



**THE DATASHEET OF  
S4008NS3RP**



Sxx08xSx & Sxx08x Series



Agency Approval	
Agency	Agency File Number
	E71639*

\* - L Package Only

Main Features		
Symbol	Value	Unit
$I_{T(RMS)}$	8	A
$V_{DRM}/V_{RRM}$	400 to 1000	V
$I_{GT}$	0.2 to 15	mA

**Additional Information**

**Datasheet**

**Resources**

**Samples**

**Description**

This Sxx08x 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 0.2 to 15 mA at approximately 1.5V, with a sensitive version of this series having a gate trigger current less than 500µA. The sensitive gate SCR version is easily triggered by sense coils, proximity switches, and microprocessors.

**Features & Benefits**

- Halogen-free and RoHS-compliant
- Glass – passivated junctions
- Voltage capability up to 1000 V
- Surge capability up to 100 A at 60 Hz half cycle
- L - Package is UL Recognized for 2500Vrms

**Applications**

Typical applications are capacitive discharge systems for strobe lights, nailers, staplers and gas engine ignition. 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 — Sensitive SCRs

Symbol	Parameter	Test Conditions		Value	Unit
$I_{T(RMS)}$	RMS on-state current	Sxx08LSy	$T_c = 80^\circ\text{C}$	8	A
		Sxx08RSy/Sxx08NSy Sxx08DSy Sxx08Vsy	$T_c = 95^\circ\text{C}$		
$I_{T(AV)}$	Average on-state current	Sxx08LSy	$T_c = 80^\circ\text{C}$	5.1	A
		Sxx08RSy/Sxx08NSy Sxx08DSy Sxx08Vsy	$T_c = 95^\circ\text{C}$		
$I_{TSM}$	Peak non-repetitive surge current	single half cycle; $f = 50\text{Hz}$ ; $T_j$ (initial) = $25^\circ\text{C}$		83	A
		single half cycle; $f = 60\text{Hz}$ ; $T_j$ (initial) = $25^\circ\text{C}$		100	
$I^2t$	$I^2t$ Value for fusing	$t_p = 8.3 \text{ ms}$		41	$\text{A}^2\text{s}$
$di/dt$	Critical rate of rise of on-state current	$f = 60 \text{ Hz}; T_j = 110^\circ\text{C}$		70	$\text{A}/\mu\text{s}$
$I_{GTM}$	Peak gate current	$T_j = 110^\circ\text{C}$		1.6	A
$P_{G(AV)}$	Average gate power dissipation	$T_j = 110^\circ\text{C}$		0.4	W
$T_{stg}$	Storage temperature range			-40 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature range			-40 to 110	$^\circ\text{C}$

Note: xx = voltage, y = sensitivity

### Absolute Maximum Ratings — Standard SCRs

Symbol	Parameter	Test Conditions		Value	Unit
$I_{T(RMS)}$	RMS on-state current	Sxx08L	$T_c = 100^\circ\text{C}$	8	A
		Sxx08R/Sxx08N Sxx08D Sxx08V	$T_c = 110^\circ\text{C}$		
$I_{T(AV)}$	Average on-state current	Sxx08L	$T_c = 100^\circ\text{C}$	5.1	A
		Sxx08R/Sxx08N Sxx08D Sxx08V	$T_c = 110^\circ\text{C}$		
$I_{TSM}$	Peak non-repetitive surge current	single half cycle; $f = 50\text{Hz}$ ; $T_j$ (initial) = $25^\circ\text{C}$		83	A
		single half cycle; $f = 60\text{Hz}$ ; $T_j$ (initial) = $25^\circ\text{C}$		100	
$I^2t$	$I^2t$ Value for fusing	$t_p = 8.3 \text{ ms}$		41	$\text{A}^2\text{s}$
$di/dt$	Critical rate-of-rise of on-state current	$f = 60 \text{ Hz}; T_j = 125^\circ\text{C}$		100	$\text{A}/\mu\text{s}$
$I_{GM}$	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	$^\circ\text{C}$

Note: xx = voltage

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

Symbol	Test Conditions		Value				Unit
			Sxx08xS1	Sxx08xS2	Sxx08xS3	Sxx08x4	
$I_{GT}$	$V_D = 6\text{V}$ $R_L = 100\ \Omega$	MAX.	50	200	500	100	$\mu\text{A}$
$V_{GT}$	$V_D = 6\text{V}$ $R_L = 100\ \Omega$	MAX.	0.8				V
dv/dt	$V_D = V_{DRM}$ ; $R_{GK} = 1\text{k}\Omega$ ; $T_J = 110^\circ\text{C}$	TYP.	8				V/ $\mu\text{s}$
$V_{GD}$	$V_D = V_{DRM}$ $R_L = 3.3\ \text{k}\Omega$ $T_J = 110^\circ\text{C}$	MIN.	0.2				V
$V_{GRM}$	$I_{GR} = 10\ \mu\text{A}$	MIN.	6				V
$I_H$	$I_T = 20\text{mA}$ (initial)	MAX.	4	6	8	5	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.	75	50	45	60	$\mu\text{s}$
$t_{gt}$	$I_G = 2 \times I_{GT}$ PW = 15 $\mu\text{s}$ $I_T = 12\text{A}$	TYP.	3	4	5	4	$\mu\text{s}$

Note: xx = voltage x = package

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

Symbol	Test Conditions			Value	Unit
				Sxx08x	
$I_{GT}$	$V_D = 12\text{V}$ $R_L = 60\ \Omega$		MAX.	15	mA
$V_{GT}$	$V_D = 12\text{V}$ $R_L = 60\ \Omega$		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.	30	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 $\mu\text{s}$ $I_T = 16\text{A}$		TYP.	2	$\mu\text{s}$

Note: xx = voltage x = package

### Static Characteristics

Symbol	Test Conditions			Value	Unit	
$V_{TM}$	$I_T = 16\text{A}$ ; $t_p = 380\ \mu\text{s}$			MAX.	1.6 V	
$I_{DRM} / I_{RRM}$	$V_{DRM} = V_{RRM}$	Sxx08xyy	$T_J = 25^\circ\text{C}$	400 - 600V	MAX.	5
			$T_J = 110^\circ\text{C}$	400 - 600V		250
		Sxx08x	$T_J = 25^\circ\text{C}$	400 - 800V		10
				1000V		20
			$T_J = 100^\circ\text{C}$	400 - 800V		200
				1000V		3000
	$T_J = 125^\circ\text{C}$	400 - 800V	500			

Note: xx = voltage, x = package, yy = sensitivity

### Thermal Resistances

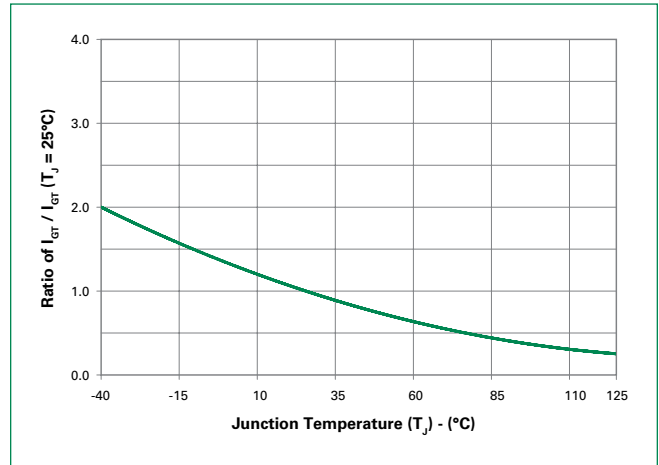
Symbol	Parameter	Value	Unit	
$R_{\theta(J-C)}$	Junction to case (AC)	Sxx08RSy / Sxx08NSy	1.8	°C/W
		Sxx08LSy	3.4	
		Sxx08Vsy	2.1	
		Sxx08DSy	1.5	
		Sxx08R / S xx08N	1.8	
		Sxx08L	3.4	
		Sxx08V	2.0	
		Sxx08D	1.5	
$R_{\theta(J-A)}$	Junction to ambient	Sxx08RSy	40	°C/W
		Sxx08LSy	65	
		Sxx08Vsy	85	
		Sxx08R	40	
		Sxx08L	50	
		Sxx08V	70	

Note: xx = voltage, y = sensitivity

**Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature (Sensitive SCR)**



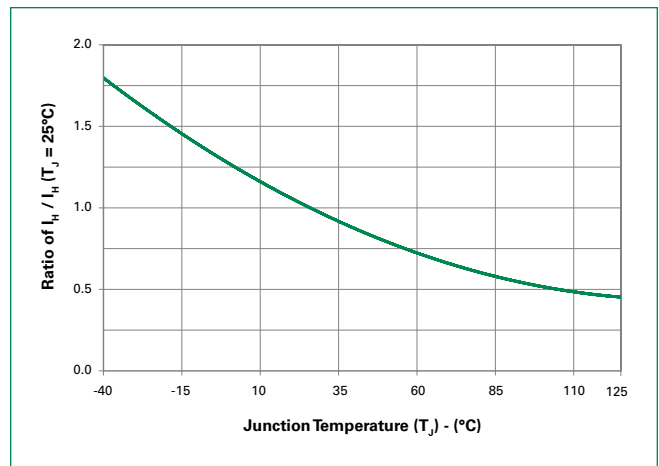
**Figure 2: Normalized DC Gate Trigger Current vs. Junction Temperature (Standard SCR)**



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



**Figure 4: Normalized DC Holding Current vs. Junction Temperature**



**Figure 5: On-State Current vs. On-State Voltage (Typical)**



**Figure 6: Power Dissipation (Typical) vs. RMS On-State Current**



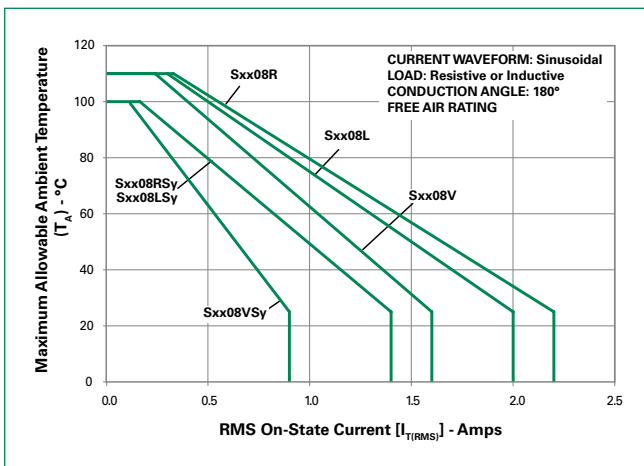
**Figure 7: Maximum Allowable Case Temperature vs. RMS On-State Current**



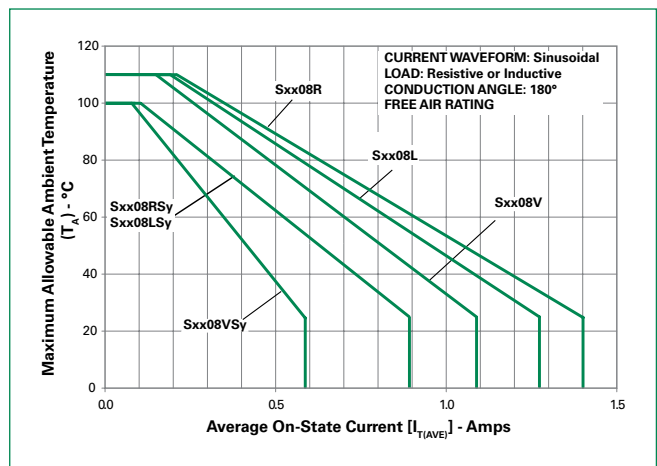
**Figure 8: Maximum Allowable Case Temperature vs. Average On-State Current**



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



**Figure 10: Maximum Allowable Ambient Temperature vs. Average On-State Current**

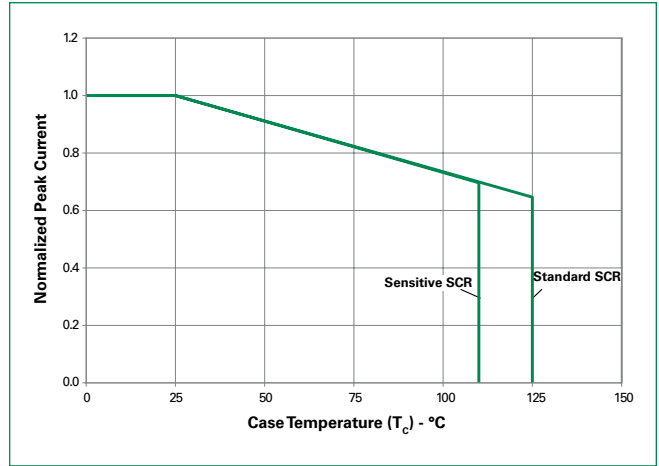


Note: xx = voltage, y = sensitivity

**Figure 11: Peak Capacitor Discharge Current**



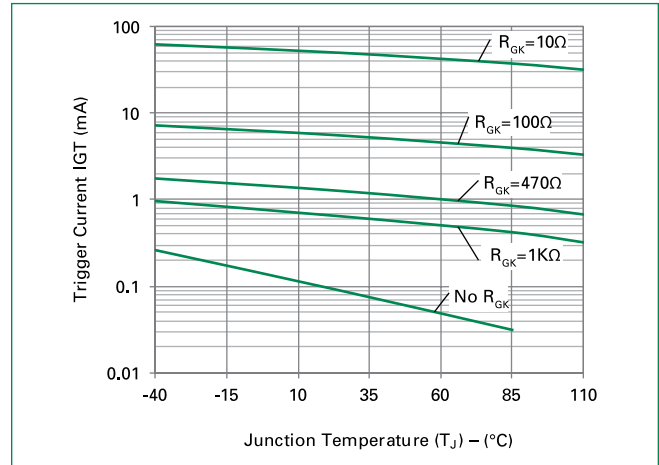
**Figure 12: Peak Capacitor Discharge Current Derating**



**Figure 13-1: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for S6008xS2**



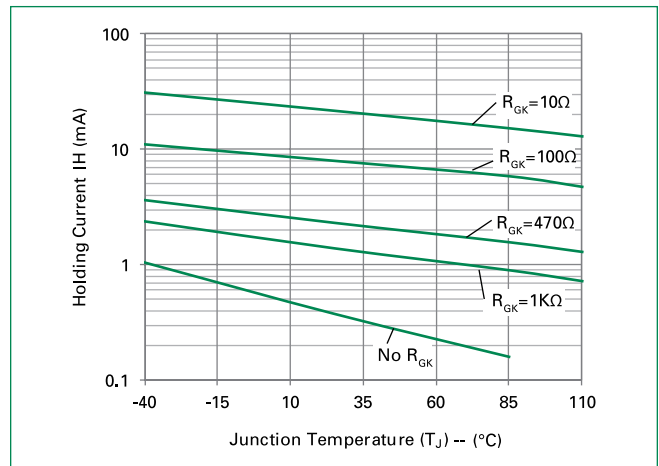
**Figure 13-2: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for S6008xS3**



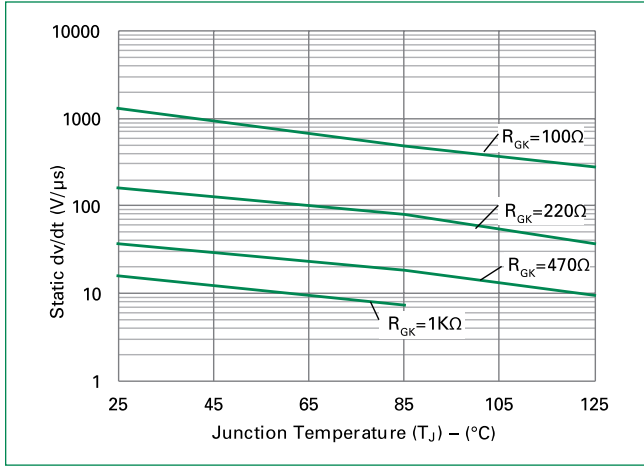
**Figure 14-1: Typical DC Holding Current with  $R_{GK}$  vs. Junction Temperature for S6008xS2**



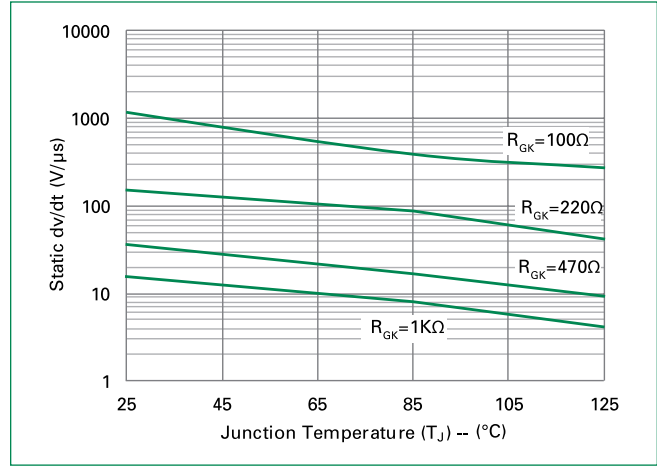
**Figure 14-1: Typical DC Holding Current with  $R_{GK}$  vs. Junction Temperature for S6008xS3**



**Figure 15-1: Typical Static dv/dt with  $R_{GK}$  vs. Junction Temperature for S6008xS2**



**Figure 15-2: Typical Static dv/dt with  $R_{GK}$  vs. Junction Temperature for S6008xS3**



**Figure 16-1: Typical turn off time with  $R_{GK}$  vs. Junction Temperature for S6008xS2**



**Figure 16-2: Typical DC Gate Trigger Current with  $R_{GK}$  vs. Junction Temperature for S6008xS3**



**Figure 17: 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

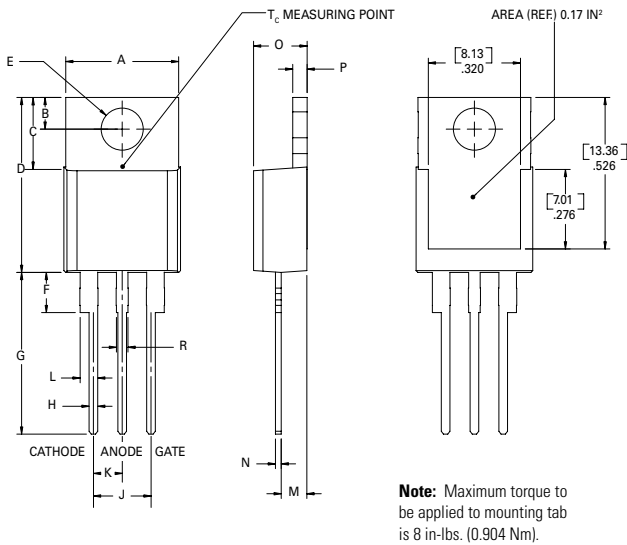
Test	Specifications and Conditions
<b>AC Blocking</b>	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
<b>Temperature Cycling</b>	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
<b>Temperature/Humidity</b>	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC; 85°C; 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 (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-220AB (L-Package) — Isolated Mounting Tab



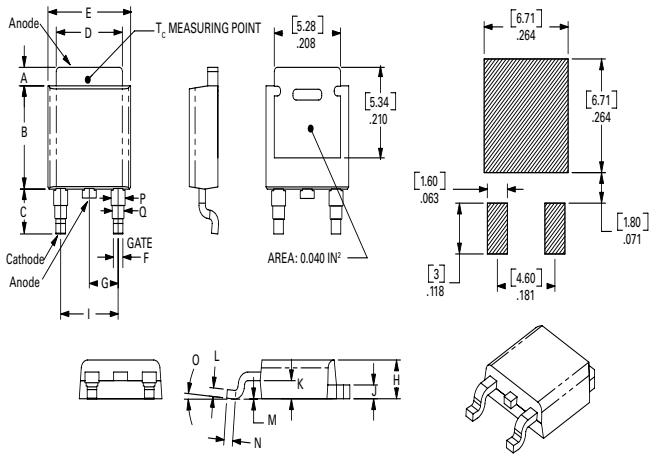
Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.380	0.420	9.65	10.67
B	0.105	0.115	2.67	2.92
C	0.230	0.250	5.84	6.35
D	0.590	0.620	14.99	15.75
E	0.142	0.147	3.61	3.73
F	0.110	0.130	2.79	3.30
G	0.540	0.575	13.72	14.61
H	0.025	0.035	0.64	0.89
J	0.195	0.205	4.95	5.21
K	0.095	0.105	2.41	2.67
L	0.060	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-251AA (V/I-Package) — V/I-PAK Through Hole



Dimension	Inches			Millimeters		
	Min	Typ	Max	Min	Typ	Max
A	0.037	0.040	0.043	0.94	1.01	1.09
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	0.035	0.037	0.039	0.90	0.95	1.00
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	0.037	0.040	0.043	0.94	1.01	1.09
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	0.035	0.037	0.039	0.90	0.95	1.00
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

### Product Selector

Part Number	Voltage				Gate Sensitivity	Type	Package
	400V	600V	800V	1000V			
Sxx08RS2	X	X	-	-	0.2mA	Sensitive SCR	TO-220R
Sxx08LS2	X	X	-	-	0.2mA	Sensitive SCR	TO-220L
Sxx08VS2	X	X	-	-	0.2mA	Sensitive SCR	TO-251
Sxx08DS2	X	X	-	-	0.2mA	Sensitive SCR	TO-252
Sxx08RS3	X	X	-	-	0.5mA	Sensitive SCR	TO-220R
Sxx08LS3	X	X	-	-	0.5mA	Sensitive SCR	TO-220L
Sxx08VS3	X	X	-	-	0.5mA	Sensitive SCR	TO-251
Sxx08DS3	X	X	-	-	0.5mA	Sensitive SCR	TO-252
Sxx08R	X	X	X	X	15mA	Standard SCR	TO-220R
Sxx08L	X	X	X	X	15mA	Standard SCR	TO-220L
Sxx08V	X	X	X	X	15mA	Standard SCR	TO-251
Sxx08D	X	X	X	X	15mA	Standard SCR	TO-252
Sxx08NS2	X	X	-	-	0.2mA	Sensitive SCR	TO-263
Sxx08NS3	X	X	-	-	0.5mA	Sensitive SCR	TO-263
Sxx08N	X	X	X	X	15mA	Standard SCR	TO-263
Sxx08DS1	-	X	-	-	50µA	Sensitive SCR	TO-252
Sxx08DS4	-	X	-	-	100µA	Sensitive SCR	TO-252

Note: xx = Voltage/10

### Packing Options

Part Number	Marking	Weight	Packing Mode	Base Quantity
Sxx08L/RyyTP	Sxx08L/Ryy	2.2 g	Tube	1000 (50 per tube)
Sxx08DyyTP	Sxx08Dyy	0.3 g	Tube	750 (75 per tube)
Sxx08DyyRP	Sxx08Dyy	0.3 g	Embossed Carrier	2500
Sxx08VyyTP	Sxx08Vyy	0.4 g	Tube	750 (75 per tube)
Sxx08L/RTP	Sxx08L/R	2.2 g	Tube	1000 (50 per tube)
Sxx08DTP	Sxx08D	0.3 g	Tube	750 (75 per tube)
Sxx08DRP	Sxx08D	0.3 g	Embossed Carrier	2500
Sxx08NyyTP	Sxx08Nyy	1.6g	Tube	1000 (50 per tube)
Sxx08NyyRP	Sxx08Nyy	1.6g	Embossed Carrier	500
Sxx08NTP	Sxx08N	1.6g	Tube	1000 (50 per tube)
Sxx08NRP	Sxx08N	1.6g	Embossed Carrier	500
Sxx08VRP	Sxx08V	0.4 g	Tube	750 (75 per tube)

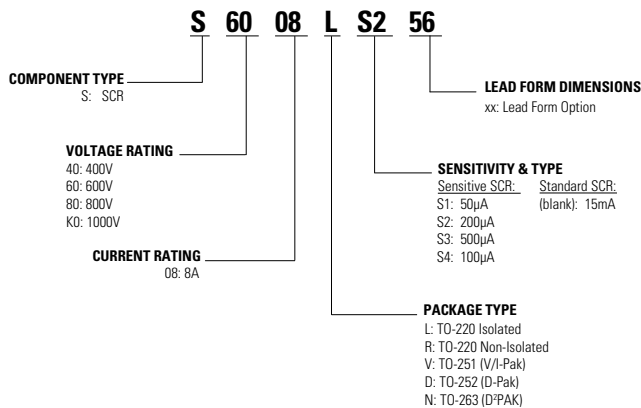
Note: xx = Voltage/10; yy = Sensitivity

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

Meets all EIA-481-2 Standards



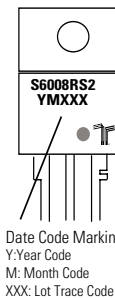
### Part Numbering System



### Part Marking System



### TO-263 AA - (N Package) TO-220 AB - (L and R Package)



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-  Alternative Solution
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