

# 6-Pin DIP High Voltage Phototransistor Optocouplers

## 4N38M, H11D1M, H11D3M, MOC8204M

### Description

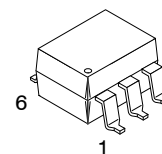
The 4N38M, H11D1M, H11D3M and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

### Features

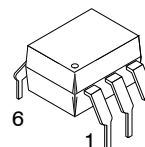
- High Voltage:
  - ♦ MOC8204M,  $BV_{CEO} = 400\text{ V}$
  - ♦ H11D1M,  $BV_{CEO} = 300\text{ V}$
  - ♦ H11D3M,  $BV_{CEO} = 200\text{ V}$
- Safety and Regulatory Approvals:
  - ♦ UL1577, 4,170 VAC<sub>RMS</sub> for 1 Minute
- DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

### Applications

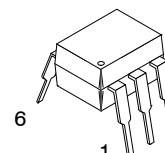
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls



PDIP6  
CASE 646BY

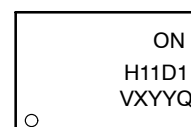


PDIP6  
CASE 646BZ



PDIP6  
CASE 646BX

### 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

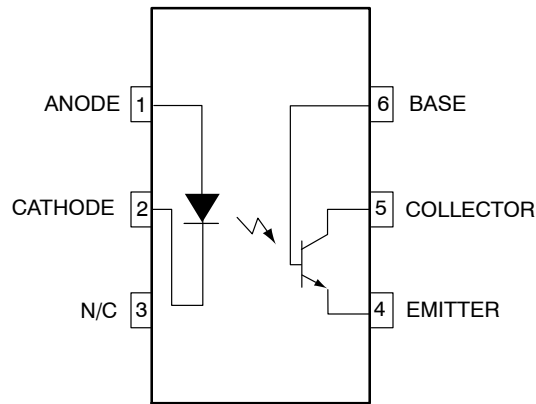


Figure 1. Schematics

## 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  |
|--------------------|--------------------------------------------------------|--------------------------------|--------------------|-------|
| TOTAL DEVICE       |                                                        |                                |                    |       |
| 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 |
| EMITTER            |                                                        |                                |                    |       |
| 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 |
| DETECTOR           |                                                        |                                |                    |       |
| P <sub>D</sub>     | Power Dissipation @ TA = 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,<br>H11D3M,<br>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 |
|--------|----------------|-----------------|--------|-----|-----|-----|------|
|--------|----------------|-----------------|--------|-----|-----|-----|------|

### INDIVIDUAL COMONENT 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  | –  | –   | V  |
| 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 RBE, 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             | –   | – | VAC <sub>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

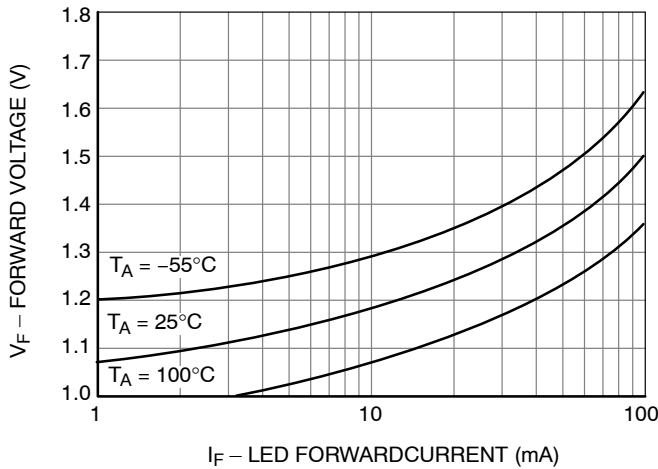


Figure 2. LED Forward Voltage vs. Forward Current

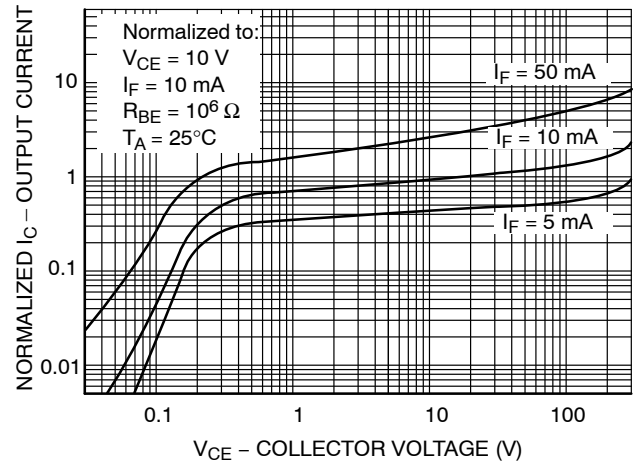


Figure 3. Normalized Output Characteristics

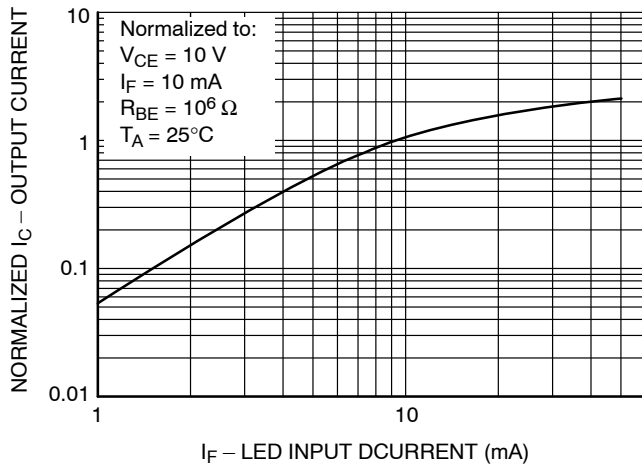


Figure 4. Normalized Output Current vs. LED Input Current

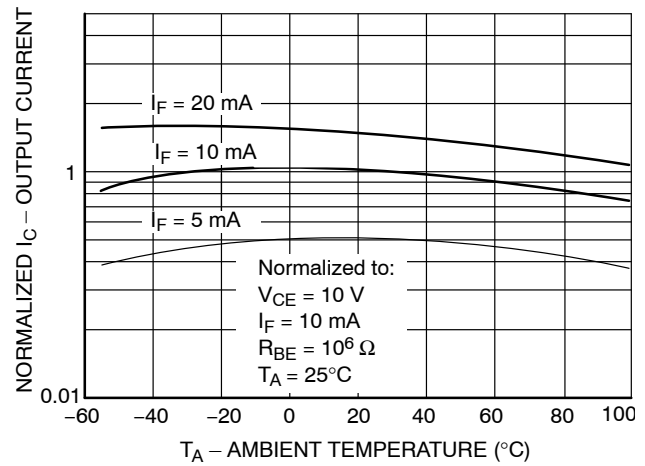


Figure 5. Normalized Output Current vs. Temperature

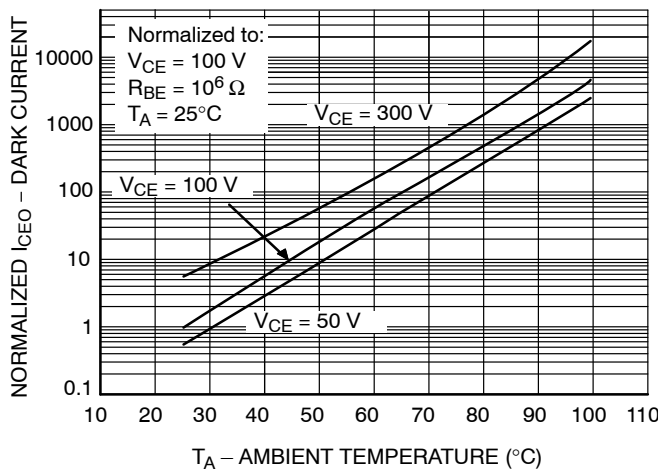


Figure 6. Normalized Dark Current vs. Ambient Temperature

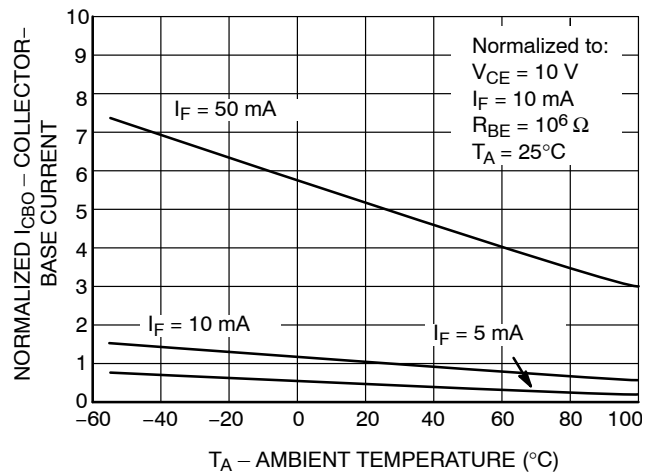


Figure 7. Normalized Collector-Base Current vs. Temperature

# REFLOW PROFILE

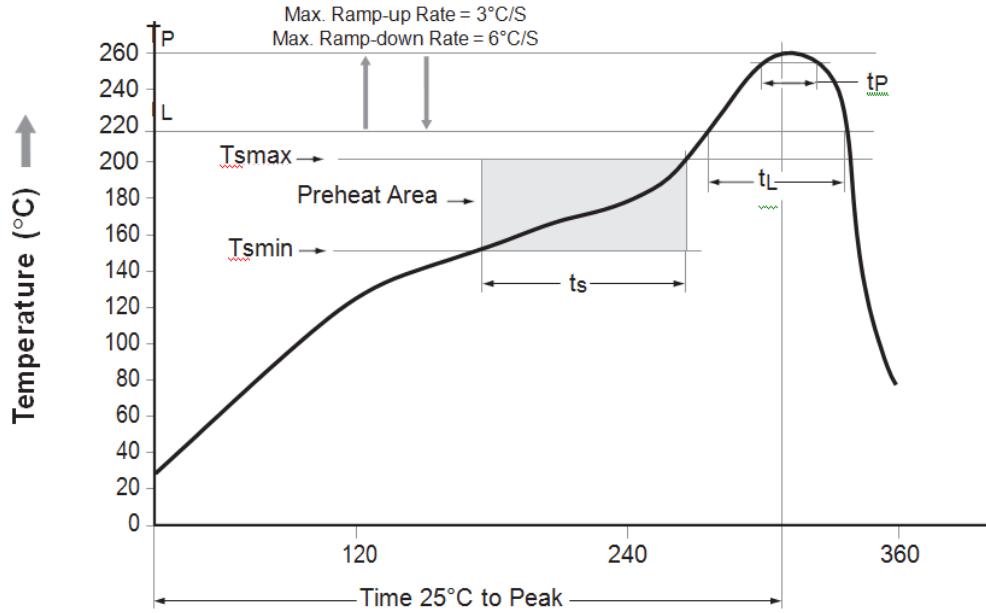


Figure 8. Reflow Profile

| Profile Feature                                                        | Pb-Free Assembly Profile |
|------------------------------------------------------------------------|--------------------------|
| Temperature Min. (T <sub>ssmin</sub> )                                 | 150°C                    |
| Temperature Max. (T <sub>smax</sub> )                                  | 200°C                    |
| Time (t <sub>s</sub> ) from (T <sub>ssmin</sub> to T <sub>smax</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

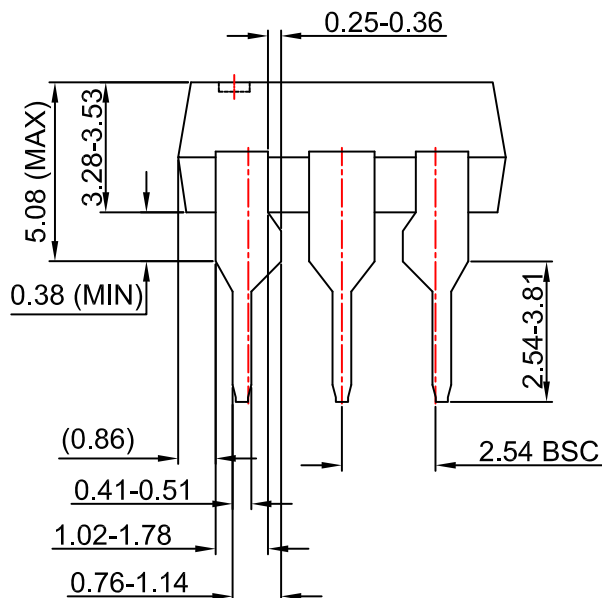
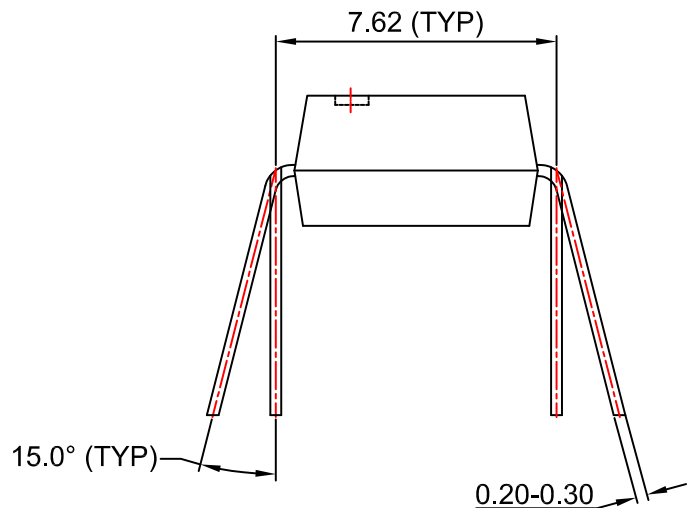
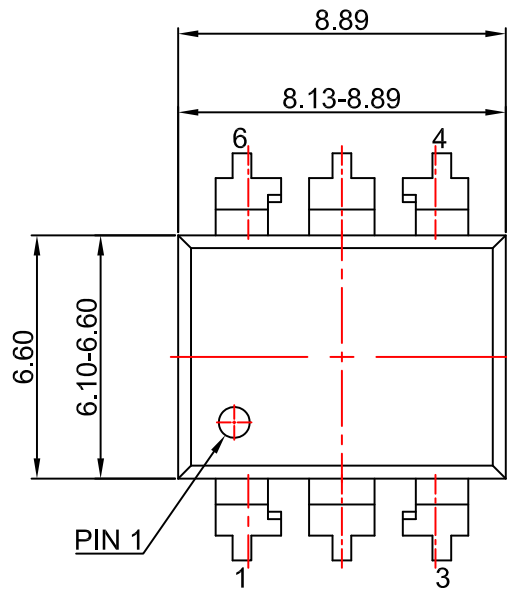
| Part Number | Package                                                  | Packing Method†            |
|-------------|----------------------------------------------------------|----------------------------|
| H11D1M      | DIP 6-Pin                                                | Tube (50 Units)            |
| 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.

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

DATE 31 JUL 2016



**NOTES:**

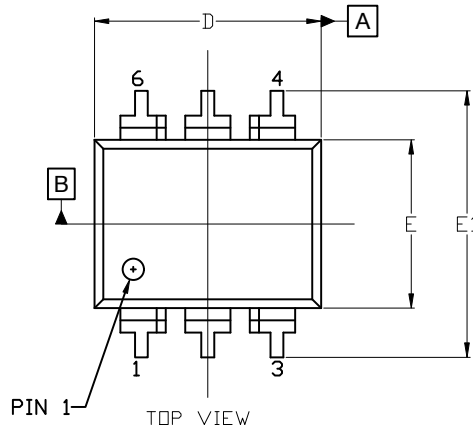
- A) NO STANDARD APPLIES TO THIS PACKAGE.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSION

|                         |                               |                                                                                                                                                                                     |
|-------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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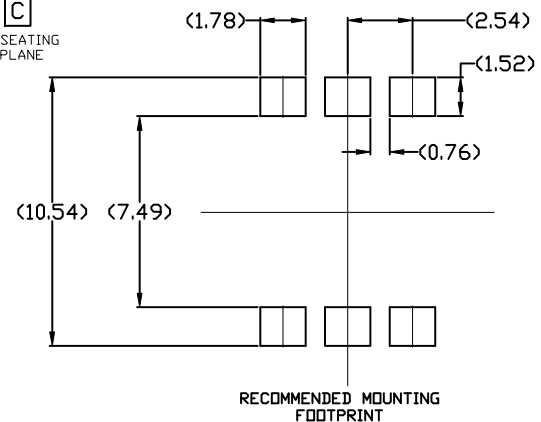
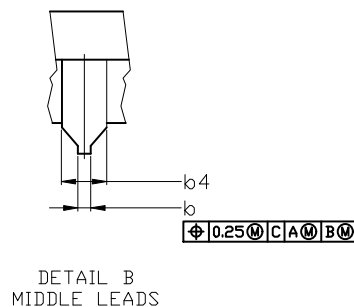
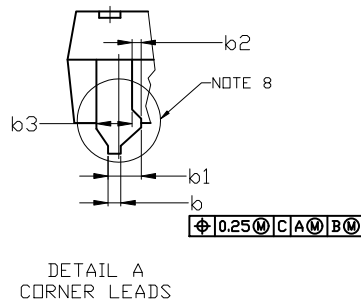
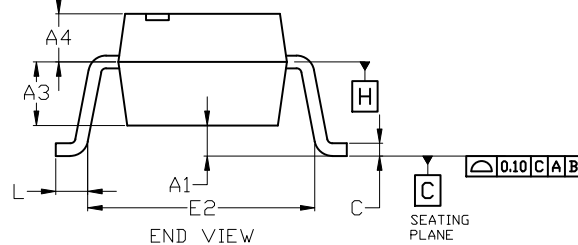
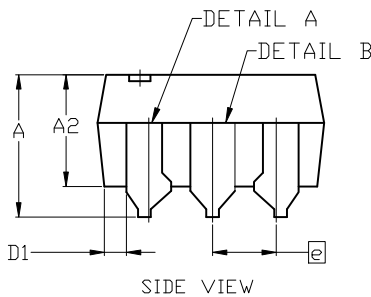
**PDIP6 8.51x6.35, 2.54P**  
**CASE 646BY**  
**ISSUE A**

DATE 15 JUL 2019


**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 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.

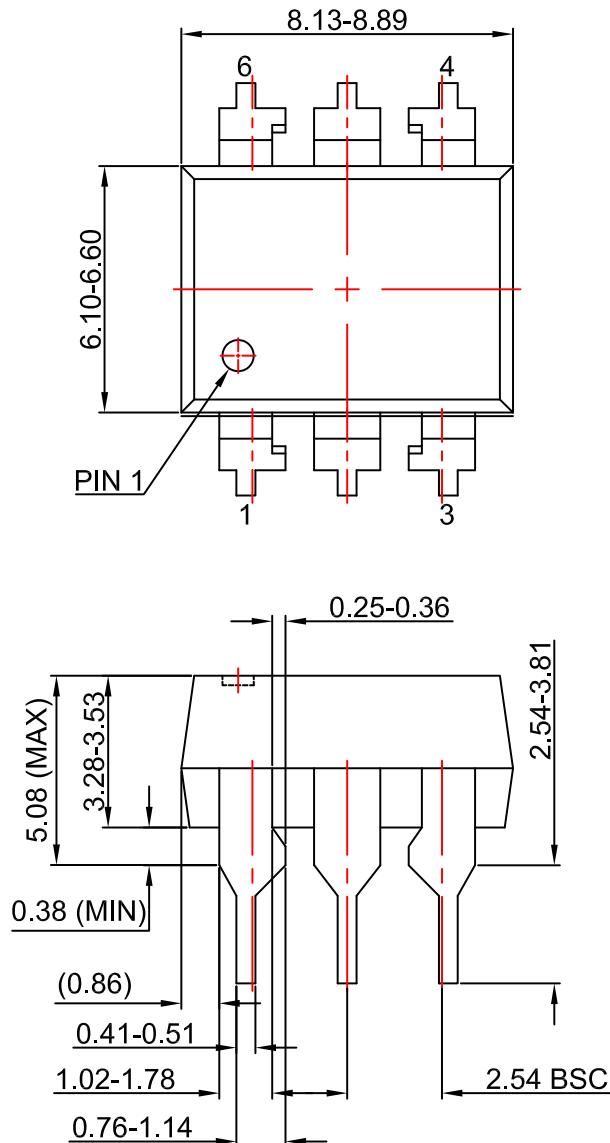
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