

# 6-Pin DIP Zero-Cross Triac Driver Output Optocoupler (250/400 Volt Peak)

## MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

### Description

The MOC303XM and MOC304XM devices consist of a GaAs infrared emitting diode optically coupled to a monolithic silicon detector performing the function of a zero voltage crossing bilateral triac driver.

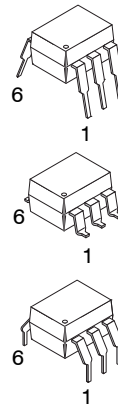
They are designed for use with a triac in the interface of logic systems to equipment powered from 115 VAC lines, such as teletypewriters, CRTs, solid-state relays, industrial controls, printers, motors, solenoids and consumer appliances, etc.

### Features

- Simplifies Logic Control of 115 VAC Power
- Zero Voltage Crossing to Minimize Conducted and Radiated Line Noise
- dv/dt of 2000 V/μs Typical, 1000 V/μs Guaranteed
- Peak Blocking Voltage
  - ◆ 250 V, MOC306xM
  - ◆ 400 V, MOC304xM
- Safety and Regulatory Approvals
  - ◆ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - ◆ DIN EN/IEC60747-5-5
- These are Pb-Free Devices

### Applications

- Solenoid/Valve Controls
- Lighting Controls
- Static Power Switches
- AC Motor Drives
- Temperature Controls
- E.M. Contactors
- AC Motor Starters
- Solid State Relays

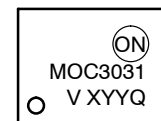


PDIP6 8.51x6.35, 2.54P  
CASE 646BX

PDIP6 8.51x6.35, 2.54P  
CASE 646BY

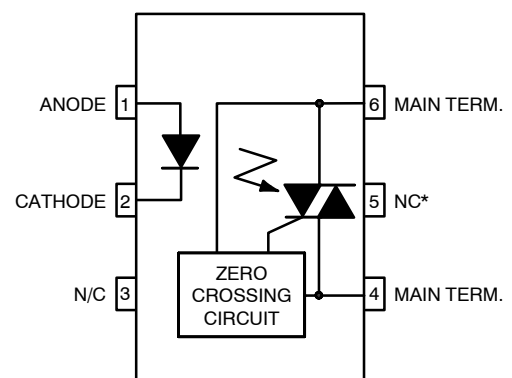
PDIP6 8.51x6.35, 2.54P  
CASE 646BZ

### MARKING DIAGRAM



- MOC3031 = Device Number
- V = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
- X = One-Digit Year Code, e.g., '5'
- YY = Two-Digit Work Week, Ranging from '01' to '53'
- Q = Assembly Package Code

### SCHEMATIC



\*DO NOT CONNECT (TRIAC SUBSTRATE)

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

**SAFETY AND INSULATION RATINGS** (As per DIN EN/IEC 60747-5-5, this optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings shall be ensured by means of protective circuits.)

| Parameter   |                       | Characteristics |
|---|-----------------------|-----------------|
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | <150 V <sub>RMS</sub> | I-IV            |
|   | <300 V <sub>RMS</sub> | I-IV            |
| Climatic Classification   |                       | 40/85/21        |
| Pollution Degree (DIN VDE 0110/1.89)  |                       | 2               |
| Comparative Tracking Index  |                       | 175             |

| Symbol            | Parameter  | Value            | Unit              |
|-------------------|--|------------------|-------------------|
| V <sub>PR</sub>   | Input-to-Output Test Voltage, Method A, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC  | 1275             | V <sub>peak</sub> |
|                   | Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC | 1594             | V <sub>peak</sub> |
| V <sub>IORM</sub> | Maximum Working Insulation Voltage   | 850              | V <sub>peak</sub> |
| V <sub>IOTM</sub> | Highest Allowable Over-Voltage   | 6000             | V <sub>peak</sub> |
|                   | External Creepage  | ≥7               | mm                |
|                   | External Clearance   | ≥7               | mm                |
|                   | External Clearance (for Option TV, 0.4" Lead Spacing)  | ≥10              | mm                |
| DTI               | Distance Through Insulation (Insulation Thickness)   | ≥0.5             | mm                |
| R <sub>IO</sub>   | Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V  | >10 <sup>9</sup> | Ω                 |

**ABSOLUTE MAXIMUM RATINGS** (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol | Parameter | Device | Value | Unit |
|--------|-----------|--------|-------|------|
|--------|-----------|--------|-------|------|

## TOTAL DEVICE

|                  |  |     |                    |       |
|------------------|--|-----|--------------------|-------|
| T <sub>STG</sub> | Storage Temperature                            | All | -40 to +125        | °C    |
| T <sub>OPR</sub> | Operating Temperature                          | All | -40 to +85         | °C    |
| T <sub>J</sub>   | Junction Temperature Range                     | All | -40 to +100        | °C    |
| T <sub>SOL</sub> | Lead Solder Temperature                        | All | 260 for 10 seconds | °C    |
| P <sub>D</sub>   | Total Device Power Dissipation at 25°C Ambient | All | 250                | mW    |
|                  | Derate Above 25°C                              |     | 2.94               | mW/°C |

## EMITTER

|                |   |     |      |       |
|----------------|---|-----|------|-------|
| I <sub>F</sub> | Continuous Forward Current              | All | 60   | mA    |
| V <sub>R</sub> | Reverse Voltage                         | All | 6    | V     |
| P <sub>D</sub> | Total Power Dissipation at 25°C Ambient | All | 120  | mW    |
|                | Derate Above 25°C                       |     | 1.41 | mW/°C |

## DETECTOR

|                  |   |                                  |      |                    |
|------------------|---|----------------------------------|------|--------------------|
| V <sub>DRM</sub> | Off-State Output Terminal Voltage                               | MOC3031M<br>MOC3032M<br>MOC3033M | 250  | V                  |
|                  |   | MOC3041M<br>MOC3042M<br>MOC3043M | 400  | V                  |
| I <sub>TSM</sub> | Peak Non-Repetitive Surge Current (Surge Cycle 60 Hz Sine Wave) | All                              | 1    | A <sub>peak</sub>  |
| I <sub>TM</sub>  | Peak Repetitive On-State Current                                | All                              | 100  | mA <sub>peak</sub> |
| P <sub>D</sub>   | Total Power Dissipation at 25°C Ambient                         | All                              | 150  | mW                 |
|                  | Derate Above 25°C   |                                  | 1.76 | mW/°C              |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Device | Min | Typ | Max | Unit |
|--------|-----------|-----------------|--------|-----|-----|-----|------|
|--------|-----------|-----------------|--------|-----|-----|-----|------|

### INDIVIDUAL COMPONENT CHARACTERISTICS

| EMITTER           |  |   |     |      |      |      |      |
|-------------------|--|---|-----|------|------|------|------|
| V <sub>F</sub>    | Input Forward Voltage                      | I <sub>F</sub> = 30 mA                                | All | –    | 1.25 | 1.50 | V    |
| I <sub>R</sub>    | Reverse Leakage Current                    | V <sub>R</sub> = 6 V                                  | All | –    | 0.01 | 100  | μA   |
| DETECTOR          |  |   |     |      |      |      |      |
| I <sub>DRM1</sub> | Peak Blocking Current, Either Direction    | V <sub>DRM</sub> = 600 V, I <sub>F</sub> = 0 (Note 1) | All | –    | –    | 100  | nA   |
| V <sub>TM</sub>   | Peak On-State Voltage, Either Direction    | I <sub>TM</sub> = 100 mA peak, I <sub>F</sub> = 0     | All | –    | 1.8  | 3.0  | V    |
| dv/dt             | Critical Rate of Rise of Off-State Voltage | I <sub>F</sub> = 0 (Note 2)                           | All | 1000 | 2000 | –    | V/μs |

### TRANSFER CHARACTERISTICS

|                 |                                   |                                      |                      |   |     |    |    |
|-----------------|-----------------------------------|--------------------------------------|----------------------|---|-----|----|----|
| I <sub>FT</sub> | LED Trigger Current               | Main Terminal Voltage = 3 V (Note 3) | MOC3031M<br>MOC3041M | – | –   | 15 | mA |
|                 |                                   |                                      | MOC3032M<br>MOC3042M | – | –   | 10 |    |
|                 |                                   |                                      | MOC3033M<br>MOC3043M | – | –   | 5  |    |
| I <sub>H</sub>  | Holding Current, Either Direction |                                      | All                  | – | 400 | –  | μA |

### ZERO CROSSING CHARACTERISTICS

|                   |                            |  |     |   |   |    |    |
|-------------------|----------------------------|--|-----|---|---|----|----|
| V <sub>IH</sub>   | Inhibit Voltage            | I <sub>F</sub> = rated I <sub>FT</sub> , MT1–MT2 voltage above which device will not trigger off-state | All | – | – | 20 | V  |
| I <sub>DRM2</sub> | Leakage in Inhibited State | I <sub>F</sub> = rated I <sub>FT</sub> , rated V <sub>DRM</sub> off-state                              | All | – | – | 2  | mA |

### ISOLATION CHARACTERISTICS

|                  |                            |              |     |      |   |   |                    |
|------------------|----------------------------|--------------|-----|------|---|---|--------------------|
| V <sub>ISO</sub> | Isolation Voltage (Note 4) | t = 1 Minute | All | 4170 | – | – | VAC <sub>RMS</sub> |
|------------------|----------------------------|--------------|-----|------|---|---|--------------------|

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.

1. Test voltage must be applied within dv/dt rating.
2. This is static dv/dt. Commutating dv/dt is a function of the load-driving thyristor(s) only.
3. All devices are guaranteed to trigger at an I<sub>F</sub> value less than or equal to max I<sub>FT</sub>. Therefore, recommended operating I<sub>F</sub> lies between max I<sub>FT</sub> (15 mA for MOC3031M and MOC3041M, 10 mA for MOC3032M and MOC3042M, 5 mA for MOC3033M and MOC3043M) and absolute maximum I<sub>F</sub> (60 mA).
4. Isolation voltage, V<sub>ISO</sub>, is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common, and pins 4, 5 and 6 are common.

TYPICAL PERFORMANCE CURVES

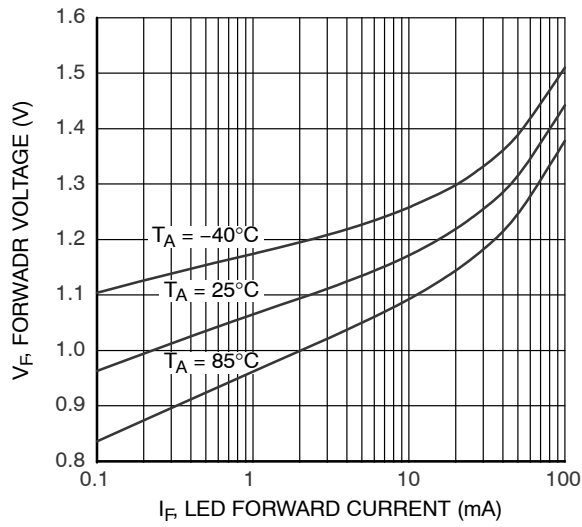


Figure 1. LED Forward Voltage vs. Forward Current

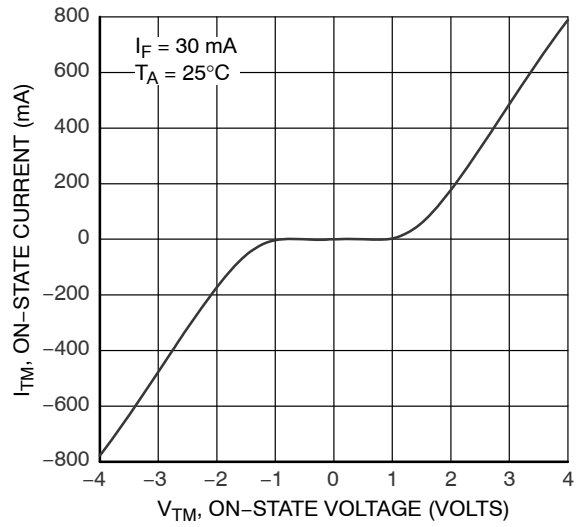


Figure 2. On-State Characteristics

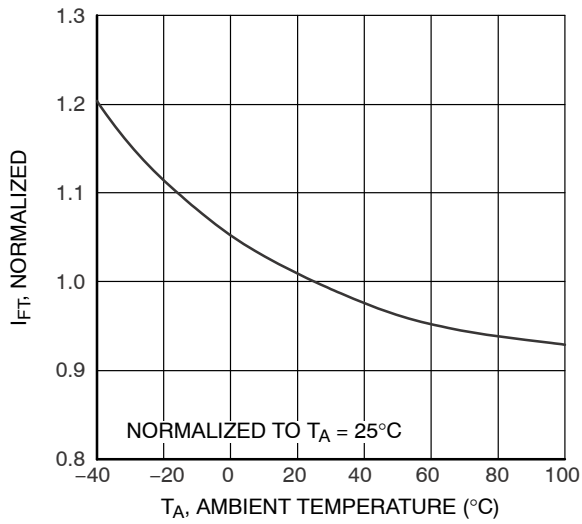


Figure 3. Trigger Current Vs. Temperature

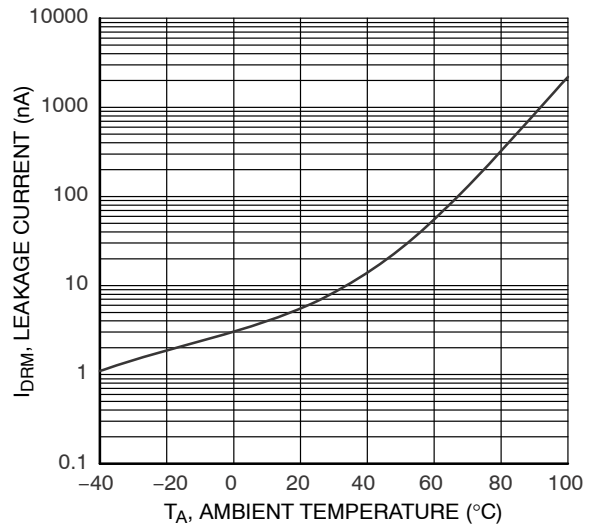


Figure 4. Leakage Current,  $I_{DRM}$  vs. Temperature

TYPICAL PERFORMANCE CURVES (Continued)

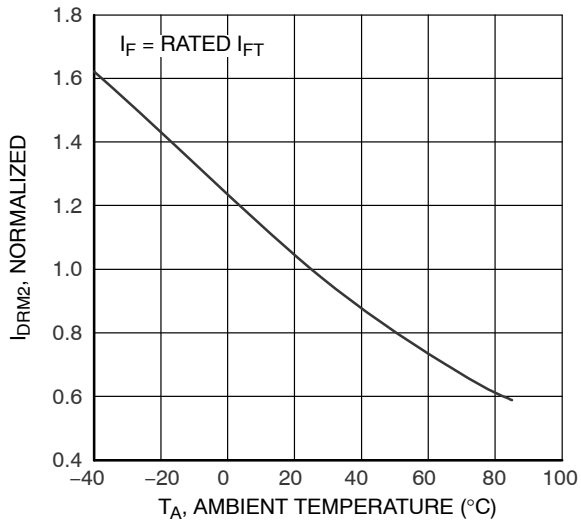


Figure 5. I<sub>DRM2</sub> - Leakage in Inhibit State vs. Temperature

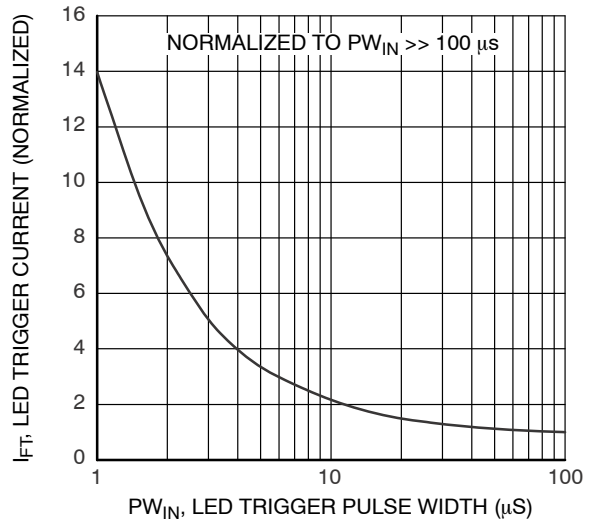


Figure 6. LED Current Required to Trigger vs. LED Pulse Width

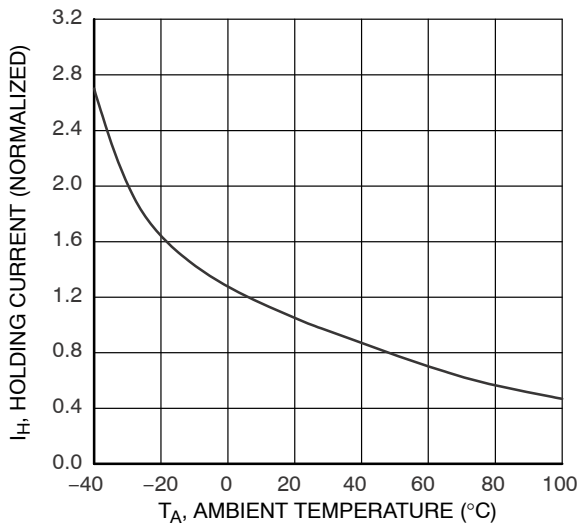


Figure 7. Holding Current, I<sub>H</sub> vs. Temperature

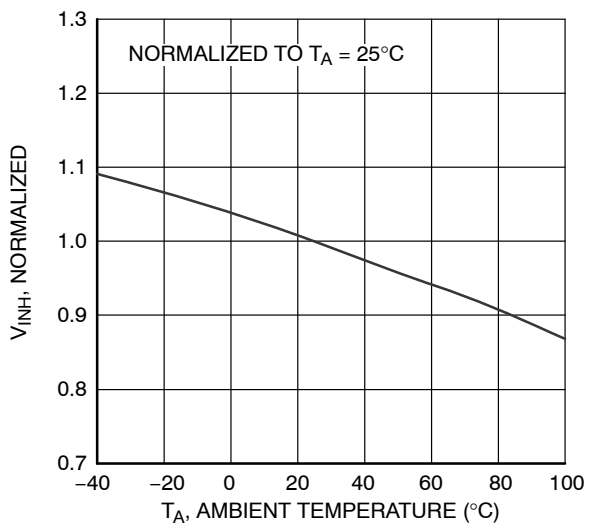


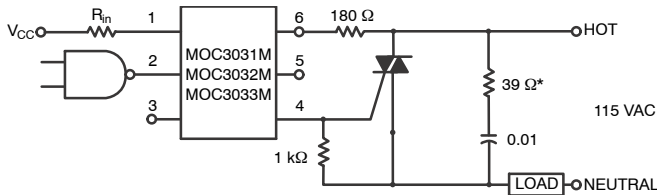
Figure 8. Inhibit Voltage vs. Temperature

APPLICATION INFORMATION

Typical circuit (Figure 9, 10) for use when hot line switching is required. In this circuit the “hot” side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

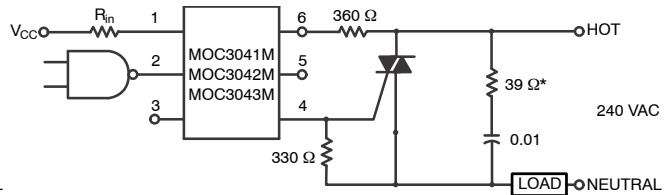
$R_{in}$  is calculated so that  $I_F$  is equal to the rated  $I_{FT}$  of the part, 5 mA for the MOC3033M and MOC3043M, 10 mA for

the MOC3032M and MOC3042M, or 15 mA for the MOC3031M and MOC3041M. The 39 ohm resistor and 0.01  $\mu$ F capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load used.



\*For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

Figure 9. Hot-Line Switching Application Circuit (MOC3031M, MOC3032M, MOC3033M)



\*For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

Figure 10. Hot-Line Switching Application Circuit (MOC3041M, MOC3042M, MOC3043M)

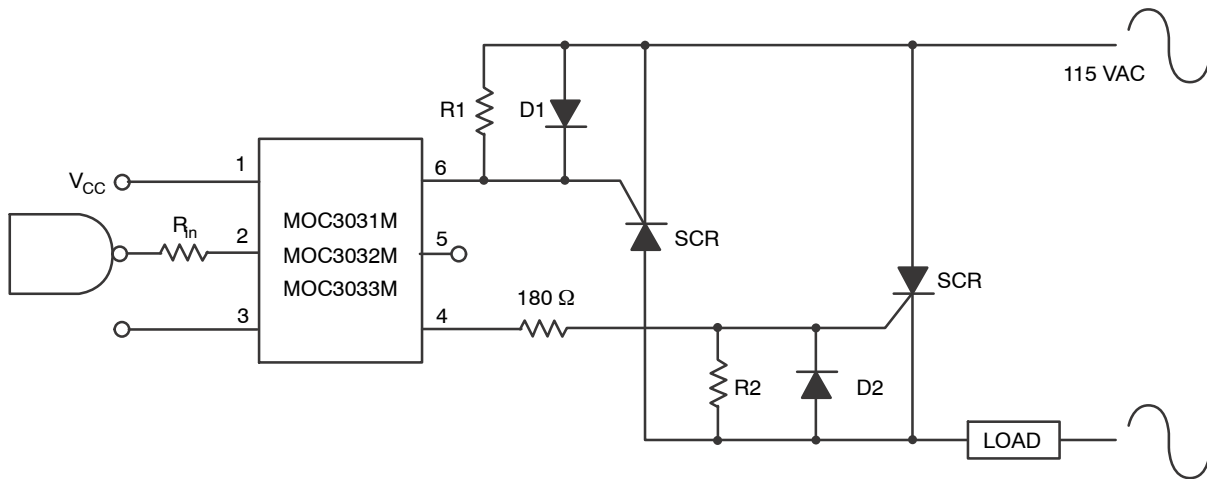
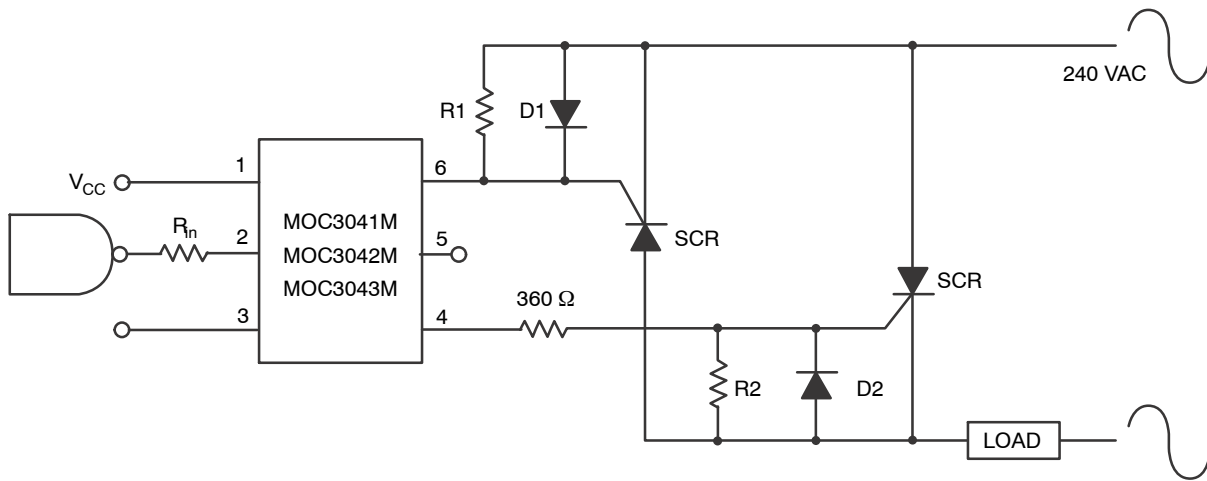


Figure 11. Inverse-Parallel SCR Driver Circuit (MOC3031M, MOC3032M, MOC3033M)

Suggested method of firing two, back-to-back SCR's with a onsemi triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 1 k $\Omega$ .

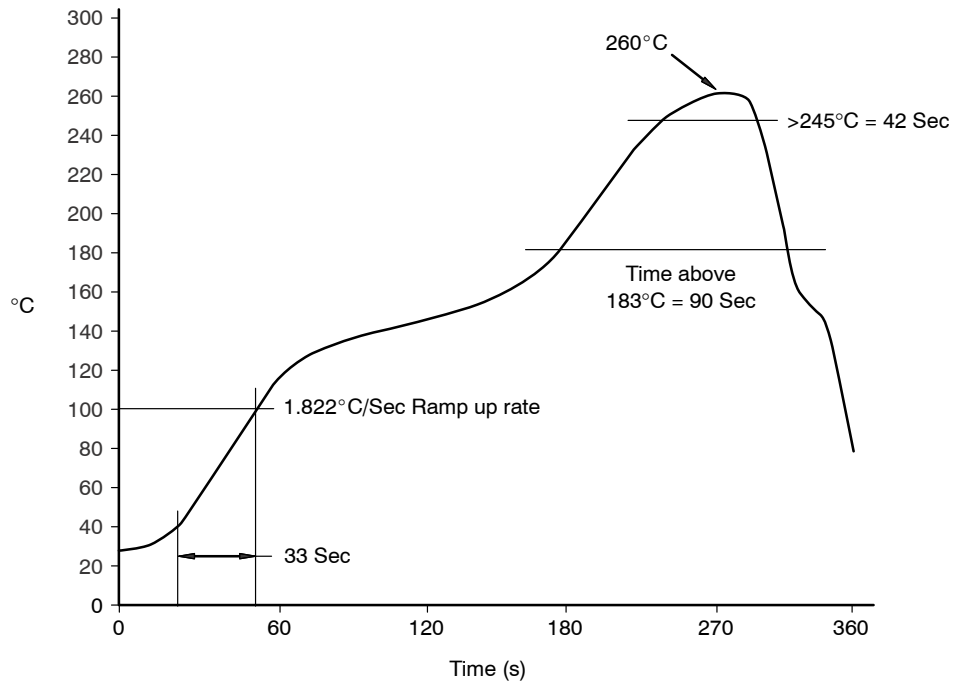
**MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M**



**Figure 12. Inverse-Parallel SCR Driver Circuit (MOC3041M, MOC3042M, MOC3043M)**

Suggested method of firing two, back-to-back SCR's with a **onsemi** triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330Ω.

NOTE: This optoisolator should not be used to drive a load directly. It is intended to be a trigger device only.



**Figure 13. Reflow Profile**

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

## ORDERING INFORMATION (Note 5)

| Part Number  | Package   | Shipping <sup>†</sup> |
|--------------|---|-----------------------|
| MOC3031M     | DIP 6-Pin<br>(Pb-Free)  | 50 Units / Tube       |
| MOC3031SM    | SMT 6-Pin (Lead Bend)<br>(Pb-Free)                                    | 50 Units / Tube       |
| MOC3031SR2M  | SMT 6-Pin (Lead Bend)<br>(Pb-Free)                                    | 1000 / Tape & Reel    |
| MOC3031VM    | DIP 6-Pin, DIN EN/IEC60747-5-5 Option<br>(Pb-Free)                    | 50 Units / Tube       |
| MOC3031SVM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option<br>(Pb-Free)        | 50 Units / Tube       |
| MOC3031SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option<br>(Pb-Free)        | 1000 / Tape & Reel    |
| MOC3031TVM   | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option<br>(Pb-Free) | 50 Units / Tube       |

<sup>†</sup>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.

5. The product orderable part number system listed in this table also applies to the MOC3032M, MOC3033M, MOC3041M, MOC3042M, and MOC3043M product families.



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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PDIP6 8.51x6.35, 2.54P  
CASE 646BX  
ISSUE O

DATE 31 JUL 2016



NOTES:

- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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### PDIP6 8.51x6.35, 2.54P

#### CASE 646BY

#### ISSUE A

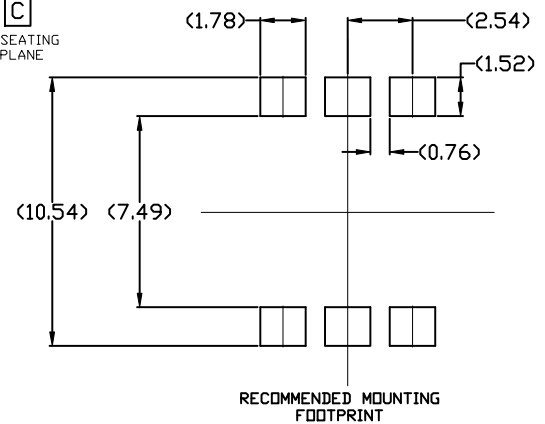
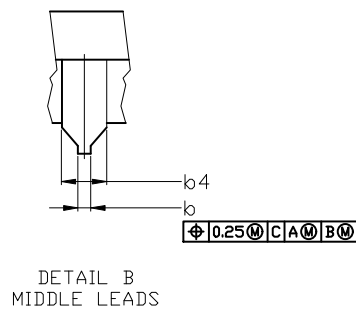
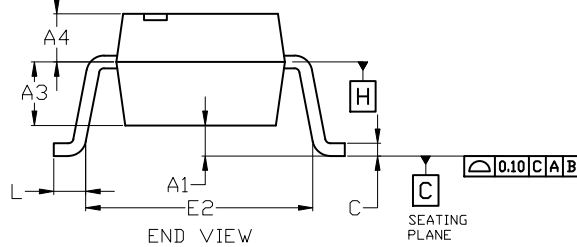
DATE 15 JUL 2019



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS ARE LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | ---         | ---  | 4.80 |
| A1  | 0.38        | ---  | ---  |
| A2  | 3.28        | 3.40 | 3.53 |
| A3  | 2.49 REF    |      |      |
| A4  | 1.89 REF    |      |      |
| b   | 0.41        | 0.46 | 0.51 |
| b1  | 0.76        | 0.92 | 1.14 |
| b2  | 0.25        | 0.28 | 0.36 |
| b3  | 1.02        | 1.40 | 1.78 |
| b4  | 1.778 REF   |      |      |
| c   | 0.20        | 0.25 | 0.30 |
| D   | 8.13        | 8.51 | 8.89 |
| D1  | 0.86 REF    |      |      |
| E   | 6.10        | 6.35 | 6.60 |
| E1  | 8.43        | 9.17 | 9.90 |
| E2  | 8.13 REF    |      |      |
| e   | 2.54 BSC    |      |      |
| L   | 0.16        | 0.52 | 0.88 |



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

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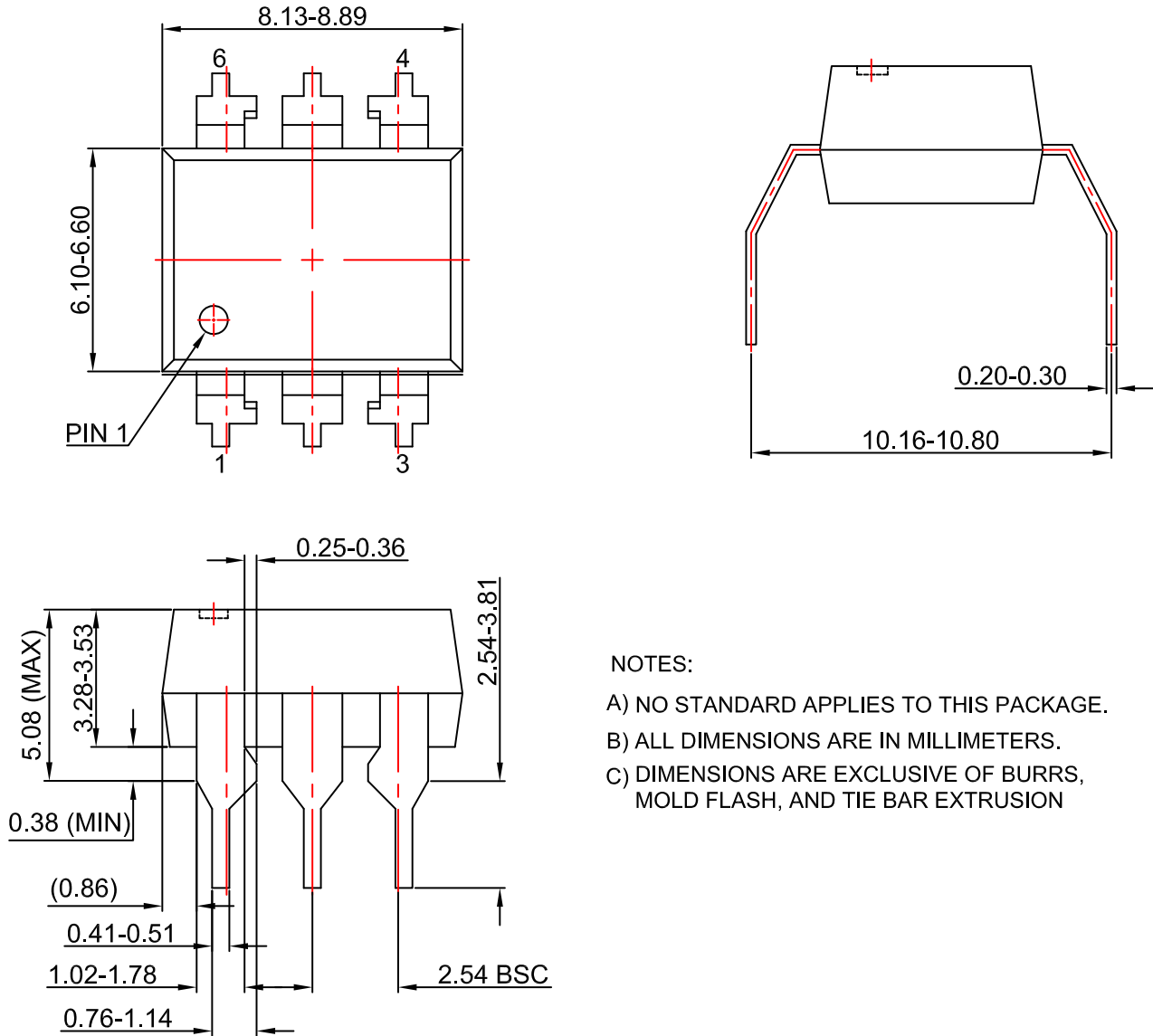
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

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PDIP6 8.51x6.35, 2.54P  
CASE 646BZ  
ISSUE O

DATE 31 JUL 2016



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