

### SxX8xSx EV Series



#### Main Features

| Symbol            | Value            | Unit    |
|-------------------|------------------|---------|
| $I_{T(RMS)}$      | 0.8              | A       |
| $V_{DRM}/V_{RRM}$ | 400, 600, or 800 | V       |
| $I_{GT}$          | 5 to 200         | $\mu A$ |

#### Applications

The SxX8xSx EV series is specifically designed for GFCI (Ground Fault Circuit Interrupter) and gas ignition applications.

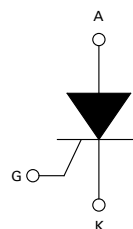
#### Description

This new component series offers high static  $dv/dt$  and low turn off time ( $t_q$ ) sensitive SCR with its small die planar construction design. It is specifically designed for GFCI (Ground Fault Circuit Interrupter) and Gas Ignition applications. All SCRs junctions are glass-passivated to ensure long term reliability and parametric stability.

#### Features

- RoHS compliant and Halogen-Free
- Thru-hole and surface mount packages
- Surge current capability > 10Amps
- Blocking voltage ( $V_{DRM}/V_{RRM}$ ) capability - up to 800V
- High  $dv/dt$  noise immunity
- Improved turn-off time ( $t_q$ ) < 25  $\mu sec$
- Sensitive gate for direct microprocessor interface

#### Schematic Symbol



#### Absolute Maximum Ratings

| Symbol       | Parameter                                                                                       | Value                                             | Unit                     |
|--------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave)                                                           | TO-92<br>$T_c = 55^\circ C$                       | 0.8<br>A                 |
|              |                                                                                                 | SOT-89<br>$T_c = 60^\circ C$                      | 0.8<br>A                 |
|              |                                                                                                 | SOT-223<br>$T_L = 60^\circ C$                     | 0.8<br>A                 |
| $I_{T(AV)}$  | Average on-state current                                                                        | TO-92<br>$T_c = 55^\circ C$                       | 0.51<br>A                |
|              |                                                                                                 | SOT-89<br>$T_c = 60^\circ C$                      | 0.51<br>A                |
|              |                                                                                                 | SOT-223<br>$T_L = 60^\circ C$                     | 0.51<br>A                |
| $I_{TSM}$    | Non repetitive surge peak on-state current (Single cycle, $T_{j\text{ initial}} = 25^\circ C$ ) | TO-92<br>SOT-89<br>SOT-223<br>$F = 50\text{Hz}$   | 8<br>A                   |
|              |                                                                                                 | $F = 60\text{Hz}$                                 | 10<br>A                  |
| $I^2t$       | $I^2t$ Value for fusing                                                                         | $t_p = 10\text{ ms}$<br>$F = 50\text{ Hz}$        | 0.32<br>$A^2s$           |
|              |                                                                                                 | $t_p = 8.3\text{ ms}$<br>$F = 60\text{ Hz}$       | 0.41<br>$A^2s$           |
| $di/dt$      | Critical rate of rise of on-state current $I_G = 10\text{mA}$                                   | TO-92<br>SOT-89<br>SOT-223<br>$T_j = 125^\circ C$ | 50<br>$A/\mu s$          |
| $I_{GM}$     | Peak Gate Current                                                                               | $t_p = 10\text{ }\mu s$<br>$T_j = 125^\circ C$    | 1.0<br>A                 |
| $P_{G(AV)}$  | Average gate power dissipation                                                                  | —<br>$T_j = 125^\circ C$                          | 0.1<br>W                 |
| $T_{stg}$    | Storage junction temperature range                                                              | —                                                 | -40 to 150<br>$^\circ C$ |
| $T_j$        | Operating junction temperature range                                                            | —                                                 | -40 to 125<br>$^\circ C$ |

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

| Symbol    | Description                                | Test Conditions                                                                                       | Limit | Value   |         |        | Unit             |
|-----------|--------------------------------------------|-------------------------------------------------------------------------------------------------------|-------|---------|---------|--------|------------------|
|           |                                            |                                                                                                       |       | SxX8yS1 | SxX8yS2 | SxX8yS |                  |
| $I_{GT}$  | DC Gate Trigger Current                    | $V_D = 6\text{V}$<br>$R_L = 100\ \Omega$                                                              | MIN.  | 0.5     | 1       | 15     | $\mu\text{A}$    |
|           |                                            |                                                                                                       | MAX.  | 5       | 50      | 200    | $\mu\text{A}$    |
| $V_{GT}$  | DC Gate Trigger Voltage                    | $V_D = 6\text{V}$<br>$R_L = 100\ \Omega$                                                              | MAX.  | 0.8     |         |        | V                |
| $V_{GRM}$ | Peak Reverse Gate Voltage                  | $I_{RG} = 10\mu\text{A}$                                                                              | MIN.  | 5       |         |        | V                |
| $I_H$     | Holding Current                            | $R_{GK} = 1\ \text{k}\Omega$<br>Initial Current = 20mA                                                | MAX.  | 5       |         |        | mA               |
| (dv/dt)s  | Critical Rate-of-Rise of Off-State Voltage | $T_J = 125^\circ\text{C}$<br>$V_D = V_{DRM}/N_{RRM}$<br>Exp. Waveform<br>$R_{GK} = 1\ \text{k}\Omega$ | MIN.  | 75      |         |        | V/ $\mu\text{s}$ |
| $V_{GD}$  | Gate Non-Trigger Voltage                   | $V_D = V_{DRM}$<br>$R_{GK} = 1\ \text{k}\Omega$<br>$T_J = 125^\circ\text{C}$                          | MIN.  | 0.2     |         |        | V                |
| $t_q$     | Turn-Off Time                              | $T_J = 25^\circ\text{C} @ 600\text{V}$<br>$R_{GK} = 1\ \text{k}\Omega$                                | MAX.  | 30      | 25      | 25     | $\mu\text{s}$    |
| $t_{gt}$  | Turn-On Time                               | $I_G = 10\text{mA}$<br>$PW = 15\mu\text{sec}$<br>$I_T = 1.6\text{A(pk)}$                              | TYP.  | 2.0     | 2.0     | 2.0    | $\mu\text{s}$    |

Note: x = voltage/100, y = package

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

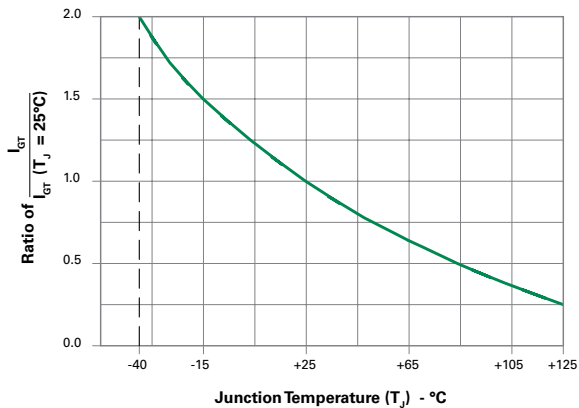
| Symbol    | Description                        | Test Conditions                                                           | Limit | Value | Unit          |
|-----------|------------------------------------|---------------------------------------------------------------------------|-------|-------|---------------|
| $V_{TM}$  | Peak On-State Voltage              | $I_{TM} = 1.6\text{A (pk)}$                                               | MAX.  | 1.70  | V             |
| $I_{DRM}$ | Off-State Current, Peak Repetitive | $T_J = 25^\circ\text{C} @ V_D = V_{DRM}$<br>$R_{GK} = 1\ \text{k}\Omega$  | MAX.  | 3     | $\mu\text{A}$ |
|           |                                    | $T_J = 125^\circ\text{C} @ V_D = V_{DRM}$<br>$R_{GK} = 1\ \text{k}\Omega$ | MAX.  | 500   | $\mu\text{A}$ |

### Thermal Resistances

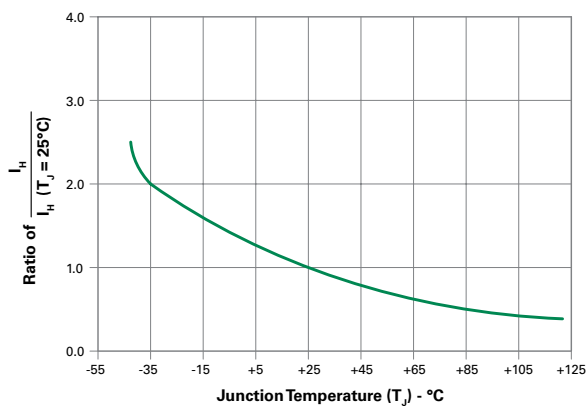
| Symbol           | Description           | Test Conditions                                     |         | Value | Unit |
|------------------|-----------------------|-----------------------------------------------------|---------|-------|------|
| R <sub>θJC</sub> | Junction to case (AC) | I <sub>T</sub> = 0.8A <sub>(RMS)</sub> <sup>1</sup> | TO-92   | 75    | °C/W |
|                  |                       |                                                     | SOT-223 | 30    | °C/W |
|                  |                       |                                                     | SOT-89  | 50    | °C/W |
| R <sub>θJC</sub> | Junction to ambient   | I <sub>T</sub> = 0.8A <sub>(RMS)</sub> <sup>1</sup> | TO-92   | 150   | °C/W |
|                  |                       |                                                     | SOT-223 | 60    | °C/W |
|                  |                       |                                                     | SOT-89  | 90    | °C/W |

<sup>1</sup> 60Hz AC resistive load condition, 100% conduction.

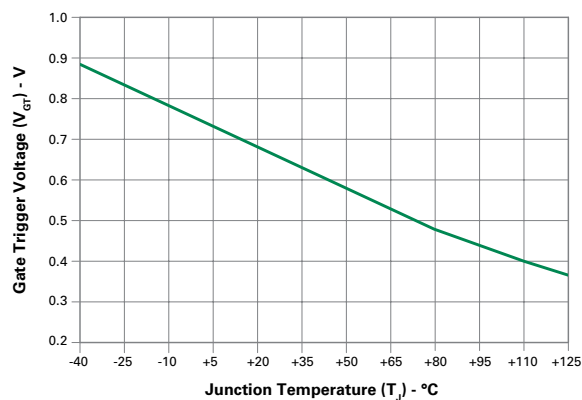
**Figure 1: Normalized DC Gate Trigger Current For All Quadrants vs. Junction Temperature**



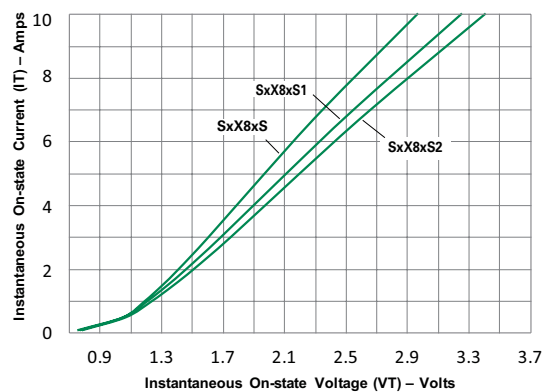
**Figure 2: Normalized DC Holding Current vs. Junction Temperature**



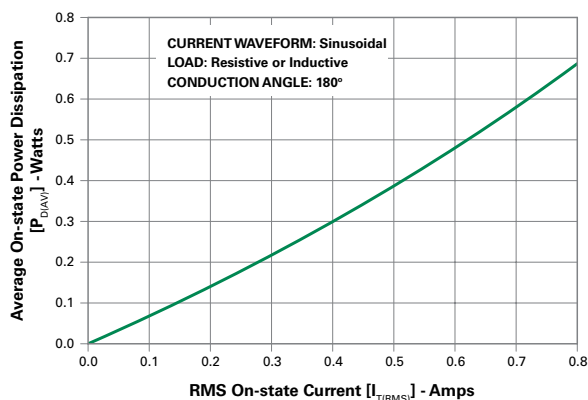
**Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



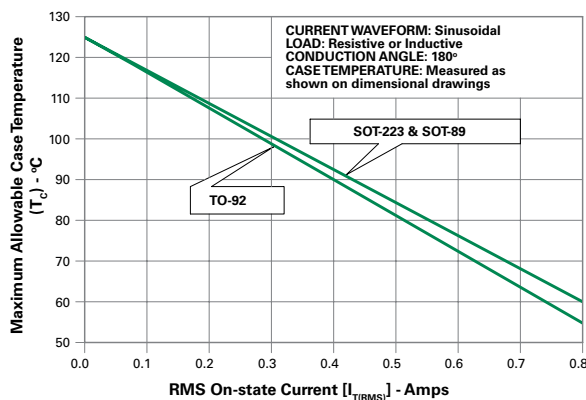
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



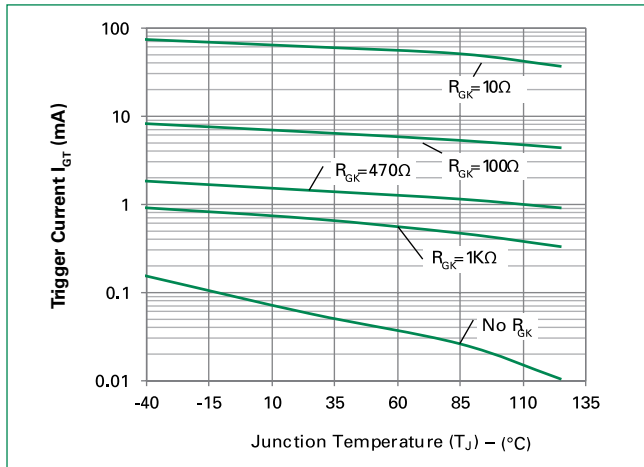
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



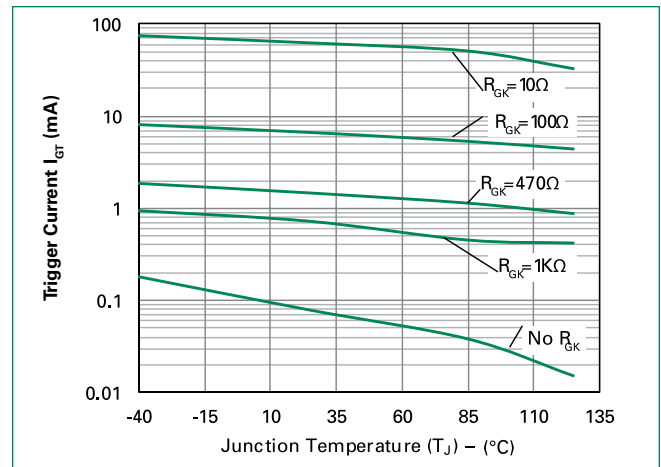
**Figure 6: Maximum Allowable Case Temperature vs. On-State Current**



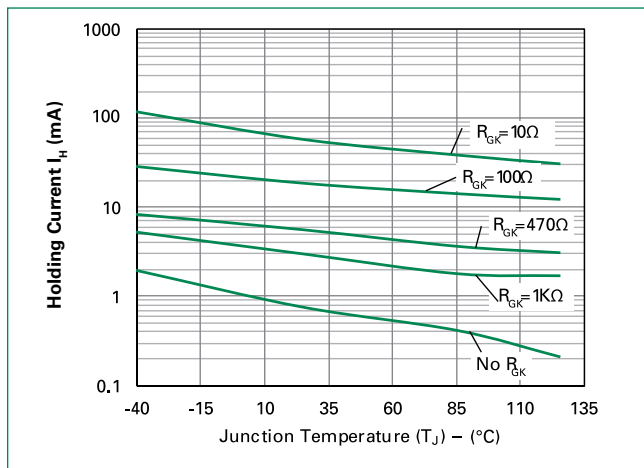
**Figure 7-1: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for S6X8BS**



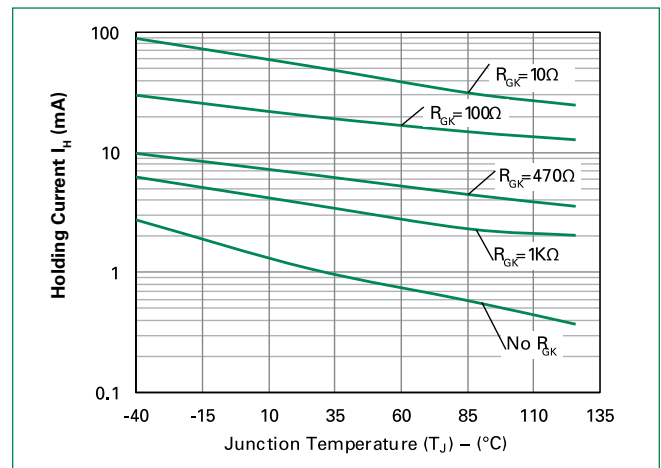
**Figure 7-2: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for S8X8ESRP**



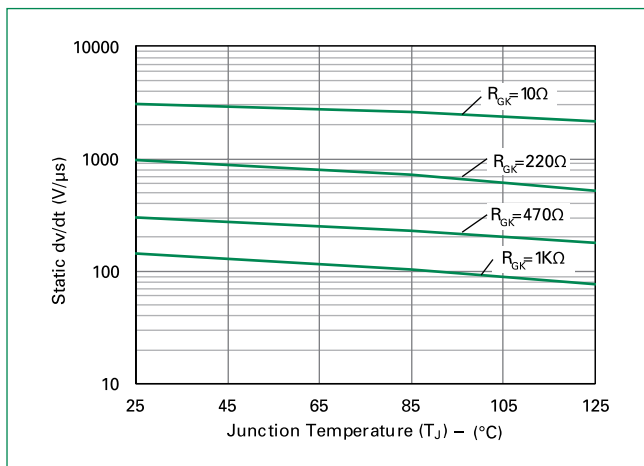
**Figure 8-1: Typical DC Holding Current with  $R_{GK}$  vs. Junction Temperature for S6X8BS**



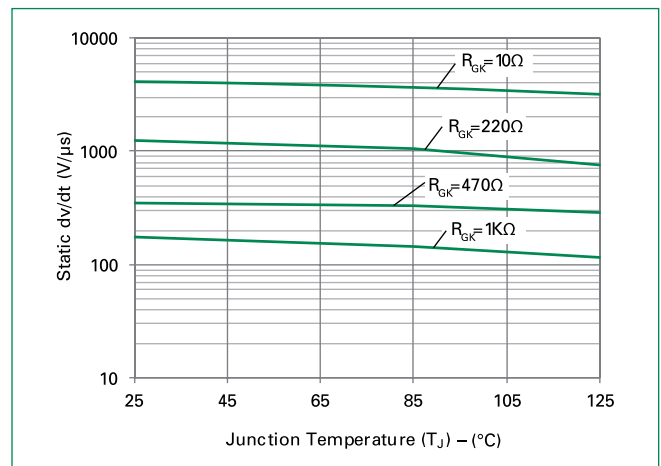
**Figure 7-2: Typical DC Holding Current with  $R_{GK}$  vs. Junction Temperature for S8X8ESRP**



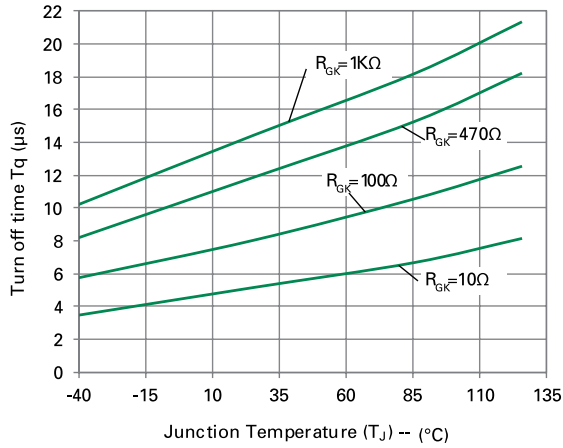
**Figure 9-1: Typical DC Static dv/dt with  $R_{GK}$  vs. Junction Temperature for S6X8BS**



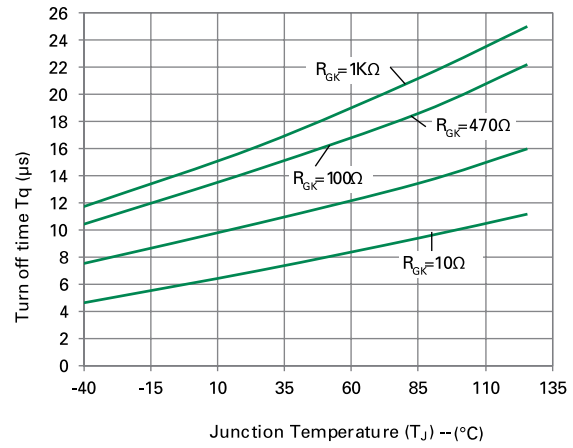
**Figure 9-2: Typical DC Static dv/dt with  $R_{GK}$  vs. Junction Temperature for S8X8ESRP**



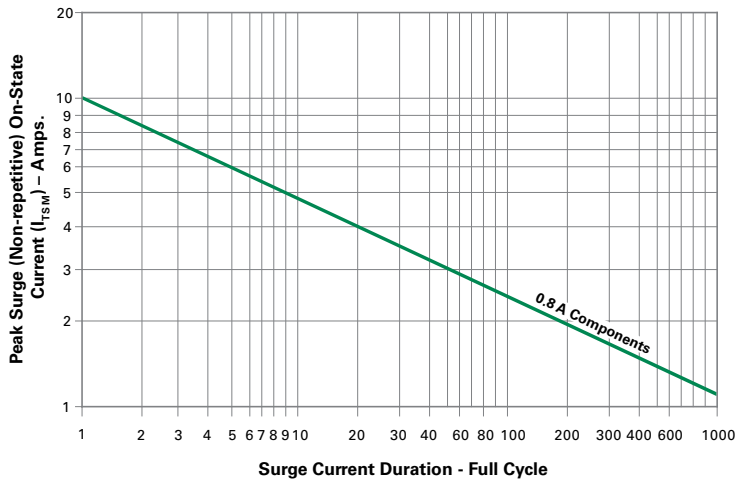
**Figure 10-1: Typical DC turn off time with  $R_{GK}$  vs. Junction Temperature for S6X8BS**



**Figure 10-2: Typical DC turn off time with  $R_{GK}$  vs. Junction Temperature for S8X8ESRP**



**Figure 11: Surge Peak On-State Current vs. Number of Cycles**



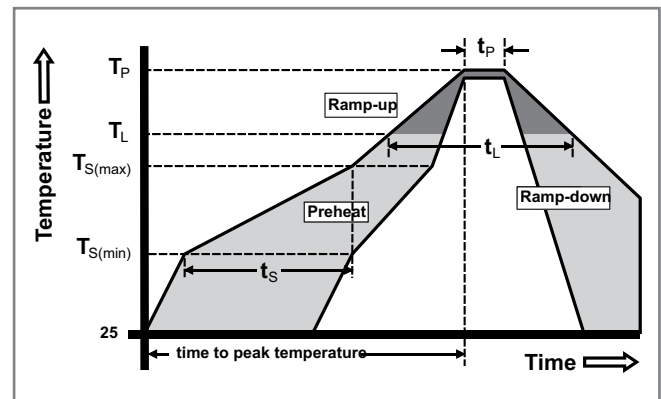
Supply Frequency: 60Hz Sinusoidal  
Load: Resistive  
RMS On-State Current ( $I_{T(RMS)}$ ): Max Rated Value at Specific Case Temperature

**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 (min to max) ( $t_s$ )      | 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                   |



### Additional Information



Datasheet



Resources



Samples

### 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                                           |

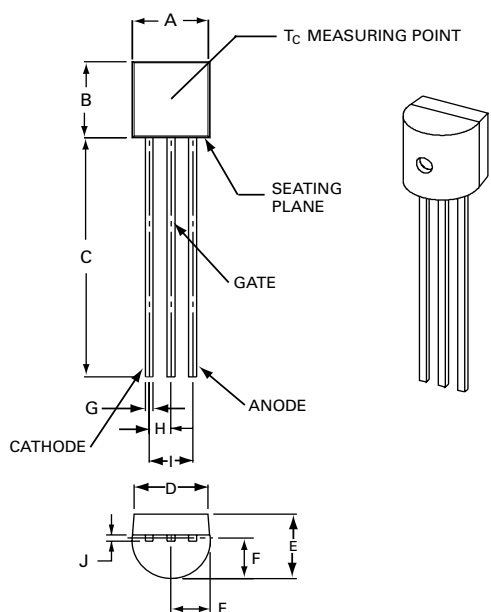
### Design Considerations

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.

### Reliability/Environmental Tests

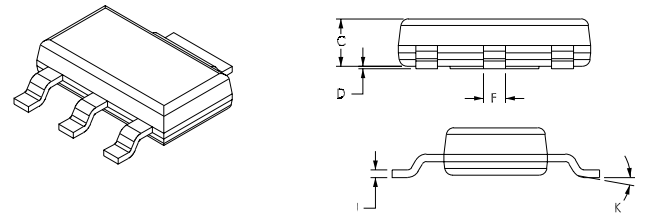
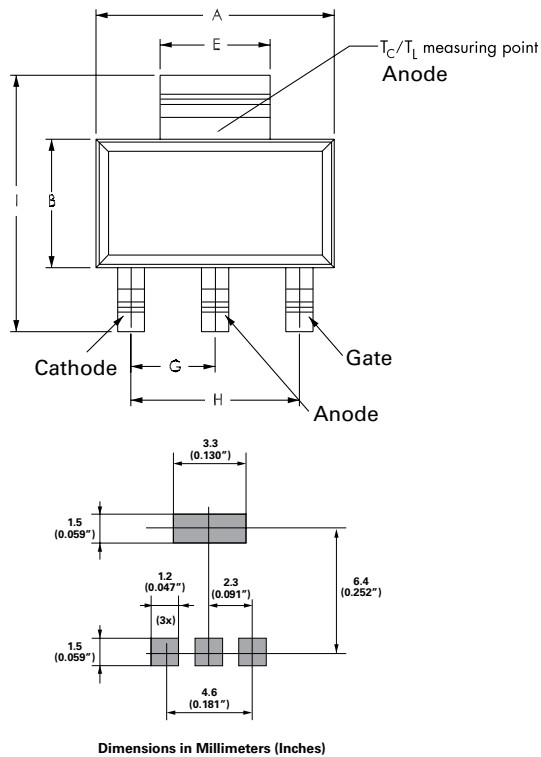
| Test                             | Specifications and Conditions                                              |
|----------------------------------|----------------------------------------------------------------------------|
| <b>AC Blocking</b>               | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 110°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-92



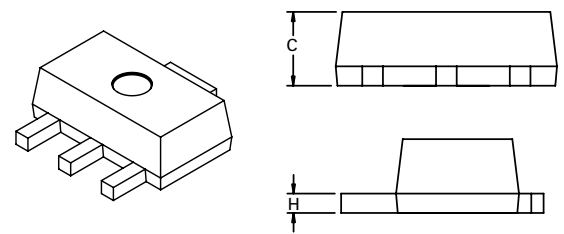
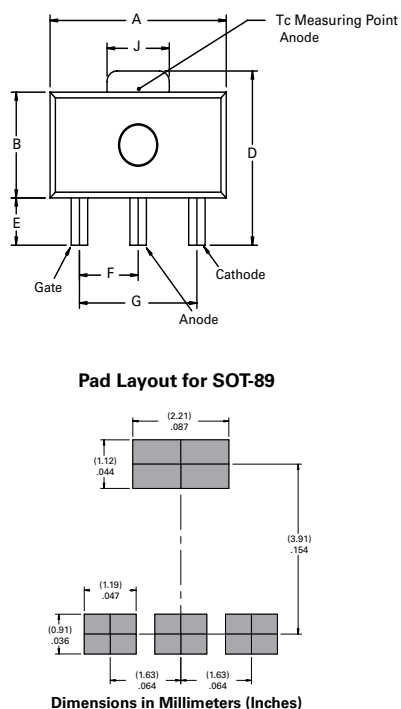
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.175  | 0.205 | 4.450       | 5.200 |
| B         | 0.170  | 0.210 | 4.320       | 5.330 |
| C         | 0.500  |       | 12.70       |       |
| D         | 0.135  |       | 3.430       |       |
| E         | 0.125  | 0.165 | 3.180       | 4.190 |
| F         | 0.080  | 0.105 | 2.040       | 2.660 |
| G         | 0.016  | 0.021 | 0.407       | 0.533 |
| H         | 0.045  | 0.055 | 1.150       | 1.390 |
| I         | 0.095  | 0.105 | 2.420       | 2.660 |
| J         | 0.015  | 0.020 | 0.380       | 0.500 |

### Dimensions – SOT-223



| Dimensions | Inches  |       |       | Millimeters |      |      |
|------------|---------|-------|-------|-------------|------|------|
|            | Min     | Typ   | Max   | Min         | Typ  | Max  |
| A          | 0.248   | 0.256 | 0.264 | 6.30        | 6.50 | 6.70 |
| B          | 0.130   | 0.138 | 0.146 | 3.30        | 3.50 | 3.70 |
| C          | —       | —     | 0.071 | —           | —    | 1.80 |
| D          | 0.001   | —     | 0.004 | 0.02        | —    | 0.10 |
| E          | 0.114   | 0.118 | 0.124 | 2.90        | 3.00 | 3.15 |
| F          | 0.024   | 0.027 | 0.034 | 0.60        | 0.70 | 0.85 |
| G          | —       | 0.090 | —     | —           | 2.30 | —    |
| H          | —       | 0.181 | —     | —           | 4.60 | —    |
| I          | 0.264   | 0.276 | 0.287 | 6.70        | 7.00 | 7.30 |
| J          | 0.009   | 0.010 | 0.014 | 0.24        | 0.26 | 0.35 |
| K          | 10° MAX |       |       |             |      |      |

### Dimensions – SOT-89



| Dimension | Inches |     |       | Millimeters |     |      |
|-----------|--------|-----|-------|-------------|-----|------|
|           | Min    | Typ | Max   | Min         | Typ | Max  |
| A         | 0.173  | —   | 0.181 | 4.40        | —   | 4.60 |
| B         | 0.090  | —   | 0.102 | 2.29        | —   | 2.60 |
| C         | 0.055  | —   | 0.063 | 1.40        | —   | 1.60 |
| D         | 0.155  | —   | 0.167 | 3.94        | —   | 4.25 |
| E         | 0.035  | —   | 0.047 | 0.89        | —   | 1.20 |
| F         | 0.056  | —   | 0.062 | 1.42        | —   | 1.57 |
| G         | 0.115  | —   | 0.121 | 2.92        | —   | 3.07 |
| H         | 0.014  | —   | 0.017 | 0.35        | —   | 0.44 |
| I         | 0.014  | —   | 0.019 | 0.36        | —   | 0.48 |
| J         | 0.064  | —   | 0.072 | 1.62        | —   | 1.83 |

### Product Selector

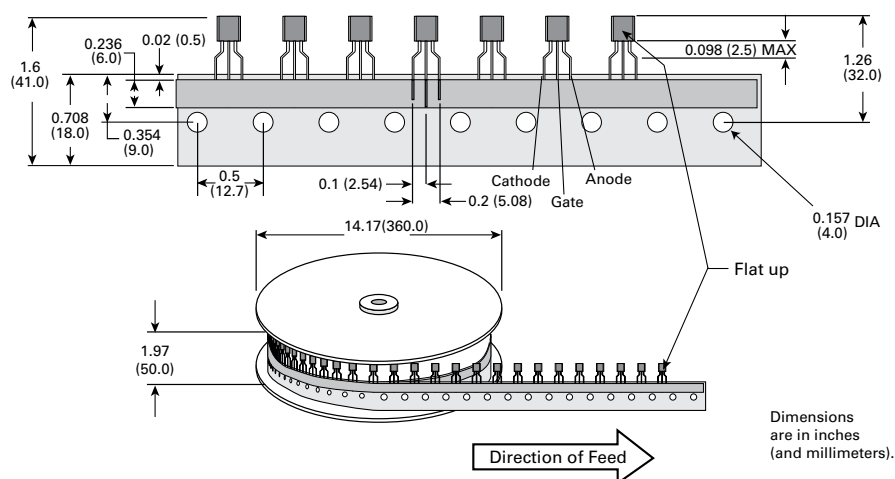
| Part Number | Voltage |      |      | Gate Sensitivity | Package |
|-------------|---------|------|------|------------------|---------|
|             | 400V    | 600V | 800V |                  |         |
| S4X8ES      | X       | —    | —    | 200 $\mu$ A      | TO-92   |
| S6X8ES      | —       | X    | —    | 200 $\mu$ A      | TO-92   |
| S8X8ES      | —       | —    | X    | 200 $\mu$ A      | TO-92   |
| S4X8TS      | X       | —    | —    | 200 $\mu$ A      | SOT-223 |
| S6X8TS      | —       | X    | —    | 200 $\mu$ A      | SOT-223 |
| S8X8TS      | —       | —    | X    | 200 $\mu$ A      | SOT-223 |
| S4X8BS      | X       | —    | —    | 200 $\mu$ A      | SOT-89  |
| S6X8BS      | —       | X    | —    | 200 $\mu$ A      | SOT-89  |
| S4X8ES1     | X       | —    | —    | 5 $\mu$ A        | TO-92   |
| S6X8ES1     | —       | X    | —    | 5 $\mu$ A        | TO-92   |
| S8X8ES1     | —       | —    | X    | 5 $\mu$ A        | TO-92   |
| S4X8TS1     | X       | —    | —    | 5 $\mu$ A        | SOT-223 |
| S6X8TS1     | —       | X    | —    | 5 $\mu$ A        | SOT-223 |
| S8X8TS1     | —       | —    | X    | 5 $\mu$ A        | SOT-223 |
| S4X8ES2     | X       | —    | —    | 50 $\mu$ A       | TO-92   |
| S6X8ES2     | —       | X    | —    | 50 $\mu$ A       | TO-92   |
| S8X8ES2     | —       | —    | X    | 50 $\mu$ A       | TO-92   |
| S4X8TS2     | X       | —    | —    | 50 $\mu$ A       | SOT-223 |
| S6X8TS2     | —       | X    | —    | 50 $\mu$ A       | SOT-223 |
| S8X8TS2     | —       | —    | X    | 50 $\mu$ A       | SOT-223 |

### Packing Options

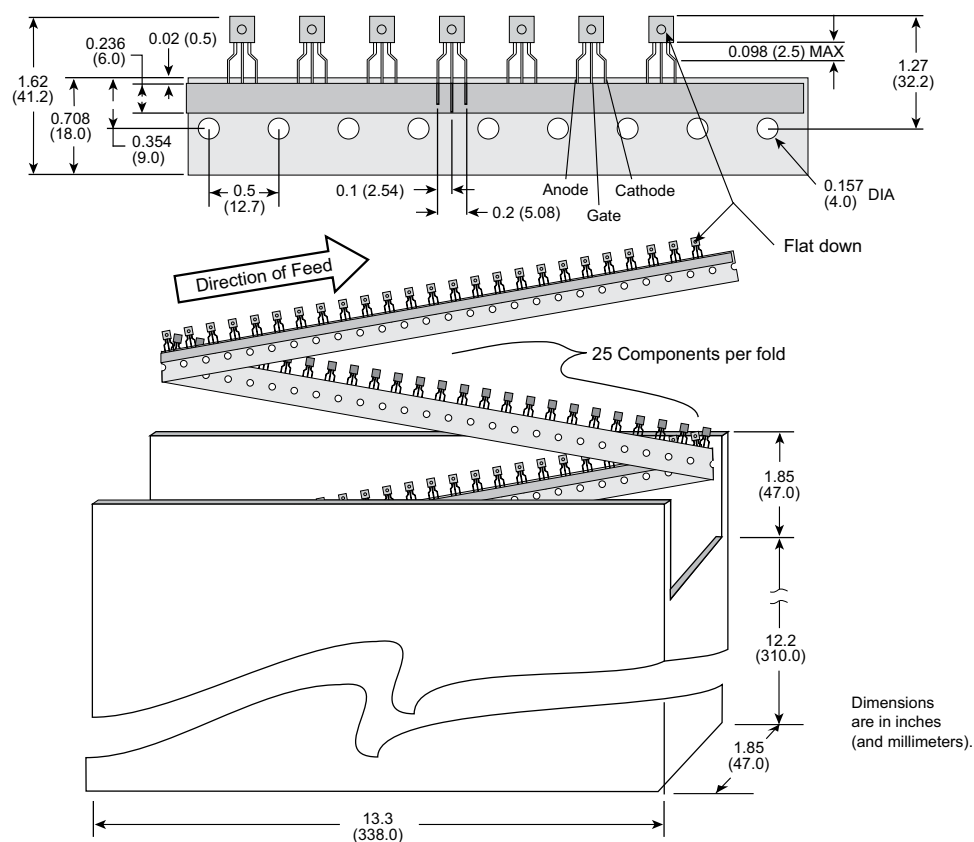
| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|-------------|---------|--------|--------------|---------------|
| SxX8ESy     | SxX8ESy | 0.217g | Bulk         | 2500          |
| SxX8ESyAP   | SxX8ESy | 0.217g | Ammo Pack    | 2000          |
| SxX8ESyRP   | SxX8ESy | 0.217g | Tape & Reel  | 2000          |
| SxX8TSyRP   | SxX8TSy | 0.120g | Tape & Reel  | 1000          |
| SxX8BSRP    | xX8     | 0.053g | Tape & Reel  | 1000          |
| SxX8BSRP1   | xX8     | 0.053g | Tape & Reel  | 1000          |

Note: x = voltage/100, y = gate sensitivity

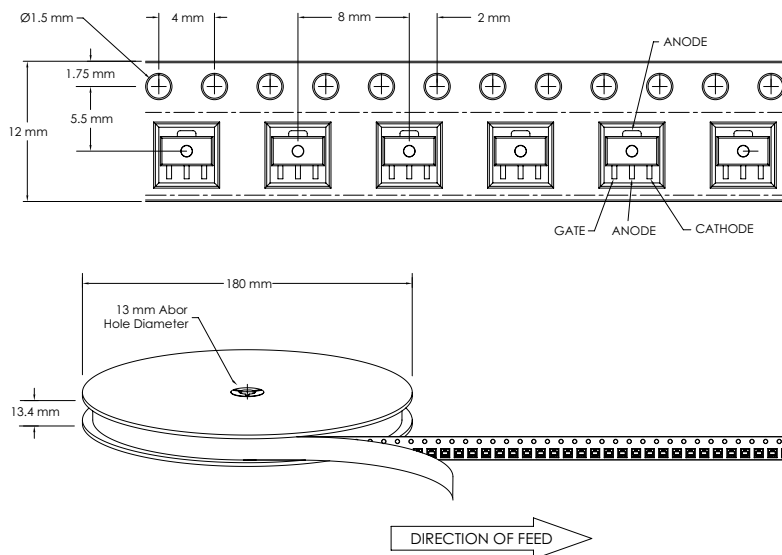
## Meets all EIA-468-C Standards



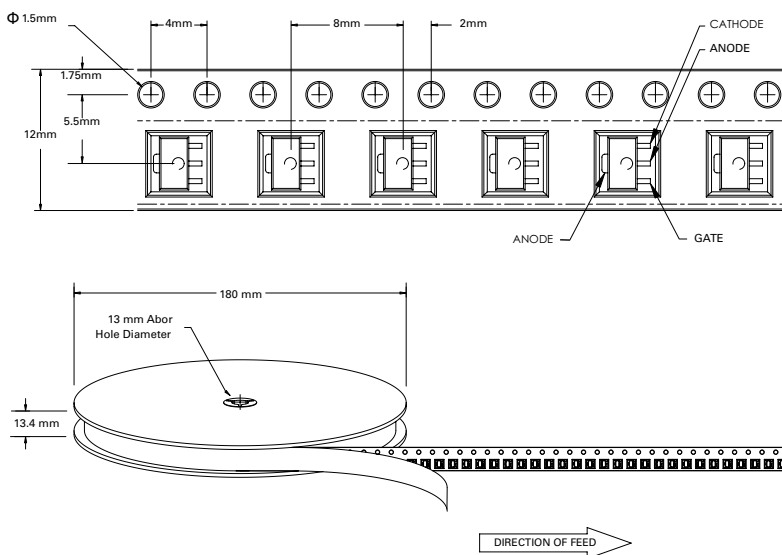
## Meets all EIA-468-C Standards



### SOT-89 Reel Pack (RP) Specifications



### SOT-89 Reel Pack (RP1) Specifications



Technical drawings of the 128Kbit EPROM package. The top drawing is a side view showing dimensions: 12 mm height, 1.75 mm pin pitch, 5.5 mm body height, and 4 mm, 8 mm, and 2 mm segment lengths. It also shows pin labels K, A, and GATE. The bottom drawing is a top view showing a 180 mm diameter and a 13 mm bore hole diameter.

**S x X8 x x x x x x**

**SERIES**  
S: SCR

**VOLTAGE**  
4: 400V  
6: 600V  
8: 800V

**CURRENT**  
X8: 0.8A

**PACKING TYPE**  
**Blank:** Bulk Pack  
**RP:** Reel Pack (TO-92)  
Embossed Carrier Pack (SOT-223)  
Embossed Carrier Pack (SOT-89)  
**RP1:** Embossed Carrier Pack (SOT-89)  
(alternate orientation)  
**AP:** Ammo Pack (TO-92)

**SENSITIVITY & TYPE**  
**S1:** 5 $\mu$ A Sensitive SCR  
**S2:** 50 $\mu$ A Sensitive SCR  
**S:** 200 $\mu$ A Sensitive SCR

**PACKAGE TYPE**  
**E:** TO-92  
**T:** SOT-223  
**B:** SOT-89

Diagram illustrating three types of Littelfuse YMLDD components:

- SOT89**: A small, rectangular component with four pins.
- SOT223**: A small, rectangular component with three pins.
- TO-92**: A small, rectangular component with three leads.

The components are labeled with the following information:

- LINE1**: Littelfuse Part Number
- LINE2**: continuation...Littelfuse Part Number
- Y**: Last Digit of Calendar Year
- M**: Letter Month Code (A-L for Jan-Dec)
- L**: Location Code
- DD**: Calendar Date