LITTON INDUSTRIES MICROWAVE TUBES

P, L, S, C, X, K BANDS

KLYSTRONS

Type Number	Frequency Range Megacycles	Peak Power (Minimum) Megawatts	Cathode Pulse Length Microseconds	RF Duty Ratio	Remarks
L-3270	1250 to 1350	2	8	0.0025	Broadband (100 megacycles between 2 megawatt points)
LT-7504 (L-3035)	1240 to 1360	2.2	8	0.0025	Long range search radar
L-3257	1280 to 1330	4	30	0.0003	For linear accelerator
L-3227	1280 to 1330	5	8	0.002	For linear accelerator
L-3250	1250 to 1350	10	7.2	0.0015	Long range search radar and linear accelerator
L-3387	1250 to 1350	30	7.2	0.0033	Long range search radar
L-3302	2855	10	7.2	0.0015	For linear accelerator and radar
L-3355	1250 to 1350	20	7.2	0.0015	Long range search radar

TRAVELING WAVE TUBES

Type Number	Frequency Range Megacycles	Power Output	Focusing	Duty Factor
L-3266	7000 to 11,000	20 mw	PPM	CW
L-3236	7000 to 11,000	2 W	PPM	CW
L-3470	4000 to 8000	20 mw	PPM	CW
L-3471	4000 to 8000	2 W	PPM	CW
L-3472*	8500 to 9600 7000 to 11,000	10 W 5 W	PPM	CW
L-3264*	100 to 300	100 W	Solenoid	CW

* *In development*

M-TYPE BACKWARD WAVE OSCILLATORS

Type Number	Frequency Range Megacycles	Power Output	Focusing	Factor	Remarks
L-3148	8500 to 11,000	150 watts minimum	Permanent magnet	CW	No holes in a 1.5/1VSWR

A complete line of M-BWO's is available but classified

PULSE MAGNETRONS

Type Number	Frequency Range Megacycles	Peak Power (Min.) KW	Duty Ratio	Remarks
L-3204	8800±25	0.04	0.25	Extremely high duty
L-3105	9300±40	0.10	0.027	Highly ruggedized; frequency stable
L-3028	9280 to 9320	0.12	0.027	Frequency stable; pulse train capability
L-3379	8800 to 9500*	1.0	0.003	Highly ruggedized; frequency stable
L-3058	9330 to 9350*	1.0	0.003	Frequency stable
L-3358	16,000 to 16,500*	1.0	0.001	Highly ruggedized; frequency stable
L-3380	8800 to 9500*	2.0	0.002	Highly ruggedized; frequency stable
L-3359	16,000 to 16,500*	2.0	0.001	Highly ruggedized; frequency stable
L-3381	8800 to 9500*	3.0	0.001	Highly ruggedized; frequency stable
L-3382	8800 to 9500*	4.0	0.001	Highly ruggedized; frequency stable
LT-6233	9280 to 9345	7.0	0.003	High duty beacon magnetron
L-3103	8500 to 9600*	30.0	0.002	High duty version of LT-6543
L-3168	9375±30	30.0	0.002	High duty version of LT-4J52A
L-3306	16,000 to 17,000*	30.0	0.002	High duty version of L-3083A
L-3083A	16,000 to 17,000*	60.0	0.001	Recommended for new systems
LT-6543A	8500 to 9600*	65.0	0.001	Recommended for MTI systems
L-3305	8600 to 9500*	65.0	0.001	Recommended for frequency diversity
LT-6510	9375±30	65.0	0.001	Recommended for MTI systems
LT-4J52A	9375±30	70.0	0.001	Recommended for new systems
L-3312	8500 to 9600*	200.0	0.001	In development
L-3313	8600 to 9500*	200.0	0.001	Hydraulically tunable for frequency diversity
LT-4J50A	9375±30	225.0	0.001	Recommended for new systems

**Fixed frequency versions available generally throughout tunable range.*

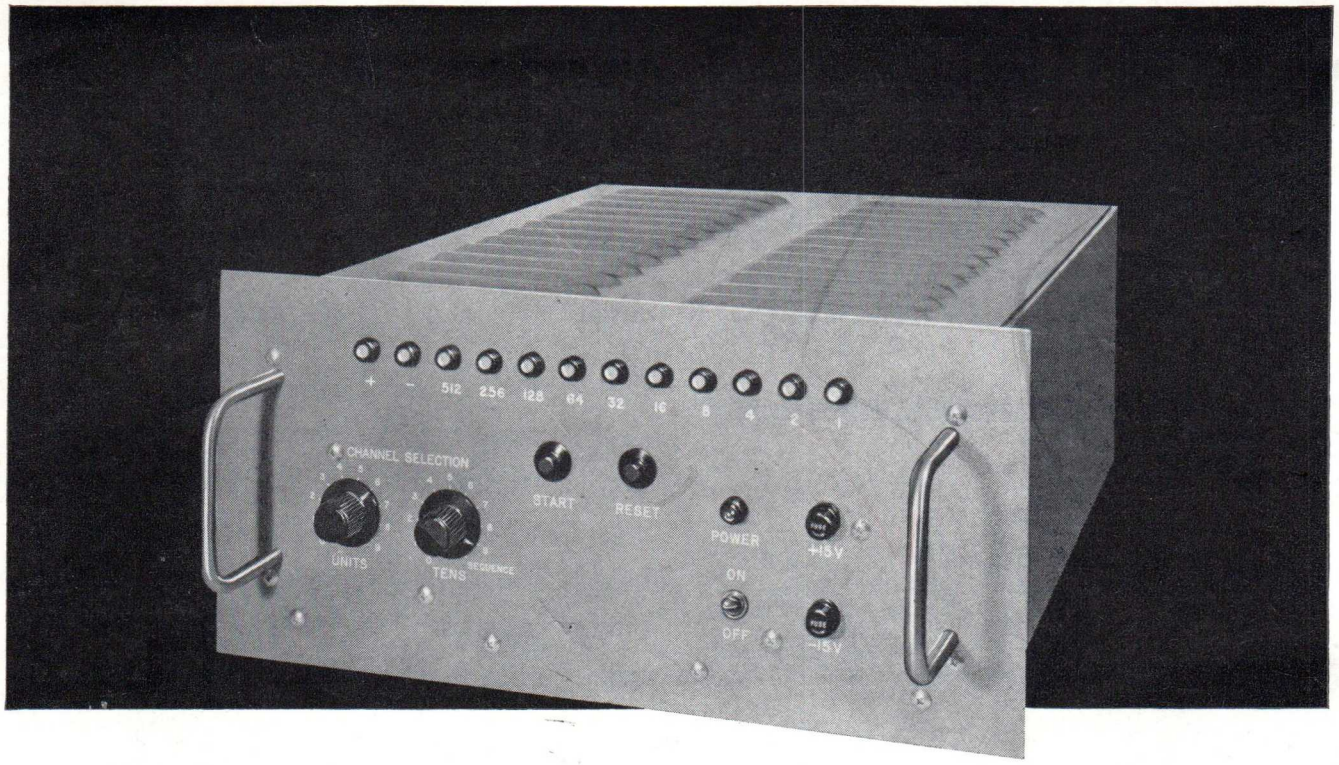
CW MAGNETRONS

Type Number	Frequency Range Megacycles	Minimum Power Watts	Remarks
L-3456	350-590	500	These CW Magnetrons may be pulsed to approximately 2 kilowatts peak power and are recommended for component testing.
L-3459	590-975	500	
L-3465	975-1500	400	
L-3464	1500-2350	400	
L-3460	2350-3575	500	
L-3461	3575-4975	400	
L-3467	4975-6175	400	
L-3468	6175-7275	300	
L-3462	7275-8775	300	
L-3463	8775-10,475	250	

CROSSED-FIELD FORWARD WAVE AMPLIFIER TUBES • BARRATRON® TRANSMITTING TUBES • MINIATURE NOISE SOURCES • DUPLEXERS & TR TUBES • DISPLAY TUBES

"CAPABILITY THAT CAN CHANGE YOUR PLANNING"

LITTON INDUSTRIES
Electron Tube Division
San Carlos, California



NOW...LOWER COST PER CONVERSION CHANNEL

WITH LINK'S NEW HIGH SPEED PRECISION MULTIPLEX CONVERTER

The Precision Multiplex Converter offers a high-speed voltage to digital conversion system that combines high speed performance with ultimate precision. This multi-channel Dialog* converter, with minimum physical dimensions, is completely transistorized to provide utmost reliability—a high-capacity multiplexer and conversion unit in one *small* package.

Advanced design concepts of the Precision Multiplex Converter include: **Automatic drift correction, solid state circuit design, integrated reference voltage supplies, incorporated visual display, no moving parts, high input impedance, unlimited modification possibilities, limited power requirements.**

Specifications of the Precision Multiplex Converter:
• Input capacity from 1 to 500 channels • input voltage, 0 to ± 10 volts with higher voltages optional • conversion format 10 or 11 bits plus sign • conversion code, natural binary • binary coded decimal or excess three • conversion speed 5 μs per bit, 60 μs per channel • accuracy .05% • output parallel or serial, automatic or on external command.

Write to Dept. PI Dialog System Sales for specific details on the Precision Multiplex Converter and other Dialog systems and components.

**DIALOG (Link Digital–Analog Systems and Components)*

Another Example of Link/Ability

LINK DIVISION
Binghamton, New York

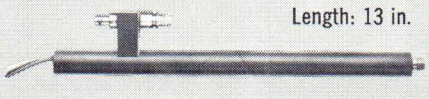
GENERAL PRECISION, INC.
Other Divisions: GPL, Kearfott, Librascope,

file Litton Industries (15)

KLYSTRONS
400-2855 Mc
100 kw to
40 Mw Pulse

Here: L-3401
1254 to 1386 Mc
Tunable
5 Mw peak
(minimum)

Height: 9 ft.

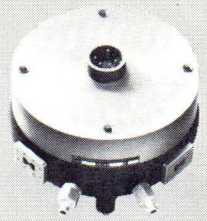


Length: 13 in.

TRAVELING WAVE TUBES
400-11,000 Mc
20 mW to 5.5 kw

Here: L-3711
4000-8000 Mc
1 W CW (minimum)

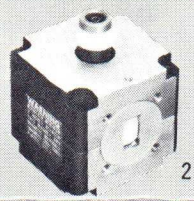
CROSSED FIELD AMPLIFIERS



8500-11,000 Mc
1 kW CW to 500 kw Pulse

Diameter: 12 in.

Here: L-3650
8500-9600 Mc Tunable
1 kW CW (minimum)

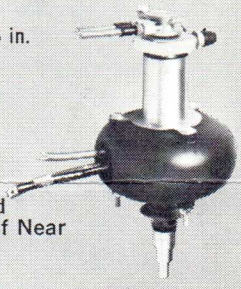


2 in. Cube

MINIATURE MAGNETRONS
8600-16,500 Mc/30 W to 4.0 kw peak

Here: L-3719
15,000 ± 100 Mc Fixed
750 W (minimum)

Diameter: 6 in.



BARRATRON®
Transmitting Tube
UHF through X-band
Broad bandwidths of Near
White Noise

Here: One of L-3330 Series

1 METER TO 4 MILLIMETERS
MILLIWATTS TO MEGAWATTS
ELECTRON TUBES BY LITTON

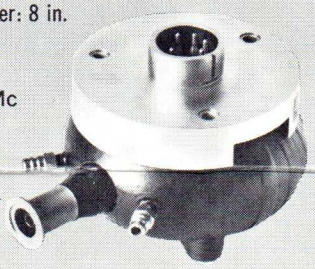
Height: 28 in.

SWITCH TUBES
150-350 kVdc Collector Voltage
20-300 A Switching Current

Here: L-3620
350 kVdc Collector Voltage
30 A Collector Current

Diameter: 8 in.

M-BWO's
1000-11,000 Mc
125-200 W CW



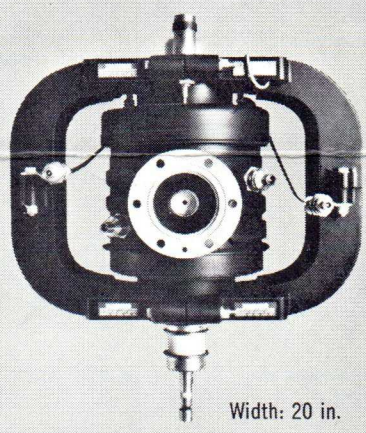
Here: L-3724
2500-3550 Mc
Tunable
180 W CW
(minimum)

Width: 8 in.

MILLIMETER WAVE TUBES

18-80 kMc
.03-50 W

Here: L-3689
68-80 kMc Tunable
0.5 W (nominal)



Width: 20 in.

PULSE & CW MAGNETRONS
406-17,000 Mc
30 W to 2 Mw peak
110 to 500 W CW

Here: L-3455
406-450 Mc Tunable
2 Mw peak (minimum)

LANG Fred SMITH

CW & PULSE MAGNETRONS / POWER KLYSTRONS / MILLIMETER WAVE TUBES / TRAVELING WAVE TUBES / M-TYPE BACKWARD WAVE OSCILLATORS / CROSSED FIELD FORWARD WAVE AMPLIFIERS

Tube Number	Tube Type	Power Output	Frequency Range
L-3674	TWT	5.0 KW	400—450
L-3403	Klystron	1.25 MW	400—450
L-3694	Klystron	1.25 MW	400—450
L-3455	Magnetron	2.0 MW	406—450
L-3714	Magnetron	165 W	475—725
L-3502	Magnetron	110 W	975—1500
L-3465	Magnetron	400 W	975—1500
L-3721	MBWO	200 W	1000—1400
L-3035	Klystron	2.2 MW	1240—1360
L-3497	TWT	5.5 KW	1240—1400
L-3270	Klystron	2.0 MW	1250—1350
L-3257	Klystron	4.0 MW	1250—1350
L-3303	Klystron	5.0 MW	1250—1350
L-3227	Klystron	5.0 MW	1250—1350
L-3250	Klystron	10 MW	1250—1350
L-3323	Klystron	10 MW	1250—1350
L-3355	Klystron	20 MW	1250—1350
L-3661	Klystron	20 MW	1250—1350
L-3530	Klystron	25 MW	1250—1350
L-3531	Klystron	25 MW	1250—1350
L-3387	Klystron	30 MW	1250—1350
L-3702	Klystron	30 MW	1250—1350
L-3486	Klystron	.250 MW	1250—1380
L-3401	Klystron	5.0 MW	1254—1386
L-3660	Klystron	10 MW	1295—1305
L-3503	Magnetron	110 W	1500—2350
L-3464	Magnetron	400 W	1500—2350
L-3499	TWT	2.0 W	2000—4000
L-3663	TWT	10 W	2000—4000
L-3619	TWT	20 W	2000—4000
L-3709	Klystron	100 KW	2100—2200
L-3504	Magnetron	110 W	2350—3575
L-3460	Magnetron	500 W	2350—3575
L-3724	MBWO	180 W	2500—3550
L-3510	Magnetron	1000 W	ISM-band
L-3647	Klystron	5.0 MW	2750—2850
L-3495	Klystron	2.0 MW	2855
L-3617	Klystron	5.0 MW	2855
L-3302	Klystron	10 MW	2855
L-3733	Klystron	10 MW	2855
L-3618	Klystron	25 MW	2855
L-3505	Magnetron	110 W	3575—4975
L-3461	Magnetron	350 W	3575—4975
L-3470	TWT	20 mW	4000—8000
L-3711	TWT	1.0 W	4000—8000
L-3471	TWT	2.0 W	4000—8000
L-3657	TWT	10 W	4000—8000
L-3658	TWT	20 W	4000—8000
L-3146	MBWO	150 W	4800—6550
L-3726	MBWO	165 W	4800—6550
L-3506	Magnetron	110 W	4975—6175
L-3467	Magnetron	400 W	4975—6175
L-3528	TWT	5.0 W	5000—11000
LT-6344A	Magnetron	175 KW	5450—5825
LT-7156	Magnetron	250 KW	5450—5825
L-3337	TWT	200 mW	5900—8400
L-3507	Magnetron	110 W	6175—7275
L-3468	Magnetron	300 W	6175—7275
L-3147	MBWO	125 W	6500—8550
L-3611	TWT	20 mW	7000—11000
L-3612	TWT	2.0 W	7000—11000
L-3472	TWT	10 W	7000—11000
L-3529	TWT	20 W	7000—11000
L-3508	Magnetron	110 W	7275—8775
L-3462	Magnetron	300 W	7275—8775
L-3614	TWT	1.0 KW	8000—11000
L-3234	MBWO	125 W	8500—9600
L-3650	C F Fwd Wave Ampl	1.0 KW	8500—9600
L-3103	Magnetron	30 KW	8500—9600
L-3305	Magnetron	65 KW	8500—9600
LT-6543	Magnetron	65 KW	8500—9600
6543A	Magnetron	65 KW	8500—9600
L-3312	Magnetron	200 KW	8500—9600
L-3685	C F Fwd Wave Ampl	500 KW	8500—9600
L-3148	MBWO	125 W	8500—11000
L-3728	MBWO	150 W	8500—11000
L-3652	C F Fwd Wave Ampl	1.0 KW	8500—11000
L-3602	Magnetron	0.03 KW	8600±40
L-3509	Magnetron	110 W	8775—10475
L-3463	Magnetron	250 W	8775—10475
L-3039R	Magnetron	225 KW	8790±90
L-3089	Magnetron	0.04 KW	8800±25
L-3039D	Magnetron	225 KW	8800±20
L-3379	Magnetron	1.0 KW	8800—9500
L-3380	Magnetron	2.0 KW	8800—9500
L-3381	Magnetron	3.0 KW	8800—9500
L-3382	Magnetron	4.0 KW	8800—9500
L-3039E	Magnetron	225 KW	8860±20
L-3039F	Magnetron	225 KW	8920±20
L-3039G	Magnetron	225 KW	8980±20
L-3030B	Magnetron	300 KW	9000±30
L-3212	Magnetron	0.12 KW	9000—9020
L-3039H	Magnetron	225 KW	9040±20
L-3213	Magnetron	0.12 KW	9050—9070
L-3039I	Magnetron	225 KW	9100±20
L-3214	Magnetron	0.12 KW	9100—9120
L-3634	TWT	1.0 KW	9100—9500
L-3218	Magnetron	0.12 KW	9150—9170
L-3039J	Magnetron	225 KW	9160±20
L-3226	Magnetron	0.12 KW	9180—9200
L-3030C	Magnetron	300 KW	9200±30
L-3180	Magnetron	0.12 KW	9200—9220
L-3039K	Magnetron	225 KW	9220±20
L-3029A	Magnetron	7.0 KW	9235—9300
L-3036F	Magnetron	65 KW	9245±30
L-3181	Magnetron	0.12 KW	9250—9270
L-3187	Magnetron	0.12 KW	9250—9270
L-3029B	Magnetron	7.0 KW	9250—9315
L-3029D	Magnetron	7.0 KW	9265—9330
L-3036B	Magnetron	65 KW	9275±15
L-3039L	Magnetron	225 KW	9280±20
L-3087A	Magnetron	0.12 KW	9280—9320
L-3384	Magnetron	1.0 KW	9280—9320
L-3028D	Magnetron	0.12 KW	9280—9330
L-3023/LT-6233	Magnetron	7.0 KW	9280—9345
L-3029C	Magnetron	7.0 KW	9295—9360
L-3603	Magnetron	0.5 KW	9300±30
L-3606	Magnetron	0.5 KW	9300±30
L-3429	Magnetron	1.0 KW	9300±30
L-3430	Magnetron	1.0 KW	9300±30
L-3604	Magnetron	1.0 KW	9300±30
L-3239	Magnetron	2.0 KW	9300±30
L-3605	Magnetron	3.0 KW	9300±30
L-3268	Magnetron	4.0 KW	9300±30
L-3105	Magnetron	0.10 KW	9300±40
L-3058	Magnetron	1.0 KW	9300—9320
L-3225	Magnetron	1.0 KW	9310—9350
L-3601	Magnetron	0.12 KW	9315—9340
L-3238	Magnetron	1.0 KW	9340±30
L-3039M	Magnetron	225 KW	9340±20
L-3327	Magnetron	0.12 KW	9365—9385
L-3635	Magnetron	10 KW	9375±30
L-3431	Magnetron	18 KW	9375±30
L-3469	Magnetron	20 KW	9375±30
L-3654	Magnetron	24 KW	9375±30
L-3168	Magnetron	30 KW	9375±30
LT-6510	Magnetron	65 KW	9375±30
LT-4J52A	Magnetron	70 KW	9375±30
L-3357	Magnetron	190 KW	9375±30
LT-4J50A	Magnetron	225 KW	9375±30
L-3039P	Magnetron	225 KW	9375±30
L-3613	Magnetron	225 KW	9375±30
L-3030	Magnetron	300 KW	9375±30
L-3039N	Magnetron	225 KW	9400±20
L-3036A	Magnetron	65 KW	9410±5
L-3434	Magnetron	0.10 KW	9950±30
L-3358	Magnetron	1.0 KW	16000—16500
L-3496	Magnetron	1.0 KW	16000—16500
L-3359	Magnetron	2.0 KW	16000—16500
L-3083A	Magnetron	60 KW	16000—17000
L-3083B	Magnetron	60 KW	16000—17000
L-3083C	Magnetron	60 KW	16000—17000
L-3101A	Magnetron	60 KW	16000—17000
L-3101B	Magnetron	60 KW	16000—17000
L-3101C	Magnetron	60 KW	16000—17000
L-3452	Magnetron	2.2 KW	16200±75
L-3383	Magnetron	1.0 KW	16250—16300
L-3498	Magnetron	2.0 KW	16280—16320
L-3306	Magnetron	30 KW	16500±150
L-3326	Magnetron	60 KW	16500±150
L-3642	Reflex Klystron	0.1 W	18000—25000
L-3692	Reflex Klystron	0.35 W	18000—25000
L-3700	Fltg Drift Tube Kly	1.0 W	21000—25000
L-3699	Fltg Drift Tube Kly	1.5 W	21000—25000
L-3631	Fltg Drift Tube Kly	8.0 W	21000—25000
L-3630	Fltg Drift Tube Kly	10 W	21000—25000
L-3632	Reflex Klystron	0.03 W	30000—37000
L-3710	Reflex Klystron	0.03 W	30000—37000
L-3633	Reflex Klystron	0.2 W	30000—37000
L-3698	Fltg Drift Tube Kly	1.0 W	30000—37000
L-3697	Fltg Drift Tube Kly	1.5 W	30000—37000
L-3659	Fltg Drift Tube Kly	5.0 W	32000—37000
L-3628	Fltg Drift Tube Kly	10 W	33000—37000
L-3629	Fltg Drift Tube Kly	15 W	33000—37000
L-3713	Fltg Drift Tube Kly	30 W	34000—36000
L-3736	Fltg Drift Tube Kly	50 W	34000—36000
L-3693	Fltg Drift Tube Kly	1.0 W	48000—52000
L-3640	Fltg Drift Tube Kly	1.0 W	48000—52000
L-3691	Fltg Drift Tube Kly	0.1 W	68000—80000
L-3690	Fltg Drift Tube Kly	0.1 W	68000—80000
L-3638	Fltg Drift Tube Kly	0.1 W	68000—80000
L-3639	Fltg Drift Tube Kly	0.5 W	68000—80000
L-3689	Fltg Drift Tube Kly	0.5 W	68000—80000

Also latest developments in display devices and accessory equipment. Contact us at San Carlos, California, for complete information.

LITTON INDUSTRIES
Electron Tube Division
MICROWAVE TUBES AND DISPLAY DEVICES

ELLIOTT-LITTON LIMITED

Provisional Data

Microwave Power Supply Type 120PMU1B

This unit is a general purpose microwave power supply for dielectric heating of non-conducting materials. Included among the many applications of this method of heating are:- curing of plastic foam mouldings and epoxy resins, drying of adhesive coatings on paper and textiles, cooking of frozen and raw foodstuffs and freeze drying.

Specification

Frequency	-	2,450 $^{+20}_{-30}$ Mc/s
Power Output	-	1.5 kW adjustable from 0.5-1.5 kW
Output Connection	-	Waveguide with flange joint
Max. VSWR of load	-	6:1
Mains Supply	-	200 - 250 V A.C. 50 c/s 3 kW

Description

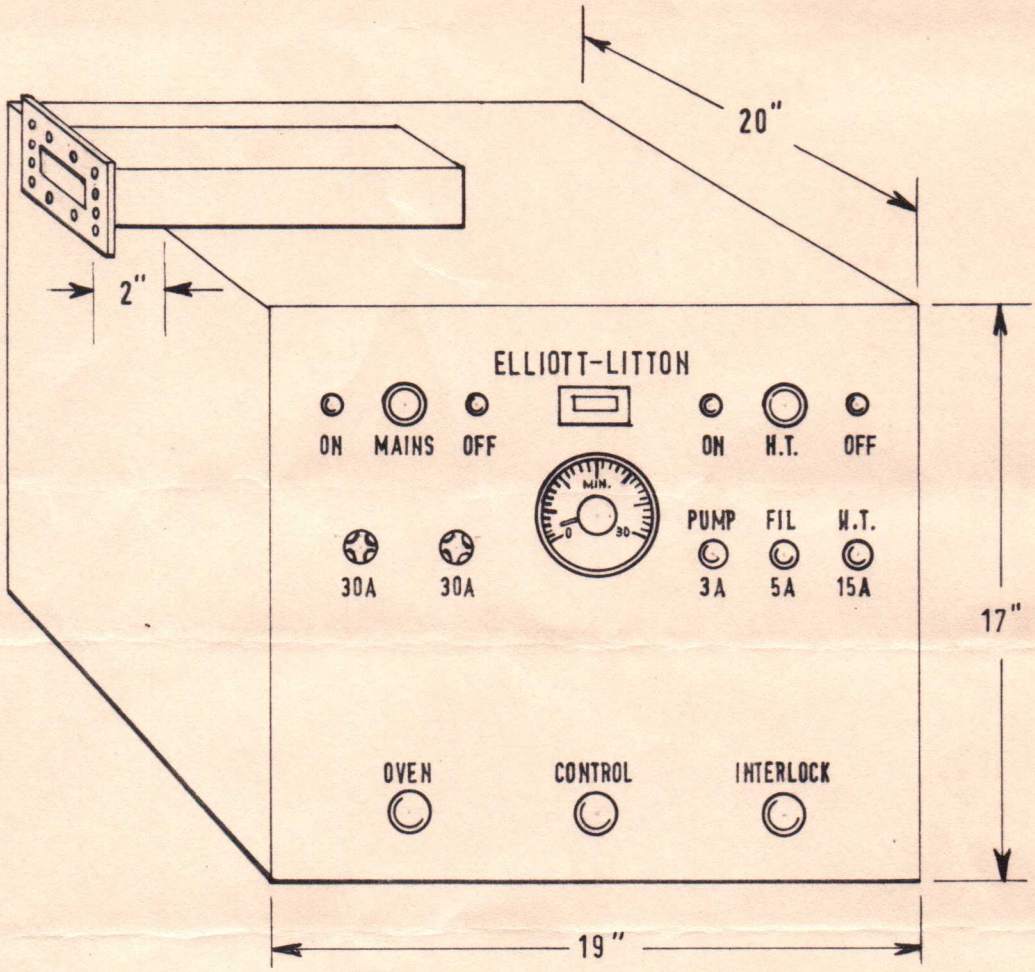
The unit incorporates a magnetron oscillator and its associated power supplies and cooling system. The magnetic field necessary for correct operation of the magnetron is provided by an electro-magnet and the power output of the unit can be varied by adjusting the current in this electro-magnet.

Suitable electrical connections to link the unit with remote switching and safety circuits of associated mechanical handling equipment are provided together with a process timer.

Applicators can be designed and supplied for a wide variety of applications.

Price and delivery on application.

SHB/MDB
29.5.63



OUTLINE DRAWING OF MICROWAVE POWER SUPPLY P.M.U. 1B.

ELLIOTT-AUTOMATION LIMITED

34 PORTLAND PLACE LONDON W1

Press Information

ELLIOTT-LITTON
PRESS CONFERENCE
28th MARCH 1963.
33/Be

THE INFORMATION CONTAINED IN THIS INVITATION IS NOT FOR PUBLICATION BEFORE 2 p.m. ON THURSDAY 28th MARCH, 1963.

INDUSTRIAL APPLICATIONS OF MICROWAVE POWER

A Press Conference and Demonstration
held at
THE CONNAUGHT ROOMS (CAMBRIA ROOM)
Great Queen Street, London, W.C.2.
at 10.30 a.m. on
Thursday 28th March 1963

Programme

10.15 a.m.	Coffee	
10.45 a.m.	Opening address -	Mr. J. Hoskin General Manager, Elliott-Litton Limited
11.00 a.m.	Demonstrations Paper Drying Curing Polyurethane Mouldings	
11.40 a.m.	Discussion	

Industrial Applications of Microwave Power

Elliott-Litton Limited, a member of the Elliott-Automation Group, designs and manufactures an extensive range of microwave equipment and systems for radar, communications, industrial and research applications.

Microwave tubes, developed for radar and communications purposes, originally delivered power only in short pulses. In recent years a number of continuous wave devices of relatively high power have been produced, opening up entirely new fields of application.

...

Microwave power is readily absorbed by certain non-metallic substances and is converted to heat in the process. An early application of this property was in the cooking of food by microwave power in a fraction of the time normally required. Domestic microwave cookers are now available both in the U.S.A. and in Europe and incorporate a magnetron supplied by Elliott-Litton Limited.

Elliott-Litton scientists have been concerned for some time in investigating the possible application of microwave power to many industrial processes, particularly those involving the heating and drying of materials with poor thermal conductivity. It was found that microwave heating techniques could be more effective because energy was absorbed only by the product which required heating and was not dissipated, as in industrial ovens or convector drying plant. Heating was also more uniform, as energy was applied to all parts of the material at the same time, to the centre as well as the outside surface. Research has been concentrated particularly on the drying of paper and pressed fibre board, and on the heating and curing of plastic materials.

Paper Drying Demonstration

The first demonstration will be a small-scale laboratory experiment designed to illustrate the drying of paper by microwave power. This will be carried out using the same basic equipment as in the foam plastic curing demonstration.

The efficiency of this method of drying paper and pressed fibre board is very high. It is indicated that, using this method, paper drying plants would occupy very much less space and would show very significant economies in both capital and operating costs over the conventional methods now employed.

Curing Polyurethane Mouldings

On the platform with Mr. Hoskins, General Manager of Elliott-Litton Limited, will be representatives of the British Motor Corporation, the Shell Chemical Company and the Viking Engineering Company.

The British Motor Corporation was the first to suggest the particular application of curing polyurethane foam plastic mouldings which is being demonstrated. The B.M.C. prototype production line, for producing polyurethane mouldings cured by microwave power, which will be installed within the next few weeks, will be the first in the world.

The Shell Chemical Company provided valuable advice during the development of the special mould required for this process and has kindly agreed to assist with this demonstration for the Press.

The Viking Engineering Company, which specialises in the manufacture of foam-plastic making machinery, is supplying the plant for B.M.C.'s prototype production line.

Early in 1962, the British Motor Corporation, which pioneered the use of polyurethane mouldings for car upholstery, asked Elliott-Litton to undertake an intensive investigation of the possibility of using microwave power to cure polyurethane mouldings as an alternative to the convected air system at present in use. From the outset, it seemed likely that the use of microwave power could substantially reduce both the capitol cost of the plant required and the running costs, in addition to speeding up the process and improving product quality.

By January 1963, a suitable mould construction had been perfected, and high-quality polyurethane mouldings, cured by microwave power, had been produced under laboratory conditions.

As a result of these laboratory demonstrations, the British Motor Corporation decided to order a prototype production plant. This will be installed within the next few weeks.

The Elliott-Litton power source used in this system will be the Type 120 PMU2, modified version of the Type 120 PMU 1B, which has been adapted in conjunction with Viking Engineering, to fit into a rotary-table type automatic handling equipment. It is a similar unit electronically to the Type PMU 1B and is capable of supplying continuous R.F. power at a frequency of 2.450 Mc/s, with a maximum power output of 1.5 KW and, with a suitable applicator, provides a quick and efficient means of heating non-metallic materials.

For the purpose of this demonstration, an Elliott-Litton Type 120 PMU 1B microwave power source will be coupled to a typical resonant-cavity type applicator as used in the production of polyurethane foam mouldings.

The unit consists of a magnetron oscillator with suitable filament and H.T. power supplies, and a self-contained water cooling system. The magnetic field necessary for correct operation of the magnetron is provided by an electro-magnet, and the power output of the unit can be varied by adjusting the current in this electro-magnet. A variable or pre-set control can be provided for this purpose.

The magnetron is coupled to a length of waveguide which extends to the side of the unit, where a flange coupling is provided to which other lengths of waveguide may be bolted to transmit the power to the applicator.

The unit is equipped with protective circuits to prevent damage to the magnetron in the event of misuse, such as coupling to an unloaded applicator, and to prevent damage in the event of failure of the water cooling or magnet supplies. Suitable electrical connections to link the unit with switching and safety circuits of associated mechanical handling equipment are also provided, together with a process timer, which can be used to control the heating cycle.

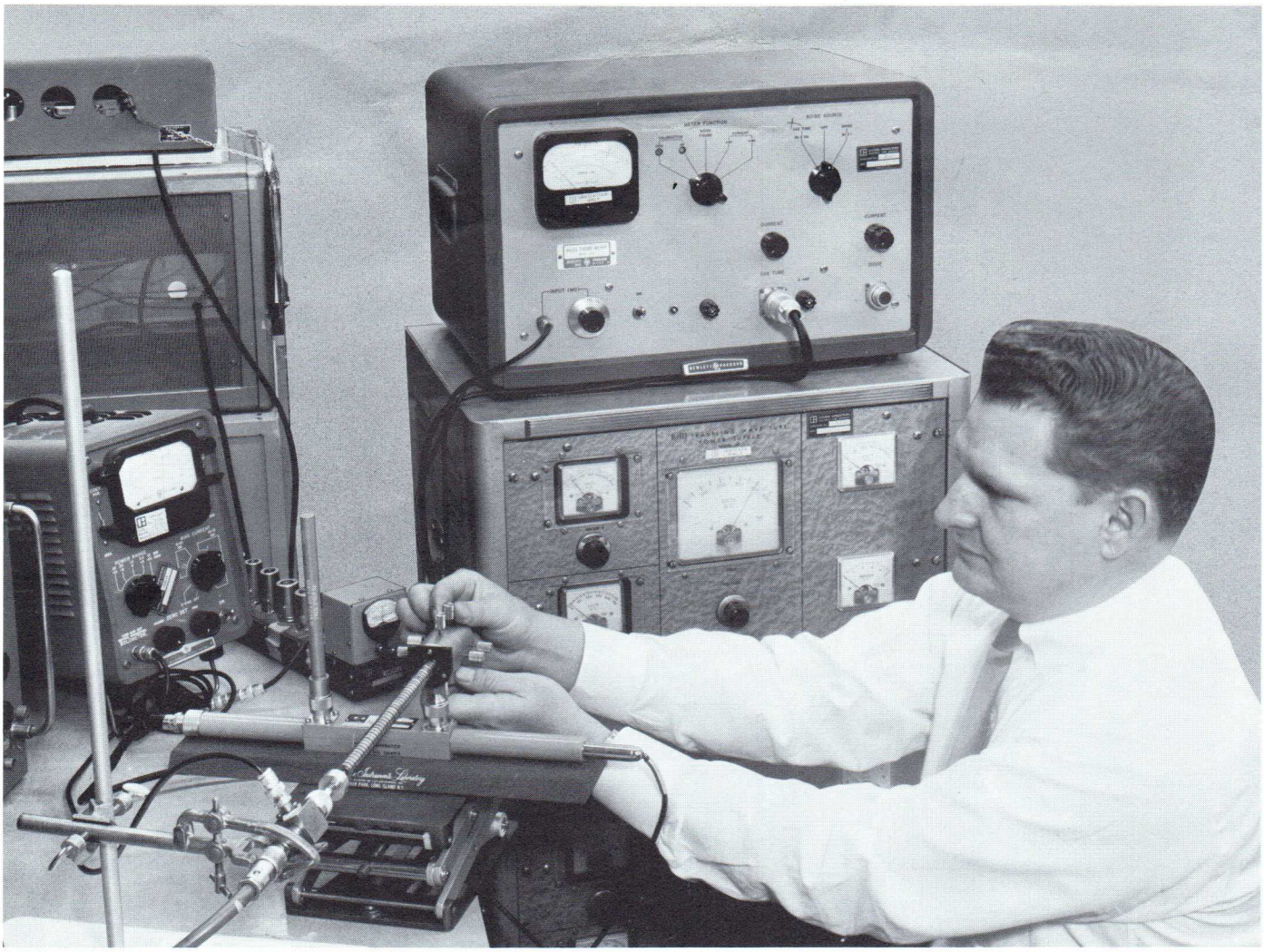
The type of mould construction specially developed by Elliott-Litton Limited for this application will be shown. The mould is manufactured in epoxy resin, or similar material, loaded with metal powder in such proportions as to produce the required rate of rise of temperature. This mould is then encased in rigid polyurethane foam for mechanical strength and heat insulation.

The resonant cavity applicator can be made in any suitable size and can be used to heat any object made from material possessing suitable dielectric properties. It is particularly useful for heating thick sections of material with poor thermal conductivity, to a uniform temperature throughout the section.

LOW NOISE TWT AMPLIFIER

TECHNICAL BULLETIN

LITTON INDUSTRIES
ELECTRON TUBE
DIVISION
SAN CARLOS, CALIFORNIA
WILLIAMSPORT, PA.



LOW NOISE TWT AMPLIFIER

Litton Industries extends its traveling wave tube amplifier capability into the low noise field with the addition of the L-5088 to its family of PPM focused tubes. This low noise amplifier has been developed through the combined efforts of development and production engineers. The result of this joint effort is a product that is not only theoretically sound, but is practical from the standpoint of mass production.

The L-5088 offers outstanding performance through a combination of small size, light weight and high small signal gain, together with low noise figures and a large dynamic range. Typically, the amplifier has a noise figure of 10 db, a small signal gain of 40 db, and a saturated power output of 10 milliwatts. The complete amplifier package weighs less than 4.5 lbs. and occupies only 75 cubic inches of space.

The power supply operates from an ac or dc input line, and the tubes supplied require no additional adjustments. On special request, the power supply can be furnished to operate remotely from the tube, up to 12 feet. This allows the equipment designer to position the tube and power supply in a minimum amount of space. Since the tube is PPM focused, and shielded, it can be mounted side-by-side with another tube and in stray magnetic fields, without loss of performance.

The rugged and exacting construction of these amplifiers permits their reliable performance under the environmental extremes of MIL-E-5400, Class 2 for airborne equipment. They are ideal for low noise applications where light weight and small size are important, such as:

- Radar Receivers
- Electronic Countermeasures Systems
- Missiles Systems
- Aircraft Systems
- Shipboard Systems
- Radiometry and Radio Astronomy Equipment
- Drone Systems
- Telemetry Equipment
- Communications Equipment

COVER PHOTO COURTESY OF DOUGLAS AIRCRAFT CORPORATION

TYPICAL PERFORMANCE CHARACTERISTICS

FIGURE 1 SATURATED POWER OUTPUT VS. FREQUENCY

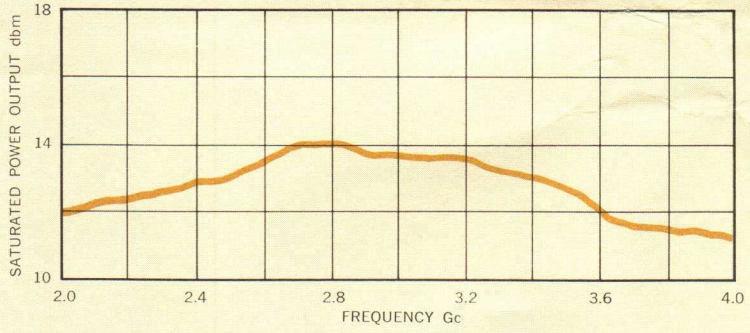


FIGURE 2 SMALL SIGNAL GAIN VS. FREQUENCY

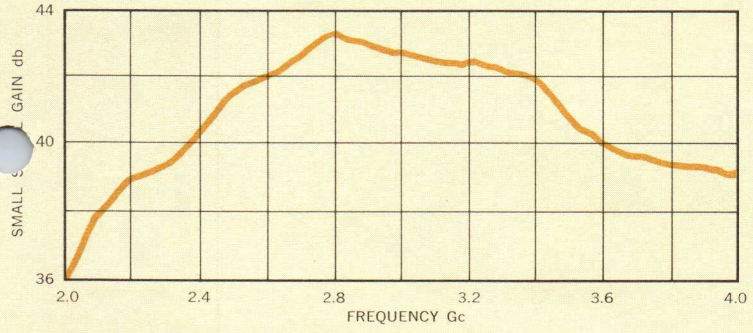
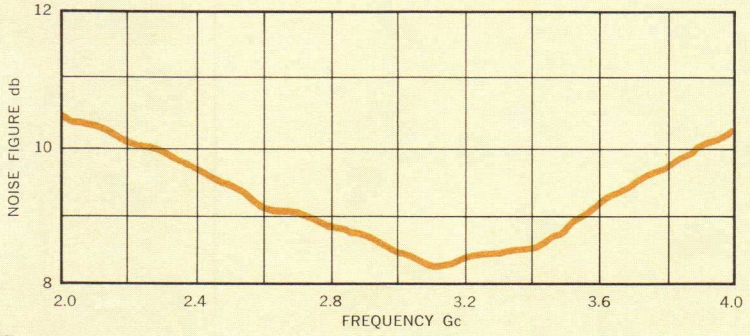


FIGURE 3 NOISE FIGURE VS. FREQUENCY



L-5088 LOW NOISE TRAVELING WAVE TUBE

DESIGN FEATURES OF LOW NOISE TWT'S

Performance – The Litton S-band low noise amplifier has been engineered to provide small size and light weight with a low noise figure, high small signal gain and high saturated power amplification. The amplifier has a typical noise figure of 10 db, typical small signal gain of 40 db and typical saturated power output of 10 milliwatts (See Fig. 1). The tubes are designed to operate in 1 watt/meter R.F.I. fields while producing a minimum R.F.I. of their own. They may be operated in any position with no performance degradation.

Reliability – Reliability is designed and built into every Litton Low Noise TWT amplifier. With Litton's methods of precision metal-ceramic construction, high temperature bake-out and controlled assembly techniques, tubes are consistently being produced which are remarkably free of electrical or mechanical variations. The high bake-out temperature assures long cathode life.

Tube-to-tube reproducibility is maintained by utilizing a rigidly supported helix structure and a precisely controlled helix winding assembly including the spread turns used for matching to the input and output couplers. As a result, the typical input and output VSWR is less than 1.5:1 and the fine grain gain variation is typically less than ±0.5 db over any 100 mc bandwidth. Amplifiers can be supplied with rigid differential phase and gain specifications.

Size and Weight – The L-5088 amplifier and power supply package weighs only 4.5 pounds and is contained in a 2.5 inch square cross section which is 12.0 inches in length (less connectors). The small size and light weight are achieved by several special features which have been developed at Litton. By using a unique magnetic field transition from the straight permanent magnetic (PM) field over the low noise gun structure to the periodic permanent magnet (PPM) field over the slow wave structure, the desired fields have been achieved with minimum size and weight.

Size and weight are further decreased by minimizing the outside diameter of the electron gun which reduces the diameter of the gun magnet needed. This has been accomplished without sacrificing tube-to-tube reproducibility by using a unique cathode-to-helix alignment procedure; a procedure that is a standard production technique used in the manufacture of all Litton medium and high power TWT's.

The added advantage of producing 40 db gain in a TWT that is only 12.0 inches long at S-band is achieved by a unique input coupler placement which eliminates approximately 1.0 inch of length from that of conventional type low noise, PPM focused TWT's. An additional 2.0 inches of length reduction is gained because of the small gun magnet and the unique output coupler-collector assembly.

Magnetically and RFI Shielded – Litton low noise amplifiers are designed to meet their required specifications in the presence of magnetic fields and strong RFI fields (1 watt/meter^2). In addition to the power supply shield, these PPM focused tubes are separately shielded. As a result, the tubes will operate side-by-side and next to a ferromagnetic material or stray magnetic fields. Since the input and output couplers provide metal-to-metal contact, minimum RFI radiation is a characteristic of the tube.

POWER SUPPLY FEATURES

The Litton Low Noise TWT / Integral Power Supply with its compact configuration provides the systems designer with an integrated subsystem which will minimize interface problems while simplifying component mounting as well. The efficient, all solid state power supply shown at the right is typical of the basic power supply design used with the Litton family of low and medium power TWT's. The power supply is an adjustment-free unit which operates from an ac or dc line voltage. The basic input voltage is 115 volts ac ±10%, 50 to 400 cps. The unit can be adapted to operate from a 28 volt dc or a 24 volt dc source. The power supply can also be ordered to be mounted remotely from the TWT, making the unit versatile in applications such as radar systems, countermeasures and communications systems. Provision can be included for modulation of the helix voltage and blanking of the second anode voltage.

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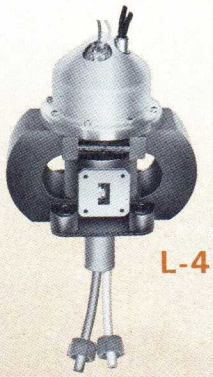
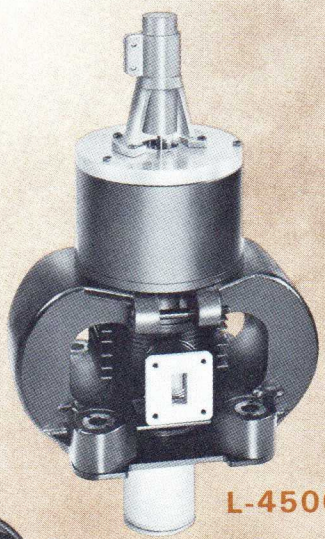
Germany

FORM NO. 503
5MCA866

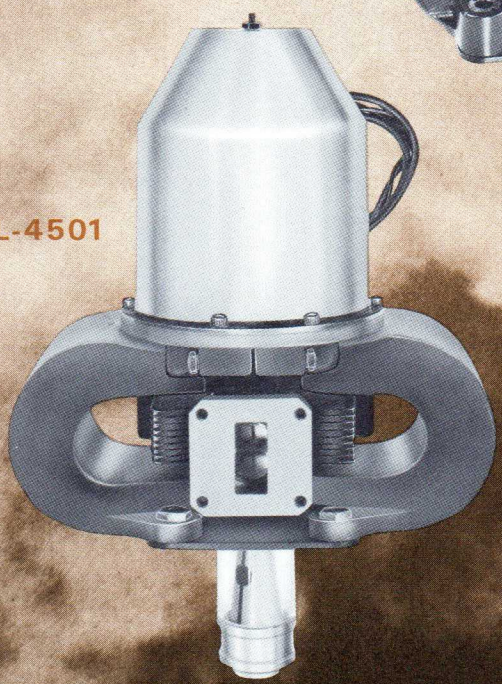
ELECTROMAGNETICALLY TUNED MAGNETRONS



L-4511



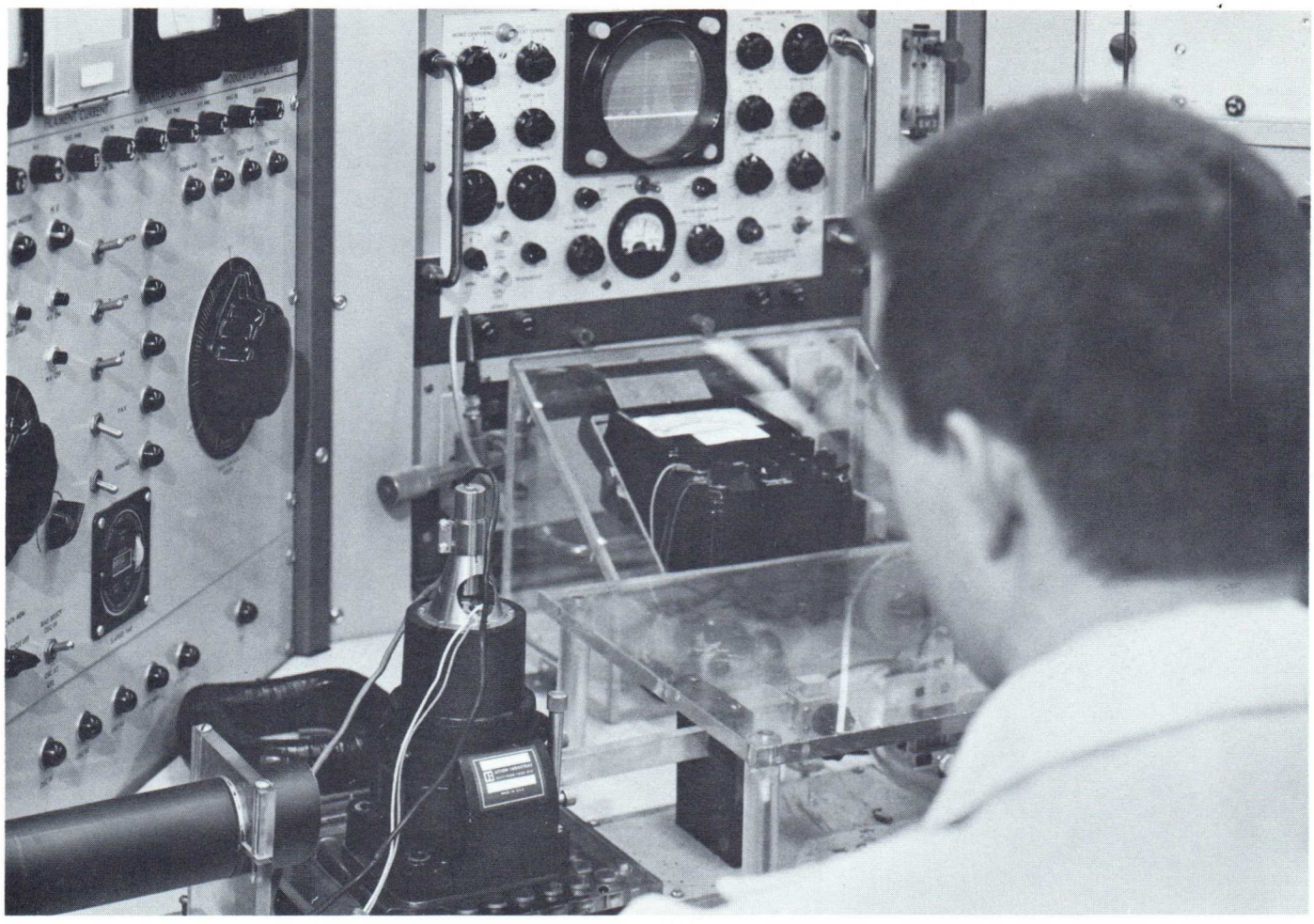
L-4500



L-4501

TECHNICAL BULLETIN

LITTON INDUSTRIES
ELECTRON TUBE DIVISION
SAN CARLOS, CALIFORNIA
WILLIAMSPORT, PA.



WHAT IS THE ELECTROMAGNETICALLY TUNED MAGNETRON?

Litton Electromagnetically Tuned Magnetrons provide a versatility in tuning performance beyond the capability of any magnetron now in system use. Developed to meet the demands of frequency agile airborne radar systems, the electromagnetically tuned magnetron has the flexibility to handle all of the following tuning modes:

- High speed random tuning to provide anti-jamming capability and at the same time permit accurate monitoring of the output frequency.
- Precise electronic setting to a fixed frequency anywhere within the tuning range, and resetting of the operating frequency in flight to overcome radio frequency interference between aircraft and narrow band "spot" jamming.
- Rapid tuning about a given frequency to increase radar resolution by reduction of clutter (background interference) and glint (distortion from out-of-phase echoes). Commonly called "dither", this method of tuning allows reception of more in-phase components.

The electromagnetically tuned magnetron achieves its tuning versatility through a completely electrical tuner which allows operation over all or any portion of the magnetron's tuning range. This tuner has tuning rates up to 5,000,000 mc/sec^2 at Ku-band and 1,500,000 mc/sec^2 at X-band, and provides a voltage reference signal proportional to the magnetron output frequency with an accuracy of ± .15% under all environmental conditions.

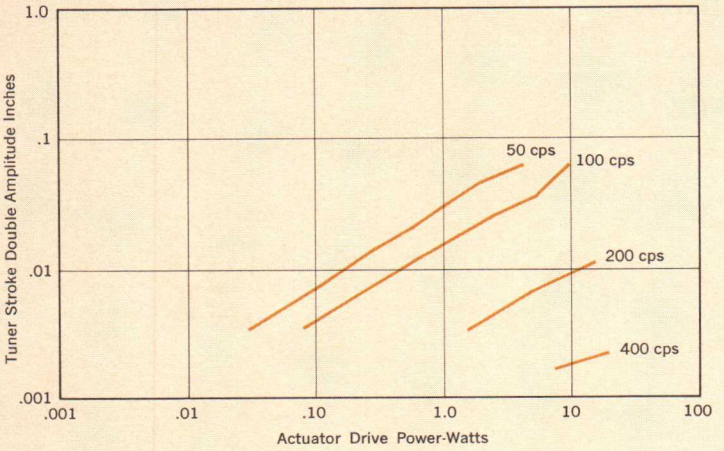
Litton electromagnetically tuned magnetrons consist of the following components:

1. A standard vane and strap, rising sun, or coaxial magnetron body.
2. An electromagnetic actuator consisting of a tuner coil and a magnetic circuit.
3. A position sensing transducer.
4. A velocity sensing circuit, when needed.
5. A servo amplifier feed-back loop, when needed.

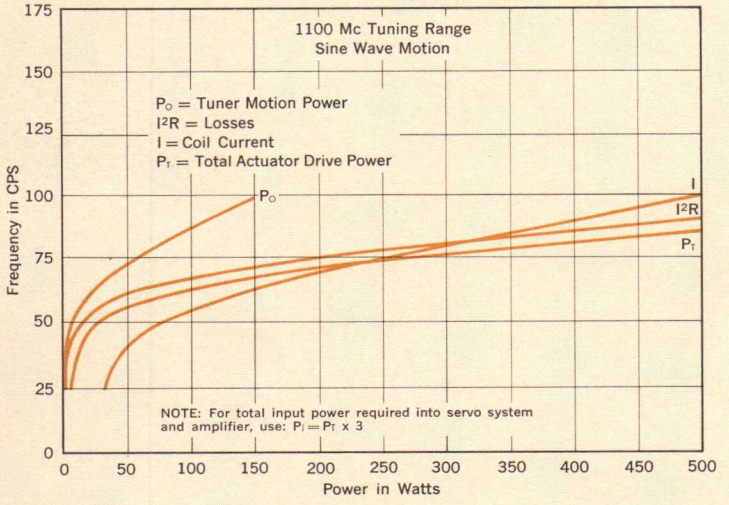
The electromagnetic tuner is a universal tuner. It can be adapted to any of Litton's tunable magnetrons without sacrificing the electrical characteristics inherent in these tubes, including tuning range. Any magnetron tuned by pins, or a tuning ring having reciprocating motion along the axis, can easily be adapted to electromagnetic tuning. Modifying an existing tube is simply accomplished by the addition of a second bellows and by attaching the coil of the tuner to the drive shaft of the magnetron. Retrofit of existing systems with electromagnetically tuned magnetrons can therefore be accomplished at low cost.

PERFORMANCE CHARACTERISTICS

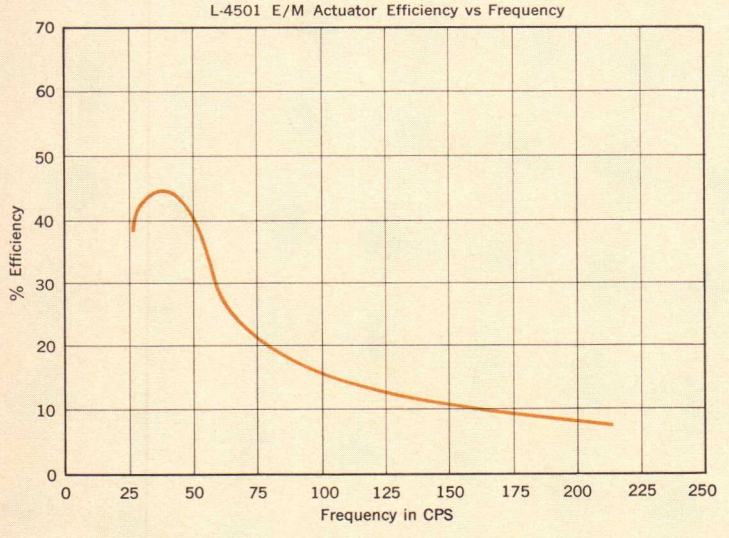
L-4500 E/M Actuator Performance Actual



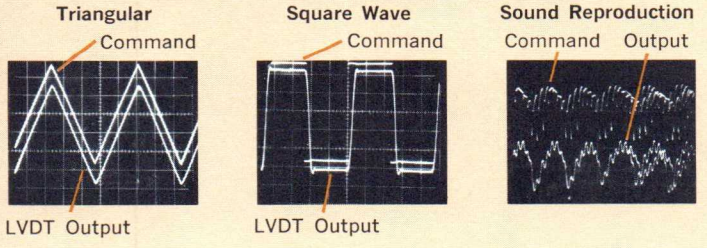
L-4501 E/M Actuator Performance Calculated



L-4501 E/M Actuator Efficiency vs Frequency



REPRESENTATIVE RESPONSE CURVES



DESIGN FEATURES OF ELECTROMAGNETICALLY TUNED MAGNETRONS

Reliability – Reliability is designed and built into every Litton E/M tuned magnetron.

The bellows are composed of stainless steel discs which are heliarc welded together alternately on the outer and inner diameter. This type of Ku-band actuator complete with bearings and bellows has completed a life test of 242,000,000 cycles without failure.

The complete actuator and all bearing surfaces are located outside of the magnetron vacuum envelope, and are assembled on the magnetron after bakeout, therefore, placing no restriction on the magnetron bakeout temperature. Because the assembly operates at environmental temperatures, it is considerably more reliable and less expensive than those which must withstand bakeout temperature within a vacuum. The E/M tuner life is well beyond the specified tube life which is nominally 1000 hours.

Versatility – The E/M tuner responds to any type of command signal such as sine, triangular, step or noise.

Tuning speeds can be greatly increased if used in the "dither" mode. With the L-4500, 950 cps has been achieved with E/M tuning, while 200 cps is the limit of hydraulic tuning. The feedback loop, transducers and amplifier may be eliminated, considerably reducing the size, weight and cost of the magnetron.

In a mechanically tuned magnetron, for example, a small auxiliary E/M tuner can be inserted in one resonator of a vane and strap or rising sun magnetron, or in the cavity of a coaxial tube. With suitable external circuitry, this tuner trimmer can be used to compensate for slow frequency drift which results, for example, from temperature changes and pulling.

In fixed frequency applications where the local oscillator is crystal controlled, this technique could reduce the need for complicated AFC circuitry. A small E/M tuner can also be used to introduce "dither" to a mechanically tuned tube, or a fixed frequency tube.

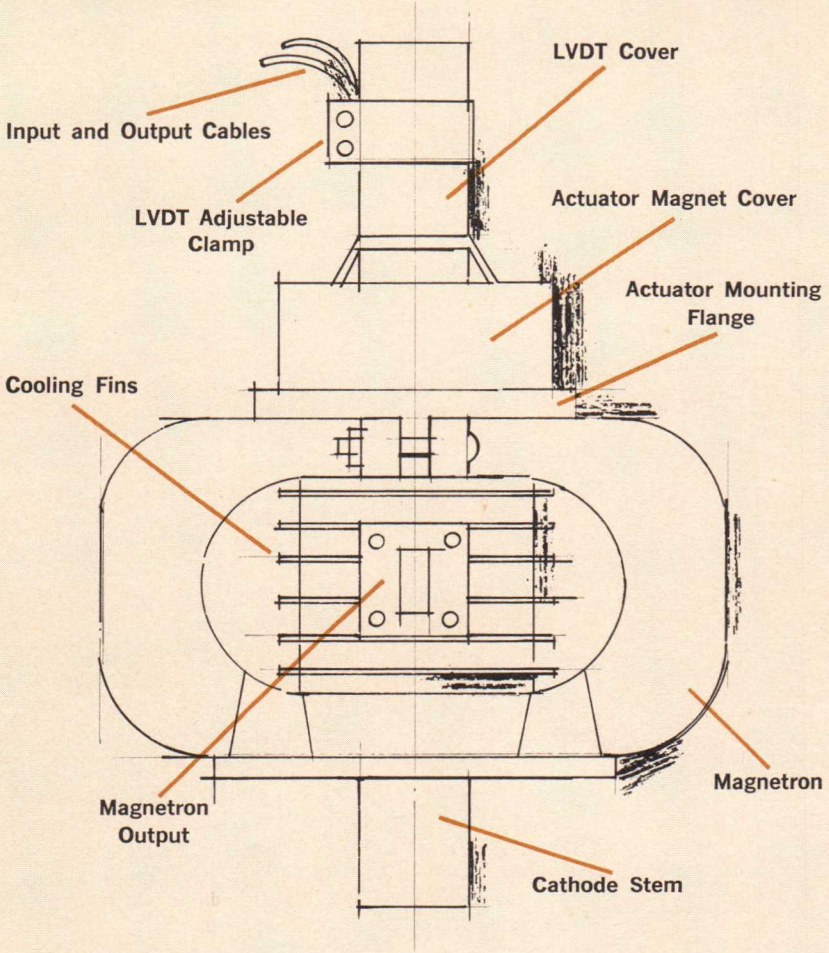
Simplicity – E/M tuner construction is mechanically simple, and proper alignment of the tuner assembly is easily maintained. Conventional components are used throughout. The alignment bearings are external to the magnetron vacuum envelope, permitting lubrication and avoiding the problems of bearings in a vacuum, with resulting friction associated with some tuner designs.

An input function and an amplifier are all that are required to drive the electromagnetic tuner. Since the tuner is completely electrical it is easy for the system designer to evaluate and use.

Size and Weight – The size and weight of the tuner are dependent upon tuning rate and length of stroke required, and constitute a significant improvement over existing hydraulic and spin-tuned magnetrons. The Ku-band L-4500 weighs 12 pounds. The X-band L-4501 weighs approximately 18 pounds.

Efficiency – The efficiency of the electromagnetic tuner is much greater than that of other high-speed tuners. For example, at Ku-band five watts of input drive power will accomplish the same tuning that requires 125 watts for a hydraulic magnetron.

Tuning Accuracy – A variation in sensitivity and linearity within 0.25% is maintained with the inductive transducer. At a particular frequency at Ku-band this permits an output voltage signal corresponding to the output frequency within ±0.15% under all environmental conditions. This is at least four times better than is possible with tuning methods requiring capacitive transducers.



COMPONENTS

In Electromagnetically tuned magnetron applications the main theme is versatility coupled with read-out, allowing the system user to provide programmed tuning with an indication of frequency along the tuning curve. This is accomplished by the use of a dual feed-back loop servo amplifier, a position transducer and an optional velocity transducer directly coupled to the actuator drive shaft.

The specific parts of the tuner and associated components are illustrated at the left. Direct coupling between the tuner coil and the drive shaft permits accurate tuner positioning in relation to applied signal. The position transducer is also coupled to the drive shaft. This transducer is of the inductive differential type, requiring an AC voltage input which is typically 10 volts r. m. s. at 20,000 cycles per second. The velocity-sensing transducer (optional) is of the fixed-coil, moveable magnet type. The output of this transducer is used to provide additional damping of high velocity motion, as in a vibration environment, and is connected to an auxiliary feedback loop of the amplifier.

In the more popular usage, the tuner of the tube is controlled by a servo amplifier of the closed loop type. Several types of amplifier circuits have been designed. However, these circuits are somewhat unique to a particular type of program, and it is recommended that a specific tuning program be discussed with Litton Application Engineers.

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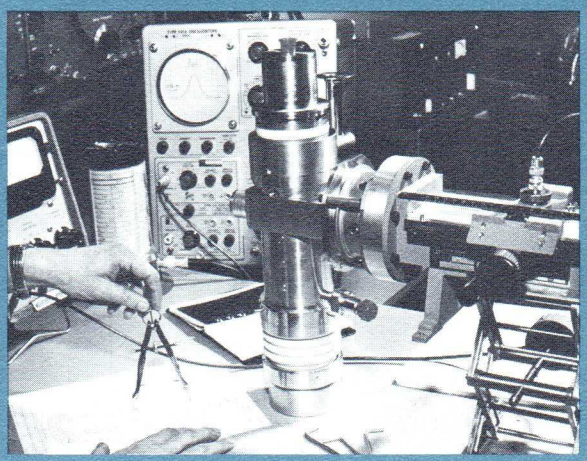
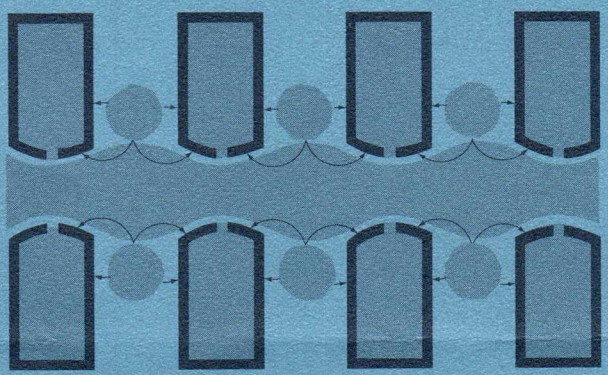
FORM NO. 501
5MCA566

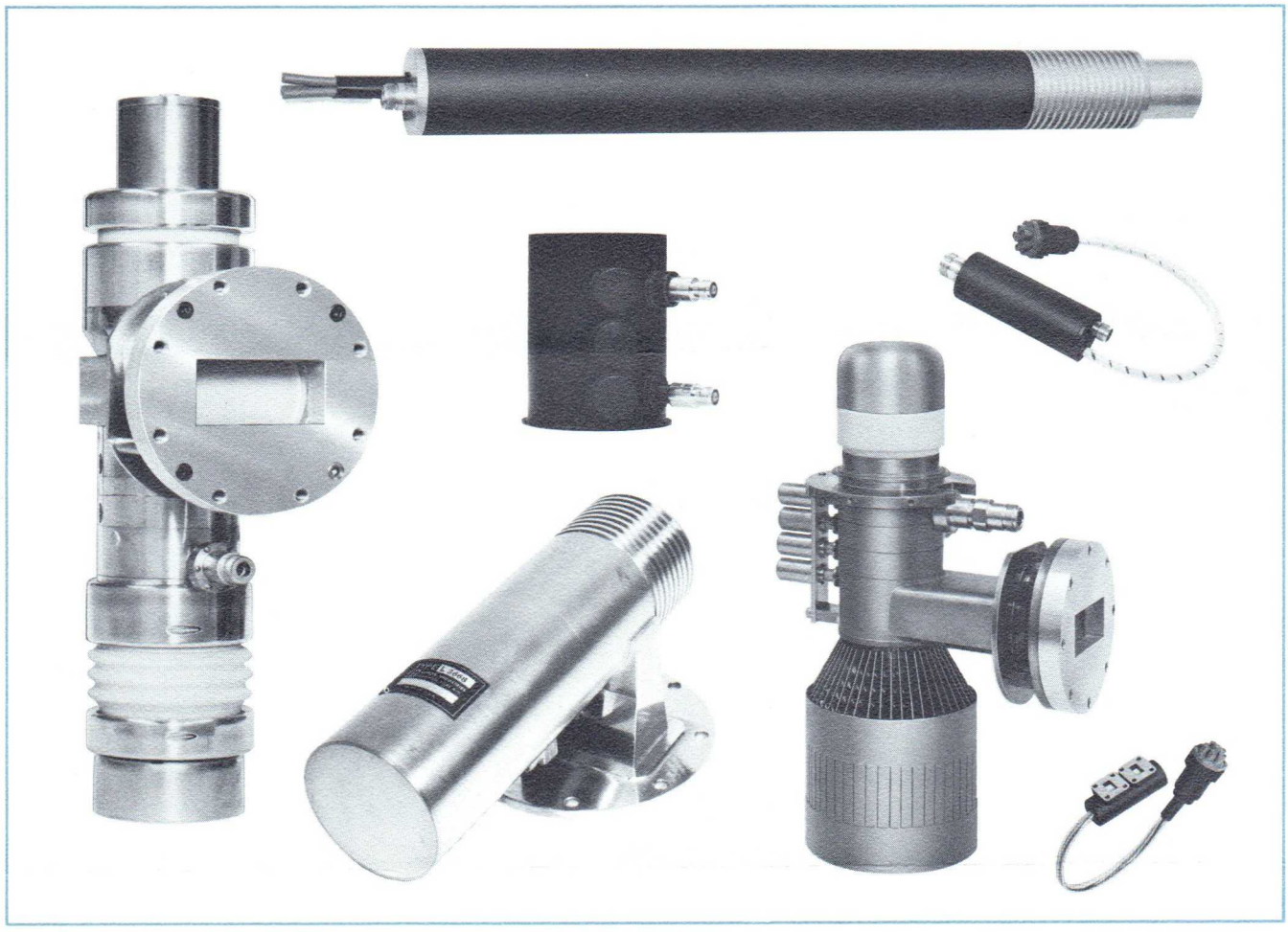
ELECTROSTATICALLY FOCUSED KLYSTRONS





TECHNICAL BULLETIN

LITTON INDUSTRIES
ELECTRON TUBE DIVISION
SAN CARLOS, CALIFORNIA



WHAT IS AN ELECTROSTATICALLY FOCUSED KLYSTRON?

The electrostatic beam focusing technique completely eliminates magnetic focusing structures; thereby greatly reducing klystron size and weight. The focusing scheme of newly developed Litton electrostatic klystrons incoporates Einzel lenses. Focusing with lenses between cavities permits a narrower, longer beam that can be used with rf structures comparable to those in magnetically focused klystrons. This new interaction principle for amplification of rf signals at UHF and microwave frequencies has lens electrodes connected to the cathode so that no separate lens voltage supply is needed. One of the significant features of the electrostatic focusing principle is that the beam remains focused for all values of cathode (and lens) voltage. This permits the ESF klystron to operate efficiently over wide ranges of power output levels by simply changing the cathode voltage.

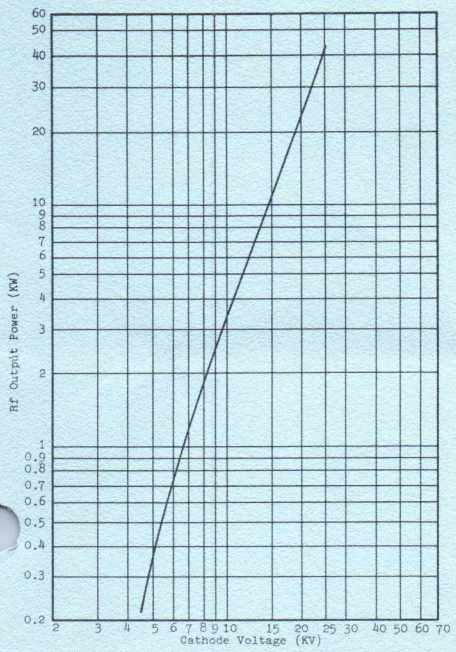
The focusing system for new Litton ESF klystrons consists of a series of ring-shaped lens electrodes designed with extensive use of the Litton Precision Resistance Network Analogue and a high speed digital computer – a research tool which has been the key to this important new development. The dimensions of the lens system are chosen so that optimum operating performance is achieved with the lens voltage equal to the cathode voltage.

Another important feature is that the rf gaps of the resonant cavities are ungridded, leading to higher values of average power, gain and efficiency.

ADVANTAGES OF AN ESF KLYSTRON OVER THE CONVENTIONAL KLYSTRON

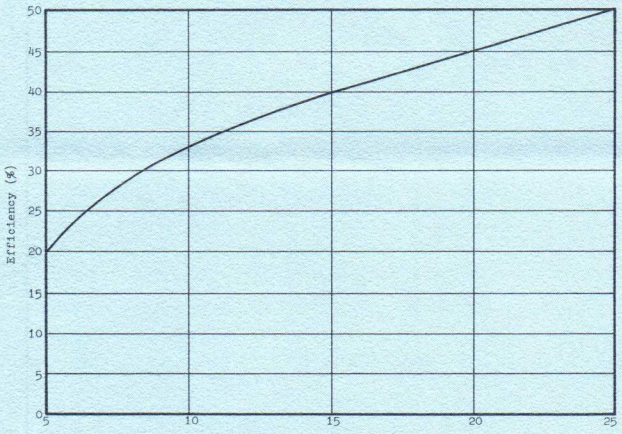
Electrostatically focused klystrons offer all the benefits of a conventional klystron – that is, high gain, power, and efficiency as well as ruggedness and long life – but in addition feature these important advantages:

1. Reduction of tube size and weight (weight and volume of magnets alone are often many times that of tube itself).
2. Elimination of external magnetic field leakage from magnets or solenoids.
3. Higher efficiency and ease of operation.
4. Longer life and greater reliability because of automatic ion removal from the beam.
5. Greater freedom from oscillational instability caused by electronic feedback in the beam.
6. Wider range of operating parameters at high efficiency.
7. No additional power supplies required.
8. Simple, reliable construction.
9. Ability of low and moderate power designs to be self-supporting on its output waveguide flange.
10. Reduced tube and system manufacturing costs.

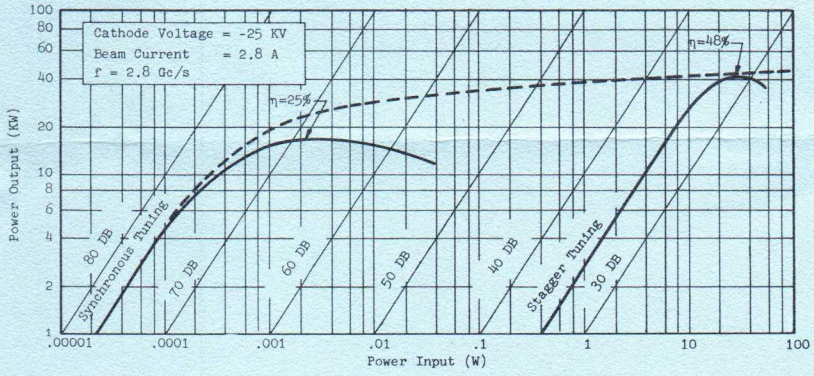


RF OUTPUT POWER VS. CATHODE VOLTAGE

Performance curves for Litton ESF klystrons showing (1) saturated power output versus cathode voltage; and (2) efficiency versus cathode voltage.



EFFICIENCY VS. CATHODE VOLTAGE



A plot of power output vs. power input for synchronous and stagger tuning. An ESF klystron can be adjusted to operate anywhere along the dotted line.

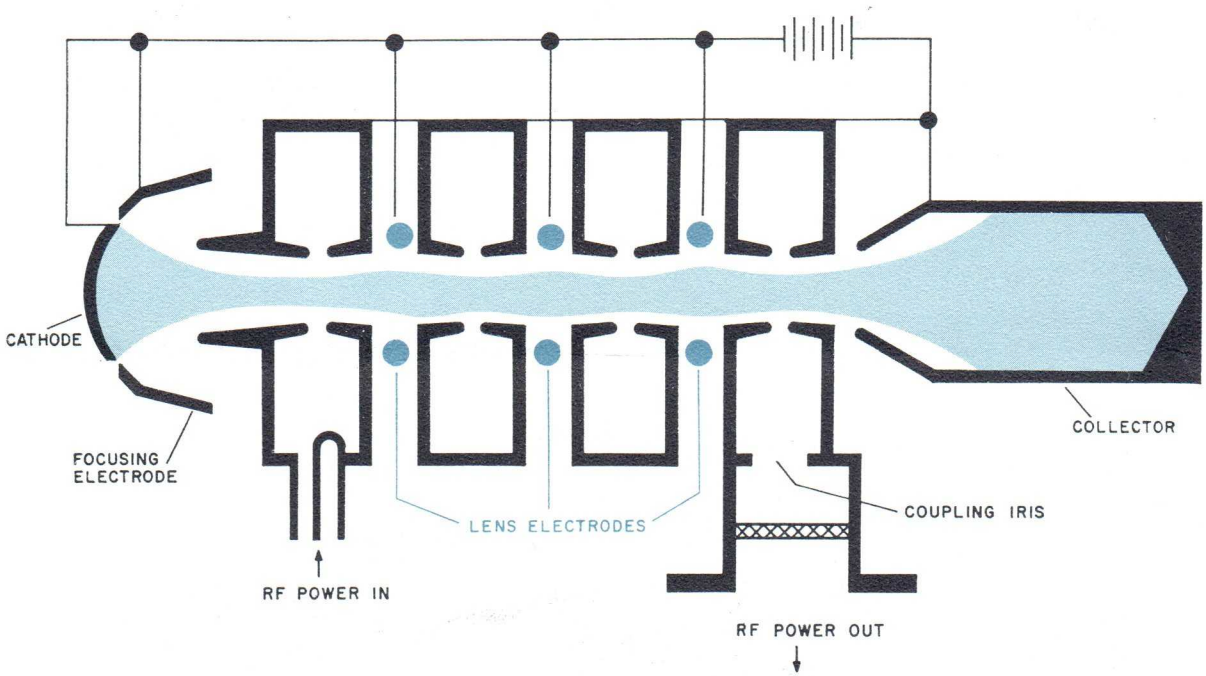
APPLICATIONS FOR NEW ESF KLYSTRONS

The electrostatically focused klystron, with its many advantages, can well be used in ground-based, mobile, airborne, missile and space electronic systems. A wide range of system applications, especially those where minimum size, weight and cost are key factors, include:

- **Phased-array radars**
- **Space communications**
- **Troposcatter communications**
- **Navigation-guidance**
- **Active radio astronomy**
- **Telemetry systems**

Since ESF klystrons have no magnetic fields, they can be placed side by side with no interaction between tubes, an important consideration for the above-mentioned applications. If desired, the ESF klystron can be mounted directly at the focal point of an antenna.

The tube's conventional filter-type bandpass characteristic is advantageous in communications systems which require rejection of signals lying outside the operating passband. Additional filters are unnecessary. Complete stability of the tube with respect to impedance mismatch promises elimination of load isolators. The ESF klystron is an ideal component in systems whose frequency bandwidth requirements lie within klystron capability.



Electrostatic Focusing Technique

ESF KLYSTRON "STATE-OF-THE-ART" —FUTURE DEVELOPMENTS

The new focusing technique has been demonstrated very successfully in S-band, four-cavity klystron amplifiers. Fifty kilowatts peak power, three kilowatts average at 48 per cent efficiency has been realized in a 30 pound package without the use of a depressed collector.

The limitation in peak power achievable is the dc electric field gradient at the focusing lenses. It is estimated that at L-band the upper limit is 15 megawatts peak power. An rf bandwidth of 50 megacycles would be achieved with a conventional cavity design, and with a doubly resonant output cavity this could be doubled. The upper limit at S-band would be in excess of one megawatt peak. At X-band, present tubes can be scaled to 40 kilowatts peak power with 100 megacyles rf bandwidth.

As the focusing system design is improved to ensure increased electron beam confinement, non-depressed collector efficiencies up to 60 per cent should be realized. Work on designs for multiple beam klystrons is also expected to raise power limits.

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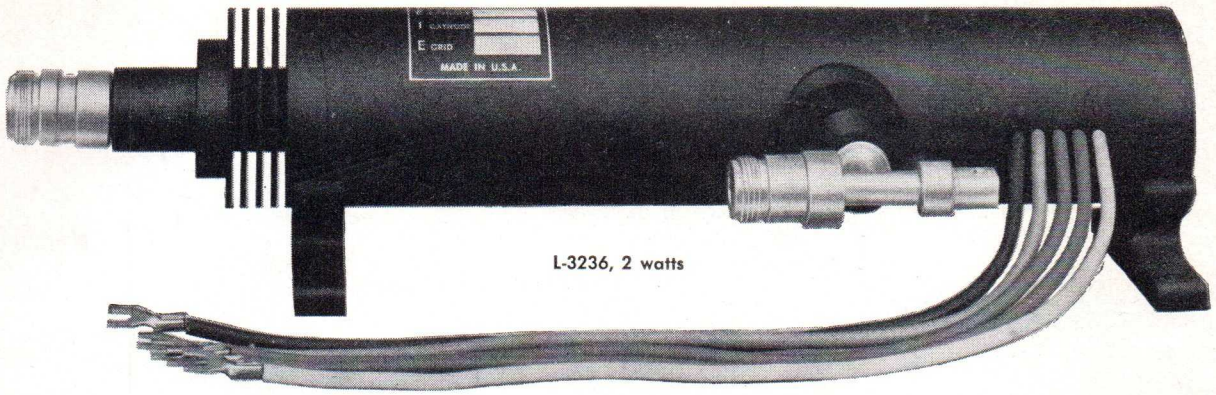
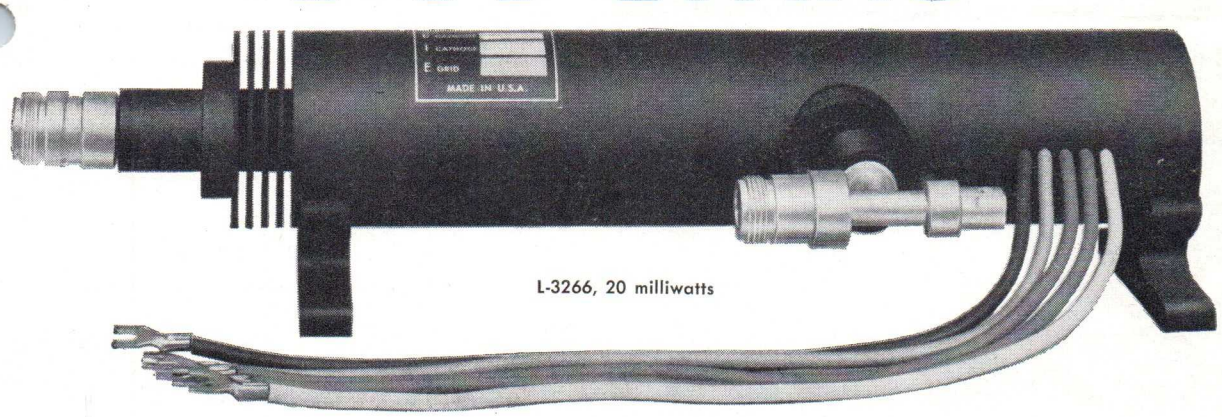


L-3236, 2 watts

TWTwins



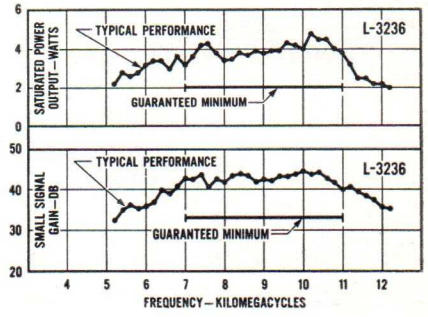
L-3266, 20 milliwatts

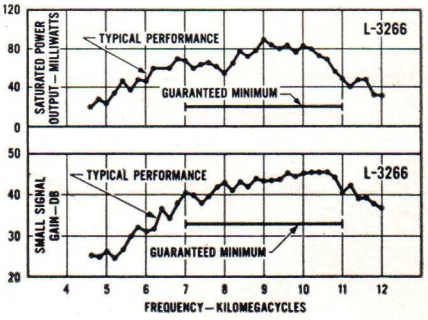
These Litton TWT twins are PPM focussed X-band traveling wave tubes. They are *not* prototypes. They are metal and ceramic tubes in field application *now*.

Designed to cover X-band with minimum saturated CW power of 20 milliwatts (L-3266) and 2 watts (L-3236), they may be operated in cascade to amplify signals as small as −50 dbm to the 2 watt level. Their performance, far exceeding the conservative specifications, is evident in the accompanying graphs.

Small size (less than 12″ in length), light weight (under 4 pounds each), and extreme environmental capability (temperature compensated −54°C to 86°C) make these tubes the ideal choice for military applications. A typical airborne equipment, designed and manufactured by Granger Associates of Palo Alto, California, incorporates the L-3266 and L-3236 and occupies only 0.75 cubic feet, including all necessary power supplies, modulating circuitry, cooling, etc. This equipment is now in field operation.

If your work involves ECM repeaters, radar target enhancement, frequency diversity radar or any application requiring broadband microwave amplifiers, appraise these new tubes. In production quantities their price is the lowest in the field. Ask for catalog sheets on the L-3266 and L-3236. Address: Litton Industries Electron Tube Division, 960 Industrial Road, San Carlos, California.





(see them at WESCON)

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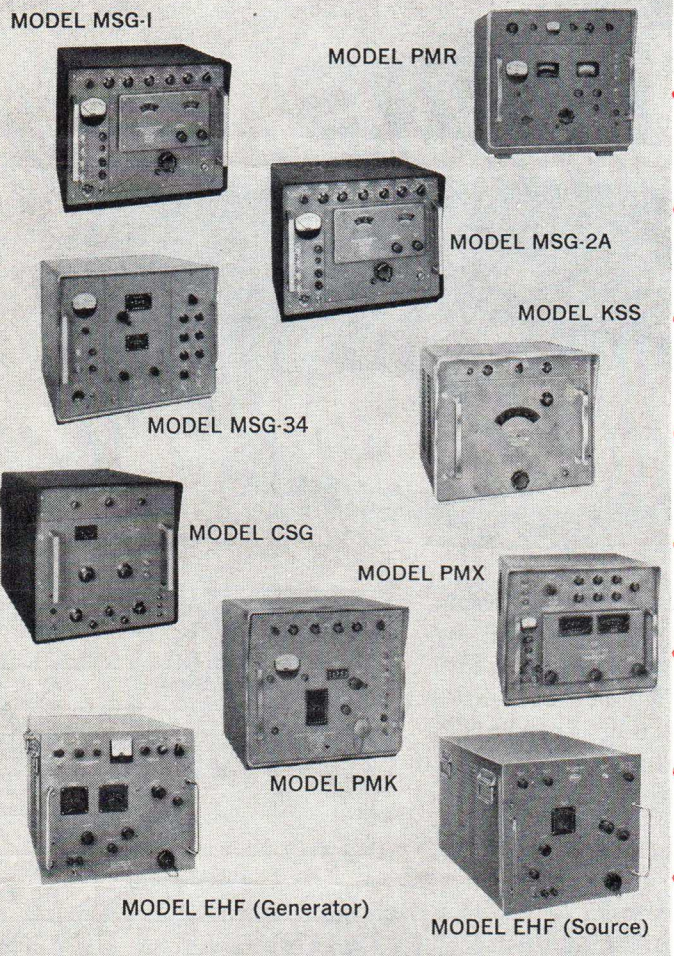

MODEL PMR	500 to 1,000 mc	Complete modulation capabilities — internal pulse modulator or FM modulator
MODEL MSG-1	950 to 2,400 mc	Complete modulation capability including square wave modulation
MODEL MSG-2A	2,000 to 4,600 mc	Complete modulation capability including square wave modulation
MODEL MSG-34	4,200 to 11,000 mc	Widest frequency range in a single instrument
MODEL KSS	1,050 to 11,000 mc	Compact high power signal source with plug-in tuning units — internal modulation
MODEL PMX	4,450 to 11,000 mc	Calibrated 1 milliwatt signal generator with complete modulation capability
MODEL CSG	1,000 to 16,000 mc	Higher power sweep generator
MODEL PMK	10,000 to 21,000 mc	Wider modulation capabilities — calibrated 10 milliwatt output
MODEL EHF (generator)	18,000 to 39,700 mc	High frequency signal generator — operates on fundamentals
MODEL EHF (source)	18,000 to 50,000 mc	Widest and highest continuous frequency range — operates on fundamentals

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Please send me information and specifications on

- ☐ Model PMR
- ☐ Model MSG-1
- ☐ Model MSG-2A
- ☐ Model MSG-34
- ☐ Model KSS
- ☐ Model PMX
- ☐ Model CSG
- ☐ Model PMK
- ☐ Model EHF (generator)
- ☐ Model EHF (source)
- ☐ A copy of "Notes on Microwave Measurements."

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Litton Electron Tubes

Introduction

Litton Industries Electron Tube Division enjoys the reputation as a company which designs and manufactures microwave tubes and display devices of the highest quality. The company's good name is founded on principles of diligent research and development, unequalled production techniques and an end-product featuring long life and reliability. Litton has been in the microwave tube business for 32 years – steadily growing, engineering new products, improving on these, and expanding its product lines.

Located in San Carlos, California, the Electron Tube Division is housed in five modern buildings totaling 204,000 square feet. Four major operating departments, each with its own engineering and production staffs include the Crossed Field Department (Magnetrons, Backward Wave Oscillators, Crossed Field Amplifiers, Barratrons® and the Microtron®); Linear Beam Department (Klystrons, Traveling Wave Tubes, Switch Tubes, Millimeter Wave Tubes); Display Devices Department (Cathode Ray Tubes, Display Systems and CRT and Microwave Equipment); and the Research Laboratory (R&D on new and advanced devices).

To insure long shelf and field life, Litton tubes are fabricated in a "super-clean" environment, made with finest metals and ceramics, brazed with gold-copper alloys and exhausted at no less than 625°C. Tooling is completed on developmental models to guarantee uniformity from tube to tube during production.

The tubes briefly described here may give you an indication of the wide diversification and capability of Litton in the microwave tube and display devices fields. Over the years, nearly 1000 different tube types have been developed. Research and development continues at a constant rate contributing state-of-the-art developments for new systems.

Intense emphasis on research, new developments and product improvement has resulted in many new advanced devices for systems designers. State-of-the-art achievements reflect higher power levels, greater efficiency and stability, smaller size and weight without affecting continuing long life and reliability.

Sophisticated new devices include electrostatically focused klystrons, crossed field amplifiers, miniature backward wave oscillators, hollow beam klystrons, miniature magnetrons and Barratrons®, lighter weight TWTs, fully-potted reflex klystrons, complete laser packages, high resolution electrostatically focused cathode ray tubes, and solid state power supplies.

Introduction of klystron amplifiers, with proprietary electrostatic focusing techniques, opens a new dimension for lightweight microwave devices for such applications as airborne and space communication systems, phased array radars, navigation-guidance, radio astronomy and telemetry systems.

Considerable advancements have been made in the Research Laboratory on Litton Crossed Field Amplifiers, which offer special advantages for new systems requiring wideband and high average power. Litton engineering has greatly raised CFA industry standards for high gain and efficiency.

More complete information is at your disposal:

Our Product Summary Catalog will be sent to you from your nearest Litton office, as shown on the back page.

Litton Industries
European Components Group
Electron Tube Division
Schwamendingenstrasse 5
8050 Zürich, Switzerland
Telephone 051/48 35 44
Telex 53646

Magnetrons – Klystrons – Electrostatic Klystrons – Crossed Field Amplifiers – Display Devices – Microwave Equipment

Magnetrons

Long life and reliability are key factors which give Litton Industries the leadership in the development and production of magnetrons of the highest quality. Litton was one of the pioneer companies in the development of these compact and rugged devices and during the past 32 years has fabricated more than 500 varieties of pulse and CW magnetrons. Advantages of Litton magnetrons include their reduced size, which permits simplier systems design. The advantage of fewer connections and associated equipment provide necessary space savings for airborne and satellite applications. The major supplier of counter-measure tubes, Litton introduced the family concept in the early 1950's; that is, the production of a complete series of mechanically and electronically interchangeable tubes, thus permitting simpler systems design with coverage over many frequency bands. Examples of the family concept may be seen in the sections describing CW/Pulse Magnetrons in our Summary Product Catalog.

Lightweight and easy to install and maintain, Litton magnetrons range in power from one watt CW to two megawatts pulse in the frequency ranges from 406 to 34,900 megacycles. Most of these rugged metal-ceramic tubes require low operating voltages. Exceptional production yields coupled with proven long life in field conditions makes Litton magnetrons extremely low cost per operating hour.
Highly efficient microwave devices, magnetrons have gained a reputation for outstanding performances in radar, navigation and guidance, counter-measures, beacons, missile applications, fire control, transponders, IFF and communications.

CW Magnetrons

Family of interchangeable
tubes covering
Frequency Ranges: 475-10745 Mc
Power Ranges: 100-400 W avg.
Liquid or Air Cooled
Fixed or Tunable

Applications include:
Doppler radar
Microwave energy sources
Electronic countermeasures
Microwave cooking and heating
Laboratory experimental work
Component and antenna testing

Pulse Magnetrons

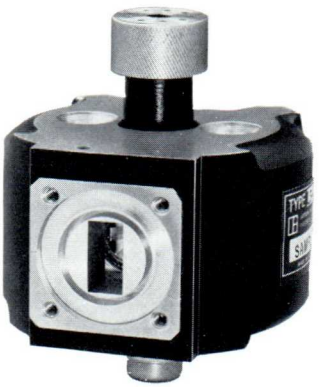
Frequency Ranges: 406-17,000 Mc
Power Ranges (Peak): 7 KW to 2 MW
(Avg.): 200 W to 4 KW
Fixed or Tunable

Applications include:
Ground,
shipboard or airborne radar,
Weather, surveillance,
fire control and navigation radar,
MTI systems

Miniature Magnetrons

Frequency Ranges: 8500-16,500 Mc
Power Ranges (Peak): .01 KW-4 KW
(Avg.): 1-10 W
Weight: As low as 9 oz.
Typically 16 oz.
Warmup: As short as 13 seconds

Applications include:
High performance aircraft and
missile systems for beacons, interrogators, IFF, transponders,
portable radar



Klystrons

In the past 13 years, Litton Industries has become a leader in the design and fabrication of quality high power klystron amplifiers. More than 2600 multi-megawatt klystrons have been delivered by Litton Industries covering the frequency bands from 400 to 3000 Mc.

First development work utilizing linear beam interaction was undertaken in 1951, under Stanford University sponsorship. Engineers from both Litton and Stanford developed a 2.2 megawatt L-band klystron, highest power linear beam tube then existing. Since that time, Litton has delivered more than 1500 of these long range radar tubes, which have averaged more than 7000 hours field life with many operating more than 20,000 rf hours.

Litton was the first company to produce broadband tubes, resulting from the Litton Skirtron® broadband technique. This development gives wide-band performance with flat power output versus frequency and linear phase shift versus frequency.

CW-Pulse

Frequency Ranges: 400-2900 Mc
Power Ranges (Peak): 0.2-30 MW
(Avg.): 4-400 KW
Gain: To 50 db
Pulse Length
(Cathode): To 2000 micro sec.
Bandwidth: To 100 Mc

Tunable, Fixed, Broadband and Hollow Beam Types

Applications include:
Long range search radar, missile and satellite tracking, tropospheric scatter communications, space communications,
linear accelerators, phased array radar and radar astronomy

ESF Klystrons

During the past year the Litton Electron Tube Division Research Laboratory has developed and introduced an important new type of microwave amplifier — the electrostatically focused klystron.

The electrostatic focusing of the beam completely eliminates magnetic focusing structures, and greatly reduces tube size, weight, and cost. There is no external leakage magnetic field surrounding this new tube, and the power supply requirements are simple since only cathode and heater voltages are required. Therefore, equipments using this tube can be designed for minimum size, weight, and cost — an important benefit significant to such applications as phased array radars.

One of the significant features of the electrostatic focusing principle is that the beam remains focused for all values of cathode (and lens) voltage. This permits the electrostatically focused klystron to operate efficiently over the wide ranges of power output levels by simply changing the beam voltage. Current study and design scaling show that the electrostatically focused klystron can be designed for a wide range of power levels and frequency bands, allowing this device to encompass an equally wide range of system applications.

Electrostatically Focused Types*

Frequency Ranges: 200-5000 Mc
Power Ranges: 1.4 KW-1 MW
Gain: 30-43 db
Efficiency: Up to 50%
Weight: As low as 2 lbs.
Typically 20 lbs.
Dimensions:
As small as 4″ x 3″ x 3″

Applications include:
Missile, airborne and mobile systems — also space and tropo-scatter communications, radar and telemetry

*Most now in development

Display Devices

The Litton Display Devices Department has demonstrated an outstanding capability in the design and production of specialized cathode ray tubes, special purpose tubes, light sources, accessory components, and equipment for electronic display and data handling systems. The specialized tube fabrication experience includes high resolution tubes, high brightness tubes, electrostatic printing tubes, alpha-numeric character generator tubes, and fiber optic CRTs.

Tube production and testing capability led to the development of sophisticated systems, such as an airborne surveillance analyzer featuring a 20 megacycle video bandwidth scanner, an electrostatic document printer, and simultaneous large area and magnified area high resolution flying spot scanners.

The following state-of-the-art original developments characterizes the achievements by Litton in this field: (a) first precision mounted and aligned beam ruggedized CRT for airborne radar display, (b) highest resolution, highest light output CRT, (c) first sealed-off, area mosaic and 1000 element per inch high speed electrostatic writing tubes, (d) first high speed extruded beam electrostatic printing device, (e) delivery in production quantities of first practical fiber optic face plate CRTs, (f) first off-the-shelf gun supply/video amplifier for driving CRTs with wide band signals in the depressed cathode mode, (g) first high level output 20 mc video system.

High Resolution Cathode Ray Tubes

1″-21″ dia. (or rectangular) faceplates. Spot size down to 0.001″ Some ruggedized and encapsulated, to specifications beyond normal requirements

Applications include:
Airborne radar display; flying spot scanning; high resolution monitors; computer controlled scanning; synthetic aperture radar recording; photographic encoding

Fiber Optics Cathode Ray Tubes

1″ and 2″ diameter faceplates for direct recording on dry process film

High Speed Electrostatic Printing Tubes

with vacuum sealed wire mosaic arrays. Element densities of 250 to 1000 per linear inch. Mosaics are composed of a single row of elements or are made 0.150″ high for printing whole characters. Printing widths from $2^{3}/_{4}$″ to 11″

Applications include:
High speed facsimile computer; readout; near real time display; high frequency recording and oscillography; TV recording; high volume labeling; document retrieval

Traveling Wave Tubes

Litton Industries, through intensive engineering efforts over the past six years, has become a leader in the design and production of lightweight, compact, broadband traveling wave tubes of the highest quality. Compatible families of TWTs covering S through X-bands feature high gain, long life, all metal-ceramic mechanically rugged structures, extremely low voltages and fully temperature compensated permanent magnets. Litton TWTs have been designed with the systems engineer in mind for a wide variety of applications including high performance aircraft and space vehicles where simplicity of operation and low voltage is important. These highly reliable devices have the built-in ability to operate under extremely adverse conditions. Most Litton TWTs are guaranteed to meet MIL-E-5400, Class II specifications. Complete encapsulation and proprietary potting techniques allow tubes to be operated from below sea level to outer space without arcing. Steel capsules eliminate effects on tube performance by shunting stray magnetic fields. Input and output circuits are coaxial, providing minimum frequency sensitivity.

Low Power

20 mW min. CW output

Medium Power

1-10 W min. CW output

High Power

1-5 KW min. output
Frequency Range: 400-11,000 Mc
Gain (Small Signal): 22-60 db
Weight: 1.3-65 lbs

Applications include:
Radar reflection enhancement, drivers for high power microwave transmitters, missile guidance and control, electronic countermeasures, space communications, telemetry, phased array radar, intermediate amplifiers, and drone vehicle guidance and control