



# FSA201 — USB2.0 Full-Speed and Audio Switches with Negative Signal Capability

## Features

- 3Ω Typical ON Resistance
- -3db Bandwidth: > 250MHz
- Low Power Consumption
- Packaged in Pb-free 10-pin MSOP and 10-Lead MicroPak™ (1.6 x 2.1mm)
- Power-off Protection on Common D+/R, D-/L Ports
- Automatically Detects V<sub>BUS</sub> for Switch Path Selection

## Applications

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

## Description

The FSA201 is a Double-Pole, Double Throw (DPDT) multiplexer that combines a low-distortion audio and a USB2.0 Full-Speed (FS) switch path. This configuration enables audio and USB data to share a common connector port. The architecture is designed to allow audio signals to swing below ground. This means a common USB and headphone jack can be used for personal media players and similar portable peripheral devices.

Since USB2.0 is an industry standard for shared data-path in portable devices, the FSA201 also incorporates a V<sub>BUS</sub> detection capability. The FSA201 includes a power-off feature to minimize current consumption when V<sub>BUS</sub> is not present. This power-off circuitry is available for the common D+/R, D-/L ports only. Typical applications involve switching in portables and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers.

## Ordering Information

Part Number	Package Number	Pb-Free	Packing Description
FSA201L10X	MAC010A	Yes	10-Lead MicroPak, JEDEC MO-255, 1.6 x 2.1mm
FSA201MUX	MUA10A	Yes	10-Lead MSOP, JEDEC MO-187, 3.0mm Wide

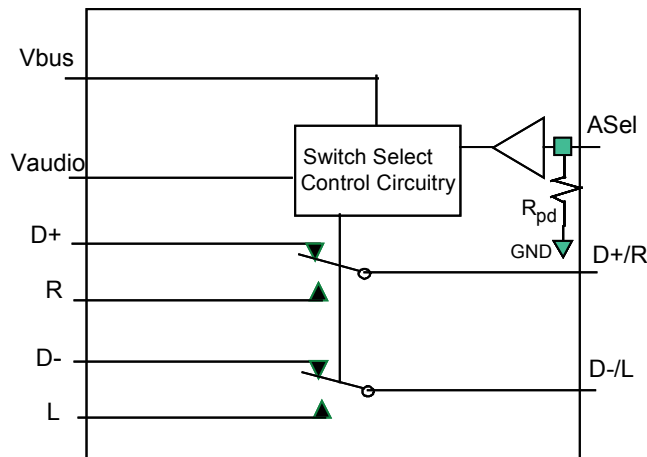


Figure 1. FSA201 Analog Symbol

## Pin Assignments

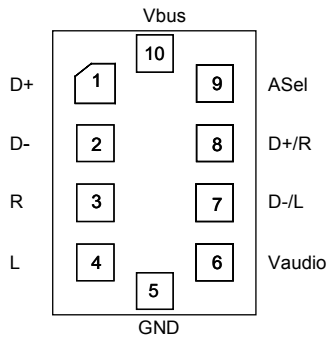


Figure 2. MicroPak™ 10-Pin

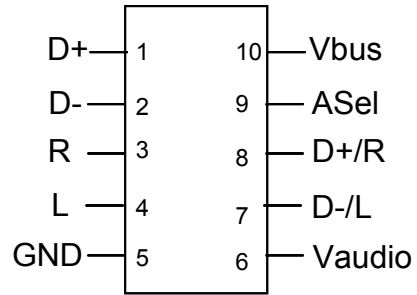


Figure 3. MSOP 10-Pin

## Pin Descriptions

Pin #	Name	Description
1, 2	D+, D-	USB data bus input sources
6	V <sub>AUDIO</sub>	Power supply (audio)
3, 4	R, L	Audio right and left input sources
9	A <sub>SEL</sub>	Audio select to override auto USB detect when V <sub>AUDIO</sub> supply is present
10	V <sub>BUS</sub>	Power supply (USB) and auto USB switch-path select
8, 7	D+/R, D-/L	USB and audio common connector ports

## Truth Table

A <sub>SEL</sub> <sup>(1)</sup>	V <sub>AUDIO</sub>	V <sub>BUS</sub>	L, R	D+, D-
Low	Low	Low	OFF	OFF
Low	Low	High <sup>(2)</sup>	OFF	ON
Low	High <sup>(2)</sup>	Low	ON	OFF
Low	High <sup>(2)</sup>	High <sup>(2)</sup>	OFF	ON
High	Low	Low	OFF	OFF
High	Low	High <sup>(2)</sup>	OFF	ON
High	High <sup>(2)</sup>	Low	ON	OFF
High	High <sup>(2)</sup>	High <sup>(2)</sup>	ON	OFF

### Notes:

1. A<sub>SEL</sub>- Internal resistor to GND provides auto-V<sub>BUS</sub> detect if there is no external connection. Forcing A<sub>SEL</sub> HIGH when V<sub>AUDIO</sub> is present overrides the USB path even if V<sub>BUS</sub> is present.
2. H - Value is the threshold as defined to meet USB2.0 V<sub>BUS</sub> requirements and audio supply threshold in a system (see DC Tables).

## Functional Description

The FSA201 is a combined USB and audio switch that enables sharing the D+/D- lines of a USB connector with stereo audio CODEC outputs. The switch is optimized for full-speed USB signals and includes an automatic  $V_{BUS}$ -detection circuit. When a USB connector, rather than a headphone, is connected to the ultra-portable device the switch is automatically configured for full-speed USB data transfer. If no  $V_{BUS}$  is detected, and yet  $V_{AUDIO}$  is present, the switch is configured for the low-distortion audio switch path. The audio switch path also handles negative signals (down to -2V), which eliminates the need for large coupling capacitors.

For those applications where the  $V_{BUS}$  is generated as a self-powered device or where  $V_{BUS}$  is not removed, the  $A_{SEL}$  pin provides the ability to switch, under software control, to the audio path. The  $A_{SEL}$  pin is internally

terminated by a resistor to GND (typical value  $3M\Omega$ ) and requires no connection for the standard ultra-portable (cell-phone, MP3, or Portable Media Player). In an application where the supply to the FSA201  $V_{BUS}$  pin is not guaranteed to be removed, a GPIO pin can be used to switch out of full-speed USB mode into audio mode, using the  $A_{SEL}$  pin.

The FSA201  $V_{BUS}$  pin must be connected directly to  $V_{BUS}$  or a supply  $> 3.8V$ , not an LDO regulated down to 3.6V or a  $V_{bat}$ -generated supply that may fall below 3.8V in normal operation (see the Application Diagram).

## Application Diagram

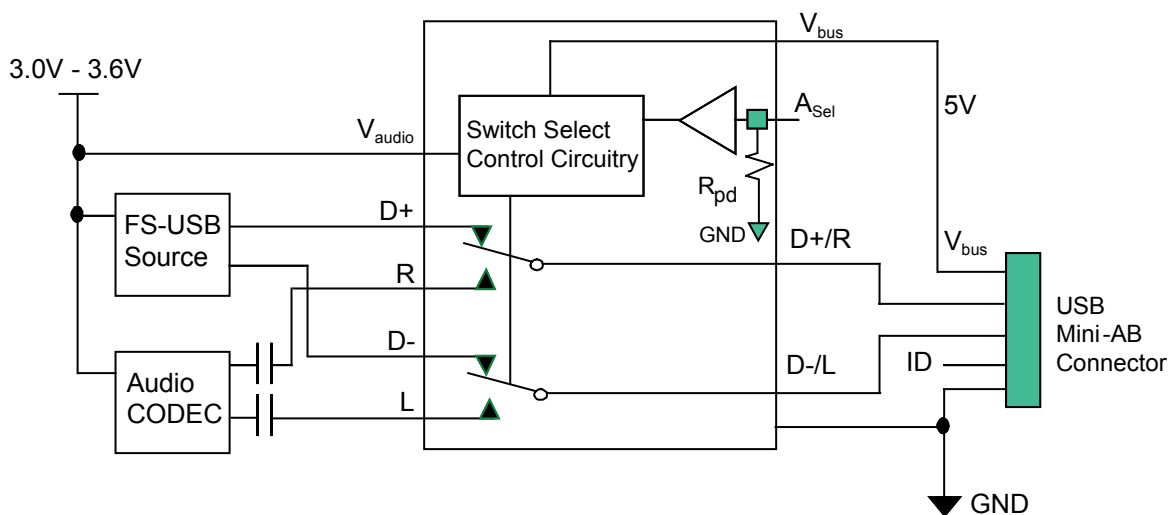


Figure 4. Application Diagram

## 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	Conditions
V <sub>AUDIO</sub>	Supply Voltage	-0.5V to 6.0V
V <sub>BUS</sub>	Supply Voltage	-0.5V to 6.0V
V <sub>SW</sub>	Switch I/O Voltage <sup>(3)</sup>	R, L Pins (V <sub>AUDIO</sub> - 7.0V) to (V <sub>AUDIO</sub> + 0.3V)
		D+, D-, D+/R, D-/L Pins (V <sub>BUS</sub> - 7.0V) to (V <sub>BUS</sub> + 0.3V)
A <sub>SEL</sub>	Control Input Voltage <sup>(3)</sup>	-0.5V to + 6.0V
I <sub>IK</sub>	Input Clamp Diode Current	- 50mA
I <sub>SW</sub>	Switch I/O Current (Continuous)	USB
		Audio
I <sub>SWPEAK</sub>	Peak Switch Current (Pulsed at 1ms Duration, <10% Duty Cycle)	USB
		Audio
T <sub>STG</sub>	Storage Temperature Range	-65°C to +150°C
T <sub>J</sub>	Maximum Junction Temperature	+150°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)	+260°C
ESD	Human Body Model (JEDEC: JESD22-A114)	I/O to GND
		All Other Pins
	Charged Device Model (JEDEC: JESD22-C101)	

**Note:**

- 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	Minimum	Maximum
V <sub>AUDIO</sub>	Supply Voltage	2.7V	3.6V
V <sub>BUS</sub>	Supply Voltage	4.25V	5.50V
A <sub>SEL</sub>	Control Input Voltage	0V	V <sub>AUDIO</sub>
V <sub>SW</sub>	Switch I/O Voltage	V <sub>AUDIO</sub> - 6.5V	V <sub>AUDIO</sub> - 0.3V
T <sub>A</sub>	Operating Temperature	-40°C	85°C
θ <sub>JA</sub>	Thermal Resistance (free air)	MicroPak 10	330°C / W (estimated)

## DC Electrical Characteristics

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	V <sub>AUDIO</sub> (V)	Conditions	T <sub>A</sub> = -40°C to +85°C			Unit
				Min.	Typ.	Max.	
<b>Common Pins</b>							
V <sub>IK</sub>	Clamp Diode Voltage	2.7	I <sub>IK</sub> = -18mA			-1.2	V
V <sub>IH</sub>	Control Input Voltage HIGH	2.7 to 3.6		1.3			
V <sub>IL</sub>	Control Input Voltage LOW	2.7 to 3.6				0.5	
I <sub>IN</sub>	A <sub>SEL</sub> Input HIGH Current	3.6	V <sub>CNTRL</sub> = 0V to 3.6V	-3		3	μA
I <sub>OFF</sub>	Power Off Leakage Current (Common Port Only D+/R, D-/L)	V <sub>AUDIO</sub> = V <sub>BUS</sub> = 0V	Common Port (D+/R, D-/L) V <sub>SW</sub> = 0V to 5.5V			1	μA
I <sub>NO(OFF)</sub>	Off Leakage Current of Port D+, D-, R, L	3.6	V <sub>BUS</sub> = 0V, 5.5V D+/R, D-/L = 0.3V, V <sub>AUDIO</sub> = 0.3V D+, D-, R, L = 0.3V, V <sub>AUDIO</sub> = -0.3V or Floating See Figure 14	-50	10	50	nA
I <sub>NC(ON)</sub>	On Leakage Current of Port D+/R or D-/L	3.6	V <sub>BUS</sub> = 0V, 5.5V D+/R, D-/L = 0.3V, V <sub>AUDIO</sub> = 0.3V D+, D-, R, L = Floating See Figure 15	-100	50	100	nA
<b>USB Switch Path</b>		V <sub>BUS</sub> (V)					
	USB Analog Signal Range			0		3.6	V
R <sub>ONUSB</sub>	FS Switch On Resistance <sup>(4)</sup>	4.25	V <sub>D+/D-</sub> = 0V, 3.0V, I <sub>ON</sub> = -8mA See Figures 6, 13		3	6	Ω
Δ R <sub>ONUSB</sub>	FS Delta R <sub>ON</sub> <sup>(4,6)</sup>	4.25	V <sub>D+/D-</sub> = 3V, I <sub>ON</sub> = -8mA		0.35		Ω
<b>Audio Switch Path</b>		V <sub>AUDIO</sub> (V)					
	Audio Analog Signal Range			V <sub>AUDIO</sub> -6.5		V <sub>AUDIO</sub>	V
R <sub>ONAUDIO</sub>	Audio Switch On Resistance <sup>(7)</sup>	2.7	V <sub>L/R</sub> = -2V, 0V, 0.7V, V <sub>AUDIO</sub> = 0.7V, V <sub>AUDIO</sub> I <sub>ON</sub> = -100mA, V <sub>BUS</sub> = 0V See Figures 5, 13		0.5	1.0	Ω
Δ R <sub>ONAudio</sub>	Audio Delta R <sub>ON</sub> <sup>(4)</sup>	2.7	V <sub>L/R</sub> = 0.7V I <sub>ON</sub> = -100mA		0.01	0.1	Ω
R <sub>FLAT(Audio)</sub>	Audio R <sub>ON</sub> Flatness <sup>(5)</sup>	2.7	V <sub>L/R</sub> = -2V, 0V, 0.7V, 2V, 2.7V I <sub>ON</sub> = -100mA			0.35	Ω

### Notes:

- Δ R<sub>ON</sub> = R<sub>ON max</sub> - R<sub>ON min</sub> measured at identical V<sub>CC</sub>, temperature, and voltage. Worst-case signal path, audio or USB channel, is characterized.
- Flatness is defined as the difference between the maximum and minimum values of on resistance over the specified range of conditions.
- Guaranteed by characterization, not production tested.
- On resistance is determined by the voltage drop between the A and B pins at the indicated current through the switch.

### DC Electrical Characteristics (Continued)

All typical values are at 25°C unless otherwise specified.

Symbol	Parameter	V <sub>AUDIO</sub> (V)	Conditions	T <sub>A</sub> = - 40°C to +85°C			Unit
				Min.	Typ.	Max.	
<b>Power Supply</b>							
V <sub>busth</sub>	V <sub>BUS</sub> Threshold Voltage			3.2		3.8	V
V <sub>audioth</sub>	V <sub>AUDIO</sub> Threshold			0.5		1.5	V
I <sub>CC(Audio)</sub>	Quiescent Supply Current (Audio)	3.0	V <sub>ASEL</sub> = 0 to V <sub>AUDIO</sub> , I <sub>OUT</sub> = 0			10	μA
I <sub>CC(VBUS)</sub>	Quiescent Supply Current (V <sub>BUS</sub> )		V <sub>ASEL</sub> = 0 to V <sub>AUDIO</sub> , I <sub>OUT</sub> = 0 V <sub>BUS</sub> = 5.5V			20	μA
I <sub>CCT</sub>	Increase in I <sub>CC</sub> Current per Control Voltage and V <sub>CC</sub>	3.0	V <sub>ASEL</sub> = 2.6V, V <sub>BUS</sub> = floating			15	μA
			V <sub>ASEL</sub> = 1.8V, V <sub>BUS</sub> = floating			18	

## AC Electrical Characteristics

All typical value are for  $V_{\text{AUDIO}} = 3.3\text{V}$  and  $V_{\text{BUS}} = 5.0$  at  $25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	$V_{\text{AUDIO}}/V_{\text{BUS}}$ (V)	Conditions	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$			Unit
				Min.	Typ.	Max.	
$T_{\text{ONAUDIO1}}$	Turn-On Time $V_{\text{AUDIO}} \uparrow$ to Output	$V_{\text{BUS}} = 0\text{V}$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 18			10	$\mu\text{s}$
$T_{\text{OFFAUDIO1}}$	Turn-Off Time $V_{\text{BUS}} \uparrow$ to Output	$V_{\text{AUDIO}} = 2.7$ for $V_{\text{BUS}} \uparrow$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 18			10	$\mu\text{s}$
$T_{\text{ONAUDIO2}}$	Turn-On Time $A_{\text{SEL}}$ to Output	$V_{\text{BUS}} = 4.25\text{V}$ $V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 17			1	$\mu\text{s}$
$T_{\text{OFFAUDIO2}}$	Turn-Off Time $A_{\text{SEL}}$ to Output	$V_{\text{BUS}} = 4.25\text{V}$ $V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 18			1	$\mu\text{s}$
$T_{\text{ONAUDIO3}}$	Turn-On Time $V_{\text{BUS}} \downarrow$ to Output	$V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 17			10	$\mu\text{s}$
$T_{\text{ONUSB}}$	Turn-On Time $V_{\text{USB}} \uparrow$ to Output	$V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 18			10	$\mu\text{s}$
$T_{\text{OFFUSB}}$	Turn-Off Time $V_{\text{USB}} \downarrow$ to Output	$V_{\text{AUDIO}} = 2.7$	$V_{\text{D+}/\text{R}, \text{D-}/\text{L}} = 1.0\text{V}$ $R_L = 50\Omega, C_L = 50\text{pF}$ See Figures 16, 18			10	$\mu\text{s}$
$T_{\text{PDUSB}}$	USB Switch Propagation Delay <sup>(8)</sup>	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$R_L = 50\Omega, C_L = 50\text{pF}$ See Figure 19		0.25		ns
$\text{OIRR}_{\text{USB}}$	Off-isolation - USB	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$f = 6\text{MHz}, R_T = 50\Omega,$ $C_L = 0\text{pF}$ See Figures 8, 23		-55		dB
$\text{OIRR}_A$	Off-Isolation - Audio	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$f = 6\text{MHz}, R_T = 50\Omega,$ $C_L = 0\text{pF}$ See Figures 7, 23		-37		dB
$X_{\text{talkUSB}}$	Non-Adjacent Channel Crosstalk - USB	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$f = 6\text{MHz}, R_T = 50\Omega,$ $C_L = 0\text{pF}$ See Figures 10, 24		-49		dB
$X_{\text{talkA}}$	Non-Adjacent Channel Crosstalk - Audio	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$f = 6\text{MHz}, R_T = 50\Omega,$ $C_L = 0\text{pF}$ See Figures 9, 24		-39		dB
BW	-3db Bandwidth	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 4.25\text{V}$	$R_T = 50\Omega, C_L = 0\text{pF},$ Signal 0dBm See Figures 11, 12, 22		400		MHz
THD	Total Harmonic Distortion	$V_{\text{AUDIO}} = 2.7$ $V_{\text{BUS}} = 0\text{V}$	$f = 20\text{Hz to } 20\text{kHz},$ $R_L = 32\Omega, V_{\text{R,L}} = 2V_{\text{pp}}$ See Figure 27		0.05		%
PSRR	Power Supply Rejection Ratio	$V_{\text{AUDIO}} = 3.3$ $V_{\text{BUS}} = 0\text{V}$	$f = 217\text{Hz on } V_{\text{AUDIO}}$ $V_{\text{R,L}} = 1.0\text{V}, R_T = 32\Omega,$ $V_{\text{Ripple}} = 600\text{mV}_{\text{pp}}$		-56		dB

**Note:**

8. Guaranteed by characterization, not production tested.

### USB Full-Speed Related AC Electrical Characteristics

Symbol	Parameter	V <sub>AUDIO</sub> / V <sub>BUS</sub> (V)	Conditions	T <sub>A</sub> = -40°C to +85°C			Unit
				Min.	Typ.	Max.	
t <sub>SK(O)</sub>	Channel-to-Channel Skew <sup>(9)</sup>	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V	t <sub>R</sub> = t <sub>F</sub> = 12ns (10-90%) at 6MHz C <sub>L</sub> = 50pF, R <sub>L</sub> = 50Ω See Figures 20, 21		150		ps
t <sub>SK(P)</sub>	Skew of Opposite Transitions of the Same Output <sup>(9)</sup>	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V	t <sub>R</sub> = t <sub>F</sub> = 12ns (10-90%) at 6MHz C <sub>L</sub> = 50pF, R <sub>L</sub> = 50Ω See Figures 20, 21		150		ps
t <sub>J</sub>	Total Jitter <sup>(9)</sup>	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 50pF, t <sub>R</sub> = t <sub>F</sub> = 12ns (10-90%) at 12Mbps (PRBS = 2 <sup>15</sup> - 1)		1.6		ns

**Note:**

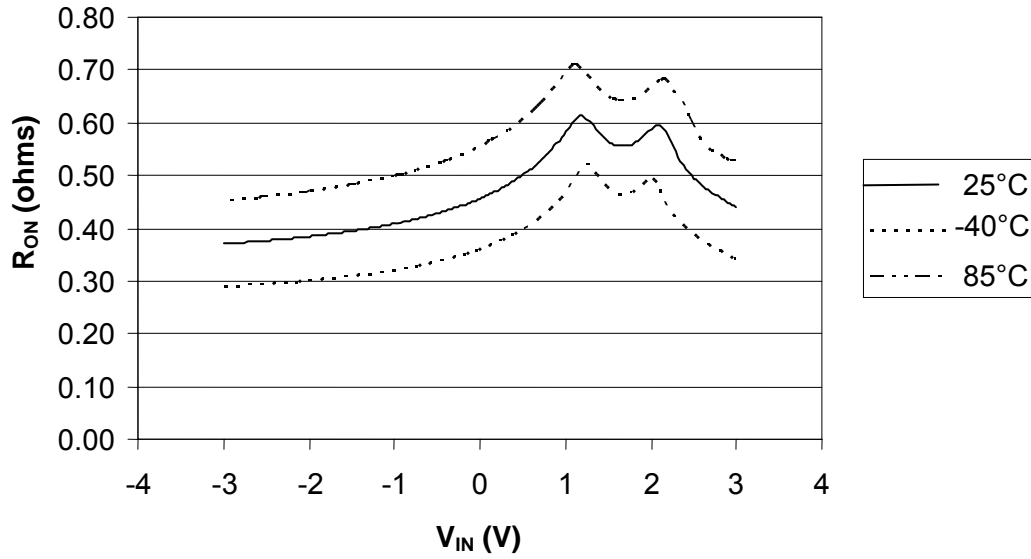
9. Guaranteed by characterization, not production tested.

### Capacitance

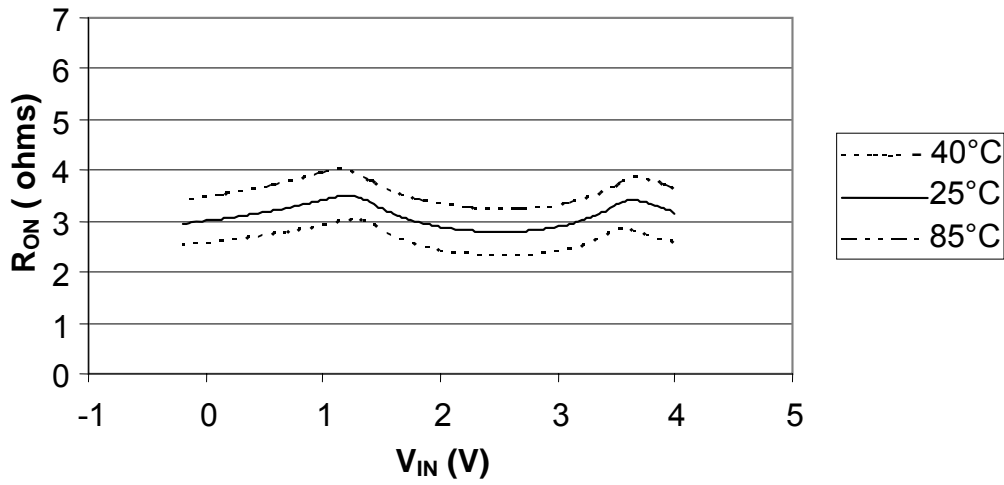
Symbol	Parameter	V <sub>AUDIO</sub> / V <sub>BUS</sub> (V)	Conditions	T <sub>A</sub> = -40°C to +85°C			Unit
				Min.	Typ.	Max.	
C <sub>IN (ASEL)</sub>	Control Pin Input Capacitance (A <sub>SEL</sub> )	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V	V <sub>Bias</sub> = 0.2V		2.5		pF
C <sub>ON(D+/R, D-/L)</sub>	D+/R, D-/L (Common Port) On Capacitance	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V A <sub>SEL</sub> = 0V (C <sub>ONUSB</sub> )	V <sub>Bias</sub> = 0.2V f = 6MHz See Figure 26		25		pF
		V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V A <sub>SEL</sub> = 2.7V (C <sub>ONAudio</sub> )	V <sub>Bias</sub> = 0.2V f = 6MHz See Figure 26		29		
C <sub>OFF(D+, D-)</sub>	USB Input Source Off Capacitance	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V A <sub>SEL</sub> = 2.7V	f = 6MHz See Figure 25		5		pF
C <sub>OFF(R/L)</sub>	Audio Input Source Off Capacitance	V <sub>AUDIO</sub> = 2.7V V <sub>BUS</sub> = 4.25V A <sub>SEL</sub> = 0V	f = 6MHz See Figure 25		17		pF



**Typical Characteristics**

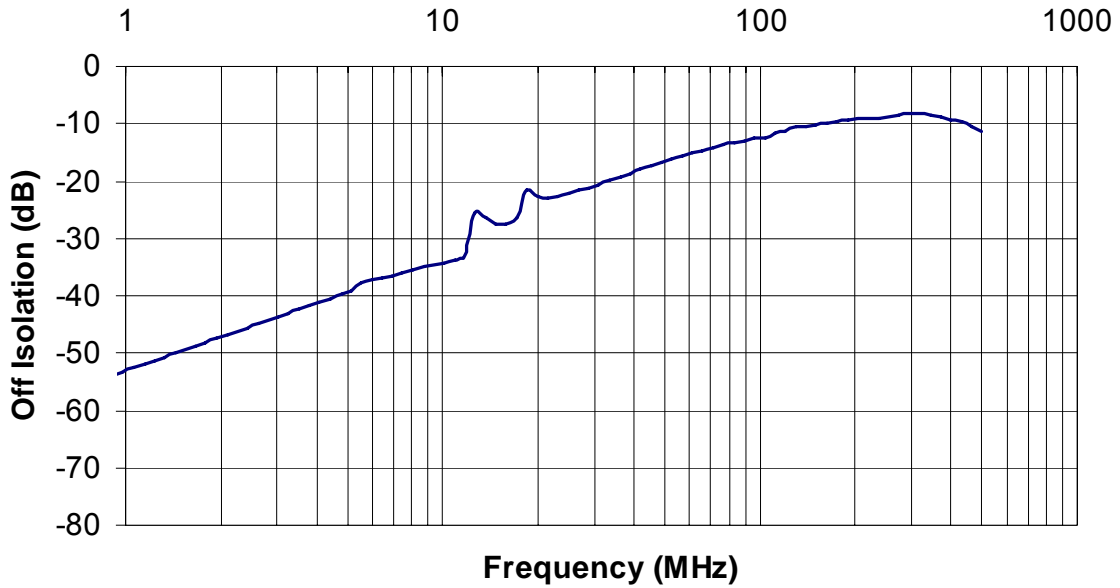


**Figure 5.**  $R_{ON}$  Audio Characterization ( $R_{ON}$  Audio R,  $V_{AUDIO} = 2.7V$ )

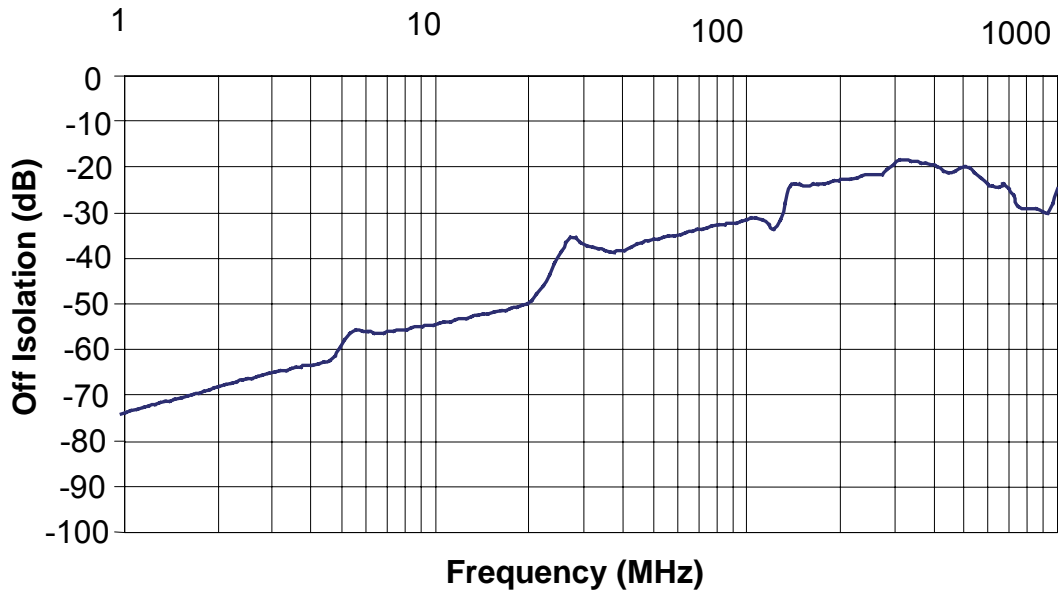


**Figure 6.**  $R_{ON}$  USB Characterization ( $R_{ON}$  USB D+)

**Typical Characteristics** (Continued)

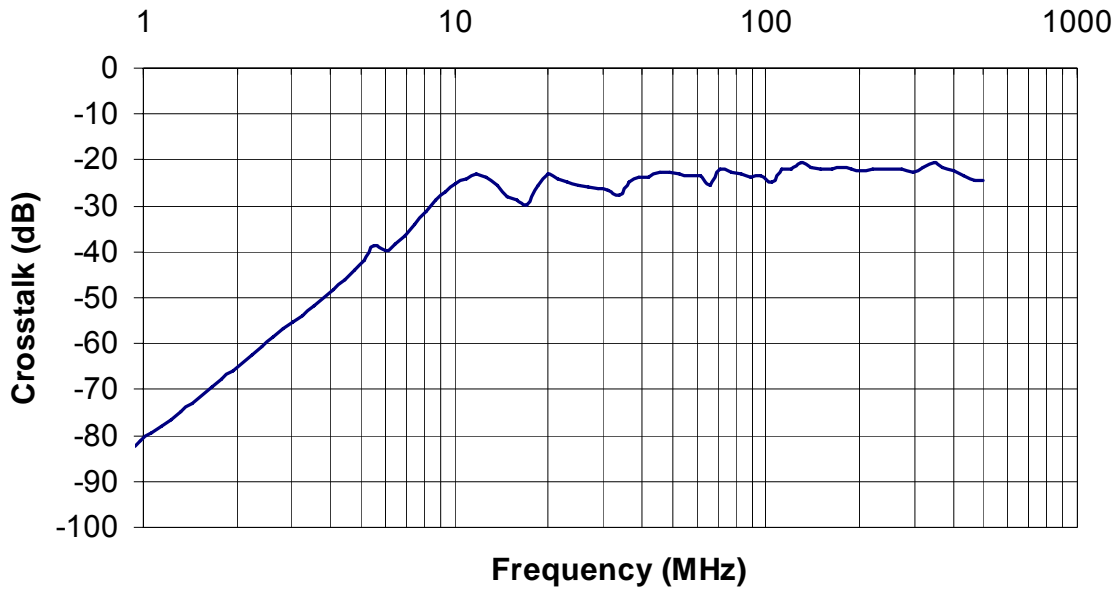


**Figure 7.** Off-Isolation (Audio) Characterization, Frequency Response at  $V_{CC} (V_{AUDIO}) = 2.7V$

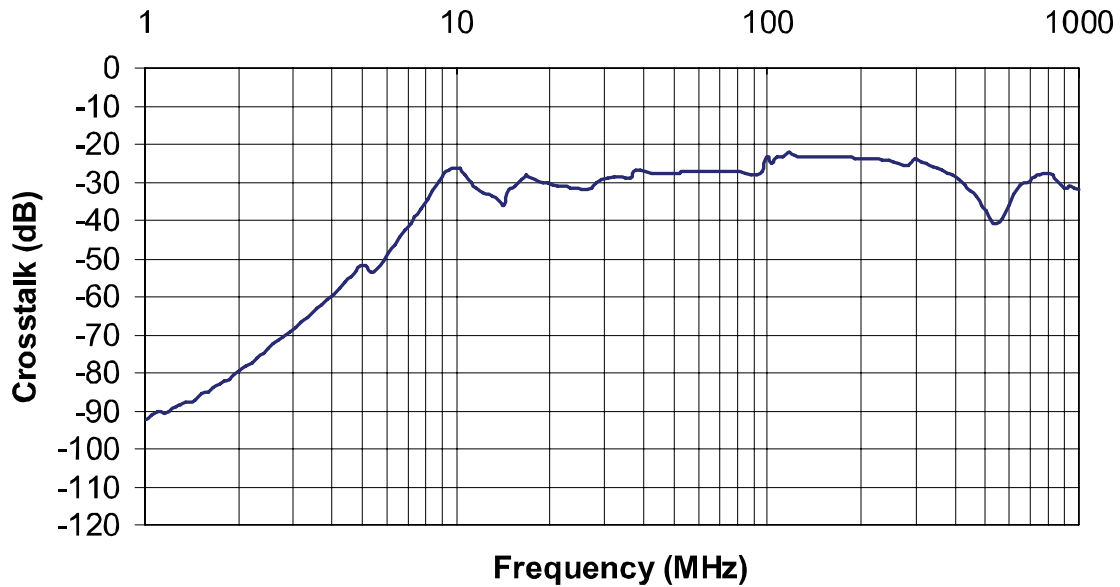


**Figure 8.** Off-Isolation (USB) Characterization, Frequency Response at  $V_{CC} (V_{BUS}) = 4.25V$

**Typical Characteristics** (Continued)



**Figure 9. Non-Adjacent Channel Crosstalk (Audio) Characterization at  $V_{CC} (V_{AUDIO}) = 2.7V$**



**Figure 10. Non-Adjacent Channel Crosstalk (USB) Characterization at  $V_{CC} (V_{BUS}) = 4.25V$**

**Typical Characteristics** (Continued)

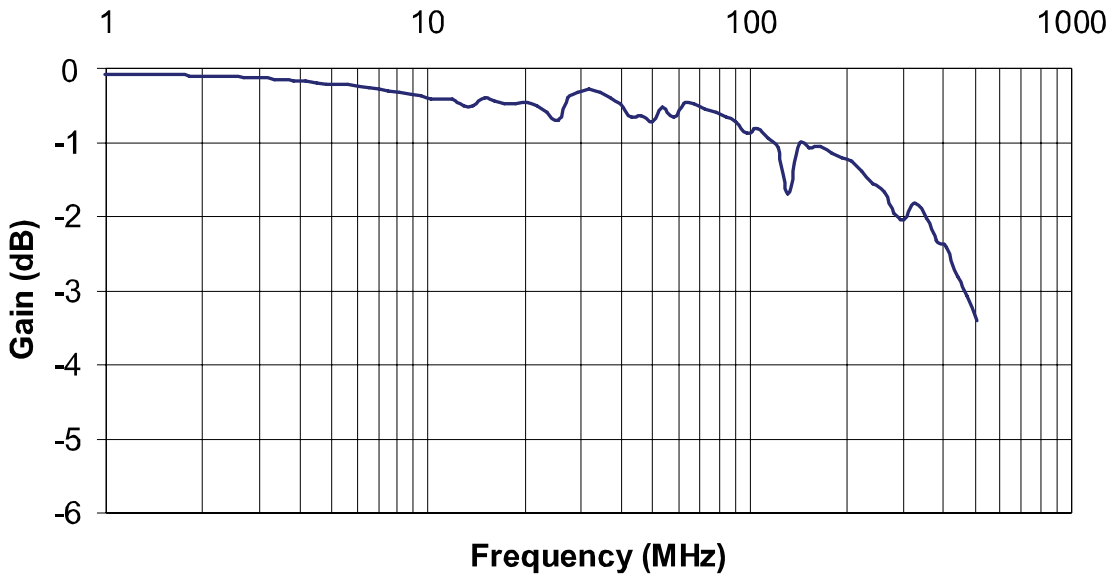


Figure 11. Bandwidth Characterization, Frequency Response at  $C_L = 0\text{pF}$ ,  $V_{CC} (V_{AUDIO}) = 2.7\text{V}$

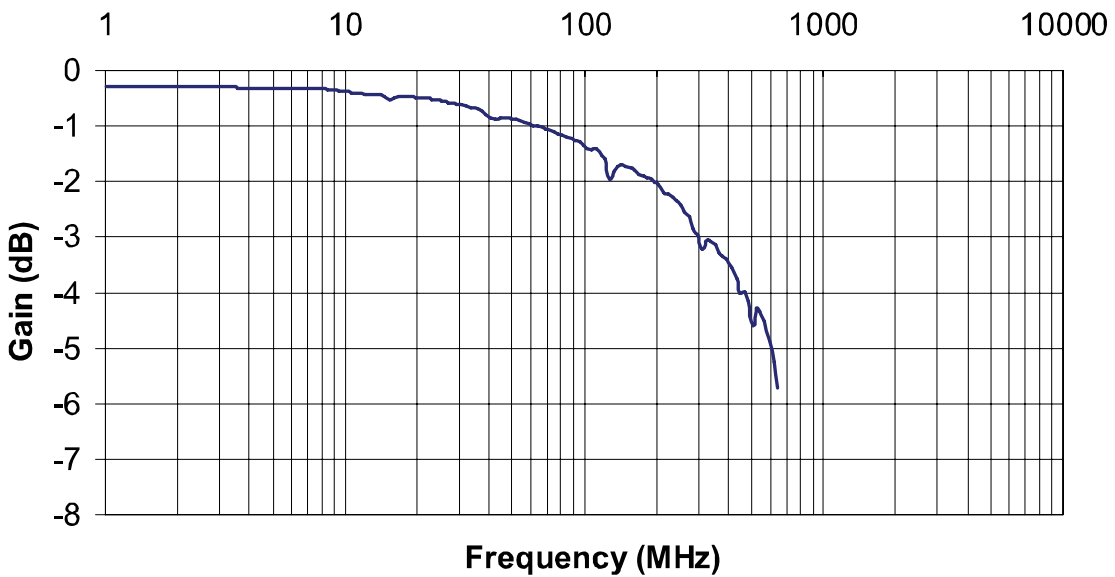
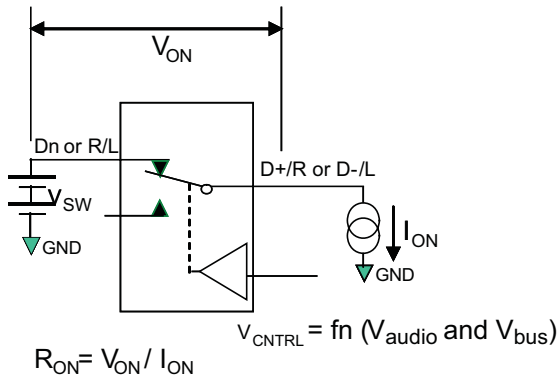
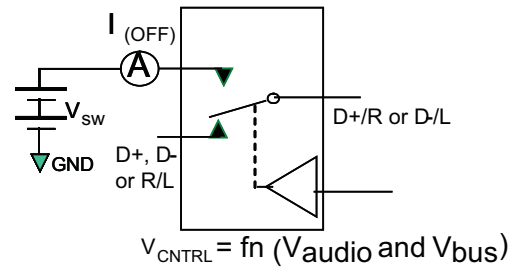


Figure 12. Bandwidth Characterization, Frequency Response at  $C_L = 0\text{pF}$ ,  $V_{CC} (V_{BUS}) = 4.25\text{V}$

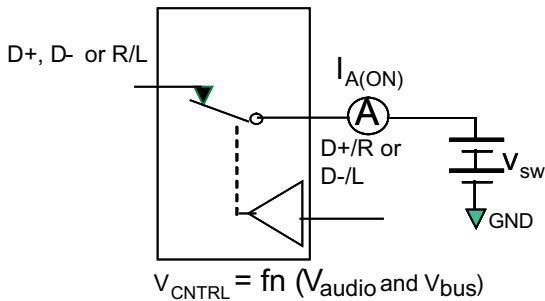
### Test Diagrams



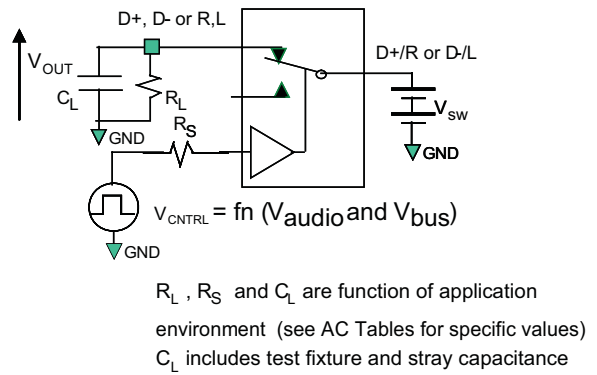
**Figure 13. On Resistance**



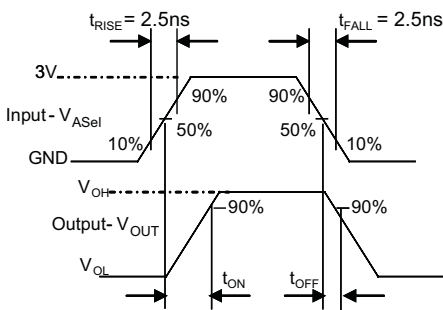
**Figure 14. Off Leakage**



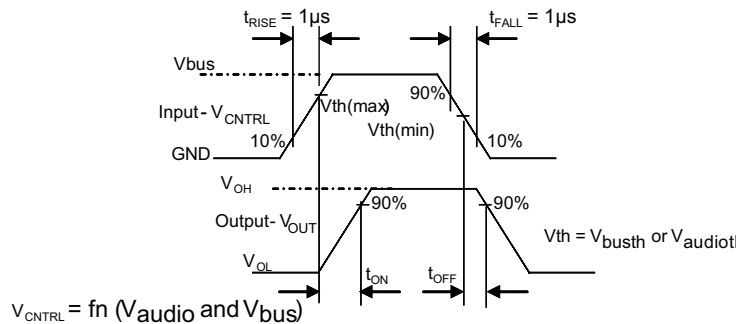
**Figure 15. On Leakage**



**Figure 16. AC Test Circuit Load**

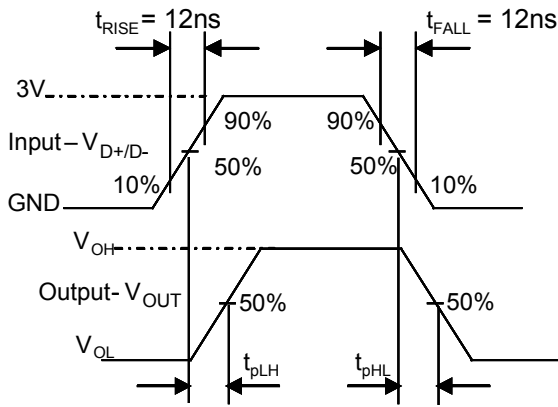


**Figure 17. Turn-On / Turn-Off Waveforms ( $A_{SEL}$ )**

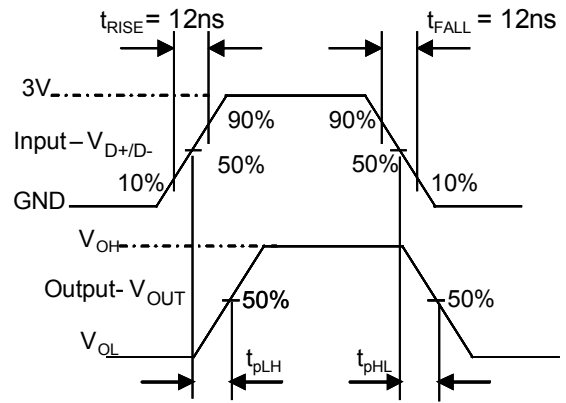


**Figure 18. Turn-On / Turn-Off Waveforms (USB/Audio)**

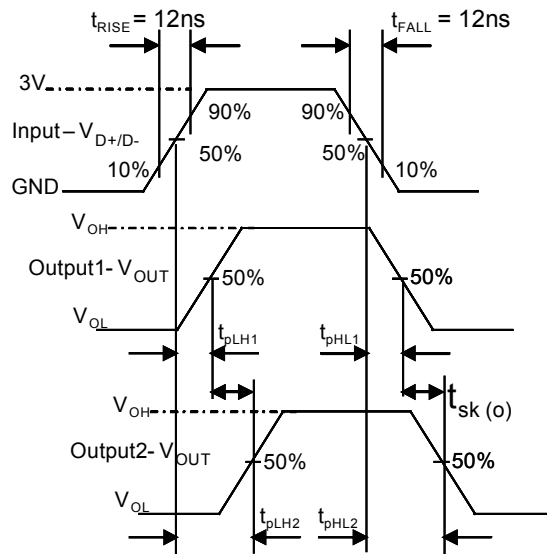
**Test Diagrams** (Continued)



**Figure 19. USB Switch Propagation Delay Waveforms**

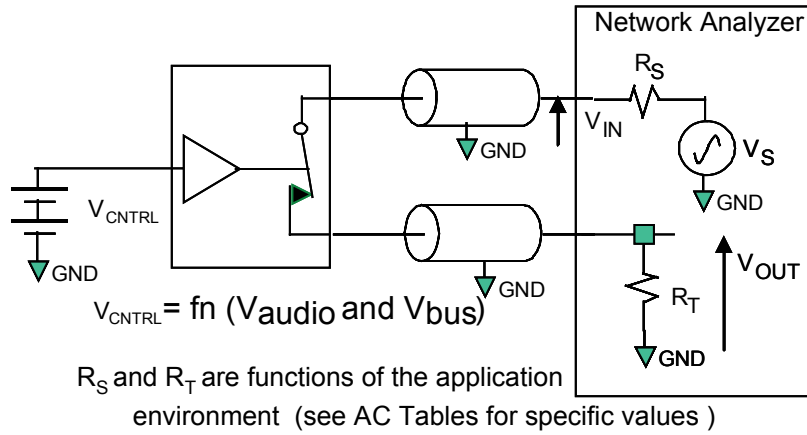


**Figure 20. Pulse Skew:  $t_{SK(P)} = |t_{pHL} - t_{pLH}|$**

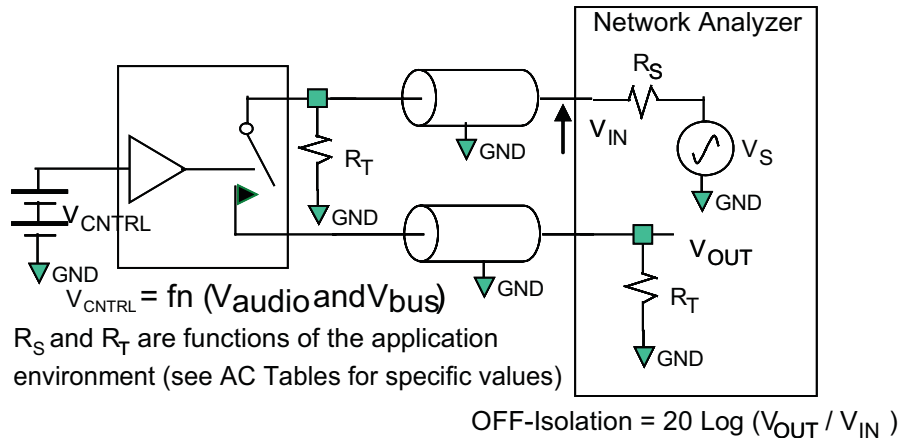


**Figure 21. Output Skew:  $t_{SK(O)} = |t_{pLH1} - t_{pLH2}|$  or  $|t_{pHL1} - t_{pHL2}|$**

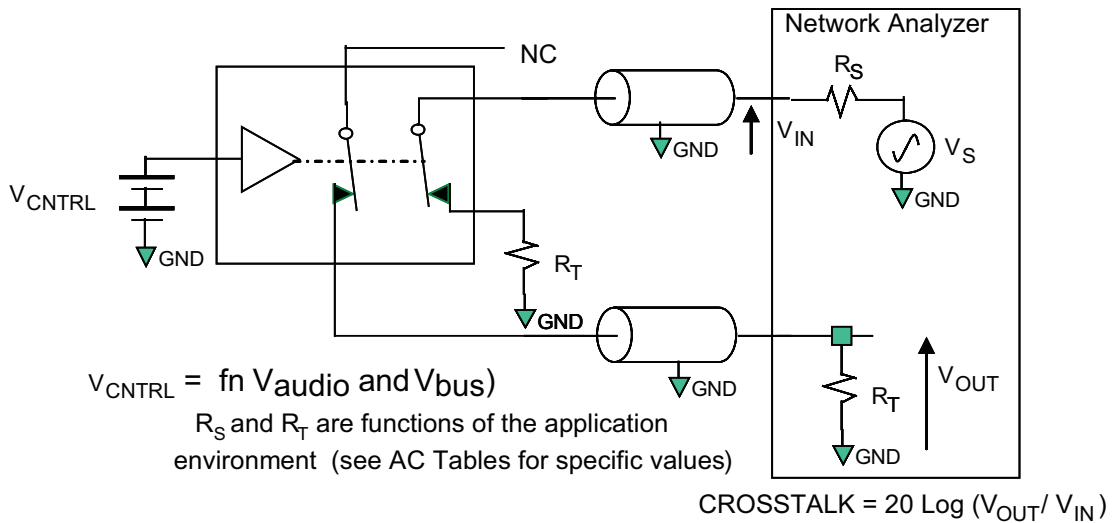
**Test Diagrams** (Continued)



**Figure 22. USB Bandwidth**

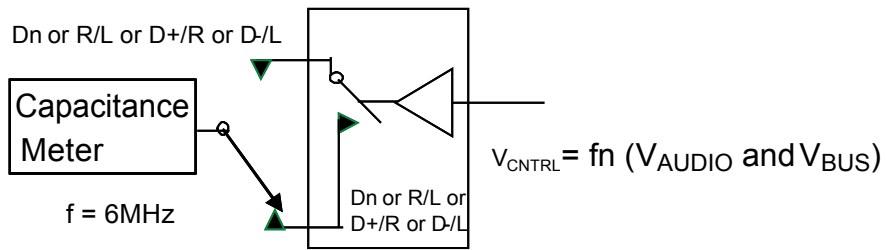


**Figure 23. Channel Off Isolation**

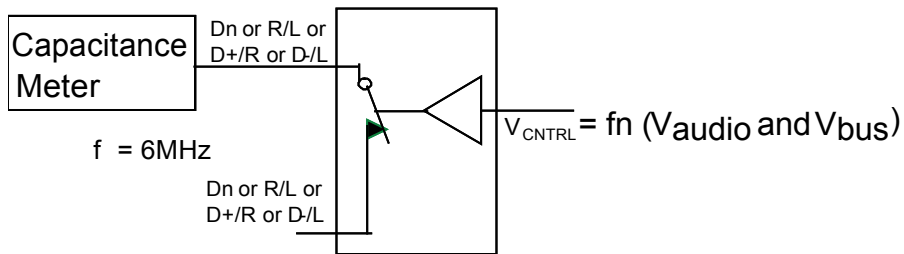


**Figure 24. Non-Adjacent Channel-to-Channel Crosstalk**

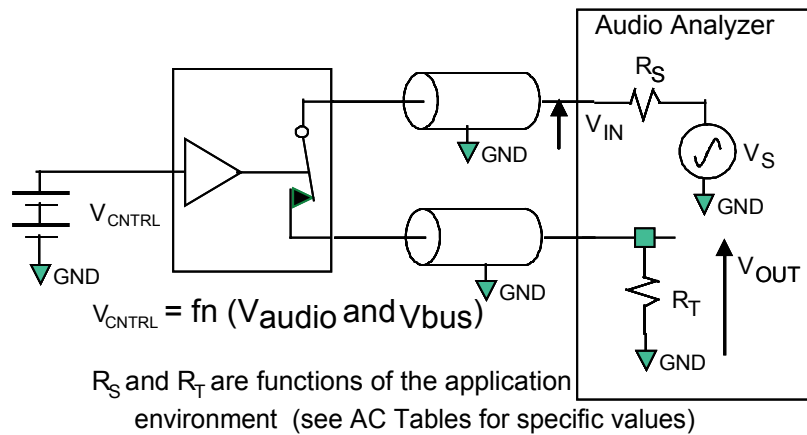
**Test Diagrams** (Continued)



**Figure 25. Channel Off Capacitance**



**Figure 26. Channel On Capacitance**



**Figure 27. Total Harmonic Distortion**

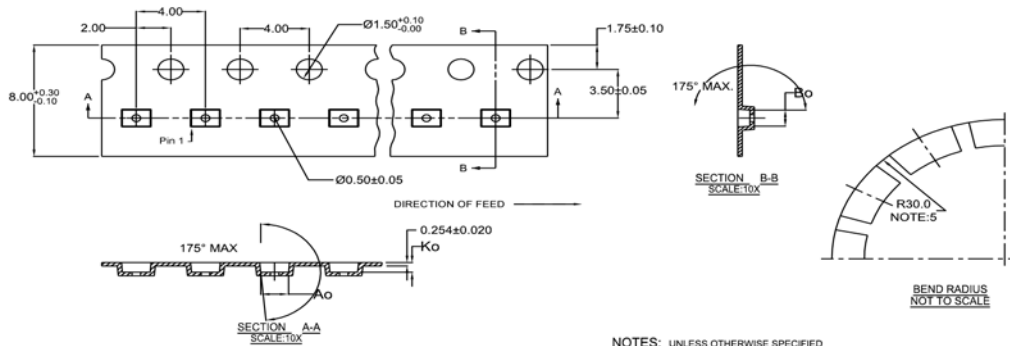


## Tape and Reel Specification

### Tape Format for MicroPak™

Dimensions are in millimeters unless otherwise noted.

Package Designator	Tape Section	Number Cavity	Cavity Status	Cover Tape Status
L10X	Leader (Start End)	125 (typical)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typical)	Empty	Sealed



10	300056	2.30 ± 0.05	1.78 ± 0.05	0.68 ± 0.05
8	300038	1.78 ± 0.05	1.78 ± 0.05	0.68 ± 0.05
6	300033	1.60 ± 0.05	1.15 ± 0.05	0.70 ± 0.05



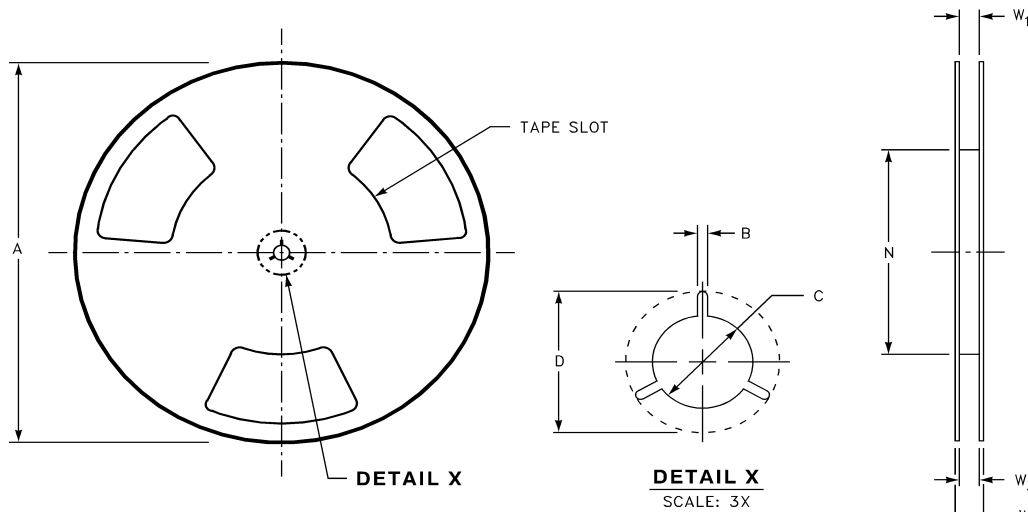
SCALE: 6X

NOTES: UNLESS OTHERWISE SPECIFIED

1. ACCUMULATED 50 SPROCKETS, SPROCKET HOLE PITCH IS 200.00 ± 0.30MM
2. NO INDICATED CORNER RADIUS IS 0.127MM
3. CAMBER NOT TO EXCEED 1MM IN 100MM
4. SMALLEST ALLOWABLE BENDING RADIUS
5. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

### Reel Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.

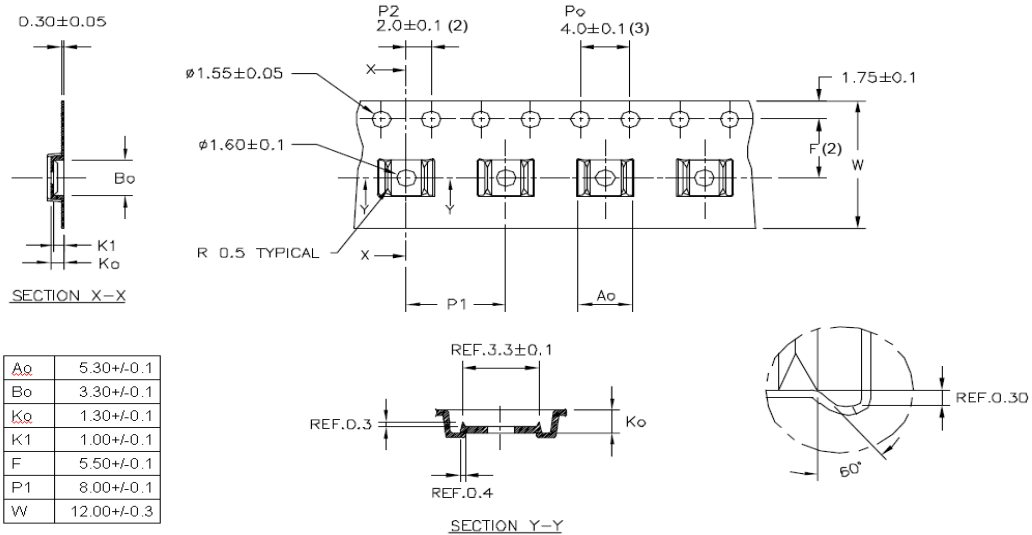


Tape Size	A	B	C	D	N	W1	W2	W3
	7.0	0.059	0.512	0.795	2.165	0.331 +0.590/-0.000	0.567	W1 + 0.078/-0.039
(8mm)	(177.8)	(1.50)	(13.0)	(20.20)	(55.00)	(8.40 +1.50/-0.00)	(14.40)	(W1+ 2.00/-1.00)

## Tape and Reel Specification

### Tape Dimensions for MSOP

Dimensions are in millimeters unless otherwise specified.

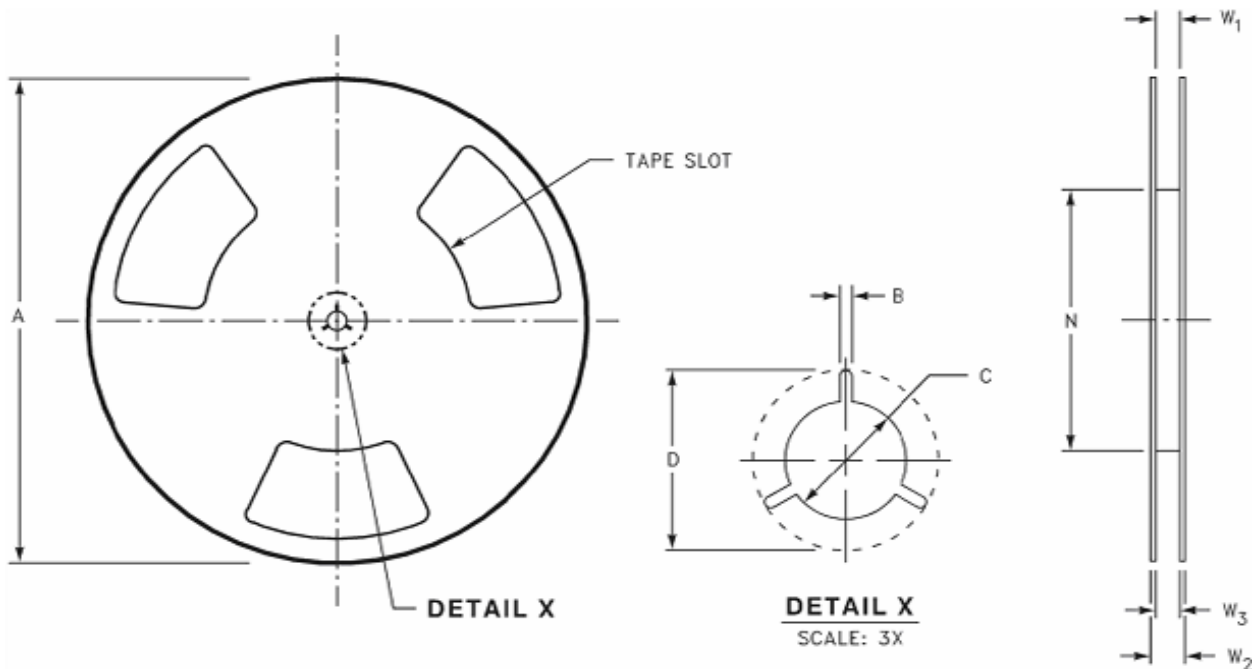


**Notes:**

1. All dimensions are in millimeters.
2. Measured from centerline of sprocket hole to centerline of pocket.
3. Cumulative tolerance of ten sprocket holes is ±0.20mm.
4. Other material available.

### Reel Dimensions for MSOP

Dimensions are in inches (millimeters) unless otherwise specified.




Tape Size	A	B	C	D	N	W1	W2	W3
	13	0.059	0.512	0.795	7.008	0.448	0.724	0.486-0.606
(12mm)	(330)	(1.5)	(13)	(20.2)	(178)	(12.4)	(18.4)	(11.9-15.4)






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FRFET <sup>®</sup>	PowerEdge <sup>™</sup>	 ™	
GlobalOptoisolator <sup>™</sup>	PowerSaver <sup>™</sup>	TinyBoost <sup>™</sup>	
GTO <sup>™</sup>	PowerTrench <sup>®</sup>	TinyBuck <sup>™</sup>	

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