MEMS microphone pushes AOP point to ultra-high levels

**Steve Taranovich** - June 26, 2019

Matt Crowley, Vesper CEO, does not develop ‘me too’ microphone designs at Vesper. His MEMS microphone design architecture is so unique and rugged, coupled with the best dynamic range along with creative low-power techniques for long-lasting battery life.

The latest development is the VM2020. This microphone solution was recognized in the **Embedded Technologies category at CES** this year by the Consumer Technology Association (CTA). This was the second consecutive year as a CES Innovation Awards Honoree for **Vesper**.

The VM2020 is an omnidirectional, differential output piezoelectric MEMS microphone with an ultra-high acoustic overload point (AOP). The design is a differential architecture and I think that this may help contribute to low noise so that the dynamic range could be maximized (**Figure 1**).

![Figure 1](image_url) A functional block diagram of the VM2020 shows the differential design out of the microphone and into the buffer, then differential out of the buffer amplifier as well. (Image courtesy of Vesper)

Crowley told me that the MEMS element itself does not overload until well into the 170s and can almost go to the 180 dB sound pressure level (SPL) before it reached 10% distortion.

The MEMS, because it is a cantilever and with the piezoelectric being a very linear effect, helps to get really high dynamic range with good sound reproduction. Capacitive MEMS have a backplate, so if a sound is loud enough, the MEMS will strike the backplate. The Vesper solution is really ASIC-
limited as to what kind of dynamic range can be achieved with the microphone.

In discussing with various customers, Vesper asked them what some of their market needs were for high dynamic range or high AOP. One application that they came across was for very high-end speakers, basically a woofer-monitoring microphone. The microphone would fit in front of a high quality woofer. You get pretty high up there in SPL and the woofers have a high non-linearity, so echo-cancelling and voice interface is very difficult with this really loud sound source right next to the microphone.

![Figure 2](image-url) A typical application circuit for the VM2020 (Image courtesy of Vesper)

Crowley told me that users want a really fantastic voice interface but also really loud bass and great music quality all in a single product. That is the initial use case.

The product is a reference design for [Media Tek’s new smart speaker and sound bar](#). Along with [DSP Concepts](#) algorithms, Vesper can produce the whole solution.

This microphone is good for speakers, soundbars, and television sets since users will not have to trade off a good voice interface and good music quality.

With the VM2020, sound systems will be able to use a less expensive woofer because of good distortion cancellation.

In many homes there are high-quality speakers, as well as many other voice nodes or sound-monitoring nodes such as in an Echo Dot; there are glass break and fire detection monitors built into their speakers.

People are also having voice interfaces in their televisions as an alternative to a remote. The challenge here is that the microphones have to go along the bottom of the TV and that’s where the speakers are. Putting the microphone right next to the speakers can be a problem. The VM2020 can help with that application as well.

The definition of AOP is at 10% distortion. In the VM2020 distortion reaches 1% at an SPL of 150; the 2% distortion is at a SPL of 153. For many of the voice interface systems, 1% distortion is probably a more important metric because that is when the voice interface begins to get worse. For most of the woofers, they are close to but not at 150, so that is where Vesper sets the 1% distortion.
Other possible applications are machine monitoring such as in very loud equipment, or even the sound of wind going across an acoustic port is around 145 SPL, which is pretty loud.

I believe there will be so many more neat applications that users will discover as time goes on. This is an excellent design and we will see it in many, many products.

Look for more innovative microphone solutions to come from Vesper.

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