

***3SM227FMT1KA* AEC-Q103 Qualified**

MEMS Microphone IC

Product Description

The *3SM227FMT1KA* 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. *3SM227FMT1KA* is ideal in many compact portable consumer electronic devices such as automotive and industrial electronics device.

Features

- AEC-Q100/103 qualified
- Top 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 4.00mm x 3.00mm x 1.06mm
- RoHS/Green compliant
- Sensitivity deviation within $\pm 1\text{dB}$
- Package type : LGA 8-pin
- Omnidirectional

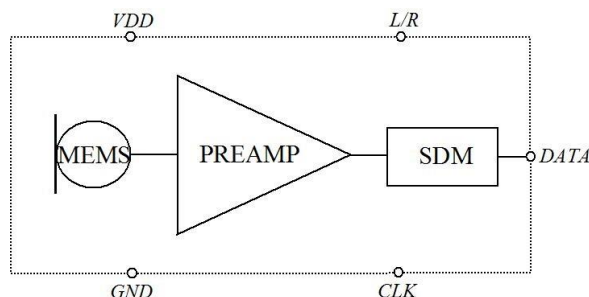
Applications

- Automotive
- Industrial

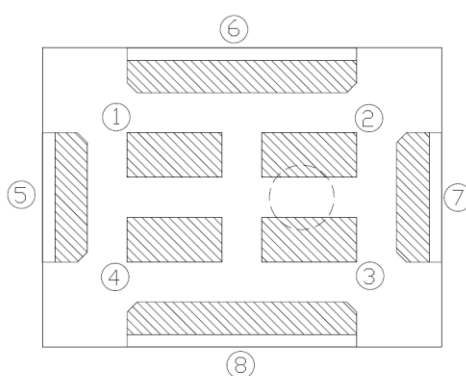
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Functional Block Diagram



Pin Definition and Function



Bottom View

Table 1.

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

Temperature Range

Table 2.

Storage Temperature	T _{STG}	-40°C ~ 150°C
Operating Temperature Range	T _A	-40°C ~ 125°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
Low Frequency Roll-off	LFRO		38		Hz	-3dB relative to 1KHz
Supply Voltage	Vdd	1.6		3.6	V	
Output Load	C _{Load}			100	pF	
Wake-up Time ⁽¹⁾			100		ms	Fclk ≥ 1MHz
Startup Time			100		ms	
Sleep Time			1		ms	Fclk ≤ 1KHz
Data Format	1/2 Cycle PDM					
Directivity	Omnidirectional					
Polarity	Decreasing 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		60		dBA	A-weighted
Equivalent Noise Level	ENL		34		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		3.25	MHz	
Current Consumption	I _{sb}		550		μA	V _{dd} =1.8V
			850		μA	V _{dd} =3.6V
Power Supply Rejection Ratio	PSRR		60		dBV/FS	1KHz, 200mV peak to peak sine wave on V _{cc} 2.1V
Power Supply Rejection	PSR+N		-80		dBFS (A)	217Hz, 100mV 1/8 duty cycle peak to peak square wave on V _{cc} 2.1V, A-weighted

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		60		dB	A-weighted
Equivalent Noise Level	ENL		34		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}		300		μA	V _{dd} =1.8V
			400		μA	V _{dd} =3.6V
Power Supply Rejection Ratio	PSRR		60		dBV/FS	1KHz, 200mV peak to peak sine wave on V _{cc} 2.1V
Power Supply Rejection	PSR+N		-80		dBFS (A)	217Hz, 100mV 1/8 duty cycle peak to peak square wave on V _{cc} 2.1V, A-weighted

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

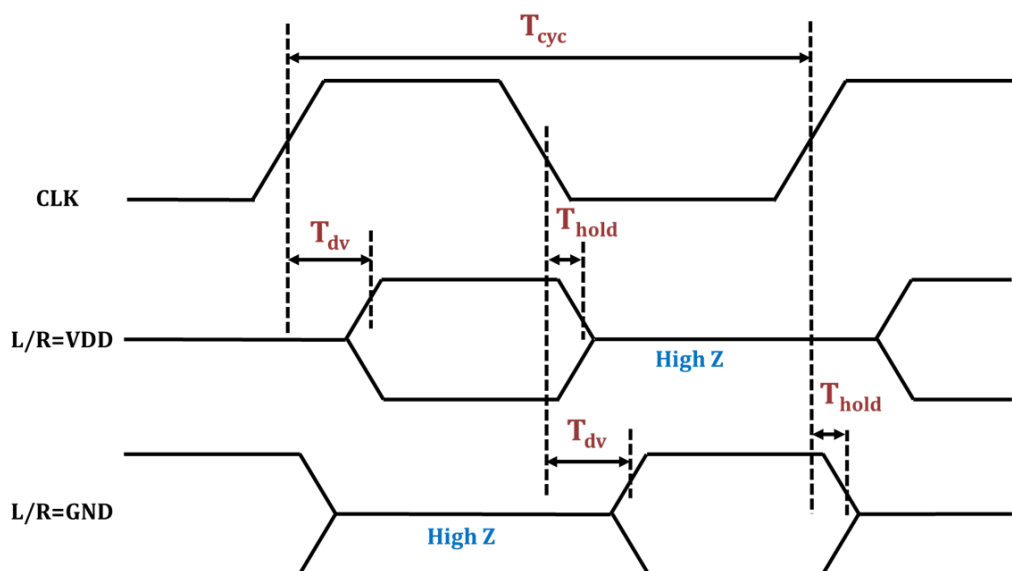
Timing Characteristics

Table 7. Microphone Interface Specifications

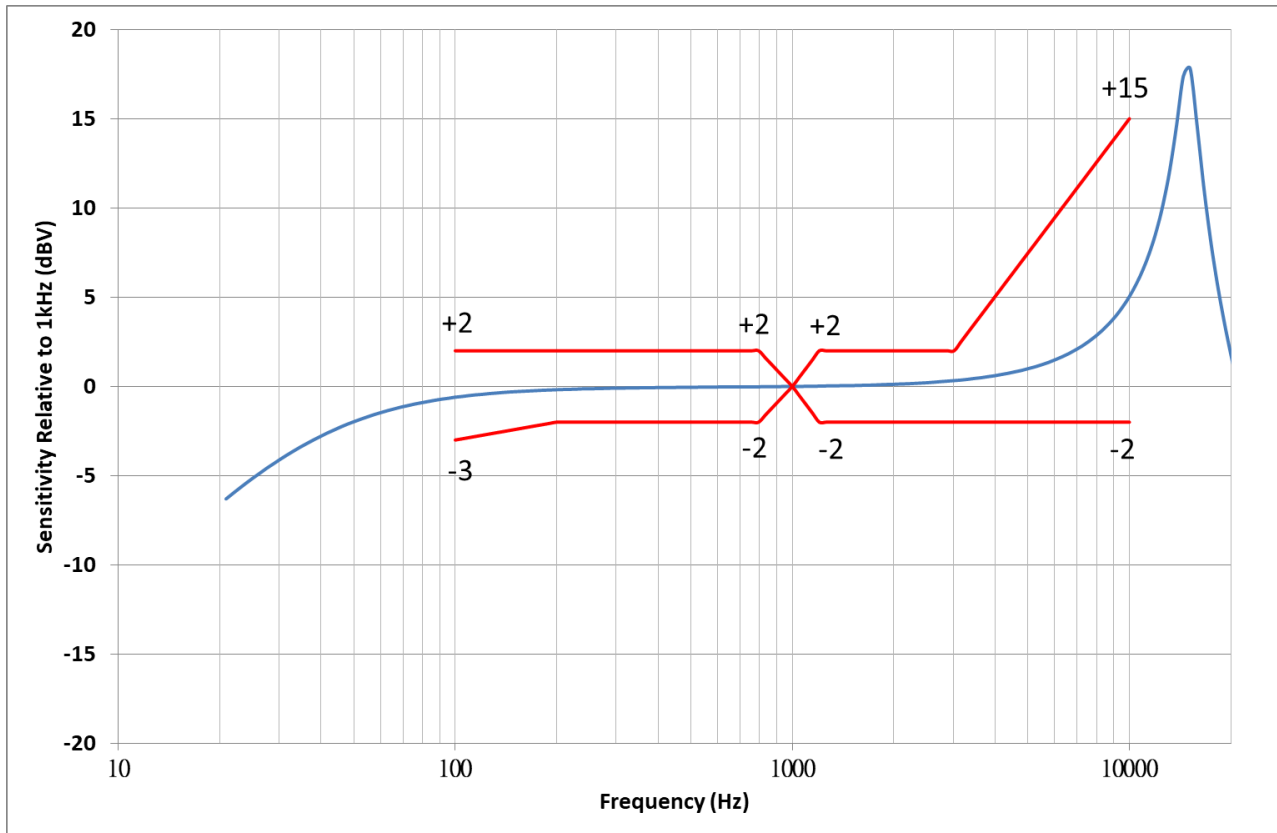
Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Logic Input High	V_{IH}	0.70x VDD		3.6	V	
Logic Input Low	V_{IL}	-0.3		0.30x VDD	V	
Logic Output High	V_{OH}	VDD -0.45		VDD	V	$I_{out} = 1\text{mA}$
Logic Output Low	V_{OL}	0		0.45	V	$I_{out} = 1\text{mA}$
Clock Frequency	F_{clock}			250	KHz	Sleep Mode
		350		800		Low-Power Mode
		1.0		3.25	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



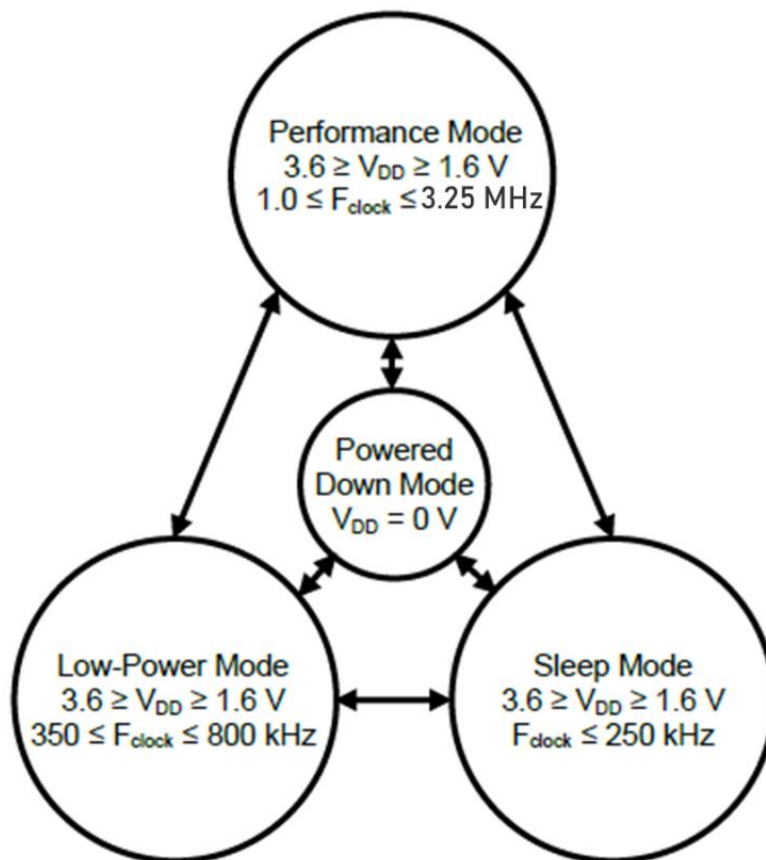
Frequency Response



* Measured frequency of 1 KHz

Upper Limit						
Hz	100	800	1000	1200	3000	10000
dB ref. 1KHz	+2	+2	0	+2	+2	+15
Lower Limit						
Hz	100	200	800	1000	1200	10000
dB ref. 1KHz	-3	-2	-2	0	-2	-2

State Diagram



Reliability Qualifications

Table 8.

Test Item	Description	Standard	Result
High Temperature Operating Life	T _A =125°C, V _{CC} =3.6V, 1000hours	AEC Q100 Rev.H	PASS
Low Temperature Operation Life	T _A =-40°C, V _{CC} =3.6V, 1000hours	JESD22-A108	PASS
High Temperature Storage Life	T _A =150°C, 1000hours	AEC Q100 Rev.H	PASS
Low Temperature Storage Life	T _A =-40°C, 1000hours	JESD22-A119	PASS
Pre-Condition	Temperature cycling 5 cycles, Bake 24hrs, Moisture sock 168hrs, Reflow 3 cycles	JESD22-A113	PASS
Temperature Humidity Bias	T _A =125°C, R.H.=85%, V _{CC} =3.6V, 1000hours	AEC Q100 Rev.H	PASS
Thermal Cycling	T _A =-55°C to 150 °C, 1000cycles	AEC Q100 Rev.H	PASS
Humidity & Temperature Cycle	+65°C/90%RH +45°C/95%RH -10°C , 5cycles	AEC Q103-003	PASS
Reflow	Peak temperature = 260°C, 5cycles	J-STD-020	PASS
Variable Frequency Vibration	Peak acceleration 20G, frequency = 20Hz to 2KHz, total 48min duration	AEC Q103-003	PASS
Mechanical Shock	Peak acceleration 10KG, 0.2ms pulse duration, 3 pulses/direction, 6 directions	JESD22-B104	PASS
Package Drop	10 drops on each of 6 faces (total 60 drops) from a high of 1.2m to concrete surface	AEC Q100 Rev.H	PASS
ESD	HBM : All pins, Test Voltage=±3KV	JESD22-A114	PASS
	MM : All pins, Test Voltage=±300V	JESD22-A115	PASS
	CDM : All pins, Test Voltage=±500V	JEDEC JS-002	PASS
	Air Discharge : Test Voltage=±15KV	IEC 61000-4-2	PASS
	Contact Discharge : Test Voltage=±8KV	IEC 61000-4-2	PASS
Latch-up	Class II, T _A =105°C, I=±150mA	AEC Q100 Rev.H	PASS

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

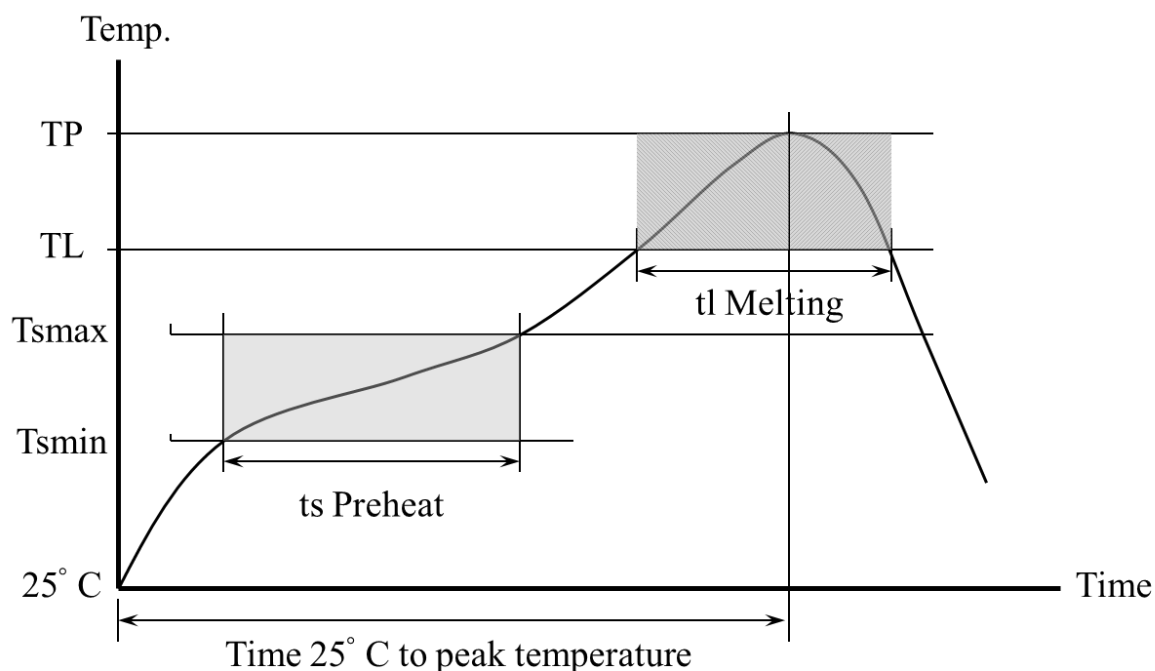


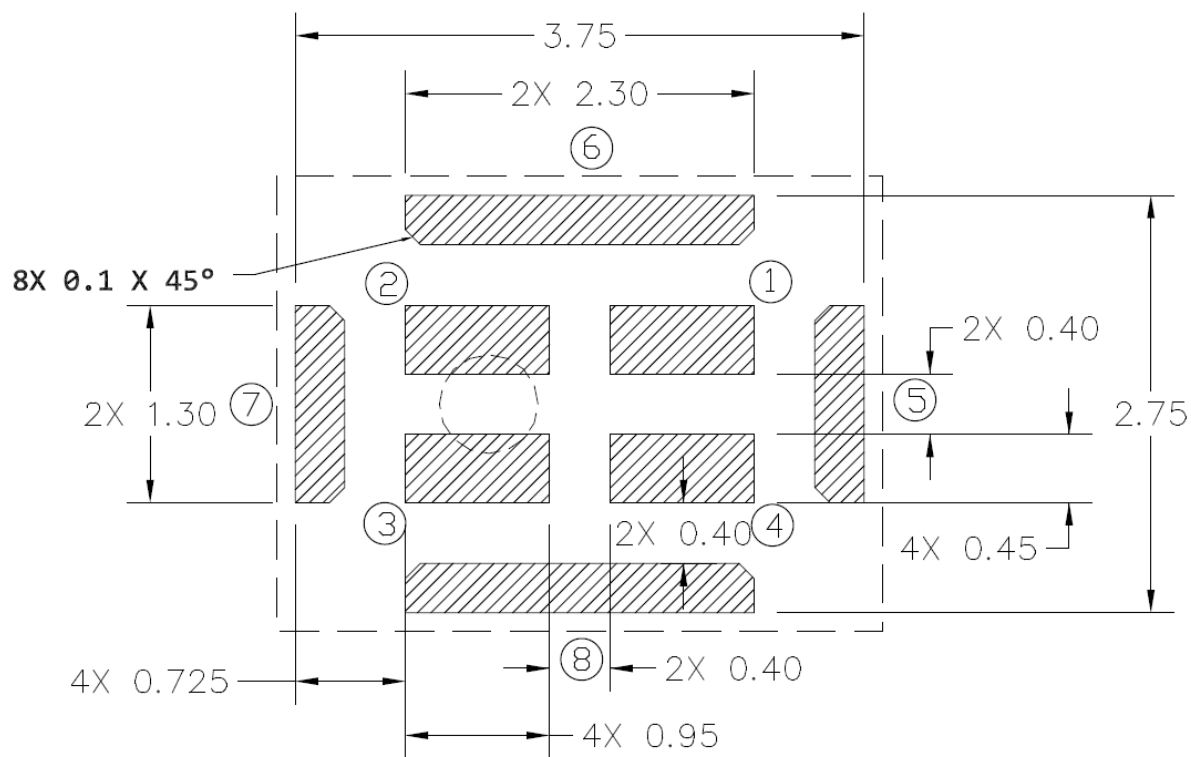
Table 9. Recommended Reflow Profile Limits

Profile Feature	Pb-free
Preheat	
Minimum temperature (T_{smin})	150 °C
Maximum temperature (T_{smax})	200 °C
Time (ts)	60~180 sec
Average Ramp up rate (T_{smax} to T_p)	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.

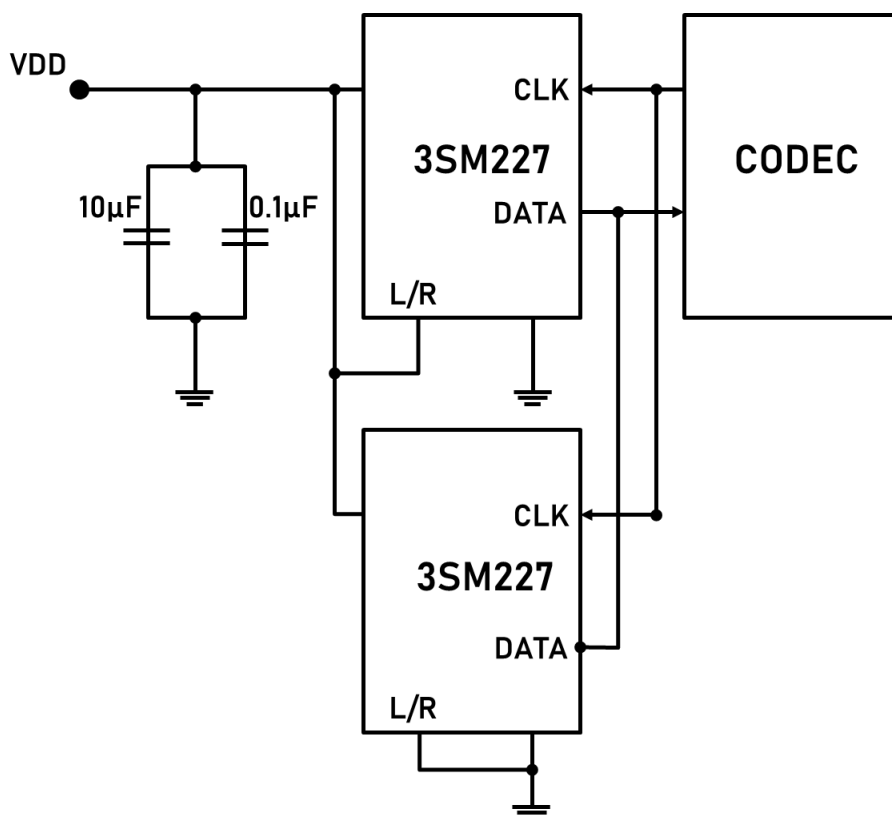
Table 10. L/R channel selection

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

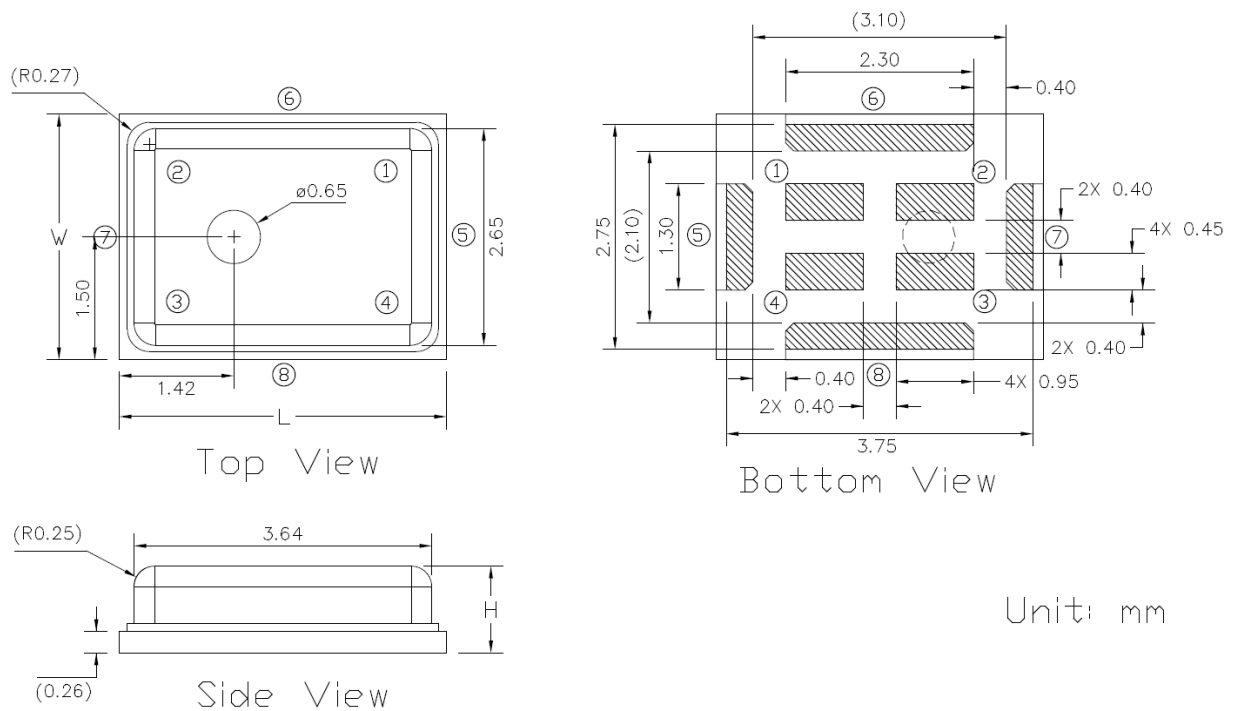
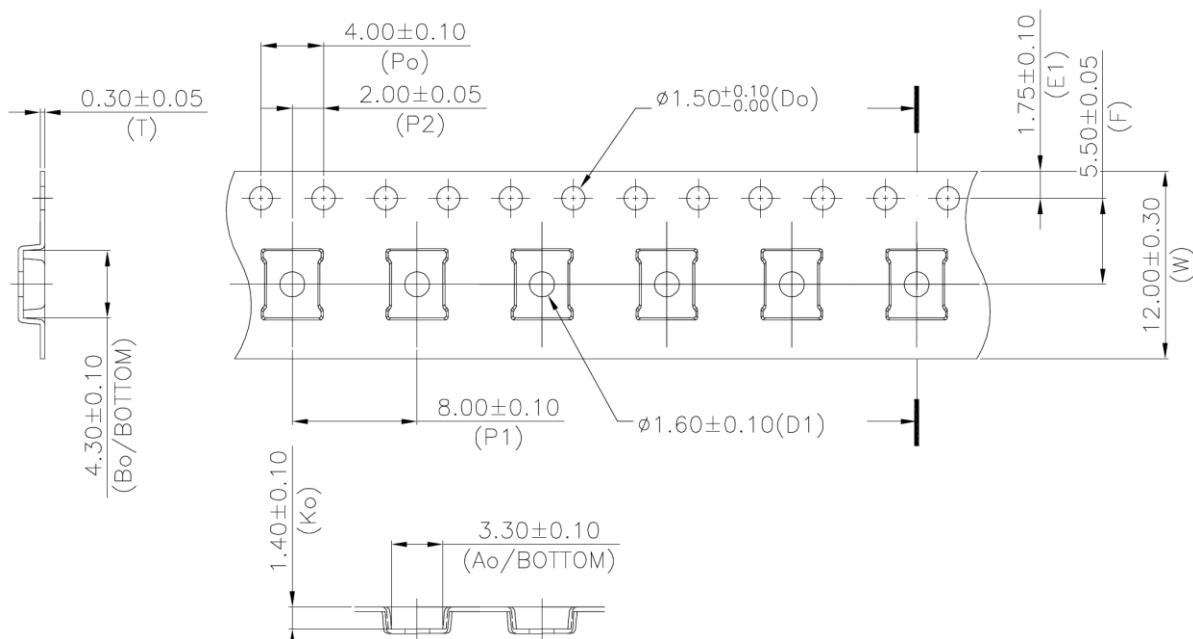


Table 11. (Top View)

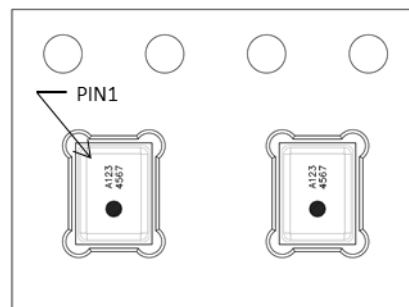
Item	Dimension	Tolerance
Length (L)	4.00 mm	± 0.10 mm
Width (W)	3.00 mm	± 0.10 mm
Height (H)	1.06 mm	± 0.10 mm
Acoustic Port	$\Phi 0.65$ mm	± 0.05 mm

Package Information

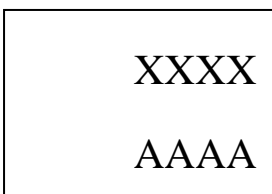
Carrier Tape:



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) Class1.

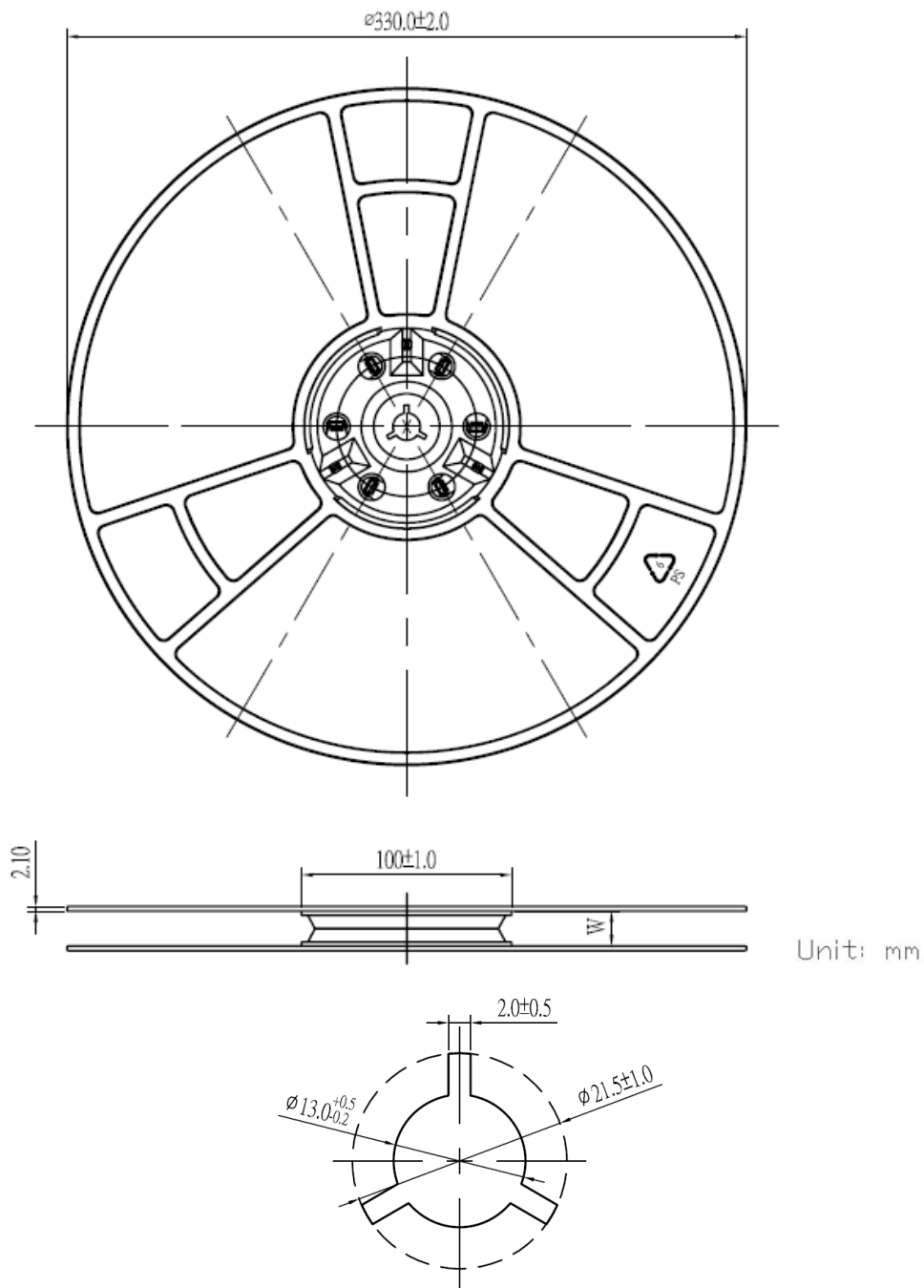


Laser Marking:



Laser marking on the top side

XXXX	Internal Tracking Code
AAAA	Lot Tracking Code

13" Tape Reel :


Model Number	Reel Diameter	Quantity Per Reel
3SM227FMT1KA	13"	5,000

Revision History

Revision	Date	Description
1.0	2023/06/06	Formal release