# MAC12D, MAC12M, MAC12N

**Preferred Device**

# Triacs

## Silicon Bidirectional Thyristors

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

### Features

- Blocking Voltage to 800 Volts
- On−State Current Rating of 12 Amperes RMS at 70°C
- Uniform Gate Trigger Currents in Three Quadrants, Q1, Q2, and Q3
- High Immunity to dv/dt − 250 V/μs Minimum at 125°C
- High Commutating di/dt − 6.5 A/ms Minimum at 125°C
- Industry Standard TO−220 AB Package
- High Surge Current Capability − 100 Amperes
- Pb−Free Packages are Available*

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

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Peak Repetitive Off−State Voltage (Note 1) ($T_J$ = −40 to 125°C, Sine Wave, 50 to 60 Hz, Gate Open)<br>MAC12D<br>MAC12M<br>MAC12N | $V_{DRM}$, $V_{RRM}$ | <br>400<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, 60 Hz, $T_J$ = 125°C) | $I_{TSM}$ | 100 | A |
| Circuit Fusing Consideration (t = 8.33 ms) | $I^2t$ | 41 | $A^2$sec |
| Peak Gate Power (Pulse Width ≤ 1.0 μs, $T_C$ = 80°C) | $P_{GM}$ | 16 | W |
| Average Gate Power (t = 8.3 ms, $T_C$ = 80°C) | $P_{G(AV)}$ | 0.35 | W |
| Operating Junction Temperature Range | $T_J$ | −40 to +125 | °C |
| Storage Temperature Range | $T_{stg}$ | −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. $V_{DRM}$ 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.

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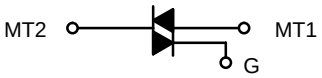
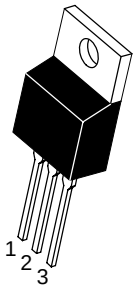
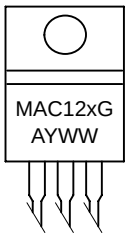
**TRIACS**
**12 AMPERES RMS**
**400 thru 800 VOLTS**




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

**MARKING DIAGRAM**




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 |
|---|---|---|
| MAC12D | TO−220AB | 50 Units / Rail |
| MAC12DG | TO−220AB (Pb−Free) | 50 Units / Rail |
| MAC12M | TO−220AB | 50 Units / Rail |
| MAC12MG | TO−220AB (Pb−Free) | 50 Units / Rail |
| MAC12N | TO−220AB | 50 Units / Rail |
| MAC12NG | TO−220AB (Pb−Free) | 50 Units / Rail |

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

## 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 |

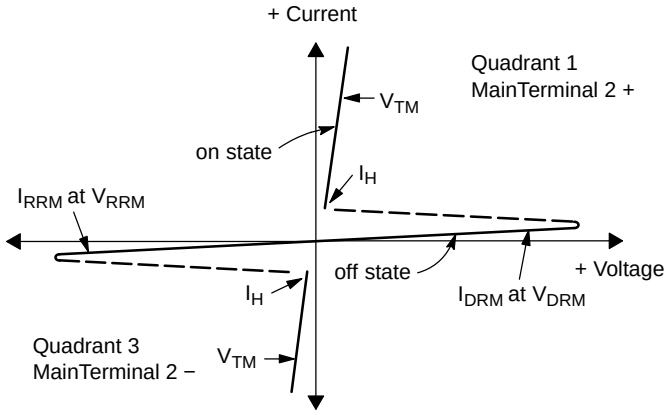
## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°C unless otherwise noted; Electricals apply in both directions)

| 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>$T_J$ = 125°C | $I_{DRM}$,<br>$I_{RRM}$ | −<br>− | −<br>− | 0.01<br>2.0 | mA |
| **ON CHARACTERISTICS** | | | | | | |
| Peak On−State Voltage (Note 2) ($I_{TM}$ = ±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>5.0<br>5.0<br>5.0 | <br>13<br>13<br>13 | <br>35<br>35<br>35 | mA |
| Hold Current ($V_D$ = 12 V, Gate Open, Initiating Current = ±150 mA) | | $I_H$ | − | 20 | 40 | mA |
| Latch Current ($V_D$ = 24 V, $I_G$ = 35 mA)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | | $I_L$ | <br>−<br>−<br>− | <br>20<br>30<br>20 | <br>50<br>80<br>50 | mA |
| Gate Trigger Voltage (Continuous dc) ($V_D$ = 12 V, $R_L$ = 100 Ω)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | | $V_{GT}$ | <br>0.5<br>0.5<br>0.5 | <br>0.78<br>0.70<br>0.71 | <br>1.5<br>1.5<br>1.5 | V |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Rate of Change of Commutating Current<br>($V_D$ = 400 V, ITM = 4.4A, Commutating dv/dt = 18 V/μs, Gate Open,<br>$T_J$ = 125°C, f = 250 Hz, No Snubber) | | (di/dt)c | 6.5 | − | − | A/ms |
| Critical Rate of Rise of Off−State Voltage<br>($V_D$ = Rated $V_{DRM}$, Exponential Waveform, Gate Open, $T_J$ = 125°C) | | dv/dt | 250 | 500 | − | V/μs |
| Repetitive Critical Rate of Rise of On-State Current<br>IPK = 50 A; PW = 40 μsec; diG/dt = 200 mA/μsec; f = 60 Hz | | di/dt | − | − | 10 | A/μs |

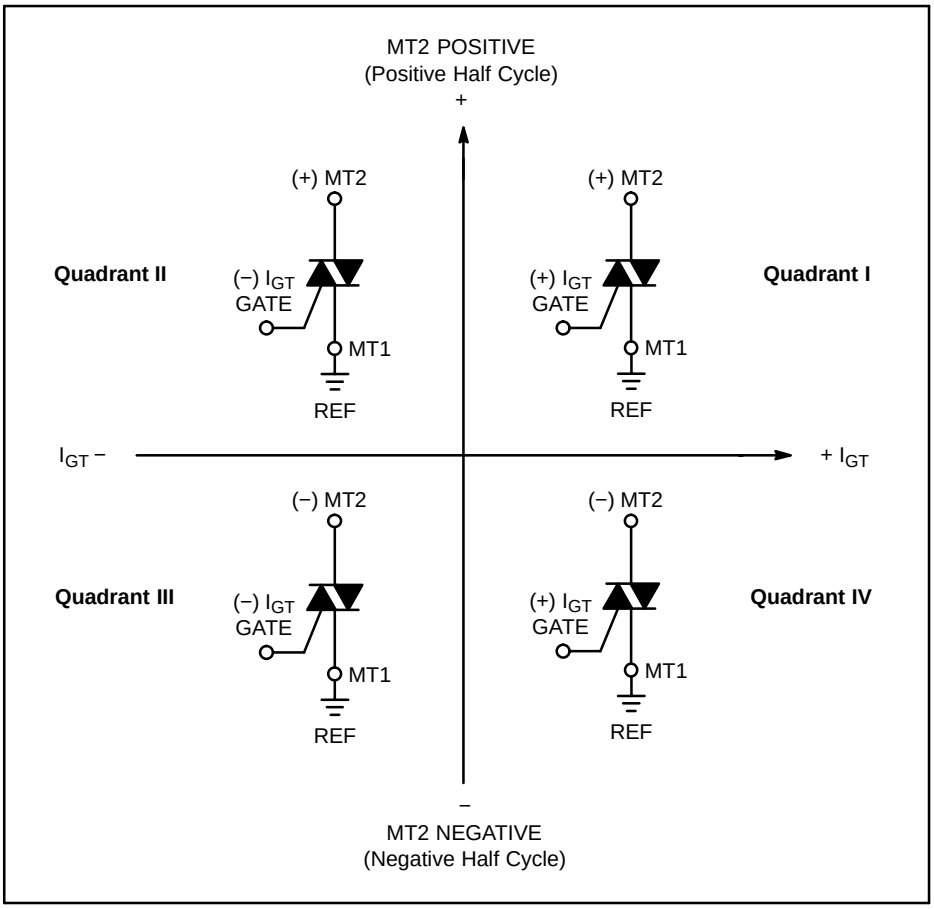
2. Pulse Test: Pulse Width ≤ 2.0 ms, Duty Cycle ≤ 2%.

## 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.

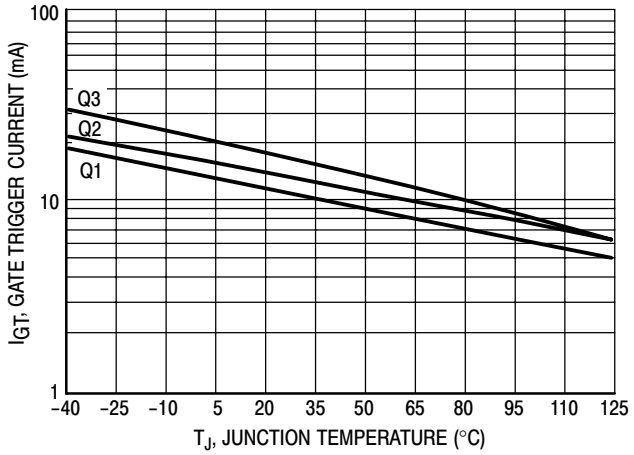



**Figure 1. Typical Gate Trigger Current versus Junction Temperature**

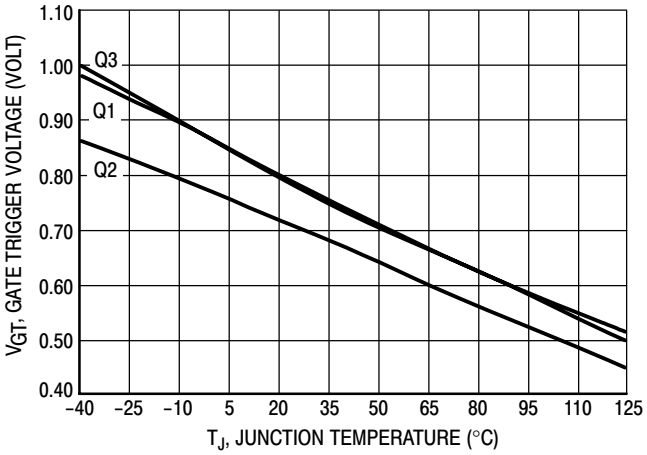



**Figure 2. Typical Gate Trigger Voltage versus Junction Temperature**

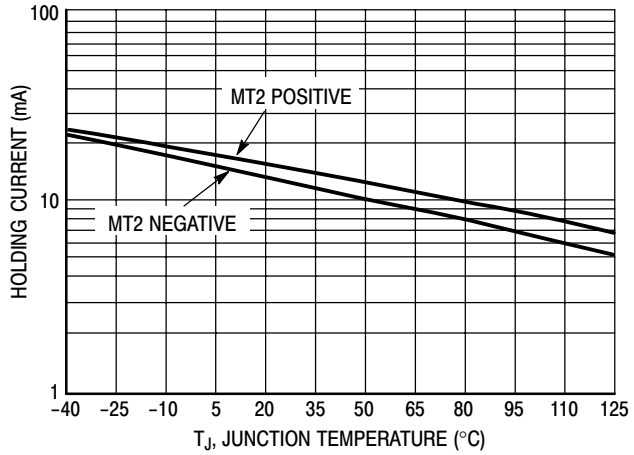



**Figure 3. Typical Holding Current versus Junction Temperature**

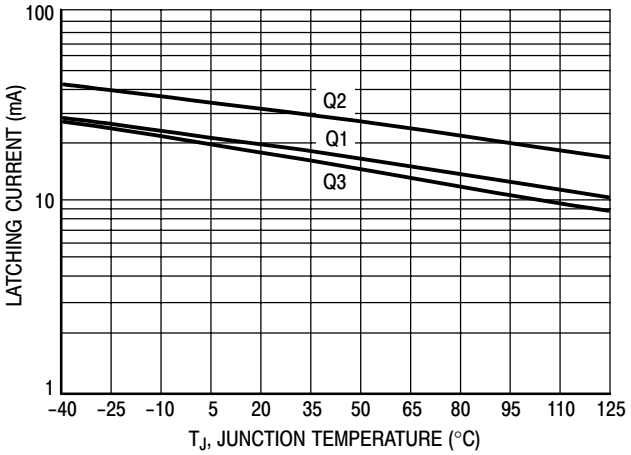



**Figure 4. Typical Latching Current versus Junction Temperature**

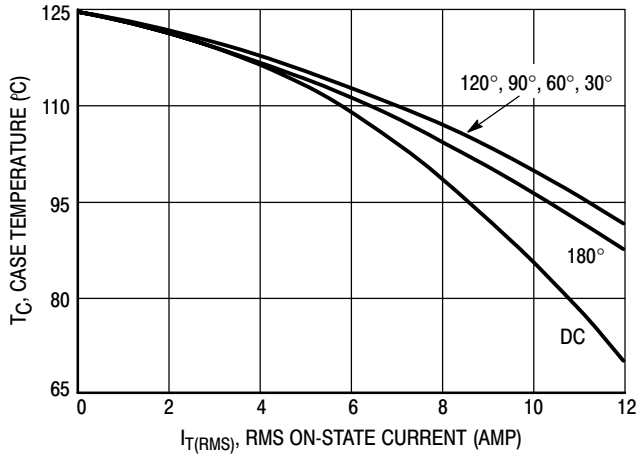



**Figure 5. Typical RMS Current Derating**

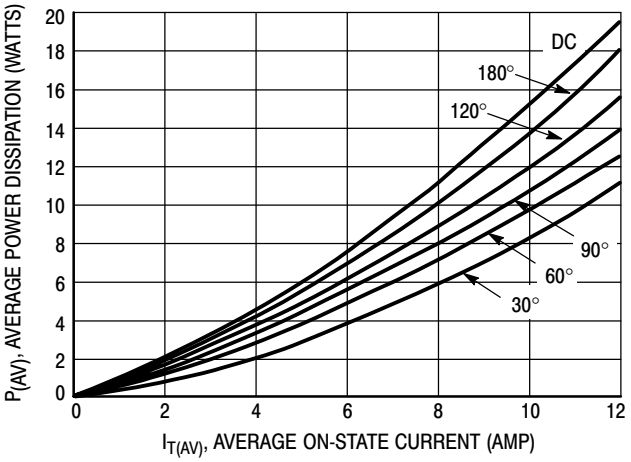



**Figure 6. On-State Power Dissipation**

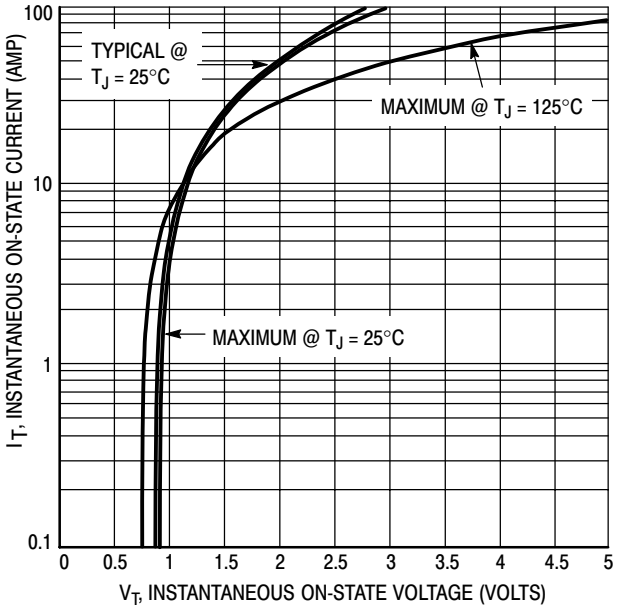



**Figure 7. Typical On-State Characteristics**

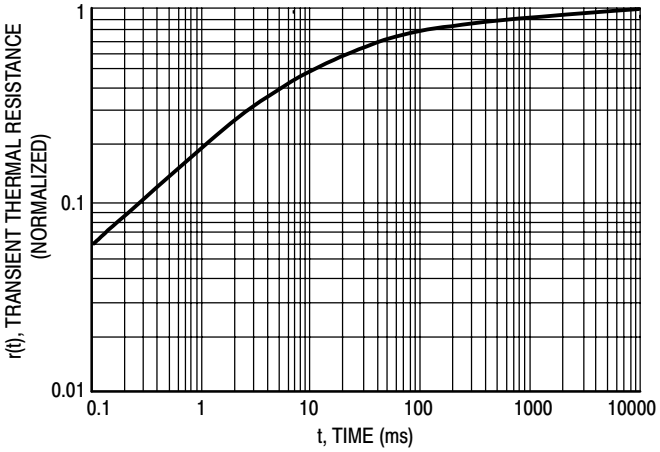
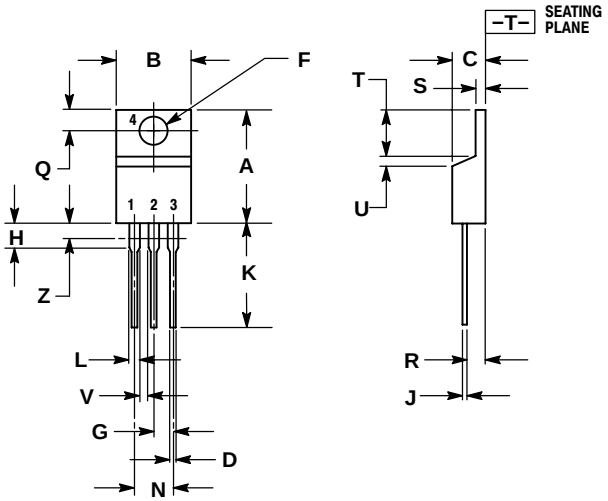



**Figure 8. Typical Thermal Response**

## PACKAGE DIMENSIONS

**TO−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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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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