

# FOD050L, FOD250L: Single Channel FOD053L: Dual Channel LVTTTL/LVCMOS 3.3V High Speed Transistor Optocouplers

## Features

- Low power consumption
- High speed
- Available in single channel 8-pin DIP (FOD250L), 8-pin SOIC (FOD050L) or dual channel 8-pin SOIC (FOD053L)
- Superior CMR –  $CM_H = 50kV/\mu s$  (typical) and  $CM_L = 35kV/\mu s$  (typical)
- Guaranteed performance over temperature: 0°C to 70°C
- U.L. recognized (File # E90700)
- VDE pending

## Applications

- Line receivers
- Pulse transformer replacement
- High speed logic ground isolation: LVTTTL/LVCMOS
- Wide bandwidth analog coupling

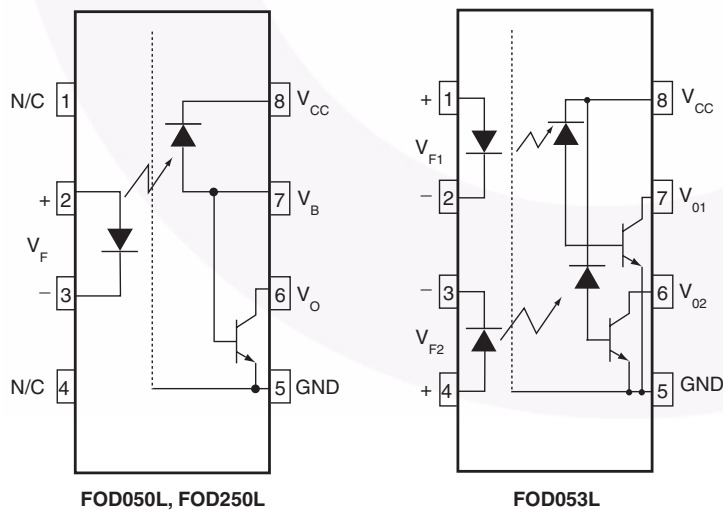
## Description

The FOD250L, FOD050L and FOD053L optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor. These devices are specified for operation at a 3.3V supply voltage.

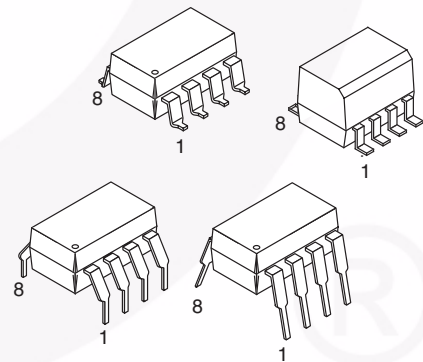
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

An internal noise shield provides superior common mode rejection of  $CM_H = 50kV/ms$  (typical) and  $CM_L = 35kV/ms$  (typical).

## Schematics



## Package Outlines



## Truth Table

LED	$V_O$
On	LOW
Off	HIGH

**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise specified.)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Value	Units
$T_{STG}$	Storage Temperature		-40 to +125	$^\circ\text{C}$
$T_{OPR}$	Operating Temperature		-40 to +85	$^\circ\text{C}$
$T_{SOL}$	Lead Solder Temperature (Wave solder only)		260 for 10 sec	$^\circ\text{C}$
<b>EMITTER</b>				
$I_F$ (avg)	DC/Average Forward Input Current	Each Channel	25	mA
$I_F$ (pk)	Peak Forward Input Current (50% duty cycle, 1ms P.W.)	Each Channel	50	mA
$I_F$ (trans)	Peak Transient Input Current ( $\leq 1 \mu\text{s}$ P.W., 300pps)	Each Channel	1.0	A
$V_R$	Reverse Input Voltage	Each Channel	5	V
$P_D$	Input Power Dissipation (No derating required up to $85^\circ\text{C}$ )	Each Channel	45	mW
<b>DETECTOR</b>				
$I_O$ (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, FOD250L 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, FOD250L only	5	mA
$P_D$	Output Power Dissipation (No derating required up to $85^\circ\text{C}$ )	Each Channel	100	mW

**Electrical Characteristics** ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified.)**Individual Component Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.*	Max.	Unit
<b>EMITTER</b>							
$V_F$	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
<b>DETECTOR</b>							
$I_{OH}$	Logic High Output Current	$I_F = 0\text{mA}$ , $V_O = V_{CC} = 3.3\text{V}$ , $T_A = 25^\circ\text{C}$	All		0.001	1	$\mu\text{A}$
$I_{CCL}$	Logic Low Supply Current	$I_F = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 3.3\text{V}$	FOD050L FOD250L			200	$\mu\text{A}$
		$I_{F1} = I_{F2} = 16\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 3.3\text{V}$	FOD053L			400	
$I_{CCH}$	Logic High Supply Current	$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 3.3\text{V}$ , $T_A = 25^\circ\text{C}$	FOD050L FOD250L			0.3	$\mu\text{A}$
		$I_F = 0\text{mA}$ , $V_O = \text{Open}$ , $V_{CC} = 3.3\text{V}$	FOD053L			10	

\*\*All Typicals at  $T_A = 25^\circ\text{C}$ **Transfer Characteristics**

Symbol	Parameter	Test Conditions	Device	Min.	Typ.**	Max.	Unit
<b>COUPLED</b>							
CTR	Current Transfer Ratio <sup>(1)</sup>	$I_F = 16\text{mA}$ , $V_O = 0.4\text{V}$ , $V_{CC} = 3.3\text{V}$ , $T_A = 25^\circ\text{C}$	All	15		50	%
$V_{OL}$	Logic Low Output Voltage Output Voltage	$I_F = 16\text{mA}$ , $I_O = 3\text{mA}$ , $V_{CC} = 3.3\text{V}$ , $T_A = 25^\circ\text{C}$	All			0.3	V

\*All Typicals at  $T_A = 25^\circ\text{C}$ **Note:**

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

**Electrical Characteristics** (Continued) ( $T_A = 0$  to  $70^\circ\text{C}$  unless otherwise specified.)**Switching Characteristics** ( $V_{CC} = 3.3\text{V}$ )

Symbol	Parameter	Test Conditions	Device	Min.	Typ.**	Max.	Unit
$T_{PHL}$	Propagation Delay Time to Logic LOW	$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(2)}$ (Fig. 10)	25°C	All		1.0	$\mu\text{s}$
						2.0	
$T_{PLH}$	Propagation Delay Time to Logic HIGH	$R_L = 1.9\text{k}\Omega$ , $I_F = 16\text{mA}^{(2)}$ (Fig. 10)	25°C	All		1.0	$\mu\text{s}$
						2.0	
$ICM_{HI}$	Common Mode Transient Immunity at Logic HIGH	$I_F = 0\text{mA}$ , $V_{CM} = 1,000\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(3,4)}$ (Fig. 11)	All	5,000	50,000		$\text{V}/\mu\text{s}$
		$I_F = 0\text{mA}$ , $V_{CM} = 1,000\text{V}_{P-P}$ , $T_A = 25^\circ\text{C}$ , $R_L = 1.9\text{k}\Omega^{(2,4)}$ (Fig. 11)		5,000	50,000		$\text{V}/\mu\text{s}$
$ICM_{LI}$	Common Mode Transient Immunity at Logic LOW	$I_F = 16\text{mA}$ , $V_{CM} = 1,000\text{V}_{P-P}$ , $R_L = 4.1\text{k}\Omega$ , $T_A = 25^\circ\text{C}^{(3,4)}$ (Fig. 11)	All	5,000	35,000		$\text{V}/\mu\text{s}$
		$I_F = 16\text{mA}$ , $V_{CM} = 1,000\text{V}_{P-P}$ , $R_L = 1.9\text{k}\Omega^{(2,4)}$ (Fig. 11)		5,000	35,000		$\text{V}/\mu\text{s}$

**Isolation Characteristics**

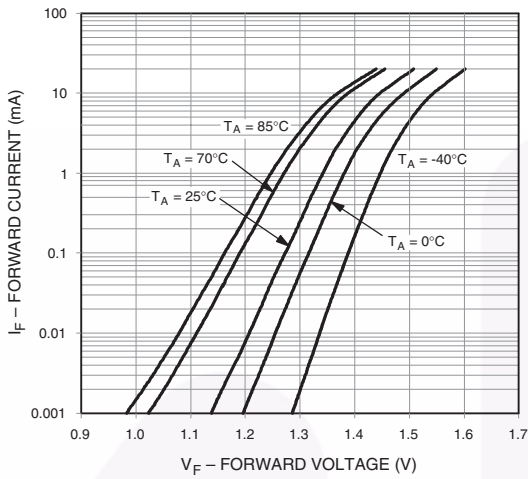
Symbol	Characteristics	Test Conditions	Device	Min.	Typ.**	Max.	Unit
$I_{I-O}$	Input-Output Insulation Leakage Current	Relative humidity = 45%, $T_A = 25^\circ\text{C}$ , $t = 5\text{s}$ , $V_{I-O} = 3000\text{VDC}^{(5)}$	All			1.0	$\mu\text{A}$
$V_{ISO}$	Withstand Insulation Test Voltage	$f = 60\text{Hz}$ , $T_A = 25^\circ\text{C}$ , $t = 1\text{min.}^{(5)}$	FOD050L FOD053L	2500			$V_{RMS}$
			FOD250L	5000			
$R_{I-O}$	Resistance (input to output)	$V_{I-O} = 500\text{VDC}^{(5)}$	All	$10^{11}$	$10^{12}$		$\Omega$
$C_{I-O}$	Capacitance (input to output)	$f = 1\text{MHz}^{(5)}$	All		0.2		$\text{pF}$

\*All Typicals at  $T_A = 25^\circ\text{C}$ **Notes:**

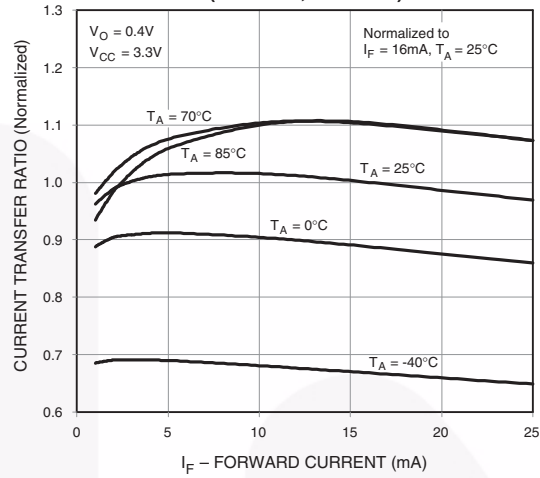
- The  $1.9\text{k}\Omega$  load represents 1 TTL unit load of  $1.6\text{mA}$  and  $5.6\text{k}\Omega$  pull-up resistor.
- The  $4.1\text{k}\Omega$  load represents 1 LSTTL unit load of  $0.36\text{mA}$  and  $6.1\text{k}\Omega$  pull-up resistor.
- Common mode transient immunity in logic high level 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.,  $V_O < 0.8\text{V}$ ).
- 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.

## Typical Performance Curves

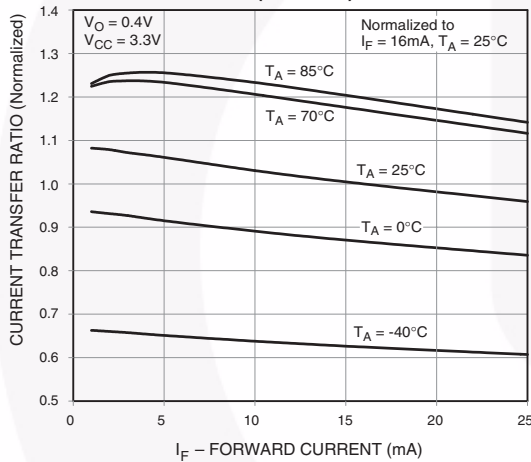
**Fig. 1 LED Forward Current vs. Forward Voltage**



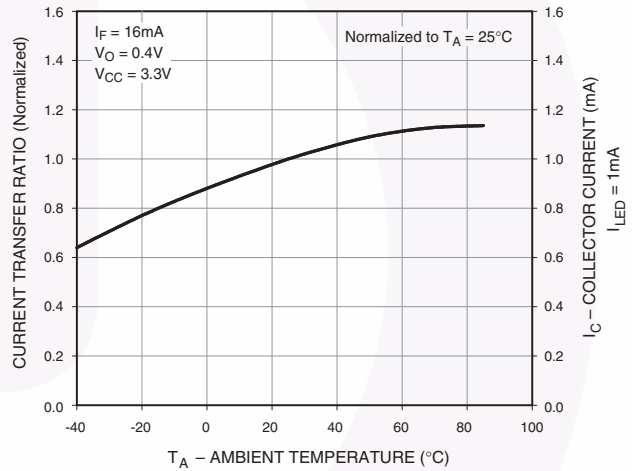
**Fig. 2 Current Transfer Ratio vs. Forward Current (FOD050L, FOD053L)**



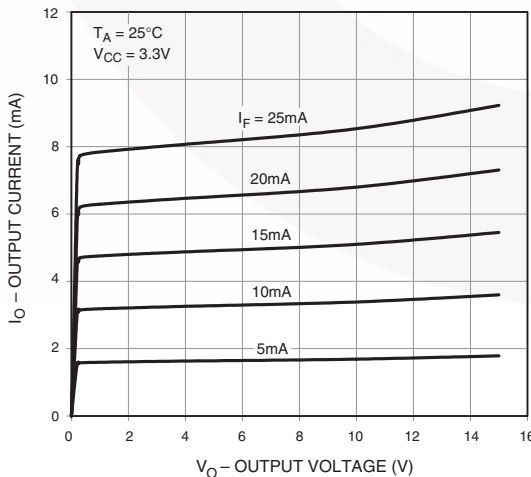
**Fig. 3 Current Transfer Ratio vs. Input Forward Current (FOD250L)**



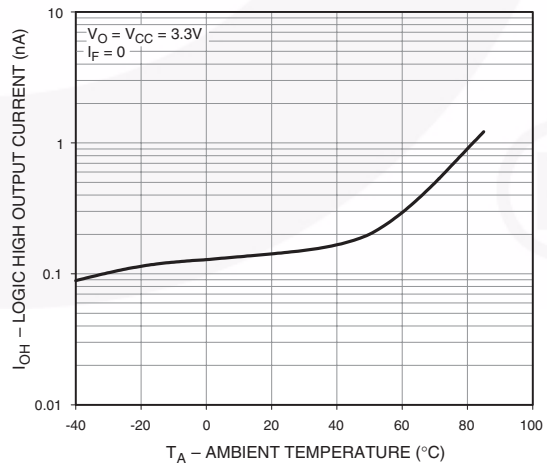
**Fig. 4 Current Transfer Ratio vs. Ambient Temperature**



**Fig. 5 Output Current vs. Output Voltage**



**Fig. 6 Logic High Output Current vs. Ambient Temperature**



Typical Performance Curves (Continued)

Fig. 7 Supply Current vs. Input Forward Current

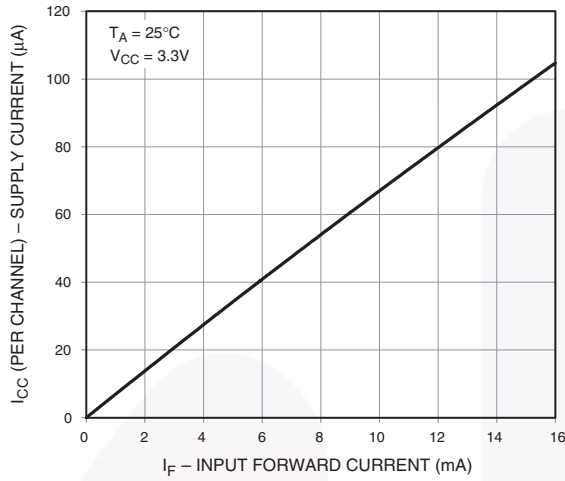


Fig. 8 Propagation Delay vs. Ambient Temperature

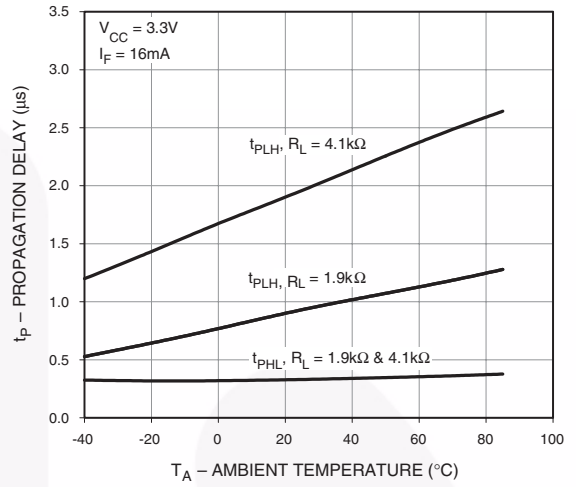
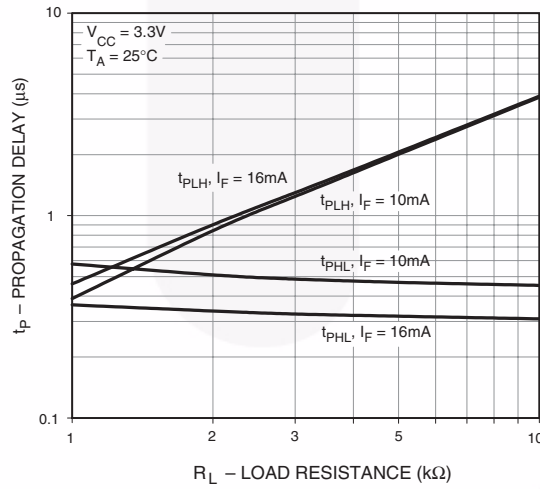
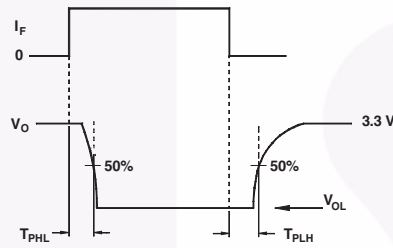
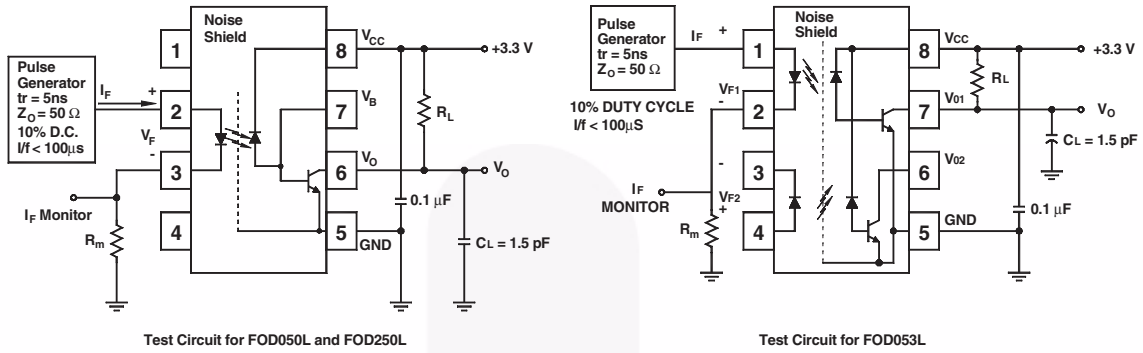


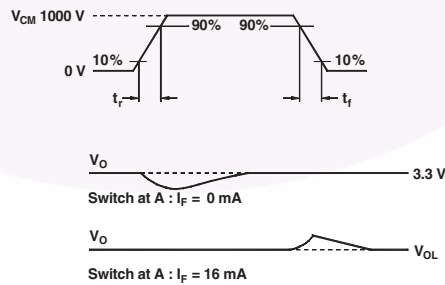
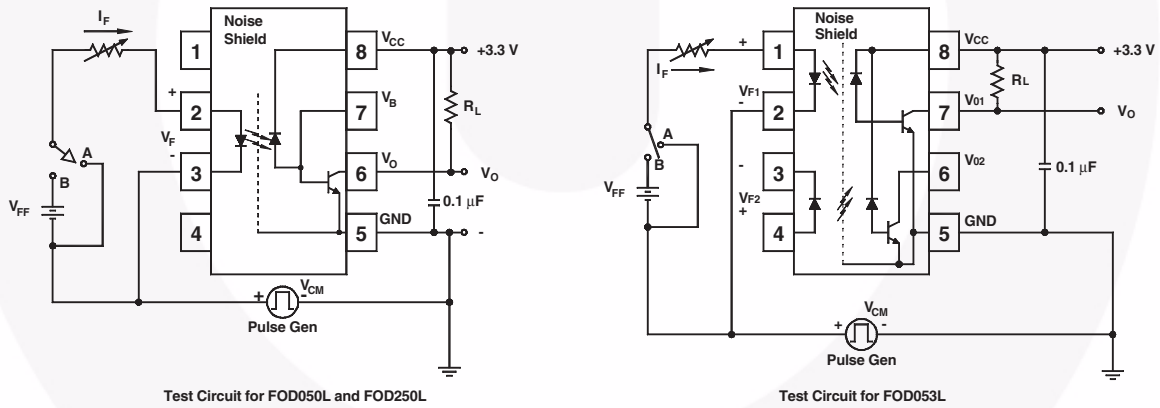
Fig. 9 Propagation Delay vs. Load Resistance



### Test Circuits



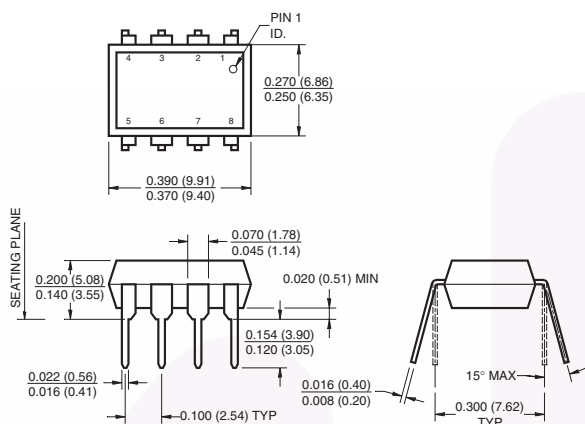
**Fig. 10 Switching Time Test Circuit**



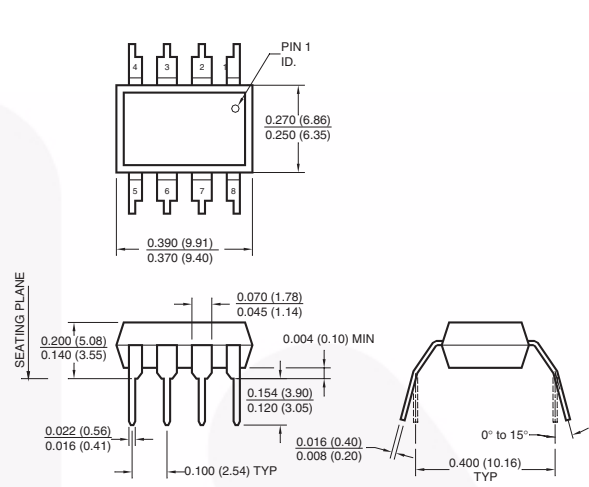
**Fig. 11 Common Mode Immunity Test Circuit**

## Package Dimensions

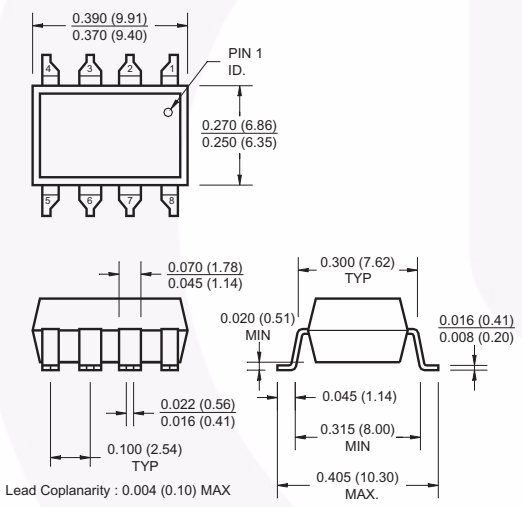
### Through Hole



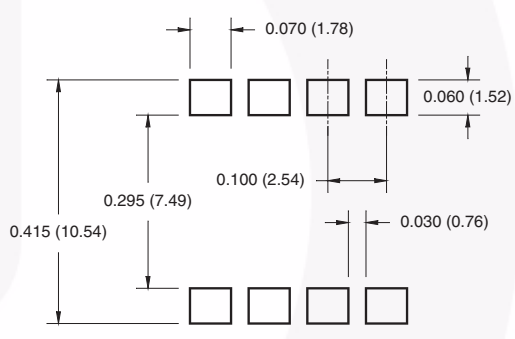
### 0.4" Lead Spacing



### Surface Mount



### 8-Pin DIP – Land Pattern

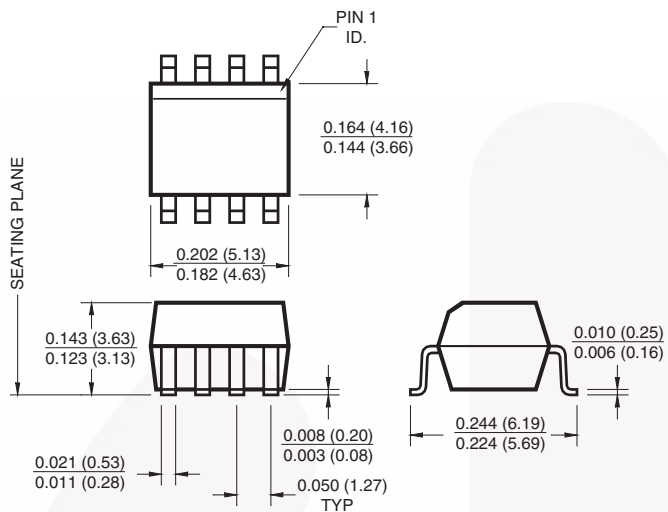


**Note:**  
All dimensions are in inches (millimeters)



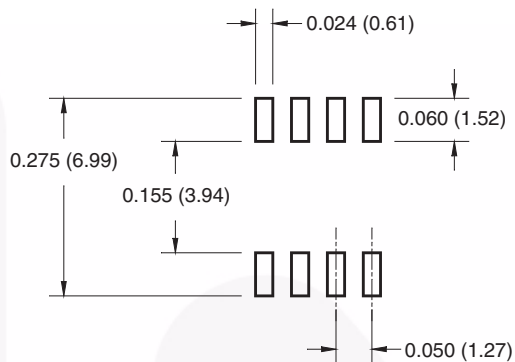
**Package Dimensions** (Continued) (8-Pin SOIC)

**Surface Mount**



Lead Coplanarity : 0.004 (0.10) MAX

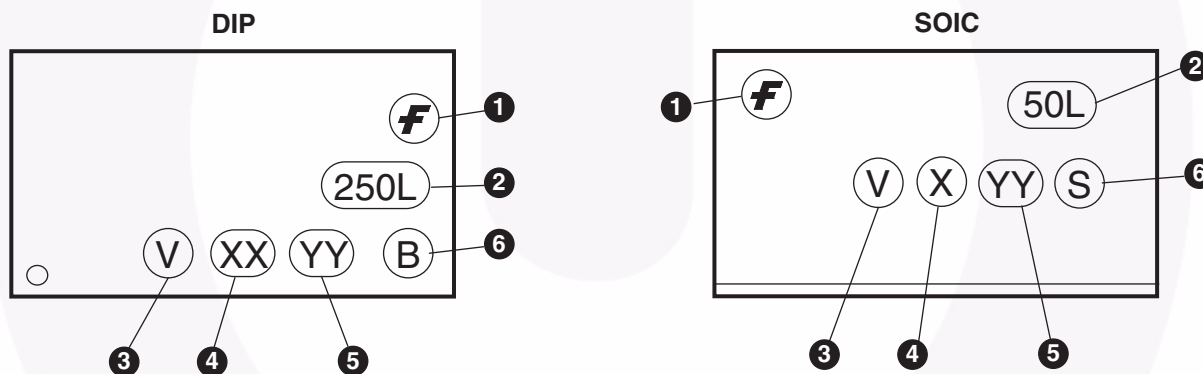
**8-Pin Small Outline**



## Ordering Information

Option	Order Entry Identifier	Description
No Suffix	FOD250L	Through Hole (DIP package only)
	FOD050L	Surface Mount Lead Form (SOIC-8 package only)
S	FOD250LS	Surface Mount Lead Bend (DIP package only)
SD	FOD250LSD	Surface Mount; Tape and reel (DIP package only)
SV	Pending Approval	Surface Mount; VDE0884 (DIP package only)
SDV	Pending Approval	Surface Mount; Tape and reel, VDE0884 (1000 units per reel) (DIP package only)
T	FOD250LT	0.4" Lead Spacing (DIP package only)
TV	Pending Approval	0.4" Lead Spacing, VDE0884 (DIP package only)
R1	FOD050LR1	Tape and Reel (500 units per reel) (SOIC-8 package only)
R1V	Pending Approval	VDE, Tape and Reel (500 units per reel) (SOIC-8 package only)
R2	FOD050LR2	Tape and Reel (2500 units per reel) (SOIC-8 package only)
R2V	Pending Approval	VDE, Tape and Reel (2500 units per reel) (SOIC-8 package only)
V	Pending Approval	VDE (SOIC-8 package only)

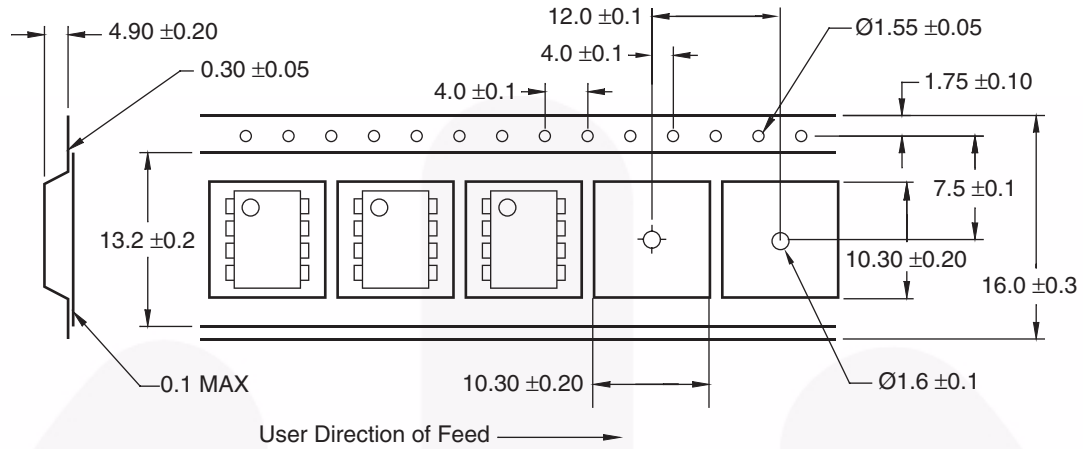
## Marking Information



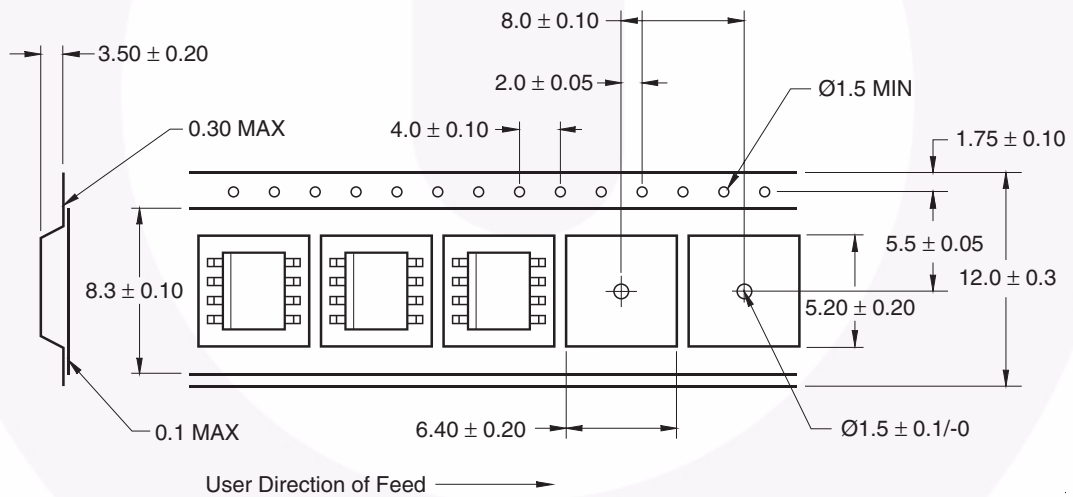
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4 (DIP)	Two digit year code, e.g., '03'
4 (SOIC)	One digit year code, e.g., '3'
5	Two digit work week ranging from '01' to '53'
6	Assembly package code

### Carrier Tape Specification

#### 8-Pin DIP (FOD250L)



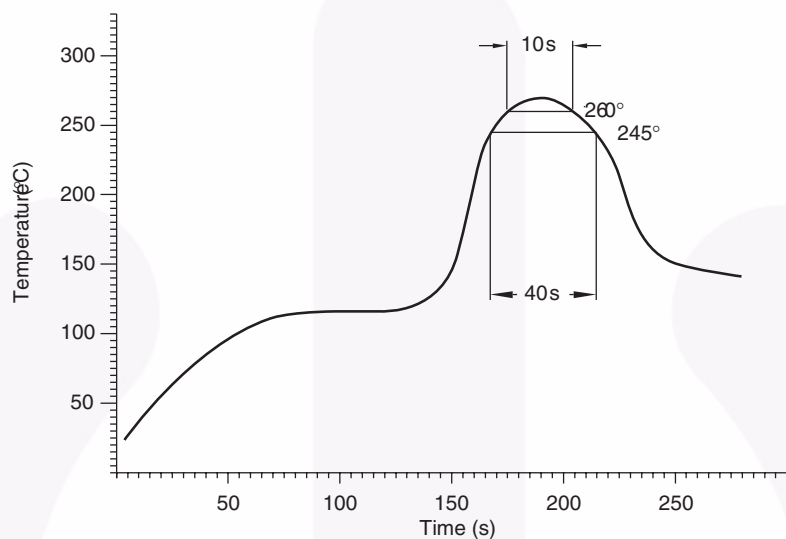
#### 8-Pin SOIC (FOD050L, FOD053L)



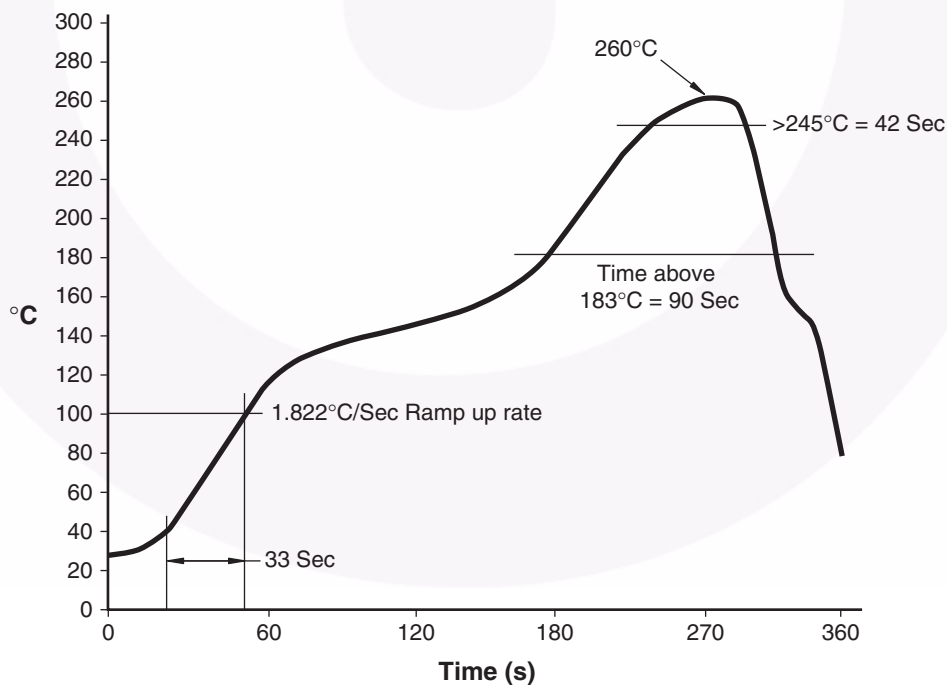
## Reflow Profile

### 8-Pin DIP (FOD250L)

- Peak reflow temperature 260°C (package surface temperature)
- Time of temperature higher than 245°C 40 seconds or less
- Number of reflows Three



### 8-Pin SOIC (FOD050L, FOD053L)





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**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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Rev. 140