FOD8173, FOD8173T

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

ON Semiconductor®

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Stretched
SOP 6 PINS

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.

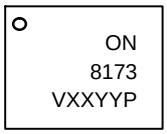
Features

- 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 Date 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

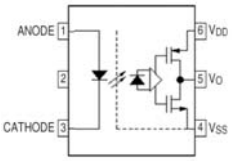
- Microprocessor System Interface
  - SPI, I2C
- Industrial Field Bus Communications
  - DeviceNet, CAN, RS485
- Programmable Logic Control
- Isolated Data Acquisition System
- Voltage Level Translator

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 ains 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
$V_{IOR}M$	Maximum Working Insulation Voltage	891	1,140	Vpeak
$V_{IOT}M$	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 $I_{S,INPUT}$ $P_{S,OUTPUT}$	Safety Limit Values – Maximum Values Allowed in the Event of a Failure, Case Temperature Input Current Output Power	 150 200 300	 150 200 300	 °C mA mW
R_{IO}	Insulation Resistance at T_S, VIO = 500 V	$>10^9$	$>10^9$	Ω

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 VDD + 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 TA = 25°C)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{ISO}	Input−Output Isolation Voltage	TA = 25°C, R.H. < 50%, t = 1.0min, II−O ≤ 20μA (Notes 3, 4)	5,000			V_{ACRMS}
R_{ISO}	Isolation Resistance	VI−O = 500V (Note 3)		10^{11}		Ω
C_{ISO}	Isolation Capacitance	VI−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 VAC_{RMS} for 1 minute duration is equivalent to 6,000 VAC_{RMS} for 1 second duration.

Table 6. ELECTRICAL CHARACTERISTICS

(Apply over all recommended conditions, T_A = −40°C to +100°C, 3.0V ≤ V_{DD} ≤ 5.5V, unless otherwise specified.
Typical value is measured at T_A = 25°C and V_{DD} = 3.3V.)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
INPUT CHARACTERISTICS						
V_F	Forward Voltage	I_F = 10 mA	1.0	1.35	1.80	V
BV_R	Input Reverse Breakdown Voltage	I_R = 10 μA	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 uA, I_F = 10 mA		0.0027	0.01	V
		I_O = 4 mA, I_F = 10 mA		0.27	0.8	
V_{OH}	Logic High Output Voltage	V_{DD} = 3.3 V, I_O = −20 μA, I_F = 0 mA	V_{DD} − 0.1	3.3		V
		V_{DD} = 3.3 V, I_O= −4 mA, I_F = 0 mA	V_{DD} − 0.5	3.1		
		V_{DD} = 5.0 V, I_O=−20 μA, I_F = 0 mA	V_{DD} − 0.1	5.0		
		V_{DD} = 5.0 V, I_O=−4 mA, I_F = 0 mA	V_{DD} − 0.5	4.9		
I_{DDL}	Logic Low Output Supply Current	I_F = 10 mA, V_{DD} = 3.3 V		3.3	4.8	mA
		I_F = 10 mA, V_{DD} = 5.0 V		4.0	5.0	
I_{DDH}	Logic High Output Supply Current	I_F = 0 mA, V_{DD} = 3.3 V		3.3	4.8	
		I_F = 0 mA, V_{DD} = 5.0 V		4.0	5.0	

Table 7. SWITCHING CHARACTERISTICS

Apply over all recommended conditions, (T_A = −40°C to +100°C, 3.0V ≤ V_{DD} ≤ 5.5V, I_F = 5 mA), unless otherwise specified.
Typical value is measured at T_A = 25°C and V_{DD} = 3.3V.

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 = 15pF		25	55	ns
t_{PLH}	Propagation Delay Time to Logic High Output	C_L = 15pF		25	55	ns
PWD	Pulse Width Distortion, $\lvert t_{PHL} - t_{PLH} \rvert$	C_L = 15pF		5.5	20	ns
t_R	Output Rise Time (10% − 90%)	C_L = 15pF		7.0		ns
t_F	Output Fall Time (90% − 10%)	C_L = 15pF		7.0		ns
$\lvert CM_H \rvert$	Common Mode Transient Immunity at Output High	I_F = 0mA, V_O > 0.8V_{DD}, V_{CM} = 1000V, T_A = 25°C (Note 6)	20	40		kV/μs
$\lvert CM_L \rvert$	Common Mode Transient Immunity at Output Low	I_F = 5mA, V_O < 0.8V, V_{CM} = 1000V, T_A = 25°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 dVcm/dt on the leading edge of the common mode impulse signal, Vcm, to assure that the output will remain high. Common mode transient immunity at output low is the maximum tolerable negative dVcm/dt on the trailing edge of the common pulse signal, Vcm, to assure that the output will remain low.

TYPICAL CHARACTERISTICS

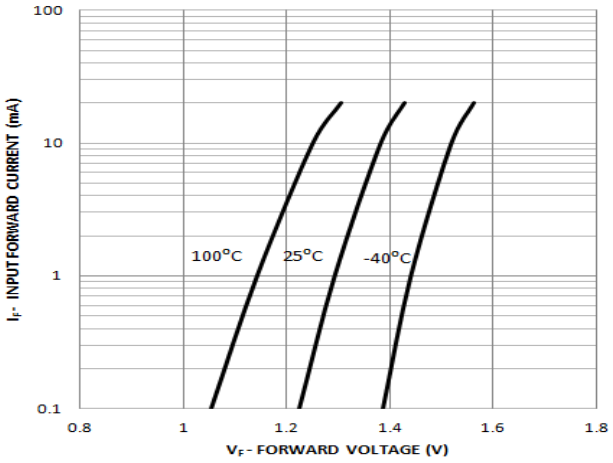

Figure 1. Input Forward Current vs. Forward Voltage

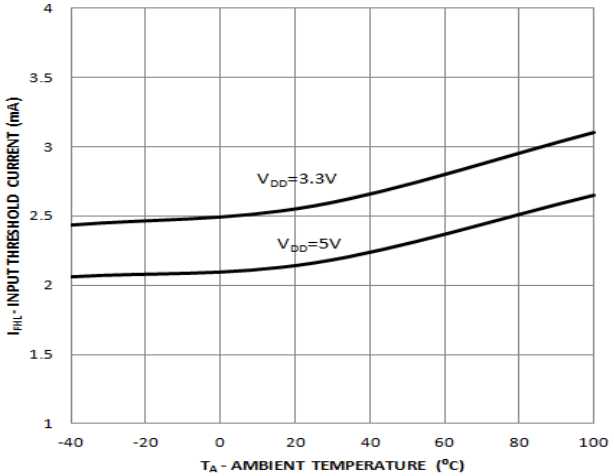

Figure 2. Input Threshold Current vs. Ambient Temperature

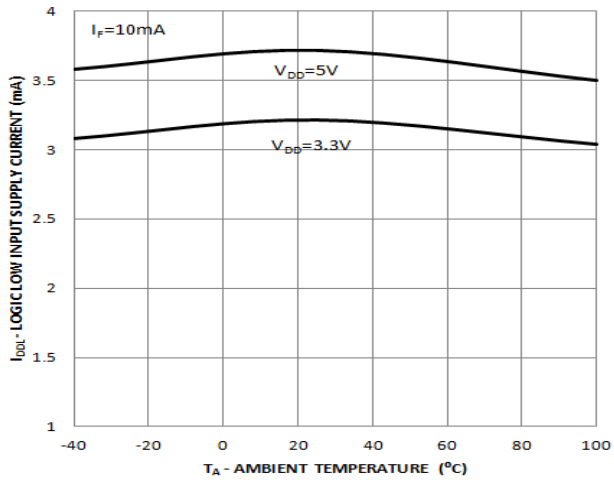

Figure 3. Logic Low Input Supply Current vs. Ambient Temperature

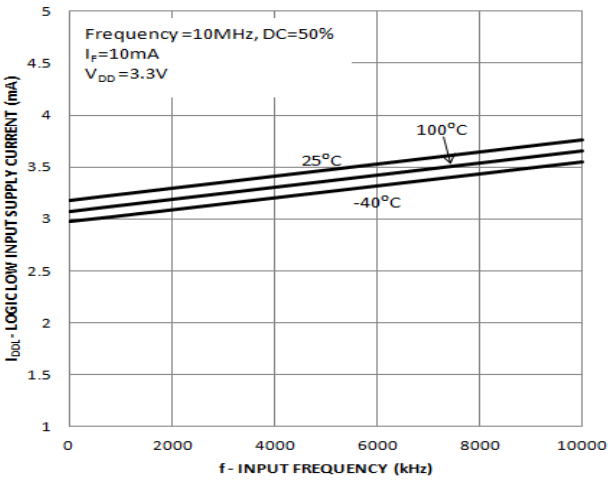

Figure 4. Logic Low Input Supply Current vs. Input Frequency (V_{DD} = 3.3 V)

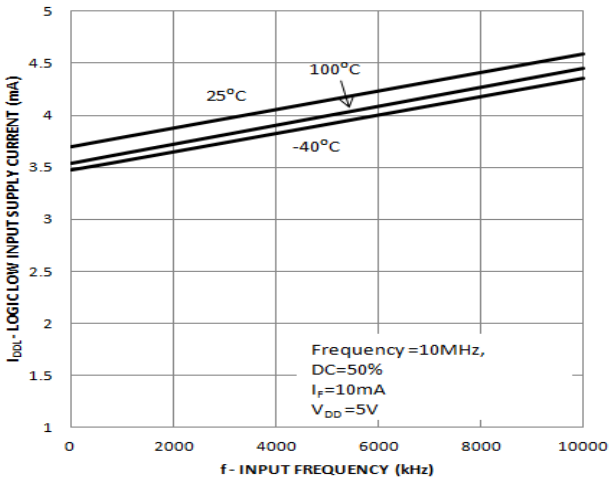

Figure 5. Logic Low Input Supply Current vs. Input Frequency (V_{DD} = 5 V)

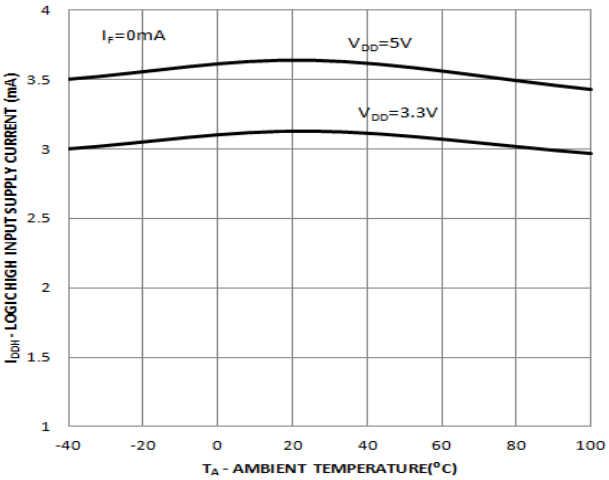

Figure 6. Logic High Input Supply Current vs. Ambient Temperature

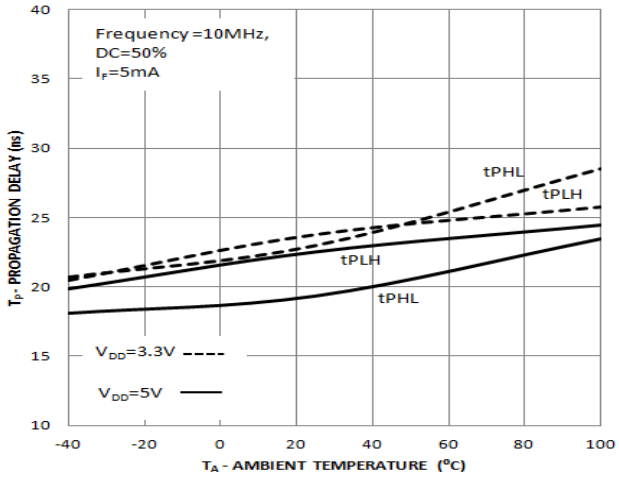

Figure 7. Propagation Delay vs. Ambient Temperature

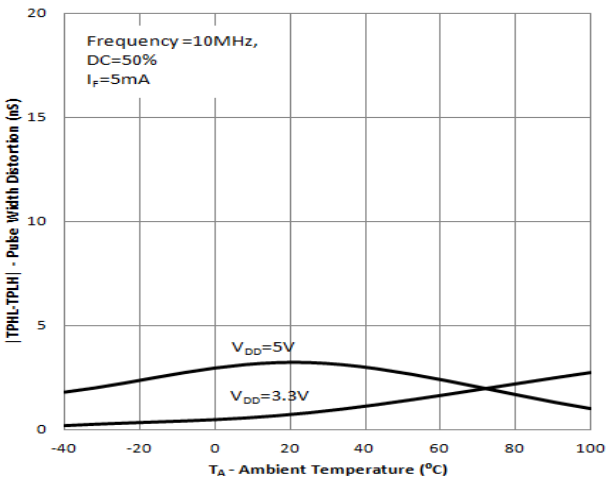

Figure 8. Pulse Width Distortion vs. Ambient Temperature

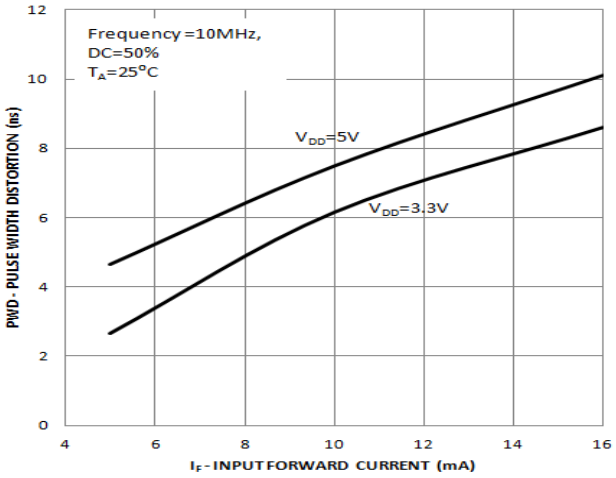

Figure 9. Pulse Width Distortion vs. Input Forward Current

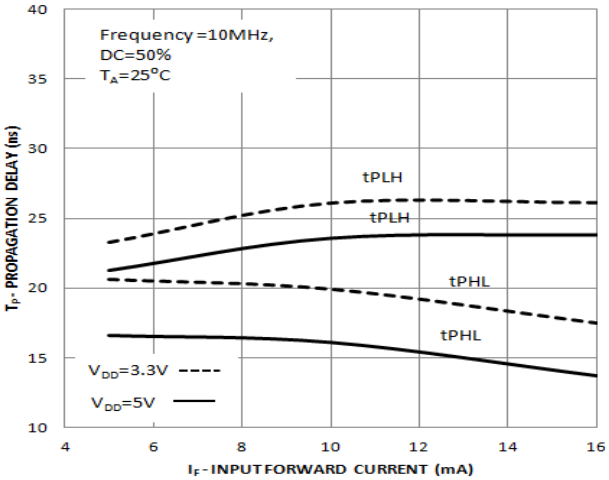

Figure 10. Propagation Delay vs. Input Forward Current

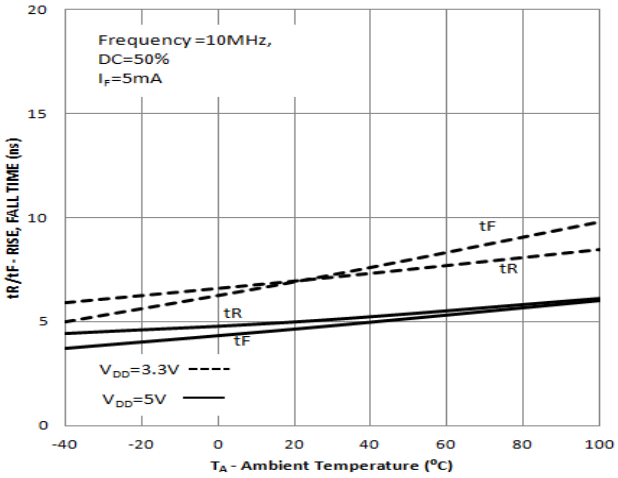

Figure 11. Rise, Fall Time vs. Ambient Temperature

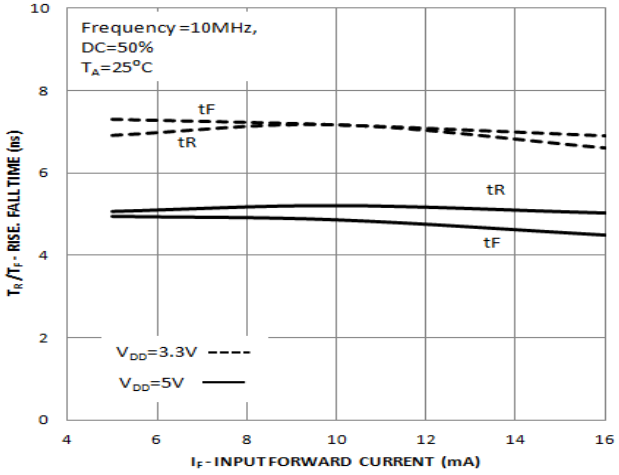

Figure 12. Rise, Fall Time vs. Input Forward Current

SCHEMATICS

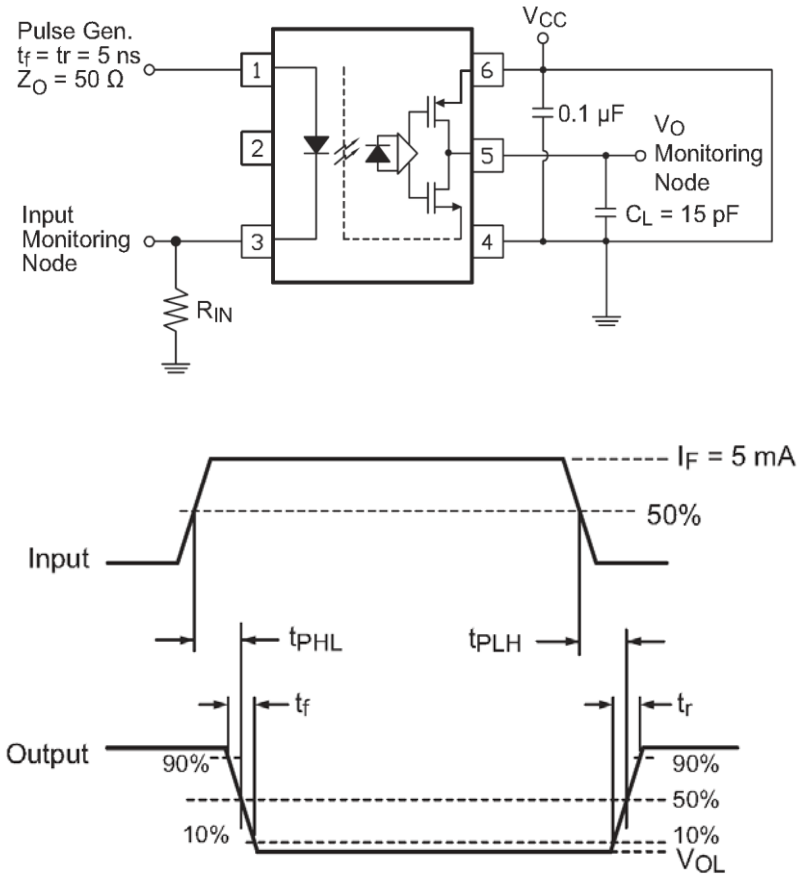

Figure 13. Test Circuit for Propagation Delay Time, Rise Time and Fall Time

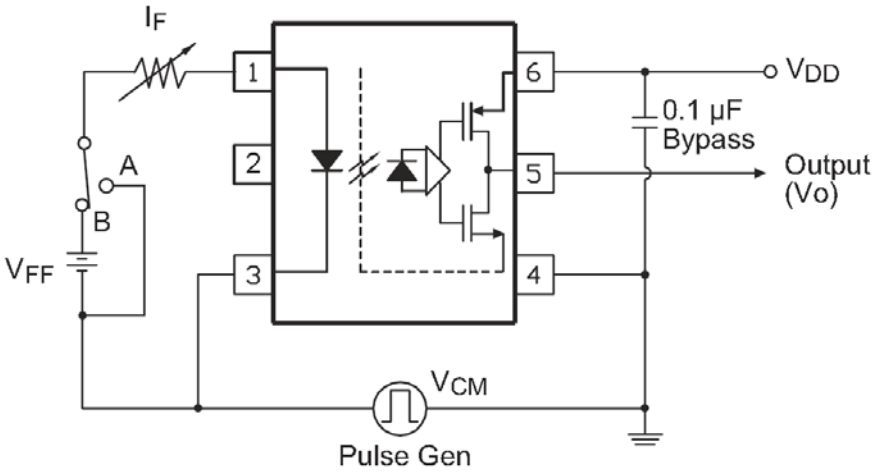

Figure 14. Test Circuit for Instantaneous Common Mode Rejection Voltage

REFLOW PROFILE

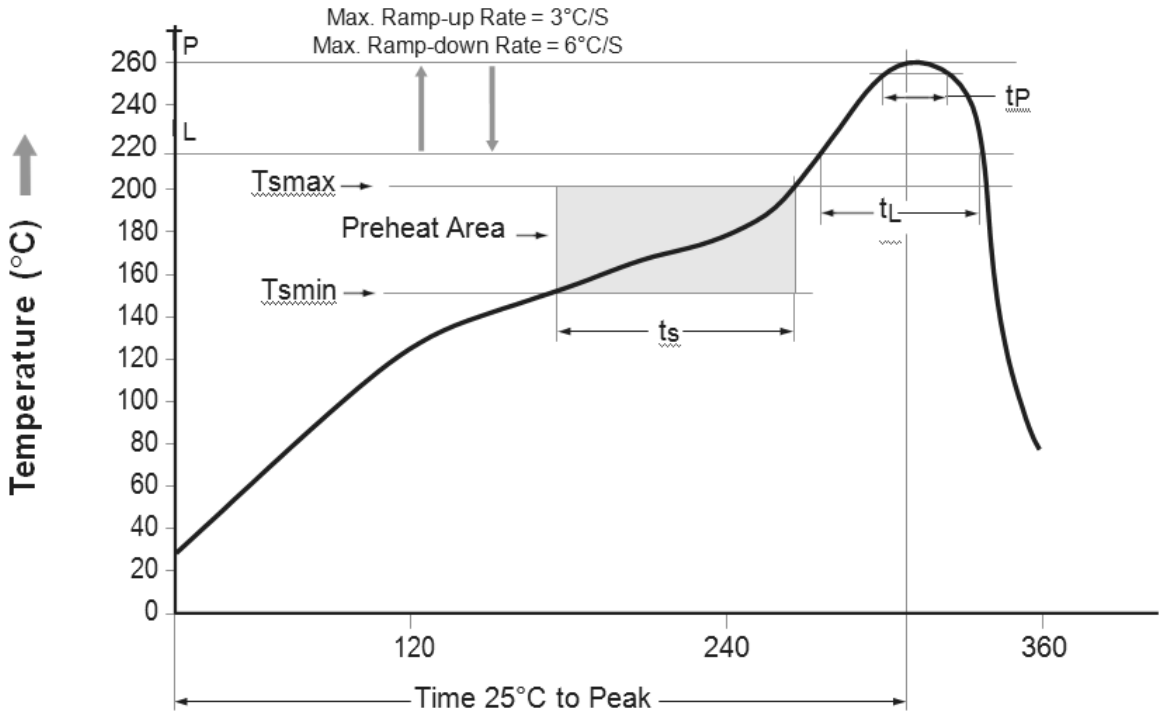

Figure 15. Reflow Profile

Table 8. REFLOW PROFILE

Profile Feature	Pb−Free Assembly Profile
Temperature Min. (Tsmin)	150°C
Temperature Max. (Tsmax)	200°C
Time (tS) from (Tsmin to Tsmax)	60 − 120 seconds
Ramp−up Rate (tL to tP)	3°C/second max
Liquidous Temperature (TL)	217°C
Time (tL) Maintained Above (TL)	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 (TP to TL)	6°C / second max.
Time 25°C to Peak Temperature	8 minutes max.

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)

PACKAGE DIMENSIONS

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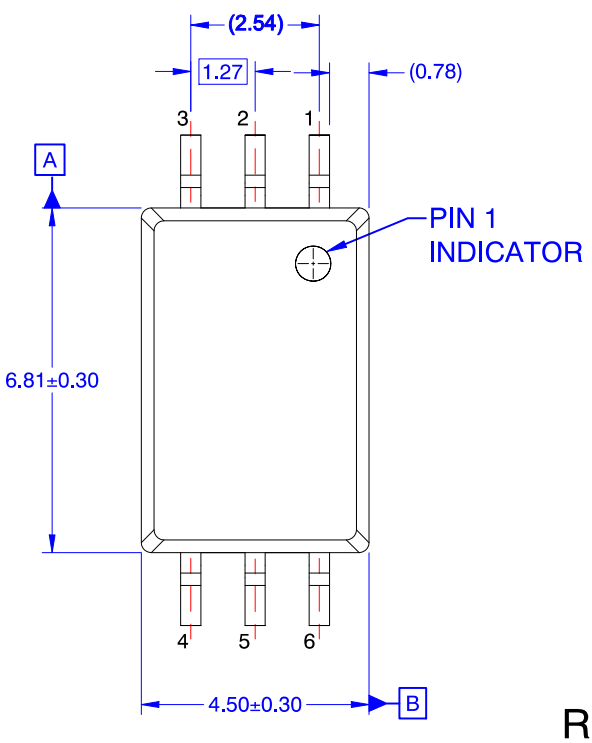
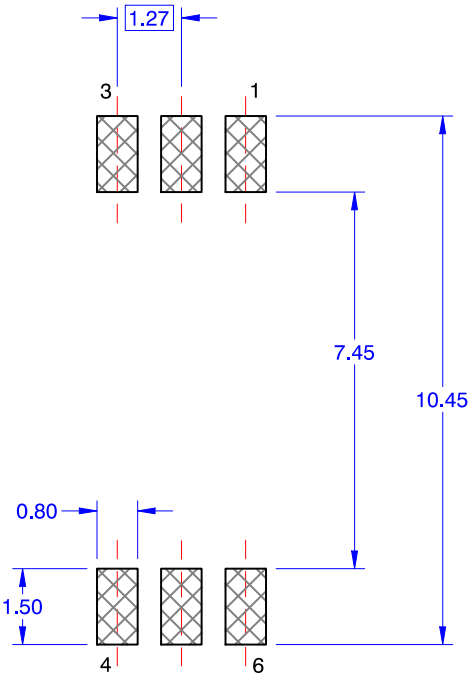
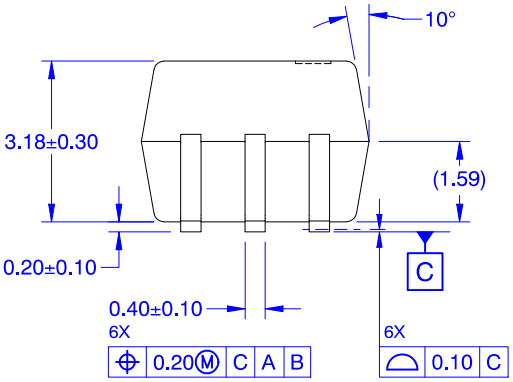
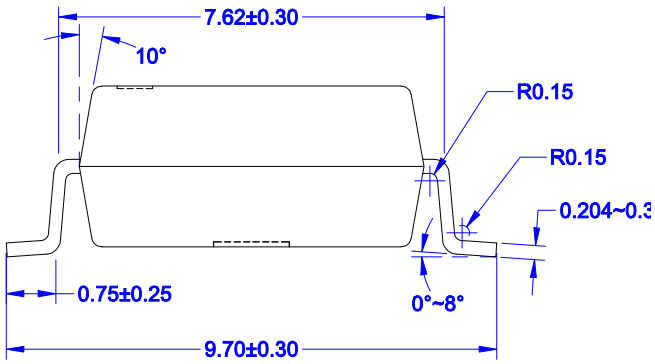
CASE 751EL
ISSUE O





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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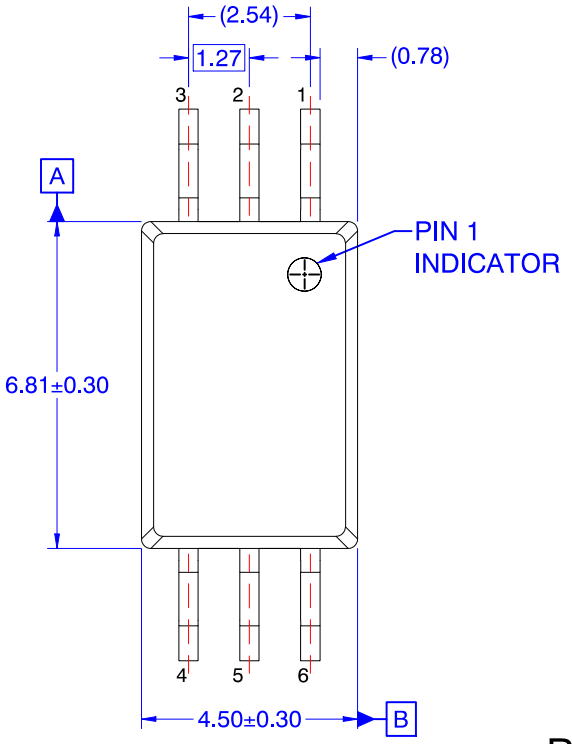
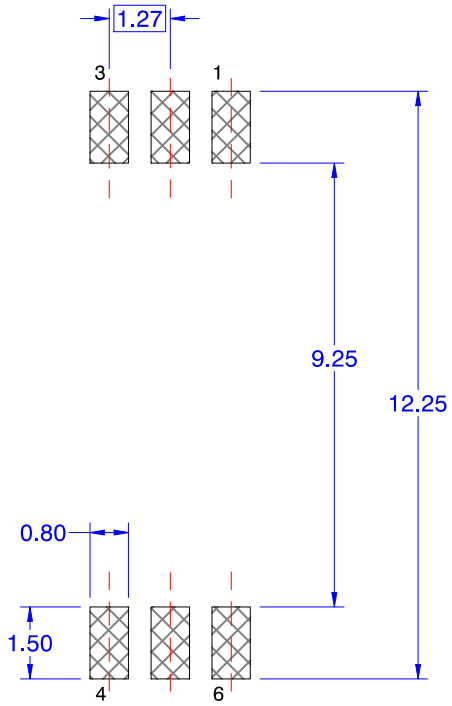
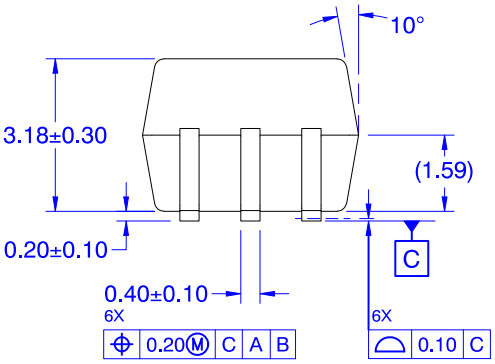
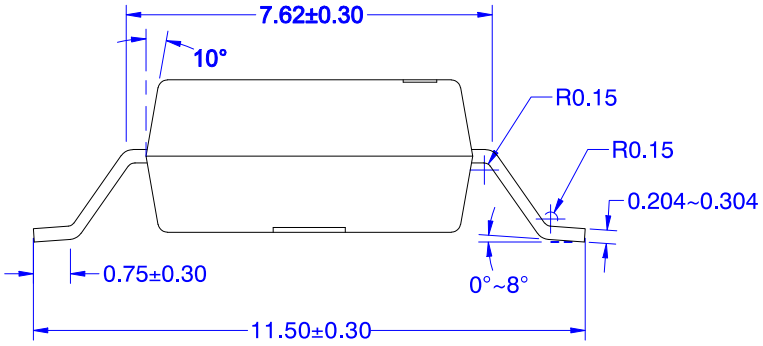
CASE 751EM
ISSUE O





RECOMMENDED LAND PATTERN





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