

# 6-Pin DIP Random-Phase Triac Driver Output Optocoupler (250/400 V Peak)

**MOC3010M, MOC3011M,  
MOC3012M, MOC3020M,  
MOC3021M, MOC3022M,  
MOC3023M**

## 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 V<sub>AC</sub> operations.

## Features

- Excellent I<sub>FT</sub> Stability – IR Emitting Diode Has Low Degradation
- Peak Blocking Voltage
  - ♦ 250 V, MOC301XM
  - ♦ 400 V, MOC302XM
- Safety and Regulatory Approvals
  - ♦ UL1577, 4,170 V<sub>AC</sub><sub>RMS</sub> for 1 Minute
  - ♦ DIN EN/IEC60747-5-5
- These are Pb-Free Devices

## Applications

- Industrial Controls
- Solenoid/Valve Controls
- Traffic Lights
- Static AC Power Switch
- Vending Machines
- Incandescent Lamp Dimmers
- Solid State Relay
- Motor Control
- Lamp Ballasts

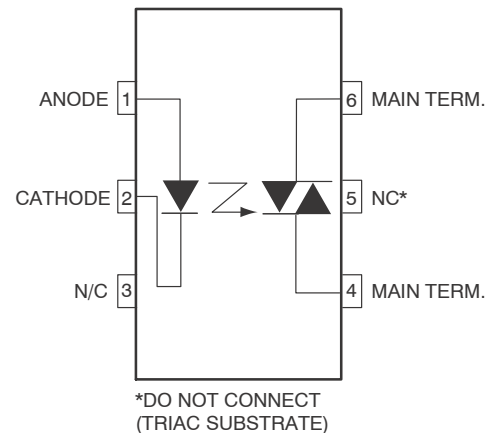
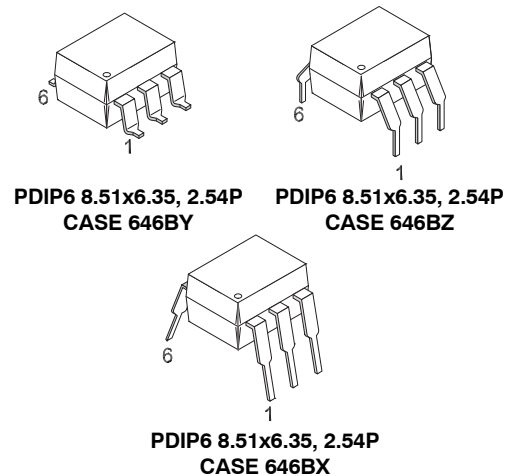


Figure 1. Schematic

## ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## 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

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameters	Device	Value	Unit
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### Total Device

$T_{\text{STG}}$	Storage Temperature	All	-40 to 125	$^\circ\text{C}$
$T_{\text{OPR}}$	Operating Temperature	All	-40 to 85	$^\circ\text{C}$
$T_J$	Junction Temperature Range	All	-40 to 100	$^\circ\text{C}$
$T_{\text{SOL}}$	Lead Solder Temperature	All	260 for 10 seconds	$^\circ\text{C}$
$P_D$	Total Device Power Dissipation at $25^\circ\text{C}$ Ambient	All	330	mW
	Derate Above $25^\circ\text{C}$		4.4	mW/ $^\circ\text{C}$

### Emitter

$I_F$	Continuous Forward Current	All	60	mA
$V_R$	Reverse Voltage	All	3	V
$P_D$	Total Power Dissipation at $25^\circ\text{C}$ Ambient	All	100	mW
	Derate Above $25^\circ\text{C}$		1.33	mW/ $^\circ\text{C}$

### Detector

$V_{\text{DRM}}$	Off-State Output Terminal Voltage	MOC3010M, MOC3011M, MOC3012M	250	V
		MOC3020M, MOC3021M, MOC3022M, MOC3023M	400	
$I_{\text{TSM}}$	Peak Repetitive Surge Current (PW = 100 $\mu\text{s}$ , 120 pps)	All	1	A
$P_D$	Total Power Dissipation at $25^\circ\text{C}$ Ambient	All	300	mW
	Derate Above $25^\circ\text{C}$		4	mW/ $^\circ\text{C}$

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.

# MOC3010M, MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, MOC3023M

## ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$  unless otherwise specified

### INDIVIDUAL COMPONENT CHARACTERISTICS

Symbol	Parameters	Test Conditions	Device	Min.	Typ.	Max.	Unit
<b>Emitter</b>							
$V_F$	Input Forward Voltage	$I_F = 10\text{ mA}$	All		1.15	1.50	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 $V_{\text{DRM}}$ , $I_F = 0^{(1)}$	All		10	100	nA
dv/dt	Critical Rate of Rise of Off-State Voltage	Rated $V_{\text{DRM}}$ , $I_F = 0$	All	1000			V/ $\mu\text{s}$

1. Test voltage must be applied within dv/dt rating.

### TRANSFER CHARACTERISTICS

Symbol	DC Characteristics	Test Conditions	Device	Min.	Typ.	Max.	Unit
$I_{\text{FT}}$	LED Trigger Current	Voltage = 3 V <sup>(2)</sup>	MOC3020M			30	mA
			MOC3010M			15	
			MOC3021M				
			MOC3011M			10	
			MOC3022M				
			MOC3012M			5	
			MOC3023M				
$V_{\text{TM}}$	Peak On-State Voltage, Either Direction	$I_{\text{TM}} = 100\text{ mA peak}$ , $I_F = \text{Rated } I_{\text{FT}}$	All		1.8	3.0	V
$I_H$	Holding Current, Either Direction		All		100		$\mu\text{A}$

2. 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  $I_{\text{FT}}$  (30 mA for MOC3020M, 15 mA for MOC3010M and MOC3021M, 10 mA for MOC3011M and MOC3022M, 5 mA for MOC3012M and MOC3023M) and absolute maximum  $I_F$  (60 mA).

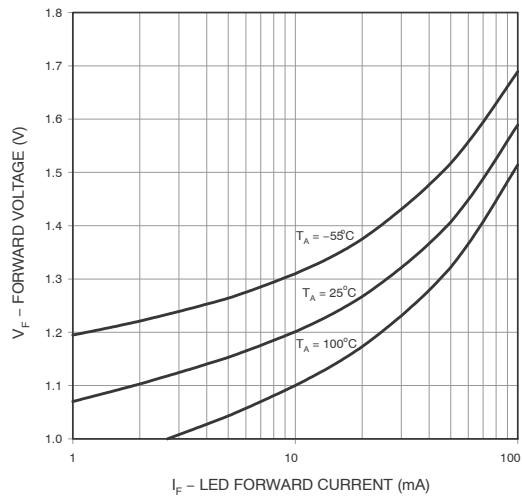
### ISOLATION CHARACTERISTICS

Symbol	Parameters	Test Conditions	Device	Min.	Typ.	Max.	Unit
$V_{\text{ISO}}$	Isolation Voltage <sup>(3)</sup>	$t = 1\text{ Minute}$	All	4170			$V_{\text{ACRMS}}$

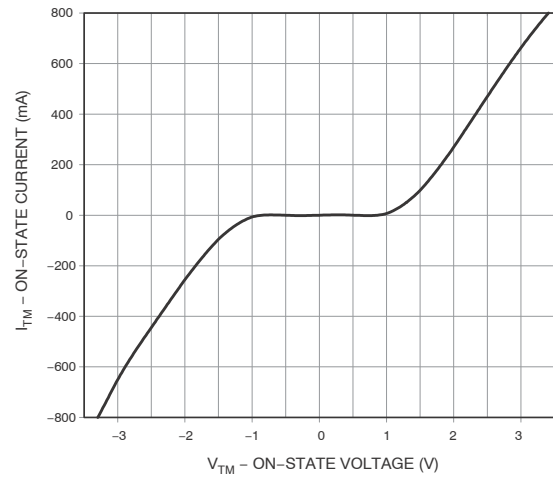
3. Isolation voltage,  $V_{\text{ISO}}$ , is an internal device dielectric breakdown rating. For this test, pins 1 and 2 are common, and pins 4, 5 and 6 are common.

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.

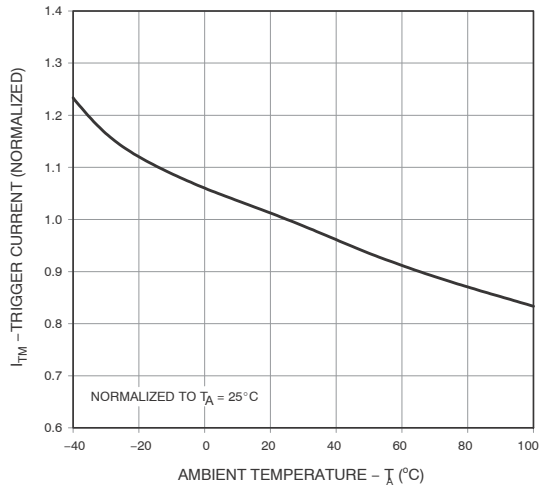
## TYPICAL PERFORMANCE CURVES



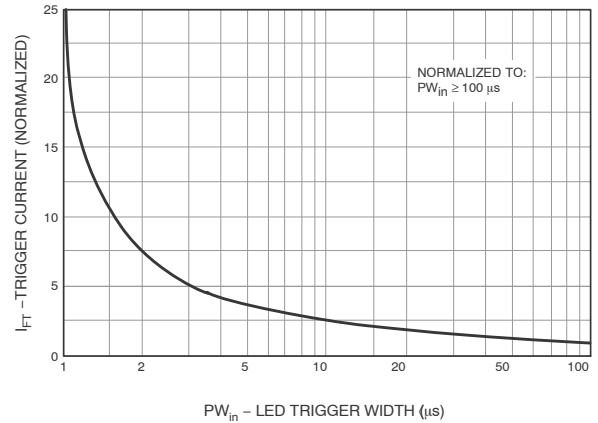
**Figure 2. LED Forward Voltage vs. Forward Current**



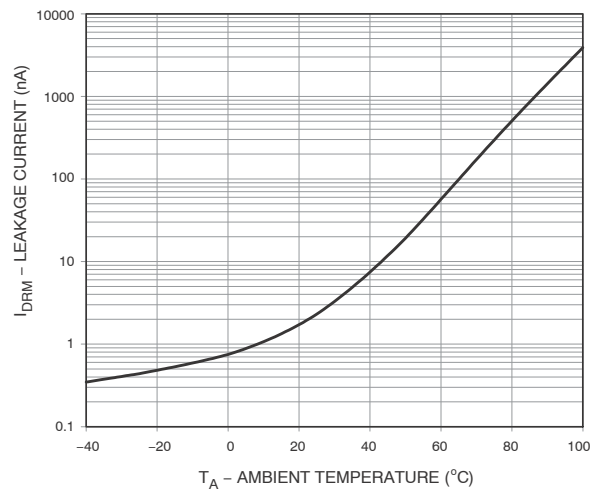
**Figure 3. On-State Characteristics**



**Figure 4. Trigger Current vs. Ambient Temperature**



**Figure 5. LED Current Required to Trigger vs. LED Pulse Width**



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

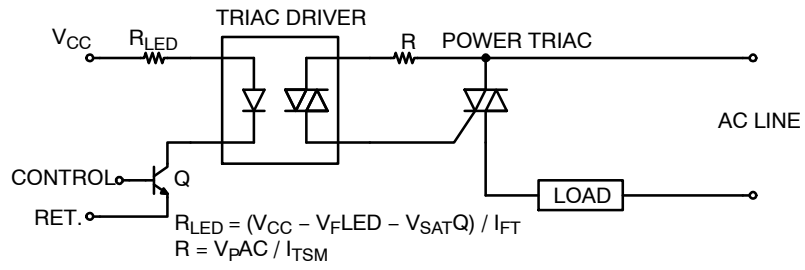
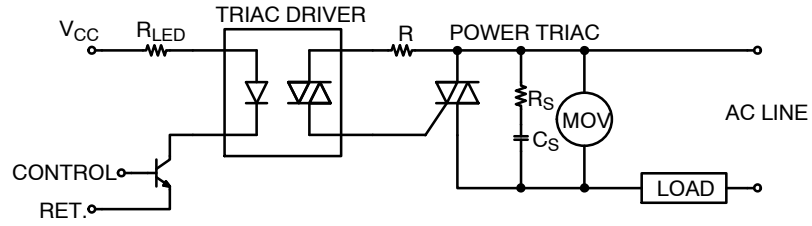


Figure 7. Basic Driver Circuit



Typical Snubber values  $R_S = 33 \Omega$ ,  $C_S = 0.01 \mu F$   
 MOV (Metal Oxide Varistor) protects power triac and  
 driver from transient overvoltages  $> V_{DRM \max}$

Figure 8. Triac Driver Circuit for Noisy Environments

## Reflow Profile

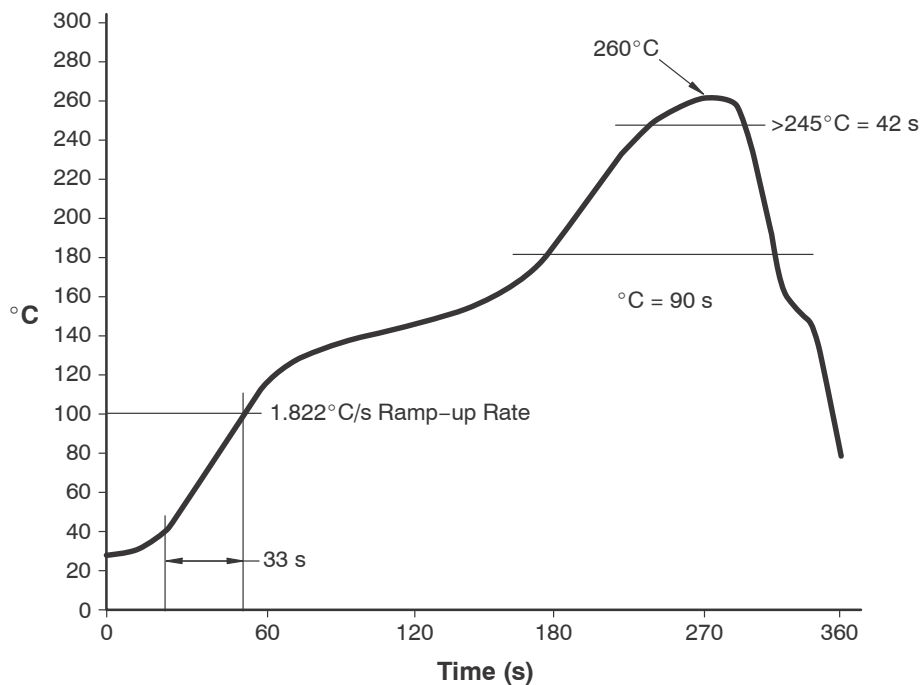


Figure 9. Reflow Profile

## ORDERING INFORMATION

Part Number	Package	Shipping
MOC3010M	DIP 6-Pin	50 Units / Tube
MOC3010SM	SMT 6-Pin (Lead Bend)	50 Units / Tube
MOC3010SR2M	SMT 6-Pin (Lead Bend)	1000 Units / Tape & Reel
MOC3010VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	50 Units / Tube
MOC3010SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	50 Units / Tube
MOC3010SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	1000 Units / Tape & Reel
MOC3010TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	50 Units / Tube

NOTE: The product orderable part number system listed in this table also applies to the MOC3011M, MOC3012M, MOC3020M, MOC3021M, MOC3022M, and MOC3023M product families.

MARKING INFORMATION

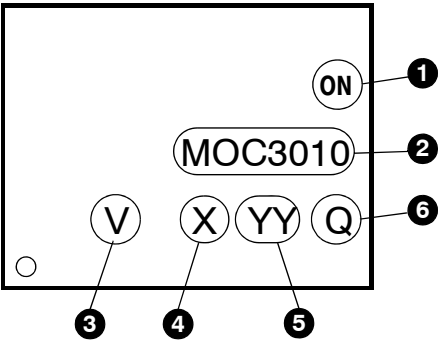


Figure 10. Top Marking

Top Mark Definitions	
1	ON Semiconductor 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



# MECHANICAL CASE OUTLINE

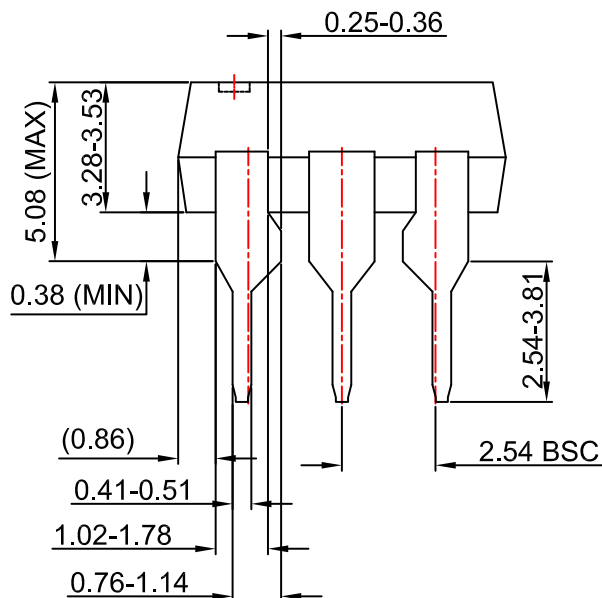
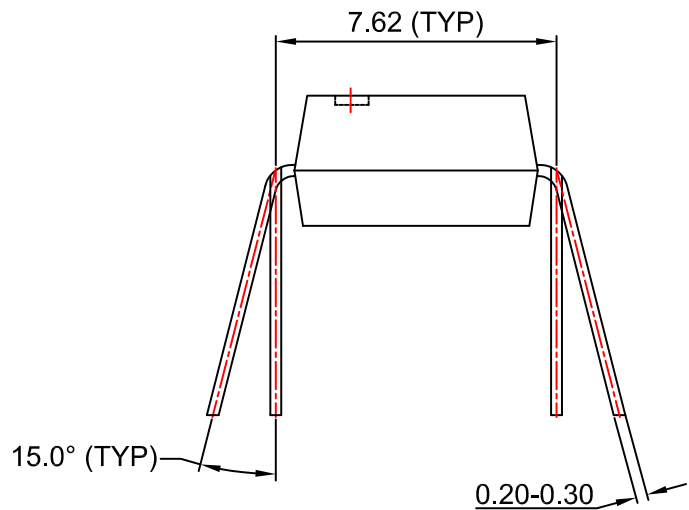
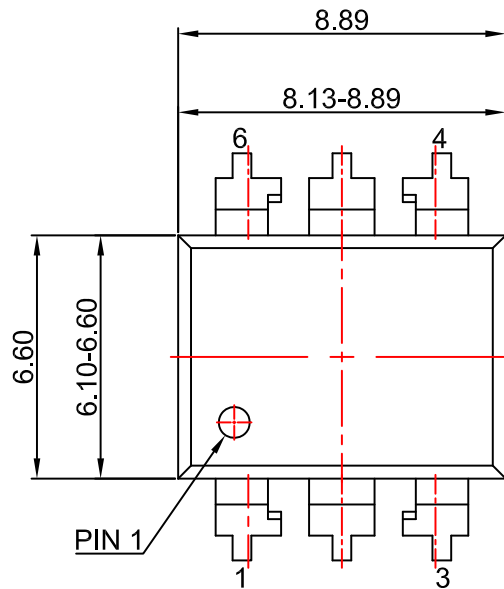
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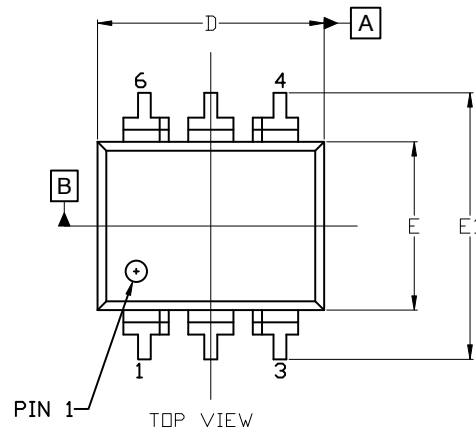
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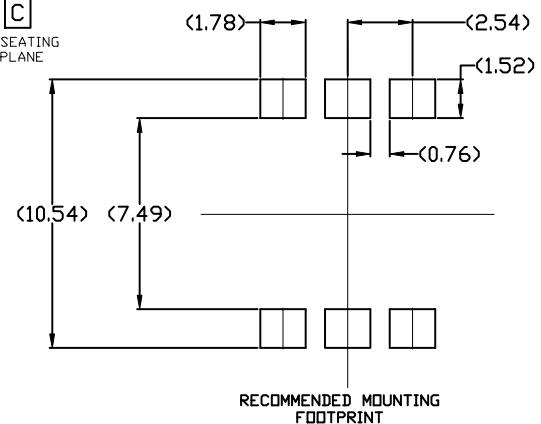
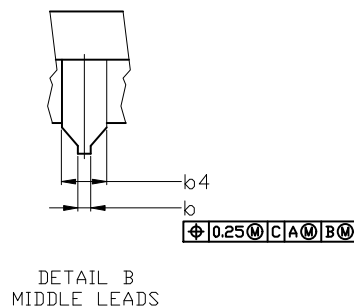
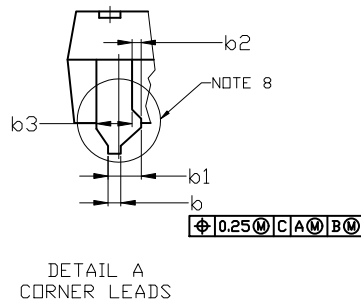
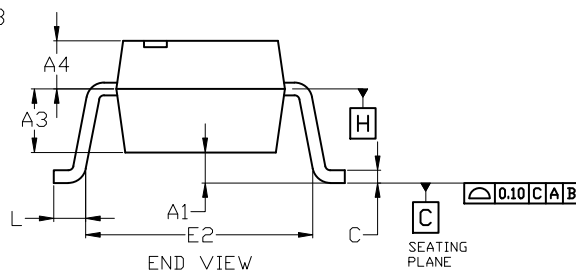
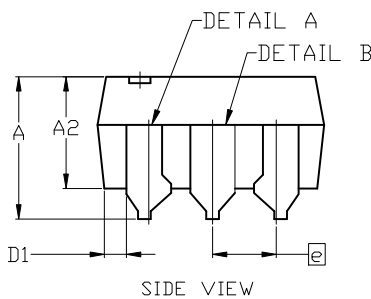
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5. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).
6. CENTER LINE OF CORNER LEADS IS LOCATED BY LOCATING THE CENTER OF FEATURE b2 AND b3.

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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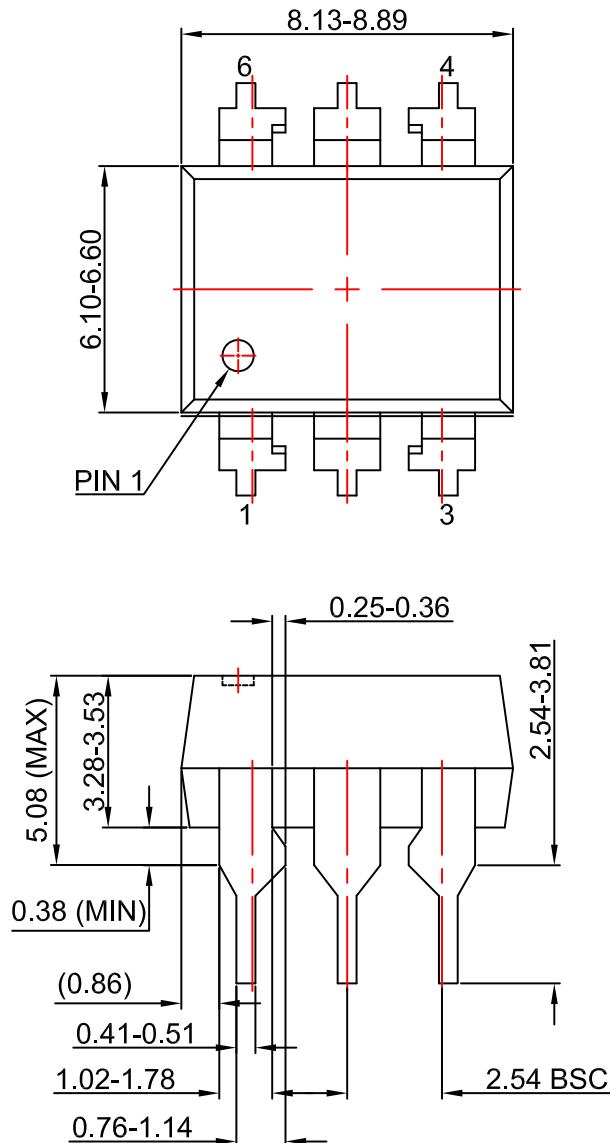
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