

Axial Lead Rectifiers

... employing the Schottky Barrier principle in a large area metal-to-silicon power diode. State-of-the-art geometry features chrome barrier metal, epitaxial construction with oxide passivation and metal overlap contact. Ideally suited for use as rectifiers in low-voltage, high-frequency inverters, free wheeling diodes, and polarity protection diodes.

- Extremely Low v_f
- Low Stored Charge, Majority Carrier Conduction
- Low Power Loss/High Efficiency

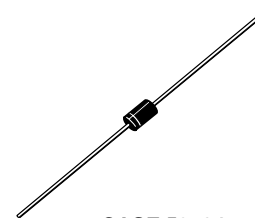
Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 0.4 gram (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead and Mounting Surface Temperature for Soldering Purposes: 220°C Max. for 10 Seconds, 1/16" from case
- Shipped in plastic bags, 1000 per bag.
- Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number
- Polarity: Cathode Indicated by Polarity Band
- Marking: 1N5817, 1N5818, 1N5819

1N5817
1N5818
1N5819

1N5817 and 1N5819 are
Motorola Preferred Devices

**SCHOTTKY BARRIER
RECTIFIERS**
1 AMPERE
20, 30 and 40 VOLTS



CASE 59-04

MAXIMUM RATINGS

| Rating | Symbol | 1N5817 | 1N5818 | 1N5819 | Unit |
|---|---------------------------------|--------------------|--------|--------|------------|
| Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage | V_{RRM} V_{RWM} V_R | 20 | 30 | 40 | V |
| Non-Repetitive Peak Reverse Voltage | V_{RSM} | 24 | 36 | 48 | V |
| RMS Reverse Voltage | $V_R(RMS)$ | 14 | 21 | 28 | V |
| Average Rectified Forward Current (2) ($V_R(equiv) \leq 0.2 V_R(dc)$, $T_L = 90^\circ C$, $R_{\theta JA} = 80^\circ C/W$, P.C. Board Mounting, see Note 2, $T_A = 55^\circ C$) | I_O | 1.0 | | | A |
| Ambient Temperature (Rated $V_R(dc)$, $P_{F(AV)} = 0$, $R_{\theta JA} = 80^\circ C/W$) | T_A | 85 | 80 | 75 | $^\circ C$ |
| Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, half-wave, single phase 60 Hz, $T_L = 70^\circ C$) | I_{FSM} | 25 (for one cycle) | | | A |
| Operating and Storage Junction Temperature Range (Reverse Voltage applied) | T_J, T_{stg} | -65 to +125 | | | $^\circ C$ |
| Peak Operating Junction Temperature (Forward Current applied) | $T_{J(pk)}$ | 150 | | | $^\circ C$ |

THERMAL CHARACTERISTICS (2)

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-----|--------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 80 | $^\circ C/W$ |

ELECTRICAL CHARACTERISTICS ($T_L = 25^\circ C$ unless otherwise noted) (2)

| Characteristic | Symbol | 1N5817 | 1N5818 | 1N5819 | Unit |
|---|--------|----------------------|-----------------------|--------------------|------|
| Maximum Instantaneous Forward Voltage (1) ($i_F = 0.1 A$) ($i_F = 1.0 A$) ($i_F = 3.0 A$) | v_F | 0.32 0.45 0.75 | 0.33 0.55 0.875 | 0.34 0.6 0.9 | V |
| Maximum Instantaneous Reverse Current @ Rated dc Voltage (1) ($T_L = 25^\circ C$) ($T_L = 100^\circ C$) | I_R | 1.0 10 | 1.0 10 | 1.0 10 | mA |

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2.0%.

(2) Lead Temperature reference is cathode lead 1/32" from case.

Preferred devices are Motorola recommended choices for future use and best overall value.

1N5817 1N5818 1N5819

NOTE 1 — DETERMINING MAXIMUM RATINGS

Reverse power dissipation and the possibility of thermal runaway must be considered when operating this rectifier at reverse voltages above $0.1 V_{RWM}$. Proper derating may be accomplished by use of equation (1).

$$T_{A(max)} = T_{J(max)} - R_{\theta JA} P_{F(AV)} - R_{\theta JA} P_{R(AV)} \quad (1)$$

where $T_{A(max)}$ = Maximum allowable ambient temperature

$T_{J(max)}$ = Maximum allowable junction temperature
(125°C or the temperature at which thermal runaway occurs, whichever is lowest)

$P_{F(AV)}$ = Average forward power dissipation

$P_{R(AV)}$ = Average reverse power dissipation

$R_{\theta JA}$ = Junction-to-ambient thermal resistance

Figures 1, 2, and 3 permit easier use of equation (1) by taking reverse power dissipation and thermal runaway into consideration. The figures solve for a reference temperature as determined by equation (2).

$$T_R = T_{J(max)} - R_{\theta JA} P_{R(AV)} \quad (2)$$

Substituting equation (2) into equation (1) yields:

$$T_{A(max)} = T_R - R_{\theta JA} P_{F(AV)} \quad (3)$$

Inspection of equations (2) and (3) reveals that T_R is the ambient temperature at which thermal runaway occurs or where $T_J = 125^\circ\text{C}$, when forward power is zero. The transition from one boundary condition to the other is evident on the curves of Figures 1, 2, and 3 as a difference in the rate of change of the slope in the vicinity of 115°C . The data of Figures 1, 2, and 3 is based upon dc conditions. For use in common rectifier circuits, Table 1 indicates suggested factors for an equivalent dc voltage to use for conservative design, that is:

$$V_{R(equiv)} = V_{in(PK)} \times F \quad (4)$$

The factor F is derived by considering the properties of the various rectifier circuits and the reverse characteristics of Schottky diodes.

EXAMPLE: Find $T_{A(max)}$ for 1N5818 operated in a 12-volt dc supply using a bridge circuit with capacitive filter such that $I_{DC} = 0.4 \text{ A}$ ($I_{F(AV)} = 0.5 \text{ A}$), $I_{(FM)}/I_{(AV)} = 10$, Input Voltage = 10 V(rms), $R_{\theta JA} = 80^\circ\text{C/W}$.

Step 1. Find $V_{R(equiv)}$. Read $F = 0.65$ from Table 1,

$$\therefore V_{R(equiv)} = (1.41)(10)(0.65) = 9.2 \text{ V.}$$

Step 2. Find T_R from Figure 2. Read $T_R = 109^\circ\text{C}$

$$\text{@ } V_R = 9.2 \text{ V and } R_{\theta JA} = 80^\circ\text{C/W.}$$

Step 3. Find $P_{F(AV)}$ from Figure 4. **Read $P_{F(AV)} = 0.5 \text{ W}$

$$\text{@ } \frac{I_{(FM)}}{I_{(AV)}} = 10 \text{ and } I_{F(AV)} = 0.5 \text{ A.}$$

Step 4. Find $T_{A(max)}$ from equation (3).

$$T_{A(max)} = 109 - (80)(0.5) = 69^\circ\text{C.}$$

**Values given are for the 1N5818. Power is slightly lower for the 1N5817 because of its lower forward voltage, and higher for the 1N5819.

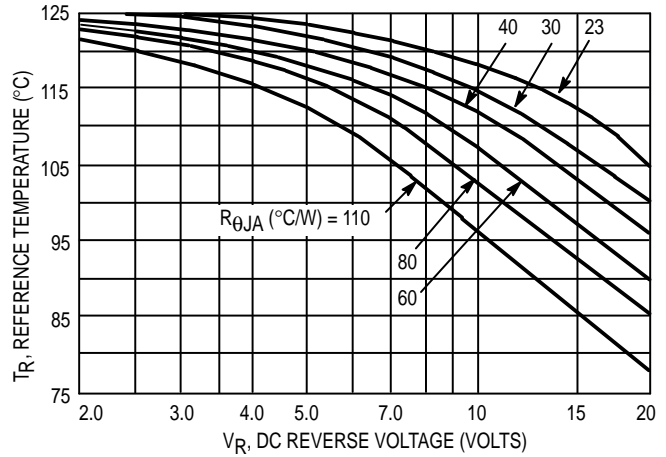


Figure 1. Maximum Reference Temperature 1N5817

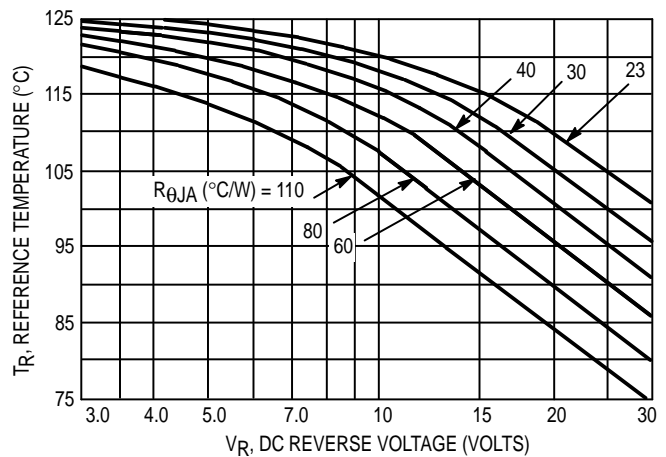


Figure 2. Maximum Reference Temperature 1N5818

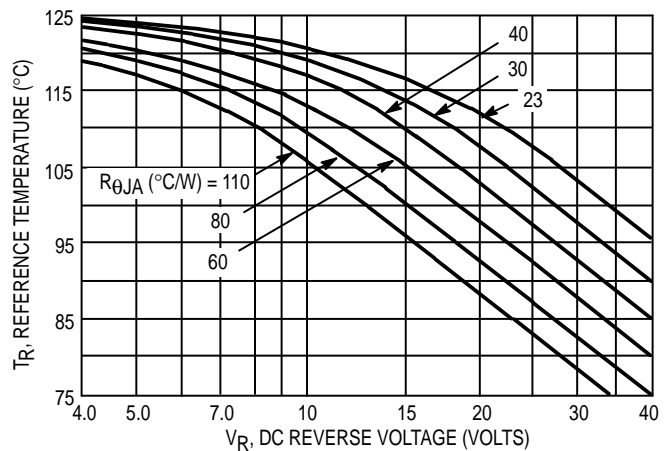


Figure 3. Maximum Reference Temperature 1N5819

Table 1. Values for Factor F

| Circuit | Half Wave | | Full Wave, Bridge | | Full Wave, Center Tapped* † | |
|-------------|-----------|-------------|-------------------|------------|-----------------------------|------------|
| | Resistive | Capacitive* | Resistive | Capacitive | Resistive | Capacitive |
| Sine Wave | 0.5 | 1.3 | 0.5 | 0.65 | 1.0 | 1.3 |
| Square Wave | 0.75 | 1.5 | 0.75 | 0.75 | 1.5 | 1.5 |

*Note that $V_{R(PK)} = 2.0 V_{in(PK)}$.

† Use line to center tap voltage for V_{in} .

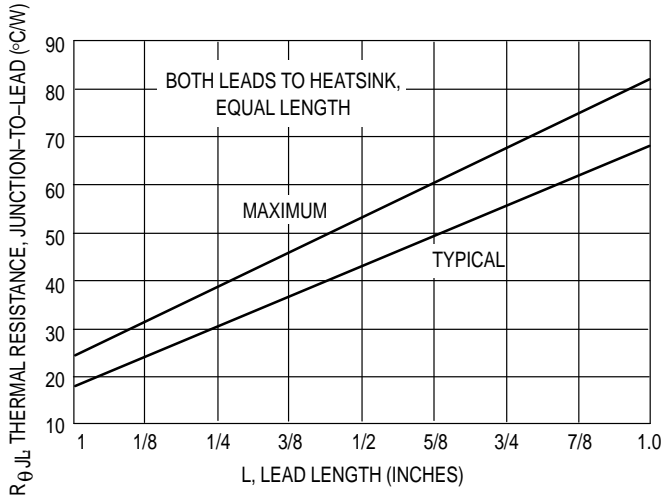


Figure 4. Steady-State Thermal Resistance

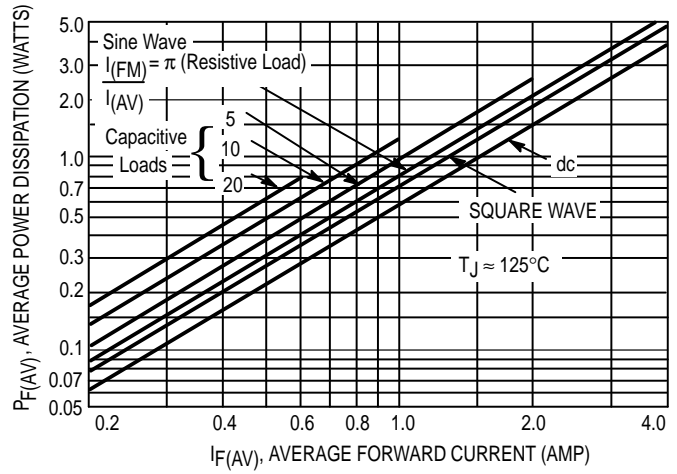


Figure 5. Forward Power Dissipation
1N5817-19

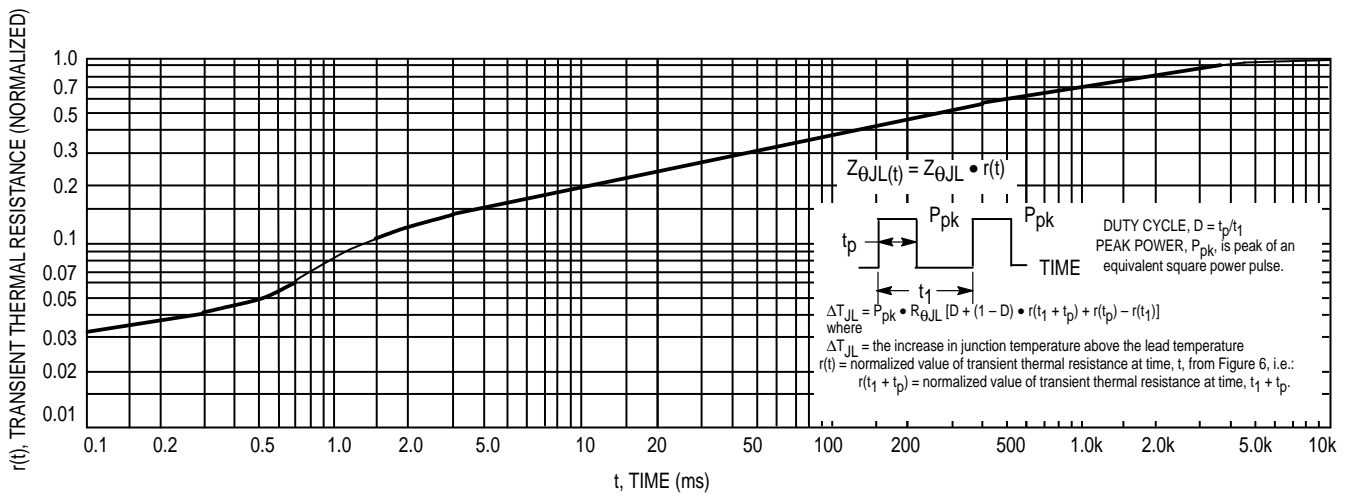


Figure 6. Thermal Response

NOTE 2 — MOUNTING DATA

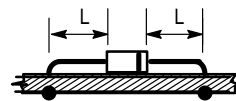
Data shown for thermal resistance junction-to-ambient ($R_{\theta JA}$) for the mountings shown is to be used as typical guideline values for preliminary engineering, or in case the tie point temperature cannot be measured.

TYPICAL VALUES FOR $R_{\theta JA}$ IN STILL AIR

| Mounting Method | Lead Length, L (in) | | | | $R_{\theta JA}$ |
|-----------------|---------------------|-----|-----|-----|-----------------|
| | 1/8 | 1/4 | 1/2 | 3/4 | |
| 1 | 52 | 65 | 72 | 85 | °C/W |
| 2 | 67 | 80 | 87 | 100 | °C/W |
| 3 | 50 | | | | °C/W |

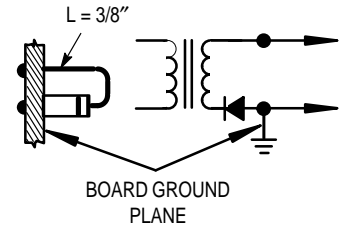
Mounting Method 1

P.C. Board with 1-1/2" x 1-1/2" copper surface.

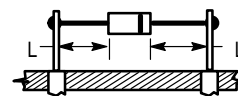


Mounting Method 3

P.C. Board with 1-1/2" x 1-1/2" copper surface.

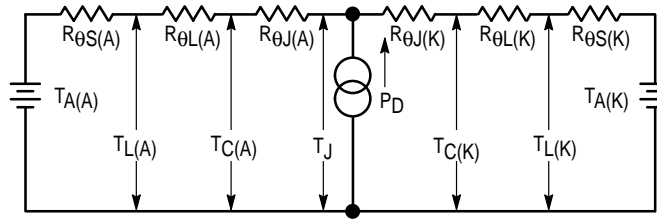


Mounting Method 2



VECTOR PIN MOUNTING

NOTE 3 — THERMAL CIRCUIT MODEL
(For heat conduction through the leads)



Use of the above model permits junction to lead thermal resistance for any mounting configuration to be found. For a given total lead length, lowest values occur when one side of the rectifier is brought as close as possible to the heatsink. Terms in the model signify:

(Subscripts A and K refer to anode and cathode sides, respectively.)
Values for thermal resistance components are:
 $R_{\theta L} = 100^\circ\text{C/W/in}$ typically and 120°C/W/in maximum
 $R_{\theta J} = 36^\circ\text{C/W}$ typically and 46°C/W maximum.

- T_A = Ambient Temperature
- T_L = Lead Temperature
- $R_{\theta S}$ = Thermal Resistance, Heatsink to Ambient
- $R_{\theta L}$ = Thermal Resistance, Lead to Heatsink
- $R_{\theta J}$ = Thermal Resistance, Junction to Case
- P_D = Power Dissipation
- T_C = Case Temperature
- T_J = Junction Temperature

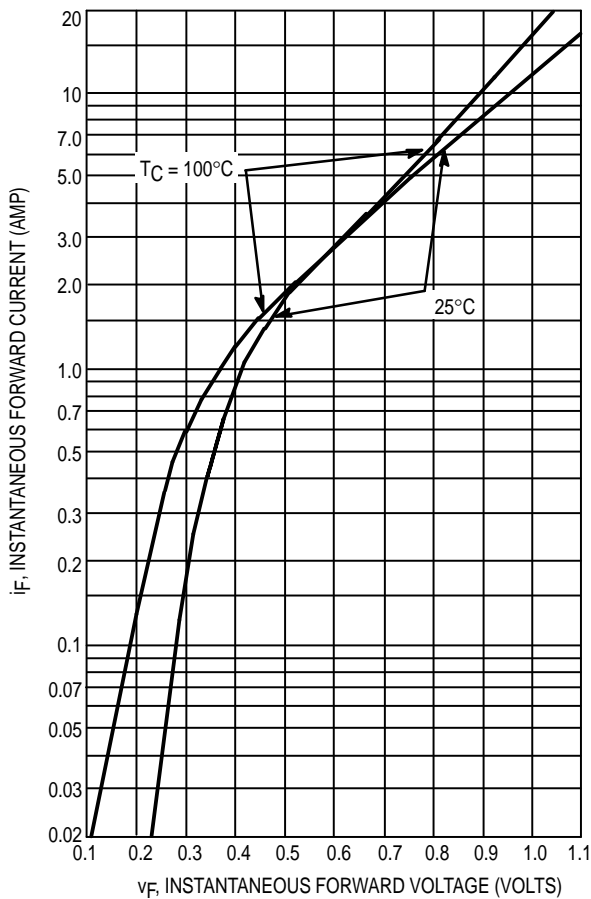


Figure 7. Typical Forward Voltage

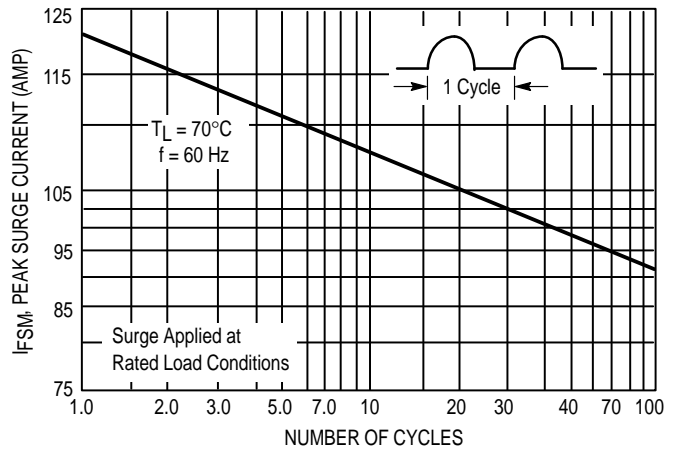


Figure 8. Maximum Non-Repetitive Surge Current

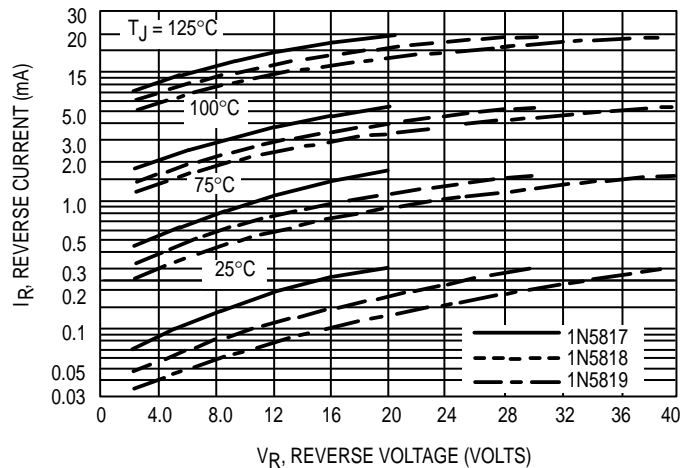


Figure 9. Typical Reverse Current

NOTE 4 — HIGH FREQUENCY OPERATION

Since current flow in a Schottky rectifier is the result of majority carrier conduction, it is not subject to junction diode forward and reverse recovery transients due to minority carrier injection and stored charge. Satisfactory circuit analysis work may be performed by using a model consisting of an ideal diode in parallel with a variable capacitance. (See Figure 10.)

Rectification efficiency measurements show that operation will be satisfactory up to several megahertz. For example, relative waveform rectification efficiency is approximately 70 percent at 2.0 MHz, e.g., the ratio of dc power to RMS power in the load is 0.28 at this frequency, whereas perfect rectification would yield 0.406 for sine wave inputs. However, in contrast to ordinary junction diodes, the loss in waveform efficiency is not indicative of power loss: it is simply a result of reverse current flow through the diode capacitance, which lowers the dc output voltage.

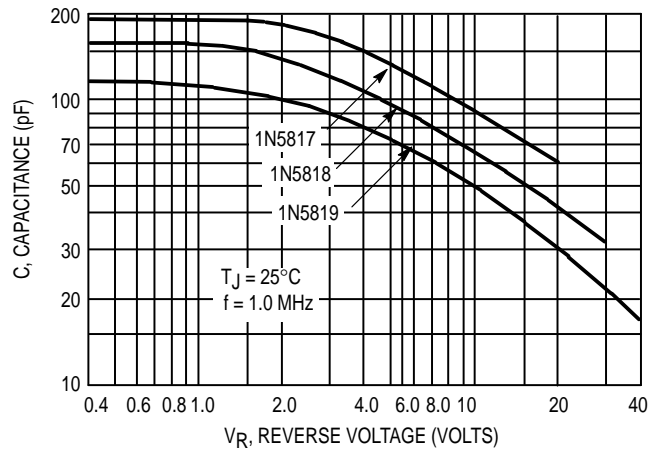
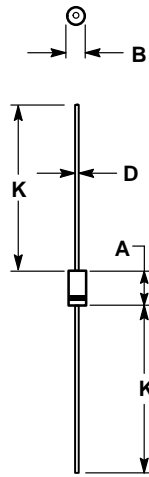


Figure 10. Typical Capacitance


PACKAGE DIMENSIONS



- NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
 2. POLARITY DENOTED BY CATHODE BAND.
 3. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 5.97 | 6.60 | 0.235 | 0.260 |
| B | 2.79 | 3.05 | 0.110 | 0.120 |
| D | 0.76 | 0.86 | 0.030 | 0.034 |
| K | 27.94 | — | 1.100 | — |

CASE 59-04
ISSUE M

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