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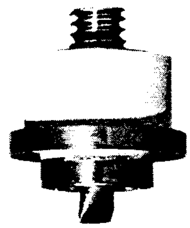
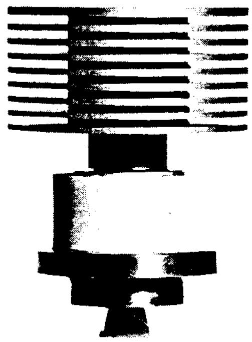




ISSUED 3-70

ML-8536
ML-8537

MACHLETT

Miniature UHF Planar Triodes

CW, Plate or Grid Pulsed
Frequency Stable
Phormat Cathode
40W CW at 2.3 GHz

DESCRIPTION

The ML-8536 and ML-8537 are ruggedized, high-mu planar triodes of ceramic-and-metal construction, designed for use as grid-pulsed, plate-pulsed, or CW oscillators, frequency multipliers, or amplifiers in radio transmitting service from low frequency to 3 GHz. The ML-8536 is supplied without a radiator for conduction-convection or heat-sink cooling. The ML-8537 is supplied with a radiator for forced-air cooling. Except for plate dissipation ratings, the characteristics of the two tubes are the same.

A distinguishing characteristic of these tubes is their miniaturization. In addition to low interelectrode capacitance, high transconductance and high mu, these tubes also incorporate design features which help to assure frequency-stable operation even under conditions of adverse ambient temperature and varying plate dissipation. The tubes also employ a Phormat type cathode which consists of an indirectly heated disc with an oxide coating impregnated in a nickel matrix. This construction, in combination with proper plate series impedance, reduces to a minimum failures of the cathode due to voltage surges.

GENERAL CHARACTERISTICS

Electrical

Heater Voltage (AC or DC)	6.0	V
Heater Current at 6.0 Volts	1.00	A
Cathode Heating Time, minimum	60	sec
Amplification Factor	80	
Transconductance ($Jk=200mA/cm^2$)	30000	μmhos
Interelectrode Capacitance, without Heater Voltage		
Grid-Plate	1.65	pf
Grid-Cathode	7.50	pf
Plate-Cathode, maximum	.040	pf

Mechanical

Mounting Position	Optional	
Type of Cooling		
With radiator (ML-8537)	Forced-air	
Without radiator (ML-8536)	Conduction and convection	
Maximum Anode Temperature	250	°C
Net Weight		
With radiator (ML-8537)	45	g
Without radiator (ML-8536)	20	g

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

CW RF Power Oscillator and Amplifier Class C

Maximum Ratings, Absolute Values		
DC Plate Voltage	2500	V
DC Grid Voltage	−150	V
Instantaneous Peak Grid-Cathode Voltage		
Grid negative to cathode	−400	v
Grid positive to cathode	30	v
DC Plate Current	150	mA
DC Grid Current	45	mA
Plate Dissipation		
Forced-air cooling (ML-8537)	150	W
Conduction and convection (ML-8536)	10	W†
Grid Dissipation	1.5	W
Frequency	2.5	GHz
Typical Operation, Power Amplifier		
Frequency	500	MHz
Filament Voltage	6.0	V
DC Plate Voltage	900	V
DC Grid Voltage	−40	V
DC Plate Current	90	mA
DC Grid Current, approximate	30	mA
Driving Power, approximate	6	W
Useful Power Output	40	W
Typical Operation, Power Amplifier		
Frequency	2.3	GHz
Filament Voltage	5.0	V
DC Plate Voltage	1000	V
DC Plate Current	150	mA
Useful Power Output	40	W
Gain	15	db

Grid-Pulsed or Plate-Pulsed RF Oscillator or Amplifier—Class C

Maximum Ratings, Absolute Values		
Plate Voltage		
Grid-pulsed, DC	2500	V
Plate-pulsed, peak pulse supply	3500	v
DC Grid Voltage	−150	V
Instantaneous Peak Grid-Cathode Voltage		
Grid negative to cathode	−750	v
Grid positive to cathode	250	v
Average Plate Current	10	mA
Average Grid Current	5	mA
Pulse Plate Current	3	a
Average Plate Dissipation		
Forced-air cooling (ML-8537)	35	W
Conduction and convection (ML-8536)	10	W†
Average Grid Dissipation	1.5	W
Pulse Duration	6	μs††
Duty Factor	.0033	††
Frequency	3	GHz
Typical Operation, Plate-Pulsed RF Amplifier		
Frequency	2.5	GHz
Filament Voltage	5.8	V
Pulse Duration	5	μs
Duty Factor	.0030	
Peak Plate Pulse Supply Voltage	3500	v
Peak Plate Current from Pulse Supply	3.0	a
Average Plate Current	9.0	mA
Average Grid Current	3.0	mA
Useful Peak Power Output, approximate	2.0	kw
Typical Operation, Grid-Pulsed RF Amplifier		
Frequency	1.1	GHz
Filament Voltage	6.0	V
Pulse Duration	3.5	μs
Duty Factor	.001	
DC Grid Voltage	1700	V
DC Plate Voltage	−45	V
Peak Plate Current from DC Supply	1.9	a
Peak Grid Current from Pulse Supply	1.1	a
Driving Power During Pulse, approximate	400	W
Useful Peak Power Output, approximate	2	kw

Pulse Modulator or Pulse Amplifier

Maximum Ratings, Absolute Values		
DC Plate Voltage	2500	V
Peak Plate Voltage	3500	v
DC Grid Voltage	−150	V
Instantaneous Peak Grid-Cathode Voltage		
Grid negative to cathode	−750	v
Grid positive to cathode	100	v
DC Plate Current	100	mA
Pulse Cathode Current	5	a
Average Plate Dissipation		
Forced-air cooling (ML-8537)	150	W
Conduction and convection (ML-8536)	10	W†
Average Grid Dissipation	1.5	W
Pulse Duration	6	μs††
Duty Factor	.0033	††

†Greater plate dissipation will be possible with the ML-8536 when the tube is used with an appropriately designed heat sink.

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

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current at 6.0V (Note 1)	.90	1.05	A
Cut-Off Bias (Note 2)	—	−25	Vdc
Grid-Plate Capacitance (Note 3)	1.50	1.80	pf
Grid-Cathode Capacitance (Note 3)	6.75	8.25	pf
Plate-Cathode Capacitance (Note 3)	—	.040	pf

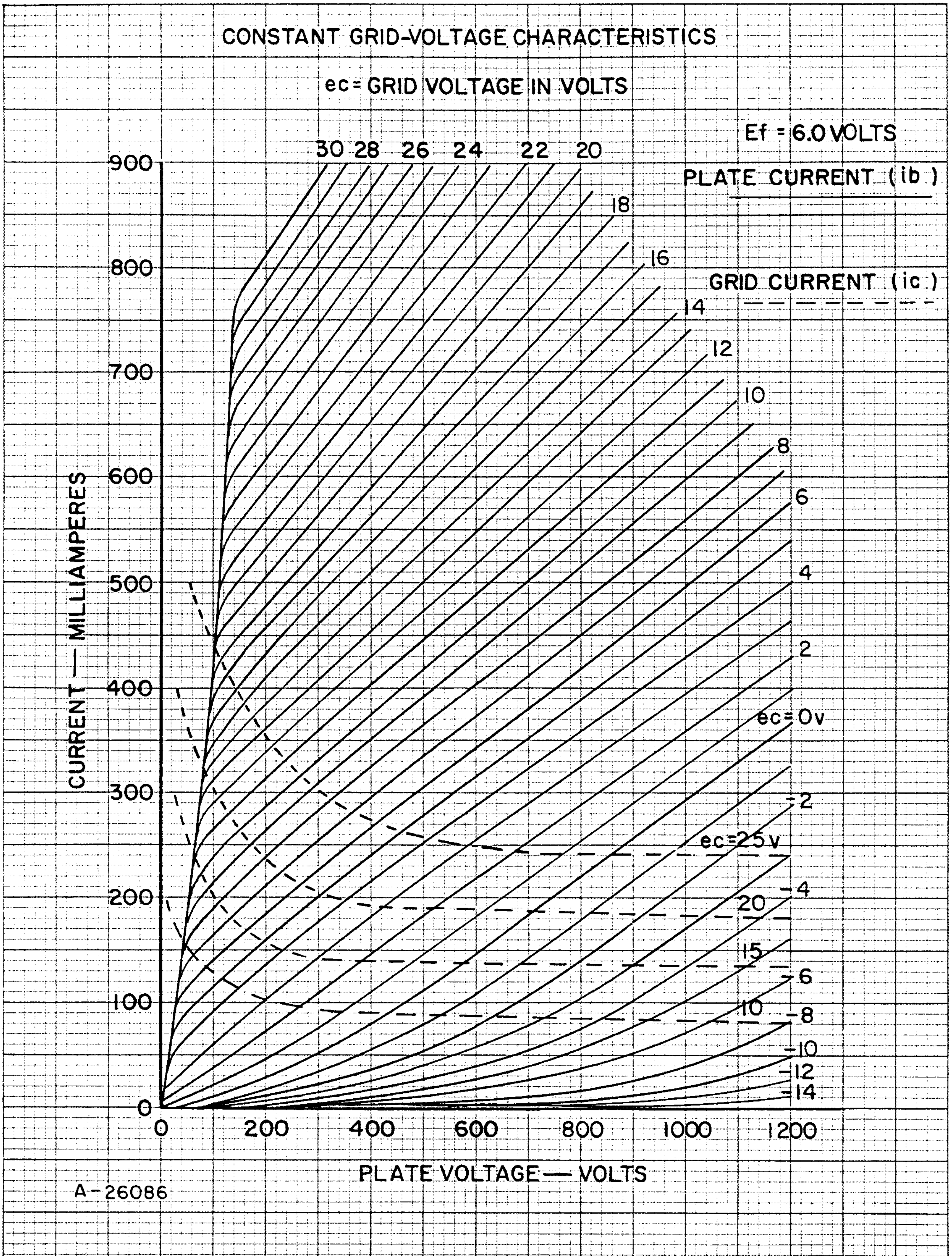
Note 1 — For reduced filament voltage see "Heater Voltage" section in *Application Notes.*

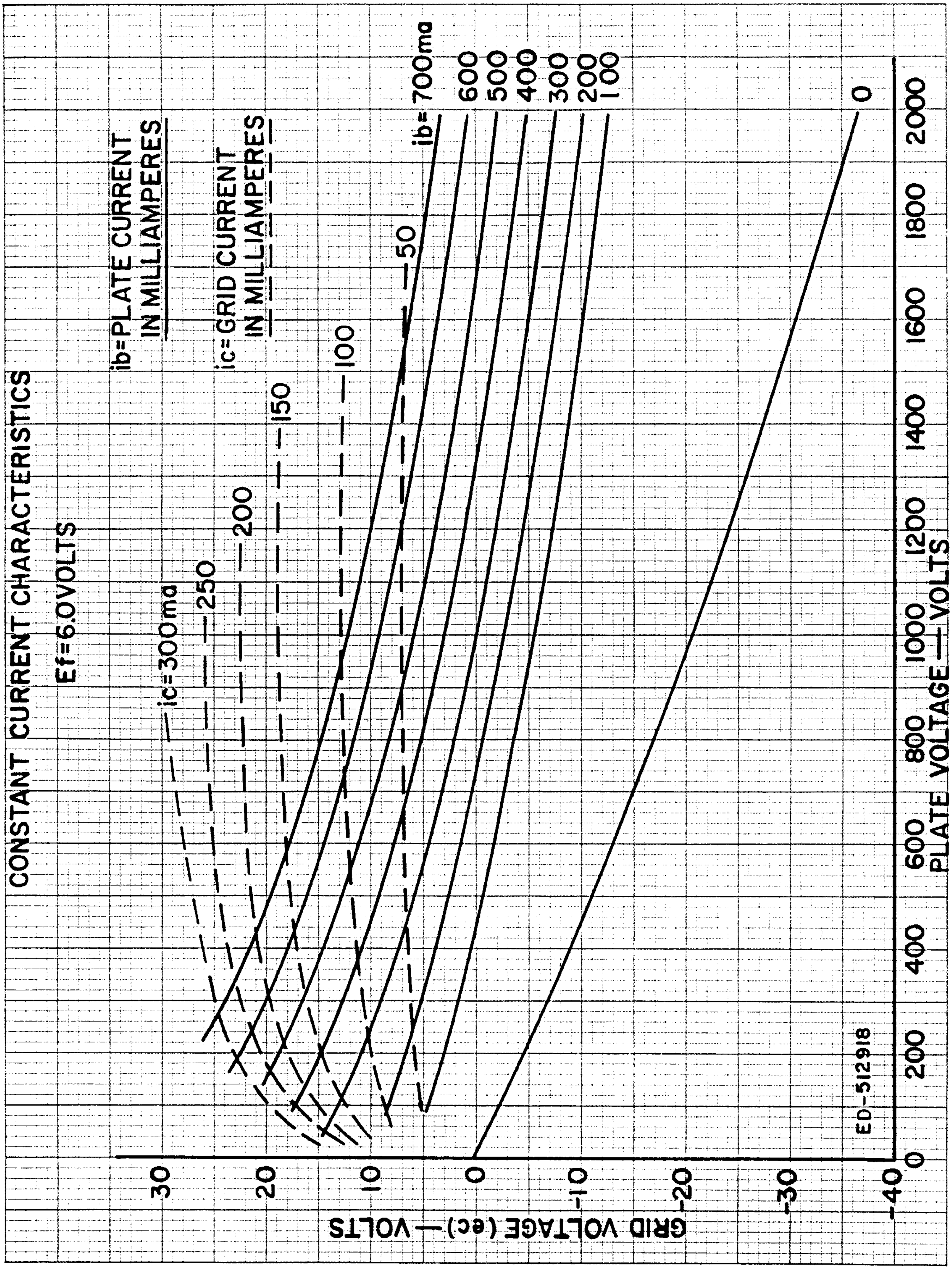
Note 2 — Measured with 1 mA plate current and a plate voltage of 1000 Vdc.

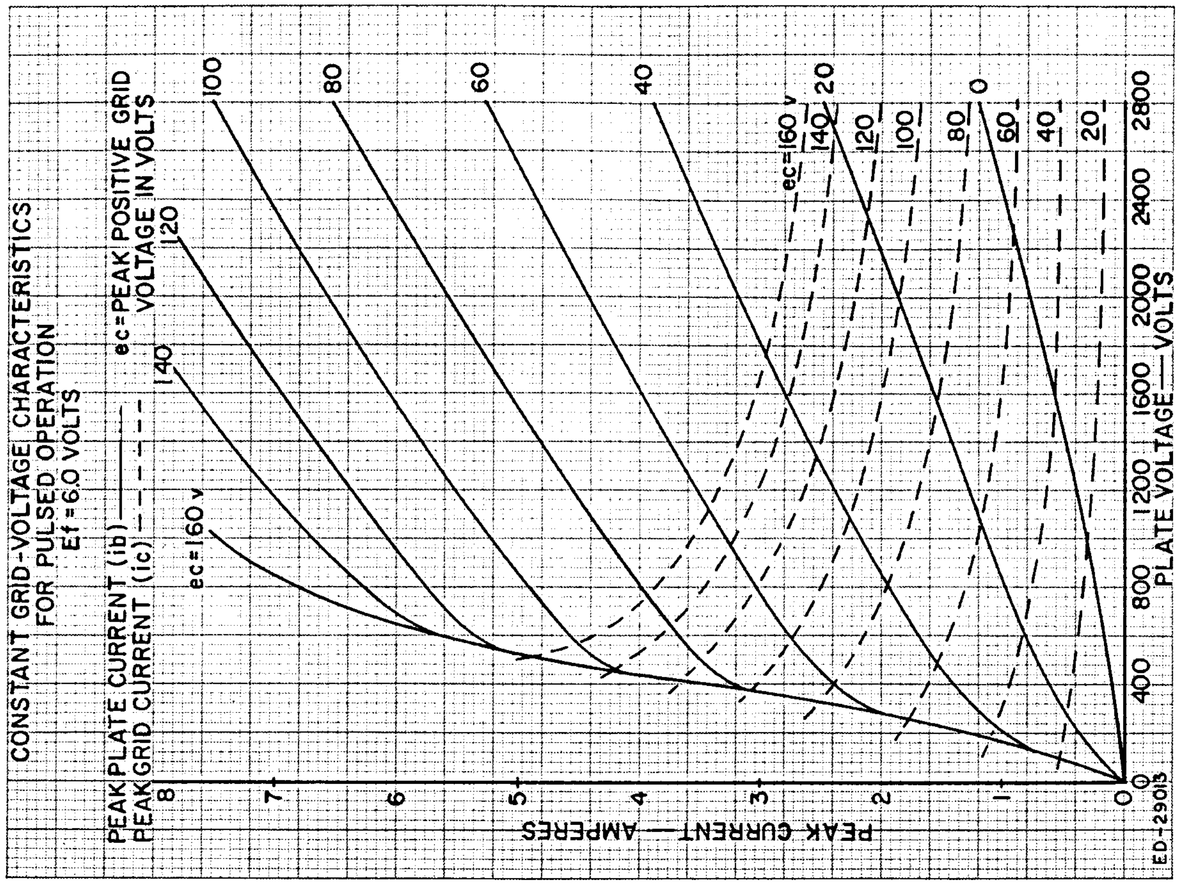
Note 3 — Capacitance values are given for a cold tube. When the filament is heated to its proper temperature, the grid-cathode capacitance will increase by approximately 1 pf due to thermal expansion of the cathode.

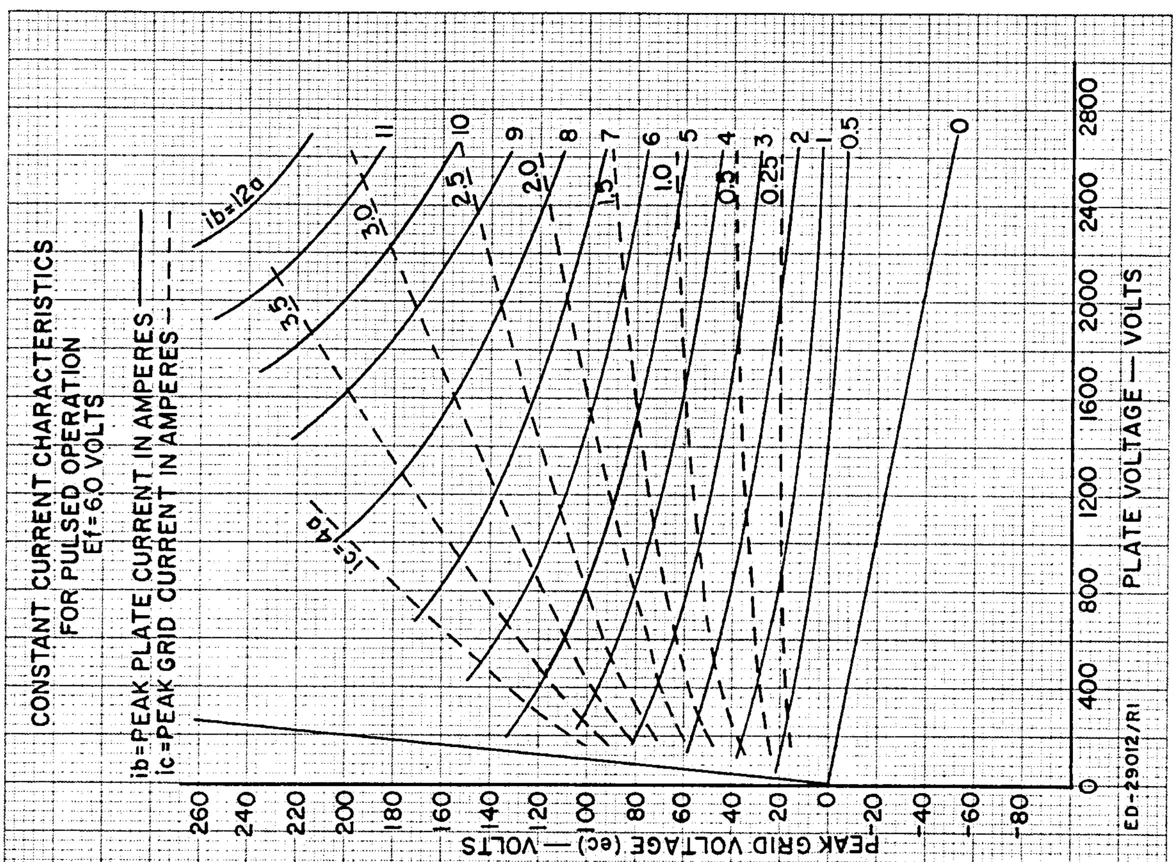
APPLICATION NOTES

Before designing equipment for use with these tubes and before installing tubes in equipment, refer to the general information given in the Machlett publication entitled *Application Notes, UHF Tubes —General.*


CONSTANT GRID-VOLTAGE CHARACTERISTICS
ec= GRID VOLTAGE IN VOLTS
Ef = 6.0 VOLTS
PLATE CURRENT (ib)
GRID CURRENT (ic)
30 28 26 24 22 20
18
16
14
12
10
8
6
4
2
ec= 0v
-2
ec=25v
-4
20
15
-6
10
-8
-10
-12
-14
900
800
700
600
500
400
300
200
100
0
CURRENT — MILLIAMPERES
0
200
400
600
800
1000
1200
PLATE VOLTAGE — VOLTS
A-26086


CONSTANT CURRENT CHARACTERISTICS
Ef=6.0VOLTS
ib=PLATE CURRENT IN MILLIAMPERES
ic=GRID CURRENT IN MILLIAMPERES
ic=300ma
250
200
150
100
50
ib=700ma
600
500
400
300
200
100
0
ED-512918
GRID VOLTAGE (ec) — VOLTS
30
20
10
0
-10
-20
-30
-40
PLATE VOLTAGE — VOLTS
0
200
400
600
800
1000
1200
1400
1600
1800
2000

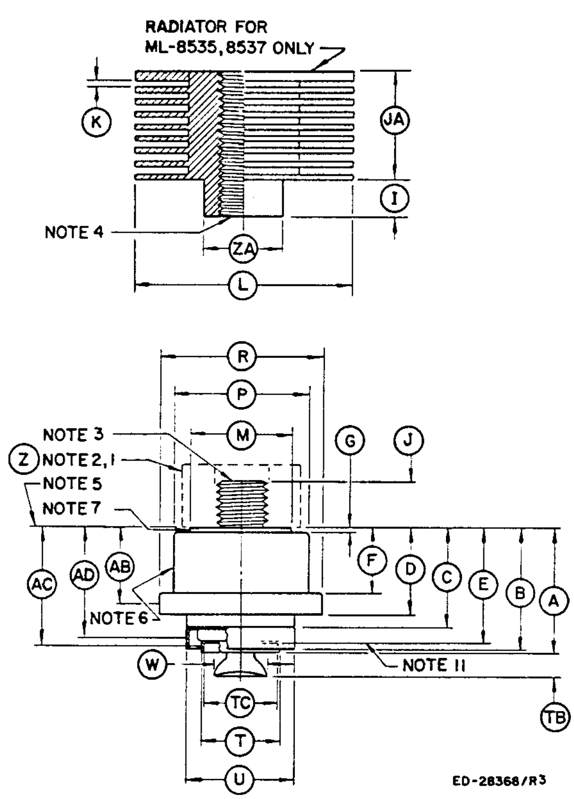

CONSTANT GRID-VOLTAGE CHARACTERISTICS
FOR PULSED OPERATION
Ef = 6.0 VOLTS
PEAK PLATE CURRENT (ib) ———
PEAK GRID CURRENT (ic) – – – –
ec = PEAK POSITIVE GRID VOLTAGE IN VOLTS
ec = 160 v
140
120
100
80
60
40
20
0
ec = 160 v
140
120
100
80
60
40
20
PEAK CURRENT — AMPERES
0
1
2
3
4
5
6
7
8
0
400
800
1200
1600
2000
2400
2800
PLATE VOLTAGE — VOLTS
ED-29013


CONSTANT CURRENT CHARACTERISTICS
FOR PULSED OPERATION
Ef = 6.0 VOLTS
ib = PEAK PLATE CURRENT IN AMPERES ———
ic = PEAK GRID CURRENT IN AMPERES – – – –
ib = 12a
11
10
9
8
7
6
5
4
3
2
1
0.5
0
ic = 4a
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
PEAK GRID VOLTAGE (ec) — VOLTS
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
0
400
800
1200
1600
2000
2400
2800
PLATE VOLTAGE — VOLTS
ED-29012/R1

DIMENSIONS FOR OUTLINE OF ML-8534, ML-8535, ML-8536, ML-8537

The millimeter dimensions are derived from the original inch dimensions.

Ref	Inches			Millimeters			Notes
	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	
A	.714		.780	18.14		19.81	
AB	.437	.476	.515	11.10	12.09	13.08	1, 8
AC	.662	.682	.702	16.81	17.32	17.83	1, 10
AD	.605	.645	.685	15.37	16.38	17.40	1, 9
B	.691		.740	17.55		18.80	
C	.570		.607	14.48		15.42	
D	.520		.547	13.21		13.89	
E	.650		.705	16.51		17.91	
F	.400		.415	10.16		10.54	
G	.022		.040	.56		1.02	
I	.192		.208	4.88		5.28	
J	.240		.275	6.10		6.98	
JA	.585		.635	14.86		16.13	
K	.028		.045	.71		1.14	
L	1.235		1.265	31.37		32.13	
M	.565		.580	14.35		14.73	
P	.775		.785	19.68		19.94	
R	.935		.950	23.75		24.13	1, 8
T	.440		.460	11.18		11.68	1, 10
TB			.250			6.35	
TC	.410		.425	10.41		10.80	
U	.595		.607	15.11		15.42	1, 9
W			.313			7.95	
Z			.015			.38	1
ZA	.440		.460	11.18		11.68	



NOTES:

1. The total indicated runout of the grid-contact surface (Note 8), the cathode-contact surface (Note 9) and the heater-contact surface (Note 10) will not exceed (Z). This measurement is made with the gage (Note 2) screwed on the anode thread (Note 3) so that the face of the gage makes full contact with the reference surface (Note 5). Runout is then measured with the gage chucked on the measurement reference axis.
2. See outline. Machlett gage No. S-L5. Details will be supplied upon request.
3. See outline. Anode, 5/16 — 24 UNF-2A thread.
4. See outline. 5/16 — 24 UNF-2B thread. Use 5/16-24 bolt in this hole for tube extraction.
5. See outline. Reference surface. The tube shall be stopped only by this surface when screwed in the socket.
6. See outline. Insulating envelope. Do not clamp or locate on this surface.
7. See outline. Measure anode temperature on this surface.
8. Grid-contact surface and reference dimension for eccentricity measurement, defined by dimensions (R) and (AB).
9. Cathode- or heater-contact surface and reference dimension for eccentricity measurement, defined by dimensions (U) and (AD).
10. Heater-contact surface and reference dimension for eccentricity measurement, defined by dimensions (T) and (AC). See also Note 11.
11. See outline. Alternate heater-contact surface. Heater contact can be made to the bottom of the heater terminal-cup by means of a coil spring having a maximum coil OD of .390 inch and a minimum coil ID of .320 inch, or some similar device.

RAYTHEON
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