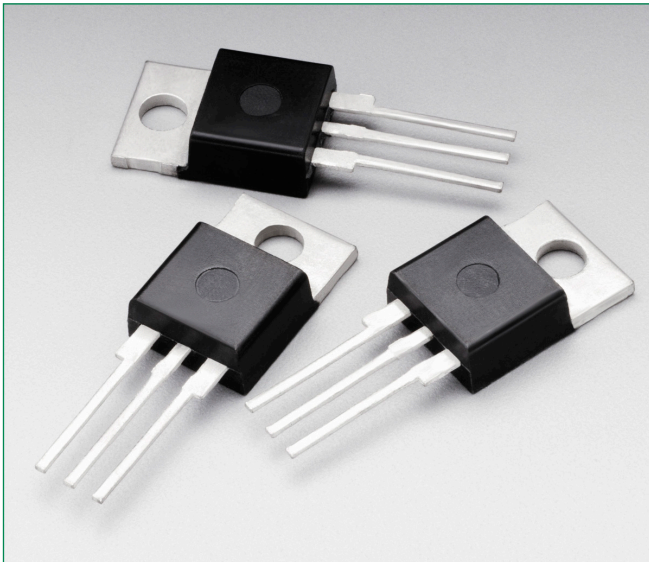
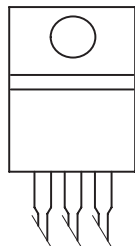
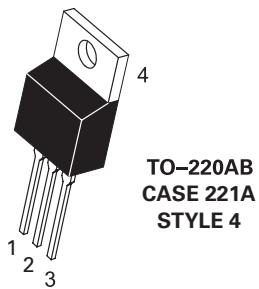


**MAC9DG, MAC9MG, MAC9NG**



**Pin Out**



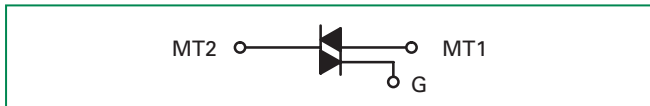
**Description**

Designed primarily for full-wave ac control applications, such as motor controls, heating controls and power supplies; or wherever half-wave silicon gate-controlled, solid-state devices are needed.

**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/ $\mu s$  minimum at 125°C
- Minimizes Snubber Networks for Protection
- Industry Standard TO-220 Package
- High Commutating  $di/dt$  – 6.5 A/ms minimum at 125°C
- These Devices are Pb-Free and are RoHS Compliant

**Functional Diagram**



**Additional Information**



**Datasheet**



**Resources**



**Samples**

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

| Rating   | Symbol                               | Value             | Unit               |
|--|--------------------------------------|-------------------|--------------------|
| Peak Repetitive Off-State Voltage (Note 1)<br>(Gate Open, Sine Wave 50 to 60 Hz, $T_J = 25^\circ$ to $100^\circ\text{C}$ ) | $V_{\text{DRM}}$<br>$V_{\text{RRM}}$ | 400<br>600<br>800 | V                  |
| On-State RMS Current (Full Cycle Sine Wave, 60 Hz, $T_C = 100^\circ\text{C}$ )   | $I_{\text{T (RMS)}}$                 | 8.0               | A                  |
| Peak Non-Repetitive Surge Current<br>(One Full Cycle Sine Wave, 60 Hz, $T_J = 125^\circ\text{C}$ )                         | $I_{\text{TSM}}$                     | 80                | A                  |
| Circuit Fusing Consideration ( $t = 8.3$ ms)   | $I^2t$                               | 26                | A <sup>2</sup> sec |
| Peak Gate Power<br>(Pulse Width $\leq 1.0$ $\mu\text{s}$ , $T_t = 80^\circ\text{C}$ )                                      | $P_{\text{GM}}$                      | 16                | W                  |
| Average Gate Power ( $t = 8.3$ ms, $T_C = 80^\circ\text{C}$ )  | $P_{\text{G (AV)}}$                  | 0.35              | W                  |
| Operating Junction Temperature Range   | $T_J$                                | -40 to +125       | $^\circ\text{C}$   |
| 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. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

### Thermal Characteristics

| Rating   | Symbol           | Value | Unit               |
|--|------------------|-------|--------------------|
| Thermal Resistance,<br>Junction-to-Case (AC)                                   | $R_{\text{8JC}}$ | 2.2   | $^\circ\text{C/W}$ |
| Junction-to-Ambient  | $R_{\text{8JA}}$ | 62.5  |                    |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds | $T_L$            | 260   | $^\circ\text{C}$   |

### Electrical Characteristics - OFF ( $T_J = 25^\circ\text{C}$ unless otherwise noted ; Electricals apply in both directions)

| Characteristic   |                           | Symbol    | Min | Typ | Max  | Unit |
|--|---------------------------|-----------|-----|-----|------|------|
| Peak Repetitive Blocking Current<br>( $V_D = V_{DRM} = V_{RRM}$ ; Gate Open) | $T_J = 25^\circ\text{C}$  | $I_{DRM}$ | -   | -   | 0.01 | mA   |
|  | $T_J = 125^\circ\text{C}$ | $I_{RRM}$ | -   | -   | 2.0  |      |

### Electrical Characteristics - ON ( $T_J = 25^\circ\text{C}$ unless otherwise noted; Electricals apply in both directions)

| Characteristic  |              | Symbol   | Min | Typ  | Max | Unit |
|---|--------------|----------|-----|------|-----|------|
| Peak On-State Voltage (Note 2) ( $I_{TM} = \pm 11\text{ A}$ )   |              | $V_{TM}$ | -   | 1.2  | 1.6 | V    |
| Gate Trigger Current<br>(Continuous dc)<br>( $V_D = 12\text{ V}$ , $R_L = 100\ \Omega$ )              | MT2(+), G(+) | $I_{GT}$ | 10  | 16   | 50  | mA   |
|   | MT2(+), G(-) |          | 10  | 18   | 50  |      |
|   | MT2(-), G(-) |          | 10  | 22   | 5.0 |      |
| Holding Current ( $V_D = 12\text{ V}$ , Gate Open, Initiating Current = $\pm 150\text{ mA}$ )         |              | $I_H$    | -   | 30   | 50  | mA   |
| Latching Current<br>( $V_D = 24\text{ V}$ , $I_G = 50\text{ mA}$ )                                    | MT2(+), G(+) | $I_L$    | -   | 20   | 50  | mA   |
|   | MT2(+), G(-) |          | -   | 30   | 80  |      |
|   | MT2(-), G(-) |          | -   | 20   | 50  |      |
| Gate Trigger Voltage<br>( $V_D = 12\text{ V}$ , $R_L = 100\ \Omega$ )                                 | MT2(+), G(+) | $V_{GT}$ | 0.5 | 0.69 | 1.5 | V    |
|   | MT2(+), G(-) |          | 0.5 | 0.77 | 1.5 |      |
|   | MT2(-), G(-) |          | 0.5 | 0.72 | 1.5 |      |
| Gate Non-Trigger Voltage<br>( $V_D = 12\text{ V}$ , $R_L = 100\ \Omega$ , $T_J = 125^\circ\text{C}$ ) | MT2(+), G(+) | $V_{GD}$ | 0.2 | -    | -   | V    |
|   | MT2(+), G(-) |          | 0.2 | -    | -   |      |
|   | MT2(-), G(-) |          | 0.2 | -    | -   |      |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

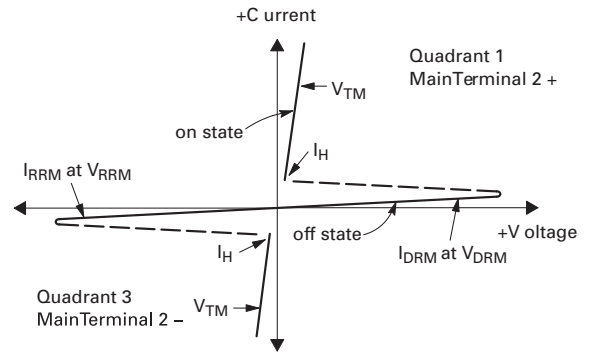
2. Indicates Pulse Test: Pulse Width  $\leq 2.0\text{ ms}$ , Duty Cycle  $\leq 2\%$ .

### Dynamic Characteristics

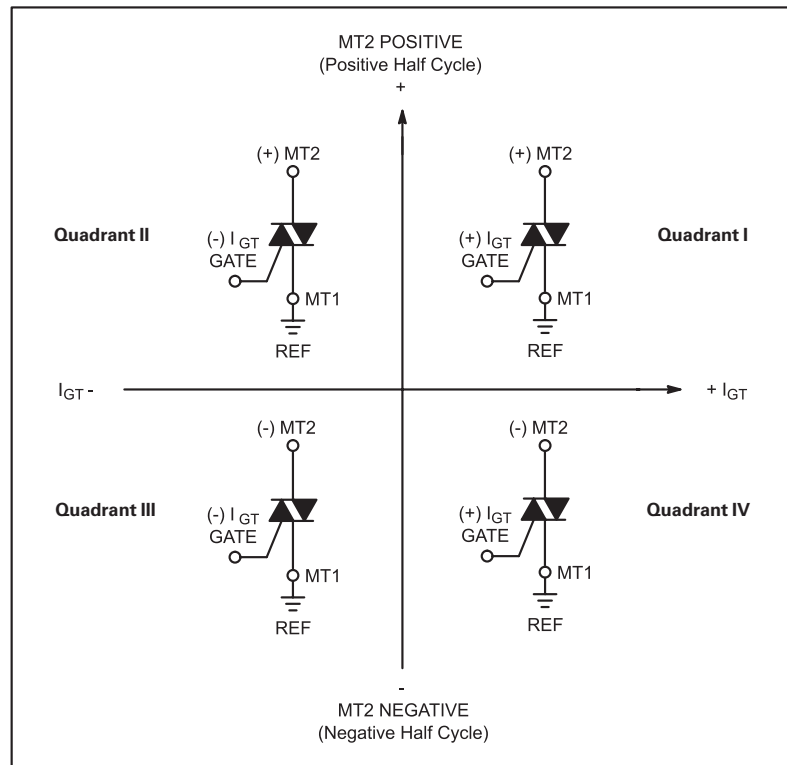
| Characteristic  | Symbol  | Min | Typ | Max | Unit             |
|---|---------|-----|-----|-----|------------------|
| Rate of Change of Commutating Current See Figure 10.<br>( $V_D = 400\text{ V}$ , $I_{TM} = 4.4\text{ A}$ , Commutating $dv/dt = 18\text{ V}/\mu\text{s}$ , Gate Open, $T_J = 125^\circ\text{C}$ ,<br>$f = 250\text{ Hz}$ , No Snubber) $C_L = 10\ \mu\text{F}$ $L_L = 40\text{ mH}$ | $dv/dt$ | 6.5 | -   | -   | A/ms             |
| Critical Rate of Rise of Off-State Voltage<br>( $V_D = \text{Rated } V_{DRM}$ , Exponential Waveform, $R_{GK} = 510\ \Omega$ , $T_J = 125^\circ\text{C}$ )  | $dv/dt$ | 500 | -   | -   | V/ $\mu\text{s}$ |

### Voltage Current Characteristic of SCR

| 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                           |



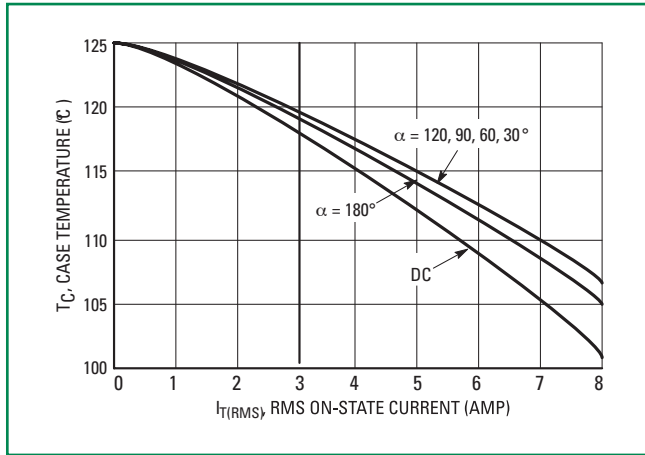
### Quadrant Definitions for a Triac



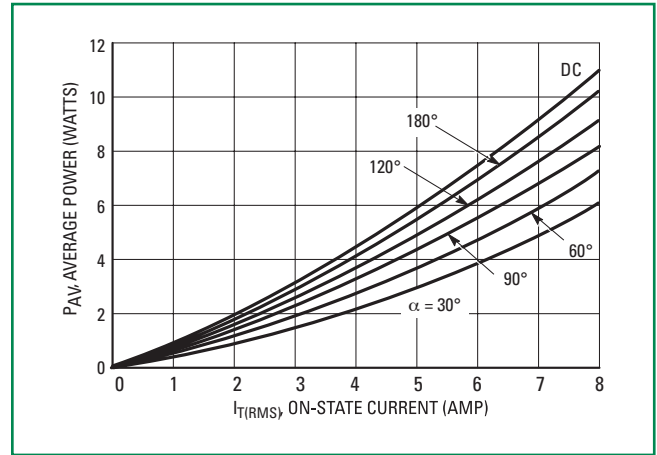
All polarities are referenced to MT1.

With in-phase signals (using standard AC lines) quadrants I and III are used.

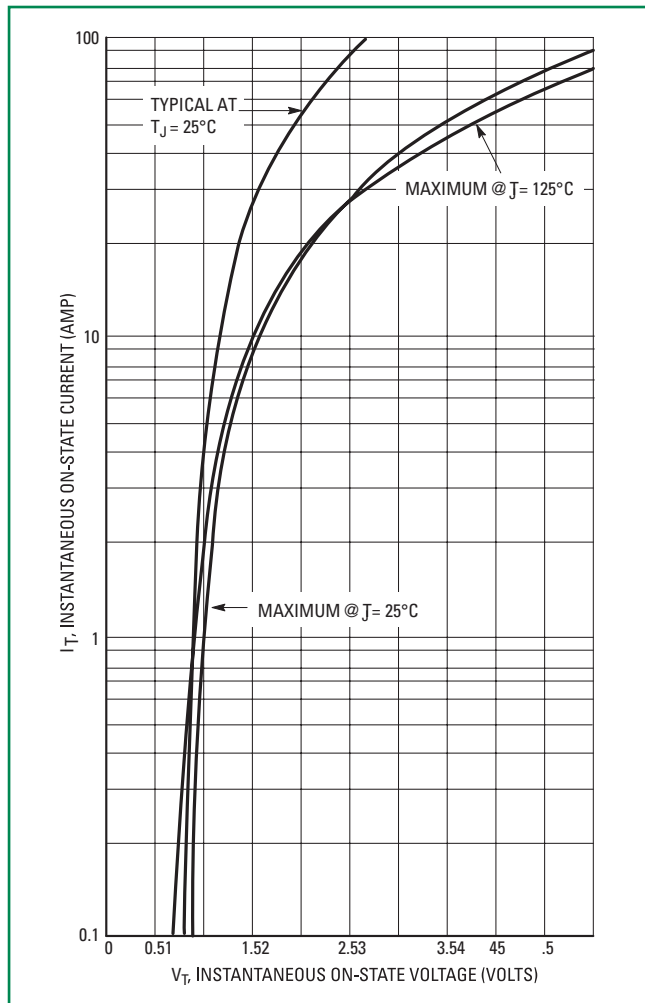
**Figure 1. RMS Current Derating**



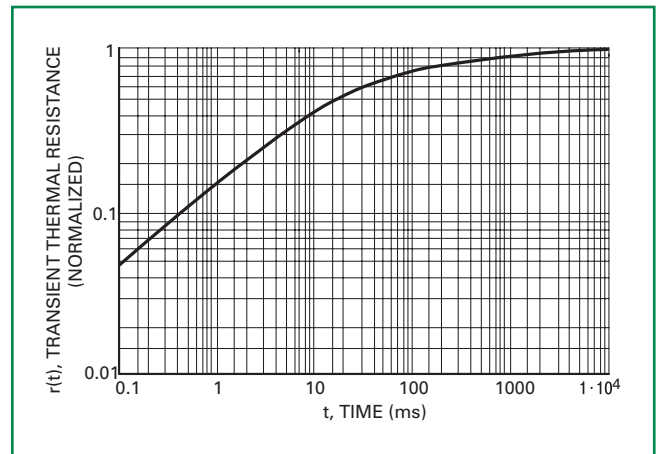
**Figure 2. On-State Power Dissipation**



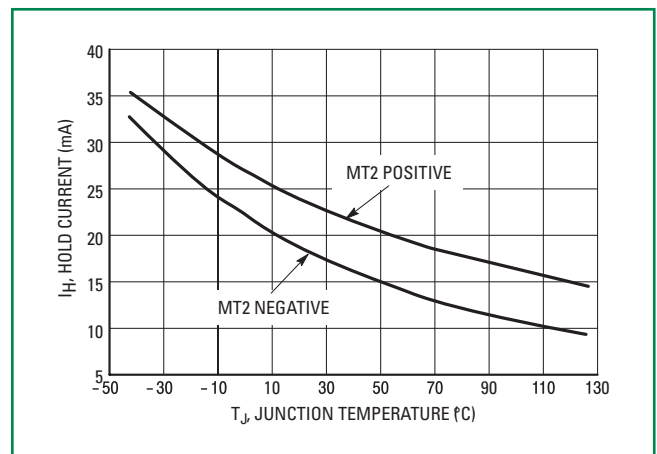
**Figure 3. On-State Characteristics**



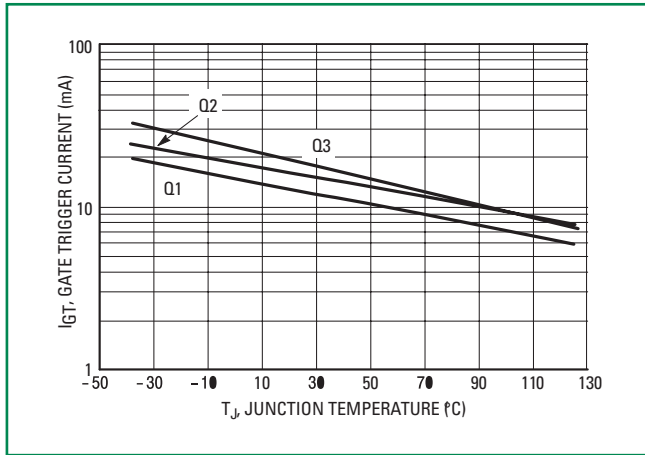
**Figure 4. Thermal Response**



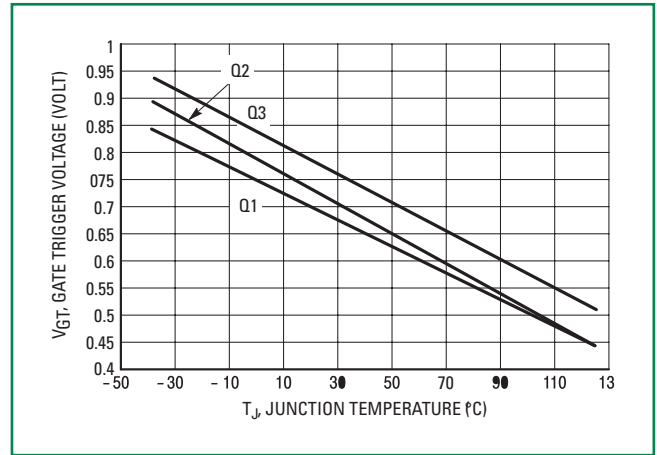
**Figure 5. Hold Current Variation**



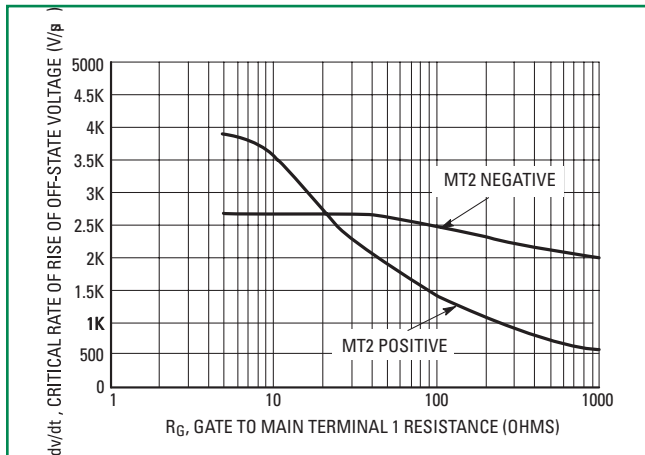
**Figure 6. Gate Trigger Current Variation**



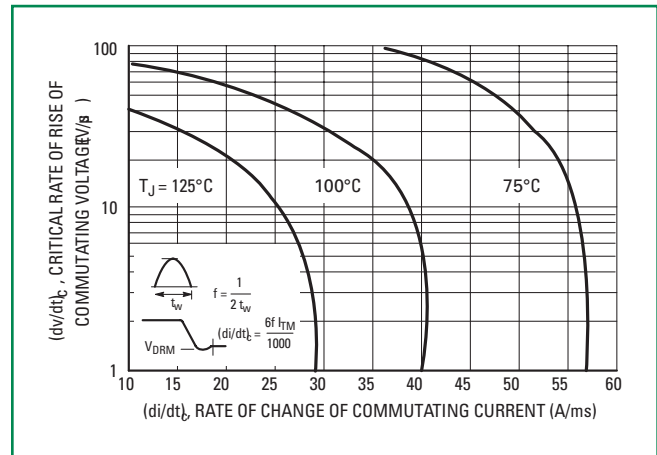
**Figure 7. Gate Trigger Voltage Variation**



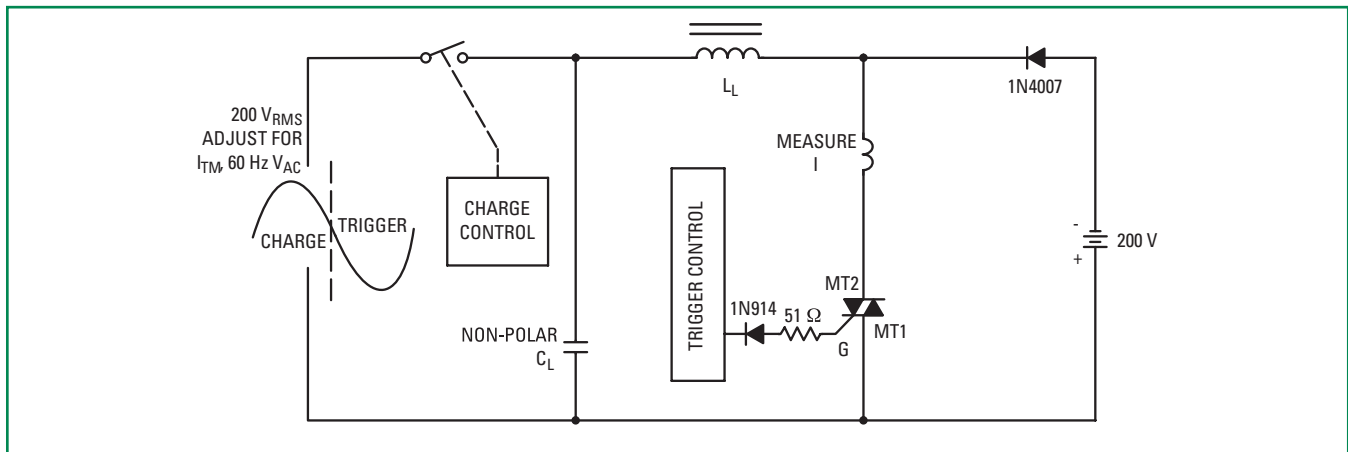
**Figure 8. Critical Rate of Rise of Off-State Voltage (Exponential)**



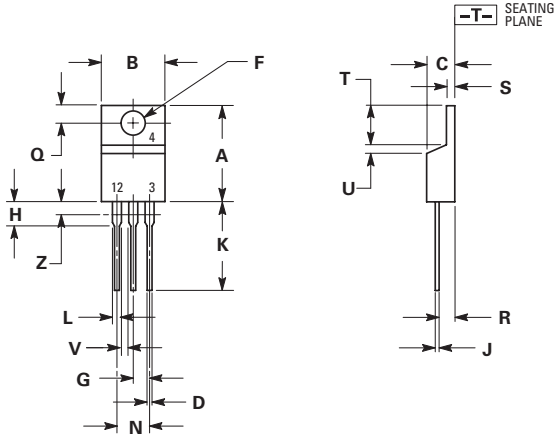
**Figure 9. Critical Rate of Rise of Commutating Voltage**



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



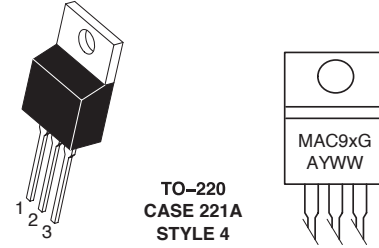
### Dimensions



| 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   | 0.014  | 0.022 | 0.36        | 0.55  |
| 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  |

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.

### Part Marking System



TO-220  
CASE 221A  
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        |
|--------|---------------------|-----------------|
| MAC9DG | TO-220<br>(Pb-Free) | 50 Units / Rail |
| MAC9MG |                     |                 |
| MAC9NG |                     |                 |

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