

# MAC4DLM

Preferred Device

## Sensitive Gate Triacs

### Silicon Bidirectional Thyristors

Designed for high volume, low cost, industrial and consumer applications such as motor control; process control; temperature, light and speed control.

#### Features

- Small Size Surface Mount DPAK Package
- Passivated Die for Reliability and Uniformity
- Four-Quadrant Triggering
- Blocking Voltage to 600 V
- On-State Current Rating of 4.0 Amperes RMS at 93°C
- Low Level Triggering and Holding Characteristics
- Epoxy Meets UL 94 V-0 @ 0.125 in
- ESD Ratings: Human Body Model, 3B > 8000 V  
Machine Model, C > 400 V
- Pb-Free Packages are Available

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

| Rating                                                                                                              | Symbol                                 | Value      | Unit               |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------|--------------------|
| Peak Repetitive Off-State Voltage (Note 1)<br>(T <sub>J</sub> = -40 to 110°C, Sine Wave,<br>50 to 60 Hz, Gate Open) | V <sub>DRM</sub> ,<br>V <sub>RPM</sub> | 600        | V                  |
| On-State RMS Current<br>(Full Cycle Sine Wave, 60 Hz, T <sub>C</sub> = 93°C)                                        | I <sub>T(RMS)</sub>                    | 4.0        | A                  |
| Peak Non-Repetitive Surge Current<br>(One Full Cycle, 60 Hz, T <sub>J</sub> = 110°C)                                | I <sub>TSM</sub>                       | 40         | A                  |
| Circuit Fusing Consideration (t = 8.3 msec)                                                                         | I <sup>2</sup> t                       | 6.6        | A <sup>2</sup> sec |
| Peak Gate Power<br>(Pulse Width ≤ 10 μsec, T <sub>C</sub> = 93°C)                                                   | P <sub>GM</sub>                        | 0.5        | W                  |
| Average Gate Power<br>(t = 8.3 msec, T <sub>C</sub> = 93°C)                                                         | P <sub>G(AV)</sub>                     | 0.1        | W                  |
| Peak Gate Current<br>(Pulse Width ≤ 10 μsec, T <sub>C</sub> = 93°C)                                                 | I <sub>GM</sub>                        | 0.2        | A                  |
| Peak Gate Voltage<br>(Pulse Width ≤ 10 μsec, T <sub>C</sub> = 93°C)                                                 | V <sub>GM</sub>                        | 5.0        | V                  |
| Operating Junction Temperature Range                                                                                | T <sub>J</sub>                         | -40 to 110 | °C                 |
| Storage Temperature Range                                                                                           | T <sub>stg</sub>                       | -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.

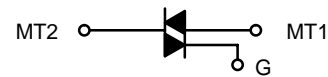
1. V<sub>DRM</sub> and V<sub>RPM</sub> for all types can be applied on a continuous basis. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the device are exceeded.



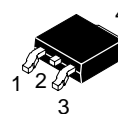
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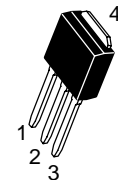
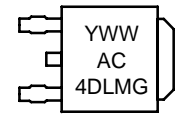
### TRIACS 4.0 AMPERES RMS 600 – 800 VOLTS



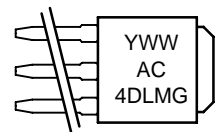
#### MARKING DIAGRAMS



DPAK  
CASE 369C  
STYLE 6



DPAK-3  
CASE 369D  
STYLE 6



Y = Year  
WW = Work Week  
AC4DLM = Device Code  
G = Pb-Free Package

#### PIN ASSIGNMENT

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

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

# MAC4DLM

## THERMAL CHARACTERISTICS

| Characteristic                                                                                      | Symbol                                                | Max             | Unit |
|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------|------|
| Thermal Resistance<br>– Junction-to-Case<br>– Junction-to-Ambient<br>– Junction-to-Ambient (Note 2) | $R_{\theta JC}$<br>$R_{\theta JA}$<br>$R_{\theta JA}$ | 3.5<br>88<br>80 | °C/W |
| Maximum Lead Temperature for Soldering Purposes (Note 3)                                            | $T_L$                                                 | 260             | °C   |

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ 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) | $I_{DRM}$ ,<br>$I_{RRM}$ | – | – | 0.01 | mA |
|                                                                                              |                          | – | – | 2.0  |    |

## ON CHARACTERISTICS

|                                                                                                                                                                                                                                                                                         |          |                          |                              |                          |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------------|------------------------------|--------------------------|----|
| Peak On-State Voltage (Note 4) – ( $I_{TM} = \pm 6.0 \text{ A}$ )                                                                                                                                                                                                                       | $V_{TM}$ | –                        | 1.3                          | 1.6                      | V  |
| Gate Trigger Current (Continuous dc) ( $V_D = 12 \text{ V}$ , $R_L = 100 \Omega$ )<br>MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)<br>MT2(–), G(+)                                                                                                                                      | $I_{GT}$ | –                        | 1.8<br>2.1<br>2.4<br>4.2     | 3.0<br>3.0<br>3.0<br>5.0 | mA |
| Gate Trigger Voltage (Continuous dc) ( $V_D = 12 \text{ V}$ , $R_L = 100 \Omega$ )<br>MT2(+), G(+)<br>MT2(+), G(–)<br>MT2(–), G(–)<br>MT2(–), G(+)                                                                                                                                      | $V_{GT}$ | 0.5<br>0.5<br>0.5<br>0.5 | 0.62<br>0.57<br>0.65<br>0.74 | 1.3<br>1.3<br>1.3<br>1.3 | V  |
| Gate Non-Trigger Voltage<br>( $V_D = 12 \text{ V}$ , $R_L = 100 \Omega$ , $T_J = 110^\circ\text{C}$ )<br>MT2(+), G(+); MT2(+), G(–); MT2(–), G(–); MT2(–), G(+)                                                                                                                         | $V_{GD}$ | 0.1                      | 0.4                          | –                        | V  |
| Holding Current<br>( $V_D = 12 \text{ V}$ , Gate Open, Initiating Current = $\pm 200 \text{ mA}$ )                                                                                                                                                                                      | $I_H$    | –                        | 1.5                          | 15                       | mA |
| Latching Current<br>MT2(+), G(+) ( $V_D = 12 \text{ V}$ , $I_G = 5.0 \text{ mA}$ )<br>MT2(+), G(–) ( $V_D = 12 \text{ V}$ , $I_G = 5.0 \text{ mA}$ )<br>MT2(–), G(–) ( $V_D = 12 \text{ V}$ , $I_G = 5.0 \text{ mA}$ )<br>MT2(–), G(+) ( $V_D = 12 \text{ V}$ , $I_G = 10 \text{ mA}$ ) | $I_L$    | –                        | 1.75<br>5.2<br>2.1<br>2.2    | 10<br>10<br>10<br>10     | mA |

## DYNAMIC CHARACTERISTICS

|                                                                                                                                                                                                                                                                                                                                      |            |    |     |   |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|----|-----|---|------------------|
| Rate of Change of Commutating Current<br>( $V_D = 200 \text{ V}$ , $I_{TM} = 1.8 \text{ A}$ , Commutating $dv/dt = 1.0 \text{ V}/\mu\text{sec}$ ,<br>$T_J = 110^\circ\text{C}$ , $f = 250 \text{ Hz}$ , $CL = 5.0 \mu\text{fd}$ , $LL = 80 \text{ mH}$ , $RS = 56 \Omega$ ,<br>$CS = 0.03 \mu\text{fd}$ ) With snubber see Figure 11 | $di/dt(c)$ | –  | 3.0 | – | 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, $T_J = 110^\circ\text{C}$ )                                                                                                                                                                          | $dv/dt$    | 10 | –   | – | V/ $\mu\text{s}$ |

2. These ratings are applicable when surface mounted on the minimum pad sizes recommended.
3. 1/8" from case for 10 seconds.
4. Pulse Test: Pulse Width  $\leq 2.0 \text{ msec}$ , Duty Cycle  $\leq 2\%$ .

## ORDERING INFORMATION

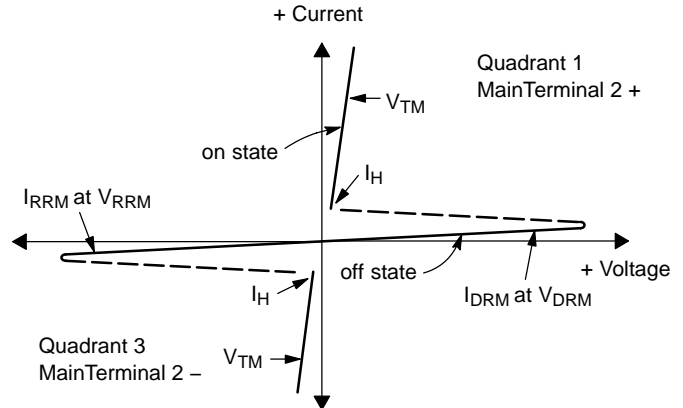
| Device       | Package Type        | Package | Shipping†          |
|--------------|---------------------|---------|--------------------|
| MAC4DLM-001  | DPAK-3              | 369D    | 75 Units / Rail    |
| MAC4DLM-001G | DPAK-3<br>(Pb-Free) | 369D    | 75 Units / Rail    |
| MAC4DLMT4    | DPAK                | 369C    | 2500 / Tape & Reel |
| MAC4DLMT4G   | DPAK<br>(Pb-Free)   | 369C    | 2500 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

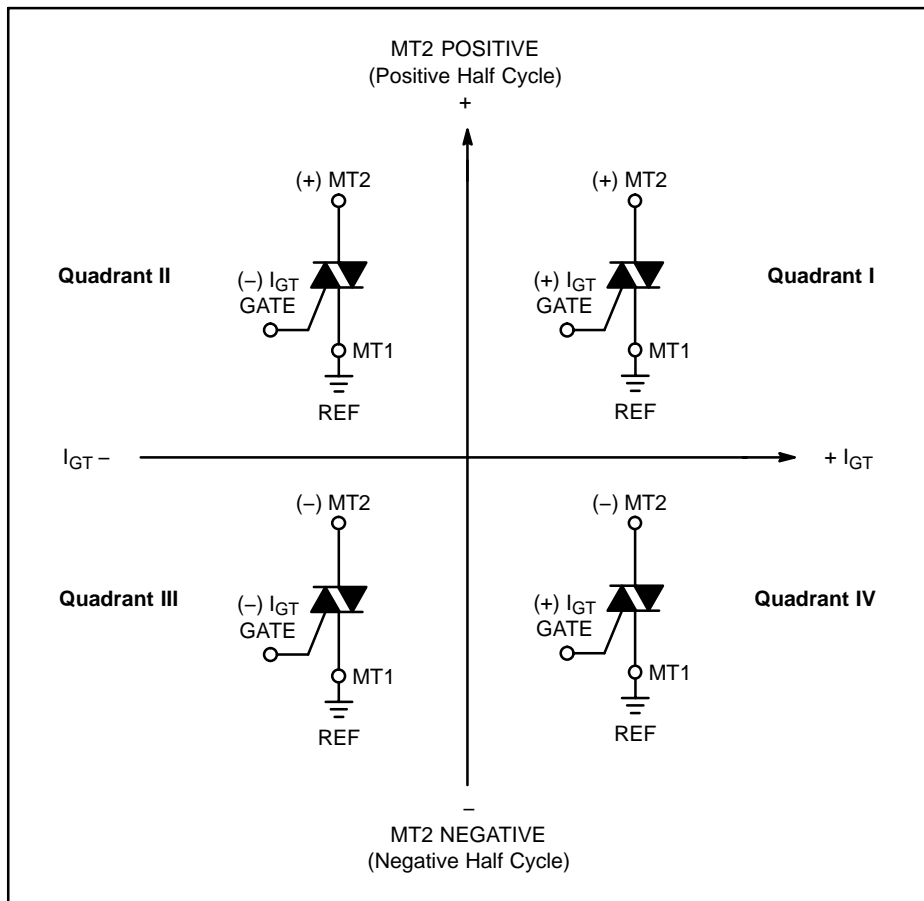
# MAC4DLM

## 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.

# MAC4DLM

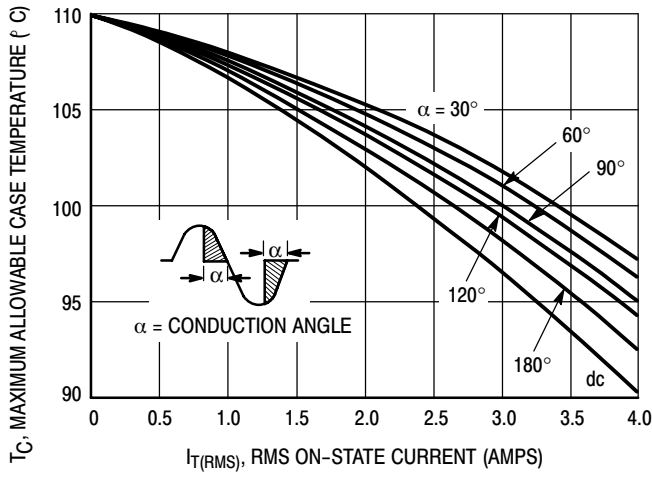


Figure 1. RMS Current Derating

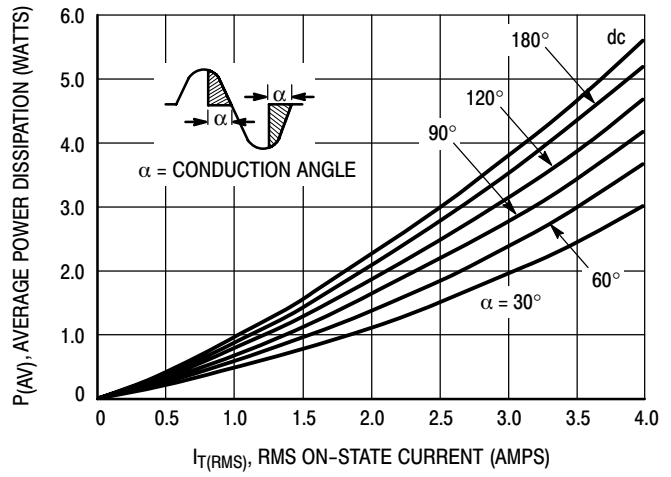


Figure 2. On-State Power Dissipation

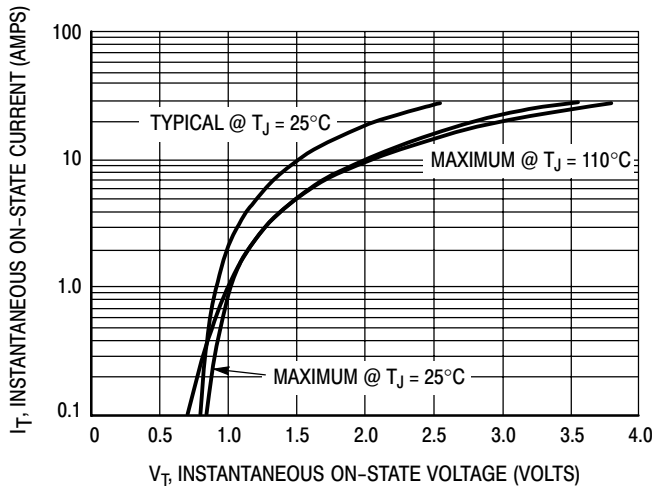


Figure 3. On-State Characteristics

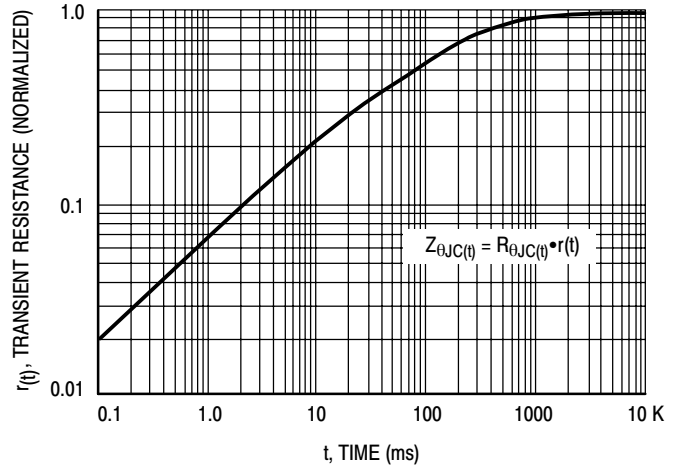


Figure 4. Transient Thermal Response

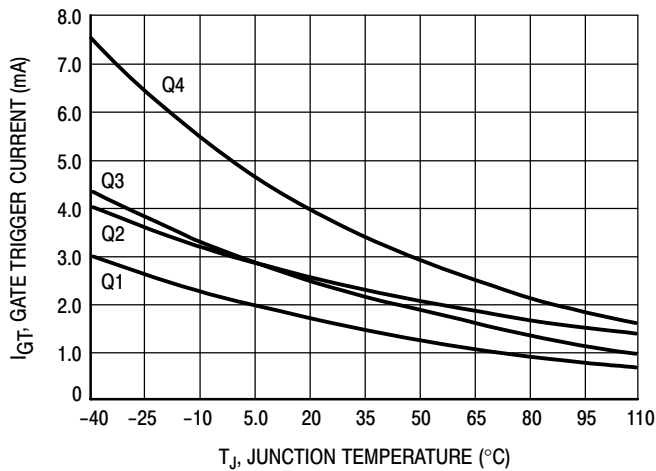


Figure 5. Typical Gate Trigger Current versus Junction Temperature

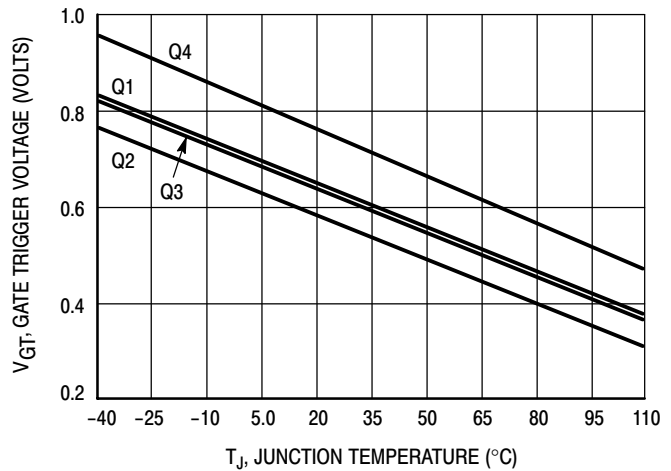


Figure 6. Typical Gate Trigger Voltage versus Junction Temperature

# MAC4DLM

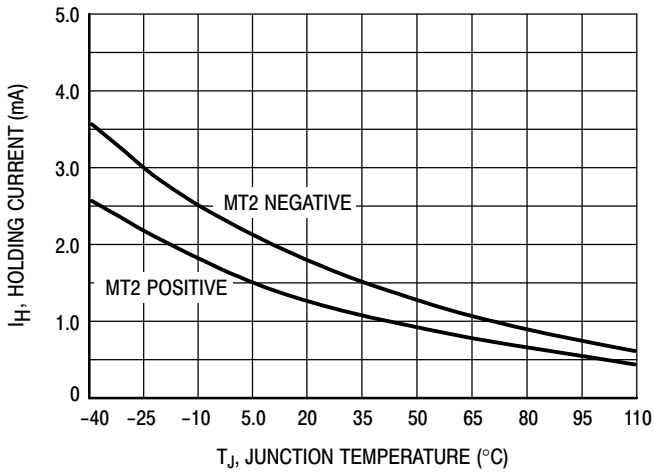


Figure 7. Typical Holding Current versus Junction Temperature

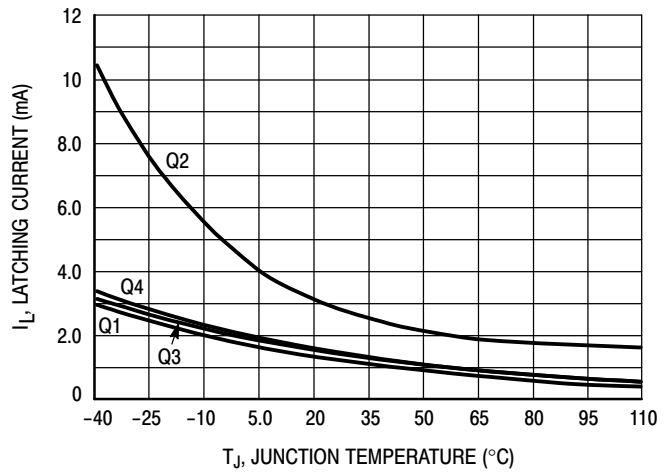


Figure 8. Typical Latching Current versus Junction Temperature

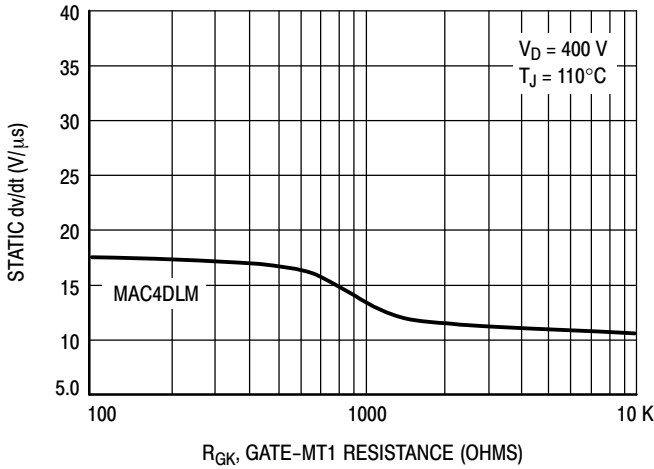


Figure 9. Minimum Exponential Static dv/dt versus Gate-MT1 Resistance

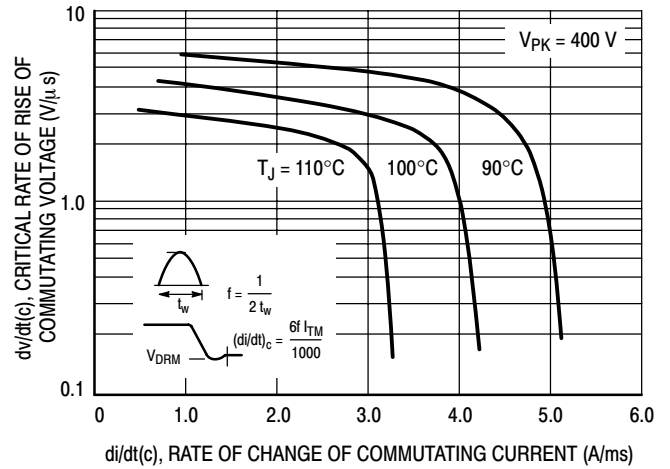
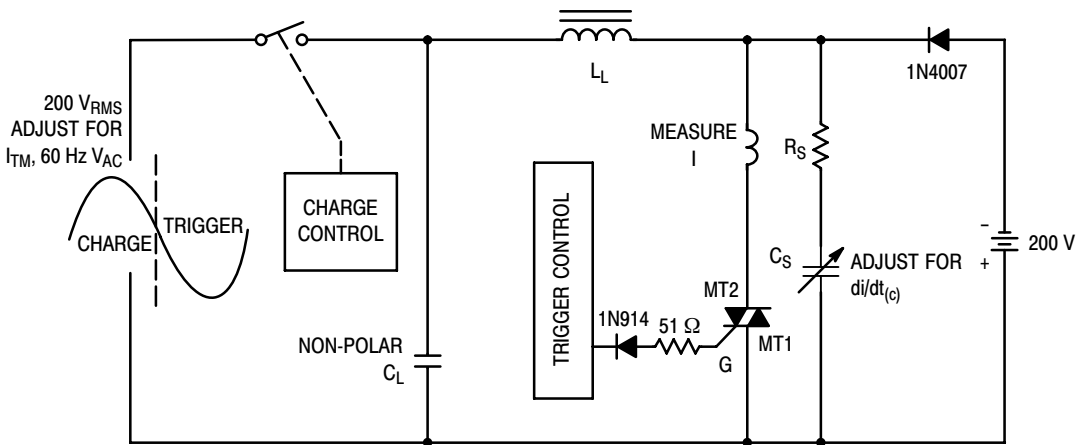


Figure 10. Critical Rate of Rise of Commutating Voltage



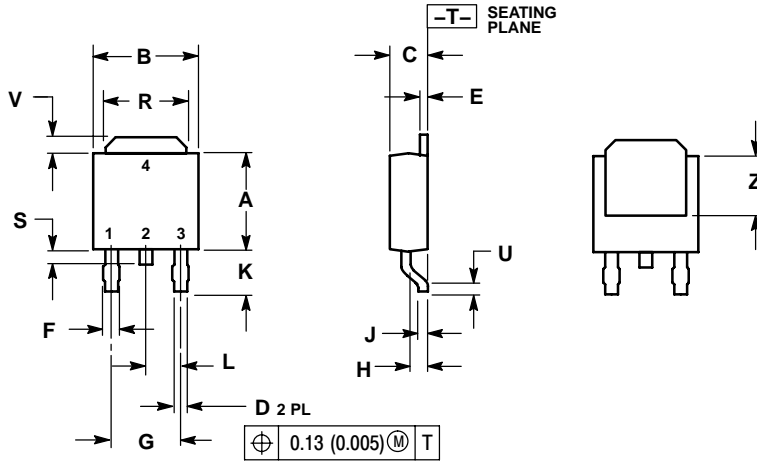
Note: Component values are for verification of rated  $(di/dt)_c$ . See AN1048 for additional information.

Figure 11. Simplified Test Circuit to Measure the Critical Rate of Rise of Commutating Current  $(di/dt)_c$

# MAC4DLM

## PACKAGE DIMENSIONS

DPAK  
CASE 369C  
ISSUE O

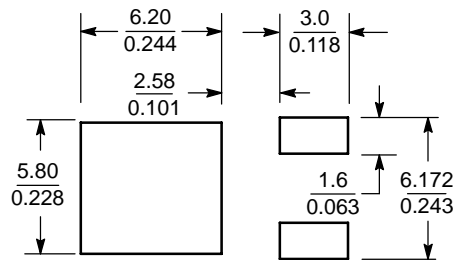


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.245 | 5.97        | 6.22 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.018     | 0.023 | 0.46        | 0.58 |
| F   | 0.037     | 0.045 | 0.94        | 1.14 |
| G   | 0.180 BSC |       | 4.58 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.102     | 0.114 | 2.60        | 2.89 |
| L   | 0.090 BSC |       | 2.29 BSC    |      |
| R   | 0.180     | 0.215 | 4.57        | 5.45 |
| S   | 0.025     | 0.040 | 0.63        | 1.01 |
| U   | 0.020     | ---   | 0.51        | ---  |
| V   | 0.035     | 0.050 | 0.89        | 1.27 |
| Z   | 0.155     | ---   | 3.93        | ---  |

- STYLE 6:  
PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

### SOLDERING FOOTPRINT\*



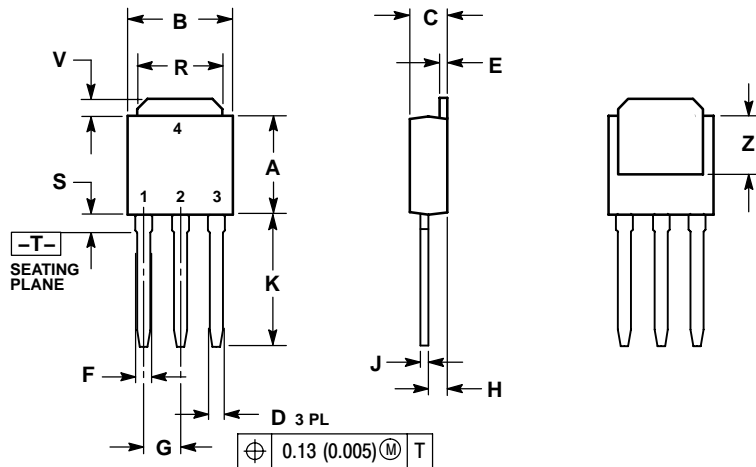
SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

# MAC4DLM

## PACKAGE DIMENSIONS

DKPAK-3  
CASE 369D-01  
ISSUE B



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.245 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.018     | 0.023 | 0.46        | 0.58 |
| F   | 0.037     | 0.045 | 0.94        | 1.14 |
| G   | 0.090 BSC |       | 2.29 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.350     | 0.380 | 8.89        | 9.65 |
| R   | 0.180     | 0.215 | 4.45        | 5.45 |
| S   | 0.025     | 0.040 | 0.63        | 1.01 |
| V   | 0.035     | 0.050 | 0.89        | 1.27 |
| Z   | 0.155     | ---   | 3.93        | ---  |

**STYLE 6:**

- PIN 1. MT1  
2. MT2  
3. GATE  
4. MT2

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