Ultralow Noise Microphone with Bottom Port and Analog Output

Data Sheet

ADMP504

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

FUNCTIONAL BLOCK DIAGRAM

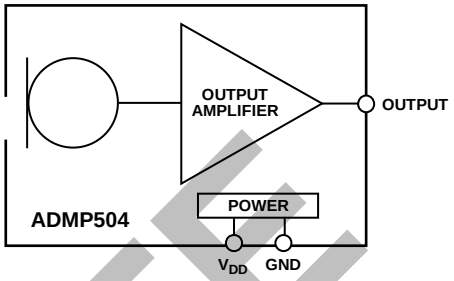

Figure 1.

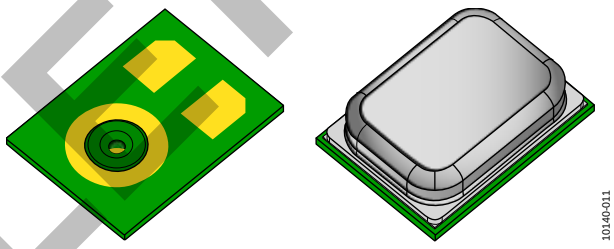

Figure 2. Isometric Views of ADMP504 Microphone Package

GENERAL DESCRIPTION

The ADMP504[1] 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.

Rev. A

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 www.analog.com
Fax: 781.461.3113

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 Codecs for the ADMP504

- For a low power SigmaDSP codec with headphone driver and PLL, we recommend the ADAU1761.
- For a low power SigmaDSP codec with mono speaker driver and PLL, we recommend the ADAU1781.
- 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

TABLE OF CONTENTS

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°C, V_{DD} = 1.8 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
PERFORMANCE						
Directionality				Omni		
Sensitivity		1 kHz, 94 dB SPL	−41	−38	−35	dBV
Signal-to-Noise Ratio	SNR	20 Hz to 20 kHz, A-weighted		65		dBA
Equivalent Input Noise	EIN	20 Hz to 20 kHz, A-weighted		29		dBA SPL
Dynamic Range		Derived from EIN and maximum acoustic input		91		dB
Frequency Response[1]		Low frequency −3 dB point		100		Hz
		High frequency −3 dB point		>20		kHz
Total Harmonic Distortion	THD	104 dB SPL			3	%
Power Supply Rejection	PSR	217 Hz, 100 mV p-p square wave superimposed on V_{DD} = 1.8 V		−70		dBV
Maximum Acoustic Input		Peak, 10% THD		120		dB SPL
POWER SUPPLY						
Supply Voltage	V_{DD}		1.6		3.3	V
Supply Current	I_S	V_{DD} = 1.8 V		180	200	µA
		V_{DD} = 3.3 V		200	225	µA
OUTPUT CHARACTERISTICS						
Output Impedance	Z_{OUT}			200		Ω
Output DC Offset				0.8		V
Output Current Limit				90		µA
Maximum Output Voltage		120 dB SPL input, peak		0.25		V
Noise Floor		20 Hz to 20 kHz, A-weighted, rms		−103		dBV

[1] See Figure 5 and Figure 7.

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.

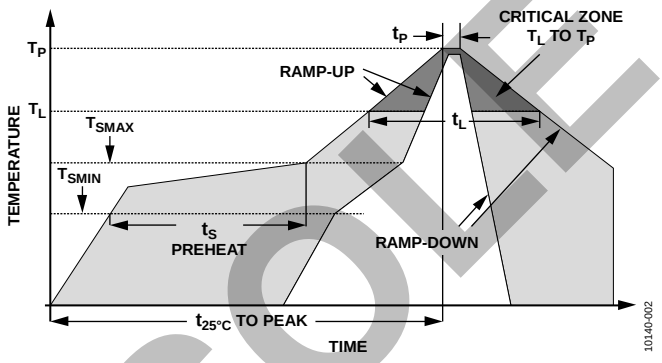

Figure 3. Recommended Soldering Profile Limits

Table 3. Recommended Soldering Profile Limits

Profile Feature	Sn63/Pb37	Pb-Free
Average Ramp Rate (T_L to T_P)	1.25°C/sec maximum	1.25°C/sec maximum
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 75 sec	60 sec to 75 sec
Ramp-Up Rate (T_{SMAX} to T_L)	1.25°C/sec	1.25°C/sec
Time Maintained Above Liquidous (t_L)	45 sec to 75 sec	~50 sec
Liquidous Temperature (T_L)	183°C	217°C
Peak Temperature (T_P)	215°C + 3°C/−3°C	260°C + 0°C/−5°C
Time Within 5°C of Actual Peak Temperature (t_P)	20 sec to 30 sec	20 sec to 30 sec
Ramp-Down Rate	3°C/sec maximum	3°C/sec maximum
Time 25°C to Peak Temperature	5 minutes maximum	5 minutes maximum

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

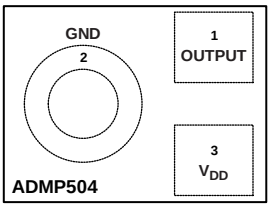

Figure 4. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	OUTPUT	Analog Output Signal
2	GND	Ground
3	V_{DD}	Power Supply

TYPICAL PERFORMANCE CHARACTERISTICS

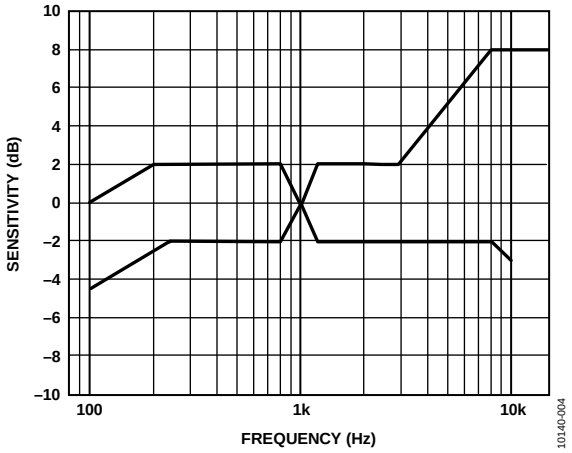

Figure 5. Frequency Response Mask

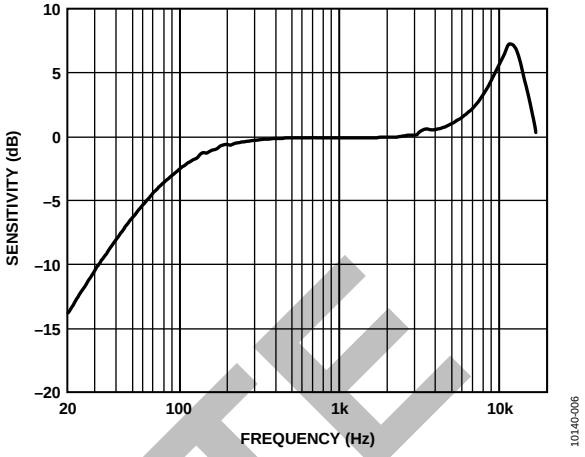

Figure 7. Typical Frequency Response (Measured)

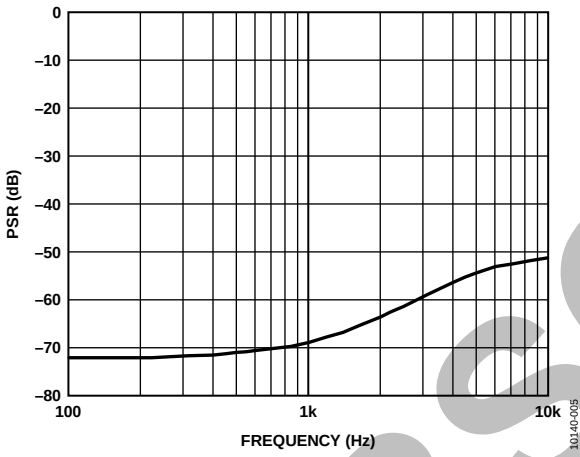

Figure 6. Typical Power Supply Rejection vs. Frequency

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

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

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.

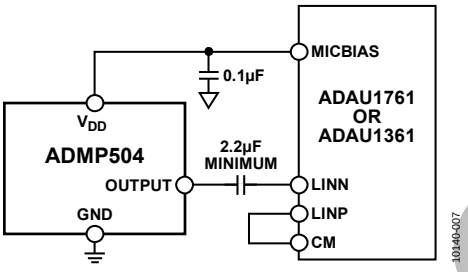

Figure 8. ADMP504 Connected to the Analog Devices ADAU1761 or ADAU1361 Codec

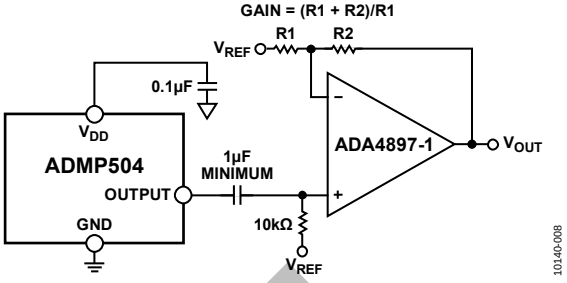

Figure 9. ADMP504 Connected to the ADA4897-1 Op Amp

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.

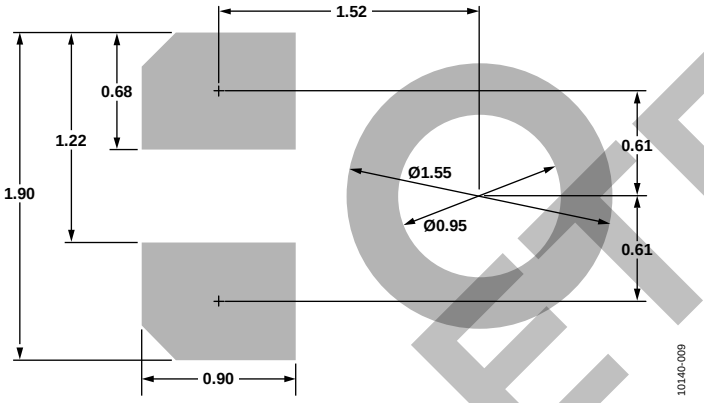

Figure 10. PCB Land Pattern Layout

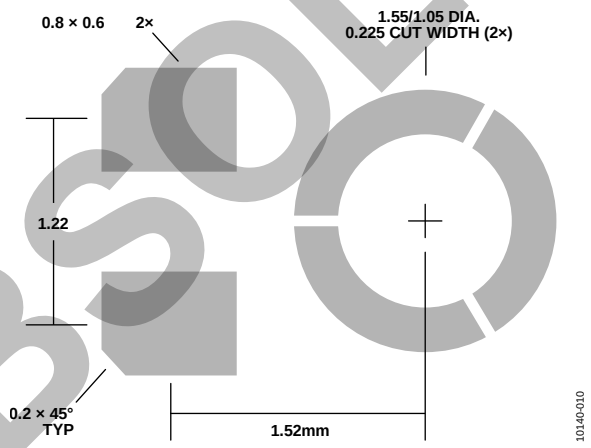

Figure 11. Suggested Solder Paste Stencil Pattern Layout

RELIABILITY SPECIFICATIONS

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

Table 5.

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

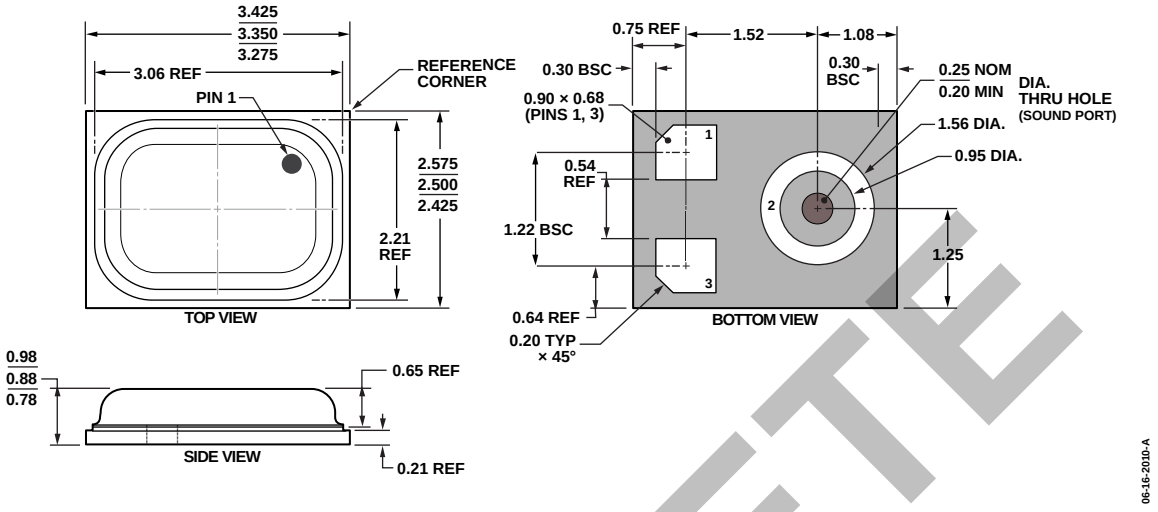

Figure 12. 3-Terminal Chip Array Small Outline No Lead Cavity [LGA_CAV]
3.35 mm × 2.50 mm Body
(CE-3-2)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option[2]	Ordering Quantity
ADMP504ACEZ-RL	−40°C to +85°C	3-Terminal LGA_CAV, 13" Tape and Reel	CE-3-2	10,000
ADMP504ACEZ-RL7	−40°C to +85°C	3-Terminal LGA_CAV, 7" Tape and Reel	CE-3-2	1,000
EVAL-ADMP504Z-FLEX		Flex Evaluation Board		

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

NOTES

D10140-0-6/12(A)

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Analog Devices Inc.:

EVAL-ADMP504Z-FLEX ADMP504ACEZ-RL7 ADMP504ACEZ-RL