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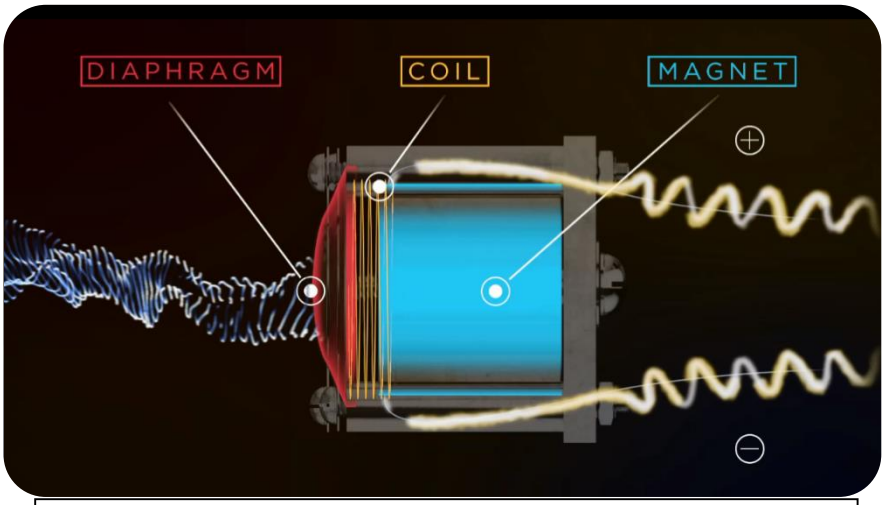
KSM8 Dualdyne™ Acoustic Design & Proximity Effect

The KSM8 Dualdyne is a premier handheld vocal microphone, featuring a patented single pattern, dual diaphragm cardioid dynamic cartridge. This technology, known as Dualdyne™, is unique due to the use of a second passive back diaphragm as part of the resistance/delay network which controls proximity effect. This brief technical note explores and explains this concept in further detail.

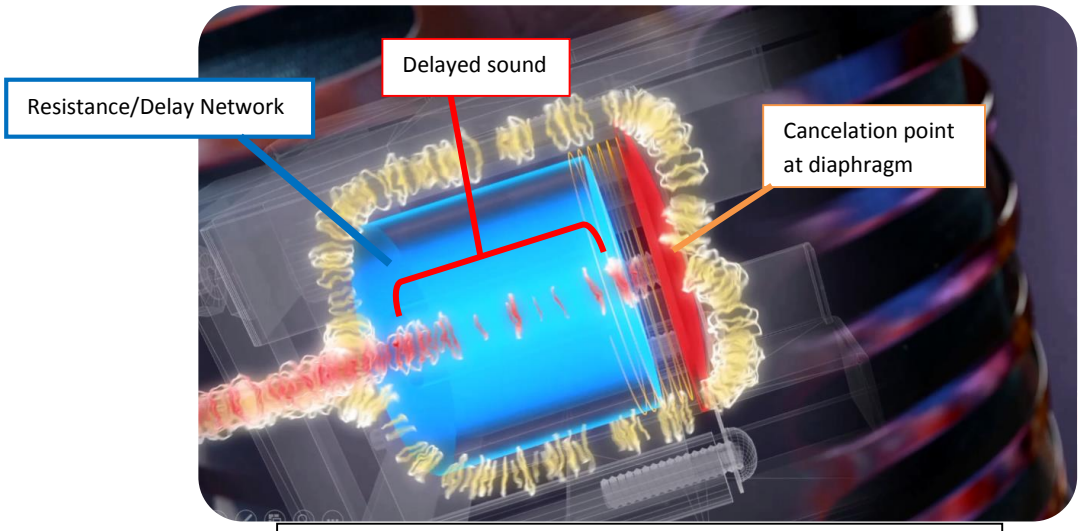
Single Diaphragm Microphones

A single diaphragm directional microphone derives its polar pattern by responding to the difference in sound pressure on the front of the diaphragm vs. the rear of the diaphragm. When sound approaches the diaphragm, the sound wave interfaces both with the front side of the diaphragm (on-axis) as well as around the diaphragm to the rear side. That means the sound entering the back of the diaphragm will be slightly delayed when compared to the sound entering the front. [This process, known as ***acoustic phase shift*** is a major component in determining the polar pattern of the microphone (omnidirectional, cardioid, supercardioid, etc.)].



Major components and operation of a dynamic microphone when sound strikes the front of the diaphragm, on axis. Sound strikes the diaphragm and moves an attached coil within a magnetic field creating voltage across the coil.

Additionally, sound coming from behind the microphone (off-axis) passes through a resistance (i.e delay) network before striking the back of the diaphragm (red airflow). This resistance delay is timed to match the amount of time it takes that sound to travel around the diaphragm (yellow airflow) and strike the front of the diaphragm. Sound strikes the front and back of the diaphragm at the same time, so the diaphragm doesn't move which causes cancellation. This is how rejection is created and this results in a **unidirectional** polar pattern response.

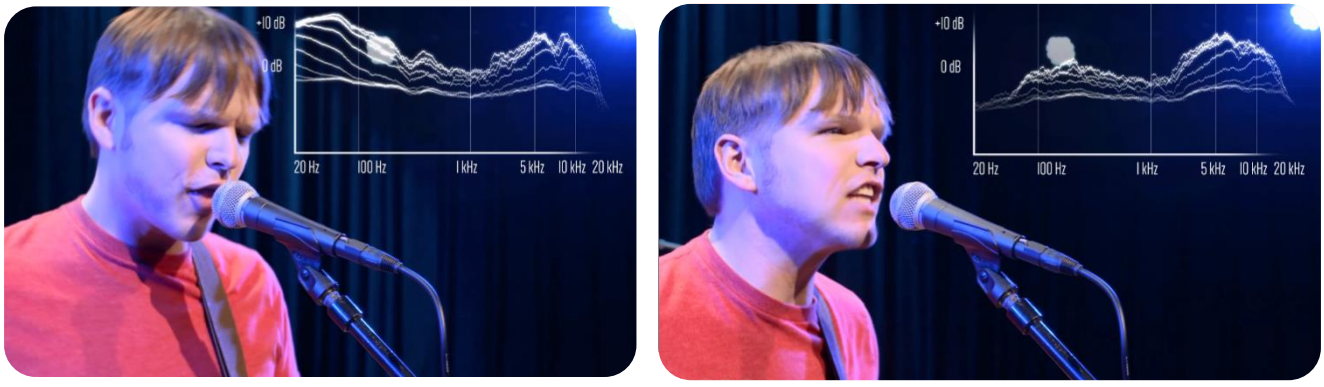


Sound approaching off axis, behind the microphone, passes through a resistance/delay network first to create rejection.

Note: Prohibiting sound from striking the back of the diaphragm by blocking off the back entry of a single diaphragm microphone creates an **omnidirectional** polar pattern.

Proximity Effect

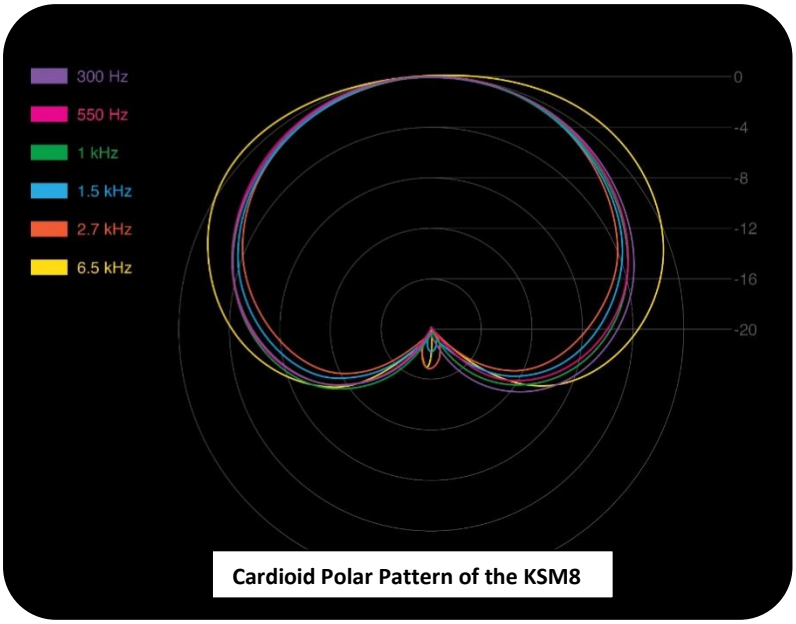
Proximity effect is the increase in bass frequencies as a sound source gets closer to a microphone. This only applies to directional microphones. It is worth mentioning that omnidirectional microphones do not exhibit proximity effect. Proximity effect influences frequencies below 1000Hz - the closer the sound source is to the microphone, the greater the effect becomes on lower frequencies.



Simulated proximity effect response when a singer is directly on a directional microphone vs. slightly away. Notice the increase in bass response as the singer is closer to the microphone.

Dualdyne Technology / Dual-Diaphragm Cartridges

The KSM8 Dualdyne is unique in the market due to both a front diaphragm and a second passive rear diaphragm that work as part of the resistance/delay network of the microphone. This second diaphragm is serves as a major component in the acoustic phase shift/delay network. The second diaphragm is acoustically transparent at higher frequencies, and partially blocks low frequencies from getting to the front diaphragm while still maintaining a true cardioid polar pattern even at low frequencies. Being a cardioid microphone, sound still strikes the *rear of the front* diaphragm to create rejection, however the second diaphragm controls the buildup of low frequency information that the front diaphragm encounters during proximity effect.



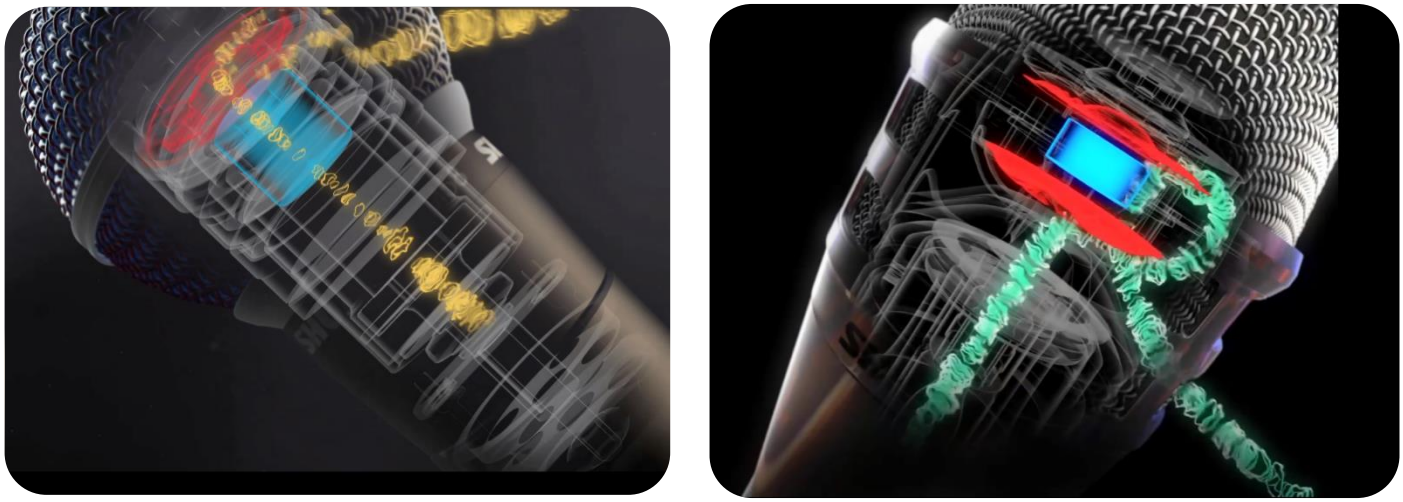
Cardioid Polar Pattern of the KSM8

In a sense, the second diaphragm tricks the front diaphragm to behave like an omnidirectional microphone at low frequencies, resulting in a substantial reduction of proximity effect.

The second diaphragm controls the proximity effect creating a large "sweet spot" for vocalists, while still maintaining a consistent polar pattern at virtually all frequencies.

The simple act of incorporating a second diaphragm in this design meant a complete overhaul of many standard aspects of dynamic microphone technology. The second diaphragm had to fit in conjunction with other standard parts and designs that are required for adequate dynamic microphone performance (resistance parts, pole piece and magnet assembly, certain cavities of air, internal and external shape and design, shock mount components, etc.). To physically fit the second diaphragm in a dynamic microphone layout, Shure engineers had to reverse the airflow typically found in dynamic microphone elements.

Reversing the airflow of the dynamic element was a major design breakthrough that allowed the dynamic microphone to not only have exceptional polar pattern coherence, frequency response, and output level, but provide the additional benefit of controlled proximity effect resulting in a very large "sweet spot".



Internal airflow of the Unidyne III (SM58) cartridge left vs. the Dualdyne (KSM8), right when sound enters from behind the microphone/off-axis.

While Shure KSM9, KSM9HS, KSM44A and KSM42 condenser microphones all benefit from controlled proximity effect due to their dual-diaphragm designs, the KSM8 Dualdyne is the first time this design has been executed in a dynamic microphone.

For more information on the KSM8 Dualdyne design, please reference the issued US patent 8,818,009 recognizing this innovative technology. US Patent: www.google.com/patents/US8818009

For a more detailed technical white paper on dual-diaphragm design, please visit the following link: http://cdn.shure.com/publication/upload/434/us_pro_dual_diaphragm_paper_ea.pdf