

## FEATURES

**Tiny 3.35 mm × 2.50 mm × 0.88 mm surface-mount package**  
**High SNR of 62 dBA**  
**High sensitivity of –38 dBV**  
**Flat frequency response from 100 Hz to 15 kHz**  
**Low current consumption: <250 μA**  
**Single-ended analog output**  
**High PSR of 70 dB**  
**Compatible with Sn/Pb and Pb-free solder processes**  
**RoHS/WEEE compliant**

## APPLICATIONS

**Smartphones and feature phones**  
**Teleconferencing systems**  
**Digital video cameras**  
**Bluetooth headsets**  
**Video phones**  
**Tablets**

## GENERAL DESCRIPTION

The **ADMP404**<sup>1</sup> is a high quality, high performance, low power, analog output bottom-ported omnidirectional MEMS microphone. The **ADMP404** consists of a MEMS microphone element, an impedance converter, and an output amplifier. The **ADMP404** sensitivity specification makes it an excellent choice for both near field and far field applications. The **ADMP404** has a high signal-to-noise ratio (SNR) and flat, wideband frequency response, resulting in natural sound with high intelligibility. Its low current consumption enables long battery life for portable applications.

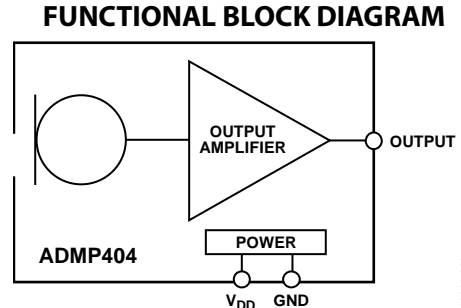


Figure 1.

0861E-001

The **ADMP404** complies with the TIA-920 *Telecommunications Telephone Terminal Equipment Transmission Requirements for Wideband Digital Wireline Telephones* standard.

The **ADMP404** is available in an ultraminiature 3.35 mm × 2.50 mm × 0.88 mm surface-mount package. It is reflow solder compatible with no sensitivity degradation. The **ADMP404** is halide free.

<sup>1</sup> Protected by U.S. Patents 7,449,356; 7,825,484; 7,885,423; 7,961,897. Other patents are pending.

### Rev. C

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## REVISION HISTORY

### 7/12—Rev. B to Rev. C

|   |    |
|---|----|
| Changes to Features Section, General Description Section,<br>Figure 1, and Page 1 Layout.....                         | 1  |
| Add Note 1.....   | 1  |
| Changes to Powers Supply Rejection Parameter, Table 1.....  | 3  |
| Changes to Temperature Range Parameter, Table 2.....  | 4  |
| Changes to Figure 5.....  | 6  |
| Changes to Connecting to Analog Devices Audio Codecs<br>Section, Figure 8, and Application Notes Section .....        | 7  |
| Added Circuit Notes Section.....  | 7  |
| Changes to Temperature Humidity Bias (THB) Description<br>Column, Table 5 and Temperature Cycle Column, Table 5 ..... | 10 |
| Changes to Ordering Guide .....   | 11 |
| Deleted Figure 12.....  | 11 |

### 8/11—Rev. A to Rev. B

|   |    |
|---|----|
| Changes to Figure 1.....  | 1  |
| Changes to Supply Voltage Parameter, Table 1 .....  | 3  |
| Changes to Table 3.....   | 4  |
| Added Connecting to Analog Devices, Inc., Audio Codecs<br>Section and Supporting Documents Section..... | 7  |
| Changes to Pick and Place Equipment<br>Section (20 kg to 10 kg) .....                                   | 9  |
| Added LGA_CAV Tape and Reel Outline Dimensions,<br>Figure 12.....                                       | 11 |

### 12/10—Rev. 0 to Rev. A

|  |   |
|--|---|
| Changes to Applications Section and General<br>Description Section ..... | 1 |
| Changes to Table 1.....  | 3 |
| Changes to Table 2.....  | 4 |

### 7/10—Revision 0: Initial Version

## SPECIFICATIONS

$T_A = 25^\circ\text{C}$ ,  $V_{DD} = 1.8\text{ V}$ , 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          |
|---------------------------------|-----------|--|-----|-------|-----|---------------|
| <b>PERFORMANCE</b>              |           |  |     |       |     |               |
| Directionality                  |           |  |     | Omni  |     |               |
| Sensitivity                     |           | 1 kHz, 94 dB SPL   | -41 | -38   | -35 | dBV           |
| Signal-to-Noise Ratio           | SNR       |  |     | 62    |     | dB            |
| Equivalent Input Noise          | EIN       |  |     | 32    |     | dB SPL        |
| Dynamic Range                   |           | Derived from EIN and maximum acoustic input                            |     | 88    |     | dB            |
| Frequency Response <sup>1</sup> |           | Low frequency -3 dB point  |     | 100   |     | Hz            |
|                                 |           | High frequency -3 dB point   |     | 15    |     | kHz           |
|                                 |           | Deviation limits from flat response within pass band                   |     | -3/+2 |     | dB            |
| Total Harmonic Distortion       | THD       | 105 dB SPL   |     |       | 3   | %             |
| Power Supply Rejection          | PSR       | 217 Hz, 100 mV p-p square wave superimposed on $V_{DD} = 1.8\text{ V}$ |     | 70    |     | dB            |
| Maximum Acoustic Input          |           | Peak   |     | 120   |     | dB SPL        |
| <b>POWER SUPPLY</b>             |           |  |     |       |     |               |
| Supply Voltage                  | $V_{DD}$  |  | 1.5 |       | 3.3 | V             |
| Supply Current                  | $I_S$     |  |     |       | 250 | $\mu\text{A}$ |
| <b>OUTPUT CHARACTERISTICS</b>   |           |  |     |       |     |               |
| Output Impedance                | $Z_{OUT}$ |  |     | 200   |     | $\Omega$      |
| Output DC Offset                |           |  |     | 0.8   |     | V             |
| Output Current Limit            |           |  |     | 90    |     | $\mu\text{A}$ |

<sup>1</sup> See Figure 4 and Figure 6.

# ABSOLUTE MAXIMUM RATINGS

Table 2.

| Parameter                  | Rating  |
|----------------------------|---|
| Supply Voltage             | -0.3 V to +3.6 V                              |
| 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 +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.

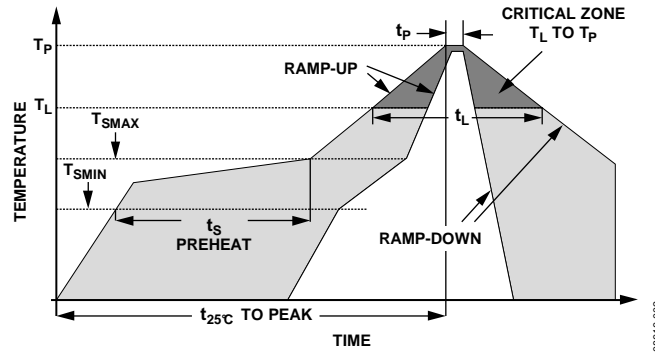
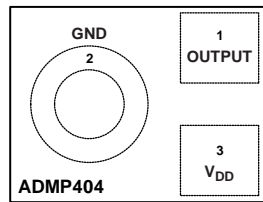


Figure 2. Recommended Soldering Profile Limits

Table 3. Recommended Soldering Profile Limits

| Profile Feature                                 | Sn63/Pb37         | Pb-Free           |
|---|-------------------|-------------------|
| Average Ramp Rate (TL to TP)                    | 125°C/sec maximum | 125°C/sec maximum |
| Preheat   |                   |                   |
| Minimum Temperature (TSMIN)                     | 100°C             | 100°C             |
| Maximum Temperature (TSMAX)                     | 150°C             | 200°C             |
| Time (TSMIN to TSMAX), ts                       | 60 sec to 75 sec  | 60 sec to 75 sec  |
| Ramp-Up Rate (TSMAX to TL)                      | 125°C/sec         | 125°C/sec         |
| Time Maintained Above Liquidous (tL)            | 45 sec to 75 sec  | ~50 sec           |
| Liquidous Temperature (TL)                      | 183°C             | 217°C             |
| Peak Temperature (TP)                           | 215°C +3°C/-3°C   | 245°C 0°C/-5°C    |
| Time Within 5°C of Actual Peak Temperature (tp) | 20 sec to 30 sec  | 20 sec to 30 sec  |
| Ramp-Down Rate                                  | 3°C/sec maximum   | 3°C/sec maximum   |
| Time 25°C (t25°C) to Peak Temperature           | 5 minute maximum  | 5 minute maximum  |

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS



TOP VIEW  
(TERMINAL SIDE DOWN)  
Not to Scale

08616-003

Figure 3. Pin Configuration

Table 4. Pin Function Descriptions

| Pin No. | Mnemonic        | Description          |
|---------|-----------------|----------------------|
| 1       | OUTPUT          | Analog Output Signal |
| 2       | GND             | Ground               |
| 3       | V <sub>DD</sub> | Power Supply         |

TYPICAL PERFORMANCE CHARACTERISTICS

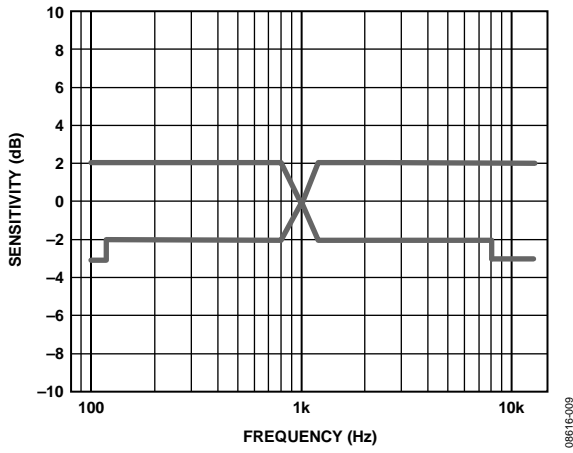


Figure 4. Frequency Response Mask

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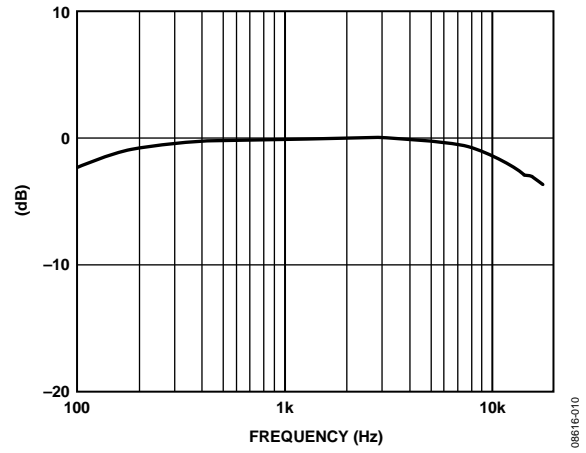


Figure 6. Typical Frequency Response (Measured)

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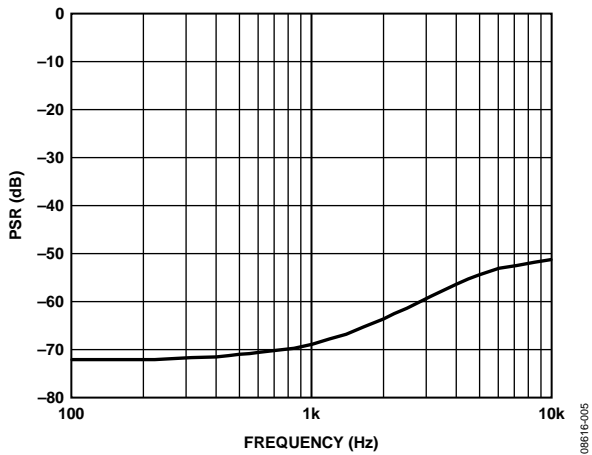


Figure 5. Typical Power Supply Rejection Ratio vs. Frequency

086F16-005

## APPLICATIONS INFORMATION

### CONNECTING TO ANALOG DEVICES AUDIO CODECS

The **ADMP404** output can be connected to a dedicated codec microphone input (see Figure 7) or to a high input impedance gain stage (see Figure 8). A 0.1  $\mu\text{F}$  ceramic capacitor placed close to the **ADMP404** supply pin is used for testing and is recommended to adequately decouple the microphone from noise on the power supply. A dc-blocking capacitor is required at the output of the microphone. This capacitor creates a high-pass filter with a corner frequency at

$$f_c = 1/(2\pi \times C \times R)$$

where  $R$  is the input impedance of the codec.

A minimum value of 2.2  $\mu\text{F}$  is recommended in Figure 7 because the input impedance of the **ADAU1361/ADAU1761** can be as low as 2 k $\Omega$  at its highest PGA gain setting, which results in a high-pass filter corner frequency at about 37 Hz. Figure 8 shows the **ADMP404** connected to the **ADA4897-1** op amp configured as a noninverting preamplifier.

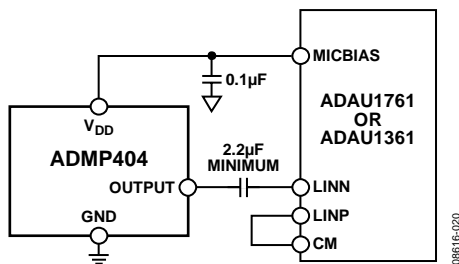


Figure 7. **ADMP404** Connected to the Analog Devices **ADAU1761** or **ADAU1361** Codec

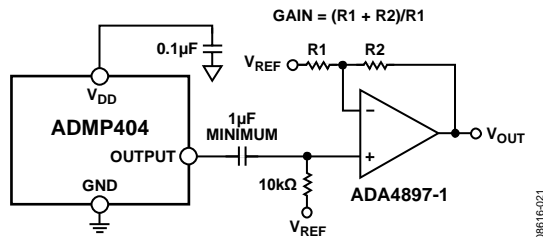


Figure 8. **ADMP404** Connected to the **ADA4897-1** Op Amp

### SUPPORTING DOCUMENTS

#### Evaluation Board User Guide

[UG-142](#), *EVAL-ADMP404Z-FLEX: Bottom-Ported Analog Output MEMS Microphone Evaluation Board*

#### 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*

#### Circuit Notes

[CN-0207](#), *High Performance Analog MEMS Microphone's Simple Interface to SigmaDSP Audio Codec*

[CN-0262](#), *Low Noise Analog MEMS Microphone and Preamp with Compression and Noise Gating*

### PCB LAND PATTERN LAYOUT

The recommended PCB land pattern for the ADMP404 should be laid out to a 1:1 ratio to the solder pads on the microphone package, as shown in Figure 9. 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 10. 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.

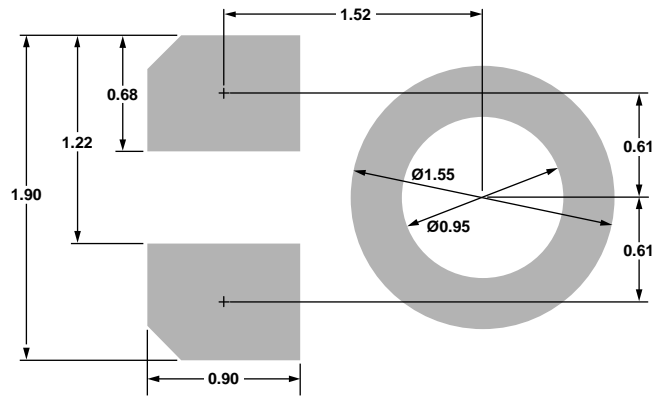


Figure 9. PCB Land Pattern Layout

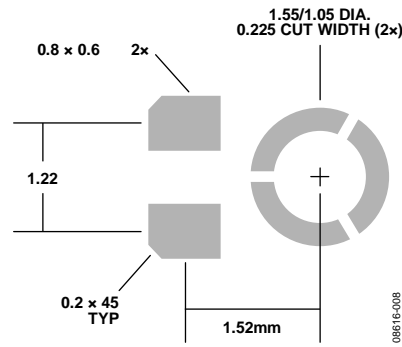


Figure 10. Suggested Solder Paste Stencil Pattern Layout

## 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 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 2 and Table 3.

### 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.

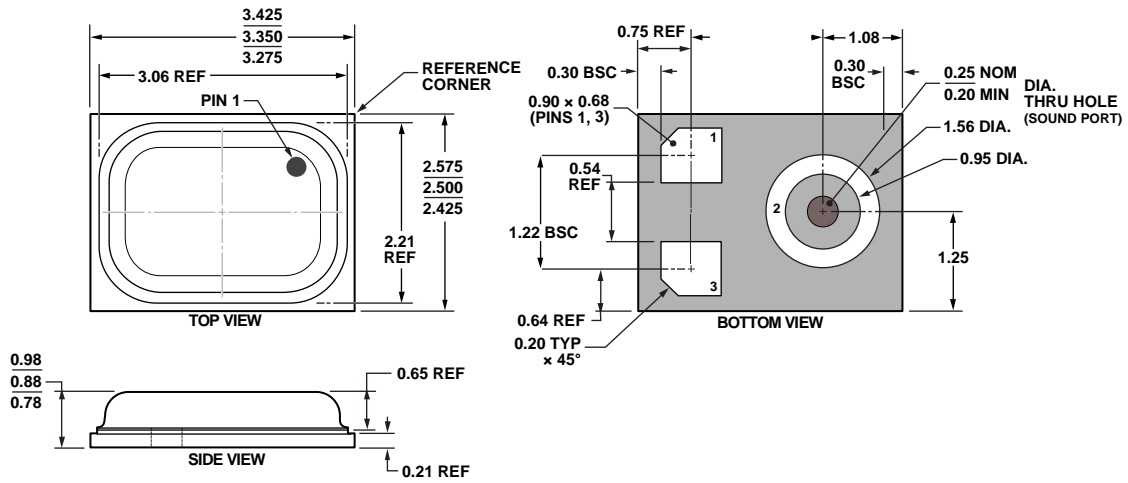
## RELIABILITY SPECIFICATIONS

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

Table 5.

| Stress Test                     | Description  |
|---------------------------------|--|
| Low Temperature Operating Life  | -40°C, 500 hours, powered                            |
| High Temperature Operating Life | +125°C, 500 hours, powered                           |
| Temperature Humidity Bias (THB) | +85°C/85% relative humidity (RH), 500 hours, powered |
| Temperature Cycle               | -40°C/+125°C, one cycle per hour, 1000 cycles        |
| High Temperature Storage        | +150°C, 500 hours                                    |
| Low Temperature Storage         | -40°C, 500 hours                                     |
| 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



06-16-2010-A

ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                   | Package Option <sup>2</sup> | Ordering Quantity |
|--------------------|-------------------|---------------------------------------|-----------------------------|-------------------|
| ADMP404ACEZ-RL     | -40°C to +85°C    | 3-Terminal LGA_CAV, 13" Tape and Reel | CE-3-2                      | 10,000            |
| ADMP404ACEZ-RL7    | -40°C to +85°C    | 3-Terminal LGA_CAV, 7" Tape and Reel  | CE-3-2                      | 1,000             |
| EVAL-ADMP404Z-FLEX |                   | Evaluation Board                      |                             |                   |

<sup>1</sup> Z = RoHS Compliant Part.

<sup>2</sup> This package option is halide free.

**NOTES**