

# 2N6400 Series

Preferred Device

## Silicon Controlled Rectifiers

### Reverse Blocking Thyristors

Designed primarily for half-wave ac control applications, such as motor controls, heating controls and power supplies; or wherever half-wave silicon gate-controlled, solid-state devices are needed.

#### Features

- Glass Passivated Junctions with Center Gate Geometry for Greater Parameter Uniformity and Stability
- Small, Rugged, Thermowatt Construction for Low Thermal Resistance, High Heat Dissipation and Durability
- Blocking Voltage to 800 Volts
- Pb-Free Packages are Available\*



**ON Semiconductor®**

<http://onsemi.com>

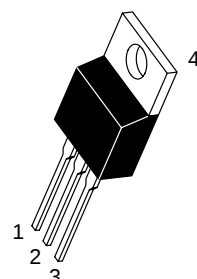
#### SCRs

**16 AMPERES RMS**

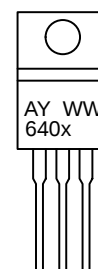
**50 thru 800 VOLTS**



#### MARKING DIAGRAM



**TO-220AB  
CASE 221A  
STYLE 3**



x = 0, 1, 2, 3, 4 or 5  
A = Assembly Location  
Y = Year  
WW = Work Week

#### PIN ASSIGNMENT

| PIN ASSIGNMENT |         |
|----------------|---------|
| 1              | Cathode |
| 2              | Anode   |
| 3              | Gate    |
| 4              | Anode   |

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

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

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## 2N6400 Series

### MAXIMUM RATINGS\* ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                                                                                 | Symbol                                 | Value                                 | Unit                 |
|------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------|----------------------|
| Peak Repetitive Off-State Voltage (Note 1)<br>( $T_J = -40$ to $125^\circ\text{C}$ , Sine Wave 50 to 60 Hz; Gate Open) | $V_{\text{DRM}}$ ,<br>$V_{\text{RRM}}$ | 50<br>100<br>200<br>400<br>600<br>800 | V                    |
| On-State Current RMS (180° Conduction Angles; $T_C = 100^\circ\text{C}$ )                                              | $I_{\text{T(RMS)}}$                    | 16                                    | A                    |
| Average On-State Current (180° Conduction Angles; $T_C = 100^\circ\text{C}$ )                                          | $I_{\text{T(AV)}}$                     | 10                                    | A                    |
| Peak Non-repetitive Surge Current (1/2 Cycle, Sine Wave 60 Hz, $T_J = 90^\circ\text{C}$ )                              | $I_{\text{TSM}}$                       | 160                                   | A                    |
| Circuit Fusing Considerations ( $t = 8.3$ ms)                                                                          | $I^2t$                                 | 145                                   | $\text{A}^2\text{s}$ |
| Forward Peak Gate Power (Pulse Width $\leq 1.0$ $\mu\text{s}$ , $T_C = 100^\circ\text{C}$ )                            | $P_{\text{GM}}$                        | 20                                    | W                    |
| Forward Average Gate Power ( $t = 8.3$ ms, $T_C = 100^\circ\text{C}$ )                                                 | $P_{\text{G(AV)}}$                     | 0.5                                   | W                    |
| Forward Peak Gate Current (Pulse Width $\leq 1.0$ $\mu\text{s}$ , $T_C = 100^\circ\text{C}$ )                          | $I_{\text{GM}}$                        | 2.0                                   | A                    |
| Operating Junction Temperature Range                                                                                   | $T_J$                                  | $-40$ to $+125$                       | $^\circ\text{C}$     |
| Storage Temperature Range                                                                                              | $T_{\text{stg}}$                       | $-40$ to $+150$                       | $^\circ\text{C}$     |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

- $V_{\text{DRM}}$  and  $V_{\text{RRM}}$  for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

### THERMAL CHARACTERISTICS

| Characteristic                                                                  | Symbol                | Max | Unit               |
|---------------------------------------------------------------------------------|-----------------------|-----|--------------------|
| Thermal Resistance, Junction-to-Case                                            | $R_{\theta\text{JC}}$ | 1.5 | $^\circ\text{C/W}$ |
| Maximum Lead Temperature for Soldering Purposes 1/8 in from Case for 10 Seconds | $T_L$                 | 260 | $^\circ\text{C}$   |

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                                           |                                        |   |   |     |               |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---|---|-----|---------------|
| *Peak Repetitive Forward or Reverse Blocking Current<br>( $V_{\text{AK}} = \text{Rated } V_{\text{DRM}}$ or $V_{\text{RRM}}$ , Gate Open) | $I_{\text{DRM}}$ ,<br>$I_{\text{RRM}}$ | – | – | 10  | $\mu\text{A}$ |
| $T_J = 25^\circ\text{C}$                                                                                                                  |                                        | – | – | 2.0 | mA            |
| $T_J = 125^\circ\text{C}$                                                                                                                 |                                        | – | – |     |               |

### ON CHARACTERISTICS

|                                                                                                                |                 |     |     |     |               |
|----------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|-----|---------------|
| *Peak Forward On-State Voltage ( $I_{\text{TM}} = 32$ A Peak, Pulse Width $\leq 1$ ms, Duty Cycle $\leq 2\%$ ) | $V_{\text{TM}}$ | –   | –   | 1.7 | V             |
| *Gate Trigger Current (Continuous dc)<br>( $V_D = 12$ Vdc, $R_L = 100$ $\Omega$ )                              | $I_{\text{GT}}$ | –   | 9.0 | 30  | mA            |
| $T_C = 25^\circ\text{C}$                                                                                       |                 | –   | –   | 60  |               |
| $T_C = -40^\circ\text{C}$                                                                                      |                 |     |     |     |               |
| *Gate Trigger Voltage (Continuous dc)<br>( $V_D = 12$ Vdc, $R_L = 100$ $\Omega$ )                              | $V_{\text{GT}}$ | –   | 0.7 | 1.5 | V             |
| $T_C = 25^\circ\text{C}$                                                                                       |                 | –   | –   | 2.5 |               |
| $T_C = -40^\circ\text{C}$                                                                                      |                 |     |     |     |               |
| Gate Non-Trigger Voltage ( $V_D = 12$ Vdc, $R_L = 100$ $\Omega$ , $T_C = +125^\circ\text{C}$ )                 | $V_{\text{GD}}$ | 0.2 | –   | –   | V             |
| *Holding Current<br>( $V_D = 12$ Vdc, Initiating Current = 200 mA, Gate Open)                                  | $I_{\text{H}}$  | –   | 18  | 40  | mA            |
| $T_C = 25^\circ\text{C}$                                                                                       |                 | –   | –   | 60  |               |
| $*T_C = -40^\circ\text{C}$                                                                                     |                 |     |     |     |               |
| Turn-On Time ( $I_{\text{TM}} = 16$ A, $I_{\text{GT}} = 40$ mAdc, $V_D = \text{Rated } V_{\text{DRM}}$ )       | $t_{\text{gt}}$ | –   | 1.0 | –   | $\mu\text{s}$ |
| Turn-Off Time ( $I_{\text{TM}} = 16$ A, $I_{\text{R}} = 16$ A, $V_D = \text{Rated } V_{\text{DRM}}$ )          | $t_{\text{q}}$  | –   | 15  | –   | $\mu\text{s}$ |
| $T_C = 25^\circ\text{C}$                                                                                       |                 | –   | 35  | –   |               |
| $T_J = +125^\circ\text{C}$                                                                                     |                 |     |     |     |               |

### DYNAMIC CHARACTERISTICS

|                                                                                                                                         |         |   |    |   |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------|---|----|---|------------------|
| Critical Rate-of-Rise of Off-State Voltage ( $V_D = \text{Rated } V_{\text{DRM}}$ , Exponential Waveform)<br>$T_J = +125^\circ\text{C}$ | $dv/dt$ | – | 50 | – | V/ $\mu\text{s}$ |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------|---|----|---|------------------|

\*Indicates JEDEC Registered Data.

## 2N6400 Series

### Voltage Current Characteristic of SCR

| Symbol    | Parameter                                 |
|-----------|-------------------------------------------|
| $V_{DRM}$ | Peak Repetitive Off State Forward Voltage |
| $I_{DRM}$ | Peak Forward Blocking Current             |
| $V_{RRM}$ | Peak Repetitive Off State Reverse Voltage |
| $I_{RRM}$ | Peak Reverse Blocking Current             |
| $V_{TM}$  | Peak On State Voltage                     |
| $I_H$     | Holding Current                           |

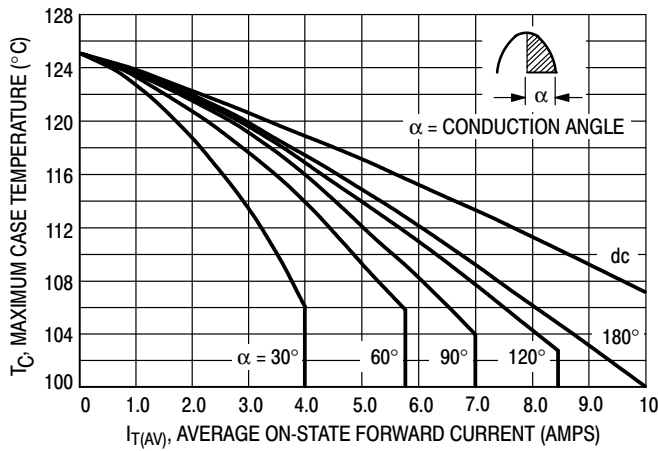
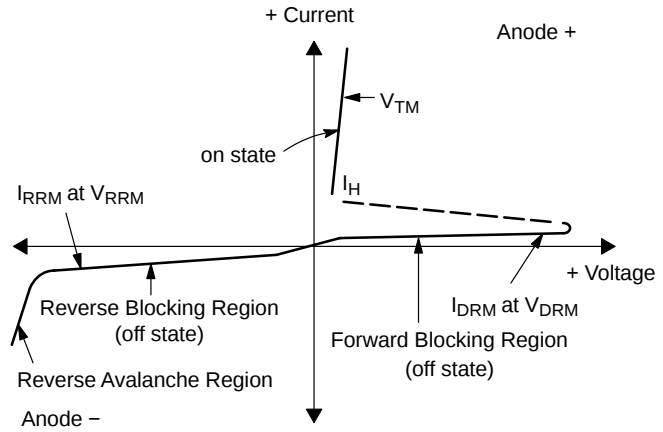


Figure 1. Average Current Derating

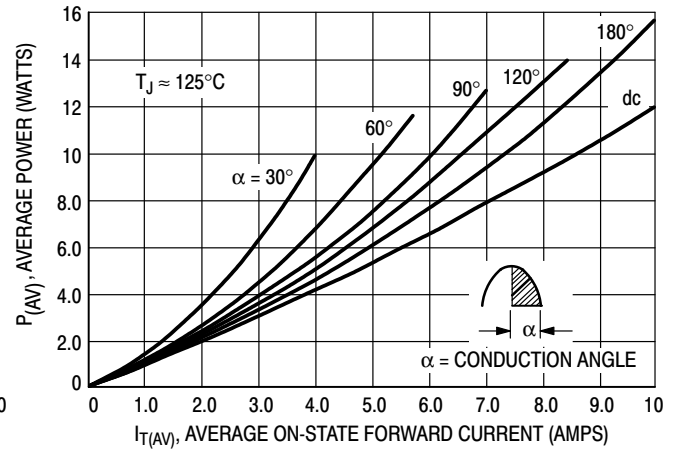


Figure 2. Maximum On-State Power Dissipation

## 2N6400 Series

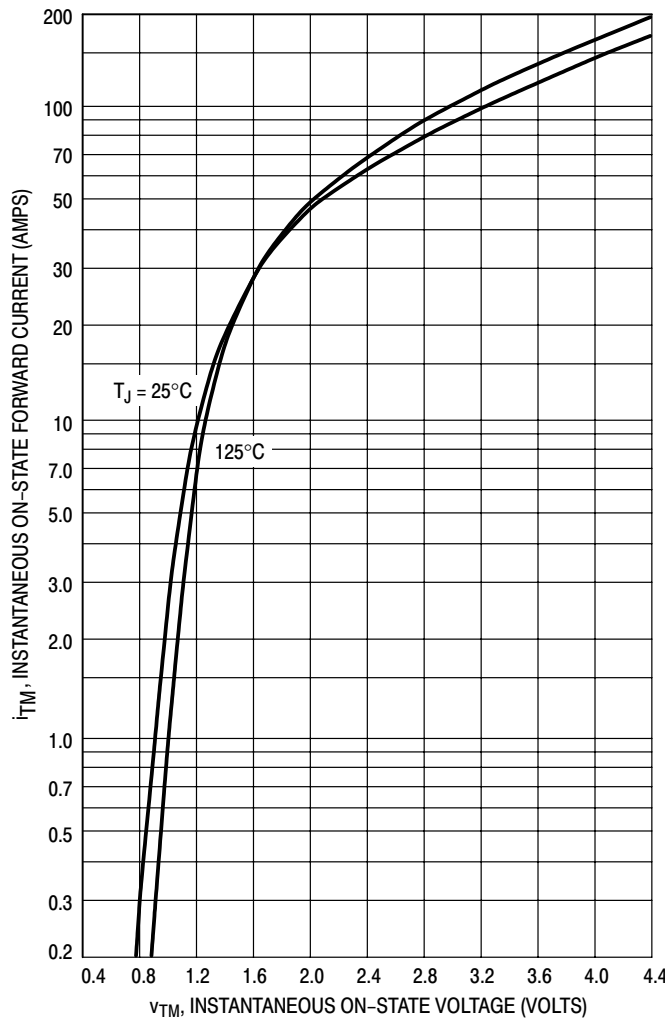


Figure 3. On-State Characteristics

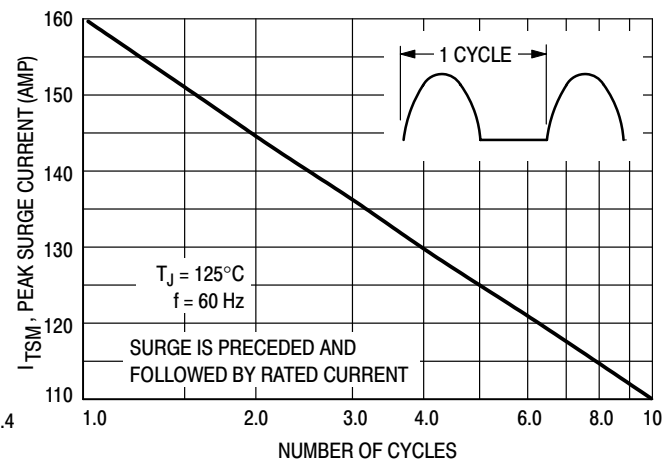


Figure 4. Maximum Non-Repetitive Surge Current

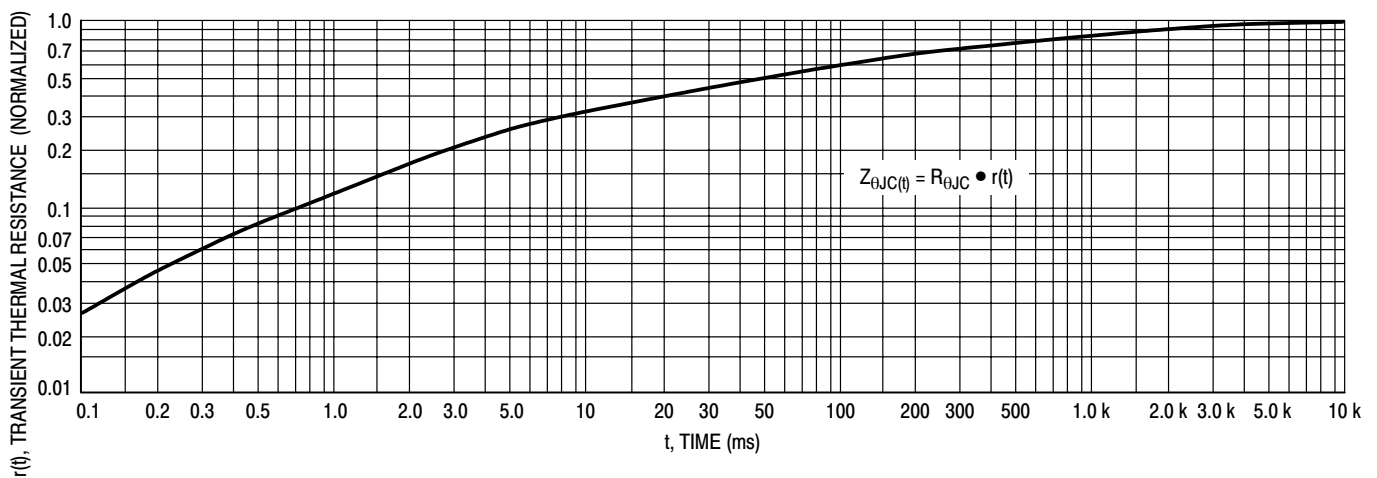


Figure 5. Thermal Response

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## TYPICAL CHARACTERISTICS

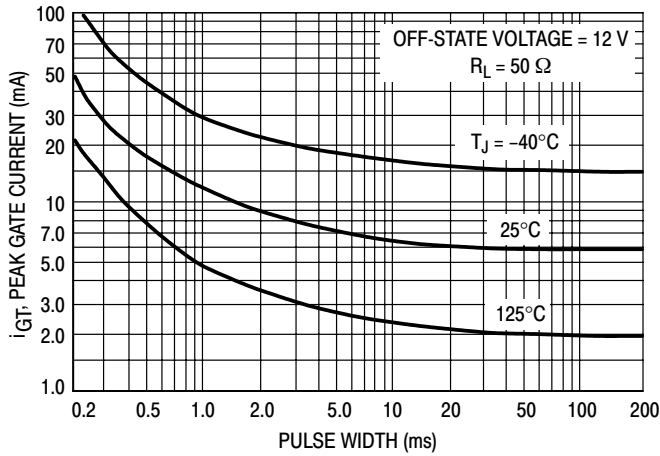


Figure 6. Typical Gate Trigger Current versus Pulse Width

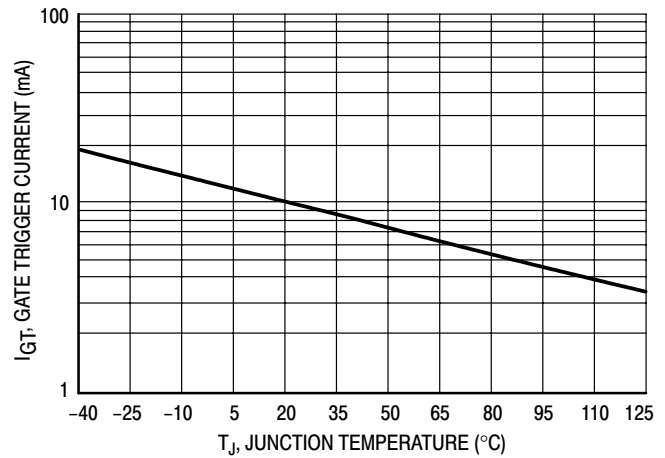


Figure 7. Typical Gate Trigger Current versus Junction Temperature

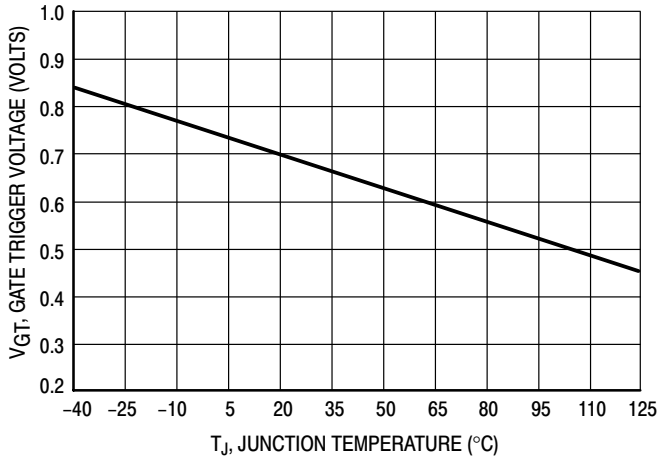


Figure 8. Typical Gate Trigger Voltage versus Junction Temperature

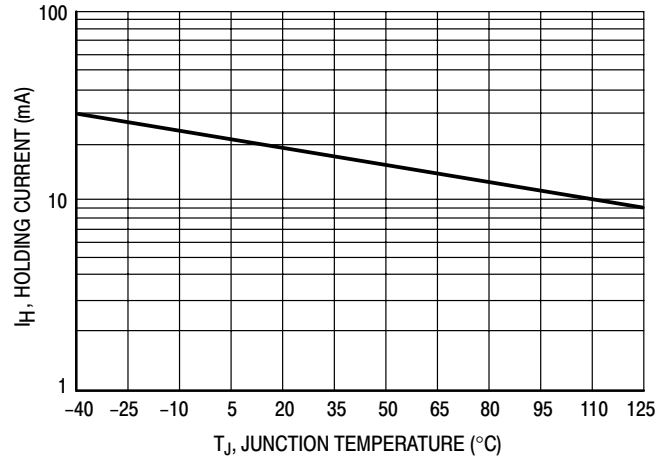


Figure 9. Typical Holding Current versus Junction Temperature

## ORDERING INFORMATION

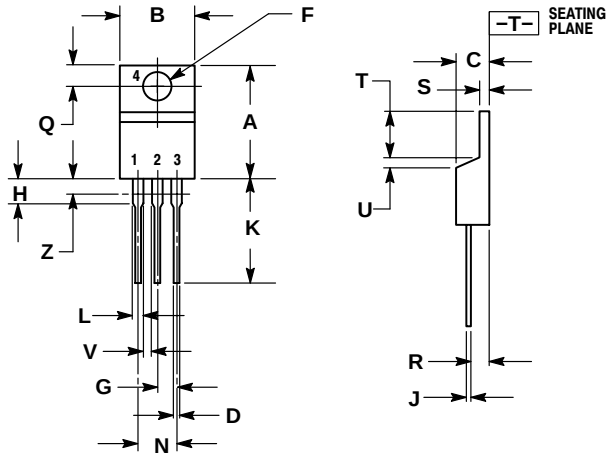
| Device  | Package               | Shipping <sup>†</sup> |
|---------|-----------------------|-----------------------|
| 2N6400  | TO-220AB              | 500 Units / Box       |
| 2N6401  | TO-220AB              |                       |
| 2N6401G | TO-220AB<br>(Pb-Free) |                       |
| 2N6402  | TO-220AB              |                       |
| 2N6403  | TO-220AB              |                       |
| 2N6404  | TO-220AB              |                       |
| 2N6405  | TO-220AB              |                       |
| 2N6405G | TO-220AB<br>(Pb-Free) |                       |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# 2N6400 Series

## PACKAGE DIMENSIONS

TO-220AB  
CASE 221A-09  
ISSUE AA



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.018  | 0.025 | 0.46        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | ---   | 1.15        | ---   |
| Z   | ---    | 0.080 | ---         | 2.04  |

### STYLE 3:

- PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

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