# Analog MEMS Microphone with Single Ended Output

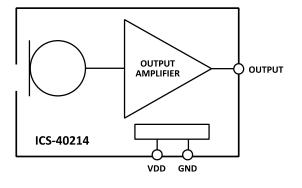
### **GENERAL DESCRIPTION**

The ICS-40214 is an analog MEMS microphone with very high dynamic range and single ended output. The ICS-40214 includes a MEMS microphone element, an impedance converter, and an output amplifier.

Other high-performance specifications include 128 dB SPL acoustic overload point and tight ±1 dB sensitivity tolerance.

The ICS-40214 is available in a small 3.50 mm  $\times$  2.65 mm  $\times$  0.98 mm bottom port surface-mount package.

#### FUNCTIONAL BLOCK DIAGRAM



### APPLICATIONS

- Smartphones
- Wearable devices
- Still and video cameras
- IoT devices

#### **FEATURES**

- Analog output
- –38 dBV sensitivity
- ±1 dB sensitivity tolerance
- Extended frequency response from 35 Hz to 20 kHz
- -88 dB PSRR
- 3.50 × 2.65 × 0.98 mm surface-mount package
- Compatible with Sn/Pb and Pb-free solder processes
- RoHS/WEEE compliant

### **ORDERING INFORMATION**

PART	TEMP RANGE	PACKAGING	
ICS-40214	–40°C to +85°C	13" Tape and Reel	
EV_ICS-40214-FX	—		

## ICS-40214

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# 2 SPECIFICATIONS

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### 2.1 TABLE 1. ELECTRICAL CHARACTERISTICS

 $T_A = 25^{\circ}$ C,  $V_{DD} = 1.65$  to 3.63 V, unless otherwise noted. Typical specifications are not guaranteed.

PARAMETER	PARAMETER CONDITIONS		ТҮР	MAX	UNITS	NOTES
	PERFORMANCE					
Directionality		Omni	Omni			
Output Polarity		Inverted	l			
Sensitivity	1 kHz, 94 dB SPL	-39	-38	-37	dBV	
Signal-to-Noise Ratio (SNR)	20 kHz bandwidth, A-weighted		66		dBA	
Equivalent Input Noise (EIN)	20 kHz bandwidth, A-weighted		28		dBA	
Dynamic Range	Derived from EIN and acoustic overload point		100		dB	
Total Harmonic Distortion (THD)	105 dB SPL		0.2	1	%	
Power Supply Rejection Ratio (PSRR)	1 kHz, 100 mV p-p sine wave superimposed on $V_{DD}$ = 2.75V		-88		dB	
Power Supply Rejection (PSR)	217 Hz, 100 mVp-p square wave superimposed on $V_{DD} = 2.75V$		-80		dBV	
Acoustic Overload Point	pint 10% THD		128		dB SPL	
	POWER SUPPLY					
Supply Voltage (V <sub>DD</sub> )	tage (V <sub>DD</sub> )			3.63	V	
Supply Current (Is)	V <sub>DD</sub> = 2.75V		165	190	μΑ	
	OUTPUT CHARACTERISTICS					
Output Impedance			190		Ω	
Output Common Mode Voltage			1.0		V	
Startup Time	Output to within ±0.5 dB of stable sensitivity		15	20	ms	
Maximum Output Voltage	128 dB SPL input		0.631		V rms	
Noise Floor	20 Hz to 20 kHz, A-weighted, rms		-104		dBV	

### 

### 3 ABSOLUTE MAXIMUM RATINGS

Stress above those listed as Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these conditions is not implied. Exposure to the absolute maximum ratings conditions for extended periods may affect device reliability.

### 3.1 TABLE 2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	
Supply Voltage (V <sub>DD</sub> )	-0.3V to +3.63V	
Sound Pressure Level	160 dB	
Mechanical Shock	10,000 <i>g</i>	
Vibration	Per MIL-STD-883 Method 2007, Test Condition B	
Temperature Range		
Biased	-40°C to +85°C	
Storage	−55°C to +150°C	

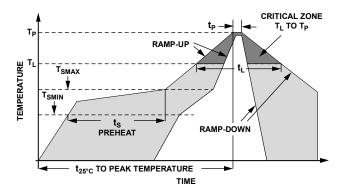
### 3.2 ESD CAUTION



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.

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### 3.3 SOLDERING PROFILE





### 3.4 TABLE 3. RECOMMENDED SOLDERING PROFILE

PROFILE FEATURE		SN63/PB37	PB-FREE	
Average Ramp Rate ( $T_L$ to $T_P$ )		1.25°C/sec max	1.25°C/sec max	
Minimum Temperature (T <sub>SMIN</sub> )		100°C	100°C	
Preheat	Maximum Temperature (T <sub>SMAX</sub> )	150°C	200°C	
	Time (T <sub>SMIN</sub> to T <sub>SMAX</sub> ), t <sub>s</sub> 60 sec to 75 sec		60 sec to 75 sec	
Ramp-Up Rate (T <sub>SMAX</sub> to T <sub>L</sub> )		1.25°C/sec	1.25°C/sec	
Time Maintaine	ed Above Liquidous (t <sub>L</sub> )	45 sec to 75 sec	~50 sec	
Liquidous Temperature (TL)		183°C	217°C	
Peak Temperature (T <sub>P</sub> )		215°C +3°C/-3°C	260°C +0°C/-5°C	
Time Within $+5^{\circ}$ C of Actual Peak Temperature (t <sub>P</sub> )		20 sec to 30 sec	20 sec to 30 sec	
Ramp-Down Rate		3°C/sec max	3°C/sec max	
Time +25°C ( $t_{25°C}$ ) to Peak Temperature		5 min max	5 min max	

Note: The reflow profile in Table 3 is recommended for board manufacturing with InvenSense MEMS microphones. All microphones are also compatible with the J-STD-020 profile.

### 4 PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

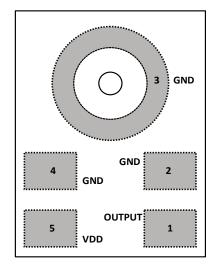


Figure 2. Pin Configuration (Top View, Terminal Side Down)

### 4.1 TABLE 4. PIN FUNCTION DESCRIPTIONS

**FDK** InvenSense

PIN	NAME	FUNCTION
1	OUTPUT	Analog Output Signal
2	GND	Ground
3	GND	Ground
4	GND	Ground
5	VDD	Power Supply

# **S** TYPICAL PERFORMANCE CHARACTERISTICS

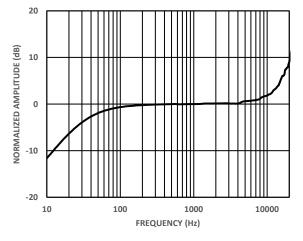


Figure 3. Typical Frequency Response (Measured)

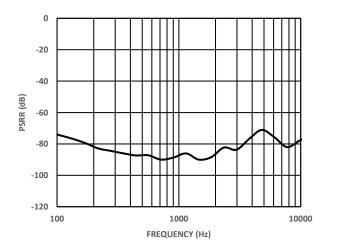


Figure 5. Power-Supply Rejection Ratio (PSRR) vs. Frequency

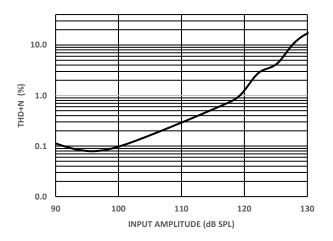


Figure 4. THD + N vs. Input Amplitude

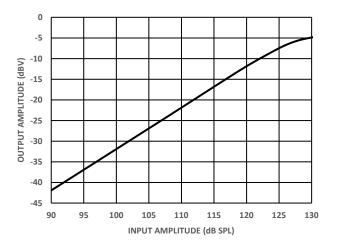


Figure 6. Linearity

### DK InvenSense **APPLICATIONS INFORMATION** 6

#### **CODEC CONNECTION** 6.1

The ICS-40214 output can be connected to a dedicated codec microphone input (see Figure 7) or to a high input impedance gain stage. A 0.1 µF ceramic capacitor placed close to the ICS-40214 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 µF is recommended in Figure 7 for codecs, which may have a very low input impedance at some PGA gain settings.

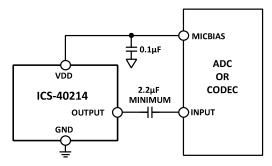


Figure 7. ICS-40214 Connected to a Codec

# **SUPPORTING DOCUMENTS**

ICS-40214

For additional information, see the following documents.

#### 7.1 EVALUATION BOARD USER GUIDE

AN-000013, Analog Output MEMS Microphone Flex Evaluation Board

#### 7.2 APPLICATION NOTES

AN-100, MEMS Microphone Handling and Assembly Guide

AN-1003, Recommendations for Mounting and Connecting the InvenSense Bottom-Ported MEMS Microphones

AN-1112, Microphone Specifications Explained

AN-1124, Recommendations for Sealing InvenSense Bottom-Port MEMS Microphones from Dust and Liquid Ingress

AN-1140, Microphone Array Beamforming

AN-1165, Op Amps for Microphone Preamp Circuits

AN-1181, Using a MEMS Microphone in a 2-Wire Microphone Circuit

AN-000056, MEMS Microphones for Active Noise Cancellation Applications

## ICS-40214

# 8 PCB DESIGN AND LAND PATTERN LAYOUT

Lay out the PCB land pattern for the ICS-40214 at a 1:1 ratio to the solder pads on the microphone package (see Figure 8.) Avoid applying solder paste to the sound hole in the PCB. Figure 9 shows a suggested solder paste stencil pattern layout.

The response of the ICS-40214 is not affected by the PCB hole size, as long as the hole is not smaller than the sound port of the microphone (0.325 mm in diameter). A 0.5 mm to 1 mm diameter for the hole is recommended.

Align the hole in the microphone package with the hole in the PCB. The exact degree of the alignment does not affect the performance of the microphone as long as the holes are not partially or completely blocked.

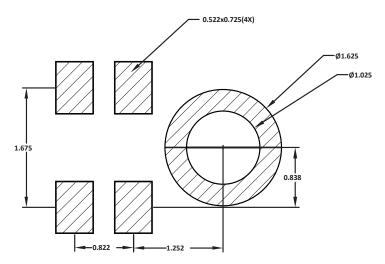


Figure 8. Recommended PCB Land Pattern Layout

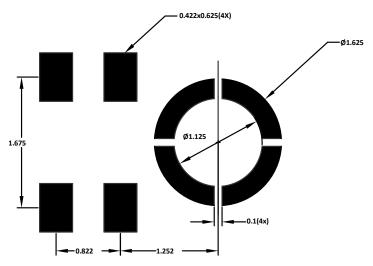


Figure 9. Recommended Solder Paste Stencil Pattern Layout

### 8.1 PCB MATERIAL AND THICKNESS

The performance of the ICS-40214 is not affected by PCB thickness. The ICS-40214 can be mounted on either a rigid or 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.

# 9 HANDLING INSTRUCTIONS

## 9.1 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.
- 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.

### 9.2 **REFLOW SOLDER**

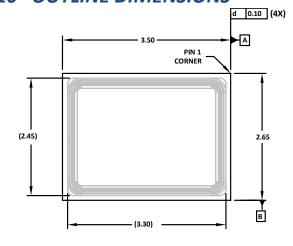
For best results, the soldering profile must be in accordance with the recommendations of the manufacturer of the solder paste used to attach the MEMS microphone to the PCB. It is recommended that the solder reflow profile not exceed the limit conditions specified in Figure 1 and Table 3.

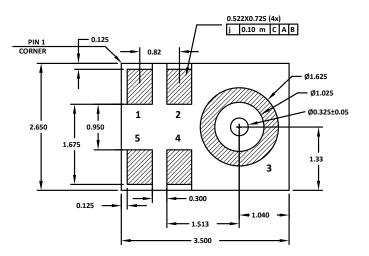
### 9.3 BOARD WASH

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



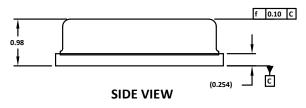
## ICS-40214





**BOTTOM VIEW** 

TOP VIEW



#### Figure 10. 5-Terminal Chip Array Small Outline No Lead Cavity 3.50 mm × 2.65 mm × 0.98 mm Body Dimensions shown in millimeters

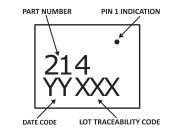


Figure 11. Package Marking Specification (Top View, not to scale)

### **10.1 ORDERING GUIDE**

PART	TEMP RANGE PACKAGE		QUANTITY	PACKAGING
ICS-40214	-40°C to +85°C	5-Terminal LGA_CAV	10,000	13" Tape and Reel
EV_ICS-40214-FX	—	Flexible Evaluation Board	—	





### **10.2 REVISION HISTORY**

REVISION DATE	REVISION	DESCRIPTION
07/02/2018	1.0	Initial Version
07/03/2019	1.1	TABLE 3 and Formatting



### **11 COMPLIANCE DECLARATION DISCLAIMER**

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