



October 2006

FSHDMI04

Wide-Bandwidth Differential Signaling HDMI Switch

Features

- 1.65 Gbps throughput
- 8kV ESD protection
- -26dB non-adjacent channel crosstalk at 825MHz
- Isolation ground between channels
- Low skew
 - Inter-pair skew <150ps
 - Intra-pair skew <90ps
- Fast turn on/off time
- Low power consumption (1μA maximum)
- Control input: TTL compatible

Applications

- UXGA and 1080p DVI and HDMI video source selection

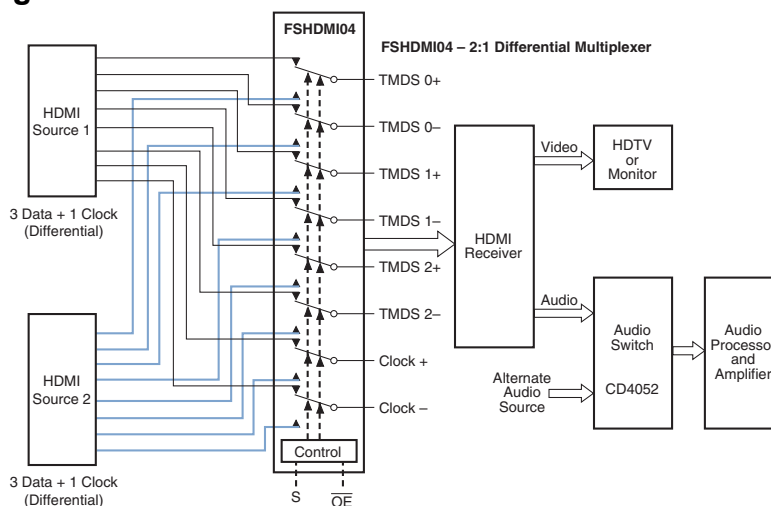
General Description

The FSHDMI04 is a wide bandwidth switch for routing HDMI Link Data and Clock signals. This device supports data rates up to 1.65Gbps per channel for UXGA resolution. It can also be used to switch TMDS-based DVI digital video streams. Possible applications include LCD TV, DVD, Set-Top Box, notebook computers and other designs with multiple digital video interfaces. The FSHDMI04 switch allows the passage of HDMI link signals with low non-adjacent channel crosstalk and superior OFF-Isolation. This performance is critical to minimize ghost images between active video sources in video applications. The wide bandwidth of this switch allows the high speed differential signal to pass through the switch with minimal additive skew and phase jitter.

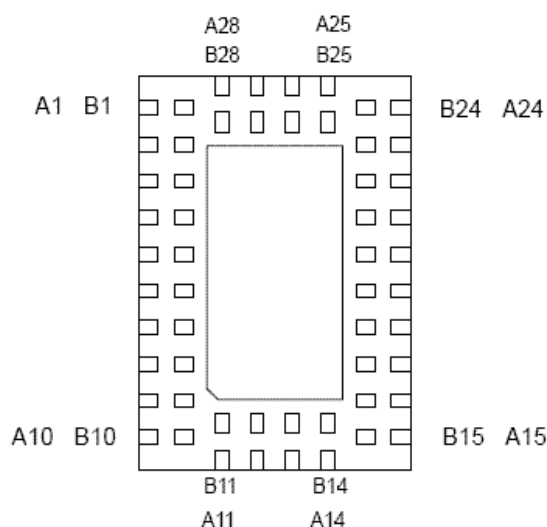
Ordering Information

Order Number	Package Number	Package Description
FSHDMI04QSPX	MQA48A	48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150inches Wide
FSHDMI04MTDX	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
FSHDMI04BQX (Preliminary)	MLP56	56-Lead Molded Leadless Package (MLP), 5x7mm Wide

Applications Diagram



Pin Assignments



Pin	Function	Pin	Function	Pin	Function
A1	NC	A21	C1-	B13	NC
A2	2C0-	A22	C1+	B14	C3-
A3	1C1+	A23	VCC	B15	GND
A4	1C1-	A24	NC	B16	C3+
A5	2C1-	A25	GND	B17	VCC
A6	GND	A26	VCC	B18	GND
A7	1C2+	A27	Vcc	B19	NC
A8	1C2-	A28	GND	B20	NC
A9	GND	B1	2C0+	B21	GND
A10	NC	B2	1C0-	B22	GND
A11	2C3-	B3	GND	B23	C0-
A12	GND	B4	2C1+	B24	GND
A13	VCC	B5	NC	B25	C0+
A14	GND	B6	NC	B26	NC
A15	NC	B7	2C2+	B27	NC
A16	GND	B8	2C2-	B28	1C0+
A17	C2-	B9	1C3+		
A18	C2+	B10	2C3+		
A19	OE	B11	1C3-		
A20	S	B12	NC		

Figure 1. MLP Pin Assignments

Pin Assignments

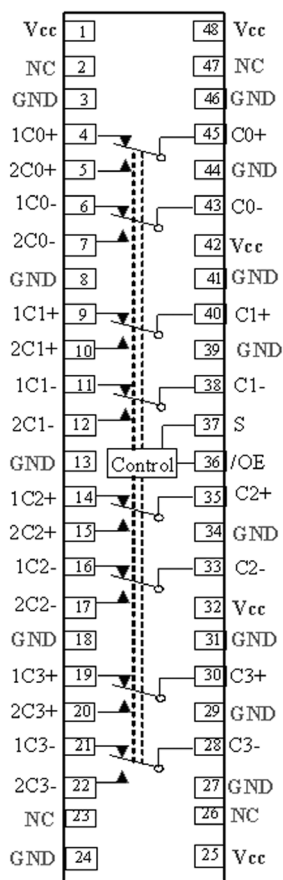


Figure 2. QVSOP and TSSOP Pin Assignments

Truth Table

S	$\overline{\text{OE}}$	Function
X	H	Disconnected
L	L	$1C_n = C_n$
H	L	$2C_n = C_n$

Pin Descriptions

Pin Name	Description
$\overline{\text{OE}}$	Bus Switch Enable
S	Select Input
$1C_n, 2C_n, C0_n, C1_n, C2_n, C3_n$	Data Ports

Absolute Maximum Ratings

The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table defines the conditions for actual device operation.

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	-0.5V to +4.6V
V_S	DC Switch Voltage	-0.5V to $V_{CC} + 0.05$
V_{IN}	DC Input Voltage ⁽¹⁾	-0.5V to +4.6V
I_{IK}	DC Input Diode Current	-50 mA
I_{OUT}	DC Output Sink Current	128 mA
T_{STG}	Storage Temperature Range	-65°C to +150°C
	ESD, Human Body Model	8,000V

Recommended Operating Conditions⁽²⁾

Symbol	Parameter	Rating
V_{CC}	Power Supply Operating	3.0V to 3.6V
V_{IN}	Control Input Voltage	0V to V_{CC}
	Switch Input Voltage	0V to V_{CC}
T_A	Operating Temperature	-40°C to 85°C

DC Electrical Characteristics

All typical values are for $V_{CC} = 3.3V$ @ 25°C unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$			Units
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage	$I_{IN} = -18\text{mA}$	3.0			-1.2	V
V_{IH}	Input Voltage HIGH		3.0–3.6	2.0			V
V_{IL}	Input Voltage LOW		3.0–3.6			0.8	V
I_{IN}	Control Input Leakage	$V_{IN} = 0$ to V_{CC}	3.6			± 1.0	μA
I_{OZ}	OFF-STATE Leakage	$0 \leq nC_n, C_n \leq V_{CC}$	3.6			± 1.0	μA
R_{ON}	Switch On Resistance ⁽³⁾	$V_{IN} = V_{CC} - 0.6$ to V_{CC} , $I_{ON} = 10\text{mA}$	3.0		12.0	19.0	Ω
$R_{ON(FLAT)}$	Switch On Resistance Flatness ⁽⁴⁾	$V_{IN} = V_{CC} - 0.6$ to V_{CC} , $I_{ON} = 10\text{mA}$	3.0		1.0		Ω
I_{CC}	Quiescent Supply Current	$V_{IN} = 0$ or V_{CC} , $I_{OUT} = 0$	3.6			1.0	μA

Notes:

1. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.
2. Unused control inputs must be held HIGH or LOW. They may not float.
3. Measured by the voltage drop between A and B pins at the indicated current through the switch. On resistance is determined by the lower of the voltages on the two (A or B) pins.
4. Flatness is defined as the difference between the maximum and minimum value on resistance over the specified range of conditions.

AC Electrical Characteristics

All typical values are for $V_{CC} = 3.3V$ @ $25^{\circ}C$ unless otherwise specified.

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^{\circ}C$ to $+85^{\circ}C$			Units	Figure Number
				Min.	Typ.	Max.		
t_{ON}	Turn ON Time S, \overline{OE} -to-Output	$V_{IN} = V_{CC} - 0.5$, $R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6		4.0	6.0	ns	Figure 7 Figure 8
t_{OFF}	Turn OFF Time S, \overline{OE} -to-Output	$V_{IN} = V_{CC} - 0.5$, $R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6		2.0	4.0	ns	Figure 7 Figure 8
t_{BBM}	Break-Before-Make Time	$V_{IN} = V_{CC} - 0.5$, $R_{PU} = 20\Omega$, $C_L = 5pF$	3.0 to 3.6		3.0			Figure 14
t_{PD} (t_{PLH} , t_{PHL})	Switch Propagation Delay	$R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6			250	ps	Figure 7 Figure 13
T_{JITTER}	Total Jitter (DJ + RJ)	$f = 165MHz$ Clock with 50% Duty Cycle, $R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6		55.0		ps	Figure 7
T_{RATIO}	Duty Cycle Ratio				50.0		%	
T_{SK1}	Intra-Pair Skew C_{n+} to C_{n-} ⁽⁵⁾	$f = 1.65Gbps$, $2^{23}-1$ PRBS $R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6		55.0	90.0	ps	Figure 7 Figure 13
T_{SK2}	Inter-Pair Skew ⁽⁵⁾ (Between any two switch paths)	$f = 1.65Gbps$, $2^{23}-1$ PRBS $R_{PU} = 50\Omega$, $C_L = 5pF$	3.0 to 3.6		90.0	150.0	ps	Figure 7 Figure 13
O_{IRR}	OFF-Isolation	$R_T = 50\Omega$, $f = 370MHz$	3.0 to 3.6		-35.0		dB	Figure 9
		$R_T = 50\Omega$, $f = 825MHz$	3.0 to 3.6		-25.0			
Xtalk	Non-Adjacent Channel Crosstalk	$R_T = 50\Omega$, $f = 370MHz$	3.0 to 3.6		-30.0		dB	Figure 10
		$R_T = 50\Omega$, $f = 825MHz$	3.0 to 3.6		-26.0			
f_{MAX}	Maximum Throughput		3.3		1.65		Gbps	

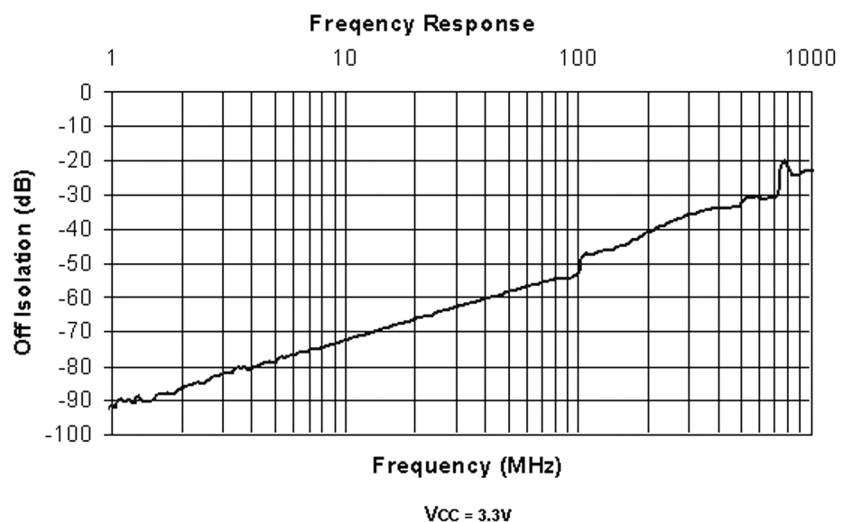
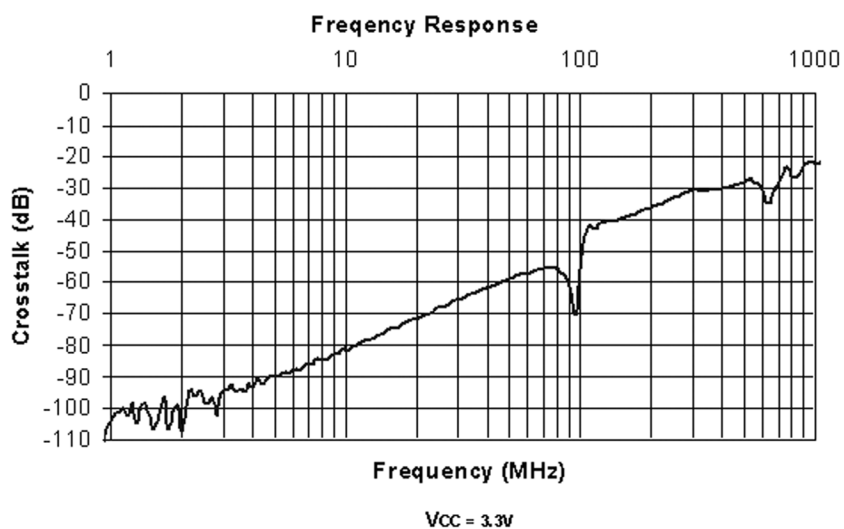
Notes:

5. Guaranteed by characteristics and design.

Capacitance

Symbol	Parameter	Conditions	$T_A = -40^{\circ}C$ to $+85^{\circ}C$			Units
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	$V_{CC} = 0V$		1.1		pF
C_{ON}	n C_n ON Capacitance	$V_{CC} = 3.3V$		6.0		pF
C_{OFF}	Port C_n OFF Capacitance	$V_{CC} = 3.3V$		2.5		pF

Typical Characteristics

Figure 3. Off- Isolation, $V_{CC} = 3.3V$ Figure 4. Crosstalk, $V_{CC} = 3.3V$

Test Diagrams

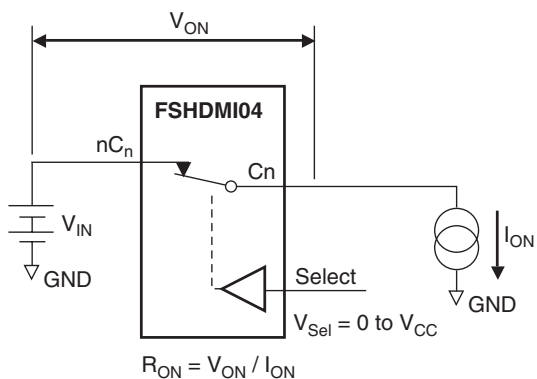


Figure 5. On Resistance

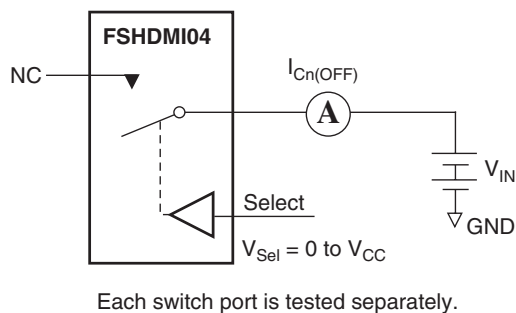
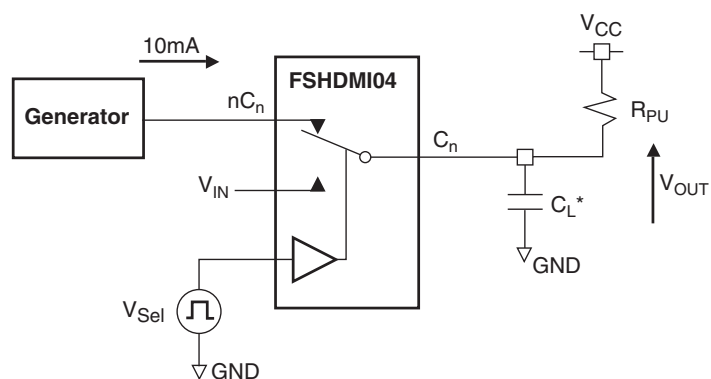


Figure 6. OFF Leakage



R_{PU} and C_L are functions of application environment (see AC/DC Tables for values of C_L and R_{PU})
 $*C_L$ includes fixture and stray capacitance

Figure 7. AC Test Circuit Load

Test Diagrams (Continued)

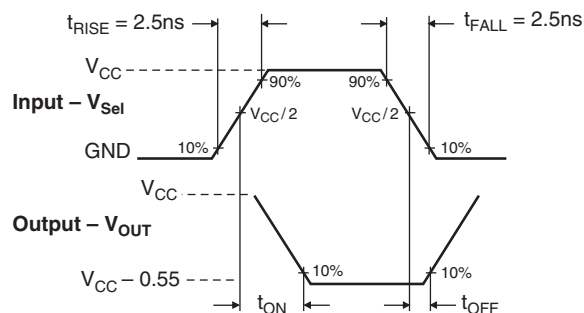
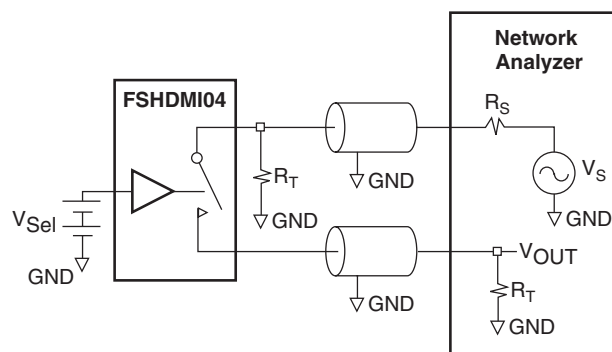


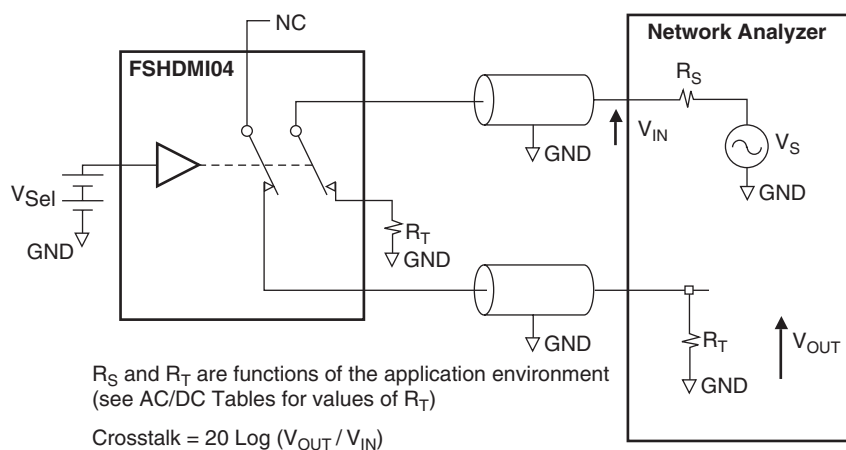
Figure 8. Turn ON / Turn OFF Waveforms



R_S and R_T are functions of the application environment (see AC/DC Tables for values of R_T)

OFF-Isolation = $20 \text{ Log } (V_{OUT} / V_{IN})$

Figure 9. Channel OFF-Isolation



R_S and R_T are functions of the application environment (see AC/DC Tables for values of R_T)

Crosstalk = $20 \text{ Log } (V_{OUT} / V_{IN})$

Figure 10. Non-adjacent Channel-to-Channel Crosstalk

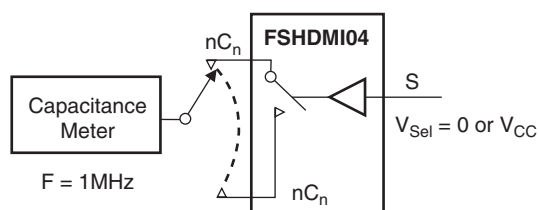


Figure 11. Channel OFF-Capacitance

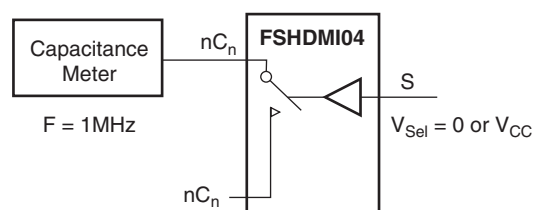


Figure 12. Channel ON-Capacitance

Test Diagrams (Continued)

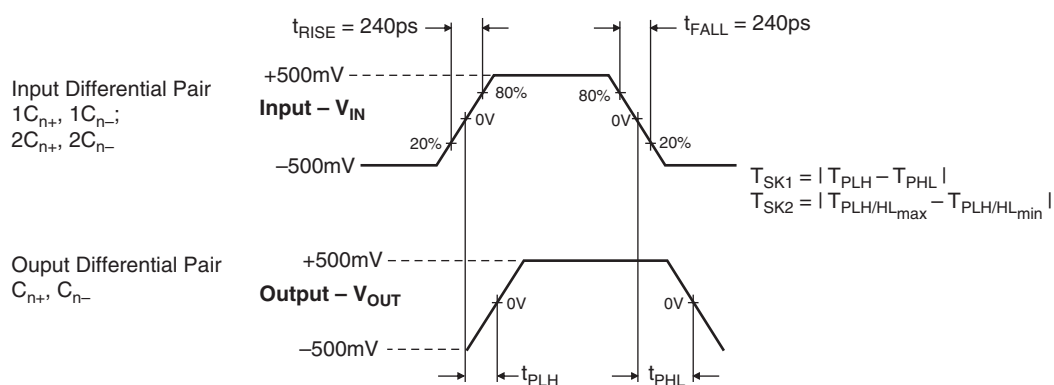
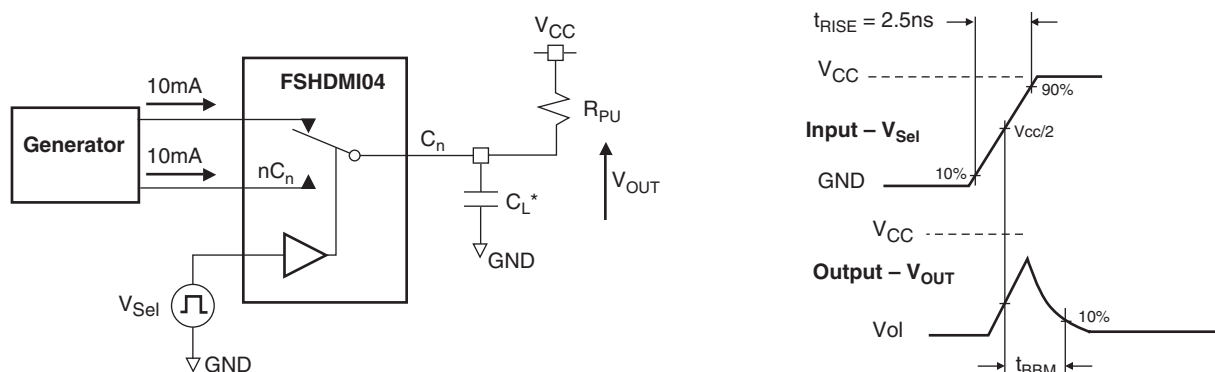


Figure 13. Intra- and Inter-Pair Skew, t_{pD}



*C_L includes fixture and stray capacitance

Figure 14. Break-Before-Make

Physical Dimensions

Dimensions are in millimeters unless otherwise noted.

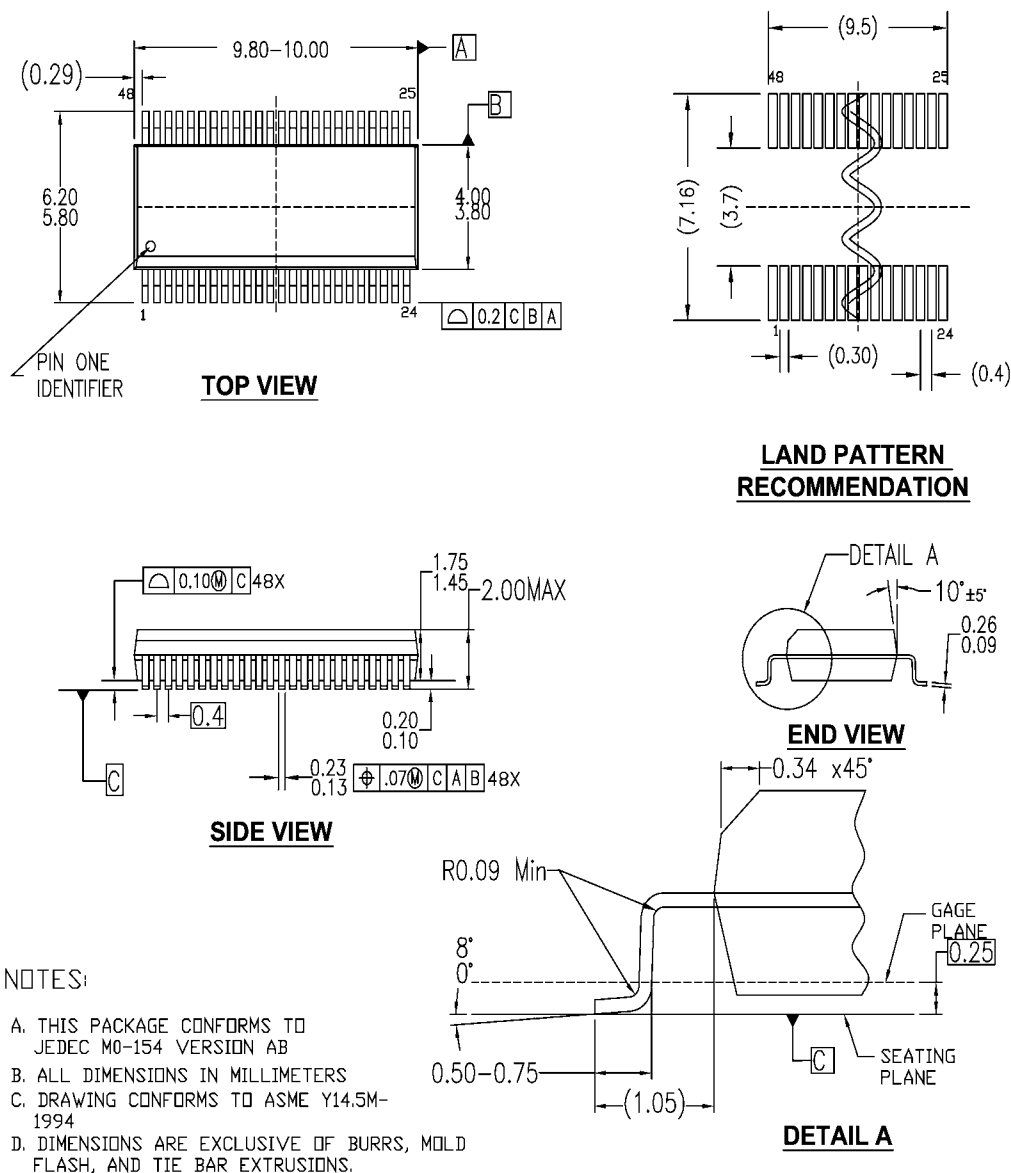
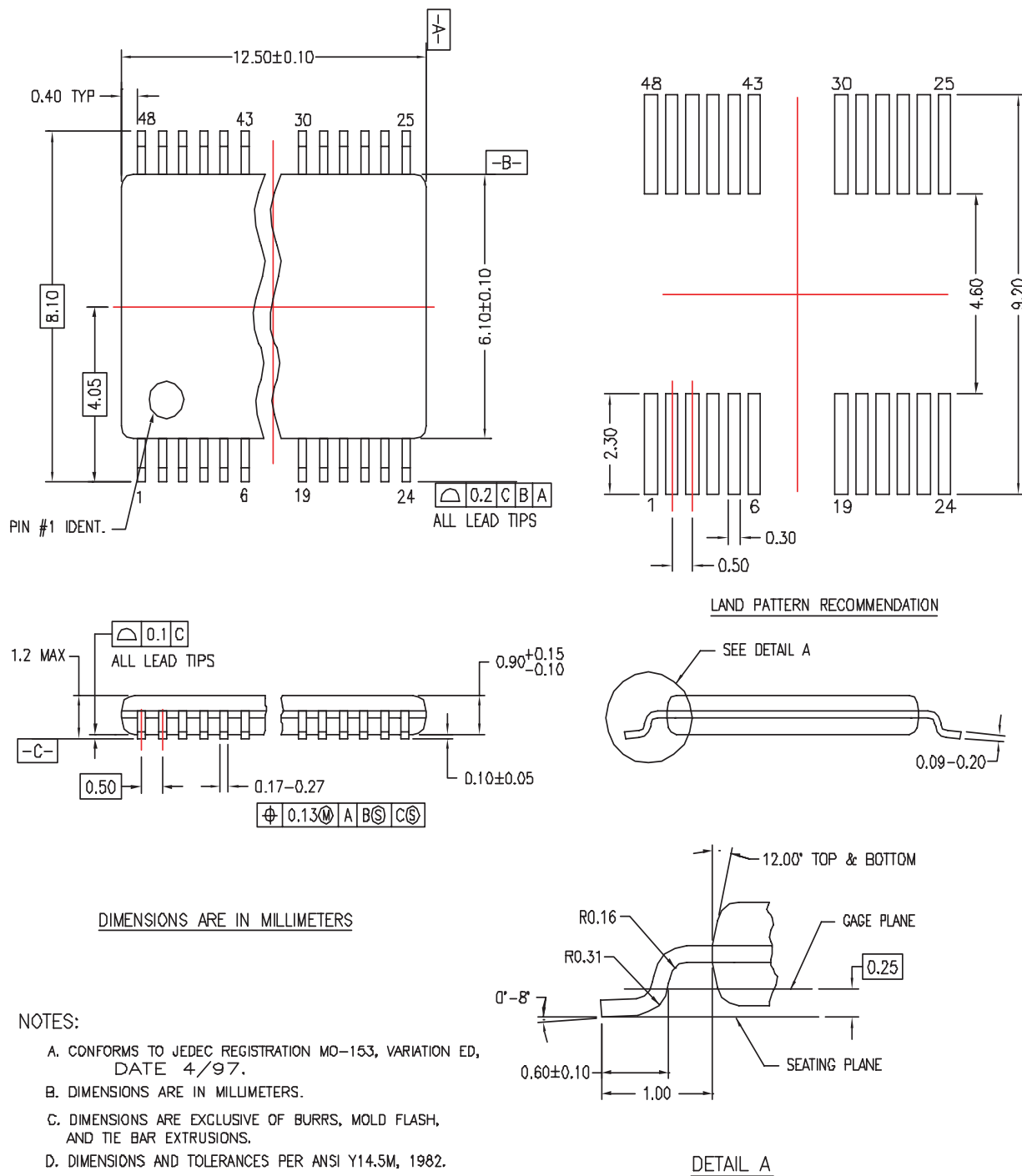


Figure 15. 48-Lead Quarter Size Very Small Outline Package (QVSOP), JEDEC MO-154, 0.150inches Wide

Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



MTD48REVC

Figure 16. 48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.

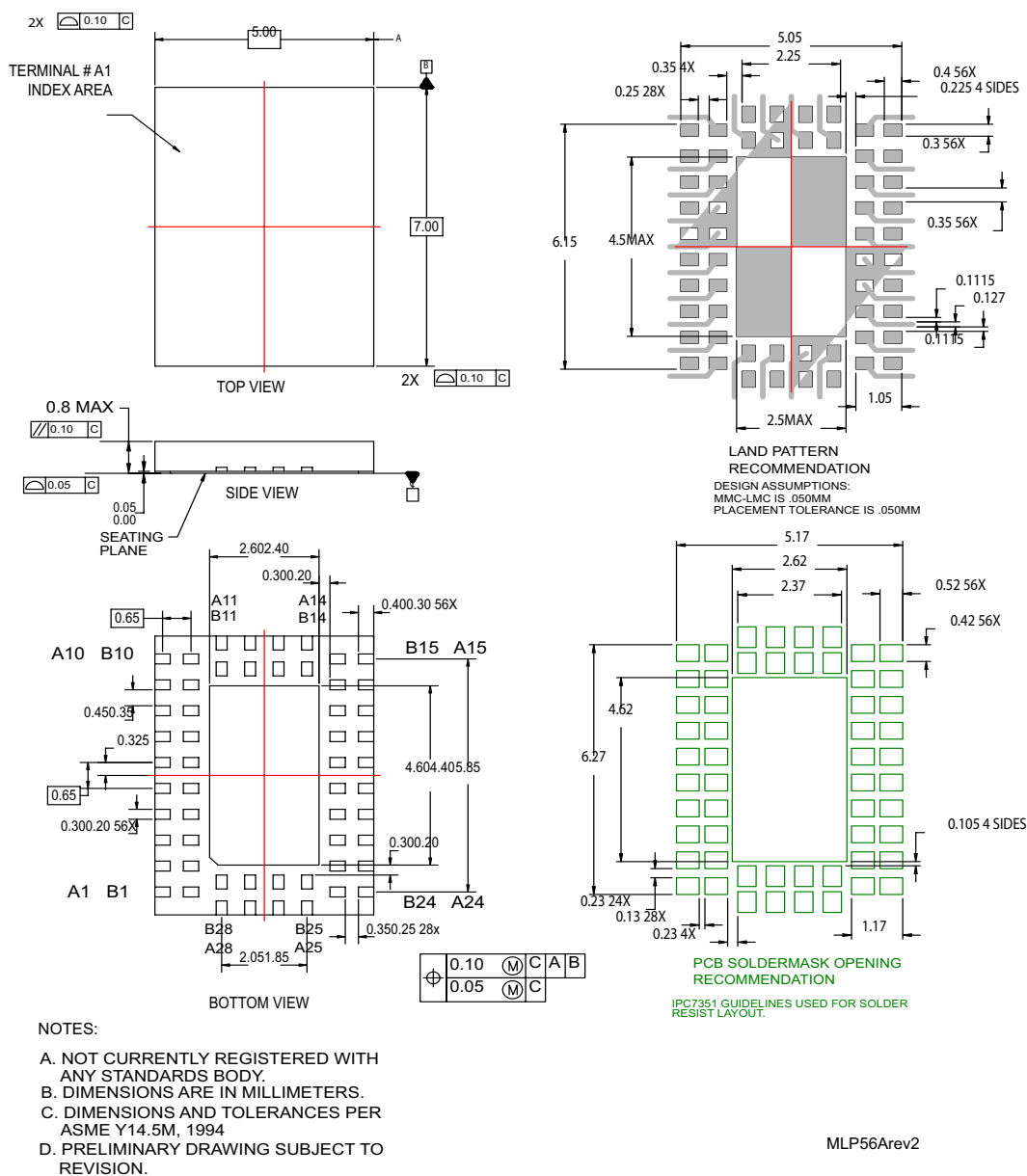


Figure 17. 56-Lead Molded Leadless Package (MLP) 5x7mm

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACE [™]	FACT Quiet Series [™]	OCX [™]	SILENT SWITCHER [®]	UniFET [™]
ActiveArray [™]	GlobalOptoisolator [™]	OCXPro [™]	SMART START [™]	UltraFET [®]
Bottomless [™]	GTO [™]	OPTOLOGIC [®]	SPM [™]	VCX [™]
Build it Now [™]	HiSeC [™]	OPTOPLANAR [™]	Stealth [™]	Wire [™]
CoolFET [™]	I ² C [™]	PACMAN [™]	SuperFET [™]	
CROSSVOLT [™]	i-Lo [™]	POP [™]	SuperSOT [™] -3	
DOME [™]	ImpliedDisconnect [™]	Power247 [™]	SuperSOT [™] -6	
EcoSPARK [™]	IntelliMAX [™]	PowerEdge [™]	SuperSOT [™] -8	
E ² CMOS [™]	ISOPPLANAR [™]	PowerSaver [™]	SyncFET [™]	
EnSigna [™]	LittleFET [™]	PowerTrench [®]	TCM [™]	
FACT [™]	MICROCOUPLER [™]	QFET [®]	TinyBoost [™]	
FAST [®]	MicroFET [™]	QS [™]	TinyBuck [™]	
FAST ^r [™]	MicroPak [™]	QT Optoelectronics [™]	TinyPWM [™]	
FPS [™]	MICROWIRE [™]	Quiet Series [™]	TinyPower [™]	
FRFET [™]	MSX [™]	RapidConfigure [™]	TinyLogic [®]	
	MSXPro [™]	RapidConnect [™]	TINYOPTO [™]	
Across the board. Around the world. [™]		μSerDes [™]	TruTranslation [™]	
The Power Franchise [®]		ScalarPump [™]	UHC [™]	
Programmable Active Droop [™]				

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. 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.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
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.

Rev. I20