

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## 6-Pin DIP Random-Phase Triac Driver Output Optocoupler (250/400 V Peak)

### Description

The MOC301XM and MOC302XM series are optically isolated triac driver devices. These devices contain a GaAs infrared emitting diode and a light activated silicon bilateral switch, which functions like a triac. They are designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 115 V<sub>AC</sub> operations.

### Features

- Excellent I<sub>FT</sub> Stability – IR Emitting Diode Has Low Degradation
- Peak Blocking Voltage
  - ◆ 250 V, MOC301XM
  - ◆ 400 V, MOC302XM
- Safety and Regulatory Approvals
  - ◆ UL1577, 4,170 V<sub>ACRMS</sub> for 1 Minute
  - ◆ DIN EN/IEC60747-5-5
- These are Pb-Free Devices

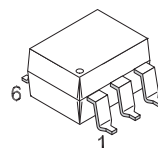
### Applications

- Industrial Controls
- Solenoid/Valve Controls
- Traffic Lights
- Static AC Power Switch
- Vending Machines
- Incandescent Lamp Dimmers
- Solid State Relay
- Motor Control
- Lamp Ballasts

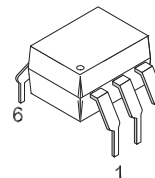


ON Semiconductor®

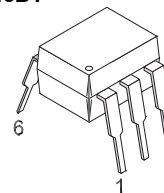
[www.onsemi.com](http://www.onsemi.com)



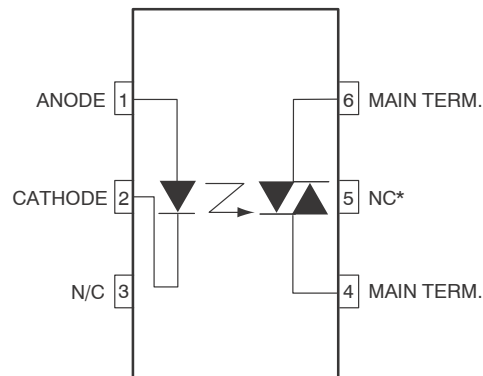
PDIP6 8.51x6.35, 2.54P  
CASE 646BY



PDIP6 8.51x6.35, 2.54P  
CASE 646BZ



PDIP6 8.51x6.35, 2.54P  
CASE 646BX



\*DO NOT CONNECT  
(TRIAC SUBSTRATE)

Figure 1. Schematic

### ORDERING INFORMATION

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

**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                 |

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

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

| Symbol | Parameters | Device | Value | Unit |
|--------|------------|--------|-------|------|
|--------|------------|--------|-------|------|

### Total Device

|                  |  |     |                    |       |
|------------------|--|-----|--------------------|-------|
| T <sub>STG</sub> | Storage Temperature                            | All | -40 to 150         | °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 | 330                | mW    |
|                  | Derate Above 25°C                              |     | 4.4                | mW/°C |

### Emitter

|                |   |     |      |       |
|----------------|---|-----|------|-------|
| I <sub>F</sub> | Continuous Forward Current              | All | 60   | mA    |
| V <sub>R</sub> | Reverse Voltage                         | All | 3    | V     |
| P <sub>D</sub> | Total Power Dissipation at 25°C Ambient | All | 100  | mW    |
|                | Derate Above 25°C                       |     | 1.33 | mW/°C |

### Detector

|                  |  |  |     |       |
|------------------|--|--|-----|-------|
| V <sub>DRM</sub> | Off-State Output Terminal Voltage                    | MOC3010M, MOC3011M, MOC3012M           | 250 | V     |
|                  |  | MOC3020M, MOC3021M, MOC3022M, MOC3023M | 400 |       |
| I <sub>TSM</sub> | Peak Repetitive Surge Current (PW = 100 μs, 120 pps) | All                                    | 1   | A     |
| P <sub>D</sub>   | Total Power Dissipation at 25°C Ambient              | All                                    | 300 | mW    |
|                  | Derate Above 25°C                                    |  | 4   | 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.

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$  unless otherwise specified

### INDIVIDUAL COMPONENT CHARACTERISTICS

| Symbol           | Parameters                              | Test Conditions                               | Device | Min. | Typ. | Max. | Unit          |
|------------------|---|---|--------|------|------|------|---------------|
| <b>Emitter</b>   |   |   |        |      |      |      |               |
| $V_F$            | Input Forward Voltage                   | $I_F = 10\text{ mA}$                          | All    |      | 1.15 | 1.50 | V             |
| $I_R$            | Reverse Leakage Current                 | $V_R = 3\text{ V}, T_A = 25^\circ\text{C}$    | All    |      | 0.01 | 100  | $\mu\text{A}$ |
| <b>Detector</b>  |   |   |        |      |      |      |               |
| $I_{\text{DRM}}$ | Peak Blocking Current, Either Direction | Rated $V_{\text{DRM}}, I_F = 0^{(1)}$         | All    |      | 10   | 100  | nA            |
| $V_{\text{TM}}$  | Peak On-State Voltage, Either Direction | $I_{\text{TM}} = 100\text{ mA peak}, I_F = 0$ | All    |      | 1.8  | 3.0  | V             |

1. Test voltage must be applied within dv/dt rating.

### TRANSFER CHARACTERISTICS

| Symbol          | DC Characteristics                | Test Conditions              | Device   | Min. | Typ. | Max. | Unit          |
|-----------------|-----------------------------------|------------------------------|----------|------|------|------|---------------|
| $I_{\text{FT}}$ | LED Trigger Current               | Voltage = 3 V <sup>(2)</sup> | MOC3020M |      |      | 30   | mA            |
|                 |                                   |                              | MOC3010M |      |      | 15   |               |
|                 |                                   |                              | MOC3021M |      |      |      |               |
|                 |                                   |                              | MOC3011M |      |      | 10   |               |
|                 |                                   |                              | MOC3022M |      |      |      |               |
|                 |                                   |                              | MOC3012M |      |      | 5    |               |
|                 |                                   |                              | MOC3023M |      |      |      |               |
| $I_H$           | Holding Current, Either Direction |                              | All      |      | 100  |      | $\mu\text{A}$ |

2. All devices are guaranteed to trigger at an  $I_F$  value less than or equal to max  $I_{\text{FT}}$ . Therefore, recommended operating  $I_F$  lies between max  $I_{\text{FT}}$  (30 mA for MOC3020M, 15 mA for MOC3010M and MOC3021M, 10 mA for MOC3011M and MOC3022M, 5 mA for MOC3012M and MOC3023M) and absolute maximum  $I_F$  (60 mA).

### ISOLATION CHARACTERISTICS

| Symbol           | Parameters                       | Test Conditions       | Device | Min. | Typ. | Max. | Unit               |
|------------------|----------------------------------|-----------------------|--------|------|------|------|--------------------|
| $V_{\text{ISO}}$ | Isolation Voltage <sup>(3)</sup> | $t = 1\text{ Minute}$ | All    | 4170 |      |      | $V_{\text{ACRMS}}$ |

3. Isolation voltage,  $V_{\text{ISO}}$ , is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common, and pins 4, 5 and 6 are common.

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.

TYPICAL PERFORMANCE CURVES

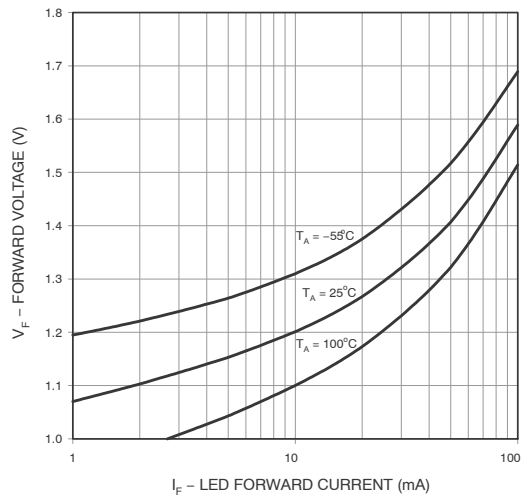


Figure 2. LED Forward Voltage vs. Forward Current

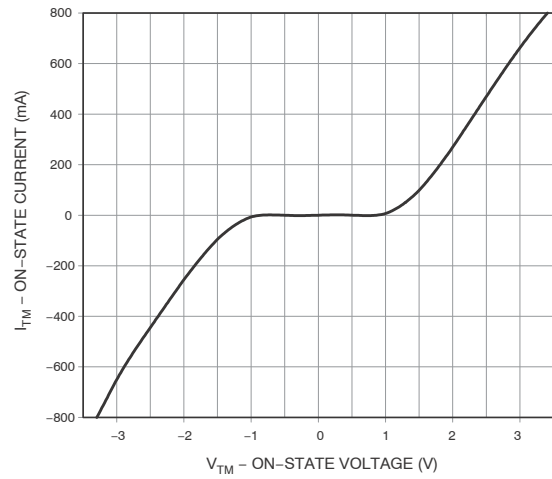


Figure 3. On-State Characteristics

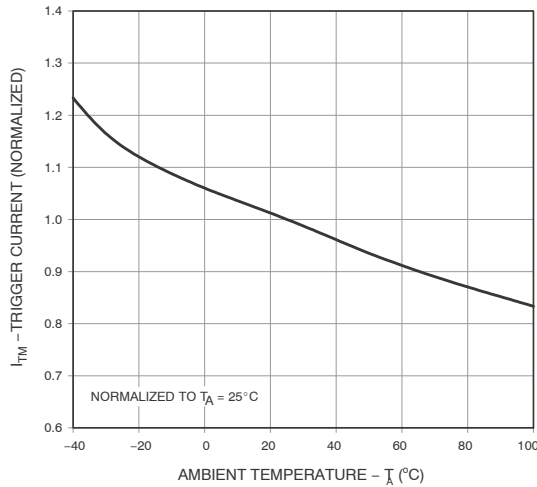


Figure 4. Trigger Current vs. Ambient Temperature

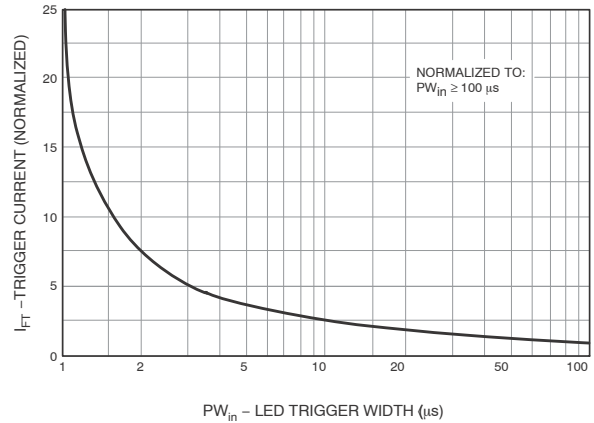


Figure 5. LED Current Required to Trigger vs. LED Pulse Width

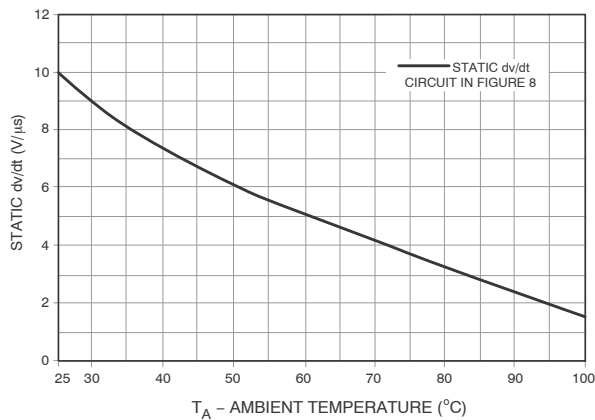


Figure 6. dv/dt vs. Temperature

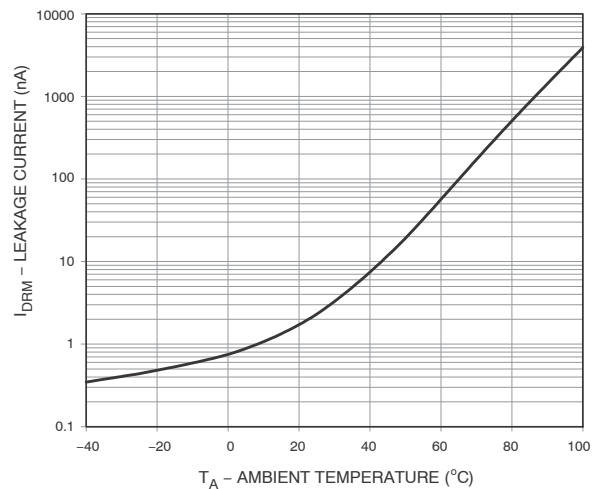
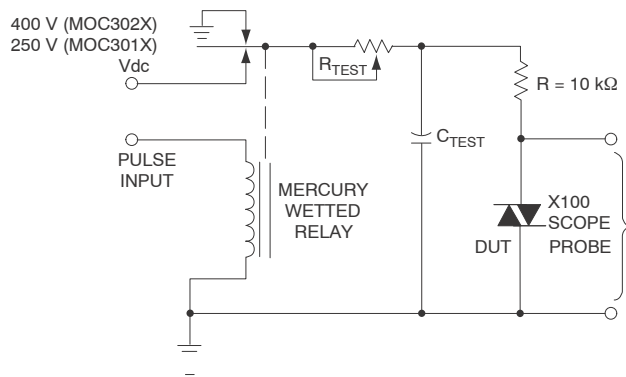
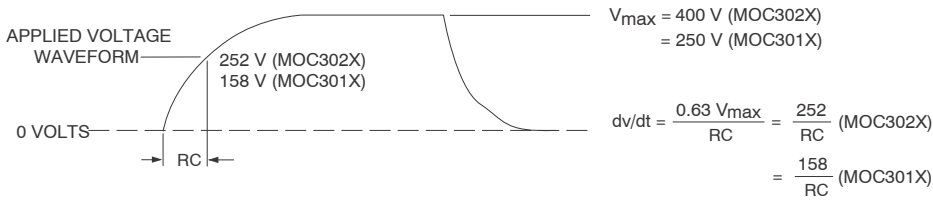


Figure 7. Leakage Current,  $I_{DRM}$  vs. Temperature

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M



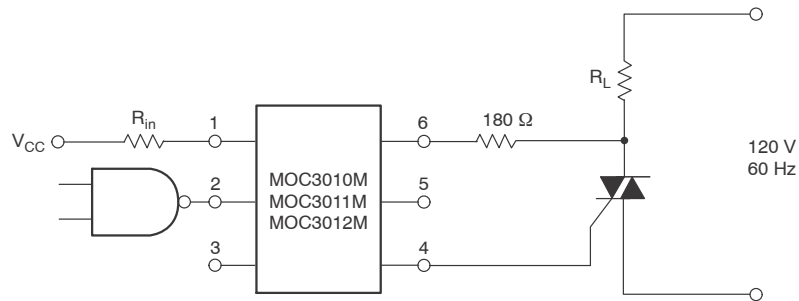
1. The mercury wetted relay provides a high speed repeated pulse to the D.U.T.
2. 100x scope probes are used, to allow high speeds and voltages.
3. The worst-case condition for static dv/dt is established by triggering the DUT with a normal LED input current, then removing the current. The variable  $R_{TEST}$  allows the dv/dt to be gradually increased until the DUT continues to trigger in response to the applied voltage pulse, even after the LED current has been removed. The dv/dt is then decreased until the DUT stops triggering.  $\tau_{RC}$  is measured at this point and recorded.



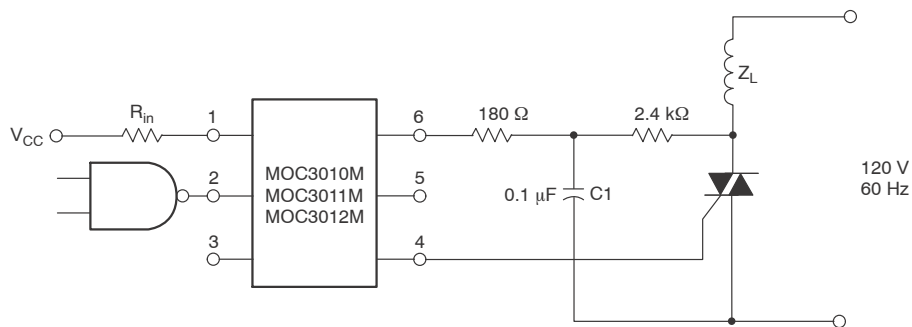
**Note:**

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

**Figure 8. Static dv/dt Test Circuit**



**Figure 9. Resistive Load**



**Figure 10. Inductive Load with Sensitive Gate Triac ( $I_{GT} \leq 15 \text{ mA}$ )**

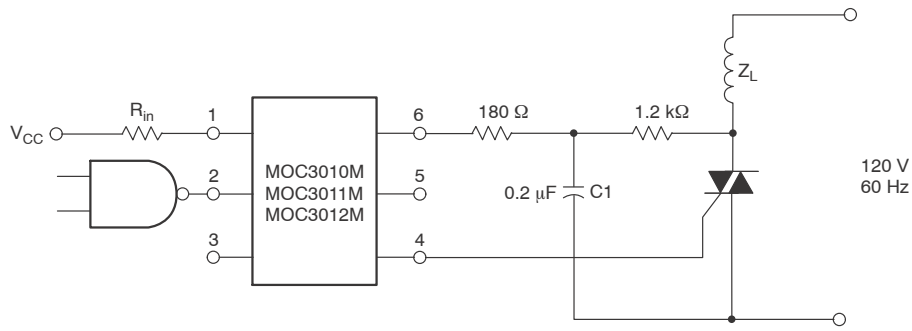
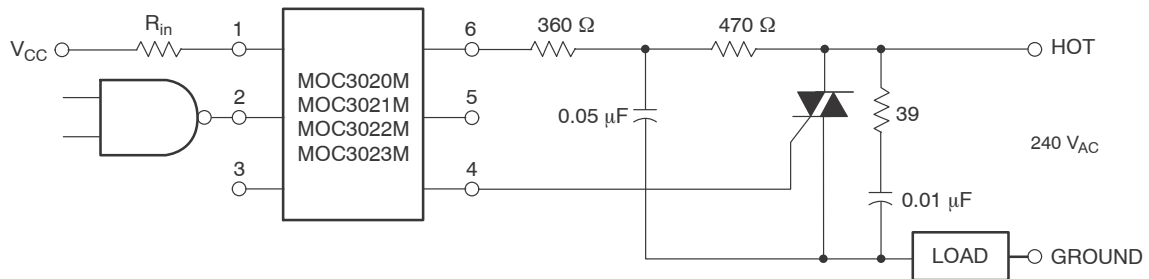


Figure 11. Inductive Load with Sensitive Gate Triac ( $I_{GT} \leq 15 \text{ mA}$ )



In this circuit the “hot” side of the line is switched and the load connected to the cold or ground side. The 39  $\Omega$  resistor and 0.01  $\mu\text{F}$  capacitor are for snubbing of the triac, and the 470  $\Omega$  resistor and 0.05  $\mu\text{F}$  capacitor are for snubbing the coupler. These components may or may not be necessary depending upon the particular and load used.

Figure 12. Typical Application Circuit

Reflow Profile

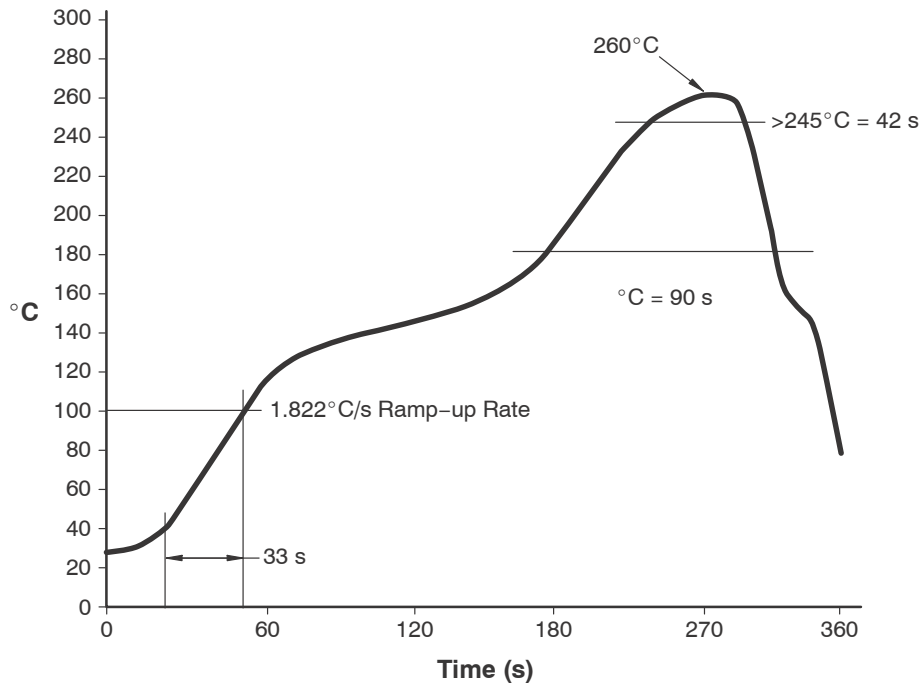


Figure 13. Reflow Profile

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## ORDERING INFORMATION

| Part Number  | Package  | Shipping                 |
|--------------|--|--------------------------|
| MOC3010M     | DIP 6-Pin  | 50 Units / Tube          |
| MOC3010SM    | SMT 6-Pin (Lead Bend)                                    | 50 Units / Tube          |
| MOC3010SR2M  | SMT 6-Pin (Lead Bend)                                    | 1000 Units / Tape & Reel |
| MOC3010VM    | DIP 6-Pin, DIN EN/IEC60747-5-5 Option                    | 50 Units / Tube          |
| MOC3010SVM   | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | 50 Units / Tube          |
| MOC3010SR2VM | SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option        | 1000 Units / Tape & Reel |
| MOC3010TVM   | DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option | 50 Units / Tube          |

NOTE: The product orderable part number system listed in this table also applies to the MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, and MOC3023M product families.

## MARKING INFORMATION

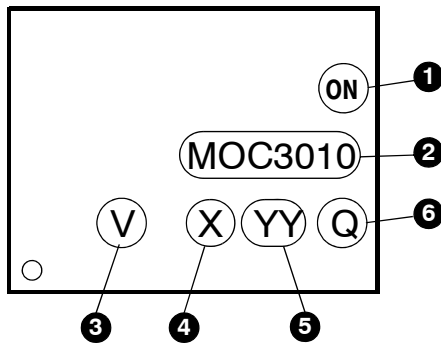


Figure 14. Top Marking

| Top Mark Definitions |   |
|----------------------|---|
| 1                    | ON Semiconductor Logo   |
| 2                    | Device Number   |
| 3                    | DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option) |
| 4                    | One-Digit Year Code, e.g., '5'  |
| 5                    | Two-Digit Work Week, Ranging from '01' to '53'                                  |
| 6                    | Assembly Package Code   |



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



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

|                         |                               |  |
|-------------------------|-------------------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13449G</b>            | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>PDIP6 8.51X6.35, 2.54P</b> | <b>PAGE 1 OF 1</b>   |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



### PDIP6 8.51x6.35, 2.54P

#### CASE 646BY

#### ISSUE A

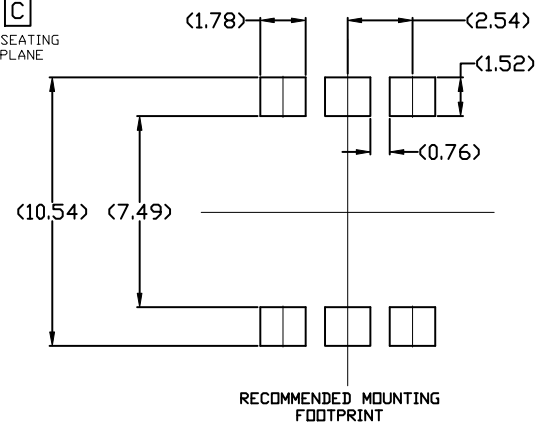
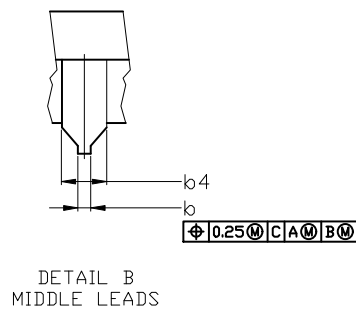
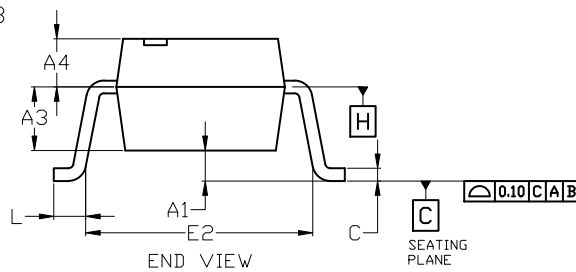
DATE 15 JUL 2019



**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.

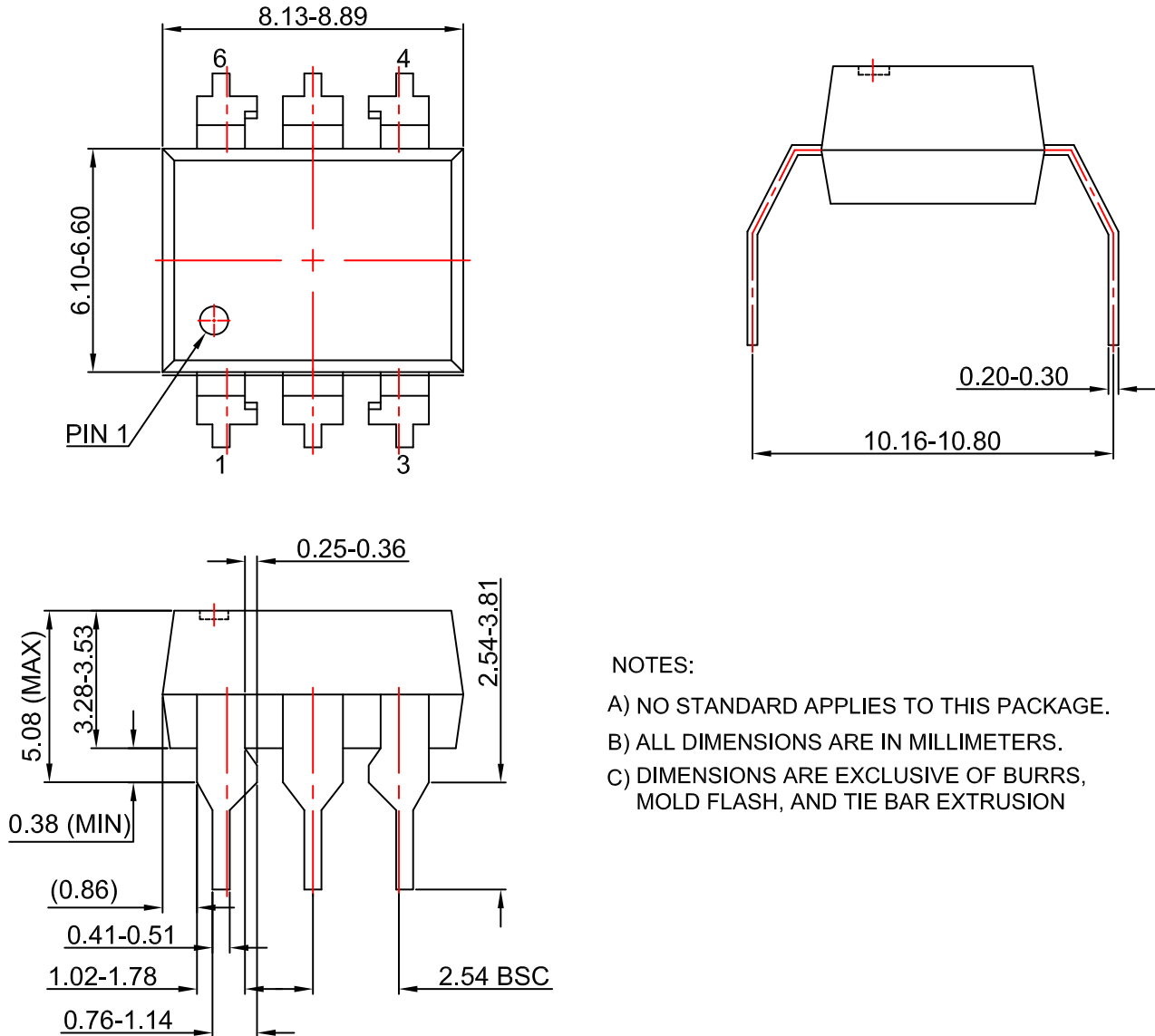
|                         |                               |  |
|-------------------------|-------------------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13450G</b>            | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>PDIP6 8.51x6.35, 2.54P</b> | <b>PAGE 1 OF 1</b>   |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

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

PDIP6 8.51x6.35, 2.54P  
CASE 646BZ  
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

|                         |                               |  |
|-------------------------|-------------------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13451G</b>            | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>PDIP6 8.51X6.35, 2.54P</b> | <b>PAGE 1 OF 1</b>   |

ON Semiconductor and **ON** are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.