



April 2015



FOD050L, FOD053L LVTTTL/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 – $CM_H = 50\text{ kV}/\mu\text{s}$ (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

Description

The FOD050L and FOD053L optocouplers consist of an AlGaAs LED optically coupled to a high speed photodiode 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 $CM_H = 50\text{ kV}/\mu\text{s}$ (typical) and $CM_L = 35\text{ kV}/\mu\text{s}$ (typical).

Schematics

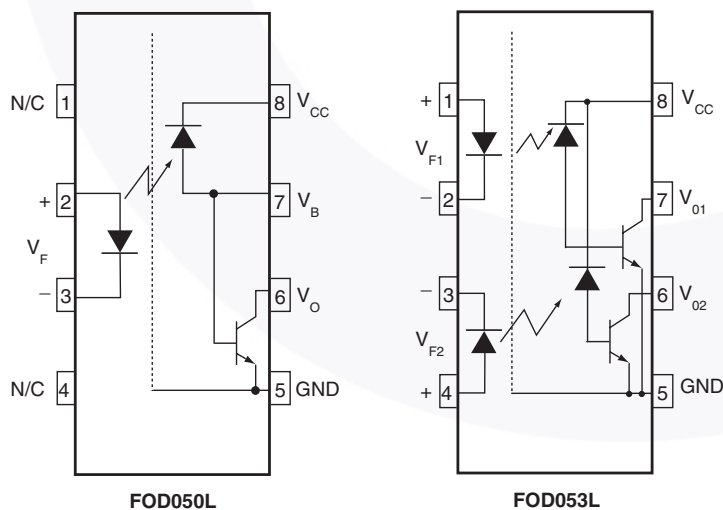


Figure 1. Schematics

Package Outline

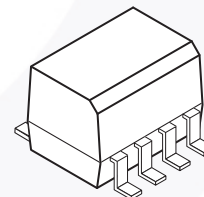


Figure 2. Package Outline

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} × 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 ⁽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. $T_A = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter		Value	Unit
T_{STG}	Storage Temperature		-40 to +125	$^\circ\text{C}$
T_{OPR}	Operating Temperature		-40 to +85	$^\circ\text{C}$
T_J	Junction Temperature		-40 to +125	$^\circ\text{C}$
T_{SOL}	Lead Solder Temperature		260 for 10 seconds	$^\circ\text{C}$
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 ($\leq 1 \mu\text{s}$ 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	$I_F = 16\text{ mA}, T_A = 25^\circ\text{C}$	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	$I_F = 0\text{ mA}, V_O = V_{CC} = 3.3\text{ V}, T_A = 25^\circ\text{C}$	All		0.001	1	μA
I_{CCL}	Logic Low Supply Current	$I_F = 16\text{ mA}, V_O = \text{Open}, V_{CC} = 3.3\text{ V}$	FOD050L			200	μA
		$I_{F1} = I_{F2} = 16\text{ mA}, V_O = \text{Open}, V_{CC} = 3.3\text{ V}$	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			0.3	μA
		$I_F = 0\text{ mA}, V_O = \text{Open}, V_{CC} = 3.3\text{ V}$	FOD053L			10	

Transfer Characteristics

Symbol	Parameter	Test Conditions	Device	Min.	Typ.	Max.	Unit
COUPLED							
CTR	Current Transfer Ratio ⁽²⁾	$I_F = 16\text{ mA}, V_O = 0.4\text{ V}, V_{CC} = 3.3\text{ V}, T_A = 25^\circ\text{C}$	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

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°C unless otherwise specified.**Switching Characteristics** ($V_{CC} = 3.3\text{ V}$)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
T_{PHL}	Propagation Delay Time to Logic LOW	$R_L = 1.9\text{ k}\Omega$, $I_F = 16\text{ mA}^{(3)}$ (Figure 11)	25°C		1.0	μs
					2.0	
T_{PLH}	Propagation Delay Time to Logic HIGH	$R_L = 1.9\text{ k}\Omega$, $I_F = 16\text{ mA}^{(3)}$ (Figure 11)	25°C		1.0	μs
					2.0	
ICM_{HI}	Common Mode Transient Immunity at Logic HIGH	$I_F = 0\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 4.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}^{(4)(5)}$ (Figure 12)	5,000	50,000		$\text{V}/\mu\text{s}$
ICM_{LI}	Common Mode Transient Immunity at Logic LOW	$I_F = 16\text{ mA}$, $V_{CM} = 1,000\text{ V}_{P-P}$, $R_L = 4.1\text{ k}\Omega$, $T_A = 25^\circ\text{C}^{(4)(5)}$ (Figure 12)	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%, $T_A = 25^\circ\text{C}$, $t = 5\text{ s}$, $V_{I-O} = 3000\text{ VDC}^{(6)}$			1.0	μA
V_{ISO}	Withstand Insulation Test Voltage	$f = 60\text{ Hz}$, $T_A = 25^\circ\text{C}$, $t = 60\text{ s}^{(6)}$	2500			V_{RMS}
R_{I-O}	Resistance (Input to Output)	$V_{I-O} = 500\text{ VDC}^{(6)}$	10^{11}	10^{12}		Ω
C_{I-O}	Capacitance (Input to Output)	$f = 1\text{ MHz}^{(6)}$		0.2		pF

Notes:

- 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.
- 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.
- 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

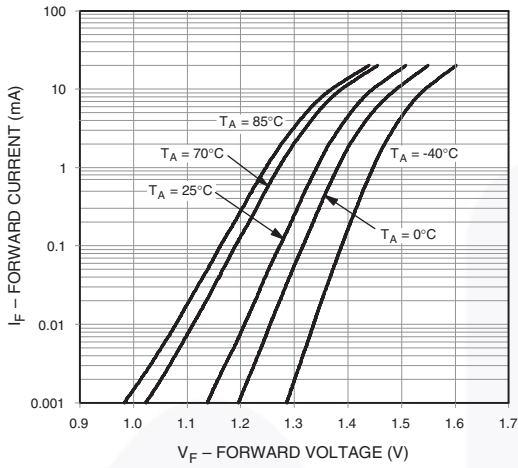


Figure 3. LED Forward Current vs. Forward Voltage

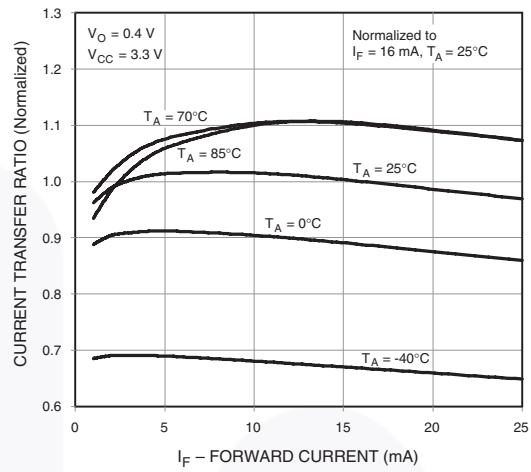


Figure 4. Current Transfer Ratio vs. Forward Current

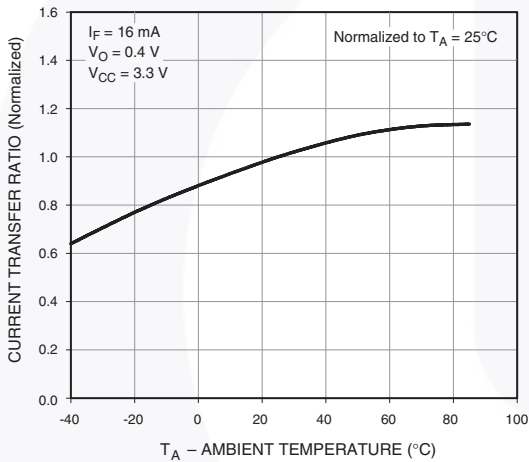


Figure 5. Current Transfer Ratio vs. Ambient Temperature

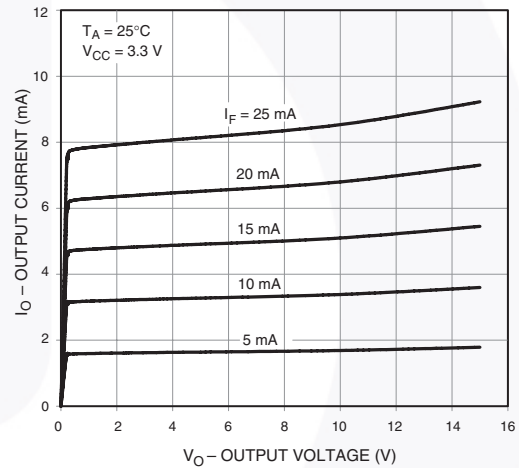


Figure 6. Output Current vs. Output Voltage

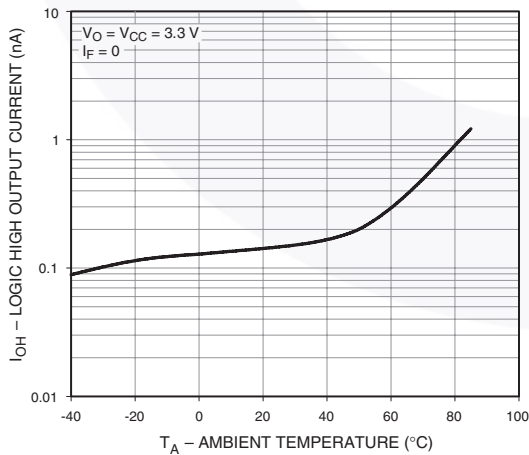


Figure 7. Logic High Output Current vs. Ambient Temperature

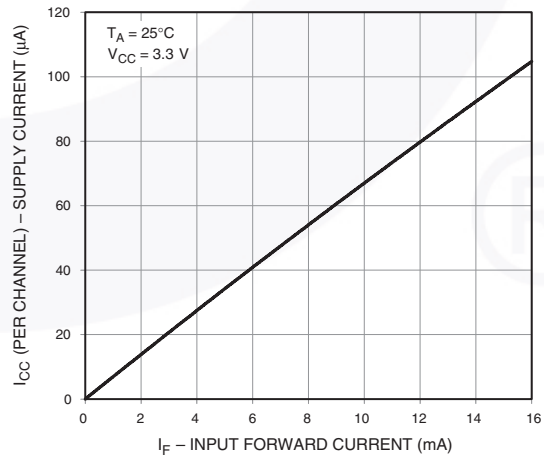


Figure 8. Supply Current vs. Input Forward Current

Typical Performance Curves (Continued)

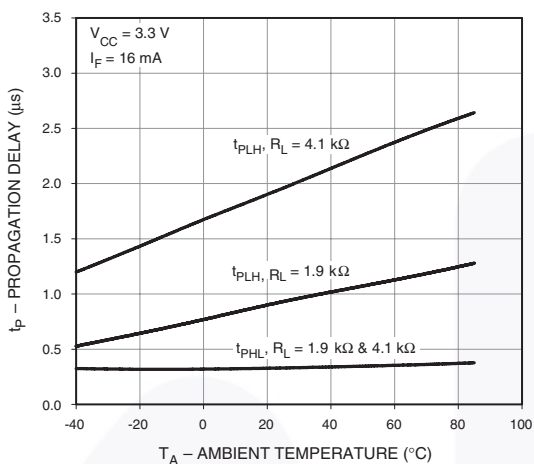


Figure 9. Propagation Delay vs. Ambient Temperature

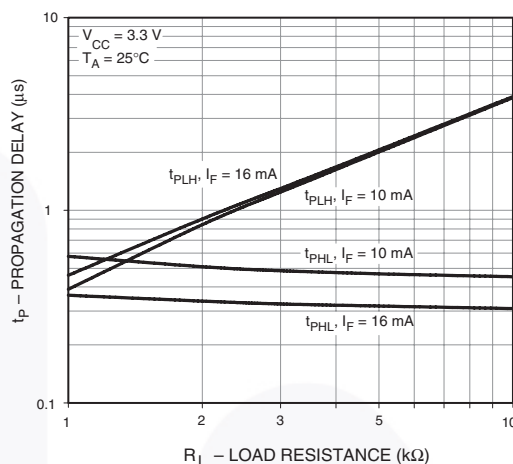


Figure 10. Propagation Delay vs. Load Resistance

Test Circuits

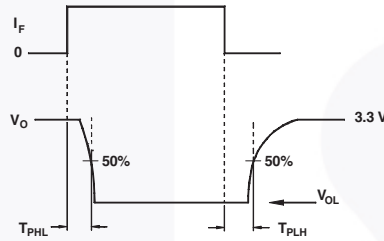
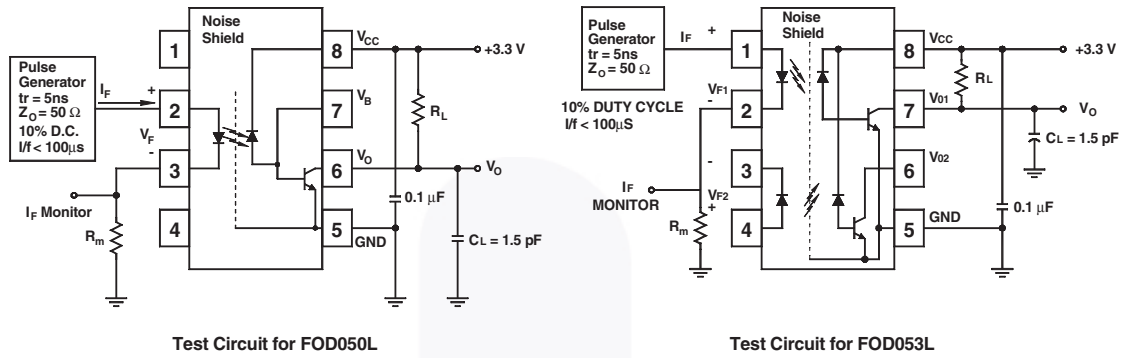


Figure 11. Switching Time Test Circuit

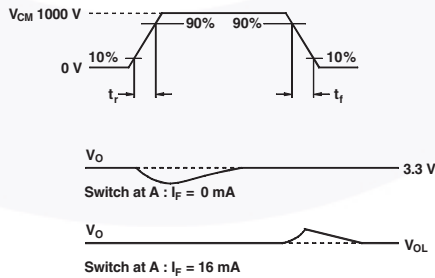
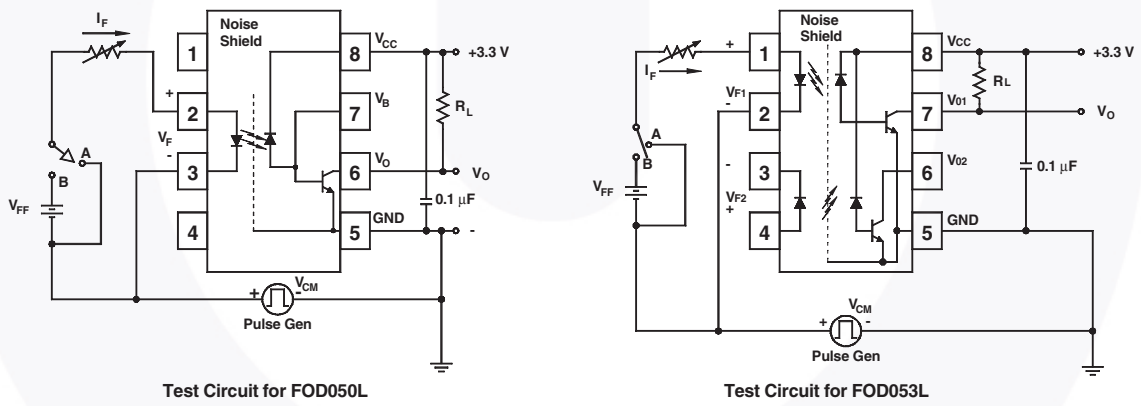


Figure 12. Common Mode Immunity Test Circuit

Reflow Profile

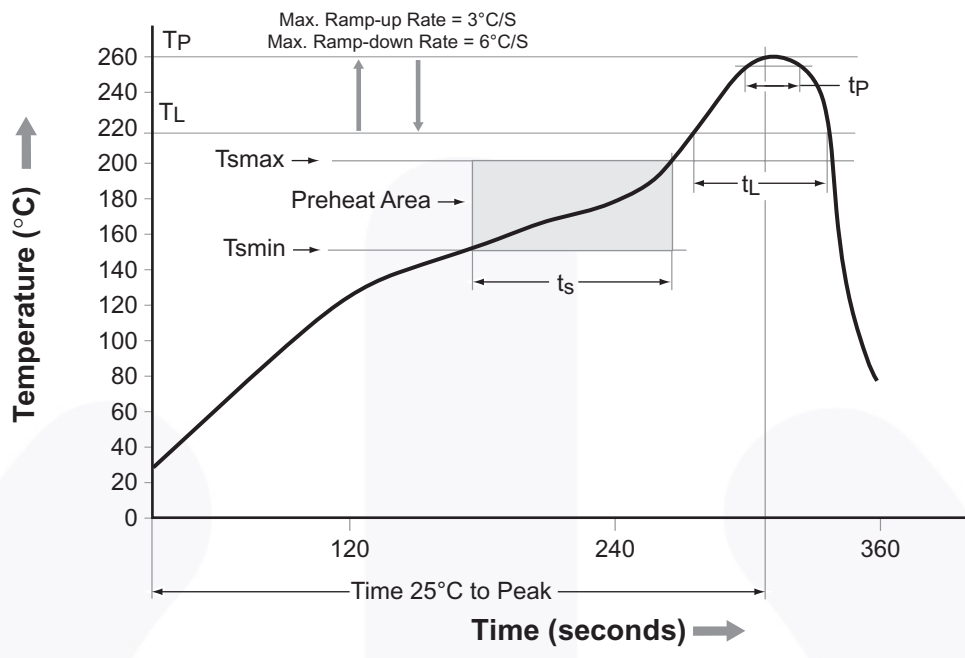


Figure 13. Reflow Profile

Profile Feature	Pb-Free Assembly Profile
Temperature Minimum (T _{min})	150°C
Temperature Maximum (T _{max})	200°C
Time (t _s) from (T _{min} to T _{max})	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

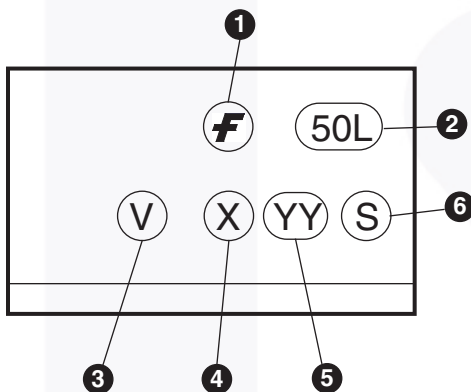


Figure 14. Top Mark

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



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





TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- AccuPower™
- AttitudeEngine™
- Awinda®
- AX-CAP®*
- BitSiC™
- Build it Now™
- CorePLUS™
- CorePOWER™
- CROSSVOL™
- CTL™
- Current Transfer Logic™
- DEUXPEED®
- Dual Cool™
- EcoSPARK®
- EfficientMax™
- ESBC™
- F**™
- Fairchild®
- Fairchild Semiconductor®
- FACT Quiet Series™
- FACT®
- FastvCore™
- FETBench™
- FPS™
- F-PFS™
- FRFET®
- Global Power ResourceSM
- GreenBridge™
- Green FPS™
- Green FPS™ e-Series™
- Gmax™
- GTO™
- IntelliMAX™
- ISOPLANAR™
- Making Small Speakers Sound Louder and Better™
- MegaBuck™
- MICROCOUPLER™
- MicroFET™
- MicroPak™
- MicroPak2™
- MillerDrive™
- MotionMax™
- MotionGrid®
- MTi®
- MTx®
- MVN®
- mWSaver®
- OptoHiT™
- OPTOLOGIC®
- OPTOPLANAR®
- ®
- Power Supply WebDesigner™
- PowerTrench®
- PowerXS™
- Programmable Active Droop™
- QFET®
- QS™
- Quiet Series™
- RapidConfigure™
- ™
- Saving our world, 1mW/W/kW at a time™
- SignalWise™
- SmartMax™
- SMART START™
- Solutions for Your Success™
- SPM®
- STEALTH™
- SuperFET®
- SuperSOT™-3
- SuperSOT™-6
- SuperSOT™-8
- SupreMOS®
- SyncFET™
- Sync-Lock™
- ®
- TinyBoost®
- TinyBuck®
- TinyCalc™
- TinyLogic®
- TINYOPTO™
- TinyPower™
- TinyPWM™
- TinyWire™
- TranSiC™
- TriFault Detect™
- TRUECURRENT®*
- μSerDes™
- ™
- UHC®
- Ultra FRFET™
- UniFET™
- VcX™
- VisualMax™
- VoltagePlus™
- XS™
- Xsens™
- 仙童®

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. TO OBTAIN THE LATEST, MOST UP-TO-DATE DATASHEET AND PRODUCT INFORMATION, VISIT OUR WEBSITE AT [HTTP://WWW.FAIRCHILDSEMI.COM](http://www.fairchildsemi.com). FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

AUTHORIZED USE

Unless otherwise specified in this data sheet, this product is a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability. This product may not be used in the following applications, unless specifically approved in writing by a Fairchild officer: (1) automotive or other transportation, (2) military/aerospace, (3) any safety critical application – including life critical medical equipment – where the failure of the Fairchild product reasonably would be expected to result in personal injury, death or property damage. Customer's use of this product is subject to agreement of this Authorized Use policy. In the event of an unauthorized use of Fairchild's product, Fairchild accepts no liability in the event of product failure. In other respects, this product shall be subject to Fairchild's Worldwide Terms and Conditions of Sale, unless a separate agreement has been signed by both Parties.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Terms of Use

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

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.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I77