Low-Power Omnidirectional MEMS Microphones for Hearing Aids

GENERAL DESCRIPTION

The INMP801 is a high-performance MEMS microphone with a unique combination of very low self-noise, tiny package volume (7.3 mm^3), and low power consumption. Running from a 1 V supply, the INMP801 consumes only 17 µA of current while providing an equivalent input noise of 27 dBA SPL with an analog 4.5 kΩ impedance output. These features, combined with the benefits of MEMS technology, reflow solder compatibility, and a highly stable response over time and temperature, make the INMP801 an ideal microphone choice for assistive listening devices (ALDs) such as hearing aids.

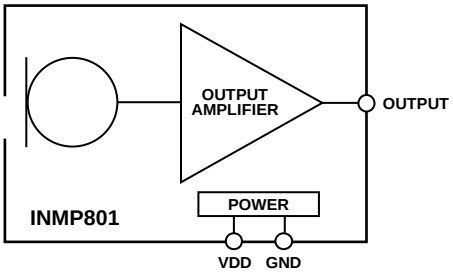
APPLICATIONS

- Hearing Aids
- Hearing Aid Accessories
- Assistive Listening/Alerting and Signaling Systems
- Audiometers
- Bone Conduction Devices
- Hearing Protection

FEATURES

- Small Surface-Mount Package: 3.35 × 2.5 × 0.98 mm
- Equivalent Input Noise: 27 dBA SPL
- Sensitivity: −35 dBV
- Hearing Aid-Compatible Voltage Range: 0.9 to 1.3 V
- Low Current Consumption: 17 µA
- 0.8 Sec Startup to within 0.2 dB of 1 kHz Sensitivity
- Flat Frequency Response
- Good Sensitivity and Frequency Response Matching
- Single-Ended Analog Output
- Compatible with Sn/Pb and Pb-Free Solder Processes
- RoHS/WEEE Compliant

FUNCTIONAL BLOCK DIAGRAM



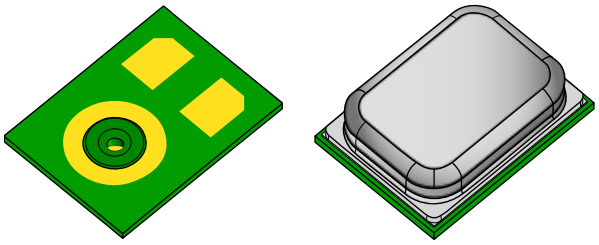
ORDERING INFORMATION

PART	TEMP RANGE
INMP801JCEZ-R0*	−5°C to +65°C
INMP801JCEZ-R7†	−5°C to +65°C
EV_INMP801-FX	—

* – 13” Tape and Reel

† – 7” Tape and reel to be discontinued.

Contact sales@invensense.com for availability.



BOTTOM **TOP**

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TABLE OF CONTENTS

Document Number: DS-INMP801-00
Revision: 1.0.

SPECIFICATIONS

TABLE 1. ELECTRICAL CHARACTERISTICS

(T_A = −5 to 65°C, V_{DD} = 1.0V, 200 kΩ load unless otherwise noted. All minimum and maximum specifications are guaranteed across temperature and voltage, and are specified in Table 1, unless otherwise noted. Typical specifications are not guaranteed.)

PARAMETER	CONDITIONS	MIN	TYP[1]	MAX	UNITS	NOTES
PERFORMANCE						
Directionality			Omni			
Sensitivity	1 kHz, 94 dB SPL	−38	−35	−32	dBV	
Equivalent Input Noise (EIN)	8 kHz bandwidth, A-weighted		27	29	dBA SPL	2
	20 kHz bandwidth, A-weighted		29		dBA SPL	2
Frequency Response	Low frequency −3 dB point		80		Hz	
Resonant Peak			10.2		kHz	
Total Harmonic Distortion (THD)	105 dB SPL		1.3	2.5	%	
Power Supply Rejection Ratio (PSRR)	1 kHz, 100 mV p-p sine wave superimposed on V_{DD}	−40	−53		dB	2
Input-Referred Vibration Sensitivity	1 kHz acceleration, axial direction		62		dB SPL/*g*	
Acoustic Overload Point	10% THD	108	110		dB SPL	2
Start-Up Time	To within ±0.2 dB of final sensitivity		0.8		sec	
POWER SUPPLY						
Supply Voltage (V_{DD})		0.9		1.3	V	
Supply Current (I_S)	Unloaded; no tone applied	10	17	23	µA	
	V_{DD} = 0.9 V		16		µA	
	V_{DD} = 1.3 V		19.5		µA	
OUTPUT CHARACTERISTICS						
Output Impedance (Z_{OUT})		2.9	4.5	10.5	kΩ	2
Output DC Bias Voltage		500	570	650	mV	2
Output Current Limit			25		µA	
Maximum Output Voltage	110 dB SPL input, peak		159		mV	
Noise Floor	20 Hz to 20 kHz, A-weighted, RMS		−100		dBV	

Note 1: Typical specifications at 25°C
Note 2: Guaranteed by design and/or characterization

Document Number: DS-INMP801-00
Revision: 1.0.

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.

TABLE 2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING
Supply Voltage (VDD)	−0.3 V to +1.45 V
Sound Pressure Level	160 dB
Mechanical Shock	10,000 *g*
Vibration	Per MIL-STD-883 Method 2007, Test Condition B
Operating Temperature Range	−5°C to +65°C
Storage Temperature Range	−55°C to +150°C

REFLOW SOLDERING

Reflow soldering must be performed in accordance with the JEDEC J-STD-020D Pb-free reflow profile for temperatures (260°C maximum), ramp rates, and dwell times. The INMP801 can withstand many different reflow profiles, but a review of the AN-1068 Application Note, *Reflow Soldering of the MEMS Microphone*, is recommended for suggestions on ways to prevent flux contamination from entering the microphone.

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.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

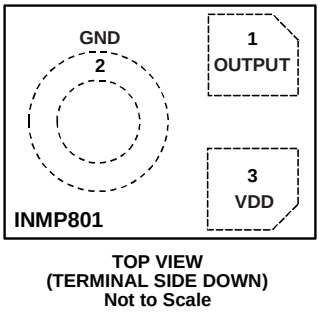

Figure 1. Pin Configuration

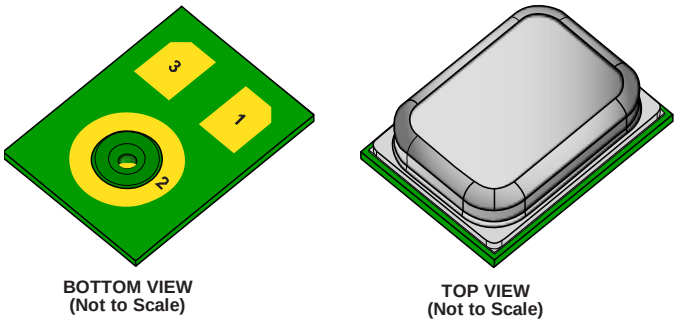

Figure 2. Pin Configuration Images (Bottom View and Top View)

TABLE 3. PIN FUNCTION DESCRIPTIONS

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

Document Number: DS-INMP801-00
Revision: 1.0.

TYPICAL PERFORMANCE CHARACTERISTICS

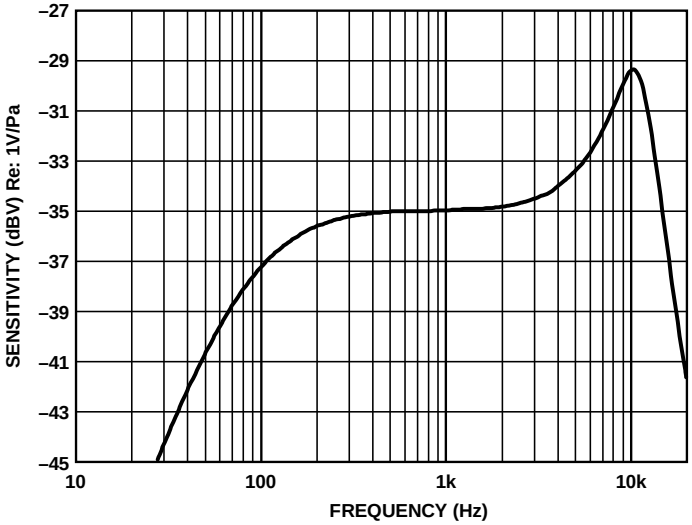

Figure 3. Typical Frequency Response

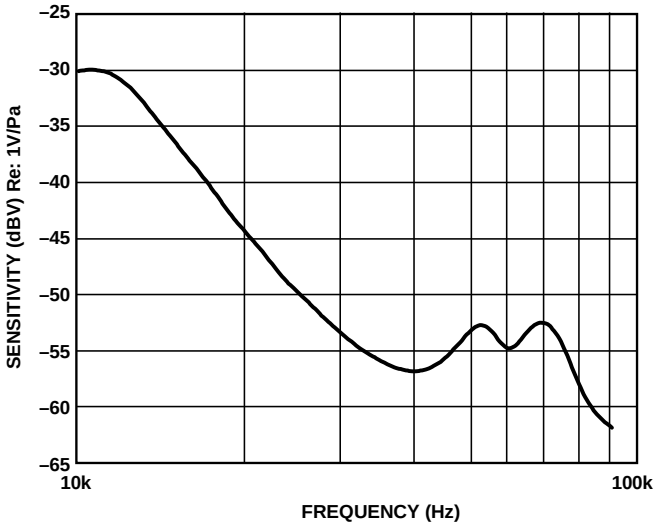

Figure 4. High Frequency Response

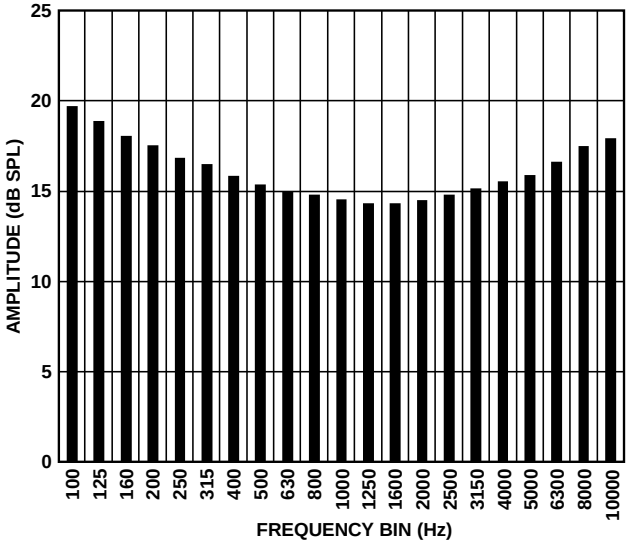

Figure 5. Typical Third-Octave Noise

Document Number: DS-INMP801-00
Revision: 1.0.

APPLICATIONS INFORMATION

OUTPUT IMPEDANCE CONSIDERATION

The INMP801 has an output impedance of 4.5 kΩ, which is significantly higher than the impedance of many other MEMS microphones. This higher output impedance enables the microphone to operate with a very low supply current, but also needs to be considered in the design of the signal chain following the microphone. The input impedance of the device to which the microphone's output is connected should be much higher than 4.5 kΩ to ensure no loss of signal amplitude through the signal chain.

SUPPORTING DOCUMENTS

For additional information, see the following documents.

EVALUATION BOARD USER GUIDE

UG-325 Analog Output MEMS Microphone Flex Evaluation Board

APPLICATION NOTES (GENERAL)

AN-1003 Recommendations for Mounting and Connecting the Invensense, Bottom-Ported MEMS Microphones
AN-1068 Reflow Soldering of the MEMS Microphone
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 MEMS Microphone Preamp Circuits

Document Number: DS-ADMP801-00
Revision: 1.0.

PCB DESIGN AND LAND PATTERN LAYOUT

The recommended PCB land pattern for the INMP801 should be laid out to a 1:1 ratio to the solder pads on the microphone package, as shown in Figure 6. 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 7. 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.

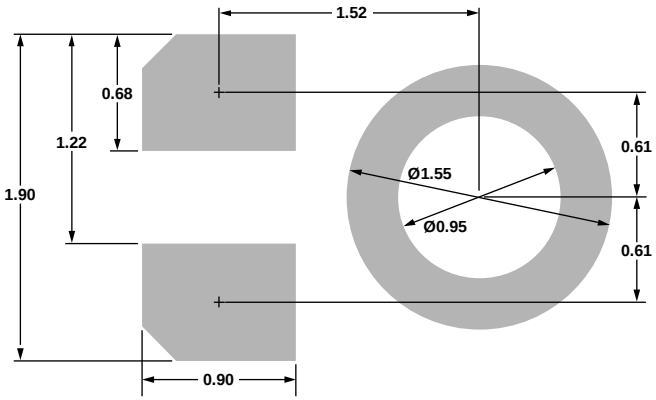

Figure 6. PCB Land Pattern Layout

Dimensions shown in millimeters

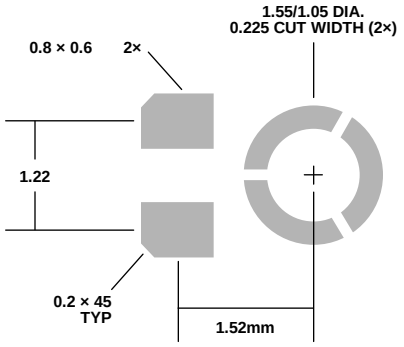

Figure 7. Suggested Solder Paste Stencil Pattern Layout
Dimensions shown in millimeters

Document Number: DS-ADMP801-00
Revision: 1.0.

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.
- 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, ensure that the soldering profile is in accordance with the recommendations of the manufacturer of the solder paste used to attach the MEMS microphone to the PCB. Perform all reflow soldering in accordance with the JEDEC J-STD-020 Pb-free reflow profile for temperatures (260°C maximum), ramp rates, and dwell times. The INMP801 can withstand many different reflow profiles; however, for suggestions on how to prevent flux contamination from entering the microphone, see the AN-1068 Application Note, *Reflow Soldering of the MEMS Microphone*.

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.

OUTLINE DIMENSIONS

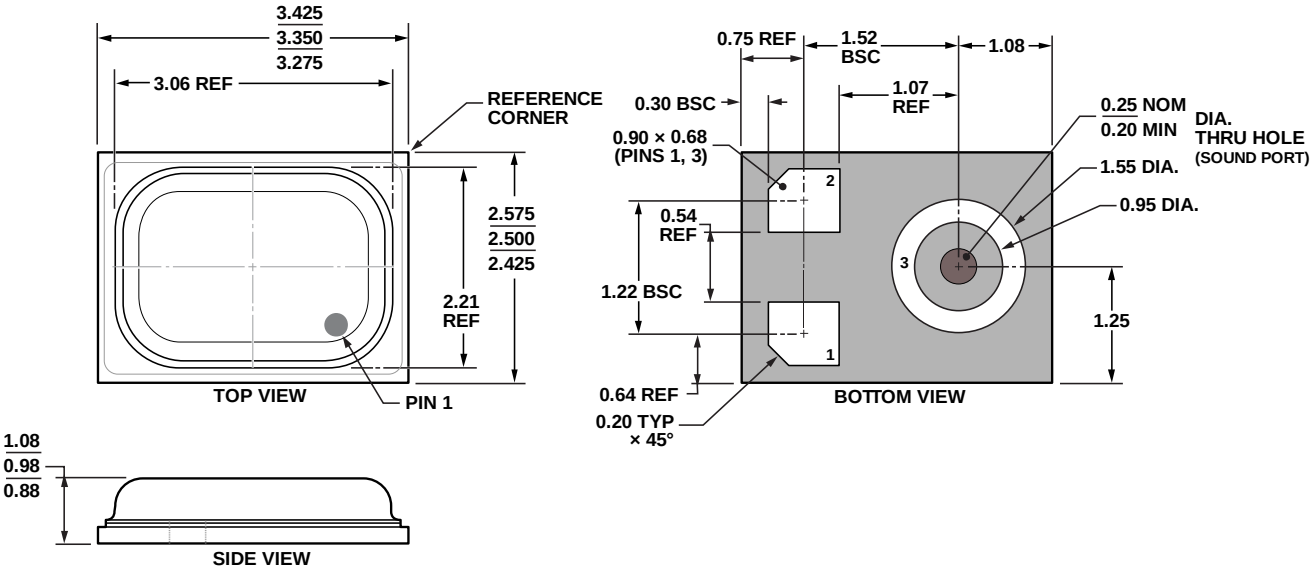

Figure 8. 3-Terminal Chip Array Small Outline No-Lead Cavity [LGA_CAV]
3.35 × 2.50 × 0.98 mm Body
Dimensions shown in millimeters

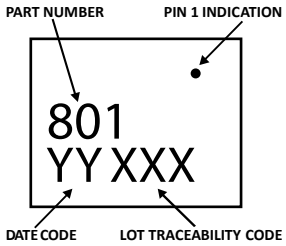

Figure 9. Package Marking Specification (Top View)

Document Number: DS-INMP801-00
Revision: 1.0.

ORDERING GUIDE

PART[1]	TEMP RANGE	PACKAGE	QUANTITY
INMP801JCEZ-R0	−5°C to +65°C	3-Terminal LGA_CAV*	10,000
INMP801JCEZ-R7	−5°C to +65°C	3-Terminal LGA_CAV†	1,000
EV_INMP621-FX	—	Flexible Evaluation Board	—

* – 13” Tape and Reel
† – 7” Tape and reel to be discontinued. Contact sales@invensense.com for availability.
[1]Z = RoHS Compliant Part

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
02/06/2014	1.0	Initial Release

COMPLIANCE DECLARATION DISCLAIMER:

InvenSense believes this compliance information to be correct but cannot guarantee accuracy or completeness. Conformity documents for the above component constitutes are on file. InvenSense subcontracts manufacturing and the information contained herein is based on data received from vendors and suppliers, which has not been validated by InvenSense.

Environmental Declaration Disclaimer:

InvenSense believes this environmental information to be correct but cannot guarantee accuracy or completeness. Conformity documents for the above component constitutes are on file. InvenSense subcontracts manufacturing and the information contained herein is based on data received from vendors and suppliers, which has not been validated by InvenSense.

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