

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M 6-Pin DIP Random-Phase Optoisolators Triac Driver Output (250/400 Volt Peak)

## Features

- Excellent  $I_{FT}$  Stability—IR Emitting Diode Has Low Degradation
- High Isolation Voltage—Minimum 5300  $V_{AC(RMS)}$
- Underwriters Laboratory (UL) Recognized—File #E90700
- Peak Blocking Voltage
  - 250 V, MOC301XM
  - 400 V, MOC302XM
- VDE Recognized (File #94766)
  - Ordering Option V (e.g., MOC3023VM)

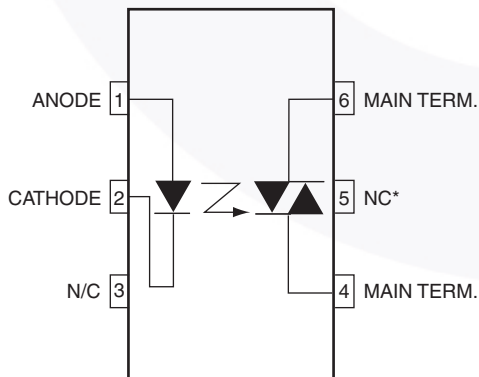
## Applications

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

## 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  $V_{AC}$  operations.

## Schematic



\*DO NOT CONNECT  
(TRIAC SUBSTRATE)

Figure 1. Schematic

## Package Outlines

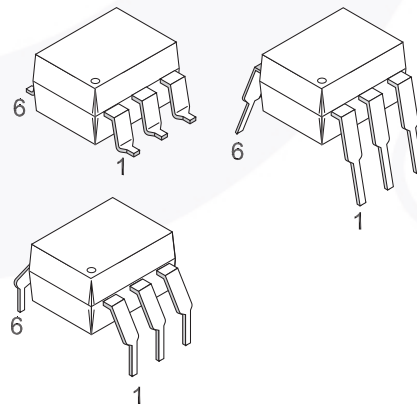


Figure 2. Package Outlines

## Safety and Insulation Ratings

As per DIN EN/IEC60747-5-2. This optocoupler is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings is ensured by means of protective circuits.

| Symbol            | Parameter  | Min.            | Typ.     | Max. | Unit              |
|-------------------|--|-----------------|----------|------|-------------------|
|                   | Installation Classifications per DIN VDE 0110/1.89 see Table 1   |                 |          |      |                   |
|                   | For Rated Mains Voltage < 150 V <sub>RMS</sub>   |                 | I-IV     |      |                   |
|                   | For Rated Mains Voltage < 300 V <sub>RMS</sub>   |                 | I-IV     |      |                   |
|                   | Climatic Classification  |                 | 40/85/21 |      |                   |
|                   | Pollution Degree (DIN VDE 0110/1.89)   |                 | 2        |      |                   |
| CTI               | Comparative Tracking Index   | 175             |          |      |                   |
| V <sub>PR</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            |          |      |                   |
|                   | Input to Output Test Voltage, Method a, V <sub>IORM</sub> × 1.5 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 60 s, Partial Discharge < 5 pC  | 1275            |          |      |                   |
| 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 T, 0.4" Lead Spacing)   | 10.16           |          |      | mm                |
|                   | 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

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.  $T_A = 25^\circ\text{C}$  unless otherwise specified.

| Symbol              | Parameters  | Device            | Value                 | Units                |
|---------------------|---|-------------------|-----------------------|----------------------|
| <b>TOTAL DEVICE</b> |   |                   |                       |                      |
| $T_{STG}$           | Storage Temperature   | All               | -40 to +150           | $^\circ\text{C}$     |
| $T_{OPR}$           | Operating Temperature   | All               | -40 to +85            | $^\circ\text{C}$     |
| $T_{SOL}$           | Lead Solder Temperature   | All               | 260 for<br>10 seconds | $^\circ\text{C}$     |
| $T_J$               | Junction Temperature Range  | All               | -40 to +100           | $^\circ\text{C}$     |
| $V_{ISO}$           | Isolation Surge Voltage <sup>(1)</sup><br>(Peak AC Voltage, 60 Hz, 1 Second Duration)           | All               | 7500                  | Vac(pk)              |
| $P_D$               | Total Device Power Dissipation at $25^\circ\text{C}$ Ambient<br>Derate Above $25^\circ\text{C}$ | All               | 330                   | mW                   |
|                     |   |                   | 4.4                   | mW/ $^\circ\text{C}$ |
| <b>EMITTER</b>      |   |                   |                       |                      |
| $I_F$               | Continuous Forward Current  | All               | 60                    | mA                   |
| $V_R$               | Reverse Voltage   | All               | 3                     | V                    |
| $P_D$               | Total Power Dissipation at $25^\circ\text{C}$ Ambient<br>Derate Above $25^\circ\text{C}$        | All               | 100                   | mW                   |
|                     |   |                   | 1.33                  | mW/ $^\circ\text{C}$ |
| <b>DETECTOR</b>     |   |                   |                       |                      |
| $V_{DRM}$           | Off-State Output Terminal Voltage   | MOC3010M/1M/2M    | 250                   | V                    |
|                     |   | MOC3020M/1M/2M/3M | 400                   |                      |
| $I_{TSM}$           | Peak Repetitive Surge Current<br>(PW = 100 $\mu\text{s}$ , 120 pps)                             | All               | 1                     | A                    |
| $P_D$               | Total Power Dissipation at $25^\circ\text{C}$ Ambient<br>Derate Above $25^\circ\text{C}$        | All               | 300                   | mW                   |
|                     |   |                   | 4                     | mW/ $^\circ\text{C}$ |

### Note:

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

## Electrical Characteristics

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

### Individual Component Characteristics

| Symbol           | Parameters                              | Test Conditions                               | Device | Min. | Typ. | Max. | Units         |
|------------------|---|---|--------|------|------|------|---------------|
| <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 $V_{\text{DRM}}, I_F = 0^{(2)}$         | 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             |

### Transfer Characteristics

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

#### Notes:

- Test voltage must be applied within  $dv/dt$  rating.
- 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).

## Typical Performance Curves

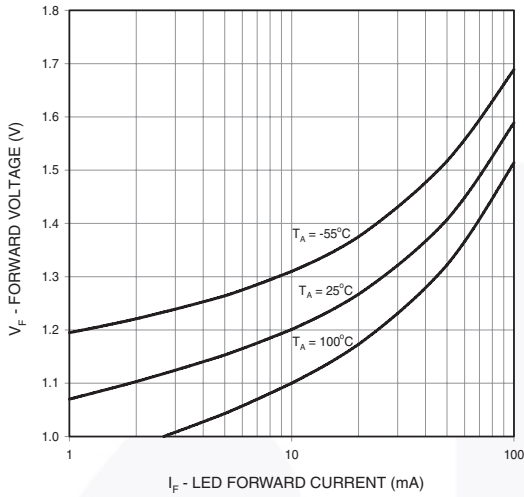


Figure 3. LED Forward Voltage vs. Forward Current

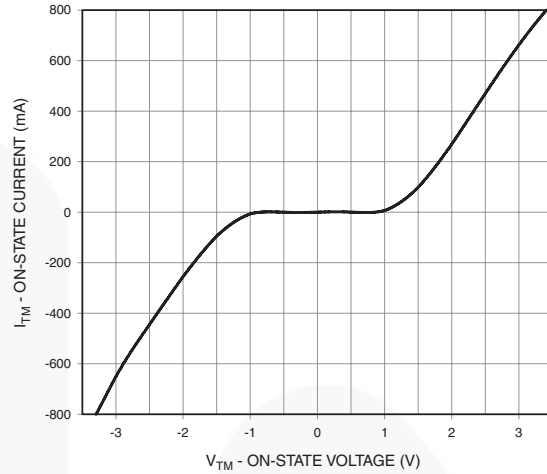


Figure 4. On-State Characteristics

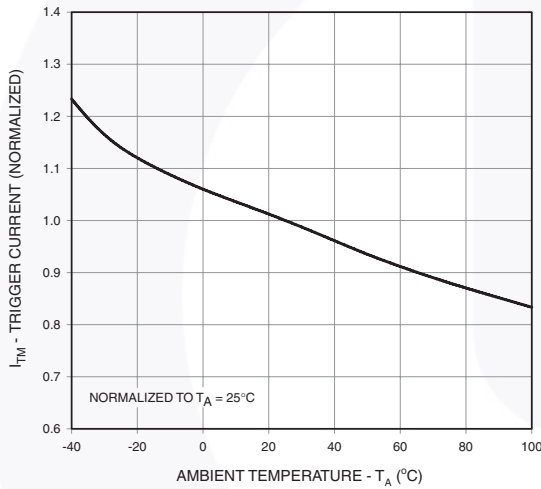


Figure 5. Trigger Current vs. Ambient Temperature

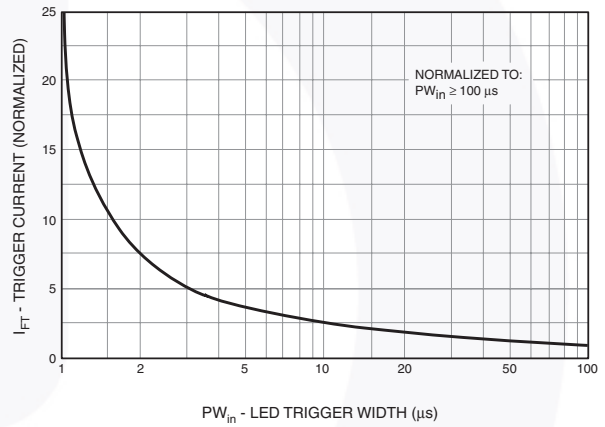


Figure 6. LED Current Required to Trigger vs. LED Pulse Width

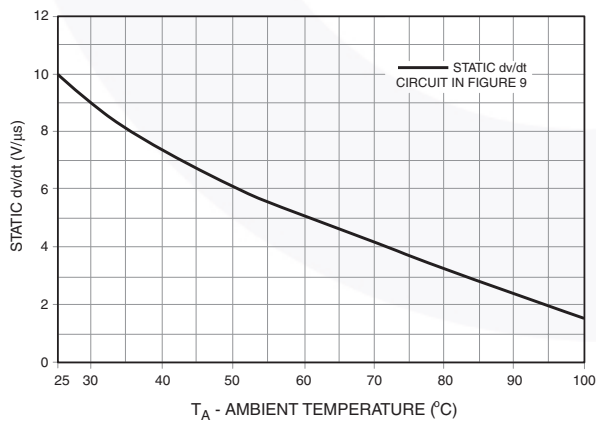


Figure 7. dv/dt vs. Temperature

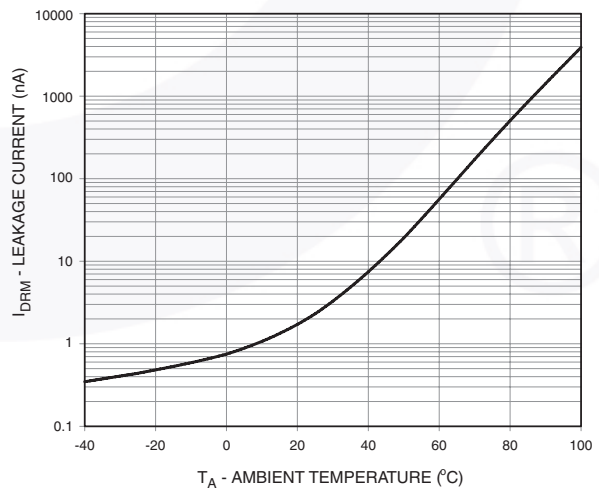
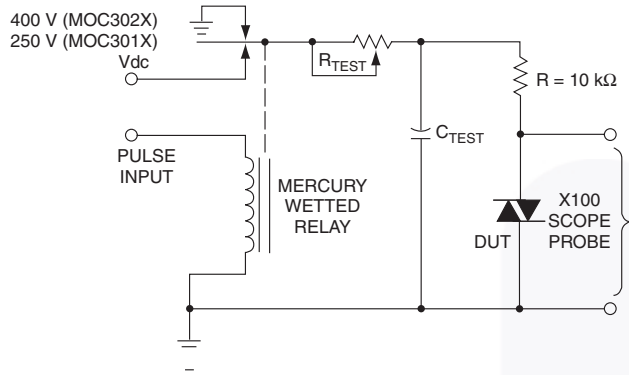
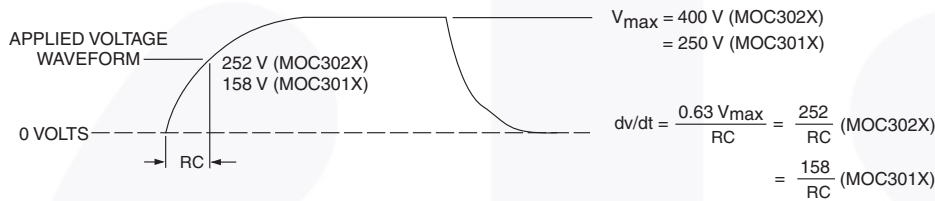


Figure 8. Leakage Current,  $I_{DRM}$  vs. Temperature



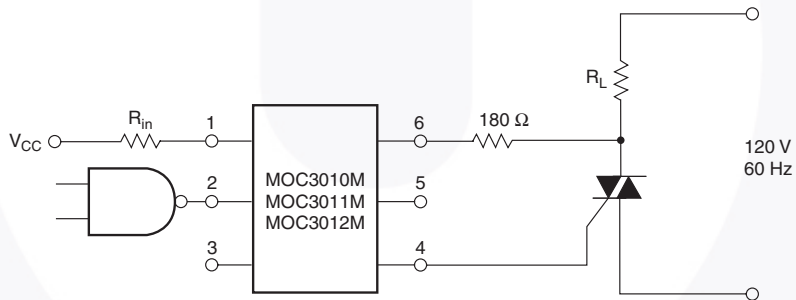
1. The mercury wetted relay provides a high speed repeated pulse to the D.U.T.
2. 100x scope probes are used, to allow high speeds and voltages.
3. The worst-case condition for static dv/dt is established by triggering the DUT with a normal LED input current, then removing the current. The variable  $R_{TEST}$  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.



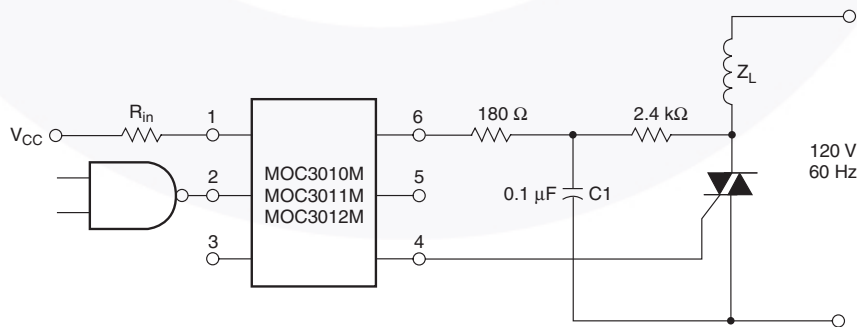
**Note:**

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

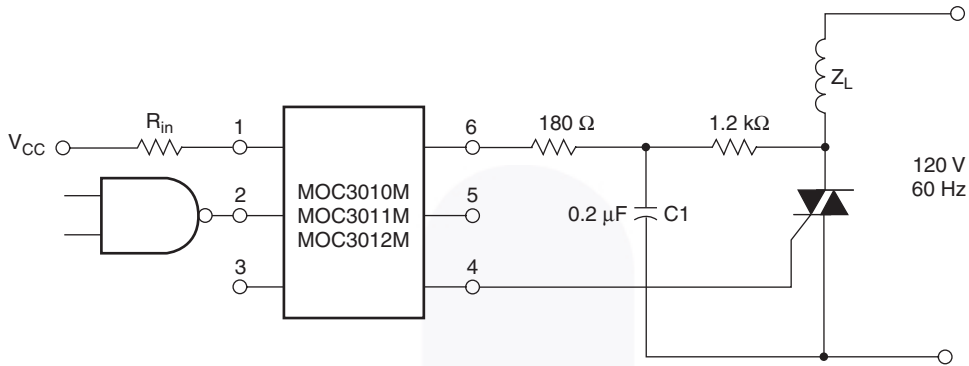
**Figure 9. Static dv/dt Test Circuit**



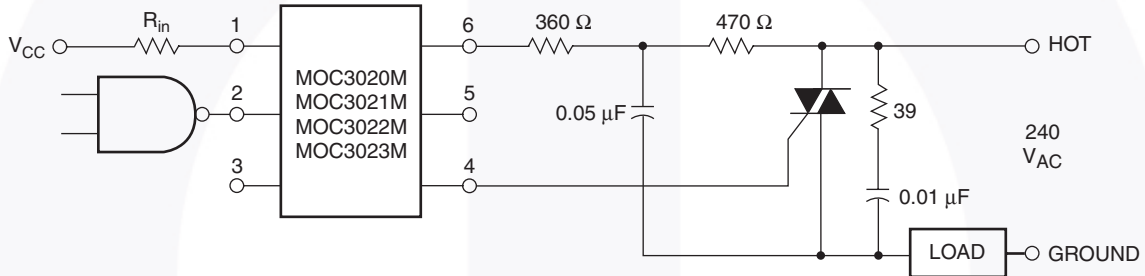
**Figure 10. Resistive Load**



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



**Figure 12. 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 13. Typical Application Circuit**

### Reflow Profile

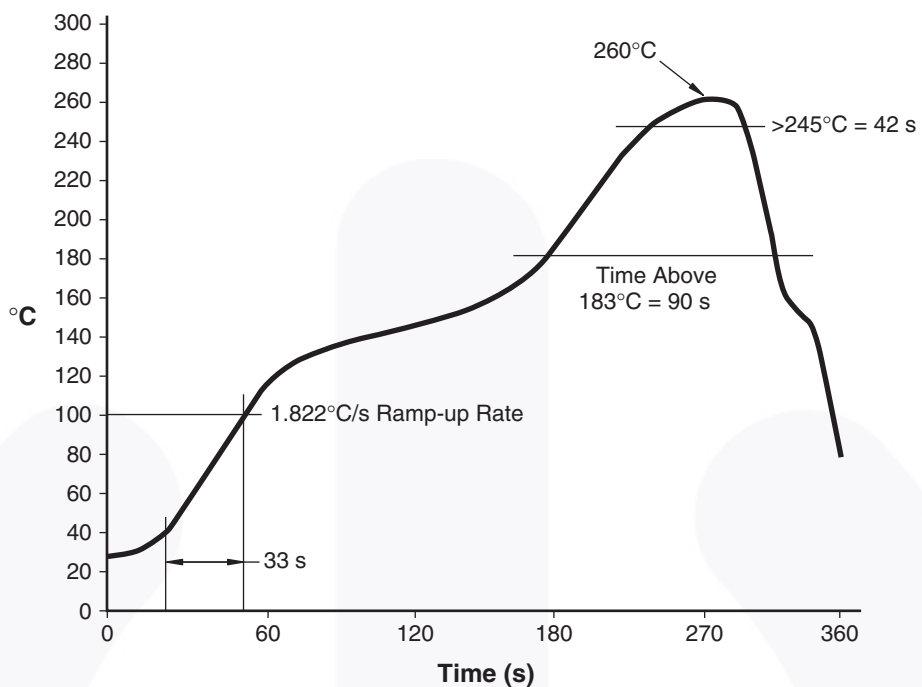


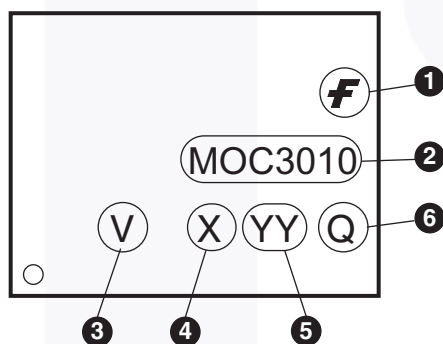
Figure 14. Reflow Profile



## Ordering Information

| Option    | Order Entry Identifier (Example) | Description                            |
|-----------|----------------------------------|--|
| No option | MOC3010M                         | Standard Through Hole Device           |
| S         | MOC3010SM                        | Surface Mount Lead Bend                |
| SR2       | MOC3010SR2M                      | Surface Mount; Tape and Reel           |
| T         | MOC3010TM                        | 0.4" Lead Spacing                      |
| V         | MOC3010VM                        | VDE 0884                               |
| TV        | MOC3010TVM                       | VDE 0884, 0.4" Lead Spacing            |
| SV        | MOC3010SVM                       | VDE 0884, Surface Mount                |
| SR2V      | MOC3010SR2VM                     | VDE 0884, Surface Mount, Tape and Reel |

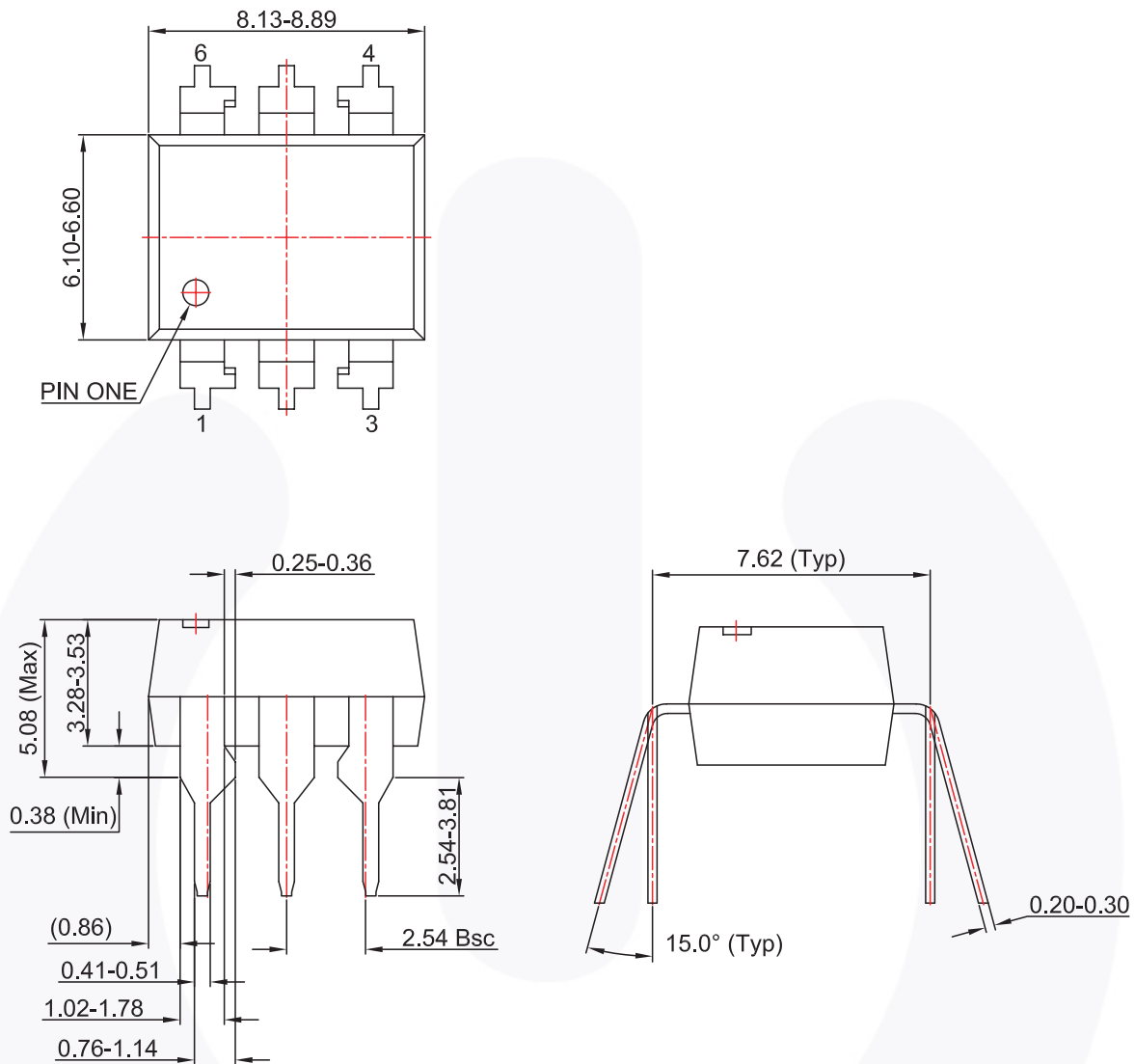
## Marking Information



| Definitions |  |
|-------------|--|
| 1           | Fairchild logo   |
| 2           | Device number  |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | One-digit year code, e.g., '3'   |
| 5           | Two-digit work week, ranging from '01' to '53'   |
| 6           | Assembly package code  |

\*Note – Parts that do not have the 'V' option (see definition 3 above) that are marked with date code '325' or earlier are marked in portrait format.

### Package Dimensions



**NOTES:**

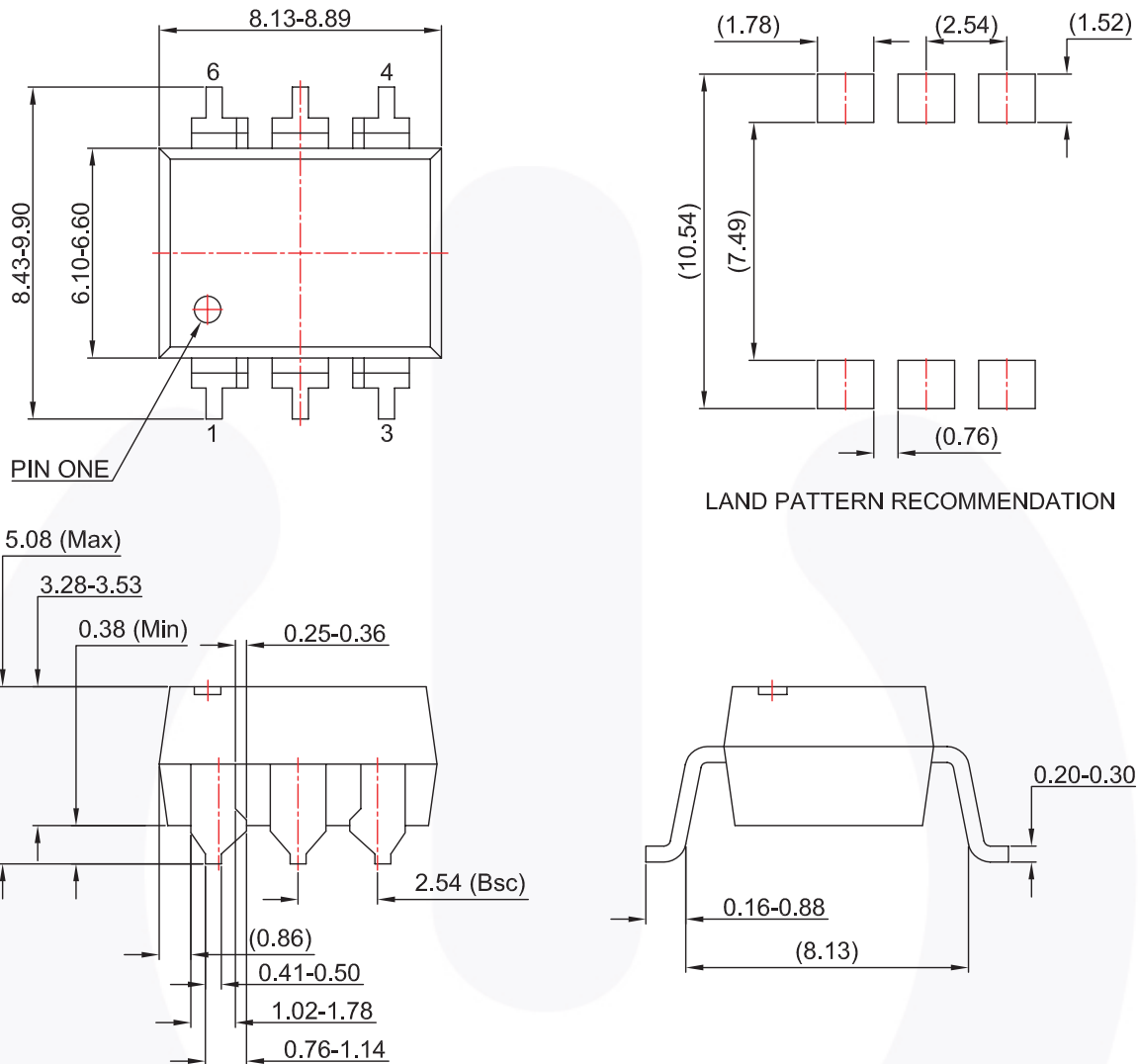
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06BREV3.

**Figure 15. 6-Pin DIP Through Hole**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:  
<http://www.fairchildsemi.com/dwg/N0/N06B.pdf>.

**Package Dimensions** (Continued)



**NOTES:**

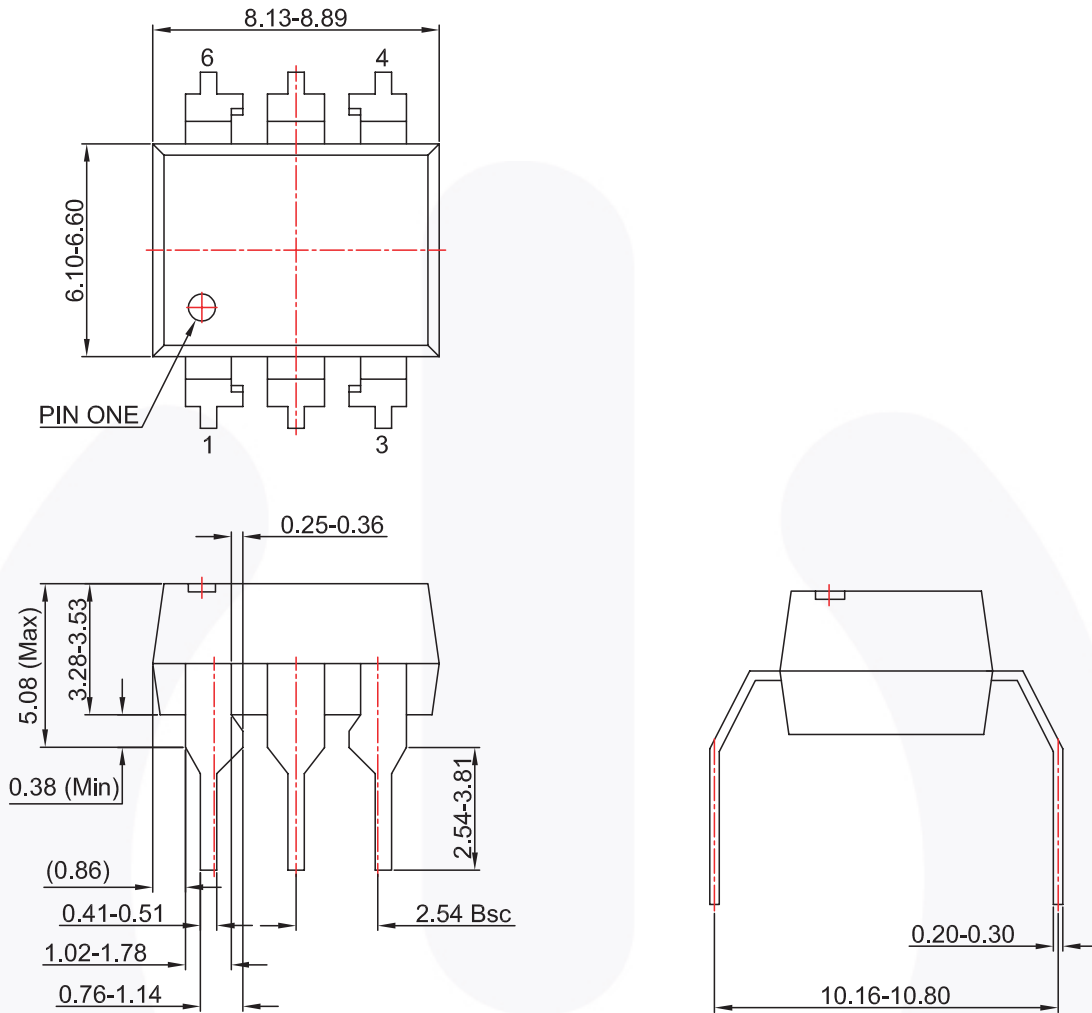
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION : MKT-N06CREV3.

**Figure 16. 6-Pin DIP Surface Mount**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:  
<http://www.fairchildsemi.com/dwg/N0/N06C.pdf>

**Package Dimensions** (Continued)



**NOTES:**

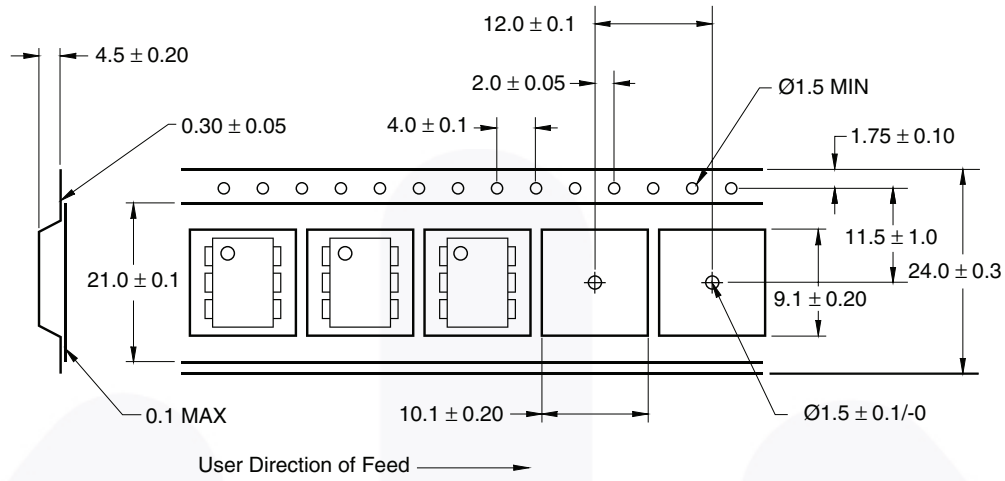
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION
- D) DRAWING FILENAME AND REVISION: MKT-N06DREV3.

**Figure 17. 6-Pin DIP 0.4" Lead Spacing**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:  
<http://www.fairchildsemi.com/dwg/N0/N06D.pdf>.

### Carrier Tape Specification








**Note:**  
All dimensions are in millimeters.

**Figure 18. Carrier Tape Specification**



**TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- |   |  |   |   |
|---|--|---|---|
| AccuPower™  | F-PFS™   |                                        | Sync-Lock™  |
| AX-CAP®*  | FRFET®   | PowerTrench®  |  |
| BitSiC™   | Global Power Resource™                         | PowerXS™  | TinyBoost®  |
| Build it Now™   | GreenBridge™                                   | Programmable Active Droop™  | TinyBuck®   |
| CorePLUS™   | Green FPS™                                     | QFET®   | TinyCalc™   |
| CorePOWER™  | Green FPS™ e-Series™                           | QS™   | TinyLogic®  |
| CROSSVOLT™  | Gmax™  | Quiet Series™   | TINYOPTO™   |
| CTL™  | GTO™   | RapidConfigure™   | TinyPower™  |
| Current Transfer Logic™   | IntelliMAX™                                    |  Saving our world, 1mW/W/kW at a time™ | TinyPWM™  |
| DEUXPEED®   | ISOPLANAR™                                     | SignalWise™   | TinyWire™   |
| Dual Cool™  | Making Small Speakers Sound Louder and Better™ | SmartMax™   | TranSiC™  |
| EcoSPARK®   | MegaBuck™                                      | SMART START™  | TriFault Detect™  |
| EfficientMax™   | MICROCOUPLER™                                  | Solutions for Your Success™   | TRUECURRENT®*   |
| ESBC™   | MicroFET™                                      | SPM®  | μSerDes™  |
|  | MicroPak™                                      | STEALTH™  |  |
| Fairchild®  | MicroPak2™                                     | SuperFET®   | UHC®  |
| Fairchild Semiconductor®  | MillerDrive™                                   | SuperSOT™-3   | Ultra FRFET™  |
| FACT Quiet Series™  | MotionMax™                                     | SuperSOT™-6   | UniFET™   |
| FACT®   | mWSaver®                                       | SuperSOT™-8   | VX™   |
| FAST®   | OptoHi™  | SupreMOS®   | VisualMax™  |
| FastvCore™  | OPTOLOGIC®                                     | SyncFET™  | VoltagePlus™  |
| FETBench™   | OPTOPLANAR®                                    |   | XS™   |
| FPS™  |  |   |   |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

**DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

**LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**ANTI-COUNTERFEITING POLICY**

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

| Datasheet Identification | Product Status        | Definition  |
|--------------------------|-----------------------|---|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.   |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.   |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.  |

Rev. I66