coolaudio

Stereo Audio Codec with USB Interface, Single-Ended Analog Input/Output and S/PDIF

V2902

1. General Description

The V2902 is a single-chip USB stereo audio codec with USB-compliant full-speed protocol controller and S/PDIF. The USB protocol controller works with no software code, but the USB descriptors can be modified in some areas (e.g., vendor ID/product ID). The V2902 employs SpAct™ architecture, an unique system that recovers the audio clock from USB packet data. On-chip analog PLLs with SpAct enable playback and record with low clock jitter and with independent playback and record sampling rates. It is mainly be used in many areas, such as USB Audio Speaker, USB Headset, USB Monitor and USB Audio Interface Box.

Features:

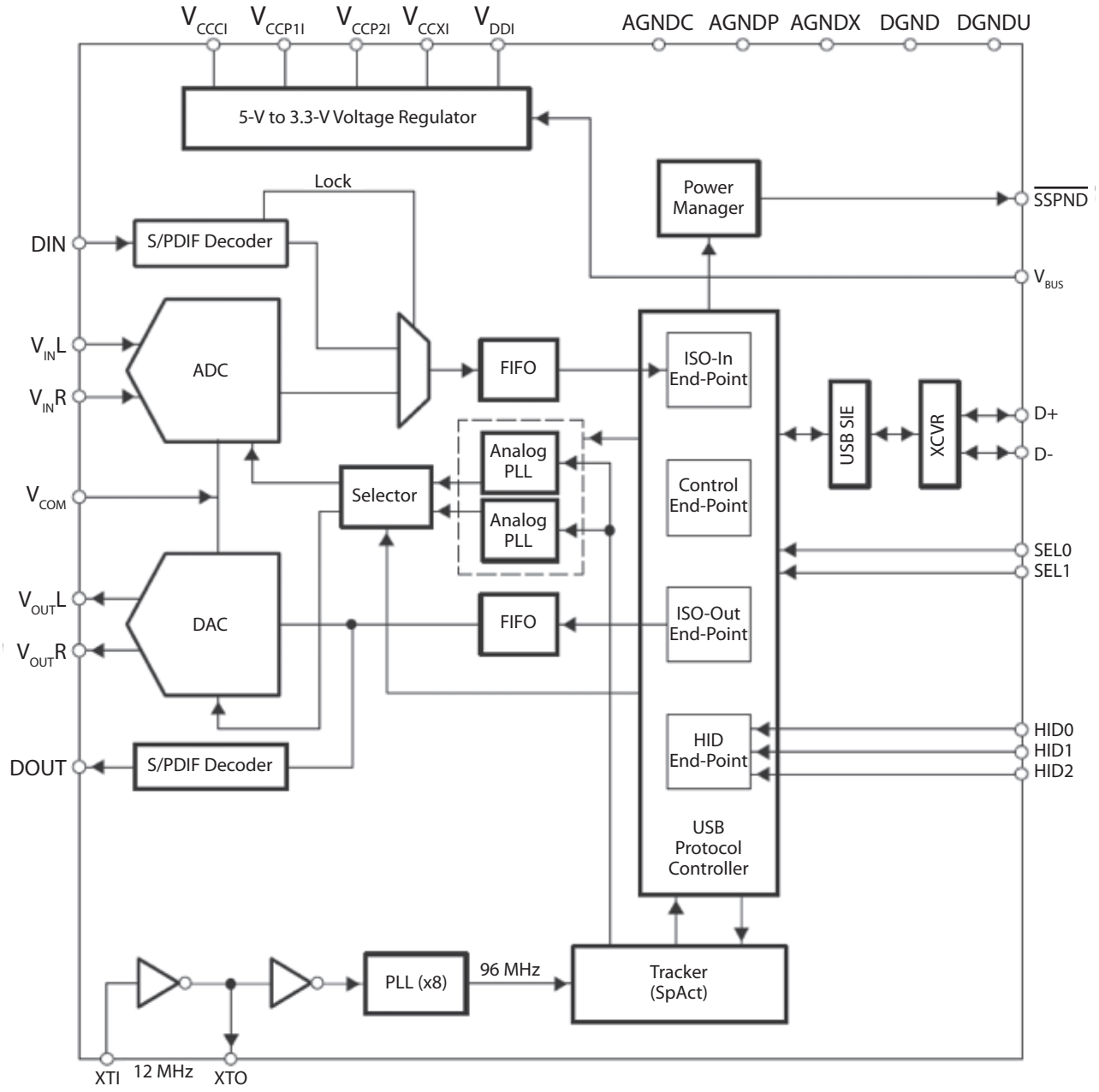
With S/PDIF

- On-Chip USB Interface
  - With Full-Speed Transceivers
  - Fully Compliant With USB 1.1 Specifi cation
  - Certifi ed by USB-IF
  - Partially Programmable Descriptors
  - USB Adaptive Mode for Playback
  - USB Asynchronous Mode for Record
  - Bus Powered
- 16-Bit Delta Sigma ADC and DAC
- Sampling Rate
  - DAC: 32, 44.1, 48 kHz
  - ADC: 8, 11.025, 16, 22.05, 32, 44.1, 48 kHz
- With Single 12-MHz Clock Source
- Single Power Supply: 5 V TYP (V_{BUS})
- Stereo ADC
  - Analog Performance at VBUS = 5 V
  - THD+N = 0.01%
  - SNR = 89 dB
  - Dynamic Range = 89 dB
  - Decimation Digital Filter
  - Pass-Band Ripple = ±0.05 dB
  - Stop-Band Attenuation = –65 dB
  - Single-Ended Voltage Input
  - Antialiasing Filter Included
  - Digital LCF Included

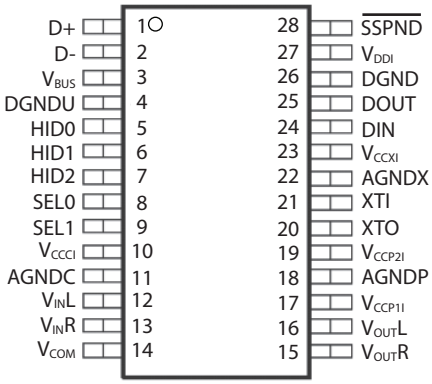
- Stereo DAC
  - Analog Performance at VBUS = 5 V
  - THD+N = 0.005%
  - SNR = 96 dB
  - Dynamic Range = 93 dB
  - Oversampling Digital Filter
  - Pass-Band Ripple = ±0.1 dB
  - Stop-Band Attenuation = –43 dB
  - Single-Ended Voltage Output
  - Analog LPF Included
- Multifunctions:
  - Human Interface Device (HID) Volume ± Control and Mute Control
  - Suspend Flag
- Package: 28-Pin SSOP

2. Block Diagram and Pin Description

2.1 Block Diagram



2.2 PIn Configurations



2.3 Pin Description

Pin No.	Pin Name	I/O	Description
1	D+	I/O	USB differential input/output plus (1)
2	D–	I/O	USB differential input/output minus (1)
3	V_{BUS}	—	Connect to USB power (V_{BUS})
4	DGNDU	—	Digital ground for USB transceiver
5	HID0	I	HID key state input (mute), active high (3)
6	HID1	I	HID key state input (volume up), active high (3)
7	HID2	I	HID key state input (volume down), active high (3)
8	SEL0	I	Must be set to high (6)
9	SEL1	I	Must be set to high (6)
10	V_{CCCI}	—	Internal analog power supply for codec (4)
11	AGNDC	—	Analog ground for codec
12	$V_{IN}L$	I	ADC analog input for L-channel
13	$V_{IN}R$	I	ADC analog input for R-channel
14	V_{COM}	—	Common for ADC/DAC (V_{CCCI}/2) (4)
15	$V_{OUT}R$	O	DAC analog output for R-channel
16	$V_{OUT}L$	O	DAC analog output for L-channel
17	V_{CCP1I}	—	Internal analog power supply for PLL (4)
18	AGNDP	—	Analog ground for PLL
19	V_{CCP2I}	—	Internal analog power supply for PLL (4)
20	XTO	O	Crystal oscillator output
21	XTI	I	Crystal oscillator input (2)
22	AGNDX	—	Analog ground for oscillator
23	V_{CCXI}	—	Internal analog power supply for oscillator (4)
24	DIN	I	S/PDIF input (5)
25	DOUT	O	S/PDIF output
26	DGND	—	Digital ground
27	V_{DDI}	—	Internal digital power supply (4)
28	$\overline{SSPND}$	O	Suspend flag, active low (Low: suspend, High: operational)

(1) LV-TTL level.

(2) 3.3-V CMOS level input.

(3) 3.3-V CMOS level input with internal pull-down. This pin informs the PC of serviceable control signals such as mute, volume up, or volume down, which has no connection with the internal DAC or ADC directly.

(4) Connect a decouple capacitor to GND.

(5) 3.3-V CMOS level input with internal pull-down, 5 V tolerant.

(6) TTL Schmitt trigger, 5 V tolerant.

3. Electrical Parameter

3.1 Absolute Maximum Ratings

(Tamb = 25 °C, All voltage referenced to GND, unless otherwise specified)

Characteristic	Symbol	Conditions	Value	Unit
Power Supply Voltage	V_{BUS}		–0.3 to 6.5	V
Ground voltage	AGNDC, AGNDP, AGNDX, DGND, DGNDU		±0.1	V
Input Current	I_{CC}		±10	mA
Digital input voltage	SEL0, SEL1, DIN		–0.3 ~ 6.5	V
	D+, D-, HID0, HID1, HID2, XTI, XTO, DOUT, SSPND		–0.3 ~ (VDDI+0.3) <4	
Analog input voltage	$V_{IN}L$, $V_{IN}R$, V_{COM}, $V_{OUT}R$, $V_{OUT}L$		–0.3 ~ (VcccI+0.3) <4	V
	V_{CCCI}, V_{CCP1I}, V_{CCP2I}, V_{CCXI}, V_{DDI}		–0.3 ~ 4	
Operating Temperature	Topr		–40 ~ 125	°C
Storage Temperature	Tstg		–55 ~ 150	°C
Soldering Temperature	T_L	5s	260	°C

3.2 Electrical Characteristics

3.2.1 DC Characteristics (All specifications at TA = 25 °C, V_{BUS} = 5 V, f_S = 44.1 kHz, f_{IN} = 1 kHz, 16-bit data, unless otherwise noted)

Parameter	Symbol	Pins	Conditions	Min.	Typ.	Max.	Unit
High-level input voltage	V_{IH}	D+, D–		2		3.3	V
		XTI, HID0, HID1, HID2		2.52		3.3	
		SEL0, SEL1		2		5.25	
		DIN		2.52		5.25	
Low-level input voltage	V_{IL}	D+, D–				0.8	V
		XTI, HID0, HID1, HID2				0.9	
		SEL0, SEL1				0.8	
		DIN				0.9	
High-level input current	I_{IH}	D+,D–,XTI, SEL0, SEL1	V_{IN} = 3.3 V			±10	µA
		HID0, HID1, HID2	V_{IN} = 3.3 V		50	80	
		DIN	V_{IN} = 3.3 V		65	100	
Low-level input current	I_{IL}	D+,D–,XTI, SEL0, SEL1	V_{IN} = 0 V			±10	µA
		HID0, HID1, HID2	V_{IN} = 0 V			±10	
		DIN	V_{IN} = 0 V			±10	
High-level output voltage	V_{OH}	D+, D–		2.8			V
		DOUT	I_{OH} = –4 mA	2.8			
		$\overline{SSPND}$	I_{OH}= –2 mA	2.8			
Low-level output voltage	V_{OL}	D+, D–				0.3	V
		DOUT	I_{OL} = 4 mA			0.5	
		$\overline{SSPND}$	I_{OL} =2 mA			0.5	
Input clock frequency	XTI			11.994	12	12.006	MHz

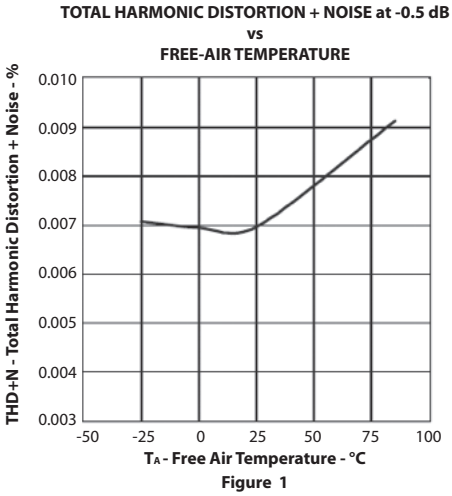
3.2.2 AC Characteristics (All specifi cations at TA = 25°C, VBUS = 5 V, fS = 44.1 kHz, fIN = 1 kHz, 16-bit data, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Dynamic Performance						
Total harmonic distortion plus noise	THD+N	V_{CCCI} =3.67 V, V_{IN} = –0.5 dB		0.01	0.02	%
		VIN = –0.5 dB		0.1		
		VIN = –60 dB		5		
Dynamic range		A-weighted	81	89		dB
Signal-to-noise ratio	SNR	A-weighted	81	89		dB
Channel separation			80	89		dB
Analog Input						
Input voltage				0.6 V_{CCCI}		V_{P-P}
Center voltage				0.5 V_{CCCI}		V
Input impedance				30		kΩ
Antialiasing fi lter frequency response		–3 dB		150		kHz
		f_{IN} = 20 kHz		–0.08		dB
Digital Filter Performance						
Pass band					0.454 f_S	Hz
Stop band			0.583 f_S			Hz
Pass-band ripple					±0.05	dB
Stop-band attenuation			–65			dB
Delay time	td			17.4/f_S		s
Clock Frequency						
Sampling frequency				32, 44.1, 48		kHz
Dynamic Performance						
Total harmonic distortion plus noise	THD+N	V_{OUT} = 0 dB		0.005	0.016	%
		V_{OUT} = –60 dB		3		
Dynamic range		EIAJ, A-weighted	87	93		dB
Signal-to-noise ratio	SNR	EIAJ, A-weighted	90	96		dB
Channel separation			86	92		dB
Analog Output						
Output voltage	V_O			0.6 V_{CCCI}		V_{P-P}
Center voltage				0.5 V_{CCCI}		V
Load impedance		AC coupling	10			kΩ
LPF frequency response		–3 dB		250		kHz
		f = 20 kHz		–0.03		dB
Digital Filter Performance						
Pass band					0.445 f_S	Hz
Stop band			0.555 f_S			Hz
Pass-band ripple					±0.1	dB
Stop-band attenuation			–43			dB
Delay time	t_d			14.3 f_S		s

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Requirements						
Voltage range	V_{BUS}		4.35	5	5.25	VDC
Supply current				56	67	mA
		Suspend mode		210		μA
Power dissipation	P_D	ADC, DAC operation		280	352	mW
		Suspend mode		1.05		mW
Internal power supply voltage	V_{CCCI}, V_{CCP1I}, VCCP2I, V_{CCXI}, and V_{DDI}		3.25	3.35	3.5	VDC

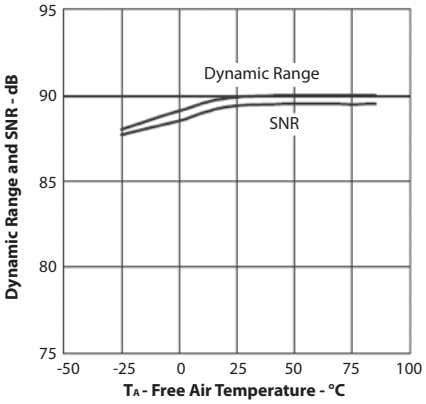
4. Characteristic Curve

ADC



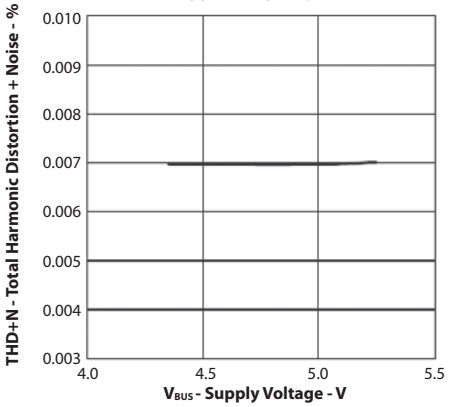
TOTAL HARMONIC DISTORTION + NOISE at -0.5 dB vs FREE-AIR TEMPERATURE

Figure 1



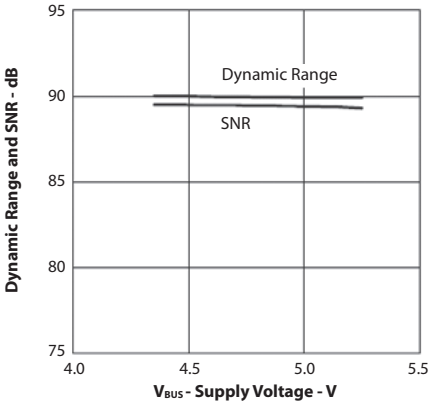
DYNAMIC RANGE and SNR vs FREE-AIR TEMPERATURE

Figure 2



TOTAL HARMONIC DISTORTION + NOISE at -0.5 dB vs SUPPLY VOLTAGE

Figure 3



DYNAMIC RANGE and SNR vs SUPPLY VOLTAGE

Figure 4

DAC

TOTAL HARMONIC DISTORTION + NOISE at 0 dB
vs
FREE-AIR TEMPERATURE

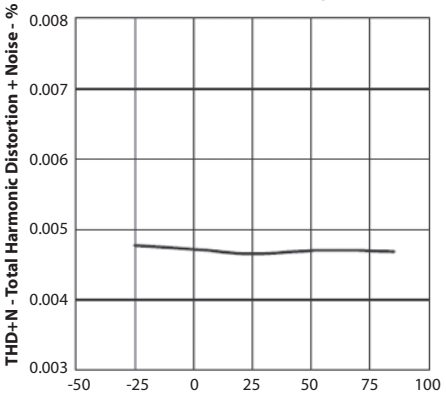


Figure 7

DYNAMIC RANGE and SNR
vs
FREE-AIR TEMPERATURE

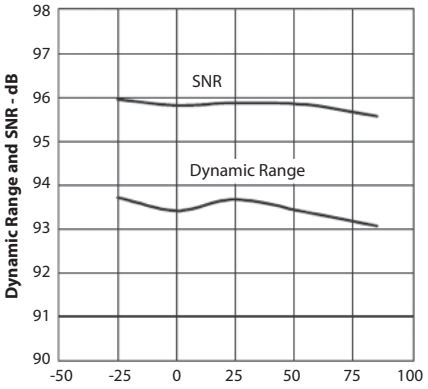


Figure 8

TOTAL HARMONIC DISTORTION + NOISE at 0 dB
vs
SUPPLY VOLTAGE

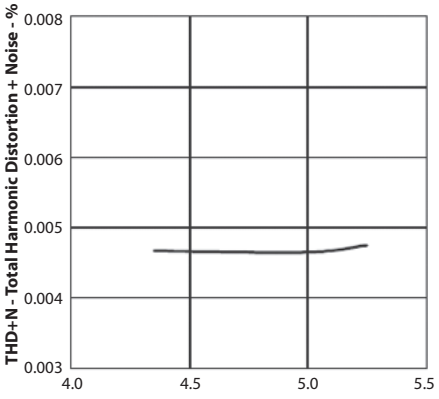


Figure 9

DYNAMIC RANGE and SNR
vs
SUPPLY VOLTAGE

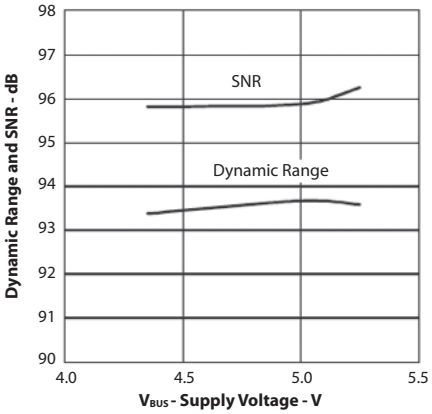


Figure 10

TOTAL HARMONIC DISTORTION + NOISE at 0 dB
vs
SAMPLING FREQUENCY

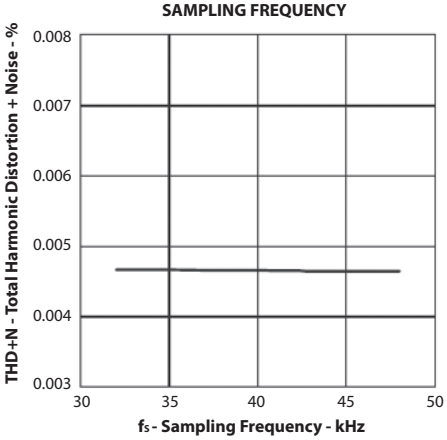


Figure 11

DYNAMIC RANGE and SNR
vs
SAMPLING FREQUENCY

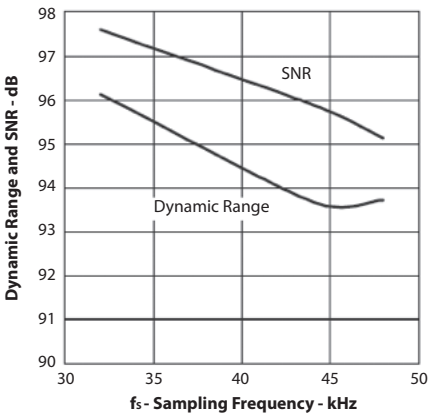


Figure 12

SUPPLY CURRENT

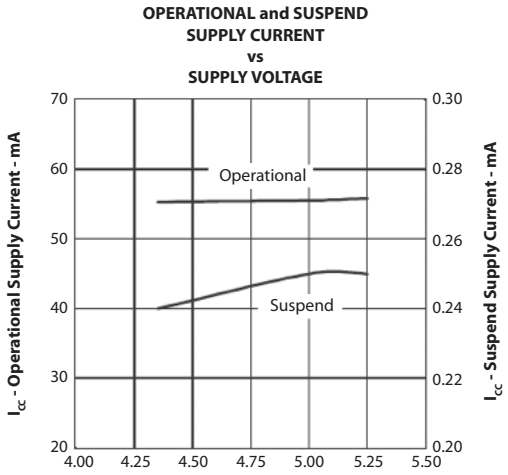


Figure 13

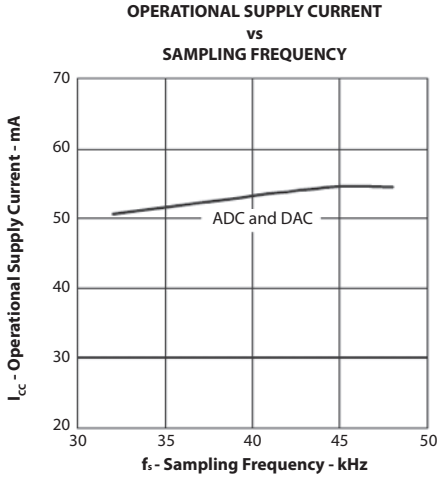


Figure 14

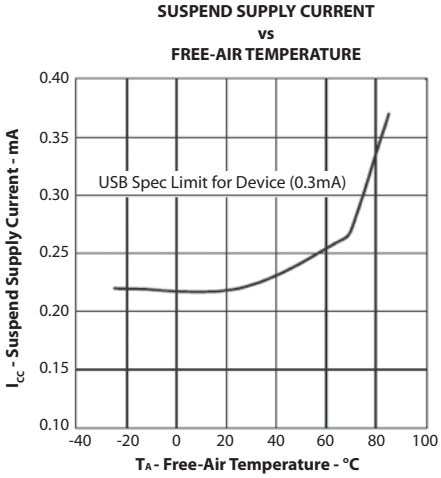


Figure 15

ADC DIGITAL DECIMATION FILTER FREQUENCY RESPONSE

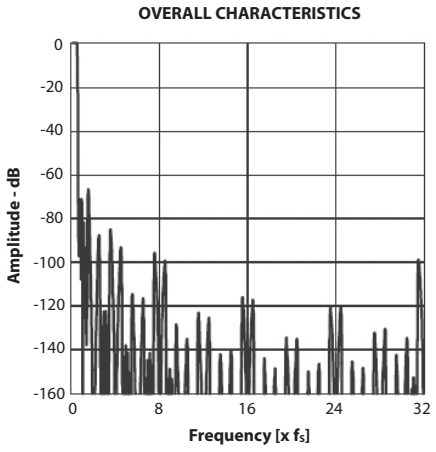


Figure 16

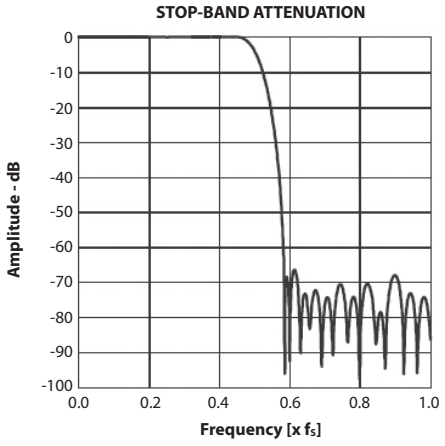


Figure 17

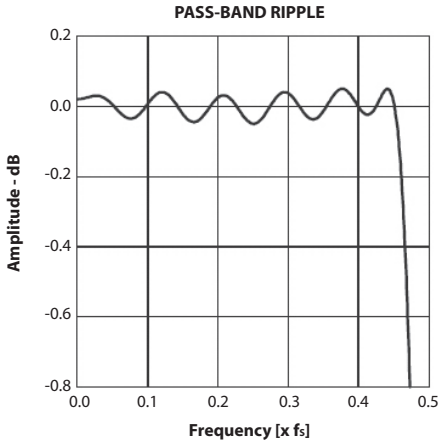


Figure 18

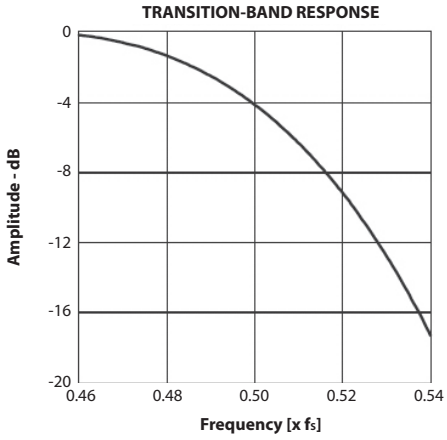


Figure 19

ADC DIGITAL HIGH-PASS FILTER FREQUENCY RESPONSE

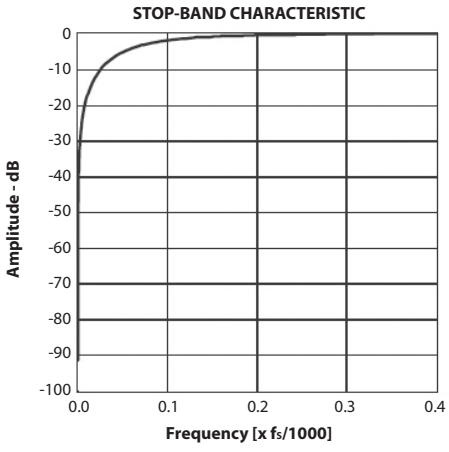


Figure 20

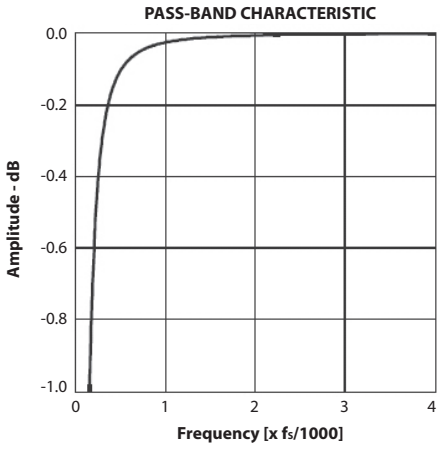


Figure 21

ADC ANALOG ANTIALIASING FILTER FREQUENCY RESPONSE

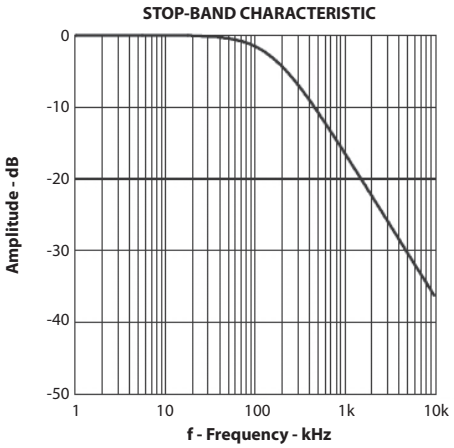


Figure 22

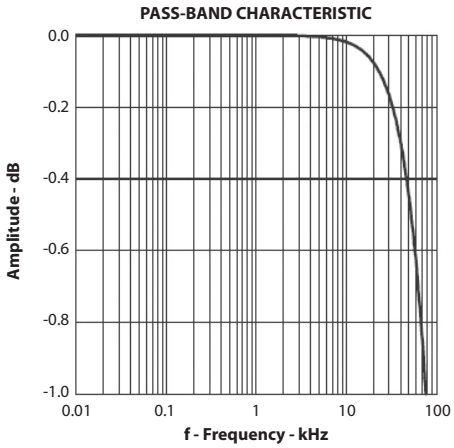


Figure 23

DAC DIGITAL INTERPOLATION FILTER FREQUENCY RESPONSE

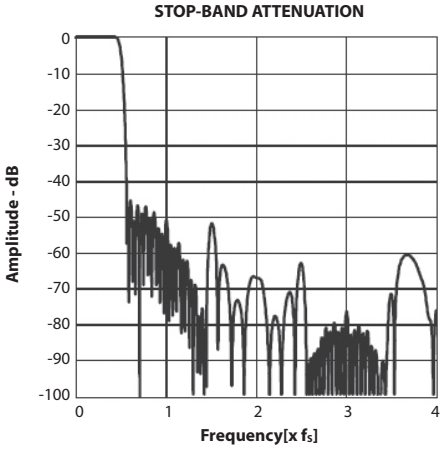


Figure 24

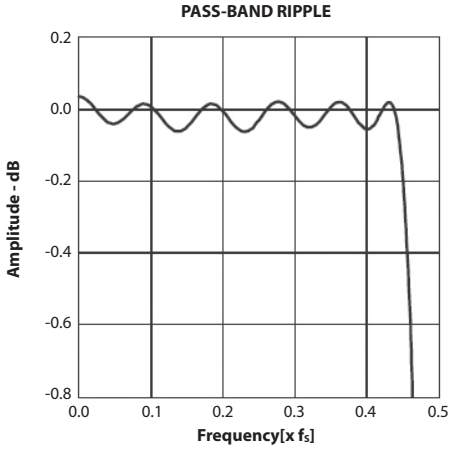


Figure 25

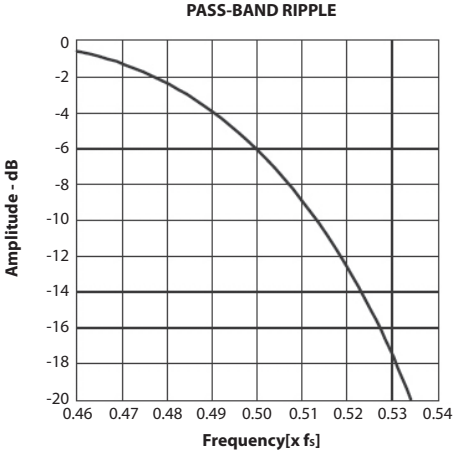


Figure 26

DAC ANALOG FIR FILTER FREQUENCY RESPONSE

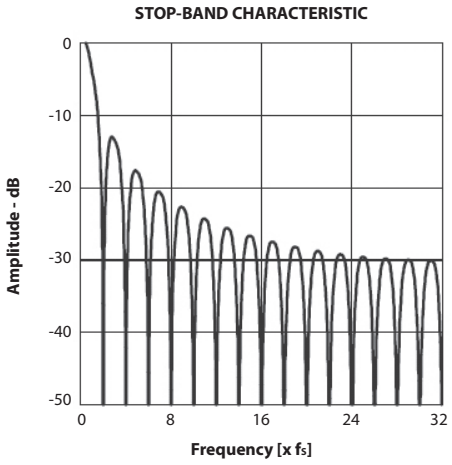


Figure 27

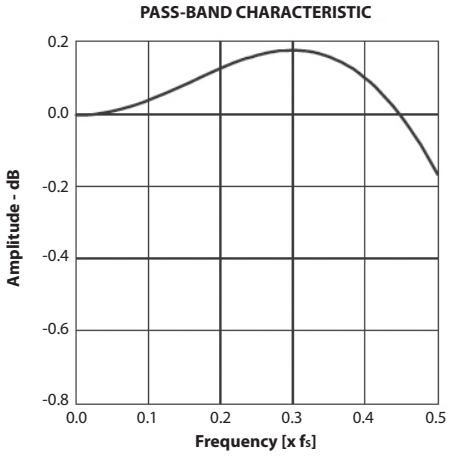


Figure 28

DAC ANALOG LOW-PASS FILTER FREQUENCY RESPONSE

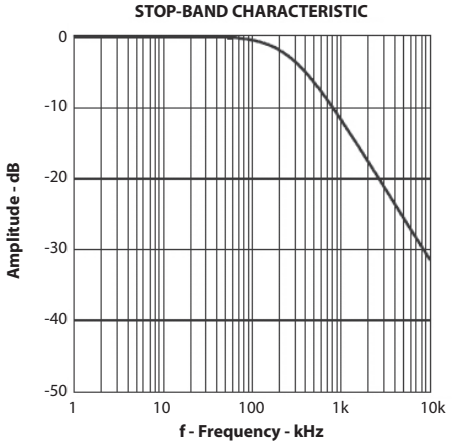


Figure 29

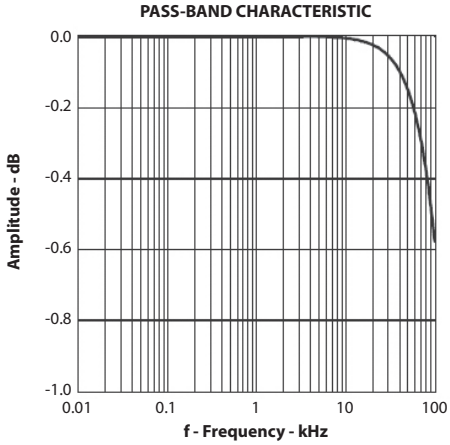


Figure 30

5. INTERFACE SEQUENCE

5.1 Power On, Attach, and Playback Sequence

The V2902 is ready for setup when the reset sequence has finished and the USB bus is attached. After connection has been established by setup, the V2902 is ready to accept USB audio data. While waiting, the audio data (idle state) and analog output are set to bipolar zero (BPZ).

When receiving the audio data, the V2902 stores the first audio packet, which contained 1-ms audio data, into the internal storage buffer. The V2902 starts playing the audio data when detecting the following start of frame (SOF) packet.

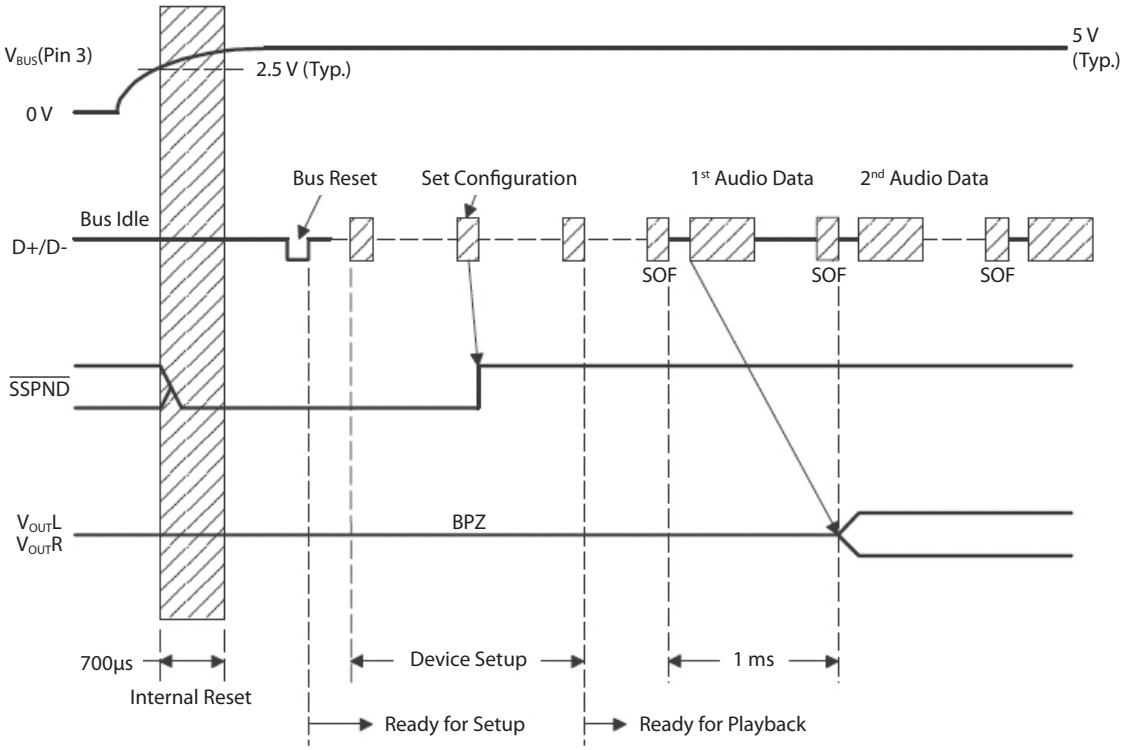


Figure 31. Initial Sequence

5.2 Play, Stop, and Detach Sequence

When the host finishes or aborts the playback, the V2902 stops playing after the last audio data has played.

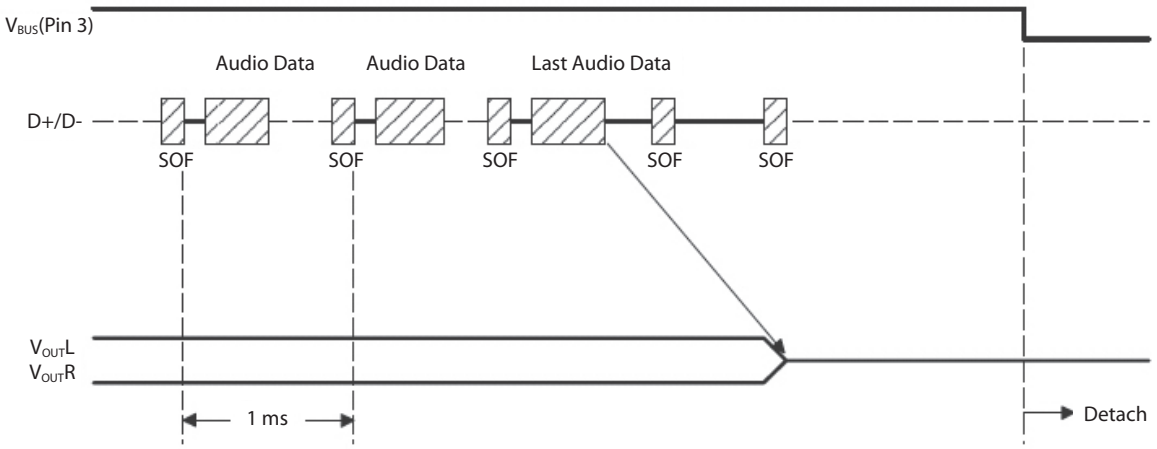


Figure 32. Play, Stop, and Detach

5.3 Record Sequence

The V2902 starts the audio capture into the internal memory after receiving the SET_INTERFACE command.

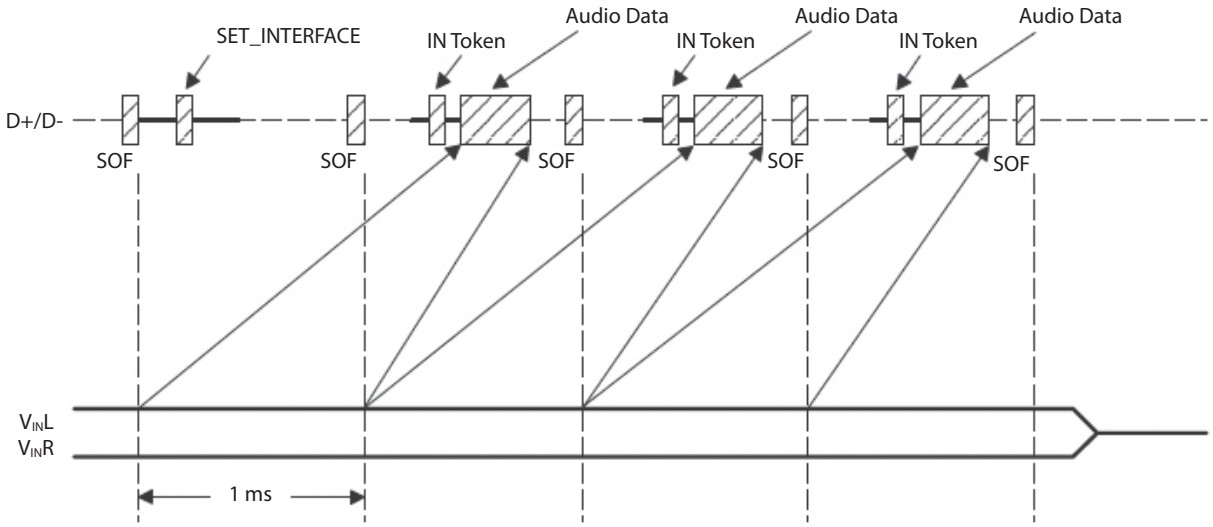


Figure 33. Record Sequence

5.4 Suspend and Resume Sequence

The V2902 enters the suspend state after it sees a constant idle state on the USB bus, approximately 5 ms. While the V2902 enters the suspend state, $\overline{SSPND}$ flag (pin 28) is asserted. The V2902 wakes up immediately when detecting the non-idle state on the USB bus.

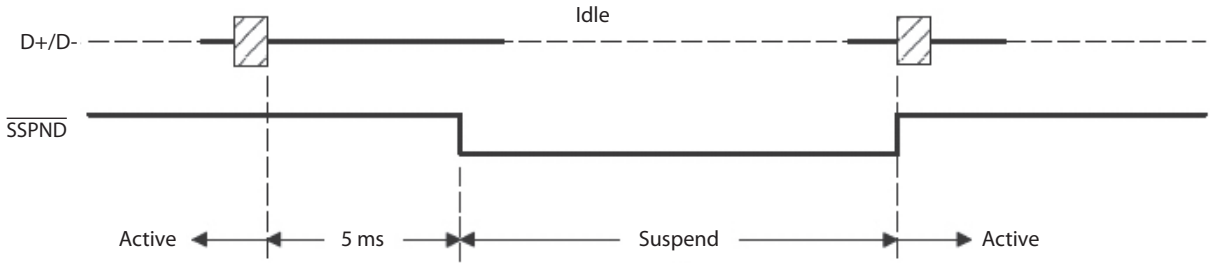
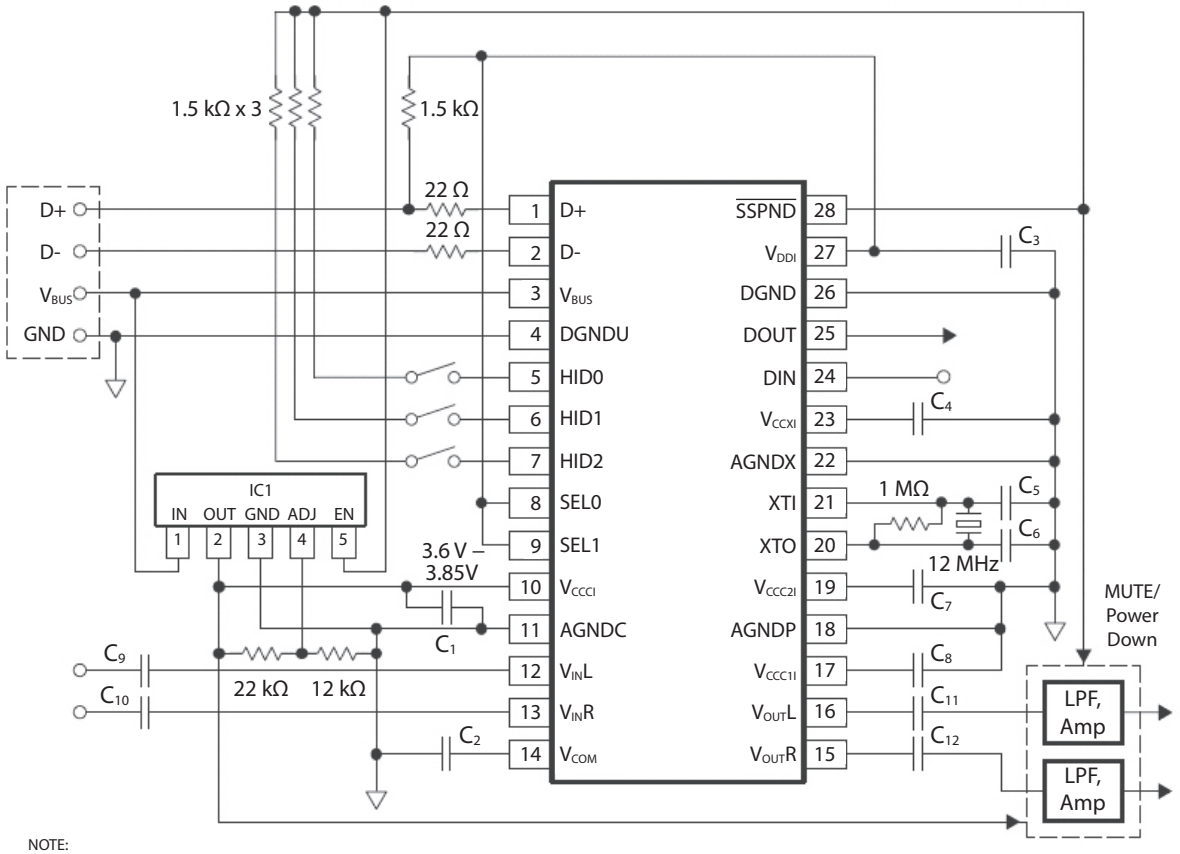


Figure 34. Suspend and Resume

6. Typical Application Circuit And Application Note

6.1 TYPICAL CIRCUIT CONNECTION 1

Figure 35 illustrates a typical circuit connection for a high-performance application. The circuit illustrated is for information only. The whole board design should be considered to meet the USB specification as a USB−compliant product.



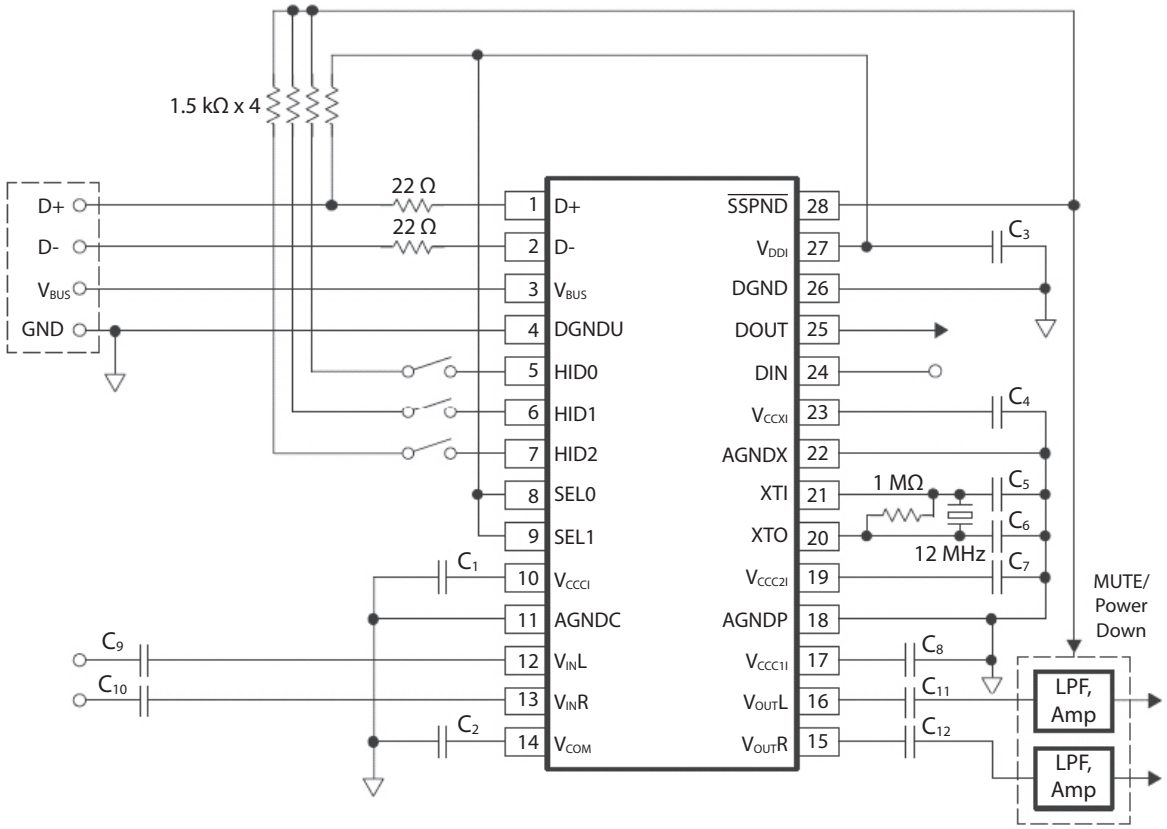
NOTE:

C1, C2: 10 µF
C3, C4, C7, C8: 1 µF (These capacitors must be less than 2 µF)
C5, C6: 10 pF to 33 pF (depending on crystal resonator)
C9, C10, C11, C12: The capacitance may vary depending on design.

Figure 35. Bus-Powered Configuration for High-Performance Application

6.2 TYPICAL CIRCUIT CONNECTION 2

Figure 36 illustrates a typical circuit connection for a simple application. The circuit illustrated is for information only. The whole board design should be considered to meet the USB specification as a USB−compliant product.



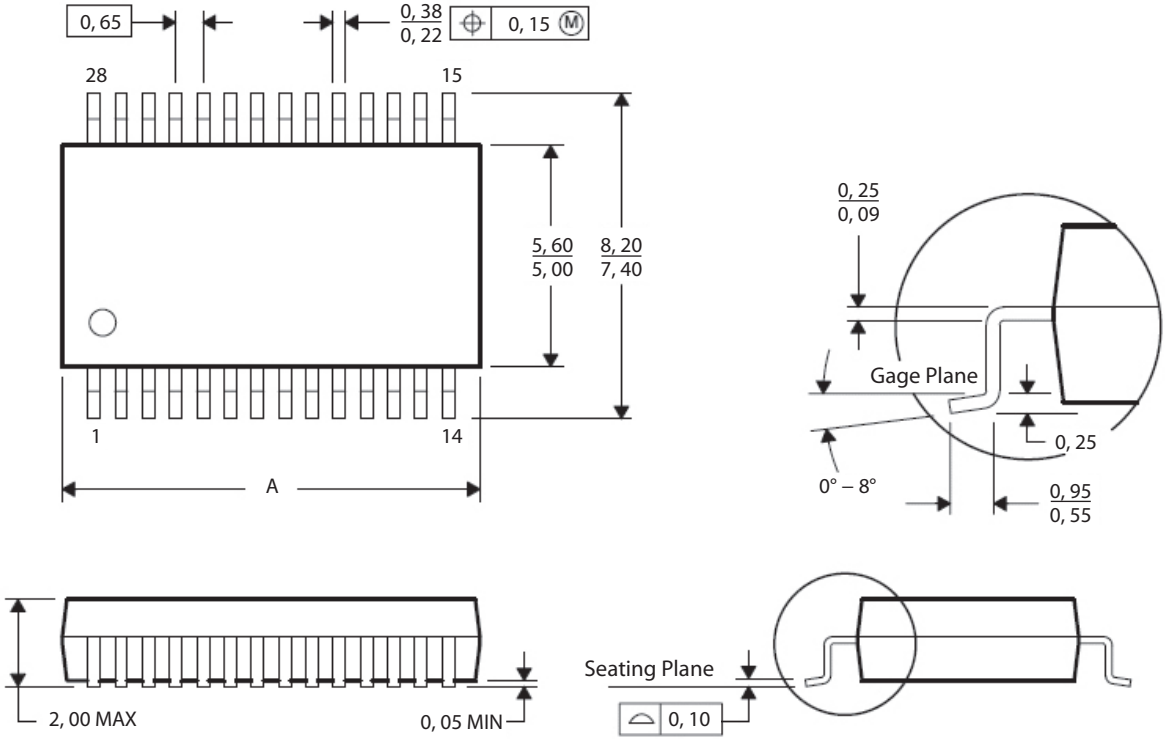
NOTE:

C1, C2: 10 µF
C3, C4, C7, C8: 1 µF (These capacitors must be less than 2 µF.)
C5, C6: 10 pF to 33 pF (depending on crystal resonator)
C9, C10, C11, C12: The capacitance may vary depending on design.
In this case analog perfomance of the A/D converter may degrade.

Figure 36.Bus-Powered Configuration

7. Package Information

7.1 SSOP28



DIM/PINS**	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

8. Statements And Notes:

8.1 The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements					
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers
Lead frame	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○
Chip	○	○	○	○	○	○
The lead	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.					

8.2 Notion:

Recommended carefully reading this information before the use of this product;

The information in this document are subject to change without notice;

This information is using to the reference only, the company is not responsible for any loss;

The company is not responsible for the any infringement of the third party patents or other rights of the responsibility.