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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

April 2015

FOD050L, FOD053L
LVTTL/LVCMOS 3.3 V High Speed Transistor Optocouplers

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 = 50kV/µs (typical) and CM_L = 35kV/µs (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: LVTTL/LVCMOS
- Wide Bandwidth Analog Coupling

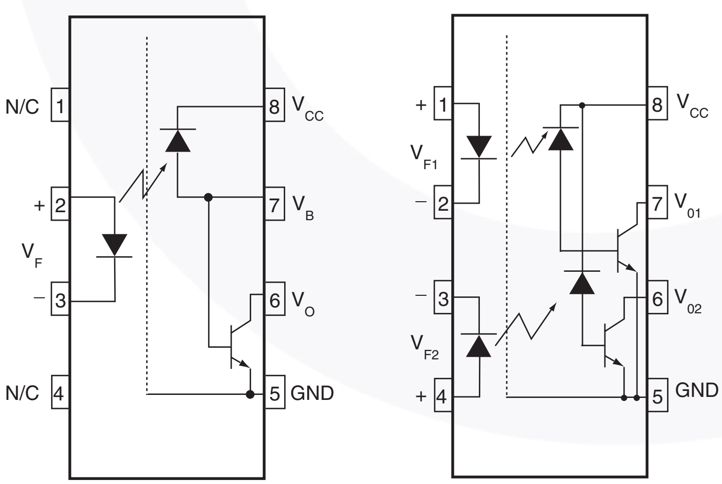
Description

The FOD050L and FOD053L optocouplers consist of an AlGaAs LED optically coupled to a high speed photo-detector transistor. These devices are specified for operation at a 3.3 V 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 = 50 kV/µs (typical) and CM_L = 35 kV/µs (typical).

Schematics



FOD050L

FOD053L

Figure 1. Schematics

Package Outline

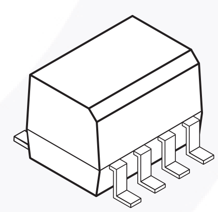


Figure 2. Package Outline

Truth Table

LED	V_O
On	LOW
Off	HIGH

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 Classifications 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} x 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} x 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(1)	150	°C
$I_{S,INPUT}$	Input Current(1)	200	mA
$P_{S,OUTPUT}$	Output Power(1)	300	mW
R_{IO}	Insulation Resistance at T_S, V_{IO} = 500 V(1)	> 10^9	Ω

Note:
1. Safety limit values – maximum values allowed in the event of a failure.

Absolute Maximum Ratings

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. 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

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

Transfer Characteristics

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

Note:

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%.

Electrical Characteristics (Continued)

T_A = 0 to 70°C unless otherwise specified.

Switching Characteristics (V_{CC} = 3.3 V)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic LOW	R_L = 1.9 kΩ, I_F = 16 mA(3) (Figure 11)	25°C			1.0	µs
						2.0	
T_{PLH}	Propagation Delay Time to Logic HIGH	R_L = 1.9 kΩ, I_F = 16 mA(3) (Figure 11)	25°C			1.0	µs
						2.0	
$\|CM_H\|$	Common Mode Transient Immunity at Logic HIGH	I_F = 0 mA, V_{CM} = 1,000 V_{P-P}, R_L = 4.1 kΩ, T_A = 25°C(4)(5) (Figure 12)		5,000	50,000		V/µs
		I_F = 0 mA, V_{CM} = 1,000 V_{P-P}, T_A = 25°C, R_L = 1.9 kΩ(3)(5) (Figure 12)		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 = 4.1 kΩ, T_A = 25°C(4)(5) (Figure 12)		5,000	35,000		V/µs
		I_F = 16 mA, V_{CM} = 1,000 V_{P-P}, R_L = 1.9 kΩ(3)(5) (Figure 12)		5,000	35,000		V/µs

Isolation Characteristics

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

Notes:

3. The 1.9 kΩ load represents 1 TTL unit load of 1.6 mA and 5.6 kΩ pull-up resistor.
4. The 4.1 kΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1 kΩ 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 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 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.

Typical Performance Curves

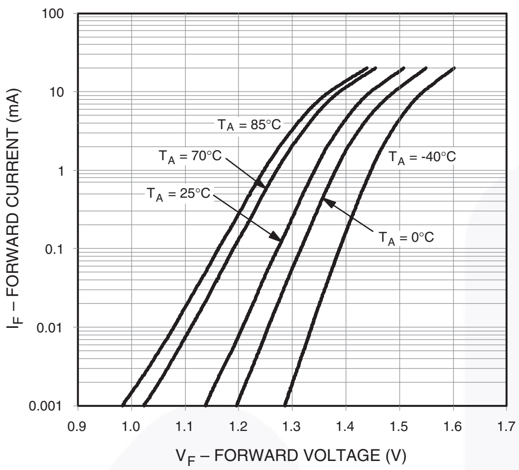


Figure 3. LED Forward Current vs. Forward Voltage

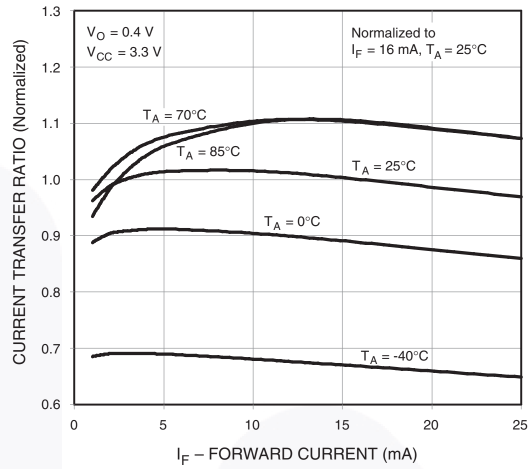


Figure 4. Current Transfer Ratio vs. Forward Current

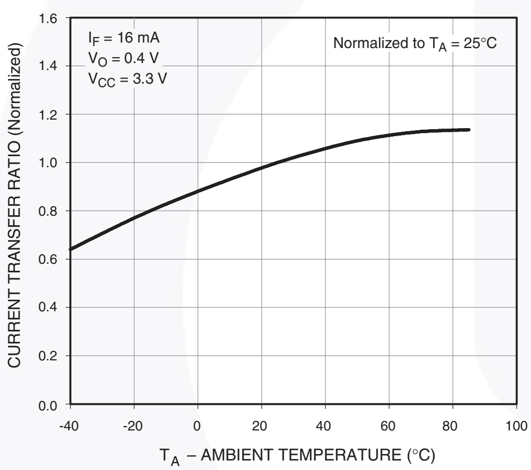


Figure 5. Current Transfer Ratio vs. Ambient Temperature

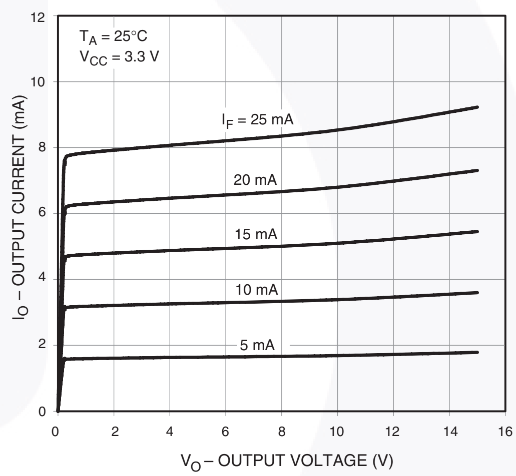


Figure 6. Output Current vs. Output Voltage

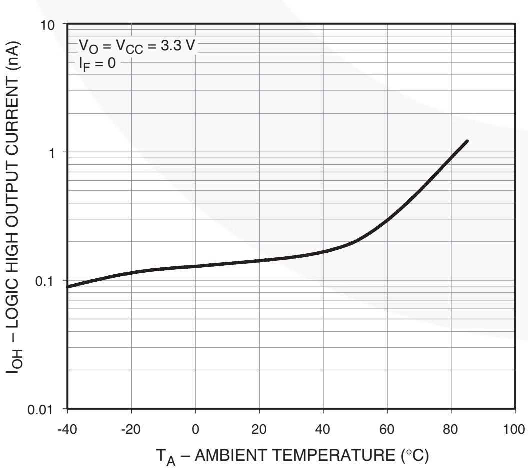


Figure 7. Logic High Output Current vs. Ambient Temperature

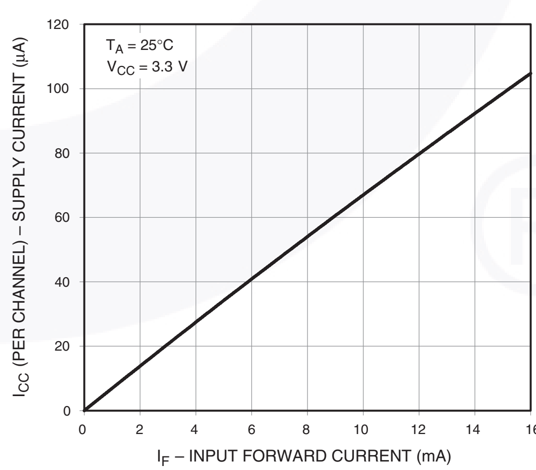


Figure 8. Supply Current vs. Input Forward Current

Typical Performance Curves (Continued)

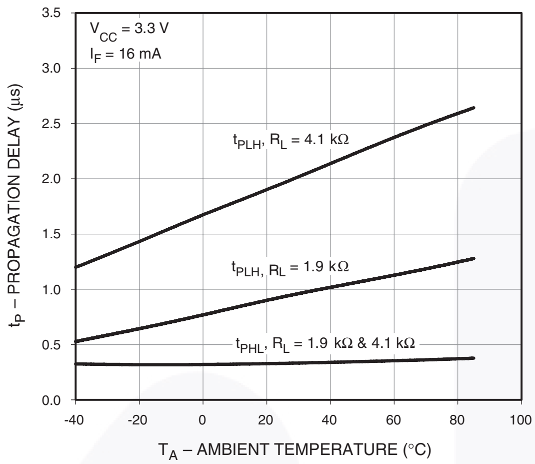


Figure 9. Propagation Delay vs. Ambient Temperature

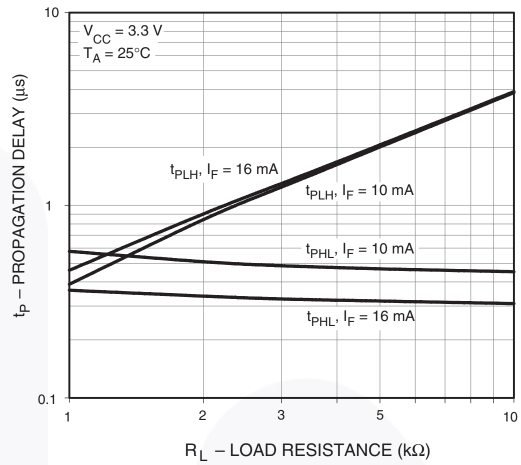
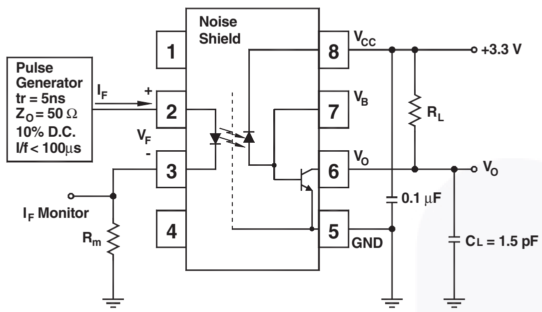
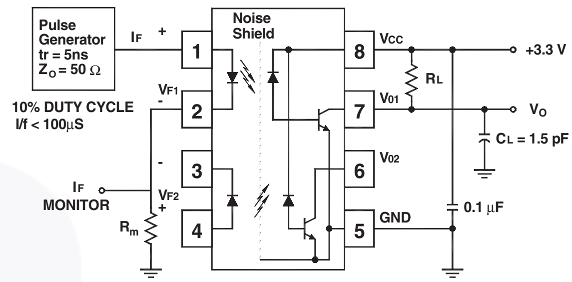


Figure 10. Propagation Delay vs. Load Resistance

Test Circuits



Test Circuit for FOD050L



Test Circuit for FOD053L

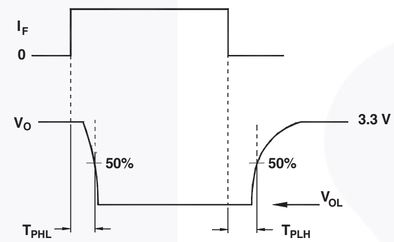
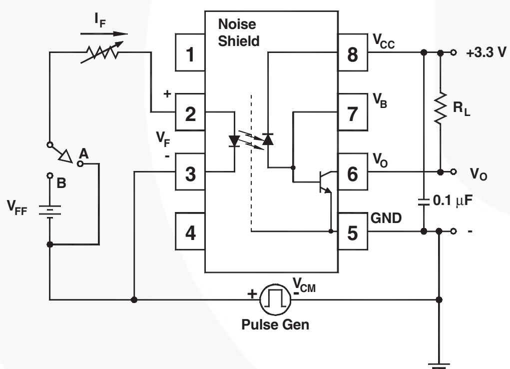
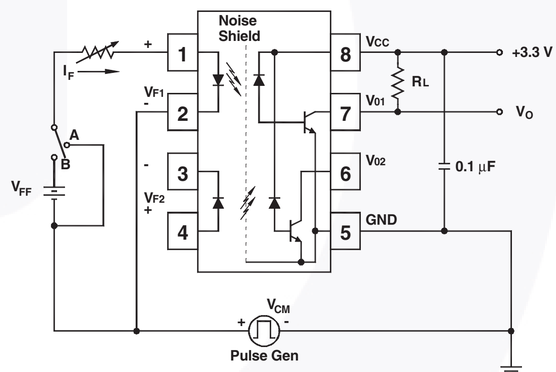


Figure 11. Switching Time Test Circuit



Test Circuit for FOD050L



Test Circuit for FOD053L

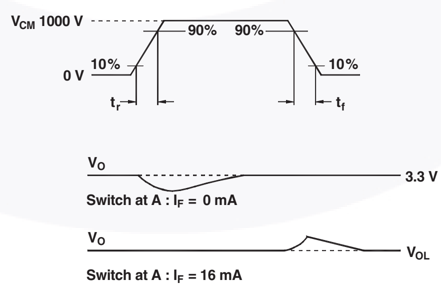


Figure 12. Common Mode Immunity Test Circuit

Reflow Profile

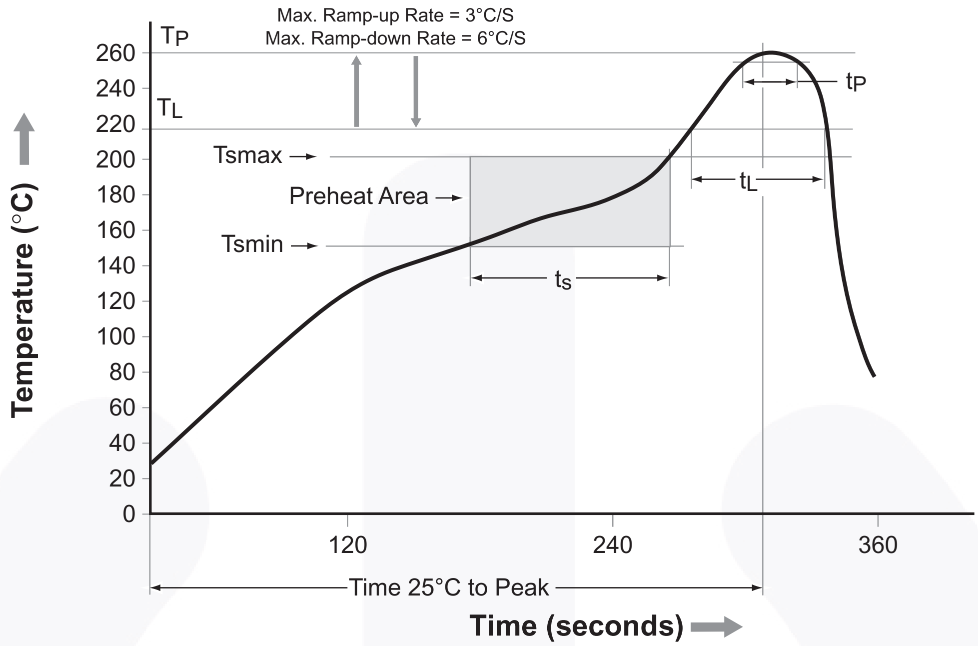


Figure 13. Reflow Profile

Profile Freature	Pb-Free Assembly Profile
Temperature Minimum (Tsmin)	150°C
Temperature Maximum (Tsmax)	200°C
Time (t_S) from (Tsmin to Tsmax)	60–120 seconds
Ramp-up Rate (t_L to t_P)	3°C/second maximum
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 maximum
Time 25°C to Peak Temperature	8 minutes maximum

Ordering Information

Part Number	Package	Packing Method
FOD050L	Small Outline 8-Pin	Tube (100 Units)
FOD050LR2	Small Outline 8-Pin	Tape and Reel (1000 Units)
FOD050LV	Small Outline 8-Pin, DIN EN/IEC60747-5-5 Option	Tube (100 Units)
FOD050LR2V	Small Outline 8-Pin, DIN EN/IEC60747-5-5 Option	Tape and Reel (1000 Units)

Note:

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

Marking Information

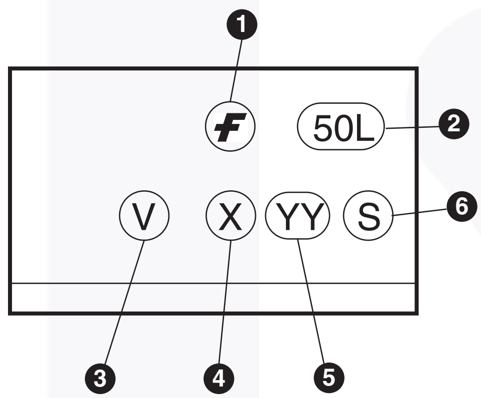
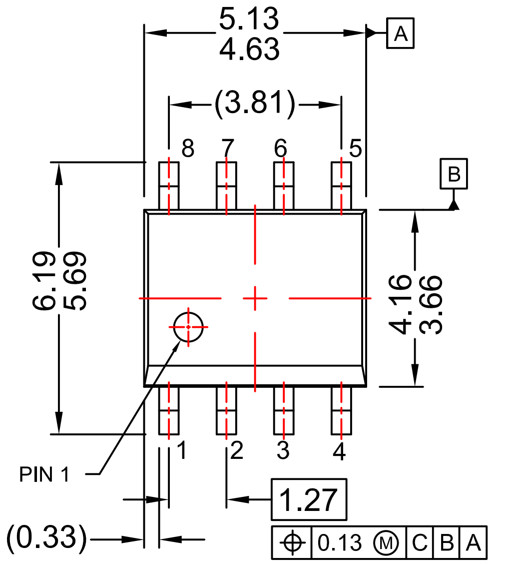
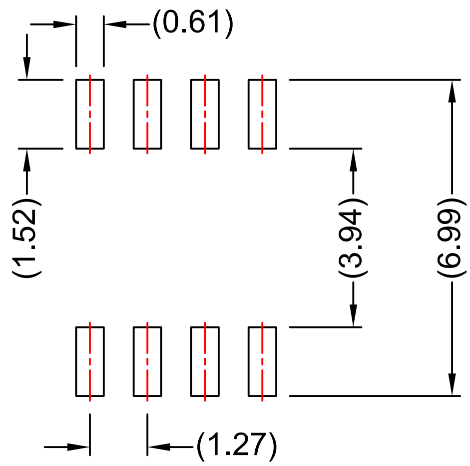


Figure 14. Top Mark

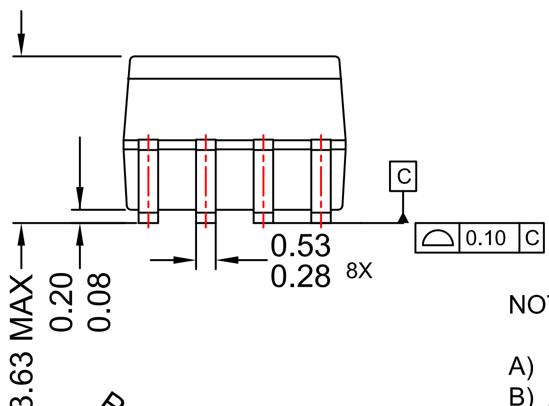
Table 1. Top Mark Definitions

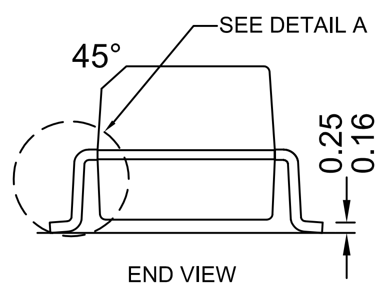
1	Fairchild Logo
2	Device Number
3	DIN EN/IEC60747-5-5 Option (only appears on component ordered with this option)
4	One-Digit Year Code, e.g., “5”
5	Digit Work Week, Ranging from “01” to “53”
6	Assembly Package Code





LAND PATTERN RECOMMENDATION

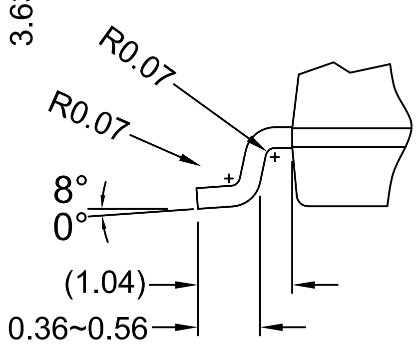




END VIEW

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.
E) DRAWING FILENAME: MKT-M08Erev5



DETAIL A
SCALE: 2:1

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