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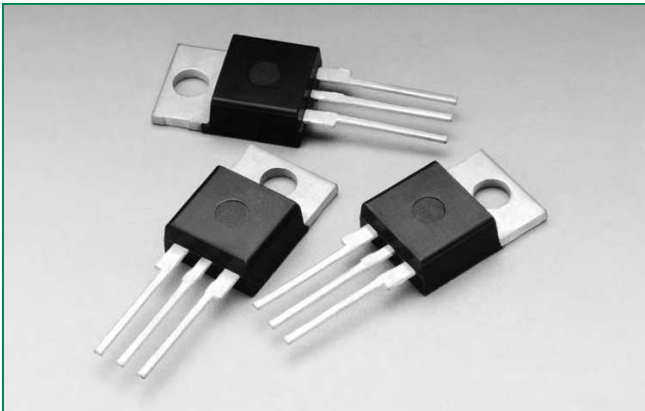
Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



**Q6012LTH1LED Series**



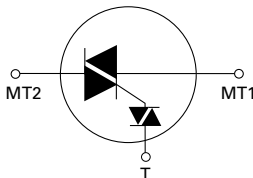
**Agency Approval**

| Agency | Agency File Number |
|--------|--------------------|
|        | L Package : E71639 |

**Main Features**

| Symbol            | Value    | Unit |
|-------------------|----------|------|
| $I_{T(RMS)}$      | 12       | A    |
| $V_{DRM}/V_{RRM}$ | 600      | V    |
| DIAC $V_{BO}$     | 33 to 43 | V    |

**Schematic Symbol**



**Additional Information**



Datasheet



Resources



Samples

**Description**

The Quadrac is an internally triggered Triac designed for AC switching and phase control applications. It is a Triac and DIAC in a single package, which saves user expense by eliminating the need for separate Triac and DIAC components.

Q6012LTH1LED series is designed to meet low load current characteristics typical in LED lighting applications.

By keeping holding current at 8mA maximum, this Quadrac series is characterized and specified to perform best with LED loads. The Q6012LTH1LED series is best suited for LED dimming controls to obtain the lowest levels of light output with a minimum probability of flickering.

Q6012LTH1LED series is offered in the industry standard TO-220AB package with an isolated mounting tab that makes it best suited for adding an external heat sink.

**Features**

- As low as 8mA max holding current
- UL Recognized TO-220AB package
- 110°C rated junction temperature
- di/dt performance of 70A/μs
- QUADRAC version includes intergrated DIAC

**Benefits**

- 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

**Applications**

Excellent for AC switching and phase control applications such as lighting and motor speed controls. Typical applications are AC solid-state switches, light dimmers with LED loads, small low current motor in power tools, and low current motors in home/brown goods appliances.

Internally constructed isolated package is offered for ease of heat sinking with highest isolation voltage.

### Absolute Maximum Ratings

| Symbol       | Parameter                                 |  | Value      | Unit                   |
|--------------|---|--|------------|------------------------|
| $I_{T(RMS)}$ | RMS forward current                       | $T_c = 90^\circ\text{C}$   | 12         | A                      |
| $I_{TSM}$    | Peak non-repetitive surge current         | single half cycle; $f = 50\text{Hz}$ ;<br>$T_J$ (initial) = $25^\circ\text{C}$ | 110        | A                      |
|              |   | single half cycle; $f = 60\text{Hz}$ ;<br>$T_J$ (initial) = $25^\circ\text{C}$ | 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 | $f = 60\text{Hz}$ ; $T_J = 110^\circ\text{C}$                                  | 70         | $\text{A}/\mu\text{s}$ |
| $I_{GM}$     | Peak gate current                         | $T_J = 110^\circ\text{C}$  | 1.5        | A                      |
| $T_{stg}$    | 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) – Alternistor Quadrac

| Symbol     | Test Conditions   |      | Value | Unit                   |
|------------|---|------|-------|------------------------|
| $I_H$      | $I_T = 20\text{mA}$ (initial)   | MAX. | 8     | mA                     |
| $dv/dt$    | $V_D = V_{DRM}$ ; gate open; $T_J = 110^\circ\text{C}$                      | MIN. | 45    | $\text{V}/\mu\text{s}$ |
| $dv/dt(c)$ | $di/dt(c) = 0.54 \times I_{T(rms)} / \text{ms}$ ; $T_J = 110^\circ\text{C}$ | MIN. | 2     | $\text{V}/\mu\text{s}$ |
| $t_{gt}$   | (note 1)  | TYP. | 3     | $\mu\text{s}$          |

(1) Reference test circuit in figure 7 and waveform in figure 8;  $C_T = 0.1\mu\text{F}$  with  $0.1\mu\text{s}$  rise time.

### Trigger DIAC Specifications

| Symbol             | Test Conditions   |      | Value | Unit          |
|--------------------|---|------|-------|---------------|
| $\Delta V_{BO}$    | Breakover Voltage Symmetry                              | MAX. | 3     | V             |
| $V_{BO}$           | Breakover Voltage, forward and reverse                  | MIN. | 33    | V             |
|                    |   | MAX. | 43    |               |
| $[\Delta V_{\pm}]$ | Dynamic Breakback Voltage, forward and reverse (note 1) | MIN. | 5     | V             |
| $I_{BO}$           | Peak Breakover Current                                  | MAX. | 25    | $\mu\text{A}$ |
| $C_T$              | Trigger Firing Capacitance                              | MAX. | 0.1   | $\mu\text{F}$ |

(1) Reference test circuit in figure 7 and waveform in figure 8.

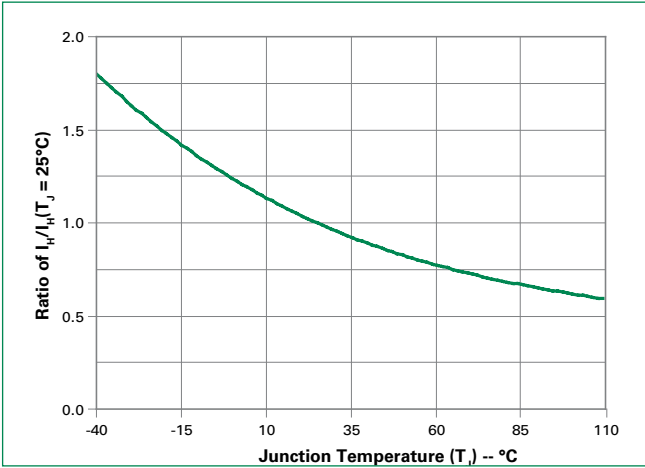
### Static Characteristics

| Symbol              | Test Conditions  |                           |      | Value | Unit          |
|---------------------|--|---------------------------|------|-------|---------------|
| $V_{TM}$            | $I_T = 1.41 \times I_{T(rms)}$ A; $t_p = 380\mu\text{s}$ |                           | MAX. | 1.6   | V             |
| $I_{DRM} / I_{RRM}$ | $V_{DRM} / V_{RRM}$                                      | $T_J = 25^\circ\text{C}$  | MAX. | 10    | $\mu\text{A}$ |
|                     |  | $T_J = 110^\circ\text{C}$ |      | 1000  |               |

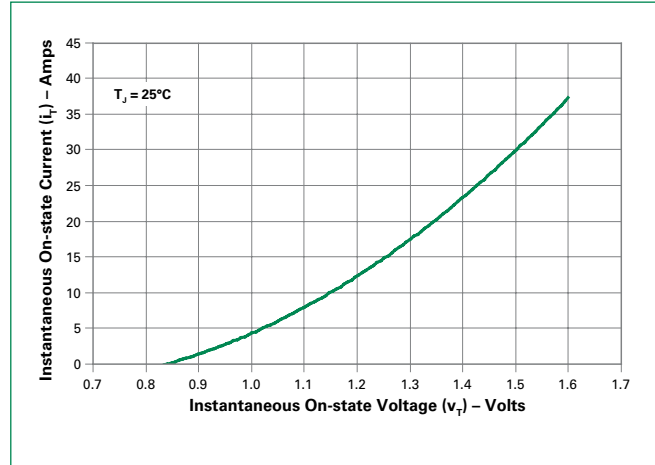
### Thermal Resistances

| Symbol            | Parameter             | Value | Unit                      |
|-------------------|-----------------------|-------|---------------------------|
| $R_{\theta(J-C)}$ | Junction to case (AC) | 2.3   | $^\circ\text{C}/\text{W}$ |
| $R_{\theta(J-A)}$ | Junction to ambient   | 50    | $^\circ\text{C}/\text{W}$ |

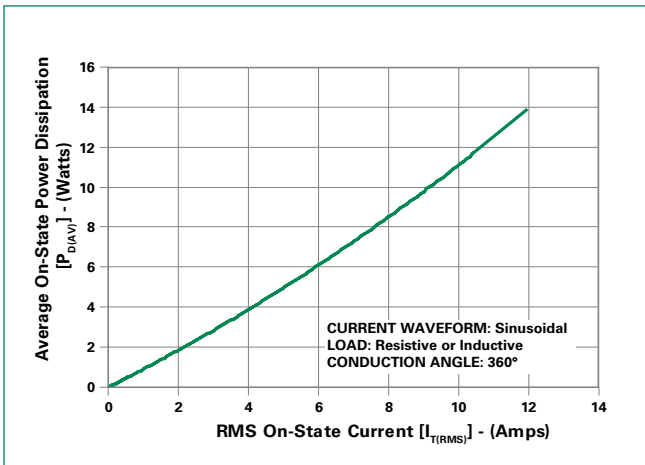
**Figure 1: Normalized DC Holding Current vs. Junction Temperature**



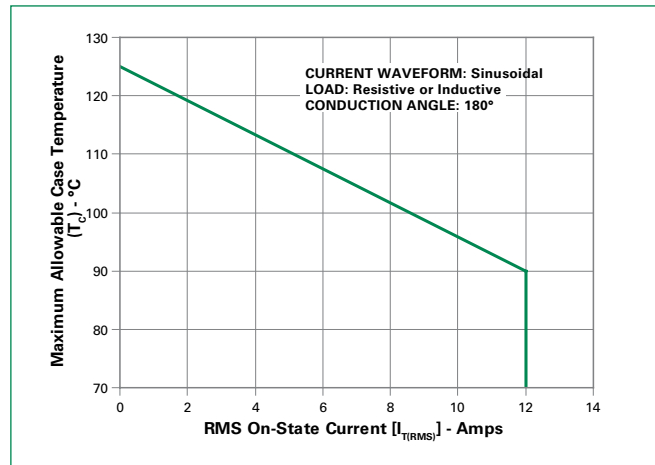
**Figure 2: On-State Current vs. On-State Voltage (Typical)**



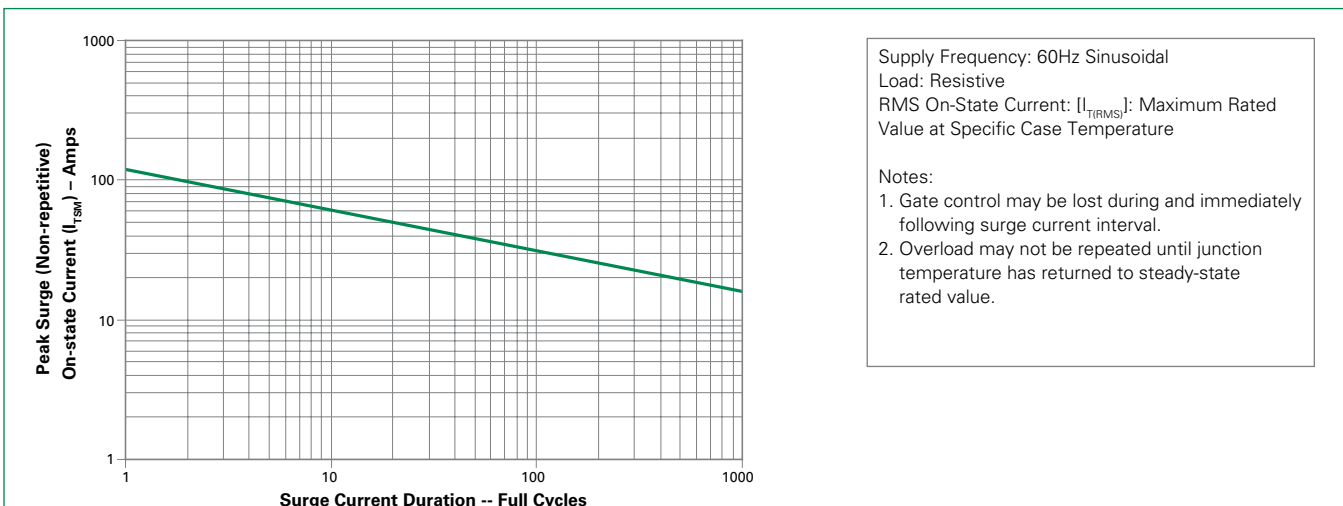
**Figure 3: Power Dissipation vs. RMS On-State Current (Typical)**



**Figure 4: Maximum Allowable Case Temperature vs. RMS On-State Current**



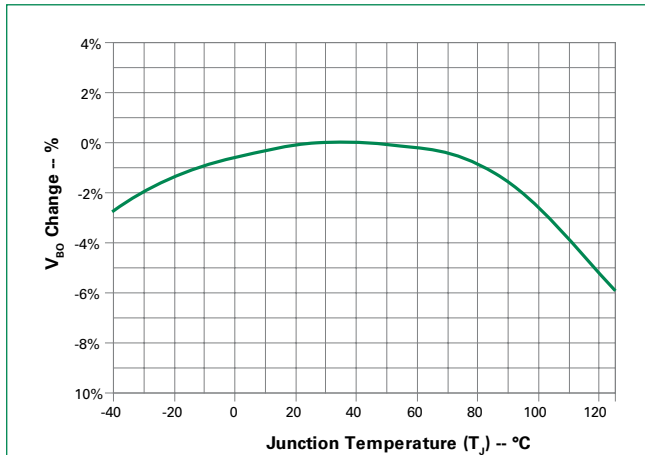
**Figure 5: Surge Peak On-State Current vs. Number of Cycles**



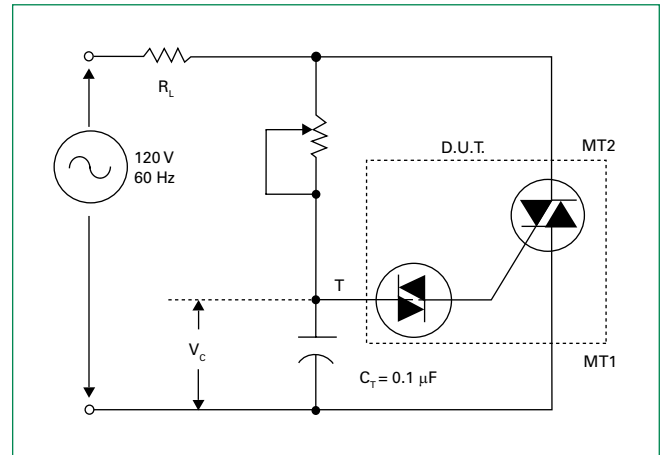
Supply Frequency: 60Hz Sinusoidal  
Load: Resistive  
RMS On-State Current: [I<sub>T(RMS)</sub>]: Maximum Rated Value at Specific Case Temperature

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.

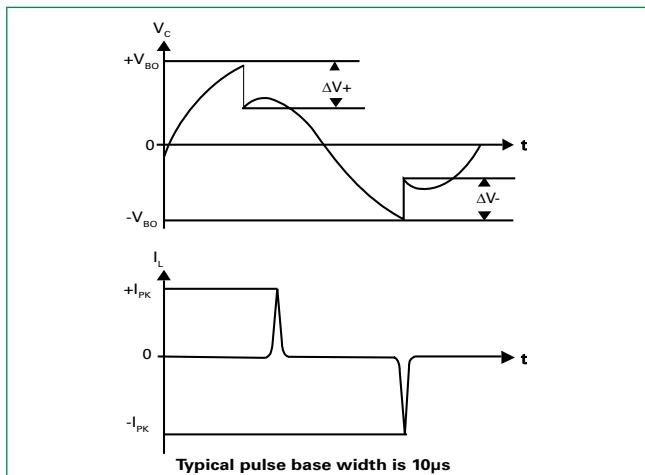
**Figure 6: DIAC  $V_{BO}$  Change vs. Junction Temperature**



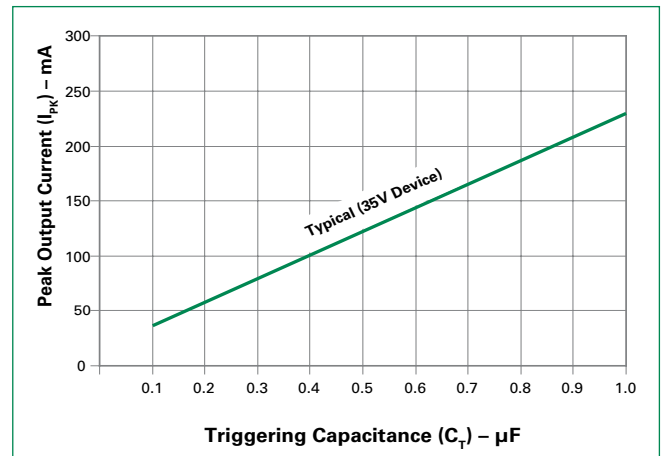
**Figure 7: Test Circuit**



**Figure 8: Test Circuit Waveform**

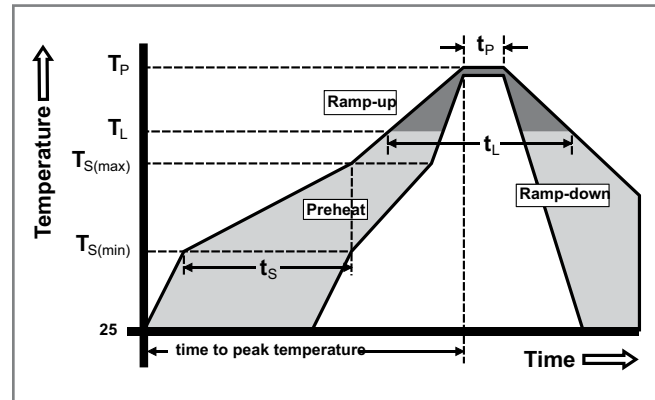


**Figure 9: Peak Output Current vs Triggering Capacitance (Per Figure 7)**



### 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                  |
|  | - Temperature ( $t_L$ )            | 60 – 150 seconds       |
| Peak Temperature ( $T_p$ )                             |                                    | 260°C <sup>+0/-5</sup> |
| 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> | 1005 Matte Tin-plated   |
| <b>Body Material</b>   | UL Recognized epoxy meeting flammability classification 94v-0 |
| <b>Lead Material</b>   | Copper Alloy  |

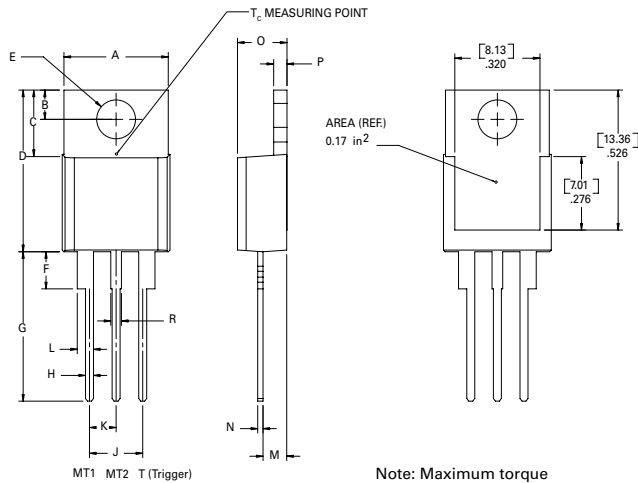
### Design Considerations

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>High Temperature Voltage Blocking</b> | MIL-STD-750: Method 1040, Condition A<br>Rated $V_{DRM}$ (VAC-peak), 110°C, 1008 hours |
| <b>Temperature Cycling</b>               | MIL-STD-750: Method 1051<br>-40°C to 150°C, 15-minute dwell, 100 cycles                |
| <b>Biased Temperature &amp; Humidity</b> | EIA/JEDEC: JESD22-A101<br>320VDC, 85°C, 85%RH, 1008 hours                              |
| <b>High Temp Storage</b>                 | MIL-STD-750: Method 1031<br>150°C, 1008 hours  |
| <b>Low-Temp Storage</b>                  | -40°C, 1008 hours  |
| <b>Resistance to Solder Heat</b>         | MIL-STD-750: Method 2031<br>260°C, 10 seconds  |
| <b>Solderability</b>                     | ANSI/J-STD-002, Category 3, Test A   |
| <b>Lead Bend</b>                         | MIL-STD-750: Method 2036, Condition 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  |

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

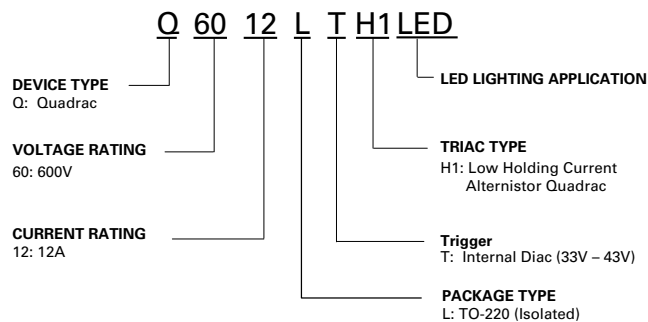
**Product Selector**

| Part Number  | Type                | Package |
|--------------|---------------------|---------|
| Q6012LTH1LED | Alternistor Quadrac | TO-220L |

**Packing Options**

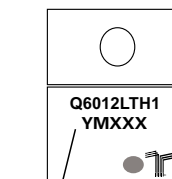
| Part Number    | Marking   | Weight | Packing Mode | Base Quantity     |
|----------------|-----------|--------|--------------|-------------------|
| Q6012LTH1LEDTP | Q6012LTH1 | 2.2 g  | Tube         | 500 (50 per tube) |

**Part Numbering System**



**Part Marking System**

TO-220 AB - (L Package)



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