

3.3 V/5 V Logic Gate Output Optocoupler with High Noise Immunity

FODM8071

Description

The FODM8071 is a 3.3 V/5 V high-speed logic gate output optocoupler, which supports isolated communications allowing digital signals to communicate between systems without conducting ground loops or hazardous voltages. It utilizes onsemi's patented coplanar packaging technology, OPTOPLANAR[®], and optimized IC design to achieve high-immunity, characterized by high common mode rejection specifications.

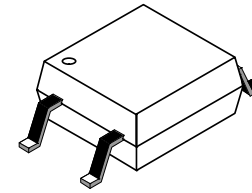
This high-speed logic gate output optocoupler, housed in a compact 5-pin Mini-Flat package, consists of a highspeed AlGaAs LED at the input coupled to a CMOS detector IC at the output. The detector IC comprises an integrated photodiode, a high-speed transimpedance amplifier and a voltage comparator with an output driver. The CMOS technology coupled with a high-efficiency LED achieves low power consumption as well as very high speed (55 ns propagation delay, 20 ns pulse width distortion).

Features

- High-noise Immunity Characterized by Common Mode Rejection
 - ◆ 20 kV/μs Minimum Common Mode Rejection
- High Speed
 - ◆ 20 Mbit/s Data Rate (NRZ)
 - ◆ 55 ns Maximum Propagation Delay
 - ◆ 20 ns Maximum Pulse Width Distortion
 - ◆ 30 ns Maximum Propagation Delay Skew
- 3.3 V and 5 V CMOS Compatibility
- Specifications Guaranteed Over 3 V to 5.5 V Supply Voltage and -40°C to +110°C Temperature Range
- Safety and Regulatory Approvals:
 - ◆ UL1577, 3750 VAC_{RMS} for 1 Minute
 - ◆ DIN EN/IEC60747-5-5
- These are Pb-Free Devices

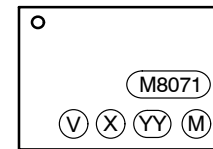
Applications

- Microprocessor System Interface:
 - SPI, I²C
- Industrial Fieldbus Communications:
 - DeviceNet, CAN, RS485
- Programmable Logic Control
- Isolated Data Acquisition System
- Voltage Level Translator



MFP5 4.1 x 4.4, 2.54P
CASE 100AM

MARKING DIAGRAM



- M8071 = Device Number
- V = DIN EN/IEC60747-5-5 Option
(Note: Only Appears on Parts Ordered with This Option)
- X = One Digit Year Code, e.g., '4'
- YY = Two Digit Work Week,
Ranging from '01' to '53'
- M = Assembly Package Code

PIN CONNECTIONS

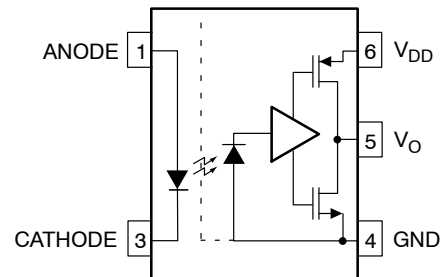


Figure 1. PIN CONNECTION

TRUTH TABLE

| LED | Output |
|-----|--------|
| Off | High |
| On | Low |

RELATED RESOURCES

- [FOD8001 Product Folder](#)
- [FOD0721 Product Folder](#)

ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

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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 _{RMS} | I-IV |
| | < 300 V _{RMS} | I-III |
| Climatic Classification | | 40/110/21 |
| 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} × 1.6 = V _{PR} , Type and Sample Test with t _m = 10 s, Partial Discharge < 5 pC | 904 | V _{peak} |
| | Input-to-Output Test Voltage, Method B, V _{IORM} × 1.875 = V _{PR} , 100% Production Test with t _m = 1 s, Partial Discharge < 5 pC | 1060 | V _{peak} |
| V _{IORM} | Maximum Working Insulation Voltage | 565 | V _{peak} |
| V _{IOTM} | Highest Allowable Over-Voltage | 4000 | V _{peak} |
| | External Creepage | ≥ 5 | mm |
| | External Clearance | ≥ 5 | mm |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥ 0.4 | mm |
| T _S | Case Temperature (Note 1) | 150 | °C |
| I _{S,INPUT} | Input Current (Note 1) | 200 | mA |
| P _{S,OUTPUT} | Output Power (Note 1) | 300 | mW |
| R _{IO} | Insulation Resistance at T _S , V _{IO} = 500 V (Note 1) | > 10 ⁹ | Ω |

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

PIN DEFINITIONS

| Number | Name | Function Description |
|--------|-----------------|-----------------------|
| 1 | ANODE | Anode |
| 3 | CATHODE | Cathode |
| 4 | GND | Output Ground |
| 5 | V _O | Output Voltage |
| 6 | V _{DD} | Output Supply Voltage |

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ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

| Symbol | Parameter | Value | Unit |
|------------------|---|-------------------------------|------|
| T _{STG} | Storage Temperature | -40 to +125 | °C |
| T _{OPR} | Operating Temperature | -40 to +110 | °C |
| T _J | Junction Temperature | -40 to +125 | °C |
| T _{SOL} | Lead Solder Temperature (Refer to Reflow Temperature Profile) | 260 for 10 s | °C |
| I _F | Forward Current | 20 | mA |
| V _R | Reverse Voltage | 5 | V |
| V _{DD} | Supply Voltage | 0 to 6.0 | V |
| V _O | Output Voltage | -0.5 to V _{DD} + 0.5 | V |
| I _O | Average Output Current | 10 | mA |
| PD _I | Input Power Dissipation (Note 2, 4) | 40 | mW |
| PD _O | Output Power Dissipation (Note 3, 4) | 70 | mW |

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. Derate linearly from 95°C at a rate of -1.4 mW/°C.

3. Derate linearly from 100°C at a rate of -3.47 mW/°C.

4. Functional operation under these conditions is not implied. Permanent damage may occur if the device is subjected to conditions outside these ratings.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|-----------------|-------------------------------|-----|------|------|
| T _A | Ambient Operating Temperature | -40 | +110 | °C |
| V _{DD} | Supply Voltages (Note 5) | 3.0 | 5.5 | V |
| V _{FL} | Logic Low Input Voltages | 0 | 0.8 | V |
| I _{FH} | Logic High Input Current | 5 | 16 | mA |
| I _{OL} | Logic Low Output Current | 0 | 7 | mA |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

5. 0.1 µF bypass capacitor must be connected between 4 and 6.

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ELECTRICAL CHARACTERISTICS Apply over all recommended conditions ($T_A = -40^{\circ}\text{C}$ to $+110^{\circ}\text{C}$, $3.0\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ unless otherwise specified.) All typical values are measured at $T_A = 25^{\circ}\text{C}$ and $V_{DD} = 3.3\text{ V}$.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|--|-----------------------|--------|------|------|
| INPUT CHARACTERISTICS | | | | | | |
| V_F | Forward Voltage | $I_F = 10\text{ mA}$ (Figure 2) | 1.05 | 1.35 | 1.80 | V |
| BV_R | Input Reverse Breakdown Voltage | $I_R = 10\text{ }\mu\text{A}$ | 5 | 15 | – | V |
| I_{FHL} | Threshold Input Current | (Figure 3) | – | 2.8 | 5.0 | mA |
| OUTPUT CHARACTERISTICS | | | | | | |
| I_{DDL} | Logic Low Output Supply Current | $V_{DD} = 3.3\text{ V}$, $I_F = 10\text{ mA}$ (Figures 4 and 6) | – | 3.3 | 4.8 | mA |
| | | $V_{DD} = 5.0\text{ V}$, $I_F = 10\text{ mA}$ (Figures 4 and 7) | – | 4.0 | 5.0 | mA |
| I_{DDH} | Logic High Output Supply Current | $V_{DD} = 3.3\text{ V}$, $I_F = 0\text{ mA}$ (Figure 5) | – | 3.3 | 4.8 | mA |
| | | $V_{DD} = 5.0\text{ V}$, $I_F = 0\text{ mA}$ (Figure 5) | – | 4.0 | 5.0 | mA |
| V_{OH} | Logic High Output Voltage | $V_{DD} = 3.3\text{ V}$, $I_O = -20\text{ }\mu\text{A}$, $I_F = 0\text{ mA}$ | $V_{DD}-0.1\text{ V}$ | 3.3 | – | V |
| | | $V_{DD} = 3.3\text{ V}$, $I_O = -4\text{ mA}$, $I_F = 0\text{ mA}$ | $V_{DD}-0.5\text{ V}$ | 3.1 | – | V |
| | | $V_{DD} = 5.0\text{ V}$, $I_O = -20\text{ }\mu\text{A}$, $I_F = 0\text{ mA}$ | $V_{DD}-0.1\text{ V}$ | 5.0 | – | V |
| | | $V_{DD} = 5.0\text{ V}$, $I_O = -4\text{ mA}$, $I_F = 0\text{ mA}$ | $V_{DD}-0.5\text{ V}$ | 4.9 | – | V |
| V_{OL} | Logic Low Output Voltage | $I_O = 20\text{ }\mu\text{A}$, $I_F = 10\text{ mA}$ | – | 0.0027 | 0.01 | V |
| | | $I_O = 4\text{ mA}$, $I_F = 10\text{ mA}$ | – | 0.27 | 0.80 | V |

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.

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SWITCHING CHARACTERISTICS Apply over all recommended conditions ($T_A = -40^{\circ}\text{C}$ to $+110^{\circ}\text{C}$, $3.0\text{ V} \leq V_{DD} \leq 5.5\text{ V}$ unless otherwise specified.) All typical values are measured at $T_A = 25^{\circ}\text{C}$ and $V_{DD} = 3.3\text{ V}$.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------------------|---|---|-----|-----|-----|-------------------|
| Date Rate (Note 6) | | | - | - | 20 | Mbps |
| t_{PW} | Pulse Width | | 50 | - | - | ns |
| t_{PHL} | Propagation Delay Time to Logic Low Output | $C_L = 15\text{ pF}$ (Figure 8, 9 and 13) | - | 31 | 55 | ns |
| t_{PLH} | Propagation Delay Time to Logic High Output | $C_L = 15\text{ pF}$ (Figure 8, 9 and 13) | - | 25 | 55 | ns |
| PWD | Pulse Width Distortion, $ t_{PHL} - t_{PLH} $ | $C_L = 15\text{ pF}$ (Figure 10 and 11) | - | 5.5 | 20 | ns |
| t_{PSK} | Propagation Delay Skew | $C_L = 15\text{ pF}$ (Note 7) | - | - | 30 | ns |
| t_R | Output Rise Time (10% to 90%) | (Figure 12 and 13) | - | 5.8 | - | ns |
| t_F | Output Fall Time (90% to 10%) | (Figure 12 and 13) | - | 5.3 | - | ns |
| $ CM_H $ | Common Mode Transient Immunity at Output High | $I_F = 0\text{ mA}$, $V_O > 0.8 V_{DD}$, $V_{CM} = 1000\text{ V}$, $T_A = 25^{\circ}\text{C}$ (Figure 14) (Note 8) | 20 | 40 | - | kV/ μs |
| $ CM_L $ | Common Mode Transient Immunity at Output Low | $I_F = 5\text{ mA}$, $V_O < 0.8\text{ V}$, $V_{CM} = 1000\text{ V}$, $T_A = 25^{\circ}\text{C}$ (Figure 14) (Note 8) | 20 | 40 | - | kV/ μs |
| C_{PDO} | Output Dynamic Power Dissipation Capacitance (Note 9) | | - | 4 | - | pF |

- Data rate is based on 10 MHz, 50% NRZ pattern with a 50 ns minimum bit time.
- t_{PSK} is equal to the magnitude of the worst case difference in t_{PHL} and/or t_{PLH} that will be seen between any two units from the same manufacturing date code that are operated at same case temperature ($\pm 5^{\circ}\text{C}$), at the same operating conditions, with equal loads ($R_L = 350\ \Omega$ and $C_L = 15\text{ pF}$), and with an input rise time less than 5 ns.
- Common mode transient immunity at output high is the maximum tolerable positive dV_{cm}/dt on the leading edge of the common mode impulse signal, V_{cm} , to assure that the output will remain high. Common mode transient immunity at output low is the maximum tolerable negative dV_{cm}/dt on the trailing edge of the common pulse signal, V_{cm} , to assure that the output will remain low.
- Unloaded dynamic power dissipation is calculated as follows: $C_{PD} \times V_{DD} \times f + I_{DD} + V_{PD}$ where f is switched time in MHz.

ISOLATION CHARACTERISTICS

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|--------------------------------|--|-----------|-----|-----|-------------|
| V_{ISO} | Input-Output Isolation Voltage | $f = 60\text{ Hz}$, $t = 1.0\text{ min.}$, $I_{I-O} \leq 10\ \mu\text{A}$ (Note 10, 11) | 3750 | - | - | V_{ACRMS} |
| R_{ISO} | Isolation Resistance | $V_{I-O} = 500\text{ V}$ (Note 10) | 10^{11} | - | - | Ω |
| C_{ISO} | Isolation Capacitance | $V_{I-O} = 0\text{ V}$, $f = 1.0\text{ Mhz}$ (Note 10) | - | 0.2 | - | pF |

- Device is considered a two terminal device: pins 1 and 3 are shorted together and pins 4, 5 and 6 are shorted together.
- 3,750 V_{ACRMS} for 1 minute duration is equivalent to 4,500 V_{ACRMS} for 1 second duration.

TYPICAL PERFORMANCE CURVES

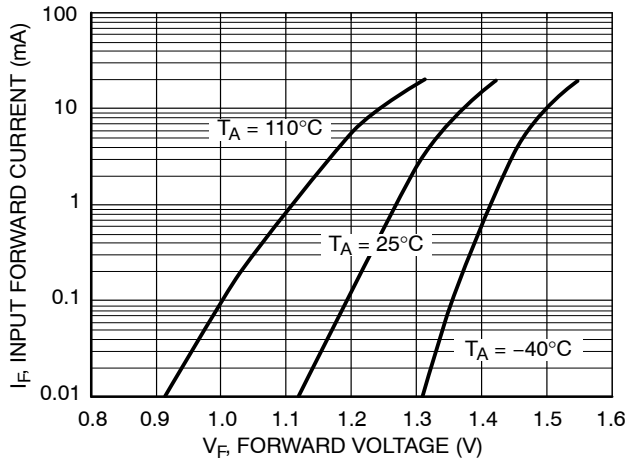


Figure 2. Input Forward Current vs. Forward Voltage

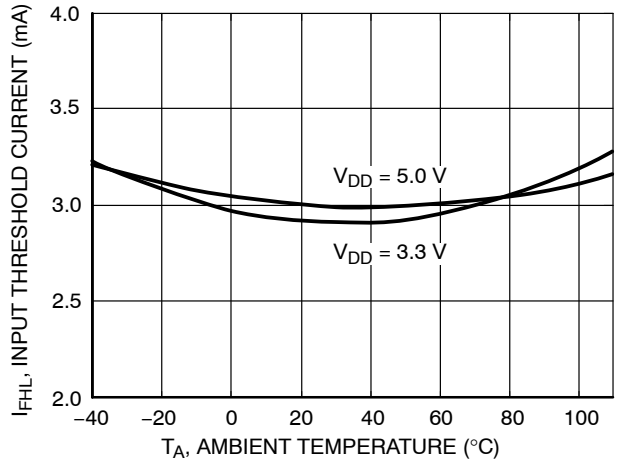


Figure 3. Input Threshold Current vs. Ambient Temperature

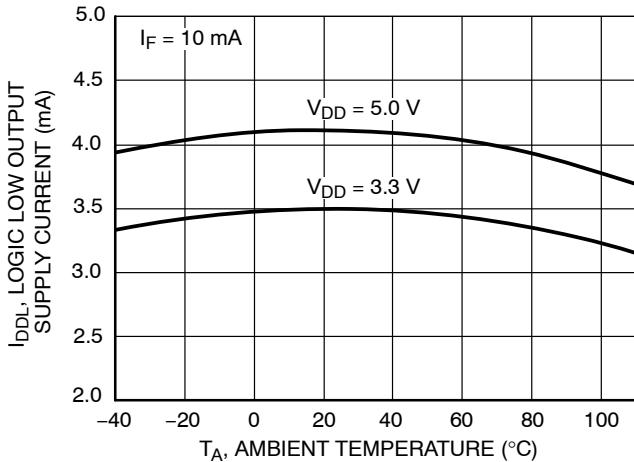


Figure 4. Logic Low Output Supply Current vs. Ambient Temperature

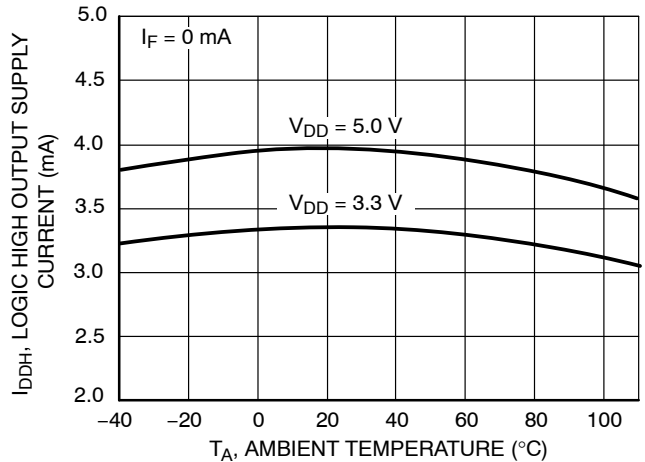


Figure 5. Logic High Output Supply Current vs. Ambient Temperature

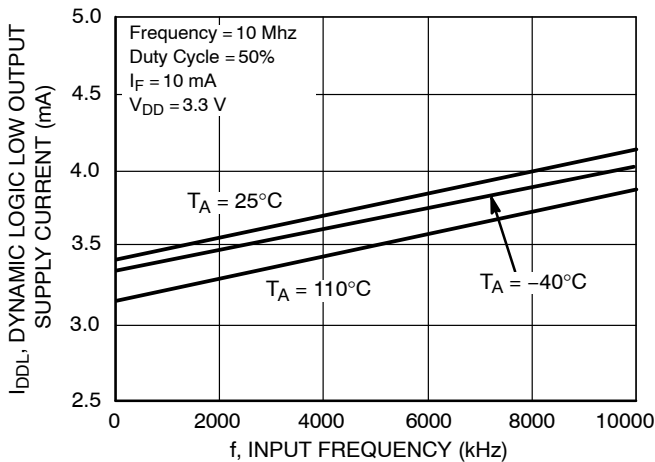


Figure 6. Dynamic Logic Low Output Supply Current vs. Input Frequency ($V_{DD} = 3.3 V$)

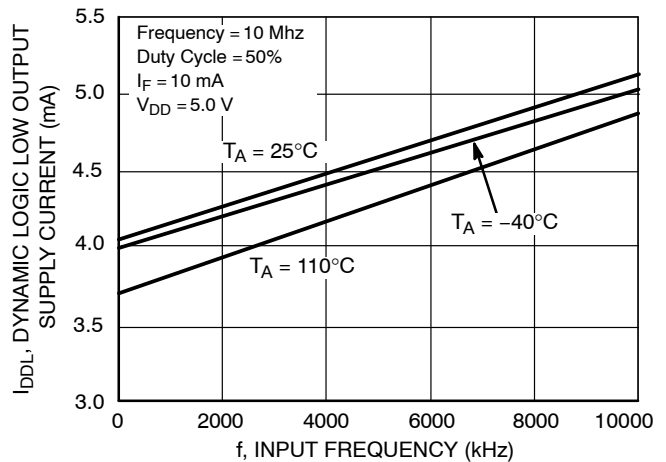


Figure 7. Dynamic Logic Low Output Supply Current vs. Input Frequency ($V_{DD} = 5.0 V$)

TYPICAL PERFORMANCE CURVES

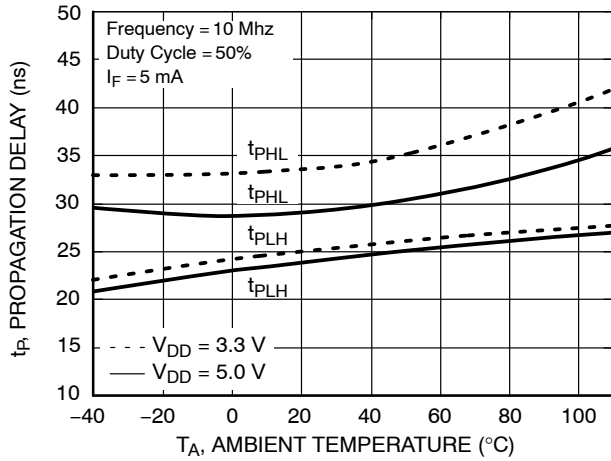


Figure 8. Propagation Delay vs. Ambient Temperature

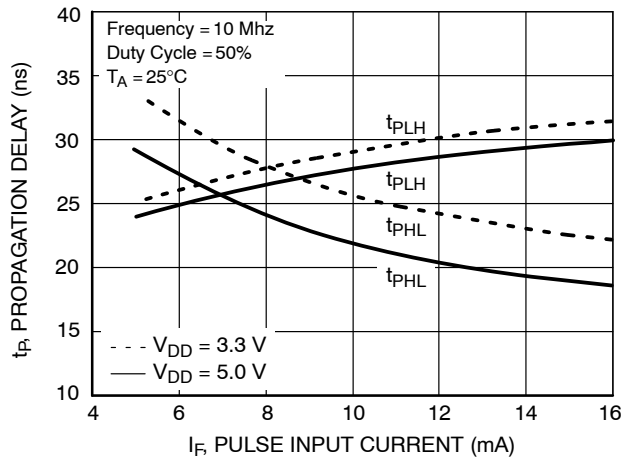


Figure 9. Propagation Delay vs. Pulse Input Current

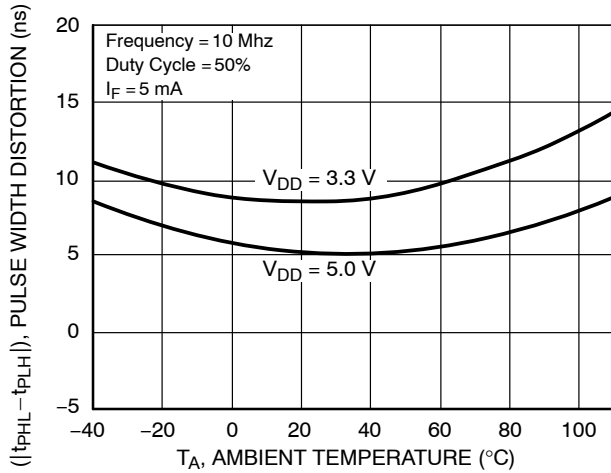


Figure 10. Pulse Width Distortion vs. Ambient Temperature

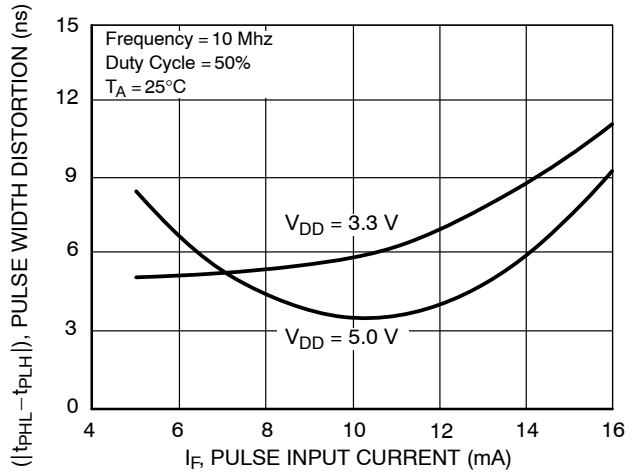


Figure 11. Pulse Width Distortion vs. Pulse Input Current

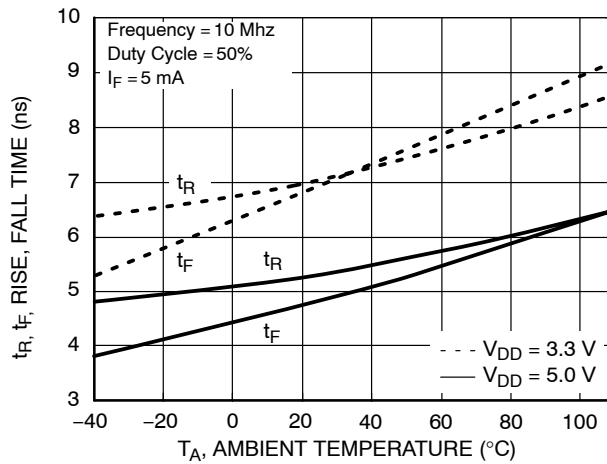


Figure 12. Rise and Fall Time vs. Ambient Temperature

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TEST CIRCUITS

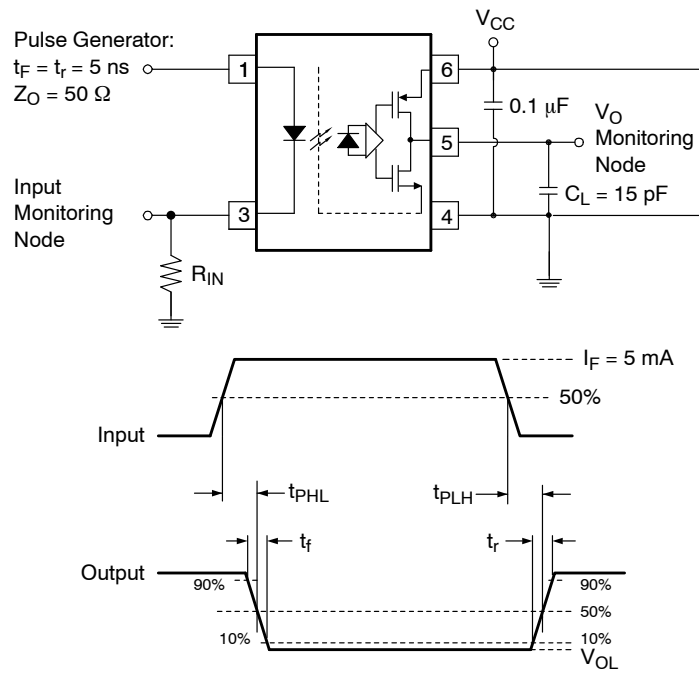


Figure 13. Test Circuit for Propagation Delay, Rise Time, and Fall Time

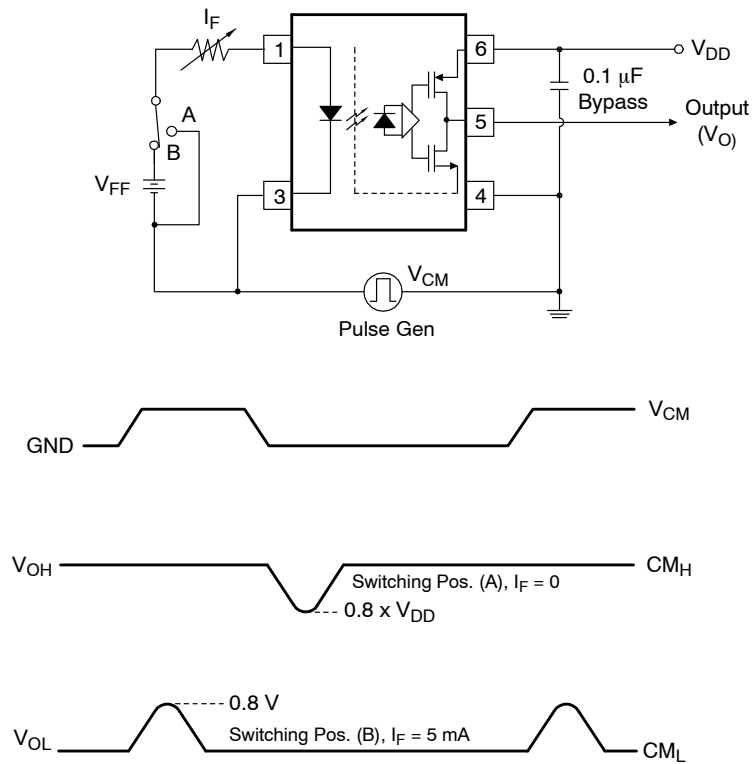


Figure 14. Test Circuit for Instantaneous Common Mode Rejection Voltage

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REFLOW PROFILE

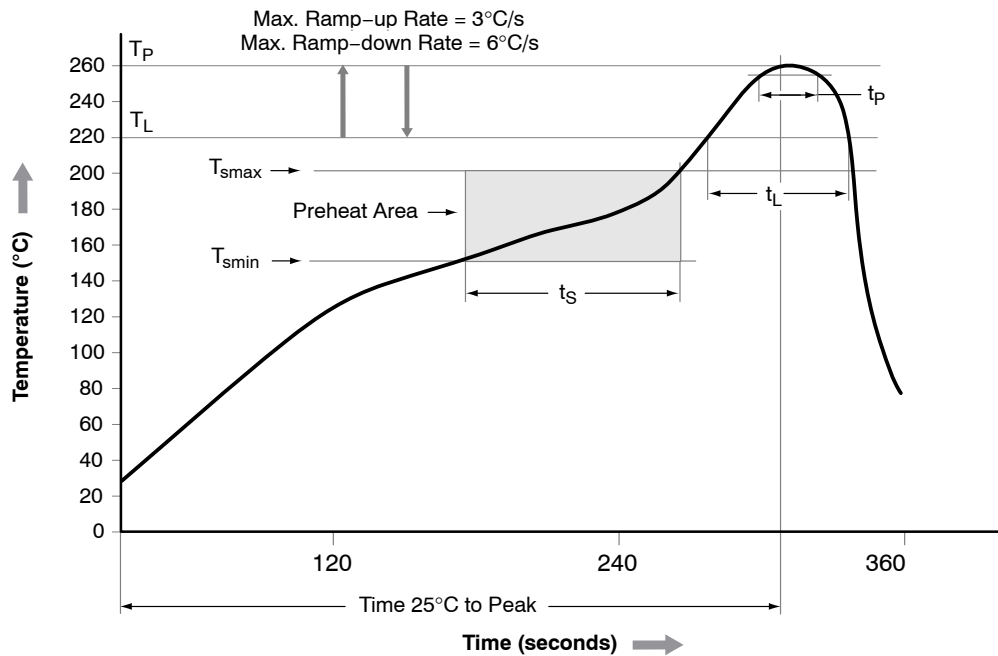


Figure 15. Reflow Profile

Table 1. REFLOW PROFILE

| Profile Feature | Pb-Free Assembly Profile |
|--|--------------------------|
| Temperature Minimum (T_{smin}) | 150°C |
| Temperature Maximum (T_{smax}) | 200°C |
| Time (t_s) from (T_{smin} to T_{smax}) | 60 – 120 seconds |
| Ramp-up Rate (t_L to t_p) | 3°C/second maximum |
| 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 maximum |
| Time 25°C to Peak Temperature | 8 minutes maximum |

ORDERING INFORMATION

| Part Number | Package | Shipping [†] |
|-------------|-----------------------------------|-----------------------|
| FODM8071 | Mini-Flat 5-Pin, 4.1 x 4.4, 2.54P | 100 Units / Tube |
| FODM8071R2 | Mini-Flat 5-Pin, 4.1 x 4.4, 2.54P | 2500 / Tape & Reel |

[†]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.

- All packages are lead free per JEDEC: J-STD-020B standard.

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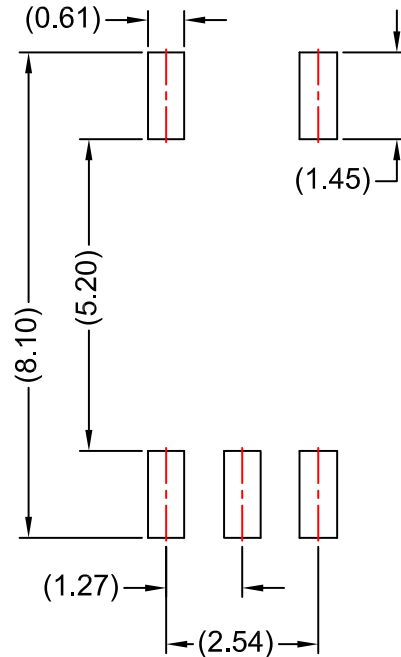
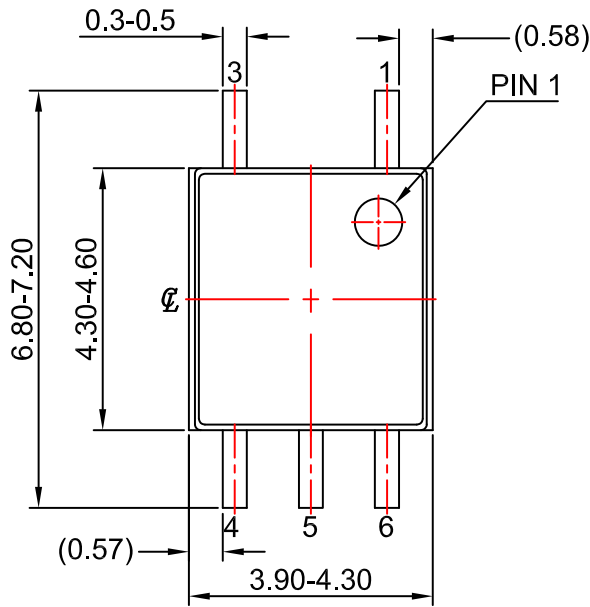
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

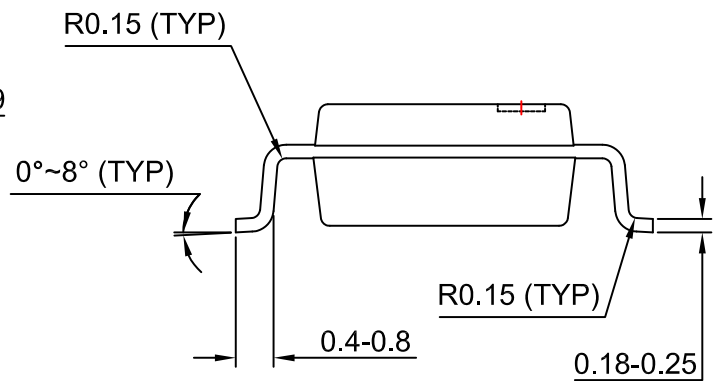
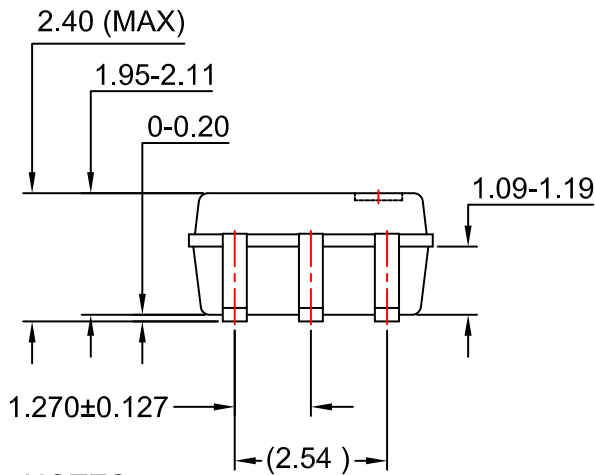


MFP5 4.1X4.4, 2.54P
CASE 100AM
ISSUE O

DATE 31 AUG 2016



LAND PATTERN RECOMMENDATION



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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