

## POWER OPTO™ Isolator

### 2 Amp Zero-Cross Triac Output

This device consists of a gallium arsenide infrared emitting diode optically coupled to a zero-cross triac driver circuit and a power triac. It is capable of driving a load of up to 2 amps (rms) directly, on line voltages from 20 to 280 volts ac (rms).

- Provides Normally Open Solid State AC Output with 2 Amp Rating
- 70 Amp Single Cycle Surge Capability
- Zero-Voltage Turn-on and Zero-Current Turn-off
- High Input-Output Isolation of 3750 vac (rms)
- Static dv/dt Rating of 400 Volts/μs Guaranteed
- 2 Amp Pilot Duty Rating Per UL508 ¶117 (Overload Test) and ¶118 (Endurance Test) [File No. 129224]
- CSA Approved [File No. CA77170-1].
- SEMKO Approved Certificate #9507228
- Exceeds NEMA 2-230 and IEEE472 Noise Immunity Test Requirements (See Fig.14)

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

| Rating | Symbol | Value | Unit |
|--------|--------|-------|------|
|--------|--------|-------|------|

#### INPUT LED

|                                                         |                    |     |    |
|---------------------------------------------------------|--------------------|-----|----|
| Forward Current — Maximum Continuous                    | I <sub>F</sub>     | 50  | mA |
| Forward Current — Maximum Peak<br>(PW = 100μs, 120 pps) | I <sub>F(pk)</sub> | 1.0 | A  |
| Reverse Voltage — Maximum                               | V <sub>R</sub>     | 6.0 | V  |

#### OUTPUT TRIAC

|                                                                           |                             |             |                    |
|---------------------------------------------------------------------------|-----------------------------|-------------|--------------------|
| Output Terminal Voltage — Maximum Transient <sup>(1)</sup>                | V <sub>DRM</sub>            | 600         | V(pk)              |
| Operating Voltage Range — Maximum Continuous<br>(f = 47 – 63 Hz)          | V <sub>T</sub>              | 20 to 280   | Vac(rms)           |
| On-State Current Range<br>(Free Air, Power Factor ≥ 0.3)                  | I <sub>T(rms)</sub>         | 0.03 to 2.0 | A                  |
| Non-Repetitive Single Cycle Surge Current —<br>Maximum Peak (t = 16.7 ms) | I <sub>TSM</sub>            | 70          | A                  |
| Main Terminal Fusing Current (t = 8.3 ms)                                 | I <sup>2</sup> <sub>T</sub> | 26          | A <sup>2</sup> sec |
| Load Power Factor Range                                                   | PF                          | 0.3 to 1.0  | —                  |
| Junction Temperature Range                                                | T <sub>J</sub>              | – 40 to 125 | °C                 |

#### TOTAL DEVICE

|                                                                                       |                   |              |          |
|---------------------------------------------------------------------------------------|-------------------|--------------|----------|
| Input-Output Isolation Voltage — Maximum <sup>(2)</sup><br>47 – 63 Hz, 1 sec Duration | V <sub>ISO</sub>  | 3750         | Vac(rms) |
| Thermal Resistance — Power Triac Junction to Case<br>(See Fig. 15)                    | R <sub>θJC</sub>  | 8.0          | °C/W     |
| Ambient Operating Temperature Range                                                   | T <sub>oper</sub> | – 40 to +100 | °C       |
| Storage Temperature Range                                                             | T <sub>stg</sub>  | – 40 to +150 | °C       |
| Lead Soldering Temperature — Maximum<br>(1/16" from Case, 10 sec Duration)            | T <sub>L</sub>    | 260          | °C       |

1. Test voltages must be applied within dv/dt rating.
2. Input-Output isolation voltage, V<sub>ISO</sub>, is an internal device dielectric breakdown rating. For this test, pins 2, 3 and the heat tab are common, and pins 7 and 9 are common.

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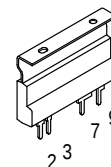
Preferred devices are Motorola recommended choices for future use and best overall value.

**MOC2A60-10**

**MOC2A60-5\***

\*Motorola Preferred Device

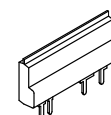
**OPTOISOLATOR**  
**2 AMP ZERO CROSS**  
**TRIAC OUTPUT**  
**600 VOLTS**



**CASE 417-02**  
**Style 2**  
PLASTIC PACKAGE

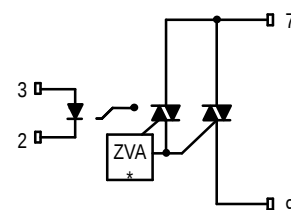


**CASE 417A-02**  
**Style 1**  
PLASTIC PACKAGE



**CASE 417B-01**  
**Style 1**  
PLASTIC PACKAGE

#### DEVICE SCHEMATIC



\* Zero Voltage Activate Circuit

- 1, 4, 5, 6, 8. NO PIN  
2. LED CATHODE  
3. LED ANODE  
7. MAIN TERMINAL 2  
9. MAIN TERMINAL 1

## MOC2A60-10 MOC2A60-5

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| Characteristic                                   | Symbol | Min  | Typ  | Max  | Unit          |
|--------------------------------------------------|--------|------|------|------|---------------|
| <b>INPUT LED</b>                                 |        |      |      |      |               |
| Forward Voltage ( $I_F = 10\text{ mA}$ )         | $V_F$  | 1.00 | 1.17 | 1.50 | V             |
| Reverse Leakage Current ( $V_R = 6.0\text{ V}$ ) | $I_R$  | —    | 1.0  | 100  | $\mu\text{A}$ |
| Capacitance                                      | C      | —    | 18   | —    | pF            |

### OUTPUT TRIAC

|                                                                                                    |                  |     |      |    |                        |
|----------------------------------------------------------------------------------------------------|------------------|-----|------|----|------------------------|
| Off-State Leakage, Either Direction ( $I_F = 0$ , $V_{\text{DRM}} = 600\text{ V}$ )                | $I_{\text{DRM}}$ | —   | 0.25 | 10 | $\mu\text{A}$          |
| Critical Rate of Rise of Off-State Voltage (Static)<br>$V_{\text{in}} = 400\text{ vac(pk)}$ (1)(2) | $dv/dt(s)$       | 400 | —    | —  | $\text{V}/\mu\text{s}$ |
| Holding Current, Either Direction ( $I_F = 0$ , $V_D = 12\text{ V}$ , $I_T = 200\text{ mA}$ )      | $I_H$            | —   | 10   | —  | mA                     |

### COUPLED

|                                                                                                                                                         |                                                                       |           |            |           |                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------|------------|-----------|------------------------|
| LED Trigger Current Required to Latch Output<br>Either Direction (Main Terminal Voltage = $2.0\text{ V}$ )(3)(4)                                        | MOC2A60-10<br>MOC2A60-5<br>$I_{\text{FT(on)}}$<br>$I_{\text{FT(on)}}$ | —<br>—    | 7.0<br>3.5 | 10<br>5.0 | mA<br>mA               |
| On-State Voltage, Either Direction ( $I_F = \text{Rated } I_{\text{FT(on)}}$ , $I_{\text{TM}} = 2.0\text{ A}$ )                                         | $V_{\text{TM}}$                                                       | —         | 0.96       | 1.3       | V                      |
| Inhibit Voltage, Either Direction ( $I_F = \text{Rated } I_{\text{FT(on)}}$ )(5)<br>(Main Terminal Voltage above which device will not trigger)         | $V_{\text{INH}}$                                                      | —         | 8.0        | 10        | V                      |
| Commutating $dv/dt$ (Rated $V_{\text{DRM}}$ , $I_T = 30\text{ mA} - 2.0\text{ A(rms)}$ ,<br>$T_A = -40 \pm 100^\circ\text{C}$ , $f = 60\text{ Hz}$ )(2) | $dv/dt(c)$                                                            | 5.0       | —          | —         | $\text{V}/\mu\text{s}$ |
| Common-mode Input-Output $dv/dt$ (2)                                                                                                                    | $dv/dt(cm)$                                                           | —         | 40,000     | —         | $\text{V}/\mu\text{s}$ |
| Input-Output Capacitance ( $V = 0$ , $f = 1.0\text{ MHz}$ )                                                                                             | $C_{\text{ISO}}$                                                      | —         | 1.3        | —         | pF                     |
| Isolation Resistance ( $V_{\text{I-O}} = 500\text{ V}$ )                                                                                                | $R_{\text{ISO}}$                                                      | $10^{12}$ | $10^{14}$  | —         | $\Omega$               |

- Per EIA/NARM standard RS-443, with  $V_p = 200\text{ V}$ , which is the instantaneous peak of the maximum operating voltage.
- Additional  $dv/dt$  information, including test methods, can be found in Motorola applications note AN1048/D, Figure 43.
- All devices are guaranteed to trigger at an  $I_F$  value less than or equal to the max  $I_{\text{FT}}$ . Therefore, the recommended operating  $I_F$  lies between the device's maximum  $I_{\text{FT(on)}}$  limit and the Maximum Rating of 50 mA.
- Current-limiting resistor required in series with LED.
- Also known as "Zero Voltage Turn-On."

### TYPICAL CHARACTERISTICS

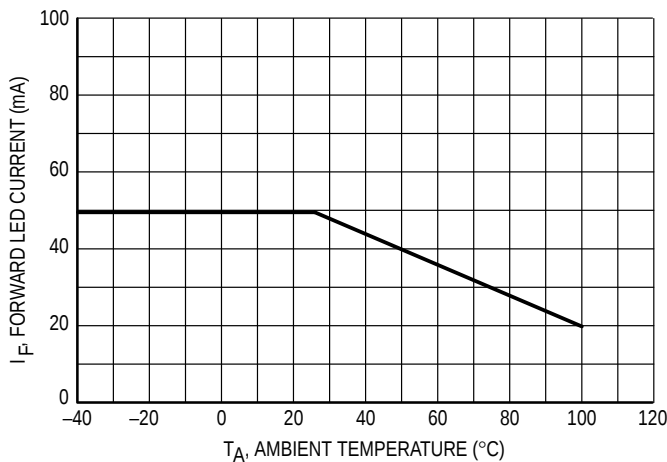


Figure 1. Maximum Allowable Forward LED Current versus Ambient Temperature

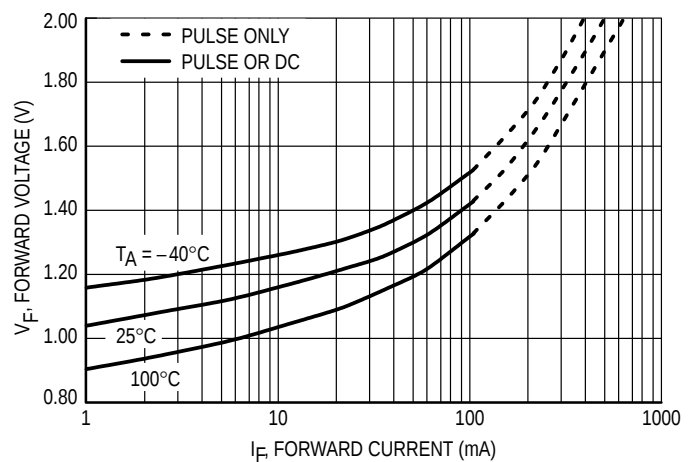
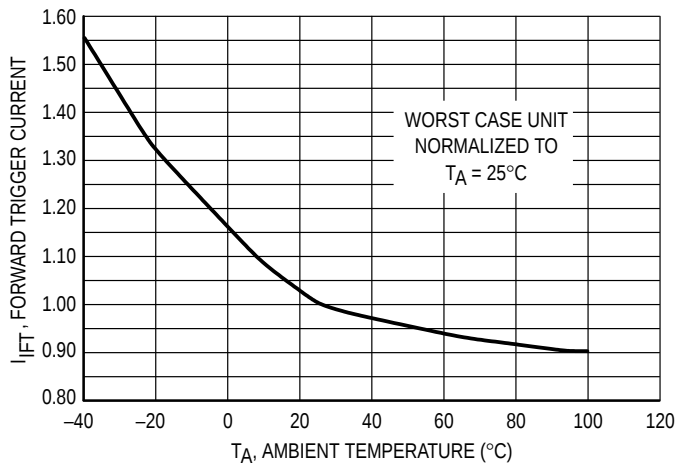
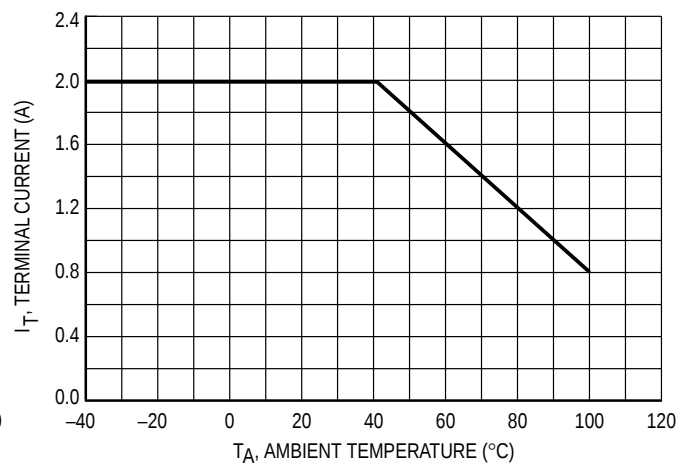


Figure 2. LED Forward Voltage versus LED Forward Current

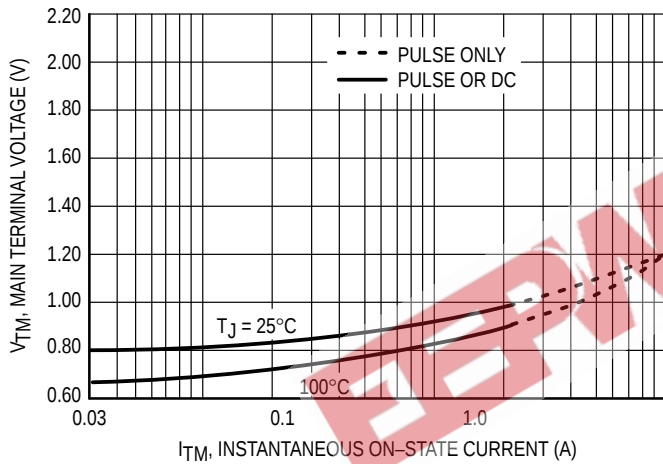
## MOC2A60-10 MOC2A60-5



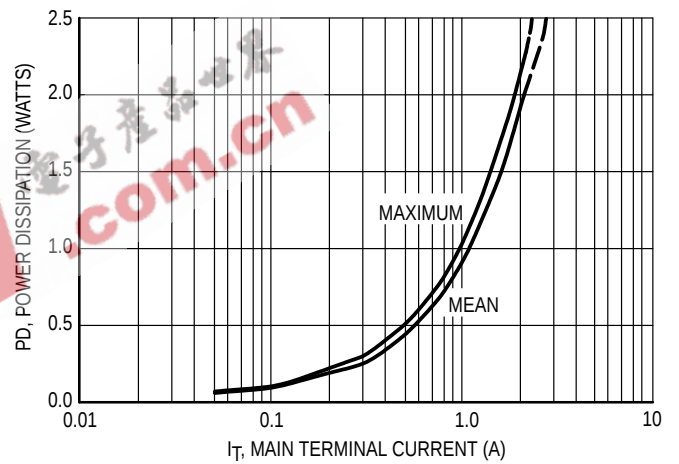
**Figure 3. Forward LED Trigger Current versus Ambient Temperature**



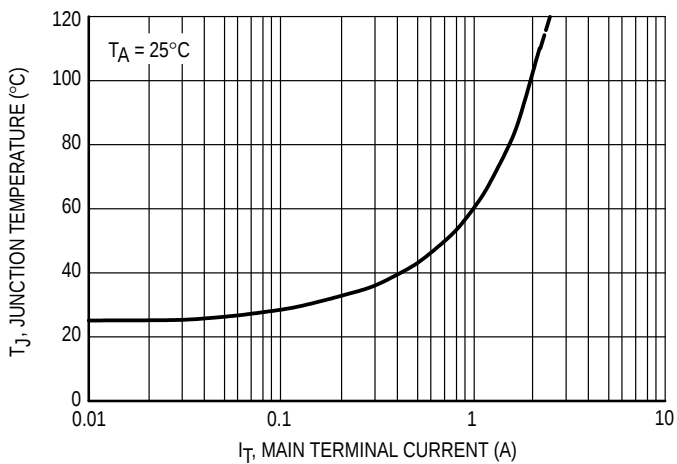
**Figure 4. Maximum Allowable On-State RMS Output Current (Free Air) versus Ambient Temperature**



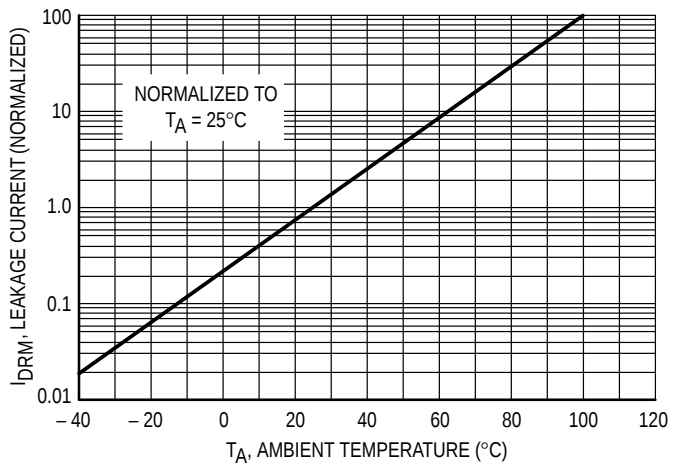
**Figure 5. On-State Voltage Drop versus Output Terminal Current**



**Figure 6. Power Dissipation versus Main Terminal Current**



**Figure 7. Junction Temperature versus Main Terminal RMS Current (Free Air)**



**Figure 8. Leakage with LED Off versus Ambient Temperature**

## MOC2A60-10 MOC2A60-5

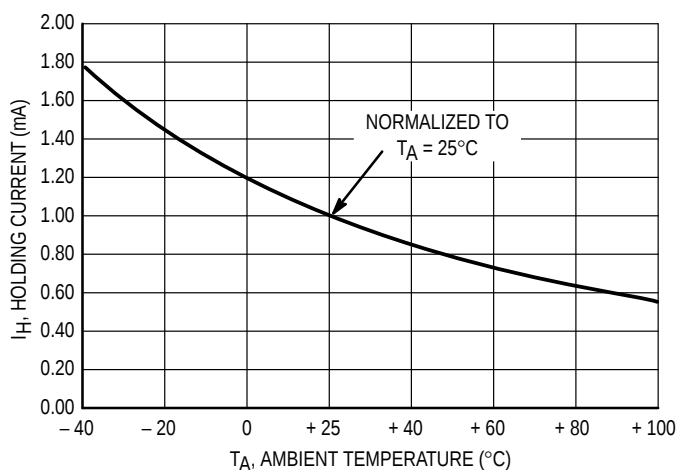


Figure 9. Holding Current versus Ambient Temperature

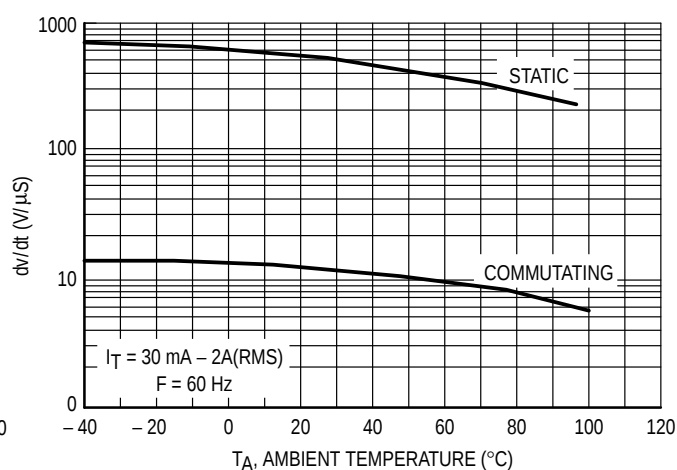


Figure 10. dv/dt versus Ambient Temperature

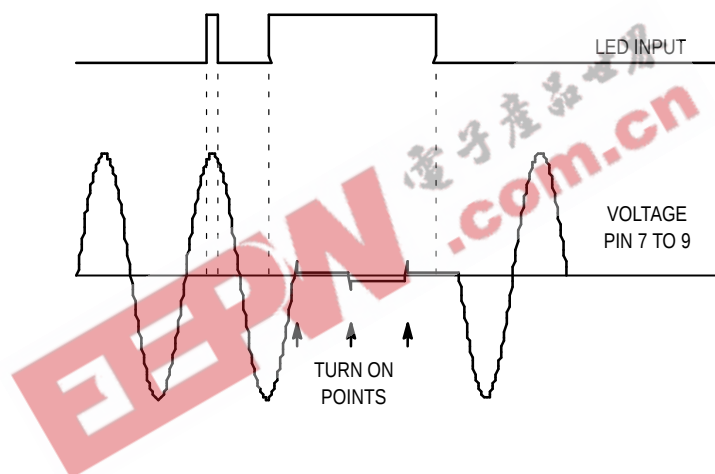


Figure 11. Operating Waveforms

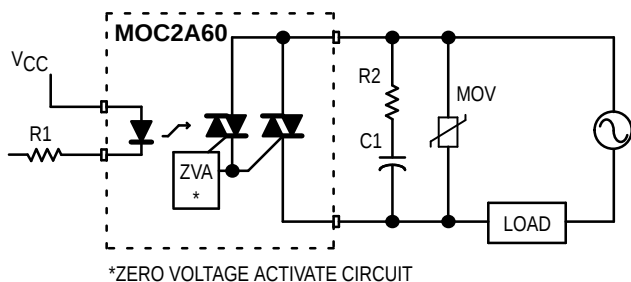


Figure 12. Typical Application Circuit

Select the value of R1 according to the following formulas:

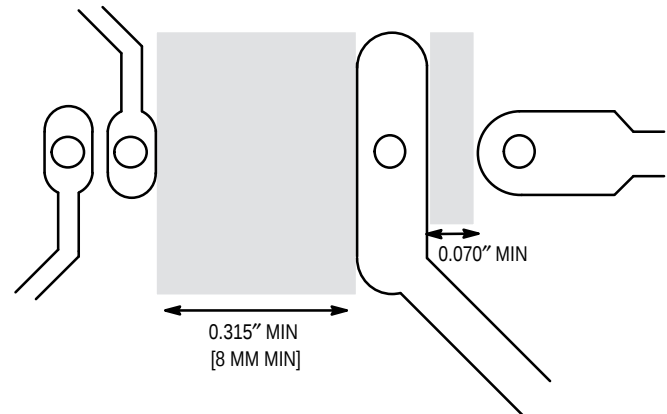
- [1]  $R1 = (V_{CC} - V_F) / \text{Max. } I_{FT} \text{ (on) per spec.}$
- [2]  $R1 = (V_{CC} - V_F) / 0.050$

Typical values for C1 and R2 are 0.01  $\mu\text{F}$  and 39  $\Omega$ , respectively. You may adjust these values for specific applications. The maximum recommended value of C1 is 0.022  $\mu\text{F}$ . See application note AN1048 for additional information on component values.

The MOV may or may not be needed depending upon the characteristics of the applied ac line voltage. For applications where line spikes may exceed the 600 V rating of the MOC2A60, an MOV is required.

Use care to maintain the minimum spacings as shown. Safety and regulatory requirements dictate a minimum of 8.0 mm between the closest points between input and output conducting paths, Pins 3 and 7. Also, 0.070 inches distance is required between the two output Pins, 7 and 9.

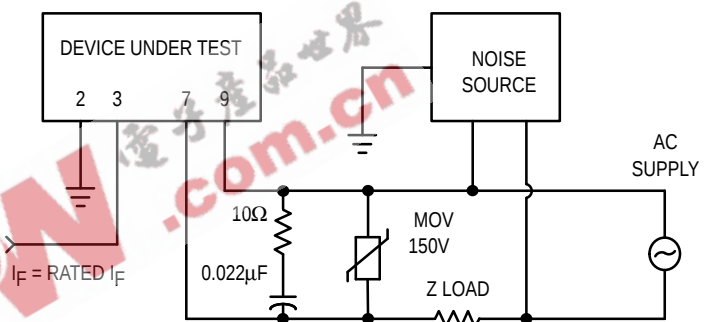
Keep pad sizes on Pins 7 and 9 as large as possible for optimal performance.



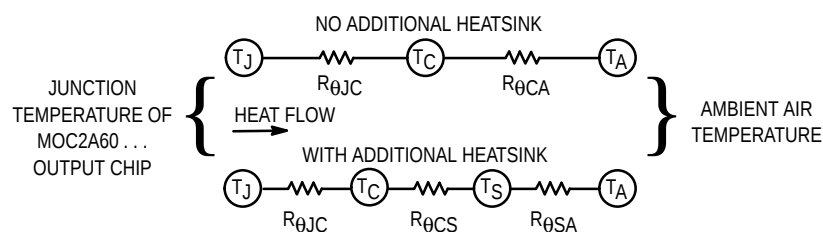
**Figure 13. PC Board Layout Recommendations**

Each device, when installed in the circuit shown in Figure 14, shall be capable of passing the following conducted noise tests:

- IEEE 472 (2.5 KV)
- Lamp Dimmer (NEMA Part DC33, § 3.4.2.1)
- NEMA ICS 2-230.45 Showering Arc
- MIL-STD-461A CS01, CS02 and CS06



**Figure 14. Test Circuit for Conducted Noise Tests**

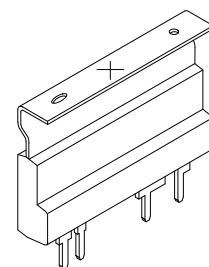


Terms in the model signify:

$T_A$  = Ambient temperature  
 $T_S$  = Optional additional heat sink temperature  
 $T_C$  = Case temperature  
 $T_J$  = Junction temperature  
 $P_D$  = Power dissipation  
 $R_{\theta SA}$  = Thermal resistance, heat sink to ambient  
 $R_{\theta CA}$  = Thermal resistance, case to ambient  
 $R_{\theta CS}$  = Thermal resistance, heat sink to case  
 $R_{\theta JC}$  = Thermal resistance, junction to case

Values for thermal resistance components are:  $R_{\theta CA} = 36^\circ\text{C/W/in}$  maximum  
 $R_{\theta JC} = 8.0^\circ\text{C/W}$  maximum

The design of any additional heatsink will determine the values of  $R_{\theta SA}$  and  $R_{\theta CS}$ .  
 $T_C - T_A = P_D (R_{\theta CA})$   
 $= P_D (R_{\theta JC}) + R_{\theta SA}$ , where  $P_D$  = Power Dissipation in Watts.

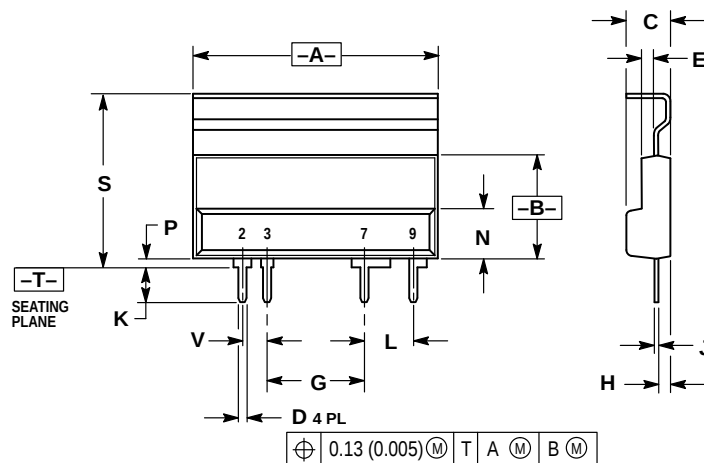


Thermal measurements of  $R_{\theta JC}$  are referenced to the point on the heat tab indicated with an 'X'. Measurements should be taken with device orientated along its vertical axis.

**Figure 15. Approximate Thermal Circuit Model**

# MOC2A60-10 MOC2A60-5

## PACKAGE DIMENSIONS



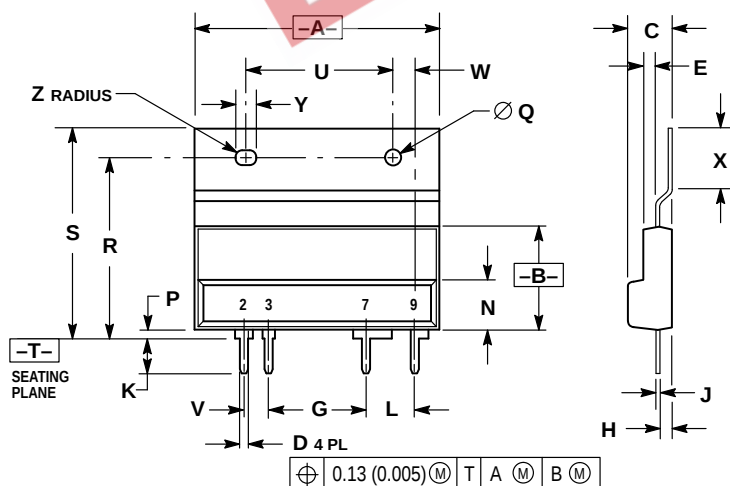
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.965     | 1.005 | 24.51       | 25.53 |
| B   | 0.416     | 0.436 | 10.57       | 11.07 |
| C   | 0.170     | 0.190 | 4.32        | 4.83  |
| D   | 0.025     | 0.035 | 0.64        | 0.89  |
| E   | 0.040     | 0.060 | 1.02        | 1.52  |
| G   | 0.400 BSC |       | 10.16 BSC   |       |
| H   | 0.040     | 0.060 | 1.02        | 1.52  |
| J   | 0.012     | 0.018 | 0.30        | 0.46  |
| K   | 0.134     | 0.154 | 3.40        | 3.91  |
| L   | 0.200 BSC |       | 5.08 BSC    |       |
| N   | 0.190     | 0.210 | 4.83        | 5.33  |
| P   | 0.023     | 0.043 | 0.58        | 1.09  |
| S   | 0.695     | 0.715 | 17.65       | 18.16 |
| V   | 0.100 BSC |       | 2.54 BSC    |       |

- STYLE 2:
- PIN 2. LED CATHODE
  - LED ANODE
  - TRIAC MT
  - TRIAC MT

CASE 417-02  
PLASTIC  
STANDARD HEAT TAB  
ISSUE C

ORDER "F" SUFFIX  
HEAT TAB OPTION  
(EX: MOC2A60-10F)



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

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.965     | 1.005 | 24.51       | 25.53 |
| B   | 0.416     | 0.436 | 10.57       | 11.07 |
| C   | 0.170     | 0.190 | 4.32        | 4.83  |
| D   | 0.025     | 0.035 | 0.64        | 0.89  |
| E   | 0.040     | 0.060 | 1.02        | 1.52  |
| G   | 0.400 BSC |       | 10.16 BSC   |       |
| H   | 0.040     | 0.060 | 1.02        | 1.52  |
| J   | 0.012     | 0.018 | 0.30        | 0.46  |
| K   | 0.134     | 0.154 | 3.40        | 3.91  |
| L   | 0.200 BSC |       | 5.08 BSC    |       |
| N   | 0.190     | 0.210 | 4.83        | 5.33  |
| P   | 0.023     | 0.043 | 0.58        | 1.09  |
| Q   | 0.057     | 0.067 | 1.45        | 1.70  |
| R   | 0.734     | 0.754 | 18.64       | 19.15 |
| S   | 0.840     | 0.870 | 21.34       | 22.10 |
| U   | 0.593     | 0.613 | 15.06       | 15.57 |
| V   | 0.100 BSC |       | 2.54 BSC    |       |
| W   | 0.074     | 0.094 | 1.88        | 2.39  |
| X   | 0.265     | 0.295 | 6.73        | 7.49  |
| Y   | 0.079     | 0.089 | 2.01        | 2.26  |
| Z   | 0.026     | 0.036 | 0.66        | 0.91  |

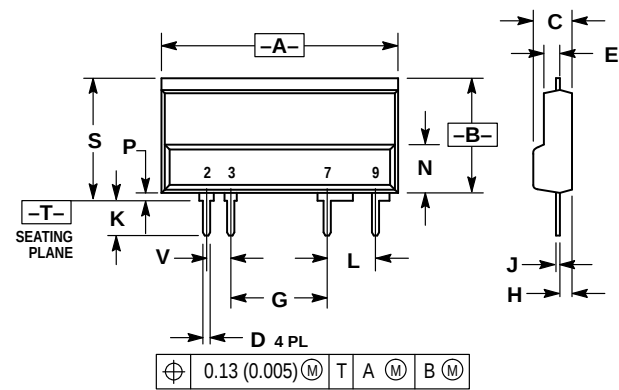
- STYLE 1:
- PIN 2. LED CATHODE
  - LED ANODE
  - TRIAC MT
  - TRIAC MT

CASE 417A-02  
PLASTIC  
FLUSH MOUNT HEAT TAB  
ISSUE A

MOC2A60-10 MOC2A60-5

PACKAGE DIMENSIONS — CONTINUED

ORDER "C" SUFFIX  
HEAT TAB OPTION  
(EX: MOC2A60-10C)



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

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.965     | 1.005 | 24.51       | 25.53 |
| B   | 0.416     | 0.436 | 10.57       | 11.07 |
| C   | 0.170     | 0.190 | 4.32        | 4.83  |
| D   | 0.025     | 0.035 | 0.64        | 0.89  |
| E   | 0.040     | 0.060 | 1.02        | 1.52  |
| G   | 0.400 BSC |       | 10.16 BSC   |       |
| H   | 0.040     | 0.060 | 1.02        | 1.52  |
| J   | 0.012     | 0.060 | 0.30        | 0.46  |
| K   | 0.134     | 0.154 | 3.40        | 3.91  |
| L   | 0.200 BSC |       | 5.08 BSC    |       |
| N   | 0.190     | 0.210 | 4.83        | 5.33  |
| P   | 0.023     | 0.043 | 0.58        | 1.09  |
| S   | 0.439     | 0.529 | 11.15       | 13.44 |
| V   | 0.100 BSC |       | 2.54 BSC    |       |

- STYLE 1:
- PIN 2. LED CATHODE
  - 3. LED ANODE
  - 7. TRIAC MT
  - 9. TRIAC MT

CASE 417B-01  
PLASTIC  
CUT HEAT TAB  
ISSUE O

## MOC2A60-10 MOC2A60-5

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**MOTOROLA**



MOC2A60-10/D

