

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

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

## 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>AC</sub><sub>RMS</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

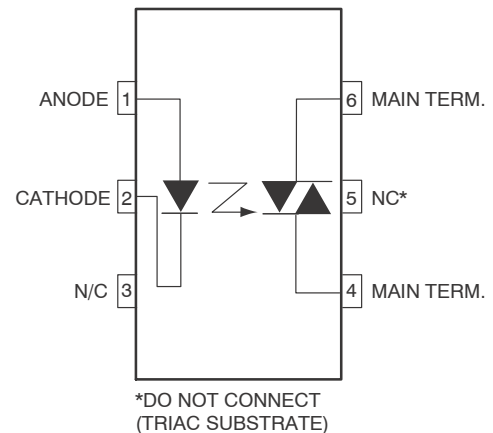
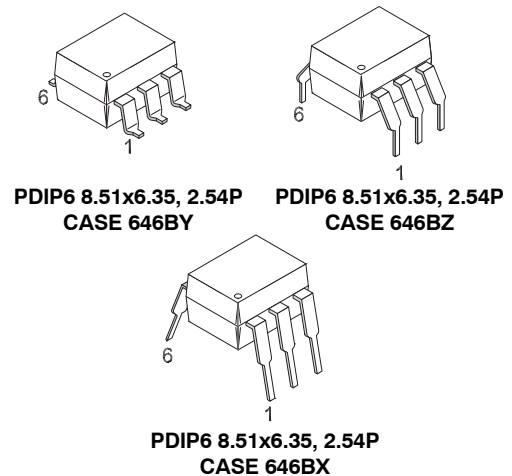


Figure 1. Schematic

## ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

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

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

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

### Total Device

|                  |                                                              |     |                    |                      |
|------------------|--------------------------------------------------------------|-----|--------------------|----------------------|
| $T_{\text{STG}}$ | Storage Temperature                                          | All | -40 to 125         | $^\circ\text{C}$     |
| $T_{\text{OPR}}$ | Operating Temperature                                        | All | -40 to 85          | $^\circ\text{C}$     |
| $T_J$            | Junction Temperature Range                                   | All | -40 to 100         | $^\circ\text{C}$     |
| $T_{\text{SOL}}$ | Lead Solder Temperature                                      | All | 260 for 10 seconds | $^\circ\text{C}$     |
| $P_D$            | Total Device Power Dissipation at $25^\circ\text{C}$ Ambient | All | 330                | mW                   |
|                  | Derate Above $25^\circ\text{C}$                              |     | 4.4                | mW/ $^\circ\text{C}$ |

### Emitter

|       |                                                       |     |      |                      |
|-------|-------------------------------------------------------|-----|------|----------------------|
| $I_F$ | Continuous Forward Current                            | All | 60   | mA                   |
| $V_R$ | Reverse Voltage                                       | All | 3    | V                    |
| $P_D$ | Total Power Dissipation at $25^\circ\text{C}$ Ambient | All | 100  | mW                   |
|       | Derate Above $25^\circ\text{C}$                       |     | 1.33 | mW/ $^\circ\text{C}$ |

### Detector

|                  |                                                                  |                                        |     |                      |
|------------------|------------------------------------------------------------------|----------------------------------------|-----|----------------------|
| $V_{\text{DRM}}$ | Off-State Output Terminal Voltage                                | MOC3010M, MOC3011M, MOC3012M           | 250 | V                    |
|                  |                                                                  | MOC3020M, MOC3021M, MOC3022M, MOC3023M | 400 |                      |
| $I_{\text{TSM}}$ | Peak Repetitive Surge Current (PW = 100 $\mu\text{s}$ , 120 pps) | All                                    | 1   | A                    |
| $P_D$            | Total Power Dissipation at $25^\circ\text{C}$ Ambient            | All                                    | 300 | mW                   |
|                  | Derate Above $25^\circ\text{C}$                                  |                                        | 4   | mW/ $^\circ\text{C}$ |

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               |
| dv/dt            | Critical Rate of Rise of Off-State Voltage | Rated $V_{\text{DRM}}$ , $I_F = 0$            | All    | 1000 |      |      | V/ $\mu\text{s}$ |

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 |      |      |      |               |
| $V_{\text{TM}}$ | Peak On-State Voltage, Either Direction | $I_{\text{TM}} = 100\text{ mA peak}$ ,<br>$I_F = \text{Rated } I_{\text{FT}}$ | All      |      | 1.8  | 3.0  | V             |
| $I_H$           | 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).

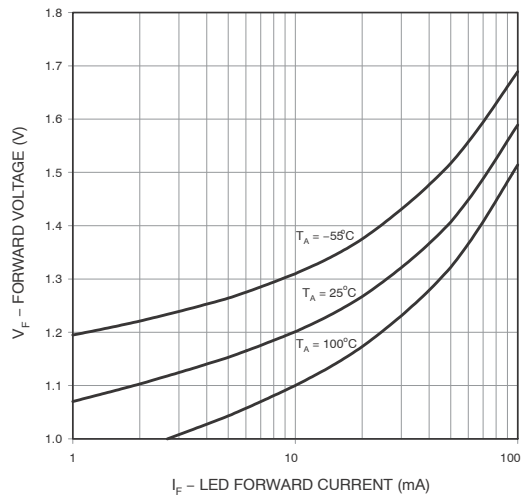
### ISOLATION CHARACTERISTICS

| 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**



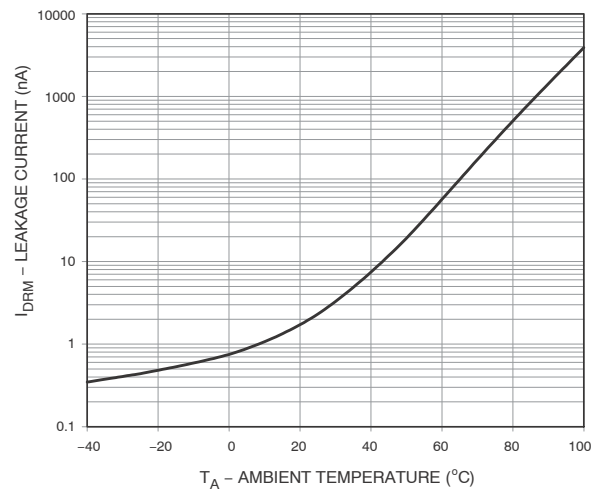
**Figure 3. On-State Characteristics**



**Figure 4. Trigger Current vs. Ambient Temperature**



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



**Figure 6. Leakage Current,  $I_{DRM}$  vs. Temperature**

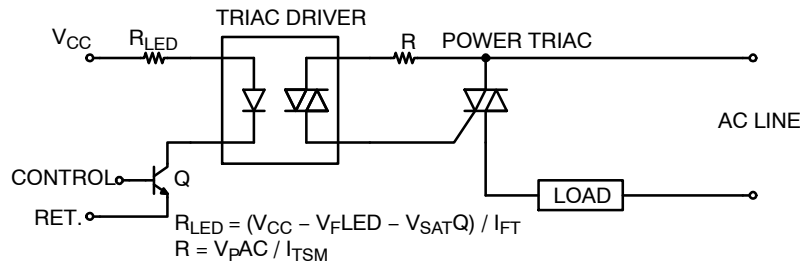


Figure 7. Basic Driver Circuit



Typical Snubber values  $R_S = 33 \Omega$ ,  $C_S = 0.01 \mu F$   
 MOV (Metal Oxide Varistor) protects power triac and  
 driver from transient overvoltages  $> V_{DRM \max}$

Figure 8. Triac Driver Circuit for Noisy Environments

## Reflow Profile



Figure 9. Reflow Profile

## 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 10. 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                                                           |

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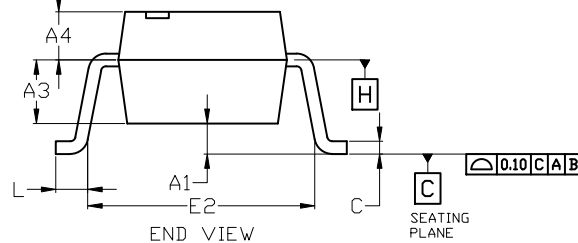
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4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS IS LOCATED BY LOCATING THE CENTER OF 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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