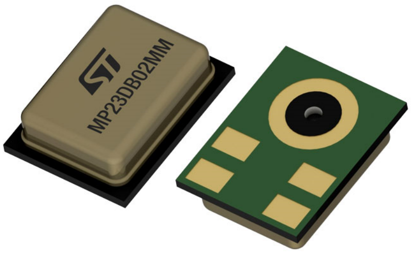
MP23DB02MM

Datasheet

MEMS audio sensor: digital microphone with multiple performance modes



RHLGA 5LD (3.5 x 2.65 x 0.98 mm)

Features

- Omnidirectional digital microphone
- Sensitivity: –26 dBFS ±1dB
- “Always-on" experience with low power consumption
- Multiple performance modes (low power, normal)
- Typical current consumption
  - 285 µA (low-power mode)
  - 800 µA (normal mode)
- 122 dBSPL acoustic overload point for all operative modes
- PDM single-bit output with option for stereo configuration
- RHLGA package
  - Bottom-port design
  - SMD-compliant
  - EMI-shielded
  - ECOPACK, RoHS and “Green” compliant

Applications

- Smartphones and handsets
- Laptop and notebook computers
- Wearable devices
- Digital still and video cameras
- Antitheft systems

Product status link
MP23DB02MM

Product summary	
Order code	MP23DB02MMTR
Temp. range [°C]	-40 to +85
Package	RHLGA 5LD (3.5 x 2.65 x 0.98) mm
Packing	Tape and reel

Description

The MP23DB02MM is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface with optional stereo configuration.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to produce audio sensors.

The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.

The MP23DB02MM offers multiple performance modes enabled by different clock frequency ranges (power down, low power and normal mode). The device has a narrow sensitivity range of ±1 dB, high SNR and low distortion for all operative modes.

The MP23DB02MM is available in a bottom-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

1 Pin description

Figure 1. Pin connections

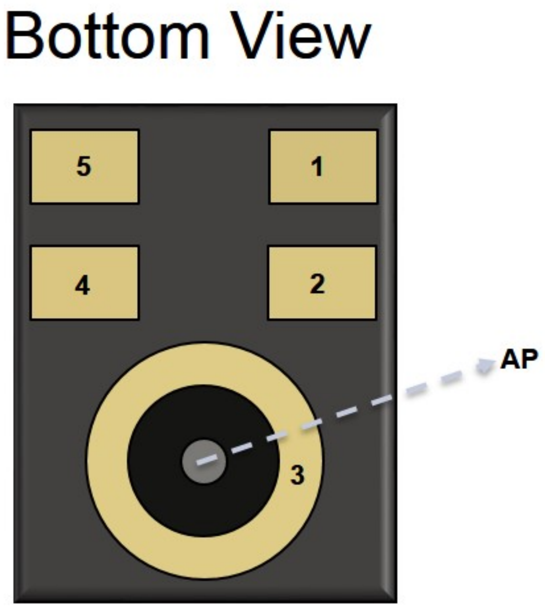


Table 1. Pin description

Pin #	Pin name	Function
1	DOUT	Left/right PDM data output
2	L/R	Left/right channel selection
3 (ground ring)	GND	0 V supply
4	CLK	Synchronization input clock
5	VDD	Supply voltage

2 Acoustic and electrical specifications

2.1 Acoustic and electrical characteristics

The values listed in the table below are specified for Vdd = 1.8 V, Clock = 2.4 MHz, T = 25 °C, no load, unless otherwise noted.

Table 2. Acoustic and electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		1.6		3.6	V
f_{CLK}	Clock frequency range(2)	Power-down mode	0		0.15	MHz
		Low-power mode	0.54	0.768	1.1	
		Normal mode	1.5	2.4	3.3	
Idd	Current consumption in normal mode	Fc = 2.4 MHz		800		µA
	Current consumption in low-power mode	Fc = 768 kHz		285		
IddPdn	Current consumption in power-down mode(3)		2		5	
Icc	Short-circuit current		1		10	mA
V_{IOL}	Low-level logic input/output voltage	Iout = 1 mA	-0.3		0.35xVdd	V
V_{IOH}	High-level logic input/output voltage	Iout = 1 mA	0.65xVdd		Vdd+0.3	V
TWK	Wake-up time(4)	guaranteed by design			20	ms
Roll-off	Frequency response	at -3 dB		35		Hz
Cload	DOUT load capacitance				100	pF
Top	Operating temperature range		-40		+85	°C

1. *Typical specifications are not guaranteed.*
2. *Duty cycle: min = 40% max = 60%*
3. *Input clock in static mode*
4. *Time from the first clock edge to valid output data*

The values listed in the table below are specified for Vdd = 1.8 V, Clock = 768 kHz, no load, T = 25 °C, unless otherwise noted.

Table 3. Low-power mode

Symbol	Parameter	Test condition	Min.	Typ. (1)	Max.	Unit
Idd	Current consumption			285		µA
So	Sensitivity	94 dBSPL @ 1 kHz	-27	-26	-25	dBFS
SNR	Signal-to-noise ratio	94 dBSPL @ 1 kHz A-weighted (20 Hz - 8 kHz)		64		dB(A)
THD	Total harmonic distortion	94 dBSPL @ 1 kHz		0.5		%
		120 dBSPL @ 1 kHz		4		
AOP	Acoustic overload point			122		dBSPL
PSR	Power supply rejection	100 mVpp sinewave @ 217 Hz		-90		dBFS

1. *Typical specifications are not guaranteed.*

The values listed in the table below are specified for Vdd = 1.8 V, Clock = 2.4 MHz, no load, T = 25 °C, unless otherwise noted.

Table 4. **Normal mode**

Symbol	Parameter	Test condition	Min.	Typ. [1]	Max.	Unit
Idd	Current consumption			800		µA
So	Sensitivity	94 dBSPL @ 1 kHz	-27	-26	-25	dBFS
SNR	Signal-to-noise ratio	94 dBSPL @ 1 kHz A-weighted (20 Hz - 8 kHz)		65		dB(A)
THD	Total harmonic distortion	94 dBSPL @ 1 kHz		0.5		%
		120 dBSPL @ 1 kHz		4		
AOP	Acoustic overload point			122		dBSPL
PSR	Power supply rejection	100 mVpp sinewave @ 217 Hz		-90		dBFS

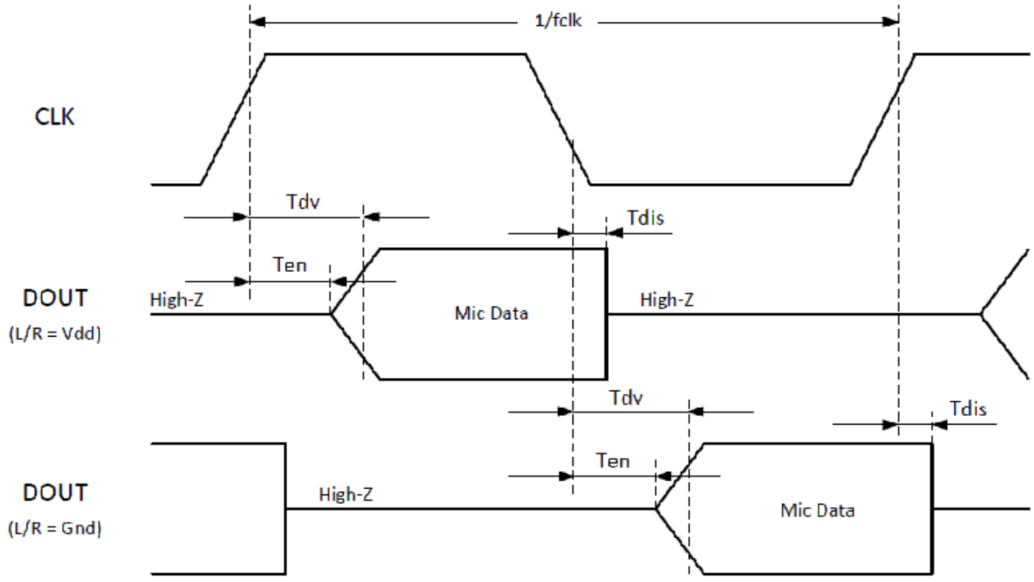
1. *Typical specifications are not guaranteed.*

2.2 Timing characteristics

Table 5. **Timing characteristics**

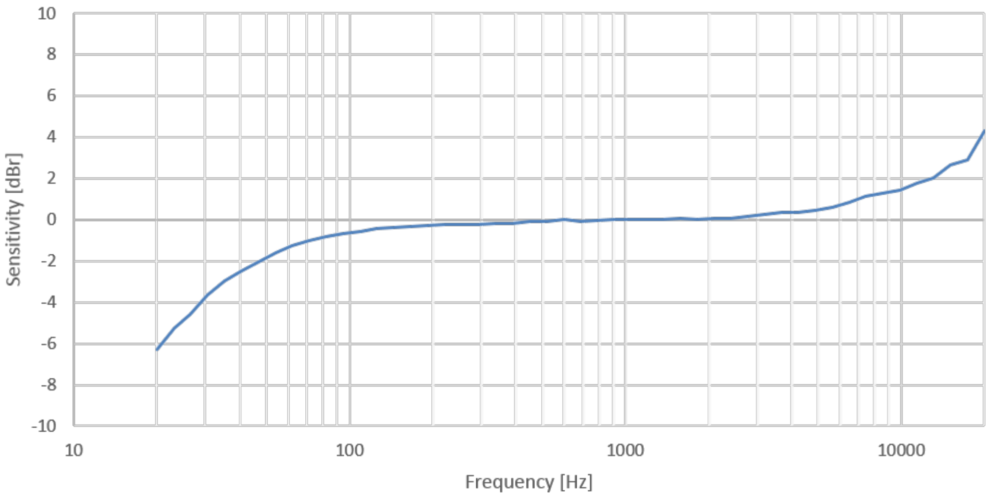
Symbol	Description	Min.	Max.	Unit
T_{dv}	Delay time to valid data (Cload = 100 pF)		120	ns
T_{en}	Delay time to data driven	19		ns
T_{dis}	Delay time to Hi-Z	4	17	ns

Figure 2. **Timing waveforms**



2.3 Frequency response

Figure 3. Normalized frequency response



3 Absolute maximum ratings

Stresses above those listed as “Absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 6. **Absolute maximum ratings**

Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.3 to 4.8	V
Vin	Input voltage on any control pin(1)	-0.3 to Vdd +0.3	V
T_{STG}	Storage temperature range	-40 to +125	°C
ESD	(HBM) ANSI/ESDA/JEDEC JS001	±2000	V
	(MM) EIA/JESD22-A115	±200	
	(CDM) JESD22-C101	±750	
ESD(2)	Per IEC61000-4-2, 150 pF, 330 Ω direct contact to housing	±8000	V

1. *Supply voltage on any pin should never exceed 4.8V*
2. *Bypass capacitor of 200nF or 1 μF (better) is highly recommended for ESD main clamp integrity.*

This device is sensitive to mechanical shock, improper handling can cause permanent damage to the part.

This device is sensitive to electrostatic discharge (ESD), improper handling can cause permanent damage to the part.

4 Functionality

4.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as indicated in the following table. The L/R pin must be connected to Vdd or GND.

Table 7. **L/R channel selection**

L/R	CLK low	CLK high
GND	Data valid	High impedance
Vdd	High impedance	Data valid

Note: As the L/R pin is internally connected to GND via a 200 kΩ pull-down resistor, it is not mandatory to connect the pin itself to GND for the respective channel selection.

5 Application recommendations

Figure 4. **MP23DB02MM electrical connections**

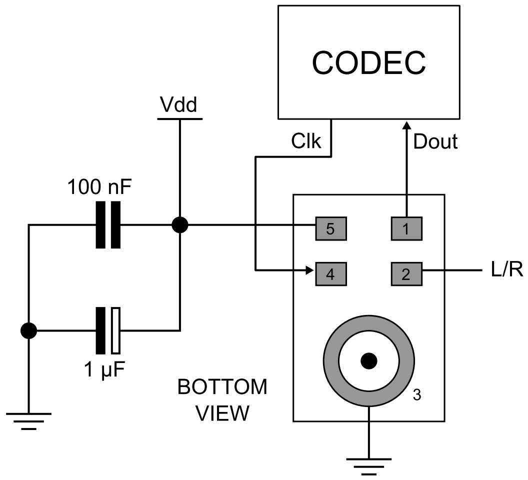
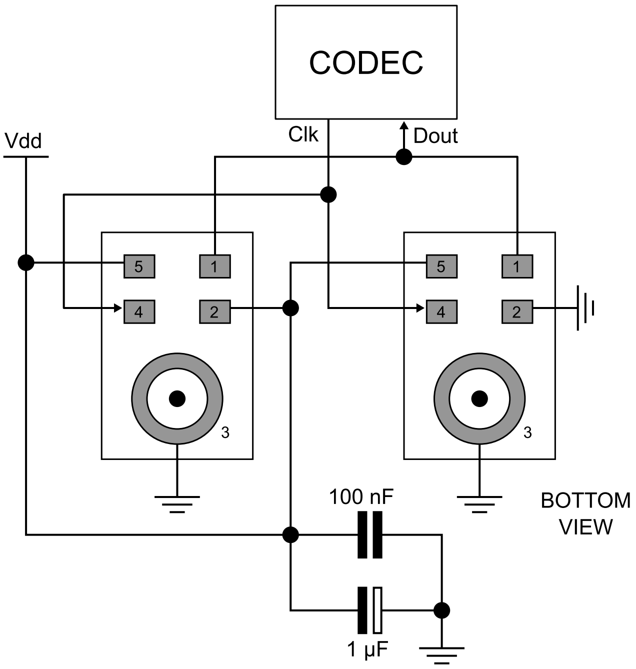


Figure 5. **MP23DB02MM electrical connections for stereo configuration**



Power supply decoupling capacitors (100 nF ceramic, 1 µF ceramic) should be placed as near as possible to pin 2 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to Table 7).

6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

6.1 Soldering information

The RHLGA (3.5 x 2.65 x 0.98) mm package is also compliant with the RoHS and "Green" standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

Landing pattern and soldering recommendations are available at www.st.com.

Figure 6. Recommended soldering profile limits

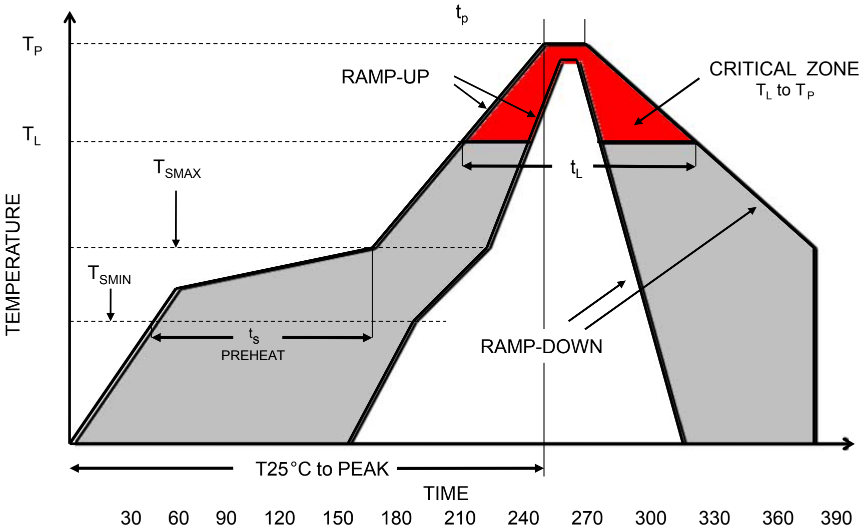
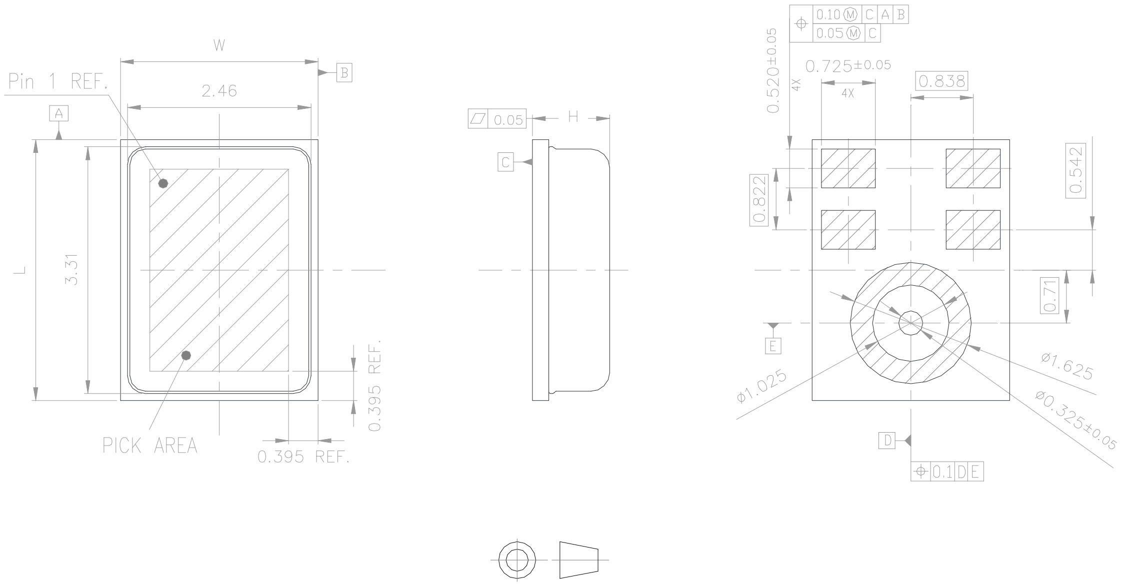


Table 8. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat		
Minimum temperature	T_{SMIN}	150 °C
Maximum temperature	T_{SMAX}	200 °C
Time (T_{SMIN} to T_{SMAX})	t_S	60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 217 °C
Peak temperature	T_P	260 °C max
Time within 5 °C of actual peak temperature		20 sec to 40 sec
Ramp-down rate		6 °C/sec max
Time 25 °C (t25 °C) to peak temperature		8 minutes max

6.2 RHLGA-5L package information

Figure 7. RHLGA 3.5 x 2.65 x 0.98 mm (metal cap) 5L package outline



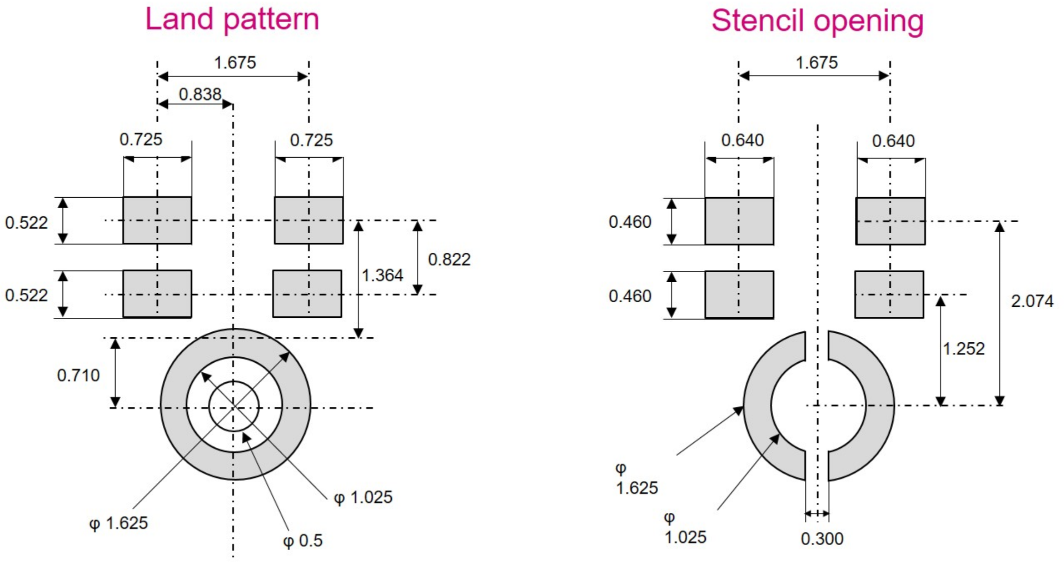
Dimensions are in millimeter unless otherwise specified
General Tolerance is +/-0.15mm unless otherwise specified

OUTER DIMENSIONS

ITEM	DIMENSION [mm]	TOLERANCE [mm]
Length [L]	3.5	±0.1
Width [W]	2.65	±0.1
Height [H]	1.08 MAX	

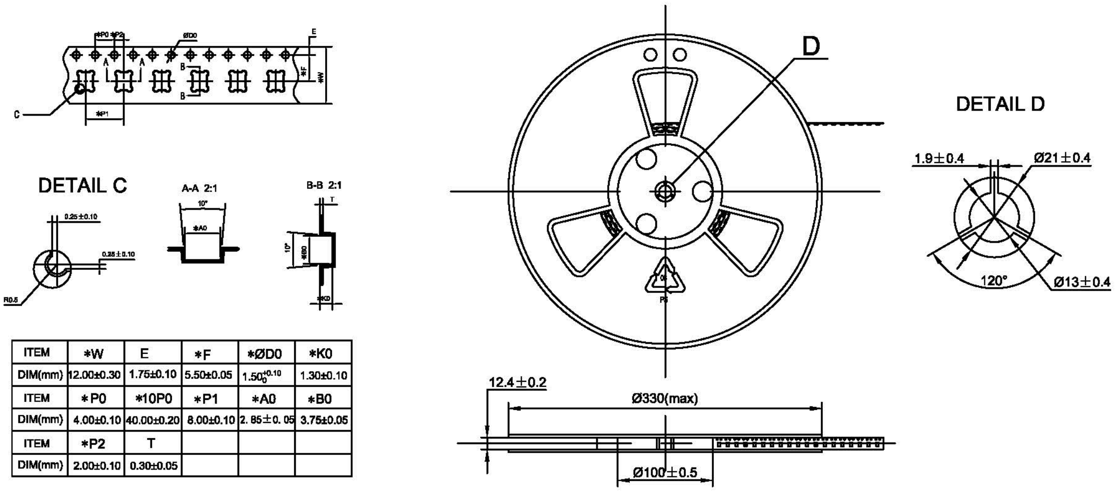
DM00368430_3

Figure 8. Land pattern and recommended stencil opening



6.3 RHLGA-5L packing information

Figure 9. Carrier tape and reel mechanical specifications



ITEM	*W	E	*F	*ØD0	*K0
DIM(mm)	12.00±0.30	1.75±0.10	5.50±0.05	$1.50_{0}^{+0.10}$	1.30±0.10
ITEM	*P0	*10P0	*P1	*A0	*B0
DIM(mm)	4.00±0.10	40.00±0.20	8.00±0.10	2. 85±0. 05	3.75±0.05
ITEM	*P2	T			
DIM(mm)	2.00±0.10	0.30±0.05			

Specifications:
1. Unmarked tolerance: ±0. 1mm;
2. Surface resistance: 10^{5}–10^{12} Ω/SQ, 25±5℃/50±5%RH;

Revision history

Table 9. **Document revision history**

Date	Version	Changes
13-Oct-2020	1	Initial release

Contents

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