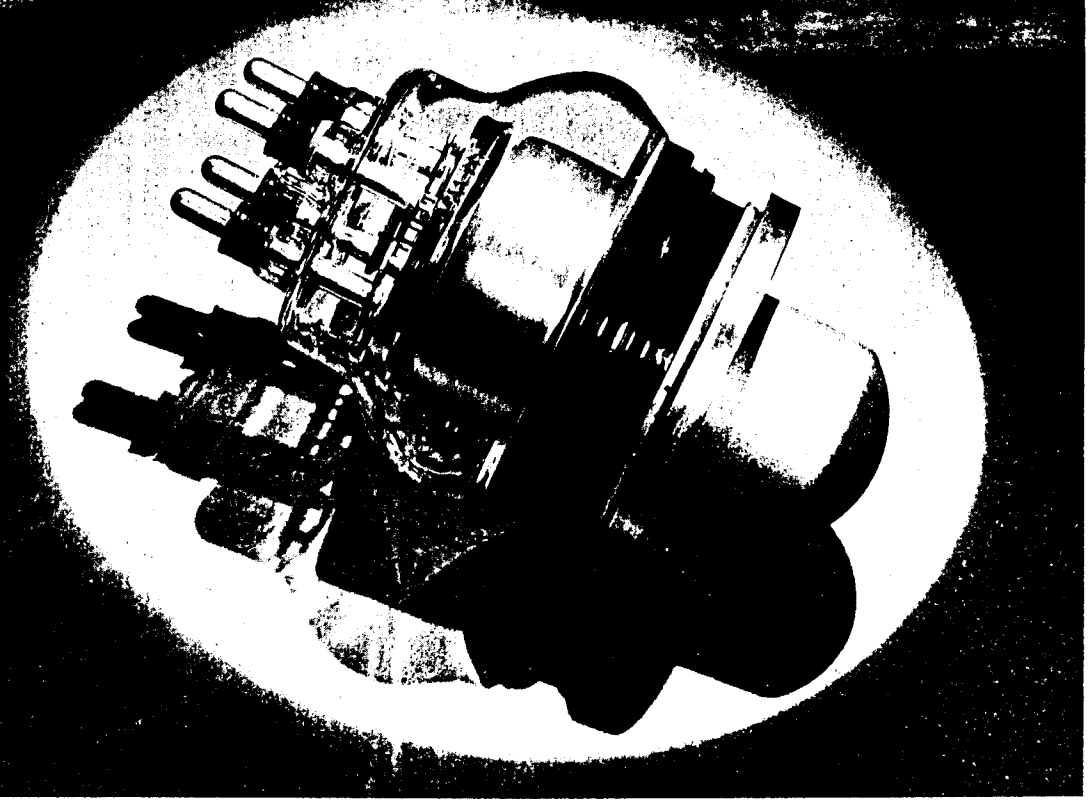


MACHLETT

ML-356

DESCRIPTION & RATINGS

DESCRIPTION

The ML-356 is a three-electrode tube designed specifically for use as a modulator, amplifier, or oscillator in broadcast, communication, and industrial service. The ML-356 is a direct replacement for the type 7085 tube. It is also mechanically and electrically equivalent to the type 880 tube, except that it requires less filament voltage and current; it replaces the 880 when provisions are made for the reduced filament power supply. The ML-356 is essentially equivalent to the type 5771 tube, differing only in its lower grid-cathode capacitance. It replaces the 5771 directly in industrial-oscillator equipment and also in radio-transmitting equipment. The lower grid-cathode capacitance of the ML-356 may require slight circuit adjustments at the higher frequencies.

Features include rugged kovar-glass seals and rigidly supported grid and filament assemblies capable of withstanding the electrically and mechanically rigorous and non-uniform operation inherent in industrial heating service. The anode is water cooled and is capable of dissipating 22.5 kW with a water flow of approximately 12 gpm. The cathode is a thoriated-tungsten stress-free filament employing no sliding contacts, insulators or tension springs. Maximum ratings of 12.5 kVdc plate voltage and 60 kW plate input apply at frequencies up to 25 Mc; operation at 50 Mc is permissible with the voltage and input reduced to three-quarters maximum ratings.

GENERAL CHARACTERISTICS

Electrical

Filament Voltage	7.5 Volts
Filament Current at 7.5 Volts	170 Amps
Filament Starting Current, maximum	800 Amps
Filament Cold Resistance	0.0056 Ohms
Amplification Factor	20
Interelectrode Capacitances:	
Grid-Plate	24.5 uuf
Grid-Filament	35 uuf
Plate-Filament	2.5 uuf

Mechanical

Mounting Position	Vertical, anode down
Type of Cooling	Water and Forced-Air
Water flow on anode, minimum for 22.5 kW dissipation	12 gpm
Maximum outgoing water temperature	70 °C
Air flow on dish from 3" nozzle	50 cfm*
Maximum Glass Temperature	165 °C
Net Weight, approximate	7 lbs.

*At frequencies above 10 Mc special attention should be given to adequate ventilation of the dish and seals to keep the temperature at the hottest point below 165°C. Heat radiating connectors for grid and filament posts are recommended when tube operation is at frequencies greater than 10 Mc.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

A-F Power Amplifier and Modulator—Class B

Maximum Ratings, Absolute Values		
D-C Plate Voltage	12500	volts
Max. Signal D-C Plate Current*	5	amps
Max. Signal Plate Input*	45	kW
Plate Dissipation*	22.5	kW
Typical Operation (Values are for 2 tubes)		
D-C Plate Voltage	12500	volts
D-C Grid Voltage	−600	volts
Peak A-F Grid-to-Grid Voltage	1900	volts
Zero-Signal D-C Plate Current	1	amp
Max.-Signal D-C Plate Current	6.4	amps
Effective Load Resistance (Plate to Plate)	4400	ohms
Max.-Signal Driving Power, approximate	430	watts
Max.-Signal Power Output, approximate	55	kW

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

Radio-Frequency Power Amplifier—Class B

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values		
D-C Plate Voltage	12500	volts
D-C Plate Current	4	amps
Plate Input	33	kW
Plate Dissipation	22.5	kW
Typical Operation		
D-C Plate Voltage	12500	volts
D-C Grid Voltage	−625	volts
Peak R-F Grid Voltage	625	volts
D-C Plate Current	2.4	amps
D-C Grid Current	0	amp
Driving Power, approximate‡	1070	watts
Power Output, approximate	12	kW

‡ At crest of audio-frequency cycle with modulation factor of 1.0.

Plate Modulated R-F Power Amplifier Class C Telephony

Carrier conditions per tube for use with a maximum modulation factor of 1.0

Maximum Ratings, Absolute Values		
D-C Plate Voltage	10000	volts
D-C Grid Voltage	−2000	volts
D-C Plate Current	4	amps
D-C Grid Current	0.8	amp
Plate Input	40	kW
Plate Dissipation	15	kW
Typical Operation		
D-C Plate Voltage	10000	volts
D-C Grid Voltage	−840	volts
Peak R-F Grid Voltage	1440	volts
D-C Plate Current	3.8	amps
D-C Grid Current, approximate	0.78	amp
Driving Power, approximate	1010	watts
Power Output, approximate	29	kW

R-F Power Amplifier and Oscillator Class C Telegraphy

Key-down conditions per tube without modulation§

Maximum Ratings, Absolute Values					
D-C Plate Voltage		12500		15000	volts
D-C Grid Voltage		−2000		−2000	volts
D-C Plate Current		6		6	amps
D-C Grid Current		0.8		0.8	amp
Plate Input		60		67.5	kW
Plate Dissipation		22.5		22.5	kW
Frequency		25		2	Mc
Typical Operation					
D-C Plate Voltage	10000	10000	12500	15000	volts
D-C Grid Voltage	−1150	−1300	−1400	−1500	volts
Peak R-F Grid Voltage	1810	2080	2060	2130	volts
Peak R-F Plate Voltage	7900	7600	9900	12500	volts
D-C Plate Current	4.5	5.6	4.7	4.4	amps
D-C Grid Current, approximate	0.55	0.72	0.42	0.37	amp
Driving Power, approximate	960	1440	850	770	watts
Power Output, approximate	32	38	42	51	kW

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

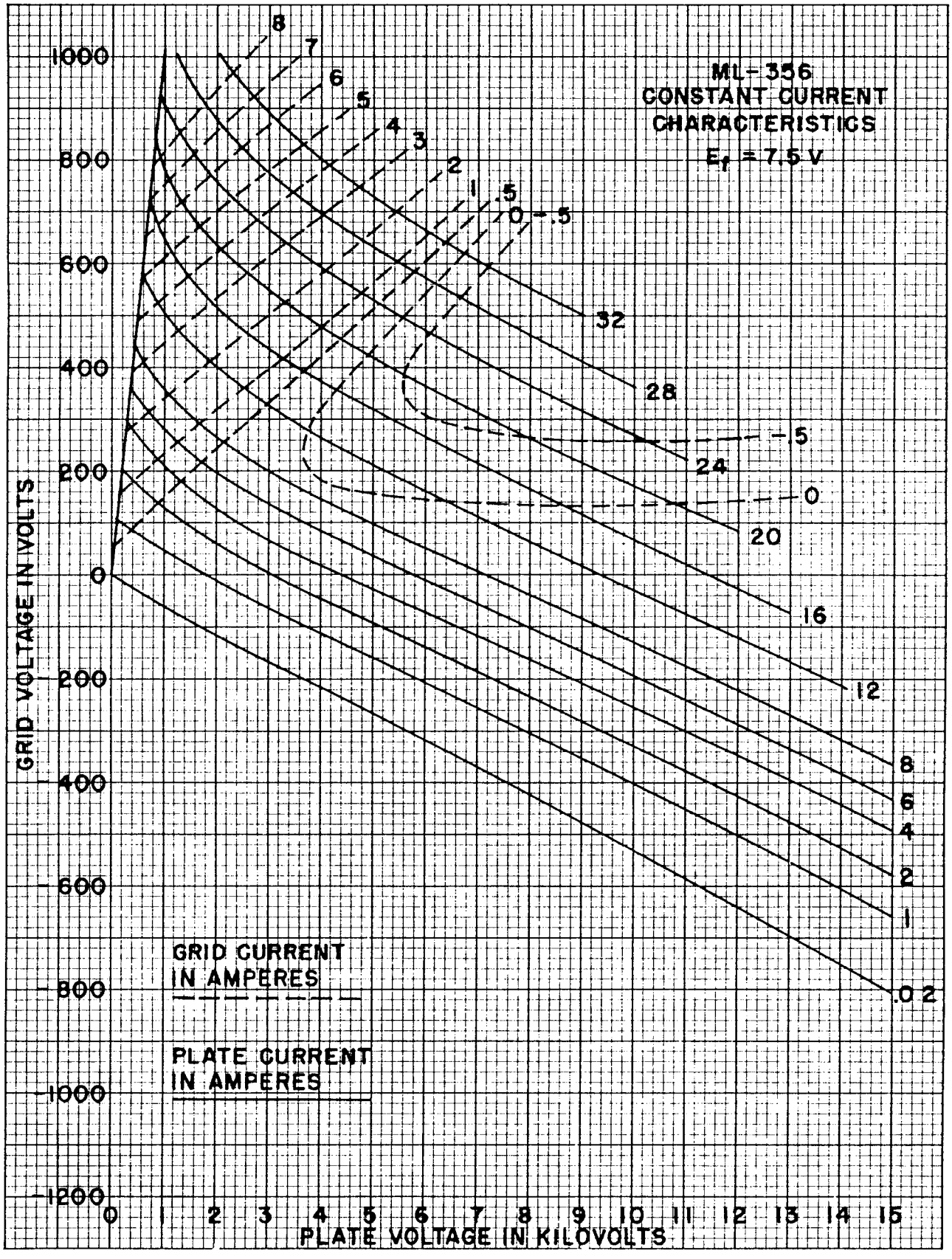
MAXIMUM FREQUENCY RATINGS

Maximum ratings apply up to 25 Mc. The tube may be operated at higher frequencies provided the maximum values of plate voltage and input are reduced in accordance with the table. For Class C Telegraphy operation at frequencies below 2 Mc, the plate voltage and input may be increased by the percentage indicated in the table. (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	2		25		50	Mc
Percentage of Minimum Rated Plate Voltage and Input						
	Volts	Watts	Volts	Watts	Volts	Watts
Class B	—	—	100	100	80	94
Class C Telephony	—	—	100	100	75	75
Class C Telegraphy	120	112.5	100	100	75	75

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

Characteristics	Conditions		Minimum	Bogey Limits	Maximum	
Grid Voltage	e_b = 1800 volts; i_b = 28 amps;	e_c:	—	—	1100	volts
Grid Current	e_b = 1800 volts; i_b = 28 amps;	i_c:	—	—	10.0	amps
Plate Voltage	E_c = 0 Vdc; I_b = 2.0 Adc;	E_b:	2.2	3.0	3.6	kVdc
Plate Voltage	E_c = − 200 Vdc; I_b = 2.0 Adc;	E_b:	6.0	7.0	7.8	kVdc
Grid Voltage	E_b = 10 kVdc; I_b = .020 Adc	E_c:	−460	−550	−640	Vdc
Plate Power Output	E_b = 15 kVdc; I_b = 4.4 Adc; I_c = 0.37 Adc; E_c = −1500 Vdc; F = 1 Mc	P_o:	43	—	—	kW


ML-356
CONSTANT CURRENT
CHARACTERISTICS
E_f = 7.5 V
GRID VOLTAGE IN VOLTS
1000
800
600
400
200
0
200
400
600
800
1000
1200
8
7
6
5
4
3
2
1
.5
0
-.5
32
28
24
20
16
12
8
6
4
2
1
.02
-.5
0
GRID CURRENT
IN AMPERES
PLATE CURRENT
IN AMPERES
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
PLATE VOLTAGE IN KILOVOLTS

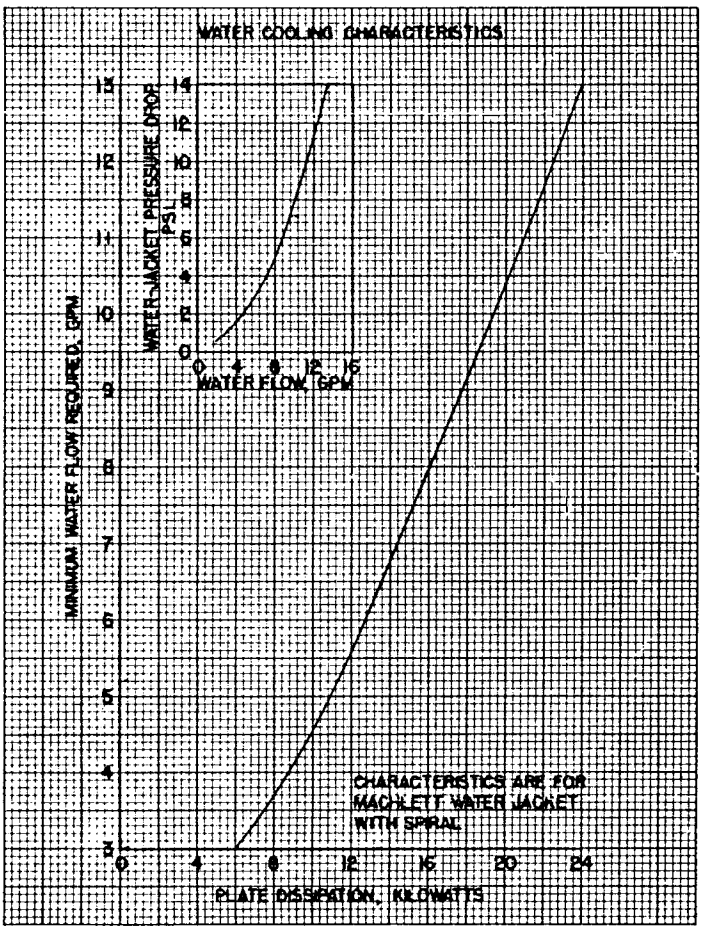
A-8452

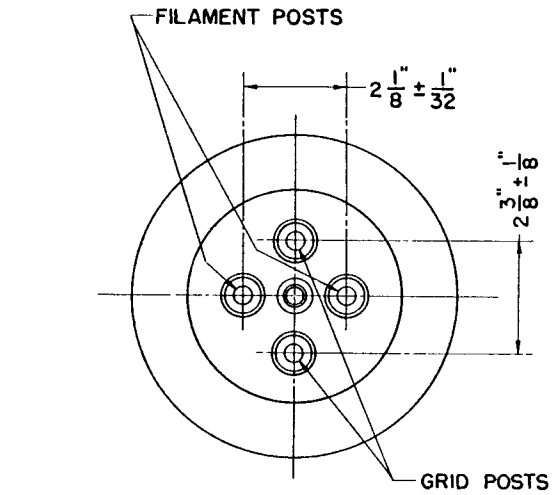
APPLICATION NOTES

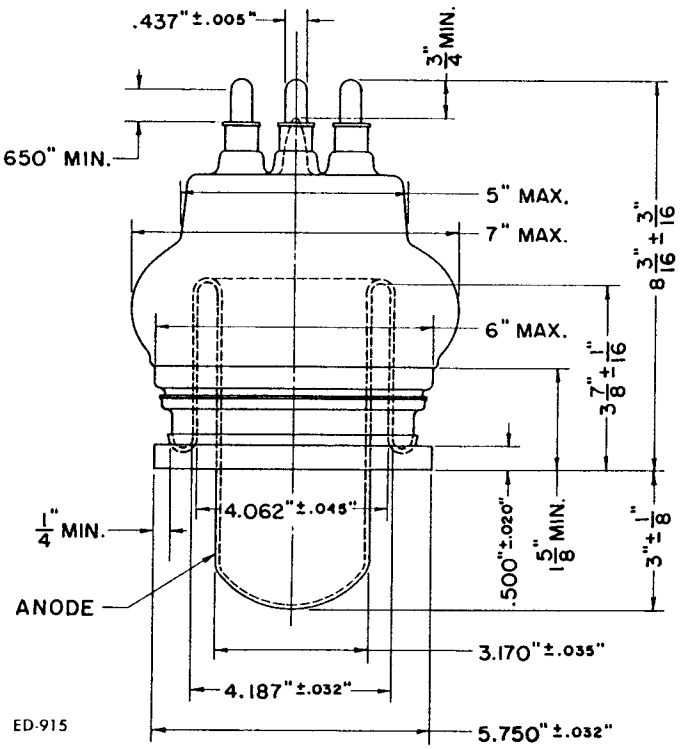
The handling of high power requires particular attention to the removal of power under fault conditions, since the large amount of energy involved can severely damage the electron tube if not properly controlled. Therefore the ground leads of the plate and grid circuits should be equipped with individual quick-acting overload relays which will remove power from these circuits within 1/10 second.

Additional protection is recommended and may be obtained by connecting a resistor in series with the plate lead of each tube for protection of the tube during the time required for the plate overload relay to act. The criterion is the total energy to which the tube can be subjected. The minimum value of total resistance which will give adequate protection with reasonably low power loss is as follows:

Maximum Power Output of Rectifier	40	100	250	640	kW
Series Resistance	10	20	40	80	ohms







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