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August 2015

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

Features

- Simplifies Logic Control of 115 VAC Power
- Zero Voltage Crossing
- dv/dt of 2000 V/µs Typical, 1000 V/µs Guaranteed
- Peak Blocking Voltage
  - 250 V, MOC303XM
  - 400 V, MOC304XM
- Safety and Regulatory Approvals
  - UL1577, 4,170 VAC_{RMS} for 1 Minute
  - DIN EN/IEC60747-5-5

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 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.

Schematic

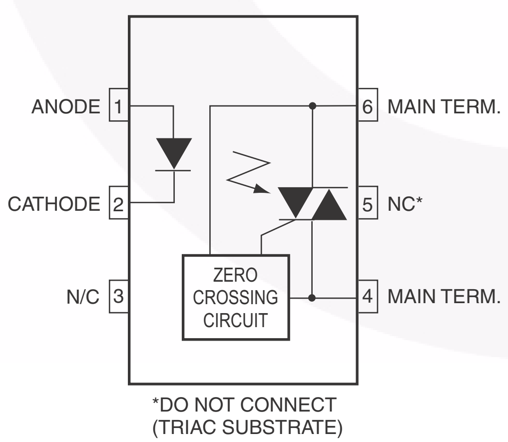


Figure 1. Schematic

Package Outlines

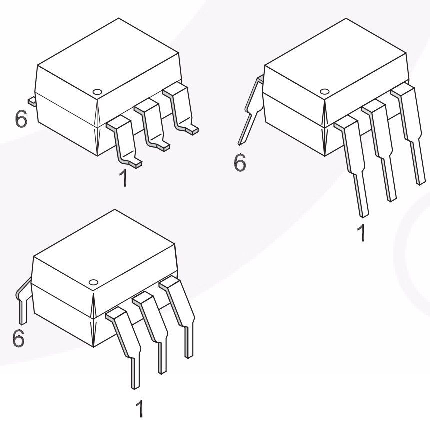


Figure 2. Package Outlines

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_{RMS}	I–IV
	< 300 V_{RMS}	I–IV
Climatic Classification		40/85/21
Pollution Degree (DIN VDE 0110/1.89)		2
Comparative Tracking Index		175

Symbol	Parameter	Value	Unit
V_{PR}	Input-to-Output Test Voltage, Method A, V_{IORM} x 1.6 = V_{PR}, Type and Sample Test with t_m = 10 s, Partial Discharge < 5 pC	1275	V_{peak}
	Input-to-Output Test Voltage, Method B, V_{IORM} x 1.875 = V_{PR}, 100% Production Test with t_m = 1 s, Partial Discharge < 5 pC	1594	V_{peak}
V_{IORM}	Maximum Working Insulation Voltage	850	V_{peak}
V_{IOTM}	Highest Allowable Over-Voltage	6000	V_{peak}
	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_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V	> 10^9	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°C unless otherwise specified.

Symbol	Parameters	Device	Value	Unit
TOTAL DEVICE				
T_{STG}	Storage Temperature	All	-40 to +150	°C
T_{OPR}	Operating Temperature	All	-40 to +85	°C
T_J	Junction Temperature Range	All	-40 to +100	°C
T_{SOL}	Lead Solder Temperature	All	260 for 10 seconds	°C
P_D	Total Device Power Dissipation at 25°C Ambient	All	250	mW
	Derate Above 25°C		2.94	mW/°C
EMITTER				
I_F	Continuous Forward Current	All	60	mA
V_R	Reverse Voltage	All	6	V
P_D	Total Power Dissipation at 25°C Ambient	All	120	mW
	Derate Above 25°C		1.41	mW/°C
DETECTOR				
V_{DRM}	Off-State Output Terminal Voltage	MOC3031M MOC3032M MOC3033M	250	V
		MOC3041M MOC3042M MOC3043M	400	
I_{TSM}	Peak Repetitive Surge Current (PW = 100 µs, 120 pps)	All	1	A
P_D	Total Power Dissipation at 25°C Ambient	All	150	mW
	Derate Above 25°C		1.76	mW/°C

Electrical Characteristics

T_A = 25°C unless otherwise specified.

Individual Component Characteristics

Symbol	Parameters	Test Conditions	Device	Min.	Typ.	Max.	Unit
EMITTER							
V_F	Input Forward Voltage	I_F = 30 mA	All		1.25	1.50	V
I_R	Reverse Leakage Current	V_R = 6 V	All		0.01	100	µA
DETECTOR							
I_{DRM1}	Peak Blocking Current, Either Direction	Rated V_{DRM}, I_F = 0(1)	All			100	nA
V_{TM}	Peak On-State Voltage, Either Direction	I_{TM} = 100 mA peak, I_F = 0	All		1.8	3.0	V
dv/dt	Critical Rate of Rise of Off-State Voltage	I_F = 0 (Figure 11)(2)	All	1000	2000		V/µs

Transfer Characteristics

Symbol	DC Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
I_{FT}	LED Trigger Current	Main Terminal Voltage = 3 V(3)	MOC3031M MOC3041M			15	mA
			MOC3032M MOC3042M			10	
			MOC3033M MOC3043M			5	
I_H	Holding Current, Either Direction		All		400		µA

Zero Crossing Characteristics

Symbol	Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
V_{IH}	Inhibit Voltage	I_F = rated I_{FT}, MT1-MT2 voltage above which device will not trigger off-state	All			20	V
I_{DRM2}	Leakage in Inhibited State	I_F = rated I_{FT}, rated V_{DRM} off-state	All			2	mA

Isolation Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
V_{ISO}	Isolation Voltage(4)	t = 1 Minute	All	4170			VAC_{RMS}

Notes:
1. Test voltage must be applied within dv/dt rating.
2. This is static dv/dt. See Figure 11 for test circuit. Commutating dv/dt is a function of the load-driving thyristor(s) only.
3. All devices are guaranteed to trigger at an I_F value less than or equal to max I_{FT}. Therefore, recommended operating I_F lies between max I_{FT} (15 mA for MOC3031M and MOC3041M, 10 mA for MOC3032M and MOC3042M, 5 mA for MOC3033M and MOC3043M) and absolute maximum I_F (60 mA).
4. Isolation 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.

Typical Performance Curves

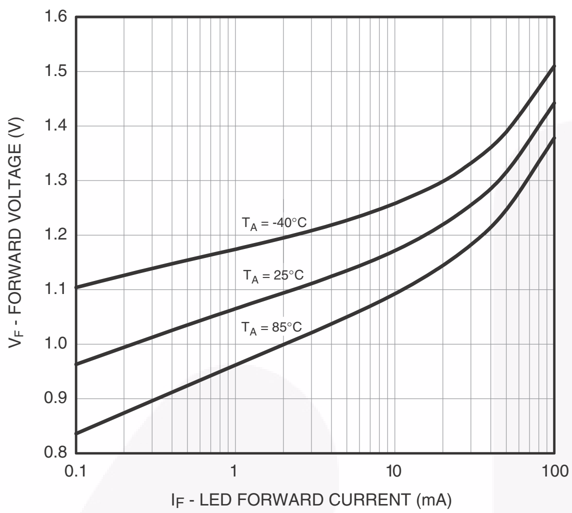


Figure 3. LED Forward Voltage vs. Forward Current

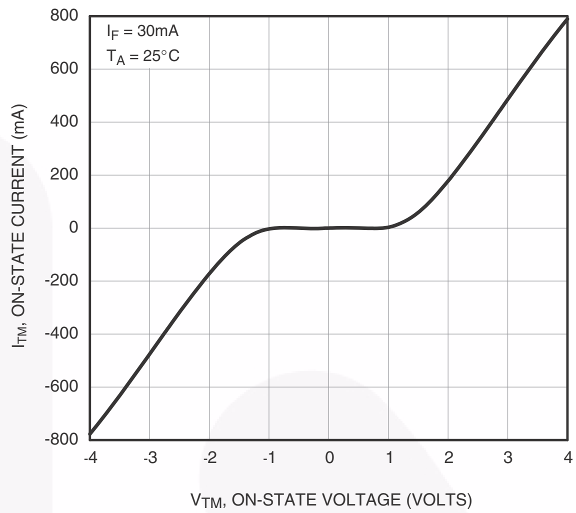


Figure 4. On-State Characteristics

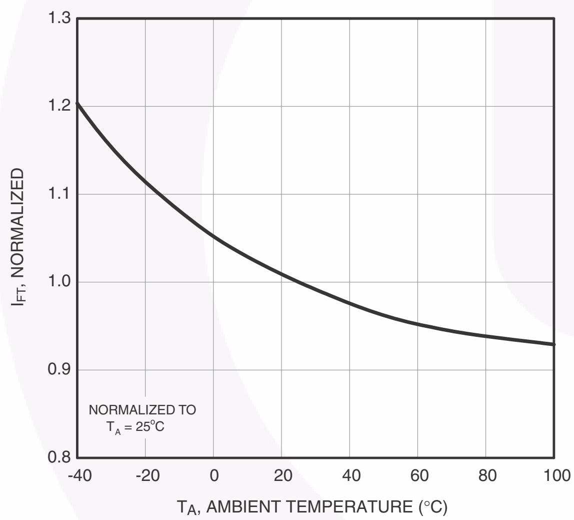


Figure 5. Trigger Current vs. Temperature

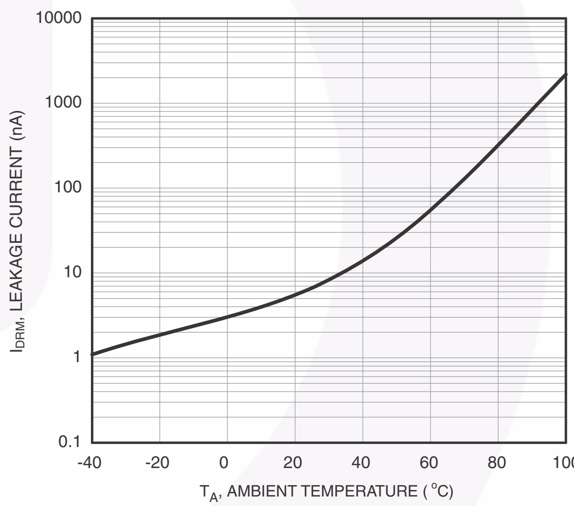


Figure 6. Leakage Current, I_{DRM} vs. Temperature

Typical Performance Curves (Continued)

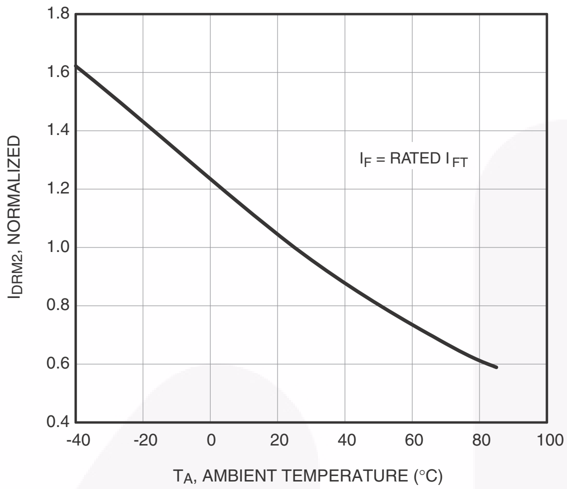


Figure 7. I_{DRM2} - Leakage in Inhibit State vs. Temperature

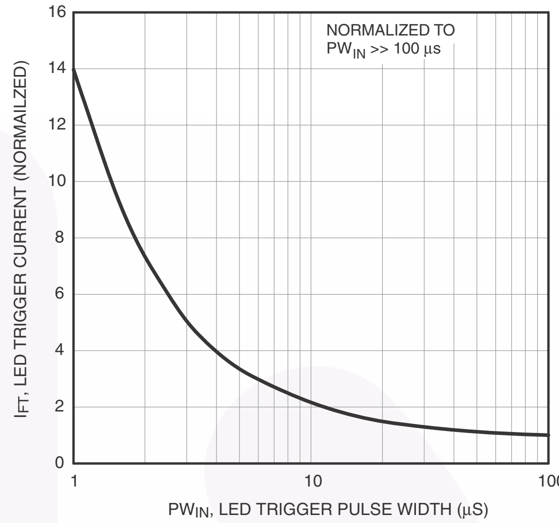


Figure 8. LED Current Required to Trigger vs. LED Pulse Width

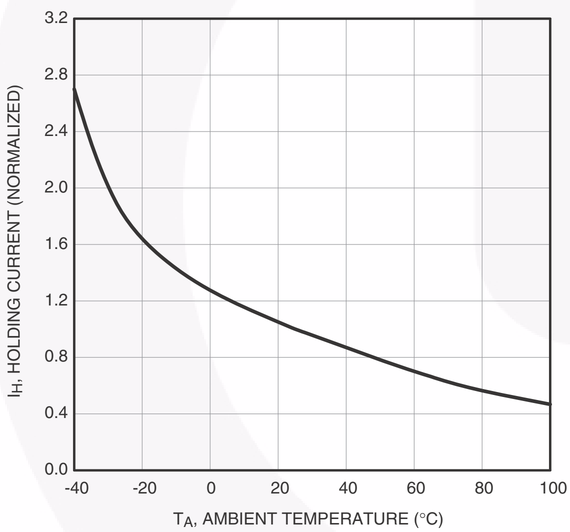


Figure 9. Holding Current, I_H vs. Temperature

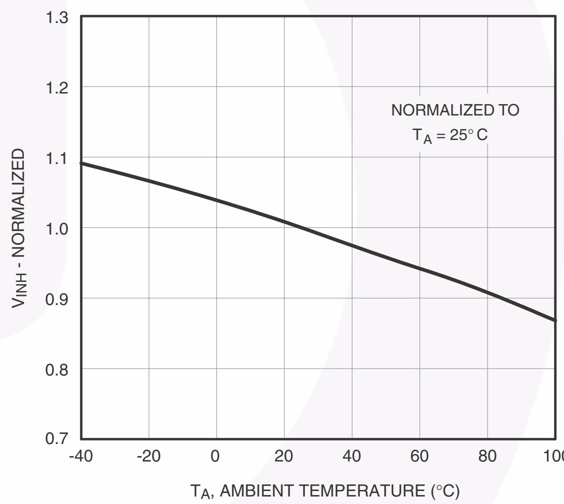


Figure 10. Inhibit Voltage vs. Temperature

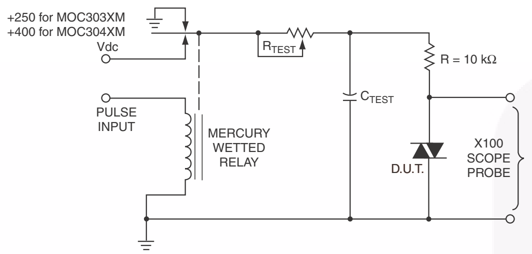


Figure 11. Static dv/dt Test Circuit

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. τ_{RC} is measured at this point and recorded.

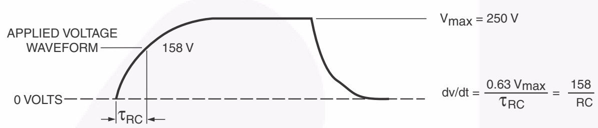


Figure 12. Static dv/dt Test Waveform (MOC3031M, MOC3032M, MOC3033M)

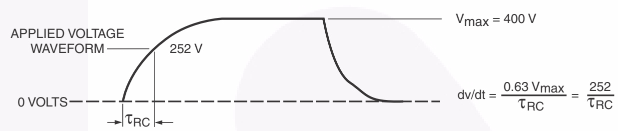
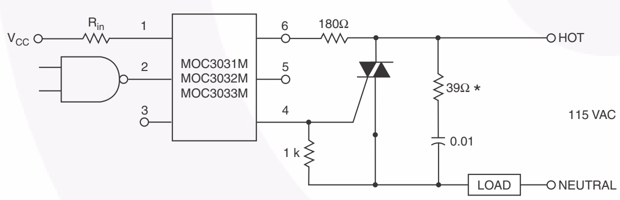


Figure 13. Static dv/dt Test Waveform (MOC3041M, MOC3042M, MOC3043M)

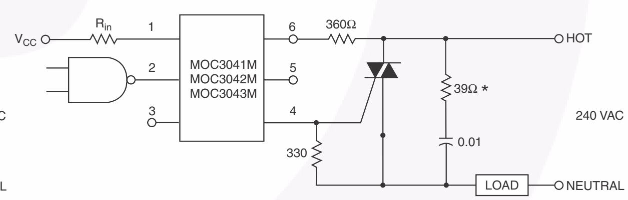
Typical circuit (Fig 14, 15) for use when hot line switching is required. In this circuit the "hot" side of the line is switched and the load connected to the cold or neutral side. The load may be connected to either the neutral or hot line.

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 14. Hot-Line Switching Application Circuit (MOC3031M, MOC3032M, MOC3033M)



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

Figure 15. Hot-Line Switching Application Circuit (MOC3041M, MOC3042M, MOC3043M)

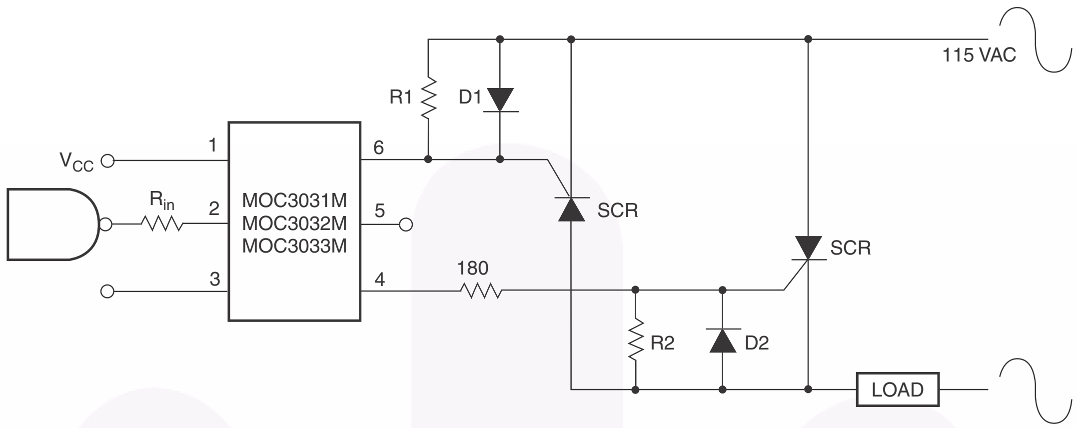


Figure 16. Inverse-Parallel SCR Driver Circuit (MOC3031M, MOC3032M, MOC3033M)

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 1kΩ.

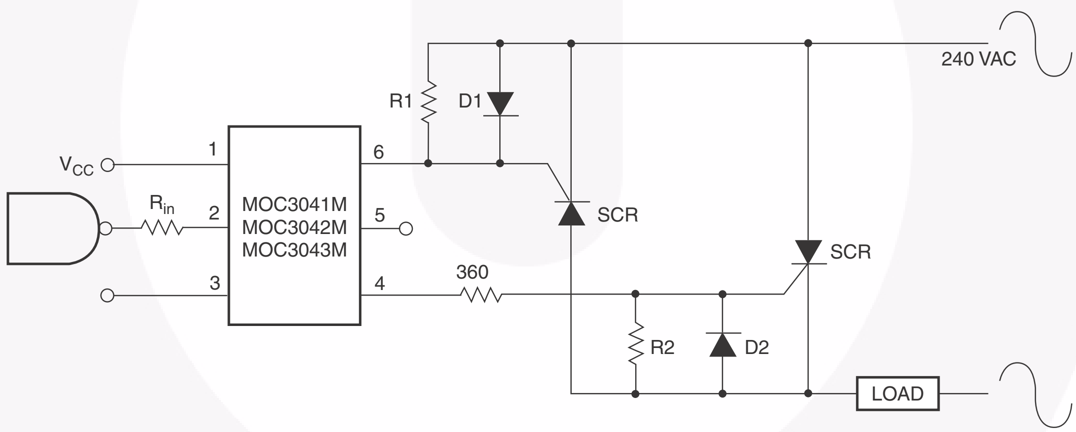


Figure 17. Inverse-Parallel SCR Driver Circuit (MOC3041M, MOC3042M, MOC3043M)

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 330Ω.

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

Reflow Profile

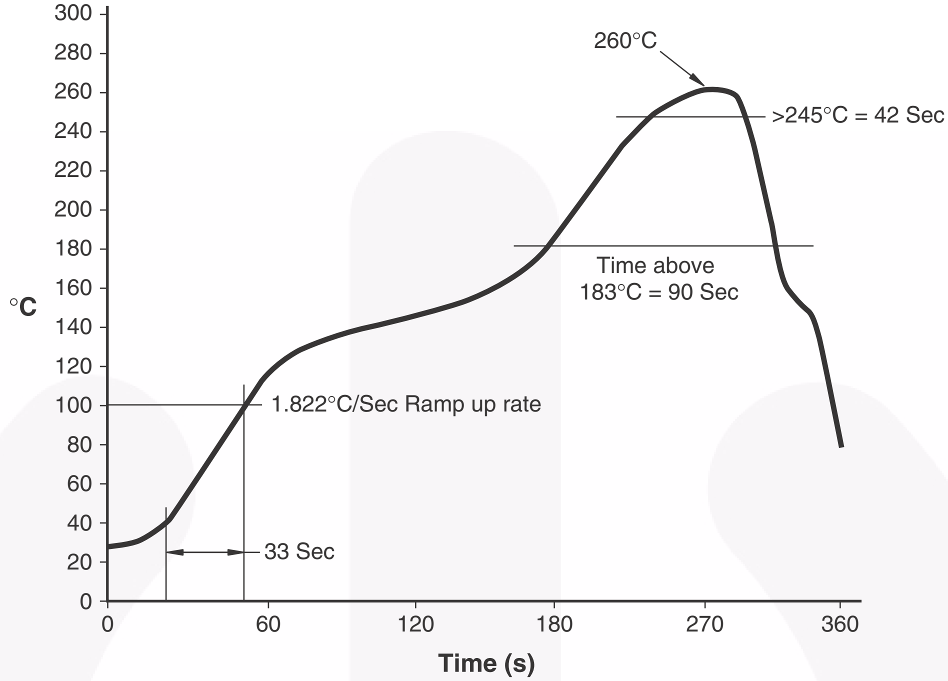


Figure 18. Reflow Profile

Ordering Information[5]

Part Number	Package	Packing Method
MOC3031M	DIP 6-Pin	Tube (50 Units)
MOC3031SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
MOC3031SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
MOC3031VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
MOC3031SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
MOC3031SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
MOC3031TVM	DIP 6-Pin, 0.4” Lead Spacing, DIN EN/IEC60747-5-5 Option	Tube (50 Units)

Note:

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

Marking Information

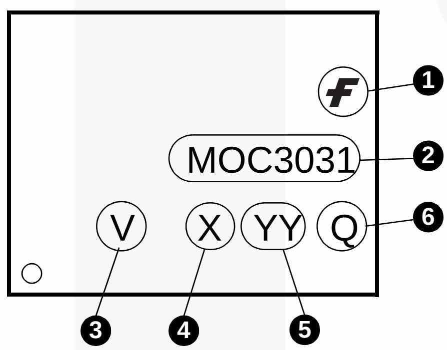
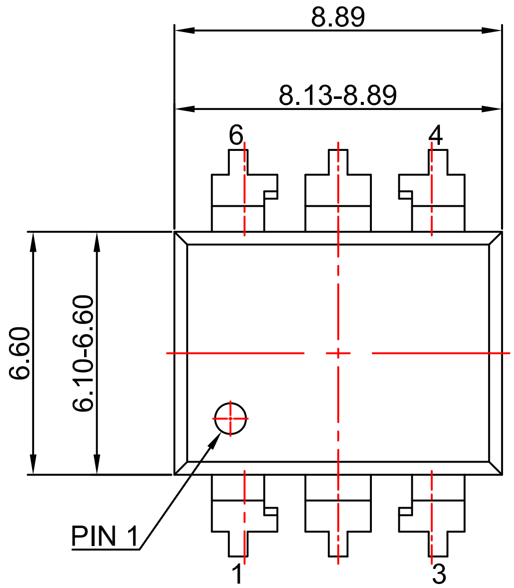
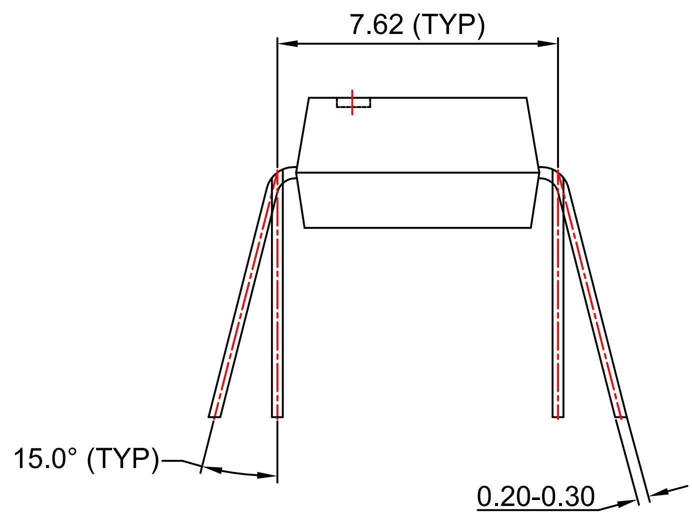
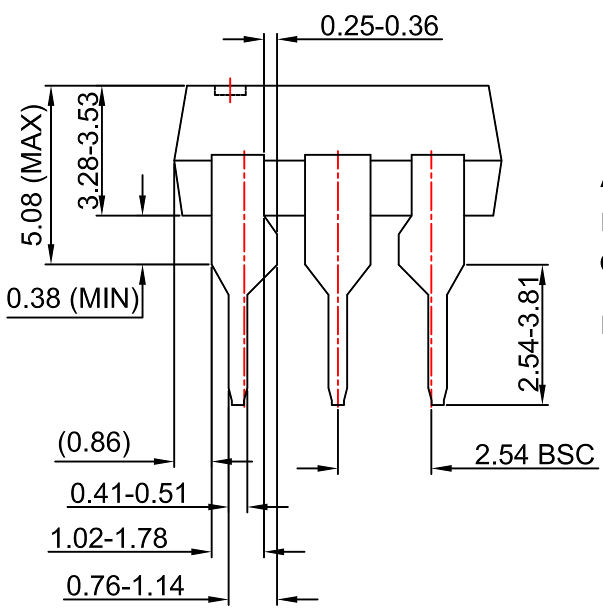


Figure 19. Top Mark

Top Mark Definitions	
1	Fairchild Logo
2	Device Number
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	One-Digit Year Code, e.g., ‘5’
5	Two-Digit Work Week, Ranging from ‘01’ to ‘53’
6	Assembly Package Code







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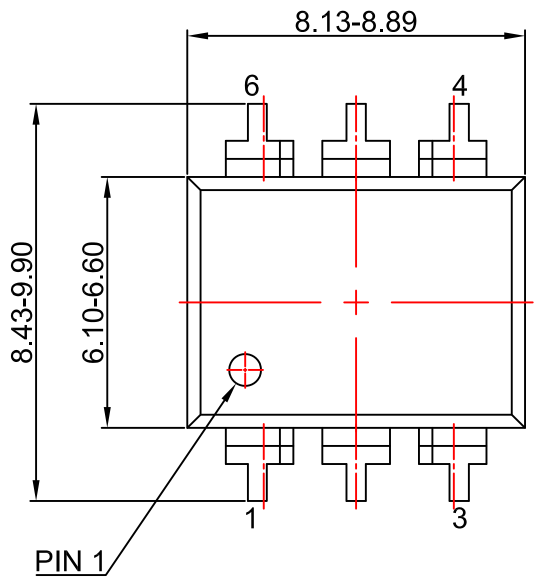
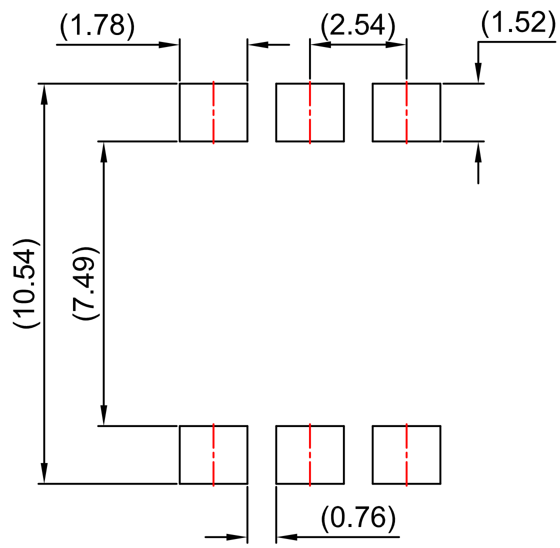
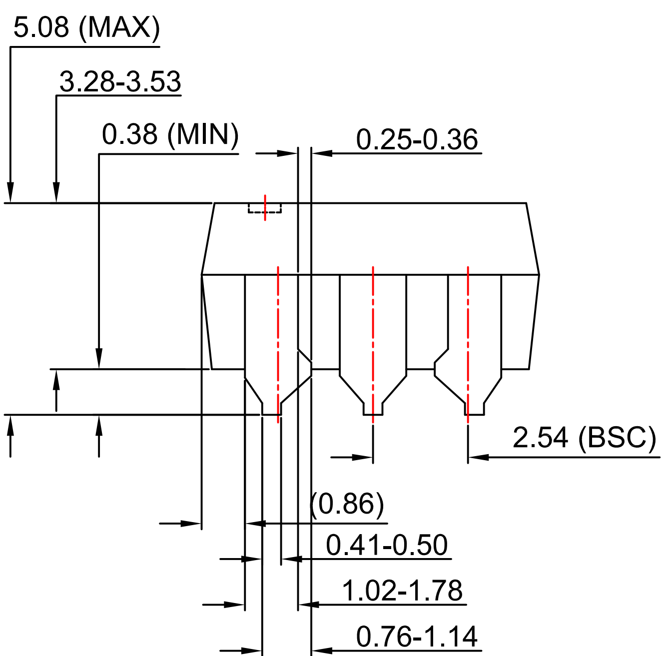
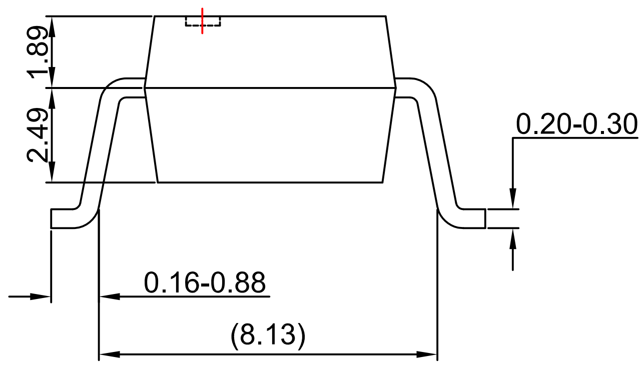




LAND PATTERN RECOMMENDATION





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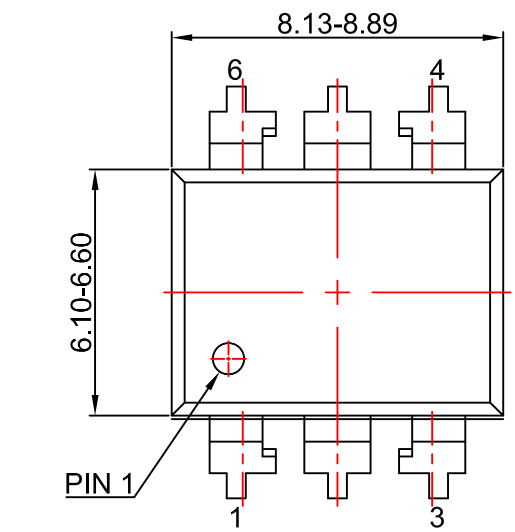

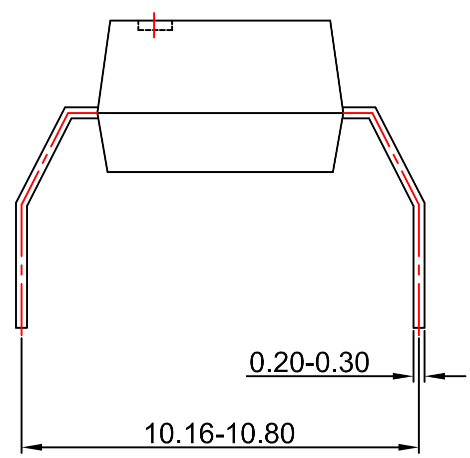

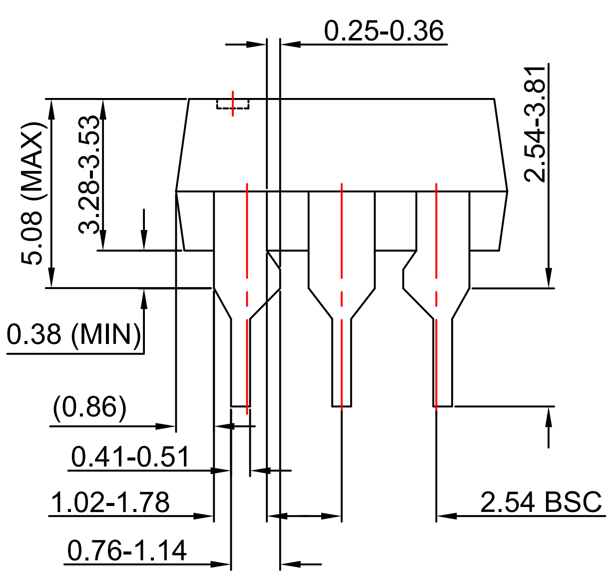

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