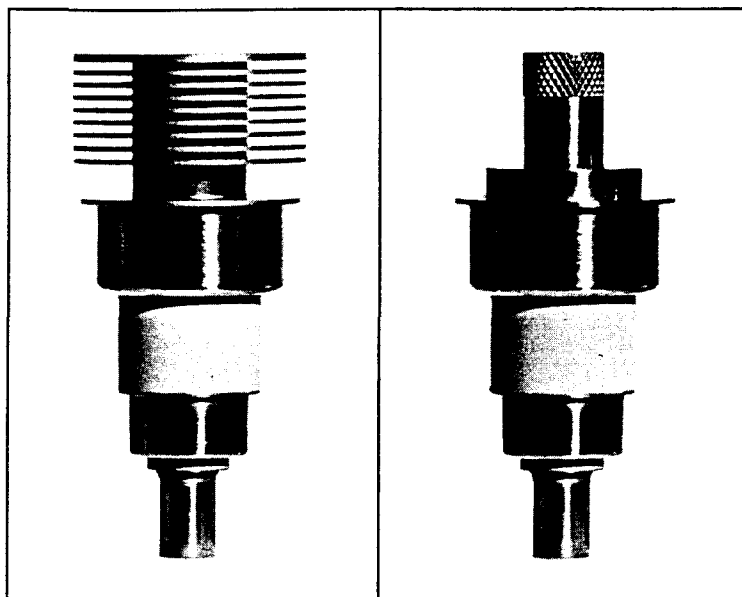




ML-7815/  
3CPN10A5  
ML-7815R



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

## DESCRIPTION

The ML-7815/3CPN10A5 and ML-7815R 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-7815/3CPN10A5 is supplied without a radiator for conduction-convection cooling. The ML-7815R is supplied with a radiator for forced-air cooling. Except for plate-dissipation ratings, the characteristics of the two tubes are the same.

A special feature of these tubes as compared to other tubes fitting the same socket is 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 inter-electrode 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) .....                                      | 6.0 V                  |
| Heater Current at 6.0 Volts .....                                    | 1.0 A                  |
| Cathode Heating Time, minimum .....                                  | 60 sec                 |
| Amplification Factor .....                                           | 100                    |
| Transconductance ( $I_b = 70\text{mA}$ , $E_b = 600\text{V}$ ) ..... | 25000 $\mu\text{mhos}$ |
| Interelectrode Capacitance, without Heater Voltage                   |                        |
| Grid-Plate .....                                                     | 1.98 pf                |
| Grid-Cathode .....                                                   | 6.30 pf                |
| Plate-Cathode, maximum .....                                         | .035 pf                |

### Mechanical

|                                           |                         |
|-------------------------------------------|-------------------------|
| Mounting Position .....                   | Optional                |
| Type of Cooling                           |                         |
| Without radiator (ML-7815/3CPN10A5) ..... | Conduction & Convection |
| With radiator (ML-7815R) .....            | Forced-Air              |
| Maximum Envelope Temperature .....        | 250 °C                  |
| Net Weight                                |                         |
| Without radiator (ML-7815/3CPN10A5) ..... | 51 g                    |
| With radiator (ML-7815R) .....            | 63 g                    |

### MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

#### 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       |
| Peak Plate Current                      | 3 a        |
| Average Plate Dissipation               |            |
| Forced-air cooling (ML-7815R)           | 35 W       |
| Conduction and convection (ML-7815)     | 10 W       |
| Average Grid Dissipation                | 2 W        |
| Pulse Duration                          | 6 $\mu$ s† |
| Duty Factor                             | .0033 †    |
| Frequency                               | 3 GHz      |

##### Typical Operation, Plate-Pulsed RF Oscillator

|                                       |           |
|---------------------------------------|-----------|
| Frequency                             | 2.5 GHz   |
| Filament Voltage                      | 5.8 V     |
| Pulse Duration                        | 5 $\mu$ s |
| Duty Factor                           | .0030     |
| Peak Plate Pulse Supply Voltage       | 3500 V    |
| Peak Plate Current from Pulse Supply  | 3 a       |
| Average Plate Current                 | 9 mA      |
| Average Grid Current                  | 3 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 $\mu$ s |
| Duty Factor                             | .001        |
| DC Plate Voltage                        | 2200 V      |
| DC Grid 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   | 2.0 kw      |

#### Pulsed 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                | 150 v  |
| DC Plate Current                        | 100 mA |
| Pulse Cathode Current                   | 4.8 a  |
| Average Plate Dissipation               |        |
| Forced-air cooling (ML-7815R)           | 100 W  |
| Conduction and convection (ML-7815)     | 10 W   |

|                          |            |
|--------------------------|------------|
| Average Grid Dissipation | 1.5 W      |
| Pulse Duration           | 6 $\mu$ s† |
| Duty Factor              | .0033 †    |

#### CW RF Power Amplifier and Oscillator Class C Telegraphy

Key-down conditions per tube without amplitude modulation‡

##### 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 Cathode Current                      | 125 mA  |
| DC Grid Current                         | 50 mA   |
| Plate Dissipation                       |         |
| Forced-air cooling (ML-7815R)           | 100 W   |
| Conduction and convection (ML-7815)     | 10 W    |
| Grid Dissipation                        | 2 W     |
| Frequency                               | 2.5 GHz |

##### Typical Operation, RF Power Amplifier, Grid Separation Circuit

|                              |         |
|------------------------------|---------|
| Frequency                    | 500 MHz |
| 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, RF Oscillator

|                              |         |
|------------------------------|---------|
| Frequency                    | 2.5 GHz |
| DC Plate Voltage             | 900 V   |
| DC Grid Voltage, approximate | —22 V   |
| DC Plate Current             | 90 mA   |
| DC Grid Current              | 10 mA   |
| Useful Power Output          | 17 W    |

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

‡Modulation essentially negative may be used if the positive peak of the envelope does not exceed 115 per cent of the carrier conditions.

### CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

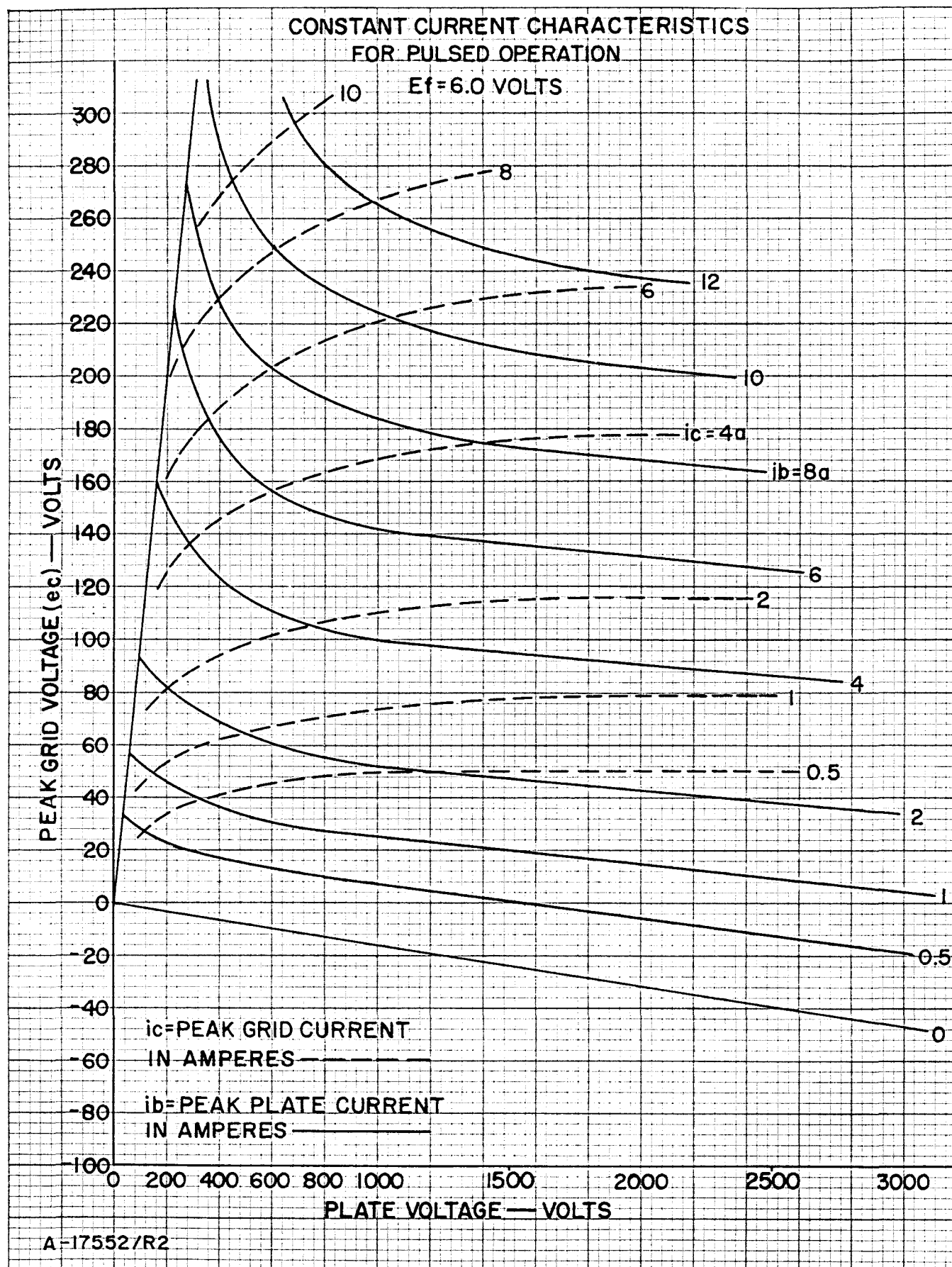
|                                    | Min. | Max.    |
|------------------------------------|------|---------|
| Filament Current at 6.0 Volts      | 0.90 | 1.05 A  |
| Cutoff Bias (Note 1)               | —    | —15 V   |
| Grid-Plate Capacitance (Note 2)    | 1.85 | 2.10 pf |
| Grid-Cathode Capacitance (Note 2)  | 5.60 | 7.00 pf |
| Plate-Cathode Capacitance (Note 2) | .035 | pf      |

Note 1 — Measured at 1 mA of plate current and a plate voltage of 600 volts.

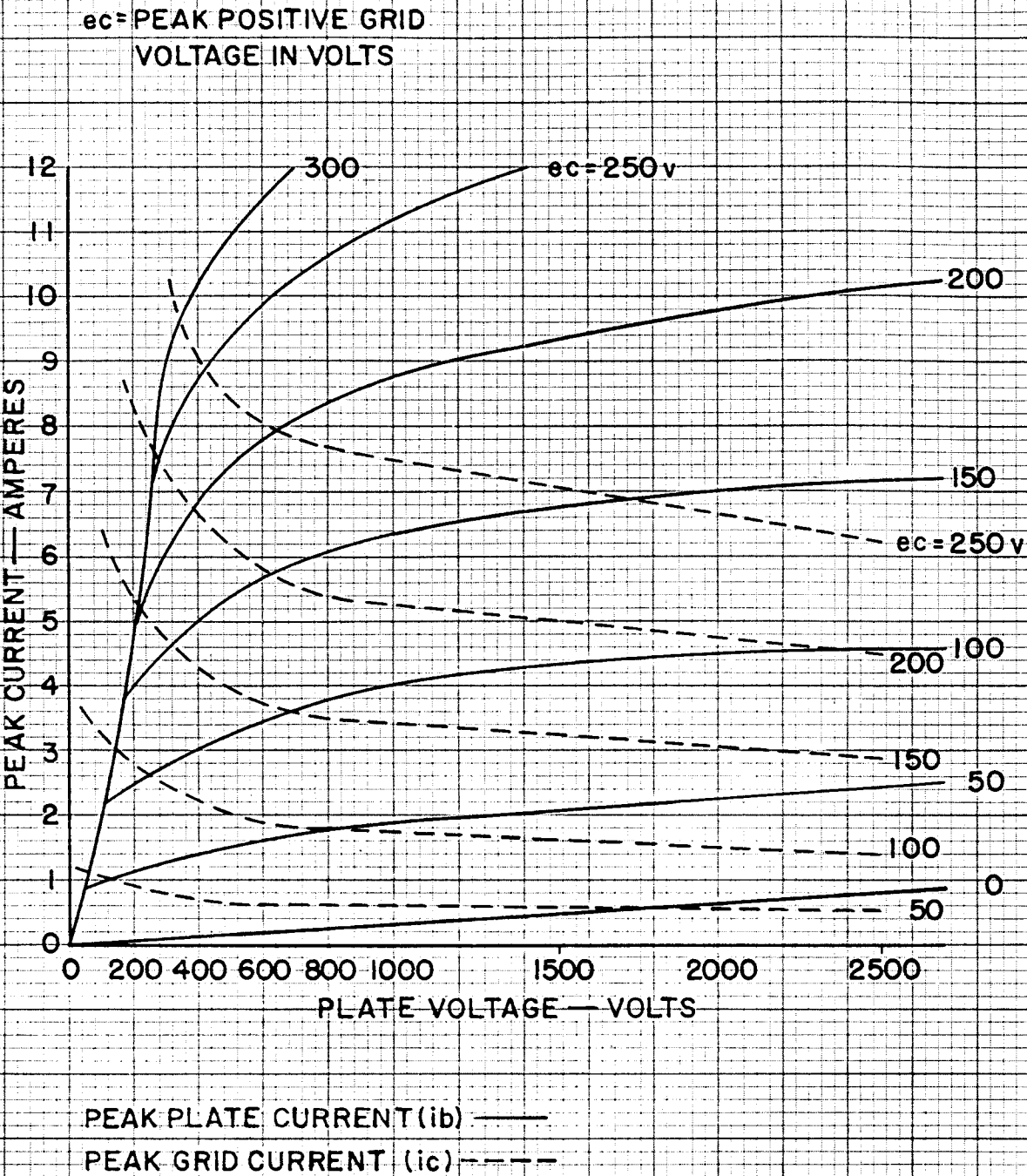
Note 2 — Capacitance measurements are made with tube cold.

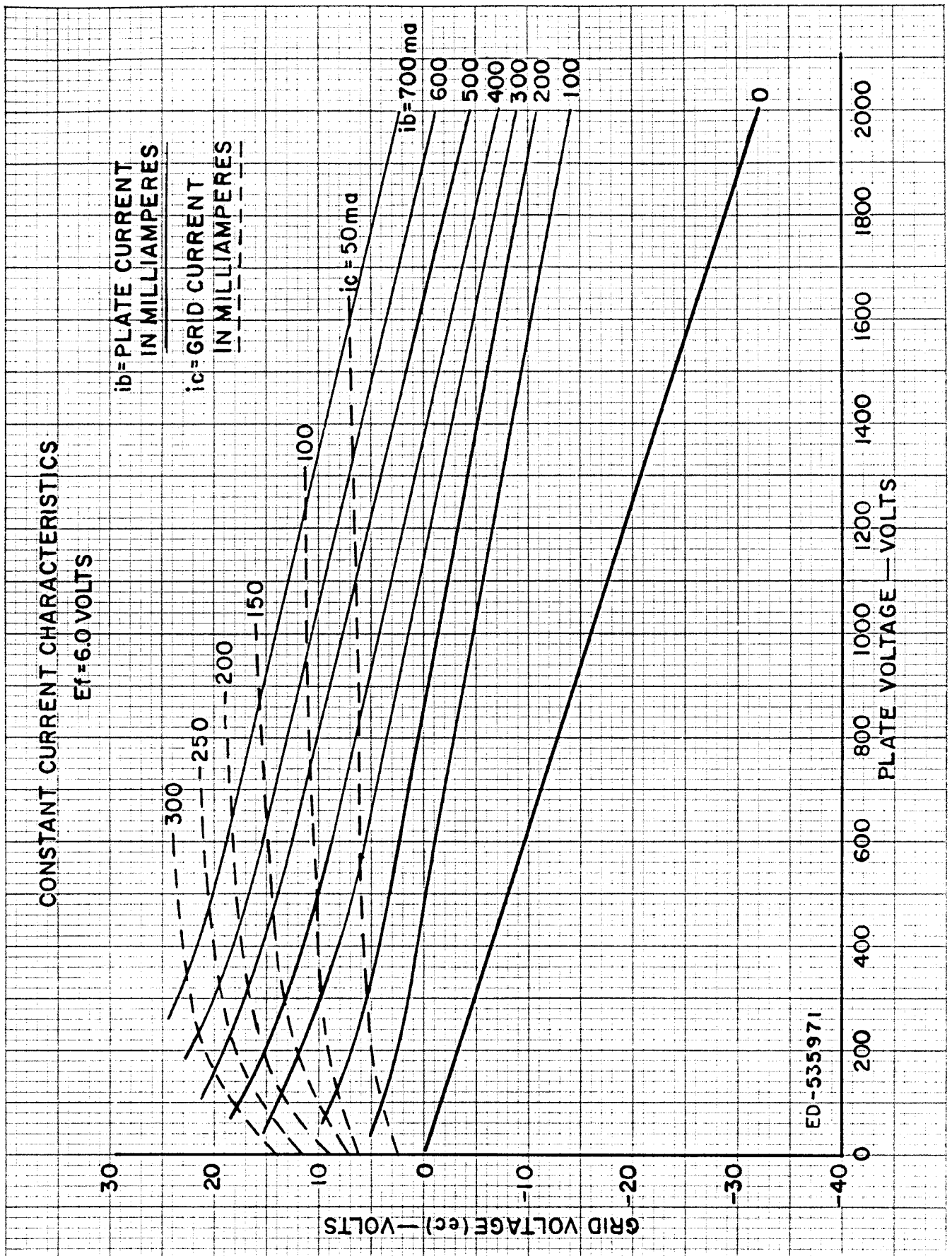
### APPLICATION NOTES

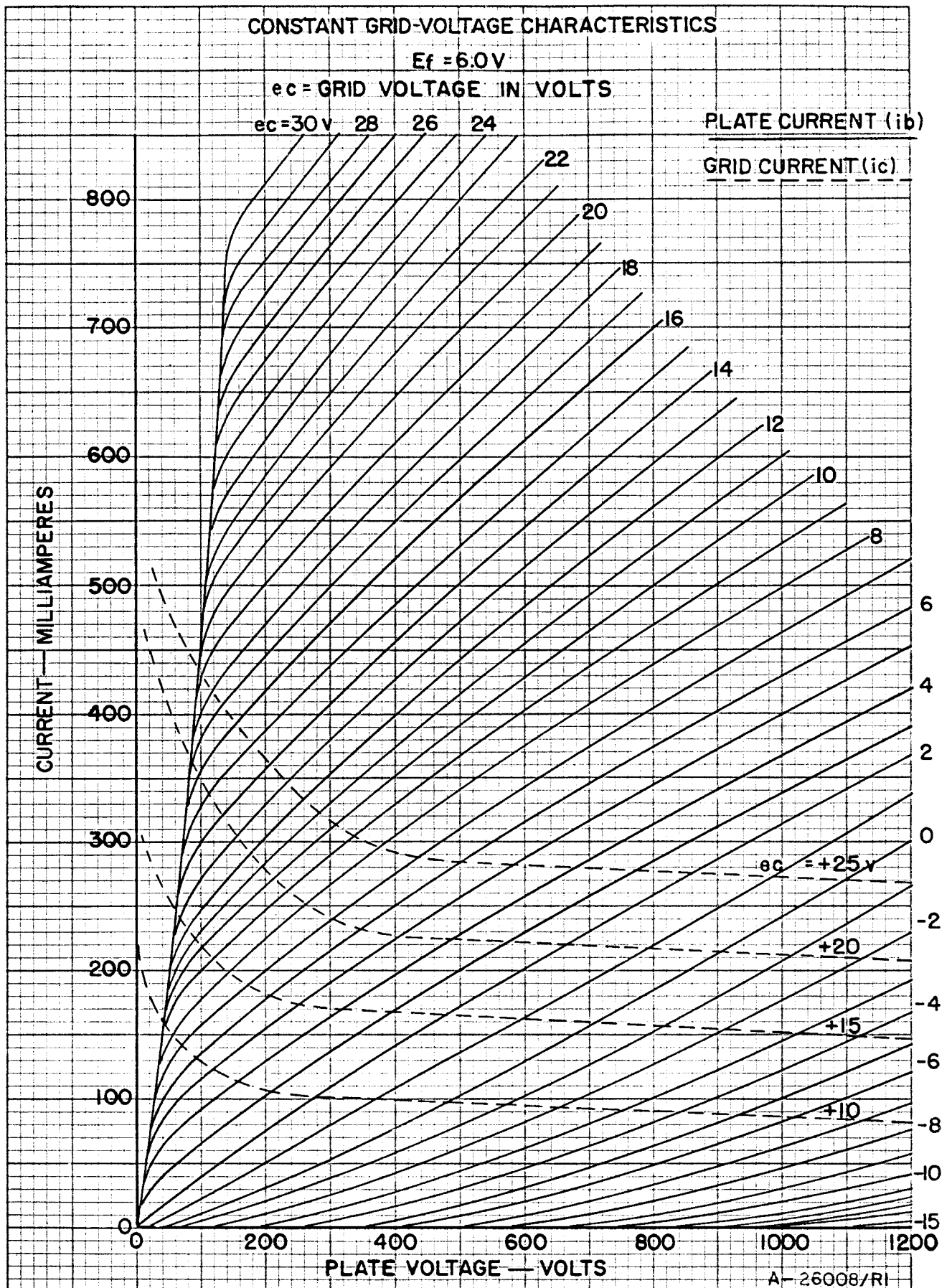
Before designing equipment for use with these tubes and before installing tubes in equipment, refer to the general information given in the Machlett publication entitled *Application Notes, UHF Tubes — General*.



CONSTANT GRID-VOLTAGE CHARACTERISTICS  
FOR PULSED OPERATION  
 $E_f = 6.0$  VOLTS



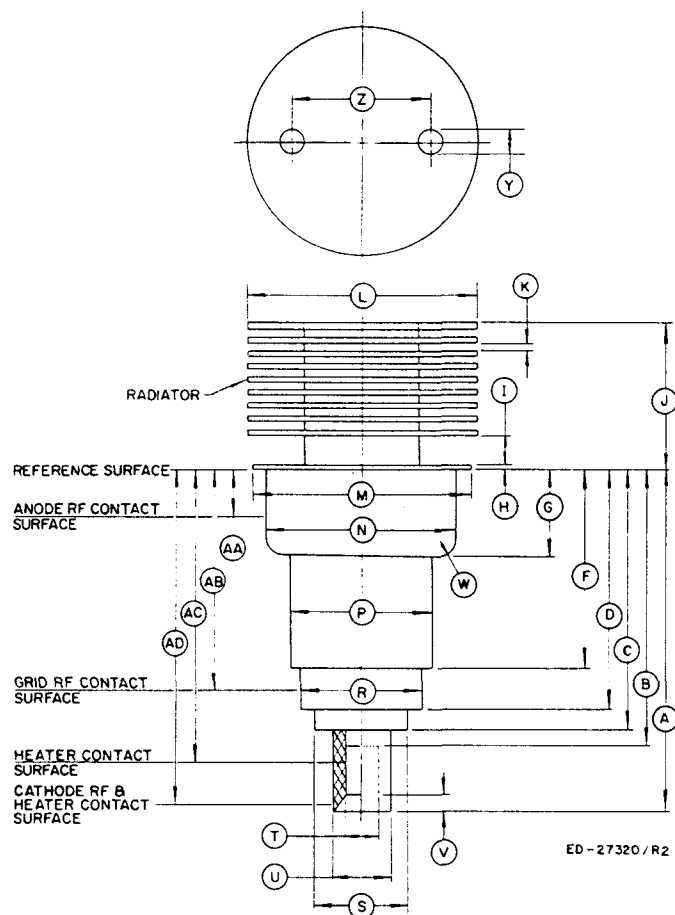




## DIMENSIONS FOR OUTLINE OF ML-7815R

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.

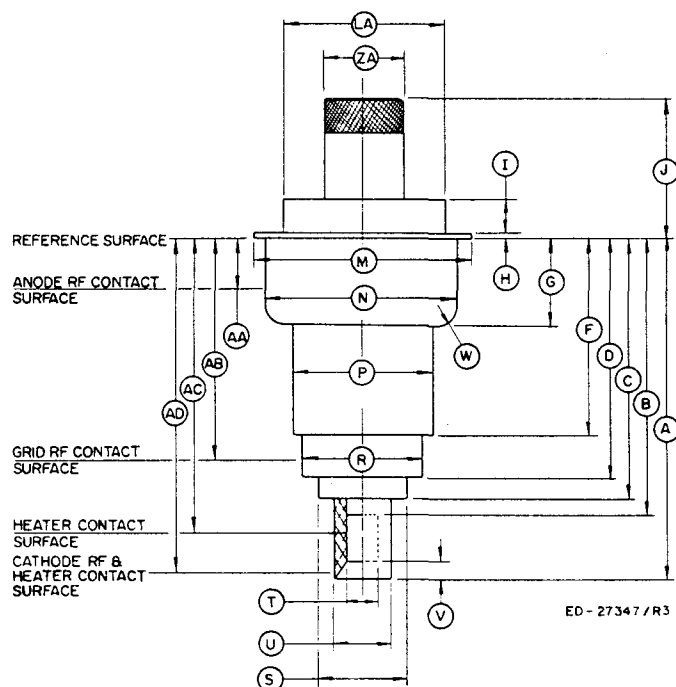
OUTLINE—ML-7815R

## DIMENSIONS FOR OUTLINE OF ML-7815/3CPN10A5

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-7815/3CPN10A5



## 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.
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RAYTHEON

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