

# 6-Pin DIP Zero-Cross Triac Driver Output Optocoupler (250/400 Volt Peak)

## MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

### Description

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

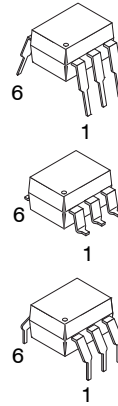
They are designed for use with a triac in the interface of logic systems to equipment powered from 115 VAC lines, such as teletypewriters, CRTs, solid-state relays, industrial controls, printers, motors, solenoids and consumer appliances, etc.

### Features

- Simplifies Logic Control of 115 VAC Power
- Zero Voltage Crossing to Minimize Conducted and Radiated Line Noise
- dv/dt of 2000 V/μs Typical, 1000 V/μs Guaranteed
- Peak Blocking Voltage
  - ◆ 250 V, MOC306xM
  - ◆ 400 V, MOC304xM
- Safety and Regulatory Approvals
  - ◆ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
  - ◆ DIN EN/IEC60747-5-5
- These are Pb-Free Devices

### Applications

- Solenoid/Valve Controls
- Lighting Controls
- Static Power Switches
- AC Motor Drives
- Temperature Controls
- E.M. Contactors
- AC Motor Starters
- Solid State Relays

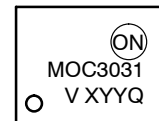


PDIP6 8.51x6.35, 2.54P  
CASE 646BX

PDIP6 8.51x6.35, 2.54P  
CASE 646BY

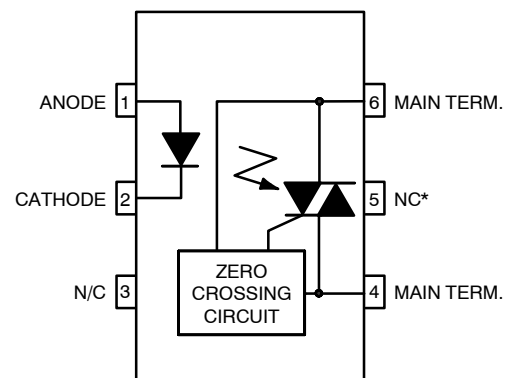
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### MARKING DIAGRAM



- MOC3031 = Device Number
- V = DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
- X = One-Digit Year Code, e.g., '5'
- YY = Two-Digit Work Week, Ranging from '01' to '53'
- Q = Assembly Package Code

### SCHEMATIC



\*DO NOT CONNECT (TRIAC SUBSTRATE)

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

**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

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Device	Value	Unit
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### TOTAL DEVICE

T <sub>STG</sub>	Storage Temperature	All	-40 to +150	°C
T <sub>OPR</sub>	Operating Temperature	All	-40 to +85	°C
T <sub>J</sub>	Junction Temperature Range	All	-40 to +100	°C
T <sub>SOL</sub>	Lead Solder Temperature	All	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation at 25°C Ambient	All	250	mW
	Derate Above 25°C		2.94	mW/°C

### EMITTER

I <sub>F</sub>	Continuous Forward Current	All	60	mA
V <sub>R</sub>	Reverse Voltage	All	6	V
P <sub>D</sub>	Total Power Dissipation at 25°C Ambient	All	120	mW
	Derate Above 25°C		1.41	mW/°C

### DETECTOR

V <sub>DRM</sub>	Off-State Output Terminal Voltage	MOC3031M MOC3032M MOC3033M	250	V
		MOC3041M MOC3042M MOC3043M	400	V
I <sub>TSM</sub>	Peak Non-Repetitive Surge Current (Surge Cycle 60 Hz Sine Wave)	All	1	A <sub>peak</sub>
I <sub>TM</sub>	Peak Repetitive On-State Current	All	100	mA <sub>peak</sub>
P <sub>D</sub>	Total Power Dissipation at 25°C Ambient	All	150	mW
	Derate Above 25°C		1.76	mW/°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.

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, unless otherwise noted)

Symbol	Parameter	Test Conditions	Device	Min	Typ	Max	Unit
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### INDIVIDUAL COMPONENT CHARACTERISTICS

EMITTER							
V <sub>F</sub>	Input Forward Voltage	I <sub>F</sub> = 30 mA	All	–	1.25	1.50	V
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> = 6 V	All	–	0.01	100	μA
DETECTOR							
I <sub>DRM1</sub>	Peak Blocking Current, Either Direction	V <sub>DRM</sub> = 600 V, I <sub>F</sub> = 0 (Note 1)	All	–	–	100	nA
V <sub>TM</sub>	Peak On-State Voltage, Either Direction	I <sub>TM</sub> = 100 mA peak, I <sub>F</sub> = 0	All	–	1.8	3.0	V
dv/dt	Critical Rate of Rise of Off-State Voltage	I <sub>F</sub> = 0 (Note 2)	All	1000	2000	–	V/μs

### TRANSFER CHARACTERISTICS

I <sub>FT</sub>	LED Trigger Current	Main Terminal Voltage = 3 V (Note 3)	MOC3031M MOC3041M	–	–	15	mA
			MOC3032M MOC3042M	–	–	10	
			MOC3033M MOC3043M	–	–	5	
I <sub>H</sub>	Holding Current, Either Direction		All	–	400	–	μA

### ZERO CROSSING CHARACTERISTICS

V <sub>IH</sub>	Inhibit Voltage	I <sub>F</sub> = rated I <sub>FT</sub> , MT1–MT2 voltage above which device will not trigger off-state	All	–	–	20	V
I <sub>DRM2</sub>	Leakage in Inhibited State	I <sub>F</sub> = rated I <sub>FT</sub> , rated V <sub>DRM</sub> off-state	All	–	–	2	mA

### ISOLATION CHARACTERISTICS

V <sub>ISO</sub>	Isolation Voltage (Note 4)	t = 1 Minute	All	4170	–	–	VAC <sub>RMS</sub>
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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.

1. Test voltage must be applied within dv/dt rating.
2. This is static dv/dt. Commutating dv/dt is a function of the load-driving thyristor(s) only.
3. All devices are guaranteed to trigger at an I<sub>F</sub> value less than or equal to max I<sub>FT</sub>. Therefore, recommended operating I<sub>F</sub> lies between max I<sub>FT</sub> (15 mA for MOC3031M and MOC3041M, 10 mA for MOC3032M and MOC3042M, 5 mA for MOC3033M and MOC3043M) and absolute maximum I<sub>F</sub> (60 mA).
4. Isolation voltage, V<sub>ISO</sub>, is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common, and pins 4, 5 and 6 are common.

TYPICAL PERFORMANCE CURVES



Figure 1. LED Forward Voltage vs. Forward Current



Figure 2. On-State Characteristics

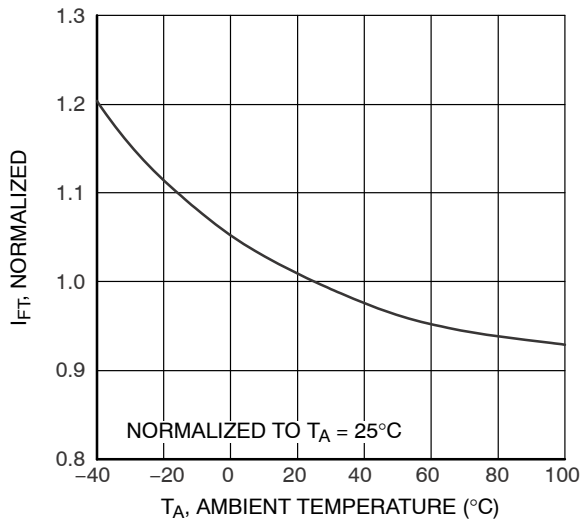


Figure 3. Trigger Current Vs. Temperature

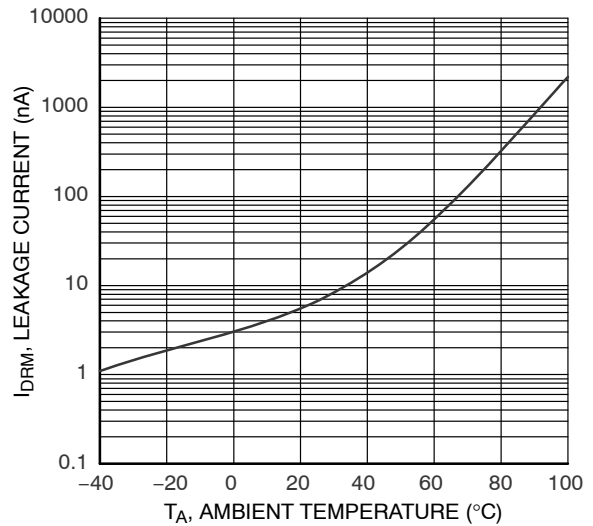


Figure 4. Leakage Current,  $I_{DRM}$  vs. Temperature

TYPICAL PERFORMANCE CURVES (Continued)

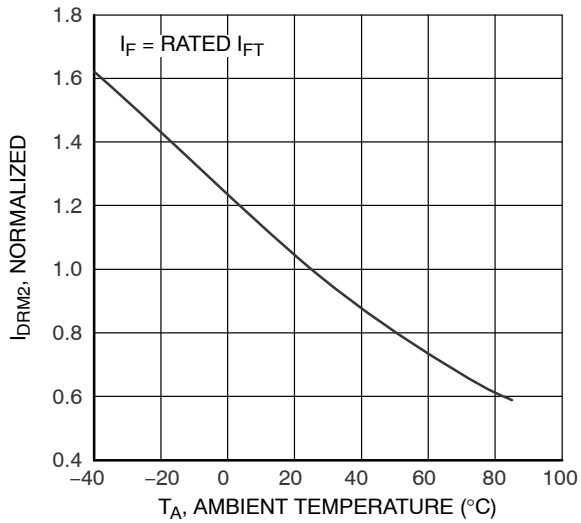


Figure 5. I<sub>DRM2</sub> - Leakage in Inhibit State vs. Temperature

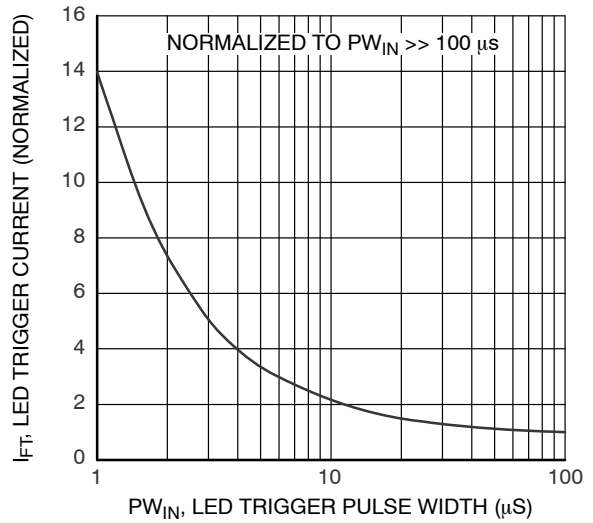


Figure 6. LED Current Required to Trigger vs. LED Pulse Width

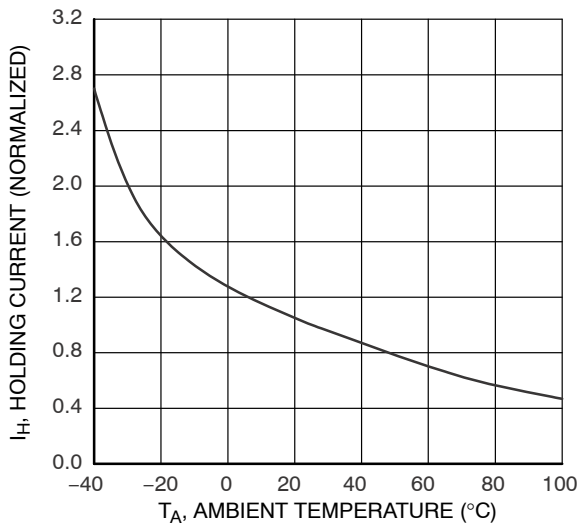


Figure 7. Holding Current, I<sub>H</sub> vs. Temperature

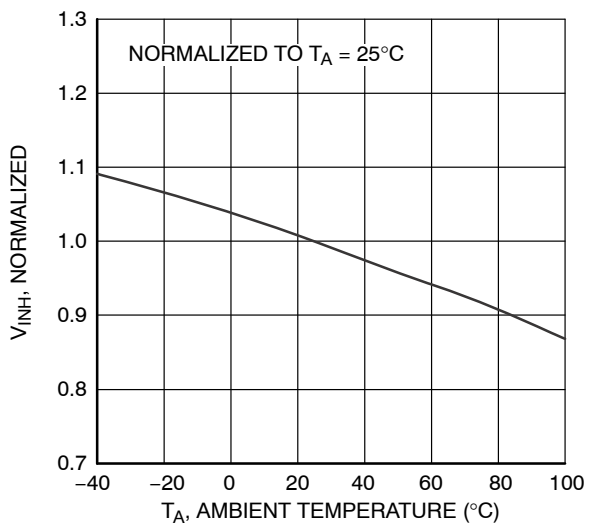


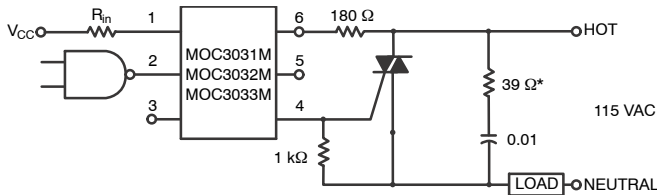
Figure 8. Inhibit Voltage vs. Temperature

APPLICATION INFORMATION

Typical circuit (Figure 9, 10) 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.

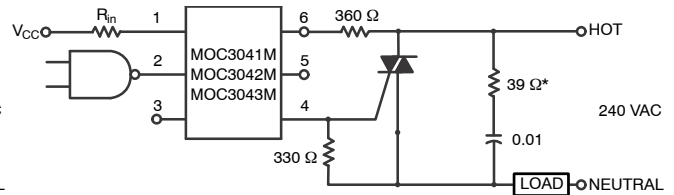
$R_{in}$  is calculated so that  $I_F$  is equal to the rated  $I_{FT}$  of the part, 5 mA for the MOC3033M and MOC3043M, 10 mA for

the MOC3032M and MOC3042M, or 15 mA for the MOC3031M and MOC3041M. The 39 ohm resistor and 0.01  $\mu$ F 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 9. Hot-Line Switching Application Circuit (MOC3031M, MOC3032M, MOC3033M)



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

Figure 10. Hot-Line Switching Application Circuit (MOC3041M, MOC3042M, MOC3043M)

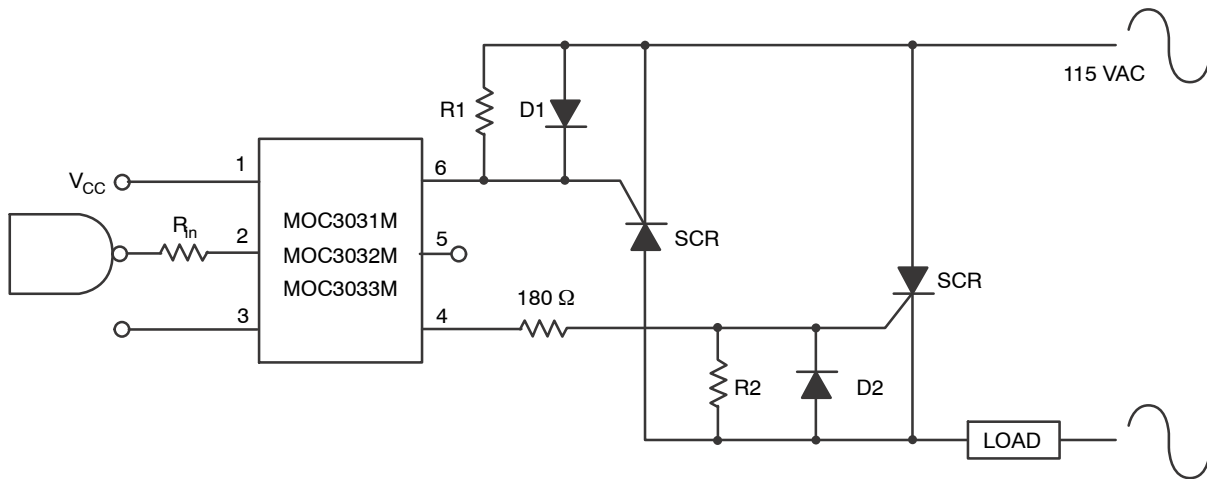
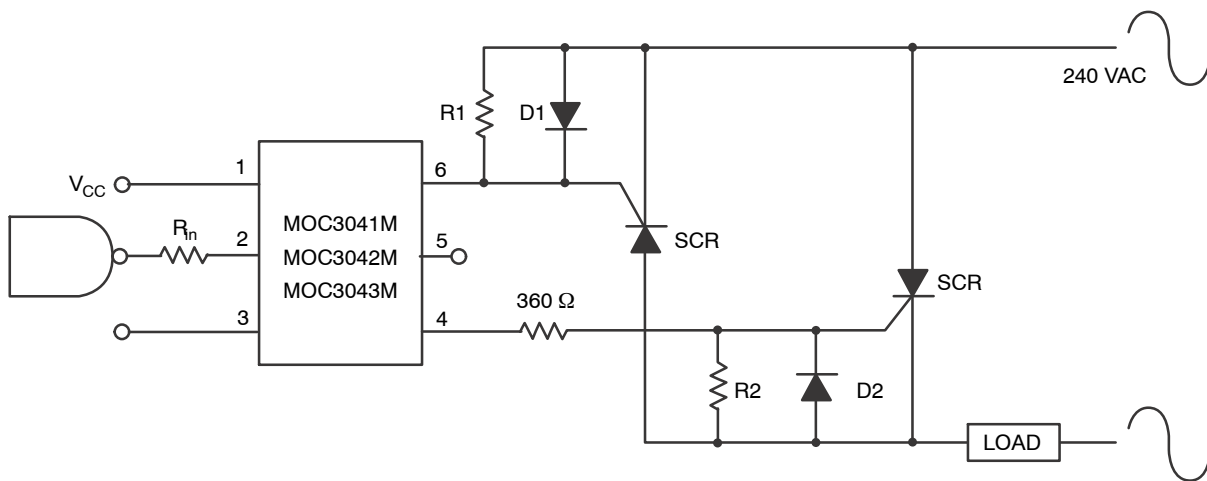


Figure 11. Inverse-Parallel SCR Driver Circuit (MOC3031M, MOC3032M, MOC3033M)

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

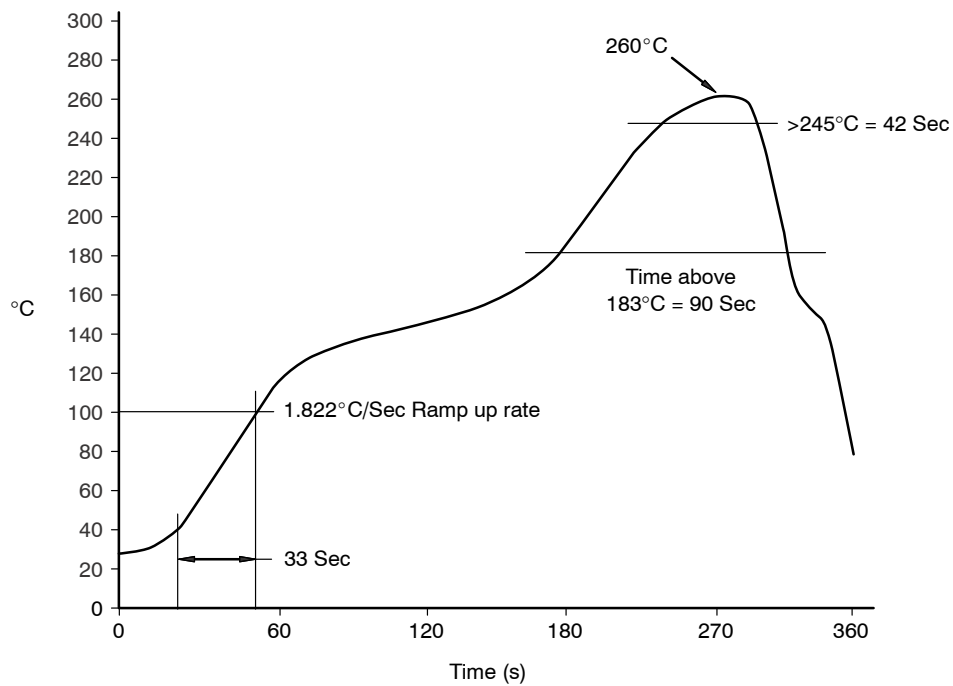
**MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M**



**Figure 12. Inverse-Parallel SCR Driver Circuit (MOC3041M, MOC3042M, MOC3043M)**

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

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



**Figure 13. Reflow Profile**

# MOC3031M, MOC3032M, MOC3033M, MOC3041M, MOC3042M, MOC3043M

## ORDERING INFORMATION (Note 5)

Part Number	Package	Shipping <sup>†</sup>
MOC3031M	DIP 6-Pin (Pb-Free)	50 Units / Tube
MOC3031SM	SMT 6-Pin (Lead Bend) (Pb-Free)	50 Units / Tube
MOC3031SR2M	SMT 6-Pin (Lead Bend) (Pb-Free)	1000 / Tape & Reel
MOC3031VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option (Pb-Free)	50 Units / Tube
MOC3031SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option (Pb-Free)	50 Units / Tube
MOC3031SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option (Pb-Free)	1000 / Tape & Reel
MOC3031TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option (Pb-Free)	50 Units / Tube

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

5. The product orderable part number system listed in this table also applies to the MOC3032M, MOC3033M, MOC3041M, MOC3042M, and MOC3043M product families.



# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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CASE 646BX  
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5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS ARE 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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