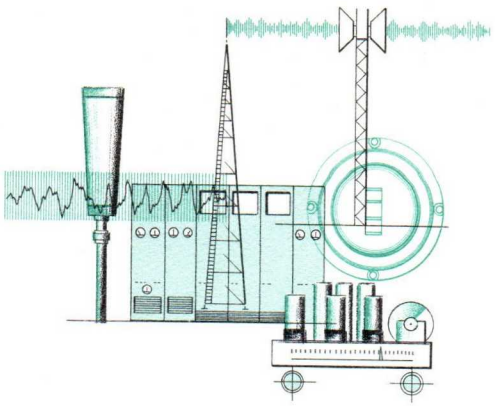
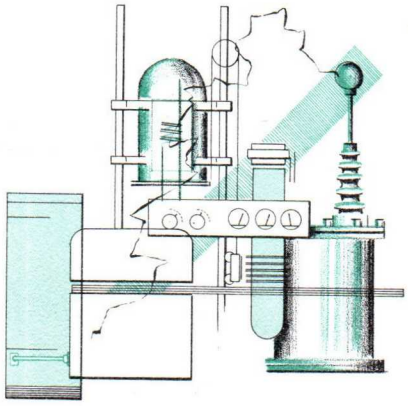
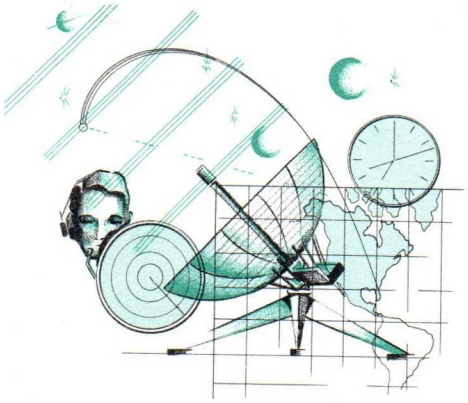
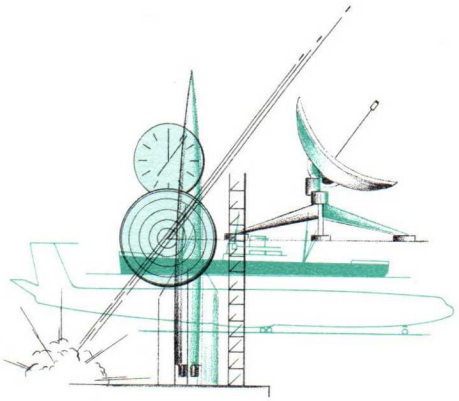
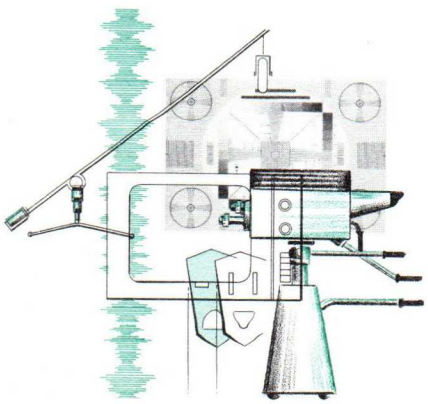










MAC 3

MACHLETT

ELECTRON

TUBES

SALES & SERVICE IN THE UNITED KINGDOM :-

B. & K. LABORATORIES LTD.

4 TILNEY ST., PARK LANE, LONDON, W.1., ENGLAND.

TELEPHONE: GROSVENOR 4567

MACHLETT

MACHLETT ELECTRON TUBES

QUICK REFERENCE GUIDE

Triodes

EXTERNAL ANODE — GENERAL PURPOSE

WATER COOLED

		Maximum Anode Input	Diss.
ML-220C		—	10 kW
ML-298A		—	100 kW
ML-342A		—	25 kW
ML-343A		—	10 kW
ML-354*	Coaxial Terminal	150	75 kW
ML-356		60	22.5 kW
ML-880		60	20 kW
ML-889A		16	5 kW
ML-891		18	6 kW
ML-892		30	10 kW
ML-893A		70	20 kW
ML-5606		25	10 kW
ML-5619		32.5	20 kW
ML-5658		60	20 kW
ML-5666		20	12.5 kW
ML-5668		28	20 kW
ML-5681*	Coaxial Terminal	150	75 kW
ML-5682*	Coaxial Terminal	300	120 kW
ML-6256*	Coaxial Terminal	7	5 kW
ML-6257*	Coaxial Terminal	7	5 kW
ML-6420*	Coaxial Terminal	20	12.5 kW
ML-6422*	Coaxial Terminal	30	20 kW
ML-6424*	Coaxial Terminal	40	20 kW
ML-6426*	Coaxial Terminal	80	40 kW
ML-6576	Low mu	45	22.5 kW
ML-6696*	Coaxial Terminal	120	60 kW
ML-7120*	Low mu; coaxial	20	12.5 kW
ML-7124*	Low mu; coaxial	80	40 kW
ML-7560*	Ceramic; coaxial	600	175 kW

EXTERNAL ANODE — GENERAL PURPOSE

FORCED-AIR-COOLED

		Maximum Anode Input	Diss.
ML-220CA		—	5 kW
ML-343AA		—	5 kW
ML-889RA		16	5 kW
ML-891R		15	4 kW
ML-892R		18	4 kW
ML-893AR		70	20 kW
ML-5530		8.75	4 kW
ML-5530H		10	4 kW
ML-5531		30	10 kW
ML-5541		23	10 kW

Continued

ML-5604		32.5	10 kW
ML-5667		20	7.5 kW
ML-5669		28	10 kW
ML-5736		5	2.5 kW
ML-6258*	Coaxial Terminal	7	3 kW
ML-6421*	Lightweight aluminum radiator; coaxial	20	10 kW
ML-6421-F		20	7.5 kW
ML-6423*	Lightweight aluminum radiator; coaxial	30	12.5 kW
ML-6423-F*		30	10 kW
ML-6425*	Lightweight aluminum radiator; coaxial	40	12.5 kW
ML-6425-F		40	10 kW
ML-6427*	Lightweight aluminum radiator; coaxial	80	20 kW
ML-6623		5	2.5 kW
ML-6697*	Lightweight aluminum radiator; coaxial	120	35 kW
ML-7121*	Low mu; lightweight; coaxial	20	10 kW
ML-7125*	Low mu; lightweight; coaxial	55	20 kW

EXTERNAL ANODE — GENERAL PURPOSE

VAPOR COOLED

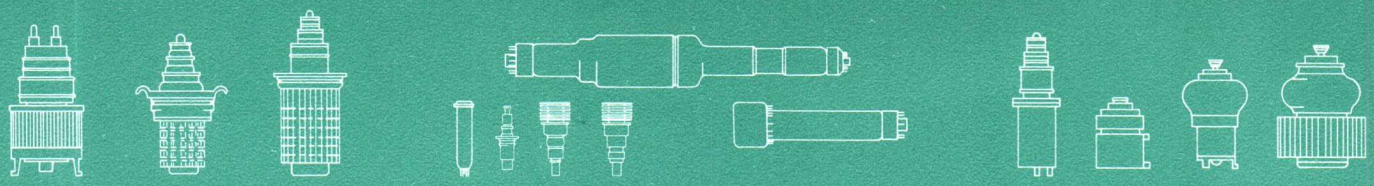
		Maximum Anode Input	Diss.
ML-7479*	Coaxial Terminal	90	50 kW
ML-7482*	Ceramic; coaxial terminal	600	200 kW

EXTERNAL ANODE — UHF PLANAR

FORCED-AIR-COOLED

		Max. Freq.
ML-2C39A	General Purpose	2500 mc
ML-2C39WA	General Purpose	2500 mc
ML-2C41	Pulsed	3000 mc
ML-3CPN10A5	Pulsed; Ceramic	3000 mc
ML-3CX100A5	General Purpose; Ceramic	2500 mc
ML-6442*	Pulsed; Ceramic	5000 mc
ML-6771*	General Purpose; Ceramic	4000 mc
ML-7209	Pulsed — High Shock Ratings	3000 mc
ML-7210*	Fast Warm Up	3000 mc
ML-7211*	Large Cathode	2500 mc
ML-7289*	Improved Gen. Purp. Ceramic	2500 mc
ML-7698*	Pulsed; Large Cathode; Ceramic	3000 mc
ML-7815	Pulsed; Ceramic	3000 mc
ML-322	See Clipper Diodes	1500 mc

***Designates tube of new equipment interest**



QUICK REFERENCE GUIDE

Triodes

INTERNAL ANODE — GENERAL PURPOSE

ML-212E	275 watts
ML-241B	275 watts
ML-242C	100 watts
ML-357B	400 watts
ML-833A	450 watts
ML-279A	1200 watts

Tetrode

FORCED-AIR-COOLED

		Maximum Anode Dissipation
ML-7007*	Ceramic replacement for type 6166, 6166A, CR-192	12 kW

Hard Pulse-Modulator Tubes

FORCED-AIR OR GAS COOLED

		Typical Pulse Power
ML-6544*	Shielded Grid Triode	1 Mw
ML-7003*	Shielded Grid Triode	2.5 Mw
ML-7335*	Ceramic Shielded Grid Triode	0.75 Mw
ML-7715*	Shielded Grid Triode	3.5 Mw

LIQUID COOLED

ML-7002*	Shielded Grid Triode	3.5 Mw
ML-7560*	Ceramic Triode	20 Mw

RADIATION COOLED

		Typical Pulse Power
ML-7248*	(Oil insulated) Tetrode	0.15 Mw
ML-7249*	(Oil insulated) Tetrode (May be operated Forced-Air-Cooled at lower power)	0.15 Mw
ML-7333*	Shielded Grid Triode	0.30 Mw
ML-7668*	(Oil insulated) Triode	0.60 Mw

Note: For pulsed ratings on Machlett high power triodes and for pulsed tubes in development, please use one of the return post cards located at the end of this catalog.

High Vacuum Diodes

CONVECTION COOLED

	PKV	A
ML-102A*	75	0.75
ML-199*	110	10.0
ML-5575/100*	150	1.0
ML-5576/200*	150	2.5

Note: Any of the High Vacuum Rectifier Tubes listed in this section may be used as Hold-Off Diodes.

OIL IMMERSED

	PKV	A
ML-141*	125	0.75
ML-142*	100	0.30
ML-148*	150	1.0
ML-6908*	150	10.0

UHF PLANAR-CLIPPER DIODE

ML-322*	to 1500 mc

Mercury Vapor Diodes

CONVECTION COOLED

	PKV	A (peak)
ML-575A	15	10.0
ML-673	15	10.0
ML-857B	22	40.0
ML-869B	22	10.0
ML-872	10	5.0
ML-8008	10	5.0

Photosensitive-TV Camera Tubes

VIDICON

ML-S-522B*	Tipless — Sensitive in near U-V
ML-558	Tipped — Low cost, general purpose
ML-6198	Tipped — General Purpose
ML-7038A*	Tipless — General Purpose — Self Aligning
ML-7291A*	Tipless — Broadcast — Self Aligning
ML-7351*	Tipped — High Sensitivity

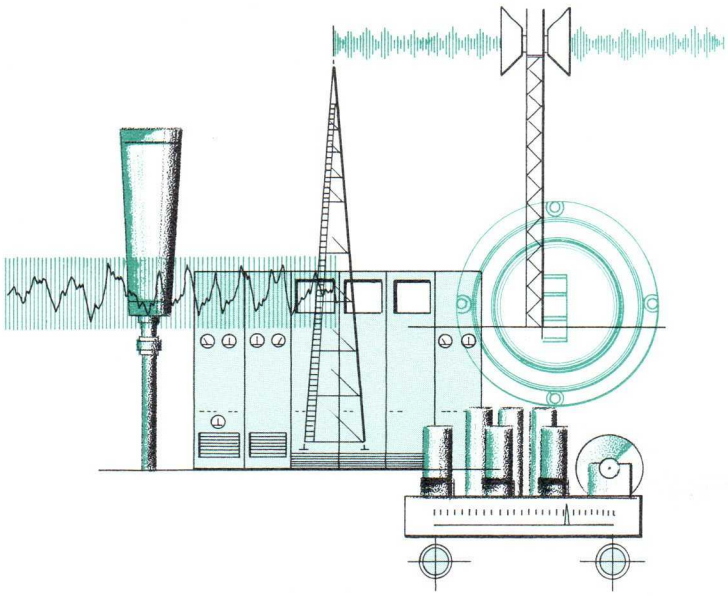
IMAGE ORTHICON

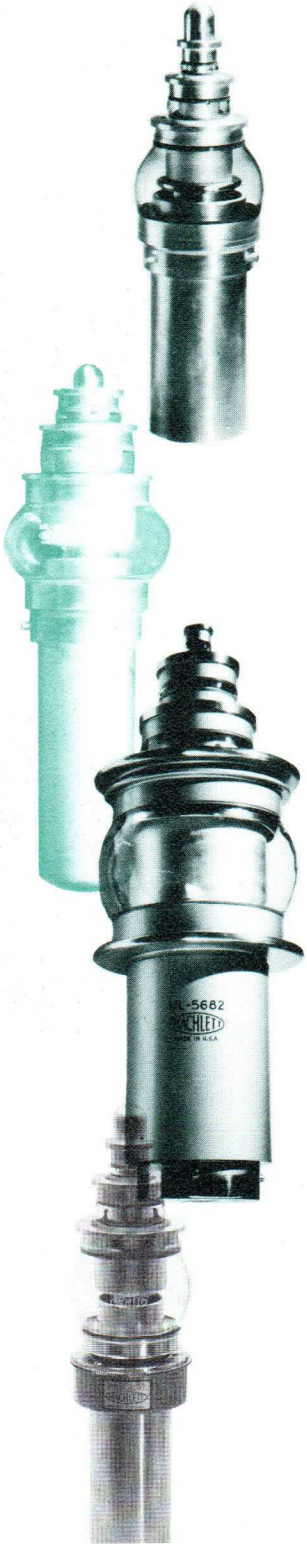
ML-5820	General Purpose — Broadcast

***Designates tube of new equipment interest**

High Power Triodes

General Design Criteria





MECHANICAL

Dimensional Stability

Dimensional Stability is essential in the large electron tube. To permit optimum electrode spacing (hence efficiency) and to prevent interelectrode short circuits, a tube must be mechanically and thermally stable. Established, proven, Machlett power tube designs — the coaxial terminal tube group — combine these requirements through the use of large-diameter, easily cooled, terminal assemblies. (Auxiliary seal cooling, for many of the coaxial tube types, is not required up to 15 mc/sec.)

Physical Ruggedness

Physical Ruggedness inherent in the compact coaxial structure, results from the use of sturdy, heavy, terminal members supported by simple glass or ceramic insulating spacers.

Terminal Structure and Connectors

In the new coaxial tube, the glass envelope, as such, disappears. Strong glass or ceramic insulating spacers, simple in shape, and having no recessed areas are sealed to sturdy, thick-sectioned Kovar pieces. This new design obsoletes the unstrengthened long glass cylinder and renders obsolescent and the "post and dish" construction. Large, easily-cooled seals, inherent to coaxial terminal design provide great strength; easily fitted and removable machined ring connectors are used with the coaxial terminal. Machlett "post and dish" terminal assemblies employ solid terminal posts mounted in sturdy silver-brazed mounts; Machlett heat-radiating connectors are recommended.

Cathode

The Machlett multi-strand thoriated-tungsten filamentary cathode reduces to the essential minimum the elements required for an efficient, long-life emitter. Multiple filament strands reduce current-per-strand, and keep filament hum levels exceedingly low. Mechanical springs and spacers, and other potentially troublesome elements, are eliminated in the Machlett self-supporting structure.

Long-life thoriated-tungsten filament cathodes reduce operating power costs by about two-thirds as compared to pure tungsten cathodes.

Anode

Heavy wall anode design provides a heavy metal heat sink to give thermal overload safety and low anode wall temperatures.

R-F final seal-in (metal to metal) permits closer design tolerances because tubes may be accurately jigged in sealing fixture. Reducing atmosphere keeps tube clean during brief (seconds long) r-f heat application. Cleanest tubes have best high-temperature high-vacuum stability.

Cooling

Aluminum fin lightweight anode coolers with high efficiency radial fins are used on the newest Machlett coaxial triodes. This new cooling system provides increased anode dissipation to 25%, greatly reduced tube weight.

Quick-acting automatic pressure-seal water jackets provide water turbulence helix for efficient cooling of heavy-wall anode water-cooled tubes.

ELECTRICAL

Efficiency

In the coaxial triode, a thermally and mechanically stable terminal structure permits optimum electrode spacing for good electrical efficiency. High perveance in Machlett coaxial tubes is achieved through use of these close spacings together with a high-emission cathode. High perveance, in turn, provides high transconductance; and this, again, is reflected by low driving power requirements.

Because grid voltage swings are kept low, a greater plate voltage swing may be used (in Class C operation). This means, of course, that most of the plate supply voltage becomes available across the circuit load as useful r-f and that only a small part is lost as tube drop.

Conservative Ratings

In all Machlett tubes, electrical and thermal ratings protect the user against all probable hazards of operation and yet provide economical performance. Typically, for example, anode dissipation (water-cooled tubes) of fifty percent of maximum power input is provided. (Thirty-three percent of maximum input is not uncommon in other manufacturer's tubes.) Grid current rating (in the Machlett coaxial triodes), to take another case, provides for safe operation in the presence of high no-load currents.

R-F Operating Stability

Rapid removal of a tube load may cause a tube to fall out of oscillation. With tubes of Machlett coaxial construction (Design Group #1), maximum load impedance increases have no unstabilizing effect. (In tests during unloaded conditions plate voltage has been snapped on and off without loss of oscillation.)

Parasitic oscillations may create high voltage spikes and subsequent arcing in tubes having leads of high or relatively high inductance (such as are employed by the long envelope tubes, or in those of "post and dish" type construction). Lead inductance is reduced by ten to one over the long envelope tubes (Design Group #3) and five to one over "post and dish" type (Design Group #2).

Loading

A wide latitude in loading is offered in the coaxial triode because of its relatively low grid current under loaded conditions at full power. Grid power can rise without detrimental effect to more than twice the normal loaded value during periods of no-load.

"Clean Signal" Response

Because "ML-" coaxial terminal triodes use a low-current-per-strand cathode, very low hum levels are possible with ac operation and exceedingly low noise is achieved with dc operation.

Low grid current requirements (a result of low grid drive) provide for low signal distortion at the grid.

MACHLETT HIGH

Power Groupings by

***Designates tube of new equipment interest**

EXTERNAL ANODE

Water Cooled Triodes — Anode Dissipation Range:
5 kW to 175 kW

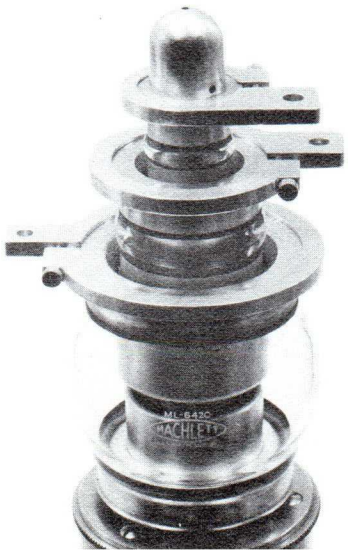
5 kW	ML-889A, ML-6256*, ML-6257*
6 kW	ML-891
10 kW	ML-220C, ML-343A, ML-892, ML-5606
12.5 kW	ML-5666, ML-6420*, ML-7120*
20 kW	ML-880, ML-893A, ML-5619, ML-5668, ML-6422*, ML-6424*
22.5 kW	ML-356, ML-6576
25 kW	ML-342A
40 kW	ML-6426*
60 kW	ML-6696*
75 kW	ML-5681*, ML-354*
120 kW	ML-5682*
175 kW	ML-7560*

Vapor Cooled Triodes — Anode Dissipation Range:
50 kW to 200 kW

50 kW	ML-7479*
200 kW	ML-7482*

MACHLETT ELECTRON

Accessories, manufactured and designed by The Machlett Laboratories, are available for its external anode triodes and hard pulse-modulator tubes. These accessories have been specifically engineered for ease of use and effectiveness of operation. In addition, they provide maximum safety factors for reliable tube performance.



POWER TRIODES

Anode Dissipation Capability

Forced-Air-Cooled Triodes — Anode Dissipation Range: **2.5 kW to 35 kW**

2.5 kW	ML-5736, ML-6623
3 kW	ML-6258*
4 kW	ML-891R, ML-892R, ML-5530, ML-5530H
5 kW	ML-220CA, ML-343AA, ML-889RA
7.5 kW	ML-5667, ML-6421-F
10 kW	ML-5531, ML-5541, ML-5604, ML-5669, ML-6421*, ML-6423-F, ML-6425-F, ML-7121*
12.5 kW	ML-6423*, ML-6425*
20 kW	ML-893AR, ML-6427*
35 kW	ML-6697*

INTERNAL ANODE

Radiation-Convection Cooled — Anode Dissipation Range: **275 watts to 1200 watts**

100 watts	ML-242C
275 watts	ML-212E, ML-241B
400 watts	ML-357B
450 watts	ML-833A
1200 watts	ML-279A

TUBE ACCESSORIES

Included among the items available are: heat dissipating terminal connectors; ring terminal connectors for coaxial terminals; quick-acting, automatic-seal water jackets; aluminum air distributors; bayonet pin water-jackets and/or water-connection tube base; various mounting and insulating hardware.

External Anode Triodes

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings
ML-220C Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	4 mc/sec.
ML-220CA Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	4 mc/sec.
ML-298A Water Cooled	#3	Oscillator, Modulator, Amplifier	40- 80 kW	4 mc/sec.
ML-342A Water Cooled	#3	Oscillator, Modulator, Amplifier	10- 30 kW	4 mc/sec.
ML-342AA Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	10- 30 kW	4 mc/sec.
ML-343A Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 15 kW	4 mc/sec.
ML-343AA Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 15 kW	4 mc/sec.
ML-354* Water Cooled	#1A	Oscillator, Modulator, Amplifier	50-115 kW	20 mc/sec.
ML-356 Water Cooled	#2C	Oscillator, Modulator, Amplifier	30- 50 kW	25 mc/sec.
ML-880 Water Cooled	#2B	Oscillator, Modulator, Amplifier	24- 40 kW	25 mc/sec.
ML-889A Water Cooled	#2A	Oscillator, Modulator, Amplifier	5- 10 kW	50 mc/sec.
ML-889RA Forced-Air-Cooled	#2A	Oscillator, Modulator, Amplifier	5- 10 kW	40 mc/sec.
ML-891 Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc/sec.
ML-891R Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc/sec.

***New Equipment design interest.**

Design Group **#1A*** Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.
#1B* Modified coaxial design. Thoriated-tungsten cathode. Heavy wall anode.
#1C* Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall vapor-cooled anode.

Design Group **#2A** "Post & dish" terminal triode. Pure tungsten, cathode. Light wall anode.
#2B "Post & dish" terminal triode. Pure tungsten, self-supporting, cathode (or variation). Heavy wall anode.
#2C "Post & dish" terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.

Design Group **#3** Long envelope structure. Pure tungsten cathode. Light wall anode.

	FILAMENT				MAXIMUM RATINGS						
					PLATE		GRID		PLATE		
	Voltage Volts	Current Amps.	Mu	Class of Service	Voltage Vdc	Current Adc	Voltage Vdc	Current Adc	Input Watts	Dissip. Watts	TUBE TYPE
ML-220C	21.5	41.0	40	C-T	15000	1.5	—	—	—	10000	**ML-220C** Water Cooled
ML-220CA	21.5	41.0	40	C-T	15000	1.5	—	—	—	5000	**ML-220CA** Forced-Air-Cooled
ML-298A	27.0	225	32	C-T	20000	11	—	—	—	100000	**ML-298A** Water Cooled
ML-342A	20.0	67	40	C-T	20000	2.5	—	—	—	25000	**ML-342A** Water Cooled
ML-342AA	20.0	67	40	C-T	20000	2.5	—	—	—	5000	**ML-342AA** Forced-Air-Cooled
ML-343A	21.5	57.5	40	C-T	18000	2.0	—	—	—	10000	**ML-343A** Water Cooled
ML-343AA	21.5	57.5	40	C-T	18000	1.5	—	—	—	5000	**ML-343AA** Forced-Air-Cooled
ML-354*	12.0	220	25	C-T	15000	12	−3200	2.0	150000	75000	**ML-354*** Water Cooled
ML-356	7.5	170	20	C-T	12500	6	−2000	0.80	60000	22500	**ML-356** Water Cooled
ML-880	12.6	315	20	C-T	10500	6.0	−1200	0.80	60000	20000	**ML-880** Water Cooled
ML-889A	11.0	120	21	C-T	8500	2.0	−1000	0.25	16000	5000	**ML-889A** Water Cooled
ML-889RA	11.0	120	21	C-T	8500	2.0	−1000	0.25	16000	5000	**ML-889RA** Forced-Air-Cooled
ML-891	22.0	60	8.5	C-T	12000	2.0	−3000	0.15	18000	6000	**ML-891** Water Cooled
ML-891R	22.0	60	8.5	C-T	10000	2.0	−3000	0.15	15000	4000	**ML-891R** Forced-Air-Cooled

C-T: R-F Power Amplifier and Oscillator, Class C Telegraphy.

External Anode Triodes

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings
ML-892 Water Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc/sec.
ML-892R Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	5- 10 kW	1.6 mc/sec.
ML-893A Water Cooled	#3	Oscillator, Modulator, Amplifier	30- 50 kW	5 mc/sec.
ML-893AR Forced-Air-Cooled	#3	Oscillator, Modulator, Amplifier	30- 50 kW	5 mc/sec.
ML-5530 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	4- 6.7 kW	110 mc/sec.
ML-5530H Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	6.7- 7.2 kW	30 mc/sec.
ML-5531 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	14- 20 kW	30 mc/sec.
ML-5541 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	6-11.5 kW	110 mc/sec.
ML-5604 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	9- 15 kW	25 mc/sec.
ML-5606 Water Cooled	#2A	Oscillator, Modulator, Amplifier	7- 15 kW	1.6 mc/sec.
ML-5619 Water Cooled	#2B	Oscillator, Modulator, Amplifier	9- 22 kW	25 mc/sec.
ML-5658 Water Cooled	#2B	Oscillator, Modulator, Amplifier	17- 38 kW	15 mc/sec.
ML-5666 Water Cooled	#2B	Oscillator, Modulator, Amplifier	6- 12 kW	22.5 mc/sec.
ML-5667 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	6- 12 kW	22.5 mc/sec.

***New Equipment design interest.**

Design Group **#1A*** Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.
#1B* Modified coaxial design. Thoriated-tungsten cathode. Heavy wall anode.
#1C* Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall vapor-cooled anode.

Design Group **#2A** "Post & dish" terminal triode. Pure tungsten, cathode. Light wall anode.
#2B "Post & dish" terminal triode. Pure tungsten, self-supporting, cathode (or variation). Heavy wall anode.
#2C "Post & dish" terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.

Design Group **#3** Long envelope structure. Pure tungsten cathode. Light wall anode.

	FILAMENT				MAXIMUM RATINGS						
					PLATE		GRID		PLATE		
	Voltage Volts	Current Amps.	Mu	Class of Service	Voltage Vdc	Current Adc	Voltage Vdc	Current Adc	Input Watts	Dissip. Watts	TUBE TYPE
ML-892	22.0	60	50	C-T	15000	2.0	−3000	0.40	30000	10000	**ML-892** Water Cooled
ML-892R	22.0	60	50	C-T	12500	2.0	−3000	0.40	18000	4000	**ML-892R** Forced-Air-Cooled
ML-893A	20.0	183	34.5	C-T	20000	4.0	−3000	0.40	70000	20000	**ML-893A** Water Cooled
ML-893AR	20.0	183	34.5	C-T	20000	4.0	−3000	0.40	70000	20000	**ML-893AR** Forced-Air-Cooled
ML-5530	5.0	55	26	C-T	5000	1.75	−1000	0.20	8750	4000	**ML-5530** Forced-Air-Cooled
ML-5530H	5.0	55	26	C-T	8500	1.75	−1000	0.40	10000	4000	**ML-5530H** Forced-Air-Cooled
ML-5531	6.3	92	24	C-T	10500	3.75	−1500	0.6	30000	10000	**ML-5531** Forced-Air-Cooled
ML-5541	7.5	57	26	C-T	8500	2.75	−1500	0.30	23000	10000	**ML-5541** Forced-Air-Cooled
ML-5604	11.0	176	20	C-T	12500	3.0	−2000	0.45	32500	10000	**ML-5604** Forced-Air-Cooled
ML-5606	22.0	60	50	C-T	14000	2.0	−1600	0.40	25000	10000	**ML-5606** Water Cooled
ML-5619	11.0	176	20	C-T	12500	3.0	−2000	0.45	32500	20000	**ML-5619** Water Cooled
ML-5658	12.0	310	20	C-T	12500	5.0	−1600	0.80	60000	20000	**ML-5658** Water Cooled
ML-5666	11.0	120	21	C-T	10000	2.0	−1500	0.35	20000	12500	**ML-5666** Water Cooled
ML-5667	11.0	120	21	C-T	10000	2.0	−1500	0.35	20000	7500	**ML-5667** Forced-Air-Cooled

C-T: R-F Power Amplifier and Oscillator, Class C Telegraphy.

External Anode Triodes

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings
ML-5668 Water Cooled	#2B	Oscillator, Modulator, Amplifier	8- 17 kW	5 mc/sec.
ML-5669 Forced-Air-Cooled	#2B	Oscillator, Modulator, Amplifier	8- 17 kW	5 mc/sec.
ML-5681* Water Cooled	#1A	Oscillator, Modulator, Amplifier	52-115 kW	30 mc/sec.
ML-5682* Water Cooled	#1A	Oscillator, Modulator, Amplifier	58-215 kW	30 mc/sec.
ML-5736 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	3- 4 kW	60 mc/sec.
ML-6256* Water Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	110 mc/sec.
ML-6257* Water Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	110 mc/sec.
ML-6258* Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	3- 4.5 kW	110 mc/sec.
ML-6420* Water Cooled	#1A	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc/sec.
ML-6421* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc/sec.
ML-6421-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	6- 13 kW	30 mc/sec.
ML-6422* Water Cooled	#1A	Oscillator, Modulator, Amplifier	12-18 kW	30 mc/sec.
ML-6423* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	12-18 kW	30 mc/sec.
ML-6423-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	12-18 kW	30 mc/sec.
ML-6424* Water Cooled	#1A	Oscillator, Modulator, Amplifier	24-30 kW	30 mc/sec.

***New Equipment design interest.**

Design Group **#1A*** Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.
#1B* Modified coaxial design. Thoriated-tungsten cathode. Heavy wall anode.
#1C* Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall vapor-cooled anode.

Design Group **#2A** "Post & dish" terminal triode. Pure tungsten, cathode. Light wall anode.
#2B "Post & dish" terminal triode. Pure tungsten, self-supporting, cathode (or variation). Heavy wall anode.
#2C "Post & dish" terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.

Design Group **#3** Long envelope structure. Pure tungsten cathode. Light wall anode.

	FILAMENT				MAXIMUM RATINGS						
					PLATE		GRID		PLATE		
	Voltage Volts	Current Amps.	Mu	Class of Service	Voltage Vdc	Current Adc	Voltage Vdc	Current Adc	Watts Input	Dissip. Watts	TUBE TYPE
ML-5668	22.0	60	50	C-T	14000	2.0	−1600	0.40	28000	20000	**ML-5668** Water Cooled
ML-5669	22.0	60	50	C-T	14000	2.0	−1600	0.40	28000	10000	**ML-5669** Forced-Air-Cooled
ML-5681*	12.0	220	25	C-T 110 mcs/sec.	15000 9000	12 12	−3200 −3200	2.0 2.0	150000 90000	75000 75000	**ML-5681*** Water Cooled
ML-5682*	16.5	325	30	C-T 88 mcs/sec.	16000 9000	20 20	−3200 −3200	4.0 2.5	300000 170000	120000 120000	**ML-5682*** Water Cooled
ML-5736	6.0	60	22	C-T	5000	1.4	−1000	0.50	5000	2500	**ML-5736** Forced-Air-Cooled
ML-6256*	12.6	29	20	C-T	5500	1.5	−1500	0.22	7000	5000	**ML-6256*** Water Cooled
ML-6257*	12.6	29	20	C-T	5500	1.5	−1500	0.22	7000	5000	**ML-6257*** Water Cooled
ML-6258*	12.6	29	20	C-T	5500	1.5	−1500	0.22	7000	3000	**ML-6258*** Forced-Air-Cooled
ML-6420*	7.0	85	20	C-T	10000	2.2	−1600	0.42	20000	12500	**ML-6420*** Water Cooled
ML-6421*	7.0	85	20	C-T	10000	2.2	−1600	0.42	20000	10000	**ML-6421*** Forced-Air-Cooled
ML-6421-F	7.0	85	20	C-T	10000	2.2	−1600	0.42	20000	7500	**ML-6421-F** Forced-Air-Cooled
ML-6422*	7.0	85	90	C-T	12500	2.5	−1400	0.50	30000	20000	**ML-6422*** Water Cooled
ML-6423*	7.0	85	90	C-T	12500	2.5	−1400	0.50	30000	12500	**ML-6423*** Forced-Air-Cooled
ML-6423-F	7.0	85	90	C-T	12500	2.5	−1400	0.50	30000	10000	**ML-6423-F** Forced-Air-Cooled
ML-6424*	7.0	120	20	C-T	12500	3.5	−2000	0.50	40000	20000	**ML-6424*** Water Cooled

C-T: R-F Power Amplifier and Oscillator, Class C Telegraphy.

External Anode Triodes

TUBE TYPE	Design Group	Application	Equipment Power Range Class C	Maximum Frequency of Operation for Maximum Ratings
ML-6425* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	24-30 kW	30 mc/sec.
ML-6425-F Forced-Air-Cooled	#1B	Oscillator, Modulator, Amplifier	24-30 kW	30 mc/sec.
ML-6426* Water Cooled	#1A	Oscillator, Modulator, Amplifier	46-55 kW	30 mc/sec.
ML-6427* Water Cooled	#1A	Oscillator, Modulator, Amplifier	46-48 kW	30 mc/sec.
ML-6576 Water Cooled	#2C	Oscillator, Modulator, Amplifier	36 kW	25 mc/sec.
ML-6623 Forced-Air-Cooled	#2C	Oscillator, Modulator, Amplifier	4 kW	30 mc/sec.
ML-6696* Water Cooled	#1A	Oscillator, Modulator, Amplifier	72-80 kW	30 mc/sec.
ML-6697* Forced-Air-Cooled	#1A	Oscillator, Modulator, Amplifier	72-80 kW	30 mc/sec.
ML-7120* Water Cooled	#1A	Modulator, Amplifier	8-10 kW	30 mc/sec.
ML-7121* Forced-Air-Cooled	#1A	Modulator, Amplifier	8-10 kW	30 mc/sec.
ML-7124* Water Cooled	#1A	Modulator, Amplifier	—	30 mc/sec.
ML-7125* Forced-Air-Cooled	#1A	Modulátor, Amplifier	—	30 mc/sec.
ML-7479* Vapor Cooled	#1B	Oscillator, Modulator, Amplifier	—	30 mc/sec.
ML-7482* Vapor Cooled Ceramic	#1B	Oscillator, Modulator, Amplifier	330-440 kW	30 mc/sec.
ML-7560* Water Cooled Ceramic	#1A	Oscillator, Modulator, Amplifier	330-440 kW	30 mc/sec.

***New Equipment design interest.**

Design Group **#1A*** Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.
#1B* Modified coaxial design. Thoriated-tungsten cathode. Heavy wall anode.
#1C* Coaxial terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall vapor-cooled anode.

Design Group **#2A** "Post & dish" terminal triode. Pure tungsten, cathode. Light wall anode.
#2B "Post & dish" terminal triode. Pure tungsten, self-supporting, cathode (or variation). Heavy wall anode.
#2C "Post & dish" terminal triode. Thoriated-tungsten, self-supporting, cathode. Heavy wall anode.

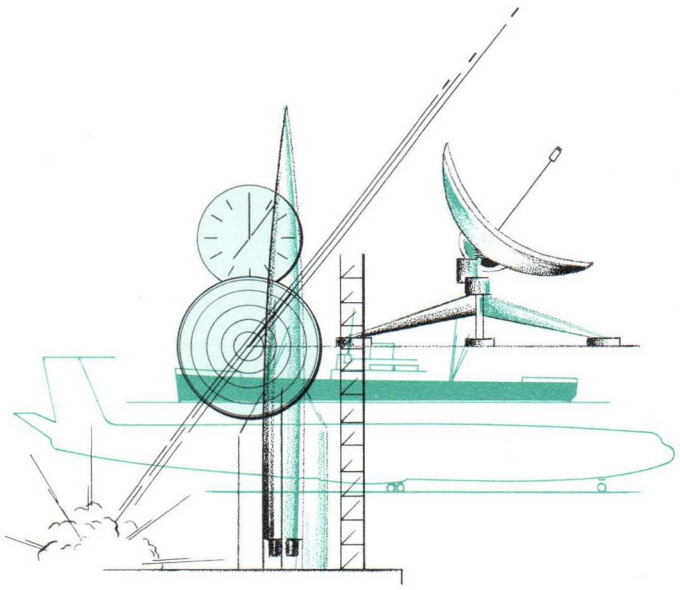
Design Group **#3** Long envelope structure. Pure tungsten cathode. Light wall anode.

	FILAMENT				MAXIMUM RATINGS						
					PLATE		GRID		PLATE		
	Voltage Volts	Current Amps.	Mu	Class of Service	Voltage Vdc	Current Adc	Voltage Vdc	Current Adc	Input Watts	Dissip. Watts	TUBE TYPE
ML-6425*	7.0	120	20	C-T	12500	3.5	−2000	0.50	40000	12500	**ML-6425*** Forced-Air-Cooled
ML-6425-F	7.0	120	20	C-T	12500	3.5	−2000	0.50	40000	10000	**ML-6425-F** Forced-Air-Cooled
ML-6426*	8.0	200	20	C-T	12500	8.0	−2000	1.0	80000	40000	**ML-6426*** Water Cooled
ML-6427*	8.0	200	20	C-T	12500	8.0	−2000	1.0	80000	20000	**ML-6427*** Water Cooled
ML-6576	7.5	170	5.5	C-T SSB	10000 12000	6.0 5.0	−2400 —	0.20 —	60000 45000	22500 22500	**ML-6576** Water Cooled
ML-6623	6.0	60	22	C-T	5000	1.4	−1000	0.5	5000	2500	**ML-6623** Forced-Air-Cooled
ML-6696*	13.0	205	20	C-T	16000	11	−3200	2.0	120000	60000	**ML-6696*** Water Cooled
ML-6697*	13.0	205	20	C-T	16000	11	−3200	2.0	120000	35000	**ML-6697*** Forced-Air-Cooled
ML-7120*	7.0	85	4.4	SSB	10000	2.2	—	—	20000	12500	**ML-7120*** Water Cooled
ML-7121*	7.0	85	4.4	SSB	10000	2.2	—	—	20000	10000	**ML-7121*** Forced-Air-Cooled
ML-7124*	8.0	200	4.7	SSB	12500	8.0	—	—	80000	40000	**ML-7124*** Water Cooled
ML-7125*	8.0	200	4.7	SSB	12500	4.5	—	—	55000	20000	**ML-7125*** Forced-Air-Cooled
ML-7479*	8.0	200	20	CT	12500	8	−2000	1.0	90000	50000	**ML-7479*** Vapor Cooled
ML-7482*	16.5	450	55	CT	20000	30	−1500	6.0	600000	200000	**ML-7482*** Vapor Cooled Ceramic
ML-7560*	16.5	450	55	CT	20000	30	−1500	6.0	600000	175000	**ML-7560*** Water Cooled Ceramic

C-T: R-F Power Amplifier and Oscillator, Class C Telegraphy.
SSB: R-F Power Amplifier Class AB Single-Sideband.

UHF Planar Triodes

General Design Criteria



MECHANICAL — ELECTRICAL

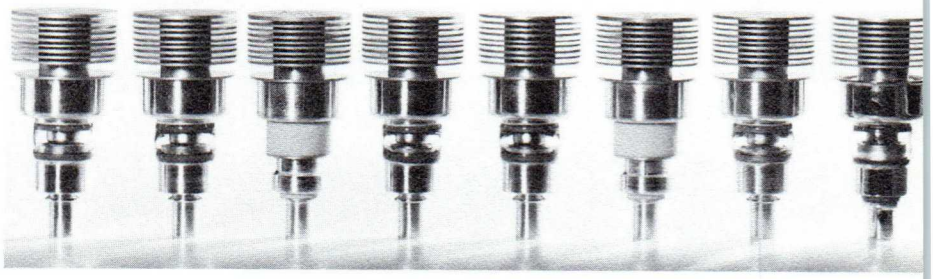
Of necessity, the UHF planar triode is a small tube. Because of this and because of the dependence of UHF circuit characteristics on the tube itself, the planar triode is subject to design demands less acutely felt in large tubes operating at lower frequencies. To reduce tube inductance and capacitance to a degree compatible with frequency requirements, the UHF tube must be small (the higher the operating frequency the lower must be the tube capacitance and inductance). Reduced size introduces problems of high voltage gradients between electrodes and of the dissipation of heat. To reduce the need for heat dissipation, stress is placed on efficiency — which is improved by bringing electrodes closer together and making optimum utilization of the space charge surrounding the cathode. On the other hand, spacing is limited by the increase of the voltage gradient and tube capacitance resulting from the decreased electrode spacing. To minimize capacity, electrode area must be kept small, yet at the same time not so small as to create, for instance, cathode overloading. Grid-cathode spacing, ultimately, becomes a matter of transit time (as reflected by frequency requirements) and of cathode current density. Grid-plate spacing is determined by the limitations of output capacitance and voltage gradient, and by the requirements of mu, and grid-plate transit time.

The UHF planar type triode evolved by Machlett as an answer to these and other conflicting design criteria is particularly distinguished by its sturdiness, stability, tube-to-tube uniformity and long life. Design-production innovations since 1945 have included: Thermally stable, mechanically stable mesh grid (since 1945); High strength "embedded Kovar" seals (since 1945); Test for UHF tuning characteristics (since 1948); Test for gas at full rated voltage and plate dissipation (since 1952); 12,000 hours mean life in microwave relay (1954); High temperature life test; High current life test.

Cathode

A satisfactory cathode must optimize the requirements of low emission density and long life (which require a large cathode area) and low capacitance with high emission density (which point to a small cathode area). The Machlett oxide-coated cathode provides an emission sufficient to maintain space charge limited operation — even when displacement currents total over one ampere (as is often the case).

Exacting controls during cathode processing and manufacture, during tube pumping and aging assure reliable tube performance. Careful control of the cathode emitter surface prevents hot spots and arcing.



Special Cathodes – Fast Warm-up Cathode

The time to reach final cathode temperature depends on the mass to be heated, the rate of heat conduction away from the cathode and the heater power used. (Ideally, the fastest warm-up would be achieved by a cathode of negligible mass, tremendous heater power, and little or no physical connection to the tube itself. Such a cathode would, if nothing else, overheat to the point of destruction on the first power application.) The final cathode design as utilized by the ML-7210, represents a wide departure from standard Machlett heaters. A light weight metal cup is heated by a pancake coiled heater. Baffles below the heater reflect radiant energy back to the cathode proper.

Mesh Grid

Typically the grid of a UHF planar triode is positioned 0.005″ from the cathode, is subject to voltage stresses of 50,000 volts per inch (or greater), and must operate at temperatures over 1000°F. In Machlett tubes a tungsten mesh gold-plated grid, prestressed and ingeniously mounted, maintains its position throughout tube life without bowing or sagging. Because of this thermal-mechanical stability, grid failure (from overheating) during tuning is eliminated; output detuning (from change of grid position) during operation is eliminated.

At higher operating frequencies the mesh grid is electrically better than the parallel wire grid of the same screening fraction. A mesh grid tube will show ten percent to twenty percent higher output with constant driving power at high average grid currents.

Large Area Cathode

A large area cathode is incorporated in the ML-7211. The high current capability of this tube is available to many users without socket change and with but minor circuit modification. The high current cathode of the ML-7211 permits good life together with a high safety factor and power output.

The ML-7211 cathode is of the matrix type, similar to those used in large klystrons. The matrix cathode allows higher internal voltage stresses because of its excellent arc resistance.

Electrode Parallelism

Close parallelism must be retained between electrodes—a one mil tilt of the cathode, at a 5 mil center spacing, can raise cathode current densities to a plus forty percent (on the close side) and lower same to a minus thirty-three percent (on the far side). Current division between plate and grid is also adversely effected by a non-parallel cathode.

In the positive grid voltage region non-parallel electrodes lower efficiency and increase driving requirements.

At Machlett exacting mechanical techniques, electronically monitored, assure the closest electrode parallelism.

UHF Triodes

TUBE TYPE	Design Group	UHF Application	Maximum Frequency of Operation for Full Ratings
ML-2C39A Forced-Air-Cooled	#3	Oscillator, Amplifier, Frequency Multiplier	2500 mc/sec.
ML-2C39WA Forced-Air-Cooled	#2	Oscillator, Amplifier, Frequency Multiplier	2500 mc/sec.
ML-2C41 Forced-Air-Cooled	#3	Plate-pulsed Oscillator, Amplifier	3000 mc/sec.
ML-3CPN10A5* Conduction/Convection Cooled	#1	Plate-pulsed Oscillator, Amplifier	3000 mc/sec.
ML-3CX100A5* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier	2500 mc/sec.
ML-6442* Conduction/Convection Cooled	#1	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier	5000 mc/sec.
ML-6771* Conduction/Convection Cooled	#1	Oscillator, Amplifier, Frequency Multiplier	4000 mc/sec.
ML-7209 Forced-Air-Cooled	#2	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier (High shock ratings)	3000 mc/sec.
ML-7210* Forced-Air-Cooled	#2	Plate-pulsed Oscillator, Amplifier, Frequency Multiplier Oscillator, Amplifier, Frequency Multiplier (12 second warm-up cathode)	3000 mc/sec. 2500 mc/sec.
ML-7211* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier (High cathode current capability)	2500 mc/sec.
ML-7289* Forced-Air-Cooled	#1	Oscillator, Amplifier, Frequency Multiplier	2500 mc/sec.
ML-7698* Conduction/Convection Cooled	#1	Plate- or Grid-pulsed Oscillator, Amplifier, Frequency Multiplier (High cathode current capability)	3000 mc/sec.
ML-7815* Conduction/Convection Cooled	#1	Plate- or Grid-pulsed Oscillator, Amplifier, Frequency Multiplier	3000 mc/sec.

***New Equipment design interest.**

Design Group **#1** Ceramic envelope; coaxial terminals; ruggedized planar electrodes; tightly held concentricity tolerances; exacting production specifications. Low interelectrode capacitance; low lead inductance; close production and testing control of cathode activity.

Design Group **#2** Similar to Group #1 except for use of glass envelope.

Design Group **#3** Glass envelope; coaxial terminals; planar electrodes. Low interelectrode capacitance; low lead inductance.

	FILAMENT Voltage Volts	FILAMENT Current Amps.	Mu	Gm	Duty	MAXIMUM RATINGS PLATE Volts	CATHODE Current Amps.	GRID Voltage Volts	GRID Current Amps.	Average Plate Dissipation Watts	TUBE TYPE
ML-2C39A	6.3	1.0	100	24000	CW	1000	0.125	−150	0.050	100	**ML-2C39A** Forced-Air-Cooled
ML-2C39WA	6.0	1.0	100	25000	CW	1000	0.125	−150	0.050	100	**ML-2C39WA** Forced-Air-Cooled
ML-2C41	6.3	1.03	100	25000	0.0025	3500‡	6.5§	−150	2.5§	35	**ML-2C41** Forced-Air-Cooled
ML-3CPN10A5*	6.0	1.0	100	25000	0.0025	3500‡	4.8§	−150	1.8§	10†	**ML-3CPN10A5*** Conduction/Convection Cooled
ML-3CX100A5*	6.0	1.0	100	25000	CW	1000	0.125	−150	0.050	100	**ML-3CX100A5*** Forced-Air-Cooled
ML-6442*	6.3	0.90	50	16500	0.001	3000‡	3.75§	−100	1.25§	8	**ML-6442*** Conduction/Convection Cooled
ML-6771*	6.3	0.57	90	23000	CW	300	0.033	−25	0.008	6.25	**ML-6771*** Conduction/Convection Cooled
ML-7209	6.0	1.0	100	25000	.0033	3500‡	4.5§	−150	1.5§	35	**ML-7209** Forced-Air-Cooled
ML-7210*	6.3	0.85	75	17000	CW 0.0025	1000 3500‡	.095 4.0§	−150 −150	0.030 1.2§	100 25	**ML-7210*** Forced-Air-Cooled
ML-7211*	6.3	1.3	80	30000	CW	1000	0.190	−150	0.045	100	**ML-7211*** Forced-Air-Cooled
ML-7289*	6.0	1.0	100	25000	CW	1000	0.125	−150	0.050	100	**ML-7289*** Forced-Air-Cooled
ML-7698*	6.3	1.3	80	30000	0.0025	3500‡ 2000 (grid pulsed)	7.5§	−150	2.5§	10†	**ML-7698*** Conduction/Convection Cooled
ML-7815*	6.0	1.0	100	25000	0.0025	3500‡ 2000 (grid pulsed)	4.8§	−150	1.8§	10†	**ML-7815*** Conduction/Convection Cooled

†Greater anode dissipation may be achieved with Conduction — and/or Forced-Air-Cooling.
‡Plate pulsed
§Peak

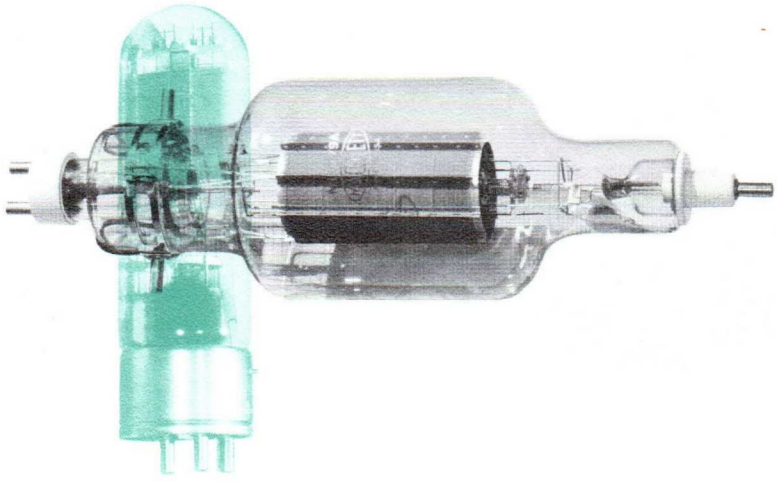
Internal Anode Triodes

TUBE TYPE	Application	Equipment Power Range Class C	Maximum Frequency for Full Power Operation
ML-212E Radiation/ Convection Cooled	Oscillator, Modulator, Amplifier	200- 400 watts	1.5 mc/sec.
ML-241B Radiation/ Convection Cooled	Oscillator, Modulator, Amplifier	200- 400 watts	7.5 mc/sec.
ML-242C Radiation/ Convection Cooled	Oscillator, Modulator, Amplifier		15 mc/sec.
ML-279A Radiation/ Convection Cooled	Oscillator, Modulator, Amplifier	700- 900 watts	20 mc/sec.
ML-357B Radiation/ Convection Cooled	Oscillator, Modulator, Amplifier	550-1200 watts	100 mc/sec.
ML-833A Forced-Air-Cooled	Oscillator, Modulator, Amplifier	300-1600 watts	20 mc/sec.

Tetrode

TUBE TYPE	Application	Power Range Class C	Maximum Frequency for Full Power Operation
ML-7007* Forced-Air-Cooled	VHF Television Service	6- 10 kW	220 mc/sec.

***New Equipment design interest.**



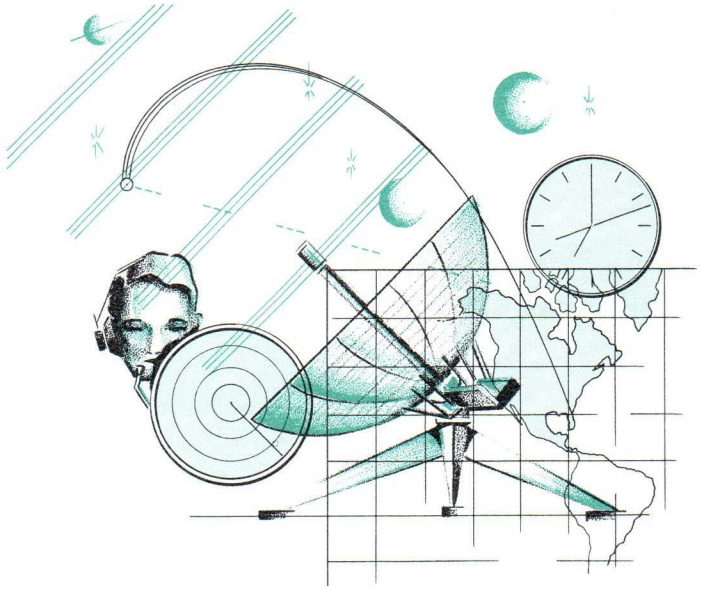
	FILAMENT Voltage Volts	FILAMENT Current Amps	Mu	Class of Service	MAXIMUM RATINGS PLATE Voltage Vdc	PLATE Current Adc	GRID Voltage Vdc	GRID Current Adc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-212E	14.0	6.0	16	C-T	3000	0.35	—	0.075	—	275	**ML-212E** Radiation/ Convection Cooled
ML-241B	14.0	6.0	16	C-T	3000	0.35	—	0.075	—	275	**ML-241B** Radiation/ Convection Cooled
ML-242C	10.0	3.25	12.5	C-T	1250	0.15	−400	0.050	188	100	**ML-242C** Radiation/ Convection Cooled
ML-279A	10.0	21.0	10	C-T	3000	0.80	—	0.10	—	1200	**ML-279A** Radiation/ Convection Cooled
ML-357B	10.0	10	30	C-T	4000	0.50	−500	0.10	1800	400	**ML-357B** Radiation/ Convection Cooled
ML-833A	10.0	10.0	35	C-T	4000	0.50	−500	0.10	1800	400	**ML-833A** Forced-Air-Cooled

	FILAMENT Voltage Volts	FILAMENT Current Amps	Mu	Class of Service	MAXIMUM RATINGS PLATE Voltage Vdc	PLATE Current Adc	SCREEN GRID Voltage Vdc	CONTROL GRID Voltage Vdc	PLATE Input Watts	PLATE Dissip. Watts	TUBE TYPE
ML-7007*	5.0	180	10	B	7500	4.0	2000	−155	24000	12000	**ML-7007*** Forced-Air-Cooled

B: R-F Power Amplifier, Class B Television Service

Hard Pulse-Modulator Tubes

General Design Criteria



SHIELDED-GRID TRIODES

Designed to provide accurate pulse modulation for r-f generators in radar service, a broad line of pulse-modulator tubes is now available from The Machlett Laboratories. Where radar performance requires multiple pulse codes, precisely timed output pulses or high pulse recurrence rates, use of the oxide-cathode, shielded-grid triodes described in this section is particularly recommended.

Basic to this new tube family is a general design which incorporates a beamed, unipotential, oxide cathode, a strong cage control grid and a similar shield grid, internally connected to the cathode. Tubes are available with liquid, forced-air, or radiation cooling.

Oxide Cathode

By designing an oxide cathode whose emission is produced only where needed and whose design is unusually sturdy, an extremely compact and rugged tube structure has been achieved. The cathode is made from a nickel cylinder on whose surface parallel grooves have been machined; an oxide emitter coats the inner surface of the grooves.

Because it is simple in structure and protected by a shield grid, the cathode gives long, stable operation at high voltage. Typical field life of the ML-6544, used in the NIKE system for several years, averages several thousand filament hours.

Shielded Grid Geometry

The beamed electrode geometry obviates the need for fine wire grids as used in conventional triodes and tetrodes. Shielded grid design provides strong electrode assemblies capable of being precisely positioned. As used in the Machlett pulse tubes, each grid is a cage consisting of vertical molybdenum strips positioned by a small ring at one end and attached to a heavy mounting flange at the other.

Since the shield grid is connected internally to the cathode, it requires no voltage supply and, of course, draws no current. Occasional internal arcing is between anode and shield only, thereby protecting the cathode from damaging bombardment.

In operation the shielded-grid tubes require only a small cut-off bias because of the high amplification factor. The beamed electrode geometry also results in low control grid current.

INTERNAL ANODE TETRODES

The tetrodes offered for pulsed service provide a high amplification factor and require low grid driving power. These are sturdy internal anode tubes and employ a four-pin base. Also mounted on the base is a cooling inlet for ducting forced air or oil to the cathode region.

COAXIAL TERMINAL TRIODES

For those pulse applications where high average power is required, the Machlett coaxial terminal triode is particularly useful. From the standard line of thoriated-tungsten filament triodes certain types have been rated for pulsed service. Long pulse durations — in general, up to several milliseconds — are practical with these tubes. Certain types may deliver pulsed power through periods of ten milliseconds or longer.

Although mention is made in this booklet only of the ML-7560, the following other tubes, listed in descending order of power, have pulsed ratings: ML-5682, ML-6696, ML-6697, ML-6426, ML-6427, ML-6424, ML-6425, ML-6422, ML-7007. For further data on pulsed ratings for Machlett tubes, or on the Developmental Tubes mentioned below, please consult the Engineering Department of The Machlett Laboratories.

TUBES IN DEVELOPMENT

Oxide and thoriated-tungsten cathode types are currently being developed for higher pulsed powers and for higher voltage operation. Expected ranges of these tubes will be to 150kV, 500 amperes, cathode current and 16 Mw switching power.

Hard Pulse-Modulator Tubes

TUBE TYPE	Design Group	Application	Typical Pulse Power	
ML-6544* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output	1 Mw
ML-7002* Liquid Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output	3.5 Mw
ML-7003* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output	2.5 Mw
ML-7248* Radiation Cooled	#2	Tetrode for Pulse Generation (Oil insulated)	Typical Pulse Output	0.15 Mw
ML-7249* Radiation and Forced-Air-Cooled	#2	Tetrode for Pulse Generation	Typical Pulse Output	0.15 Mw
ML-7333* Radiation Cooled	#1B	Shielded Grid Triode for Pulse Generation	Typical Pulse Output	0.30 Mw
ML-7335* Forced-Air-Cooled	#1C	Shielded Grid Triode for Pulse Generation (High average current, high duty factor, or high peak current, low duty factor; airborne application).	Typical Pulse Output	0.75 Mw
ML-7560* Water Cooled	#1D	Triode for Pulse Generation (Very high peak current, very high average power).	Typical Pulse Output	20 Mw
ML-7668* Radiation Cooled	#1E	Triode for Pulse Generation (Oil insulated)	Typical Pulse Output	0.60 Mw
ML-7715* Forced-Air-Cooled	#1A	Shielded Grid Triode for Pulse Generation	Typical Pulse Output	3.5 Mw

***New Equipment design interest.**

Design Group **#1A*** Shielded Grid Triode. Unipotential oxide cathode; external anode. Beamed electrode design; shield grid protects cathode from arcs; stable operation at high voltage. High mu and low grid current provide low drive.

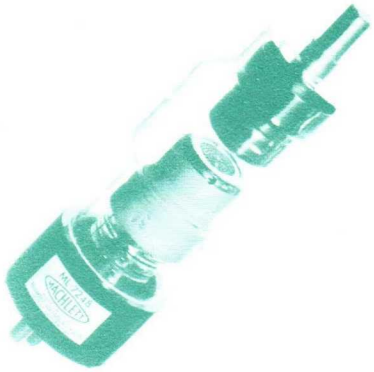
Design Group **#1B*** Similar to 1A; employs internal anode.

Design Group **#1C*** Similar to 1A; ceramic envelope; has integral anode liquid cooler.

Design Group **#1D*** Coaxial terminal triode; ceramic envelope.

Design Group **#1E** Internal anode triode; thoriated-tungsten filament.

Design Group **#2** Internal anode tetrode.



	MAXIMUM RATINGS											
	FILAMENT		PLATE				GRID					
	Voltage Volts	Current Amps.	Voltage Vdc	Voltage Peak - kv	Current mAdc	Current Peak† Amps.	Voltage Volts	Voltage Peak positive Volts	Pulse Duration	Duty Factor	Plate Dissi-pation	TUBE TYPE
ML-6544*	6.0	60	20000	25	250	75	−600	1500	6 μsec.	0.03	1 kW	**ML-6544*** Forced-Air-Cooled
ML-7002*	6.0	60	65000	70	250	90	−600	1500	25 μsec.	0.03	3 kW	**ML-7002*** Liquid Cooled
ML-7003*	6.0	60	45000	50	250	90	−600	1500	25 μsec.	0.03	3 kW	**ML-7003*** Forced-Air-Cooled
ML-7248*	6.3	11.7	—	125	—	2.0	−420	350 (1000‡)	Millisecond Range	—§	0.2 kW	**ML-7248*** Radiation Cooled
ML-7249*	6.3	11.7	— —	125 (oil ins.) 65 (air ins.)	— —	2.0	−420	350 (1000‡)	Millisecond Range	—§	0.5 kW (oil) 0.3 kW (air)	**ML-7249*** Radiation and Forced-Air-Cooled
ML-7333*	6.0	16	20000	25	20	18	−200	1500	25 μsec.	0.001	60 watts	**ML-7333*** Radiation Cooled
ML-7335*	6.0	70	16000	20	200	75	−300	1000	10 μsec.	0.03	5 kW	**ML-7335*** Forced-Air-Cooled
ML-7560*	16.5	450	50000	55	—	550	−3000	—	1 Millisecond	—	175 kW	**ML-7560*** Water Cooled
ML-7668*	12.6	29	—	150	—	15	−1000	500	Millisecond Range	—§	0.75 kW	**ML-7668*** Radiation Cooled
ML-7715*	6.0	60	65000	70	250	90	−600	1500	25 μsec.	0.03	3 kW	**ML-7715*** Forced-Air-Cooled

†Pulse cathode current
‡Maximum screen voltage
§Depends on mode of operation

High Vacuum Diodes

General

Design

Criteria

TUBE TYPE	Design Group	Application
ML-102A* Radiation/ Convection Cooled	#1A	Electrostatic Particle Precipitation Service
ML-141* Radiation/ Convection Cooled	#1A	Electrostatic Particle Precipitation Service
ML-142* Radiation/ Convection Cooled	#1A	Compact High Voltage Applications
ML-148* Radiation/ Convection Cooled	#1A	Voltage Multiplier & Energy Storage Circuits Requiring High Peak Power
ML-199* Radiation/ Convection Cooled	#1A	Electrostatic Particle Precipitation Service Hold-off Diode Service in Radar Application
ML-5575/100* Radiation/ Convection Cooled	#1A	Electrostatic Particle Precipitation Service
ML-5576/200* Radiation/ Convection Cooled	#1A	Electrostatic Particle Precipitation Service
ML-6908* External Anode/ Oil Cooled	#1B	High Power High Voltage Supplies Hold-off Diode Service in Radar Application
UHF PLANAR DIODE		
ML-322* Forced-Air-Cooled	#2	Modulation Clipper (See UHF Design Group)

***New Equipment design interest.**

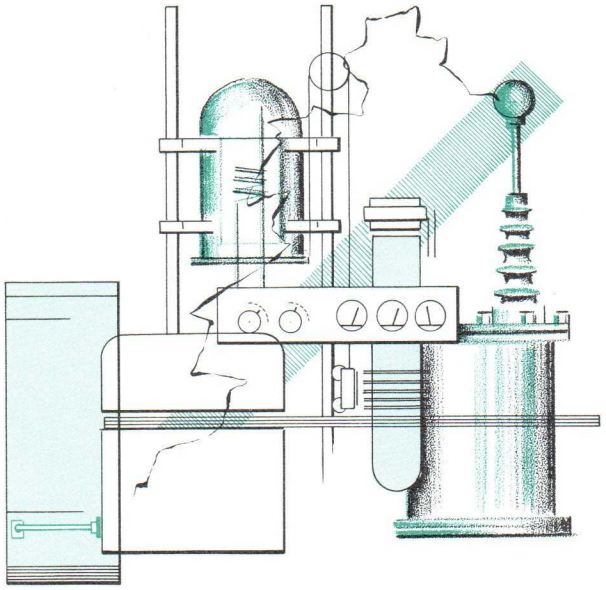
Design Group **#1A*** Glass envelope; internal anode. Self-shielding catenary type filament.
#1B* Glass envelope; external anode. Self-shielding catenary type filament.

Electron tubes designed for use in particle precipitation, cable testing and similar applications must be capable of withstanding peak inverse voltages of 125 to 200 kilovolts and delivering 100 to 2500 milliamperes or more of peak anode current, depending upon the tube type. For such high inverse voltage ratings, tubes must be of high-vacuum type, which can be made to insulate about ten times the maximum operating voltage of vapor-filled types of similar sizes.

Maximum rectification efficiency in Machlett high vacuum diodes is achieved through use of a catenary type filament which permits optimum spacing between cathode and anode and eliminates the need for an auxiliary electrostatic shield. Because the cathode itself is self-shielding and can be located close to the anode the forward voltage or voltage drop within the tube is greatly reduced compared to conventionally designed tubes. For example, while operating at full rated current, the ML-5575/100 requires only one-third of its potential anode dissipation. Competitive types operating at 65% of rated current utilize the entire anode dissipation capability.

	GENERAL CHARACTERISTICS					MAXIMUM RATINGS			
		FILAMENT		ANODE			Load Current Rating		
	Insulating Medium	Voltage Volts	Approx. Current Amps.	Peak Inverse Anode Voltage PKV	Peak Anode Current Amps.	Circuit	Unfiltered† Amps.	Filtered‡ Amps.	TUBE TYPE
ML-102A*	Air	20	19	75	0.75	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.48 0.72	0.75 0.75	**ML-102A*** Radiation/ Convection Cooled
ML-141*	Air	5.5	6.5	80 (Air Insulation) 125 (Oil Insulation)	0.75	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.40 0.60	0.47 0.60	**ML-141*** Radiation/ Convection Cooled
ML-142*	Air or Oil	3.8	6.6	50 (Air Insulation) 100 (Oil Insulation)	0.30	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.15 0.225	0.20 0.225	**ML-142*** Radiation/ Convection Cooled
ML-148*	Air or Oil	5.7	6.6	80 (Air Insulation) 150 (Oil Insulation)	1.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.30 0.45	0.32 0.45	**ML-148*** Radiation/ Convection Cooled
ML-199*	Air	12	23	110	10.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	2.60 3.50	2.90 3.60	**ML-199*** Radiation/ Convection Cooled
ML-5575/100*	Air	20	24	150	1.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	0.64 0.96	1.0 1.0	**ML-5575/100*** Radiation/ Convection Cooled
ML-5576/200*	Air	20	32	150	2.5	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	1.59 2.40	2.50 2.50	**ML-5576/200*** Radiation/ Convection Cooled
ML-6908*	Oil	12	23	150	10.0	Single-phase, Four-Tube, Full Wave Three-phase, Full-Wave	3.20 4.40	3.50 4.50	**ML-6908*** External Anode/ Oil Cooled
UHF PLANAR DIODE									**UHF PLANAR DIODE**
ML-322*	Air	6.3	0.95	0.8	0.60	Clipper Diode Operation to 1500 mc/sec.			**ML-322*** Forced-Air-Cooled

Mercury-Vapor Half-Wave Rectifier Tubes



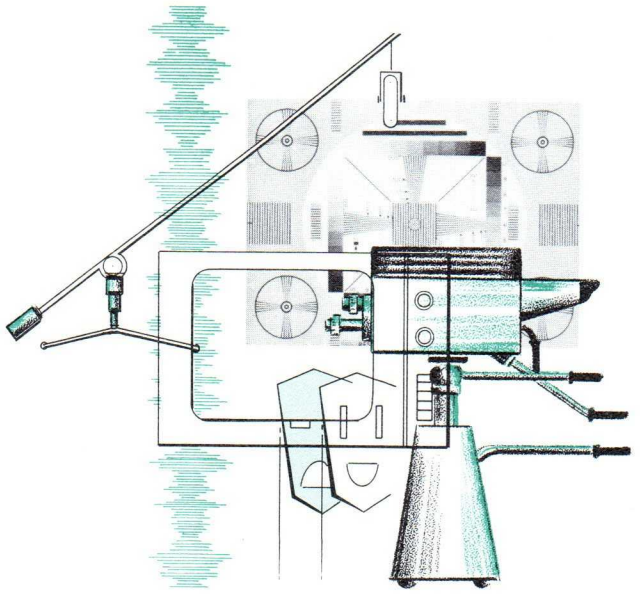
General Design Criteria

Mercury vapor type rectifier tubes for direct current power supplies give especially reliable and efficient performance. They are capable of withstanding peak inverse voltages of five to twenty-five kilovolts and delivering average currents per tube of one to ten or more amperes, depending upon the tube type. A mercury vapor filled diode can provide appreciably higher plate current than a high vacuum diode of the same dimensions. This is due to the fact that the very low voltage drop inherent in tubes of the former type, as a result of partial neutralization of the electron space charge in the vicinity of the cathode, permits the use of a large oxide-coated filament. This type of cathode is very efficient with respect to milliamperes emission per watt of filament power and can therefore be made with a comparatively large surface area for the greater emission of electrons. Although mercury vapor tubes conduct current with inappreciable tube voltage drop, vapor pressures in these tubes are sufficiently low to insure tube stability during operation at the inverse voltages for which they are designed.

TUBE TYPE	FILAMENT Voltage Volts	FILAMENT Current Amps.	MAXIMUM RATINGS (for Filament Excitation Listed) Filament Excitation	Condensed Mercury Temp. Range	Peak Inverse Voltage Volts	Peak Anode Current Amps.	Average Anode Current Amps.	Surge Current Amps.	TUBE TYPE
ML-575A	5.0	10	Quadrature	20°-50°C	15000	10	2.5	100	**ML-575A** Convection Cooled
ML-673	5.0	10	Quadrature	20°-50°C	15000	10	2.5	100	**ML-673** Convection Cooled
ML-857B	5.0	30	Quadrature	30°-40°C	22000	40	10	400	**ML-857B** Forced-Air-Cooled
ML-869B	5.0	19	Quadrature	30°-40°C	22000	10	2.5	100	**ML-869B** Forced-Air-Cooled
ML-872A	5.0	7.5	In-phase	20°-60°C	10000	5	1.25	50	**ML-872A** Convection Cooled
ML-8008	5.0	7.5	In-phase	20°-60°C	10000	5	1.25	50	**ML-8008** Convection Cooled

Photosensitive Television Camera Tubes

Vidicon Design Criteria



The Machlett Vidicon, a precise electronic device, is rugged and capable of producing excellent pictures. As described below the typical Machlett Vidicon exhibits good resolution over a broad dynamic range, full field focus and low lag. Typically, also, the tube operates in any position and provides a self-aligning gun.

The following criteria are of considerable importance in judging and selecting a vidicon tube.

Good Resolution with Broad Dynamic Range. Good resolution should be maintained without overbeaming. For a given scene the tube should provide optimum resolution over a wide range of light levels with controls set to discharge the highest light level. (And with no further adjustment necessary should light levels drop.) Tube should show no twist or distortion up to high (.4μa) Signal Current.

Full Field Focus. There should be uniform focus across the full field of view and with no loss of resolution in the corners. The tube should not have to be adjusted for a compromise focus (electrical) between center and corners.

Low Lag or Image Retention. Visualization of fast moving scenes without blurring should be easily attainable.

Operation in Any Position. The light sensitive surface should be protected against damage by particles. Particle shields should be an integral part of the envelope for greater ruggedness. Only the Machlett ML-7038A* and ML-7291A* Vidicons offer unique 100% protection against particle damage of the photoconductive surface.

Self-aligned gun.** The use of permanent magnets or coils for proper gun alignment correction is eliminated: the gun structure is pre-aligned with respect to the precision glass envelope and a shield maintains accurate alignment, even when stray magnetic fields are present. Only Machlett Vidicons ML-7038A and ML-7291A have this unique advantage.

Rugged, Simplified Assembly.** Aluminized G-3 structure of Machlett Vidicons eliminates metal cylinder and its supports which often introduce vibration. Only Machlett Vidicons ML-7038A and ML-7291A offer this feature.

Low Microphonics. A good tube will not provide a spurious "microphonic" response (a bar pattern on the monitor). Sturdily-built Machlett tubes are outstanding for low microphonic response.

High Effective Sensitivity. An extremely uniform photoconductive surface (of Machlett Vidicons) permits satisfactory operation at higher values of dark currents to provide high effective sensitivity. This is done within normal ranges of target voltage.

*ML-7038A general purpose vidicon; ML-7291A broadcast type.

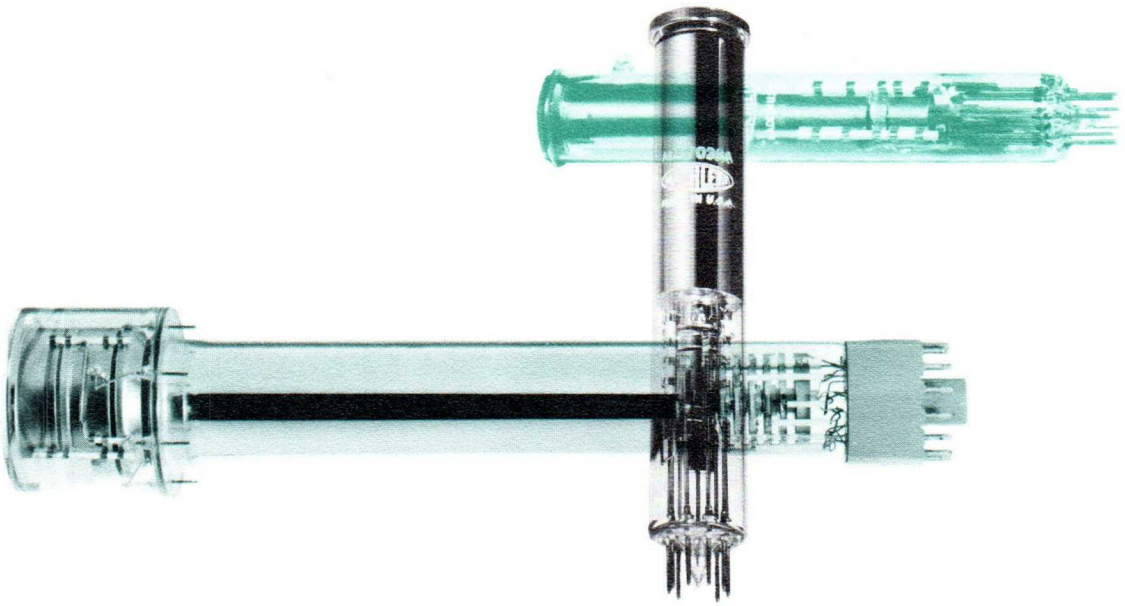
**Patent Pending

Vidicon

TUBE TYPE	Design Group	Application	Deflection Method
ML-S-522B*	#2	For special application. Spectral response in the near ultra-violet region.	Magnetic
ML-558	#3	Low cost vidicon for general application.	Magnetic
ML-6198	#3	For general closed-circuit TV application.	Magnetic
ML-7038A*†	#1	Modern design tube for general closed-circuit TV application.	Magnetic
ML-7291A*	#1	Modern design tube for Broadcast Television.	Magnetic
ML-7351*†	#3	For special application. High sensitivity response, ten times or more that of the 6198.	Magnetic
IMAGE ORTHICON			
ML-5820		For Broadcast Television.	Magnetic

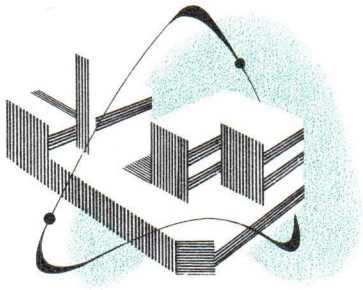
***New Equipment design interest.**

Design Group #1* Tipless tube; "cold seal" faceplate. Self-aligning gun; metalized G-3.
Design Group #2 Tipless tube; "cold seal" faceplate. Conventional G-3 and gun.
Design Group #3 Tipped tube. Conventional G-3 and gun.



	FILAMENT Volts	FILAMENT Amps.	Photocathode size diagonal	Spectral Response	Operating Signal Output	Target Voltage Volts	Maximum Grid Volts G_1	G_2	G_3	G_4	G_5	TUBE TYPE
ML-S-522B*	6.3	0.6	.63″	U-V	.1 — .3ua (.4ua/uw peak sens)	10- 50	—125	350	350	350	—	**ML-S-522B***
ML-558	6.3	0.6	.63″	S-18	.1 — .2ua (3 to 10ftc)	20- 70	—125	350	350	350	—	**ML-558**
ML-6198	6.3	0.6	.63″	S-18	.1 — .2ua (3 to 10ftc)	20- 70	—125	350	350	350	—	**ML-6198**
ML-7038A*†	6.3	0.6	.63″	S-18	.1 — .3ua (2 — 14ftc)	15-100	—125	350	350	350	—	**ML-7038A*†**
ML-7291A*	6.3	0.6	.63″	S-18	.1 — .3ua (2 — 14ftc)	15-50	—125	350	350	350	—	**ML-7291A***
ML-7351*†	6.3	0.6	.63″	Peak at 6000A°	.1 — .32ua (.1 — 1.0ftc)	15-50	—125	350	350	350	—	**ML-7351*†**
ML-5820	6.3	0.6	1.8″	S-10	3 — 24ua	—	—24 to —110	300	250 to 330	140 to 180	0 to 125	**ML-5820**

†Also available with 6.3v 0.15a heater.



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