

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**
- RoHS/WEEE compliant**

APPLICATIONS

- Smartphones 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 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 high reliability. The ADMP421 complies with the TIA-920 *Telecommunications Telephone Terminal Equipment 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. The ADMP421 is halide free.

FUNCTIONAL BLOCK DIAGRAM

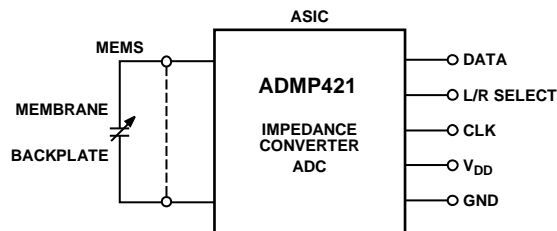


Figure 1.

Rev. 0

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REVISION HISTORY

¶10—Revision 0: Initial Version

SPECIFICATIONS

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

Table 1.

Parameter	Symbol	Test Conditions/Comments	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
Total Harmonic Distortion	THD	Deviation from flat response within pass band	-3		+2	dB
Power Supply Rejection Ratio	PSRR	105 dB SPL		80	3	%
Maximum Acoustic Input		217 Hz, 100 mV p-p square wave superimposed on $V_{DD} = 1.8\text{ V}$ 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 Figure 5 and Figure 6.

³ The microphone operates at any clock frequency between 1.0 MHz 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.

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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 disabled after rising clock edge		20	ns
t_{2OUTEN}	DATA2 driven after rising clock edge	30		ns
$t_{2OUTDIS}$	DATA2 disabled after falling clock edge		20	ns

Timing Diagram

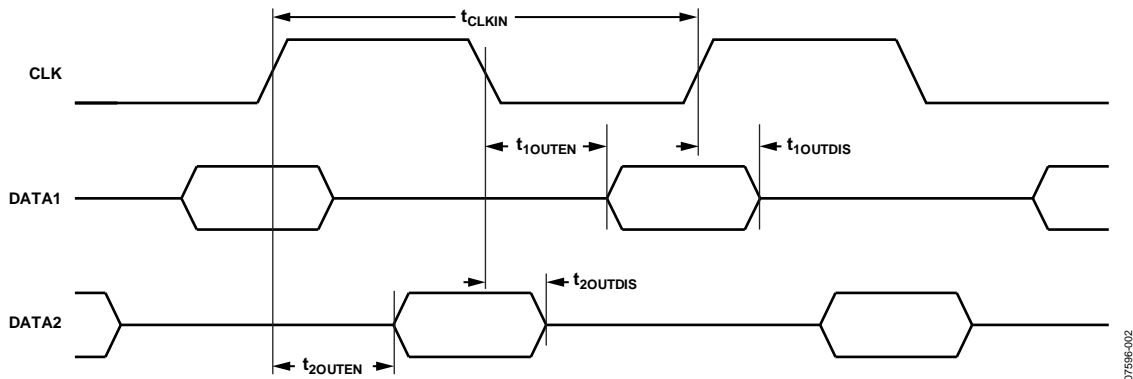


Figure 2. Pulse Density-Modulated Output Timing

07558-002

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	3.6V
Sound Pressure Level (SPL)	160 dB
Mechanical Shock	10,000 g
Vibration	Per MIL-STD-883 Method 2007, Test Condition B
Temperature Range	-40°C to +70°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.

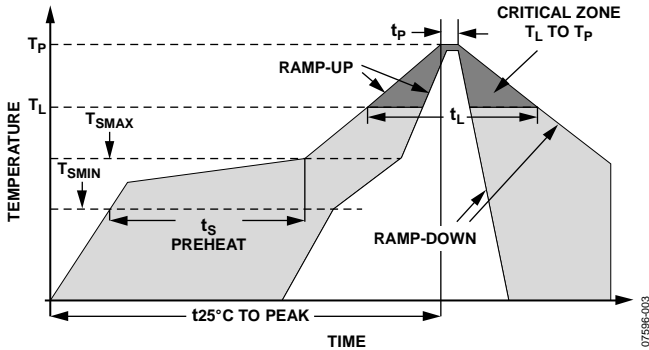


Figure 3. Recommended Soldering Profile Limits

Table 4. Recommended Soldering Profile Limits

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
Ramp-Up Rate (T _{SMAX} to T _L)	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 (t _{25°C}) to Peak Temperature	6 minute max	8 minute max

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

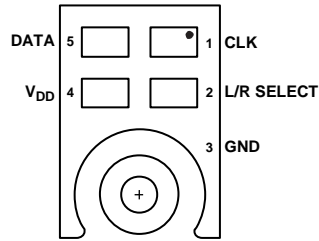


Figure 4. Pin Configuration (Bottom View)

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. 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.
5	DATA	Digital Output Signal (DATA1, DATA2).

TYPICAL PERFORMANCE CHARACTERISTICS

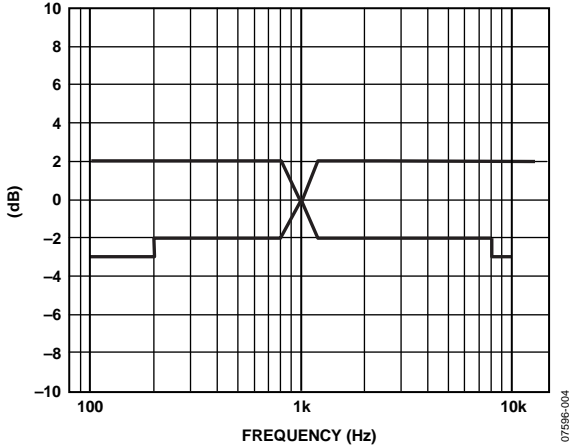


Figure 5. Frequency Response Mask

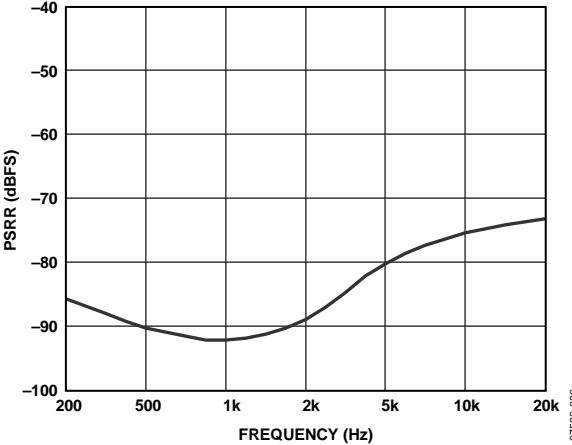


Figure 7. Typical Power Supply Rejection Ratio vs. Frequency

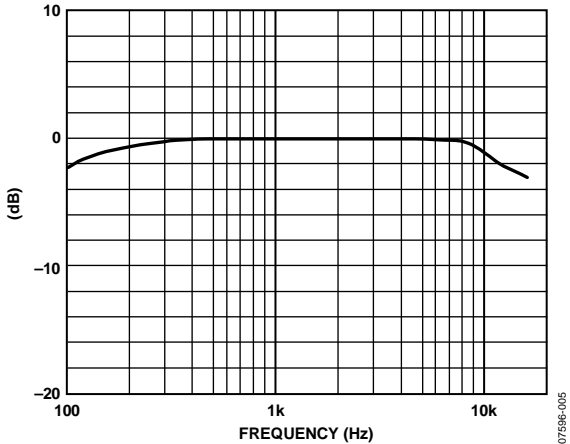


Figure 6. Typical Frequency Response (Measured)

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PCB LAND PATTERN LAYOUT

The recommended PCB land pattern for the ADMP421 should be laid out to a 1:1 ratio to the solder pads on the microphone package, as shown in Figure 8. Care should be taken to avoid applying solder paste to the sound hole in the PCB. A suggested

solder paste stencil pattern layout is shown in Figure 9. The diameter of the sound hole in the PCB should be larger than the diameter of the sound port of the microphone. A minimum diameter of 0.5 mm is recommended.

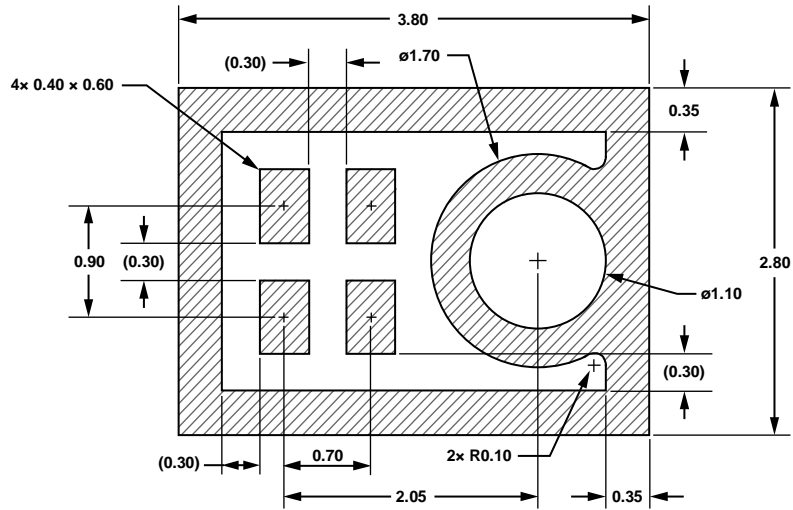


Figure 8. Suggested PCB Land Pattern Layout

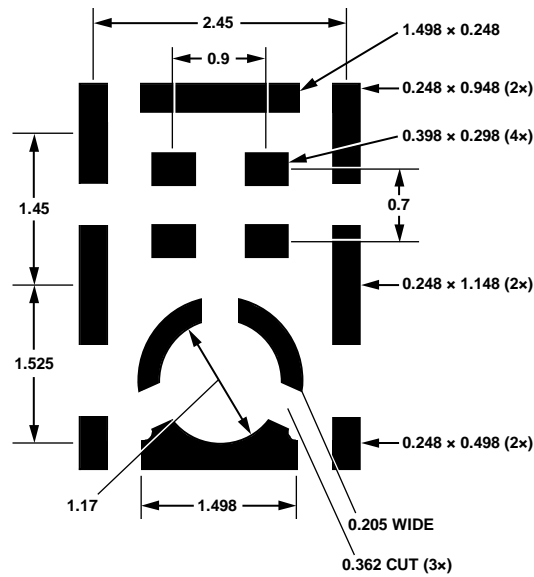


Figure 9. Suggested Solder Paste Stencil Pattern Layout

EVALUATION BOARD

Figure 10 and Figure 11 show the ADMP421 evaluation board schematic and layout, respectively. The ADMP421 evaluation board is designed to plug directly into Connector J6 on the Analog Devices, Inc., [EVAL-ADAU1761Z](#).

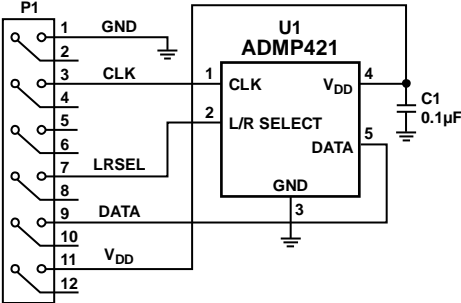


Figure 10. ADMP421 Evaluation Board Schematic

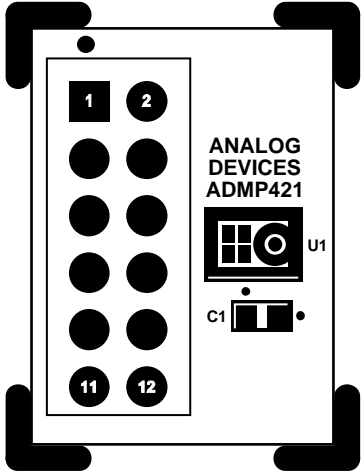


Figure 11. ADMP421 Evaluation Board Layout

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

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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 shown in

Figure 12 and Figure 13, and refer to the ADMP421 AN-1003 Application Note and the codecs' respective data sheets for more details on the digital microphone interface.

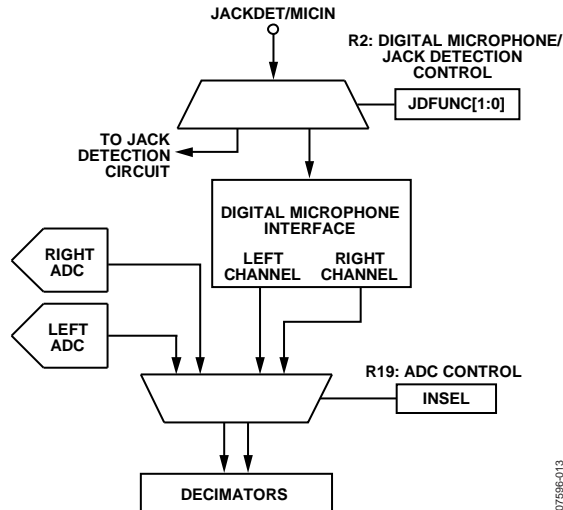


Figure 12. Digital Microphone Signal Routing Block Diagram

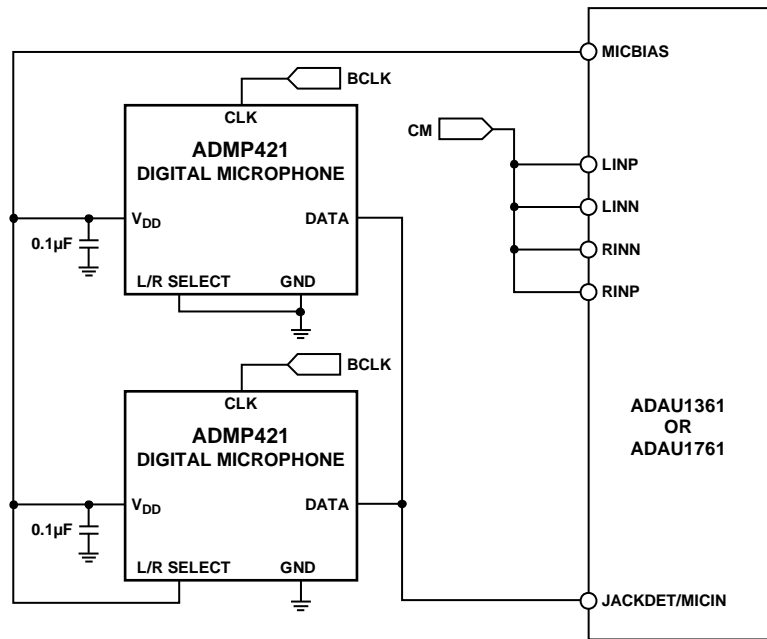


Figure 13. ADAU1361 and ADAU1761 Stereo Interface Block Diagram

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 that no high shock events above 20 kg are experienced because such events 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 of or blow air into the microphone port.
- Do not use excessive force to place the microphone on the PCB.

REFLOW SOLDER

For best results, the soldering profile should be in accordance with the recommendations of the manufacturer of the solder paste used to attach the MEMS microphone to the PCB. It is recommended that the solder reflow profile not exceed the limit conditions specified in Figure 3 and Table 4.

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.

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RELIABILITY SPECIFICATIONS

The microphone sensitivity after stress must deviate by no more than 3 dB from the initial value.

Table 7.

Stress Test	Description
Low Temperature Operating Life	-40°C, 500 hrs, powered
High Temperature Operating Life	+125°C, 500 hrs, powered
THB	65°C/85% relative humidity (RH), 500 hrs, powered
Temperature Cycle	-40°C/+125°C, one cycle per hour, 100 cycles
High Temperature Storage	150°C, 500 hrs
Low Temperature Storage	-40°C, 500 hrs
Component CDM ESD	All pins, 0.5 kV
Component HBM ESD	All pins, 1.5 kV
Component MM ESD	All pins, 0.2 kV

OUTLINE DIMENSIONS

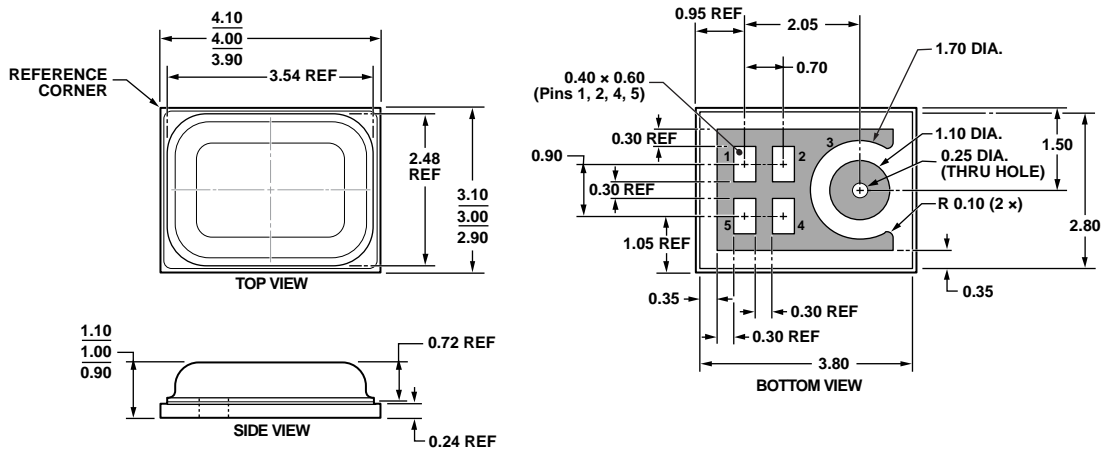
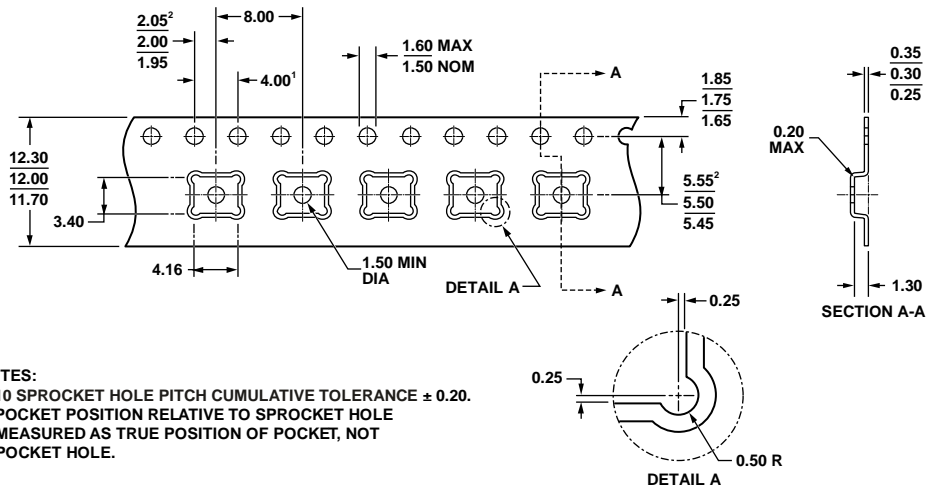


Figure 14. 5-Terminal Chip Array Small Outline No Lead Cavity [LGA_CAV]
4 mm x 3 mm Body
(CE-5-1)
Dimensions shown in millimeters

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- NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ± 0.20 .
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.

Figure 15. LGA_CAV Tape and Reel Outline Dimensions
Dimensions shown in millimeters

062409-A

ORDERING GUIDE

Model ¹	Temperature Range	Package Description	Package Option	Ordering Quantity
ADMP421ACEZ-RL	-40°C to +70°C	5-Terminal LGA_CAV, 13" Tape and Reel	CE-5-1 ²	5,000
ADMP421ACEZ-RL7	-40°C to +70°C	5-Terminal LGA_CAV, 7" Tape and Reel	CE-5-1 ²	1,000
EVAL-ADMP421Z		Evaluation Board		

¹ Z = RoHS Compliant Part.

² This package option is halide free.

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