FAIRCHILD SEMICONDUCTOR®

October 2006

FOD050L, FOD250L: Single Channel
FOD053L: Dual Channel
LVTTL/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/μs (typical) and CM_L = 35kV/μs (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: LVTTL/LVCMOS
- Wide bandwidth analog coupling

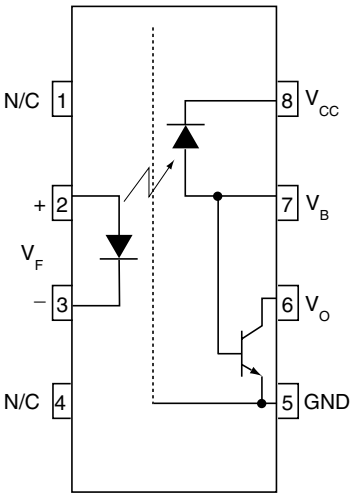
Description

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.

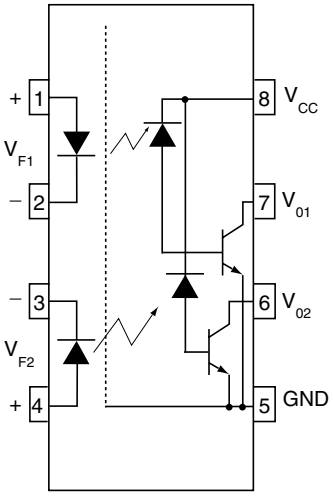
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional
phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

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

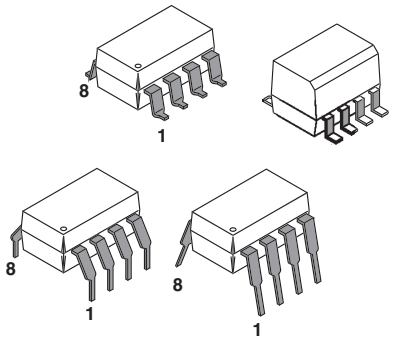
Schematic



FOD050L, FOD250L



FOD053L



Truth Table

LED	V_O
On	LOW
Off	HIGH

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 +85	°C
T_{SOL}	Lead Solder Temperature (Wave solder only)		260 for 10 sec	°C
EMITTER				
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 (≤1 µs 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°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, 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°C)	Each Channel	100	mW

Electrical Characteristics (T_A = 0 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 = 16mA, T_A =25°C	All		1.45	1.7	V
		I_F = 16mA				1.8	
B_{VR}	Input Reverse Breakdown Voltage	I_R = 10µA	All	5.0			V
DETECTOR							
I_{OH}	Logic High Output Current	I_F = 0mA, V_O = V_{CC} = 3.3V, T_A = 25°C	All		0.001	1	µA
I_{CCL}	Logic Low Supply Current	I_F = 16mA, V_O = Open, V_{CC} = 3.3V	FOD050L FOD250L			200	µA
		I_{F1} = I_{F2} = 16mA, V_O = Open, V_{CC} = 3.3V	FOD053L			400	
I_{CCH}	Logic High Supply Current	I_F = 0mA, V_O = Open, V_{CC} = 3.3V, T_A = 25°C	FOD050L FOD250L			0.3	µA
		I_F = 0mA, V_O = Open, V_{CC} = 3.3V	FOD053L			10	

**All Typicals at T_A = 25°C

Transfer Characteristics

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

**All Typicals at T_A = 25°C

Note:

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

Switching Characteristics (T_A = 0 to 70°C Unless otherwise specified, V_{CC} = 3.3V.)

Symbol	Parameter	Test Conditions		Device	Min.	Typ.**	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic Low	R_L = 1.9kΩ, I_F = 16mA[2] (Fig. 10)	25°C	All			1.0	µs
							2.0	
T_{PLH}	Propagation Delay Time to Logic High	R_L = 1.9kΩ, I_F = 16mA[2] (Fig. 10)	25°C	All			1.0	µs
							2.0	
$\|CM_H\|$	Common Mode Transient Immunity at Logic High	I_F = 0mA, V_{CM} = 1,000V_{P-P}, R_L = 4.1kΩ, T_A = 25°C[3,4] (Fig. 11)		All	5,000	50,000		V/µs
		I_F = 0mA, V_{CM} = 1,000V_{P-P}, T_A = 25°C, R_L = 1.9kΩ[2,4] (Fig. 11)			5,000	50,000		V/µs
$\|CM_L\|$	Common Mode Transient Immunity at Logic Low	I_F = 16mA, V_{CM} = 1,000V_{P-P}, R_L = 4.1kΩ. T_A = 25°C[3,4] (Fig. 11)		All	5,000	35,000		V/µs
		I_F = 16mA, V_{CM} = 1,000 V_{P-P}, R_L = 1.9kΩ[2,4] (Fig. 11)			5,000	35,000		V/µs

** All Typicals at T_A = 25°C

Isolation Characteristics (T_A = 0 to 70°C Unless otherwise specified.)

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

Notes:

2. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and 5.6kΩ pull-up resistor.
3. The 4.1kΩ load represents 1 LSTTL unit load of 0.36mA and 6.1kΩ pull-up resistor.
4. 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 > 2.0V). 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 < 0.8V).
5. 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

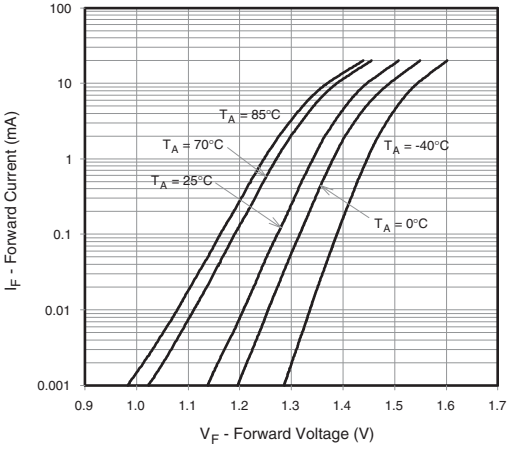


Fig. 2 Current Transfer Ratio vs. Forward Current (FOD050L, FOD053L)

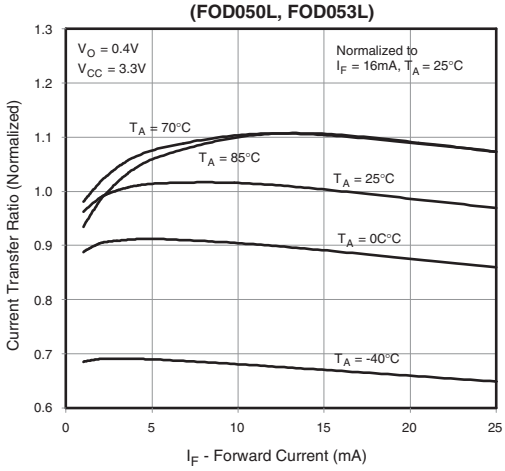


Fig. 3 Current Transfer Ratio vs. Input Forward Current (FOD250L)

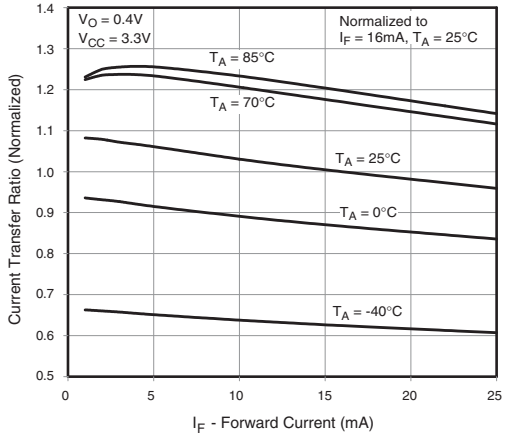


Fig. 4 Current Transfer Ratio vs. Ambient Temperature

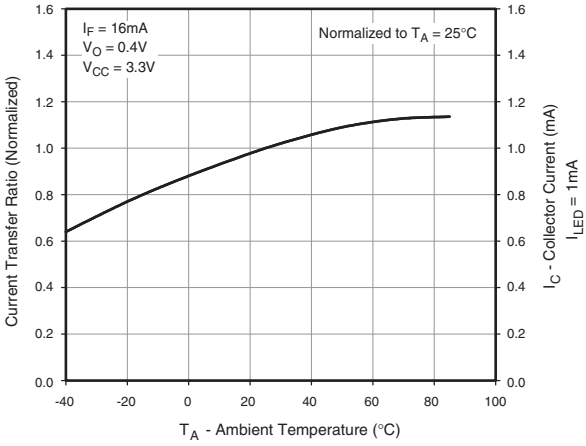


Fig. 5 Output Current vs. Output Voltage

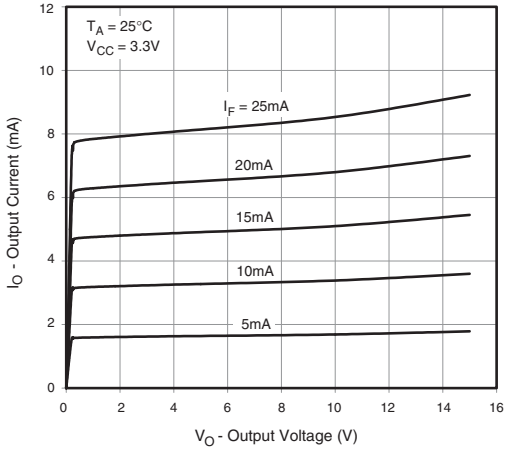


Fig 6. Logic High Output Current vs. Ambient Temperature

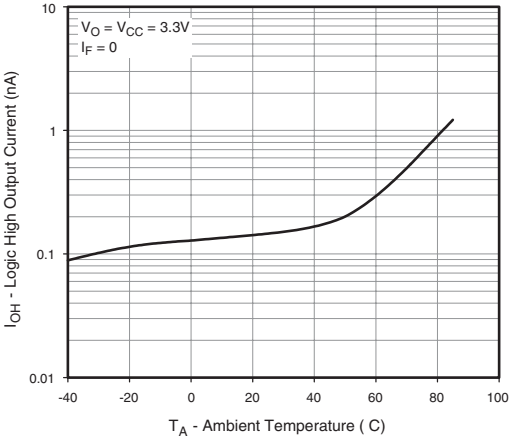


Fig. 7 Supply Current vs. Input Forward Current

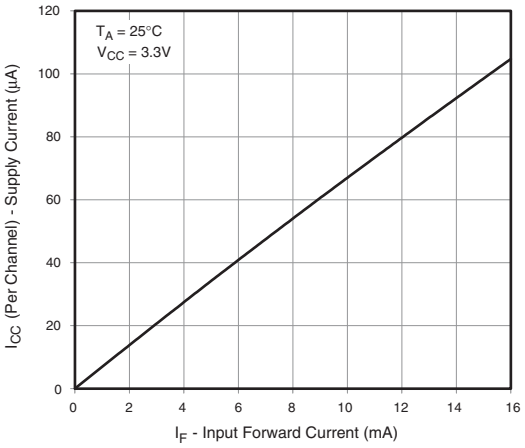


Fig. 8 Propagation Delay vs. Ambient Temperature

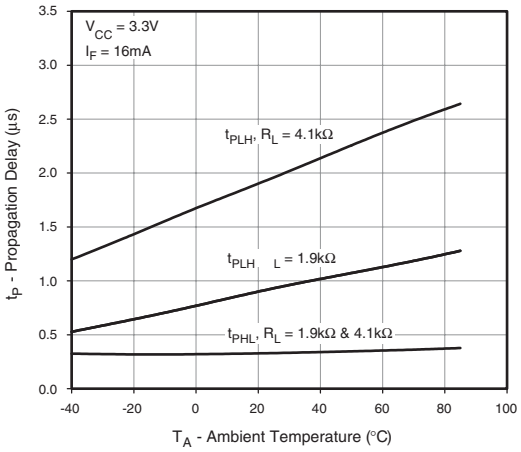


Fig. 9 Propagation Delay vs Load Resistance

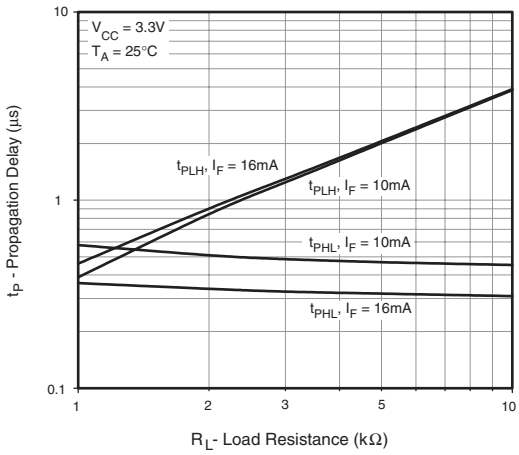


Fig. 10 Switching Time Test Circuit

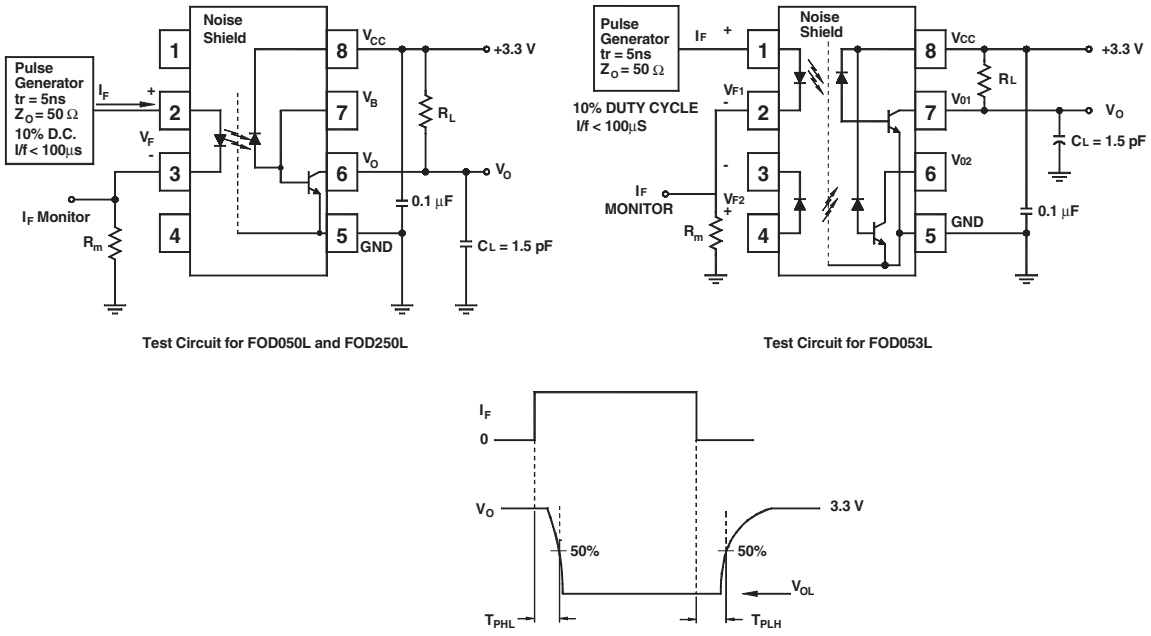
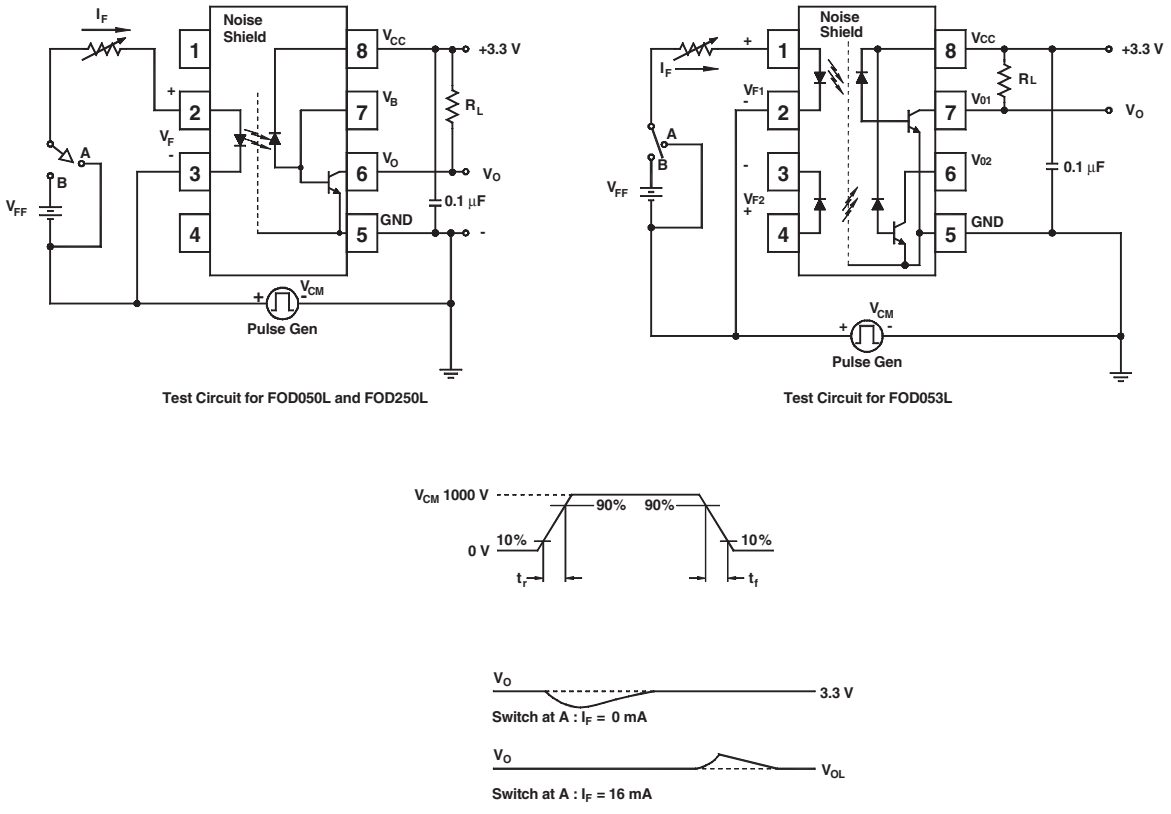


Fig. 11 Common Mode Immunity Test Circuit

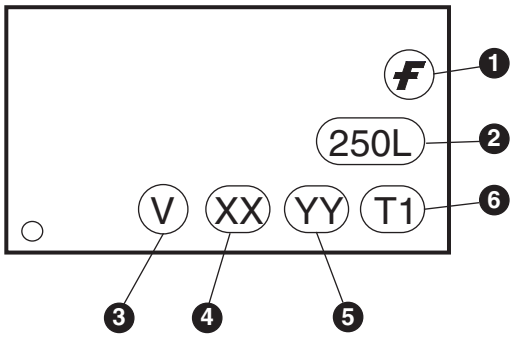


Ordering Information

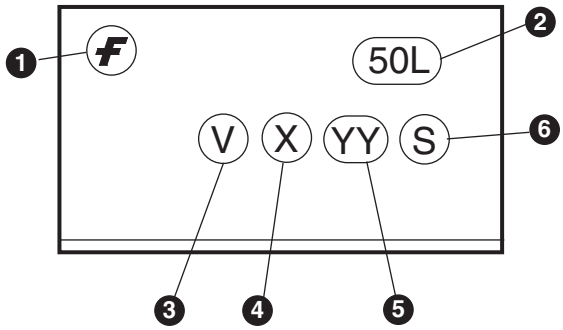
Option	Order Entry Identifier	Description
No Suffix	FOD250L	Through Hole (DIP package only)
	FOD050L	Surface Mount Lead Form (SOIC-8 package only)
S	FOD250LS	Surface Mount Lead Bend (DIP package only)
SD	FOD250LSD	Surface Mount; Tape and reel (DIP package only)
SV	Pending Approval	Surface Mount; VDE0884 (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

DIP



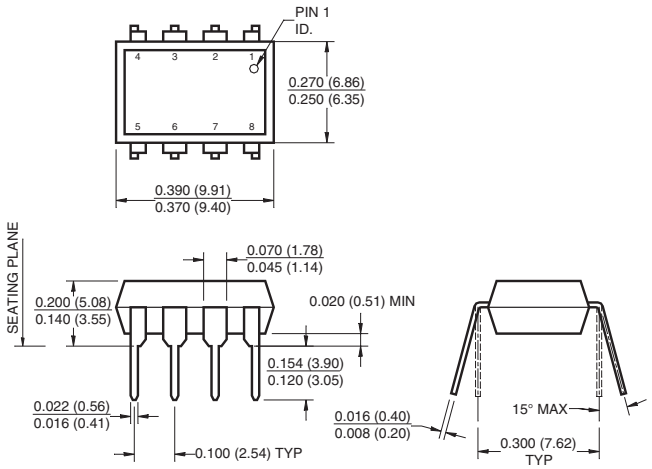
SOIC



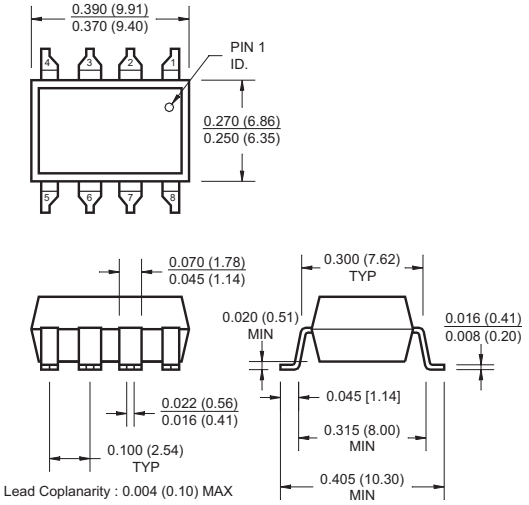
Definitions	
1	Fairchild logo
2	Device number
3	VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table)
4 (DIP)	Two digit year code, e.g., ‘03’
4 (SOIC)	One digit year code, e.g., ‘3’
5	Two digit work week ranging from ‘01’ to ‘53’
6	Assembly package code

Package Dimensions (8-Pin DIP)

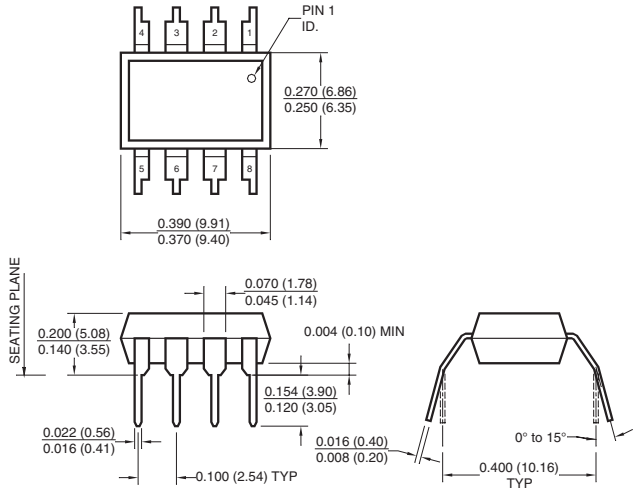
Through Hole



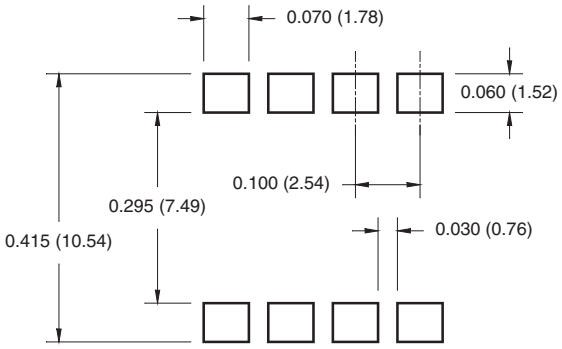
Surface Mount



0.4" Lead Spacing



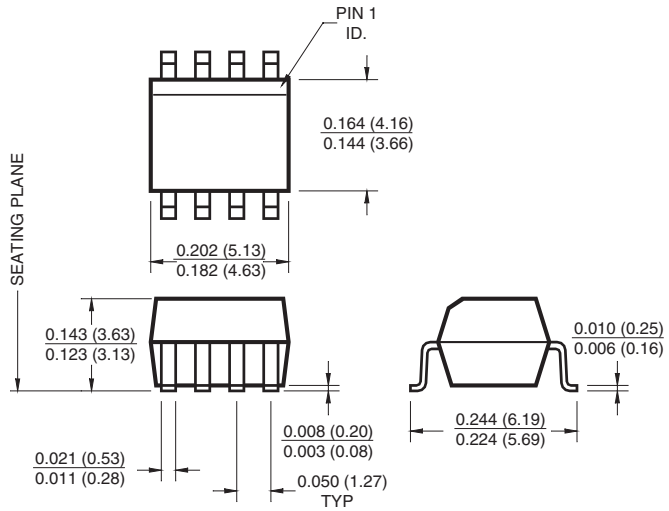
8-Pin DIP



Note:
All dimensions are in inches (millimeters)

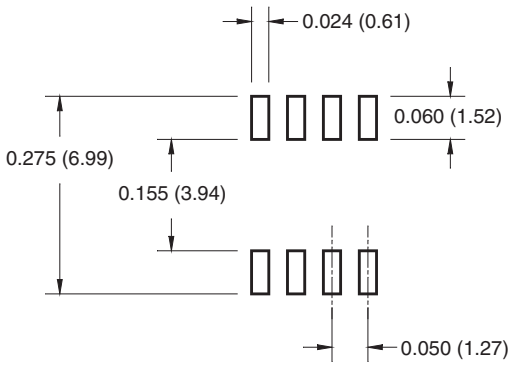
Package Dimensions (8-Pin SOIC)

Surface Mount



Lead Coplanarity : 0.004 (0.10) MAX

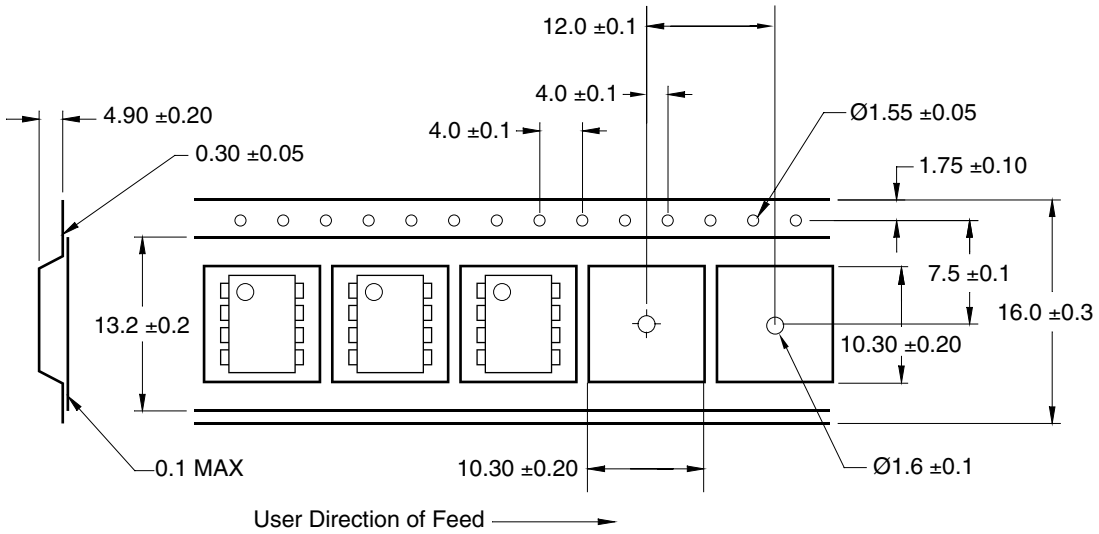
8-Pin Small Outline



Note:
All dimensions are in inches (millimeters)

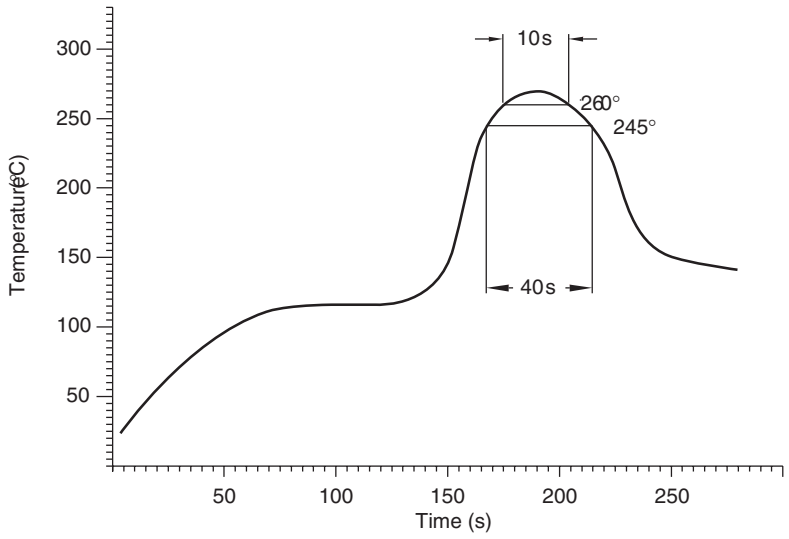
8-Pin DIP (FOD250L)

Carrier Tape Specification



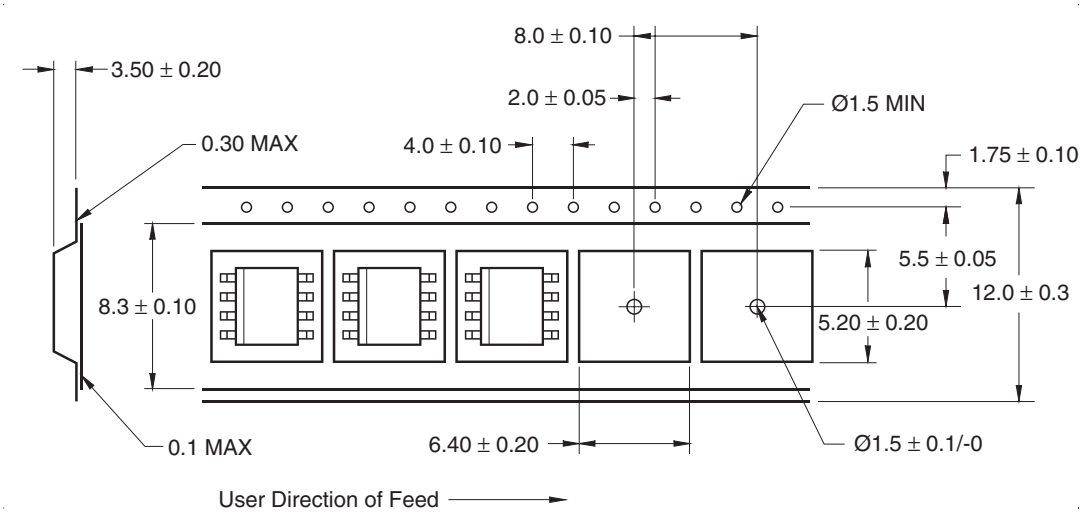
Reflow Profile

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

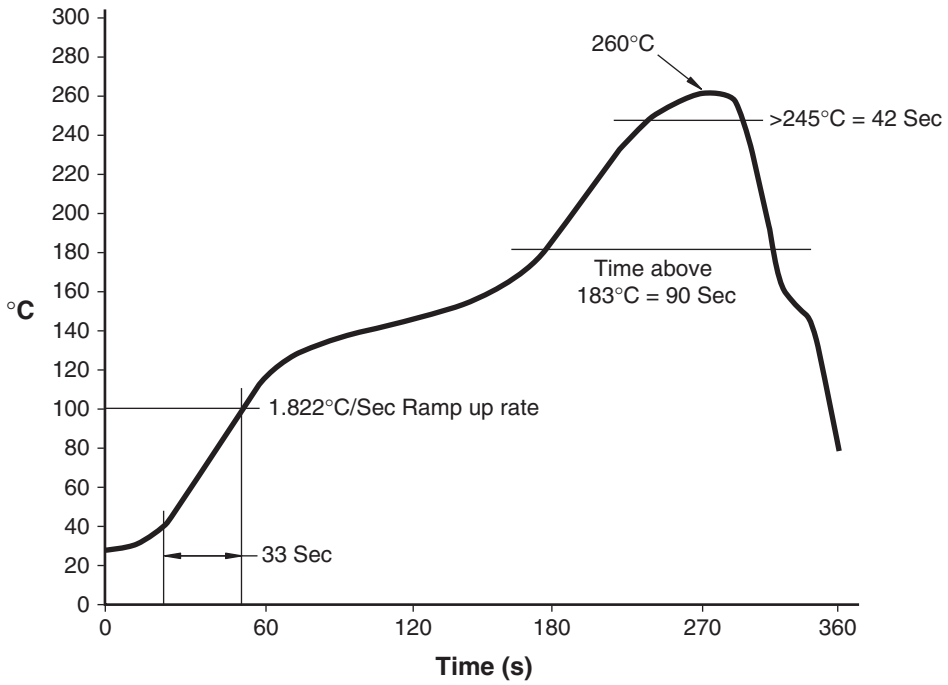


8-Pin SOIC (FOD050L, FOD053L)

Carrier Tape Specification



Reflow Profile



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CROSSVOLT™	*i-Lo*™	POP™	SuperSOT™-3	
DOME™	ImpliedDisconnect™	Power247™	SuperSOT™-6	
EcoSPARK™	IntelliMAX™	PowerEdge™	SuperSOT™-8	
E^2CMOS™	ISOPLANAR™	PowerSaver™	SyncFET™	
EnSigna™	LittleFET™	PowerTrench®	TCM™	
FACT™	MICROCOUPLER™	QFET®	TinyBoost™	
FAST®	MicroFET™	QS™	TinyBuck™	
FASTr™	MicroPak™	QT Optoelectronics™	TinyPWM™	
FPS™	MICROWIRE™	Quiet Series™	TinyPower™	
FRFET™	MSX™	RapidConfigure™	TinyLogic®	
	MSXPro™	RapidConnect™	TINYOPTO™	
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The Power Franchise®		ScalarPump™	UHC™	
Programmable Active Droop™				

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and 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	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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