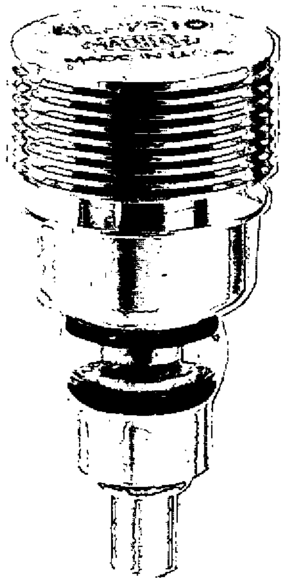


MACHLETT

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".

from JEDEC release #2916, Aug. 1, 1960

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.

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.

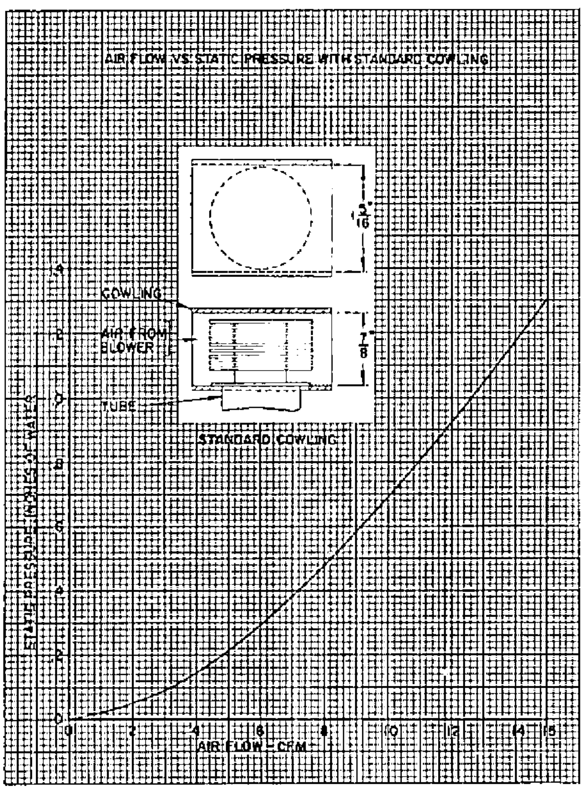
For pulsed operation, a bypassed or unbypassed grid resistor is usually satisfactory provided suitable plate surge-limiting impedance is used.

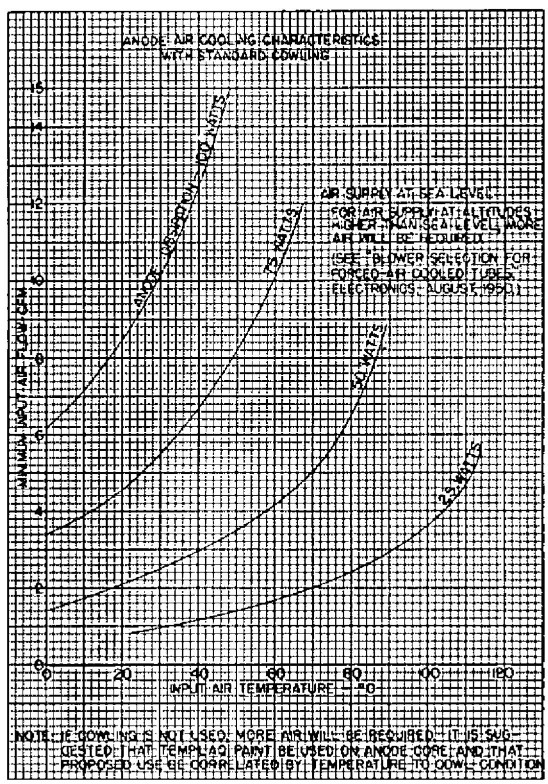
Determination of Proper Grid Drive

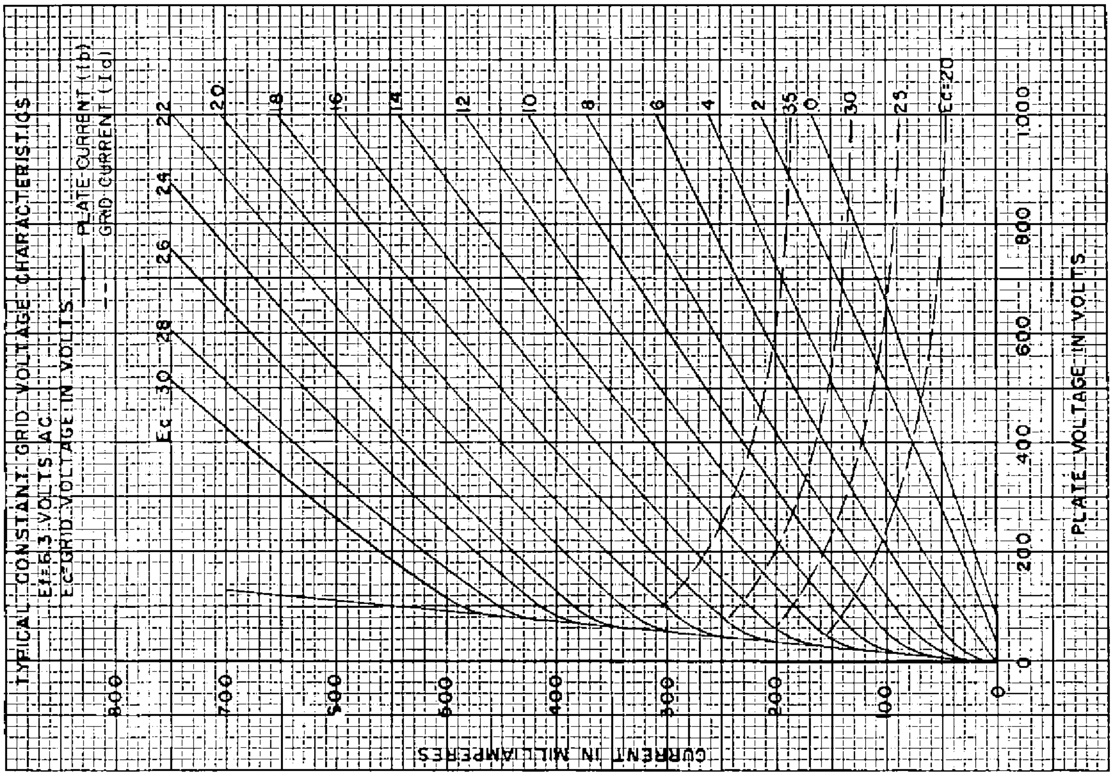
In grounded-cathode stages, the power output tends to saturate as the grid drive increases. In grid-separation circuits, increased output power is always obtainable from increased grid drive, due to the fact that a considerable portion of the grid driving power appears in the output load. Whereas high 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.

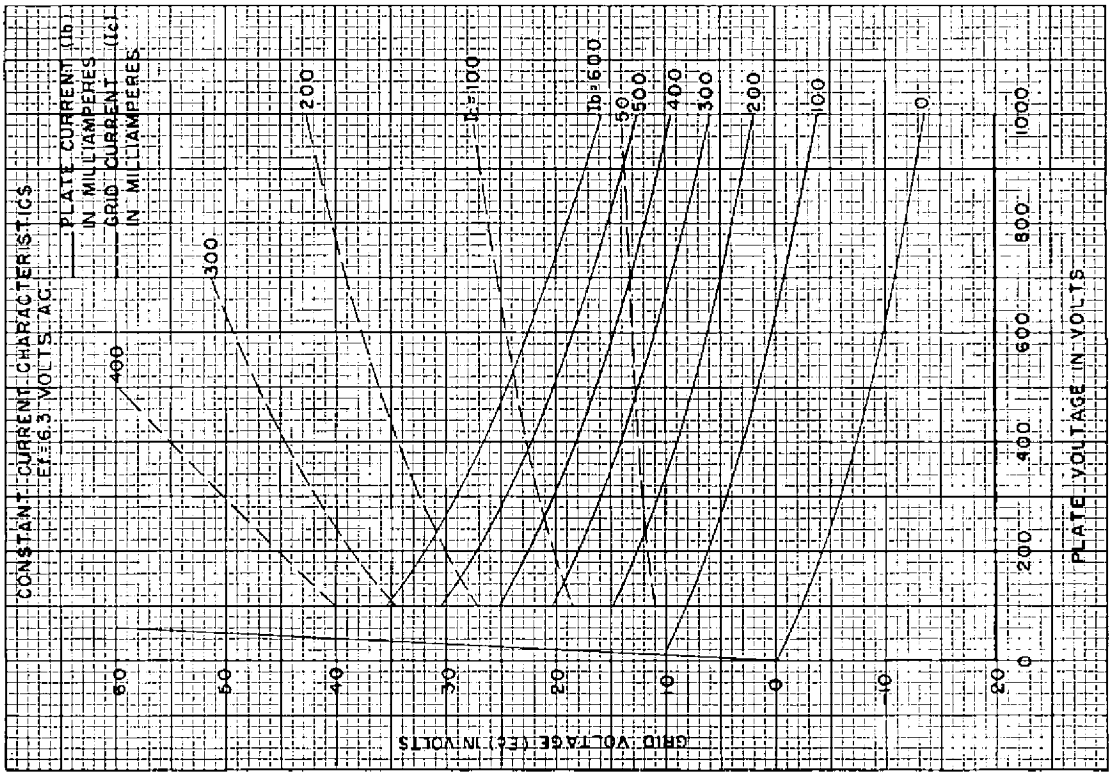
Unusual Applications

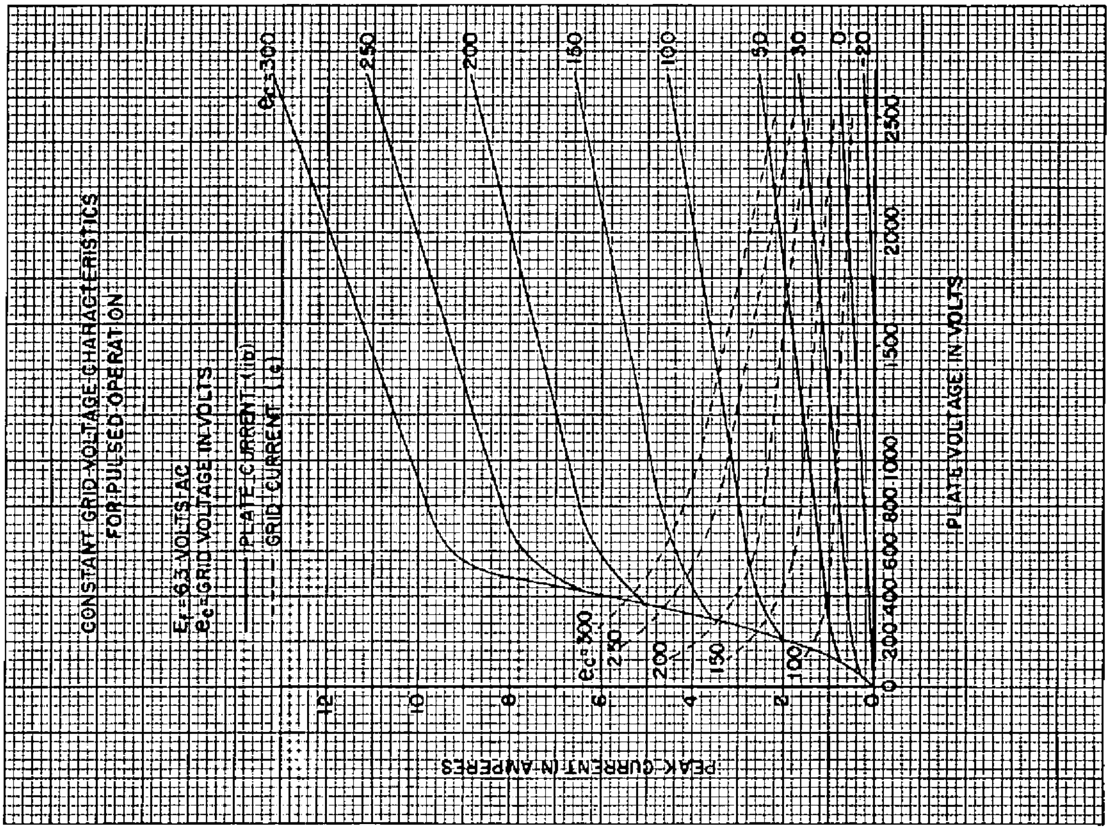
If conditions are such that the preceding ratings do not apply, additional information may be obtained from the Machlett Engineering Department.

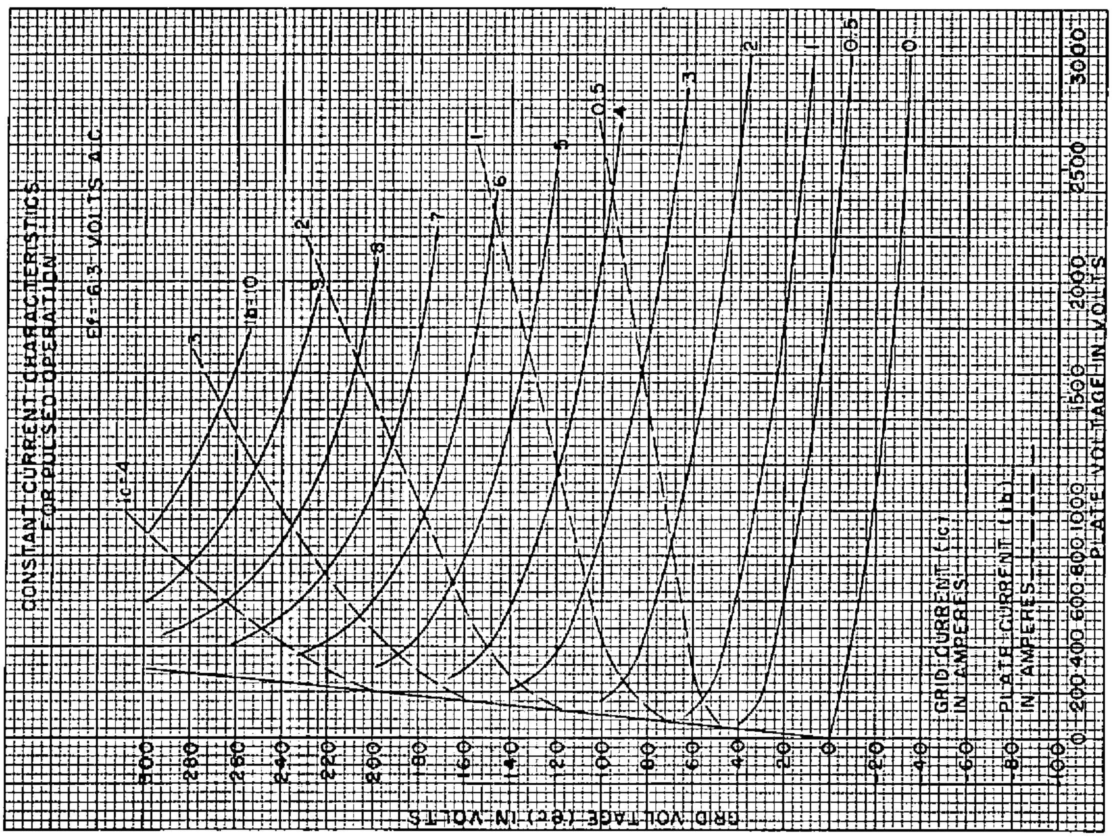





TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
Ef=6.3 VOLTS AC
Ec=GRID VOLTAGE IN VOLTS
PLATE CURRENT (Ib)
GRID CURRENT (Ic)
CURRENT IN MILLIAMPERES
PLATE VOLTAGE IN VOLTS


CONSTANT CURRENT CHARACTERISTICS
Ef=6.3 VOLTS AC
PLATE CURRENT (Ib) IN MILLIAMPERES
GRID CURRENT (Ic) IN MILLIAMPERES
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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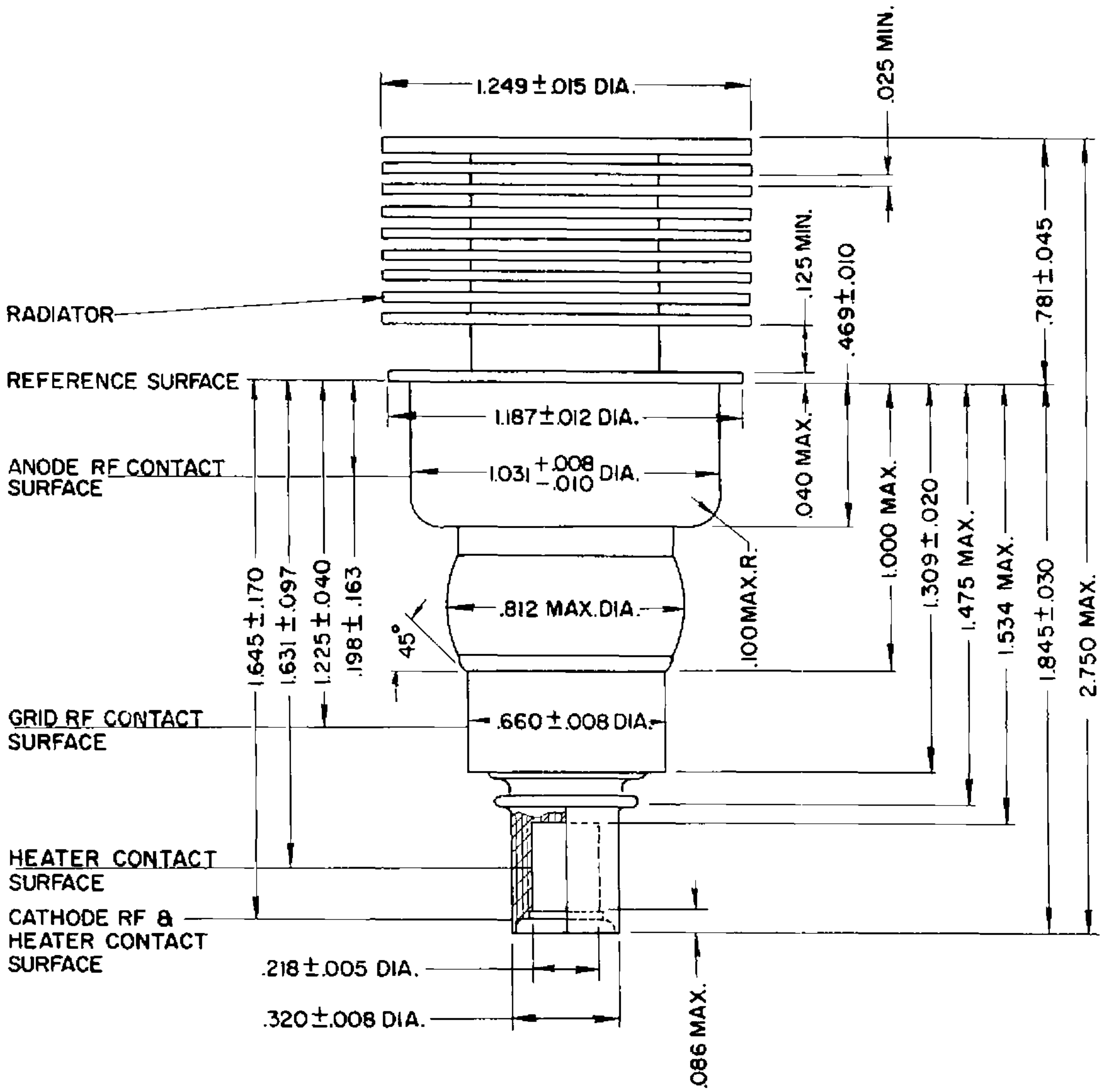

NOTES:

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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