HD Audio SoundMAX® Codec

AD1981HD

FEATURES

- 2 DAC channels: 16-, 20-, or 24-bit
- 2 ADC channels: 16- or 20-bit
- HD audio sample rates
  - 8 kHz, 11.025 kHz, 16 kHz, 22.05 kHz, 32 kHz, 44.1 kHz, 48 kHz
- Greater than 90 dB dynamic range
- S/PDIF output: 32 kHz, 44.1 kHz or 48 kHz, 16- or 24-bit
- Digital beep and analog PC beep pass-through
- Integrated headphone amplifiers on two ports
- Port retasking
- Selectable microphone and line inputs
- Full analog mixer
- Legacy inputs: CD and auxiliary inputs
- External amplifier power-down (EAPD)
- 48-pin, Pb-free LQFP

ENHANCED FEATURES

- No AFILT pins, results in BOM savings
- 5.0 V AV_{DD} supply, 3.3 V DV_{DD} supply
- Jack-sensing autoconfiguration options
  - Mute line output and monaural output (MONO_OUT) when headphones are used
  - Mute MONO_OUT when a device is in the line out jack
- Selectable trip level: high/low supports all jack types
- Peripheral identification/enumeration
- Jack event/presence detection using SENSE or GPIO pins
- Microphone to MONO_OUT for speakerphone applications
- Advanced power management modes
- 4 software-controlled microphone bias pins
- Up to 30 dB microphone boost
- 4 GPIOs—external control or traditional jack sense

FUNCTIONAL BLOCK DIAGRAM

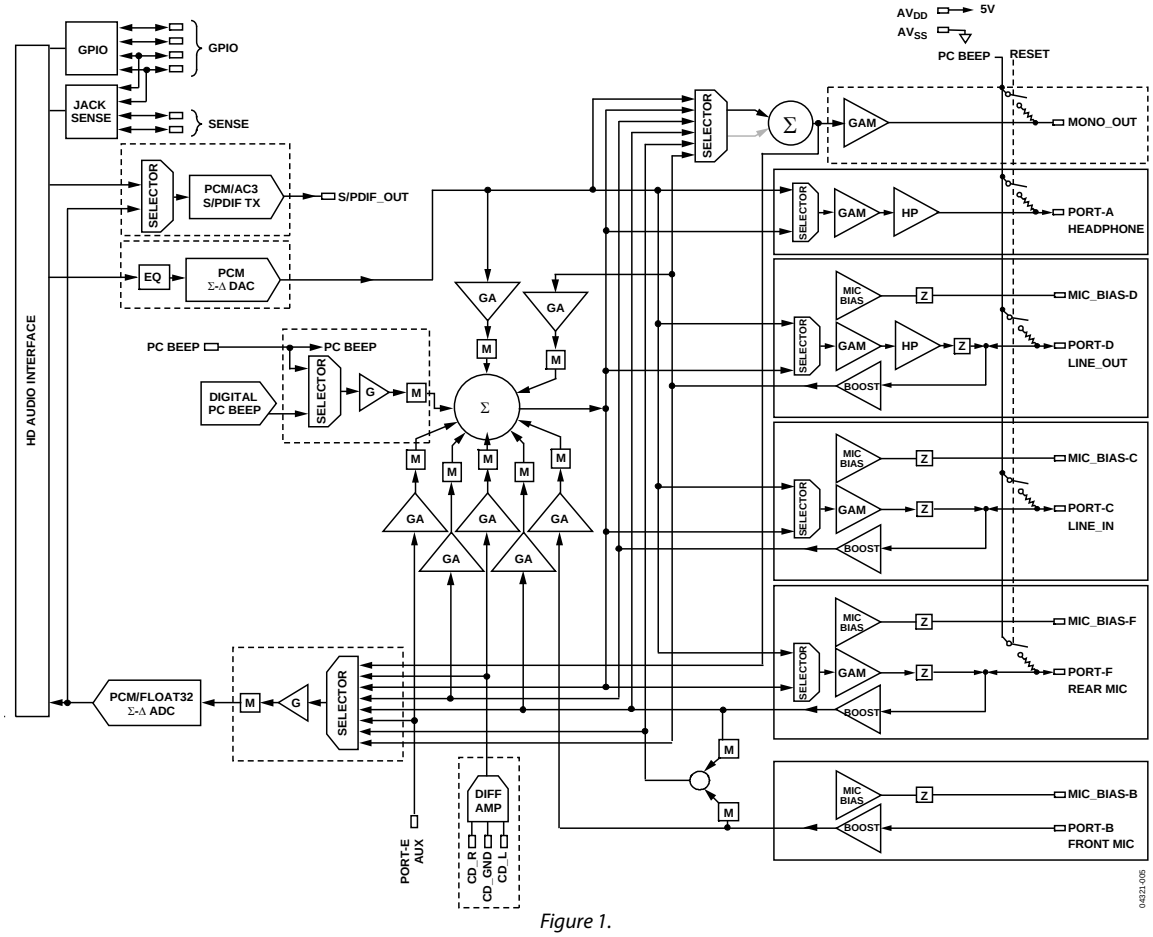

Figure 1.

Rev. 0

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REVISION HISTORY

6/05—Initial Version: Revision 0

FUNCTIONAL BLOCK DIAGRAM DETAILS

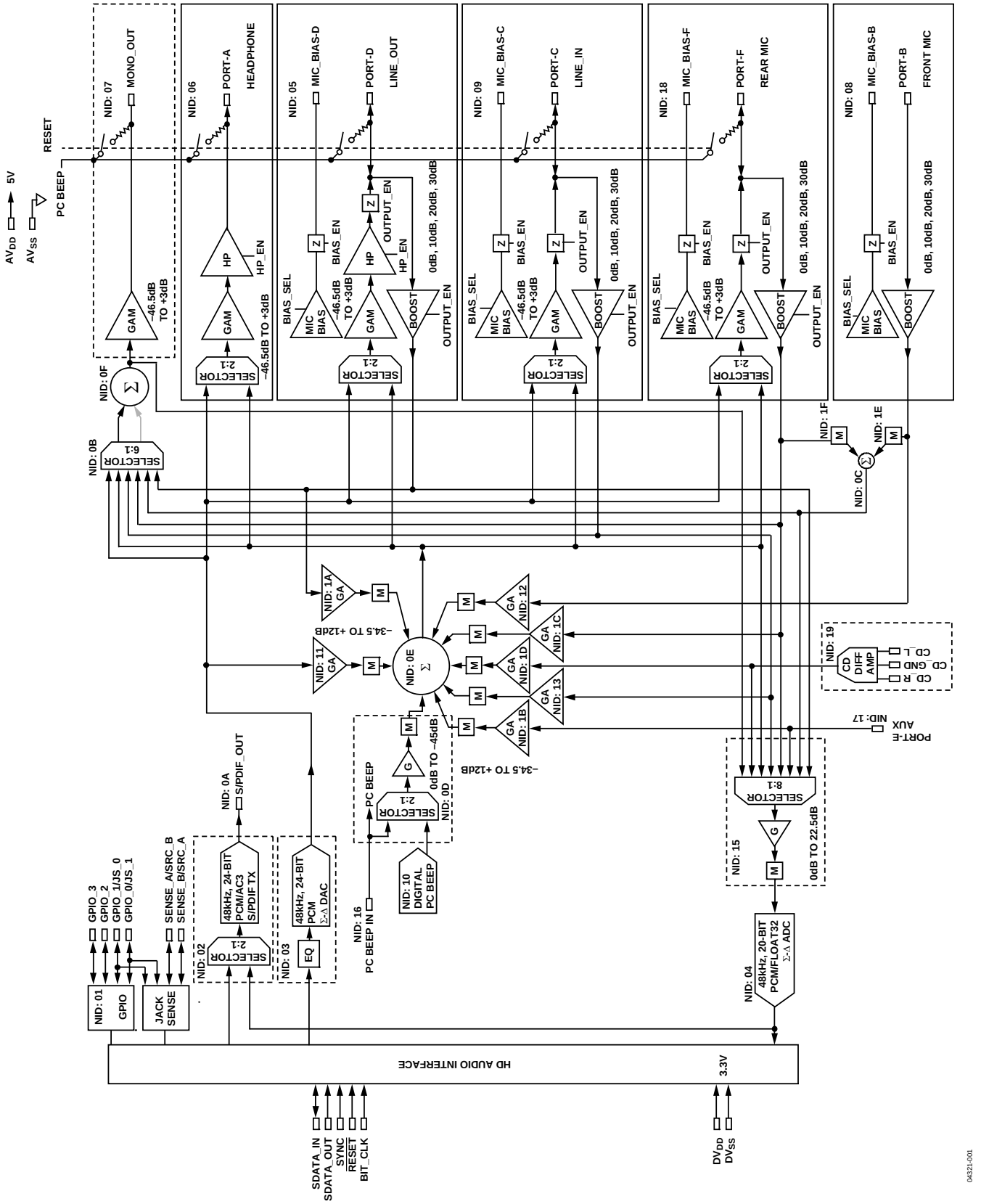

Figure 2.

SPECIFICATIONS

Test conditions, unless otherwise noted.

Table 1. Test Conditions

Parameter	Typ	Unit
TEMPERATURE	25	°C
DIGITAL SUPPLY (DV_{DD})	3.3 ±10%	V
ANALOG SUPPLY (AV_{DD})	5.0 ±10%	V
SAMPLE RATE (F_S)	48	kHz
INPUT SIGNAL	1.0	kHz
ANALOG OUTPUT PASS BAND	20 to 20,000	Hz
V_{IH}	2.0	V
V_{IL}	0.8	V
V_{IH}	2.4	V
V_{IL}	0.6	V

DAC Test Conditions
Calibrated
Output −3 dB relative to full scale
10 kΩ output load, Ports C, D, F, and mono
32 Ω output load, Port A

ADC Test Conditions
Calibrated
0 dB PGA gain
Input −3.0 dB relative to full scale
Input sourced on Port B, 0 dB boost

Table 2. Analog Input

Parameter	Min	Typ	Max	Unit
PORTS B, C, D, E: 0 dB		1		V rms [1]
		2.83		V p-p
PORTS B, C, D, E: 30 dB		0.032		V rms
		0.089		V p-p
PORTS B, C, D, E: 20 dB		0.1		V rms
		0.283		V p-p
PORTS B, C, D, E: 10 dB		0.316		V rms
		0.894		V p-p
PORT F, CD IN		1		V rms
		2.83		V p-p
INPUT IMPEDANCE[2]		20		kΩ
INPUT CAPACITANCE		5	7.5	pF

[1] RMS values assume sine wave input.
[2] Guaranteed by design; not production tested.

Table 3. Master Volume

Parameter	Min	Typ	Max	Unit
STEP SIZE (Ports A, B, C, D, E, MONO_OUT)		1.5		dB
OUTPUT GAIN RANGE	−46.5		+3	dB
MUTE ATTENUATION OF 0 dB FUNDAMENTAL	80			dB

[1] Guaranteed by design; not production tested.

Table 4. Programmable Gain Amplifier—ADC

Parameter	Min	Typ	Max	Unit
STEP SIZE		1.5		dB
PGA GAIN RANGE SPAN	0.0		22.5	dB

Table 5. Analog Mixer—Input Gain/Amplifiers/Attenuators

Parameter	Min	Typ	Max	Unit
SIGNAL-TO-NOISE RATIO (SNR)				
Line In to Line Out		85		dB
Microphone In to Line Out[1]		80		dB
STEP SIZE: ALL MIXER INPUTS (Except PC BEEP)		1.5		dB
STEP SIZE: PC BEEP		3.0		dB
INPUT GAIN RANGE: ALL MIXER INPUTS (Except PC BEEP)	−34.5		+12.0	dB
DIGITAL PC BEEP	−45.0		0.0	dB

[1] Guaranteed by design; not production tested.

Table 6. Digital Decimation and Interpolation Filters[1]

Parameter	Min	Typ	Max	Unit
PASS BAND	0		$0.4 \times F_S$	Hz
PASS-BAND RIPPLE			±0.09	dB
TRANSITION BAND	$0.4 \times F_S$		$0.6 \times F_S$	Hz
STOP BAND	$0.6 \times F_S$		∞	Hz
STOP-BAND REJECTION	−74			dB
GROUP DELAY		$16/F_S$		sec
GROUP DELAY VARIATION OVER PASS BAND		0		µs

[1] Guaranteed by design; not production tested.

Table 7. Analog-to-Digital Converters

Parameter	Min	Typ	Max	Unit
RESOLUTION		20		Bits
TOTAL HARMONIC DISTORTION (THD)		−95		dB
DYNAMIC RANGE (−60 dB Input, THD + N Referenced to Full Scale, A-Weighted)		−85		dB
CROSSTALK: LINE INPUTS (Input L, Ground R, Read R; Input R, Ground L, Read L)		−80		dB
CROSSTALK: LINE INPUTS AND OTHER INPUTS		−100	−80	dB
GAIN ERROR (Full-Scale Span Relative to Nominal Input Voltage)		±10		%
INTERCHANNEL GAIN MISMATCH (Difference of Gain Errors)			±0.5	dB
ADC OFFSET ERROR			±5	mV

Table 8. Digital-to-Analog Converters

Parameter	Min	Typ	Max	Unit
RESOLUTION		24		Bits
TOTAL HARMONIC DISTORTION (Line Out)		−92		dB
TOTAL HARMONIC DISTORTION (Headphone Out)		−75		dB
DYNAMIC RANGE (−60 dB Input, THD + N Referenced to Full Scale, A-Weighted)		90		dB
GAIN ERROR (Full-Scale Span Relative to Nominal Input Voltage)		±10		%
INTERCHANNEL GAIN MISMATCH (Difference of Gain Errors)			±0.7	dB
DAC CROSSTALK[1] (Input L, Zero R, Read R Out; Input R, Zero L, Read L Out)			−80	dB

[1] Guaranteed by design; not production tested.

Table 9. Analog Output

Parameter	Min	Typ	Max	Unit
FULL-SCALE OUTPUT VOLTAGE (Headphone Disabled)		1		V rms
		2.83		V p-p
Output Impedance[1]		300		Ω
External Load Impedance	10			kΩ
Output Capacitance		15		pF
External Load Capacitance			1000	pF
FULL-SCALE OUTPUT VOLTAGE (Headphone Out)		1		V rms
		2.83		V p-p
Output Impedance			1	Ω
External Load Impedance	32			Ω
Output Capacitance		15		pF
External Load Capacitance			1000	pF
VREF_FILT	2.050	2.250	2.450	V
MIC_BIAS (Ports B, C, D)		2.250		V
(xVREF [2:0] = 100, A_{VDD} = 5.0 V)		3.700		V
(xVREF [2:0] = 010)		0.0		V
Current Drive			5	mA
MUTE CLICK (MUTED OUTPUT, UNMUTED MIDSCALE DAC OUTPUT)		±5		mV

[1] Guaranteed by design; not production tested.

Table 10. Static Digital Specifications

Parameter	Min	Typ	Max	Unit
HIGH LEVEL INPUT VOLTAGE (V_{IH}), DIGITAL INPUTS	0.65 × DV_{DD}			V
LOW LEVEL INPUT VOLTAGE (V_{IL})			0.35 × DV_{DD}	V
HIGH LEVEL OUTPUT VOLTAGE (V_{OH}), I_{OH} = 2 mA	0.90 × DV_{DD}			V
LOW LEVEL OUTPUT VOLTAGE (V_{OL}), I_{OL} = 2 mA			0.10 × DV_{DD}	V
INPUT LEAKAGE CURRENT	−10		+10	µA
OUTPUT LEAKAGE CURRENT	−10		+10	µA
INPUT/OUTPUT PIN CAPACITANCE			7.5	pF

Table 11. Power Supply

Parameter	Min	Typ	Max	Unit
POWER SUPPLY RANGE—ANALOG (AV_{DD}) ±10%	4.5		5.5	V
POWER SUPPLY RANGE—DIGITAL (DV_{DD}) ±10%	2.97		3.63	V
POWER DISSIPATION—ANALOG (AV_{DD})/DIGITAL (DV_{DD})		275/132		mW
ANALOG SUPPLY CURRENT—ANALOG (AV_{DD})		43		mA
DIGITAL SUPPLY CURRENT—DIGITAL (DV_{DD})		40		mA
POWER SUPPLY REJECTION (100 mV p-p Signal @ 1 kHz)		40		dB

Table 12. D3 Power-Down Savings

Parameter	DV_{DD}	AV_{DD}	Unit
FUNCTION NODE	0.5	0.0	mA
DAC	6.2	9.0	mA
ADC	8.0	8.0	mA
MIXER	0.0	15	mA

ABSOLUTE MAXIMUM RATINGS

Table 13.

Power Supply	Min	Max	Unit
Digital (DV_{DD})	−0.3	+3.6	V
Analog (AV_{DD})	−0.3	+6.0	V
Input Current (Except Supply Pins)		±10.0	mA
Analog Input Voltage (Signal Pins)	−0.3	AV_{DD} + 0.3	V
Digital Input Voltage (Signal Pins)	−0.3	DV_{DD} + 0.3	V
Ambient Temperature (Operating)			
Commercial	0°C	70°C	°C
Industrial	–40°C	+85°C	°C
Storage Temperature	–65°C	+150°C	°C

Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ENVIRONMENTAL CONDITIONS

Ambient Temperature Rating

$$T_{AMB} = T_{CASE} - (PD \times \theta_{CA})$$

where:
T_{CASE} is the case temperature in °C
PD is the power dissipation in W
θ_{CA} is the thermal resistance (case-to-ambient)

Table 14. Thermal Resistance

Package	θ_{JA}[1]	θ_{JC}[2]	θ_{CA}
LQFP	76.2°C/W	17°C/W	59.2°C/W

[1] θ_{JA} is the thermal resistance (junction-to-ambient).
[2] θ_{JC} is the thermal resistance (junction-to-case).

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

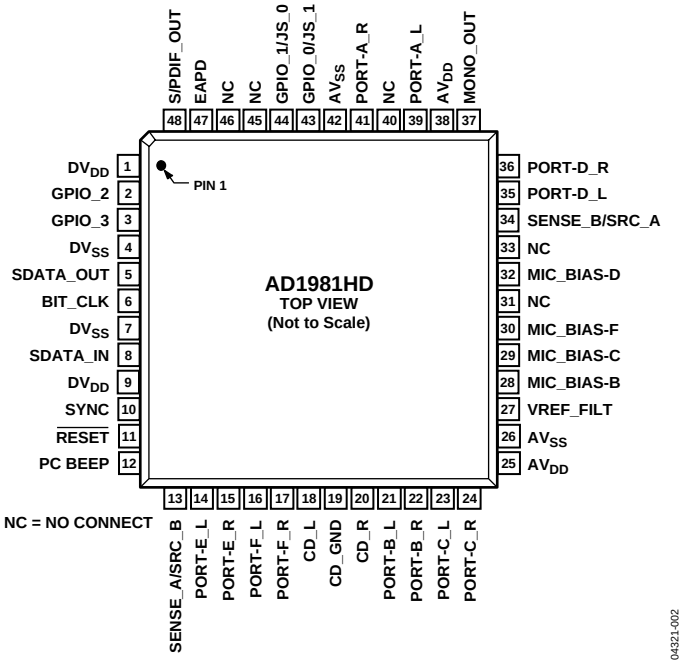

Figure 3. Pin Configuration

Table 15. Pin Function Descriptions

Mnemonic	Pin No.	I/O	Description
SDATA_OUT	5	I	HD Audio Link Serial Data Output. Codec input stream.
BIT_CLK	6	I	HD Audio Link Bit Clock Input. 24 MHz.
SDATA_IN	8	I/O	HD Audio Link Serial Data Input. Codec output stream.
SYNC	10	I	HD Audio Link Frame Sync.
$\overline{\text{RESET}}$#	11	I	HD Audio Link Reset. Master hardware reset.

Table 16. Digital Input/Output Pin Function Descriptions

Mnemonic	Pin No.	I/O	Description
GPIO_2	2	I/O	General-Purpose Input/Output. Digital signal used to sense/control external circuits.
GPIO_3	3	I/O	General-Purpose Input/Output. Digital signal used to sense/control external circuits.
GPIO_0/JS_1	43	I/O	GPIO_0—General-Purpose Input/Output. Digital signal used to sense/control external circuits. JS_1—Classic (DC) Jack Sense for Headphone Out Pins. Low indicates that nothing is plugged into the jack; high indicates that a peripheral is plugged into the jack.
GPIO_1/JS_0	44	I/O	GPIO_1—General-Purpose Input/Output. Digital signal used to sense/control external circuits JS_0—Classic (DC) Jack Sense for Line Out Pins. Low indicates that nothing is plugged into the jack; high indicates that a peripheral is plugged into the jack.
SENSE_A/SRC_B	13	I/O	SENSE_A—Jack Sense A–D Input. For use with isolated switches on audio jacks.[1]
SENSE_B/SRC_A	34	I/O	SENSE_B—Jack Sense E–F Input. For use with isolated switches on audio jacks.[1]
EAPD	47	O	External Amplifier Power-Down Output.
S/PDIF_OUT	48	O	S/PDIF Output.

[1] To reduce SENSE_A/B static current draw, connect a single 2.69 kΩ resistor between Pins 13 and 34. Remove the resistors from Pins 33 and 13 to AV_{DD}.

Table 17. Analog Input/Output Pin Function Descriptions

Mnemonic	Pin No.	I/O	Channel	Description	Function[1]
PC Beep	12	I	N/A	Analog Input for PC Beep Pass-Through, Even While in Reset.	LI
PORT-E_L	14	I	Left	Line Input (Typically Auxiliary Input).	
PORT-E_R	15	I	Right	Line Input (Typically Auxiliary Input).	LI
PORT-F_L	16	I/O	Left	Multifunction Analog I/O Jack (Typically Rear Microphone).	MIC, LI, LO
PORT-F_R	17	I/O	Right	Multifunction Analog I/O Jack (Typically Rear Microphone).	MIC, LI, LO
CD_L	18	I	Left	CD Input, Left Channel.	LI
CD_GND	19	I	Ground	CD Input, Ground.	LI
CD_R	20	I	Right	CD Input, Right Channel.	LI
PORT-B _L	21	I	Left	Multifunction Analog I/O Jack (Typically Front Microphone).	MIC, LI
PORT-B_R	22	I	Right	Multifunction Analog I/O Jack (Typically Front Microphone).	MIC, LI
PORT-C_L	23	I/O	Left	Multifunction Analog I/O Jack (Typically Rear Line Input).	MIC, LI, LO
PORT-C_R	24	I/O	Right	Multifunction Analog I/O Jack (Typically Rear Line Input).	MIC, LI, LO
PORT-D_L	35	I/O	Left	Multifunction Analog I/O Jack (Typically Rear Line Output).	MIC, LI, LO
PORT-D_R	36	I/O	Right	Multifunction Analog I/O Jack (Typically Rear Line Output).	MIC, LI, LO
MONO_OUT	37	O	-	Monaural Output to Telephony Subsystem Speakerphone.	LO
PORT-A_L	39	O	Left	Headphone Output, Left Channel.	LO, HP
PORT-A_R	41	O	Right	Headphone Output, Right Channel.	LO, HP

[1] MIC—Microphone capable, includes programmable MIC_BIAS pins and integrated boost amplifier; LI—line level analog inputs; LO— line level analog outputs; HP—headphone support, includes integrated headphone amplifier.

Table 18. Filter/Reference Pin Function Descriptions

Mnemonic	Pin No.	I/O	Description
VREF_FILT	27	O	Voltage Reference Filter.
MIC_BIAS-B	28	O	Programmable Microphone Bias Output. Intended for connection to Port B.
MIC_BIAS-C	29	O	Programmable Microphone Bias Output. Intended for connection to Port C.
MIC_BIAS-F	30	O	Programmable Microphone Bias Output. Intended for connection to Port F.
MIC_BIAS-D	32	O	Programmable Microphone Bias Output. Intended for connection to Port D.

Table 19. Power and Ground Pin Function Descriptions

Mnemonic	Pin No.	I/O	Description
DV_{SS}	4, 7	I	Digital Supply Return (Ground).
DV_{DD}	1, 9	I	Digital Supply Voltage (3.3 V).
AV_{SS}	26, 42	I	Analog Supply Return (Ground).
AV_{DD}	25, 38	I	Analog Supply Voltage (5.0 V).
			AV_{DD} supplies should be well filtered because supply noise degrades audio performance.

HD AUDIO CODEC INFORMATION

Table 20. Widget List and Descriptions

NID	Name	Type ID	Type	Description
00	ROOT	x	Root	Device identification.
01	FUNCTION	x	Function	Designates this device as an audio codec.
02	S/PDIF	0	Audio output	Designates the codec S/PDIF digital stream output interface.
03	Front DAC	0	Audio output	Designates the playback channel digital/audio converters.
04	Record ADC	1	Audio input	Designates the record channel audio/digital converters.
05	Port-D (Line Out)	4	Pin complex	Port-D pin drivers. Typically used as rear panel line output.
06	Port-A (Headphone Out)	4	Pin complex	Port-A pin drivers. Typically used as front panel headphone output.
07	MONO_OUT	4	Pin complex	Monaural output pin driver. Typically used to drive an internal speaker or as a microphone selector on a telephony system.
08	Port-B (Front Microphone)	4	Pin complex	Port-B pin drivers. Typically used as front panel microphone.
09	Port-C (Line In)	4	Pin complex	Port-C pin drivers. Typically used as rear panel line input.
0A	S/PDIF_OUT	4	Pin complex	S/PDIF output digital interface.
0B	Monaural Selector	3	Audio selector	Chooses which signals drive the monaural output mixer and pin.
0C	Microphone Mixer	2	Audio mixer	Allows selective mixing of the front/rear microphone sources to a single combined signal.
0D	PC Beep Selector	3	Audio selector	Selects between the digital beep generator and the analog PC BEEP pin as the source for the analog mixer.
0E	Analog Mixer	2	Audio mixer	Selectively mixes analog input signals into a single signal.
0F	Monaural Mixer	2	Audio mixer	Stereo-to-monaural mixer for MONO_OUT.
10	Digital PC Beep	7	Beep generator	Digital PC beep generator.
11	Front Mix Amp	3	Audio selector	Individual gain control for the DAC (front) input to the Analog Mixer.
12	Port-B Mix Amp	3	Audio selector	Individual gain control for the Port-B (front microphone) input to the analog mixer.
13	Port-C Mix Amp	3	Audio selector	Individual gain control for the Port-C (line in) input to the analog mixer.
14	Analog Power-Down	5	Power widget	Power control on the analog mixer and associated amplifiers.
15	Record Selector	3	Audio selector	Chooses which signal is recorded by the record ADC. Also contains the record gain controls.
16	PC Beep In	4	Pin complex	Analog PC Beep in pin drivers. This signal is coupled to the outputs while the codec is held in reset. This may be selected as an input to the analog mixer after reset has been released.
17	Port-E (Aux In)	4	Pin complex	Port-E pin drivers. Typically used as auxiliary input.
18	Port-F (Rear Microphone)	4	Pin complex	Port-F pin drivers. Typically used as rear panel microphone.
19	CD In	4	Pin complex	CD in pin drivers.
1A	Port-D Mix Amp	3	Audio selector	Individual gain control for the Port D (front) input to the analog mixer.
1B	Port-E Mix Amp	3	Audio selector	Individual gain control for the Port E (aux) input to the analog mixer.
1C	Port-F Mix Amp	3	Audio selector	Individual gain control for the Port F (rear microphone) input to the analog mixer.
1D	CD Mix Amp	3	Audio selector	Individual gain control for the CD input to the analog mixer.
1E	Front Microphone Mute	3	Audio selector	Mute control for Port B (front microphone) into microphone mixer.
1F	Rear Microphone Mute	3	Audio selector	Mute control for Port F (rear microphone) into the microphone mixer.

Table 21. Root and Function Node Parameters

NID	Name	Type ID	Vendor ID PID 00[1]	Revision ID PID 02	Sub Node Count PID 04	Function Group Type PID 05	Audio F.G. Caps PID 08	GPIO Caps PID 11
00	ROOT	X	11D41981	00100200	00010001			
01	FUNCTION	X			0002001E	00000001	00010C0C	40000004

[1] PID = parameter ID.

Table 22. Widget Parameters

NID	Name	Widget Caps PID 09[1]	PCM Size, Rate PID 0A	Stream Format PID 0B	Pin Caps PID 0C	Input Amp Caps PID 0D	Con. List Len PID 0E	Power States PID 0F	Processing Caps PID 10	Output Amp Caps PID 12	Vendor-Specific PID F0
00	ROOT										
01	FUNCTION		000E007F	00000001		00270300		00000009		80053F3D	00000004
02	S/PDIF	00030311	00020060	00000005			00000002				
03	Front DAC	00000441	000E007F	00000001			00000000	00000009	00004601		00000010
04	Record ADC	00100511	0006007F	00000001			00000001	00000009			
05	Port-D (Line Out)	00400187			0001173F	00270300	00000002			80053F3D	00000008
06	Port-A (Headphone Out)	00400185			0000001F		00000002			80053F3D	00000008
07	MONO_OUT	00400104			00000010		00000001			80053F3D	
08	Port-B (Front Microphone)	00400083			00001727	00270300	00000000				00000008
09	Port-C (Line In)	00400187			00001737	00270300	00000002			80053F3D	00000008
0A	S/PDIF_OUT	00400301			00000010		00000001				
0B	Monaural Selector	00300101					00000006				
0C	Microphone Mixer	00200101					00000002				
0D	PC Beep Selector	0030010C					00000002			800B0F0F	
0E	Analog Mixer	00200101					00000008				
0F	Monaural Mixer	00200100					00000001				
10	Digital PC Beep	00700000					00000000				
11	Front Mix Amp	0030010D					00000001			80051F17	
12	Port-B Mix Amp	0030010D					00000001			80051F17	
13	Port-C Mix Amp	0030010D					00000001			80051F17	
14	Analog Power-Down	00500500					00000006	00000009			
15	Record Selector	0030010D					00000008			80050F00	
16	PC Beep In	00400000			00000020		00000000				
17	Port-E (Aux In)	00400081			00000027		00000000				00000008
18	Port-F (Rear Microphone)	00400187			00001737	00270300	00000002			80053F3D	00000008
19	CD In	00400001			00000020		00000000				
1A	Port-D Mix Amp	0030010D					00000001			80051F17	
1B	Port-E Mix Amp	0030010D					00000001			80051F17	
1C	Port-F Mix Amp	0030010D					00000001			80051F17	
1D	CD Mix Amp	0030010D					00000001			80051F17	
1E	Front Microphone Mute	0030010D					00000001			80000000	
1F	Rear Microphone Mute	0030010D					00000001			80000000	

[1] PID = parameter ID.

Default SSID: BFD10000

Table 23. Default Configuration Parameters

			31	29	27	23	19	15	8	7	3
			30	28	24	20	16	12	8	4	0
				Location					Misc.		
Node ID	Name	Value	Connector	Chassis	Position	Def. Device	Conn. Type	Color	Ovrrd.	Def. Assn.	Sequence
05	Port-D (Line Out)	01014010	Jack	External	Rear	Line Out	1/8" Jack	Green	0	1	0
06	Port-A (HP Out)	0221401F	Jack	External	Front	HP Out	1/8" Jack	Green	0	1	F
07	Mono Out	90130130	Fixed	Internal	N/A	Speaker	ATAPI	unknown	1	3	0
08	Port-B (Front MIC)	02A19040	Jack	External	Front	Mic In	1/8" Jack	Pink	0	4	0
09	Port-C (Line In)	01813041	Jack	External	Rear	Line In	1/8" Jack	Blue	0	4	1
0A	S/PDIF Out	01451020	Jack	External	Rear	SPDIF Out	Optical	Black	0	2	0
16	PC Beep In	90F30150	Fixed	Internal	N/A	other	ATAPI	unknown	1	5	0
17	Port-E (Aux In)	99930144	Fixed	Internal	Special 3	AUX	ATAPI	unknown	1	4	4
18	Port-F (Rear MIC)	01A19043	Jack	External	Rear	Mic In	1/8" Jack	Pink	0	4	3
19	CD In	99330142	Fixed	Internal	Special 3	CD	ATAPI	unknown	1	4	2

Table 24. Widget Connection List

		Index									
		0	1	2	3	4	5	6	7	8	9
NID	Name	NID	NID	NID	NID	NID	NID	NID	NID	NID	NID
2	S/PDIF	01	04								
3	Front DAC										
4	Record ADC	15									
5	Port-D (Line Out)	03	0E								
6	Port-A (Headphone Out)	03	0E								
7	MONO_OUT	0F									
8	Port-B (Front Microphone)										
9	Port-C (Line In)	03	0E								
0A	S/PDIF_OUT	02									
0B	Monaural Selector	03	0C	09	0E	05	18				
0C	Microphone Mixer	1E	1F								
0D	PC Beep Selector	10	16								
0E	Analog Mixer	0D	11	12	13	1A	1B	1C	1D		
0F	Monaural Mixer	0B									
10	Digital PC Beep										
11	Front Mix Amp	03									
12	Port-B Mix Amp	08									
13	Port-C Mix Amp	09									
14	Analog Power-Down	0D	0E	10	11	12	13	1A	1B	1C	1D
15	Record Selector	0C	09	0E	0F	19	05	18	17		
16	PC Beep In										
17	Port-E (Aux In)										
18	Port-F (Rear Microphone)	03	0E								
19	CD In										
1A	Port-D Mix Amp	05									
1B	Port-E Mix Amp	17									
1C	Port-F Mix Amp	18									
1D	CD Mix Amp	19									
1E	Front Microphone Mute	08									
1F	Rear Microphone Mute	18									

Table 25. Widget Verb Support

NID	NAME	TYPE ID / GET / SET	STREAM FORMAT	AMPLIFIER GAIN/MUTE	PROCESSING COEFFICIENT	COFFICIENT INDEX	PARAMETER	CONNECTION SELECT	CONNECTION LIST ENTRY	PROCESSING STATE	SDATA_IN SELECT	POWER STATE	CHANNEL/ STREAM ID	PIN WIDGET CONTROL	UNSOLICITED ENABLE	PIN SENSE	BEEP GENERATOR	EAPD/BTL ENABLE	DIGITAL CONVERTER 1	DIGITAL CONVERTER 2
		GET	0xAxx	0xBXX	0xCxx	0xDxx	0xF00	0xF01	0xF02	0xF03	0xF04	0xF05	0xF06	0xF07	0xF08	0xF09	0xF0A	0xF0C	0xF0D	
		SET	0x2xx	0x3xx	0x4xx	0x5xx	---	0x701	---	0x703	0x704	0x705	0x706	0x707	0x708	0x709	0x70A	0x70C	0x70D	0x70E
00	ROOT	X					Y													
01	FUNCTION	X			2	2	Y			1		Y								
02	S/PDIF	0	Y				Y	Y	Y		1		Y						Y	Y
03	FRONT DAC	0	Y		Y	Y	Y			Y	1	Y	Y							
04	RECORD ADC	1	Y				Y		Y		1	Y	Y							
05	PORT-D (LINE OUT)	4		Y			Y	Y	Y					Y	Y	Y		Y		
06	PORT-A (HEADPHONE OUT)	4		Y			Y	Y	Y					Y	Y	Y				
07	MONO_OUT	4		Y			Y		Y					Y						
08	PORT-B (FRONT MICROPHONE)	4		Y			Y							Y	Y	Y				
09	PORT-C (LINE IN)	4		Y			Y	Y	Y					Y	Y	Y				
0A	S/PDIF_OUT	4					Y		Y					Y						
0B	MONAURAL SELECTOR	3					Y	Y	Y											
0C	MICROPHONE MIXER	2					Y		Y											
0D	PC BEEP SELECTOR	3		Y			Y	Y	Y											
0E	ANALOG MIXER	2					Y		Y											
0F	MONAURAL MIXER	2					Y		Y											
10	DIGITAL PC BEEP	7					Y										Y			
11	FRONT MIX AMP	3		Y			Y		Y											
12	PORT-B MIX AMP	3		Y			Y		Y											
13	PORT-C MIX AMP	3		Y			Y		Y											
14	ANALOG POWER-DOWN	5					Y		Y			Y								
15	RECORD SELECTOR	3		Y			Y	Y	Y											
16	PC BEEP IN	4					Y							Y						
17	PORT-E (AUX IN)	4					Y							Y	Y	Y				
18	PORT-F (REAR MICROPHONE)	4		Y			Y	Y	Y					Y	Y	Y				
19	CD IN	4					Y							Y						
1A	PORT-D MIX AMP	3		Y			Y		Y											
1B	PORT-E MIX AMP	3		Y			Y		Y											
1C	PORT-F MIX AMP	3		Y			Y		Y											
1D	CD MIX AMP	3		Y			Y		Y											
1E	FRONT MICROPHONE MUTE	3		Y			Y		Y											
1F	REAR MICROPHONE MUTE	3		Y			Y		Y											

[1]UNSUPPORTED IN THE AD1981HD. GET VERB ALWAYS RETURNS 0; SET VERBS IGNORED.
[2]SUPPORTS ADI SPECIFIC FUNCTIONALITY. REFER TO THE AD1981HD PROGRAMMER'S MANUAL FOR MORE INFORMATION.

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Table 26. Widget Extended Verb Support

NID	NAME	TYPE ID	GET SET	0xF10 0x710	0xF11 0x711	0xF12 0x712	0xF13 0x713	0xF14 0x714	0xF15 0x715	0xF16 0x716	0xF17 0x717	0xF18 0x718	0xF19 0x719	0xF1A 0x71A	0xF1C 0x71C	0xF1C 0x71D	0xF1C 0x71E	0xF1C 0x71F	0xF20 0x720	0xF20 0x721	0xF20 0x722	0xF20 0x723	... 0x7FF
				GPI DATA	GPI WAKE ENABLE	GPI UNSOLICITED MASK	GPI STICKY MASK	GPO DATA	GPIO DATA	GPIO ENABLE	GPIO DIRECTI ON	GPIO WAKE MASK	GPIO UNSOLICITED MASK	GPIO STICKY MASK	CONFIG DEF BYTE 1 (07:00)	CONFIG DEF BYTE 2 (15:08	CONFIG DEF BYTE 3 (23:16)	CONFIG DEF BYTE 4 (31:24)	SUBSYSTEM ID BYTE 1 (07:00)	SUBSYSTEM ID BYTE 2 (15:08)	SUBSYSTEM ID BYTE 3 (23:16)	SUBSYSTEM ID BYTE 4 (31:24)	RESET
01	FUNCTION	X							Y	Y	Y	1	Y	1									
05	PORT-D (LINE OUT)	4													Y	Y	Y	Y	Y	Y	Y	Y	
06	PORT-A (HEADPHONE OUT)	4													Y	Y	Y	Y	Y	Y	Y	Y	
07	MONO_OUT	4													Y	Y	Y	Y	Y	Y	Y	Y	
08	PORT-B (FRONTMICROPHONE)	4													Y	Y	Y	Y	Y	Y	Y	Y	
09	PORT-C (LINE IN)	4													Y	Y	Y	Y	Y	Y	Y	Y	
0A	S/PDIF_OUT	4													Y	Y	Y	Y	Y	Y	Y	Y	
16	PC BEEP IN	4													Y	Y	Y	Y	Y	Y	Y	Y	
17	PORT-E (AUX IN)	4													Y	Y	Y	Y	Y	Y	Y	Y	
18	PORT-F (REAR MICROPHONE)	4													Y	Y	Y	Y	Y	Y	Y	Y	
19	CD IN	4													Y	Y	Y	Y	Y	Y	Y	Y	

[1]UNSUPPORTED IN THE AD1981HD. GET VERB ALWAYS RETURNS 0; SET VERBS IGNORED.

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JACK PRESENCE DETECTION

HD AUDIO STYLE JACK PRESENCE DETECTION

The AD1981HD uses two jack sense lines for jack presence detection. Combined with the peripheral enumeration engines, this enables software to determine if there is a device plugged into the circuit and what type of device it is. Software can also reconfigure jacks and amplifiers as necessary, ensuring proper audio operation and providing jack retasking.

Jack presence is detected using a resistor tree arrangement outlined in the HD audio specification. Up to four jacks can be sensed on a single sense line by using different value resistors for each jack between the sense line and ground (AV_{SS}). Jacks must normally have open, isolated switches to use this method of jack presence detection.

Jack presence is reflected in the HD audio pin widget pin sense verb. The MSB (Bit 31) indicates the current plugged state of the connected jack. Jack change interrupts can be enabled using the unsolicited response verb on each of these nodes. Each jack can be set to generate a different value to provide event identification within the software interrupt.

There are two methods to connect the codec to the jack presence detection pins. In the first method, use a single 2.69 kΩ 1% resistor between the SENSE_A and SENSE_B lines, but no capacitor. In the second method use a single 2.69 kΩ resister between SENSE_A and AV_{DD} and between SENSE_B and AV_{DD}. In the second method, the designer can add up to 1 µF of capacitance on each sense line. Designers should offer both methods for maximum flexibility.

The specific resistor value for each jack is shown in Table 27. Use 1% resistors for all jack presence detect circuitry to ensure accurate detection.

CLASSIC JACK PRESENCE DETECTION

The AD1981HD GPIO pins can be used as classic jack sense pins in JS_0- and JS_1-style operation (similar to AD1981B operation). Only two jacks, typically line out and headphone out, are supported in this configuration. The GPIO pins can be connected to the left channel wrap-back switch on the jack via a 2.2 kΩ (typical) resistor. The left channel needs a 20 kΩ (typical) resistor-to-analog ground to complete the circuit. This configuration allows autoconfiguration when other devices are plugged in; for example, when headphones are plugged in, the external speakers are disabled for private listening.

Table 27. Jack Sense Mapping

	SENSE_A			SENSE_B		
Resistor (1% tolerance)	**Name**	**Port**	**HD Audio Node ID**	**Name**	**Port**	**HD Audio Node ID**
5.1 kΩ	Line Out	D	0x05	N/A	N/A	N/A
10.0 kΩ	Line In	C	0x09	N/A	N/A	N/A
20.0 kΩ	Front Microphone	B	0x08	Rear Microphone	F	0x18
39.2 kΩ	Headphone Out	A	0x06	Aux In	E	0x17

OUTLINE DIMENSIONS

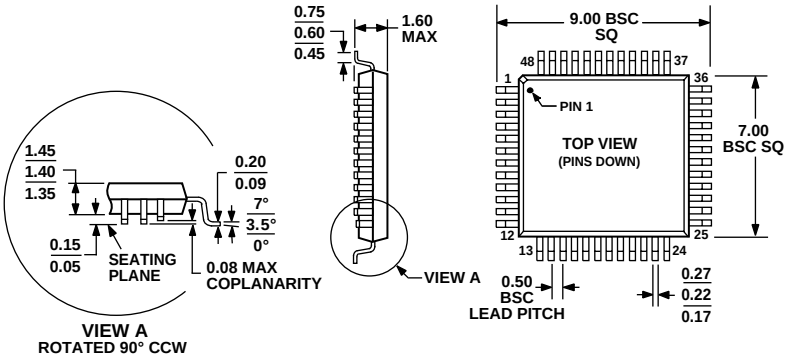

Figure 4. 48-Lead Low Profile Quad Flat Package [LQFP]
(ST-48)
Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD1981HDJSTZ[1]	0°C to +70°C	48-Lead LQFP, Tray Version	ST-48
AD1981HDJSTZ-REEL	0°C to +70°C	48-Lead LQFP, Reel Version	ST-48

[1] Z = Pb-free part.

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