

# 6-Pin DIP High Voltage Phototransistor Optocouplers

## 4N38M, H11D1M, H11D3M, MOC8204M

### Description

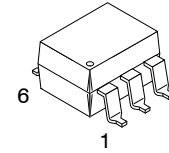
The 4N38M, H11D1M, H11D3M and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

### Features

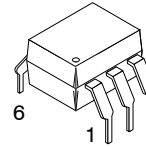
- High Voltage:
  - ◆ MOC8204M,  $BV_{CEO} = 400\text{ V}$
  - ◆ H11D1M,  $BV_{CEO} = 300\text{ V}$
  - ◆ H11D3M,  $BV_{CEO} = 200\text{ V}$
- Safety and Regulatory Approvals:
  - ◆ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
- DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

### Applications

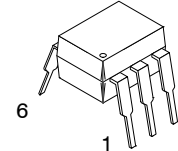
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls



PDIP6  
CASE 646BY

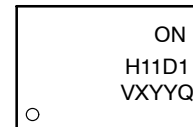


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### MARKING DIAGRAM

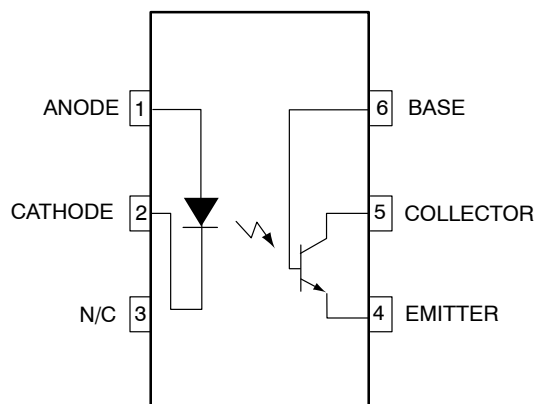


- ON = Company Logo
- H11D1 = Specific Device Code
- V = DIN EN/IEC60747-5-5 Option  
(only appears on component ordered with this option)
- X = One-Digit Year Code
- YY = Digit Work Week
- Q = Assembly Package Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 410 of this data sheet.

**SCHEMATICS**



**Figure 1. Schematics**

**SAFETY AND INSULATION RATINGS**

Parameter		Characteristic
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		55/100/21
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> x 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC	1360	V <sub>peak</sub>
	Input-to-Output Test Voltage, Method B, V <sub>IORM</sub> x 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
T <sub>S</sub>	Case Temperature (Note 1)	175	°C
I <sub>S,INPUT</sub>	Input Current (Note 1)	350	mA
P <sub>S,OUTPUT</sub>	Output Power (Note 1)	800	mW
R <sub>IO</sub>	Insulation Resistance at T <sub>S</sub> , V <sub>IO</sub> = 500 V (Note 1)	> 10 <sup>9</sup>	Ω

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.

1. Safety limit values – maximum values allowed in the event of a failure.

## 4N38M, H11D1M, H11D3M, MOC8204M

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Device	Value	Unit
<b>TOTAL DEVICE</b>				
T <sub>STG</sub>	Storage Temperature	All	-40 to + 125	°C
T <sub>OPR</sub>	Operating Temperature	All	-40 to + 100	°C
T <sub>J</sub>	Junction Temperature	All	-40 to + 125	°C
T <sub>SOL</sub>	Lead Solder Temperature	All	260 for 10 seconds	°C
P <sub>D</sub>	Total Device Power Dissipation @ T <sub>A</sub> = 25°C	All	420	mW
	Derate Above 25°C		3.5	mW/°C
<b>EMITTER</b>				
I <sub>F</sub>	Forward DC Current (Note 2)	All	80	mA
V <sub>R</sub>	Reverse Input Voltage (Note 2)	All	6.0	V
I <sub>F(pk)</sub>	Forward Current – Peak (1 μs pulse, 300 pps) (Note 2)	All	3.0	A
P <sub>D</sub>	LED Power Dissipation @ T <sub>A</sub> = 25°C (Note 2)	All	120	mW
	Derate Above 25°C		1.41	mW/°C
<b>DETECTOR</b>				
P <sub>D</sub>	Power Dissipation @ T <sub>A</sub> = 25°C	All	300	mW
	Derate Linearly Above 25°C		4.0	mW/°C
V <sub>CEO</sub>	Collector to Emitter Voltage (Note 2)	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V <sub>CBO</sub>	Collector Base Voltage (Note 2)	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V <sub>ECO</sub>	Emitter to Collector Voltage (Note 2)	H11D1M, H11D3M, MOC8204M	7	V
I <sub>C</sub>	Collector Current (Continuous)	All	100	mA

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.

2. Parameters meet or exceed JEDEC registered data (for 4N38M only).

# 4N38M, H11D1M, H11D3M, MOC8204M

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

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

#### Emitter

V <sub>F</sub>	Forward Voltage (Note 3)	I <sub>F</sub> = 10 mA	All	-	1.15	1.50	V
$\frac{\Delta V_F}{\Delta T_A}$	Forward Voltage Temperature Coefficient		All	-	-1.8	-	mV/°C
BV <sub>R</sub>	Reverse Breakdown Voltage	I <sub>R</sub> = 10 μA	All	6	25	-	V
C <sub>J</sub>	Junction Capacitance	V <sub>F</sub> = 0 V, f = 1 MHz	All	-	50	-	pF
		V <sub>F</sub> = 1 V, f = 1 MHz		-	65	-	pF
I <sub>R</sub>	Reverse Leakage Current (Note 3)	V <sub>R</sub> = 6 V	All	-	0.05	10	μA

#### Detector

BV <sub>CEO</sub>	Breakdown Voltage Collector-to-Emitter (Note 3)	R <sub>BE</sub> = 1 MΩ, I <sub>C</sub> = 1.0 mA, I <sub>F</sub> = 0	MOC8204M	400	-	-	V
			H11D1M	300	-	-	V
			H11D3M	200	-	-	V
			No RBE, I <sub>C</sub> = 1.0 mA	4N38M	80	-	-
BV <sub>CBO</sub>	Collector to Base (Note 3)	I <sub>C</sub> = 100 μA, I <sub>F</sub> = 0	MOC8204M	400	-	-	V
			H11D1M	300	-	-	V
			H11D3M	200	-	-	V
			4N38M	80	-	-	V
BV <sub>EBO</sub>	Emitter to Base	I <sub>E</sub> = 100 μA, I <sub>F</sub> = 0	4N38M	7	-	-	V
BV <sub>ECO</sub>	Emitter to Collector	I <sub>E</sub> = 100 μA, I <sub>F</sub> = 0	All	7	10	-	V
I <sub>CEO</sub>	Leakage Current Collector to Emitter (Note 3) (R <sub>BE</sub> = 1 MΩ)	V <sub>CE</sub> = 300 V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	MOC8204M	-	-	100	nA
		V <sub>CE</sub> = 300 V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C		-	-	250	μA
		V <sub>CE</sub> = 200 V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	H11D1M	-	-	100	nA
		V <sub>CE</sub> = 200 V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C		-	-	250	μA
		V <sub>CE</sub> = 100 V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	H11D3M	-	-	100	nA
		V <sub>CE</sub> = 100 V, I <sub>F</sub> = 0, T <sub>A</sub> = 100°C		-	-	250	μA
		No R <sub>BE</sub> , V <sub>CE</sub> = 60 V, I <sub>F</sub> = 0, T <sub>A</sub> = 25°C	4N38M	-	-	50	nA

### TRANSFER CHARACTERISTICS

#### Emitter

CTR	Current Transfer Ratio, Collector-to-Emitter	I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V, R <sub>BE</sub> = 1 MΩ	H11D1M, H11D3M, MOC8204M	2 (20)	-	-	mA (%)
		I <sub>F</sub> = 10 mA, V <sub>CE</sub> = 10 V	4N38M	2 (20)	-	-	mA (%)
V <sub>CE(SAT)</sub>	Saturation Voltage (Note 3)	I <sub>F</sub> = 10 mA, I <sub>C</sub> = 0.5 mA, R <sub>BE</sub> = 1 MΩ	H11D1M, H11D3M, MOC8204M	-	0.1	0.4	V
		I <sub>F</sub> = 20 mA, I <sub>C</sub> = 4 mA	4N38M	-	-	1.0	V

#### Switching Times

t <sub>ON</sub>	Non-Saturated Turn-on Time	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 2 mA, R <sub>L</sub> = 100 Ω	All	-	5	-	μs
t <sub>OFF</sub>	Turn-off Time		All	-	5	-	μs

### ISOLATION CHARACTERISTICS

V <sub>ISO</sub>	Input-Output Isolation Voltage	t = 1 Minute	4170	-	-	V <sub>AC(RMS)</sub>
C <sub>ISO</sub>	Isolation Capacitance	V <sub>I-O</sub> = 0 V, f = 1 MHz	-	0.2	-	pF
R <sub>ISO</sub>	Isolation Resistance	V <sub>I-O</sub> = ±500 V <sub>DC</sub> , T <sub>A</sub> = 25°C	10 <sup>11</sup>	-	-	Ω

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.

3. Parameters meet or exceed JEDEC registered data (for 4N38M only).

TYPICAL PERFORMANCE CURVES

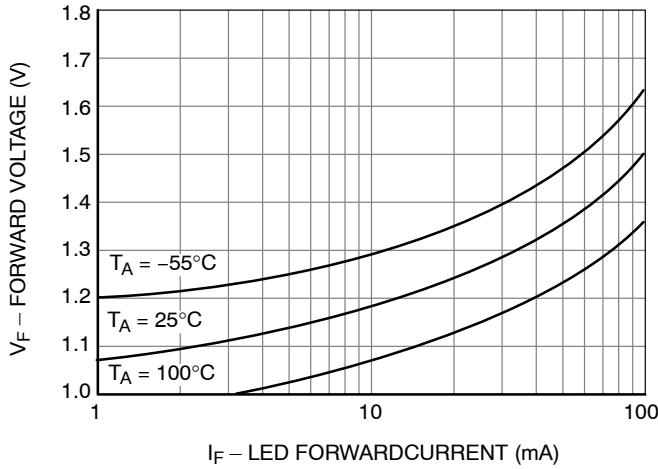


Figure 2. LED Forward Voltage vs. Forward Current

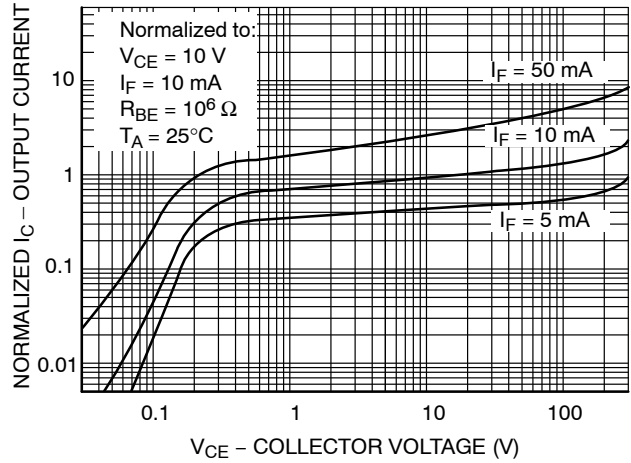


Figure 3. Normalized Output Characteristics

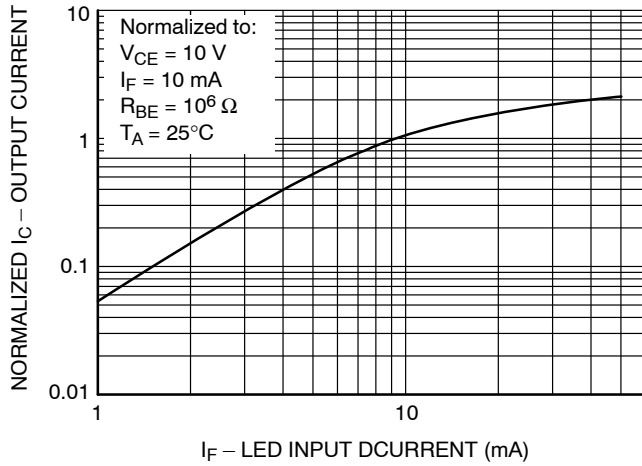


Figure 4. Normalized Output Current vs. LED Input Current

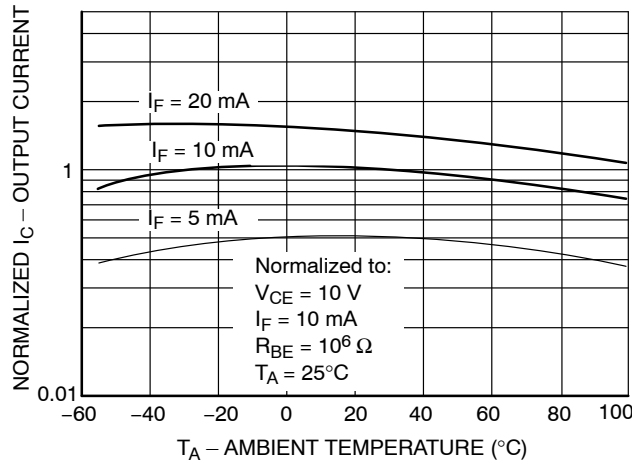


Figure 5. Normalized Output Current vs. Temperature

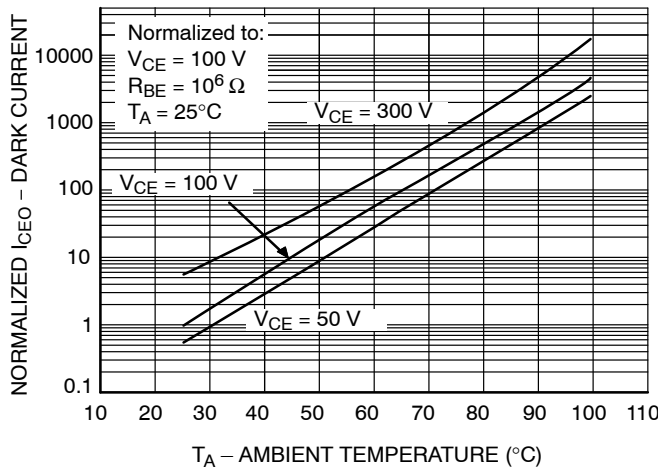


Figure 6. Normalized Dark Current vs. Ambient Temperature

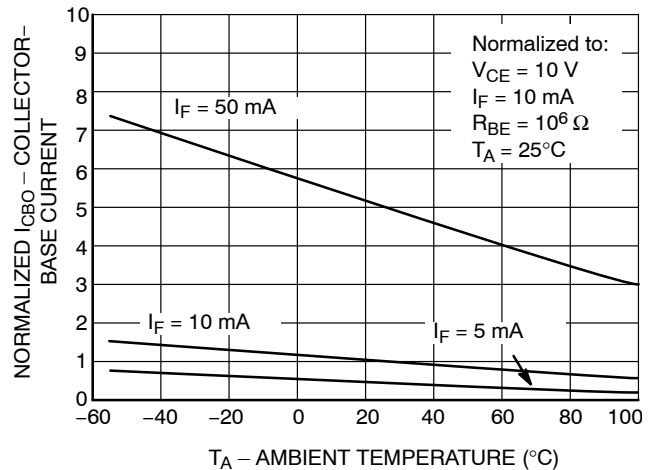


Figure 7. Normalized Collector-Base Current vs. Temperature

# 4N38M, H11D1M, H11D3M, MOC8204M

## REFLOW PROFILE

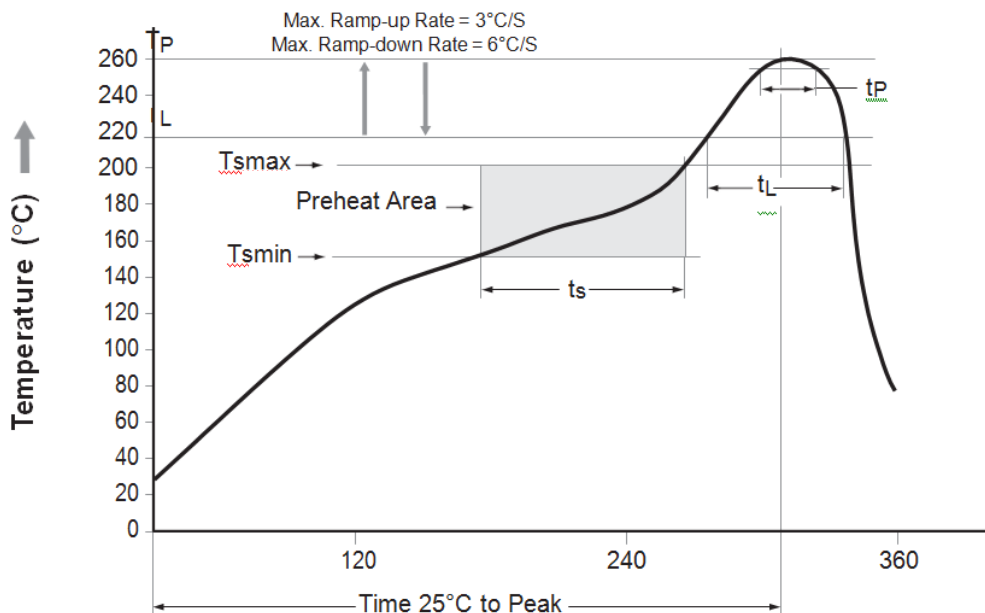


Figure 8. Reflow Profile

Profile Feature	Pb-Free Assembly Profile
Temperature Min. (T <sub>ssmin</sub> )	150°C
Temperature Max. (T <sub>ssmax</sub> )	200°C
Time (t <sub>s</sub> ) from (T <sub>ssmin</sub> to T <sub>ssmax</sub> )	60 – 120 seconds
Ramp-up Rate (t to t <sub>P</sub> )	3°C / second max.
Liquidous Temperature (T <sub>L</sub> )	217°C
Time (t <sub>L</sub> ) Maintained Above (T <sub>L</sub> )	60 – 150 seconds
Peak Body Package Temperature	260°C + 0°C / -5°C
Time (t <sub>P</sub> ) within 5°C of 260°C	30 seconds
Ramp-down Rate (T <sub>P</sub> to T <sub>L</sub> )	6°C / second max.
Time 25°C to Peak Temperature	8 minutes max.

Table 1. ORDERING INFORMATION

Part Number	Package	Packing Method†
H11D1M	DIP 6-Pin	Tube (50 Units)
H11D1SM	SMT 6-Pin (Lead Bend)	Tube (50 Units)
H11D1SR2M	SMT 6-Pin (Lead Bend)	Tape and Reel (1000 Units)
H11D1VM	DIP 6-Pin, DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11D1SVM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tube (50 Units)
H11D1SR2VM	SMT 6-Pin (Lead Bend), DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)
H11D1TVM	DIP 6-Pin, 0.4" Lead Spacing, DIN EN/IEC60747-5-5 Option	Tube (50 Units)

†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.

4. The product orderable part number system listed in this table also applies to the 4N38M, H11D3M, and MOC8204M devices.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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PDIP6 8.51x6.35, 2.54P  
CASE 646BX  
ISSUE O

DATE 31 JUL 2016



NOTES:

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# MECHANICAL CASE OUTLINE

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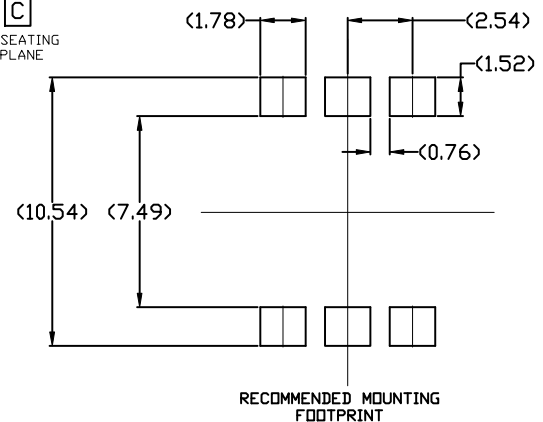
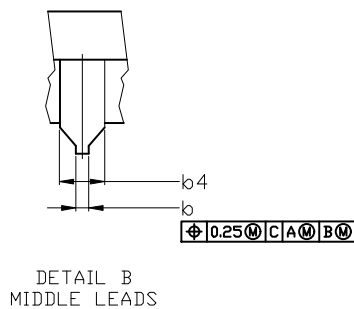
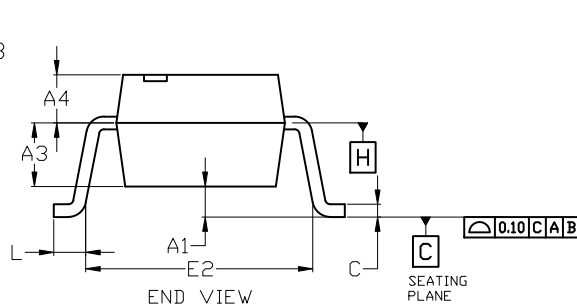
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NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
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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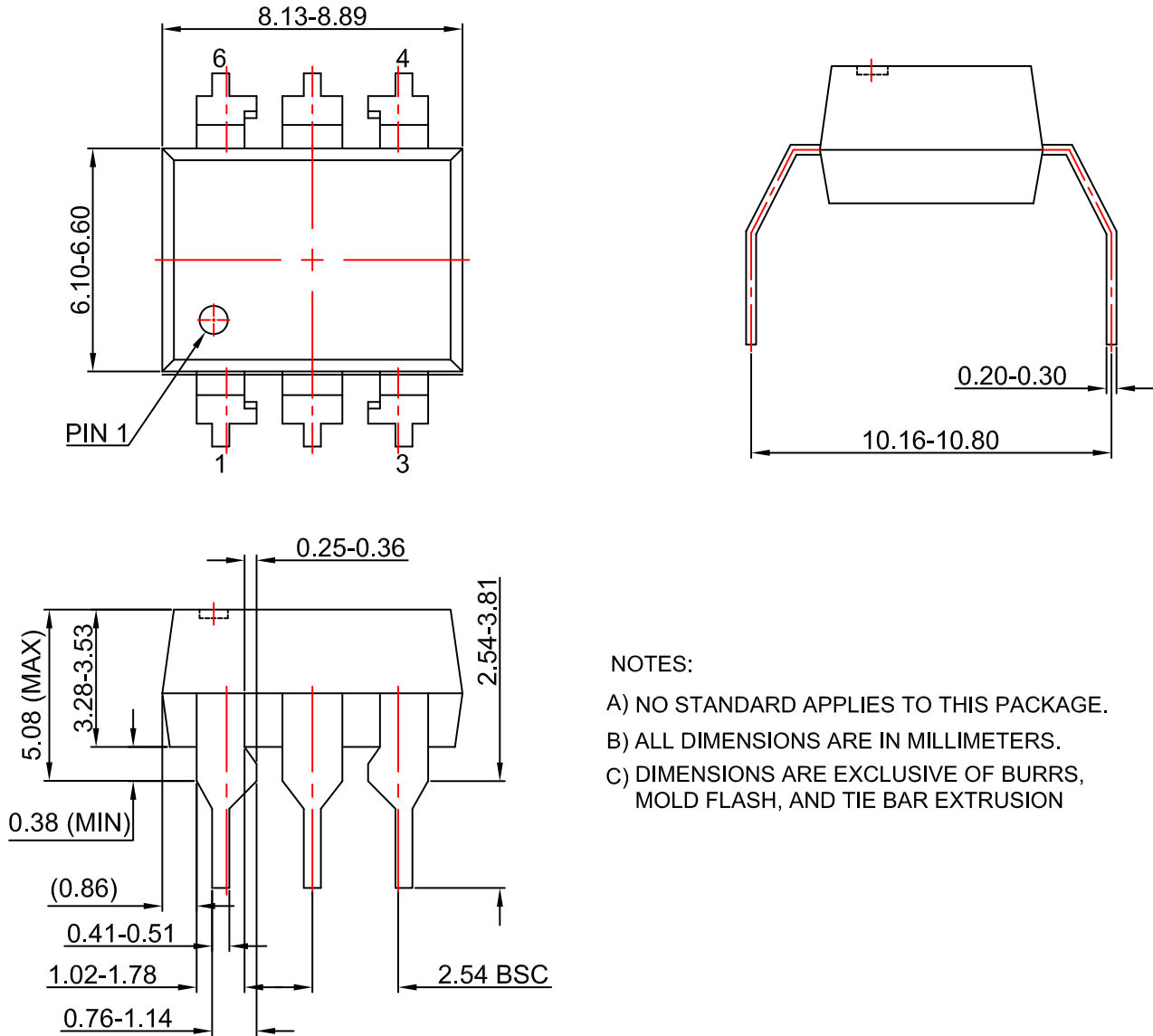
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**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

PDIP6 8.51x6.35, 2.54P  
CASE 646BZ  
ISSUE O

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