CONNECTING PDM MICROPHONES

A PDM output microphone is typically connected to a codec with a dedicated PDM input. This codec separately decodes the left and right channels and filters the high sample rate modulated data back to the audio frequency band. This codec also generates the clock for the PDM microphones or is synchronous with the source that is generating the clock. See the Applications Information section for additional details on connecting the ADMP521 to Analog Devices, Inc., audio codecs with a PDM input. Figure 11 and Figure 12 show mono and stereo connections of the ADMP521 and a codec. The mono connection shows an ADMP521 set to output data on the right channel. To output on the left channel, tie the L/R SELECT pin to V_{DD} instead of GND.

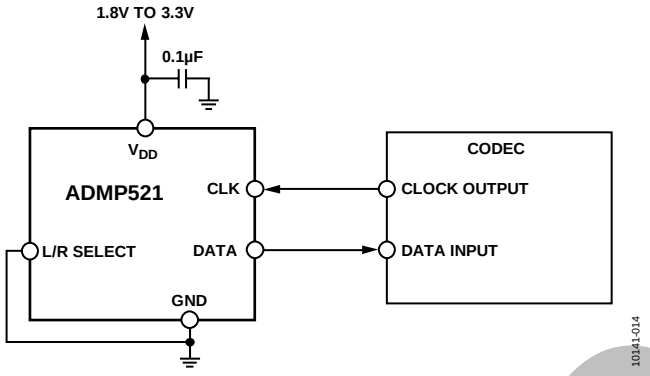

Figure 11. Mono PDM Microphone (Right Channel) Connection to Codec

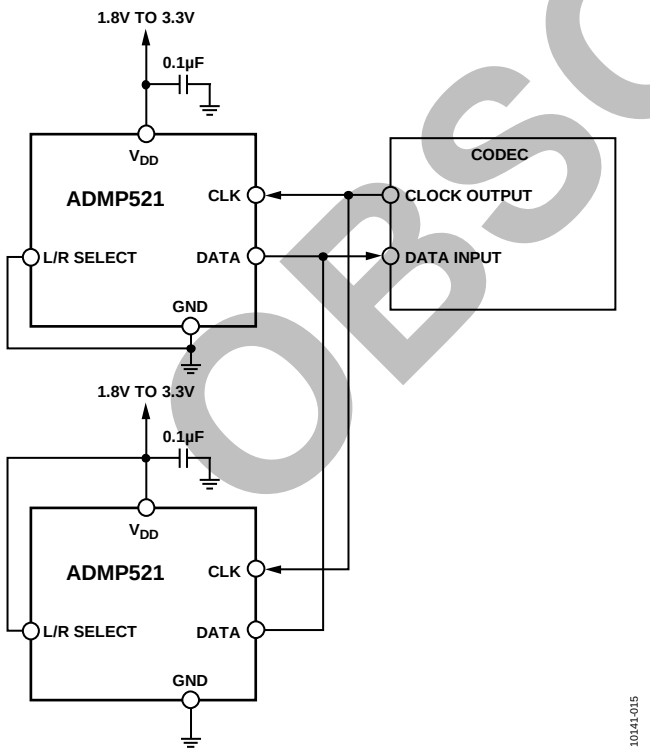

Figure 12. Stereo PDM Microphone Connection to Codec

Decouple the V_{DD} pin of the ADMP521 to GND with a 0.1 µF capacitor. Place this capacitor as close to V_{DD} as the printed circuit board (PCB) layout allows.

Do not use a pull-up or pull-down resistor on the PDM data signal line because it can pull the signal to an incorrect state during the period that the signal line is tristated.

The DATA signal does not need to be buffered in normal use when the ADMP521 microphone(s) is placed close to the codec on the PCB. If the ADMP521 needs to drive the DATA signal over a long cable (>15 cm) or other large capacitive load, a digital buffer may be needed. Only use a signal buffer on the DATA line when one microphone is in use or after the point where two microphones have been connected (see Figure 13). The DATA output of each microphone in a stereo configuration cannot be individually buffered because the two buffer outputs cannot drive a single signal line. If a buffer is used, take care to select one with low propagation delay so that the timing of the data connected to the codec is not corrupted.

When long wires are used to connect the codec to the ADMP521, a 100 Ω source termination resistor may be used on the clock output of the codec instead of a buffer to minimize signal overshoot or ringing. Depending on the drive capability of the codec clock output, a buffer may still be needed, as shown in Figure 13.

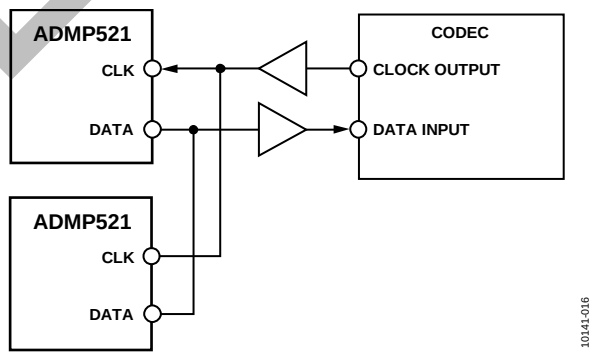

Figure 13. Buffered Connection Between Stereo ADMP521s and a Codec

SLEEP MODE

The microphone enters sleep mode when the clock frequency falls below 1 kHz. In this mode, the microphone data output is in a high impedance state. The current consumption in sleep mode is less than 1 µA.

The ADMP521 enters sleep mode within 1 ms of the clock frequency falling below 1 kHz. The microphone wakes up from sleep mode in 32,768 cycles after the clock becomes active. With a 3.072 MHz clock, the microphone wake time is 10.7 ms; for a 2.4 MHz clock, the microphone wake time is 13.7 ms.

START-UP

The start-up time of the ADMP521 from when the clock is active is the same time as the waking from sleep time. The microphone starts up 32,768 cycles after the clock is active.

APPLICATIONS INFORMATION

INTERFACING WITH ANALOG DEVICES CODECS

The PDM output of the ADMP521 interfaces directly with the digital microphone inputs on Analog Devices ADAU1361, ADAU1761, and ADAU1781 codecs. See the connection diagram shown in Figure 14, and refer to the AN-1003 Application Note and the respective data sheets of the codecs for more details on the digital microphone interface.

The CN-0078 Circuit Note describes the connection between these codecs and a digital microphone. All configuration information is the same for the ADMP521 as it is for the ADMP421.

SUPPORTING DOCUMENTS

For additional information, see the following.

Evaluation Board User Guides

UG-326, *EVAL-ADMP521Z-FLEX: Bottom-Ported, Digital Output, MEMS Microphone Evaluation Board*

UG-335, *EVAL-ADMP521Z Bottom Port Digital Output MEMS Microphone Evaluation Board*

Circuit Note

CN-0078, *Digital MEMS Microphone Simple Interface to a SigmaDSP Audio Codec*

Application Notes

AN-1003, *Recommendations for Mounting and Connecting Analog Devices, Inc., Bottom-Ported MEMS Microphones*

AN-1068, *Reflow Soldering of the MEMS Microphone*

AN-1112, *Microphone Specifications Explained*

AN-1124, *Recommendations for Sealing Analog Devices, Inc., Bottom-Port MEMS Microphones from Dust and Liquid Ingress*

AN-1140, *Microphone Array Beamforming*

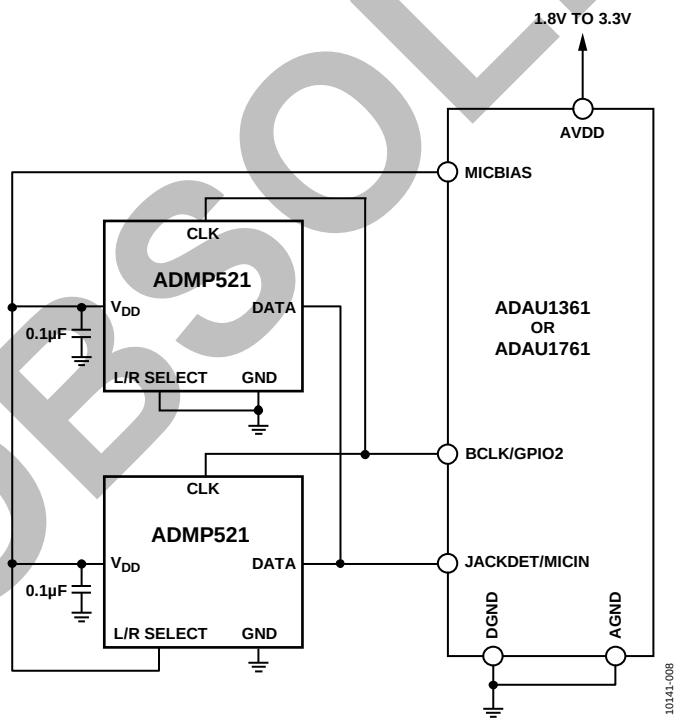

Figure 14. ADAU1361 or ADAU1761 Stereo Interface Block Diagram

PCB DESIGN AND LAYOUT

The recommended PCB land pattern for the ADMP521 should be laid out to a 1:1 ratio to the solder pads on the microphone package, as shown in Figure 15. Take care to avoid applying solder paste to the sound hole in the PCB. A suggested solder paste stencil pattern layout is shown in Figure 16.

The response of the ADMP521 is not affected by the PCB hole size as long as the hole is not smaller than the sound port of the microphone (0.25 mm, or 0.010", in diameter). A 0.5 mm to 1 mm (0.020 inch to 0.040 inch) diameter for the hole is recommended. Take care to align the hole in the microphone package with the hole in the PCB. The exact degree of the alignment does not affect the microphone performance as long as the holes are not partially or completely blocked.

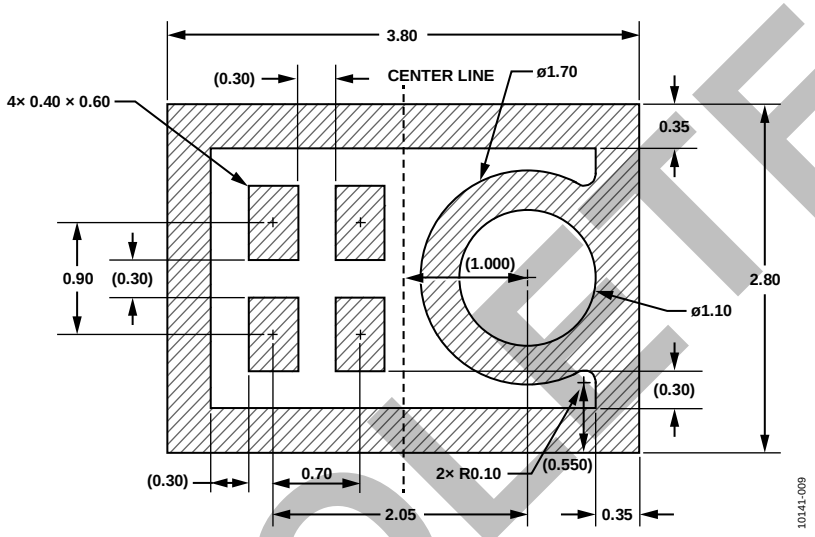

Figure 15. Suggested PCB Land Pattern Layout

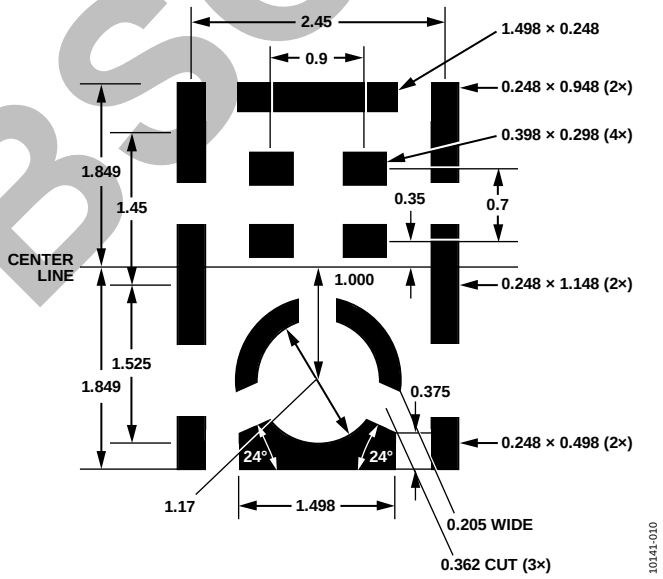

Figure 16. Suggested Solder Paste Stencil Pattern Layout

ALTERNATIVE PCB LAND PATTERNS

The standard PCB land pattern of the ADMP521 has a solid ring around the edge of the footprint that may make routing the microphone signals more difficult in some board designs. This ring is used to improve the RF immunity performance of the ADMP521; however, it is not necessary to have this full ring connected for electrical functionality. If a design can tolerate reduced RF immunity, this ring can either be broken or removed completely from the PCB footprint. Figure 17 shows an example PCB land pattern with no enclosing ring around the edge of the part, and Figure 18 shows an example PCB land pattern with the ring broken on two sides so that the inner pads can be more easily routed on the PCB.

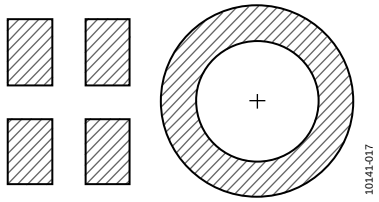

Figure 17. Example PCB Land Pattern with No Enclosing Ring

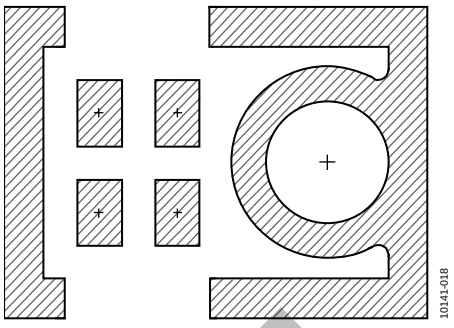

Figure 18. Example PCB Land Pattern with Broken Enclosing Ring

Note that in both of these patterns, the solid ring around the sound port is still present; this ring is needed to ground the microphone and for acoustic performance. The pad on the package connected to this ring is ground and still needs a solid electrical connection to the PCB ground. If a pattern like one of these two examples is used on a PCB, take care that the unconnected ring on the bottom of the ADMP521 is not placed directly over any exposed copper. This ring on the microphone is still at ground and any PCB traces routed underneath it need to be properly masked to avoid short circuits.

PCB MATERIAL AND THICKNESS

The performance of the ADMP521 is not affected by PCB thickness and can be mounted on both a rigid and flexible PCB. A flexible PCB with the microphone can be attached directly to the device housing with an adhesive layer. This mounting method offers a reliable seal around the sound port, while providing the shortest acoustic path for good sound quality.

HANDLING INSTRUCTIONS

PICK-AND-PLACE EQUIPMENT

The MEMS microphone can be handled using standard pick-and-place and chip shooting equipment. Take care 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 10 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 4 and Table 4.

BOARD WASH

When washing the PCB, ensure that water does not make contact with the microphone port. Do not use blow-off procedures and ultrasonic cleaning.

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, 1000 hours, powered
High Temperature Operating Life	+125°C, 1000 hours, powered
Temperature Humidity Bias (THB)	+85°C/85% relative humidity (RH), 1000 hours, powered
Temperature Cycle	−40°C/+125°C, one cycle per hour, 1000 cycles
High Temperature Storage	150°C, 1000 hours
Low Temperature Storage	−40°C, 1000 hours

OUTLINE DIMENSIONS

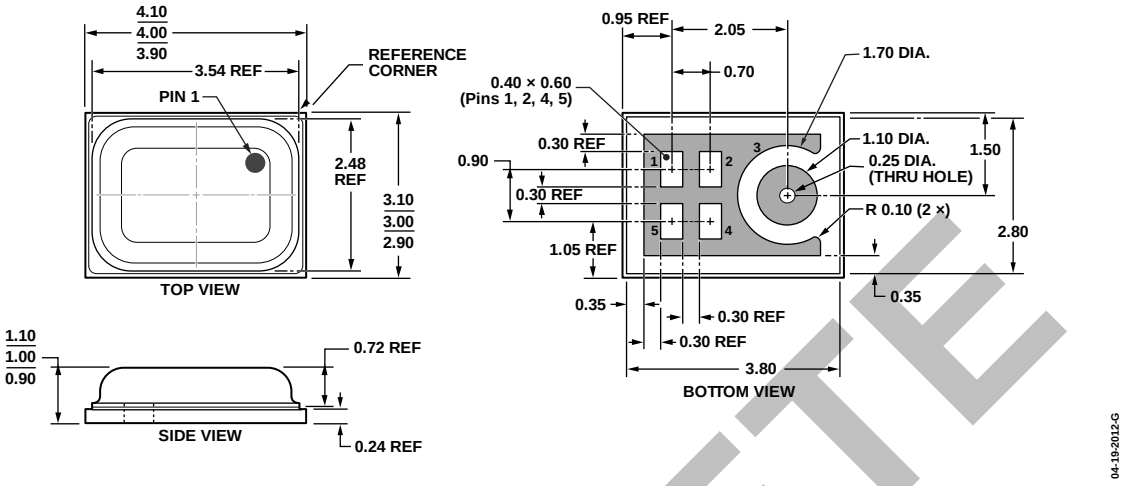

Figure 19. 5-Terminal Chip Array Small Outline No Lead Cavity [LGA_CAV]
4 mm × 3 mm Body
(CE-5-1)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option[2]	Ordering Quantity
ADMP521ACEZ-RL	−40°C to +85°C	5-Terminal LGA_CAV, 13″ Tape and Reel	CE-5-1	5,000
ADMP521ACEZ-RL7	−40°C to +85°C	5-Terminal LGA_CAV, 7″ Tape and Reel	CE-5-1	1,000
EVAL-ADMP521Z		Evaluation Board		
EVAL-ADMP521Z-FLEX		Flexible Evaluation Board		

[1] Z = RoHS Compliant Part.
[2] This package option is halide free.

NOTES

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