TRAVELING WAVE TUBES

LOW NOISE

LOW POWER

MEDIUM POWER

HIGH POWER

MINIATURE

AUGMENTORS

SPECIAL PURPOSE

PACKAGED AMPLIFIERS

SOLID STATE DELAY DEVICES

MICROWAVE ELECTRONICS

A TELEDYNE COMPANY

M E C

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This listing is only a representative sampling of the MEC product line. Please contact the factory for complete product information.

INTRODUCTION: FAMILY CHARACTERISTICS

Since its founding in early 1959, MEC has provided an ever-growing family of TWTs for industry, defense, and space applications. MEC TWTs meet r.f. requirements across the frequency spectrum from UHF through Ka band, and from low noise, low power through the 200 watt cw, and 1 Kw pulsed power levels. MEC TWTs are highly reliable. Performance data has established failure rates as low as 51 per 1,000,000 hours at a confidence level of 90%. The following characteristics are common to the tubes in this family: ☐ PPM focusing with Alnico or ferrite magnets—to permit satisfactory tube operation over the temperature range of −55°C to +110°C without loss of performance and with complete magnetic shielding. ☐ Rugged metal-ceramic construction, allowing evacuation at elevated temperatures—to provide a cleaner environment for longer cathode life and more stable performance. ☐ Stacked gun construction with all elements completely supported around their periphery—to greatly reduce the effects of vibration and shock. ☐ Integral or separate power supplies—to enhance the electrical and electronic performance, increase the reliability, and minimize the possibility of interface problems between the tube and its companion equipment. ☐ Stringent military environmental requirements of MIL-E-5400, Class II (airborne) are fully met or exceeded.
or exceeded.

LOW NOISE TWTs

MEC low noise TWTs comprise the industry's widest frequency range of PPM-focused low noise traveling-wave tubes. Most of these tubes have small signal gain levels in excess of 30 db with a saturated power output greater than 10 dbm. Power consumption of 4 watts, including filaments, is typical. Weights range from 2 to 7 lbs. All tubes are magnetically shielded.

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. SPo (dbm)
M2102G	L	1.0- 2.6	13	25	7
M2102F2	L	1.0- 2.0	11	25	7
M5517	S	2.0- 4.0	10	35	10
M5549	S/C	2.6- 5.2	10	35	10
M5515	S/C	2.6- 5.2	13	48	10
M5518	C	4.0- 8.0	10	35	10
M5526	C/X	7.0-11.0	10	35	10
M5519	X	8.0-12.4	10	35	10
M2114 I	Ku	11.8-18.2	17	30	7
M5364	Ku	12.0-18.0	12.5	30	10
M5318	Ku	12.0-18.2	14	25	3
M5365	K	18.0-26.0	14	30	10
M5366	Ka	26.0-40.0	18	25	3

MICROWAVE PACKAGED AMPLIFIERS

MEC microwave packaged amplifiers are smaller and lighter than any other TWTA on the market. Because of MEC's efforts into "second generation" packaged amplifiers, these highly reliable models are completely integral and adjustment free.

The MEC packaged amplifier weighs less than 4 pounds. Meeting or surpassing all MIL-E-5400 (airborne) requirements, it will operate on either 115 volts, 48 to 420 cycles ac, or 150 volt dc at efficiencies greater than 70%.

11⅜ inches in length
by 2⅜ inches square.

Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. SPo (dbm)	Max. Wt. (lbs.)
M9071	S	2.0- 4.0	10	35	10	4
M9089	S/C	2.6- 5.2	10	35	10	4
M9074	S/C	2.6- 5.2	13	48	10	4
M9072	C	4.0- 8.0	10	35	10	4
M9080	C/X	7.0-11.0	10	35	10	4
M9073	X	8.0-12.4	10	35	10	4

MINIATURE TWTs

MEC miniature TWTs equal or surpass the performance of their conventional predecessors; yet, they come in packages that are radically small and light. For example: matched gain models are only 6 inches in length and weigh only 12 oz.

Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. SPo (dbm)	R.F. Connector (type)
M5517	S	2.0- 4.0	10	35	10	OSM
M5383	S	2.0- 4.0	25	10	10	OSM
M5549	S/C	2.6- 5.2	10	35	10	OSM
M5515	S/C	2.6- 5.2	13	48	10	OSM
M5518	C	4.0- 8.0	10	35	10	OSM
M5384	C	4.0- 8.0	27	10	10	OSM
M5526	C/X	7.0-11.0	10	35	10	OSM
M5519	X	8.0-12.4	10	35	10	OSM
M5364	Ku	12.0-18.0	12.5	30	10	W/G
M5365	K	18.0-26.0	14	30	10	W/G
M5366	Ka	26.0-40.0	18	25	3	W/G

LOW POWER TWTs

MEC low power TWTs are designed to provide saturated power output levels between 10 and 15 dbm over octave bandwidths. For special narrowband applications, they can be specified to 25 dbm power output levels. Noise figures of 15 to 20 db and a total power consumption of 5 to 10 watts are characteristic of TWTs in this category.

Tube Type	Band	Freq. Range (GHz)	Min. SPo (dbm)	Min. SSG (db)	Max. NF (db)
M5351	P	0.5- 1.0	10	30	20
M5352	L	1.0- 2.0	10	30	15
M5367	L	1.0- 2.0	13	30	20
M5387	L	1.0- 2.0	10	30	20
M5341	S	2.0- 4.0	10	30	20
M5353	S	2.0- 4.0	10	30	15
M5368	S	2.0- 4.0	13	30	20
M5362	S/C	2.3- 4.45	10	30	15
M5371	S/C	2.3- 4.45	13	30	20
M5389	C	4.0- 8.0	10	30	20
M5354	C	4.0- 8.0	10	30	15
M5369	C	4.0- 8.0	13	30	20
M5390	C/X	7.0-11.0	10	30	20
M5355	C/X	7.0-11.0	10	30	15
M5370	C/X	7.0-11.0	13	30	20
M5391	C/X	7.0-12.4	10	30	20

MEDIUM POWER TWTs

MEC medium power TWTs provide saturated power output levels from 1 to 5 watts; and, variations of the same basic tube sustain the power output levels in excess of 10 watts over specified narrow bandwidths. Typical noise figures and power consumption values are 25 to 35 db and 10 to 50 watts, respectively. MEC is the primary supplier of medium power TWTs to many manufacturers of microwave amplifiers for laboratory, industrial, or military use.

Tube Type	Band	Freq. Range (GHz)	Min. SPo (watts)	Min. SSG (db)	Max. NF (db)
M4268	L	1.0- 2.0	1	30	30
M5375	L	1.0- 2.0	2	30	30
M4260	S	2.0- 4.0	1	30	30
M5376	S	2.0- 4.0	2	30	30
M4278	C	4.0- 8.0	1	30	30
M5377	C	4.0- 8.0	2	30	30
M4273	C/X	7.0-12.4	1	30	30
M5046	Ku	12.0-18.0	3	30	35

HIGH POWER TWTs

MEC high power TWTs are fully environmentalized and can operate up to 70,000 feet. These 20, 100, and 200 watt (cw) tubes deliver rated performance at efficiencies exceeding 20%. Completely militarized for ECM, telemetry, and communications systems, MEC High Power TWTs provide the widest choice across the microwave spectrum. Air, liquid, or heat sink cooled versions are available.

Type	Band	Freq. Range (GHz)	Peak Power Output	Max. Duty	Gain at Rated Power	Grid	Focusing	Cooling	Remarks
M4383A	P	0.5-1.0	1kw	1%	30	Yes	PPM	Air 10 cfm at sea level	Operates to MIL-E-5400 Class II with standard vane-axial fan
M4446	L	1-2	100w	CW	30	No	PPM	Air 60 cfm at sea level	
M5311	L	1-2	100w	CW	30	No	PPM	Keep heat sink below 100° C	
M4447	S	2-4	100w	CW	30	No	PPM	Air 60 cfm at sea level	
M5312	S	2-4	100w	CW	30	No	PPM	Keep heat sink below 100° C	Meets full MIL-E-5400 Class II environment
M5605	S	2-4	200w	CW	30	No	PPM	Air 60 cfm at sea level	
M5581	S-C	2.6-5.2	20w	CW	30	No	PPM	Keep heat sink below 100° C	Meets MIL-E-5400 Cl.II
M5508	S-C	2.6-5.2	100w	CW	30	No	PPM	Keep heat sink below 100° C	Meets MIL-E-5400 Cl.II
M5348	C	4-8	100w	CW	30	No	PPM	Air 60 cfm at sea level	
M5313	C	4-8	100w	CW	30	No	PPM	Keep heat sink below 100° C	Meets MIL-E-5400 Cl.II
M5392	C	4-8	200w	CW	30	No	PPM	Air 60 cfm at sea level	
M5462	C	4-8	200w	CW	30	No	PPM	Keep heat sink below 100° C	Meets MIL-E-5400 Cl.II
M5586	C	5.925-6.425	7kw	CW	37	—	Solenoid	Water and Air	Modulation Anode
M5600	C	5.925-6.425	8kw	CW	40	—	Solenoid	Water and Air	Modulation Anode
M5350	C-X	5-11	20w	CW	30	No	PPM	Heat Sink	Meets MIL-E-5400 Cl.II
M5333	X	10.5-12.5	35w	CW	40	No	PPM	Heat Sink	Meets MIL-E-5400 Cl. II
M4369	X	7-11	100w	CW	30	No	PPM	Air 60 cfm at sea level	
M5314	X	7-11	100w	CW	30	No	PPM	Keep heat sink below 100° C	Meets MIL-E-5400 Cl.II
M4444	X	7.7-8.4	12.5 kw	CW	33	No	Solenoid	Water 10 gpm at 100 psi	

SPECIAL PURPOSE TWTs

MEC special purpose TWTs include wideband amplifiers, controlled-gain and phase TWTs, limiters, serrodyne tubes, and freq-memory TWTs and packages. Each has been designed to perform specialized functions not expected in a conventional TWT.

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. SPo (dbm)	Application
M4429	S-Ku	2.0-16.0	37	12	17	Wideband Amplifier
M5383	S	2.0- 4.0	25	10	10	Miniature Matched Gain
M5384	C	4.0- 8.0	27	10	10	Miniature Matched Gain
M5140	S	2.0- 4.0	15	30	0	Matched Gain and Phase
M5216	C/X	7.5-10.5	15	27	−28	Limiter Input
M5217	C/X	7.5-10.5	30	35	9	Limiter Driver
M5122	S	2.0- 3.0	15	20		Serrodyne
M5236	C/X	7.0-10.0	30	20	10	Serrodyne
M5127	X	8.9- 9.2		25	10	Serrodyne
M5144	X	8.0-12.0	10	30	10	Phase Shifter
M5349	C/X	5.0-11.0	35	30	40	Augmentor
M5350	C/X	5.0-11.0	35	30	43	Augmentor
M5123	C/X	5.4-11.0	35	60	30	Augmentor
M4347-DA	X/Ku	8.0-14.0	40	55	30	Augmentor

HIPOLON® TWTs

MEC HIPOLON® TWTs reach new levels in microwave amplifier performance. The outstanding feature delivered by the HIgh POwer LOw Noise tube is dynamic range—a sensitive threshold to signals, coupled with the capability of linear amplification to high average output levels. All HIPOLON® TWTs have small signal gain levels exceeding 35 db and a saturated power output of more than 27 dbm, combined with a max.noise figure as low as 12 db.

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. SPo (dbm)
M5608	S	2.0- 4.0	12	35	28
M5610	S/C	2.6- 5.2	14	35	27
M5328	C/X	7.0-11.0	27	43	33

MICROWAVE MEMORY TWTs

MEC is the leading supplier of microwave frequency memory tubes for circuits employing recirculating feedback loops. Special tube types have been developed to be compatible with both coaxial and waveguide feedback circuits. Feedback circuits may be specified and supplied by the customer, or MEC can supply the tube and circuit as a mated unit. For applications with stringent requirements, it may be necessary to match each tube and feedback circuit in order to eliminate interface problems. MEC also supplies solid state power supplies and pulse generators for tube or microwave switch gating. All components can be supplied individually or mounted into an integral unit. Please contact MEC to discuss each requirement.

Typical memory TWT characteristics are:

Band	Freq. Range[1] (GHz)	Memory Time[2] (μsec)	Power Out[3] (mw)	SSG[4] (db)	NF (db)
S	2- 4	4-10	20	35	30
C	4- 8	4-10	20	35	30
C/X	7-11	20-40	5	35	30
X	8-12	20-40	5	35	30

1. Tubes can also be developed to cover any 4 GHz range from X through Ka-band. 2. Storage times in S & C Bands are for coaxial circuits—waveguide in C/X and X Bands 3. Tubes have been developed for power levels up to 1 watt. 4. Gain level is dictated by the loss of feedback circuit; total circuit loss should not exceed 20 to 25 db.

SOLID STATE DELAY DEVICES

MEC solid state delay devices are available for UHF, L, S, C, and X bands. Typical delay times range from 2 μsec. to 20 μsec. Sizes vary from ¾ x ¾ x 1 in. to ¾ x 2 x 3 in. with weights ranging from 2 to 7 ounces.

Frequency Band	Typical Delay (min.-max.)	Typical Bandwidth/Loss Narrowband	Broadband	Typical Size Dia. x Length	Typical Weight
UHF	20 μsec (½—40)	10%/35 db	Octave/60 db	¾ x 2 x 3 in.	7 oz.
L	10 μsec (½—20)	10%/45 db	50%/65 db	¾ x 1½ x 2½ in.	5 oz.
S	5 μsec (½—10)	10%/50 db	40%/70 db	¾ x 1¾ x 2 in.	3 oz.
C	3 μsec (½—6)	6%/60 db	30%/80 db	¾ x ¾ x 1 in.	2 oz.
X	2 μsec (½—4)	3%/95 db	20%/95 db	¾ x ¾ x 1 in.	2 oz.

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MEC CAPABILITY

By employing production methods and tooling techniques at the beginning of a development program, MEC can quickly shift to full scale production when volume specifications are finally established. In the development phase, this means a sufficient number of units can be produced for use in the evaluation of baseline performance and/or specifications relative to user requirements. ☐ Since tooling and jigging are already available, MEC customers benefit during the production phase because:

- The lead time between concept and finished product is minimized—permitting faster delivery.
- The investments in time and tooling costs are considerably reduced because a design proceeds through the development, preproduction, product refinement, and volume production phases using the basic jigs and fixtures. ☐ Concurrent tooling and jigging provide a uniformly reproducible product with built-in reliability. This product reliability is enhanced through repeated checks in MEC's extensive quality control and testing facilities operated in accordance with MIL-Q-9858A. ☐ By successfully applying this approach, MEC has developed a family of traveling wave tubes comprising more than 20 basic types in over 200 varieties and configurations. The flexibility of the approach permits quick reaction time in cases where special parameters—such as controlled gain and phase, limiter characteristics, and dynamic range—must be satisfied to meet customer requirements. ☐ Because the same successful methods of TWT manufacture are applied to solid-state power supplies and delay devices, as well as microwave packaged amplifiers, MEC provides its customers with quick and reliable service for a complete product line of traveling wave tubes and associated electronic devices. ☐ We welcome your inquiry and would be pleased to satisfy your requirements—whether major production programs, QRC programs, or state-of-the-art efforts. ☐ Our representatives, listed on the following page, are ready to discuss your requirements.

SUPER COMPONENTS

To minimize the TWT/system interface problem, MEC developed a series of traveling wave tube and auxiliary component combinations, some of which are mated with companion solid state power supplies. These combinations of devices—or **"Super Components"**—reflect MEC's understanding of the systems application of microwave tubes and solid state delay devices. ☐ Recirculating loop-memory systems, TWT and solid state limiter, TWT and solid state equalizer, and multiple stage high gain chains of TWTs are only a few of the possible combinations. ☐ **Super Components** satisfy the rf requirements for electron devices in microwave systems and facilitate obtaining optimum performance from them. For example, a microwave packaged amplifier and solid state equalizer combination requires only the application of primary power and connection of rf cabling to function as a distinct stage in a system. ☐ In addition, the size and weight of the integrated package are usually much less than the separate components designed to be mutually compatible. ☐ Our applications staff will be pleased to discuss your individual requirements for military, commercial, or industrial applications.

MEC REPRESENTATIVES

MEC sales engineering offices are located in most major cities both domestically and internationally. For information on the location of the branch nearest you, contact MEC directly, or any of the principal offices listed below.

NAME	STATE
AERTRONICS ASSOCIATES 5899 Huberville Avenue Dayton, Ohio 45431 (513) 253-8144	Michigan, Ohio, Kentucky, Western Pennsylvania
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ELECTRONIC MARKETING ASSOC. 11501 Huff Court Kensington, Maryland (301) 946-0300 TWX: (710) 825-9645	West Virginia, Virginia, Maryland, Delaware, Washington, D.C.
GAWLER-KNOOP COMPANY 14 Beaufort Avenue Roseland, New Jersey 07068 (201) 226-4545	Northern New Jersey, Long Island, New York City
GEORGE GREGORY ASSOCIATES 7 Erie Drive Natick, Massachusetts (617) 235-9070	Massachusetts, Connecticut
HARRY LEVINSON COMPANY 1211 East Denny Way Seattle, Washington (206) 323-5100 TWX: (910) 444-2154	Washington, Oregon
MEDCO ASSOCIATES, INC. 115 Fifth Avenue Indialantic, Florida 32901 (305) 723-6924 TWX: (510) 959-6050	North Carolina, South Carolina, Tennessee, Georgia, Florida, Alabama, Mississippi, Louisiana
NACO ELECTRONIC CORPORATION 119 Luther Avenue Liverpool, New York 13088 (315) 474-7481 TWX: (710) 541-0439	New York State
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JAY STONE & ASSOCIATES 140 Main Street Los Altos, California (415) 948-4563 TWX: (910) 370-7953	Northern California
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THE THORSON COMPANY 7700 Carpenter Freeway Dallas, Texas 75247 (214) 631-5440 TWX: (910) 861-4423	Texas, Oklahoma, Arkansas

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NORDISK ELEKTRONIK AB Stureplan 3 Stockholm 7 Sweden Telephone: 08/24 83 40 Cable: NORDTRON	Denmark, Finland, Norway, Sweden
RIKEI TRADING COMPANY LTD. No. 18-14 Nishi-Shimbashi, 1-Chome, Minato-ku, Tokyo Japan Telephone: (591) 5246 Cable: RIKEIGOOD	Japan
SAMPLE ELECTRONICS (N.Z.) LTD. 8 Matipo Street P.O. Box 13258 Auckland 6 New Zealand Telephone: 667-356 Cable: ELPMAS	New Zealand
TECHNIQUE ET PRODUITS 63 bis, Rue D'Aguesseau Boulogne-sur-Seine France Telephone: 408-14-00 Cable: PRODUTEC	France
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Your local representative is:

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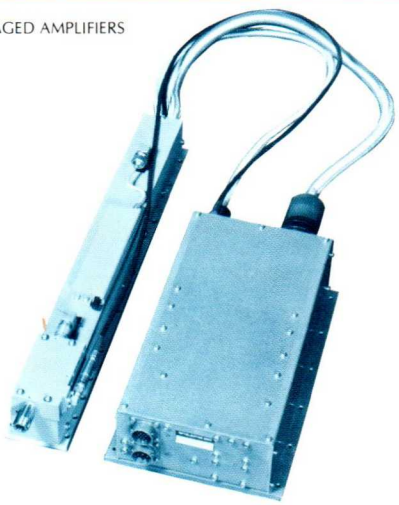
HIGH POWER
TRAVELING WAVE TUBES

MEDIUM POWER
CONDUCTION TWT's

AIR COOLED
100/200 WATT CW
TWT's

1 TO 2 KILOWATT
PULSE TWT's

PACKAGED AMPLIFIERS



TELEDYNE MEC

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TEL #415 493-1770 • TWX (910) 373-1746

Putting tubes and power supplies together is our business. MEC builds a complete line of **High Power Amplifier (HPA's)** providing pulse or CW power over wide frequency ranges. A HPA will vary in its complexity according to the requirements, but will consist basically, of a high power traveling wave tube (pulse or CW), its power supply (and modulator if required) and such other protective circuitry as is required. Protection against excess temperature, excess helix current, arcing and input line surges is standard and is incorporated in all HPA's. Reflected power protection, filtering and power monitoring are some of the many options that can be included to meet your individual needs.

Our HPA's are designed to operate in MIL-E-5400 and MIL-E-16400 environments and can be supplied with air, conduction or liquid cooling.

By purchasing a complete HPA from MEC, you get:

- Improved over-all system performance. A total amplifier designed by one manufacturer leads to optimum performance.
- Design, manufacture and testing carried out by microwave specialists.
- Lower cost. Specifying separate components is time consuming and expensive. Our ability to make the best technical selection between components leads to better over-all engineering design and results in savings of time and cost.
- Better delivery. Since we build our own tubes and power supplies, we maintain close liaison and control between component departments. If a problem develops this leads to quicker solution and avoids last-minute delays.
- Smaller size. Having complete responsibility for the HPA and components permits better mechanical design and high density packaging. The result is smaller and lighter HPA's.
- Assurance that final terminal-to-terminal performance will be met. Letting microwave tube and power supply specialist build a complete HPA to your specification provides this assurance.

Some of the features that can be included in our HPA's to meet special needs are:

- Filtering—to reduce harmonic or noise power output.
- Driver amplifiers.
- Oscillators or exciters.
- Remote control console.
- Automatic fault clearance and reset.
- Gain equalization.
- Reflected power protection.

Worried about field maintainability?

MEC's power supplies incorporate an automatic voltage reset feature which enables tubes to be replaced easily and quickly in the field without the need for highly trained personnel or expensive high-impedance voltage measuring equipment.

The auto reset feature also means broader frequency coverage in one HPA. Coverage over two or more octaves is possible by a simple substitution of traveling wave tubes.

MEC has years of experience in solving interface problems and in "making things work" in military systems. This experience, coupled with our continuing engineering and production efforts to improve component and system reliability and to simplify field maintenance, means that we are able to anticipate and avoid many costly system problems.

COMMUNICATIONS TWT's

In 1970, MEC high power communication TWT's were put in operation in Satellite Earth Terminals. Now, more than 25,000 operating hours later, MEC TWT's are still providing world-wide communications.

The advanced design of these communication tubes is the result of years of TWT experience. MEC introduced the first high power, PPM focused TWT in 1963—years ahead of other manufacturers, and has sold thousands of these devices since then. MEC has more high power TWT's operating in more different systems than any other TWT manufacturer in the world.

MEC has developed a highly efficient, low-pressure-drop air cooling system that results in reduced air flow and lower blower noise. MEC's communication tubes incorporate proprietary equalizer designs to reduce small-signal gain variation and improve phase linearity characteristics.

MEC has the broadest range of communication TWT's available. We can provide tubes to suit your needs from 1 through 18 GHz at most power levels.

Frequency (GHz)	Power Level (Watts)	Focusing Method	Part Number
5.9-6.4	300	PPM	**M5392E**
5.9-6.4	400	PPM	**M5897**
5.9-6.4	600	PPM	**M6001**
5.9-6.4	1500	Solenoid	**M5819A**
5.9-6.4	8000	Solenoid	**M5600**
7.9-8.4	400	PPM	**M6010**
7.9-8.4	12000	Solenoid	**M4444**
14-14.5	150	PPM	**M5837D**
14-14.5	300	PPM	**M5856B**

PULSE HIGH POWER TWT's

Teledyne MEC has many years of experience in the design and manufacture of high power pulse traveling-wave tubes. (MEC holds the patent on the first "shadow grid" TWT, developed in 1963.) Our pulse traveling-wave tubes provide peak power of one kilowatt or more over octave bandwidths in compact, ruggedized, PPM-focused format designed for military airborne use.

In order to provide the highest possible duty cycles, MEC's pulsed traveling wave tubes employ the same thermal design and manufacturing techniques as those in our high power CW tubes. The use of dispenser cathodes and high temperature bakeout insures long life and reliability.

Frequency (GHz)	Peak Power (P_o Watts)	Duty Cycle	Gain at P_o (dB)	Noise Figure (dB)	RF Connectors	Part Number
0.5-1	1000	.01	30	40	Type N	**M5383A**
0.75-1.1	1000	.01	36	40	Type N	**M5383C**
2.6-3.8	10,000	.01	40	40	SMA Input, SC Output	**M5730**
2.6-5.2	1000	.02	55	40	SMA Input, TNC Output	**M5845**
7-11	1000	.02	35	40	SMA Input, TNC Output	**M5813**
7-11	1000	.02	60	40	SMA Input, TNC Output	**M5813A**
7-11	1000	.01	60	40	SMA Input, TNC Output	**M5813D**
7-11	1000	.03	60	40	SMA Input, TNC Output	**M5813G**
7-11	1000	.04	60	40	SMA Input, TNC Output	**M5813F**
7-11	2000	.02	40	40	SMA Input, TNC Output	**M5813U**
7-12	1000	.02	56	40	SMA Input, TNC Output	**M5827**

MULTI-HUNDRED-WATT LEVEL

Teledyne MEC was the first to develop a complete family of 100-watt and 200-watt CW, PPM-focused, traveling-wave tubes. Continuing development has maintained this position of leadership, both in technological advances and in manufacturing capability. MEC has a record of manufacturing experience and field-proven reliability which cannot be equaled.

Large numbers of our tubes are now operating in commercial and military systems, and have demonstrated long life under rigorous environmental conditions. The use of dispenser cathodes and high temperature bakeout processing insures longer life and greater reliability. All tubes may be operated with collector depressed. Protection against overheating is provided by an internal thermal relay which can be connected to a power supply trip-out circuit.

Frequency (GHz)	Power, P_O (Watts)	Gain at P_O (dB)	Noise Figure (dB)	RF Connectors	Part Number
100/400-WATT, CONDUCTION COOLED					
1-2	100	30	35	TNC	**M5311K**
2-4	100	30	35	TNC	**M5312K**
4-8	100	30	35	TNC	**M5313K**
7-11	100	30	35	TNC	**M5314K**
8-12.4	100	30	35	TNC	**M5808K**
8.5-17	100	35	35	SMA Input, UG 1581/U	**M5844**
1-2	200	30	35	TNC	**M5670K**
2-4	200	40	35	TNC	**M5888K**
2.6-5.2	200	30	35	TNC	**M5849K**
2.6-5.2	200	45	35	SMA Input, SC Output	**M5877**
4-8	200	40	35	TNC	**M5889K**
4.8-9.6	200	40	35	SMA Input, UG 1577/U Output	**M5878K**
4.8-9.6	400	40	35	SMA Input, UG 1577/U Output	**M5897**
7-11	200	40	35	SMA Input, UG 1493/U Output	**M5872**
8-12.4	200	40	35	SMA Input, UG 39/U Output	**M5807**
9-16	200	35	35	SMA Input, UG 1580/U Output	**M5856**
100/200-WATT, AIR COOLED					
1-2	100	30	35	TNC	**M5477K**
2-4	100	30	35	TNC	**M5478K**
4-8	100	30	35	TNC	**M5479K**
7-11	100	30	35	TNC	**M5480K**
8-12.4	100	30	35	TNC	**M5613K**
8-12.4	100	30	35	SMA Input, UG 39/U Output	**M5613G**
12-18	100	30	35	SMA Input, UG 419/U Output	**M5722K**
1-2	200	30	35	TNC	**M5673K**
2-4	200	30	35	TNC	**M5605K**
2.6-5.2	200	30	35	TNC	**M5849K**
4-8	200	30	35	TNC	**M5392K**
7-11	200	30	35	SMA Input, UG 1493/U Output	**M5805K**
8-12.4	200	30	35	SMA Input, UG 39/U Output	**M5806K**
100- TO 500-WATT, LIQUID COOLED					
2-4	350	35	—	SMA Input, SC Output	**M5848**

MEDIUM POWER TWT's

These CW tubes provide 20-watts of rf power with frequency coverage from L- through X-band. The very wide instantaneous bandwidth of the traveling-wave tube makes it useful in communications, data links, radar and countermeasures systems. MEC's lightweight, militarized, PPM-focused tubes operate with depressed collector for better efficiency, and include a low current anode which may be used for modulation purposes. The vacuum envelopes are of metal-ceramic construction. Dispenser cathodes, designed to operate at low current density levels, are used to increase life and reliability. Overheating protection is provided by an internal thermal relay which can be connected to a power supply trip-out circuit.

Frequency (GHz)	Power, P_O (Watts)	Gain at P_O (dB) (2)	Noise Figure (dB)	RF Connectors	Part Number Number
1-2	20	35	35	TNC	**M5788**
2-4	20	35	35	TNC	**M5754**
2.6-5.2	20	35	35	TNC	**M5709**
4-8	20	35	35	TNC	**M5789**
5.4-11	Note 1	60	35	Type N	**M5752**
6-11	20	35	35	TNC	**M5790**
8-12.4	20	33	35	TNC	**M5793**

Note 1. Output power is 20 watts over 7 to 11 GHz and 10 watts over 5.4 to 7.0 GHz.

2. High gain versions are available upon request.

CW HIGH POWER TWT's

Teledyne MEC's high power CW traveling-wave tubes fall into two categories:

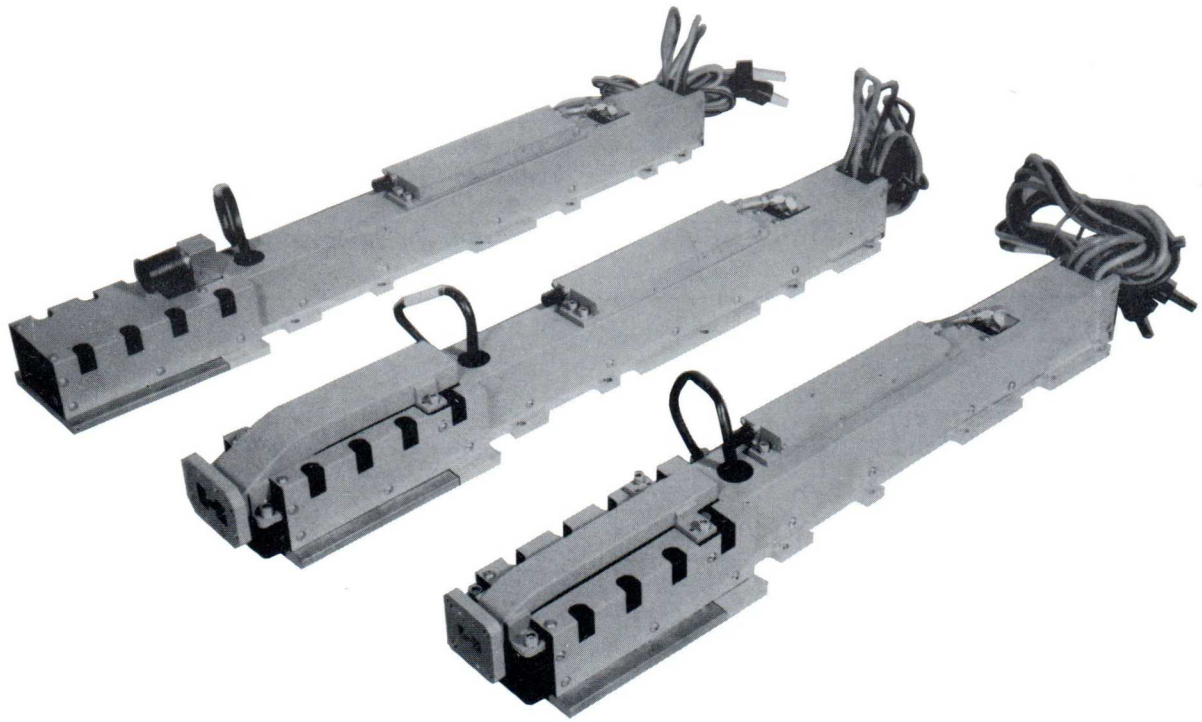
- Solenoid-focused, liquid cooled providing one kilowatt or more.
- PPM-focused, conduction or air cooled providing several hundred watts.

Both categories feature high gain and efficiency over broad bandwidths. MEC manufactures tubes for ground, shipboard and airborne environments, and specializes in meeting the needs of the airborne ECM market.

KILOWATT LEVEL CW TWT's

For military and commercial applications requiring higher power and efficiency over broad bandwidths, MEC offers an extensive line of traveling wave tubes which deliver output from one to several kilowatts. These tubes are solenoid focused and are liquid cooled. Those operating over octave bandwidths are of helix design while those covering narrower bandwidths use coupled-cavity circuits. Many tubes have been designed for communications systems where gain and phase variation, spurious modulation and AM to PM conversion are of utmost importance. All tubes use dispenser cathodes, are processed using high temperature bake-out, and incorporate ion pumps to improve life and reliability. These tubes are suitable for ground or airborne communications, or for ECM systems.

Frequency (GHz)	Power, P_O (Watts)	Gain at P_O (dB)	Noise Figure (dB)	RF Connectors	Part Number
2-4	2,000	27	45	SMA Input, UG 1571/U Output	**M5833**
4-7.5	1,000	35	47	SMA Input, UG 1574/U Output	**M5819**
5.9-6.5	8,000	48	50	UG 344/U	**M5600**
7.9-8.4	2,000	38	50	UG 51/U	**M5701**
7.9-8.4	3,000	38	50	SMA Input, UG 51/U Output	**M5731**
7.9-8.4	12,000	35	50	UG 51/U	**M4444**
7.5-10	1,000	27	45	SMA Input, UG 51/U Output	**M5803A**
8-10	1,000	30	45	UG 51/U	**M5654B**



Broadband, dual mode traveling wave tubes provide the ECM systems designer with CW and pulse jamming power in a single, lightweight device. Considerable volume and weight is saved by the elimination of the second tube, its driver, cooling, power supply, transmission lines and other microwave components.

MEC produces a family of dual mode traveling wave tubes that cover octave frequency ranges from 1 to 18 GHz and provide CW power up to 400 watts. With the application of a single, low voltage beam control signal, these tubes will pulse up to at least twice their CW power level. (Development of tubes with higher pulse-to-CW ratios is in progress.) These dual mode tubes utilize the same proven techniques and technology that have established MEC's reputation as a supplier of highly reliable, high power CW traveling wave tubes.

Compact, ruggedized, PPM-focused designs ensure the performance required for military airborne use. Cooling method is conduction. Low cathode loading and high temperature bakeout result in long life and high reliability.

Frequency (GHz)	Power (watts) CW	Pulse	Duty (%)	Gain at P_o (dB)	N.F. (dB)	RF Connectors	Part Number
2-4	400	800	5	30	35	SMA Input SC Output	**M5852**
4-8	200	400	10	30	35	SMA Input SC Output	**M5853**
5-10	250	500	50	30	35	SMA	**M5854**
8-16	100	200	10	40	35	SMA Input UG1581/U Output	**M5855**

introduction . . .

Teledyne MEC is a recognized leader in the design, development and manufacture of broadband, pulse and CW helix, and CW coupled-cavity, traveling-wave tubes. The tubes listed in this product guide are representative of the medium and high power tubes available from MEC, and are typical of those developed and manufactured through the years for commercial and military applications. They incorporate the latest proven technological developments.

A few of the many **options available** for applications that require special features are:

- Improved performance over reduced frequency ranges.
- Broader bandwidths.
- Modulation capability.
- Various RF input/output connector combinations.
- Higher gain.

MEC manufactures, or can quickly and economically develop, traveling wave tubes to meet your needs. Since we are constantly broadening our product line and improving product capability, it may well be that the component you need is already available. Get in touch with our applications engineers for more details and advice on using MEC products in your applications.

The technical data in this product guide is arranged for your convenience in the following categories:

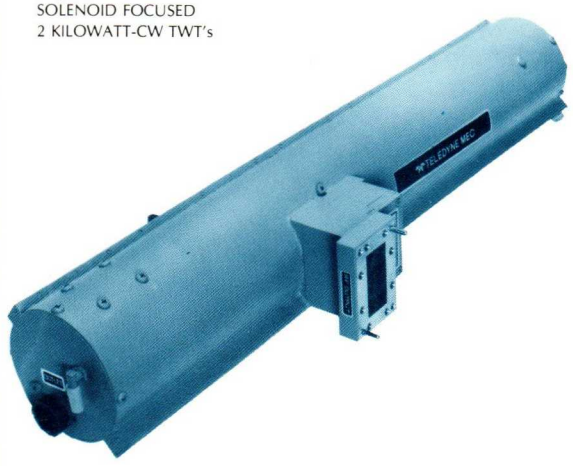
- **Medium Power TWT's**
- **High Power CW TWT's**
- **High Power Pulse TWT's**
- **Dual Mode TWT's**
- **Packaged Amplifiers**
- **Communications TWT's**

Teledyne MEC has product guides covering Low Power and Low Noise traveling wave tubes and amplifiers, delay devices, supercomponents (including memory systems) and solid state devices. Please ask us for them. Complete specifications, performance curves, and mechanical and electrical data on the products listed are available on request from the Teledyne MEC Marketing Office.

This listing is only a representative sampling of the MEC products. Please contact MEC for complete product information.

HIGH POWER
TRAVELING WAVE TUBES

LIQUID COOLED
SOLENOID FOCUSED
2 KILOWATT-CW TWT's



COMMUNICATION
COUPLED CAVITY
TWT's

CONDUCTION COOLED
100/400 WATT CW
TWT's

PPM FOCUSED
DUAL MODE
TWT's

TELEDYNE MEC

3165 PORTER DR. PALO ALTO, CA. 94304
TEL #415 493-1770 • TWX (910) 373-1746

HIPOLON® TWT

MEC

ENGINEERING DATA BULLETIN M5608

September 1, 1967

Traveling-Wave Tube
Type M5608
2.0 to 4.0 GHz, 28 dbm CW
35 db Gain, PPM Focused
Noise Figure 12 db
Metal-Ceramic Vacuum Envelope
MIL-E-5400, Class 2

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification Min.	Max.	Units
Frequency Range	2.0	4.0	GHz
Saturated Power Output	28.0	--	dbm
Small-Signal Gain	35	--	db
Noise Figure	--	12.0	db
VSWR	--	2.5:1	--
Special Characteristics:	Helix and collector grounded		

ELECTRICAL CHARACTERISTICS: **

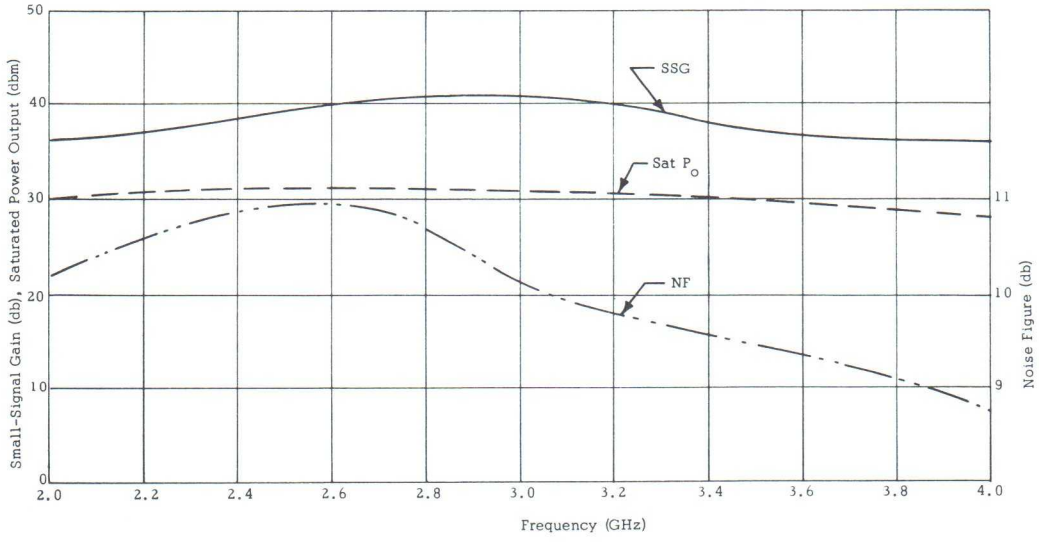
Element	Heater	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5		Helix	Collector	Cathode
V, min	6.1	-200	0	100	100	100		1100	1100	0
V, max	6.5	0	180	650	650	650		1300	1300	0
I, max	1.0 A	20 μA	20 μA	20 μA	20 μA	20 μA		--	--	10 mA
Lead	Brown	Green	Blue	Gray	White	Grn/Blk Trace		Orange		Yellow

** All voltages measured with respect to cathode.

MECHANICAL CHARACTERISTICS:

Weight:	4.5 pounds
Length:	14.75 inches
RF Connectors:	TNC, Female
DC Connectors:	Flying leads
Cooling:	Conduction
Environmental:	MIL-E-5400, Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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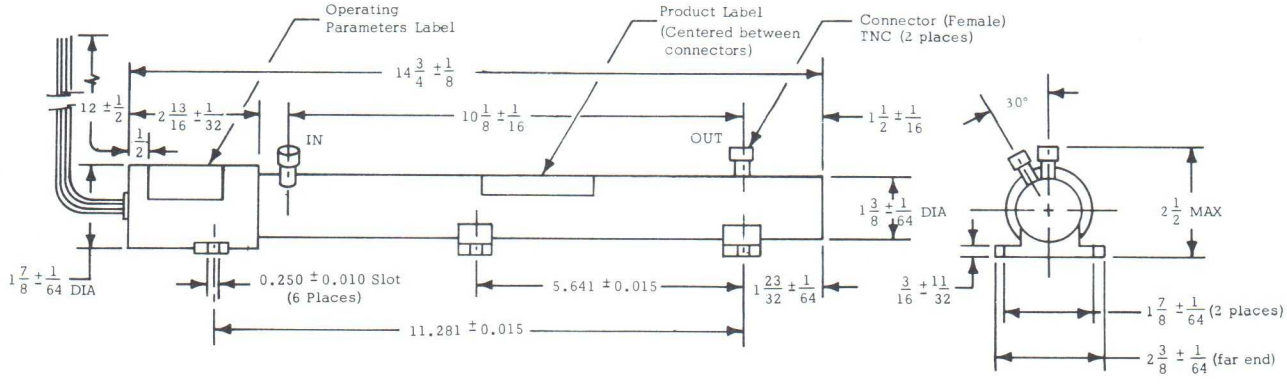


HIPOLON® TWT

MEC

ENGINEERING DATA BULLETIN M5610

September 1, 1967

Traveling-Wave Tube
Type M5610
2.6 to 5.2 GHz, 27 dbm CW
35 db Gain, PPM Focused
Noise Figure 14 db
Metal-Ceramic Vacuum Envelope
MIL-E-5400, Class 2

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification Min.	Max.	Units
Frequency Range	2.6	5.2	GHz
Saturated Power Output	27.0	--	dbm
Small-Signal Gain	35	--	db
Noise Figure	--	14	db
VSWR	--	2.5:1	--
Special Characteristics:	Helix and collector grounded		

ELECTRICAL CHARACTERISTICS:

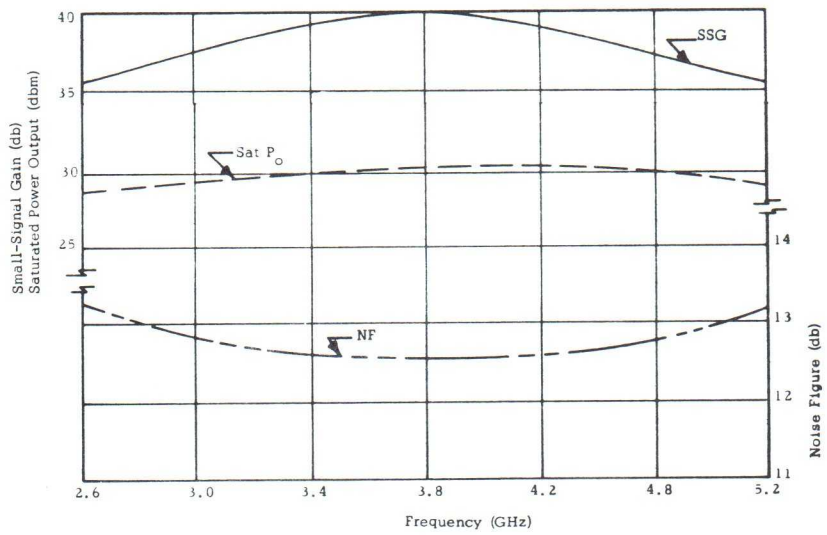
Element	Heater	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5		Helix	Collector	Cathode
V, min	6.1	-200	0	100	100	100		1100	1100	0
V, max	6.5	0	180	650	650	650		1300	1300	0
I, max	1.0 A	20 μA	20 μA	20 μA	20 μA	20 μA				10 mA
Lead	Brown	Green	Blue	Gray	White	Grn/ Blk Trace		Orange		Yellow

Microwave Electronics A DIVISION OF TELEDYNE, INC. — 3165 PORTER DRIVE • PALO ALTO, CALIFORNIA • PHONE (415) 321-1770

MECHANICAL CHARACTERISTICS:

Weight:	4.5 Pounds
Length:	14 inches
RF Connectors:	TNC Female
DC Connectors:	Flying Leads
Cooling:	Conduction
Environmental	MIL-E-5400, Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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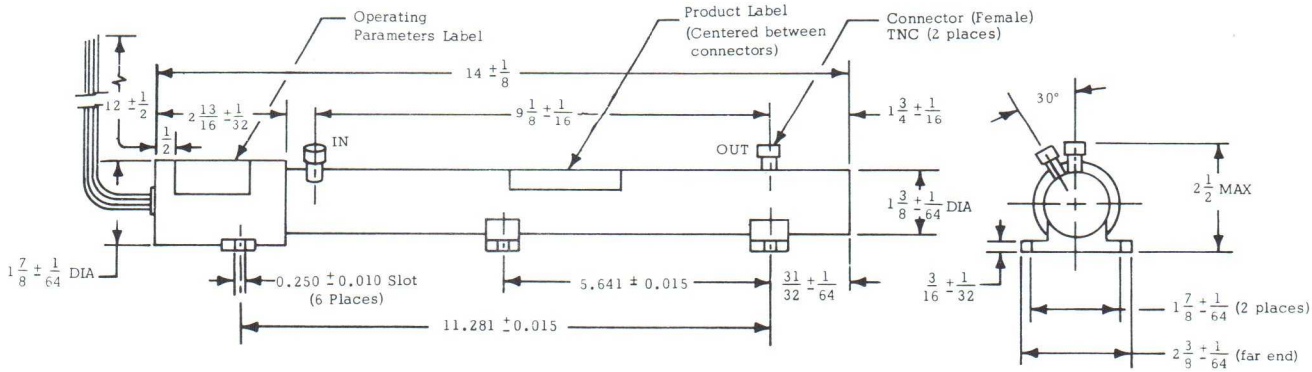


PRODUCT FEATURE

X-BAND TRAVELING WAVE TUBE

MICROWAVE ELECTRONICS CORP.
A Teledyne Company
Palo Alto, California

This X-band traveling wave tube is the first of a series developed at Microwave Electronics, A Teledyne Company, which extends the state-of-the-art in high peak power, broadband, grid-pulsed traveling wave tubes. Designated the Model M5655, the design incorporates a double grid structure to reduce grid current. The second grid is very near the cathode surface and has its mesh wires exactly aligned with those of the gating element. It operates at cathode potential and thus prevents emission of those electrons which would normally be intercepted by the control grid.

This innovation in TWT design removes the limitation placed on duty factor by grid burn-out failure. The average power limitation now is determined by helix support techniques. Circuit support techniques previously developed for a 200-watt CW family of tubes were employed in this 1 kW design, to extend the circuit thermal dissipation capability.

These same new grid techniques are applicable for a wide range of peak power levels, and multikilowatt, high average power pulse designs are now feasible through 18 GHz. It is interesting to note that this five percent duty model has already been successfully operated at the ten percent duty level.

The air-cooled version shown in the photograph is three inches in diameter and the conduction-cooled version is two inches high and 2-1/2 inches wide. Either model weighs less than ten pounds. The collector of the tube is insulated and can be operated with collector depression for improved efficiency.

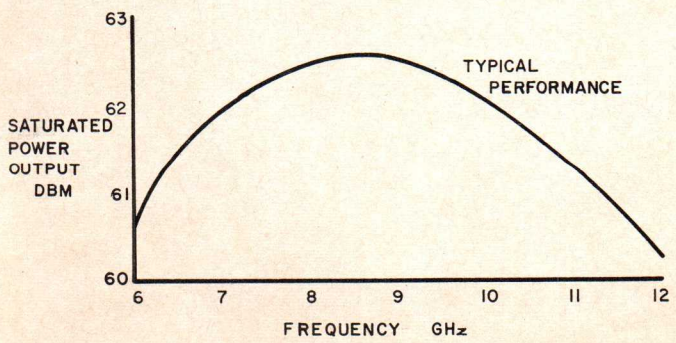
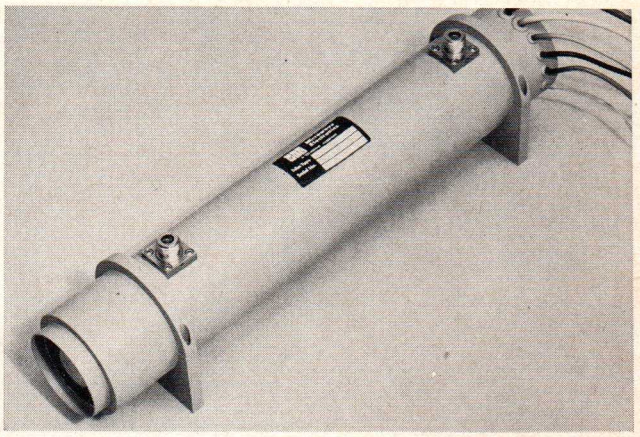


Fig. 1 — Typical power performance.



SPECIFICATIONS

A. PERFORMANCE

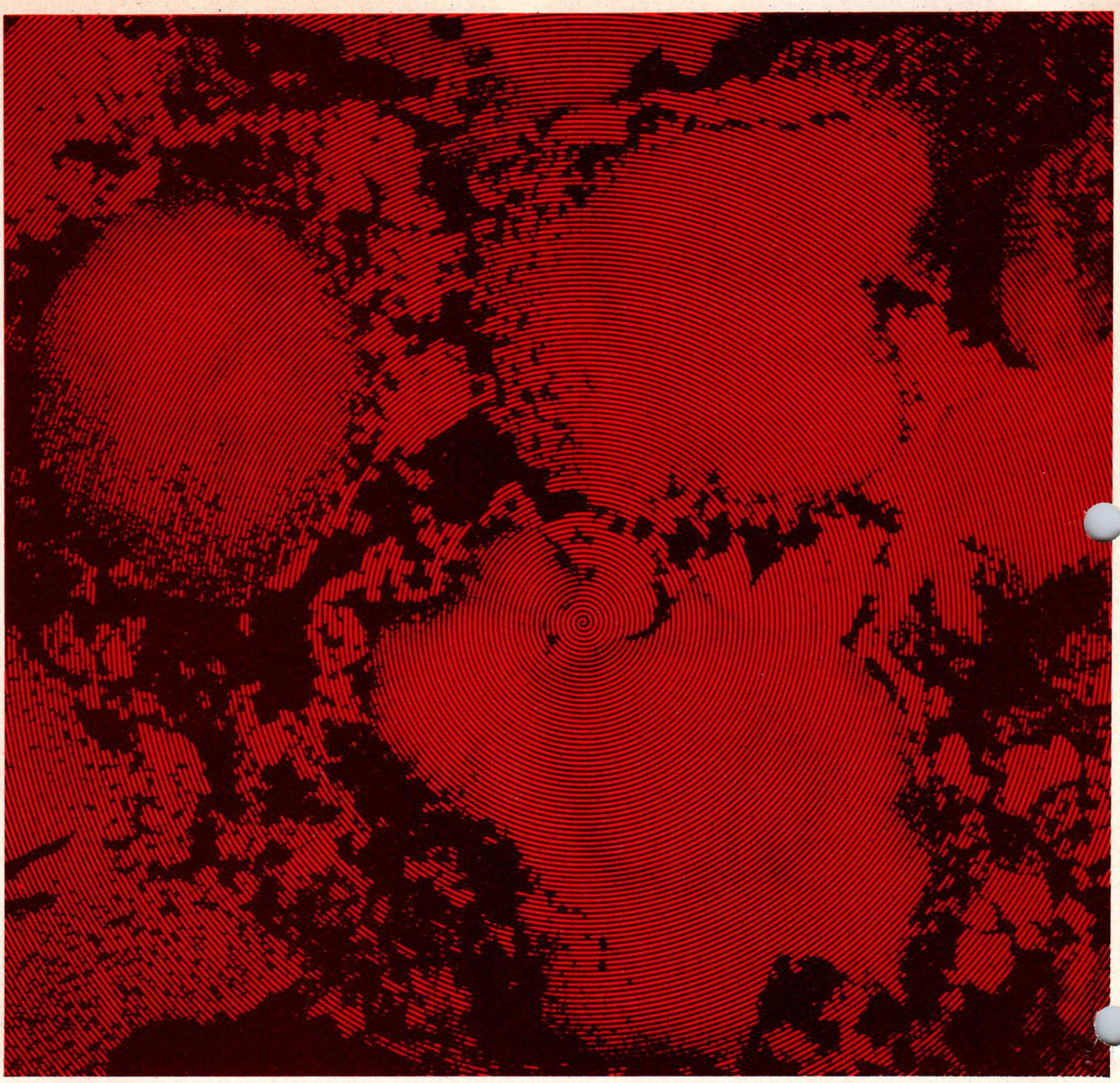
	Minimum	Maximum	Typical
Peak Power:	1 kW	——	1.5 kW
Small Signal Gain:	33 dB	——	40 dB
Saturated Gain:	30 dB	——	36 dB
Frequency:	7-11 GHz	——	6-12 GHz
Duty:	5%	——	5%

B. PARAMETERS**

Cathode Voltage	**	**	**
Cathode Current:	——	1.8 A peak	1.4 A peak
Grid Bias Voltage:	—150 Vdc	—90 Vdc	—100 Vdc
Grid Pulse Voltage:	+200 V peak	+400 V peak	+300 V peak
Grid Pulse Current:	——	80 mA peak	40 mA peak
Helix Voltage:			
(grounded)	9.5 kV	11.5 kV	10.5 kV
Helix Current:	——	250 mA	150 mA
Collector Voltage:	6.0 kV	11.5 kV	optional
Collector Current:	——	1.8 A peak	1.2 A peak

** All voltages referenced to cathode potential

Circle 152 on Reader Service Card



OPTIMUM PERFORMANCE AT MINIMUM COST

Whether your interest is in satellite communications, telemetry, radio astronomy, or tracking and surveillance radar, it's rare, indeed, when improved performance is available at a reduction in cost. But, the ESSCO Integrated Radome / Antenna / Pedestal System, the first such system available, will provide performance superior to any existing exposed antenna system, and, at a lower cost!

New computer design techniques have utilized the protection of the radome enclosure, eliminating the environmental loads on the reflector. The resultant, low inertia, lightweight "equaload" reflector has greatly decreased the power requirements for the pedestal drives. For example, the nominal 40-foot diameter antenna at satcom tracking rates requires only fractional horsepower motors on both axes!

This reduction in weight and cost more than offsets the radome cost, and as an added benefit, permits full time operation regardless of external weather conditions.

For the complete story on how your next antenna system can provide improved performance at a lower cost, call or write ESSCO.

ESSCO

Old Powder Mill Road, West Concord, Massachusetts 01781 • (617) 369-7200

Circle 26 on Reader Service Card

HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN M4369

July 31, 1965

(with vane-axial blower)

Traveling-Wave Tube
Type M4369
7 – 11 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	7 – 11 Gc	7 – 11 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	0.7°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-6.6 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	200 ma	0.5 ma	15 ma	200 ma
Nominal Voltage	6.3 v	-6.1 kv	+175 v	Ground	-2.5 kv
Nominal Current	1.6 a	190 ma	0.05 ma	10 ma	180 ma
Minimum Voltage	5.5 v	-5.6 kv	+100 v	Ground	-3.6 kv
Minimum Current	1.3 a	165 ma	0	0	150 ma

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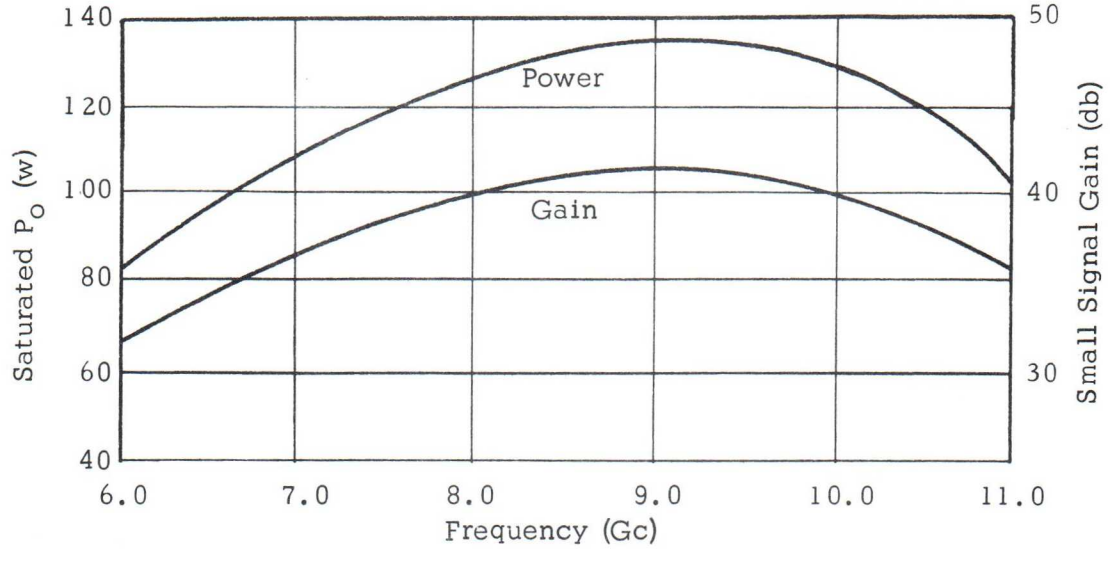
MECHANICAL CHARACTERISTICS:

Weight	2.5 Pounds
Length	12 1/2 Inches
Diameter	2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Forced Air — 60 cfm at sea level at less than 50°C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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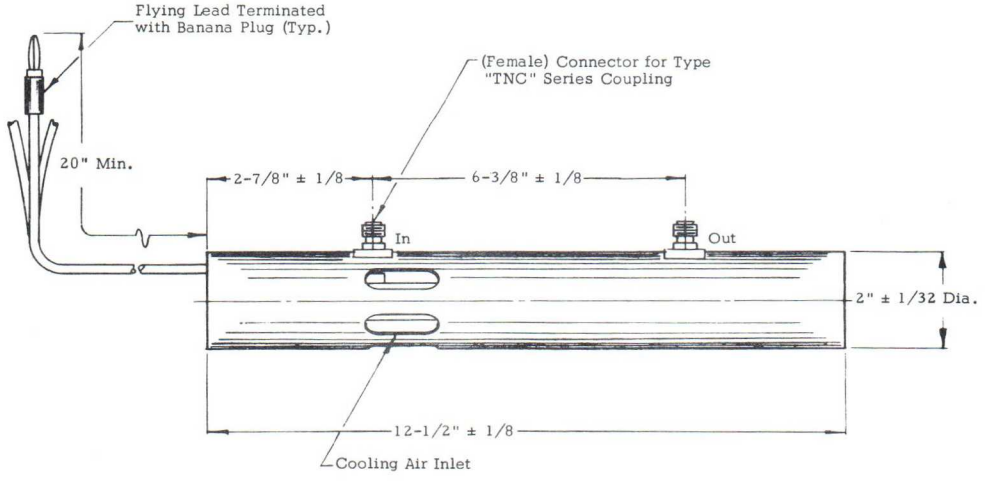


HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN

August 15, 1965

M4383A

(No Photograph Available)	Traveling-Wave Tube Type M4383A 0.5 - 1.0 Gc, 1 kw Pulsed Peak Power Duty 0.01, 30 db Saturation Gain Gridded, PPM Focused Metal-Ceramic Vacuum Envelope Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	0.5 – 1.0 Gc	0.5 – 1.0 Gc
Saturated Power Output Peak	1.0 kw (min)	1.4 kw
Gain at 1 kw Out	30 db (min)	31.4 db
Small Signal Gain	37 db (min)	40 db
Noise Figure	35 db (max)	30 db
Input VSWR	2.0:1 (max)	1.5:1
Beam Voltage Phase Sensitivity	---	0.1°/v
Grid Voltage Power Sensitivity	---	0.4 db/v
Duty	0.01 (max)	---

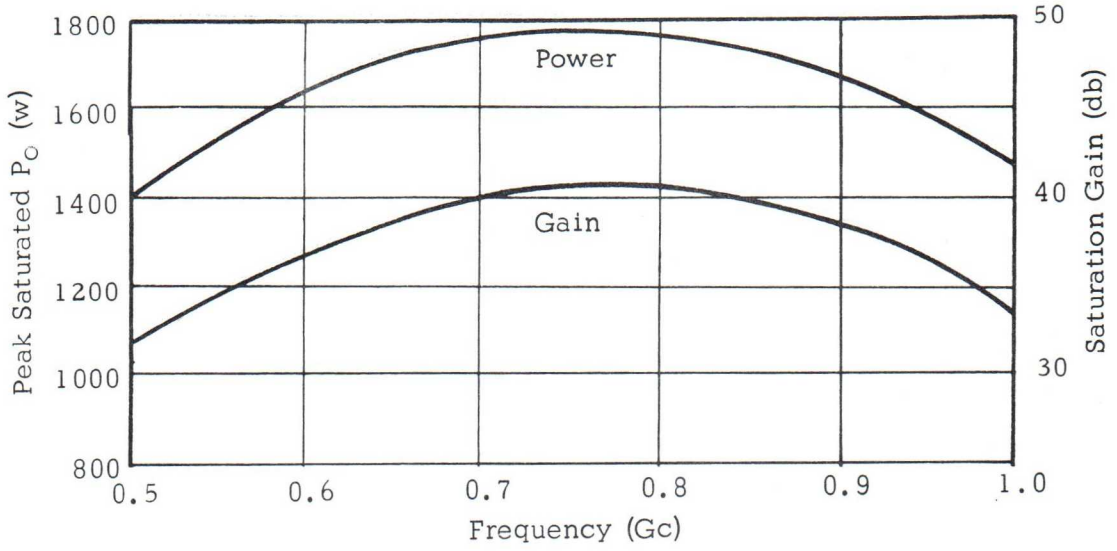
ELECTRICAL CHARACTERISTICS:

	Element					
	Heater	Peak Heater Cathode	Peak Grid Pulse	Grid Bias	Helix Peak	Collector Peak
Lead Color	(Brown)	(Yellow)	(Green)	(Green)	---	---
Maximum Voltage	22.0 v	-10.0 kv	+450 v	-100 v	Ground	Ground
Maximum Current	5.5 a	3.0 a	500 ma	---	300 ma	3 a
Nominal Voltage	20.0 v	-8.5 kv	+350 v	-60 v	Ground	Ground
Nominal Current	5.0 a	2.5 a	200 ma	---	100 ma	2.2 a
Minimum Voltage	18.0 v	-7.0 kv	+250 v	-50 v	Ground	Ground
Minimum Current	4.5 a	2.0 a	---	---	0	2.0 a

MECHANICAL CHARACTERISTICS:

Weight	45 Pounds
Length	40 Inches
Diameter	4 Inches
RF Connectors	Type N Jack
DC Connectors	Flying Leads
Cooling	Forced Air — 0.6 lb/min at 20° C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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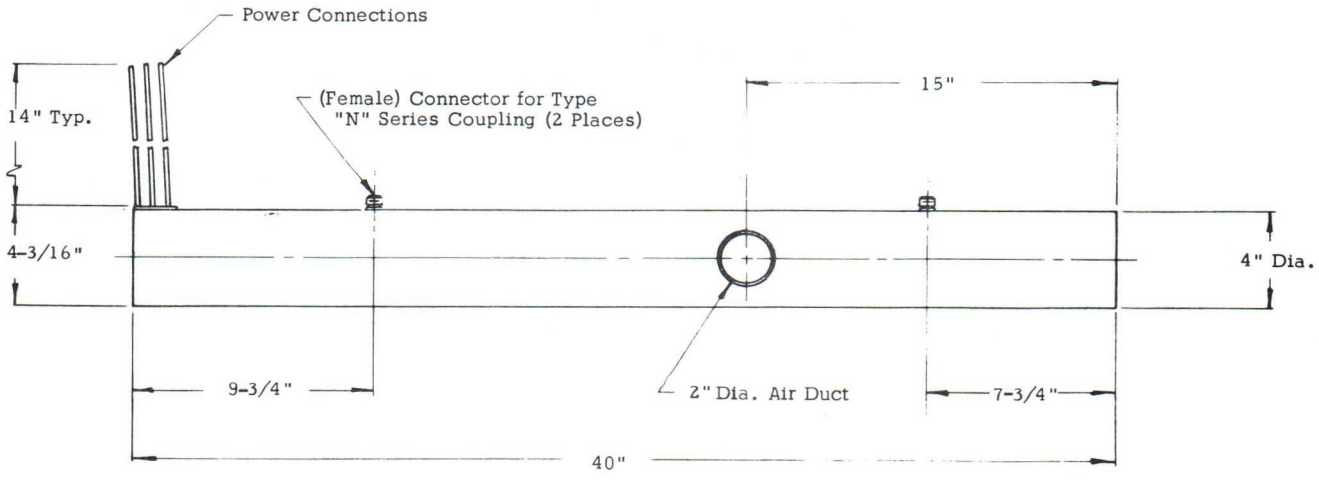
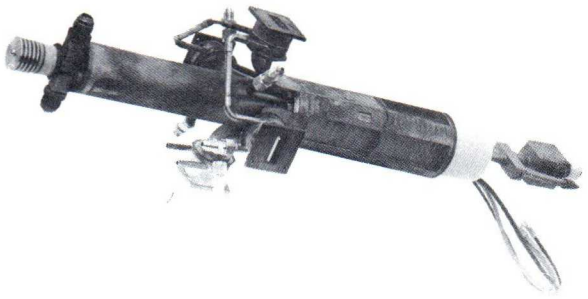


HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN
July 31, 1965

M4444



Traveling-Wave Tube
Type M4444
7.7 – 8.4 Gc, 12 kw CW
40 db Gain, Solenoid Focused
30 percent Efficiency with Depressed Collector
Metal-Ceramic, Water Cooled

RF PERFORMANCE

	Guaranteed	Typical
Frequency Range	7.7 – 8.4 Gc	7.7 – 8.4 Gc
Saturated Power Output	12 kw (min)	12.5 kw (min)
Saturated Gain	35 db (min)	38 db
Small Signal Gain	40 db (min)	45 db
Noise Figure	50 db (max)	45 db
Input VSWR	3.0:1 (max)	2.0:1
Phase Linearity (at saturation)	–	8°/db

ELECTRICAL CHARACTERISTICS:

	Element					
	Heater	Heater Cathode*	Anode	Body	Collector	Solenoid
Maximum Voltage	14 v	-21 kv	+500 v	Ground	0 v	250 v
Maximum Current	3.0 a	3.1 a	10 a	250 ma	3 a	10 a
Nominal Voltage	12.5 v	-20 kv	+500 v	Ground	-7 kv	200 v
Nominal Current	2.1 a	2.8 a	1 ma	100 ma	2.7 a	8 a
Minimum Voltage	12.0 v	-18 kv	+400 v	Ground	-9 v	120 v
Minimum Current	1.9 a	2.4 a	0	0	2.3 a	7 a

*Cathode potential must be applied to the tube within 1 millisecond of turn on.

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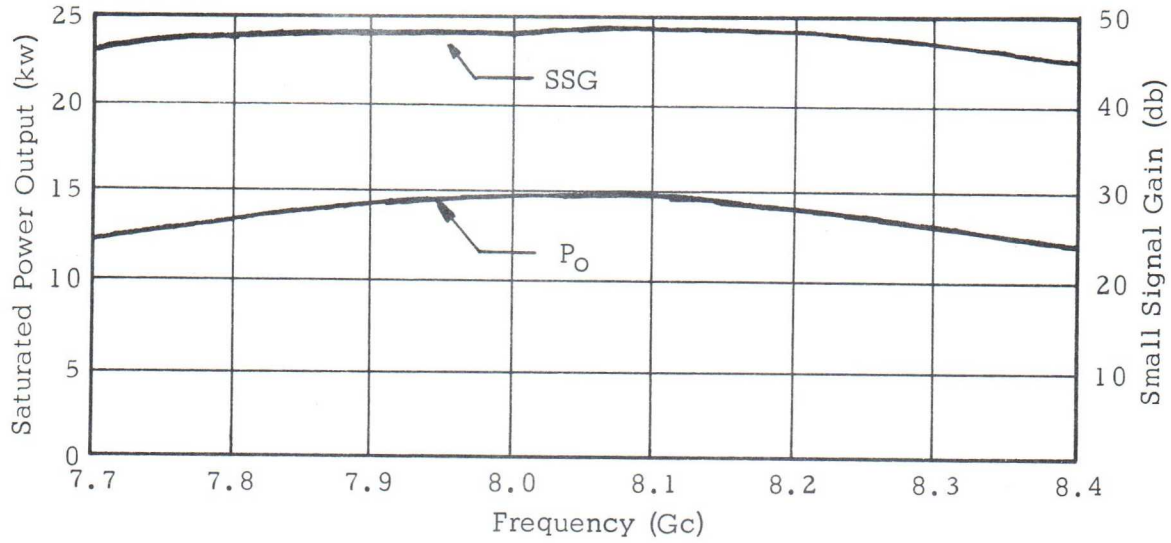
MECHANICAL CHARACTERISTICS:

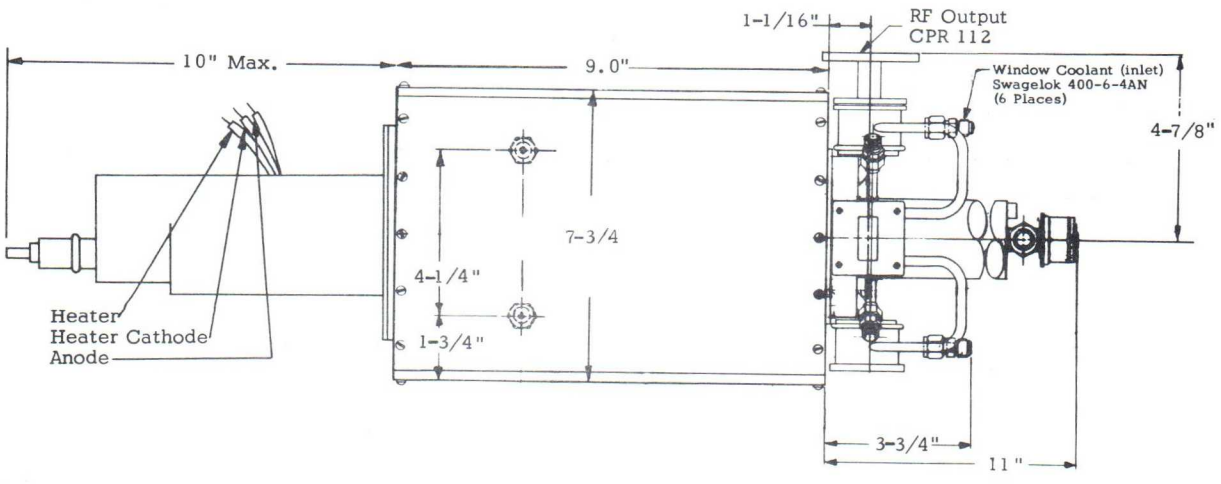
Weight		120 Pounds
Length		28 1/2 Inches
Cross Section		7 3/4 Inches Square
RF Connections:	Input and 2 Load Ports*	RG51/U
	Output	RG51/U or CPR 112
DC Connections		Flying Leads
Cooling (Water):	Tube and Solenoid	15 gpm at 100 psi
	Windows	1 gpm at 35 psi
Mounting		Any Position

*2 RF loads are required for operation with this tube. One 1 kw and one 2 kw load.

TYPICAL PERFORMANCE CHARACTERISTICS:



OUTLINE DRAWING:



HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN M4446

July 31, 1965

(with vane-axial blower)

Traveling-Wave Tube
Type M4446
1 – 2 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	1 – 2 Gc	1 – 2 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.03 db/v

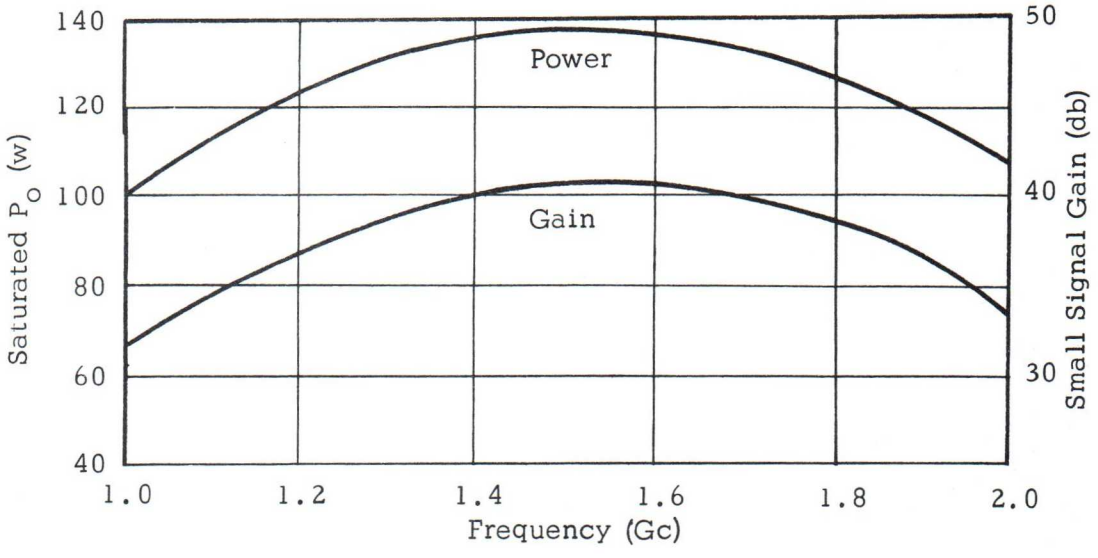
ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	13.0 v	-3.0 kv	+300 v	Ground	Ground
Maximum Current	4.5 a	400 ma	2.0 ma	50 ma	400 ma
Nominal Voltage	12.6 v	-2.65 kv	+175 v	Ground	-1.0 kv
Nominal Current	4.0 a	350 ma	0.5 ma	30 ma	320 ma
Minimum Voltage	10.0 v	-2.45 kv	+100 v	Ground	-1.3 kv
Minimum Current	3.0 a	300 ma	0	0	270 ma

MECHANICAL CHARACTERISTICS:

Weight	5 Pounds
Length	23 Inches
Diameter	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Forced Air — 60 cfm at sea level at less than 50°C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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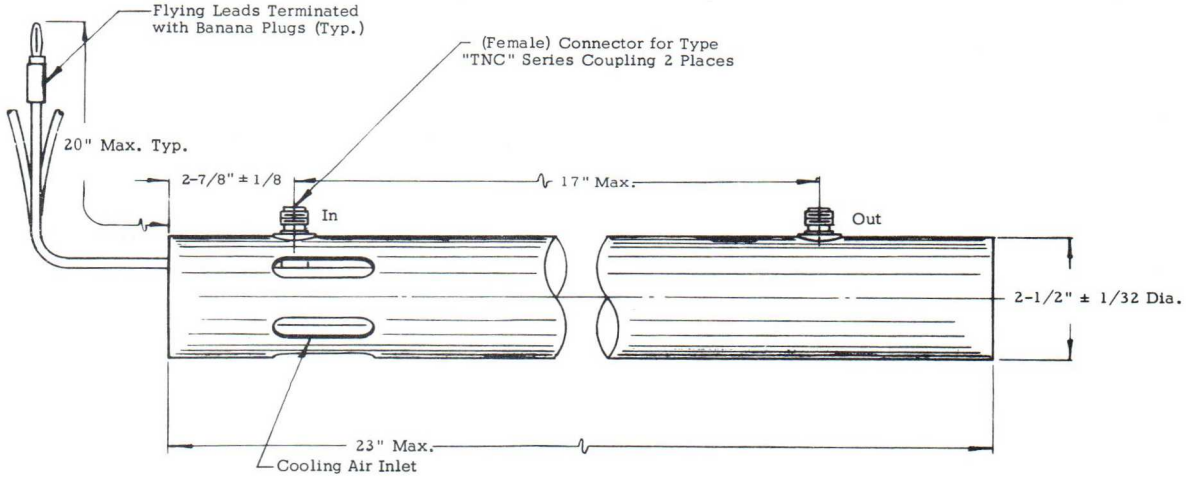

HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN M4447

July 31, 1965

(with vane-axial blower)

Traveling-Wave Tube
Type M4447
2 – 4 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	2 – 4 Gc	2 – 4 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.02 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-4.0 kv	+300 v	Ground	Ground
Maximum Current	3.2 a	330 ma	0.5 ma	30 ma	330 ma
Nominal Voltage	6.3 v	-3.7 kv	+175 v	Ground	-1.2 kv
Nominal Current	2.8 a	285 ma	0.1 ma	15 ma	270 ma
Minimum Voltage	5.5 v	-3.2 kv	+100 v	Ground	-1.5 kv
Minimum Current	2.6 a	220 ma	0	0	190 ma

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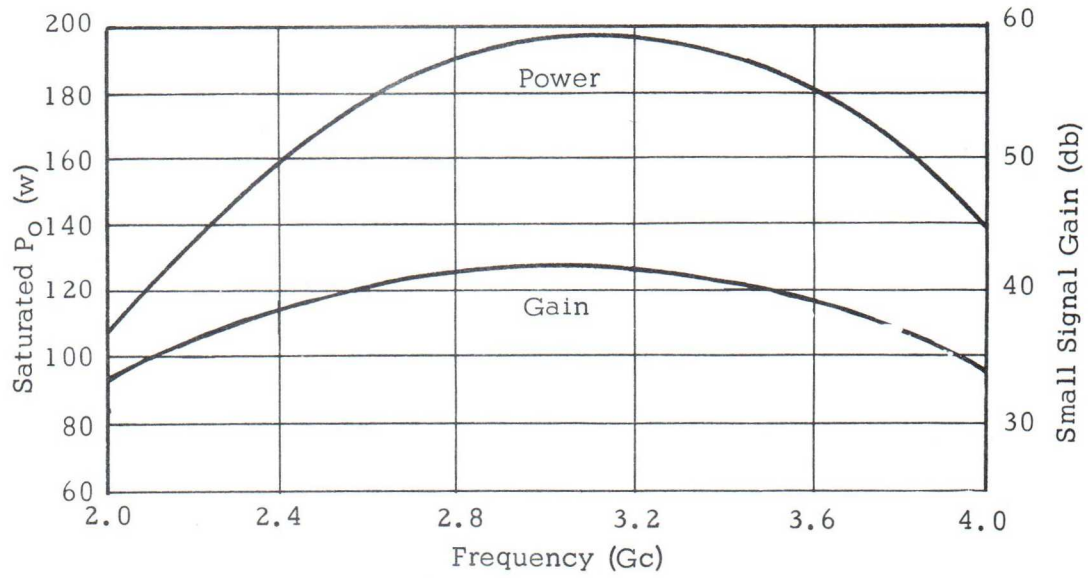
MECHANICAL CHARACTERISTICS:

Weight	3 1/2 Pounds
Length	18 Inches
Diameter	2 3/8 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Forced Air – 60 cfm at sea level at less than 50° C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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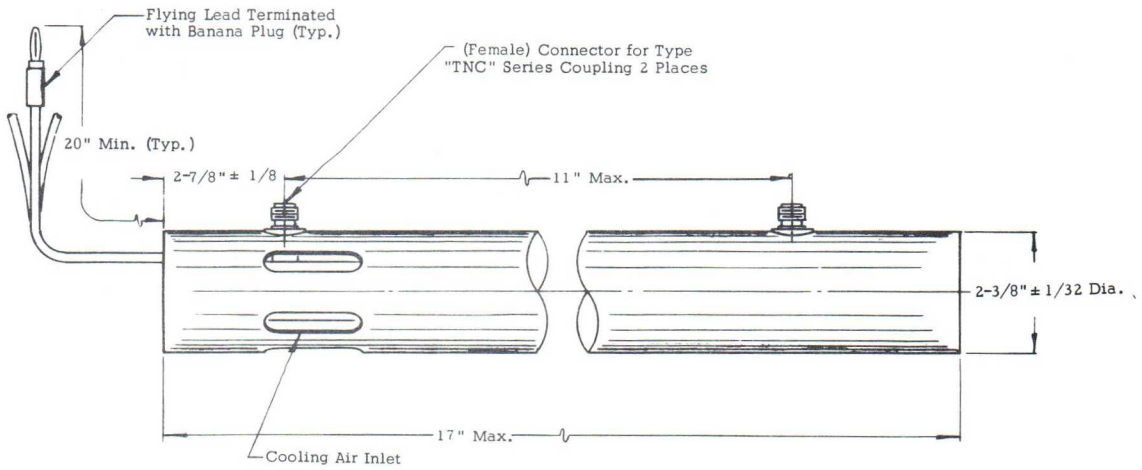

HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN M4448

July 31, 1965

(with vane-axial blower)

Traveling-Wave Tube
Type M4448
4 – 8 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	4 – 8 Gc	4 – 8 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.02 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-4.2 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	330 ma	0.5 ma	20 ma	330 ma
Nominal Voltage	6.3 v	-3.7 kv	+175 v	Ground	-1.2 kv
Nominal Current	1.6 a	260 ma	0.1 ma	10 ma	250 ma
Minimum Voltage	5.5 v	-3.2 kv	+100 v	Ground	-1.5 kv
Minimum Current	1.3 a	220 ma	0	0	200 ma

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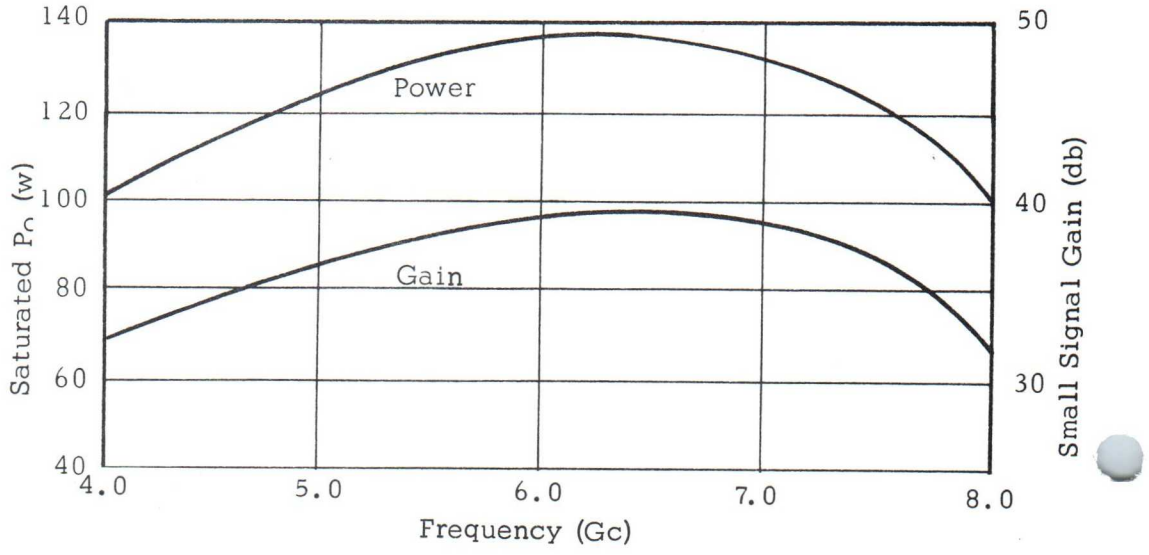
MECHANICAL CHARACTERISTICS:

Weight	2 1/4 Pounds
Length	12 1/4 Inches
Diameter	2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Forced Air – 60 cfm at sea level at less than 50°C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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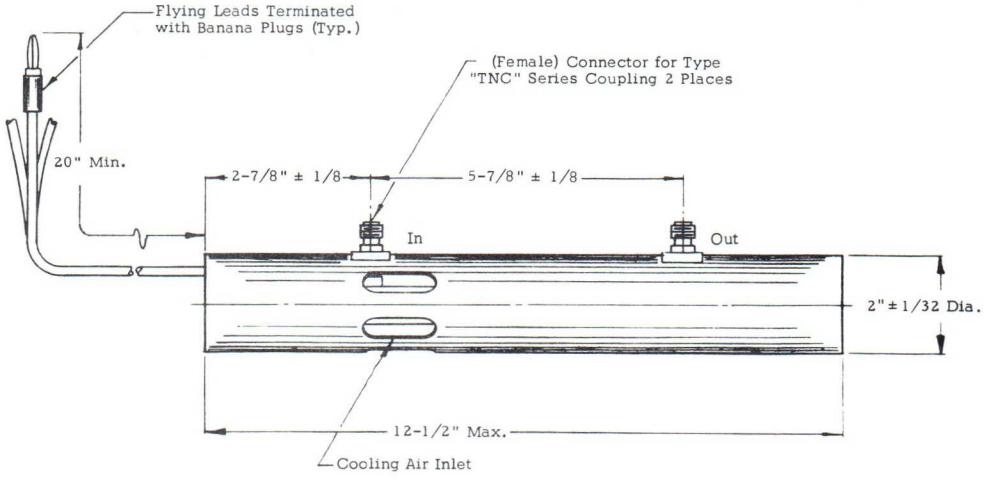
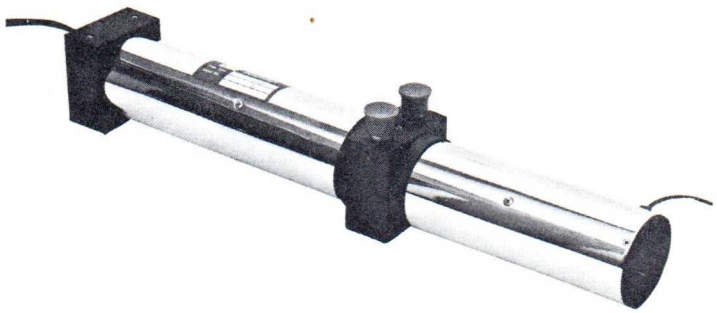


SPECIAL-PURPOSE TWT

ENGINEERING DATA BULLETIN

July 31, 1965

M5122



Traveling-Wave Tube
Type M5122
2.0 - 3.0 Gc
20 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
MIL-E-5400 Class 2

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification			Units
	Min.	Max.	Typical	
Frequency Range	2.0	3.0	----	Gc
Saturated Power Output	----	----	----	--
Small-Signal Gain	20.0	----	30.0	db
Noise Figure	----	15.0	10.0	db
VSWR	----	2.5:1	<2.5:1	--
Special Characteristics (If Any)	Sideband Suppression: 25 db minimum. Serrodyne Frequency Range: 1 - 10 kc.			

ELECTRICAL CHARACTERISTICS:

Element	Heater	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Grid 6	Helix	Collector	Cathode
V_{min}	6.3	-50	0	25	75	---	---	300	V_H+100	0
V_{max}	6.3	0	100	200	300	---	---	500	V_H+350	0
I_{max}	0.3 A	50 μa	50 μa	50 μa	50 μa	---	---	0.5 ma	1.5 ma	1.5 ma
Lead	Brown	Green	Blue	Grey	White	Green/ Black	Purple	Orange	Red	Yellow

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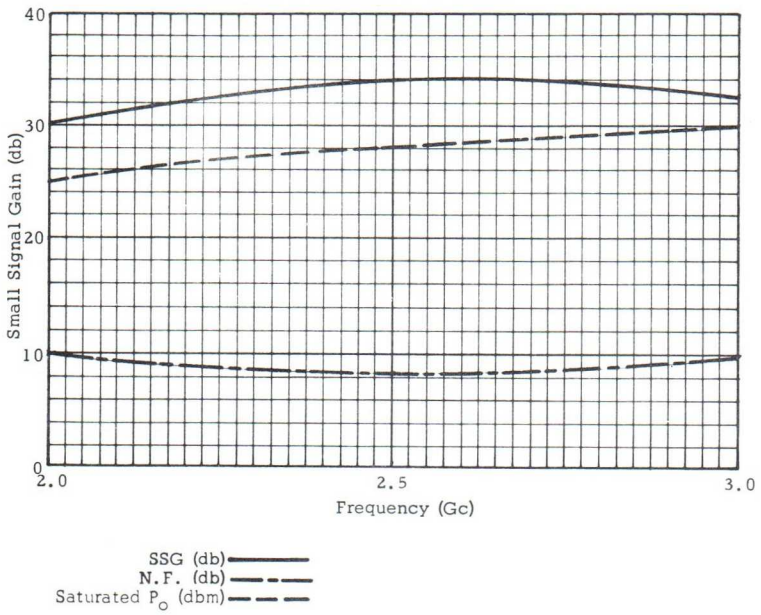
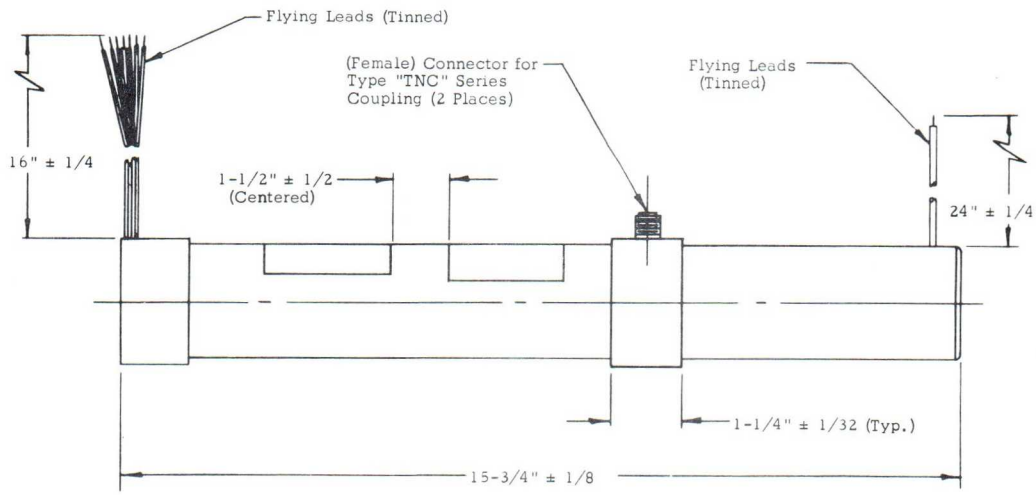
MECHANICAL CHARACTERISTICS:

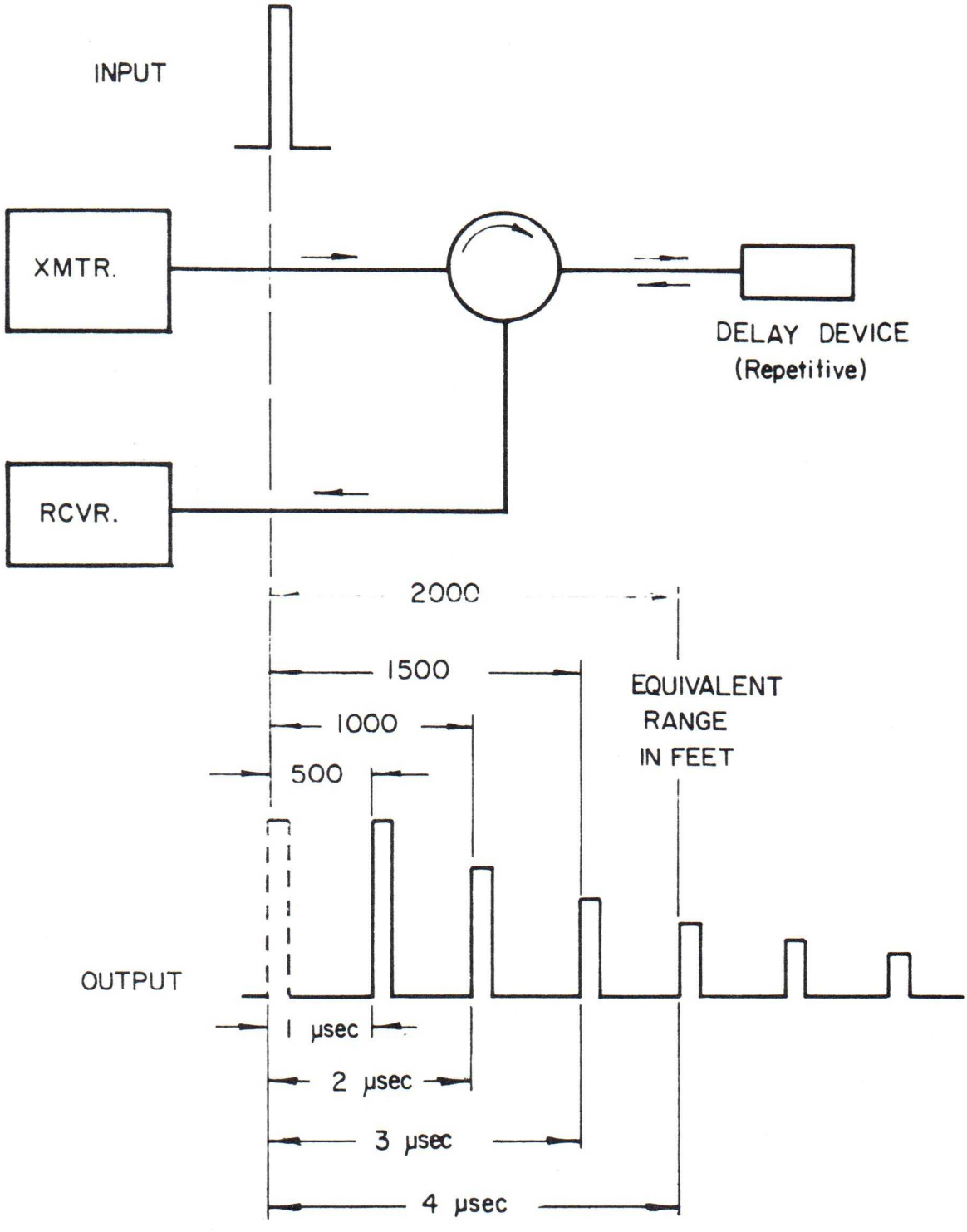
Parameter	
Weight	7 Pounds
Length	15.75 Inches
RF Connectors	TNC
DC Connectors	Flying Leads
Cooling	Conduction
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



OUTLINE DRAWING:





RADAR ALTIMETER CALIBRATION USING REPETITIVE DELAY DEVICE

SPECIAL-PURPOSE TWT

ENGINEERING DATA BULLETIN

July 31, 1965

M5127

Traveling-Wave Tube
Type M5127
8.9 - 9.2 Gc, 10 dbm CW
25 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification			Units
	Min.	Max.	Typical	
Frequency Range	8.9	9.2	----	Gc
Saturated Power Output	10.0	----	20.0	dbm
Small-Signal Gain	25.0	----	30.0	db
Noise Figure	----	----	----	--
VSWR	----	2.0:1	<2.0:1	--
Special Characteristics (If Any)	Sideband suppression; serrodyne parameters. Special pulse response characteristics.			

ELECTRICAL CHARACTERISTICS:

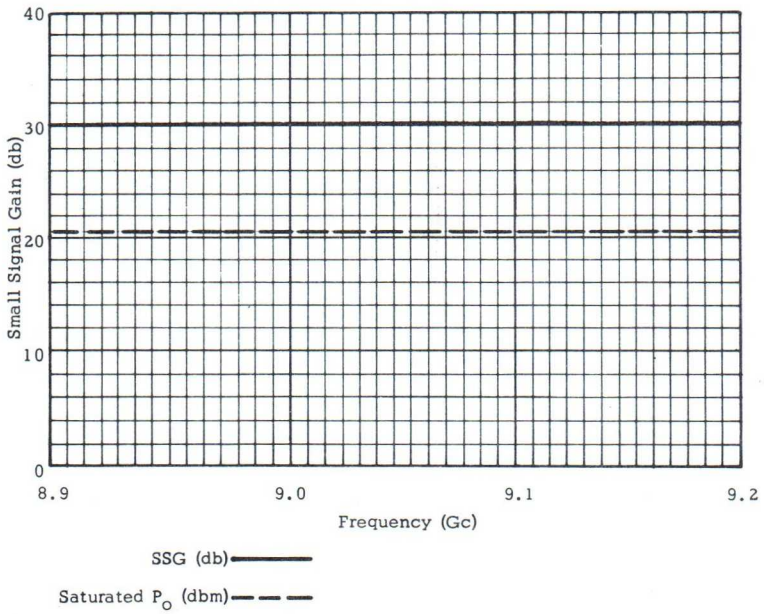
Element	Heater	Grid 1	Grid 2	Helix	Collector	Cathode
V_{min}*	6.3	-50	160	1100	V_H	0
V_{max}*	6.3	0	500	1300	V_H	0
I_{max}	0.3 A	10 ma	50 ma	**	2.9 ma	2.9 ma
Lead	Brown	Green	Blue	Orange	Red	Yellow

*All voltages in vdc.
**0.8 ma max. with I_{sol} 0.86 to 1.06 A

MECHANICAL CHARACTERISTICS:

Parameter	
Weight	3 Pounds
Length	14.75 Inches
RF Connectors	N
DC Connectors	M7P
Cooling	Conduction
Environmental	

TYPICAL PERFORMANCE CHARACTERISTICS:



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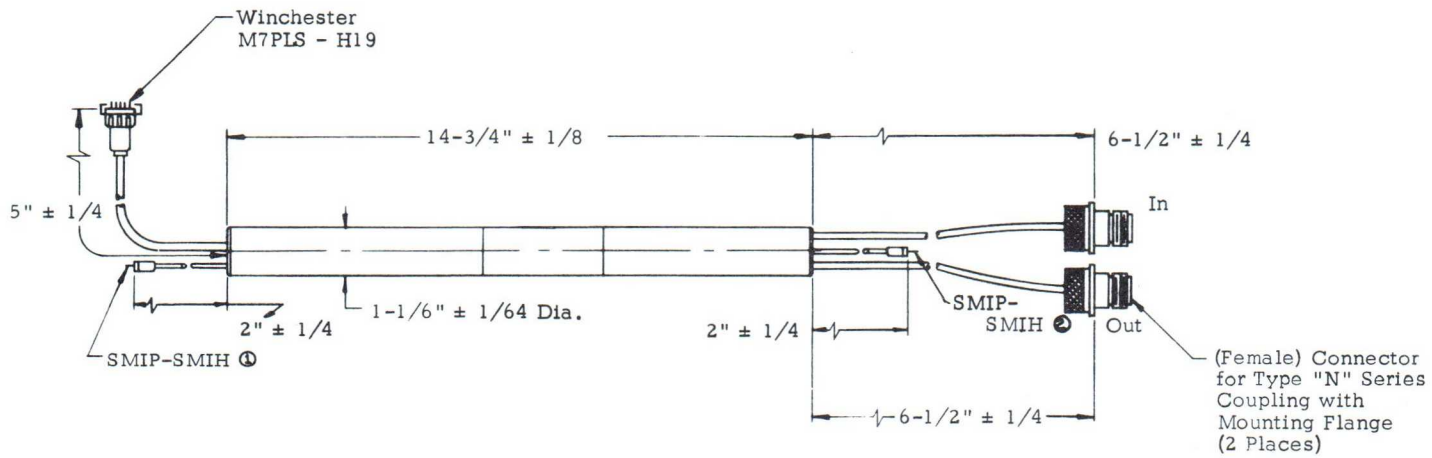
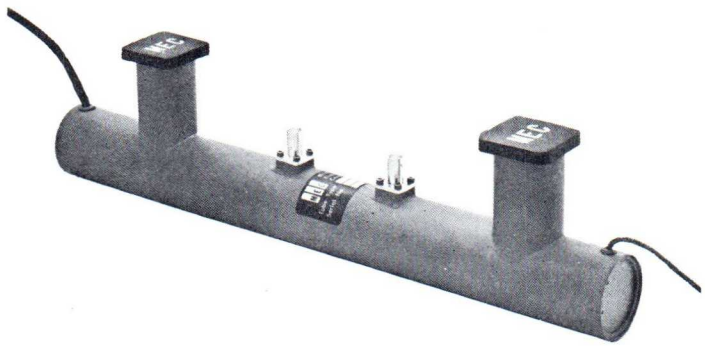


SPECIAL-PURPOSE TWT

ENGINEERING DATA BULLETIN

July 31, 1965

M5144



Traveling-Wave Phase-Shifter Tube
Type M5144
8.0 - 12.0 Gc, 10 dbm CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Phase and Gain Tracking

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification Min.	Specification Max.	Units
Frequency Range	8.0	12.0	Gc
Saturated Power Output	7.0	14.0	dbm
Small-Signal Gain	30.0	40.0	db
Noise Figure	10.0	13.0	db
VSWR	---	2.5:1	--
Special Characteristics (If Any)	In pairs, tubes phase track to within ±18° and gain track within ±1 db across band.		

ELECTRICAL CHARACTERISTICS:

Element	Heater	Grid 1	Grid 2	Grid 3	Grid 4	Grid 5	Input Helix	Output Helix	Collector	Delay Tube
V_{min}	6.24	-10	30	40	250	---	1150	1150	V_{H_2}	1100
V_{max}	6.36	-75	75	200	600	---	1300	1300	V_{H_2} + 200	1500
I_{max}	0.3 A	0	0	0	0	---	0.1 ma	0.1 ma	0.70 ma	0.1 ma
Lead	Brown	Green	Blue	Grey	White	---	Orange	BNC	Red	BNC

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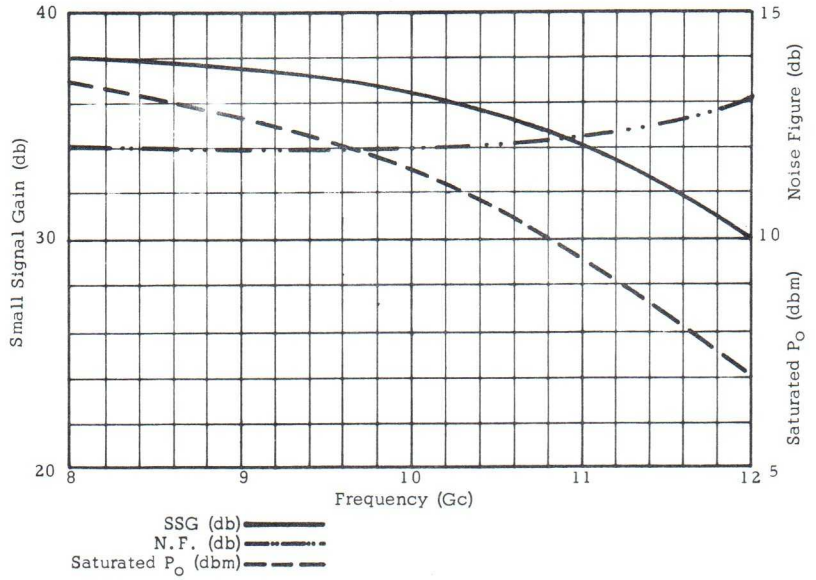
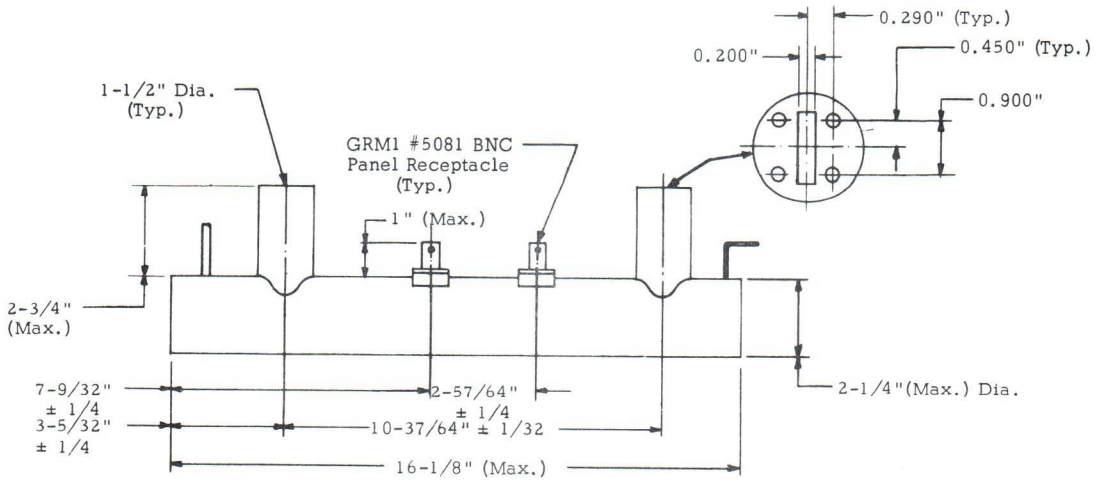
MECHANICAL CHARACTERISTICS:

Parameter	
Weight	6.5 Pounds
Length	16.12 Inches
RF Connectors	WG
DC Connectors	Flying Leads (12" Min.)
Cooling	Convection

TYPICAL PERFORMANCE CHARACTERISTICS:



OUTLINE DRAWING:



SPECIAL-PURPOSE TWT

MEC

ENGINEERING DATA BULLETIN

July 31, 1965

M5236

(No Photograph Available)

Traveling-Wave Tube
Type M5236
7.0 - 10.0 Gc, 10 dbm CW
20 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
MIL-E-5400

RF PERFORMANCE CHARACTERISTICS:

Parameter	Specification			Units
	Min.	Max.	Typical	
Frequency Range	7.0	10.0	----	Gc
Saturated Power Output	10.0	----	13.0	dbm
Small-Signal Gain	20.0	----	40.0	db
Noise Figure	----	30.0	<30.0	db
VSWR	----	2.0:1	<2.0:1	--
Special Characteristics (If Any)	Sideband Suppression, $V_{2\pi}$ sweep, spurious. AM Specs. are special.			

ELECTRICAL CHARACTERISTICS:

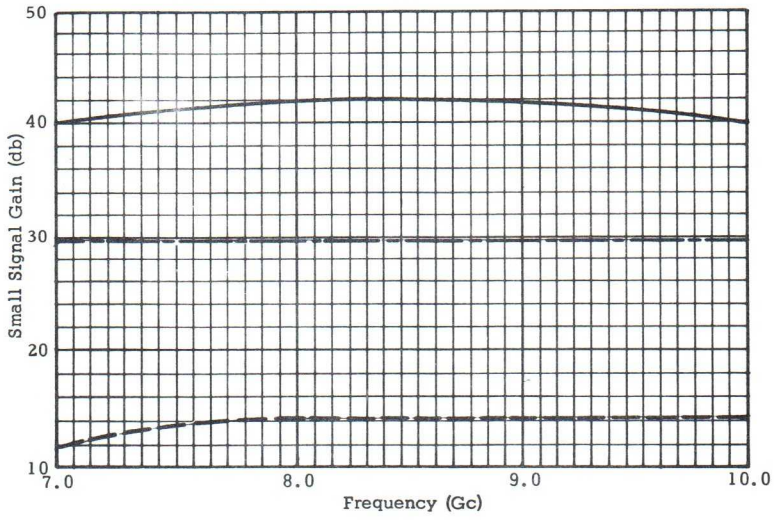
Element	Heater	Grid 1	Grid 2	Helix	Collector	Cathode
V_{min}*	6.3	0	0	1100	V_H	0
V_{max}*	6.3	0	450	1300	V_H	0
I_{max}	0.3 A	50 μa	50 μa	2.5 ma	3.1 ma	3.1 ma
Lead	Brown	Green	Blue	Orange	Red	Yellow

*All voltages in vdc.

MECHANICAL CHARACTERISTICS:

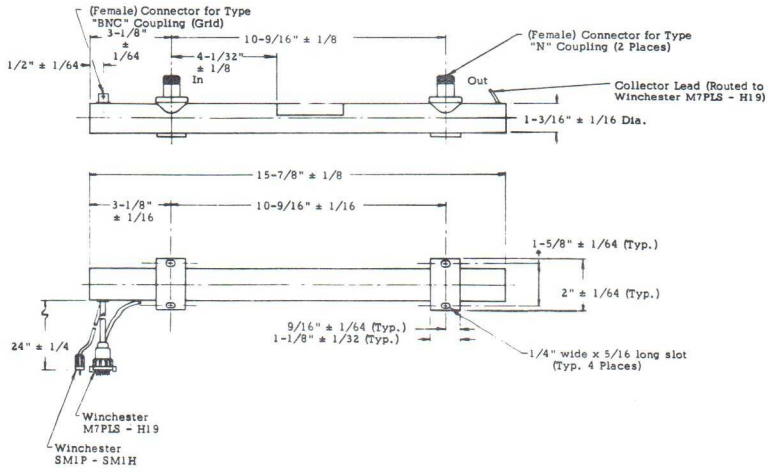
Parameter	
Weight	4.5 Pounds
Length	15.75 Inches
RF Connectors	N
DC Connectors	M7P
Cooling	Conduction
Environmental	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



SSG (db) ——————
N.F. (db) — — —
Saturated P_o (dbm) — — —

OUTLINE DRAWING:



HIGH-POWER TWT

ENGINEERING DATA BULLETIN M5311

July 31, 1965

(heat sink not shown)

Traveling-Wave Tube
Type M5311
1 – 2 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	1 – 2 Gc	1 – 2 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.03 db/v

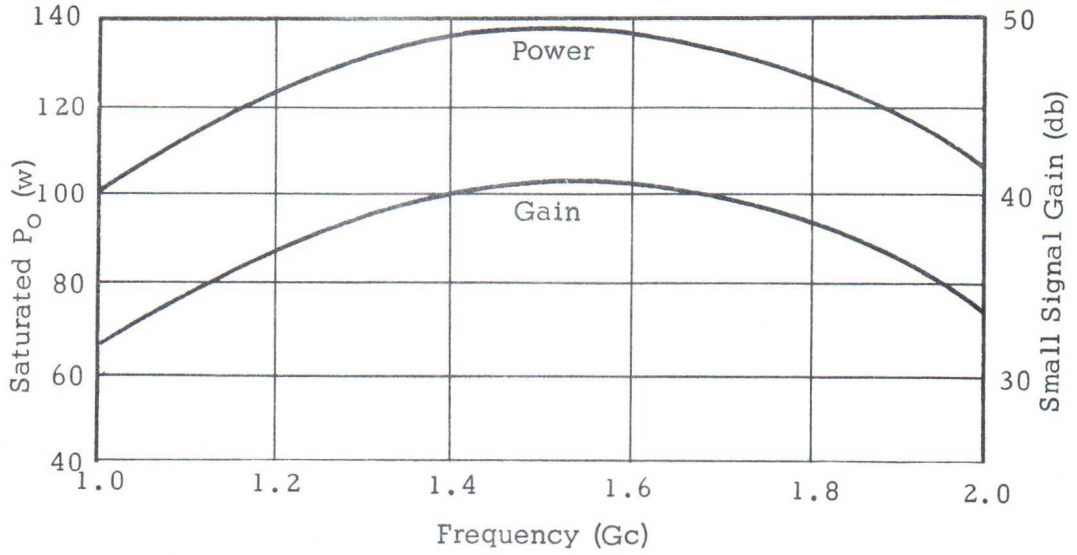
ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	13.0 v	-3.0 kv	+300 v	Ground	Ground
Maximum Current	4.5 a	400 ma	2.0 ma	50 ma	400 ma
Nominal Voltage	12.6 v	-2.65 kv	+175 v	Ground	-1.0 kv
Nominal Current	4.0 a	350 ma	0.5 ma	30 ma	320 ma
Minimum Voltage	10.0 v	-2.45 kv	+100 v	Ground	-1.3 kv
Minimum Current	3.0 a	300 ma	0	0	270 ma

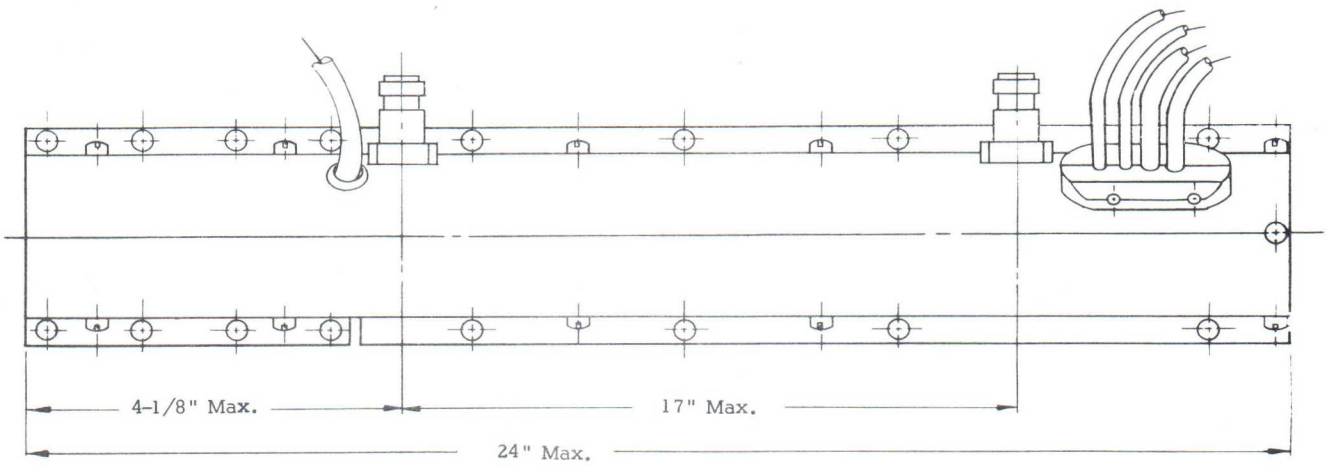
MECHANICAL CHARACTERISTICS:

Weight	7.5 Pounds
Length	24 Inches
Height	2 Inches
Width	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled – Heat Sink kept below 100°C
Environmental	MIL-E-5400, Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



OUTLINE DRAWING:



HIGH-POWER TWT

ENGINEERING DATA BULLETIN M5312

July 31, 1965

(heat sink not shown)

Traveling-Wave Tube
Type M5312
2 – 4 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	2 – 4 Gc	2 – 4 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.02 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-4.0 kv	+300 v	Ground	Ground
Maximum Current	3.2 a	330 ma	0.5 ma	30 ma	330 ma
Nominal Voltage	6.3 v	-3.7 kv	+175 v	Ground	-1.2 kv
Nominal Current	2.8 a	285 ma	0.1 ma	15 ma	270 ma
Minimum Voltage	5.5 v	-3.2 kv	+100 v	Ground	-1.5 kv
Minimum Current	2.6 a	220 ma	0	0	190 ma

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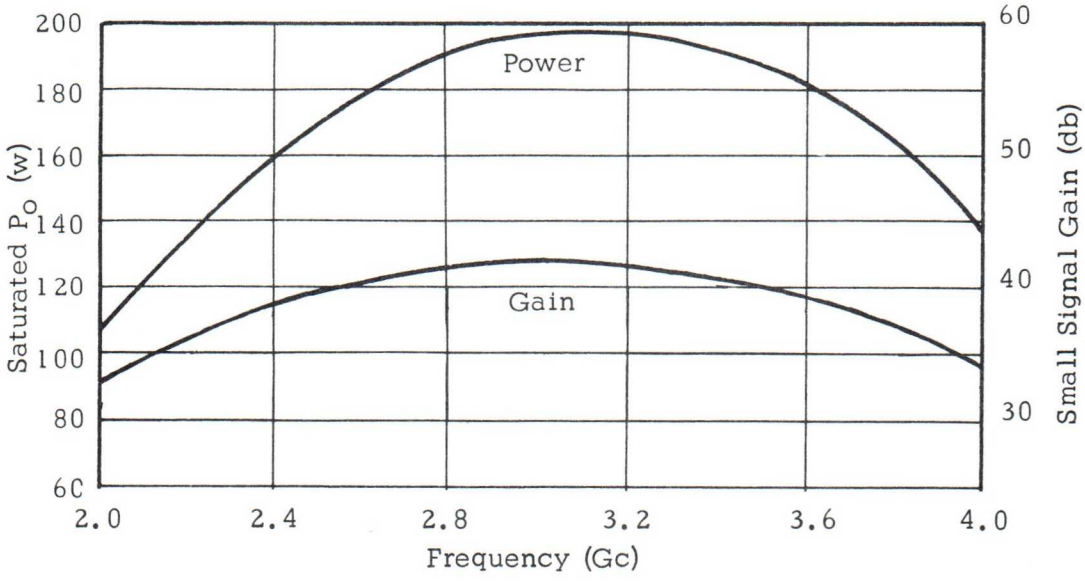
MECHANICAL CHARACTERISTICS:

Weight	6 Pounds
Length	18 Inches
Height	2 Inches
Width	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled — Heat Sink kept below 100°C
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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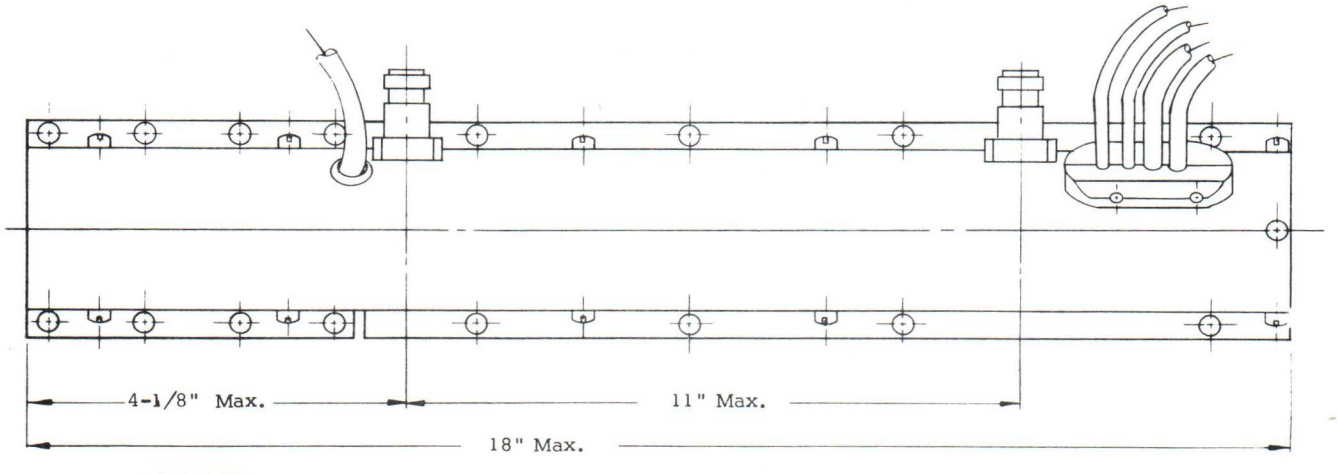

HIGH-POWER TWT

ENGINEERING DATA BULLETIN M5313

July 31, 1965

(heat sink not shown)

Traveling-Wave Tube
Type M5313
4 – 8 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	4 – 8 Gc	4 – 8 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	0.7°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-6.6 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	200 ma	0.5 ma	15 ma	200 ma
Nominal Voltage	6.3 v	-6.1 kv	+175 v	Ground	-2.5 kv
Nominal Current	1.6 a	190 ma	0.05 ma	10 ma	180 ma
Minimum Voltage	5.5 v	-5.6 kv	+100 v	Ground	-3.6 kv
Minimum Current	1.3 a	165 ma	0	0	150 ma

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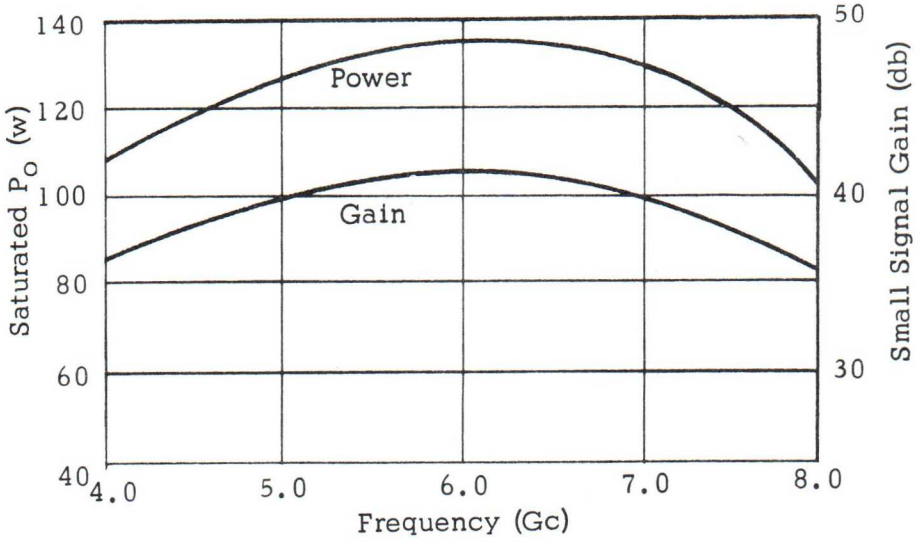
MECHANICAL CHARACTERISTICS:

Weight	6 Pounds
Length	18 Inches
Height	2 Inches
Width	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled — Heat Sink kept below 100°C
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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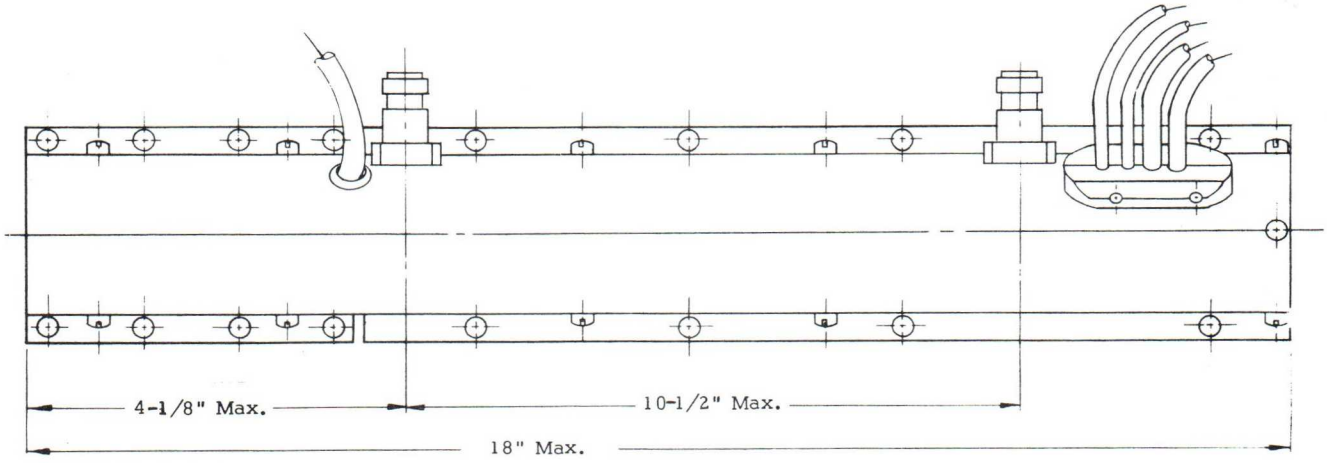

HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN M5314

July 31, 1965

(heat sink not shown)

Traveling-Wave Tube
Type M5314
7 – 11 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	7 – 11 Gc	7 – 11 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	0.7°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-6.6 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	200 ma	0.5 ma	15 ma	200 ma
Nominal Voltage	6.3 v	-6.1 kv	+175 v	Ground	-2.5 kv
Nominal Current	1.6 a	190 ma	0.05 ma	10 ma	180 ma
Minimum Voltage	5.5 v	-5.6 kv	+100 v	Ground	-3.6 kv
Minimum Current	1.3 a	165 ma	0	0	150 ma

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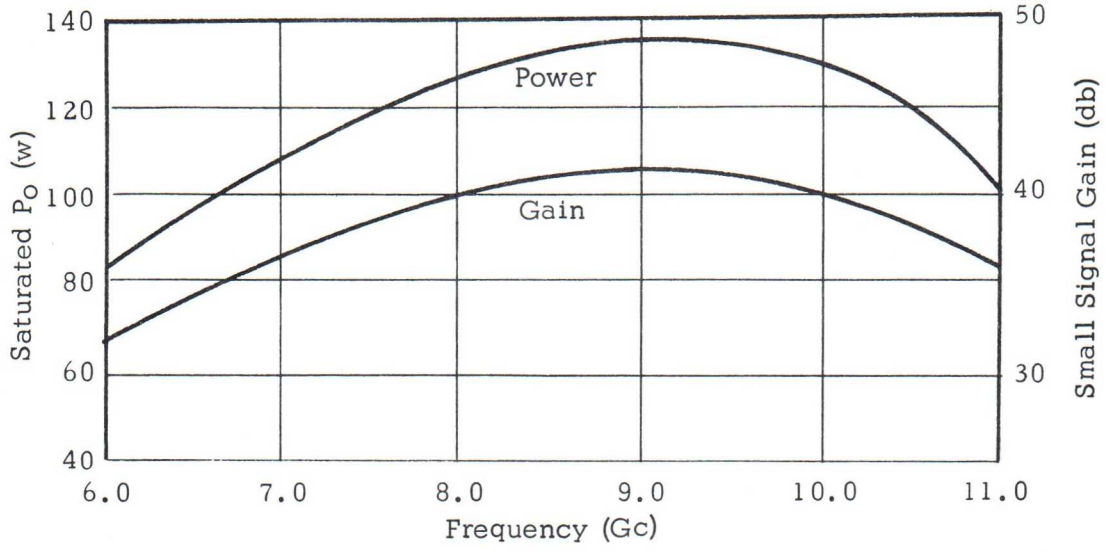
MECHANICAL CHARACTERISTICS:

Weight	5.5 Pounds
Length	13 3/4 Inches
Height	2 Inches
Width	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled – Heat Sink kept below 100°C
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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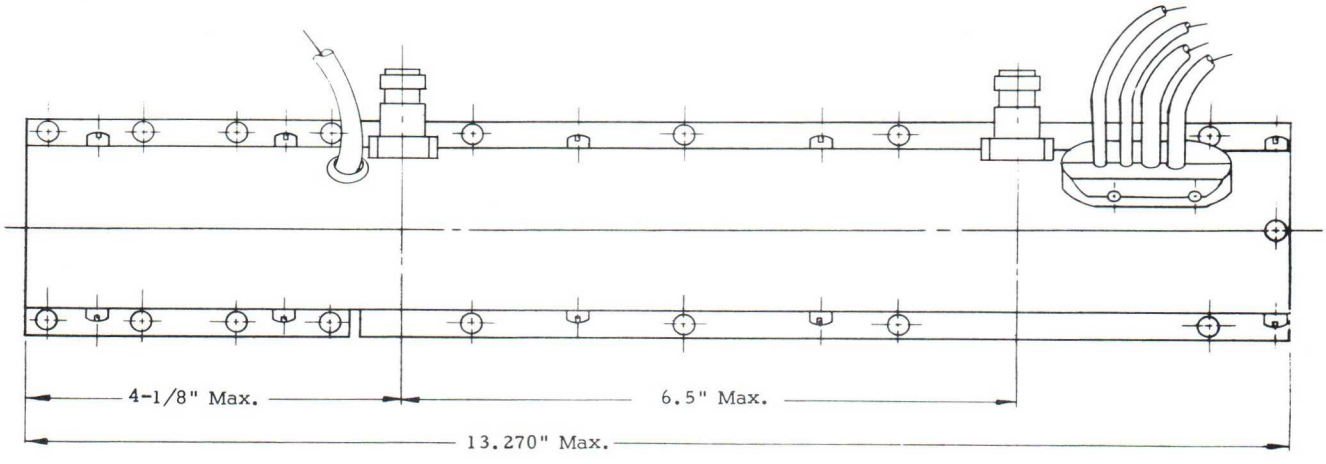


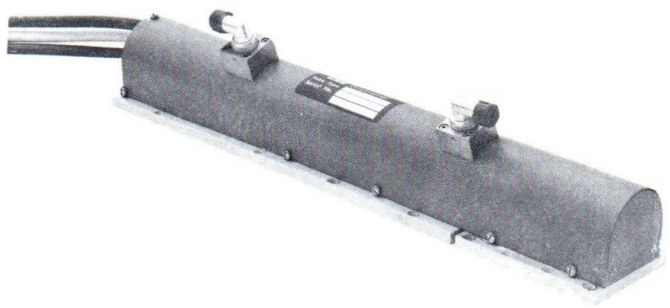
HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN

August 15, 1965

M5333



Traveling-Wave Tube
Type M5333
10.5 - 12.5 Gc, 35 Watts CW
40 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	10.5 - 12.5 Gc	10.0 - 12.5 Gc
Saturated Power Output	35 w (min)	35 w
Gain at 35 Watts Out	40 db (min)	40 db
Small Signal Gain	42 db (min)	43 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-4.4 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	120 ma	0.5 ma	15 ma	120 ma
Nominal Voltage	6.3 v	-4.0 kv	+175 v	Ground	-1.6 kv
Nominal Current	1.6 a	100 ma	0.1 ma	10 ma	95 ma
Minimum Voltage	5.5 v	-3.6 kv	+100 v	Ground	-2.0 kv
Minimum Current	1.3 a	80 ma	0	0	70 ma

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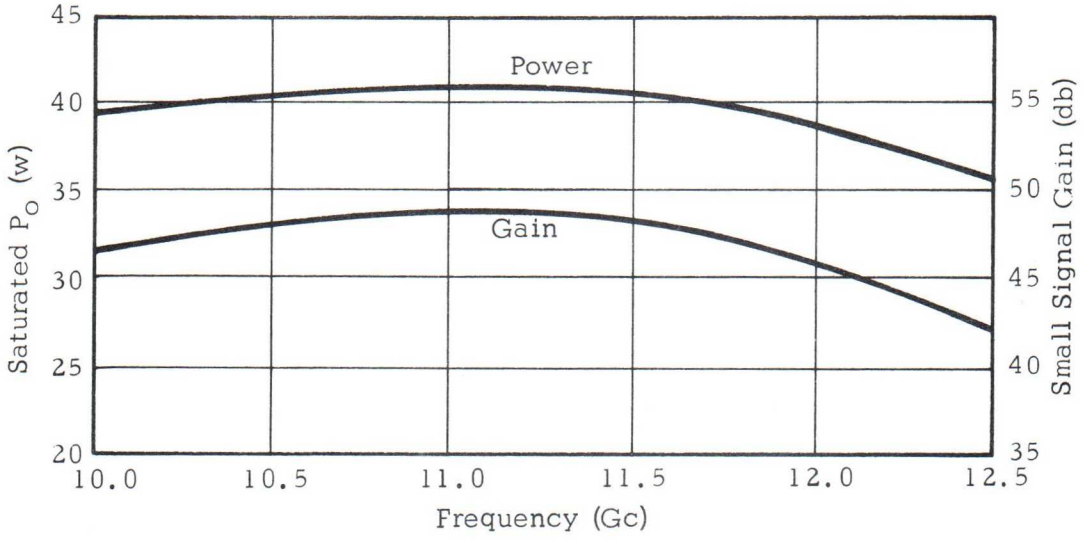
MECHANICAL CHARACTERISTICS:	
Weight	3 Pounds
Length	11 1/4 Inches
Height	2 7/8 Inches
Width	2 1/8 Inches
RF Connectors	TNC Right Angle Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled – Heat Sink kept below 100°C
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



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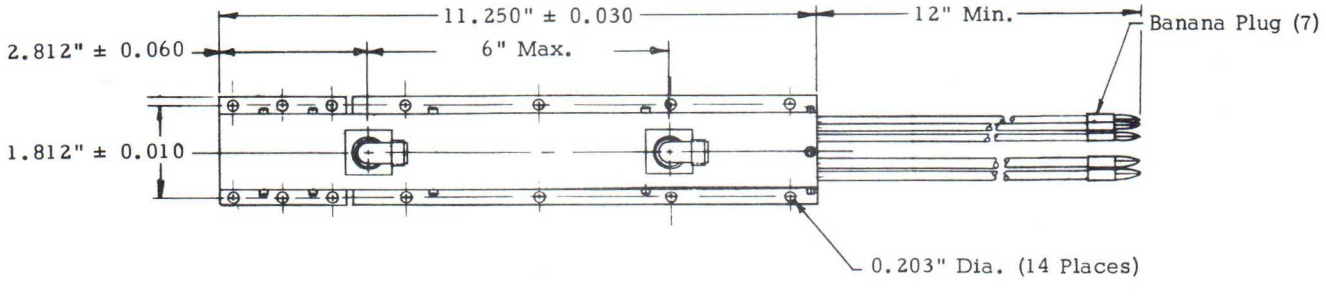


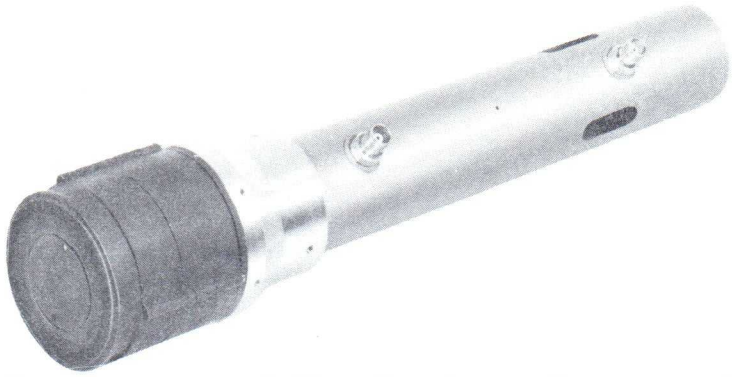
HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN

August 15, 1965

M5348



Traveling-Wave Tube
Type M5348
4 - 8 Gc, 100 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Air Cooled

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	4 – 8 Gc	4 – 8 Gc
Saturated Power Output	100 w (min)	100 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	0.7°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-6.6 kv	+300 v	Ground	Ground
Maximum Current	3.2 a	200 ma	0.5 ma	15 ma	200 ma
Nominal Voltage	6.3 v	-6.1 kv	+175 v	Ground	-2.5 kv
Nominal Current	2.9 a	190 ma	0.05 ma	10 ma	180 ma
Minimum Voltage	5.5 v	-5.6 kv	+100 v	Ground	-3.6 kv
Minimum Current	2.6 a	150 ma	0	0	150 ma

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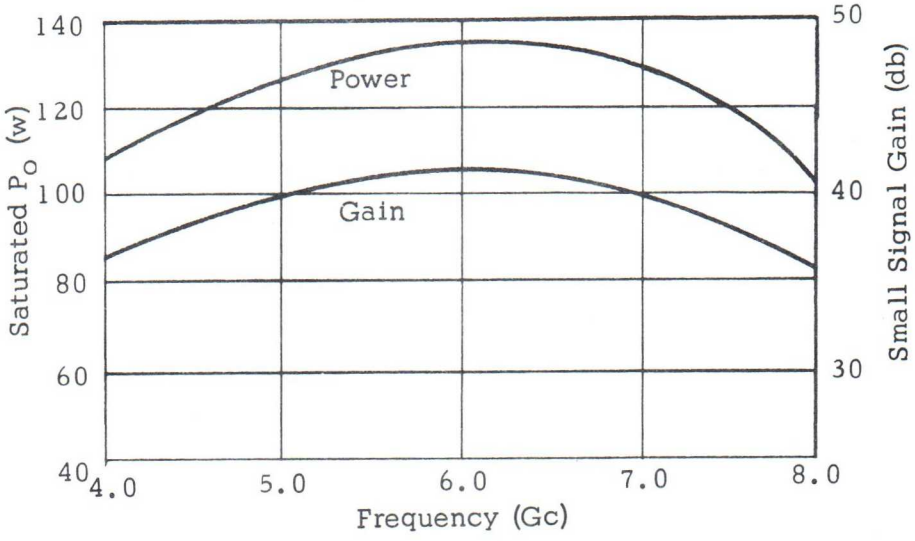
MECHANICAL CHARACTERISTICS:

Weight	3.5 Pounds
Length	17.5 Inches
Diameter	2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Forced air — 60 cfm at sea level at less than 50°C
Shock and Vibration	MIL-E-5400

TYPICAL PERFORMANCE CHARACTERISTICS:



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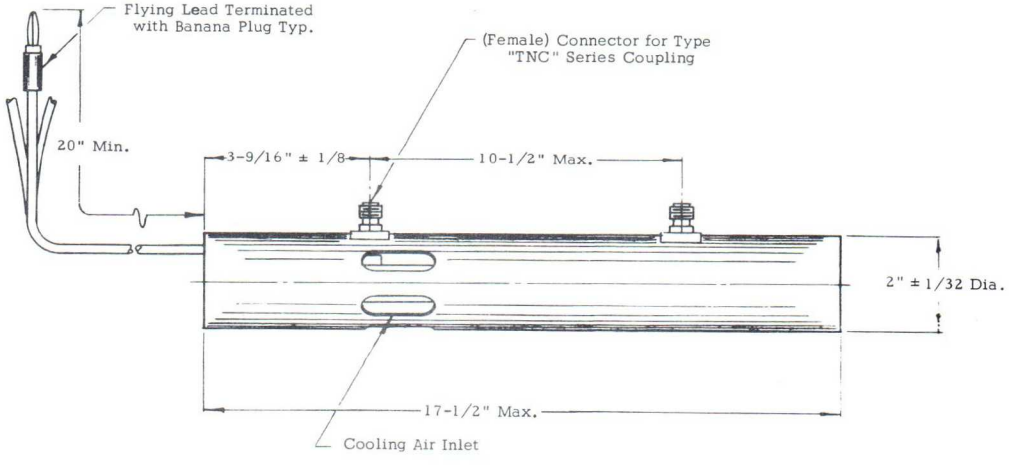


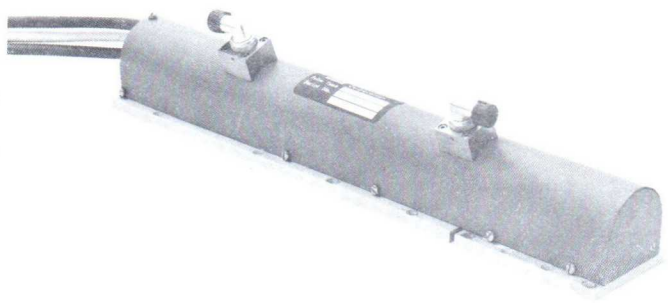
HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN
(Tentative)

M5349

August 15, 1965



Traveling-Wave Tube
Type M5349
5 – 11 Gc, 10 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	5 - 11 Gc	5 - 11 Gc
Saturated Power Output	10 w (min)	10 w
Gain at 100 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix & Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-3.1 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	90 ma	2.0 ma	15 ma	90 ma
Nominal Voltage	6.3 v	-2.8 kv	+175 v	Ground	-1.0 kv
Nominal Current	1.6 a	70 ma	0.5 ma	10 ma	65 ma
Minimum Voltage	5.5 v	-2.5 kv	+100 v	Ground	-1.2 kv
Minimum Current	1.3 a	50 ma	0	0	45 ma

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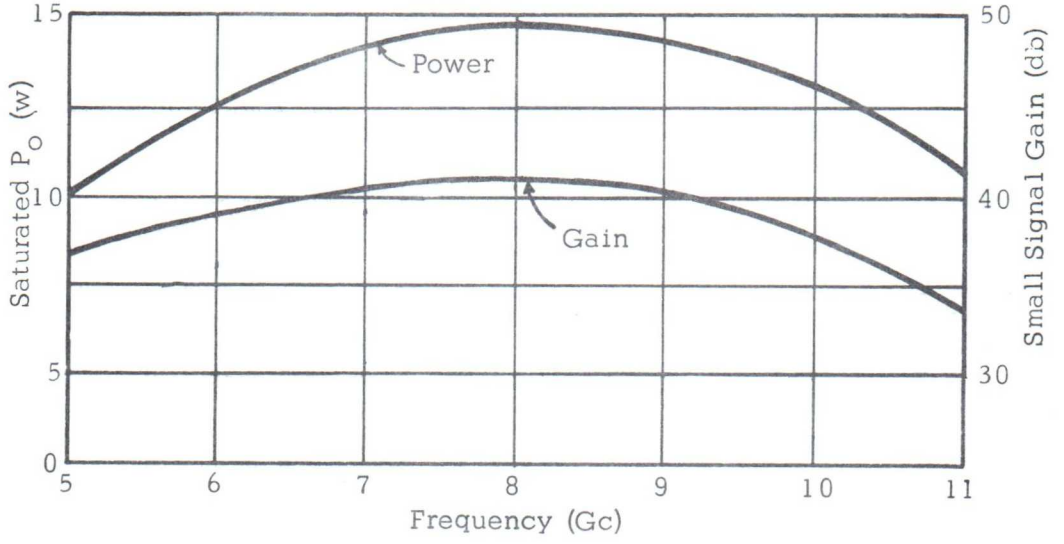
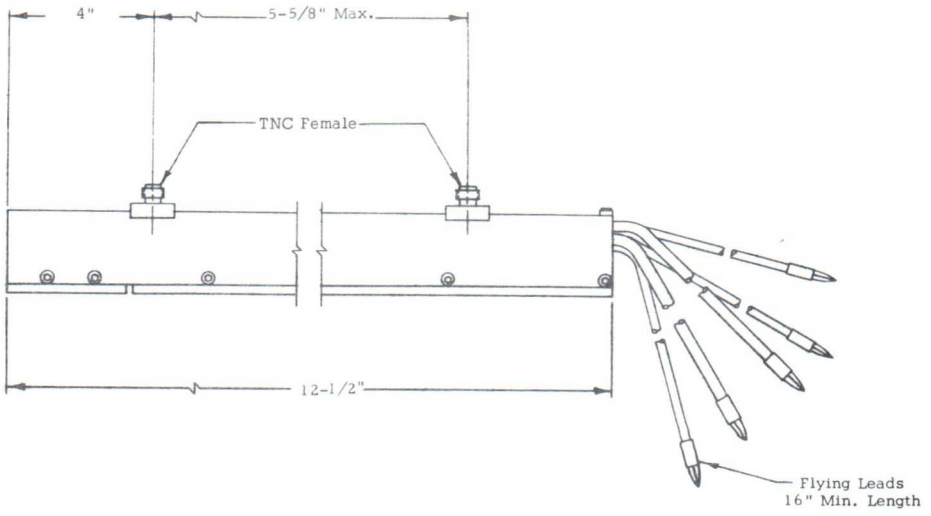
MECHANICAL CHARACTERISTICS:	
Weight	4 1/2 Pounds
Length	12 1/2 Inches
Height	2 Inches
Widht	2 1/2 Inches
RF Connectors	TNC Female
DC Connectors	Flying Leads
Cooling	Conduction Cooled – Heat Sink kept below 100°C
Environmental	MIL-E-5400, Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:



OUTLINE DRAWING:



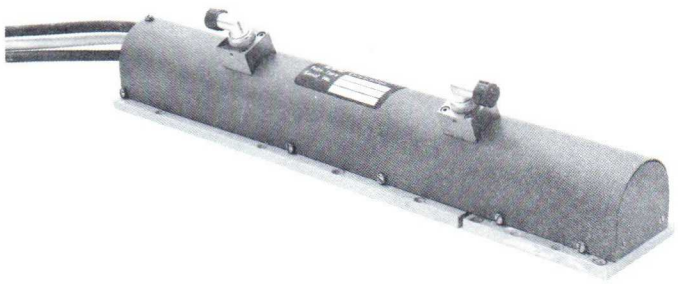
HIGH-POWER TWT

MEC

ENGINEERING DATA BULLETIN

July 31, 1965

M5350



Traveling-Wave Tube
Type M5350
5 — 11 Gc, 20 Watts CW
30 db Gain, PPM Focused
Metal-Ceramic Vacuum Envelope
Conduction Cooled
MIL-E-5400 Class 2

RF PERFORMANCE:

	Guaranteed	Typical
Frequency Range	5 — 11 Gc	5 — 11 Gc
Saturated Power Output	20 w (min)	20 w
Gain at 20 Watts Out	30 db (min)	30 db
Small Signal Gain	33 db (min)	36 db
Noise Figure	35 db (max)	30 db
Input VSWR	3.0:1 (max)	2.0:1
Beam Voltage Phase Sensitivity	---	1°/v
Beam Voltage Power Sensitivity	---	0.01 db/v

ELECTRICAL CHARACTERISTICS:

	Element				
	Heater	Heater Cathode	Anode	Helix Capsule	Collector
Lead Color	(Brown)	(Yellow)	(Blue)	(Black)	(Red)
Maximum Voltage	7.0 v	-4.1 kv	+300 v	Ground	Ground
Maximum Current	1.8 a	120 ma	2.0 ma	15 ma	120 ma
Nominal Voltage	6.3 v	-3.8 kv	+175 v	Ground	-1.3 kv
Nominal Current	1.6 a	95 ma	0.5 ma	10 ma	90 ma
Minimum Voltage	5.5 v	-3.5 kv	+100 v	Ground	-1.5 kv
Minimum Current	1.3 a	75 ma	0	0	70 ma

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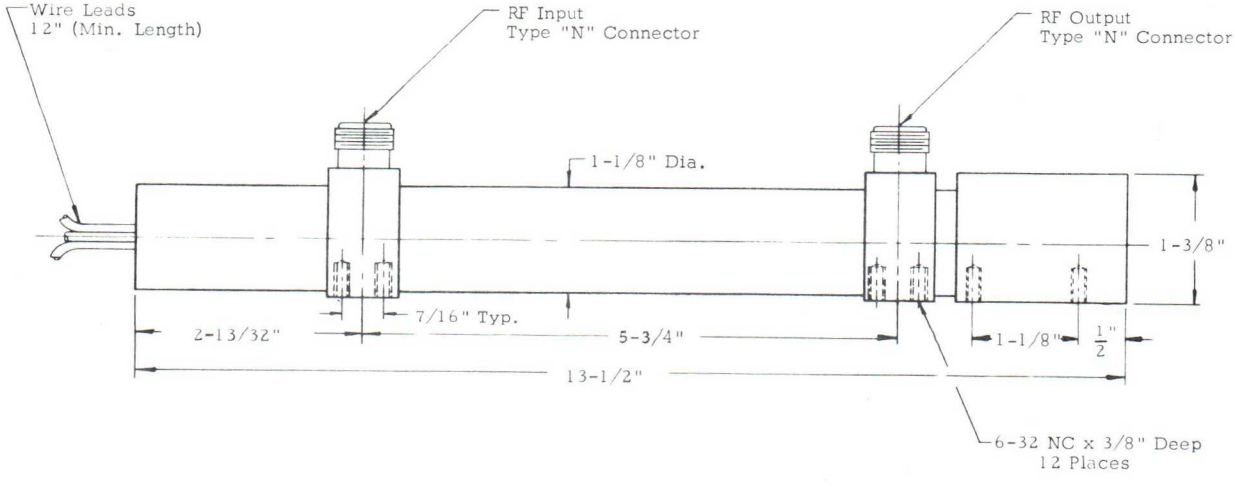
MECHANICAL CHARACTERISTICS:

Parameter	
Weight	4.5 Pounds
Length	13.5 Inches
RF Connectors	N
DC Connectors	Flying Leads
Cooling	Conduction
Environmental	MIL-E-5400 Class 2

TYPICAL PERFORMANCE CHARACTERISTICS:

OUTLINE DRAWING:



HIGH POWER TWTs

Fig. 1.

INTRODUCTION

MEC is a leading source for high power traveling wave tubes across the microwave spectrum. In L, S, C, and X-bands, 100 and 200 watt fully militarized tubes have been delivered for ECM, telemetry, and communications systems. For satellite communications ground stations, TWTs, providing more than 12 Kw of cw power, have been delivered. In addition, a broad band augmentation amplifier, capable of operating at the 20 watt level, has been completed.

The 20, 100, and 200 watt tubes are fully environmentalized and can operate up to 70,000 feet. They are lightweight, PPM focused, and deliver rated performance at efficiencies exceeding 20%. The vacuum envelopes are of metal-ceramic construction; and conduction cooled versions can operate with heat sink temperatures up to 100°C. These classes of tubes are also available in liquid and air cooled formats. See Fig. 1.

MEC maintains a continuing development program in high power TWTs with emphasis on broadening frequency coverage, increasing power, and reducing size and weight. As a part of this program, several advanced concepts in the design and assembly of interaction structures for high power TWTs have been successfully implemented. In addition, MEC has established capability for scaling power level, frequency, and other parameters for specialized requirements.

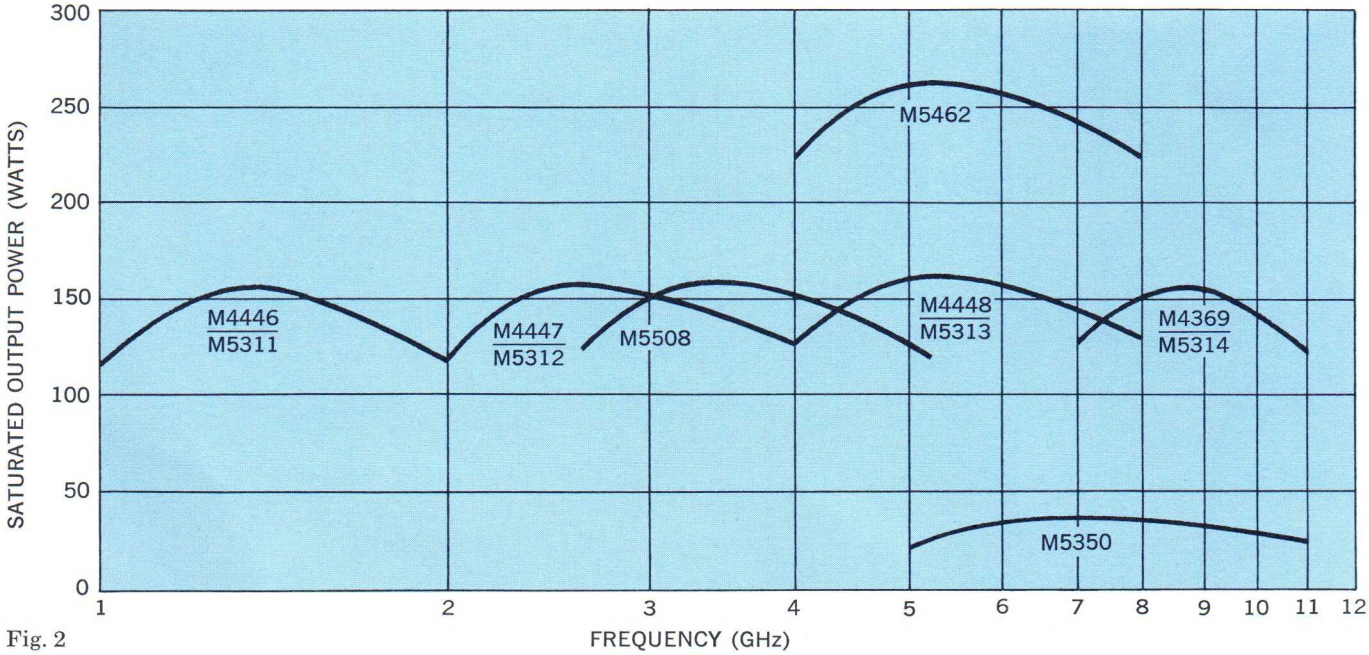


Fig. 2

MEC HIGH POWER TWTs

INTERACTION STRUCTURES

Unlike low power TWTs, which ordinarily use a helix for the interaction structure, high power TWTs use several different interaction structures, depending on the power levels and frequency range.
These structures include:

The simple helix
The ring-bar helix
The coupled cavity circuit

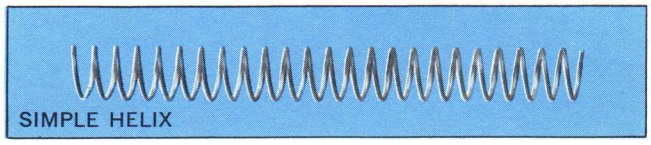
The simple helix is an ideal broadband device for low level TWTs; however, as power levels increase, this type of structure becomes unstable and is not useful for microwave amplification. Space harmonic modes of propagation become dominant and preclude effective amplification of forward traveling waves. To overcome this limitation, alternate structures are required. These structures must be capable of amplifying wideband signals, of operating without oscillating, while also being capable of dissipating high average powers.

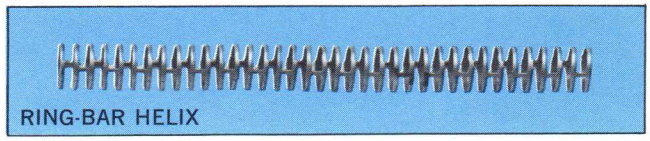
At power levels of 100 and 200 watts the helix *is* a stable structure; however, above the kilowatt level, a different structure is required. Depending on the design considerations, either a ring-bar helix or a coupled cavity structure is necessary. For an illustrated comparison of these structures, see Fig. 2.

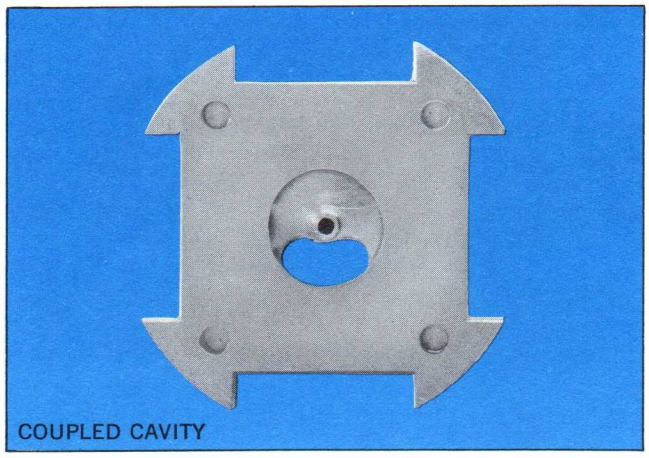
The coupled cavity structure is suitable for very high average power levels at the higher frequency (C-band and above); however, it is ordinarily limited to 20% or 30% bandwidth. The structure does have the important capability of operating at extremely high average powers —for example, 15 Kw of Cw power at X-band has been demonstrated.

Generally the interaction structure is the key component of the TWT. MEC has a variety of electron guns, focusing structures, and mechanical formats that can be adapted to most tubes.

Figure 3 illustrates the types of structures used at various frequencies and power levels. The chart depicts several "gray areas" where performance can be satisfied by more than one structure. In these cases, the overall design considerations and the ultimate use of the device help the tube designer select the proper structure. In situations where the requirements do not fit an existing design exactly, an interaction structure can usually be scaled, precluding an extensive design. MEC is experienced in modifying all three classes of structures—simple helix, ring-bar helix, and coupled cavities.







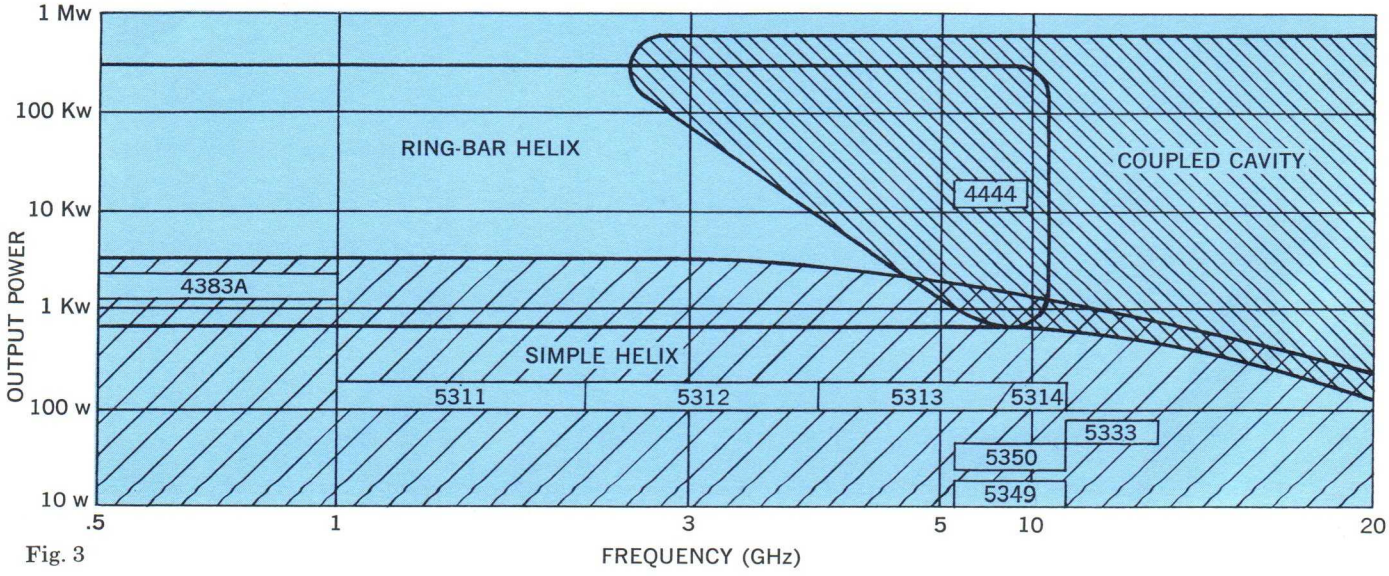


Fig. 3

ENVIRONMENTAL INTEGRITY

All MEC high power tubes are designed for application in severe environments. They are available in either conduction cooled, liquid cooled, or air cooled formats; full MIL-spec compliance is standard; and most tubes satisfy the requirements of MIL-E-5400 Class II. MEC tubes are used in the most advanced systems "on the line" today. Special heat sink configurations are available, some featuring quick disconnect cooling connectors.

INTEGRAL POWER SUPPLY CAPABILITY

MEC now offers militarized power supplies for its complete line of 20, 100, and 200 watt tubes. These supplies, completely solid state, offer the systems designer a lightweight, highly efficient, dependable combination designed for operation with a particular class of device. Typical performance characteristics are:

Efficiency	80% (worst case)
Ripple	1 volt rms.
Regulation	1%
Environment	MIL-E-5400 Class II

Representative supplies are illustrated in Figs. 5 and 6. These supply packages, combined with the appropriate TWT, provide all of the necessary components to make a highly reliable TWT amplifier. In most cases, only the primary power and rf cabling connections are required. Because of the combinations of TWTs and power supplies offered by MEC, the system designer can adapt a tube to a system, rather than adapt a system to a tube.

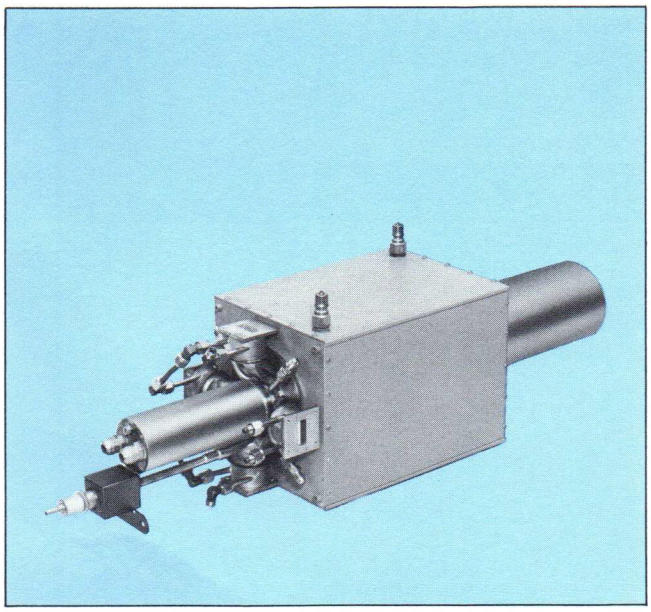


Fig. 4. 12 Kilowatt cw, 7.7-8.4 GHz TWT, Model M-4444

The M4444 is designed for use as a highly efficient, broad band, transmitting tube for satellite communications ground terminals. With depressed collector operation, efficiency is greater than 35%, and the instantaneous bandwidth is an order of magnitude greater than that of a klystron.

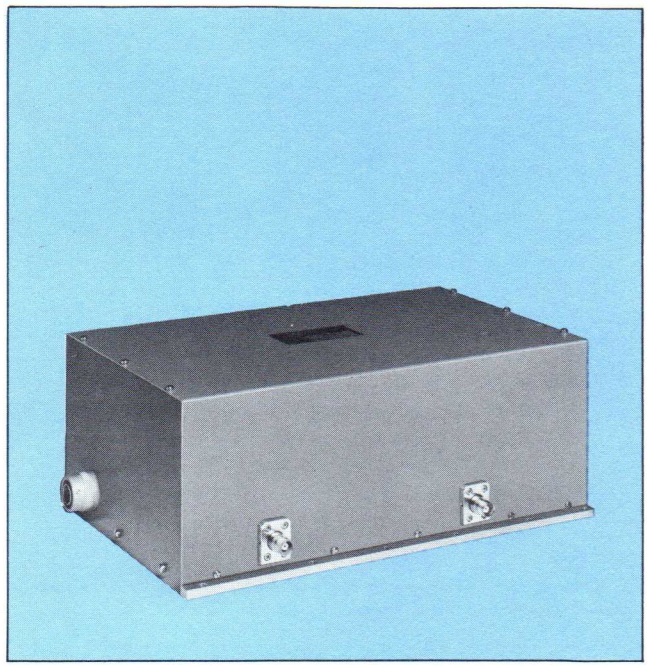


Fig. 5. 100 Watt 7-11 GHz Amplifier

This package is a combination of a 100 watt PPM focused, metal-ceramic TWT and its companion solid state power supply. Both tube and supply are capable of operating in MIL-E-5400 Class II environments, and the package will deliver rated performance with heat sink temperatures up to 100° C. Depressed collector operation of the TWT provides over 20% efficiency. Size: 5 x 8 x 13 inches. Weight: 22 pounds.

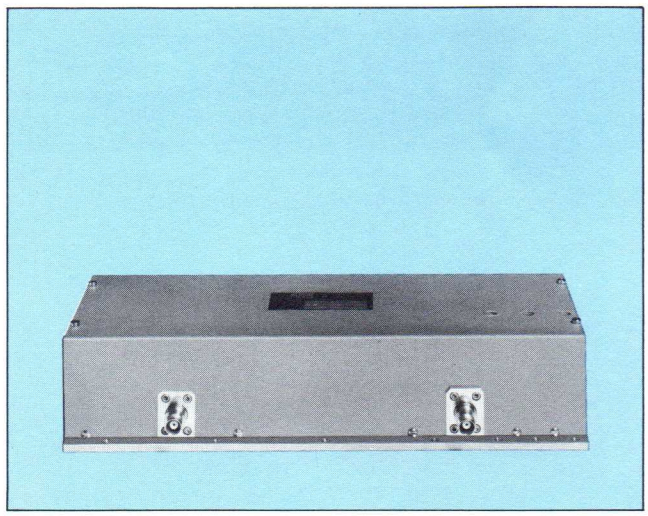


Fig. 6. 20 Watt 5-11 GHz Amplifier

This tube/solid state power supply combination was developed for medium power electronic warfare, radar augmentation, or laboratory systems. The combination will deliver rated performance in MIL-E-5400 Class II environments with heat sink temperatures up to 100° C. Size: 3 x 5 x 12 inches. Weight: 11 pounds.

MEC HIGH POWER TWTs

Tube Category	Electronic Characteristics	Electrical/Mechanical	Applications
100—1 Kw CW	Octave bandwidths 30 db minimum saturated gain 20% efficiency with depressed collector operation	Conventional helix structure Metal-ceramic, PPM focusing, modulating anode. MIL-E-5400 versions use liquid-cooled heat sinks	ECM Telemetry Communications Doppler radar
1-10 Kw Pulsed	Octave bandwidths 30-40 db gain levels 10-15% efficiency	High-μ and aligned-grid guns reduce grid current to 2% of cathode current MIL-E-5400 versions	ECM
12 Kw CW	7.7 to 8.4 GHz 30% efficiency with depressed collector operation 35 db gain Can be sealed to other frequency bands	Coupled-cavity structure Liquid-cooled Solenoid focusing	Satellite communications Troposcatter systems Doppler radar

Fig. 7.

FIELD UTILIZATION

All MEC high power tubes are fully magnetically shielded; that is, any tube can be placed in *any* position with respect to any other tube without affecting the performance of either device. MEC high power tubes can be cooled in a variety of ways; however, in military systems, conduction cooling is most often used. In this case, the heat sink temperature may rise to 100°C without degrading performance. Classified programs are being conducted to investigate alternate cooling methods and to improve the heat transfer characteristics of the interface between the interaction structure and the supporting vacuum envelope. Discussions of these techniques will be handled on a "need to know" basis. Version of high power tubes cooled by air flow or liquid are also available as standard items.

PRODUCTION CAPABILITY

The table in Figure 7 illustrates a cross section of MEC's product line. Our manufacturing facilities are geared to volume production on a regularly scheduled basis, as well as for quick reaction. Special models, designed for prototype evaluation, are also handled promptly; and our applications engineering staff is ready to assist you with your design problems.

Across the frequency/power spectrum, MEC has demonstrated the ability to design, develop, and produce TWTs which operate from 500 MHz to 20 GHz and which develop powers ranging from 20 watts to tens of kilowatts. Performance data, covering many of these tubes, is available. We invite your inquiry about our capability.

Microwave Electronics
a Division of Teledyne, Inc.
3165 Porter Drive
Palo Alto, California

HIGH-POWER TWT PRODUCT LINE

Type	Band	Freq. (Gc)	Peak Power Output	Maximum Duty	Saturation Gain (db)	Grid	Focusing	Typical Cathode Voltage (kv)	Typical Cathode Current (amps)	Depressed Collector Voltage (Cathode Collector Voltage) (kv)	Grid Bias (vdc)	Grid Pulse (Above Bias) (vdc)	Cooling	Length (ins.)	Weight (lbs.)	Remarks
M4383A	P	0.5 – 1.0	1 kw	1%	30	Yes	PPM	8.5	2.0	6.0	-60	350	Air 10 cfm at sea level	40	45	Operates to MIL-E-5400 Class II with standard vane-axial fan
M4446	L	1 – 2	100 w	CW	30	No	PPM	2.65	0.350	1.7	---	---	Air 60 cfm at sea level	23	5	Tentative
M5311		1 – 2	100 w	CW	30	No	PPM	2.65	0.350	1.7	---	---	Keep heat sink below 100°C	24	7.5	Tentative
M4447	S	2 – 4	100 w	CW	30	No	PPM	3.7	0.285	2.4	---	---	Air 60 cfm at sea level	17	3.5	
M5312		2 – 4	100 w	CW	30	No	PPM	3.7	0.285	2.4	---	---	Keep heat sink below 100°C	18	6.0	Meets full MIL-E-5400 Class II environment
M4448	C	4 – 8	100 w	CW	30	No	PPM	3.7	0.260	3.0	---	---	Air 60 cfm at sea level	12	2.25	Tentative
M5348		4 – 8	100 w	CW	30	No	PPM	6.0	0.170	4.0	---	---	Air 60 cfm at sea level	18	3.5	
M5313		4 – 8	100 w	CW	30	No	PPM	6.0	0.170	4.0	---	---	Keep heat sink below 100°C	18	6.0	Meets full MIL-E-5400 Class II environment
M5349	C-X	5 – 11	10 w	CW	30	No	PPM	2.8	0.070	1.8	---	---	Heat sink	12.5	4.5	Tentative
M5350		5 – 11	20 w	CW	30	No	PPM	3.8	0.095	2.5	---	---	Heat sink	13.25	4.5	MIL-E-5400 Class II
M5333	X	10.5 – 12.5	35 w	CW	40	No	PPM	4.0	0.100	2.6	---	---		11.25	3	MIL-E-5400 Class II
M4369		7 – 11	100 w	CW	30	No	PPM	6.0	0.170	4.0	---	---	Air 60 cfm at sea level	12.5	2.5	
M5314		7 – 11	100 w	CW	30	No	PPM	6.0	0.170	4.0	---	---	Keep heat sink below 100°C	13.75	5.5	Meets full MIL-E-5400 Class II environment
M4444		7.7–8.4	12.5 kw	CW	34	No	Solenoid	18.0	3.0	13	---	---	Water 10 gpm at 100 psi	18	125	Weight includes solenoid

For further information contact:

Microwave Electronics Corporation

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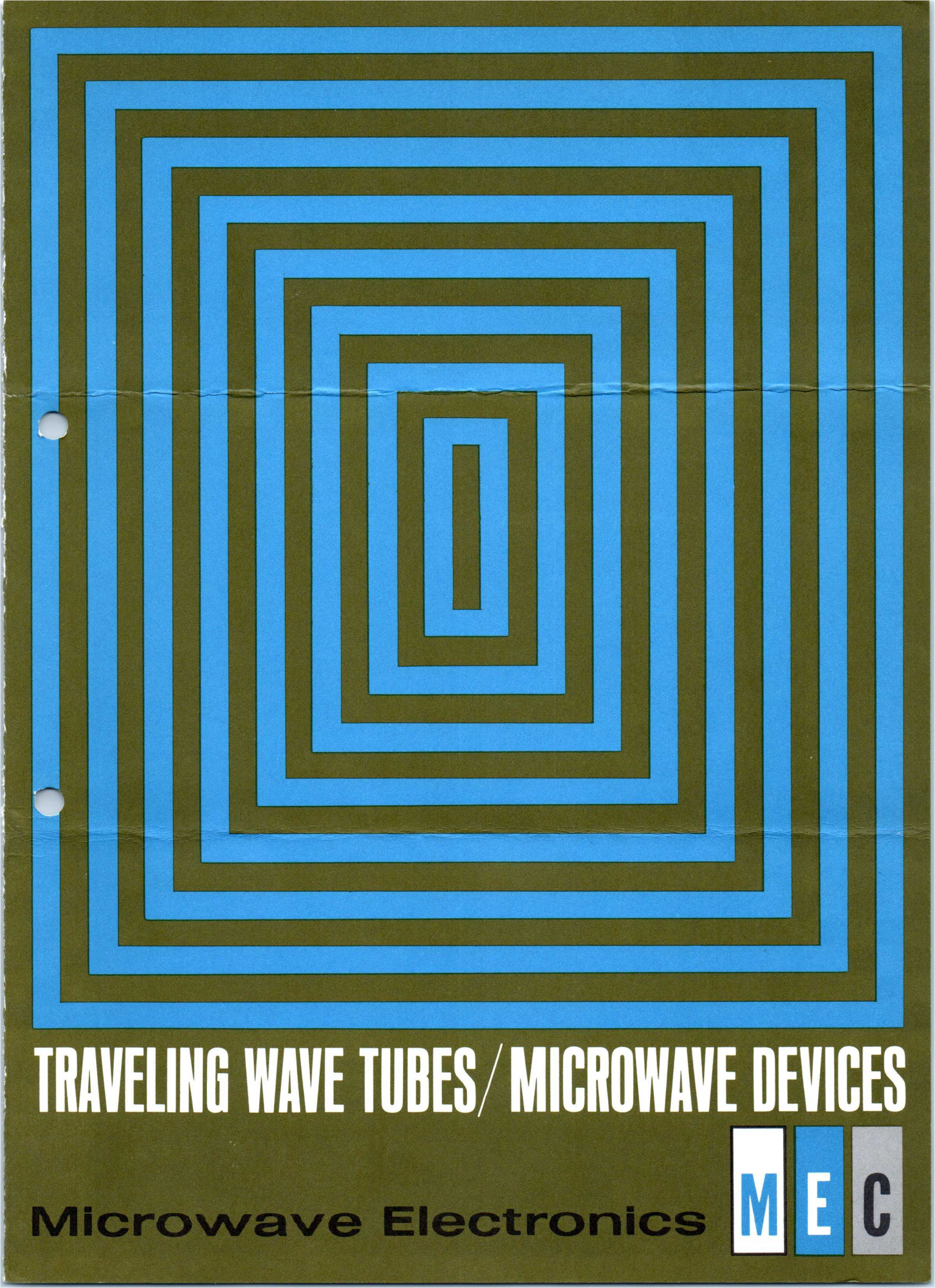


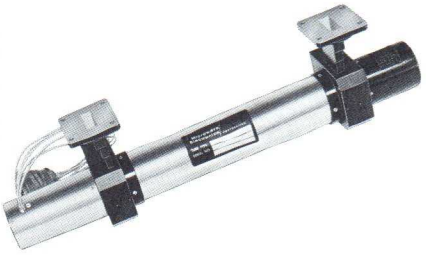
TRAVELING WAVE TUBES / MICROWAVE DEVICES

Microwave Electronics

MEC

MEC

CAPABILITY MEC manufactures a broad line of metal ceramic traveling wave tubes, backward wave oscillators, and solid state delay devices—many with compatible power supplies. This capability enables a designer to select from a range of devices which operate from UHF through K_a bands in frequency—and from low noise, low power through the 100 watt CW level and 1 kilowatt pulsed power. All MEC products offer high reliability, long life and reproducibility based upon conservative engineering and precision manufacturing techniques.



Tube Type	Band	Freq. Range (GHz)	Min. Po (dbm)	Min. SSG (qp)	Max. NF (db)
M 5351	P	0.5-1.0	10.0	30	20
M 5352	L	1.0-2.0	10.0	30	15
M 5367	L	1.0-2.0	13.0	30	20
M 5387	L	1.0-2.0	10.0	30	20
M 5341	S	2.0-4.0	10.0	30	20
M 5353	S	2.0-4.0	10.0	30	15
M 5368	S	2.0-4.0	13.0	30	20
M 5362	S	2.3-4.45	10.0	30	15
M 5371	S	2.3-4.45	13.0	30	20
M 5389	C	4.0-8.0	10.0	30	20
M 5354	C	4.0-8.0	10.0	30	15
M 5369	C	4.0-8.0	13.0	30	20
M 5391	X	7.0-12.4	10.0	30	20
M 5390	X	7.0-11.0	10.0	30	20
M 5355	X	7.0-11.0	10.0	30	15
M 5370	X	7.0-11.0	13.0	30	20

LOW POWER TWTs

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. Po (dbm)
M 5356	L	1.0- 2.6	12	30	7
M 2102G	L	1.0- 2.6	13	25	7
M 2102F2	L	1.0- 2.0	11	25	7
M 5357	S	2.0- 4.0	10	30	10
M 5388	S	2.0- 4.0	10	30	10
M 5397	S	2.0- 4.0	12	30	10
M 5363	S	2.3-4.45	10	30	10
M 5358	C	4.0- 8.0	10	30	10
M 5399	X	7.0-11.0	10	30	10
M 5359	X	7.0-11.0	11	30	10
M 5361	X	7.0-12.4	12	30	10
M 5360	X	8.0-12.4	12	30	10
M 2114I	Ku	11.8-18.2	17	30	7
M 5364	Ku	12.0-18.0	12.5	25	5
M 5318	Ku	12.0-18.0	14	25	3
M 5365	K	18.0-26.0	13	25	5
M 5366	Ka	26.0-40.0	16	25	3

LOW NOISE TWTs

Tube Type	Band	Freq. Range (GHz)	Min. Po (watts)	Min. SSG (db)	Max. NF (db)
M 4268	L	1.0-2.0	1	30	30
M 5375	L	1.0-2.0	2	30	30
M 4260	S	2.0-4.0	1	30	30
M 5376	S	2.0-4.0	2	30	30
M 5379	S	2.5-4.0	2	41 (max)	N. A.
M 4278	C	4.0-8.0	1	30	30
M 5377	C	4.0-8.0	2	30	30
M 4273	X	7.0-12.4	1	30	30
M 5378	X	8.0-11.0	2	41 (max)	N. A.
M 5046	Ku	12.4-18.0	3	30	35

MEDIUM POWER TWTs

HIPOLON TWTs

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. Po (dbm)
M 5380	S	2.0- 4.0	15	30	27
M 5328	X	7.0-11.0	27	43	33
M 5398	X	7.0-11.0	22	43	33

MINIATURE TWTs

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. Po (dbm)	RF Connector (Type)
M 5388	S	2.0-4.0	10	30	10	OSM
M 5397	S	2.0-4.0	12	30	10	OSM
M 5383	S	2.0-4.0	25	10	10	OSM
M 5384	C	4.0-8.0	27	10	10	OSM
M 5364	Ku	12.0-18.0	12.5	25	5	WG
M 5365	K	18.0-26.0	13	25	5	WG
M 5366	Ka	26.0-40.0	16	25	3	WG

GUARANTEE MEC offers one of the most liberal service guarantees in the industry. This policy is continually being updated and improved, as the performance history on a given type of device is accrued.

HIGH POWER TWTs

Type	Band	Freq. Range (GHz)	Peak Power Output	Maximum Duty	Saturation Gain (db)	Grid	Focusing	Cooling	Remarks
M 4383A	P	0.5–1.0	1 kw	1%	30	Yes	PPM	Air 10 cfm at sea level	Operates to MIL-E-5400 Class II with standard vane-axial fan
M 4446	L	1–2	100 w	CW	30	No	PPM	Air 60 cfm at sea level	Tentative
M 5311		1–2	100 w	CW	30	No	PPM	Keep heat sink below 100°C	Tentative
M 4447	S	2–4	100 w	CW	30	No	PPM	Air 60 cfm at sea level	
M 5312		2–4	100 w	CW	30	No	PPM	Keep heat sink below 100°C	Meets full MIL-E-5400 Class II environment
M 4448	C	4–8	100 w	CW	30	No	PPM	Air 60 cfm at sea level	Tentative
M 5348		4–8	100 w	CW	30	No	PPM	Air 60 cfm at sea level	
M 5313		4–8	100 w	CW	30	No	PPM	Keep heat sink below 100°C	Meets full MIL-E-5400 Class II environment
M 5349	C-X	5–11	10 w	CW	30	No	PPM	Heat sink	Tentative
M 5350		5–11	20 w	CW	30	No	PPM	Heat sink	MIL-E-5400 Class II
M 5333	X	10.5–12.5	35 w	CW	40	No	PPM	Heat sink	MIL-E-5400 Class II
M 4369		7–11	100 w	CW	30	No	PPM	Air 60 cfm at sea level	
M 5314		7–11	100 w	CW	30	No	PPM	Keep heat sink below 100°C	Meets full MIL-E-5400 Class II environment
M 4444		7.7–8.4	12.5 kw	CW	34	No	Solenoid	Water 10 gpm at 100 psi	Weight includes solenoid, 125 lbs.

Tube Type	Band	Freq. Range (GHz)	Min. Po (watts)	Min. SSG (db)	Max. NF (db)
M 5381	L	1.0- 2.0	1	40	—
M 5349	C-X	5.0-11.0	10	30	—
M 5350	C-X	5.0-11.0	20	30	35
M 5123	C-X	5.4-11.0	1	60	35

AUGMENTOR TWTs

CONSTRUCTION MEC construction features a helix rigidly supported by ceramic rods over its entire length. Critical turn spacing is accurately maintained to assure uniform gain characteristics from tube to tube. Indeed, repeatability from tube to tube is a leading attribute of MEC construction. MEC tubes can be operated in any position with no degradation in performance.

Tube Type	Band	Freq. Range (GHz)	Max. NF (db)	Min. SSG (db)	Min. Po (dbm)	Application
M 4429	S-Ku	2.0-16.0	37	12	17	Wideband Amplifier
M 5383	S	2.0- 4.0	25	10	10	Miniature Matched Gain
M 5384	C	4.0- 8.0	27	10	10	Miniature Matched Gain
M 5140	S	2.0- 4.0	15	30	0	Matched Gain and Phase
M 4325	S	2.0- 4.0	30	25	10	Phase Matched
M 5216	X	7.5-10.5	15	27	-28	Limiter Input
M 5217	X	7.5-10.5	30	35	9	Limiter Driver
M 5122	S	2.0- 3.0	15	20	..	Serrodyne
M 5236	X	7.0-10.0	30	20	10	Serrodyne
M 5127	X	8.9- 9.2	..	25	10	Serrodyne
M 5403	S-C-X	2.5-12.4	35	30	27	Wideband Amplifier
M 5144	X	8.0-12.0	10	30	10	Phase Shifter

SPECIAL PURPOSE TWTs

PPM BACKWARD WAVE OSCILLATORS

Type	Band	Freq. Range (GHz)	Min. Power Output (mw)	Max. Po Variation (db)	Load VSWR (max.)	Max. Cathode Current (ma)	Helix Voltage Range (vdc)	Max. Helix Current (ma)	Modulation Sensitivity	Length (ins.)	Weight (oz.)	Environment	Remarks
M 5248	S	2–4	30	6	2.5:1	15	325–1600	7	2.0 ± 0.5 Mc/v at 4.0 Gc 3.5 ± 0.5 Mc/v at 2.0 Gc	14	18	MIL-E-5400 Class 2	Full Magnetic Shielding
M 5249	C	4–8	30	6	2.5:1	15	325–1600	7	2.0 ± 0.5 Mc/v at 8.0 Gc 5.0 ± 0.5 Mc/v at 4.0 Gc	10½	14	MIL-E-5400 Class 2	Full Magnetic Shielding
M 5250	X	8–12.4	30	6	2.5:1	12	600–1850	6	3.0 ± 0.5 Mc/v at 12.4 Gc 5.0 ± 0.5 Mc/v at 8.0 Gc	8¼	11	MIL-E-5400 Class 2	Full Magnetic Shielding
M 5251	Ku	12.0–18.0	10	6	2.5:1	10	600–1750	5	4.5 ± 0.5 Mc/v at 18.0 Gc 7.0 ± 0.5 Mc/v at 12.4 Gc	7¼	10	MIL-E-5400 Class 2	Full Magnetic Shielding

SOLID STATE DELAY DEVICES

Frequency Band	Typical Delay (min.-max.)	Typical Bandwidth/Loss Narrowband	Broadband	Typical Size Dia. x Length	Typical Weight
UHF	20 μsec (½–40)	10%/40 db	Octave/60 db	2 x 7 inches	14 oz
L	10 μsec (½–20)	10%/45 db	50%/65 db	1.5 x 5 inches	10 oz
S	5 μsec (½–10)	10%/50 db	40%/70 db	1 x 4 inches	8 oz
C	3 μsec (½– 6)	6%/60 db	30%/80 db	1 x 3 inches	6 oz
X	2 μsec (½– 4)	3%/95 db	20%/95 db	1 x 3 inches	6 oz

Specifications subject to change without notice.

Microwave Electronics

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AN ADDITIONAL WORD ABOUT CAPABILITY

The products listed on the preceding pages reflect the general product line of MEC. However, this catalog gives only a representative sample of the scope of frequency ranges, power levels and types of devices currently in production. Many companion devices are also being produced which incorporate modifications to satisfy special requirements. In addition, developmental programs are underway to improve and supplant many of today's standards.

MEC always strives to maintain its leadership in the development and production of microwave devices, and total performance has been our hallmark. In the past, however, emphasis was on low and medium power TWTs. But, as this catalog indicates, the same kind of developmental skill and production flexibility also exists in the solid state and in the high power area.

We welcome your inquiry, and we would be pleased to be given an opportunity to satisfy your requirements, whether they be major production programs, QRC programs or a state of the art effort.

Our representatives are ready to help.

MEC REPRESENTATIVES

NAME	STATE
Aertronics Associates 5899 Huberville Avenue Dayton, Ohio 45431 (513) 253-8144	Michigan, Ohio, Kentucky
Ahearn & Soper, Ltd. 844 Caledonia Road Toronto 19, Ontario, Canada (416) 789-4325	Canada
Electronic Marketing Assoc. 11411 Amherst Avenue P. O. Box 1707 Wheaton, Maryland (301) 946-0300	West Virginia, Virginia, Maryland, Delaware, Washington, D. C.
Gawler-Knoop Company 14 Beaufort Avenue Roseland, New Jersey 07068 (201) 226-4545	Pennsylvania, New Jersey, Long Island, New York City
Gentry Associates 2517 B East Colonial Drive P. O. Box 11096 Orlando, Florida 32803 (305) 424-0730	Mississippi, Louisiana, Alabama, Georgia, Florida, Tennessee, North Carolina, South Carolina
George Gregory Associates 7 Erie Drive Natick, Massachusetts (617) 235-9070	Massachusetts, Connecticut, Vermont, New Hampshire, Maine
Harry Levinson Company 1211 East Denny Way Seattle, Washington (206) 323-5100	Washington, Oregon
NACO Electronics Corp. 119 Luther Avenue Liverpool, New York 13088 (315) 474-7481	New York State
H. G. Pretat, Inc. 7716 West North Avenue Elmwood Park, Illinois 60635 (312) 453-3380	Iowa, Illinois, Indiana

NAME	STATE
Scott Electronic Sales 5209 West 60th Street Minneapolis, Minnesota (612) 929-2985	North Dakota, South Dakota, Minnesota, Wisconsin
Simpson Enterprises P. O. Box 3066 Southeast Station Wichita, Kansas (316) 943-0502	Nebraska, Kansas, Missouri
Jay Stone Associates 140 Main Street Los Altos, California (415) 948-4563	Northern California
The Thorson Company 6824 Melrose Avenue Los Angeles, California 90038 (213) 937-0790	Southern California, Nevada
The Thorson Company 2505 East Thomas Road Phoenix 16, Arizona (602) 264-5878	Arizona, New Mexico
The Thorson Company 3600 South Lincoln Street Englewood, Colorado (303) 789-1841	Colorado, Utah, Wyoming, Montana, Idaho
The Thorson Company 7700 Carpenter Freeway Dallas, Texas 75247 (214) 631-5440	Texas, Oklahoma, Arkansas
Frazar & Hansen, Ltd. 150 California Street San Francisco 11, California (415) 981-5262	Export

Microwave Electronics

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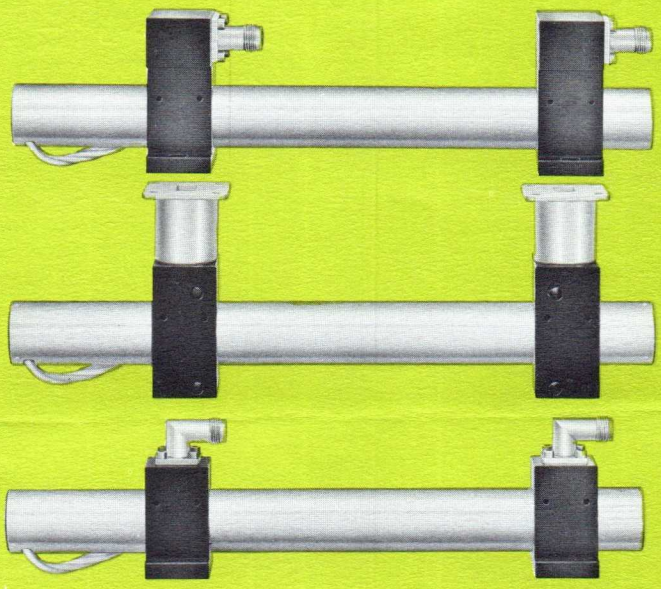
INTERNATIONAL DEPARTMENT • FRAZAR & HANSEN LTD., 150 CALIFORNIA STREET, SAN FRANCISCO 11, CALIF., U.S.A.

AUGUST, 1962

PRODUCTION ENGINEERED TRAVELING WAVE TUBES

MEC



MICROWAVE ELECTRONICS CORPORATION

PALO ALTO, CALIFORNIA

about MEC

Microwave Electronics Corporation was formed early in 1959 to provide a production source of traveling wave tubes of high reliability, long life, and reproducible characteristics. To achieve this end the company has assembled a group combining the scientific skills of electronic design with the manufacturing experience required to convert these designs into reproducible products.

Briefly stated, MEC takes the position that production methods and tooling concepts should be integrated with the electronic design at the outset of any developmental program. Such an approach allows the manufacture of many tubes during initial investigation and encourages complete evaluation of electrical parameters, materials, and problems of fabrication.

This approach has resulted in the broad line of metal ceramic traveling wave tubes described in this catalog. Tube types represented range from L band through K_a band in frequency and from low noise-low power through the 10 watt CW power level and 200 W pulsed.

Among the "firsts" by MEC are broadband, PPM focused low noise TWT's with noise figures below 10 db in S, C, and X bands; a family of broadband PPM focused tubes in K_u band; a 10 watt CW TWT amplifier in X band; a frequency multiplier for operation at 40 kmc, and an operational maser at S band using a closed cycle refrigerator.

WARRANTY

MEC offers one of the best warranties in the TWT industry. Shelf life and operating life are conservatively stated. Expected life is based on "in plant" life tests and field experience, and considerably exceeds the guaranteed warranty.

Low Power Output—500 hrs. unconditional; 2000 hrs. pro-rated.

Medium Power Output—500 hrs. unconditional; 1000 hrs. pro-rated.

Low Noise—500 hrs. unconditional; 1500 hrs. pro-rated.

12 months unconditional shelf life.

The same warranty applies on all replacement instrument tubes. These tubes, available directly from MEC on an expedited basis, are listed in bold face type in this catalog.

TERMS

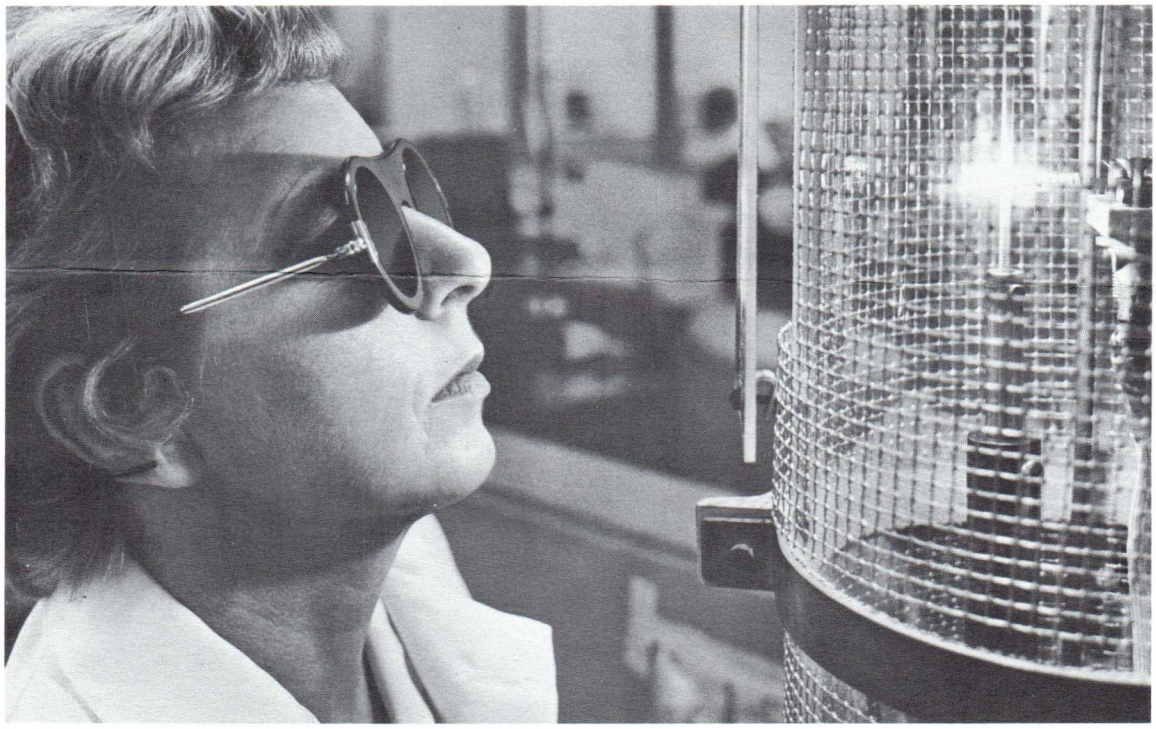
Our normal terms in connection with a standard procurement are as follows:

Payment—Net 30 days from date of invoice.

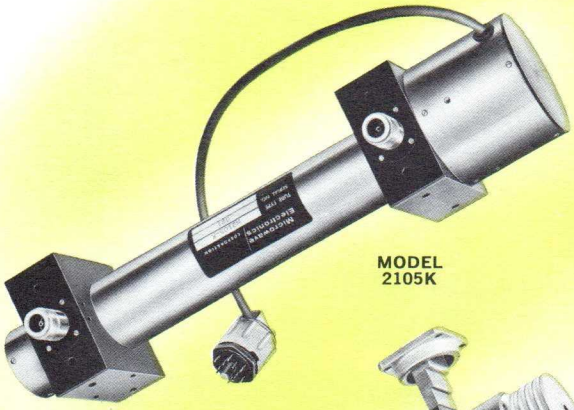
Shipment—F.O.B. manufacturer's plant. Air Express collect unless otherwise specified on the order.

Inspection—Where government source inspection is required, inspection by the local Navy inspection agency having cognizance of our plant shall be used to meet the requirements of the order.

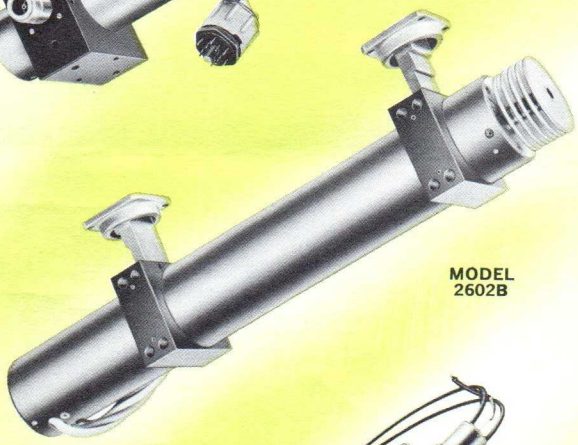
Terms and Conditions of Customer's Purchase Order—Terms and conditions of customer's purchase order in regard to such items as patents, proprietary data, rights in data, quality control procedures, packing and packaging, etc., shall be reviewed by plant personnel prior to acceptance.



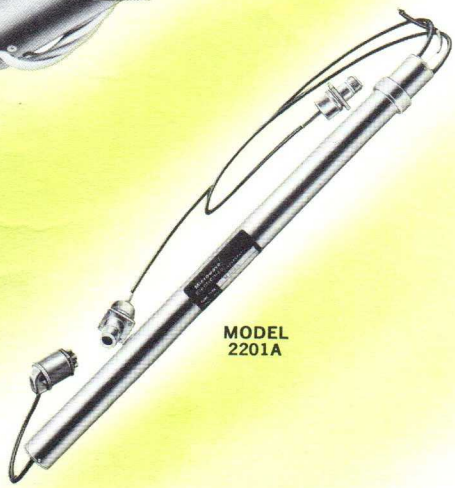
High temperature brazing of metal ceramic seal



MODEL 2105K



MODEL 2602B



MODEL 2201A

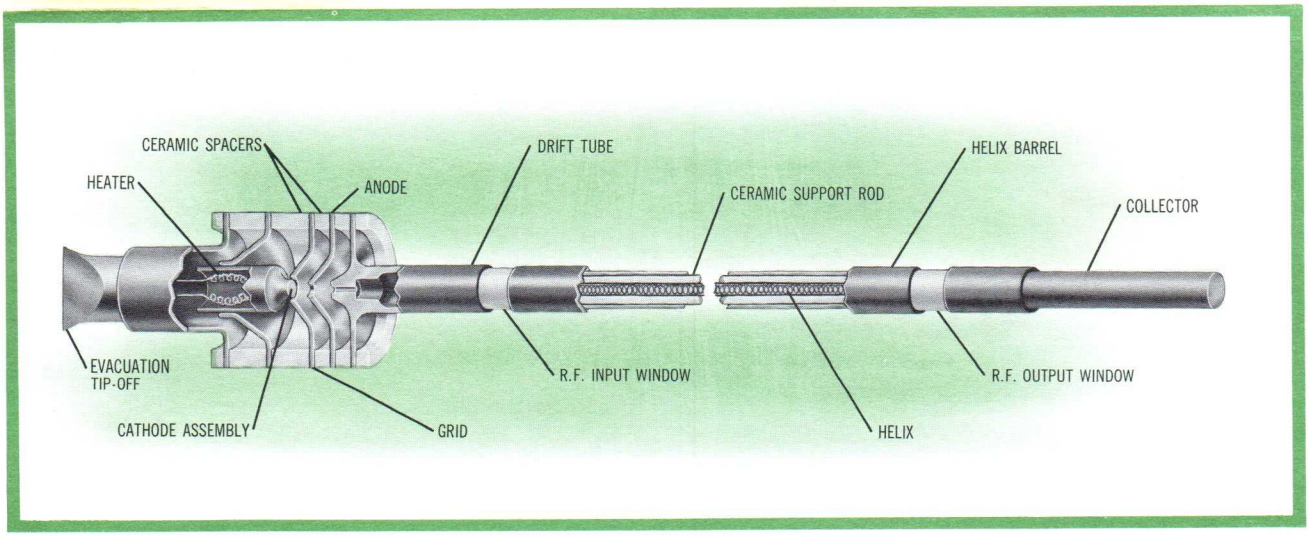
Reliability

...the result of engineering skill and manufacturing care

Because MEC traveling wave tubes feature metal-ceramic construction, they have a headstart on reliability. They are evacuated at elevated temperatures (650°C) and high vacuums which produces a cleaner environment for long cathode life.

Inherently rugged, MEC tubes provide superior performance over environmental extremes. As a result, MEC guarantees all PPM focused tubes and solenoid focused tubes to satisfy the environmental specifications in MIL-T-16400. In addition, all PPM focused tubes can be packaged to satisfy the requirements of MIL-E-5400, Class I or Class II. If necessary, packages designed to satisfy specific military environments are also available.

MEC construction features a helix rigidly supported by ceramic rods over its entire length. Critical turn spacing is accurately maintained to assure uniform gain characteristics from tube to tube. Indeed, repeatability from tube to tube is a leading attribute of MEC construction. MEC tubes can be operated in any position with no degradation in performance.



LOW NOISE TUBES

PPM FOCUSED

	Tube Type	Freq. Range kmc	Max. N.F. db	Min. SS Gain db	Min. Output Power dbm	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anodes: Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Anode 4 vdc	R.F. Connector Type	Outline	Overall L'gth in.	Wgt. lbs.	Environment
L	M2102F	1.0-2.0	11	25	7	200-500	1.5	—50 to 0	0-100	0-300	0-300	0-500	TNC	K	17	7	MS*
	M2102FA	1.1-2.2	12	25	7	200-500	1.5	—50 to 0	0-100	0-300	0-300	0-500	TNC	K	17	7	MS
	M2102G	1.0-2.6	13	25	7	200-500	1.5	—50 to 0	0-100	0-300	0-300	0-500	TNC	K	17	7	MS
	M2102C	1.0-2.0	15	25	7	200-500	1.5	—50 to 0	0-100	0-300	0-300	0-500	TNC	K	17	7	MS
	M5036	1.0-2.0	15	30	7	200-500	1.5	—50 to 0	0-100	0-300	0-300	0-500	TNC	K	17	7	MS
S	M2103K	2.0-4.0	11	35	7	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M2103L	2.0-4.0	11	30	7	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	N	C	16⅜	6½	MS
	M2103V	2.0-4.0	11	25	7	375-450	1.25	—50 to 0	0-100	20-200	20-200	100-300	TNC	K	16	6½	SME*
	M2103Y	2.3-4.45	11	30	7	400-475	1.5	—50 to —8	0-50	0-90	60-270	110-300	TNC	K	16	6½	SME
	M2103NA	2.0-4.0	11	30	7	350-450	2.0	—60 to 0	0-300	0-300	0-300	100-400	N	K	16	6½	MS
	M2103NC	2.0-4.0	11	30	7	350-450	2.0	—60 to 0	0-300	0-300	0-300	100-400	TNC	K	16	6½	SME
	M2103YA	2.3-4.45	11	30	7	400-475	1.5	—50 to —8	0-50	0-90	60-270	100-300	TNC	K	16	6½	MS
	M2103NB	2.0-4.0	13	31	7	300-450	1.5	—50 to 0	0-50	0-90	70-270	100-400	TNC	K	16	6½	SME
	M2103F	2.3-4.45	15	30	10	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M2103P	2.0-4.0	15	30	10	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M2103W	2.0-4.0	15	30	10	375-450	2.25	—50 to 0	0-100	25-200	75-300		TNC	K	16	6½	SME
	M2103C	2.0-4.0	20	30	10	300-500	1.5	—50 to 0	0-150	0-300	0-300		TNC	K	16	6½	MS
	M2103N	2.0-4.0	10	25	7	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M2103Q	2.3-4.45	10	25	7	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M5012	2.0-4.0	20	30	10	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	TNC	K	16	6½	MS
	M2110D	3.2-3.7	10	35	10	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	N	C	17	6½	SME
	M2110DA	2.5-3.4	10	35	10	300-500	1.5	—50 to 0	0-150	0-300	0-300	100-400	N	C	17	6½	SME
C	M2112I	4.0-8.0	11	30	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M2112L	4.0-7.5	11	25	7	700-850	1.55	—50 to 0	20-100	30-150	300-800	100-300	N	A	15¼	6	SME
	M2112O	4.3-7.35	11	30	7	700-850	2.0	—50 to —8	0-50	0-170	70-250	400-600	N	A	15¼	6	MS
	M2112P	4.1-7.0	11	30	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M5030	4.3-7.35	11	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15¼	6	MS
	M5040	4.0-8.0	12	30	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M2112IA	4.0-8.0	13	31	7	700-850	1.55	—50 to 0	0-50	0-170	70-250	200-600	N	A	15	6	SME
	M2112E	4.3-7.35	15	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M2112H	4.0-8.0	15	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M2112M	4.0-7.5	15	30	10	700-850	2.25	—50 to 0	0-100	0-150	300-800		N	A	15¼	6	SME
	M2112K	4.0-8.0	20	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
	M2112HA	5.4-5.9	15	35	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	SME
	M2112HB	5.4-5.9	15	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	SME
	M2112C	5.0-7.0	15	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	C	15	6	SME
	M2109D	4.2-4.7	10	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	TNC	A	15	6	SME
	M2109DA	5.4-5.9	10	30	10	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	SME
	M2112G	4.0-8.0	10	30	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	200-600	N	A	15	6	MS
X	M2105J	7.0-11.0	11	30	10	1100-1300	1.5	—50 to 0	0-125	0-250	100-600		N	A	12½	5	MS
	M2105G	7.05-10.75	11	30	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	SME
	M2105GA	7.05-10.75	11	30	7	1175-1300	1.5	—50 to —8	0-150	0-150	160-410		N	A	12½	5	MS
	M2105GB	7.05-10.75	11	30	7	1175-1300	1.5	—50 to —8	0-150	0-150	160-410		N	A	12½	5	SME
	M2105H	5.5-11.0	17 (5.5-7) 12 (7-11)	20 (5.5-7) 30 (7-11)	7 (5.5-7) 10 (7-11)	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	SME
	M2105BA	8.0-10.5	11 (8-10.5) 10 (8.5-9.5)	25	0	1100-1300	1.5	—50 to 0	0-150	0-300	250-600		N	A	12½	5	MS
	M2105BB	8.0-10.5	13	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		W/G	B	12½	5	MS
	M2105BC	7.0-10.0	11	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2105BD	8.5-9.5	10.5	35	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2105E	8.0-11.0	11	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2105R	7.5-12.0	12	25	7	1100-1300	1.5	—50 to 0	25-100	25-200	250-750		W/G	B	13½	5	SME
	M5027	8.0-12.0	12	30	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2105JA	7.0-11.0	13	31	7	1100-1300	1.5	—50 to 0	0-150	0-150	250-600		N	A	12½	6	SME
	M2105L	8.0-12.0	13	25	0	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		W/G	B	12½	5	SME
	M2105M	7.0-11.0	15	30	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2105S	7.5-12.0	15	30	10	1100-1300	1.75	—50 to 0	25-100	50-200	250-700		W/G	B	13½	5	SME
	M2106HA	7.0-11.0	15	30	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	MS
	M2106I	7.05-10.75	15	30	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	MS
	M2105K	7.0-11.0	10	30	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	A	12½	5	MS
	M2106H	8.0-11.0	15	30	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	SME
	M2106D	8.0-11.0	18	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	SME
	M2106C	7.0-11.0	20	30	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	MS
	M2106G	7.0-11.0	20	33	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13⅝	3½	SME
	M2106J	7.0-11.0	20	30	10	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	C	13½	3½	MS
K_u	M2114H	12.0-18.0	14	25	3	1100-1300	1.5	—50 to 0	0-250	0-300	100-400		W/G	I	12⅞	6	SME
	M2114I	12.0-18.0	17	30	7	1100-1300	1.75	—50 to 0	0-100	0-200	150-650		W/G	I	12⅞	6	SME
	M2114E	10.0-20.0	18	20	7	1200-1500	1.5	—50 to 0	0-250	0-300	100-400		W/G	I	12⅞	6	SME
	M2114G	12.4-18.0	20	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	100-600		W/G	H	12⅞	6	MS
K_a	M2116C	34.5-35.5	20	10	0	2500-2700	2.0	—50 to 0	0-150	400-900	750-1250	2600-2800	W/G	I	13	6	SME
	M2116A	20.0-40.0	20	15	0	2500-2700	2.0	—50 to 0	0-150	400-900	750-1250	2600-2800	W/G	I	13	6	DEV*

SOLENOID FOCUSED

	Tube Type	Freq. Range kmc	Max. N.F. db	Min. SS Gain db	Min. Output Power dbm	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anodes: Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Anode 4 vdc	R.F. Connector Type	Outline	Overall L'gth in.	Magnetic Field Gauss
L	M2102B	1.0-2.0	10	25	7	150-400	1.5	—50 to 0	0-100	0-300	0-300	50-350	N	E	16	600
	M2102E	1.0-2.3	10	25	7	150-400	1.5	—50 to 0	0-100	0-300	0-300	50-350	N	E	16	600
S	M2102E	2.0-4.0	10	30	7	300-500	1.5	—50 to 0	0-100	0-300	0-300	50-350	N	E	16	600
C	M2107A	4.0-8.0	10	30	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	300-800	N	E	16⅛	1000
	M2112B	4.95-5.50	12	25	7	700-900	2.0	—50 to 0	0-100	0-300	0-300	300-800	TNC	E	16	1000
X	M2101E	8.0-12.0	10	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	E	16	1000
	M2101H	7.0-11.0	10	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	200-700		N	E	16	1000
K_u	M2114A	12.4-18.0	12	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	350-850		W/G	E	16	1000
	M2114F	12.4-18.0	17	25	7	1100-1300	1.5	—50 to 0	0-150	0-300	350-850		W/G	E	16	1000

*MS, Mil Spec; **SME,** Special Mil Environment; **DEV,** Development.

NOTE 1: Model M2116C Collector operates below helix approximately 100 v.

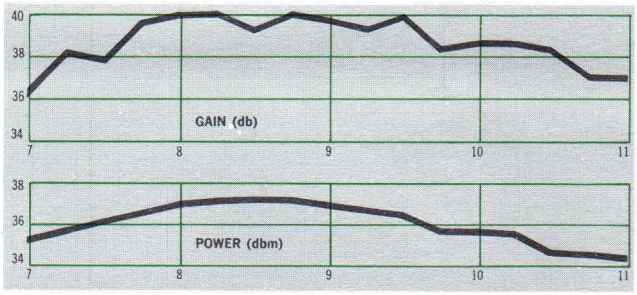
NOTE 2: Model M2116A Collector operates below helix approximately 100 v.

NOTE: Unless otherwise specified (see M2116A, M2116C), 1. All low noise tubes operate with 6.3 v, 0.3 amp max. (rms) heaters. 2. For optimum transmission all low noise tubes should operate with the collector approximately 100 v or 10% above helix voltage, whichever is greater.

MODEL 2201G

Model 2201G high gain, low power PPM focused TWT with typical gain and power output curves.

MODEL 2403



Model 2403E High Gain medium power PPM focused TWT with typical gain and power output curves.

PPM FOCUSED

	Tube Type	Freq. Range kmc	Min. Power Output mw	Min. SS Gain db	Max. N.F. db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	R.F. Connector Type	Outline	Overall Length in.	Weight lbs.	Environment
C	M2207B	4.0-8.0	10	30	30	650-800	3	0	0-500	N	C	15 1/8	4	MS*
	M2207E	4.0-8.0	10	30	30	650-800	3	0	0-500	N	C	14 1/8	4	MS
	M2207H	4.0-8.0	20	30	30	650-800	3	0	0-500	N	C	14 1/8	4	MS
	M2207I	4.0-8.0	10	30	30	650-800	3	0	0-500	N	C	14 1/8	4	MS
	M2207J	4.0-7.5	10	30	27	650-800	3	0	0-500	N	C	16 1/8	4	SME*
X	M2201C	8.0-12.4	10	30	30	1100-1300	3	0	0-500	N	C	12 1/4	3 1/2	MS
	M2201D	8.2-12.4	10	30	30	1100-1300	3	0	0-500	N	C	12 1/8	3 1/2	MS
	M2201G	8.2-11.0	10	30	30	1100-1300	3	0	0-500	N	C	15 1/2	3 1/2	SME
	M2201L	7.0-11.0	10	33	30	1100-1300	3	0	0-500	N	C	15 1/2	3 1/2	SME
	M2201M	7.0-11.0	10	30	30	1100-1300	3	0	0-500	N	C	12 1/8	3 1/2	MS
	M2201N	7.0-11.0	10	33	30	1100-1300	3	0	0-500	W/G	I	14 15/16	3 1/2	SME
	M2211C	7.5-12.0	10	30	30	1100-1300	3	0	0-500	N	I	14 15/16	3 1/2	SME
K_u	M2208B	12.4-18.0	10	30	30	1100-1300	4	0	0-500	W/G	H	13 1/2	5	MS
	M2208C	12.0-18.0	10	30	30	1100-1300	4	0	0-500	W/G	L	12 11/16	5	SME
	M2208D	12.0-18.0	10	30	30	1100-1300	4	0	0-500	W/G	H	13 1/2	5	SME
	M2208DA	12.0-18.0	20	30	30	1100-1300	4	0	0-500	W/G	H	13 1/2	5	SME

SOLENOID FOCUSED

	Tube Type	Freq. Range kmc	Min. Power Output mw	Min. SS Gain db	Max. N.F. db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	R.F. Connector Type	Outline	Overall Length in.	Magnetic Field Gauss
C	M2207A	4.0-8.0	20	30	30	650-800	3	0	0-500	N	E	16 3/8	400
	M2207D	4.0-8.0	10	30	30	650-800	3	0	0-500	N	E	16 3/8	400
	M2207G	4.0-8.0	10	30	30	650-800	3	0	0-500	N	E	16 3/8	400
						650-800	3	0	0-500	N	E	16 3/8	400
X	M2201A	7.0-12.4	10	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201B	8.0-12.4	10	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201BA	8.0-12.4	10	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201BB	8.0-12.4	10	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201E	8.0-12.4	10	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201H	8.0-12.4	50 (8.2-10.5) 25 (10.5-12.4)	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
	M2201K	7.0-12.4	20	30	30	1100-1300	3	0	0-500	N	E	16 3/8	400
K_u	M2208A	12.4-18	10	30	30	1100-1300	4	0	0-600	W/G	G	11 1/4	400

* **MS,** Mil Spec; **SME,** Special Mil Environment.

NOTE: The M2207A is used in the h-p 492A amplifier and is listed for replacement purposes. Consult the factory or local sales office for its M5000 Series electrical/mechanical equivalent.

The M2201A and M2201K are used in the h-p 494 amplifier and are listed for replacement purposes. Consult the factory or local sales office for their M5000 Series electrical/mechanical equivalent.

The M2201B, BA and BB are used in the Alfred 504 amplifier and are listed for replacement purposes. Consult the factory or local sales office for their M5000 Series electrical/mechanical equivalents.

All low power tubes operate with 6.3 v, 0.3 amp max. (rms) heaters, and with the collector at helix potential.

MEDIUM POWER TUBES

Instrument tubes are shown in bold face type.

PPM FOCUSED

	Tube Type	Freq. Range kmc	Min. Power Output watts	Min. SS Gain db	Max. N.F. db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	R.F. Connector Type	Outline	Overall Length in.	Wgt. lbs.	Environment	Remarks
	M2407BA	**5.4-5.9**	**1**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.***	**Alfred 5-542 ( )**
	M2407BB	**4.0-8.0**	**1 (4.0-8.0) 2 (4.5-6.5)**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.**	**Alfred 5-542 ( )**
	M2407D	4.0-8.0	1	30	35	2000-2500	30	—50 to 0	1300-2000	N	D	13¾	6	MS*	Insulated Coll.
	M2407DB	**4.0-8.0**	**1**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**TNC**	**D**	**13¾**	**6**	**Inst.**	**Insulated Coll. h-p 493A amp**
	M2407G	4.0-8.0	1	30	35	2000-2500	30	—50 to 0	1300-2000	H	D	13	6	MS	Alfred 5-542 ( )
	M2407B	**4.5-6.5**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.**	**Alfred 5-542 ( )**
	M2407DC	**4.0-8.0**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13¾**	**6**	**Inst.**	**Insulated Coll.**
C	M2407E	4.0-8.0	2 (4.0-8.0) 5 (4.5-5.5)	30	35	2000-2500	30	—50 to 0	1300-2000	N	D	13	6	SME*	
	M2407GA	**4.0-8.0**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.**	**Alfred 5-542 ( )**
	M2407C	**5.0-6.0**	**5**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.**	**Alfred 5-542 C**
	M2407CA	5.0-6.0	5 (5.0-6.0) 7 (5.25-5.75)	30	35	2000-2500	30	—50 to 0	1300-2000	N	D	13	6	SME	
	M2407CB	**6.29-6.49**	**5**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**13**	**6**	**Inst.**	**Alfred 5-542 ( )**
	M2408C	4.0-8.0	10	30	35	3000-3600	60	—50 to 0	2000-3600	N	D	15	6	MS	
	M2403KA	7.0-11.0	1	30	35	2000-2500	30	—50 to 0	1000-2000	N	M	13⅛	6	MS	Gd. Coll. Heat Sink
	M2403L	7.0-12.4	1	30	35	2000-2500	30	—50 to 0	1300-2000	N	D	12⅛	6	MS	Insulated Coll.
	M2403LB	**7.0-12.4**	**1**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**TNC**	**D**	**12⅛**	**6**	**Inst.**	**Insulated Coll. h-p 495A amp**
	M2403O	7.0-12.4	1	30	35	2000-2500	30	—50 to 0	1300-2000	N	D	11	6	MS	
	M2411D	7.5-11.0	1	30	35	2750-3250	20	0	1300-2000	W/G	I	15	6	MS	
	M2403N	7.5-11.0	1	30	35	2750-3250	20	0	1300-2000	W/G	I	15	6	SME	
	M2403NA	7.5-11.0	1	30	35	2750-3250	20	0	1300-2000	W/G	I	15	6	SME	
X	**M2403I**	**8.0-12.4**	**1**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**12⅛**	**6**	**Inst.**	**Insulated Coll.**
	M2403K	8.2-10.0	1	38	35	2000-2500	30	—50 to 0	1300-1800	N	M	13⅛	6	SME	Gd. Coll. Heat Sink
	M2403E	**7.0-11.0**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**11**	**6**	**Inst.**	**Coopertronix 762**
	M2403H	**7.0-11.0**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**12⅛**	**6**	**Inst.**	**Insulated Coll.**
	M2403LC	**8.0-12.4**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**12⅛**	**6**	**Inst.**	**Insul. Coll. Coopertronix 735**
	M2403Q	**9.25-10.75**	**2**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**D**	**11**	**6**	**Inst.**	**Coopertronix 762**
	M2404F	7.0-11.0	5	30	35	3000-3600	50	—50 to 0	2000-3600	N	D	14	6½	MS	
	M2404L	7.0-11.0	10	30	35	3000-3600	60	—50 to 0	2000-3600	N	D	14	6½	MS	
	M2404M	7.125-8.5	10	35	35	3000-3600	60	—50 to 0	2000-3600	N	D	14	6½	SME	
	M2405B	12.4-18.0	1	30	35	2900-3300	35	—50 to 0	1300-2500	W/G	I	11½	6	MS	
	M2405DA	**10.0-20.0**	**1 (12.4-18) 0.25 (10-20)**	**30 (12.4-18) 24 (10-20)**	**35**	**2900-3300**	**35**	**—50 to 0**	**1300-2500**	**W/G**	**I**	**11½**	**6**	**Inst.**	**Amer Elect Lab T602**
K_u	M2405H	10.0-20.0	1 (12.4-18) 0.25 (10-20)	30 (12.4-18) 24 (10-20)	35	2900-3300	35	—50 to 0	1300-2500	W/G	I	11½	6	MS	
	M2405BB	12.4-18.0	2	30	35	2900-3500	40	—50 to 0	1300-2800	W/G	I	11½	6	MS	
	M2405BA	14.0-18.0	2	30	35	2900-3500	35	—50 to 0	1300-2800	W/G	I	11½	6	MS	
	M5047	13.5 ±200 mc	4	30	35	2900-3300	35	—50 to 0	1300-2500	W/G	I	11½	6	MS	

SOLENOID FOCUSED

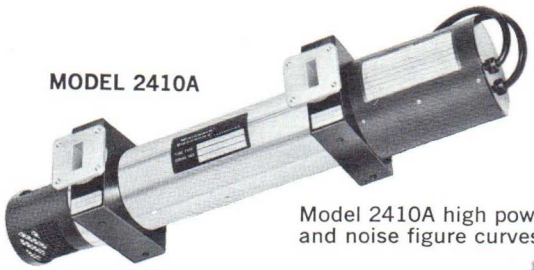
	Tube Type	Freq. Range kmc	Min. Power Output watts	Min. SS Gain db	Max. N.F. db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	R.F. Connector Type	Outline	Overall Length in.	Magnetic Field Gauss	Environment
C	**M2407A**	**4.0-8.0**	**1**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**F**	**14¾**	**1000**	**Inst.**
	M2408B	**4.0-8.0**	**10**	**30**	**35**	**3000-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**14¾**	**1200**	**Inst.**
	M2403F	**7.0-12.4**	**2 (7-11) 1 (7-12.4)**	**30**	**35**	**2000-2500**	**30**	**—50 to 0**	**1300-2000**	**N**	**F**	**11**	**1000**	**Inst. MPE 742 A**
	M2404I	**8.0-12.4**	**5 (8.0-11) 2 (8.0-12.4)**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 5-6996 C**
	M2404P	**8.0-12.4**	**5 (8.0-11) 2 (8.0-12.4)**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 527**
X	**M2404H**	**7.0-11.0**	**5**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**11**	**1200**	**Inst. Alfred 5-6996 B**
	M2404O	**7.0-11.0**	**5**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 528**
	M2404PA	**11.0-12.4**	**5**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 528 ( )**
	M2404G	**7.0-10.0**	**10**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**11**	**1200**	**Inst. MPE 744 B**
	M2404GA	**7.0-8.0**	**10**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**11**	**1200**	**Inst. Alfred 528 ( )**
	M2404K	**8.0-11.0**	**10**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**11**	**1200**	**Inst. MPE 744 A**
	M2404KA	**8.0-11.0**	**10**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 527-51**
	M2404N	8.0-9.6	10	30	35	2900-3600	60	—50 to 0	2900-3600	N	J	11	1300	
	M2404Q	**7.0-11.0**	**10**	**30**	**35**	**2900-3600**	**60**	**—50 to 0**	**2000-3600**	**N**	**F**	**10Ⅼ 3/16**	**1200**	**Inst. Alfred 528A**
	M2405A	12.4-18.0	1	30	35	2900-3600	30	—50 to 0	2000-3600	W/G	G	11¼	1200	
	M2405F	**12.4-18.0**	**1**	**30**	**35**	**2900-3600**	**30**	**—50 to 0**	**2000-3600**	**W/G**	**G**	**11¼**	**1200**	**Inst. Alfred 526**
	M2405G	12.0-18.0	1	30	35	2900-3600	30	—50 to 0	2000-3600	W/G	G	11Ⅼ 3/16	1200	Spec. Mil. Env.
K_u	M2405E	12.4-18.0	5 (12.4-16) 2 (16-18)	30	35	2900-3600	30	—50 to 0	2000-3600	W/G	G	11¼	1200	Del. with Solenoid
	M2405I	12.4-18.0	4	30	35	2900-3600	40	—50 to 0	2000-3600	W/G	G	11¼	1300	Del. with Solenoid

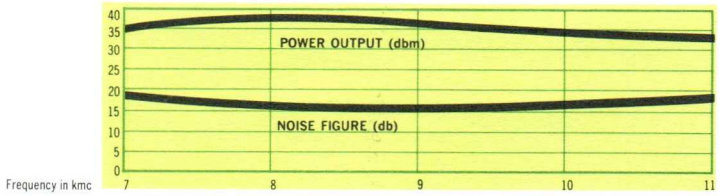
*Inst., Instrument; MS, Mil Spec; SME, Special Mil Environment.

NOTE: 1. The tubes tabulated in the instrument category above are listed for replacement purposes. Contact the factory or local sales office for their M5000 Series electrical/mechanical equivalents. 2. All medium power tubes operate with 6.3 v, 0.5 amp max. (rms) heaters, and with the collector at helix potential.

SERRODYNE, SPECIAL PURPOSE AND HIGH POWER PULSED TUBES

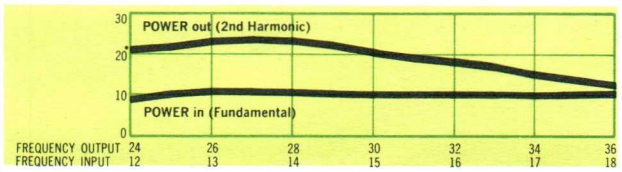
MODEL 2410A





Model 2410A high power, low noise TPM focused TWT with typical power output and noise figure curves.

MODEL 4301A



M4301-A Harmonic Generator with typical conversion gain and harmonic power output characteristics.

Special purpose tube types are offered by MEC designed for such applications as serrodyne modulators, pulse modulators, phase modulators, and harmonic generators. Other traveling wave tube types manufactured to customer requirements are also available.

HIGH POWER LOW NOISE

Tube Type	Freq. Range kmc	Min. Power Output watts	Max. N.F. db	Min. SS Gain db	Helix Voltage vdc	Max. Cath. Curr. ma	Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Anode 4 vdc	Overall Length in.	Wgt. lbs.	Focus	Remarks
M2410A	7.0-11.0	2	20	30	3000-3600	20	0-150	0-300	0-300	200-700	15	8	PPM	Adv. Dev.

HIGH POWER PULSED*

Tube Type	Freq. Range kmc	Peak Power watts	Duty Cyc. %	Beam Vol. kv dc	Beam Curr. ma	Grid Bias vdc	Grid Pulse vdc	Out-line	Overall Length in.	Wgt. lbs.	P.W. max. μsec
M2602B	8.2-10	250	½	6.7-7.4	600	—100 to 0	350	I	15	8	5
M2602BA	8.2-10	200 (8.5-9.7) 100 (8.2-10)	1	6.7-7.4	600	—100 to 0	350	I	15	8	5
M2602C	7.5-11.0	200	1	6.7-7.4	600	—100 to 0	350	I	15	8	5
M2603B	7.5-11.0	100	1	6.7-7.4	600	—100 to 0	350	I	15	8	5

*Medium Power Heater and Collector Note applies.

MICROWAVE LIMITERS*

Tube Type	Freq. Range kmc	Pwr. Out for Input —40 to 0 dbm	Min. SS Gain db	Max. N.F. db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Focus	Con-nector Type	Wgt. lbs.	Length in.
M2117A	7.0-11.0	10 ±5	50	15	1100-1300	1.5	—65 to 0	0-150	100-300	300-800	PPM	W/G	6	14
M2111B	7.0-11.0	10 ±5	50	15	1100-1300	1.5	—65 to 0	0-150	100-300	300-800	PPM	N	6	14

*Low Noise Heater and Collector Note applies.

SERRODYNE TUBES*

Tube Type	Freq. Range kmc	Max. SS Gain db	Min. Sideband Suppression db	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	Field Strength Gauss	Overall Length in.
M2204E	9.0-10.0	30†	20 @ 150 kc	1100-1300	3	0	0-450	400	16 1/16
M2204AE	9.0-10.2	15	33 @ 150 kc	1100-1300	3	0	0-450	400	16 1/16
M2204AF	7.5-8.5	18	33 @ 150 kc	1100-1300	3	0	0-450	400	16 1/16
M2204AG	10.25-10.5	18	33 @ 150 kc	1100-1300	3	0	0-450	400	16 1/16
M2204FE	9.0-10.2	15	33 @ 150 kc	1100-1300	3	0	0-450	PPM	14 7/32
M2204FG	10.25-10.5	18	33 @ 150 kc	1100-1300	3	0	0-450	PPM	14 7/32
M2204B	Any 1.5 kmc portion of X band	25	33 @ 150 kc	1100-1300	3 3	0 0	0-450	400	16 1/16
M2203B	Any 1.5 kmc portion of C Band	25	33 @ 150 kc	750-900	3	0	0-450	400	16 1/16
M2203D	5.0-6.0	25	33 @ 150 kc	650-750			0-450	400	16 1/16
M2203E	5.0-6.5	30		750-900	3	0	0-450	PPM	14 7/32

†The M2204E operates with 30 db min. small signal gain.
*Low Power Heater and Collector Note applies.

HARMONIC GENERATORS*

Tube Type	Freq. Input kmc	Freq. Output kmc	Power Input dbm	Power Output dbm	Helix Voltage vdc	Max. Cath. Curr. ma	Grid Voltage vdc	Anode Voltage vdc	Magnetic Field Gauss
M4310A	12.4-18	24.8-36	+10	+20	2900-3600	50	—50 to 0	2000-3600	1200
M4304A	4.75	9.5	+5	+30 @ 4.75 +23 @ 9.5	2000-2500	30	—50 to 0	1300-2000	PPM

*Medium Power Heater and Collector Note applies.

New Areas of Capability

MEC's research and development have extended the company's capability into several new areas, significantly increasing the product line in terms of frequency, sensitivity and power. The products described below are all designed for field application and can be delivered within a reasonable period. For additional information on any of these devices, please let us know your requirements and you will receive details promptly.

High Power, Low-Noise TWT

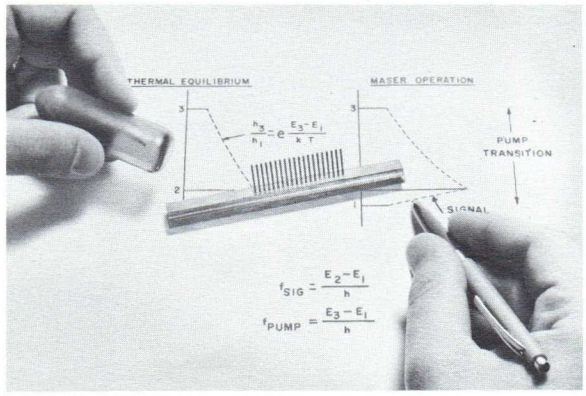
Designed to operate in X-band from 7-11 kmc, this tube delivers between 2-5 watts of saturated output power while operating at the 30 db gain level with a noise figure no greater than 20 db. This TWT is PPM focused, magnetically shielded, and weighs 8 lbs. The packaging satisfies military airborne environments. See Page 7 for preliminary specifications. Developments are underway to produce similar tubes in other frequency bands.

Backward Wave Oscillators

MEC has developed a line of metal-ceramic backward wave oscillators for use in X-band and above. These tubes are designed to satisfy the tuning and power requirements for either laboratory instruments or military systems applications. Further development work in other frequency ranges is in progress.

Radar Augmentor Tubes

MEC is active in the production of broadband, high gain traveling wave tubes designed to operate from S through X bands, as well as a miniaturized high gain augmentor designed for application in C-band.



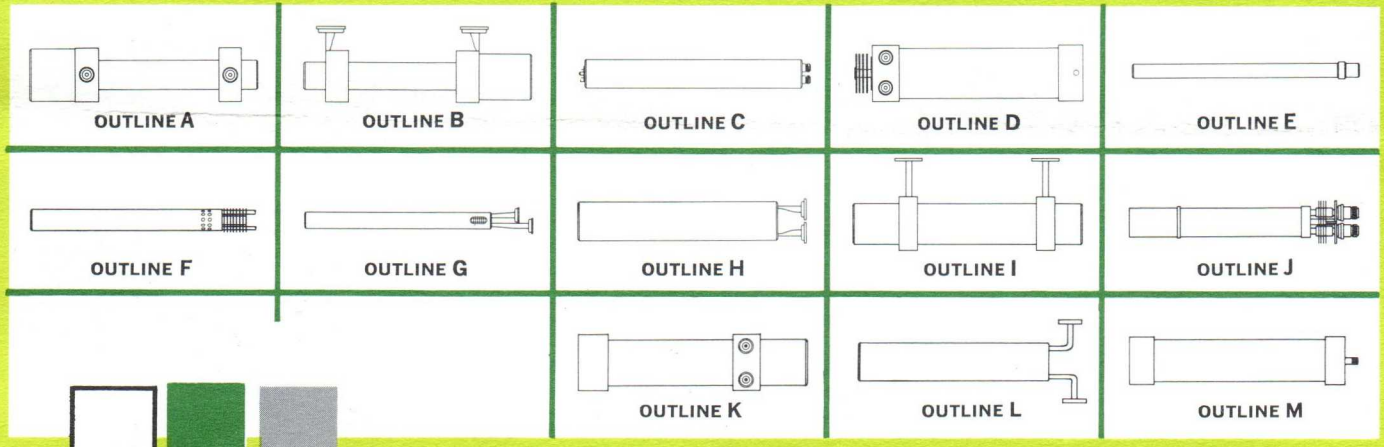
Masers

Under the direction of Dr. Robert DeGrasse, MEC has developed traveling wave masers designed for field applications. Closed cycle refrigeration, used in conjunction with this device, allows operation for extended periods of time without shut-down for the addition of liquid helium. Present maser activity is at S-band; the interaction structure is a dielectrically loaded ruby.

Miniaturized Matched Gain Tubes

MEC has developed a three tube series of matched gain TWT's which provide continuous coverage from S to above K_u band. Magnetically shielded and PPM focused, these tubes exhibit gain matching of better than 2 db at any frequency in their operating bands. MEC matched gain tubes weigh 2 lbs., measure 10" long maximum, and meet all temperature and shock requirements of MIL-E-5400 Class II.

OUTLINES



MICROWAVE ELECTRONICS CORPORATION

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AREA CODE 415, 492-9359

After January 1, 1963, MEC's address will be 3165 Porter Drive, Stanford Industrial Park, Palo Alto, California. Phone and TWX numbers will be the same.

Printed in U.S.A.

Short guide to MEC's microwave capabilities

TWTs

Militarized Low-Noise TWTs—The industry's broadest line of low-noise, metal-ceramic, PPM-focused tubes, covering L through K_u bands, come environmentalized through MIL-E-5400 Class 2. Typical 5-db small signal-gain flatness, full magnetic shielding. Other typical specifications:

Band	L	S	C	X	K_u	K	K_a
N.F. (db)	11	10	10	11	13	13	14
SSG (db)	35	35	35	35	30	25	25
P_o (mw)	10	10	10	10	10	7	5

(Solenoid types available with still lower N.F.)

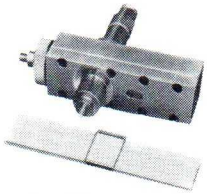
Miniature TWTs—L-K_u band coverage, with tubes 6" long, ¾" diameter and 10 ounces light. Tight gain matching is attainable, in addition to all the usual constructional and environmentalized MEC features.

Miniature Low-Noise TWTs—Ultimately intended to supersede standard types, these new TWTs are low-noise versions of earlier miniaturized types already in volume production (see previous photograph). L-K_a band types available for evaluation with specifications equal to or better than the MEC standard line (see top).

Hipolon TWTs—MEC's name for high-power, low-noise tubes. Wide dynamic range is the key here. In S band, you get 1 watt saturated power at the 30-db gain level with noise figure below 10 db. Comparable performance is available in X band, with C- and K_u-band coverage coming.

High-power TWTs—MEC is the industry's leading source for 100-watt CW TWTs from L through X bands for ECM, telemetry and communications applications—rugged construction, light weight and high efficiency (20%) are basic to this line of tubes.

SOLID STATE



Ultralow-noise Paramps and Masers—Cooled and uncooled paramps from L through X bands available now for high-sensitivity, ultralow-noise amplification chores in such applications as Comsat tracking and telemetry. Masers? Remember MEC's pioneering installations on the Goldstone and Point Mugu antennas used on the Mariner probe and the Olympic Games TV coverage. MEC is one of the world's most experienced cryogenic amplifier suppliers.

Advanced Microwave Delay Devices—Microwave acoustics principles are being applied to the development of advanced solid-state microwave delay lines at MEC. Fixed-delay units are available. Variable and repetitive delay devices are in late development.

TYPICAL FIXED-DELAY UNIT SPECIFICATIONS

Parameter	Typical Value
Delay	3-5 μsec (up to 40 μsec at lower frequencies)
Frequency	2 Gc
Bandwidth	25 per cent
Insertion Loss	45 db
Size	2" long x 1.5" dia.
Weight	16 ounces

SPECIAL PURPOSE TWTs

Special-purpose TWTs—MEC is an established source for the following types, and can find a solution to your TWT needs based on experience:

- Augmentors—L through K_u bands at up to 20 watts
- Limiters—L through K_a bands
- Crystal-protector preamplifiers L through K_u bands
- Serrodyne and synchrodyne tubes
- Phase-shifter TWTs
- Matched-gain and matched-phase types
- Tubes for rf memory systems

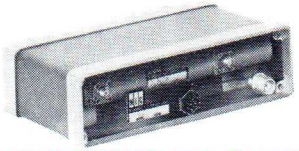
OSCILLATORS & STALOS

Next-Generation PPM BWOs—Advantages? Weight and size drastically reduced. Full magnetic shielding allows side-by-side mounting and tight packaging. Environmentalization meets the most stringent MIL specifications. In fact, all critical parameters equal or exceed those of comparable PM types. Broadband and narrowband types are available. Sixty-day deliveries in full S, X and K_u bands.

Conventional PM BWOs—MEC's advanced design assures long, stable operating life. Unique electron gun introduces a highly convergent hollow beam into the interaction structure while maintaining beam stability. Fine structure typically less than 0.25 db. Available in wide variety of rugged formats covering X-K_u bands.

Cavities—Mitek® Reference and Stabilizing Cavities cover the entire microwave range for frequency discriminators and frequency standards in AFC circuits, in signal comparators and noise monitoring equipment, and for stabilizing oscillators whose frequency is affected by load impedance. Mitek cavities can be provided with precision micrometer tuners covering up to 20% bandwidths. Fixed-frequency units are also available between 4 Gc and 40 Gc. Evacuated and hermetically sealed cavities are available in all frequency bands for improved frequency stability.

PACKAGED AMPLIFIERS



Integrated TWT/Power Supplies—Most convenient, useful approach yet to the integral or separable TWT/power supply. Mount the tube remotely or integrally with the power supply as your configuration dictates—both can be field replaceable. Either way, just plug in and turn on for instant, adjustment-free performance—available on most MEC TWTs.

Microwave Electronics Corporation
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Phone: (415) 321-1770

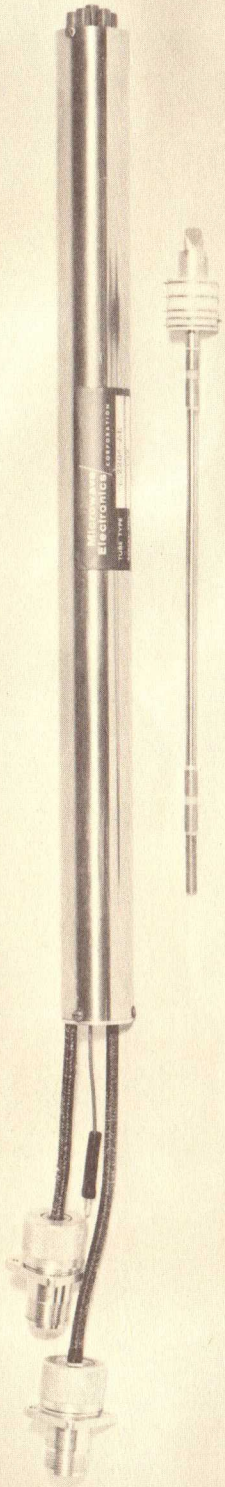
T.PD

(1)

Microwave Electronics CORPORATION

Development and Manufacture
of Microwave Tubes

4061 TRANSPORT STREET / PALO ALTO, CALIFORNIA



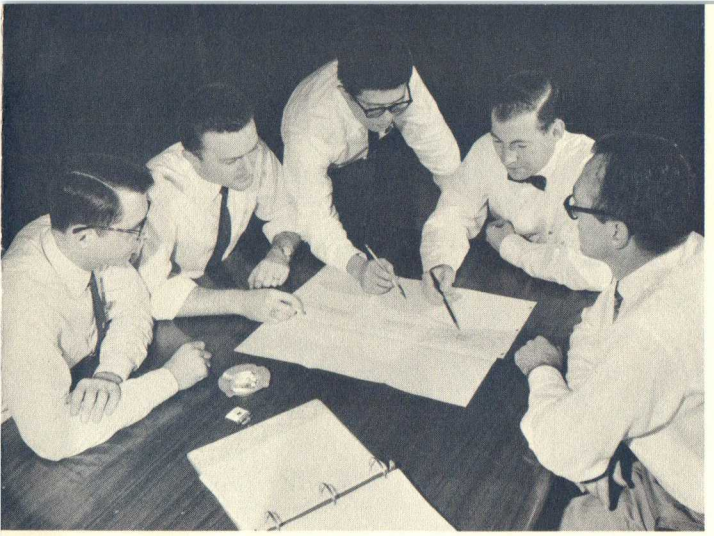
Microwave Electronics CORPORATION

is a product-oriented organization which was formed to develop and manufacture microwave electron devices that are rugged, reliable and reasonably priced. Microwave Electronics stresses quality of product and high reliability to meet the rigid requirements of modern instruments and systems.

Since the Company was organized in early 1959, its research, development and production capabilities have been directed toward the product objective. As a result, Microwave Electronics has successfully developed and placed in quantity production a family of low power, broad-band, high performance traveling-wave tubes of metal-ceramic construction. Current development programs are directed toward further improvement and broadening of the traveling-wave tube product line and entry into the backward-wave oscillator market. At the same time, research effort is being directed toward advancing the state of the art of these and related electron devices.

The philosophy of tube development at Microwave Electronics is to employ production methods and tooling concepts at the initiation of a development program. This approach makes it feasible to build numbers of tubes during an investigation in order to evaluate concurrently electrical results, materials, and fabrication techniques. Sufficient quantities of developmental samples are fabricated to permit a complete evaluation of the user's engineering applications problems. Consequently, a baseline of expected tube performance can be established. When the development phase of a program is completed, production methods and tooling are available to provide the capability for immediate production.

Microwave Electronics' organization and facilities reflect its basic intentions and direction. Integrated, experienced engineering and production staffs make it possible to pursue a practical approach—from sound electronic design through the employment of latest production techniques—the delivery of components meeting the reliability and reproducibility requirements of military and commercial customers. The company's modern development and production facility is located in the Palo Alto Industrial Park, just three miles from Stanford University. Its proximity to Stanford permits close liaison between the company and Stanford engineering faculty members who serve as consultants and on the Board of Directors.

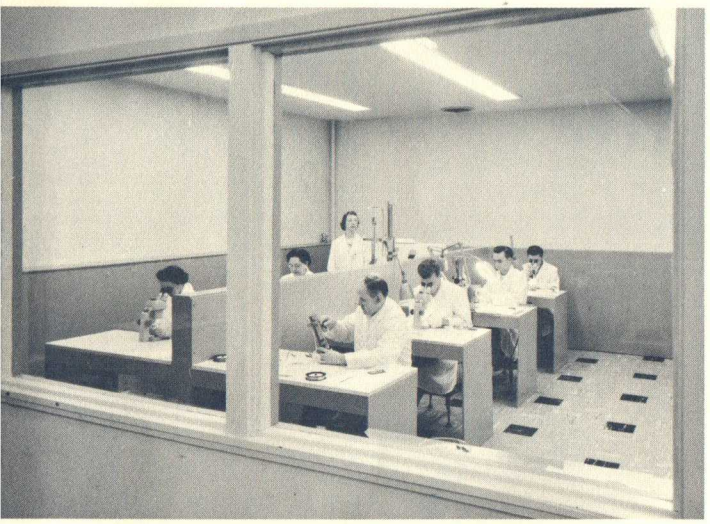


ENGINEERING STAFF

The technical staff is both design- and production-oriented. It is well versed in modern electron design principles and experienced in the disciplines and physical arts of quality electron tube construction.

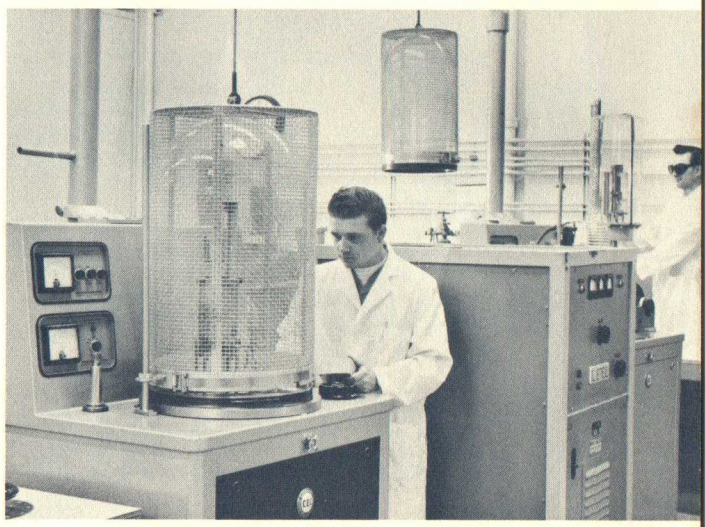
MACHINE SHOP

A fully equipped facility is maintained to permit flexibility in tool and die work and close quality control of production parts. In addition to the usual machine tools, the shop is equipped with specially constructed helix winding and assembly machines.



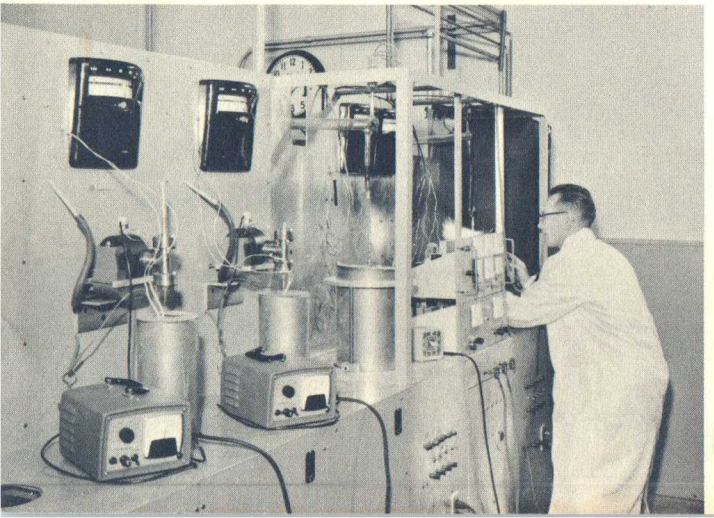
ASSEMBLY ROOM

Chemically cleaned and vacuum processed parts are fabricated into final assemblies in a dust-free filtered-air area. Such critical operations as cathode spraying are conducted in a special booth within the "clean" room.



PROCESSING FACILITIES

High temperature atmosphere furnaces, hydrogen bell jars, and high vacuum r-f induction furnaces make up a part of the necessary tube processing equipment.



EXHAUST STATIONS

Both ion pumps and oil diffusion equipment are used to create ultra-high vacuum required for long life. Bake-out under high vacuum at elevated temperatures ensures that all residual gases are removed.

PRODUCTION TEST

Final packaging and testing are performed on production tubes in this area. A similar facility is maintained in engineering to permit simultaneous testing of development tubes without interrupting production flow.

MANAGEMENT

STANLEY F. KAISEL, President and Technical Director

Dr. Kaisel is a graduate of Washington University and holder of advanced degrees (M.A. and Ph.D. in E.E.) from Stanford University. Prior to forming Microwave Electronics he was Manager of Engineering at Litton Industries' Electron Tube Division and Product Line Manager for traveling-wave tubes. As a member of the senior staff of the Stanford Electronics Research Laboratory, he was a Group Leader, Head of the Tube Construction Laboratory, and a lecturer in Electrical Engineering. Other experience has included assignments as research engineer at RCA Laboratories, Princeton, New Jersey, and special research associate at the Radio Research Laboratory, Harvard University, during World War II.

ARTHUR L. WEBB, Production Manager

Mr. Webb attended Vincennes University and did additional work in Electrical Engineering at Purdue University. Immediately before his present connection he was Supervisor of CW magnetron assembly operations at the Electron Tube Division, Litton Industries. Earlier (1949-56) he was employed in the Electron Tube Laboratory at Hughes Aircraft Company. He served as a chief radio technician in the U.S. Navy Submarine Service during World War II.

ROBERT O. DEHLENDORF, II, Business Manager

Mr. Dehlendorf holds a B.A. degree in Economics from Amherst College and an M.B.A. from the Harvard Graduate School of Business Administration. Prior to joining Microwave he was Treasurer of Kimball Mfg. Corp., a Bristol-Meyers subsidiary, and a commissioned officer assigned to the Comptroller's staff, Sixth Army Headquarters, San Francisco.

FRED M. SCHUMACHER, Assistant Technical Director

Mr. Schumacher has a B.S. in E.E. from Fresno State College and an M.S. in E.E. from Stanford University. He was a consulting engineer on traveling-wave tubes at General Electric Microwave Laboratory. While at Stanford he was employed in the applied research program of the Electronics Research Laboratory.

WILLIAM J. FLEIG, Senior Engineer

Mr. Fleig holds a B.S. in E.E. from the University of Michigan and is an M.S. candidate in E.E. at Stanford University. Formerly he was Director of Product Development and Engineering Manager at Huggins Laboratories, Inc. At the University of Michigan he was a graduate research assistant in the Tube Laboratory. He was also associated with Bell Telephone Laboratories and Sperry Gyroscope Company.

WELDON FITTS, Supervisor of Tube Assembly Operations

Mr. Fitts was employed by the Electron Tube Division, Litton Industries (1954-59), before joining Microwave Electronics. During this period he was successively Assistant Supervisor and then Supervisor of CW magnetron assembly operations.

ALFRED MACCAN, Supervisor of Machine Shop Operations

Mr. Maccan was Supervisor of the Production Tool and Die Shop at the Electron Tube Division, Litton Industries, from 1953 until joining Microwave Electronics in 1959.

Kaisel, Webb, Dehlendorf and Schumacher

BOARD OF DIRECTORS

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Stanford University

TPD (5)

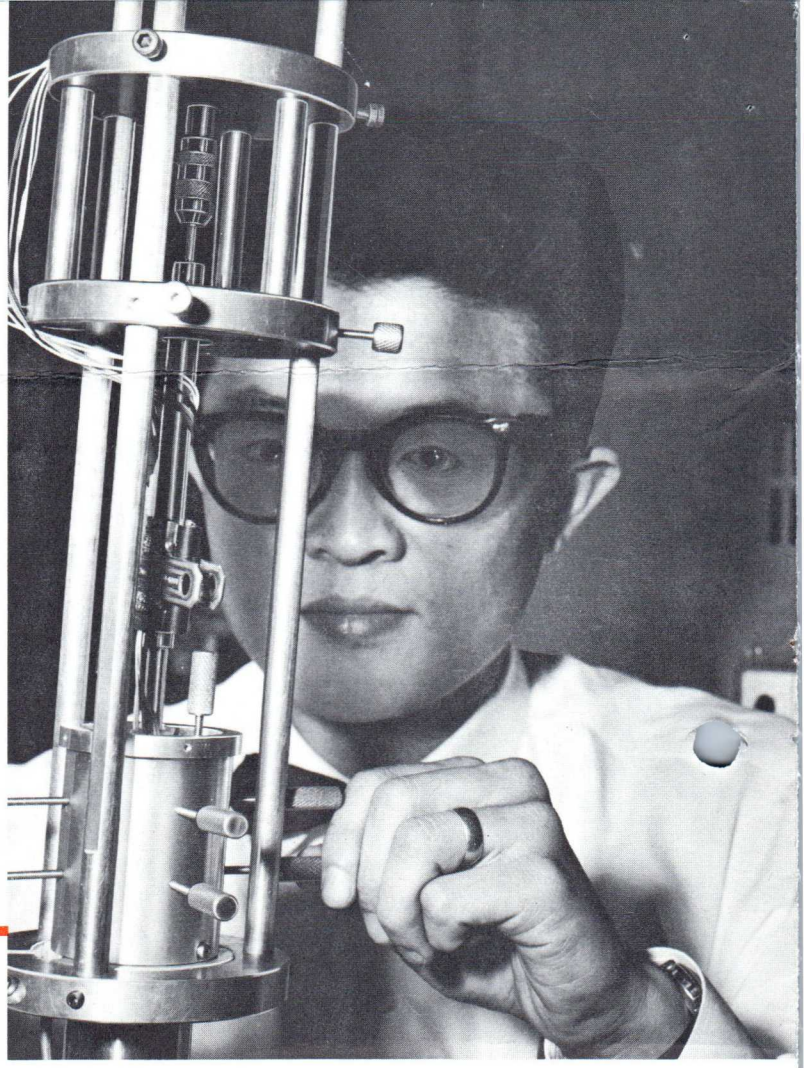
MEC

Production Engineered Traveling Wave Tubes

MICROWAVE ELECTRONICS CORPORATION
Palo Alto, California

AUGUST, 1961

Alignment fixture used in focusing X band traveling wave tube limiter in PPM assembly.



About MEC

Microwave Electronics Corporation was formed early in 1959 to provide a production source of traveling wave tubes of high reliability, long life, and reproducible characteristics. To achieve this end the company has assembled a group combining the scientific skills of electronic design with the manufacturing experience required to convert these designs into producible products.

Briefly stated, MEC takes the position that production methods and tooling concepts should be integrated with the electronic design at the outset of any developmental program. Such an approach allows the manufacture of many tubes during initial investigation and encourages complete evaluation of electrical parameters, materials, and problems of fabrication.

This approach has resulted in the broad line of low level traveling wave tubes described in this catalog. Tube types represented range from S band through K_u band in frequency and from low noise-low power through the 10 watt CW power level.

Among the "firsts" by MEC are broadband, PPM focused low noise TWT's with noise figures below 10 db in S, C, and X bands; a family of broadband PPM focused tubes in K_u band; a 10 watt CW TWT amplifier in X band; and a frequency multiplier for operation at 40 kmc.

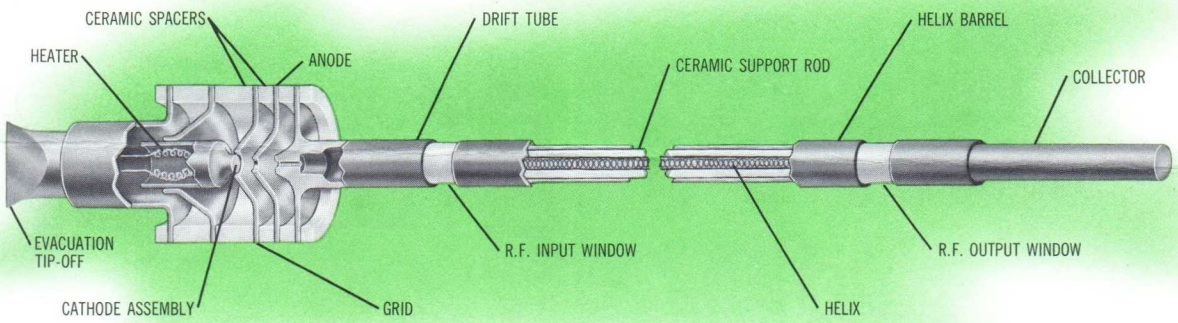
WARRANTY—*MEC offers one of the best warranties in the TWT industry. Shelf life and operating life are conservatively stated. Expected life is based on "in plant" life tests and field experience, considerably exceeds the guaranteed warranty.*

LOW POWER OUTPUT—500 hrs. unconditional; 2000 hrs. pro-rated.

MEDIUM POWER OUTPUT—500 hrs. unconditional; 1000 hrs. pro-rated.

LOW NOISE—500 hrs. unconditional; 1500 hrs. pro-rated.

12 months unconditional shelf life.



MODEL 2105K

Reliability...

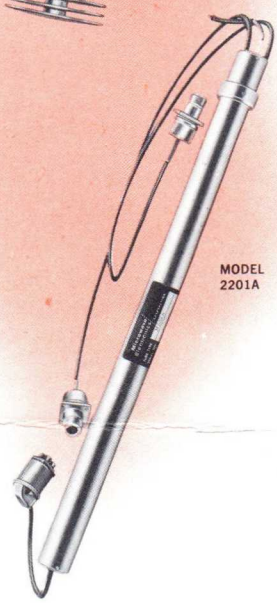
...the result of engineering skill and manufacturing care

Because MEC traveling wave tubes feature metal-ceramic construction, they have a headstart on reliability. They are evacuated at elevated temperatures (650° C) and high vacuums which produces a cleaner environment for long cathode life.

Inherently rugged, MEC tubes provide superior performance over environmental extremes. Typically, temperature compensation can be provided to meet the requirements of MIL-E-5400, Class 2. The tubes have been tested at 20 g shock and 15 g vibration from 5 to 2000 cps with no performance degradation.

MEC construction features a helix rigidly supported by ceramic rods over its entire length. Critical turn spacing is accurately maintained to assure uniform gain characteristics from tube to tube. Indeed, repeatability from tube to tube is a leading attribute of MEC construction. MEC tubes can be operated in any position with no degradation in performance.

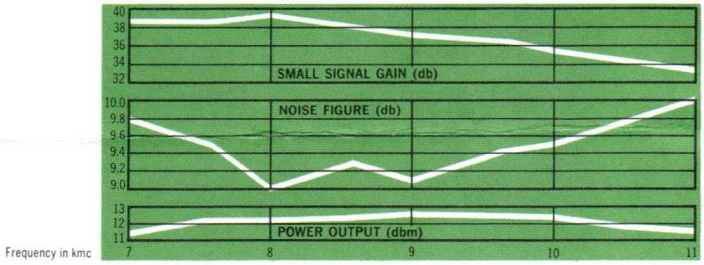
MODEL 2403E



MODEL 2201A

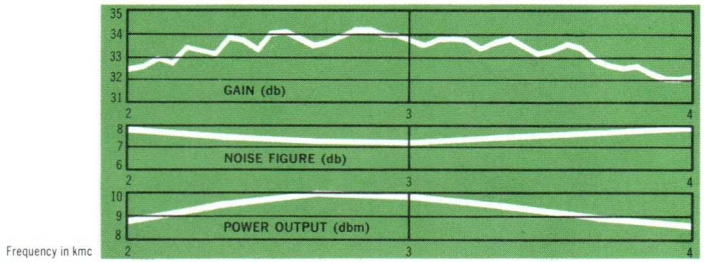
Low Noise Tubes

MODEL 2105K



Model 2105K Low Noise PPM focused TWT with typical gain and power output characteristics.

MODEL 2103



Model 2103 Low Noise Solenoid focused TWT with typical gain and power output curves. MEC offers long life, low noise traveling wave tubes in both PPM and solenoid focused formats. They are available in various frequency groups covering the spectrum from 2 to 18 kmc.

PPM*

	Tube Type	Frequency Range kmc	Max. NF db	Min. Small Signal Gain db	Min. Power Output dbm	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltages				Outline	Overall Length in.	Weight lbs.
									Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Anode 4 vdc			
S	M2103N	2.0-4.0	10	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	C	17	6
	M2103Q	2.3-4.4	10	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	C	17	6
	M2103R	0.5 kmc portion of S Band	8	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	C	17	6
	M2103P	2.0-4.0	15	30	+10	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	C	17	6
	M2103C	2.0-4.0	20	30	+10	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	C	17	6
C	M2112G	4.0-8.0	10	30	+7	700-900	2.0	−40 to 0	0-100	0-300	0-300	300-800	A	15	6
	M2112H	4.0-8.0	15	30	+10	700-900	2.0	−40 to 0	0-100	0-300	0-300	300-800	C	15	6
	M2112K	4.0-8.0	20	30	+10	700-900	2.0	−40 to 0	0-100	0-300	0-300	300-800	C	15	6
X	M2105K	7.0-11.0	10	30	+10	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105M	7.0-11.0	15	30	+10	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105N	7.0-11.0	20	30	+10	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105H	5.5-11.0	17	20	+10	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105O	8.2-12.4	10	25	+7	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105P	8.2-12.4	15	25	+7	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
	M2105Q	8.2-12.4	20	25	+7	1100-1300	1.5	−50 to 0	0-150	0-300	200-700	...	A	12½	5
K_u (P)	M2114B	12.4-18.0	14	25	+7	1100-1300	1.5	−50 to 0	0-150	0-300	100-600	...	H	13	6
	M2114G	12.4-18.0	20	25	+7	1100-1300	1.5	−50 to 0	0-150	0-300	100-600	...	H	13	6

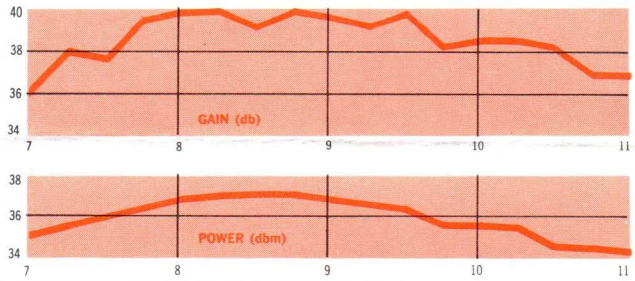
SOLENOID*

	Tube Type	Frequency Range kmc	Max. NF db	Min. Small Signal Gain db	Min. Power Output dbm	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltages				Outline	Overall Length in.	Magnetic Field Gauss
									Anode 1 vdc	Anode 2 vdc	Anode 3 vdc	Anode 4 vdc			
S	M2103M	2.0-4.0	8	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	E	16	600
	M2103S	0.5 kmc portion of S Band	6	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	E	16	600
	M2103T	2.3-4.4	8	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	E	16	600
	M2103O	2.0-4.0	15	30	+7	350-450	1.5	−40 to 0	0-150	0-300	0-300	100-400	E	16	600
C	M2107A	4.0-8.0	10	30	+7	700-900	2.0	−40 to 0	0-150	0-300	0-300	300-800	E	16	1000
	M2107B	4.0-8.0	15	30	+7	700-900	2.0	−40 to 0	0-150	0-300	0-300	300-800	E	16	1000
X	M2101J	7.0-11.0	9	30	+10	1100-1300	1.5	−40 to 0	0-150	0-300	300-800	...	E	16	1000
	M2101K	7.0-11.0	15	30	+10	1100-1300	1.5	−40 to 0	0-150	0-300	300-800	...	E	16	1000
	M2101L	8.2-12.4	10	25	+7	1100-1300	1.5	−40 to 0	0-150	0-300	300-800	...	E	16	1000
	M2101M	8.2-12.4	15	25	+7	1100-1300	1.5	−40 to 0	0-150	0-300	300-800	...	E	16	1000
K_u (P)	M2114A	12.4-18.0	12	25	+7	1100-1300	1.5	−40 to 0	0-150	0-300	350-850	...	G	13	1000
	M2114F	12.4-18.0	17	25	+7	1100-1300	1.5	−40 to 0	0-150	0-300	350-850	...	G	13	1000

*Other versions of these tube types are available. Please contact our representative in your area for further information. A complete catalog is available upon request.

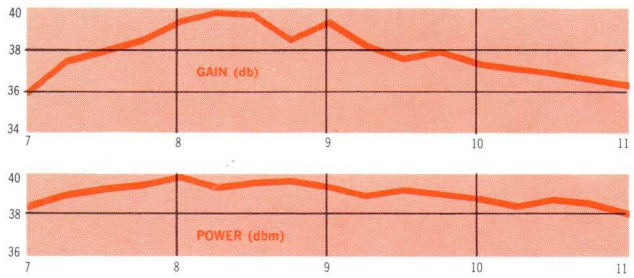
Medium Power Tubes

MODEL 2403E



Model 2403E High Gain medium power PPM focused TWT with typical gain and power output curves.

MODEL 2404G



Model 2404G solenoid focused high gain, medium power TWT with typical gain and power curves. MEC production engineered medium power TWT's are available in both PPM and solenoid focused formats in various frequency groupings from 4 to 18 kmc.

PPM*

	Tube Type	Frequency Range kmc	Min. Power Output watts	Min. Small Signal Gain db	Max. Noise Figure db	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Out-line	Overall Length in.	Weight lbs.
C	M2407G	4.0-8.0	1	30	35	2000-2500	30	—50 to 0	1800-2500	D	13	6
	†M2407D	4.0-8.0	1	30	35	2000-2500	30	—50 to 0	1800-2500	D	13⅞	6⅛
	M2407B	4.5-6.5	2	30	35	2000-2500	30	—50 to 0	1800-2500	D	13	6
	M2407C	5.0-6.0	5	30	35	2000-2500	30	—50 to 0	1800-2500	D	13	6
	M2408C	4.0-8.0	10	30	35	3000-3600	60	—50 to 0	2300-3600	D	15	6 DEV
X	M2403E	7.0-11.0	2	30	35	2100-2500	30	—50 to 0	1600-2500	D	11	5
	†M2403H	7.0-11.0	2	30	35	2100-2500	30	—50 to 0	1600-2500	D	11⅞	5⅛
	M2403O	7.0-12.4	1	30	35	2100-2500	30	—50 to 0	1600-2500	D	11	5
	†M2403L	7.0-12.4	1	30	35	2100-2500	30	—50 to 0	1600-2500	D	11⅞	5⅛
	M2404F	7.0-11.0	5	30	35	2900-3600	50	—50 to 0	2300-3600	D	12	6 DEV
	M2404L	7.0-11.0	10	30	35	2900-3600	60	—50 to 0	2300-3600	D	13	6½ DEV
K_u (P)	M2405B	12.4-18.0	1	30	35	2900-3300	35	—50 to 0	2300-3300	I	11½	5
	M2405D	10.0-20.0	1(12.4-18) 0.1(10-20)	25 30	35	2900-3300	35	—50 to 0	2300-3300	H	14¼	5½

†All elements insulated from ground.

SOLENOID*

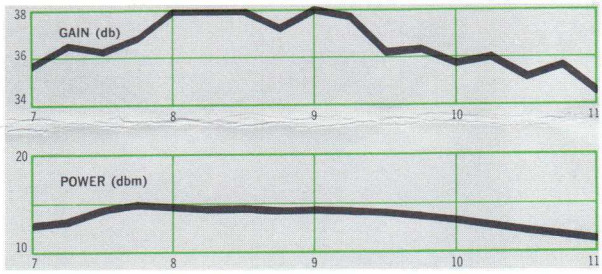
	Tube Type	Frequency Range kmc	Power Output watts	Small Signal Gain db	Noise Figure db	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Out-line	Overall Length in.	Field Strength Gauss
C	M2407A	4.0-8.0	1	30	35	2000-2500	30	—50 to 0	1800-2500	F	14¾	800
	M2408B	4.0-8.0	10	30	35	3000-3600	60	—50 to 0	2300-3600	F	14¾	1000
X	M2403F	7.0-12.4	2(7-11) 1(7-12.4)	30	35	2100-2500	30	—50 to 0	1600-2500	F	11	1000
	M2404B	7.0-11.0	5	30	35	2900-3600	50	—50 to 0	2300-3600	J	12	1300
	M2404H	7.0-11.0	5	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1200
	M2404O	7.0-11.0	5	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1200
	M2404C	8.0-12.4	5(8.0-11.0 kmc) 2(8.0-12.4 kmc)	30	35	2900-3600	50	—50 to 0	2300-3600	J	11	1300
	M2404I	8.0-12.4	5(8.0-11.0 kmc) 2(8.0-12.4 kmc)	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1200
	M2404P	8.0-12.4	5(8.0-11.0 kmc) 2(8.0-12.4 kmc)	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1200
	M2404G	7.0-10.0	10	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1250
	M2404K	8.0-11.0	10	30	35	2900-3600	60	—50 to 0	2300-3600	F	11	1250
	M2404N	8.0-9.6	10	30	35	2900-3600	60	—50 to 0	2900-3600	J	12	1200
K_u (P)	M2405A	12.4-18.0	1	30	35	2900-3300	30	—50 to 0	2300-3300	G	11¼	1200
	M2405F	12.4-18.0	1	30	35	2900-3300	30	—50 to 0	2300-3300	G	11¼	1200

The M2407DB is used in the h/p 493A amplifier. The M2405F is used in the ALFRED 526 amplifier. The M2404O is used in the ALFRED 528 amplifier.
The M2403LB is used in the h/p 495A amplifier. The M2404P is used in the ALFRED 527 amplifier. The M2404I is used in the ALFRED 5-6996C amplifier.
The M2404H is used in the ALFRED 5-6996B amplifier.

*Other versions of these tube types are available. Please contact our representative in your area for further information.
A complete catalog is available upon request.

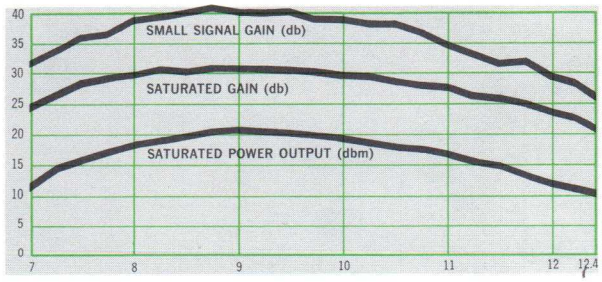
Low Power Tubes

MODEL 2201G



Model 2201G high gain, low power PPM focused TWT with typical gain and power output curves.

MODEL 2201A



Model 2201A high gain, low power solenoid focused TWT with typical gain and power output characteristics.

Broadband, high gain, low power, metal-ceramic traveling wave tubes are available from MEC in both PPM and solenoid focused formats in frequency ranges from 4 to 18 kmc.

PPM*

	Tube Type	Frequency Range	Min. Power Output mw	Min. Small Signal Gain db	Max. Noise Figure db	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Out-line	Overall Length in.	Weight lbs.
C	M2207H	4.0-8.0	20	30	30	650-800	3	0	350-500	C	14⅛	4
X	M2201M	7.0-11.0	10	30	30	1100-1300	3	0	350-500	C	12⅛	4
	M2301C	7.0-11.0	100	30	30	1100-1300	4	0	350-600	C	12⅛	4
	M2201D	8.2-12.4	10	30	30	1100-1300	3	0	350-500	C	12⅛	4
K_u (P)	M2208B	12.4-18.0	10	30	30	1100-1300	4	0	350-500	H	13½	5

SOLENOID*

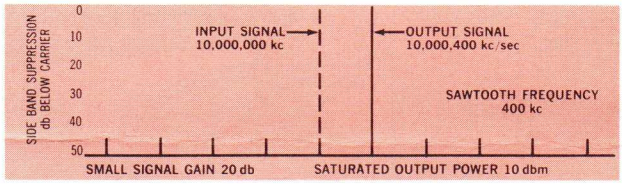
	Tube Type	Frequency Range	Min. Power Output mw	Min. Small Signal Gain db	Max. Noise Figure db	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Out-line	Overall Length in.	Magnetic Field Gauss
C	M2207G	4.0-8.0	10	30	30	650-800	3	0	350-500	E	16⅜	400
	M2207A	4.0-8.0	20	30	30	650-800	3	0	350-500	E	16⅜	400
X	M2201A	7.0-12.4	10	30	30	1100-1300	3	0	350-500	E	16⅜	400
	M2201K	7.0-12.4	20	30	30	1100-1300	3	0	350-500	E	16⅜	400
	M2201B	8.0-12.4	10	30	30	1100-1300	3	0	350-500	E	13½	400
	M2201E	8.0-12.4	10	30	30	1100-1300	3	0	350-500	E	14¾	400
	M2301D	7.0-11.0	100	30	30	1100-1300	4	0	350-600	E	13½	400
K_u (P)	M2208A	12.4-18.0	10	30	30	1100-1300	4	0	350-600	G	11¼	400

The Model M2201A is used in the h/p 494A amplifier.
The Model M2201K is used in the h/p 494A amplifier.
The Model M2201B is used in the ALFRED 504 amplifier.
The Model M2201E is used in the Menlo Park TA-4 amplifier.

*Other versions of these tube types are available. Please contact our representative in your area for further information. A complete catalog is available upon request.

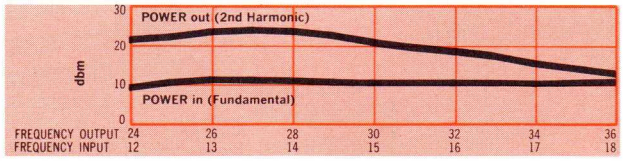
Serrodyne and Special Purpose Tubes

MODEL M2204-A



M2204-A Serrodyne modulator used for phase shifting and for doppler shift simulation with typical gain, power output, and sideband suppression characteristics.

MODEL M4301-A



M4301-A Harmonic Generator with typical conversion gain and harmonic power output characteristics.

Special purpose tube types are offered by MEC designed for such applications as serrodyne modulators, pulse modulators, phase modulators, and harmonic generators. Other traveling wave tube types manufactured to customer requirements are also available.

SERRODYNE TUBES

	Tube Type	Frequency Range	Small Signal Gain	Min. Sideband Suppression	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Field Strength Gauss	Notes
X	M2204AE	9.0-10.2	20	33 @ 150 kc	1100-1300	3	0	300-500	400	Dymec 5248 Signal Gen.
	M2204AF	7.5-8.5	20	33 @ 150 kc	1100-1300	3	0	300-500	400	Dymec 5065 Signal Gen.
	M2204AG	10.25-10.5	20	33 @ 150 kc	1100-1300	3	0	300-500	400	Dymec 5130 Signal Gen.
	M2204B	Any 1.5 kmc portion of X Band	25	33 @ 150 kc	1100-1300	3	0	300-500	400	h/p 494A Amplifier
C	M2203B	Any 1.5 kmc portion of C Band	25	33 @ 150 kc	750-900	3	0	300-450	400	Dymec 6170/6172 Signal Gen.
	M2203D	5.0-6.0	25 max.	33 @ 150 kc	650-750	3	0	300-450	400	Dymec 6172 Signal Gen.
	M2203E	5.0-6.5	30	....	750-900	3	0	300-450	PPM	Special Purpose Modulator

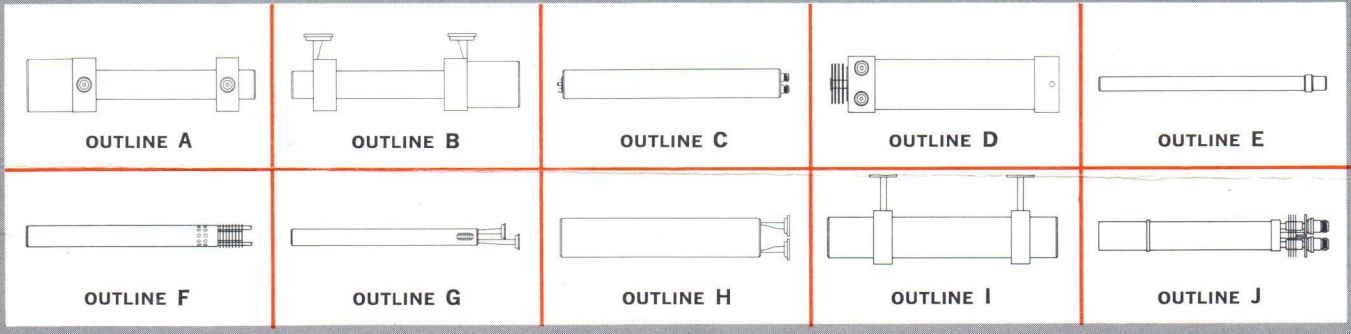
HARMONIC GENERATOR

Type	Frequency Input	Frequency Output	Power In (nominal)	Power Out (nominal)	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltage vdc	Field Strength Gauss
M4301A	12.4-18.0	24.8-36.0	10 mw	100 to 20 mw	2900-3300	50	—50 to 0	2300-3300	1300

MICROWAVE LIMITER

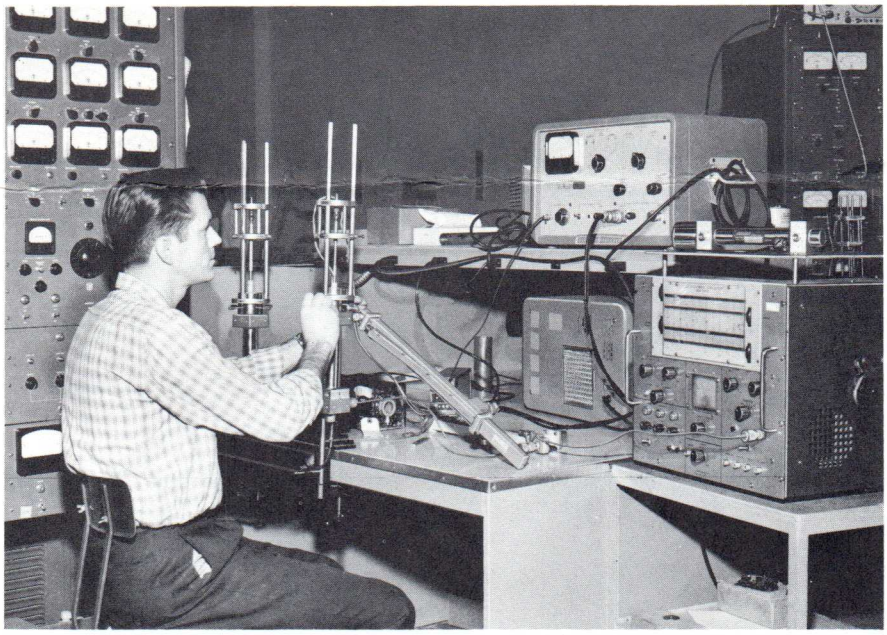
Type	Frequency Range	Power Output over Input Range —40 to 0 dbm	Min. Small Signal Gain db	Max. Noise Figure db	Helix Voltage vdc	Max. Cathode Current ma	Grid Voltage vdc	Anode Voltages			Focusing	Wgt. lbs.	Length in.
								Anode 1 vdc	Anode 2 vdc	Anode 3 vdc			
M2117A	7.0-11.0	10 dbm ± 5 dbm	50	15	1100-1300	1.5	—65 to 0	0-150	100-300	300-800	PPM	6	14

Temperature compensated for operation between —50° C and +80° C.



Environmental Tests

Many of MEC's tubes have been packaged for rugged environments and some have been environmentally tested in detail. Because the basic design is the same on all tubes, every tube can be packaged by proper potting and sealing to meet these same environmental specifications. This summary of tests is indicative of the performance that can be provided.



Testing X band PPM focused low noise traveling wave tube.

	SOLENOID FOCUSED	PPM FOCUSED
SHOCK — non-operating* in both directions along 3 mutually perpendicular axes.	20 g; no change in performance.	20 g; no change in performance.
VIBRATION OPERATING	5-2000 cps at 3 g max. Less than 0.05 db amplitude modulation. 5-500 cps at 13 g max. Less than 0.5 db amplitude modulation.**	5-100 cps at 10 g max. Less than 0.1 db amplitude modulation. 100-2000 cps at 10 g max. Less than 0.5 db amplitude modulation.
TEMPERATURE OPERATING	−65°C to +140°C; no change in performance.	−55°C to +80°C; change in gain, ±2 db max.
HUMIDITY OPERATING	100% R.H. at 55°C 24 hrs.; no change in performance.	100% R.H. at 55°C 24 hrs.; no change in performance.
ALTITUDE	75,000 ft.	75,000 ft.
LIFE	11,000 hrs. and still operating to specifications.	5,000 hrs. and still operating to specifications.

*No operating shock tests have been performed; however, operating vibration tests of 5-2000 cps at 10 g's indicate no problems should arise.

**Higher g values have not been run above 500 cps, but solenoid tubes should perform equally as well as PPM tubes if the solenoid is ruggedized.

MICROWAVE ELECTRONICS CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • PHONE: DAvenport 1-1770

Printed in U.S.A.

MICROWAVE
ELECTRONICS / CORPORATION
PALO ALTO, CALIFORNIA

FINAL TEST DATA SHEET

TUBE TYPE M2 7-DB
SERIAL NO. 334

OPERATING CONDITIONS			POWER SUPPLY REQUIREMENTS		
Element	Voltage	Current	Voltage Minimum	Voltage Maximum	Current Maximum
Heater	6.3	.37 A	6.3 V	3 %Reg	1.5A
Grid	-4.8	0 ua	-30	-1	50 ua
Anode	1760	0	62.5 to 97.5% of hel		.25 ma
Helix	2073	.4 ma	2000	2500	4 ma
Collector	2073	22.3 ma	2000	2500	30 ma
Cathode	0	22.7 ma	0		30 ma

Measured With Respect To Cathode

Helix Current: (4 ma Maximum)
1. Tube Operated At Maximum Power Out 1.1 ma
2. During Grid Cut-Off From P Max. Condition 2.4 ma

POWER SUPPLY CONNECTIONS	
1 - Collector	Red
2 - Helix	Orange
3 - Anode	Blue
4 - Cathode	White
5 - Grid	Green
6 Heater-Cathode	Gray
7 - Heater	Brown
8 - Capsule-Ground	Black

Spurious Modulation > 45 45 db down
VSWR, Input < 3.0:1 3.0:1 Maximum
VSWR, Output < 3.0:1 3.0:1 Maximum

RF PERFORMANCE			
Freq.	Small Signal Gain	Gain at 1 Watt Output	Power out With ⊕ P_i -3 dbm
Minimum	30 db	30 db	30 dbm
Maximum	None	None	None
Gc	db	db	dbm
4.0	34.0	33.5	30.7
4.5	39.5	39.0	34.2
5.0	41.0	40.0	34.2
5.5	41.5	40.5	35.0
6.0	41.5	41.0	35.1
6.5	41.0	40.0	34.4
7.0	39.5	39.0	33.4
7.5	37.5	36.5	32.2
8.0	34.5	33.0	30.0

⊕ Set for +30 dbm Power Output Gain variation with input set to give 30 dbm output at minimum power point, 6 db maximum.

Small Signal Gain Variation
1. Across the band 13 db maximum.
2. Over any 300 mc range 5 db maximum.

TESTED BY [signature]
APPROVED BY [signature]
DATE SHIPPED FEB 25 1963

PALO ALTO, CALIFORNIA

TUBE TYPE [illegible]
SERIAL NO. 331

	ELECTRODE CONNECTIONS		POWER SUPPLY REQUIREMENTS		
Element	Voltage	Current	Voltage Minimum	Voltage Maximum	Current Maximum
Heater	6.3	.37 A	6.3 V	3 %Rod	1.5 A
* Grid	-3.7	0 ua	-30	-3	50 ua
* Anode	1822	0	62.5 to 97	% of helix	25 ma
* Helix	2046	1.1 ma	2000	2500	4 ma
* Collector	2046	23.5 ma	2000	2500	30 ma
Cathode	0	24.6 ma	0		30 ma

* Measured With Respect To Cathode

Helix Current: (4 ma Maximum)
1. Tube Operated At Maximum Power Out ____ ? ma
2. During Grid Cut-Off From P Max. Condition ____ ma

POWER SUPPLY CONNECTIONS	
1 - Collector	Red
2 - Helix	Orange
3 - Anode	Blue
4 - Cathode	White
5 - Grid	Gr
6 - Heater-Cathode	G
7 - Heater	
8 - Capsule-Ground	

Spurious Modulation	> 45	45 db down
VSWR, Input	< 3.0:1	3.0:1 Maximum
VSWR, Output	< 3.0:1	3.0:1 Maximum

RF PERFORMANCE			
Freq.	Small Signal Gain	Gain at 1 Watt Output	Power out With ⊙ P_i -2 dbm
Minimum	30 db	30 db	30 dbm
Maximum	None	None	None
Gc	db	db	dbm
4.0	33.5	33.5	31.6
4.5	40.0	39.5	34.8
5.0	41.5	41.5	35.7
5.5	42.5	41.5	35.3
6.0	42.0	41.0	35.1
6.5	40.5	39.5	33.8
7.0	39.5	37.5	32.7
7.5	37.5	35.0	31.2
8.0	35.0	32.0	30.0

⊙ Set for +30 dbm Power Output Gain [illegible]tation with input set to give 30 dbm output at minimum power point, 6 db maximum.

Small Signal Gain Variation
1. Across the band 13 db maximum.
2. Over any 300 mc range 5 db maximum.

TESTED BY [signature]

APPROVED BY Robert A Norman
FEB 8 1963

DATE SHIPPED ____

FINAL TEST DATA SHEET

MICROWAVE ELECTRONICS / CORPORATION
PALO ALTO, CALIFORNIA

TUBE TYPE 8[illegible]7-DB
SERIAL NO. 328

OPERATING CONDITIONS			POWER SUPPLY REQUIREMENTS		
Element	Voltage	Current	Voltage Minimum	Voltage Maximum	Current Maximum
Heater	6.3	.37 A	6.3 V	3 %Reg	1.5A
* Grid	-3.9	0 ua	-30	-1	50 ua
* Anode	1962	60 ua	62.5 to 97.5% of helix		.25 ma
* Helix	2076	.2 ma	2000	2500	4 ma
* Collector	2076	27.0 ma	2000	2500	30 ma
Cathode	0	27.2 ma	0		30 ma

* Measured With Respect To Cathode

Helix Current: (4 ma Maximum)
1. Tube Operated At Maximum Power Out 1.2 ma
2. During Grid Cut-Off From P Max. Condition 2.8 ma

POWER SUPPLY CONNECTIONS	
1 - Collector	Red
2 - Helix	Orange
3 - Anode	Blue
4 - Cathode	White
5 - Grid	Green
6 - Heater-Cathode	Gray
7 - Heater	Brown
8 - Capsule-Ground	Black

Spurious Modulation	> 45	45 db down
VSWR, Input	< 3.0:1	3.0:1 Maximum
VSWR, Output	< 3.0:1	3.0:1 Maximum

RF PERFORMANCE			
Freq.	Small Signal Gain	Gain at 1 Watt Output	Power out With ⊕ P_i -1 dbm
Minimum	30 db	30 db	30 dbm
Maximum	None	None	None
Gc	db	db	dbm
4.0	36.5	35.5	33.4
4.5	38.0	37.0	34.5
5.0	40.5	39.5	35.2
5.5	44.0	42.0	36.0
6.0	41.5	40.5	35.4
6.5	41.0	40.0	34.9
7.0	38.5	37.5	33.9
7.5	35.5	35.0	32.4
8.0	34.0	31.0	30.0

⊕ Set for +30 dbm Power Output Gain variation with input set to give 30 dbm output at minimum power point, 6 db maximum.

Small Signal Gain Variation
1. Across the band 13 db maximum.
2. Over any 300 mc range 5 db maximum.

TESTED BY Leon J Cole
APPROVED BY J Mitchell
DATE SHIPPED FEB 1 1963

FINAL TEST DATA SHEET

MICROWAVE
ELECTRONICS
/ CORPORATION
PALO ALTO, CALIFORNIA

TUBE TYPE M2407-DB
SERIAL NO. 324

OPERATING CONDITIONS			POWER SUPPLY REQUIREMENTS		
Element	Voltage	Current	Voltage Minimum	Voltage Maximum	Current Maximum
Heater	6.3	.37 A	6.3 V	3 %Reg	1.5 A
* Grid	-9.6	0 ua	-30	-1	50 ua
* Anode	1820	0 ua	62.5 to 97.5% of helix		.25 ma
* Helix	2070	.6 ma	2000	2500	4 ma
* Collector	2070	23.8 ma	2000	2500	30 ma
Cathode	0	24.4 ma	0		30 ma

* Measured With Respect To Cathode

Helix Current: (4 ma Maximum)

1. Tube Operated At Maximum Power Out 1.5 ma
2. During Grid Cut-Off From P Max. Condition 3.2 ma

POWER SUPPLY CONNECTIONS	
1 - Collector	Red
2 - Helix	Orange
3 - Anode	Blue
4 - Cathode	White
5 - Grid	Green
6 - Heater-Cathode	Gray
7 - Heater	Brown
8 - Capsule-Ground	Black

Spurious Modulation	> 45	45 db down
VSWR, Input	< 3.0:1	3.0:1 Maximum
VSWR, Output	< 3.0:1	3.0:1 Maximum

RF PERFORMANCE			
Freq.	Small Signal Gain	Gain at 1 Watt Output	Power out With ⊕ P_i -1.5 dbm
Minimum	30 db	30 db	30 dbm
Maximum	None	None	None
Gc	db	db	dbm
4.0	33.0	32.5	30.8
4.5	39.0	38.0	34.6
5.0	39.0	38.5	35.0
5.5	41.0	39.5	35.4
6.0	41.0	40.0	35.4
6.5	40.5	39.5	35.1
7.0	38.0	37.0	33.7
7.5	36.0	35.5	32.3
8.0	33.0	32.0	30.4

⊕ Set for +30 dbm Power Output Gain variation with input set to give 30 dbm output at minimum power point, 6 db maximum.

Small Signal Gain Variation

1. Across the band 13 db maximum.
2. Over any 300 mc range 5 db maximum.

TESTED BY [signature]

APPROVED BY [signature]

DATE SHIPPED JAN 29 1963

FINAL TEST DATA SHEET

MICROWAVE ELECTRONICS CORPORATION
PALO ALTO, CALIFORNIA

TUBE TYPE M 07-DB
SERIAL NO. 321

OPERATING CONDITIONS			POWER SUPPLY REQUIREMENTS		
Element	Voltage	Current	Voltage Minimum	Voltage Maximum	Current Maximum
Heater	6.3	.37 A	6.3 V	3 %Reg	1.5 A
* Grid	-8.3	0 ua	-30	-1	50 ua
* Anode	1528	0 ua	62.5 to 97.5% of helix		.25 ma
* Helix	2097	.4 ma	2000	2500	4 ma
* Collector	2097	16.6 ma	2000	2500	30 ma
Cathode	0	17.0 ma	0		30 ma

* Measured With Respect To Cathode

Helix Current: (4 ma Maximum)

1. Tube Operated At Maximum Power Out 1.5 ma
2. During Grid Cut-Off From P Max. Condition 1.9 ma

POWER SUPPLY CONNECTIONS	
1 - Collector	Red
2 - Helix	Orange
3 - Anode	Blue
4 - Cathode	White
5 - Grid	Green
6 - Heater-Cathode	Gray
7 - Heater	Brown
8 - Capsule-Ground	Black

Spurious Modulation	> 45	45 db down
VSWR, Input	< 3.0:1	3.0:1 Maximum
VSWR, Output	< 3.0:1	3.0:1 Maximum

RF PERFORMANCE			
Freq.	Small Signal Gain	Gain at 1 Watt Output	Power out With ⊕ P_i -3 dbm
Minimum	30 db	30 db	30 dbm
Maximum	None	None	None
Gc	db	db	dbm
4.0	34.0	34.0	30.7
4.5	39.5	39.0	33.6
5.0	39.0	38.0	33.4
5.5	41.0	40.5	34.5
6.0	39.0	39.0	34.0
6.5	40.0	40.0	34.7
7.0	39.0	39.0	34.3
7.5	35.5	35.5	32.1
8.0	33.0	33.0	30.0

⊕ Set for +30 dbm Power Output Gain variation with input set to give 30 dbm output at minimum power point, 6 db maximum.

Small Signal Gain Variation

1. Across the band 13 db maximum.
2. Over any 300 mc range 5 db maximum.

TESTED BY Ginn Schol

APPROVED BY Robert A Haurwitz

DATE SHIPPED FEB 25 1963

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(4)

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

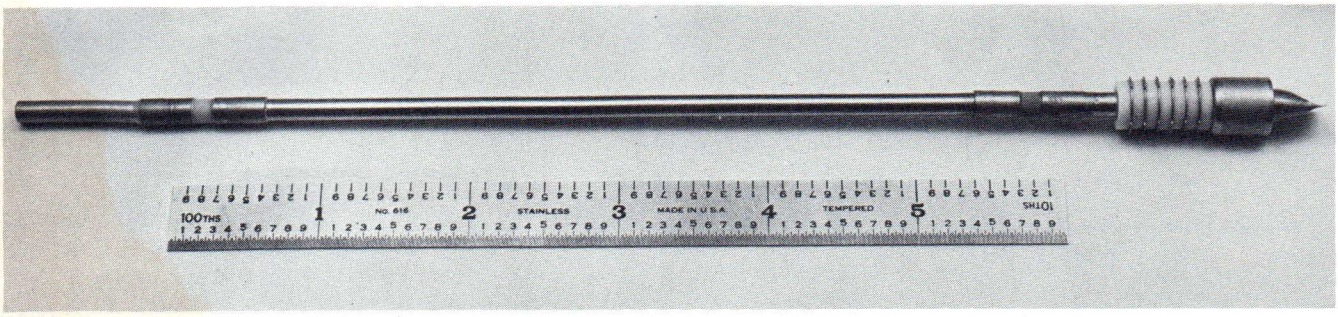
M2101-A

Number 108 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / LOW NOISE / LOW POWER / METAL-CERAMIC

8.0 to 11.0 kmc / 10 db Noise Figure



The M2101-A is a broad-band, solenoid focused, low noise traveling-wave tube designed for use in the 8.0 to 11.0 kmc frequency range. This tube provides a minimum of 5 mw of r-f power at a low level gain of 25 db, and has a nominal broad-band noise figure of 10 db. It is specifically designed for applications needing a broad-band low noise preamplifier.

The vacuum tube is of metal-ceramic construction and uses a thin, dense oxide coated cathode designed for low noise performance and low heater power consumption. These features enable the M2101-A to provide a new order of reliability, stable performance and long life necessary for system applications.

OPERATING CONDITIONS:

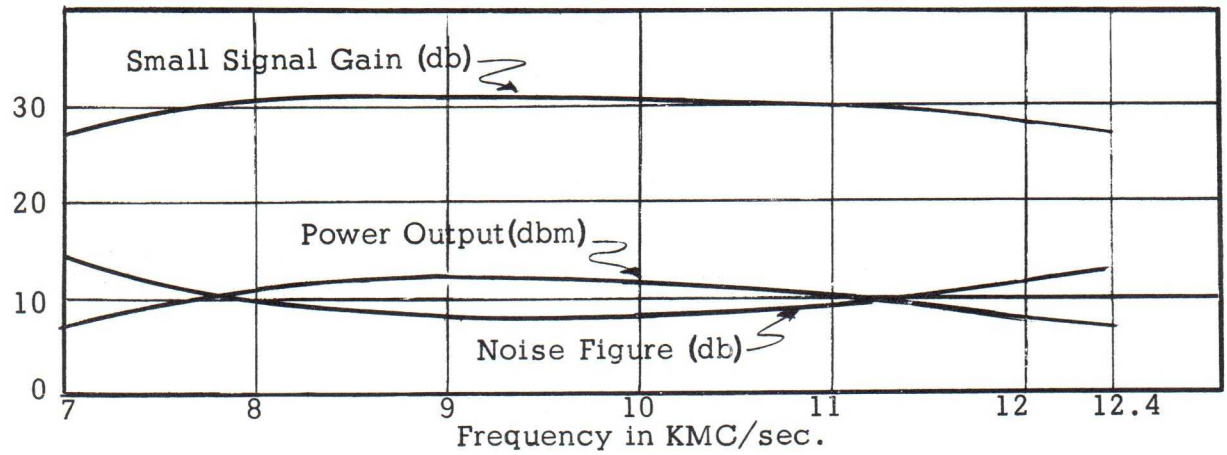
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current, maximum	.10 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	1.5 ma
D.C. Grid Voltage	-50 to 0
D.C. Anode 1 Voltage	0 to +150
D.C. Anode 2 Voltage	150 to +300
D.C. Anode 3 Voltage	400 to +800
Element at Ground Potential	Any
Magnetic Field Strength	800 - 1000 gauss uniform over 8-1/2"

M2101-A (Continued)

PERFORMANCE CHARACTERISTICS:

Frequency Range	8.0 to 11.0 kmc
Small Signal Gain	25 db, minimum
Saturation Power Output	5 mw, minimum
Noise Figure	10 db, nominal
Spurious Modulation	>50 db below output
Input VSWR	2:1
Output VSWR	2:1

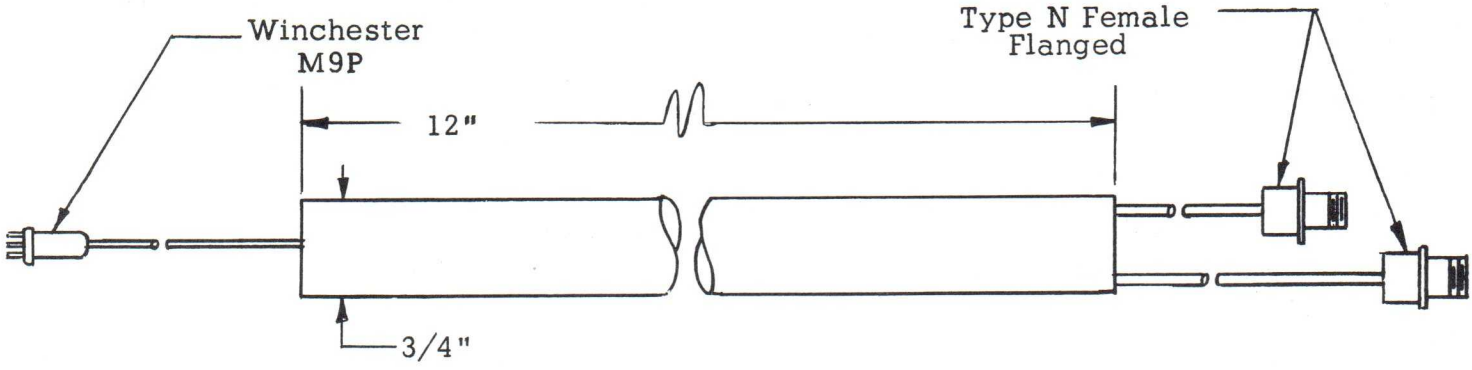
Typical Gain and Power Output



MECHANICAL:

Physical Dimensions	See Outline Drawing
Maximum Over-all Length	12"
Shell Diameter	3/4"*
Mounting Position	Any
Weight	1.0 pound
Input R.F. Connector	Type N Female Flanged
Output R.F. Connector	Type N Female Flanged
Cooling	Convection

* Available in larger diameters.



Outline Drawing M2101-A

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

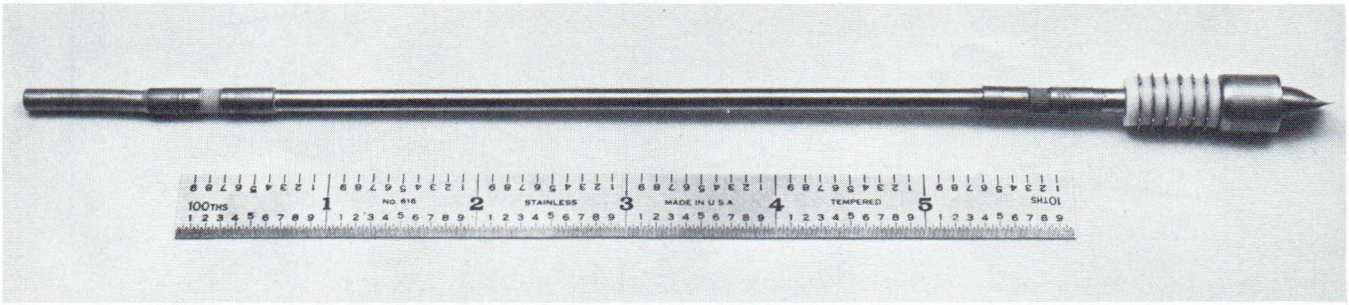
M2101-B

Number 111 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / LOW NOISE / METAL-CERAMIC / RUGGEDIZED

P.P.M. FOCUSED / TEMPERATURE COMPENSATED



The M2101-B is a broad-band, periodically focused low noise traveling-wave tube designed for use in the 8.0 to 11.0 kmc frequency range. This tube provides a minimum of 5 mw of r-f power, has a low level gain of 25 db, and has a nominal broad-band noise figure of 13 db. It is specifically designed for applications needing a broad-band low noise preamplifier.

The vacuum tube is of metal-ceramic construction, and uses a thin, dense oxide coated cathode designed for low noise performance, and low heater power consumption. The packaging is ruggedized and the periodic magnet assembly is temperature compensated, making the M2101-B ideal for operation under severe environmental conditions. These features enable the M2101-B to provide a new order of reliability, stable performance and long life necessary for systems applications.

OPERATING CONDITIONS:

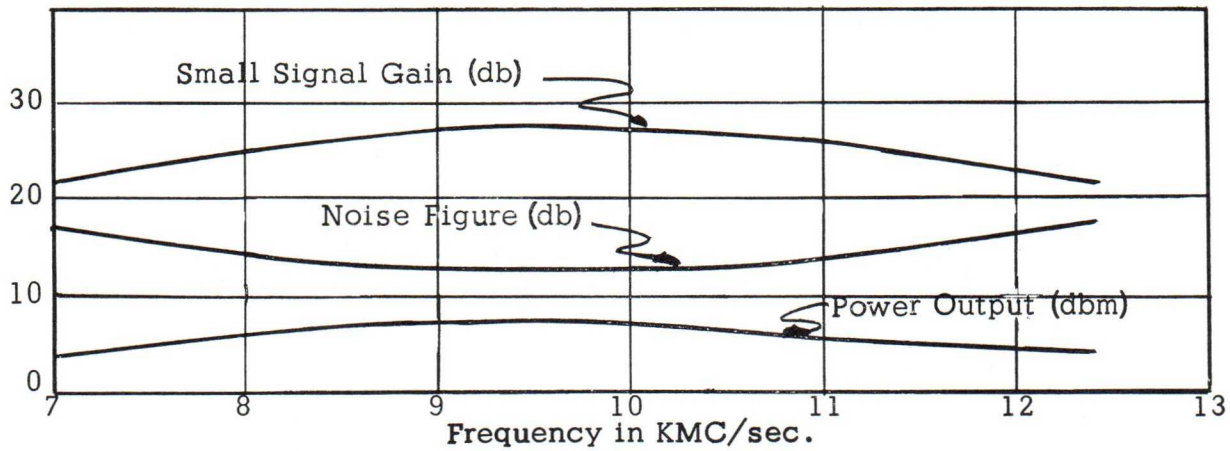
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current	0.100 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	1.0 ma
D.C. Grid Voltage	-50 to 0
D.C. Anode 1 Voltage	0 to +150
D.C. Anode 2 Voltage	150 to +300
D.C. Anode 3 Voltage	400 to +800
Element at Ground Potential	Any

M2101-B (Continued)

PERFORMANCE CHARACTERISTICS:

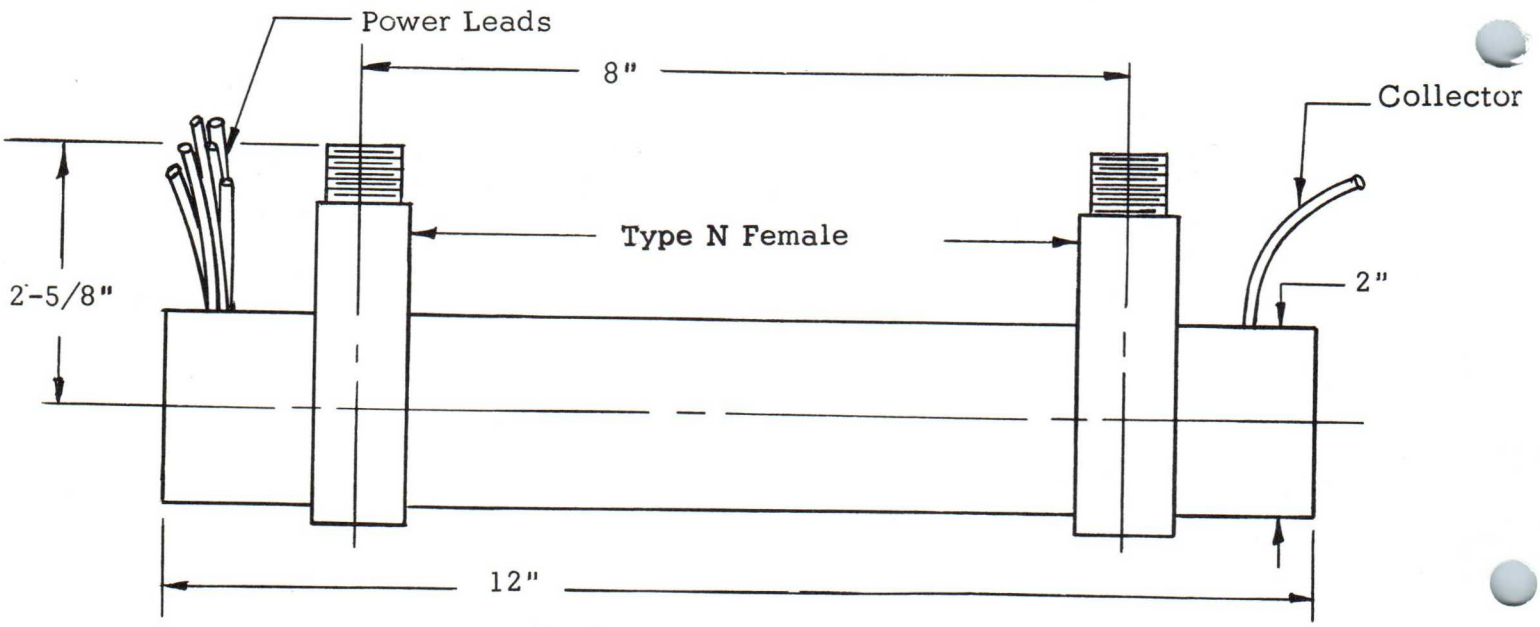
Frequency Range	8.0 to 11 kmc
Small Signal Gain	25 db, minimum
Saturated Power Output	5 mw, minimum
Noise Figure	15 db, maximum
Spurious Modulation	>50 db below output
Input VSWR	2:1
Output VSWR	2:1

Typical Gain and Power Output



MECHANICAL:

Mounting Position	Any
D.C. Connection	Flying Leads
R.F. Connectors	Type N Female
Over-all Length	12 inches
Net Weight	3.5 pounds



Outline Drawing M2101-B

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

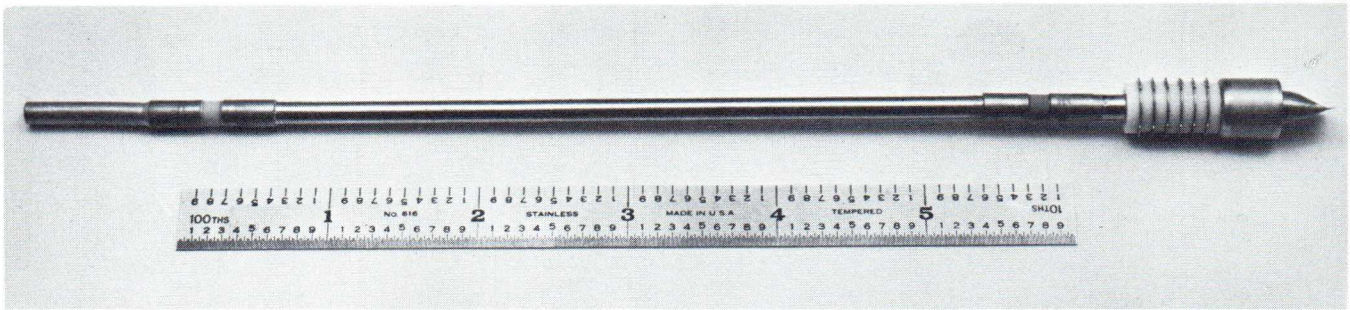
M2106-A

Number 109 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / MEDIUM NOISE / METAL-CERAMIC / RUGGEDIZED

P.P.M. FOCUSED / TEMPERATURE COMPENSATED



The M2106-A is a broad-band, periodically focused low noise traveling-wave tube designed for use in the 7.0 to 11.0 kmc frequency range. This tube provides a minimum of 10 mw of r-f power, has a low level gain of 30 db, and has a nominal broad-band noise figure of 20 db. It is specifically designed for applications needing a broad-band medium noise preamplifier.

The vacuum tube is of metal-ceramic construction, and uses a thin, dense oxide coated cathode designed for low noise performance, and low heater power consumption. The packaging is ruggedized and the periodic magnet assembly is temperature compensated, making the M2106-A ideal for operation under severe environmental conditions. These features enable the M2106-A to provide a new order of reliability, stable performance and long life necessary for systems applications.

OPERATING CONDITIONS:

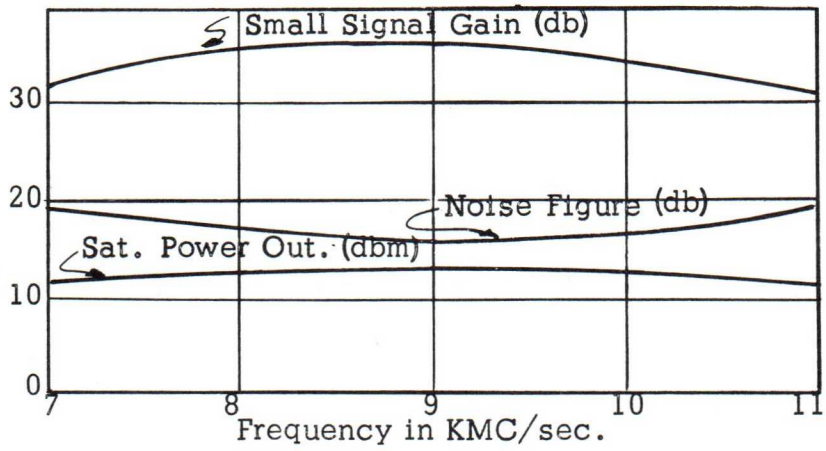
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current	0.100 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	1.5 ma
D.C. Grid Voltage	-50 to 0
D.C. Anode 1 Voltage	0 to +150
D.C. Anode 2 Voltage	150 to +300
D.C. Anode 3 Voltage	400 to +800
Element to Ground Potential	Any

M2106-A (Continued)

PERFORMANCE CHARACTERISTICS:

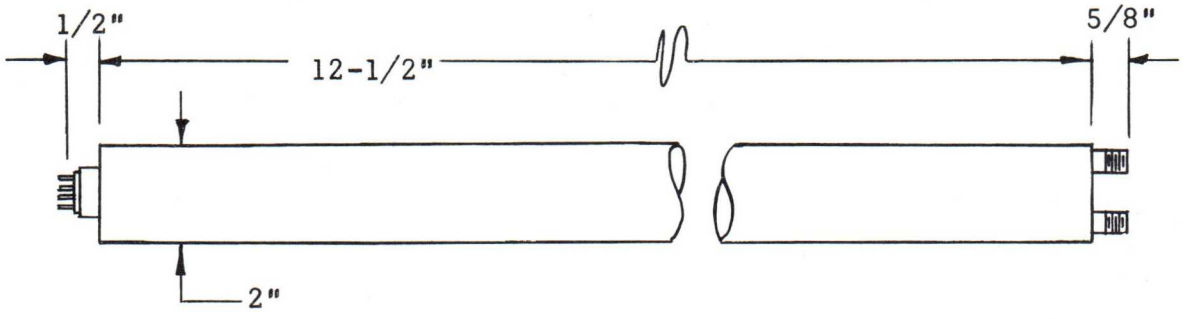
Frequency Range	7.0 to 11 kmc
Small Signal Gain	25 db, minimum
Saturated Power Output	10 mw, minimum
Noise Figure	20 db, maximum
Spurious Modulation	>50 db below output
Input VSWR	2:1
Output VSWR	2:1

Typical Gain and Power Output



MECHANICAL:

Mounting Position	Any
D.C. Socket	Winchester M12P
R.F. Connectors	Type N Female
Over-all Length	13-5/8 inches
Net Weight	3.8 pounds



Outline Drawing M2106-A

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

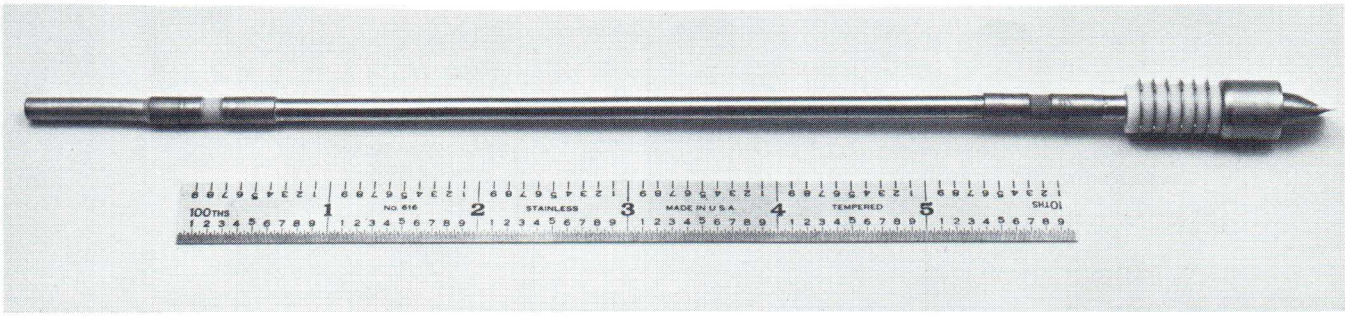
M2106-B

Number 110 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / MEDIUM NOISE / METAL-CERAMIC / RUGGEDIZED

P.P.M. FOCUSED / TEMPERATURE COMPENSATED



The M2106-B is a broad-band, periodically focused low noise traveling-wave tube designed for use in the 7.0 to 11.0 kmc frequency range. This tube provides a minimum of 10 mw of r-f power, has a low level gain of 30 db, and has a nominal broad-band noise figure of 20 db. It is specifically designed for applications needing a broad-band medium noise preamplifier.

The vacuum tube is of metal-ceramic construction, and uses a thin, dense oxide coated cathode designed for low noise performance, and low heater power consumption. The packaging is ruggedized and the periodic magnet assembly is temperature compensated, making the M2106-B ideal for operation under severe environmental conditions. These features enable the M2106-B to provide a new order of reliability, stable performance and long life necessary for systems applications.

OPERATING CONDITIONS:

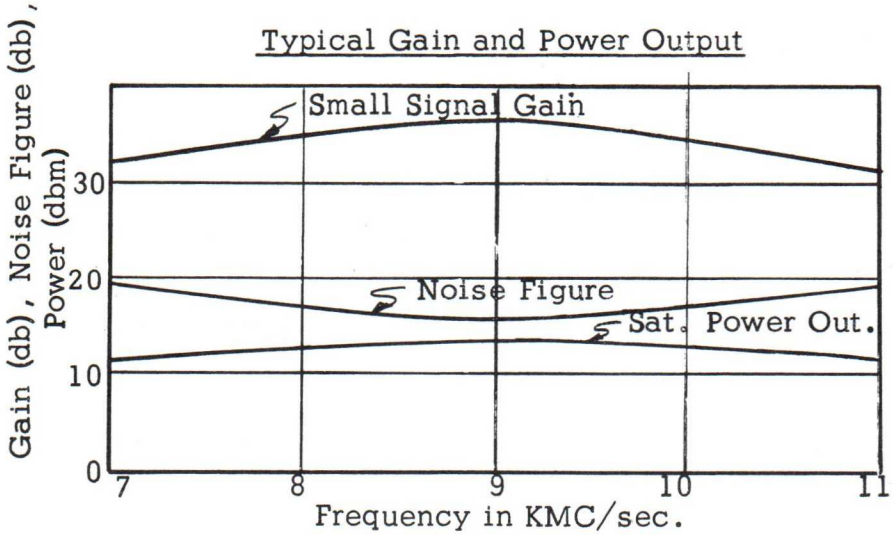
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current	0.100 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	1.5 ma
D.C. Grid Voltage	-50 to 0
D.C. Anode 1 Voltage	0 to +150
D.C. Anode 2 Voltage	150 to +300
D.C. Anode 3 Voltage	400 to +800
Element to Ground Potential	Any

M2106-B (Continued)

PERFORMANCE CHARACTERISTICS:

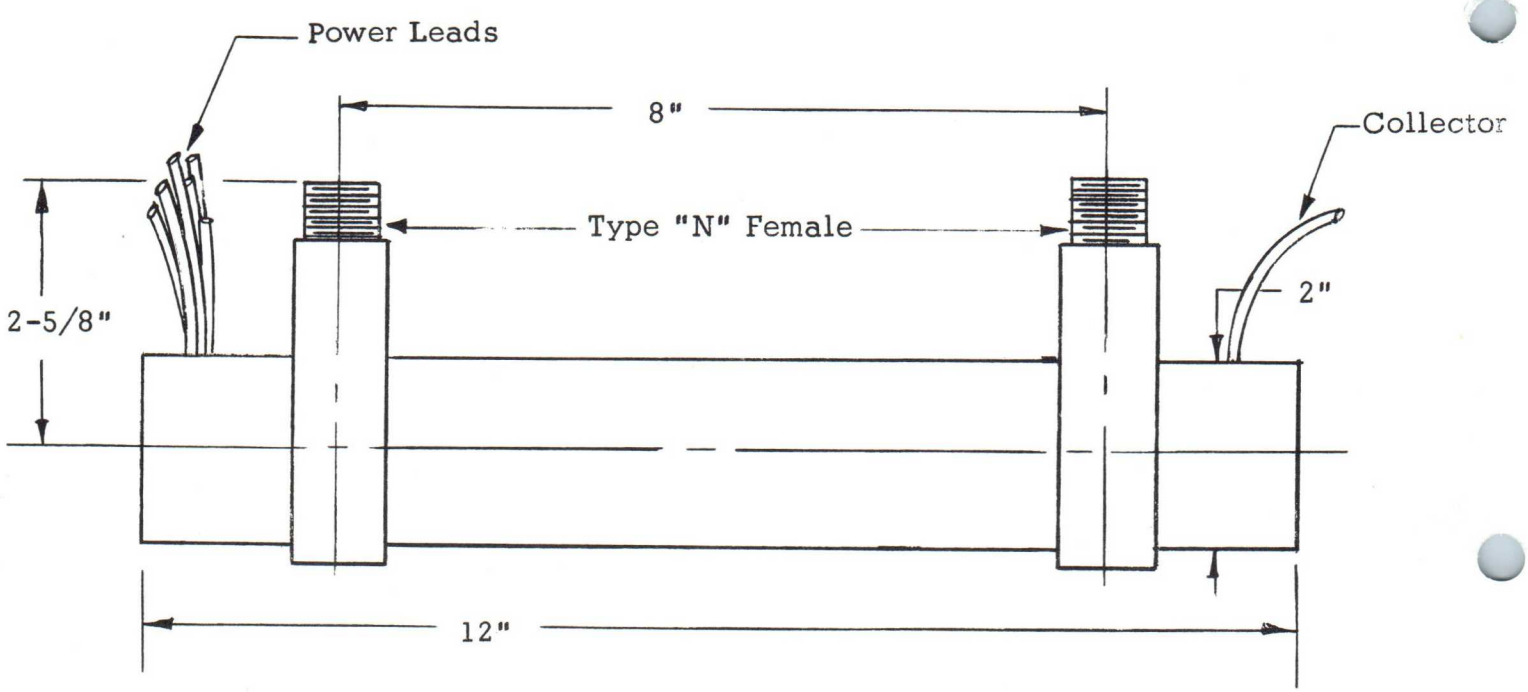
Frequency Range	7.0 to 11 kmc
Small Signal Gain	25 db, minimum
Saturated Power Output	10 mw, minimum
Noise Figure	20 db, maximum
Spurious Modulation	>50 db below output
Input VSWR	2:1
Output VSWR	2:1

Typical Gain and Power Output



MECHANICAL:

Mounting Position	Any
D.C. Connection	Flying Leads
R.F. Connectors	Type N Female
Over-all Length	12 inches
Net Weight	3.5 pounds



Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

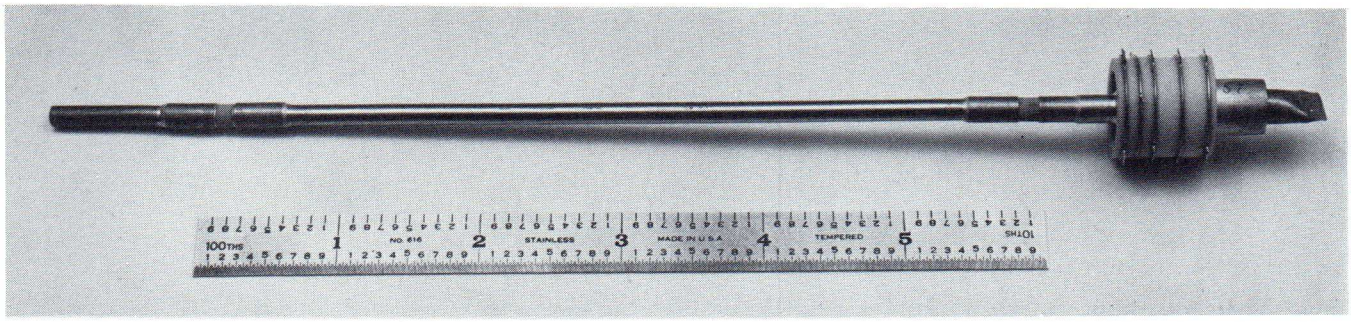
M2201-A

Number 101 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / HIGH GAIN / MEDIUM POWER / METAL-CERAMIC

7.0 to 12.4 kmc / 10 milliwatt Power Output



The M2201-A is a broad-band traveling-wave tube designed for use in the 7.0 to 12.4 kmc frequency range. This tube provides a minimum of 10 mw of r-f power and has a nominal low level power gain of 30 db. It is specifically designed as a replacement unit for laboratory instrument amplifiers.

The vacuum tube is of metal-ceramic construction, and uses a unipotential oxide-coated cathode, designed for low cathode loading, and low heater power. These features enable the M2201-A to provide a new order of reliability, stable performance, and long life in instrument applications.

OPERATING CONDITIONS:

Heater Voltage*	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current, maximum	0.5 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	350 - 450 volts
D.C. Anode Current	< 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any
Magnetic Field Strength, minimum	400 gauss

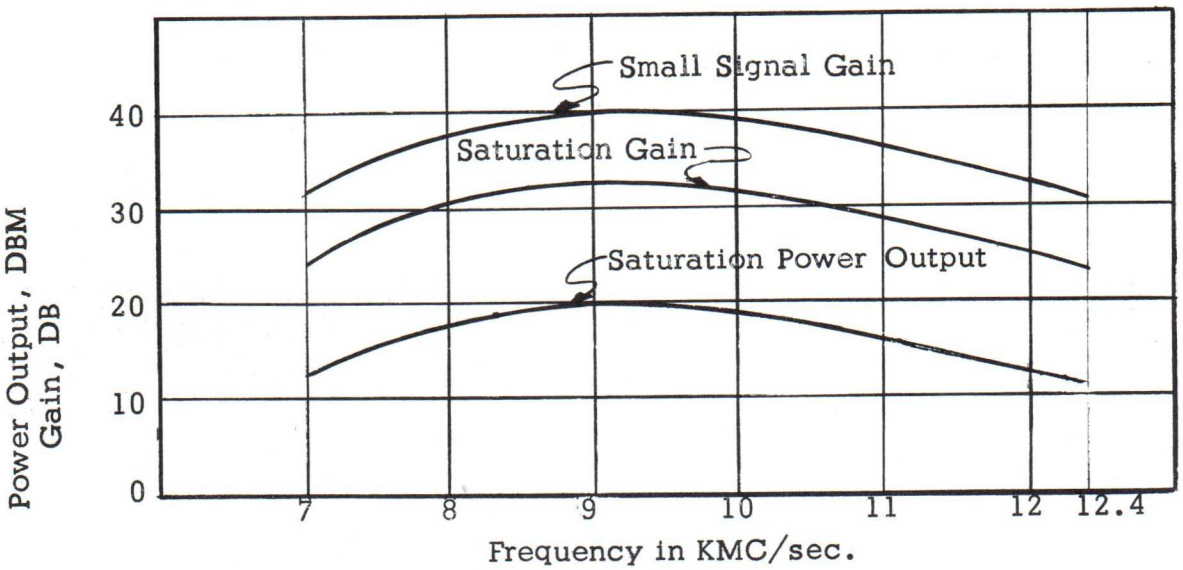
* Because of the low heater power requirements for this tube, units employing ballast tube regulation for heater power must be modified with a suitable shunting resistor, across the TWT filaments to provide 6.3 volts for heater operation.

Note: The M2201-A is an electrical replacement for use in the Hewlett-Packard 494A traveling-wave amplifier unit and has been accepted as an approved replacement by the Hewlett-Packard Company. It is also a direct mechanical replacement for the Hewlett-Packard 494A, except for the position of the power connector. A simple modification kit is included with each tube to allow the position of the 494A power connector to be changed.

PERFORMANCE CHARACTERISTICS:

Frequency Range	7.0 to 12.4 kmc
Small Signal Gain	25 db, minimum
Saturation Power Output	10 mw, minimum
Spurious Modulation	>50 db below output
Noise Figure	30 db, maximum
Input VSWR	2:1
Output VSWR	2:1

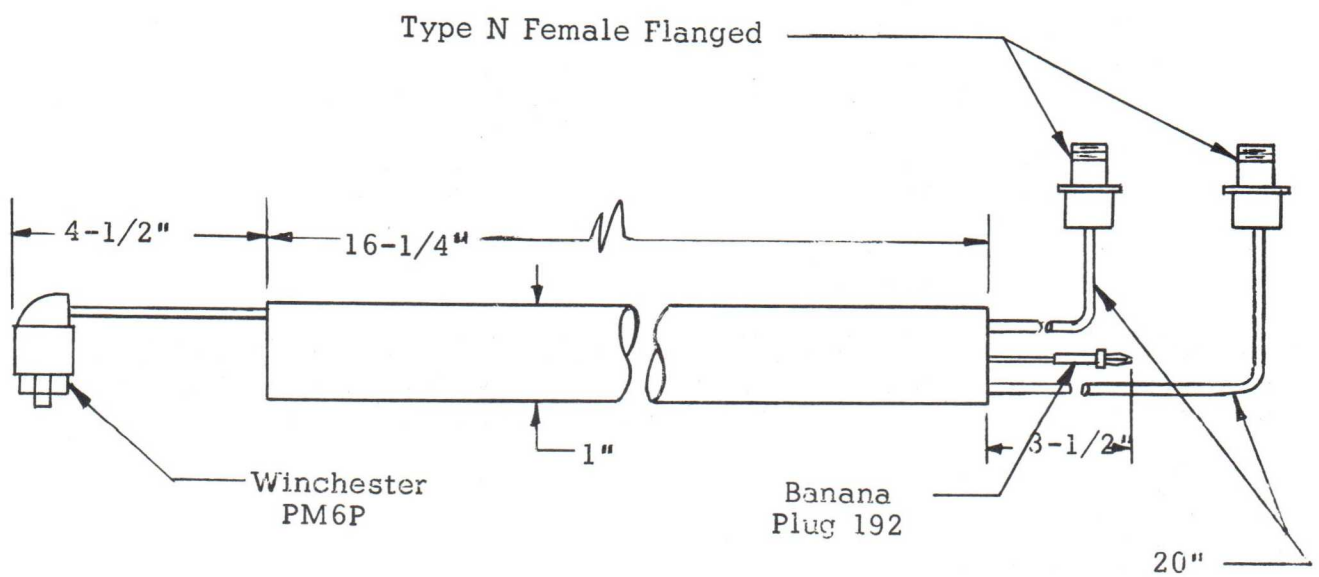
Typical Gain and Power Output



MECHANICAL:

Physical Dimensions	See outline drawing
Maximum Over-all Length	16-1/4 inches
Maximum Shell Diameter	1 inch
Mounting Position	Any
Weight	1.0 pound
Input R.F. Connector	Type N Female Flanged
Output R.F. Connector	Type N Female Flanged
Cooling	Convection

Outline Drawing M2201-A



Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

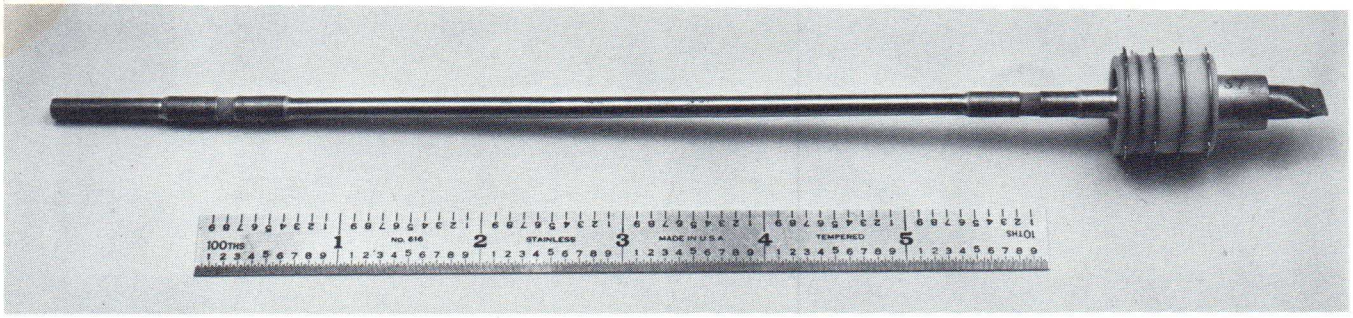
M2201-B

Number 102 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / HIGH GAIN / LOW POWER / METAL-CERAMIC

8.0 to 12.4 kmc / 10 milliwatt Power Output



The M2201-B is a broad-band traveling-wave tube for use in the 8.0 - 12.4 kmc frequency range. This tube provides a minimum of 10 milliwatts of r-f power, with a minimum low level power gain of 30 db. It is specifically designed as a replacement unit for laboratory instrument amplifiers.

The vacuum tube is of metal-ceramic construction and uses a unipotential oxide-coated cathode, designed for low cathode loading and low heater power. These features enable the M2201-B to provide a new order of reliability, stable performance, and long life in instrument applications.

OPERATING CONDITIONS:

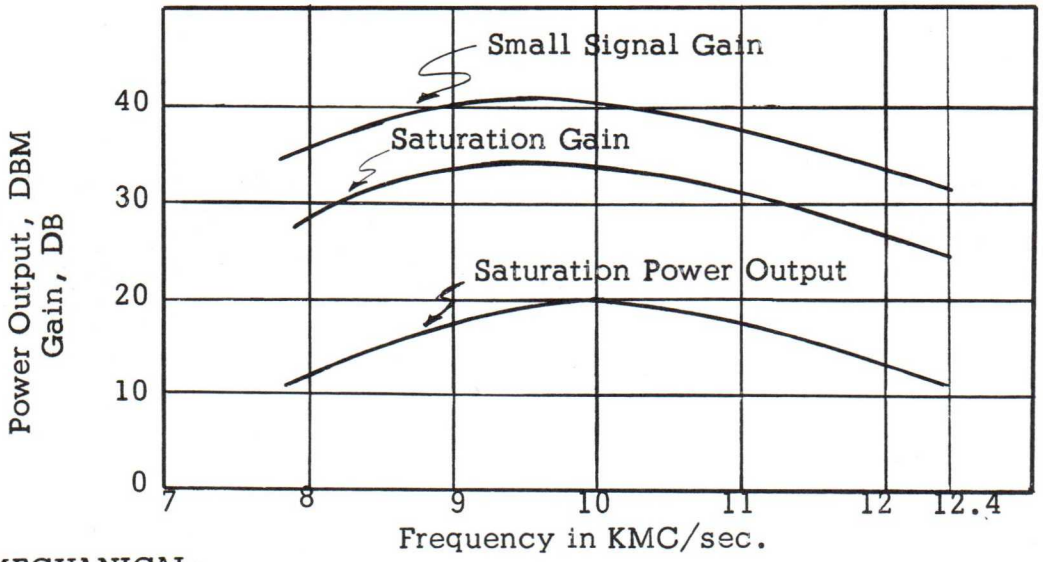
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current, maximum	1.0 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	350 - 435 volts
D.C. Anode Current	< 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any
Magnetic Field Strength, minimum	400 gauss

Note: The M2201-B is an electrical and mechanical replacement for use in the Alfred Electronics Model 504 amplifier unit, and has been accepted as an approved replacement by Alfred Electronics.

ELECTRICAL PERFORMANCE:

Frequency Range	8.0 to 12.4 kmc
Small Signal Gain, minimum	30 db
Saturation Power Output, minimum	10 mw
Spurious Modulation	>50 db below output
Noise Figure	30 db, maximum
Input VSWR	2:1
Output VSWR	2:1

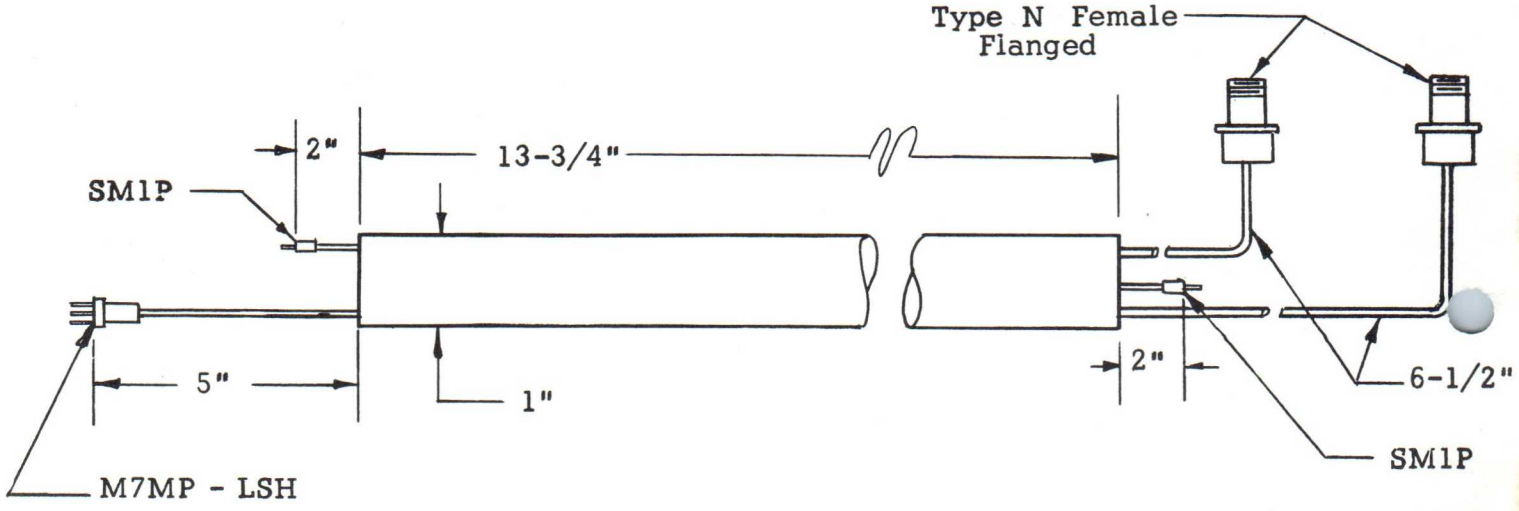
Typical Gain and Power Output



MECHANICAL:

Physical Dimensions	See Outline Drawing
Maximum Over-all Length	13-3/4 inches
Maximum Shell Diameter	1 inch
Mounting Position	Any
Weight	1.0 pound
Input R.F. Connector	Type N Female Flanged
Output R.F. Connector	Type N Female Flanged
Cooling	Convection

Outline Drawing M2201-B



Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

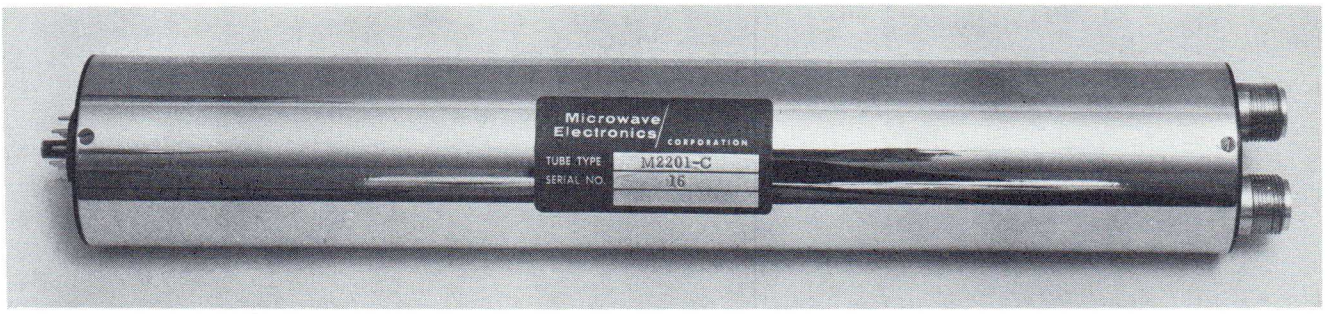
M2201-C

Number 114 - April 1960

TRAVELING - WAVE TUBE

BROAD-BAND / HIGH GAIN / LOW POWER / METAL-CERAMIC

8.0 to 11.0 kmc / 10 milliwatt Power Output / PPM Focused



The M2201-C is a broad-band traveling-wave tube for use in the 8.0 - 11.0 kmc frequency range. This tube provides a minimum of 10 milliwatts of r-f power, with a minimum low level power gain of 30 db. It is specifically designed for applications requiring light weight, dense packaging and low power consumption.

The vacuum tube is of metal-ceramic construction and uses a unipotential oxide-coated cathode, designed for low cathode loading and low heater power. These features enable the M2201-C to provide a new order of reliability, stable performance, and long life in systems applications.

OPERATING CONDITIONS:

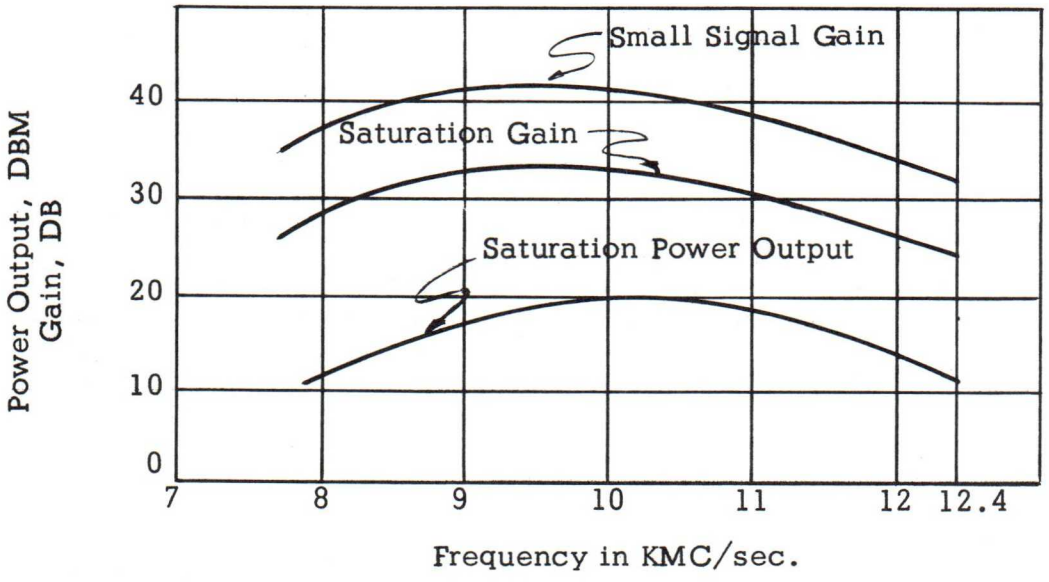
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current, maximum	1.0 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	350 - 450 volts
D.C. Anode Current	$<$ 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any

M2201-C (Continued)

ELECTRICAL PERFORMANCE:

Frequency Range	8.0 to 11.0 kmc
Small Signal Gain, minimum	30 db
Saturation Power Output, minimum	10 mw
Spurious Modulation	>50 db below output
Noise Figure	30 db, maximum
Input VSWR	2:1
Output VSWR	2:1

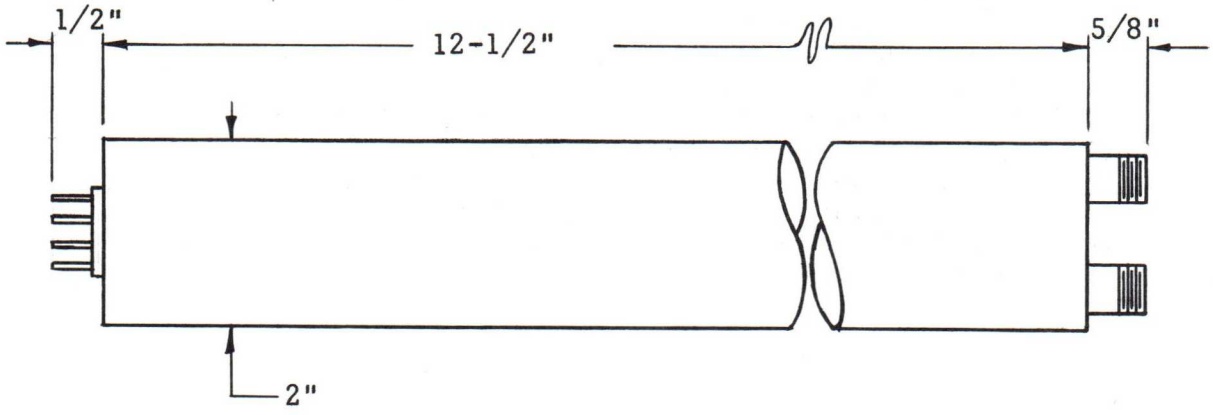
Typical Gain and Power Output



MECHANICAL:

Mounting Position	Any
D.C. Socket	Winchester M12P
R.F. Connectors	Type N Female
Over-all Length*	13-5/8 inches
Net Weight	3.5 pounds

Outline Drawing M2201-C



* Available in longer capsule lengths

Microwave Electronics CORPORATION

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TECHNICAL DATA

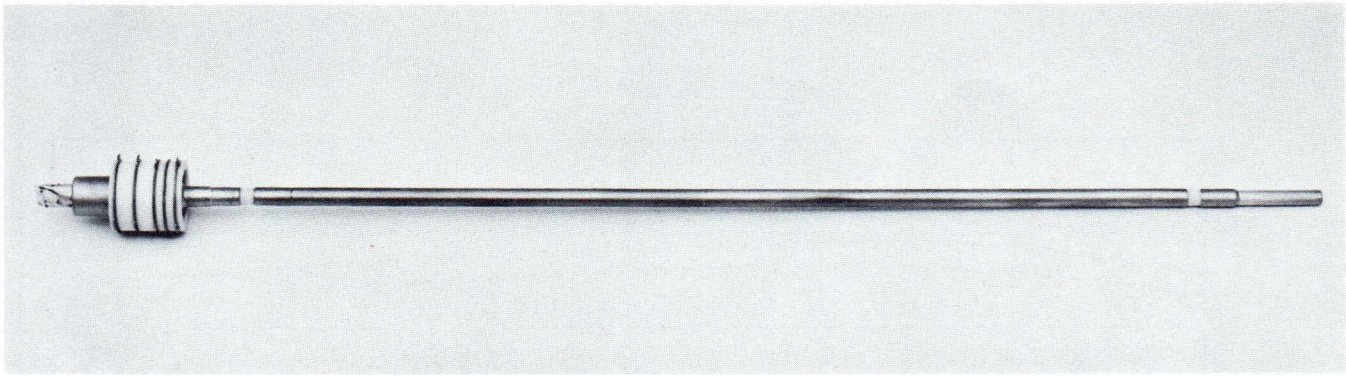
M2203-B

Number 113 - April 1960

TRAVELING - WAVE TUBE

AMPLITUDE MODULATOR / SERRODYNE MODULATOR / METAL-CERAMIC

C-Band



The M2203-B is a broad-band, solenoid-focused, traveling-wave tube designed for use in selected portions of the 4.0 to 8.0 kmc frequency range. This tube provides a minimum of 10 mw of r-f power, and has a nominal low level power gain of 20 db. It is specifically designed as an amplitude modulator, and as a phase shift modulator for serrodyne operation. When used as a phase shifter, the sideband suppression under sawtooth modulation is greater than 30 db.

The vacuum tube is of ceramic-metal construction and uses a unipotential oxide-coated cathode, designed for low cathode loading and low heater power. These features enable the M2203-B to provide a new order of reliability, stable performance, and long life for instrumentation or systems applications.

OPERATING CONDITIONS:

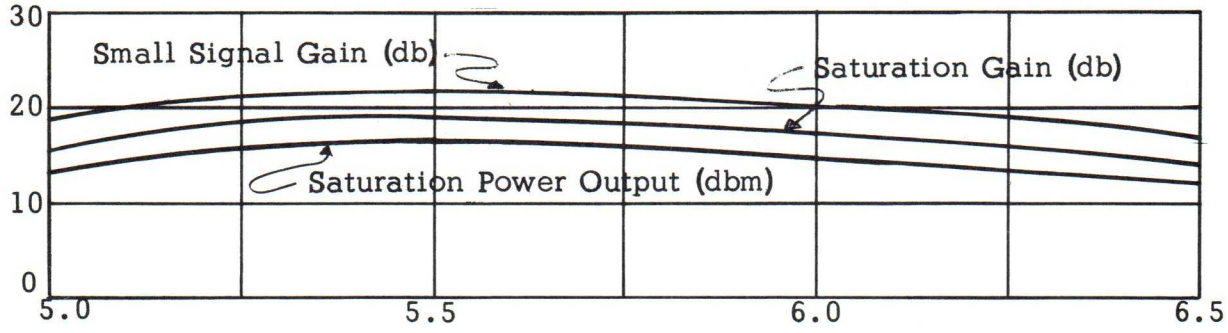
Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	650 - 800 volts
D.C. Helix Current, maximum	0.5 ma
D.C. Collector Voltage	650 - 800 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	300 - 450 volts
D.C. Anode Current	< 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any
Magnetic Field Strength	400 gauss, minimum

M2203-B (Continued)

ELECTRICAL PERFORMANCE:

Frequency Range	Any 1500 mc portion of the 4.0 to 8.0 kmc range
Small Signal Gain	15 db minimum
Saturation Power Output	10 mw, minimum
Helix Voltage Change for 2π phase shift	5 - 40 volts peak-to-peak, depending upon frequency range
Gain Variation for 2π phase shift	$<$ 1/2 db
Sideband Suppression (150 kc modulation rate)	$>$ 33 db
Grid Modulation Sensitivity	$>$3/4 db/volt
Grid Modulation Linearity	$\pm$ 1/2 db over a 10 db range
RF Leakage	$>$70 db below output level
Spurious Modulation	$>$50 db below output
Input VSWR	2:1
Output VSWR	2:1

Typical Gain and Power Output

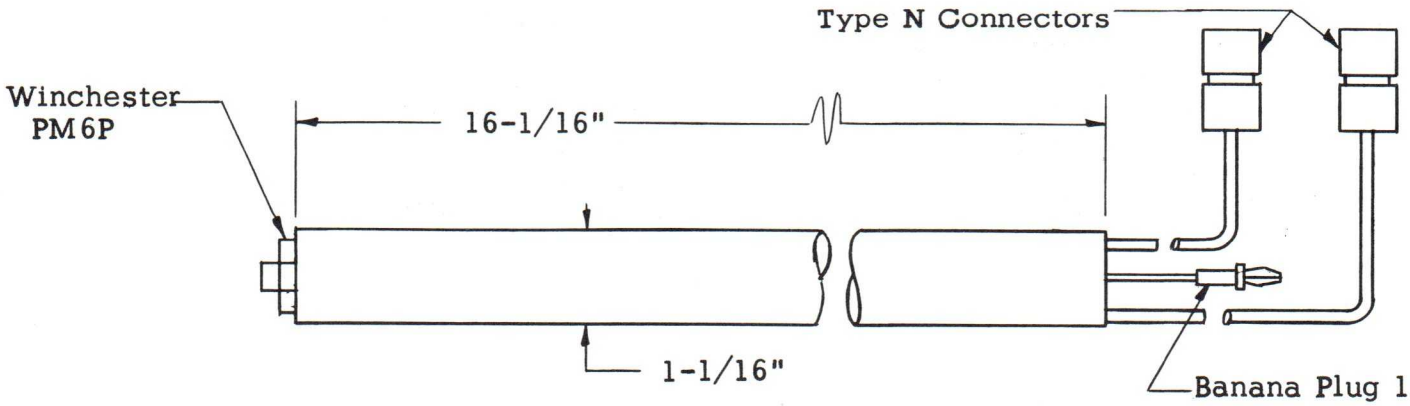


Frequency in KMC/sec.

MECHANICAL:

Physical Dimensions	See Outline Drawing
Maximum Over-all Length	16-1/16 inches
Maximum Shell Diameter	1-1/16 inches
Mounting Position	Any
Weight	1.0 pound approx.
Input RF Connector	Type N Male
Output RF Connector	Type N Male
Cooling	Convection

Outline Drawing M2203-B



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TECHNICAL DATA

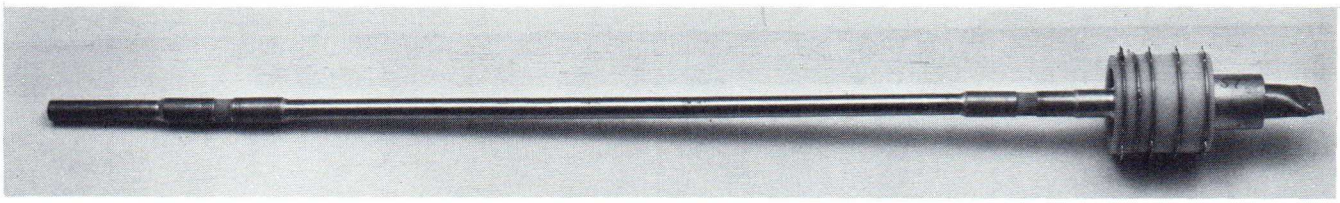
M2204-A

Number 107 - February 1960

TRAVELING - WAVE TUBE

AMPLITUDE MODULATOR / SERRODYNE MODULATOR / METAL-CERAMIC

X-Band



The M2204-A is a broad-band, solenoid-focused, traveling-wave tube designed for use in selected portions of the 7.0 to 12.4 kmc frequency range. This tube provides a minimum of 10 mw of r-f power, and has a nominal low level power gain of 15 db. It is specifically designed as an amplitude modulator, and as a phase shift modulator for serrodyne operation. When used as a phase shifter, the sideband suppression under sawtooth modulation is greater than 30 db.

The vacuum tube is of ceramic-metal construction and uses a unipotential oxide-coated cathode, designed for low cathode loading and low heater power. These features enable the M2204-A to provide a new order of reliability, stable performance, and long life for instrumentation or systems applications.

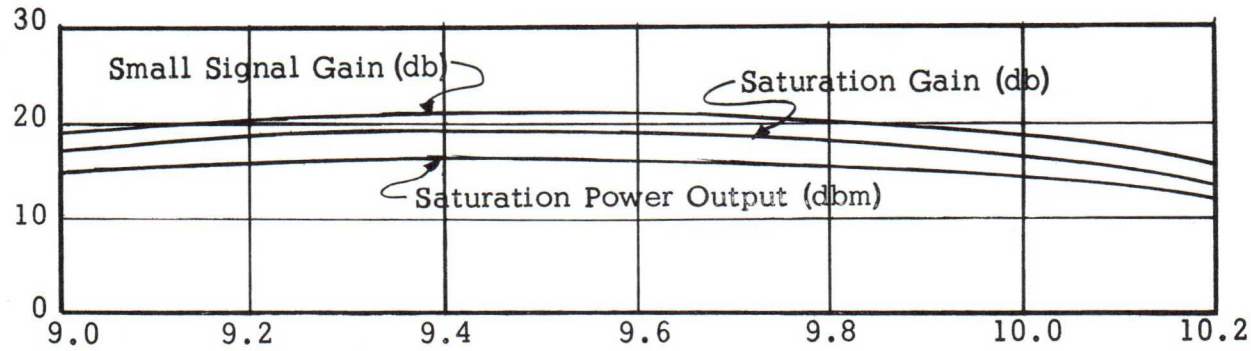
OPERATING CONDITIONS:

Heater Voltage	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	1100 - 1200 volts
D.C. Helix Current, maximum	0.5 ma
D.C. Collector Voltage	1100 - 1200 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	350 - 450 volts
D.C. Anode Current	$<$ 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any
Magnetic Field Strength	400 gauss, minimum

M2204-A (Continued)

ELECTRICAL PERFORMANCE:

Frequency Range	Any 1500 mc portion of the 7.0 to 12.4 kmc range
Small Signal Gain	10 db, minimum
Saturation Power Output	10 mw, minimum
Helix Voltage Change for 2π phase shift	24 - 32 volts peak-to-peak
Gain Variation for 2π phase shift	$<$ 0.35 db
Sideband Suppression (150 kc modulation rate)	$>$33 db
Grid Modulation Sensitivity	$>$3/4 db/volt
Grid Modulation Linearity	$\pm$ 1/2 db over a 10 db range
RF Leakage	$>$70 db below output level
Spurious Modulation	$>$50 db below output
Input VSWR	2:1
Output VSWR	2:1

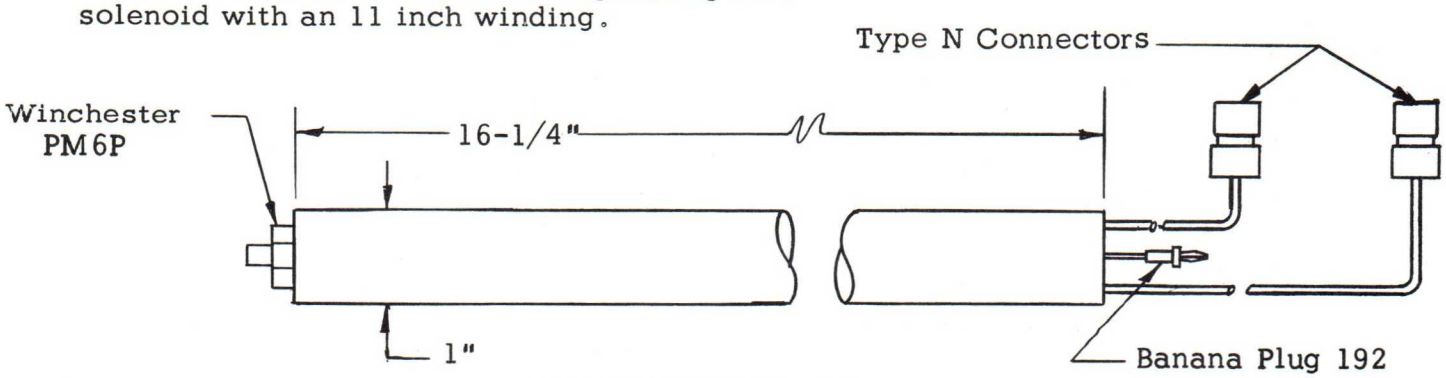


Typical Gain and Power Output

MECHANICAL:

Physical Dimensions	See Outline Drawing
Maximum Over-all Length*	16-1/4 inches
Maximum Shell Diameter	1 inch
Mounting Position	Any
Weight	1.0 pound approx.
Input RF Connector	Type N Male
Output RF Connector	Type N Male
Cooling	Convection

* 14 inch capsule available for operating in a solenoid with an 11 inch winding.



Outline Drawing M2204-A

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

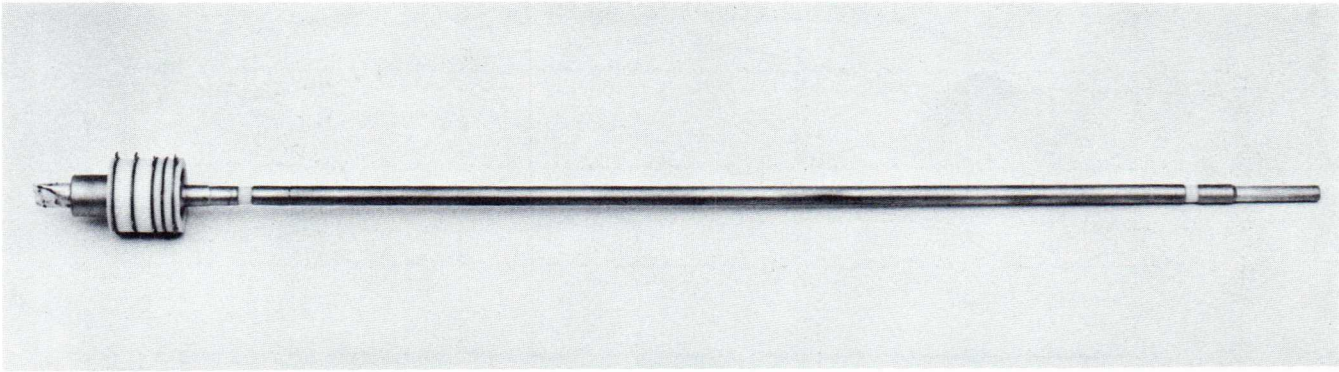
M2207-A

Number 112 - April 1960

TRAVELING - WAVE TUBE

BROAD-BAND / HIGH GAIN / LOW POWER / METAL-CERAMIC

4.0 to 8.0 kmc / 10 milliwatt Power Output



The M2207-A is a broad-band traveling-wave tube designed for use in the 4.0 to 8.0 kmc frequency range. This tube provides a minimum of 10 mw of r-f power and has a nominal low level power gain of 30 db. It is specifically designed as a replacement unit for laboratory instrument amplifiers.

The vacuum tube is of metal-ceramic construction, and uses a unipotential oxide-coated cathode, designed for low cathode loading, and low heater power. These features enable the M2207-A to provide a new order of reliability, stable performance, and long life in instrument applications.

OPERATING CONDITIONS:

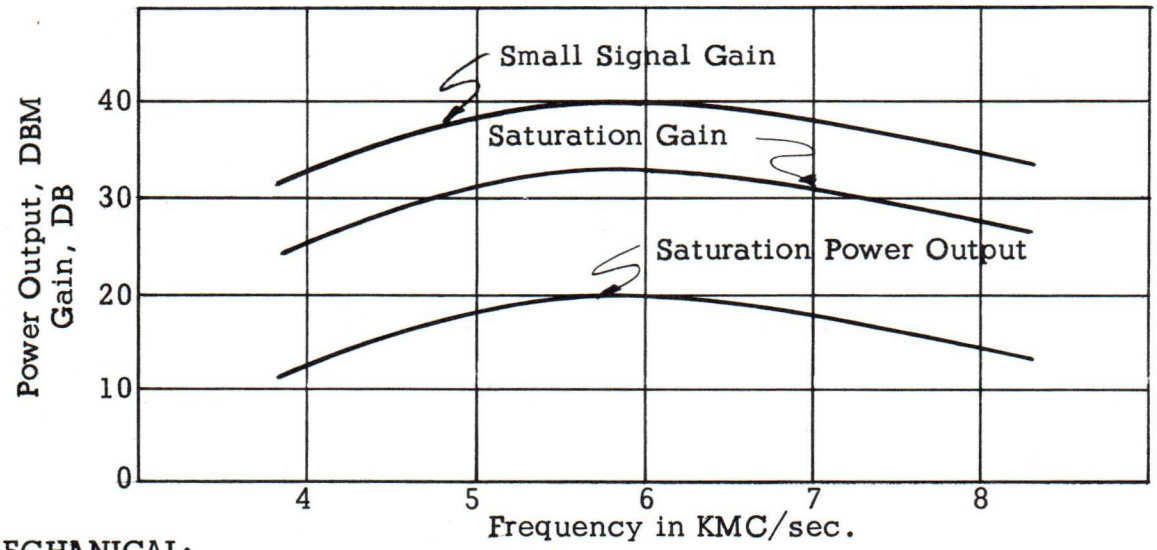
Heater Voltage*	6.3 volts
Heater Current, maximum	0.25 amps
D.C. Helix Voltage	650 - 800 volts
D.C. Helix Current, maximum	0.5 ma
D.C. Collector Voltage	650 - 800 volts
D.C. Collector Current, maximum	3.0 ma
D.C. Anode Voltage	300 - 450 volts
D.C. Anode Current	$<$ 50 microamperes
D.C. Grid Voltage	0 volts
Element at Ground Potential	Any
Magnetic Field Strength, minimum	400 gauss

* Because of the low heater power requirements for this tube, units employing ballast tube regulation for heater power must be modified with a suitable shunting resistor, across the TWT filaments to provide 6.3 volts for heater operation.

PERFORMANCE CHARACTERISTICS:

Frequency Range	4.0 to 8.0 kmc
Small Signal Gain	30 db, minimum
Saturation Power Output	10 mw, minimum
Spurious Modulation	>50 db below output
Noise Figure	25 db, maximum
Input VSWR	2:1
Output VSWR	2:1

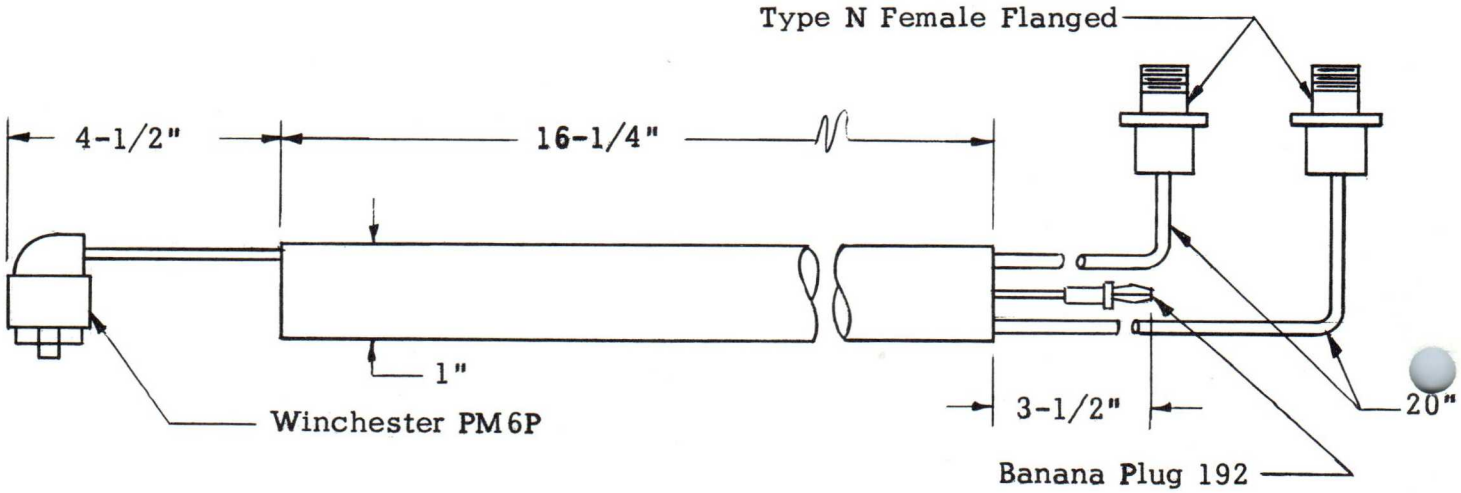
Typical Gain and Power Output



MECHANICAL:

Physical Dimensions	See outline drawing
Maximum Over-all Length	16-1/4 inches*
Maximum Shell Diameter	1 inch
Mounting Position	Any
Weight	1.0 pound
Input R.F. Connector	Type N Female Flanged
Output R.F. Connector	Type N Female Flanged
Cooling	Convection

Outline Drawing M2207-A



* Tube Available in shorter lengths

Microwave Electronics CORPORATION

4061 TRANSPORT STREET • PALO ALTO, CALIFORNIA • DAvenport 1-1770

TECHNICAL DATA

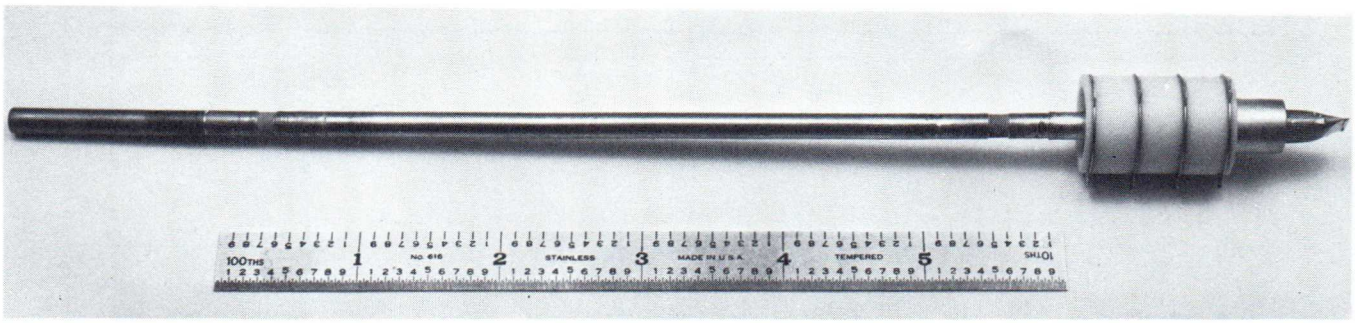
M2403-A

Number 106 - February 1960

TRAVELING - WAVE TUBE

BROAD-BAND / HIGH GAIN / MEDIUM POWER / METAL-CERAMIC

8.0 to 12.4 kmc / 1 watt Power Output



The M2403-A is a broad-band, solenoid focused, traveling-wave tube designed for use in the 8.0 to 12.4 kmc frequency range. This tube provides a minimum of 30 db gain at 1 watt of r-f output, and is specifically designed for laboratory instrument amplifier application.

The vacuum tube is of metal-ceramic construction and uses a unipotential oxide-coated cathode, designed for low cathode loading, and low heater power. These features enable the M2403-A to provide a new order of reliability, stable performance, and long life necessary for instrument applications.

TYPICAL OPERATING CONDITIONS:

Heater Voltage	6.3 volts
Heater Current, maximum	0.5 amps
D.C. Helix Voltage	2100 - 2300 volts
D.C. Helix Current, maximum	5.0 ma
D.C. Collector Voltage	2100 - 2300 volts
D.C. Collector Current, maximum	27 ma
D.C. Anode Voltage*	Anode connected internally to helix
D.C. Grid Voltage	0 to -30 volts
Element at Ground Potential	Collector
Magnetic Field Strength	1000 gauss

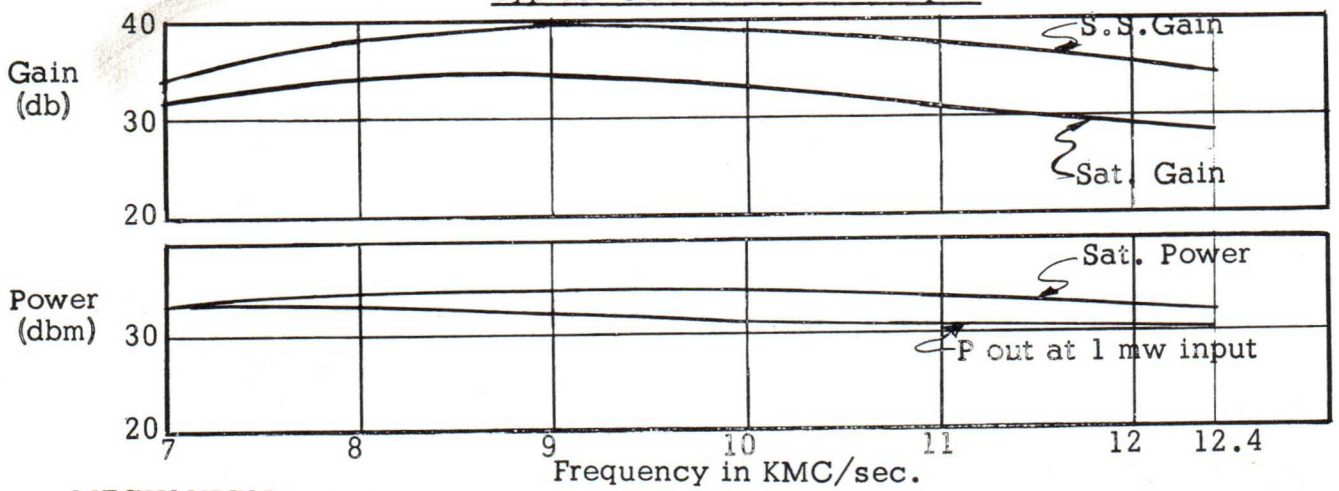
* Tubes can be supplied with a separate anode connection.

M2403-A (Continued)

ELECTRICAL PERFORMANCE:

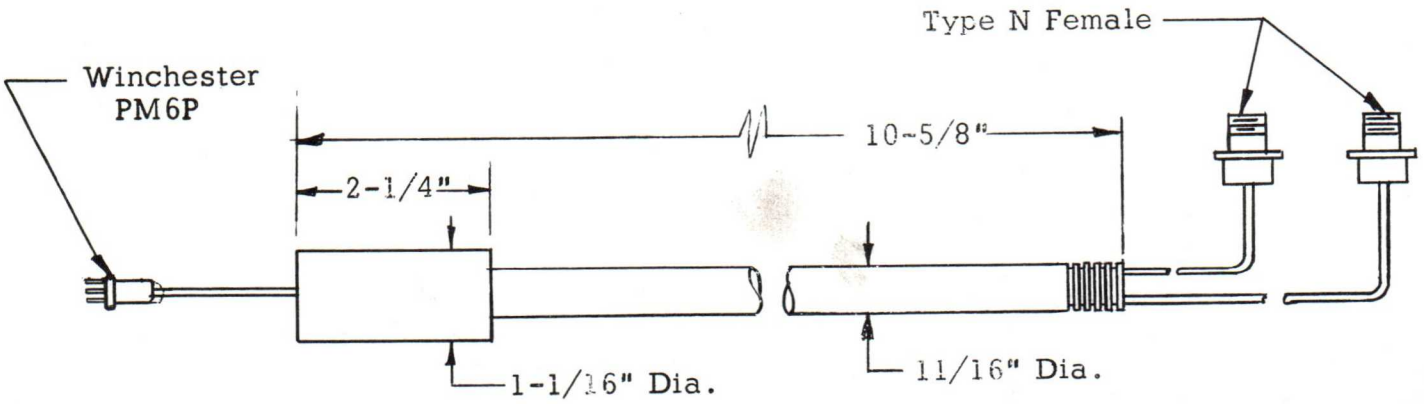
Frequency Range	8.0 to 12.4 kmc
Small Signal Gain	33 db, minimum
Gain at 1 watt output	30 db, minimum
Power Output	1 watt CW, minimum
Spurious Modulation	>50 db below output
Input VSWR	2:1
Output VSWR	2:1

Typical Gain and Power Output



MECHANICAL:

Physical Dimensions	See Outline Drawing
Over-all Length	11", maximum
Diameter (Gun Region)	1-1/16", maximum
Diameter (Solenoid Region)	23/32", maximum
Mounting Position	Any
Weight	1 pound
Input RF Connector	Type N Female
Output RF Connector	Type N Female
Cooling	Forced Air



Outline Drawing M2403-A

TPD (3)

SUMMARY OF ENVIRONMENTAL CAPABILITIES OF MICROWAVE ELECTRONICS CORPORATION'S METAL-CERAMIC TUBES

Microwave Electronics Corporation's objective as a new supplier in the microwave tube field is to provide the industry with traveling-wave tubes which are engineered for long service life under the most adverse field conditions. This requirement led to the basic design concepts employed in all MEC's traveling-wave tubes.

It is difficult to assess their maximum capabilities or all the problem areas due to the short time that the Company has been delivering tubes. However, the following notes and comments indicate some of the results obtained to date.

DESIGN FEATURES:

Some of the features that enable Microwave Electronics Corporation's tubes to provide a new order of reliability and environmental capabilities are the following:

All metal and ceramic construction: Every part, including the envelope, is vacuum fired at temperatures on the order of 1,000°C and the tube is baked during exhaust at 625°C. These tubes can be baked at much higher temperatures, and such techniques are presently being evaluated.

Stacked Gun Design: There are no internal leads or delicately supported gun elements that can cause microphonics.

Ceramic Rod Supported Helix: The helix is securely supported at each turn so that it cannot move under shock and vibration.

ENVIRONMENTAL TESTS:

Some of MEC's tubes have been packaged for rugged environments and have been environmentally tested in detail. The basic design is the same on all tubes so every tube can be packaged by proper potting and sealing to meet these same environmental specifications.

The following is a summary of tests conducted to customer specifications and are indicative of the performance that can be provided:

	Solenoid Focused	PPM Focused
1. Shock - non-operating* in both directions along 3 mutually perpendicular axes.	20g - no change in performance	20g - no change in performance
2. Vibration - operating	5 - 2000 cps at 3g ≠ max. Less than .05 db amplitude modulation	5 - 100 cps at 10g max. Less than 0.1 db amplitude modulation. 100 - 2000 cps at 10g max. Less than 0.5 db amplitude modulation.
3. Temperature - operating	-65°C to +140°C no change in performance	-55°C to +65°C change in gain, ± 2 db max.
4. Humidity - operating	100% R.H. at 55°C 24 hrs. - no change in performance	100% R.H. at 55°C 24 hrs. - no change in performance
5. Altitude	55,000 ft.	55,000 ft.
6. Life	5,000 hrs. and still operating to specifications	#

* No operating shock tests have been performed; however, operating vibration tests of 5 - 2,000 cps at 10 g's indicate no problems should arise.

≠ Larger g values have not been run, but solenoid tubes should perform equally as well as PPM tubes if the solenoid is ruggedized.

\# Should be no different than solenoid life tests.

8/15/60

Microwave Electronics CORPORATION
4061 Transport St., Palo Alto, California, DA 1-1770

Effective Date August 15, 1960
PRODUCTION TRAVELING WAVE TUBES

	TUBE TYPE NO. & DESCRIPTION	FREQUENCY RANGE (kmc)	MINIMUM POWER OUTPUT (mw)	MINIMUM SMALL SIGNAL GAIN (db)	MAXIMUM NOISE FIGURE (db)	SERRODYNE TUBES ONLY		HELIX-COLLECTOR VOLTAGE (volts dc)	MAXIMUM COLLECTOR CURRENT (ma)	GRID VOLTAGE (volts dc)	ANODE VOLTAGES			MINIMUM MAGNETIC FIELD STRENGTH (Gauss)
						PEAK-TO-PEAK HELIX VOLTAGE CHANGE FOR 2π PHASE SHIFT	MINIMUM SIDEBAND SUPPRESSION AT 150 kc MODULATION RATE (db)				ALL TUBES ANODE 1 (volts dc)	LOW NOISE TUBES ONLY ANODE 2 (volts dc)	LOW NOISE TUBES ONLY ANODE 3 (volts dc)	
X-Band	M2101-A Low noise X-band TWT. Solenoid focused.	8.0-11.0	5	25	10	—	—	1100-1200	1.5	-50 to 0	0-150	100-300	400-800	800
X-Band	M2101-B Low noise X-band TWT. PPM focused.	8.0-11.0	5	25	15	—	—	1100-1200	1.0	-50 to 0	0-150	100-300	400-800	PPM
X-Band	M2201-A 10 mw X-band TWT. Solenoid focused.	7.0-12.4	10	25	30	—	—	1100-1200	3.0	0	350-450	—	—	400
X-Band	M2201-B 10 mw X-band TWT. Solenoid focused.	8.0-12.4	10	30	30	—	—	1100-1200	3.0	0	350-435	—	—	400
X-Band	M2106-G 10 mw X-band TWT. PPM focused.	7.0-11.0	10	33	20	—	—	1100-1200	1.5	-50 to 0	0-150	100-300	400-800	PPM
X-Band	M2201-C 10 mw X-band TWT. PPM focused.	8.0-11.0	10	30	30	—	—	1100-1200	3.0	0	350-450	—	—	PPM
X-Band	M2403-A 1 watt X-band TWT. Solenoid focused.	8.0-12.4	1000	33	—	—	—	2100-2300	27.0	-30 to 0	Helix Potential*	—	—	1000
X-Band	M2204-A X-band Serrodyne TWT. Solenoid focused.	7.0-12.4 Over any 1.5 kmc portion	10	20	—	24 to 32	33	1100-1200	3.0	0	300-450	—	—	400
C-Band	M2207-A 10 mw C-band TWT. Solenoid focused.	4.0-8.0	10	30	25	—	—	650-800	3.0	0	300-450	—	—	400
C-Band	M2203-E 50 mw C-band TWT. PPM focused. May be used as Serrodyne Tube.	5.4-5.9	50	35	—	—	—	800-900	2.0	0	300-400	—	—	PPM
C-Band	M2203-B C-band Serrodyne TWT. Solenoid focused.	4.0-8.0 Over any 1.5 kmc portion	10	25	—	5 to 40	33	650-800	3.0	0	300-450	—	—	400

* Tubes may be furnished with separate anode connection. Collector is grounded.

DEVELOPMENT TUBES - SEE OTHER SIDE

TPD (2)

Microwave Electronics CORPORATION

4061 Transport St., Palo Alto, California, DA 1-1770

Effective Date August 15, 1960

OBJECTIVE SPECIFICATIONS ON TRAVELING WAVE TUBES UNDER DEVELOPMENT

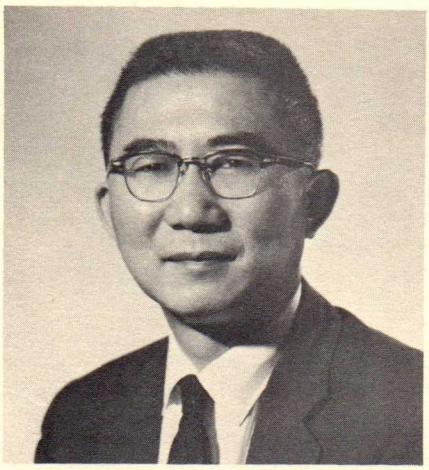
TUBE TYPE NO. & DESCRIPTION	FREQUENCY RANGE (kmc)	MINIMUM POWER OUTPUT (mw)	MINIMUM SMALL SIGNAL GAIN (db)	MAXIMUM NOISE FIGURE (db)	HELIX-COLLECTOR VOLTAGE (volts dc)	MAXIMUM COLLECTOR CURRENT (ma)	GRID VOLTAGE (volts dc)	ANODE VOLTAGES			MINIMUM MAGNETIC FIELD STRENGTH (Gauss)
								ALL TUBES	LOW NOISE TUBES ONLY		
								ANODE 1	ANODE 2	ANODE 3	
M2405-A 1 watt K_u-band TWT. Solenoid focused.	12.0-18.0	1000	30	35	2900-3300	30.0	-200 to 0	2300-3300	—	—	1200
M2404-A 5 watt X-band TWT. Solenoid focused.	8.0-9.6	5000	30	—	2900-3300	50.0	-250 to 0	2300-3300	—	—	1200
M2108-A X-band low noise TWT. PPM focused.	7.05-10.75	10	30	10	1100-1200	1.0	-50 to 0	0-150	100-300	400-800	PPM
M2109-A C-band low noise TWT. PPM focused.	4.3-7.35	10	30	10	600-800	1.0	-30 to 0	0-150	100-300	200-500	PPM
M2109-B C-band low noise TWT. Solenoid focused.	4.0-8.0	5	25	10	600-800	1.5	-30 to 0	0-150	100-300	200-500	800
M2110-A S-band low noise TWT. PPM focused.	2.3-4.45	10	30	10	300-500	2.0	-20 to 0	0-100	50-250	150-400	PPM
M2111-A X-band limiter TWT. PPM focused.	7.0-11.0	10*	50	10	1100-1200	1.0	-50 to 0	0-150	100-300	400-800	PPM

* Power output 10 dbm ±5 db over input range -40 to 0 dbm.

PRODUCTION TUBES - SEE OTHER SIDE

Microwave Electronics CORPORATION is pleased to announce—

THREE ADDITIONS TO THE SENIOR STAFF



MOSES C. LONG has joined the executive staff as Assistant to the President, with principal assignments in Sales and Marketing. Mr. Long came from Hughes Aircraft Co., where he began as a member of the technical staff and helped to translate the first traveling-wave tubes and backward wave oscillators to pilot production. Subsequently he became assistant to the Technical Director in the Products Group and staff engineer concerned with marketing in the Microwave Tube Division.

Mr. Long was with the Office of Naval Research for ten years before Hughes Aircraft. During that period he was intimately involved with the early research and development of traveling-wave tubes and high power klystrons. He also established the ONR Millimeter Wave Research Program and the ONR Advisory Committee on Millimeter Wave Research. He was a commissioned officer in the U. S. Signal Corps during World War II, assigned to radar, electronic countermeasures and guided missiles.

DR. WILLIAM E. WATERS, Senior Engineer, is joining Microwave Electronics from the Army's Diamond Ordnance Fuse Laboratory. He was previously with the Tube Laboratory of the National Bureau of Standards, doing R and D on microwave tubes for use in guided missiles. He joined DOFL when it was formed in 1953 and worked extensively in the microwave field -- most lately on an electrostatically-focused backward wave oscillator and a new crossed-field BWO for higher power levels and higher efficiency. He was made Chief of the Microwave Tube Section of DOFL in 1956 and Research Supervisor, with cognizance over microwave tube R and D, in 1958. A graduate of the University of Kentucky, his advanced degrees are from there (MS in Physics) and the University of Maryland (Ph.D. in Physics). During parts of 1958-59 he was at Stanford University studying microwave tube problems as recipient of a Secretary-of-the-Army Study Fellowship.

DR. ROBERT W. DEGRASSE, Senior Engineer, joins the technical staff in early September. He is coming from Bell Telephone Laboratories, which he joined in 1957 and since served as supervisor of maser development for military applications. After graduating from CalTech he spent three years with Jet Propulsion Lab, working on flight radar in the missile program. Later he became a research assistant at Stanford's Electronics Research Laboratory and was primarily involved with development and feasibility test of the first microwave frequency memory devices. He has his Ph. D. from Stanford. At BTL he developed a C-band TW maser and lately has been engaged in further developments at C-band, S-band and L-band.

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