FAIRCHILD SEMICONDUCTOR®

August 2009

FSHDMI08 — Low-Voltage, Wide-Bandwidth, HDMI Switch with DDC and CEC Multiplexer

Features

- -25db Non-Adjacent Channel Crosstalk at 1.65Gbps
- Low Signal Loss: -1.5dBg attenuation at 1.65Gbps
- Isolation Ground Between Channels
- Fast Turn-on/off Time (< 6ns)
- 1.65Gbps Throughput
- 8kV ESD Protection
- Low Skew: Intra-pair <90ps, Inter-pair < 150ps
- Low Power Consumption: 1µA Maximum

Applications

- XGA and 720p DVI and HDMI Video Source Selection

Description

The FSHDMI08 is a wide-bandwidth switch designed for routing HDMI link data, clock, and the relevant DDC and CEC control signals that support the data rate up to 1.65Gbps per channel for UXGA resolution. Applications include LCD TVs, DVD, set-top boxes, and notebook designs with multiple digital video interfaces.

This switch allows the passage of HDMI link signals with ultra-low non-adjacent channel crosstalk and ultra-low off isolation. This 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 with minimal additive skew and phase jitter. The pinout supports an HDMI standard-A connector PCB layout.

IMPORTANT NOTE:

For additional information, please contact analogswitch@fairchildsemi.com.

Ordering Information

Order Number	Eco Status	Package Description	Packing Method
FSHDMI08MTDX	RoHS	56-Lead, Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide	Tape and Reel

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

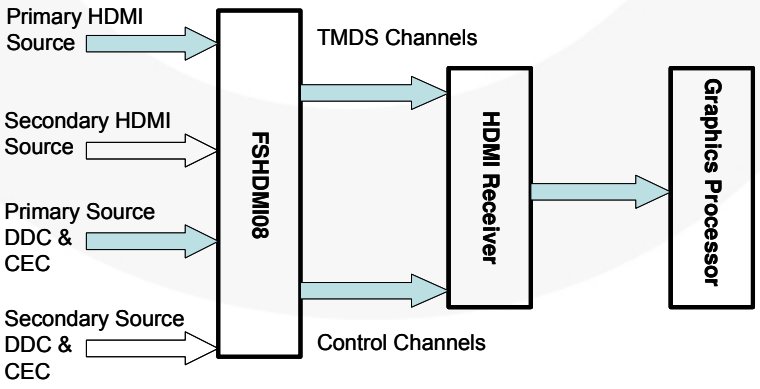


Figure 1. Single-Link HDMI Application

Functional Diagram

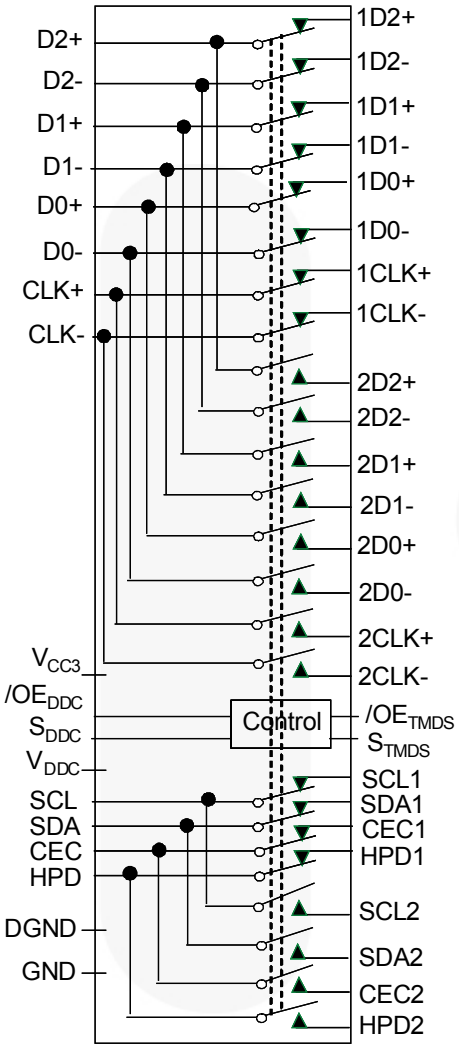


Figure 2. Functional Diagram

Pin Descriptions

Pin	Name	Description
1-4,6,7,11-14,16,17, 47,48,50,51,53,54	1Dn+, 1Dn-, 2Dn+, 2Dn-, Dn+, Dn-	TMDS Data Channels
8,9,18,19,44,45	1CLK+, 1CLK-, 2CLK+, 2CLK-, CLK+, CLK-	TMDS Clock Channels
24,28,33	HPD1, HPD2, HPD	Hot Plug Detects
22,26,35	SCL1, SCL2, SCL	Serial Clock (DDC)
23,27,34	SDA1, SDA2, SDA	Serial Data (DDC)
21,25,36	CEC1, CEC2, CEC	Consumer Electronics Control (CEC)
29	V_{DDC}	DDC Power
20,39,40,55,56	V_{CC3}	TMDS Power
30	DGND	DDC/CEC GND
5,10,15,38,43,46,49,52	GND	GND
32,42	S_{TMDS}, S_{DDC}	Select Pins (TMDS, DDC)
31,41	$/OE_{TMDS}$, $/OE_{DDC}$	Output Enable (TMDS, DDC)

Pin Assignments

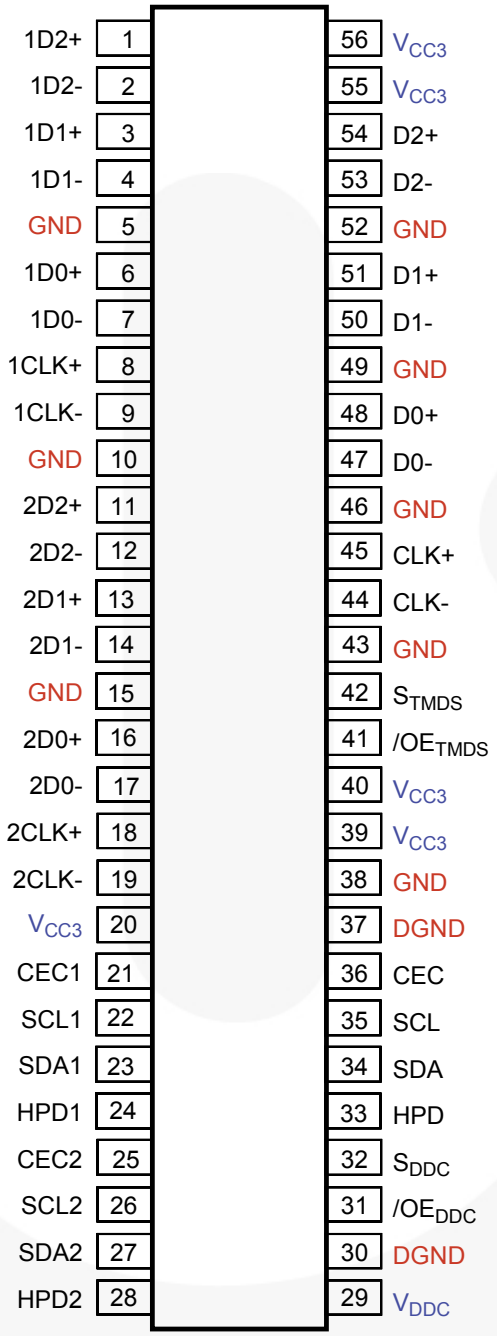


Figure 3. Pin Assignments

Truth Table

S_{TMDS}, S_{DDC}	$/OE_{TMDS}$, $/OE_{DDC}$	Function
Don't' Care	Logic Level HIGH	All Ports Disconnected (Hi-Z)
Logic Level LOW	Logic Level LOW	1Dn+/1Dn-=Dn+/Dn-; 1CLK+/ 1CLK-=CLK+/CLK-; HPD1=HPD; SCL1=SCL; SDA1=SDA; CEC1=CEC
Logic Level HIGH	Logic Level LOW	2Dn+/2Dn-=Dn+/Dn-; 2CLK+/ 2CLK-=CLK+/CLK-; HPD2=HPD; SCL2=SCL; SDA2=SDA; CEC2=CEC

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.

Symbol	Parameter		Min.	Max.	Unit
V_{CC3}	Supply Voltage – TMDS Channels		-0.5	4.6	V
V_{DDC}	Supply Voltage – 5V DDC		-0.5	6.0	V
V_{SWTMDS}(1)	Switch I/O Voltage	1Dn+, 1Dn-, 2Dn+, 2Dn-, Dn+, Dn-, 1CLK+, 1CLK-, 2CLK+, 2CLK-, CLK+, CLK-	-0.5	V_{CC3} + 0.3	V
V_{SWDDC}(1)	Switch I/O Voltage	HPD1, HPD2, HPD, SCL1, SCL2, SCL, SDA1, SDA2, SDA, CEC1, CEC2, CEC	-0.5	V_{DDC} + 0.3	V
V_{CNTRLT}(1)	Control Input Voltage	S_{TMDS}, $/OE_{TMDS}$	-0.5	4.6	V
V_{CNTRLD}(1)	Control Input Voltage	S_{DDC}, $/OE_{DDC}$	-0.5	6.0	V
I_{IK}	Input Clamp Diode Current			-50	mA
I_{SW}	Switch I/O Current (Continuous)			128	mA
T_{STG}	Storage Temperature Range		-65	+150	°C
T_J	Maximum Junction Temperature			+150	°C
T_L	Lead Temperature (Soldering, 10 Seconds)			+260	°C
ESD	Human Body Model (JEDEC: JESD22-A114)	I/O to GND		8.0	kV
		All Other Pins		2.5	
	Charged Device Model (JEDEC: JESD22-C101)			2.0	

Note:
1. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Unit
V_{CC3}	TMDS Supply Voltage – 3V	3.0	4.3	V
V_{DDC}	DDC Supply Voltage	3.0	5.5	V
V_{CNTRLT}	Control Input Voltage – S_{TMDS}, $/OE_{TMDS}$	0	V_{CC3}	V
V_{CNTRLD}	Control Input Voltage – S_{DDC}, $/OE_{DDC}$	0	V_{DDC}	V
V_{SWTMDS}	Switch I/O Voltage for HDMI path	V_{CC3} – 0.6	V_{CC3}	V
V_{SWDDC}	Switch I/O Voltage for DDC path	0	V_{DDC}	V
T_A	Operating Temperature	-40	+85	ºC
θ_{JA}	Thermal Resistance (Free Air)		+80	ºC/W

DC Electrical Characteristics

All typical values are for V_{CC3}=3.3V and V_{DDC}=5.0V at 25°C unless otherwise specified.

Symbol	Parameter	V_{CC3} / V_{DDC} (V)	Conditions	T_A=- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage	V_{CC3}=3.0 V_{DDC}=5.0	I_{IN}=-18mA			-1.2	V
V_{IH}	Control Input Voltage High	V_{CC3}=3.0 to 3.6 V_{DDC}=3.0 to 5.5		2			V
V_{IL}	Control Input Voltage Low	V_{CC3}=3.0 to 3.6 V_{DDC}=3.0 to 5.5				0.8	V
I_{OZTMDS}	Off State Leakage TMDS Channels	V_{CC3}=3.6 V_{DDC}=5.5	0 ≤ V_{SWTMDS} ≤ V_{CC3} Figure 5	-1		1	µA
I_{OZDDC}	Off State Leakage DDC/CEC Channels	V_{CC3}=3.6 V_{DDC} =5.5	0 ≤ V_{SWDDC} ≤ V_{DDC} Figure 5	-5		5	µA
I_{INTMDS}	Control Input Leakage (S_{TMDS}, /OE_{TMDS})	V_{CC3}=3.6 V_{DDC} =5.5	V_{SWDDC}=0 to V_{CC3}	-1		1	µA
I_{INDDC}	Control Input Leakage (S_{DDC}, /OE_{DDC})	V_{CC3}=3.6 V_{DDC} =5.5	V_{SWDDC}=0 to V_{DDC}	-1		1	µA
I_{CC3}	Quiescent Supply Current -TMDS	V_{CC3}=3.6 V_{DDC} =5.5	V_{SWTMDS}=V_{CC3} – 0.6 or V_{CC3}, I_{OUT}=0			2	µA
I_{DDC}	Quiescent Supply Current -DDC	V_{CC3}=3.6 V_{DDC} =5.5	V_{SWDDC}=0 or V_{DDC}, I_{OUT}=0			2	µA
ΔI_{CCT3}	Increase in I_{CC3}	V_{CC3}=3.6 V_{CC5}=5.5	One input at 3.0V; Other inputs at V_{CC3}-0.6 or V_{CC3}			100	µA
ΔI_{CCTD}	Increase in I_{DDC}	V_{CC3}=3.6 V_{CC5}=5.5	One input at 3.0V; Other inputs at V_{DDC}			15	µA

AC Electrical Characteristics

All typical values are for V_{CC3}=3.3V and V_{DDC}=5.0V at 25°C unless otherwise specified.

Symbol	Parameter	V_{CC3}/ V_{DDC} (V)	Conditions	T_A=- 40ºC to +85ºC			Unit
				Min.	Typ.	Max.	
TMDS Channels							
t_{ONTMDS}	Turn-On Time S, /OE to Output	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	V_{SWTMDS}=V_{CC3} -0.5, R_{PU}=50Ω, C_L=5pf Figure 6, Figure 7		4	6	ns
$t_{OFFTMDS}$	Turn-Off Time S to Output	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	V_{SWTMDS}=V_{CC3} -0.5, R_{PU}=50Ω, C_L=5pf Figure 6, Figure 7		2	4	
$t_{BBM-TMDS}$	Break-Before-Make Time(2)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	V_{SWTMDS}=V_{CC3} -0.5, R_{PU}=50Ω, C_L=5pf Figure 15	1			ns
t_{pd} (t_{pLH},t_{pHL})	Switch Propagation Delay(2)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	R_{PU}=50Ω, C_L=5pf Figure 14			400	ps
t_{jitter}	Total Jitter (DJ+RJ)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	f=165MHz clock with 50% duty cycle, R_{PU}=50Ω, C_L=5pf Figure 14			90	ps
t_{ratio}	Duty Cycle Ratio	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	f=165MHz clock with 50% duty cycle, R_{PU}=50Ω, C_L=5pf Figure 14	40	50	60	%
t_{SK1}	Intra-Pair Skew (TMDS Cn+ to Cn-)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	f=1.65Gbps, 2^{23}-1 PRBS, R_{PU}=50Ω, C_L=5pf Figure 14		55	100	ps
t_{SK2}	Inter-Pair Skew (Between any two TMDS switch pair paths)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	f=1.65Gbps, 2^{23}-1 PRBS, R_{PU}=50Ω, C_L=5pf Figure 14		90	160	ps
$OIRR_{TMDS}$	Off-Isolation (TMDS Channels)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	R_T=50Ω, f=370MHz Figure 10	-30			dB
		V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	R_T=50Ω, f=825MHz Figure 10	-25			
$Xtalk_{TMDS}$	Non-Adjacent Channel Crosstalk (TMDS Channels)	V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	R_T=50Ω, f=370MHz Figure 11	-25			dB
		V_{CC3}=3.0 to 3.6 V_{DDC} =5.0	R_T=50Ω, f=825MHz Figure 11	-20			
f_{max}	Maximum Throughput(2)	V_{CC3}=3.3 V_{DDC} =5.0			1.65		Gbps
Control Channels – DDC / CEC							
t_{ONDDC}	Turn-On Time; S_{DDC}, $/OE_{DDC}$ to Output	V_{CC3}=3.3 V_{DDC} =3.0 to 5.5	V_{SWDDC}=2V, R_{DDC}=1kΩ, C_L=5pf			28	ns
t_{OFFDDC}	Turn-Off Time; S_{DDC}, $/OE_{DDC}$ to Output	V_{CC3}=3.3 V_{DDC} =3.0 to 5.5	V_{SWDDC}=2V, R_L=1kΩ, C_L=5pf			24	ns

Note:

2. Guaranteed by characterization, not production tested.

Test Diagrams

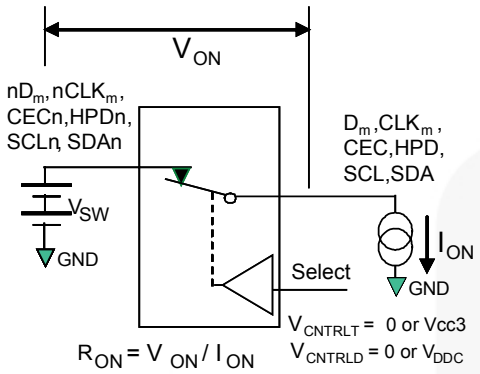
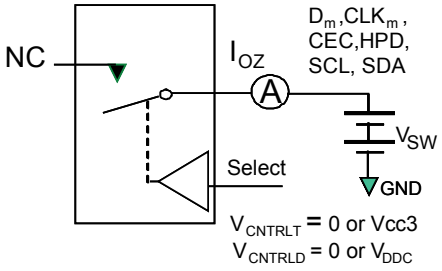
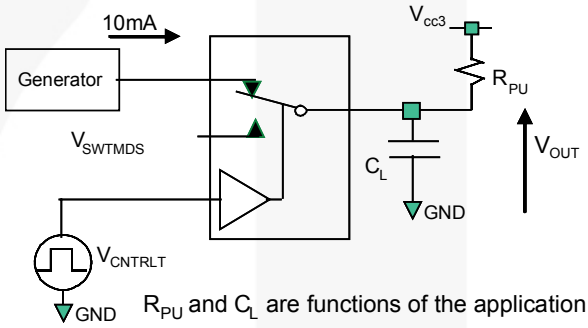


Figure 4. On Resistance



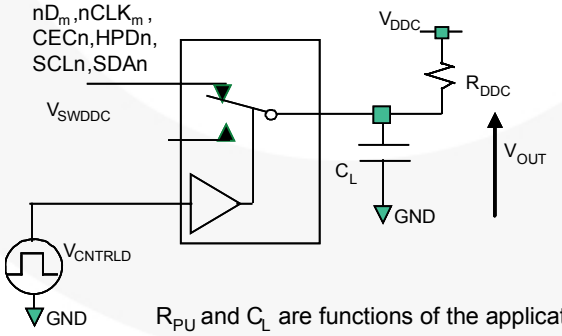
Each switch port is tested separately.

Figure 5. Off Leakage



R_{PU} and C_L are functions of the application environment (see AC/DC tables for values of C_L and R_{PU}).
C_L includes test fixture and stray capacitance.

Figure 6. TMDS Test Circuit Load



R_{PU} and C_L are functions of the application environment (see AC/DC tables for values of C_L and R_{DDC}).
C_L includes test fixture and stray capacitance.

Figure 7. DDC Test Circuit Load

Test Diagrams

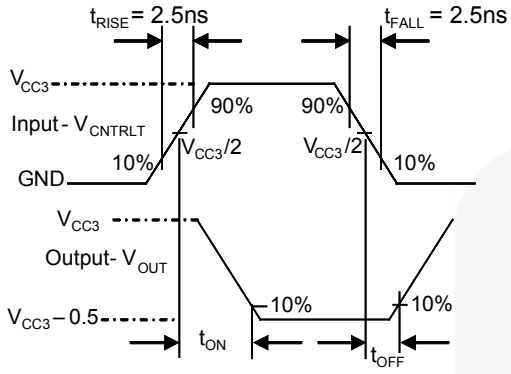


Figure 8. Turn-on / Turn-off Waveforms

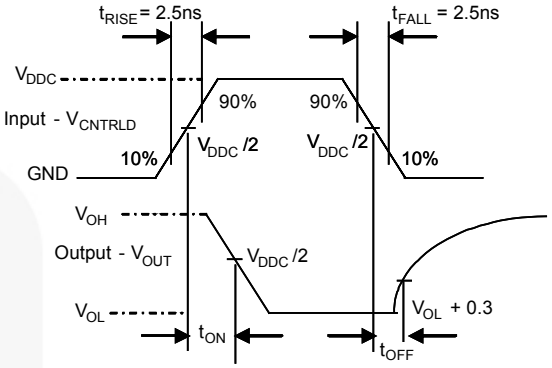


Figure 9. DDC Turn-on / Turn-off Waveforms

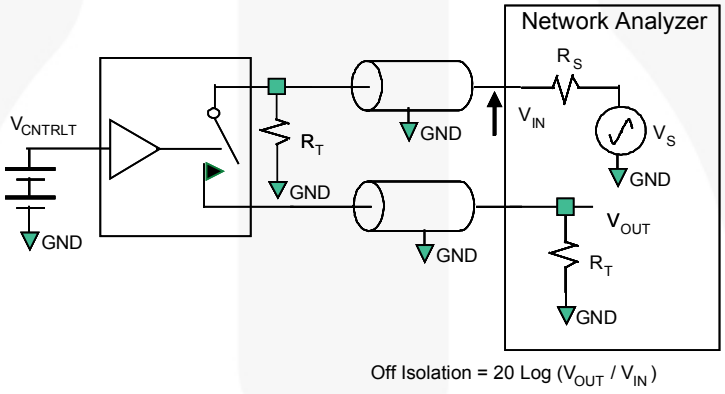


Figure 10. Channel Off Isolation

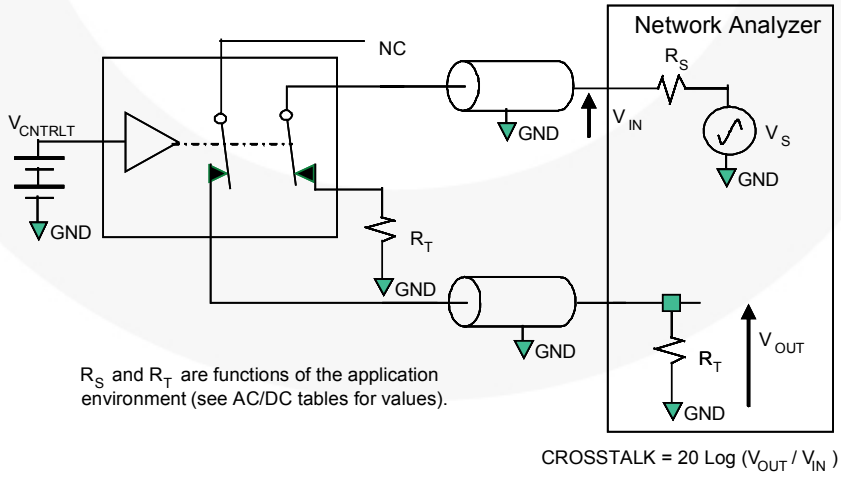


Figure 11. Non-Adjacent Channel-to-Channel Crosstalk

Test Diagrams

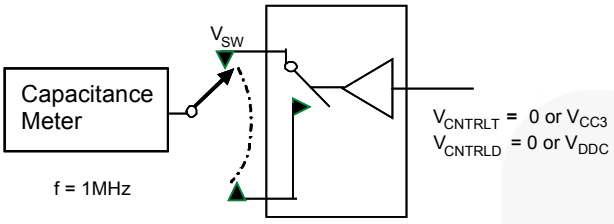


Figure 12. Channel Off Capacitance

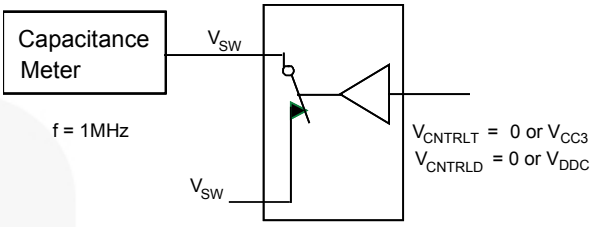


Figure 13. Channel On Capacitance

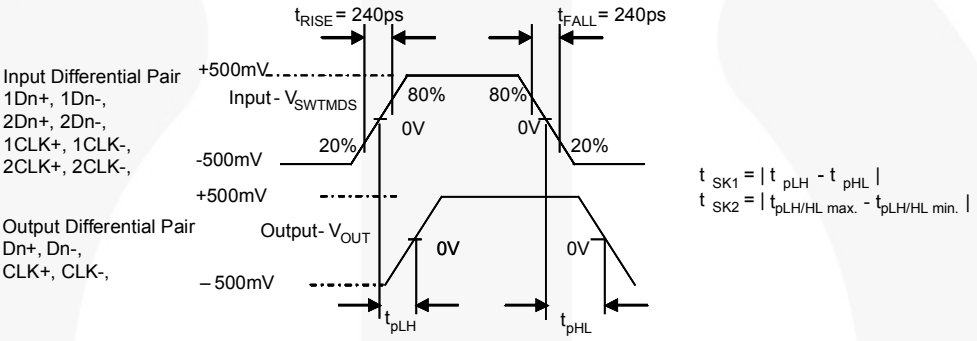
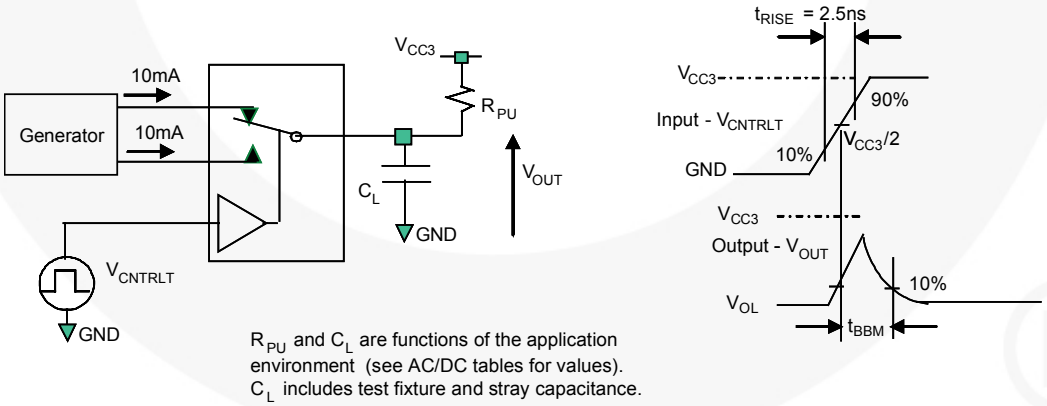


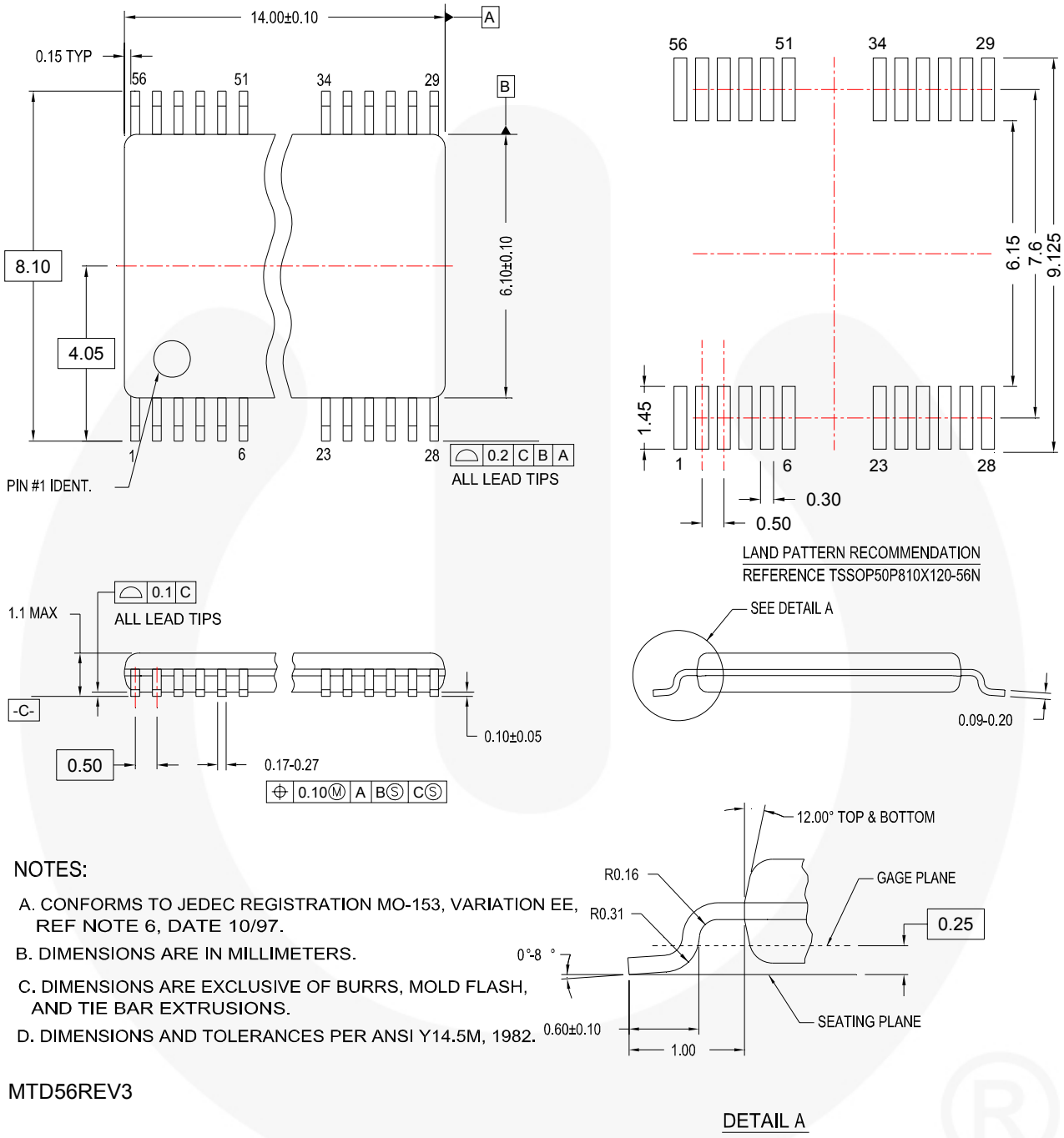
Figure 14. Intra- and Inter-Pair Skew t_{pd}



R_{PU} and C_L are functions of the application environment (see AC/DC tables for values).
C_L includes test fixture and stray capacitance.

Figure 15. Break Before Make

Physical Dimensions



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION EE, REF NOTE 6, DATE 10/97.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTD56REV3

Figure 16. 56-Pin Thin-Shrink Small Outline Package (TSSOP)

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2. A critical component in 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.

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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.

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