

# 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 VAC RMS
- Underwriters Laboratory (UL) recognized—File #E90700
- Peak blocking voltage
  - 250V-MOC301XM
  - 400V-MOC302XM
- VDE recognized (File #94766)
  - Ordering option V (e.g. MOC3023VM)

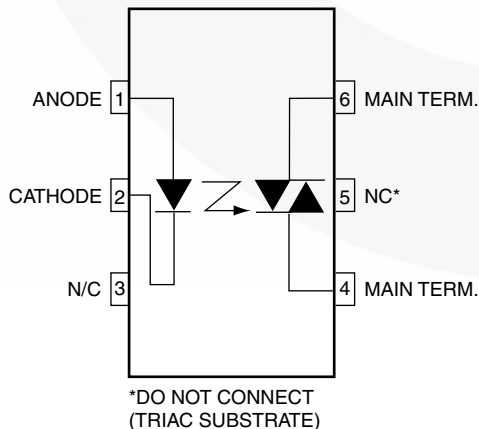
## Applications

- Industrial controls
- Solenoid/valve controls
- Traffic lights
- Static AC power switch
- Vending machines
- Incandescent lamp dimmers
- Solid state relay
- Motor control
- Lamp ballasts

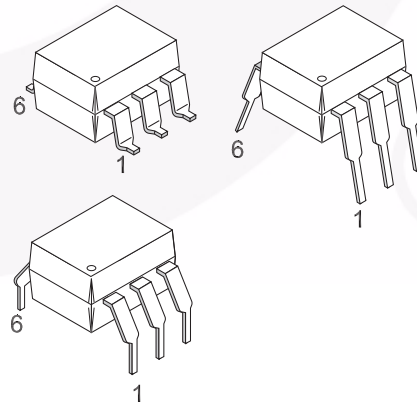
## Description

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 VAC operations.

## Schematic



## Package Outlines



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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.

| 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 10 sec | $^\circ\text{C}$     |
| $T_J$               | Junction Temperature Range   | All               | -40 to +100    | $^\circ\text{C}$     |
| $V_{ISO}$           | Isolation Surge Voltage <sup>(1)</sup><br>(peak AC voltage, 60Hz, 1 sec. duration)               | All               | 7500           | Vac(pk)              |
| $P_D$               | Total Device Power Dissipation @ 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 @ 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 = 1ms, 120pps)  | All               | 1              | A                    |
| $P_D$               | Total Power Dissipation @ 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 | 1.5  | 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    | 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  $I_{\text{FT}}$  (30mA for MOC3020M, 15mA for MOC3010M and MOC3021M, 10mA for MOC3011M and MOC3022M, 5mA for MOC3012M and MOC3023M) and absolute max  $I_F$  (60mA).

## Safety and Insulation Ratings

As per IEC 60747-5-2, 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.

| Symbol     | Parameter   | Min.   | Typ.      | Max. | Unit       |
|------------|---|--------|-----------|------|------------|
|            | Installation Classifications per DIN VDE 0110/1.89 Table 1  |        |           |      |            |
|            | For Rated Main Voltage < 150Vrms  |        | I-IV      |      |            |
|            | For Rated Main voltage < 300Vrms  |        | I-IV      |      |            |
|            | Climatic Classification   |        | 55/100/21 |      |            |
|            | Pollution Degree (DIN VDE 0110/1.89)  |        | 2         |      |            |
| CTI        | Comparative Tracking Index  | 175    |           |      |            |
| $V_{PR}$   | Input to Output Test Voltage, Method b, $V_{IORM} \times 1.875 = V_{PR}$ , 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5pC | 1594   |           |      | $V_{peak}$ |
|            | Input to Output Test Voltage, Method a, $V_{IORM} \times 1.5 = V_{PR}$ , Type and Sample Test with $t_m = 60$ sec, Partial Discharge < 5pC  | 1275   |           |      | $V_{peak}$ |
| $V_{IORM}$ | Max. Working Insulation Voltage   | 850    |           |      | $V_{peak}$ |
| $V_{IOTM}$ | Highest Allowable Over Voltage  | 6000   |           |      | $V_{peak}$ |
|            | External Creepage   | 7      |           |      | mm         |
|            | External Clearance  | 7      |           |      | mm         |
|            | Insulation Thickness  | 0.5    |           |      | mm         |
| RIO        | Insulation Resistance at $T_s$ , $V_{IO} = 500V$  | $10^9$ |           |      | $\Omega$   |

## Typical Performance Curves

Figure 1. LED Forward Voltage vs. Forward Current

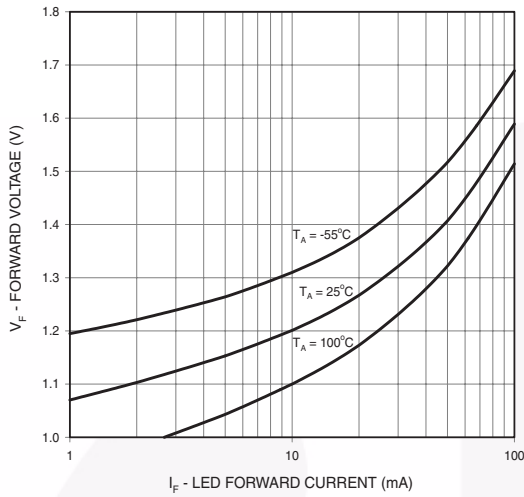


Figure 2. On-State Characteristics

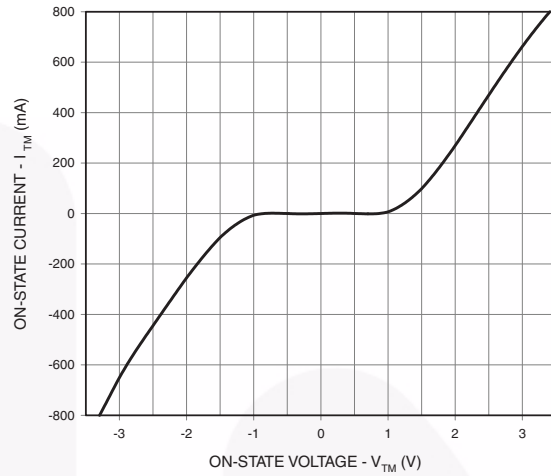


Figure 3. Trigger Current vs. Ambient Temperature

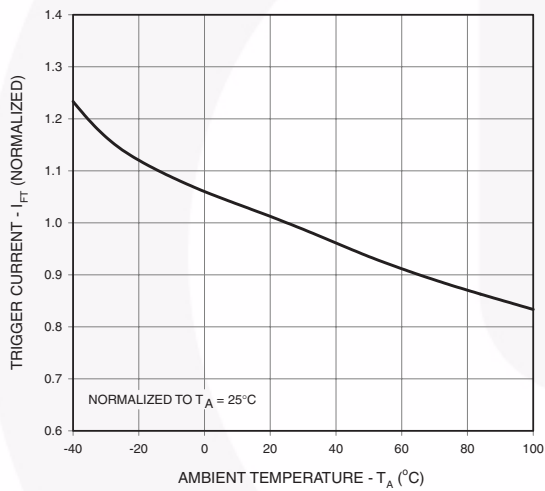


Figure 4. LED Current Required to Trigger vs. LED Pulse Width

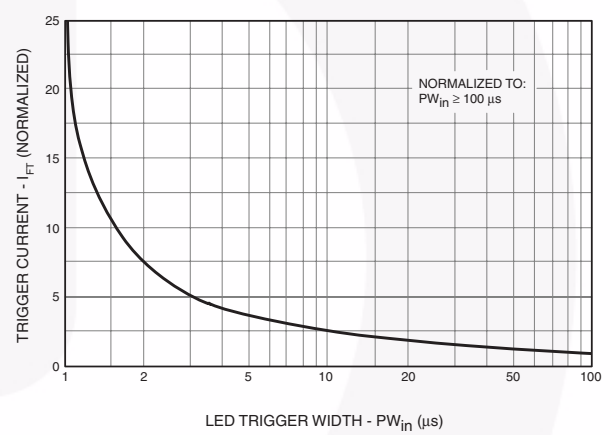


Figure 5. dv/dt vs. Temperature

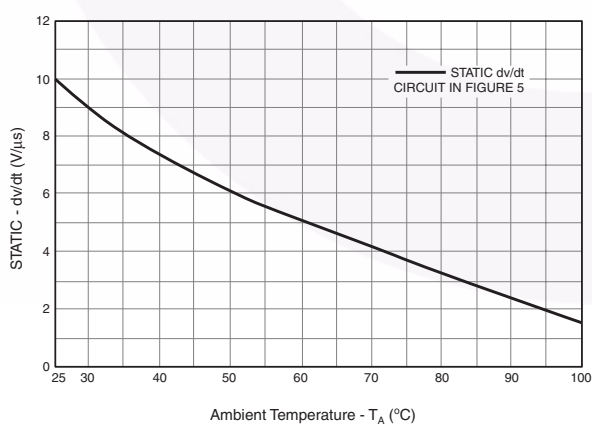
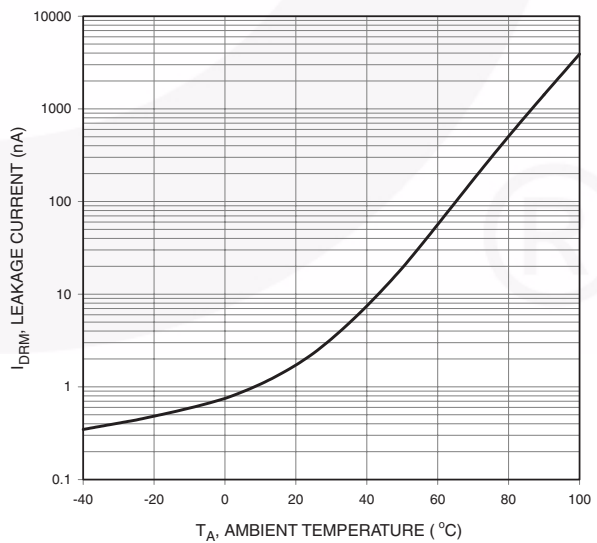
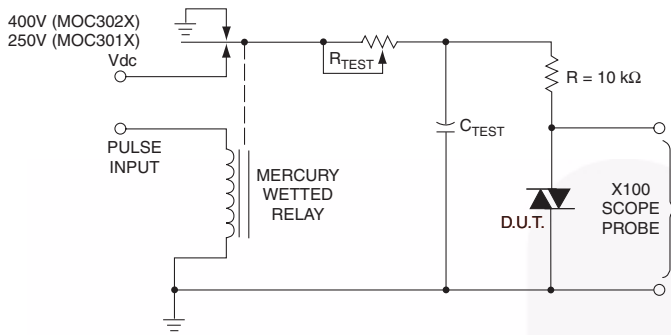


Figure 6. Leakage Current,  $I_{DRM}$  vs. Temperature





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 D.U.T. with a normal LED input current, then removing the current. The variable  $R_{TEST}$  allows the dv/dt to be gradually increased until the D.U.T. 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 D.U.T. stops triggering.  $\tau_{RC}$  is measured at this point and recorded.

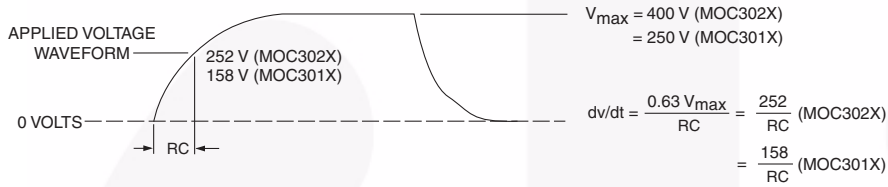


Figure 5. Static dv/dt Test Circuit

**Note:**

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

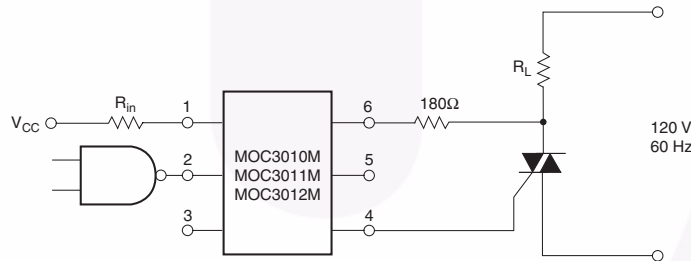


Figure 6. Resistive Load

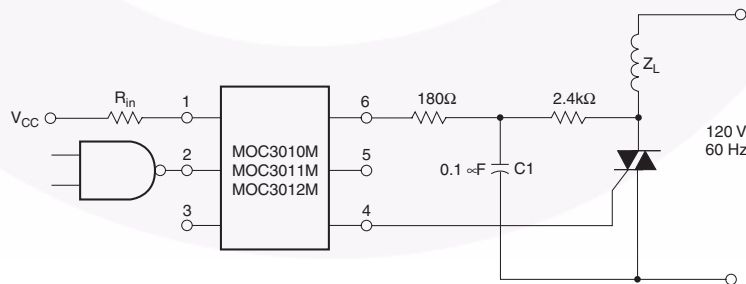
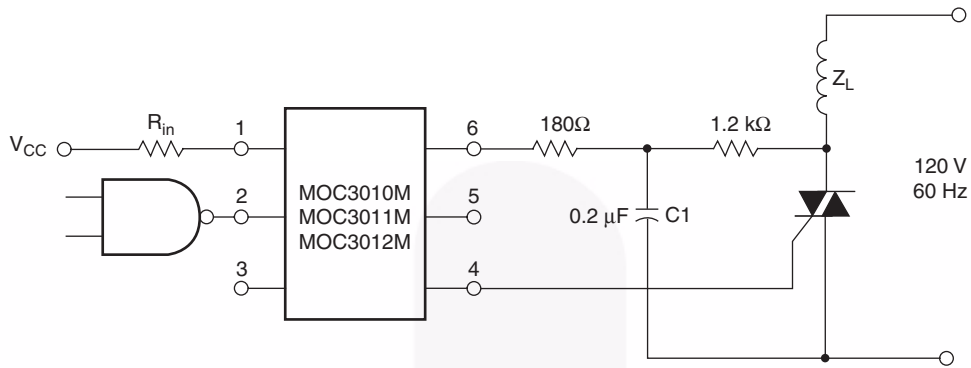
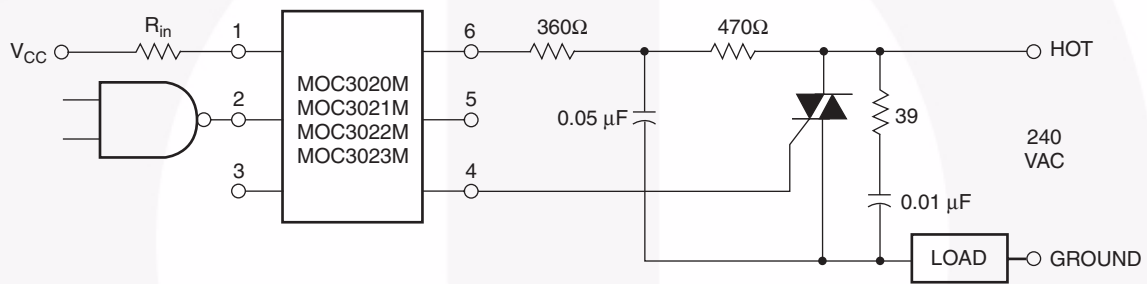


Figure 7. Inductive Load with Sensitive Gate Triac ( $I_{GT} = 15 \text{ mA}$ )



**Figure 8. Inductive Load with Sensitive Gate Triac ( $I_{GT} \leq 15 \text{ mA}$ )**

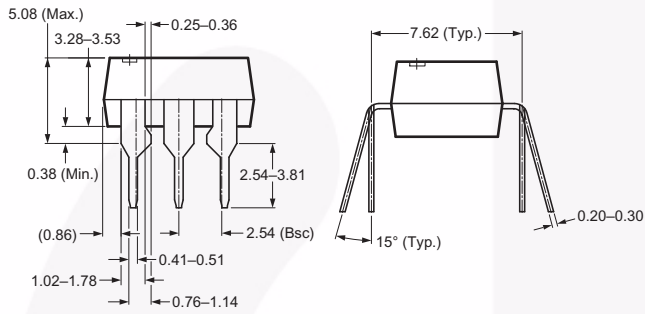
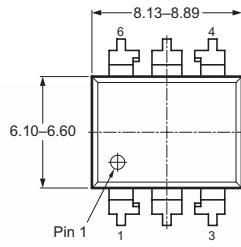


In this circuit the “hot” side of the line is switched and the load connected to the cold or ground side. The 39Ω resistor and 0.01μF capacitor are for snubbing of the triac, and the 470Ω resistor and 0.05μF capacitor are for snubbing the coupler. These components may or may not be necessary depending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

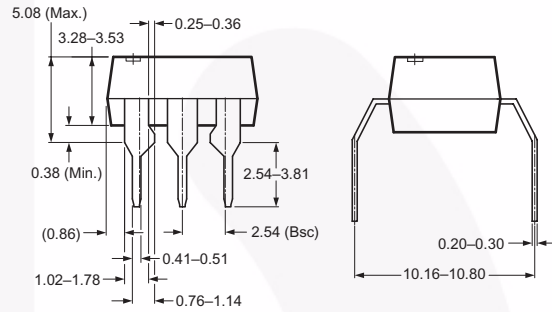
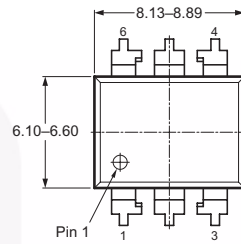
**Figure 9. Typical Application Circuit**

## Package Dimensions

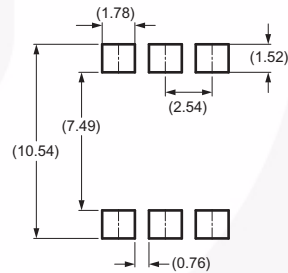
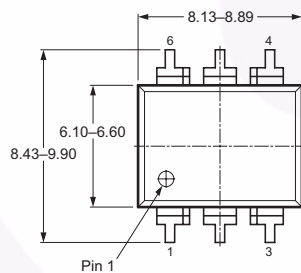
### Through Hole



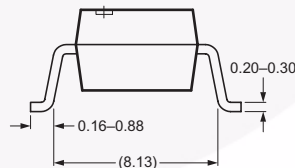
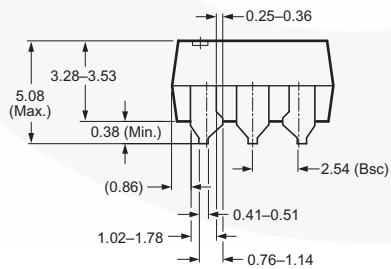
### 0.4" Lead Spacing



### Surface Mount



Recommended Pad Layout



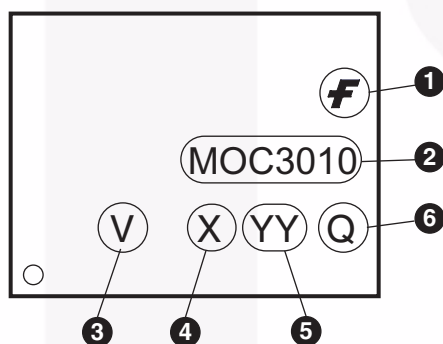
**Note:**  
All dimensions in mm.



## 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 |

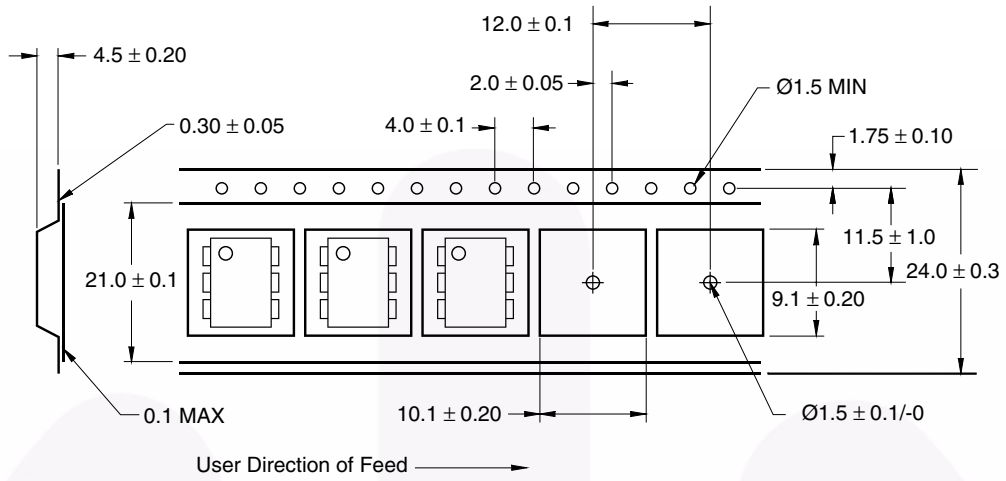
## Marking Information



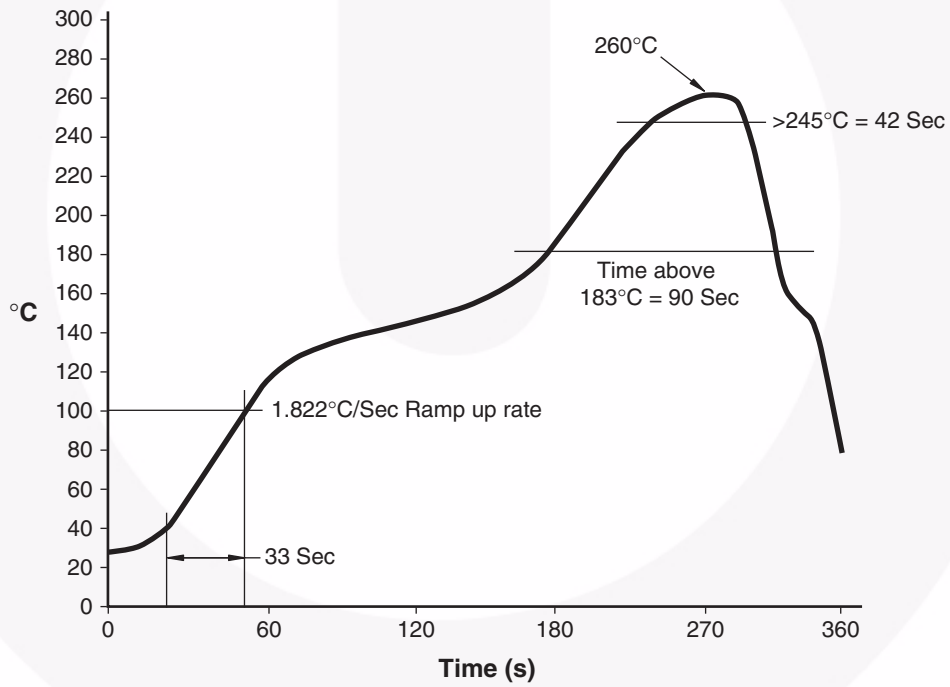
| Definitions |  |
|-------------|--|
| 1           | Fairchild logo   |
| 2           | Device number  |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | One digit year code, e.g., '3'   |
| 5           | Two digit work week ranging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

### Carrier Tape Specification








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|--------------------------|-----------------------|---|
| 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. |
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