Omnidirectional Microphone with Bottom Port and Digital Output

Preliminary Technical Data

ADMP421

FEATURES

Small and thin 3 mm × 4 mm × 1 mm surface-mount package
High SNR of 61 dBA
High sensitivity of –26 dBFS
Flat frequency response from 100 Hz to 15 kHz
Low current consumption: <650 µA
High PSRR of 80 dBFS
Fourth-order Σ-Δ modulator
Digital PDM output
Compatible with Sn/Pb and Pb-free solder processes
GREEN product – RoHS/WEEE compliant

APPLICATIONS

Smart phones and feature phones
Digital video cameras
Bluetooth headsets
Video phones
Teleconferencing systems

GENERAL DESCRIPTION

The ADMP421 is a low cost, low power, digital output bottom ported omnidirectional MEMS microphone. The ADMP421 consists of a MEMS microphone element, an impedance converter amplifier, and a fourth-order Σ-Δ modulator. The digital interface allows for the pulse density modulated (PDM) output of two microphones to be time multiplexed on a single data line using a single clock.

The ADMP421 has a high SNR and a high sensitivity, making it an excellent choice for far field applications. The ADMP421 has a flat wideband frequency response resulting in natural sound with high intelligibility. Low current consumption and a sleep mode enable long battery life for portable applications. A built-in particle filter provides for high reliability. The ADMP421 complies with the TIA-920 "Transmission Requirements for Wideband Digital Wireline Telephones" standard.

The ADMP421 is available in a thin 3 mm × 4 mm × 1 mm surface-mount package. It is reflow solder compatible with no sensitivity degradation.

FUNCTIONAL BLOCK DIAGRAM

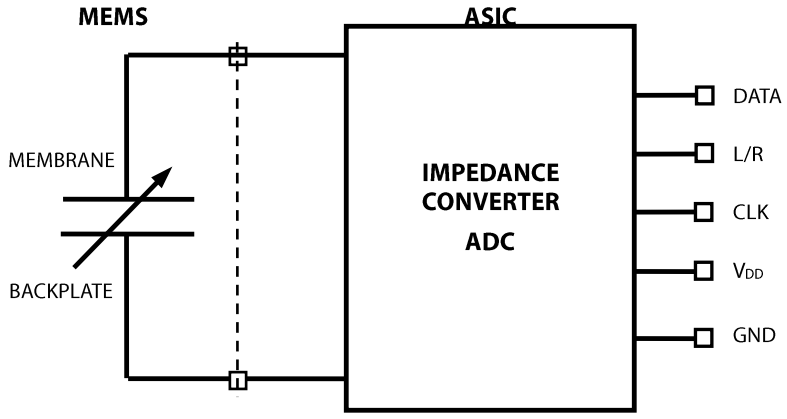

Figure 1.

Rev. PrB
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SPECIFICATIONS

T_A = 25°C, V_{DD} = 1.8 V, CLK = 2.4 MHz, unless otherwise noted. All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
PERFORMANCE						
Directionality				Omni		
Sensitivity[1]		1 kHz, 94 dB SPL	−29	−26	−23	dBFS
Signal-to-Noise Ratio	SNR	20 kHz bandwidth, A-weighted		61		dBA
Equivalent Input Noise	EIN	20 kHz bandwidth, A-weighted		33		dBA SPL
Frequency Response[2]		Low frequency −3 dB point		100		Hz
		High frequency −3 dB point		15		kHz
		Deviation from flat response within passband	−3		+2	dB
Total Harmonic Distortion	THD	105 dB SPL			3	%
Power Supply Rejection Ratio	PSRR	217 Hz, 100 mV p-p square wave superimposed on V_{DD} = 1.8 V		80		dBFS
Maximum Acoustic Input		Peak		120		dB SPL
INPUT CHARACTERISTICS						
Clock	CLK			2.4[3]		MHz
Supply Voltage	V_{DD}		1.65		3.6	V
Supply Current	I_S	Normal mode			650	µA
		Sleep mode			50	µA
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}			V_{DD}		V
Output Voltage Low	V_{OL}			0		V
Latency				<30		µs
Wake-up Time		From sleep mode, power on		10		ms
Polarity				Noninverting[4]		

[1] Relative to the rms level of a sine wave with positive amplitude equal to 100% 1s density, and negative amplitude equal to 0% 1s density.
[2] See Figures 4 and 6 on page 6 for frequency response charts.
[3] The microphone will operate at any clock frequency between 1.0 and 3.3 MHz. Some specifications may not be guaranteed at frequencies other than 2.4 MHz.
[4] Positive going (increasing) pressure on the membrane results in an increase in the number of 1s at the output.

TIMING CHARACTERISTICS

Table 2.

Parameter	Description	Min	Max	Unit
Input				
t_{CLKIN}	Input Clock Period	310	1000	ns
Output				
t_{1OUTEN}	DATA1 driven after falling clock edge	30		ns
$t_{1OUTDIS}$	DATA1 disable after rising clock edge		20	ns
t_{2OUTEN}	DATA2 driven after rising clock edge	30		ns
$t_{2OUTDIS}$	DATA2 disable after falling clock edge		20	ns

TIMING DIAGRAM

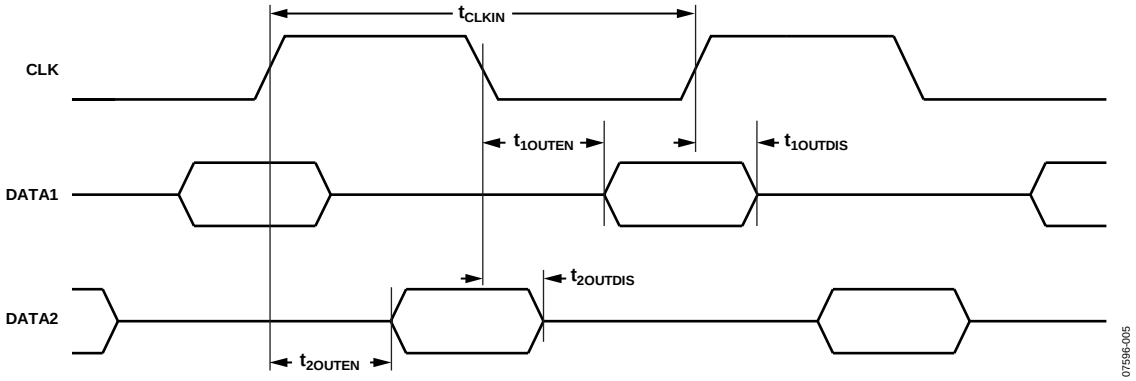


Figure 2. Pulse Density-Modulated Output Timing

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	3.6 V
Sound Pressure Level (SPL)	160 dB
Mechanical Shock	20,000 *g*
Vibration	Per Military 883E specification
Temperature Range	−40°C to +85°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.

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.

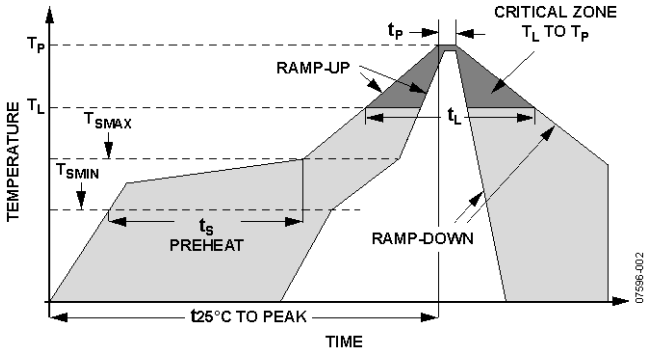


Figure 3. Recommended Soldering Profile

Table 4. Recommended Soldering Profile

Profile Feature	Sn63/Pb37	Pb-Free
Average Ramp Rate (T_L to T_P)	3°C/sec max	3°C/sec max
Preheat		
Minimum Temperature (T_{SMIN})	100°C	150°C
Maximum Temperature (T_{SMAX})	150°C	200°C
Time (T_{SMIN} to T_{SMAX}), t_S	60 sec to 120 sec	60 sec to 120 sec
T_{SMAX} to T_L		
Ramp-Up Rate	3°C/sec	3°C/sec
Time Maintained Above Liquidous (t_L)	60 sec to 150 sec	60 sec to 150 sec
Liquidous Temperature (T_L)	183°C	217°C
Peak Temperature (T_P)	240°C + 0°C/−5°C	260°C + 0°C/−5°C
Time within 5°C of Actual Peak Temperature (t_P)	10 sec to 30 sec	20 sec to 40 sec
Ramp-Down Rate	6°C/sec max	6°C/sec max
Time 25°C to Peak Temperature	6 minute max	8 minute max

TYPICAL PERFORMANCE CHARACTERISTICS

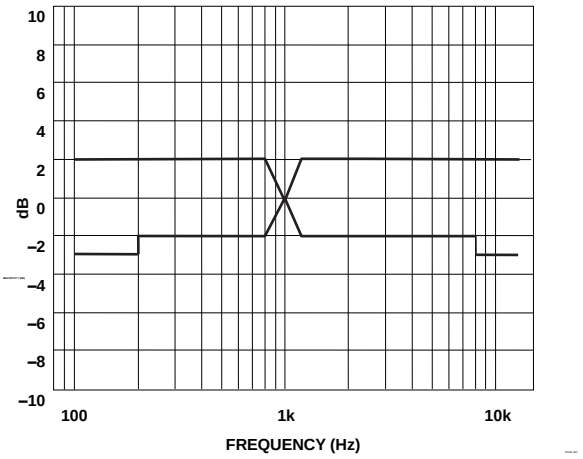


Figure 4. Frequency Response Mask

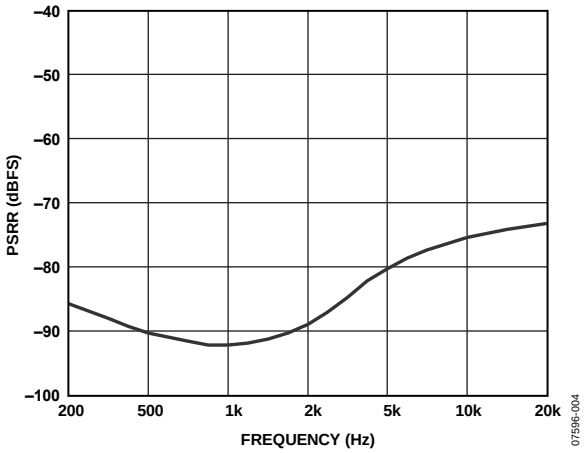


Figure 5. Typical Power Supply Rejection Ratio vs. Frequency

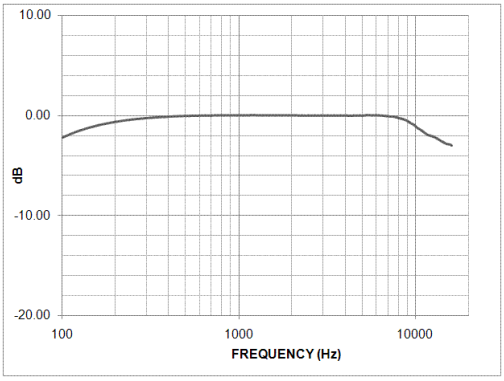


Figure 6. Typical Frequency Response (Measured)

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

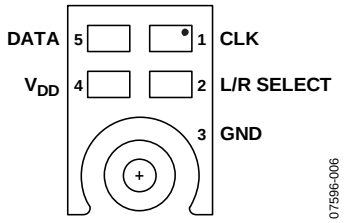


Figure 7. Pin Configuration (Bottom View)

Table 5. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	CLK	Clock Input to Microphone.
2	L/R SELECT	Left Channel or Right Channel Select. DATA1 (Right): L/R SELECT tied to GND. DATA2 (Left): L/R SELECT pulled to V_{DD}.
3	GND	Ground.
4	V_{DD}	Power Supply.
5	DATA	Digital Output Signal (DATA1, DATA2).

POWER SUPPLY BYPASS NOTE

For best performance and to avoid potential parasitic artifacts placing a 0.1 µF (100 nF) ceramic type X7R or better capacitor between Pin 4 (V_{DD}) and Ground is strongly recommended. The capacitor should be placed as close to Pin 4 as possible.

PCB LAND PATTERN LAYOUT

A 1:1 ratio for the PCB land pad layout is recommended. See Fig. 12 on page 9 for dimensions.

EVALUATION BOARD

The ADMP421 evaluation board schematic and layout are shown in Figure 8 and Figure 9 respectively. The ADMP421 evaluation board is designed to plug directly into connector J6 on the Analog Devices EVAL-ADAU1761Z evaluation board.

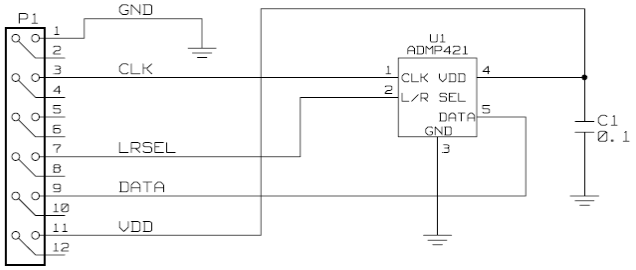


Figure 8. ADMP421 Evaluation board schematic.

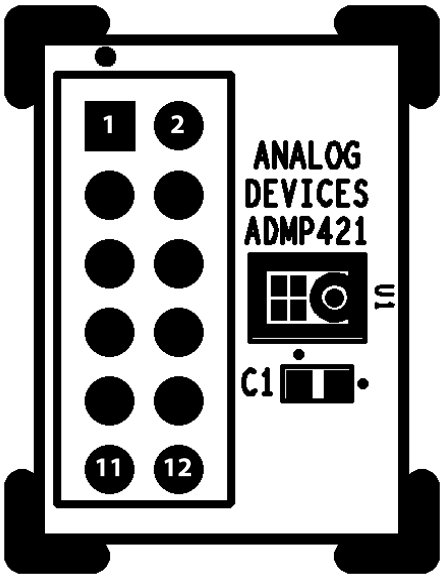


Figure 9. ADMP421 Evaluation board layout.

Table 6. Evaluation Board Connector Pin Functions

Pin No.	Description	Pin No.	Description
1	GND	2	not connected
3	CLK	4	not connected
5	not connected	6	not connected
7	L/R SELECT	8	not connected
9	DATA	10	not connected
11	V_{DD}	12	not connected

INTERFACING WITH ANALOG DEVICES CODECS

Analog Devices ADAU1361 and ADAU1761 codecs feature digital microphone inputs that support the ADMP421 PDM output data format. See the connection diagrams below and refer to ADMP421 Application Note and codecs' respective datasheets for more details on digital microphone interface.

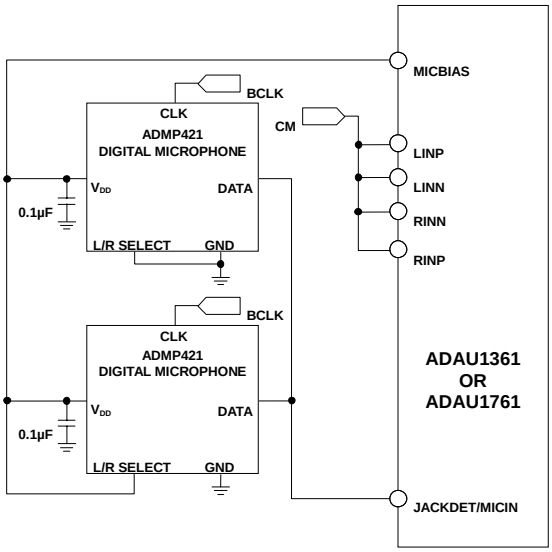


Figure10. ADAU1361 and 1761stereo interface block diagram.

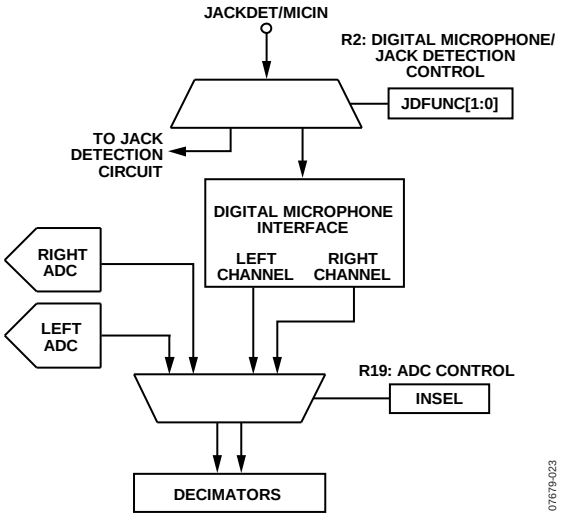


Figure 11. Digital microphone signal routing block diagram.

HANDLING INSTRUCTIONS

PICK AND PLACE EQUIPMENT

The MEMS microphone can be handled using standard pick-and-place and chip shooting equipment. Care should be taken to avoid damage to the MEMS microphone structure as follows:

- Use a standard pickup tool to handle the microphone. Because the microphone hole is on the bottom of the package, the pickup tool can make contact with any part of the lid surface.
- Use care during pick-and-place to ensure no high shock events above 20 kg are experienced because this may cause damage to the microphone.
- Do not pick up the microphone with a vacuum tool that makes contact with the bottom side of the microphone. Do not pull air out or blow air into the microphone port.
- Do not use excessive force to place the microphone on the PCB.

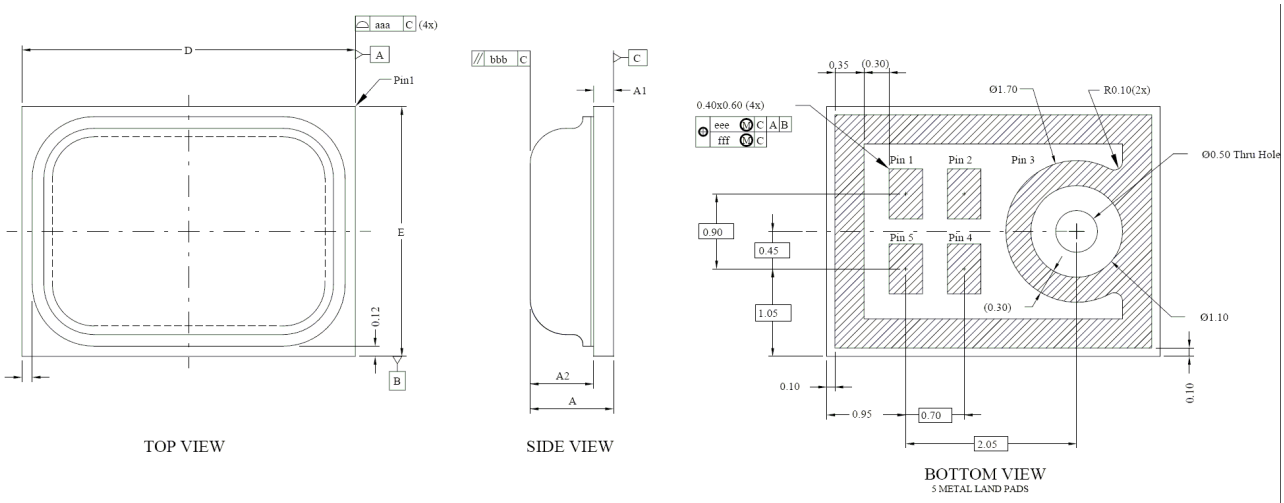
REFLOW SOLDER

Standard reflow solder conditions specified in Figure 3 can be used to attach the MEMS microphone to the PCB.

BOARD WASH

When washing the PCB, ensure that water does not make contact with the microphone port. Blow-off procedures and ultrasonic cleaning must not be used.

OUTLINE DIMENSIONS



Data Table			
Dim	Min.	Nom.	Max
A	0.90	1.00	1.10
A1		(0.24)	
A2	0.70	0.76	0.82
D	3.95	4.00	4.05
E	2.95	3.00	3.05
aaa		0.10	
bbb		0.10	
eee		0.10	
fff		0.05	

Figure 12. 5-Terminal Chip Array Small Outline No Lead Cavity [LGA_CAV]
4 mm × 3 mm Body
(CE-5-1)
Dimensions shown in millimeters

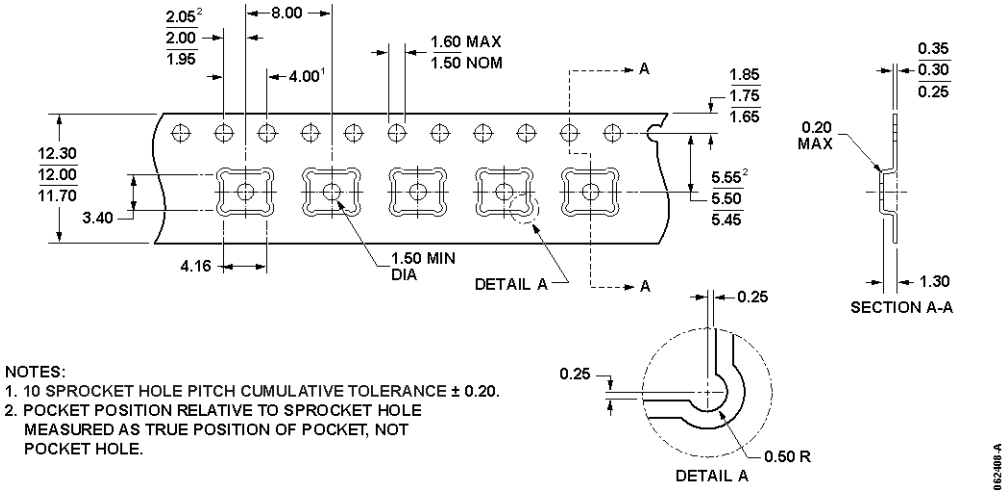


Figure 13. LGA_CAV Tape and Reel Outline Dimensions
Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Ordering Quantity
ADMP421ACEZ-RL[1]	−40°C to +85°C	5-Terminal LGA_CAV, 13" Tape and Reel	CE-5-1	4,000
ADMP421ACEZ-RL7[1]	−40°C to +85°C	5-Terminal LGA_CAV, 7" Tape and Reel	CE-5-1	1,000
EVAL-ADMP421Z[1]		Evaluation Board		

[1] Z = RoHS Compliant Part.

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