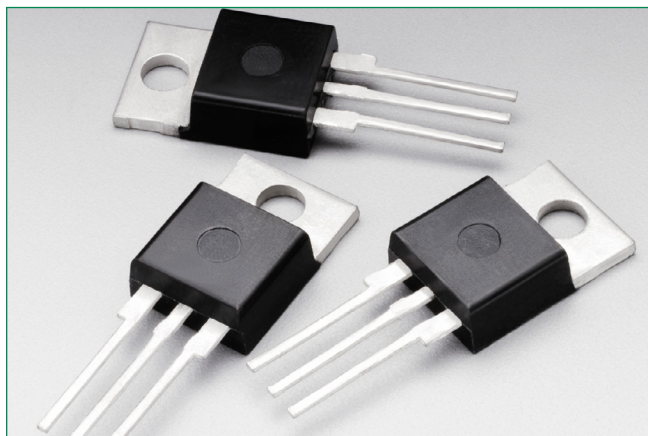


# MAC12HCDG, MAC12HCMG, MAC12HCNG

## Surface Mount – 400V - 800V



### Additional Information



Resources

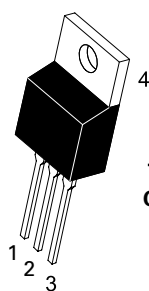


Accessories

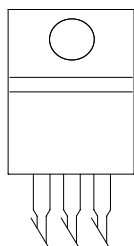


Samples

### Pin Out



TO-220AB  
CASE 221A  
STYLE 4



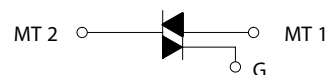
### Description

Designed primarily for full-wave ac control applications, such as motor controls, heating controls or dimmers; or wherever fullwave, silicon gate–controlled devices are needed.

### Features

- Uniform Gate Trigger Currents in Three Quadrants, Q1, Q2, and Q3
- High Commutating di/dt and High Immunity to dv/dt @ 125°C
- Minimizes Snubber Networks for Protection
- Blocking Voltage to 800 Volts
- On-State Current Rating of 12 Amperes RMS at 80°C
- High Surge Current Capability – 100 Amperes
- Industry Standard TO-220AB Package for Ease of Design
- Glass Passivated Junctions for Reliability and Uniformity
- These Devices are Pb–Free and are RoHS Compliant

### Functional Diagram



# MAC12HCDG, MAC12HCMG, MAC12HCNG

## Surface Mount – 400V - 800V

### Maximum Ratings (T<sub>J</sub> = 25°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 <sub>J</sub> = 40° to 125°C) | $V_{DRM}$<br>$V_{RRM}$ | 400<br>600<br>800 | V                  |
| On-State RMS Current (Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 80°C)                                       | $I_{T(RMS)}$           | 12                | A                  |
| Peak Non-Repetitive Surge Current<br>(One Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 125°C)                  | $I_{TSM}$              | 100               | A                  |
| Circuit Fusing Consideration (t = 8.3 ms)                                                                       | $I^2t$                 | 41                | A <sup>2</sup> sec |
| Peak Gate Power (Pulse Width ≤ 1.0 μs, T <sub>C</sub> = 80°C)                                                   | $P_{GM}$               | 16                | W                  |
| Average Gate Power (t = 8.3 ms, T <sub>C</sub> = 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                 |

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.  $V_{DRM}$  and  $V_{RRM}$  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)<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 - OFF (T<sub>J</sub> = 25°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) | $I_{DRM}$<br>$I_{RRM}$ | -   | -   | 0.01 | mA   |
|                                                                              |                        | -   | -   | 2.0  |      |

### Electrical Characteristics - ON (T<sub>J</sub> = 25°C unless otherwise noted; Electricals apply in both directions)

| Characteristic                                                            | Symbol   | Min | Max  | Unit |
|---------------------------------------------------------------------------|----------|-----|------|------|
| Peak On-State Voltage (Note 2) ( $I_{TM} = \pm 17$ A)                     | $V_{TM}$ | –   | 1.85 | V    |
| Gate Trigger Current<br>(Continuous dc)<br>( $V_D = 12$ V, $R_L = 100$ Ω) | $I_{GT}$ | 10  | 50   | mA   |
|                                                                           |          | 10  | 50   |      |
|                                                                           |          | 10  | 50   |      |
| Holding Current ( $V_D = 12$ V, Gate Open, Initiating Current = ±150 mA)  | $I_H$    | –   | 60   | mA   |
| Latching Current<br>( $V_D = 12$ V, $I_G = 50$ mA)                        | $I_L$    | –   | 60   | mA   |
|                                                                           |          | –   | 80   |      |
|                                                                           |          | –   | 60   |      |
| Gate Trigger Voltage<br>( $V_D = 12$ V, $R_L = 100$ Ω)                    | $V_{GT}$ | 0.5 | 1.5  | V    |
|                                                                           |          | 0.5 | 1.5  |      |
|                                                                           |          | 0.5 | 1.5  |      |

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 ≤ 2.0 ms, Duty Cycle ≤ 2%.

# MAC12HCDG, MAC12HCMG, MAC12HCNG

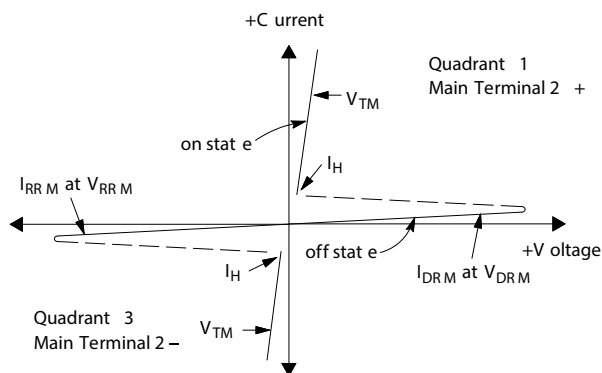
Surface Mount – 400V - 800V

## Dynamic Characteristics

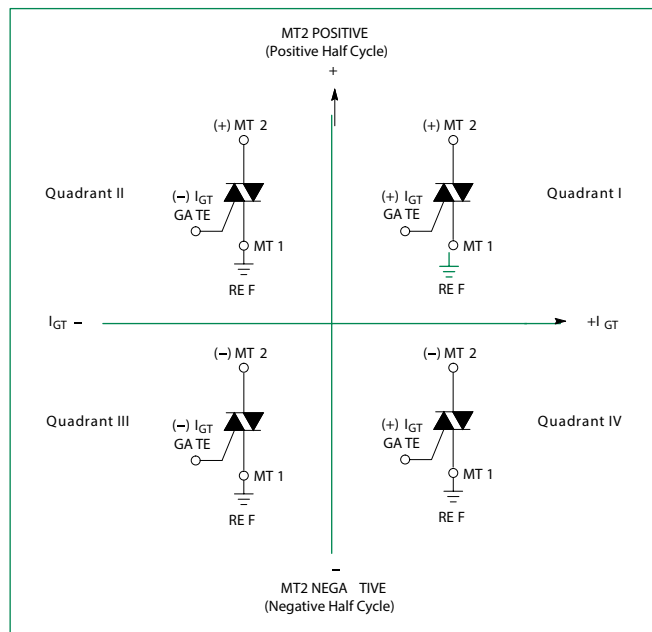
| Characteristic                                                                                                                                                                                                                                                                           | Symbol      | Min | 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, $T_J = 125^\circ\text{C}$ , $f = 250\text{ Hz}$ , with Snubber) $C_L = 10\text{ }\mu\text{F}$ $L_L = 40\text{ mH}$ | $(di/dt)_c$ | 15  | –   | –   | A/ms             |
| Critical Rate of Rise of Off-State Voltage<br>( $V_D = \text{Rated } V_{DRM}$ , Exponential Waveform, $R_{GK} = 510\text{ }\Omega$ , $T_J = 125^\circ\text{C}$ )                                                                                                                         | $dV/dt$     | 600 | –   | –   | V/ $\mu\text{s}$ |
| Repetitive Critical Rate of Rise of On-State Current<br>IPK = 50 A; PW = 40 $\mu\text{sec}$ ; $diG/dt = 200\text{ mA}/\mu\text{sec}$ ; $f = 60\text{ Hz}$                                                                                                                                | $di/dt$     | –   | –   | 10  | A/ $\mu\text{s}$ |

## 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



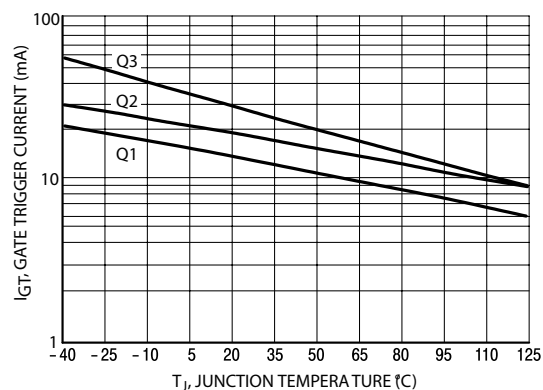
All polarities are referenced to MT1.

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

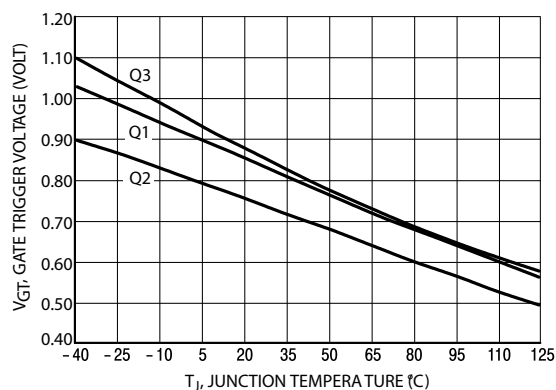
# MAC12HCDG, MAC12HCMG, MAC12HCNG

## Surface Mount – 400V - 800V

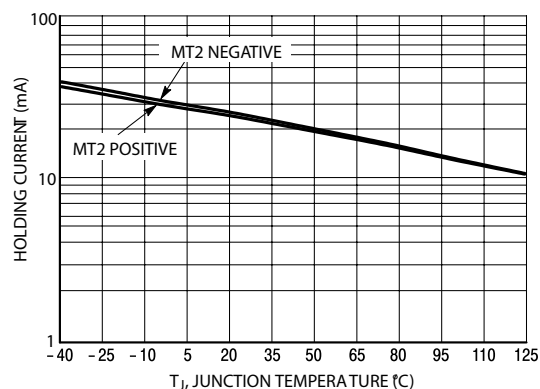
**Figure 1. Typical Gate Trigger Current vs Junction Temperature**



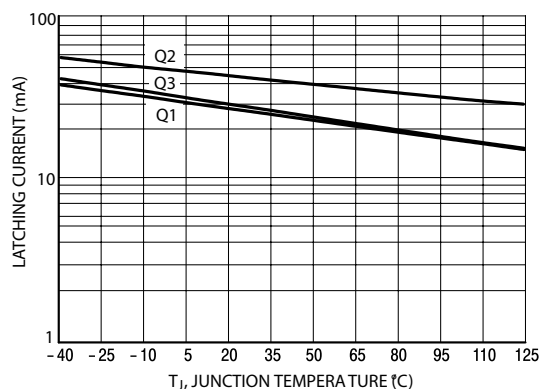
**Figure 2. Typical Gate Trigger Voltage vs Junction Temperature**



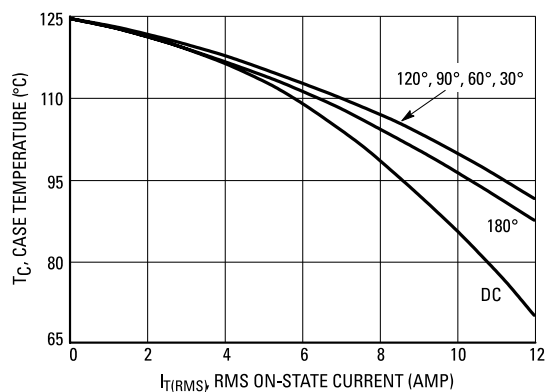
**Figure 3. Typical Holding Current vs Junction Temperature**



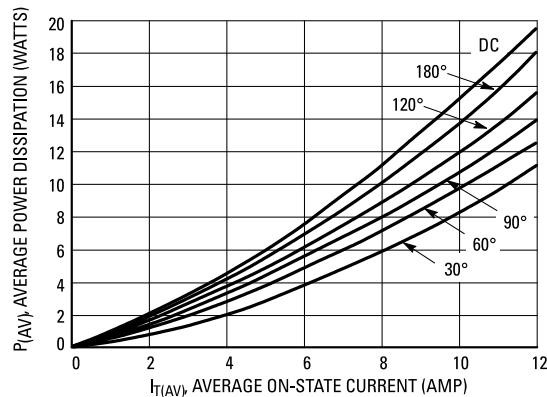
**Figure 4. Typical Latching Current vs Junction Temperature**



**Figure 5. Typical RMS Current Derating**



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



# MAC12HCDG, MAC12HCMG, MAC12HCNG

Surface Mount – 400V - 800V

Figure 7. Typical On-State Characteristics

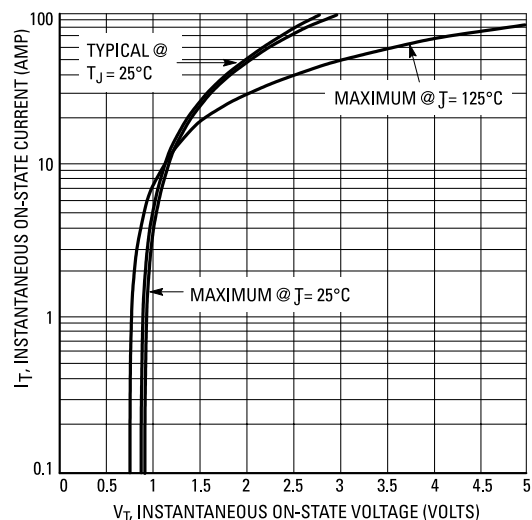
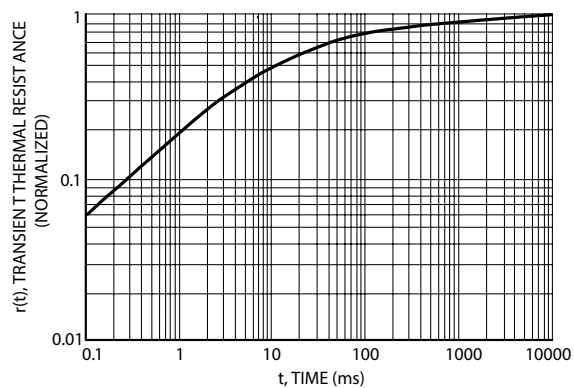


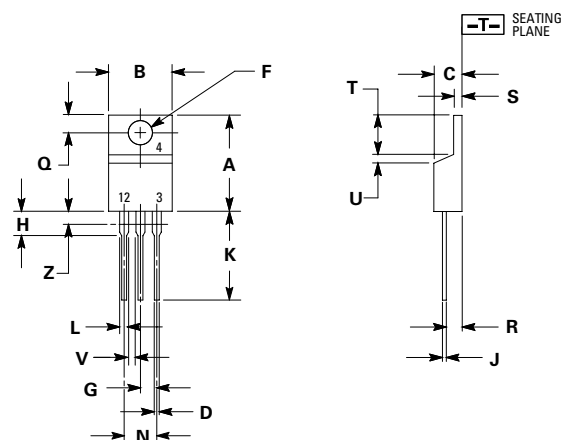
Figure 8. Typical Thermal Response



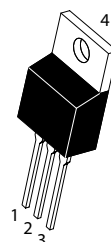
# MAC12HCDG, MAC12HCMG, MAC12HCNG

Surface Mount – 400V - 800V

## Dimensions

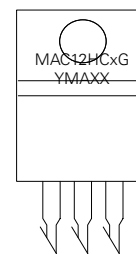


## Part Marking System



TO-220AB  
CASE 221A  
STYLE 12

x = D, M, or N  
Y = Year  
M = Month  
A = Assembly Site  
XX = Lot Serial Code  
G = Pb-Free Package



| Dim | Inches |       | Millimeters |       |
|-----|--------|-------|-------------|-------|
|     | Min    | Max   | Min         | Max   |
| A   | 0.590  | 0.620 | 14.99       | 15.75 |
| B   | 0.380  | 0.420 | 9.65        | 10.67 |
| C   | 0.178  | 0.188 | 4.52        | 4.78  |
| D   | 0.025  | 0.035 | 0.64        | 0.89  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.41        | 2.67  |
| H   | 0.110  | 0.130 | 2.79        | 3.30  |
| J   | 0.018  | 0.024 | 0.46        | 0.61  |
| K   | 0.540  | 0.575 | 13.72       | 14.61 |
| L   | 0.060  | 0.075 | 1.52        | 1.91  |
| N   | 0.195  | 0.205 | 4.95        | 5.21  |
| Q   | 0.105  | 0.115 | 2.67        | 2.92  |
| R   | 0.085  | 0.095 | 2.16        | 2.41  |
| S   | 0.045  | 0.060 | 1.14        | 1.52  |
| 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.

| Pin Assignment |                 |
|----------------|-----------------|
| 1              | Main Terminal 1 |
| 2              | Main Terminal 2 |
| 3              | Gate            |
| 4              | No Connection   |

## Ordering Information

| Device    | Package               | Shipping         |
|-----------|-----------------------|------------------|
| MAC12HCDG | TO-220AB<br>(Pb-Free) | 1000 Units / Box |
| MAC12HCMG |                       |                  |
| MAC12HCNG |                       |                  |

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