

ML-7211  
 ML-7698



**UHF Planar Triodes**  
 CW, Plate or Grid Pulsed  
 Phormat Cathode  
 High Cathode-Current Capability  
 100W CW at 1 GHz  
 30W CW at 2.5 GHz

**DESCRIPTION**

The ML-7211 and ML-7698 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-7698 is supplied without a radiator for conduction-convection cooling. The ML-7211 is supplied with a radiator for forced-air cooling. Except for plate-dissipation ratings, the characteristics of the two tubes are the same.\*

Special features of these tubes as compared to other tubes fitting the same socket include high cathode-current capa-

bility and an extended grid-anode insulator in the tube envelope. The extended grid-anode insulator is an important feature in airborne equipment operating at high altitudes. Other features of these tubes include low interelectrode capacitance, high transconductance, and great mechanical strength. 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) .....	6.3 V
Heater Current at 6.3 Volts .....	1.3 A
Cathode Heating Time, minimum .....	60 sec
Amplification Factor .....	80
Transconductance ( $I_b=100\text{mA}$ , $E_b=600\text{V}$ ) .....	30000 $\mu\text{mhos}$
Interelectrode Capacitance, without Heater Voltage	
Grid-Plate .....	2.25 pf
Grid-Cathode .....	8.0 pf
Plate-Cathode, maximum .....	.06 pf

**Mechanical**

Mounting Position .....	Optional
Type of Cooling	
With radiator (ML-7211) .....	Forced-Air
Without radiator (ML-7698) .....	Conduction & Convection
Maximum Anode Temperature .....	250 °C
Net Weight	
With radiator (ML-7211) .....	63 g
Without radiator (ML-7698) .....	51 g

\*NOTE: Data for the ML-7211 applies also to the ML-7698R, which is identical in all respects.

**MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS**

**CW RF Power Oscillator or 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	145	mA
DC Grid Current	45	mA
Plate Dissipation		
Forced-air cooling (ML-7211)	100	W
Conduction and convection (ML-7698)	10	W
Grid Dissipation	2	W
Frequency	2.5	GHz

Typical Operation, Amplifier

Frequency	500	MHz
DC Plate Voltage	900	V
DC Grid Voltage	-30	V
DC Plate Current	140	mA
DC Grid Current, approximate	40	mA
Driving Power, approximate	9	W
Useful Power Output	65	W

Typical Operation, Oscillator

Frequency	2.5	GHz
DC Plate Voltage	1000	V
DC Grid Voltage, approximate	-20	V
DC Plate Current	140	mA
DC Grid Current	15	mA
Useful Power Output	30	W

**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	16	mA
Average Grid Current	6	mA
Peak Plate Current	5	a
Average Plate Dissipation		
Forced-air cooling (ML-7211)	60	W
Conduction and convection (ML-7698)	10	W
Average Grid Dissipation	2	W
Pulse Duration	6	μs†
Duty Factor	.0033	†
Frequency	3	GHz

Typical Operation, Grid-Pulsed RF Amplifier

Frequency	1.1	GHz
Filament Voltage	6.3	V
Pulse Duration	3.5	μs†
Duty Factor	.001	

DC Plate Voltage	2000	V
DC Grid Voltage	-70	V
Peak Plate Current from DC Supply	3	a
Peak Grid Current from Pulse Supply	1	a
Driving Power during Pulse, approximate	400	w
Useful Peak Power Output, approximate	2.5	kw

Typical Operation, Plate-Pulsed RF Oscillator

Frequency	3	GHz
Filament Voltage	5.8	V
Pulse Duration	3	μs
Duty Factor	.0025	
Peak Plate Pulse Supply Voltage	3500	V
Peak Plate Current from Pulse Supply	4.8	a
Average Plate Current	12	mA
Average Grid Current	4	mA
Useful Peak Power Output, approximate	2.5	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	110	v
DC Plate Current	150	mA
Pulse Cathode Current	7.5	a
Average Plate Dissipation		
Forced-air cooling (ML-7211)	100	W
Conduction and convection (ML-7698)	10	W
Average Grid Dissipation	2	W
Pulse Duration	6	μs†
Duty Factor	.0033	†

†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 6.3 V (Note 1)	1.20	1.40	A
Cut-Off Bias (Note 2)	—	-20	Vdc
Grid-Plate Capacitance (Note 3)	2.10	2.40	pf
Grid-Cathode Capacitance (Note 3)	7.0	9.0	pf
Plate-Cathode Capacitance (Note 3)	—	.06	pf

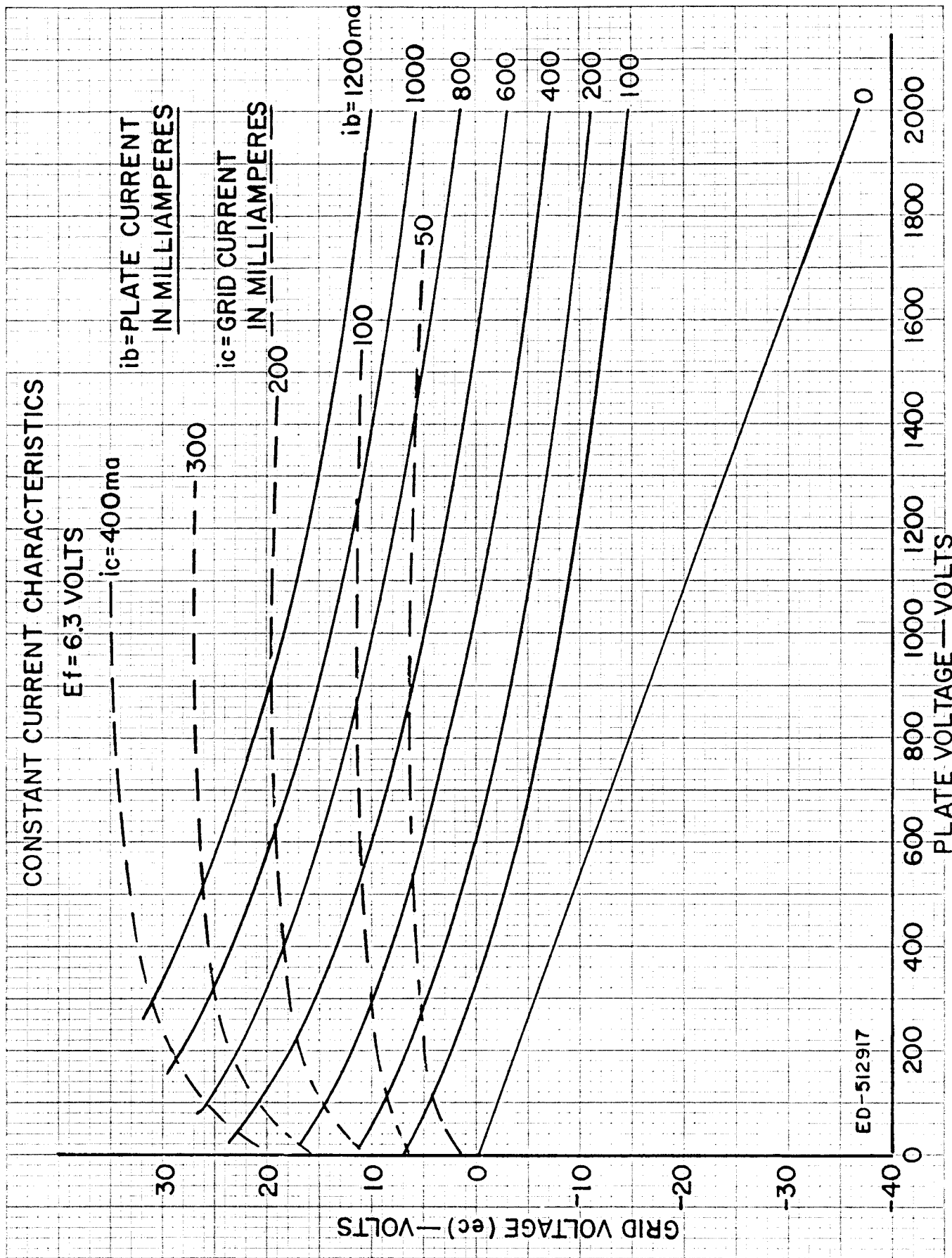
Note 1 — For operation with reduced filament voltage, see "Heater Voltage" section in *Application Notes*.

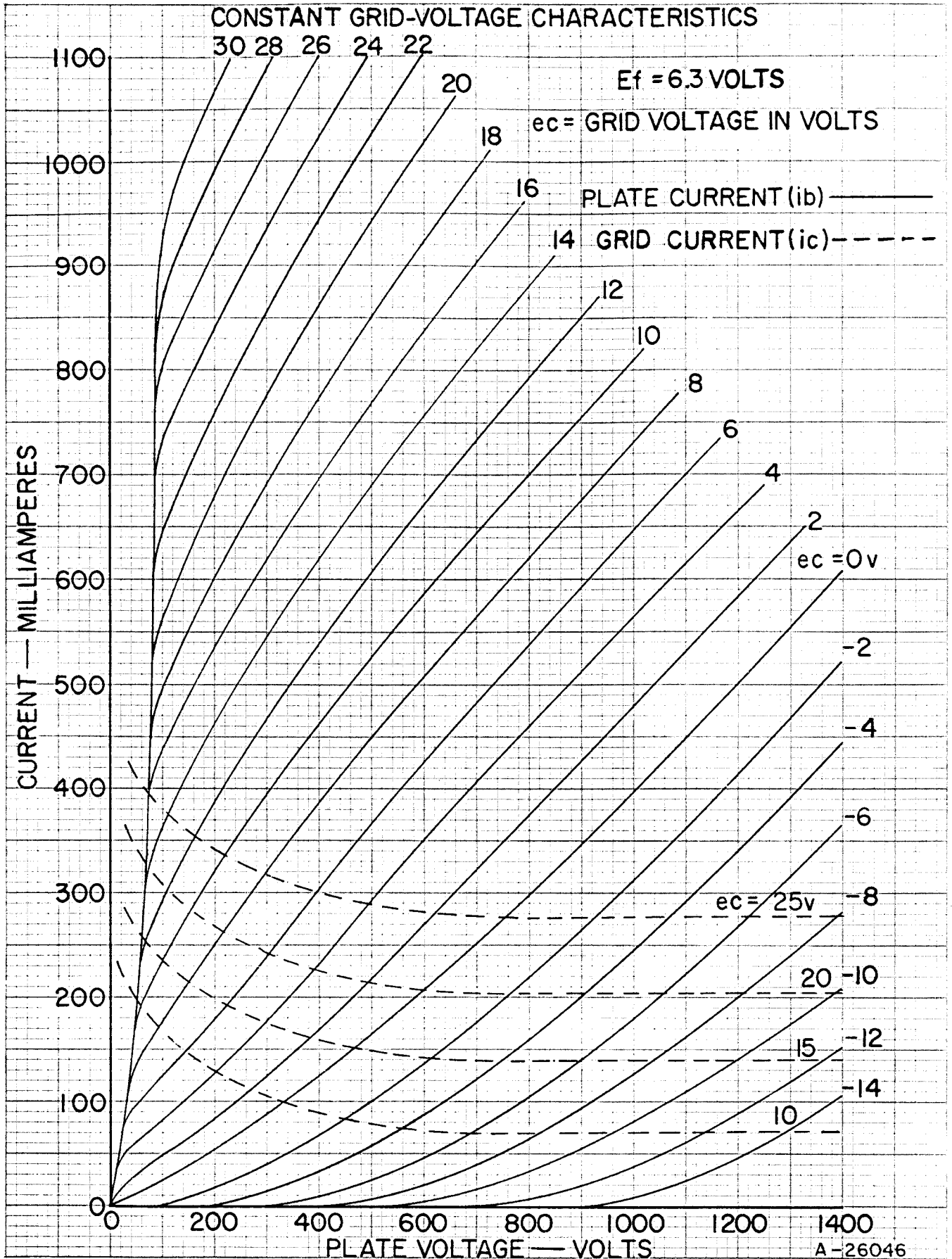
Note 2 — Measured with 1 mA plate current and a plate voltage of 600 Vdc.

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.

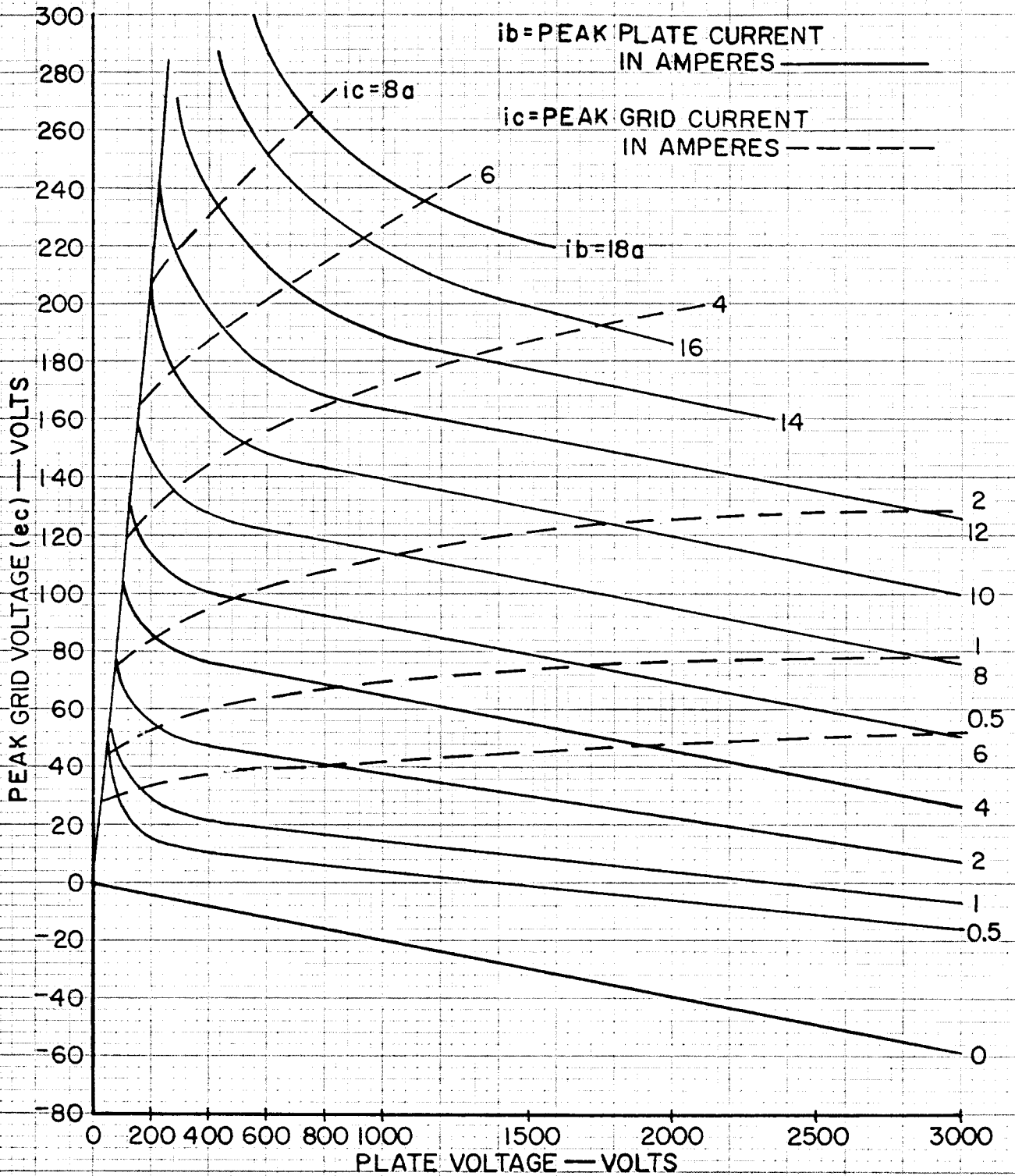
**APPLICATION NOTES**

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*.

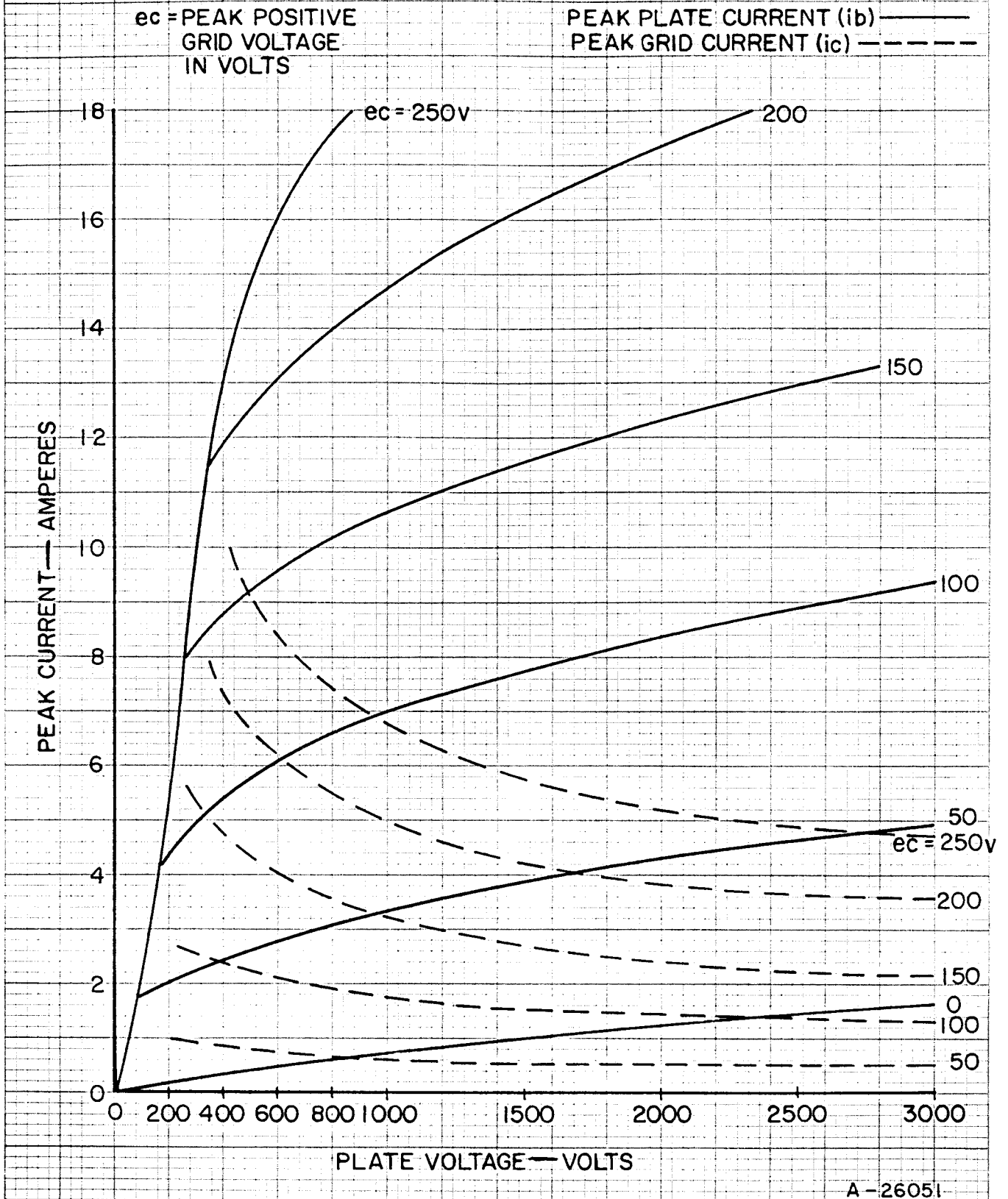




CONSTANT CURRENT CHARACTERISTICS  
FOR PULSED OPERATION  
 $E_f = 6.3$  VOLTS



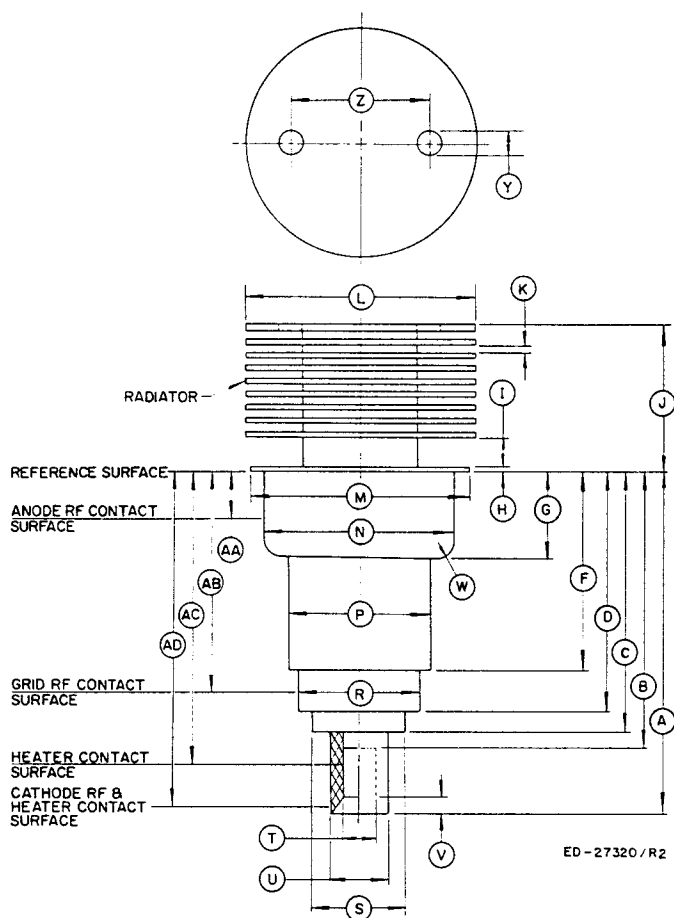
CONSTANT GRID-VOLTAGE CHARACTERISTICS  
FOR PULSED OPERATION  
 $E_f = 6.3$  VOLTS



DIMENSIONS FOR OUTLINE OF ML-7211

The millimeter dimensions are derived from the original inch dimensions.

Ref.	Inches			Millimeters			Notes
	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	
A	1.815		1.875	46.10		47.62	
AA	.035	.198	.361	.89	5.03	9.17	1, 5
AB	1.185	1.225	1.265	30.10	31.12	32.13	2, 5
AC	1.534	1.631	1.728	38.96	41.43	43.89	3, 6
AD	1.475	1.645	1.815	37.46	41.78	46.10	4, 5, 6
B			1.534			38.96	
C			1.475			37.46	
D	1.289		1.329	32.74		33.76	
F	.970		1.010	24.64		25.65	
G	.462		.477	11.73		12.12	
H			.040			1.02	
I	.125		.185	3.18		4.70	
J	.766		.826	19.46		20.98	
K	.025		.046	.64		1.17	
L	1.234		1.264	31.34		32.11	
M	1.180		1.195	29.97		30.35	
N	1.025		1.035	26.04		26.29	5
P	.752		.792	19.10		20.12	
R	.655		.665	16.64		16.89	5
S			.545			13.84	
T	.213		.223	5.41		5.66	6
U	.315		.325	8.00		8.26	5, 6
V			.086			2.18	
W			.100			2.54	
Y	.105		.145	2.67		3.68	
Z	.650		.850	16.51		21.59	



NOTES:

1. Anode rf contact surface and reference dimension for eccentricity measurements.
2. Grid rf contact surface and reference dimension for eccentricity measurements.
3. Heater contact surface and reference dimension for eccentricity measurements.
4. Heater and cathode rf contact surface and reference dimension for eccentricity measurements.
5. The total indicated runout of the anode and grid contact surface with respect to the cathode contact surface will not exceed .020 inch.
6. The total indicated runout of the cathode contact surface with respect to the heater contact surface will not exceed .012 inch.

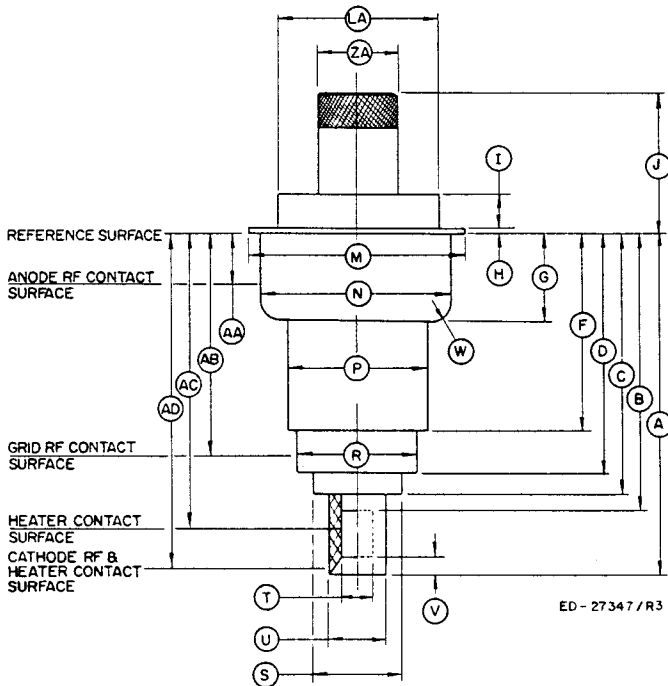
OUTLINE — ML-7211

DIMENSIONS FOR OUTLINE OF ML-7698

The millimeter dimensions are derived from the original inch dimensions.

Ref.	Inches			Millimeters			Notes
	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum	
A	1.815		1.875	46.10		47.62	
AA	.035		.361	.89	5.03	9.17	1, 5
AB	1.185	1.225	1.265	30.10	31.12	32.13	2, 5
AC	1.534	1.631	1.728	38.96	41.43	43.89	3, 6
AD	1.475	1.645	1.815	37.46	41.78	46.10	4, 5, 6
B			1.534			38.96	
C			1.475			37.46	
D	1.289		1.329	32.74		33.76	
F	.970		1.010	24.64		25.65	
G	.462		.477	11.73		12.12	
H			.040			1.02	
I			.185			4.70	
J	.766		.826	19.46		20.98	
LA	.840		.860	21.34		21.84	
M	1.180		1.195	29.97		30.35	
N	1.025		1.035	26.04		26.29	
P	.752		.792	19.10		20.12	5
R	.655		.665	16.64		16.89	
S			.545			13.84	
T	.213		.223	5.41		5.66	
U	.315		.325	8.00		8.26	5, 6
V			.086			2.18	
W			.100			2.54	
ZA	.427		.447	10.85		11.35	

OUTLINE — ML-7698



NOTES:

1. Anode rf contact surface and reference dimension for eccentricity measurements.
2. Grid rf contact surface and reference dimension for eccentricity measurements.
3. Heater contact surface and reference dimension for eccentricity measurements.
4. Heater and cathode rf contact surface and reference dimension for eccentricity measurements.
5. The total indicated runout of the anode and grid contact surface with respect to the cathode contact surface will not exceed .020 inch.
6. The total indicated runout of the cathode contact surface with respect to the heater contact surface will not exceed .012 inch.



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