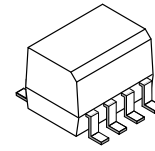


3.3 V and 5 V High Speed Transistor Optocouplers

FOD050L, FOD053L



SOIC8
CASE 751DZ

Description

The FOD050L and FOD053L optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor. These devices are specified for operation at 3.3 V and 5 V supply voltages.

A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

An internal noise shield provides superior common mode rejection of $CM_H = 50 \text{ kV}/\mu\text{s}$ (typical) and $CM_L = 35 \text{ kV}/\mu\text{s}$ (typical).

Features

- Low Power Consumption
- High Speed
- Available in Single-Channel 8-Pin SOIC (FOD050L) or Dual-Channel 8-Pin SOIC (FOD053L)
- Superior CMR – $CM_H = 50 \text{ kV}/\mu\text{s}$ (typical) and $CM_L = 35 \text{ kV}/\mu\text{s}$ (typical)
- Guaranteed Performance over Temperature: 0°C to 70°C
- Safety and Regulatory Approvals:
 - ◆ UL1577, 2,500 VAC_{RMS} for 1 Minute
 - ◆ DIN-EN/IEC60747-5-5, 565 V Peak Working Insulation Voltage

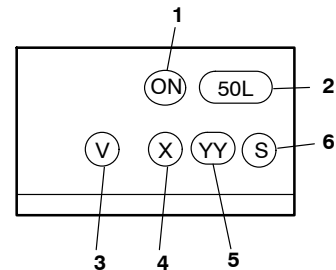
Applications

- Line Receivers
- Pulse Transformer Replacement
- High-Speed Logic Ground Isolation: LVTTTL/LVCMOS
- Wide Bandwidth Analog Coupling

TRUTH TABLE

| LED | V _O |
|-----|----------------|
| On | LOW |
| Off | HIGH |

MARKING DIAGRAM



1. ON = onsemi Logo
2. 50L = Device Number (50L or 53L)
3. V = DIN EN/IEC60747-5-5 Option (only appears on component with this option)
4. X = One-Digit Year Code, e.g. '5'
5. YY = Two Digit Work Week, Ranging from '01' to '53'
6. S = Assembly Package Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

FOD050L, FOD053L

Schematics

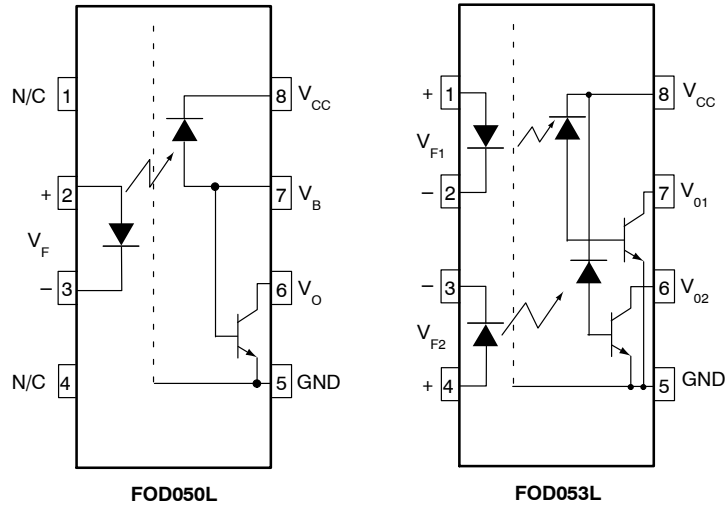


Figure 1. Schematics

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 Classification per DIN VDE 0110/1.89 Table 1, For Rated Mains Voltage | < 150 V _{RMS} | I-IV |
| | < 300 V _{RMS} | I-III |
| 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} × 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 | ≥ 4 | mm |
| | External Clearance | ≥ 4 | 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.

FOD050L, FOD053L

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

| Symbol | Parameter | Value | Unit |
|------------------|-------------------------|--------------------|------|
| T _{STG} | Storage Temperature | -40 to +125 | °C |
| T _{OPR} | Operating Temperature | -40 to +85 | °C |
| T _J | Junction Temperature | -40 to +125 | °C |
| T _{SOL} | Lead Solder Temperature | 260 for 10 seconds | °C |

EMITTER

| | | | | |
|------------------------|---|--------------|-----|----|
| I _F (avg) | DC/Average Forward Input Current | Each Channel | 25 | mA |
| I _F (pk) | Peak Forward Input Current (50% duty cycle, 1 ms P.W.) | Each Channel | 50 | mA |
| I _F (trans) | Peak Transient Input Current (≤1 μs P.W., 300 pps) | Each Channel | 1.0 | A |
| V _R | Reverse Input Voltage | Each Channel | 5 | V |
| P _D | Input Power Dissipation (No derating required up to 85°C) | Each Channel | 45 | mW |

DETECTOR

| | | | | |
|----------------------|--|--------------|-----------|----|
| I _O (avg) | Average Output Current | Each Channel | 8 | mA |
| I _O (pk) | Peak Output Current | Each Channel | 16 | mA |
| V _{EBR} | Emitter-Base Reverse Voltage | FOD050L only | 5 | V |
| V _{CC} | Supply Voltage | | -0.5 to 7 | V |
| V _O | Output Voltage | | -0.5 to 7 | V |
| I _B | Base Current | FOD050L only | 5 | mA |
| P _D | Output Power Dissipation (No derating required up to 85°C) | Each Channel | 100 | 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.

FOD050L, FOD053L

ELECTRICAL CHARACTERISTICS

($T_A = 0^\circ\text{C}$ to 70°C , unless otherwise specified.)

INDIVIDUAL COMPONENT CHARACTERISTICS

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|----------------|---------------------------------|---|--------|------|------|------|------|
| EMITTER | | | | | | | |
| V_F | Input Forward Voltage | $I_F = 16\text{ mA}$, $T_A = 25^\circ\text{C}$ | All | | 1.45 | 1.7 | V |
| | | $I_F = 16\text{ mA}$ | | | | 1.8 | |
| B_{VR} | Input Reverse Breakdown Voltage | $I_R = 10\ \mu\text{A}$ | All | 5.0 | | | V |

DETECTOR

| | | | | | | | |
|-----------|---------------------------|---|---------|--|-------|-----|---------------|
| I_{OH} | Logic High Output Current | $I_F = 0\text{ mA}$, $V_O = V_{CC} = 3.3\text{ V} \& 5\text{ V}$, $T_A = 25^\circ\text{C}$ | All | | 0.001 | 1 | μA |
| I_{CCL} | Logic Low Supply Current | $I_F = 16\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$ | FOD050L | | | 200 | μA |
| | | $I_{F1} = I_{F2} = 16\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$ | FOD053L | | | 400 | |
| I_{CCH} | Logic High Supply Current | $I_F = 0\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$, $T_A = 25^\circ\text{C}$ | FOD050L | | | 0.3 | μA |
| | | $I_F = 0\text{ mA}$, $V_O = \text{Open}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$ | FOD053L | | | 10 | |

TRANSFER CHARACTERISTICS

| Symbol | Parameter | Test Conditions | Device | Min. | Typ. | Max. | Unit |
|----------------|------------------------------------|---|--------|------|------|------|------|
| COUPLED | | | | | | | |
| CTR | Current Transfer Ratio (Note 2) | $I_F = 16\text{ mA}$, $V_O = 0.4\text{ V}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$, $T_A = 25^\circ\text{C}$ | All | 15 | | 50 | % |
| V_{OL} | Logic Low Output Voltage | $I_F = 16\text{ mA}$, $I_O = 3\text{ mA}$, $V_{CC} = 3.3\text{ V} \& 5\text{ V}$, $T_A = 25^\circ\text{C}$ | All | | | 0.3 | 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.

2. Current Transfer Ratio is defined as a ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.

FOD050L, FOD053L

ELECTRICAL CHARACTERISTICS (Continued)

($T_A = 0^\circ\text{C}$ to 70°C , unless otherwise specified.)

SWITCHING CHARACTERISTICS ($V_{CC} = 3.3\text{ V}$ & 5 V)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------|--|---|-------|--------|------|------------------------|
| T_{PHL} | Propagation Delay Time to Logic LOW | $R_L = 1.9\text{ k}\Omega$, $I_F = 16\text{ mA}$ (Note 3) | | | 1.0 | μs |
| | | (Figure 10) | | | 2.0 | |
| T_{PLH} | Propagation Delay Time to Logic HIGH | $R_L = 1.9\text{ k}\Omega$, $I_F = 16\text{ mA}$ (Note 3) | | | 1.0 | μs |
| | | (Figure 10) | | | 2.0 | |
| CM _H | Common Mode Transient Immunity at Logic HIGH | $I_F = 0\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 4.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ (Notes 4, 5) (Figure 11) | 5,000 | 50,000 | | $\text{V}/\mu\text{s}$ |
| | | $I_F = 0\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 1.9\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ (Notes 3, 5) (Figure 11) | 5,000 | 50,000 | | $\text{V}/\mu\text{s}$ |
| CM _L | Common Mode Transient Immunity at Logic LOW | $I_F = 16\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 4.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ (Notes 4, 5) (Figure 11) | 5,000 | 35,000 | | $\text{V}/\mu\text{s}$ |
| | | $I_F = 16\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 1.9\text{ k}\Omega$, $T_A = 25^\circ\text{C}$ (Notes 3, 5) (Figure 11) | 5,000 | 35,000 | | $\text{V}/\mu\text{s}$ |

ISOLATION CHARACTERISTICS

| Symbol | Characteristics | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------|---|--|-----------|-----------|------|------------------|
| I_{I-O} | Input-Output Insulation Leakage Current | Relative humidity = 45%, $T_A = 25^\circ\text{C}$, $t = 5\text{ s}$, $V_{I-O} = 3000\text{ VDC}$ (Note 6) | | | 1.0 | μA |
| V_{ISO} | Withstand Insulation Test Voltage | $f = 60\text{ Hz}$, $T_A = 25^\circ\text{C}$, $t = 60\text{ s}$ (Note 6) | 2500 | | | V_{RMS} |
| R_{I-O} | Resistance (Input to Output) | $V_{I-O} = 500\text{ VDC}$ (Note 6) | 10^{11} | 10^{12} | | Ω |
| C_{I-O} | Capacitance (Input to Output) | $f = 1\text{ MHz}$ (Note 6) | | 0.2 | | pF |

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. The $1.9\text{ k}\Omega$ load represents 1 TTL unit load of 1.6 mA and $5.6\text{ k}\Omega$ pull-up resistor.

4. The $4.1\text{ k}\Omega$ load represents 1 LSTTL unit load of 0.36 mA and $6.1\text{ k}\Omega$ pull-up resistor.

5. Common mode transient immunity in logic high level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse signal V_{CM} , to assure that the output will remain in a logic high state (i.e., $V_O > 2.0\text{ V}$). Common mode transient immunity in logic low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{CM} , to assure that the output will remain in a logic low state (i.e., $V_O < 0.8\text{ V}$).

6. Device is considered a two terminal device: pins 1, 2, 3 and 4 are shorted together and pins 5, 6, 7 and 8 are shorted together.

FOD050L, FOD053L

TYPICAL PERFORMANCE CURVES

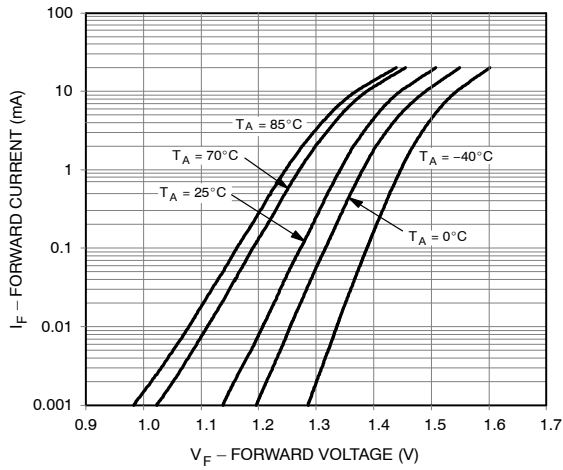


Figure 2. LED Forward Current vs. Forward Voltage

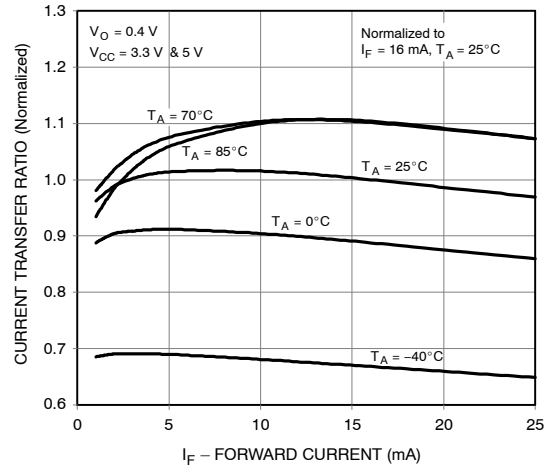


Figure 3. Current Transfer Ratio vs. Forward Current

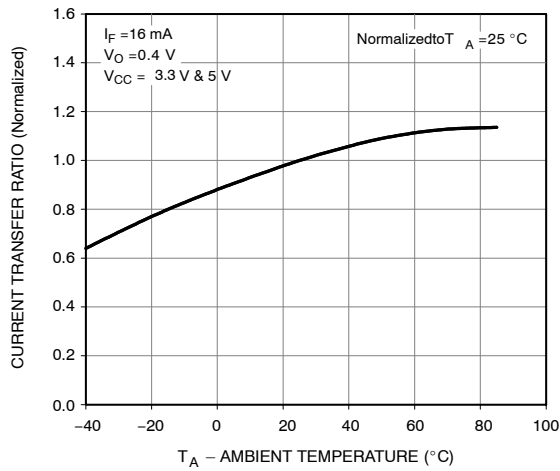


Figure 4. Current Transfer Ratio vs. Ambient Temperature

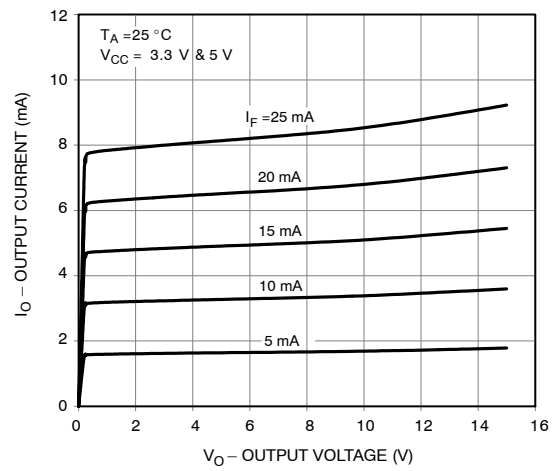


Figure 5. Output Current vs. Output Voltage

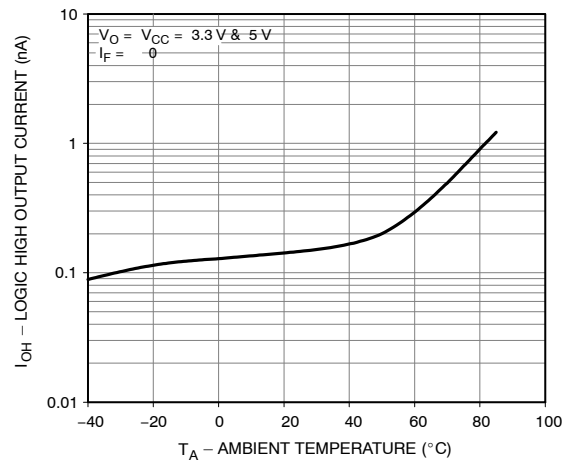


Figure 6. Logic High Output Current vs. Ambient Temperature

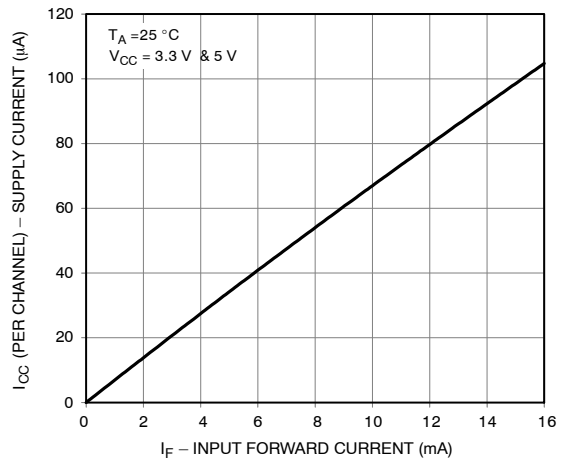


Figure 7. Supply Current vs. Input Forward Current

FOD050L, FOD053L

TYPICAL PERFORMANCE CURVES (Continued)

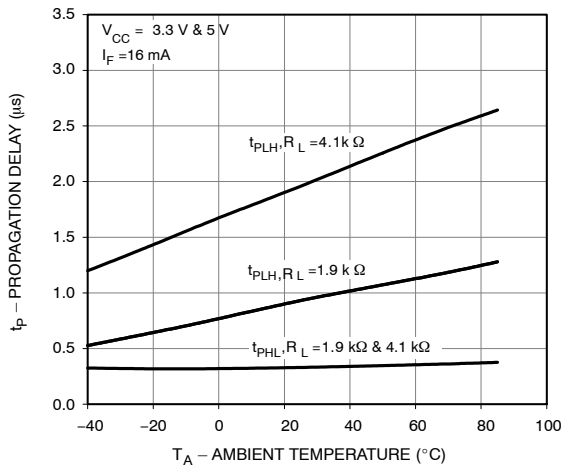


Figure 8. Propagation Delay vs. Ambient Temperature

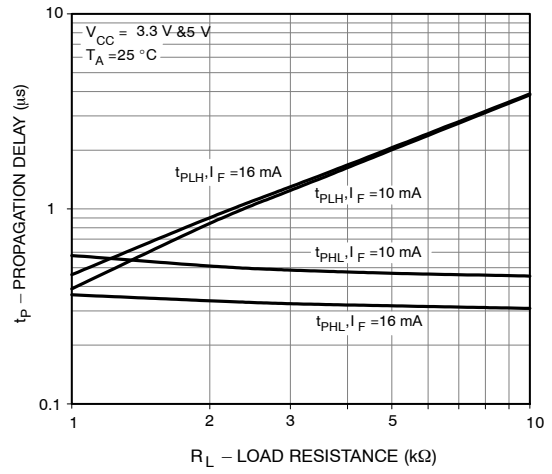
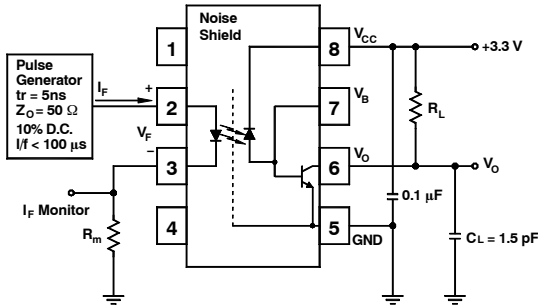


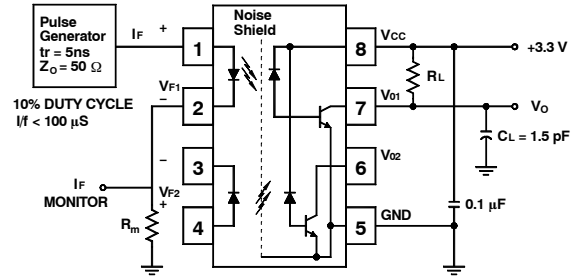
Figure 9. Propagation Delay vs. Load Resistance

FOD050L, FOD053L

TEST CIRCUITS



Test Circuit for FOD050L



Test Circuit for FOD053L

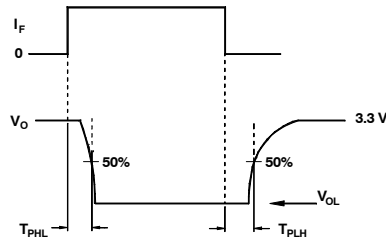
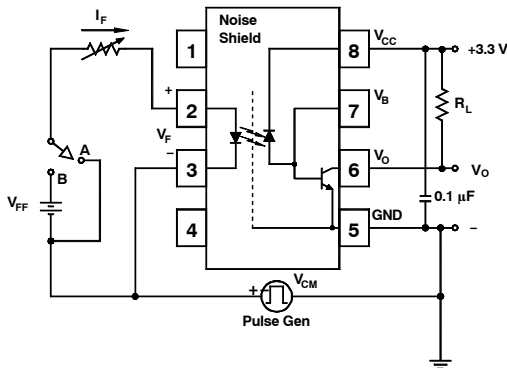
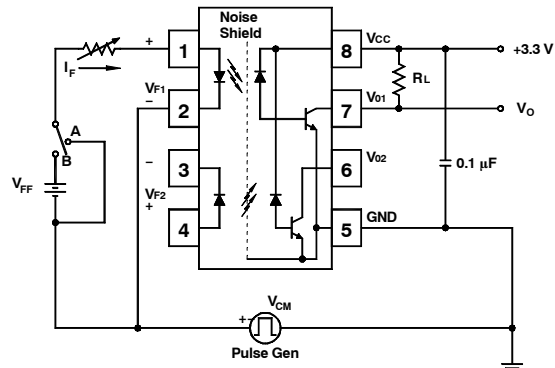


Figure 10. Switching Time Test Circuit



Test Circuit for FOD050L



Test Circuit for FOD053L

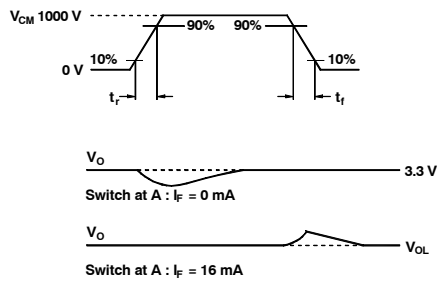


Figure 11. Common Mode Immunity Test Circuit

FOD050L, FOD053L

REFLOW PROFILE

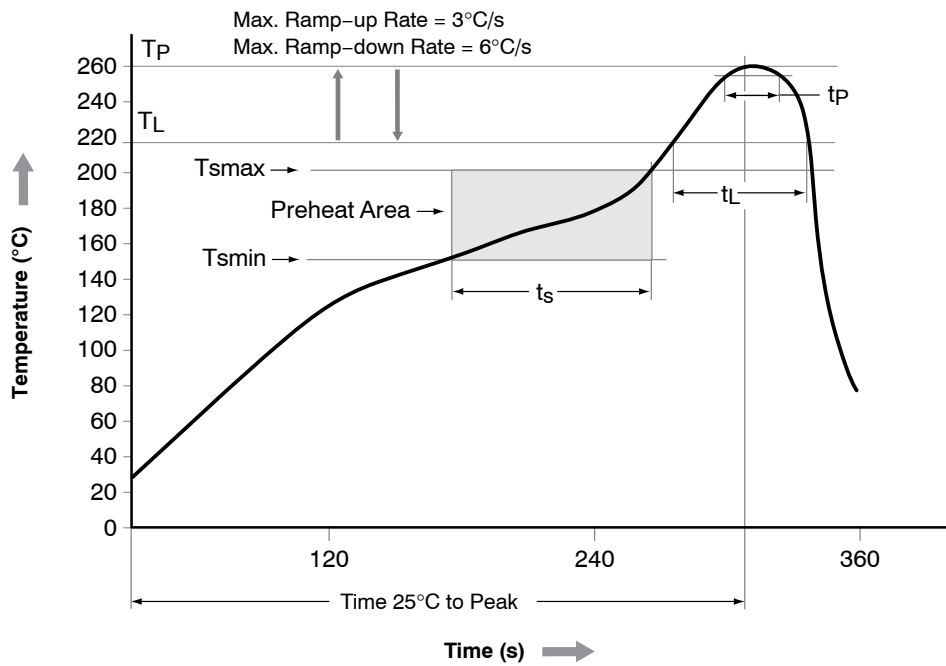


Figure 12. Reflow Profile

| 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 s |
| Ramp-up Rate (t_L to t_p) | 3°C/s max. |
| Liquidous Temperature (T_L) | 217°C |
| Time (t_L) Maintained Above (T_L) | 60 – 150 s |
| Peak Body Package Temperature | 260°C + 0°C / -5°C |
| Time (t_p) within 5°C of 260°C | 30 s |
| Ramp-down Rate (T_P to T_L) | 6°C/s max. |
| Time 25°C to Peak Temperature | 8 minutes max. |

FOD050L, FOD053L

ORDERING INFORMATION

| Part Number (Note 7) | Package | Packing Method† |
|----------------------|---|-------------------------------------|
| FOD050L | SOIC8 (Pb-Free) | Tube (50 Units per Tube) |
| FOD050LR2 | SOIC8 (Pb-Free) | Tape and Reel (1000 Units per Reel) |
| FOD050LV | SOIC8 (Pb-Free), DIN EN/IEC60747-5-5 Option | Tube (50 Units per Tube) |
| FOD050LR2V | SOIC8 (Pb-Free), DIN EN/IEC60747-5-5 Option | Tape and Reel (1000 Units per 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.

7. The product orderable part number system listed in this table also applies to the FOD053L product.

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MECHANICAL CASE OUTLINE

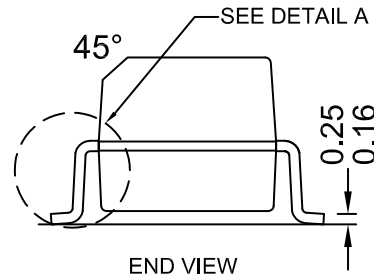
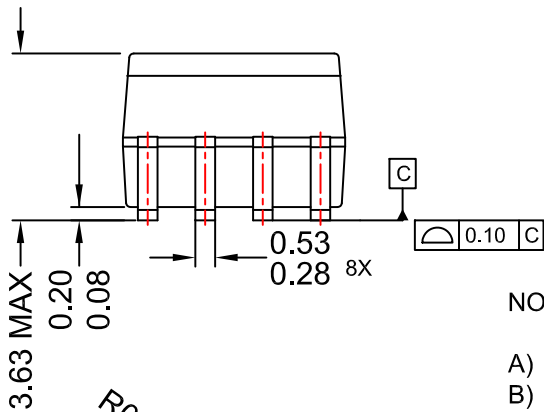
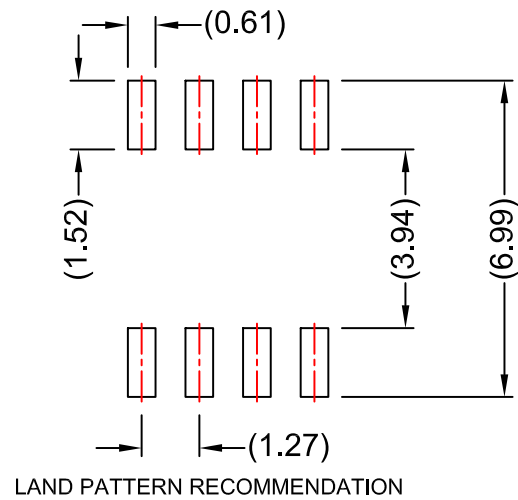
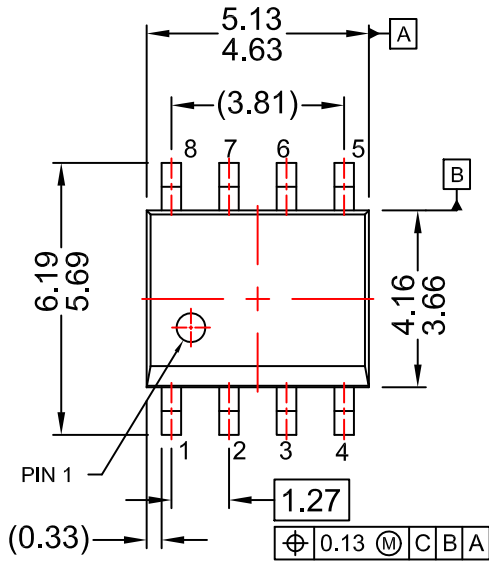
PACKAGE DIMENSIONS

ON Semiconductor®



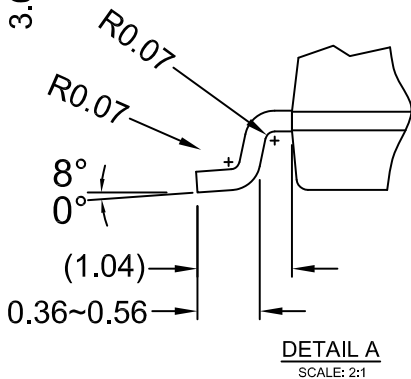
SOIC8
CASE 751DZ
ISSUE O

DATE 30 SEP 2016



NOTES:

- A) NO STANDARD APPLIES TO THIS PACKAGE
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M.



| | | |
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