

Acoustic Simulation Of Ear Canal Pressure Reduction - Occlusion Relief Dynamic Vent

Michael A. Ricci¹

¹xMEMS Labs, Inc.

Abstract

Problem - The occlusion effect is an increase in loudness (sound pressure level) of your internal voice, especially in the low frequency range. Also, self-generated sounds such as chewing, swallowing, walking or running are amplified when the ears are blocked or occluded. Occlusion occurs when wearing earplugs, earphones or for professional musicians, installing In Ear Monitors into the ear. This increase in volume of your speaking voice (singing voice for performing musicians) results in audio competition with the source your listening too or instruments that musicians need to monitor during a performance. Therefore, most consumers and musicians using these occluded listening products reach for the volume and turn up the volume to counteract the occlusion affect. For stage performers, installing and removing custom molded In Ear Monitors takes some time and completely occludes the ear canal making communication with bandmates, production crew and the audience very difficult.

Modeling - By using COMSOL to model the occlusion affect, xMEMS was able to develop a Piezo-MEMS actuated dynamic vent that provides control over the pressure conditions in the ear canal and through the occluded listening device. The simulation results used to tune the dynamic vent as well as the correlated occlusion reduction (LFRO) measurement results will be shown, validating the Piezo-MEMS dynamic vent model.

Solution - Using a controllable pressure relief vent in an occluded fit listening device can reduce or eliminate the occlusion affect, allowing users to lower the volume to safer listening levels and have a more natural speaking experience when taking calls. Opening a dynamic vent installed in a custom fit IEM allows stage performers to significantly reduce the loud head-voice experienced when singing, enabling a lower volume (safer) monitor mix. Using COMSOL to model various implementations of the Piezo-MEMS dynamic vent allows xMEMS to support different customer product implementations and use cases, helping manufactures of occluded listing devices and hearing protection to deliver safer products into the market.

Reference

https://en.wikipedia.org/wiki/Occlusion_effect

<https://xmems.com/products/#skyline>

Figures used in the abstract



Figure 1 : xMEMS - Skyline Piezo-MEMS Acoustic Vent