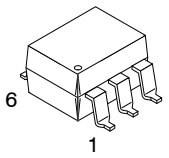
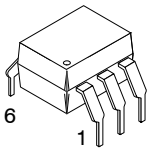
6-Pin DIP High Voltage Phototransistor Optocouplers

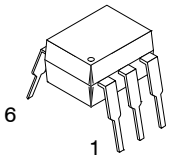
4N38M, H11D1M, H11D3M, MOC8204M



PDIP6
CASE 646BY



PDIP6
CASE 646BZ



PDIP6
CASE 646BX

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.

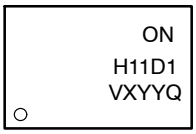
Features

- High Voltage:
  - MOC8204M, BV_{CEO} = 400 V
  - H11D1M, BV_{CEO} = 300 V
  - H11D3M, BV_{CEO} = 200 V
- Safety and Regulatory Approvals:
  - UL1577, 4,170 VAC_{RMS} 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

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.

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SCHEMATICS

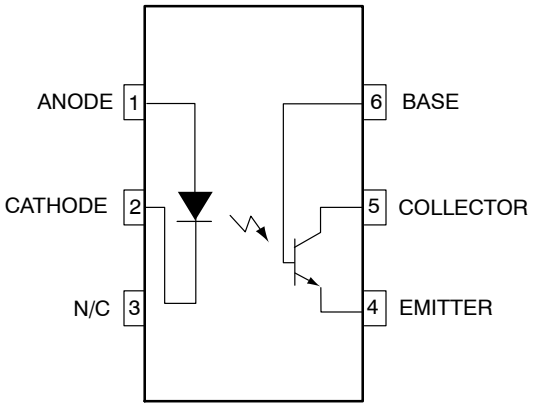

Figure 1. Schematics

SAFETY AND INSULATION RATINGS

Parameter		Characteristic
Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage	< 150 V_{RMS}	I – IV
	< 300 V_{RMS}	I – IV
Climatic Classification		55/100/21
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	1360	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
T_S	Case Temperature (Note 1)	175	°C
$I_{S,INPUT}$	Input Current (Note 1)	350	mA
$P_{S,OUTPUT}$	Output Power (Note 1)	800	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V (Note 1)	> 10^9	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.

ABSOLUTE MAXIUM RATINGS

Symbol	Parameter	Device	Value	Unit
TOTAL DEVICE				
T_{STG}	Storage Temperature	All	−40 to + 125	°C
T_{OPR}	Operating Temperature	All	−40 to + 100	°C
T_J	Junction Temperature	All	−40 to + 125	°C
T_{SOL}	Lead Solder Temperature	All	260 for 10 seconds	°C
P_D	Total Device Power Dissipation @ T_A = 25°C	All	420	mW
	Derate Above 25°C		3.5	mW/°C
EMITTER				
I_F	Forward DC Current (Note 2)	All	80	mA
V_R	Reverse Input Voltage (Note 2)	All	6.0	V
I_F(pk)	Forward Current − Peak (1 μs pulse, 300 pps) (Note 2)	All	3.0	A
P_D	LED Power Dissipation @ T_A = 25°C (Note 2)	All	120	mW
	Derate Above 25°C		1.41	mW/°C
DETECTOR				
P_D	Power Dissipation @ TA = 25°C	All	300	mW
	Derate Linearly Above 25°C		4.0	mW/°C
V_{CEO}	Collector to Emitter Voltage (Note 2)	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V_{CBO}	Collector Base Voltage (Note 2)	MOC8204M	400	V
		H11D1M	300	V
		H11D3M	200	V
		4N38M	80	V
V_{ECO}	Emitter to Collector Voltage (Note 2)	H11D1M, H11D3M, MOC8204M	7	V
I_C	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).

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Symbol	Characteristic	Test Conditions	Device	Min	Typ	Max	Unit
INDIVIDUAL COMONENT CHARACTERISTICS							
Emitter							
V_F	Forward Voltage (Note 3)	I_F = 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_R	Reverse Breakdown Voltage	I_R = 10 μA	All	6	25	–	V
C_J	Junction Capacitance	V_F = 0 V, f = 1 MHz	All	–	50	–	pF
		V_F = 1 V, f = 1 MHz		–	65	–	pF
I_R	Reverse Leakage Current (Note 3)	V_R = 6 V	All	–	0.05	10	μA
Detector							
BV_{CEO}	Breakdown Voltage Collector−to−Emitter (Note 3)	R_{BE} = 1 MΩ, I_C = 1.0 mA, I_F = 0	MOC8204M	400	–	–	V
			H11D1M	300	–	–	V
			H11D3M	200	–	–	V
		No RBE, I_C = 1.0 mA	4N38M	80	–	–	V
BV_{CBO}	Collector to Base (Note 3)	I_C = 100 μA, I_F = 0	MOC8204M	400	–	–	V
			H11D1M	300	–	–	V
			H11D3M	200	–	–	V
			4N38M	80	–	–	V
BV_{EBO}	Emitter to Base	I_E = 100 μA, I_F = 0	4N38M	7	–	–	V
BV_{ECO}	Emitter to Collector	I_E = 100 μA, I_F = 0	All	7	10	–	V
I_{CEO}	Leakage Current Collector to Emitter (Note 3) (R_{BE} = 1 MΩ)	V_{CE} = 300 V, I_F = 0, T_A = 25°C	MOC8204M	–	–	100	nA
		V_{CE} = 300 V, I_F = 0, T_A = 100°C		–	–	250	μA
		V_{CE} = 200 V, I_F = 0, T_A = 25°C	H11D1M	–	–	100	nA
		V_{CE} = 200 V, I_F = 0, T_A = 100°C		–	–	250	μA
		V_{CE} = 100 V, I_F = 0, T_A = 25°C	H11D3M	–	–	100	nA
		V_{CE} = 100 V, I_F = 0, T_A = 100°C		–	–	250	μA
		No R_{BE}, V_{CE} = 60 V, I_F = 0, T_A = 25°C	4N38M	–	–	50	nA
TRANSFER CHARACTERISTICS							
Emitter							
CTR	Current Transfer Ratio, Collector−to−Emitter	I_F = 10 mA, V_{CE} = 10 V, R_{BE} = 1 MΩ	H11D1M, H11D3M, MOC8204M	2 (20)	–	–	mA (%)
		I_F = 10 mA, V_{CE} = 10 V	4N38M	2 (20)	–	–	mA (%)
$V_{CE(SAT)}$	Saturation Voltage (Note 3)	I_F = 10 mA, I_C = 0.5 mA, R_{BE} = 1 MΩ	H11D1M, H11D3M, MOC8204M	–	0.1	0.4	V
		I_F = 20 mA, I_C = 4 mA	4N38M	–	–	1.0	V
Switching Times							
t_{ON}	Non−Saturated Turn−on Time	V_{CE} = 10 V, I_C = 2 mA, R_L = 100 Ω	All	–	5	–	μs
t_{OFF}	Turn−off Time		All	–	5	–	μs
ISOLATION CHARACTERISTICS							
V_{ISO}	Input−Output Isolation Voltage	t = 1 Minute		4170	–	–	VAC_{RMS}
C_{ISO}	Isolation Capacitance	V_{I-O} = 0 V, f = 1 MHz		–	0.2	–	pF
R_{ISO}	Isolation Resistance	V_{I-O} = ±500 V_{DC}, T_A = 25°C		10^{11}	–	–	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

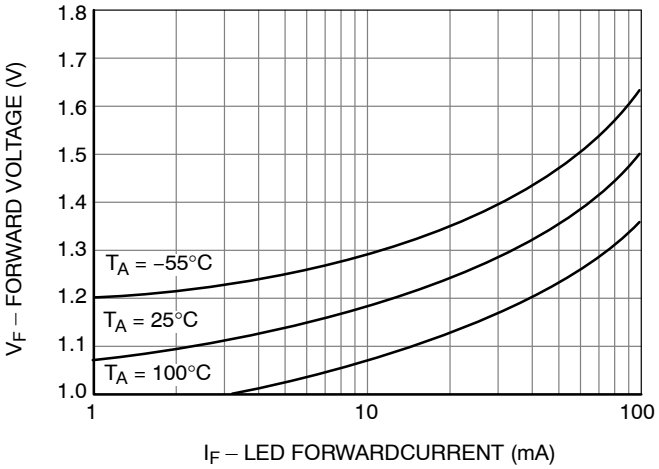

Figure 2. LED Forward Voltage vs. Forward Current

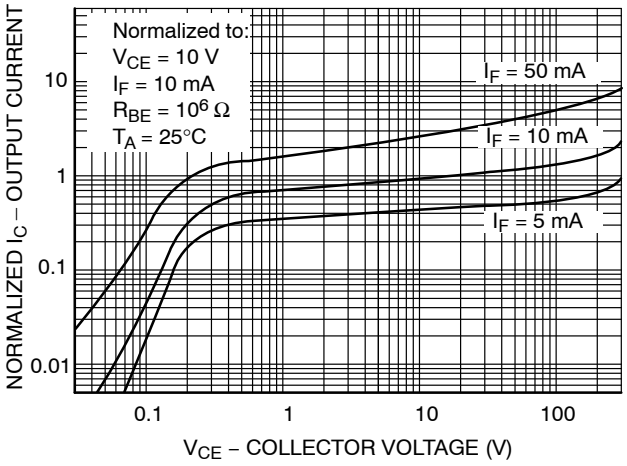

Figure 3. Normalized Output Characteristics

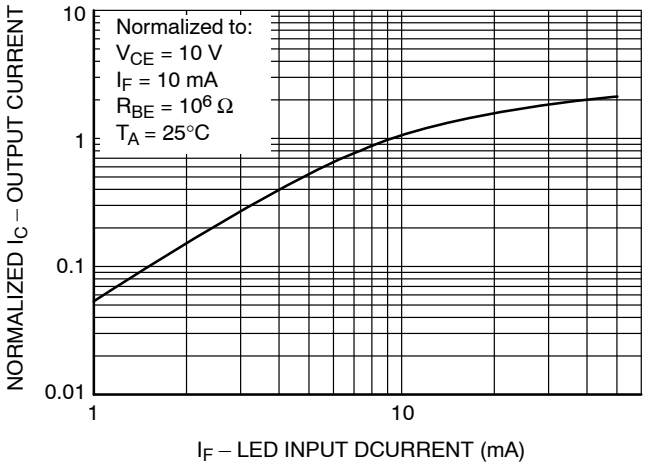

Figure 4. Normalized Output Current vs. LED Input Current

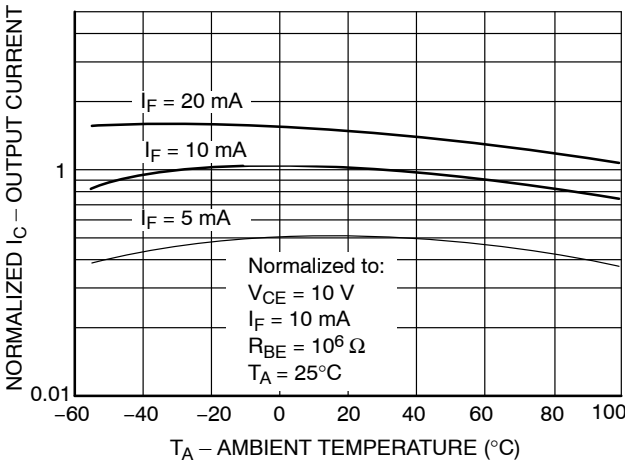

Figure 5. Normalized Output Current vs. Temperature

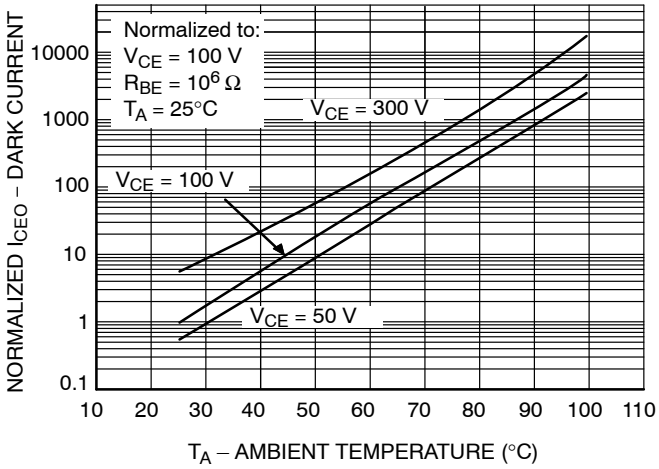

Figure 6. Normalized Dark Current vs. Ambient Temperature

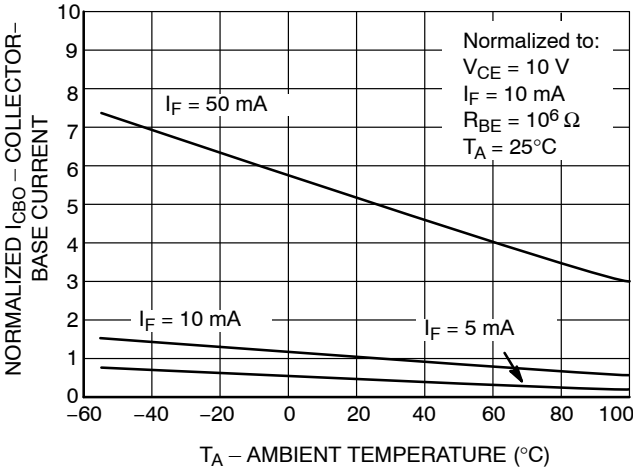

Figure 7. Normalized Collector−Base Current vs. Temperature

REFLOW PROFILE

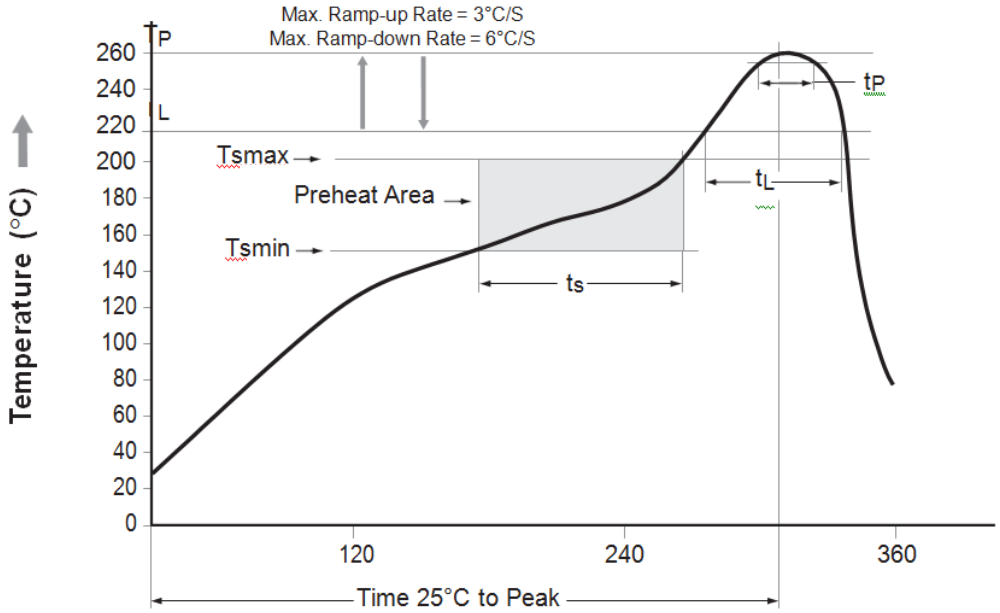

Figure 8. Reflow Profile

Profile Feature	Pb−Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60 – 120 seconds
Ramp−up Rate (t to t_P)	3°C / second max.
Liquidous Temperature (T_L)	217°C
Time (t_L) Maintained Above (T_L)	60 – 150 seconds
Peak Body Package Temperature	260°C + 0°C / −5°C
Time (t_P) within 5°C of 260°C	30 seconds
Ramp−down Rate (T_P to T_L)	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.

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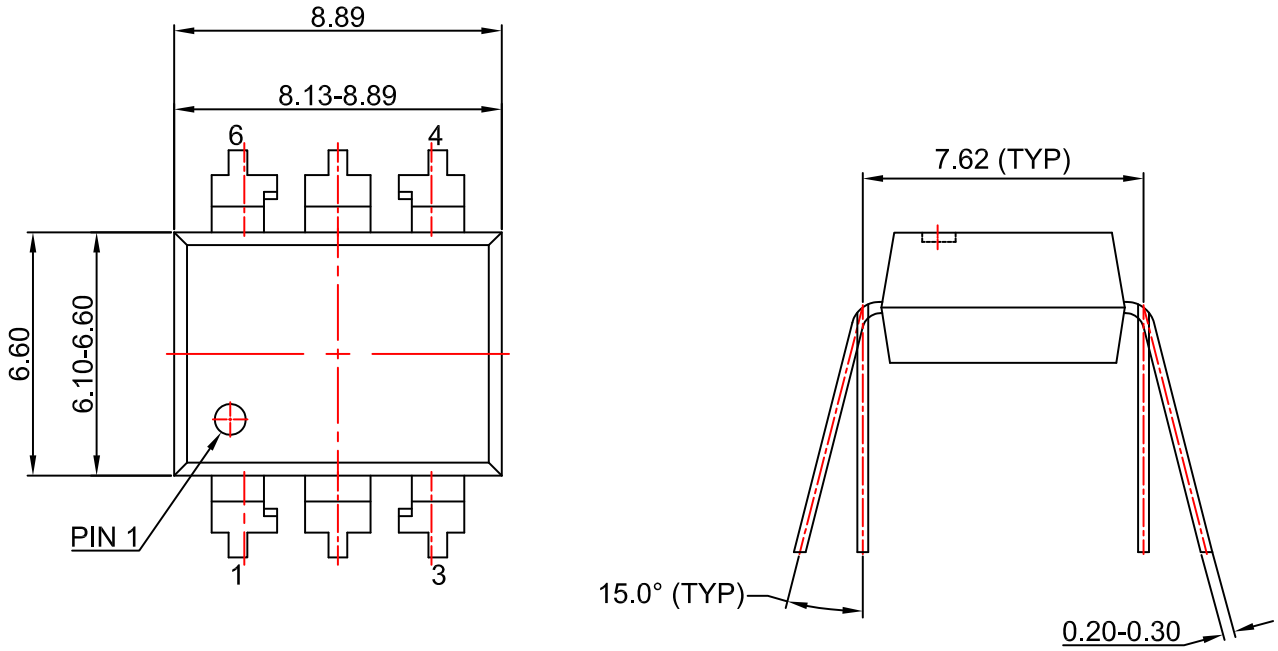

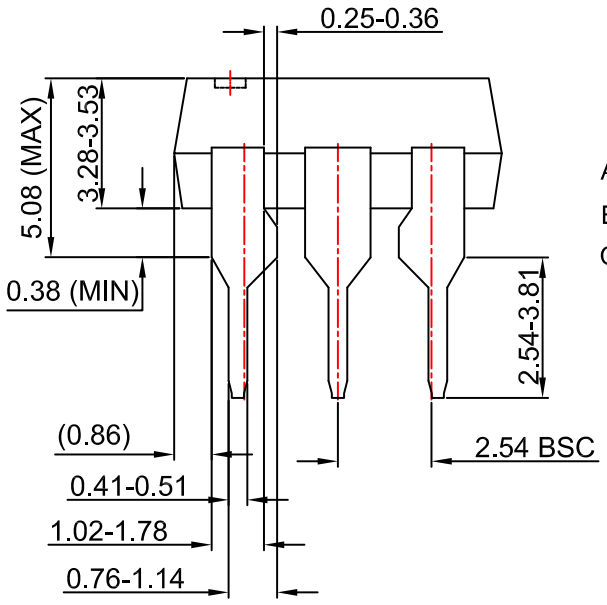

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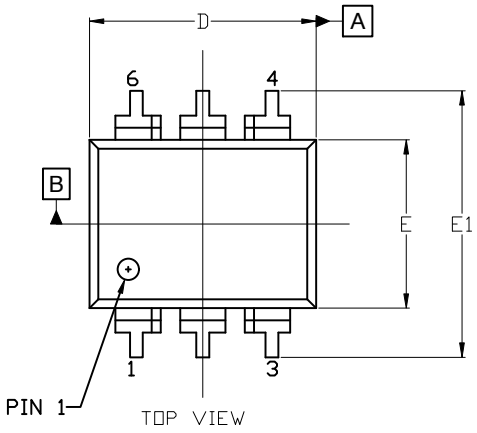
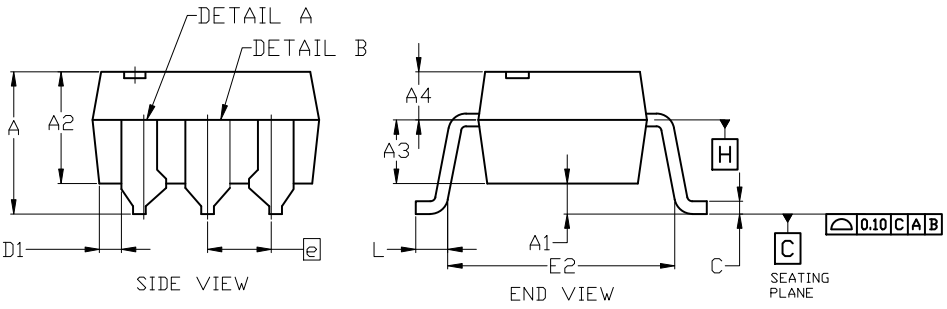
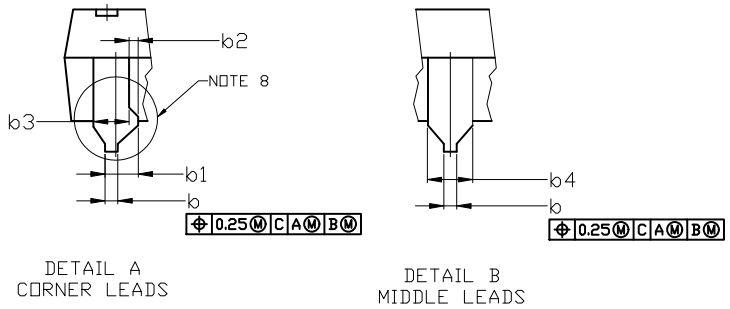
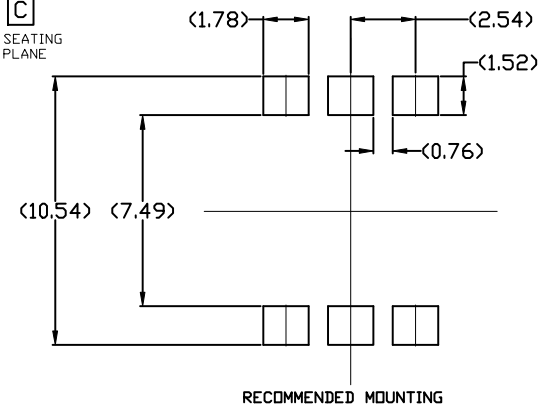


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS A, A1, AND L ARE MEASURED WITH THE PACKAGE SEATED.
4. DIMENSIONS D, D1, AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 2.54mm.
5. PACKAGE CONTOUR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

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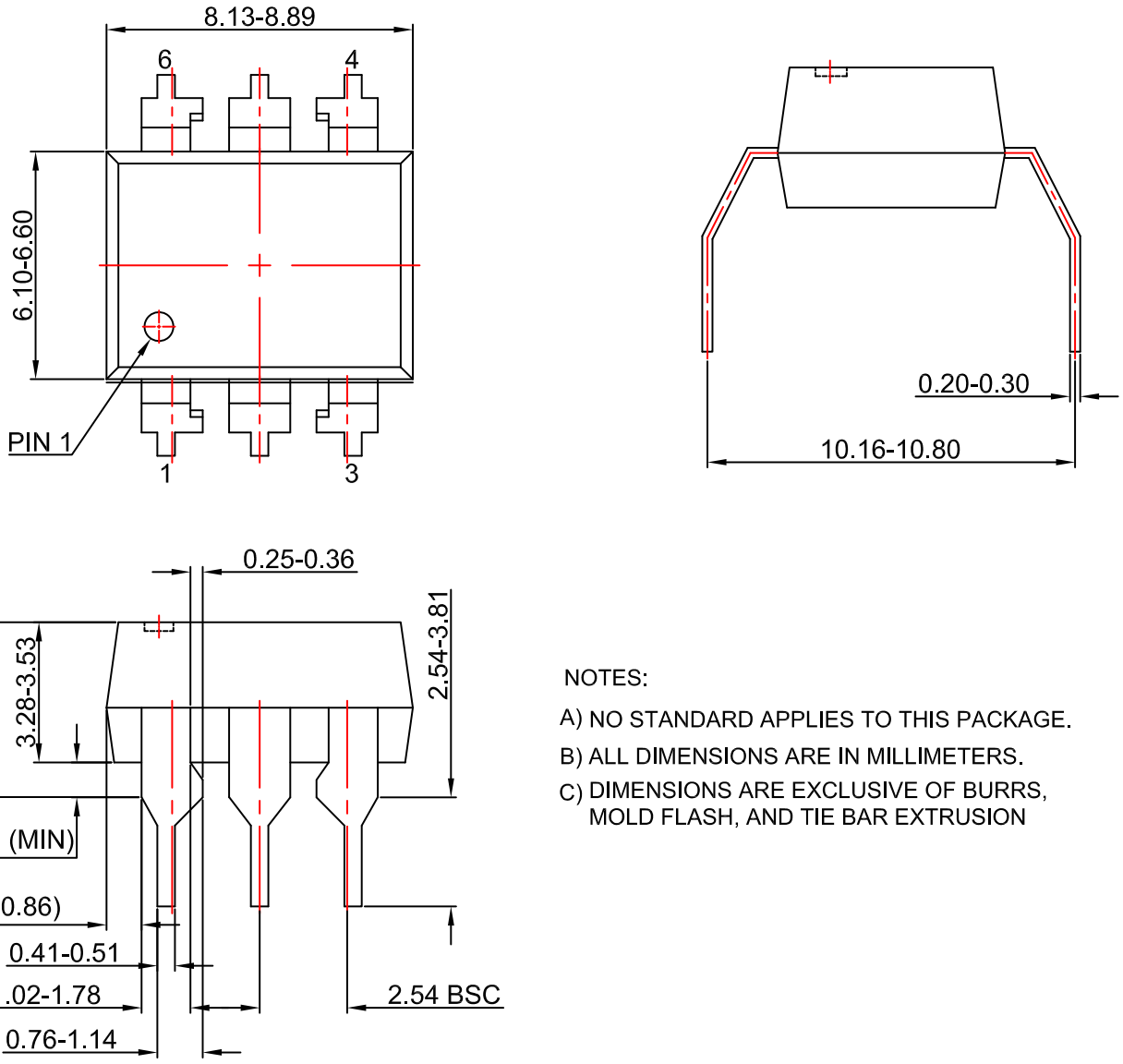

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