# MAC12SM, MAC12SN

## 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.

**Features**

- Sensitive Gate Allows Triggering by Microcontrollers and other Logic Circuits
- Blocking Voltage to 800 Volts
- On-State Current Rating of 12 Amperes RMS at 70°C
- High Surge Current Capability − 90 Amperes
- Rugged, Economical TO−220AB Package
- Glass Passivated Junctions for Reliability and Uniformity
- Maximum Values of $I_{GT}$, $V_{GT}$ and $I_H$ Specified for Ease of Design
- High Commutating di/dt − 8.0 A/ms Minimum at 110°C
- Immunity to dV/dt − 15 V/μsec Minimum at 110°C
- Operational in Three Quadrants: Q1, Q2, and Q3
- These Devices are Pb−Free and are RoHS Compliant*

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

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Peak Repetitive Off−State Voltage (Note 1) ($T_J$ = −40 to 110°C, Sine Wave, 50 to 60 Hz, Gate Open)<br>MAC12SM<br>MAC12SN | $V_{DRM}$,<br>$V_{RRM}$ | <br>600<br>800 | V |
| On-State RMS Current (All Conduction Angles; $T_C$ = 70°C) | $I_{T(RMS)}$ | 12 | A |
| Peak Non-Repetitive Surge Current (One Full Cycle Sine Wave, 60 Hz, $T_J$ = 110°C) | $I_{TSM}$ | 90 | A |
| Circuit Fusing Consideration (t = 8.33 ms) | $I^2t$ | 33 | $A^2$sec |
| Peak Gate Power (Pulse Width = 1.0 μsec, $T_C$ = 70°C) | $P_{GM}$ | 16 | W |
| Average Gate Power (t = 8.3 msec, $T_C$ = 70°C) | $P_{G(AV)}$ | 0.35 | W |
| Operating Junction Temperature Range | $T_J$ | −40 to 110 | °C |
| Storage Temperature Range | $T_{stg}$ | −40 to 150 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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**®

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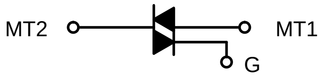
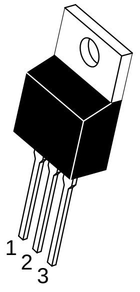
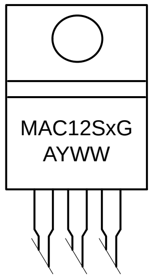
**TRIACS**
**12 AMPERES RMS**
**600 thru 800 VOLTS**



**MARKING DIAGRAM**



**TO−220**
**CASE 221A**
**STYLE 4**



x = 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 |
|---|---|---|
| MAC12SMG | TO−220<br>(Pb−Free) | 50 Units / Rail |
| MAC12SNG | TO−220<br>(Pb−Free) | 50 Units / Rail |

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

November, 2014 − Rev. 4

## 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 | °C/W |
| Maximum Lead Temperature for Soldering Purposes 1/8″ from Case for 10 Seconds | $T_L$ | 260 | °C |

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

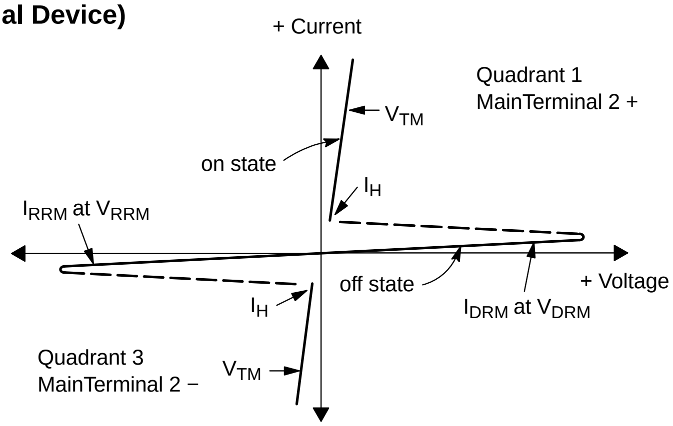
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Peak Repetitive Blocking Current<br>($V_D$ = Rated $V_{DRM}$, $V_{RRM}$; Gate Open) $T_J$ = 25°C<br>$T_J$ = 110°C | $I_{DRM}$,<br>$I_{RRM}$ | –<br>– | –<br>– | 0.01<br>2.0 | mA |
| **ON CHARACTERISTICS** | | | | | |
| Peak On-State Voltage (Note 2)<br>($I_{TM}$ = ±17 A) | $V_{TM}$ | – | – | 1.85 | V |
| Gate Trigger Current (Continuous dc) ($V_D$ = 12 V, $R_L$ = 100 Ω)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | $I_{GT}$ | –<br>–<br>– | 1.5<br>2.5<br>2.7 | 5.0<br>5.0<br>5.0 | mA |
| Holding Current<br>($V_D$ = 12 V, Gate Open, Initiating Current = ±200 mA) | $I_H$ | – | 2.5 | 10 | mA |
| Latching Current ($V_D$ = 12 V, $I_G$ = 5 mA)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | $I_L$ | –<br>–<br>– | 3.0<br>5.0<br>3.0 | 15<br>20<br>15 | mA |
| Gate Trigger Voltage (Continuous dc) ($V_D$ = 12 V, $R_L$ = 100 Ω)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | $V_{GT}$ | 0.45<br>0.45<br>0.45 | 0.68<br>0.62<br>0.67 | 1.5<br>1.5<br>1.5 | V |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Critical Rate of Change of Commutating Current<br>($V_D$ = 400 V, $I_{TM}$ = 3.5 A, Commutating dV/dt = 10 V/μs, Gate Open, $T_J$ = 110°C, f = 500 Hz, Snubber: Cs = 0.01 μf, Rs = 15 Ω) | $(di/dt)_c$ | 8.0 | 10 | – | A/ms |
| Critical Rate of Rise of Off-State Voltage<br>($V_D$ = 67% $V_{DRM}$, Exponential Waveform, $R_{GK}$ = 1 KΩ, $T_J$ = 110°C) | dV/dt | 15 | 40 | – | V/μs |
| Repetitive Critical Rate of Rise of On-State Current<br>IPK = 50 A; PW = 40 μsec; diG/dt = 1 A/μsec; Igt = 100 mA; f = 60 Hz | di/dt | – | – | 10 | A/μs |

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.

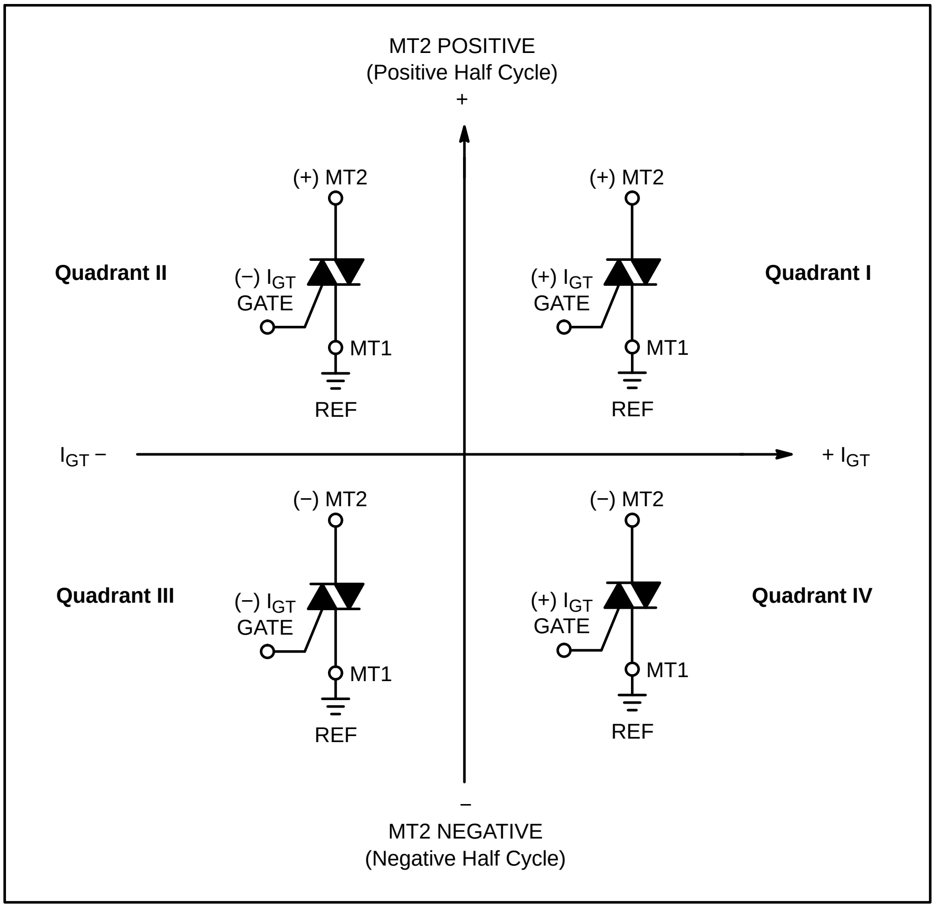
2. Pulse Test: Pulse Width ≤ 2.0 ms, Duty Cycle ≤ 2%.

## 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.

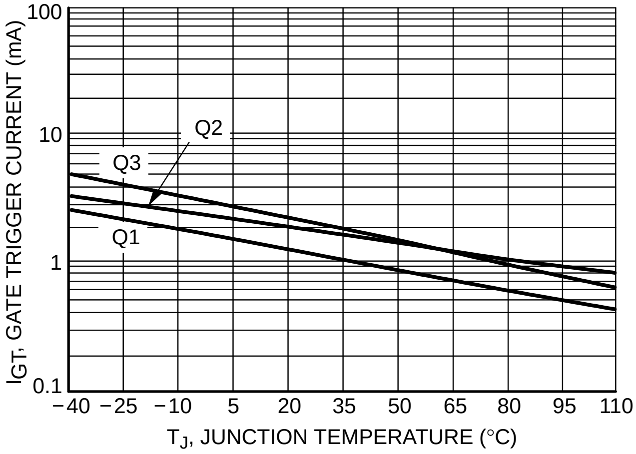


**Figure 1. Typical Gate Trigger Current versus Junction Temperature**

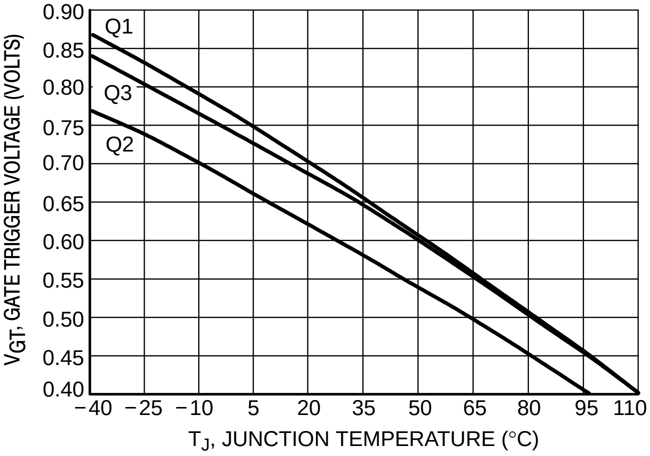


**Figure 2. Typical Gate Trigger Voltage versus Junction Temperature**

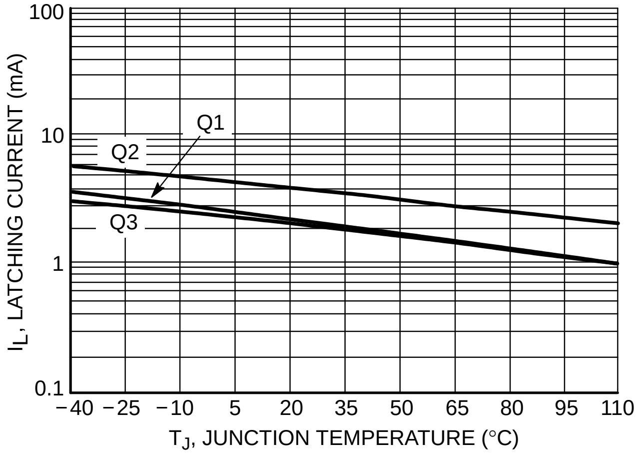


Figure 3. Typical Latching Current versus Junction Temperature

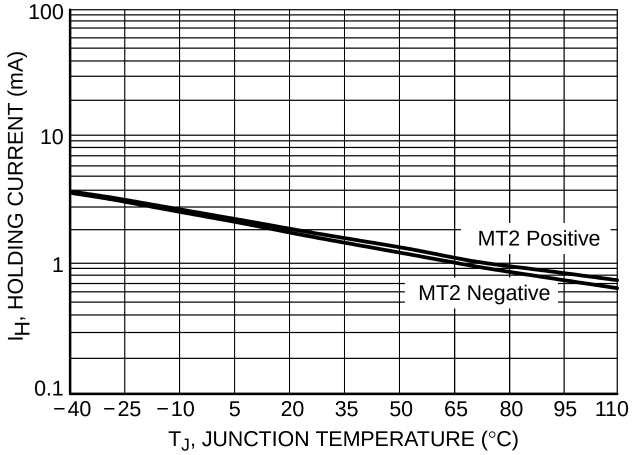


Figure 4. Typical Holding Current versus Junction Temperature

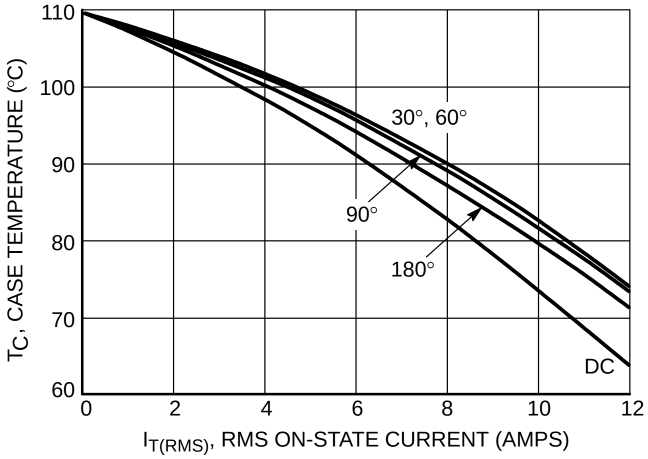


Figure 5. Typical RMS Current Derating

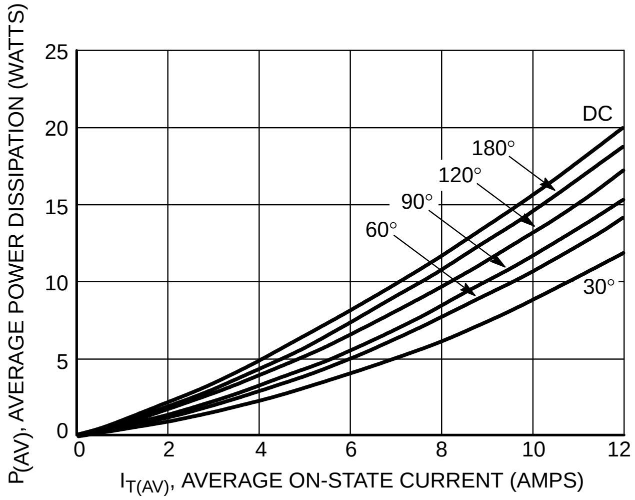


Figure 6. On-State Power Dissipation

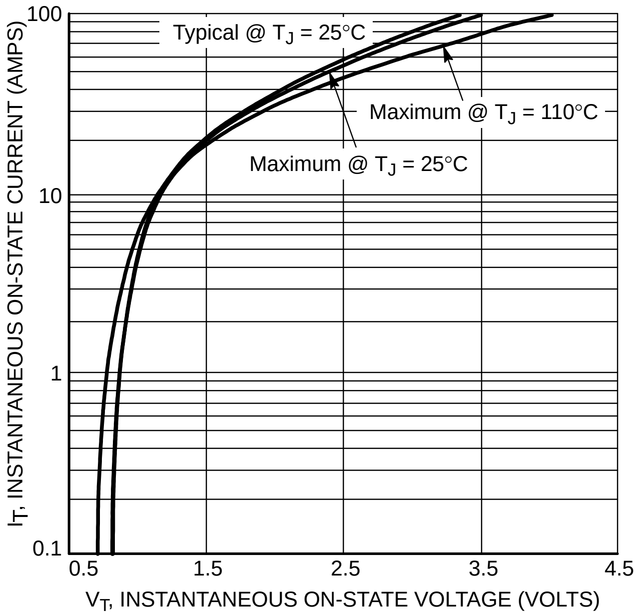


Figure 7. Typical On-State Characteristics

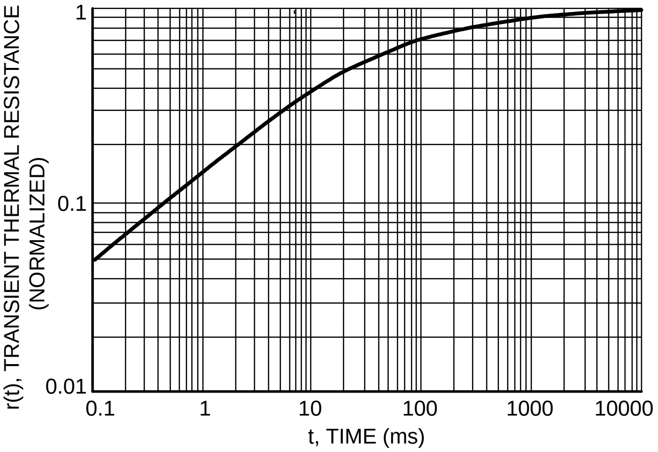
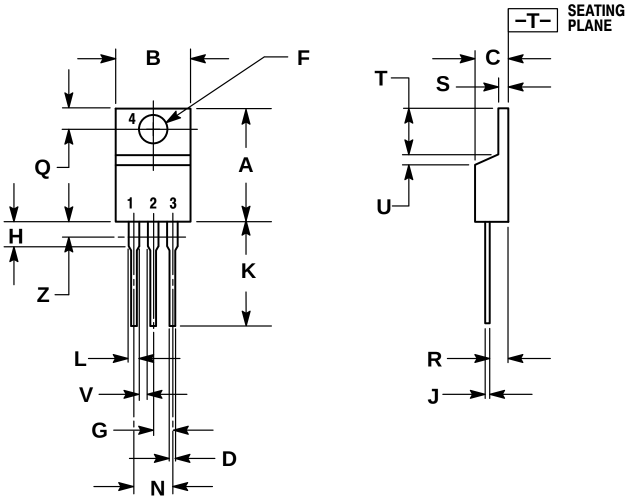


Figure 8. Typical Thermal Response

## PACKAGE DIMENSIONS

### TO−220

CASE 221A−09
ISSUE AH



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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.415 | 9.66 | 10.53 |
| C | 0.160 | 0.190 | 4.07 | 4.83 |
| D | 0.025 | 0.038 | 0.64 | 0.96 |
| F | 0.142 | 0.161 | 3.61 | 4.09 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.161 | 2.80 | 4.10 |
| J | 0.014 | 0.024 | 0.36 | 0.61 |
| 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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