# High Definition Audio SoundMAX Codec

# AD1989B

## FEATURES

**Ten 192 kHz, 101 dB DACs**
   7.1 surround sound plus independent headphone
   All independent sample rates, 8 kHz through 192 kHz
   Selectable stereo mixer on outputs
   16-, 20-, and 24-bit resolution
**Six 192 kHz, 92 dB ADCs**
   Simultaneous record of up to 3 stereo channels
   All independent sample rates, 8 kHz through 192 kHz
   16-, 20-, and 24-bit resolution
**S/PDIF output**
   2 independent transmitters, second S/PDIF can support
      external HDMI interface
   Supports 44.1 kHz through 192 kHz sample rates
   16-, 20-, and 24-bit data; PCM, and AC3 formats
   Digital PCM gain control

**S/PDIF input**
   Supports 44.1 kHz through 192 kHz sample rates
   16-, 20-, and 24-bit data; PCM, and AC3 formats
   Digital PCM gain control
   Auto synchronizes to source sample rate
**Dedicated auxiliary pins**
   Stereo CD/auxiliary I/O port w/GND sense
   MONO_OUT pin for internal speaker with EAPD support
**Microsoft Vista Premium® logo compliant**
**Support up to 9 audio jacks**
**Impedance and presence detection; retasking**
**5 adjustable microphone bias pins**
**Digital and analog PCBeep**
**3 general-purpose digital I/O (GPIO) pins**
**Multiple EAPD pins for external circuit control**
**3.3 V analog and digital supply voltages**
**1.5 V and 3.3 V HD Audio link signaling**
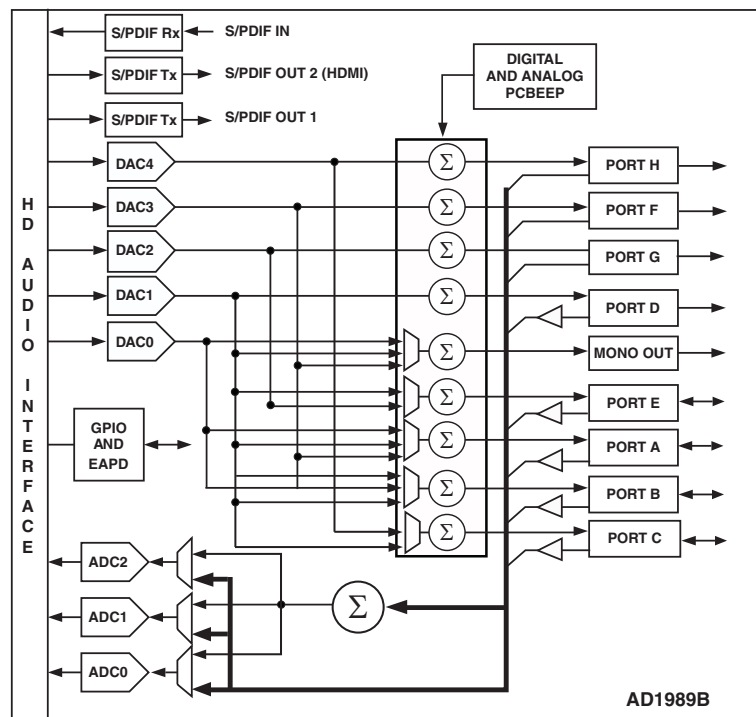**Advanced power management modes**



*Figure 1.  AD1989B Block Diagram*

**Rev. 0**

# AD1989B

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## REVISION HISTORY

**8/08—Revision 0: Initial Version**

# GENERAL DESCRIPTION

The AD1989B audio codec and SoundMAX® software provides superior HD audio quality that exceeds Vista Premium performance. The AD1989B has ten 101 dB DACs and six 92 dB ADCs, three stereo headphone ports, C/LFE swapping, digital and analog PCBeep, and two independent S/PDIF outputs, making the AD1989B the right choice for PCs where performance and a rich feature set are primary considerations.

The jack retasking feature on this product supports various configurations including 7.1 on 5 jacks, 5.1 on 3 jacks, and front panel jack retasking.

The AD1989B is available in a 48-lead RoHS compliant lead frame chip scale package in both reels and trays. See Ordering Guide on Page 20.

## SPECIAL SOFTWARE FEATURES

The AD1989B audio codec also supports the following additional software features:

- BlackHawk® and SoundMAX GUI contain all user audio controls
- Voice input enhancement: Andrea Electronics best-in-class noise reduction, beam forming, and echo cancellation
- Output enhancement: Sensaura/Sonic Focus, spreading/downmixing, MP3 refinement, adaptive dynamics, compressor/limiter, speaker/graphic EQ, Voice Clarity/X-Matrix™, AGC, UI tuning tools
- DTS®, SRS®, EAX® for gaming

## ADDITIONAL INFORMATION

This data sheet provides a general overview of the AD1989B SoundMAX codec's architecture and functionality. Additional information on the AD1989B is available in the AD1989B Programmers Reference Manual. Please contact your local Analog Devices, Inc., sales representative for more information. For information on SoundMAX codecs and software, see Analog Devices website at http://www.analog.com/soundMAX.

## JACK CONFIGURATION

The guidelines shown in Table 1 and Table 2 should be used when selecting ports for particular functions.

**Table 1. Typical Desktop Applications with Discreet Jacks (Default Configuration)**

| Port | Function |
|------|----------|
| Port A | Front Panel Headphone |
| Port B | Front Panel Microphone |
| Port C | Rear Line-In |
| Port D | Rear Line-Out |
| Port E | Rear Microphone |
| Port F | Rear Surround (5.1) |
| Port G | Rear C/LFE |
| Port H | Rear Surround (7.1) |

**Table 2. Typical Desktop Retasking to Support Input/5.1 on 3 Jacks**

| Port | Function |
|------|----------|
| Port A | Front Panel Headphone |
| Port B | Front Panel Microphone |
| Port C | Rear Line-In/Surround Out |
| Port D | Rear Line-Out |
| Port E | Rear Microphone/C/LFE |

# AD1989B

## SPECIFICATIONS

### TEST CONDITIONS

| Parameter | Test Condition |
|---|---|
| Temperature | 25°C |
| Digital Supply | 3.3 V |
| Analog Supply | 3.3 V |
| MIC_BIAS_IN (via Low-Pass Filter) | 5.0 V |
| Sample Rate $f_S$ | 48 kHz |
| Input Signal (Frequency Sine Wave) | 1008 Hz |
| Amplitude for THD + N | −3.0 dB Full Scale |
| Analog Output Pass Band | 20 Hz to 20 kHz |
| DAC | 10 kΩ Output Load: Line-Out Tests |
| | 32 Ω Output Load: Headphone Tests |
| ADC | 0 dB Gain |

### PERFORMANCE

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Line-Out Drive (10 kΩ loads—DAC to Pin) | | | | |
| Total Harmonic Distortion (THD + N) | | −86 | | dB |
| Dynamic Range (–60 dB in ref to $f_S$ A-Weighted) | | 101 | | dB |
| Signal-to-Noise Ratio | | 101 | | dB |
| Headphone Drive (32 Ω loads—DAC to Pin) | | | | |
| Total Harmonic Distortion (THD + N) | | −84 | | dB |
| Dynamic Range (–60 dB in ref to $f_S$ A-Weighted) | | 101 | | dB |
| Signal-to-Noise Ratio | | 101 | | dB |
| Input Ports (Mic Boost = 0 dB) | | | | |
| Total Harmonic Distortion (THD + N) | | −80 | | dB |
| Dynamic Range (–60 dB in ref to $f_S$ A-Weighted) | | 92 | | dB |
| Signal-to-Noise Ratio | | 92 | | dB |

### GENERAL SPECIFICATIONS

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| DIGITAL DECIMATION AND INTERPOLATION FILTERS—$f_S$ = 8 kHz to 96 kHz[1] | | | | |
| Pass Band | 0 | | 0.4 $f_S$ | Hz |
| Pass-Band Ripple | | | ±0.005 | dB |
| Stop Band | 0.6 $f_S$ | | | Hz |
| Stop-Band Rejection | −110 | | | dB |
| Group Delay | | 20 | | 1/$f_S$ |
| Group Delay Variation Over Pass Band | | 0 | | µs |
| ANALOG-TO-DIGITAL CONVERTERS | | | | |
| Resolution | | 24 | | Bits |
| Gain Error (Full-Scale Span Relative to Nominal Input Voltage)[2] | | | ±10 | % |
| Interchannel Gain Mismatch (Difference of Gain Errors) | | ±0.2 | ±0.5 | dB |
| ADC Offset Error[1] | | | ±5 | mV |
| ADC Crosstalk[1] | | | | |
| Line Inputs (Input L, Ground R, Read R; Input R, Ground L, Read L) | | −94 | | dB |
| Line Inputs to Other | | −100 | −80 | dB |
| DIGITAL-TO-ANALOG CONVERTERS | | | | |
| Resolution | | 24 | | Bits |
| Gain Error (Full-Scale Span Relative to Nominal Input Voltage)[1] | | | ±10 | % |
| Interchannel Gain Mismatch (Difference of Gain Errors) | | | ±0.5 | dB |
| DAC Crosstalk (Input L, Zero R, Measure R_OUT; Input R, Zero L, Measure L_OUT)[1] | | −104 | | dB |

| Parameter | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| DAC VOLUMES | | | | | |
| Step Size (DAC0, DAC1, DAC2, DAC3) | | | 1.5 | | dB |
| Output Gain/Attenuation Range | | −58.5 | | 0 | dB |
| Mute Attenuation of 0 dB Fundamental[1] | | | −80 | | dB |
| ADC VOLUMES | | | | | |
| Step Size (ADCSEL-0, ADCSEL-1) | | | 1.5 | | dB |
| PGA Gain/Attenuation Range | | −58.5 | | +22.5 | dB |
| Mute Attenuation of 0 dB Fundamental[1] | | | −80 | | dB |
| ANALOG MIXER | | | | | |
| Signal-to-Noise Reduction (SNR) Input to Output | | | 95 | | dB |
| Step Size: All Mixer Inputs | | | −1.5 | | dB |
| Input Gain/Attenuation Range: All Mixer Inputs | | −34.5 | | +12.0 | dB |
| ANALOG LINE LEVEL OUTPUTS | | | | | |
| Full-Scale Output Voltage: Line-Out Drive Enabled | | 1.0 | | | V rms[3] |
| | Output Impedance[1] | | 190 | | Ω |
| | External Load Impedance[1] | 10 | | | kΩ |
| | Output Capacitance[1] | | 15 | | pF |
| | External Load Capacitance[1] | | | 1000 | pF |
| ANALOG HP DRIVE OUTPUTS | | | | | |
| Full-Scale Output Voltage: Line-Out Drive Enabled | | 1.0 | | | V rms[3] |
| Ports A, B and D (when HP Drive is Enabled) | | 2.83 | | | V p-p |
| | Output Impedance[1] | | | 0.5 | Ω |
| | External Load Impedance[1] | 32 | | | Ω |
| | Output Capacitance[1] | | 15 | | pF |
| | External Load Capacitance[1] | | | 1000 | pF |
| ANALOG INPUTS | | | | | |
| Input Voltages—Ports A, B, C, or E | | | | | |
| | Mic Boost = 0 dB | | 1 | | V rms[3] |
| | | | 2.83 | | V p-p |
| Input Voltages—Microphone Boost | Mic Boost = +10 dB | | 0.316 | | V rms[3] |
| Amplifier, Ports B, C, or E | | | 0.894 | | V p-p |
| | Mic Boost = +20 dB | | 0.1 | | V rms[3] |
| | | | 0.283 | | V p-p |
| | Mic Boost = +30 dB | | 0.032 | | V rms[3] |
| | | | 0.089 | | V p-p |
| Input Impedance | | | | | |
| PCBEEP | | | 23 | | kΩ |
| Ports A, B, C, E (Mic Boost = 0 dB) | | | 150 | | kΩ |
| Input Capacitance[1] | | | 5 | 7.5 | pF |
| MICROPHONE BIAS | | | | | |
| MIC_BIAS-B, MIC_BIAS-C | | | | | |
| MIC_BIAS_IN (Pin 33) = +5 V or +3.3 V | $V_{REF}$ Setting = High-Z | | High-Z | | |
| | $V_{REF}$ Setting = 0 V | | 0 | | V dc |
| | $V_{REF}$ Setting = 50% | | 1.65 | | V dc |
| MIC_BIAS_IN (Pin 33) = +5 V | $V_{REF}$ Setting = 80% | | 3.7 | | V dc |
| | $V_{REF}$ Setting = 100% | | 3.9 | | V dc |
| MIC_BIAS_IN (Pin 33) = +3.3 V | $V_{REF}$ Setting = 80% | | 2.86 | | V dc |
| | $V_{REF}$ Setting = 100% | | 3.0 | | V dc |
| MIC_BIAS-E (When enabled as BIAS) | $V_{REF}$ Setting = High-Z | | High-Z | | |
| | $V_{REF}$ Setting = 0 V | | 0 | | V dc |
| | $V_{REF}$ Setting = 50% | | 1.65 | | V dc |
| | $V_{REF}$ Setting = 80% | | 2.86 | | V dc |
| | $V_{REF}$ Setting = 100% | | 3.0 | | V dc |
| Output Drive Current | $V_{REF}$ Setting = 50%, 80%, or 100% | | 1.6 | | mA |

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| Parameter | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| GPIO_0, GPIO_1, and GPIO_2 | | | | | |
| Input Signal High ($V_{IH}$) | | $DV_{GPIO} \times 0.60$ | | $DV_{GPIO}$ | V |
| Input Signal Low ($V_{IL}$) | | 0 | | $DV_{GPIO} \times 0.24$ | V |
| Output Signal High ($V_{OH}$) | $I_{OUT} = -500\ \mu A$ | $DV_{GPIO} \times 0.72$ | | $DV_{GPIO}$ | V |
| Output Signal Low ($V_{OL}$) | $I_{OUT} = +1500\ \mu A$ | 0 | | $DV_{GPIO} \times 0.10$ | V |
| Input Leakage Current (Signal High) ($I_{IH}$) | | | −150 | | nA |
| Input Leakage Current (Signal Low) ($I_{IL}$) | | | −50 | | μA |
| S/PDIF-Out_1, S/PDIF-Out_2 | | | | | |
| Output Signal High ($V_{OH}$) | $I_{OUT} = -500\ \mu A$ | $DV_{GPIO} \times 0.72$ | | $DV_{GPIO}$ | V |
| Output Signal Low ($V_{OL}$) | $I_{OUT} = +1500\ \mu A$ | 0 | | $DV_{GPIO} \times 0.10$ | V |
| S/PDIF_IN | | | | | |
| Input Signal High ($V_{IH}$) | | $DV_{GPIO} \times 0.60$ | | $DV_{GPIO}$ | V |
| Input Signal Low ($V_{IL}$) | | 0 | | $DV_{GPIO} \times 0.24$ | V |
| Input Leakage Current (Signal High) ($I_{IH}$) | | | 150 | | nA |
| Input Leakage Current (Signal Low) ($I_{IL}$) | | | −50 | | μA |
| POWER SUPPLY | | | | | |
| Analog ($AV_{DD}$) 3.3 V ± 5% | | | | | |
| Power Supply Range | | 3.13 | 3.30 | 3.46 | V |
| Power Dissipation | | | 162 | | mW |
| Supply Current | | | 49 | | mA |
| Digital ($DV_{DD}$) 3.3 V ± 10% | | | | | |
| Power Supply Range | | 2.97 | 3.30 | 3.63 | V |
| Power Dissipation | | | 241 | | mW |
| Supply Current | | | 73 | | mA |
| Digital I/O ($DV_{IO}$) 3.3 V ± 10% | | | | | |
| Power Supply Range | | 2.97 | 3.30 | 3.63 | V |
| Power Dissipation | | | 0.66 | | mW |
| Supply Current | | | 0.20 | | mA |
| Digital I/O ($DV_{IO}$) 1.5 V ± 5.5% | | | | | |
| Power Supply Range | | 1.42 | 1.50 | 1.58 | V |
| Power Dissipation | | | 0.03 | | mW |
| Supply Current | | | 0.20 | | mA |
| Digital GPIO ($DV_{GPIO}$) 3.3 V ± 10% | | | | | |
| Power Supply Range | | 2.97 | 3.30 | 3.63 | V |
| Power Dissipation | | | 3.63 | | mW |
| Supply Current | | | 1.10 | | mA |
| Power Supply Rejection (Reference to $f_S$ 100 mV p-p Signal @ 1 kHz)[1] | | | 80 | | dB |

[1] Guaranteed but not tested.

[2] Measurements reflect main ADC.

[3] RMS values assume sine wave input.

## HD AUDIO LINK SPECIFICATION

HD Audio signals comply with the High Definition Audio Spec-ifications. Please refer to these specifications at: *http://www.intel.com/standards/hdaudio/*

## POWER-DOWN STATES

| Parameter | $IDV_{DD}$ Typ | $IAV_{DD}$ Typ | Unit |
|---|---|---|---|
| Function Node in D0, All Nodes Active | 73 | 49 | mA |
| Function Node in D3 | 24 | 1 | mA |
| Codec in RESET | 3 | 3 | mA |
| Individual Block Power Savings | | | |
| DAC Pair Powered Down Saves (Each) | 6 | 5 | mA |
| ADC Pair Powered Down Saves (Each) | 6 | 3 | mA |
| Mixer Power Control (and Associated Amps) Saves | 0 | 2 | mA |
| MIC_BIAS Powered Down Saves[1, 2] | 0 | 0.1 | mA |

[1] Powering down the MIC_BIAS powers down all port MIC_BIAS pins. This disables all microphone bias circuits, setting them to the high-Z state.
[2] Test conditions: 30 pF load, 2.0 MHz frequency, 3.3 V $A_{VDD}$.

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## ABSOLUTE MAXIMUM RATINGS

Stresses greater than those listed below 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.

| Parameter | Rating |
|---|---|
| Digital (DV$_{DD}$) | −0.30 V to +3.65 V |
| Digital I/O (DV$_{IO}$) | −0.30 V to +3.65 V |
| Digital GPIO (DV$_{GPIO}$) | −0.30 V to +3.65 V |
| Analog (AV$_{DD}$) | −0.30 V to +3.65 V |
| Input Current (Except Supply Pins) | ±10.0 mA |
| Analog Input Voltage (Signal Pins) | −0.30 V to AV$_{DD}$ + 0.3 V |
| Digital Input Voltage (Signal Pins) | −0.30 V to DV$_{IO}$ + 0.3 V |
| Ambient Temperature (Operating) | 0°C to +70°C |
| Storage Temperature | −65°C to +150°C |

## ESD CAUTION

**ESD (electrostatic discharge) sensitive device.**
Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## ENVIRONMENTAL CONDITIONS

Ambient Temperature Rating

$T_{AMB} = T_{CASE} − (PD \times \theta_{CA})$
$T_{CASE}$ = Case Temperature in °C
PD = Power Dissipation in W
$\theta_{CA}$ = Thermal Resistance (Case-to-Ambient)
$\theta_{JA}$ = Thermal Resistance (Junction-to-Ambient)
$\theta_{JC}$ = Thermal Resistance (Junction-to-Case)

All measurements per EIA-JESD51 with 2S2P test board per EIA-JESD51-7.

**Table 3. Thermal Resistance**

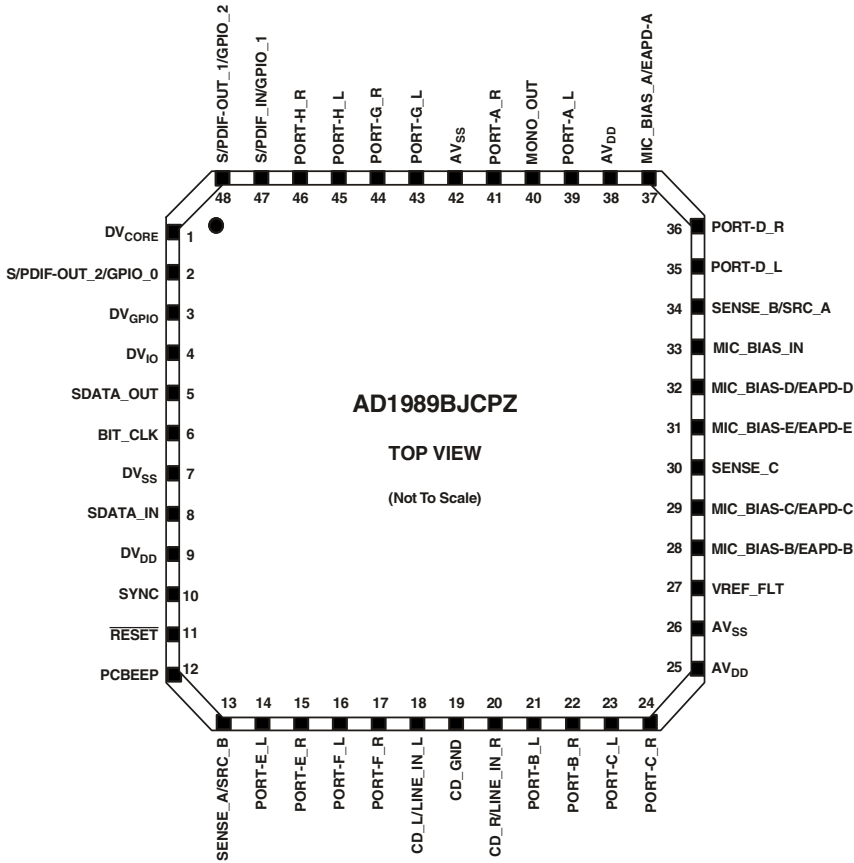| Package | $\theta_{JA}$ | $\theta_{JC}$ | $\theta_{CA}$ | Unit |
|---|---|---|---|---|
| LFCSP_VQ | 47 | 15 | 32 | °C/W |

# PIN CONFIGURATION AND FUNCTION DESCRIPTIONS



*Figure 2. AD1989B 48-Lead Package and Pinout*

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**Table 4. Pin Function Descriptions**

| Mnemonic | Pin No. | Function | Description |
|---|---|---|---|
| **DIGITAL INTERFACE** | | | |
| SDATA_OUT | 5 | I | Link Serial Data Output. Clocked on both edges of BIT_CLK. |
| BIT_CLK | 6 | I | Link Bit Clock. 24.000 MHz serial data clock. |
| SDATA_IN | 8 | I/O | Link Serial Data Input. AD1989B output stream clocked only on one edge of BIT_CLK. |
| SYNC | 10 | I | Link Frame Sync. |
| $\overline{RESET}$ | 11 | I | Link Reset. Master hardware reset. |
| **DIGITAL I/O** | | | |
| S/PDIF-OUT_2/GPIO_0 | 2 | I/O | S/PDIF Out or GPIO. Supports S/PDIF output as primary function. |
| S/PDIF_IN/GPIO_1 | 47 | I/O | S/PDIF Input/General-Purpose Input/Output Pin. Supports S/PDIF input as primary function. |
| S/PDIF-OUT_1/GPIO_2 | 48 | I/O | S/PDIF_OUT or GPIO. Supports S/PDIF output as primary function. |
| **JACK SENSE** | | | |
| SENSE_A/SRC_B | 13 | I/O | JACK Sense A-D Input/Sense B drive. |
| SENSE_B/SRC_A | 34 | I/O | JACK Sense E-H Input/Sense A drive. |
| SENSE_C | 30 | I | JACK Sense CD/Line inputs. |
| **ANALOG I/O** | | | |
| PCBEEP | 12 | LI | Monaural Input From System for Analog PCBeep. |
| Port-E_L | 14 | LI, MIC, LO, SWAP | Auxiliary Input/Output Left Channel. |
| Port-E_R | 15 | LI, MIC, LO, SWAP | Auxiliary Input/Output Right Channel. |
| Port-F_L | 16 | LO | Auxiliary Input/Surround Rear (5.1) Left Channel. |
| Port-F_R | 17 | LO | Auxiliary Input/Surround Rear (5.1) Right Channel. |
| CD_L/LINE_IN_L | 18 | LI | CD Audio Left Channel. |
| CD_GND | 19 | LI | CD Audio Analog Ground Reference (for Differential CD Input). Must be connected to AGND via 0.1 µF capacitor if not in use as CD_GND. |
| CD_R/LINE_IN_R | 20 | LI | CD Audio Right Channel. |
| Port-B_L | 21 | LI, MIC, HP, LO | Front Panel Stereo MIC/Line-In. |
| Port-B_R | 22 | LI, MIC, HP, LO | Front Panel Stereo MIC/Line-In. |
| Port-C_L | 23 | LI, MIC, LO | Rear Panel Stereo MIC/Line-In. |
| Port-C_R | 24 | LI, MIC, LO | Rear Panel Stereo MIC/Line-In. |
| Port-D_L | 35 | LI, HP, LO | Rear Panel Headphone/Line-Out. |
| Port-D_R | 36 | LI, HP, LO | Rear Panel Headphone/Line-Out. |
| Port-A_L | 39 | LI, MIC, HP, LO | Front Panel Headphone/Line-Out. |
| MONO_OUT | 40 | LO | Monaural Output to Internal Speaker or Telephony Subsystem Speakerphone. |
| Port-A_R | 41 | LI, MIC, HP, LO | Front Panel Headphone/Line-Out. |
| Port-G_L | 43 | LO, SWAP | Rear Panel C/LFE Output. |
| Port-G_R | 44 | LO, SWAP | Rear Panel C/LFE Output. |
| Port-H_L | 45 | LO | Rear Panel Surround Center/Side (7.1). |
| Port-H_R | 46 | LO | Rear Panel Surround Center/Side (7.1). |
| **FILTER/REFERENCE** | | | |
| MIC_BIAS-B/EAPD-B | 28 | O | Switchable Microphone Bias. For use with Port B (Pins 21, 22). |
| MIC_BIAS-C/EAPD-C | 29 | O | Switchable Microphone Bias. For use with Port C (Pins 23, 24). |
| MIC_BIAS-E/EAPD-E | 31 | O | Switchable Microphone Bias. For use with Port E (Pins 14, 15). |
| MIC_BIAS-D/EAPD-D | 32 | O | Switchable Microphone Bias. For use with Port D (Pins 35, 36) |
| MIC_BIAS-A/EAPD-A | 37 | O | Switchable Microphone Bias. For use with Port A (Pins 39, 41) |
| | | | All MIC_BIAS pins are capable of: High-Z, 0 V, 1.65 V, 3.78 V, and 3.95 V (with 5.0 V on Pin 33) High-Z, 0 V, 1.65 V, 2.86 V, and 3.00 V (with 3.3 V on Pin 33). |
| VREF_FILT | 27 | O | Voltage Reference Filter. |
| $DV_{CORE}$ | 1 | O | CAUTION: DO NOT APPLY 3.3 V TO THIS PIN! Filter connection for internal core voltage regulator. This pin must be connected to filter caps: 10 µF, 1.0 µF, and 0.1 µF connected in parallel between Pin 1 and $DV_{SS}$ (Pin 4). |

The symbols used in this table are defined as: I = input, O = output, LI = line level input, LO = line level output, HP = output capable of driving headphone load, MIC = input supports microphones with MIC bias and boost amplifier, SWAP = outputs can swap L/R channels (typically used to support C/LFE or shared C/LFE function).

**Table 4.  Pin Function Descriptions (Continued)**

| Mnemonic | Pin No. | Function | Description |
|---|---|---|---|
| POWER AND GROUND | | | |
| DV$_{GPIO}$ 3.3 V ± 10% | 3 | I | GPIO and S/PDIF Out (1 and 2) Signal Level (independent of DV$_{IO}$). Connect to 3.3 V ±10%. |
| DV$_{IO}$ 3.3 V ± 10% or DV$_{IO}$ 1.5 V ± 5.5% | 4 | I | Connect to the I/O voltage used for the HD Audio controller signals. |
| DV$_{SS}$ | 7 | I | Digital Supply Return (Ground). |
| DV$_{DD}$ 3.3 V ± 10% | 9 | I | Digital Supply Voltage 3.3 V. This is regulated down to Pin 1 to supply the internal digital core. |
| AV$_{DD}$ 3.3 V ± 5% | 25, 38 | I | CAUTION: DO NOT APPLY 5.0 V TO THESE PINS! Analog Supply Voltage 3.3 V ONLY. Note: AV$_{DD}$ supplies should be well regulated and filtered as supply noise degrades audio performance. |
| MIC_BIAS_IN | 33 | I | Source for Microphone Bias Circuitry. Connect this pin to 5.0 V via a low-pass filter. When connected this way the AD1989B is capable of providing +3.95 V as a mic bias to all of the MIC_BIAS pins. If 5 V is not available, connect this pin to +3.3 V (AV$_{DD}$) via a low-pass filter. The AD1989B produces a mic bias voltage relative to the AV$_{DD}$ supply (typically 3.0 V @ AV$_{DD}$ = 3.3 V). |
| AV$_{SS}$ | 26, 42 | I | Analog Supply Return (Ground). AV$_{SS}$ should be connected to DV$_{SS}$ using a conductive trace under, or close to, the AD1989B. |

The symbols used in this table are defined as: I = input, O = output, LI = line level input, LO = line level output, HP = output capable of driving headphone load, MIC = input supports microphones with MIC bias and boost amplifier, SWAP = outputs can swap L/R channels (typically used to support C/LFE or shared C/LFE function).

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## HD AUDIO WIDGETS

**Table 5. HD Audio Widgets[1]**

| Node ID | 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_1 DAC | 0 | Audio Output | S/PDIF-1 digital stream output interface |
| 03 | DAC_0 | 0 | Audio Output | Headphone/surround side (7.1) channel digital/audio converters |
| 04 | DAC_1 | 0 | Audio Output | Stereo front channel digital/audio converters |
| 05 | DAC_2 | 0 | Audio Output | Stereo C/LFE channel digital/audio converters |
| 06 | DAC_3 | 0 | Audio Output | Stereo surround-back (5.1) channel digital/audio converters |
| 07 | S/PDIF ADC | 1 | Audio Input | S/PDIF digital stream input interface |
| 08 | ADC_0 | 1 | Audio Input | Stereo record Channel 1 audio/digital converters |
| 09 | ADC_1 | 1 | Audio Input | Stereo record Channel 2 audio/digital converters |
| 0A | DAC_4 | 1 | Audio Output | Stereo surround side (7.1) channel digital/audio converters |
| 0B | S/PDIF_2 DAC | 0 | Audio Output | S/PDIF-2 output (typically used for HDMI) |
| 0C | ADC Selector 0 | 3 | Audio Selector | Selects and amplifies/attenuates the input to ADC0 |
| 0D | ADC Selector 1 | 3 | Audio Selector | Selects and amplifies/attenuates the input to ADC1 |
| 0E | ADC Selector 2 | 3 | Audio Selector | Selects and amplifies/attenuates the input to ADC2 |
| 0F | ADC_2 | 3 | Audio Input | Stereo record channel 2 audio/digital converters |
| 10 | Digital Beep | 7 | Beep Generator | Internal digital PCBeep signal |
| 11 | Port A (Headphone) | 4 | Pin Complex | Front panel headphone/microphone jack |
| 12 | Port D (Front L/R) | 4 | Pin Complex | Rear panel output/headphone output |
| 13 | Mono Out | 4 | Pin Complex | Monaural output pin (internal speakers or telephony system) |
| 14 | Port B (Front Mic) | 4 | Pin Complex | Front panel microphone/headphone jack |
| 15 | Port C (Line In) | 4 | Pin Complex | Line-in jack (rear or front) |
| 16 | Port F (Surr Back) | 4 | Pin Complex | Rear panel surround-rear (5.1) jack |
| 17 | Port E (Rear Mic) | 4 | Pin Complex | Rear panel mic jack |
| 18 | CD In/Line In | 4 | Pin Complex | Analog CD input or line input |
| 19 | Mixer Power Down | 5 | Power Widget | Powers down the analog mixer and associated amps |
| 1A | Analog PCBeep | 4 | Pin Complex | External analog PCBeep signal input |
| 1B | S/PDIF Out_1 | 4 | Pin Complex | S/PDIF_1 output pin |
| 1C | S/PDIF In | 4 | Pin Complex | S/PDIF input pin |
| 1D | S/PDIF Out_2 | 4 | Audio Mixer | S/PDIF_2 output pin |
| 1E | Mono Out Mixer | 2 | Audio Mixer | Selects which source drives the mono out signal |
| 20 | Analog Mixer | 2 | Audio Mixer | Mixes individually gainable analog inputs |
| 21 | Mixer Output Atten | 3 | Audio Selector | Attenuates the mixer output to drive the port mixers |
| 22 | Port A Mixer | 2 | Audio Mixer | Mixes the Port A Selected DAC and mixer output amps to drive Port A |
| 23 | $V_{REF}$ Power Down | F | Vendor Defined | Powers down the Internal and external $V_{REF}$ circuitry |
| 24 | Port G (C/LFE) | 4 | Pin Complex | Rear panel C/LFE jack |
| 25 | Port H (Surr Side) | 4 | Pin Complex | Rear panel surround-side (7.1) jack |
| 26 | Port E Mixer | 2 | Audio Mixer | Mixes DAC4 and mixer output amps to drive Port E |
| 27 | Port G Mixer | 2 | Audio Mixer | Mixes DAC2 and mixer output amps to drive Port G |
| 28 | Port H Mixer | 2 | Audio Mixer | Mixes DAC0 and mixer output amps to drive Port H |
| 29 | Port D Mixer | 2 | Audio Mixer | Mixes DAC1 and mixer output amps to drive Port D |
| 2A | Port F Mixer | 2 | Audio Mixer | Mixes DAC3 and mixer output amps to drive Port F |
| 2B | Port B Mixer | 2 | Audio Mixer | Mixes the Port B selected DAC and mixer output amps to drive Port B |
| 2C | Port C Mixer | 2 | Audio Mixer | Mixes the Port C selected DAC and mixer output amps to drive Port C |
| 2D | Stereo Mix Down | 2 | Audio Mixer | Mixes the stereo L/R channels to drive mono output |
| 2F | BIAS Power Down | F | Vendor Defined | Powers down the internal MIC_BIAS_FILT and all MIC_BIAS Pins |
| 30 | Port B Out Selector | 3 | Audio Selector | Selects the Port B DAC (0, 1) |
| 31 | Port C Out Selector | 3 | Audio Selector | Selects the Port C DAC (0, 3) |
| 32 | Port E Out Selector | 3 | Audio Selector | Selects the Port E DAC (2, 4) |
| 33 | Port C In Selector | 3 | Audio Selector | Selects from the Port C, G, and H inputs to drive the mixer input |
| 34 | Port E In Selector | 3 | Audio Selector | Selects from the Port E, G, and H inputs to drive the mixer input |
| 36 | Mono Out Selector | 3 | Audio Selector | Selects the mono out DAC (0, 1, 3) |

**Table 5. HD Audio Widgets[1] (Continued)**

| Node ID | Name | Type ID | Type | Description |
|---------|------|---------|------|-------------|
| 37 | Port A Selector | 3 | Audio Selector | Selects the Port A DAC (0, 1, 3) |
| 38 | Port A Boost | 3 | Audio Selector | Microphone boost amp for Port A |
| 39 | Port B Boost | 3 | Audio Selector | Microphone boost amp for Port B |
| 3A | Port C Boost | 3 | Audio Selector | Microphone boost amp for Port C |
| 3C | Port E Boost | 3 | Audio Selector | Microphone boost amp for Port E |
| 3D | Port D Boost | 3 | Audio Selector | Microphone boost amp for Port D |

[1] All node IDs (NIDs) are sequential in the codec. Any NIDs missing from this table are vendor defined.

# AD1989B

## HD AUDIO PARAMETERS

**Table 6. Root and Function Node Parameters**

| Node ID | Name | Vendor ID 00 | 01 | Revision ID 02[1] | 03 | Sub Node Count 04 | Func. Group Type 05 | Audio F.G. Caps 08 | GPIO Caps 11 |
|---------|----------|-----------|----|----------|----|----------|----------|----------|----------|
| 00 | ROOT | 11D4989B | | 00100300 | | 00010001 | | | |
| 01 | FUNCTION | | | | | 0002003C | 00000001 | 00010C0C | 40000003 |

[1] Subject to change with silicon stepping.

**Table 7. SubSystem ID [1]**

| Node ID | Name | Value | 31:16 SSID | 15:8 SKU | 7:0 ASM ID |
|---------|----------|-----------|-------|------|------|
| 01 | FUNCTION | BFD80000 | BFD8 | 00 | 00 |

[1] The default SSID is overwritten by platform BIOS after power on. It is preserved across HD Audio link reset and verb reset.

# WIDGET PARAMETERS

**Table 8. Widget Parameters**

| Node ID | Widget Capabilities 09 | PCM Size, Rate 0A | Stream Formats 0B | Pin Capabilities 0C | Input Amp Capabilities 0D | ConnList Length 0E | Power States 0F | Output Amp Capabilities 12 |
|---|---|---|---|---|---|---|---|---|
| 01 | 0x0000 0480 | 0x000E 07FF | 0x0000 0001 | | 0x8000 0000 | | 0x0000 0009 | 0x0005 2727 |
| 02 | 0x0003 0211 | 0x000E 07E0 | 0x0000 0005 | | | 0x0000 0000 | | |
| 03 | 0x0000 0405 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0000 | 0x0000 0009 | 0x0005 2727 |
| 04 | 0x0000 0405 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0000 | 0x0000 0009 | 0x0005 2727 |
| 05 | 0x0000 0405 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0000 | 0x0000 0009 | 0x0005 2727 |
| 06 | 0x0000 0405 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0000 | 0x0000 0009 | 0x0005 2727 |
| 07 | 0x0013 0391 | 0x000E 07E0 | 0x0000 0005 | | | 0x0000 0001 | | |
| 08 | 0x0010 0501 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0001 | 0x0000 0009 | |
| 09 | 0x0010 0501 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0001 | 0x0000 0009 | |
| 0A | 0x0000 0405 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0000 | 0x0000 0009 | 0x0005 2727 |
| 0B | 0x0030 0211 | 0x000E 07E0 | 0x0000 0005 | | | 0x0000 0000 | | |
| 0C | 0x0030 010D | | | | | 0x0000 0008 | | 0x8005 3627 |
| 0D | 0x0030 010D | | | | | 0x0000 0007 | | 0x8005 3627 |
| 0E | 0x0030 010D | | | | | 0x0000 0007 | | 0x8005 3627 |
| 0F | 0x0010 0501 | 0x000E 07FF | 0x0000 0001 | | | 0x0000 0001 | 0x0000 0009 | |
| 10 | 0x0070 000C | | | | | 0x0000 0000 | | 0x800B 0F0F |
| 11 | 0x0040 018D | | | 0x0000 373F | | 0x0000 0001 | | 0x8000 0000 |
| 12 | 0x0040 018D | | | 0x0000 373F | | 0x0000 0001 | | 0x8000 0000 |
| 13 | 0x0040 010C | | | 0x0000 0010 | | 0x0000 0001 | | 0x8005 1F1F |
| 14 | 0x0040 018D | | | 0x0000 373F | | 0x0000 0001 | | 0x8000 0000 |
| 15 | 0x0040 018D | | | 0x0000 3737 | | 0x0000 0001 | | 0x8000 0000 |
| 16 | 0x0040 018D | | | 0x0000 0037 | | 0x0000 0001 | | 0x8000 0000 |
| 17 | 0x0040 098D | | | 0x0000 3737 | | 0x0000 0001 | | 0x8000 0000 |
| 18 | 0x0040 0081 | | | 0x0000 0024 | | 0x0000 0000 | | |
| 19 | 0x0050 0500 | | | | | 0x0000 0002 | 0x0000 0009 | |
| 1A | 0x0040 0000 | | | 0x0000 0020 | | 0x0000 0000 | | |
| 1B | 0x0040 030D | | | 0x0000 0010 | | 0x0000 0001 | | 0x8005 2727 |
| 1C | 0x0040 020B | | | 0x0000 0020 | 0x8005 1F17 | 0x0000 0000 | | |
| 1D | 0x0040 030D | | | 0x0000 0010 | | 0x0000 0001 | | 0x8005 2727 |
| 1E | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 20 | 0x0020 010B | | | | 0x8005 1F17 | 0x0000 0008 | | |
| 21 | 0x0030 010D | | | | | 0x0000 0001 | | 0x8005 1F1F |
| 22 | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 23 | 0x00F0 0100 | | | | | 0x0000 0008 | | |
| 24 | 0x0040 098D | | | 0x0000 0037 | | 0x0000 0001 | | 0x8000 0000 |
| 25 | 0x0040 018D | | | 0x0000 0037 | | 0x0000 0001 | | 0x8000 0000 |
| 26 | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 27 | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 28 | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 29 | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 2A | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 2B | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 2C | 0x0020 0103 | | | | 0x8000 0000 | 0x0000 0002 | | |
| 2D | 0x0020 0100 | | | | | 0x0000 0001 | | |
| 2F | 0x00F0 0100 | | | | | 0x0000 0006 | | |
| 30 | 0x0030 0101 | | | | | 0x0000 0003 | | |
| 31 | 0x0030 0101 | | | | | 0x0000 0002 | | |
| 32 | 0x0030 0101 | | | | | 0x0000 0002 | | |
| 33 | 0x0030 0101 | | | | | 0x0000 0003 | | |
| 34 | 0x0030 0101 | | | | | 0x0000 0003 | | |

**Table 8. Widget Parameters (Continued)**

| Node ID | Widget Capabilities 09 | PCM Size, Rate 0A | Stream Formats 0B | Pin Capabilities 0C | Input Amp Capabilities 0D | ConnList Length 0E | Power States 0F | Output Amp Capabilities 12 |
|---------|------------------------|-------------------|-------------------|---------------------|---------------------------|--------------------|-----------------|----------------------------|
| 36 | 0x0030 0101 | | | | | 0x0000 0003 | | |
| 37 | 0x0030 0101 | | | | | 0x0000 0003 | | |
| 38 | 0x0030 010D | | | | | 0x0000 0001 | | 0x0027 0300 |
| 39 | 0x0030 010D | | | | | 0x0000 0001 | | 0x0027 0300 |
| 3A | 0x0030 010D | | | | | 0x0000 0001 | | 0x0027 0300 |
| 3C | 0x0030 010D | | | | | 0x0000 0001 | | 0x0027 0300 |
| 3D | 0x0030 010D | | | | | 0x0000 0001 | | 0x0027 0300 |

# CONNECTION LIST

**Table 9. Connection List**

| | Connections | | 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Node ID | [0–3] | [4–7] | NID | I | NID | I | NID | I | NID | I | NID | I | NID | I | NID | I | NID |
| 02 | | | | | | | | | | | | | | | | | |
| 03 | | | | | | | | | | | | | | | | | |
| 04 | | | | | | | | | | | | | | | | | |
| 05 | | | | | | | | | | | | | | | | | |
| 06 | | | | | | | | | | | | | | | | | |
| 07 | 0x0000 001C | | 0x1C | | | | | | | | | | | | | | |
| 08 | 0x0000 000C | | 0x0C | | | | | | | | | | | | | | |
| 09 | 0x0000 000D | | 0x0D | | | | | | | | | | | | | | |
| 0A | | | | | | | | | | | | | | | | | |
| 0B | | | | | | | | | | | | | | | | | |
| 0C | 0x2418 BC38 | 0x1F20 3D25 | 0x38 | 1 | 0x3C | 1 | 0x18 | | 0x24 | | 0x25 | | 0x3D | | 0x20 | | 0x1F |
| 0D | 0x2418 BC38 | 0x0020 3D25 | 0x38 | 1 | 0x3C | 1 | 0x18 | | 0x24 | | 0x25 | | 0x3D | | 0x20 | | |
| 0E | 0x2418 BC38 | 0x0020 3D25 | 0x38 | 1 | 0x3C | 1 | 0x18 | | 0x24 | | 0x25 | | 0x3D | | 0x20 | | |
| 0F | 0x0000 000E | | 0x0E | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | |
| 11 | 0x0000 0022 | | 0x22 | | | | | | | | | | | | | | |
| 12 | 0x0000 0029 | | 0x29 | | | | | | | | | | | | | | |
| 13 | 0x0000 002D | | 0x2D | | | | | | | | | | | | | | |
| 14 | 0x0000 002B | | 0x2B | | | | | | | | | | | | | | |
| 15 | 0x0000 002C | | 0x2C | | | | | | | | | | | | | | |
| 16 | 0x0000 002A | | 0x2A | | | | | | | | | | | | | | |
| 17 | 0x0000 0026 | | 0x26 | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | |
| 19 | 0x0000 2120 | | 0x20 | | 0x21 | | | | | | | | | | | | |
| 1A | | | | | | | | | | | | | | | | | |
| 1B | 0x0000 0002 | | 0x02 | | | | | | | | | | | | | | |
| 1C | | | | | | | | | | | | | | | | | |
| 1D | 0x0000 000B | | 0x0B | | | | | | | | | | | | | | |
| 1E | 0x0000 2136 | | 0x36 | | 0x21 | | | | | | | | | | | | |
| 20 | 0x3D38 3339 | 0x1A18 3B34 | 0x39 | | 0x33 | | 0x38 | | 0x3D | | 0x34 | | 0x3B | | 0x18 | | 0x1A |
| 21 | 0x0000 0020 | | 0x20 | | | | | | | | | | | | | | |
| 22 | 0x0000 2137 | | 0x37 | | 0x21 | | | | | | | | | | | | |
| 23 | 0x2524 9811 | 0x2120 BD38 | 0x11 | 1 | 0x18 | | 0x24 | 1 | 0x25 | | 0x38 | 1 | 0x3D | | 0x20 | | 0x21 |
| 24 | 0x0000 0027 | | 0x27 | | | | | | | | | | | | | | |
| 25 | 0x0000 0028 | | 0x28 | | | | | | | | | | | | | | |
| 26 | 0x0000 2132 | | 0x32 | | 0x21 | | | | | | | | | | | | |
| 27 | 0x0000 2105 | | 0x05 | | 0x21 | | | | | | | | | | | | |
| 28 | 0x0000 210A | | 0x0A | | 0x21 | | | | | | | | | | | | |
| 29 | 0x0000 2104 | | 0x04 | | 0x21 | | | | | | | | | | | | |
| 2A | 0x0000 2106 | | 0x06 | | 0x21 | | | | | | | | | | | | |
| 2B | 0x0000 2130 | | 0x30 | | 0x21 | | | | | | | | | | | | |
| 2C | 0x0000 2131 | | 0x31 | | 0x21 | | | | | | | | | | | | |
| 2D | 0x0000 001E | | 0x1E | | | | | | | | | | | | | | |
| 2F | 0x1514 1211 | 0x0000 1716 | 0x11 | | 0x12 | | 0x14 | | 0x15 | | 0x16 | | 0x17 | | | | |
| 30 | 0x0060 0403 | | 0x03 | | 0x04 | | 0x06 | | | | | | | | | | |
| 31 | 0x0000 0A04 | | 0x04 | | 0x0A | | | | | | | | | | | | |
| 32 | 0x0000 0405 | | 0x05 | | 0x04 | | | | | | | | | | | | |
| 33 | 0x0024 253A | | 0x3A | | 0x25 | | 0x24 | | | | | | | | | | |
| 34 | 0x0024 253C | | 0x3C | | 0x25 | | 0x24 | | | | | | | | | | |
| 36 | 0x0006 0403 | | 0x03 | | 0x04 | | 0x06 | | | | | | | | | | |

**Table 9. Connection List (Continued)**

| Node ID | Connections [0–3] | [4–7] | 0 NID | I | 1 NID | I | 2 NID | I | 3 NID | I | 4 NID | I | 5 NID | I | 6 NID | I | 7 NID |
|---------|-------------------|-------|-------|---|-------|---|-------|---|-------|---|-------|---|-------|---|-------|---|-------|
| 37 | 0x0006 0403 | | 0x03 | | 0x04 | | 0x06 | | | | | | | | | | |
| 38 | 0x0000 0011 | | 0x11 | | | | | | | | | | | | | | |
| 39 | 0x0000 0014 | | 0x14 | | | | | | | | | | | | | | |
| 3A | 0x0000 0015 | | 0x15 | | | | | | | | | | | | | | |
| 3C | 0x0000 0017 | | 0x17 | | | | | | | | | | | | | | |
| 3D | 0x0000 0012 | | 0x12 | | | | | | | | | | | | | | |

# DEFAULT CONFIGURATION BYTES

In Table 10, default configuration values are set on codec power-up only. Default configuration values are not reset by link or soft reset to preserve modifications by BIOS control.

**Table 10. Default Configuration Bytes**

| Name | Value | 31:30 Connectivity | 29:28 Location Chassis | 27:24 Location Position | 23:20 Def. Device | 19:16 Conn Type | 15:12 Color | 8 JD | 7:4 Def Assn | 3:0 Sequence |
|---|---|---|---|---|---|---|---|---|---|---|
| Port A (Headphone) | 0x0221 4030 | Jack | External | Front | HP Out | 1/8" Jack | Green | 0 | 3 | 0 |
| Port D (Front L/R) | 0x0101 4010 | Jack | External | Rear | Line Out | 1/8" Jack | Green | 0 | 1 | 0 |
| Mono Out | 0x9913 01F0 | Fixed | Internal | Special 3 | Speaker | ATAPI | Unknown | 1 | F | 0 |
| Port B (Front Mic) | 0x02A1 9040 | Jack | External | Front | Mic In | 1/8" Jack | Pink | 0 | 4 | 0 |
| Port C (Line In) | 0x0181 3021 | Jack | External | Rear | Line In | 1/8" Jack | Blue | 0 | 2 | 1 |
| Port F (Surr Back) | 0x0101 1012 | Jack | External | Rear | Line Out | 1/8" Jack | Black | 0 | 1 | 2 |
| Port E (Rear Mic) | 0x01A1 9020 | Jack | External | Rear | Mic In | 1/8" Jack | Pink | 0 | 2 | 0 |
| CD IN/ Line In | 0x9933 012E | Fixed | Internal | Special 3 | CD | ATAPI | Unknown | 1 | 2 | E |
| Analog PCBeep | 0x99F3 01F0 | Fixed | Internal | Special 3 | Other | ATAPI | Unknown | 1 | F | 0 |
| S/PDIF_1 Out | 0x0145 11F0 | Jack | External | Rear | S/PDIF Out | Optical | Black | 1 | F | 0 |
| S/PDIF In | 0x01C5 11F0 | Jack | External | Rear | S/PDIF In | Optical | Black | 1 | F | 0 |
| S/PDIF_2 Out | 0x9856 01F0 | Fixed | Internal | Special 2 | Digital Out | Other Digital | Unknown | 1 | F | 0 |
| Port G (C/LFE) | 0x0101 6011 | Jack | External | Rear | Line Out | 1/8" Jack | Orange | 0 | 1 | 1 |
| Port H (7.1) | 0x0101 2014 | Jack | External | Rear | Line Out | 1/8" Jack | Grey | 0 | 1 | 4 |

# AD1989B

## OUTLINE DIMENSIONS

Dimensions are shown in millimeters.
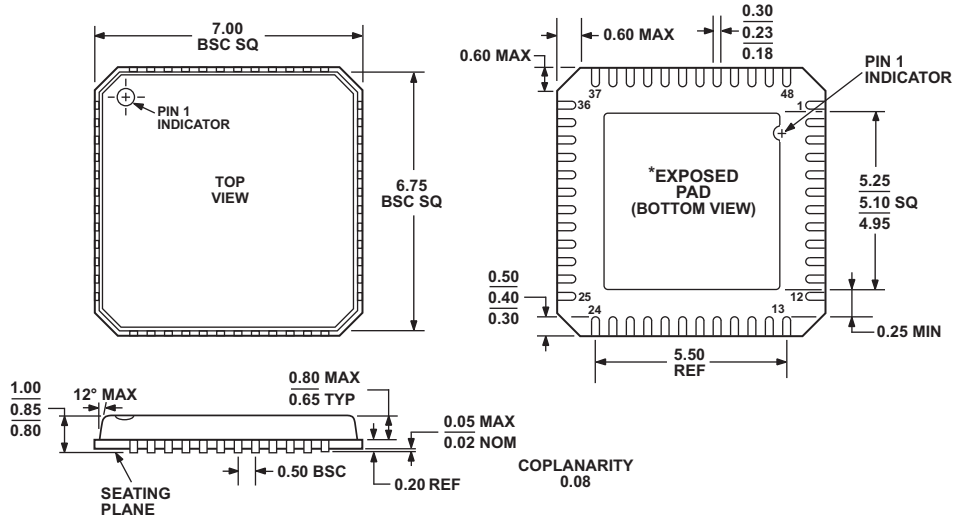


COMPLIANT TO JEDEC STANDARDS MO-220-VKKD-2

*NOTE:
THE EXPOSED PAD IS REQUIRED TO BE ELECTRICALLY AND THERMALLY CONNECTED TO VSS.
THIS SHOULD BE IMPLEMENTED BY SOLDERING THE EXPOSED PAD TO A VSS PCB LAND THAT IS THE SAME SIZE
AS THE EXPOSED PAD. THE VSS PCB LAND SHOULD BE ROBUSTLY CONNECTED TO THE VSS PLANE IN THE PCB
WITH AN ARRAY OF THERMAL VIAS FOR BEST PERFORMANCE.

*Figure 3. 48-Lead, Lead Frame Chip Scale Package [LFCSP_VQ]*
*7 mm × 7 mm Body, Very Thin Quad*
*(CP-48-1)*
*Dimensions shown in millimeters*

## ORDERING GUIDE

| Model | Temperature Range | Package Description | Package Option |
|---|---|---|---|
| AD1989BJCPZ[1] | 0°C to 70°C | 48-Lead LFCSP_VQ | CP-48-1 |
| AD1989BJCPZ-RL[1] | 0°C to 70°C | 48-Lead LFCSP_VQ, 13" Tape and Reel | CP-48-1 |

[1] Z = RoHS Compliant Part.

ANALOG DEVICES

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