Technical documents
Kits and boards

Ultra-low power digital PDM XENSIV™ MEMS microphone

RoHS
Green
Halogen-free

Features

- Low current consumption in normal mode (580µA)
- Ultra-low current consumption in low power mode (190µA)
- Signal-to-noise ratio (SNR) of 67.5dB(A)
- Acoustic overload point at 128dBSPL
- Flat frequency response with low frequency roll-off at 20Hz
- Component level IP57 dust and water resistant
- Package dimensions: 3.5mm x 2.65mm x 0.98mm
- Enhanced RF shielding
- Digital PDM output
- Bottom port

Potential applications

- Active Noise Cancellation (ANC) headphones and earbuds
- Smartphones and mobile devices
- High quality audio capturing
  - Laptops and tablets
  - Conference systems
  - Cameras, camcorders, and camera accessories
- Devices with Voice User Interface (VUI)
  - Smart speakers
  - Home automation
  - IOT devices
- Industrial or home monitoring with audio pattern detection

Product validation

Technology qualified for industrial applications.

Ready for validation in industrial applications according to the relevant tests of IEC 60747 and 60749 or alternatively JEDEC47/20/22.

Description

Discover the IM68D128BV01 – an ultra-low power digital XENSIV™ MEMS microphone, designed for applications which require long battery life and environmental robustness in a small package.

With a Signal-to-noise ratio (SNR) of 67.5dB(A) and low corner frequency of 20Hz the microphone enables a clear audio experience without compromising on battery life.

Enabled by a revolutionary digital microphone ASIC, the IM68D128BV01 balances performance in a small package at a low current consumption of 580µA.

Type	Package	Marking	Ordering code
IM68D128BV01	PG-TLGA-5-9	I68D33	SP006086453

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1 Block diagram

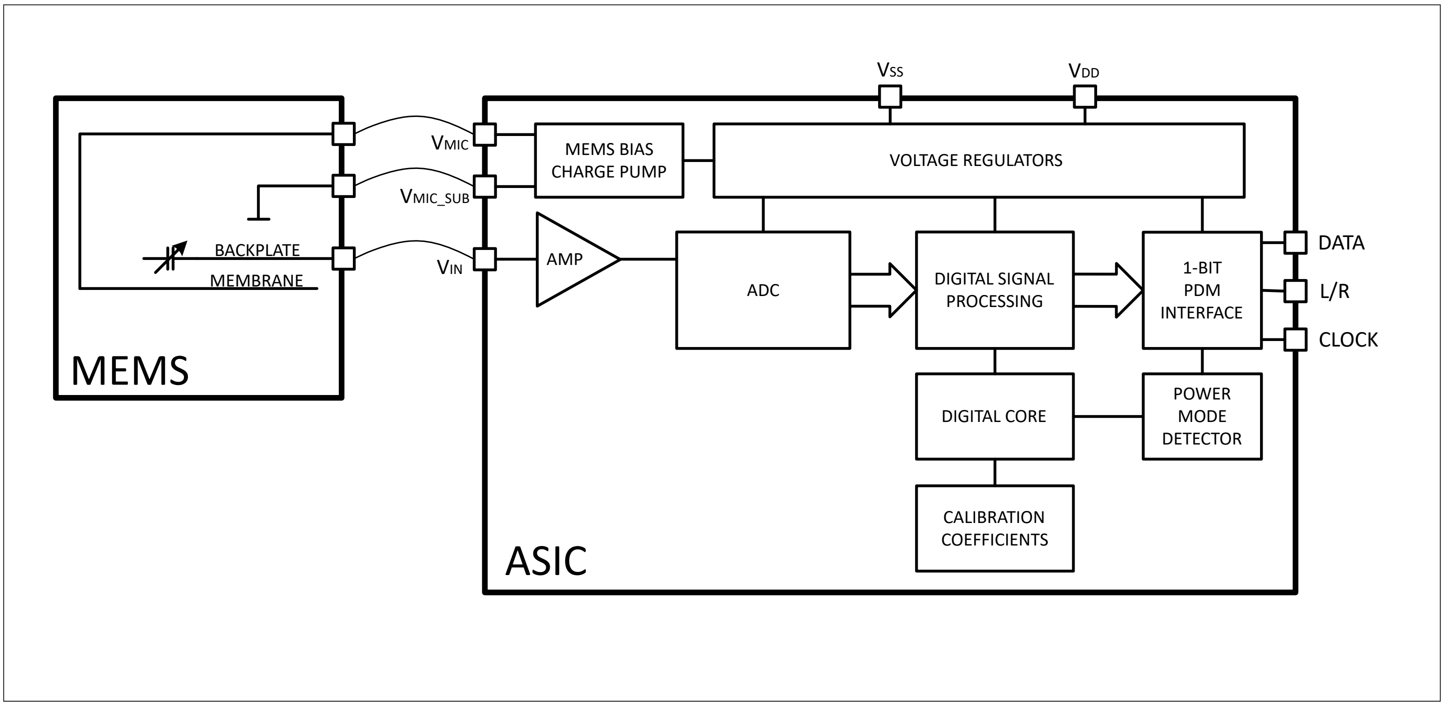

Figure 1 Block diagram

2 Typical performance characteristics

Test conditions: V_{DD}=1.8V, f_{CLK}=3.072MHz, T_A=25°C, unless otherwise specified.

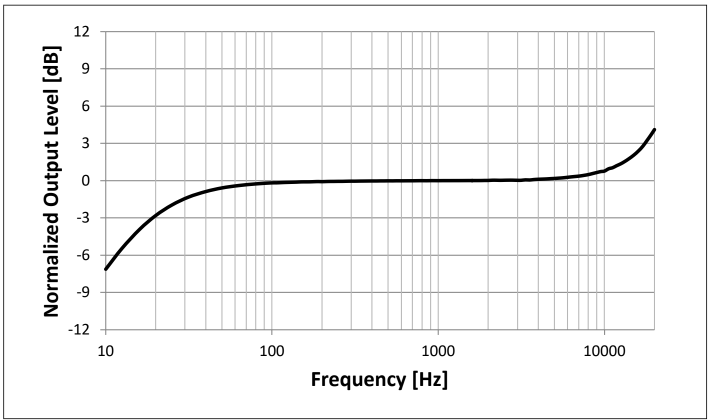

Figure 2 Typical amplitude response

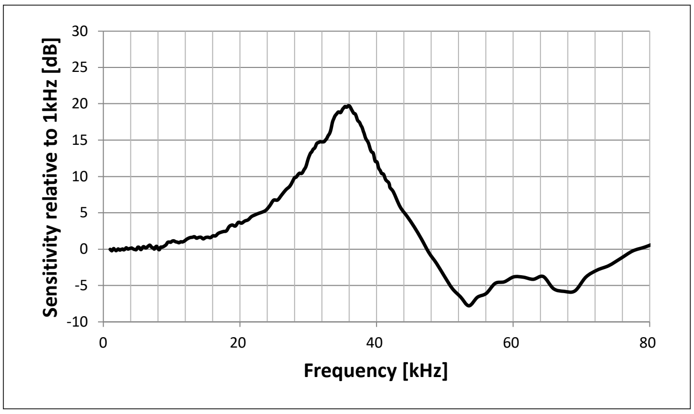

Figure 3 Typical ultrasonic response

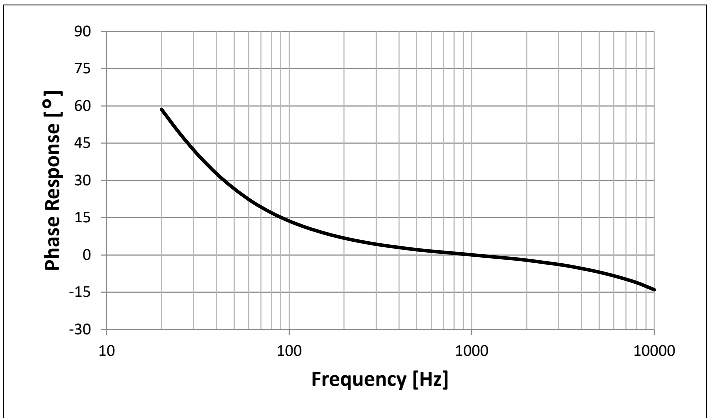

Figure 4 Typical phase response

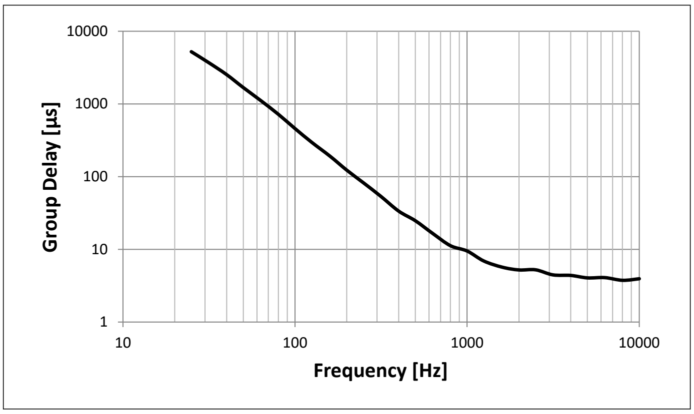

Figure 5 Typical group delay

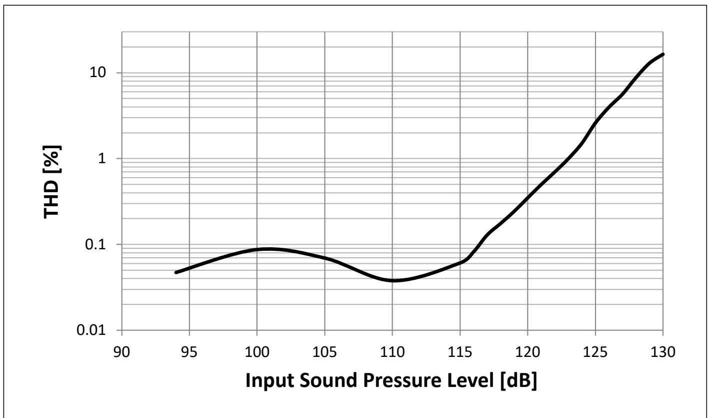

Figure 6 Typical THD vs SPL

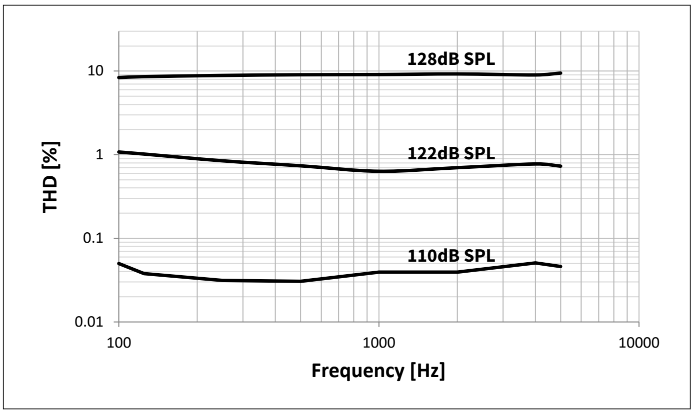

Figure 7 Typical THD vs frequency

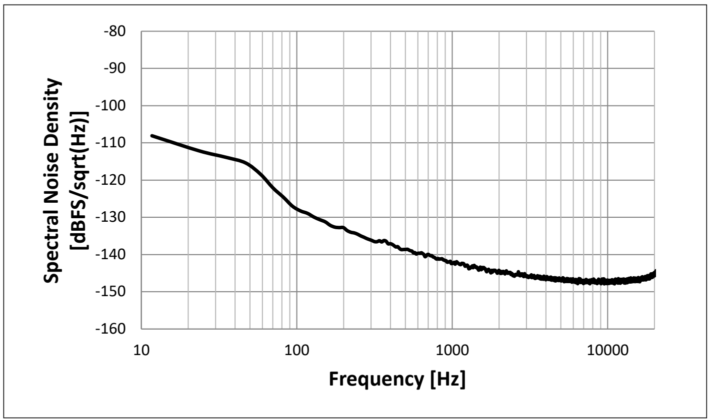

Figure 8 **Typical noise floor power spectral density (unweighted)**

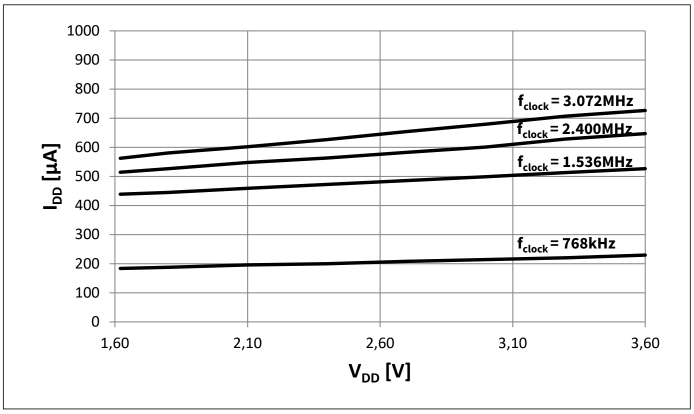

Figure 9 **Typical I_{DD} vs V_{DD}**

3 Acoustic characteristics

Table 1 **Acoustic specifications normal mode**

Test conditions (unless otherwise specified in the table): V_{DD} = 1.8V, F_{clock} = 3.072MHz, OSR=64, T_A = 25°C, 55% R.H., audio bandwidth 20Hz to 20kHz, select pin grounded, no load on DATA, T_{edge} = 9ns

Parameter		Symbol	Values			Unit	Note or Test Condition
			Min.	Typ.	Max.		
Sensitivity		S	-38	-37	-36	dBFS	1kHz, 94dBSPL
Low Frequency Roll-off		LFRO		20		Hz	-3dB relative to 1kHz
Resonance Frequency Peak				36		kHz	
Signal-to-Noise Ratio	F_{clock} = 1.536MHz	SNR		66.5		dB(A)	20Hz to 20kHz bandwidth, A-weighted
	F_{clock} = 2.0MHz			67			
	F_{clock} = 2.4MHz			67.5			
	F_{clock} = 3.072MHz			67.5			
Total Harmonic Distortion	94dBSPL	THD			0.3	%	Measuring 2nd to 5th harmonics; 1kHz. S=typ
	122dBSPL			1.0			
	128dBSPL			10.0			
Acoustic Overload Point	10% THD	AOP		128		dBSPL	Measuring 2nd to 5th harmonics; 1kHz. S=typ
Group Delay	100Hz			460		µs	
	1kHz			10			
	4kHz			4			
Phase Response	100Hz			14		°	
	1kHz			0			
	4kHz			-5			
Directivity			Omnidirectional				
Polarity			Positive pressure increases density of 1's, negative pressure decreases density of 1's in data output				

Table 2 Acoustic specifications low power mode

Test conditions (unless otherwise specified in the table): V_{DD} = 1.8V, F_{clock} = 768kHz, OSR=48, T_A = 25°C, 55% R.H., audio bandwidth 20Hz to 8kHz, select pin grounded, no load on DATA, T_{edge} = 9ns

Parameter		Symbol	Values			Unit	Note or Test Condition
			Min.	Typ.	Max.		
Sensitivity		S	-38	-37	-36	dBFS	1kHz, 94dBSPL
Signal-to-Noise Ratio	F_{clock} = 768kHz	SNR		66		dB(A)	20Hz to 8kHz bandwidth, A-weighted
Total Harmonic Distortion	94dBSPL	THD			0.3	%	Measuring 2nd to 5th harmonics; 1kHz. S=typ
	120dBSPL			1.0			
	128dBSPL			10.0			
Acoustic Overload Point	10% THD	AOP		128		dBSPL	Measuring 2nd to 5th harmonics; 1kHz. S=typ

4 Electrical characteristics and parameters

4.1 Absolute maximum ratings

Table 3 Absolute maximum ratings

Stresses exceeding the listed maximum ratings may affect device reliability or cause permanent device damage. Functional device operation at these conditions is not guaranteed.

Parameter	Symbol	Values		Unit	Note / Test Condition
		Min.	Max.		
Voltage on any Pin	V_{max}		3.6	V	
Storage Temperature	T_S	-40	125	°C	
Ambient Temperature	T_A	-40	85	°C	

4.2 Electrical parameters

Table 4 Electrical parameters and digital interface input

Test conditions (unless otherwise specified in the table): V_{DD} = 1.8V, T_A = 25°C, 55% R.H.

Parameter		Symbol	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Supply Voltage		V_{DD}	1.6	1.8	3.465	V	1)
Clock Frequency Range	Standby Mode	f_{clock}			330	kHz	2)
	Low Power Mode		370	406	440	kHz	3)
			480	600	650		
			720	768	840		
			930	1000	1220		
	Normal Mode		1.34	1.536	1.72	MHz	
			1.91	2.0	2.09		
			2.31	2.4	2.57		
			2.84	3.072	3.44		
			3.81	4.0	4.18		
V_{DD} Ramp-up Time					50	ms	Time until $V_{DD} \geq V_{DD\_min}$
Input Logic Low Level		V_{IL}			$0.3xV_{DD}$	V	
Input Logic High Level		V_{IH}	$0.7xV_{DD}$			V	
Clock Rise/Fall Time		T_{CR}/T_{CF}			13	ns	10% to 90% of V_{DD}
Clock Duty Cycle			45		55	%	
Clock input capacitance		C_{in}		45		pF	
Data output load		C_{load}			100	pF	

1 A 1µF bypass capacitor shall be placed close to the microphone V_{DD} pad to ensure best SNR performance.
2 Data pad is high impedance in standby mode.
3 The clock frequencies between the switching thresholds of different modes cannot be used.

4.3 Electrical characteristics

Table 5 **General electrical characteristics**

Test conditions (unless otherwise specified in the table): V_{DD} = 1.8V, T_A = 25°C, 55% R.H.

Parameter		Symbol	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Current Consumption	Clock Off Mode	I_{clock_off}		1	5	µA	CLOCK pulled low
	Standby Mode	$I_{standby}$		95			No load on DATA
	F_{clock} = 768kHz	I_{DD}		190	230		<5pF load on DATA
	F_{clock} = 1.536MHz			450			
	F_{clock} = 2.4MHz			530			
	F_{clock} = 3.072MHz			580	680		
Short Circuit Current			1		20	mA	Grounded DATA pin
Start up Time	After powered down, F_{clock} ≥ 768 kHz[4]				25	ms	Time after stable clock until sensitivity accuracy ±1.0dB
	After powered down, F_{clock} < 768kHz[5]				45	ms	Time after stable clock until sensitivity accuracy ±1.0dB
Power Supply Rejection		PSR_{1k_NM}		-88		dBFS	100mV_{pp} sine wave on V_{DD} swept from 200Hz to 20kHz.
		PSR_{217_NM}		-90		dBFS(A)	100mV_{pp}, 217Hz square wave on V_{DD}. A-weighted.
Output Logic Low Level		V_{OL}			0.2xV_{DD}	V	
Output Logic High Level		V_{OH}	0.8xV_{DD}				
Delay Time for DATA Driven		t_{DD}	60		100	ns	Delay time from CLOCK edge (0.5xV_{DD}) to DATA driven.
Delay Time for DATA High-Z[6]		t_{HZ}	5		30	ns	Delay time from CLOCK edge (0.5xV_{DD}) to DATA high impedance state
Delay Time for DATA Valid[7]		t_{DV}			140	ns	Delay time from CLOCK edge (0.5xV_{DD}) to DATA valid (<0.3xV_{DD} or >0.7xV_{DD})
Power-on behaviour		Idle tone is output over PDM within 3ms of applying V_{DD} and f_{clock}, remains until a valid microphone signal is available. Idle tone consists of alternating 1s and 0s, representing a zero input signal.					

4 Mode switch time to any specified frequency ≥ 768 kHz, from any specified frequency ≥ 768 kHz or Off. VDD is always present during mode switching.

5 Mode switch time to any specified frequency <768kHz, from any specified frequency or Off. VDD is always present during the mode switching

6 t_{hold} is dependent on C_{load}

7 Load on data: C_{load}=100pF, R_{load}=100kΩ

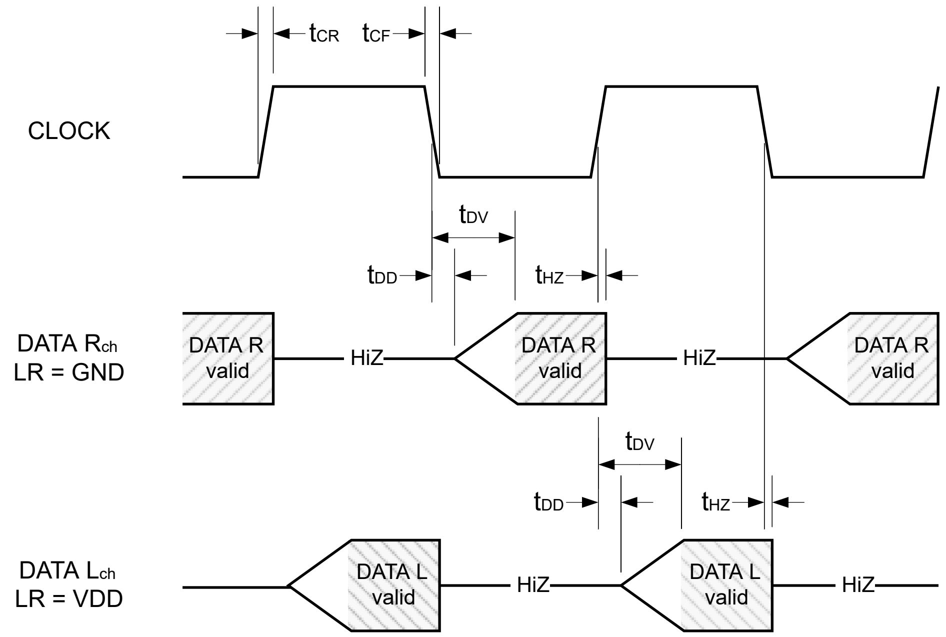

Figure 10 **Timing diagram**

4.4 Audio DC offset

The DC output level encoded in the DC bit stream is determined by the LR state on startup. In each case the DC output level is stable over time and does not vary with input signal level.

Table 6 **DC output level using LR pin**

LR state	DC output level (typical)	Unit
LR = GND	-90	dBFS
LR = VDD	-30	dBFS

4.5 Stereo PDM configuration

The IM68D128BV01 is designed to function in circuits with one or two microphones on the PDM bus. When two microphones are connected, data is transmitted alternately according to the LR pin status of each microphone. When two microphones are connected to a shared PDM bus, the power modes of both microphones will be the same as both are controlled by the same PDM clock. The performance is unchanged relative to a single microphone per bus configuration.

Table 7 PDM channel configuration using LR pin.

Channel	Data driven	Data high-Z	LR connection
DATA1	Falling clock edge	Rising clock edge	GND
DATA2	Rising clock edge	Falling clock edge	V_{DD}

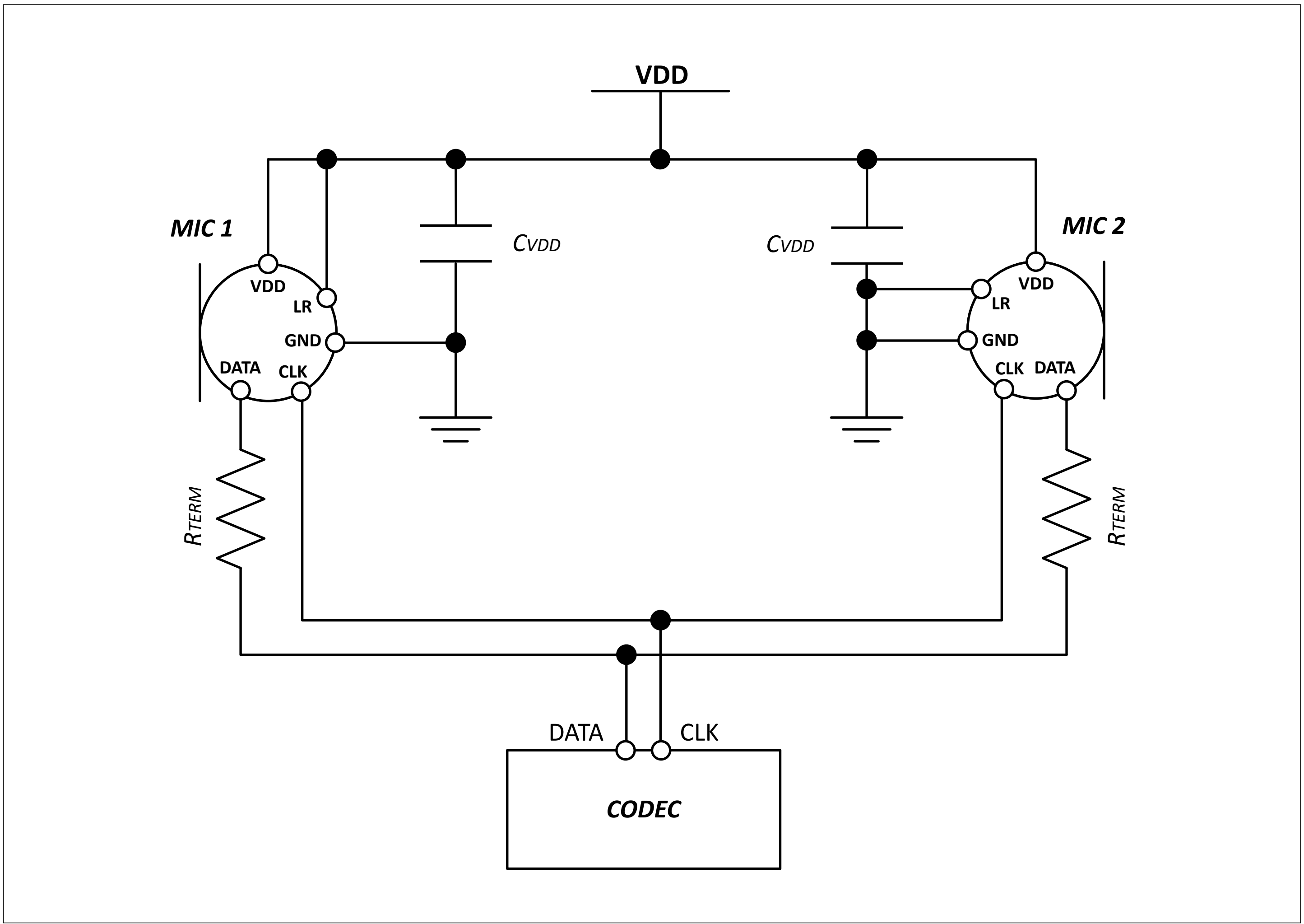

Figure 11 Typical stereo mode configuration

***Note**: For best performance it is strongly recommended to place a 1µF ($C_{VDD\_typical}$) capacitor between V_{DD} and ground. The capacitor should be placed as close to V_{DD} as possible. A termination resistor (R_{TERM}) of about 100Ω may be added to reduce the ringing and overshoot on the output signal.*

5 Package information

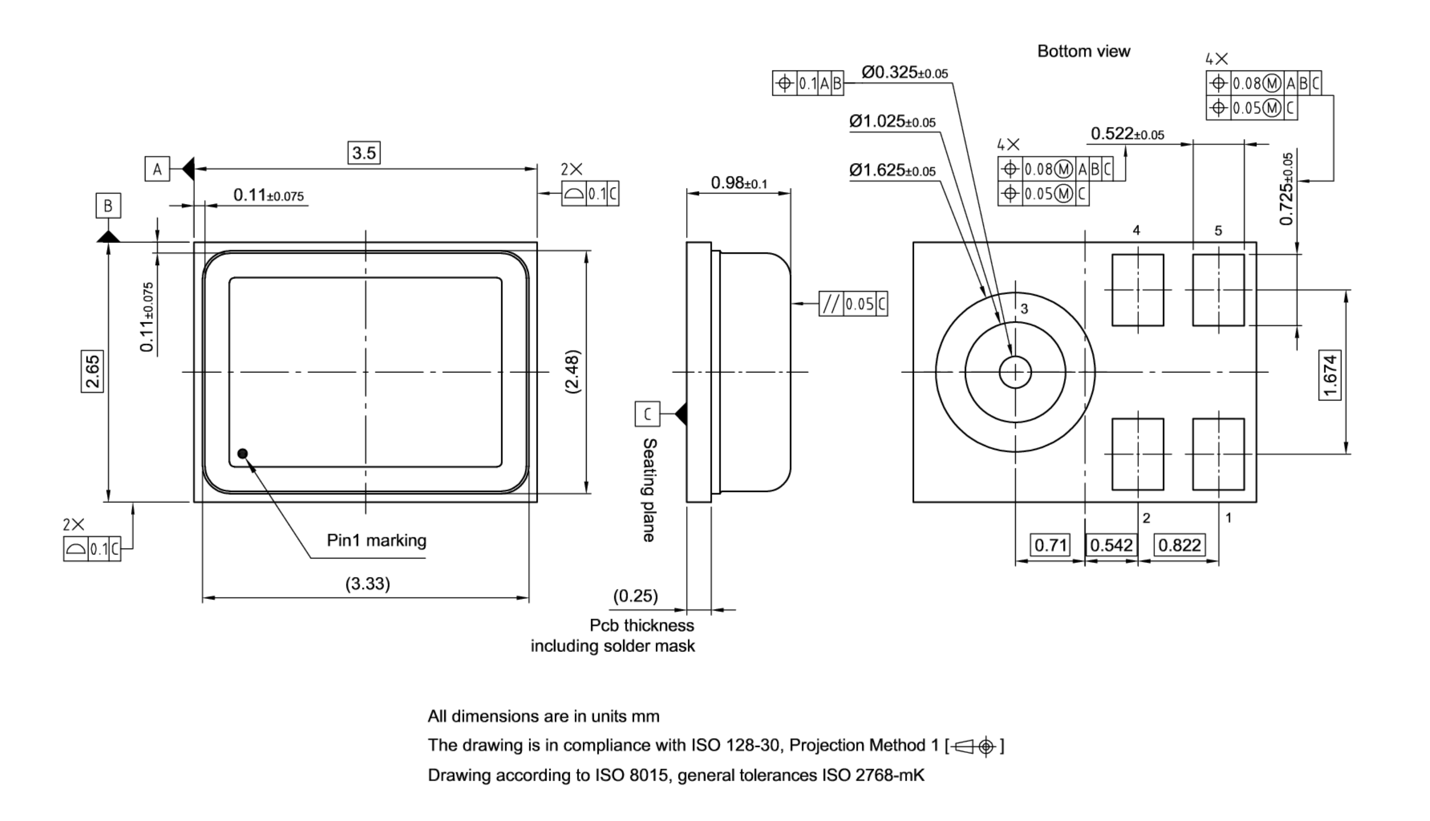

Figure 12 **IM68D128BV01 package drawing**

Table 8 **IM68D128BV01 pin configuration**

Pin Number	Name	Description
1	DATA	PDM data output
2	LR select	PDM left/right select
3	GND	Ground
4	CLOCK	PDM clock input
5	V_{DD}	Power supply

6 Packing information

For shipping and assembly the Infineon microphones are packed in product specific tape-and-reel carriers. A detailed drawing of the carrier can be seen in

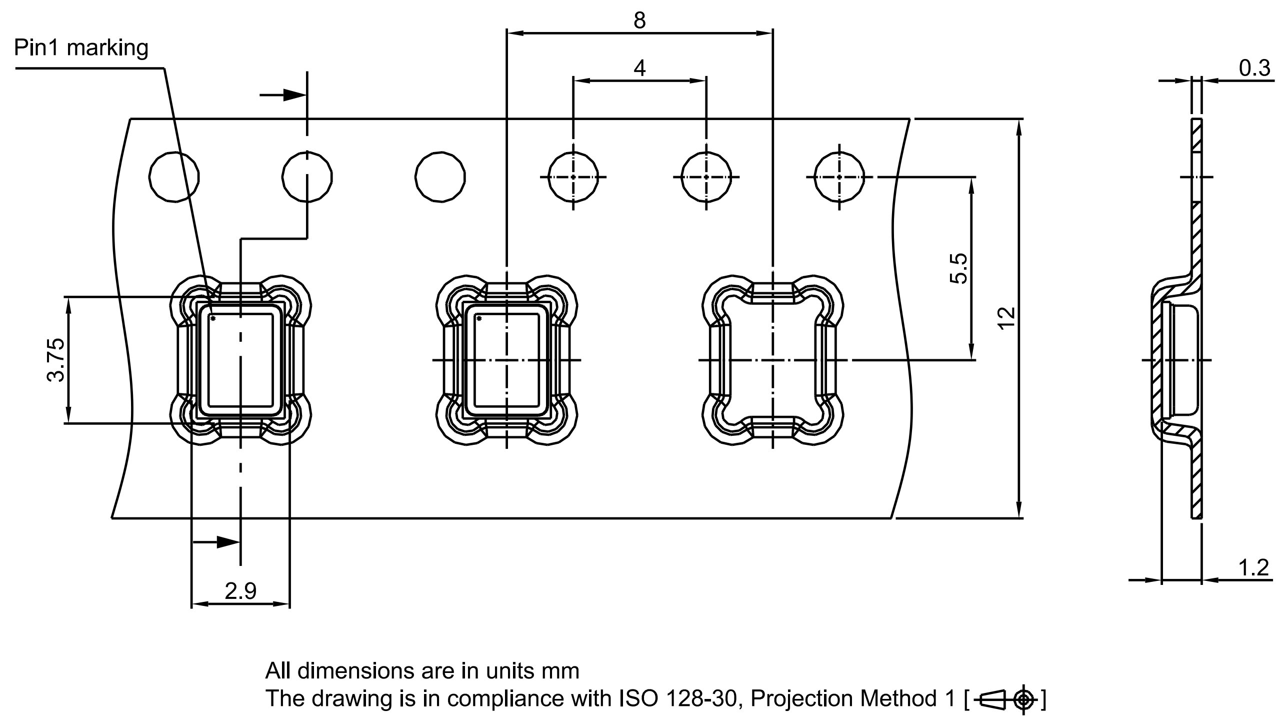

Figure 13 IM68D128BV01 tape and reel packing information

Table 9 IM68D128BV01 packaging information

Product	Type code	Reel diameter	Quantity per reel
IM68D128BV01	I68D33	13"	5000

7 Footprint and stencil recommendation

The acoustic port hole diameter in the PCB should be larger than the acoustic port hole diameter of the MEMS microphone to ensure optimal performance. A PCB sound port size of diameter 0.6 mm is recommended.

The board pad and stencil aperture recommendations shown below are based on Non-Solder Mask Defined (NSMD) pads. The specific design rules of the board manufacturer should be considered for individual design optimizations or adaptations.

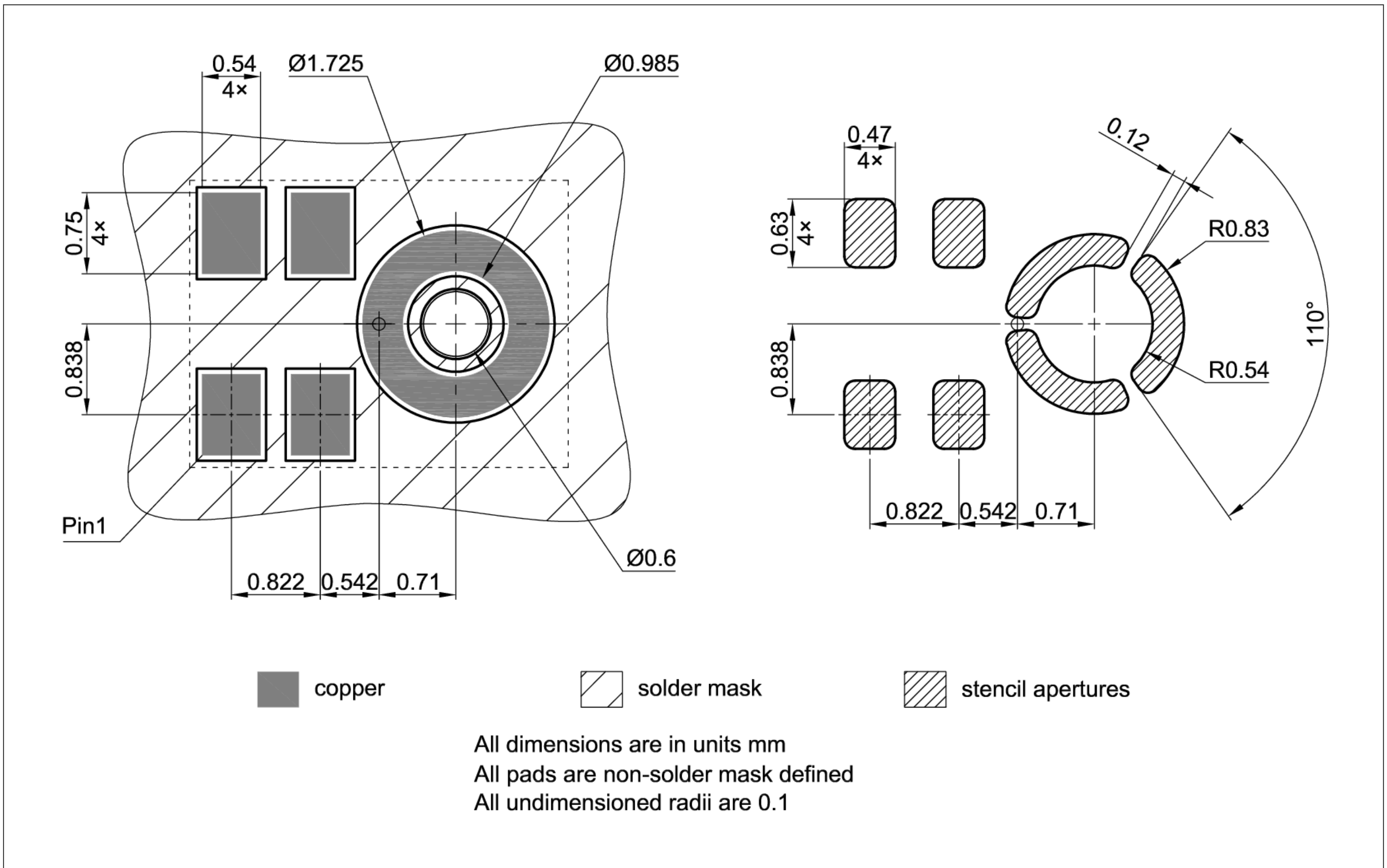

Figure 14 Footprint and stencil recommendation

8 Reflow soldering and board assembly

Infineon MEMS microphones are qualified in accordance with the IPC/JEDEC J-STD-020D-01. The moisture sensitivity level of MEMS microphones is rated as MSL1. For PCB assembly of the MEMS microphone the widely used reflow soldering using a forced convection oven is recommended.

The soldering profile should be in accordance with the recommendations of the solder paste manufacturer to reach an optimal solder joint quality. The reflow profile shown in Figure 15 is recommended for board manufacturing with Infineon MEMS microphones.

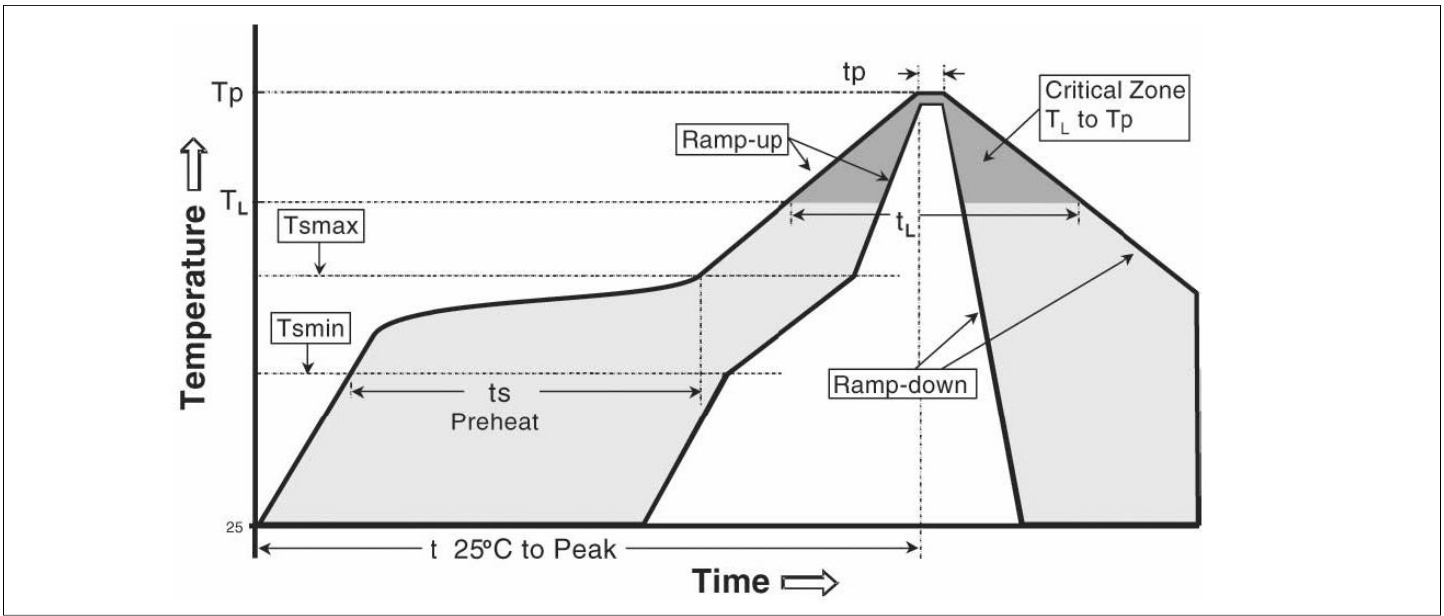

Figure 15 **Recommended reflow profile**

Table 10 **Reflow profile limits**

Profile feature	Pb-Free assembly	Sn-Pb Eutectic assembly
Temperature Min (T_{smin})	150 °C	100 °C
Temperature Max (T_{smax})	200 °C	150 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Ramp-up rate (T_L to T_P)	3 °C/second max.	3 °C/second max.
Liquidous temperature (T_L)	217 °C	183 °C
Time (t_L) maintained above T_L	60-150 seconds	60-150 seconds
Peak Temperature (T_p)	260°C +0°C/-5°C	235°C +0°C/-5°C
Time within 5°C of actual peak temperature (tp) [8]	20-40 seconds	10-30 seconds
Ramp-down rate	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	8 minutes max.	6 minutes max.

***Note**: For further information please consult the 'General recommendation for assembly of Infineon packages' document which is available on the Infineon Technologies web page*

8 Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum

The MEMS microphones can be handled using industry standard pick and place equipment. Care should be taken to avoid damage to the microphone structure as follows:

- Do not pick the microphone with vacuum tools which make contact with the microphone acoustic port hole.
- The microphone acoustic port hole should not be exposed to vacuum, this can destroy or damage the MEMS.
- Do not blow air into the microphone acoustic port hole. If an air blow cleaning process is used, the port hole must be sealed to prevent particle contamination.
- It is recommended to perform the PCB assembly in a clean room environment in order to avoid microphone contamination.
- Air blow and ultrasonic cleaning procedures shall not be applied to MEMS Microphones. A no-clean paste is recommended for the assembly to avoid subsequent cleaning steps. The microphone MEMS can be severely damaged by cleaning substances.
- To prevent the blocking or partial blocking of the sound port during PCB assembly, it is recommended to cover the sound port with protective tape during PCB sawing or system assembly.
- Do not use excessive force to place the microphone on the PCB. The use of industry standard pick and place tools is recommended in order to limit the mechanical force exerted on the package.

9 Reliability specifications

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

Table 11 Reliability specification

Test	Abbreviation	Test Condition	Standard
Low Temperature Operating Life	LTOL	T_a=-40°C, VDD=3.6V, 1000 hours	JESD22-A108
Low Temperature Storage Life	LTSL	T_a=-40°C, 1000 hours	JESD22-A119
High Temperature Operation Life	HTOL	T_a=+125°C, VDD=3.6V, 1000 hours	JESD22-A108
High Temperature Storage Life	HTSL	T_a=+125°C, 1000 hours	JESD22-A103
Temperature Cycling	PC + TC	Pre conditioning MSL-1	JESD22-A113
		1000 cycles, -40°C to +125°C, 30 minutes per cycle	JESD22-A104
Temperature Humidity Bias	PC + THB	Pre conditioning MSL-1	JESD22-A113
		T_a=+85°C, R.H = 85%, VDD=3.6V, 1000 hours	JESD22-A101
Vibration Test	VVF	20Hz to 2000Hz with a peak acceleration of 20g in X, Y, and Z for 4 minutes each, total 4 -cycles	IEC 60068-2-6
Mechanical Shock	MS	10000g/0.2msec direction ±x,y,z, 5 shocks in each direction, 5 shocks in total	IEC 60068-2-27
Reflow Solder[9)]	RS	3 reflow cycles, peak temperature = +260°C	IPC-JEDEC J-STD-020D-01
Electrostatic Discharge -System Level Test	ESD - SLT	3 air discharges of ±15kV via the lid	IEC-61000-4-2
		3 discharges of ±8kV direct contact to lid while V_{dd} is supplied according to the operational modes; (V_{dd} ground is separated from earth ground)	
Electrostatic Discharge - Human Body Model	ESD - HBM	1 pulse of ±2kV between all I/O pin combinations	JEDEC-JS001
Electrostatic Discharge - Charged Device Model	ESD - CDM	3 discharges of ±500V direct contact to I/O pins.	JEDEC JS-002
Latch Up	LU	Trigger current from ±100mA	JESD78E

9 The microphone sensitivity must deviate by no more than 1dB from the initial value after 3 reflow cycles.

9.1 Environmental robustness

Infineon's latest Single Backplate MEMS technology delivers high ingress protection (IP57) on microphone level. The MEMS is designed to reduce the risk of mechanical blockage or electrical fail caused by water or dust.

Table 12 Environmental robustness

Test Standard	Test Condition
IP5x dust resistance[10)]	Arizona dust A4 coarse, vertical orientation, sound hole upwards, 10 cycles (15 minutes sedimentation, 6 sec blowing)
IPx7 water immersion[11)]	Temporary immersion of 1 meters for 30 minutes. Microphone tested 6 hours after removal

10 The number "5" stands for the dust ingress rating or the capacity to withstand the effects of fine, abrasive dust particles.
11 The "7" specifies the higher water immersion rating.

Revision history

Document version	Date of release	Description of changes
V1.0	2025-03-13	Initial release
V1.1	2025-04-14	Fixed typos, no change in acoustic or electrical performance

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