**APPLICATION**

The ML-23431 is a general-purpose triode suitable for various rf applications. The rugged coaxial mounting structure provides high-dissipation, low-inductance rf electrode terminals. The tube is rated at 20 kVdc plate voltage (maximum) in CW operation. Maximum ratings apply at frequencies up to 30 MHz. Useful power output can be obtained at frequencies up to 110 MHz with reduced ratings.

**CONSTRUCTION**

The cathode of this tube consists of sturdy, self-supporting, stress-free, thoriated-tungsten filaments. The water-cooled, heavy-wall anode is capable of dissipating 175 kW. Envelope construction employs low-loss ceramics.

**WARNING**

When operating at peak voltage in excess of 15 kV, this electron tube may give off x-rays which can be harmful unless adequately shielded by the enclosure within which the tube is used. Instructions for protective installation are given in National Bureau of Standards Handbook 114, "Safety Standard for Non-Medical X-Ray and Sealed Gamma Ray Sources." Additional information is available in National Council on Radiation Protection and Measurements Report No. 33, "Medical X-Ray and Gamma Ray Protection for Energies up to 10 MeV." Periodic checks of shielding effectiveness are also required since x-ray radiation levels may increase with the operating life of the tube.

**ORDERING NOTES**

Refer to Machlett price list. When ordering specify:

- tube type
- accessories
  - small filament connector  
F-27218
  - large filament connector  
F-27219
  - grid connector  
F-27220
  - mounting socket  
F-12527
  - small gasket (for mounting socket)  
P-12272
  - large gasket (for mounting socket)  
P-13745

**SPECIFICATION****ELECTRICAL CHARACTERISTICS**

Filament Voltage:	14.5 volts
Filament Current:	450 amps
Filament Starting Current, maximum:	1,200 amps
Filament Cold Resistance:	0.0035 ohm
Amplification Factor:	45
Interelectrode Capacitances:	
Grid Plate:	75 pf
Grid Filament:	200 pf
Plate Filament:	4 pf

**MECHANICAL CHARACTERISTICS**

Mounting Position:	Vertical, anode down
Type of Cooling:	Water and forced air
Water Flow on Anode for 175 kW Dissipation, Minimum:	40 gal/min (151 L/min)
Maximum Outgoing Water Temperature:	70°C (158°F)
Maximum Water Pressure:	80 psi (552 kPa)
Air Flow on Insulators and Seals, approximate:	500 cfm*
Maximum Ceramic Temperature:	165°C (329°F)
Net Weight approximate:	110 lbs (50 kg)

\*At frequencies up to 15 MHz, air flow should be directed primarily on the filament seals and main ceramic insulator; 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°C (329°F) around the circumference of the seals.

## MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

### RF Power Amplifier and Oscillator Class C Telegraphy

Key-down conditions per tube without amplitude modulations

Maximum Ratings, Absolute Values	<u>ML-23431</u>	
DC Plate Voltage .....	20000 V	
DC Grid Voltage .....	- 1500 V	
DC Plate Current .....	35 A	
DC Grid Current .....	4.0 A	
Plate Dissipation .....	175 kW	
Typical Operation	<u>ML-23431</u>	
DC Plate Voltage .....	20000 V	16000 V
DC Grid Voltage .....	- 1000 V	- 900 V
Peak RF Grid Voltage .....	1680 v	1550 v
Peak RF Plate Voltage .....	17400 v	13000 v
DC Plate Current .....	29 A	29.3 A
DC Grid Current .....	3.4 A	3.2 A
RF Load Resistance .....	330 ohms	2.50 ohms
Driving Power, approximate .....	6 kW	4.8 kW
Power Output, approximate .....	440 kW	340 kW

### MAXIMUM FREQUENCY RATINGS

Maximum ratings apply up to 30 MHz except as noted. This tube 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 Megahertz .....	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 10 microseconds. For some basic electronic-crowbar fault-protection circuit considerations, as well as test of the effectiveness of a protection device, refer to the references listed.

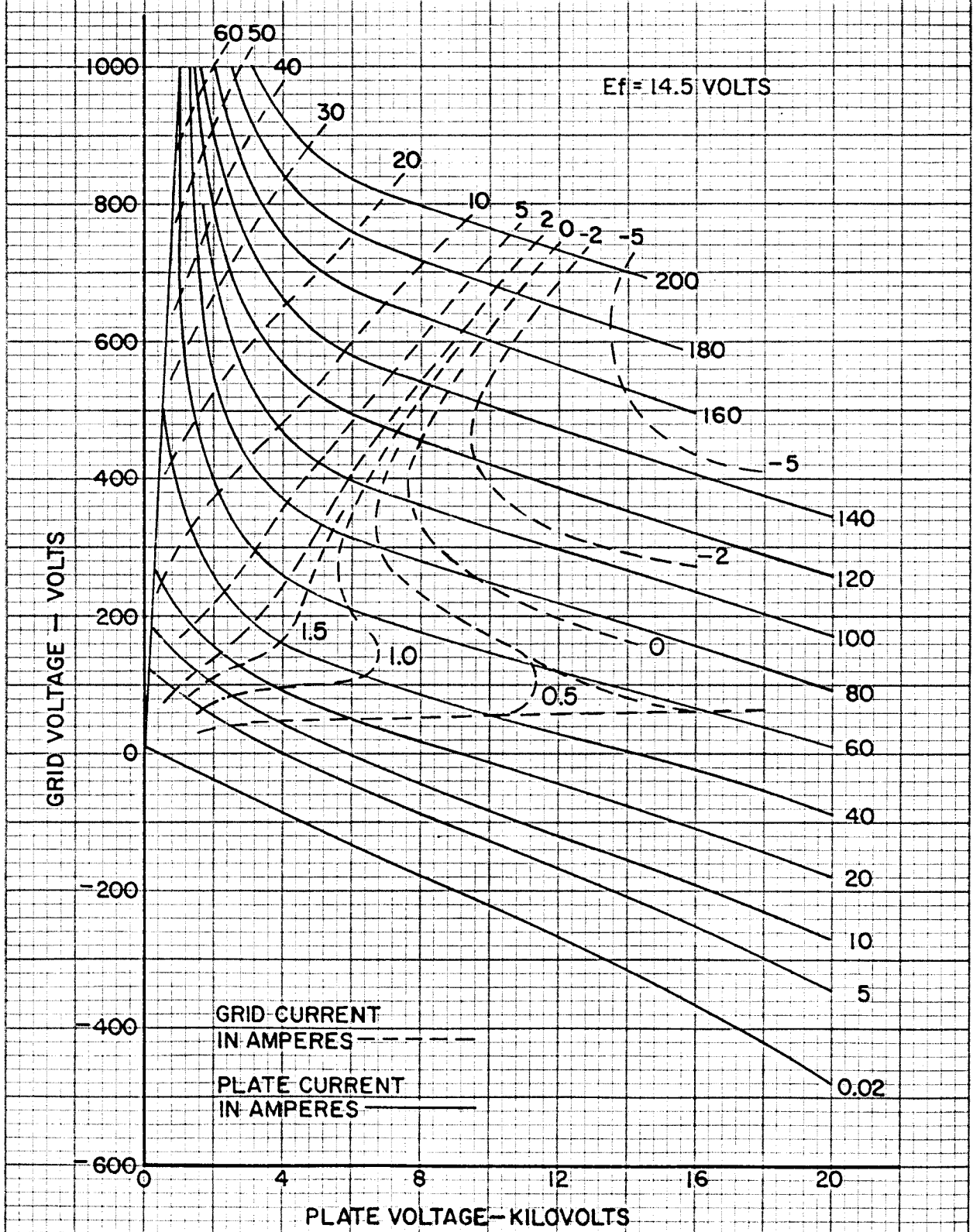
A nominal value of resistance must be placed in the plate lead of the tube being protected in order to be assured that the impedance of this tube under a flash arc condition is greater than that of the crowbar device when the latter is triggered. Critical damping is required for the crowbar discharge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

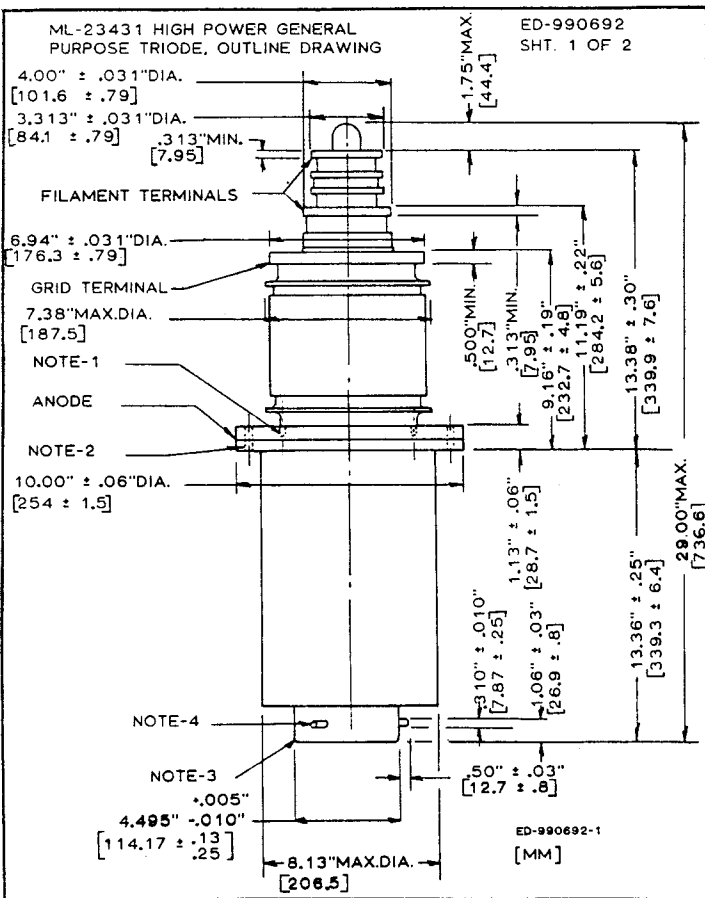
1. W.N. Parker and M.V. Hoover, "Gas Tubes Protect High Power Transmitters," *Electronics*, 29, 144, January 1956.
2. H.D. Doolittle, "High Power Hydrogen Thyratrons," *Cathode Press*, 1, 6, 1954.

# CONSTANT CURRENT CHARACTERISTICS



A-26057/R2

# OUTLINE DATA



## NOTES:

1. FOUR HOLES, 5/16" DEEP, 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.
3. WATER INLET AND OUTLET.
4. 3 BAYONET PINS, 120° APART FOR SOCKET CONNECTIONS.

