

3SM222NMB1HA MEMS Microphone IC

Product Description

The *3SM222NMB1HA* microphone IC are integrated with specialized pre-amplification & analog-to-digital converter ASIC to provide high SNR output from a capacitive audio sensor. It's packaged for surface mounting and high temperature reflow assembly. *3SM222NMB1HA* is ideal in many compact portable consumer electronic devices such as TV, notebooks and smart speaker.

Features

- Bottom port
- High stability - no risk of membrane aging
- Suitable for automatic pick-and-place handler and SMT process
- Pulse density modulator (PDM) output interface supports two microphones on a single data line
- Miniature dimension 3.50mm x 2.65mm x 0.98mm
- RoHS/Green compliant
- Sensitivity deviation within ± 1 dB
- Package type : LGA 5-pin
- Omnidirectional

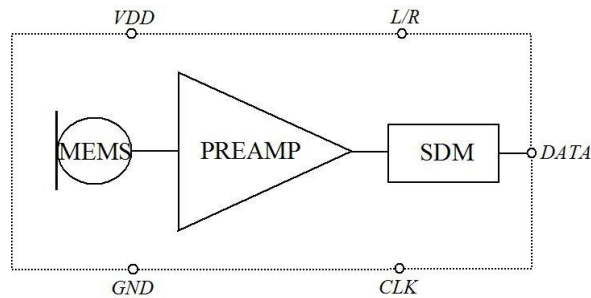
Applications

- TVs
- Smart Speakers
- IoT Devices
- Notebooks

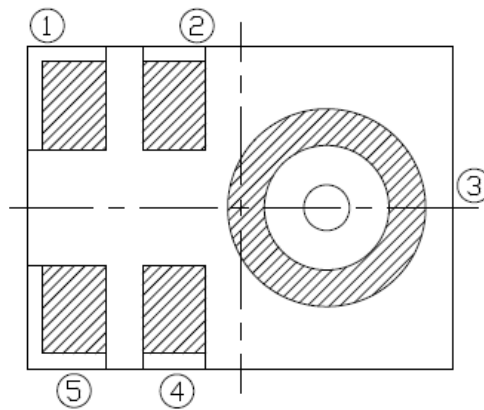
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Functional Block Diagram



Pin Definition and Function



Bottom View

Table 1.

Pin #	Symbol	Type	Function
1	DATA	Digital O	Digital Output Signal
2	L/R	Non-Digital I	Left(Low) / Right(High) Select Pin
3	GND	Power	Ground
4	CLK	Digital I	Clock Input to Microphone
5	VDD	Power	Power Supply

Temperature Range

Table 2.

Storage Temperature	T _{STG}	-40°C ~ 125°C
Operating Temperature Range	T _A	-40°C ~ 105°C

Acoustical and Electrical Characteristics

Table 3. General Microphone Specifications

Typical test conditions are TA = 23 °C, VDD = 1.8V and R.H. = 50 % measured in a pressure chamber test setup. All voltages refer to GND node

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Supply Voltage	Vdd	1.6		3.6	V	
Low Frequency Roll-off	LFRO		10		Hz	-3dB relative to 1KHz
High Frequency Flatness			13		kHz	+3dB relative to 1KHz
Resonant Frequency Peak			24		kHz	
Output Load	C _{Load}			100	pF	
Wake-up Time ⁽¹⁾			50		ms	Fclk ≥ 1MHz
Startup Time			50		ms	
Sleep Time			1		ms	Fclk ≤ 1KHz
DC Offset		-3.2		0.3	%FS	Fullscale = ±100
Data Format	1/2 Cycle PDM					
Directivity	Omnidirectional					
Polarity	Increasing density of 1's					Increasing sound pressure

Table 4. Performance Mode Microphone Specifications

Typical test conditions are TA = 23 °C, VDD = 1.8V, Clock=2.4MHz and R.H. = 50 % measured in a pressure chamber test setup. All voltages refer to GND node

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Acoustic						
Sensitivity	S	-27	-26	-25	dBFS	1KHz, 94dB SPL
Signal to Noise Ratio	S/N		67		dBA	A-weighted
Equivalent Noise Level	ENL		27		dBA	A-weighted
Total Harmonic Distortion	THD		<0.2		%	94dB SPL
			1		%	110dB SPL
Acoustic Overload Point	AOP		120		dB SPL	10% THD@1KHz, S = Typ.
Electrical						
Clock Frequency	Fclk	1.0		4.8	MHz	
Current Consumption	Isb		1150		μA	Vdd=1.8V
			1250		μA	Vdd=3.6V
Power Supply Rejection Ratio	PSRR		70		dBV/FS	1KHz, 200mV peak to peak sine wave
Power Supply Rejection	PSR+N		-90		dBFS (A)	217Hz, 100mV 1/8 duty cycle peak to peak square wave

Table 5. Low-Power Mode Microphone Specifications

Typical test conditions are $T_A = 23\text{ }^\circ\text{C}$, $V_{DD} = 1.8\text{V}$, $\text{Clock} = 768\text{KHz}$ and $R.H. = 50\%$ measured in a pressure chamber test setup. All voltages refer to GND node

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Acoustic						
Sensitivity	S	-27	-26	-25	dBFS	1KHz, 94dB SPL
Signal to Noise Ratio	S/N		67		dB	A-weighted
Equivalent Noise Level	ENL		27		dB	A-weighted
Total Harmonic Distortion	THD		<0.2		%	94dB SPL
			1		%	110dB SPL
Acoustic Overload Point	AOP		120		dB SPL	10% THD@1KHz, S = Typ.
Electrical						
Clock Frequency	Fclk	350		800	KHz	
Current Consumption	I _{sb}		400		μA	V _{dd} =1.8V
			450		μA	V _{dd} =3.6V
Power Supply Rejection Ratio	PSRR		70		dBV/FS	1KHz, 200mV peak to peak sine wave
Power Supply Rejection	PSR+N		-90		dBFS (A)	217Hz, 100mV 1/8 duty cycle peak to peak square wave

Table 6. Sleep Mode Microphone Specifications

Typical test conditions are $T_A = 23\text{ }^\circ\text{C}$, $V_{DD} = 1.8\text{V}$, $\text{Clock} = 0\text{Hz}$ and $R.H. = 50\%$ measured in a pressure chamber test setup. All voltages refer to GND node

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Clock Frequency	Fclk	0		250	KHz	
Current Consumption Sleep Mode	I _{sleep}		10		μA	Clock = V _{DD} or GND

(1). Time from the first clock edge to valid output data

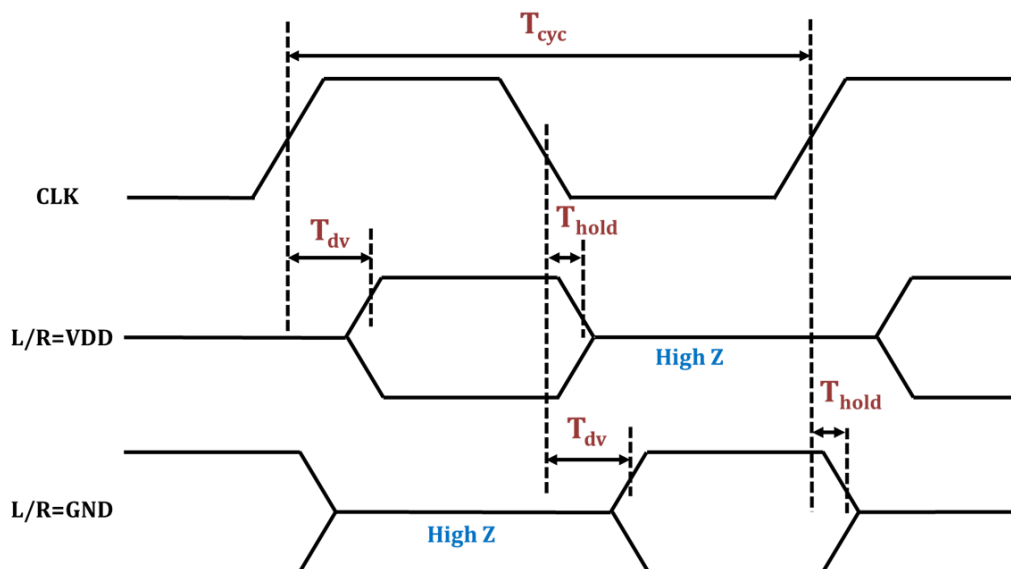
Timing Characteristics

Table 7. Microphone Interface Specifications

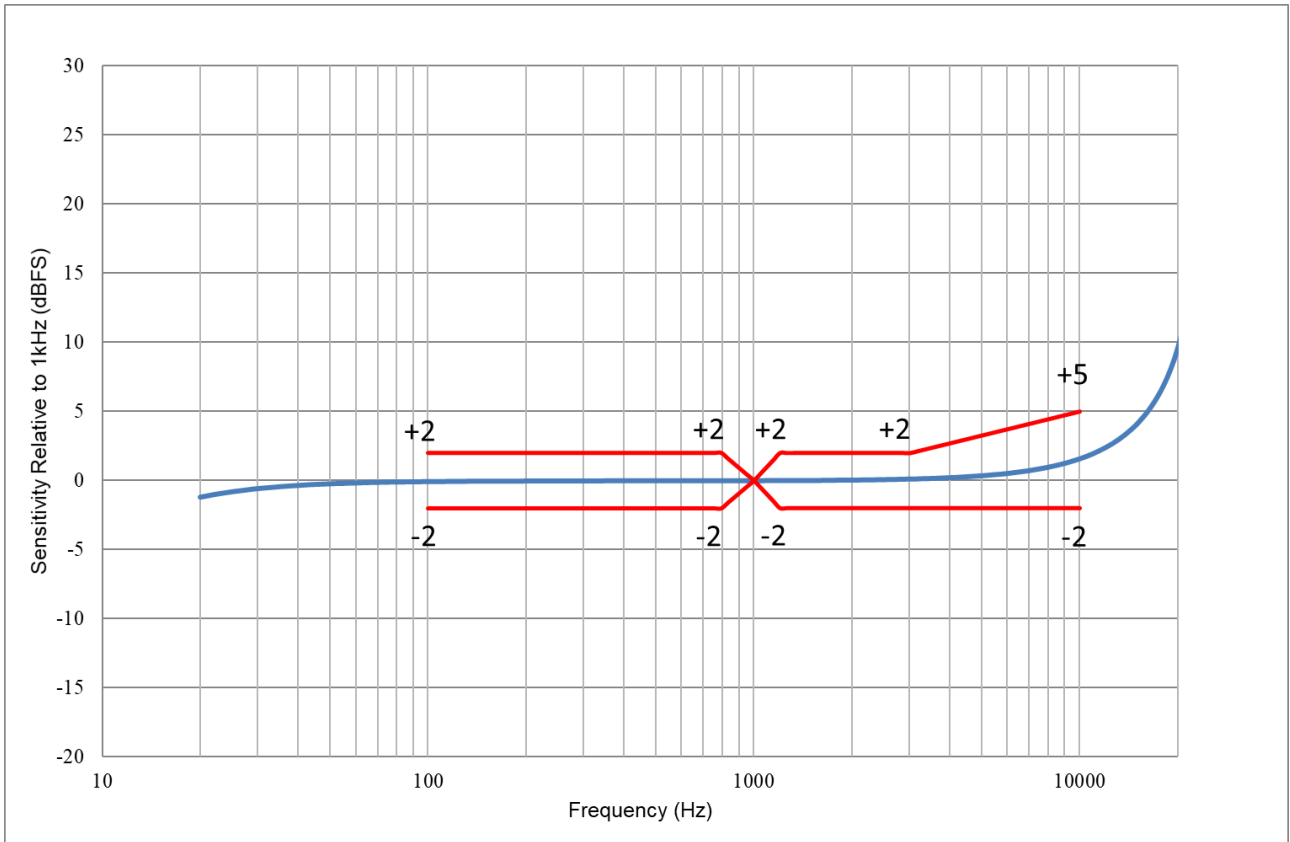
Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Logic Input High	V_{IH}	0.65x VDD		3.6	V	
Logic Input Low	V_{IL}	-0.3		0.35x VDD	V	
Logic Output High	V_{OH}	VDD -0.45		VDD	V	$I_{out} = 1\text{mA}$
Logic Output Low	V_{OL}	0		0.45	V	$I_{out} = 1\text{mA}$
Clock Frequency	F_{clock}			250	KHz	Sleep Mode
		350		800		Low-Power Mode
		1.0		4.8	MHz	Performance Mode
Clock Duty Cycle		40		60	%	
Clock Period for Normal Mode	T_{cyc}	208		1000	ns	
Data Setup Time	T_{dv}			100 ⁽¹⁾	ns	
Data Hold Time	T_{hold}	3 ⁽¹⁾			ns	

(1). Guaranteed by design

Timing Waveforms



Frequency Response



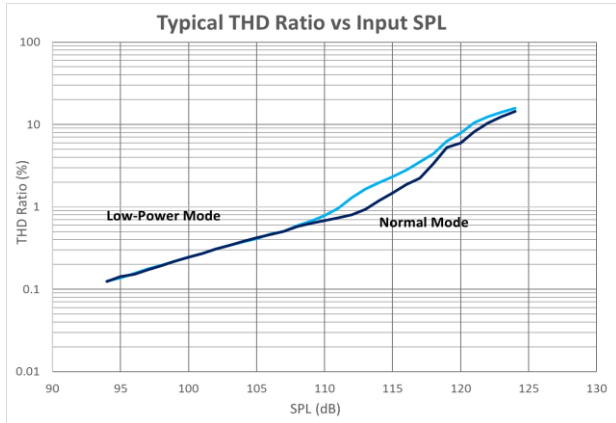
* Measured frequency of 1 KHz

Upper Limit						
Hz	100	800	1000	1200	3000	10000
dB ref. 1KHz	+2	+2	0	+2	+2	+5
Lower Limit						
Hz	100	800	1000	1200	3000	10000
dB ref. 1KHz	-2	-2	0	-2	-2	-2

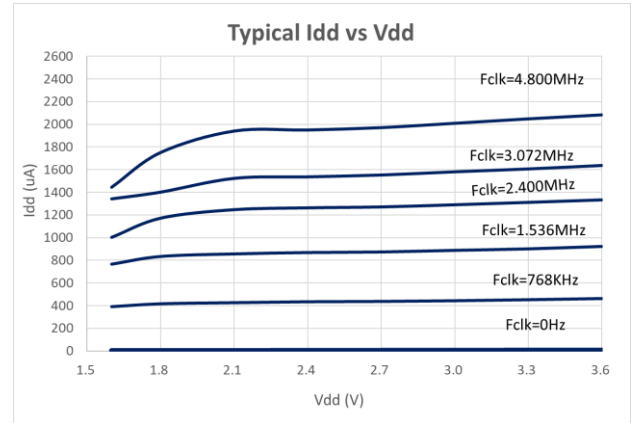
Performance Curves

Typical test conditions are $T_A = 23\text{ }^\circ\text{C}$, $V_{DD} = 1.8\text{V}$ and $R.H. = 50\%$, output unloaded

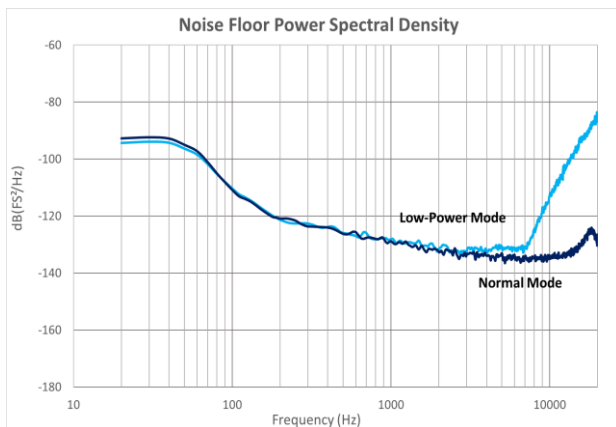
Typical THD vs Input SPL



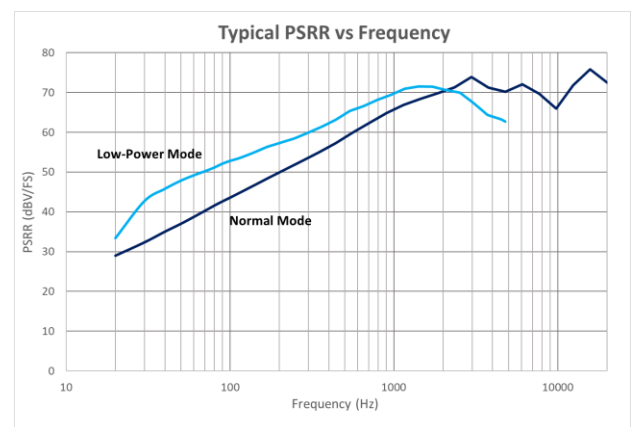
Typical I_{dd} vs V_{dd}



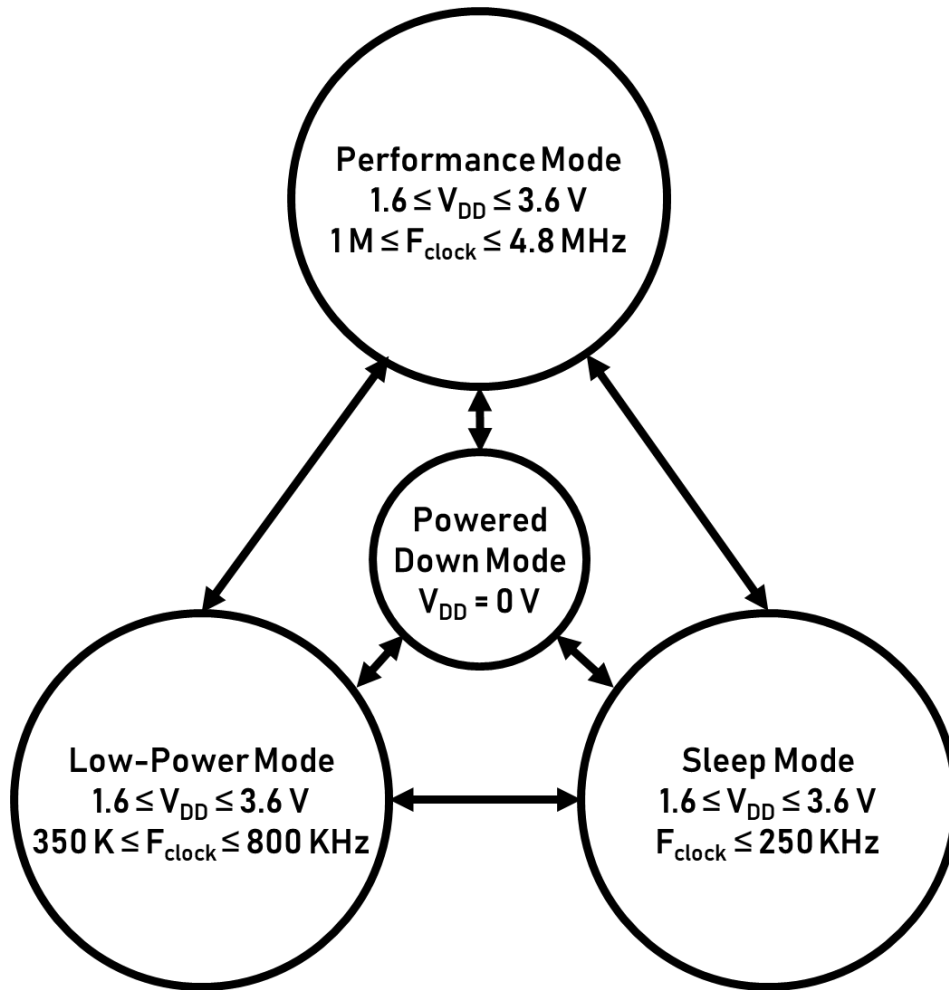
Noise Floor Power Spectral Density



Typical PSRR vs Frequency



State Diagram



Reliability Qualifications

Table 8.

Test Item	Description
High Temperature Storage	Storage at 125°C for 1,000 hours JESD22-A103
Low Temperature Storage	Storage at -40°C for 1,000 hours JESD22-A119
High Temperature Operation Bias	Under Bias at 105°C for 1,000 hours JESD22-A108
Low Temperature Operation Bias	Under Bias at -40°C for 1,000 hours JESD22-A108
Temperature Humidity Bias	Under Bias at 85°C/85%RH for 1,000 hours JESD22-A101
Thermal Cycling Test	Thermal Cycle from -40°C~125°C, 100 cycles JESD22-A104
Reflow	5 reflow cycles with peak 260°C J-STD-020
Vibration	4 cycles lasting 12 minutes from 20 to 2KHz in X, Y and Z with peak acceleration of 20G JESD22-B103
Mechanical Shock	Total 18 pulses 10,000G in X,Y and Z JESD22-B104
ESD	HBM:3KV, MM:300V, CDM:500V Air Discharge:15KV, Contact Discharg:8KV JESD22-A114(HBM) JESD22-A115(MM) JESD22-C101(CDM) IEC 61000-4-2(Air Discharge) IEC 61000-4-2(Contact Discharge)

Notes: Microphones meet all acoustic and electrical specifications before and after reliability testing, except sensitivity which can deviate up to 3dB from its initial value.

After 5 reflow cycles, the sensitivity of the microphone shall not deviate more than 1 dB from its initial value.

Reflow Profile

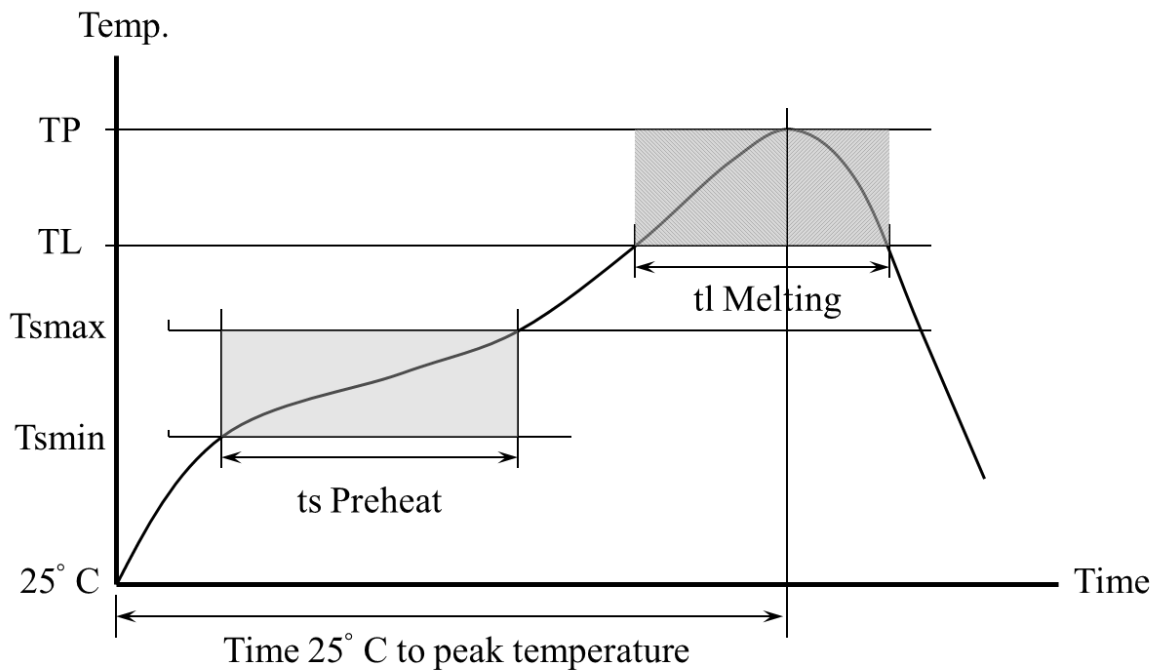


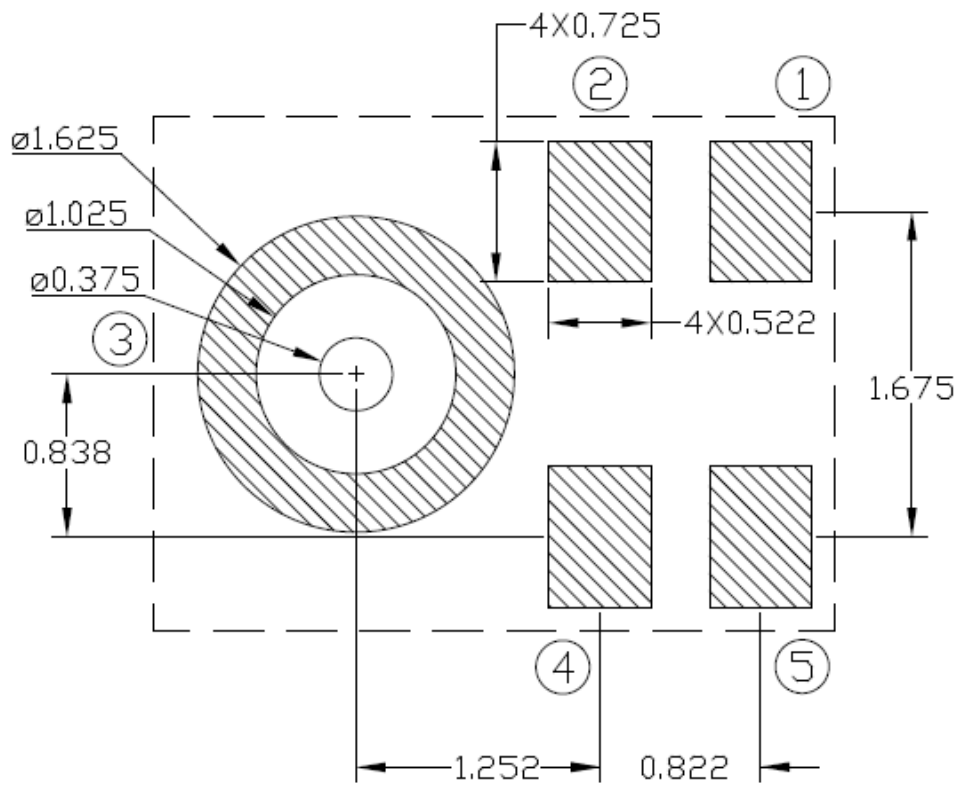
Table 9. Recommended Reflow Profile Limits

Profile Feature	Pb-free
Preheat	
Minimum temperature (Tsmin)	150 °C
Maximum temperature (Tsmax)	200 °C
Time (ts)	60~180 sec
Average Ramp up rate (Tsmax to Tp)	3 °C/sec
Melting area	
Melting temperature (TL)	217 °C
Time maintained above melting (tl)	60~150 sec
Peak Temperature (TP)	260 °C
Time within 5°C of actual peak temperature	20~40 sec
Ramp down rate	6 °C/sec maximum
Time 25°C to peak temperature	8 minute maximum

Notes: Based on IPC/JDEC J-STD-020 Revision F.

All temperatures refer to topside of the package, measured on the package body surface

PCB Land Pattern Layout



Application Circuit

The L/R pad lets the user to select the DATA signal pattern as explained in Table 7. The L/R pin must be connected to either VDD or GND.

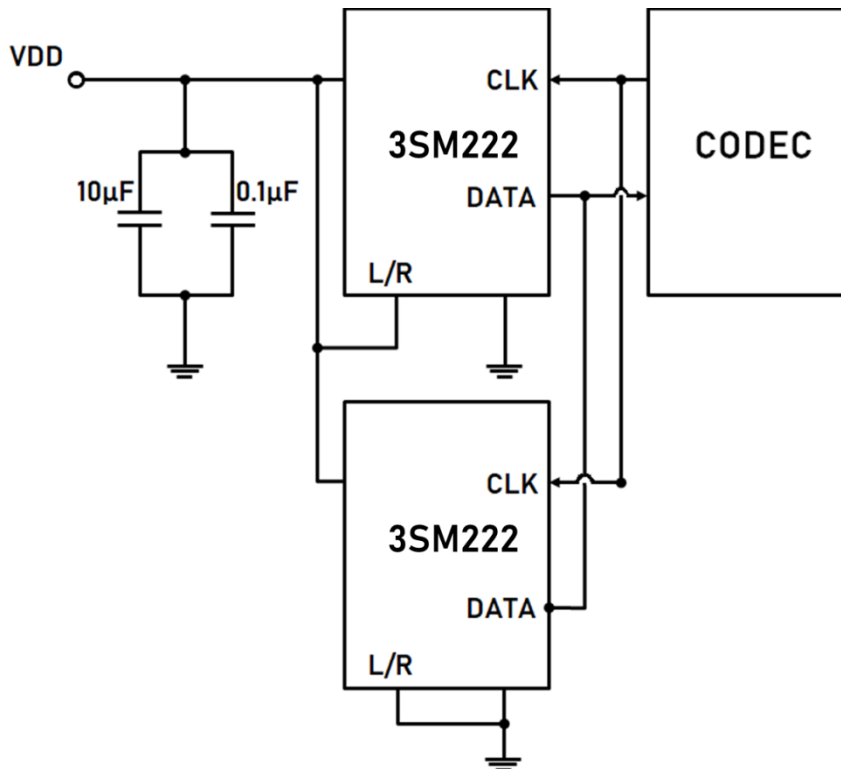
Table 10. L/R channel selection

L/R	CLK low	CLK high
GND	DATA valid	High impedance
VDD	High impedance	DATA valid

Single microphone application:

0.1 μ F ceramic, and 10 μ F ceramic power supply decoupling capacitors should be placed as near as possible to VDD of the device. The L/R pin must be connected to VDD or GND.

Two microphones application:

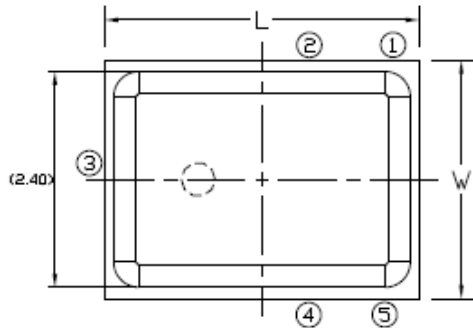


Handling Instructions

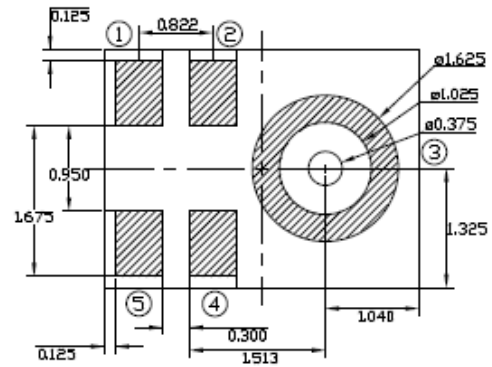
The MEMS microphone IC can be handled using standard pick-and-place and chip shooting equipment. Care should be taken to avoid damage to the MEMS microphone IC structure as follows:

- Do not apply vacuum nozzle over the acoustic port (AP) of the microphone to avoid damage to the device.
- Do not blow air directly into acoustic port.
- Brushing the board with/without solvents may damage the device.
- Do not use excessive force to place the microphone on the PCB.
- In case of manual handling, it should be handled with plastic tweezers to avoid damage the device.

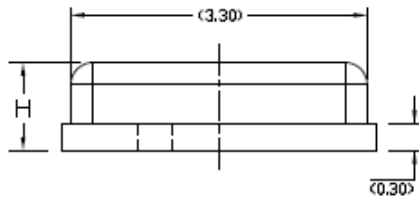
Dimensions



Top View



Bottom View



Side View

Unit: mm

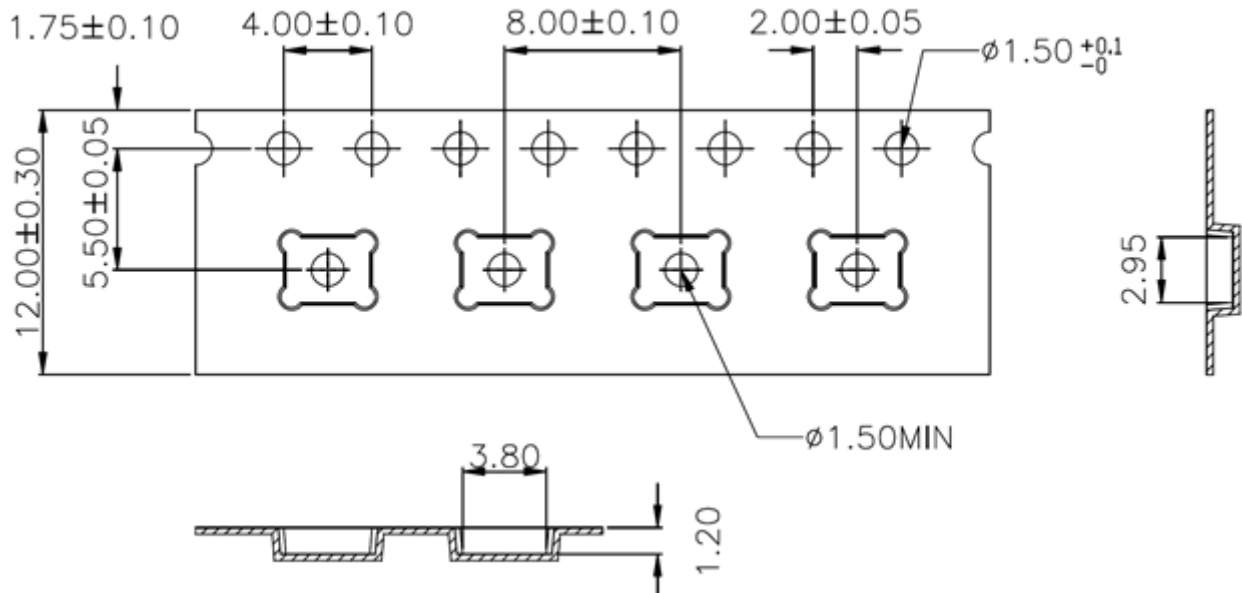
Dimension tolerance is ± 0.15 mm unless otherwise specified

Table 11. (Top View)

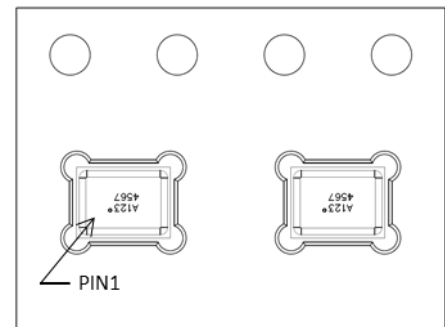
Item	Dimension	Tolerance
Length (L)	3.50 mm	± 0.10 mm
Width (W)	2.65 mm	± 0.10 mm
Height (H)	0.98 mm	± 0.10 mm
Acoustic Port	$\Phi 0.375$ mm	± 0.05 mm

Package Information

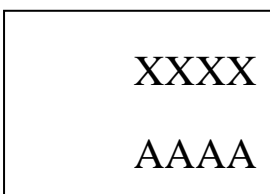
Carrier Tape:



1. 10 sprocket hole pitch cumulative tolerance ± 0.20 .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481 requirements.
5. Thickness : 0.30 ± 0.05 mm.
6. MSL(Moisture sensitivity level) 1.
7. Materials comply with ANSI/ESD S20.20 and IEC61340-5-1 standard.

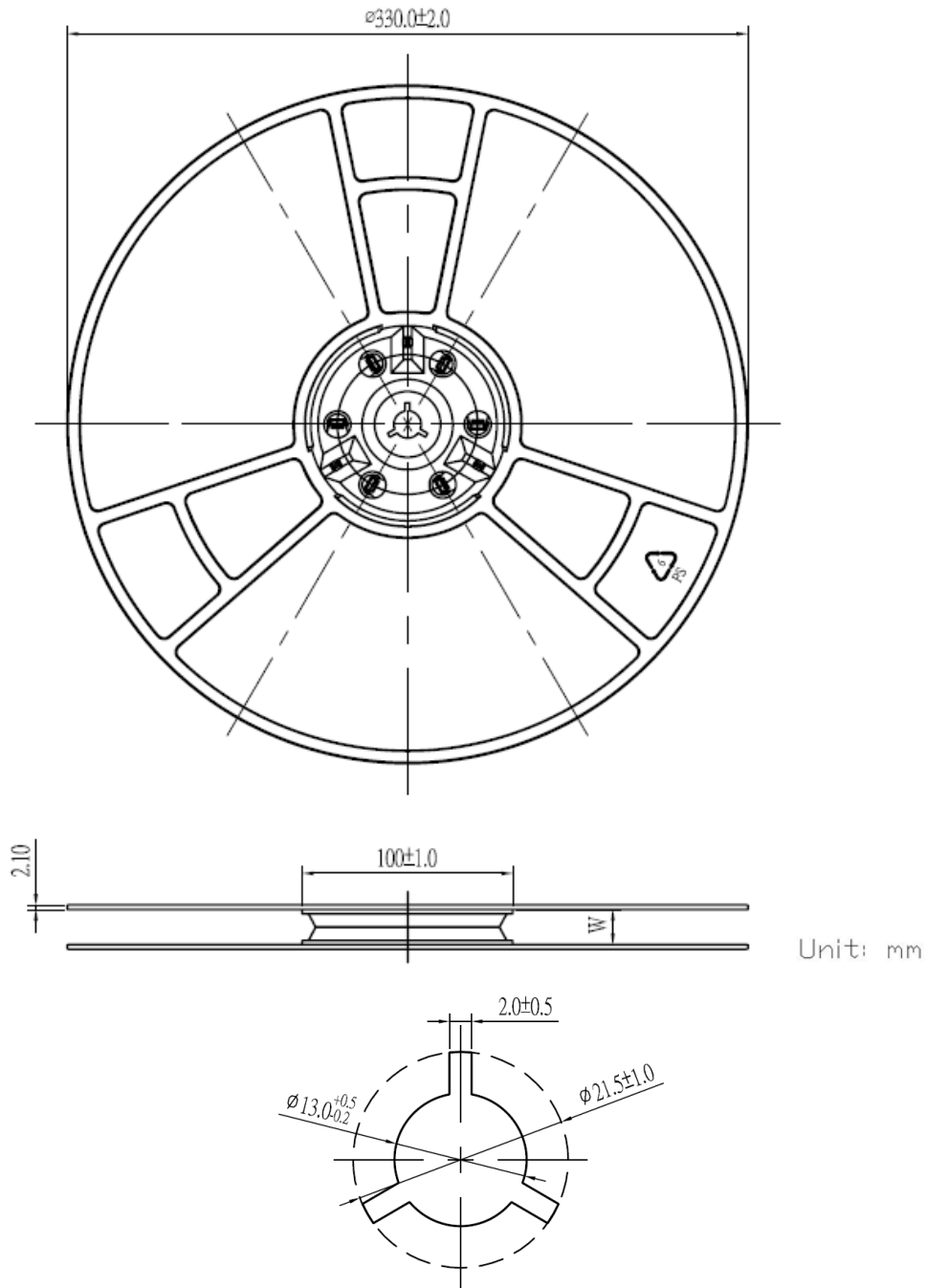


Laser Marking:

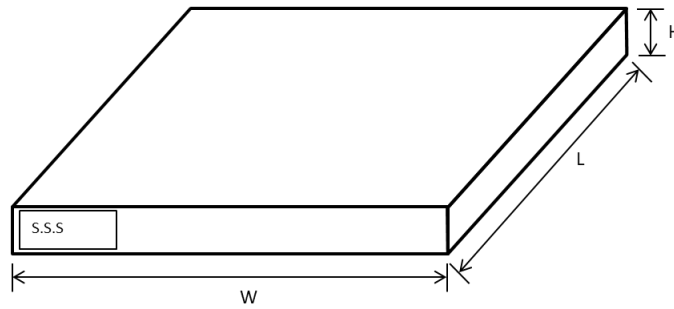


Laser marking on the top side

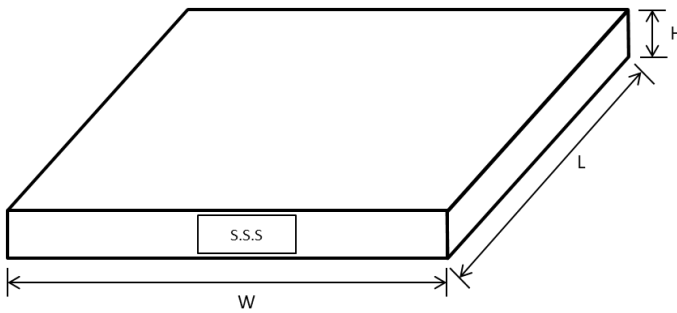
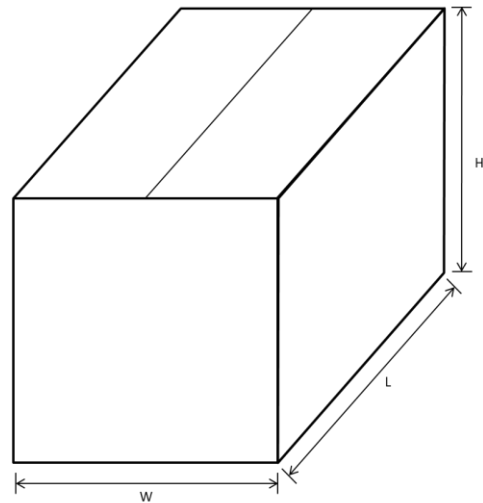
XXXX	Internal Tracking Code
AAAA	Lot Tracking Code

13" Tape Reel :


Model Number	Reel Diameter	Quantity Per Reel
3SM222MMB1HA	13"	5,000

Dimensions for Inner Box :

Unit : mm

L	W	H
355	375	40

Dimensions for Outer Box:
Outer Box for Quantity 5K-10K

Outer Box for Quantity 15K-30K, 35K-50K

Unit : mm

Quantity	L	W	H
5K - 10K	400	410	100
15K - 30K	380	280	380
35K - 50K	420	380	380

Revision History

Revision	Date	Description
1.0	2024/08/15	Formal release
1.1	2024/10/17	Modify “Frequency Response”
1.2	2024/10/23	Modify “Acoustical and Electrical Characteristics”
1.3	2025/03/28	Modify “Acoustical and Electrical Characteristics”