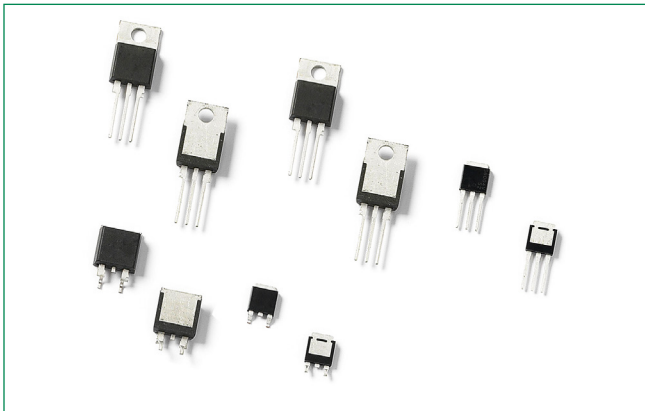




**THE DATASHEET OF  
S8012DTP**



Sxx12x Series



**Agency Approval**

| Agency | Agency File Number |
|--------|--------------------|
|        | E71639*            |

\* - L Packages Only

**Main Features**

| Symbol            | Value       | Unit |
|-------------------|-------------|------|
| $I_{T(RMS)}$      | 12          | A    |
| $V_{DRM}/V_{RRM}$ | 400 to 1000 | V    |
| $I_{GT}$          | 20          | mA   |

**Additional Information**



Datasheet



Resources



Samples

**Description**

This Sxx12x SCR series is ideal for uni-directional switch applications such as phase control, heating, motor speed controls, converters/rectifiers and capacitive discharge ignitions.

These SCRs have a low gate current trigger level of 20 mA at approximately 1.5V.

**Features & Benefits**

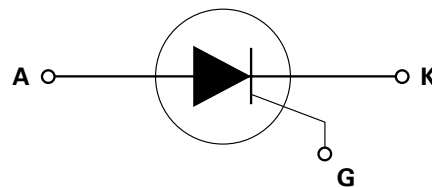
- Halogen-free and RoHS-compliant
- Glass – passivated junctions
- Electrically isolated “L-Package” is UL Recognized for 2500Vrms
- Voltage capability up to 1000 V
- Surge capability up to 120 A at 60 Hz half cycle

**Applications**

Typical applications includes capacitive discharge system for motorcycle engine CDI, portable generator engine ignition, strobe lights and nailers, as well as generic rectifiers, battery voltage regulators and converters. Also AC control & rectification for power tools, home/brown goods, white goods appliances and 2-wheeler rectifier/battery regulators.

Internally constructed isolated packages are offered for ease of heat sinking with highest isolation voltage.

**Schematic Symbol**



### Absolute Maximum Ratings

| Symbol       | Parameter   | Test Conditions                     |                           | Value      | Unit             |
|--------------|---|-------------------------------------|---------------------------|------------|------------------|
| $I_{T(RMS)}$ | RMS on-state current  | Sxx12L                              | $T_c = 72^\circ\text{C}$  | 12         | A                |
|              |   | Sxx12R / Sxx12N<br>Sxx12D<br>Sxx12V | $T_c = 105^\circ\text{C}$ |            |                  |
| $I_{T(AV)}$  | Average on-state current  | Sxx12L                              | $T_c = 72^\circ\text{C}$  | 7.6        | A                |
|              |   | Sxx12R<br>Sxx12D<br>Sxx12V          | $T_c = 105^\circ\text{C}$ |            |                  |
| $I_{TSM}$    | Peak non-repetitive surge current<br>(single half cycle, $T_J$ (initial) = $25^\circ\text{C}$ ) | Sxx12L                              | f = 50Hz                  | 120        | A                |
|              |   | Sxx12R / Sxx12N                     | f = 60Hz                  | 130        |                  |
|              |   | Sxx12D                              | f = 50Hz                  | 100        |                  |
|              |   | Sxx12V                              | f = 60Hz                  | 120        |                  |
| $I^2t$       | $I^2t$ Value for fusing   | Sxx12L<br>Sxx12R / Sxx12N           | $t_p = 8.3 \text{ ms}$    | 70         | A <sup>2</sup> s |
|              |   | Sxx12D<br>Sxx12V                    |                           | 60         |                  |
| di/dt        | Critical rate of rise of on-state current   | f = 60Hz; $T_J = 125^\circ\text{C}$ |                           | 100        | A/ $\mu\text{s}$ |
| $I_{GM}$     | Peak gate current   | $T_J = 125^\circ\text{C}$           |                           | 2          | A                |
| $P_{G(AV)}$  | Average gate power dissipation  | $T_J = 125^\circ\text{C}$           |                           | 0.5        | W                |
| $T_{stg}$    | Storage temperature range   |                                     |                           | -40 to 150 | $^\circ\text{C}$ |
| $T_J$        | Operating junction temperature range  |                                     |                           | -40 to 125 |                  |

Note: xx = voltage

### Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified)

| Symbol   | Test Conditions  |       | Value | Unit          |                  |
|----------|--|-------|-------|---------------|------------------|
| $I_{GT}$ | $V_D = 12\text{V}$ $R_L = 60 \Omega$   | MAX.  | 20    | mA            |                  |
|          |  | MIN.  | 1     |               |                  |
| $V_{GT}$ | $V_D = 12\text{V}$ $R_L = 60 \Omega$   | MAX.  | 1.5   | V             |                  |
| dv/dt    | $V_D = V_{DRM}$ ; gate open; $T_J = 100^\circ\text{C}$   | 400V  | MIN.  | 350           | V/ $\mu\text{s}$ |
|          |  | 600V  |       | 300           |                  |
|          |  | 800V  |       | 250           |                  |
|          |  | 1000V |       | 100           |                  |
|          | $V_D = V_{DRM}$ ; gate open; $T_J = 125^\circ\text{C}$   | 400V  | 250   |               |                  |
|          |  | 600V  | 225   |               |                  |
| 800V     | 200  |       |       |               |                  |
| $V_{GD}$ | $V_D = V_{DRM}$ $R_L = 3.3 \text{ k}\Omega$ $T_J = 125^\circ\text{C}$                              | MIN.  | 0.2   | V             |                  |
| $I_H$    | $I_T = 200\text{mA}$ (initial)   | MAX.  | 40    | mA            |                  |
| $t_q$    | $I_T = 2\text{A}$ ; $t_p = 50\mu\text{s}$ ; dv/dt = 5V/ $\mu\text{s}$ ; di/dt = 30A/ $\mu\text{s}$ | MAX.  | 35    | $\mu\text{s}$ |                  |
| $t_{gt}$ | $I_G = 2 \times I_{GT}$ PW = 15 $\mu\text{s}$ $I_T = 20\text{A}$                                   | TYP.  | 2     | $\mu\text{s}$ |                  |

**Static Characteristics**

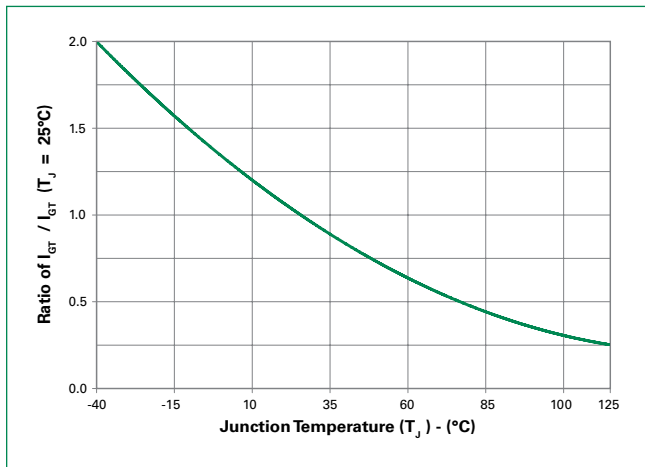
| Symbol              | Test Conditions              |                     | Value       | Unit |         |
|---------------------|------------------------------|---------------------|-------------|------|---------|
| $V_{TM}$            | $I_T = 24A; t_p = 380 \mu s$ |                     | MAX.        | 1.6  | V       |
| $I_{DRM} / I_{RRM}$ | $V_{DRM} = V_{RRM}$          | $T_J = 25^\circ C$  | 400 – 600V  | 10   | $\mu A$ |
|                     |                              |                     | 800 – 1000V | 20   |         |
|                     |                              | $T_J = 100^\circ C$ | 400 – 800V  | 500  |         |
|                     |                              |                     | 1000V       | 3000 |         |
| $T_J = 125^\circ C$ | 400 – 800V                   | 1000                |             |      |         |

**Thermal Resistances**

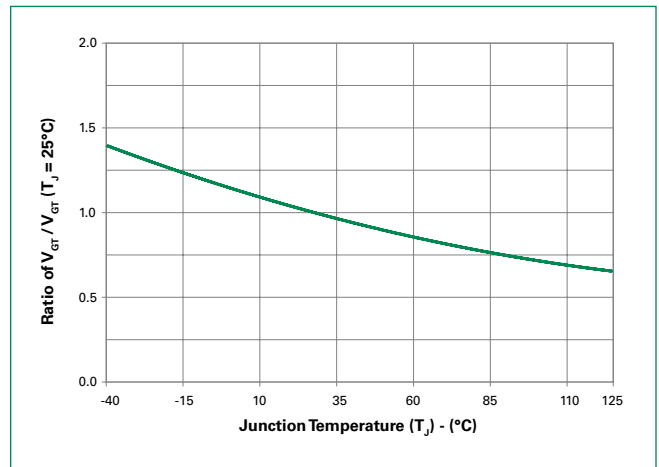
| Symbol            | Parameter             | Value           | Unit |              |
|-------------------|-----------------------|-----------------|------|--------------|
| $R_{\theta(J-C)}$ | Junction to case (AC) | Sxx12L          | 3.2  | $^\circ C/W$ |
|                   |                       | Sxx12R / Sxx12N | 1.5  |              |
|                   |                       | Sxx12V          | 1.6  |              |
|                   |                       | Sxx12D          | 1.4  |              |
| $R_{\theta(J-A)}$ | Junction to ambient   | Sxx12L          | 50   | $^\circ C/W$ |
|                   |                       | Sxx12R          | 40   |              |
|                   |                       | Sxx12V          | 70   |              |

Note: xx = voltage

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



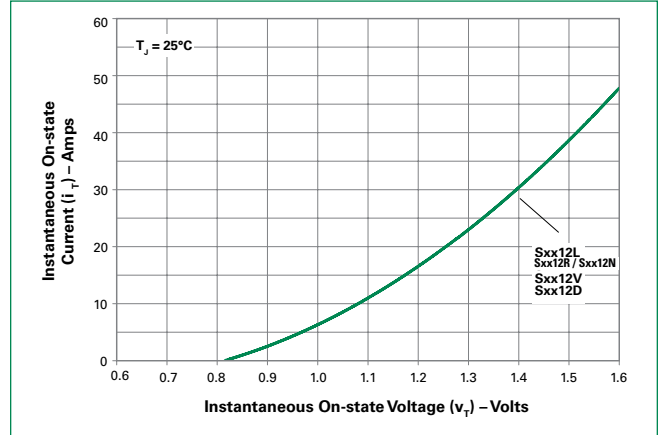
**Figure 2: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



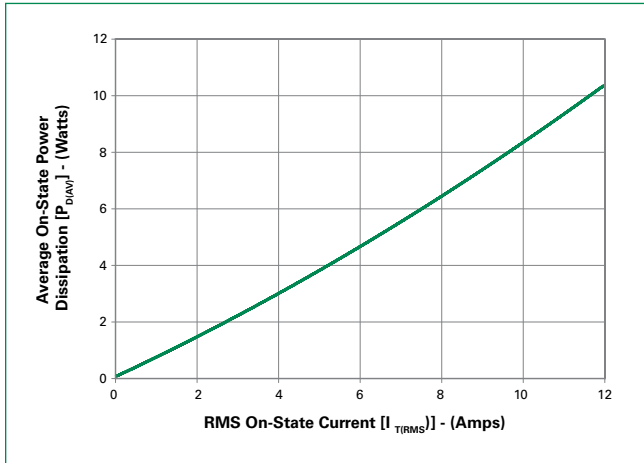
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



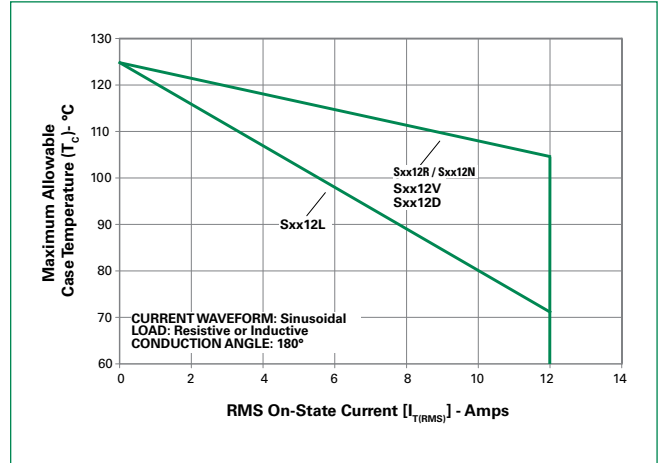
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



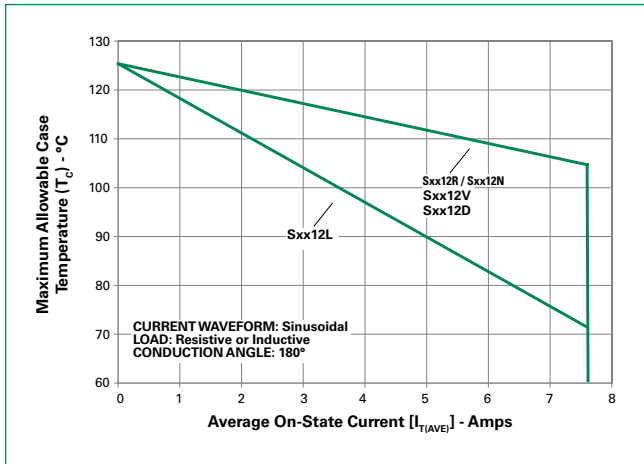
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



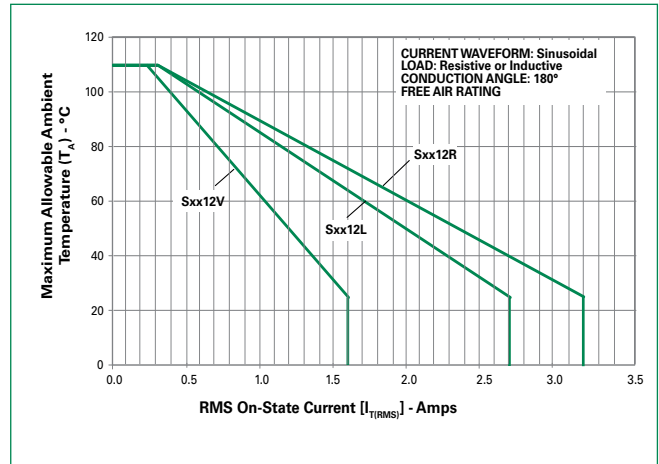
**Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current**



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

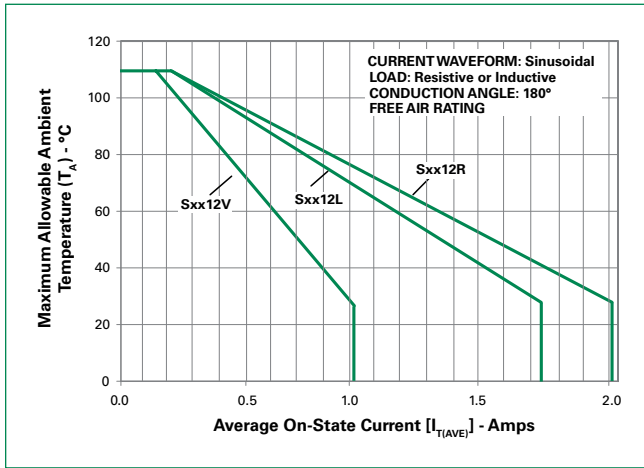


**Figure 8: Maximum Allowable Ambient Temperature vs. RMS On-State Current**

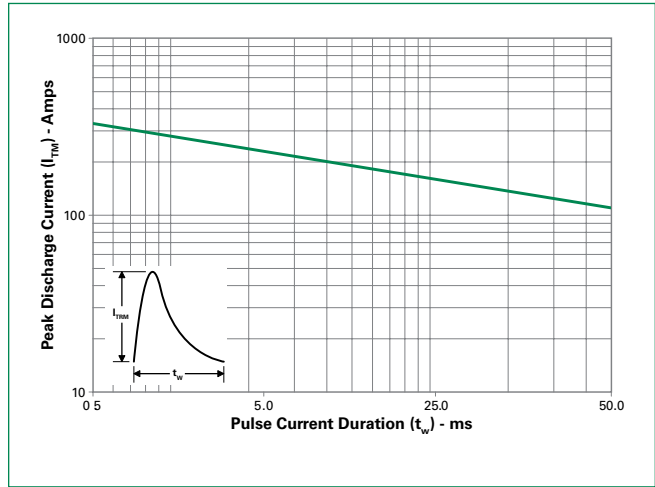


Note: xx = voltage

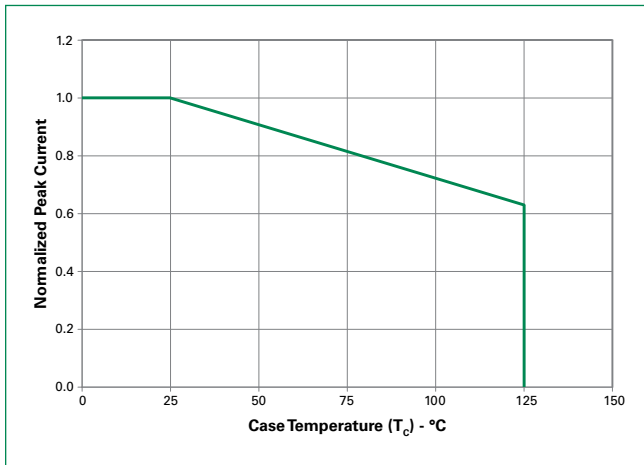
**Figure 9: Maximum Allowable Ambient Temperature vs. Average On-State Current**



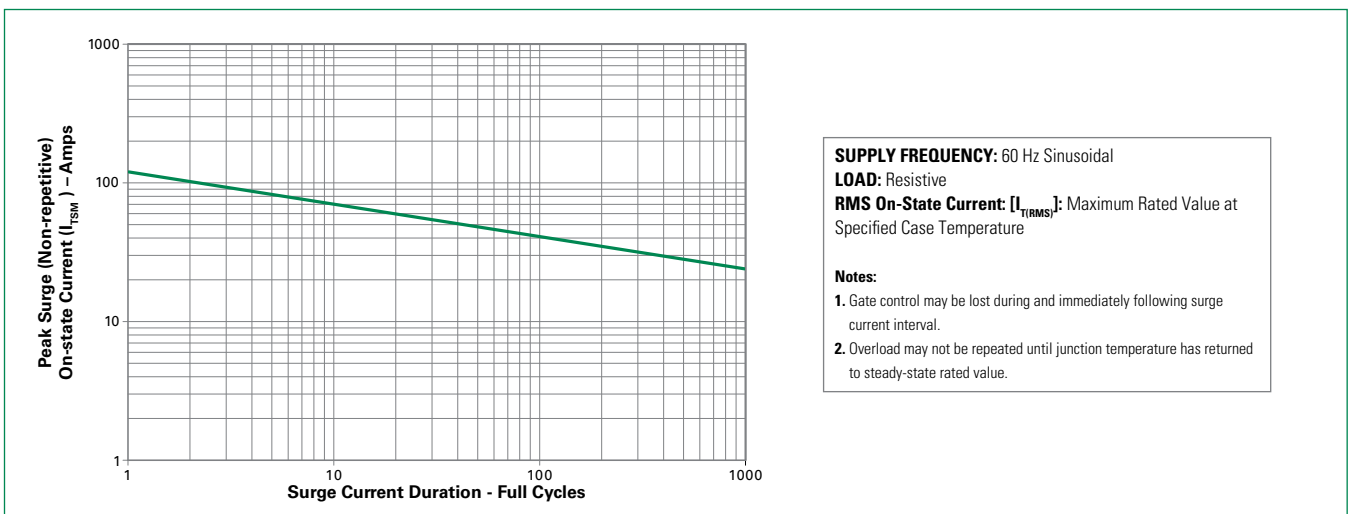
**Figure 10: Peak Capacitor Discharge Current**



**Figure 11: Peak Capacitor Discharge Current Derating**

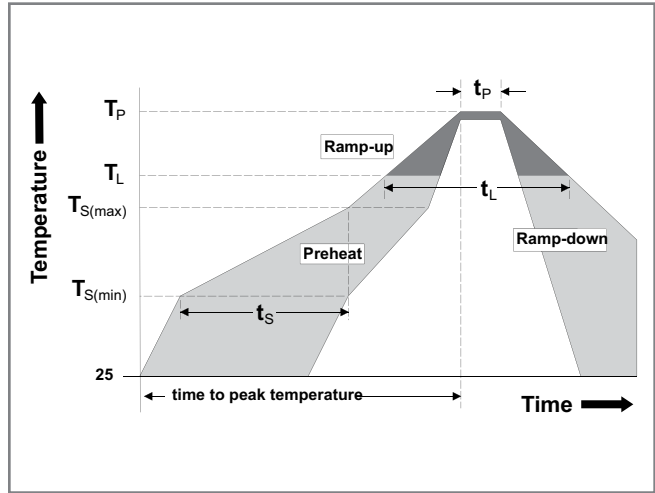


**Figure 12: Surge Peak On-State Current vs. Number of Cycles**



**Soldering Parameters**

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



**Physical Specifications**

|                        |   |
|------------------------|---|
| <b>Terminal Finish</b> | 100% Matte Tin-plated                                 |
| <b>Body Material</b>   | UL Recognized epoxy meeting flammability rating 94V-0 |
| <b>Lead Material</b>   | Copper Alloy  |

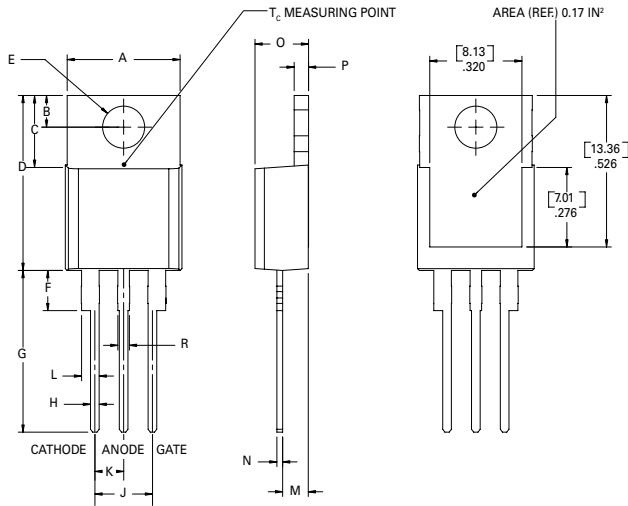
**Design Considerations**

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**

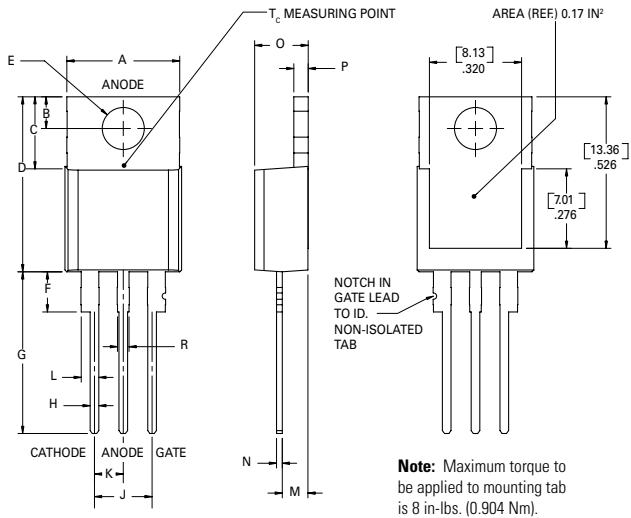
| Test                             | Specifications and Conditions  |
|----------------------------------|--|
| <b>AC Blocking</b>               | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours |
| <b>Temperature Cycling</b>       | MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time        |
| <b>Temperature/Humidity</b>      | EIA / JEDEC, JESD22-A101 1008 hours; 320V - 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   |

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



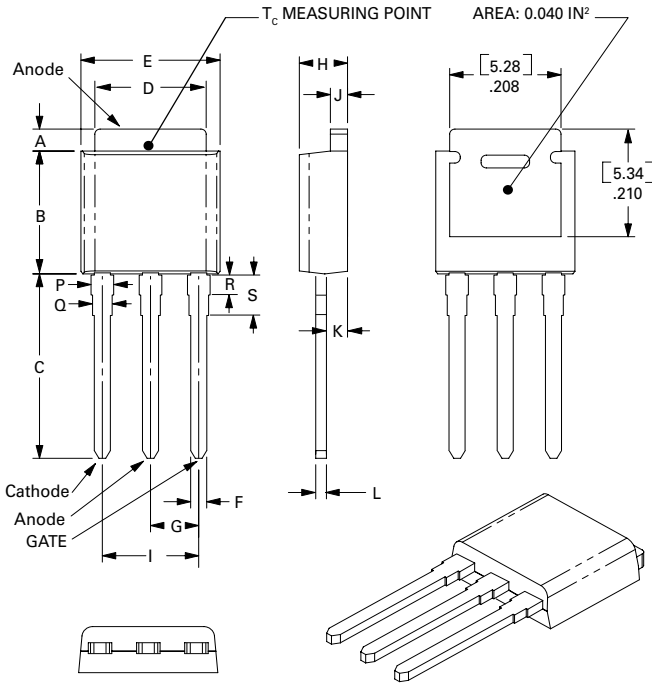
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.380  | 0.420 | 9.65        | 10.67 |
| B         | 0.105  | 0.115 | 2.67        | 2.92  |
| C         | 0.230  | 0.250 | 5.84        | 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



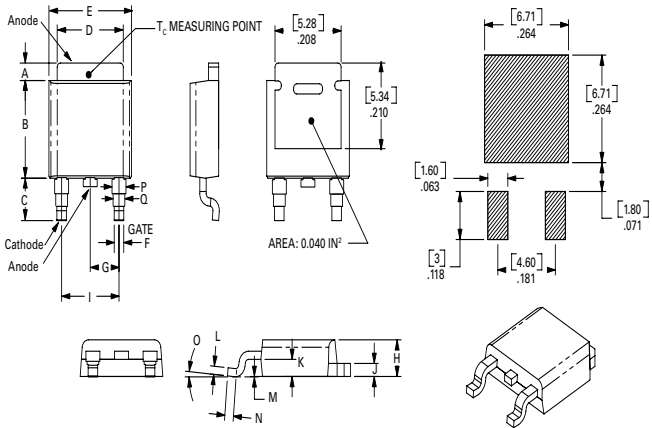
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.380  | 0.420 | 9.65        | 10.67 |
| B         | 0.105  | 0.115 | 2.67        | 2.92  |
| C         | 0.230  | 0.250 | 5.84        | 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-251AA (V/I-Package) — V/I-PAK Through Hole**



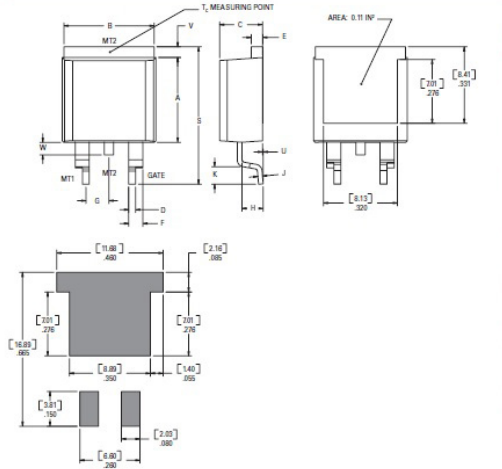
| Dimension | Inches |       |       | Millimeters |      |      |
|-----------|--------|-------|-------|-------------|------|------|
|           | Min    | Typ   | Max   | Min         | Typ  | Max  |
| A         | 0.040  | 0.044 | 0.050 | 1.02        | 1.11 | 1.27 |
| B         | 0.235  | 0.242 | 0.245 | 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 |

**Dimensions — TO-263 (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  |

**Product Selector**

| Part Number | Voltage |      |      |       | Gate Sensitivity | Type          | Package |
|-------------|---------|------|------|-------|------------------|---------------|---------|
|             | 400V    | 600V | 800V | 1000V |                  |               |         |
| Sxx12L      | X       | X    | X    | X     | 20mA             | Sensitive SCR | TO-220L |
| Sxx12R      | X       | X    | X    | X     | 20mA             | Sensitive SCR | TO-220R |
| Sxx12V      | X       | X    | X    | X     | 20mA             | Standard SCR  | TO-251  |
| Sxx12D      | X       | X    | X    | X     | 20mA             | Standard SCR  | TO-252  |
| Sxx12N      | X       | X    | X    | X     | 20mA             | Standard SCR  | TO-263  |

Note: xx = voltage/10

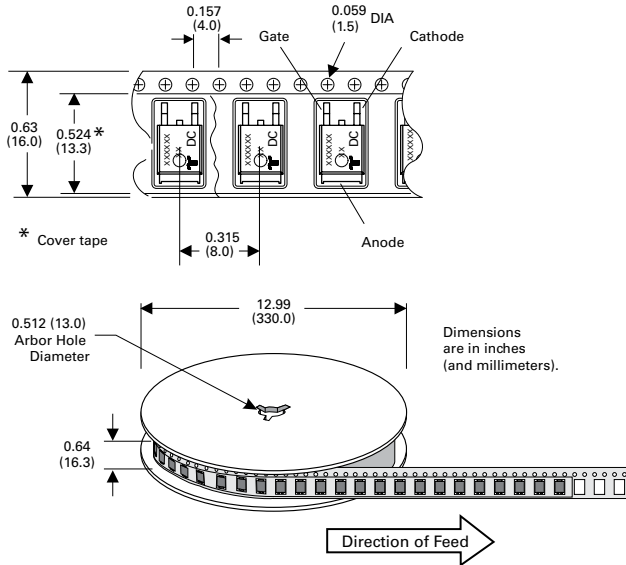
**Packing Options**

| Part Number | Marking | Weight | Packing Mode     | Base Quantity      |
|-------------|---------|--------|------------------|--------------------|
| Sxx12LTP    | Sxx12L  | 2.2 g  | Tube             | 1000 (50 per tube) |
| Sxx12RTP    | Sxx12R  | 2.2 g  | Tube             | 1000 (50 per tube) |
| Sxx12DTP    | Sxx12D  | 0.3 g  | Tube             | 750 (75 per tube)  |
| Sxx12DRP    | Sxx12D  | 0.3 g  | Embossed Carrier | 2500               |
| Sxx12VTP    | Sxx12V  | 0.4 g  | Tube             | 750 (75 per tube)  |
| Sxx12NRP    | Sxx12N  | 1.6g   | Embossed Carrier | 2500               |
| Sxx12NTP    | Sxx12N  | 1.6 g  | Tube             | 1000 (50 per tube) |

Note: xx = Voltage/10

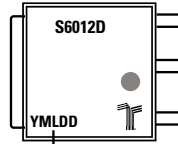
### TO-252 Embossed Carrier Reel Pack (RP) Specifications

Meets all EIA-481-2 Standards



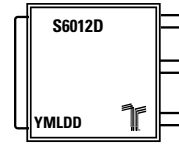
### Part Marking System

TO-251AA - (V Package)

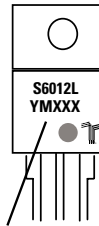


Date Code Marking  
 Y: Year Code  
 M: Month Code  
 L: Location Code  
 DD: Calendar Code

TO-252AA - (D Package)



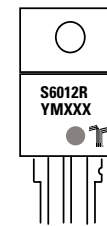
TO-220 AB - (L Package)



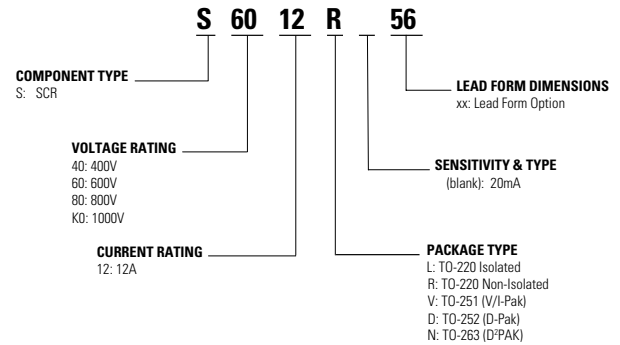
Date Code Marking  
 Y: Year Code

TO-263AA (N Package)

TO-220 AB - (R Package)



### Part Numbering System



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