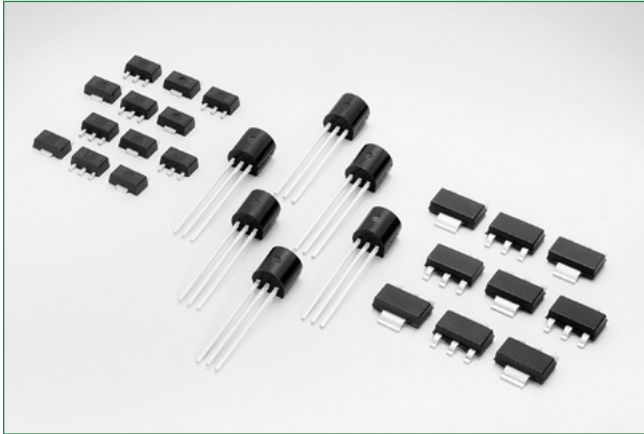


# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

HF RoHS

### Description

This new 1.5A sensitive gate SCR component series offers high static dv/dt and low turn-off time (t<sub>q</sub>) All SCR junctions are glass-passivated to ensure long term reliability and parametric stability.

### Features

- Surge capability > 15Amps
- Blocking voltage (V<sub>DRM</sub>/V<sub>RRM</sub>) capability — up to 600V
- High dv/dt noise immunity
- Improved turn-off time (t<sub>q</sub>) < 35 μsec.
- Sensitive gate for direct microprocessor interface
- Thru hole and surface mount packages
- RoHS compliant and Halogen-Free

### Additional Information



Resources



Accessories



Samples

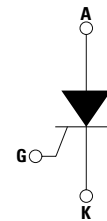
### Main Features

| Symbol                             | Value      | Unit |
|------------------------------------|------------|------|
| I <sub>T(RMS)</sub>                | 1.5        | A    |
| V <sub>DRM</sub> /V <sub>RRM</sub> | 400 or 600 | V    |
| I <sub>GT</sub>                    | 200        | μA   |

### Applications

The Sx02xSx EV series is specifically designed for solenoid drive often seen in GFCI and similar safety cut-off devices.

### Schematic Symbol



### Absolute Maximum Ratings

| Symbol              | Parameter  | Value  | Unit                     |
|---------------------|--|--|--------------------------|
| I <sub>T(RMS)</sub> | RMS on-state current (full sine wave)  | TO-92<br>T <sub>c</sub> = 65°C                       | 1.5<br>A                 |
|                     |  | SOT-89<br>T <sub>c</sub> = 80°C                      |                          |
|                     |  | SOT-223<br>T <sub>c</sub> = 95°C                     |                          |
| I <sub>T(AV)</sub>  | Average on-state current   | TO-92<br>T <sub>c</sub> = 65°C                       | 0.95<br>A                |
|                     |  | SOT-89<br>T <sub>c</sub> = 80°C                      |                          |
|                     |  | SOT-223<br>T <sub>c</sub> = 95°C                     |                          |
| I <sub>TSM</sub>    | Non repetitive surge peak on-state current (Single cycle, T <sub>j</sub> initial = 25°C) | TO-92<br>F = 50 Hz                                   | 12.5<br>A                |
|                     |  | SOT-89<br>F = 60 Hz                                  |                          |
|                     |  | SOT-223<br>F = 60 Hz                                 |                          |
| I <sup>2</sup> t    | I <sup>2</sup> t Value for fusing  | t <sub>p</sub> = 10 ms<br>F = 50 Hz                  | 0.78<br>A <sup>2</sup> s |
|                     |  | t <sub>p</sub> = 8.3 ms<br>F = 60 Hz                 |                          |
| di/dt               | Critical rate of rise of on-state current I <sub>G</sub> = 10mA                          | TO-92<br>SOT-89<br>SOT-223<br>T <sub>j</sub> = 125°C | 50<br>A/μs               |
| I <sub>GM</sub>     | Peak gate current  | t <sub>p</sub> = 10 μs<br>T <sub>j</sub> = 125°C     | 1.0<br>A                 |
| P <sub>G(AV)</sub>  | Average gate power dissipation   | T <sub>j</sub> = 125°C                               | 0.1<br>W                 |
| T <sub>stg</sub>    | Storage junction temperature range   |  | -40 to 150<br>°C         |
| T <sub>j</sub>      | Operating junction temperature range   |  | -40 to 125<br>°C         |

# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

### Electrical Characteristics (T<sub>J</sub> = 25°C, unless otherwise specified)

| Symbol               | Description                                  | Test Conditions  | Sx02xS |     | Sx02xS1 |     | Sx02xS2 |     | Units |
|----------------------|--|--|--------|-----|---------|-----|---------|-----|-------|
|                      |  |  | Min    | Max | Min     | Max | Min     | Max |       |
| I <sub>GT</sub>      | DC Gate Trigger Current                      | V <sub>D</sub> = 12V; R <sub>L</sub> = 60 Ω  | 15     | 200 | 15      | 100 | 15      | 50  | μA    |
| V <sub>GT</sub>      | DC Gate Trigger Voltage                      | V <sub>D</sub> = 12V; R <sub>L</sub> = 60 Ω  | —      | 0.8 | —       | 0.8 | —       | 0.8 | V     |
| V <sub>GRRM</sub>    | Peak Reverse Gate Voltage                    | I <sub>RG</sub> = 10μA   | 5      | —   | 5       | —   | 5       | —   | V     |
| I <sub>H</sub>       | Holding Current                              | R <sub>GK</sub> = 1 kΩ   | —      | 5   | —       | 3   | —       | 3   | mA    |
| (dv/dt) <sub>s</sub> | "Critical Rate-of-Rise of Off-State Voltage" | "T <sub>J</sub> = 125°C<br>V <sub>D</sub> = V <sub>DRM</sub> / V <sub>RRM</sub><br>Exponential Waveform<br>R <sub>GK</sub> = 1 kΩ" | 25     | —   | 25      | —   | 25      | —   | V/μs  |
| t <sub>q</sub>       | Turn-Off Time                                | "T <sub>J</sub> = 125°C @ 600 V<br>R <sub>GK</sub> = 1 kΩ"   | —      | 35  | —       | 35  | —       | 35  | μs    |
| t <sub>gt</sub>      | Turn-On Time                                 | "I <sub>G</sub> = 10mA<br>PW = 15μsec<br>I <sub>T</sub> = 3.0A (pk)"   | —      | 3   | —       | 3   | —       | 3   | μs    |
| V <sub>GD</sub>      | Gate Non-Trigger Voltage                     | "V <sub>D</sub> = V <sub>DRM</sub> , T <sub>J</sub> = 125°C,<br>R <sub>L</sub> = 3.3kΩ"  | 0.2    | —   | 0.2     | —   | 0.2     | —   | V     |

x0 = voltage/10

### Static Characteristics (T<sub>J</sub> = 25°C, unless otherwise specified)

| Symbol           | Description                        | Test Conditions  | Value |      | Unit |
|------------------|------------------------------------|--|-------|------|------|
|                  |                                    |  | Min   | Max  |      |
| V <sub>TM</sub>  | Peak On-State Voltage              | I <sub>TM</sub> = 3.0A (pk)  | —     | 1.70 | V    |
| I <sub>DRM</sub> | Off-State Current, Peak Repetitive | T <sub>J</sub> = 25°C @ V <sub>D</sub> = V <sub>DRM</sub><br>R <sub>GK</sub> = 1 kΩ  | —     | 5    | μA   |
|                  |                                    | T <sub>J</sub> = 125°C @ V <sub>D</sub> = V <sub>DRM</sub><br>R <sub>GK</sub> = 1 kΩ | —     | 500  | μA   |

### Thermal Resistances

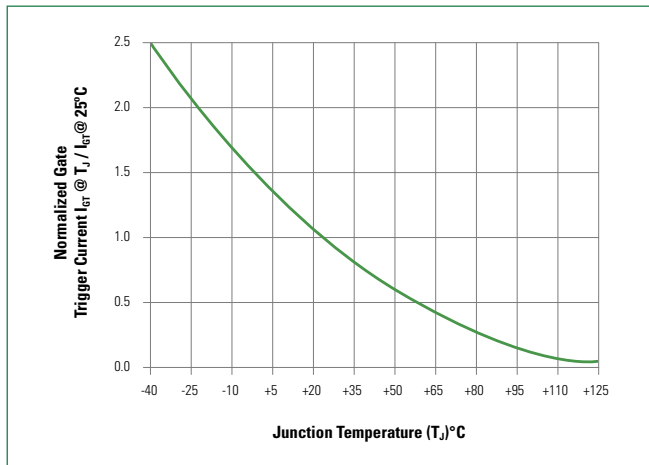
| Symbol              | Parameter             | Test Conditions                                     | Value   | Unit |      |
|---------------------|-----------------------|---|---------|------|------|
| R <sub>θ(J-C)</sub> | Junction to case (AC) | I <sub>T</sub> = 1.5A <sub>(RMS)</sub> <sup>1</sup> | TO-92   | 50   | °C/W |
|                     |                       |   | SOT-89  | 35   |      |
|                     |                       |   | SOT-223 | 25   |      |
| R <sub>θ(J-A)</sub> | Junction to ambient   | I <sub>T</sub> = 1.5A <sub>(RMS)</sub> <sup>1</sup> | TO-92   | 160  | °C/W |
|                     |                       |   | SOT-89  | 90   |      |
|                     |                       |   | SOT-223 | 60   |      |

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

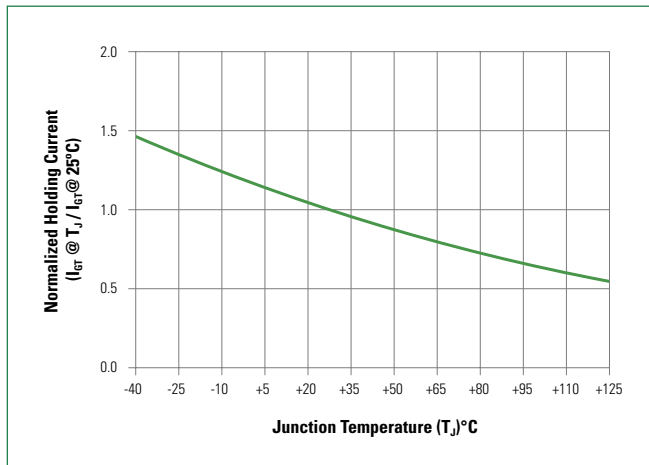
# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

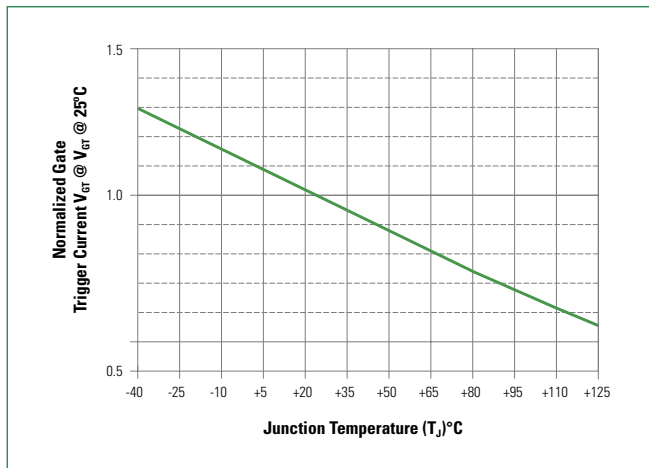
**Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature**



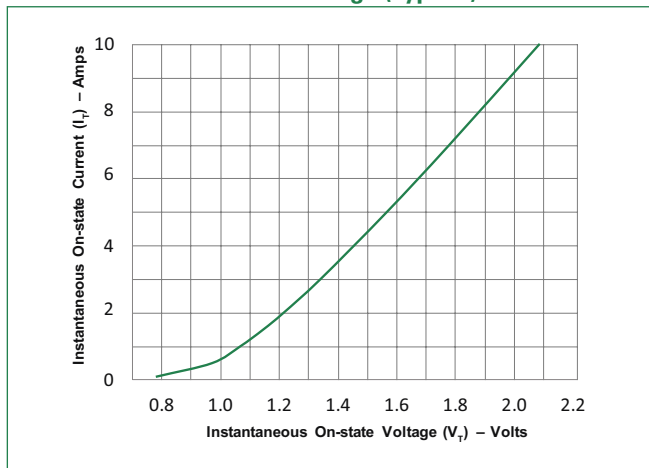
**Figure 2: Normalized DC Holding Current vs. Junction Temperature**



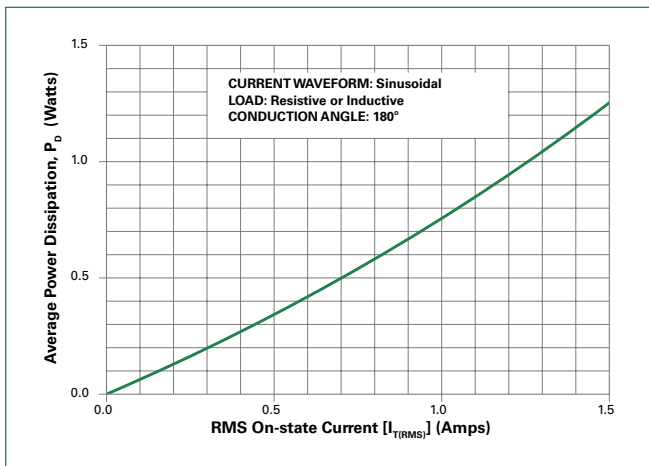
**Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



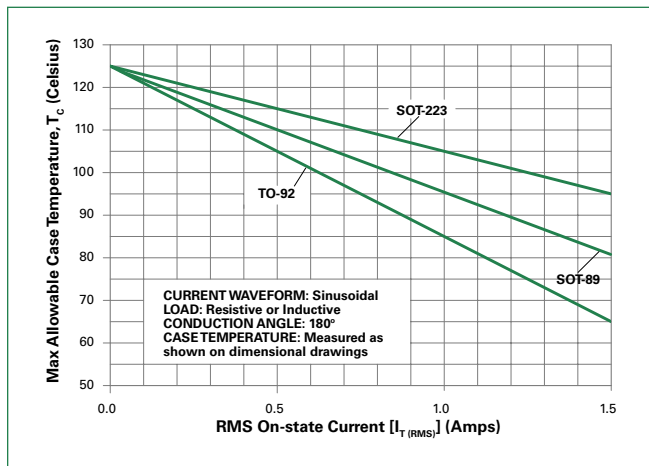
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



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



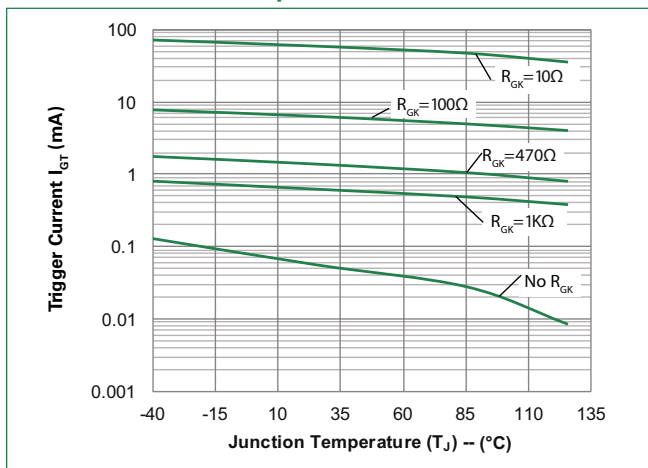
**Figure 6: Maximum Allowable Case Temperature vs. On-State Current**



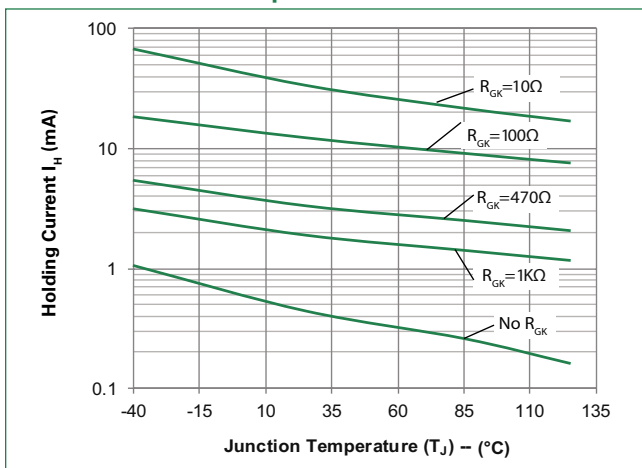
# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

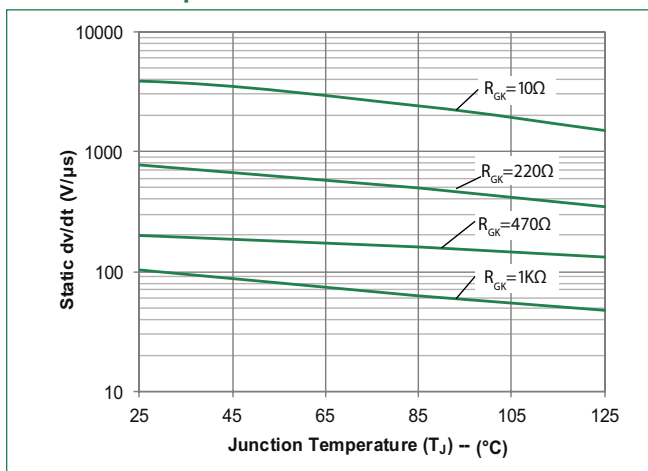
**Figure 7: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for Sx02xS**



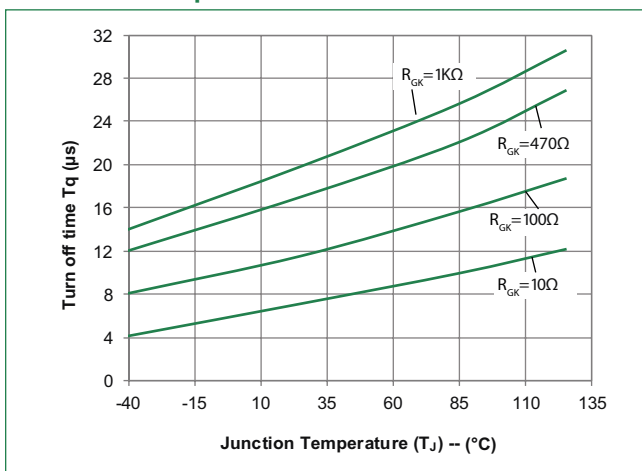
**Figure 8: Typical DC Holding Current with  $R_{GK}$  vs. Junction Temperature for Sx02xS**



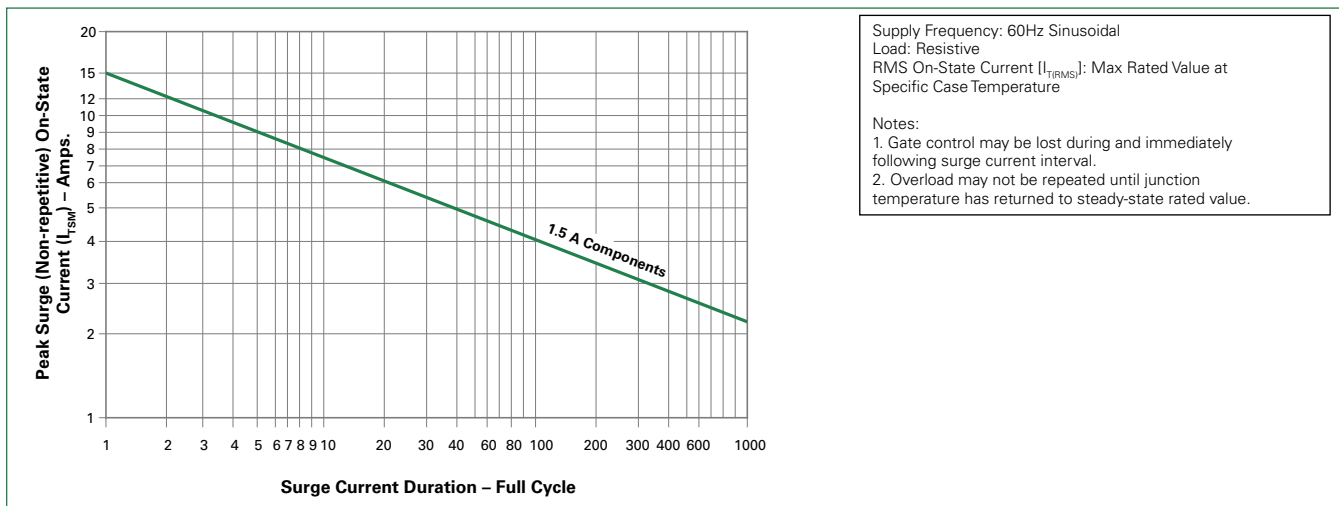
**Figure 9: Typical Static dv/dt with  $R_{GK}$  vs. Junction Temperature for Sx02xS**



**Figure 10: Typical turn off time with  $R_{GK}$  vs. Junction Temperature for Sx02xS**



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

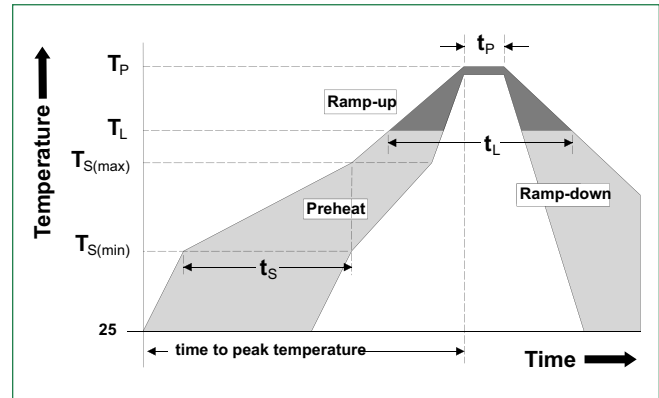


# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

### 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                   |
|  | - Time (min to max) ( $t_s$ )      | 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 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.

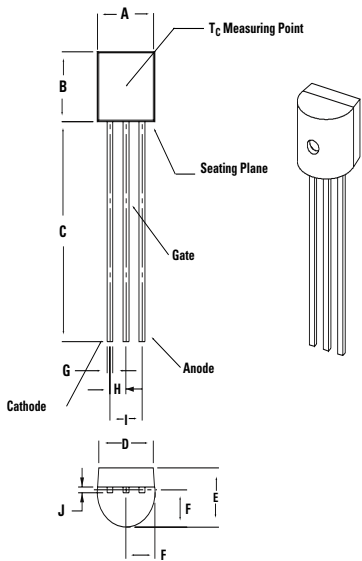
### Environmental Specifications

| Test                             | Specifications and Conditions  |
|----------------------------------|--|
| <b>AC Blocking</b>               | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 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; 160V - DC; 85°C; 85% rel humidity     |
| <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   |

# Sx02xSx EV Series

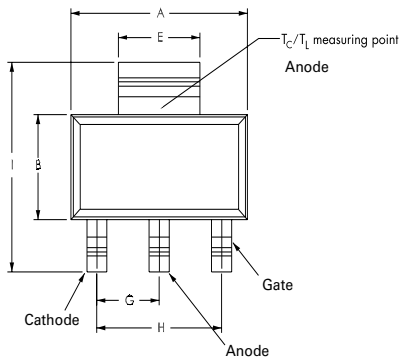
## EV Series 1.5 Amp Sensitive SCRs

### Dimensions – TO-92 (E Package)

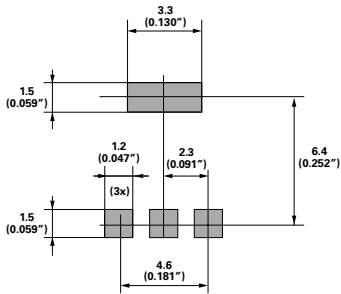


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| <b>A</b>   | 0.175  | 0.205 | 4.450       | 5.200 |
| <b>B</b>   | 0.170  | 0.210 | 4.320       | 5.330 |
| <b>C</b>   | 0.500  | —     | 12.700      | —     |
| <b>D</b>   | 0.135  | —     | 3.430       | —     |
| <b>E</b>   | 0.125  | 0.165 | 3.180       | 4.190 |
| <b>F</b>   | 0.080  | 0.105 | 2.040       | 2.660 |
| <b>G</b>   | 0.016  | 0.021 | 0.407       | 0.533 |
| <b>H</b>   | 0.045  | 0.055 | 1.150       | 1.390 |
| <b>I</b>   | 0.095  | 0.105 | 2.420       | 2.660 |
| <b>J</b>   | 0.015  | 0.020 | 0.380       | 0.500 |

### Dimensions – SOT-223



Pad Layout for SOT-223



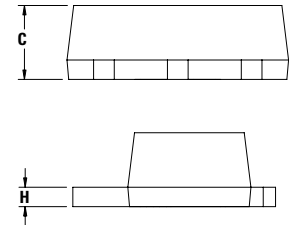
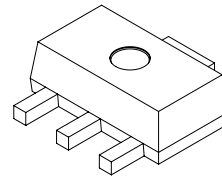
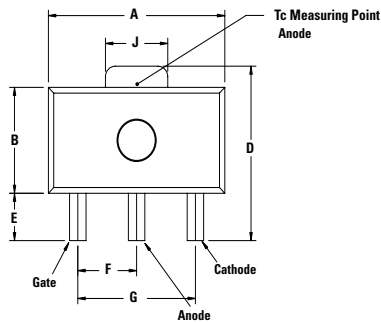
Dimensions in Millimeters (Inches)

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

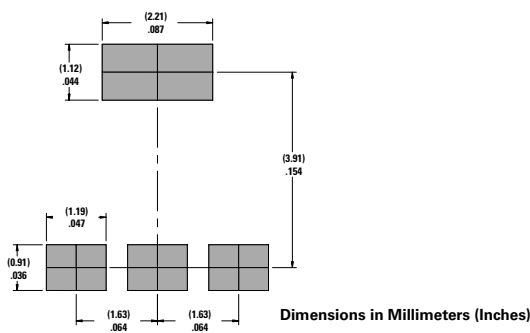
# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

### Dimensions – SOT-89



Pad Layout for 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 Numbr | Voltage |      | Gate Sensitivity | Package |
|------------|---------|------|------------------|---------|
|            | 400V    | 600V |                  |         |
| Sx02BS     | X       | X    | 200 $\mu$ A      | SOT-89  |
| Sx02ES     | X       | X    | 200 $\mu$ A      | TO-92   |
| Sx02TS     | X       | X    | 200 $\mu$ A      | SOT-223 |
| Sx02BS1    | X       | X    | 100 $\mu$ A      | SOT-89  |
| Sx02ES1    | X       | X    | 100 $\mu$ A      | TO-92   |
| Sx02TS1    | X       | X    | 100 $\mu$ A      | SOT-223 |
| Sx02BS2    | —       | X    | 50 $\mu$ A       | SOT-89  |

Note: x = voltage/100

### Packing Options

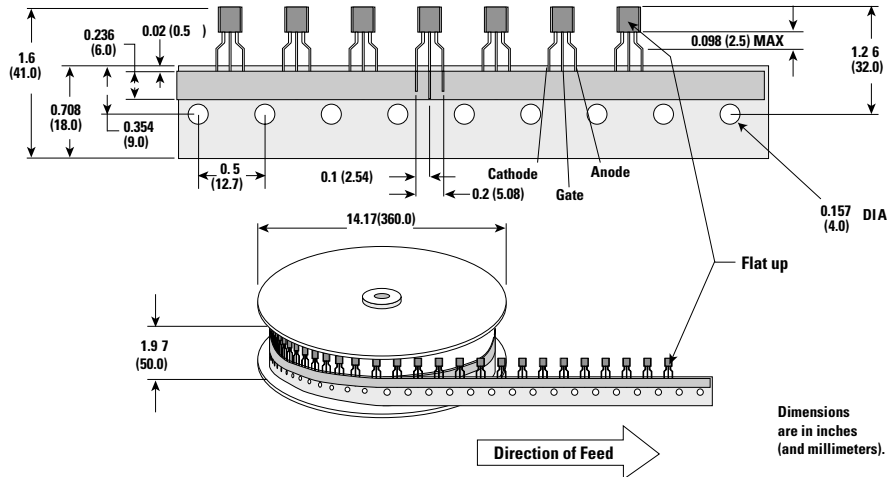
| Part Number | Marking | Weight  | Packing Mode | Base Quantity |
|-------------|---------|---------|--------------|---------------|
| Sx02ESy     | Sx02ESy | 0.217 g | Bulk         | 2500          |
| Sx02ESyAP   | Sx02ESy | 0.217 g | Ammo Pack    | 2000          |
| Sx02ESyRP   | Sx02ESy | 0.217 g | Tape & Reel  | 2000          |
| Sx02TSyRP   | Sx02TSy | 0.120 g | Tape & Reel  | 1000          |
| Sx02BSyRP   | x02y    | 0.053 g | Tape & Reel  | 1000          |
| Sx02BSyRP1  | x02y    | 0.053 g | Tape & Reel  | 1000          |

# Sx02xSx EV Series

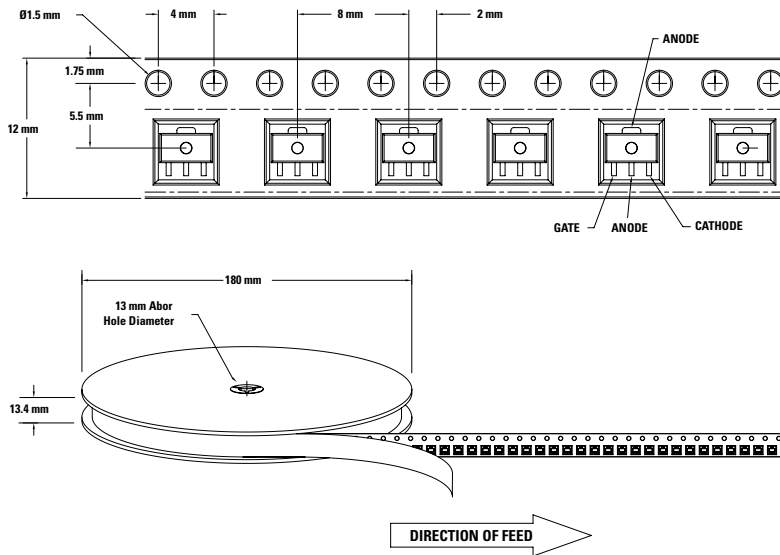
## EV Series 1.5 Amp Sensitive SCRs

### TO-92 (3-lead) Reel Pack (RP) Radial Leaded Specifications

Meets all EIA-468-C Standards



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

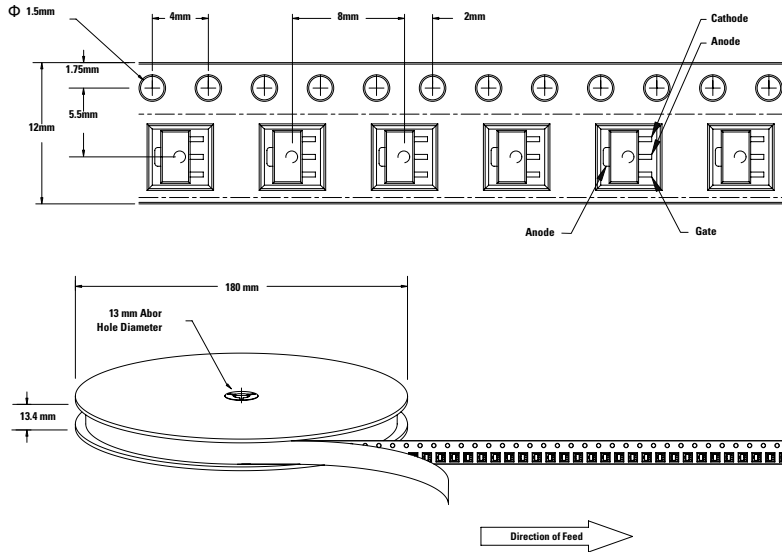




# Sx02xSx EV Series

## EV Series 1.5 Amp Sensitive SCRs

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



### TO-92 (3-lead) Ammo Pack (AP) Radial Leaded Specifications

Meets all EIA-468-C Standards

