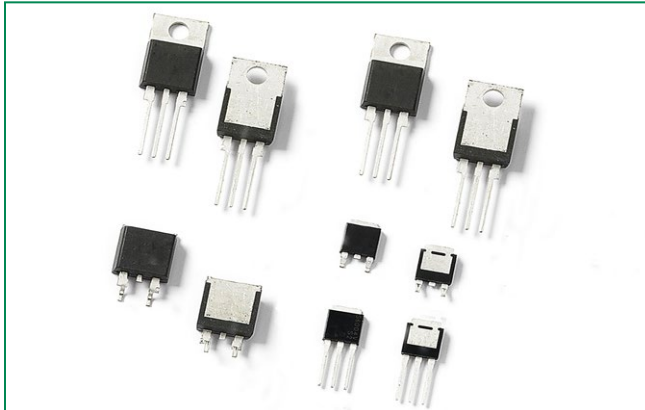


**SJxx12xx series**



**Description**

This SJxx12xx high junction temperature SCR series is ideal for uni-directional switch applications such as phase control in heating, motor speed controls, converters/rectifiers, inrush current control and capacitive discharge ignitions.

These SCRs have a low gate current trigger level of 6mA, 10mA or 20mA maximum at approximately 1.5V.

**Features & Benefits**

- Halogen free and RoHS compliant
- Surge capability up to 120 A at 60 Hz half cycle
- 150°C maximum junction temperature

**Applications**

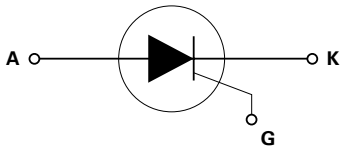
Typical applications include AC Generator (ACG) rectifiers, battery voltage regulators and generic converters and inrush current controller in various AC to DC applications. Additional applications include controls for power tools, home/brown good and white goods appliances.

Isolated packages offered for ease of heat sinking.

**Agency Approval**

| Agency | Agency File Number |
|--------|--------------------|
|        | L Packages: E71639 |

**Schematic Symbol**



**Main Features**

| Symbol            | Value      | Unit |
|-------------------|------------|------|
| $I_{T(RMS)}$      | 12         | A    |
| $V_{DRM}/V_{RRM}$ | 400 or 600 | V    |
| $I_{GT}$          | 6 to 20    | mA   |

### Absolute Maximum Ratings

| Symbol             | Parameter   | Test Conditions                                   | Value                  | Unit             |
|--------------------|---|---|------------------------|------------------|
| $V_{DSM}, V_{RSM}$ | Peak non-repetitive blocking voltage  | Pw=100 $\mu$ s                                    | $V_{DRM}, V_{RRM}+100$ | V                |
| $I_{T(RMS)}$       | RMS on-state current  | SJxx12Lx<br>$T_c = 110^\circ\text{C}$             | 12                     | A                |
|                    |   | SJxx12Rx<br>SJxx12Nx<br>$T_c = 135^\circ\text{C}$ |                        |                  |
|                    |   | SJxx12Dx<br>SJxx12Vx<br>$T_c = 125^\circ\text{C}$ |                        |                  |
| $I_{T(AV)}$        | Average on-state current  | SJxx12Lx<br>$T_c = 110^\circ\text{C}$             | 7.6                    | A                |
|                    |   | SJxx12Rx<br>SJxx12Ny<br>$T_c = 135^\circ\text{C}$ |                        |                  |
|                    |   | SJxx12Dx<br>SJxx12Vx<br>$T_c = 125^\circ\text{C}$ |                        |                  |
| $I_{TSM}$          | Peak non-repetitive surge current (single half cycle, $T_J$ (initial) = 25°C) | f = 50Hz  | 100                    | A                |
|                    |   | f = 60Hz  | 120                    |                  |
| $I^2t$             | $I^2t$ Value for fusing   | $t_p = 8.3$ ms                                    | 60                     | A <sup>2</sup> s |
| di/dt              | Critical rate of rise of on-state current                                     | f = 60Hz; $T_J = 150^\circ\text{C}$               | 100                    | A/ $\mu$ s       |
| $I_{GM}$           | Peak gate current   | $T_J = 150^\circ\text{C}$                         | 2                      | A                |
| $P_{G(AV)}$        | Average gate power dissipation  | $T_J = 150^\circ\text{C}$                         | 0.5                    | W                |
| $T_{stg}$          | Storage temperature range   |   | -40 to 150             | °C               |
| $T_J$              | Operating junction temperature range  |   | -40 to 150             |                  |

Note: xx=voltage/10, x=sensitivity

### Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified) - TO-220L, TO-220R and TO-263 package

| Symbol   | Test Conditions   |      | SJxx12x | SJxx12x1 | SJxx12x2 | Unit       |
|----------|---|------|---------|----------|----------|------------|
| $I_{GT}$ | $V_D = 12\text{V}$ $R_L = 60 \Omega$  | MAX. | 20      | 6        | 10       | mA         |
|          |   | MIN. | 8       | 2        | 5        |            |
| $V_{GT}$ | $V_D = 12\text{V}$ $R_L = 60 \Omega$  | MAX. | 1.5     | 1.5      | 1.5      | V          |
| dv/dt    | $V_D = 67\% V_{DRM}$ ; gate open; $T_J = 125^\circ\text{C}$                           | MIN. | 800     | 70       | 500      | V/ $\mu$ s |
|          | $V_D = 67\% V_{DRM}$ ; gate open; $T_J = 150^\circ\text{C}$                           |      | 400     | -        | 200      |            |
| $V_{GD}$ | $V_D = V_{DRM}$ $R_L = 3.3 \text{ k}\Omega$ $T_J = 125^\circ\text{C}$                 | MIN. | 0.2     | 0.2      | 0.2      | V          |
| $I_H$    | $I_T = 200\text{mA}$ (initial)  | MAX. | 60      | 15       | 35       | mA         |
| $t_q$    | $I_T = 2\text{A}$ ; $t_p = 50\mu\text{s}$ ; dv/dt = 5V/ $\mu$ s; di/dt = 30A/ $\mu$ s | MAX. | 40      | 40       | 40       | $\mu$ s    |
| $t_{gt}$ | $I_G = 2 \times I_{GT}$ PW = 15 $\mu$ s $I_T = 24\text{A}$                            | TYP. | 2       | 2        | 2        | $\mu$ s    |

Note: xx=voltage/10, x=package

### Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified) - TO-251 and TO-252 package

| Symbol   | Test Conditions  | Value    |         | Unit             |
|----------|--|----------|---------|------------------|
|          |  | SJxx12x1 | SJxx12x |                  |
| $I_{GT}$ | $V_D = 12\text{V}$ $R_L = 60\ \Omega$  | MAX.     | 6       | mA               |
|          |  | MIN.     | 2       |                  |
| $V_{GT}$ |  | MAX.     | 1.5     | V                |
| $dv/dt$  | $V_D = V_{DRM}$ ; gate open; $T_J = 125^\circ\text{C}$   | 400V     | 100     | V/ $\mu\text{s}$ |
|          |  | 600V     | 75      |                  |
|          | $V_D = V_{DRM}$ ; gate open; $T_J = 150^\circ\text{C}$   | 400V     | 50      |                  |
|          |  | 600V     | 10      |                  |
| $V_{GD}$ | $V_D = V_{DRM}$ $R_L = 3.3\ \text{k}\Omega$ $T_J = 125^\circ\text{C}$  | MIN.     | 0.2     | V                |
|          | $V_D = V_{DRM}$ $R_L = 3.3\ \text{k}\Omega$ $T_J = 150^\circ\text{C}$  | MIN.     | 0.1     |                  |
| $I_H$    | $I_T = 200\text{mA}$ (initial)   | MAX.     | 20      | mA               |
| $t_q$    | $I_T = 2\text{A}$ ; $t_p = 50\ \mu\text{s}$ ; $dv/dt = 5\text{V}/\mu\text{s}$ ; $di/dt = 30\text{A}/\mu\text{s}$ | MAX.     | 35      | $\mu\text{s}$    |
| $t_{gt}$ | $I_G = 2 \times I_{GT}$ $PW = 15\ \mu\text{s}$ $I_T = 12\text{A}$  | TYP.     | 0.5     | $\mu\text{s}$    |

Note: xx=voltage/10, x=package

### Static Characteristics

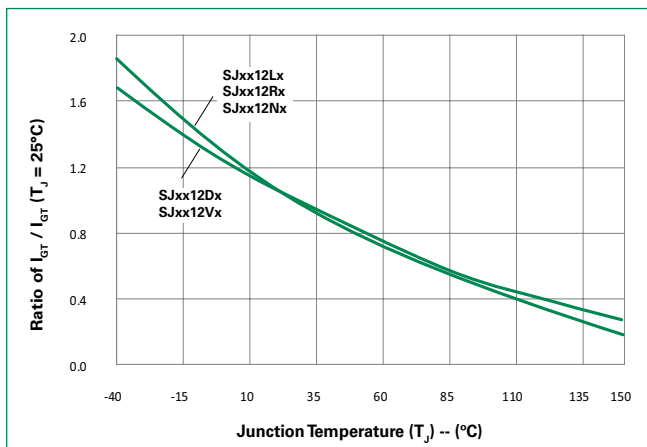
| Symbol              | Test Conditions   | Value                     | Unit |
|---------------------|---|---------------------------|------|
| $V_{TM}$            | Component $I_T = 24\text{A}$ ; $t_p = 380\ \mu\text{s}$ | MAX.                      | V    |
| $I_{DRM} / I_{RRM}$ | $V_{DRM} = V_{RRM}$                                     | $T_J = 25^\circ\text{C}$  | 10   |
|                     |   | $T_J = 125^\circ\text{C}$ | 500  |
|                     |   | $T_J = 150^\circ\text{C}$ | 2000 |

### Thermal Resistances

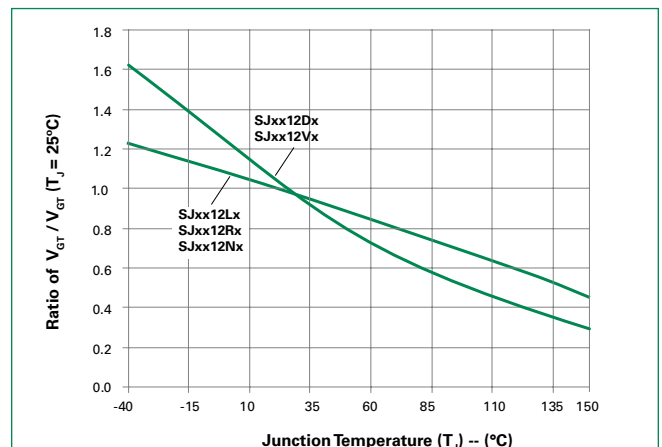
| Symbol           | Parameter             | Value                | Unit |
|------------------|-----------------------|----------------------|------|
| $R_{\theta(JC)}$ | Junction to case (AC) | SJxx12Lx             | 2.4  |
|                  |                       | SJxx12Rx<br>SJxx12Nx | 1.1  |
|                  |                       | SJxx12Dx<br>SJxx12Vx | 1.4  |

Note: xx=voltage/10, x=sensitivity

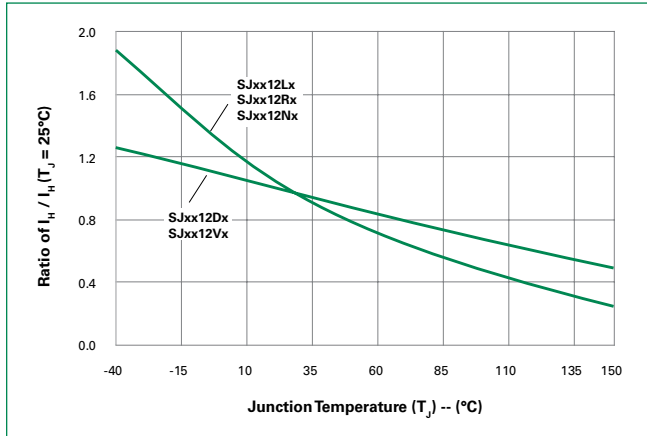
**Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature**



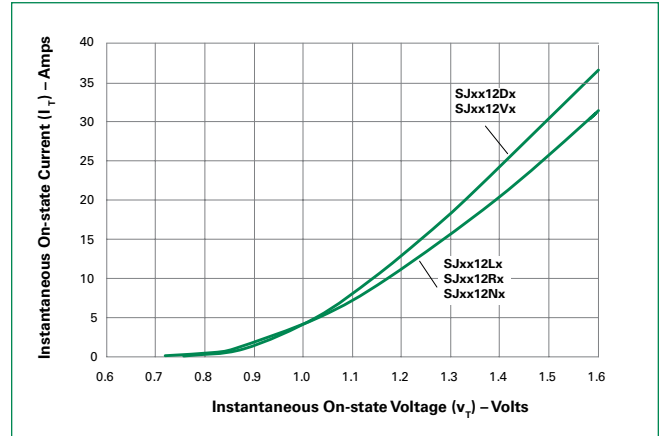
**Figure 2: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



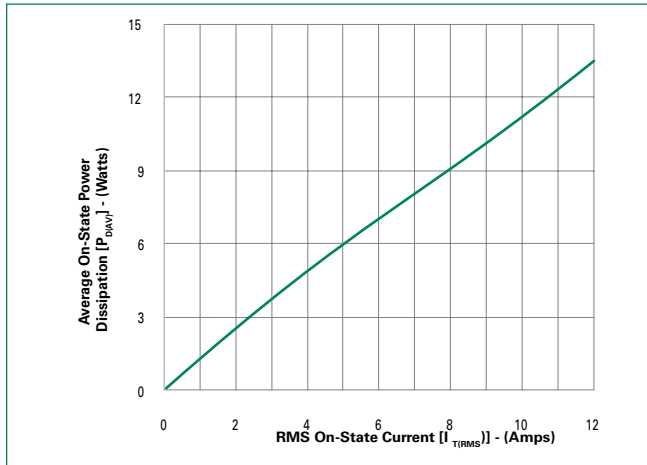
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



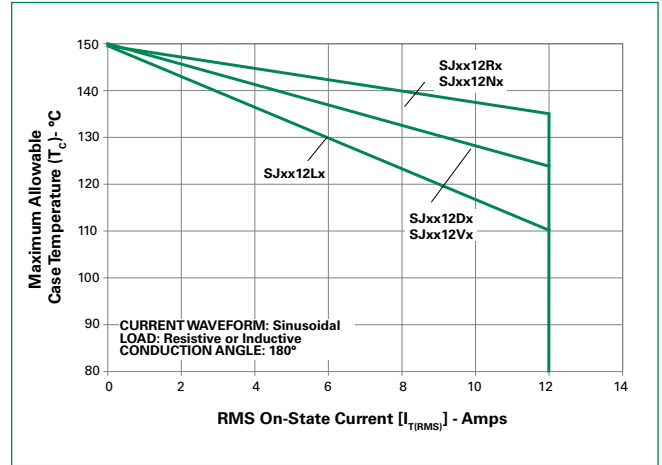
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



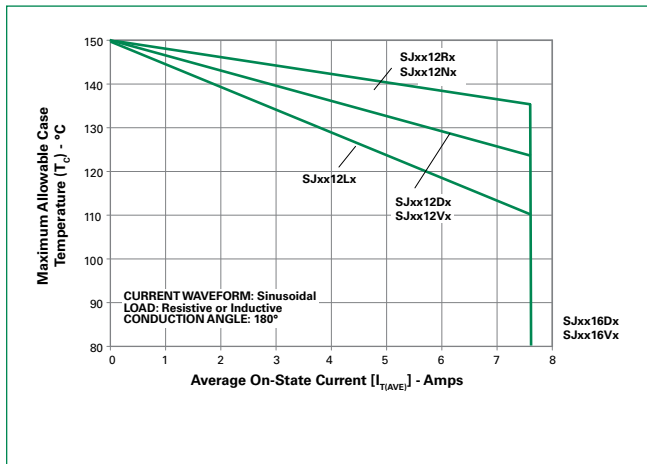
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



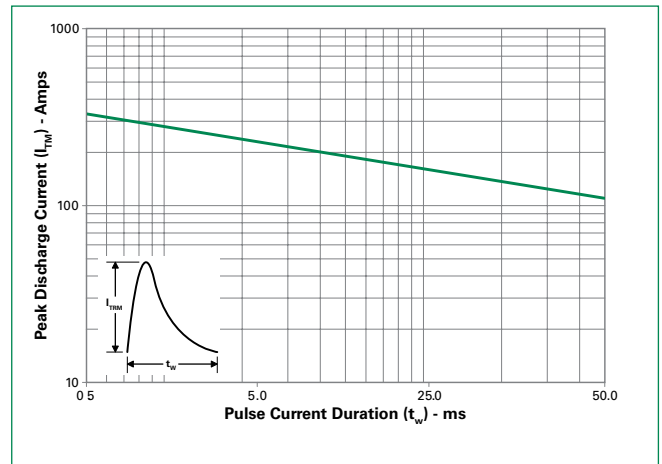
**Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current**



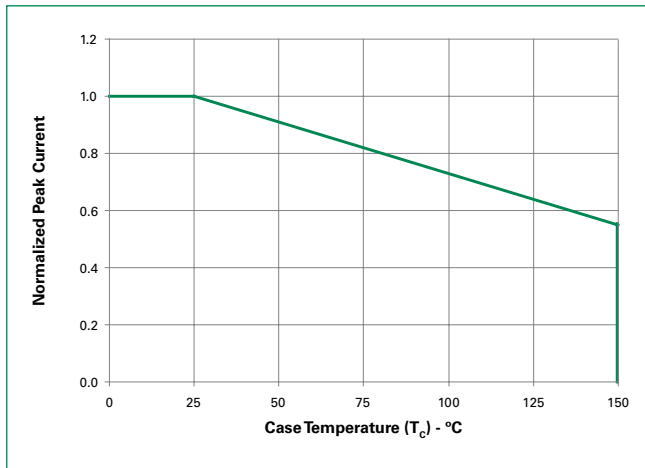
**Figure 7: Maximum Allowable Case Temperature vs. Average On-State Current**



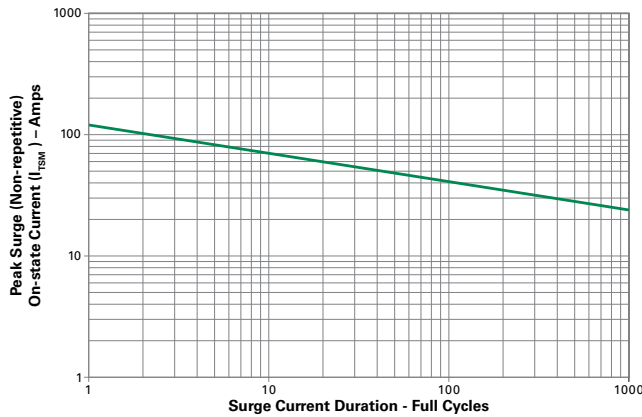
**Figure 8: Peak Capacitor Discharge Current**



**Figure 9: Peak Capacitor Discharge Current Derating**



**Figure 10: Surge Peak On-State Current vs. Number of Cycles**



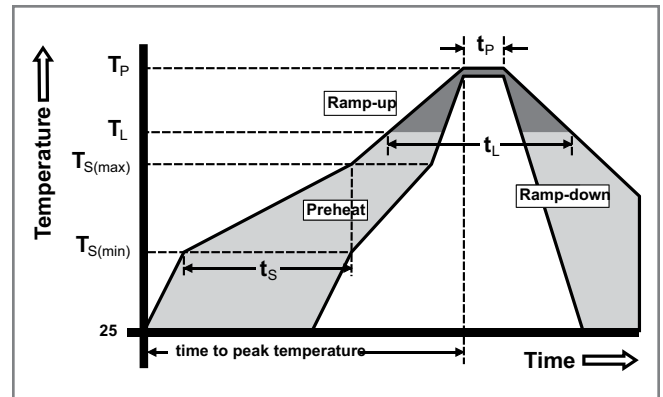
SUPPLY FREQUENCY: 60 Hz Sinusoidal  
LOAD: Resistive  
RMS On-State Current: [ $I_{T(RMS)}$ ]: Maximum Rated Value at Specified Case Temperature

Notes:

1. Gate control may be lost during and immediately following surge current interval.
2. Overload may not be repeated until junction temperature has returned to steady-state rated value.

**Soldering Parameters**

|  |                                    |                         |
|--|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Pb – Free assembly      |
| Pre Heat   | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|  | - Time (min to max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp) ( $T_L$ ) to peak |                                    | 5°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max          |
| Reflow   | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|  | - Time ( $t_L$ )                   | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 20 – 40 seconds         |
| Ramp-down Rate   |                                    | 5°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed  |                                    | 280°C                   |



### Physical Specifications

|                        |   |
|------------------------|---|
| <b>Terminal Finish</b> | 100% Matte Tin-plated                                   |
| <b>Body Material</b>   | UL recognized compound meeting flammability rating V-0. |
| <b>Lead Material</b>   | Copper Alloy  |

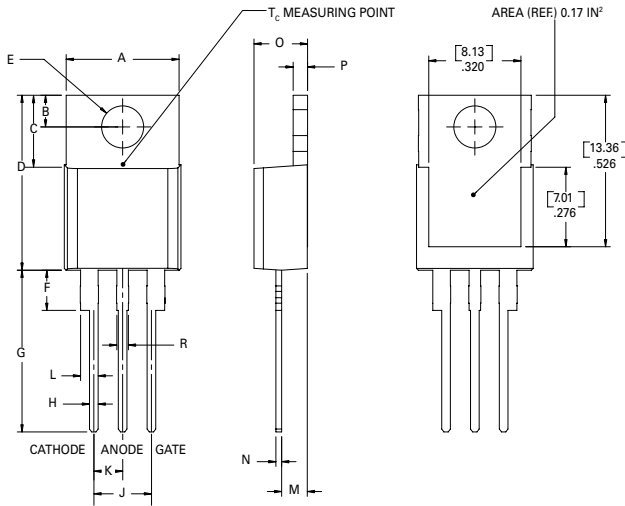
### Design Considerations

Careful selection of the correct component for the application's operating parameters and environment will go a long way toward extending the operating life of the Thyristor. Good design practice should limit the maximum continuous current through the main terminals to 75% of the component rating. Other ways to ensure long life for a power discrete semiconductor are proper heat sinking and selection of voltage ratings for worst case conditions. Overheating, overvoltage (including dv/dt), and surge currents are the main killers of semiconductors. Correct mounting, soldering, and forming of the leads also help protect against component damage.

### Environmental Specifications

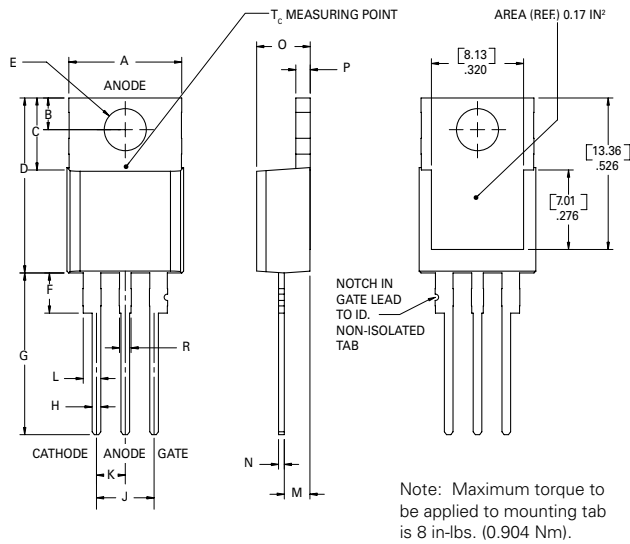
| Test                              | Specifications and Conditions  |
|-----------------------------------|--|
| <b>AC Blocking</b>                | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 150°C for 1008 hours |
| <b>Temperature Cycling</b>        | MIL-STD-750, M-1051, 100 cycles; -55°C to +150°C; 15-min dwell-time        |
| <b>Temperature/Humidity</b>       | EIA / JEDEC, JESD22-A101 1008 hours; 160V - DC: 85°C; 85% rel humidity     |
| <b>High Temp Storage</b>          | MIL-STD-750, M-1031, 1008 hours; 150°C                                     |
| <b>Low-Temp Storage</b>           | 1008 hours; -40°C  |
| <b>Resistance to Solder Heat</b>  | MIL-STD-750 Method 2031  |
| <b>Solderability</b>              | ANSI/J-STD-002, category 3, Test A   |
| <b>Lead Bend</b>                  | MIL-STD-750, M-2036 Cond E   |
| <b>Moisture Sensitivity Level</b> | Level 1, JEDEC-J-STD-020D  |

### Dimensions — TO-220AB (L-Package) — Isolated Mounting Tab



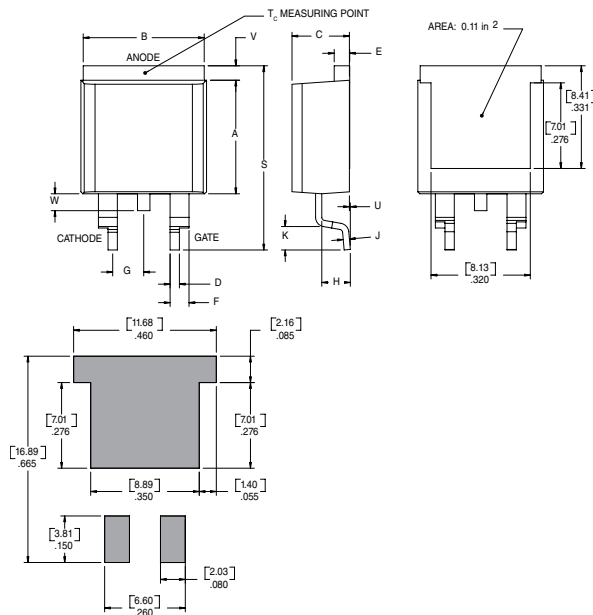
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.380  | 0.420 | 9.65        | 10.67 |
| B         | 0.105  | 0.115 | 2.67        | 2.92  |
| C         | 0.230  | 0.250 | 5.84        | 6.35  |
| D         | 0.590  | 0.620 | 14.99       | 15.75 |
| E         | 0.142  | 0.147 | 3.61        | 3.73  |
| F         | 0.110  | 0.130 | 2.79        | 3.30  |
| G         | 0.540  | 0.575 | 13.72       | 14.61 |
| H         | 0.025  | 0.035 | 0.64        | 0.89  |
| J         | 0.195  | 0.205 | 4.95        | 5.21  |
| K         | 0.095  | 0.105 | 2.41        | 2.67  |
| L         | 0.060  | 0.075 | 1.52        | 1.91  |
| M         | 0.085  | 0.095 | 2.16        | 2.41  |
| N         | 0.018  | 0.024 | 0.46        | 0.61  |
| O         | 0.178  | 0.188 | 4.52        | 4.78  |
| P         | 0.045  | 0.060 | 1.14        | 1.52  |
| R         | 0.038  | 0.048 | 0.97        | 1.22  |

**Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead**



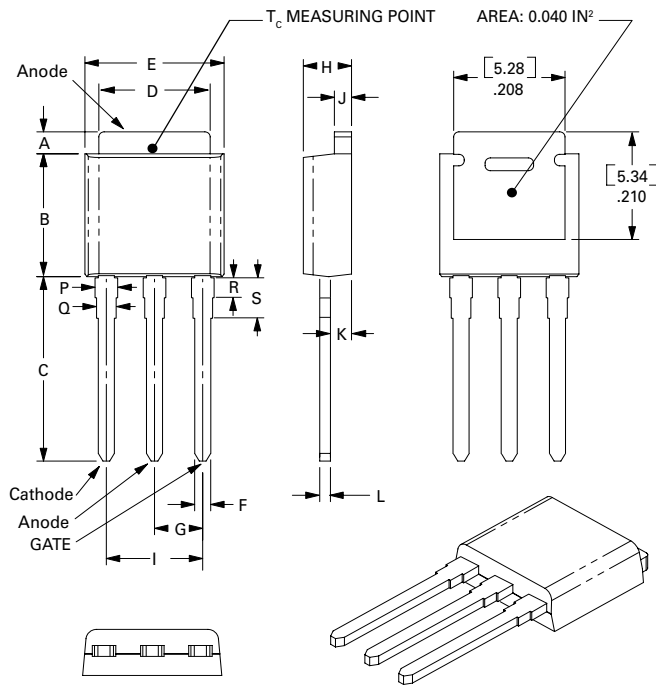
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.380  | 0.420 | 9.65        | 10.67 |
| B         | 0.105  | 0.115 | 2.67        | 2.92  |
| C         | 0.230  | 0.250 | 5.84        | 6.35  |
| D         | 0.590  | 0.620 | 14.99       | 15.75 |
| E         | 0.142  | 0.147 | 3.61        | 3.73  |
| F         | 0.110  | 0.130 | 2.79        | 3.30  |
| G         | 0.540  | 0.575 | 13.72       | 14.61 |
| H         | 0.025  | 0.035 | 0.64        | 0.89  |
| J         | 0.195  | 0.205 | 4.95        | 5.21  |
| K         | 0.095  | 0.105 | 2.41        | 2.67  |
| L         | 0.060  | 0.075 | 1.52        | 1.91  |
| M         | 0.085  | 0.095 | 2.16        | 2.41  |
| N         | 0.018  | 0.024 | 0.46        | 0.61  |
| O         | 0.178  | 0.188 | 4.52        | 4.78  |
| P         | 0.045  | 0.060 | 1.14        | 1.52  |
| R         | 0.038  | 0.048 | 0.97        | 1.22  |

**Dimensions — TO- 263AB (N-package) — D<sup>2</sup>-Pak Surface Mount**



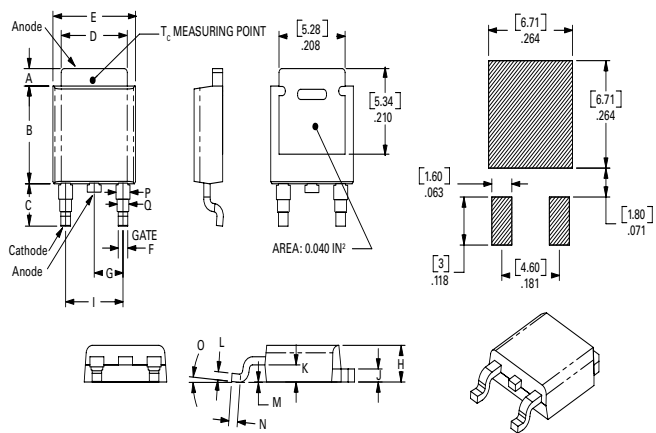
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.360  | 0.370 | 9.14        | 9.40  |
| B         | 0.380  | 0.420 | 9.65        | 10.67 |
| C         | 0.178  | 0.188 | 4.52        | 4.78  |
| D         | 0.025  | 0.035 | 0.64        | 0.89  |
| E         | 0.045  | 0.060 | 1.14        | 1.52  |
| F         | 0.060  | 0.075 | 1.52        | 1.91  |
| G         | 0.095  | 0.105 | 2.41        | 2.67  |
| H         | 0.092  | 0.102 | 2.34        | 2.59  |
| J         | 0.018  | 0.024 | 0.46        | 0.61  |
| K         | 0.090  | 0.110 | 2.29        | 2.79  |
| S         | 0.590  | 0.625 | 14.99       | 15.88 |
| V         | 0.035  | 0.045 | 0.89        | 1.14  |
| U         | 0.002  | 0.010 | 0.05        | 0.25  |
| W         | 0.040  | 0.070 | 1.02        | 1.78  |

**Dimensions — TO-251AA (V/I-Package) — V/I-PAK Through Hole**



| Dimension | Inches |       |       | Millimeters |      |      |
|-----------|--------|-------|-------|-------------|------|------|
|           | Min    | Typ   | Max   | Min         | Typ  | Max  |
| A         | 0.040  | 0.044 | 0.050 | 1.02        | 1.11 | 1.27 |
| B         | 0.235  | 0.242 | 0.245 | 5.97        | 6.15 | 6.22 |
| C         | 0.350  | 0.361 | 0.375 | 8.89        | 9.18 | 9.53 |
| D         | 0.205  | 0.208 | 0.213 | 5.21        | 5.29 | 5.41 |
| E         | 0.255  | 0.262 | 0.265 | 6.48        | 6.66 | 6.73 |
| F         | 0.027  | 0.031 | 0.033 | 0.69        | 0.80 | 0.84 |
| G         | 0.087  | 0.090 | 0.093 | 2.21        | 2.28 | 2.36 |
| H         | 0.085  | 0.092 | 0.095 | 2.16        | 2.34 | 2.41 |
| I         | 0.176  | 0.180 | 0.184 | 4.47        | 4.57 | 4.67 |
| J         | 0.018  | 0.020 | 0.023 | 0.46        | 0.51 | 0.58 |
| K         | 0.038  | 0.040 | 0.044 | 0.97        | 1.01 | 1.12 |
| L         | 0.018  | 0.020 | 0.023 | 0.46        | 0.52 | 0.58 |
| P         | 0.042  | 0.047 | 0.052 | 1.06        | 1.20 | 1.32 |
| Q         | 0.034  | 0.039 | 0.044 | 0.86        | 1.00 | 1.11 |
| R         | 0.034  | 0.039 | 0.044 | 0.86        | 1.00 | 1.11 |
| S         | 0.074  | 0.079 | 0.084 | 1.86        | 2.00 | 2.11 |

**Dimensions — TO-252AA (D-Package) — D-PAK Surface Mount**



| Dimension | Inches |       |       | Millimeters |      |      |
|-----------|--------|-------|-------|-------------|------|------|
|           | Min    | Typ   | Max   | Min         | Typ  | Max  |
| A         | 0.040  | 0.043 | 0.050 | 1.02        | 1.09 | 1.27 |
| B         | 0.235  | 0.243 | 0.245 | 5.97        | 6.16 | 6.22 |
| C         | 0.106  | 0.108 | 0.113 | 2.69        | 2.74 | 2.87 |
| D         | 0.205  | 0.208 | 0.213 | 5.21        | 5.29 | 5.41 |
| E         | 0.255  | 0.262 | 0.265 | 6.48        | 6.65 | 6.73 |
| F         | 0.027  | 0.031 | 0.033 | 0.69        | 0.80 | 0.84 |
| G         | 0.087  | 0.090 | 0.093 | 2.21        | 2.28 | 2.36 |
| H         | 0.085  | 0.092 | 0.095 | 2.16        | 2.33 | 2.41 |
| I         | 0.176  | 0.179 | 0.184 | 4.47        | 4.55 | 4.67 |
| J         | 0.018  | 0.020 | 0.023 | 0.46        | 0.51 | 0.58 |
| K         | 0.038  | 0.040 | 0.044 | 0.97        | 1.02 | 1.12 |
| L         | 0.018  | 0.020 | 0.023 | 0.46        | 0.51 | 0.58 |
| M         | 0.000  | 0.000 | 0.004 | 0.00        | 0.00 | 0.10 |
| N         | 0.021  | 0.026 | 0.027 | 0.53        | 0.67 | 0.69 |
| O         | 0°     | 0°    | 5°    | 0°          | 0°   | 5°   |
| P         | 0.042  | 0.047 | 0.052 | 1.06        | 1.20 | 1.32 |
| Q         | 0.034  | 0.039 | 0.044 | 0.86        | 1.00 | 1.11 |



### Product Selector

| Part Number | Voltage |      | Gate Sensitivity | Type         | Package |
|-------------|---------|------|------------------|--------------|---------|
|             | 400V    | 600V |                  |              |         |
| SJxx12L     | X       | X    | 20mA             | Standard SCR | TO-220L |
| SJxx12R     | X       | X    | 20mA             | Standard SCR | TO-220R |
| SJxx12N     | X       | X    | 20mA             | Standard SCR | TO-263  |
| SJxx12V     | X       | X    | 20mA             | Standard SCR | TO-251  |
| SJxx12D     | X       | X    | 20mA             | Standard SCR | TO-252  |
| SJxx12L1    | X       | X    | 6mA              | Standard SCR | TO-220L |
| SJxx12R1    | X       | X    | 6mA              | Standard SCR | TO-220R |
| SJxx12N1    | X       | X    | 6mA              | Standard SCR | TO-263  |
| SJxx12V1    | X       | X    | 6mA              | Standard SCR | TO-251  |
| SJxx12D1    | X       | X    | 6mA              | Standard SCR | TO-252  |
| SJxx12L2    | X       | X    | 10mA             | Standard SCR | TO-220L |
| SJxx12R2    | X       | X    | 10mA             | Standard SCR | TO-220R |
| SJxx12N2    | X       | X    | 10mA             | Standard SCR | TO-263  |

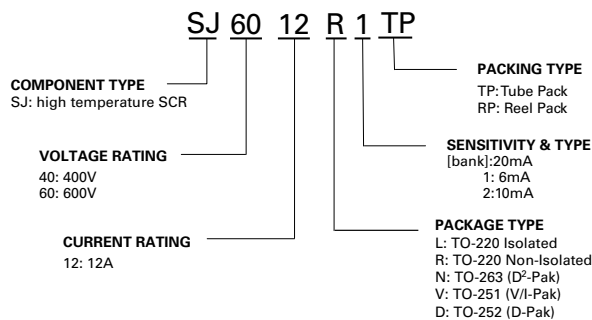
Note: xx = Voltage/10

### Packing Options

| Part Number | Marking  | Weight | Packing Mode     | Base Quantity     |
|-------------|----------|--------|------------------|-------------------|
| SJxx12LxTP  | SJxx12Ly | 2.2g   | Tube             | 500 (50 per tube) |
| SJxx12RxTP  | SJxx12Ry | 2.2g   | Tube             | 500 (50 per tube) |
| SJxx12NxTP  | SJxx12Ny | 1.6g   | Tube             | 500 (50 per tube) |
| SJxx12NxRP  | SJxx12Ny | 1.6g   | Embossed Carrier | 500               |
| SJxx12DxTP  | SJxx12Dx | 0.3 g  | Tube             | 750 (75 per tube) |
| SJxx12DxRP  | SJxx12Dx | 0.3 g  | Embossed Carrier | 2500              |
| SJxx12VxTP  | SJxx12Vx | 0.4 g  | Tube             | 750 (75 per tube) |

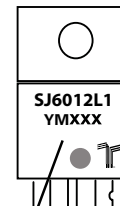
Note: xx=voltage/10, x=sensitivity

### Part Numbering System



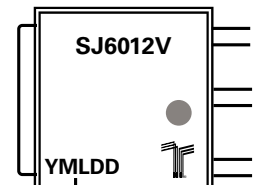
### Part Marking System

TO-220 AB - (L and R Package)  
TO-263 AB - (N Package)



**Date Code Marking**  
Y: Year Code  
M: Month Code  
XXX: Lot Trace Code

TO-251 (V/I-Pak)  
TO-252 (D-Pak)



**Date Code Marking**  
Y: Year Code  
M: Month Code  
L: Location Code  
DD: Calendar Code