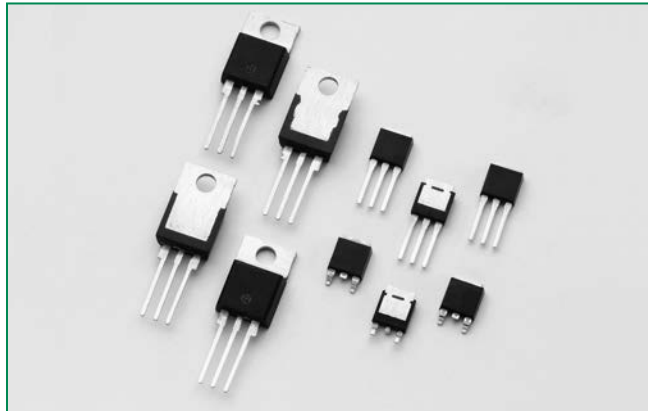



Lxx04xx & Qxx04xx Series



Agency Approval

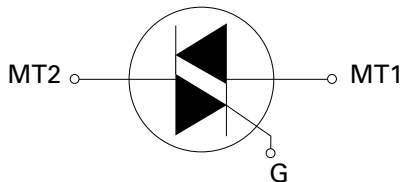
| Agency | Agency File Number |
|---|--------------------|
|  | E71639* |

* - L Package Only

Main Features

| Symbol | Value | Unit |
|-------------------|-----------------------|------|
| $I_{T(RMS)}$ | 4 | A |
| V_{DRM}/V_{RRM} | 400, 600, 800 or 1000 | V |
| $I_{GT(Q1)}$ | 3 to 25 | mA |

Schematic Symbol



Description

This 4 Amp bidirectional 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.

Sensitive type devices guarantee gate control in Quadrants I & IV as needed for digital control circuitry.

Standard type devices normally operate in Quadrants I & III triggered from AC line.

Features & Benefits

- RoHS Compliant
- Glass – passivated junctions
- Voltage capability up to 1000 V
- Surge capability up to 55 A
- The L-package has an isolation rating of 2500V_{RMS}
- 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 of sine wave
- Requires only a short gate activation pulse in each half-cycle

Applications

Typical applications are AC solid-state switches, power tools, home/brown goods and white goods appliances.

Sensitive gate Triacs can be directly driven by microprocessor or popular opto-couplers/isolators.

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

Absolute Maximum Ratings – Sensitive Triacs (4 Quadrants)

| Symbol | Parameter | Value | Unit |
|--------------|---|---|-------------------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | Lxx04Ly $T_c = 90^\circ\text{C}$ | 4 A |
| | | Lxx04Ry/Lxx04Vy/Lxx04Dy $T_c = 95^\circ\text{C}$ | |
| I_{TSM} | Non repetitive surge peak on-state current (full cycle, T_j initial = 25°C) | f = 50 Hz t = 20 ms | 33 A |
| | | f = 60 Hz t = 16.7 ms | |
| I^2t | I^2t Value for fusing | $t_p = 8.3$ ms | 6.6 A ² s |
| di/dt | Critical rate of rise of on-state current ($I_G = 50\text{mA}$ with $\leq 0.1\mu\text{s}$ rise time) | f = 120 Hz $T_j = 110^\circ\text{C}$ | 50 A/ μs |
| I_{GTM} | Peak gate trigger current | $t_p = 20\mu\text{s}$ $T_j = 110^\circ\text{C}$ | 1.2 A |
| $P_{G(AV)}$ | Average gate power dissipation | $T_j = 110^\circ\text{C}$ | 0.3 W |
| T_{stg} | Storage temperature range | | -40 to 150 °C |
| T_j | Operating junction temperature range | | -40 to 110 °C |

Note: xx = voltage/10, y = sensitivity

Absolute Maximum Ratings — Standard Triacs

| Symbol | Parameter | | | Value | Unit |
|--------------|--|-------------------------|---------------------------|------------|------------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | Qxx04Ly | $T_c = 105^\circ\text{C}$ | 4 | A |
| | | Qxx04Ry/Qxx04Vy/Qxx04Dy | $T_c = 110^\circ\text{C}$ | | |
| I_{TSM} | Non repetitive surge peak on-state current (full cycle, T_J initial = 25°C) | f = 50 Hz | t = 20 ms | 46 | A |
| | | f = 60 Hz | t = 16.7 ms | 55 | |
| I^2t | I^2t Value for fusing | $t_p = 8.3$ ms | | 12.5 | A ² s |
| di/dt | Critical rate of rise of on-state current ($I_G = 50\text{mA}$ with $\leq 0.1\mu\text{s}$ rise time) | f = 120 Hz | $T_J = 125^\circ\text{C}$ | 50 | A/ μs |
| I_{GTM} | Peak gate trigger current | $t_p = 20\mu\text{s}$ | $T_J = 125^\circ\text{C}$ | 4 | A |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_J = 125^\circ\text{C}$ | 0.3 | 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/10, y = sensitivity

Electrical Characteristics ($T_J = 25^\circ\text{C}$, unless otherwise specified) — Sensitive Triac (4 Quadrants)

| Symbol | Test Conditions | Quadrant | | Lxx04x3 | Lxx04x5 | Lxx04x6 | Lxx04x8 | Unit |
|----------|---|--------------|------|---------|---------|---------|---------|------------------|
| I_{GT} | $V_D = 12\text{V}$ $R_L = 60\ \Omega$ | I – II – III | MAX. | 3 | 5 | 5 | 10 | mA |
| | | IV | | 3 | 5 | 10 | 20 | |
| V_{GT} | $V_D = 12\text{V}$ $R_L = 60\ \Omega$ | ALL | MAX. | 1.3 | | | | V |
| V_{GD} | $V_D = V_{DRM}$ $R_L = 3.3\ \text{k}\Omega$ $T_J = 110^\circ\text{C}$ | ALL | MIN. | 0.2 | | | | V |
| I_H | $I_T = 100\text{mA}$ | | MAX. | 5 | 10 | 10 | 15 | mA |
| dv/dt | $V_D = V_{DRM}$ Gate Open $T_J = 100^\circ\text{C}$ | 400V | TYP. | 25 | 25 | 30 | 35 | V/ μs |
| | | 600V | | 15 | 15 | 20 | 25 | |
| (dv/dt)c | (di/dt)c = 2.16 A/ms $T_J = 110^\circ\text{C}$ | | TYP. | 0.5 | 1 | 1 | 1 | V/ μs |
| t_{gt} | $I_G = 2 \times I_{GT}$ PW = 15 μs $I_T = 5.6\ \text{A(pk)}$ | | TYP. | 2.8 | 3.0 | 3.0 | 3.2 | μs |

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

| Symbol | Test Conditions | Quadrant | | Oxx04x3 | Oxx04x4 | Unit |
|----------|---|--------------|------|---------|---------|------------------|
| I_{GT} | $V_D = 12\text{V}$ $R_L = 60\ \Omega$ | I – II – III | MAX. | 10 | 25 | mA |
| | | IV | TYP. | 25 | 50 | |
| V_{GT} | $V_D = 12\text{V}$ $R_L = 60\ \Omega$ | I – II – III | MAX. | 1.3 | 1.3 | V |
| V_{GD} | $V_D = V_{DRM}$ $R_L = 3.3\ \text{k}\Omega$ $T_J = 125^\circ\text{C}$ | ALL | MIN. | 0.2 | 0.2 | V |
| I_H | $I_T = 200\text{mA}$ | | MAX. | 20 | 30 | mA |
| dv/dt | $V_D = V_{DRM}$ Gate Open $T_J = 125^\circ\text{C}$ | 400V | MIN. | 40 | 75 | V/ μs |
| | | 600V | | 30 | 50 | |
| | | 800V | | | 40 | |
| | $V_D = V_{DRM}$ Gate Open $T_J = 100^\circ\text{C}$ | 1000V | | | 50 | |
| (dv/dt)c | (di/dt)c = 2.16 A/ms $T_J = 125^\circ\text{C}$ | | TYP. | 2 | 2 | V/ μs |
| t_{gt} | $I_G = 2 \times I_{GT}$ PW = 15 μs $I_T = 5.6\ \text{A(pk)}$ | | TYP. | 2.5 | 3.0 | μs |

Note: xx = voltage/10, x = package

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

| Symbol | Test Conditions | Value | Unit | |
|------------------------------------|---|-------|------------------------------------|-------------------|
| V_{TM} | $I_{TM} = 5.6\text{A}$ $t_p = 380\ \mu\text{s}$ | MAX. | 1.60 V | |
| I_{DRM} I_{RRM} | $V_{DRM} = V_{RRM}$ | MAX. | Lxx04xy | |
| | | | $T_J = 25^\circ\text{C}$ 400-600V | 5 μA |
| | | | $T_J = 110^\circ\text{C}$ 400-600V | 200 μA |
| | | | Qxx04xy | |
| $T_J = 25^\circ\text{C}$ 400-1000V | 10 μA | | | |
| $T_J = 125^\circ\text{C}$ 400-800V | 2 mA | | | |
| $T_J = 100^\circ\text{C}$ 1000V | 3 mA | | | |

Thermal Resistances

| Symbol | Parameter | Value | Unit |
|-------------------|-----------------------|-----------|------|
| $R_{\theta(J-C)}$ | Junction to case (AC) | L/Qxx04Dy | 1.5 |
| | | L/Qxx04Ly | 3.5 |
| | | L/Qxx04Ry | 2.2 |
| | | L/Qxx04Vy | 1.5 |
| $R_{\theta(J-A)}$ | Junction to ambient | L/Qxx04Ly | 50 |
| | | L/Qxx04Ry | 45 |
| | | L/Qxx04Vy | 70 |

Note: xx = voltage/10, x = package, y = sensitivity

Figure 1: Definition of Quadrants

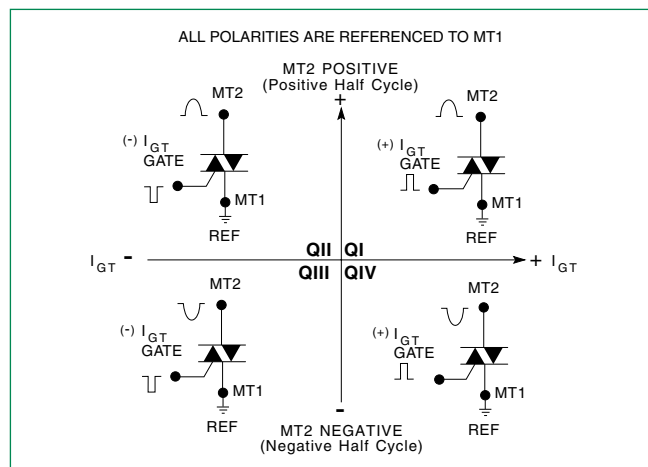
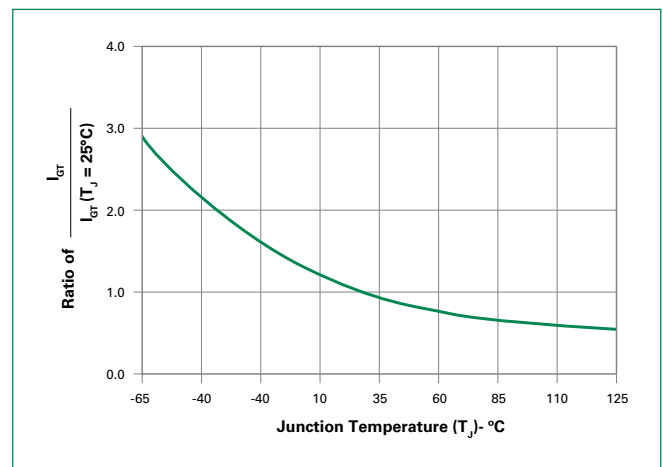


Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature



Additional Information



Datasheet



Resources



Samples

Figure 3: Normalized DC Holding Current vs. Junction Temperature

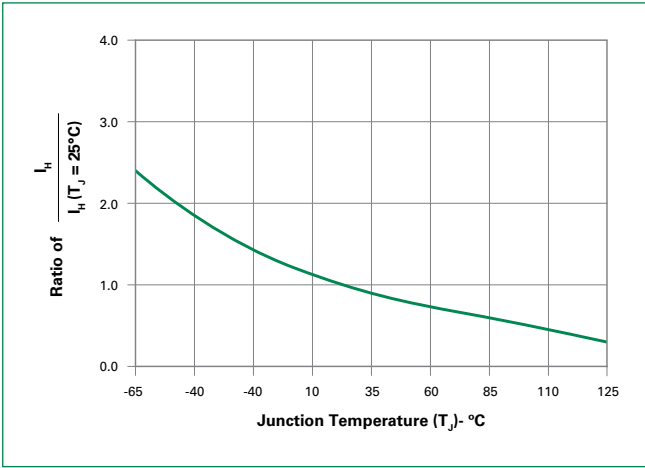


Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature

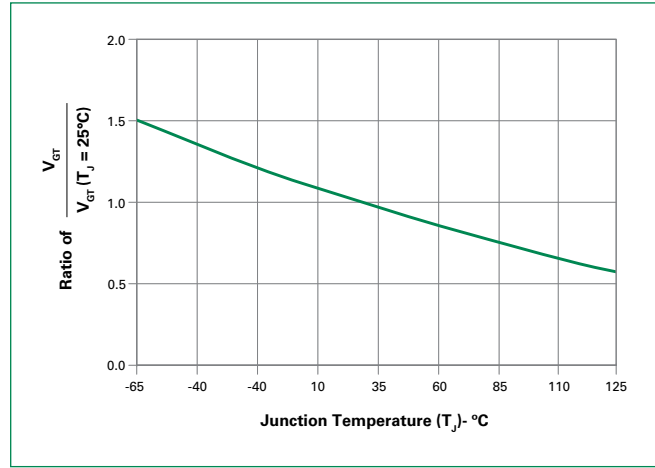


Figure 5: Power Dissipation (Typical) vs. RMS On-State Current

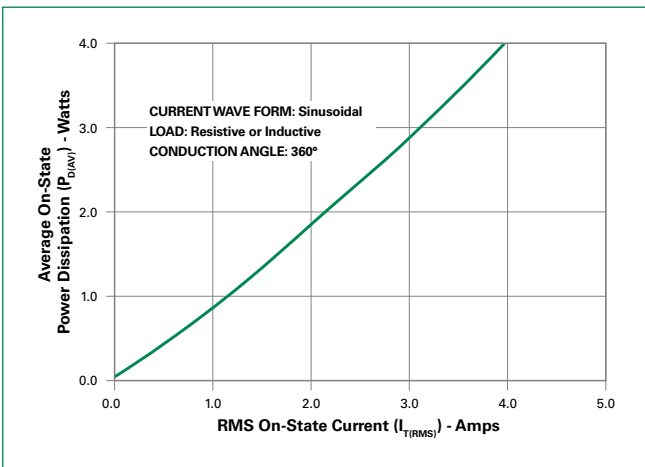


Figure 6: Maximum Allowable Case Temperature vs. On-State Current

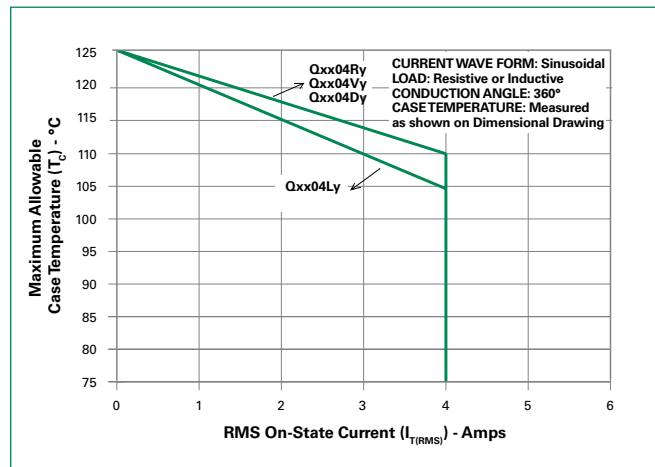
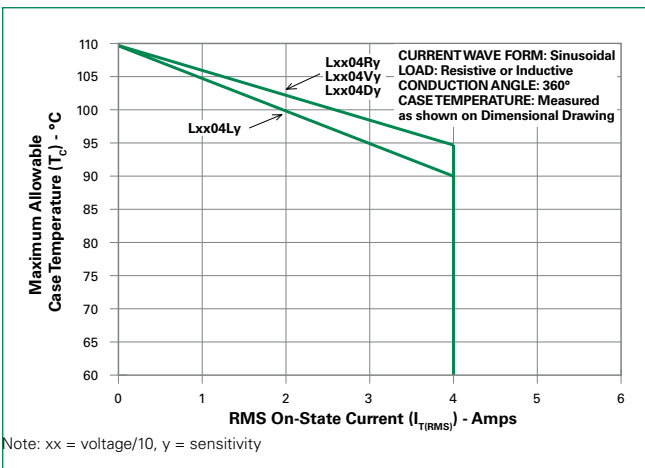


Figure 7: Maximum Allowable Case Temperature vs. On-State Current



Note: xx = voltage/10, y = sensitivity

Figure 8: Maximum Allowable Ambient Temperature vs. On-State Current

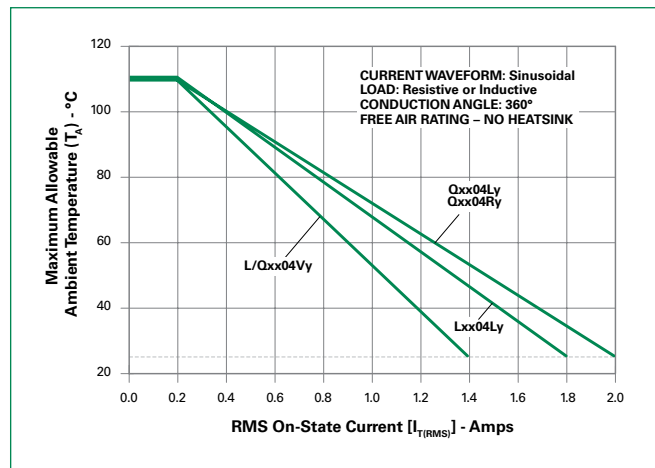


Figure 9: On-State Current vs. On-State Voltage (Typical)

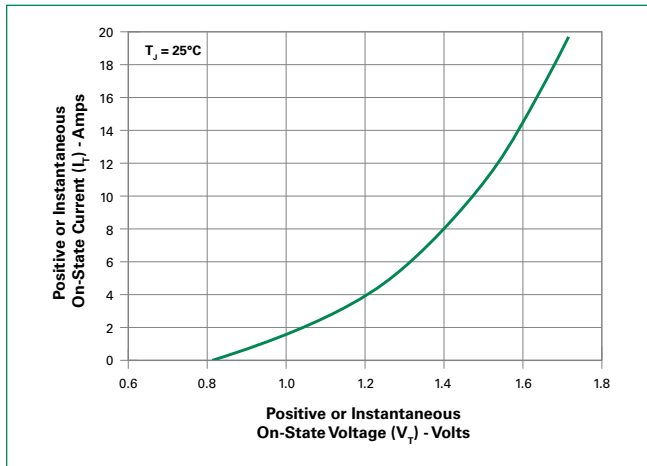
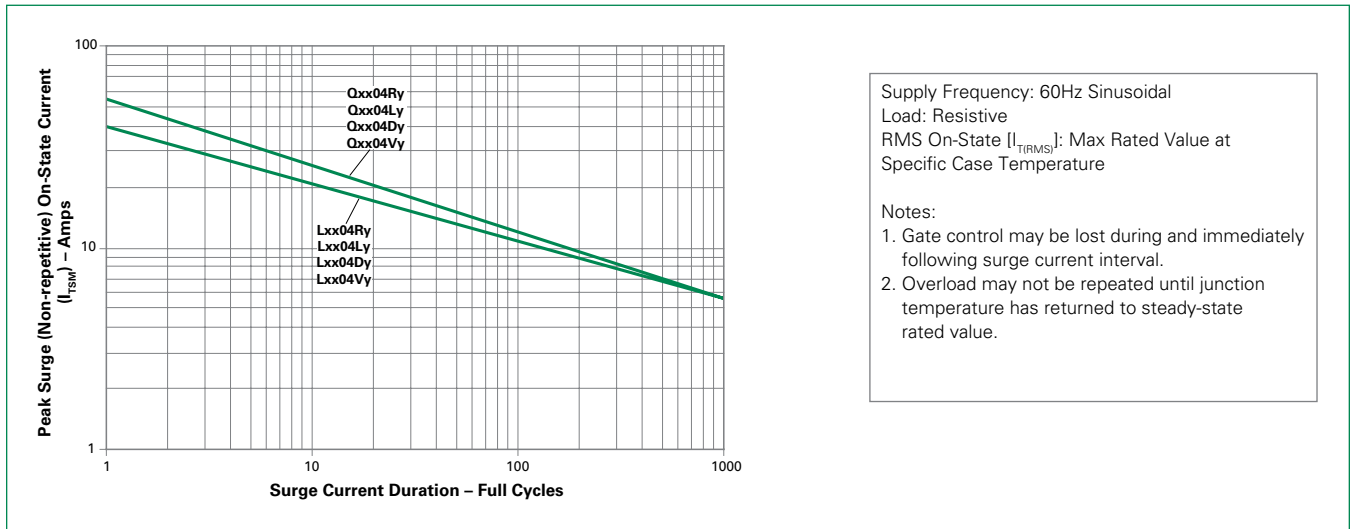


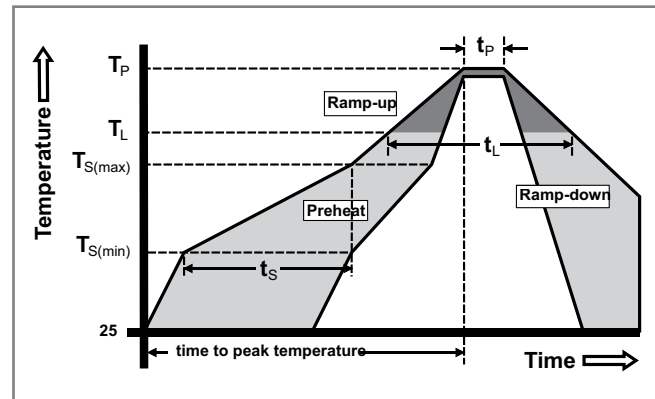
Figure 10: Surge Peak On-State Current vs. Number of Cycles



Note: xx = voltage/10, y = sensitivity

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 | 100% Matte Tin-plated |
| Body Material | UL Recognized compound meeting flammability rating V-0 |
| Terminal Material | Copper Alloy |

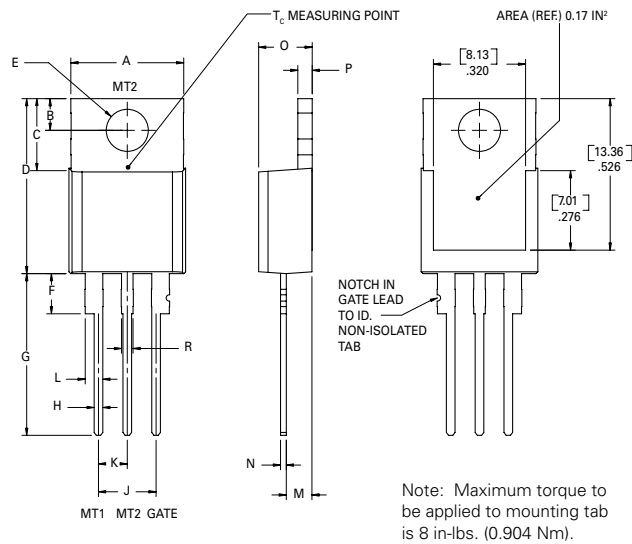
Design Considerations

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

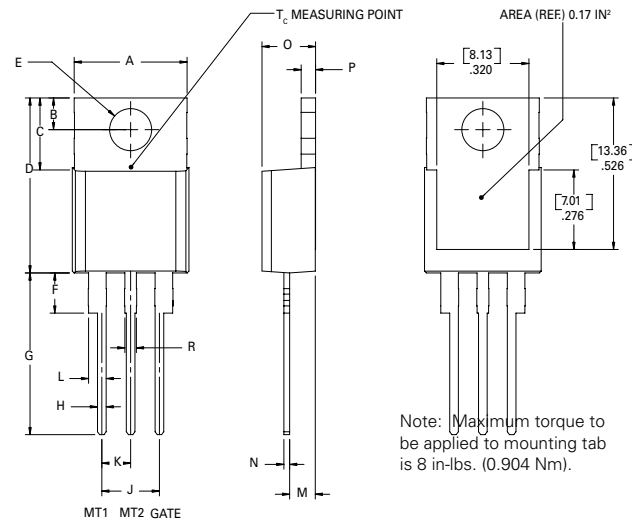
| Test | Specifications and Conditions |
|----------------------------------|--|
| AC Blocking | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours |
| Temperature Cycling | MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell time |
| Temperature/Humidity | EIA / JEDEC, 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 |
| 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



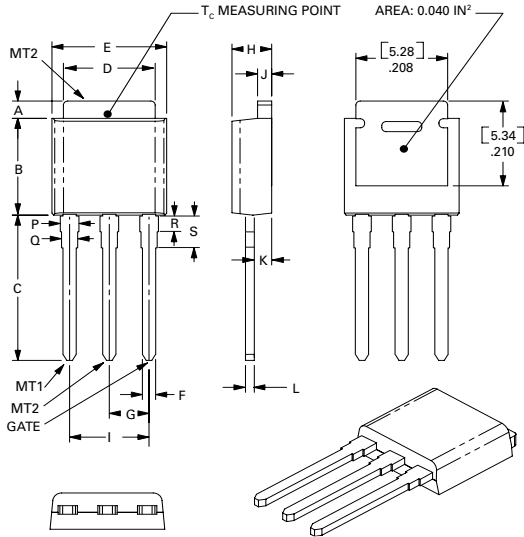
| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.380 | 0.420 | 9.65 | 10.67 |
| B | 0.105 | 0.115 | 2.67 | 2.92 |
| C | 0.230 | 0.250 | 5.84 | 6.35 |
| D | 0.590 | 0.620 | 14.99 | 15.75 |
| E | 0.142 | 0.147 | 3.61 | 3.73 |
| 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



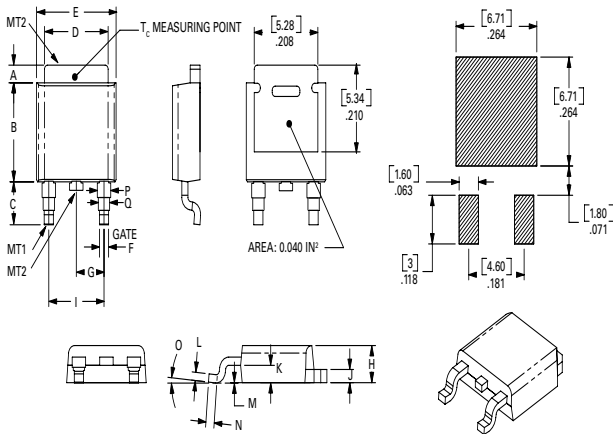
| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.380 | 0.420 | 9.65 | 10.67 |
| B | 0.105 | 0.115 | 2.67 | 2.92 |
| C | 0.230 | 0.250 | 5.84 | 6.35 |
| D | 0.590 | 0.620 | 14.99 | 15.75 |
| E | 0.142 | 0.147 | 3.61 | 3.73 |
| 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-251AA (V-Package) — V-PAK Through Hole



| Dim | Inches | | | Millimeters | | |
|-----|--------|-------|-------|-------------|------|------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.037 | 0.040 | 0.043 | 0.94 | 1.01 | 1.09 |
| B | 0.235 | 0.242 | 0.245 | 5.97 | 6.15 | 6.22 |
| C | 0.350 | 0.361 | 0.375 | 8.89 | 9.18 | 9.53 |
| D | 0.205 | 0.208 | 0.213 | 5.21 | 5.29 | 5.41 |
| E | 0.255 | 0.262 | 0.265 | 6.48 | 6.66 | 6.73 |
| F | 0.027 | 0.031 | 0.033 | 0.69 | 0.80 | 0.84 |
| G | 0.087 | 0.090 | 0.093 | 2.21 | 2.28 | 2.36 |
| H | 0.085 | 0.092 | 0.095 | 2.16 | 2.34 | 2.41 |
| I | 0.176 | 0.180 | 0.184 | 4.47 | 4.57 | 4.67 |
| J | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| K | 0.035 | 0.037 | 0.039 | 0.90 | 0.95 | 1.00 |
| L | 0.018 | 0.020 | 0.023 | 0.46 | 0.52 | 0.58 |
| P | 0.042 | 0.047 | 0.052 | 1.06 | 1.20 | 1.32 |
| Q | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |
| R | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |
| S | 0.074 | 0.079 | 0.084 | 1.86 | 2.00 | 2.11 |

Dimensions — TO-252AA (D-Package) — D-PAK Surface Mount



| Dim | Inches | | | Millimeters | | |
|-----|--------|-------|-------|-------------|------|------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.037 | 0.040 | 0.043 | 0.94 | 1.01 | 1.09 |
| B | 0.235 | 0.243 | 0.245 | 5.97 | 6.16 | 6.22 |
| C | 0.106 | 0.108 | 0.113 | 2.69 | 2.74 | 2.87 |
| D | 0.205 | 0.208 | 0.213 | 5.21 | 5.29 | 5.41 |
| E | 0.255 | 0.262 | 0.265 | 6.48 | 6.65 | 6.73 |
| F | 0.027 | 0.031 | 0.033 | 0.69 | 0.80 | 0.84 |
| G | 0.087 | 0.090 | 0.093 | 2.21 | 2.28 | 2.36 |
| H | 0.085 | 0.092 | 0.095 | 2.16 | 2.33 | 2.41 |
| I | 0.176 | 0.179 | 0.184 | 4.47 | 4.55 | 4.67 |
| J | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| K | 0.035 | 0.037 | 0.039 | 0.90 | 0.95 | 1.00 |
| L | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| M | 0.000 | 0.000 | 0.004 | 0.00 | 0.00 | 0.10 |
| N | 0.021 | 0.026 | 0.027 | 0.53 | 0.67 | 0.69 |
| O | 0° | 0° | 5° | 0° | 0° | 5° |
| P | 0.042 | 0.047 | 0.052 | 1.06 | 1.20 | 1.32 |
| Q | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |

Product Selector

| Part Number | Voltage | | | | Gate Sensitivity Quadrants | | Type | Package |
|-------------|---------|------|------|-------|----------------------------|-------|-----------------|--------------|
| | 400V | 600V | 800V | 1000V | I – II – III | IV | | |
| Lxx04L3 | X | X | | | 3 mA | 3 mA | Sensitive Triac | TO-220L |
| Lxx04D3 | X | X | | | 3 mA | 3 mA | Sensitive Triac | TO-252 D-PAK |
| Lxx04R3 | X | X | | | 3mA | 3mA | Sensitive Triac | TO-220R |
| Lxx04V3 | X | X | | | 3 mA | 3 mA | Sensitive Triac | TO-251 V-PAK |
| Lxx04L5 | X | X | | | 5 mA | 5 mA | Sensitive Triac | TO-220L |
| Lxx04D5 | X | X | | | 5 mA | 5 mA | Sensitive Triac | TO-252 D-PAK |
| Lxx04R5 | X | X | | | 5mA | 5mA | Sensitive Triac | TO-220R |
| Lxx04V5 | X | X | | | 5 mA | 5 mA | Sensitive Triac | TO-251 V-PAK |
| Lxx04L6 | X | X | | | 5 mA | 10 mA | Sensitive Triac | TO-220L |
| Lxx04D6 | X | X | | | 5 mA | 10 mA | Sensitive Triac | TO-252 D-PAK |
| Lxx04R6 | X | X | | | 5mA | 10mA | Sensitive Triac | TO-220R |
| Lxx04V6 | X | X | | | 5 mA | 10 mA | Sensitive Triac | TO-251 V-PAK |
| Lxx04L8 | X | X | | | 10 mA | 20 mA | Sensitive Triac | TO-220L |
| Lxx04D8 | X | X | | | 10 mA | 20 mA | Sensitive Triac | TO-252 D-PAK |
| Lxx04R8 | X | X | | | 10mA | 20mA | Sensitive Triac | TO-220R |
| Lxx04V8 | X | X | | | 10 mA | 20 mA | Sensitive Triac | TO-251 V-PAK |
| Qxx04L3 | X | X | | | 10 mA | | Standard Triac | TO-220L |
| Qxx04D3 | X | X | | | 10 mA | | Standard Triac | TO-252 D-PAK |
| Qxx04V3 | X | X | | | 10 mA | | Standard Triac | TO-251 V-PAK |
| Qxx04R3 | X | X | | | 10mA | | Standard Triac | TO-220R |
| Qxx04L4 | X | X | X | X | 25 mA | | Standard Triac | TO-220L |
| Qxx04D4 | X | X | X | X | 25 mA | | Standard Triac | TO-252 D-PAK |
| Qxx04R4 | X | X | X | X | 25mA | | Standard Triac | TO-220R |
| Qxx04V4 | X | X | X | X | 25 mA | | Standard Triac | TO-251 V-PAK |

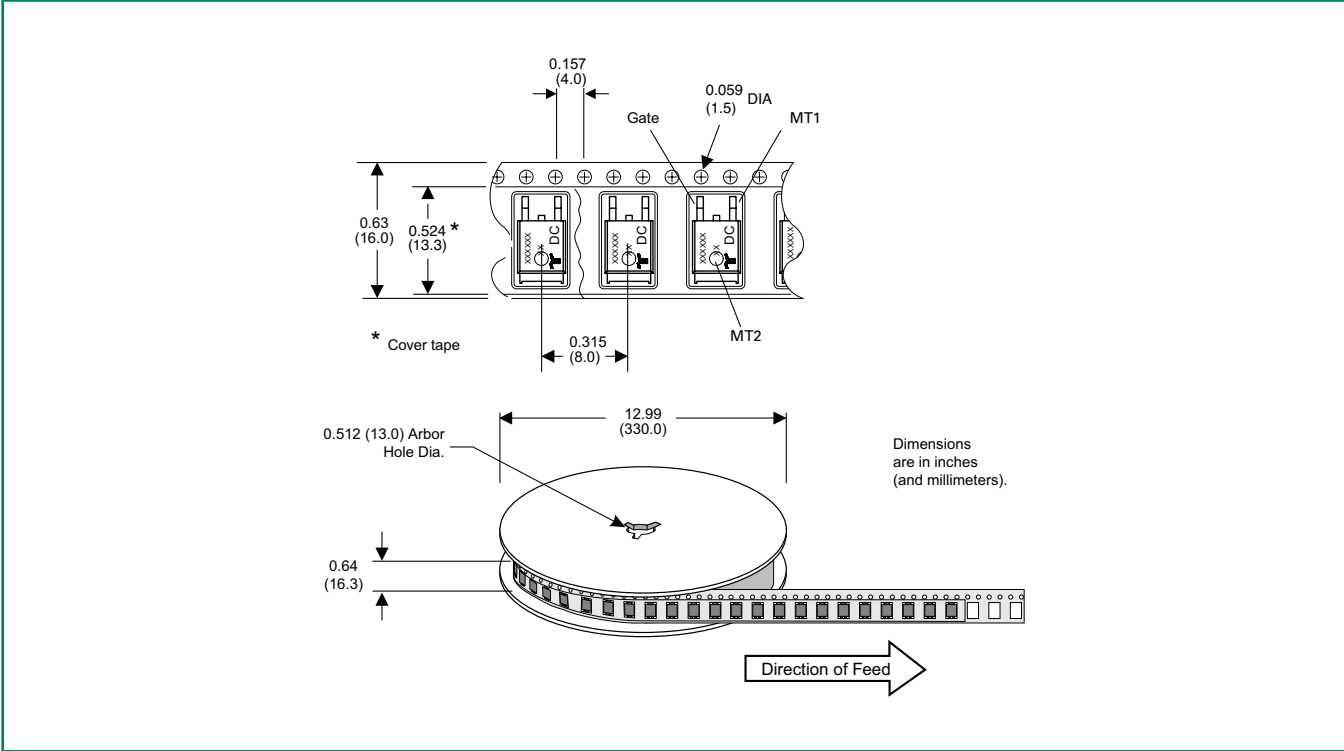
Packing Options

| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|-------------|-----------|--------|------------------|-------------------|
| L/Qxx04LyTP | L/Qxx04Ly | 2.2 g | Tube | 500 (50 per tube) |
| L/Qxx04DyRP | L/Qxx04Dy | 0.3 g | Embossed Carrier | 2500 |
| L/Qxx04DyTP | L/Qxx04Dy | 0.3 g | Tube Pack | 750 (75 per tube) |
| L/Qxx04VyTP | L/Qxx04Vy | 0.4 g | Tube Pack | 750 (75 per tube) |

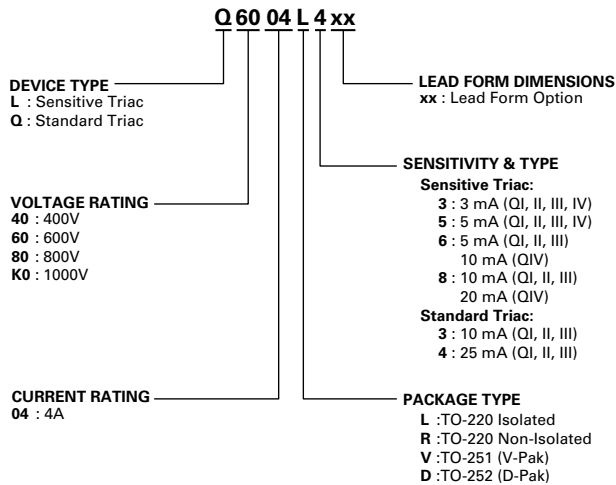
Note: xx = Voltage/10; y = Sensitivity

TO-252 Embossed Carrier Reel Pack (RP) Specifications

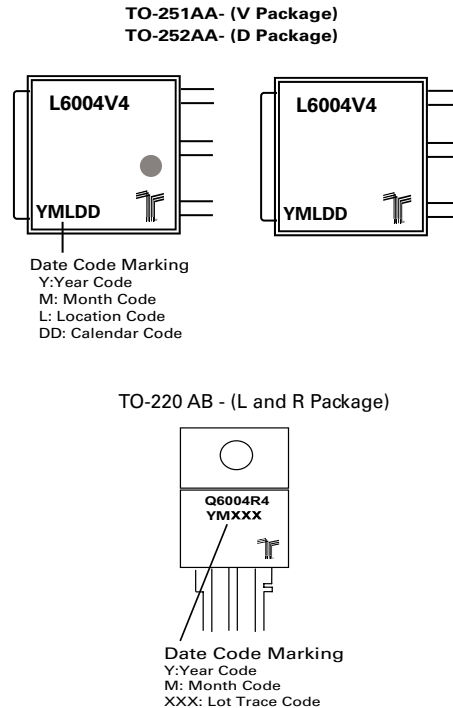
Meets all EIA-481-2 Standards



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