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 (tq). All SCR junctions are glass-passivated to ensure long term reliability and parametric stability.

Features

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

Additional Information

Resources | Accessories | Samples

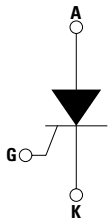
Applications

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

Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	1.5	A
V_{DRM}/V_{RRM}	400 or 600	V
I_{GT}	200	µA

Schematic Symbol



Absolute Maximum Ratings

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current (full sine wave)	TO-92	T_C = 65°C	1.5	A
		SOT-89	T_C = 80°C		
		SOT-223	T_C = 95°C		
$I_{T(AV)}$	Average on-state current	TO-92	T_C = 65°C	0.95	A
		SOT-89	T_C = 80°C		
		SOT-223	T_C = 95°C		
I_{TSM}	Non repetitive surge peak on-state current (Single cycle, T_J initial = 25°C)	TO-92 SOT-89 SOT-223	F = 50 Hz	12.5	A
			F = 60 Hz	15.0	
I^2t	I^2t Value for fusing	t_p = 10 ms	F = 50 Hz	0.78	A^2s
		t_p = 8.3 ms	F = 60 Hz	0.93	
di/dt	Critical rate of rise of on-state current IG = 10mA	TO-92 SOT-89 SOT-223	T_J = 125°C	50	A/µs
I_{GM}	Peak gate current	t_p = 10 µs	T_J = 125°C	1.0	A
$P_{G(AV)}$	Average gate power dissipation		T_J = 125°C	0.1	W
T_{stg}	Storage junction temperature range			-40 to 150	°C
T_J	Operating junction temperature range			-40 to 125	°C

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Sx02xSx EV Series
EV Series 1.5 Amp Sensitive SCRs

Electrical Characteristics (TJ = 25°C, unless otherwise specified)

Symbol	Description	Test Conditions	Sx02xS		Sx02xS1		Sx02xS2		Units
			Min	Max	Min	Max	Min	Max	
I_{GT}	DC Gate Trigger Current	V_D = 12V; R_L = 60 Ω	15	200	15	100	15	50	µA
V_{GT}	DC Gate Trigger Voltage	V_D = 12V; R_L = 60 Ω	—	0.8	—	0.8	—	0.8	V
V_{GRM}	Peak Reverse Gate Voltage	I_{RG} = 10µA	5	—	5	—	5	—	V
I_H	Holding Current	R_{GK} = 1 kΩ	—	5	—	3	—	3	mA
(dv/dt)s	"Critical Rate-of-Rise of Off-State Voltage"	"T_J = 125°C $V_D = V_{DRM} / V_{RRM}$ Exponential Waveform R_{GK} = 1 kΩ"	25	—	25	—	25	—	V/µs
t_q	Turn-Off Time	"TJ = 125°C @ 600 V R_{GK} = 1 kΩ"	—	35	—	35	—	35	µs
t_{gt}	Turn-On Time	"I_G = 10mA PW = 15µsec I_T = 3.0A (pk)"	—	3	—	3	—	3	µs
V_{GD}	Gate Non-Trigger Voltage	"$V_D=V_{DRM}$, T_J=125°C, R_L=3.3KΩ"	0.2	—	0.2	—	0.2	—	V

x0 = voltage/10

Static Characteristics (TJ = 25°C, unless otherwise specified)

Symbol	Description	Test Conditions	Value		Unit
			Min	Max	
V_{TM}	Peak On-State Voltage	I_{TM} = 3.0A (pk)	—	1.70	V
I_{DRM}	Off-State Current, Peak Repetitive	T_J = 25°C @ $V_D = V_{DRM}$ R_{GK} = 1 kΩ	—	5	µA
		T_J = 125°C @ $V_D = V_{DRM}$ R_{GK} = 1 kΩ	—	500	µA

Thermal Resistances

Symbol	Parameter			Value	Unit
$R_{\Theta(J-C)}$	Junction to case (AC)	I_T = 1.5A $_{(RMS)}$[1]	TO-92	50	°C/W
			SOT-89	35	
			SOT-223	25	
$R_{\Theta(J-A)}$	Junction to ambient	I_T = 1.5A $_{(RMS)}$[1]	TO-92	160	°C/W
			SOT-89	90	
			SOT-223	60	

[1] 60Hz AC resistive load condition, 100% conduction.

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Sx02xSx EV Series

EV Series 1.5 Amp Sensitive SCRs

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

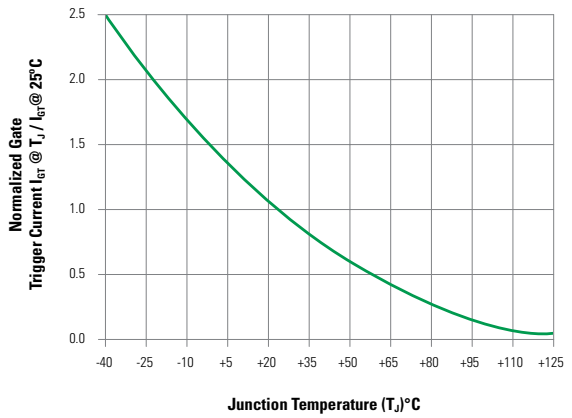


Figure 2: Normalized DC Holding Current vs. Junction Temperature

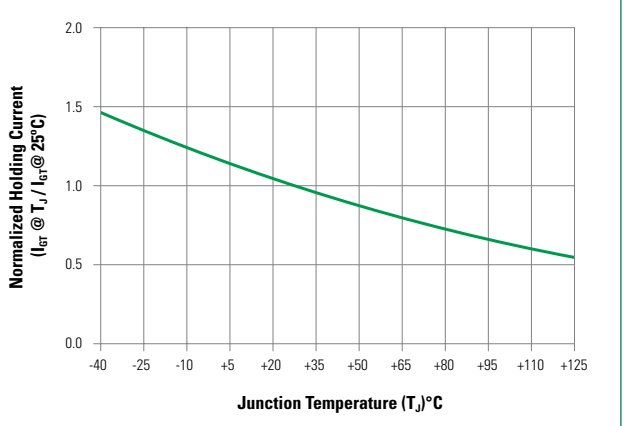


Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature

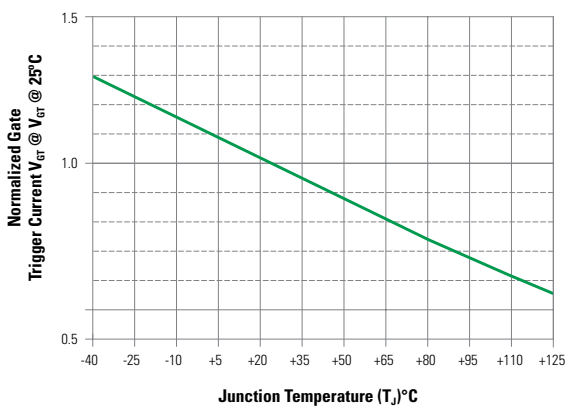


Figure 4: On-State Current vs. On-State Voltage (Typical)

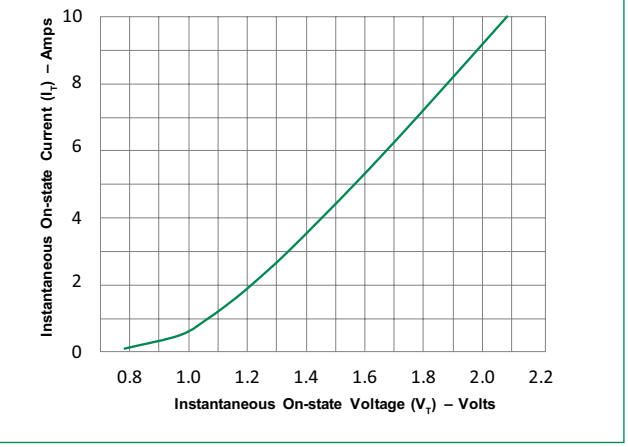


Figure 5: Power Dissipation (Typical) vs. RMS On-State Current

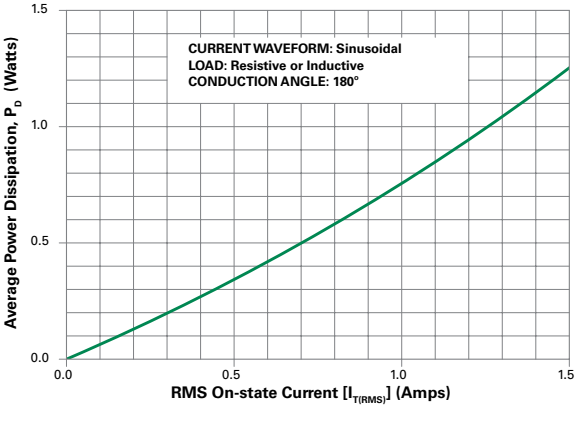
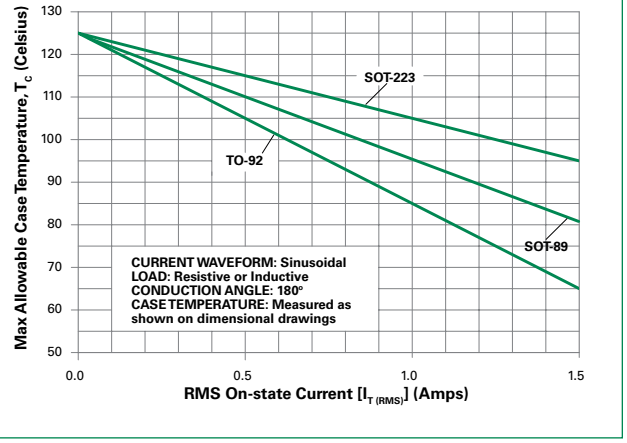


Figure 6: Maximum Allowable Case Temperature vs. On-State Current



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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

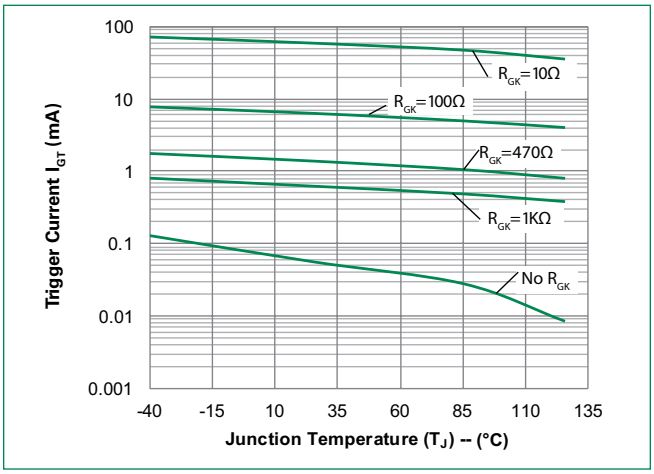


Figure 8: Typical DC Holding Current with R_{GK} vs. Junction Temperature for Sx02xS

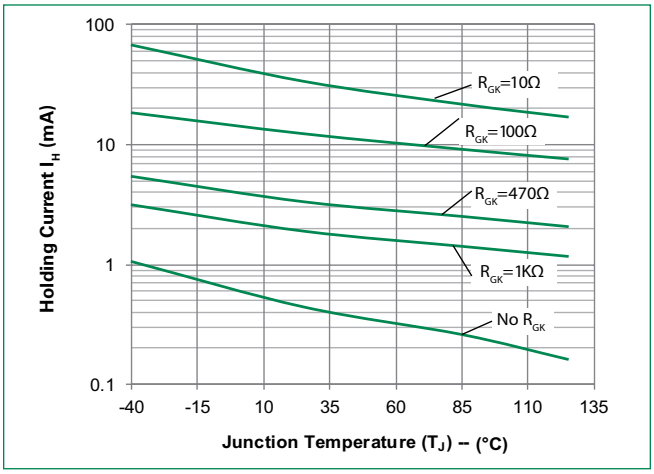


Figure 9: Typical Static dv/dt with R_{GK} vs. Junction Temperature for Sx02xS

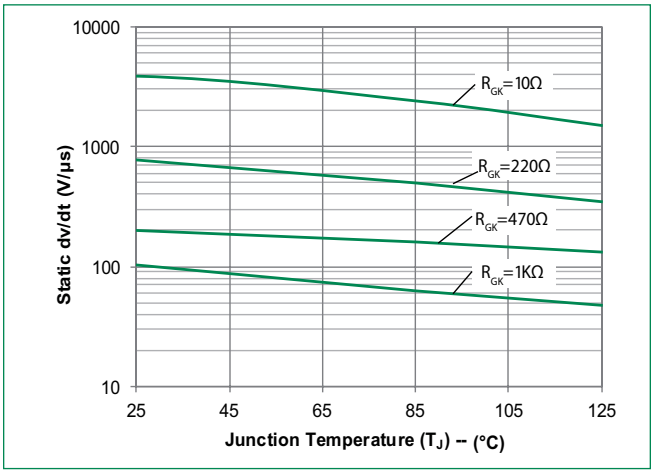


Figure 10: Typical turn off time with R_{GK} vs. Junction Temperature for Sx02xS

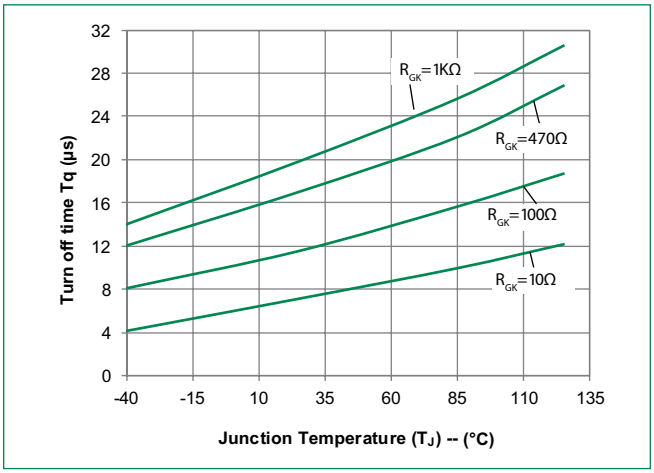
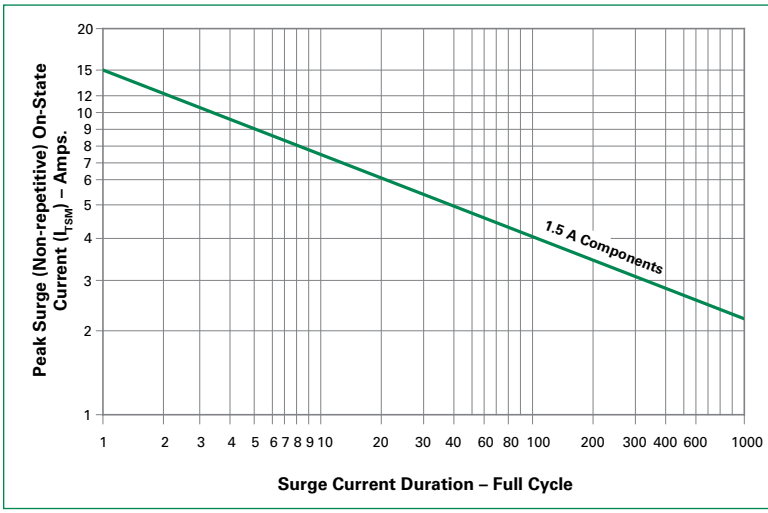


Figure 11: Surge Peak On-State Current vs. Number of Cycles



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.

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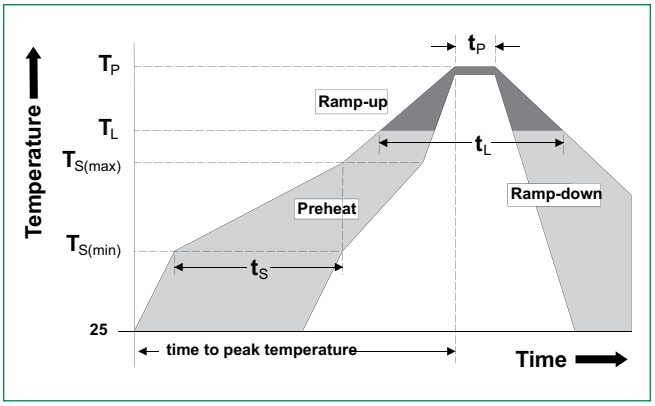
Sx02xSx EV Series

EV Series 1.5 Amp Sensitive SCRs

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 – 120 secs
Average ramp up rate (Liquidus Temp) (T_L) to peak		3°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)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Physical Specifications

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

Environmental Specifications

Test	Specifications and Conditions
AC Blocking	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
Temperature Cycling	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
Temperature/ Humidity	EIA / JEDEC, JESD22-A101 1008 hours; 160V - DC: 85°C; 85% rel humidity
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

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.

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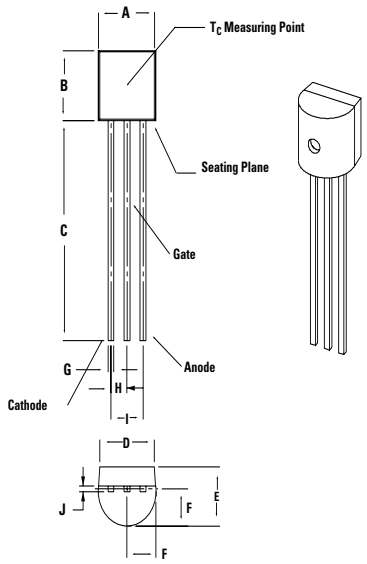
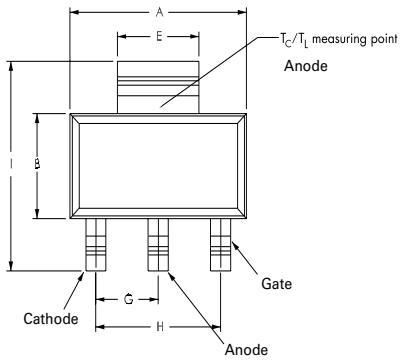
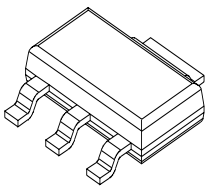
Dimensions — TO-92 (E Package)

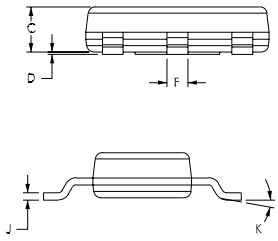


Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	0.175	0.205	4.450	5.200
B	0.170	0.210	4.320	5.330
C	0.500	—	12.700	—
D	0.135	—	3.430	—
E	0.125	0.165	3.180	4.190
F	0.080	0.105	2.040	2.660
G	0.016	0.021	0.407	0.533
H	0.045	0.055	1.150	1.390
I	0.095	0.105	2.420	2.660
J	0.015	0.020	0.380	0.500

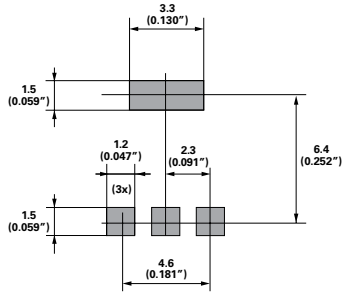
Dimensions – SOT-223







Pad Layout for SOT-223



Dimensions in Millimeters (Inches)

Dimensions	Inches			Millimeters		
	Min	Typ	Max	Min	Typ	Max
A	0.248	0.256	0.264	6.30	6.50	6.71
B	0.130	0.138	0.146	3.30	3.50	3.70
C	—	—	0.071	—	—	1.80
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					

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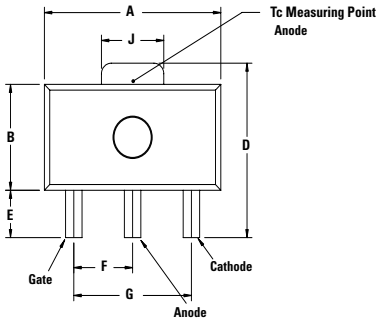
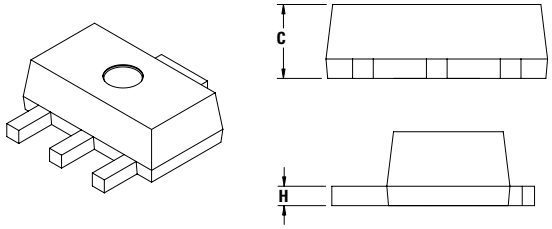
Sx02xSx EV Series

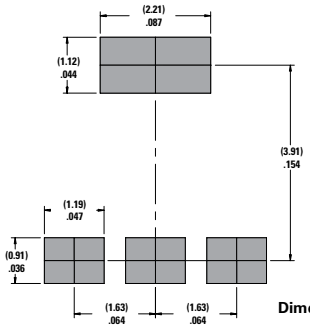
EV Series 1.5 Amp Sensitive SCRs

Dimensions – SOT-89





Pad Layout for SOT-89



Dimensions in Millimeters (Inches)

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	0.032	—	0.047	0.81	—	1.20
F	—	0.059	—	—	1.5	—
G	—	0.118	—	—	3	—
H	0.014	—	0.017	0.35	—	0.44
I	0.014	—	0.019	0.36	—	0.48
J	—	0.067	—	—	1.69	—

Product Selector

Part Numbr	Voltage		Gate Sensitivity	Package
	400V	600V		
Sx02BS	X	X	200 µA	SOT-89
Sx02ES	X	X	200 µA	TO-92
Sx02TS	X	X	200 µA	SOT-223
Sx02BS1	X	X	100 µA	SOT-89
Sx02ES1	X	X	100 µA	TO-92
Sx02TS1	X	X	100 µA	SOT-223
Sx02BS2	—	X	50 µA	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

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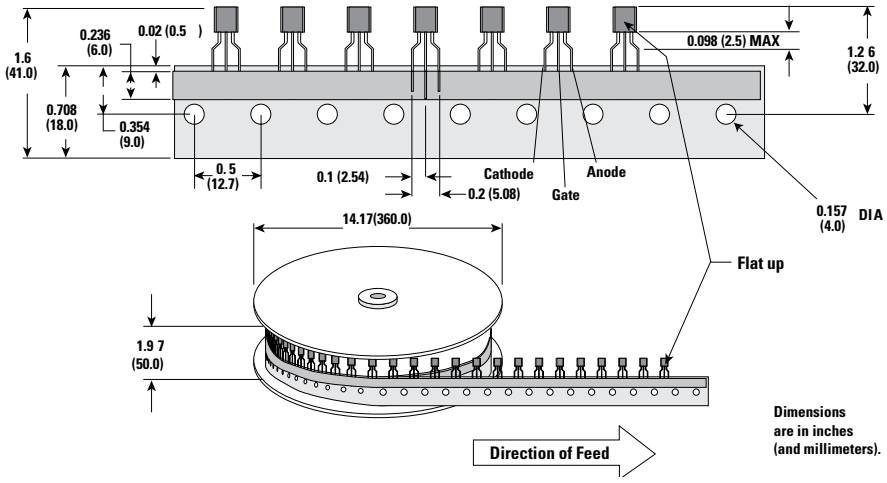
Sx02xSx EV Series

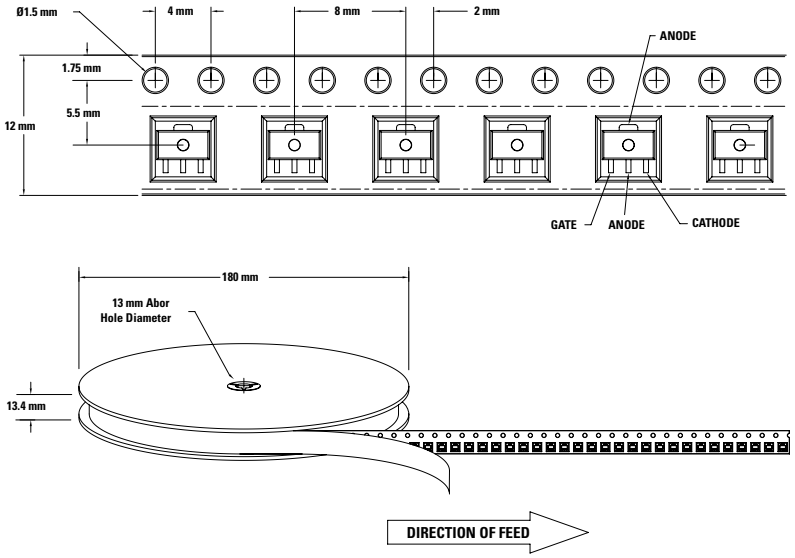
EV Series 1.5 Amp Sensitive SCRs

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

Meets all EIA-468-C Standards



SOT-89 Reel Pack (RP) Specifications



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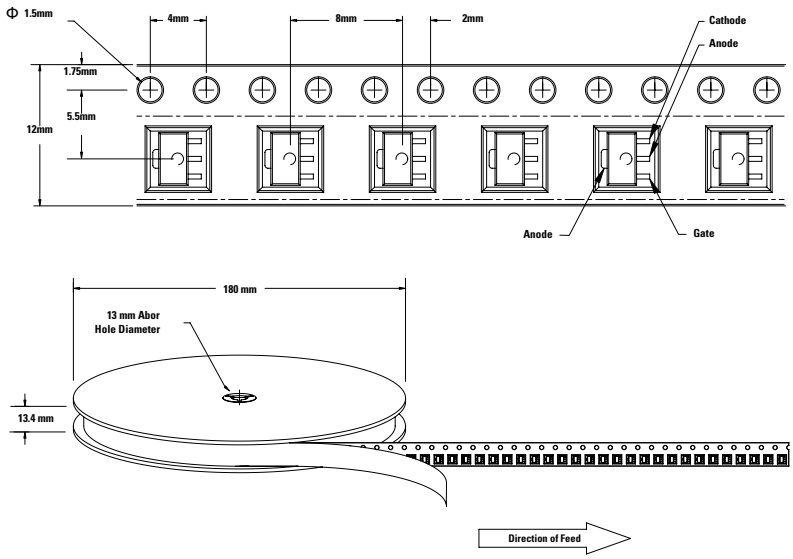
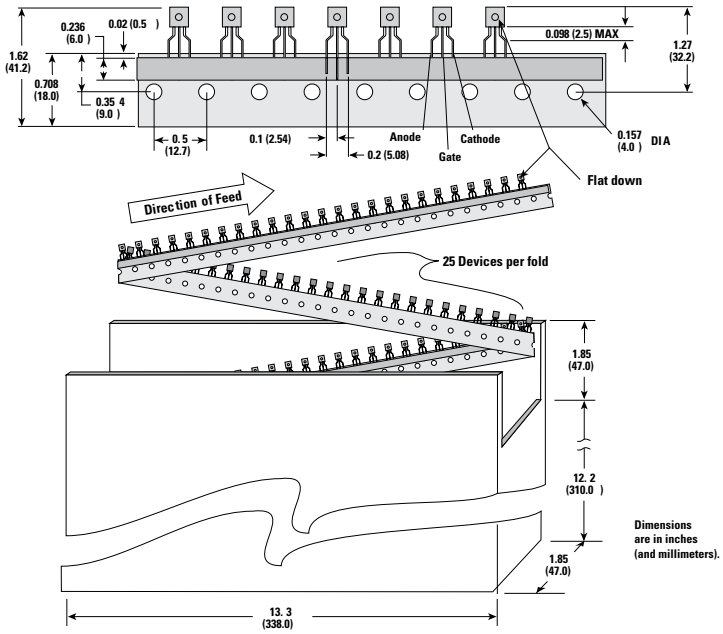
SOT-89 Reel Pack (RP1) Specifications



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

Meets all EIA-468-C Standards



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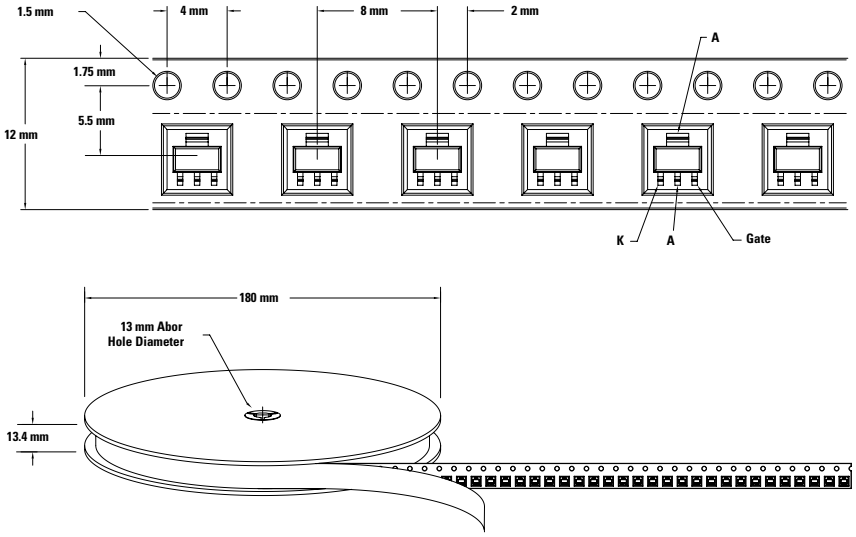
EV Series 1.5 Amp Sensitive SCRs

SOT-223 Reel Pack (RP) Specifications



Part Numbering System

S x 02 x xx xx

SCR Series

Voltage
4: 400V
6: 600V

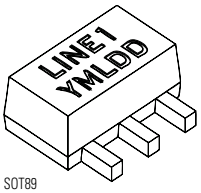
Current
02: 1.5A

Sensitivity
S: 200µA Sensitive SCR
S1: 100µA Sensitive SCR
S2: 50µA Sensitive SCR

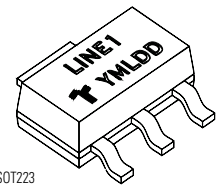
Package Type
E: TO-92
T: SOT-223
B: SOT-89

Packing Type
Blank: Bulk
RP: Reel Pack (TO-92)
: Embossed Carrier Pack (SOT-223)
AP: Ammo Pack (TO-92)

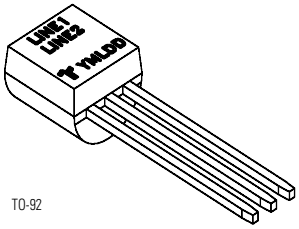
Part Marking System



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

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