MP23DB01HP

MEMS audio sensor: digital microphone with multiple performance modes

Datasheet - production data

RHLGA 5LD (3.5 x 2.65 x 0.98 mm)

Features

- Omnidirectional digital microphone
- Very low distortion / very high AOP
  - 135 dBSPL acoustic overload point
- Multiple performance modes (sleep, low-power, performance)
- Typ. current consumption
  - 2 µA (sleep mode)
  - 285 µA (low-power mode)
  - 800 µA (performance mode)
- Sensitivity matching
- 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
- Devices enabling always-on feature
- Digital still and video cameras
- Antitheft systems

Description

The MP23DB01HP is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface with stereo operation capability.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated to producing 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 MP23DB01HP offers multiple performance modes (power-down, low-power and performance mode) enabled by different clock frequency ranges. The device has a very high AOP in performance mode, sensitivity range of ±1 dB and high SNR for all operative modes.

The MP23DB01HP 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.

Table 1. Device summary

Part number	Temperature range [°C]	Package	Packing
MP23DB01HPTR	-40 to +85	RHLGA 5LD (3.5 x 2.65 x 0.98) mm	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

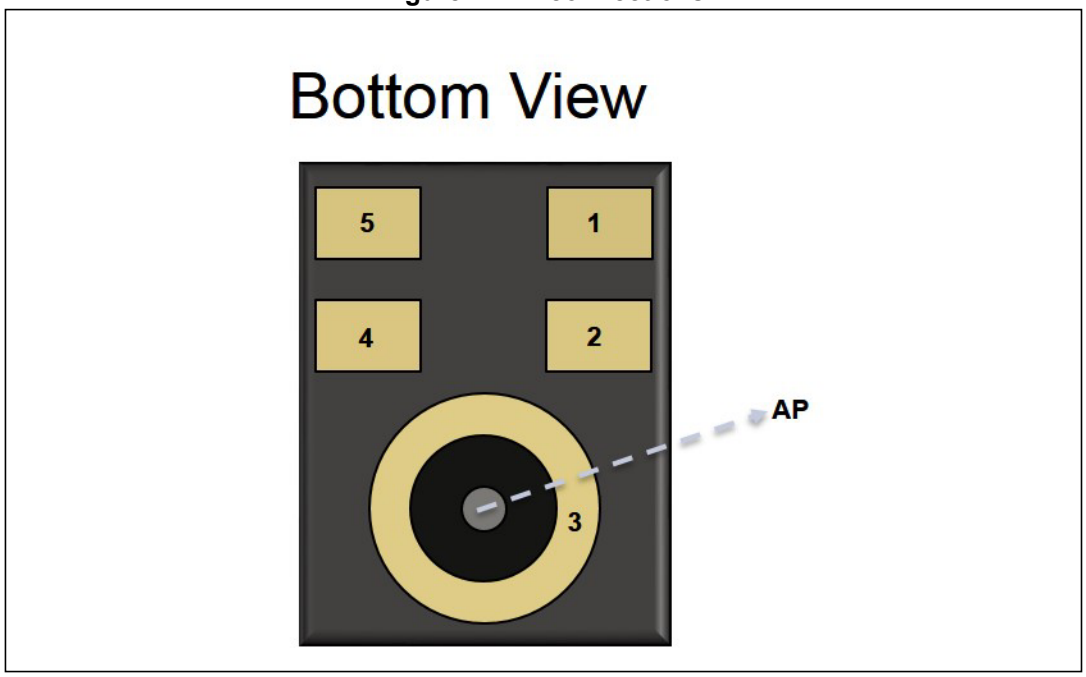


Table 2. Pin description

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 3. General microphone specifications

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		1.6	1.8	3.6	V
fclk	Clock frequency range(2)(3)	Power-down mode	0		0.15	MHz
		Low-power mode	0.54	0.768	1.1	
		Performance mode	1.5	2.4	3.3	
Idd	Current consumption in low-power mode	Fc = 768 kHz		285		µA
Idd	Current consumption in performance mode	Fc = 2.4 MHz		800		µA
		Fc = 3.072 MHz		880		µA
IddPdn	Current consumption in power-down(4)			2	5	µA
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(5)	Guaranteed by design			10	ms
Roll-off	Frequency response	-3 dB point		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. In case of mode change (from low-power to performance mode or vice versa), the clock has to be continuous or has to be stopped for at least 50 µs.
4. Input clock in static mode
5. 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 4. Low-power mode

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Idd	Current consumption			285		µA
So	Sensitivity	94 dBSPL @ 1 kHz	-25	-24	-23	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		0.2		%
AOP	Acoustic overload point			120		dBSPL
PSR	Power supply rejection	100 mVpp sine wave @ 217 Hz		-85		dBFS

1. Typical specifications are not guaranteed.

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

Table 5. Performance mode

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Idd	Current consumption	2.4 MHz		800		µA
		3.072 MHz		880		
So	Sensitivity	94 dBSPL @1 kHz	-42	-41	-40	dBFS
SNR	Signal-to-noise ratio 94 dBSPL @ 1 kHz A-weighted (20 Hz - 20 kHz)	2.4 MHz		65		dB(A)
		3.072 MHz		65.5		
THD	Total harmonic distortion	94 dBSPL @1 kHz		0.2		%
		110 dBSPL @1 kHz		0.5		
AOP	Acoustic overload point			135		dBSPL
PSR	Power supply rejection	100mVpp sinewave @ 217 Hz		-95		dBFS

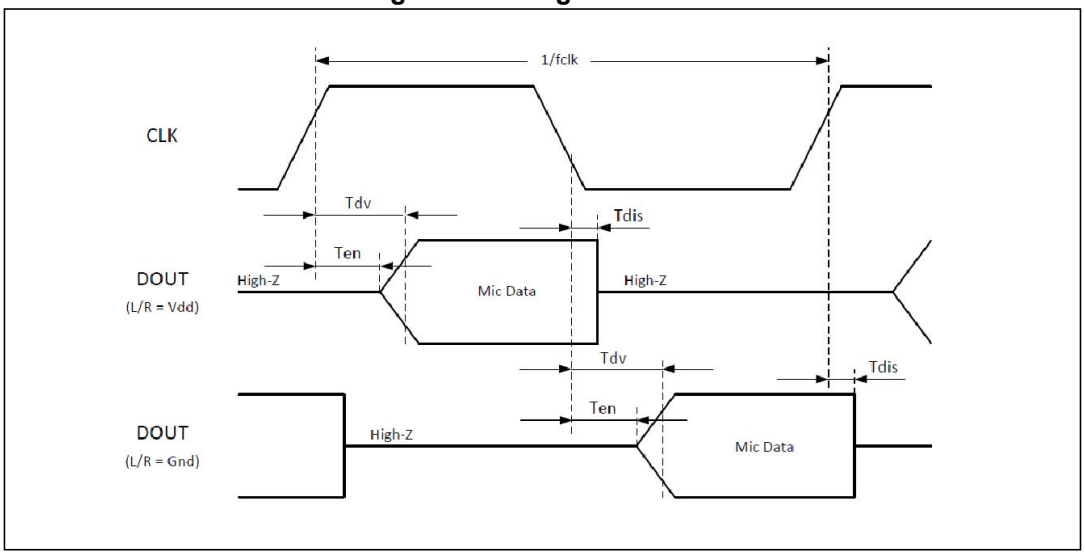
1. Typical specifications are not guaranteed.

2.2 Timing characteristics

Table 6. Timing characteristics

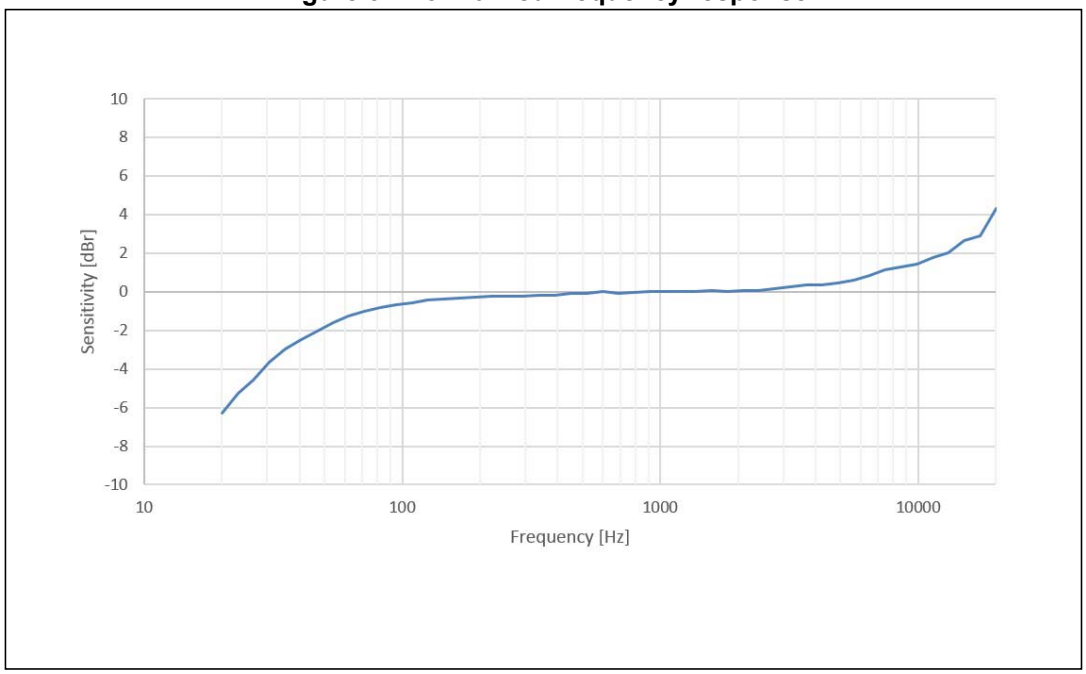
Parameter	Description	Min	Max	Unit
T_{dv}	Delay time to valid data (Cload = 100 pF)		120	ns
T_{en}	Delay time to data driven	19		ns
T_{dis}	Delay time to Hi-Z	4	17	ns

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 7. 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_{OP}	Operating temperature range	-40 to +105	°C
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 W direct contact to housing	±8000	V

1. Supply voltage on any pin should never exceed 4.8 V.
2. Bypass capacitor of 200 nF 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 explained in *Table 8*. The L/R pin must be connected to Vdd or GND.

Table 8. 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 200k pull-down resistor, it is not mandatory to connect the pin itself to GND for the respective channel selection.

5 Application recommendations

Figure 4. MP23DB01HP electrical connections

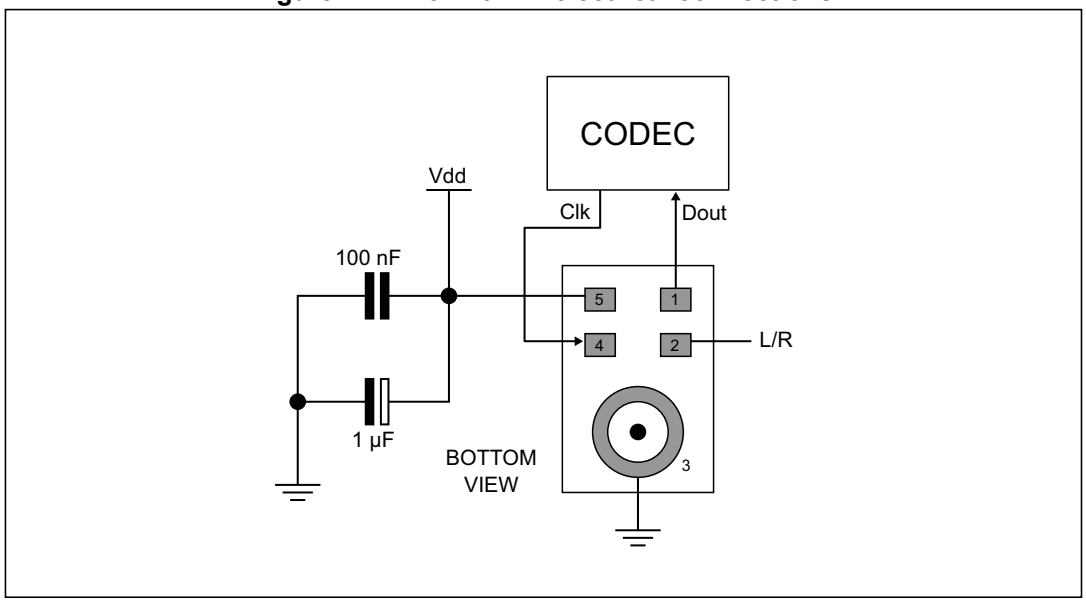
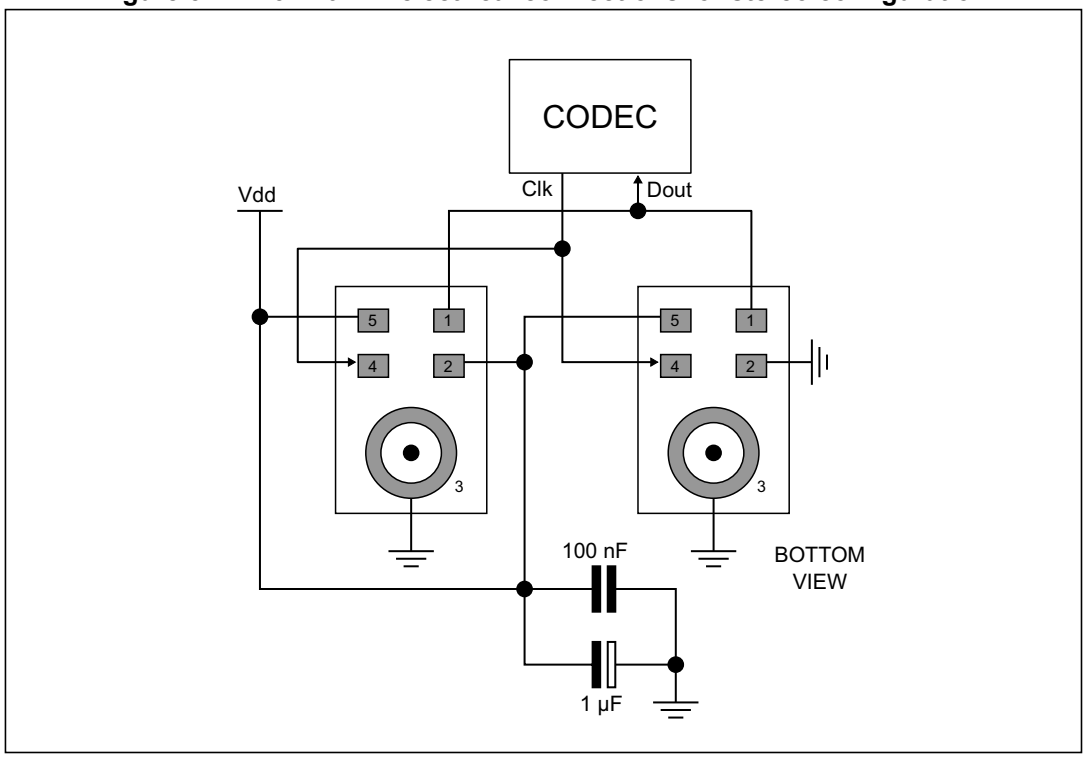


Figure 5. MP23DB01HP electrical connections for stereo configuration



Power supply decoupling capacitors (100 nF ceramic, 1 µF ceramic) should be placed as near as possible to pin 5 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to *Table 8*).

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.

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

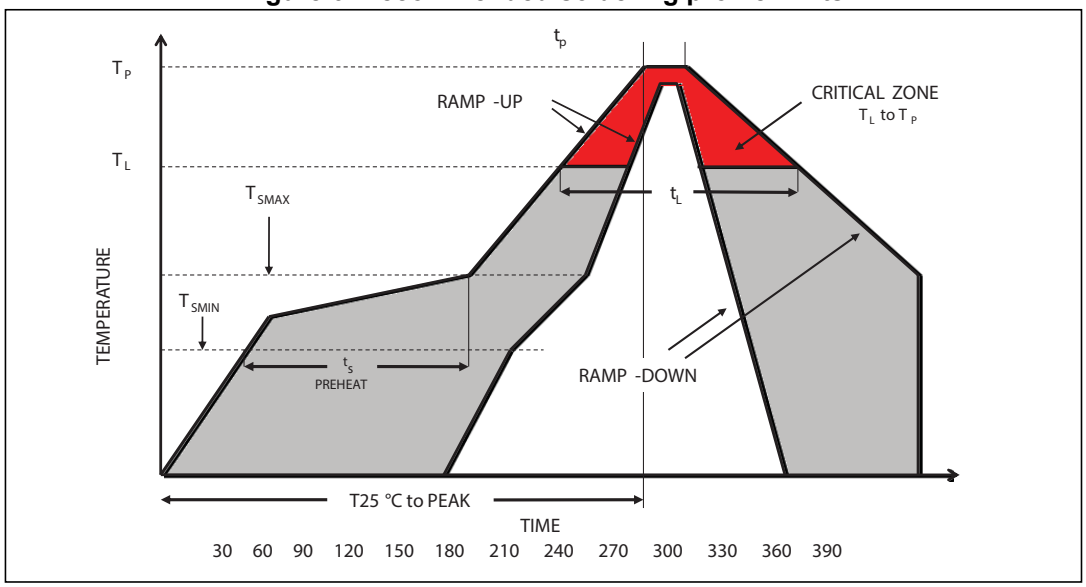


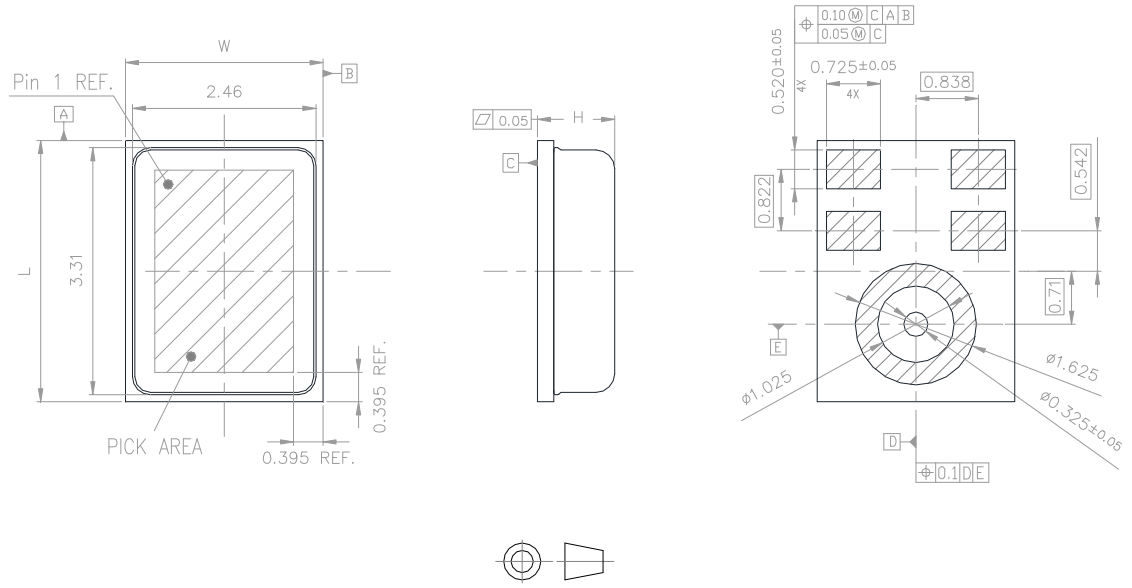
Table 9. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidous temperature Liquidous 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

Table 9. Recommended soldering profile limits (continued)

Description	Parameter	Pb free
Ramp-down rate		6 °C/sec max
Time 25 °C (t25 °C) to peak temperature		8 minutes max

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

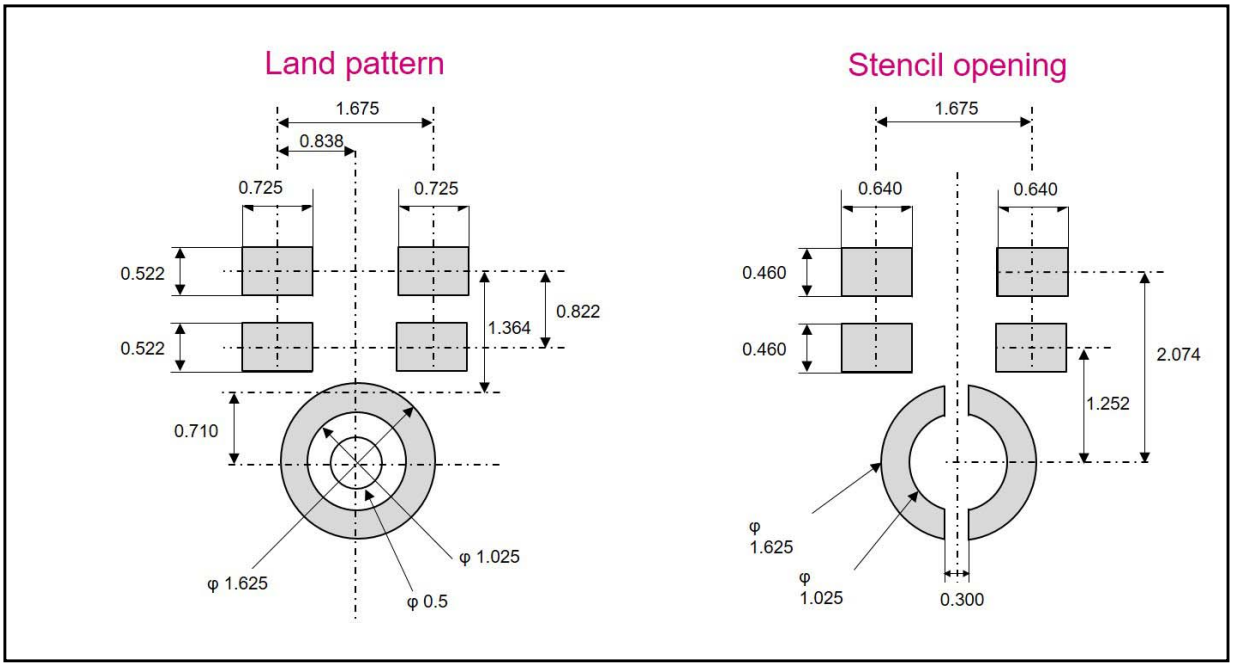
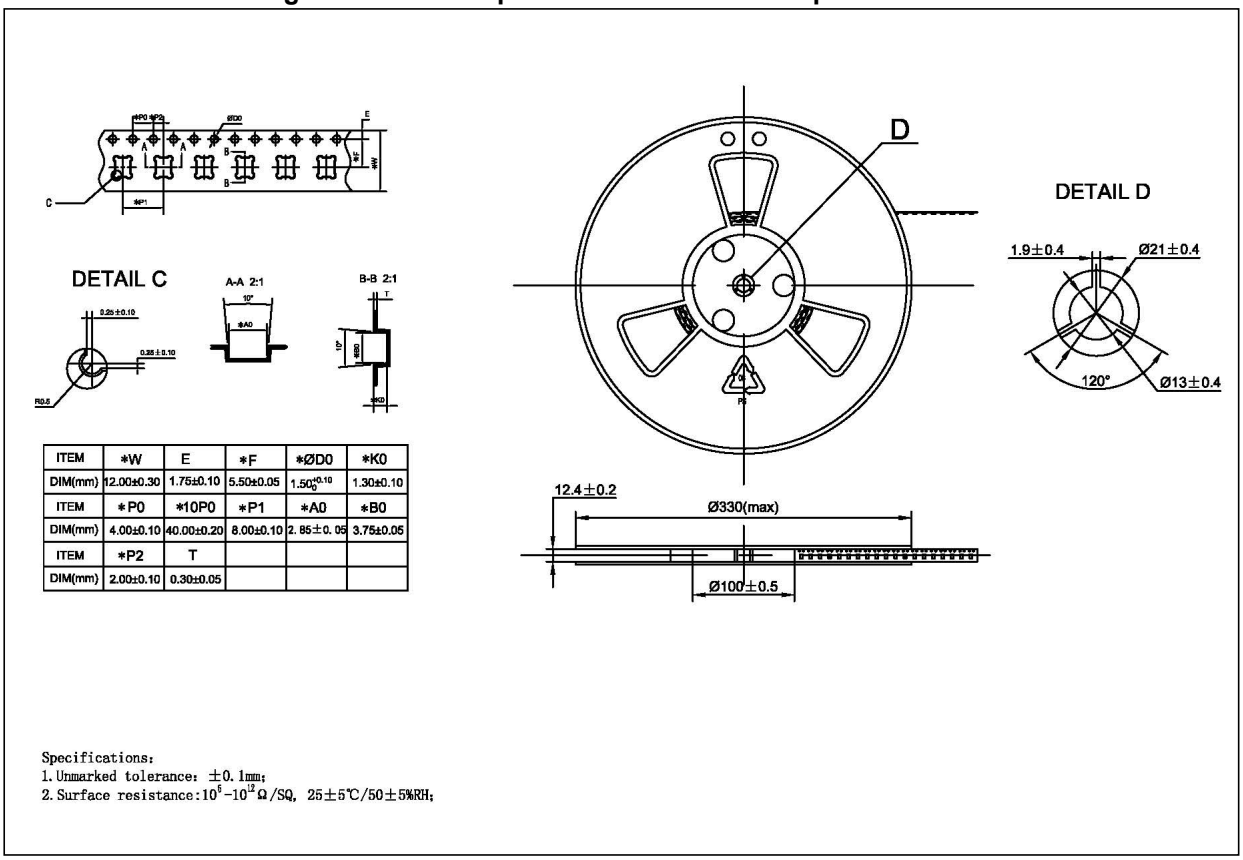


Figure 9. Carrier tape and reel mechanical specifications



ITEM	*W	E	*F	*ØD0	*K0
DIM(mm)	12.00±0.30	1.75±0.10	5.50±0.05	$1.50^{+0.10}_{0}$	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;

7 Revision history

Table 10. Document revision history

Date	Revision	Changes
29-Apr-2020	1	Initial release
27-Jul-2020	2	Added footnote *3* regarding the clock to *Table 3: General microphone specifications*