

FOD8173, FOD8173T

3.3 V/5 V, 20 Mbit/sec, Logic Gate Optocoupler in Stretched Body SOP 6-Pin

Description

The FOD8173 series packaged in a stretched body 6-pin small outline plastic package, consists of an aluminum gallium arsenide (AlGaAs) light emitting diode and a CMOS detector IC comprises an integrated photodiode, a high speed transimpedance amplifier and a voltage comparator with a totem-pole output driver. The electrical and switching characteristics are guaranteed over the extended industrial temperature range of -40°C to 100°C and a V_{DD} range of 3 V to 5.5 V.

Features

- FOD8173T – 8 mm Creepage and Clearance Distance, and 0.4 mm insulation distance to achieve reliable and high voltage insulation
- High Noise Immunity characterized by common mode transient immunity (CMTI)
- 20 kV/ μs Minimum CMTI
- 3.3 V and 5 V CMOS Compatibility
- Specifications Guaranteed Over 3 V to 5.5 V supply voltage and -40 to 100°C extended industrial temperature range
- High Speed
 - ◆ 20 Mbit/sec Data Rate (NRZ)
 - ◆ 55 ns max. Propagation Delay
 - ◆ 20 ns max. Pulse Width Distortion
- Safety and regulatory pending approvals
 - ◆ UL1577, 5,000 VAC_{RMS} for 1 min.
 - ◆ DIN-EN/IEC60747-5-5, 1,140 V peak working insulation voltage for FOD8173T

Typical Applications

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



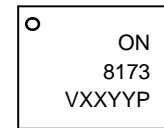
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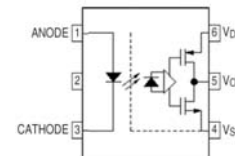
Stretched
SOP 6 PINS

MARKING DIAGRAM



- ON = Corporate Name
- 8173 = Device Number
- V = DIN EN/IEC60747-5-5 Option
- XX = Two Digit Year Code
- YY = Digit Work Week
- P = Assembly Package Code

PIN CONNECTIONS



TRUTH TABLE

| LED | V_{O} |
|-----|----------------|
| Off | High |
| On | Low |

ORDERING INFORMATION

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

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SAFETY AND INSULATIONS RATING

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.

Table 1.

| Parameter | | Characteristics | |
|---|------------|-----------------|-----------|
| | | FOD8173 | FOD8173T |
| Installation Classifications per DIN VDE 0110/1.89 Table 1, For Rated mains Voltage | < 150 VRMS | I-IV | I-IV |
| | < 300 VRMS | I-IV | I-IV |
| | < 450 VRMS | I-III | I-IV |
| | < 600 VRMS | I-III | I-III |
| Climatic Classification | | 40/100/21 | 40/100/21 |
| Pollution Degree (DIN VDE 0110/1.89) | | 2 | 2 |
| Comparative Tracking Index | | 175 | 175 |

Table 2.

| Symbol | Parameter | Characteristics | | Unit |
|-----------------------|---|------------------|------------------|-------|
| | | FOD8173 | FOD8173T | |
| V _{PR} | Input-to-Output Test Voltage, Method B, VIORM x 1.875 = VPR, 100% Production Test with tm = 1 s, Partial Discharge < 5 pC | 1,671 | 2,137 | Vpeak |
| | Input-to-Output Test Voltage, Method A, VIORM x 1.6 = VPR, Type and Sample Test with tm = 10 s, Partial Discharge < 5 pC | 1,426 | 1,824 | Vpeak |
| V _{IORM} | Maximum Working Insulation Voltage | 891 | 1,140 | Vpeak |
| V _{IOTM} | Highest Allowable Over-Voltage | 6,000 | 8,000 | Vpeak |
| | External Creepage | ≥ 8.0 | ≥ 8.0 | mm |
| | External Clearance | ≥ 7.0 | ≥ 8.0 | mm |
| DTI | Distance Through Insulation (Insulation Thickness) | ≥ 0.4 | ≥ 0.4 | mm |
| T _S | Safety Limit Values – Maximum Values Allowed in the Event of a Failure, Case Temperature | 150 | 150 | °C |
| I _{S,INPUT} | Input Current | 200 | 200 | mA |
| P _{S,OUTPUT} | Output Power | 300 | 300 | mW |
| R _{IO} | Insulation Resistance at T _S , VIO = 500 V | >10 ⁹ | >10 ⁹ | Ω |

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Table 3. ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

| Symbol | Parameter | Value | Units |
|-------------------------------|---|-------------------------------|-------|
| T _{STG} | Storage Temperature | -40 to +125 | °C |
| T _{OPR} | Operating Temperature | -40 to +100 | °C |
| T _J | Junction Temperature | -40 to +125 | °C |
| T _{SOL} | Lead Solder Temperature (Refer to Reflow Temperature Profile) | 260 for 10sec | °C |
| Input Characteristics | | | |
| I _F | Average Forward Input Current | 20 | mA |
| V _R | Reverse Input Voltage | 5.0 | V |
| P _{DI} | Input Power Dissipation (Note 1) | 40 | mW |
| Output Characteristics | | | |
| 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 |
| P _{DO} | Output Power Dissipation (Note 1) | 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.

RECOMMENDED OPERATING CONDITIONS

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 4.

| Symbol | Parameter | Min. | Max. | Unit |
|-----------------|-------------------------------|------|------|------|
| T _A | Ambient Operating Temperature | -40 | +100 | °C |
| V _{DD} | Supply Voltages (Note 2) | 3.0 | 5.5 | V |
| V _{FL} | Logic Low Input Voltage | 0 | 0.8 | V |
| I _{OL} | Logic Low Output Current | 0 | 7 | mA |
| I _{FH} | Logic High Input Current | 5.0 | 16 | mA |

Table 5. ISOLATION CHARACTERISTICS

(Apply over all recommended conditions, typical value is measured at T_A = 25°C)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|------------------|--------------------------------|---|-------|------------------|------|--------------------|
| V _{ISO} | Input-Output Isolation Voltage | T _A = 25°C, R.H. < 50%, t = 1.0min, I _{I-O} ≤ 20μA (Notes 3, 4) | 5,000 | | | V _{ACRMS} |
| R _{ISO} | Isolation Resistance | V _{I-O} = 500V (Note 3) | | 10 ¹¹ | | Ω |
| C _{ISO} | Isolation Capacitance | V _{I-O} = 0V, freq=1.0Mhz (Note 3) | | 1.0 | | pF |

1. No derating required to 100°C.
2. 0.1 μF bypass capacitor must be connected between 4 and 6.
3. Device is considered a two terminal device: Pins 1, 2 and 3 are shorted together and Pins 4, 5, and 6 are shorted together.
4. 5,000 V_{ACRMS} for 1 minute duration is equivalent to 6,000 V_{ACRMS} for 1 second duration.

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Table 6. ELECTRICAL CHARACTERISTICS

(Apply over all recommended conditions, $T_A = -40^{\circ}\text{C}$ to $+100^{\circ}\text{C}$, $3.0\text{V} \leq V_{DD} \leq 5.5\text{V}$, unless otherwise specified. Typical value is measured at $T_A = 25^{\circ}\text{C}$ and $V_{DD} = 3.3\text{V}$.)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|-------------------------------|----------------------------------|--|----------------|--------|------|-------|
| INPUT CHARACTERISTICS | | | | | | |
| V_F | Forward Voltage | $I_F = 10\text{ mA}$ | 1.0 | 1.35 | 1.80 | V |
| BV_R | Input Reverse Breakdown Voltage | $I_R = 10\text{ }\mu\text{A}$ | 5.0 | 18 | | V |
| I_{FHL} | Threshold Input Current | | | 2.8 | 5.0 | mA |
| OUTPUT CHARACTERISTICS | | | | | | |
| 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 | 0.8 | |
| V_{OH} | Logic High Output Voltage | $V_{DD} = 3.3\text{ V}$, $I_O = -20\text{ }\mu\text{A}$, $I_F = 0\text{ mA}$ | $V_{DD} - 0.1$ | 3.3 | | V |
| | | $V_{DD} = 3.3\text{ V}$, $I_O = -4\text{ mA}$, $I_F = 0\text{ mA}$ | $V_{DD} - 0.5$ | 3.1 | | |
| | | $V_{DD} = 5.0\text{ V}$, $I_O = -20\text{ }\mu\text{A}$, $I_F = 0\text{ mA}$ | $V_{DD} - 0.1$ | 5.0 | | |
| | | $V_{DD} = 5.0\text{ V}$, $I_O = -4\text{ mA}$, $I_F = 0\text{ mA}$ | $V_{DD} - 0.5$ | 4.9 | | |
| I_{DDL} | Logic Low Output Supply Current | $I_F = 10\text{ mA}$, $V_{DD} = 3.3\text{ V}$ | | 3.3 | 4.8 | mA |
| | | $I_F = 10\text{ mA}$, $V_{DD} = 5.0\text{ V}$ | | 4.0 | 5.0 | |
| I_{DDH} | Logic High Output Supply Current | $I_F = 0\text{ mA}$, $V_{DD} = 3.3\text{ V}$ | | 3.3 | 4.8 | |
| | | $I_F = 0\text{ mA}$, $V_{DD} = 5.0\text{ V}$ | | 4.0 | 5.0 | |

Table 7. SWITCHING CHARACTERISTICS

(Apply over all recommended conditions, ($T_A = -40^{\circ}\text{C}$ to $+100^{\circ}\text{C}$, $3.0\text{V} \leq V_{DD} \leq 5.5\text{V}$, $I_F = 5\text{ mA}$), unless otherwise specified. Typical value is measured at $T_A = 25^{\circ}\text{C}$ and $V_{DD} = 3.3\text{V}$.)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|--------------------|--|---|------|------|------|-------------------|
| Date Rate (Note 5) | | | | | 20 | Mbit/sec |
| t_{PW} | Pulse Width | | 50 | | | ns |
| t_{PHL} | Propagation Delay Time to Logic Low Output | $C_L = 15\text{ pF}$ | | 25 | 55 | ns |
| t_{PLH} | Propagation Delay Time to Logic High Output | $C_L = 15\text{ pF}$ | | 25 | 55 | ns |
| PWD | Pulse Width Distortion, $ \ t_{PHL} - t_{PLH} \ $ | $C_L = 15\text{ pF}$ | | 5.5 | 20 | ns |
| t_R | Output Rise Time (10% – 90%) | $C_L = 15\text{ pF}$ | | 7.0 | | ns |
| t_F | Output Fall Time (90% – 10%) | $C_L = 15\text{ pF}$ | | 7.0 | | ns |
| $ CM_H $ | Common Mode Transient Immunity at Output High | $I_F = 0\text{ mA}$, $V_O > 0.8V_{DD}$, $V_{CM} = 1000\text{V}$, $T_A = 25^{\circ}\text{C}$ (Note 6) | 20 | 40 | | kV/ μs |
| $ CM_L $ | Common Mode Transient Immunity at Output Low | $I_F = 5\text{ mA}$, $V_O < 0.8V_{DD}$, $V_{CM} = 1000\text{V}$, $T_A = 25^{\circ}\text{C}$ (Note 6) | 20 | 40 | | kV/ μs |

5. Data rate is based on 10 MHz, 50% NRZ pattern with a 50 nsec minimum bit time.

6. 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.

TYPICAL CHARACTERISTICS

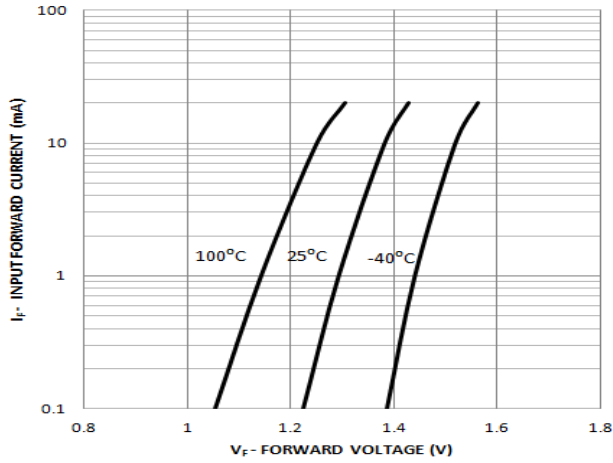


Figure 1. Input Forward Current vs. Forward Voltage

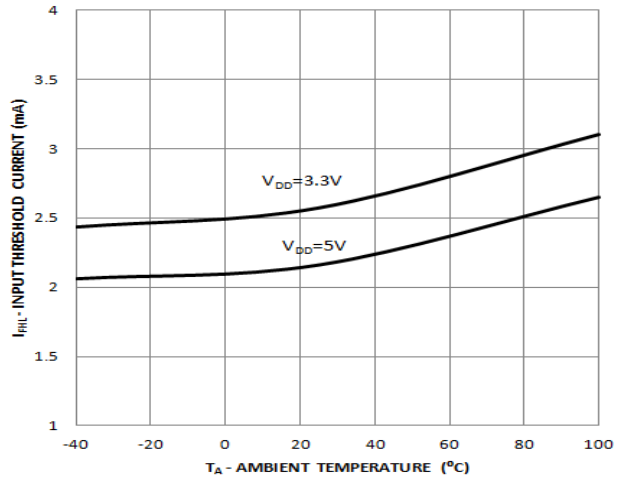


Figure 2. Input Threshold Current vs. Ambient Temperature

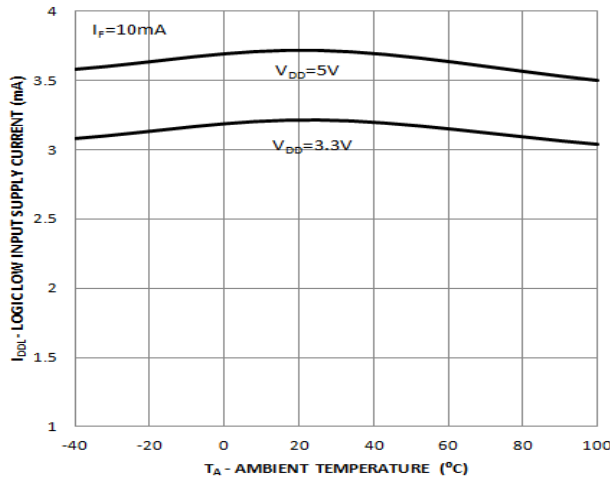


Figure 3. Logic Low Input Supply Current vs. Ambient Temperature

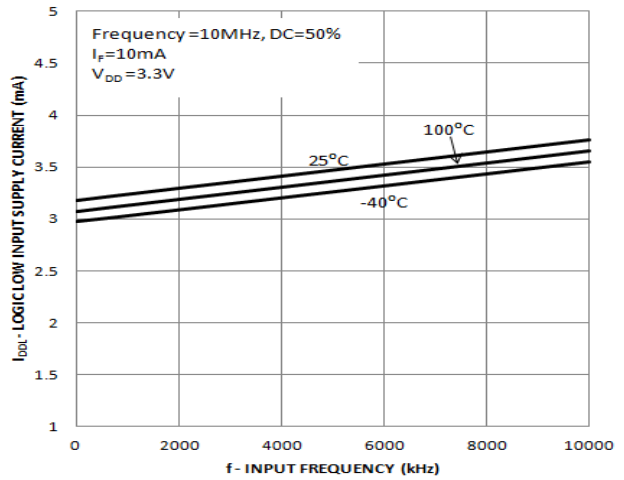


Figure 4. Logic Low Input Supply Current vs. Input Frequency ($V_{DD} = 3.3 V$)

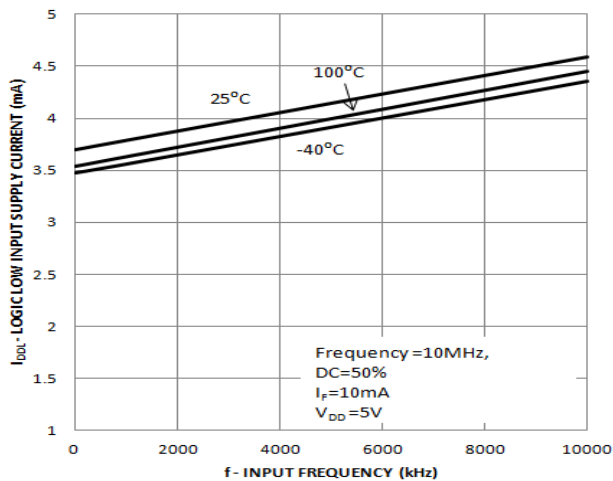


Figure 5. Logic Low Input Supply Current vs. Input Frequency ($V_{DD} = 5 V$)

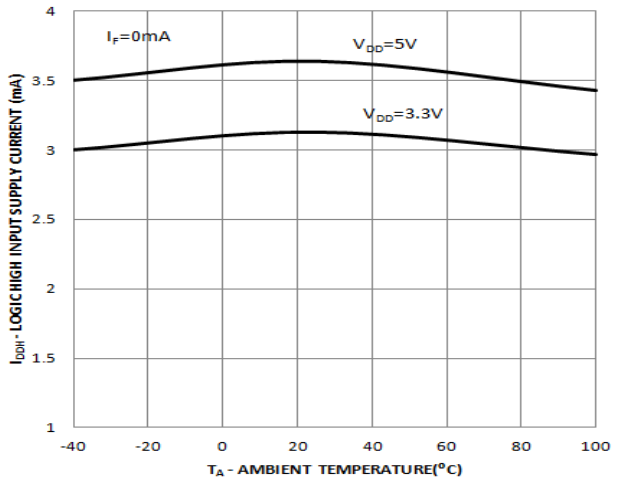


Figure 6. Logic High Input Supply Current vs. Ambient Temperature

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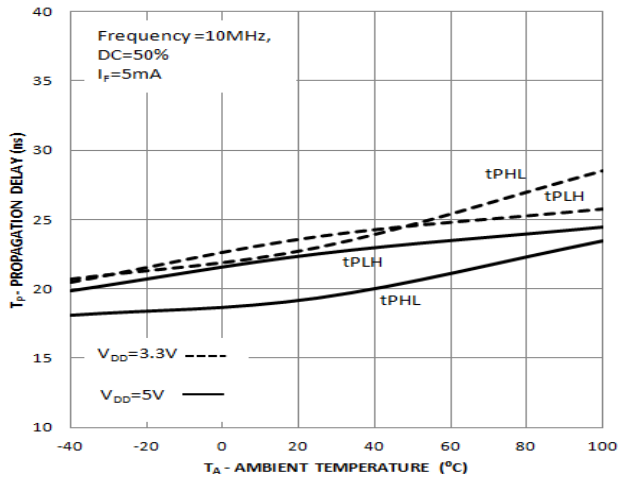


Figure 7. Propagation Delay vs. Ambient Temperature

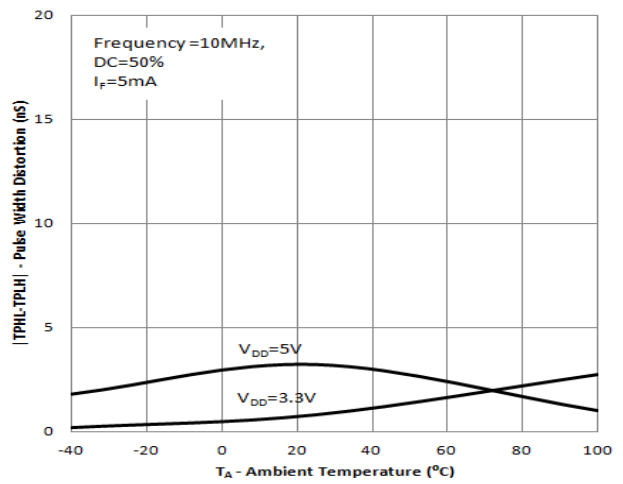


Figure 8. Pulse Width Distortion vs. Ambient Temperature

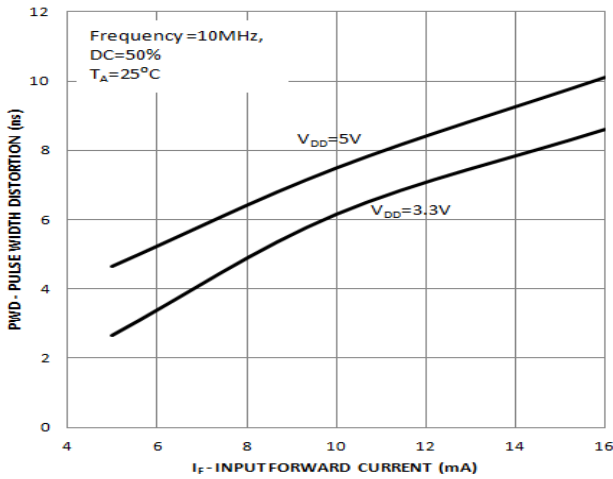


Figure 9. Pulse Width Distortion vs. Input Forward Current

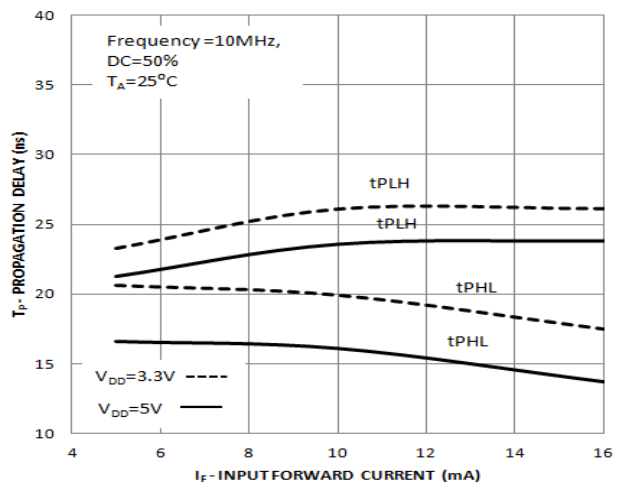


Figure 10. Propagation Delay vs. Input Forward Current

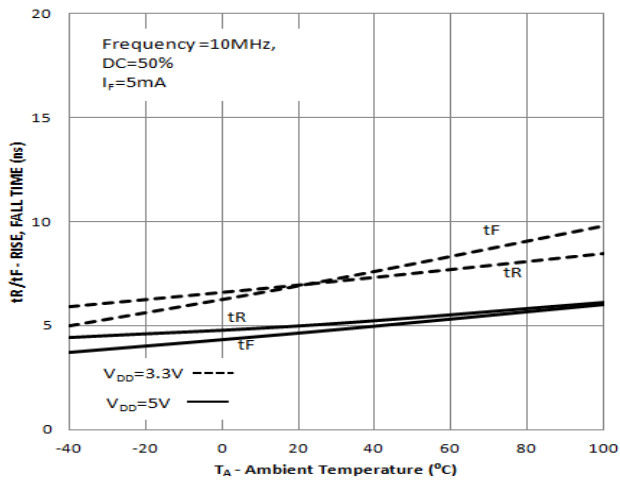


Figure 11. Rise, Fall Time vs. Ambient Temperature

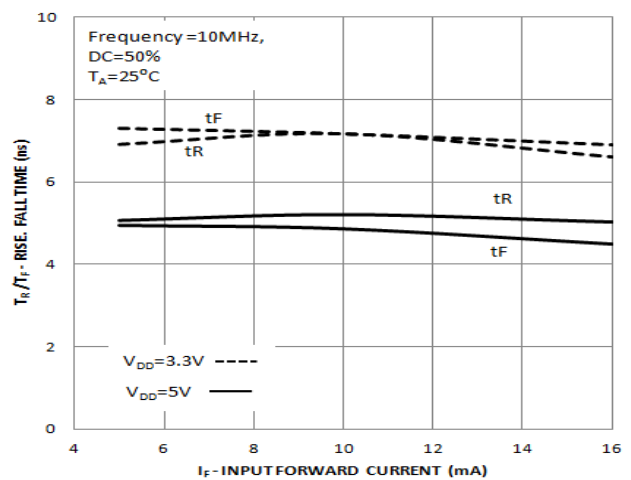


Figure 12. Rise, Fall Time vs. Input Forward Current

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SCHEMATICS

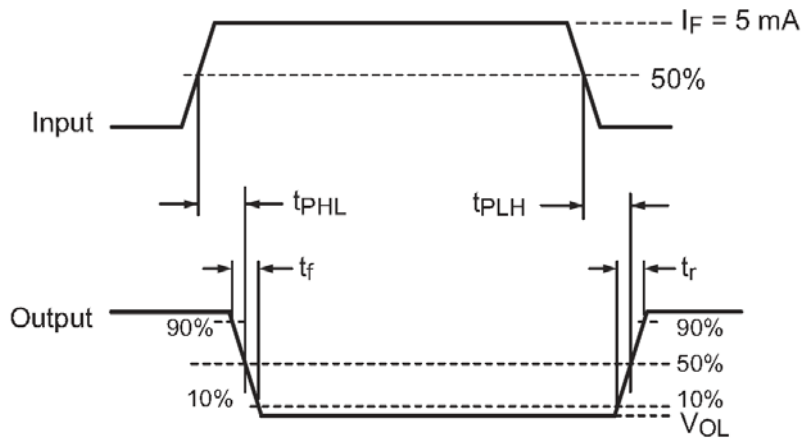
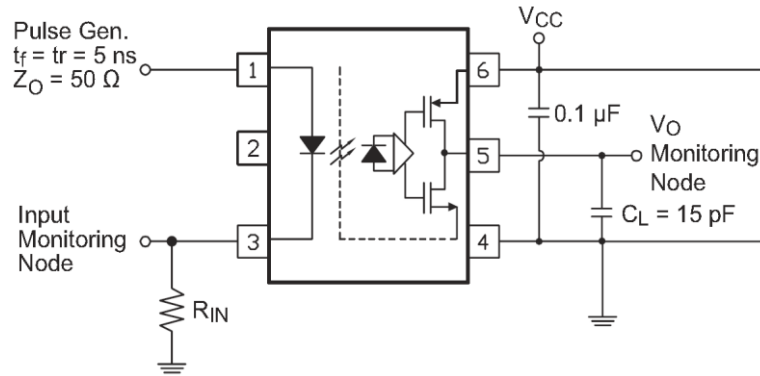


Figure 13. Test Circuit for Propagation Delay Time, Rise Time and Fall Time

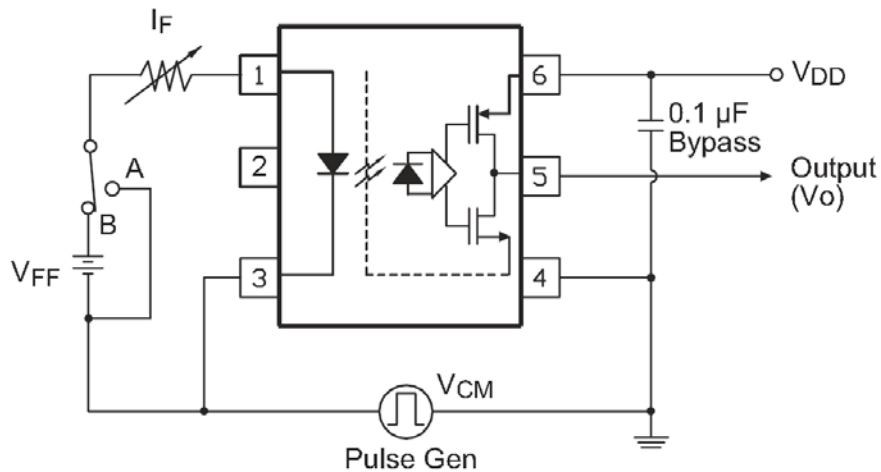


Figure 14. Test Circuit for Instantaneous Common Mode Rejection Voltage

REFLOW PROFILE

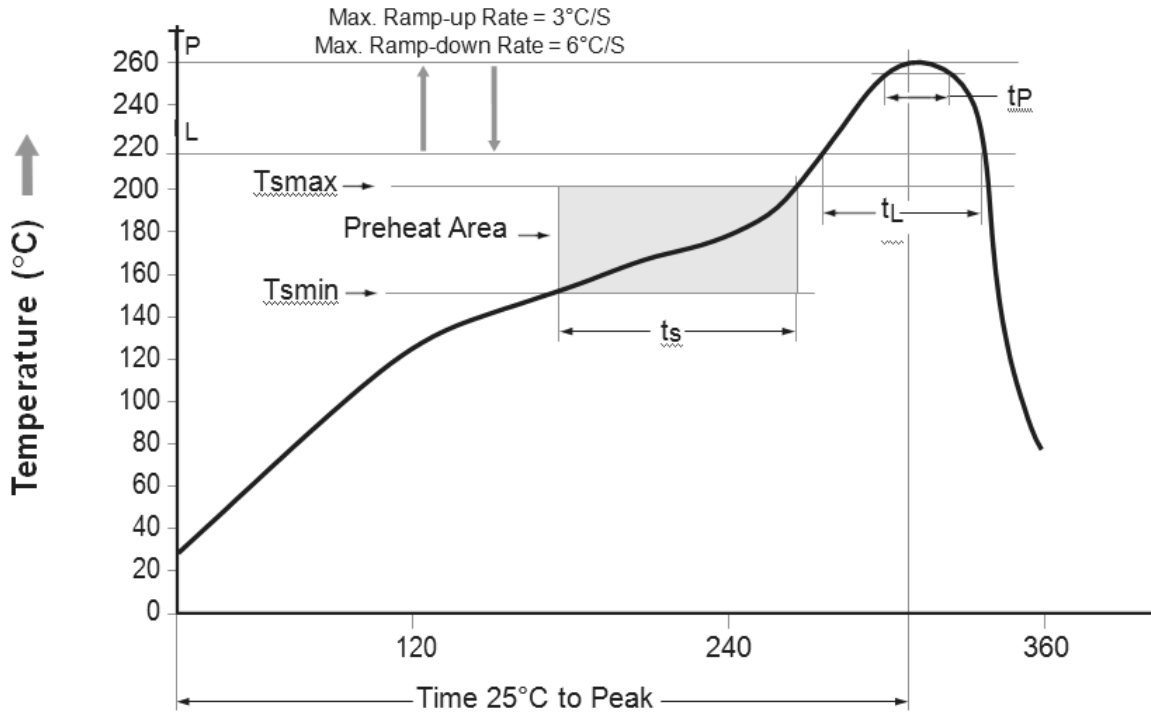


Figure 15. Reflow Profile

Table 8. REFLOW PROFILE

| Profile Feature | Pb-Free Assembly Profile |
|--|--------------------------|
| Temperature Min. (T_{smin}) | 150°C |
| Temperature Max. (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 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. |

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Table 9. ORDERING INFORMATION

| Part Number | Package | Packing Method |
|--------------------|---|--------------------------------------|
| FOD8173 | Stretched Body SOP 6-Pin | Tube (100 units per tube) |
| FOD8173R2 | Stretched Body SOP 6-Pin | Tape and Reel (1,000 units per reel) |
| FOD8173V | Stretched Body SOP 6-Pin, DIN EN/IEC60747-5-5 Option (pending) | Tube (100 units per tube) |
| FOD8173R2V | Stretched Body SOP 6-Pin, DIN EN/ IEC60747-5-5 Option (pending) | Tape and Reel (1,000 units per reel) |
| FOD8173T | Stretched Body SOP 6-Pin, Wide Lead | Tube (100 units per tube) |
| FOD8173TR2 | Stretched Body SOP 6-Pin, Wide Lead | Tape and Reel (1,000 units per reel) |
| FOD8173TV | Stretched Body SOP 6-Pin, Wide Lead, DIN EN/IEC60747-5-5 Option (pending) | Tube (100 units per tube) |
| FOD8173TR2V | Stretched Body SOP 6-Pin, Wide Lead, DIN EN/ IEC60747-5-5 Option (pending) | Tape and Reel (1,000 units per reel) |

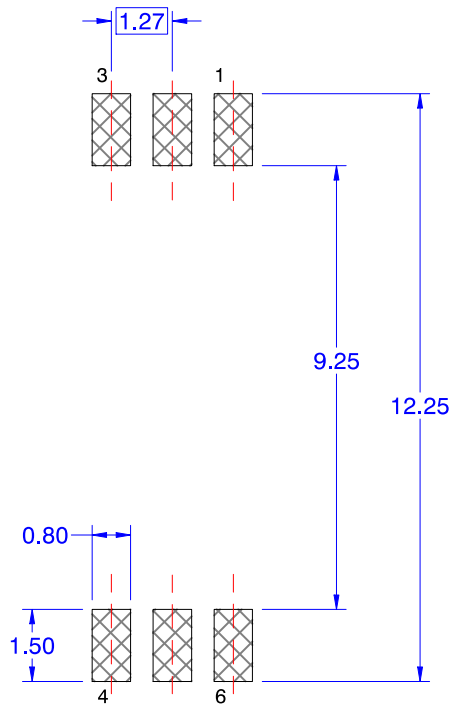
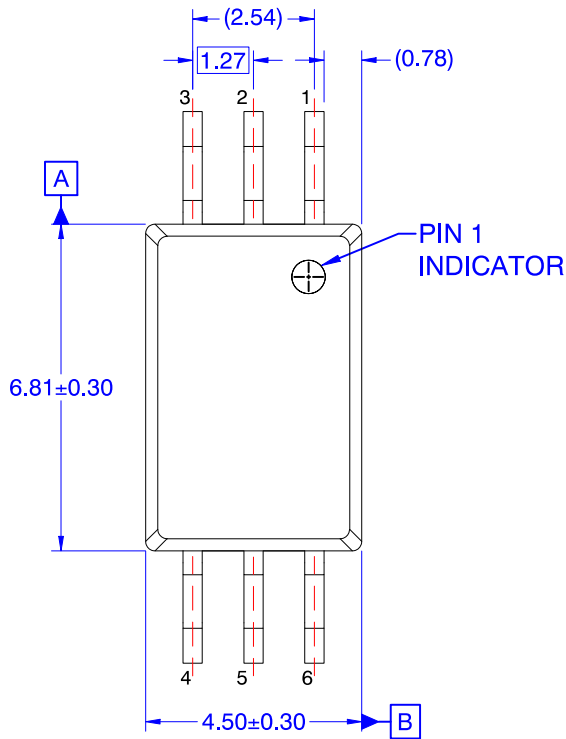
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

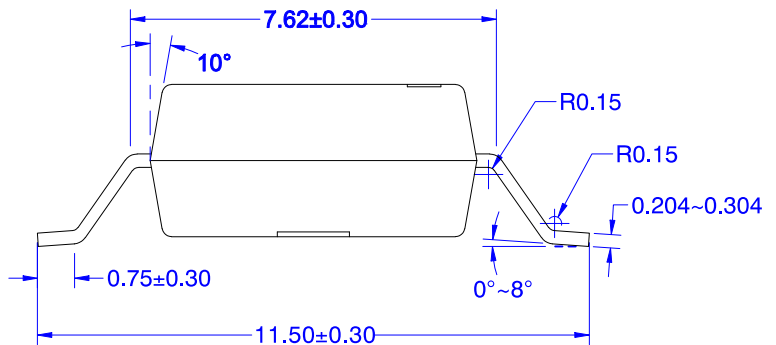
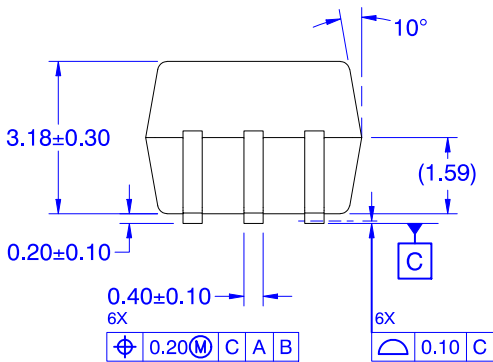


SOIC6 W
CASE 751EM
ISSUE O

DATE 30 SEP 2016



RECOMMENDED LAND PATTERN



- NOTES: UNLESS OTHERWISE SPECIFIED**
- A) NO STANDARD APPLIES TO THIS PACKAGE
 - B) ALL DIMENSIONS ARE IN MILLIMETERS.
 - C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH, AND TIE BAR EXTRUSION.
 - D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.

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