

# MAC4SM, MAC4SN

Preferred Device

## Sensitive Gate Triacs

### Silicon Bidirectional Thyristors

Designed for industrial and consumer applications for full wave control of ac loads such as appliance controls, heater controls, motor controls, and other power switching applications.

- Sensitive Gate Allows Triggering by Microcontrollers and other Logic Circuits
- High Immunity to  $dv/dt$  — 50 V/ $\mu s$  Minimum at 125°C
- Commutating  $di/dt$  — 3.0 A/ms Minimum at 125°C
- Minimum and Maximum Values of  $I_{GT}$ ,  $V_{GT}$  and  $I_H$  Specified for Ease of Design
- On-State Current Rating of 4 Amperes RMS at 100°C
- High Surge Current Capability — 40 Amperes
- Blocking Voltage to 800 Volts
- Rugged, Economical TO220AB Package
- Operational in Three Quadrants: Q1, Q2, and Q3
- Device Marking: Logo, Device Type, e.g., MAC4SM, Date Code

#### MAXIMUM RATINGS ( $T_J = 25^\circ C$ unless otherwise noted)

| Rating                                                                                                                                         | Symbol                   | Value          | Unit               |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|--------------------|
| Peak Repetitive Off-State Voltage <sup>(1)</sup><br>( $T_J = -40$ to $125^\circ C$ , Sine Wave,<br>50 to 60 Hz, Gate Open)<br>MAC4SM<br>MAC4SN | $V_{DRM}$ ,<br>$V_{RRM}$ | 600<br>800     | Volts              |
| On-State RMS Current<br>(Full Cycle Sine Wave, 60 Hz,<br>$T_C = 100^\circ C$ )                                                                 | $I_T(RMS)$               | 4.0            | Amps               |
| Peak Non-Repetitive Surge Current<br>(One Full Cycle, 60 Hz, $T_J = 125^\circ C$ )                                                             | $I_{TSM}$                | 40             | Amps               |
| Circuit Fusing Consideration<br>( $t = 8.33$ ms)                                                                                               | $I^2t$                   | 6.6            | A <sup>2</sup> sec |
| Peak Gate Power<br>(Pulse Width $\leq 1.0$ $\mu s$ , $T_C = 100^\circ C$ )                                                                     | $P_{GM}$                 | 0.5            | Watt               |
| Average Gate Power<br>( $t = 8.3$ ms, $T_C = 100^\circ C$ )                                                                                    | $P_{G(AV)}$              | 0.1            | Watt               |
| Operating Junction Temperature Range                                                                                                           | $T_J$                    | -40 to<br>+125 | °C                 |
| Storage Temperature Range                                                                                                                      | $T_{stg}$                | -40 to<br>+150 | °C                 |

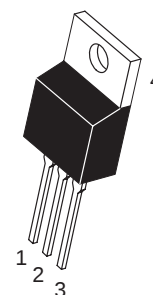
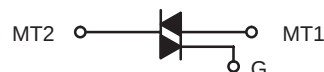
(1)  $V_{DRM}$  and  $V_{RRM}$  for all types can be applied on a continuous basis. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.



ON Semiconductor

<http://onsemi.com>

**TRIACS**  
**4 AMPERES RMS**  
**600 thru 800 VOLTS**



TO-220AB  
CASE 221A  
STYLE 4

#### PIN ASSIGNMENT

|   |                 |
|---|-----------------|
| 1 | Main Terminal 1 |
| 2 | Main Terminal 2 |
| 3 | Gate            |
| 4 | Main Terminal 2 |

#### ORDERING INFORMATION

| Device | Package | Shipping      |
|--------|---------|---------------|
| MAC4SM | TO220AB | 50 Units/Rail |
| MAC4SN | TO220AB | 50 Units/Rail |

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

# MAC4SM, MAC4SN

## THERMAL CHARACTERISTICS

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

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                           |                    |        |        |             |    |
|-------------------------------------------------------------------------------------------|--------------------|--------|--------|-------------|----|
| Peak Repetitive Blocking Current<br>( $V_D = \text{Rated } V_{DRM}, V_{RRM}$ ; Gate Open) | $I_{DRM}, I_{RRM}$ | —<br>— | —<br>— | 0.01<br>2.0 | mA |
| $T_J = 25^{\circ}C$<br>$T_J = 125^{\circ}C$                                               |                    |        |        |             |    |

### ON CHARACTERISTICS

|                                                                                                                         |          |                   |                   |                   |    |
|-------------------------------------------------------------------------------------------------------------------------|----------|-------------------|-------------------|-------------------|----|
| Peak On-State Voltage <sup>(1)</sup><br>( $I_{TM} = \pm 6.0 A$ )                                                        | $V_{TM}$ | —                 | 1.3               | 1.6               | V  |
| Gate Trigger Current (Continuous dc) ( $V_D = 12 V, R_L = 100 \Omega$ )<br>MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–) | $I_{GT}$ | 2.9<br>2.9<br>2.9 | 4.0<br>4.7<br>6.0 | 10<br>10<br>10    | mA |
| Holding Current<br>( $V_D = 12 V$ , Gate Open, Initiating Current = $\pm 200 mA$ )                                      | $I_H$    | 2.0               | 5.0               | 15                | mA |
| Latching Current ( $V_D = 12 V, I_G = 10 mA$ )<br>MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)                          | $I_L$    | —<br>—<br>—       | 6.0<br>15<br>6.0  | 30<br>30<br>30    | mA |
| Gate Trigger Voltage (Continuous dc) ( $V_D = 12 V, R_L = 100 \Omega$ )<br>MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–) | $V_{GT}$ | 0.5<br>0.5<br>0.5 | 0.7<br>.65<br>0.7 | 1.3<br>1.3<br>1.3 | V  |

### DYNAMIC CHARACTERISTICS

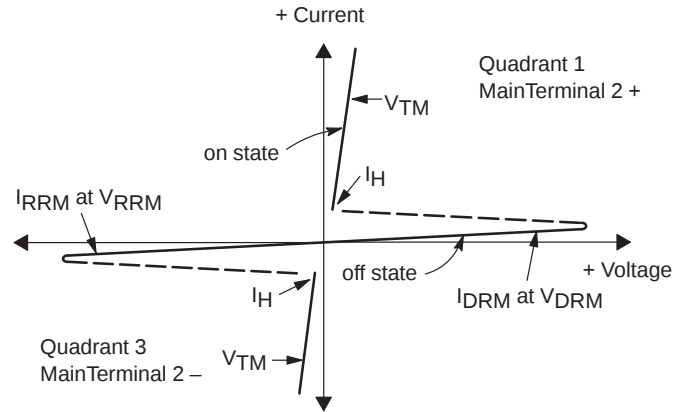
|                                                                                                                                                                                                          |             |     |     |    |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|-----|----|------------|
| Rate of Change of Commutating Current<br>( $V_D = 400 V, I_{TM} = 3.5 A$ , Commutating $dv/dt = 10 V/\mu s$ , Gate Open,<br>$T_J = 125^{\circ}C, f = 500 Hz, C_L = 5.0 \mu F, L_L = 20 mH$ , No Snubber) | $(di/dt)_C$ | 3.0 | 4.0 | —  | A/ms       |
| Critical Rate of Rise of Off-State Voltage<br>( $V_D = 0.67 \times \text{Rated } V_{DRM}$ , Exponential Waveform,<br>Gate Open, $T_J = 125^{\circ}C$ )                                                   | $dv/dt$     | 50  | 150 | —  | V/ $\mu s$ |
| Repetitive Critical Rate of Rise of On-State Current<br>IPK = 50 A; PW = 40 $\mu s$ ; $di_G/dt = 200 mA/\mu s$ ; $f = 60 Hz$                                                                             | $di/dt$     | —   | —   | 10 | A/ $\mu s$ |

(1) Pulse Test: Pulse Width  $\leq 2.0 ms$ , Duty Cycle  $\leq 2\%$ .

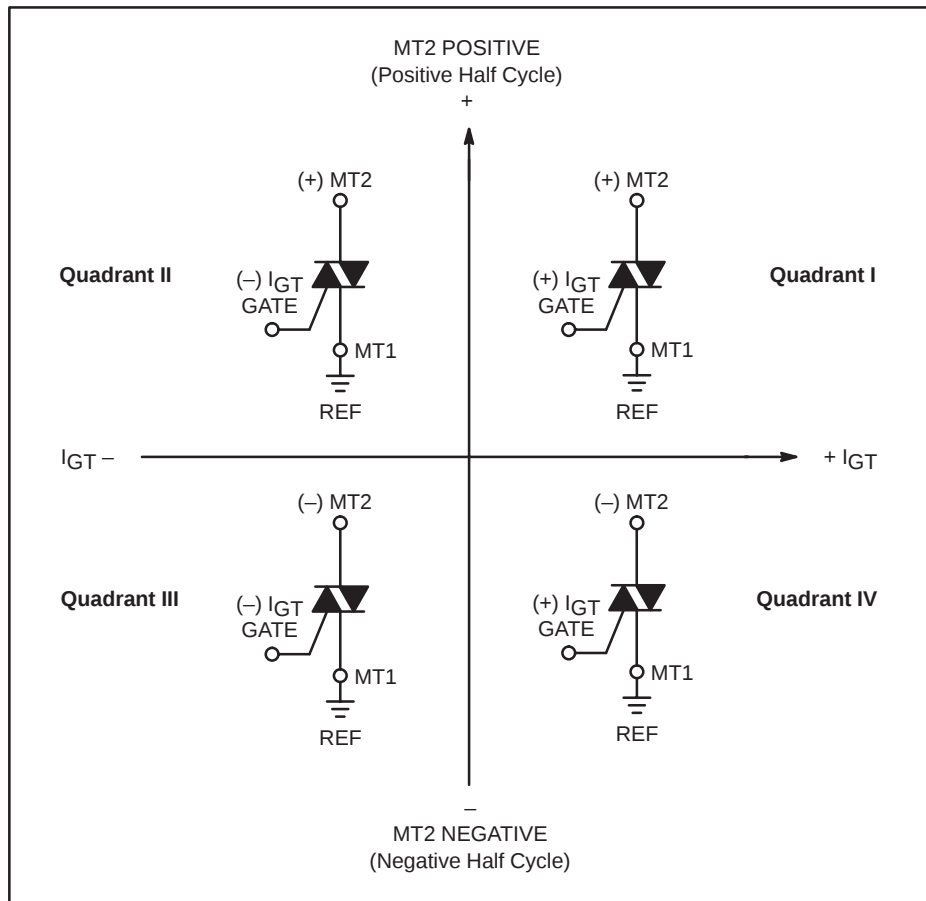
## MAC4SM, MAC4SN

### 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                           |



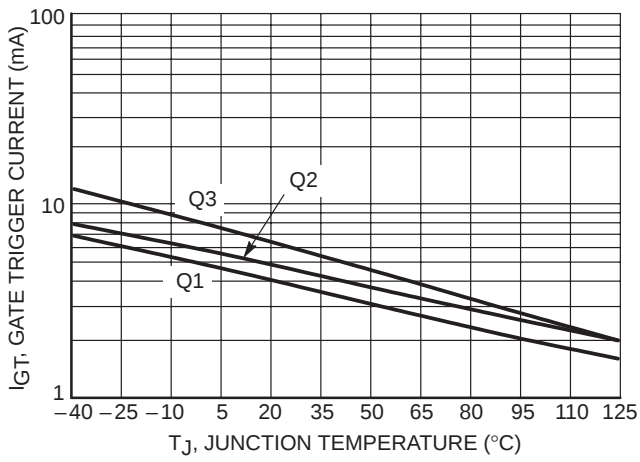
### Quadrant Definitions for a Triac



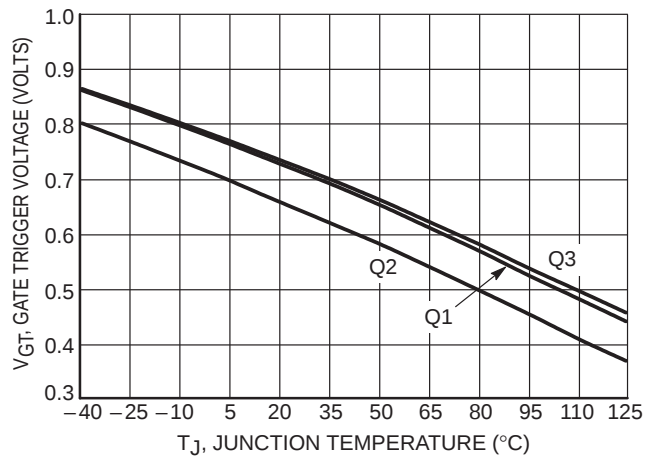
All polarities are referenced to MT1.

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

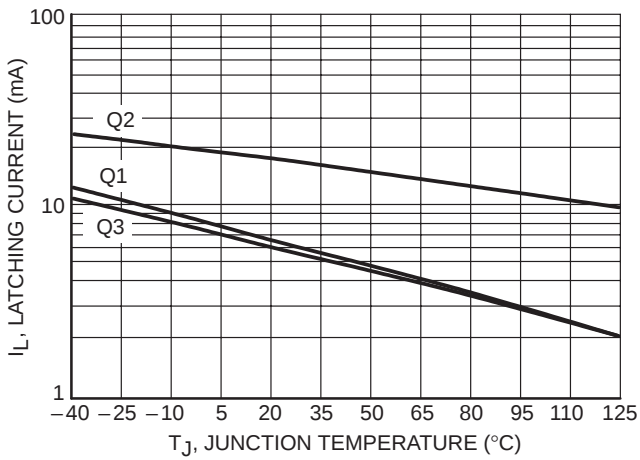
# MAC4SM, MAC4SN



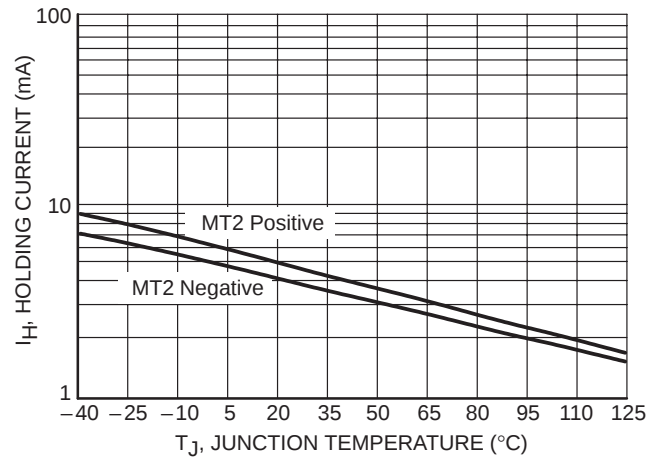
**Figure 1. Typical Gate Trigger Current versus Junction Temperature**



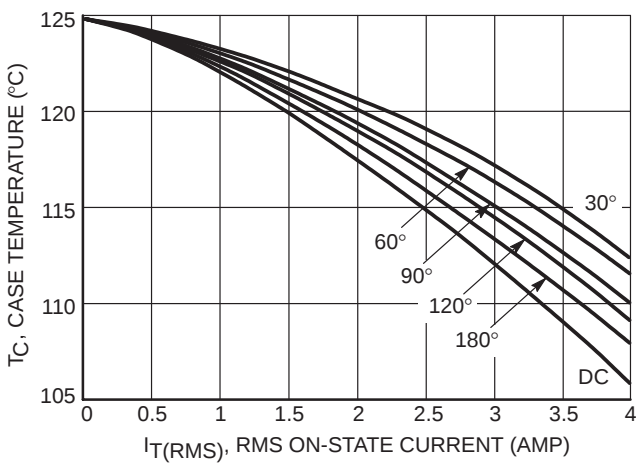
**Figure 2. Typical Gate Trigger Voltage versus Junction Temperature**



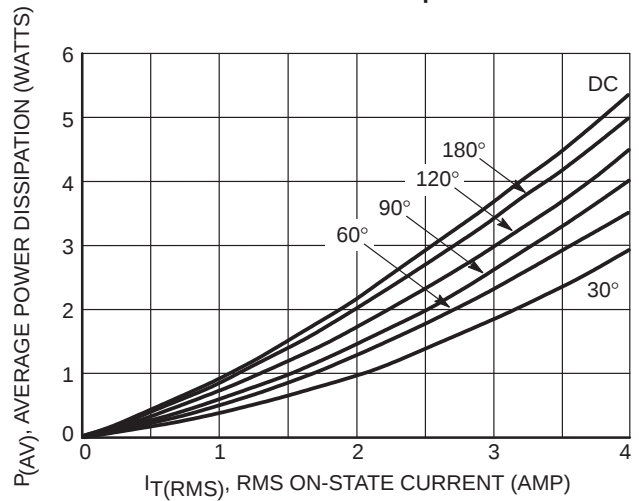
**Figure 3. Typical Latching Current versus Junction Temperature**



**Figure 4. Typical Holding Current versus Junction Temperature**

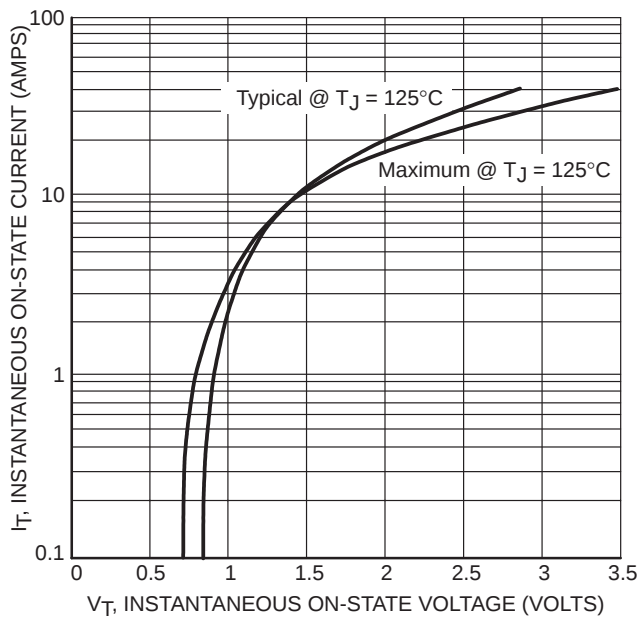


**Figure 5. Typical RMS Current Derating**

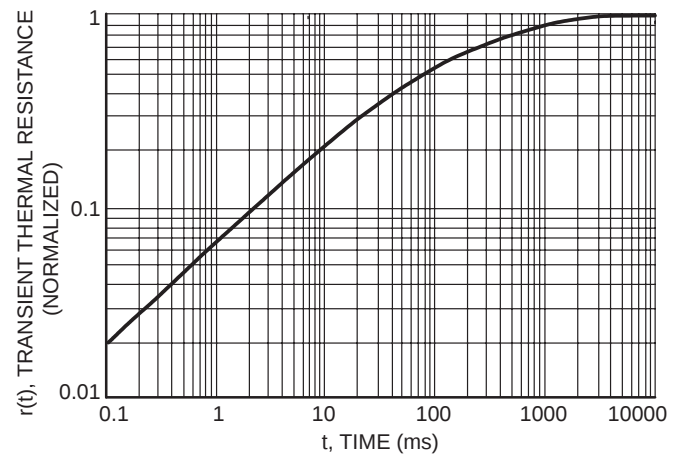


**Figure 6. On-State Power Dissipation**

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**Figure 7. Typical On-State Characteristics**

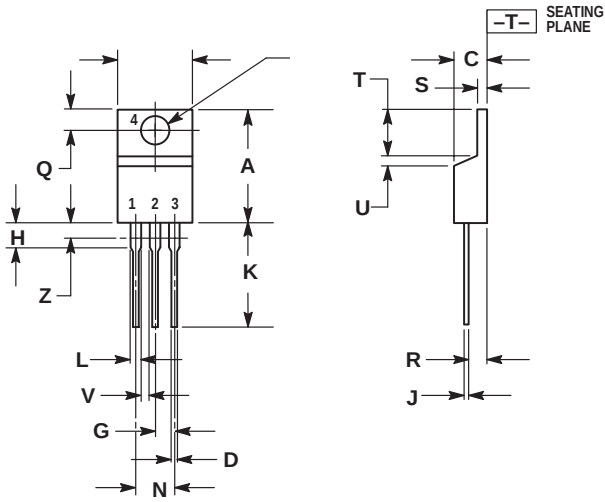


**Figure 8. Typical Thermal Response**

# MAC4SM, MAC4SN

## PACKAGE DIMENSIONS

### TO-220AB CASE 221A-09 ISSUE Z



- 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

## Notes

# MAC4SM, MAC4SN

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