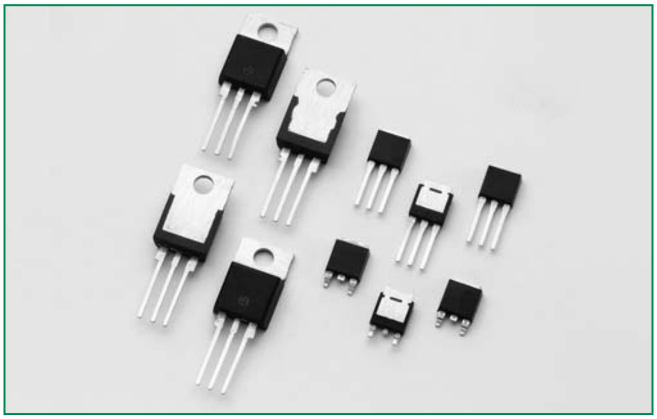
RoHS

Sxx06xSx & Sxx06x Series



Description

Excellent unidirectional switches for phase control applications such as heating and motor speed controls.

Sensitive gate SCRs are easily triggered with microAmps of current as furnished by sense coils, proximity switches, and microprocessors.

Standard phase control SCRs are triggered with few milliamperes of current at less than 1.5V potential.

Features & Benefits

- RoHS compliant
- Glass – passivated junctions
- Voltage capability up to 1000 V
- Surge capability up to 100 A

Applications

Typical applications are capacitive discharge systems for strobe lights, nailers, staplers and gas engine ignition. Also controls for power tools, home/brown goods and white goods appliances.

Internally constructed isolated packages are offered for ease of heat sinking with highest isolation voltage.

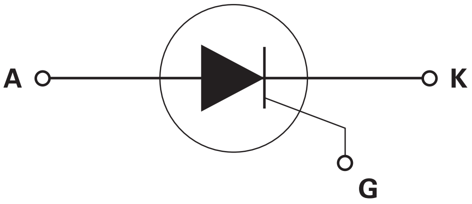
Agency Approval

Agency	Agency File Number
®	L Package: E71639

Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	6	A
V_{DRM}/V_{RRM}	400 to 1000	V
I_{GT}	0.2 to 15	mA

Schematic Symbol



Absolute Maximum Ratings — Sensitive SCRs

Symbol	Parameter	Test Conditions		Value	Unit
$I_{T(RMS)}$	RMS on-state current	Sxx06LSy	T_C = 80°C	6	A
		Sxx06RSy Sxx06DSy Sxx06VSy	T_C = 95°C		
I_{TSM}	Peak non-repetitive surge current	single half cycle; f = 50Hz; T_J (initial) = 25°C		83	A
		single half cycle; f = 60Hz; T_J (initial) = 25°C		100	
I^2t	I^2t Value for fusing	t_p = 8.3 ms		41	A^2s
di/dt	Critical rate of rise of on-state current	f = 60Hz; T_J = 110°C		100	A/μs
I_{GTM}	Peak gate current	T_J = 110°C		1	A
$P_{G(AV)}$	Average gate power dissipation	T_J = 110°C		0.1	W
T_{stg}	Storage temperature range			-40 to 150	°C
T_J	Operating junction temperature range			-40 to 110	°C

Note: xx = voltage, y = sensitivity

Absolute Maximum Ratings — Standard SCRs

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current	Sxx06L	T_C = 100°C	6	A
		Sxx06R Sxx06D Sxx06V	T_C = 110°C		
I_{TSM}	Peak non-repetitive surge current	single half cycle; f = 50Hz; T_J (initial) = 25°C		83	A
		single half cycle; f = 60Hz; T_J (initial) = 25°C		100	
I^2t	I^2t value for fusing	t_p = 8.3 ms		41	A^2s
di/dt	Critical rate-of-rise of on-state current	f = 60Hz; T_J =125°C		100	A/μs
I_{GTM}	Peak gate current	T_J = 125°C		2	A
$P_{G(AV)}$	Average gate power dissipation	T_J = 125°C		0.5	W
T_{stg}	Storage temperature range			-40 to 150	°C
T_J	Operating junction temperature range			-40 to 125	°C

Note: xx = voltage

Electrical Characteristics (T_J = 25°C, unless otherwise specified) — Sensitive SCRs

Symbol	Test Conditions		Value		Unit
			Sxx06xS2	Sxx06xS3	
I_{GT}	V_D = 6V R_L = 100 Ω	MAX.	200	500	μA
V_{GT}		MAX.	0.8		V
dv/dt	$V_D = V_{DRM}$; R_{GK} = 1kΩ; T_J = 110°C	TYP.	8		V/μs
V_{GD}	$V_D = V_{DRM}$ R_L = 3.3 kΩ T_J = 110°C	MIN.	0.2		V
V_{GRM}	I_{GR} = 10μA	MIN.	6		V
I_H	I_T = 20mA (initial)	MAX.	6	8	mA
t_q	I_T = 2A; t_p= 50μs; dv/dt=5V/μs; di/dt=-30A/μs	MAX.	50	45	μs
t_{gt}	$I_G = 2 \times I_{GT}$ PW = 15μs I_T = 12A	TYP.	4	5	μs

Note: xx = voltage, x = package

Electrical Characteristics (T_J = 25°C, unless otherwise specified) — Standard SCRs

Symbol	Test Conditions			Value	Unit
				Sxx06x	
I_{GT}	V_D = 12V R_L = 60 Ω		MAX.	15	mA
V_{GT}			MAX.	1.5	V
dv/dt	$V_D = V_{DRM}$; gate open; T_J = 100°C	400V	MIN.	350	V/μs
		600V		300	
		800V		250	
		1000V		100	
	$V_D = V_{DRM}$; gate open; T_J = 125°C	400V		250	
		600V		225	
		800V		200	
V_{GD}	$V_D = V_{DRM}$ R_L = 3.3 kΩ T_J = 125°C		MIN.	0.2	V
I_H	I_T = 200mA (initial)		MAX.	30	mA
t_q	I_T = 2A; t_p= 50μs; dv/dt=5V/μs; di/dt=-30A/μs		MAX.	35	μs
t_{gt}	$I_G = 2 \times I_{GT}$ PW = 15μs I_T = 12A		TYP.	2	μs

Note: xx = voltage, x = package

Static Characteristics

Symbol	Test Conditions					Value	Unit
V_{TM}	I_T = 12A; t_p = 380 µs				MAX.	1.6	V
I_{DRM} / I_{RRM}	V_{DRM} = V_{RRM}	Sxx06xyy	T_J = 25°C	400 – 600V	MAX.	5	µA
			T_J = 110°C	400 – 600V		250	
		Sxx06x	T_J = 25°C	400 – 800V		10	
				1000V		20	
			T_J = 100°C	400 – 800V		200	
				1000V		3000	
			T_J = 125°C	400 – 800V		500	

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

Thermal Resistances

Symbol	Parameter		Value	Unit
$R_{\theta(J\text{-}C)}$	Junction to case (AC)	Sxx06RSy	2.6	°C/W
		Sxx06LSy	4.3	
		Sxx06VSy	2.4	
		Sxx06DSy	1.8	
		Sxx06R	2.5	
		Sxx06L	4.0	
		Sxx06V	2.3	
		Sxx06D	1.7	
$R_{\theta(J\text{-}A)}$	Junction to ambient	Sxx06RSy	40	°C/W
		Sxx06LSy	65	
		Sxx06VSy	85	
		Sxx06R	40	
		Sxx06L	50	
		Sxx06V	70	

Note: xx = voltage, y = sensitivity

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

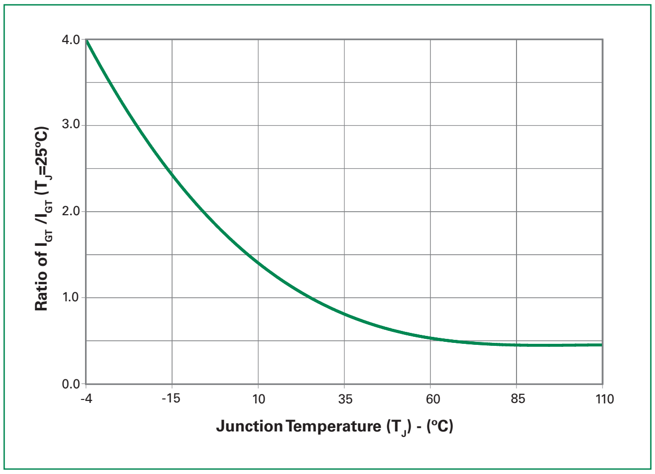


Figure 2: Normalized DC Gate Trigger Current vs. Junction Temperature (Standard SCR)

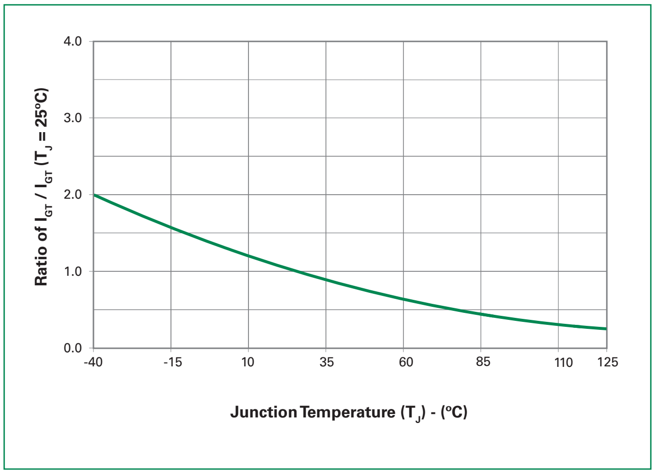


Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature

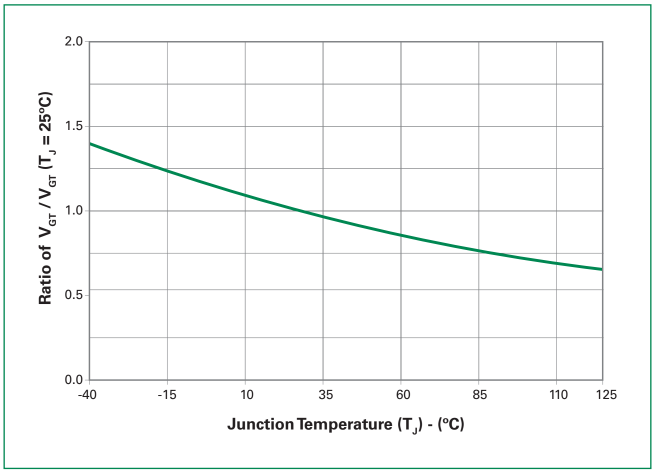


Figure 4: Normalized DC Holding Current vs. Junction Temperature

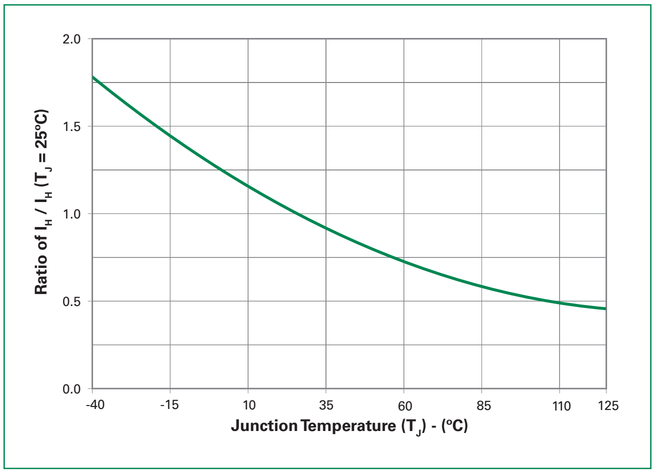


Figure 5: On-State Current vs. On-State Voltage (Typical)

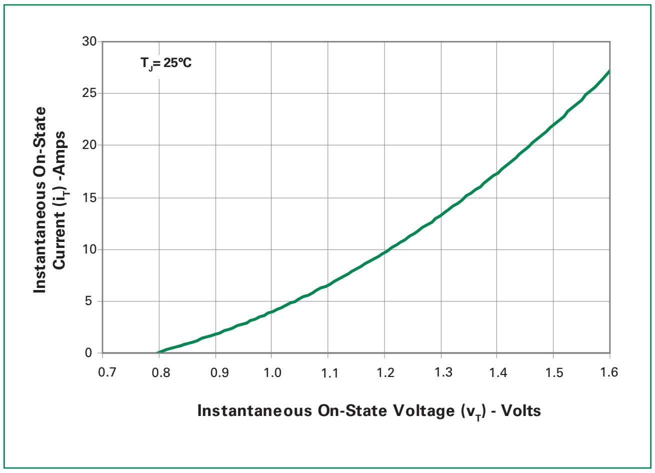


Figure 6: Power Dissipation (Typical) vs. RMS On-State Current

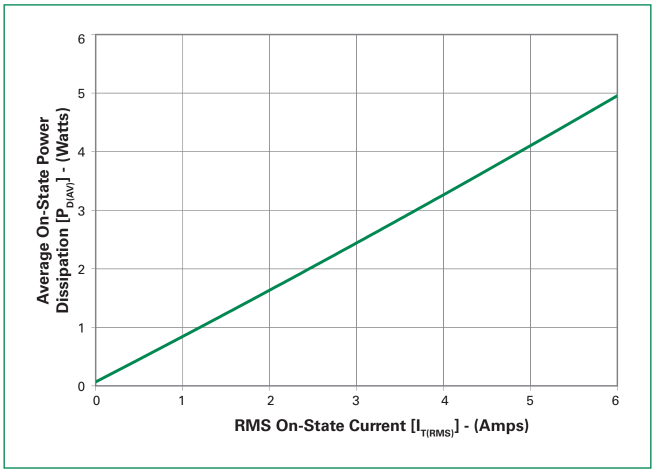


Figure 7: Maximum Allowable Case Temperature vs. RMS On-State Current

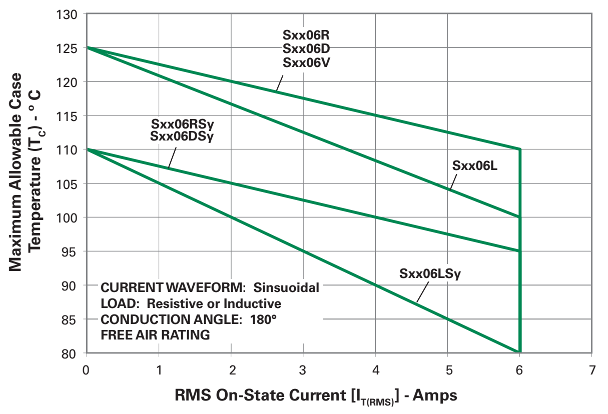


Figure 8: Maximum Allowable Case Temperature vs. Average On-State Current

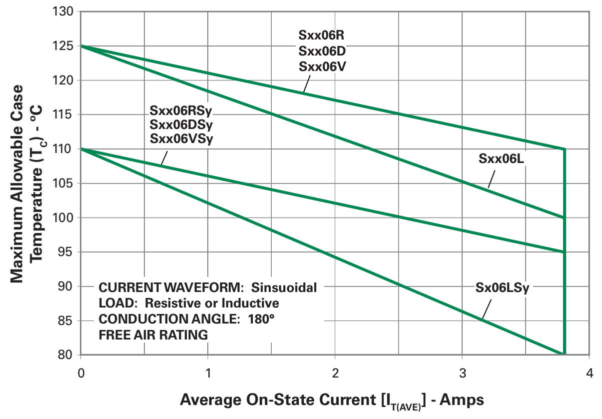


Figure 9: Maximum Allowable Ambient Temperature vs. RMS On-State Current

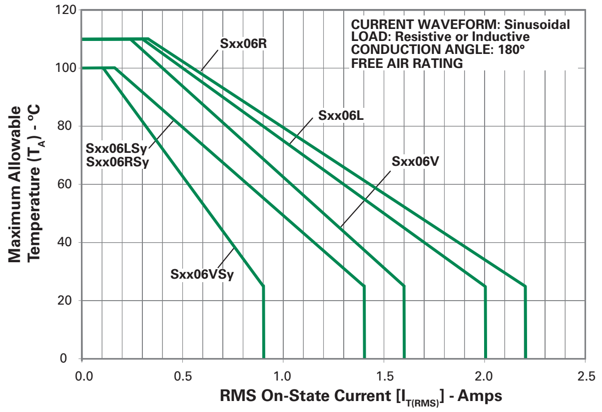
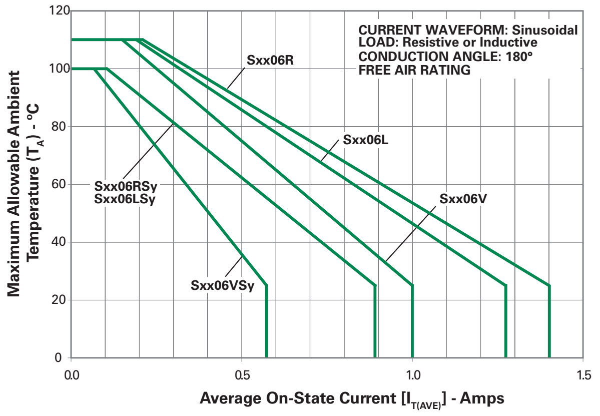


Figure 10: Maximum Allowable Ambient Temperature vs. Average On-State Current



Note: xx = voltage, y = sensitivity

Figure 11: Peak Capacitor Discharge Current

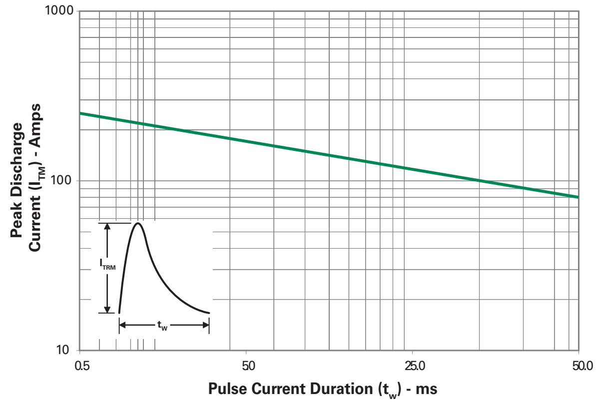


Figure 12: Peak Capacitor Discharge Current Derating

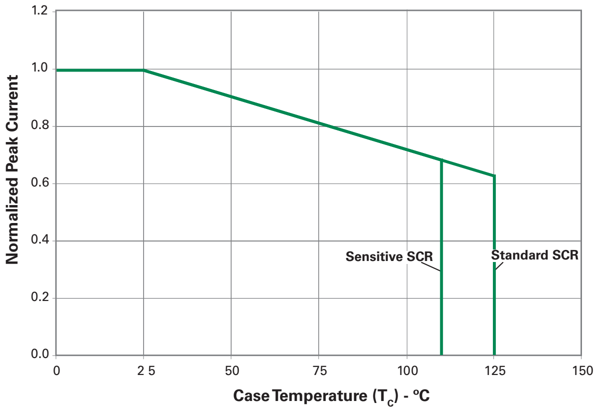
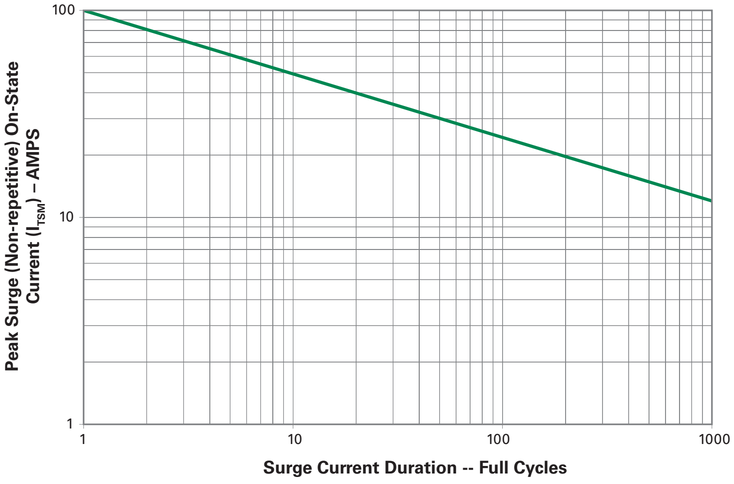


Figure 13: Surge Peak On-State Current vs. Number of Cycles



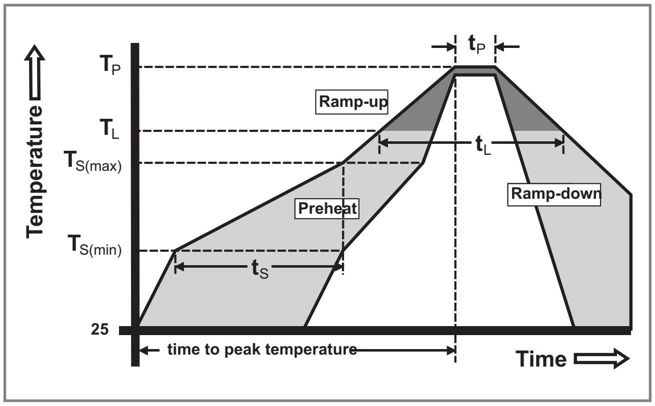
SUPPLY FREQUENCY: 60 Hz Sinusoidal
LOAD: Resistive
RMS On-State Current: [$I_{T(RMS)}$]: Maximum Rated Value at Specified Case Temperature

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

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 – 190 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
	- Temperature (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



Physical Specifications

Terminal Finish	100% Matte Tin-plated
Body Material	UL recognized epoxy meeting flammability classification 94V-0
Lead Material	Copper Alloy

Design Considerations

Careful selection of the correct device 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 device 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

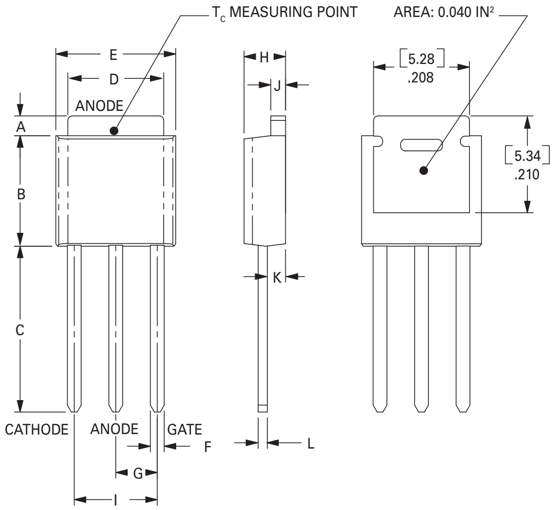
Test	Specifications and Conditions
AC Blocking	MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours
Temperature Cycling	MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time
Temperature/ Humidity	EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C; 85% rel humidity
High Temp Storage	MIL-STD-750, M-1031, 1008 hours; 150°C
Low-Temp Storage	1008 hours; -40°C
Thermal Shock	MIL-STD-750, M-1056 10 cycles; 0°C to 100°C; 5-min dwell-time at each temperature; 10 sec (max) transfer time between temperature
Autoclave	EIA / JEDEC, JESD22-A102 168 hours (121°C at 2 ATMs) and 100% R/H
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

Product Selector

Part Number	Voltage				Gate Sensitivity	Type	Package
	400V	600V	800V	1000V			
Sxx06RS2	X	X			0.2mA	Sensitive SCR	TO-220R
Sxx06LS2	X	X			0.2mA	Sensitive SCR	TO-220L
Sxx06VS2	X	X			0.2mA	Sensitive SCR	TO-251
Sxx06DS2	X	X			0.2mA	Sensitive SCR	TO-252
Sxx06RS3	X	X			0.5mA	Sensitive SCR	TO-220R
Sxx06LS3	X	X			0.5mA	Sensitive SCR	TO-220L
Sxx06VS3	X	X			0.5mA	Sensitive SCR	TO-251
Sxx06DS3	X	X			0.5mA	Sensitive SCR	TO-252
Sxx06R	X	X	X	X	15mA	Standard SCR	TO-220R
Sxx06L	X	X	X	X	15mA	Standard SCR	TO-220L
Sxx06V	X	X	X	X	15mA	Standard SCR	TO-251
Sxx06D	X	X	X	X	15mA	Standard SCR	TO-252

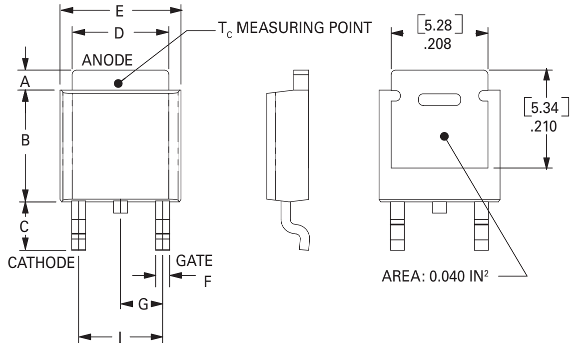
Note: xx = voltage

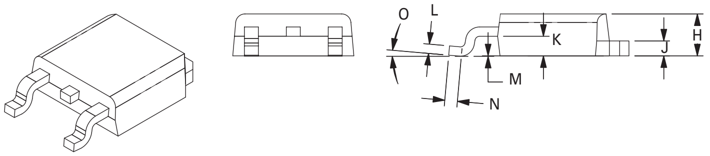
Dimensions — TO-251AA (V/I-Package) — V/I-PAK Through Hole



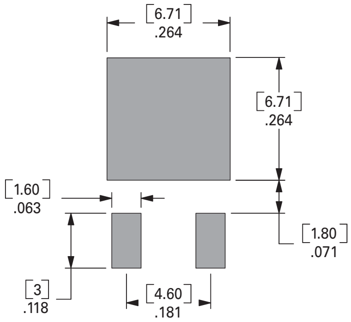
Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.040	0.050	1.02	1.27
B	0.235	0.245	5.97	6.22
C	0.350	0.375	8.89	9.53
D	0.205	0.213	5.21	5.41
E	0.255	0.265	6.48	6.73
F	0.027	0.033	0.69	0.84
G	0.087	0.093	2.21	2.36
H	0.085	0.095	2.16	2.41
I	0.176	0.184	4.47	4.67
J	0.018	0.023	0.46	0.58
K	0.038	0.044	0.97	1.12
L	0.018	0.023	0.46	0.58

Dimensions — TO-252AA (D-Package) — D-PAK Surface Mount



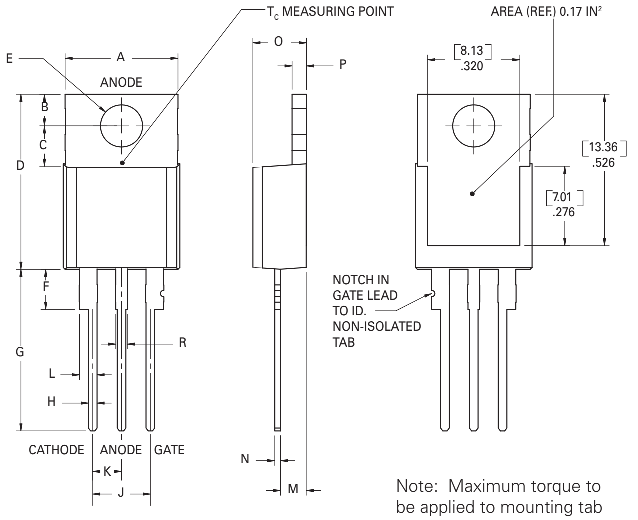


Pad Layout for TO-252AA (D-Package)



Dimension	Inches		Millimeters	
	Min	Max	Min	Max
A	0.040	0.050	1.02	1.27
B	0.235	0.245	5.97	6.22
C	0.106	0.113	2.69	2.87
D	0.205	0.213	5.21	5.41
E	0.255	0.265	6.48	6.73
F	0.027	0.033	0.69	0.84
G	0.087	0.093	2.21	2.36
H	0.085	0.095	2.16	2.41
I	0.176	0.184	4.47	4.67
J	0.018	0.023	0.46	0.58
K	0.038	0.044	0.97	1.12
L	0.018	0.023	0.46	0.58
M	0.000	0.004	0.00	0.10
N	0.021	0.027	0.53	0.69
O	0°	5°	0°	5°

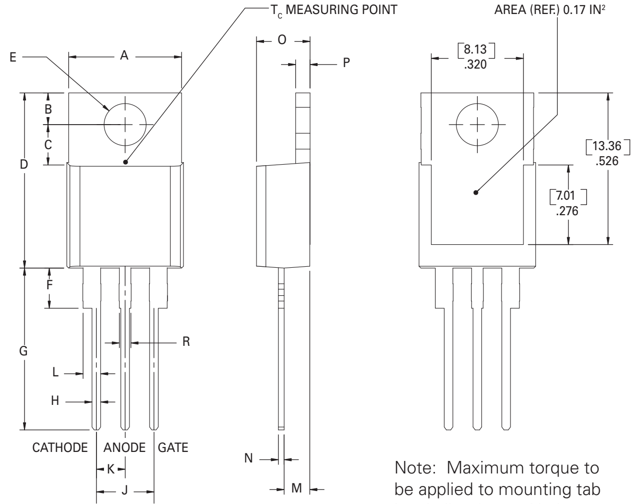
Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead



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

Dimension	Inches		Millimeters	
	Min	Max	Min	Max
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



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

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

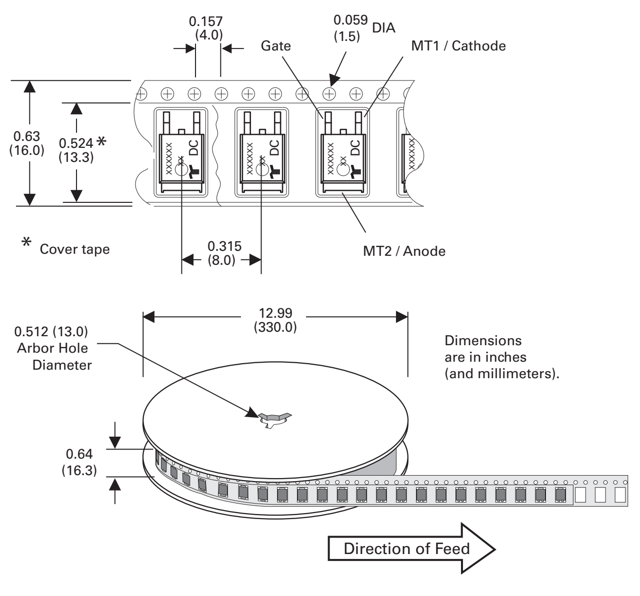
Packing Options

Part Number	Marking	Weight	Packing Mode	Base Quantity
Sxx06L/Ryy	Sxx06L/Ryy	2.2 g	Bulk	500
Sxx06L/RyyTP	Sxx06L/Ryy	2.2 g	Tube	500
Sxx06DyyTP	Sxx06Dyy	0.3 g	Tube	750
Sxx06DyyRP	Sxx06Dyy	0.3 g	Embossed Carrier	2500
Sxx06VyyTP	Sxx06Vyy	0.4 g	Tube	750
Sxx06VyyRP	Sxx06Vyy	0.4 g	Embossed Carrier	2500
Sxx06L/R	Sxx06L/R	2.2 g	Bulk	500
Sxx06L/RTP	Sxx06L/R	2.2 g	Tube	500
Sxx06DTP	Sxx06D	0.3 g	Tube	750
Sxx06DRP	Sxx06D	0.3 g	Embossed Carrier	2500
Sxx06VTP	Sxx06V	0.4 g	Tube	750
Sxx06VRP	Sxx06V	0.4 g	Embossed Carrier	2500

Note: xx = Voltage; yy = Sensitivity

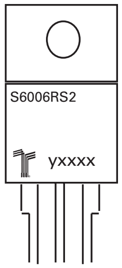
TO-252 Embossed Carrier Reel Pack (RP) Specs

Meets all EIA-481-2 Standards

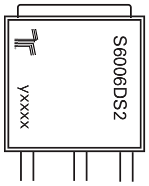


Part Marking System

TO-220AB (R and L Packages)



TO-251AA – (V Package)
TO-252AA – (D Package)



Part Numbering System

S 60 06 L S2 56

DEVICE TYPE
S: SCR

VOLTAGE RATING
40: 400V
60: 600V
80: 800V
K0: 1000V

CURRENT RATING
06: 6A

LEAD FORM DIMENSIONS
xx: Lead Form Option

SENSITIVITY & TYPE
Sensitive SCR:
S2: 200μA
S3: 500μA
Standard SCR:
(blank): 15mA

PACKAGE TYPE
L: TO-220 Isolated
R: TO-220 Non-Isolated
V: TO-251 (V/I-Pak)
D: TO-252 (D-Pak)