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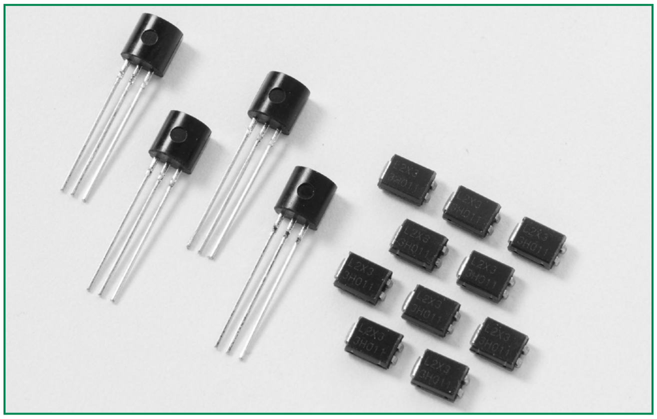
RoHS

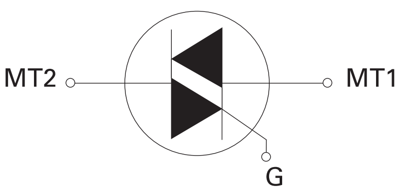
# LxX8Ex & LxXx & QxX8E & QxXx Series



## Main Features

| Symbol | Value | Unit |
|---|---|---|
| $I_{T(RMS)}$ | 0.8 | A |
| $V_{DRM}/V_{RRM}$ | 400 to 600 | V |
| $I_{GT\ (Q1)}$ | 3 to 25 | mA |

## Schematic Symbol




## Description

0.8 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.

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

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

## Features

- RoHS Compliant
- Glass – passivated junctions
- Voltage capability up to 600 V
- Surge capability up to 10 A

## Applications

Excellent for lower current heating controls, water valves, and solenoids.

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

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



## Absolute Maximum Ratings — Sensitive Triacs (4 Quadrants)

| Symbol | Parameter | | | Value | Unit |
|---|---|---|---|---|---|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | LxX8y/LxXy | $T_C$ = 50°C | 0.8 | A |
| $I_{TSM}$ | Non repetitive surge peak on-state current (full cycle, $T_J$ initial = 25°C) | f = 50 Hz | t = 20 ms | 8.3 | A |
| | | f = 60 Hz | t = 16.7 ms | 10 | |
| $I^2t$ | $I^2t$ Value for fusing | $t_p$ = 8.3 ms | | 0.41 | $A^2s$ |
| di/dt | Critical rate of rise of on-state current ($I_G$ = 50mA with ≤ 0.1µs rise time) | f = 120 Hz | $T_J$ = 110°C | 20 | A/µs |
| $I_{GTM}$ | Peak gate trigger current | $t_p$ = 10 µs | $T_J$ = 110°C | 1 | A |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_J$ = 110°C | 0.2 | W |
| $T_{stg}$ | Storage temperature range | | LxX8Ey | -65 to 150 | °C |
| | | | LxXy | -40 to 150 | |
| $T_J$ | Operating junction temperature range | | LxX8Ey | -65 to 110 | °C |
| | | | LxXy | -40 to 110 | |

Note: x = voltage, y = sensitivity

## Absolute Maximum Ratings — Standard Triac

| Symbol | Parameter | | | Value | Unit |
|---|---|---|---|---|---|
| $I_{T(RMS)}$ | RMS on-state current (full sine wave) | QxXE8y/ QxXy | $T_C$ = 60°C | 0.8 | A |
| $I_{TSM}$ | Non repetitive surge peak on-state current (full cycle, $T_J$ initial = 25°C) | f = 50 Hz | t = 20 ms | 8.3 | A |
| | | f = 60 Hz | t = 16.7 ms | 10 | |
| $I^2t$ | $I^2t$ Value for fusing | $t_p$ = 8.3 ms | | 0.41 | $A^2s$ |
| di/dt | Critical rate of rise of on-state current ($I_G$ = 200mA with ≤ 0.1μs rise time) | f = 120 Hz | $T_J$ = 125°C | 20 | A/μs |
| $I_{GTM}$ | Peak gate trigger current | $t_p$ = 10 μs; $I_{GT}$ ≤ $I_{GTM}$ | $T_J$ = 125°C | 1 | A |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_J$ = 125°C | 0.2 | W |
| $T_{stg}$ | Storage junction temperature range | | L/QxX8Ey | -65 to 150 | °C |
| | | | L/QxXy | -40 to 150 | |
| $T_J$ | Operating junction temperature range | | L/QxX8Ey | -65 to 125 | °C |
| | | | L/QxXy | -40 to 125 | |

Note: x = voltage, y = sensitivity

## Electrical Characteristics ($T_J$ = 25°C, unless otherwise specified) — Sensitive Triac (4 Quadrants)

| Symbol | Test Conditions | Quadrant | | LxX8E3 LxX3 | LxX8E5 LxX5 | LxX8E6 LxX6 | LxX8E8 LxX8 | Unit |
|---|---|---|---|---|---|---|---|---|
| $I_{GT}$ | $V_D$ = 12V $R_L$ = 30 Ω | I – II – III | MAX. | 3 | 5 | 5 | 10 | mA |
| | | IV | | 3 | 5 | 10 | 20 | |
| $V_{GT}$ | | ALL | MAX. | 1.3 | | | | V |
| $V_{GD}$ | $V_D$ = $V_{DRM}$ $R_L$ = 3.3 kΩ $T_J$ = 110°C | ALL | MIN. | 0.2 | | | | V |
| $I_H$ | $I_T$ = 100mA | | MAX. | 5 | 10 | 10 | 15 | mA |
| dv/dt | $V_D$ = $V_{DRM}$ Gate Open $T_J$ = 100°C | 400V | TYP. | 15 | 15 | 25 | 30 | V/μs |
| | | 600V | | 10 | 10 | 20 | 25 | |
| (dv/dt)c | (di/dt)c = 0.43 A/ms $T_J$ = 110°C | | TYP. | 0.5 | 1 | 1 | 2 | V/μs |
| $t_{gt}$ | $I_G$ = 2 x $I_{GT}$ PW = 15μs $I_T$ = 1.13 A(pk) | | TYP. | 2.8 | 3.0 | 3.0 | 3.2 | μs |

## Electrical Characteristics ($T_J$ = 25°C, unless otherwise specified) — Standard Triac

| Symbol | Test Conditions | Quadrant | | QxX8E3 QxX3 | QxX8E4 QxX4 | Unit |
|---|---|---|---|---|---|---|
| $I_{GT}$ | $V_D$ = 12V $R_L$ = 60 Ω | I – II – III | MAX. | 10 | 25 | mA |
| | | IV | TYP. | 25 | 50 | |
| $V_{GT}$ | | I – II – III | MAX. | 1.3 | 1.3 | V |
| $V_{GD}$ | $V_D$ = $V_{DRM}$ $R_L$ = 3.3 kΩ $T_J$ = 125°C | ALL | MIN. | 0.2 | 0.2 | V |
| $I_H$ | $I_T$ = 200mA | | MAX. | 15 | 25 | mA |
| dv/dt | $V_D$ = $V_{DRM}$ Gate Open $T_J$ = 125°C | 400V | MIN. | 25 | 35 | V/μs |
| | | 600V | | 15 | 25 | |
| (dv/dt)c | (di/dt)c = 0.43 A/ms $T_J$ = 125°C | | TYP. | 1 | 1 | V/μs |
| $t_{gt}$ | $I_G$ = 2 x $I_{GT}$ PW = 15μs $I_T$ = 1.13 A(pk) | | TYP. | 2.5 | 3.0 | μs |

Note: x = voltage

## Static Characteristics ($T_J$ = 25°C, unless otherwise specified)

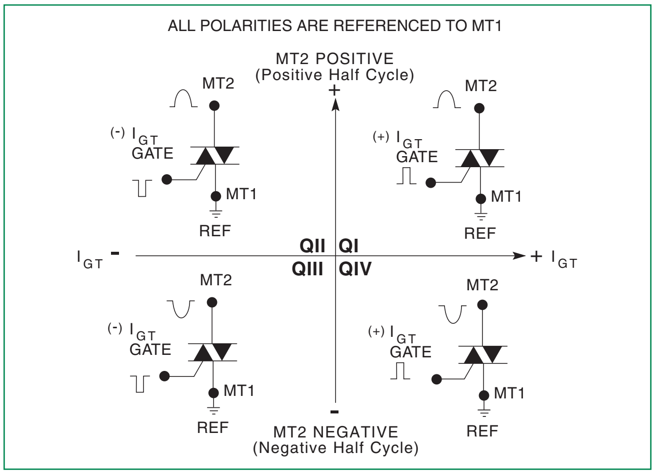
| Symbol | Test Conditions | | | | | Value | Unit |
|---|---|---|---|---|---|---|---|
| $V_{TM}$ | $I_{TM}$ = 1.13A $t_p$ = 380 µs | MAX. | | | | 1.60 | V |
| $I_{DRM}$ $I_{RRM}$ | $V_{DRM} = V_{RRM}$ | MAX. | LxX8Ey / LxXy | $T_J$ = 25°C | 400-600V | 2 | µA |
| | | | | $T_J$ = 110°C | 400-600V | 0.1 | mA |
| | | | QxX8Ey / QxXy | $T_J$ = 25°C | 400-600V | 5 | µA |
| | | | | $T_J$ = 125°C | 400-600V | 1 | mA |

## Thermal Resistances

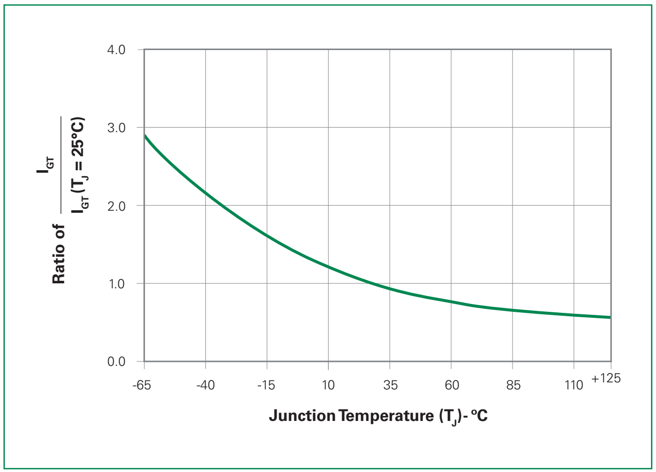
| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $R_{\theta(J-C)}$ | Junction to case (AC) | L/QxX8Ey | 60 | °C/W |
| | | L/QxXy | 60* | |
| $R_{\theta(J-A)}$ | Junction to ambient | L/QxX8Ey | 135 | °C/W |

Note: * = Mounted on 1 cm² 1 copper (two-ounce) foil surface

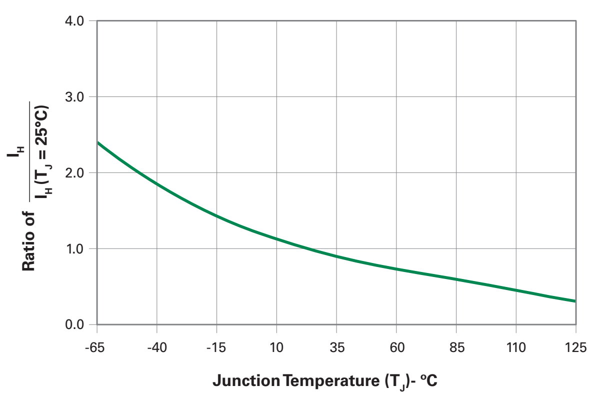
## Figure 1: Definition of Quadrants



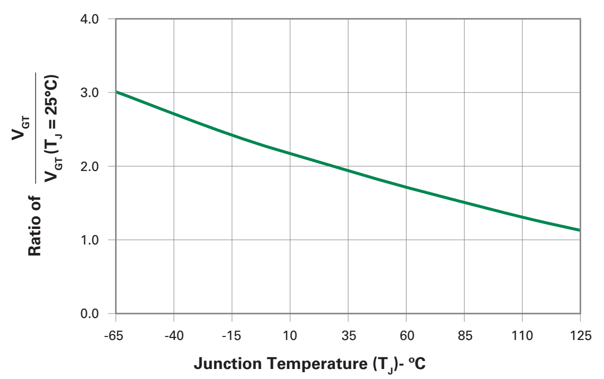

## Figure 2: Normalized DC Gate Trigger Current for All Quadrants vs. Junction Temperature



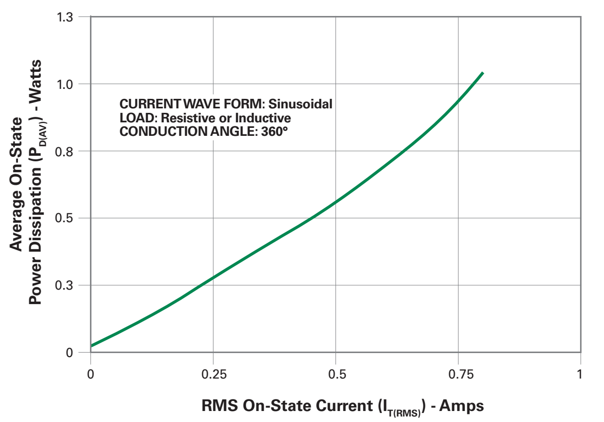
## Figure 3: Normalized DC Holding Current vs. Junction Temperature



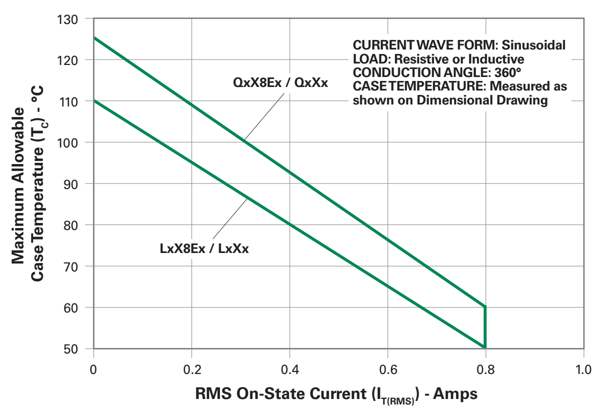

## Figure 4: Normalized DC Gate Trigger Voltage for All Quadrants vs. Junction Temperature



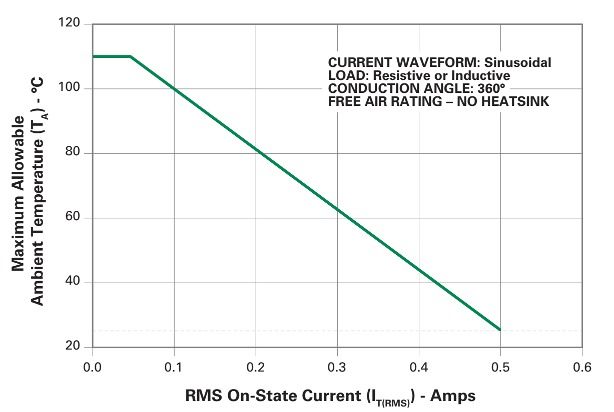

## Figure 5: Power Dissipation (Typical) vs. RMS On-State Current



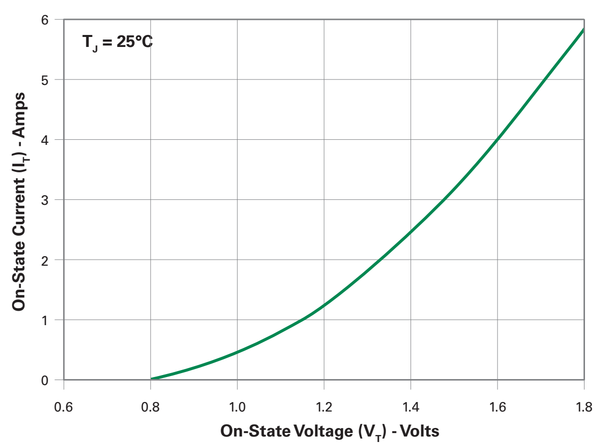

## Figure 6: Maximum Allowable Case Temperature vs. On-State Current



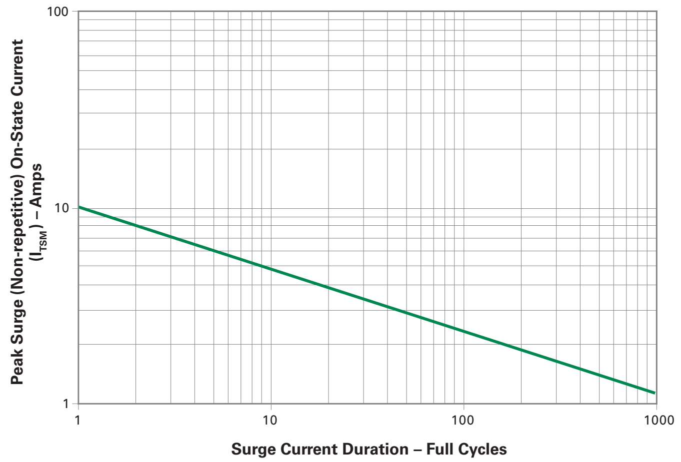

## Figure 7: Maximum Allowable Ambient Temperature vs. On-State Current




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



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



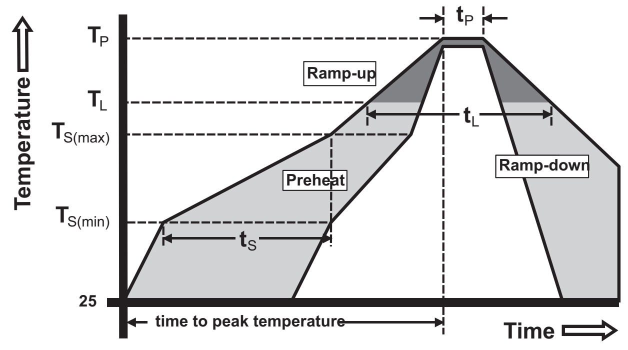

Supply Frequency: 60Hz Sinusoidal
Load: Resistive
RMS On-State [$I_{T(RMS)}$]: Max Rated Value at Specific Case Temperature

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 |
| | - Temperature ($t_L$) | 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 |
| **Lead Material** | Copper Alloy |

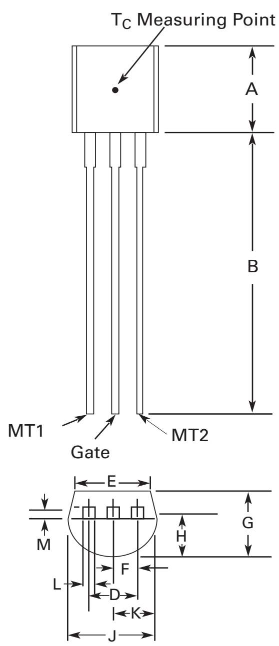
## Design Considerations

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 |
|---|---|
| **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 |

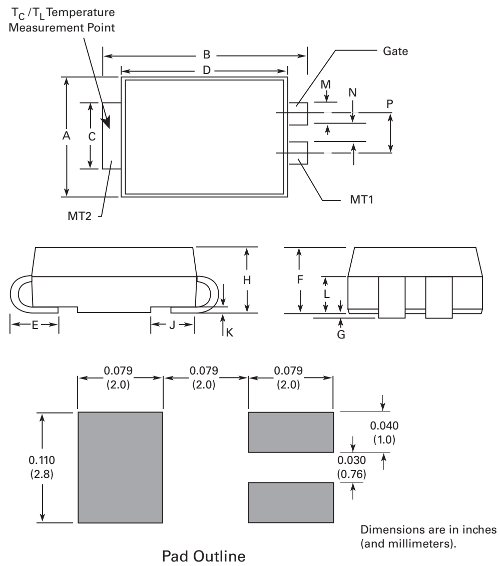
## Dimensions — TO-92 (E Package)




| Dimension | Inches | | Millimeters | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.176 | 0.196 | 4.47 | 4.98 |
| B | 0.500 | | 12.70 | |
| D | 0.095 | 0.105 | 2.41 | 2.67 |
| E | 0.150 | | 3.81 | |
| F | 0.046 | 0.054 | 1.16 | 1.37 |
| G | 0.135 | 0.145 | 3.43 | 3.68 |
| H | 0.088 | 0.096 | 2.23 | 2.44 |
| J | 0.176 | 0.186 | 4.47 | 4.73 |
| K | 0.088 | 0.096 | 2.23 | 2.44 |
| L | 0.013 | 0.019 | 0.33 | 0.48 |
| M | 0.013 | 0.017 | 0.33 | 0.43 |

All leads insulated from case. Case is electrically nonconductive.

## Dimensions — Compak (C Package)




| Dimension | Inches | | Millimeters | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.130 | 0.156 | 3.30 | 3.95 |
| B | 0.201 | 0.220 | 5.10 | 5.60 |
| C | 0.077 | 0.087 | 1.95 | 2.20 |
| D | 0.159 | 0.181 | 4.05 | 4.60 |
| E | 0.030 | 0.063 | 0.75 | 1.60 |
| F | 0.075 | 0.096 | 1.90 | 2.45 |
| G | 0.002 | 0.008 | 0.05 | 0.20 |
| H | 0.077 | 0.104 | 1.95 | 2.65 |
| J | 0.043 | 0.053 | 1.09 | 1.35 |
| K | 0.006 | 0.016 | 0.15 | 0.41 |
| L | 0.030 | 0.055 | 0.76 | 1.40 |
| M | 0.022 | 0.028 | 0.56 | 0.71 |
| N | 0.027 | 0.033 | 0.69 | 0.84 |
| P | 0.052 | 0.058 | 1.32 | 1.47 |

## Product Selector

| Part Number | Voltage | | Gate Sensitivity Quadrants | | Type | Package |
|---|---|---|---|---|---|---|
| | 400V | 600V | I – II – III | IV | | |
| LxX8E3 | X | X | 3 mA | 3 mA | Sensitive Triac | TO-92 |
| LxX3 | X | X | 3 mA | 3 mA | Sensitive Triac | Compak |
| LxX8E5 | X | X | 5 mA | 5 mA | Sensitive Triac | TO-92 |
| LxX5 | X | X | 5 mA | 5 mA | Sensitive Triac | Compak |
| LxX8E6 | X | X | 5 mA | 10 mA | Sensitive Triac | TO-92 |
| LxX8E8 | X | X | 10 mA | 20 mA | Sensitive Triac | TO-92 |
| QxX8E3 | X | X | 10 mA | | Standard Triac | TO-92 |
| QxX3 | X | X | 10 mA | | Standard Triac | Compak |
| QxX8E4 | X | X | 25 mA | | Standard Triac | TO-92 |
| QxX4 | X | X | 25 mA | | Standard Triac | Compak |

Note: x = voltage

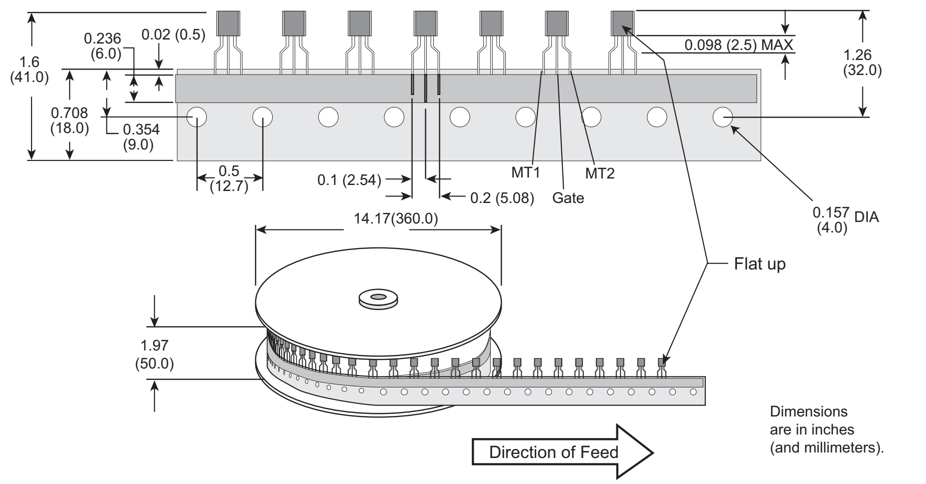
## Packing Options

| Part Number | Marking | Weight | Packing Mode | Base Quantity |
|---|---|---|---|---|
| L/QxX8Ey | L/QxX8Ey | 0.188 g | Bulk | 2000 |
| L/QxX8EyRP | L/QxX8Ey | 0.188 g | Reel Pack | 2000 |
| L/QxX8EyAP | L/QxX8Ey | 0.188 g | Ammo Pack | 2000 |
| L/QxXyRP | L/QxXy | 0.081 g | Embossed Carrier | 2500 |

Note: x = voltage, y = sensitivity

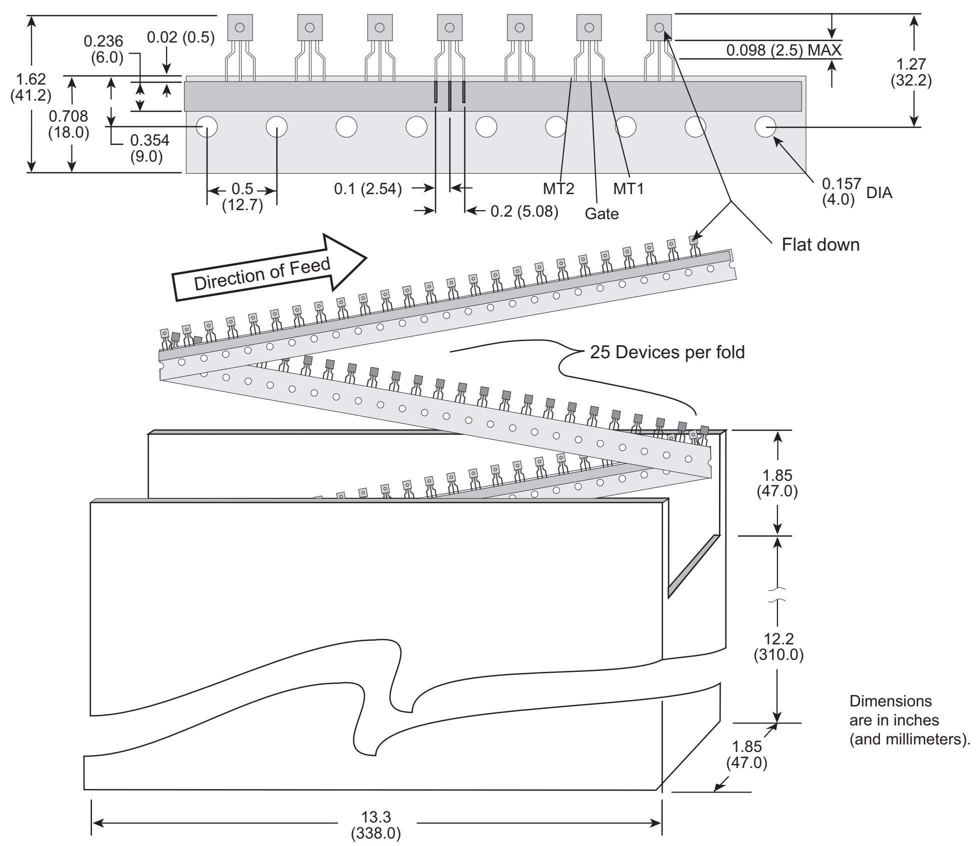
## TO-92 (3-lead) Reel Pack (RP) Radial Leaded Specifications

### Meets all EIA-468-B 1994 Standards



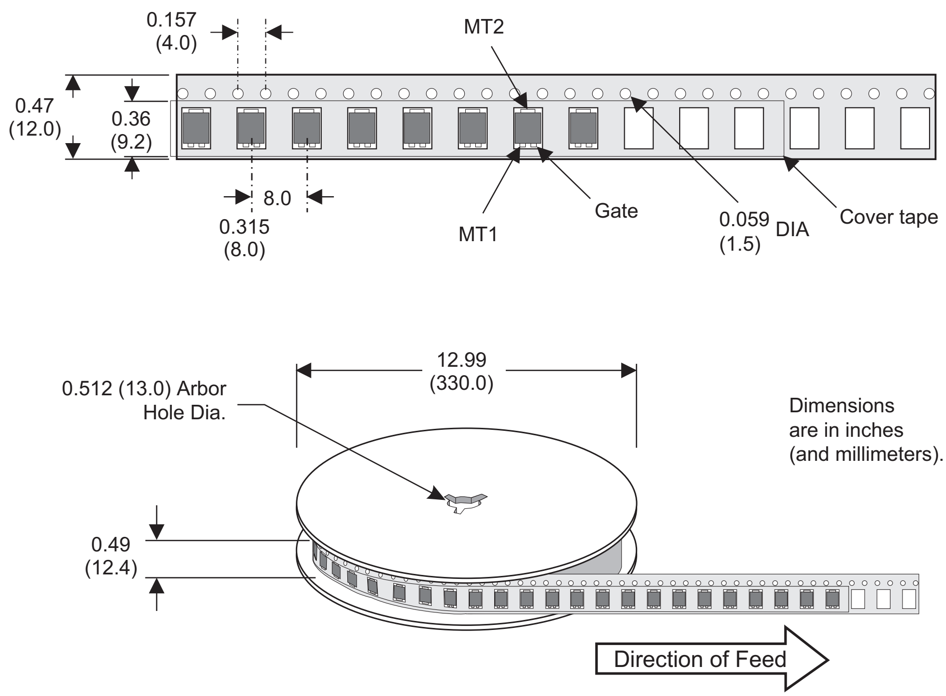

## TO-92 (3-lead) Ammo Pack (AP) Radial Leaded Specifications

### Meets all EIA-468-B 1994 Standards



## Compak Embossed Carrier Reel Pack (RP) Specifications

### Meets all EIA-481-1 Standards




Dimensions are in inches (and millimeters).



## Part Numbering System

**L 4 X8 E 5**

**DEVICE TYPE**
**L** : Sensitive Triac
**Q** : Triac

**VOLTAGE RATING**
**4** : 400V
**6** : 600V

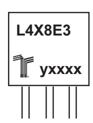
**CURRENT RATING**
**X8** : 0.8A (TO-92)
**X** : 0.8A (Compak)

**SENSITIVITY & TYPE**
**Sensitive Triac:**
**3** : 3 mA (QI, II, III, IV)
**5** : 5 mA (QI, II, III, IV)
**6** : 5 mA (QI, II, III)
10 mA (QIV)
**8** : 10 mA (QI, II, III)
20 mA (QIV)
**Standard Triac:**
**3** : 10 mA (QI, II, III)
**4** : 25 mA (QI, II, III)

**PACKAGE TYPE**
**Blank** : Compak (Surface Mount)
**E** : TO-92

## Part Marking System

TO-92 (E Package)




Compak (C Package)