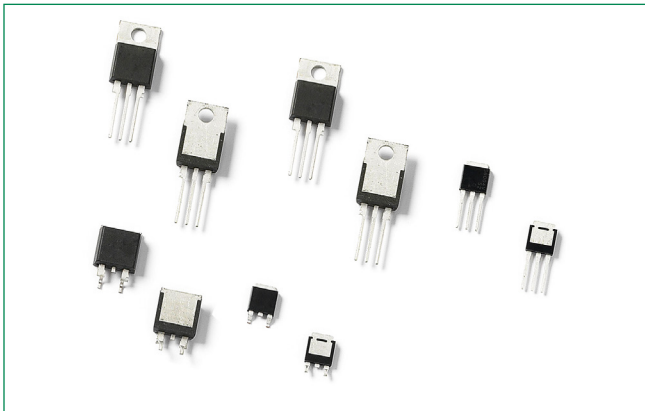




**THE DATASHEET OF  
S4012L**



Sxx12x Series



**Agency Approval**

Agency	Agency File Number
	E71639*

\* - L Packages Only

**Main Features**

Symbol	Value	Unit
$I_{T(RMS)}$	12	A
$V_{DRM}/V_{RRM}$	400 to 1000	V
$I_{GT}$	20	mA

**Additional Information**



Datasheet



Resources



Samples

**Description**

This Sxx12x 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 20 mA at approximately 1.5V.

**Features & Benefits**

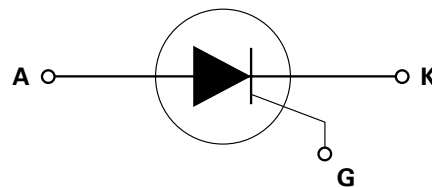
- Halogen-free and RoHS-compliant
- Glass – passivated junctions
- Electrically isolated “L-Package” is UL Recognized for 2500Vrms
- Voltage capability up to 1000 V
- Surge capability up to 120 A at 60 Hz half cycle

**Applications**

Typical applications includes capacitive discharge system for motorcycle engine CDI, portable generator engine ignition, strobe lights and nailers, as well as generic rectifiers, battery voltage regulators and converters. 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

Symbol	Parameter	Test Conditions		Value	Unit
$I_{T(RMS)}$	RMS on-state current	Sxx12L	$T_c = 72^\circ\text{C}$	12	A
		Sxx12R / Sxx12N Sxx12D Sxx12V	$T_c = 105^\circ\text{C}$		
$I_{T(AV)}$	Average on-state current	Sxx12L	$T_c = 72^\circ\text{C}$	7.6	A
		Sxx12R Sxx12D Sxx12V	$T_c = 105^\circ\text{C}$		
$I_{TSM}$	Peak non-repetitive surge current (single half cycle, $T_J$ (initial) = $25^\circ\text{C}$ )	Sxx12L	f = 50Hz	120	A
		Sxx12R / Sxx12N	f = 60Hz	130	
		Sxx12D	f = 50Hz	100	
		Sxx12V	f = 60Hz	120	
$I^2t$	$I^2t$ Value for fusing	Sxx12L Sxx12R / Sxx12N	$t_p = 8.3 \text{ ms}$	70	A <sup>2</sup> s
		Sxx12D Sxx12V		60	
di/dt	Critical rate of rise of on-state current	f = 60Hz; $T_J = 125^\circ\text{C}$		100	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	

Note: xx = voltage

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

Symbol	Test Conditions		Value	Unit	
$I_{GT}$	$V_D = 12\text{V}$ $R_L = 60 \Omega$	MAX.	20	mA	
		MIN.	1		
$V_{GT}$	$V_D = 12\text{V}$ $R_L = 60 \Omega$	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.	40	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 $\mu\text{s}$ $I_T = 20\text{A}$	TYP.	2	$\mu\text{s}$	

**Static Characteristics**

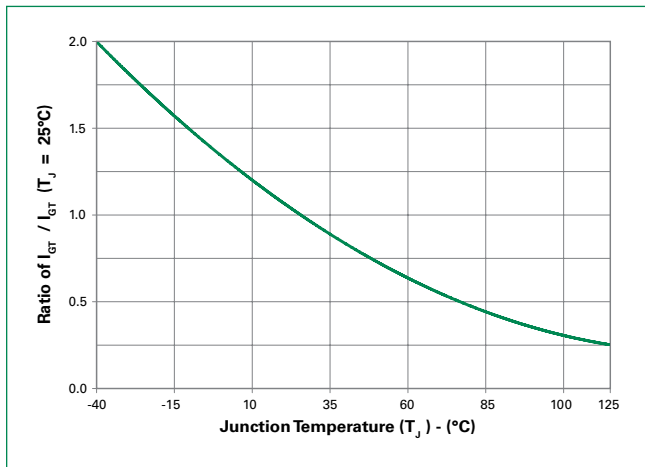
Symbol	Test Conditions		Value	Unit	
$V_{TM}$	$I_T = 24A; t_p = 380 \mu s$		MAX.	1.6	V
$I_{DRM} / I_{RRM}$	$V_{DRM} = V_{RRM}$	$T_J = 25^\circ C$	400 – 600V	10	$\mu A$
			800 – 1000V	20	
		$T_J = 100^\circ C$	400 – 800V	500	
			1000V	3000	
$T_J = 125^\circ C$	400 – 800V	1000			

**Thermal Resistances**

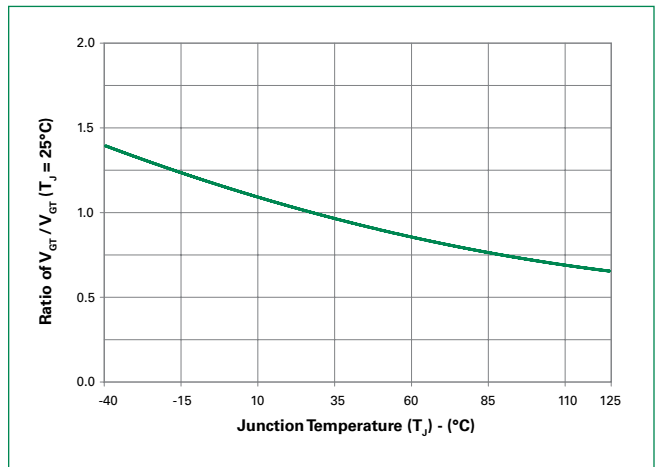
Symbol	Parameter	Value	Unit	
$R_{\theta(J-C)}$	Junction to case (AC)	Sxx12L	3.2	$^\circ C/W$
		Sxx12R / Sxx12N	1.5	
		Sxx12V	1.6	
		Sxx12D	1.4	
$R_{\theta(J-A)}$	Junction to ambient	Sxx12L	50	$^\circ C/W$
		Sxx12R	40	
		Sxx12V	70	

Note: xx = voltage

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



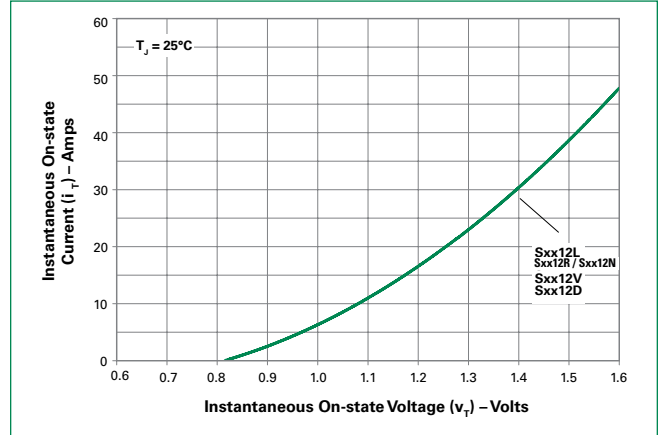
**Figure 2: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



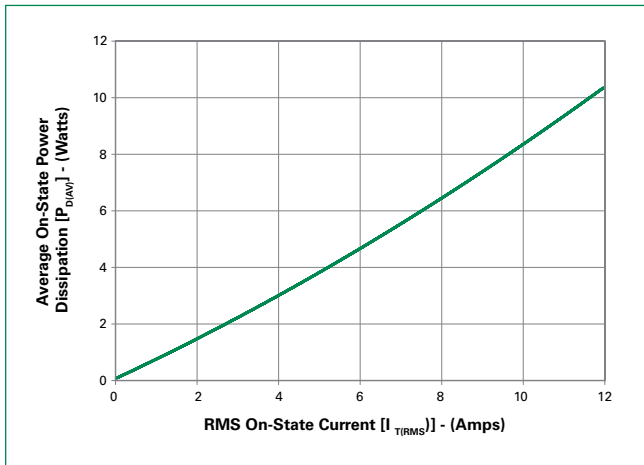
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



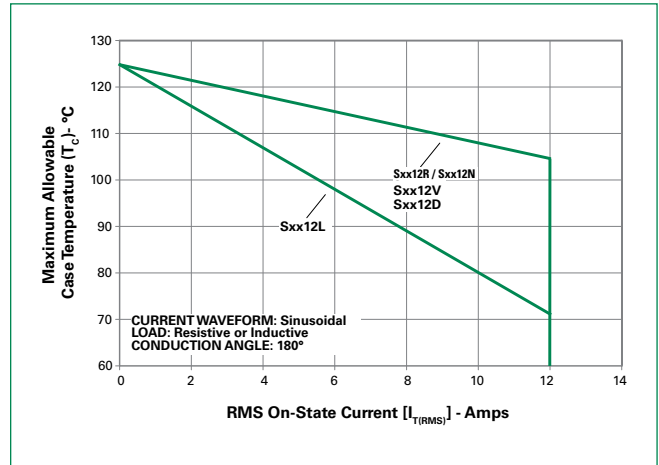
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



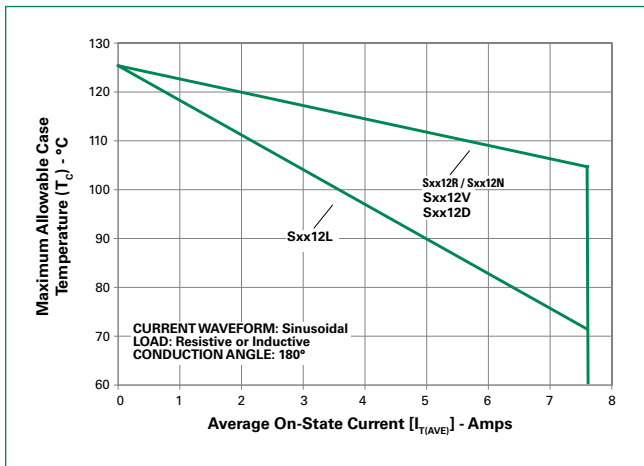
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



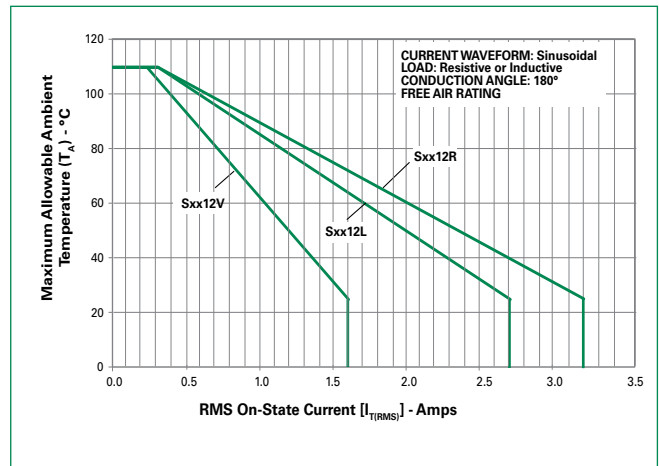
**Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current**



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

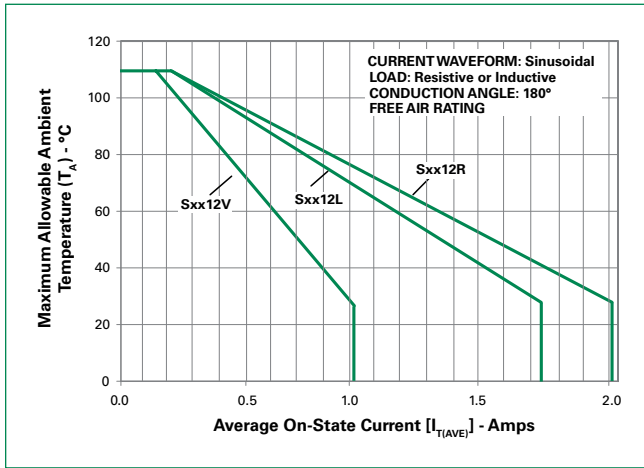


**Figure 8: Maximum Allowable Ambient Temperature vs. RMS On-State Current**

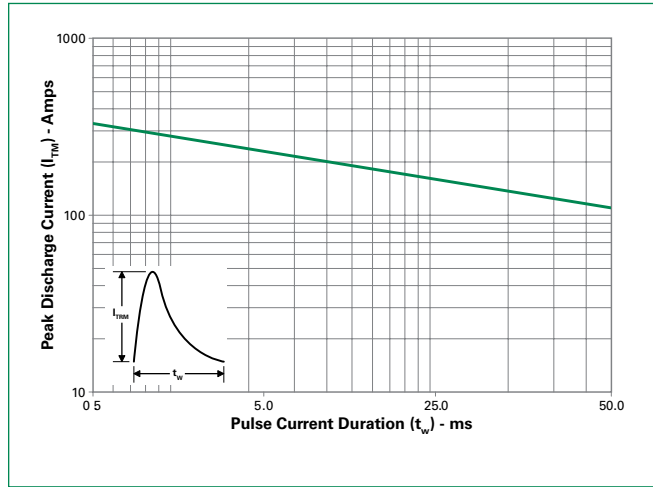


Note: xx = voltage

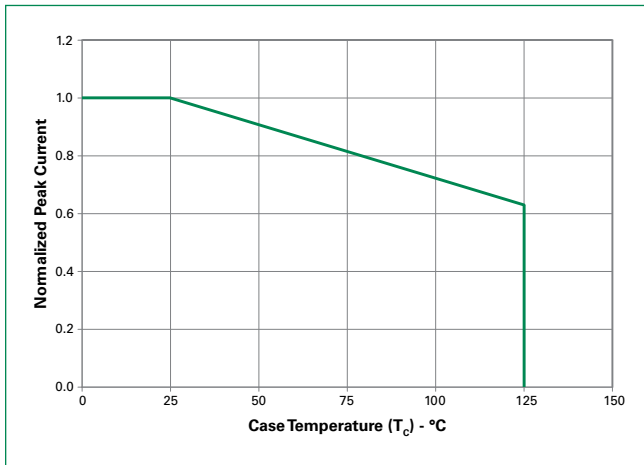
**Figure 9: Maximum Allowable Ambient Temperature vs. Average On-State Current**



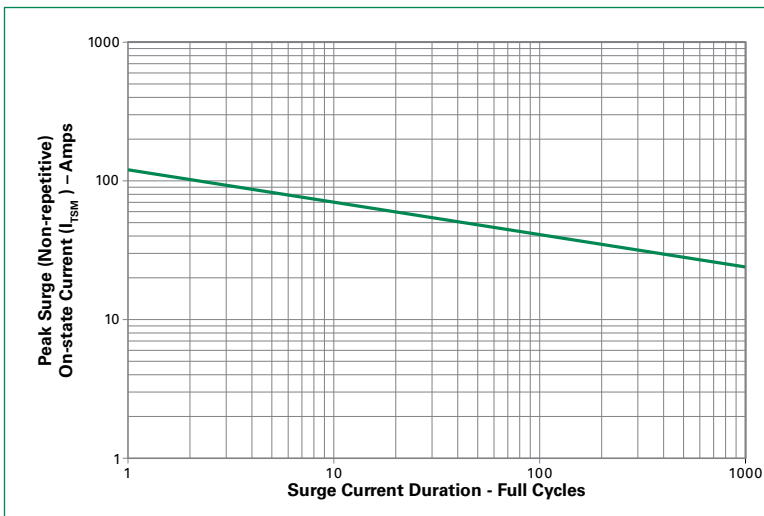
**Figure 10: Peak Capacitor Discharge Current**



**Figure 11: Peak Capacitor Discharge Current Derating**



**Figure 12: Surge Peak On-State Current vs. Number of Cycles**



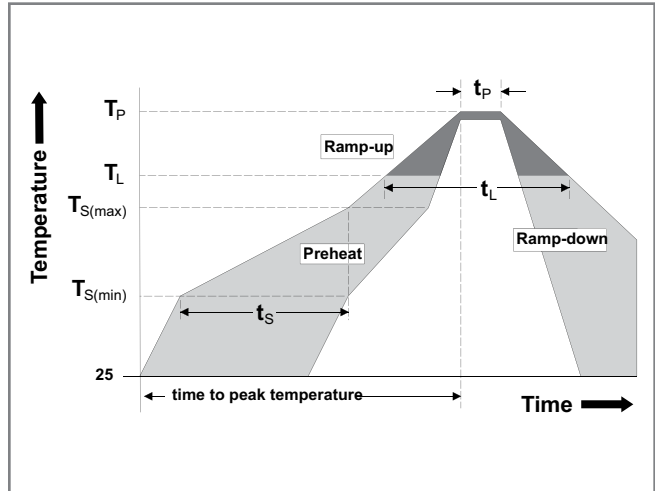
**SUPPLY FREQUENCY:** 60 Hz Sinusoidal  
**LOAD:** Resistive  
**RMS On-State Current [I<sub>T(RMS)</sub>]:** Maximum Rated Value at Specified Case Temperature

**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**

<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

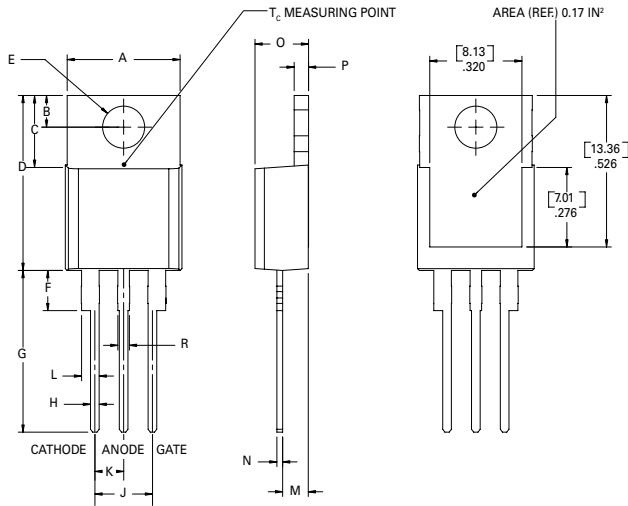
**Design Considerations**

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**

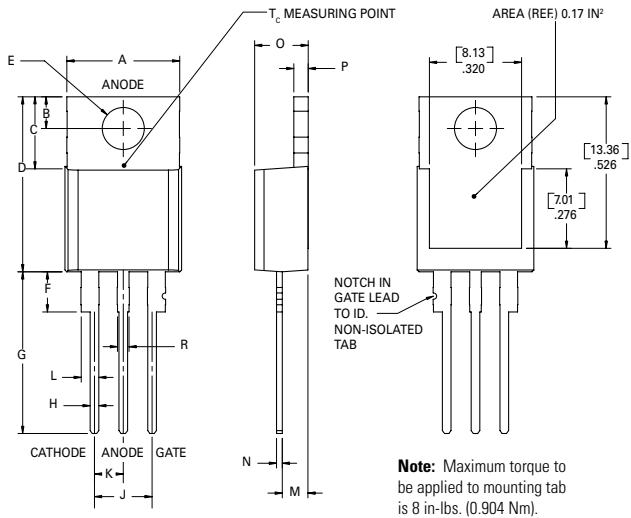
Test	Specifications and Conditions
<b>AC Blocking</b>	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
<b>Temperature Cycling</b>	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
<b>Temperature/Humidity</b>	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C;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

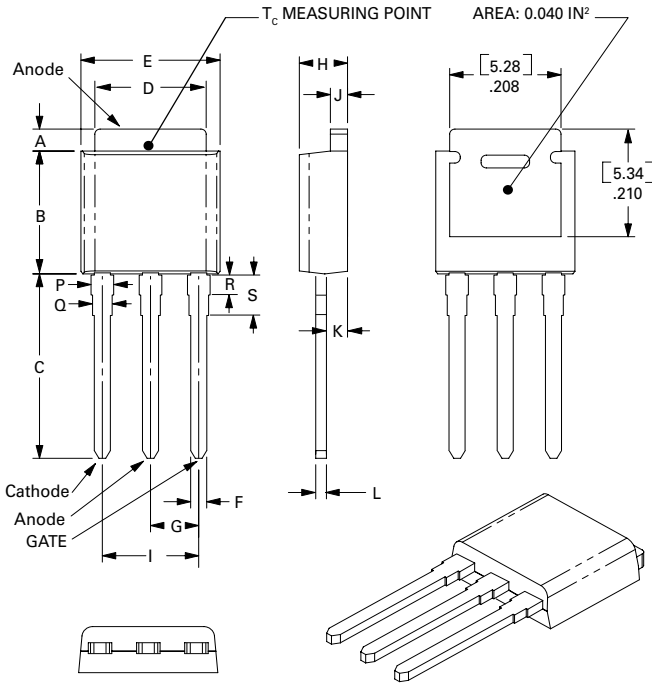
### Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead



**Note:** Maximum torque to be applied to mounting tab is 8 in-lbs. (0.904 Nm).

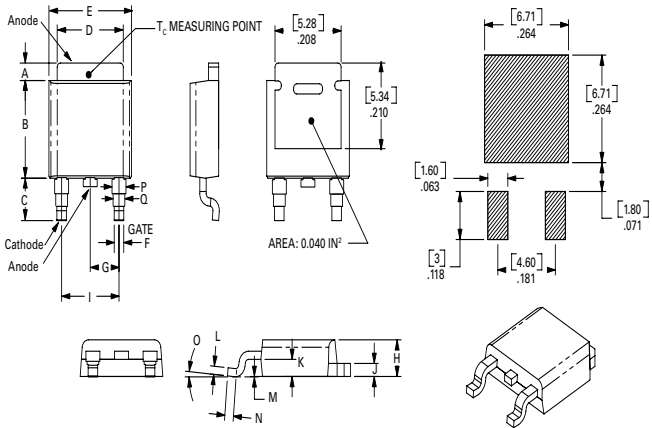
Dimension	Inches		Millimeters	
	Min	Max	Min	Max
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C	0.230	0.250	5.84	6.35
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E	0.142	0.147	3.61	3.73
F	0.110	0.130	2.79	3.30
G	0.540	0.575	13.72	14.61
H	0.025	0.035	0.64	0.89
J	0.195	0.205	4.95	5.21
K	0.095	0.105	2.41	2.67
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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**



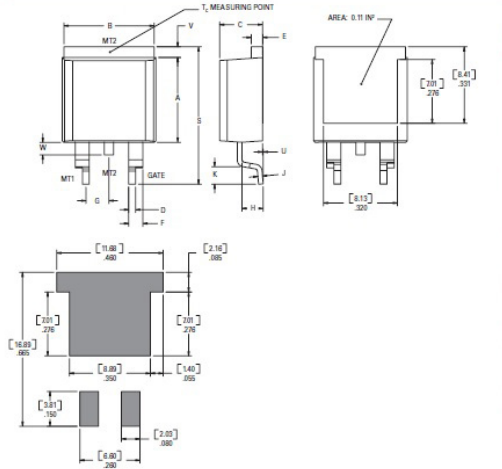
Dimension	Inches			Millimeters		
	Min	Typ	Max	Min	Typ	Max
A	0.040	0.044	0.050	1.02	1.11	1.27
B	0.235	0.242	0.245	5.97	6.15	6.22
C	0.350	0.361	0.375	8.89	9.18	9.53
D	0.205	0.208	0.213	5.21	5.29	5.41
E	0.255	0.262	0.265	6.48	6.66	6.73
F	0.027	0.031	0.033	0.69	0.80	0.84
G	0.087	0.090	0.093	2.21	2.28	2.36
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	0.038	0.040	0.044	0.97	1.01	1.12
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	0.040	0.043	0.050	1.02	1.09	1.27
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	0.038	0.040	0.044	0.97	1.02	1.12
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

**Dimensions — TO-263 (N-Package) — D<sup>2</sup>PAK Surface Mount**



Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.360	0.370	9.14	9.40
B	0.380	0.420	9.65	10.67
C	0.178	0.188	4.52	4.78
D	0.025	0.035	0.64	0.89
E	0.045	0.060	1.14	1.52
F	0.060	0.075	1.52	1.91
G	0.095	0.105	2.41	2.67
H	0.092	0.102	2.34	2.59
J	0.018	0.024	0.46	0.61
K	0.090	0.110	2.29	2.79
S	0.590	0.625	14.99	15.88
V	0.035	0.045	0.89	1.14
U	0.002	0.010	0.05	0.25
W	0.040	0.070	1.02	1.78

**Product Selector**

Part Number	Voltage				Gate Sensitivity	Type	Package
	400V	600V	800V	1000V			
Sxx12L	X	X	X	X	20mA	Sensitive SCR	TO-220L
Sxx12R	X	X	X	X	20mA	Sensitive SCR	TO-220R
Sxx12V	X	X	X	X	20mA	Standard SCR	TO-251
Sxx12D	X	X	X	X	20mA	Standard SCR	TO-252
Sxx12N	X	X	X	X	20mA	Standard SCR	TO-263

Note: xx = voltage/10

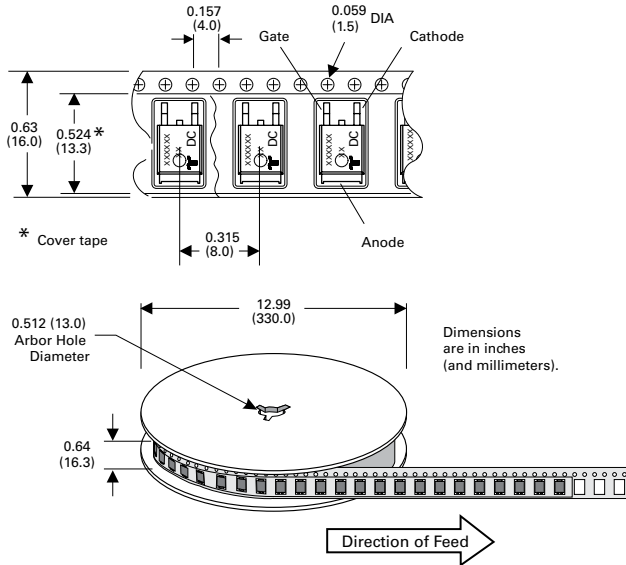
**Packing Options**

Part Number	Marking	Weight	Packing Mode	Base Quantity
Sxx12LTP	Sxx12L	2.2 g	Tube	1000 (50 per tube)
Sxx12RTP	Sxx12R	2.2 g	Tube	1000 (50 per tube)
Sxx12DTP	Sxx12D	0.3 g	Tube	750 (75 per tube)
Sxx12DRP	Sxx12D	0.3 g	Embossed Carrier	2500
Sxx12VTP	Sxx12V	0.4 g	Tube	750 (75 per tube)
Sxx12NRP	Sxx12N	1.6g	Embossed Carrier	2500
Sxx12NTP	Sxx12N	1.6 g	Tube	1000 (50 per tube)

Note: xx = Voltage/10

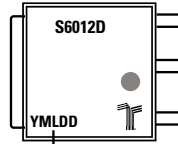
### TO-252 Embossed Carrier Reel Pack (RP) Specifications

Meets all EIA-481-2 Standards



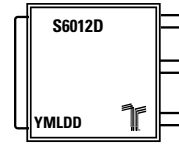
### Part Marking System

TO-251AA - (V Package)

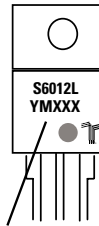


Date Code Marking  
 Y: Year Code  
 M: Month Code  
 L: Location Code  
 DD: Calendar Code

TO-252AA - (D Package)



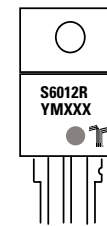
TO-220 AB - (L Package)



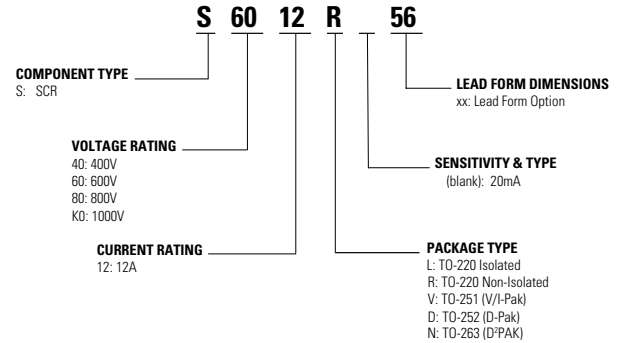
Date Code Marking  
 Y: Year Code

TO-263AA (N Package)

TO-220 AB - (R Package)




### Part Numbering System



## Looking for pricing, stock, or lifecycle information?

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