# MAC8SD, MAC8SM, MAC8SN

**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.

### Features

- Sensitive Gate Allows Triggering by Microcontrollers and other Logic Circuits
- Uniform Gate Trigger Currents in Three Quadrants; Q1, Q2, and Q3
- High Immunity to dv/dt − 25 V/μs Minimum at 110°C
- High Commutating di/dt − 8.0 A/ms Minimum at 110°C
- Maximum Values of $I_{GT}$, $V_{GT}$ and $I_H$ Specified for Ease of Design
- On-State Current Rating of 8 Amperes RMS at 70°C
- High Surge Current Capability − 70 Amperes
- Blocking Voltage to 800 Volts
- Rugged, Economical TO−220AB Package
- 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 110°C, Sine Wave, 50 to 60 Hz, Gate Open) MAC8SD MAC8SM MAC8SN | $V_{DRM}$, $V_{RRM}$ | 400 600 800 | V |
| On-State RMS Current (Full Cycle Sine Wave, 60 Hz, $T_C$ = 70°C) | $I_{T(RMS)}$ | 8.0 | A |
| Peak Non-Repetitive Surge Current (One Full Cycle Sine Wave, 60 Hz, $T_J$ = 110°C) | $I_{TSM}$ | 70 | A |
| Circuit Fusing Consideration (t = 8.3 ms) | $I^2t$ | 20 | $A^2$sec |
| Peak Gate Power (Pulse Width ≤ 1.0 μs, $T_C$ = 70°C) | $P_{GM}$ | 16 | W |
| Average Gate Power (t = 8.3 ms, $T_C$ = 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 |

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.

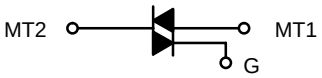
1. $V_{DRM}$ and $V_{RRM}$ for all types can be applied on a continuous basis. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

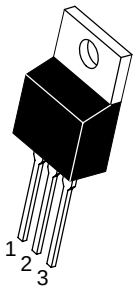
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**ON Semiconductor®**

**http://onsemi.com**

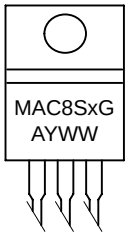
**TRIACS**
**8 AMPERES RMS**
**400 thru 800 VOLTS**




**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 |
|---|---|---|
| MAC8SD | TO−220AB | 50 Units / Rail |
| MAC8SDG | TO−220AB (Pb−Free) | 50 Units / Rail |
| MAC8SM | TO−220AB | 50 Units / Rail |
| MAC8SMG | TO−220AB (Pb−Free) | 50 Units / Rail |
| MAC8SN | TO−220AB | 50 Units / Rail |
| MAC8SNG | 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 |

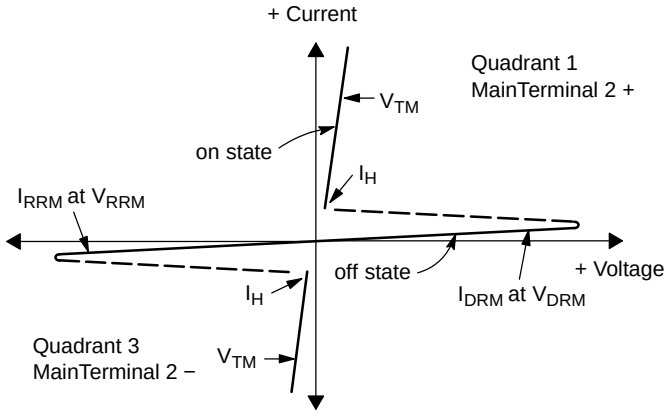
## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°C unless otherwise noted; Electricals apply in both directions)

| 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>$T_J$ = 110°C | $I_{DRM}$, $I_{RRM}$ | −<br>− | −<br>− | 0.01<br>2.0 | mA |
| **ON CHARACTERISTICS** | | | | | | |
| Peak On-State Voltage (Note ) ($I_{TM}$ = ±11A) | | $V_{TM}$ | − | − | 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>−<br>− | <br>2.0<br>3.0<br>3.0 | <br>5.0<br>5.0<br>5.0 | mA |
| Holding Current ($V_D$ = 12V, Gate Open, Initiating Current = ±150mA) | | $I_H$ | − | 3.0 | 10 | mA |
| Latching Current ($V_D$ = 24V, $I_G$ = 5mA)<br>MT2(+), G(+)<br>MT2(−), G(−)<br>MT2(+), G(−) | | $I_L$ | <br>−<br>−<br>− | <br>5.0<br>10<br>5.0 | <br>15<br>20<br>15 | mA |
| Gate Trigger Voltage (Continuous dc) ($V_D$ = 12 V, $R_L$ = 100Ω)<br>MT2(+), G(+)<br>MT2(+), G(−)<br>MT2(−), G(−) | | $V_{GT}$ | <br>0.45<br>0.45<br>0.45 | <br>0.62<br>0.60<br>0.65 | <br>1.5<br>1.5<br>1.5 | V |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Rate of Change of Commutating Current<br>$V_D$ = 400 V, $I_{TM}$ = 3.5 A, Commutating dv/dt = 10 V μ/sec,<br>Gate Open, $T_J$ = 110°C, f = 500 Hz, Snubber: $C_S$ = 0.01 μF,<br>$R_S$ =15 Ω, See Figure 16.) | | $di/dt_{(c)}$ | 8.0 | 10 | − | A/ms |
| Critical Rate of Rise of Off-State Voltage<br>($V_D$ = Rate $V_{DRM}$, Exponential Waveform, $R_{GK}$ = 510 Ω, $T_J$ = 110°C) | | dv/dt | 25 | 75 | − | V/μs |

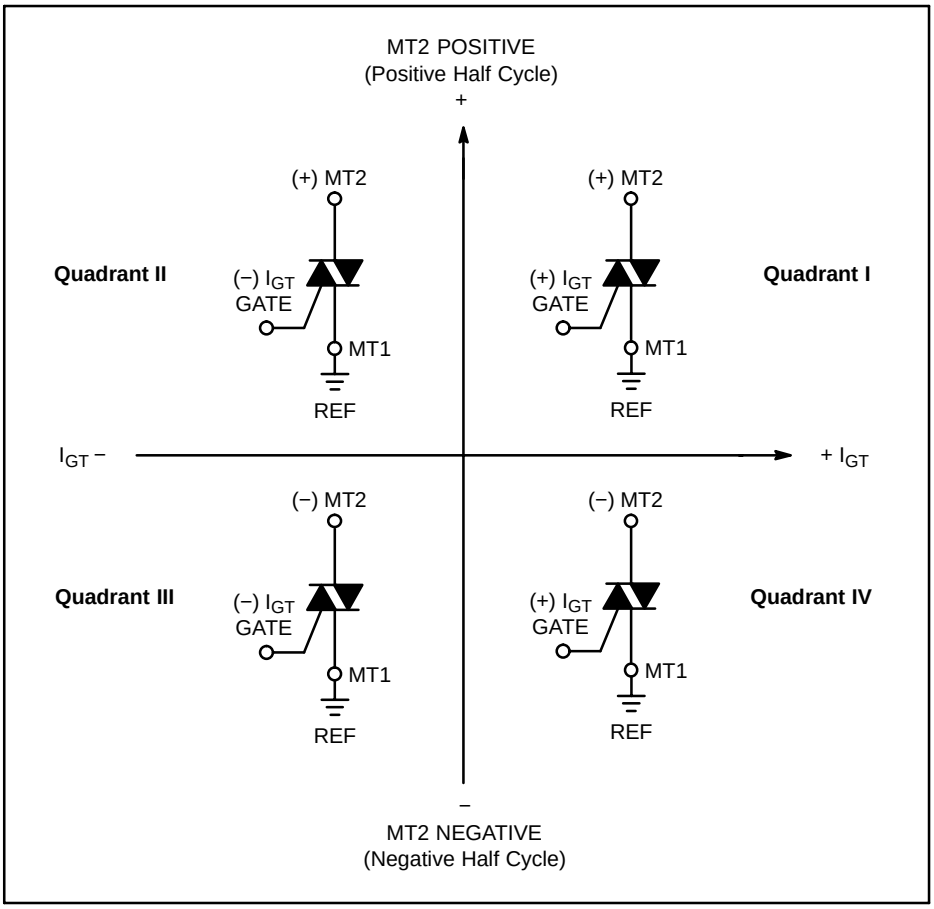
2. Indicates Pulse Test: Pulse Width ≤ 2.0 ms, Duty Cycle ≤ 2%.

## 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.

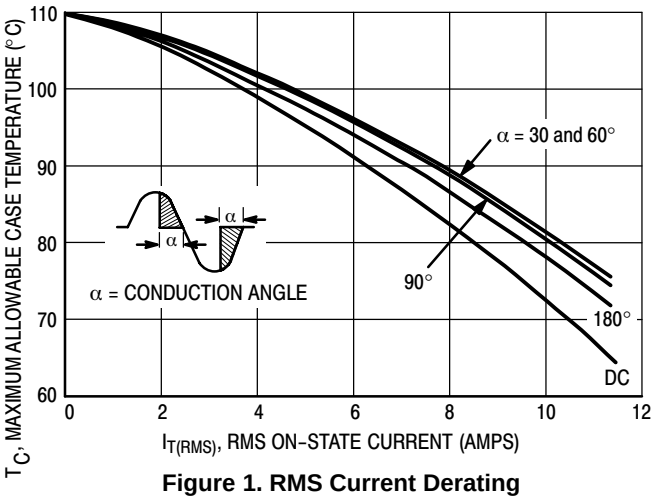



**Figure 1. RMS Current Derating**

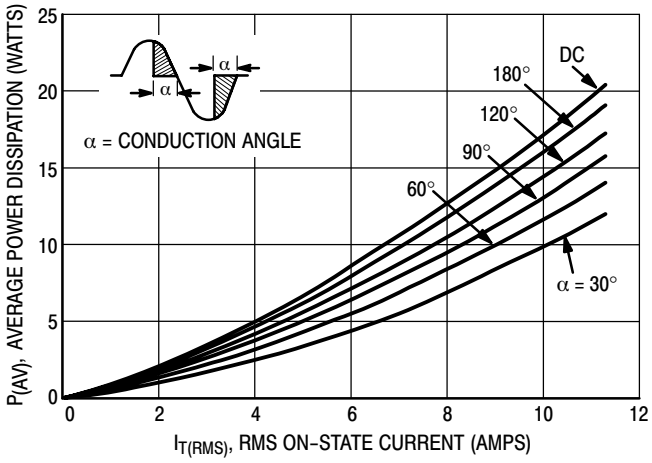



**Figure 2. Maximum On−State Power Dissipation**

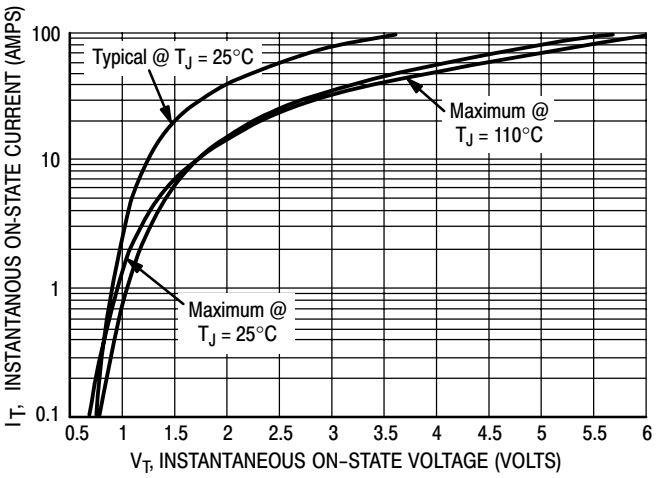



**Figure 3. On−State Characteristics**

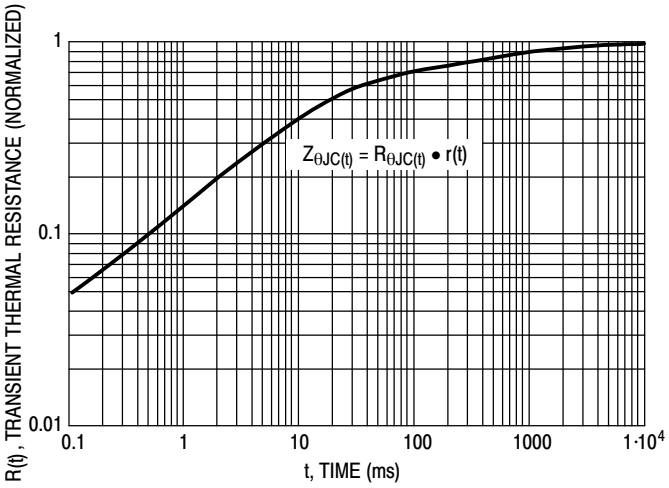



**Figure 4. Transient Thermal Response**

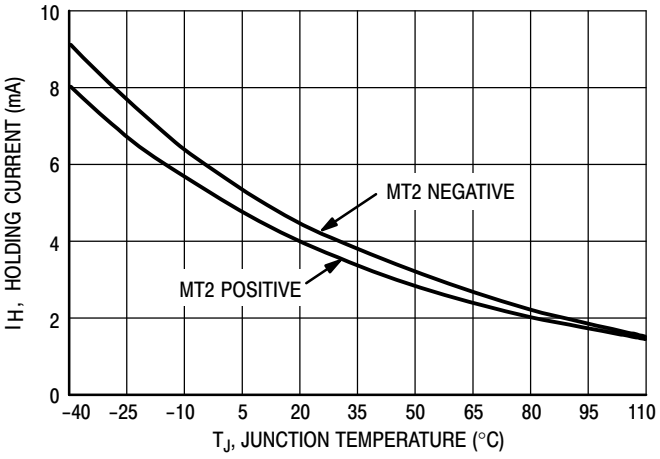



**Figure 5. Typical Holding Current Versus Junction Temperature**

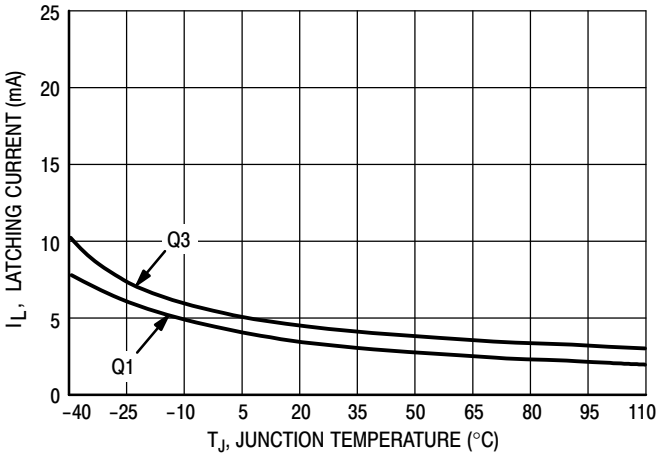



**Figure 6. Typical Latching Current Versus Junction Temperature**

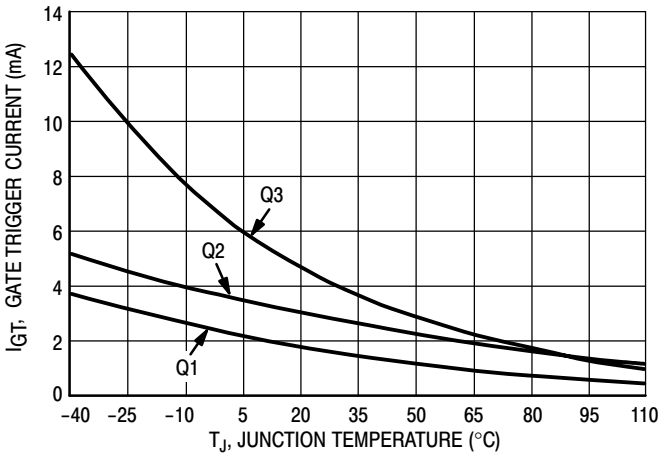



**Figure 7. Typical Gate Trigger Current Versus Junction Temperature**

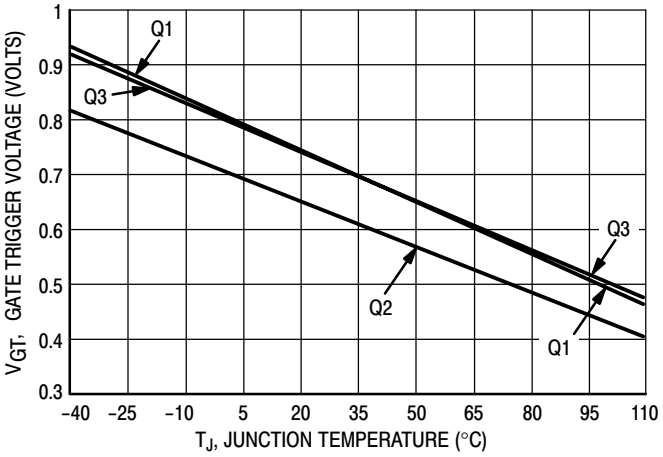



**Figure 8. Typical Gate Trigger Voltage Versus Junction Temperature**

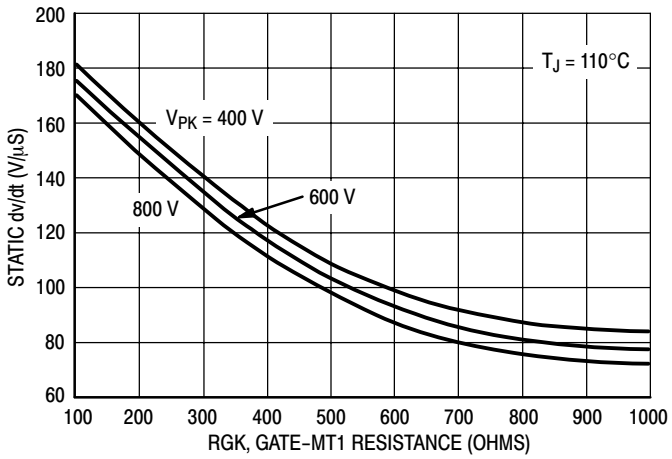



**Figure 9. Typical Exponential Static dv/dt Versus Gate−MT1 Resistance, MT2(+)**

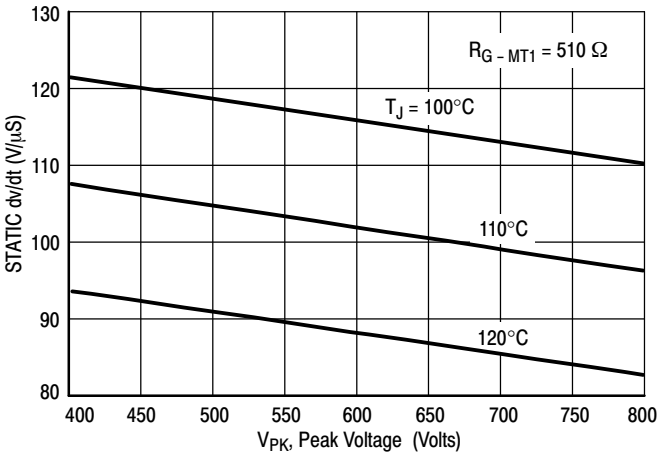



**Figure 10. Typical Exponential Static dv/dt Versus Peak Voltage, MT2(+)**

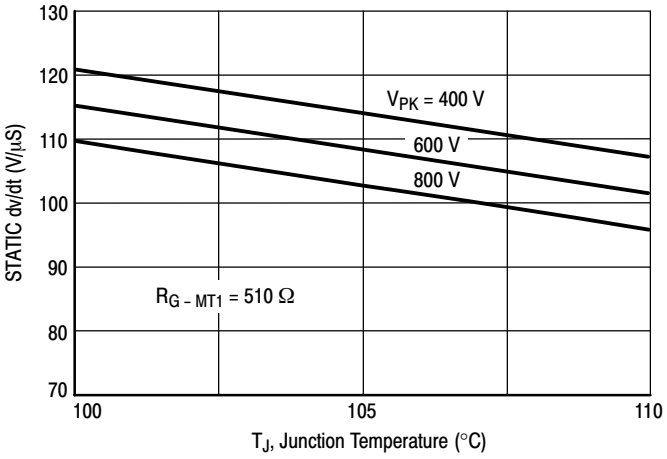



**Figure 11. Typical Exponential Static dv/dt Versus Junction Temperature, MT2(+)**

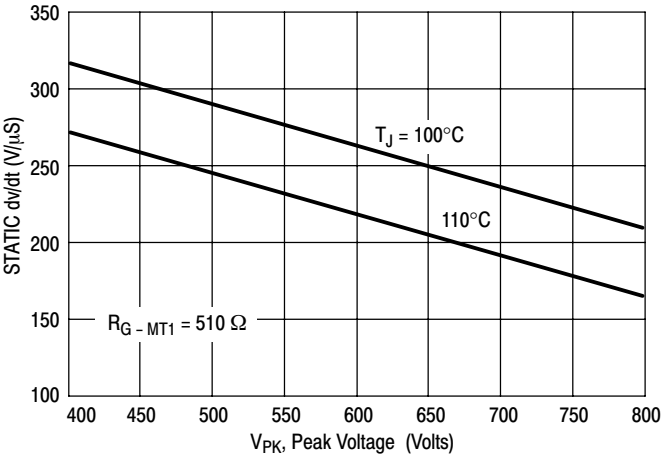



**Figure 12. Typical Exponential Static dv/dt Versus Peak Voltage, MT2(−)**

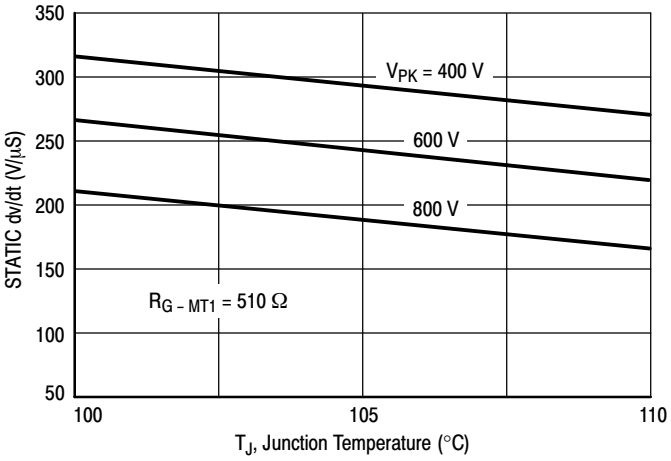



**Figure 13. Typical Exponential Static dv/dt Versus Junction Temperature, MT2(−)**

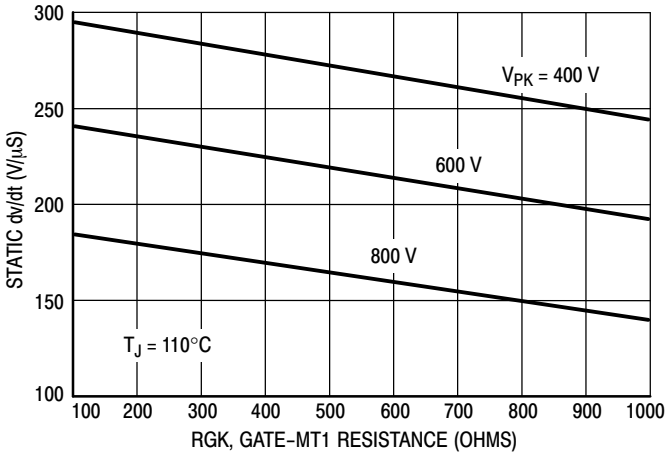



**Figure 14. Typical Exponential Static dv/dt Versus Gate−MT1 Resistance, MT2(−)**

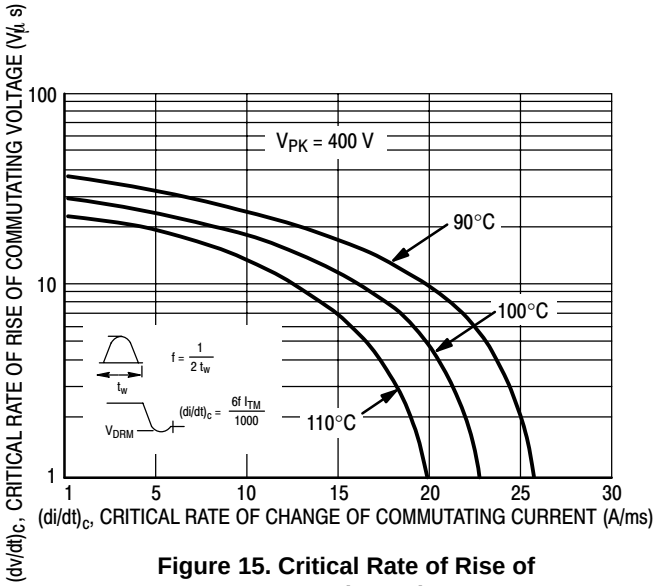
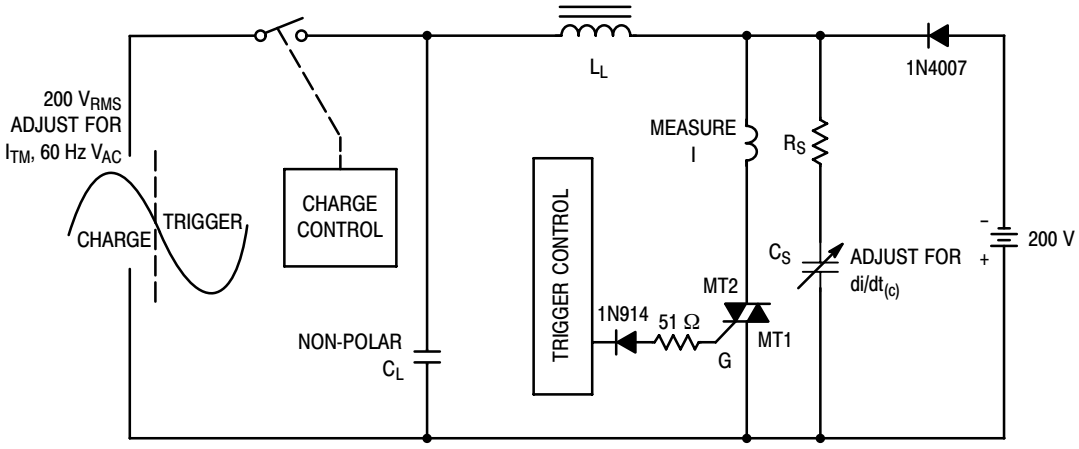



**Figure 15. Critical Rate of Rise of Commutating Voltage**

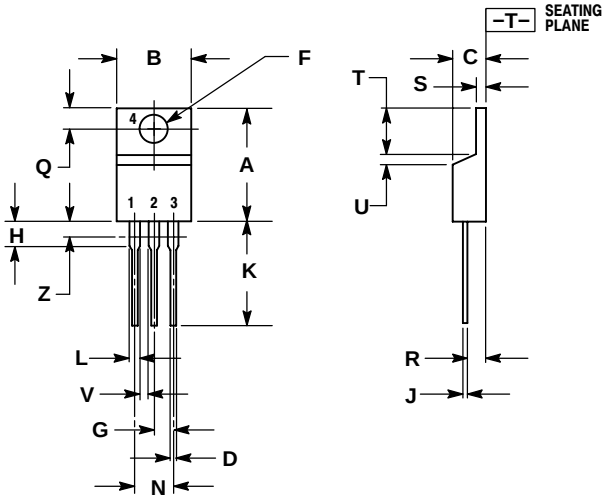



Note: Component values are for verification of rated $(di/dt)_c$. See AN1048 for additional information.

**Figure 16. Simplified Test Circuit to Measure the Critical Rate of Rise of Commutating Current $(di/dt)_c$**

## 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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