JOINT ELECTRON DEVICE ENGINEERING COUNCIL

2260 Salmon Tower
11 West Forty-Second Street
New York 36, N. Y.
Telephone: LOngacre 5-0717

Announcement

of

Electron Device Type Registration

Release No. 2916

August 1, 1960

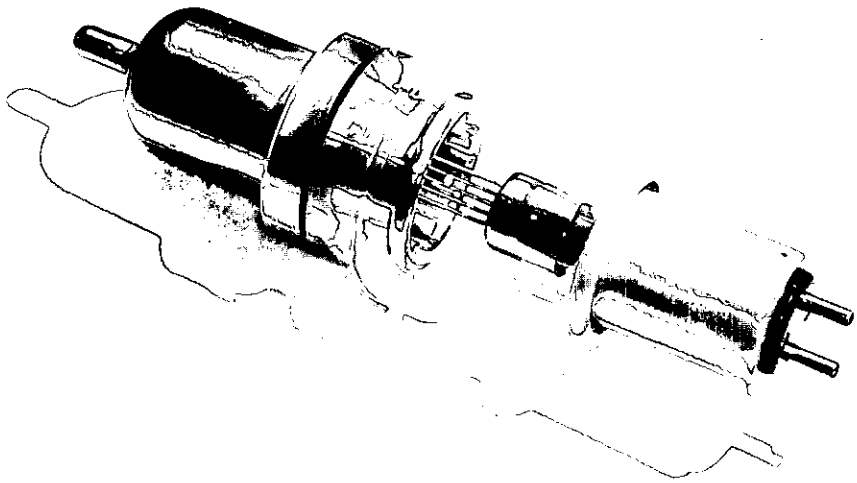
The Joint Electron Device Engineering Council announces the registration of the following electron device designations

6908
7003
7120
7121
7209
7210
7211
7248
7249
7351

according to the ratings and characteristics found on the attached data sheets on the application of

Machlett Laboratories, Inc.
Springdale, Connecticut

NOTE: Please note that prefix letters "ML" on the attached data sheets are not part of the JEDEC designation.



MACHLETT

ML-6908

DESCRIPTION AND RATINGS

DESCRIPTION

The ML-6908 is an oil-immersed, high-vacuum rectifier tube having maximum ratings of 150 PKV inverse voltage and 10 amperes peak anode current. It is especially adaptable to certain pulsing circuits as a hold-off diode and to power supplies in high-power radar units, where insensitivity to low ambient temperatures and high current capacity at high voltages are essential.

This tube incorporates those special features of construction which characterize Machlett high-vacuum rectifiers for high power-level applications. These features insure ruggedness, long life, low internal voltage drop and high average load current capacity. The cathode is a thoriated-tungsten filament of the catenary type, allowing close anode-to-cathode spacing without distortion of the filament by electrostatic forces. The heavy-wall copper anode provides a high safety factor against accidental overload.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament Voltage	12 Volts
Filament Current, approximate	23 Amps
Filament Heating Time, minimum (Before applying Plate Voltage)	30 Secs
Tube Voltage Drop, maximum (I_b—10.0 amperes)	2400 Volts

MECHANICAL

Mounting Position	Optional
Type of Cooling	Convection†
Maximum oil temperature for maximum dissipation	75 °C
Insulating Medium	Oil††
Net Weight, approximate	6¾ lbs

† When the ML-6908 is operated anode up, forced-oil cooling of the glass within the cathode base is required. An oil flow of approximately 1 quart per minute, introduced through the cathode base tubulation, is sufficient.

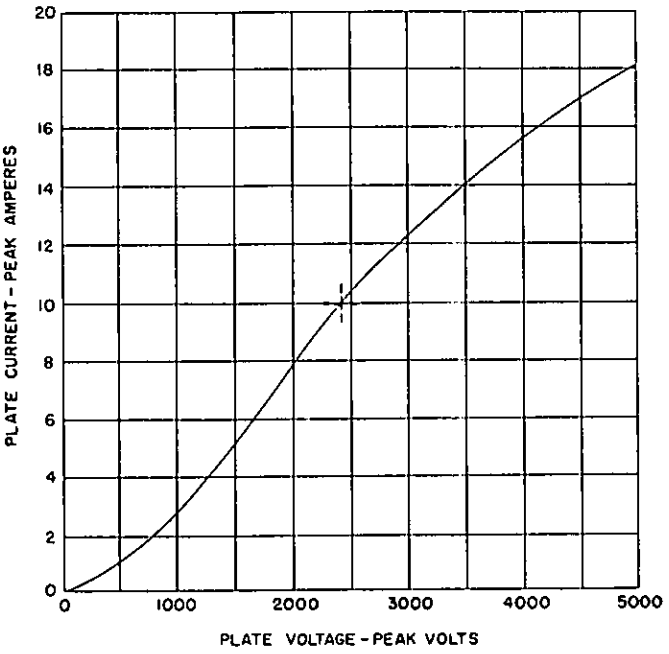
†† The dielectric value of the insulating oil should be no less than 25,000 volts peak per 0.1 inch.

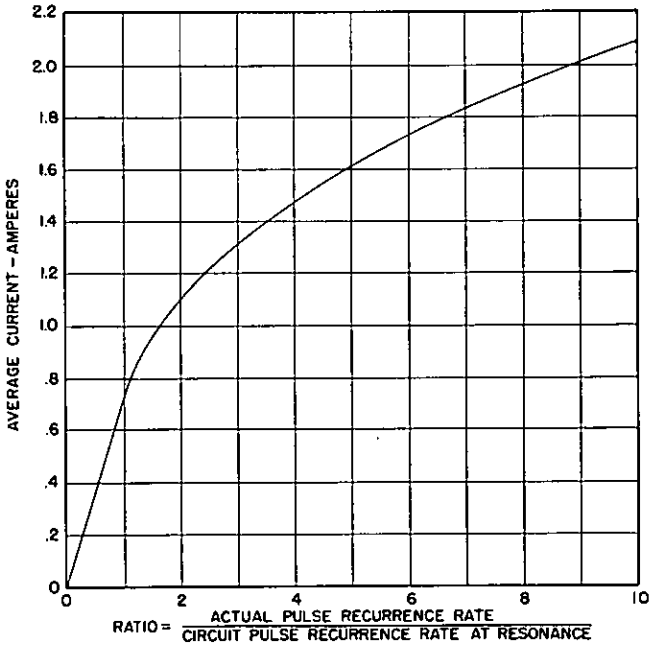
MAXIMUM RATINGS

Peak Inverse Anode Voltage		150,000 Volts
Peak Anode Current		10.0 Amps
Plate Dissipation		2000 Watts
Load Current (Average D-C)		
Circuit Application	Unfiltered*	Filtered**
Single-phase, two-tube, half-wave	1.6	..... Amps
Single-phase, four-tube, full-wave	3.2	3.5 Amps
Three-phase, double-Y parallel	8.8	9.0 Amps
Three-phase, full-wave	4.4	4.5 Amps

* Unfiltered Load Current Ratings are based on sine-wave voltage input and resistance load without inductive or capacitive effects.

** Filtered Load Current Ratings are based on sine-wave input and infinite inductance choke input filter.



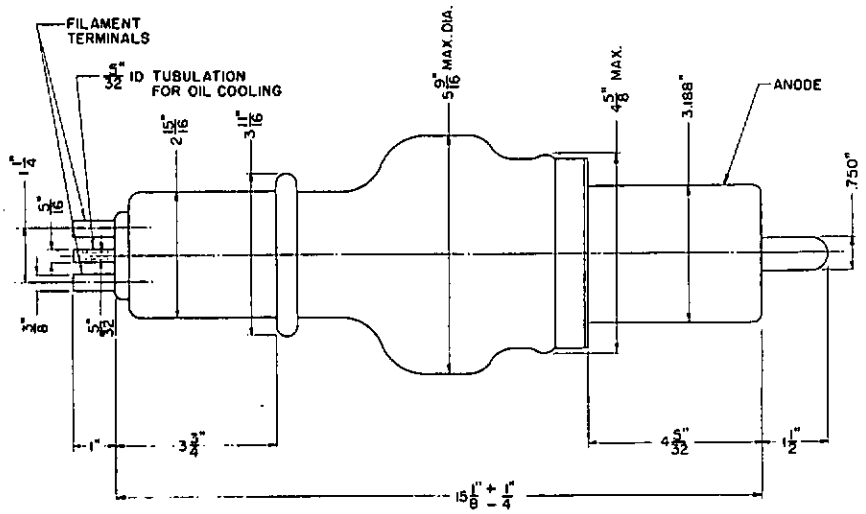


APPLICATION NOTES

When the ML-6908 is employed as a rectifier in conventional power supply circuits, the average dc load currents specified under "Maximum Ratings" apply.

When the ML-6908 is used as a hold-off diode in connection with resonant charging of line-type pulsers, the average charging current permissible depends on the ratio of actual pulse recurrence rate to circuit pulse recurrence rate at resonance. The right-hand curve above indicates maximum permissible average currents at various values of this ratio.

When the tube is initially installed or has been inoperative for an extended period, maximum rated voltage must not be applied instantaneously. The tube should be "warmed-up" by operating at 60% of maximum rated voltage for 5 minutes, gradually increasing the voltage to 80% during the next 15 minutes and finally gradually increasing from 80% to maximum rated voltage in 20 minutes. For operating voltages less than the maximum rated voltage, the applicable part of the above procedure should be used.



DIMENSIONS — ML-6908

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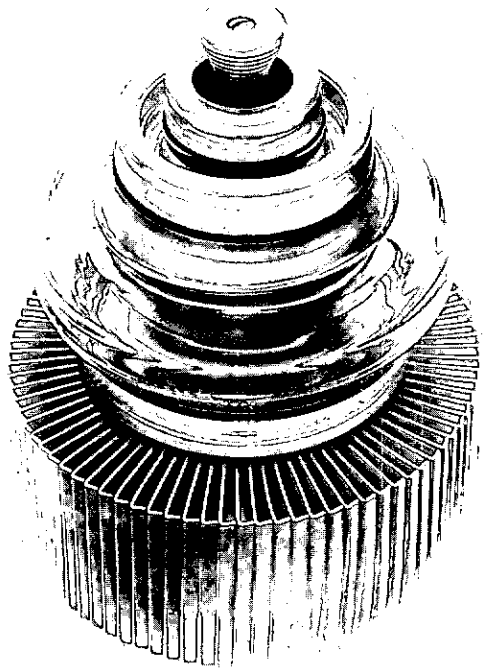


MACHLETT

ML-7003

DESCRIPTION AND RATINGS

DESCRIPTION

The ML-7003 is a shielded-grid triode designed primarily to operate as a switch tube in hard-tube pulse modulators, for radar and similar applications. In this service it can deliver more than two megawatts pulse power output with less than 10 kilowatts driving power. .

The ML-7003 has sturdy electrodes arranged to form a cylindrical array of electron-optical systems, featuring a shield electrode connected internally to the cathode by direct, low-impedance paths. This design permits operation with low grid current, and it results in favorably low grid-plate capacitance. The presence of the ground-potential shield adjacent to the anode, furthermore, protects the cathode and grid from damage by transient arcs.

The cathode is a unipotential, oxide-coated type. The anode is forced-air cooled and is capable of dissipating 3kW with an air flow of 150 cfm.

GENERAL CHARACTERISTICS AND RATINGS

Electrical		
Heater Voltage	6.0±5%	Volts
Heater Current	60	Amps
Heater Starting Current, maximum	300	Amps
Cathode Warm-up Time	10	Minutes*
Amplification Factor	200	
Interelectrode Capacitances:		
Grid-Plate	3.5	$\mu\mu f$
Grid-Cathode	250	$\mu\mu f$
Plate Cathode	40	$\mu\mu f$
Mechanical		
Mounting Position (support tube by anode radiator only)	Any	
Type of Cooling	Forced-air†	
Air flow on anode, minimum for 3kW dissipation	150 cfm at 0.2" water	
Air flow on grid	50	cfm
Maximum incoming air temperature	65	°C
Maximum Glass Temperature	175	°C†
Net Weight, approximate	25	lbs.

*For accelerated cathode warm-up, the filament may be energized at 7.0 volts for 5 minutes and then reduced to 6.0 volts for high-voltage operation. If a filament stand-by voltage of 5.0 volts is used, the minimum cathode warm-up time is 1 minute at 6.0 volts.

†Sufficient air flow must be provided to maintain glass temperatures at less than 175°C under all conditions of operation.

WARNING: Operation of the ML-7003 may produce soft x-rays which constitute a health hazard. Adequate shielding must therefore be provided in the equipment.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

Pulse Modulator or Pulse Amplifier

Maximum Ratings, Absolute Values

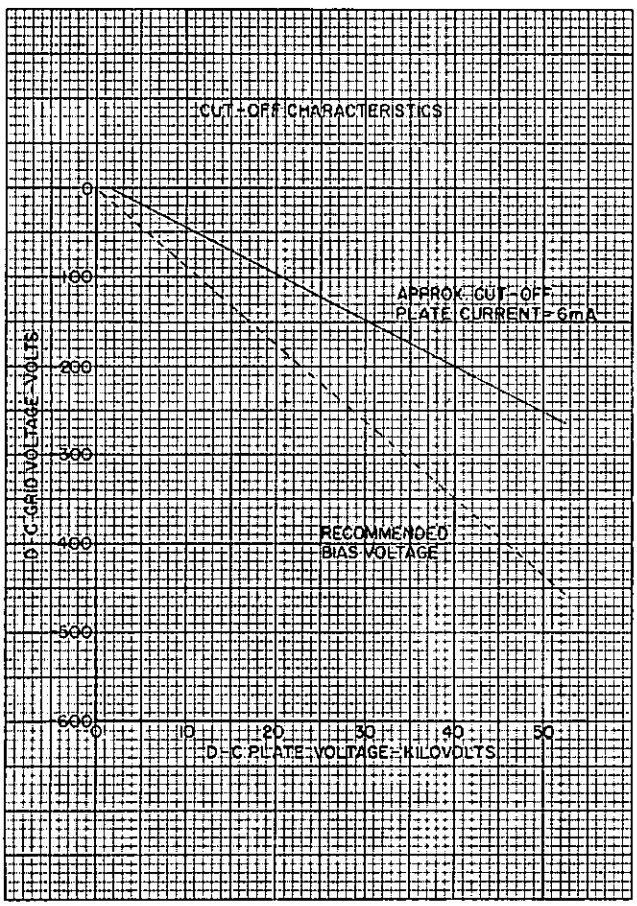
D-C Plate Voltage	45	kV
Peak Plate Voltage	50	kv
D-C Grid Voltage	−600	volts
Peak Positive Grid Voltage	+1.5	kv
Peak Plate Current*	200	amp
Pulse Cathode Current	90	amp
D-C Plate Current	250	mA
Grid Dissipation	75	watts
Plate Dissipation	3.0	kW
Pulse Duration	25	μsec
Duty Factor	0.03	

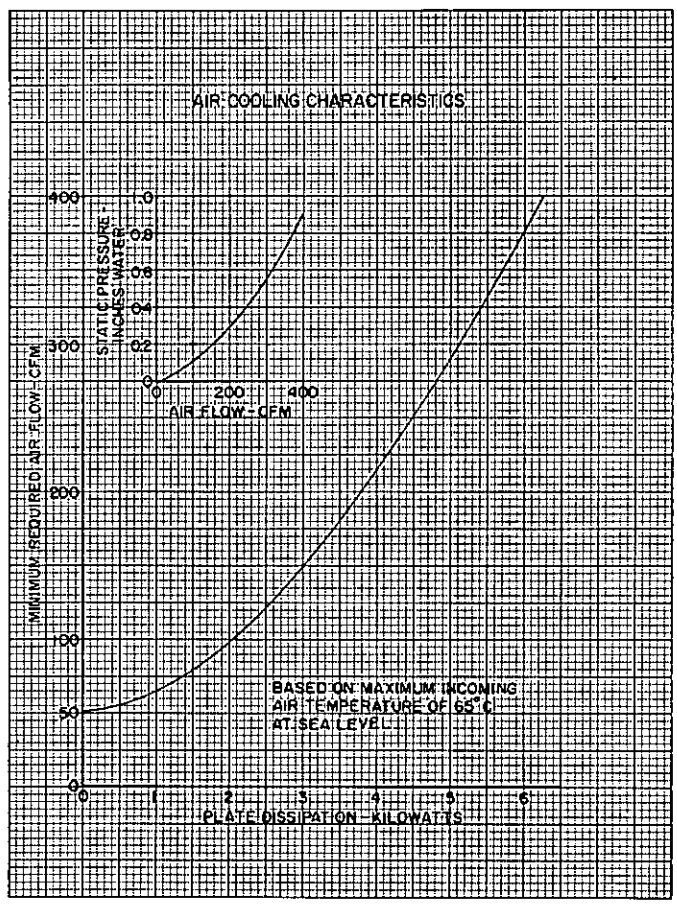
Typical Operation

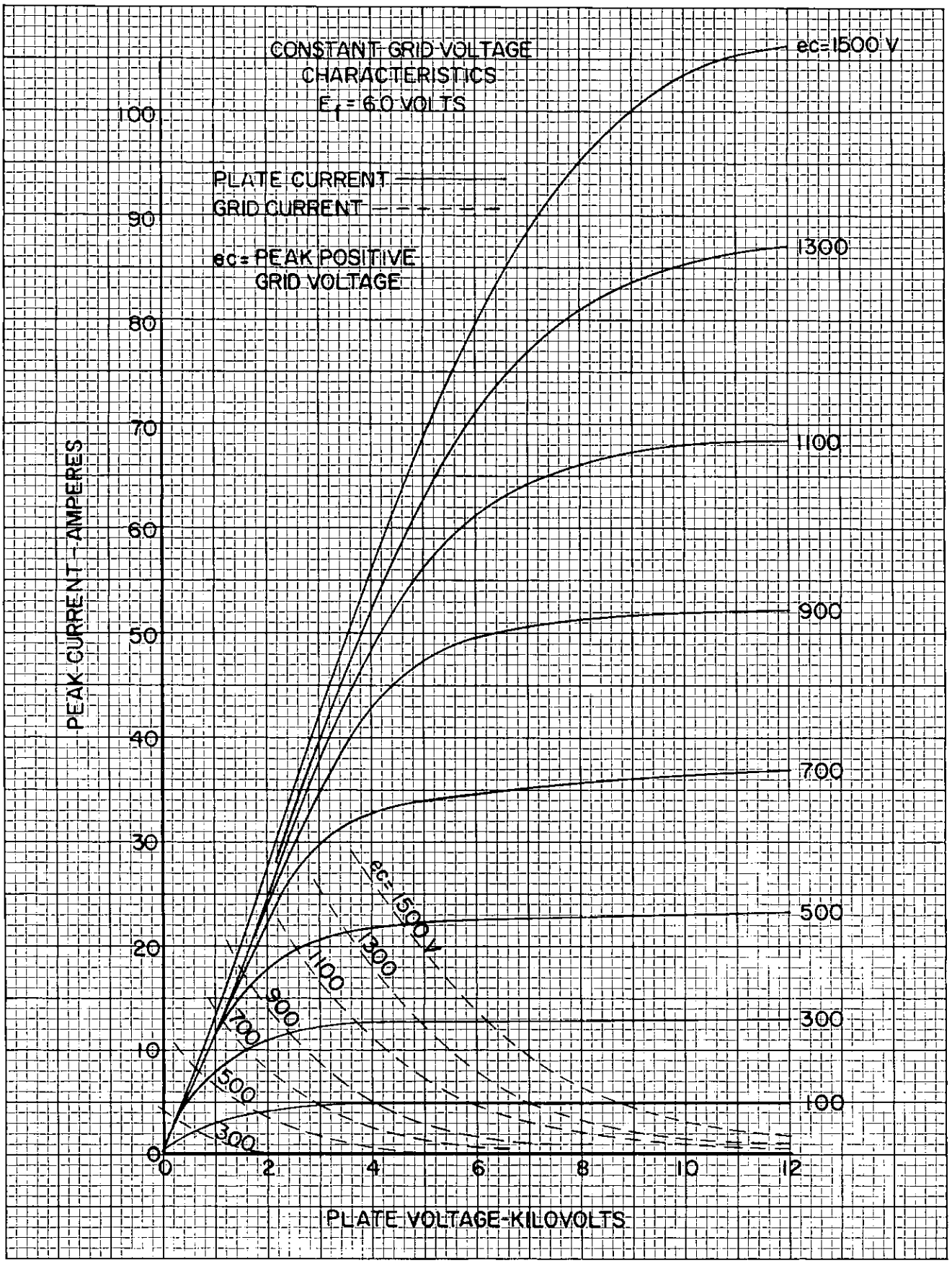
D-C Plate Voltage	35	40	kV
D-C Grid Voltage	−300	−350	volts
Pulse Positive Grid Voltage	+0.8	+1.3	kv
Pulse Plate Current	40	80	amp
Pulse Grid Current	3	4	amp
Pulse Driving Power	3.3	6.6	kw
Pulse Power Output	1.2	2.5	Mw
Plate Output Voltage	30	32	kv

Note: For operation under conditions not covered by the above ratings, consult the Machlett Engineering Department.

*Charging current available during pulse rise time of 0.1 μsec maximum.






CONSTANT GRID VOLTAGE
CHARACTERISTICS
E_f = 6.0 VOLTS
PLATE CURRENT
GRID CURRENT
ec = PEAK POSITIVE
GRID VOLTAGE
ec=1500 V
1300
1100
900
700
500
300
100
PEAK CURRENT-AMPERES
PLATE VOLTAGE-KILOVOLTS
0
2
4
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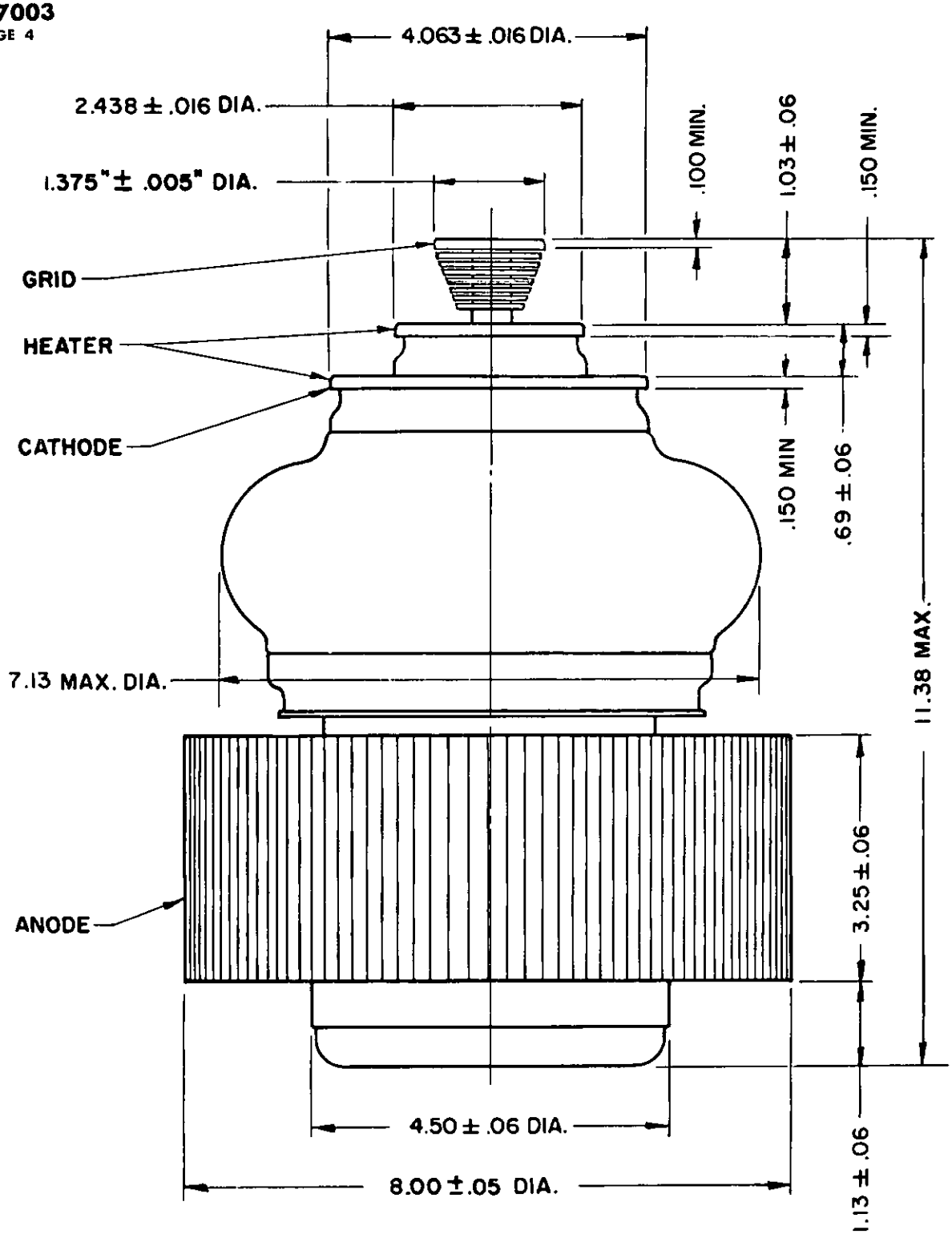
70
80
90
100



ALL DIMENSIONS IN INCHES

DIMENSIONS — ML-7003

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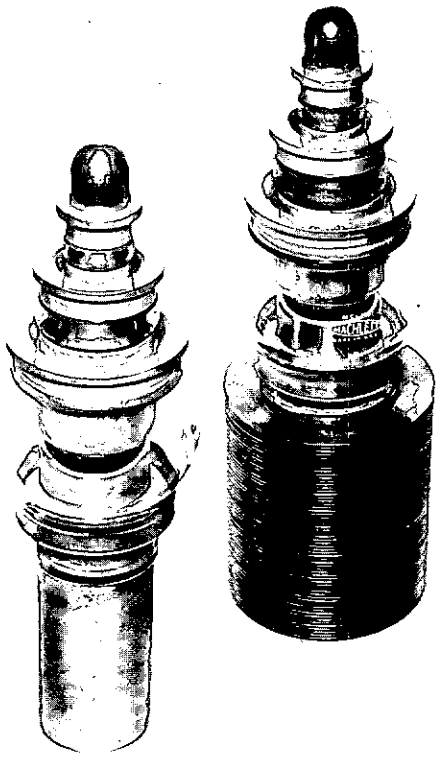


MACHLETT

ML-7120
ML-7121

DESCRIPTION & RATINGS

DESCRIPTION

The **ML-7120** and **ML-7121** are low-mu, three-electrode tubes designed specifically for use as Class AB1 linear amplifiers or modulators. The **ML-7120** and **ML-7121** are mechanically equivalent to the **ML-6420** and **ML-6421**, respectively. The cathode of each type is a sturdy, self-supporting, stress-free, thoriated-tungsten filament. The **ML-7120** has a water-cooled, heavy-wall anode capable of dissipating 12.5 kW with a water flow of approximately 5 gpm. The **ML-7121** has a forced-air-cooled, heavy-wall anode capable of dissipating 10 kW with an air flow of approximately 475 cfm*. Maximum ratings of 10 kVdc plate voltage and 20 kW plate input apply at frequencies up to 30 Mc.

GENERAL CHARACTERISTICS

Electrical

Filament Voltage	7.0	Volts
Filament Current	85	Amps
Filament Starting Current, maximum	400	Amps
Filament Cold Resistance	0.0095	Ohm
Amplification Factor	4.4	
Interelectrode Capacitances:		
Grid-Plate	23	$\mu\mu f$
Grid-Filament	32	$\mu\mu f$
Plate-Filament	1.7	$\mu\mu f$

Mechanical

Mounting Position	Vertical, anode down	
Type of Cooling — ML-7120	Water and Forced air†	
Water flow on anode, minimum for 12.5 kW dissipation	5	gpm
Maximum outgoing water temperature	70	°C
Type of Cooling — ML-7121	Forced-air	
Air flow on anode, minimum for 10 kW dissipation *	Pressure: 475 cfm at 3.3" water Exhaust: 550 cfm at 3.5" water	
Maximum incoming air temperature	50	°C
Maximum Glass Temperature	165	°C†
Net Weight, approximate		
ML-7120	10	lbs.
ML-7121	13.5	lbs.

*When used with Machlett ML-7121 Air Distributor F-17796.

†At frequencies up to 15 Mc, normal cabinet ventilation should be sufficient; at higher frequencies or high ambient temperature, auxiliary air flow of 25-50 cfm may be required and should be distributed to maintain uniform glass temperature, not greater than 165°C, around the circumference of the seals.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

(Continuous Commercial Service)

VALUES APPLY TO BOTH TYPES UNLESS OTHERWISE SPECIFIED

Audio-Frequency Power Amplifier and Modulator Class AB1

Maximum Ratings, Absolute Values				
D-C Plate Voltage			10000	volts
Max.-Signal D-C Plate Current			2.2	amps
Max.-Signal Plate Input			20	kW
Plate Dissipation				
ML-7120			12.5	kW
ML-7121			10	kW
Typical Operation (Values are for two tubes)				
D-C Plate Voltage	6000	8500	10000	volts
D-C Grid Voltage	−1450	−2050	−2350	volts
Peak A-F Grid-to-Grid Voltage	2800	4000	4600	volts
Peak A-F Plate-to-Plate Voltage	8600	13000	12800	volts
Zero-Signal D-C Plate Current	0.2	0.4	0.6	amp
Max.-Signal D-C Plate Current	1.2	1.6	4.2	amps
Effective Load Resistance, Plate-to-Plate	9150	10400	3900	ohms
Max.-Signal Driving Power	0	0	0	watts
Max.-Signal Power Output, approximate	4.0	8.1	21	kW

Typical Operation (Values are for two tubes)			
Random Noise Drive Conditions	ML-7120		
D-C Plate Voltage	10000	10000	volts
D-C Grid Voltage	−2350	−2350	volts
Peak A-F Grid-to-Grid Voltage	4650	4650	volts
Peak A-F Plate-to-Plate Voltage	15200	15800	volts
Zero-Signal D-C Plate Current	0.6	0.6	amp
Max.-Signal D-C Plate Current	2.5	2.0	amps
Effective Load Resistance, Plate-to-Plate	7750	10000	ohms
Max.-Signal Driving Power	0	0	watts
Max.-Signal Power Output at 1.0 Power Factor	15	12.5	kVA
Load Power Factor	0-1.0	0-1.0	

Linear RF Power Amplifier — Class AB

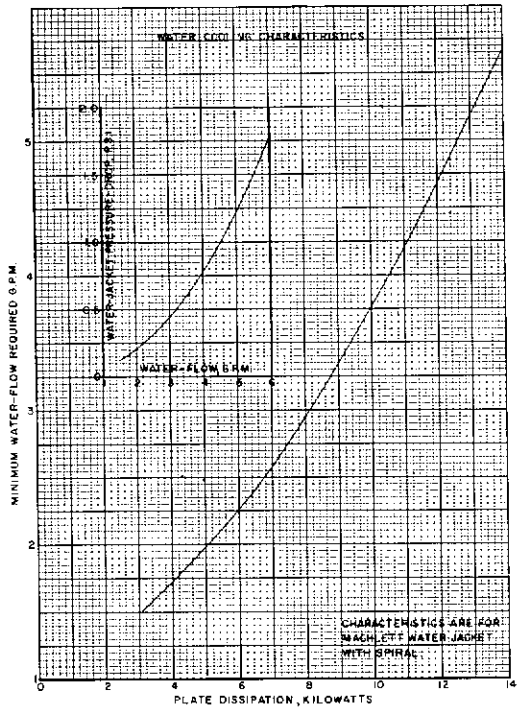
Single-Sideband Suppressed-Carrier Service

Maximum Ratings, Absolute Values		
D-C Plate Voltage	10000	volts
Max.-Signal DC Plate Current	2.2	amps
Max.-Signal Plate Input	20	kW
Max.-Signal DC Grid Current	100	mA
Plate Dissipation		
ML-7120	12.5	kW
ML-7121	10	kW
Typical Operation		
DC Plate Voltage	10000	volts
DC Grid Voltage	−2350	volts
Zero-Signal DC Plate Current	0.3	amp
Effective RF Load Resistance	3050	ohms
Single-Tone Modulation		
Max.-Signal DC Plate Current	1.5	amps
Max.-Signal DC Grid Current	0	mA
Max.-Signal Peak RF Plate Voltage	7200	volts
Max.-Signal Peak RF Grid Voltage	2325	volts
Max.-Signal Driving Power	0	watts
Max.-Signal Plate Power Output	8.5	kW
Two-Tone Modulation		
Average DC Plate Current	0.95	amp
Average DC Grid Current	0	mA
Max.-Resultant Signal Peak RF Grid Voltage	2325	volts
Average Plate Power Output	4.25	kW
Peak Envelope Plate Power Ouput	8.5	kW

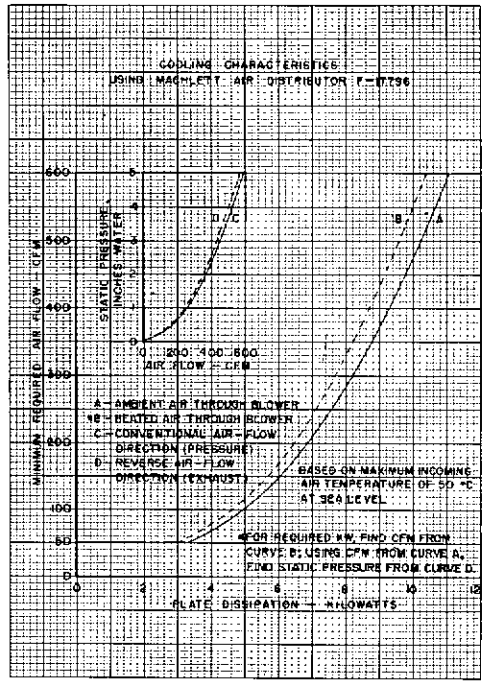
CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

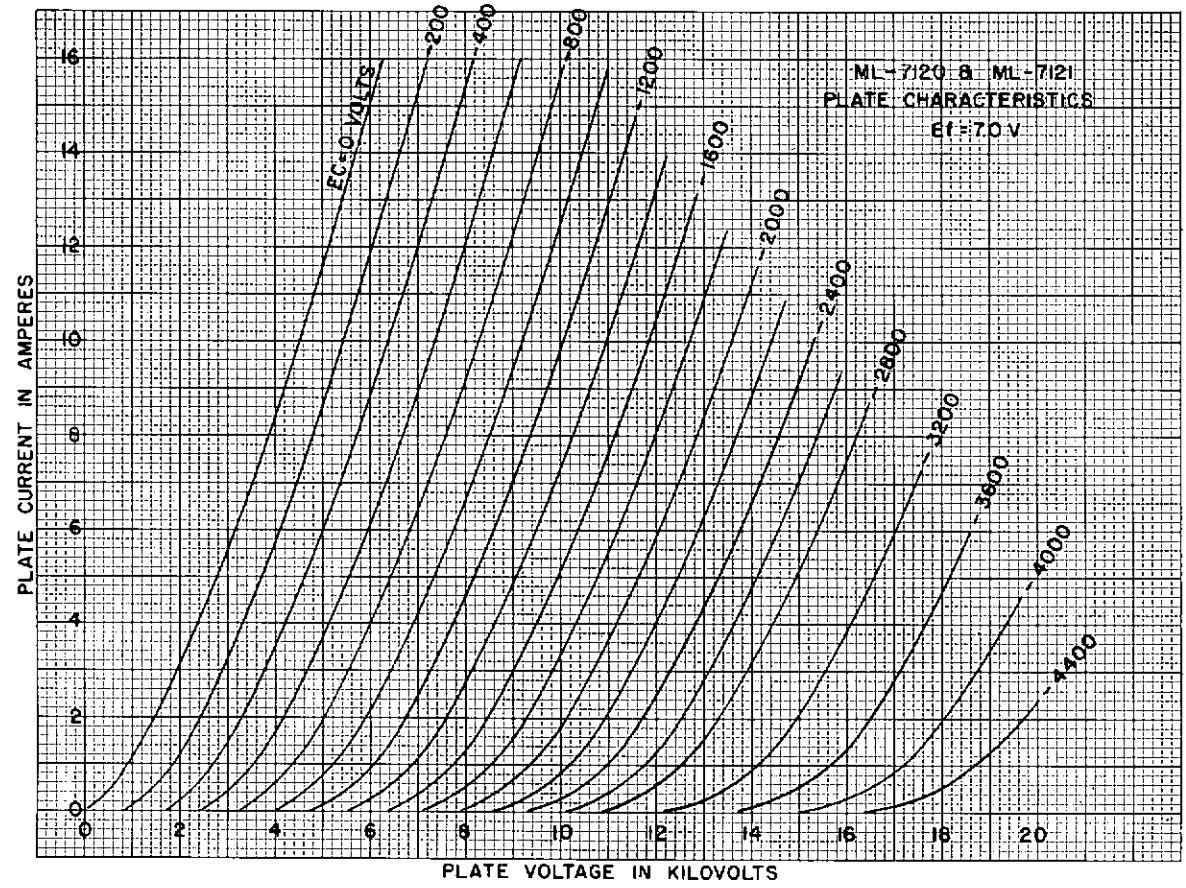
Characteristic	Conditions		Limits Minimum	Bogey	Maximum	
Plate Voltage	e_c = 0 volts; i_b = 15 amps	e_b:	——	6.0	6.4	kv
Plate Voltage	E_c = 0 Vdc; I_b = 1.0 Adc	E_b:	0.7	0.85	1.0	kVdc
Plate Voltage	E_c = −1000 Vdc; I_b = 1.0 Adc	E_b:	4.9	5.25	5.6	kVdc
Grid Voltage	E_b = 7.0 kVdc; I_b = 0.020 Adc	E_c:	−1600	−1800	−2000	Vdc
Plate Power Output	E_b = 10.0 kVdc; I_b = 1.5 Adc E_c = −2350 Vdc; I_c = 0 Adc	P_o:	7.5	8.5	——	kW

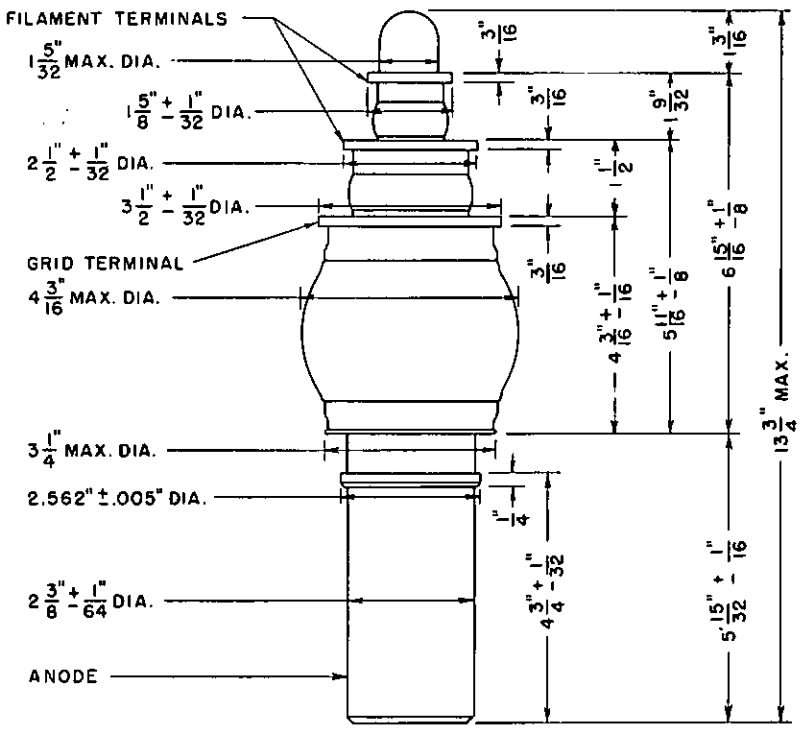
ML-7120



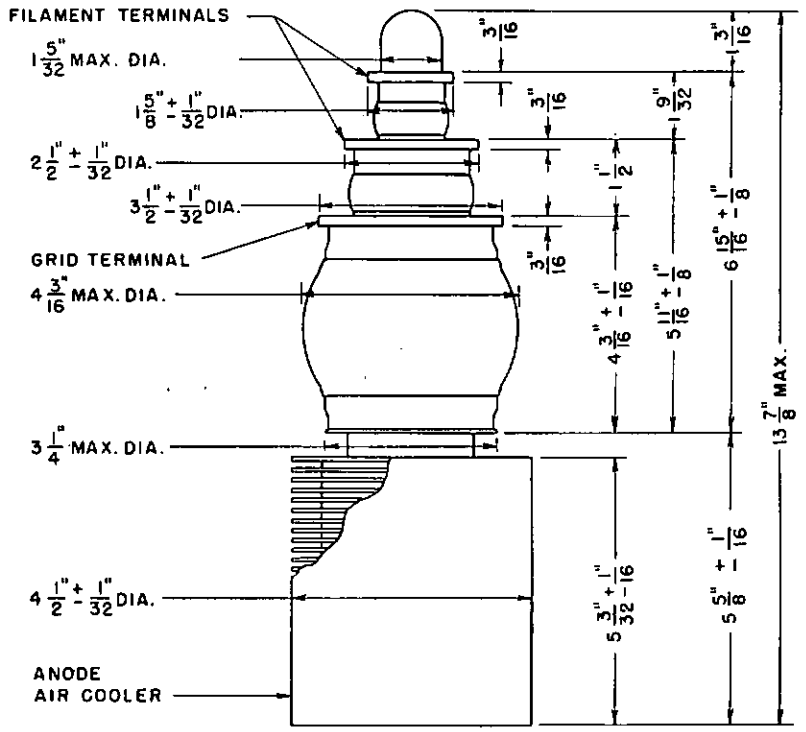
ML-7121







DIMENSIONS — ML-7120



DIMENSIONS — ML-7121

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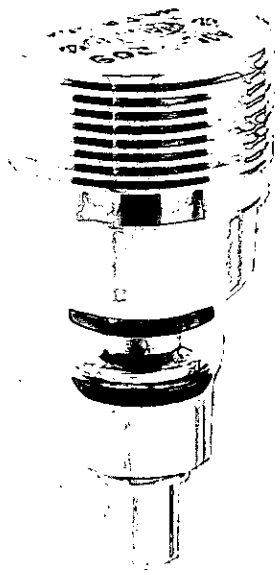


MACHLETT

ML-7209

DESCRIPTION & RATINGS

DESCRIPTION

The ML-7209 is a high-mu triode of the planar-electrode type designed for use as a plate-pulsed oscillator, frequency multiplier, or power amplifier in radio transmitting service from low frequency to 3000 Mc. Features include low interelectrode capacitances, high transconductance and great mechanical strength. Lead inductances and r.f. losses are minimized by a compact, rugged coaxial construction, making the tube ideally suited to cavity type circuits as well as for parallel line operation. The cathode is an indirectly-heated, oxide-coated disc. The anode is forced-air cooled.

GENERAL CHARACTERISTICS

Electrical

Heater Voltage (See Application Notes)	6.0	Volts
Heater Current (AC or DC) at 6.0 volts	1.0	Amp
Heater Heating Time, minimum	60	sec
Amplification Factor	100	
Transconductance (I_b = 70 mA, E_b = 600 v)	25000	μmhos
Interelectrode Capacitances (without heater voltage)		
Grid-Plate	2.01	μμf
Grid-Cathode	6.60	μμf
Plate-Cathode, maximum	0.035	μμf
Duty Factor	.0033	†
Maximum Pulse Length	5	μsecs†
Frequency for Maximum Ratings	3000	Mc

Mechanical

Mounting Position	Optional	
Type of Cooling	Forced Air*	
Maximum Anode Temperature	200	°C
Net Weight	2¼	oz.

†For applications requiring longer pulse lengths or higher duty factors, consult the Machlett Engineering Department.

*For cooling requirements, refer to "Cooling" under "Application Notes".

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

Plate-Pulsed Oscillator and Amplifier—Class C

Maximum Ratings, Absolute Values		
For a pulse length of	5	μsec
Duty Factor	3.3×10^{-3}	
Peak Plate Pulse Supply Voltage	3500	volts
DC Grid Bias Voltage‡	-150	volts
Peak Plate Current from Pulse Supply	3	amps
Average Plate Current	10	mA
Average Grid Current	5	mA
Average Plate Dissipation	35	watts
Average Grid Dissipation	2	watts
Typical Operation: 2500 Mc Oscillator		
Pulse Length	5	μsec
Duty Factor	3.0×10^{-3}	
Peak Plate Pulse Supply Voltage	3500	volts
DC Grid Bias Voltage	-100	volts
Peak R-F Grid Voltage	340	volts
Peak R-F Plate Voltage	2500	volts
Peak Plate Current from Pulse Supply	3	amps
Average Plate Current	9	mA
Average Grid Current	3	mA
Driving Power During Pulse, Approximate	450	watts
Useful Power Output at Peak of Pulse, Approx.	2200	watts
Pulse Recurrence Rate	660	pps

Frequency Doubler—Class C Telegraphy

Maximum Ratings, Absolute Values		
For a pulse length of	5	μsec
Duty Factor	3.3×10^{-3}	
Peak Plate Pulse Supply Voltage	3500	volts
Grid Bias Voltage (from cathode resistor)‡	-200	volts
Peak Cathode Current	3	amps
Average Plate Current	6.5	mA
Average Grid Current	2.0	mA
Average Plate Input	25	watts
Average Plate Dissipation	25	watts
Average Grid Dissipation	1.0	watt
Typical Operation — Doubler 600 to 1200 Mc		
Pulse Length	3	μsec
Duty Factor	3.0×10^{-3}	
Filament Voltage (See Application Notes)	5.5	volts
Peak Plate Pulse Supply Voltage	3500	volts
Grid Bias Voltage (from cathode resistor)	-190	volts
Cathode Resistor	160	ohms
Peak Plate Current	1.2	amps
Driving Power During Pulse, Approximate	600	watts
Useful Power Output at Peak of Pulse, Approx.	1200	watts
Average Plate Dissipation	9	watts

‡The maximum instantaneous peak grid-cathode voltage should be within the range of +250 to −750 volts.

Characteristic Range Values for Equipment Design

	Min.	Max.	
Filament Current at 6.0 volts (Note 1)	0.90	1.05	A
Plate Current (Note 2)	60	95	mAdc
Cut-off Bias (Note 3)	—	-15	Vdc
Transconductance	20,000	30,000	
Grid-Plate Capacitance (Note 4)	1.86	2.16	μμf
Grid-Cathode Capacitance (Note 4)	5.60	7.60	μμf
Plate-Cathode Capacitance (Note 4)	—	.035	μμf
Plate Tuning Range (Note 5)	1980	2020	Mc

Note 1 — For reduced filament voltage see "Heater Voltage" section under "Application Notes".

Note 2 — Measure at a plate voltage of 600 volts and a cathode-bias resistor of 30 ohms.

Note 3 — Measured at 1 mA of plate current and a plate voltage of 600 volts.

Note 4 — Capacitance measurements are with the tube cold. When the filament is heated to proper operating temperature the grid-cathode capacitance will increase by about 1 μμf due to thermal expansion of the cathode.

Note 5 — With a plate-grid coaxial cavity of fixed dimensions, all tubes will resonate within the specified frequency range.

APPLICATION NOTES

MECHANICAL

Mounting

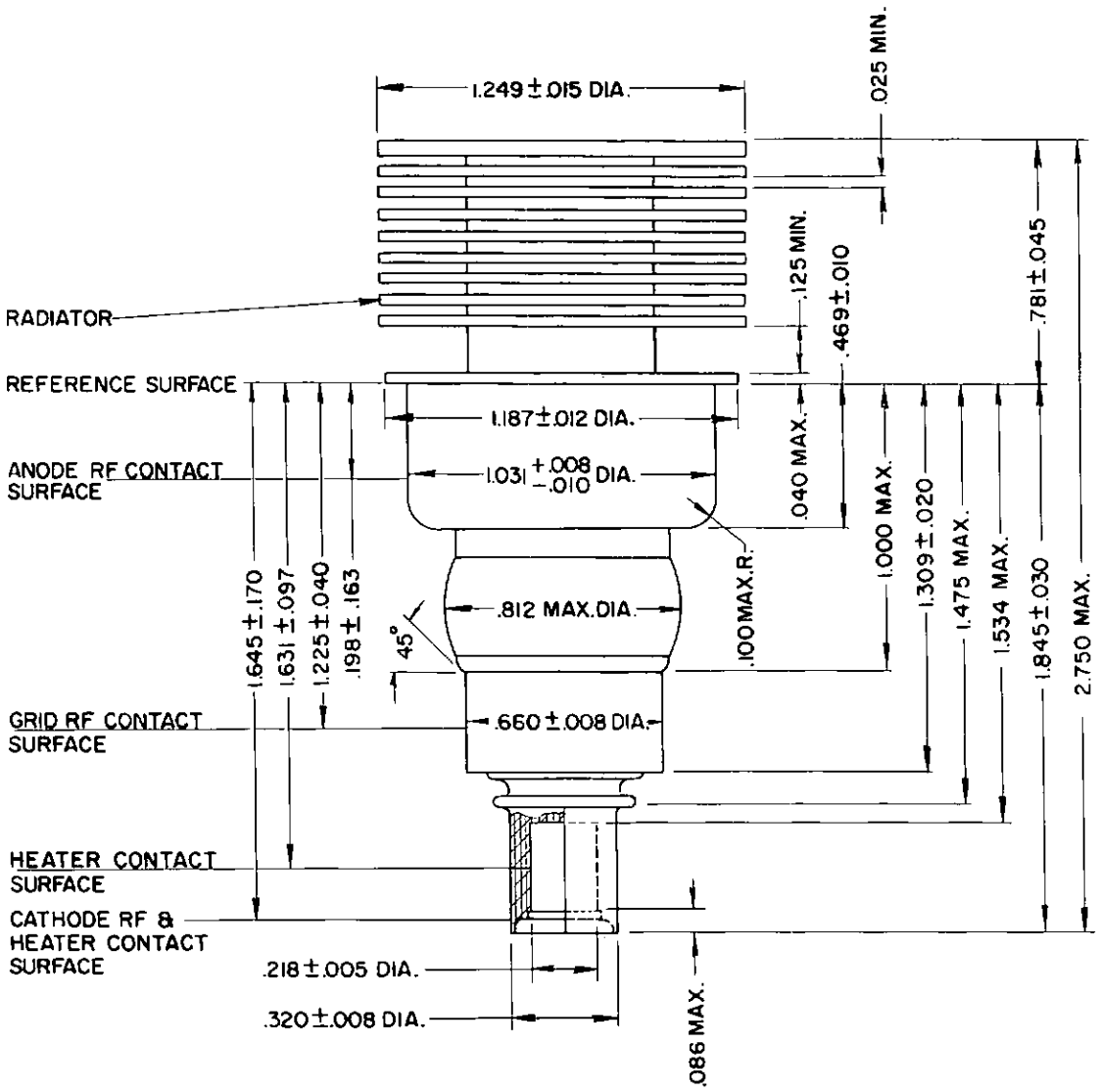
Contact to anode, grid, cathode and heater terminals should be made by means of spring fingers or spring collets bearing on the cylindrical surfaces within the dimensional limits and tolerances specified on the tube outline drawing. The tube when in the socket should seat against the anode flange. The tube should not be seated or stopped by any other surfaces. When the tube must be clamped in its socket to prevent loosening due to shock and vibration, clamp pressure should only be applied to the anode flange.

Cooling

Sufficient air cooling must be provided so that the maximum temperature of anode, grid and cathode seals does not exceed 200°C under any condition of operation. Improved tube life and greater reliability may be obtained if all seals are cooled well below this maximum.

Charts following these notes show the minimum air flow required to cool the anode at various rates of plate dissipation and incoming air temperature. These charts apply only to the cooling of the anode when enclosed in a standard cowling as illustrated. Since the cathode end of the tube may be well enclosed in the high-frequency tuning circuit, additional air flow, apart from that flowing through the cowling and used to cool the anode, may be required to cool seals. Tempilaq* paint is suggested for making temperature measurements at such points.

*Product of Tempil Corporation, New York, N. Y.



NOTES:

1. THE TOTAL INDICATED RUNOUT OF THE ANODE AND GRID CONTACT SURFACES WITH RESPECT TO THE CATHODE CONTACT SURFACE WILL NOT EXCEED .030
2. THE TOTAL INDICATED RUNOUT OF THE CATHODE CONTACT SURFACE WITH RESPECT TO THE HEATER CONTACT SURFACE WILL NOT EXCEED .018
3. ALL DIMENSIONS IN INCHES.

MACHLETT LABORATORIES, INC.

SPRINGDALE MACHLETT **CONNECTICUT**

U.S.A.

ELECTRICAL

Heater Voltage

In the frequency range where this tube is usually operated, the electron transit time is not necessarily small with respect to the period of oscillation. The transit time heating effect should be compensated by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, plate current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. The following table is intended as a guide in this respect for maximum duty conditions, where liberal seal cooling is provided:

Frequency	Ef
Up to 1000 Mc	6.0 volts
1000 to 2000 Mc	5.8 volts
Over 2000 Mc	5.5 volts

Permitted tolerances on filament voltage are ±10% of the values given above. For long tube life, however, a maximum variation in filament voltage of ±5% is advised. If such improved regulation is provided, Ef can advantageously be lowered 5% below the values given in the table. For particular applications above 500 Mc, it is suggested that the Machlett Engineering Department be consulted for optimum heater voltages.

Plate Surge-Limiting Impedance

In tubes such as the ML-7209, which have very closely spaced electrodes, extremely high voltage gradients occur even with moderate tube operating voltages. Any tube flash-arcing may be destructive. A series impedance in the B+ lead is recommended to limit the peak current under surge conditions to 10 times maximum rating or less. Such operation is particularly advisable where d-c heater excitation is used and the heater voltage is used to obtain a d-c- grid bias. Under such conditions surge currents can get to the negative plate voltage supply lead only through the cathode heater winding, and may cause shorting of the heater element unless current limiting is provided. Failure of tubes due to internal flash-arcs are much more prevalent when the circuit is not tuned to optimum conditions. Even though laboratory tests indicate no such protection is needed, poor circuit adjustment in the field may result in shortened tube life.

Provision for Circuit Tuning

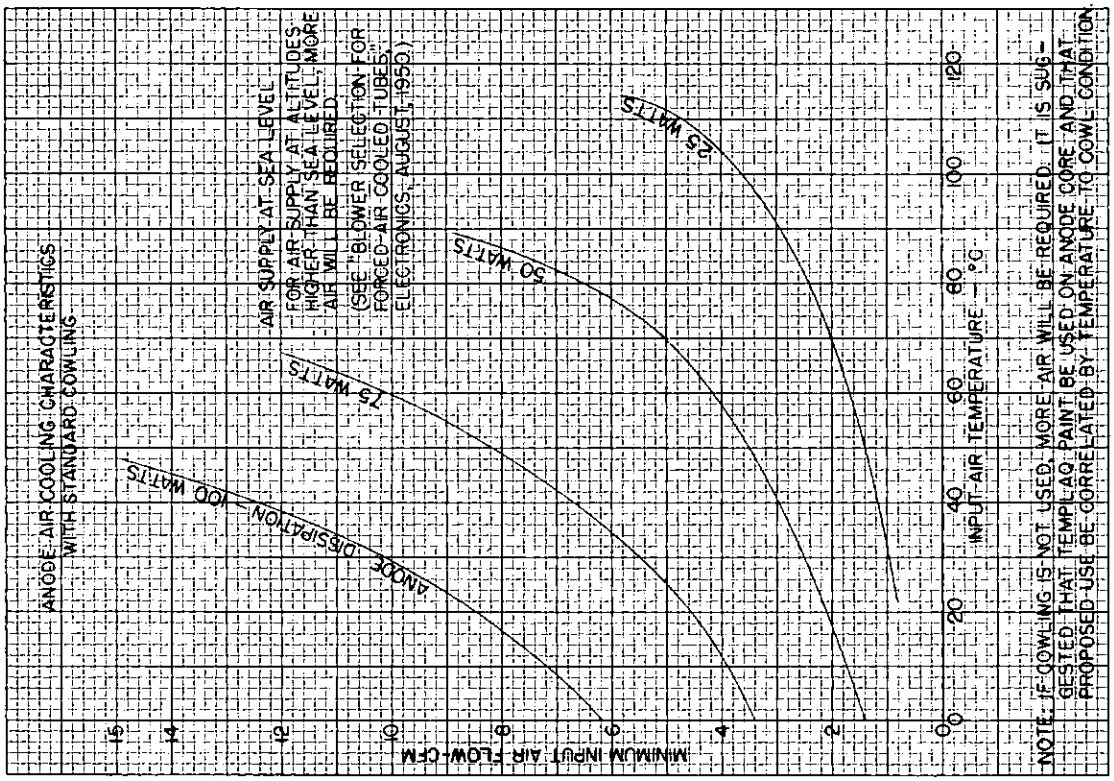
With high-frequency circuits, a very small motion of a tuning plunger may throw the tube out of resonance and result in high plate current and/or excessive anode dissipation. If the tube is operated at or close to maximum ratings, it is suggested that provision be made for tuneup at reduced plate voltage in any circuit where the above conditions obtain.

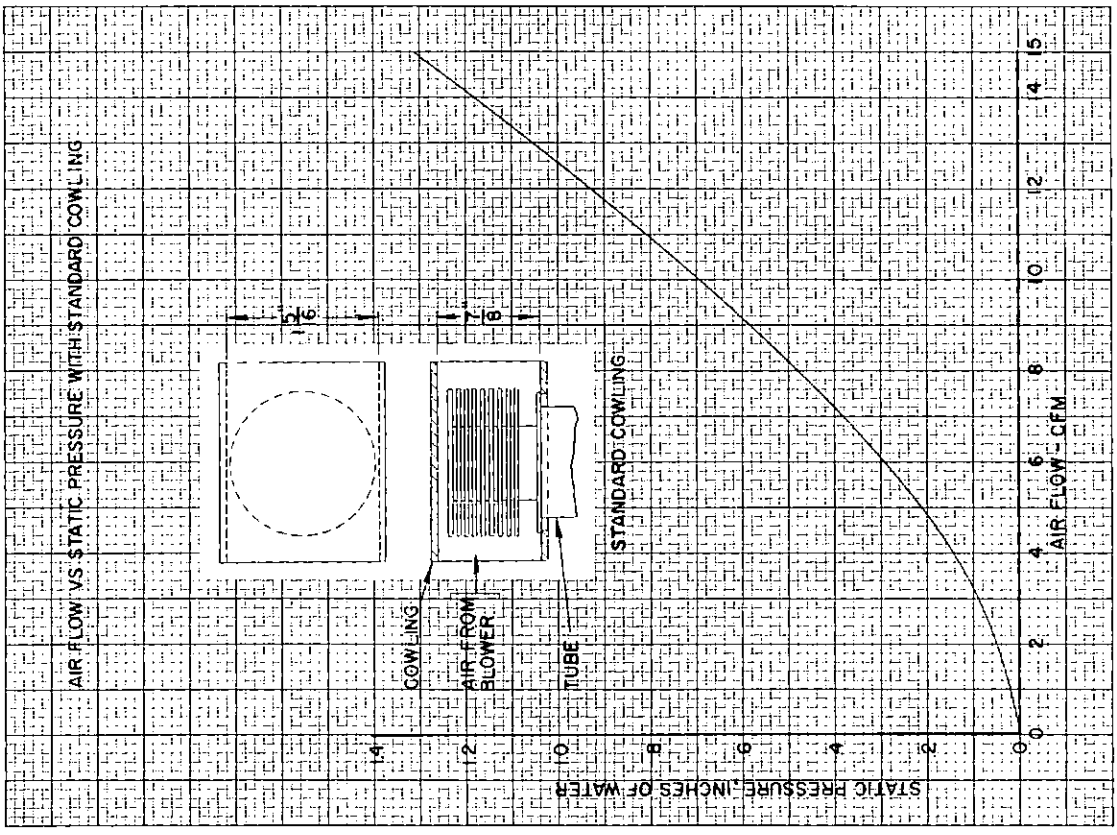
Determination of Proper Grid Drive

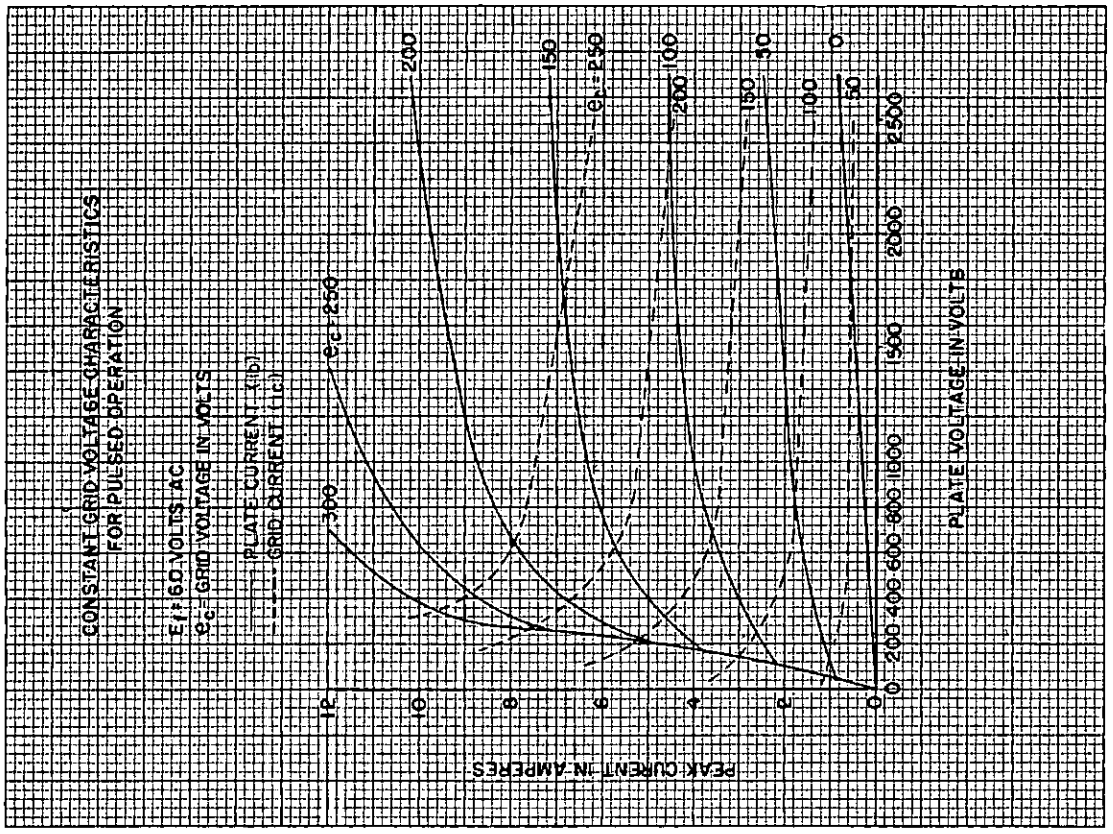
In grounded-cathode stages, the power output tends to saturate as the grid drive increases. In grid-separation circuits, increased output power is always obtainable from increased grid drive, due to the fact that a considerable portion of the grid driving power appears in the output load. Whereas high grid driving power leads to somewhat greater power output in grid-separation amplifiers, it also results in high grid current, increased back heating of the cathode, and shorter tube life.

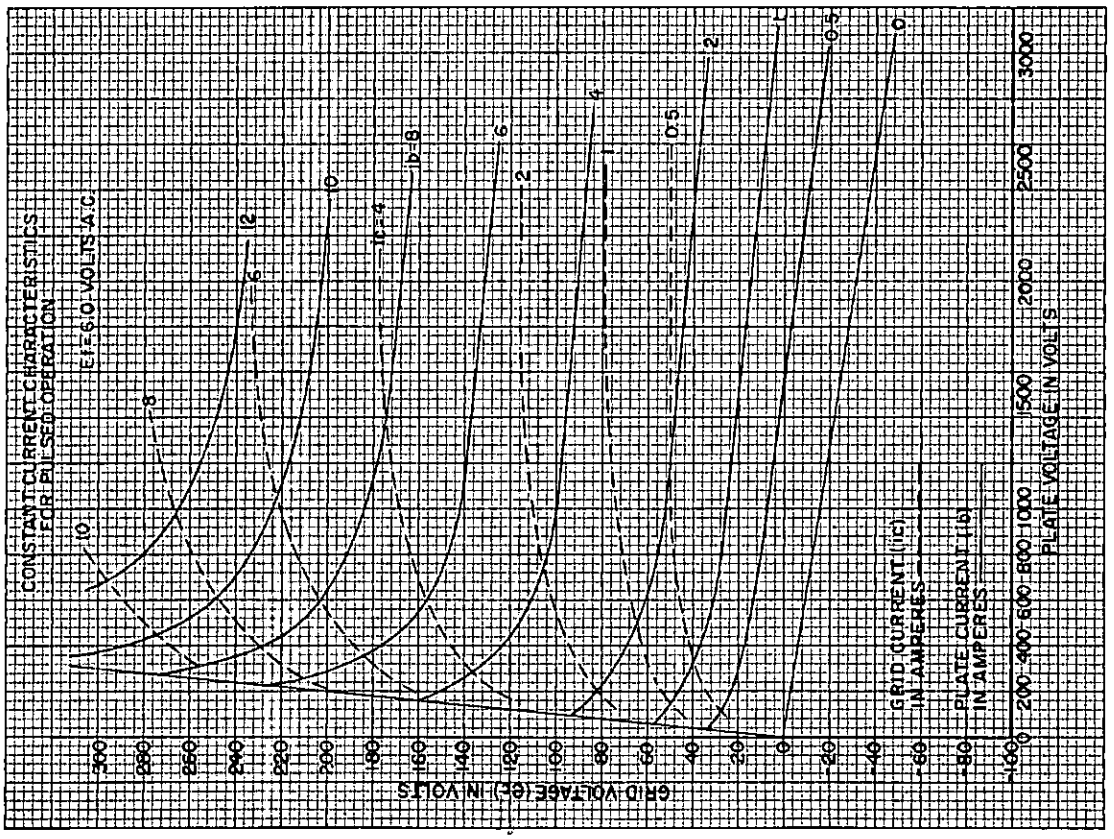
Unusual Applications

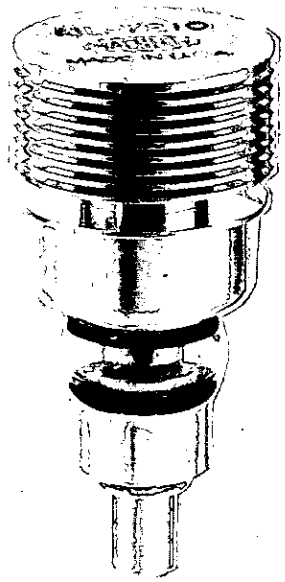
If conditions are such that the preceding ratings do not apply, additional information may be obtained from the Machlett Engineering Department.


ANODE AIR-COOLING CHARACTERISTICS
WITH STANDARD COWLING
AIR SUPPLY AT SEA LEVEL
FOR AIR SUPPLY AT ALTITUDES HIGHER THAN SEA LEVEL, MORE AIR WILL BE REQUIRED.
(SEE "BLOWER SELECTION FOR FORCED-AIR COOLED TUBES," ELECTRONICS, AUGUST, 1950.)
ANODE DISSIPATION
100 WATTS
75 WATTS
50 WATTS
25 WATTS
MINIMUM INPUT AIR FLOW-CFM
INPUT AIR TEMPERATURE — °C
NOTE: IF COWLING IS NOT USED, MORE AIR WILL BE REQUIRED. IT IS SUGGESTED THAT TEMPILAQ PAINT BE USED ON ANODE CORE AND THAT PROPOSED USE BE CORRELATED BY TEMPERATURE TO COWL CONDITION.


AIR FLOW VS STATIC PRESSURE WITH STANDARD COWLING
STANDARD COWLING
COWLING
AIR FROM BLOWER
TUBE
STATIC PRESSURE, INCHES OF WATER
AIR FLOW - CFM


CONSTANT GRID-VOLTAGE CHARACTERISTICS
FOR PULSED OPERATION
Ef = 6.0 VOLTS AC
ec = GRID VOLTAGE IN VOLTS
PLATE CURRENT (Ib)
GRID CURRENT (Ic)
PEAK CURRENT IN AMPERES
PLATE VOLTAGE IN VOLTS


CONSTANT CURRENT CHARACTERISTICS
FOR PULSED OPERATION
Ef = 6.0 VOLTS A.C.
GRID VOLTAGE (ec) IN VOLTS
GRID CURRENT (Ic) IN AMPERES
PLATE CURRENT (Ib) IN AMPERES
PLATE VOLTAGE IN VOLTS



MACHLETT

ML-7210

DESCRIPTION & RATINGS

DESCRIPTION

The ML-7210 is a quick-heating cathode, high-mu planar triode designed for use as a plate-pulsed or CW oscillator, frequency multiplier or power amplifier in radio transmitting service from low frequency to 3000 Mc. The tube may be operated at higher frequencies with reduced ratings. Features include low interelectrode capacitances, high transconductance and great mechanical strength. Lead inductances and r-f losses are minimized by a compact, rugged construction with ring-type seals, making the tube ideally suited to cavity-type circuits as well as for parallel-line operation. The cathode is an indirectly-heated, oxide-coated disc. The anode is forced-air cooled.

GENERAL CHARACTERISTICS

Electrical

Heater Voltage (see Application Notes)	6.3	Volts
Heater Current (AC or DC) at 6.3 Volts	0.85	Amp
Heater Heating Time, minimum	12	secs
Amplification Factor	75	
Transconductance (I_b = 70 mA, E_b = 600 v)	17,000	μmhos
Interelectrode Capacitances (without heater voltage)		
Grid-Plate	2.0	μμf
Grid-Cathode	5.0	μμf
Plate-Cathode, maximum	0.040	μμf
Duty Factor	.0025	†
Maximum Pulse Length	3	μsec†
Frequency for Maximum Ratings	3000	Mc

Mechanical

Mounting Position	Optional	
Type of Cooling	Forced Air*	
Maximum Anode Temperature	200	°C
Net Weight	2¼	oz.

†For applications requiring longer pulse lengths or higher duty factors, consult the Machlett Engineering Department.

*For cooling requirements, refer to "Cooling" under "Application Notes".

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

R-F Power Amplifier and Oscillator

Key-down conditions per tube without amplitude modulation‡

Maximum Ratings, Absolute Values		
D-C Plate Voltage	1000	volts
D-C Grid Voltage	-150	volts
D-C Cathode Current	95	mA
D-C Grid Current§	30	mA
Peak Positive RF Grid Voltage	30	volts
Peak Negative RF Grid Voltage	-400	volts
Plate Dissipation† (Forced-air Cooling)	100	watts
Grid Dissipation	1.5	watts

Plate-Pulsed Oscillator and Amplifier Class C

Maximum Ratings, Absolute Values		
Pulse Length	3	μsec
Duty Factor	0.0025	
Peak Plate Pulse Supply Voltage	3500	volts
DC Grid Bias Voltage*	-150	volts
Peak Plate Current from Pulse Supply	2.8	amps
Average Plate Current	7.0	mA
Average Grid Current	3.0	mA
Average Plate Dissipation	25	watts
Average Grid Dissipation	1.5	watts

‡Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115 per cent of the carrier conditions.

§See "Application Notes" on "Determination of Proper Grid Drive".

†Refer to "Cooling" under "Application Notes".

*The maximum instantaneous peak grid-cathode voltage should be within the range of +250 to —500 volts.

Characteristic Range Values for Equipment Design

	Min.	Max.	
Filament Current at 6.3 volts	.75	.95	A
Plate Current (Note 1)	55	90	mAdc
Cut-off bias (Note 2)	—	-20	volts
Transconductance	12,000	22,000	μmhos
Grid-Plate Capacitance (Note 3)	1.84	2.16	μμf
Grid-Cathode Capacitance (Note 3)	4.00	6.00	μμf
Plate Tuning Range (Note 4)	1970	2030	Mc

Note 1 — Measured at a plate voltage of 600 volts and a cathode-bias resistor of 30 ohms.

Note 2 — Measured at 1 mA of plate current and a plate voltage of 600 volts.

Note 3 — Capacitance measurements are with the tube cold.

Note 4 — With a plate-grid coaxial cavity of fixed dimensions, all tubes will resonate within the specified frequency range.

APPLICATION NOTES

MECHANICAL

Mounting

Contacts to anode, grid, cathode and heater terminals should be made by means of spring fingers or spring collets bearing on the cylindrical surfaces within the dimensional limits specified on the tube outline. The tube when in the socket should seat against the anode flange. The tube should not be seated or stopped by any other surfaces. When the tube must be clamped in its socket to prevent loosening due to shock and vibration, clamp pressure should only be applied to the anode flange.

Cooling

Sufficient air cooling must be provided so that the maximum temperature of anode, grid and cathode seals does not exceed 200°C under any condition of operation. Improved tube life and greater reliability may be obtained if all seals are cooled well below this maximum.

Charts following these notes show the minimum air flow required to cool the anode at various rates of plate dissipation and incoming air temperature. These charts apply only to the cooling of the anode when enclosed in a standard cowling as illustrated. Since the cathode end of the tube may be well enclosed in the high-frequency tuning circuit, additional air flow, apart from that flowing through the cowling and used to cool the anode, may be required to cool seals. Tempilaq* paint is suggested for making temperature measurement at such points.

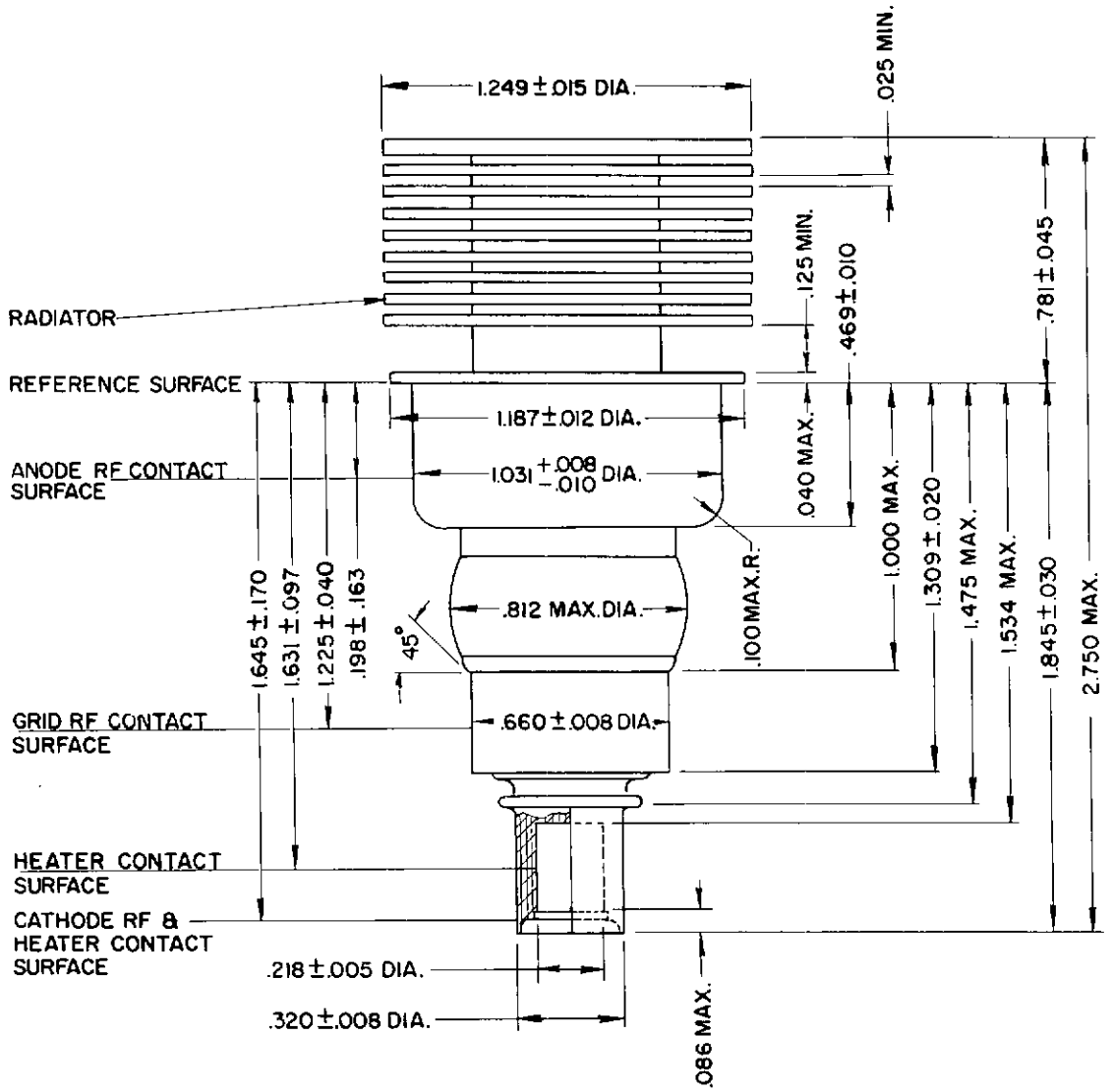
ELECTRICAL

Heater Voltage

In the frequency range where this tube is usually operated, the electron transit time is not necessarily small with respect to the period of oscillation. The transit time heating effect should be compensated by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, plate current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ±5% from optimum is permitted.

For applications above 500 Mc it is suggested that the Machlett Engineering Department be consulted for optimum heater voltages.

*Product of Tempil Corporation, New York, N. Y.



NOTES:

1. THE TOTAL INDICATED RUNOUT OF THE ANODE AND GRID CONTACT SURFACES WITH RESPECT TO THE CATHODE CONTACT SURFACE WILL NOT EXCEED .030
2. THE TOTAL INDICATED RUNOUT OF THE CATHODE CONTACT SURFACE WITH RESPECT TO THE HEATER CONTACT SURFACE WILL NOT EXCEED .018
3. ALL DIMENSIONS IN INCHES.

MACHLETT LABORATORIES, INC.

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U. S. A.

Plate Surge-Limiting Impedance

In tubes such as the ML-7210 with very closely spaced electrodes, extremely high voltage gradients occur even with moderate tube operating voltages. Any tube flash-arcing may be destructive. A series impedance in the B+ lead is recommended which limits the peak current under surge conditions to 15 amperes or less for CW operation or ten times maximum rating or less for pulsed operation. Such operation is particularly advisable where d.c. heater excitation is used and the heater voltage is used to obtain a d.c. grid bias. Under such conditions, surge currents can get to the negative plate voltage supply lead only through the heater winding and may cause shorting of the heater element unless current limiting is provided. Failure of tubes due to internal flash-arcs is much more prevalent when the circuit is not tuned to optimum conditions. Even though laboratory tests indicate no such protection is needed, poor circuit adjustment in the field may result in shortened tube life.

Provision for Circuit Tuning

With high-frequency circuits a very small motion of a tuning plunger may throw the tube out of resonance and result in high plate current and/or excessive anode dissipation. If the tube is operated at or close to maximum ratings, it is suggested that provision be made for tuneup at reduced plate voltage in any circuit where the above conditions obtain.

Self Biasing Operation

In general, for CW operation, an RC bias should be in the cathode circuit such that with normal d.c. plate voltage and no grid drive the plate current does not exceed 95 mA, i.e. the maximum rated cathode current. Both cathode and grid resistance biasing may be used. If grid resistor biasing is used, special care must be taken to protect the tube against loss of excitation; otherwise excessive plate currents may damage the cathode.

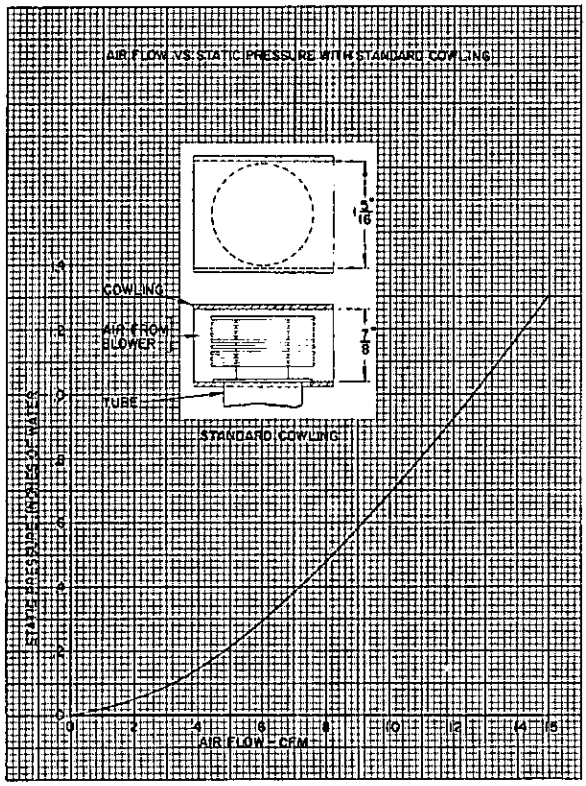
For pulsed operation, a bypassed or unbypassed grid resistor is usually satisfactory provided suitable plate surge-limiting impedance is used.

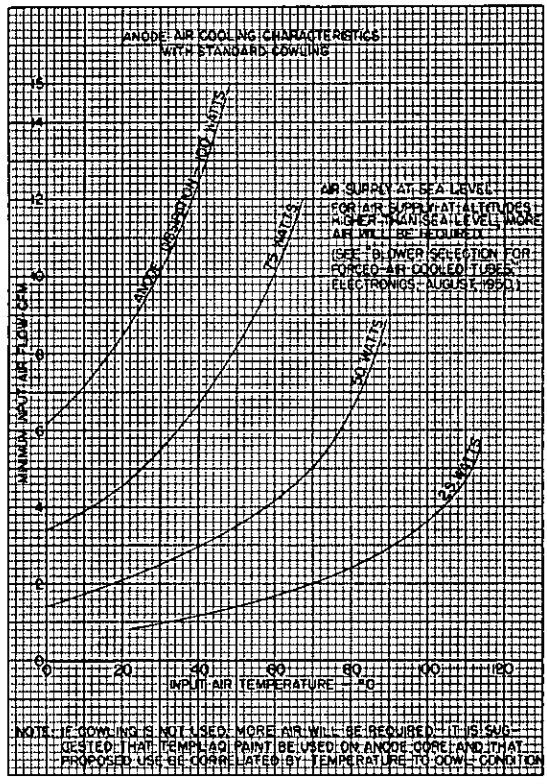
Determination of Proper Grid Drive

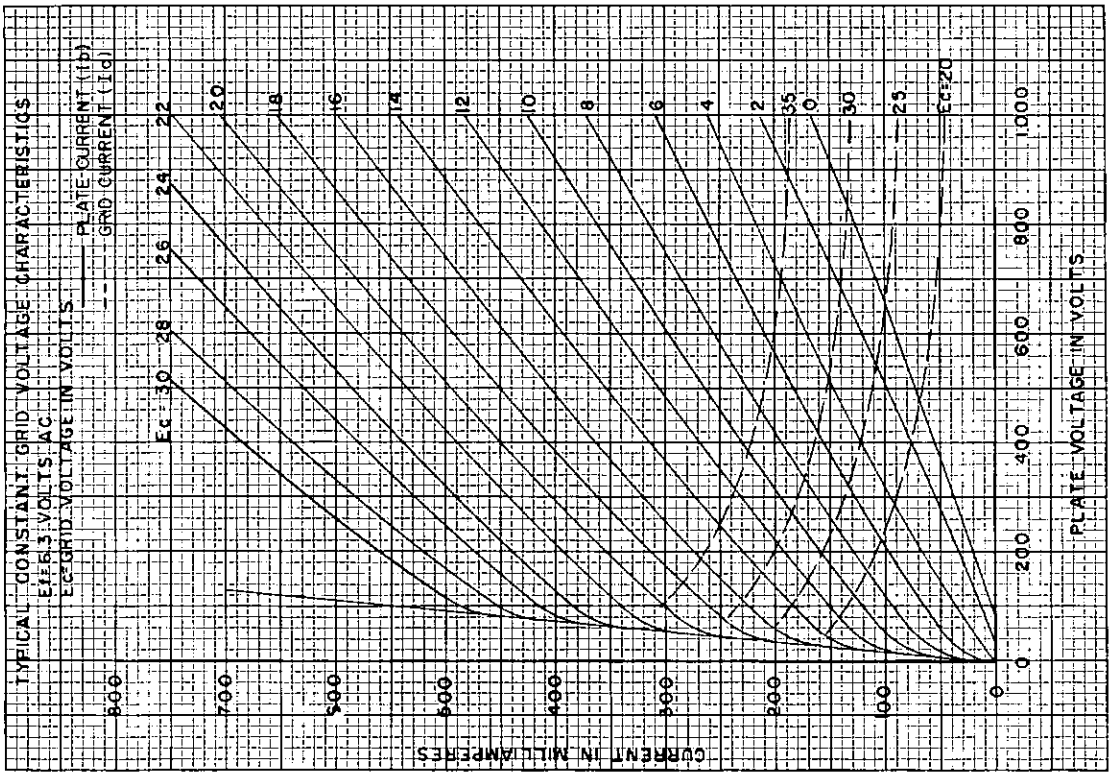
In grounded-cathode stages, the power output tends to saturate as the grid drive increases. In grid-separation circuits, increased output power is always obtainable from increased grid drive, due to the fact that a considerable portion of the grid driving power appears in the output load. Whereas high grid driving power leads to somewhat greater power output in grid-separation amplifiers, it also results in high grid current, increased back heating of the cathode and distortion of the r.f. signals due to the heavy loading of the grid signal in the positive grid region; this usually shortens the life of the tube.

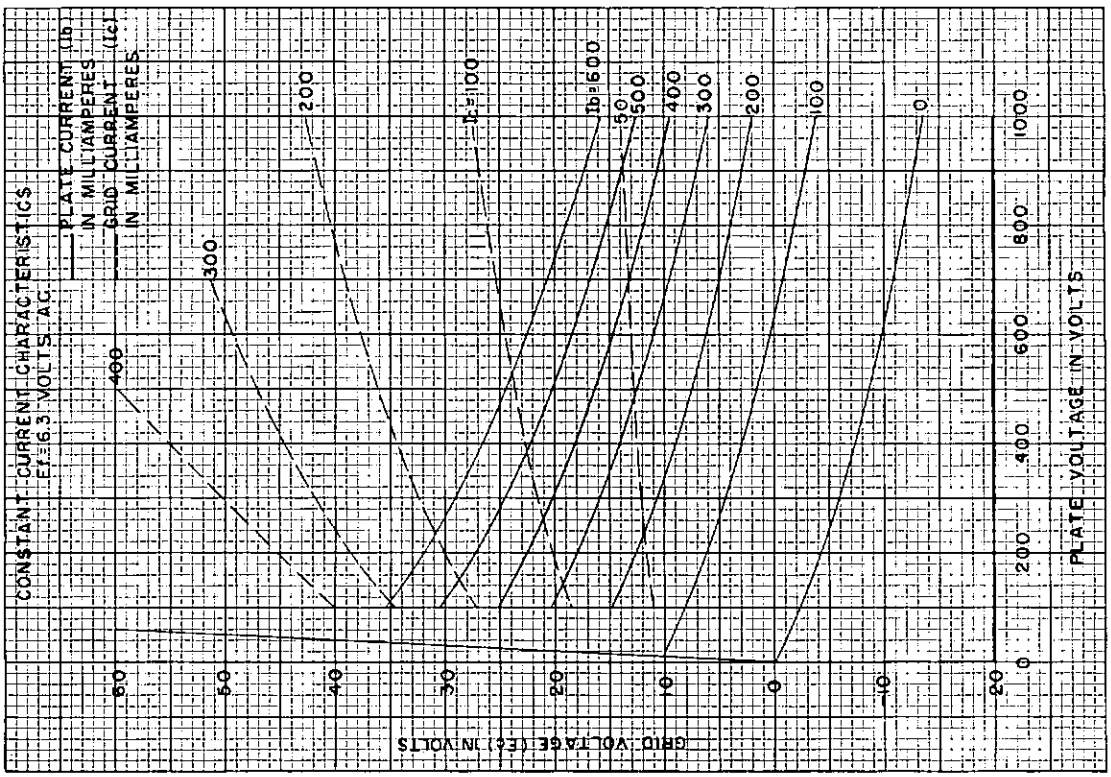
Unusual Applications

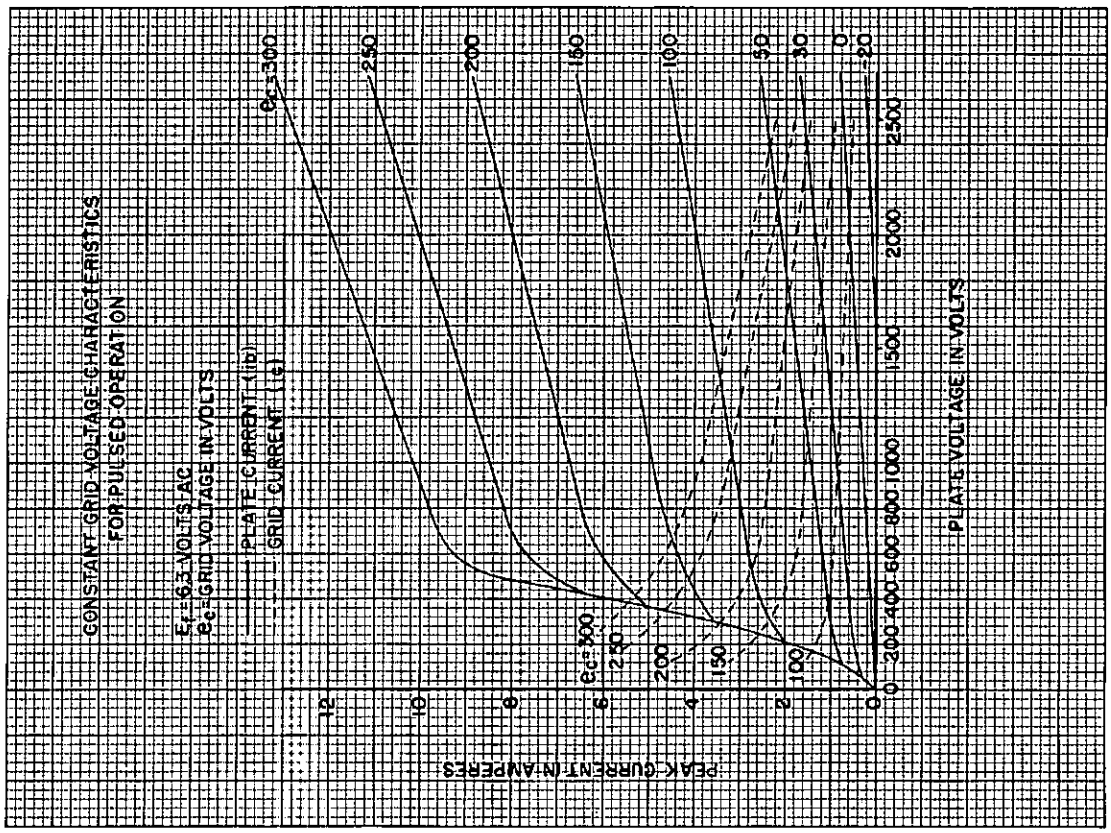
If conditions are such that the preceding ratings do not apply, additional information may be obtained from the Machlett Engineering Department.

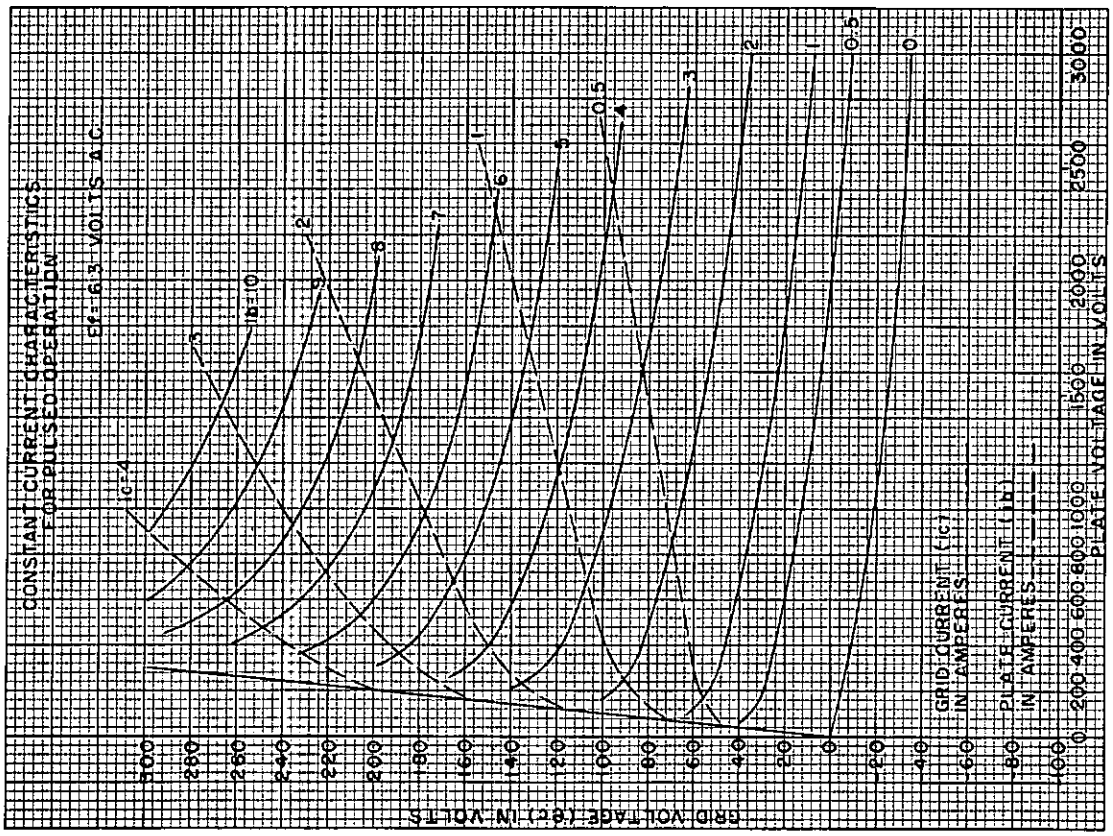


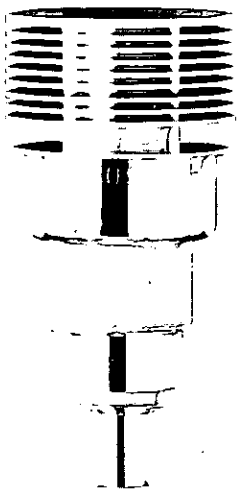



TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
Ef=6.3 VOLTS AC.
Ec=GRID VOLTAGE IN VOLTS
PLATE CURRENT (Ib)
GRID CURRENT (Ic)
Ec= 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 35 0 30 25 Ec=20
CURRENT IN MILLIAMPERES
PLATE VOLTAGE IN VOLTS


CONSTANT CURRENT CHARACTERISTICS
Ef=6.3 VOLTS AC.
PLATE CURRENT Ib IN MILLIAMPERES
GRID CURRENT (Ic) IN MILLIAMPERES
Ib=100
Ib=600
GRID VOLTAGE (Ec) IN VOLTS
PLATE VOLTAGE IN VOLTS


CONSTANT-GRID-VOLTAGE CHARACTERISTICS
FOR PULSED OPERATION
Ef=6.3 VOLTS AC
ec=GRID VOLTAGE IN VOLTS
PLATE CURRENT (ib)
GRID CURRENT (ic)
PEAK CURRENT IN AMPERES
PLATE VOLTAGE IN VOLTS
ec=300
250
200
150
100
50
30
0
-20
-50


CONSTANT CURRENT CHARACTERISTICS
FOR PULSED OPERATION
Ef=6.3 VOLTS A.C.
ib=10
GRID VOLTAGE (ec) IN VOLTS
GRID CURRENT (ic)
IN AMPERES
PLATE CURRENT (ib)
IN AMPERES
PLATE VOLTAGE IN VOLTS
0
0.5
1
2
3
4
5
6
7
8
9



MACHLETT

ML-7211

DESCRIPTION & RATINGS

DESCRIPTION

The **ML-7211** is a ruggedized, high-mu, planar triode of ceramic and metal construction designed specifically for use as an oscillator, frequency multiplier, or amplifier in radio transmitting service at frequencies up to 2500 Mc. The tube may be operated at higher frequencies with reduced ratings.

Features of this tube include low interelectrode capacitance, high transconductance, high cathode current capability and great mechanical strength. The cathode is an indirectly-heated oxide-coated disc. The anode is forced-air cooled. This tube is manufactured to exacting dimensional tolerances to insure mechanical uniformity. Improved reliability and a minimum variation in electrical characteristics are achieved through extensive and precise electrical testing. The **ML-7211** is capable of sustained, reliable operation at elevated temperatures.

GENERAL CHARACTERISTICS

Electrical

Heater Voltage (See Application Notes)	6.3	Volts
Heater Current (AC or DC) at 6.3 Volts	1.3	Amp
Heater Heating Time, minimum	60	Seconds
Amplification Factor	80	
Transconductance (I_b = 100 mA, E_b = 600 v)	30,000	μmhos
Interelectrode Capacitances (without heater voltage)		
Grid-Plate	2.25	$\mu\mu f$
Grid-Cathode	8.0	$\mu\mu f$
Plate-Cathode, maximum	0.06	$\mu\mu f$
Frequency for Maximum Ratings	2500	Mc

Mechanical

Mounting Position	Optional	
Type of Cooling	Forced Air*	
Maximum Anode Temperature	250	°C
Net Weight	2.5	oz.

*For cooling requirements, refer to "Cooling" under "Application Notes".

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

R-F Power Amplifier and Oscillator

Key-down conditions per tube without amplitude modulation‡

Maximum Ratings, Absolute Values

D-C Plate Voltage	1000	volts
D-C Grid Voltage	-150	volts
D-C Cathode Current	190	mA
D-C Grid Current§	45	mA
Peak Positive RF Grid-Cathode Voltage	30	volts
Peak Negative RF Grid-Cathode Voltage	-400	volts
Plate Dissipation† (Forced-air Cooling)	100	watts
Grid Dissipation	2	watts

Typical Operation

Power Amplifier, Grid Separation Circuit — 500 Mc

D-C Plate Voltage	900	volts
D-C Grid Voltage	-30	volts
D-C Plate Current	140	mA
D-C Grid Current, Approximate	40	mA
Driving Power, Appproximate	9	watts
Useful Power Output	65	watts

RF Oscillator — 2500 Mc

D-C Plate Voltage	900	volts
D-C Grid Voltage, Approximate	-20	volts
D-C Plate Current	140	mA
D-C Grid Current	15	mA
Useful Power Output	25	watts

Characteristic Range Values for Equipment Design

	Min.	Max.	
Filament Current at 6.3 volts	1.20	1.40	A
Cut-off bias (Note 1)	—	-20	volts
Grid-Plate Capacitance (Note 2)	2.10	2.40	$\mu\mu f$
Grid-Cathode Capacitance (Note 2)	7.0	9.0	$\mu\mu f$

Note 1 — Measured at 1 mA of plate current and a plate voltage of 600 volts.

Note 2 — Capacitance measurements are with the tube cold.

APPLICATION NOTES

MECHANICAL

Mounting

Contacts to anode, grid, cathode and heater terminals should be made by means of spring fingers or spring collets bearing on the cylindrical surfaces within the dimensional limits specified on the tube outline. The tube, when in the socket, should seat against the anode flange. The tube should not be seated or stopped by any other surfaces. When the tube must be clamped in its socket to prevent loosening due to shock and vibration, clamp pressure should only be applied to the anode flange.

‡Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115 per cent of the carrier conditions.
§See "Application Notes" on "Determination of Proper Grid Drive".
†Refer to "Cooling" under "Application Notes".

Cooling

Sufficient air cooling must be provided so that the maximum temperature of anode, grid and cathode seals does not exceed 250°C under any condition of operation. Improved tube life and greater reliability may be obtained if all seals are cooled well below this maximum.

Charts following these notes show the minimum air flow required to cool the anode at various rates of plate dissipation and incoming air temperature. These charts apply only to the cooling of the anode when enclosed in a standard cowling as illustrated. Since the cathode end of the tube may be well enclosed in the high-frequency tuning circuit, additional air flow, apart from that flowing through the cowling and used to cool the anode, may be required to cool seals. Tempilaq* paint is suggested for making temperature measurements at such points.

ELECTRICAL

Heater Voltage

In the frequency range where this tube is usually operated, the electron transit time is not necessarily small with respect to the period of oscillation. The transit time heating effect should be compensated by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, plate current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of $\pm 5\%$ from optimum is permitted.

For applications above 500 Mc it is suggested that the Machlett Engineering Department be consulted for optimum heater voltages.

Plate Surge-Limiting Impedance

In tubes such as the ML-7211 with very closely spaced electrodes, extremely high voltage gradients occur even with moderate tube operating voltages. Any tube flash-arcing may be destructive. A series impedance in the B+ lead which limits the peak current under surge conditions to 15 amperes or less is recommended. Such operation is particularly advisable where d.c. heater excitation is used and the heater voltage is used to obtain a d.c. grid bias. Under such conditions, surge currents can get to the negative plate voltage

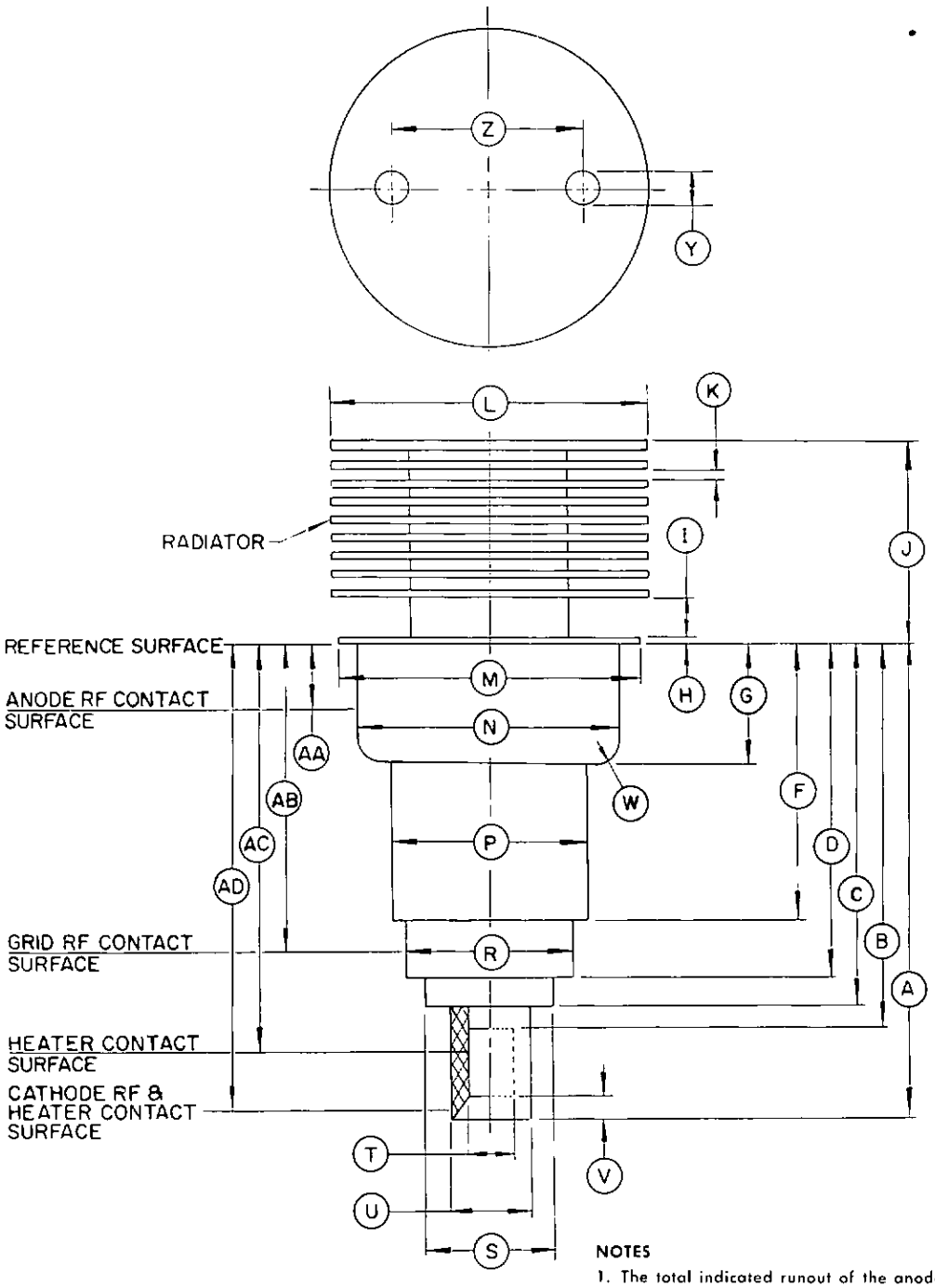
*Product of Tempil Corporation, New York, N. Y.

OUTLINE DIMENSIONS

Ref.	Minimum	Maximum
A	1.815	1.875
B	—	1.534
C	—	1.475
D	1.289	1.329
F	.970	1.010
G	.462	.477
H	—	.040
I	.125	.185
J	.766	.826
K	.025	.046
L	1.234	1.264
M	1.180	1.195
N	1.025	1.135
P	.752	.792
R	.655	.665
S	—	.545
T	.213	.223
U	.315	.325
V	—	.086
W	—	.100
Y	.105	.145
Z	.650	.850

DIMENSIONS
ELECTRODE CONTACT AREA

Ref.	Limits	Contact
AA	.198 ± .163	Anode
AB	1.225 ± .040	Grid
AC	1.631 ± .097	Heater
AD	1.645 ± .170	Cathode



NOTES

1. The total indicated runout of the anode and grid contact surfaces with respect to the cathode contact surface will not exceed .020.
2. The total indicated runout of the cathode contact surface with respect to the heater contact surface will not exceed .012.
3. All dimensions in inches.

OUTLINE DRAWING DIMENSIONS AND NOTES

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ST-1705 5M 5-60

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supply lead only through the heater winding, and may cause shorting of the heater element unless current limiting is provided. Failure of tubes due to internal flash-arcs is much more prevalent when the circuit is not tuned to optimum conditions. Even though laboratory tests indicate no such protection is needed, poor circuit adjustment in the field may result in shortened tube life.

Provision for Circuit Tuning

With high-frequency circuits a very small motion of a tuning plunger may throw the tube out of resonance and result in high plate current and/or excessive anode dissipation. If the tube is operated at or close to maximum ratings, it is suggested that provision be made for tuneup at reduced plate voltage in any circuit where the above conditions obtain.

Self Biasing Operation

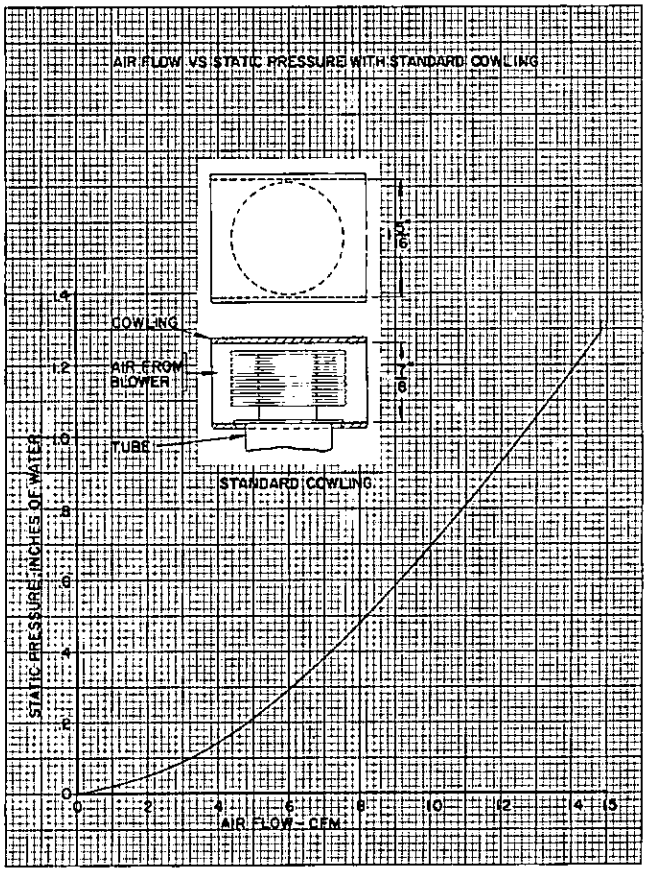
In general, an RC bias should be in the cathode circuit such that with normal d.c. plate voltage and no grid drive the plate current does not exceed 190 mA, i.e. the maximum rated cathode current. Both cathode and grid resistance biasing may be used. If grid resistor biasing is used, special care must be taken to protect the tube against loss of excitation; otherwise excessive plate currents may damage the cathode.

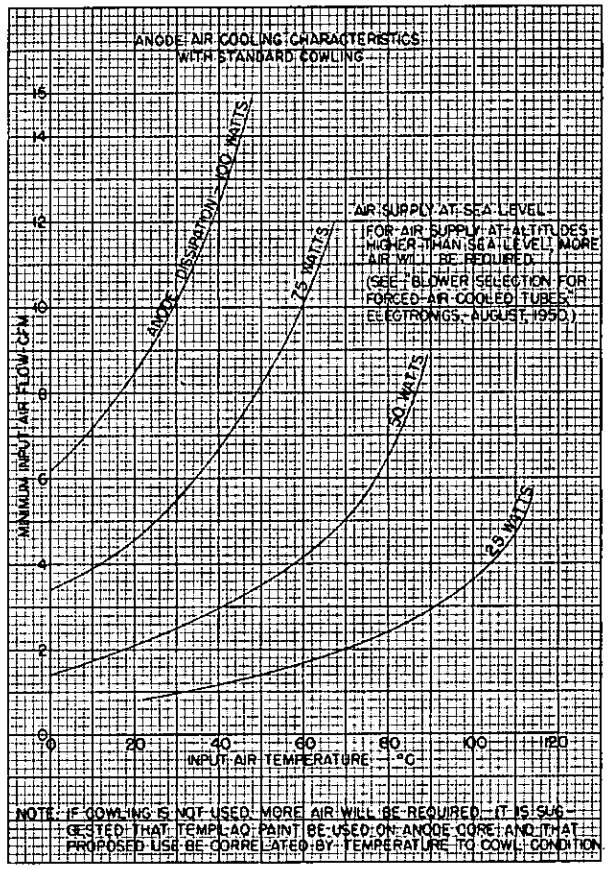
Determination of Proper Grid Drive

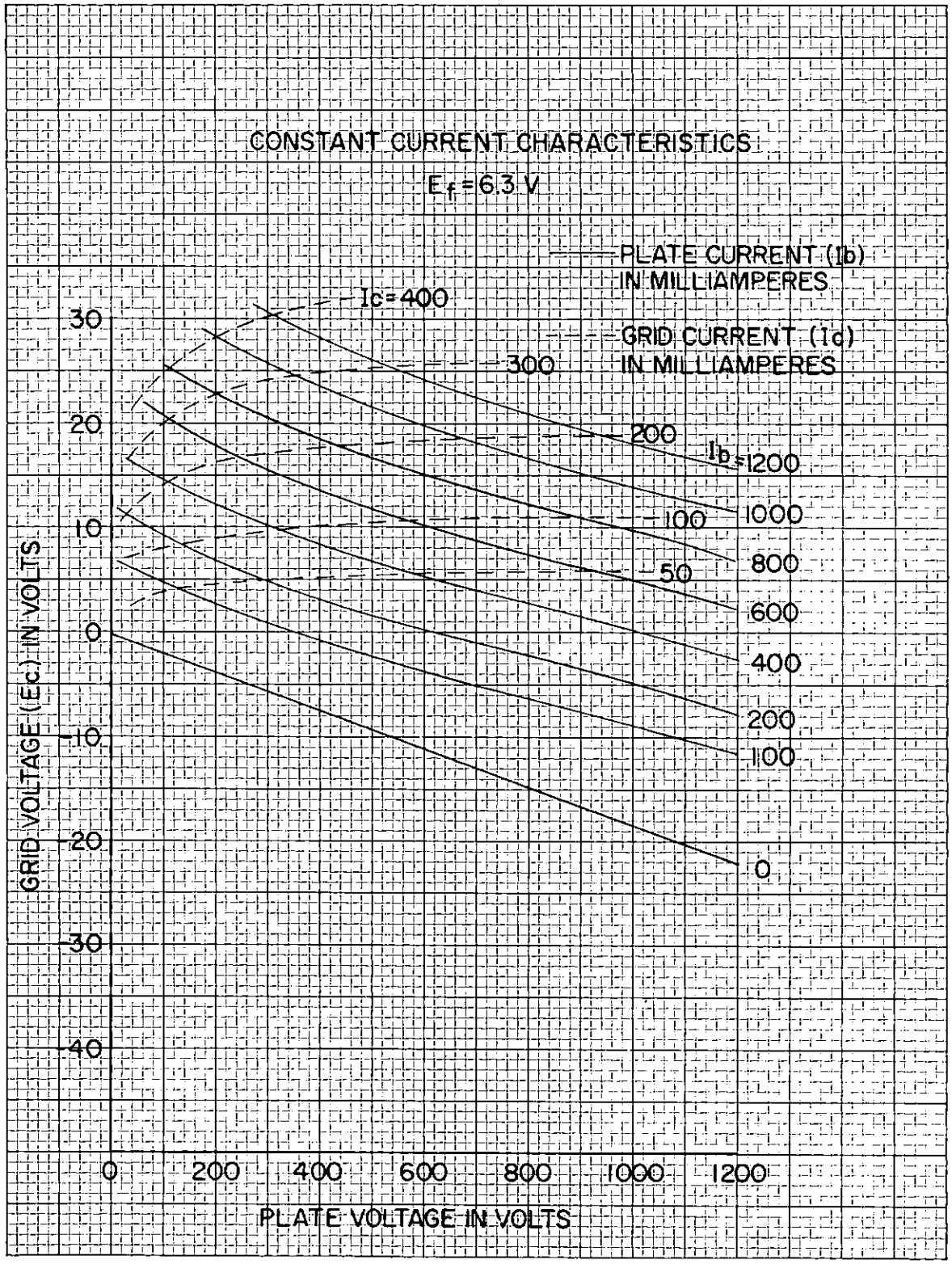
In grounded-cathode stages, the power output tends to saturate as the grid drive increases. In grid-separation circuits, increased output power is always obtainable from increased grid drive, due to the fact that a considerable portion of the grid driving power appears in the output load. Whereas high grid driving power leads to somewhat greater power output in grid-separation amplifiers, it also results in high grid current, increased back heating of the cathode and distortion of the r.f. signals due to the heavy loading of the grid signal in the positive grid region; this usually shortens the life of the tube. For normal operation the average grid current should not exceed 30% of the average plate current. At higher operating frequencies this percentage should be even lower. The tube should never be operated without a suitable plate load.

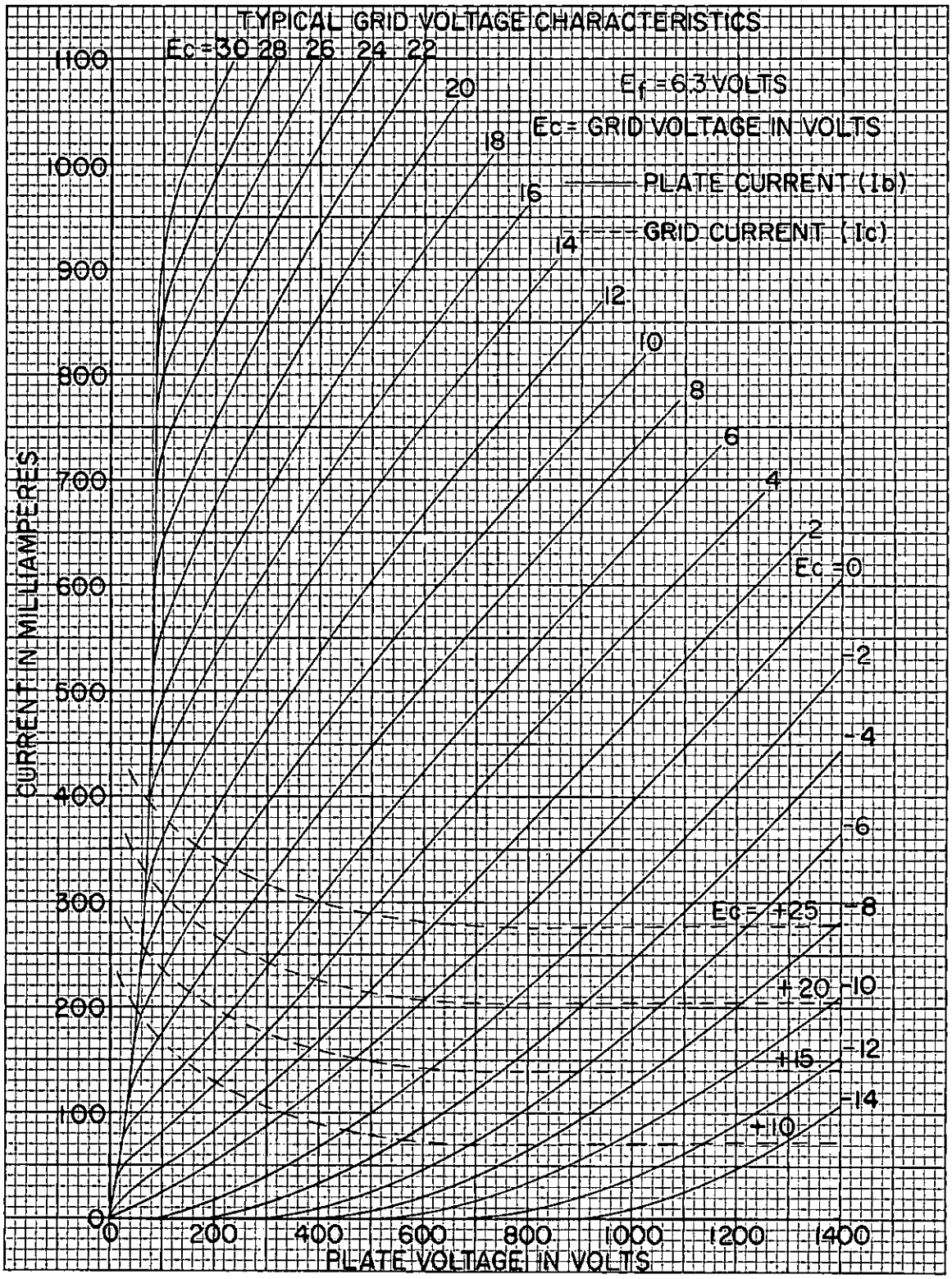
Unusual Applications

If conditions are such that the preceding ratings do not apply, additional information may be obtained from the Machlett Engineering Department.






CONSTANT CURRENT CHARACTERISTICS
E_f = 6.3 V
PLATE CURRENT (Ib) IN MILLIAMPERES
GRID CURRENT (Ic) IN MILLIAMPERES
Ic=400
300
200
100
50
Ib=1200
1000
800
600
400
200
100
0
30
20
10
0
-10
-20
-30
-40
GRID VOLTAGE (Ec) IN VOLTS
0
200
400
600
800
1000
1200
PLATE VOLTAGE IN VOLTS


TYPICAL GRID VOLTAGE CHARACTERISTICS
Ec=30 28 26 24 22
20
18
16
14
12
10
8
6
4
2
Ec=0
-2
-4
-6
-8
-10
-12
-14
Ec=+25
+20
+15
+10
Ef=6.3 VOLTS
Ec= GRID VOLTAGE IN VOLTS
PLATE CURRENT (Ib)
GRID CURRENT (Ic)
CURRENT IN MILLIAMPERES
1100
1000
900
800
700
600
500
400
300
200
100
0
0
200
400
600
800
1000
1200
1400
PLATE VOLTAGE IN VOLTS

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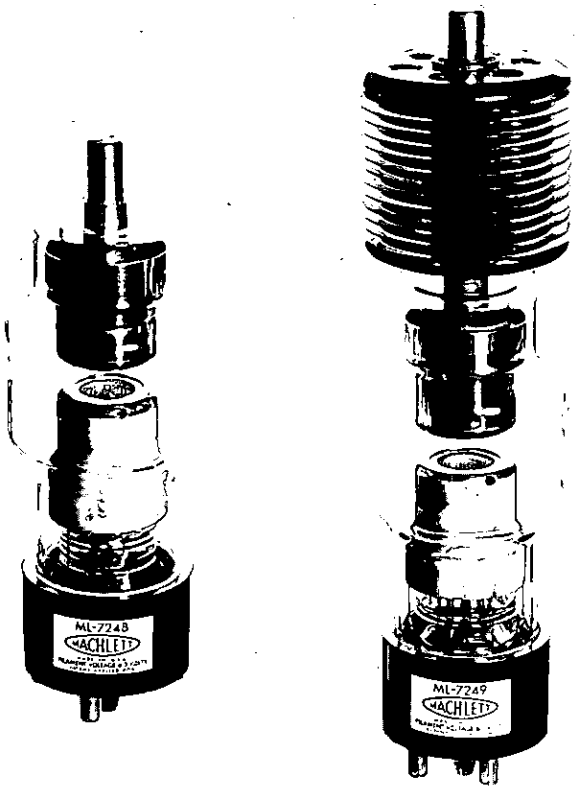


MACHLETT

ML-7248
ML-7249

DESCRIPTION & RATINGS

DESCRIPTION

The **ML-7248** and **ML-7249** are high voltage tetrodes, having identical electrical characteristics, designed for use as switch tubes in hard pulse modulators for radar applications and as general-purpose, high-voltage electronic switches in high-voltage switching and control circuits.

The **ML-7248** is designed for oil immersed operation and has a maximum hold-off and inverse voltage rating of 125 PKV. The **ML-7249**, which incorporates a radiator for increased plate dissipation ratings, is designed for either air insulation or oil immersed operation. When operated in air, the maximum hold-off and inverse voltage rating is 65 KV; in oil, the corresponding rating is 125 KV.

GENERAL CHARACTERISTICS

Electrical		
Filament Voltage	6.3	volts
Filament Current, approximate	11.7	Amps
Direct Interelectrode Capacitances, approximate		
Cathode-control grid	6.7	$\mu\mu f$
Cathode-screen grid	3.5	$\mu\mu f$
Cathode-plate	0.08	$\mu\mu f$
Plate-control grid	0.08	$\mu\mu f$
Plate-screen grid	2.0	$\mu\mu f$
Control grid-screen grid	20.0	$\mu\mu f$
Mechanical		
Mounting Position	Horizontal or vertical cathode end down	
Type of Cooling		
With oil insulation — ML-7248 & ML-7249	Convection†	
Maximum oil temperature for maximum dissipation	75	°C
With air insulation — ML-7249	Forced air‡	
Air flow on radiator	See Air Cooling Characteristics	
Maximum incoming air temperature	50	°C

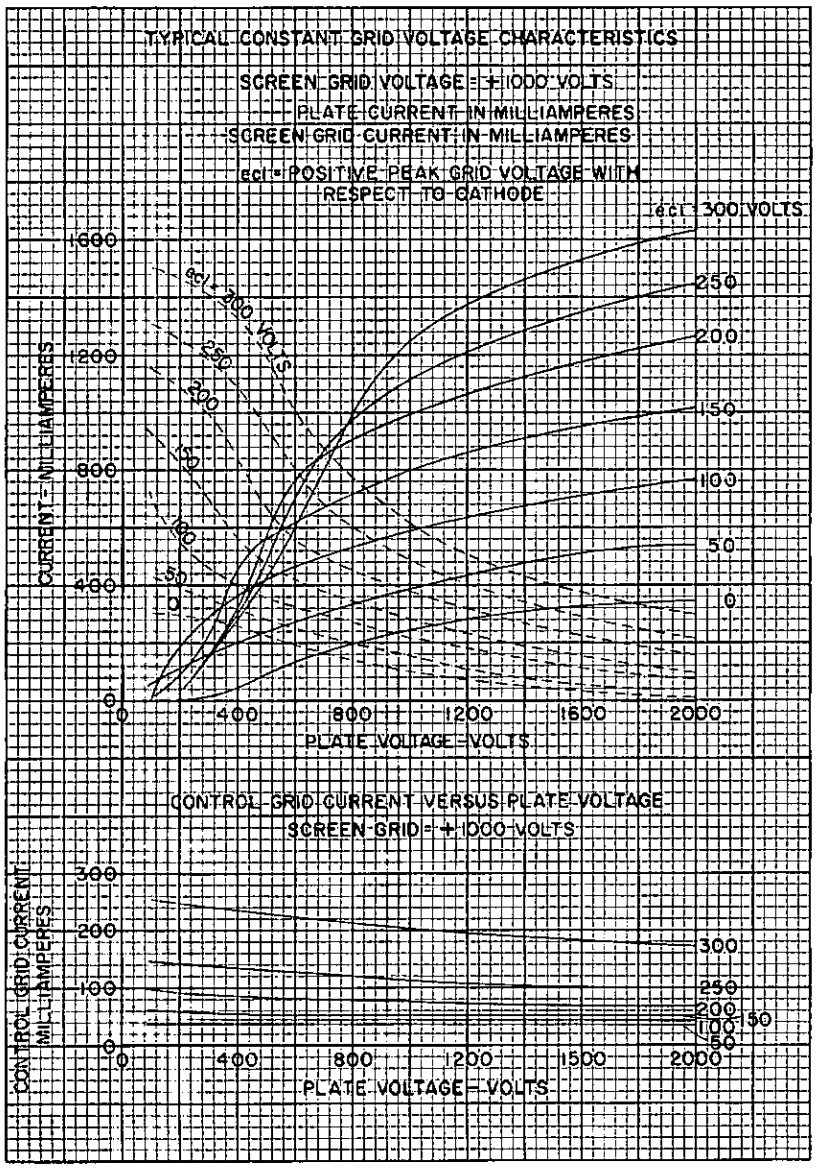
† When the ML-7248 or ML-7249 is mounted cathode end down in oil, a minimum oil flow of 3 pints per minute must be directed at the cathode stem during the application of filament power. (See outline drawing).

‡ When the ML-7249 is operated in air, a minimum air flow of 1½ cfm must be directed into the cathode stem before and during the application of filament power. (See outline drawing. This requirement applies to the ML-7248 if filament power is applied while the tube is in air.)

MAXIMUM RATINGS

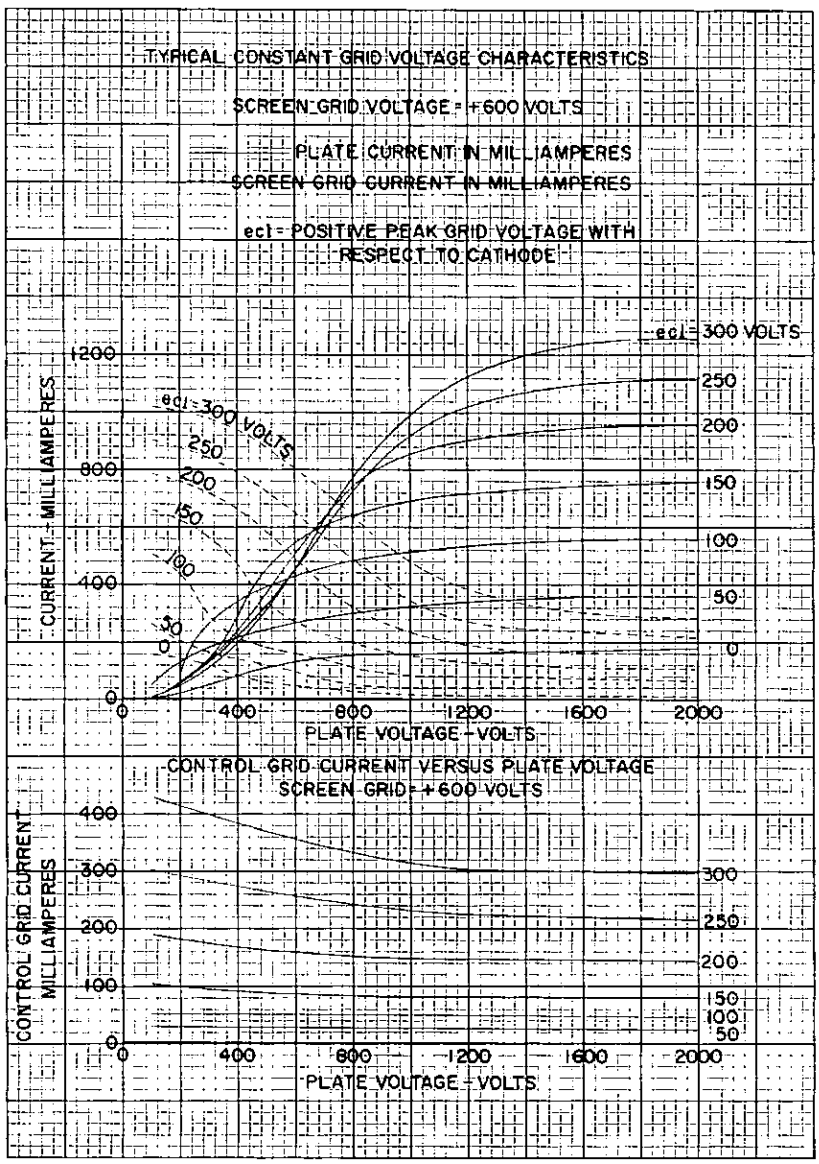
Maximum Ratings, Absolute Values	ML-7248	ML-7249	
Hold-off voltage — oil	125	125	KV
air	—	65	KV
Inverse voltage — oil	125	125	KV
air	—	65	KV
Cut-off control grid voltage (for 125 PKV hold-off voltage and 1,000 volts screen voltage)	−420	−420	Volts
Peak cathode current**	2.0	2.0	Amps
Plate dissipation — in air	—	300	Watts
Plate dissipation — in oil	200	500	Watts
Screen grid dissipation	20	20	Watts
Control grid dissipation	10	10	Watts
Maximum glass temperature	150	150	°C

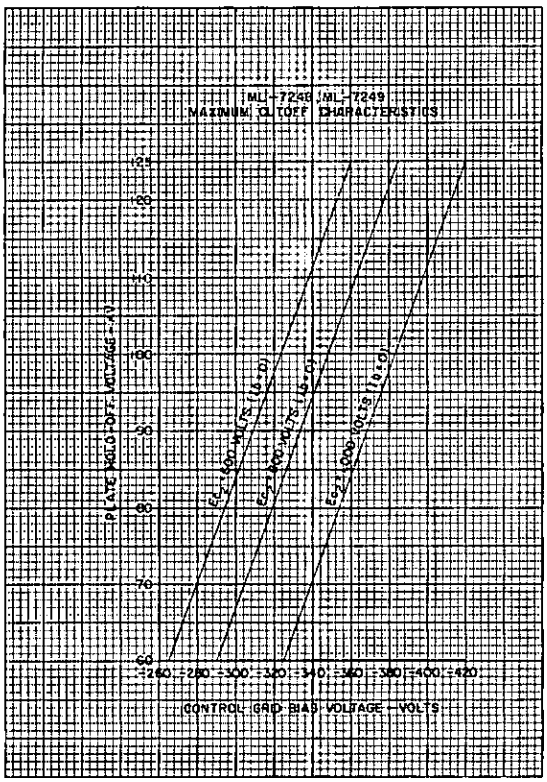
** Represents maximum usable cathode current (plate current plus current to each grid) for any conditions of operation.

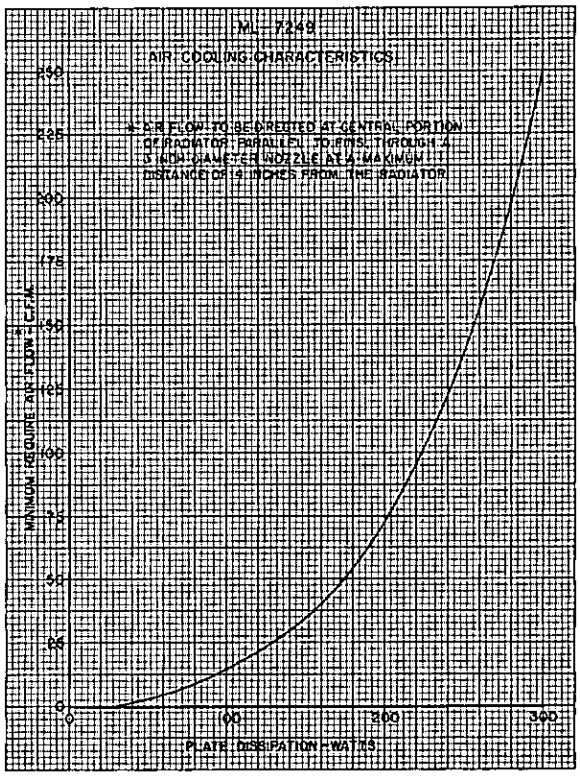


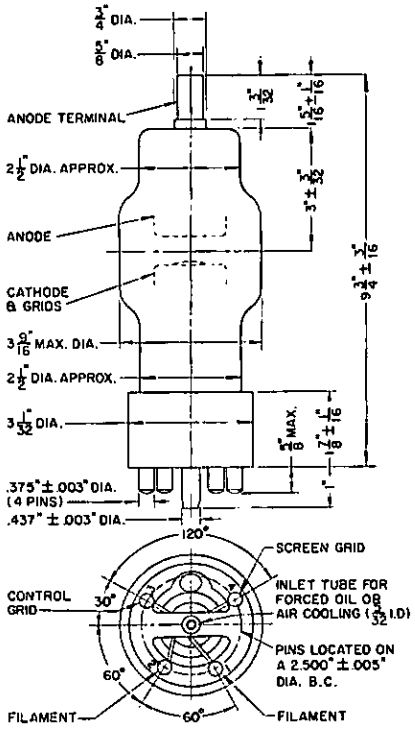
TYPICAL OPERATING CONDITIONS

Typical Operation (in oil) — Pulse High-Voltage Switching		
Control Grid Bias Voltage, for 125 PKV hold-off voltage	−360	Volts
Screen Grid Voltage	600	Volts
Positive Control Grid Drive Voltage	250	Volts
Tube Drop	1,200	Volts
Pulse Plate Current	1.02	Amps
Pulse Control Grid Current	.22	Amps
Pulse Screen Grid Current	.27	Amps
Duty, maximum for this condition of operation	12	%

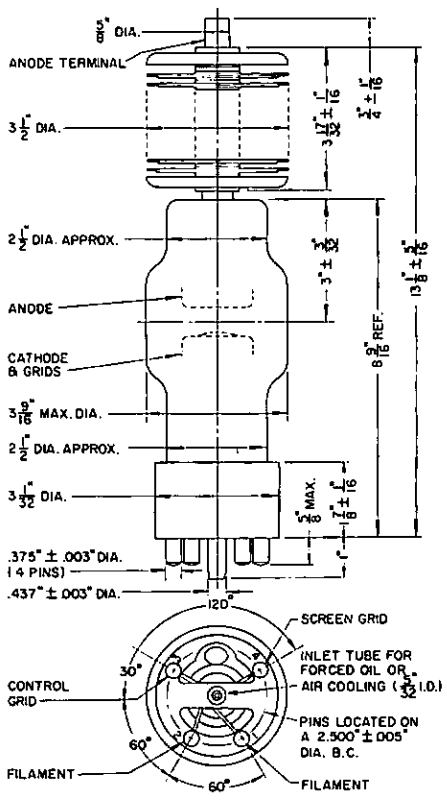








DIMENSIONS — ML-7248



DIMENSIONS — ML-7249

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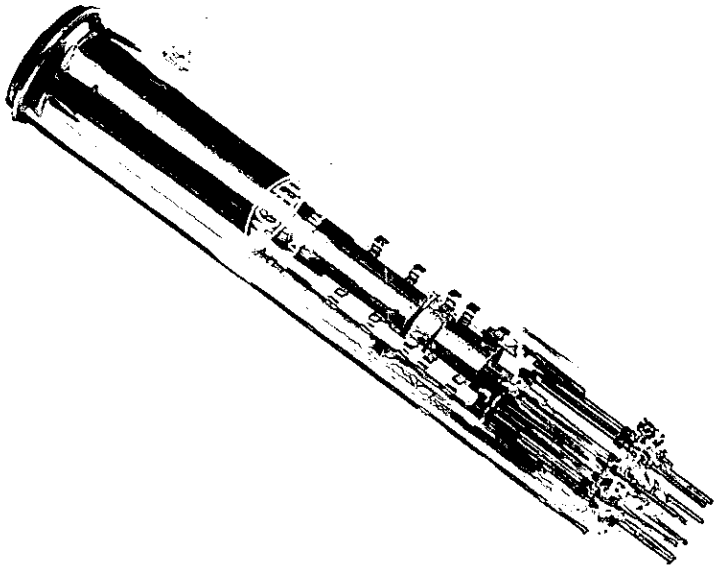


MACHLETT

ML-7351

DESCRIPTION & RATINGS

DESCRIPTION

The ML-7351 is a small television camera tube designed primarily for use at low light level in industrial applications with limited subject motion. Its resolution capability is about 500 lines. Using a photoconductive layer as its light sensitive element, the ML-7351 has a sensitivity which permits televising scenes with about 0.1 foot-candles illumination on the faceplate of the tube. For average scenes, this corresponds to approximately 5 foot-candles illumination on the scene when using an f/2 lens. The spectral response characteristic of the photoconductive layer exhibits a peak in the red and is somewhat dependent on dark current. The signal decay rate or lag of the ML-7351 is approximately twice that of the ML-6198.

GENERAL CHARACTERISTICS

Heater, for Unipotential Cathode:	
Voltage (AC or DC)	6.3 ± 10% volts
Current	0.6 ampere
Direct Interelectrode Capacitance:	
Signal Electrode to All Other Electrodes	4.5 $\mu\mu f$
Spectral Response	See Curve
Photoconductive Layer:	
Maximum Useful Diagonal of Rectangular Image (4 x 3 Aspect Ratio)	0.62 inch
Orientation of Quality Rectangle — Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and short index pin.	
Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	6¼″ ± ¼″
Greatest Diameter, excluding side tip	1.125″ ± 0.010″
Maximum Radius, including side tip	0.800″
Bulb	T-8

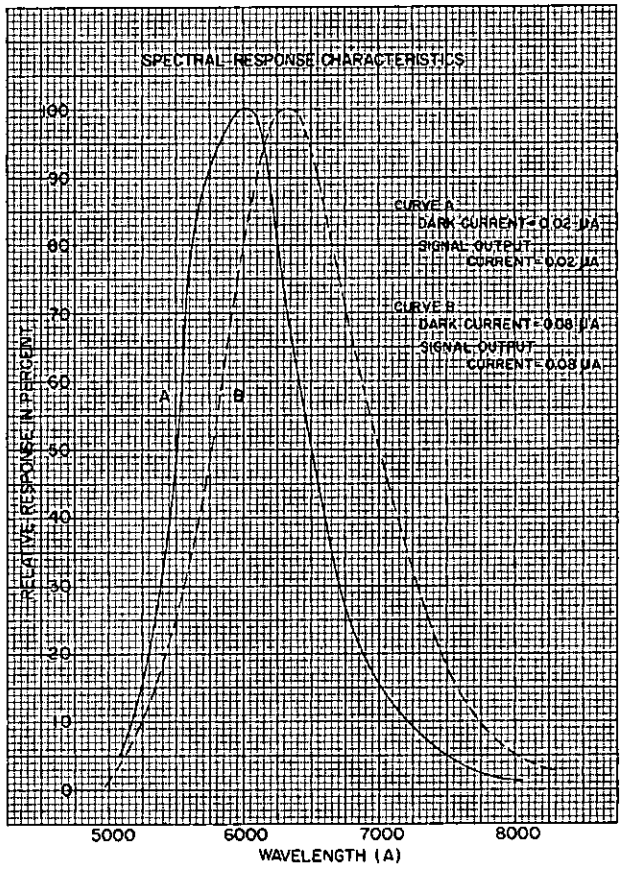
TYPICAL OPERATING CONDITIONS

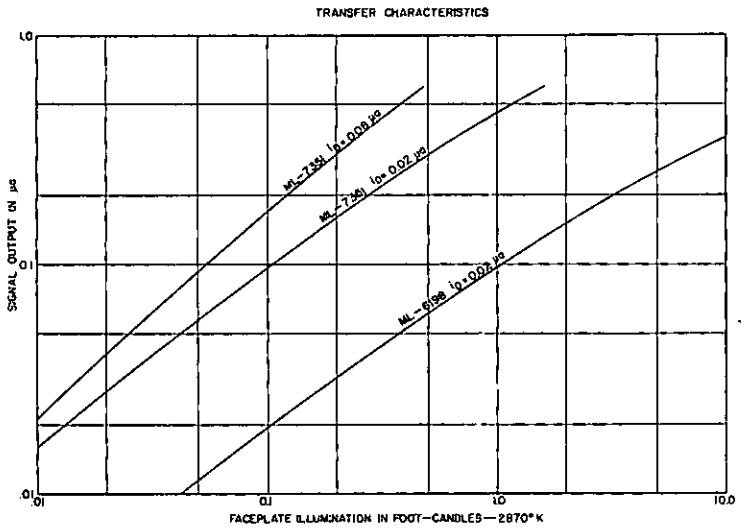
Typical Operation		
Faceplate Illumination (Highlight)	0.3 to 0.7	ft-c
Signal-Electrode Voltage	10 to 25	volts
Maximum Rating	40	volts
Grid No. 4 (Decelerator) & Grid No. 3 (Beam Focus) Voltage	250† to 300	volts
Grid No. 2 (Accelerator) Voltage	300	volts
Grid No. 1 Voltage (For picture cutoff)‡	−45 to −100	volts
Highlight Signal-Output Current	0.2 to 0.4	μamps
Maximum Dark Current	0.08	μamp
Uniform 2870°K Tungsten Illumination on Tube Face to Produce Signal-Output Current of 0.1 to 0.2 μamp	0.1 to 0.3	ft-c
"Gamma" of Transfer Characteristic	0.6 to 0.7	
Visual Equipment Signal-to-Noise Ratio (Approx.)*	300:1	
Maximum Peak-to-Peak Blanking Voltage:		
When applied to grid No. 1	40	volts
When applied to cathode	10	volts
Field Strength at Center Focusing Device	40	gausses
Field Strength of Adjustable Alignment Coil	0 to 4	gausses

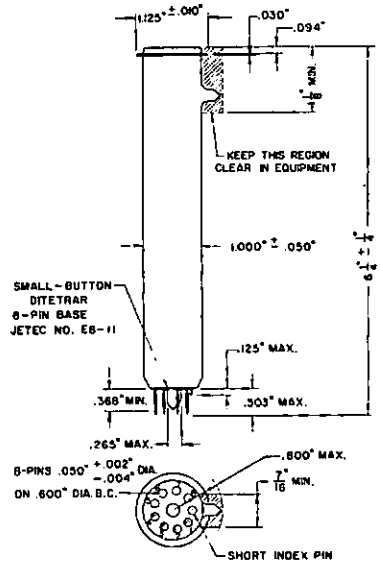
†Definition, focus uniformity, and picture quality decrease with decreasing grid No. 3 and grid No. 4 voltage. In general, grid No. 3 and grid No. 4 should not be operated below 250 volts.

‡With no blanking voltage on grid No. 1.

*Measured with a high-gain, low-noise, cascode-input amplifier having bandwidth of 5 Mc.







PIN NO.	ELEMENT
1	HEATER
2	GRID NO. 1
3	INTERNAL CONNECTION DO NOT USE
4	INTERNAL CONNECTION DO NOT USE
5	GRID NO. 2
6	GRIDS NO. 3 & NO. 4
7	CATHODE
8	HEATER
FLANGE	SIGNAL ELECTRODE
SHORT INDEX PIN	INTERNAL CONNECTION MAKE NO CONNECTION

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