

# 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 ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

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

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.  $V_{\text{DRM}}$  and  $V_{\text{RRM}}$  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.

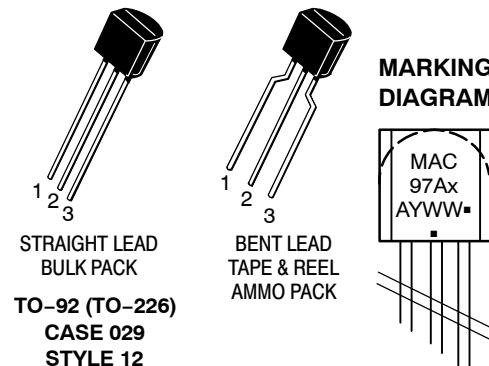
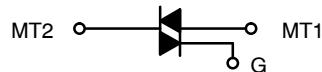
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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### TRIACS 0.8 AMPERE RMS 200 thru 600 VOLTS



**MARKING DIAGRAM**  
TO-92 (TO-226)  
CASE 029  
STYLE 12

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.

# MAC97 Series

## 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 ( $T_C = 25^\circ\text{C}$ unless otherwise noted; Electricals apply in both directions)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Peak Repetitive Blocking Current ( $V_D$ = Rated $V_{DRM}$ , $V_{RRM}$ ; Gate Open)	$I_{DRM}$ , $I_{RRM}$	–	–	10	$\mu\text{A}$
		$T_J = 25^\circ\text{C}$		100	$\mu\text{A}$
		$T_J = +110^\circ\text{C}$			

### ON CHARACTERISTICS

Peak On-State Voltage ( $I_{TM} = \pm .85 \text{ A Peak}$ ; Pulse Width $\leq 2.0 \text{ ms}$ , Duty Cycle $\leq 2.0\%$ )	$V_{TM}$	–	–	1.9	V
Gate Trigger Current (Continuous dc) ( $V_D = 12 \text{ Vdc}$ , $R_L = 100 \Omega$ ) MT2(+), G(+) MT2(+), G(–) MT2(–), G(–) MT2(–), G(+)	$I_{GT}$	–	–	5.0	mA
		–	–	5.0	
		–	–	5.0	
		–	–	7.0	
Gate Trigger Voltage (Continuous dc) ( $V_D = 12 \text{ Vdc}$ , $R_L = 100 \Omega$ ) MT2(+), G(+) All Types MT2(+), G(–) All Types MT2(–), G(–) All Types MT2(–), G(+) All Types	$V_{GT}$	–	.66	2.0	V
		–	.77	2.0	
		–	.84	2.0	
		–	.88	2.5	
Gate Non-Trigger Voltage ( $V_D = 12 \text{ V}$ , $R_L = 100 \Omega$ , $T_J = 110^\circ\text{C}$ ) All Four Quadrants	$V_{GD}$	0.1	–	–	V
Holding Current ( $V_D = 12 \text{ Vdc}$ , Initiating Current = 200 mA, Gate Open)	$I_H$	–	1.5	10	mA
Turn-On Time ( $V_D$ = Rated $V_{DRM}$ , $I_{TM} = 1.0 \text{ A pk}$ , $I_G = 25 \text{ mA}$ )	$t_{gt}$	–	2.0	–	$\mu\text{s}$

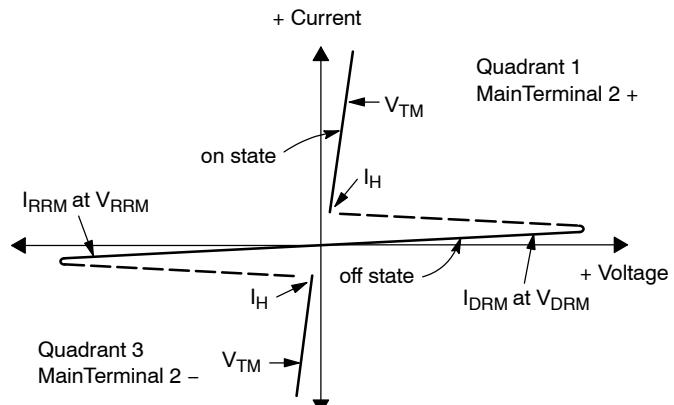
### DYNAMIC CHARACTERISTICS

Critical Rate-of-Rise of Commutation Voltage ( $V_D$ = Rated $V_{DRM}$ , $I_{TM} = .84 \text{ A}$ , Commutating $di/dt = .3 \text{ A/ms}$ , Gate Unenergized, $T_C = 50^\circ\text{C}$ )	$dV/dt(c)$	–	5.0	–	$\text{V}/\mu\text{s}$
Critical Rate of Rise of Off-State Voltage ( $V_D$ = Rated $V_{DRM}$ , $T_C = 110^\circ\text{C}$ , Gate Open, Exponential Waveform)	$dv/dt$	–	25	–	$\text{V}/\mu\text{s}$

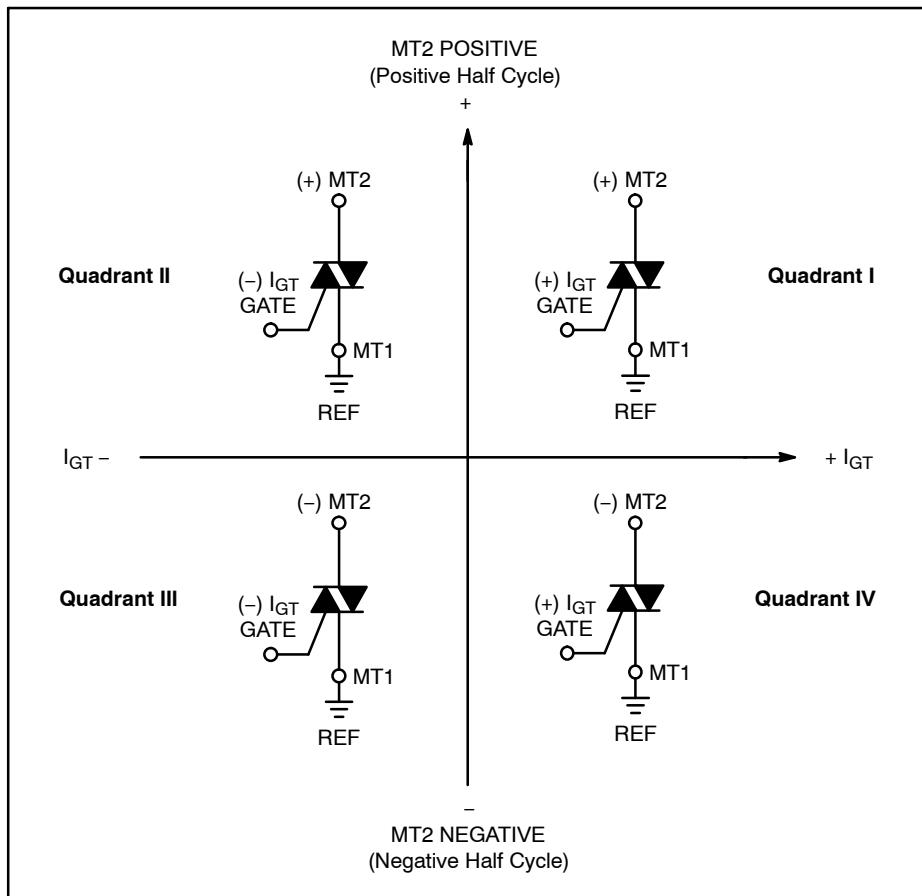
# MAC97 Series

## 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.

## MAC97 Series

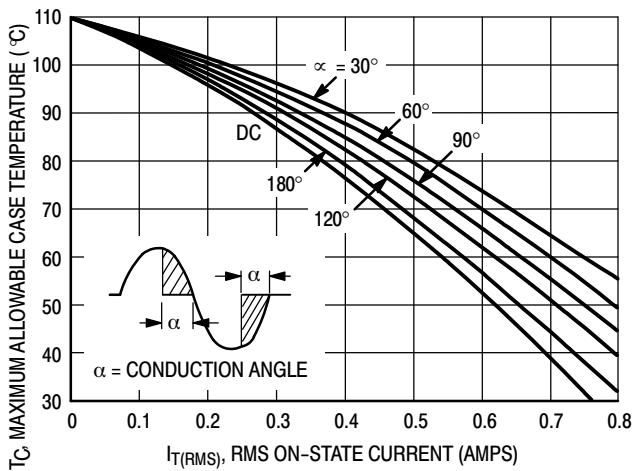


Figure 1. RMS Current Derating

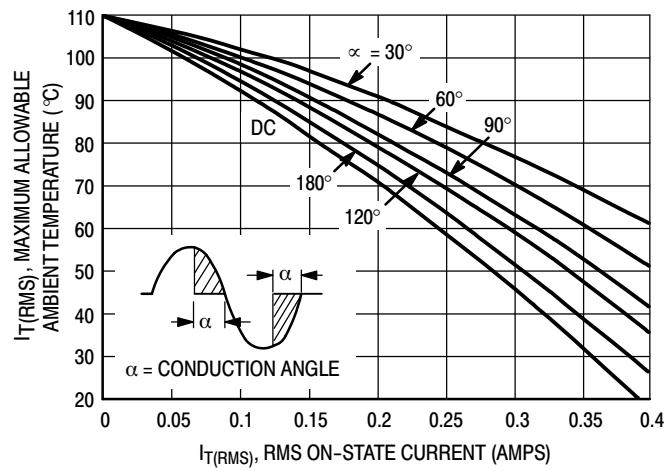


Figure 2. RMS Current Derating

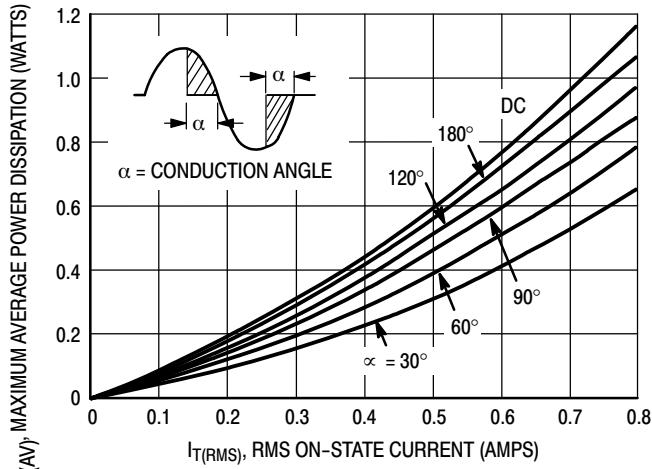


Figure 3. Power Dissipation

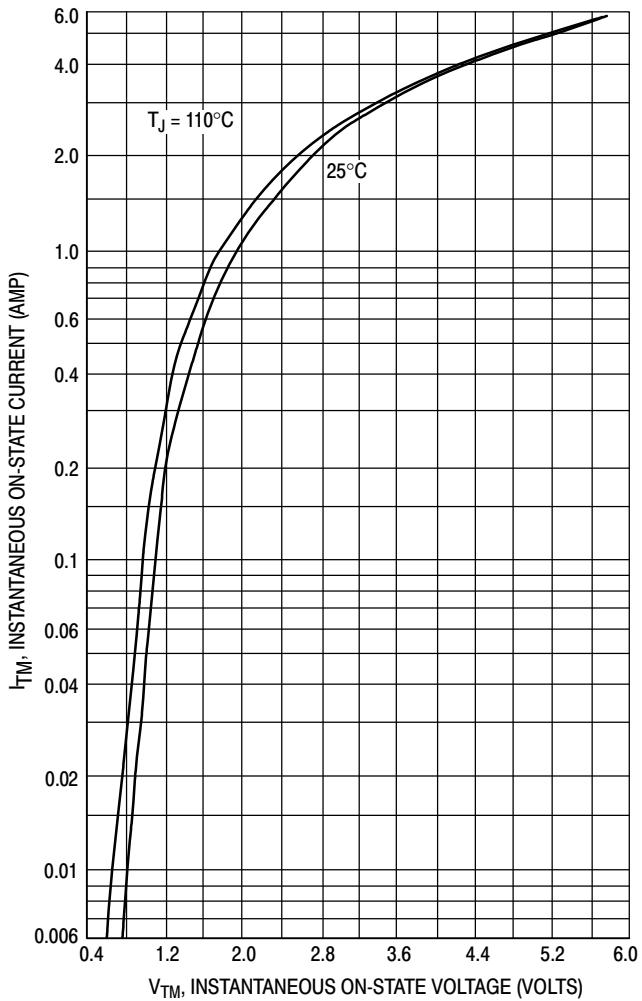
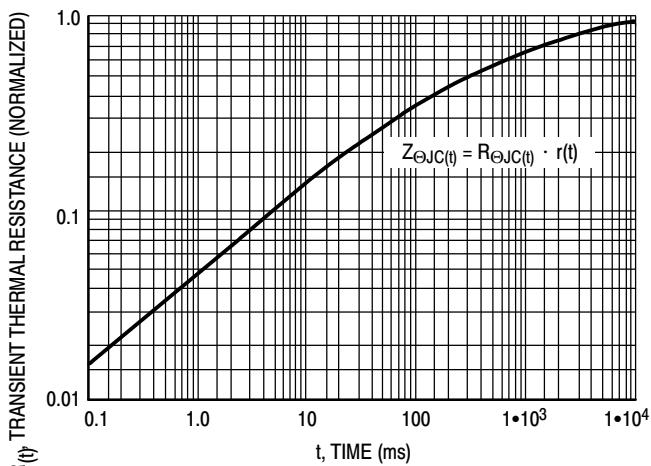
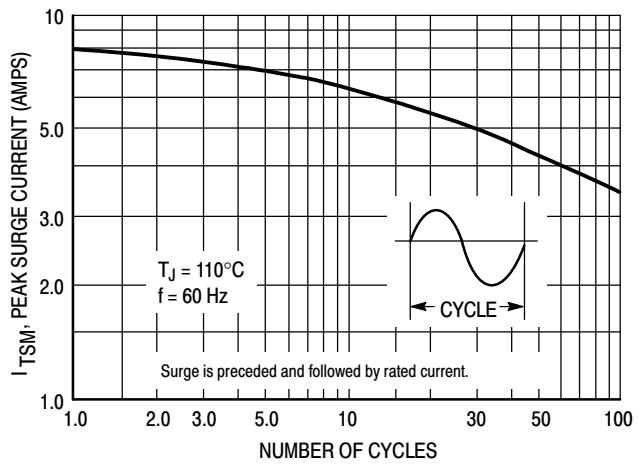


Figure 4. On-State Characteristics

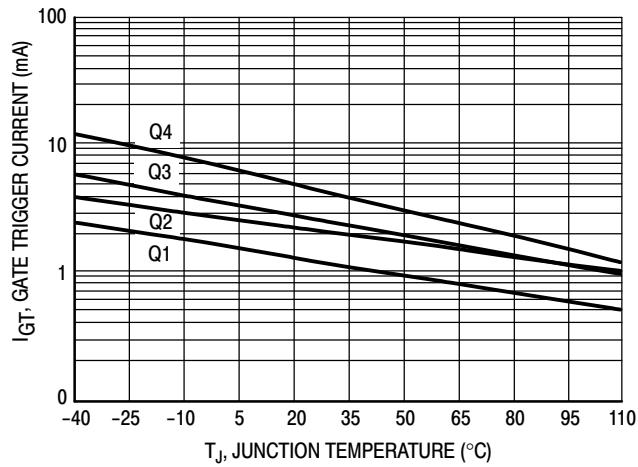
## MAC97 Series



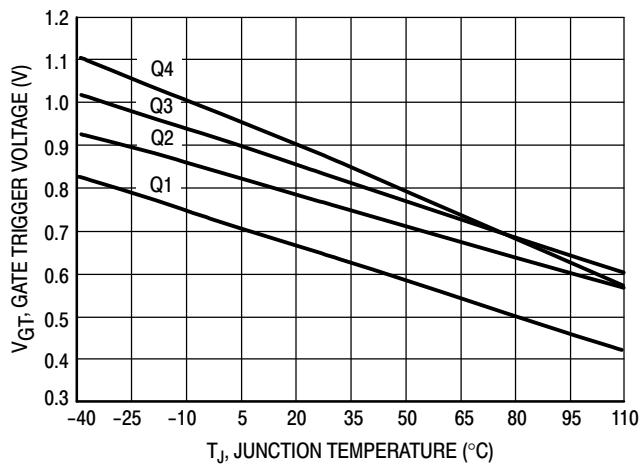
**Figure 5. Transient Thermal Response**



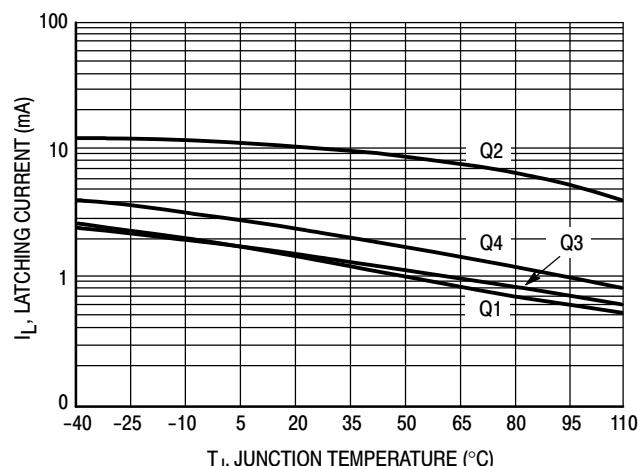
**Figure 6. Maximum Allowable Surge Current**



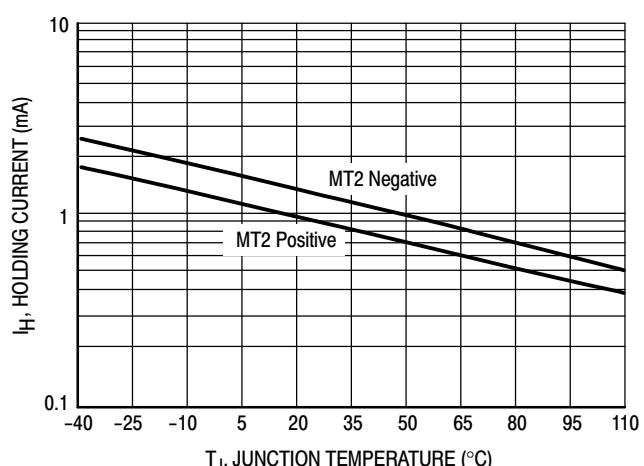
**Figure 7. Typical Gate Trigger Current versus Junction Temperature**



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

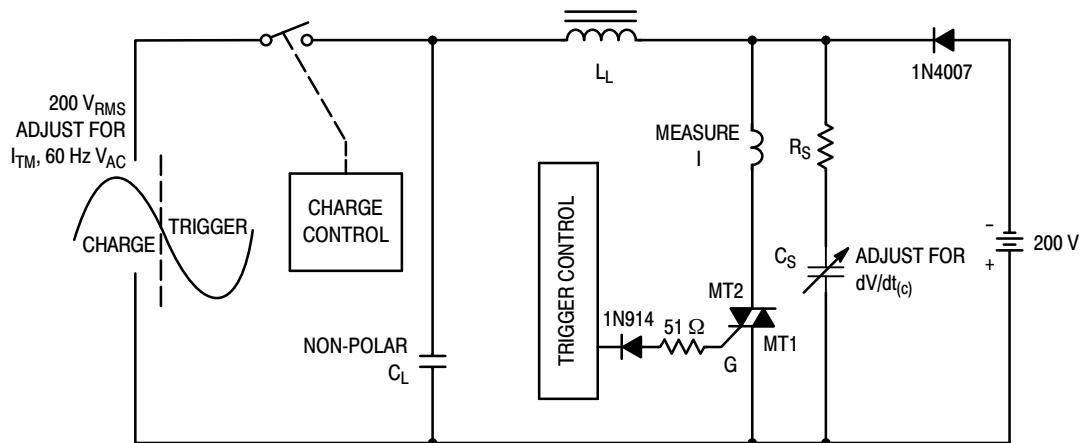


**Figure 9. Typical Latching Current versus Junction Temperature**



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

## MAC97 Series



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 ( $dV/dt$ )<sub>c</sub>**

### 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

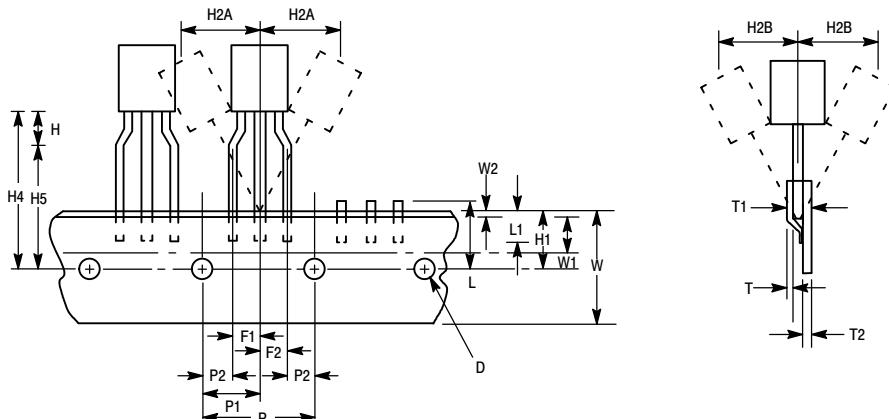


Figure 12. Device Positioning on Tape

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

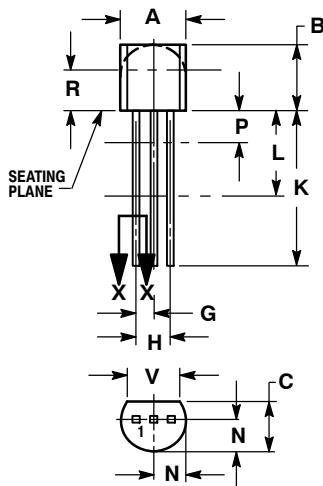
## NOTES:

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. Holdown 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.

# MAC97 Series

## PACKAGE DIMENSIONS

### TO-92 (TO-226) CASE 29-11 ISSUE AM



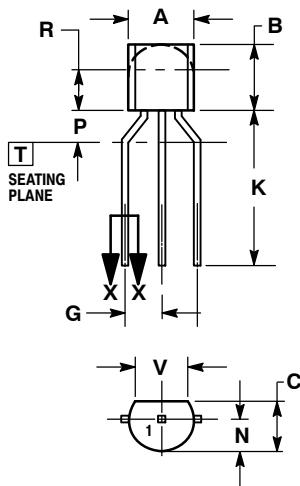
STRAIGHT LEAD  
BULK PACK

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.

DIM	INCHES		MILLIMETERS	
	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

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.

DIM	MILLIMETERS	
	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	---

SECTION X-X

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[MAC97A8RLRP](#)