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VOICE COIL

THE PERIODICAL FOR THE LOUDSPEAKER INDUSTRY

IN THIS ISSUE

Industry News & Developments

By Vance Dickason

MAG Audio

I reviewed (explicated) two of MAG Audio's pro sound OEM drivers in the *Voice Coil* Test Bench column a number of years ago. Specifically, I featured a 6.5" pro sound midrange, the MO610, in the November 2013 issue; and the MAG Audio 10" pro sound woofer, the 10N501, in the January 2016 issue. Since that time, MAG Audio has discontinued its OEM driver product lines in favor of a full line of complete PA products, but that is not the point. The point is that MAG Audio is located in Bila Tserkva, about 85 kilometers south of Kyiv, Ukraine.

I checked MAG Audio's website recently and found the cartoon drawing you see on this page. I also found the following statement from our brother/sister audio engineers at MAG:

Focus

Innovative Speaker Drivers

By Mike Klasco (Menlo Scientific, Ltd.)

This month, we will focus on the recent crop of innovative speakers (transducers), each with a different take to achieve more of something (e.g., higher efficiency or acoustic output, etc.) or less of something (e.g., reduced depth or lower distortion, etc.). The industry has seen a massive shift over the last decade with the widespread acceptance of size-constrained mass market audio systems, especially smart speakers and soundbars with subwoofers.

In cleaning out my basement this weekend I came upon a remote control from my Pioneer Esoteric surround sound receiver, it has about 100 buttons! Dark memories of connecting this monster receiver and its awkward operation for family members reminded me why I ended up replacing it with a Samsung soundbar from Costco—it is all about user-experience, not to mention the sleeker and more compact soundbar form-factor, especially now that all the speaker boxes around the room have joined the Pioneer remote in the basement. But while looking pretty, the soundbar audio quality is less enchanting, yet we all want to have our cake and eat it too. In this article, we highlight a festival of ingenious speaker drivers that might help smart speaker and soundbar designers crawl back to high-fidelity in style.

Back in September 2021, we provided an overview of unique drivers from Premium Sound Solutions (PSS), Resonado Labs, Trulli Audio, and Tectonic Audio Labs, along with some other developments that complement these speakers, such as the Dinaburg passive ring radiator and Klippel's Klippel Controlled Sound (KCS) distortion-nulling amplifier chips from Nuvoton.

Yet for new designs, the speaker industry can be conservative in embracing unconventional designs. This reticence to adaptation of new technology is not a resistance to learning tricks, but innate common sense.

Material Selection Risks

Most speakers are born from the existing parts bin, or at least from a supply chain of the usual suspects. For existing designs, speaker engineers already have a sense of the materials appropriate for the required speaker performance and stability for the anticipated product life cycle. But a flat or square diaphragm, or a planar voice coil on a flat strip bobbin, or very high excursion, all may stress the usual materials and even the knowledge of the specific parts vendors.

Getting performance shortcomings, failure modes, and predictable time to market can all have hidden issues, some of which may only surface when the project is ready to fly. The first product test will have to go slowly for pre-production to evaluate yield vs. tolerances and how this impact consistency and even sensitivity.

Changing the topology of the motor, such as a non-cylindrical voice coil (e.g., a rectangular coil, which is now common for smartphone microspeakers) can require adding precision servo-tensioners to the coil winding operation, otherwise the voice gap would have to be opened up or higher energy magnets used.

Life testing—The most dangerous situation is the unique aspects that provide some benefits in performance will also stress some component parts more than anticipated and after a few months there are too many field failures.

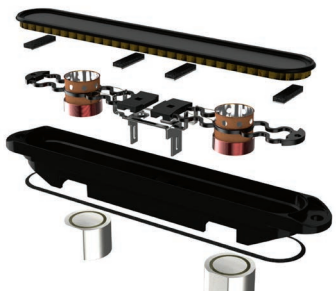
In reviewing these unconventional speakers, I realized every single one results in a more shallow and compact solution. Some of these speakers are already shipping, and others are "coming soon."

Premium Sound Solutions (PSS)

Premium Sound Solutions (PSS), whose ancestry leads back more than a half century to Philips' speakers, is a golden example of where the exception proves the rule of the risks of early adoption. PSS has R&D facilities in Belgium, US, China, and Malaysia and manufacturing facilities in Belgium, Hungary, China, Malaysia, and Mexico. PSS offers its patented and popular Coscone shallow speaker technology, scalable from 2″ to 8″, with wideband and woofer. It is innovative and established even in the rigorous autosound OEM market, but also in conferencing and soundbars. Essentially by moving the magnet position forward and wrapping the diaphragm over the magnetic structure (easier said than done) enables about 50% depth reduction without compromising Xmax. The shallow cone's integrity is due to the unusual contoured rib structure. The stable and linear excursion and low distortion provides extra margin from acoustic echo cancellation processing (full-duplex) and is offered in neodymium and ferrite.

Another innovation from PSS is Coil Disc Drive (CDD) high power/high excursion shallow woofer technology with inverted magnet structure. CDD confers both physical robustness due to enhanced damper to coil connection and increased thermal capacity.

www.premiumsoundsolutions.com



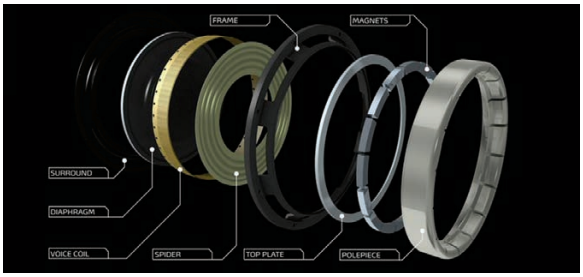
Tectonic Audio Labs

NXT came on the speaker scene more than 20 years ago, and only recently has the flat panel Distributed Mode

Loudspeaker (DML) taken off in sound reinforcement applications. More recent derivations, such as the Balanced Mode Radiator (BMR), use a different bending wave configuration, operating just as a conventional piston speaker at low frequencies while maintaining broad directivity across the entire audio band virtually independent of diaphragm size. Tectonic Audio Labs was formed about a decade ago to continue the development of NXT's work. In recent years, the company has made significant refinements and inroads into large volume products that require the technical advantages of BMRs, particularly a smooth sound power response ensuring high intelligibility and wider listening sweet spot.

Most recent is its High Aspect Ratio Panel (HARP) audio transducers in the form of slim rectangular BMRs to deliver both extended frequency response and wider directivity along its length (long axis) and width (short axis). Two motor structures are used to drive the HARP diaphragm in current configurations. It is especially handy for applications with constrained mechanical dimensions along with a unique replacement for conventional high-frequency (tweeter) components in two-way systems allowing for a lower, vastly preferable (<500Hz) crossover point. The highly compact form-factor and new suspension approach, measuring only 100mm (L) × 16mm (W) × 20mm (H) with application to TVs, monitors, A/B/C pillars in cars, compact soundbars, and more, where it could be easily crossed over to a compact bass drive unit, with a full-range variant in development.

www.tectonicaudiolabs.com



Trulli Audio

Trulli Audio is recognized for its pioneering effort with ThinDriver designs, in development previously under the Prescient brand since 2008. The company evolved to focus on solutions for efficient consumer designs with its TD38S 2″ thin speakers as a promising solution for portable applications, automotive near-field arrays, long-term active noise cancelling without power compression and personal sound zones, due to its combination of high thermal power handling while maintaining a small footprint and shallow depth. The flat diaphragm topology, repositions and expands the voice coil to the juncture of the diaphragm periphery and the juncture of the surround.

Trulli Audio is now shipping the JAM5 High Fidelity Bluetooth Speaker, which retails for $199. Engineered to leverage the company's patented ThinDriver technology. The Trulli TD38S 2Ω square driver with its high thermal power handling, while maintaining a small footprint and shallow depth. The 38mm square diaphragm confers over 20% more piston area than a round diaphragm and its configuration

enables more spider corrugations with huge gains in excursion. In the JAM5, the two TD38S units are combined with two opposite passive radiators and a center tweeter. The unique dual-layered passive radiators are tuned to maximize low bass extension while ensuring sound quality remains punchy and accurate. By the time you read this, its T200 high excursion/ shallow subwoofer with ThinDriver signature huge diameter voice coil should be shipping.

www.trulliaudio.com

Resonado Labs

Resonado Labs' Flat Core Speaker (FCS) has the form-factor advantages of racetrack drivers along with shallow construction. The motor structure of FCS is the key differentiator of the technology as the flat voice coil is able to run along the entire length of the diaphragm and apply uniform force. This enables a larger bandwidth of pistonic behavior for a high-aspect ratio, low-depth driver superior to that of a conventional racetrack driver. For smart speakers, Resonado Labs has introduced FCS Dual Core adding a second motor structure underneath one flat diaphragm. This enables a larger cone and greater surface area to push more air for the reproduction of lower frequencies. Resonado Labs licenses FCS technology and is currently licensing partners with Asian OEM/ODMs Zylux Acoustic and SoundLab. Recent developments include a wide range of ODM product platforms, from higher power subwoofers, marine, and full-range for smart speakers, soundbars, and more.

www.resonado.com

Sound Solutions International (SSI)

Sound Solutions International (SSI) was founded in 2016, and is the successor to Philips in Vienna, Austria, where it continues with R&D headquartered in Zhenjiang, China, as part of Foxconn's Group FIT (Foxconn Interconnect Technologies).

SSI has developed the Coil-Anchor System (CAS) for rocking suppression on the short and long axis. The patent-pending high-excursion Manticore speaker family's initial three models are for smartphones and laptop/tablets, but the topology is highly scalable. The audio quality of smartphones, even when the speakers are low distortion, is still marginal due to the limited dynamic range and weak low-end (700Hz at best). Equalization won't help inadequate excursion, and even when the suspension and mechanical clearance is provided, the peripheral one-point suspension is not stable enough to suppress rocking. The ideal mode for electrodynamic speakers is the piston movement of the membrane, for maximum air pumping (volume velocity). But the breakup modes let the membrane "rock," which results in lower sound pressure and increased distortion. SSI's solution is to shift the so-called rocking frequencies into an area where they do no harm to the acoustic performance by adding a second suspension system (CAS) to "anchor" the coil. Four spring elements in the corners increase the lateral stiffness on both the long and the short axis of the speaker. Besides the rocking suppression, the spring elements are the contact system for the coil removing the leadout wires and gain extra space for more magnet material (or higher excursion or some combination). This not only eliminates a quality risk of breaking wire loops but also enables a higher electrical efficiency and acoustic output of the speaker.

www.sound-solutions.com

Dinaburg Technology

Dinaburg Technology has developed a speaker design based on a concentric passive ring radiator. Most interesting is that this approach is compatible with all the speakers discussed in this report, as the form factor of the passive can be round, square, oval, or rectangular. This passive radiator takes the form of a flat ring that is compliantly held in place by surrounds on both the inner and outer periphery. There are a number of positive aspects with the ring configuration beyond the obvious benefits of a conventional vent-substitute design.

The design techniques, both through Comsol modeling as well as testing, enable lower distortion, extended frequency range, higher efficiency, and wider and more consistent beamwidth (dispersion). The invention has wide applications and can be used for near-field studio monitors, autosound (including headrest audio), ceiling speakers, in-walls, and more uniquely to under-couch subwoofers or even pendant lights with integrated speaker (with a translucent passive ring for illumination).

This passive ring is compliantly held in place by surrounds on both the inner and outer periphery and provides for tighter constructive coupling to the active speaker (and to the room) compared to an open bass reflex port or a nonconcentric passive radiator, which might have to be located on a different side of the enclosure.

Dinaburg Technology is currently focused on inviting collaboration with brands to offer its design innovations and technical support for a wide range of applications.

http://dinaburgtech.com

Mayht

Mayht is a technology company from the Netherlands that has developed Heartmotion drivers to work at their optimum in compact form factors. The Heartmotion driver is intriguing with the "visual theater" reminiscent of the Devialet speakers (think of the characters in the Transformer movies). Intriguingly enough, the company was just acquired by Sonos.

The driver uses two membranes moving in opposing directions driven by multiple motors, symmetrically distributed across the membrane, and allowing for a shallow design. This is the most efficient way to increase air displacement capability and prevent mechanical resonance of an enclosure without increasing depth by having to mount two drivers back-to-back.

Because the Mayht driver has two membranes, the total Sd is doubled, further increasing the maximum air displacement. At maximum excursion, the membranes almost touch each other. Because of that, there is not any

space for a conventional secondary suspension. The Mayht driver contains a distributed suspension technology for maximum control, reliability and linearity of movement. For maximum design flexibility, Heartmotion comes with three air displacement variations: dual firing, front side firing, and front firing. In order to redirect the air, Mayht developed the Heartmotion Duct to redirect air displacement of one or both membranes.

The company is looking to apply its new transducer designs in flat TVs, portable speakers, soundbars and even portable PA and musical instrument systems.

www.mayht.com

KEF

Another integrated dual diaphragm force cancelling design is KEF's Uni-Core KC62 6"×2, a very compact sealed micro sub with integrated dual drivers. KEF has fused two opposing low-frequency drivers by devising a common motor. The two voice coils each have different diameters nestled concentrically within the other. This arrangement allows the voice coils to travel within their own gap without colliding. Two drivers mean more surface area (Sd).

The long throw drivers' novel folded surround's higher integrity is claimed rather than the half-roll approach. The patented "P-Flex" surround is a pressure-resistant, pleated design to resist the deformation caused by the internal air pressure of the cabinet, at extended, linear movement. The Uni-Core is used in conjunction with "Smart Distortion Control Technology" (SDCT), a hybrid system combining DSP pre-correction with indirect cone motion sensing and feedback.

https://us.kef.com

Nuvoton and Klippel

Dr. Wolfgang Klippel's Klippel Controlled Sound (KCS) is another sophisticated DSP pre-correction solution that will change how most of us design not just integrated speaker systems, but the drivers themselves. This is Klippel's KCS in chip form from Nuvoton. KCS technology, integrated in a Nuvoton audio amplifier chip, creates a versatile solution to improve speaker performance and sound quality by compensating for nonlinear speaker responses.

Essentially a dynamic pre-distortion circuit that is calibrated to the speaker and enclosure. You might think of it as the next generation of smart-amplifier. A smart amp, typically designed with the smartphone as its intended home, is predominately a feed-forward protection circuit specifically tuned for the limits of the speaker, both displacement and thermal.

The challenge was to increase the maximum acoustic output without creating new failure modes by inadvertently crossing the line with fatigue failure issues by dancing at the edge (getting smartphones back with worn out speakers might annoy Apple, Samsung, etc.) or worse, driving to the edge on ring tones and speakerphone functions might inadvertently stumble into long-term speaker failure modes.

It has been a few years now and NXP, Maxim, Texas Instruments, Cirrus Logic, Infineon, and Qualcomm have all succeeded with their smart amps, all of which are only a couple of watts—more than enough for smartphones considering battery drain and what the microspeaker can handle. At this point speakers can play as loud as possible without rattling buzzing, or failing—allowing everyone in the smart amp business to sleep soundly.

For functionality, aside from saving the speakers from damage, how about we drop distortion, and for applications where there is full duplex with acoustic echo cancellers, along with painless barge-in, provide a significant margin before echoes.

Another intriguing aspect is what Dr. Klippel has defined as "green speaker design." Given the materials' budget, you can design an underhung voice coil with a huge magnetic structure and achieve high linearity—at a cost in weight. Or you can draw up a less extravagant design and use dynamic pre-distortion to keep your driver on its best linear behavior. Nuvoton is shipping a 7W and 20W KCS amplifier with the 30 x 2 /60W mono sampling now.

www.nuvoton.com | www.klippel.de

Overall Impressions

Premium Sound Solutions, Tectonic Audio Labs, and SSI are ODM/OEM vendors for their unique transducers. Nuvoton is offering Klippel's KCS in integrated circuit form. KEF and Mayht/Sonos are focused on their market reach through their brands and established distribution channels. Dinaburg and Trulli are very receptive to collaborations. ***VC***