SPECIFICATION

受控

Customer:

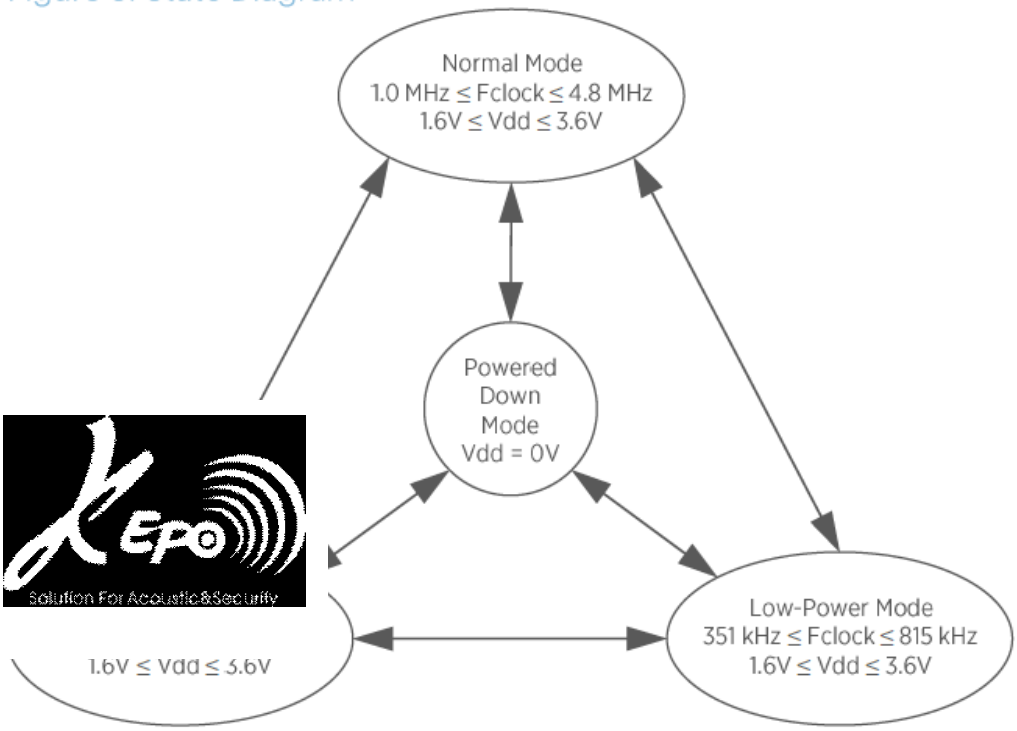
Product Name: MEMS

Model : KPCM-0141LM4H -26DB-A

Drawing No.: 308-0302-00018

Compliance with ROHS (本品符合 ROHS 指令)

Figure 3: State Diagram



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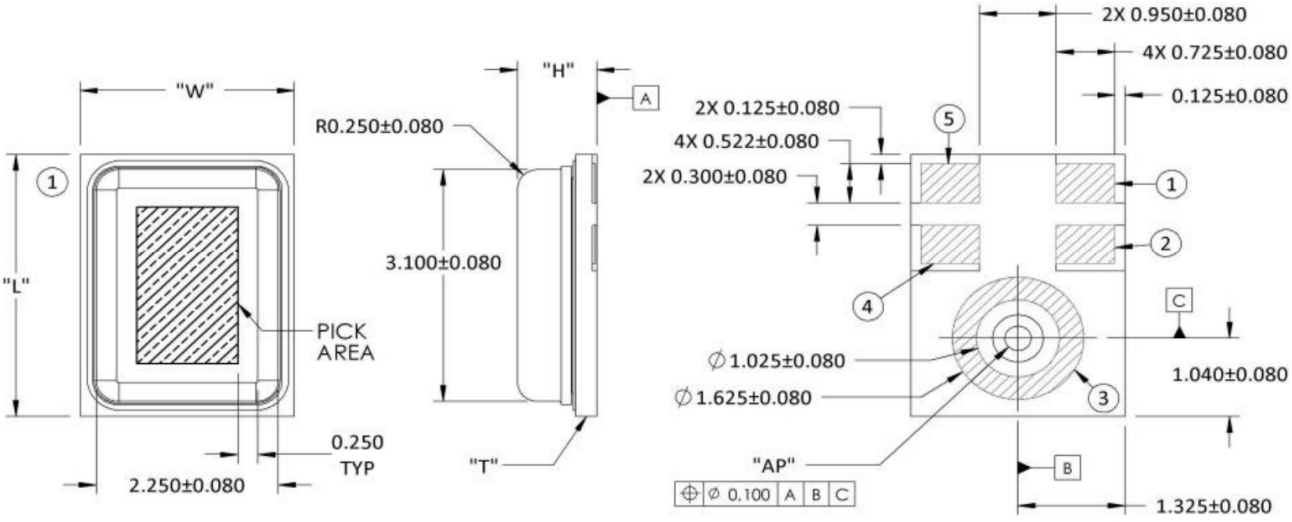
1. Mechanical Layout and Dimensions 机械布局与尺寸

1.1 Dimensions 尺寸



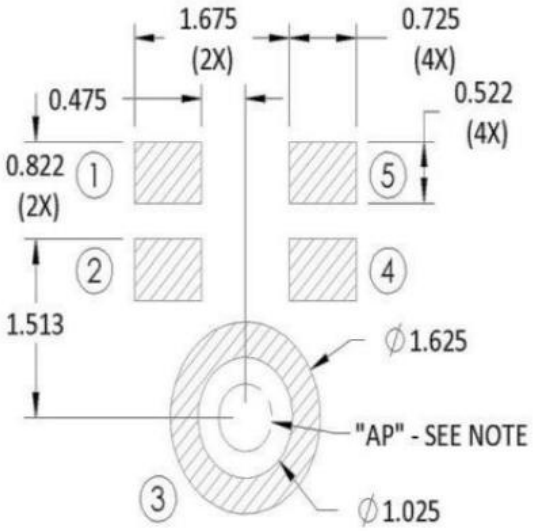
Item	Dimension	Tolerance
Length (L)	3.5	±0.10
Width (W)	2.65	±0.10
Height (H)	0.98	±0.10
Acoustic Port	Ø0.325	±0.05
PCB Thickness(T)	0.307	±0.05

Pin #	Pin Name	Type	Description
1	DATA	Digital O	PDM Output
2	SELECT	Digital I	Lo/Hi(L/R)Select Connect to Vdd orGND
3	GROUND	Power	Ground
4	CLOCK	Digital I	Clock input
5	Vdd	Power	Power Supply.Pull low to turn off and do not leave floating

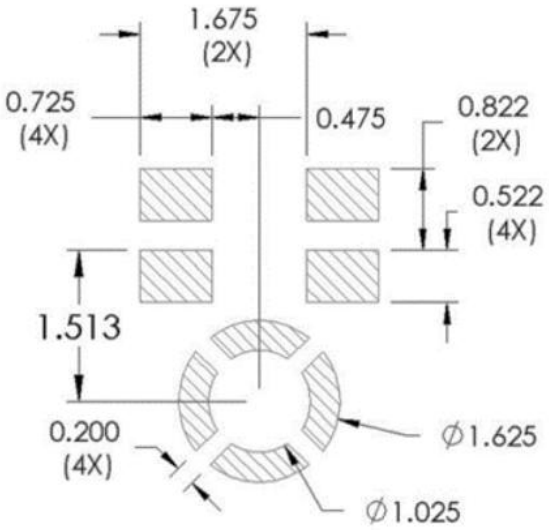
Notes: Pick Area only extends to 0.25 mm of any edge or hole unless otherwise specified.Dimensions are in millimeters unless otherwise specified. Tolerance is ±0.15mm unless otherwise specified
除非另有规定，否则拾取区域仅延伸到任何边或孔的0.25 mm。除非另有规定，否则尺寸单位为毫米。除非另有规定，否则公差为±0.15mm

1.2 Recommended Customer Land Pattern & stencil pattrn layout：
推荐客户布线

Example Land Pattern



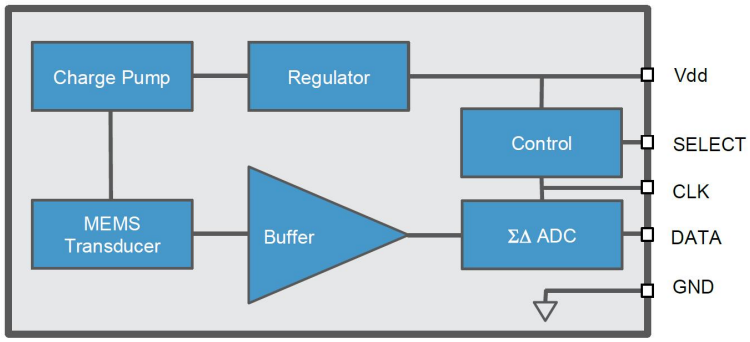
Example Solder Stencil Pattern



NOTES:

Pick Area only extends to 0.25 mm of any edge or hole unless otherwise specified.
Dimensions are in millimeters unless otherwise specified.
Tolerance is ±0.15mm unless otherwise specified
In the acoustic path, the recommended PCB Hole Diameter is $0.6 \leq D \leq 1.0$mm, the recommended Gasket Cavity Diameter is $D \geq 1.0$mm and the recommended Case Hole Diameter is $1.0 \leq D \leq 1.5$mm. Further optimizations based on application should be performed.

2. Electrical and Acoustic Characteristics.电声参数



2.1 ACOUSTIC & ELECTRICAL SPECIFICATIONS

Table 1: Absolute Maximum Ratings

Parameter	Absolute Maximum Rating	Units
Vdd to Ground	-0.3, +5.0	V
DATA, CLOCK, SELECT to Ground	-0.3, +5.0	V
Input Current	±5	mA
Short Circuit to/from DATA	Indefinite to Ground or Vdd	sec
Storage Temperature	-40 to +100	ºC
Operating Temperature	-40 to +100	ºC

Stresses exceeding these "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation at these or any other conditions beyond those indicated under "Acoustic & Electrical Specifications" is not implied. Exposure beyond those indicated under "Acoustic & Electrical Specifications" for extended periods may affect device reliability.

Table 2: General Microphone Specifications

Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Tedge ≤ 3ns, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage	Vdd		1.6	1.8	3.6	V
Low Frequency Rolloff	LFRO	-3dB relative to 1 kHz	-	45	-	Hz
High Frequency Flatness		+3dB relative to 1 kHz	-	TBD	-	kHz
Resonant Frequency Peak	Fres	Free Field response	-	TBD	-	kHz
DC Offset		Fullscale = ±100	-	0	-	% FS
Directivity			Omnidirectional			
Polarity		Increasing sound pressure	Increasing density of 1's			
Data Format			½ Cycle PDM			
Sensitivity Drop		Vdd(min) ≤ Vdd ≤ Vdd(max)	-	-	±0.25	dB
Clock Input Capacitance	Cin		-	5	-	pF
Data Output Capacitance	Cout		-	18	-	pF
Data Output Load	Cload		-	-	140	pF
SELECT (high)			Vdd-0.2	-	3.6	V
SELECT (low)			-0.3	-	0.2	V
Short Circuit Current	Isc	Grounded DATA pin	1	-	20	mA
Fall-asleep Time[3,4]		Fclock < 250kHz	-	-	10	ms
Wake-up Time[3,5]		Fclock ≥ 500kHz	-	-	15	ms
Startup Time[3]		Powered Down → Active, S within 1 dB of final value	-	-	50	ms
Time to First Data Bit[6]		Time from valid Vdd and CLK until the first logical bit is driven on the DATA line. The output is tristate until First Data Bit.	-	15	-	ms
Mode-Change Time[3, 6]		Low Power Mode ⇔ Normal Mode	-	-	10	ms

Table 3: Normal Mode

Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Fclock = 2.4 MHz (D.C. = 50%), Tedge ≤ 3ns, SELECT grounded, no load, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current[2]	Idd	Fclock = 2.4 MHz	-	620	700	µA
Sensitivity	S	94 dB SPL @ 1 kHz	-27	-26	-25	dBFS
Signal to Noise Ratio	SNR	94 dB SPL @ 1 kHz, A-weighted, Fclock = 2.4 MHz	-	64	-	dB(A)
Near-Ultrasonic SNR		94 dB SPL, @ 19 kHz , BW = 18.5 - 20.0 kHz	-	TBD	-	dB
Total Harmonic Distortion	THD	94 dB SPL @ 1 kHz	-	0.2	-	%
		115 dB SPL @ 1 kHz	-	2	-	
		1% THD @ 1 kHz, S = typ	-	108	-	dB SPL
Acoustic Overload Point	AOP	10% THD @ 1 kHz, S = typ	-	120	-	dB SPL
Power Supply Rejection Ratio	PSRR	200 mVpp sinewave @ 1 kHz	-	55	-	dB V/FS
Power Supply Rejection	PSR+N	200 mVpp 7/8 duty cycle rectangular waveform @ 217 Hz, A-weighted	-	-84	-	dBFS(A)

Table 4: Low-Power Mode

Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Fclock = 768 kHz (D.C. = 50%), OSR=48, Tedge ≤ 3ns, SELECT grounded, no load, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Current[2]	Idd		-	235	270	µA
Sensitivity	S	94 dB SPL @ 1 kHz	-27	-26	-25	dBFS
Signal to Noise Ratio	SNR	94 dB SPL @ 1 kHz, A-weighted (BW = 8 kHz)	-	64	-	dB(A)
Total Harmonic Distortion	THD	94 dB SPL @ 1 kHz	-	0.2	-	%
		1% THD @ 1 kHz, S = typ	-	108	-	dB SPL
Acoustic Overload Point	AOP	10% THD @ 1 kHz, S = typ	-	120	-	dB SPL
Power Supply Rejection Ratio	PSRR	200 mVpp sinewave @ 1 kHz	-	59	-	dBV/FS
Power Supply Rejection	PSR+N	200 mVpp 7/8 duty cycle rectangular waveform @ 217 Hz, A-weighted	-	-86	-	dBFS(A)

Table 5: Sleep Mode

Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Fclock = 0 Hz, SELECT grounded, no load, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Sleep Current	Isleep		-	25	40	µA

[1] Sensitivity and Supply Current are 100% tested.

[2] Idd varies with Cload according to: ΔIdd = 0.5*Vdd*ΔCload*Fclock.

[3] Valid microphones states are: Powered Down Mode (mic off), Sleep Mode (low current, DATA = high-Z, fast startup), Low-Power Mode (low clock speed) and Normal Mode.

[4] Time from Fclock < 280 kHz to Isleep specification is met when transitioning from Active Mode to Sleep Mode.

[5] Time from Fclock ≥ 351 kHz to all applicable specifications are met when transitioning from Sleep Mode to Active Mode.

[6] Audio is temporarily muted during the transition between any microphone state.

Table 6: Digital Interface

Test Conditions: 23 ±2°C, 55±20% R.H., Vdd=1.8 V, Tedge ≤ 3ns, unless otherwise indicated

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Logic Input High[7]	Vih		0.7xVdd	-	3.6	V
Logic Input Low[7]	Vil		-0.3	-	0.3xVdd	V
Logic Output High[7]	Voh	I_{OUT} = 2 mA	Vdd-0.45	-	-	V
Logic Output Low[7]	Vol	I_{OUT} = 2 mA	0	-	0.45	V
Low→High Threshold[8]	Vl-h		-	-	0.65xVdd	V
High→Low Threshold[8]	Vh-l		0.35xVdd	-	-	V
Hysteresis Width[8]	Vhyst		0.05xVdd	-	0.25xVdd	V
Clock Frequency[7]	Fclock	Sleep Mode	0	-	280	kHz
		Low-Power Mode	351	-	815	
		Normal Mode	1.0	-	4.8	MHz
Clock Duty Cycle	D.C.		40	50	60	%
Delay Time to Data Line Driven[7]	Tdd		18	-	40	ns
Delay Time to Valid Data[7]	Tdv	Max Cload	-	-	100	ns
Delay Time to High Z[7]	Tdz		3	-	16	ns
Hold Time[7]	Thold	Thold, as observed by the input device, will be dependent on Cload	3	-	-	ns

[7] See Figure 1: Timing Diagram.

[8] See Figure 2: Hysteresis Diagram.

2.2 Measurement Block Diagram
测试图

Figure 1: Timing Diagram

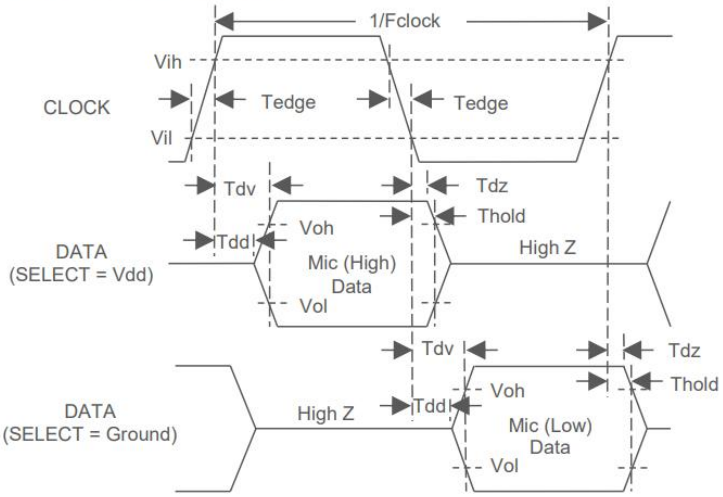


Figure 2: Hysteresis Diagram

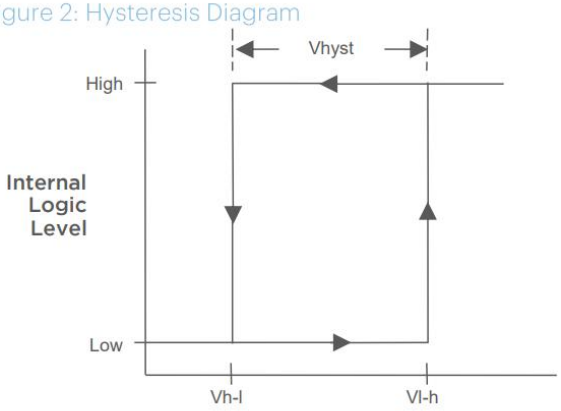


Figure 3: State Diagram

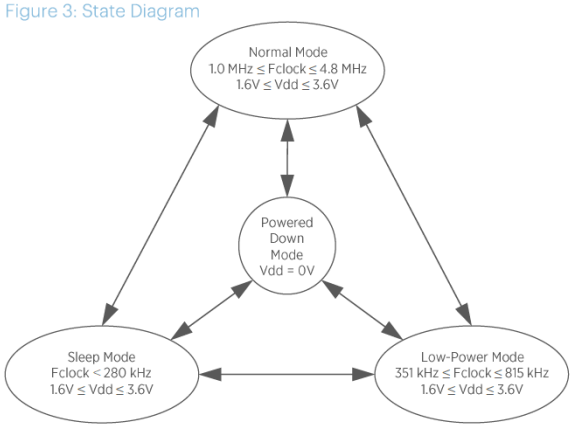


Figure 4: Typical Stereo Application Circuit

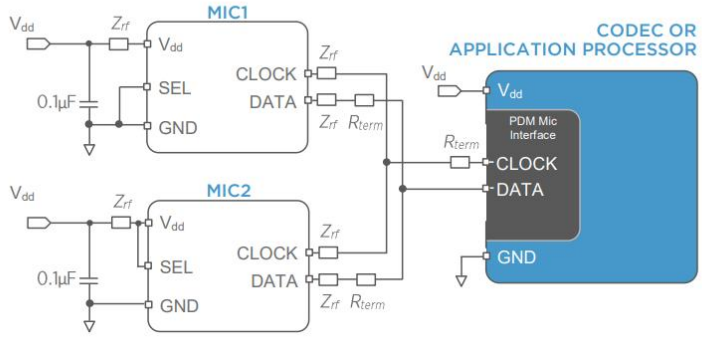
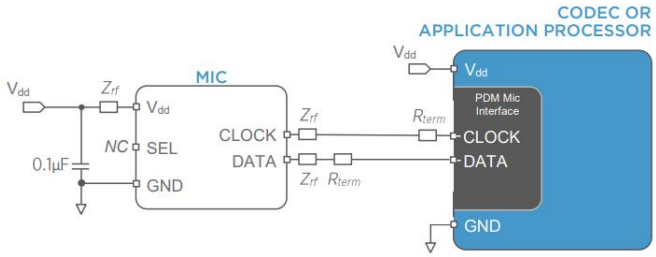


Figure 5: Typical Single-Microphone Application Circuit



Ext CLOCK
Input

NOTES:

All Ground pins must be connected to ground.
If necessary to improve RF performance, optional series components (resistors, ferrites, etc.) should be placed closest to the microphone pads.
Bypass capacitors should be placed near each Vdd pin for best performance.
Capacitors near the microphone should not contain Class 2 dielectrics due to their piezoelectric effect.

Table 7: SELECT Functionality

Microphone	SELECT	Asserts DATA on	Latch DATA on
Mic (High)	Vdd	CLK rising edge	CLK falling edge
Mic (Low)	Ground	CLK falling edge	CLK rising edge

2.3 Typical Frequency Response Curve 频率响应曲线

Figure 6: Typical Free Field Magnitude and Masks

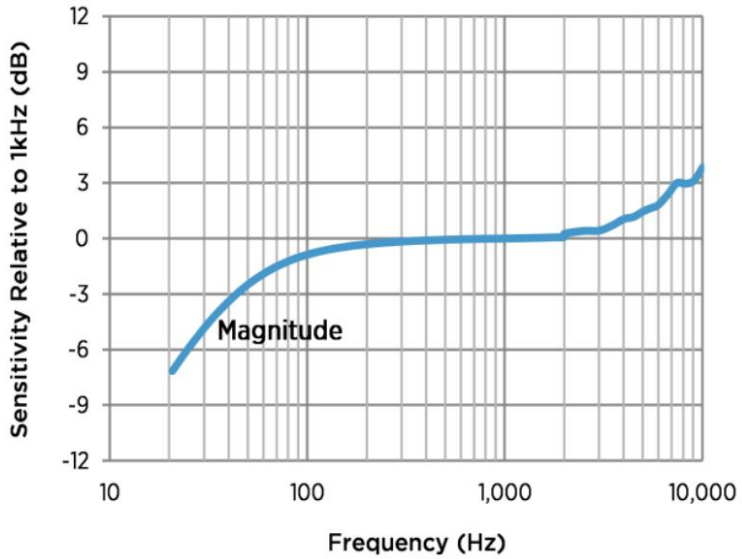


Figure 7: Typical Phase and Group Delay

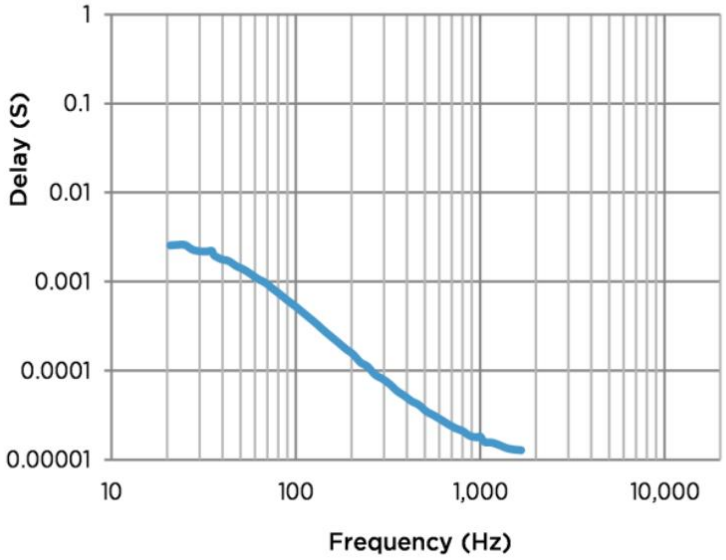


Figure 8: Typical THD vs SPL

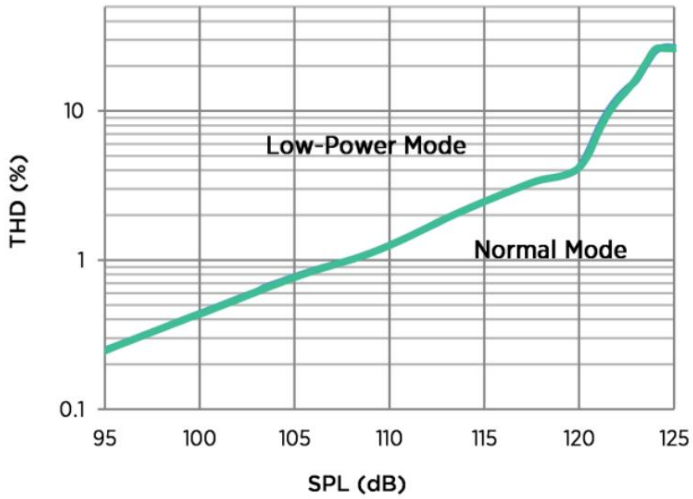


Figure 9: Typical THD vs Frequency

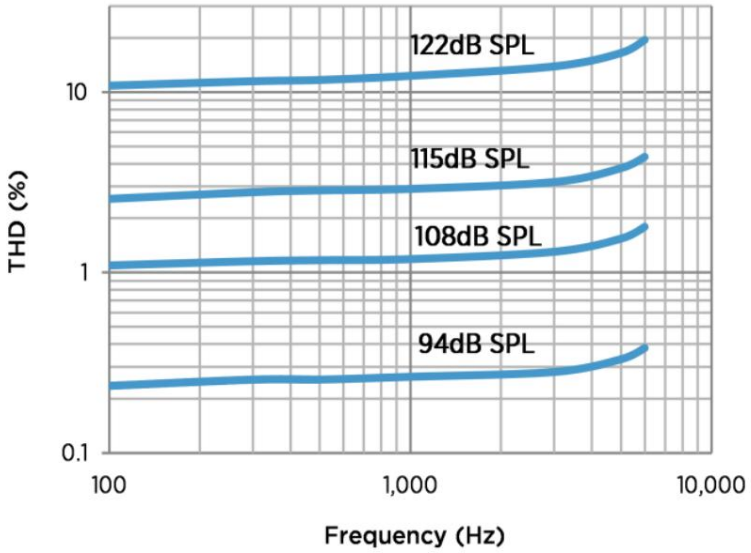


Figure 10: Typical Free Field Ultrasonic Response

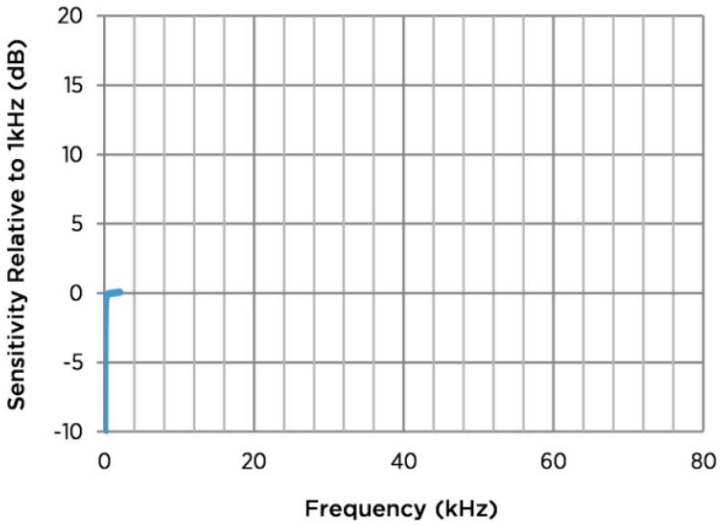


Figure 11: Typical Idd vs Vdd

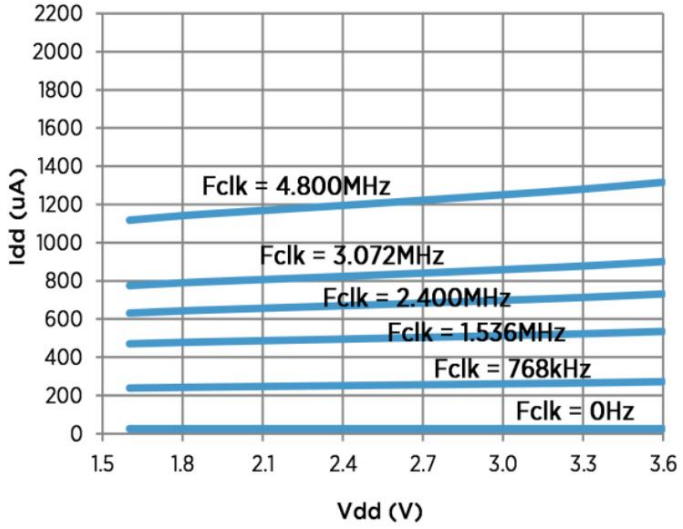


Figure 12: Noise Floor Power Spectral Density

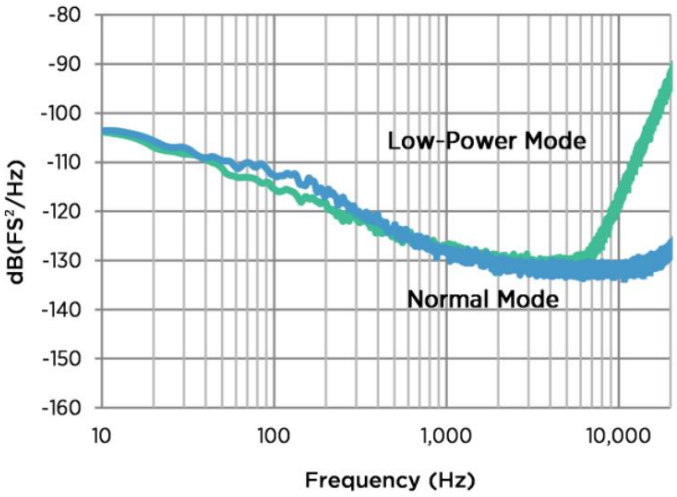
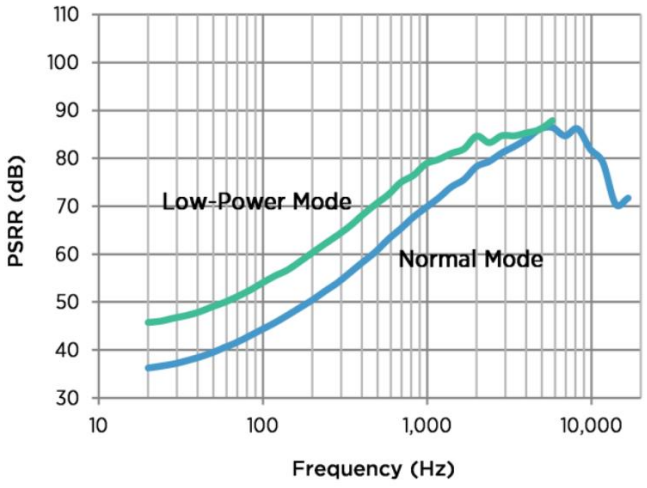


Figure 13: Typical PSRR



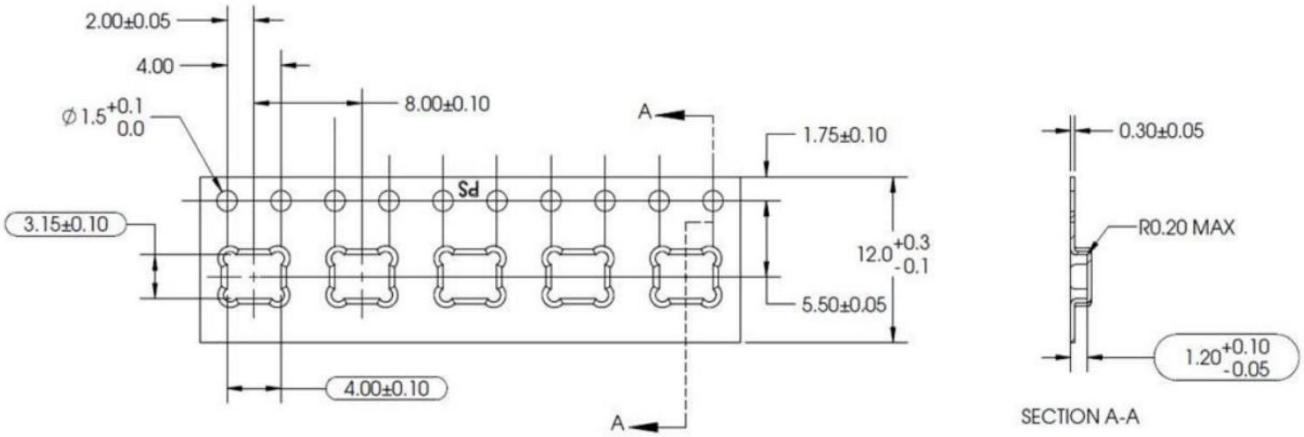
3. Mechanical characteristics and environmental test

机械特性和环境试验

Test	Description
Thermal Shock	100 cycles air-to-air thermal shock from -40°C to +125°C with 15 minute soaks. (IEC 68-2-4)
High Temperature Storage	1,000 hours at +105°C environment (IEC 68-2-2 Test Ba)
Low Temperature Storage	1,000 hours at -40°C environment (IEC 68-2-2 Test Aa)
High Temperature Bias	1,000 hours at +105°C under bias (IEC 68-2-2 Test Ba)
Low Temperature Bias	1,000 hours at -40°C under bias (IEC 68-2-2 Test Aa)
Temperature / Humidity Bias	1,000 hours at +85°C/85% R.H. under bias. (JESD22-A101A-B)
Vibration	4 cycles of 20 to 2,000 Hz sinusoidal sweep with 20 G peak acceleration lasting 12 minutes in X, Y, and Z directions. (Mil-Std-883E, method 2007.2 A)
ESD-HBM	3 discharges of ±2 kV direct contact to I/O pins. (ESD STM5.2)
ESD-LID/GND	3 discharges of ±8 kV direct contact to lid while unit is grounded. (IEC 61000-4-2)
ESD-MM	3 discharges of ±2 kV direct contact to I/O pins. (MIL 883E, Method 3015.7)
Reflow	5 reflow cycles with peak temperature of +260°C
Mechanical Shock	3 pulses of 10,000 G in the X, Y, and Z direction (IEC 68-2-27, Test Ea)

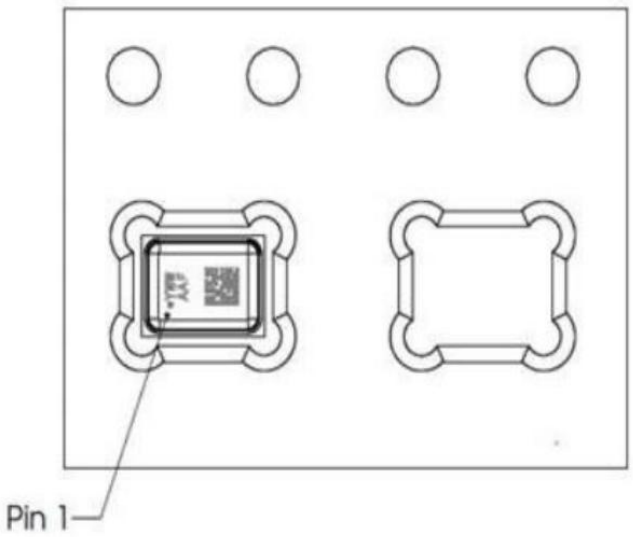
Note: After reliability tests are performed, the sensitivity of the microphones shall not deviate more than 3 dB from its initial value.After 3 reflow cycles, the sensitivity of the microphone shall not deviate more than 1dB from its initial value.进行可靠性试验后，麦克风的灵敏度与初始值的偏差不得超过 3 dB。3 次回流循环后，传声器的灵敏度与初始值的偏差不得超过 1dB。

4. Packaging Specifications 包装规格



Model Number	Suffix	Reel	Quantity Per
SH0141LM4H-1	-8	13”	5900

Component	Surface Resistance (ohms)
Reel	10^5-10^9
Carrier Tape	10^5-10^9
Cover Tape	10^4-10^{10}



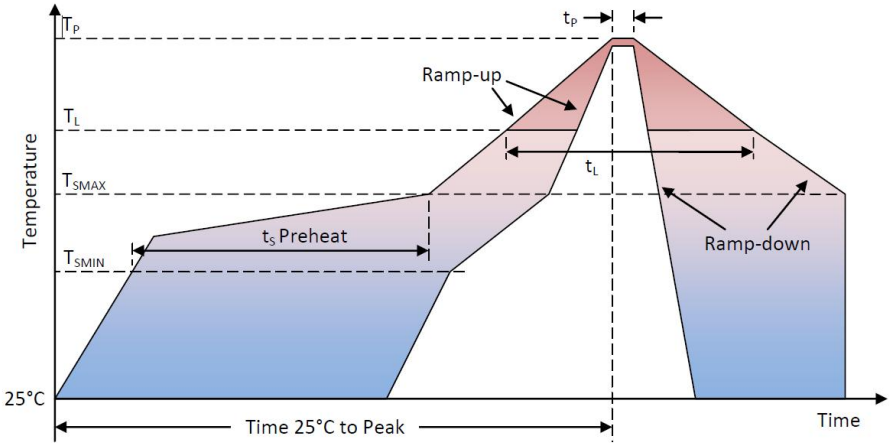
Letter: “o”, orientation mark (pin 1)
Date Code YWW:
"Y": Last digit of year
"WW": Work week
AA = Project Name Designator:
Luiso
F = Factory Location:
"M": Knowles Factory KEM3
"C": Knowles Factory KES2
"P": Knowles KEI
2D barcode "ABCDEFGHJKLMNPQRSTUVWXYZ0123456789":
Unique Job Identification Number for product traceability

NOTES:

Dimensions are in millimeters unless otherwise specified.
Vacuum pickup only in the pick area indicated in Mechanical Specifications.
Tape & reel per EIA-481.
Labels applied directly to reel and external package.
Shelf life: Twelve (12) months when devices are stored in the factory-supplied, unopened ESD moisture sensitive bag under the maximum environmental conditions of 30°C, 70% R.H.

5.Solder Reflow Profile

回流焊条件



Profile Feature	Pb-Free
Average Ramp-up rate (T_{SMAX} to T_P)	3°C/second max.
Preheat • Temperature Min (T_{SMIN}) • Temperature Max (T_{SMAX}) • Time (T_{SMIN} to T_{SMAX}) (t_S)	 150°C 200°C 60-180 seconds
Time maintained above: • Temperature (T_L) • Time (t_L)	 217°C 60-150 seconds
Peak Temperature (T_P)	260°C
Time within 5°C of actual Peak Temperature (t_P)	20-40 seconds
Ramp-down rate (T_P to T_{SMAX})	6°C/second max
Time 25°C to Peak Temperature	8 minutes max

Notes: Based on IPC/JDEC J-STD-020 Revision C.
All temperatures refer to topside of the package, measured on the package body surface.

6. Additional Notes 注意事项

(A) Shelf life: Twelve (12) months when devices are to be stored in factory supplied, unopened
(B) ESD moisture sensitive bag under maximum environmental conditions of 30°C, 70% R.H.
(C) 保质期：在 30°C、70%相对湿度的最大环境条件下，将设备储存在工厂提供的未打开的 ESD 湿敏袋中时，保质期为十二（12）个月。
(D) MSL (moisture sensitivity level) Class 1. MSL（水分敏感性水平）1 级。
(E) Maximum of 3 reflow cycles is recommended. 建议最多 3 个回流循环。
(F) In order to minimize device damage: 为了尽量减少设备损坏：

- Do not board wash or clean after the reflow process.
- 回流焊后，不得进行板清洗或清洁。
- Do not brush board with or without solvents after the reflow process.
- 回流焊后，不得在有溶剂或无溶剂的情况下刷板。
- Do not directly expose to ultrasonic processing, welding, or cleaning.
- 不要直接接触超声波处理、焊接或清洁。
- Do not insert any object in port hole of device at any time.
- 任何时候都不要在设备的端口孔中插入任何物体
- Do not apply over 30 psi of air pressure into the port hole.
- 不要向端口孔施加超过 30 psi 的气压。
- Do not pull a vacuum over port hole of the microphone.
- 请勿将真空吸尘器拉过麦克风的端口孔。
- Do not apply a vacuum when repacking into sealed bags at a rate faster than 0.5 atm/sec.
- 当以超过 0.5 atm/sec 的速度重新包装到密封袋中时，不要使用真空。

7. MATERIALS STATEMENT 材料声明

Meets the requirements of the European RoHS directive 2011/65/EC as amended.
Meets the requirements of the industry standard IEC 61249-2-21:2003 for halogenated substances and Knowles Green Materials Standards Policy section on Halogen-Free.
Ozone depleting substances are not used in the product or the processes used to make the product, including compounds listed in Annex A, B, and C of the “Montreal Protocol on Substances That Deplete the Ozone Layer.”
符合经修订的欧洲RoHS指令2011/65/EC的要求。
符合行业标准IEC 61249-2-21:2003关于卤化物质和Knowles绿色材料标准政策部分关于无卤素的要求。
产品或用于制造产品的工艺中未使用消耗臭氧层的物质，包括《关于消耗臭氧层物质的蒙特利尔议定书》附件A、B和C中列出的化合物

8.REVISION HISTORY: 覆历

Revision	Subjects (major changes since last revision)	Date
1.0	Preliminary Edition	2023-06-09*