

## 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 generator
- Integrated headphone amplifiers
- Selectable microphone inputs with preamplifiers
- Stereo line level inputs
- Full analog mixer
- 2 GPIOs for external circuit control, jack sense
- 32-lead, Pb-free LFCSP VQ (QFN) package

## ENHANCED FEATURES

- No AFILT pins, results in BOM savings**
- 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 sense trip level: high/low supports all jack types**
- Peripheral identification/enumeration**
- Jack presence detection: HD Audio SENSE and GPIOs**
- Microphone to MONO\_OUT for speakerphone**
- Advanced power management modes**
- 2 software-controlled microphone bias pins**
- Stereo microphone array capture**
  - Source from two different ports**
  - 0 dB, 10 dB, 20 dB, and 30 dB boost options**

## FUNCTIONAL BLOCK DIAGRAM

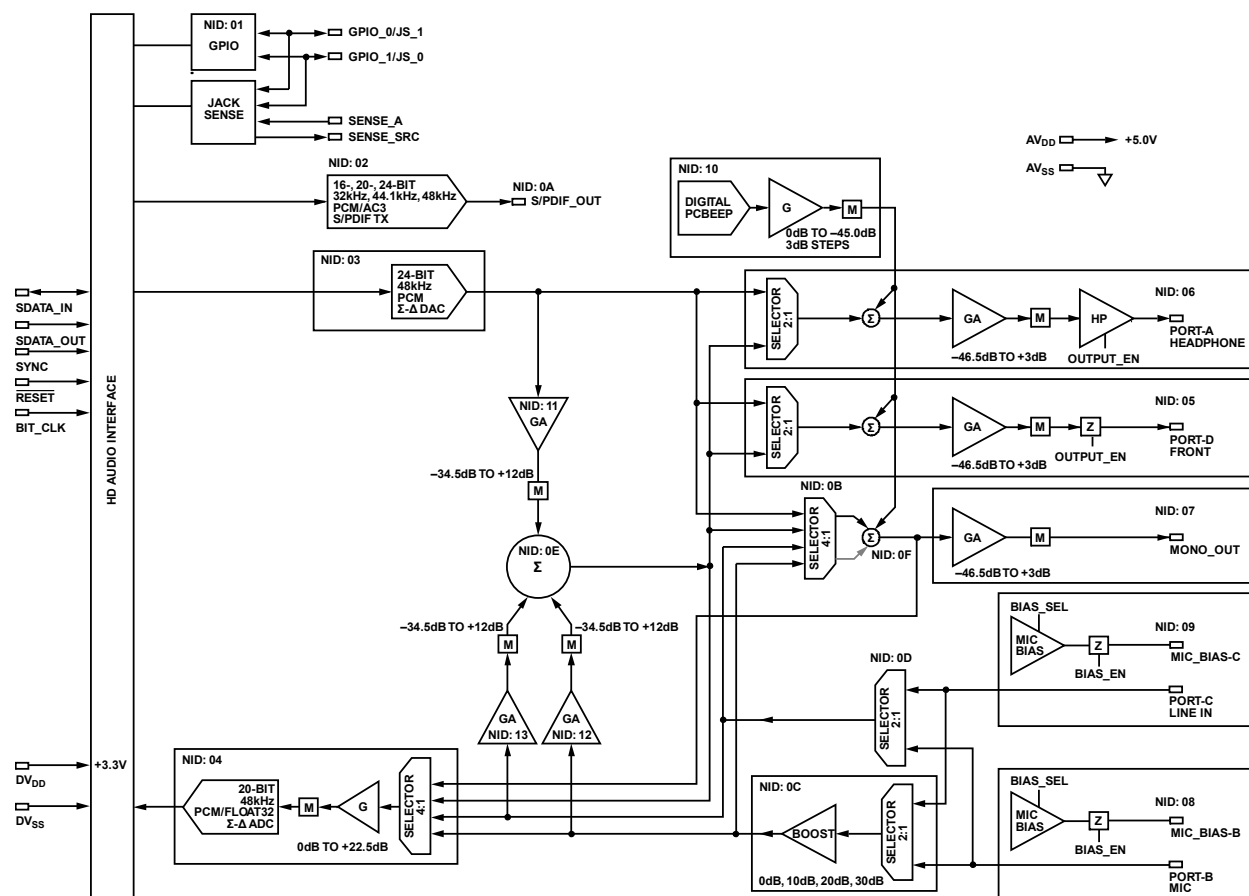


Figure 1.

## Rev. 0

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TABLE OF CONTENTS

|                                |   |                                                  |    |
|--------------------------------|---|--------------------------------------------------|----|
| Features .....                 | 1 | Environmental Conditions .....                   | 6  |
| Enhanced Features.....         | 1 | ESD Caution.....                                 | 6  |
| Functional Block Diagram ..... | 1 | Pin Configuration and Function Descriptions..... | 7  |
| Revision History .....         | 2 | HD Audio Codec Information .....                 | 9  |
| Specifications.....            | 3 | Verb Support .....                               | 12 |
| Test Conditions.....           | 3 | Jack Presence Detection.....                     | 14 |
| Power Down Dissipation.....    | 5 | Outline Dimensions .....                         | 15 |
| Absolute Maximum Ratings.....  | 6 | Ordering Guide .....                             | 15 |

REVISION HISTORY

4/06—Revision 0: Initial Version

# SPECIFICATIONS

## TEST CONDITIONS

Test conditions for the AD1983 are as follows, unless otherwise noted.

### General Test Conditions

Temperature at 25°C  
 Digital supply ( $DV_{DD}$ ) at  $3.3\text{ V} \pm 10\%$   
 Analog supply ( $AV_{DD}$ ) at  $5.0\text{ V} \pm 10\%$   
 Sample rate ( $F_S$ ) at 48 kHz  
 Input signal at 1.0 kHz  
 Analog output pass band at 20 Hz to 20,000 Hz  
 $V_{IH}$  at 2.0 V  
 $V_{IL}$  at 0.8 V  
 $V_{IH}$  at 2.4 V  
 $V_{IL}$  at 0.6 V

### DAC Test Conditions

Calibrated  
 Output  $-3\text{ dB}$  relative to full scale  
 10 k $\Omega$  output load, Port D, and MONO\_OUT  
 32  $\Omega$  output load, Port A

### ADC Test Conditions

Calibrated  
 0 dB PGA gain  
 Input  $-3.0\text{ dB}$  relative to full scale

Table 1.

| Parameter                                                 | Conditions                              | Min              | Typ   | Max              | Unit        |
|-----------------------------------------------------------|-----------------------------------------|------------------|-------|------------------|-------------|
| ANALOG INPUT                                              |                                         |                  |       |                  |             |
| Port-B, Port-C                                            | 0 dB                                    |                  | 1     |                  | $V_{rms}^1$ |
|                                                           |                                         |                  | 2.83  |                  | $V_{p-p}$   |
| Port-B, Port-C                                            | 10 dB                                   |                  | 0.316 |                  | $V_{rms}$   |
|                                                           |                                         |                  | 0.894 |                  | $V_{p-p}$   |
| Port-B, Port-C                                            | 20 dB                                   |                  | 0.1   |                  | $V_{rms}$   |
|                                                           |                                         |                  | 0.283 |                  | $V_{p-p}$   |
| Port-B, Port-C                                            | 30 dB                                   |                  | 0.032 |                  | $V_{rms}$   |
|                                                           |                                         |                  | 0.089 |                  | $V_{p-p}$   |
| Input Impedance <sup>2</sup>                              |                                         |                  | 20    |                  | k $\Omega$  |
| Input Capacitance <sup>2</sup>                            |                                         |                  | 5     | 7.5              | pF          |
| MASTER VOLUME                                             |                                         |                  |       |                  |             |
| Step Size                                                 | Port-A, Port-D, MONO_OUT                |                  | 1.5   |                  | dB          |
| Output Gain Range                                         |                                         | $-46.5$          |       | $+3$             | dB          |
| Mute Attenuation of 0 dB Fundamental                      |                                         | 80               |       |                  | dB          |
| PROGRAMMABLE GAIN AMPLIFIER—ADC                           |                                         |                  |       |                  |             |
| Step Size                                                 |                                         |                  | 1.5   |                  | dB          |
| PGA Gain Range                                            |                                         | 0.0              |       | 22.5             | dB          |
| ANALOG MIXER—INPUT GAIN/AMPLIFIERS/ATTENUATORS            |                                         |                  |       |                  |             |
| Signal-to-Noise Ratio (SNR)                               |                                         |                  |       |                  |             |
| Line In to Line Out                                       |                                         |                  | 85    |                  | dB          |
| Microphone In to Line Out <sup>2</sup>                    |                                         |                  | 80    |                  | dB          |
| Step Size                                                 | All mixer inputs except digital PC BEEP |                  | 1.5   |                  | dB          |
| Step Size: Digital PC Beep                                |                                         |                  | 3.0   |                  | dB          |
| Input Gain Range                                          | All mixer inputs except digital PC BEEP | $-34.5$          |       | $+12.0$          | dB          |
| Digital PC Beep                                           |                                         | $-45.0$          |       | 0.0              | dB          |
| DIGITAL DECIMATION AND INTERPOLATION FILTERS <sup>2</sup> |                                         |                  |       |                  |             |
| Pass Band                                                 |                                         | 0                |       | $0.4 \times F_S$ | Hz          |
| Pass-Band Ripple                                          |                                         |                  |       | $\pm 0.09$       | dB          |
| Transition Band                                           |                                         | $0.4 \times F_S$ |       | $0.6 \times F_S$ | Hz          |
| Stop Band                                                 |                                         | $0.6 \times F_S$ |       | $\infty$         | Hz          |
| Stop-Band Rejection                                       |                                         | $-74$            |       |                  | dB          |

# AD1983

| Parameter                                                   | Conditions                                                        | Min                     | Typ                     | Max   | Unit             |
|-------------------------------------------------------------|-------------------------------------------------------------------|-------------------------|-------------------------|-------|------------------|
| Group Delay                                                 |                                                                   |                         | 16/F <sub>S</sub>       |       | sec              |
| Group Delay Variation over Pass Band                        |                                                                   |                         | 0                       |       | µs               |
| ANALOG-TO-DIGITAL CONVERTERS                                |                                                                   |                         |                         |       |                  |
| Resolution                                                  |                                                                   |                         | +20                     |       | Bits             |
| Total Harmonic Distortion (THD)                             |                                                                   |                         | −92                     |       | dB               |
| Dynamic Range                                               | −60 dB input, THD + N referenced to F <sub>S</sub> , A-weighted   |                         | −85                     |       | dB               |
| Crosstalk <sup>2</sup>                                      | Line inputs: Input L, Ground R, Read R; Input R, Ground L, Read L |                         | −80                     |       | dB               |
|                                                             | 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 <sup>2</sup>                               |                                                                   |                         |                         | ±5    | mV               |
| DIGITAL-TO-ANALOG CONVERTERS                                |                                                                   |                         |                         |       |                  |
| Resolution                                                  |                                                                   |                         | +24                     |       | Bits             |
| Total Harmonic Distortion (THD)                             | Line out                                                          |                         | −86                     |       | dB               |
|                                                             | Headphone out                                                     |                         | −76                     |       | dB               |
| Dynamic Range                                               | −60 dB input, THD + N referenced to F <sub>S</sub> , 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 <sup>2</sup>                                  | Input L, Zero R, Read R out; Input R, Zero L, Read L out          |                         |                         | −80   | dB               |
| ANALOG OUTPUT                                               |                                                                   |                         |                         |       |                  |
| Full-Scale Output Voltage                                   | Port-D and MONO_OUT                                               |                         | 1                       |       | V <sub>rms</sub> |
|                                                             |                                                                   |                         | 2.83                    |       | V <sub>p-p</sub> |
| Output Impedance <sup>2</sup>                               |                                                                   | 10                      | 300                     |       | Ω                |
| External Load Impedance <sup>2</sup>                        |                                                                   |                         |                         |       | kΩ               |
| Output Capacitance <sup>2</sup>                             |                                                                   |                         | 15                      |       | pF               |
| External Load Capacitance                                   |                                                                   |                         |                         | 1000  | pF               |
| Full-Scale Output Voltage                                   | Port-A: headphone out                                             |                         | 1                       |       | V <sub>rms</sub> |
|                                                             |                                                                   |                         | 2.83                    |       | V <sub>p-p</sub> |
| External Load Impedance <sup>2</sup>                        |                                                                   | 32                      |                         |       | Ω                |
| Output Capacitance <sup>2</sup>                             |                                                                   |                         | 15                      |       | pF               |
| External Load Capacitance <sup>2</sup>                      |                                                                   |                         |                         | 1000  | pF               |
| VREF_FILT                                                   |                                                                   | 2.050                   | 2.250                   | 2.450 | V                |
| MIC_BIAS (Port-B and Port-C)                                | At 50% setting                                                    |                         | 2.250                   |       | V                |
|                                                             | At 80% setting                                                    |                         | 3.700                   |       | V                |
|                                                             | At 0% setting                                                     |                         | 0.0                     |       | V                |
| Current Drive                                               |                                                                   |                         |                         | 5     | mA               |
| Mute Click                                                  | Muted output, unmuted midscale DAC output                         |                         | ±5                      |       | mV               |
| STATIC DIGITAL SPECIFICATIONS                               |                                                                   |                         |                         |       |                  |
| High Level Input Voltage (V <sub>IH</sub> ), Digital Inputs |                                                                   | 0.65 × DV <sub>DD</sub> |                         |       | V                |
| Low Level Input Voltage (V <sub>IL</sub> )                  |                                                                   |                         | 0.35 × DV <sub>DD</sub> |       | V                |
| High Level Output Voltage (V <sub>OH</sub> )                | I <sub>OH</sub> = 2 mA                                            | 0.90 × DV <sub>DD</sub> |                         |       | V                |
| Low Level Output Voltage (V <sub>OL</sub> )                 | I <sub>OL</sub> = 2 mA                                            |                         | 0.10 × DV <sub>DD</sub> |       | V                |
| Input Leakage Current                                       |                                                                   | −10                     | +10                     |       | µA               |
| Output Leakage Current                                      |                                                                   | −10                     | +10                     |       | µA               |
| Input/Output Pin Capacitance                                |                                                                   |                         | 7.5                     |       | pF               |

| Parameter                                                                   | Conditions                | Min  | Typ     | Max  | Unit |
|-----------------------------------------------------------------------------|---------------------------|------|---------|------|------|
| <b>POWER SUPPLY</b>                                                         |                           |      |         |      |      |
| Power Supply Range                                                          |                           |      |         |      |      |
| Analog                                                                      | (AV <sub>DD</sub> ) ±10%  | 4.5  |         | 5.5  | V    |
| Digital                                                                     | (DV <sub>DD</sub> ) ±10%  | 2.97 |         | 3.63 | V    |
| Power Dissipation—Analog<br>(AV <sub>DD</sub> )/Digital (DV <sub>DD</sub> ) |                           |      | 165/125 |      | mW   |
| Analog Supply Current—Analog<br>(AV <sub>DD</sub> )                         |                           |      | 33      |      | mA   |
| Digital Supply Current—Digital<br>(DV <sub>DD</sub> )                       |                           |      | 38      |      | mA   |
| Power Supply Rejection                                                      | 100 mV p-p signal @ 1 kHz |      | 40      |      | dB   |

<sup>1</sup> RMS values assume sine wave input.

<sup>2</sup> Guaranteed by design; not production tested.

## POWER DOWN DISSIPATION

Table 2.

| Parameter                  | DV <sub>DD</sub> | AV <sub>DD</sub> | Unit |
|----------------------------|------------------|------------------|------|
| FUNCTION NODE <sup>1</sup> | 0                | 1.8              | mA   |
| DAC                        | 30               | 26               | mA   |
| ADC                        | 28               | 26               | mA   |
| MIXER                      | 37               | 17               | mA   |

<sup>1</sup> BIT\_CLK off.

## ABSOLUTE MAXIMUM RATINGS

Table 3.

| Parameter                           | Rating                      |
|-------------------------------------|-----------------------------|
| Digital ( $DV_{DD}$ )               | −0.3 V to +3.6 V            |
| Analog ( $AV_{DD}$ )                | −0.3 V to +6.0 V            |
| Input Current (Except Supply Pins)  | ±10.0 mA                    |
| Analog Input Voltage (Signal Pins)  | −0.3 V to $AV_{DD} + 0.3$ V |
| Digital Input Voltage (Signal Pins) | −0.3 V to $DV_{DD} + 0.3$ V |
| Ambient Temperature (Operating)     |                             |
| Commercial Range                    | 0°C to 70°C                 |
| Industrial Range                    | −40°C to +85°C              |
| Storage Temperature Range           | −65°C to +150°C             |

Stresses above 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

Table 4. Thermal Resistance

| Package  | $\theta_{JA}$ <sup>1</sup> | $\theta_{JC}^2$ (bottom) | $\theta_{JC}^2$ (top) | Unit |
|----------|----------------------------|--------------------------|-----------------------|------|
| LFCSP_VQ | 58.8                       | 1.52                     | 23.69                 | °C/W |

<sup>1</sup>  $\theta_{JA}$  is the thermal resistance (junction-to-ambient). Bottom pad not soldered.

<sup>2</sup>  $\theta_{JC}$  is the thermal resistance (junction-to-case). Bottom pad not soldered.

## 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

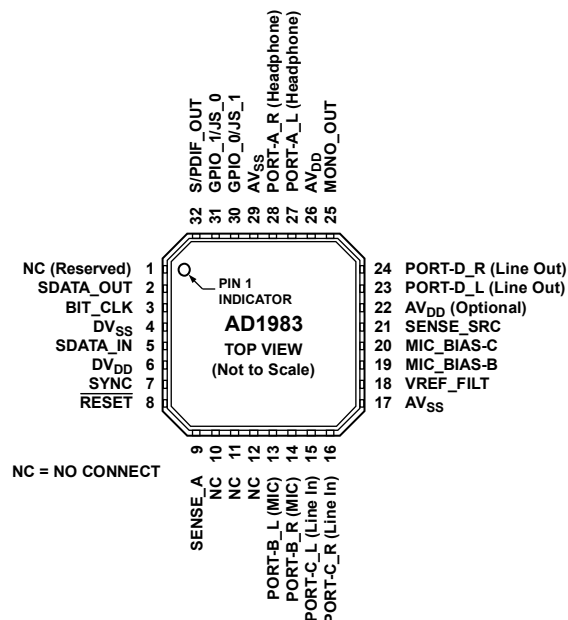


Figure 2. Pin Configuration

Table 5. Pin Function Descriptions

| Mnemonic             | Pin No. | I/O <sup>1</sup> | Description                                                                                                                                                                                                                   |
|----------------------|---------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SDATA_OUT            | 2       | I                | HD Audio Link Serial Data Output. Codec input stream.                                                                                                                                                                         |
| BIT_CLK              | 3       | I                | HD Audio Link Bit Clock Input. 24 MHz.                                                                                                                                                                                        |
| SDATA_IN             | 5       | I/O              | HD Audio Link Serial Data Input. Codec output stream.                                                                                                                                                                         |
| SYNC                 | 7       | I                | HD Audio Link Frame Sync.                                                                                                                                                                                                     |
| RESET                | 8       | I                | HD Audio Link Reset. Master hardware reset.                                                                                                                                                                                   |
| GPIO_1/JS_0          | 31      | Digital I/O      | GPIO_1: General Purpose Input/Output Pin. Digital signal used for circuit control.<br>JS_0: Classical (DC) Jack Sense for Line_Out Pins. Low = jack not present, high = jack present.                                         |
| GPIO_0/JS_1          | 30      | Digital I/O      | GPIO_0: General Purpose Input/Output Pin. Digital signal used circuit control.<br>JS_1: Classical (DC) Jack Sense for Headphone. Low = jack not present, high = jack present.                                                 |
| SENSE_A              | 9       | Digital I        | Jack Sense Input for Presence Detect on Port A Through Port D. Used with isolated switches on audio jacks.                                                                                                                    |
| SENSE_SRC            | 21      | Digital O        | Connect via 2.67 kΩ 1% resistor to Pin 9 (SENSE_A) when using the SENSE_A functionality. This reduces the current draw of the jack presence tree during idle states. Remove the resistor between Pin 9 and AVDD in this mode. |
| PORT-B_L (MIC)       | 13      | Analog I         | Microphone or Line-In Left Input.                                                                                                                                                                                             |
| PORT-B_R (MIC)       | 14      | Analog I         | Microphone or Line-In Right Input.                                                                                                                                                                                            |
| PORT-C_L (Line In)   | 15      | Analog I         | Line-In or Microphone Left Input.                                                                                                                                                                                             |
| PORT-C_R (Line In)   | 16      | Analog I         | Line-In or Microphone Right Input.                                                                                                                                                                                            |
| PORT-D_L (Line Out)  | 23      | Analog O         | Line-Out-(Front)-Left Channel.                                                                                                                                                                                                |
| PORT-D_R (Line Out)  | 24      | Analog O         | Line-Out-(Front)-Right Channel.                                                                                                                                                                                               |
| MONO_OUT             | 25      | Analog O         | Monaural Output to Telephony Subsystem Speakerphone.                                                                                                                                                                          |
| PORT-A_L (Headphone) | 27      | Analog O         | Headphone-Out-Left Channel.                                                                                                                                                                                                   |
| PORT-A_R (Headphone) | 28      | Analog O         | Headphone-Out-Right Channel.                                                                                                                                                                                                  |
| VREF_FILT            | 18      | O                | Voltage Reference Filter.                                                                                                                                                                                                     |
| MIC_BIAS-B           | 19      | O                | Programmable Microphone Bias Output. Intended for connection to Port-B.                                                                                                                                                       |

# AD1983

| Mnemonic         | Pin No.     | I/O <sup>1</sup> | Description                                                                                                                                                         |
|------------------|-------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MIC_BIAS-C       | 20          | O                | Programmable Microphone Bias Output. Intended for connection to Port-C.                                                                                             |
| DV <sub>SS</sub> | 4           | I                | Digital Supply Return (Ground).                                                                                                                                     |
| DV <sub>DD</sub> | 6           | I                | Digital Supply Voltage (3.3 V).                                                                                                                                     |
| AV <sub>SS</sub> | 17, 29      | I                | Analog Supply Return (Ground).                                                                                                                                      |
| AV <sub>DD</sub> | 22, 26      | I                | Analog Supply Voltage (5.0 V). AV <sub>DD</sub> supplies should be well filtered because supply noise degrades audio performance. Connection to Pin 22 is optional. |
| S/PDIF_OUT       | 32          | Digital O        | Supports S/PDIF Output.                                                                                                                                             |
| NC               | 1, 10 to 12 |                  |                                                                                                                                                                     |

<sup>1</sup> I refers to input and O refers to output.

## HD AUDIO CODEC INFORMATION

Table 6. Widget List and Descriptions

| NID (Hex) | 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        | Mono Selector             | 3       | Audio selector | Chooses the signals that drive the mono output mixer and pin.                                                              |
| 0C        | Microphone Selector/Boost | 3       | Audio mixer    | Allows microphone source port selection and boost preamplifier setting.                                                    |
| 0D        | Line In Selector          | 3       | Audio selector | Allows line in source port selection.                                                                                      |
| 0E        | Analog Mixer              | 2       | Audio mixer    | Selectively mixes analog input signals into a single signal.                                                               |
| 0F        | Mono Mixer                | 2       | Audio mixer    | Stereo-to-Mono mixer.                                                                                                      |
| 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        | Record Selector           | 3       | Audio selector | Chooses the signal that is recorded by the record ADC. Also contains the record gain controls.                             |
| 15        | Analog Power-Down         | 5       | Power widget   | Controls power on analog mixer and associated amplifiers. This controls the power of all widgets in its connection list.   |

Table 7. Root and Function Node Parameters<sup>1</sup>

| NID (Hex) | Name     | Type ID | Type     | Vendor ID<br>PID 00 <sup>2</sup> | Revision ID<br>PID 02 <sup>2</sup> | Sub Node Count<br>PID 04 <sup>2</sup> | Function Group Type<br>PID 05 <sup>2</sup> | Audio F.G. Caps<br>PID 08 <sup>2</sup> | GPIO Caps<br>PID 11 <sup>2</sup> |
|-----------|----------|---------|----------|----------------------------------|------------------------------------|---------------------------------------|--------------------------------------------|----------------------------------------|----------------------------------|
| 00        | ROOT     | X       | Root     | 11D41983                         | 00100400                           | 00010001                              |                                            |                                        |                                  |
| 01        | FUNCTION | X       | Function |                                  |                                    | 00020014                              | 00000001                                   | 00010C0C                               | 40000002                         |

<sup>1</sup> Default SSID: BFD30000.

<sup>2</sup> PID = parameter ID.

Table 8. Widget Parameters

| NID<br>(Hex) | Name                         | Widget<br>Caps<br>PID 09 <sup>1</sup> | PCM Size,<br>Rate<br>PID 0A <sup>1</sup> | Stream<br>Format<br>PID 0B <sup>1</sup> | Pin<br>Caps<br>PID 0C <sup>1</sup> | Input<br>Amp Caps<br>PID 0D <sup>1</sup> | Con. List<br>Len<br>PID 0E <sup>1</sup> | Power<br>States<br>PID 0F <sup>1</sup> | Processing<br>Caps<br>PID 10 <sup>1</sup> | GPIO<br>Caps<br>PID 11 <sup>1</sup> | Vendor-<br>Specific<br>PID F0 <sup>1</sup> |
|--------------|------------------------------|---------------------------------------|------------------------------------------|-----------------------------------------|------------------------------------|------------------------------------------|-----------------------------------------|----------------------------------------|-------------------------------------------|-------------------------------------|--------------------------------------------|
| 01           | FUNCTION                     | 000004C0                              | 000E007F                                 | 00000001                                |                                    | 00000000                                 |                                         | 00000009                               | 00000001                                  | 80053F3D                            | 00000084                                   |
| 02           | S/PDIF                       | 00030311                              | 00020060                                 | 00000005                                |                                    |                                          | 00000002                                |                                        |                                           |                                     |                                            |
| 03           | Front DAC                    | 00000441                              | 000E007F                                 | 00000001                                |                                    |                                          | 00000000                                | 00000009                               | 00004601                                  |                                     | 00000010                                   |
| 04           | Record ADC                   | 00100501                              | 000E007F                                 | 00000001                                |                                    |                                          | 00000001                                | 00000009                               |                                           |                                     |                                            |
| 05           | Port-D (Line Out)            | 00400185                              |                                          |                                         | 00000017                           |                                          | 00000002                                |                                        |                                           | 80053F3D                            | 00000008                                   |
| 06           | Port-A<br>(Headphone Out)    | 00400185                              |                                          |                                         | 0000001F                           |                                          | 00000002                                |                                        |                                           | 80053F3D                            | 00000008                                   |
| 07           | MONO_OUT                     | 00400104                              |                                          |                                         | 00000010                           |                                          | 00000001                                |                                        |                                           | 80053F3D                            |                                            |
| 08           | Port-B (Front<br>Microphone) | 00400081                              |                                          |                                         | 00001727                           |                                          | 00000000                                |                                        |                                           |                                     | 00000008                                   |
| 09           | Port-C (Line In)             | 00400081                              |                                          |                                         | 00001727                           |                                          | 00000000                                |                                        |                                           |                                     | 00000008                                   |
| 0A           | S/PDIF_OUT                   | 00400301                              |                                          |                                         | 00000010                           |                                          | 00000001                                |                                        |                                           |                                     |                                            |
| 0B           | Mono Selector                | 00300101                              |                                          |                                         |                                    |                                          | 00000004                                |                                        |                                           |                                     |                                            |
| 0C           | Microphone<br>Selector/Boost | 0030010D                              |                                          |                                         |                                    |                                          | 00000002                                |                                        |                                           | 00270300                            |                                            |
| 0D           | Line In Selector             | 00300101                              |                                          |                                         |                                    |                                          | 00000002                                |                                        |                                           |                                     |                                            |
| 0E           | Analog Mixer                 | 00200101                              |                                          |                                         |                                    |                                          | 00000003                                |                                        |                                           |                                     |                                            |
| 0F           | Mono Mixer                   | 00200100                              |                                          |                                         |                                    |                                          | 00000001                                |                                        |                                           |                                     | 00000002                                   |
| 10           | Digital PC Beep              | 0070000C                              |                                          |                                         |                                    |                                          | 00000000                                |                                        |                                           | 800B0F0F                            |                                            |
| 11           | Front Mix Amp                | 0030010D                              |                                          |                                         |                                    |                                          | 00000001                                |                                        |                                           | 80051F17                            |                                            |
| 12           | Port-B Mix Amp               | 0030010D                              |                                          |                                         |                                    |                                          | 00000001                                |                                        |                                           | 80051F17                            |                                            |
| 13           | Port-C Mix Amp               | 0030010D                              |                                          |                                         |                                    |                                          | 00000001                                |                                        |                                           | 80051F17                            |                                            |
| 14           | Record Selector              | 0030010D                              |                                          |                                         |                                    |                                          | 00000004                                |                                        |                                           | 80050F00                            |                                            |
| 15           | Analog Power-<br>Down        | 00500500                              |                                          |                                         |                                    |                                          | 00000004                                | 00000009                               |                                           |                                     |                                            |

<sup>1</sup> PID = parameter ID.

Table 9. Default Configuration Parameters

| Node ID (Hex) | Name          | Type ID | Bit Bit  | 31 30   | 29 28    | 27 24     | 23 20       | 19 16      | 15 12   | 8 8   | 7 4        | 3 0      |
|---------------|---------------|---------|----------|---------|----------|-----------|-------------|------------|---------|-------|------------|----------|
|               |               |         | Value    | Connect | Location |           | Def. Device | Conn. Type | Color   | Misc. | Def. Assn. | Sequence |
|               |               |         |          |         | Chassis  | Position  |             |            |         |       |            |          |
| 05            | Line Out      | 4       | 01014010 | Jack    | External | Rear      | Line Out    | 1/8" Jack  | Green   | 0     | 1          | 0        |
| 06            | HP Out        | 4       | 0221401F | Jack    | External | Front     | HP Out      | 1/8" Jack  | Green   | 0     | 1          | F        |
| 07            | Mono Out      | 4       | 991301F0 | Fixed   | Internal | Special 3 | Speaker     | ATAPI      | Unknown | 1     | F          | 0        |
| 08            | Microphone In | 4       | 02A19020 | Jack    | External | Front     | Mic In      | 1/8" Jack  | Pink    | 0     | 2          | 0        |
| 09            | Line In       | 4       | 0181302E | Jack    | External | Rear      | Line In     | 1/8" Jack  | Blue    | 0     | 2          | E        |
| 0A            | S/PDIF Out    | 4       | 014511F0 | Jack    | External | Rear      | SPDIF Out   | Optical    | Black   | 1     | F          | 0        |

Table 10. Widget Connection List

| NID (Hex) | Name                      | Index     |           |           |           |
|-----------|---------------------------|-----------|-----------|-----------|-----------|
|           |                           | 0         | 1         | 2         | 3         |
|           |                           | NID (Hex) | NID (Hex) | NID (Hex) | NID (Hex) |
| 02        | S/PDIF                    | 01        | 04        |           |           |
| 03        | Front DAC                 |           |           |           |           |
| 04        | Record ADC                | 14        |           |           |           |
| 05        | Port-D (Line Out)         | 03        | 0E        |           |           |
| 06        | Port-A (Headphone Out)    | 03        | 0E        |           |           |
| 07        | MONO_OUT                  | 0F        |           |           |           |
| 08        | Port-B (Front Microphone) |           |           |           |           |
| 09        | Port-C (Line In)          |           |           |           |           |
| 0A        | S/PDIF_OUT                | 02        |           |           |           |
| 0B        | Mono Selector             | 03        | 0C        | 0D        | 0E        |
| 0C        | Microphone Selector/Boost | 08        | 09        |           |           |
| 0D        | Line In Selector          | 09        | 08        |           |           |
| 0E        | Analog Mixer              | 11        | 12        | 13        |           |
| 0F        | Mono Mixer                | 0B        |           |           |           |
| 10        | Digital PC Beep           |           |           |           |           |
| 11        | Front Mix Amp             | 03        |           |           |           |
| 12        | Port-B Mix Amp            | 0C        |           |           |           |
| 13        | Port-C Mix Amp            | 0D        |           |           |           |
| 14        | Record Selector           | 0C        | 0D        | 0E        | 0F        |
| 15        | Analog Power-Down         | 05        | 09        | 0B        | 14        |

# AD1983

## VERB SUPPORT

Table 11 and Table 12 list only those HD audio verbs that are supported.

Table 11. Widget Verb Support

| Node ID (Hex) | Name                | Get (Hex) | Stream Format | Amplifier Gain/Mute | Processing Coefficient | Coefficient Index | Parameter | Connection Select | Connection List Entry | Processing State | SDI Select     | Power State | Channel / Stream ID | Pin Widget Control | Unsolicited Enable | Pin Sense | Beep Generator | Digital Converter 1 | Digital Converter 2 |
|---------------|---------------------|-----------|---------------|---------------------|------------------------|-------------------|-----------|-------------------|-----------------------|------------------|----------------|-------------|---------------------|--------------------|--------------------|-----------|----------------|---------------------|---------------------|
|               |                     |           | Axx           | Bxx                 | Cxx                    | Dxx               | F00       | F01               | F02                   | F03              | F04            | F05         | F06                 | F07                | F08                | F09       | F0A            | F0D                 |                     |
|               |                     |           | 2xx           | 3xx                 | 4xx                    | 5xx               | ---       | 701               | ---                   | 703              | 704            | 705         | 706                 | 707                | 708                | 709       | 70A            | 70D                 | 70E                 |
| 00            | ROOT                |           |               |                     |                        |                   | √         |                   |                       |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 01            | FUNCTION            |           |               |                     | S <sup>1</sup>         | S <sup>1</sup>    | √         |                   |                       | U <sup>2</sup>   |                | √           |                     |                    | √                  |           |                |                     |                     |
| 02            | S/PDIF              |           | √             |                     |                        |                   | √         | √                 | √                     | S <sup>1</sup>   | U <sup>2</sup> |             | √                   |                    |                    |           |                | √                   | √                   |
| 03            | Front DAC           |           | √             |                     | √                      | √                 | √         |                   |                       | √                | U <sup>2</sup> | √           | √                   |                    |                    |           |                |                     |                     |
| 04            | Record ADC          |           | √             |                     |                        |                   | √         |                   | √                     |                  | U <sup>2</sup> | √           | √                   |                    |                    |           |                |                     |                     |
| 05            | Line Out            |           |               | √                   |                        |                   | √         | √                 | √                     |                  |                |             |                     | √                  | √                  | √         |                |                     |                     |
| 06            | HP Out              |           |               | √                   |                        |                   | √         | √                 | √                     |                  |                |             |                     | √                  | √                  | √         |                |                     |                     |
| 07            | Mono Out            |           |               | √                   |                        |                   | √         |                   | √                     |                  |                |             |                     | √                  |                    |           |                |                     |                     |
| 08            | Microphone In       |           |               |                     |                        |                   | √         |                   |                       |                  |                |             |                     | √                  | √                  | √         |                |                     |                     |
| 09            | Line In             |           |               |                     |                        |                   | √         |                   |                       |                  |                |             |                     | √                  | √                  | √         |                |                     |                     |
| 0A            | S/PDIF Out          |           |               |                     |                        |                   | √         |                   | √                     |                  |                |             |                     | √                  |                    |           |                |                     |                     |
| 0B            | Mono Selector       |           |               |                     |                        |                   | √         | √                 | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 0C            | Microphone Selector |           |               | √                   |                        |                   | √         | √                 | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 0D            | Line In Selector    |           |               |                     |                        |                   | √         | √                 | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 0E            | Analog Mixer        |           |               |                     |                        |                   | √         |                   | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 0F            | Mono Mixer          |           |               |                     |                        |                   | √         |                   | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 10            | Digital PCBeep      |           |               | √                   |                        |                   | √         |                   |                       |                  |                |             |                     |                    |                    |           | √              |                     |                     |
| 11            | Front MixAmp        |           |               | √                   |                        |                   | √         |                   | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 12            | Microphone MixAmp   |           |               | √                   |                        |                   | √         |                   | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 13            | Line In MixAmp      |           |               | √                   |                        |                   | √         |                   | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 14            | ADC Selector        |           |               | √                   |                        |                   | √         | √                 | √                     |                  |                |             |                     |                    |                    |           |                |                     |                     |
| 15            | Analog Power Down   |           |               |                     |                        |                   | √         |                   | √                     |                  |                | √           |                     |                    |                    |           |                |                     |                     |

<sup>1</sup> S = supports ADI specific functionality. Refer to the Programming Guide for more details (available from your assigned Applications Engineer).

<sup>2</sup> U = unsupported in the AD1983; the get verb always returns 0, the set verbs are ignored.

Table 12. Widget Extended Verb Support

| Node ID         | Name       |           | GPI/O Data | GPI/O Enable | GPI/O Direction | GPI/O Wake Mask | GPI/O Unsolicited | GPI/O Sticky Mask | Config Def Byte1 | Config Def Byte2 | Config Def Byte3 | Config Def Byte4 | Subsystem ID Byte1 | Subsystem ID Byte2 | Subsystem ID Byte3 | Subsystem ID Byte4 |
|-----------------|------------|-----------|------------|--------------|-----------------|-----------------|-------------------|-------------------|------------------|------------------|------------------|------------------|--------------------|--------------------|--------------------|--------------------|
|                 |            | Get (Hex) | F15        | F16          | F17             | F18             | F19               | F1A               | F1C              |                  |                  |                  | F20                |                    |                    |                    |
|                 |            | Set (Hex) | 715        | 716          | 717             | 718             | 719               | 71A               | 71C              | 71D              | 71E              | 71F              | 720                | 721                | 722                | 723                |
| 01 <sup>1</sup> | FUNCTION   |           | √          | √            | √               | U <sup>2</sup>  | √                 | U <sup>2</sup>    |                  |                  |                  |                  | √                  | √                  | √                  | √                  |
| 05              | Line Out   |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |
| 06              | HP Out     |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |
| 07              | Mono Out   |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |
| 08              | Microphone |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |
| 09              | Line In    |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |
| 0A              | S/PDIF Out |           |            |              |                 |                 |                   |                   | √                | √                | √                | √                |                    |                    |                    |                    |

<sup>1</sup> Only the FUNCTION node (Node ID 01) supports the RESET Verb 7FF (set verb only).<sup>2</sup> U = unsupported in the AD1983. The get verb always returns 0, and the set verbs are ignored.

JACK PRESENCE DETECTION

The AD1983 uses one jack sense line for presence detection on up to four external jacks. This enables software to determine if there is a device plugged into a jack; then, the AD1983 sensing engine can determine what type of device it is. 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 a different value resistor for each between the sense line and ground (AV<sub>SS</sub>). Jacks must have normally-open, isolated switches to use this method of jack presence detection.

For proper operation there must be a 2.67 kΩ 1% resistor connected between SENSE\_A and AV<sub>DD</sub>. For this configuration R1 and C1 should be installed; however, R2 should not be installed (see Figure 3).

The specific resistor values for each jack are shown in Table 13. To ensure accurate detection, use 1% tolerance resistors for all jack presence circuitry.

Table 13. Jack Sense Mapping

| Resistor (1%) | SENSE_A       |      |               |
|---------------|---------------|------|---------------|
|               | Name          | Port | Node ID (Hex) |
| 5.1 kΩ        | Line Out      | D    | 05            |
| 10.0 kΩ       | Line In       | C    | 09            |
| 20.0 kΩ       | Microphone    | B    | 08            |
| 39.2 kΩ       | Headphone Out | A    | 06            |

An alternate method reduces the current for sensing by connecting a single 2.67 kΩ 1% resistor between the SENSE\_A and SENSE\_SRC pins. For this configuration R1 and C1 are not installed; however, R2 is installed (see Figure 3).

It is recommended that designers place circuitry for both sensing methods and only install one of the two options.

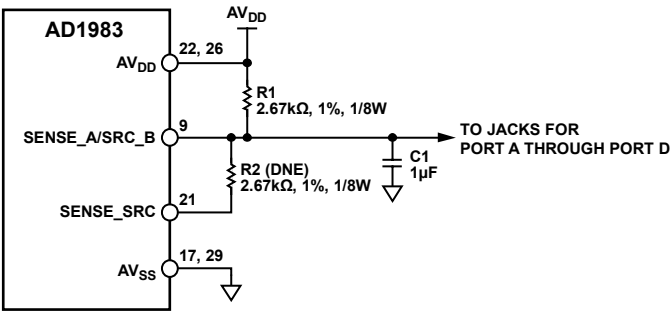


Figure 3. Jack Presence Detection

05205-003



**AD1983**

## **NOTES**