High-Performance Digital MEMS Microphone Simple Interface to SigmaDSP Audio Codec

CIRCUIT FUNCTION AND BENEFITS

The circuit shown in Figure 1 allows up to two digital MEMS microphones to be interfaced to an audio codec. The INMP421 consists of a MEMS microphone element, an output amplifier, and a fourth order sigma-delta modulator. Digital MEMS microphones output data in a pulse density modulated (PDM) bit stream that is immune to noise and crosstalk issues that may degrade performance of an analog microphone connection. In small form-factor applications such as mobile phones, digital cameras, or portable navigation devices, where isolating sensitive audio signal paths may not be possible, a digital MEMS microphone signal path provides flexibility in microphone and codec placement and layout.

Up to two INMP421 digital MEMS microphones can be input to an ADAU1761 low power codec on a single PDM bit stream.

CIRCUIT DESCRIPTION

The INMP421 digital MEMS microphones are connected to the ADAU1761 with a PDM data signal, clock, power, and ground. The only necessary passive components in this circuit are a single 0.1 µF bypass capacitor for each INMP421. The bypass capacitors should be placed as close to the INMP421 V_{DD} pin (Pin 4) as possible. A 100 Ω series resistor placed close to the ADAU1761 BCLK/GPIO2 pin may also be needed to properly drive the microphone clock signal and minimize ringing due to capacitive loading, depending on layout and trace length.

The INMP421 power supply is provided from the ADAU1761 MICBIAS pin. MICBIAS can be set to be either 0.9 × AVDD or 0.65 × AVDD, where allowable values of AVDD are between 1.8 V and 3.3 V.

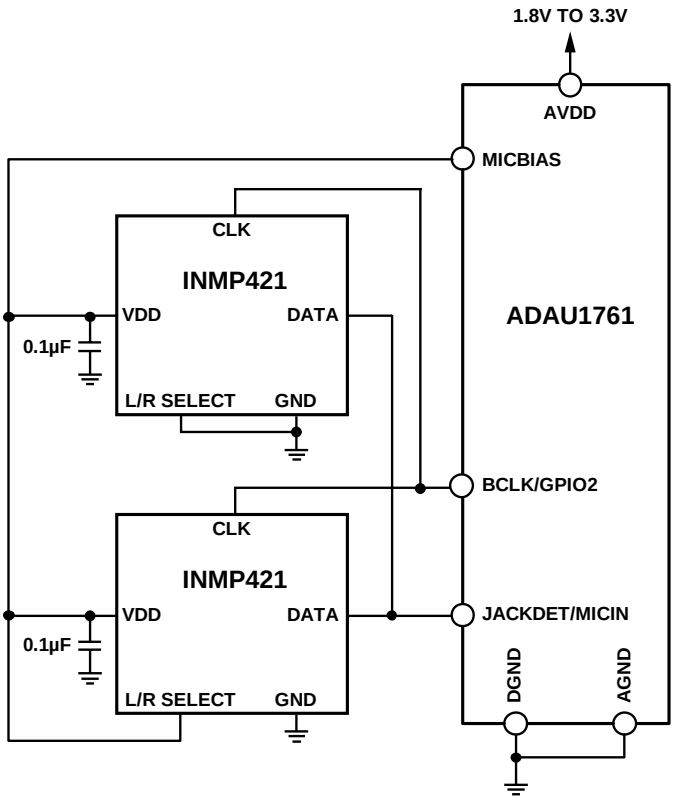

Figure 1. Digital MEMS Microphone Connection to Audio Codec (Simplified Schematic: Power-Supply Decoupling and All Connections Not Shown)

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The two INMP421 digital MEMS microphones in the circuit share a common time-multiplexed data output line. Each microphone is set to provide output on either the left or right channel in the output stream by tying pin L/R SELECT to either V_{DD} (left) or GND (right). The ADAU1761 supplies the digital MEMS microphone clock from the BCLK/GPIO2 pin. The ADAU1761 must be a master on this clock line for proper operation. The INMP421 can accept clock frequencies between 1 MHz and 3.3 MHz. By default, the clock output from the ADAU1761 is 64 × f_S, but it can also be set to 32 × f_S, 48 × f_S, 128 × f_S, and 256 × f_S through the serial port control registers. With f_S = 48 kHz, the default 64 × f_S BCLK is 3.072 MHz.

Register Settings

Three register bit fields must be set in the ADAU1761 to enable its digital microphone input. These setting are

- JDFUNC[1:0] in Register R2 to 0b10—sets the JACKDET/MICIN pin to digital microphone input mode
- MS in Register R15 to 0b1—sets the serial port to master mode
- INSEL in Register R19 to 0b1—enables the digital microphone inputs and disables the ADC inputs

COMMON VARIATIONS

This circuit can also be set up with an ADAU1361 instead of an ADAU1761. The primary difference between these two codecs is that the ADAU1761 has a SigmaDSP® processor core and the ADAU1361 does not.

A mono microphone circuit using a single INMP421 can be set up by removing one of the INMP421 ICs and its associated bypass capacitor. The other connections remain the same in this mono configuration.

The INMP521 and INMP522 are higher signal-to-noise ratio (SNR) MEMS microphone and can replace the INMP421 in this circuit. The INMP521 and the INMP522 have a 65 dB SNR, while the SNR for the INMP421 is 61 dB. The INMP522's sensitivity tolerance is ±1 dB, while the tolerance for the other two microphones is ±3 dB. These microphones are all pin- and footprint-compatible; therefore, no electrical connections need to be changed.

CIRCUIT EVALUATION AND TEST

The INMP421 evaluation board (EVAL-INMP421Z) is a simple evaluation board that allows quick evaluation of the performance of the INMP421 bottom port digital output omni-directional microphone. The board is described in UG-118. The EVAL-INMP421Z has a dual-row 12-pin, 0.1 inch spaced header for access to all microphone pins. The EVAL-INMP421Z is designed to plug directly into Connector J6 on EVAL-ADAU1761Z evaluation board (see documentation package).

Equipment Needed

The SigmaStudio GUI software requires a PC meeting the following: Windows® Vista, Windows XP Professional, or Home Edition with SP2, 128 MB of RAM (256 MB recommended), 50 MB of available hard disk space, 1024 × 768 screen resolution, USB 1.1/2.0 data port.

In addition, the ADAU1761 evaluation board (EVAL-ADAU1761Z) and the INMP421 evaluation board (EVAL-INMP421Z) are required.

Getting Started

Connect the EVAL-INMP421Z evaluation board to the EVAL-ADAU1761Z evaluation as described in UG-118. From this point, follow the documentation for the EVAL-ADAU1761Z regarding software installation, setup, and operation of the system.

Functional Block Diagram

The documentation for the ADAU1761 evaluation board (EVAL-ADAU1761Z) describes the system setup and gives a complete schematic of the board. The only external connections required are the USB connection to the PC and to the audio outputs of the ADAU1761 evaluation board.

Setup and Test

See the EVAL-ADAU1761Z board documentation for additional details regarding circuit description, jumper settings, setup, and testing.

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
2/22/2014	1.0	Initial Release

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