

ML-8618

ML-8618V



High Power-Gain Triodes

200 kW, CW

8 Mw Pulse Power

DESCRIPTION

The ML-8618 and ML-8618V are magnetically beamed, high-power, general-purpose, water-cooled triodes. Their unique design, using a magnetic field to beam electron flow, produces extremely favorable plate-grid current division, which results in minimum drive-power requirements and high overall operating efficiency. The cathode of each type consists of sturdy thoriated-tungsten filaments. Parallel plane anode construction reduces filament power requirements by utilizing both sides of the filaments. The coaxial terminals have low inductance and high heat dissipation capability. Insulating members are low-loss ceramic. The ML-8618V is identical to the ML-8618 except that it is provided with an ion getter pump.

When operated as a class C amplifier or oscillator, these tubes are capable of a continuous output of up to 200 kW with about 700 W driving power. When used as switch tubes in hard-tube pulse modulators for radar, particle accelerators, or similar applications, they can deliver 8 Mw pulse output. Since the magnetic beaming reduces the grid dissipation, the tubes are capable of operating with much longer pulses and higher duty factors than conventional tubes of similar size.

The water-cooled anodes of these tubes are capable of dissipating up to 80 kW. The tubes can be operated in air at maximum plate voltage ratings. Maximum ratings apply at frequencies up to 30 MHz. Useful power output can be obtained at higher frequencies with a reduction in plate voltage.

GENERAL CHARACTERISTICS

Electrical	
Filament Voltage (AC)	7.5 V
Filament Current	320 A
Filament Starting Current, maximum	700 A
Filament Cold Resistance0028 ohm
Amplification Factor	25
Interelectrode Capacitances, approximate	
Grid-Plate	50 pf
Grid-Filament	145 pf
Plate-Filament	9 pf
Strapped Resonant Frequencies	
Grid-Plate, approximate	135 MHz
Grid-Cathode, approximate	120 MHz
Mechanical	
Mounting Position	Vertical, Anode down
Type of Cooling	Water & Forced-Air
Maximum water inlet pressure	30 psi†
Maximum outgoing water temperature	70 °C
Water flow on anode for 80 kW dissipation	45 gpm††
Water jacket pressure drop for 45 gpm flow	10 psi
Maximum Envelope Temperature	200 °C
Net Weight, approximate	
Tube only	56 lb
Water jacket and magnet	90 lb

†A 30 psi pressure relief valve should be connected to the water jacket.

††Additional forced-air cooling of the grid and filament terminals will be required. This should consist of an air flow of about 200 cfm uniformly distributed on the ceramic bulb and the terminal assembly.

WARNING: This electron tube may give off x-rays when operating at peak voltages in excess of 15 kv, which can be harmful unless adequately shielded by the enclosure within which it is used. Instructions for protective installation are given in National Bureau of Standards Handbook 93, "Safety Standards for Non-Medical X-Ray and Sealed Gamma-Ray Sources".

ACCESSORIES

Item	Part No.
Small Filament Connector	F-27218*
Large Filament Connector	F-27219*
Grid Connector	F-27220*
Water Jacket and Magnet Assembly	F-535437
Water Jacket Assembly with O-Ring Gasket	F-512759
Magnet	P-511165

*For additional information on these accessories, refer to Accessory Data Sheet No. ST-2097.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

(Continuous Commercial Service)

Pulse Modulator or Pulse Amplifier

Maximum Ratings, Absolute Values‡

DC Plate Voltage	45 kV
Peak Plate Voltage	50 kV
DC Grid Voltage	-5000 V
Pulse Cathode Current	200 a
Grid Dissipation	500 W
Plate Dissipation	80 kW
Pulse Duration	10000 μ s#
Duty Factor06 #

Typical Operation

DC Plate Voltage	40 kV
Pulse Output Voltage	37 kv
DC Grid Voltage	-3600 V
Pulse Positive Grid Voltage	1500 v
Pulse Plate Current	150 a
Pulse Grid Current	2.5 a
Pulse Driving Power	12.8 kw
Pulse Output Power	5.5 Mw
Duty Factor06

‡All given maximum ratings may not apply simultaneously. Due to the possibility of instantaneous overheating of electrodes during the pulse, it may be necessary to restrict some of the parameters, e.g., peak plate current, tube drop, pulse duration, duty or average dissipation, in order not to adversely affect the performance of the tube. Because of the many possible combinations of operating conditions, all restrictions cannot be delineated here, and it is suggested to review new applications with the Machlett Engineering Department.

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

**RF Power Amplifier and Oscillator
Class C Telegraphy §**

Keydown conditions per tube without amplitude modulation

Maximum Ratings, Absolute Values

DC Plate Voltage	17 kV
DC Grid Voltage	-4000 V
DC Plate Current	15 A
Grid Dissipation	500 W
Plate Dissipation	80 kW

Typical Operation

DC Plate Voltage	16 kV
DC Grid Voltage	-2000 V
Peak RF Plate Voltage	14.4 kv
Peak RF Grid Voltage	3000 v
DC Plate Current	13 A
DC Grid Current, approximate2 A
RF Load Resistance	595 Ohms
Driving Power, approximate	600 W
Plate Dissipation	35 kW
Grid Dissipation	200 W
Power Output	175 kW
Power Gain	290

§Consult The Machlett Laboratories Engineering Department for this application.

TUBE PROTECTION

The handling of very high power requires particular attention to the removal of power from tubes during fault conditions (initiated by tube or circuit instabilities) since the larger amount of energy involved can cause tube damage if not properly controlled. The tube must, therefore, be protected by limiting the time elapsed from inception of a fault condition to diverting the energy from the tube, as well as the amount of energy expended in the tube during this interval.

In addition to the normal circuit breakers and overload relays, it is necessary that a fast-acting electronic protective device (crowbar) or equivalent be used. This device will in most cases be a triggered gaseous device connected across the output of the plate supply filter, if used, to dissipate the filter-circuit energy as well as the rectifier output. The complete energy source must be shorted out as quickly as possible after the inception of a "fault", and in most cases the time interval should not be allowed to exceed approximately ten microseconds. For some basic electronic-crowbar fault-protection circuit considerations, as well as tests of the effectiveness of a protection device, refer to the references listed.

A nominal value of resistance must be placed in the plate lead of the tube being protected in order to be assured that the impedance of this tube under a flash arc condition is greater than that of the crowbar device when the latter is triggered. Critical damping is required for the crowbar discharge circuit. It is also recommended that a minimum of five to ten ohms resistance be connected in series with each rectifier tube in order to limit surge currents.

In circuits where high transient voltages may be developed due to a shorted load or other fault, special precautions are necessary to keep these excessive voltages from appearing at the tube electrodes.

References:

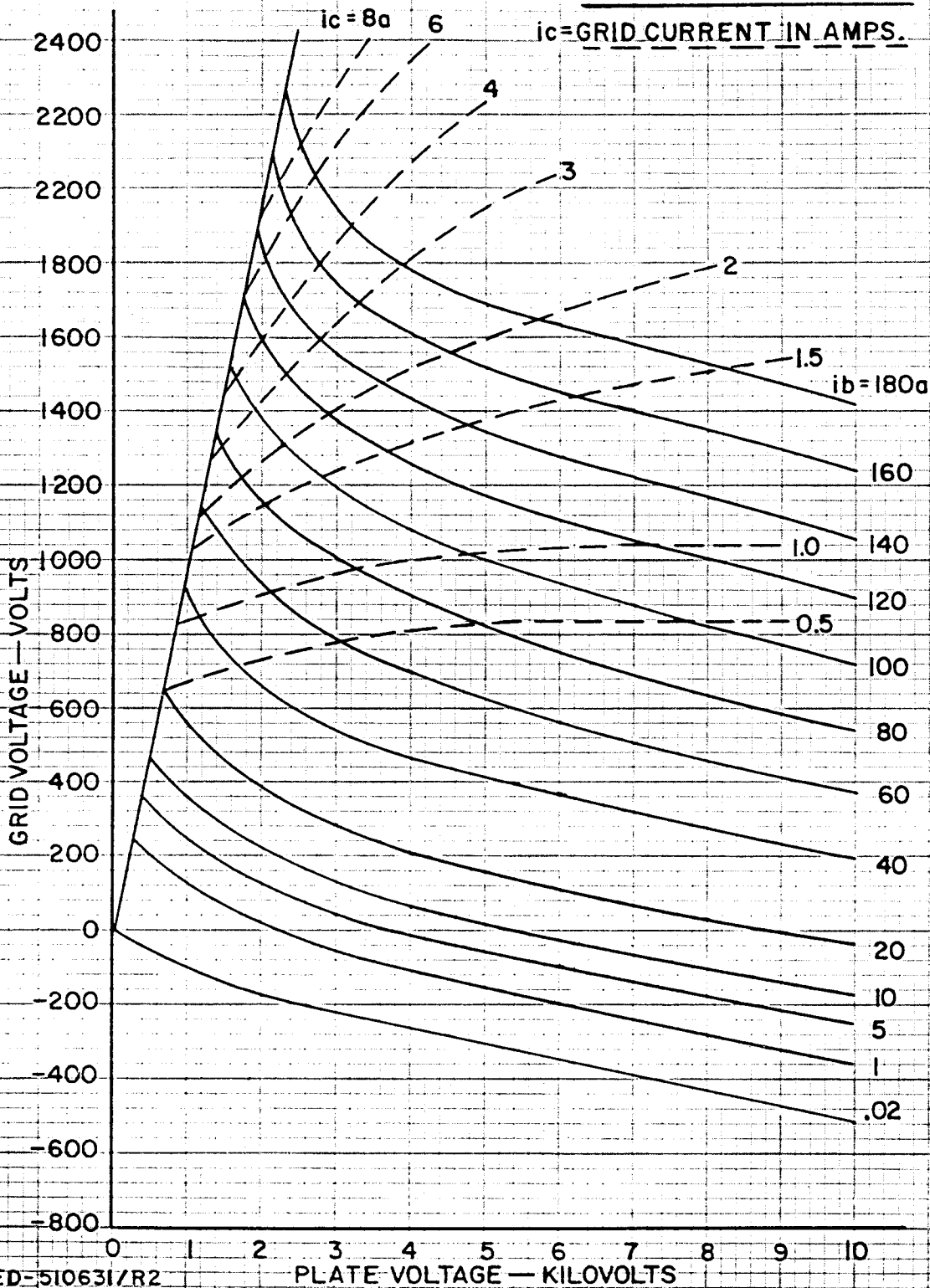
1. W. N. Parker and M. V. Hoover, "Gas Tubes Protect High Power Transmitters", *Electronics*, 29, 144, January 1956.
2. H. D. Doolittle, "High Power Hydrogen Thyratrons", *Cathode Press*, 1, 6, 1954.

CONSTANT CURRENT CHARACTERISTICS

$E_f = 7.5V$

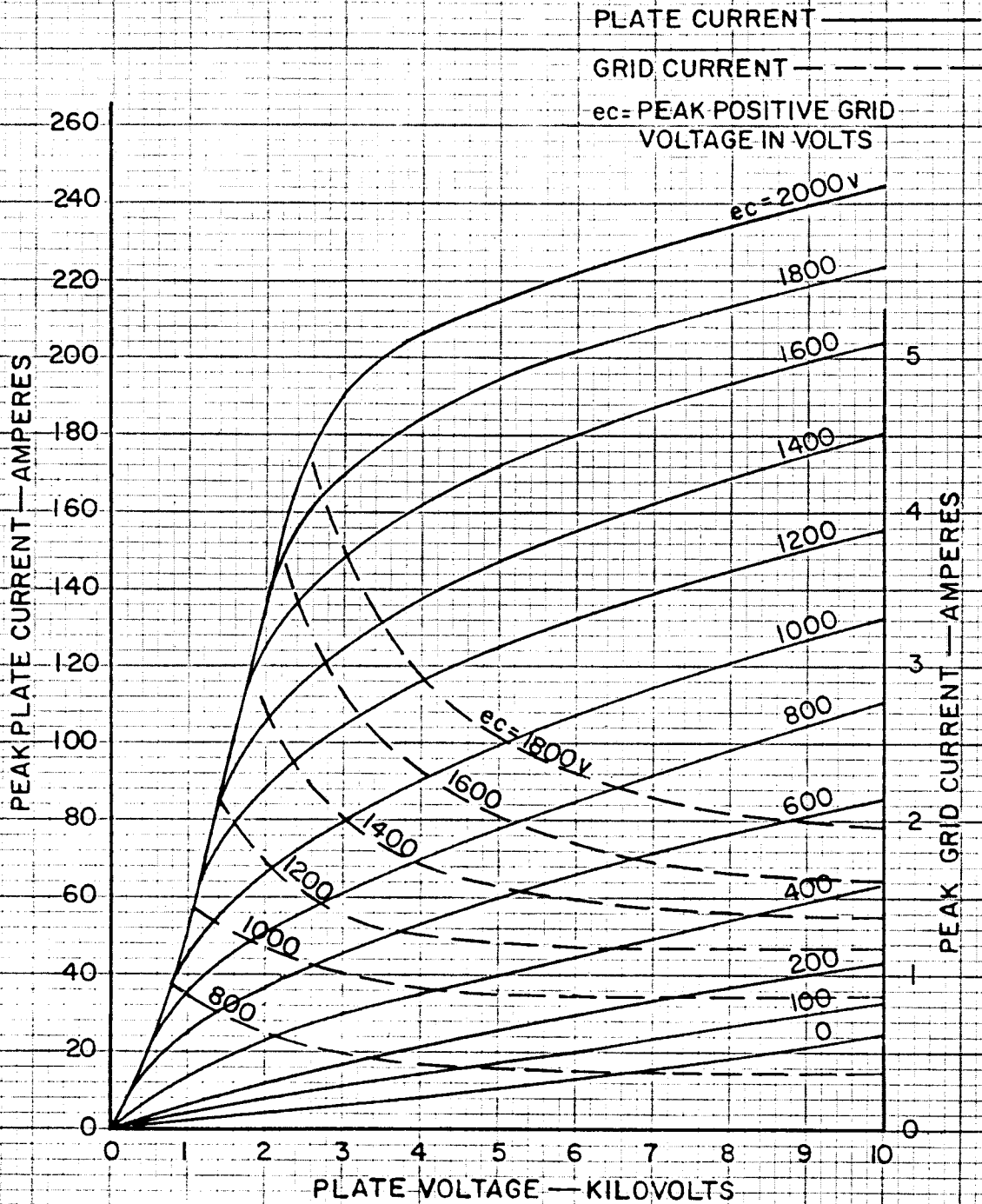
$i_b =$ PLATE CURRENT IN AMPS.

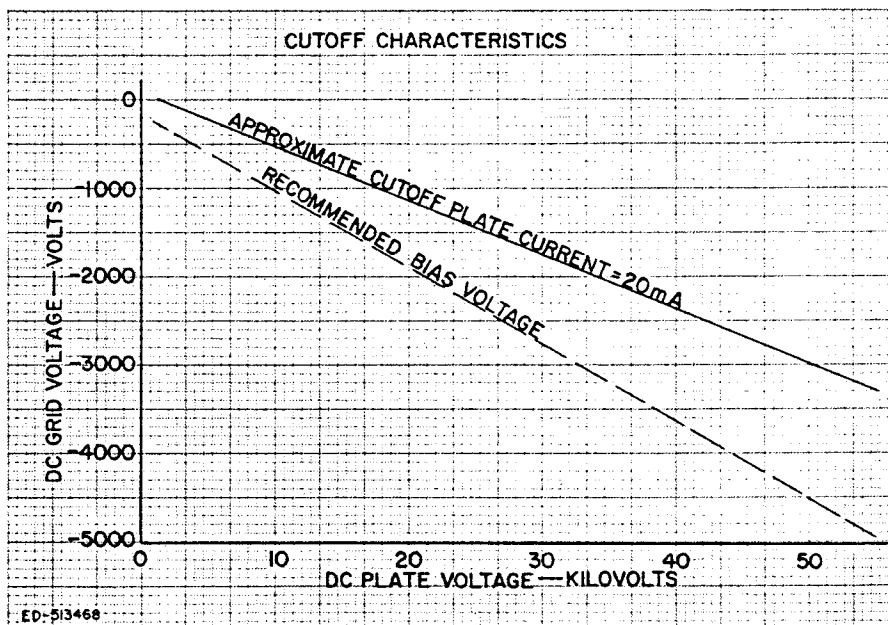
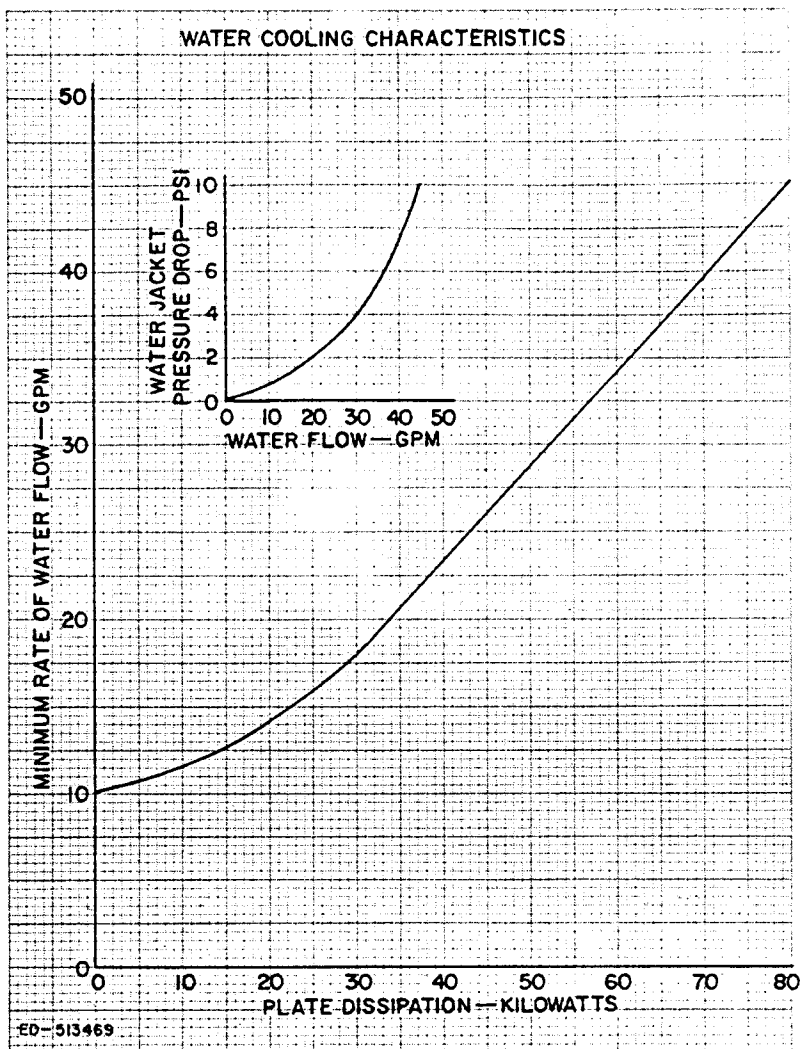
$i_c =$ GRID CURRENT IN AMPS.

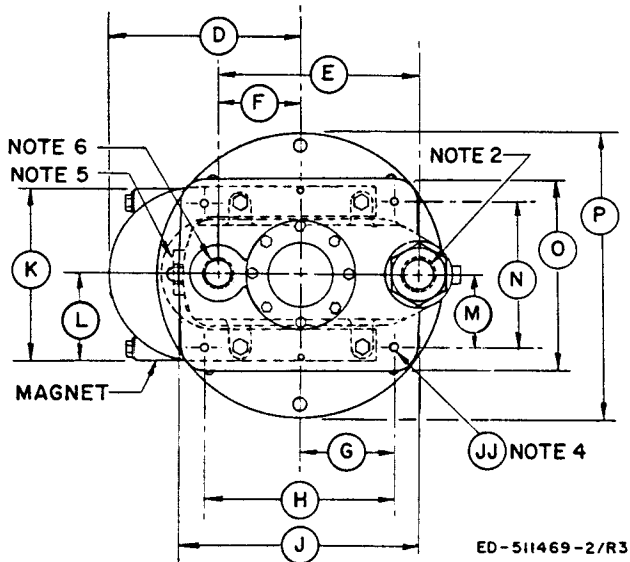
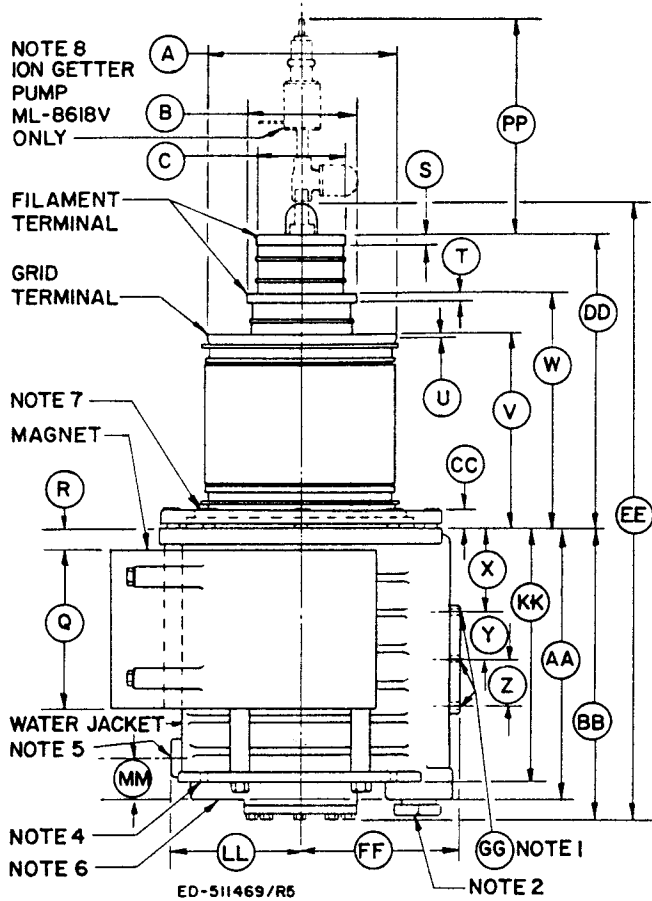


CONSTANT GRID-VOLTAGE CHARACTERISTICS

$E_f = 7.5 \text{ V}$







DIMENSIONS FOR OUTLINE OF ML-8618 AND ML-8618V

Ref	Inches			Notes
	Minimum	Nominal	Maximum	
A	6.917	6.937	6.957	3
B	3.985	4.005	4.025	3
C	3.298	3.318	3.338	3
D	—	7.00	7.50	
E	7.28	7.34	7.40	
F	2.94	3.00	3.06	
G	3.47	3.50	3.53	
H	6.97	7.00	7.03	
J	—	8.88	9.10	
K	—	6.75	6.95	
L	—	3.38	3.48	
M	2.66	2.69	2.72	
N	5.35	5.38	5.41	
O	—	7.00	7.20	
P	—	10.56	10.80	
Q	—	6.00	6.20	
R	.62	.82	1.02	
S	.31	.38	—	
T	.31	.38	—	
U	.10	.13	—	
V	7.17	7.27	7.37	
W	8.61	8.76	8.91	
X	2.75	2.95	3.15	
Y	1.66	1.69	1.72	
Z	1.66	1.69	1.72	
AA	9.90	10.10	10.30	
BB	10.53	10.73	10.93	
CC	.64	.69	.74	
DD	10.74	10.94	11.14	
EE	—	22.86	23.20	
FF	5.72	5.92	6.12	
GG	.30	.38	—	1
JJ	.302	.312	.322	4
KK	9.40	9.60	9.80	
LL	4.49	4.69	4.89	
MM	1.21	1.41	1.61	
PP	—	8.25	8.75	

NOTES:

1. Three holes, ¼-20 tap, (GG) inches deep, for plate connection.
2. Water outlet, 1" NPT tap.
3. Add ± .01" to maximum and minimum for out-of-roundness.
4. Four through holes diameter (JJ) for stand-off insulator mounting.
5. Connection for pressure relief valve, ½" NPT tap.
6. Water inlet, 1" NPT tap.
7. Hold-down ring holds tube in water jacket. Fastened by eight screws.
8. Vac Ion pump, Varian No. 913-0035 (modified) or equivalent and magnet, Varian No. 913-0011 supplied with ML-8618V tube only.

OUTLINE OF ML-8618 AND ML-8618 V



THE MACHLETT LABORATORIES, INC.

1063 Hope Street • Stamford, Conn. 06907 • Printed in U.S.A.

A Raytheon Company