

ML-8906
ML-8907
ML-8906/AL



UHF Planar Triodes
CW, Plate or Grid Pulsed
Phormat Cathode
High Cathode Current Capability
Extended Grid-Anode Insulator
3 GHz

DESCRIPTION

The ML-8906, ML-8907 and ML-8906/AL are ruggedized, high- μ planar triodes of ceramic-and-metal construction designed for use as grid-pulsed, plate-pulsed or CW oscillators, amplifiers or frequency multipliers in transmitting service at frequencies up to 3 GHz. They may also be used as pulse modulators, pulse amplifiers or voltage regulators. The ML-8907 is fitted with a radiator for forced-air cooling. The ML-8906 and ML-8906/AL are intended for conduction and convection cooling. The ML-8906/AL is specially processed and tested for application in airline avionics service where long life and uninterrupted service are of prime importance.

These tubes are provided with an extended grid-anode insulator in the tube envelope making them suitable for high-altitude operation. They 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. The ceramic insulators of these tubes are provided with spew shields to minimize changes in grid-plate capacitance with life. Other features of these tubes include high cathode current capability, low interelectrode capacitance, high transconductance and great mechanical strength.

The envelopes of these tubes are dimensionally equivalent to the ML-7211, ML-7698, ML-7815, ML-7815R, ML-7815/AL and ML-7815R/AL. The ML-8906, ML-8907 and ML-8906/AL have a larger cathode surface than the ML-7815, ML-7815R, ML-7815/AL and ML-7815R/AL. The tubes can be used to replace the ML-7211 and ML-7698 with a reduction in heater power requirements.

GENERAL CHARACTERISTICS

Electrical

Heater Voltage (AC or DC)	
ML-8906, ML-8907	6.0 $\pm$ 3 V
ML-8906/AL	5.7 $\pm$ 2% V
Heater Current	
ML-8906, ML-8907 (at 6.0 V)	1.00 A
ML-8906/AL (at 5.7 V)	.95 A
Cathode Heating Time, minimum	60 sec
Amplification Factor	80
Transconductance (Ib=100 mA, Eb=600 V)	30000 μ mhos
Interelectrode Capacitance, without heater voltage	
Grid-Plate	1.98 pf
Grid-Cathode	8.00 pf
Plate-Cathode, maximum	.06 pf

Mechanical and Environmental

Mounting Position	Optional
Type of Cooling	
With radiator (ML-8907)	Forced-Air \$
Without radiator (ML-8906, ML-8906/AL)	Conduction & Convection \$
Maximum Envelope or Anode Temperature	250 °C
Non-Operating Shock, 11 millisecond	60 G
Vibration, All Axis, Operating, 55 to 500 Hertz	10 G
Altitude, maximum	70000 ft
Net Weight	
ML-8906, ML-8906/AL	51 g
ML-8907	63 g

\$ For cooling data refer to Machlett Application Notes, UHF Tubes — General

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	150	mA
DC Grid Current	45	mA
Plate Dissipation		
Forced-air cooling (ML-8907)	100	W
Conduction and convection (ML-8906, ML-8906/AL)	10	W
Grid Dissipation	1.5	W
Frequency	2.5	GHz

Typical Operation, Cathode Drive Amplifier

Frequency	.7	GHz
DC Plate Voltage	630	V
DC Grid Voltage, approximate	—5	V
DC Cathode Current	140	mA
DC Grid Current	25	mA
Driving Power, approximate	4	W
Useful Power Output	45	W

Typical Operation, Cathode Drive Oscillator

Frequency	2.5	GHz
Heater Voltage	5.0	V*
DC Plate Voltage	1000	V
DC Grid Voltage, approximate	—20	V
DC Plate Current	140	mA
DC Grid Current, approximate	30	mA
Useful Power Output	30	W

*The heater voltage is reduced approximately 15% in this application due to back heating of the cathode.

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

Maximum Ratings, Absolute Values

Plate Voltage		
Grid-Pulsed, DC	3500	V
Plate-Pulsed, Peak Pulse Supply	4500	v
DC Grid Voltage	—150	V
Instantaneous Peak Grid-Cathode Voltage		
Grid negative to cathode		
ML-8906, ML-8907	—700	v
ML-8906/AL	—750	v
Grid positive to cathode		
ML-8906, ML-8907	200	v
ML-8906/AL	250	v
Pulse Plate Current	5	a
Pulse Grid Current	2.5	a
Average Plate Dissipation		
Forced-air cooling (ML-8907)	100	W
Conduction and convection (ML-8906, ML-8906/AL)	10	W
Average Grid Dissipation		
ML-8906, ML-8907	1.5	W
ML-8906/AL	2	W
Pulse Duration	6	μs**
Duty Factor	0.0033	**
Frequency	3	GHz

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

Typical Operation, Grid-Pulsed RF Amplifier, ML-8906, ML-8907

Frequency	1.1	GHz
Heater Voltage	6.0	V
Pulse Duration	3	μs
Duty Factor	0.002	
DC Plate Voltage	2200	V
DC Grid Voltage	—50	V
Peak Video Plate Current	2.5	a
Peak Video Grid Current	1	a

Driving Power during Pulse	400	W
Useful Peak Power Output, approximate	2.5	kw
Typical Operation, Grid-Pulsed RF Oscillator, ML-8906/AL		
Frequency	1.1	GHz
Heater Voltage	5.7	V
Pulse Duration	.5	μs
Duty Factor	0.001	
DC Plate Voltage	2000	V
DC Grid Voltage	—75	V
Peak Video Plate Current	1.1	a
Peak Video Grid Current	.8	a
Useful Peak Power Output, approximate	850	w

Typical Operation, Plate-Pulsed RF Amplifier, ML-8906/AL

Frequency	1.1	GHz
Heater Voltage	5.7	V
Pulse Duration	3.5	μs
Duty Factor	0.001	
Peak Plate Pulse Supply Voltage	2000	v
DC Grid Voltage	—45	V
Peak Video Plate Current	2	a
Peak Video Grid Current	1	a
Driving Power	300	W
Useful Peak Power Output, approximate	2	kw

Typical Operation, Plate-Pulsed RF Oscillator, ML-8906, ML-8907

Frequency	3	GHz
Heater Voltage	5.8	V
Pulse Duration	3	μs
Duty Factor	0.0025	
Peak Plate Pulse Supply Voltage	3500	v
Peak Video Plate Current	4.8	a
Peak Video Grid Current	1.5	a
Useful Peak Power Output, approximate	3	kw

Pulse Modulator or Pulse Amplifier

Maximum Ratings, Absolute Values

DC Plate Voltage	3500	V
Peak Plate Voltage	4500	v
DC Grid Voltage	—150	V
Instantaneous Peak Grid-Cathode Voltage		
Grid negative to cathode	—750	v
Grid positive to cathode	150	v
DC Plate Current	150	mA
Pulse Cathode Current	7.5	a
Average Plate Dissipation		
Forced-air cooling (ML-8907)	100	W
Conduction and convection (ML-8906, ML-8906/AL)	10	W
Average Grid Dissipation	1.5	W
Cutoff Amplification Factor	60	
Pulse Duration	6	μs**
Duty Factor	0.0033	**

**For applications requiring longer pulse duration or higher duty factor, consult the Machlett Engineering Department

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min	Max
Filament Current		
ML-8906, ML-8907 (at 6.0 V)	.90	1.05 A
ML-8906/AL (at 5.7 V)	.87	1.02 A
Cut-Off Bias (Note 1)	—	—30 V
Grid-Plate Capacitance (Note 2)	1.85	1.20 pf
Grid-Cathode Capacitance (Note 2)	7.0	9.0 pf
Plate-Cathode Capacitance (Note 2)	—	.06 pf
Note 1 — Measured at 1 mA of plate current and a plate voltage of 1000 Vdc.		
Note 2 — Capacitance values are given for a cold tube. When the cathode is heated to its proper temperature, the grid-cathode capacitance will increase by approximately 1 pf due to thermal expansion of the cathode support structure.		

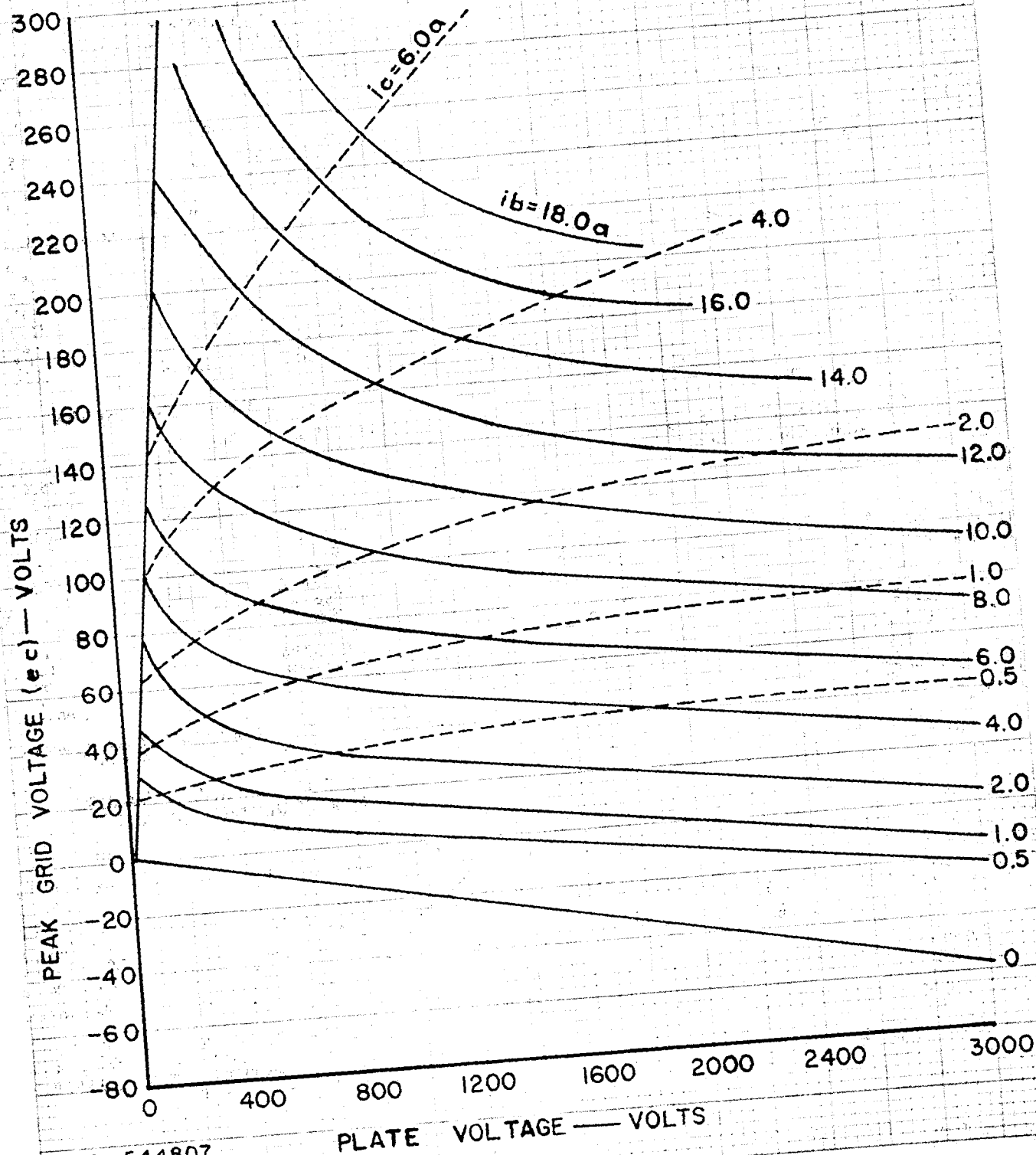
APPLICATION NOTES

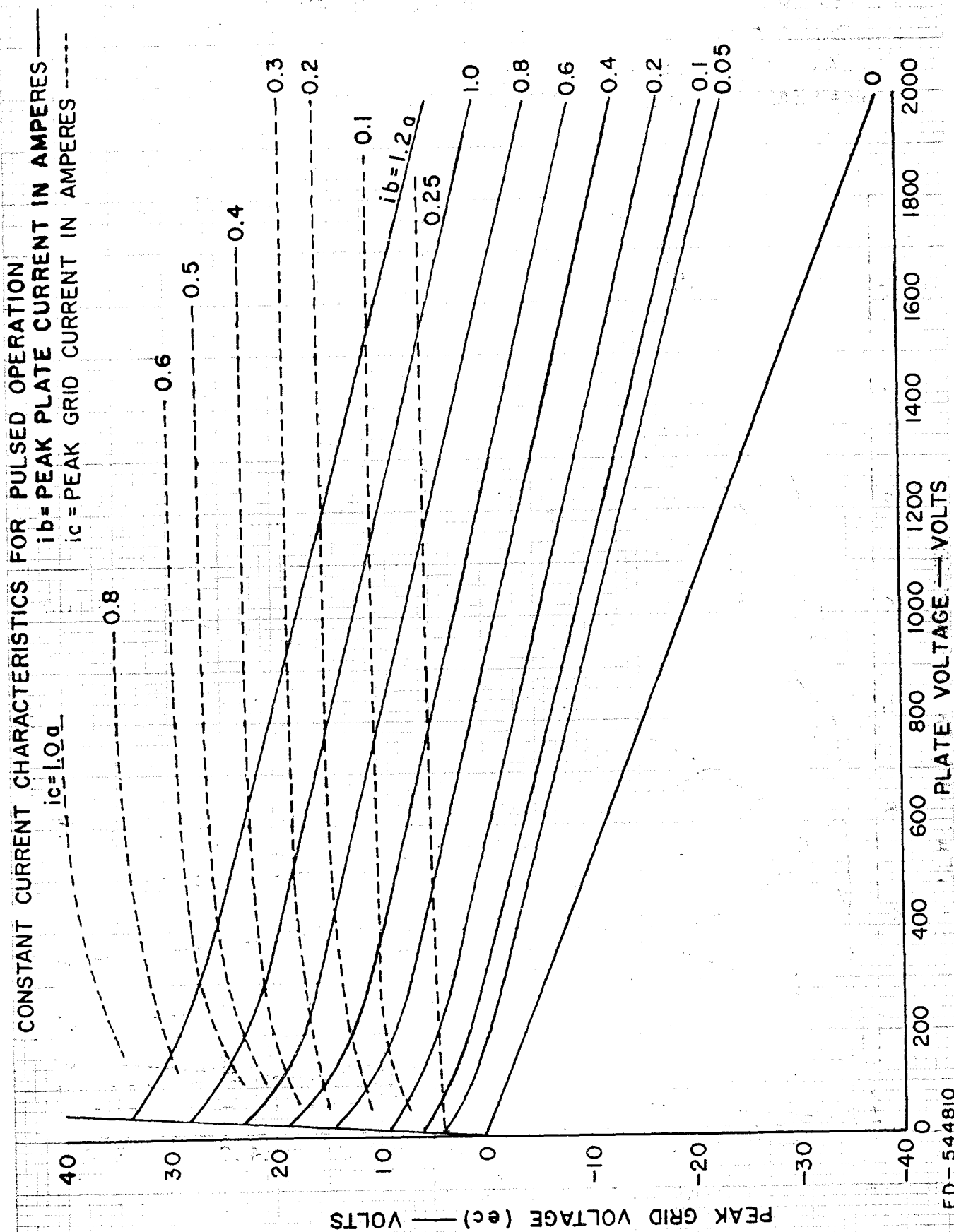
Before designing equipment for use with these tubes and before installing tubes in equipment, refer to the general information given in the Machlett publications entitled *Application Notes, UHF Tubes — General and Application Notes, UHF Triodes, Extended Life AL Series Tubes for Airline Operation*.

CONSTANT CURRENT CHARACTERISTICS FOR PULSED OPERATION

i_b = PEAK PLATE CURRENT IN AMPERES ———

i_c = PEAK GRID CURRENT IN AMPERES - - - - -



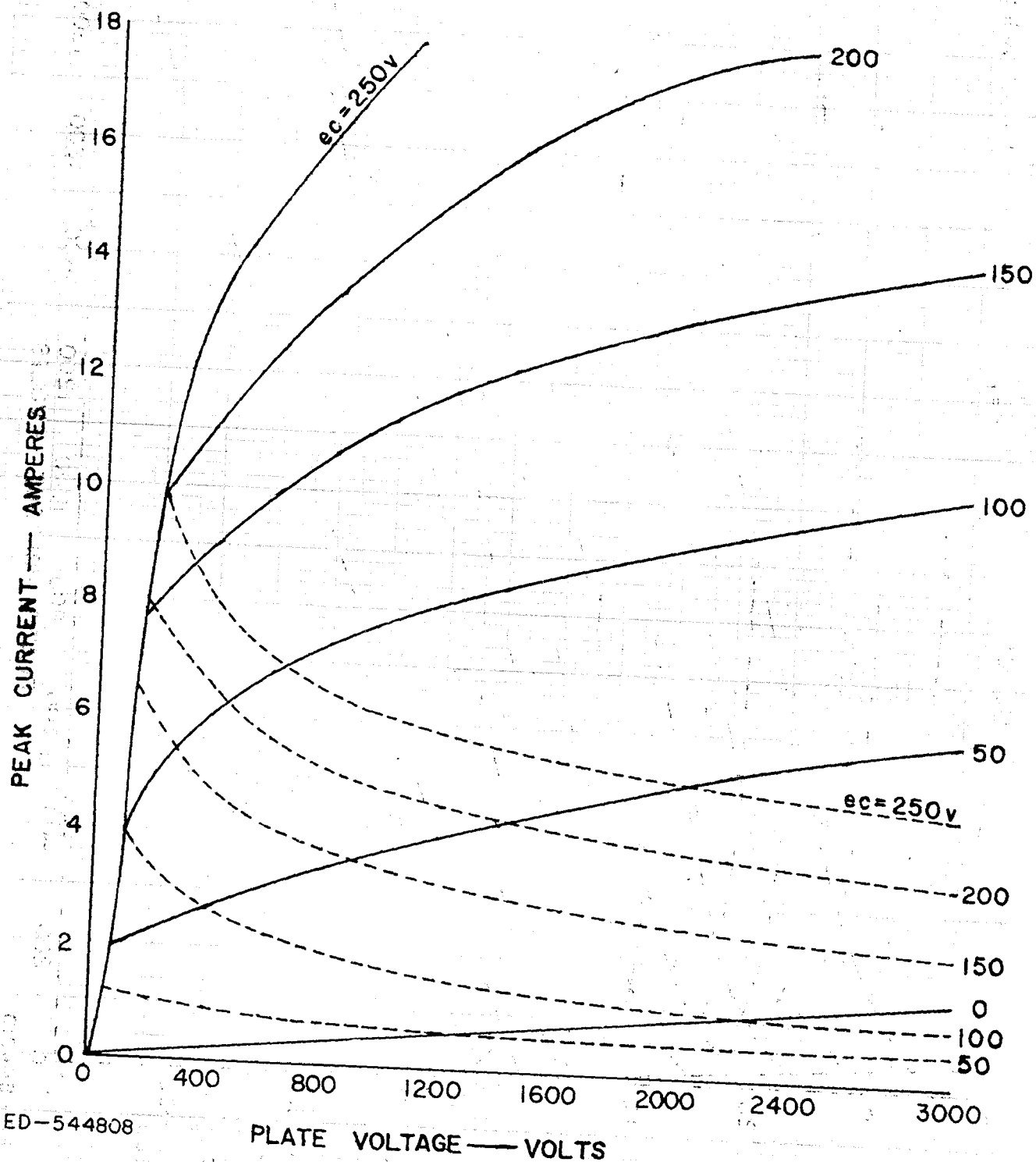


CONSTANT GRID-VOLTAGE CHARACTERISTICS FOR PULSED OPERATION

PEAK PLATE CURRENT (i_b) ———

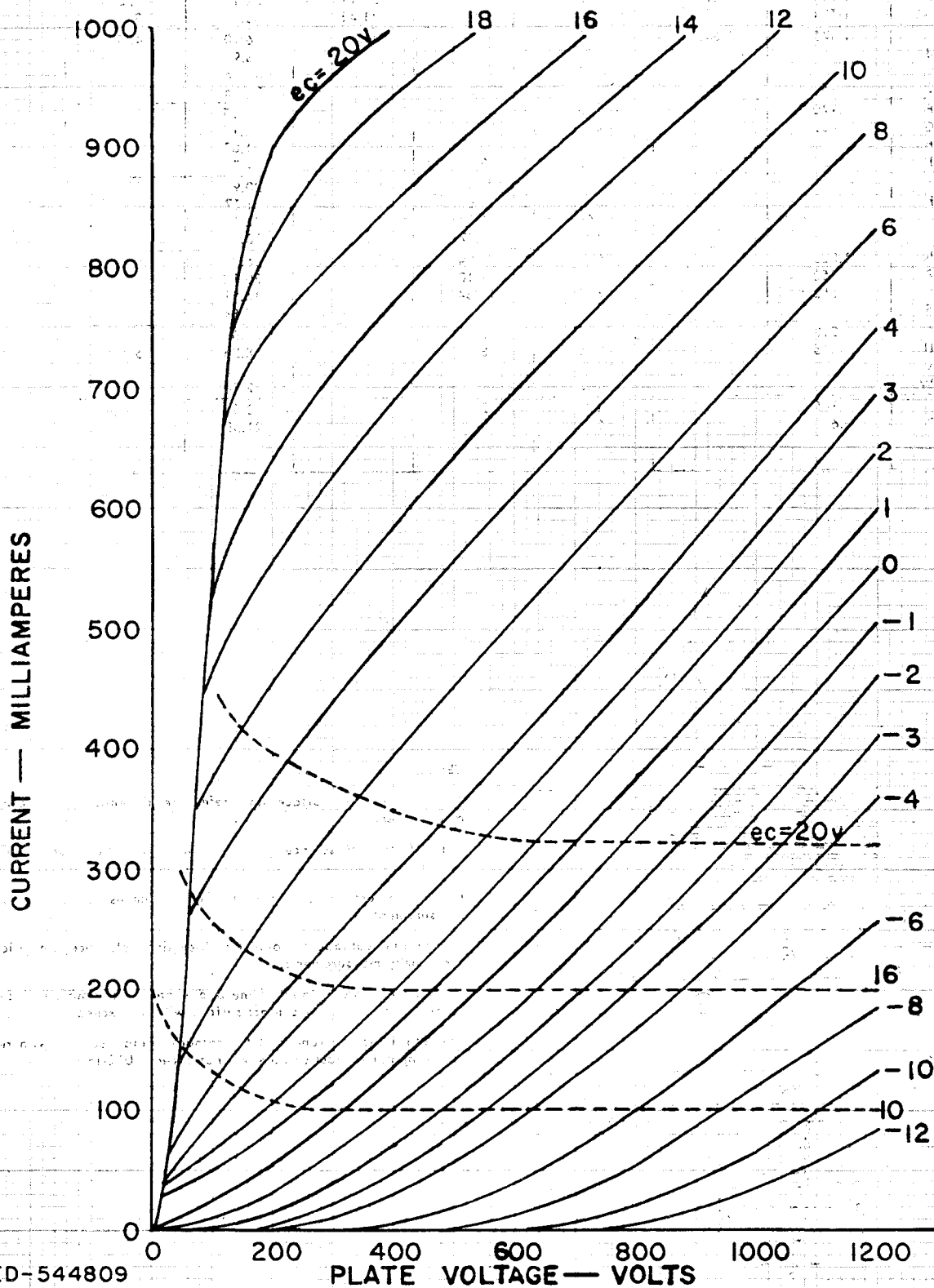
PEAK GRID CURRENT (i_c) - - - - -

e_c = PEAK POSITIVE GRID VOLTAGE IN VOLTS



CONSTANT GRID - VOLTAGE CHARACTERISTICS

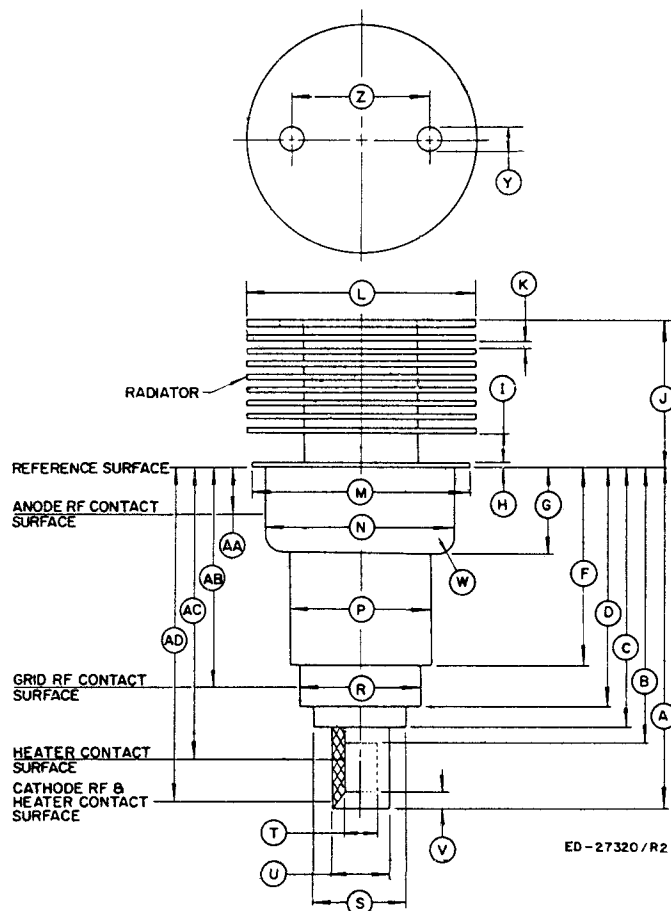
PLATE CURRENT (i_b) ———
GRID CURRENT (i_c) - - - -
 e_c = GRID VOLTAGE IN VOLTS



DIMENSIONS FOR OUTLINE OF ML-8907

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		3.63	
Z	.650		.850	16.51		21.59	



NOTES:

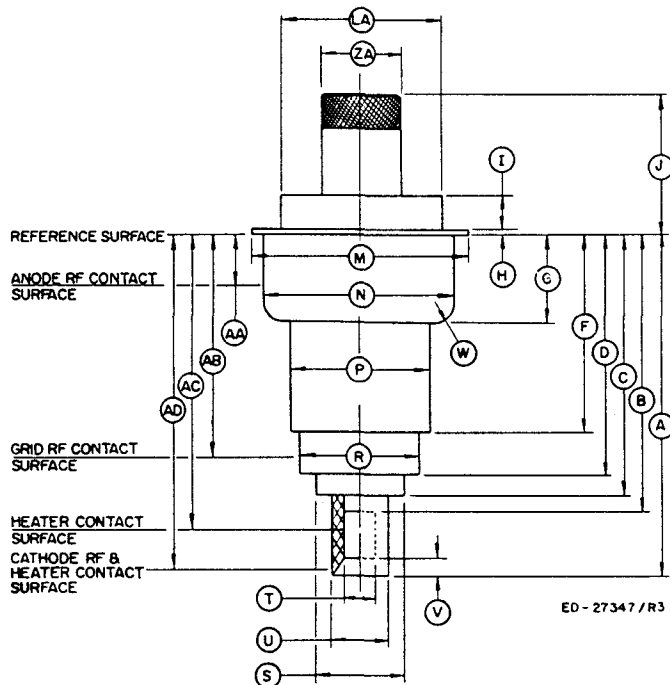
1. Anode rf contact surface and reference dimension for eccentricity measurements.
2. Grid rf contact surface and reference dimension for eccentricity measurements.
3. Heater contact surface and reference dimension for eccentricity measurements.
4. Heater and cathode rf contact surface and reference 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.

DIMENSIONS FOR OUTLINE OF ML-8906 and ML-8906/AL

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			.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	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	
ZA	.427		.447	10.85		11.35	

OUTLINE — ML-8906 & ML-8906/AL



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.

RAYTHEON

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