# MAC97 Series

# Sensitive Gate Triacs

## Silicon Bidirectional Thyristors

Designed for use in solid state relays, MPU interface, TTL logic and any other light industrial or consumer application. Supplied in an inexpensive TO−92 package which is readily adaptable for use in automatic insertion equipment.

### Features

- One−Piece, Injection−Molded Package
- Blocking Voltage to 600 Volts
- Sensitive Gate Triggering in Four Trigger Modes (Quadrants) for all possible Combinations of Trigger Sources, and especially for Circuits that Source Gate Drives
- All Diffused and Glassivated Junctions for Maximum Uniformity of Parameters and Reliability
- These are Pb−Free Devices*

**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Peak Repetitive Off-State Voltage ($T_J$ = −40 to +110°C) (Note 1) Sine Wave 50 to 60 Hz, Gate Open<br>MAC97A4<br>MAC97A6<br>MAC97A8 | $V_{DRM}$, $V_{RRM}$ | <br>200<br>400<br>600 | V |
| On-State RMS Current Full Cycle Sine Wave 50 to 60 Hz ($T_C$ = +50°C) | $I_{T(RMS)}$ | 0.6 | A |
| Peak Non−Repetitive Surge Current One Full Cycle, Sine Wave 60 Hz ($T_C$ = 110°C) | $I_{TSM}$ | 8.0 | A |
| Circuit Fusing Considerations (t = 8.3 ms) | $I^2t$ | 0.26 | $A^2s$ |
| Peak Gate Voltage ($t \le 2.0$ μs, $T_C$ = +80°C) | $V_{GM}$ | 5.0 | V |
| Peak Gate Power ($t \le 2.0$ μs, $T_C$ = +80°C) | $P_{GM}$ | 5.0 | W |
| Average Gate Power ($T_C$ = 80°C, $t \le 8.3$ ms) | $P_{G(AV)}$ | 0.1 | W |
| Peak Gate Current ($t \le 2.0$ μs, $T_C$ = +80°C) | $I_{GM}$ | 1.0 | A |
| Operating Junction Temperature Range | $T_J$ | −40 to +110 | °C |
| Storage Temperature Range | $T_{stg}$ | −40 to +150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

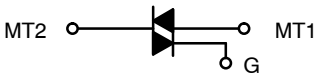
1. $V_{DRM}$ and $V_{RRM}$ for all types can be applied on a continuous basis. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

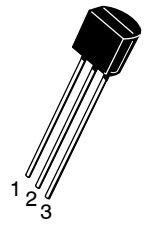
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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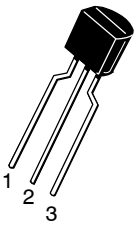
**http://onsemi.com**

**TRIACS**
**0.8 AMPERE RMS**
**200 thru 600 VOLTS**



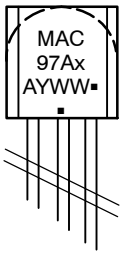

STRAIGHT LEAD
BULK PACK




BENT LEAD
TAPE & REEL
AMMO PACK

**TO−92 (TO−226)**
**CASE 029**
**STYLE 12**

**MARKING DIAGRAM**




MAC97Ax = Device Code
x = 4, 6, or 8
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

| PIN ASSIGNMENT | |
|---|---|
| 1 | Main Terminal 1 |
| 2 | Gate |
| 3 | Main Terminal 2 |

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

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## THERMAL CHARACTERISTICS

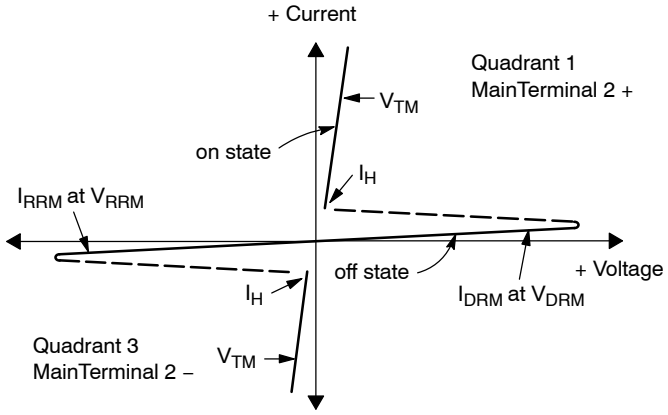
| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction−to−Case | $R_{\theta JC}$ | 75 | °C/W |
| Thermal Resistance, Junction−to−Ambient | $R_{\theta JA}$ | 200 | °C/W |
| Maximum Lead Temperature for Soldering Purposes for 10 Seconds | $T_L$ | 260 | °C |

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C unless otherwise noted; Electricals apply in both directions)

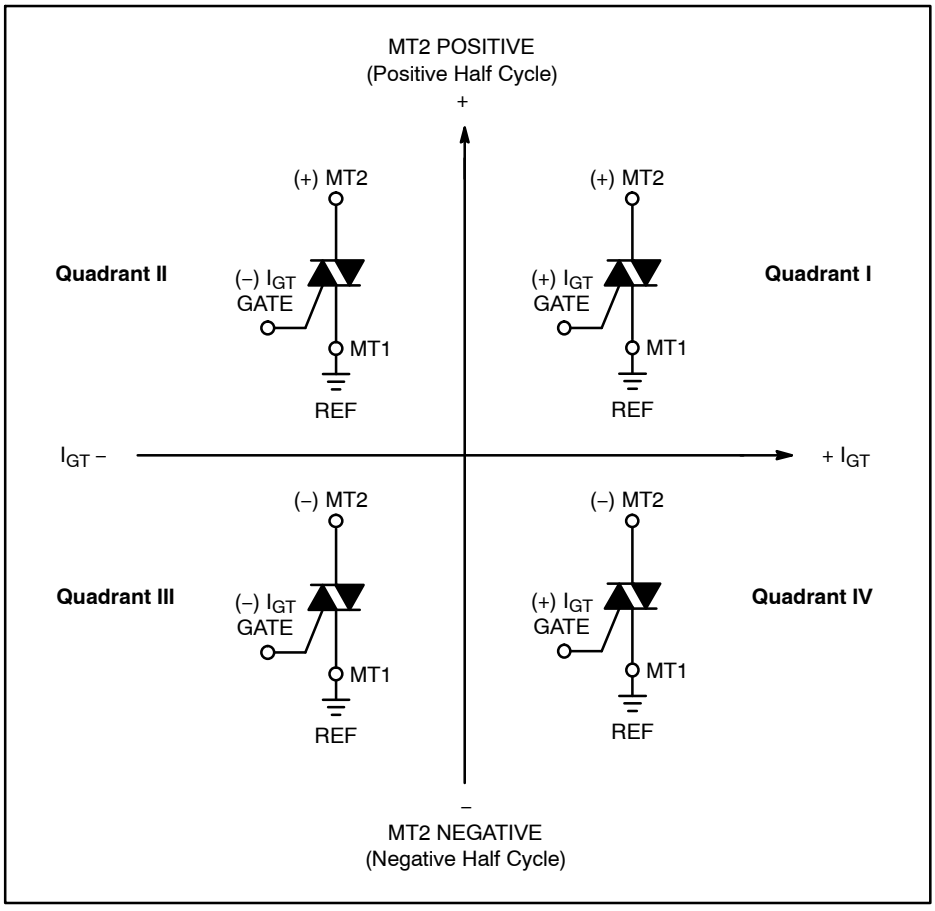
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Peak Repetitive Blocking Current ($V_D$ = Rated $V_{DRM}$, $V_{RRM}$; Gate Open) $T_J$ = 25°C | $I_{DRM}$, $I_{RRM}$ | – | – | 10 | μA |
| $T_J$ = +110°C | | – | – | 100 | μA |
| **ON CHARACTERISTICS** | | | | | |
| Peak On−State Voltage ($I_{TM}$ = ±.85 A Peak; Pulse Width ≤ 2.0 ms, Duty Cycle ≤ 2.0%) | $V_{TM}$ | – | – | 1.9 | V |
| Gate Trigger Current (Continuous dc) ($V_D$ = 12 Vdc, $R_L$ = 100 Ω) | $I_{GT}$ | | | | mA |
| MT2(+), G(+) | | – | – | 5.0 | |
| MT2(+), G(−) | | – | – | 5.0 | |
| MT2(−), G(−) | | – | – | 5.0 | |
| MT2(−), G(+) | | – | – | 7.0 | |
| Gate Trigger Voltage (Continuous dc) ($V_D$ = 12 Vdc, $R_L$ = 100 Ω) | $V_{GT}$ | | | | V |
| MT2(+), G(+) All Types | | – | .66 | 2.0 | |
| MT2(+), G(−) All Types | | – | .77 | 2.0 | |
| MT2(−), G(−) All Types | | – | .84 | 2.0 | |
| MT2(−), G(+) All Types | | – | .88 | 2.5 | |
| Gate Non−Trigger Voltage ($V_D$ = 12 V, $R_L$ = 100 Ω, $T_J$ = 110°C) All Four Quadrants | $V_{GD}$ | 0.1 | – | – | V |
| Holding Current ($V_D$ = 12 Vdc, Initiating Current = 200 mA, Gate Open) | $I_H$ | – | 1.5 | 10 | mA |
| Turn-On Time ($V_D$ = Rated $V_{DRM}$, $I_{TM}$ = 1.0 A pk, $I_G$ = 25 mA) | $t_{gt}$ | – | 2.0 | – | μs |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Critical Rate−of−Rise of Commutation Voltage ($V_D$ = Rated $V_{DRM}$, $I_{TM}$ = .84 A, Commutating di/dt = .3 A/ms, Gate Unenergized, $T_C$ = 50°C) | dV/dt(c) | – | 5.0 | – | V/μs |
| Critical Rate of Rise of Off−State Voltage ($V_D$ = Rated $V_{DRM}$, $T_C$ = 110°C, Gate Open, Exponential Waveform | dv/dt | – | 25 | – | V/μs |

## Voltage Current Characteristic of Triacs (Bidirectional Device)

| Symbol | Parameter |
|---|---|
| $V_{DRM}$ | Peak Repetitive Forward Off State Voltage |
| $I_{DRM}$ | Peak Forward Blocking Current |
| $V_{RRM}$ | Peak Repetitive Reverse Off State Voltage |
| $I_{RRM}$ | Peak Reverse Blocking Current |
| $V_{TM}$ | Maximum On State Voltage |
| $I_H$ | Holding Current |




## Quadrant Definitions for a Triac




All polarities are referenced to MT1.
With in−phase signals (using standard AC lines) quadrants I and III are used.

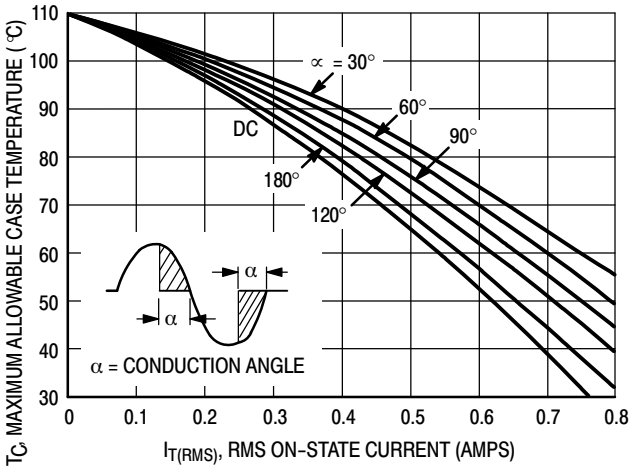



**Figure 1. RMS Current Derating**

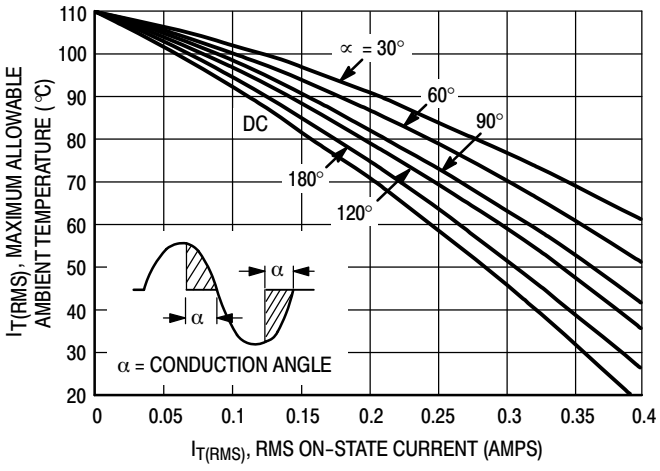



**Figure 2. RMS Current Derating**

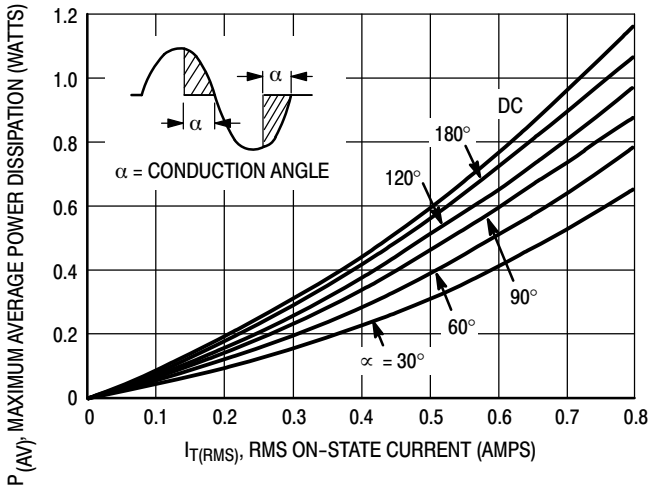



**Figure 3. Power Dissipation**

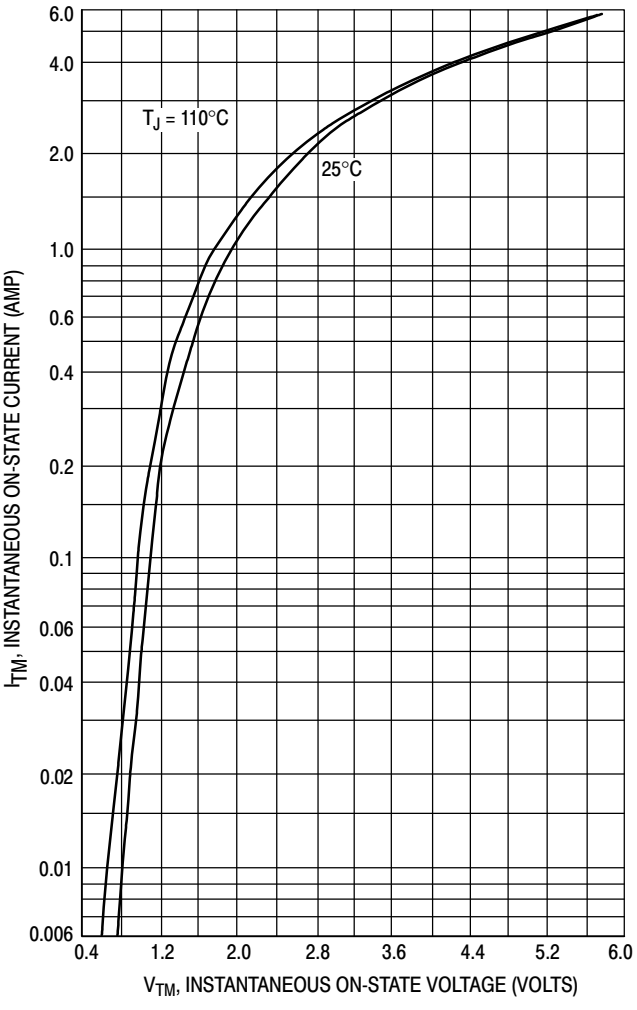



**Figure 4. On−State Characteristics**

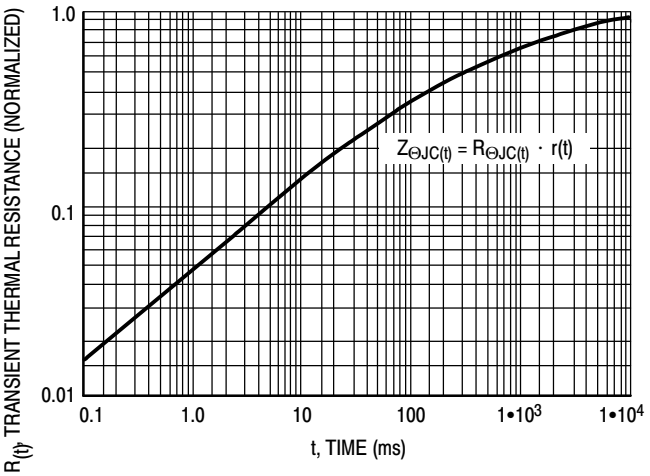



**Figure 5. Transient Thermal Response**

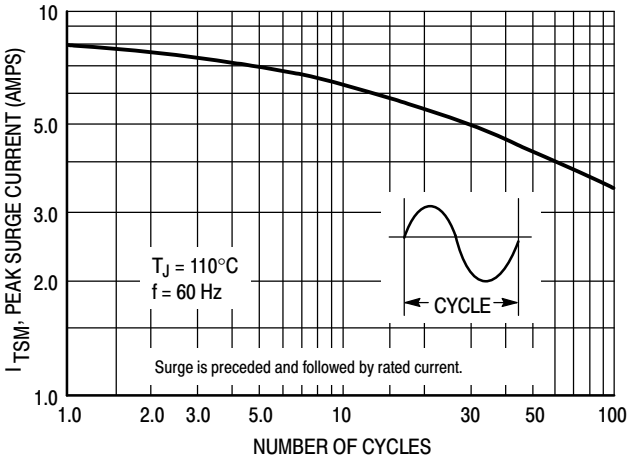



**Figure 6. Maximum Allowable Surge Current**

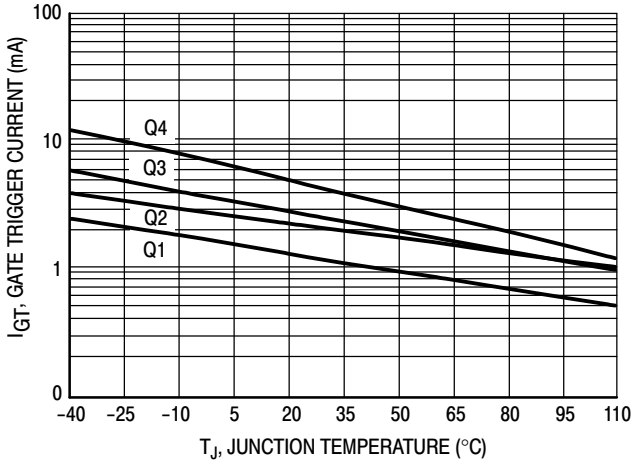



**Figure 7. Typical Gate Trigger Current versus Junction Temperature**

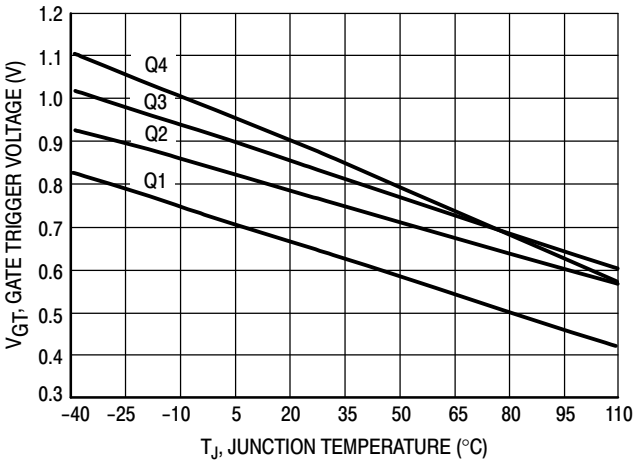



**Figure 8. Typical Gate Trigger Voltage versus Junction Temperature**

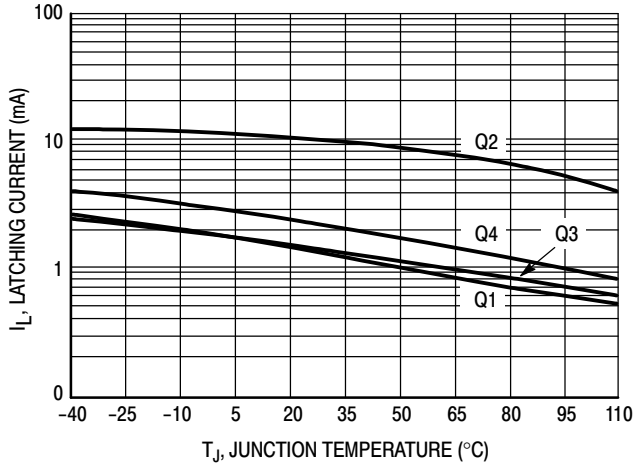



**Figure 9. Typical Latching Current versus Junction Temperature**

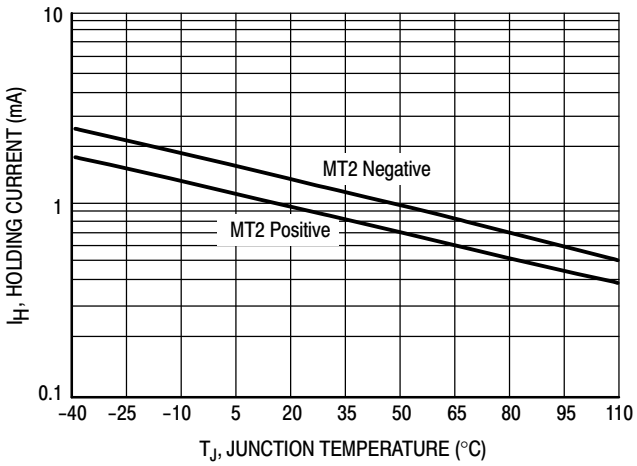
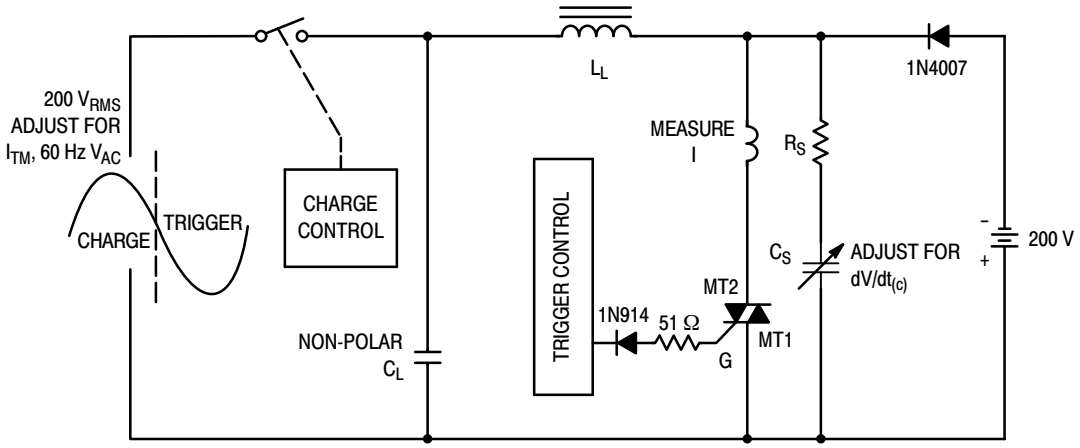



**Figure 10. Typical Holding Current versus Junction Temperature**




Note: Component values are for verification of rated $(dv/dt)_c$. See AN1048 for additional information.

**Figure 11. Simplified Test Circuit to Measure the Critical Rate of Rise of Commutating Voltage $(dV/dt)_c$**

**ORDERING & SHIPPING INFORMATION**

| U.S. | Europe Equivalent | Shipping | Description of TO92 Tape Orientation |
|---|---|---|---|
| | MAC97A6RL1G | Radial Tape & Reel (2K/Reel) (Pb−Free) | Flat side of TO92 & adhesive tape visible |
| MAC97A8RLRMG | MAC97A8RL1G | Radial Tape & Reel (2K/Reel) (Pb−Free) | Flat side of TO92 & adhesive tape visible |
| MAC97A4G | | Bulk in Box (5K/Box) (Pb−Free) | N/A, Bulk |
| MAC97A6G | | Bulk in Box (5K/Box) (Pb−Free) | N/A, Bulk |
| MAC97A8G | | Bulk in Box (5K/Box) (Pb−Free) | N/A, Bulk |
| MAC97A4RLRFG | | Radial Tape & Reel (2K/Reel) (Pb−Free) | Round side of TO92 & adhesive tape on reverse side |
| MAC97A4RLRPG | | Radial Tape & Reel (2K/Reel) (Pb−Free) | Round side of TO92 & adhesive tape on reverse side |
| MAC97A6RLRFG | | Radial Tape & Reel (2K/Reel) (Pb−Free) | Round side of TO92 & adhesive tape on reverse side |
| MAC97A6RLRPG | | Radial Tape & Reel (2K/Reel) (Pb−Free) | Round side of TO92 & adhesive tape on reverse side |
| MAC97A8RLRPG | | Radial Tape / Fan Fold Box (2K/Box) (Pb−Free) | Round side of TO92 & adhesive tape visible |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# TO−92 EIA RADIAL TAPE IN FAN FOLD BOX OR ON REEL

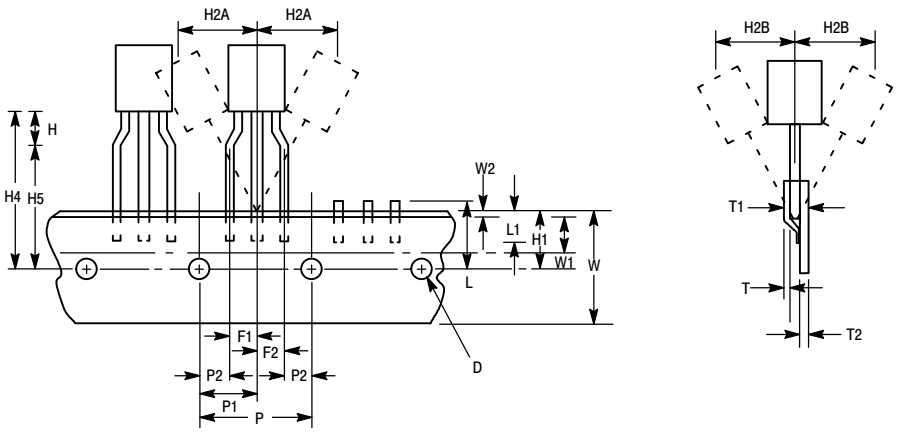


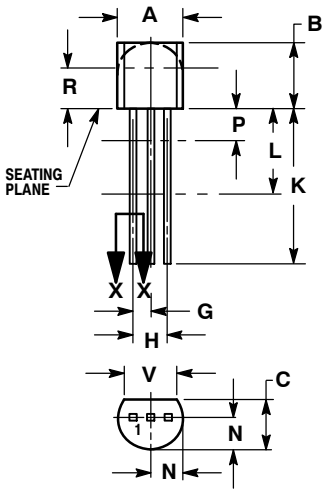

**Figure 12. Device Positioning on Tape**

| Symbol | Item | Specification | | | |
|---|---|---|---|---|---|
| | | Inches | | Millimeter | |
| | | Min | Max | Min | Max |
| D | Tape Feedhole Diameter | 0.1496 | 0.1653 | 3.8 | 4.2 |
| D2 | Component Lead Thickness Dimension | 0.015 | 0.020 | 0.38 | 0.51 |
| F1, F2 | Component Lead Pitch | 0.0945 | 0.110 | 2.4 | 2.8 |
| H | Bottom of Component to Seating Plane | .059 | 0.156 | 1.5 | 4.0 |
| H1 | Feedhole Location | 0.3346 | 0.3741 | 8.5 | 9.5 |
| H2A | Deflection Left or Right | 0 | 0.039 | 0 | 1.0 |
| H2B | Deflection Front or Rear | 0 | 0.051 | 0 | 1.0 |
| H4 | Feedhole to Bottom of Component | 0.7086 | 0.768 | 18 | 19.5 |
| H5 | Feedhole to Seating Plane | 0.610 | 0.649 | 15.5 | 16.5 |
| L | Defective Unit Clipped Dimension | 0.3346 | 0.433 | 8.5 | 11 |
| L1 | Lead Wire Enclosure | 0.09842 | – | 2.5 | – |
| P | Feedhole Pitch | 0.4921 | 0.5079 | 12.5 | 12.9 |
| P1 | Feedhole Center to Center Lead | 0.2342 | 0.2658 | 5.95 | 6.75 |
| P2 | First Lead Spacing Dimension | 0.1397 | 0.1556 | 3.55 | 3.95 |
| T | Adhesive Tape Thickness | 0.06 | 0.08 | 0.15 | 0.20 |
| T1 | Overall Taped Package Thickness | – | 0.0567 | – | 1.44 |
| T2 | Carrier Strip Thickness | 0.014 | 0.027 | 0.35 | 0.65 |
| W | Carrier Strip Width | 0.6889 | 0.7481 | 17.5 | 19 |
| W1 | Adhesive Tape Width | 0.2165 | 0.2841 | 5.5 | 6.3 |
| W2 | Adhesive Tape Position | 0.0059 | 0.01968 | 0.15 | 0.5 |

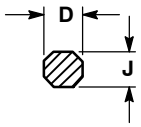
NOTES:
2. Maximum alignment deviation between leads not to be greater than 0.2 mm.
3. Defective components shall be clipped from the carrier tape such that the remaining protrusion (L) does not exceed a maximum of 11 mm.
4. Component lead to tape adhesion must meet the pull test requirements.
5. Maximum non−cumulative variation between tape feed holes shall not exceed 1 mm in 20 pitches.
6. Holddown tape not to extend beyond the edge(s) of carrier tape and there shall be no exposure of adhesive.
7. No more than 1 consecutive missing component is permitted.
8. A tape trailer and leader, having at least three feed holes is required before the first and after the last component.
9. Splices will not interfere with the sprocket feed holes.

## PACKAGE DIMENSIONS

**TO−92 (TO−226)**
CASE 29−11
ISSUE AM




STRAIGHT LEAD
BULK PACK

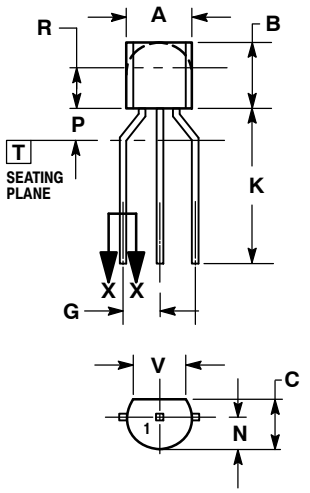



**SECTION X−X**

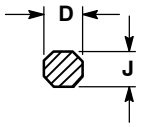
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.021 | 0.407 | 0.533 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | --- | 12.70 | --- |
| L | 0.250 | --- | 6.35 | --- |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | --- | 0.100 | --- | 2.54 |
| R | 0.115 | --- | 2.93 | --- |
| V | 0.135 | --- | 3.43 | --- |

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. GATE
3. MAIN TERMINAL 2




BENT LEAD
TAPE & REEL
AMMO PACK




**SECTION X−X**

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 4.45 | 5.20 |
| B | 4.32 | 5.33 |
| C | 3.18 | 4.19 |
| D | 0.40 | 0.54 |
| G | 2.40 | 2.80 |
| J | 0.39 | 0.50 |
| K | 12.70 | --- |
| N | 2.04 | 2.66 |
| P | 1.50 | 4.00 |
| R | 2.93 | --- |
| V | 3.43 | --- |

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