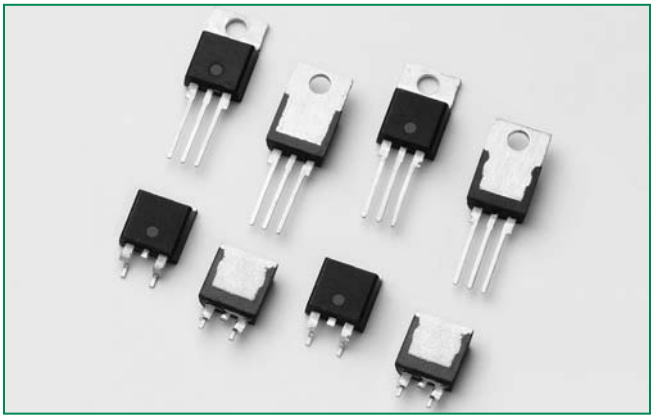
RoHS Qxx12xHx Series



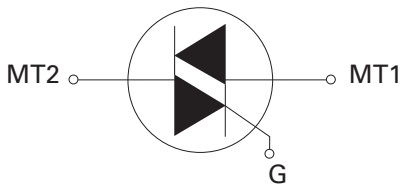
Agency Approval

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.

Absolute Maximum Ratings — Alternistor (3 Quadrants)

Symbol	Parameter			Value	Unit
$I_{T(RMS)}$	RMS on-state current (full sine wave)	Qxx12LHy	T_C = 90°C	12	A
		Qxx12RHy Qxx12NHy	T_C = 105°C		
I_{TSM}	Non repetitive surge peak on-state current (full cycle, T_J initial = 25°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	A^2s
di/dt	Critical rate of rise of on-state current	f = 120 Hz	T_J = 125°C	70	A/µs
I_{GTM}	Peak gate trigger current	$t_p \leq 10$ µs; $I_{GT} \leq I_{GTM}$	T_J = 125°C	2.0	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, y = sensitivity

Electrical Characteristics (T_J = 25°C, unless otherwise specified) — Alternistor Triac (3 Quadrants)

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

Static Characteristics

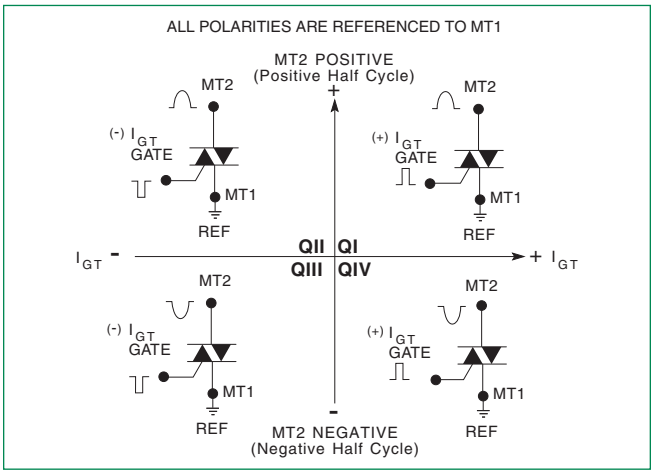
Symbol	Test Conditions				Value	Unit
V_{TM}	I_{TM} = 17.0A t_p = 380 µs			MAX.	1.60	V
I_{DRM} I_{RRM}	$V_D = V_{DRM} / V_{RRM}$	T_J = 25°C	400-1000V	MAX.	10	µA
		T_J = 125°C	400-800V		2	mA
		T_J = 100°C	1000V		3	

Thermal Resistances

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

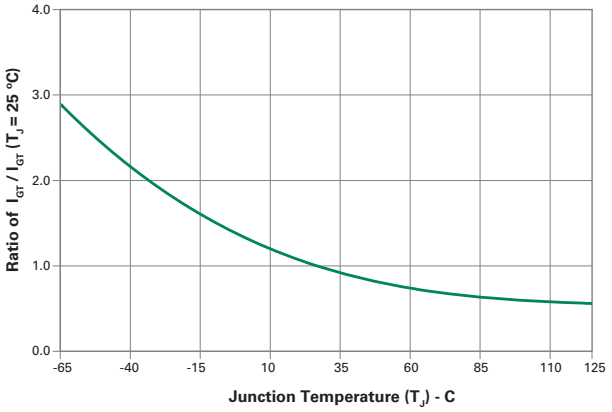


Figure 3: Normalized DC Holding Current vs. Junction Temperature

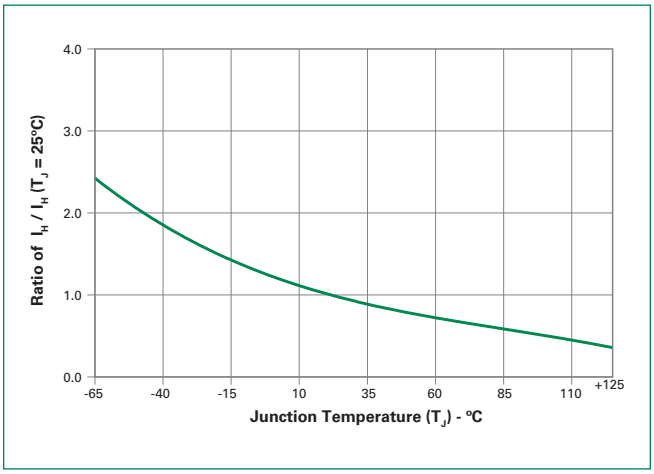


Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature

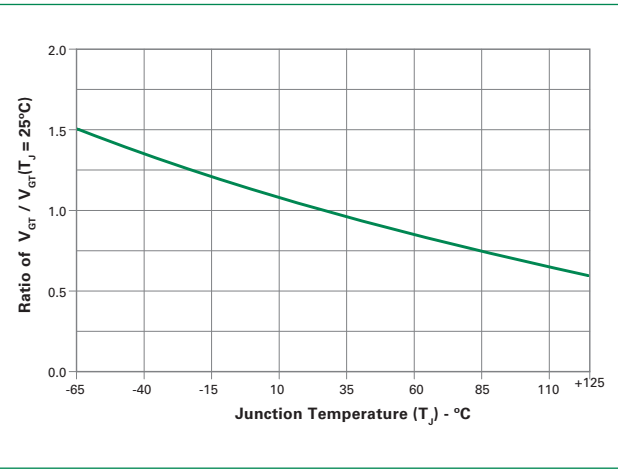


Figure 5: Power Dissipation (Typical) vs. RMS On-State Current

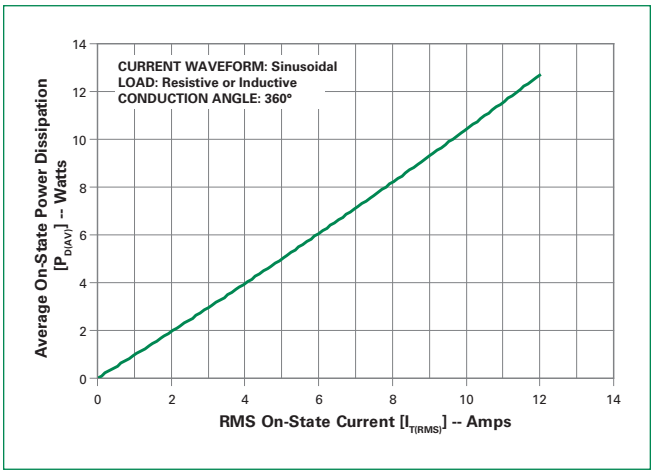


Figure 6: Maximum Allowable Case Temperature vs. On-State Current

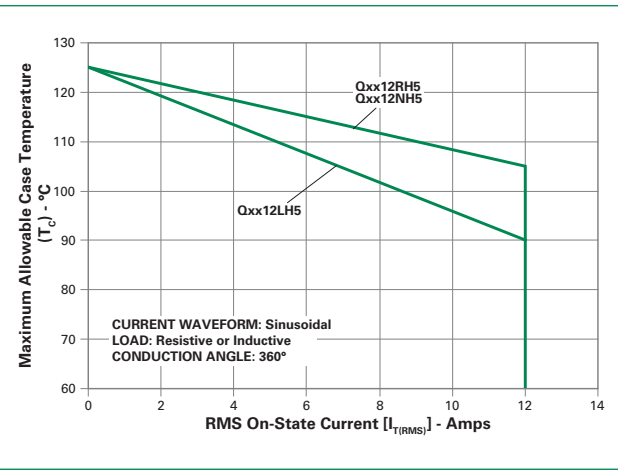


Figure 7: Maximum Allowable Ambient Temperature vs. On-State Current

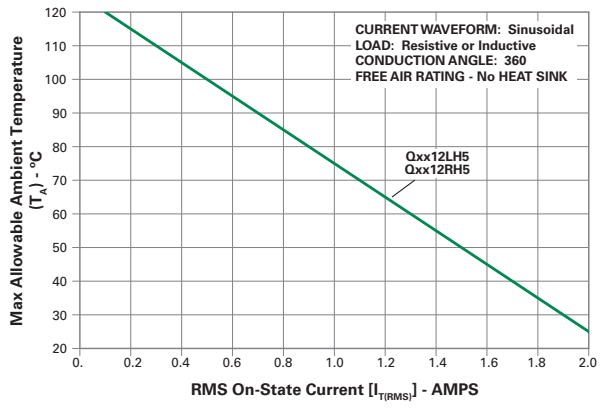


Figure 8: On-State Current vs. On-State Voltage (Typical)

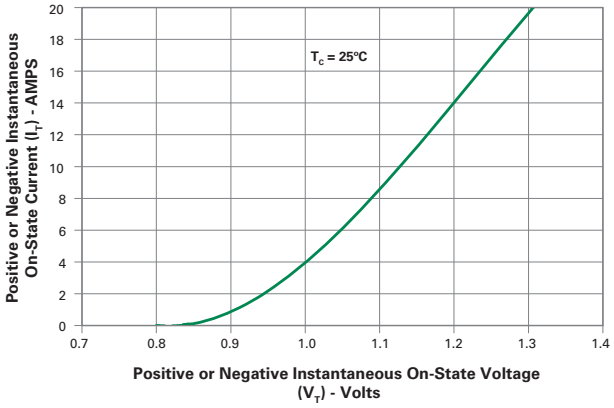
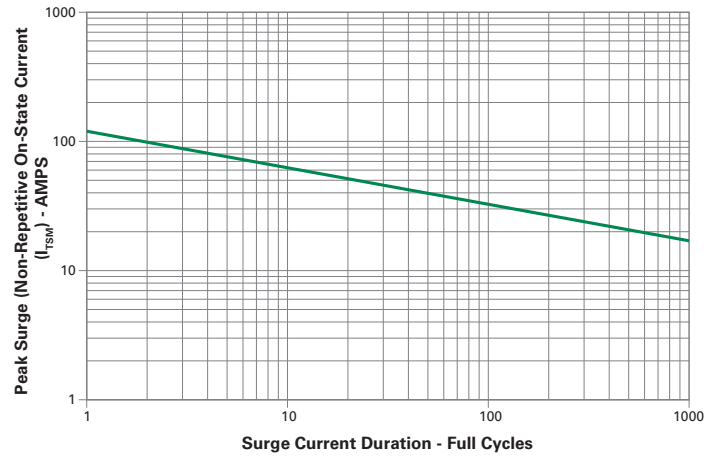


Figure 9: Surge Peak On-State Current vs. Number of Cycles

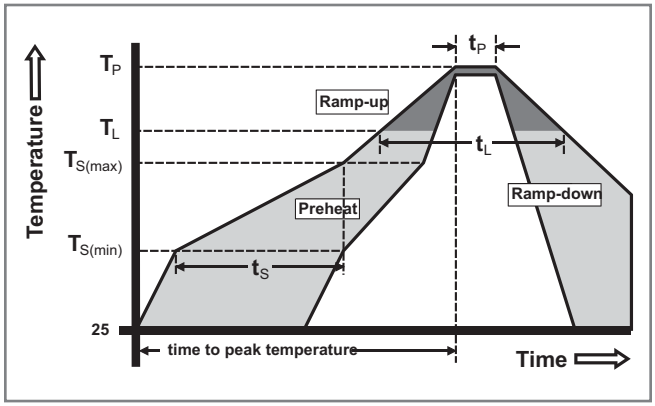


Supply Frequency: 60Hz Sinusoidal
Load: Resistive
RMS On-State Current [$I_{T(RMS)}$: Maximum]
Rated Value at Specific Case Temperature

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

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)		$260^{+0/5}$°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
Terminal Material	Copper Alloy

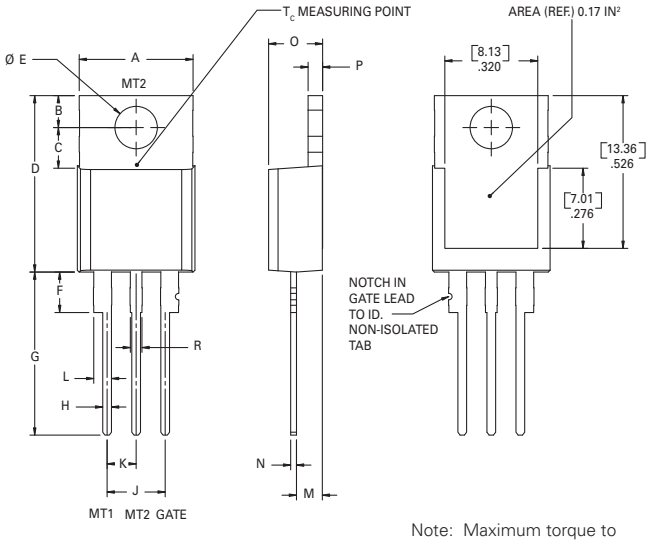
Design Considerations

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

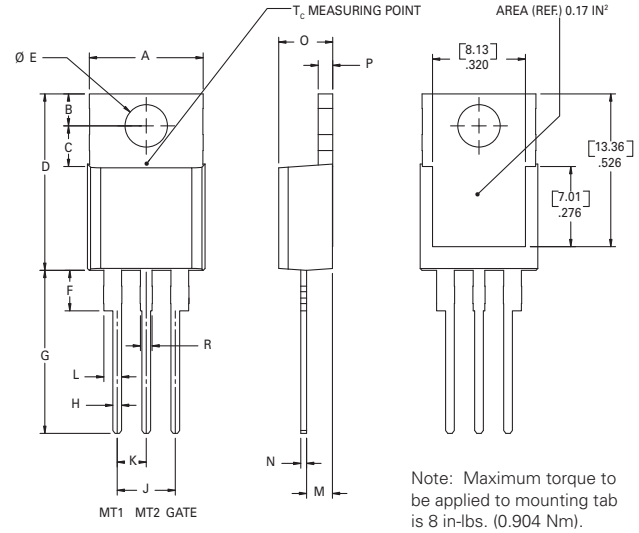
Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead



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



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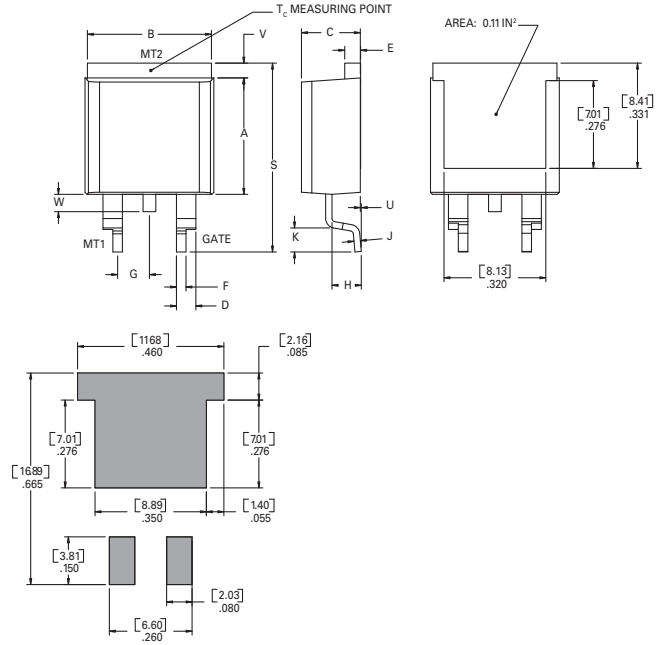
G	0.540	0.575	13.72	14.61
H	0.025	0.035	0.64	0.89
J	0.195	0.205	4.95	5.21
K	0.095	0.105	2.41	2.67
L	0.060	0.075	1.52	1.91
M	0.085	0.095	2.16	2.41
N	0.018	0.024	0.46	0.61
O	0.178	0.188	4.52	4.78
P	0.045	0.060	1.14	1.52
R	0.038	0.048	0.97	1.22

Dimensions — TO-263AB (N-Package) — D²Pak 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	Type	Package
	400V	600V	800V	1000V	I – II – III		
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 D²-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 D²-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
Qxx12NHyTP	Qxx12NHy	1.6 g	Tube	500
Qxx12NHyRP	Qxx12NHy	1.6 g	Embossed Carrier	500

Note: xx = Voltage; y = Sensitivity

Part Numbering System

Q 60 12 L H5 56

DEVICE TYPE
Q: Alternistor

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

CURRENT RATING
12: 12A

PACAGE TYPE
L: TO-220 Isolated
R: TO-220 Non-Isolated
N: TO-263 (D_2-Pak)

SENSITIVITY & TYPE
H2: 10mA (QI, II, III)
H5: 50mA (QI, II, III)

LEAD FORM DIMENSIONS
xx: Lead Form Option

Part Marking System

TO-220 AB & TO-263
(R, L and N Packages)