

# MAC9D, MAC9M, MAC9N

Preferred Device

## Triacs

### Silicon Bidirectional Thyristors

Designed for high performance full-wave ac control applications where high noise immunity and high commutating di/dt are required.

#### Features

- Blocking Voltage to 800 Volts
- On-State Current Rating of 8.0 Amperes RMS at 100°C
- Uniform Gate Trigger Currents in Three Quadrants
- High Immunity to dv/dt – 500 V/μs minimum at 125°C
- Minimizes Snubber Networks for Protection
- Industry Standard TO-220AB Package
- High Commutating di/dt – 6.5 A/ms minimum at 125°C
- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Off-State Voltage (Note 1) (T <sub>J</sub> = -40 to 125°C, Sine Wave, 50 to 60 Hz, Gate Open)	V <sub>DRM</sub> , V <sub>RIRM</sub>	400 600 800	V
On-State RMS Current (Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 100°C)	I <sub>T(RMS)</sub>	8.0	A
Peak Non-Repetitive Surge Current (One Full Cycle Sine Wave, 60 Hz, T <sub>J</sub> = 125°C)	I <sub>TSM</sub>	80	A
Circuit Fusing Consideration (t = 8.3 ms)	I <sup>2</sup> t	26	A <sup>2</sup> sec
Peak Gate Power (Pulse Width ≤ 1.0 μs, T <sub>C</sub> = 80°C)	P <sub>GM</sub>	16	W
Average Gate Power (t = 8.3 ms, T <sub>C</sub> = 80°C)	P <sub>G(AV)</sub>	0.35	W
Operating Junction Temperature Range	T <sub>J</sub>	-40 to +125	°C
Storage Temperature Range	T <sub>stg</sub>	-40 to +150	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. V<sub>DRM</sub> and V<sub>RIRM</sub> 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.

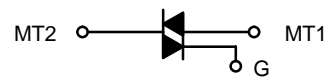
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



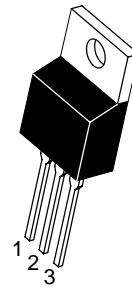
ON Semiconductor®

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**TRIACS**  
**8 AMPERES RMS**  
**400 thru 800 VOLTS**



#### MARKING DIAGRAM



**TO-220AB**  
**CASE 221A-09**  
**STYLE 4**

- x = D, M, or N
- A = Assembly Location
- Y = Year
- WW = Work Week
- G = Pb-Free Package

#### PIN ASSIGNMENT

1	Main Terminal 1
2	Main Terminal 2
3	Gate
4	Main Terminal 2

#### ORDERING INFORMATION

Device	Package	Shipping
MAC9D	TO-220AB	50 Units / Rail
MAC9DG	TO-220AB (Pb-Free)	50 Units / Rail
MAC9M	TO-220AB	50 Units / Rail
MAC9MG	TO-220AB (Pb-Free)	50 Units / Rail
MAC9N	TO-220AB	50 Units / Rail
MAC9NG	TO-220AB (Pb-Free)	50 Units / Rail

Preferred devices are recommended choices for future use and best overall value.

# MAC9D, MAC9M, MAC9N

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	2.2	$^{\circ}\text{C}/\text{W}$
Junction-to-Ambient	$R_{\theta JA}$	62.5	$^{\circ}\text{C}/\text{W}$
Maximum Lead Temperature for Soldering Purposes 1/8" from Case for 10 Seconds	$T_L$	260	$^{\circ}\text{C}$

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Peak Repetitive Blocking Current ( $V_D = \text{Rated } V_{DRM}, V_{RRM}, \text{ Gate Open}$ )	$I_{DRM}, I_{RRM}$	-	-	0.01	mA
		-	-	2.0	

## ON CHARACTERISTICS

Peak On-State Voltage (Note 2) ( $I_{TM} = \pm 11 \text{ A Peak}$ )	$V_{TM}$	-	1.2	1.6	V
Gate Trigger Current (Continuous dc) ( $V_D = 12 \text{ V}, R_L = 100 \Omega$ ) MT2(+), G(+) MT2(+), G(-) MT2(-), G(-)	$I_{GT}$	10 10 10	16 18 22	50 50 50	mA
Holding Current ( $V_D = 12 \text{ V}, \text{ Gate Open}, \text{ Initiating Current} = \pm 150 \text{ mA}$ )	$I_H$	-	30	50	mA
Latching Current ( $V_D = 24 \text{ V}, I_G = 50 \text{ mA}$ ) MT2(+), G(+); MT2(-), G(-) MT2(+), G(-)	$I_L$	- -	20 30	50 80	mA
Gate Trigger Voltage ( $V_D = 12 \text{ V}, R_L = 100 \Omega$ ) MT2(+), G(+) MT2(+), G(-) MT2(-), G(-)	$V_{GT}$	0.5 0.5 0.5	0.69 0.77 0.72	1.5 1.5 1.5	V
Gate Non-Trigger Voltage ( $V_D = 12 \text{ V}, R_L = 100 \Omega, T_J = 125^{\circ}\text{C}$ ) MT2(+), G(+); MT2(+), G(-); MT2(-), G(-)	$V_{GD}$	0.2	-	-	V

## DYNAMIC CHARACTERISTICS

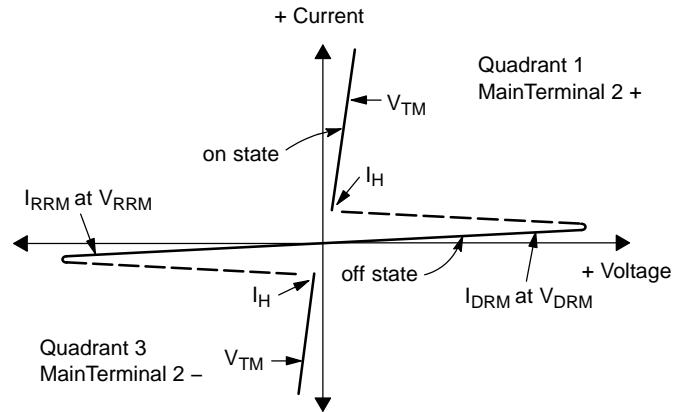
Rate of Change of Commutating Current; See Figure 10. ( $V_D = 400 \text{ V}, I_{TM} = 4.4 \text{ A}, \text{ Commutating } dv/dt = 18 \text{ V}/\mu\text{s},$ Gate Open, $T_J = 125^{\circ}\text{C}, f = 250 \text{ Hz}, \text{ No Snubber}$ )	$(di/dt)_c$	6.5	-		A/ms
					$C_L = 10 \mu\text{F}$ $L_L = 40 \text{ mH}$
Critical Rate of Rise of Off-State Voltage ( $V_D = \text{Rated } V_{DRM}, \text{ Exponential Waveform},$ Gate Open, $T_J = 125^{\circ}\text{C}$ )	$dv/dt$	500	-	-	V/ $\mu\text{s}$

2. Indicates Pulse Test: Pulse Width  $\leq 2.0 \text{ ms}$ , Duty Cycle  $\leq 2\%$ .

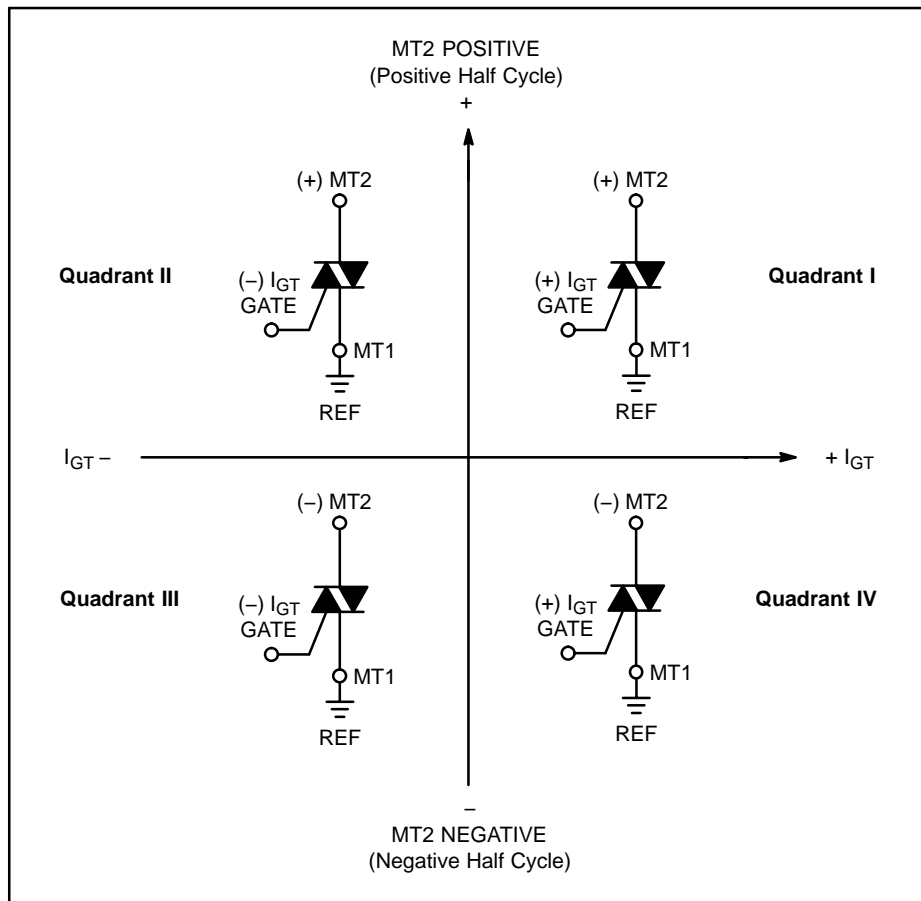
# MAC9D, MAC9M, MAC9N

## 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.

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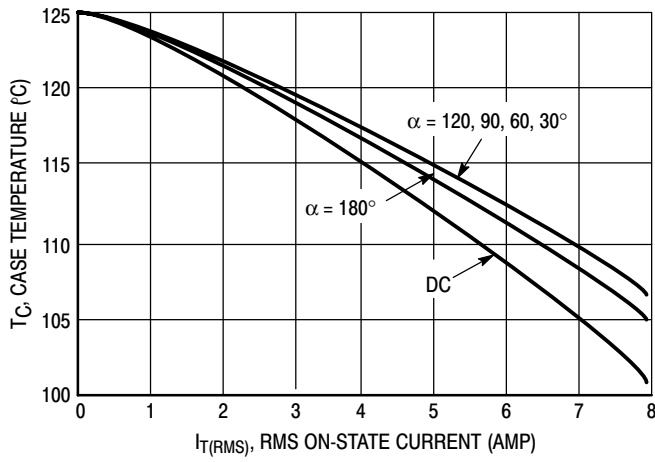


Figure 1. RMS Current Derating

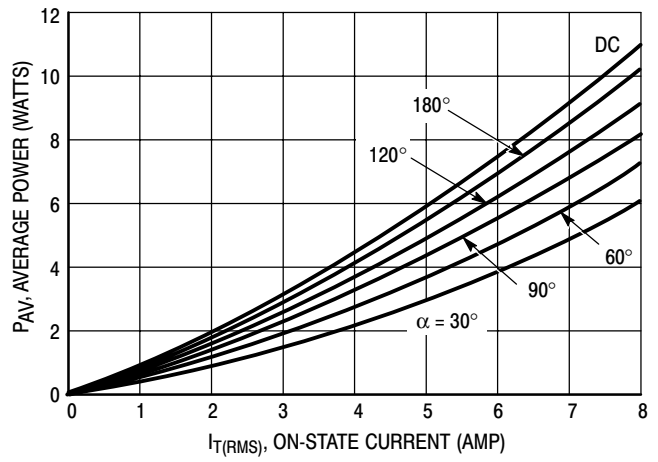


Figure 2. On-State Power Dissipation

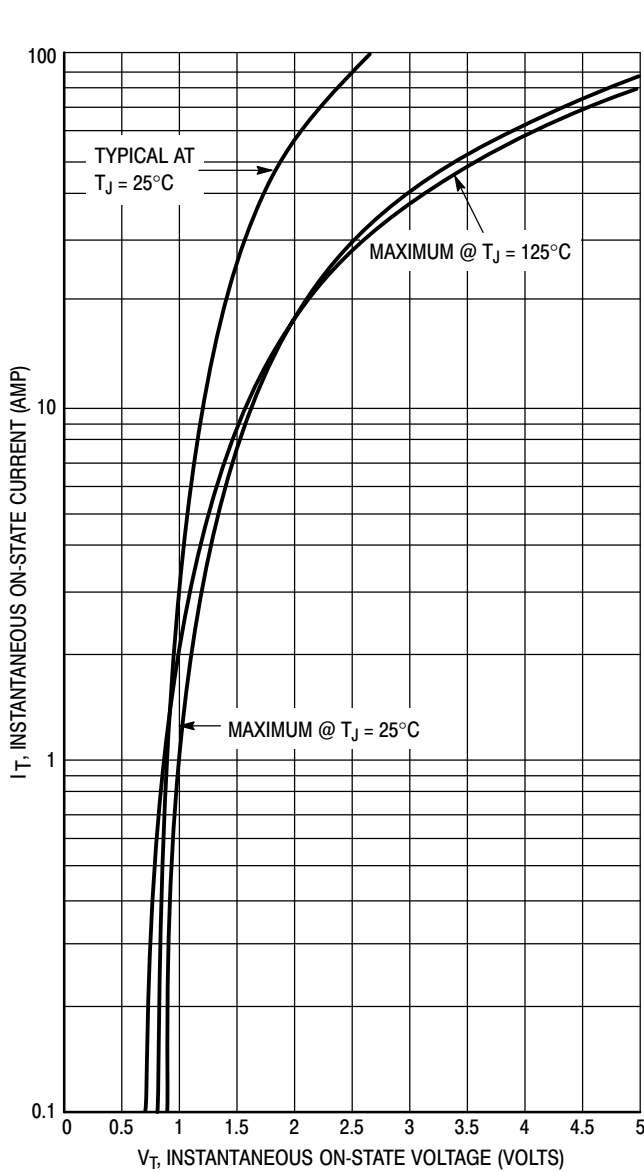


Figure 3. On-State Characteristics

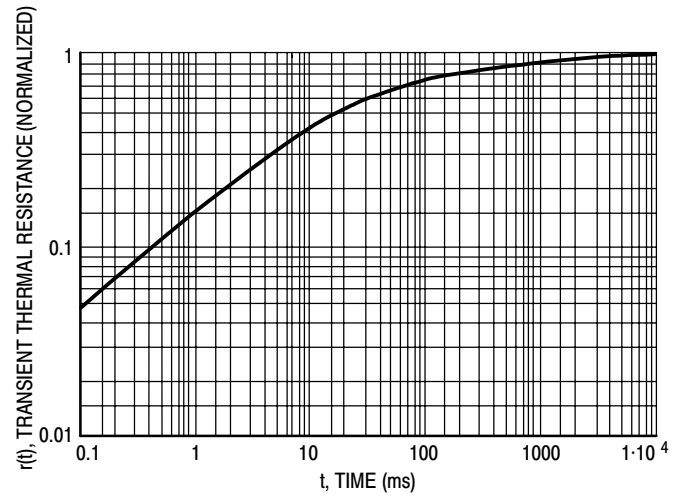


Figure 4. Thermal Response

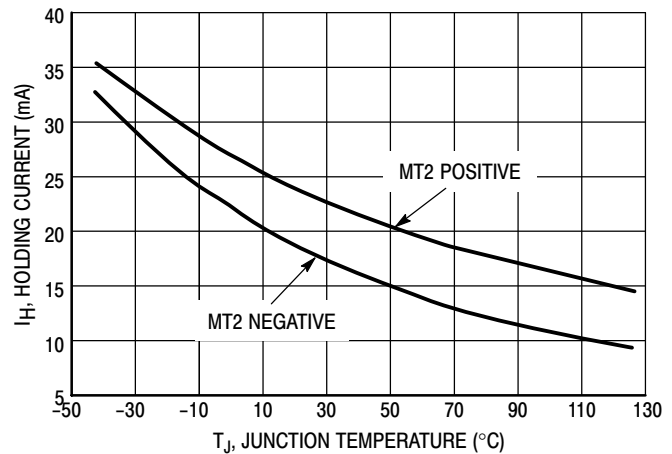


Figure 5. Holding Current Variation

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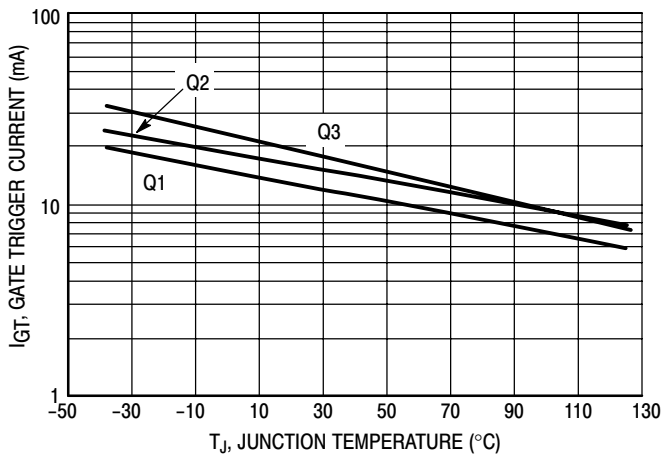


Figure 6. Gate Trigger Current Variation

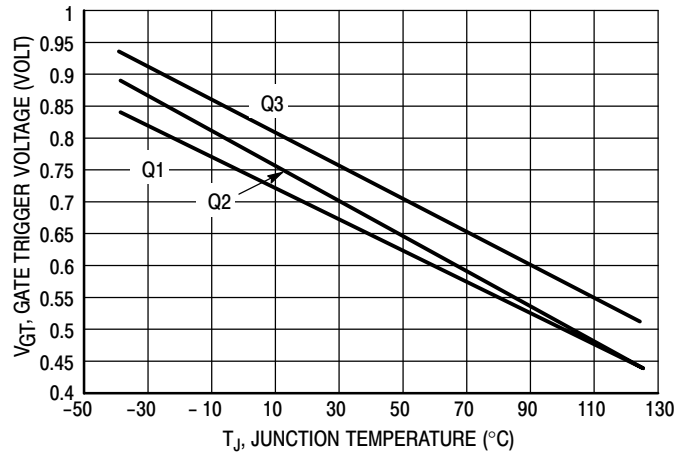


Figure 7. Gate Trigger Voltage Variation

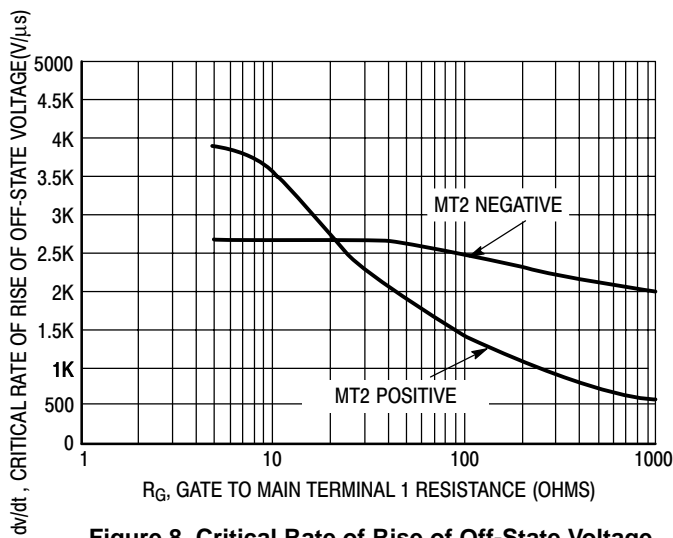


Figure 8. Critical Rate of Rise of Off-State Voltage (Exponential)

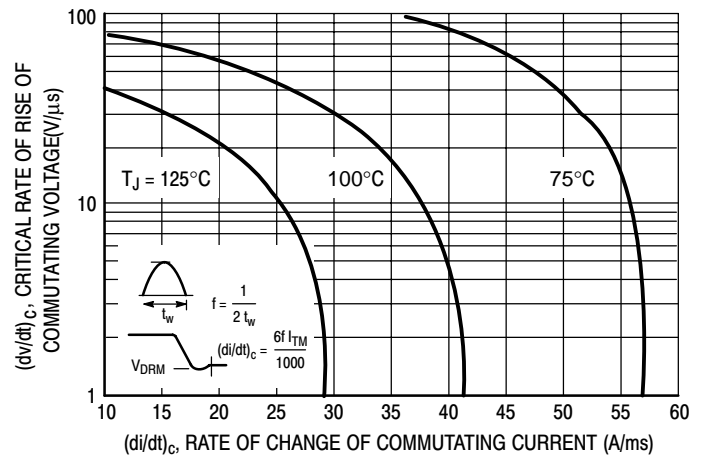
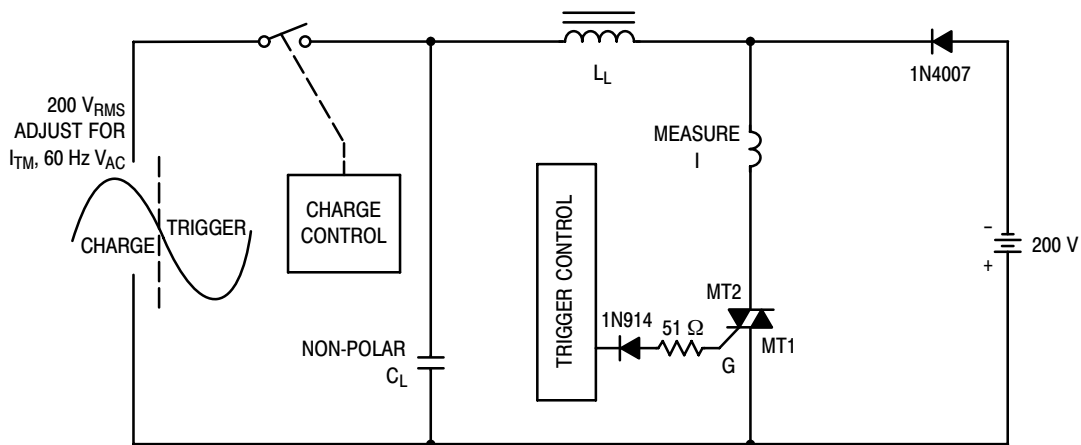


Figure 9. Critical Rate of Rise of Commutating Voltage



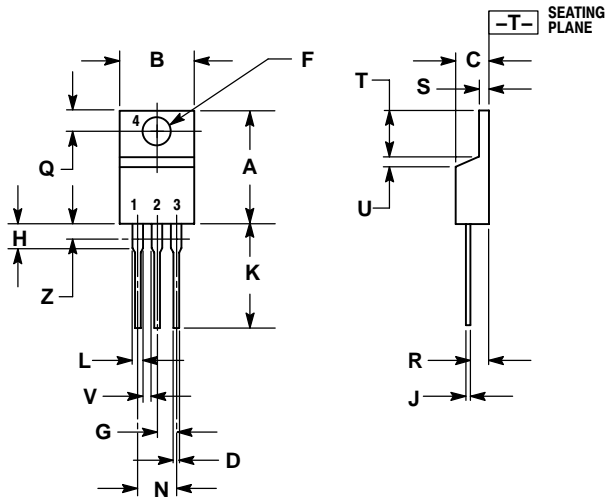
Note: Component values are for verification of rated  $(di/dt)_c$ . See AN1048 for additional information.

Figure 10. Simplified Test Circuit to Measure the Critical Rate of Rise of Commutating Current  $(di/dt)_c$

# MAC9D, MAC9M, MAC9N

## PACKAGE DIMENSIONS

TO-220AB  
CASE 221A-09  
ISSUE AA



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

**STYLE 4:**

- PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. MAIN TERMINAL 2

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