

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M 6-Pin DIP Zero-Cross Optoisolators Triac Driver Output (250/400 Volt Peak)

## Features

- Simplifies logic control of 115 VAC power
- Zero voltage crossing
- $dv/dt$  of 2000 V/ $\mu$ s typical, 1000 V/ $\mu$ s guaranteed
- VDE recognized (File # 94766), ordering option V (e.g., MOC3043VM)

## Applications

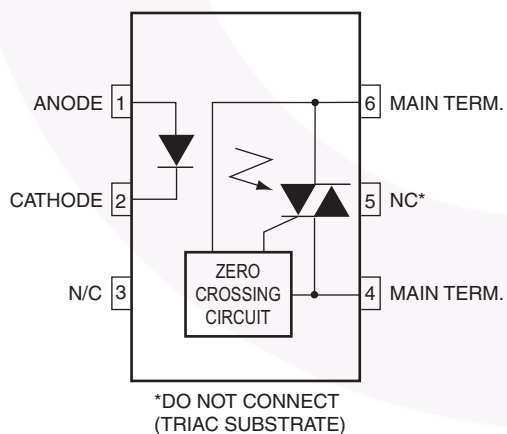
- Solenoid/valve controls
- Lighting controls
- Static power switches
- AC motor drives
- Temperature controls
- E.M. contactors
- AC motor starters
- Solid state relays

## Description

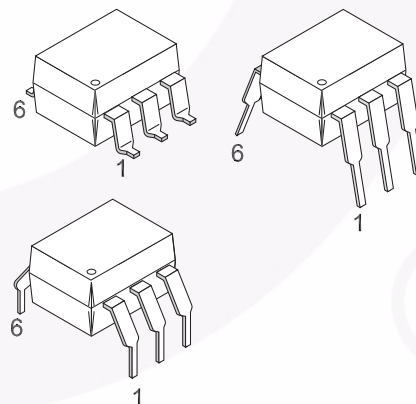
The MOC303XM and MOC304XM devices consist of a AlGaAs infrared emitting diode optically coupled to a monolithic silicon detector performing the function of a zero voltage crossing bilateral triac driver.

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

## 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> (peak AC voltage, 60Hz, 1 sec. duration, $I_{I-O} \leq 2\mu\text{A}$ )	All	7500	Vac(pk)
$P_D$	Total Device Power Dissipation @ $25^\circ\text{C}$ Derate above $25^\circ\text{C}$	All	250	mW
			2.94	mW/ $^\circ\text{C}$
<b>EMITTER</b>				
$I_F$	Continuous Forward Current	All	60	mA
$V_R$	Reverse Voltage	All	6	V
$P_D$	Total Power Dissipation $25^\circ\text{C}$ Ambient Derate above $25^\circ\text{C}$	All	120	mW
			1.41	mW/ $^\circ\text{C}$
<b>DETECTOR</b>				
$V_{DRM}$	Off-State Output Terminal Voltage	MOC3031M/2M/3M	250	V
		MOC3041M/2M/3M	400	
$I_{TSM}$	Peak Repetitive Surge Current (PW = 100 $\mu\text{s}$ , 120 pps)	All	1	A
$P_D$	Total Power Dissipation @ $25^\circ\text{C}$ Ambient Derate above $25^\circ\text{C}$	All	150	mW
		All	1.76	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	$I_F = 30\text{mA}$	All		1.25	1.5	V
$I_R$	Reverse Leakage Current	$V_R = 6\text{V}$	All		0.01	100	$\mu\text{A}$
<b>DETECTOR</b>							
$I_{\text{DRM1}}$	Peak Blocking Current, Either Direction	Rated $V_{\text{DRM}}$ ; $I_F = 0^{(2)}$	All			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
dv/dt	Critical Rate of Rise of Off-State Voltage	$I_F = 0$ (Figure 9) <sup>(4)</sup>	All	1000			V/ $\mu\text{s}$

**Transfer Characteristics**

Symbol	DC Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Units
$I_{\text{FT}}$	LED Trigger Current	Main Terminal Voltage = $3\text{V}^{(3)}$	MOC3031M/ MOC3041M			15	mA
			MOC3032M/ MOC3042M			10	
			MOC3033M/ MOC3043M			5	
$I_{\text{H}}$	Holding Current, Either Direction		All		400		$\mu\text{A}$

**Zero Crossing Characteristics**

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Units
$V_{\text{IH}}$	Inhibit Voltage	$I_F = \text{rated } I_{\text{FT}}$ , MT1-MT2 voltage above which device will not trigger off-state	All			20	V
$I_{\text{DRM2}}$	Leakage in Inhibited State	$I_F = \text{rated } I_F$ , rated $V_{\text{DRM}}$ , off-state	All			500	$\mu\text{A}$

**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  $I_{\text{FT}}$  (15mA for MOC3031M & MOC3041M, 10mA for MOC3032M & MOC3042M, 5mA for MOC3033M & MOC3043M) and absolute max  $I_F$  (60mA).
- This is static dv/dt. See Figure 9 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.

## 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

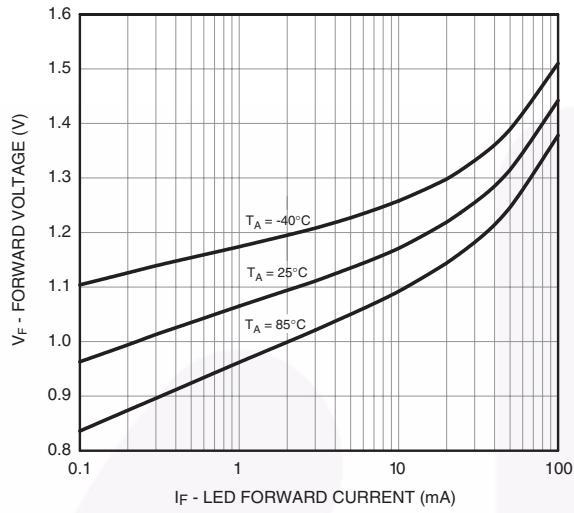


Figure 2. On-State Characteristics

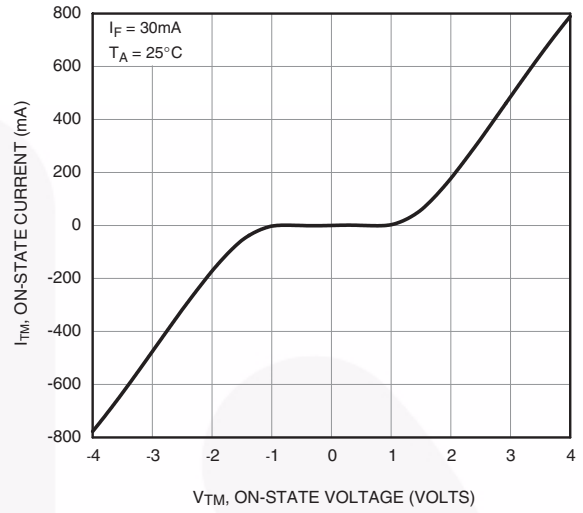


Figure 3. Trigger Current vs. Temperature

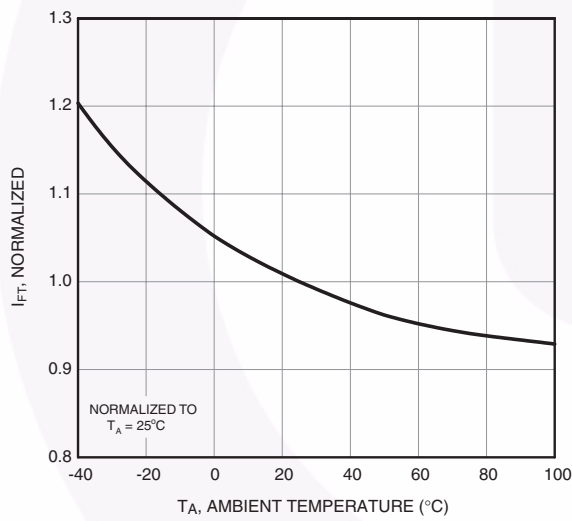
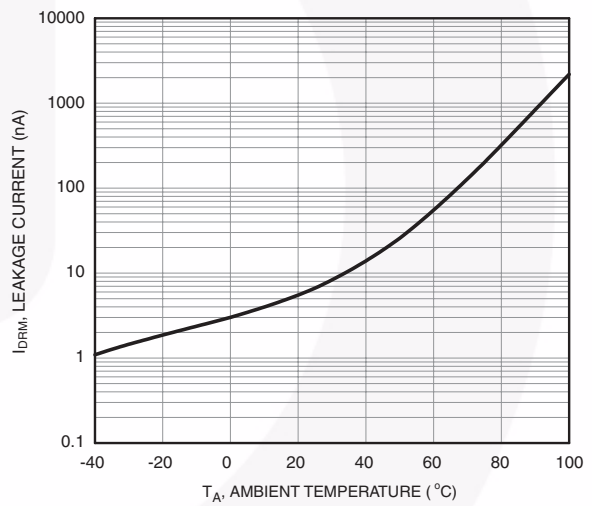


Figure 4. Leakage Current,  $I_{DRM}$  vs. Temperature



## Typical Performance Curves (Continued)

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

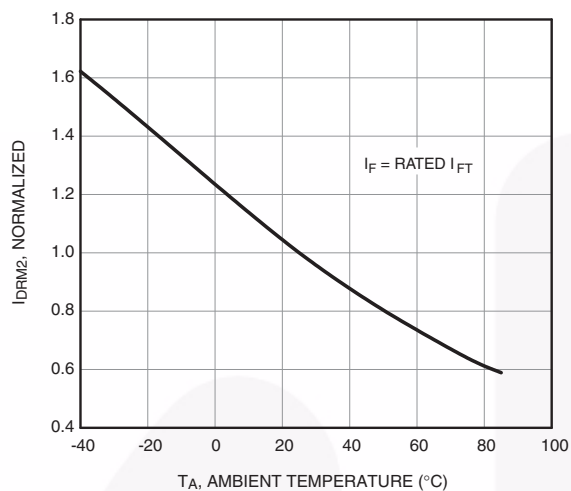


Figure 6. LED Current Required to Trigger vs. LED Pulse Width

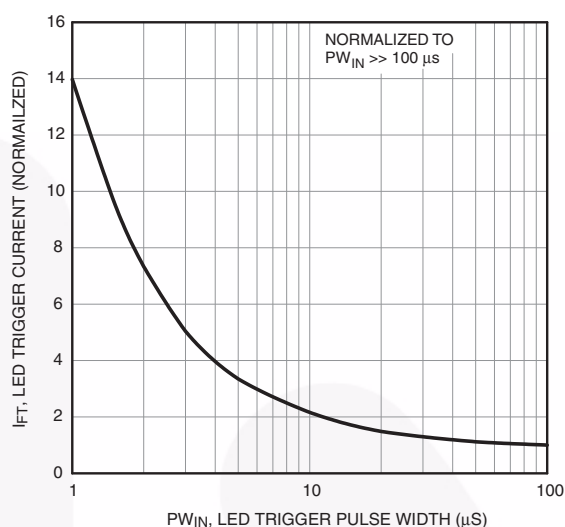


Figure 7. Holding Current,  $I_H$  vs. Temperature

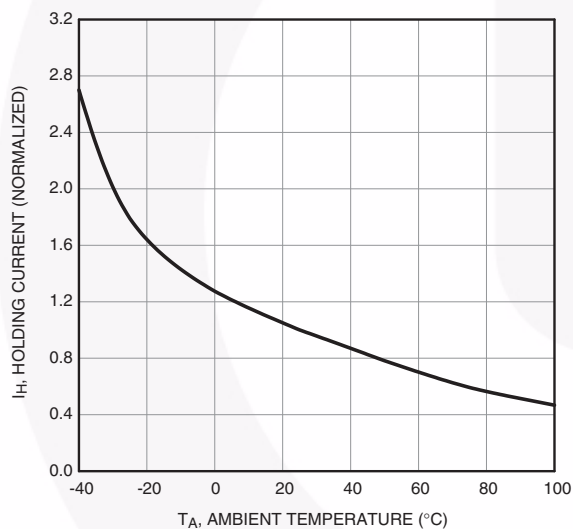
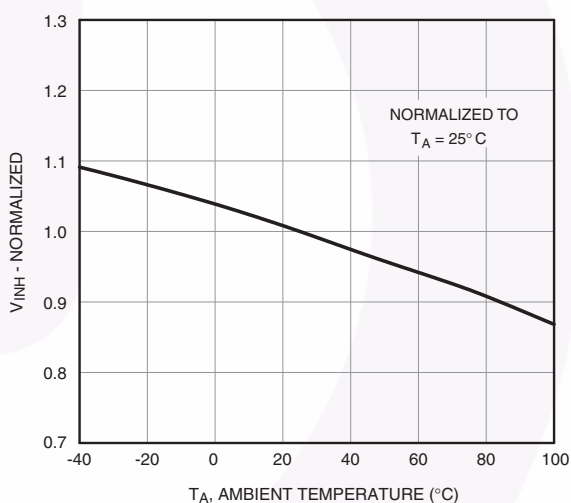
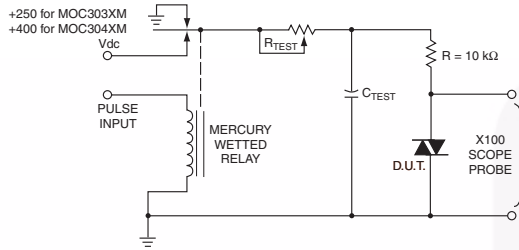


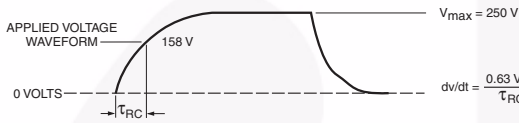
Figure 8. Inhibit Voltage vs. Temperature



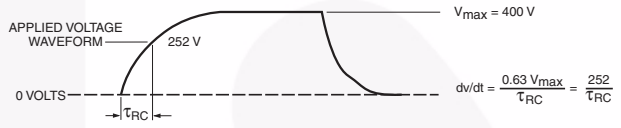


**Figure 9. Static dv/dt Test Circuit**

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.



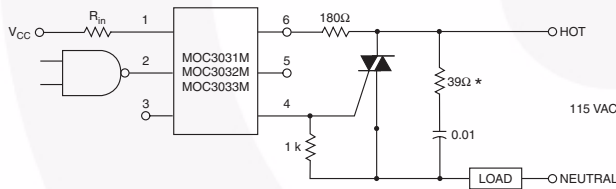
**Figure 10. Static dv/dt Test Waveform (MOC3031M, MOC3032M, MOC3033M)**



**Figure 11. Static dv/dt Test Waveform (MOC3041M, MOC3042M, MOC3043M)**

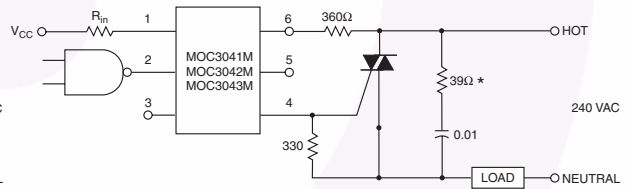
Typical circuit (Fig 12, 13) for use when hot line switching is required. In this circuit the “hot” side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

$R_{in}$  is calculated so that  $I_F$  is equal to the rated  $I_{FT}$  of the part, 5mA for the MOC3033M and MOC3043M, 10mA for the MOC3032M and MOC3042M, or 15mA for the MOC3031M and MOC3041M. The 39 ohm resistor and 0.01μF capacitor are for snubbing of the triac and may or may not be necessary depending upon the particular triac and load used.



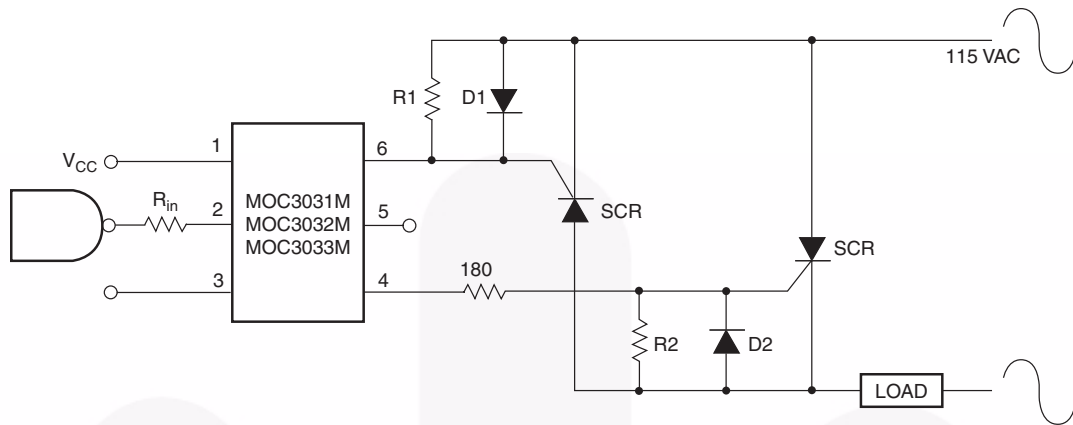
\*For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

**Figure 12. Hot-Line Switching Application Circuit (MOC3031M, MOC3032M, MOC3033M)**



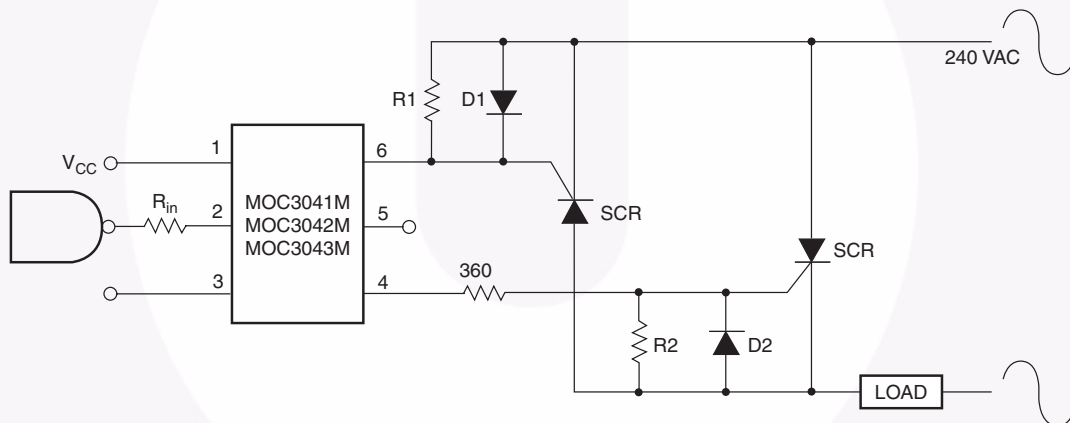
\*For highly inductive loads (power factor < 0.5), change this value to 360 ohms.

**Figure 13. Hot-Line Switching Application Circuit (MOC3041M, MOC3042M, MOC3043M)**



**Figure 14. Inverse-Parallel SCR Driver Circuit (MOC3031M, MOC3032M, MOC3033M)**

Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 1k $\Omega$ .



**Figure 15. Inverse-Parallel SCR Driver Circuit (MOC3041M, MOC3042M, MOC3043M)**

Suggested method of firing two, back-to-back SCR's with a Fairchild triac driver. Diodes can be 1N4001; resistors, R1 and R2, are optional 330 $\Omega$ .

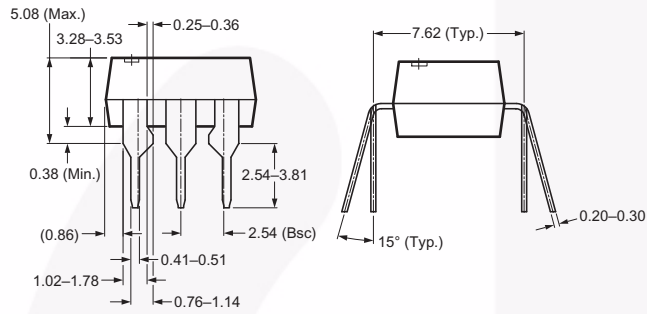
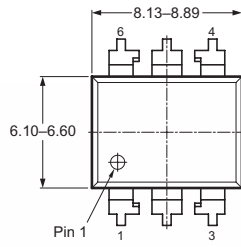
**Note:**

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

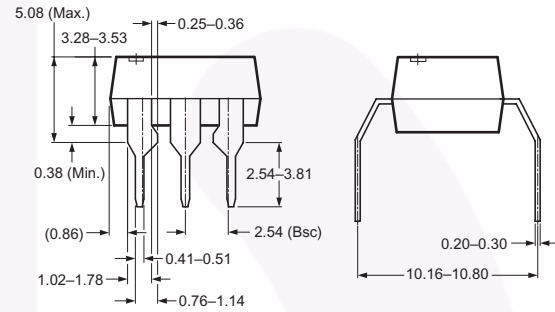
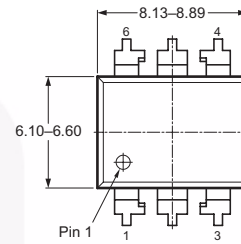


## Package Dimensions

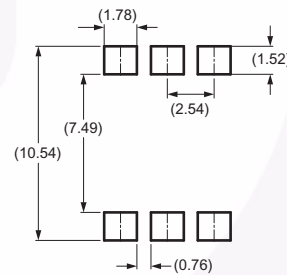
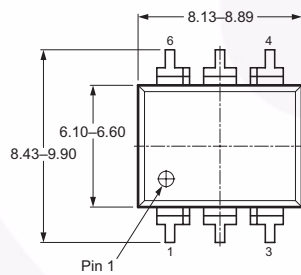
### Through Hole



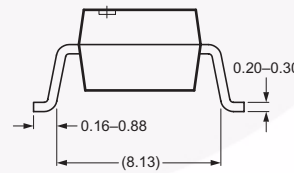
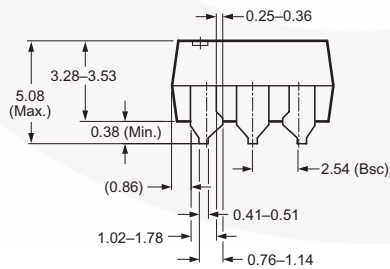
### 0.4" Lead Spacing



### Surface Mount



Recommended Pad Layout

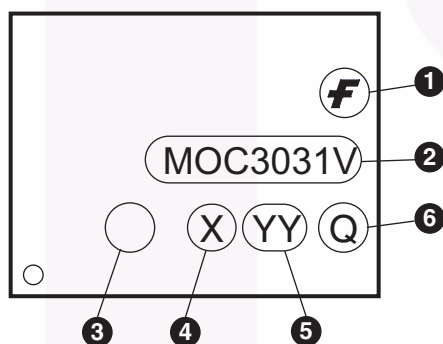


**Note:**  
All dimensions in mm.

## Ordering Information

Option	Order Entry Identifier (Example)	Description
No option	MOC3031M	Standard Through Hole Device
S	MOC3031SM	Surface Mount Lead Bend
SR2	MOC3031SR2M	Surface Mount; Tape and Reel
T	MOC3031TM	0.4" Lead Spacing
V	MOC3031VM	VDE 0884
TV	MOC3031TVM	VDE 0884, 0.4" Lead Spacing
SV	MOC3031SVM	VDE 0884, Surface Mount
SR2V	MOC3031SR2VM	VDE 0884, Surface Mount, Tape and Reel

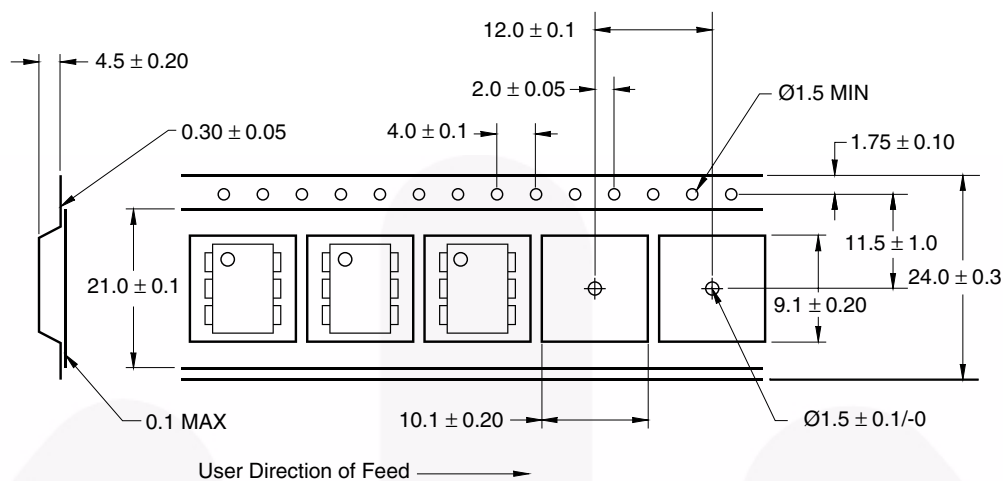
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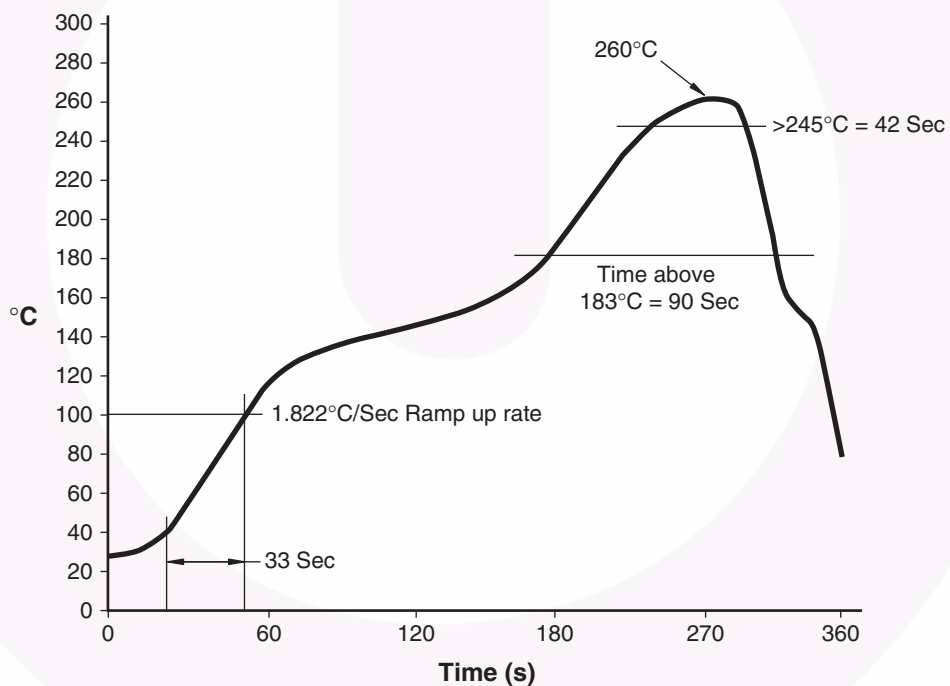
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

\*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







### Reflow Profile





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| FACT®  | Motion-SPM™   | SuperSOT™-6  | UniFET™   |
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| FETBench™  |  ™ | SyncFET™   | XS™   |
| FlashWriter®*  | PDP SPM™  | Sync-Lock™   |   |
| FPS™   | Power-SPM™  |  ™* |   |

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**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. I40