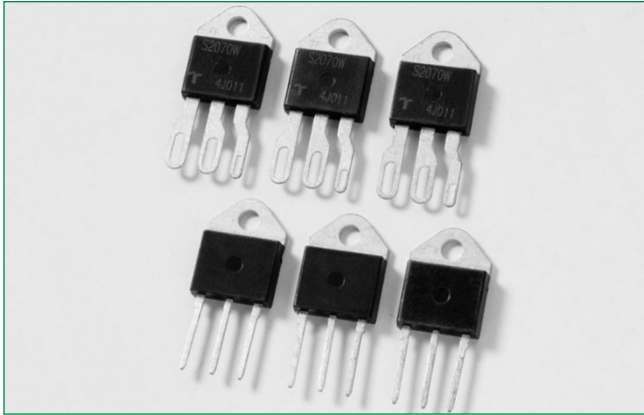


Qxx40xx Series



Description

The 40 Amp bi-directional solid state switch series is designed for AC switching and phase control applications such as motor speed, temperature modulation controls, lighting controls, and static switching relays.

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

Standard type devices operate in quadrants I,II,III & IV.

Agency Approval

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

* - K and J Packages

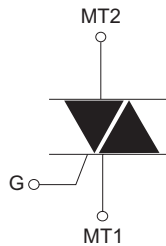
Features & Benefits

- RoHS Compliant
- Glass – passivated junctions
- Voltage capability up to 1000V
- Surge capability up to 400A
- Electrically isolated K & J -Packages are UL Recognized for 2500Vrms

Main Features

| Symbol | Value | Unit |
|-------------------|-------------|------|
| $I_{T(RMS)}$ | 40 | A |
| V_{DRM}/V_{RRM} | 400 to 1000 | V |
| $I_{GT(Q1)}$ | 35 to 100 | mA |

Schematic Symbol



Applications

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

Typical applications are AC solid-state switches, industrial power tools, exercise equipment, white goods and commercial 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 Triac (3 Quadrants)

| Symbol | Parameter | | Value | Unit |
|--------------|---|-----------------------|-----------------------------------|-------------------------|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | Qxx40x7 Qxx40xH6 | $T_C = 75\text{ }^\circ\text{C}$ | 40 A |
| I_{TSM} | Non repetitive surge peak on-state current (full cycle, T_J initial = $25\text{ }^\circ\text{C}$) | $f = 50\text{ Hz}$ | $t = 20\text{ ms}$ | 335 A |
| | | $f = 60\text{ Hz}$ | $t = 16.7\text{ ms}$ | 400 |
| I^2t | I ² t Value for fusing | | $t_p = 8.3\text{ ms}$ | 664 A ² s |
| di/dt | Critical rate of rise of on-state current ($I_G = 2 \times I_{GT}$, $t_r \leq 100\text{ ns}$) | $f = 120\text{ Hz}$ | $T_J = 125\text{ }^\circ\text{C}$ | 150 A/ μs |
| I_{GTM} | Peak gate trigger current | $t_p = 20\mu\text{s}$ | $T_J = 125\text{ }^\circ\text{C}$ | 4 A |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_J = 125\text{ }^\circ\text{C}$ | 0.5 W |
| T_{stg} | Storage temperature range | | | -40 to 150 °C |
| T_J | Operating junction temperature range | | | -40 to 125 °C |

Absolute Maximum Ratings – Standard Triac (4 Quadrants)

| Symbol | Parameter | Test Conditions | | Value | Unit |
|--------------|---|--|-----------------------------------|------------|------------------|
| $I_{T(RMS)}$ | RMS on-state current | Qxx40J3/Qxx40K3 Qxx40J4/Qxx40K4 | $T_C = 75\text{ }^\circ\text{C}$ | 40 | A |
| | | Qxx40M4 | $T_C = 95\text{ }^\circ\text{C}$ | 40 | |
| I_{TSM} | Peak non-repetitive surge current | $f = 50\text{ Hz}$ | $t = 20\text{ ms}$ | 400 | A |
| | | $f = 60\text{ Hz}$ | $t = 16\text{ ms}$ | 480 | |
| I^2t | I ² t Value for fusing | | $t_p = 8.3\text{ ms}$ | 956 | A ² s |
| di/dt | Critical rate-of-rise of on-state current | $f = 120\text{ Hz}; T_J = 125\text{ }^\circ\text{C}$ | | 150 | A/ μs |
| I_{GTM} | Peak gate current | $t_p = 20\mu\text{s}$ | $T_J = 125\text{ }^\circ\text{C}$ | 4 | A |
| $P_{G(AV)}$ | Average gate power dissipation | $T_J = 125\text{ }^\circ\text{C}$ | | 0.5 | W |
| T_{stg} | Storage temperature range | | | -40 to 150 | °C |
| T_J | Operating junction temperature range | | | -40 to 125 | °C |

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

| Symbol | Test Conditions | Quadrant | | Value | | | Unit |
|----------|--|--------------|------|----------|---------|---------|------------------|
| | | | | Qxx40xH6 | Qxx40K5 | Qxx40x7 | |
| I_{GT} | $V_D = 12\text{ V}$ $R_L = 60\ \Omega$ | I – II – III | MAX. | 80 | 50 | 100 | mA |
| V_{GT} | $V_D = 12\text{ V}$ $R_L = 60\ \Omega$ | I – II – III | MAX. | 1.3 | 1.3 | 2.0 | V |
| V_{GD} | $V_D = V_{DRM}$ $R_L = 3.3\text{ k}\Omega$ $T_J = 125\text{ }^\circ\text{C}$ | I – II – III | MIN. | 0.2 | | | V |
| I_H | $I_T = 400\text{ mA}$ | | MAX. | 80 | 75 | 100 | mA |
| dv/dt | $V_D = V_{DRM}$ Gate Open $T_J = 125\text{ }^\circ\text{C}$ | 400V | MIN. | 600 | 500 | 700 | V/ μs |
| | | 600V | | 500 | 475 | 625 | |
| | | 800V | | 475 | 400 | 575 | |
| | | 1000V | | 1000 | 800 | 1200 | |
| (dv/dt)c | (di/dt)c = 21.6 A/ms $T_J = 125\text{ }^\circ\text{C}$ | | MIN. | 30 | 20 | 50 | V/ μs |
| t_{gt} | $I_G = 2 \times I_{GT}$ $PW = 15\mu\text{s}$ $I_T = 56.6\text{ A(pk)}$ | | TYP. | 5 | | | μs |

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

| Symbol | Test Conditions | Quadrant | | Qxx40x3 | Value | | Unit |
|----------|--|--------------|------|---------|---------|------------------|------|
| | | | | | Qxx40x4 | | |
| I_{GT} | $V_D = 12\text{ V}; R_L = 60\ \Omega$ | I – II – III | MAX. | 35 | 50 | mA | |
| | | IV | MAX. | 70 | 100 | | |
| V_{GT} | $V_D = 12\text{ V}; R_L = 60\ \Omega$ | ALL | 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 | $I_T = 400\text{mA (initial)}$ | | MAX. | 80 | 80 | mA | |
| dv/dt | $V_D = V_{DRM}; \text{Gate Open}; T_J = 125^\circ\text{C}$ | 400V | MIN. | 400 | 400 | V/ μs | |
| | | 600V | | 400 | 400 | | |
| | | 800V | | 400 | 400 | | |
| (dv/dt)c | (di/dt)c = 4.3 A/ms; $T_J = 125^\circ\text{C}$ | | MIN. | 10 | 10 | V/ μs | |
| t_{gt} | $I_G = 2 \times I_{GT}; PW = 15\ \mu\text{s}; I_T = 35.4\text{ A}$ | | TYP. | 5 | 5 | μs | |
| dv/dt | $VD=V_{DRM}, \text{Gate Open}, T_J=100^\circ\text{C}$ | | - | - | 300 | V/ μs | |

Static Characteristics

| Symbol | Test Conditions | | | Value | Unit |
|------------------------|---------------------------|---------------------------|--------------------------|-------|------------------|
| V_{TM} | $I_{TM} = 56.6\text{ A}$ | $t_p = 380\ \mu\text{s}$ | $T_J = 25^\circ\text{C}$ | MAX. | 1.8 V |
| I_{DRM} I_{RRM} | $V_D = V_{DRM} / V_{RRM}$ | $T_J = 25^\circ\text{C}$ | 400 – 1000V | MAX. | 20 μA |
| | | $T_J = 125^\circ\text{C}$ | 400 – 800V | MAX. | 5 mA |
| | | $T_J = 100^\circ\text{C}$ | 1000V | MAX. | 5 mA |

Thermal Resistances

| Symbol | Parameter | | Value | Unit |
|-------------------|-----------------------|--|-------|---------------------------|
| $R_{\theta(J-C)}$ | Junction to case (AC) | Qxx40KH6 Qxx40K5/7 Qxx40K4/J4 Qxx40K3 | 0.97 | $^\circ\text{C}/\text{W}$ |
| | | Qxx40JH6 Qxx40J7 | 0.95 | |
| | | Qxx40M4 | 0.6 | $^\circ\text{C}/\text{W}$ |

Note: xx = voltage

Figure 1: Definition of Quadrants

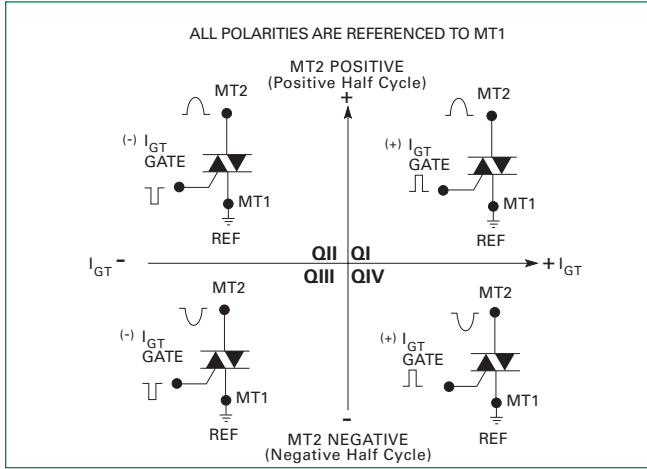


Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature

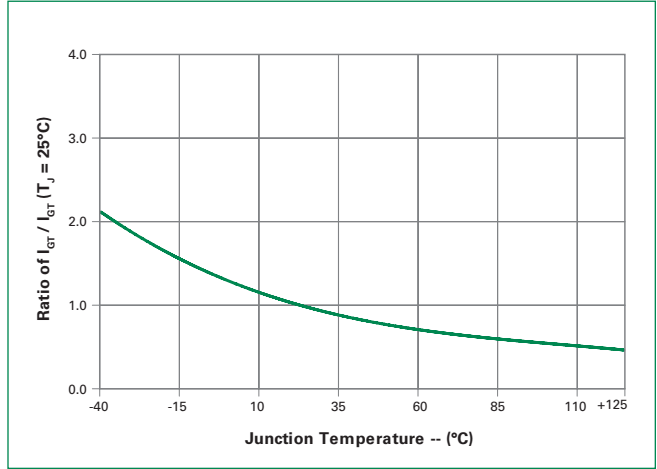


Figure 3: Normalized DC Holding Current vs. Junction Temperature

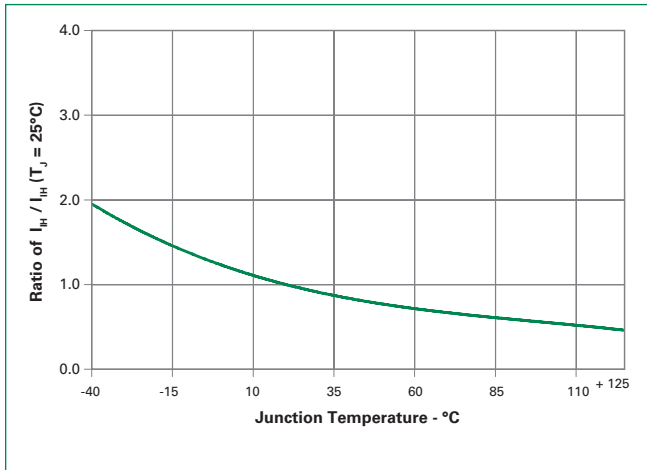


Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature

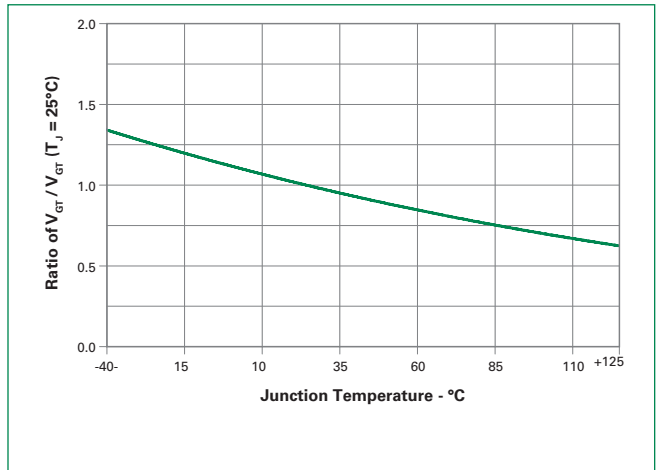


Figure 5: Power Dissipation (Typical) vs. RMS On-State Current

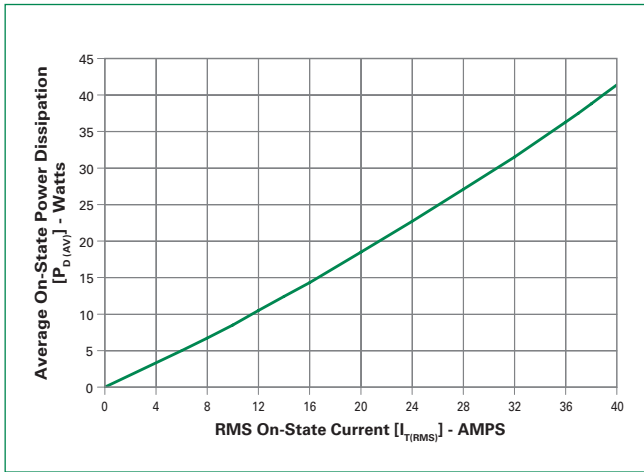


Figure 6: Maximum Allowable Case Temperature vs. On-State Current

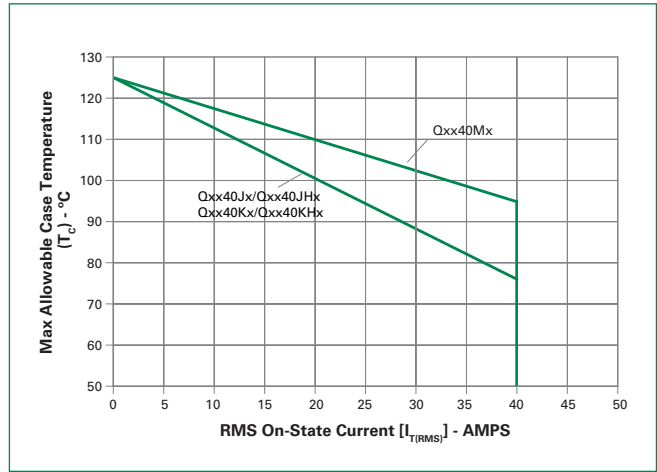


Figure 7: On-State Current vs. On-State Voltage (Typical)

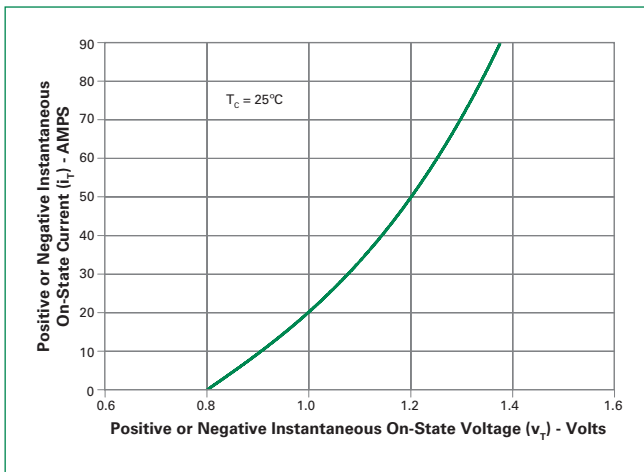
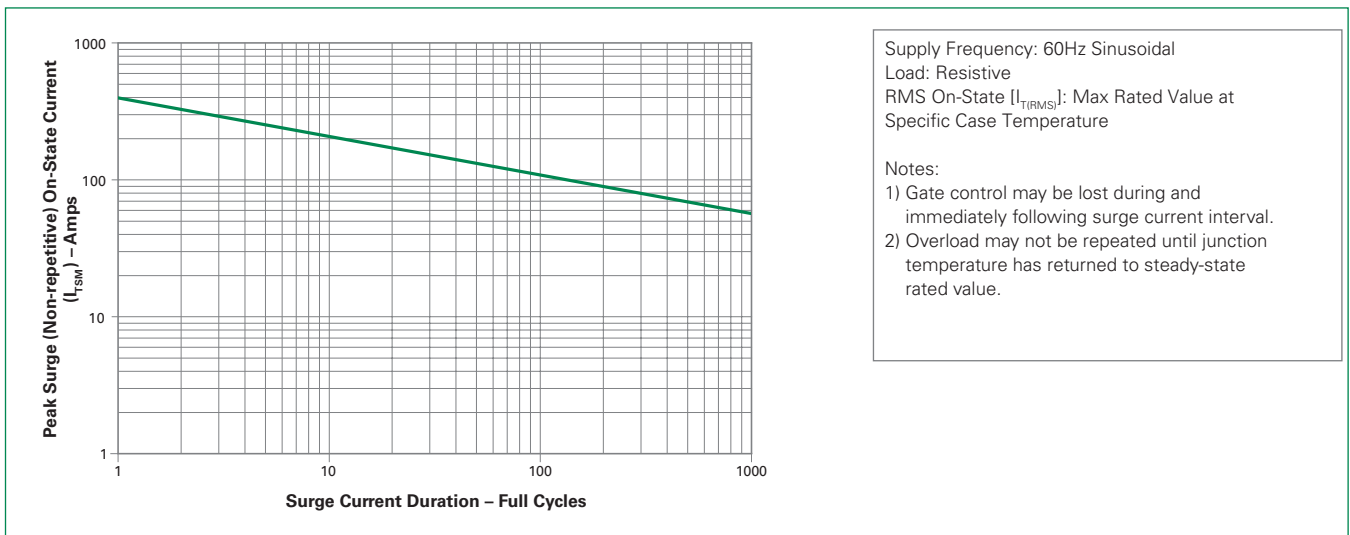
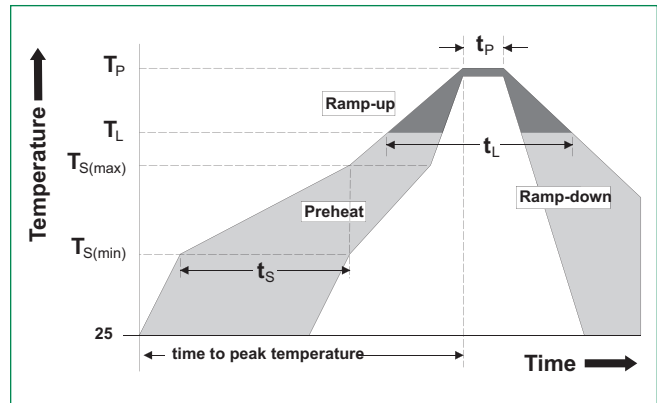


Figure 8: Surge Peak On-State Current vs. Number of Cycles



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 ^{+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 compound meeting flammability rating V-0 |
| Lead Material | Copper Alloy |

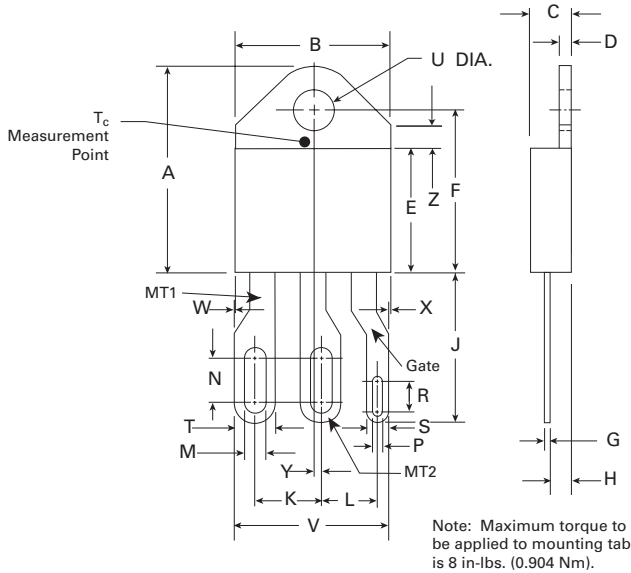
Design Considerations

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

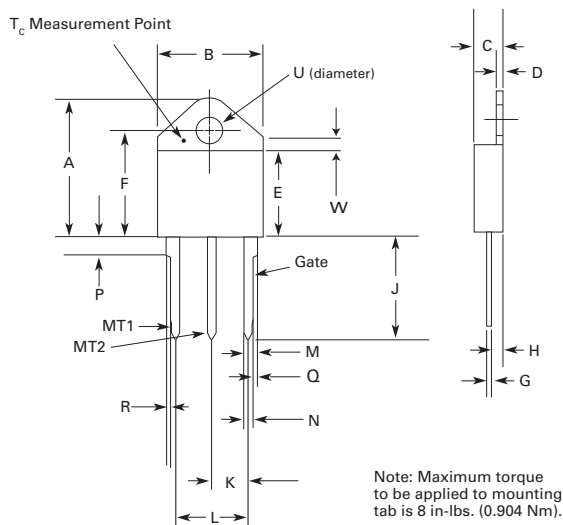
| | |
|----------------------------------|--|
| AC Blocking | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours |
| Temperature Cycling | MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time |
| Temperature/Humidity | EIA / JEDEC, JESD22-A101 1008 hours; 320V - 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-218X (J Package) — Isolated Mounting Tab



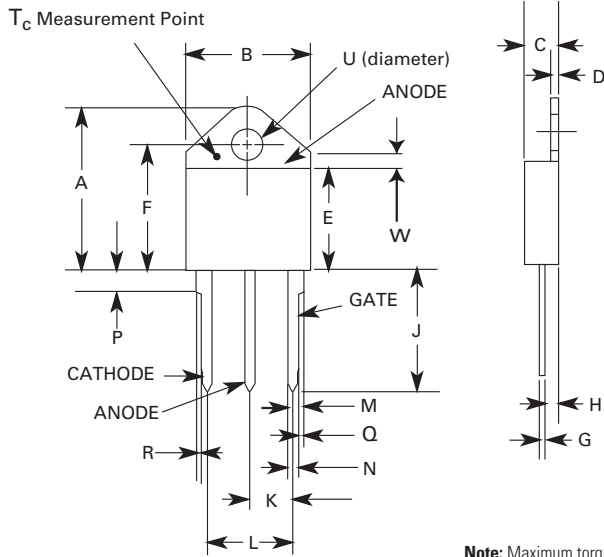
| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.810 | 0.835 | 20.57 | 21.21 |
| B | 0.610 | 0.630 | 15.49 | 16.00 |
| C | 0.178 | 0.188 | 4.52 | 4.78 |
| D | 0.055 | 0.070 | 1.40 | 1.78 |
| E | 0.487 | 0.497 | 12.37 | 12.62 |
| F | 0.635 | 0.655 | 16.13 | 16.64 |
| G | 0.022 | 0.029 | 0.56 | 0.74 |
| H | 0.075 | 0.095 | 1.91 | 2.41 |
| J | 0.575 | 0.625 | 14.61 | 15.88 |
| K | 0.256 | 0.264 | 6.50 | 6.71 |
| L | 0.220 | 0.228 | 5.58 | 5.79 |
| M | 0.080 | 0.088 | 2.03 | 2.24 |
| N | 0.169 | 0.177 | 4.29 | 4.49 |
| P | 0.034 | 0.042 | 0.86 | 1.07 |
| R | 0.113 | 0.121 | 2.87 | 3.07 |
| S | 0.086 | 0.096 | 2.18 | 2.44 |
| T | 0.156 | 0.166 | 3.96 | 4.22 |
| U | 0.161 | 0.165 | 4.10 | 4.20 |
| V | 0.603 | 0.618 | 15.31 | 15.70 |
| W | 0.000 | 0.005 | 0.00 | 0.13 |
| X | 0.003 | 0.012 | 0.07 | 0.30 |
| Y | 0.028 | 0.032 | 0.71 | 0.81 |
| Z | 0.085 | 0.095 | 2.17 | 2.42 |

Dimensions — TO-218AC (K Package) — Isolated Mounting Tab



| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.810 | 0.835 | 20.57 | 21.21 |
| B | 0.610 | 0.630 | 15.49 | 16.00 |
| C | 0.178 | 0.188 | 4.52 | 4.78 |
| D | 0.055 | 0.070 | 1.40 | 1.78 |
| E | 0.487 | 0.497 | 12.37 | 12.62 |
| F | 0.635 | 0.655 | 16.13 | 16.64 |
| G | 0.022 | 0.029 | 0.56 | 0.74 |
| H | 0.075 | 0.095 | 1.91 | 2.41 |
| J | 0.575 | 0.625 | 14.61 | 15.88 |
| K | 0.211 | 0.219 | 5.36 | 5.56 |
| L | 0.422 | 0.437 | 10.72 | 11.10 |
| M | 0.058 | 0.068 | 1.47 | 1.73 |
| N | 0.045 | 0.055 | 1.14 | 1.40 |
| P | 0.095 | 0.115 | 2.41 | 2.92 |
| Q | 0.008 | 0.016 | 0.20 | 0.41 |
| R | 0.008 | 0.016 | 0.20 | 0.41 |
| U | 0.161 | 0.165 | 4.10 | 4.20 |
| W | 0.085 | 0.095 | 2.17 | 2.42 |

Dimensions – TO-218AC (M 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 | 0.810 | 0.835 | 20.57 | 21.21 |
| B | 0.610 | 0.630 | 15.49 | 16.00 |
| C | 0.178 | 0.188 | 4.52 | 4.78 |
| D | 0.055 | 0.070 | 1.40 | 1.78 |
| E | 0.487 | 0.497 | 12.37 | 12.62 |
| F | 0.635 | 0.655 | 16.13 | 16.64 |
| G | 0.022 | 0.029 | 0.56 | 0.74 |
| H | 0.075 | 0.095 | 1.91 | 2.41 |
| J | 0.575 | 0.625 | 14.61 | 15.88 |
| K | 0.211 | 0.219 | 5.36 | 5.56 |
| L | 0.422 | 0.437 | 10.72 | 11.10 |
| M | 0.058 | 0.068 | 1.47 | 1.73 |
| N | 0.045 | 0.055 | 1.14 | 1.40 |
| P | 0.095 | 0.115 | 2.41 | 2.92 |
| Q | 0.008 | 0.016 | 0.20 | 0.41 |
| R | 0.008 | 0.016 | 0.20 | 0.41 |
| U | 0.164 | 0.165 | 4.10 | 4.20 |
| W | 0.085 | 0.095 | 2.17 | 2.42 |

Product Selector

| Part Number | Voltage | | | | Gate Sensitivity Quadrants | | I _{T(RMS)} | Type | Package |
|-------------|---------|------|------|-------|----------------------------|--------|---------------------|-------------------|----------|
| | 400V | 600V | 800V | 1000V | I – II – III | IV | | | |
| Qxx40KH6 | X | X | X | X | 80 mA | - | 40 A | Alternistor Triac | TO-218AC |
| Qxx40JH6 | X | X | X | - | 80 mA | - | 40 A | Alternistor Triac | TO-218X |
| Qxx40K5 | X | X | X | X | 50 mA | - | 40 A | Alternistor Triac | TO-218AC |
| Qxx40K7 | X | X | X | X | 100 mA | - | 40 A | Alternistor Triac | TO-218AC |
| Qxx40J7 | X | X | X | - | 100 mA | - | 40 A | Alternistor Triac | TO-218X |
| Qxx40K4 | X | X | X | X | 50 mA | 100 mA | 40 A | Standard Triac | TO-218AC |
| Qxx40K3 | - | - | X | - | 35 mA | 70 mA | 40 A | Standard Triac | TO-218AC |
| Qxx40J4 | - | - | - | X | 50 mA | 100 mA | 40 A | Standard Triac | TO-218X |
| Qxx40M4 | X | X | X | X | 50 mA | 100 mA | 40 A | Standard Triac | TO-218AC |

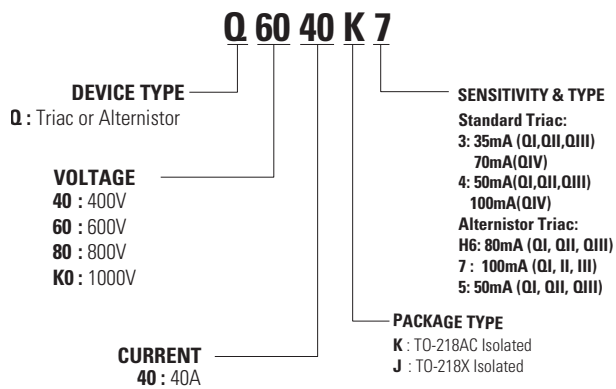
Note: xx = Voltage

Packing Options

| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|-------------|----------|--------|--------------|-------------------|
| Qxx40KH6TP | Qxx40KH6 | 4.40 g | Tube Pack | 250 (25 per tube) |
| Qxx40JH6TP | Qxx40JH6 | 5.23 g | Tube Pack | 250 (25 per tube) |
| Qxx40K5TP | Qxx40K5 | 4.40 g | Tube Pack | 250 (25 per tube) |
| Qxx40K7TP | Qxx40K7 | 4.40 g | Tube Pack | 250 (25 per tube) |
| Qxx40J7TP | Qxx40J7 | 5.23 g | Tube Pack | 250 (25 per tube) |
| Qxx40K4TP | Qxx40K4 | 4.40 g | Tube Pack | 250 (25 per tube) |
| Qxx40K3TP | Qxx40K3 | 4.40g | Tube Pack | 250 (25 per tube) |
| Qxx40J4TP | Qxx40J4 | 5.23g | Tube Pack | 250 (25 per tube) |
| Qxx40M4TP | Qxx40M4 | 4.40g | Tube Pack | 250 (25 per tube) |

Note: xx = Voltage

Part Numbering System



Part Marking System

TO-218 AC - (K/M Package)
TO-218 X - (J Package)

