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CS7331P

Miniature Bottom Port Analog MEMS Microphone

Features

- High acoustic overload point (AOP, 124-dB SPL)
- High signal-to-noise ratio (63-dB SNR)
- Low variation in sensitivity (±1 dB)
- Low current consumption (55 μA)
- Analog output
- Bottom-port LGA package
- 1.6- to 3.6-V supply

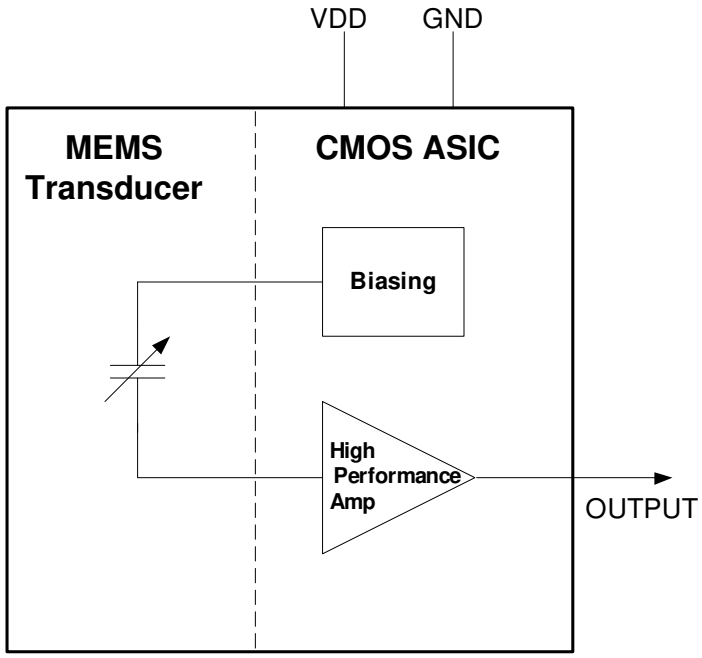
Description

The CS7331P is a low-profile analog MEMS microphone. It offers miniature dimensions and low-current consumption, making it ideal for always-on, always-listening use in space-constrained applications.

The CS7331P incorporates Cirrus Logic® proprietary CMOS/MEMS membrane technology, offering high reliability and high performance. The CS7331P is designed to withstand the high temperatures associated with automated flow solder assembly processes.

The CS7331P is ideally suited to the Cirrus Logic SoundClear™ suite of audio processing algorithms, including speech recognition, voice trigger, and noise cancelation.

The CS7331P is available in a 2.5 × 1.6 × 0.9-mm, bottom-port LGA package, with a 0.25-mm port diameter. It is ideal for portable applications such as noise-canceling earbuds, smartphones, wearables, and cameras.



Preliminary Product Information

This document contains information for a new product.
Cirrus Logic reserves the right to modify this product without notice.

Table of Contents

1 Pin Descriptions

1.1 LGA Pinout

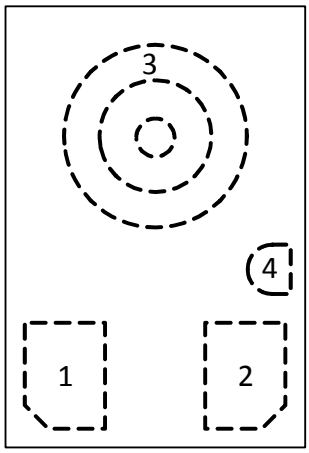


Figure 1-1. Top-Down (Through-Package) View

1.2 Pin Descriptions

A description of each pin on the CS7331P is provided in Table 1-1.

Table 1-1. Pin Descriptions

Name	Pin #	I/O	Description
VDD	1	—	Power supply
OUTPUT	2	O	Microphone analog output signal
GND	3	—	Ground
GND	4	—	Can be left floating (recommended), or connected to GND

2 Typical Connection Diagram

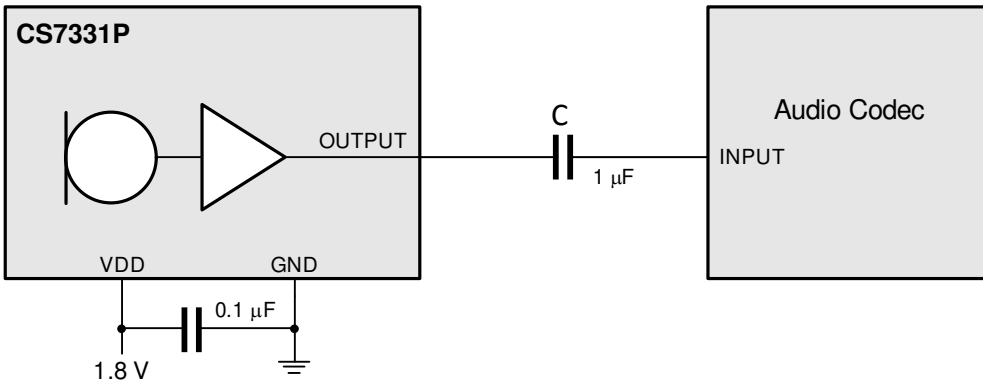


Figure 2-1. Typical Connection Diagram

The recommended connection of a CS7331P silicon microphone is shown in Fig. 2-1.

A DC-blocking capacitor is required on the OUTPUT pin. The capacitor must be correctly selected as it affects the cut-off frequency of the output path. A low cut-off frequency is desirable to ensure there is no significant filtering of the audio bandwidth.

The 3-dB cut-off frequency of the output path can be calculated using Eq. 2-1, where *C* is the output capacitance and *R* is the input resistance of the audio codec.

$$\text{3-dB filter cut-off frequency} = \frac{1}{2\pi RC}$$

Equation 2-1. Low-Pass Filter Calculation

A typical recommended configuration uses a 1-µF DC-blocking capacitor and a 20-kΩ codec input impedance, which results in a 3-dB cut-off frequency of 10 Hz or less. Tantalum electrolytic capacitors are particularly suitable for the DC-blocking components as they offer high stability in a small package size.

It is also recommended to place a 0.1-µF decoupling capacitor close to the VDD pin of the CS7331P.

3 Characteristics and Specifications

Table 3-1. Parameter Definitions

Parameter	Definition
Sensitivity	A measure of the microphone output response to the acoustic pressure of a 1-kHz, 94 dB SPL (1 Pa RMS) sine wave.
Total harmonic distortion (THD)	The ratio of the RMS sum of the harmonic distortion products in the specified bandwidth (see note) relative to the RMS amplitude of the fundamental (i.e., test frequency) output.
Signal-to-noise ratio (SNR)	A measure of the difference in level between the output response of a 1-kHz, 94 dB SPL sine wave and the idle noise output.
Dynamic Range (DR)	The ratio of the 10% THD microphone output level (in response to a sine wave input) and the idle noise output.

Note: Unless otherwise specified, all performance measurements are specified with a 20-kHz, low-pass brick-wall filter and, where noted, an A-weighted filter. The low-pass filter removes out-of-band noise.

Table 3-2. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Analog supply range	VDD	1.6	1.8	3.6	V
Ground	GND	—	0	—	V
Operating temperature range	T_A	–40	—	+85	ºC

Table 3-3. Absolute Maximum Ratings

Absolute maximum ratings are stress ratings only. Permanent damage to the device may be caused by continuously operating at or beyond these limits. Device functional operating limits and guaranteed performance specifications are given under electrical characteristics at the test conditions specified.

Parameter	Symbol	Min	Max	Units
Supply voltage [1]	VDD	–0.3	4.2	V
Operating temperature range	T_A	–40	+105	ºC
Storage temperature prior to soldering	T_{Stgp}	—	30	ºC
Storage relative humidity prior to soldering	RH_{Stgp}	—	60	%
Storage temperature after soldering	T_{Stg}	–40	+105	ºC

ESD-sensitive device. The CS7331P is manufactured on a CMOS process. It is therefore generically susceptible to damage from excessive static voltages. Proper ESD precautions must be taken during handling and storage of this device. This device is qualified to current JEDEC ESD standards

1. All voltages are measured with respect to GND.

Table 3-4. Acoustic and Electrical Characteristics

Test conditions (unless specified otherwise): GND = 0 V; voltages are with respect to ground; performance data taken with VDD = 1.8 V, R_L = 10 kΩ, C_L = 100 pF, T_A = +25ºC, 55 ±15% RH; 1 kHz test signal.

Parameter [1]		Min	Typ	Max	Units
Directivity		Omnidirectional			—
Polarity	Positive sound pressure	Positive output voltage			—
Sensitivity		–39	–38	–37	dBV
Acoustic overload	THD < 10%	—	124	—	dB SPL
THD	94 dB SPL	—	0.04	—	%
	114 dB SPL	—	0.3	—	%
	120 dB SPL	—	1	—	%
SNR	A-weighted	—	63	—	dB
DR	A-weighted	—	93	—	dB
Acoustic noise floor	A-weighted	—	31	—	dB SPL
Electrical noise floor	A-weighted	—	–101	—	dBV
PSRR (with respect to VDD)	217 Hz sine wave, 100 mV (peak-peak)	—	62	—	dB
PSR (with respect to VDD)	217 Hz square wave, 100 mV (peak-peak)	—	–88	—	dBV
Frequency response	–3 dB low frequency	—	85	—	Hz
	+3 dB high frequency	—	15	—	kHz
Frequency response flatness	200 Hz–7 kHz	–1	—	+1	dB
Part-to-part phase matching	80–100 Hz	—	—	±10	°
	200 Hz	—	—	±5	°
Current consumption		—	55	60	µA
Output DC impedance		—	200	400	Ω

1. All performance measurements are specified with a 20-kHz, low-pass brick-wall filter and, where noted, an A-weighted filter. The low-pass filter removes out-of-band noise.

4 Typical Performance

4.1 Audio Frequency Response

Test conditions: VDD = 1.8 V, GND = 0 V, no output load.

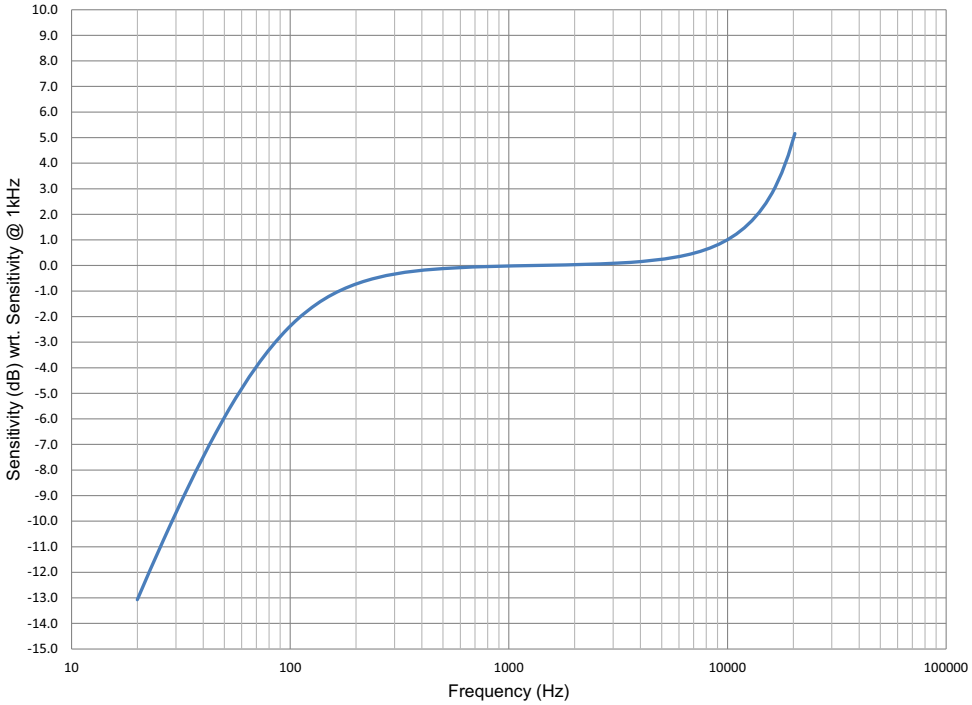


Figure 4-1. Sensitivity vs. Audio Frequency (20 Hz–20 kHz)

4.2 Ultrasonic Frequency Response

Test conditions: VDD = 1.8 V, GND = 0 V, no output load.

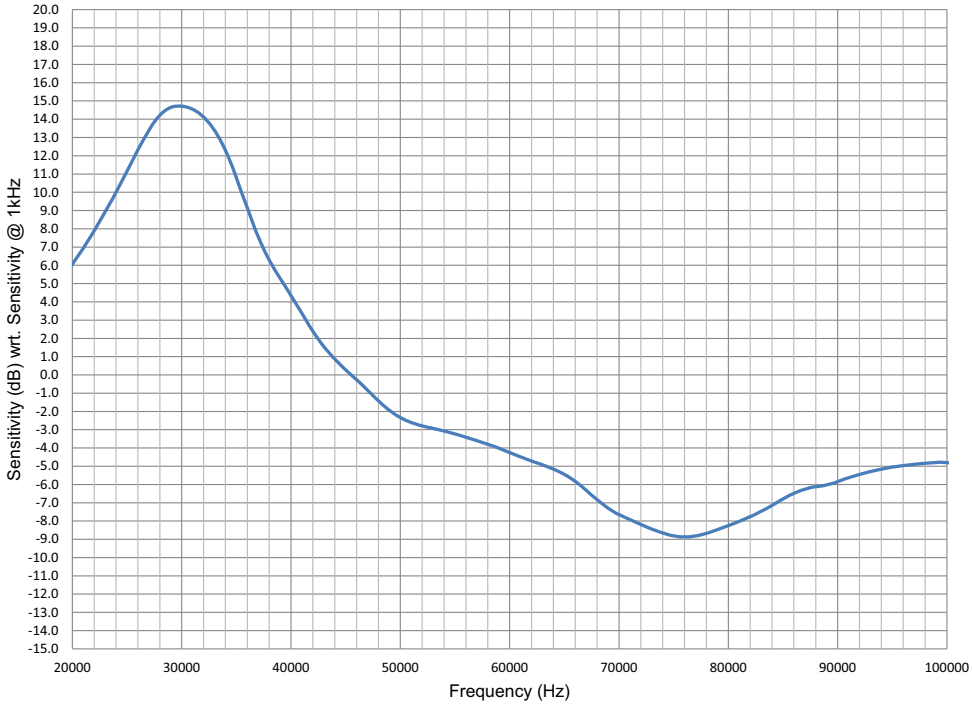


Figure 4-2. Sensitivity vs. Ultrasonic Frequency (20 kHz–100 kHz)

4.3 Phase Response

Test conditions: VDD = 1.8 V, GND = 0 V, no output load.

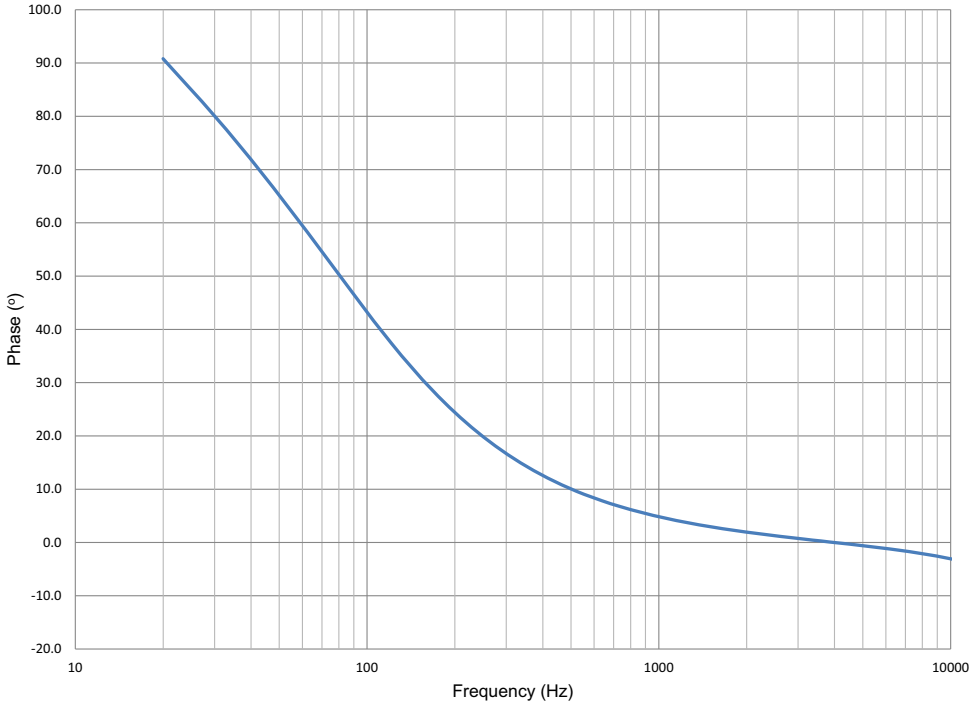


Figure 4-3. Phase Response vs. Frequency (20 Hz–10 kHz)

4.4 THD Performance

Test conditions: VDD = 1.8 V, GND = 0 V, no output load.

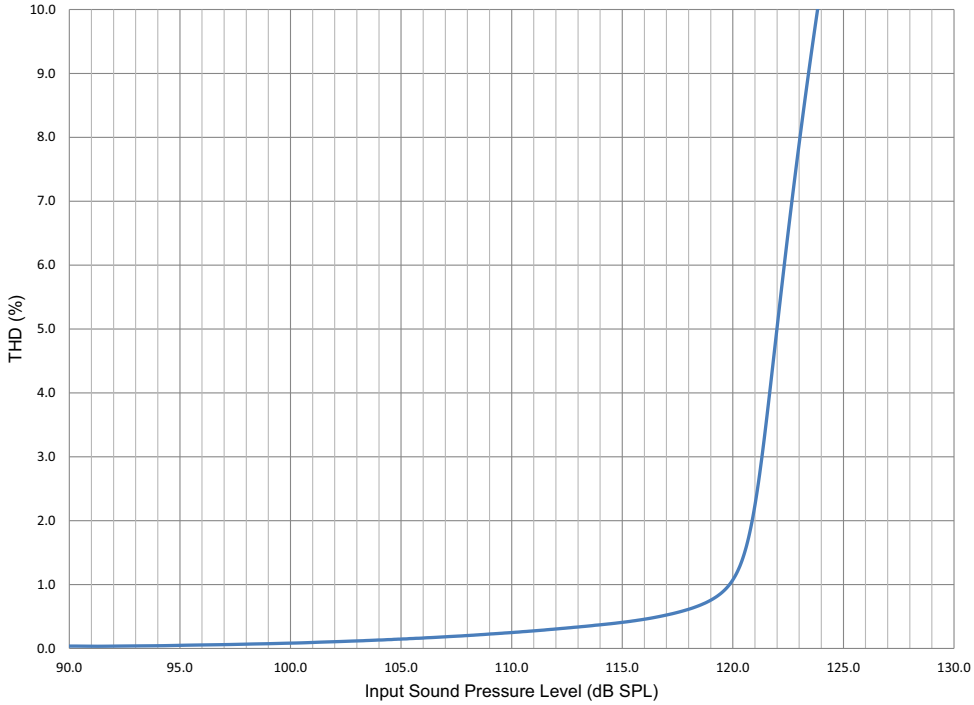


Figure 4-4. THD (%) vs. Input Sound Pressure Level (dB SPL)

4.5 PSRR Performance

Test conditions: VDD = 1.8 V, GND = 0 V, no output load.

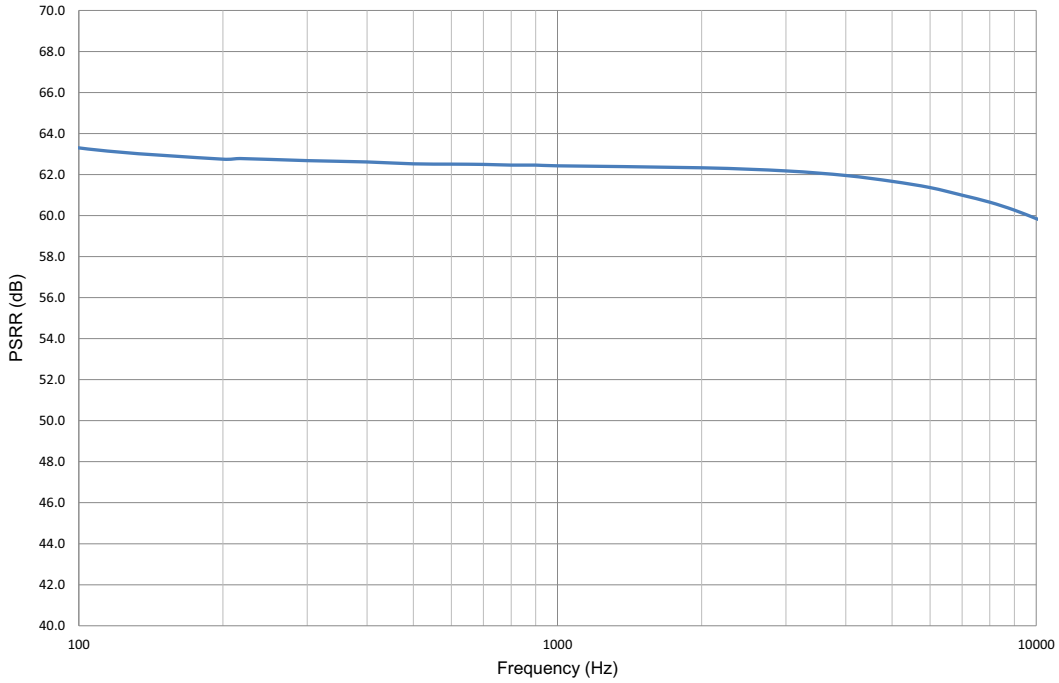


Figure 4-5. PSRR (dB) vs. Frequency (100 Hz–10 kHz)

5 Applications Information

Cirrus Logic provides a range of audio codecs incorporating an analog microphone input interface. These codecs support direct connections to silicon microphones such as the CS7331P.

Further information on Cirrus Logic audio codecs is provided in the respective product data sheet, which is available from the Cirrus Logic website.

5.1 Important Assembly Guidelines

- Do not put a vacuum over the port hole of the microphone. Placing a vacuum over the port hole can damage the device.
- Do not board wash the microphone after a reflow process. Board washing and the associated cleaning agents can damage the device.
- Do not expose to ultrasonic cleaning methods.
- Do not use a vapor phase reflow process. The vapor can damage the device.
- Please refer to application note WAN0273 *MEMS Mic Assembly and Handling Guidelines* for further assembly and handling guidelines.

5.2 PCB Land Pattern and Paste Stencil

The recommended PCB Land Pattern and Paste Stencil Pattern for the CS7331P microphone are shown in Fig. 5-1 and Fig. 5-2 respectively.

Note that no connection to Pin 4 should be made on the PCB. To avoid accidental connection to Pin 4, it is recommended to ensure there are no exposed tracks, vias, or copper areas beneath Pin 4.

See also application note WAN0284 *General Design Considerations for MEMS Microphones* for further details of PCB footprint design. Full definition of the package dimensions is provided in Section 6.

The recommended PCB Land Pattern is shown in Fig. 5-1.

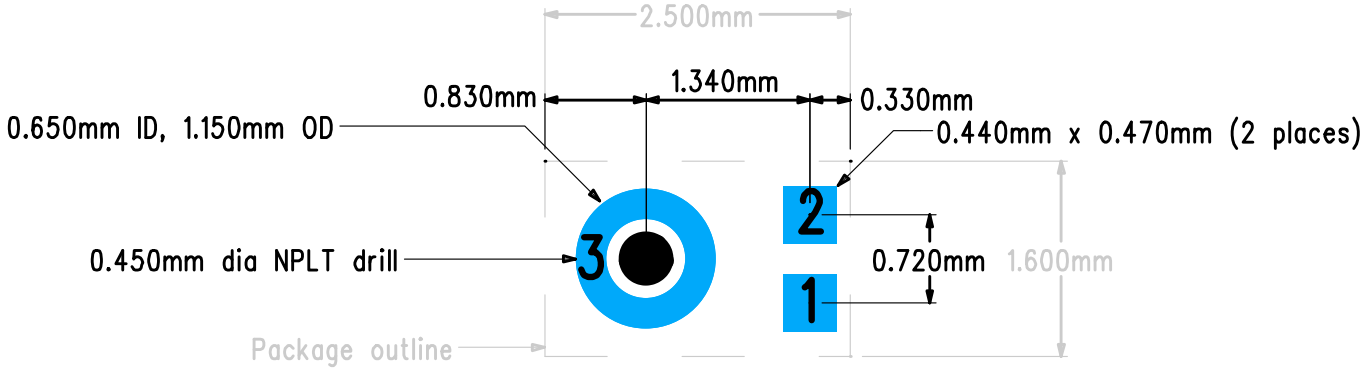


Figure 5-1. PCB Land Pattern, Top View

The recommended PCB Paste Stencil Pattern is shown in Fig. 5-2.

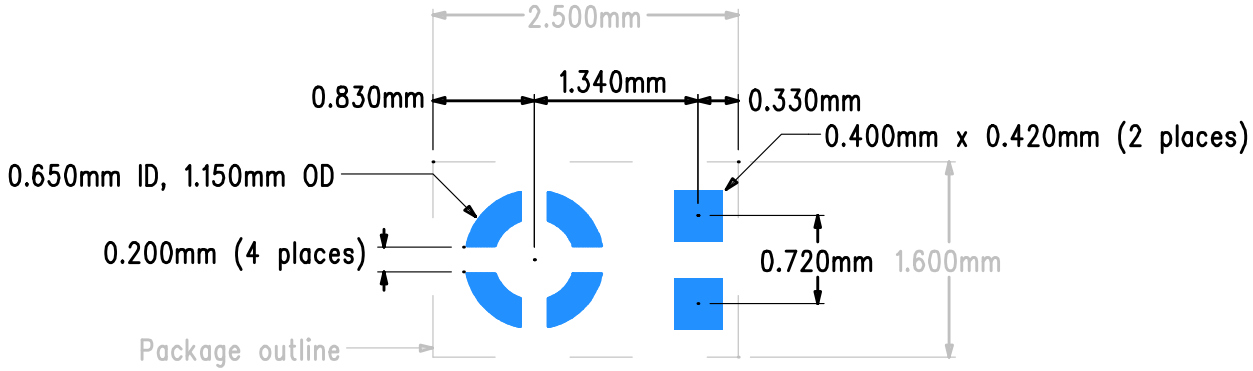
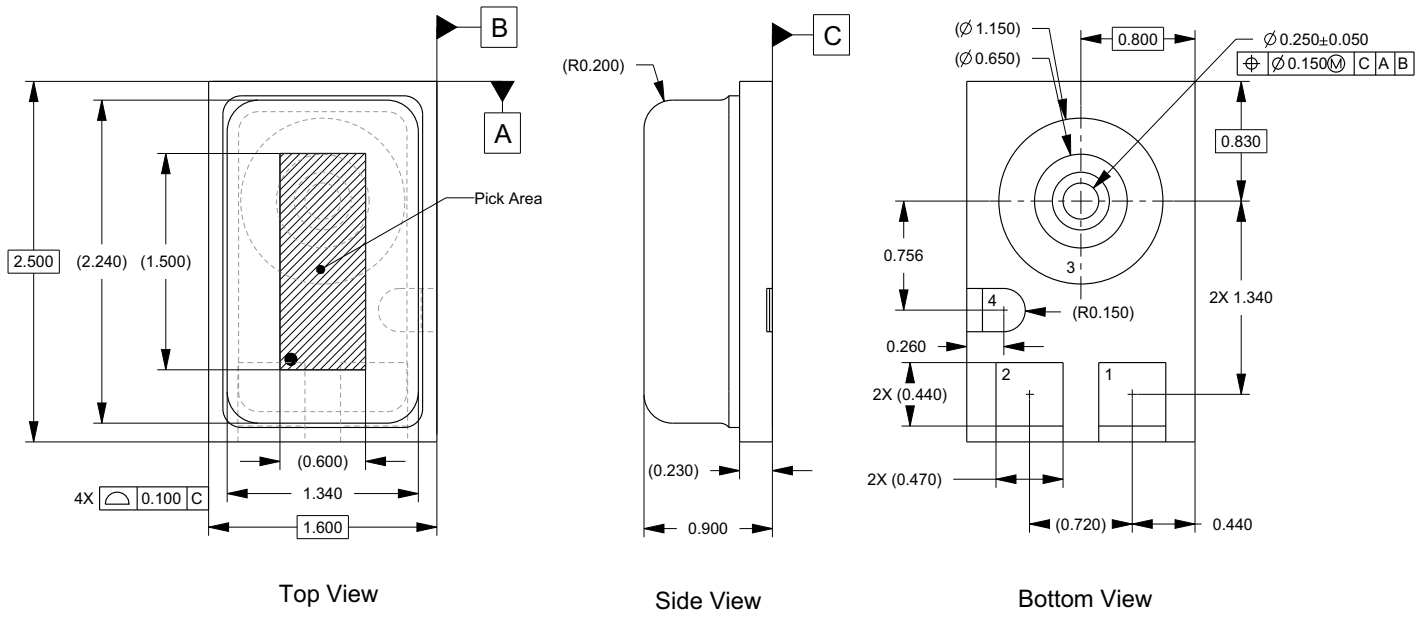


Figure 5-2. PCB Paste Stencil, Top View

6 Package Dimensions



Unless otherwise specified, dimensions/tolerances are in millimeters and tolerance is ±0.100

7 Ordering Information

Table 7-1. Ordering Information

Product	Description	Package	Halogen Free	Pb Free	Grade	Temperature Range	Container	Order #
CS7331P	Miniature Bottom Port Analog MEMS Microphone	LGA	Yes	Yes	Commercial	–40 to +85°C	Tape and Reel [1]	CS7331P-CAZR

1. Reel quantity = 6,000 units.

8 References

- WAN0273 *MEMS Mic Assembly and Handling Guidelines*
- WAN0284 *General Design Considerations for MEMS Microphones*

9 Revision History

Table 9-1. Revision History

Revision	Changes
PP1 FEB ‘17	• PSRR performance plot added (Fig. 4-5). • PCB land pattern and paste stencil drawings added (Section 5.2).

Contacting Cirrus Logic Support

For all product questions and inquiries, contact a Cirrus Logic Sales Representative.
To find the one nearest you, go to www.cirrus.com.