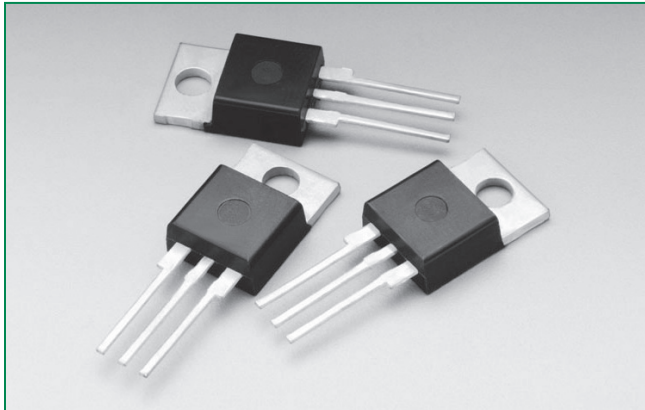


Q6012LTH1LED Series



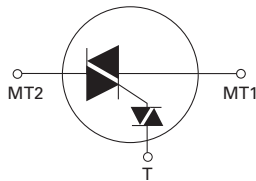
Agency Approval

| 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



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_{AC} 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; $f = 50\text{Hz}$; T_J (initial) = 25°C | 110 | A |
| | | single half cycle; $f = 60\text{Hz}$; T_J (initial) = 25°C | 120 | |
| I^2t | I^2t value for fusing | $t_p = 8.3\text{ms}$ | 60 | A^2s |
| 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 | μs |

(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 |
|--------------------|---------------------------------------------------------|------|-------|---------------|
| ΔV_{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 | μA |
| C_T | Trigger Firing Capacitance | MAX. | 0.1 | μF |

(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 | μA |
| | | $T_J = 110^\circ\text{C}$ | | 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

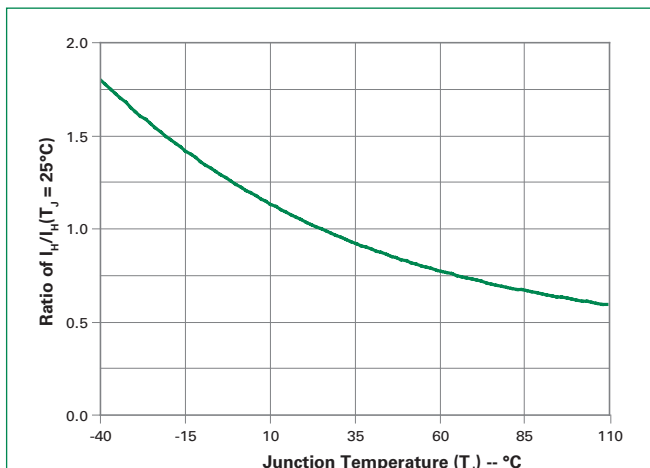


Figure 2: On-State Current vs. On-State Voltage (Typical)

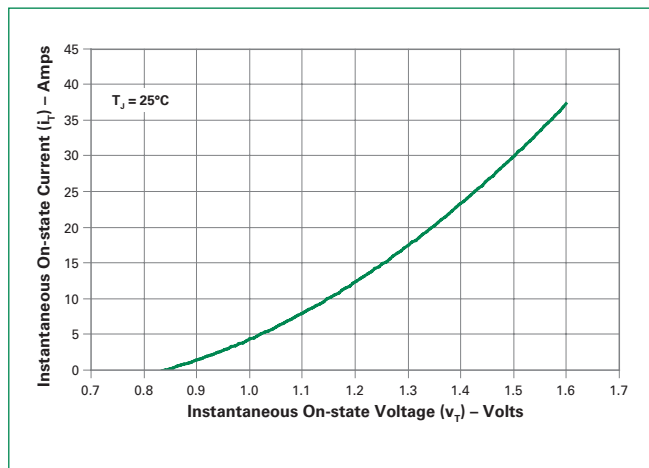


Figure 3: Power Dissipation vs. RMS On-State Current (Typical)

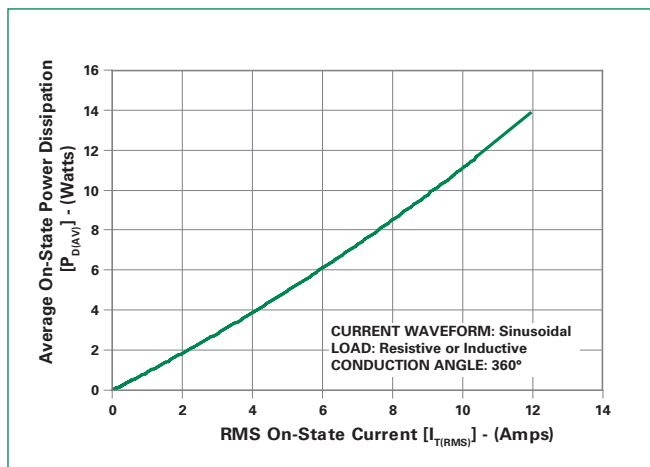


Figure 4: Maximum Allowable Case Temperature vs. RMS On-State Current

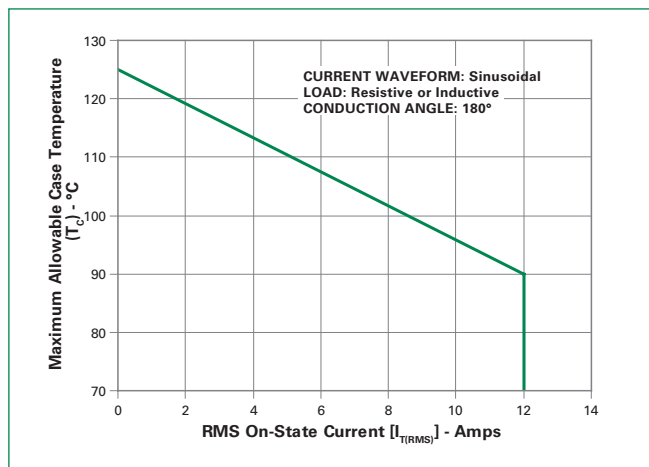
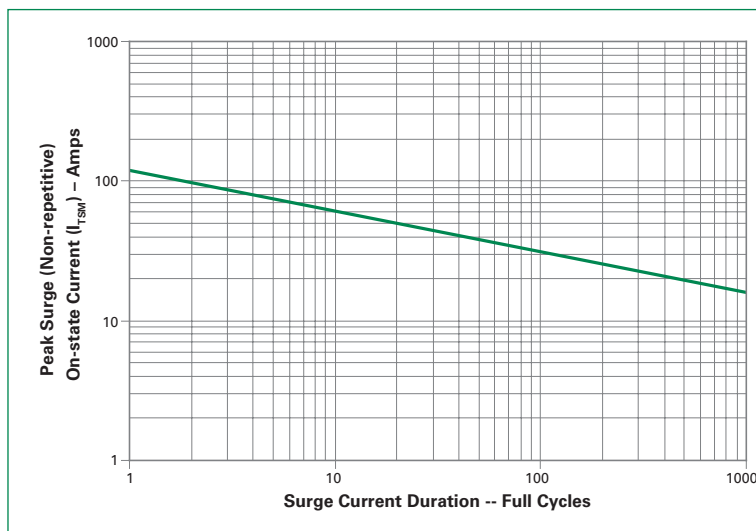


Figure 5: Surge Peak On-State Current vs. Number of Cycles



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

- Notes:
- Gate control may be lost during and immediately following surge current interval.
 - Overload may not be repeated until junction temperature has returned to steady-state rated value.

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

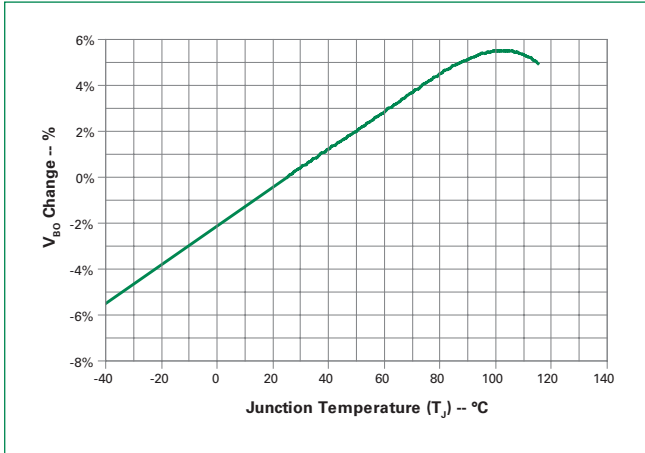


Figure 7: Test Circuit

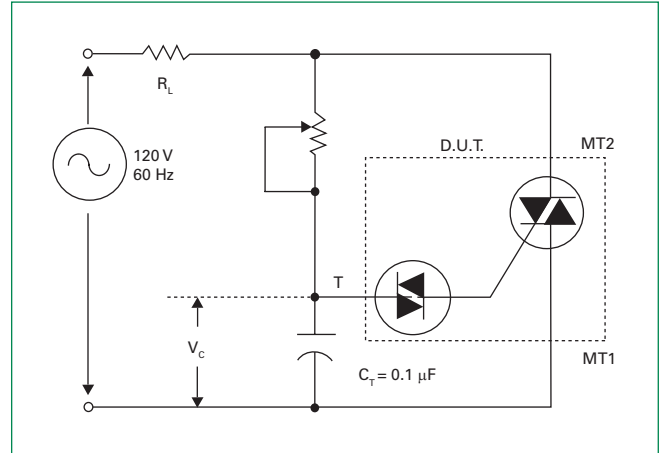
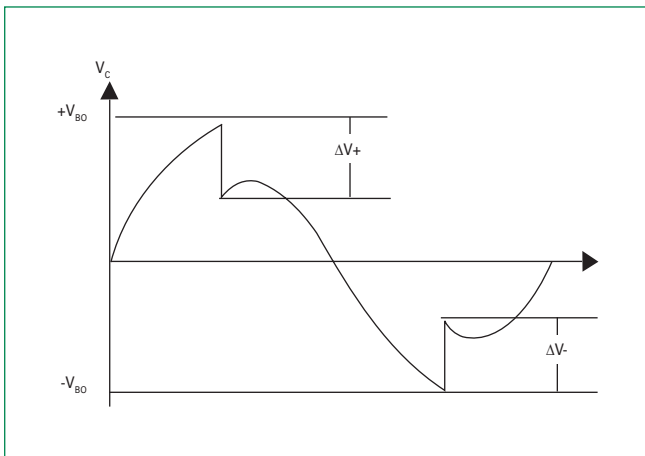
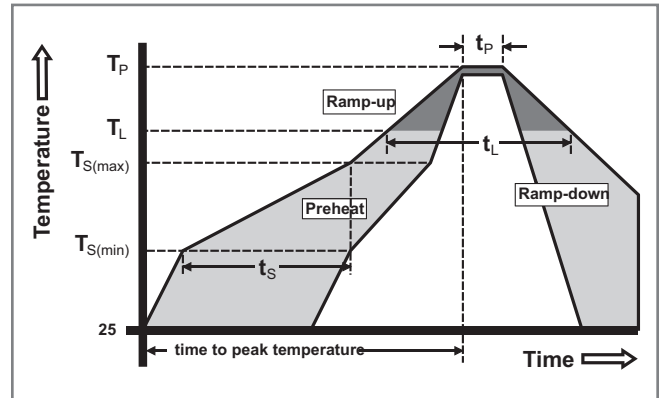


Figure 8: Test Circuit Waveform



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 ^{+0/-5} |
| 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 | 1005 Matte Tin-plated |
| Body Material | UL Recognized epoxy meeting flammability classification 94v-0 |
| Lead Material | Copper Alloy |

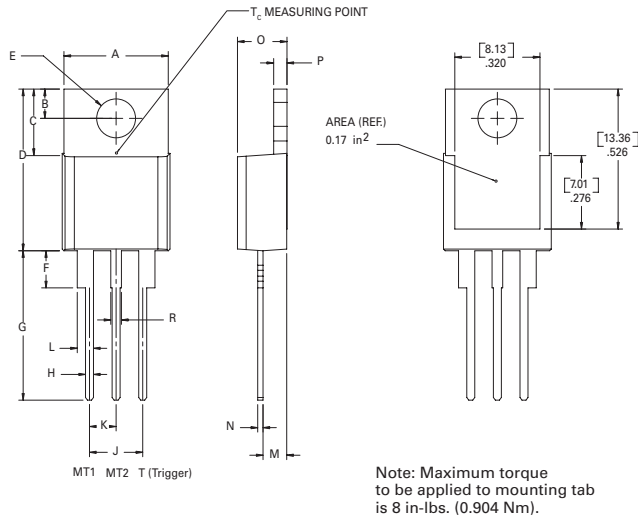
Design Considerations

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 |
|------------------------------------------|--------------------------------------------------------------------------------------|
| High Temperature Voltage Blocking | MIL-STD-750: Method 1040, Condition A Rated V_{DRM} (VAC-peak), 110°C, 1008 hours |
| Temperature Cycling | MIL-STD-750: Method 1051 -40°C to 150°C, 15-minute dwell, 100 cycles |
| Biased Temperature & Humidity | EIA/JEDEC: JESD22-A101 320VDC, 85°C, 85%RH, 1008 hours |
| High Temp Storage | MIL-STD-750: Method 1031 150°C, 1008 hours |
| Low-Temp Storage | -40°C, 1008 hours |
| Thermal Shock | MIL-STD-750: Method 1056 0°C to 100°C, 5-minute dwell, 10-second transfer, 10 cycles |
| Autoclave (Pressure Cooker Test) | EIA/JEDEC: JESD22-A102 121°C, 100%RH, 2atm, 168 hours |
| Resistance to Solder Heat | MIL-STD-750: Method 2031 260°C, 10 seconds |
| Solderability | ANSI/J-STD-002, Category 3, Test A |
| Lead Bend | 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 |

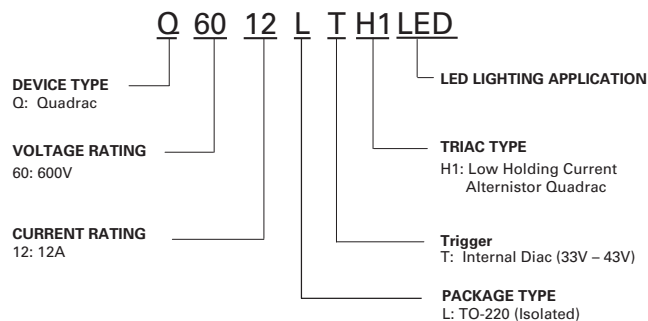
Product Selector

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

Packing Options

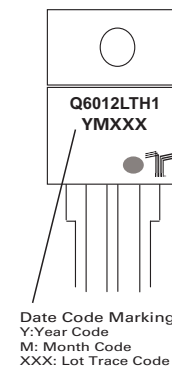
| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|----------------|-----------|--------|--------------|-------------------|
| Q6012LTH1LED | Q6012LTH1 | 2.2 g | Bulk | 500 |
| Q6012LTH1LEDTP | Q6012LTH1 | 2.2 g | Tube | 500 (50 per tube) |

Part Numbering System



Part Marking System

TO-220 AB - (L Package)



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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9