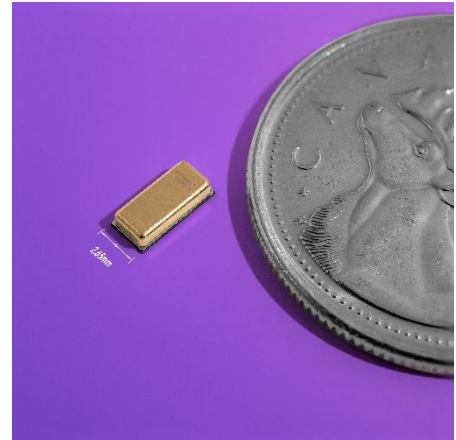




The SKR0710 Directional Microphone

The SKR0710 is an in-plane, directional PDM MEMS microphone that delivers superior signal isolation. This microphone provides a compact solution to achieve a directional audio pickup. By pairing the SKR0710 with a traditional omnidirectional microphone, designers enable beamforming and other audio enhancement related algorithms. This application note covers the integration of the SKR0710 with an omnidirectional microphone and the various design considerations that need to be accounted for. For guidance on how to use the SKR0710 without an omnidirectional microphone, please see AN320.



Why Pair with an Omnidirectional Microphone?

The SKR0710 produces a dipole polar pattern with sensitivity at both 0° and 180° and nulls at $\pm 90^\circ$. This polar pattern gradually changes as we look at higher frequencies. By adding an omnidirectional microphone and combining the signals in a DSP, designers can:

- **Create different polar patterns** including cardioids, hypercardioids, supercardioids, or adaptively switch between them for low distortion audio pickup.
- **Switch direction** by turning the beamformer to the backside
- **Achieve consistent directionality** over the full audio band (20Hz – 20kHz).
- **Correct for acoustic effects** from product shapes through DSP compensation
- **Enable nonlinear processing** for highly directional beamformers with low distortion

Maximizing Performance

The SKR0710’s fundamental polar pattern is that of a dipole. By placing both sound ports on the PCB side of the microphone (see Figure 1), the microphone can be integrated into end products similarly to omnidirectional microphones. This construction has the adverse effect that the dipole begins to lose its nulls as at higher frequencies (see Figure 2). Additionally, the close port spacing reduces the SNR compared to directional microphones that place their second sound port in the microphone lid (see Figure 3). However, even when the SKR0710 directivity pattern becomes degraded, its unique phase information is maintained. This becomes a great benefit when combining it with an omnidirectional microphone.

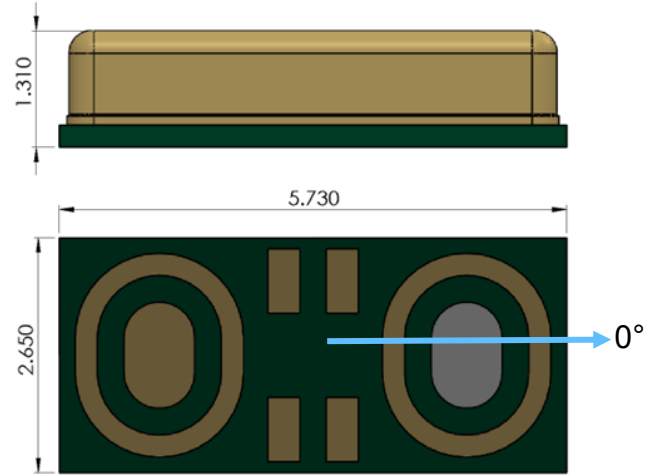


Figure 1: SKR0710 Side and Bottom View

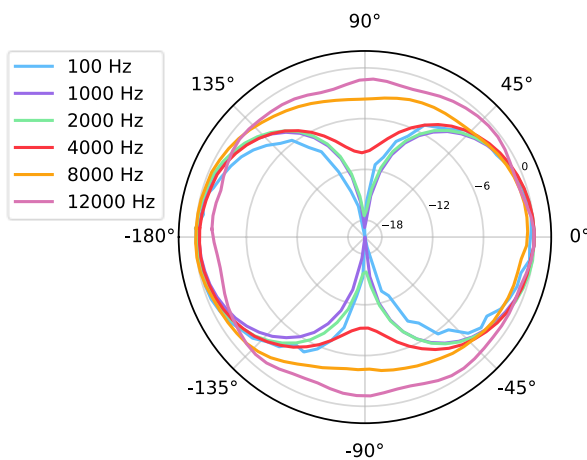


Figure 2: SKR0710 Polar Pattern (bare microphone)

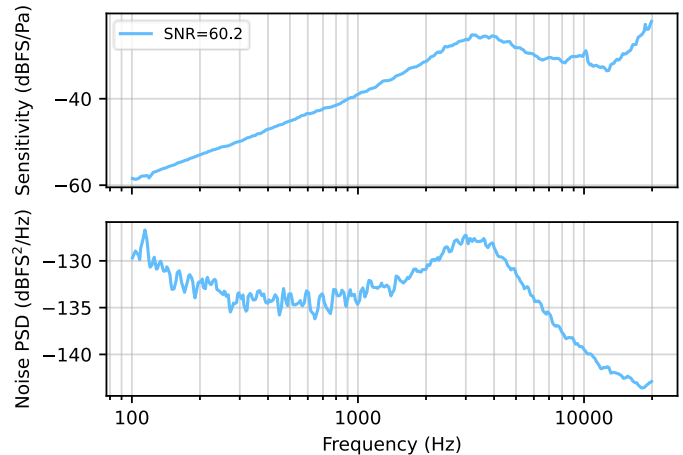


Figure 3: SKR0710 Frequency Response and Power Spectral Density (bare microphone)

By pairing the SKR0710 with an omnidirectional microphone (see Figure 4), a beamformer can be created leveraging the relative phase difference between the two microphones. The signals from the two microphones can be combined to create a cardioid pattern (see Figure 5) or any other standard beam pattern with very consistent directivity across the audible range. Additionally, the two microphone signals add constructively to increase the SNR of the beamformer compared to just a bare SKR0710. For example, when the SKR0710 is combined with a 68dB omnidirectional microphone, the SNR of the resulting cardioid beamformer is 66dB SNR (see Figure 5).

Besides the consistent directivity pattern and high SNR, one benefit of the microphone architecture is that the two microphones can be placed side-by-side, in a very compact footprint. This is in contrast to alternative omnidirectional microphone arrays that require large spacing between the microphones for effective beamforming.

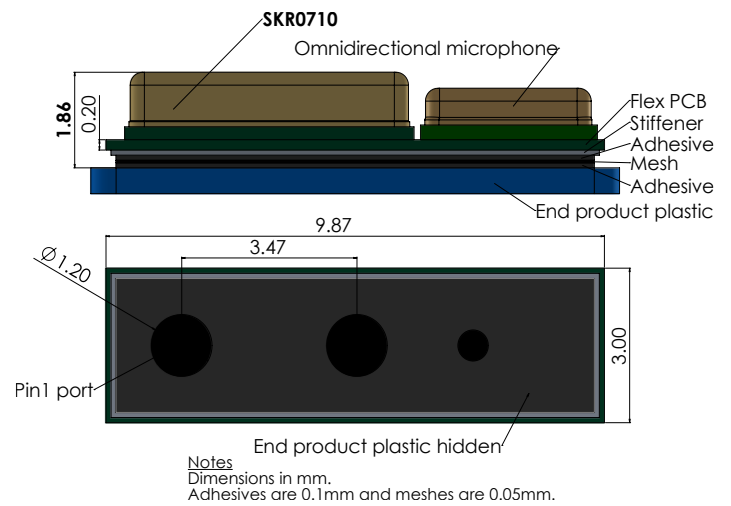


Figure 4: SKR0710 and Omnidirectional Microphone Array

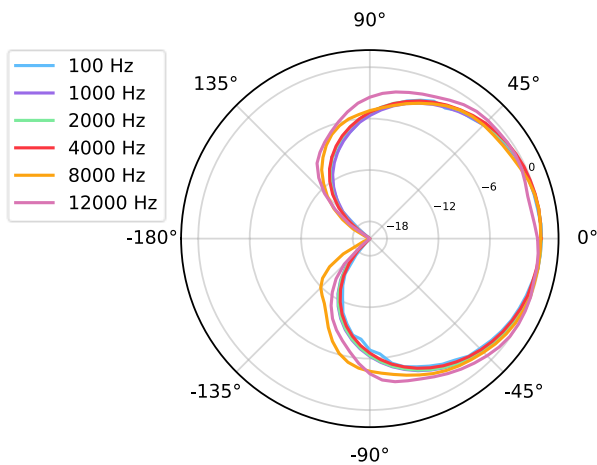


Figure 5: Cardioid Polar Plot using an Omnidirectional Paired Microphone.

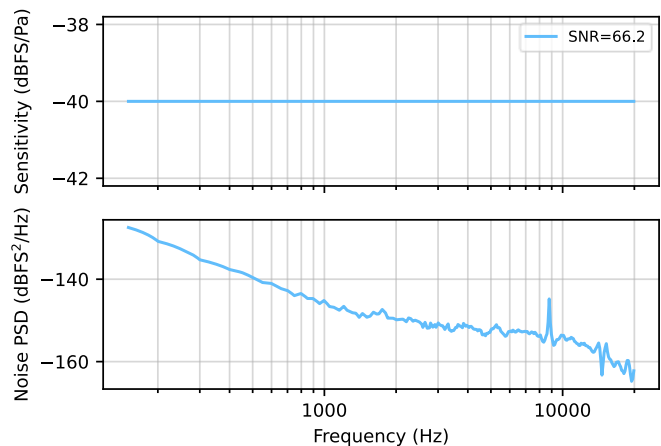


Figure 6: Calculated Cardioid SNR using an Omnidirectional Paired Microphone.

Positioning the Omnidirectional Microphone

The omnidirectional microphone should be placed on the opposite end of the lid marking. Placing the omnidirectional microphone on the lid marking side of the SKR0710 will result in degraded performance. Placing the omnidirectional microphone as close as possible to the SKR0710 will result in the best performance for most applications.

Table 1: Omnidirectional Microphone Positioning Guidelines

Requirement	Specification
Allowable spacing between microphones	<15 mm
Omnidirectional position	Opposite lid marking side only

Identifying the Lid Marking

The lid marking side in the CAD STP file is identified by a small circle on the component lid. The acoustic port on this side should be on the opposite side of the omnidirectional microphone.

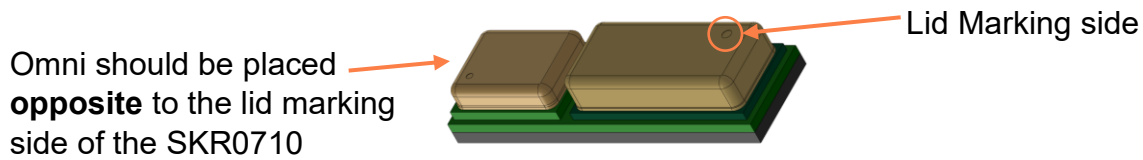


Figure 7: SKR0710 Lid Marking and Relative Omnidirectional Microphone Position

Inline Positioning (Recommended): The omnidirectional microphone positioning is optimal when aligned with the SKR0710 on its primary axis adjacent to the lid marking. This is the recommended configuration shown in the datasheet and in production integration examples. The port spacing is the distance between the center of the omnidirectional and dipole sound ports. Figure 10 shows the impact of increasing the port spacing on the achievable cardioid beam pattern.

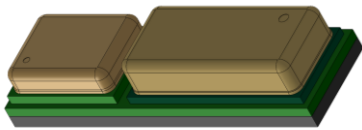


Figure 8: SKR0710 and Omnidirectional Microphone Inline Positioning

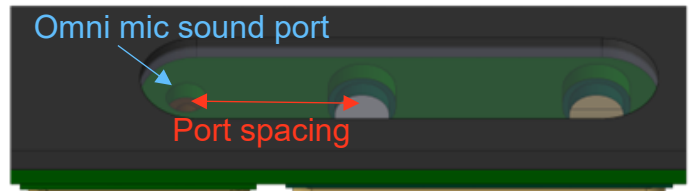


Figure 9: SKR0710 and Omnidirectional Inline Spacing

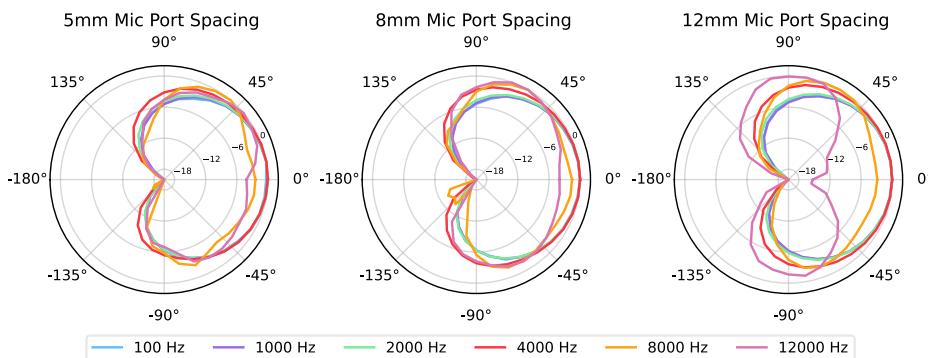


Figure 10: Inline Positioning Polar Plots

Side-by-Side: In this layout, the omnidirectional microphone is placed on the side of the SKR0710. This placement introduces a mild, frequency-dependent change in directionality, useful when PCB routing or other component constraints prevent an inline layout. The figures below show the performance of the beamformer when the omnidirectional microphone sound port is placed 3.5mm to the side of the SKR0710 (center-to-center port spacing).

Omnidirectional microphone port

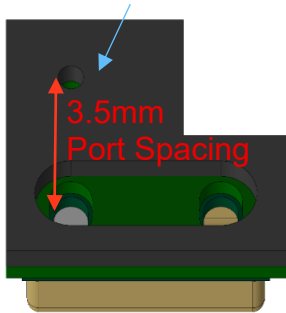


Figure 11: Side-by-Side Bottom View

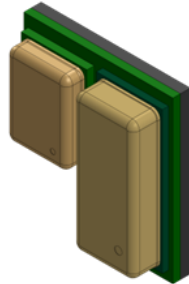


Figure 12: Side-by-Side Top View

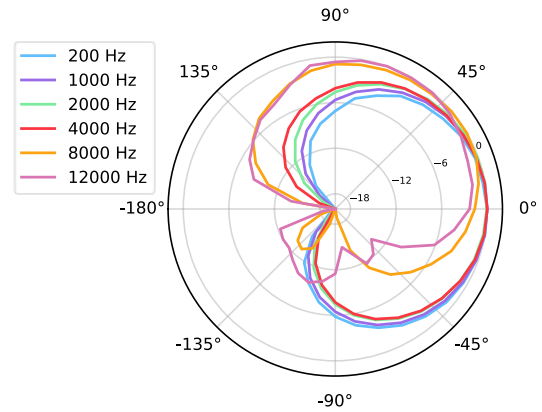


Figure 13: Side-by-Side Polar Plot

Closer to Lid Marking (Avoid): In this layout, the omnidirectional microphone is placed next to the directional microphone on the lid marking side. This will introduce irregular frequency dependent effects to the polar pattern. The SKR0710 microphone is mechanically symmetrical, so there is never any reason for an omnidirectional microphone to be placed nearer to the lid marking side of the dipole instead of the other.

Omnidirectional microphone port

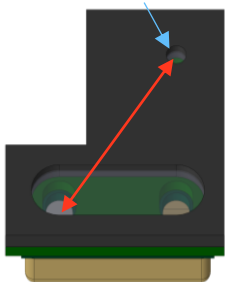


Figure 14: Lid Marking Adjacent Position Port View

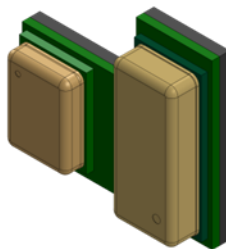


Figure 15: Lid Marking Adjacent Position Top View

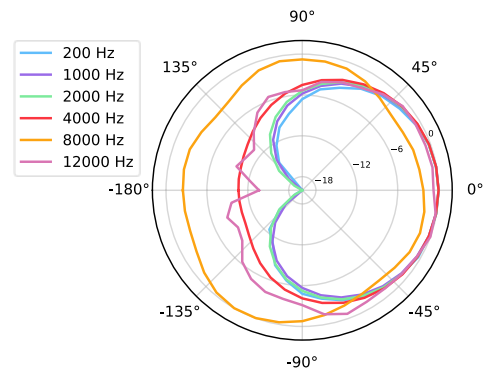


Figure 16: Lid Marking Position Polar Plot

Choosing the Appropriate Omnidirectional Microphone

When choosing which omnidirectional microphone to pair with the SKR0710, several considerations should be taken into account.

Signal-to-Noise Ratio (SNR)

The SNR of the omnidirectional microphone is the most impactful specification when determining the overall performance of the beamformer. The beamformer combines the signals from the SKR0710 and the omnidirectional microphone on-axis. Using a higher-SNR omnidirectional microphone improves the beamformer SNR, but with diminishing returns. For example, as stated in Figure 6, when the SKR0710 is combined with a 68 dB omnidirectional microphone, the resulting cardioid beamformer achieves 66 dB SNR. Generally, an omnidirectional microphone with an SNR of 66 dBA or higher is recommended.

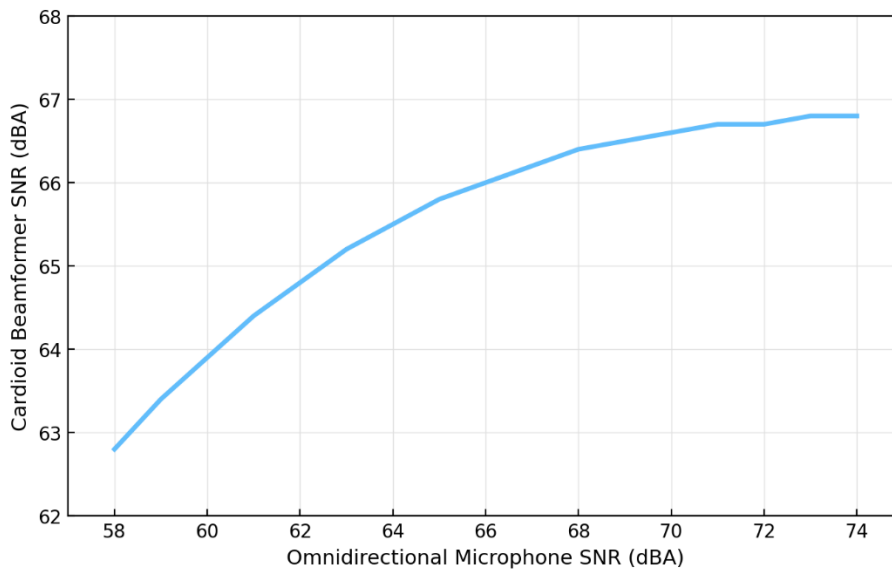


Figure 17: Simulated Cardioid beamformer vs Omnidirectional Microphone SNR

Acoustic Overload Point (AOP)

The omnidirectional microphone should have a sufficiently high AOP to match the dynamic range of the system. Since the beamformer output is a product of both the omnidirectional and dipole microphone, clipping or distortion on either of the individual microphones will degrade the beamformer output. An omnidirectional microphone with an AOP of at least 120 dB SPL is recommended.

Interface Compatibility

The SKR0710 outputs a PDM digital signal. The omnidirectional microphone should also use a PDM output to maintain a straightforward system architecture. The recommended PDM clock frequency is 3.072 MHz for best full band SNR. Please refer to the datasheet for information on performance vs clock frequency. Both microphones should go through the same Codec for simplicity.



Additional Support

For further information on Soundskrit's products, visit our website at <http://www.soundskrit.ca> where you can find more application notes, datasheets, and purchasing information. If you have any questions or need technical support, please reach out to applications@soundskrit.ca.

Revision History

Rev	Date	Changes
-	April 2026	Initial release



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.

