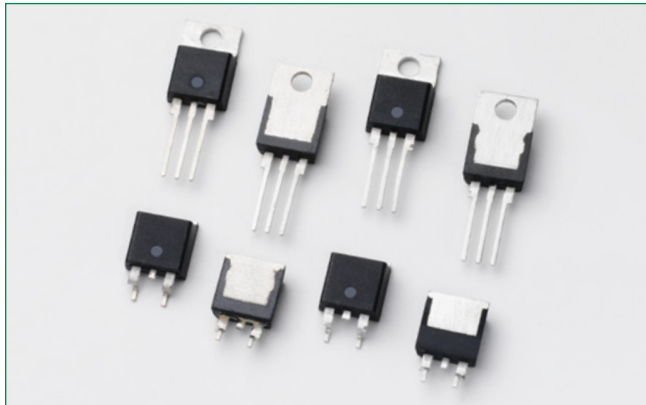



### Q6012xH1LED Series



#### Agency Approval

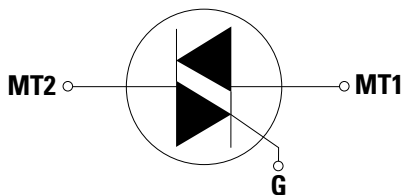
Agency	Agency File Number
	E71639*

\* - L Package only

#### Main Features

Symbol	Value	Unit
$I_{T(RMS)}$	12	A
$V_{DRM}/V_{RRM}$	600	V
$I_{GT}$	10	mA

#### Schematic Symbol



#### Additional Information



Datasheet



Resources



Samples

#### Description

Q6012xH1LED series is designed to meet low load current characteristics typical in LED lighting applications.

By keeping holding current at 8mA maximum, this Triac series is characterized and specified to perform best with LED loads. The Q6012xH1LED series is best suited for LED dimming controls to obtain the lowest levels of light output with a minimum probability of flickering.

#### Features

- RoHS-compliant
- As low as 8mA max holding current
- L-Package is UL Recognized for 2500Vrms
- 110°C rated junction temperature
- di/dt performance of 70A/μs
- QUADRAC version includes intergrated DIAC
- Provides full control of light out put at the extreme low end of load conditions.
- 2500V<sub>AC</sub> min isolation between mounting tab and active terminals
- Improves margin of safe operation with less heat sinking required
- Enable survivability of typically LED load operating characteristics
- Simplicity of circuit design & layout
- UL 1557 as an Electrically Isolated Semiconductor Device

#### Applications

Excellent for AC switching and phase control applications such as heating, lighting, and motor speed controls.

Typical applications are AC solid-state switches, lighting controls with LED lamp loads, small low current motor in power tools, lower current motor in home/brown goods appliances.

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

### Absolute Maximum Ratings

Symbol	Parameter	Value	Unit		
$I_{T(RMS)}$	RMS on-state current (full sine wave)	Q6012LH1LED	$T_C = 90^\circ\text{C}$	12	A
		Q6012RH1LED Q6012NH1LED			
$I_{TSM}$	Non repetitive surge peak on-state current (full cycle, $T_J$ initial = $25^\circ\text{C}$ )	$f = 50\text{ Hz}$	$t = 20\text{ ms}$	110	A
		$f = 60\text{ Hz}$	$t = 16.7\text{ ms}$	120	
$I^2t$	$I^2t$ Value for fusing	-	$t_p = 8.3\text{ ms}$	60	$\text{A}^2\text{s}$
$di/dt$	Critical rate of rise of on-state current	$f = 120\text{ Hz}$	$T_J = 110^\circ\text{C}$	70	$\text{A}/\mu\text{s}$
$I_{GTM}$	Peak gate trigger current	$t_p \leq 10\ \mu\text{s};$ $I_{GT} \leq I_{GTM}$	$T_J = 110^\circ\text{C}$	2.0	A
$P_{G(AV)}$	Average gate power dissipation	-	$T_J = 110^\circ\text{C}$	0.5	W
$T_{stg}$	Storage temperature range	-	-	-40 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range	-	-	-40 to 110	$^\circ\text{C}$

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

Symbol	Test Conditions	Quadrant	Value	Unit	
$I_{GT}$	$V_D = 12\text{V}$ $R_L = 60\ \Omega$	I – II – III	MAX.	10	mA
$V_{GT}$		I – II – III	MAX.	1.3	V
$V_{GD}$	$V_D = V_{DRM}$ $R_L = 3.3\text{ k}\Omega$ $T_J = 110^\circ\text{C}$	I – II – III	MIN.	0.2	V
$I_H$	$I_T = 20\text{mA}$		MAX.	8	mA
$dv/dt$	$V_D = V_{DRM}$ Gate Open $T_J = 110^\circ\text{C}$		MIN.	45	$\text{V}/\mu\text{s}$
$(dv/dt)_c$	$(di/dt)_c = 6.5\text{ A/ms}$ $T_J = 110^\circ\text{C}$		MIN.	2	$\text{V}/\mu\text{s}$
$t_{gt}$	$I_G = 2 \times I_{GT}$ $\text{PW} = 15\mu\text{s}$ $I_T = 17.0\text{ A(pk)}$		TYP.	4	$\mu\text{s}$

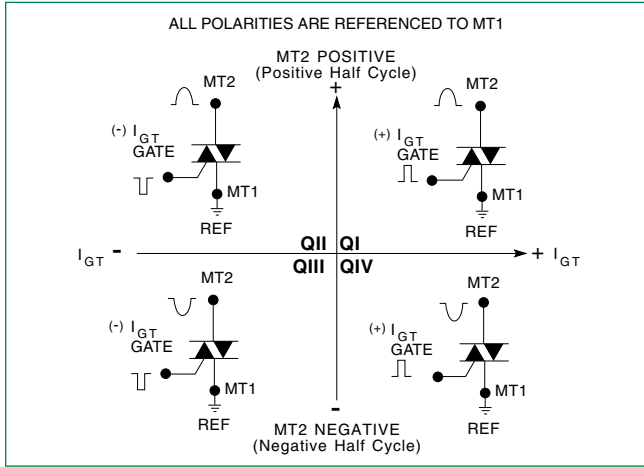
### Static Characteristics

Symbol	Test Conditions	Value	Unit		
$V_{TM}$	$I_{TM} = 17.0\text{A}$ $t_p = 380\ \mu\text{s}$	MAX.	1.60	V	
$I_{DRM}$ $I_{RRM}$	$V_D = V_{DRM} / V_{RRM}$	$T_J = 25^\circ\text{C}$	MAX.	10	$\mu\text{A}$
		$T_J = 110^\circ\text{C}$		1	mA

### Thermal Resistances

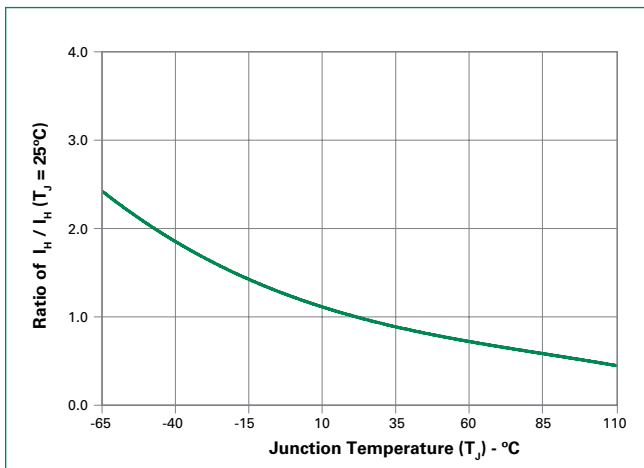
Symbol	Parameter	Value	Unit	
$R_{\theta(J-C)}$	Junction to case (AC)	Q6012LH1LED	2.3	$^\circ\text{C}/\text{W}$
		Q6012RH1LED	1.2	
		Q6012NH1LED		

**Figure 1: Definition of Quadrants**

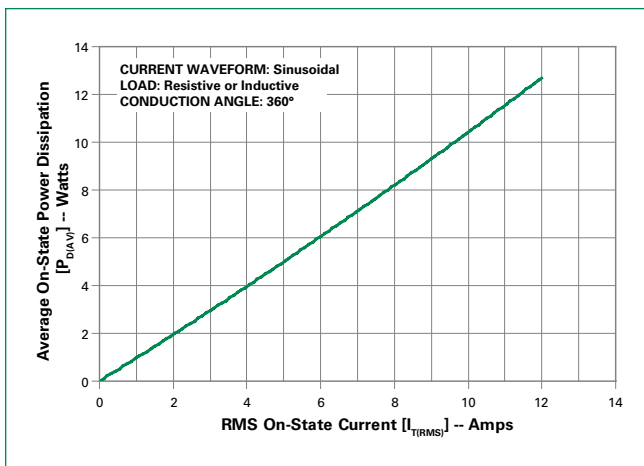


Note: Alternistors will not operate in QIV

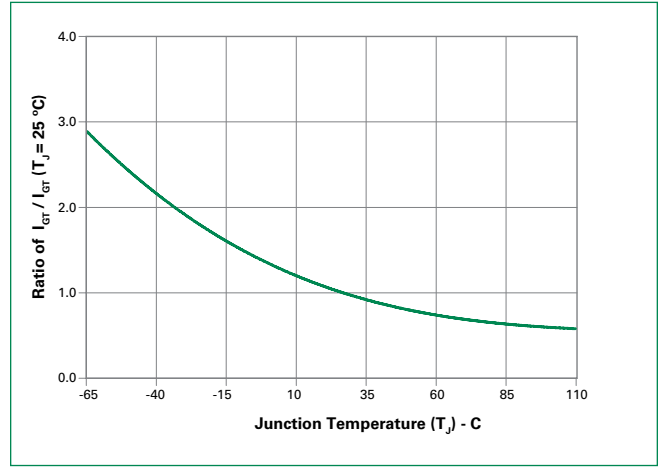
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



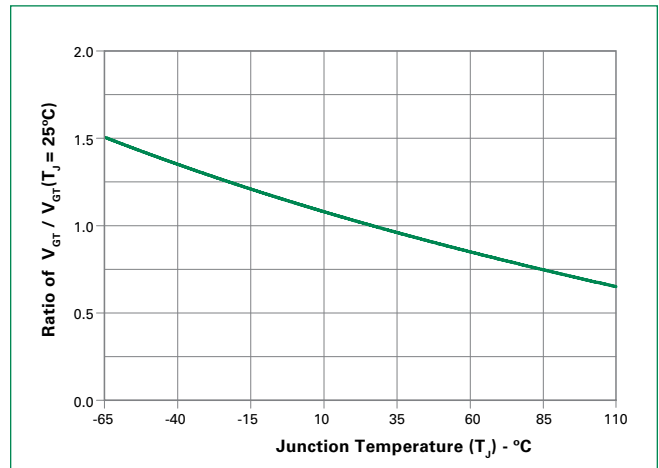
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



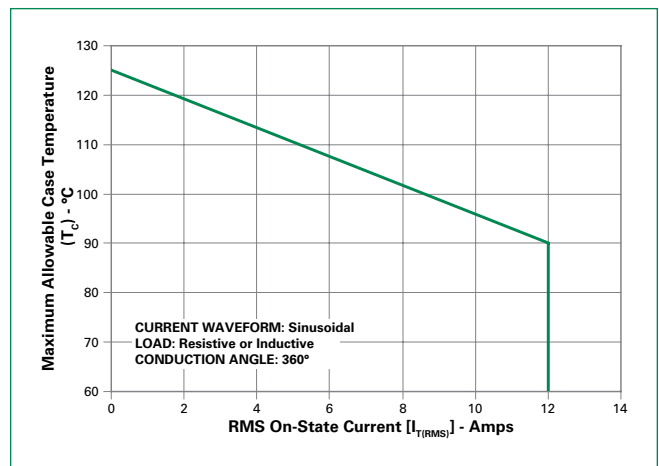
**Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature**



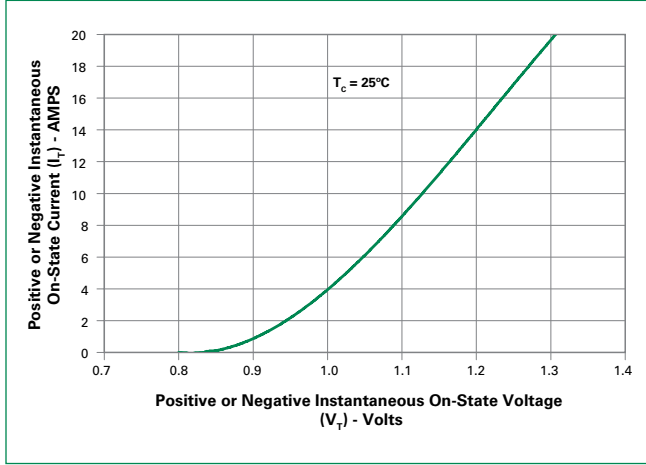
**Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature**



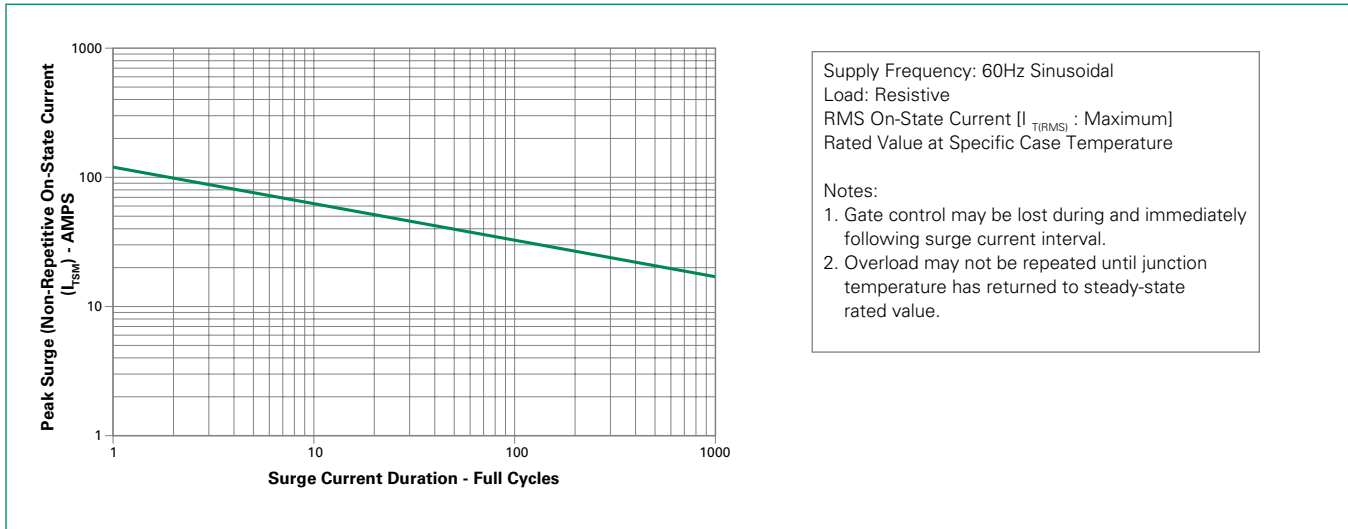
**Figure 6: Maximum Allowable Case Temperature vs. On-State Current**



**Figure 7: On-State Current vs. On-State Voltage (Typical)**



**Figure 8: Surge Peak On-State Current vs. Number of Cycles**

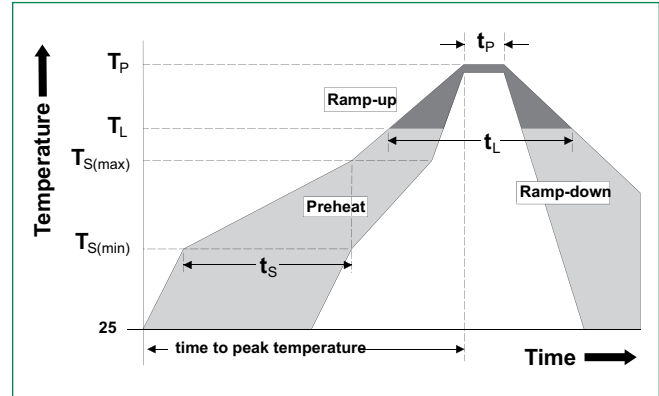


Supply Frequency: 60Hz Sinusoidal  
Load: Resistive  
RMS On-State Current [ $I_{T(RMS)}$ ]: Maximum  
Rated Value at Specific Case Temperature

- 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.

### 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
	- Time (min to max) ( $t_s$ )	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 classification 94V-0
<b>Terminal Material</b>	Copper Alloy

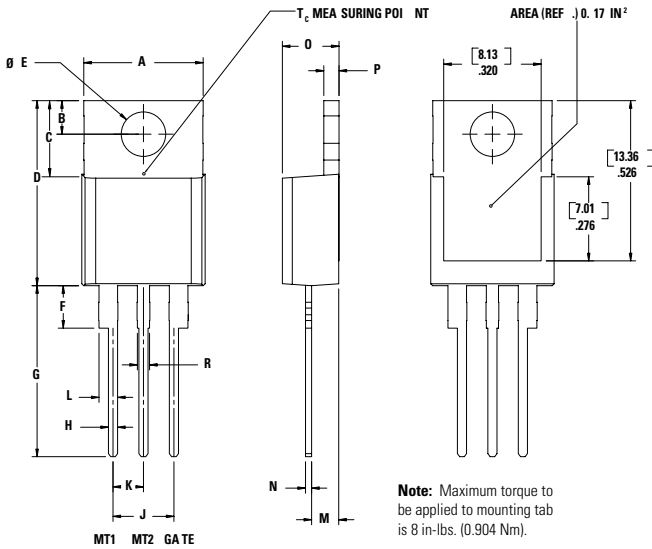
### Design Considerations

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 @ 110°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

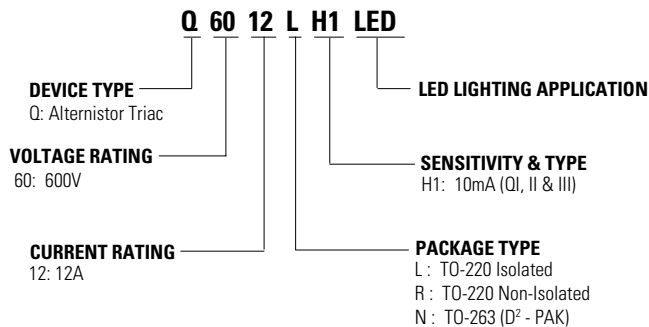
### Product Selector

Part Number	Gate Sensitivity Quadrants	Type	Package
	I – II – III		
Q6012LH1LED	10mA	Alternistor Triac	TO-220L
Q6012RH1LED			TO-220R
Q6012NH1LED			TO-263 D <sup>2</sup> - PAK

### Packing Options

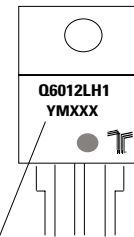
Part Number	Marking	Weight	Packing Mode	Base Quantity
Q6012LH1LEDTP	Q6012LH1	2.2 g	Tube Pack	1000 (50 per tube)
Q6012RH1LEDTP	Q6012RH1	2.2 g	Tube Pack	1000 (50 per tube)
Q6012NH1LEDTP	Q6012NH1	1.6 g	Tube Pack	1000 (50 per tube)
Q6012NH1LEDRP	Q6012NH1	1.6 g	Embossed Carrier	500

### Part Numbering System



### Part Marking System

TO-220 AB - (L & R Package)  
TO-263 AB - (N Package)



Date Code Marking  
Y: Year Code  
M: Month Code  
XXX: Lot Trace Code