

Qxx12xHx Series



**Agency Approval**

Agency	Agency File Number
	L Package: E71639

**Main Features**

Symbol	Value	Unit
$I_{T(RMS)}$	12	A
$V_{DRM}/V_{RRM}$	400 to 1000	V
$I_{GT (Q1)}$	10 to 50	mA

**Schematic Symbol**



**Description**

12 Amp bi-directional solid state switch series is designed for AC switching and phase control applications such as motor speed and temperature modulation controls, lighting controls, and static switching relays.

Alternistor type devices only operate in quadrants I, II, & III and are used in circuits requiring high dv/dt capability.

**Features & Benefits**

- RoHS Compliant
- Glass – passivated junctions
- Voltage capability up to 1000 V
- Surge capability up to 120 A
- Electrically isolated “L-Package” is UL recognized for 2500Vrms
- Solid-state switching eliminates arcing or contact bounce that create voltage transients
- No contacts to wear out from reaction of switching events
- Restricted (or limited) RFI generation, depending on activation point sine wave
- Requires only a small gate activation pulse in each half-cycle

**Applications**

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

Typical applications are AC solid-state switches, light dimmers, power tools, lawn care equipment, home/brown goods and white goods appliances.

Alternistor Triacs (no snubber required) are used in applications with extremely inductive loads requiring highest commutation performance.

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

**Additional Information**



Datasheet



Resources



Samples

**Absolute Maximum Ratings — Alternistor (3 Quadrants)**

Symbol	Parameter	Value	Unit	
$I_{T(RMS)}$	RMS on-state current (full sine wave)	Qxx12LHy $T_C = 90^\circ\text{C}$	12	A
		Qxx12RHy Qxx12NHy $T_C = 105^\circ\text{C}$		
$I_{TSM}$	Non repetitive surge peak on-state current (full cycle, $T_J$ initial = $25^\circ\text{C}$ )	f = 50 Hz t = 20 ms	110	A
		f = 60 Hz t = 16.7 ms	120	
$I^2t$	$I^2t$ Value for fusing	$t_p = 8.3$ ms	60	$\text{A}^2\text{s}$
di/dt	Critical rate of rise of on-state current	f = 120 Hz $T_J = 125^\circ\text{C}$	70	$\text{A}/\mu\text{s}$
$I_{GTM}$	Peak gate trigger current	$t_{GT} \leq 10 \mu\text{s};$ $I_{GT} \leq I_{GTM}$ $T_J = 125^\circ\text{C}$	2.0	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, y = sensitivity

**Electrical Characteristics ( $T_J = 25^\circ\text{C}$ , unless otherwise specified) — Alternistor Triac (3 Quadrants)**

Symbol	Test Conditions	Quadrant	Qxx12xH2	Qxx12xH5	Unit	
$I_{GT}$	$V_D = 12\text{V}$ $R_L = 60 \Omega$	I – II – III	10	50	mA	
$V_{GT}$		I – II – III	1.3	1.3	V	
$V_{GD}$	$V_D = V_{DRM}$ $R_L = 3.3 \text{ k}\Omega$ $T_J = 125^\circ\text{C}$	I – II – III	0.2	0.2	V	
$I_H$	$I_T = 100\text{mA}$	MAX.	15	50	mA	
dv/dt	$V_D = V_{DRM}$ Gate Open $T_J = 125^\circ\text{C}$	400V	MIN.	300	750	$\text{V}/\mu\text{s}$
		600V		200	650	
		800V		150	500	
	$V_D = V_{DRM}$ Gate Open $T_J = 100^\circ\text{C}$	1000V		150	300	
(dv/dt)c	(di/dt)c = 6.5 A/ms $T_J = 125^\circ\text{C}$	MIN.	2	30	$\text{V}/\mu\text{s}$	
$t_{gt}$	$I_G = 2 \times I_{GT}$ PW = 15 $\mu\text{s}$ $I_T = 17.0 \text{ A(pk)}$	TYP.	4	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	
$I_{DRM}$ $I_{RRM}$	$V_D = V_{DRM} / V_{RRM}$	$T_J = 25^\circ\text{C}$ 400-1000V	MAX.	10	$\mu\text{A}$
		$T_J = 125^\circ\text{C}$ 400-800V		2	mA
		$T_J = 100^\circ\text{C}$ 1000V		3	

**Thermal Resistances**

Symbol	Parameter	Value	Unit	
$R_{\theta(J-C)}$	Junction to case (AC)	Qxx12RHy Qxx12NHy	1.2	$^\circ\text{C}/\text{W}$
		Qxx12LHy	2.3	
$R_{\theta(J-A)}$	Junction to ambient (AC)	Qxx12RHy	45	$^\circ\text{C}/\text{W}$
		Qxx12LHy	90	

Note: xx = voltage, y = sensitivity

**Figure 1: Definition of Quadrants**



Note: Alternistors will not operate in QIV

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



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



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



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



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



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



**Figure 8: On-State Current vs. On-State Voltage (Typical)**



**Figure 9: Surge Peak On-State Current vs. Number of Cycles**



### 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 – 180 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
	- Time (min to max) ( $t_s$ )	60 – 150 seconds
Peak Temperature ( $T_p$ )		260 <sup>+0/-5</sup> °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

<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 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
<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>Thermal Shock</b>	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
<b>Autoclave</b>	EIA / JEDEC, JESD22-A102 168 hours (121°C at 2 ATMs) and 100% R/H
<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**



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

### Dimensions — TO-263AB (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 Quadrants I – II – III	Type	Package
	400V	600V	800V	1000V			
Qxx12LH2	X	X	X		10 mA	Alternistor Triac	TO-220L
Qxx12RH2	X	X	X		10 mA	Alternistor Triac	TO-220R
Qxx12NH2	X	X	X		10 mA	Alternistor Triac	TO-263 D <sup>2</sup> PAK
Qxx12LH5	X	X	X	X	50 mA	Alternistor Triac	TO-220L
Qxx12RH5	X	X	X	X	50 mA	Alternistor Triac	TO-220R
Qxx12NH5	X	X	X	X	50 mA	Alternistor Triac	TO-263 D <sup>2</sup> PAK

### Packing Options

Part Number	Marking	Weight	Packing Mode	Base Quantity
Qxx12L/RHy	Qxx12L/RHy	2.2 g	Bulk	500
Qxx12L/RHyTP	Qxx12L/RHy	2.2 g	Tube Pack	500 (50 per tube)
Qxx12NHyTP	Qxx12NHy	1.6 g	Tube	500 (50 per tube)
Qxx12NHyRP	Qxx12NHy	1.6 g	Embossed Carrier	500

Note: xx = Voltage; y = Sensitivity

**TO-263 Embossed Carrier Reel Pack (RP)**

Meets all EIA-481-2 Standards



**Part Numbering System**



**Part Marking System**





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