.75A
Preheat Time	20 sec., min.
Anode-Cathode Capacitance	18 pF, nom.
Duty Cycle (ratio)	.002 max.
Pulse Length	.03 to 1.2μs

Environmental Characteristics

Cooling	Conduction/Convection
Ambient Temperature	−55°C to + 100°C
Vibration	(50 to 2500 cps) 15 G, max.
Shock (11 ± 1 ms)	50 G

Note: 1. Range of tuning where f_o is center frequency to be chosen within the band 34.5 to 36.5 GHz.

All specifications are subject to change without notice.



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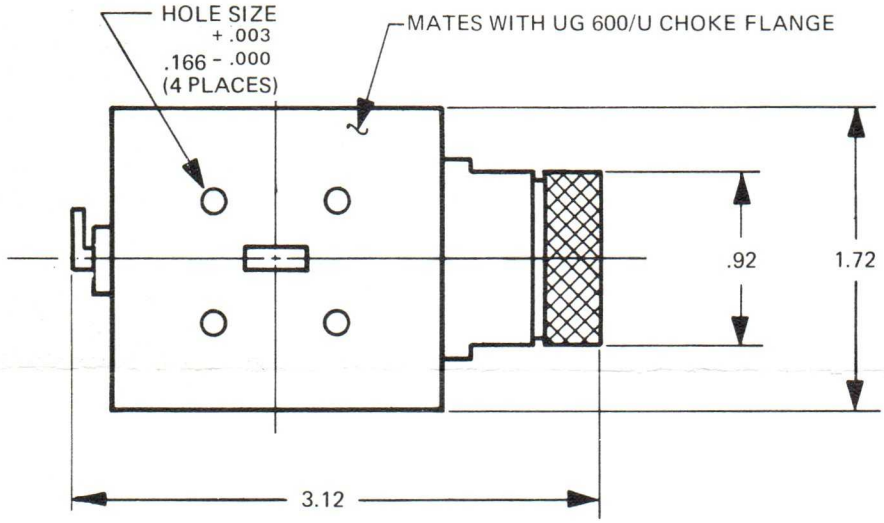
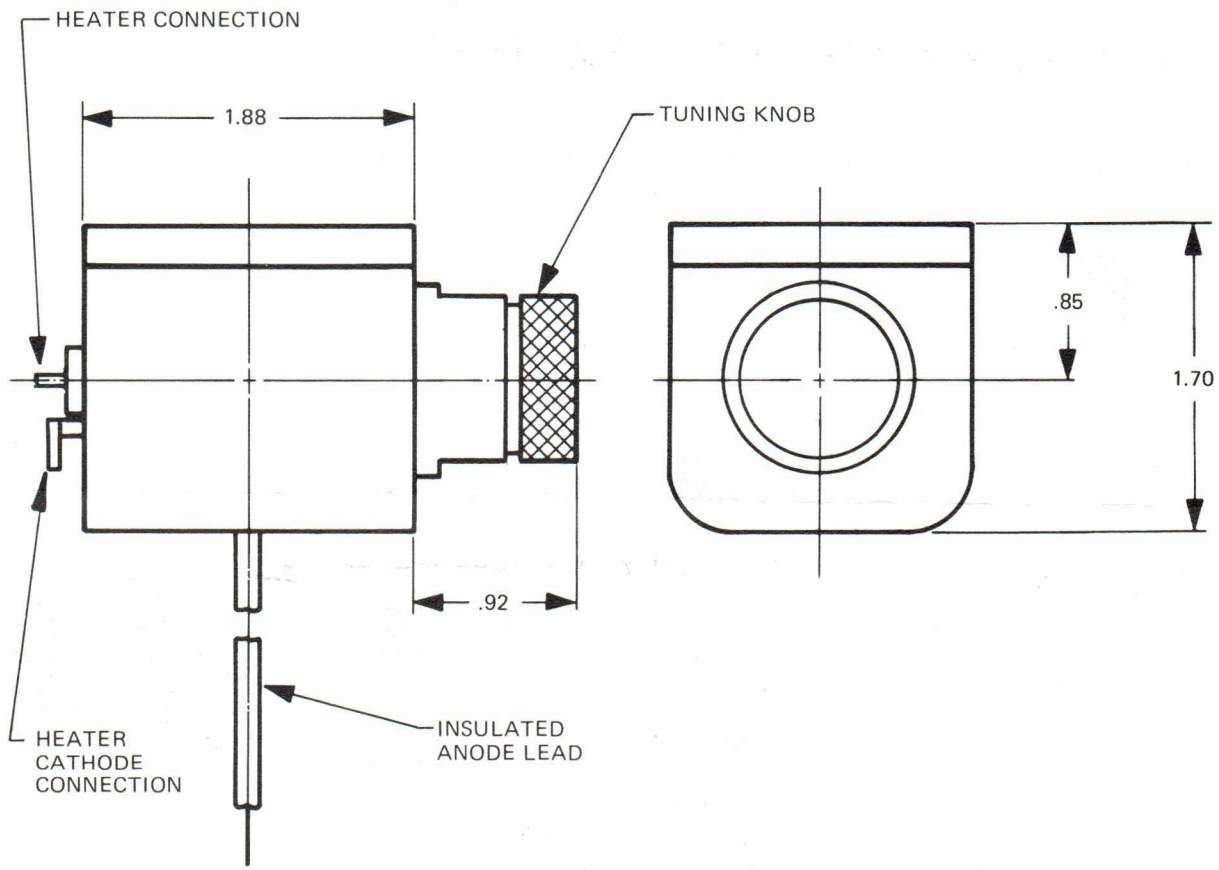
OUTLINE DRAWING

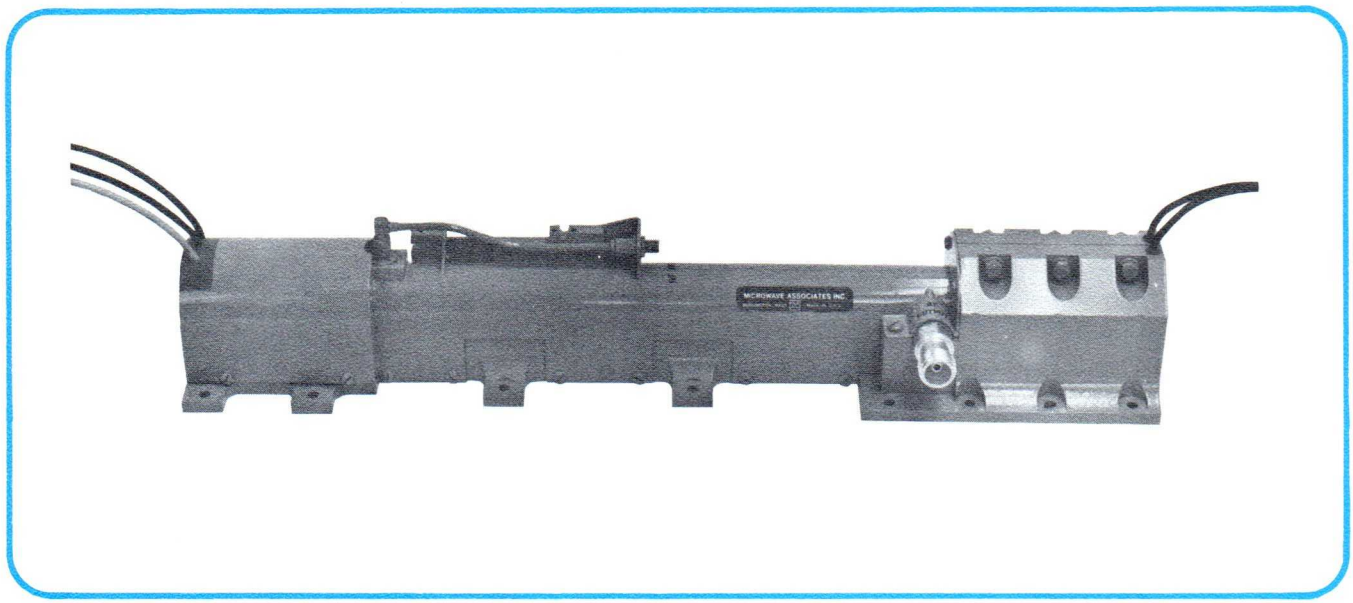




MA-2074 TWT

DUAL-MODE

Bulletin 1877



DESCRIPTION

The MA-2074 traveling wave tube is a high performance dual-mode power amplifier featuring rugged metal-to-ceramic construction, lightweight PPM focusing, an RF circuit of unique thermal capability and a non-intercepting control grid. The nominal CW power output of the tube is 300 watts with a minimum gain of 30 dB. The non-intercepting grid permits 3 dB pulse-up operation at any duty cycle up to 50%.

APPLICATIONS

The MA-2074 traveling wave tube is ideally suited for applications in ECM systems either in the broadband noise mode or selected frequency application. It may also be employed effectively as RF power source, driver or intermediate amplifier. The tube is designed to withstand the stress of an airborne environment.

Microwave Associates, Inc. Burlington, Massachusetts Tel. (617) 272-3000

Western Union Fax
TWX: 710-332-6789
Telex: 94-9464

SPECIFICATIONS

Electrical Characteristics

Frequency Range	2.7 to 5.4 GHz	
	C-Mode	**P-Mode**
Duty Cycle	0.1 to 100%	0.1 to 50%
Output Power	300 W, Min.	600 W, Min.
Gain at Rated Output	30 dB, Min.	33 dB, Min.

Power Supply Requirements

Element	**Voltage**	**Current, Max.**	
Heater	6.3 V	5.5 A	
		C-Mode	**P-Mode (Peak)**
Helix	5.4 kV	.050 A	.100 A
Collector	3.5 kV	.350 A	.425 A
Grid, Cut-Off	−150 V	.0002 A	
Grid, C-Mode	+80 V	.002 A	
Grid, P-Mode	+110 V		.003 A
Grid to Cathode Capacitance			35 pF

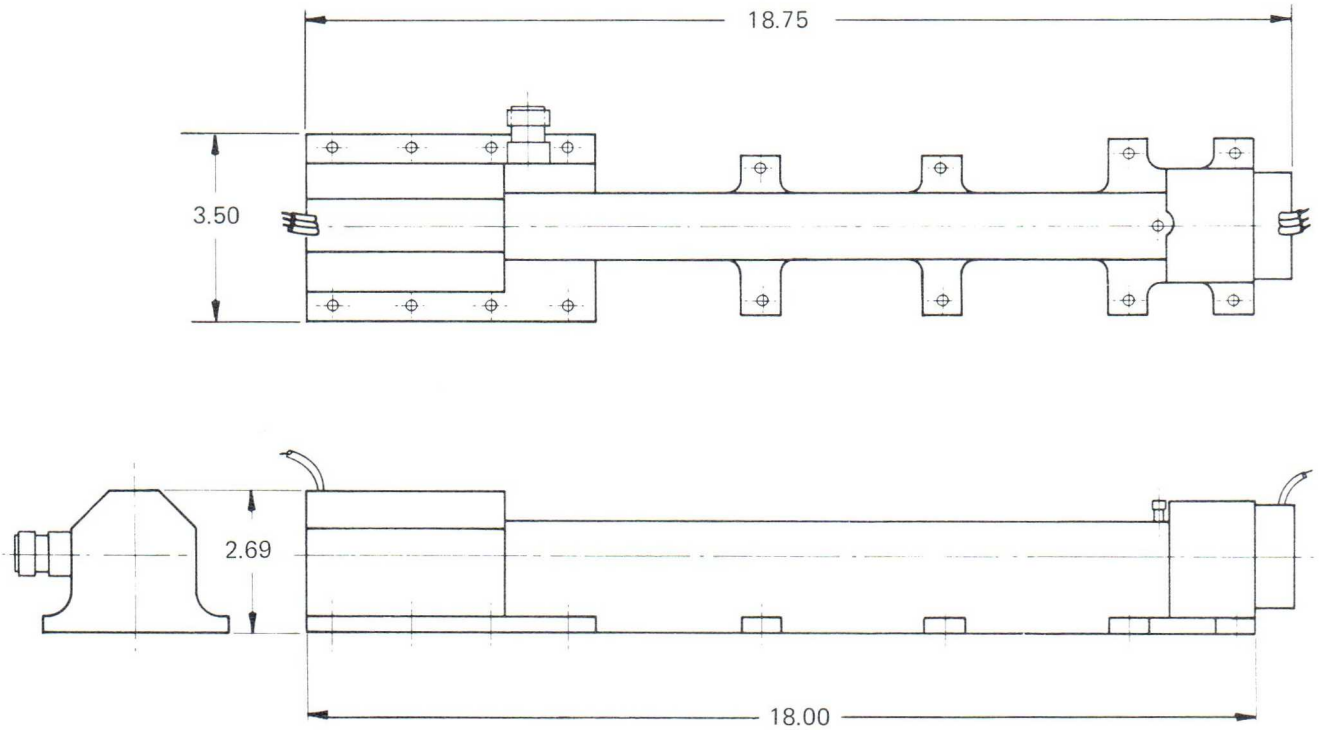
Mechanical Characteristics

Size	Refer to Outline Drawing	RF Connectors:	
Weight	8.5 lbs.	Input	SMA
Focusing	PPM	Output	S/C
Cooling	Conduction	Electrical	Flying Leads
		Mounting Position	Any

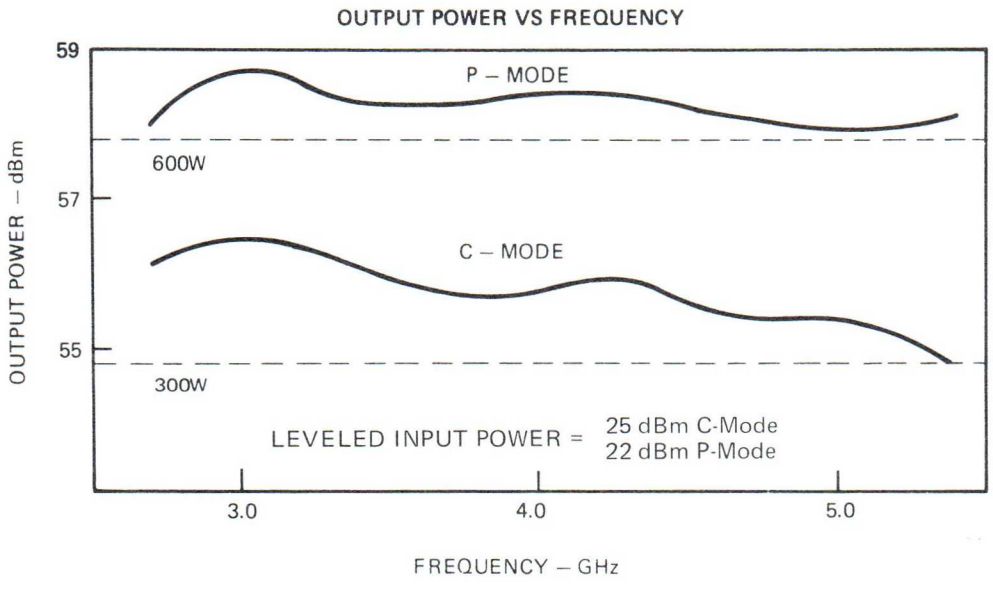
Environmental Characteristics

Applicable Military Spec.	MIL-E-5400, Class 1	Vibration (@ 500 cps)	10 g's
Altitude	70,000 Ft.	Shock (@ 11 ms)	15 g's

OUTLINE DRAWING



TYPICAL PERFORMANCE CURVE



1/73 Printed in U. S. A.

MA-3154
S-Band
Dual Pre-TR
TR-Tube

Bulletin 129

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 617-272-1492

MA-3154

DESCRIPTION

The MA-3154 is a dual pre-TR-TR tube operating in S band. This unit provides positive receiver protection for traveling wave tubes.

ELECTRICAL SPECIFICATIONS

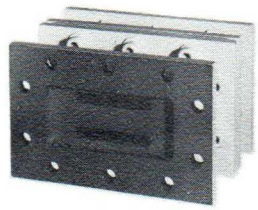
frequency	3.35 to 3.65 GHz
peak power	750 kW max.
VSWR	1.6:1
duplexer loss	0.5 dB (with 100 μa on ignitors)
recovery time	30 μsec.
life test	1000 hours
life test end points:	
recovery time	60 μsec.
duplexer loss	0.5 dB

ENVIRONMENTAL SPECIFICATIONS

temperature range	0° to +65 °C
vibration	per Test Condition D, Method 204A of MIL-STD-202B
low pressure	altitude of 90,000 ft.

Complete specification in MIL-format available on request.

All specifications subject to change without notice.



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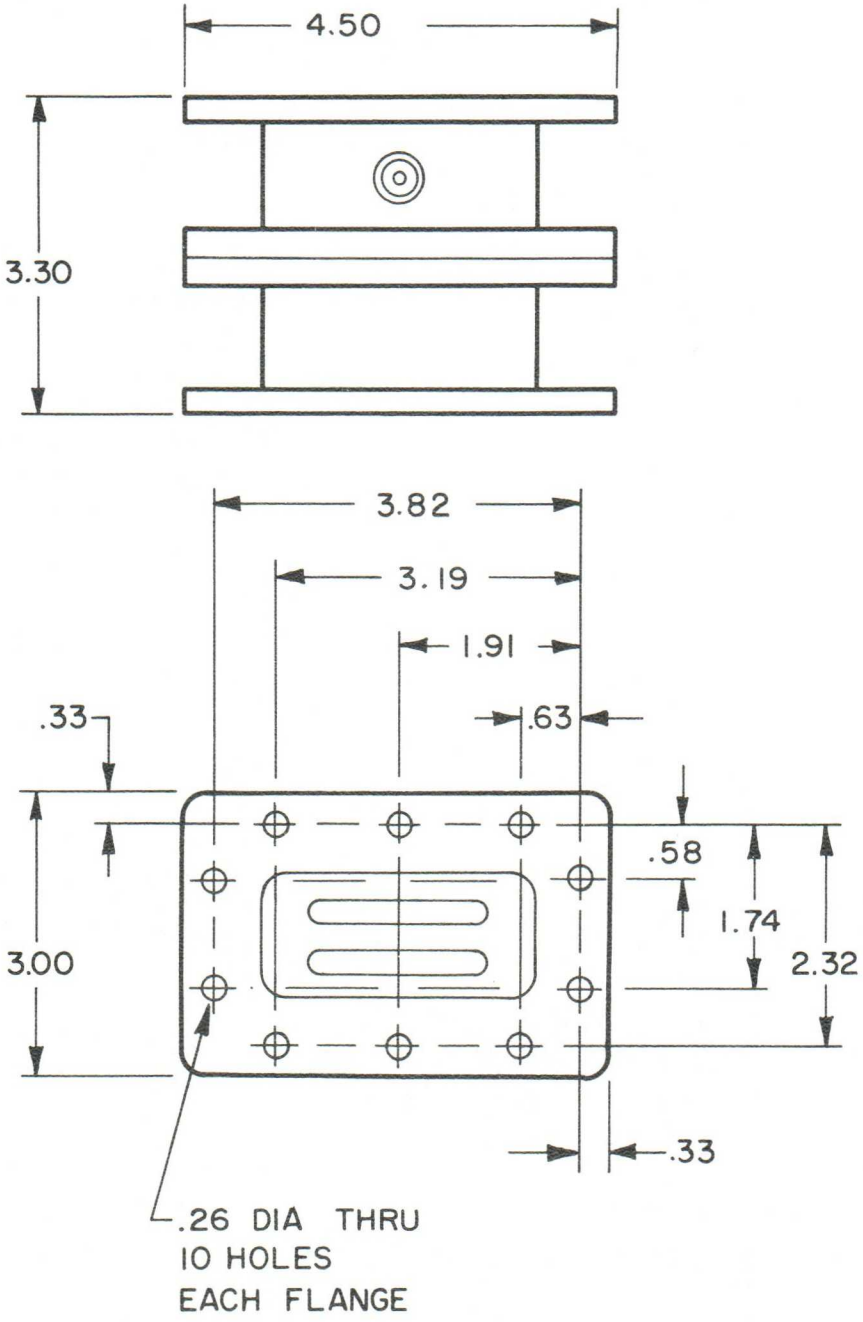


NOTE:

ALL DIMENSIONS ARE IN INCHES AND ARE NOMINAL.

MA-3706 X-Band Dual TR Tube

Bulletin 131

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 617-272-1492

MA-3706

DESCRIPTION

The MA-3706 is an X-band phase-controlled TR tube designed to operate over extreme temperature ranges.

ELECTRICAL SPECIFICATIONS

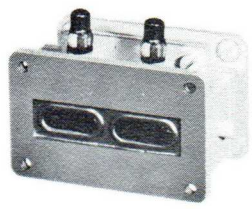
frequency	8.6 to 9.6 GHz
peak power	200 kW max.
VSWR	1.2:1
insertion loss	0.7 dB max.
spike leakage	0.15 ergs (125 °C)
flat leakage	15 mW (125 °C)
recovery time	5.0 μs (−55 °C)
ignitor noise ratio	1.3
life test	2000 hours (T_f = 125 °C)
life test end points:	
recovery time	5 μs (25 °C)
insertion loss	0.8 dB
noise figure degradation	3.0 dB (crystal noise)

ENVIRONMENTAL SPECIFICATIONS

temperature range	−55 ° to +125 °C
vibration	per Test Condition C, Method 204A of MIL-STD-202B
low pressure	altitude of 90,000 ft.

Complete specification in MIL-format available on request.

All specifications subject to change without notice.



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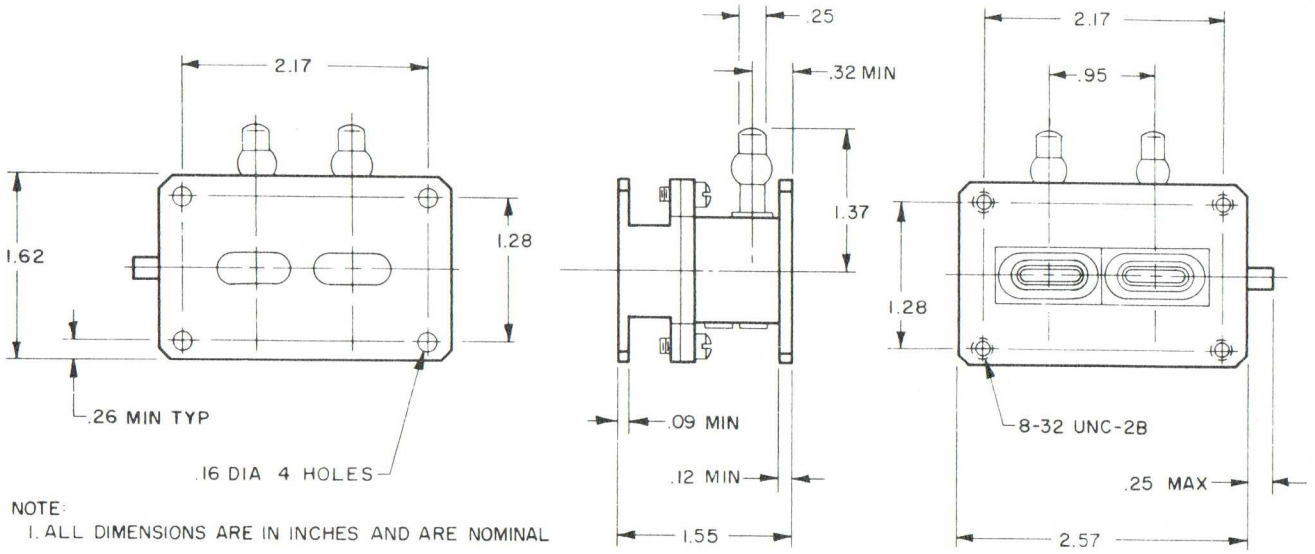
OUTLINE DRAWING



NOTE:
1. ALL DIMENSIONS ARE IN INCHES AND ARE NOMINAL

MA-3801
TR-Switch

Bulletin 125

Microwave Associates, Inc.

Burlington
Massachusetts
Tel. (617) 272-3000
Western Union Fax
TWX: 617-272-1492

MA-3801 TR-Switch

DESCRIPTION

The MA-3801 TR-Switch combines in a single package a gas TR tube and a solid-state switch.

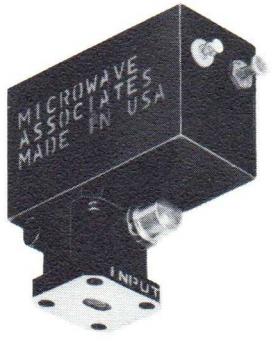
APPLICATIONS

The MA-3801 provides positive protection for standard crystal receivers and tunnel diode amplifiers.

SPECIFICATIONS

Complete, formal specifications in MIL-E-1 format are available on request.

Frequency	32.9-36.0 GHz
Maximum Peak Power	10 kw
VSWR	1.5
Insertion Loss	1.5 dB
Spike Leakage	0.02 ergs per pulse
Flat Leakage	40 mw
Ignitor Noise Ratio	1.15
Recovery Time	2 μs
Life Test	1,000 hours
Temperature Range	−55° to +85°C
Size	See outline drawing.



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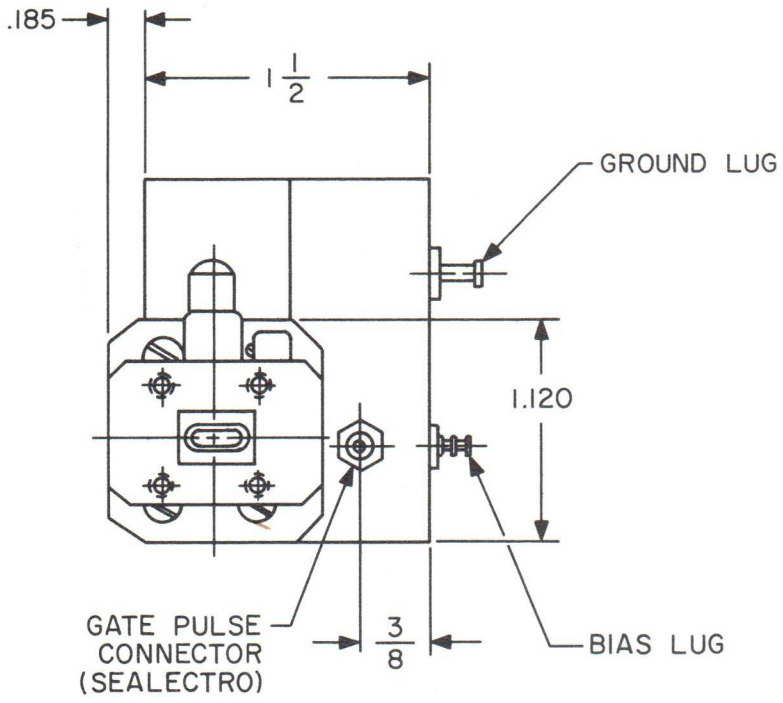
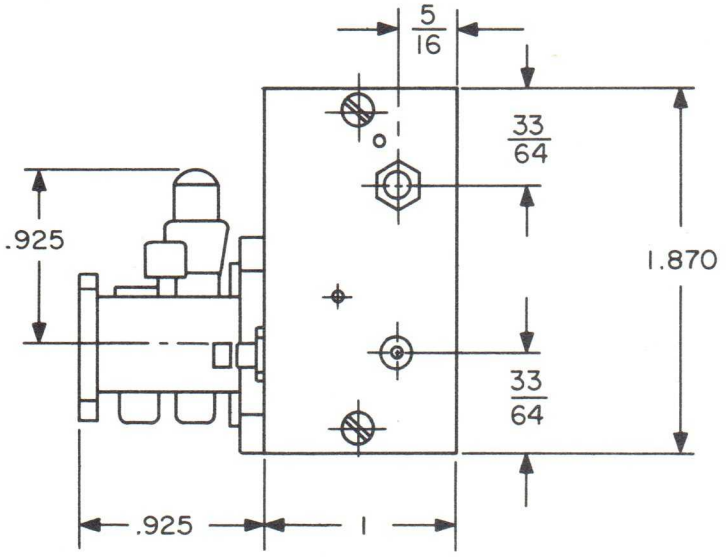
OUTLINE DRAWING





NOTES:

1. ALL DIMENSIONS ARE IN INCHES
2. ALL DIMENSIONS ARE FOR REFERENCE ONLY

LE MATERIEL TELEPHONIQUE
Boulogne-Billancourt

VISA SGN DMT 27

LMT 459.108
Edition 2 du 15.1-69
Page 3

SPECIFICATION DU TUBE TR/LIMITEUR

1 - FOURNISSEUR

Microwave Associates - Burlington - Mass. (USA)

Importateur : TRANCHANT Electronique
19 - 21 rue Madame de Sanzillon - 92 CLICHY
Tél. 270.22.55

Référence : MA 3 830 X.

2 - CARACTERISTIQUES ELECTRIQUES

- Gamme de fréquences :
- Puissance crête maximum : 10 kW
- Puissance moyenne maximum : 10 W
- Tension d'alimentation : - 700 à - 1000 V

Le tube TR sera conforme à la norme MIL-E-1-E, cette spécification tenant lieu de feuille particulière. En cas de contradiction entre la norme MIL-E-1-E et la feuille particulière cette dernière fera foi.

3 - CARACTERISTIQUES MECANIQUES

3.1 - Caractéristiques générales

Les dimensions extérieures seront conformes au dessin de la page 2. Le tube TR sera fourni équipé de 4 vis BH 8-32 x 3/4 en acier inoxydable.

La plaque d'identification fera apparaître :

- le nom du constructeur
- la référence du constructeur.

3.2 - Essais mécaniques

a) Essai de vibrations :

suivant les prescriptions du fascicule 16/A de la spécification CCTU 01-01 A, sévérité 55 B (équivalant à la méthode 201 de la spécification MIL-STD-202 B)

b) Essai de secousses :

suivant les prescriptions du fascicule 24 de la norme CCTU-01-01 A. Les 4000 secousses seront également réparties entre les trois directions perpendiculaires (équivalant à l'annexe 4 de la spécification NEPR40).

c) Aucun essai de fonctionnement ni aucune mesure ne seront effectués durant les essais mécaniques. Les mesures électriques (§ 5.1 b)) seront effectuées à nouveau après les essais ; leurs résultats devront se trouver dans les limites prescrites.

4 - CARACTERISTIQUES CLIMATIQUES

4.1 - Caractéristiques générales

Le tube TR devra pouvoir fonctionner à toute température comprise entre - 55°C et + 85°C. Il sera étudié de manière à pouvoir satisfaire les essais décrits au § 4.2.

4.2 - Essais climatiques

Paragraphe de la norme MIL-E-1-E	Type de mesure	Conditions	
E - 50.2	Temps de stockage (Holding période)	t = 168 h.	
E - 4006	Vie en cycles thermiques	- 55° à + 85° 10 cycles	
E - 1016 (méthode 106 MIL-STD-202)	Essai d'humidité		
4.7	Durée de vie	P_o = 10 kW ± 5% t_p = 1 ± 0,15 µs Du = 0,001 F = 9500 MHz ± 5% I_i = 100 µA	t_{min} = 1000 h
4.7.3	Points de fin de vie	- temps de recouvrement - pertes d'insertion	≤ 4 µs ≤ 1 dB

5 - CONDITIONS DE RECETTE

5.1 - Contrôle unitaire

a) Inspection mécanique et visuelle suivant § 3.1.

VISA
SGM DMT
27 AVR. 1971

b) Mesures électriques

Paragraphe de la norme MIL-E-1-E	Type de mesure	Conditions	
E - 4006	Cycle thermique	- 55° à + 85°C	1 cycle
E - 4401	temps d'allumage	E = - 1000 V R = 7 Mégohms	t ⩽ 5 s
E - 4406	Chute de tension	I_i = 100 µA	200 ⩽ V ⩽ 450 V
E - 4474	TOS (ou VSWR)	F = 9400 MHz ± 0,1% F = 9600 MHz ± 0,1%	⩽ 1,4 ⩽ 1,4
E - 4416	Pertes d'insertion	F = 9400 MHz ± 0,1% F = 9600 MHz ± 0,1% I_i = 100 µAcc	0,8 dB
E 4441 et) E 4446)	Energie crête transmise	P_o = 10 kW ± 10% t_{p_1} = 1,0 ± 0,15 µs t_{p_2} = 0,5 ± 0,15 µs F_r = 1 kHz ± 5% F = 9500 MHz ± 5% I_i = 100 µAcc	⩽ 0,06 erg.
E - 4451	Puissance transmise	mêmes conditions	P ⩽ 40 mW
E - 4421	Temps de recouvrement	mêmes conditions	t ⩽ 2 µs

5.2 - Contrôle par prélèvements

Les prélèvements seront déterminés par le Service de l'Inspection en accord avec l'ingénieur responsable de la commande à LMT.

Les essais mécaniques (§ 3.2) et climatiques (§ 4.2) seront effectués par prélèvements.

Référence : spécification LCT 5.560.211, édition 1 du 6 mars 1967.

JC/YT

VISA
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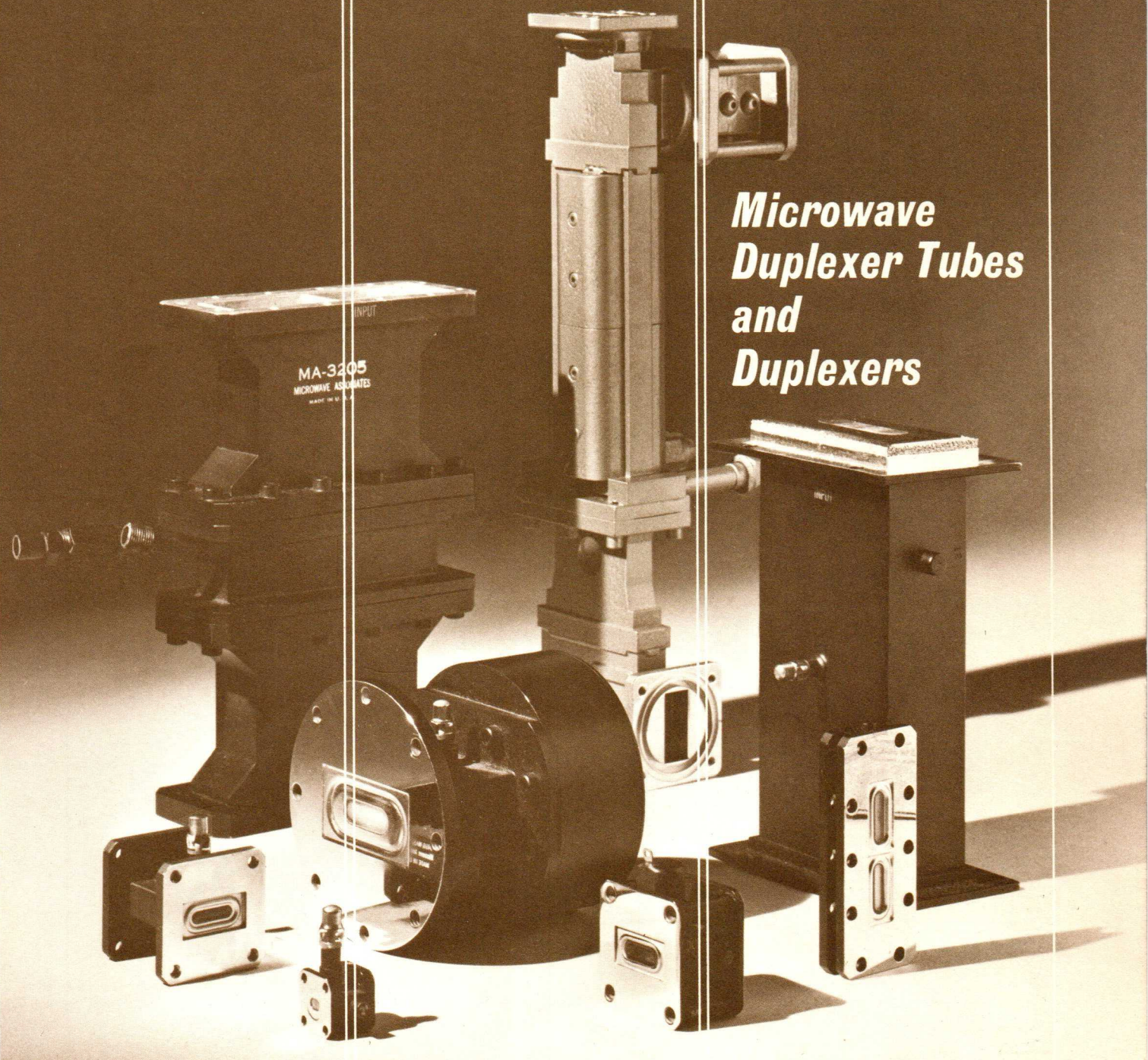
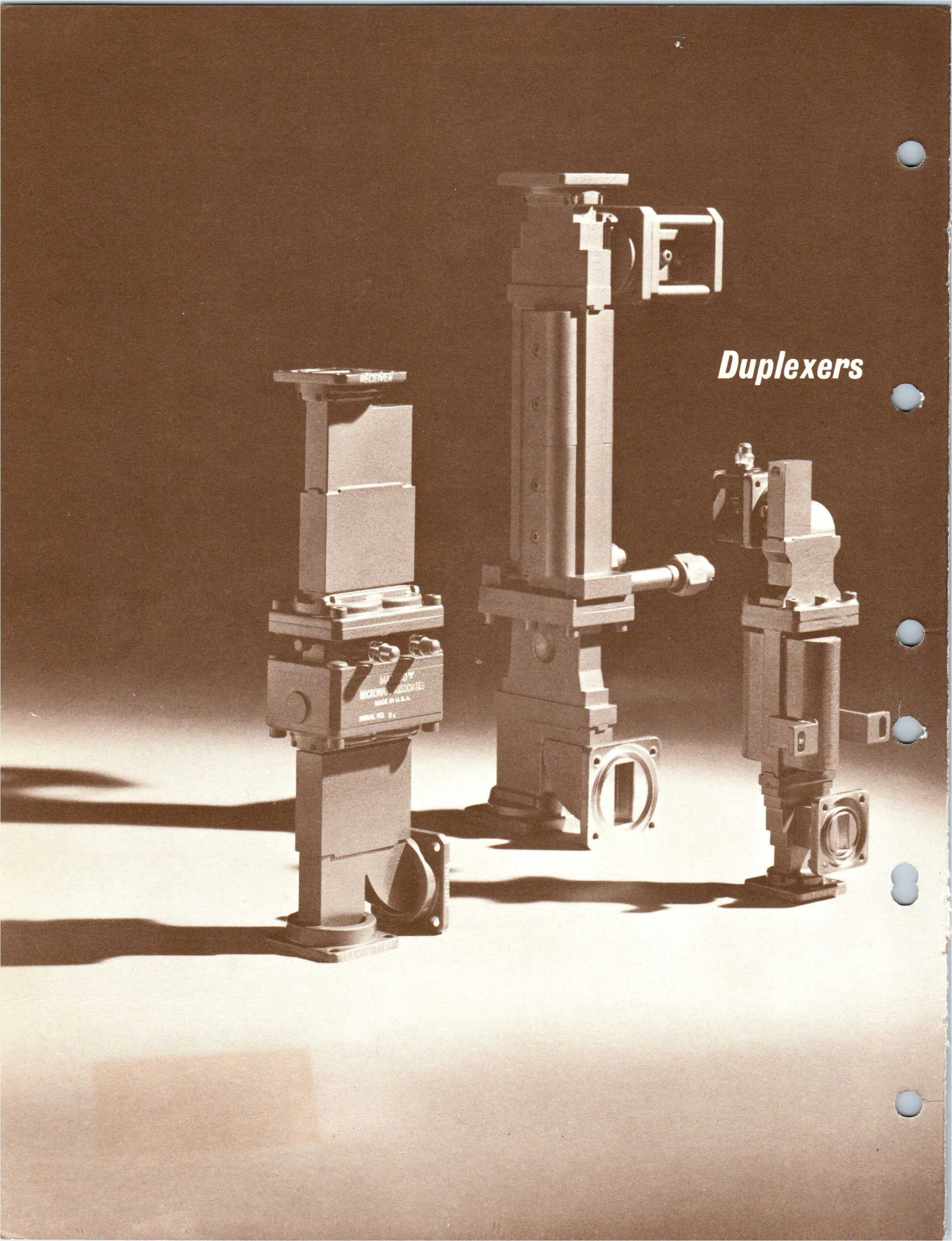
27 AVR. 1971

Catalog SF-102/June, 1964

Microwave Associates, Inc.

Microwave Duplexer Tubes and Duplexers





Duplexers

Gas Tube

	Type	Frequency (Mc)	Peak Power (MW)	Ave. Power (KW)	Pulse Width (μs)	Recovery Time (μs)	Low Level Loss* (db)	High Level Loss (db)	
UHF	MA-3212	Tunable 400-450	5	400	2000	500	0.5	0.1	
	MA-3212A	400-450	5	150	50	100	0.5	0.1	
	MA-3213	400-450	25	75	10	150	0.5	0.1	
	MA-3228	400-450	30	30	10	100	0.5	0.1	
	MA-3235	430-440	20	100	30	50	0.5	0.1	
	MA-3200	510-690	4	20	8	100	0.8	0.1	
L	MA-3206	1250-1350	25	50	6	200	0.5	0.1	
	MA-3218	1250-1350	50	100	6	200	0.7	0.1	
	MA-3222	1215-1365	10	50	30	10	0.3	0.1	
	MA-3204	1105-1495	6	13	6	50	0.5	0.1	
S	MA-3230	200 Mc in 2500 to 3600 Mc Range	6	30	10	20	0.2	0.1	
	MA-3210	2700-3000	1	2	10	100	0.8	0.2	
	MA-3211	2700-3000	2	5	10	30	0.5	0.1	
	MA-3215	2900-3100	1	5	5	60	0.4	0.3	
	MA-3233	3000-3200	3	30	30	20	0.2	0.4	Ferri-Gas Design**
	MA-3225	3400-3600	5	15	5	10	0.1	0.25	
C	MA-3226	5250-5750	5	5.0	1	10	0.1	0.25	
	MA-3205A	500 Mc in C Band	7	3.5	6	25	0.3	0.1	
X	MA-3214	8500-9600	500 KW	500 W	1	5	1.0	0.2	
	MA-3232	8500-9600	300 KW	300 W	0.3	2	1.0	0.2	
	MA-3236	8500-9600	350 KW	350 W	1	3	0.6	0.2	
Ku	MA-3208	15,000-17,000	100 KW	100 W	1	5	1.2	0.3	

*Center Frequency

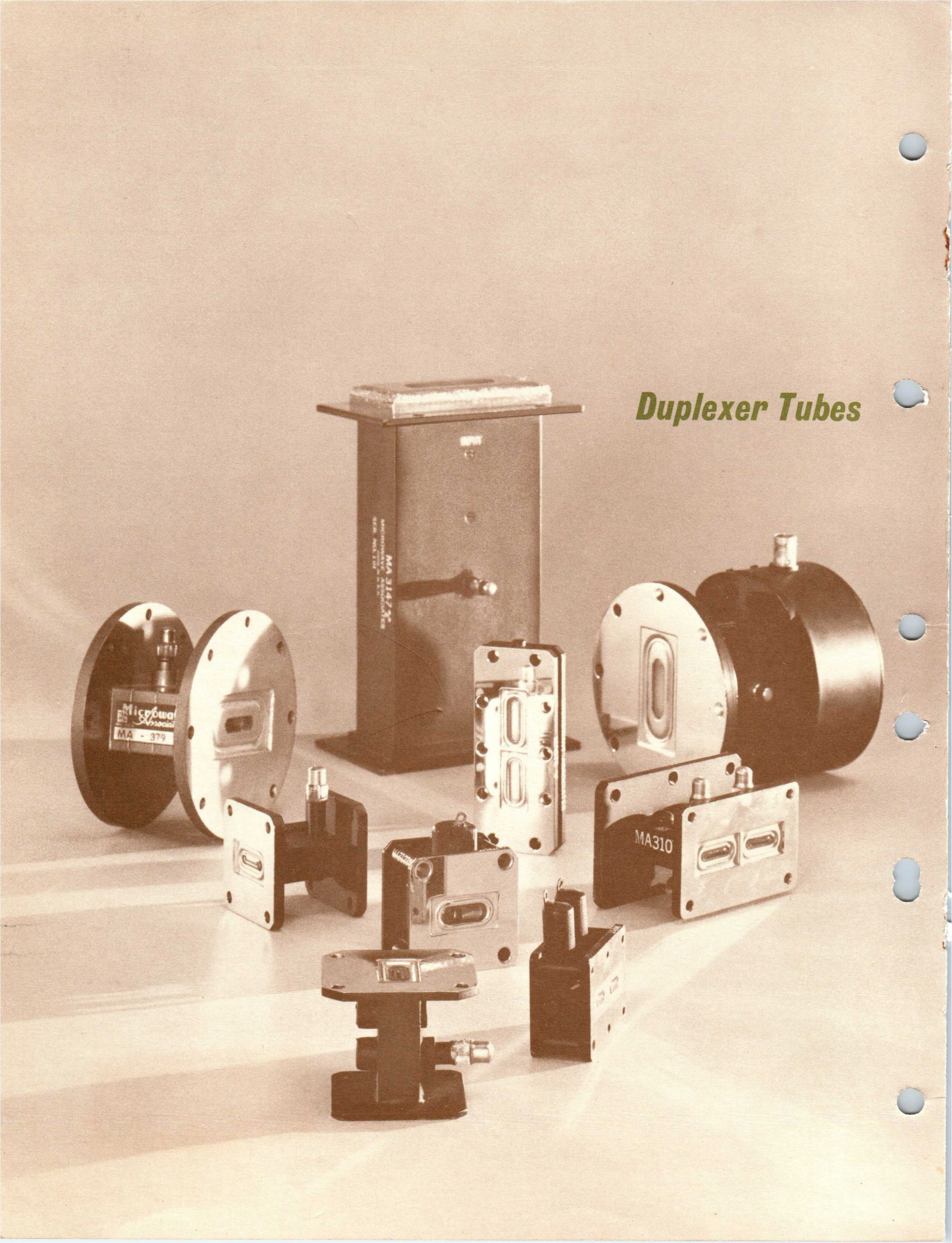
**Microwave Associates' Ferri-Gas Duplexer design provides a unique combination of ferrite and gas tube technology in a single integrated package for minimum overall system losses. The design is particularly adaptable to new sophisticated high power radars. In addition to the duplexers shown above, Microwave Associates can provide numerous configurations utilizing these devices in conjunction with our diode technology. Short form catalog SF-7002 shows a full line of complete diode duplexers.

Ferrite

S	MA-136T	2700-2900	3	6	10	25	0.9	0.5
	MA-136AT	2700-2900	3	15	10	25	1.0	0.6
C	MA-132T	500 Mc in C Band	5	5	6	20	0.8	0.3
X	MA-124T	8500-9600	1000 KW	1000 W	1	2	1.2	0.3
	MA-121T	8500-9600	500 KW	500 W	1	2	1.2	0.3
	MA-120T	8500-9600	250 KW	250 W	1	2	1.0	0.4
Ku	MA-140BT	13,500-15,500	150 KW	150 W	1	5	1.2	0.4
	MA-122AT	15,500-17,500	150 KW	150 W	1	2	1.2	0.3
	MA-141AT	17,500-19,500	100 KW	100 W	1	5	1.2	0.4
Ka	MA-125T	34,700-35,000	50 KW	50 W	1	3	1.2	0.5

Note: Each of the above Ferrite Duplexers includes a receiver protector for guaranteed crystal protection. The low level loss column includes the insertion loss of the receiver protector.

Duplexer Tubes

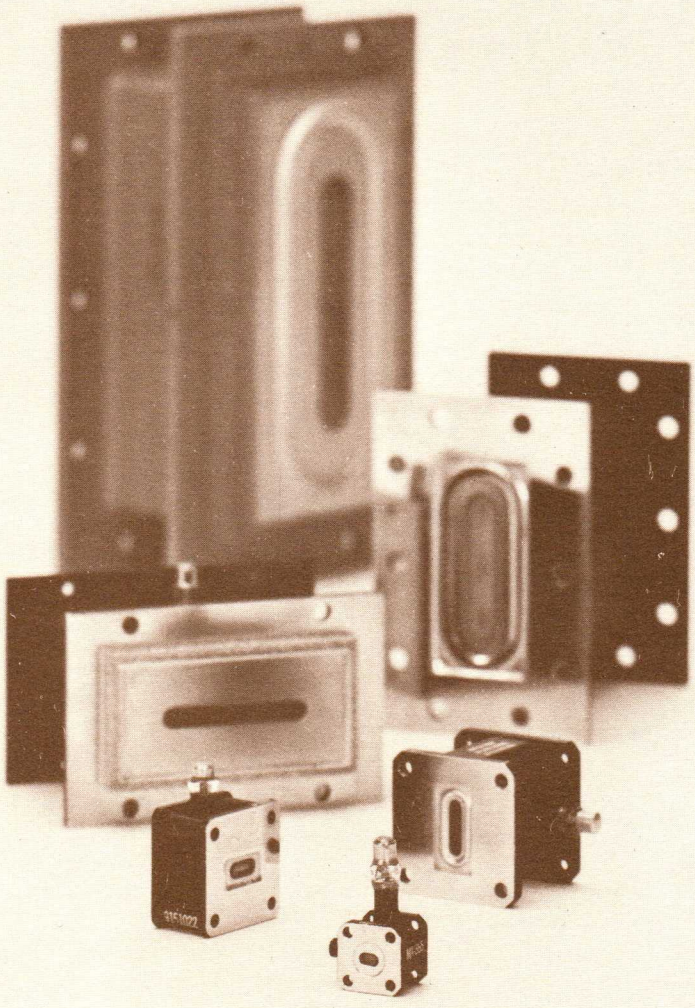


TR and ATR Tubes

	Tube Type	Descr.	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (MW)	Life Test Conditions Av. Pwr. (KW)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)	Comments
	MA-360	TR	200-600	2	3.6	1000	100	0.5	Cell type
UHF	MA-3117	ATR	425	2	200	1000	500	N/A	Tunable 400-450
UHF	MA-3118	ATR	425	2	75	1000	100	N/A	Tunable 400-500
UHF	MA-3170	TR	400-450	15	15	1000	100	0.2	Replaceable cells and windows
	MA-336/7166	TR	1220-1365	2	2	1000	20	0.5	Replaces 6633
L	MA-339/6962	ATR	1285	2	2	2000	—	N/A	Half-height waveguide
L	MA-337A	ATR	1300	2	4	2000	—	N/A	
L	MA-337C	ATR	1300	3	6	2000	—	N/A	
	MA-378	TR	2665-2965	750 KW	600 W	500	15	0.5	Replaces 1B58 — Short Length
	MA-330A	TR	2665-2965	1.5	6	500	150	0.6	
	MA-3147A	TR	2700-2950	1	1	1000	30	0.35	Replaces 1B58
S	MA-333	ATR	2800	1	1.2	1000	50	N/A	Replaces 6024
S	MA-3160	TR	2900-3100	500 KW	500 W	1000	15	0.3	
S	MA-331A	ATR	2950	1	2.4	1000	60	N/A	Replaces 5792
S	MA-331B	ATR	3050	1	2.4	1000	60	N/A	Replaces 5793
S	MA-345A	ATR	2800	1	6	500	150	N/A	
	MA-351	TR	8490-9610	200 KW	200 W	500	3	0.9	Replaces 1B63A — Operation to +85°C
	MA-352	TR	8490-9610	200 KW	200 W	500	3	0.9	Short Version of Ma-351
	MA-3176	TR	8500-9600	75 KW	75 W	1000	2.0	0.3	
	MA-3178	TR	8500-9600	75 KW	75 W	1000	2.0	0.8	1000 hr. version of 1B63A
	MA-3172	TR	8500-9600	200 KW	200 W	2000	5.0	0.7	350°C version of 1B63A
X	MA-3174	TR	8500-9600	200 KW	200 W	2000	5.0	0.7	Phase controlled operation to 350°C (6/64 type)
X	6164	TR	8500-9600	200 KW	200 W	500	10	1.0	Controlled Phase
X	6163	ATR	9050	200 KW	200 W	500	8	N/A	
X	MA-363	ATR	9050	250 KW	250 W	500	—	—	Contact Mount
X	MA-381	ATR	9500	2.2 KW	650 W	150	0.1	N/A	High duty cycle — Operation to +150°C
X	MA-3167	TR	8500-9800	50 KW	50 W	500	4.0	1.0	

Single and Dual Pre-TR Tubes

UHF	MA-390	Dual Pre-TR	510-690	4	20	500	100	0.3	Top wall design
UHF	MA-3109	Dual Pre-TR	510-690	4	20	500	100	0.3	Side wall design
	MA-3168	Dual Pre-TR	1200-1300	30	30	1000	100	0.5	
	MA-346/6605	Pre-TR	1250-1350	2	2	1000	20	0.4	
	MA-348A/7152	Pre-TR	1250-1350	3	6	2000	30	0.3	
L	MA-355	Dual Pre-TR	1250-1350	2	2.4	1000	25	0.3	
L	MA-355A	Dual Pre-TR	1250-1350	6	12	1000	100	0.3	
L	MA-355B	Dual Pre-TR	1250-1350	6	6	1000	20	0.3	
L	MA-355C	Dual Pre-TR	1250-1350	25	50	500	200	0.3	
L	MA-394	Dual Pre-TR	1105-1495	6	13	1000	50	0.4	Top wall design
	MA-3137	Dual Pre-TR	2700-2900	6	30	500	30	0.1	
S	MA-385	Dual Pre-TR	2650-2950	1	5	500	30	0.4	
S	MA-386	Dual Pre-TR	2700-3600	1	1	500	15	0.3	Top wall design
C	MA-396A	Dual Pre-TR	5250-5750	7	3.5	1000	25	0.2	Liquid Cooled
C	MA-399	Dual Pre-TR	5400-5900	40 KW	40 W	500	12	0.8	
	MA-3138	Dual Pre-TR	8500-9600	500 KW	500 W	500	3	0.3	
X	MA-373	Dual Pre-TR	8500-9600	200 KW	200 W	500	10	0.6	
X	MA-3129	Dual Pre-TR	8500-9600	1	1	2000	5	0.3	
Ku	MA-371A	Dual Pre-TR	15500-17500	150 KW	150 W	500	10	0.5	Operation to +85°C



Dual TR Tubes

	Tube Type	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (KW)	Life Test Conditions Av. Pwr. (W)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)	Comments
L	MA-3120	1250-1350	40	2 KW	150	500	0.5	
S	MA-376/6636	2665-2965	750	600	500	15	0.5	
	MA-388	2400-2800	10	500	500	10	0.5	
	MA-398	2700-2900	1000	1000	500	15	0.5	Top wall design
	MA-391	2700-2900	500	500	500	15	0.5	
C	MA-377	5220-5340	625	625	500	12	0.6	
	MA-3193	5250-5750	1000	1000	500	10	0.5	
X	MA-338A/7381	8490-9610	150	150	500	3	1.2	Replaces 6334 — Operation to +125°C
	MA-3158A	8550-8650	100	100	1000	3	0.3	
	MA-3173	8500-9600	200	200	2000	5	1.0	Operation to 350°C
	MA-3135	8500-9600	150	150	700	3	0.5	Phase Controlled
	MA-358	8500-9600	300	200	500	3	1.2	Short Length — Operation to +85°C
	MA-306B/7379	8490-9610	500	500	500	5	1.1	
	MA-3180	8600-9600	500	500	1500	3	0.5	Operation to 125°C
	MA-3162	8600-9600	500	500	1200	2	0.65	Phase controlled operation to 100°C
	MA-324B	8600-9600	500	500	500	5	1.0	
	MA-332B	8600-9600	500	500	500	7	1.0	Operation to +85°C
	MA-3107	8490-9610	500	500	500	3	1.2	Phase controlled — High temp. oper.
	MA-358AS	8500-9600	400	400	500	3	1.2	Dual Tube with Shutter
	MA-370AS	8500-9600	200	200	500	5	1.2	Dual Tube with Shutter
	MA-3158	8500-9600	80	80	1000	4	1.0	Operation to 100°C
Ku	MA-375/7563	15000-17000	90	135	500	5	1.0	
	MA-375A/6560	15000-17000	100	150	500	10	1.0	
	MA-375B	15000-17000	100	150	500	5	1.0	Phase controlled
	MA-382A	16000-17000	4	4	500	—	0.5	Dynamic and static phase controlled

Crystal Protector Tubes

	Tube Type	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (KW)	Life Test Conditions Av. Pwr. (W)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)	Comments
UHF	See our solid state limiters and coaxial switches available for UHF receiver protection.							
L	MA-356	1250-1350	100	100	1000	6	0.5	
	MA-395	1105-1495	10	10	1000	10	0.3	
S	MA-378C	2665-2965	100	100	1000	15	0.5	
	MA-350	2700-2900	50	50	500	15	0.5	
	MA-387	2700-3600	50	50	500	15	0.3	30% Bandwidth
	MA-354	2900-3100	500	500	500	15	0.5	Replaces 5853
	MA-354B	2900-3100	500	500	1000	15	0.5	
	MA-328	3100-3500	50	50	500	15	0.5	
	MA-3154	3350-3650	750	3500	1000	30	0.5	TWT Protector
	MA-369	3400-3700	50	50	500	15	0.5	
	MA-369C	3400-3700	100	100	1000	15	0.5	
C	MA-3148S	5100-5750	10	10	2500	5	0.3	Supplied with shutter
	MA-3124S	5250-5750	350	425	1000	1	0.5	Incorporates external shutter
	MA-379	5395-5905	10	10	500	7	0.6	Operation to +85°C
	MA-397A	5250-5750	10	10	500	7	0.3	Phase controlled TWT Protector
	MA-3161S	5450-5825	100	500	500	15	0.5	Includes external shutter
X	MA-366	9400-9600	20W	4	250	0.25	0.6	Operation to +85°C High PRR
	MA-349	8700-8900	200W	10	500	1.2	0.9	
	MA-349B	8700-8900	125W	6	500	0.4	0.9	Operation to +85°C
	MA-340D	8500-9600	10	10	500	2.0	0.6	
	MA-3163	8600-9600	5	5	2000	2.0	0.7	Phase controlled operation to +125°C
	MA-340N	8500-9600	10	10	1000	2.0	0.5	Available with phase control
	MA-3175	8500-9600	10	10	2000	3.0	0.75	Operation to +350°C

Crystal Protector Tubes (continued)

	Tube Type	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (KW)	Life Test Conditions Av. Pwr. (W)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)	Comments
X	MA-340B	8490-9610	10	10	500	2	0.7	Operation to +85°C
	MA-3108	8490-9610	20	20	500	3	0.7	Phase controlled
	MA-361	9275-9375	10	10	500	4	0.8	Operation to +85°C
Ku	MA-3101	13500-15500	10	10	500	5	0.7	Operation to +85°C
	MA-362E	15000-15700	10	5	500	5.0	0.7	Wide Temp. range
	MA-372	15500-17500	10	10	500	5	0.7	Operation to +85°C
	MA-362B	16200-16600	5	5	500	5.0	0.6	
	MA-362C	16000-17000	10	10	500	3.0	0.5	Phase controlled
	MA-362D	16000-17000	5	10	500	1.0	0.6	Phase controlled
	MA-362	16000-17000	5	5	500	5	0.7	Operation to +125°C
	MA-3102	17500-19500	10	10	500	5	0.7	Operation to +85°C
Ka	MA-365	34700-35000	6	3.6	500	3	0.8	Operation to +75°C
	MA-365A	34500-35200	6	3.6	500	3	0.8	Operation to +75°C
	MA-365B	32900-3350Q	6	3.6	500	3	0.8	Operation to +75°C
	MA-3184	32900-35800	10	5	1000	1.0	0.8	
	MA-3188	32900-35800	2	1	1000	1.0	0.7	
	MA-365C	34700-35000	8	8	500	3	0.8	Operation to +75°C

NOTE: All M/A receiver protectors guarantee crystal protection over wide temperature ranges and under extreme environmental conditions.

Low Loss, Long Life Crystal Protector Tubes

	Tube Type	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (KW)	Life Test Conditions Av. Pwr. (W)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)
L	MA-356E	1250-1350	500	500	1000	20.0	0.40
	MA-3139	1210-1380	100	100	1000	5.0	0.40
S	MA-3140	2900-3100	50	50	1000	5.0	0.40
C	MA-3141	5250-5750	25	25	1000	5.0	0.40
	MA-3153S	5400-5900	50	350	1000	20.0	0.50
X	MA-3142	8500-9600	10	10	1000	2.0	0.50
	MA-3143	8500-9600	10	10	1000	2.0	0.40
	MA-3157	8500-9600	20	20	1000	3.0	0.50
	MA-3157B	8500-9600	30	30	500	3.0	0.20
	MA-3189	9000-10000	25	20	1000	3.0	0.40
Ku	MA-3144	15.5-17.5 Gc	5	5	1000	2.0	0.50
Ka	MA-3145	34.7-35.0 Gc	2	2	1000	2.0	0.50

Low Loss, Long Life Parametric Amplifier Protectors

	Tube Type	Bandwidth (Mc/Sec)	Life Test Conditions Pk. Pwr. (KW)	Life Test Conditions Av. Pwr. (W)	Life Test Conditions Hours	Rec. Time Max (μs)	Insertion Loss Max (db)	Noise Ratio	Comments
UHF	MA-3114	400-450	100	10	1000	50	0.5	—	Waveguide type
	MA-3171	400-450	30	30	1000	25	0.5	—	Includes s.s. limiter and low pass filter
L	MA-3146	1250-1350	100	100	2500	7.0	0.35	1.02	
	MA-3192	1250-1350	1	2	2000	30.0	0.30	—	
	MA-356H	1350-1450	500	500	1000	25.0	0.50	—	
S	MA-3147	2900-3100	500	500	2500	7.0	0.35	1.02	
	MA-3159	2900-3100	50	50	2500	—	—	—	
C	MA-3148	5100-5750	25	25	2500	5.0	0.35	1.02	

Microwave Associates, Inc.

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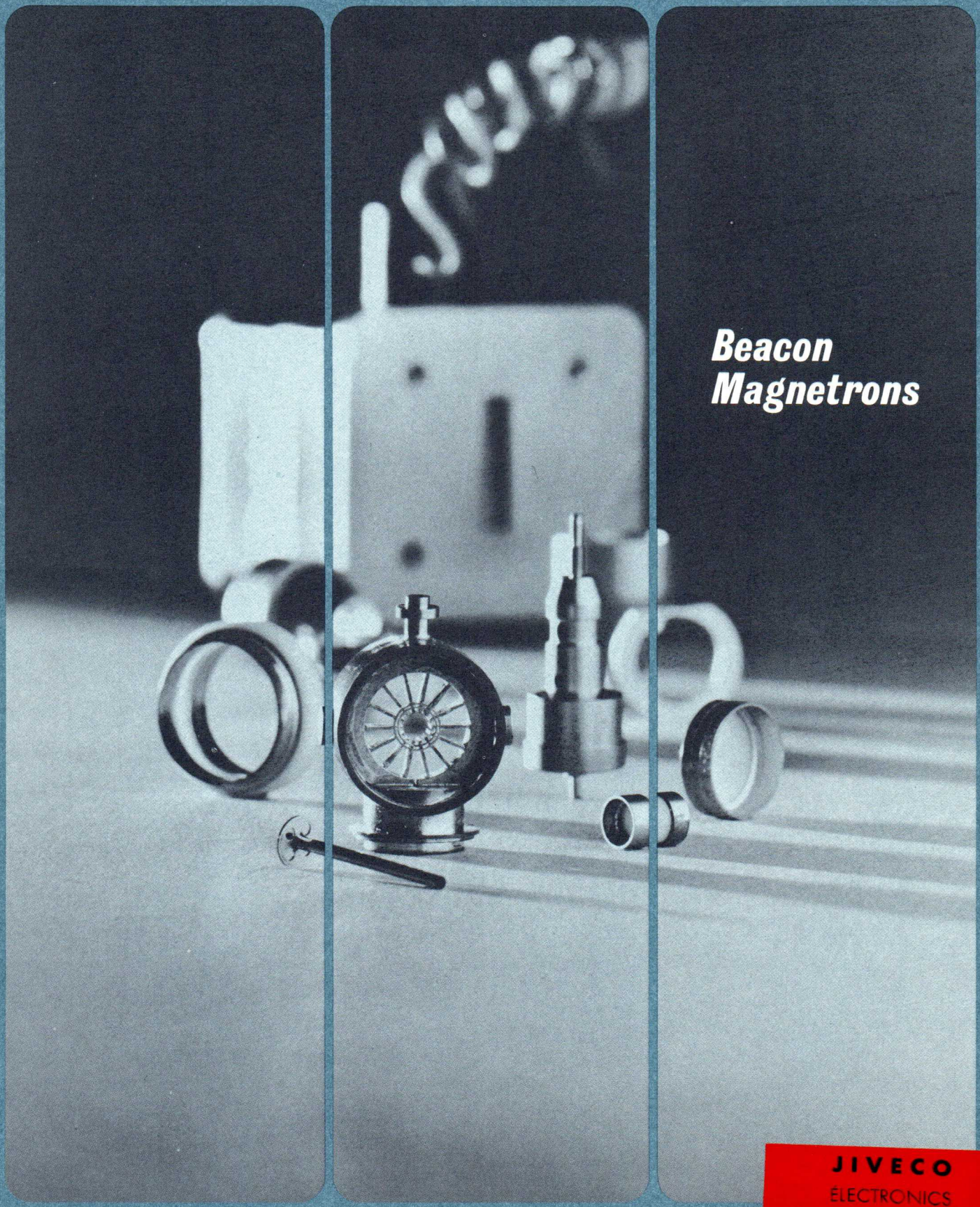
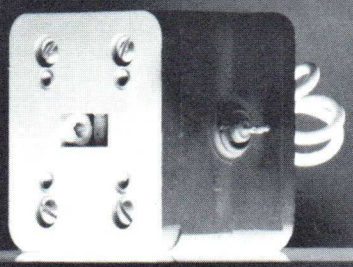


Beacon Magnetrons



Fact	Benefit
Microwave Associates Magnetrons are designed for operation under the most severe environmental stress.	You may go ahead with the design of your system without being stymied by difficult environmental requirements. As an outstanding example, we are designing an X-band tube to withstand the following: Temperature —62°C to +125°C Vibration 100 G, 60 to 2000 cps Shock 200 G for 6 ms Acceleration 200 G
Microwave Associates Magnetrons are operated with a grounded cathode.*	You will: a. eliminate bi-filar pulse transformer for line type modulators b. eliminate heater transformer capacitance to ground c. achieve increased efficiency d. achieve a lighter, smaller package size e. achieve shorter pulses and faster rise times f. eliminate internal arcing problems g. greatly reduce spectrum difficulties (i.e. discontinuities, "twinning", etc.) h. increase ability to withstand shock and vibration.
Microwave Associates Magnetrons may be shipped on loan, in certain cases, for 30 days evaluation.	You may determine the suitability of our tube for your application prior to committing yourself to a design.
Microwave Associates doesn't make all kinds of magnetrons.	You can buy the best beacon magnetrons from a specialized manufacturer. Ours is the most advanced line of beacon magnetrons available today.
Microwave Associates Magnetrons are designed for operation at widely varying duty ratios.	You may confidently select the particular pulse configuration you require, be it ultra-short pulses, long pulses, or CW power. See back cover for a description of a typical tube capable of operating CW or pulsed.

*Except those tubes indicated by N under pulse polarity.

Fixed Frequency Magnetrons

Tube Type	Frequency (Gc)	Min. Peak Power (w)	Duty Cycle	Pulse Width (μs)	Pulse Polarity	Peak Anode Voltage (Kv)	Peak Anode Current (amps)	Weight (oz)
MA 221B	7.5-8.8	1.5	CW	—	P	0.45	0.020	11
MA 231B	7.5-8.8	20.0	CW	—	P	0.93	0.055	11
MA 212B	8.8-10.0	1.5	CW	—	P	0.46	0.020	11
MA 232B	8.8-10.0	15.0	CW	—	P	0.93	0.060	11
MA 239B	13.0-13.6	10.0	CW	—	P	0.80	0.06	23
MA 221A	7.5-8.8	10.0	0.01	1.0	P	0.50	0.150	11
MA 221C	7.5-8.8	10.0	0.01	5.0	P	0.50	0.150	11
MA 221D	7.5-8.8	20.0	0.005	1.0	P	0.53	0.300	11
MA 231A	7.5-8.8	200.0	0.05	1.0	P	1.00	0.750	11
MA 212A	8.8-10.0	10.0	0.01	1.0	P	0.52	0.150	11
MA 212C	8.8-10.0	10.0	0.01	5.0	P	0.52	0.150	11
MA 212D	8.8-10.0	20.0	0.005	1.0	P	0.56	0.300	11
MA 232A	8.8-10.0	150.0	0.05	1.0	P	1.00	0.750	11
MA 252A	8.8-10.0	250.0	0.005	0.5	P	1.15	0.65	11
MA 222	9.3-9.4	7000.0	0.002	1.0	N	5.5	4.5	48
MA 239	13.280-13.370	40.0	0.25	2.5	P	0.85	0.22	23
MA 240	13.7-14.6	500.0	0.013	1.0	P	1.70	1.40	16
MA 240A	13.7-14.6	700.0	0.013	1.0	P	1.75	1.80	16
MA 245	15.4-15.6	20.0	0.50	5.0	P	1.0	0.14	23
MA 246	16.5-16.7	100.0	0.005	0.5	P	1.15	0.45	16

Tunable Magnetrons

MA 219F	8.5-9.0	3.0	CW	—	P	0.63	0.020	14
MA 219B	8.5-9.6	1.0	CW	—	P	0.47	0.020	14
MA 214H	9.0-9.5	3.0	CW	—	P	0.65	0.020	14
MA 214B	9.0-10.0	1.0	CW	—	P	0.47	0.020	14
MA 249	9.250-9.450	17.0	CW	—	P	1.0	0.050	14
MA 219A	8.5-9.6	10.0	0.005	1.0	P	0.53	0.150	14
MA 219C	8.5-9.6	20.0	0.01	1.0	P	0.56	0.300	14
6229	8.9-9.4	400.0	0.0005	0.25	N	4.0	0.5	24
6230	8.9-9.4	900.0	0.003	1.0	N	4.3	0.8	24
7521	8.9-9.4	800.0	0.003	0.2	N	4.3	0.9	24
MA 214C	9.0-10.0	8.0	0.005	1.0	P	0.54	0.150	14
MA 214D	9.0-10.0	16.0	0.005	1.0	P	0.57	0.300	14
MA 241	9.1-9.4	150.0	0.001	1.0	N	2.75	1.0	24
MA 218	9.3-10.0	7000.0	0.002	1.0	N	5.9	4.5	—
MA 232T	9.5-9.8	150.0	0.002	1.0	P	1.0	0.7	14

Typical X-Band Data — CW and Pulsed Performance from One Tube

General Description

A compact, fixed-frequency, X-band magnetron incorporating a grounded-cathode, isolated-anode design. The tube is a light-weight, rugged unit of ceramic and metal construction. Inherently efficient, this tube is suitable for applications requiring 200 watts of peak pulse power or 20 watts of CW power.

Applications

This tube offers excellent performance in beacon and navigation systems, radar detection applications, missile-ground support equipment, transponders, and airborne radar applications.

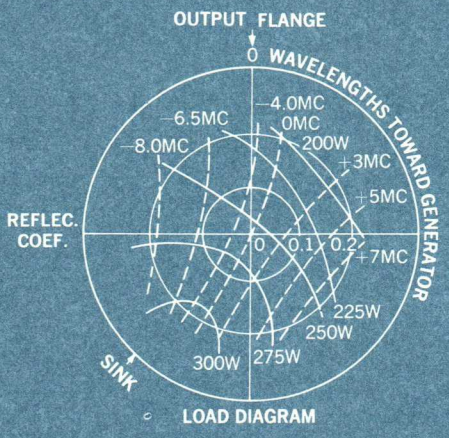
Typical Performance Data

	PULSED OPERATION	CW OPERATION
Fixed Frequency:	F = 7.5 to 8.8 Gc	7.5 to 8.8 Gc
Power Output:	200 watts peak (min)	20 watts (min)
Pulling Figure:	13 Mc	13 Mc
Thermal Coefficient:	0.1 Mc/°C	0.1 Mc/°C
Life:	300 hours (min)	300 hours (min)
Time Jitter:	4 ns (pk to pk) (max)	
Frequency Jitter:	250 Kc (max)	
Input Capacitance:	16 pF	
Pulse Width:	1.0 microsecond	
Duty Ratio:	0.05	
Anode Voltage:	+1000 volts peak	930 volts
Anode Current:	0.75 amperes peak	0.060 amperes

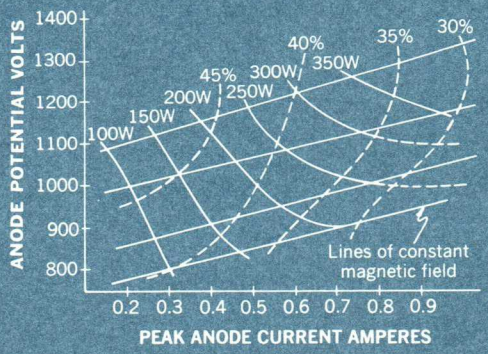
All voltages may be applied simultaneously

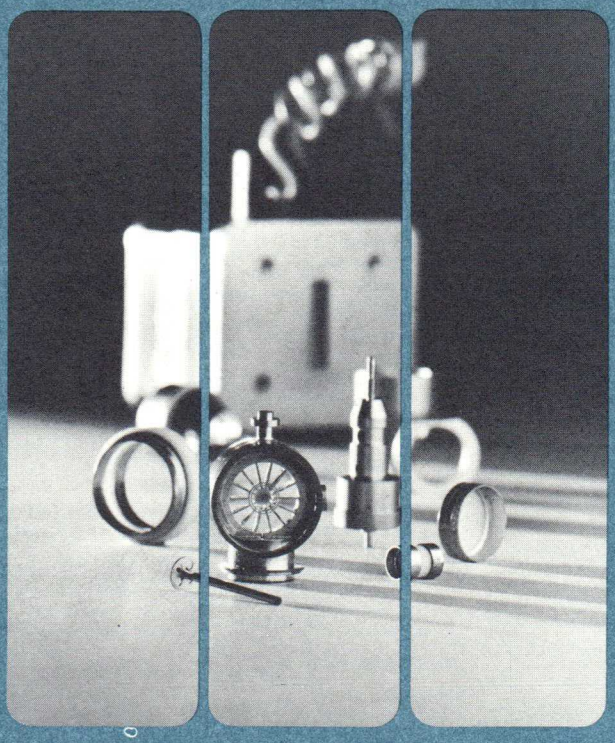
Mechanical Characteristics

Size:	1.75" x 1.75" x 1.75"
Weight:	11 ounces
Mounting Support:	Output flange mates with standard UG/39U flange (Can be delivered to operate into either full or half-height waveguide)
Input Connections:	Solder Terminals
Cooling:	Convection
Environmental Capability:	100 G shock for 6 ms duration 20 G vibration 50 to 2000 cps



LOAD DIAGRAM





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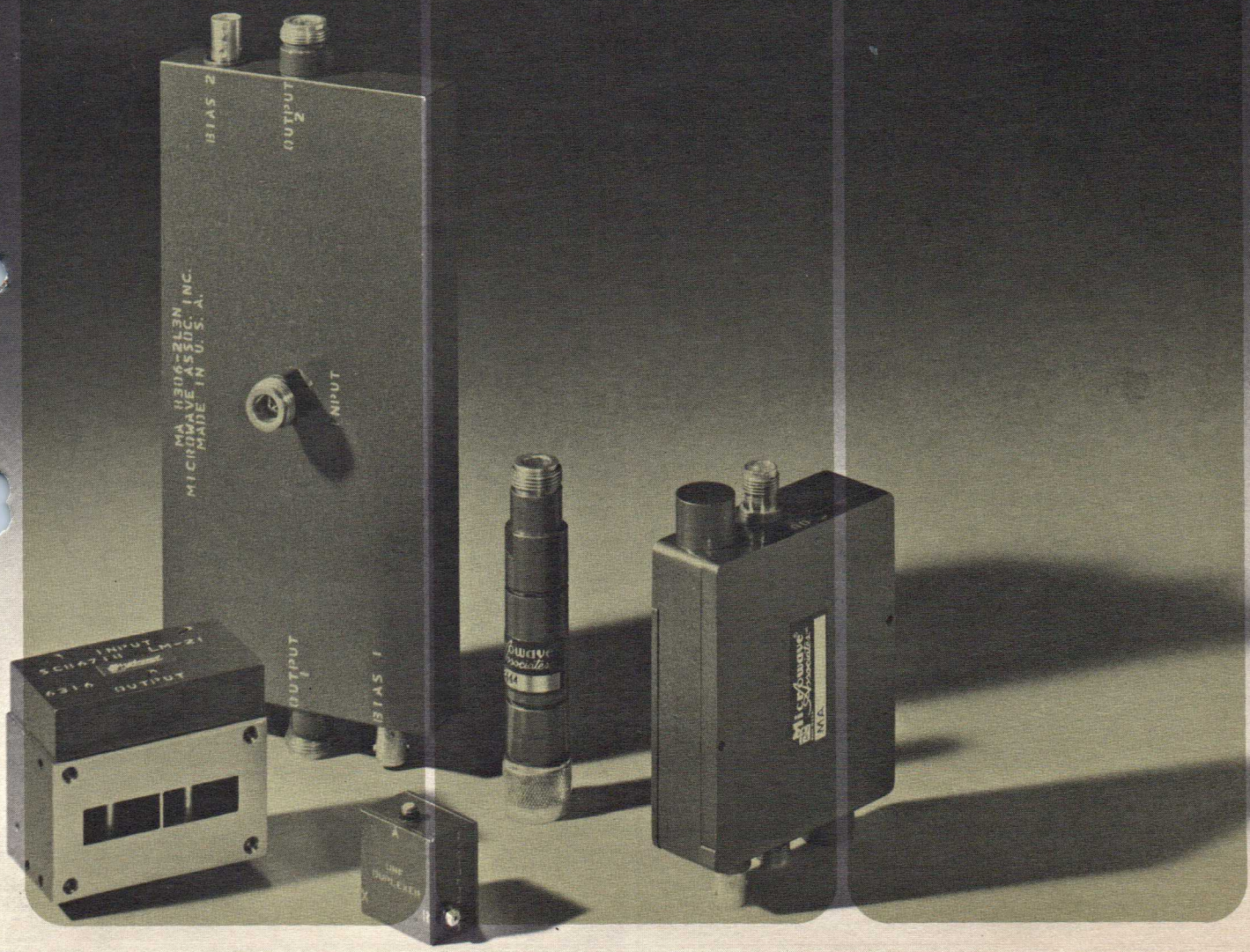
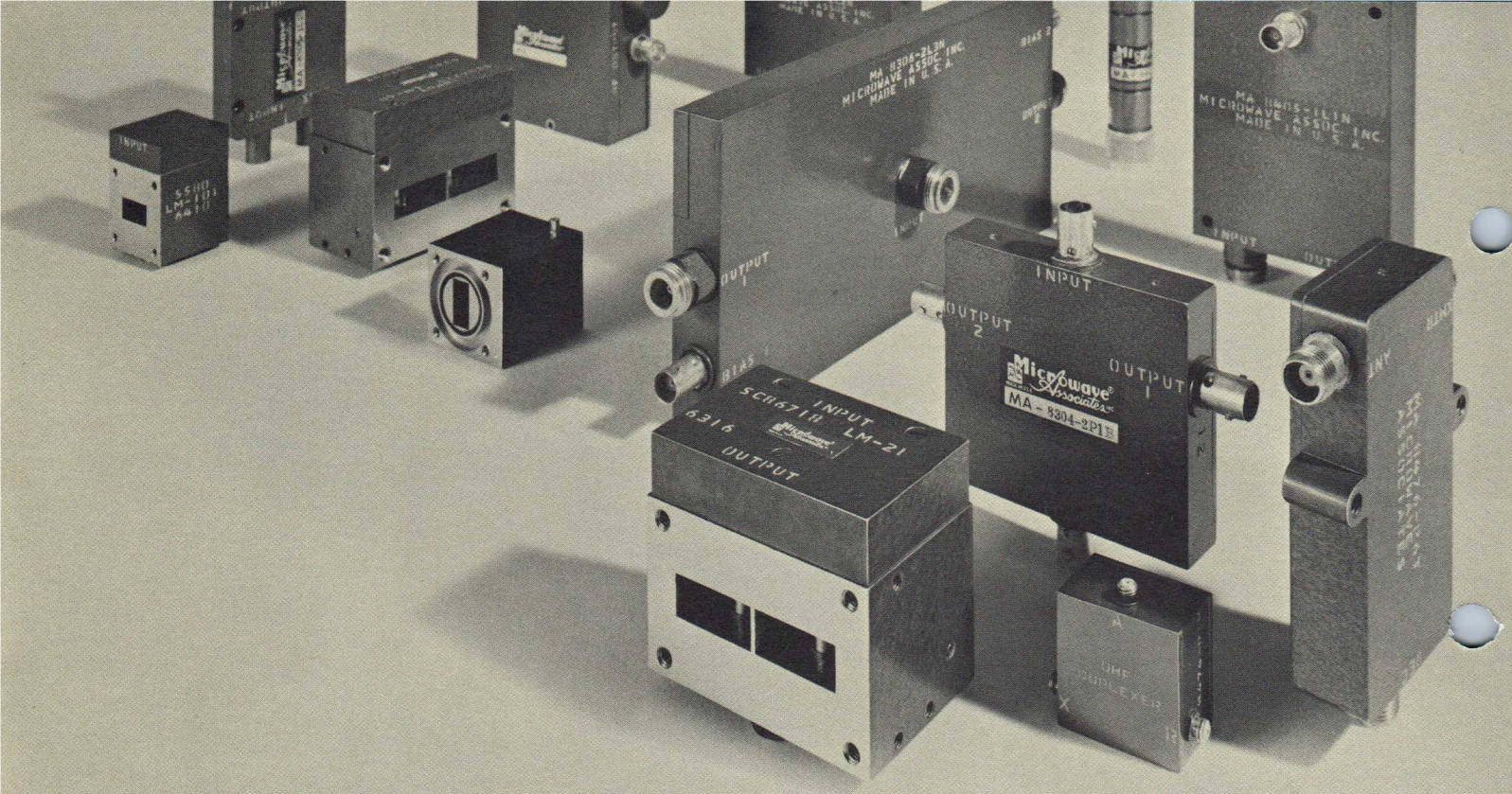
Solid State Control Devices





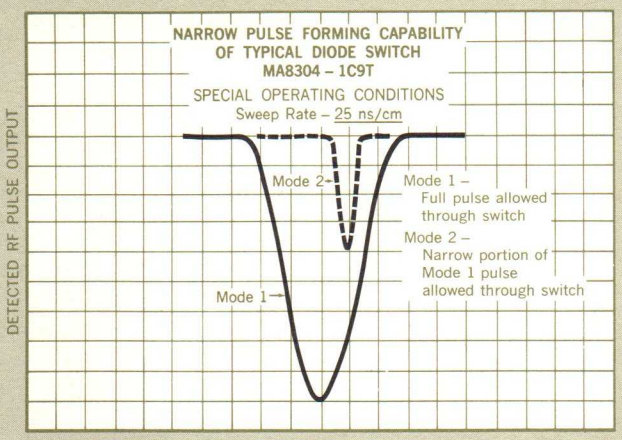
Switches

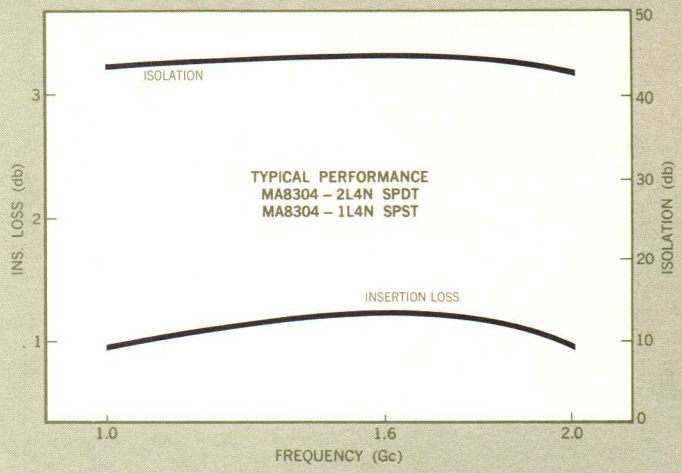
Solid state diode switches provide the designer with a wide degree of flexibility in system concepts:

- High speed (nanosecond response time) for extreme accuracy in pulse forming, coding and selection.
- High power handling for both CW and pulse systems.
- Broadband frequency capabilities for communication and countermeasure applications.
- High switching ratios for greater selection and suppression of undesired signals.
- Solid state reliability and low drive power.
- Multiple throw capability for high speed selection of transmitters, antennas and receivers.

Power ratings above 10W are based upon a maximum load VSWR of 1.5:1. Derating for more severe load conditions is necessary.

Switching speeds listed are conservative and in most cases can be shortened further by proper choice of driver circuits. High speed video bias signals often cause problems in receiver systems and care must be exercised in the selection of switching speeds.





	M.A. NUMBER	BANDWIDTH Mc	TYPE	SWITCHING TIME ns	MAXIMUM OPER. POWER PEAK @ .001 D_U W	MAXIMUM OPER. POWER CW W	MAX. INS. LOSS db	MIN. ISO db	SWITCHING BIAS LOW LOSS Max. V	LOW LOSS Max. mA	ISOLATION Max. V	ISOLATION Max. μA	COMMENTS
VHF	8304–1W1N	10–100	Coax	1000	50	0.100	0.75	40	+2	100	−50	10	
	8304–2W1N	10–100	Coax	1000	50	0.100	1.0	40	+2	100	−50	10	
	8301–10W1M	25–75	Coax	150		0.050	0.75	40	+1	10	−10	10mA	Special
	8304–1P7N	100–250	Coax	100	50	0.100	1.0	40	+2	100	−50	10	
	8304–2P7N	100–250	Coax	100	50	0.100	1.0	40	+2	100	−50	10	
UHF	8304–1P12N	200–500	Coax	50	50	0.100	1.0	40	+2	100	−50	10	
	8304–2P12N	200–500	Coax	50	50	0.100	1.0	40	+2	100	−50	10	
	8304–1P16N	215–260	Coax	200		25	0.5	30	+2	100	−50	10	
	8304–2P16N	215–260	Coax	200		50	0.75	35	+2	100	−50	10	
	8304–1P17N	400–450	Coax	200		25	0.5	30	+2	100	−50	10	
	8304–2P17N	400–450	Coax	200		50	0.75	35	+2	100	−50	10	
	8304–1T2N	500–1000	Coax	10	50	0.100	1.0	40	+2	100	−50	10	
	8304–2T2N	500–1000	Coax	10	50	0.100	1.0	40	+2	100	−50	10	
L	8304–1L4N	1000–2000	Coax	10	50	0.100	1.5	35	+2	100	−50	10	
	8304–2L4N	1000–2000	Coax	10	50	0.100	1.5	35	+2	100	−50	10	
	8302–1S6N	1000–4000	Coax	10		0.5	1.0	40	−25	0.01	2	30mA	Broadband
	8306–1S6N	1000–4000	Coax	200	1000	1.0	1.0	40	−75	0.01	2	200mA	Broadband
	8306–1L(*)N 1	1000–2000	Coax	200	1000	5	1.0	30	+2	100	−50	10	
	8306–2L13N	1005–1055	Coax	200	5000	10	1.0	30	+2	100	−50	10	
	8306–1L5N	1030–1090	Coax	200	1000	5	1.0	30	+2	100	−50	10	
	8306–2L12N	1030–1090	Coax	200	2000	10	1.0	30	+2	100	−50	10	
	8306–2L16N	1030–1090	Coax	200	5000	10	1.0	30	+2	100	−50	10	
	8304–1L10N	1200–1400	Coax	200		25	0.5	30	+2	100	−50	10	
	8304–2L10N	1200–1400	Coax	200		50	0.75	35	+2	100	−50	10	
	8309–2L1N	1400–1460	Coax	200	20	1.0	0.5	20	+2	100	−50	10	DPDT Special
S	8302–1S6N	1000–4000	Coax	10		0.5	1.0	40	−25	0.01	2	30mA	Broadband
	8306–1S6N	1000–4000	Coax	200	1000	1.0	1.0	40	−75	0.01	2	200mA	Broadband
	8304–1S2N	2000–4000	Coax	10	50	0.100	1.5	30	+2	100	−50	10	
	8304–2S2N	2000–4000	Coax	10	50	0.100	1.5	30	+2	100	−50	10	
	8306–1S(*)N 2	2000–4000	Coax	200	1000	5	1.0	30	+2	100	−50	10	
	8306–1S5N	2900–3100	Coax	200	1000	5	1.0	30	+2	100	−50	10	
C	8302–1C6N	4000–8000	Coax	10		0.5	1.0	35	+25	0.01	−2	30mA	Broadband
	8306–1C6N	4000–8000	Coax	200	1000	1.0	1.0	35	+75	0.01	−2	200mA	Broadband
	8304–1C9T	4500–4700	Coax	10	25	1.0	2.0	30	−50	0.1	2	75	
	8304–1C1N	5400–5900	Coax	50	50	1	1.0	30	2	75	−50	10	
	8304–2C1N	5400–5900	Coax	50	50	1	1.5	30	2	75	−50	10	
	8321–1C2	5400–5900	W.G.	200	500	1	1	20	2	50	−50	10	Special
	8306–4C4M	5715–5815	Coax	300	6000	6	1.2	23	−2	75	+100	10	Special

*State center frequency.
1 Any 10% within indicated range.
2 Any 5% within indicated range.

8304 1 W1N

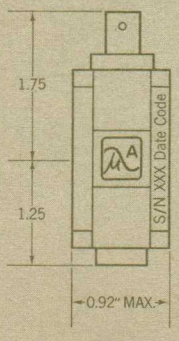
This digit represents numbers of throw positions.

Switches (continued)

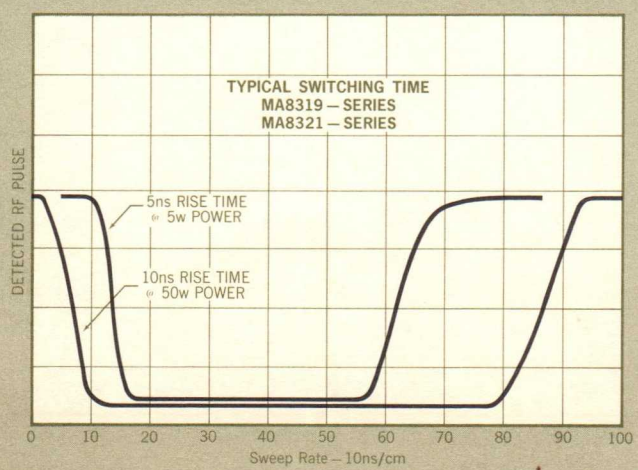
	M.A. NUMBER		BANDWIDTH Mc	TYPE	SWITCHING TIME ns	MAXIMUM OPER. POWER PEAK @ .001 D_U W	MAXIMUM OPER. POWER CW W	MAX. INS. LOSS db	MIN. ISO db	SWITCHING BIAS LOW LOSS Max. V	SWITCHING BIAS LOW LOSS Max. mA	SWITCHING BIAS ISOLATION Max. V	SWITCHING BIAS ISOLATION Max. mA	COMMENTS
	8302-1X6N		7000–11,000	Coax	10		0.5	1.5	30	+25	0.01	−2	30	Broadband
	8306-1X6N		7000–11,000	Coax	200	1000	1.0	1.0	30	+75	0.01	−2	200	Broadband
	8319-1X(*)	3	7200–10,000	W.G.	5	5	0.20	0.75	25	−35	0.01	2	25	
	8319-2X(*)	3	7200–10,000	W.G.	5	5	0.2	1.0	28	−35	0.01	2	25	
	8321-1X(*)	3	7200–10,000	W.G.	50	100	1	0.75	25	−50	.01	2	50	
	8321-2X(*)	3	7200–10,000	W.G.	50	100	1	1.0	28	−50	.01	2	50	
	8322-1X(*)	3	7200–10,000	W.G.	200	1000	4	0.75	25	−75	.01	2	50	
	8322-2X(*)	3	7200–10,000	W.G.	200	1000	4	1.0	28	−75	.01	2	50	
X	8319-1X16		8500–9600	W.G.	5	5	0.20	1.5	17	−35	.01	2	25	
	8319-1X17		8500–9600	W.G.	5	5	0.20	1.0	30	−35	.01	4	50	
	8321-1X16		8500–9600	W.G.	50	100	1	1.5	17	−50	.01	2	50	
	8321-1X17		8500–9600	W.G.	50	100	1	1.0	30	−50	.01	4	100	
	8322-1X16		8500–9600	W.G.	200	1000	4	1.5	17	−75	.01	2	50	
	8322-1X17		8500–9600	W.G.	200	1000	4	1.0	30	−75	.01	4	100	
	8319-1X20		9200–9500	W.G.	5	5	1	1.0	80	−25	.02	4	75	Special
	8321-2X1		9200–9600	W.G.	50	100	1	1.5	40	−50	.02	4	100	
	8321-2X2		9200–9600	W.G.	50	100	1	2.5	60	−50	.03	4	150	
	8319-1Z(*)	4	12,400–18,000	W.G.	5	5	0.2	1	35	−35	.02	4	50	
	8319-2Z(*)	3	12,400–18,000	W.G.	5	5	0.2	1	28	−35	.01	2	25	
	8321-1Z(*)	4	12,400–18,000	W.G.	50	100	1	1	35	−50	.02	4	100	
	8321-2Z(*)	3	12,400–18,000	W.G.	50	100	1	1	28	−50	.01	2	50	
	8322-1Z(*)	4	12,400–18,000	W.G.	200	1000	4	1	35	−75	.02	4	100	
	8322-2Z(*)	3	12,400–18,000	W.G.	200	1000	4	1	28	−75	.01	2	50	
Ku	8319-1Z5		13,000–13,500	W.G.	5	5	0.2	1	25	−35	.01	2	25	
	8321-1Z5		13,000–13,500	W.G.	50	100	1	1	25	−50	.01	2	50	
	8321-2Z1		13,000–13,500	W.G.	50	100	1	1.5	40	−50	.02	4	100	
	8322-1Z5		13,000–13,500	W.G.	200	1000	4	1	25	−75	.01	2	50	
	8319-1Z6		16,000–16,500	W.G.	5	5	0.2	1	25	−35	.01	2	25	
	8321-1Z6		16,000–16,500	W.G.	50	100	1	1	25	−50	.01	2	50	
	8321-2Z2		16,000–16,500	W.G.	50	100	1	1.5	40	−50	.02	4	100	
	8322-1Z6		16,000–16,500	W.G.	200	1000	4	1	25	−75	.01	2	50	

3 Any 300 Mc within indicated range.
4 Any 500 Mc within indicated range.
*State center frequency.

OUTLINE DRAWING
X BAND SWITCHES, SERIES
MA8319 – 1 X (*)
MA8321 – 1 X (*)
MA8322 – 1 X (*)



SIDE VIEW



OUTLINE DRAWING
K_U BAND SWITCHES, SERIES
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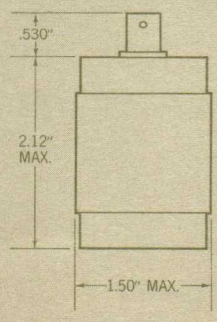
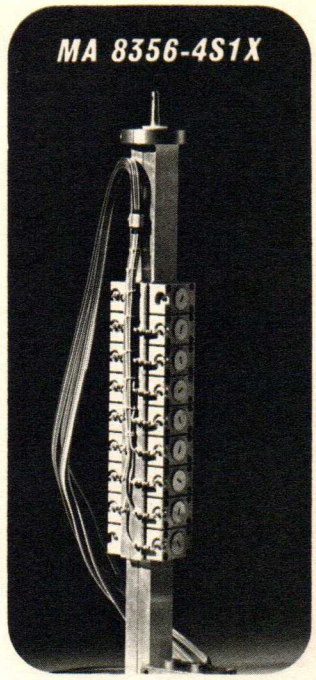
MA8321 – 1 Z (*)
MA8322 – 1 Z (*)



SIDE VIEW



Phase Shifters

High and low power rapid microwave phase shifting can be accomplished by semiconductor techniques. Low drive powers and small variations of characteristics with temperature are inherent features.

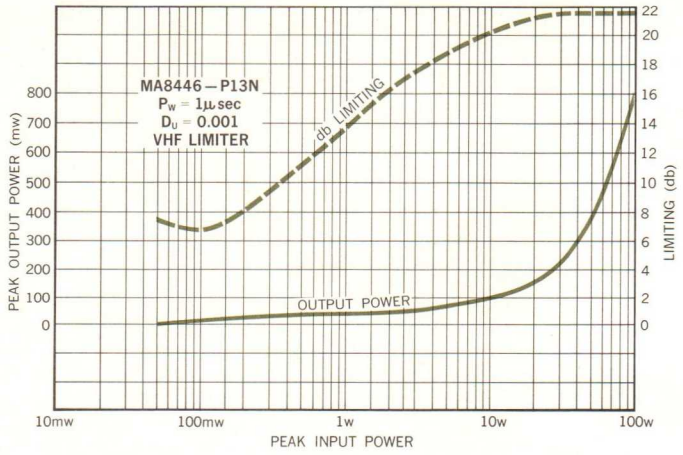
Continuous and binary step types are available for large phased array antennae and other receiver and transmitter applications.

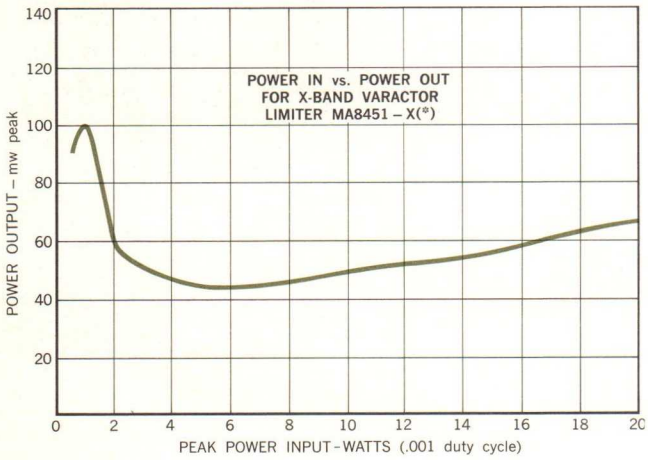
MA NUMBER	BANDWIDTH Mc	MAXIMUM OPER. POWER** Peak @ .001 Du W	CW W	TOTAL PHASE RANGE	INS. LOSS RANGE db	MAX. VSWR	MAXIMUM CONTROL BIAS STEP OR RANGE	CONTROL TIME μs	COMMENTS
8352-2L1T	800–1600	1.0	0.1	90°	2.0	1.6	0–90V	0.1	Continuous
8356-0L2X	1250–1350	7500	250	22.5°	0.4	1.5	+5v @ 200 ma −200v @ 1.0 ma	0.4	1 step
8356-1L2X	1250–1350	7500	250	45°	0.5	1.5	+5v @ 400 ma −200v @ 1.0 ma	0.4	2 steps
8356-2L2X	1250–1350	7500	250	90°	0.7	1.5	+5v @ 800 ma −200v @ 1.0 ma	0.4	4 steps
8356-4L2X	1250–1350	7500	250	180°	1.0	1.5	+5v @ 1.6a −200v @ 1.0 ma	0.4	8 steps
8356-0S1X	2900–3100	2000	125	22.5°	1.0	1.7	+5v @ 200 ma −200v @ 1 ma	0.4	1 step
8356-1S1X	2900–3100	2000	125	45°	1.0	1.7	+5v @ 400 ma −200v @ 1 ma	0.4	2 steps
8356-2S1X	2900–3100	2000	125	90°	1.5	1.7	+5v @ 800 ma −200v @ 1 ma	0.4	4 steps
8356-4S1X	2900–3100	2000	125	180°	2.0	1.7	+5v @ 1.6 a −200v @ 1 ma	0.4	8 steps
8361-4X(*)	Any 100 Mc 7400–9600	*	1.0	180°	1.0		+2v @ 25 ma −30v @ 10 μa	0.01	1 step
8364-4X(*)	Any 100 mc 7400–9600	500	4	180°	1.0		+2v @ 50 ma −75v @ 10 μa	0.4	1 step

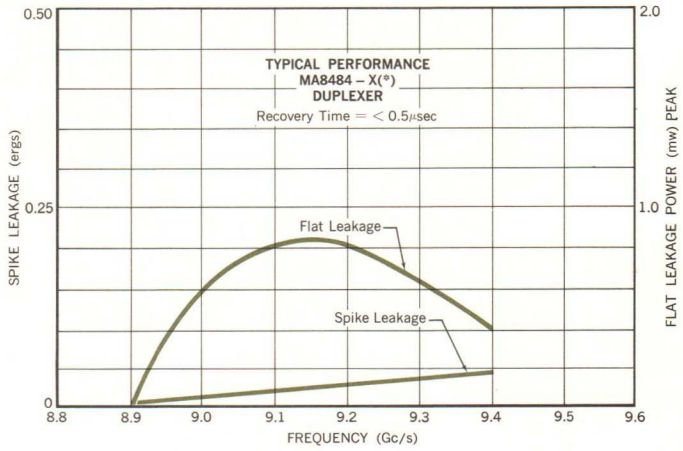
**With output terminated in matched load.

*Specify center frequency.

RF Power Limiters/ Receiver Protectors & Duplexers







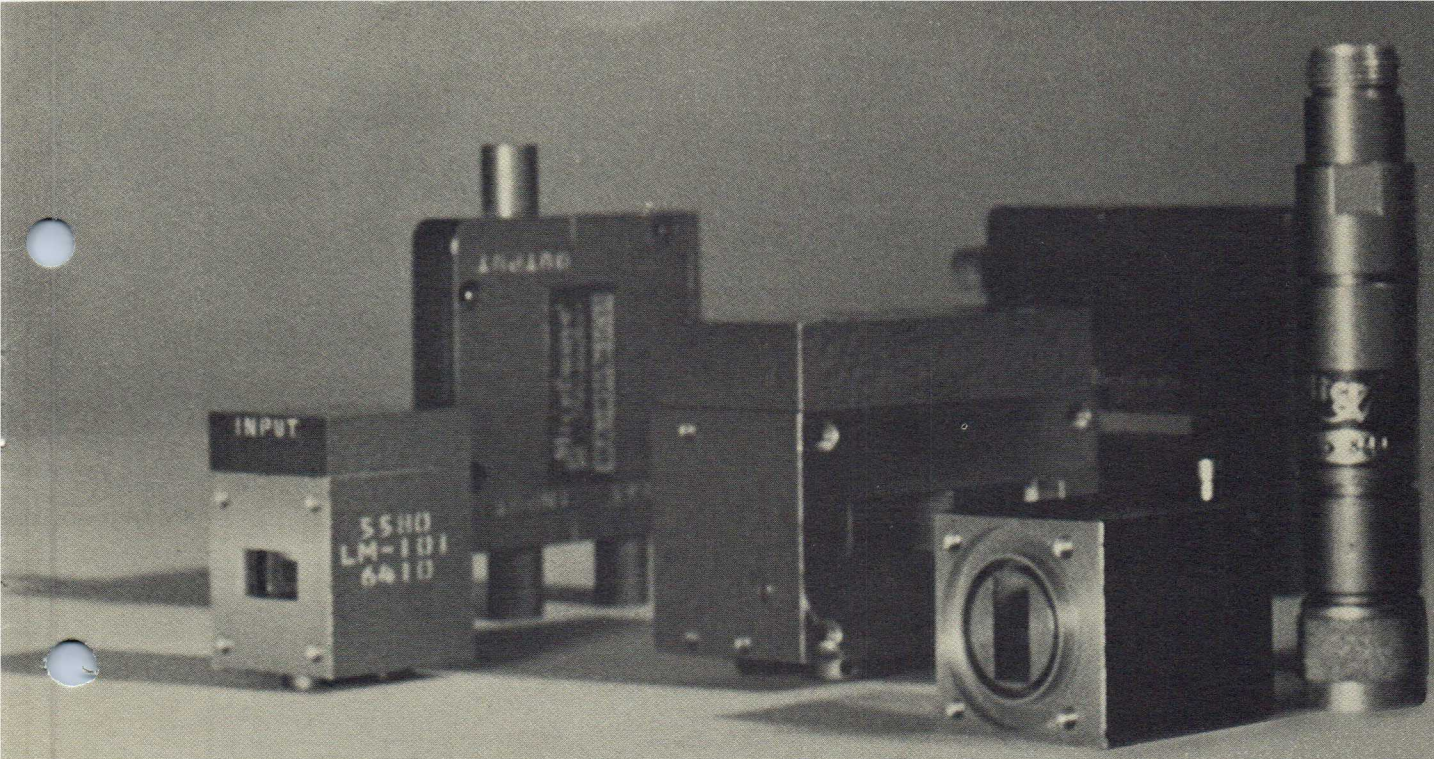
- Passive RF power control for protection of receiver systems.
- Elimination of spike leakage from existing gas type duplexing circuits.
- Complete solid state duplexing for long life and extremely fast recovery time.

The above capabilities provide the system designer with greater protection for all existing receiver systems behind gas TR tubes, ferrite circulators and other duplexing and diplexing networks.

Special High Power Solid State Duplexers *

PRODUCT	TYPE	MA-NUMBER	BANDWIDTH	MAX. POWER IN PEAK KW	MAX. POWER IN AV KW	REC. LOSS db	XMIT LOSS db	ISOL db
Duplexer	Coax	8477-P2S	200–225 Mc	200 Pw=200 μs	10	2.2	0.1	65
Duplexer (Ferrite/Diode)	Coax	8801-	400–450 Mc	300 Pw=60 μs	3	2.0	0.5	60

*Recovery Time 1 μs max.



	PRODUCT	TYPE	MA-NUMBER		B.W. Mc	MAX. POWER IN PEAK W	MAX. POWER IN AV W	MAX. INS. LOSS db	MIN. ISO. AT PK. POWER db	MAX. SPIKE LEAK ergs	MAX. FLAT LEAK mW	MAX. REC. TIME ns
VHF	Limiter	Coax	8444-P11N		1–450	10	1	0.3	25			50
	Limiter	Coax	8445-P11N		1–450	100	10	0.3	25			50
	Limiter	Coax	8446-P11N		1–450	1000	10	0.5	33			50
	Duplexer	Coax	8476-P9T		100–200	1500	75	1.0	30			50
	Duplexer	Coax	8474-P2M		135–145	20	2.5	1.0	25			50
	Duplexer	Coax	8476-P8T		135–145	1500	75	1.0	30			50
	Limiter	Coax	8446-P12N		200–250	1000	1	0.3	20			50
	Limiter	Coax	8446-P13N		400–450	100	1	0.3	20			50
	Duplexer	Coax	8476-P13T		400–450	1000	10	1.0	27			
UHF	Limiter	Coax	8444-T11N		1–1000	10	1.0	0.5	25			50
	Limiter	Coax	8445-T11N		1–1000	100	10	0.5	25			50
	Limiter	Coax	8446-T11N		1–1000	1000	10	0.7	33			50
	Duplexer	Coax	8475-T2N		300–1000	250	1.0	1	30			
L	Limiter	Coax	8444-L6N		1200–1400	10	1	0.5	20			50
	Limiter	Coax	8445-L6N		1200–1400	100	10	0.5	25			50
	Limiter	Coax	8446-L6N		1200–1400	1000	10	0.7	33			50
S	Limiter	Coax	8444-S5N		2000–4000	40	2	0.5	30			50
	Limiter	Coax	8444-S6N		2375–2400	15	7.5	0.5		0.2	50	500
	Limiter	Coax	8446-S1N		2900–3100	1000	5.0	0.6		0.2	75	500
C	Limiter	Coax	8444-C5N		4000–7000	20	1.5	1.0	25			50
X	Limiter	Coax	8444-X5N		7000–11,000	10	1	1.6	20			50
	Limiter	W.G.	8451-X(*)	1	7200–10,000	10	1	0.75	23			50
	Limiter	W.G.	8452-X(*)	1	7200–10,000	50	2	0.75	23			50
	Limiter	W.G.	8453-X(*)	2	7400–9600	500	2	1.0		0.25	50	500
	Duplexer	W.G.	8484-X(*)	2	8200–9600	1000	1.0	1.0		.1	20	500
	Limiter	W.G.	8452-X9		8500–9600	50	2	1.0	30			50
Ku	Limiter	W.G.	8451-Z(*)	1	12.4–18 Gc	10	0.5	0.75	20			50
	Limiter	W.G.	8452-Z(*)	1	12.4–18 Gc	50	2	0.75	20			50
	Limiter	W.G.	8453-Z(*)	3	12.4–18 Gc	500	2	1.2		0.25	50	500
	Duplexer	W.G.	8484-Z(*)	3	12.4–18 Gc	1000	1.0	1.2		.1	20	500

1 Any 300 Mc bandwidth within indicated range.
2 Any 400 Mc bandwidth within indicated range.
3 Any 500 Mc bandwidth within indicated range.
*Specify center frequency.

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Technical Note

Harmonically-Enhanced Two-Octave TWTA

a traveling-wave tube amplifier that can handle more than one frequency at a time with a minimum of complexity

J. J. HAMILTON and D. ZAVADIL
Microwave Associates, Burlington, MA

Emphasis on power TWT amplifier development has, in the past year or two, been focused primarily on such sophisticated aspects as dual-mode operation, conduction-cooling, high efficiency, and wide bandwidth. This note reports some advanced results obtained on tube type MA 2064, in which extraordinarily broadband RF performance has been attained in recent months, at respectable efficiency levels.

Special attention was paid to the development of the helix delay line circuit of the tube, which was designed as a 500-watt CW amplifier for the frequency range of 1.5 to 4.0 GHz. Optimum circuit design was arrived at by means of a lightly, anisotropically-loaded helix, following extensive cold testing. Subsequent hot-test data revealed that the operating bandwidth of the tube was close to its objectives, although the design frequency center itself was somewhat high.

It was therefore particularly gratifying to discover that, with harmonic enhancement, the band-edge performance of the tube could be extended so as to provide a full-blown operating bandwidth in excess of two octaves.

BASIC TWT PERFORMANCE

The MA 2064 is a low voltage, high perveance, lightweight traveling-wave amplifier configured primarily for airborne application. Some typical operating parameters are listed in **Table 1**. The tube has been designed to operate with an input of 2500 watts, exclusive of heater power, with an efficiency of better than 20%. It provides a gain of 23 dB at saturation with the second-harmonic signal component 7 dB or more below the fundamental.

TABLE 1

TYPICAL OPERATING PARAMETERS FOR MA2064 AMPLIFIER ELECTRICAL

HELIX VOLTAGE	5.5kV
HELIX CURRENT	50mA
COLLECTOR VOLTAGE	3.5kV
COLLECTOR CURRENT	600mA
GRID VOLTAGE (CW OPERATION)	+105V
GRID VOLTAGE (CUT-OFF)	-150V
HEATER VOLTAGE	6.3V
HEATER POWER	50W

500 watts output, as shown in **Figure 1**, is attained over a bandwidth in excess of 1.5 octaves with somewhat reduced gain and higher harmonic content. Furthermore, starting with a 300- to 400-watt CW level it is possible to pulse-up 3 dB* and obtain dual-mode operation across an octave-plus band.

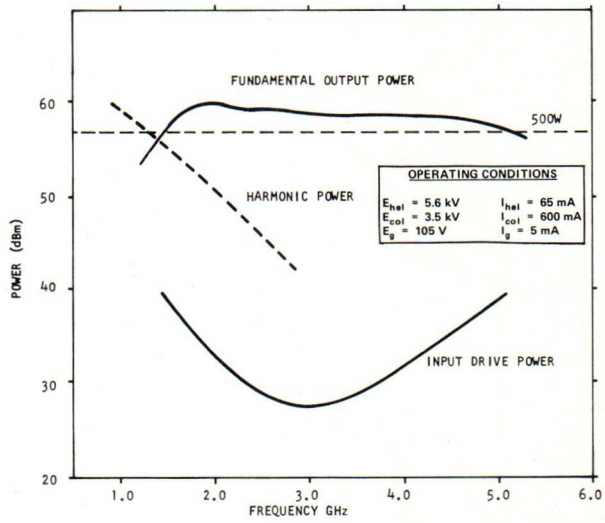

Fig. 1 Power output vs frequency.

The primary mechanical-design objective was to maximize thermal dissipation within as rugged and lightweight a package as possible. The electron gun incorporates a high-μ, non-intercepting shadow grid to allow both pulsed and CW operation to take place with negligible beam-current interception. A tungsten-impregnated cathode is employed which operates with a loading of 0.3 A/cm^2 to ensure long life and reliability. The tube is constructed for either liquid or conduction cooling.

Figure 2 shows the liquid-cooled version which employs a single-stage collector capable of 35% depression below the cathode potential. The beam is PPM-focused with Alnico VIII magnets. Beam transmission to the collector exceeds 88% in a fully saturated, collector-depressed condition.

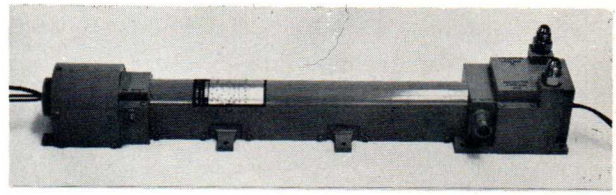

Fig. 2 MA 2064 TWTA.

The delay line consists of a copper-tape helix brazed into a copper-circuit housing on beryllia segments. The circuit embodies minimum dielectric loading and tailored frequency dispersion to achieve maximum frequency bandwidth consistent with good conversion efficiency. Construction of the circuit is similar to that used in tubes operating at RF output power levels 3 to 6 dB above that of the MA 2064. The tube is provided with OSM input and S/C output connectors.

* A technique to obtain 3-dB greater peak-power output at 50% duty factor by using somewhat higher beam voltage (Editor).

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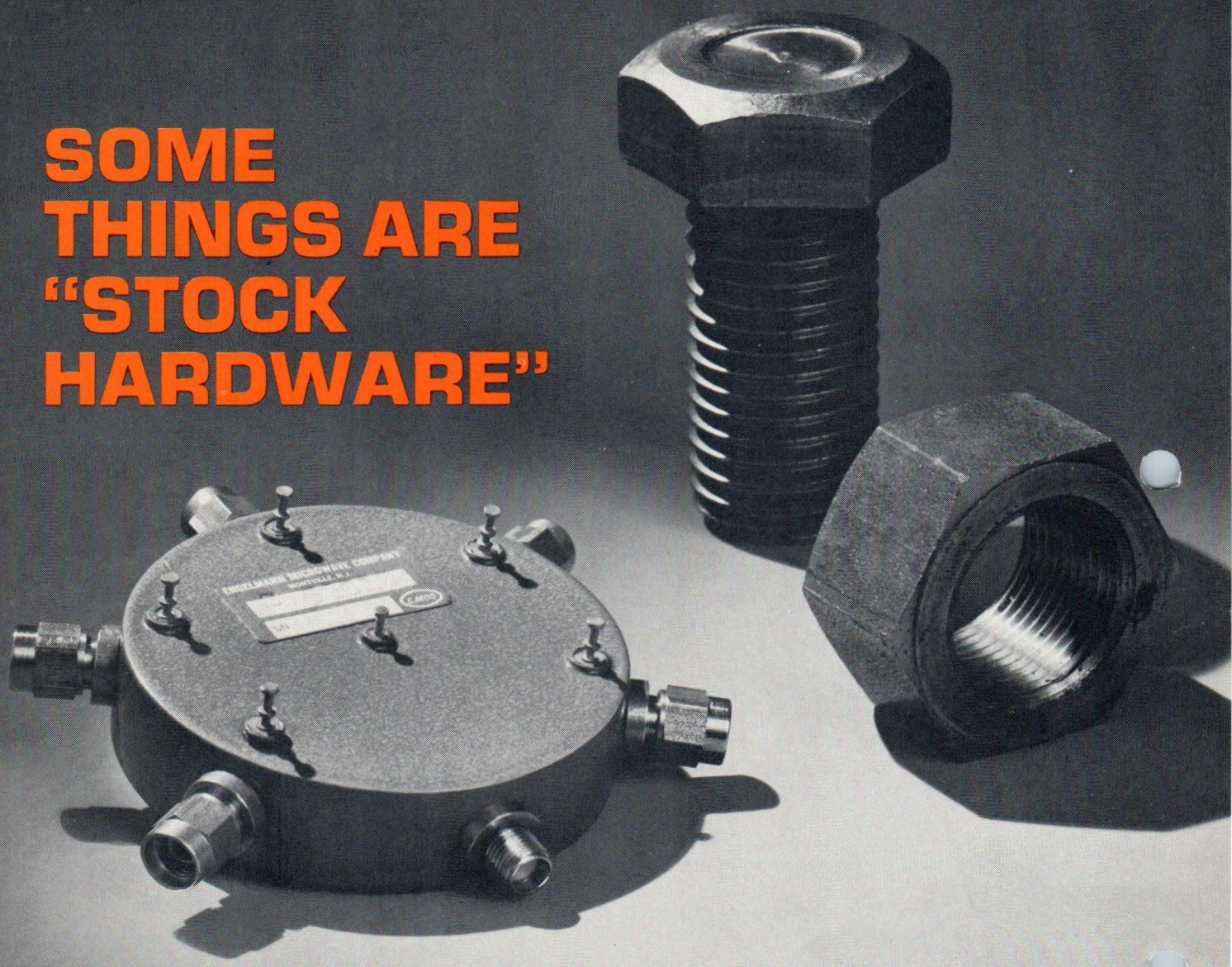

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TWT PERFORMANCE WITH HARMONIC ENHANCEMENT

The performance of the basic tube outlined above is limited to a 1¼ octave bandwidth by a phenomenon known as *harmonic capture*. At the low end of the frequency band, primarily between 1.0 and 1.6 GHz, the harmonic-signal components are preferentially amplified and thus absorb power from the fundamental. This causes the gain of the fundamental to fall off at these frequencies, thus narrowing the tube's bandwidth. Such behavior is typical of TWT's with inherent multioctave bandwidth capability. It occurs because harmonics present in the input drive signal, as well as those generated by distortion of the signal waveform within the tube itself, are amplified as readily or with even greater facility than the fundamental signal.[1]

Earlier work has shown that harmonic-capture effects can be reduced if the input signal containes a significant second-harmonic component properly phased, at each frequency, with respect to the fundamental.

In the case of the MA 2064 this was accomplished as follows: a driver TWT capable of delivering an adequate level of second-harmonic power output over the frequency range of interest was selected, and a passive second-harmonic phase compensator was inserted between the latter and the MA 2064 TWT, as shown in the chain configuration of **Figure 3**. Proper relative phase adjustment between

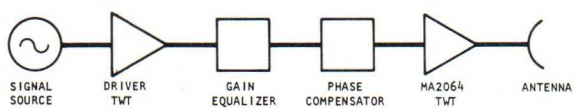

Fig. 3 TWT Amplifier Chain Employing Harmonic Enhancement.

the fundamental and harmonic components of the drive signal was provided at every point across the lower portion of the frequency band of the MA 2064, by this mechanically adjustable phase compensator, resulting in the improved RF performance curves of **Figure 4**.

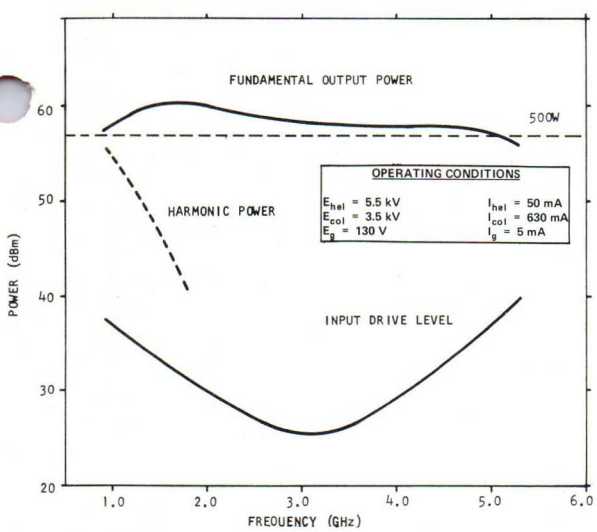

Fig. 4 Power output vs frequency, with harmonic enhancement.

At the lower frequencies, harmonic enhancement not only increased the fundamental output power but it also improved gain while suppressing the second harmonic content of the output signal. A full two-octave band extending from 1.2 to 4.8 GHz thereby became available with a minimum saturated gain of 23 dB and harmonic components 8 dB or more below the fundamental.

An improvement of the high frequency gain characteristic also resulted from a slight reduction of helix voltage,

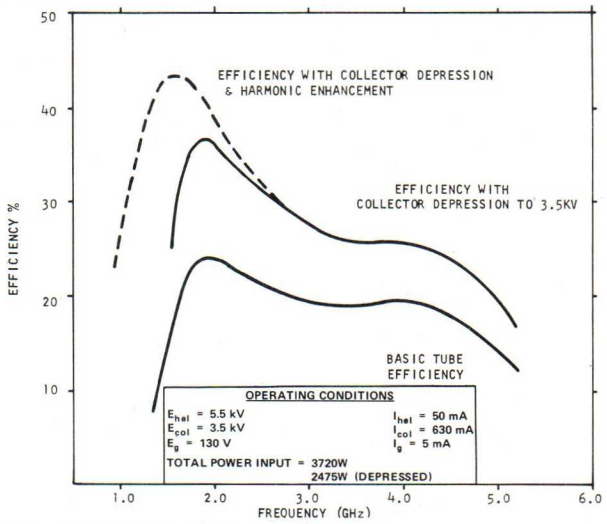

Fig. 5 Effect of collector depression and harmonic enhancement on basic conversion efficiency.

made feasible by the enhanced lower band-edge performance of the tube. This made possible the attainment of a minimum depressed collector efficiency of 22% over the entire two-octave bandwidth, as shown in **Figure 5**.

The two-octave performance achieved in the PPM-focused MA 2064 power amplifier, with the aid of harmonic enhancement presents two factors that are particularly noteworthy. The first one concerns the actual, high level of power output delivered by the tube, fairly uniformly and efficiently, across the operating frequency band. The second is the simple fact that reasonable efficiency within this extraordinary frequency range is attained through single-stage collector depression alone.

Table 2 summarizes some of the major performance characteristics of the tube, with and without harmonic enhancement. For practical system applications, instantaneous bandwidth capability is, of course, necessary. Devices capable of providing instantaneous phase compensation across the full TWT operating frequency band have been under development at MA and elsewhere for some time. The finished products should appear on the market very shortly.

TABLE 2

COMPARISON OF MA2064 PERFORMANCE CHARACTERISTICS WITH AND WITHOUT HARMONIC ENHANCEMENT

PARAMETER	MA2064 BASIC PERFORMANCE	MA2064 HARMONICALLY ENHANCED PERFORMANCE
FREQUENCY BANDWIDTH	1.8/4.5 GHz	1.2/4.8 GHz
MIN SATURATED GAIN	23 dB	23 dB
MIN POWER OUTPUT	500 W	500 W
MIN EFFICIENCY	25%	22%
MIN HARMONIC RATIO	7 dB	8 dB

REFERENCE

1. Dionne, N.J., "Harmonic Generation in Octave-Bandwidth Traveling Wave Tubes," *IEEE Trans on Elect Devices*, Vol ED-17, pp. 365-372, April 1970.

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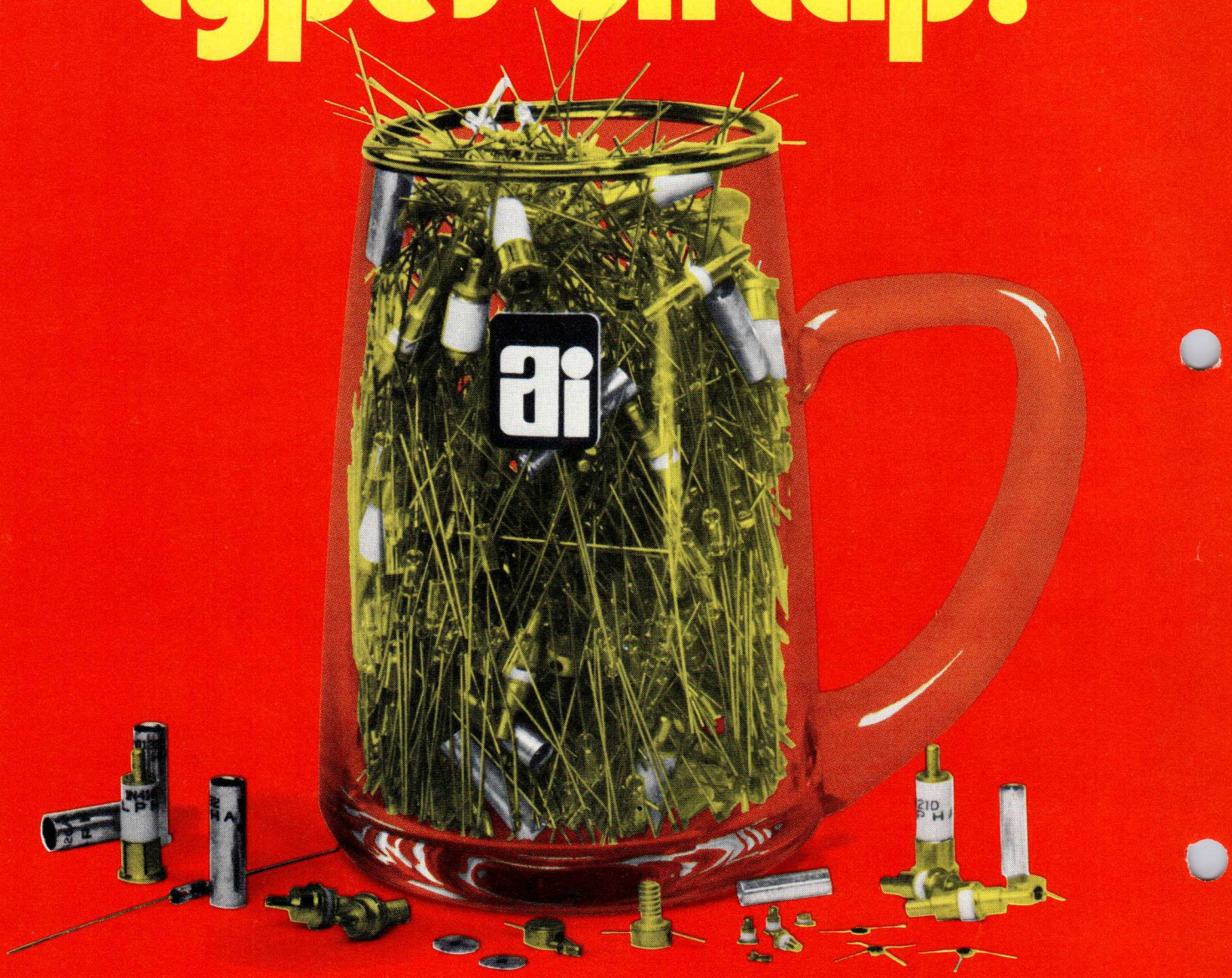

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INTRODUCTION

Switches, Limiters, Duplexers, Voltage Variable Attenuators, and Phase Shifters all utilise two basic semiconductor junction building blocks i.e. the variable reactance and variable resistance junction (P.I.N). In both cases the devices utilise the non linear behaviour of the junction under the influence of either an applied D.C. or R.F. voltage.

These devices show present day high - power performance and future capabilities never before normally associated with semiconductor diodes.

GENERAL

Three families of **SWITCHES** can be defined; a low power family primarily for receiver application, a medium power family for switching powers of the order of 150 watts peak and 5 watts C.W., and a high power family capable of switching powers of the order of 10KW peak and 100 watts average. These devices have the advantage of fast switching time and low driving power requirements. In general the low power and medium power switches have switching time capabilities of the order of several nano-seconds and the high power switch has capabilities of switching in the order of 100 nano-seconds to one microsecond.

Since **LIMITER** devices are self limiting, no external biases are required to achieve the limiting action. By virtue of this characteristic, highly reliable performance is achieved. The problems normally associated with interpulse and standby protection in conventional devices are eliminated. Over a wide range of input power, the output power remains relatively constant. In addition to power protection applications, the limiter may be employed as a microwave leveller. By application of a fixed bias, the value of levelled output can be controlled.

The semiconductor **DUPLEXER** has several advantages; of most importance are recovery times of the order of nano-seconds and isolation values of the order of 25 to 45 dB. The device also has the capabilities of miniaturisation and in terms of performance a high degree of reliability and long life are achieved.

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COAXIAL SWITCHES

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3300-1P5N	210-270	.100	.100	0.2	20	-30	0.01	1	10	10
8300-1P6N	270-320	.100	.100	0.2	20	-30	0.01	1	10	10
8300-1P7N	400-450	.100	.100	0.2	20	-30	0.01	1	10	10
8300-1T1N	570-630	.100	.100	0.2	20	-30	0.01	1	10	10
8300-1T2N	890-990	.100	.100	0.3	20	-30	0.01	1	10	10
8300-1L3N	1250-1350	.100	.100	0.3	20	-30	0.01	1	10	10
8300-1L4N	1350-1450	.100	.100	0.3	20	-30	0.01	1	10	10
8300-1S1N	2750-2850	.100	.100	0.5	20	-30	0.01	1	10	10

HIGH SPEED - MEDIUM POWER - SINGLE POLE - SINGLE THROW

8305-1W4N	1-100	75	1.0	1.0	70	2	75	-50	0.1	5μS
8305-1P10N	95-160	75	1.0	1.0	40	2	75	-50	0.1	50
8305-1P11N	150-200	75	1.0	1.0	30	2	75	-50	0.1	50
8305-1P12N	250-500	75	1.0	1.5	60	2	75	-50	0.1	50
8305-1T9N	200-1200	75	1.0	1.5	40	2	75	-50	0.1	50
8305-1L16N	1000-2000	75	1.0	1.5	35	2	75	-50	0.1	50
8305-1L17N	1000-2000	75	1.0	1.5	65	2	75	-50	0.1	50
8305-1L18N	1250-1350	75	1.0	0.5	20	2	75	-50	0.1	50
8305-1L19N	800-2400	75	1.0	1.5	33	2	75	-50	0.1	50
8305-1S6N	2000-4000	75	1.0	2.0	30	2	75	-50	0.1	50
8305-1S7N	2000-4000	75	1.0	1.5	30	2	75	-50	0.1	50
8305-1C9T	4500-4700	75	1.0	2.0	30	-50	0.1	2	75	50
8305-1C12N	5400-5900	75	1.0	1.5	30	2	75	-50	0.1	30

HIGH SPEED - MEDIUM POWER - SINGLE POLE MULTI-THROW

8305-2P8N	100-200	75	1.0	0.8	37	2	75	-50	0.1	50
8305-2P9N	216-240	75	1.0	0.5	40	2	75	-50	0.1	50
8305-2T3N	400-600	75	1.0	1.0	30	2	75	-50	0.1	50
8305-2T4N	200-1000	75	1.0	2.0	25	2	75	-50	0.1	50
8305-2L10N	1400-2300	75	1.0	1.5	33	2	75	-50	0.1	50
8305-2L11N	1000-2000	75	1.0	1.5	40	2	75	-50	0.1	50
8305-2L12N	1250-1350	75	1.0	0.8	25	2	75	-50	0.1	50
8305-2S7N	2000-4000	75	1.0	1.5	30	2	75	-50	0.1	50
8305-2S8N	2800-3200	75	1.0	1.0	30	2	75	-50	0.1	50
8303-4L2T	1400-1700	75	2.0	2.0	60	2	100	-50	0.1	100
8305-2C5N	5400-5900	75	2.0	1.5	30	-50	0.1	2.0	75mA	50

COAXIAL SWITCHES

HIGH CW POWER - SINGLE POLE - SINGLE THROW

Model MA-	Bandwidth	Max. Operating Power		Max. Ins. Loss	Min. Iso.	Switching Bias				Switch Time (nS)
						Low Loss		Isolation		
	Mc/s	Peak @ .001 Du (W)	CW (W)	(db)	(db)	Max. V (V)	Max. I (mA)	Max. V (V)	Max.I (μa)	
8304-1P4B	215-260	-	20	0.5	30	2	100	-50	0.1	200
8304-1P5N	200-400	-	20	0.75	30	2	100	-50	0.1	200
8304-1P6N	400-450	-	20	1.0	30	2	100	-50	0.1	200
8304-1L2N	1000-2000	-	20	1.0	30	2	100	-50	0.1	200
8304-1L3N	1200-1400	-	20	1.0	30	2	100	-50	0.1	200

HIGH CW POWER - SINGLE POLE - MULTI-THROW

8304-2P4N	200-400	-	50	0.75	30	2	100	-50	0.1	200
8304-2P5N	400-450	-	50	1.0	30	2	100	-50	0.1	200
8304-2P6N	215-260	-	50	0.5	30	2	100	-50	0.1	200
8304-2L1N	1200-1400	-	50	1.0	30	2	100	-50	0.1	200
8304-2L2N	1000-2000	-	50	1.0	30	2	100	-50	0.1	200
8305-2L14N	1200-1400	-	250	0.5	30	-250V	1	+1	200	200
8305-2P10N	210-270	-	250	0.5	40	-250	1	+1	200	1μs
8305-2S9N	2200-2400	-	200	0.5	20	-250	1	+1	200	200

HIGH PEAK POWER - SINGLE POLE-SINGLE THROW

8306-1L4N	1000-1100	1000	30	0.8	25	-100	0.1	2	200	200
8306-1S3N	2900-3100	1000	10	1.0	25	-100	0.1	2	300	200
8306-1C2M	5600-5800	500	10	1.2	20	2	100	-100	0.1	200

HIGH PEAK POWER - SINGLE POLE - MULTI-THROW

8306-2L11N	1030-1090	1500	15	0.7	20	-100	0.1	2	200	200
8306-2L12N	1030-1090	1500	15	1.0	35	-100	0.1	2	200	200
8306-2L14N	1370-1470	1000	10	1.0	25	-100	0.1	2	200	200
8306-2C2M	5600-5800	2000	10	1.2	20	2	100	-100	0.1	200
8307-2L3N	1030-1090	10 KW	30	1.0	30	-100	0.1	2	200	200

HIGH PEAK POWER - DOUBLE POLE - DOUBLE THROW

8309-2L1N	1400-1460	500	4	0.5	20	2	100	-100	0.1	200

WAVEGUIDE SWITCHES

HIGH SPEED - MEDIUM POWER - SINGLE POLE - SINGLE THROW

Model MA-	Bandwidth Gc/s	Max. Operating Power Peak @ .001 Du (W)	Max. Operating Power CW (W)	Max. Ins. Loss (db)	Min. Iso. (db)	Switching Bias Low Loss Max. V (V)	Switching Bias Low Loss Max. I (mA)	Switching Bias Isolation Max. V (V)	Switching Bias Isolation Max. I (μa)	Switch Time (nS)
8319-1X3	8.5-9.5		2	1.0	30	-30	0.1	2	100	30
8320-1X12	8.5-9.6	50	4	1.5	17	-30	0.1	2	100	30
8320-1Z4	13.29-13.36	10	4	1.0	30	2	100	-30	0.1	30
8320-1X	*	50	4	0.75	25	-30	0.1	2	100	30

*Any 150 Mc/s from 7.0 - 9.8 Gc/s

HIGH SPEED - MEDIUM POWER - SINGLE POLE - MULTI THROW

8319-2X2	9.25-9.5		2	4.5	60	2	100	-30	0.1	30
8319-4X1	7.7-7.8		2	1.0	35	-30	0.1	2	100	30
8320-2X	*	50	4	0.75	25	-30	0.1	2	100	30

*Any 150 Mc/s from 7.0 - 9.8 Gc/s

HIGH POWER - SINGLE POLE - SINGLE THROW

8321-1C2	5.4-5.9	250	4	1.0	20	-100	0.1	2	100	200
8322-1X	**	1KW	10	0.75	23	-150	0.1	2	100	250

**Any 100 Mc/s from 8.5-9.6 Gc/s

LIMITERS

COAXIAL TYPES

Model MA-	Bandwidth Mc/s	Max. Power Peak @ .001 Du (kW)	Max. Power CW (W)	Max. Ins. Loss (db)	Min. Iso. (db)	Recovery Time (nS)
8444-P8N	0-400	-	20	0.3	20	50
8444-T1N	0-1000	-	5	0.5	20	50
8444-L4N	1000-2000	10w	1	0.5	25	50
8446-P4N	400-450	1	10	0.3	30	50
8446-P5N	0-450	1	10	0.3	30	50
8446-P6N	215-235	4	10	0.2	20	50
8446-P7N	400-450	4	10	0.3	20	50
8446-T2N	0-1000	1	5	0.5	25	50
8446-L3N	1250-1350	1	5	0.5	25	50
8446-S1N	2900-3100	1	5	0.6	30	50

WAVEGUIDE TYPES

8451-X	†	10w	1	1	20	50
8452-X	†	50	2	1	20	50
8452-X-9	8.5-9.6	50w	2	1	20	50
8453-X	††	500	0.5	1	35	500

† Any 300 Mc/s from 8.5 to 9.6 Gc/s. †† Any 400 Mc/s from 8.5 to 9.6 Gc/s.

DUPLEXERS

COAXIAL TYPES

Model MA-	Bandwidth Mc/s	Max. Power Peak @ .001 Du (kW)	Max. Power CW (W)	Low Ins. Loss (db)	High Ins. Loss (db)	Min. Iso. (db)	Recovery Time (nS)
8474-P2M	139-143	20w	2.5	1.0	1.0	25	50
8475-T2N	300-1000	250w	1	1.0	1.0	30	50
8476-P8T	100-200	1.5	75	1.0	1.0	40	50
8476-P10T	139-143	1.5	75	1.0	1.0	30	50
8576-P9T	400-450	1.0	10	1.0	1.0	40	50

WAVEGUIDE TYPES

8484-X1	8500-8900	1	1	1.0	0.5	45	1.5 μS
8484-X2	8800-9200	1	1	1.0	0.5	45	1.5 μS
8484-X3	9200-9600	1	1	1.0	0.5	45	1.5 μS

PHASE SHIFTERS

COAXIAL TYPES

Model MA-	Bandwidth Mc/s	Max. Operating Power Peak @ .001 Du (kW)	Max. Operating Power CW (W)	Total Phase Range (deg.)	Ins. Loss Range (db)	Control Bias Step or Range	Control Time (μS)
8352-2L1T	800-1600	1W	0.1	0-90°	2.0	0 – 90V	0.1
8357-0L1N	L Step-Type	10	20	0-22.5°	0.8	+5V @ 200 mA −200V @ 0.5 mA	0.2
8357-2L1N	L Step-Type	10	20	0-90°	0.8	+5V @ 200 mA −200V @ 0.5 mA	0.2
8357-1L1N	L Step-Type	10	20	0-45°	0.8	+5V @ 200 mA −200V @ 0.5 mA	0.2
8357-4L1N	L Step-Type	10	20	0-180°	0.8	+5V @ 200 mA −200V @ 0.5 mA	0.2

VOLTAGE VARIABLE ATTENUATORS

COAXIAL TYPES

Model MA-	Bandwidth Mc/s	Max. Operating Power CW (W)	Attenuation Range Max. Ins. Loss (db)	Attenuation Range Min. Ins. Loss (db)	Bias Range Max. Ins. Loss	Bias Range Min. Ins. Loss
8405-1L1N	1250-1350	1	10	1	3 mA	O mA
8403-1L3T	1200-1350	1	10	1	0 mA	50 mA

NOTES:

1. Peak power ratings in this data sheet, above 10 watts, are based upon a maximum load VSWR of 1.5:1. Duty cycle ratings utilize a maximum pulse width of 2 microseconds.

2. Rated insertion loss values include mismatch effects.

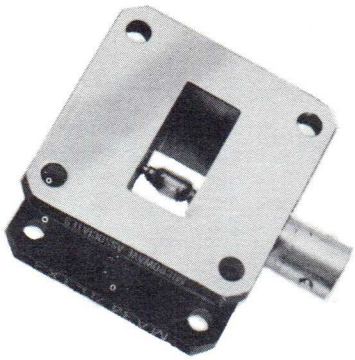
3. Other connectors such as TNC, BNC, etc. can be supplied at slight increase in cost.

4. Fast switching speed bias circuits can be supplied upon request.

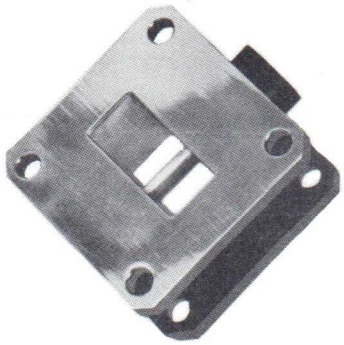
5. Switching time ratings are realistic and intentionally conservative in most cases. In many systems consideration must be given to video feed-through to the main RF transmission line. For example: 10 nanosecond switching operation can be realized in most semiconductor elements at all RF frequencies. However, frequency components in the video circuit approach the RF frequency resulting in major system problems.

   Video feed-through in this listing is held to a minimum by the proper choice of bias and RF circuitry.

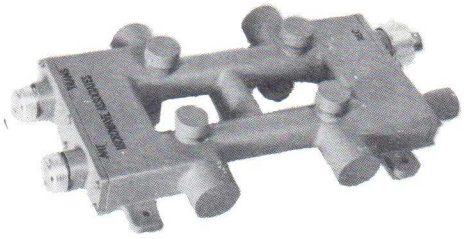
SWITCHES



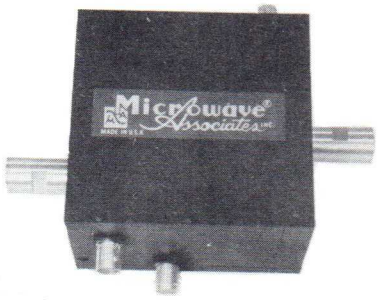
LIMITERS



DUPLEXERS

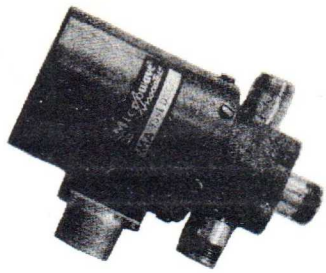


PHASE SHIFTERS



MICROWAVE ASSOCIATES LTD
CRADOCK ROAD, LUTON BEDS. TEL: LUTON 53363

DATA SHEET | DEC. 63



COAXIAL SWITCHES

0-10Gc/s

MA-7501 REMOTE ACTUATION

DESCRIPTION

The remotely actuated switches of the MA-7501 series consist of single-channel, multiple position units of radial configuration and broad bandwidth characteristics for use where control from a distant location is required in order to avoid running R.F. cabling to and from the control point. These units are compact, rugged, of minimum weight and long life. They are characterized by low VSWR, crosstalk and insertion loss at frequencies up to 10,000 megacycles.

APPLICATION

These switches are for application as original equipment or for replacement directly in military and commercial radio and radar equipment where excellent R.F. characteristics and remote actuation are required. They are designed for base mounting. The construction is weatherproof and resists degradation due to dust, corrosion, water and fungus. The MA-7501 series units are designed to meet the requirements of specification MIL-S-3928.

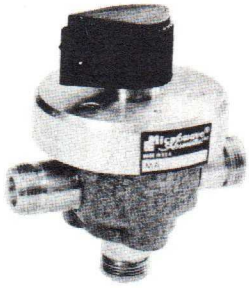
SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

TYPE CONNECTOR	C or SC	N	BNC	TNC	HN	LN
Frequency Range	0-10 Gc					
RF Power Rating (max.) (avg.)	300 watts to 3 Gc 1200 watts to 0.3 Gc 3000 watts to 30 Mc					100 watts to 3Gc 350 watts to 0.3Gc 1200 watts to 30Mc
Voltage Rating (RMS)	500 volts					
Insertion Loss (max.)	0.3db, 0-3Gc 0.5db, 3-10Gc	0.3db, 0-3Gc 0.5db, 3-10Gc	0.3db, 0-3Gc	0.3db, 0-3Gc 0.5db, 3-10Gc	0.3db, 0-3Gc	0.3db, 0-3Gc
Voltage Standing Wave Ratio (max.)	1.4, 0-3Gc	1.3, 0-3Gc 1.5, 3-10Gc	1.3, 0.3Gc	1.3, 0-3Gc 1.6, 3-10Gc	1.3, 0-3Gc	1.4, 0-3Gc
Isolation (min.)	60db, 0-3Gc 40db, 3-10Gc	60db, 0-3Gc 40db, 3-10Gc	60db, 0-3Gc	60db, 0-3Gc 40db, 3-10Gc	60db, 0-3Gc	60db, 0-3Gc

PHYSICAL CHARACTERISTICS

Operating Life	30,000 cycles minimum
Operating Temperature Range	-55 to +55°C
Switching Rate	40 cycles per min. max.
Switching Time	0.07 sec. max. per 60 deg. throw
RF Connector	Coaxial – See Table 1
Power Connector	See Table II
Weight	1 lb. 10 oz., plus RF connectors



O-10Gc/s

MA-7501 MANUAL

DESCRIPTION

The manual R.F. switches of the 7501 series consist of single-channel, multiple position units of broad bandwidth characteristics for use where remote control is not required. These units are compact, rugged and of minimum weight. They are characterized by their low VSWR, cross-talk and insertion loss at all frequencies up to 10,000 megacycles.

APPLICATION

These units are for application as original equipment or as replacement directly in military and commercial prime equipment, laboratory equipment and bench test setups. They are provided with tapped holes for either panel or base mounting. The construction is weatherproof and resists degradation due to dust, corrosion, water and fungi. The 7501 series units are designed to meet the service requirements of specification MIL-S-3928 and the high shock requirements of MIL-S-901B.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

TYPE CONNECTOR	C or SC	N	BNC	TNC	HN	LN
Frequency Range	0-10 Gc					
RF Power Rating (max.) (avg.)	300 watts to 3 Gc 1200 watts to 0.3 Gc 3000 watts to 30 Mc					100 watts to 3Gc 350 watts to 0.3Gc 1200 watts to 30Mc
Voltage Rating (RMS)	500 volts					
Insertion Loss (max.)	0.3 db, 0-3Gc 0.5 db, 3-10Gc	0.3 db, 0-3 Gc 0.5 db, 3-10 Gc	0.3 db, 0-3 Gc	0.3 db, 0-3 Gc 0.5 db, 3-10Gc	0.3 db, 0-3 Gc	0.3 db, 0-3 Gc
Voltage Standing Wave Ratio (max.)	1.4, 0-3 Gc	1.3, 0-3 Gc 1.5, 3-10 Gc	1.3, 0-3 Gc	1.3, 0-3 Gc 1.6, 3-10 Gc	1.3, 0-3 Gc	1.4, 0-3 Gc
Isolation (min.)	60 db, 0-3 Gc 40 db, 3-10 Gc	60 db, 0-3 Gc 40 db, 3-10 Gc	60 db, 0-3 Gc	60 db, 0-3 Gc 40 db, 3-10 Gc	60 db, 0-3 Gc	60 db, 0-3 Gc

PHYSICAL CHARACTERISTICS

Operating Life	30,000 cycles minimum
Operating Temperature Range	-55° to +85°C
Switching Rate	- N/A -
Switching Time	- N/A -
RF Connector	Coaxial - See Table I
Power Connector	- N/A -
Weight	13.5 oz. max., plus RF connectors

(Typical)

KEY FOR ORDERING BY MODEL NUMBER

MA-7501 | D | T | M | |

- Number and angle of connectors, Table II
- Connector type, Table I
- Actuation (Manual "M")
- Special feature identification (assigned by M/A)

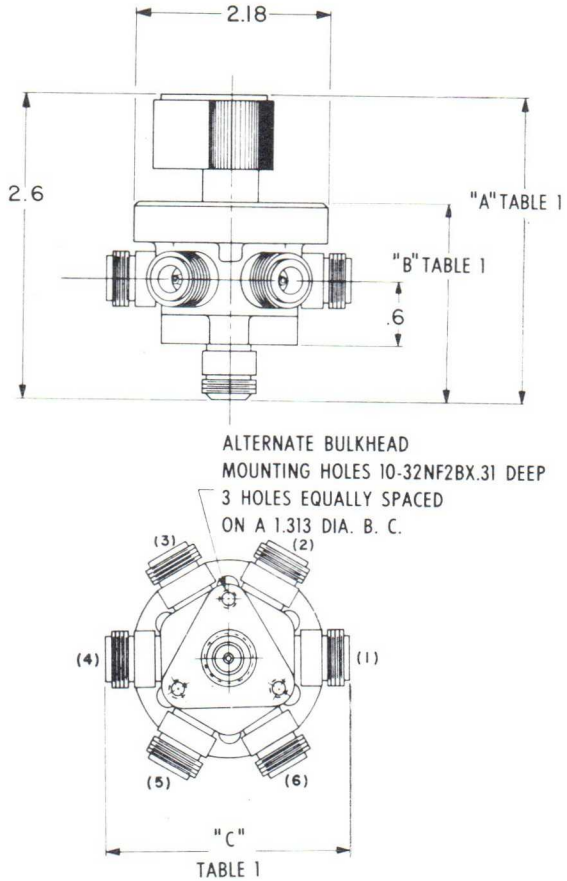
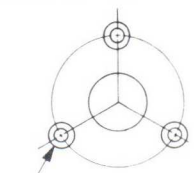


TABLE I

RF Connector	Dim. "A"	Dim. "B"	Dim. "C"	Wt.(Oz. Each)
N	3.2	2.2	2.9	0.51
B (BNC)	3.0	2.0	2.4	0.03
T (TNC)	3.1	2.1	2.7	0.13
C	3.1	2.1	2.6	0.11
H (HN)	3.3	2.3	2.9	0.50
L (LN)	3.3	2.3	2.9	0.80
X (SC)	3.2	2.2	2.9	0.41

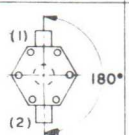
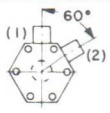
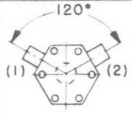
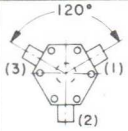
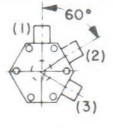
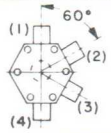
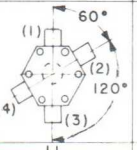
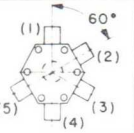
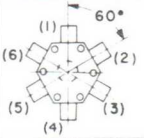
PANEL MOUNTING HOLE PATTERN

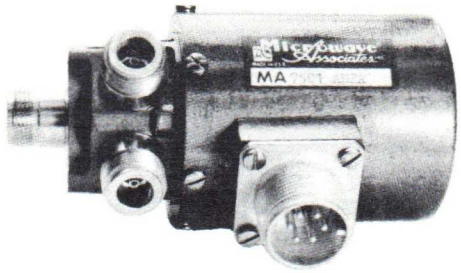


NO. 23(.154 DIA.) DRILL THRU,
C'SINK 82°X.29 DIA. 3 HOLES
EQUALLY SPACED ON A 1.485 DIA. B. C.

TABLE II

CONNECTOR ORIENTATION DIAGRAMS (KNOB END VIEW)

2 POS 180°	2 POS 60°	2 POS 120°	3 POS 120°	3 POS 60°	4 POS 60°	4 POS 612	5 POS 60°	6 POS 60°
								
D	A	C	F	E	G	H	J	K



O-10Gc/s

MA-7501 REMOTE CONTROL (FAIL-SAFE)

DESCRIPTION

This series consists of single-channel, two-position RF switches for use where fail safe (spring return) remote control operation is required in combination with excellent RF characteristics. The spring return actuator (as opposed to the stepping type used in other remote control series) requires a holding current in position 2, and provides automatic return to position 1 whenever the actuating voltage is interrupted (as in relays). The units are light in weight, compact, and feature minimum VSWR, insertion loss and crosstalk. Weatherproof construction resists degradation due to dust, corrosion, water and fungi. The electromechanical action of these units is of long life and highest reliability.

APPLICATION

This series is for application as original equipment or for replacement in the antenna circuits of transmitter receiver combinations and other applications where return to a specified position is desired upon removal of actuating voltage, either deliberately or through power failure. These switches have base mounting provision. They are designed to meet the requirements of specification MIL-S-3928

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

TYPE CONNECTOR	C or SC	N	BNC	TNC	HN	LN
Frequency Range	0-10 Gc					
RF Power Rating (max.) (avg.)	300 watts to 3 Gc 1200 watts to 0.3 Gc 3000 watts to 30 Mc					100 watts to 3 Gc 350 watts to 0.3Gc 1200 watts to 30Mc
Voltage Rating (RMS)	500 volts					
Insertion Loss (max.)	0.3 db, 0-3Gc 0.5 db, 3-10Gc	0.3 db, 0-3 Gc 0.5 db, 3-10 Gc	0.3 db, 0-3 Gc	0.3 db, 0-3 Gc 0.5 db, 3-10 Gc	0.3 db, 0-3 Gc	0.3 db, 0-3 Gc
Voltage Standing Wave Ratio (max.)	1.4, 0-3 Gc	1.3, 0-3 Gc 1.5, 3-10 Gc	1.3, 0-3 Gc	1.3, 0-3 Gc 1.6, 3-10 Gc	1.3, 0-3 Gc	1.4, 0-3 Gc
Isolation (min.)	60 db, 0-3 Gc 40 db, 3-10Gc	60 db, 0-3 Gc 40 db, 3-10 Gc	60 db, 0-3 Gc	60 db, 0-3 Gc 40 db, 3-10 Gc	60 db, 0-3 Gc	60 db, 0-3 Gc

PHYSICAL CHARACTERISTICS

Operating Life	30,000 cycles minimum
Operating Temperature Range	-55 to +55°C
Switching Rate	40 cycles per min. max.
Switching Time	0.07 sec. max. per 60 deg. throw
RF Connector	Coaxial - See table 1
Power Connector	See table II
Weight	1 lb. 10 oz., plus RF connectors

(Typical)

KEY FOR ORDERING BY MODEL NUMBER

MA-7501 | A | T | D | —

- Two Position, 60° Configuration Only (Table I)
- Connector Type (Table II)
- Drive Type (Spring Return) and Voltage (Table III)
- Indicator Circuits ("A" Table IV) or Other Special Features (Nomenclature Assigned by M/A)

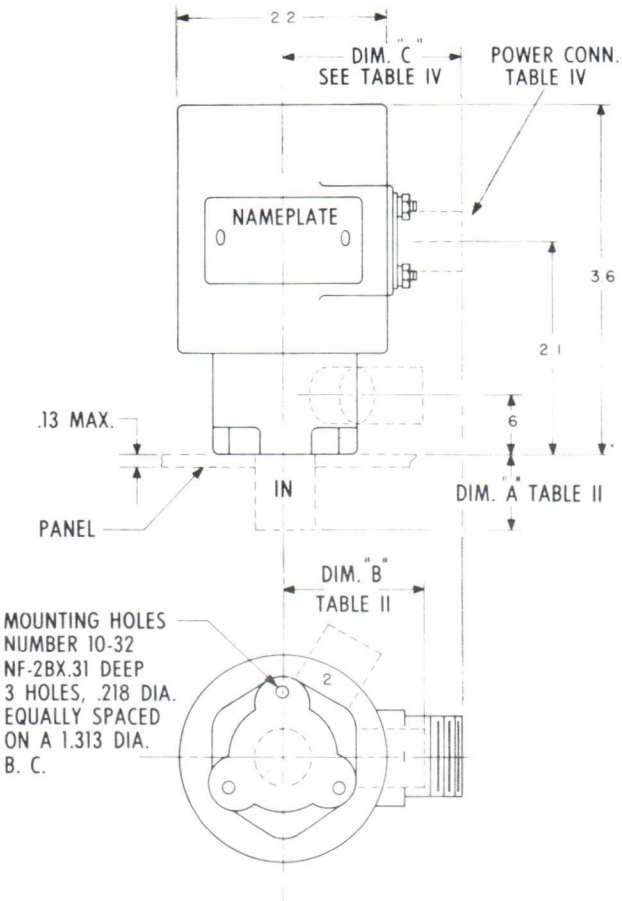
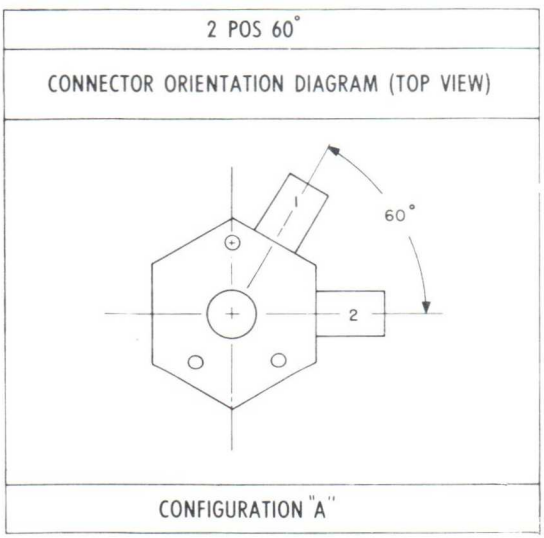
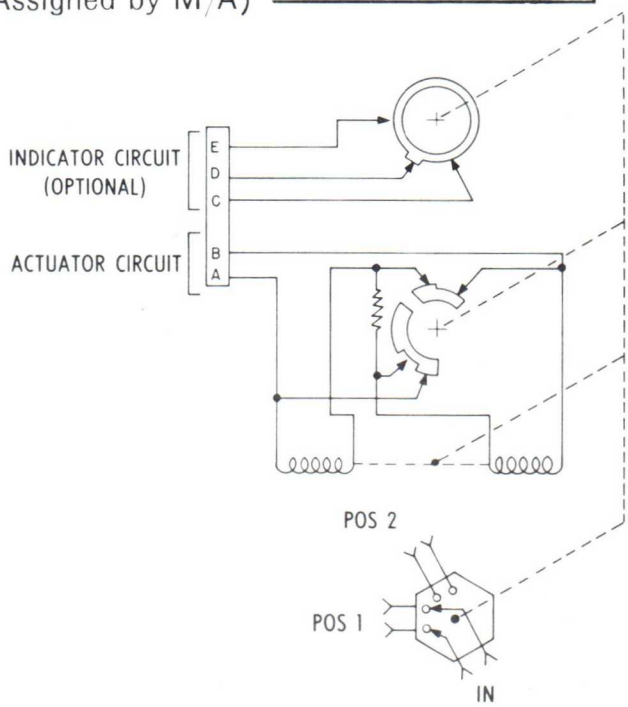
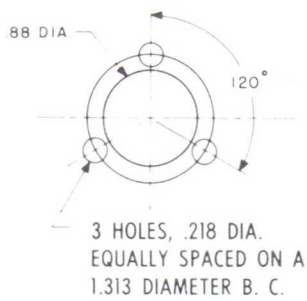


TABLE I



* Typical actuator "pull-in" power consumed momentarily during switching from position 1 to 2; 55 watts. Typical "hold-in" power in position 2; 14 watts at 20°C.





BASE MOUNTING HOLE PATTERN

TABLE II

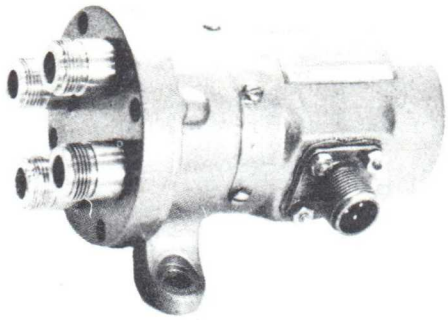
RF Connector	Dim "A"	Dim "B"	Wt. Oz. Each
N	.7	1.4	0.51
B (BNC)	.4	1.2	0.03
T (TNC)	.6	1.3	0.13
C	.5	1.3	0.11
H (HN)	.7	1.5	0.50
L (LN)	.7	1.5	0.80
X (SC)	.7	1.4	0.41

TABLE III

Desig.	Drive Voltages*
D	28 VDC
E	110 VDC
F	115 VAC 50-1500 cps

TABLE IV

Indicator Light Ckt.	Power Conn.	Dim "C"
Without (-)	MS3102-10SL-4P	1.9
With (A)	MS3102C14S-5P	1.9



O-10 Gc/s

MA-7502T REMOTE ACTUATION

DESCRIPTION

The remotely actuated transfer switches of the MA-7502T series are characterized by four Radio Frequency connectors. These are interconnected internally (by a dual channel rotor) in parallel pairs and switch at right angles for transfer coaxial switching purposes. These units are remotely actuated through position seeking rotary stepping solenoids. They exhibit low VSWR, crosstalk and insertion loss at frequencies up to 10,000 megacycles, and have good compactness and light weight. Weatherproof construction resists degradation due to dust, water, corrosion and fungi. The units are of long life and highest reliability.

APPLICATION

These units are for application as original equipment or for replacement where highly dependable transfer switching is desired. Typical installations include the interchanging of two antennas on two receivers or transmitters, or the insertion of additional elements (attenuators, travelling wave amplifiers, etc.) in a transmission line, particularly where this must be accomplished by remote actuation. The units are supplied with mounting feet. They are designed to meet the requirements of MIL-S-3928A.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

TYPE CONNECTOR	C or SC	N	TNC	HN	LN
Frequency Range	0-10 Gc				
RF Power Rating (max.) (avg.)	100 watts .3 - 3.0 Gc 350 watts 30 Mc-.3 Gc 1200 watts 0-30 Mc				
Voltage Rating (RMS)	500 volts				
Insertion Loss (Max.)	0.2 db, 0-3 Gc	0.2 db, 0-3 Gc .5 db, 3-10 Gc	0.2 db, 0-3 Gc	0.2 db, 0-3 Gc	0.2 db, 0-3 Gc
Voltage Standing Wave Ratio (max.)	1.4, 0-3 Gc	1.4, 0-10 Gc	1.3, 0-3 Gc 1.6, 3-10 Gc	1.3, 0-3 Gc	1.4, 0-3 Gc
Isolation (min.)			60 db, 0-3 Gc		

PHYSICAL CHARACTERISTICS

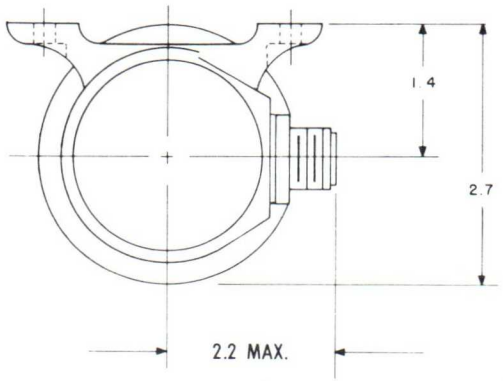
Operating Life	120,000 actuations minimum
Operating Temperature Range	-55° to $+55^{\circ}$C
Switching Rate	40 cycles per minute
Switching Time	0.15 sec. max.
RF Connectors	Coaxial, see table I
Power Connector	See table II
Weight	1 lb., 9 oz. max., plus RF connectors

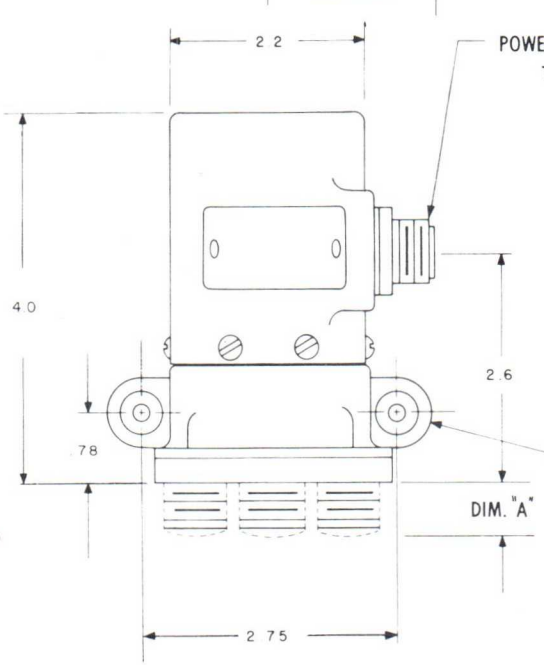
(Typical)

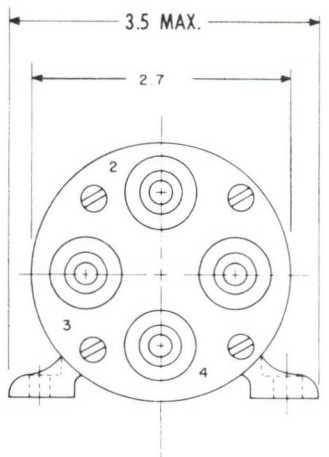
KEY FOR ORDERING BY MODEL NUMBER

MA-7502 | T | N | A | B

- Transfer Configuration, 4 Connectors at 90°
- Connector Type, Table I
- Actuation, Table III
- Indicator Circuit "A" or Other Special Features*
  (Assigned By MA)







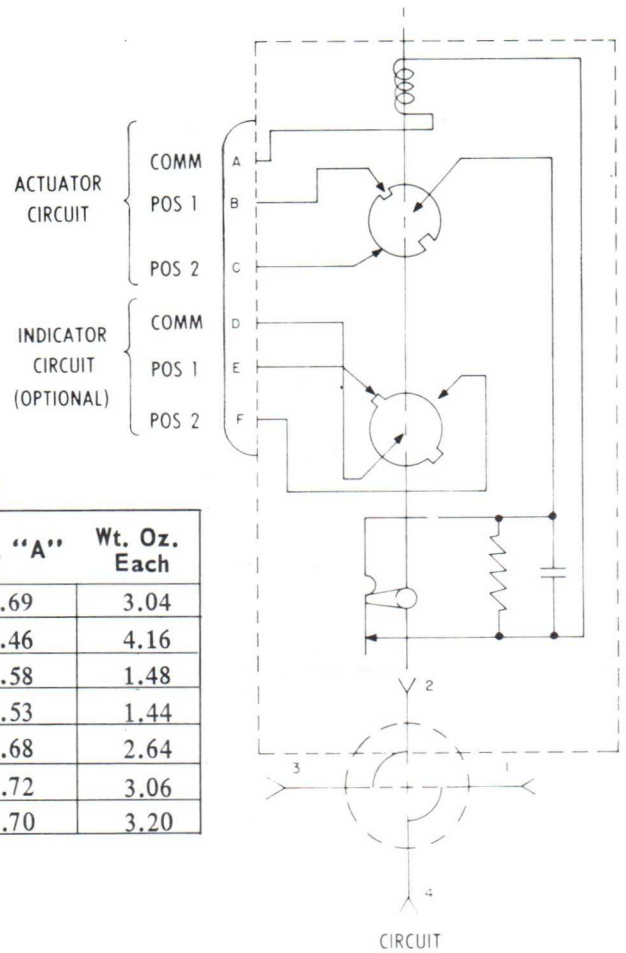


TABLE I

RF Connector	Dim. "A"	Wt. Oz. Each
N	.69	3.04
B (BNC)	.46	4.16
T (TNC)	.58	1.48
C	.53	1.44
X (SC)	.68	2.64
H (HN)	.72	3.06
L (LN)	.70	3.20

* NOTE: AVAILABLE ON SPECIAL ORDER

Special Replacement Models available with parallel mounting feet (.875 x 1.187 inch mounting hole centers — four holes tapped 10-32 x 5/16" deep self locking). These units have power plug at head of solenoid cover and max. width dimension of 2.50 inches.

Nomenclature "B": Not Including Indicator Circuit
(Last Position) "C": Including Indicator Circuit.

Please contact the factory.

TABLE II

Indicator Circuit Power Connector	
Without	MS3102C-10SL-3P
With ("A")	MS3102C-14S-6P

TABLE III

Desig.	Drive Voltages*
A	28 VDC
B	110 VDC
C	115 VAC 50-1500 cps

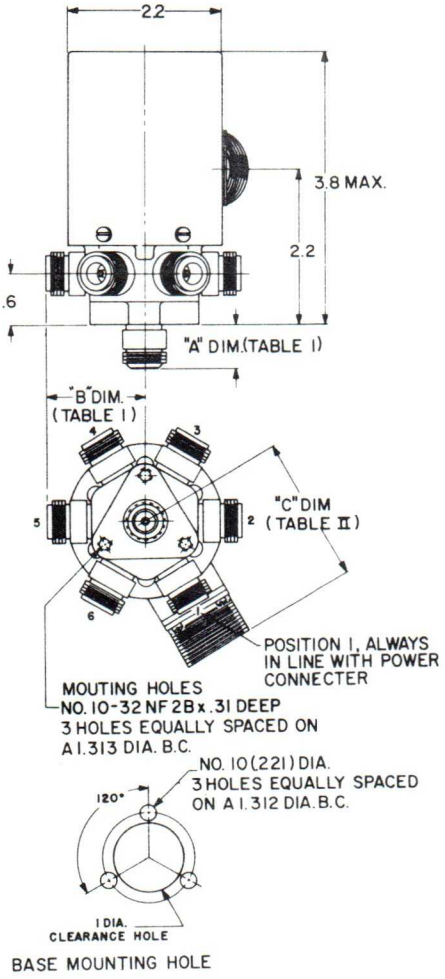
* Typical actuator power momentarily consumed during switching only; 50 watts at 20°C.

KEY FOR ORDERING BY MODEL NUMBER

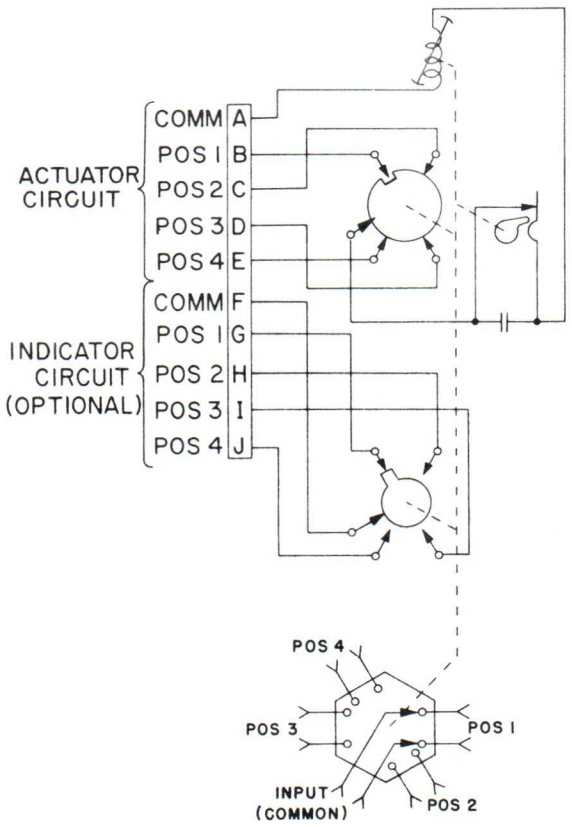
(Typical)

MA 7501 -- | K | N | A | A |

Number and orientation of connectors, Table IV
Connector Type, Table I
Actuation, Table III
Indicator Circuit "A" or other special feature (assigned by MA)
(Power Connectors in accordance with Table II



TYPICAL SCHEMATIC



Connector pins are wired in numerical-alphabetical sequence starting with the actuator "common". Indicator circuit (common) starts with first available pin in alphabetical order after last actuator circuit pin used.

TABLE I

RF CONNECTOR	DIM. "A"	DIM. "B"	WT. (OZ. EACH)
N	.7	1.4	0.51
B (BNC)	.4	1.2	0.03
T (TNC)	.6	1.3	0.13
C	.5	1.3	0.11
H (HN)	.7	1.5	0.50
L (LN)	.7	1.5	0.80
X (SC)	.7	1.4	0.41

TABLE II

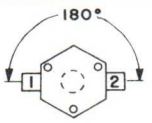
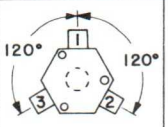
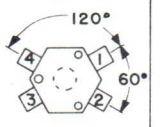
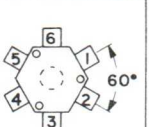
NO. OF POS.	INDICATOR CKT.	POWER CONNECTOR		DIM "C"
2	Without	MS3102	10SL-3P	2.0
	With ("A")	"	14S-6P	2.0
3	Without	"	14S-2P	2.0
	With ("A")	"	18-8P	2.0
4	Without	"	14S-5P	2.0
	With ("A")	"	18-1P	2.2
6	Without	"	16S-1P	2.0
	With ("A")	"	20-27P	2.2

TABLE III

DESIG.	DRIVE VOLTAGES*
A	28 V DC
B	110 V DC
C	115 V AC 50-1500 cps

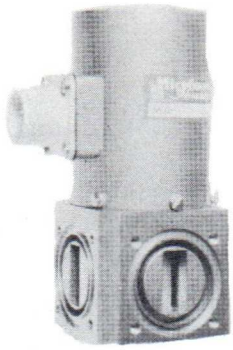
TABLE IV

CONNECTOR ORIENTATION DIAGRAMS (VIEW FROM TOP)

2 POS 180°	3 POS 120	4 POS 612	6 POS 60°
			
D	F	H	K

MICROWAVE ASSOCIATES LTD
CRADOCK ROAD, LUTON BEDS. TEL: LUTON 53363

DATA SHEET | NOV. 63



X-BAND WAVEGUIDE SWITCHES

MA-7509 REMOTE ACTUATION

DESCRIPTION

The remotely actuated waveguide switches of the MA-7509 series provide either single channel/two position or double channel transfer switching in the .400 by .900 inch waveguide size. These switches are of a 90 Degree port configuration with all bends occurring in the E plane. They are remotely operated by position-seeking rotary stepping solenoids which draw current only during switching (requiring no holding current). They are of excellent RF characteristics, presenting minimum V.S.W.R., insertion loss and crosstalk leakage in systems in which they are used. A choice of choke and cover-type flange faces is offered.

APPLICATION

The units are for original equipment, replacement and laboratory use where RF channel selection is required (3 port type), or where interchanging of channels or switching of components in and out of a channel is called for (4 port or "transfer" type). The remote control feature is both practical and highly reliable, eliminating the need for running waveguide to the control point. A choice of actuating voltages provides for use under a number of conditions. These units are designed for use under the requirements of Specification MIL-E-5400D and MIL-E-5272E.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

Frequency Range	8.2-12.4 Gc
RF Power Rating	200 Kw Peak (Max.) 500 Watts Average (Max.)
Insertion Loss (max.)	0.2 db
Voltage Standing Wave Ratio (max.)	1.10
Isolation (min.)	60 db

PHYSICAL CHARACTERISTICS

Operating Life	30,000 cycles minimum
Operating Temperature Range	-55 to +85°C
Switching Rate	20 cycles/minute max.
Switching Time	0.15 sec. max.
RF Connector	Flange (table 1)
Power Connector	See table 11
Weight	2 lb. approx.
Construction	Aluminium
Finish (Switch Body)	Irridite

MA-7509 MANUAL ACTUATION

DESCRIPTION

The Manual Waveguide Switches of the MA-7509 series provide either single channel/two position or double channel transfer switching in the .400 by .900 inch waveguide size. These switches are of 90 Degree port configuration with all bends occurring in the E plane. They are of excellent RF characteristics, presenting minimum V.S.W.R., insertion loss and crosstalk leakage in systems in which they are used. A choice of choke and cover-type flange faces is offered.

APPLICATION

The units are for original equipment, replacement and laboratory use where R.F. channel selection is required (3 Port type), or where interchanging of channels or switching of components in and out of a channel is called for (''Transfer'' or 4 Port type). These manual switches are designed for use under the requirements of Specifications MIL-E-5400D and MIL-E-5272E.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

Frequency Range	8.2-12.4 Gc
RF Power Rating	200 Kw Peak (Max.) 500 Watts Average (Max.)
Insertion Loss (max.)	0.2 db
Voltage Standing Wave Ratio (max.)	1.10
Isolation (min.)	60 db

PHYSICAL CHARACTERISTICS

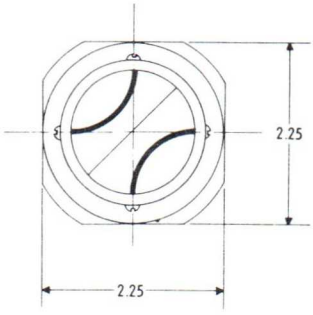
Operating Life	30,000 cycles minimum
Operating Temperature Range	-55 to -85°C
Switching Rate	N/A
Switching Time	N/A
RF Connector	Flange (table 1)
Power Connector	N/A
Weight	1 lb.
Construction	Aluminium
Finish (Switch Body)	Irridite

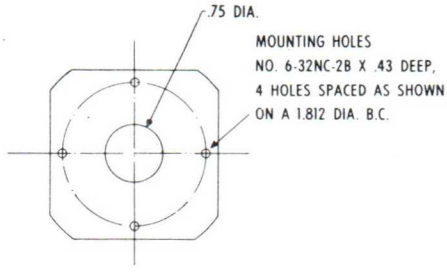
(Typical)

KEY FOR ORDERING BY MODEL NUMBER

MA-7509 — | T | Z | M | — |

- Number and Orientation of Ports, Table II
- Flange Face, Table I
- Manual Actuation "M"
- Special Features (Assigned By MA)





PANEL MOUNTING DATA

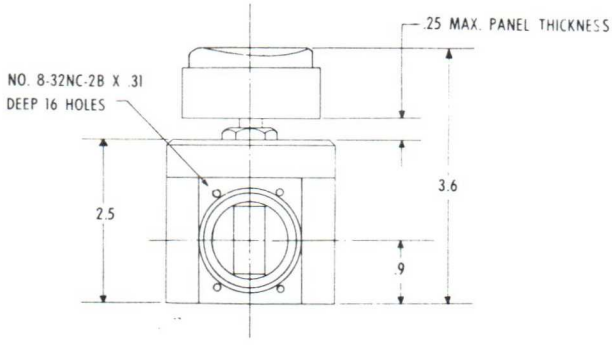


TABLE 1

RF Connector	DESCRIPTION	MATES WITH
Z	Choke flange	UG-39/U
Y	Cover flange	UG-40/U

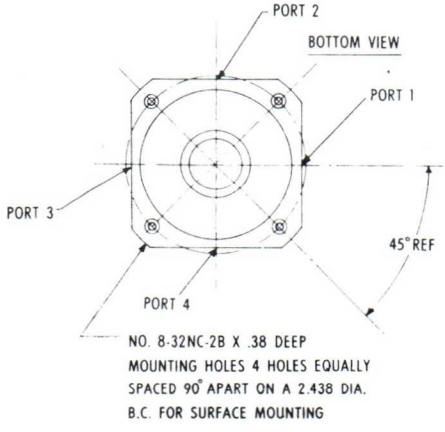
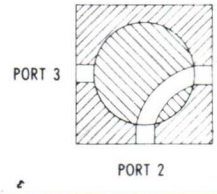
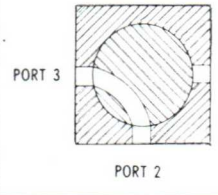
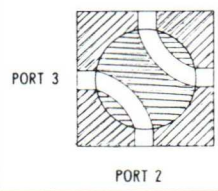
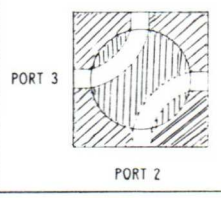


TABLE II

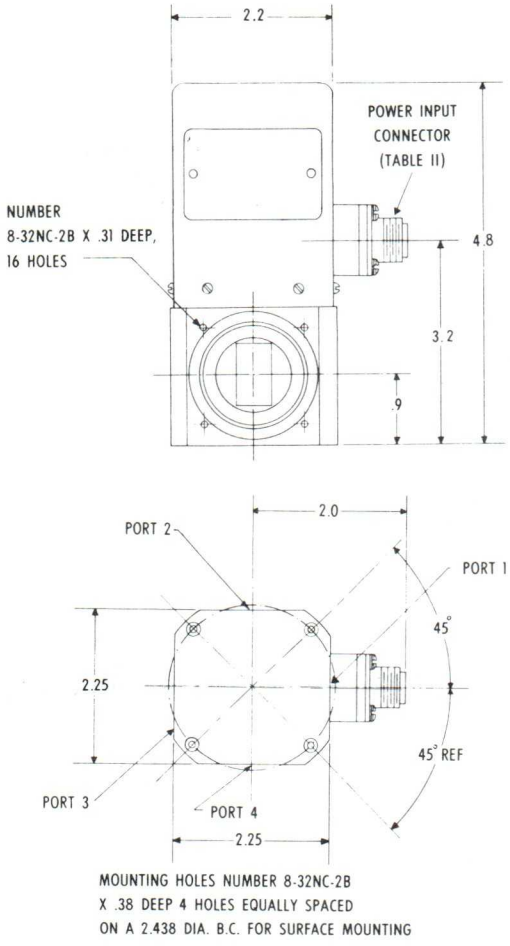
"B" 3 PORTS AT 90° (VIEWED FROM TOP)	
POSITION 1	POSITION 2
	
"T" TRANSFER 4 PORTS AT 90°	
POSITION 1	POSITION 2
	

KEY FOR ORDERING BY MODEL NUMBER

(Typical)

MA-7509 — B | Y | A | A

- Number and Orientation of Ports, Table IV
- Flange Face, Table I
- Actuation, Table III
- Indicator Circuit "A" or Other Special Feature (Assigned By MA)



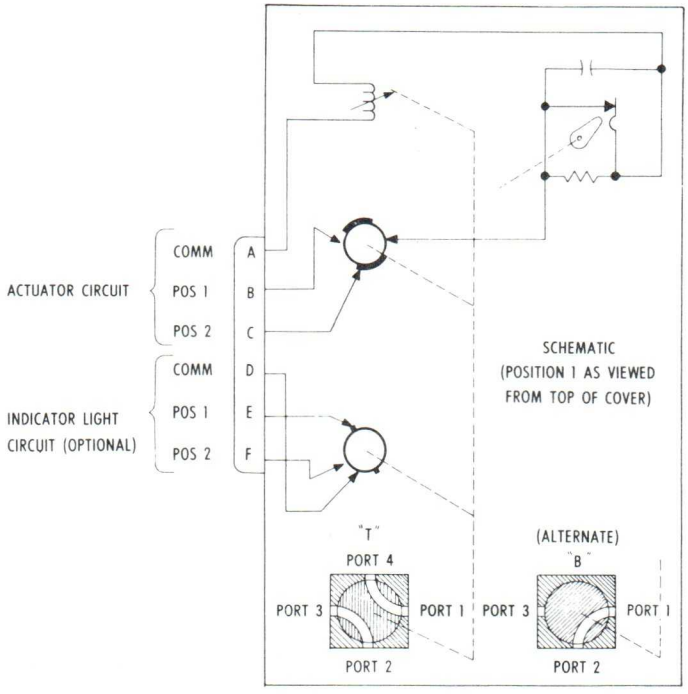


TABLE 1

RF Connector	DESCRIPTION	MATES WITH
Z	Choke flange	UG-39/U
Y	Cover flange	UG-40/U

TABLE 11

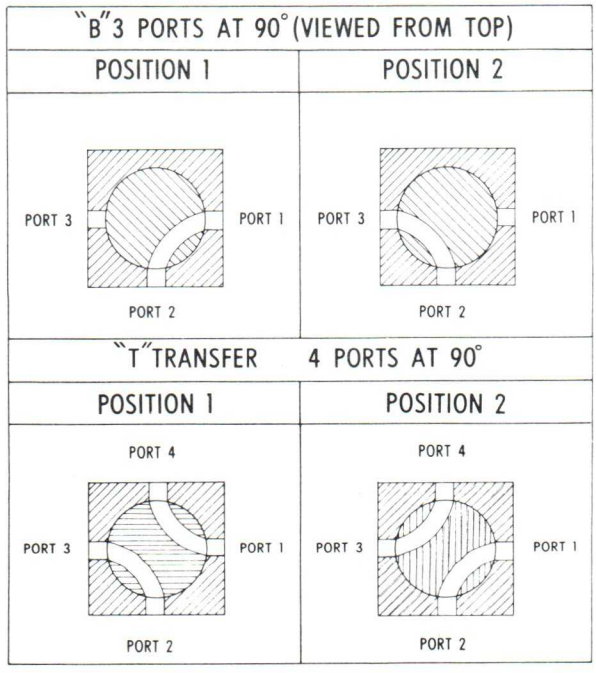
INDICATOR LIGHT CKT.	POWER CONNECTOR
Without (-)	MS3102C-14S-7P
With ("A")	MS3102C-14S-6P

TABLE 111

DESIG.	VOLTAGE*
A	28 VDC
B	110 VDC
C	115 VAC 50-1500 cps

*Typical actuator power consumed during switching only; 50 watts at 20°C.

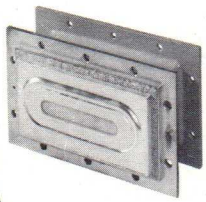
TABLE IV



SHORT FORM CATALOG

SF60

Mr. Mayes
For your file
HH



TR TUBES
DUPLEXERS
FERRITE DEVICES
MAGNETRONS
LIMITERS
SWITCHES
MODULATORS

DUPLEXER TUBES

TR AND ATR TUBES

FREQ.	TUBE TYPE	DESCR.	BANDWIDTH (Mc/Sec)	LIFE TEST CONDITIONS			REC. TIME MAX (μs)	INSERTION LOSS MAX (db)	COMMENTS
				Pk. Pwr. (kw)	Ave. Pwr. (W)	Hours (Min)			
UHF	MA-360	TR	200 — 600	2000	3600	1000	100	0.5	Cell type
L	MA-336/7166	TR	1220 — 1365	2000	2000	1000	20	0.5	Replaces 6635
	MA-339/6962	ATR	1285	2000	2000	2000	—	N/A	Half height waveguide
	MA-337	ATR	1300	2000	2000	2000	—	N/A	
	MA-337A	ATR	1300	2000	4000	2000	—	N/A	
S	MA-378	TR	2665 — 2965	750	600	500	15	0.5	Replaces 1B58 — Short Length
	MA-330A	TR	2665 — 2965	1250	5500	500	150	0.6	
	MA-333	ATR	2800	1000	1200	1000	50	N/A	Replaces 6024
	MA-357	ATR	2850	1200	1200	1000	60	N/A	Replaces 1B56
	MA-331A	ATR	2950	2000	2400	1000	60	N/A	Replaces 5792
	MA-331B	ATR	3050	2000	2400	1000	60	N/A	Replaces 5793
	MA-345A	ATR	2800	1250	5500	500	150	N/A	
	MA-320	ATR	2750	1000	1200	1000	60	N/A	Replaces 1B44
X	MA-343	TR	8750 — 9450	100	100	500	5	0.8	Operation to +85°C
	MA-342	TR	8490 — 9610	150	150	500	2.5	0.9	
	MA-344	TR	8490 — 9610	200	200	500	3	0.8	Operation to +85°C
	MA-351	TR	8490 — 9610	200	200	500	3	0.9	Replaces 1B63A — Operation to +85°C
	MA-352	TR	8490 — 9610	200	200	500	3	0.9	Short Version of MA-351
	6164	TR	8500 — 9600	200	200	500	10	1.0	Controlled Phase
	6163	ATR	9050	200	200	500	8	N/A	
	MA-381	ATR	9500	1.6	160	150	0.1	N/A	

SINGLE AND DUAL PRE-TR TUBES

UHF	MA-390 Dual	Pre-TR	510 — 690	4 Mw	20 KW	500	200	0.3	Top wall design
L	MA-346/6605	Pre-TR	1250 — 1350	2 Mw	2 KW	1000	20	0.4	
	MA-348A	Pre-TR	1250 — 1350	3 Mw	6 KW	1000	30	0.3	
	MA-355	Dual Pre-TR	1250 — 1350	2 Mw	2.4 KW	1000	25	0.3	
	MA-355A		1250 — 1350	6 Mw	12 KW	1000	100	0.3	
	MA-355B		1250 — 1350	6 Mw	6 KW	1000	30	0.3	
	MA-355C		1250 — 1350	25 Mw	50 KW	500	200	0.3	
	MA-394		1105 — 1495	6 Mw	13 KW	1000	50	0.4	Top wall design
S	MA-329	Dual Pre-TR	3400 — 3600	3 Mw	10 KW	500	200	0.8	Liquid Cooled
	MA-385		2650 — 2950	1 Mw	2 KW	500	30	0.4	
	MA-386		2700 — 3600	1 Mw	1 KW	500	15	0.3	Top wall design
C	MA-396	Dual Pre-TR	5250 — 5750	5 Mw	2.5 KW	500	50	0.6	Liquid Cooled
	MA-399		5400 — 5900	40 kw	40 W	500	12	0.8	
X	MA-341	Dual Pre-TR	8500 — 9600	200 kw	200 W	500	3	0.6	
	MA-373		8500 — 9600	200 kw	200 W	500	10	0.6	
Ku	MA-371	Dual Pre-TR	15500 — 17500	150 kw	150 W	500	10	0.5	Operation to +85°C

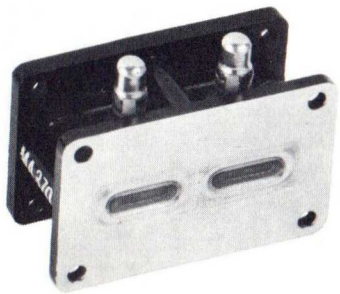
DUAL TR TUBES

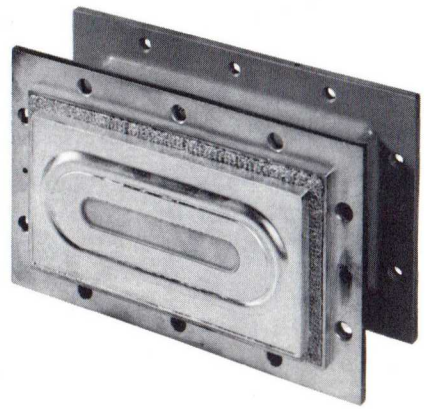
FREQ.	TUBE TYPE		BANDWIDTH (Mc/Sec)	LIFE TEST CONDITIONS Pk. Pwr. (kw)	Ave. Pwr. (W)	Hours (Min)	REC. TIME MAX (μs)	INSERTION LOSS MAX (db)	COMMENTS
S	MA-376/6636		2665 — 2965	750	600	500	15	0.5	
	MA-388		2400 — 2800	10	500	500	10	0.5	
	MA-398		2700 — 2900	1000	1000	500	15	0.5	Top wall design
	MA-391		2700 — 2900	500	500	500	15	0.5	
C	MA-377		5220 — 5340	625	625	500	12	0.6	
X	MA-338A		8490 — 9610	150	150	500	3	1.2	Replaces 6334 — Operation to +125°C
	MA-338/7381		8490 — 9610	200	200	500	3	1.2	Replaces 6334 — Operation to +85°C
	MA-358		8500 — 9600	300	300	500	3	1.2	Short length — Operation to +85°C
	MA-306B/7379		8490 — 9610	500	500	500	5	1.1	
	MA-324B		8600 — 9600	500	500	500	5	1.0	
	MA-332/7380		8600 — 9600	500	500	500	7	1.0	
	MA-332B		8600 — 9600	500	500	500	7	1.0	Operation to +85°C
Ku	MA-375/7563		15000 — 17000	90	135	500	5	1.0	

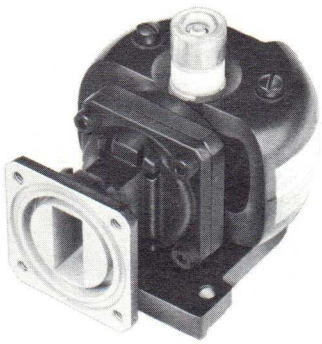
RECEIVER PROTECTOR TUBES

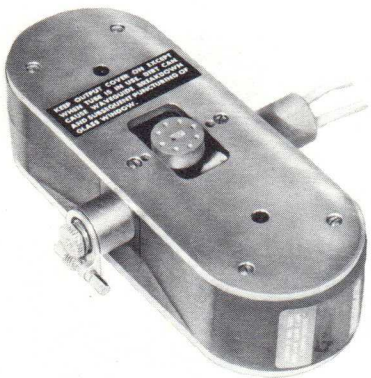
UHF	See our solid state limiters and coaxial switches available for UHF receiver protection.								
L	MA-356		1250 — 1350	100	100	1000	6	0.5	
	MA-395		1105 — 1495	10	10	1000	10	0.3	
S	MA-350		2700 — 2900	50	50	500	15	0.5	Replaces 1B58
	MA-354		2900 — 3100	50	50	500	15	0.5	Replaces 5853
	MA-364		3100 — 3500	50	50	500	15	0.5	Replaces 5927
	MA-369		3400 — 3700	50	50	500	15	0.5	Replaces 1B55
	MA-387		2700 — 3600	50	50	500	15	0.3	30% Bandwidth
C	MA-379		5395 — 5905	10	10	500	7	0.6	Operation to +85°C
	MA-397		5250 — 5750	10	10	500	7	0.6	Phase controlled
X	MA-347		9280 — 9320	0.100	1	500	3	0.8	Operation to +110°C
	MA-366		9400 — 9600	0.020	4	250	0.1	0.5	Operation to +85°C High PRR
	MA-349		8700 — 8900	0.200	10	500	1.2	0.9	
	MA-340B		8490 — 9610	10	10	500	2.0	0.7	Operation to +85°C
	MA-349B		8700 — 8900	0.125	6	500	0.5	0.9	Operation to +85°C
	MA-361		9275 — 9375	10	10	500	4	0.8	Operation to +85°C
Ku	MA-372		15500 — 17500	10	10	500	5.0	0.7	Operation to +85°C
	MA-362		16000 — 17000	5	5	500	5.0	0.7	Operation to +110°C
Ka	MA-365		34700 — 35000	8	10	500	3.0	0.8	Operation to +75°C
	MA-365A		34500 — 35200	8	10	500	3.0	0.8	Operation to +75°C
	MA-365B		32900 — 33500	6	3	500	3.0	0.8	Operation to +75°C

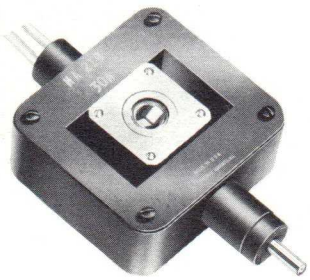
NOTE: All M/A receiver protectors guarantee crystal protection over wide temperature ranges and under extreme environmental conditions.











MAGNETRONS

X-BAND MAGNETRONS

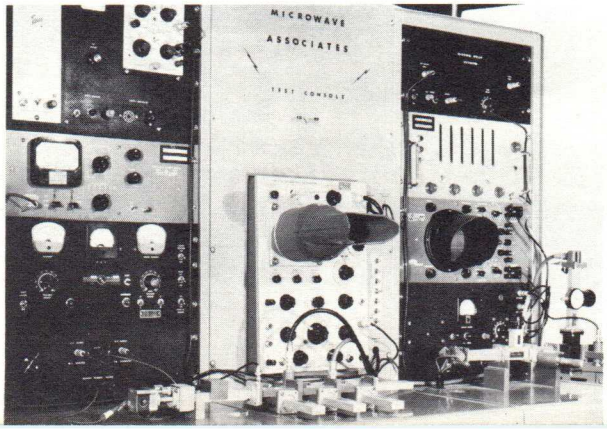
	Type	Tuning	Freq. Range (kMc)	Peak Power Output (Min.) po kw	w	Pulse Width (μs)	Duty Cycle Du	Peak dc Anode Voltage eb(kv)	Peak dc Anode Current ib(a)	Approx. Weight (Pounds)
CW	MA-221	Fixed-Frequency	7500-8800		1.0	CW	1.0	0.42	0.015	0.8
CW	MA-212	Fixed-Frequency	8800-10,000		1.0	CW	1.0	0.42	0.015	0.8
CW	MA-217	Mech. Tunable	7500-8500		1.0	CW	1.0	0.43	0.015	1.0
CW	MA-219	Mech. Tunable	8500-9600		1.0	CW	1.0	0.43	0.015	1.0
CW	MA-214	Mech. Tunable	9000-10,000		0.5	CW	1.0	0.43	0.015	1.0
PULSED	MA-221	Fixed-Frequency	7500-8800		10.0 10.0 20.0	0.20 5.00 0.25	0.1 0.1 0.0001	0.50 0.50 0.52	0.150 0.150 0.350	0.8
PULSED	MA-212	Fixed-Frequency	8800-10,000		10.0 10.0 15.0	0.20 5.00 0.25	0.1 0.1 0.0001	0.50 0.50 0.52	0.150 0.150 0.350	0.8
PULSED	MA-217	Mech. Tunable	7500-8500		10.0 10.0 20.0	0.20 5.00 0.25	0.1 0.1 0.0001	0.50 0.50 0.52	0.150 0.150 0.350	1.0
PULSED	MA-219	Mech. Tunable	8500-9600		10.0 10.0 20.0	0.20 5.00 0.25	0.1 0.1 0.0001	0.50 0.50 0.52	0.150 0.150 0.350	1.0
PULSED	MA-214	Mech. Tunable	9000-10,000		5.0 5.0 5.0	0.20 5.00 0.25	0.1 0.1 0.003	0.50 0.50 0.50	0.150 0.150 0.150	1.0
PULSED	MA-208	Mech. Tunable	7125-8500		20.0	0.3	0.02	0.80	0.200	2.0
PULSED	MA-205 7579	Fixed-Frequency	8775-8825		40.0 40.0	5.0 1.25	0.25 0.25	0.80 0.80	0.200 0.200	1.2
PULSED	MA-215	Fixed-Frequency	8800-9600		100.0	1.0	0.05	0.90	0.500	1.1
PULSED	6229	Mech. Tunable	8900-9400	(kilowatts) 0.4		0.25	0.0005	4.0	0.5	1.5
PULSED	6230	Mech. Tunable	8900-9400	0.9		1.0	0.003	4.3	0.8	1.5
PULSED	2J42	Fixed-Frequency	9345-9405	7.0		1.0	0.002	5.5	4.5	3.0
PULSED	MA-222	Fixed-Frequency	9345-9405	7.0		1.0	0.002	5.5	4.5	3.0
PULSED	2J42H	Fixed-Frequency	9345-9405	9.0		1.0	0.002	5.4	4.5	3.0
PULSED	6027(2J42A)	Fixed-Frequency	9345-9405	20.0		1.0	0.001	7.0	7.5	5.0
PULSED	MA-201	Fixed-Frequency	9345-9405	20.0		1.0	0.001	7.0	7.5	5.0
PULSED	MA-209	Mech. Tunable	9300-10,000	7.0 7.0		0.5 1.0	0.001 0.002	5.8 5.8	4.5 4.5	2.4
PULSED	MA-218	Mech. Tunable	9300-10,000	7.0 7.0		0.5 1.0	0.001 0.002	5.8 5.8	4.5 4.5	2.8

Ka-BAND MAGNETRONS

	MA-226	Fixed-Frequency	33.0-33.4	16.0	0.25	0.0005	12.0	10	10.5
	MA-225	Mech. Tunable	32.95-33.45	32.0	0.25	0.0004	12.0	20	10.5
	MA-224	Fixed-Frequency	33.0-33.4	32.0	0.25	0.00025	12.0	20	10.5
	MA-227	Fixed-Frequency	33.0-33.4	20.0	0.25	0.0008	12.0	10	10.5
	MA-206	Fixed-Frequency	34.7-35.0	16.0	0.25	0.0005	12.0	10	10.5
	MA-210A	Mech. Tunable	34.2-34.7	32.0	0.25	0.0004	12.0	20	10.5
	MA-210B	Mech. Tunable	34.6-35.1	32.0	0.25	0.0004	12.0	20	10.5
	MA-210C	Mech. Tunable	35.0-35.5	32.0	0.25	0.0004	12.0	20	10.5
	MA-200	Fixed-Frequency	34.7-35.0	32.0	0.25	0.00025	12.0	20	10.5
	5789	Fixed-Frequency	34.5-35.2	32.0	0.25	0.00025	12.5	20	12.0
	MA-207A	Fixed-Frequency	34.7-35.0	50.0	0.25	0.0004	12.0	20	10.5

C-BAND MAGNETRONS

	MA-220	Mech. Tunable	5.4-5.9	40.0	10.0	0.0003	10.0	12	



MODULATORS FOR MICROWAVE ASSOCIATES MAGNETRONS

In order to insure optimum operation of Microwave Associates magnetrons it is recommended that we also supply the modulator. We are prepared to design and fabricate modulators and pulse transformers consistent with your weight, size, and power limitations which will insure attainment of proper RF characteristics with our magnetrons. We can also supply complete test consoles specifically designed to facilitate accurate performance and operational testing of Microwave Associates magnetrons.

Your specific inquiries are requested.

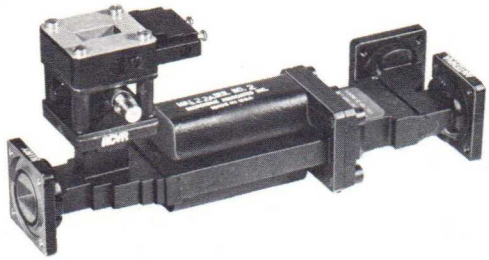
DUPLEXERS

	TYPE	FREQ	BANDWIDTH Mc/Sec	PEAK POWER	AVE. POWER	PULSE WIDTH	RECOVERY TIME	LOW LEVEL LOSS	HIGH LEVEL LOSS
G	MA-3212	UHF	Tunable 400-450 Mc	5 Mw	200 KW	1 μs	1 μs	0.5 db	0.1 db
G	MA-3213		400-450 Mc	25 Mw	75 KW	10 μs	200 μs	0.5 db	0.1 db
G	MA-3206	L	1250-1350	25 Mw	50 KW	6 μs	200 μs	0.5 db	0.1 db
G	MA-3204		1105-1495	6 Mw	13 KW	6 μs	50 μs	0.5 db	0.1 db
G	MA-3207	S	200 Mc in 2200 to 3600 Mc Range	3 Mw	30 KW	10 μs	150 μs	0.8 db	0.1 db
G	MA-3210		2700-3000	1 Mw	2 KW	10 μs	100 μs	0.8 db	0.2 db
F	MA-136T		2700-2900	3 Mw	6 KW	10 μs	25 μs	0.9 db	0.5 db
F	MA-132T	C	500 Mc in C Band	5 Mw	5 KW	6 μs	20 μs	0.8 db	0.3 db
G	MA-3205		500 Mc in C Band	5 Mw	2.5 KW	6 μs	100 μs	0.7 db	0.1 db
F	MA-124T	X	8500-9600	1000 kw	1000 W	1 μs	2 μs	1.2 db	0.3 db
F	MA-121T		8500-9600	500 kw	500 W	1 μs	2 μs	1.2 db	0.3 db
G	MA-3214		8500-9500	500 kw	500 W	1 μs	5 μs	1.0 db	0.2 db
F	MA-120T		8500-9600	250 kw	250 W	1 μs	2 μs	1.0 db	0.4 db
F	MA-122AT	Ku	15,500-17,500	150 kw	150 W	1 μs	2 μs	1.2 db	0.3 db
G	MA-3208		15,000-17,000	100 kw	100 W	1 μs	5 μs	1.2 db	0.3 db
F	MA-125T	Ka	34,700-35,300	50 kw	50 W	1 μs	3 μs	1.2 db	0.5 db

Note: Each of the above duplexers includes a receiver protector for guaranteed crystal protection. The low level loss column includes the insertion loss of the receiver protector.

G = Gas

F = Ferrite



SEMICONDUCTOR DEVICES

COAXIAL LIMITERS (Type N — Input and Output Connections)

TYPE NUMBER	FREQUENCY	BANDWIDTH (Mc/Sec)	PEAK POWER, (MAX.) (AT 0.002 DUTY CYCLE AND 6μs PULSE WIDTH)	LOW LEVEL LOSS (MAX.) (db)	HIGH LEVEL LOSS (MIN.) (db)
MA-3404	UHF	215-235	500 w	0.2	20
MA-3400	UHF	400-450	500 w	0.3	20
MA-3401	UHF	570-630	500 w	0.3	20
MA-3402	UHF	510-690	250 w	0.3	20
MA-3405	L	1275-1325	200 w	0.5	20

COAXIAL SWITCHES High Speed — Low Power (Type N — Input and Output Connections)

TYPE NUMBER	FREQUENCY	BANDWIDTH Mc/Sec	VOLTAGE RANGE (APPROX.)	LOW LEVEL LOSS (MAX.) (db)	HIGH LEVEL LOSS (MIN.) (db)
MA-3452	UHF	210-240		0.2	20
MA-3450	UHF	400-450		0.3	20
MA-3451	UHF	570-630	+ 1.5 to − 6V	0.3	20
MA-3453	L	1250-1350		0.5	20
MA-3454	S	2750-2850		0.5	20

FERRITE DEVICES

HIGH-POWER ISOLATORS

TYPE	BANDWIDTH Mc/Sec		MAX OPERATING POWER		AT OPERATING POWER AND OVER TEMP RANGE		INPUT VSWR Max.	TEMPERATURE OPERATION RANGE		PRESSURE MIN. PSIG	WAVEGUIDE SIZE	APPROX. WEIGHT lbs.
			Peak kw	Av. Watts	Insertion Loss-Max. db	Isolation Min. db		Min.	Max.			
MA-181	1250	1350	3 Mw	2.5 Kw	0.50	10	1.15	Liquid Cooling		20	RG-103/U	40
MA-183	2400	2800		800	0.5	10	1.15	−50°C	+100°C		RG-48/U	36
MA-153	2700	2900	1000	1000	0.4	10	1.15	−40°C	+ 65°C	10	RG-48/U	18
MA-172	2750	3250	1000	1000	0.6	8	1.15	−50°C	+100°C	10	RG-48/U	18
MA-188	2900	3300	1250	1250	0.5	8	1.15	−50°C	+100°C	10	RG-48/U	18
MA-189	2900	3500	1250	1250	0.5	7	1.15	−50°C	+100°C	10	RG-48/U	18
MA-154	2700	2900	5000	4000	0.4	10	1.10	Liquid Cooled		20	RG-48/U	50
MA-186	2900	3100	3000	15000	0.4	10	1.10	Liquid Cooled		20	RG 48/U	50
MA-166	5400	5900	300	300	0.4	10	1.10	−50°C	−100°C	–	RG-49/U	10
MA-167	5400	5900	1000	1000	0.4	10	1.10	−50°C	+100°C	10	RG-49/U	20
MA-177	500 Mc in C Band		5000	2500	0.5	16	1.05	Liquid Cooled		60	RG-49/U	55
MA 150	8500	9600	250	250	0.5	20	1.15	−55°C	+100°C	10	RG-52/U	2.5
MA-151	8500	9600	250	250	0.4	20	1.15	−55°C	+100°C	10	RG-51/U	3
MA-164	8500	9600	300	300	0.5	10	1.10	−55°C	+100°C	10	RG-51/U	2.5
MA-152	8500	9600	500	500	0.3	10	1.10	−55°C	+100°C	10	RG-51/U	3
MA-155	16000	17000	150	150	0.5	20	1.10	−55°C	+100°C	10	RG-91/U	2.5
MA-156	34700	35300	50	50	0.7	25	1.10	−40°C	+100°C	10	RG-96/U	3

NOTE: MA-177 Operates into 3.0 :1 VSWR.

LOW POWER ISOLATORS (Broadband)

MA-170	2600	3950	20	20	1.0	20	1.15	−55°C	+100°C		RG-48/U	10
MA-180	3950	5850	20	20	1.0	20	1.15	−55°C	+100°C		RG-49/U	6
MA-178	5850	8200	20	20	1.0	20	1.15	−55°C	+100°C		RG-50/U	5
MA-165	7050	10000	20	20	1.0	30	1.15	−55°C	+100°C		RG-51/U	4
MA-159	8200	12400	10	10	1.0	30	1.15	−55°C	+100°C		RG-52/U	4
MA-160	12400	18000	10	10	1.0	20	1.15	−55°C	+100°C		RG-91/U	6
MA-161	18000	26500	10	10	0.8	10	1.15	−55°C	+100°C		RG-53/U	6
MA-162	26500	34000	10	10	1.0	10	1.15	−55°C	+100°C		RG-96/U	2.5

LOW POWER ISOLATORS (Narrow Band)

MA-168	5100	5900	20	20	0.8	25	1.15	−55°C	+100°C		RG-49/U	4
MA-190	5400	5900	20	20	0.8	25	1.15	−55°C	+100°C		RG-50/U	3
MA-184	8000	9000	10	10	1.0	40	1.15	−55°C	+100°C		RG-52/U	2
MA-191	8500	9600	10	10	0.5	25	1.15	−55°C	+100°C		RG-52/U	1.3
MA-157	8500	9600	10	10	1.2	40	1.15	−55°C	+100°C		RG-52/U	2
MA-182	9200	10000	5	5	0.5	20	1.15	−55°C	+100°C		RG-52/U	0.5
MA-176	11000	12000	10	10	1.2	40	1.15	−55°C	+100°C		RG-52/U	2
MA-158	16000	17000	10	10	1.0	30	1.15	−55°C	+100°C		RG-91/U	1.5
MA-169	68000	72000	–	100 Mw	1.5	12	1.40	−55°C	+100°C		RG-98/U	3

NOTE: All isolators rated for o[illegible]tion into a 1.5:1 VSWR unless otherwise stated.

HIGH-POWER CIRCULATORS

TYPE	BANDWIDTH Mc/Sec	MAX OPERATING POWER		MINIMUM ISOLATION — db		INSERTION LOSS — MAX db	INPUT VSWR MAX	PRESSURE — PSIG		WAVEGUIDE SIZE	APPROX. WEIGHT lbs.	OTHER FEATURES
		Peak kw	Av. Watts	Transmitter-Receiver	Antenna-Transmitter			MIN	MAX			
MA-136	2700 2900	3.0 Mw	6000	25	20	0.6	1.15	30	45	RG-48/U	65	Liquid Cooled
MA-131	5400 5900	300	300	25	20	0.5	1.15	10	30	RG-49/U	12	
MA-132	500 Mc in C Band	5.0 Mw	5000	25	17	0.4	1.15	45	60	RG-95/U	175	Liquid Cooled
MA-123	7500 8500	CW	1800	25	20	0.3	1.15	—	30	RG-51/U	10	
MA-120	8500 9600	250	250	25	20	0.4	1.15	—	30	RG-67/U	1.3	Temp. Range −50°C to +85°C
MA-121	8500 9600	500	500	25	20	0.3	1.15	10	30	RG-51/U	4.5	Temp. Range −50°C to +85°C
MA-124	8500 9600	1000	1000	25	20	0.3	1.15	15	30	RG-51/U	4.5	Liquid Cooled Temp. Range −50°C to +85°C
MA-129	9200 10000	5	650	25	25	0.4	1.15	—	30	RG-67/U	—	Temp. Range −50°C to +85°C
MA-122	16000 17000	150	150	25	20	0.4	1.15	7	30	RG-91/U	1.3	Temp. Range −50°C to +125°C
MA-122A	15500 17500	150	150	25	20	0.4	1.15	7	30	RG-91/U	1.3	Temp. Range −50°C to +125°C
MA-125	34500 35900	50	50	25	20	0.5	1.20	10	30	RG-96/U	1.5	

LOW-POWER CIRCULATORS

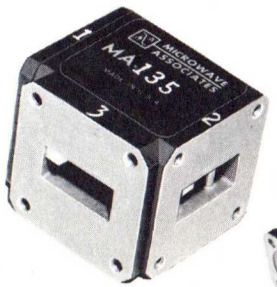
MA-128	2700 2900	10	10	25	20	0.25	1.15			RG-75/U	5	
MA-127	5400 5900	10	10	25	20	0.25	1.15			RG-49/U	10	
MA-126	8500 9600	10	10	25	20	0.25	1.15			RG-67/U	1.3	

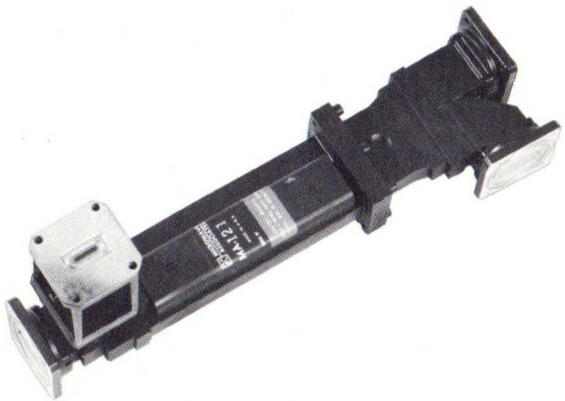
3 PORT CIRCULATORS

MA-137	5400 5900	50	100	20	20	0.5	1.20			RG-49 /U	0.5	−40°C to +100°C
MA-138	8500 9600	25	200	15	15	0.6	1.25			RG-52 /U	0.4	−40°C to +100°C
MA-135	200 Mc in X Band	1	200	20	20	0.3	1.2			RG-52 /U	0.4	−40°C to +100°C
MA-139	16000 17000	20	50	20	20	0.5	1.20			RG-91 /U	0.4	−40°C to +100°C

CIRCULATOR SWITCHES (Slow Speed S. P. D. T.)

TYPE	BANDWIDTH Mc/Sec	MAX OPERATING POWER		ISOLATION MIN (db)	INSERTION LOSS MAX (db)	INPUT VSWR MAX	SWITCHING TIME MIN (ms)	SWITCHING POWER WATTS	PRESSURE — PSIG		WAVEGUIDE SIZE	APPROX. WEIGHT lbs.	OTHER FEATURES
		Peak kw	Av. Watts						MIN	MAX			
MA-136E	2700 2900	3.0 Mw	6000	20	0.6	1.15	20	100	30	45	RG-48/U	125	Liquid Cooled
MA-132E	500 Mc in C Band	5.0 Mw	5000	17	0.4	1.15	20	150	45	60	RG-95/U	175	Liquid Cooled
MA-121E	8500 9600	500	500	20	0.3	1.15	10	20	10	30	RG 51/U	6	
MA-122E	1000 Mc in Ku Band	150	150	20	0.5	1.20	10	15	7	30	RG-91/U	4	
MA-125E	34500 35900	50	50	20	0.5	1.20	10	15	10	30	RG-96/U	4	





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