

# 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> (peak AC voltage, 60Hz, 1 sec. duration)	All	7500	Vac(pk)
$P_D$	Total Device Power Dissipation @ 25 $^\circ\text{C}$ Ambient 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 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 (PW = 1ms, 120pps)	All	1	A
$P_D$	Total Power Dissipation @ 25 $^\circ\text{C}$ Ambient 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

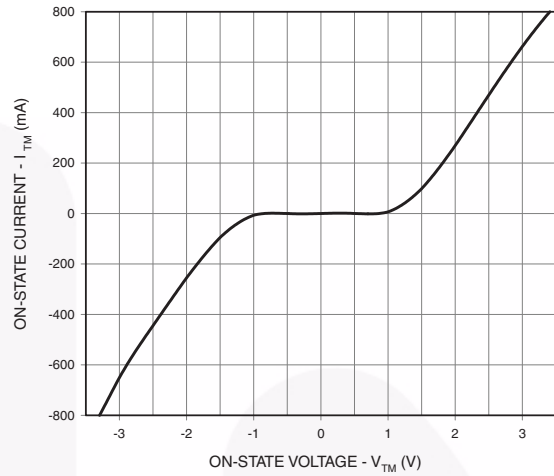


Figure 3. Trigger Current vs. Ambient Temperature



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



Figure 5. dv/dt vs. Temperature

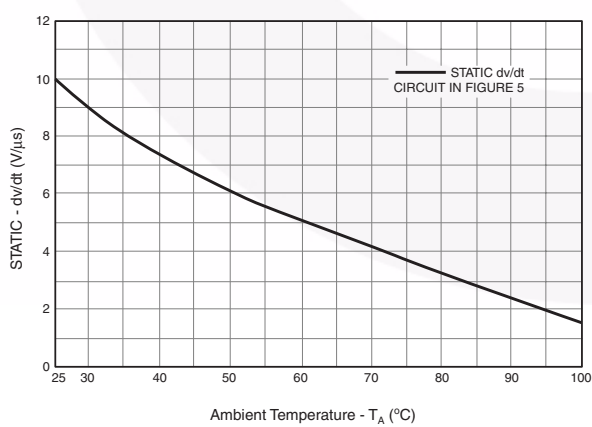
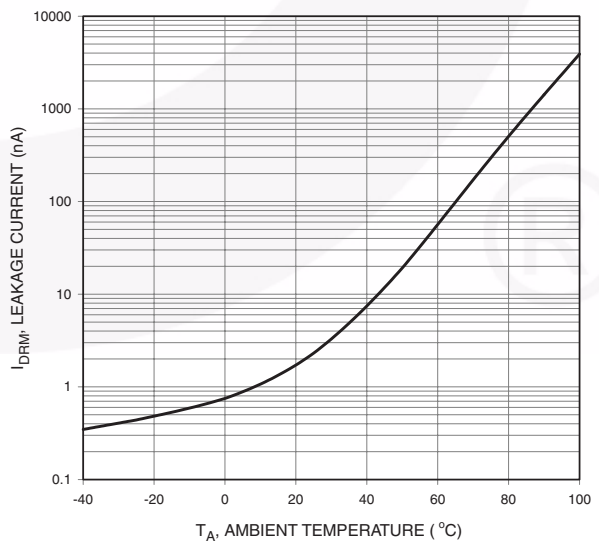
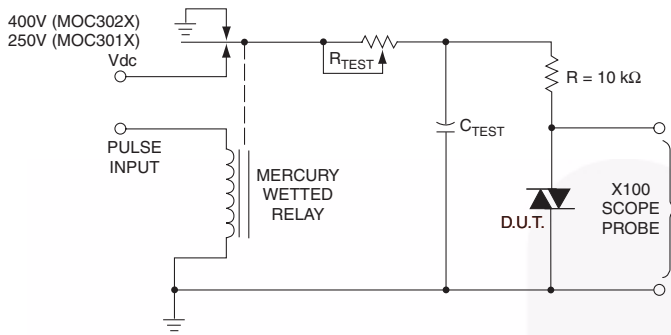


Figure 6. Leakage Current,  $I_{DRM}$  vs. Temperature





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.

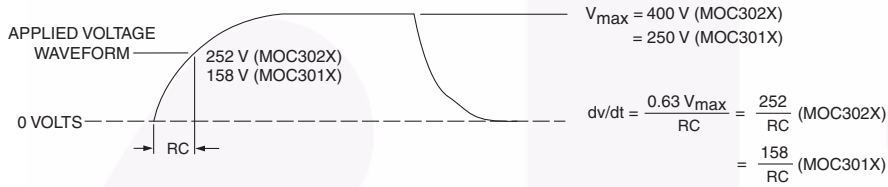


Figure 5. Static dv/dt Test Circuit

**Note:**

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

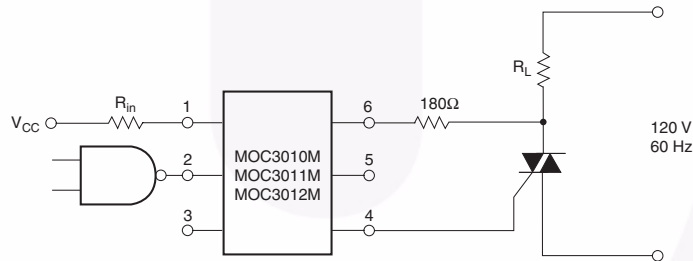


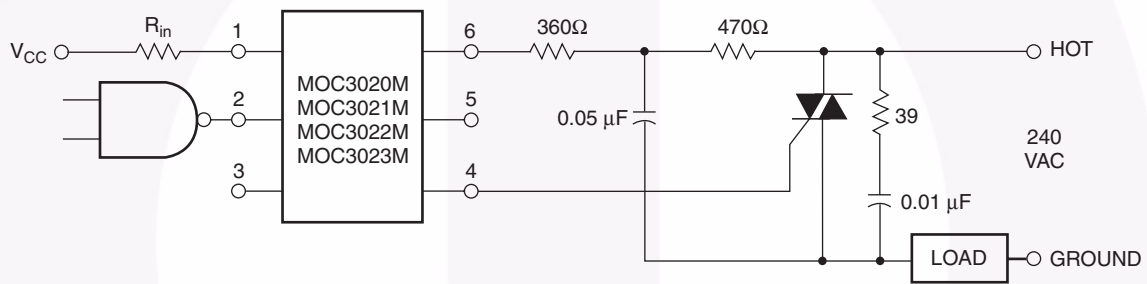
Figure 6. Resistive Load



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



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

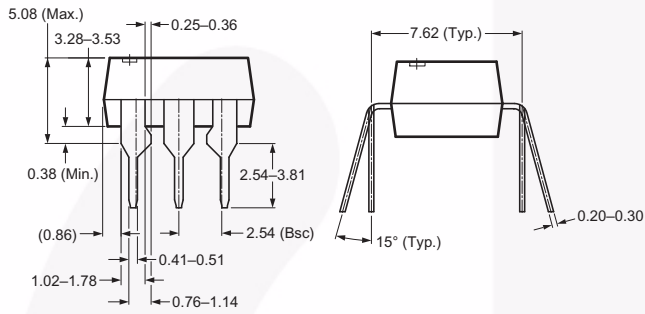


In this circuit the “hot” side of the line is switched and the load connected to the cold or ground side. The 39Ω resistor and 0.01μF capacitor are for snubbing of the triac, and the 470Ω resistor and 0.05μF capacitor are for snubbing of the coupler. These components may or may not be necessary depending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

**Figure 9. Typical Application Circuit**

## Package Dimensions

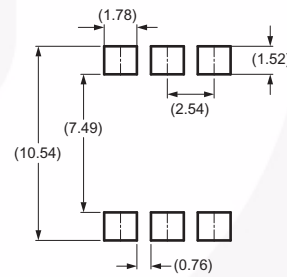
### Through Hole



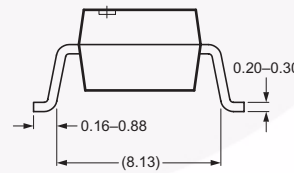
### 0.4" Lead Spacing



### 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



### Reflow Profile





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