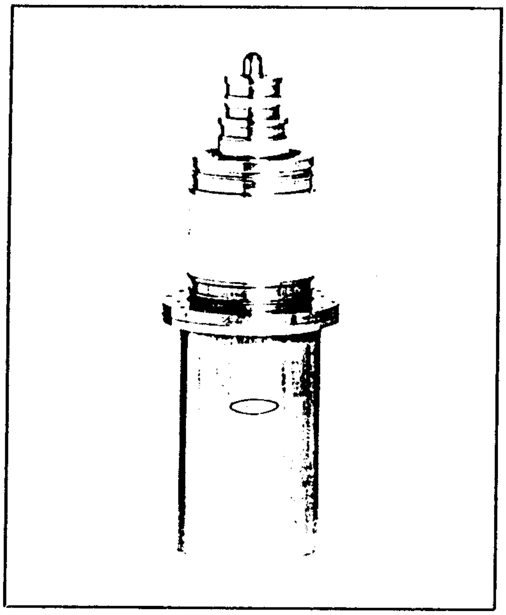
ISSUED 5-64



ML-8547

General Purpose Triode
200 kW CW
15 Mw Pulse Power

MACHLETT
ELECTRON TUBE SPECIALIST

DESCRIPTION

The ML-8547 is a general-purpose, water-cooled, high-power triode designed for applications requiring high plate currents at relatively low plate voltages. It is of particular interest for industrial heating, audio frequency power generation and pulse modulation.

The ML-8547 is capable of switching 6 Mw in a pulse modulator. As an RF generator, it can develop up to 250 kW of output power at 11 kV plate voltage. In class B push-pull circuitry, two tubes can generate approximately 300 kW audio frequency power. Maximum ratings apply up to 30 Mc. Useful power can be obtained at higher frequency with a reduction in ratings.

The anode incorporates an integral water jacket, and is designed to dissipate 175 kW. Sturdy coaxial grid and cathode mounting structures provide low-inductance, high-dissipation, RF terminals. The cathode is a sturdy, self-supporting, stress-free, thoriated-tungsten filament. Envelope insulation members are strong, low-loss ceramic cylinders.

GENERAL CHARACTERISTICS

Electrical

Filament Voltage	14.5	V†
Filament Current	450	A
Filament Starting Current, maximum	1200	A
Filament Cold Resistance	.0035	Ohm
Amplification Factor	14	
Interelectrode Capacitances		
Grid-Plate	170	pf
Grid-Cathode	200	pf
Plate-Cathode	8	pf

Mechanical

Mounting Position	Vertical, anode down	
Type of Cooling	Water and forced-air	
Water flow on anode, minimum for 175 kW plate dissipation	40	gpm
Maximum outgoing water temperature	70	°C
Air flow on bulb and seals, approximate	500	cfm††
Maximum Ceramic Temperature	165	°C
Net Weight, approximate	100	lb

†For cathode currents in excess of 350 amps, filament voltage must be 15.0 volts.

††At frequencies up to 15 Mc, air flow should be directed primarily on filament seals and the main ceramic bulb; at higher frequencies or high ambient temperatures, additional air flow may be required on the grid seals. Air flow should be distributed to maintain uniform temperature, not greater than 165°, around the circumference of the seals.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

AF Power Amplifier and Modulator Class B

Maximum Ratings, Absolute Values

DC Plate Voltage	11	kV
Maximum-Signal DC Plate Current	40	A*
Maximum-Signal DC Grid Current	3.5	A*
Plate Dissipation	175	kW*

Typical Operation (Values are for two tubes)

DC Plate Voltage	10	10	kV
DC Grid Voltage	−750	−750	V
Peak AF Grid-to-Grid Voltage	2300	2800	v
Peak AF Plate-to-Plate Voltage	16	18	kv
Zero-Signal DC Plate Current	2	2	A
Maximum-Signal DC Plate Current	48	72	A
Effective Load Resistance, Plate-to-Plate	428	318	ohms
Maximum-Signal Driving Power, approximate	400	6700	W
Maximum-Signal Power Output	300	510	kW

*Averaged over any audio-frequency cycle of sine-wave form.

RF Power Amplifier and Oscillator Class C Telegraphy

Key-down conditions per tube without amplitude modulation.‡

Maximum Ratings, Absolute Values

DC Plate Voltage	11	kV
DC Grid Voltage	−3500	V
DC Plate Current	30	A
DC Grid Current	3.5	A
Plate Dissipation	175	kW

Typical Operation

DC Plate Voltage	10.5	kV
DC Grid Voltage	−2000	V
Peak RF Grid Voltage	2700	v
Peak RF Plate Voltage	9.5	kv
DC Plate Current	22	A
DC Grid Current	2.7	A
RF Load Resistance	238	ohms
Driving Power, approximate	7300	W
Power Output, approximate	190	kW

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

Pulse Modulator or Pulse Amplifier

Maximum Ratings, Absolute Values

DC Plate Voltage	17	kV
Peak Plate Voltage	19	kv
DC Grid Voltage	−3500	V
Peak Negative Grid Voltage	−4500	v
Pulse Cathode Current	550	a
Grid Dissipation	2500	W
Plate Dissipation	175	kW
Pulse Duration	1000	μs#
Duty Factor	.01	#

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

Typical Operation

DC Plate Voltage	16	kV
DC Grid Voltage	−1750	V
Pulse Positive Grid Voltage	1400	v
Pulse Plate Current	350	a
Pulse Grid Current	80	a
Pulse Driving Power	252	kw
Pulse Power Output	4.9	Mw
Plate Output Voltage	14	kv
Pulse Duration	1000	μs
Duty Factor	.01	

WARNING: Operation of this tube may produce x-rays. Adequate rayproof shielding must therefore be provided in the equipment.

MAXIMUM FREQUENCY RATINGS

Maximum ratings apply up to 30 Mc except as noted. These tubes may be operated at higher frequencies provided the maximum value of plate voltage is reduced according to the tabulation below (other maximum ratings are the same as shown above). Special attention should be given to adequate ventilation of the bulb at the higher frequencies.

Frequency in Megacycles	30	70	110
Percent Maximum Rated Plate Voltage	100	80	60

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.

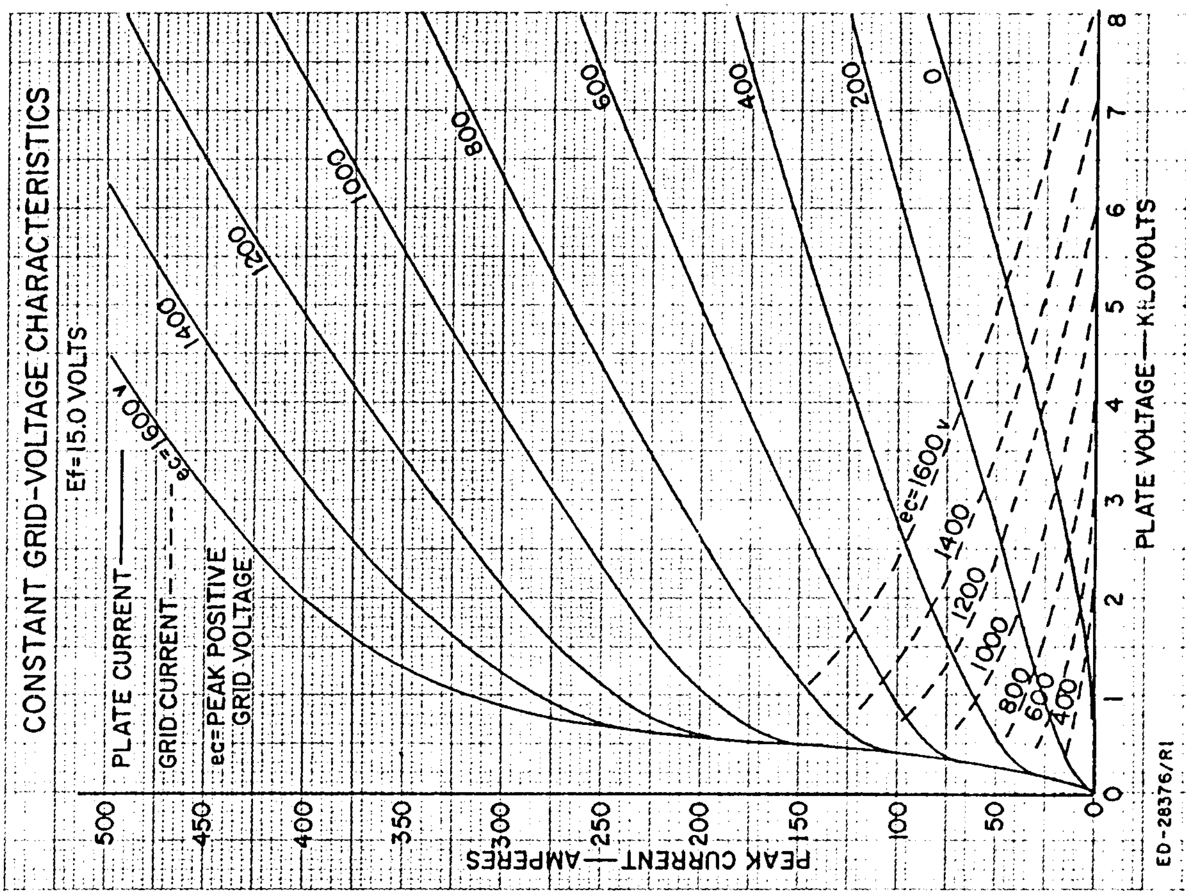
In addition to the normal circuit breakers and overload relays, it is necessary that a fast-acting electronic protective device (crowbar) or equivalent be used. This device will in most cases be a triggered gaseous device connected across the output of the plate supply filter, if used, to dissipate the 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 elecronic-crowbar fault-protection circuit considerations, as well as tests of the effectiveness of a protection device, refer to the references listed.

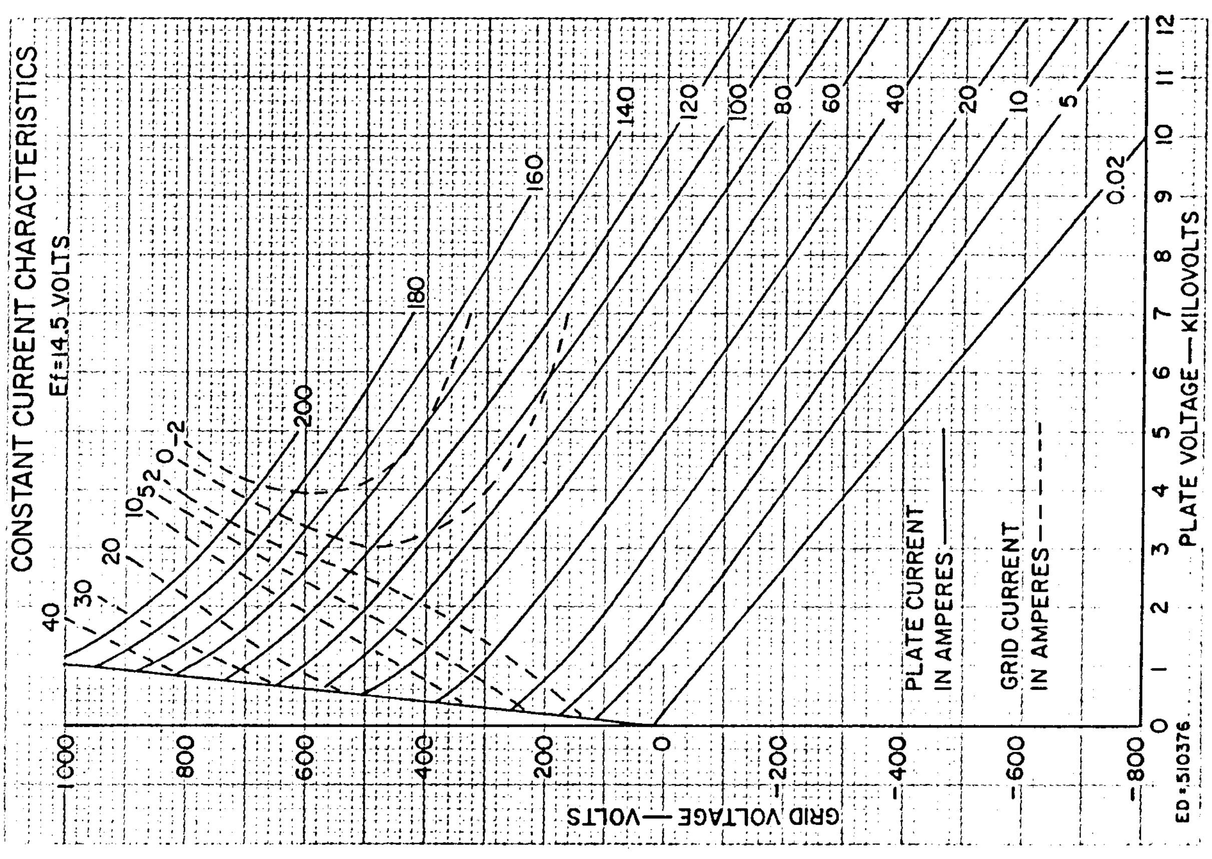
A nominal value of resistance must be placed in the plate lead of the tube being protected in order to be assured that the impedance of this tube under a flash arc condition is greater than that of the crowbar device when the latter is triggered. Critical damping is required for the crowbar discharge 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.

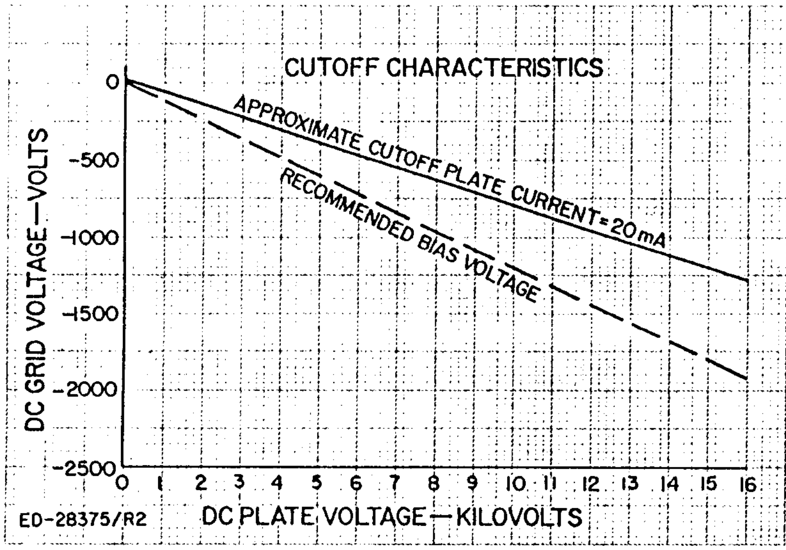
In circuits where high transient voltages may be developed due to a shorted load or other fault, special precautions are necessary to keep these excessive voltages from appearing at the tube electrodes.

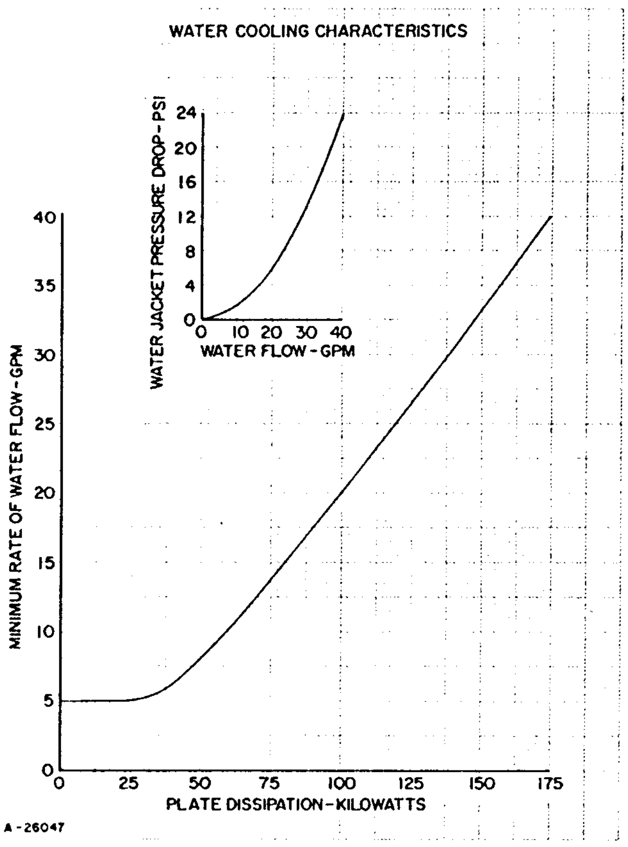
References:

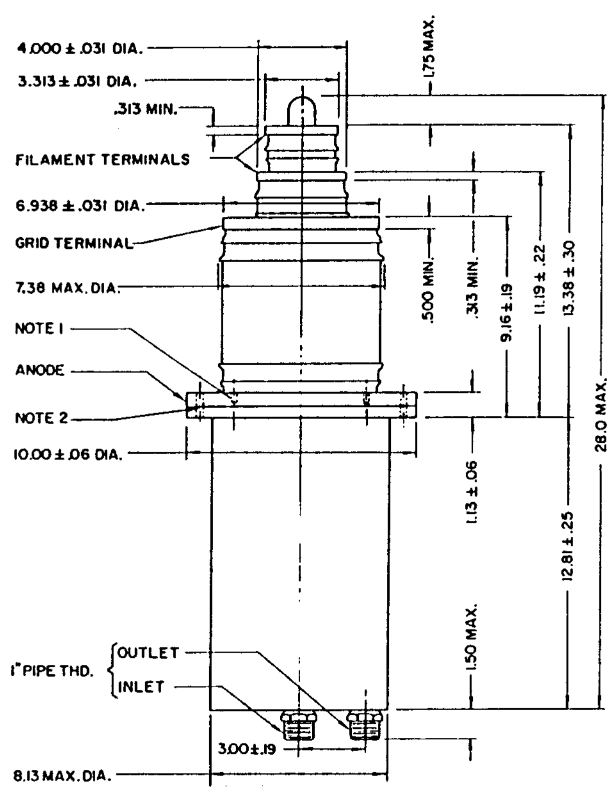
1. W. N. Parker and M. V. Hoover, "Gas Tubes Protect High Power Transmitters", *Electronics*, *29*, 144, January 1956.
2. H. D. Doolittle, "High Power Hydrogen Thyratrons", *Cathode Press*, *1*, *6*, 1954.


CONSTANT GRID-VOLTAGE CHARACTERISTICS
Ef=15.0 VOLTS
PLATE CURRENT
GRID CURRENT
ec=PEAK POSITIVE GRID VOLTAGE
ec=1600 v
1400
1200
1000
800
600
400
200
0
PEAK CURRENT—AMPERES
PLATE VOLTAGE—KILOVOLTS
ED-28376/R1


CONSTANT CURRENT CHARACTERISTICS
Ef=14.5 VOLTS
PLATE CURRENT IN AMPERES
GRID CURRENT IN AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—KILOVOLTS
ED-510376







NOTES:
1. FOUR HOLES, $\frac{5}{16}$ DEEP, $\frac{1}{4}$ – 20 TAP, EQUALLY SPACED ON 8.19 ± .03 B.C., FOR LIFTING.
2. FOUR THROUGH HOLES .290 DIA. ON 9.16 ± .03 B.C. FOR MOUNTING, LOCATED APPROX. 45° FROM TAPPED HOLES.

ALL DIMENSIONS IN INCHES.

ED-27362/R1