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FAIRCHILD SEMICONDUCTOR®

July 2013

FSA110 — Audio and Wired-OR USB2.0 Hi-Speed (480Mbps) Switch with Negative Signal Capability and Built-in Termination

Features

- 6pF Typical Switch Off Capacitance for HS USB
- 2.5Ω Typical On Resistance for Audio Signaling
- Negative-Swing-Capable Audio Channel
- Automatic USB Detection Available
- Power-Off Protection on the D+/R, D-/L Ports
- Flow-Through Pin Out Eliminates PCB Vias
- Built-In Termination on Unselected Audio Paths Inhibits Audio Pop

Applications

- Cell Phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

Description

The FSA110 is a Double-Pole, Single Throw (DPST) switch that combines a low-distortion audio path with low off capacitance for USB applications. This configuration is ideal for wired-OR configurations, enabling shared USB2.0 Hi-Speed (HS) and audio on a single connector. The architecture is designed to allow audio signals to swing below ground so a common USB and headphone jack can be used for personal media players and portable peripheral devices.

The FSA110 is configured for default USB transfer, which gives the user control of when the audio path is enabled. The audio path defaults to audio mute and is enabled with /OE. The FSA110 includes a power-off feature on the common port when V_{CC}=0V to guarantee signal isolation.

IMPORTANT NOTE:

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

Ordering Information

Part Number	Top Mark	Eco Status	Package Description
FSA110K8X	A110	Green	8-Lead US8, JEDEC MO-187, Variation CA, 3.0mm Wide Package
FSA110UMX	GZ	Green	10-Lead Quad, Ultrathin MLP, 1.4 x 1.8mm

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

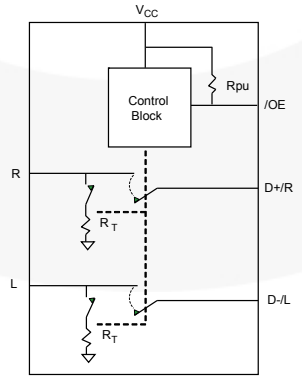


Figure 1. Analog Symbol

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Pin Configuration

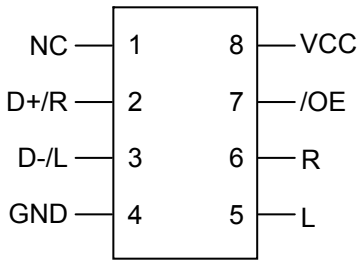


Figure 2. 8-Lead US8

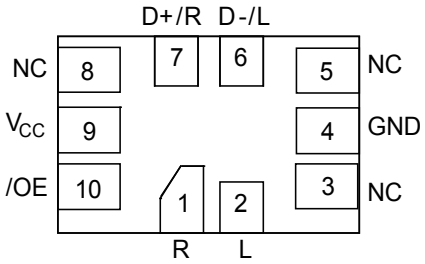


Figure 3. 10-Pin UMLP

Pin Descriptions

Name	Description
V_{CC}	Power supply.
/OE	Output enable. This pin defaults HIGH, allowing the user to mute the audio channel during power up. The audio path is only connected when /OE is driven LOW. The switch defaults to USB mode.
R, L	Audio right and left input sources.
D+/R, D-/L	USB and audio common connector port.

Truth Table

V_{CC}	/OE[1]	Audio Mode	USB Mode
LOW	-	OFF	ON
HIGH	LOW	ON	OFF
-	HIGH	OFF	ON

Note:

1. /OE- Internal pull-up resistor to V_{CC} provides a default USB connection. /OE must be driven LOW to activate the audio path.

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Functional Description

The FSA110 is a combined USB and audio switch that enables sharing the D+/D- lines of a USB connector with stereo audio CODEC outputs. The /OE pin has an internal pull-up resistor, which results in a default USB mode configuration. This configuration provides built-in mute on the audio path during system power-up and in default USB mode allows the system to transmit USB data regardless of the switch V_{CC} supply. This configuration allows the user to override the USB default state and send analog audio on the USB path when the USB cable is connected. In such a configuration, there is no need for auto USB detection. The audio switch path is capable of handling negative signals, eliminating the need for large coupling capacitors and greatly reducing the potential for audio pop. Termination resistors on the audio R, L ports are enabled when the switch is in USB mode; which reduces the incidence of audio pop when enabling the audio path.

Application Diagram

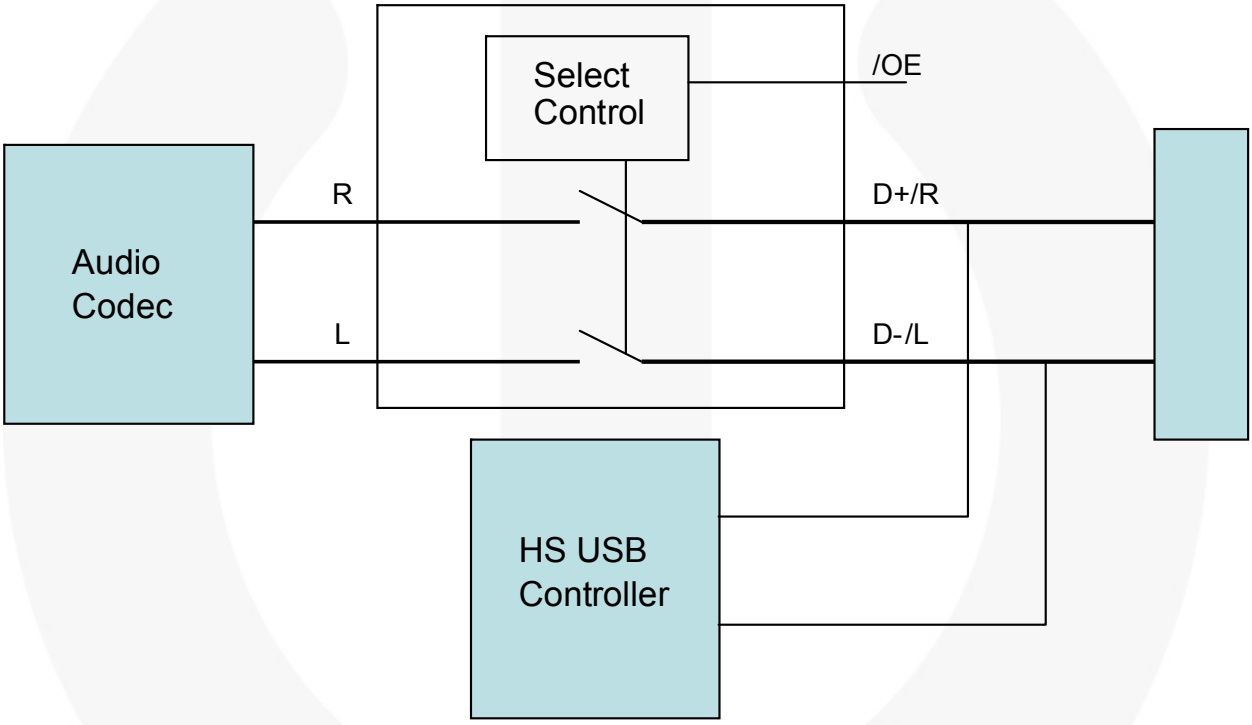


Figure 4. Typical Application Diagram

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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.	Units
V_{CC}	Supply Voltage		-0.5	4.6	V
/OE	Output Enable Control Signal		-0.5	4.6	V
V_{SW}	Switch I/O Voltage[2]	USB Path Active	-1.0	4.6	V
		Audio Path Active	V_{CC}–4.6	4.6	V
I_{IK}	Input Clamp Diode Current			- 50	mA
I_{SW}	Switch I/O Current (Continuous)	Audio		100	mA
I_{SWPEAK}	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)	Audio		150	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	12		kV
		All Other Pins	2		
		V_{CC} to GND	12		
	Charged Discharge Model (JEDEC: JESD22-C101)		2		

Note:
2. 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.	Units
V_{CC}	Supply Voltage		2.7	4.3	V
/OE	Output Enable Control Signal		3.0	4.3	V
V_{SW}	Switch I/O Voltage	USB Path Active	0V	4.3	V
		Audio Path Active	V_{cc}-4.3	4.3	V
T_A	Operating Temperature		-40	+85	°C

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DC Electrical Characteristics

All typical values are at 25ºC unless otherwise specified.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = -40 to +85°C			Unit
				Min.	Typ.[6]	Max.	
Common Pins							
V_{IK}	Clamp Diode Voltage	3.0	I_{IK} = -18mA			-1.2	V
V_{IH}	Control Input Voltage HIGH	2.7 to 4.3		1.7			
V_{IL}	Control Input Voltage LOW	2.7 to 4.3				0.6	
			V_{IN} = 4.3V	1		-1	
I_{OFF}	Power Off Leakage Current (Common Port Only D+/R, D-/L)	0	Common Port (D+/R, D-/L) V_{SW} = 4.3V or Floating	-10		10	µA
$I_{NC(0N)}$	On-Leakage Current of Port D+/R or D-/L	4.3	D+/R, D-/L = 0.3V, 4.0V D+, D-, R, L = Floating Figure 10	-250	1	250	nA
$R_{Pu,}$	/OE Internal Pull-Up Resistor	4.3			3		MΩ
R_T	Audio Path Termination Resistors	4.3	V_{IN}=0.3V or 4.0V		100		Ω
Audio Switch Path							
V_{Audio}	Audio Analog Signal Range	2.7 to 4.3		V_{CC}-4.3V		V_{CC}	V
$R_{ONAudio}$	Audio Switch On Resistance[3]	2.7	$V_{L/R}$ = -1.5V, 0V,1.5V I_{ON} = 60ma		1.5	3.0	Ω
Δ $R_{ONAudio}$	Audio Delta R_{ON}[4]	2.7	$V_{L/R}$ = 0.7V I_{ON} = 60mA		0.4		Ω
$R_{FLAT(Audio)}$	Audio R_{ON} Flatness[5]	2.7	V_{SW}=-1.5V to 1.5V I_{ON} = 60mA		0.4	0.8	Ω
Power Supply							
I_{CC}	Quiescent Supply Current	4.3	/OE = Low or V_{CC}, I_{OUT} = 0		1.5	15	µA

Notes:

3. On resistance is determined by the voltage drop between the A and B pins at the indicated current through the switch.
4. Δ R_{ON} = $R_{ON\ max}$ – $R_{ON\ min}$ measured at identical V_{CC}, temperature, and voltage. Worst-case signal path, audio or USB channel, is characterized.
5. Flatness is defined as the difference between the maximum and minimum values of on resistance over the specified range of conditions.
6. Guaranteed by characterization; not production tested.

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AC Electrical Characteristics

All typical value are for V_{CC} = 3.6V at 25ºC unless otherwise specified.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = - 40 to +85°C			Unit
				Min.	Typ.(7)	Max.	
t_{ON}	Turn-On Time, /OE to Output	2.7 to 4.3	$V_{D+/R, D-/L}$ = 1.0V R_L = 50Ω, C_L = 50Pf Figure 11, Figure 12, Figure 13		2		µs
t_{OFF}	Turn-Off Time, /OE to Output	2.7 to 4.3	$V_{D+/R, D-/L}$ = 1.0V R_L = 50Ω, C_L = 50pF Figure 11, Figure 12, Figure 13		2		µs
Xtalk	Non-Adjacent Channel Crosstalk (Audio Mode)	3.3 to 4.3	f = 20kHz, R_T = 32Ω, C_L = 0pF Figure 18		-75		dB
THD	Total Harmonic Distortion (Audio Mode)	3.0 to 4.3	f = 20Hz to 20 kHz R_L = 32Ω, V_{IN} = $2V_{pp}$ Figure 16		0.05		%
SNR	Signal-to-Noise Ratio (Audio Mode)	3.3 to 4.3	f = 20kHz to 20kHz, R_L = 32Ω, V_{IN} = $2V_{PP}$ Figure 16		80		dB

Note:
7. Guaranteed by characterization; not production tested.

Capacitance

All typical values are at 25ºC unless otherwise specified.

Symbol	Parameter	V_{CC} (V)	Conditions	T_A = - 40 to +85°C			Unit
				Min.	Typ.(8)	Max.	
C_{IN}	Control Pin Input Capacitance	3.0 to 4.3	V_{BIAS} = 0.2V		2.5		pF
C_{OFF}	Switch Off Capacitance	3.0 to 4.3	f = 240MHz Figure 14		6.0		pF

Note:
8. Guaranteed by characterization; not production tested.

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Typical Characteristics

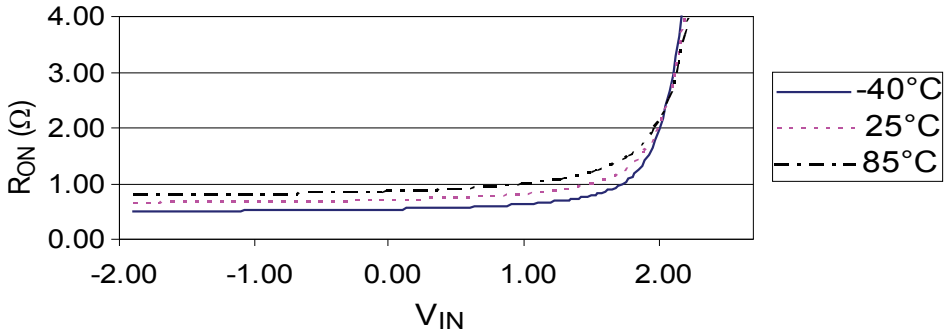


Figure 5. R_{ON} Audio, V_{CC}=2.7V

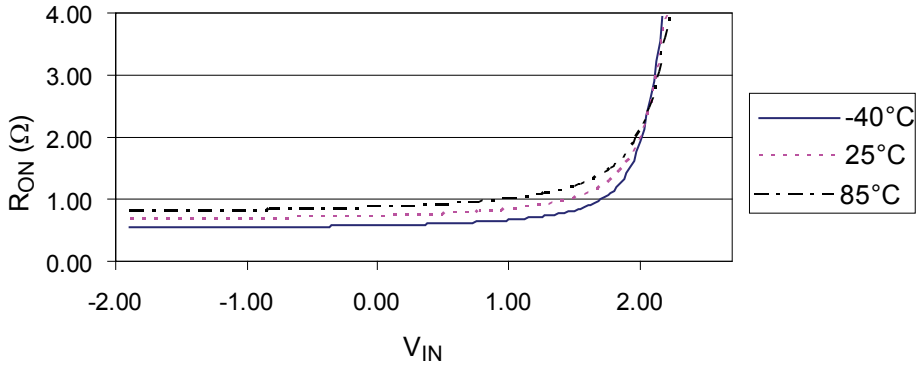


Figure 6. R_{ON} Audio, V_{CC}=2.7V

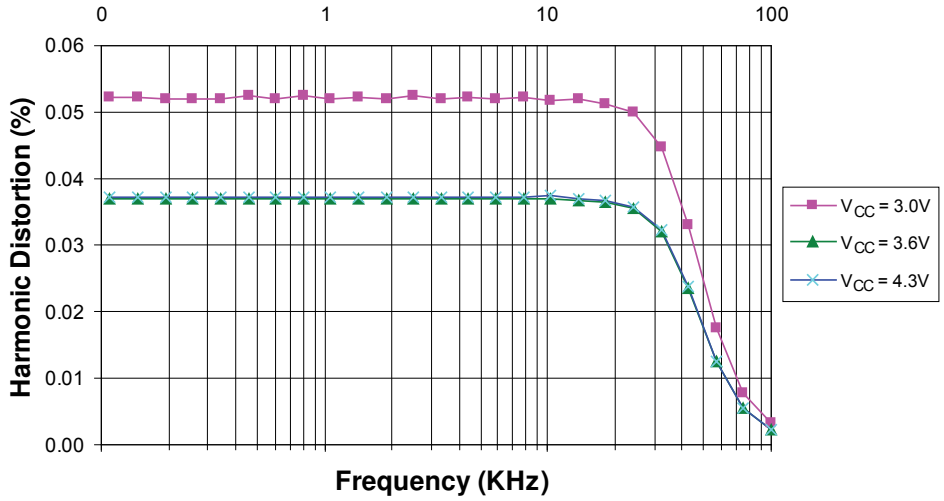


Figure 7. Total Harmonic Distortion

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Test Diagrams

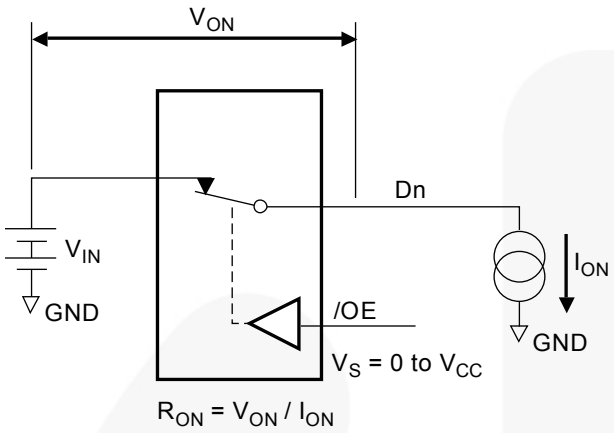
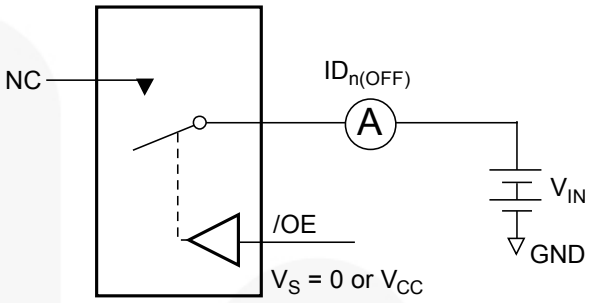


Figure 8. On Resistance



Each switch port is tested separately.

Figure 9. Off Leakage

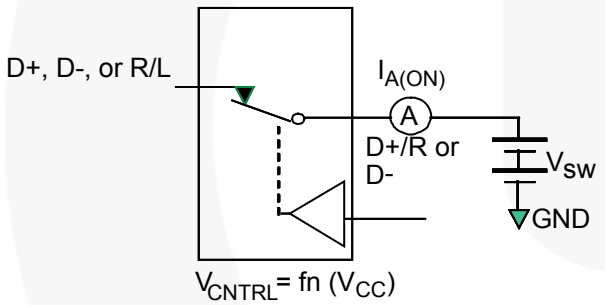
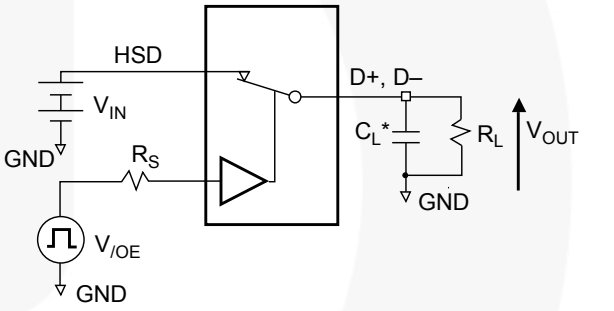


Figure 10. On Leakage



RL, RS, and CL are functions of the application environment (see tables for specific values).

*CL includes test fixture and stray capacitance.

Figure 11. AC Test Circuit Load

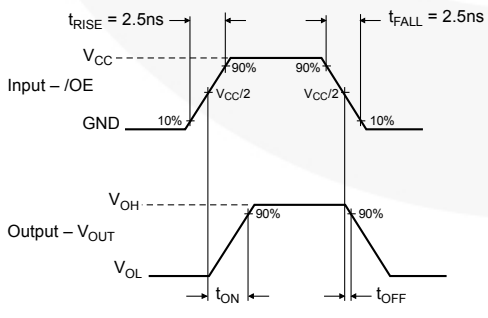


Figure 12. Turn-On / Turn-Off Waveforms

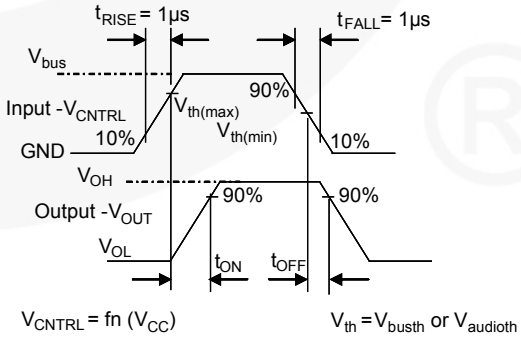


Figure 13. Turn-On / Turn-Off Waveforms

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Test Diagrams (Continued)

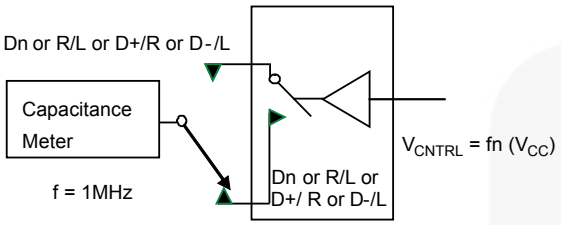


Figure 14. Channel Off Capacitance

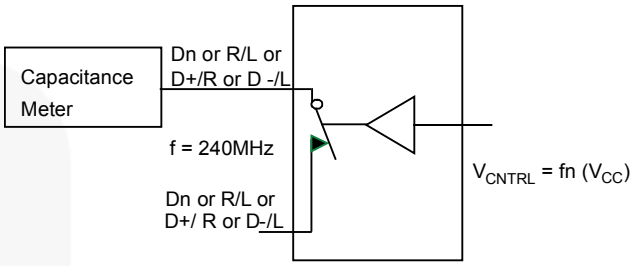


Figure 15. Channel On Capacitance

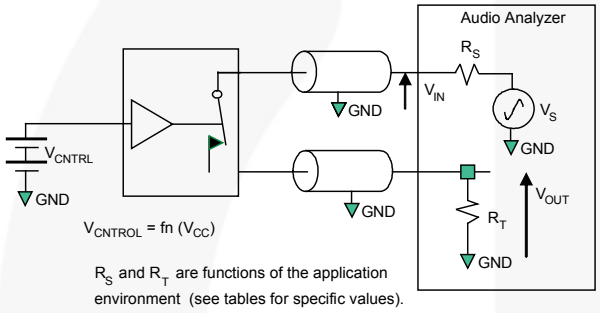


Figure 16. Total Harmonic Distortion

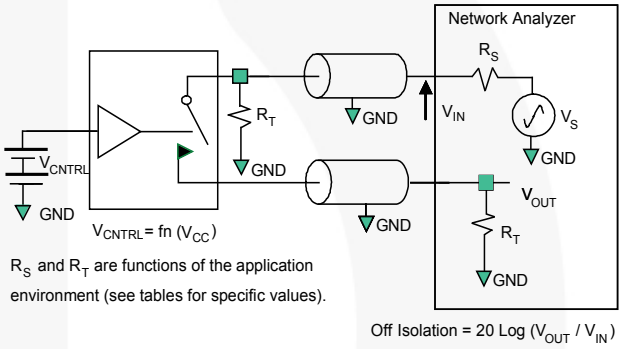


Figure 17. Channel Off Isolation

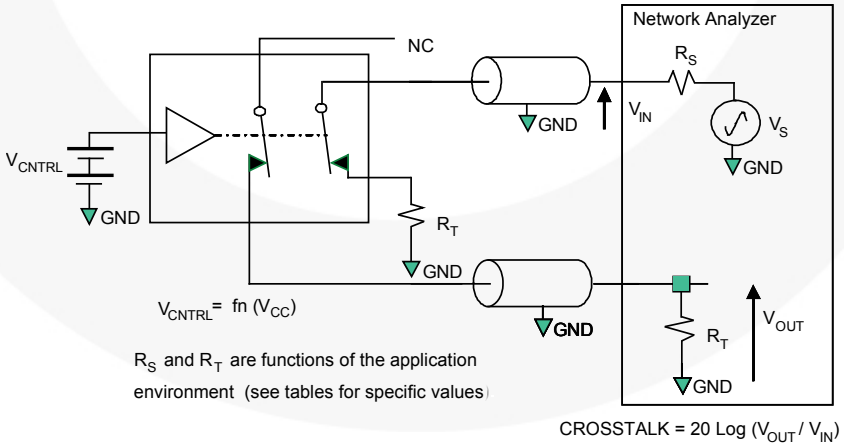
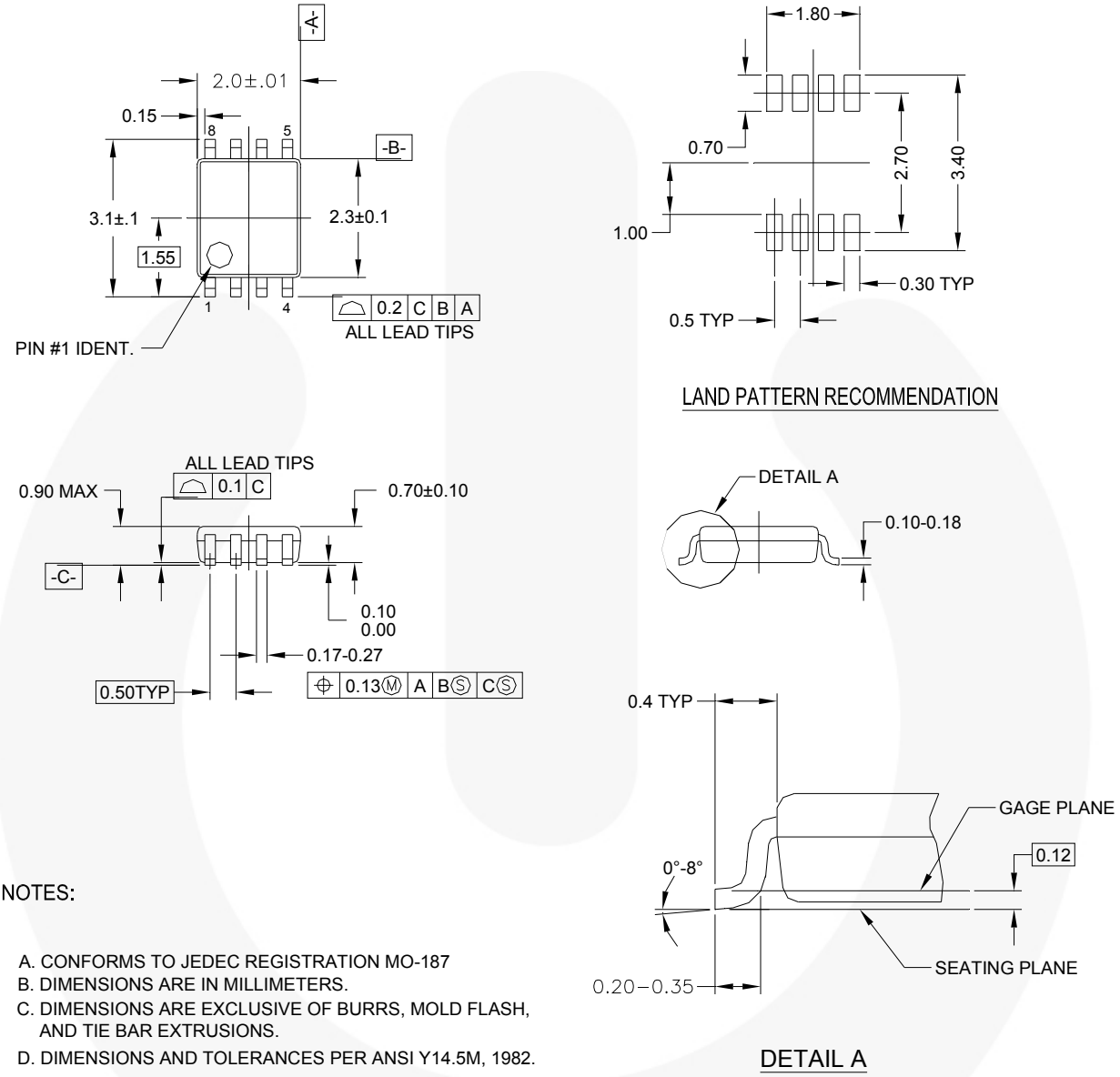


Figure 18. Non-Adjacent Channel-to-Channel Crosstalk

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Physical Dimensions



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-187
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.

MAB08AREVC

Figure 19. 8-Lead US8, JEDEC MO-187, Variation CA, 3.0mm Wide Package

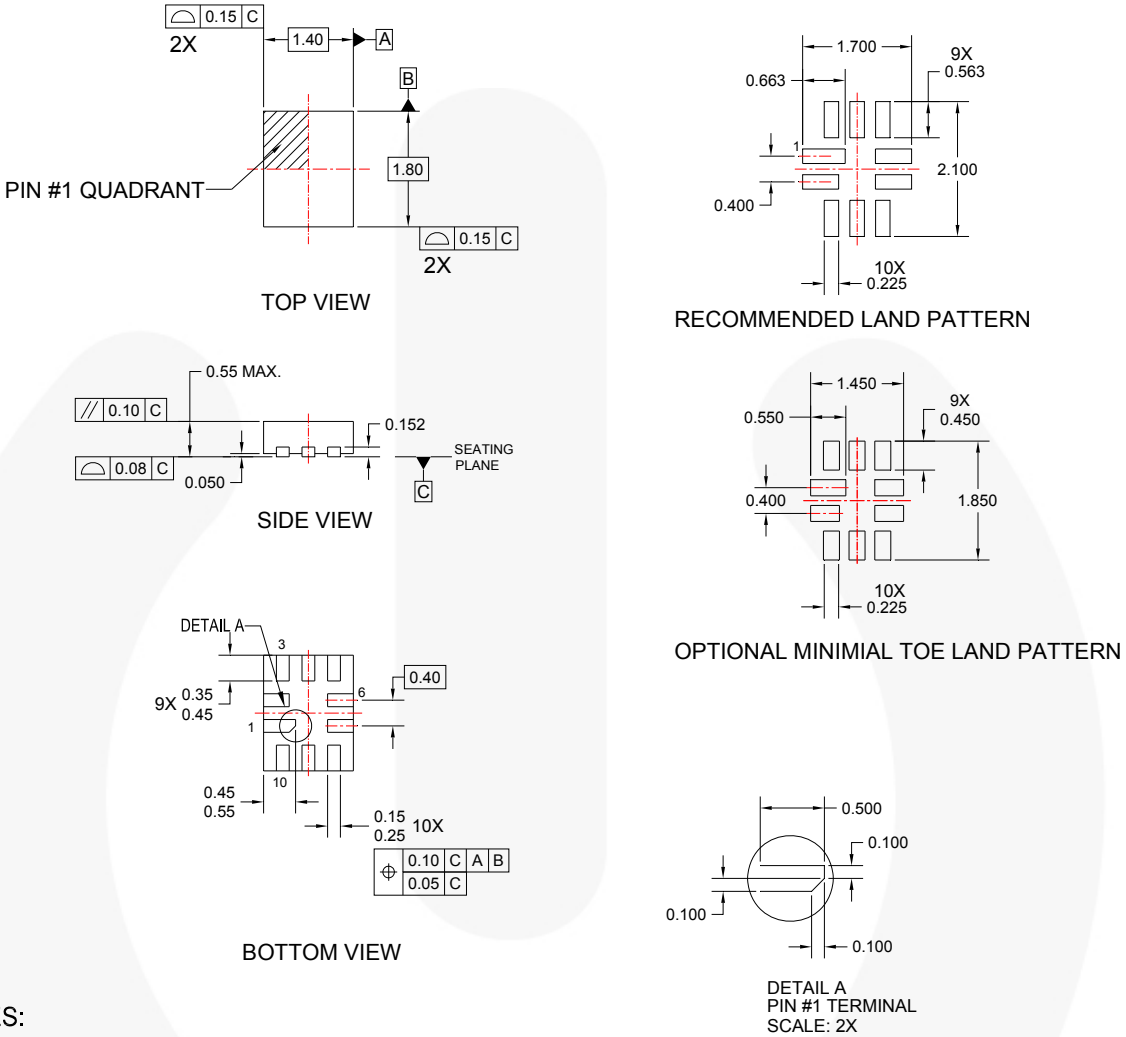
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Physical Dimensions



NOTES:

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B. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

C. DRAWING FILENAME: UMLP10Arev2

Figure 20. 10-Lead Quad Ultrathin Molded Leadless Package (MLP)

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TinyLogic®
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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

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