

6-Pin DIP High Voltage Phototransistor Optocouplers

4N38M, H11D1M, H11D3M, MOC8204M

Description

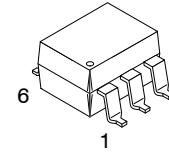
The 4N38M, H11D1M, H11D3M and MOC8204M are phototransistor-type optically coupled optoisolators. A gallium arsenide infrared emitting diode is coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

Features

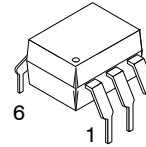
- High Voltage:
 - ◆ MOC8204M, $BV_{CEO} = 400\text{ V}$
 - ◆ H11D1M, $BV_{CEO} = 300\text{ V}$
 - ◆ H11D3M, $BV_{CEO} = 200\text{ V}$
- Safety and Regulatory Approvals:
 - ◆ UL1577, 4,170 VAC_{RMS} for 1 Minute
- DIN-EN/IEC60747-5-5, 850 V Peak Working Insulation Voltage

Applications

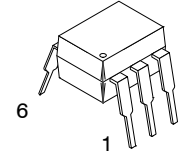
- Power Supply Regulators
- Digital Logic Inputs
- Microprocessor Inputs
- Appliance Sensor Systems
- Industrial Controls



PDIP6
CASE 646BY

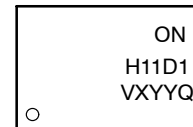


PDIP6
CASE 646BZ



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.

4N38M, H11D1M, H11D3M, MOC8204M

SCHEMATICS

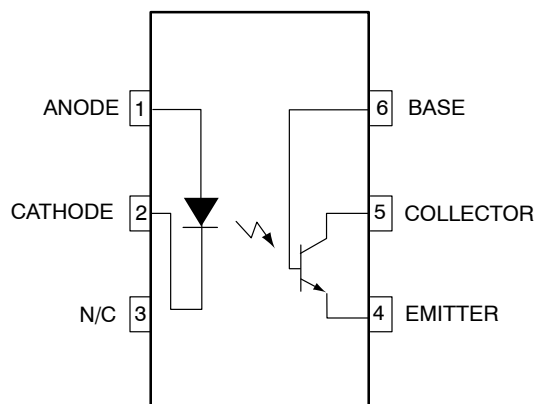


Figure 1. Schematics

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.

4N38M, H11D1M, H11D3M, MOC8204M

ABSOLUTE MAXIMUM 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 @ T _A = 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).

4N38M, H11D1M, H11D3M, MOC8204M

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

| Symbol | Characteristic | Test Conditions | Device | Min | Typ | Max | Unit |
|--------|----------------|-----------------|--------|-----|-----|-----|------|
|--------|----------------|-----------------|--------|-----|-----|-----|------|

INDIVIDUAL COMPONENT 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 | – | – |
| 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 | – | – | V _{AC(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

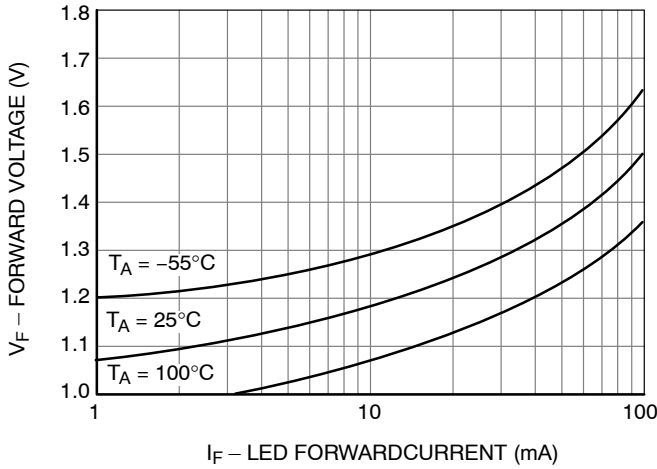


Figure 2. LED Forward Voltage vs. Forward Current

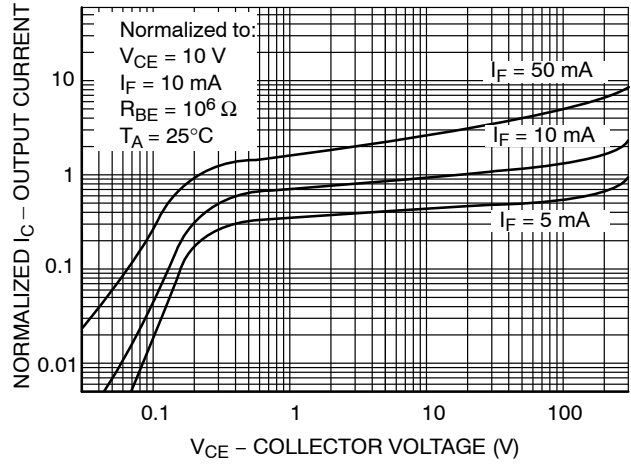


Figure 3. Normalized Output Characteristics

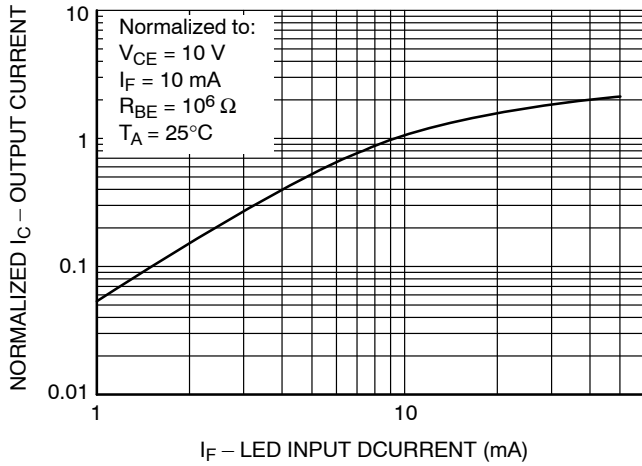


Figure 4. Normalized Output Current vs. LED Input Current

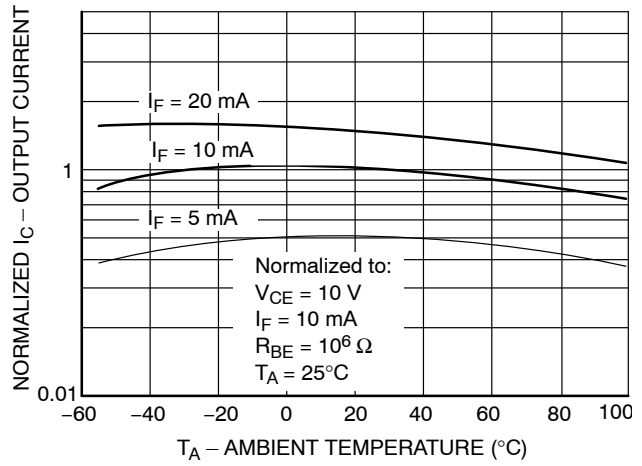


Figure 5. Normalized Output Current vs. Temperature

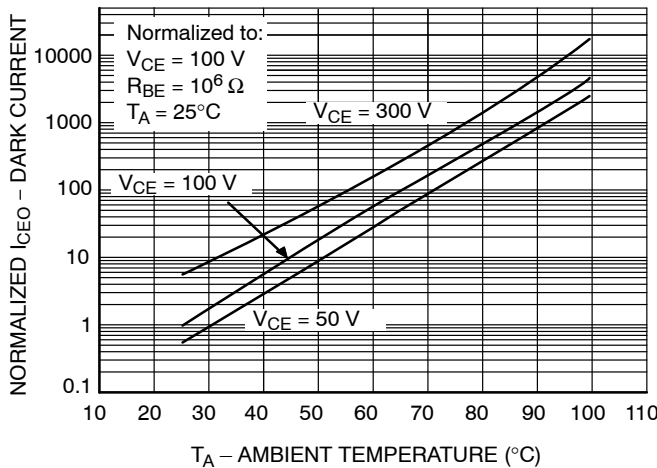


Figure 6. Normalized Dark Current vs. Ambient Temperature

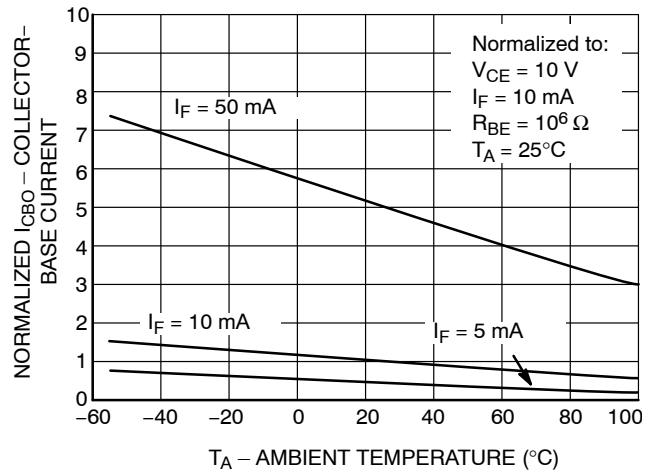


Figure 7. Normalized Collector-Base Current vs. Temperature

REFLOW PROFILE

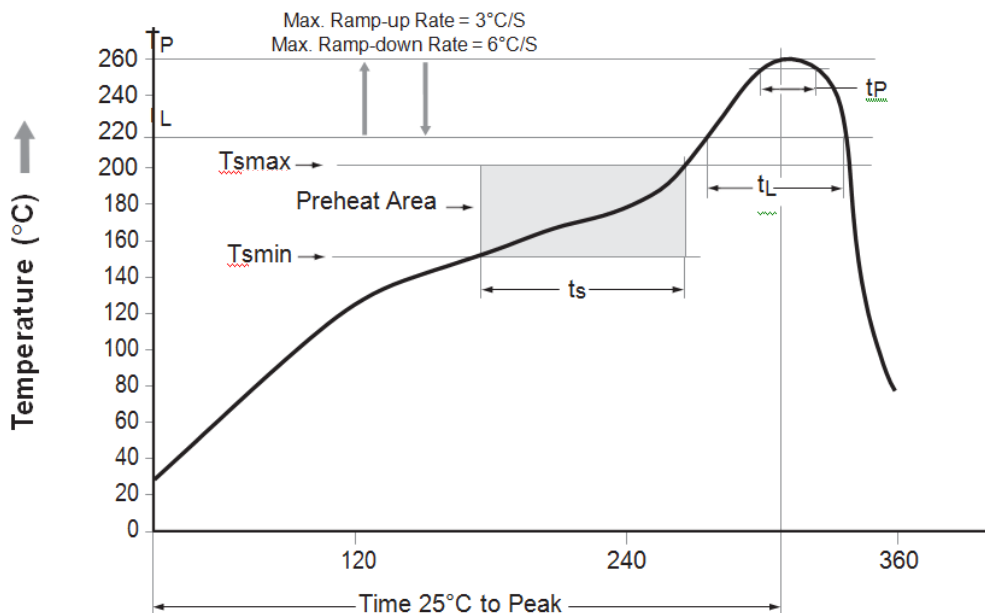


Figure 8. Reflow Profile

| Profile Feature | Pb-Free Assembly Profile |
|-----------------------------------|--------------------------|
| Temperature Min. (T Amin) | 150°C |
| Temperature Max. (Tsmax) | 200°C |
| Time (ts) from (T Amin to Tsmax) | 60 – 120 seconds |
| Ramp-up Rate (t to tp) | 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 (tp) 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.

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



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

| | | |
|-------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98AON13449G | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION: | PDIP6 8.51X6.35, 2.54P | PAGE 1 OF 1 |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



PDIP6 8.51x6.35, 2.54P

CASE 646BY

ISSUE A

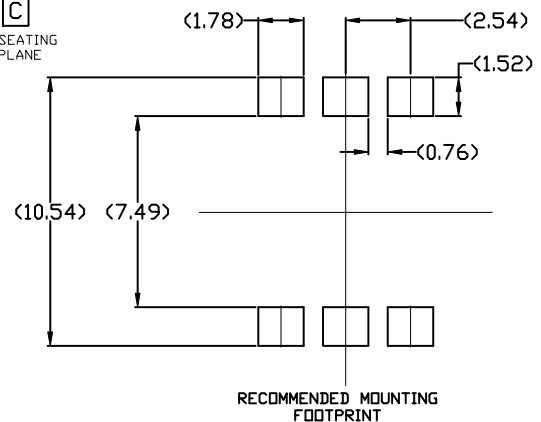
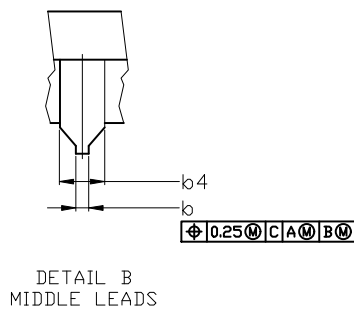
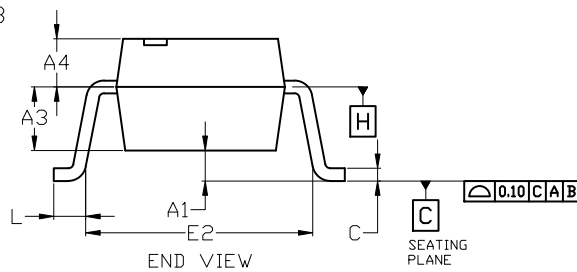
DATE 15 JUL 2019



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 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.

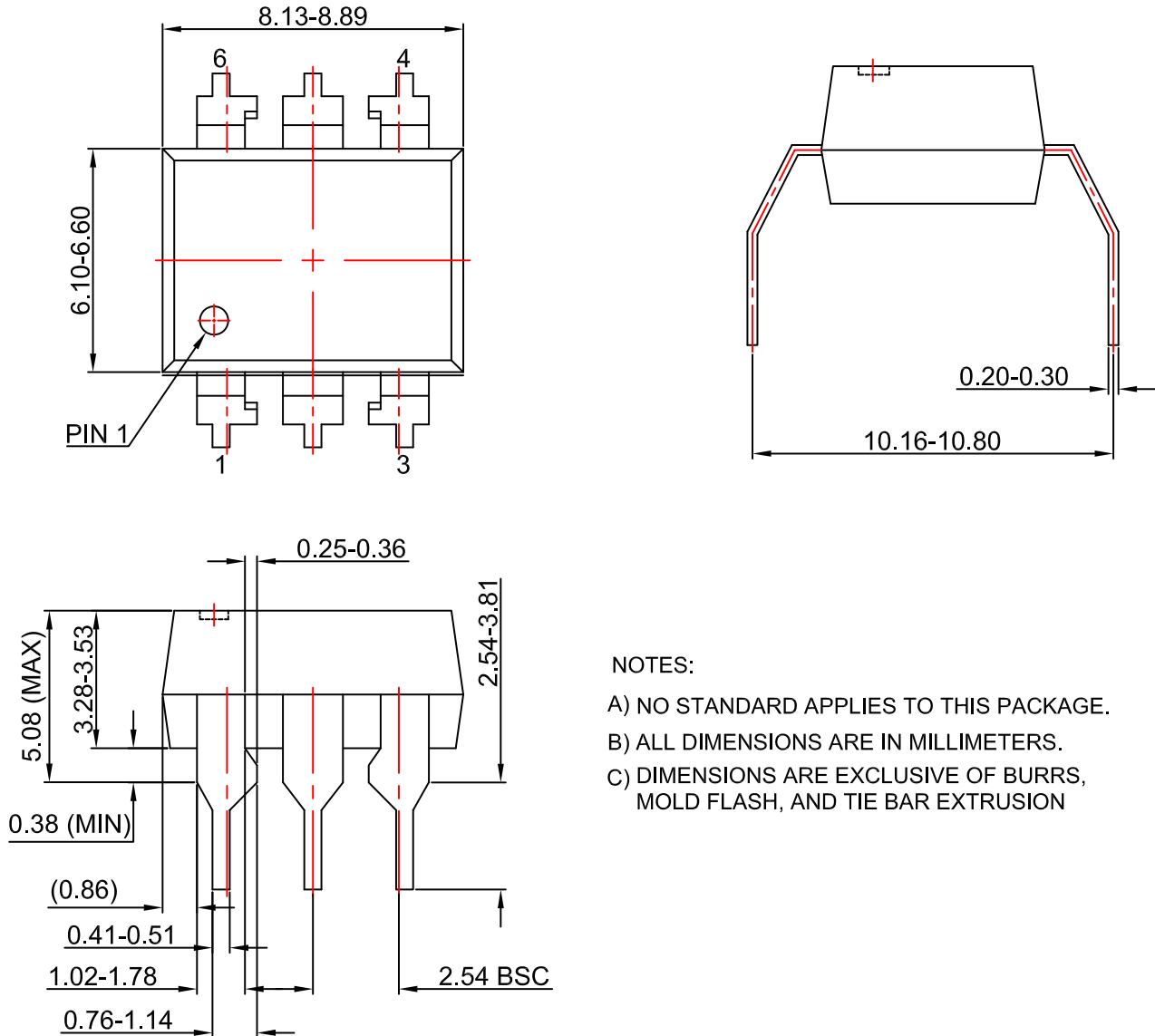
| | | |
|-------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98AON13450G | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION: | PDIP6 8.51x6.35, 2.54P | PAGE 1 OF 1 |

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

PDIP6 8.51x6.35, 2.54P
CASE 646BZ
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

| | | |
|-------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DOCUMENT NUMBER: | 98AON13451G | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION: | PDIP6 8.51X6.35, 2.54P | PAGE 1 OF 1 |

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales