FEATURES
Tiny, 3.35 mm × 2.50 mm × 0.88 mm surface-mount package
Omnidirectional response
Very high SNR of 65 dBA
Sensitivity of -38 dBV
Extended frequency response from 100 Hz to 20 kHz
Low current consumption: 180 µA
Single-ended analog output
120 dB maximum SPL
High PSR of 70 dBV
Compatible with Sn/Pb and Pb-free solder processes
RoHS/WEEE compliant

APPLICATIONS
Smartphones and feature phones
Tablet computers
Teleconferencing systems
Digital still and video cameras
Bluetooth headsets
Notebook PCs
Security and surveillance

GENERAL DESCRIPTION
The ADMP504 is a high performance, very low noise, low power, analog output, bottom-ported omnidirectional MEMS microphone. The ADMP504 consists of a MEMS microphone element, an impedance converter and an output amplifier. The ADMP504 sensitivity specification makes it an excellent choice for both near field and far field applications. The ADMP504 is function- and pin-compatible with the ADMP404 microphone, providing an easy upgrade path.

The ADMP504 has very high SNR and extended wideband frequency response, resulting in natural sound with high intelligibility. Low current consumption enables long battery life for portable applications. The ADMP504 complies with the TIA-920 Telecommunications Telephone Terminal Equipment Transmission Requirements for Wideband Digital Wireline Telephones standard.

The ADMP504 is available in an ultraminiature 3.35 mm × 2.5 mm × 0.88 mm surface-mount package. It is reflow solder compatible with no sensitivity degradation. The ADMP504 is halide free.

1 Protected by U.S. Patents 7,449,356; 7,825,484; 7,885,423; 7,961,897. Other patents are pending.
IMPORTANT LINKS for the ADMP504

Last content update 09/20/2013 09:44 pm

PARAMETRIC SELECTION TABLES
Find Similar Products By Operating Parameters
Consider ADMP401: Omnidirectional Microphone with Bottom Port and Analog Output
Consider ADMP404: Omnidirectional Microphone with Bottom Port and Analog Output
Consider ADMP405: Omnidirectional Microphone with Bottom Port and Analog Output
Consider ADMP421: Omnidirectional Microphone with Bottom Port and Analog Output
Consider ADMP441: Omnidirectional Microphone with Bottom Port and Analog Output
Consider ADMP521: Omnidirectional Microphone with Bottom Port and Analog Output

DESIGN TOOLS, MODELS, DRIVERS & SOFTWARE
Microphone Beamforming Simulation Tool (32-bit)
- Documentation for the microphone beamforming simulator
Microphone Beamforming Simulation Tool (64-bit)
- Documentation for the microphone beamforming simulator

PRODUCT RECOMMENDATIONS & REFERENCE DESIGNS
CN-0262: Low Noise Analog MEMS Microphone and Preamp with Compression and Noise Gating
CN-0207: High Performance Analog MEMS Microphone’s Simple Interface to SigmaDSP Audio Codec

SUGGESTED COMPANION PRODUCTS
Recommended Audio Codes for the ADMP504
- For a low power SigmaDSP codec with headphone driver and PLL, we recommend the ADAU1781.
- For a low power SigmaDSP codec with mono speaker driver and PLL, we recommend the ADAU1361.
- For a low power, 24-bit audio codec with headphone driver and PLL, we recommend the ADAU1361.
- For a low power, 24-bit audio codec with a fixed-function tunable signal processor, we recommend the ADAU1381.
- For a low power, multi-channel, 24-bit audio codec in a wafer level chip scale package, we recommend the ADAU1373.
- For a low power, stereo codec with mono microphone input, we recommend the SSM2603.

Recommended Microphone Preamplifiers for the ADMP504
- For low noise, variable compression and noise gating, we recommend the SSM2166 or the SSM2167.
- For low power, ultralow noise, low distortion, we recommend the ADA4075-2 dual opamp.

DOCUMENTATION
AN-1181: Using a MEMS Microphone in a 2-Wire Microphone Circuit
AN-1165: Op Amps for MEMS Microphone Preamp Circuits
AN-1140: Microphone Array Beamforming
AN-1124: Recommendations for Sealing Analog Devices, Inc., Bottom-Port MEMS Microphones from Dust and Liquid Ingress
AN-1112: Microphone Specifications Explained
AN-1068: Reflow Soldering of the MEMS Microphone
AN-1003: Recommendations for Mounting and Connecting Analog Devices, Inc., Bottom-Ported MEMS Microphones
CN-0262: Low Noise Analog MEMS Microphone and Preamp with Compression and Noise Gating
ADI MEMS Mics Set New Bar in Noise Performance
UG-325: Analog Output MEMS Microphone Flex Evaluation Board
MS-2472: Analog and Digital MEMS Microphone Design Considerations
MS-2348: Low Self Noise: The First Step to High Performance MEMS Microphone Applications
MS-2275: Common Inter-IC Digital Interfaces for Audio Data Transfer
A History of Consumer Microphones:
Analog Devices Sets High-Performance Benchmark With The Industry’s Lowest-Noise MEMS Microphone

EVALUATION KITS & SYMBOLS & FOOTPRINTS
MEMS Microphone Evaluation Boards
ADMP504 Flex Eval Board
Symbols and Footprints

DESIGN COLLABORATION COMMUNITY
Collaborate Online with the ADI support team and other designers about select ADI products.

SAMPLE & BUY
ADMP504
- View Price & Packaging
- Request Evaluation Board
- Request Samples
- Check Inventory & Purchase
Find Local Distributors

* This page was dynamically generated by Analog Devices, Inc. and inserted into this data sheet.
Note: Dynamic changes to the content on this page (labeled ‘Important Links’) does not constitute a change to the revision number of the product data sheet. This content may be frequently modified.
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REVISION HISTORY

6/12—Rev. 0 to Rev. A
Changes to Figure 2 ................................................ 1
Changes to General Description Section ................ 1
Change to Power Supply Rejection Parameter, Table 1 3
Changes to Supporting Documents Section .............. 7
Changes to Reflow Solder Section .......................... 8

10/11—Revision 0: Initial Version
SPECIFICATIONS

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

Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions/Comments</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directionality</td>
<td></td>
<td></td>
<td>Omni</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>SNR</td>
<td>1 kHz, 94 dB SPL</td>
<td>−41</td>
<td>−38</td>
<td>−35</td>
<td>dBV</td>
</tr>
<tr>
<td>Signal-to-Noise Ratio</td>
<td>SNR</td>
<td>20 Hz to 20 kHz, A-weighted</td>
<td>65</td>
<td></td>
<td></td>
<td>dBA</td>
</tr>
<tr>
<td>Equivalent Input Noise</td>
<td>EIN</td>
<td>20 Hz to 20 kHz, A-weighted</td>
<td>29</td>
<td></td>
<td></td>
<td>dBA SPL</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td></td>
<td>Derived from EIN and maximum acoustic input</td>
<td>91</td>
<td></td>
<td></td>
<td>dBA</td>
</tr>
<tr>
<td>Frequency Response $^1$</td>
<td></td>
<td>Low frequency −3 dB point</td>
<td>100</td>
<td></td>
<td></td>
<td>Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High frequency −3 dB point</td>
<td>&gt;20</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>THD</td>
<td>104 dB SPL</td>
<td>104</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Power Supply Rejection</td>
<td>PSR</td>
<td>217 Hz, 100 mV p-p square wave superimposed on $V_{DD} = 1.8$ V</td>
<td>−70</td>
<td></td>
<td></td>
<td>dBV</td>
</tr>
<tr>
<td>Maximum Acoustic Input</td>
<td></td>
<td>Peak, 10% THD</td>
<td>120</td>
<td></td>
<td></td>
<td>dB SPL</td>
</tr>
<tr>
<td><strong>POWER SUPPLY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>$V_{DD}$</td>
<td></td>
<td>1.6</td>
<td>3.3</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>$I_s$</td>
<td>$V_{DD} = 1.8$ V</td>
<td>180</td>
<td>200</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{DD} = 3.3$ V</td>
<td>200</td>
<td>225</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td><strong>OUTPUT CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>$Z_{OUT}$</td>
<td></td>
<td>200</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Output DC Offset</td>
<td></td>
<td></td>
<td>0.8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Current Limit</td>
<td></td>
<td></td>
<td>90</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Maximum Output Voltage</td>
<td></td>
<td>120 dB SPL input, peak</td>
<td>0.25</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Noise Floor</td>
<td></td>
<td>20 Hz to 20 kHz, A-weighted, rms</td>
<td>−103</td>
<td></td>
<td></td>
<td>dBV</td>
</tr>
</tbody>
</table>

$^1$ See Figure 5 and Figure 7.
**ABSOLUTE MAXIMUM RATINGS**

Table 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>−0.3 V to +3.6 V</td>
</tr>
<tr>
<td>Sound Pressure Level (SPL)</td>
<td>160 dB</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>10,000 g</td>
</tr>
<tr>
<td>Vibration</td>
<td>Per MIL-STD-883 Method 2007,</td>
</tr>
<tr>
<td></td>
<td>Test Condition B</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>−40°C to +85°C</td>
</tr>
</tbody>
</table>

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.

---

**Table 3. Recommended Soldering Profile Limits**

<table>
<thead>
<tr>
<th>Profile Feature</th>
<th>Sn63/Pb37</th>
<th>Pb-Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Ramp Rate (T_L to T_P)</td>
<td>1.25°C/sec maximum</td>
<td>1.25°C/sec maximum</td>
</tr>
<tr>
<td>Preheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Temperature (T_SMIN)</td>
<td>100°C</td>
<td>150°C</td>
</tr>
<tr>
<td>Maximum Temperature (T_SMAX)</td>
<td>150°C</td>
<td>200°C</td>
</tr>
<tr>
<td>Time (T_SMIN to T_SMAX), t_S</td>
<td>60 sec to 75 sec</td>
<td>60 sec to 75 sec</td>
</tr>
<tr>
<td>Ramp-Up Rate (T_SMAX to T_L)</td>
<td>1.25°C/sec</td>
<td>1.25°C/sec</td>
</tr>
<tr>
<td>Time Maintained Above Liquidous (t_L)</td>
<td>45 sec to 75 sec</td>
<td>~50 sec</td>
</tr>
<tr>
<td>Liquidous Temperature (T_L)</td>
<td>183°C</td>
<td>217°C</td>
</tr>
<tr>
<td>Peak Temperature (T_P)</td>
<td>215°C + 3°C/−3°C</td>
<td>260°C + 0°C/−5°C</td>
</tr>
<tr>
<td>Time Within 5°C of Actual Peak Temperature (t_P)</td>
<td>20 sec to 30 sec</td>
<td>20 sec to 30 sec</td>
</tr>
<tr>
<td>Ramp-Down Rate</td>
<td>3°C/sec maximum</td>
<td>3°C/sec maximum</td>
</tr>
<tr>
<td>Time 25°C to Peak Temperature</td>
<td>5 minutes maximum</td>
<td>5 minutes maximum</td>
</tr>
</tbody>
</table>
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

Figure 4. Pin Configuration

Table 4. Pin Function Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OUTPUT</td>
<td>Analog Output Signal</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>VDD</td>
<td>Power Supply</td>
</tr>
</tbody>
</table>
TYPICAL PERFORMANCE CHARACTERISTICS

Figure 5. Frequency Response Mask

Figure 6. Typical Power Supply Rejection vs. Frequency

Figure 7. Typical Frequency Response (Measured)
APPLICATIONS INFORMATION

The ADMP504 output can be connected to a dedicated codec microphone input (see Figure 8) or to a high input impedance gain stage (see Figure 9). A 0.1 μF ceramic capacitor placed close to the ADMP504 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

\[ f_c = \frac{1}{(2\pi \times C \times R)} \]

where \( R \) is the codec’s input impedance.

A minimum value of 2.2 μF is recommended in Figure 8 because the input impedance of the ADAU1361/ADAU1761 can be as low as 2 kΩ at its highest PGA gain setting, which would result in a high-pass filter corner frequency at about 37 Hz.

Figure 9 shows the ADMP504 connected to an ADA4897-1 op amp configured as a noninverting preamplifier.

**SUPPORTING DOCUMENTS**

**Evaluation Board User Guide**

UG-325, EVAL-ADMP504Z-FLEX: Bottom-Ported Analog Output MEMS Microphone Evaluation Board

**Circuit Note**

CN-0207, High Performance Analog MEMS Microphone’s Simple Interface to 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
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 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
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 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.
PCB LAND PATTERN LAYOUT

The recommended PCB land pattern for the ADMP504 should be laid out to a 1:1 ratio to the solder pads on the microphone package, as shown in Figure 10. 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 11. 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 10. PCB Land Pattern Layout](image)

![Figure 11. Suggested Solder Paste Stencil Pattern Layout](image)
RELIABILITY SPECIFICATIONS

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

Table 5.

<table>
<thead>
<tr>
<th>Stress Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Temperature Operating Life</td>
<td>−40°C, 1000 hrs, powered</td>
</tr>
<tr>
<td>High Temperature Operating Life</td>
<td>+125°C, 1000 hrs, powered</td>
</tr>
<tr>
<td>Temperature Humidity Bias (THB)</td>
<td>+85°C/+85% relative humidity (RH), 1000 hrs, powered</td>
</tr>
<tr>
<td>Temperature Cycle</td>
<td>−40°C/+125°C, one cycle per hour, 1000 cycles</td>
</tr>
<tr>
<td>High Temperature Storage</td>
<td>+150°C, 1000 hrs</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>−40°C, 1000 hrs</td>
</tr>
<tr>
<td>Component CDM ESD</td>
<td>All pins, 0.5 kV</td>
</tr>
<tr>
<td>Component HBM ESD</td>
<td>All pins, 1.5 kV</td>
</tr>
<tr>
<td>Component MM ESD</td>
<td>All pins, 0.2 kV</td>
</tr>
</tbody>
</table>
OUTLINE DIMENSIONS

Figure 12. 3-Terminal Chip Array Small Outline No Lead Cavity [LGA_CAV]
3.35 mm × 2.50 mm Body
(CE-3-2)
Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model1</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option2</th>
<th>Ordering Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMP504ACEZ-RL</td>
<td>−40°C to +85°C</td>
<td>3-Terminal LGA_CAV, 13&quot; Tape and Reel</td>
<td>CE-3-2</td>
<td>10,000</td>
</tr>
<tr>
<td>ADMP504ACEZ-RL7</td>
<td>−40°C to +85°C</td>
<td>3-Terminal LGA_CAV, 7&quot; Tape and Reel</td>
<td>CE-3-2</td>
<td>1,000</td>
</tr>
<tr>
<td>EVAL-ADMP504Z-FLEX</td>
<td></td>
<td>Flex Evaluation Board</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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