1. Characteristics

SKR0710 paired with omnidirectional microphone software cardioid

- 66 dBA SNR
- Switchable front/back cardioid from 20 Hz to 20 kHz
- Three acoustic ports

SKR0710 standalone hardware supercardioid

- 65 dBA SNR
- Fixed front supercardioid from 20 Hz to 8 kHz
- Gasket with 9.6 mm port spacing
- Two acoustic ports

2. Applications

- Webcams
- AR/VR Devices
- Headsets
- Conferencing Devices
- Laptops and Tablets
- OTC Hearing Aids

3. Description

The SKR0710 is an in-plane, directional PDM MEMS microphone that delivers superior signal isolation via a dipole pickup pattern. The SKR0710 can be used in two configurations:

- Paired with an omnidirectional microphone
- Standalone with a gasket to increase port spacing

When paired with an omnidirectional microphone, the SKR0710 yields a high performance switchable cardioid pattern across the audible frequency range. When used standalone, the SKR0710 offers a high performance fixed supercardioid across the voice bandwidth. The high SNR makes the SKR0710 ideal for products that require professional-grade audio quality or extended listening ranges.

Packaged in a subminiature 15.2 mm^2 footprint, the SKR0710 fits the tightest spaces while outperforming traditional omnidirectional arrays in noise suppression and directionality.
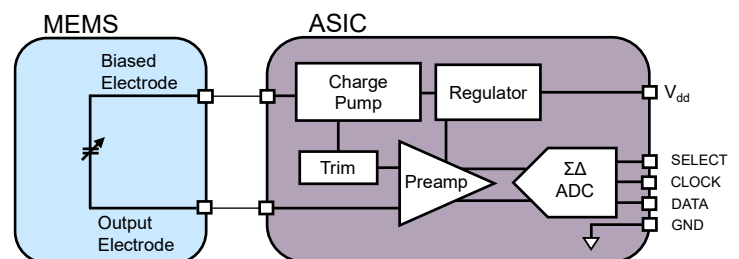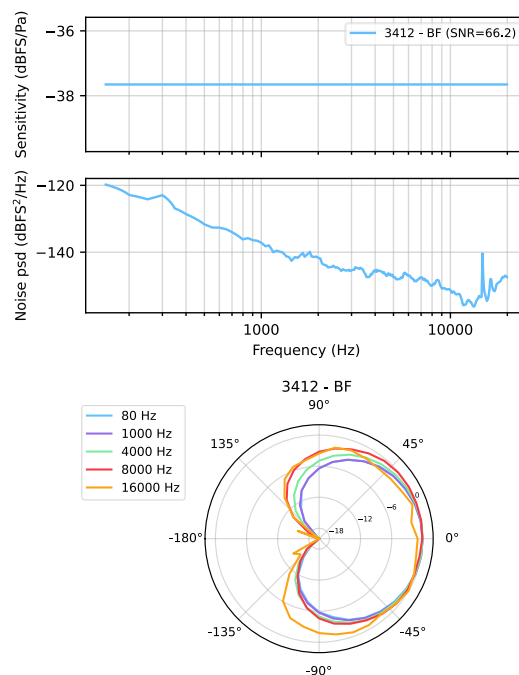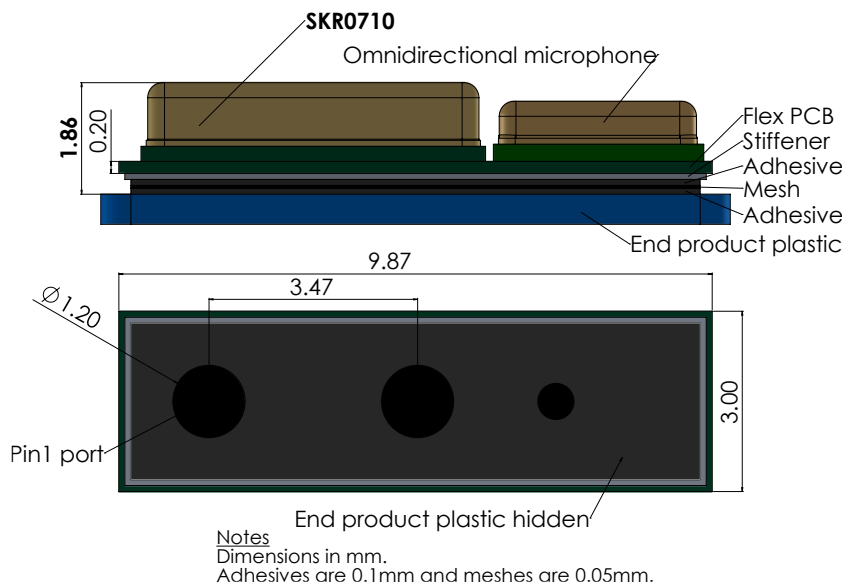
4. Functional Block Diagram

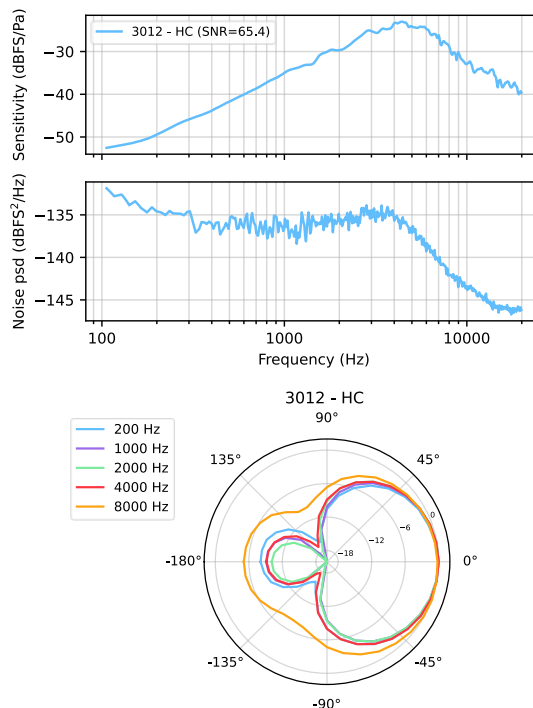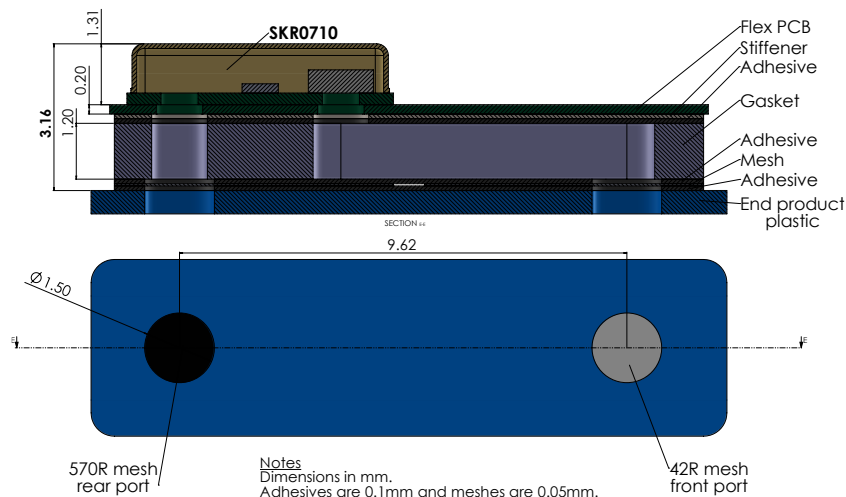*Figure 4.1: Functional block diagram*

5. Typical Integration

Saati 042HY or equivalent meshes (≥42R and hydrophobic coating) are used to achieve IP58. Tesa61365 or equivalent can be used as adhesives. The standalone hardware supercardioid uses a 570R mesh on the rear port to achieve a supercardioid pattern.

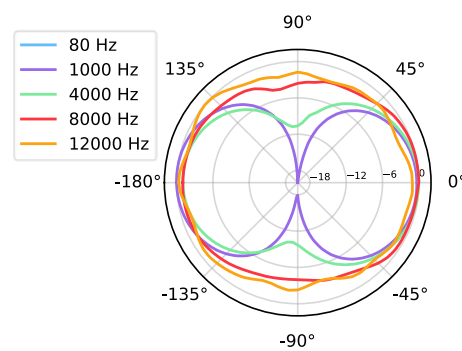## 5.1 SKR0710 Paired with Omnidirectional Microphone (Software Cardioid)

The omnidirectional microphone has an SNR of ≥68.0 dBA and the position of the two microphones and ports (see SKR0710 Pin1 port) are positioned as shown below to ensure optimal performance.

Notes
Dimensions in mm.
Adhesives are 0.1mm and meshes are 0.05mm.

5.2 SKR0710 Standalone Hardware Supercardioid

Notes
Dimensions in mm.
Adhesives are 0.1mm and meshes are 0.05mm.

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5.3 SKR0710 (bare component)

Table of Contents

6. Typical Application Circuit

The SKR0710 can be used alone, as shown in the single microphone application circuit (Figure 6.1), or paired with another PDM microphone, such as a dipole or omnidirectional microphone, as shown in the stereo application circuit (Figure 6.2).

The recommended operating conditions are CLK = 3.072 MHz and V_{dd} = 1.8 V. Using CLK <3.072 MHz will increase high-frequency noise and decrease SNR due to insufficient oversampling of the PDM signal. CLK >3.072 MHz will increase the current consumption without any improvement in SNR, AOP, or any other specification. Using V_{dd} >1.8 V will increase current consumption without any improvement in SNR, AOP, or any other specification.

The PDM interface (PDM to PCM converter) of the application processor should have a resolution ≥24 bit to achieve maximum SNR. A 16-bit resolution can also be used but will add high-frequency noise to the SKR0710 and reduce SNR by 1dB.

A 0.1 µF capacitor should be placed between V_{dd} and GND as close to the microphone as possible to reduce supply noise. According to the PCB trace impedance, damping resistors R_{term} of 33 Ω to 100 Ω may be placed near the microphone DATA pin and near the application processor's CLOCK to reduce overshoots and ringing.
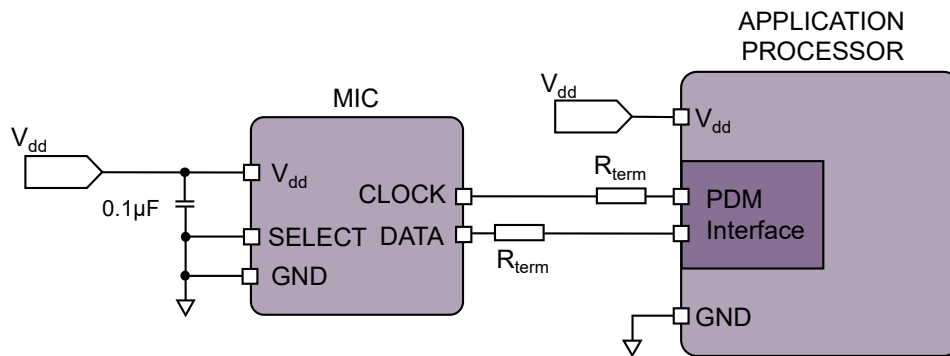

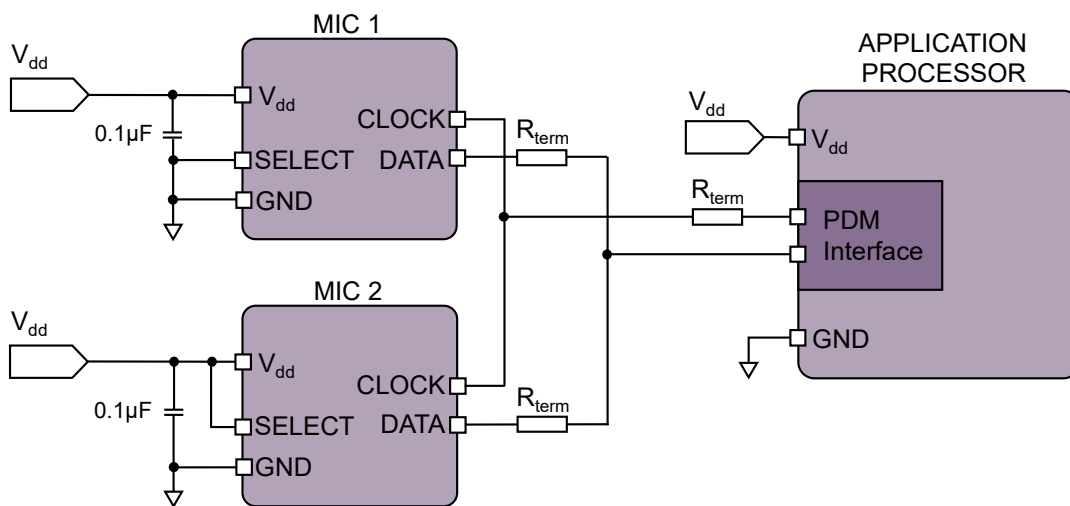*Figure 6.1: Typical single microphone application circuit*

Figure 6.2: Typical stereo application circuit

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7. Specifications (bare component)

Unless otherwise specified, all measurements are taken with these test conditions: 25 ºC, 55 ± 20% R.H., V_{dd} = 1.8 V, f_{clock} = 3.072 MHz, T_{edge}<3 ns, SELECT grounded, 1 m away, 3.47 mm acoustic path length[1], no load, Pin1 port facing toward the loudspeaker (0º rotation).

7.1 Acoustic and Electrical Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Pickup Pattern				Dipole (figure-8)		
Polarity		Increasing sound pressure at Pin1 port		Decreasing density of 1's		
		Increasing sound pressure at MEMS port		Increasing density of 1's		
Average Directivity Index[2]		Integrated from 20 Hz to 20 kHz		3.9		dB
Null Angle				90, 270		º
Supply Voltage	V_{dd}		1.6	1.8	3.6	V
Supply Current	I_{dd}	f_{clock} = 3.072 MHz		780		µA
		f_{clock} = 2.400 MHz		730		
		f_{clock} = 1.536 MHz		675		
		f_{clock} = 0.768 MHz		290		
	$I_{standby}$	f_{clock} < 0.100 MHz		5		
Sensitivity	S	f_{clock} ≥ 0.100 MHz, 94 dB SPL, 1 kHz	-40	-39	-38	dBFS
Noise Floor		f_{clock} = 3.072 MHz		-91.0		dBFS(A)
		f_{clock} = 2.400 MHz		-91.0		
		f_{clock} = 1.536 MHz		-89.0		
		f_{clock} = 0.768 MHz, 20 Hz to 8 kHz		-76.0		
Signal to Noise Ratio[3]	SNR	f_{clock} = 3.072 MHz, 94 dB SPL		60.0		dBA
		f_{clock} = 2.400 MHz, 94 dB SPL		59.5		
		f_{clock} = 1.536 MHz, 94 dB SPL		54.0		
		f_{clock} = 0.768 MHz, 20 Hz to 8 kHz, 94 dB SPL		57.5		
Total Harmonic Distortion[4]	THD	1% THD, 1 kHz		121		dB SPL
Acoustic Overload Point	AOP	10% THD, 1 kHz		142		
Resonant Frequency	F_{res}			3.3		kHz
Phase Response		75 Hz		-11		º
		1 kHz		-35		
		3 kHz		-89		
Group Delay		250 Hz		79		µs
		600 Hz		72		
		1 kHz		68		
		4 kHz		92		
Power Supply Rejection Ratio	PSRR	200 mV$_{pp}$ sine wave on V_{dd} at 1 kHz		75		dB(V/FS)
Power Supply Rejection	PSR+N	200 mV$_{pp}$ 7/8 duty cycle rectangular waveform @ 217 Hz, A-weighted, BW = 22.4 kHz		-89		dBFS(A)
Output Load Capacitance	C_{load}	On DATA pin		200		pF
Clock Duty Cycle		f_{clock} < 2.7 MHz	45		55	%
		f_{clock} ≥ 2.7 MHz	48	50	52	
Logic Input/Output Low	V_{IL} / V_{OL}		-0.3		0.35V_{dd}	V
Logic Input/Output High	V_{IH} / V_{OH}		0.65V_{dd}		0.3+V_{dd}	V
Delay Time for Valid Data	t_{DV}	Delay time from CLOCK edge (0.5V_{DD}) to DATA valid (<0.3V_{DD} or >0.7V_{DD})	30		180	ns
Delay Time for High Z	t_{HZ}	Delay time for CLOCK edge (0.5V_{DD}) to DATA high impedance state	1		14	ns
Startup Time		Sensitivity within 1 dB of final value, outputs AC coupled		60		ms

Table 7.1: Acoustic and electrical specifications

---

[1] The acoustic path length is the minimum distance a soundwave must travel between the ports of the microphone. See Acoustic Path Length Definition for details.

[2] The directivity index is a measure of directionality based on the ratio of direct sound to diffuse sound captured. See Directivity Index Calculation for details.

[3] A directional microphone has a non-flat frequency response, as such, the SNR must be calculated for the entire frequency range. See SNR Calculation for details.

[4] To calculate the THD of a microphone with a non-flat frequency response, the frequency response must first be equalized. See THD Calculation for details.

7.2 Absolute Maximum Ratings

Stresses at or above the Absolute Maximum Ratings could permanently damage the devices.

Parameter	Absolute Maximum Rating	Unit
V_{dd} to GND	5.0	V
Input Current	±5	mA
Storage Temperature	-40 to 125	°C
Operating Temperature	-40 to 105	°C

Table 7.2: Absolute maximum ratings

7.3 Timing Diagram
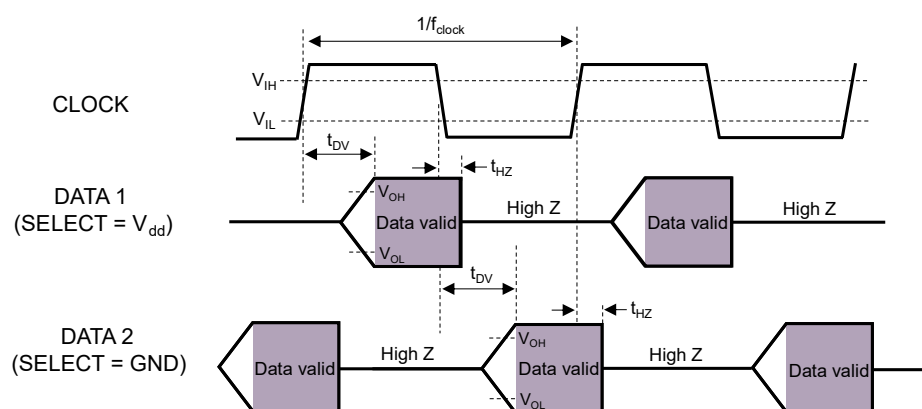
Figure 7.1: Timing diagram for output logic for select pin options

Microphone	Select	Asserts DATA on	Latch DATA on
Mic (High)	V_{dd}	CLOCK rising edge	CLOCK falling edge
Mic (Low)	Grounded	CLOCK falling edge	CLOCK rising edge

Table 7.3: Microphone select input

7.4 Specification Calculation Details

Acoustic Path Length Definition

The acoustic path length is the minimum distance a sound wave must travel between the two ports.

Directivity Index and Average Directivity Index Calculation

The **directivity index** (DI) measures the ratio of the microphone output for a sound positioned directly in front of the microphone ($\theta = 0°$) versus sound with the same amount of total acoustic power coming from all directions equally. The directivity index at each frequency is calculated with the equation below.

$$DI = 10 log_{10} \left(4 \frac{amplitude(\theta = 0)^2 \left[\frac{V^2}{Pa^2}, \frac{FS^2}{Pa^2}\right]}{\int_0^{2\pi} amplitude(\theta)^2 \left[\frac{V^2}{Pa^2}, \frac{FS^2}{Pa^2}\right] |sin\,\theta| d\theta} \right)$$

Equation 7.1: Directivity Index

The average directivity index is calculated by logarithmically weighting the directionality index at each frequency and then taking the average of these weighted values from 20 Hz to 20 kHz.

SNR Calculation

The SNR of a directional microphone with a non-flat frequency response must be calculated differently than the typical method used for omnidirectional microphones that have a flat frequency response. Instead of only using the 1 kHz sensitivity, the electrical noise of the microphone at each frequency (units of V^2/Hz) must be divided by the corresponding sensitivity squared at each frequency (units of V^2/Pa^2) to obtain the input referred acoustic noise at each frequency (units of Pa^2/Hz). Then, the acoustic noise is A-weighted by multiplying it by the A-weighting factor (A_w) squared and this A-weighted acoustic noise is integrated over the full audio bandwidth and converted to an equivalent sound pressure level (dBA SPL) by dividing by the reference pressure (P_{ref}=20 µPa). Finally, the SNR is calculated by subtracting the integrated input referred noise from 94 dB SPL. The equation for the calculation is shown below.

$$SNR = 94 - 10\,log_{10} \left(\frac{1}{P_{ref}^2[Pa^2]} \int_{20Hz}^{20kHz} \frac{noise\left[\frac{V^2}{Hz}, \frac{FS^2}{Hz}\right]}{sensitivity\left[\frac{V^2}{Pa^2}, \frac{FS^2}{Pa^2}\right]} A_w^2 df[Hz] \right)$$

Equation 7.2: Full-spectrum SNR calculation

THD Calculation

THD is calculated by playing an acoustic sine wave at a specific sound pressure level and frequency and dividing the sum of the powers of the harmonic components of the captured signal by the power of the fundamental frequency. To calculate the THD of a microphone with a non-flat frequency response, the response must first be equalized to equally weigh the fundamental frequency and its respective harmonics.

For more information on these calculations, refer to the app note: AN-110: Attributes of Soundskrit Directional Microphones.
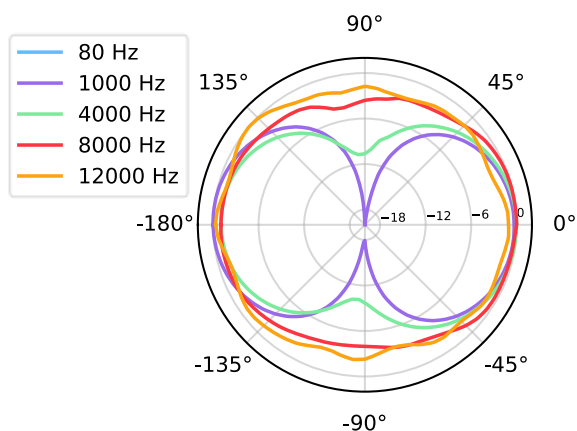
7.5 Performance Curves (bare component)
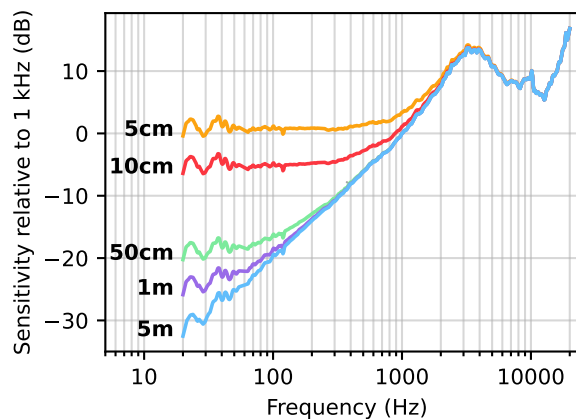

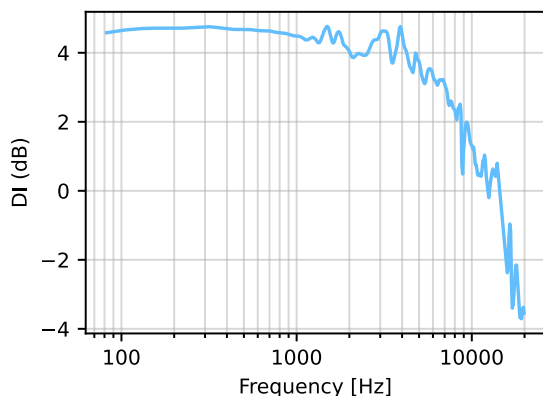*Figure 7.2: Pickup pattern vs. frequency*

Figure 7.3: Magnitude response[5]

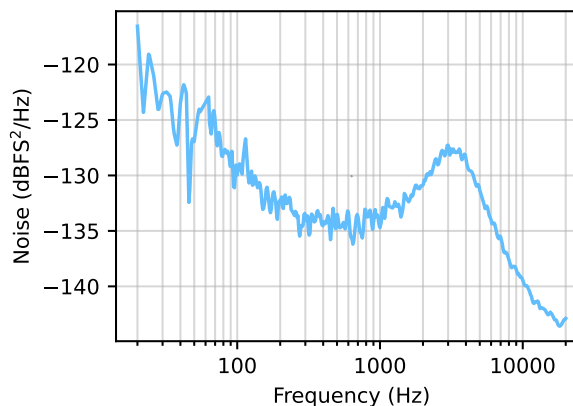*Figure 7.4: Directionality index vs frequency*
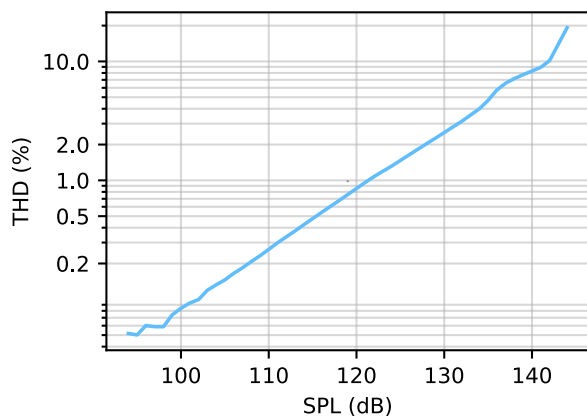

Figure 7.5: Noise floor

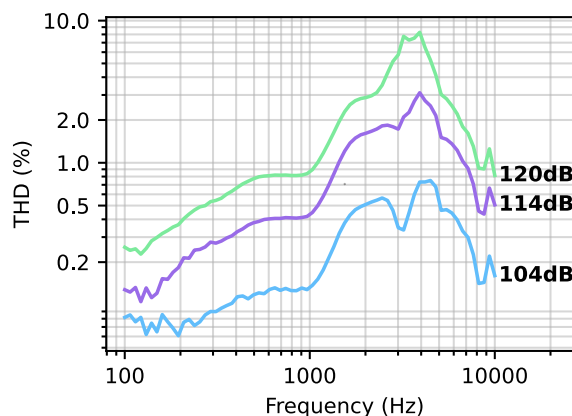*Figure 7.6: THD (1 kHz) vs SPL*

Figure 7.7: THD vs frequency

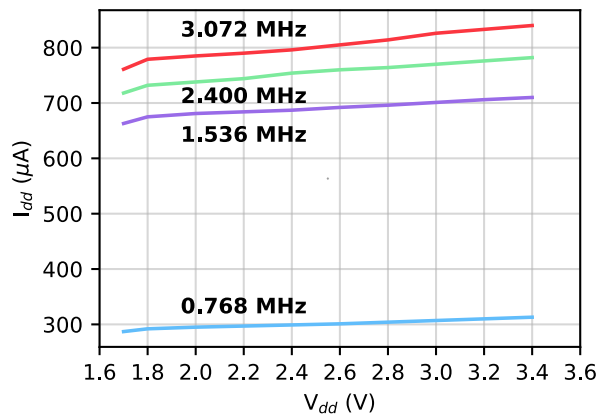[5] The increased bass response at close distances is known as the 'Proximity Effect.' See AN-110 for details.
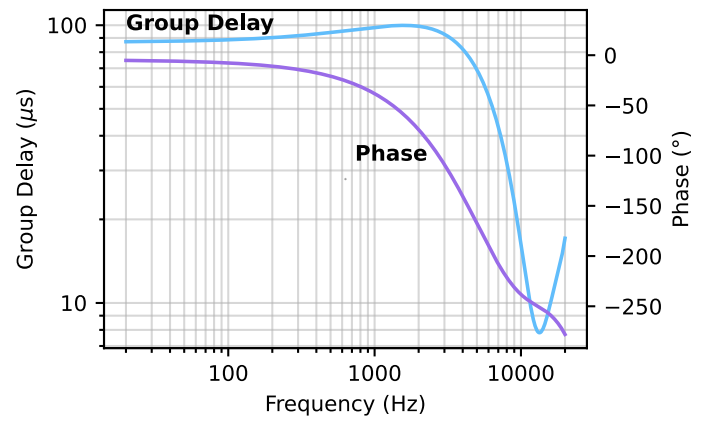
Figure 7.8: Supply current vs input voltage

Figure 7.9: Phase and group delay

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8. Mechanical, Packaging, and Manufacturing Information
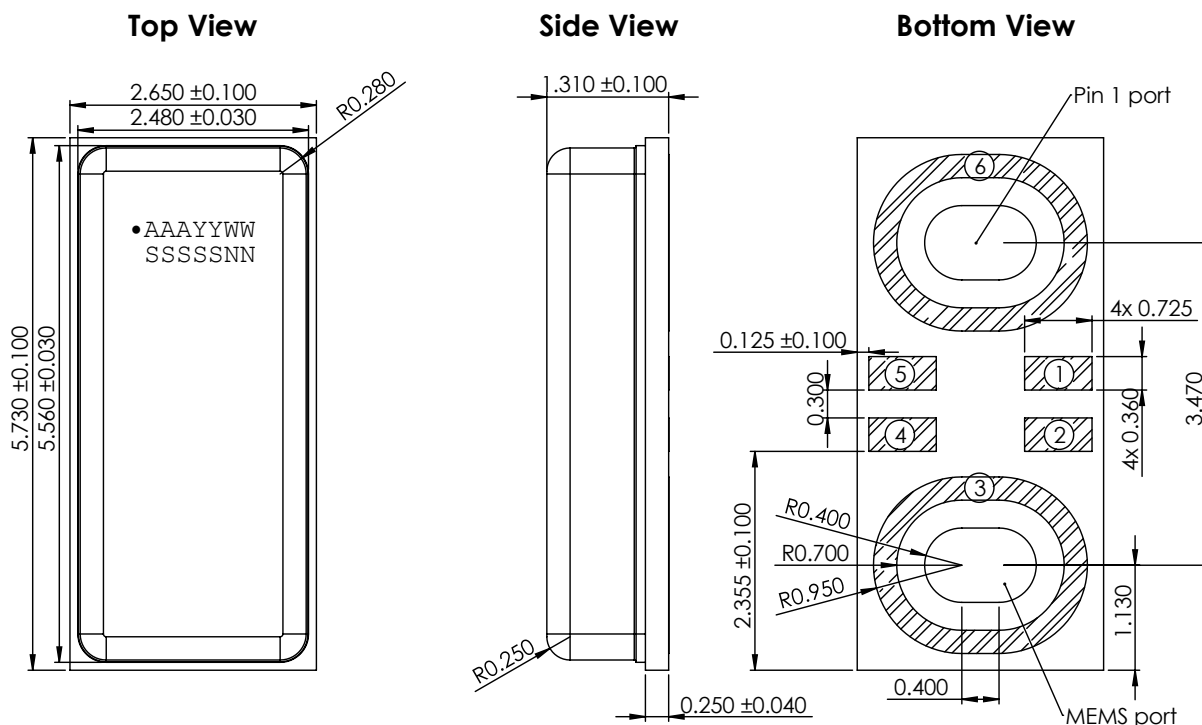
8.1 Mechanical Dimensions and Product Marking

Top View

Side View

Bottom View

Figure 8.1: Mechanical drawings (mm) and product marking

Table 8.1: Mechanical specifications

Item	Dimensions (mm)
Length	5.730 ± 0.100
Width	2.650 ± 0.100
Height	1.310 ± 0.100
Acoustic Ports	1.200 x 0.800 ± 0.050

Table 8.2: Pinout

Pin #	Pin Name	Description
1	DATA	PDM Output Signal
2	SELECT	LR Select Input
3,6	GND	Ground
4	CLOCK	Clock
5	VDD	Power Supply

Table 8.3: Product marking

Marking	Description
AAA	Model Code: SKR0AAA
YY	Year 20YY
WW	Week WW of the year
SSSSSNN	Internal Codes

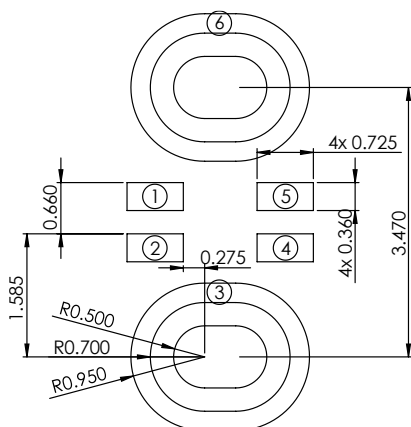## 8.2 Land Pattern and Solder Stencil
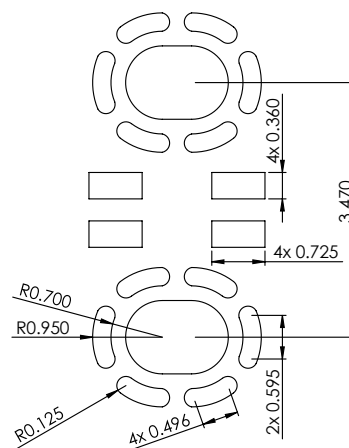

Figure 8.2 Example land pattern (mm)

Figure 8.3 Example solder stencil pattern (mm)

8.3 CAD Models

The CAD model and KiCAD layout and footprint are available here: <u>STEP File and KiCAD.</u>
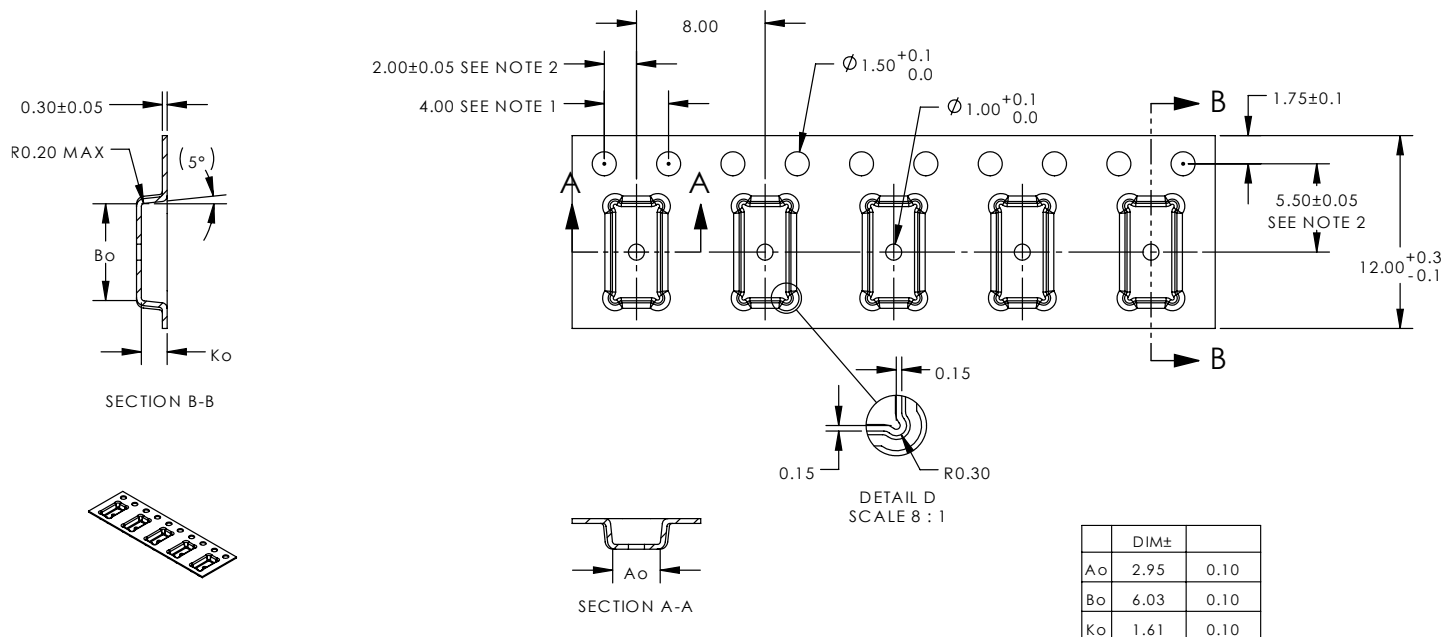
8.4 Packaging and Ordering Information

*Figure 8.4 Reel dimensions (mm)*

Table 8.4: Ordering Information

Model Number	Reel Diameter	Quantity per Reel
SKR0710-7	7"	1300
SKR0710-13	13"	5000

Table 8.5: Packaging Information

Component	Surface Resistance (Ω)
Reel	10^5 to 10^{12}
Carrier Tape	10^5 to 10^{11}
Cover Tape	10^5 to 10^{12}

8.5 Reflow Profile and Handling Instructions

Figure 8.5 shows the recommended reflow profile for soldering the microphone. The reflow profile is based on the standard J-STD-020D. The microphone has a moisture sensitivity level (MSL) of Class 1.
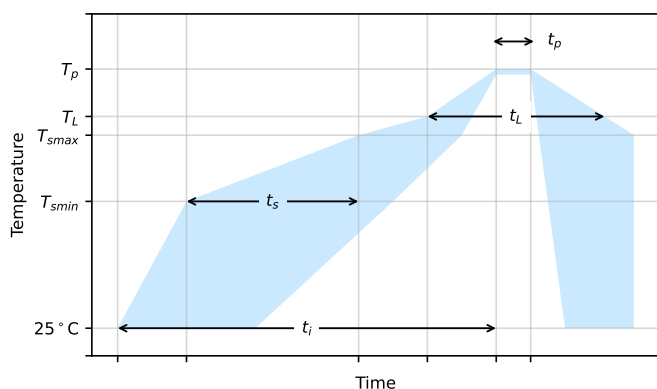
Profile Feature	Symbol	Pb-Free Assembly
Temperature Min	T_{smin}	140 °C
Temperature Max	T_{smax}	200 °C
Time from T_{smin} to T_{smax}	t_s	70 seconds
Ramp-up rate from T_L to T_p		3 °C/second max
Liquidous temperature	T_L	217 °C
Time maintained above T_L	t_L	150 seconds
Peak package body temperature	T_p	260 °C
Time within 5 °C of T_p	t_p	30 seconds[6]
Ramp-down rate from T_p to T_L		2 °C/second max
Maximum time 25 °C to peak temperature	t_i	8 minutes

Figure 8.5: Reflow profile

---

[6] Tolerance for peak profile temperature (T_P) is defined as a supplier minimum and a user maximum.

The MEMS microphones should be handled using industry standard pick and place equipment or appropriate manual handling procedures. To minimize damage, please carefully follow the guidelines below:

- The pick-up area anywhere on top surface of the lid.
- Do not apply a vacuum or high pressure over the acoustic port holes.
- Do not apply air blow and ultrasonic cleaning procedures over the acoustic port holes.
- Do not board wash or clean after the reflow process.
- Do not expose the acoustic port holes to harsh chemicals.
- Do not directly expose the acoustic port holes to solder fumes or vapor phase soldering.
- Do not apply a vacuum when packing parts in sealed bags at a suction flow rate exceeding 0.85 CFM.

9. Reliability Specifications

The microphone sensitivity must deviate by no more than 1 dB from the initial value after 3 reflow cycles for the reflow test and no more than 3 dB for the other tests.

Test	Test Condition	Standard
ESD-CDM	3 discharges of ±500 V with direct contact to I/O pins	JEDEC-JS002
ESD-HBM	3 discharges of ±2 kV with direct contact to I/O pins	JEDEC-JS001
ESD-LID/GND	3 discharges of ±8 kV with direct contact to lid while unit is under bias	IEC-61000-4-2
Free Fall	Microphone put in a 150g block, drop from 1.5m onto concrete floor, 4 drops for each surface and corner, total 40 drops	IEC 60068-2-32
High Temperature Bias	+125 °C for 1,000 hours under bias	JESD22 A-108F
High Temperature Storage	+125 °C for 1,000 hours	JESD22 A-103E
Low Temperature Bias	-40 °C for 1,000 hours under bias	JESD22 A-108F
Low Temperature Storage	-40 °C for 1,000 hours	JESD22-A119A
Mechanical Shock	5 shocks of 10,000 g / 0.1 msec in each direction of ±x, ±y, ±z, 30 shocks in total	IEC 60068-2-27
Reflow	3 reflow cycles with +260 °C peak temperature	IPC-JEDEC J-STD-020E
Temperature Humidity Bias	+85 °C/85% R.H. for 1,000 hours under bias	JESD22-A101D
Thermal Shock	100 cycles, air-to-air, -40 °C to +125 °C, 15 minutes soak	JESD22.A104E
Tumble	Microphone put in a 150g block, drop from 1m onto steel base, rotation speed 10-11 times/min, 300 drops	IEC 60068-2-32
Vibration	4 cycles of 4 minutes each in each x, y, z axis from 20 Hz to 2000 Hz with peak acceleration of 20 G	MIL-STD-883E-2007-2-A

Table 9.1: Reliability specifications

10. Device and Documentation Support

Supporting application notes can be found on our [application notes page](#).

11. Revision History

Revision Label	Revision Date	Sections Revised
-	July 2025	Preliminary release
A		

Soundskrit developed the first high-performance directional MEMS microphone on the market, leveraging years of research in bio-inspired MEMS based on how spiders and other insects in nature hear. In combination with Soundskrit's in-house audio processing algorithms, directional microphones can be used to capture and isolate any sound in an environment with a fraction of the size, power, and computation of traditional omnidirectional-based microphone arrays.

Soundskrit was founded in 2019 and is headquartered in Montreal, Quebec with an R&D facility in Ann Arbor, Michigan.