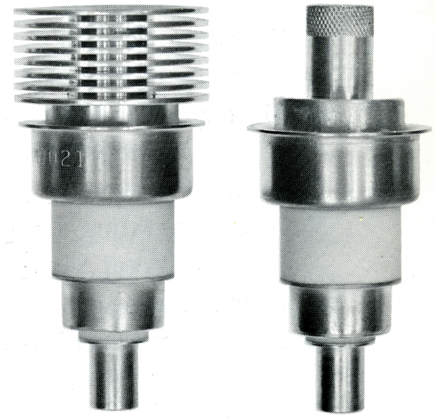
TECHNICAL DATA

# 7855AL
# 7855KAL

PLANAR TRIODE



7855AL 7855KAL

The EIMAC 7855AL and 7855KAL are ceramic/metal planar triodes specially processed and tested to assure high reliability in airborne service. Evaluation of these tubes is based upon operating conditions found in commercial airborne applications such as transponders. The testing emphasizes cathode emission capability at reduced heater voltage and high voltage hold-off, both features which are demanded in airline service.

The 7855AL is derived from the 7855, the 7855KAL from the 7855K. These new improved tubes also contain features of the original types such as a frequency stable anode, rugged ceramic/metal construction, low interelectrode capacitance, high transconductance and high mu.

In addition to these features, these tubes also incorporate the arc-resistant cathode which assures stable operation under adverse conditions and which minimizes catastrophic failures due to arc-over during circuit malfunction. These tubes are useable from dc to 3 GHz.

The 7855KAL utilizes conduction-convection cooling. The 7855AL is supplied with a radiator for forced-air cooling. Except for the plate dissipation ratings, the two tubes have identical electrical characteristics.

## GENERAL CHARACTERISTICS[1]

### ELECTRICAL

| | | |
|---|---|---|
| Cathode: Oxide Coated, Unipotential | | |
| Heater: Voltage | 5.7 ± 2% | V |
| Current, at 5.7 volts | 0.95 | A |
| Transconductance (Average): | | |
| $I_b$ = 70 mAdc, $E_b$ = 600 Vdc | 25 | mmhos |
| Amplification Factor (Average) | 100 | |
| Direct Interelectrode Capacitance (grounded cathode)[2] | | |
| Cin | 6.80 | pF |
| Cout | 0.04 | pF max. |
| Cgp | 2.50 | pF |
| Cut-off Bias[3] | -30 | V |
| Frequency of Maximum Rating: | | |
| Plate or Grid-Pulsed | 3000 | MHz |

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture. When the cathode is heated to the proper temperature, the grid-cathode capacitance will increase from the cold value by approximately 1 pf due to thermal expansion of the cathode.

3. Measured with one milliampere plate current and a plate voltage of 1 kVdc.

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## MECHANICAL

| | |
|---|---|
| Maximum Overall Dimensions: | |
| Length (7855AL) | 2.386 in; 60.60 mm |
| (7855KAL) | 2.386 in; 60.60 mm |
| Diameter (7855AL) | 1.264 in; 32.11 mm |
| (7855KAL) | 1.195 in; 30.35 mm |
| Net Weight (7855AL) | 2.01 oz; 57 gm |
| (7855KAL) | 1.41 oz; 40 gm |
| Operating Position | Any |
| Maximum Operating Temperature: | |
| Ceramic/Metal Seals | 250°C |
| Anode Core | 250°C |
| Cooling - 7855AL (With Radiator) | Forced Air |
| - 7855KAL (Without Radiator) | Conduction and Convection |
| Terminals | Coaxial special |

## RANGE VALUES FOR EQUIPMENT DESIGN

| | Min. | Max. | |
|---|---|---|---|
| Heater: Current at 5.7 volts | 0.87 | 1.02 | A |
| Cathode Warmup Time | 60 | --- | sec. |
| Interelectrode Capacitance[1] (grounded cathode connection) | | | |
| Cin | 6.00 | 7.50 | pF |
| Cout | --- | 0.40 | pF |
| Cgp | 2.35 | 2.65 | pF |

1. Capacitance values are for a cold tube as measured in a special shielded fixture.

## GRID PULSED OR PLATE PULSED AMPLIFIER OR OSCILLATOR

ABSOLUTE MAXIMUM RATINGS:

| | | |
|---|---|---|
| DC PLATE VOLTAGE (grid pulsed) | 2500 | VOLTS |
| PEAK PULSE PLATE VOLTAGE (plate pulsed) | 3500 | VOLTS |
| DC GRID VOLTAGE | -150 | VOLTS |
| INSTANTANEOUS PEAK GRID-CATHODE VOLTAGE | | |
| Grid negative to cathode | -750 | VOLTS |
| Grid positive to cathode | 250 | VOLTS |
| PULSE PLATE CURRENT | 3.0 | AMPERES |
| PULSE GRID CURRENT | 1.8 | AMPERES |
| AVERAGE PLATE DISSIPATION | | |
| Conduction and convection(7855KAL) | 10 | WATTS |
| Forced Air(7855AL)[1] | 35 | WATTS |
| GRID DISSIPATION (Average) | 2.0 | WATTS |
| FREQUENCY | 3.0 | GHz |
| PULSE DURATION[2] | 6.0 | $\mu s$ |
| DUTY FACTOR [2] | .0033 | |

1. Using EIMAC radiator PN 158601.

2. For applications using longer pulse duration and/or higher duty cycle consult the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City.

OPERATING CONDITIONS

GRID PULSED OSCILLATOR

| | | |
|---|---|---|
| Frequency | 1.090 | GHz |
| Heater Voltage | 5.7 | V |
| DC Plate Voltage | 2000 | Vdc |
| DC Grid Voltage | -75 | Vdc |
| Peak Video Plate Current | 1.3 | a |
| Peak Video Grid Current | 0.8 | a |
| Useful Power Output (approx.) | 750 | w |
| Pulse Duration | 0.5 | $\mu s$ |
| Duty Factor | 0.001 | |

PLATE PULSED AMPLIFIER

| | | |
|---|---|---|
| Frequency | 1.1 | GHz |
| Heater Voltage | 5.7 | V |
| Peak Plate Voltage | 2000 | v |
| Peak Video Plate Current | 1.8 | a |
| Peak Video Grid Current | 1.0 | a |
| Useful Power Output (approx.) | 1800 | w |
| Pulse Duration | 3.5 | $\mu s$ |
| Duty Factor | 0.001 | |
| Gain | 8 | db |
| Plate Efficiency | 50 | % |

# APPLICATION

## MECHANICAL

*MOUNTING* - The important dimensions of the tube are carefully controlled with respect to the reference surface as shown on the outline drawing. The reference surface is intended to serve as a tube stop and the location of the tube in the circuit should therefore be determined by this surface coming in positive contact with a precisely positioned member of the socket or cavity. Adherence to this practice will assure both mechanical and electrical interchangeability of all tubes of a given type. If a non-designated surface is used as a tube stop, faulty positioning of the tube in the cavity and possible incomplete electrical contact can result in improper tuning, reduced power output and damage to the cavity, tube or both. Contact surfaces, with reference to the designated tube stop are shown in the outline drawing. Electrical contact to the cathode, grid, anode and also the heater should be restricted to these designated contact areas.

Dimensions should never be taken from sample tubes. Dimensional changes due to normal variations in undimensioned surfaces may occur within the limits specified on the outline drawing. Use of nondesignated electrical contact surfaces might therefore result in incomplete contact or mechanical interference, causing changes in cavity tuning.

Electrical contact should be made by spring finger collets bearing against the previously described contact areas. If connections are employed which do not provide multiple contacts to the designated contact areas, concentration of RF current will result in loss of output power, especially at higher frequencies. The spring contacts used should exert a firm pressure without gouging the plated contact surface. This latter phenomena can result in loose particles of material which can cause arcing or unstable operation of the cavity.

If the tubes are used in applications which call for severe shock or vibration the tube may be clamped in place by the knob or radiator, exerting pressure only on this part of the tube and against the tube stop. No other portion of the tube should be subject to any clamping force. In particular, electrical contacts which utilize setscrews or rigid clamps should be avoided. Such contact schemes can distort the contact surfaces causing undue stress in the metal-to-ceramic seal area which may result in a vacuum leak. Soldered electrical connections can be made, however great care should be taken during the solder operation to avoid fracture of the seal area due to thermal shock. All contact surfaces should be kept clean to minimize losses.

*COOLING* - The EIMAC planar triodes are designed to operate at envelope and anode temperatures of up to the maximum rated value of 250°C. However, performance and long-term reliability of any component are improved when it is kept as cool as technically feasible. Therefore, it is recommended that sufficient cooling be provided to keep the anode and seal areas well below the specified maximum temperature, where long tube life and high reliability are of great importance.

The maximum plate dissipation of the 7855KAL is 10 watts average power. This can be accomplished by conduction, natural convection or forced air convection cooling. The maximum plate dissipation of the 7855AL in pulse service is 35 watts average and forced air cooling must be employed at that level. When forced air cooling is used, it is recommended that additional airflow, apart from that flowing through the radiator be used to cool the tube envelope and other tube terminals. A certain amount of conduction cooling is usually inherent in the contact finger configuration. It should be noted, however, that spring fingers provide poor heat conduction and measurements have shown a temperature difference as much as 50°C between the contact finger and contact area.

It is suggested that in all new applications the envelope temperature be measured, especially if the tube is used close to the upper temperature limit. The temperature can easily be determined by the use of Tempilaq paint (Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield N.J. 07080) or Temp-Plate stickers (Pydrodyne, Inc., 1001 Colorado, Santa Monica, Calif. 90404).

## ELECTRICAL

*HEATER VOLTAGE* - The rated heater voltage for either tube type is 5.7 volts and should be controlled within ±2% to obtain maximum tube life and to minimize variations in circuit performance. The rated heater voltage is optimum for most existing airborne applications such as DME and transponder systems. However, there are other applications where a different heater voltage than the nominal should be used to obtain the longest possible tube life. Depending on pulse width, power output and frequency of oscillation used a different heater voltage may be better for long reliable life. Electron transit time is not necessarily small with respect to the period of oscillation and the amount of driving power diverted will contribute to the cathode heating by electron bombardment.

The proper adjustment of the heater voltage must be made to compensate for this additional heating, which depends on operating frequency and duty cycle employed.

*INTERELECTRODE CAPACITANCES* - As indicated, the capacitance values are shown for measurements made with no heater voltage. The cathode to grid and cathode to plate capacitance will increase with the application of the heater voltage, due to the thermal expansion of the cathode support. Typically, the increase in the grid to cathode capacitance will be 15%, or more, depending on the heater voltage. Since the heater voltage can vary depending on use, data taken without heater voltage is more useful for control of tube-to-tube uniformity. The grid to anode capacitance is not effected by the application of the heater voltage.

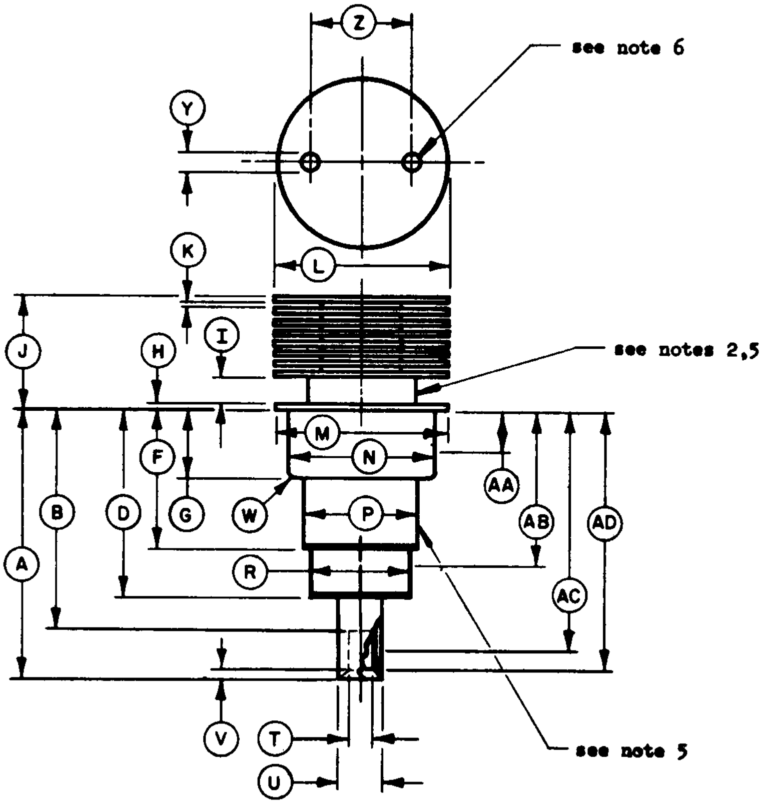
*CIRCUIT TUNING* - Especially under grid pulse conditions, it is important that the tube does not lose bias or momentarily go into a CW mode. Either of these events may result in tube failure. It is suggested that provision be made for initial circuit tune-up at reduced anode voltage and for extra tube protection when the circuit adjustment is critical. The average grid dissipation capability of these tubes is 2.0 watts. For many applications the limiting factor is often not anode dissipation or cathode emission capability, but grid dissipation. If pulse width control is lost in pulse applications the grid can exceed safe operating temperatures in 50 ms or less. Appropriate circuit protection during tune up is therefore recommended.

*CATHODE OPERATION* - The 7855AL and 7855KAL contain an arc-resistant cathode. Performance in the field and laboratory indicates these tubes are capable of withstanding some abuse due to high voltage arcs, however, poor circuit adjustment in the field may result in shortened tube life. It is, therefore, suggested that wherever feasible, the plate supply be designed such that its impedance limits the short circuit current to within five to ten times the maximum forward current. For pulse service the peak current should be limited to the values listed. Higher pulse width and duty cycles than given can be obtained with proper derating of the current. For this and special applications it is recommended that the user request additional information pertaining to his special application from the nearest Varian Electron Tube & Devices Field Office, or the Product Manager, EIMAC Division of Varian, Salt Lake City, Utah.

*SPECIAL APPLICATION* - For further operating information refer to EIMAC bulletin #15 "Operating Instructions for Planar Triodes".

| ELECTRODE CONTACT DIMS. (see note 7) | | | | |
|---|---|---|---|---|
| Dim. in Inches | | Dim. | Dim. in Millim. | |
| Min. | Max. | | Min. | Max. |
| .035 | .361 | AA | .89 | 9.17 |
| 1.021 | 1.101 | AB | 25.93 | 27.97 |
| 1.219 | 1.413 | AC | 30.96 | 35.89 |
| 1.160 | 1.500 | AD | 29.46 | 38.10 |

| DIMENSIONAL DATA | | | | |
|---|---|---|---|---|
| Dim. in Inches | | | Dim. in Millimeters | |
| Min. | Max. | Dim. | MIN. | MAX. |
| 1.500 | 1.560 | A | 38.10 | 39.62 |
| | 1.214 | B | | 30.84 |
| 1.125 | 1.165 | D | 28.58 | 29.59 |
| .800 | .840 | F | 20.32 | 21.34 |
| .462 | .477 | G | 11.73 | 12.12 |
| | .040 | H | | 1.02 |
| .125 | .185 | I | 3.18 | 4.70 |
| .766 | .826 | J | 19.46 | 20.98 |
| .025 | .046 | K | .64 | 1.17 |
| 1.234 | 1.264 | L | 31.34 | 32.11 |
| 1.180 | 1.195 | M | 29.97 | 30.35 |
| 1.025 | 1.035 | N | 26.04 | 26.29 |
| .752 | .792 | P | 19.10 | 20.12 |
| .655 | .665 | R | 16.64 | 16.89 |
| .213 | .223 | T | 5.41 | 5.66 |
| .315 | .325 | U | 8.00 | 8.26 |
| | .086 | V | | 2.18 |
| | .100 | W | | 2.54 |
| .105 | .145 | Y | 2.67 | 3.68 |
| .650 | .850 | Z | 16.51 | 21.59 |




NOTES:

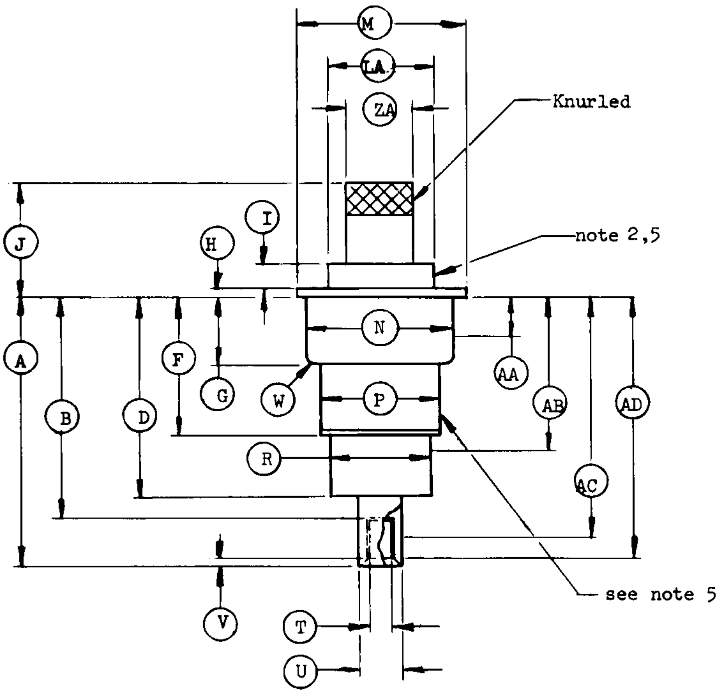
1. Metric equivalents, to the nearest .01 mm, are given for general information only & are based on 1 inch = 25.4 mm.
2. This surface to be used to measure anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

| Contact Surface | TIR Max. | Reference |
|---|---|---|
| Anode | .020 | Cathode |
| Grid | .020 | Cathode |
| Heater | .012 | Cathode |

4. Dias. N,R,T & U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Holes for extractor thru top fin only.
7. Electrode Contact dims. are for socket design purposes & are not intended for inspection purposes.

| ELECTRODE CONTACT AREA (see note 6) | | | | |
|---|---|---|---|---|
| Dim. in Millimeters | | Dim. | Dim. in Inches | |
| Min. | Max. | | Min. | Max. |
| .89 | 9.17 | AA | .035 | .361 |
| 25.93 | 27.97 | AB | 1.021 | 1.101 |
| 30.96 | 35.89 | AC | 1.219 | 1.413 |
| 29.46 | 38.10 | AD | 1.160 | 1.500 |

| DIMENSIONAL DATA | | | | |
|---|---|---|---|---|
| Dim. in Inches | | Dim. in Millimetres | | |
| Min. | Max. | Dim. | MIN. | MAX. |
| 1.500 | 1.560 | A | 38.10 | 39.62 |
| | 1.214 | B | | 30.84 |
| 1.125 | 1.165 | D | 28.58 | 29.59 |
| .800 | .840 | F | 20.32 | 21.34 |
| .462 | .477 | G | 11.73 | 12.12 |
| | .040 | H | | 1.02 |
| | .185 | I | | 4.70 |
| .766 | .826 | J | 19.46 | 20.98 |
| .025 | .046 | K | .64 | 1.17 |
| 1.234 | 1.264 | L | 31.34 | 32.11 |
| 1.180 | 1.195 | M | 29.97 | 30.35 |
| 1.025 | 1.035 | N | 26.04 | 26.29 |
| .752 | .792 | P | 19.10 | 20.12 |
| .655 | .665 | R | 16.64 | 16.89 |
| .213 | .223 | T | 5.41 | 5.66 |
| .315 | .325 | U | 8.00 | 8.26 |
| | .086 | V | | 2.18 |
| | .100 | W | | 2.54 |
| .840 | .860 | LA | 21.34 | 21.84 |
| .427 | .447 | ZA | 10.85 | 11.35 |

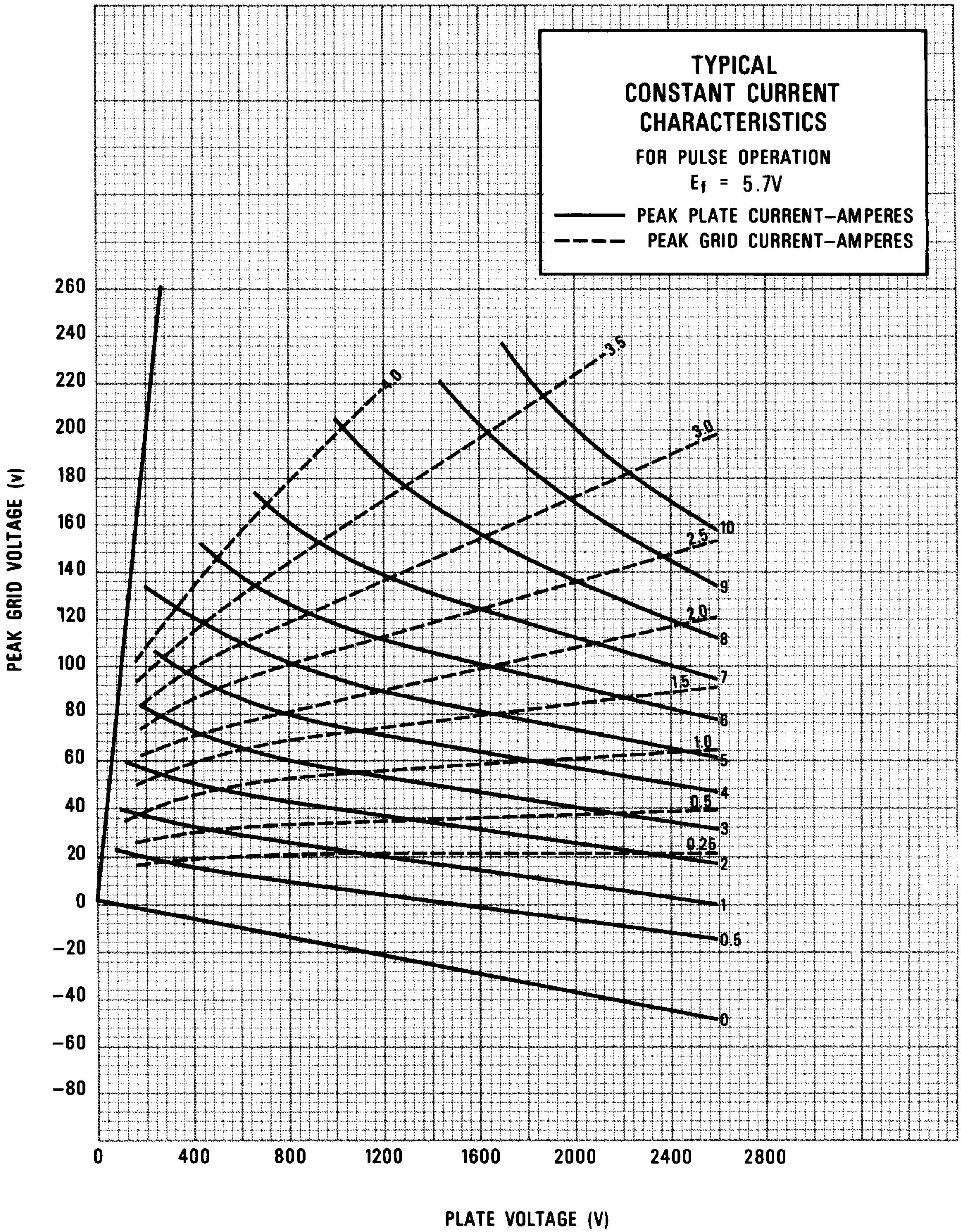



NOTES:

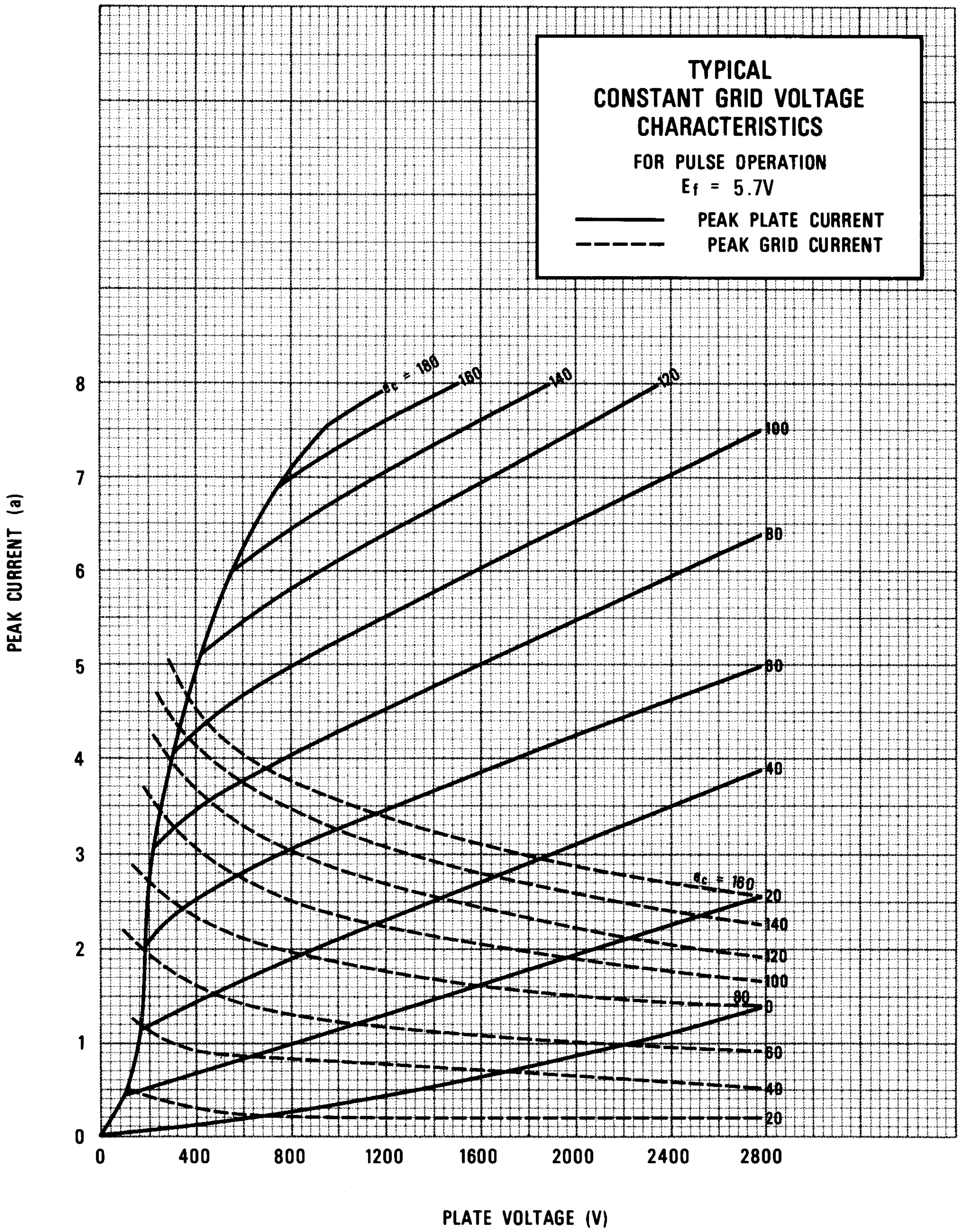
1. Metric equivalents to the nearest .01mm, are given for general information only & are based on 1 inch= 25.4 mm.
2. This surface shall be used to measure Anode shank temperature.
3. Eccentricity of contact surfaces shall be gaged from center line of reference & shall be as follows:

| Contact Surface | TIR Max. | Reference |
|---|---|---|
| Anode | .020 | Cathode |
| Grid | .020 | Cathode |
| Heater | .012 | Cathode |

4. Dias. N,R,T,U shall apply throughout entire lenght as defined by dims. AA,AB,AC,AD respectively.
5. This surface shall not be used for clamping or locating.
6. Electrode Contact Dims. are intended for socket design only & are not intended for inspection purposes.



TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
FOR PULSE OPERATION
$E_f$ = 5.7V
PEAK PLATE CURRENT–AMPERES
PEAK GRID CURRENT–AMPERES
PEAK GRID VOLTAGE (v)
PLATE VOLTAGE (V)
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
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
10
9
8
7
6
5
4
3
2
1
0.5
0


TYPICAL
CONSTANT GRID VOLTAGE
CHARACTERISTICS
FOR PULSE OPERATION
Ef = 5.7V
PEAK PLATE CURRENT
PEAK GRID CURRENT
ec = 180
160
140
120
100
80
60
40
20
0
ec = 180
140
120
100
80
60
40
20
PEAK CURRENT (a)
0
1
2
3
4
5
6
7
8
0
400
800
1200
1600
2000
2400
2800
PLATE VOLTAGE (V)