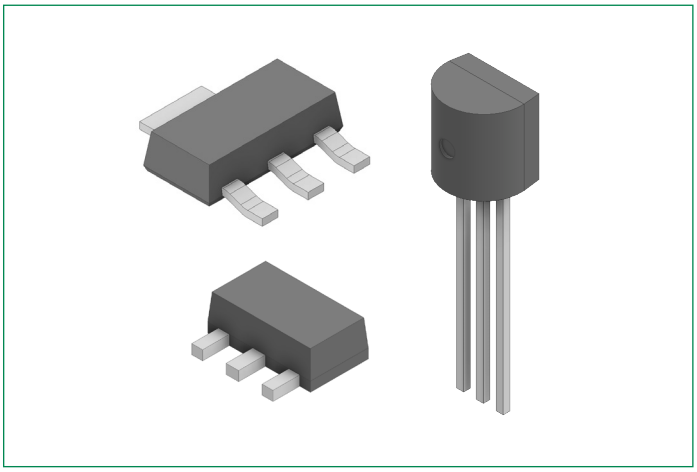
# SxX8xSx EV Series

## 0.8 A Sensitive SCRs

HF RoHS



## Description:

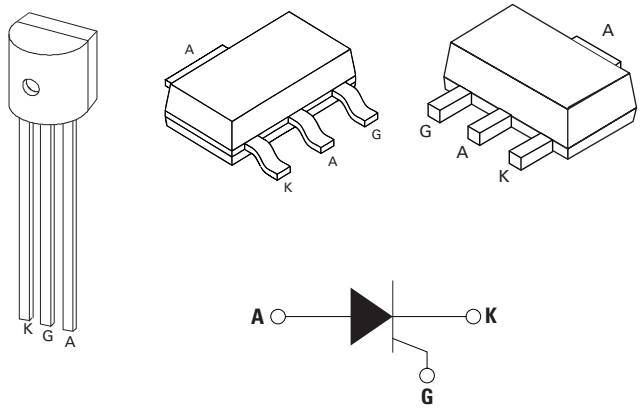
This new component series offers high static dv/dt and low turn off time ($t_q$) sensitive SCR. It is specifically designed for Ground Fault Circuit Interrupter (GFCI) and gas ignition applications. All SCR junctions are glass-passivated to ensure long term reliability and parametric stability.

## Features:

- RoHS compliant and halogen-free
- Through-hole and surface mount packages
- Blocking voltage ($V_{DRM}$ / $V_{RRM}$) capability up to 800 V
- High dv/dt noise immunity
- Surge current capability > 10 A
- Improved turn-off time ($t_q$) < 25 µs
- Sensitive gate for direct microprocessor interface

## Pinout Diagram

TO-92 SOT-223 SOT-89




## Applications:

- Ground Fault Circuit Interuppter (GFCI) applications
- Gas ignition applications

## Product Summary

| Characteristic | Value | Unit |
|---|---|---|
| $I_{T(RMS)}$ | 0.8 | A |
| $V_{DRM}$/ $V_{RRM}$ | 400, 600, or 800 | V |
| $I_{GT(Q1)}$ | 5 to 450 | µA |

**A**: Anode; **K**: Cathode; **G**: Gate




Revised: TK.06/28/2024

## Maximum Ratings

| Symbol | Characteristics | Conditions | | | Value | Units |
|---|---|---|---|---|---|---|
| $I_{T(RMS)}$ | On-state RMS Current | TO-92 | | $T_C$ = 55 °C | 0.8 | A |
| | | SOT-89 | | $T_C$ = 60 °C | | |
| | | SOT-223 | | $T_L$ = 60 °C | | |
| $I_{T(AV)}$ | Average On-state Current | TO-92 | | $T_C$ = 55 °C | 0.51 | A |
| | | SOT-89 | | $T_C$ = 60 °C | | |
| | | SOT-223 | | $T_L$ = 60 °C | | |
| $I_{TSM}$ | Non-repetitive Surge Peak On-state Current | TO-92 SOT-89 SOT-223 | f = 50 Hz, t = 20 ms | $T_{vj}$ initial = 25 °C, single cycle | 8 | A |
| | | | f = 60 Hz, t = 16.7 ms | | 10 | |
| $I^2t$ | $I^2t$ Value for Fusing | $t_p$ = 10 ms | | f = 50 Hz | 0.32 | $A^2s$ |
| | | $t_p$ = 8.3 ms | | f = 60 Hz | 0.41 | |
| di/dt | Critical Rate of Rise of On-state Current | TO-92 SOT-89 SOT-223 | | $I_G$ = 10 mA, $T_{vj}$ = 125 °C | 50 | A/µs |
| $I_{GM}$ | Peak Gate Current | $t_p$ = 10 µs | | $T_{vj}$ = 125 °C | 1 | A |
| $P_{G(AV)}$ | Average Gate Power Dissipation | $T_{vj}$ = 125 °C | | | 1 | W |
| $T_{stg}$ | Storage Temperature Range | – | | | –40 to 150 | °C |
| $T_{vj}$ | Virtual Junction Temperature Range | – | | | –40 to 125 | °C |

## Electrical Characteristics ($T_{vj}$ = 25 °C, unless otherwise specified)

| Symbol | Characteristics | Conditions | Limit | Value | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | SxX8yS1 | SxX8yS2 | SxX8yS | SxX8yS3 | |
| $I_{GT}$ | DC Gate Trigger Current | $V_D$ = 6 V, $R_L$ = 100 Ω | Min. | 0.5 | 1 | 15 | 70 | µA |
| | | | Max. | 5 | 50 | 200 | 450 | |
| $V_{GT}$ | DC Gate Trigger Voltage | $V_D$ = 6 V, $R_L$ = 100 Ω | Max. | 0.8 | | | | V |
| $V_{GRM}$ | Peak Reverse Gate Voltage | $I_{RG}$ = 10 µA | Min. | 5 | | | | V |
| $V_{GD}$ | Gate Non-trigger Voltage | $V_D = V_{DRM}$, $R_{GK}$ = 1 kΩ, $T_{vj}$ = 125 °C | Min. | 0.2 | | | | V |
| $I_H$ | Holding Current | $R_{GK}$ = 1 kΩ, Initial current = 20 mA | Max. | 5 | | | 10 | mA |
| $(dv/dt)_{cr}$ | Critical Rate-of-rise of Off-stage Voltage | $T_{vj}$ = 125 °C, $V_D = V_{DRM}/V_{RRM}$, Exp. Waveform, $R_{GK}$ = 1 kΩ | Min. | 75 | | | 200 | V/µs |
| $t_q$ | Turn-off Time | $T_{vj}$ = 25 °C @ 600 V, $R_{GK}$ = 1 kΩ | Max. | 30 | 25 | 25 | 15 | µs |
| $t_{gt}$ | Turn-on Time | $I_G$ = 10 mA, $P_W$ = 15 µs, $I_T$ = 1.6 $A_{pk}$ | Typ. | 2.0 | | | 4 | µs |

**Note:** x = voltage/100, y = package

## Static Characteristics ($T_{vj}$ = 25 °C, unless otherwise specified)

| Symbol | Characteristics | Conditions | Maximum Value | | | | Units |
|---|---|---|---|---|---|---|---|
| | | | SxX8yS1 | SxX8yS2 | SxX8yS | SxX8yS3 | |
| $V_{TM}$ | Peak On-state Voltage | $I_T$ = 35.4 A $t_p$ = 380 µs | 1.7 | | | | V |
| $I_{DRM}$ | Off-state Current, Peak Repetitive | $T_{vj}$ = 25 °C @ $V_D$ = $V_{DRM}$, $R_{GK}$ = 1 kΩ | 3 | | | | µA |
| | | $T_{vj}$ = 125 °C @ $V_D$ = $V_{DRM,}$ $R_{GK}$ = 1 kΩ | 500 | | | 100 | |

## Thermal Characteristics

| Symbol | Characteristics | Conditions | | Value | Units |
|---|---|---|---|---|---|
| $R_{thJC}$ | Thermal Resistance, Junction to Case (AC) | $I_T$ = 0.8 $A_{(RMS)}$[1] | TO-92 | 75 | K/W |
| | | | SOT-223 | 30 | |
| | | | SOT-89 | 50 | |
| $R_{thJA}$ | Thermal Resistance, Junction to Ambient | $I_T$ = 0.8 $A_{(RMS)}$[1] | TO-92 | 150 | K/W |
| | | | SOT-223 | 60 | |
| | | | SOT-89 | 90 | |

**Note 1:** 60 Hz AC resistive load condition, 100% conduction

## Characteristic Curves

**Fig. 1. Normalized DC Gate Trigger Current for all Quadrants vs. Junction Temperature**

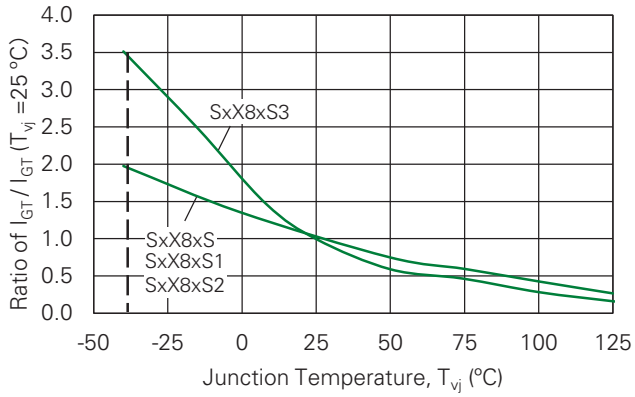



**Fig. 2. Normalized DC Holding Current vs. Junction Temperature**

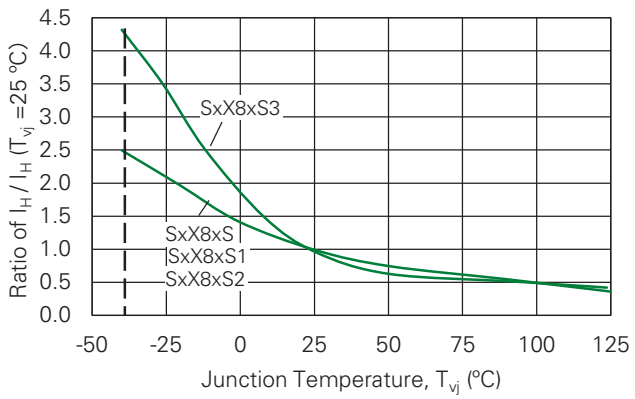



**Fig. 3. Normalized DC Gate Trigger Voltage vs. Junction Temperature**

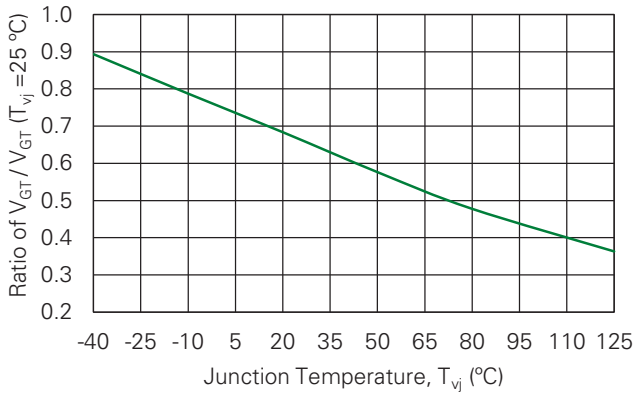



**Fig. 4. Typical On-state Current vs. On-state Voltage**

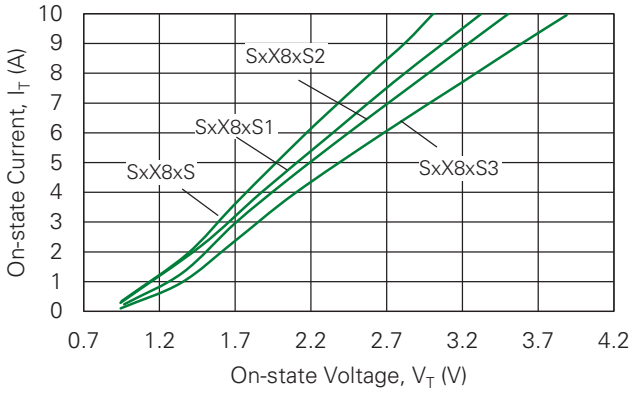



**Fig. 5. Typical Power Dissipation vs. RMS On-state Current**

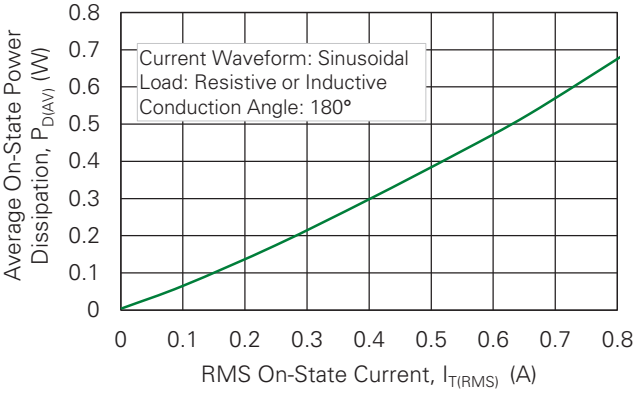
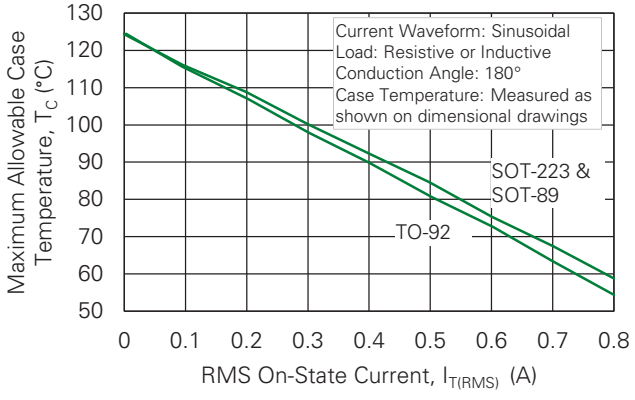



**Fig. 6. Maximum Allowable Case Temperature vs. On-state Current**







Revised: TK.06/28/2024

**Fig. 7-1. Typical DC Gate Trigger Current with $R_{GK}$ vs. Junction Temperature for S6X8xS**

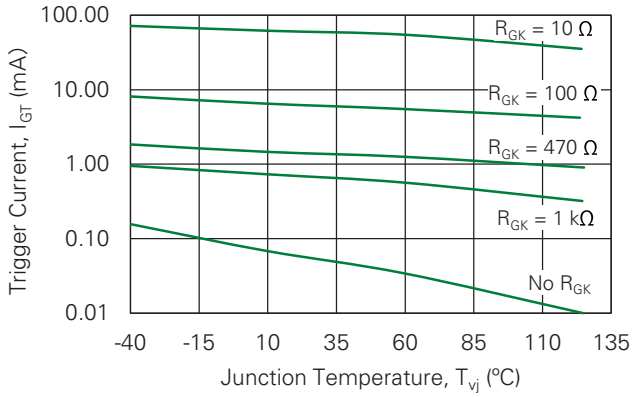



**Fig. 7-2. Typical DC Gate Trigger Current with $R_{GK}$ vs. Junction Temperature for S8X8xS**

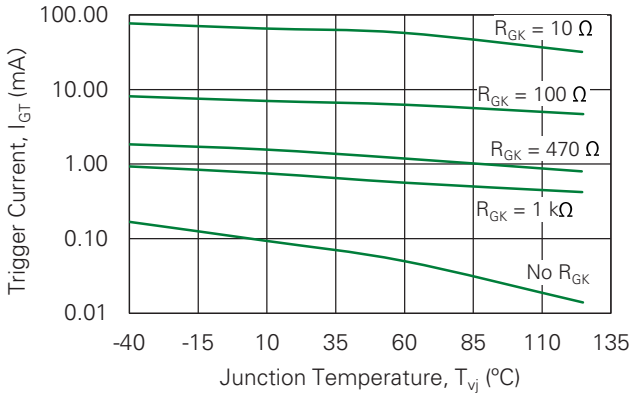



**Fig. 7-3. Typical DC Gate Trigger Current with $R_{GK}$ vs. Junction Temperature for S6X8xS3**

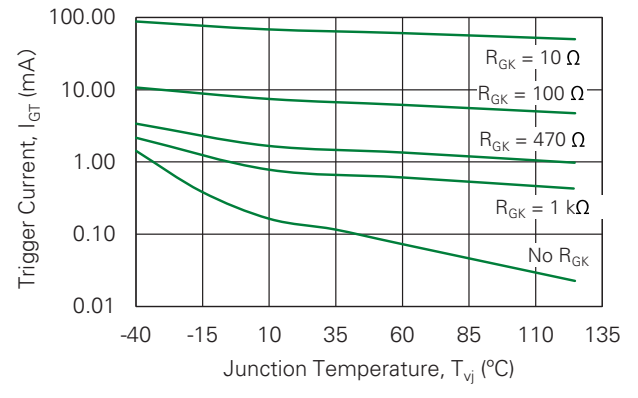



**Fig. 8-1. Typical DC Holding Current with $R_{GK}$ vs. Junction Temperature for S6X8xS**

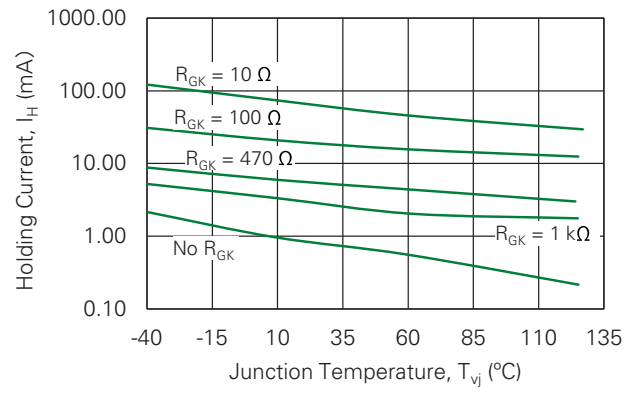



**Fig. 8-2. Typical DC Holding Current with $R_{GK}$ vs. Junction Temperature for S8X8xS**

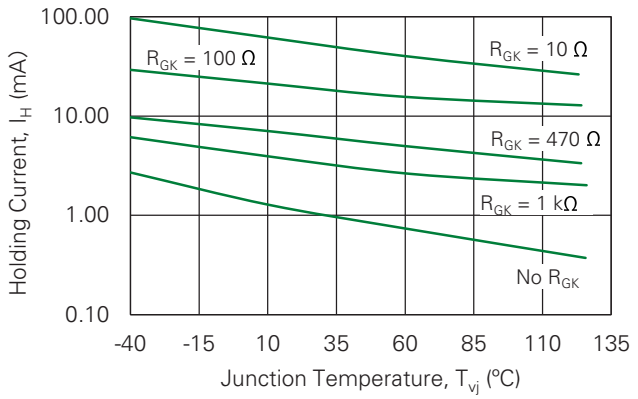



**Fig. 8-3. Typical DC Holding Current with $R_{GK}$ vs. Junction Temperature for S6X8xS3**

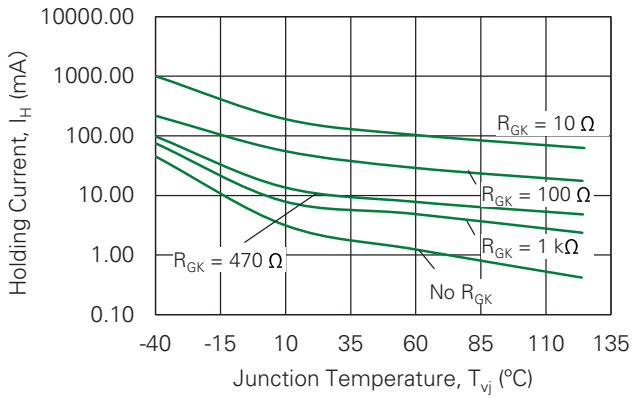


**Fig. 9-1. Typical DC Static dv/dt with $R_{GK}$ vs. Junction Temperature for S6X8xS**

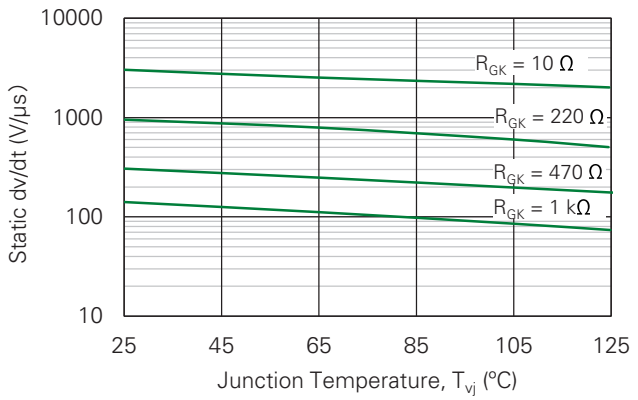



**Fig. 9-2. Typical DC Static dv/dt with $R_{GK}$ vs. Junction Temperature for S8X8xS**

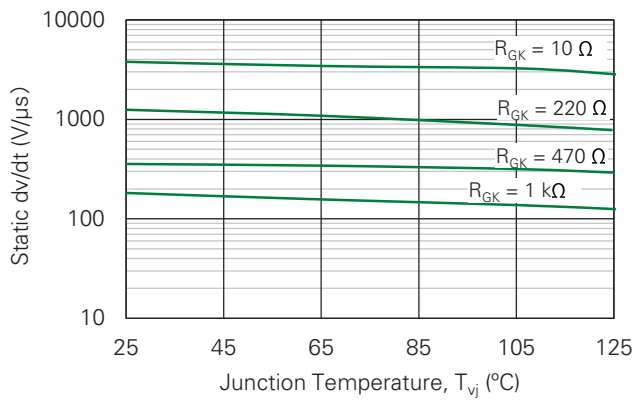



**Fig. 9-3. Typical DC Static dv/dt with $R_{GK}$ vs. Junction Temperature for S6X8xS3**

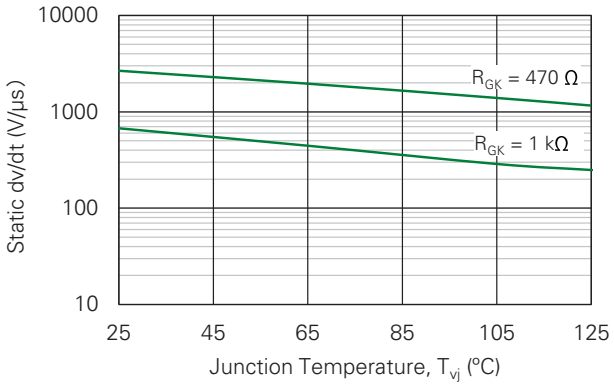



**Fig. 10-1. Typical DC Turn-off Time with $R_{GK}$ vs. Junction Temperature for S6X8xS**

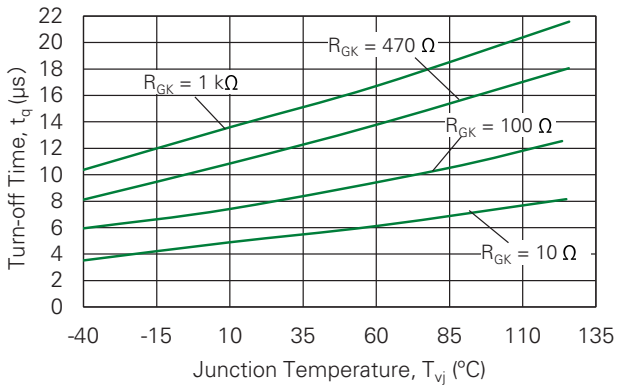



**Fig. 10-2. Typical DC Turn-off Time with $R_{GK}$ vs. Junction Temperature for S8X8xS**

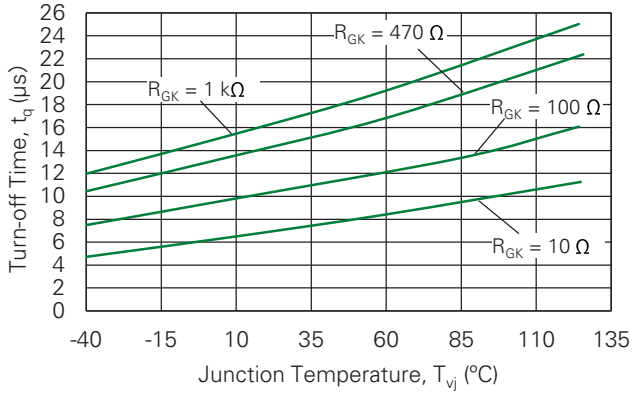
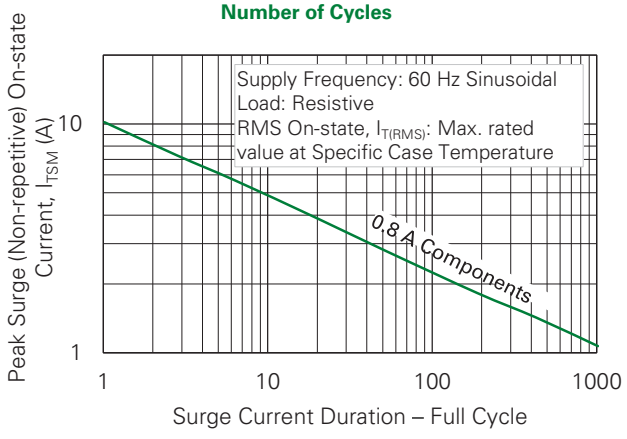



**Fig. 11. Surge Peak On-state Current vs. Number of Cycles**

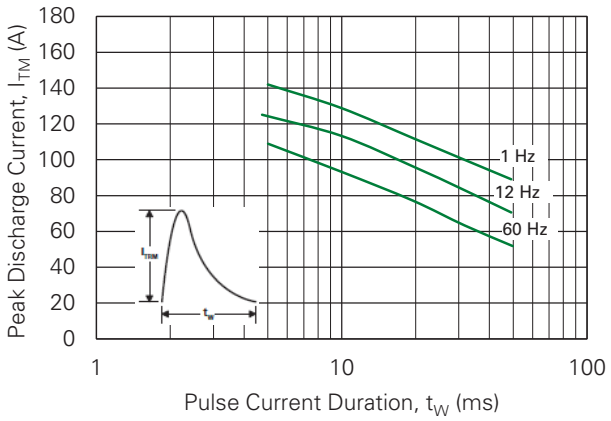



Notes:

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.

**Fig. 12. Peak Repetitive Sinusoidal Pulse Current**

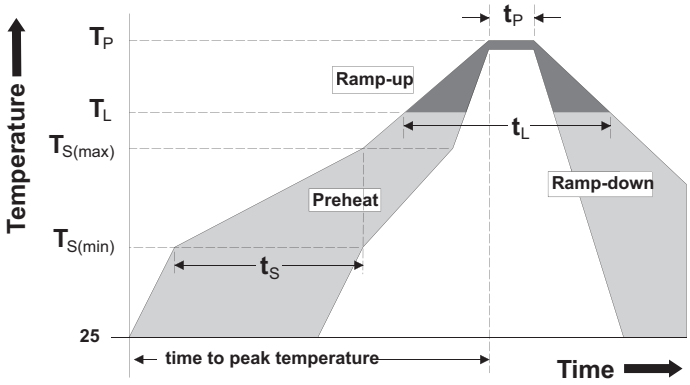



## Soldering Parameters

| Characteristic | | Value |
|---|---|---|
| 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 ($T_P$) | | $260^{+0/-5}$ °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 |

## 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 |
|---|---|
| AC Blocking | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 110 °C for 1008 hours |
| Temperature/Humidity | EIA / JEDEC, JESD22-A101, 1008 hours; 320 V - DC: 85 °C; 85 % relative humidity |
| Temperature Cycling | MIL-STD-750, M-1051,100 cycles; -40 °C to +150 °C; 15-min dwell-time |
| High-temperature Storage | MIL-STD-750, M-1031, 1008 hours; 150 °C |
| Low-temperature Storage | 1008 hours; -40 °C |
| Resistance to Solder Heat | MIL-STD-750: Method 2031 |
| Solderability | ANSI/J-STD-002: category 3, Test A |
| Lead Bend | MIL-STD-750, M-2036 Cond E |

## Physical Specifications

| Characteristic | Value |
|---|---|
| Terminal Finish | 100% Matte Tin-plated |
| Body Material | UL Recognized compound meeting flammability rating V-0 |
| Lead Material | Copper Alloy |

## Product Selector

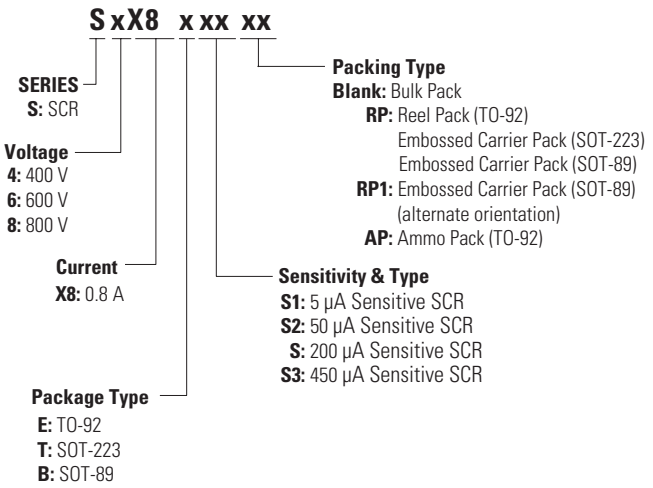
| Part Number | Voltage | | | Gate Sensitivity | Package |
|---|---|---|---|---|---|
| | 400 V | 600 V | 800 V | | |
| SxX8BS | X | X | – | 200 µA | SOT-89 |
| SxX8ES | X | X | X | 200 µA | TO-92 |
| SxX8TS | X | X | X | 200 µA | SOT-223 |
| SxX8BS1 | X | X | – | 5 µA | SOT-89 |
| SxX8ES1 | X | X | X | 5 µA | TO-92 |
| SxX8TS1 | X | X | X | 5 µA | SOT-223 |
| SxX8BS2 | X | X | – | 50 µA | SOT-223 |
| SxX8ES2 | X | X | X | 50 µA | SOT-89 |
| SxX8TS2 | X | X | X | 50 µA | TO-92 |
| SxX8TS3 | – | X | – | 450 µA | SOT-223 |

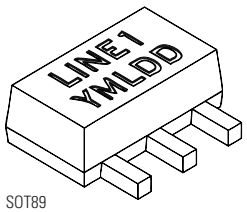
## Packing Options

| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|---|---|---|---|---|
| SxX8ESy | SxX8ESy | 0.217 g | Bulk | 2500 |
| SxX8ESyAP | SxX8ESy | 0.217 g | Ammo Pack | 2000 |
| SxX8ESyRP | SxX8ESy | 0.217 g | Tape & Reel | 2000 |
| SxX8TSyRP | SxX8TSy | 0.120 g | Tape & Reel | 1000 |
| SxX8BSyRP | xX8y | 0.053 g | Tape & Reel | 1000 |
| SxX8BSyRP1 | xX8y | 0.053 g | Tape & Reel | 1000 |

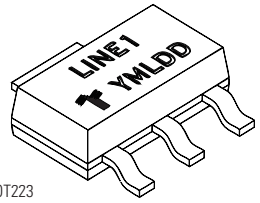
**Note:** x = voltage/100, y = gate sensitivity

## Part Numbering and Marking

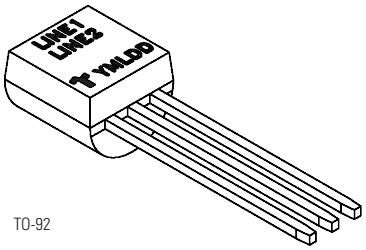



SOT89



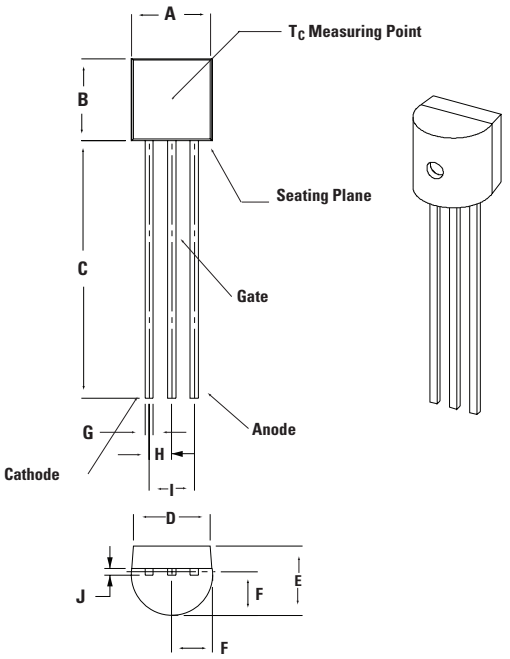

SOT223




TO-92

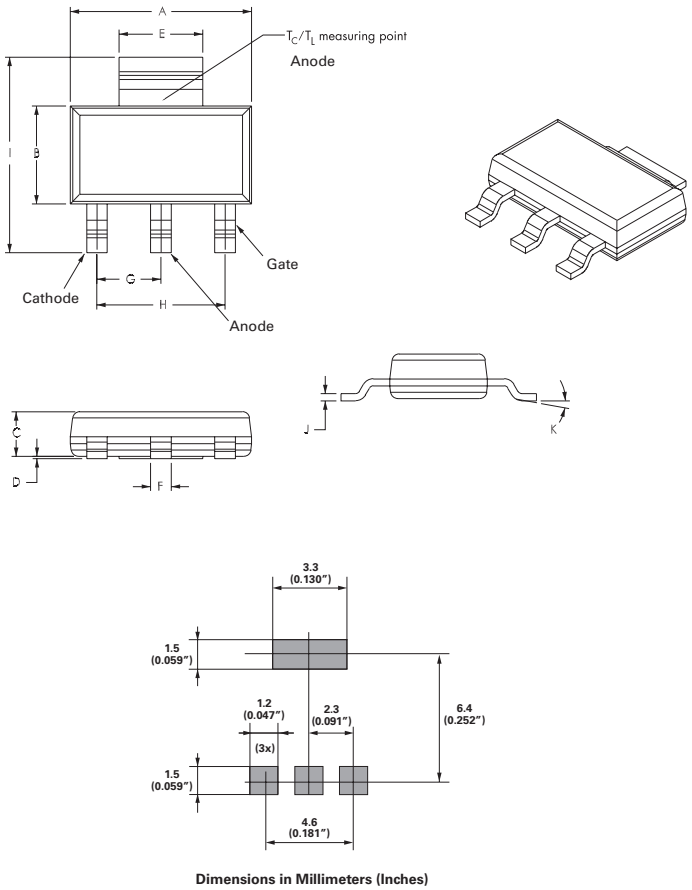
Line1 = Littelfuse Part Number
Line2 = continuation…Littelfuse Part Number
Y = Last Digit of Calendar Year
M = Letter Month Code (A-L for Jan-Dec)
L = Location Code
DD = Calendar Date

## **Package Dimensions** TO-92




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

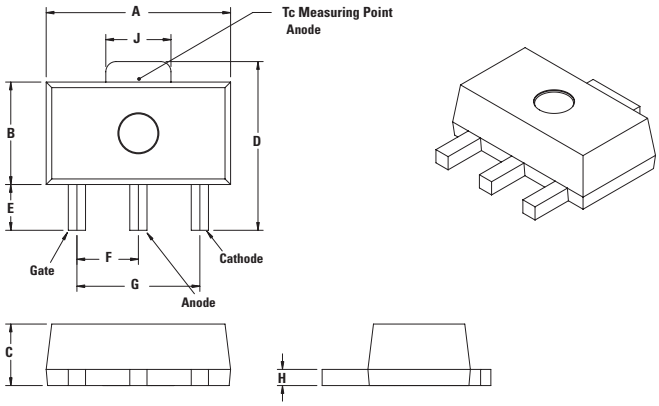
## **Package Dimensions** SOT-223




Dimensions in Millimeters (Inches)

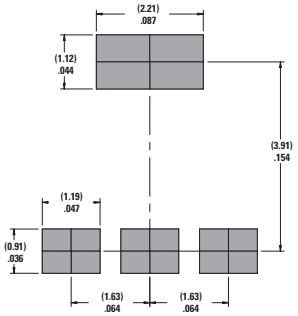
| Symbol | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max |
| A | 0.248 | 0.256 | 0.264 | 0.248 | 0.256 | 0.264 |
| B | 0.130 | 0.138 | 0.146 | 0.130 | 0.138 | 0.146 |
| C | – | – | 0.071 | – | – | 0.071 |
| D | 0.001 | – | 0.005 | 0.02 | – | 0.13 |
| 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 | 0.23 | 0.26 | 0.35 |
| K | 10° MAX. | | | | | |

## Package Dimensions SOT-89




| Symbol | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max |
| A | 4.40 | – | 4.60 | 0.173 | – | 0.181 |
| B | 2.29 | – | 2.60 | 0.090 | – | 0.102 |
| C | 1.40 | – | 1.60 | 0.055 | – | 0.063 |
| D | 3.94 | – | 4.25 | 0.155 | – | 0.167 |
| E | 0.89 | – | 1.20 | 0.035 | – | 0.047 |
| F | 1.42 | – | 1.57 | 0.056 | – | 0.062 |
| G | 2.92 | – | 3.07 | 0.115 | – | 0.121 |
| H | 0.35 | – | 0.44 | 0.014 | – | 0.017 |
| I | 0.36 | – | 0.48 | 0.014 | – | 0.019 |
| J | 1.62 | 1.69 | 1.83 | 0.064 | 0.067 | 0.072 |

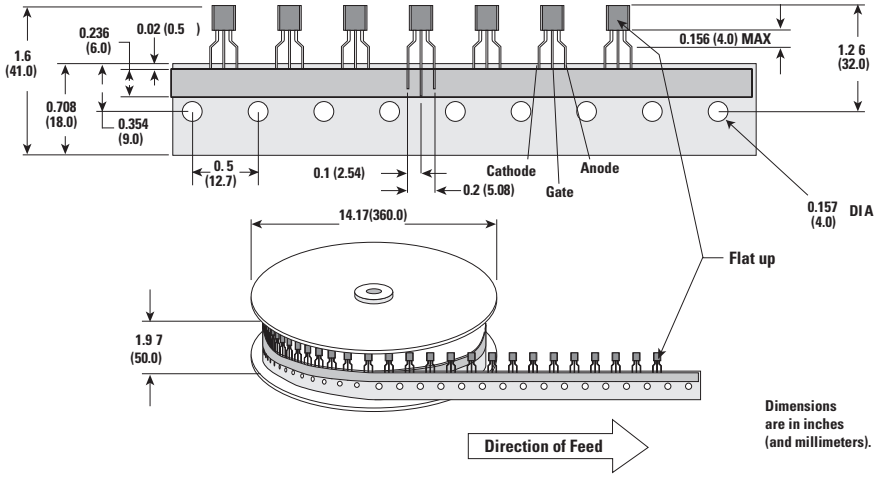
Pad Layout for SOT-89




Dimensions in Millimeters (Inches)

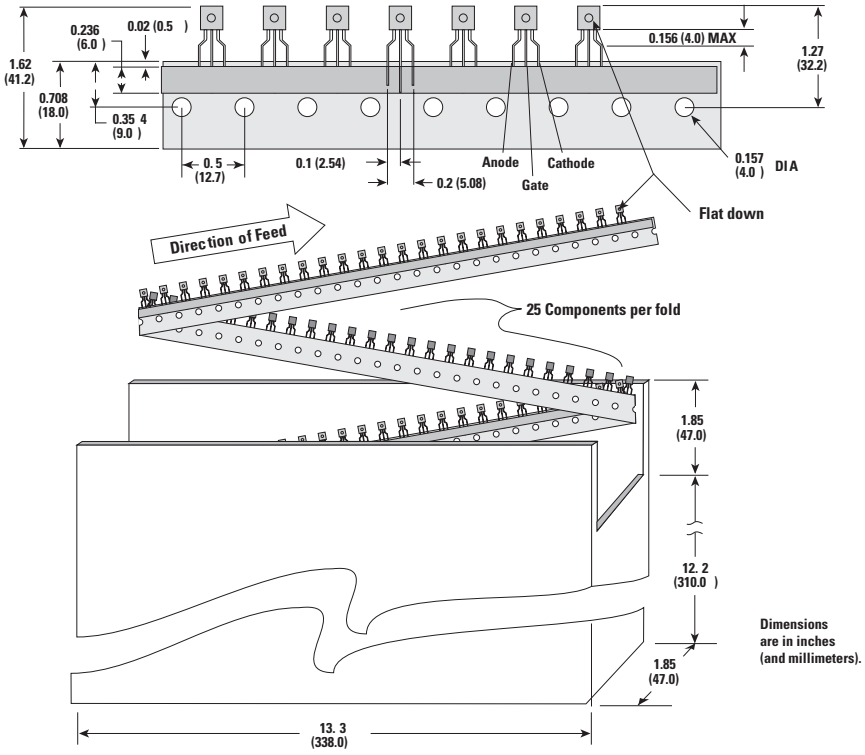
## TO-92 (3-lead) Reel Pack (RP) Radial Leaded Specifications

Meets all EIA-468-C Standards

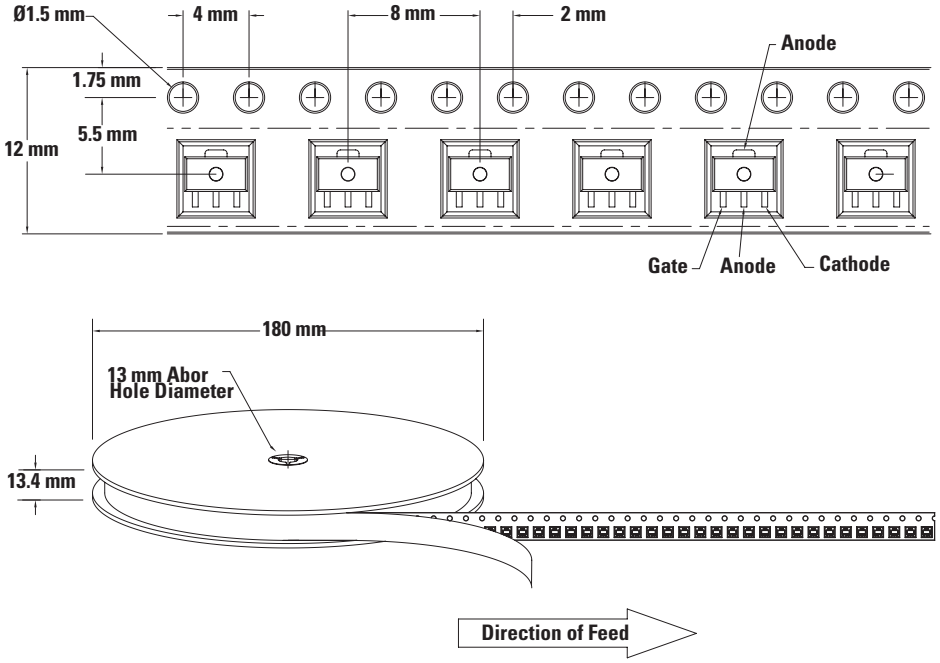


## TO-92 (3-lead) Ammo Pack (AP) Radial Leaded Specifications

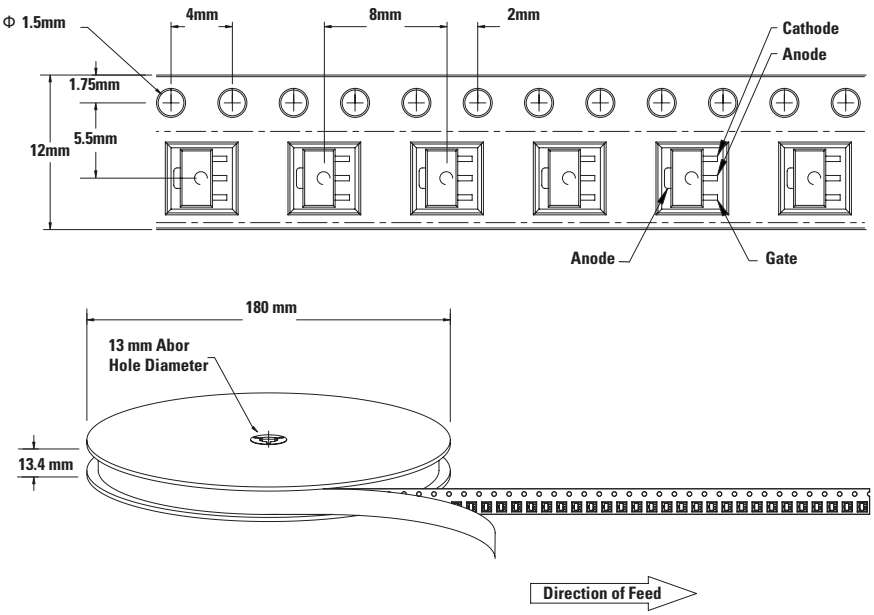
Meets all EIA-468-C Standards




## SOT-89 Reel Pack (RP) Specifications



## SOT-89 Reel Pack (RP1) Specifications




## SOT-223 Reel Pack (RP) Specifications