

# 6-Pin DIP Zero-Cross Triac Driver Optocoupler (600 Volt Peak)

## MOC3061M, MOC3062M, MOC3063M, MOC3162M, MOC3163M

### Description

The MOC306XM and MOC316XM 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.

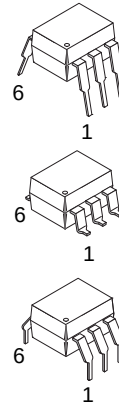
They are designed for use with a triac in the interface of logic systems to equipment powered from 115/240 VAC lines, such as solid-state relays, industrial controls, motors, solenoids and consumer appliances, etc.

### Features

- Simplifies Logic Control of 115/240 VAC Power
- Zero Voltage Crossing to Minimize Conducted and Radiated Line Noise
- 600 V Peak Blocking Voltage
- Superior Static dv/dt
  - ♦ 600 V/μs (MOC306xM)
  - ♦ 1000 V/μs (MOC316xM)
- 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
- Static Power Switches
- Temperature Controls
- AC Motor Starters
- Lighting Controls
- AC Motor Drives
- E.M. Contactors
- Solid State Relays

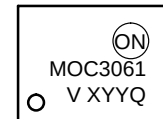


PDIP6 8.51x6.35, 2.54P  
CASE 646BX

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CASE 646BY

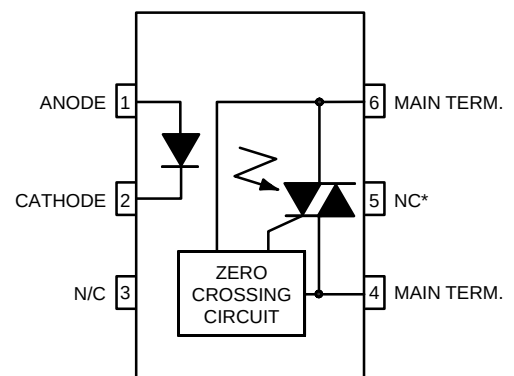
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### MARKING DIAGRAM



MOC3061 = 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.

# MOC3061M, MOC3062M, MOC3063M, MOC3162M, MOC3163M

**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  | 1360             | 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                                | All | 600  | V                  |
| I <sub>TSM</sub> | Peak Non-Repetitive Surge Current (Single 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.

# MOC3061M, MOC3062M, MOC3063M, MOC3162M, MOC3163M

## 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      | –    | 1.3   | 1.5 | V    |
| I <sub>R</sub>    | Reverse Leakage Current                    | V <sub>R</sub> = 6 V                                  | All      | –    | 0.005 | 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) | MOC306XM | –    | 10    | 500 | nA   |
|                   |                                            |                                                       | MOC316XM | –    | 10    | 100 |      |
| dv/dt             | Critical Rate of Rise of Off-State Voltage | I <sub>F</sub> = 0 (Note 2)                           | MOC306XM | 600  | 1500  | –   | V/μs |
|                   |                                            |                                                       | MOC316XM | 1000 | –     | –   |      |

### TRANSFER CHARACTERISTICS

|                 |                                              |                                                                       |                      |   |     |     |    |
|-----------------|----------------------------------------------|-----------------------------------------------------------------------|----------------------|---|-----|-----|----|
| I <sub>FT</sub> | LED Trigger Current (Rated I <sub>FT</sub> ) | Main Terminal Voltage = 3 V (Note 3)                                  | MOC3061M             | – | –   | 15  | mA |
|                 |                                              |                                                                       | MOC3062M<br>MOC3162M | – | –   | 10  |    |
|                 |                                              |                                                                       | MOC3063M<br>MOC3163M | – | –   | 5   |    |
| V <sub>TM</sub> | Peak On-State Voltage, Either Direction      | I <sub>TM</sub> = 100 mA peak, I <sub>F</sub> = rated I <sub>FT</sub> | All                  | – | 1.8 | 3.0 | V  |
| I <sub>H</sub>  | Holding Current, Either Direction            |                                                                       | All                  | – | 500 | –   | μA |

### ZERO CROSSING CHARACTERISTICS

|                   |                                                                       |                                                                              |                                  |   |    |    |    |
|-------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------|---|----|----|----|
| V <sub>INH</sub>  | Inhibit Voltage (MT1–MT2 Voltage Above Which Device will not Trigger) | I <sub>F</sub> = rated I <sub>FT</sub>                                       | MOC3061M<br>MOC3062M<br>MOC3063M | – | 12 | 20 | V  |
|                   |                                                                       |                                                                              | MOC3162M<br>MOC3163M             | – | 12 | 15 |    |
| I <sub>DRM2</sub> | Leakage in Inhibited State                                            | I <sub>F</sub> = rated I <sub>FT</sub> , V <sub>DRM</sub> = 600 V, off-state | All                              | – | –  | 2  | mA |

### ISOLATION CHARACTERISTICS

|                  |                            |                                        |  |      |                  |   |                    |
|------------------|----------------------------|----------------------------------------|--|------|------------------|---|--------------------|
| V <sub>ISO</sub> | Isolation Voltage (Note 4) | f = 60 Hz, t = 1 Minute                |  | 4170 | –                | – | VAC <sub>RMS</sub> |
| R <sub>ISO</sub> | Isolation Resistance       | V <sub>I-O</sub> = 500 V <sub>DC</sub> |  | –    | 10 <sup>11</sup> | – | Ω                  |
| C <sub>ISO</sub> | Isolation Capacitance      | V = 0 V, f = 1 MHz                     |  | –    | 0.2              | – | pF                 |

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 MOC3061M, 10 mA for MOC3062M and MOC3162M, 5 mA for MOC3063M and MOC3163M) 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

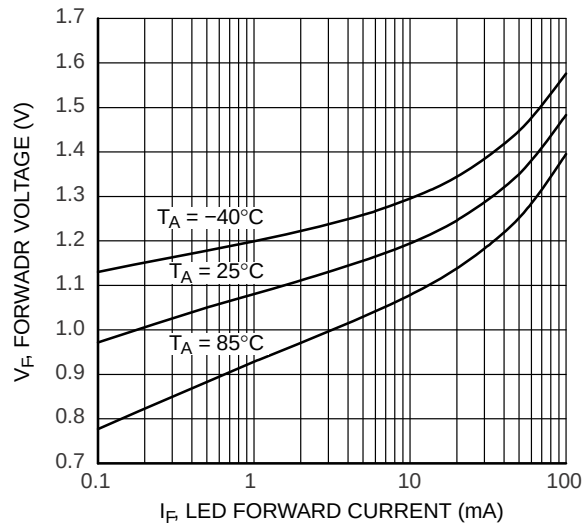


Figure 1. LED Forward Voltage vs. Forward Current

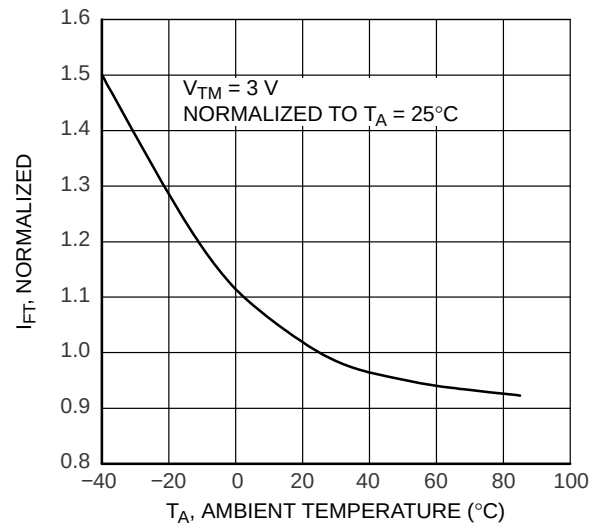


Figure 2. Trigger Current Vs. Temperature

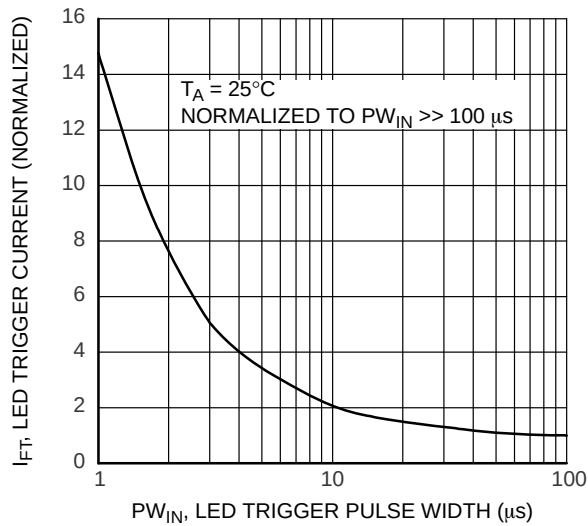


Figure 3. LED Current Required to Trigger vs. LED Pulse Width

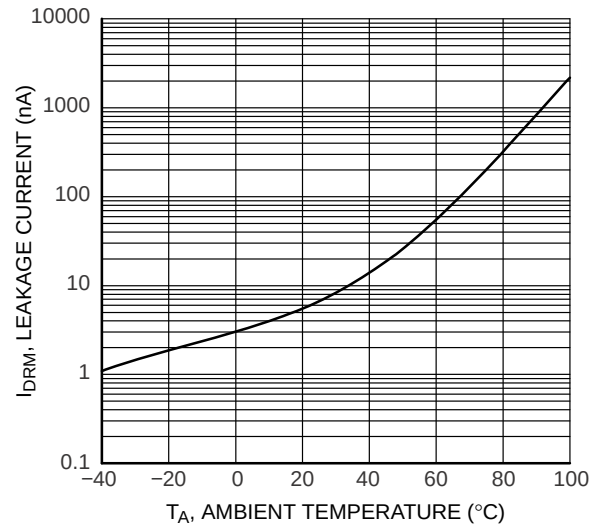


Figure 4. Leakage Current,  $I_{DRM}$  vs. Temperature

TYPICAL PERFORMANCE CURVES (Continued)

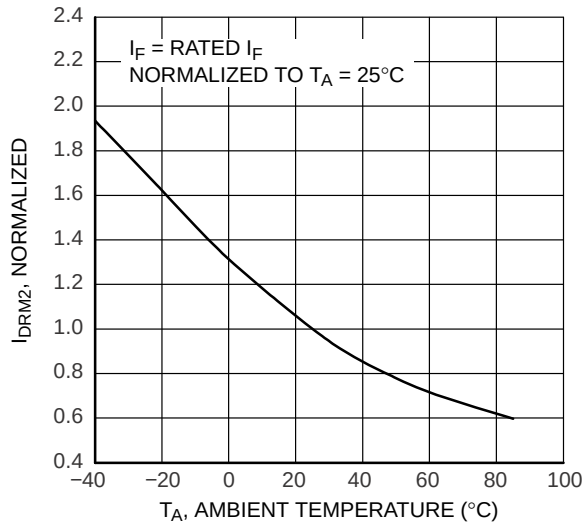


Figure 5.  $I_{DRM2}$ , Leakage in Inhibit State vs. Temperature

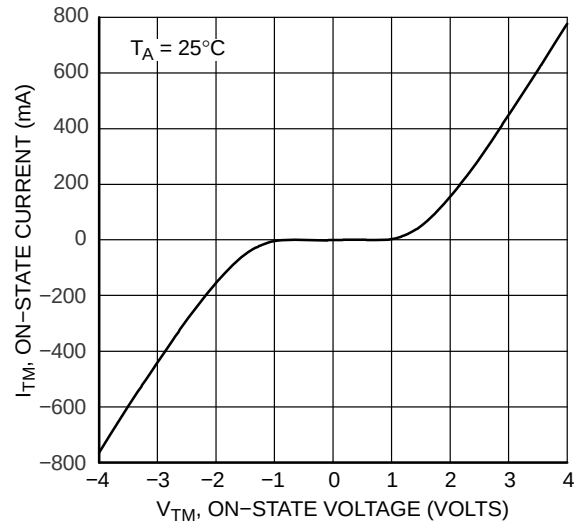


Figure 6. On-State Characteristics

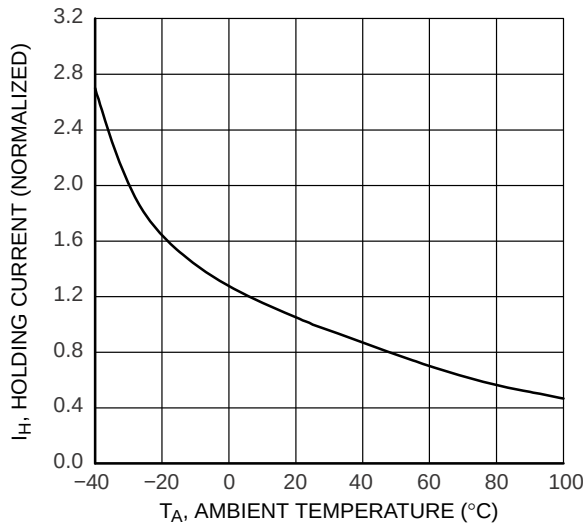


Figure 7.  $I_H$ , Holding Current vs. Temperature

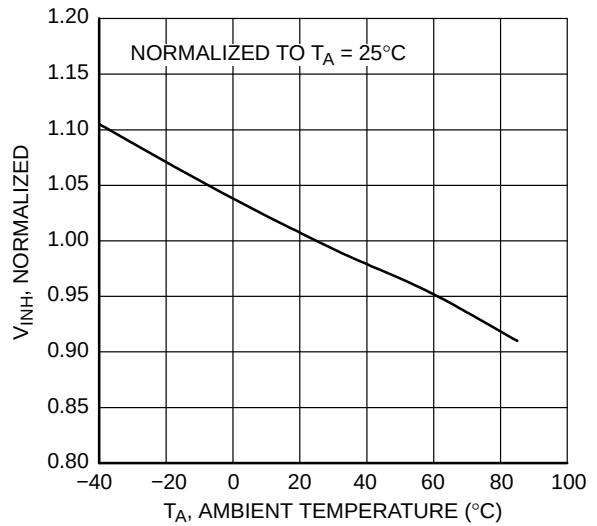


Figure 8. Inhibit Voltage vs. Temperature

## APPLICATION INFORMATION

### Basic Applications

Typical circuit 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, 15 mA for the MOC3061M, 10 mA for the MOC3062M, or 5 mA for the MOC3063M.

The 39  $\Omega$  resistor and 0.01  $\mu$ F capacitor are for snubbing of the triac and is often, but not always, necessary depending upon the particular triac and load used.

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 330  $\Omega$ .

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

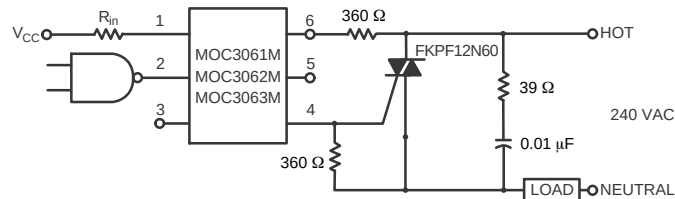


Figure 9. Hot-Line Switching Application Circuit

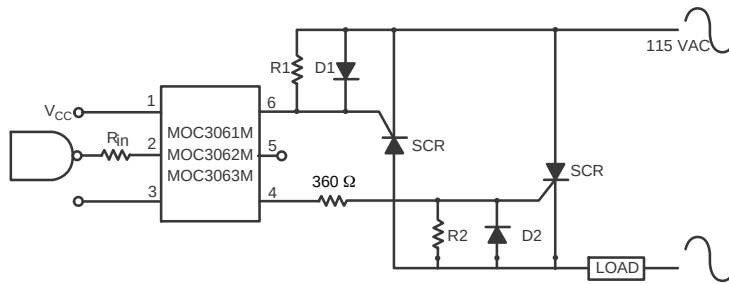
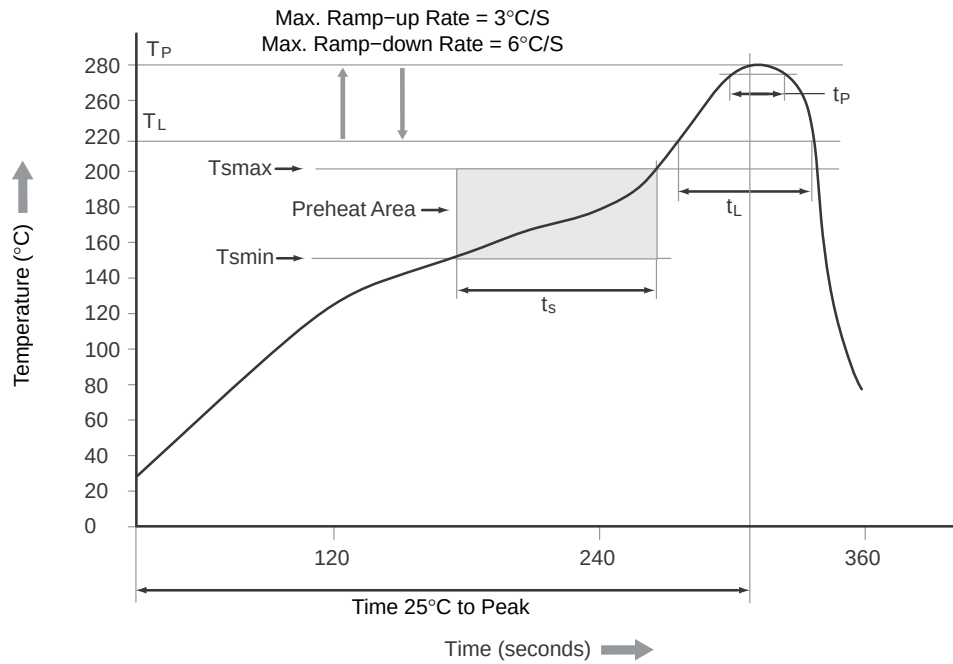


Figure 10. Inverse-Parallel SCR Driver Circuit

**MOC3061M, MOC3062M, MOC3063M, MOC3162M, MOC3163M**



|                                                  |                           |
|--------------------------------------------------|---------------------------|
| Temperature Minimum ( $T_{smin}$ )               | 150°C                     |
| Temperature Maximum ( $T_{smax}$ )               | 200°C                     |
| Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ ) | 60 seconds to 120 seconds |
| Ramp-up Rate ( $T_L$ to $T_P$ )                  | 3°C/second maximum        |
| Liquidous Temperature ( $T_L$ )                  | 217°C                     |
| Time ( $t_L$ ) Maintained Above ( $T_L$ )        | 60 seconds to 150 seconds |
| Peak Body Package Temperature                    | 260°C +0°C / -5°C         |
| Time ( $t_P$ ) within 5°C of 260°C               | 30 seconds                |
| Ramp-down Rate ( $T_P$ to $T_L$ )                | 6°C/second maximum        |
| Time 25°C to Peak Temperature                    | 8 minutes maximum         |

**Figure 11. Reflow Profile**

## MOC3061M, MOC3062M, MOC3063M, MOC3162M, MOC3163M

### ORDERING INFORMATION (Note 5)

| Part Number  | Package                                                               | Shipping <sup>†</sup> |
|--------------|-----------------------------------------------------------------------|-----------------------|
| MOC3061M     | DIP 6-Pin<br>(Pb-Free)                                                | 50 Units / Tube       |
| MOC3061SM    | SMT 6-Pin (Lead Bend)<br>(Pb-Free)                                    | 50 Units / Tube       |
| MOC3061SR2M  | SMT 6-Pin (Lead Bend)<br>(Pb-Free)                                    | 1000 / Tape & Reel    |
| MOC3061VM    | DIP 6-Pin, DIN EN/IEC60747-5-5 Option<br>(Pb-Free)                    | 50 Units / Tube       |
| MOC3061SVM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option<br>(Pb-Free)        | 50 Units / Tube       |
| MOC3061SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option<br>(Pb-Free)        | 1000 / Tape & Reel    |
| MOC3061TVM   | 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 MOC3062M, MOC3063M, MOC3162M, and MOC3163M product families.

# MECHANICAL CASE OUTLINE

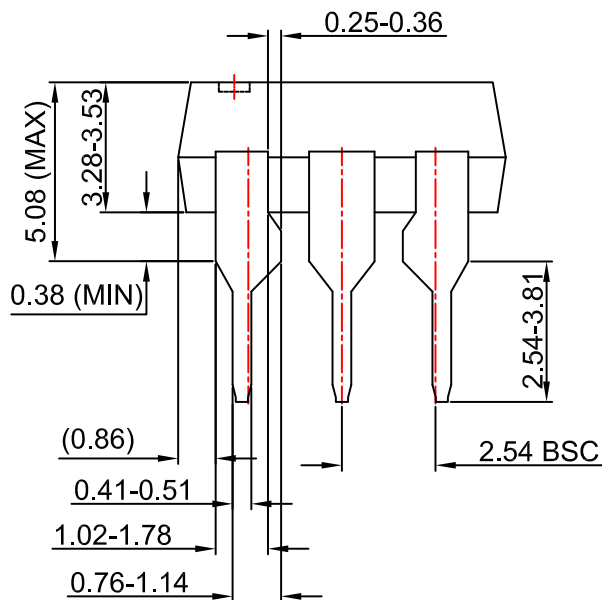
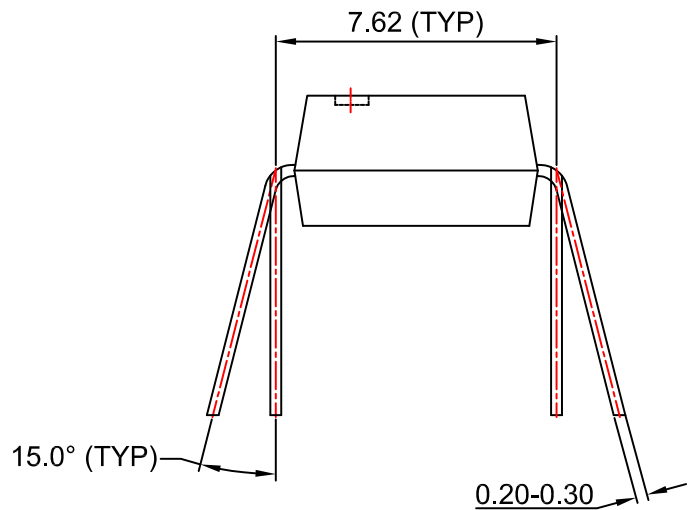
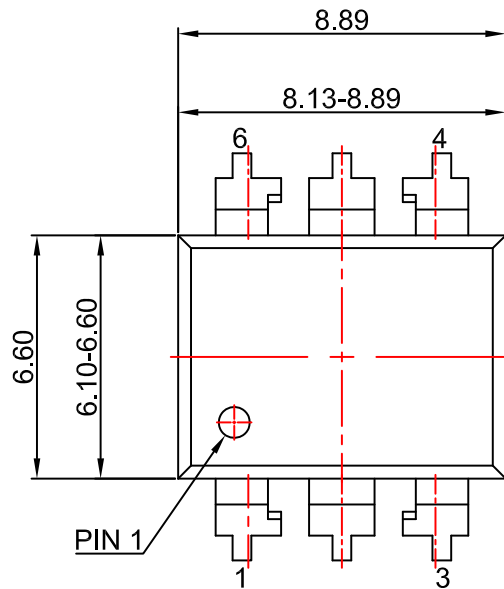
## PACKAGE DIMENSIONS

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### NOTES:

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- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

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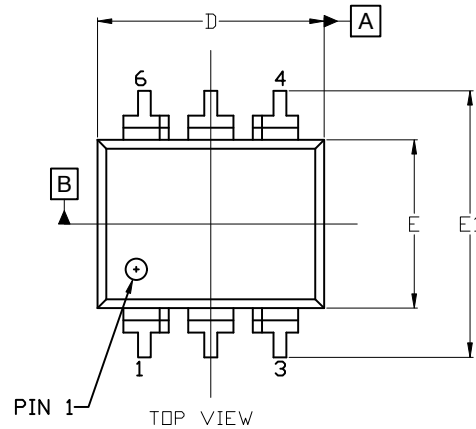
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#### CASE 646BY

#### ISSUE A

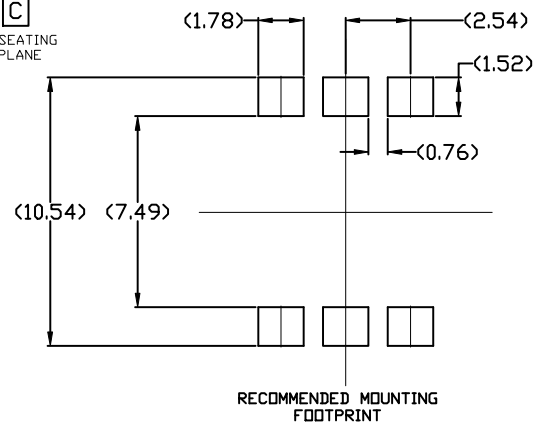
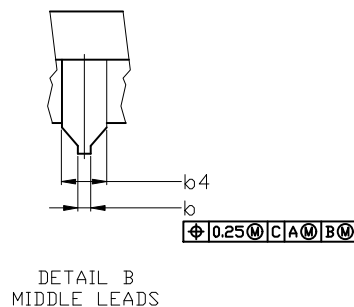
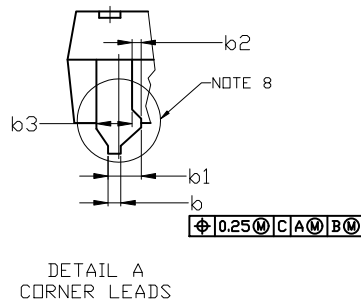
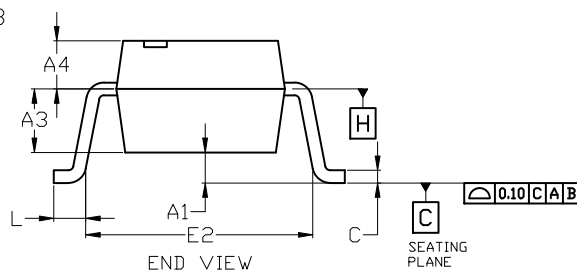
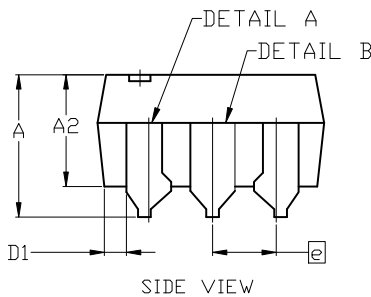
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#### NOTES:

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 IS 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, SOLDERM/D.

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# MECHANICAL CASE OUTLINE

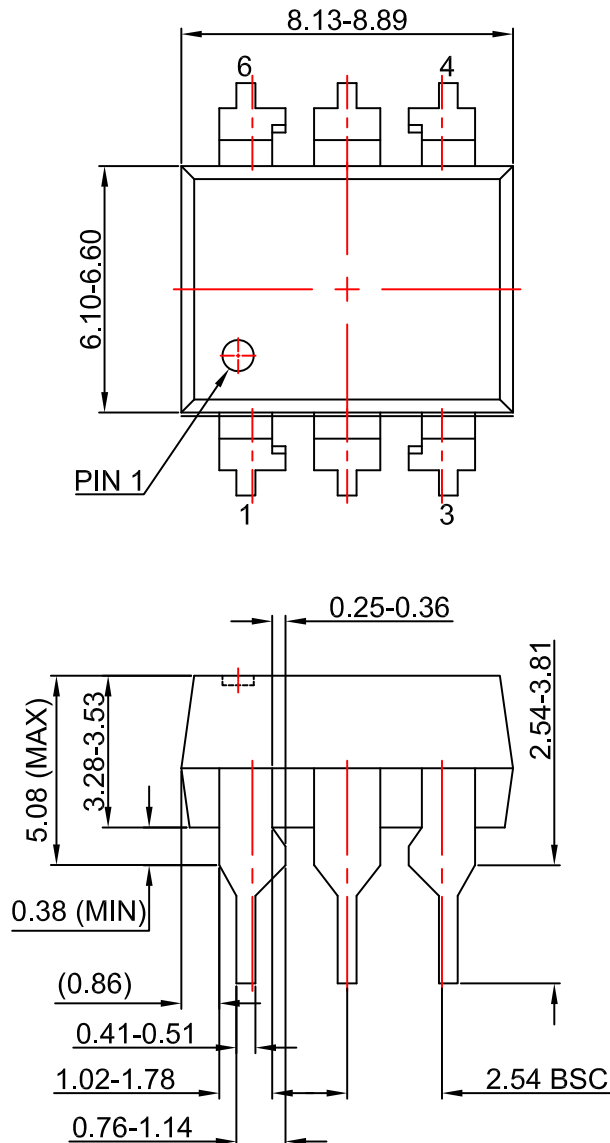
## PACKAGE DIMENSIONS

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