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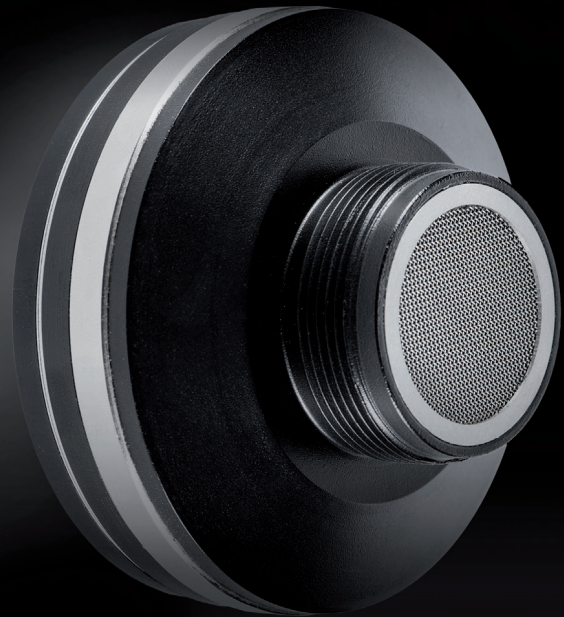
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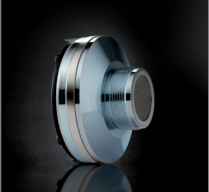
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Evolving in Changing Times

The *Loudspeaker Industry Sourcebook (LIS)* has been published every year for the past 27 years, and more industry professionals are now familiar with *LIS* and its online directory format (www.loudspeakerindustrysourcebook.com). Each year, this online resource serves as a reference for everyone working in R&D, manufacturing, sourcing, product management, technical support, marketing, and sales in the loudspeaker and related industries. The listings submitted online are compiled annually to generate the printed edition, but the *LIS* publication and website also contain must-read articles, interviews with audio professionals on trending industry topics, and annual industry reports about the state of the industry.

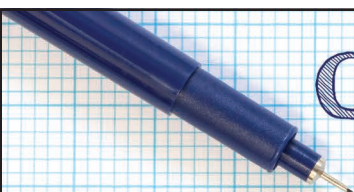
In 2023, the loudspeaker industry reflects a technology acceleration that is basically inherited from larger industries. Everyone is talking about Artificial Intelligence (AI) and Machine Learning (ML), which are essentially tools that are going to accelerate much of the evolution already taking place. This is going to increase our ability to research and develop new solutions that we couldn't even previously conceive. It's being felt in all disciplines, but transducers are one the greatest beneficiaries of the tremendous evolution in computer simulation tools, modeling, and new material engineering, removing much of the guesswork and time-consuming experimentation. Test and measurement solutions are also evolving, enabling a more accessible approach for R&D all the way to quality control in production lines.

And it's not just technology, it's also the methods and the expanding supply chain and production structure. Following the pandemic disruption, with component, parts, and raw material shortages, the audio industry has been forced to accelerate an inevitable transition. Sometimes, to replace products that will never be viable again for health and environmental reasons, lack of resources, or purely because of economics that no longer make sense. The use of rare earth materials in general is one of those examples with a direct impact in the speaker industry. And yet, thanks to the dynamics being felt in the energy and automotive industries, we are on the verge of breakthrough alternatives that enable exciting new possibilities for audio applications.

Markets have reopened in 2023 and we have learned to better appreciate our partnerships and suppliers, with a growing understanding of how interconnected we all are. But things are also evolving, and the audio industry is more open to exploring new sources and solutions. And we can see manufacturers investing in geographical dispersion and vertical integration again—where it makes sense and to avoid future disruptions.

More importantly, the audio industry continues to innovate and expand, with audio increasingly recognized as a vital part of everyone's life. As always, all this is reflected in the pages of this industry publication and its directories. Please enjoy the 2023 edition of *LIS*!

—The *LIS* Staff



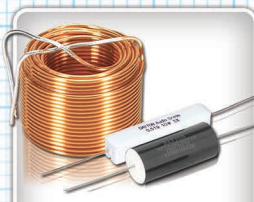
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2023 State of Speaker Industry

The Year to Rebuild, Reimagine

By
J. Martins



A complete overview of the loudspeaker industry entails looking at many application segments and industries. This 2022/2023 analysis does just that and also looks more closely at how the consumer market is shaping up, offering perspective on voice, spatial audio, soundbars, wireless audio and high-end home audio applications. Pictured: KEF R Series with Metamaterial Absorption Technology (MAT) technology.

The loudspeaker industry has entered the year 2023 in a seemingly determined and energetic way, judging from the number of product announcements, following a period of recovery from the global pandemic and the supply chain disruptions. In 2022, we started returning to some form of normalcy, with the partial reopening of key markets, the return to travel and trade shows, and finally an opportunity for companies to assess the situation in the field.

But as 2023 is shaping up, the complex reality is also creating a high degree of anxiety. There isn't a clear picture in any market segment, although in general the economy has proven resilient and consumer demand remains strong. Contributing to the uncertainty is the fact that market indicators and metrics remain elusive and unreliable as we noted in our 2022 report.

Market research firms continue to struggle to update their data and there's nothing we could find that would be of some use for the audio industry or any of its product segments. Clearly, the only reliable approach consists in a more detailed view of product categories and market segments, bearing in mind that manufacturers are still constrained not so much due to demand, but more for their ability to control production volumes, and manage distribution and the rising costs.

Getting Back on the Road

In the professional audio market, as the pandemic effects cleared, activities in live entertainment and events made a very strong comeback in 2022, allowing for some degree of optimism as the demand for products has clearly reemerged in segments that had stagnated. After two years of forced inactivity, everyone is eager for collective experiences, and consequently concerts and touring have seen increased demand. But the economic impact of that spike of activity in the show industry will not be clearly understood until the end of 2023.

Because of strict quarantine and travel restrictions during the pandemic, full-scale live events did not resume until the Summer of 2022. And now the performance and events industries are trying to coordinate both the productions that were on hold for two years and the many new ones that were planned during the pandemic.

Demand for production technology and sound reinforcement systems is clearly high, but many large investments have also been conditioned by the need from many of the industry's organizations, particularly rental companies, to redeem previous investments. Not surprisingly, the whole live entertainment industry has seen major restructuring happen all over the world with bankruptcies, mergers, and many acquisitions.

Commercial installation has remained resilient throughout, with many large projects finally resuming pace and the pressures over stocks and deliveries starting to indicate strong volumes and demand. The largest problem affecting the professional segments seems to be the consequences of the pandemic period that affected key parts suppliers, particularly in Asia, forcing even the largest companies to rethink their sourcing strategies and requiring some product redesigns.



One of the most significant speaker launches of 2023, the Razer Leviathan V2 Pro gaming soundbar, brings to the market the remarkable 3D audio beamforming technology from British company Audioscenic. This is the world's first desktop soundbar with THX Spatial Audio combined with Audioscenic's unique technology that allows a truly personalized, immersive 3D listening experience with head-tracking AI without the need for headphones thanks to the integrated IR camera that detects the user's position. This allows the soundbar to adapt the audio beams to the listener's positioning in real-time, ensuring the listener is always in the sweet spot for the best audio experience.



In 2023, speakerphones are evolving and being integrated with cameras in soundbars (also called videobars) and smart designs such as the latest from Owl Labs, the creators of the first AI-powered speakerphone and 360-degree video conferencing solution, updated this year. The Owl Bar is a new front-of-room camera, microphone, and speaker that pairs with the existing Meeting Owl device and Whiteboard Owl camera to make hybrid meetings even more immersive. Combined, these solutions create an effective multi-camera communications solution that enhances meetings.

Again, it's a shame that no clear market intelligence is available at this critical juncture. Even from the most relevant source of data insights for the commercial installation sector, which used to be InfoComm, now the Audiovisual and Integrated Experience Association (AVIXA), no updated market reports have been published with data relevant to the audio industry. AVIXA now characterizes the sector under the ambiguous term of "AV Industry" mixing too many unrelated product categories and applications so no one really knows what it involves.

The residential integration sector—another key professional audio category for many brands and manufacturers—continues to show momentum, with the pandemic having revived the trend for further investment in the home, and homeowners valuing their long-term improvements. Following a period of restricted activity during the pandemic, demand for new projects quickly accelerated in 2022 and remains very strong in 2023, matching an enthusiasm with new technologies and products associated with the broad smart home category.

For pro audio's component and speaker driver assembly side, the consequences of the pandemic are starting to become visible. The largest disruptions clearly happened on the sourcing side, with many industrial operations in Asia affected by the lack of workers (in certain regions, many workers fled urban industrialized zones during the quarantines and have not returned).

Consequently, depending on each company's degree of vertical integration, some companies have reinforced their positions, while others are struggling to stay afloat. But even the largest speaker driver manufacturers have been forced to modify or remove familiar references from their portfolios, with likely consequences to be felt further down the line, creating the need for more replacement parts or even the removal of products from the market. No doubt, we will see further consolidation with possible mergers and acquisitions for this core side of the loudspeaker industry.

The Consumer Rollercoaster

For the consumer market segments, we have mainly seen a new series of disruptions, caused by quickly changing market conditions post-pandemic, with continuous price pressures, excess inventory, and new forms of supply chain disruptions affecting some companies and product segments—particularly those that had seen strong demand during the pandemic. Macroeconomic instability (with inflation as a key consideration) is making it difficult to forecast how this will

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impact the markets, creating further anxiety. As China's industrial capacity resumed after the New Year, travel restrictions were dropped and borders reopened.

Now, we are starting to get a clearer picture of how things have actually changed. Brands have in some cases found that their production—or part thereof—had been relocated without their knowledge, while others have found that their new orders are now at the end of the line, following a period of inactivity. In general, consumer categories are suffering from excess inventory, much of which originated from the inability to predict demand for successful products during the pandemic, followed by the fear-of-missing-out, which motivated many brands (and their copycats) to flood the market with me-too products. After all, no one could have accurately predicted the way the pandemic quickly subsided and what would follow.

But even in the consumer product segments, there is a huge diversity of circumstances and trends. Let's look at gaming as an example. The product category exploded during the pandemic, with spectacular demand, and the industry in general was unable to match that demand. The pandemic also created an unforeseen demand for unusual products including microphones, articulated boom arms, and headphones, which

quickly decreased in 2022, precisely at the moment when many brands had managed to update their product strategies and were responding with much better designs and even innovative propositions. Suddenly, speakers for the desktop, including a new category of desktop smart soundbars is taking over the gaming segment, while portable products are again seeing demand.

In contrast, home audio and hi-fi have seen robust demand throughout the pandemic years, reversing the trends that had been previously noticeable, but never originating the spikes in demand or the appearance of completely new product-defining designs that we now see in gaming or in work-from-home systems.

In general, companies with good manufacturing capabilities, updated product catalogs, and strong distribution networks or sales channels have seen uptakes in sales, but that's about it. Many other companies struggled to benefit from the fact that consumers were at home and willing to invest in home technologies, because they were not ready, had no appealing propositions, had limited regional range, or simply had no manufacturing capability to meet a sudden demand.

And overall, the materials and electronic component supply chain problems have affected everyone, and pressures are now visible in the discontinuation of many classic references. Curiously, although luxury audio has shown to be extremely resilient, the more expensive audio products were affected by those supply chain issues in pretty much the same measure as the more affordable mid-price categories in hi-fi and home audio. Again, benefiting companies and brands that were more vertically integrated, had better control over manufacturing and had better distribution networks.

From Portable to Party Speakers

As noted in our 2022 report, in consumer electronics, we have witnessed a veritable rollercoaster of demand and inverting product trends. As whole families had to share the household for months, each room in the house received more technology. Not surprisingly, headphones became mandatory when everyone was chatting or watching content at the same time. And for many, the living room suddenly became the meeting point and shared entertainment center for the whole family—reimagined for multiple uses, from leisure time to fitness activity. But obviously the audio industry was not able to readjust and launch products that suited that new reality in such a short time. In the post-



Bang & Olufsen announced a new generation of its Beosound A9 and Beosound 2 home audio speakers. Available in new Black Anthracite, Gold Tone, and Natural finishes, the two speakers now join Bang & Olufsen's range of future-proof products on the Mozart software platform. Mozart was created by Bang & Olufsen to ensure product longevity beyond physical design. Designed to be updated and improved, the Mozart platform is easy to service and allows for future upgrades of the streaming module.

pandemic, the problem now remains the need to readjust inventory to meet quickly changing demand—particularly for product categories that remained on the shelf—at a moment of inflation when the economics and price structures have been completely altered.

Portable Bluetooth speakers are one of those products that was at the center of the hurricane during this period. Manufacturers who had designed products and strategies thinking about outdoor activities and travel didn't know what to expect when the world quarantined in 2020. But no one can blame them for suspending or cutting production at that moment, although demand from consumers in online channels has proven extremely strong.

Who cares if the brochures show users on a mountain trail? The same portable speaker can be used for exercise routines in the backyard, and its portability makes it a valuable personal item in all home activities, depending on the right level of features and technologies. The result can be seen from the best-selling lists of products in that period, where we can consistently find either the established brands (Sony, JBL, Bose) or the products offered by brands with strong OEM ties such as Anker.

Overall, sales of portable Bluetooth products remained strong and resilient for the pandemic years and remains strong in 2023, independently of the use case. In fact, Bluetooth speakers are the big winners in 2023, replacing the former smart speaker products from the large technology companies, and even replacing many other product categories in the home (unfortunately). In that category, we should obviously include party speakers, which continues to rapidly expand, and is finally gaining consumer awareness outside of Asia, where they originated (rooted in karaoke speakers).

How Voice Is Shaping Speakers

I believe a quick reference to the crossover category of speakerphones, desktop soundbars, and work-from-home peripherals is also mandatory. The work-from-home market was clearly saturated in 2022, and this year we have seen the launch of many products that are basically the result of several brands reacting to the pandemic effects, with the introduction of a series of desktop speakers and speakerphones from companies such as Dell and HP, gaming companies, and even completely new consumer-oriented companies that had a good idea in 2020, but arrived too late to market in 2023.

More significant is the fact that many of the traditional UC&C companies have launched desktop soundbars/speakerphones or even videobars (an emerging category) that can be described as work-from-anywhere products, and consequently have also been marketed directly to consumers. As for the speaker category, the most interesting aspect may be the fact that it's where we can see increasing adoption of more innovative thin speaker drivers, including racetrack formats, benefiting from all the experience with soundbar and smart speaker design. Those drivers are naturally pushed to their physical limits with optimization via DSP to achieve the goals of speaker intelligibility but also to provide some added value to consumers when pitched as potential portable speakers for music listening. The results diverge from shockingly bad to surprisingly balanced in low volumes.

What's important to note is the availability of a much more powerful set of digital signal processing technologies, both on the hardware and software components, complemented with a growing integration of the electronics, efficient amplifiers, feed-forward protection circuits, and even built-in sensors. Both in the consumer and the professional audio segments, the combination of those technologies has progressed from home smart speakers, now into new product segments, and we are seeing that in speakerphones, soundbars, and even portable speakers.

Another important factor to consider is the evolution of transducers and how emerging use



The Pulse M speaker expanded Bluesound's line of wireless, multi-room streaming speakers. It looks like a smart speaker, but the "smarts" are truly in its unique Omni-Hybrid driver design and wireless music streaming features, adding a valuable expansion to the Bluesound and BluOS high-resolution audio ecosystem.

cases are changing designers' priorities and industry volumes. The first outstanding example being voice applications—not necessarily just to support voice interfaces and voice assistants in smart speakers or smart home products, but generically to deliver high-quality voice reproduction in speakerphones, conferencing systems, desktop soundbars, and even hearing assist products.

Voice is inspiring many new loudspeaker manufacturers to consider alternative approaches in transducers and speaker design that wouldn't simply be viable in other traditional applications. This is benefiting new speaker companies that are exploring planar magnetic, balanced mode

radiator, flat core, and other topologies currently available.

Spatial Audio Compact Speakers

Because the loudspeaker industry is seeing so many contrasts and rapid changes in market segments, product categories, and application sectors, I believe the best way to characterize the state of the industry on the consumer side is to look at notable examples of products launched over the past 12 months or now making an arrival.

To start, there's no better example than the unexpected return of the Apple HomePod. The main story with the HomePod Gen2 is that it comes with a variety of (much needed) updated technologies, including Bluetooth 5, UWB, Airplay 2, and the same smart, adaptive listening experience. But that is not reason enough for consumers to buy a product that looks exactly like the old one. The reason why we need to highlight the HomePod in this report is that it contains all the elements that helps us redefine the smart speaker category—at a time when we do not expect to see much level of innovation from the other original smart speaker players, such as Amazon or Google.

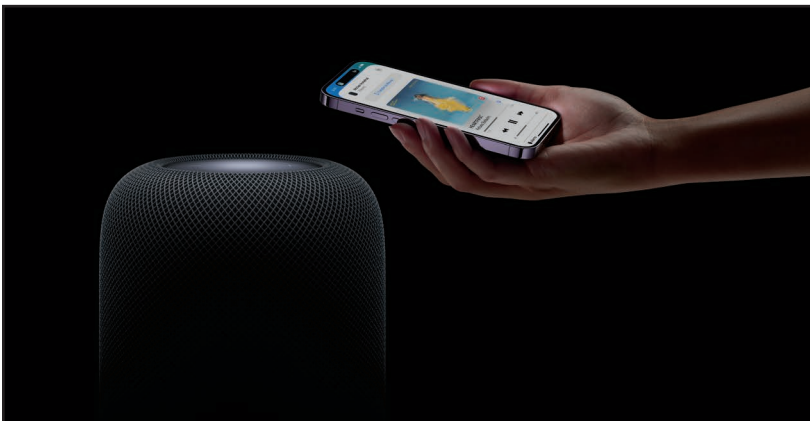
It's good to know that Apple's audio engineering team continued to work on perfecting its iconic HomePod speaker, discontinued in March 2021. The new Apple HomePod (2nd generation) is now a powerful smart speaker that delivers next-level acoustics in the same iconic design as the first generation, packed with the technology that should have been available in the original. The Apple HomePod now offers advanced computational audio to improve the listening experience, including support for immersive Spatial Audio tracks—as should be expected, since this product is a natural extension for Apple Music subscribers, who have been enjoying Dolby Atmos Music tracks on AirPods exclusively (considering that not many will have a full Dolby Atmos speaker array at home).

The new HomePod features a custom-engineered 4" high-excursion woofer, built-in bass-EQ mic, and beamforming array of five tweeters around the base. The Apple S7 chip is combined with software and system-sensing technology to offer even more advanced computational audio that maximizes the full potential of its acoustic system.

With room-sensing adaptive technology and four far-field microphones, the HomePod recognizes sound reflections from nearby surfaces to determine if it is against a wall or freestanding, and then adapts sound in real time.



With basically the same acoustically transparent and 100% recycled mesh fabric and a backlit touch surface that illuminates from edge to edge, the new HomePod boasts a recognized design, available in white and midnight, with a color-matched woven power cable.



As Apple did with the HomePod mini, enhancing the "smart speaker" features, the HomePod (2nd generation) offers convenient new ways to manage everyday tasks and control the smart home, including already support for Matter-compatible peripherals and systems. And users can now create smart home automations using Siri, get notified when a smoke or carbon monoxide alarm is detected in their home, and check temperature and humidity in a room—all hands-free.

Two or more HomePod (2nd generation) or HomePod mini speakers unlock a variety of powerful features, starting with multiroom audio with AirPlay 2, and can even be used as an intercom to broadcast messages to other rooms. Users can also create a stereo pair with two HomePod speakers in the same space. And the new HomePod easily pairs with Apple TV 4K for a home theater experience, including to make HomePod the audio system for all devices connected to the TV. Available for \$299 (US), the new HomePod (2nd generation) establishes a new reference in the smart speaker category.

In comparison, the latest Amazon Echo devices, updated in 2022, introduced slightly better-sounding models of the compact Echo Dot and Echo Dot with Clock, while the larger Echo Studio flagship features a new spatial audio processing technology and upgraded drivers to do what it promised when it launched four years ago.

Amazon continues to refresh Echo devices basically to perform their fundamental role of reliably capturing voice interactions and to continuously improve the Alexa voice assistant experience. Because to perfect an ecosystem based on a voice assistant, there's nothing better than actual hardware devices with quality audio front ends placed in different rooms of the house and having different members of the family interacting with them daily.

In 2022 Amazon launched a new generation of Echo Dot and Echo Auto, creating more reasons for users to bring Alexa into every room of their homes and into their cars. In addition, Amazon announced a new generation of Echo Dot Kids with updated fabric designs, to expand its ecosystem with children, a key demographic for the Alexa strategy. Kids have a unique way of interacting and communicating with a voice assistant, which introduces valuable machine learning improvements, while also creating new generations of users that have grown up with Alexa.

These new Echo smart speakers are powered by the AZ2 Neural Edge processor, which means that the Echo Dot and Echo Dot with Clock enable more of those simple commands and interactions to be processed on-device, resulting in faster responses for tap gestures, ultrasound motion detection, and on-device execution for some of the most common requests to Alexa. Also, to care for privacy concerns, Amazon added a microphone on/off button.

More relevant for this market overview is the larger Echo Studio model, which was originally



introduced as the best-sounding Echo speaker and was mainly intended to be the platform that would enable a whole new generation of users to learn about spatial audio, including Dolby Atmos and Sony 360 Reality Audio—the two formats available through the Amazon Music HD streaming service. The updated Echo Studio is available for \$199.99 in White and Charcoal.

Although not part of the smart speaker category, the HomePod (2nd generation) and the Amazon Echo Studio could be compared with the Sony SRS-RA5000 and the SRS-RA3000 wireless speakers, which the company introduced in 2021 to reinforce its research efforts in spatial audio and specifically its 360 Reality Audio and Immersive Audio Enhancement technologies.

Generating the sense of “spatial,” or “immersive,” or 3D sound, or whatever brands decide to call it, has proven successful only with multichannel installations using multiple speakers

Four years later, Amazon says that its Echo Studio is now even better with new spatial audio processing technology and frequency range extension, also enhancing stereo source material from a single speaker.



The Sony SRS-RA5000 was designed to deliver spatial audio and optimized for reproduction of Sony's 360 Reality Audio object-based audio technology. The speaker is effectively able to deliver an enhanced tridimensional experience, designed with multiple drivers and equipped with smart processing, which includes sound calibration.

surrounding the user, including from above, or generated binaurally through headphones, combining sophisticated processing and position sensors—an experience that is improved when adding personal head-related transfer function (HRTF) profiles, as Sony has proven with its 360 Reality Audio demonstrations.

Trying to generate the same tridimensional immersion with sound radiating from a single source is an obvious challenge. With two speakers, or an array of speakers placed at a certain distance, as is done with soundbars, the effect can be impressive, as the Sennheiser/Fraunhofer AMBEO 3D soundbar has proven (and without relying on the effect of room reflections). But claiming Dolby Atmos reproduction from the sound generated by an Amazon Echo Studio speaker is the equivalent of a gimmick—designed to impress an unsuspecting listener in the same way as switching from mono to stereo or adding an Aphex Aural Exciter to a stereo source.

Sony believes that its 360 Reality Audio technology can go a step further when combined with a dedicated speaker, designed with multiple drivers, and equipped with smart processing, which includes sound calibration. It is aimed at improving music listening at home as an alternative to what millions of people currently use, which is a single Bluetooth speaker placed somewhere in a room, playing summed-up stereo from a single tweeter and a down-firing woofer (if it's a good one). Not exactly a replacement for a premium high-end,

hi-fidelity audio system—no matter what the marketing message might suggest.

The Sony SRS-RA5000 and the SRS-RA3000 wireless home speakers are equipped with Sony's "unique spatial sound technologies" and, according to Sony, can "create ambient room-filling sound, designed for those daily situations when users are reading, cooking, working, or listening to music, primarily functioning as "a high-quality and premium two-channel audio experience that fits perfectly into any home."

The Sony RA5000 is also Hi-Res Audio certified (mandatory in Japan) and features a trio of up-firing speakers that spread music vertically, while the three middle-sited speakers spread sound horizontally. Each driver features a mica reinforced cellular diaphragm with reinforced rigidity while maintaining a compact size. These multiple drivers are complemented by a down-firing subwoofer. Together, the sound system can generate a rich full-range sound with deep bass, superior to standard compact wireless speakers.

The slimmer RA3000 achieves omnidirectional sound with deep bass by using a full-range speaker, an omni-diffuser that spreads sound throughout the room in every direction, combined with a dual passive radiator to reinforce the bass. The speaker's overlapping beam tweeters form a wave front that goes upward, which is the part that creates the "immersive" experience. The RA3000 is also humidity resistant, so that users can use it in the kitchen and bathroom.

Just like Apple's HomePod, the RA5000 and the RA3000 speakers both feature Sound Calibration, allowing optimal sound performance wherever they are positioned within the home.

As premium speakers, the new Sony RA5000 and the RA3000 are compatible with Amazon Alexa and Google Assistant-enabled devices, and have Chromecast built in. Both models are Wi-Fi enabled (but don't support Apple AirPlay), feature Bluetooth and NFC, and support Spotify Connect. Both speakers also support multiroom playback that lets users play the same, or different, songs in separate rooms at the same time via speaker groups setup with the Google Home or Amazon Alexa apps.

And users can control the speaker from anywhere in the house using the Sony Music Centre app on a smartphone, which also allows controlling the various settings for a personalized listening experience. Since they are Sony products, the RA5000 and the RA3000 are also able to wirelessly connect to compatible Sony Bravia TVs via Bluetooth, to expand the audio performance



The new Era 300 boasts six powerful drivers that direct sound left, right, forward, and upward, all with the intent of maximizing the performance as a single speaker and being able to deliver a different experience with Dolby Atmos source material, movies, or music.

of those TVs. The Sony SRS-RA5000 model retails for approximately \$799, while the SRS-RA3000 sells for under \$399.

And finally, already in 2023, Sonos has debuted its Sonos Era 300 and Sonos Era 100, the company's next generation of connected, home audio speakers that also have smart features, but more importantly pave the way for a whole new chapter in sound and design innovation from the brand.

The new Sonos Era 300 is a bold new speaker design for the company, built to deliver the largest, most impactful sound. Sonos claims the Era 300 can reproduce spatial audio with Dolby Atmos as a single speaker, which is in itself a preclusion, or when used in actual multichannel immersive configurations, which is the most interesting aspect. And although again not strictly falling into the smart speaker category, Sonos doesn't hesitate to call the Era speakers its "next generation of smart speakers," given the level of technology that is integrated.

For both models, Sonos expanded its Trueplay technology to measure the room and fine tune the response no matter where the speakers are placed. Until now, Trueplay required using an iPhone app and the actual microphones on the iPhone, which were the only ones consistent enough to be used for the purpose. Now, using the built-in microphone array in the Era 100 and the Era 300, Trueplay can optimize the sound with the support of an iOS or Android app.

In a single compact speaker, the new Era 300 boasts six powerful drivers that direct sound left, right, forward, and upward, all with the intent of maximizing the performance as a single speaker and being able to deliver a different experience with Dolby Atmos source material, movies, or music. Sonos has also embarked on the spatial audio hype for strategic reasons, since the company introduced support for spatial audio on Apple Music, an important official endorsement. Apple Music with spatial audio is available on the new Sonos Era 300, and on the Arc and the Beam (Gen 2) soundbars.

Of course, the Era 300 sounds basically like an omnidirectional speaker would, removing the stage and enhancing the tridimensional "bling," which is not exactly how music should sound. And the reason why the "spatial" effect is little more than "bling" should be obvious from the acoustic design, with every angle, proportion, and perforation enhancing the direction and dispersion of sound.

As Sonos highlights, the Era 300 is the brand's first speaker that is also designed to be part of a

multichannel surround sound setup, when used as home theater rears. Users can pair two speakers with Arc or Beam (Gen 2) and a Sonos Sub to create a surround sound system that correctly decodes the Dolby Atmos soundtrack into what can basically be described as 4.1 system—or 5.1 at best. Sonos says some of the drivers on the Era 300 do act as upfiring height channels, but the result will depend greatly on the room size and ceiling materials.

With all the spatial audio hype, Sonos didn't help much to highlight the merits of the Era 100, announced at the same time. Being slightly larger than its predecessor, Sonos One, the new Sonos



Another important aspect of the new Sonos Era 100 and the Era 300 is the new intuitive user interface, including a new capacitive volume slider for simple control that complements quick and private control of the music with Sonos Voice Control, the Sonos app, Apple AirPlay 2, and Bluetooth. Both speakers support direct streaming via Wi-Fi or from external Bluetooth devices, and can be connected to other audio devices such as a turntable using an auxiliary cable and the Sonos Line-In Adapter (USB-C).



In the new LG 2023 soundbar lineup, the new SC9 flagship combines a series of sound processing technologies to optimize the user experience with any type of content. Designed to deliver maximum impact with Dolby Atmos and immersive audio formats, this soundbar employs channel analysis performed by an HRTF-based 3D engine to add a virtual mid-layer and enhanced AI Room Calibration that analyzes the room and adjusts the frequency response and overall balance.



The Bose Soundbar 600 is artfully designed to be small and compact. Without adding height to the enclosure, it still fits all of the transducers required to deliver high-quality audio—so performance is not compromised for size.

Era 100 features all-new hardware and software, with next-generation acoustics and design, two angled tweeters that send crisp high frequencies left and right for a richer stereo experience from a single source, while a larger midwoofer creates better bass—unexpected from a single compact speaker. Sonos also catered to the possibility that smart users will buy two Era 100 speakers and use them as a stereo pair for music, or as rear surrounds with a soundbar to create a home theater experience during movie night.

The new Era 300 and the Era 100 are also the first speakers built to Sonos' new responsible design standards. Both speakers are made with post-consumer recycled (PCR) plastic and packaged in 100% sustainably sourced paper, while also engineered to reduce power consumption with under 2W idle power consumption and a new advanced sleep function.

Both speakers also work with Sonos' own Sonos Voice Control system. For those concerned

with voice recognition features and loss of privacy, Sonos has added a switch on both new designs, which should reassure users that the microphones are off. This way, it doesn't need to add a separate non-voice model as it did with the Sonos One SL. The Era 300 is selling for \$449 USD, while the Era 100 costs \$249 USD—both are extremely affordable for the technology they contain.

The Age of the Soundbar

2022 was—and 2023 continues to be—a very strong year for the soundbar, although home cinema continues to be one of the largest untapped opportunities in home audio given the stigma and the (manufacturers) trauma still vivid from the home-theater-in-a-box debacle. The unpredictability of the pandemic didn't allow enough time for the audio industry to react and deliver a convenient wireless multichannel upgrade solution for home cinema, which is clearly within reach. And the soundbar could be the starting point for that much overdue transition.

Today, soundbars are an easy sell, starting with the more affordable, "lifestyle" models that basically are meant to add decent sound to thin-panel displays, all the way to the "smart" soundbar that is intended to be both the center of the wireless home cinema and the hub for the home multiroom system. In between, 2022/2023 has seen the introduction of truly great soundbar products that have evolved from the previous years of experience.

As an example, already in 2023, LG Electronics unveiled two new Wi-Fi-enabled soundbars, designed to work in harmony with LG's latest OLED TVs powered by WebOS. These sound systems target immersive audio environments in the home, including Dolby Atmos, DTS:X, and high-resolution audio support via MQA and Tidal Connect. With convenient functions, enhanced LG TV integration and powerful sound, the latest MQA-compatible soundbars are both appealing to demanding consumers who care about high-quality audio, but also want the convenience of the tight integration within an entertainment center.

The new LG 2023 soundbar lineup, including the new SC9 and SE6 models, offers features such as WOW Orchestra, which utilizes every one of the two products' audio channels to create an expanded soundstage with improved height, depth, and power.

The company's premium home entertainment audio solutions also bring the intuitive interface to the Home Dashboard on LG TV, enabling users to easily manage their soundbar's settings and



The Harman showroom at CES 2023, with ongoing demonstrations of the new range of JBL soundbars, all designed to deliver surround or even immersive sound formats in the most impactful, convincing, and convenient way.

share sound modes with the TV. What's more, WOWCAST (Wideband On Wireless) allows the 2023 soundbar models to connect wirelessly with LG TVs, providing cable-free convenience and a tidier look in the living room without any sacrifice to audio quality.

And these soundbars feature LG's Triple Sound Technology, which includes the world's first Triple Up-Firing Speaker and Triple Level Spatial Sound Technology. This last concept employs channel analysis performed by an HRTF-based 3D engine to add a virtual mid-layer. The result is a convincing sense of space that puts listeners at the center of an immersive audio environment. And users will also be able to hear the difference thanks to upmixing two-channel audio into surround, and enhanced AI Room Calibration that analyzes the room and adjusts the frequency response and overall balance. The new soundbars even use AI to optimize the sound for any type of content, whether it is movies, sporting events, games, or music.

Another significant product introduction in this segment was the Bose Smart Soundbar 600—a small, sleek soundbar that features Dolby Atmos and proprietary Bose TrueSpace technology to deliver convincing immersive audio for its size. Meeting consumers' expectations in the growing category, the Bose Smart Soundbar 600 elevates movies, TV, and music by precisely placing dialogue and vocals, sound effects and instruments to the left, right, and even above the listener.

Featuring Wi-Fi, Bluetooth, and Chromecast built-in, Google Assistant, and Amazon Alexa voice control, Bose also added its new Voice4Video technology, which when used with Alexa allows for a single command to turn the TV, switch input and tune to any favorite channel.

When Dolby Atmos content is available, the Bose Smart Soundbar 600 uses digital signal processing and Atmos decoding to produce sound around the entire listening area from just five transducers. Working in conjunction with each other, two side-firing racetrack-shaped transducers project audio horizontally into the room, a center tweeter delivers dialogue, and two up-firing transducers not only help the horizontal soundscapes but reflect sound upward off the ceiling to make it seem as though it's coming from overhead.

When users are not watching Dolby Atmos-enabled content, they can still experience upmixed audio with support from the same five transducers. For TV and music listening, the

built-in Bose QuietPort technology adds deep bass performance with virtually no distortion at every volume.

Another fundamental aspect of the new Bose Smart Soundbar 600 design is the simplicity of its setup and control interfaces. Users just need to connect one cable—either an HDMI eARC or optical cable—from the soundbar to the TV, and the soundbar automatically configures itself for the provided source.

Using the Bose Music app, users can set up, operate, and personalize the Smart Soundbar 600, as well as access Bose SimpleSync and get the latest software updates.

In contrast, Harman introduced four new soundbars in 2023, including the feature packed JBL Bar 1000, which delivers a true home cinema experience without wires. Marketed as a 7.1.4 channel system, the JBL Bar 1000 effectively uses four up-firing drivers to create an enveloping sphere of Dolby Atmos and DTS:X 3D surround sound. The JBL Bar 300, JBL Bar 500, and JBL Bar



Going a step further in the effort to deliver on the immersive sound promise, the flagship JBL Bar 1000, with its detachable wireless surround speakers and 10" wireless subwoofer, becomes the most convincing of the range. Featuring Harman's own MultiBeam technology in combination with the four up-firing drivers, the JBL Bar 1000 creates realistic, accurate height effects for the Dolby Atmos and DTS:X 3D channels and object-based immersive content.

800 join the JBL Bar 1000 to complete the all-new JBL Bar Series.

The new JBL soundbars are intended to be affordable, mainstream consumer electronics products that will improve upon the experience that most family have at home when watching content from streaming platforms, all of which can now deliver surround or even immersive sound formats. To make a convincing case from these affordable systems, Harman has opted to create well-designed soundbars, which include detachable rear-surround speakers (battery operated for total convenience) and a separate subwoofer to add the required extra-dimension and dynamics that compacts systems like soundbars require.

The JBL Bar 1000, with its detachable wireless surround speakers and 10" wireless subwoofer, becomes the most convincing of the range, capable of simply improving TV sound at any moment, and suddenly becoming a full-featured immersive system for movies, games, and even music. Users can place the two detachable battery-powered surround speakers in the back of the room, or right behind them to create an immersive environment, free from wires or extra power connections. In addition, Harman's own MultiBeam technology in combination with the four up-firing drivers on the JBL Bar 1000 create realistic, accurate height effects for the Dolby Atmos and DTS:X 3D channels and object-based immersive content.

Harman's MultiBeam technology appeared originally in the first Harman Kardon soundbars, and explore a combination of driver design, positioning, and room reflections, in combination with dedicated digital signal processing (DSP). An angled speaker array is used with an immersive DSP algorithm to form a sharp directivity and

"beam" the primary sound onto side walls. MultiBeam technology strengthens the sideward directivity while limiting the forward directivity.

The key to creating a spacious effect and surround experience is forming such a sharp directivity pattern in a wideband frequency range. By generating an accurate sidewall reflection, the sound mirrors to the listening location, creating spacious sound. For any movie that features 5.1 or 7.1 surround sound, MultiBeam can reproduce the surround sound effect, while for stereo content such as music or broadcast television, a multichannel upmixer changes the two-channel content into a 5.1 or 7.1 mix for MultiBeam processing. All four of the new soundbars also feature PureVoice technology, using an algorithm to optimize voice clarity so users can clearly understand the dialogue, even when the surround effects are at their peak.

The JBL One app lets users set up these systems with ease and browse integrated music platforms, adding fully customizable EQ settings. Users can also link any system of the new JBL Bar range with a voice assistant-enabled device and ask Alexa, Google Assistant, or Siri to stream content to the soundbar. Each of the new soundbars also supports AirPlay 2, Alexa MRM, and Chromecast built-in.

But the undisputed flagship in the soundbar category continues to be Sennheiser's AMBEO soundbar, which established the benchmark in the form-factor when it comes to bringing immersive audio into living rooms in an unforgettable quality—be it for TV sound or music streaming. For 2023, Sennheiser introduced the new AMBEO Soundbar Plus, expanding the concept in a more compact soundbar and separate subwoofer, still driven by the same groundbreaking 3D sound developed in collaboration with the Fraunhofer Institute for Integrated Circuits (IIS), incorporating upHear Processing and MPEG-H Audio.

This brings the concept within reach of more consumers, while bringing the acoustic innovations of the original design to a wider market. Two upHear technologies are used to perfectly match the immersive sound of the Sennheiser AMBEO Soundbar Plus to the room it is placed in. The upHear Immersive Audio Virtualizer is a codec-agnostic post-processing technology that powers the authentic 3D sound of the soundbar. Thanks to it, the device creates high-quality spatial sound that eliminates the need for the rear speakers typical for traditional surround setups. This is achieved by the technology's sophisticated device-specific processing, which was designed to create



The new Sennheiser AMBEO Soundbar Plus condenses the benefits of the original AMBEO Soundbar (now renamed as Max) into a more compact format, re-imagined with the addition of the AMBEO Sub.

high-end sound and deep bass even with more compact devices.

In addition, the advanced upHear Calibration algorithm tunes the upHear Immersive Audio Virtualizer to the room and device position. During the setup process, the calibration technology uses the integrated microphones of the soundbar and subwoofer to analyze the room. Based on the collected data, the soundbar optimizes the playback for the specific environment. To round off the advanced features of the AMBEO Soundbar Plus, the upmix feature of the upHear processing turns even stereo content into a 3D music experience.

Apart from 360 Reality Audio and MPEG-H Audio, the Sennheiser AMBEO Soundbar also supports Dolby Atmos and DTS:X source content. The Sennheiser AMBEO Soundbar Plus uses the AMBEO|OS platform that enables multiple music streaming services, such as Apple AirPlay 2, Spotify Connect, TIDAL Connect, and works with a Google Assistant-enabled device with Chromecast built-in. Furthermore, it provides seamless integration with Alexa Built-in (where available) and Apple Siri.

The AMBEO Sub also extends the advanced self-calibration with a built-in far-field microphone that allows the device to precisely learn the acoustics of the room and adjust to every environment in combination with the AMBEO Soundbar Plus.

Finally, no description of this product segment would be complete without mentioning that consumers are now able to have a fully featured Dolby Atmos setup for the home, completely wireless and at an affordable price (less than some soundbars just mentioned, in fact).

Thirty months after the original announcement that the technology promoted by the Wireless Speaker and Audio Association (WiSA) would be able to support Dolby Atmos height channels, WiSA Technologies confirmed that the new Monaco 5.1.2 speaker system from Platin Audio would be the first fully immersive, multichannel, separates-based home theater system on the market to be WiSA HT Certified and Dolby Atmos enabled.

Platin Audio has been a sort of “house-brand” for WiSA but is in fact a brand created by Hansong, which is also a key supplier for WiSA Technologies. Hansong is effectively a global group of companies with large manufacturing and engineering capabilities, and an established OEM supplier for many consumer and professional audio brands. Platin is a Danish engineering and product design company, founded in 2016, which has focused on amplifier and connectivity modules, and

has produced several affordable home theater surround systems, all based on WiSA.

Now the company launched the Platin Audio Monaco 5.1.2 with a WiSA SoundSend audio transmitter (Easy Connect Pro), the first wireless audio system to incorporate true Dolby Atmos height speakers, expanding from the original Monaco 5.1 configuration. This latest home cinema solution from Platin Audio offers a true multichannel configuration based on separate speakers, which can generate the height channels and retails for just \$1,499. This Dolby Atmos system is WiSA HT Certified, the new designation for the original WiSA technology developed for home theater, to distinguish from the new WiSA DS implementation on 2.4GHz.

The Monaco 5.1.2 system from Platin offers a simple plug-and-play setup that creates theater-level experiences in the home environment, uniquely engineered to the Dolby specifications for Dolby Atmos, providing a truly immersive and spatial sound arena for listeners. With this implementation, there’s hope that we will finally see a series of announcements of similar 5.1.2 and (at least) 5.1.4 configurations by many of the brands and manufacturers that license the WISA technology.

The High-End Home Audio

If we must paint a picture of the state-of-the-art in-home speakers for 2023, we should definitely look closely at the high-end audio European manufacturers and particularly what is happening in Denmark. Not that there aren’t truly deserving designs from Germany, France, Italy, and the UK, but I have no doubt that there are two references that stand out this year, both with a common origin.



Leveraging the latest WISA HT technology, the Monaco 5.1.2 system from Platin is the first truly affordable, fully wireless, home-theater system with separate speakers for all positions, engineered to the Dolby specifications for Dolby Atmos. The first of many?

First, I will mention the new high-end audio loudspeaker, the Cue-100 from Lyngdorf Audio. The Lyngdorf Cue-100 is the first loudspeaker from the brand merging modern Danish design with the latest Purifi speaker technology. The benchmark-setting Purifi aluminum drivers are integrated in a uniquely shaped cabinet, finished in satin-black or satin-white with solid oak elements, and available with a selection of five all-around fabric covers by Gabriel from Denmark.

Founded in 2005 by Peter Lyngdorf, Lyngdorf Audio is the high-end loudspeaker and amplifier brand that better translates its founder's spirit and vision. Beginning as a distributor of home entertainment components in 1975, in 1980, Peter Lyngdorf established the Northern European audio retail chain, HiFi Klubben, followed in 1983 by the introduction of his own loudspeaker brand, Danish Audiophile Loudspeaker Industries (DALI). Following the creation of Lyngdorf Audio, in 2007 he acquired exclusive Steinway & Sons rights to manufacture audio systems under the brand name Steinway Lyngdorf.

Today, Steinway Lyngdorf and Lyngdorf Audio share most of the same company structure and share the same booth at trade shows. Both brands meet the unique needs of different customers with different levels of money to spend, and both brands offer specific products for custom installation. Otherwise, all Lyngdorf Audio

components share the technologically advanced DNA of the Steinway Lyngdorf product line, with the additional benefit of flexible connectivity and the ability to be combined with other audio and video component brands.

In 2014, Peter Lyngdorf, together with Lars Risbo and Bruno Putzeys, invested in Purifi ApS to focus on the development and verification of accurate mathematical models to solve real problems in sound reproduction. Apart from these brands and investments, Peter Lyngdorf's holding company consists of multiple development facilities and factories in Denmark and China and more than 1,000 employees.

As the company states on its own website, Lyngdorf Audio approach to product development "has always been to implement technologies which are tested, proven, and supported by hard facts." We have seen the Purifi Eigentakt 1ET400A amplifier modules already inside the latest Lyngdorf Audio streaming amplifiers, but we still had to see a Lyngdorf Audio loudspeaker design using the fast-expanding range of Purifi transducers.

Designed and made at Lyngdorf Audio in Skive, Denmark, the new Cue-100 is a loudspeaker for design-conscious music lovers, and the first to feature prominently the advancements of Purifi Audio, which has set new benchmarks in speaker technology by creating ultra-low-distortion long-stroke woofers. Its speaker drivers achieve the market's overall best measured performance for its extended frequency response range, as demonstrated in multiple independent tests. Several innovative technologies were developed to achieve this result. The most recognizable is the Neutral Surround Geometry, where the ring shape consists of alternating mountain ridges. As a result of its ultra-low distortion these drivers also award superior sound reproduction and detail resolution.

For the Cue-100 speaker, Lyngdorf Audio selected a Purifi 6.5X04NAA, aluminum cone midrange/woofer with a die-cast vented basket, and a four-layer copper-clad aluminum voice coil with variable winding pitch on a fiberglass former. To extend the bass response, there are two ultra-low distortion Purifi PTT6.5PR aluminum cone passive radiators, positioned on each side of the triangular shaped cabinet. Being acoustically coupled to the front woofer, these two passive radiators deliver an even bass response around the speaker, making placement in the room easier.

To deliver the higher range, the company's engineers paired this Purifi driver with a house-



The new Cue-100 from Lyngdorf Audio is undoubtedly the most original loudspeaker to be launched in 2023, also the first to prominently feature the advancements of Purifi Audio, with its unique design, unmistakably Danish.

made Kapton foil Air Motion Transformer (AMT) that extends the overall sound performance. Frequency response is extended to 35Hz thanks to the long-stroke performance and efficiency of the Purifi woofer, with the Cue-100 responding all the way to 22kHz (-3dB). The low distortion of the combination can be largely explained by the ability of the Purifi midrange driver to crossover to the AMT at 2.3kHz.

In terms of design, the unique triangular shape of the standmount loudspeaker cabinet consists of three tapered and slightly rounded sides, CNC-machined from 35mm thick MDF. This design reduces resonance and internal standing waves, while giving the speaker a slender appearance when viewed from the listening angle. The base is machined from solid oak and increases the rigidity further, helping to attach the included tripod stand (also with solid oak legs). With four different cabinet combinations and five different optional fabric covers made by Gabriel from Denmark, the Cue-100 is customizable in 24 different color combinations.

When using the Cue-100 together with a Lyngdorf TDAI amplifier or multichannel processor (MP), the company's own RoomPerfect room correction technology acoustically adapts the Cue-100 to the room and optimizes the sound performance. RoomPerfect also allows an unusually high degree of freedom when placing the speakers in the room, meeting the highest demands in interior design as well as high-end audio.

Gabriel from Denmark is one of the leading fabric specialists since 1851, creating fabrics for furniture, interiors, and acoustics. For the Cue-100 the company designed an all-around speaker cloth, available as an optional accessory in grey, black, petrol blue, dusty green, and red.

And from DALI comes one of the most spectacular announcements in 2022. The leading Danish speaker designer and manufacturer introduced a new flagship loudspeaker, the DALI KORE. Designed, crafted, and built by DALI at the company's facilities in Denmark, this new powerhouse of a speaker incorporates all new DALI technologies resulting in an outstanding sound performance. It's also a BIG, heavy speaker, worthy of a flagship product, and a statement of its artistry.

The DALI KORE speakers are almost as tall as an average person and are heavy (353 pounds!). And that's because its huge ratio between moving mass and cabinet mass contributes to effortless sound reproduction. After all, the KORE is a statement in sound for the brand—at a higher price point of \$100,000/pair USD.

The DALI KORE is an electro-acoustic masterpiece, balancing technical specifications and sound characteristics to perfection. It features five unique drivers, including two 11.5" bass drivers and a 7" dedicated midrange driver, all with Balanced Drive SMC Gen-2 technology. SMC stands for Soft Magnetic Compound and is a DALI patented technology for woofers, where the pole piece of the woofer magnet motor system is coated with this material. It eliminates the modulations of the flux in the magnet gap when current running through the voice coil windings generates new "competing" flux in the magnet gap. The result is an extremely agile, well-behaving, ultra-low-loss woofer with a significant reduction of distortion from mechanical loss.

Positioned as an ultra-high-end loudspeaker, the DALI KORE is also a masterpiece of visual design and technology. Each material used in the DALI KORE enclosure has been chosen with form and function in mind. The curved wood laminate, gloss-lacquered Ammara Ebony veneer, and contrasting textured finish, has been taken directly from the world of luxury furniture design.

The tweeter and midrange die-cast aluminum baffle features gold-plated trim rings, while the bass driver baffle uses mineral loaded (glass fiber) composite resin. The die-cast aluminum



Taking things to the extreme, DALI designed a new flagship speaker. The DALI KORE incorporates five unique custom drivers. Twin differentially filtered 11.5" bass drivers and a 7" dedicated midrange driver, all using Balanced Drive SMC Gen-2 technology, together with an EVO-K Hybrid Tweeter module comprising a 35mm diameter soft-dome tweeter (1.37") and a 55mm x 10mm ribbon element.

and structural composite materials offer more design freedom and a highly rigid platform for the drivers. The 34kg cement-based resin composite plinth provides a solid foundation for the speaker's substantial 160kg (353 pounds) overall weight.

The DALI KORE is manufactured exclusively at DALI's production facilities in Nørager, Denmark, and is supported by local specialist manufacturers in central Denmark. An unashamedly ambitious high-end hi-fi speaker, and the ultimate expression of Danish design, engineering, and manufacturing, among the best that the world has to offer.

And to close these highlights in home audio, on the other side of the Atlantic and in a much more affordable price category, very much representative of current trends in home audio and hi-fi is the new Alpha iQ Streaming Powered Speakers with BluOS by PSB Speakers.

The brand's first pair of wireless streaming bookshelf speakers that integrate control, source, and amplification are an affordable all-in-one system that at the same time expand the Lenbrook Bluesound wireless audio ecosystem, managed with the BluOS Controller app.

Ideal for modern home environments as great quality options to have music in any room, the Alpha iQ speakers are a refined product design, worthy of the company founded by Paul Barton, now celebrating 50 years in business.

The fully active design, with DSP crossover and dedicated amplifiers for each driver, are

specified at 60W for each woofer and 30W for each tweeter, which generously beats today's common products in this space. Each speaker features a 4" polypropylene mid-bass driver with a steel basket and a rubber surround, combined with a 0.75" aluminum dome tweeter with a neodymium magnet and ferrofluid cooling.

With a network streamer based on the BluOS multiroom music platform, the Alpha iQ system offers direct access to streaming services and Internet radio stations. And the speakers have a wide array of inputs so users can connect source components such as a turntable, TV, disc player, or game console, which can then be also shared over a home network with up to 63 other BluOS-enabled components.

The Alpha iQ speakers also have built-in two-way Bluetooth, with support for the high-quality aptX HD codec for wireless streaming from any mobile device. Apple AirPlay 2, Spotify Connect, and Tidal Connect are options over Wi-Fi. The Alpha iQ's hi-fi quality DAC supports resolutions up to 24-bit/192kHz and has full MQA decoding and rendering capability for high-res streaming from Tidal Masters.

Available in satin white and satin black finishes, the two Alpha iQ speakers have a sleek, modern design, and both just need to be connected to power. The left and the right speakers communicate via a wireless link that can cover most rooms in an average-size home, so that music stays synched and clear regardless of speaker placement. And there's even a subwoofer output with DSP-enabled low-pass and high-pass filters.

As we previously mentioned, the integration possibilities offered by these Alpha iQ speakers are one of its biggest selling-points, with streamed music potentially being played through as many as 63 additional BluOS-enabled components.

The USB port also allows for connecting an external drive containing music files, which can be available to stream to other rooms. And at the local level, users can benefit from a MM phono preamp, HDMI eARC, optical, and auxiliary inputs, creating a complete hi-fi system for modern lifestyles.

For integration, support for Control4, Crestron, ELAN, RTI, and URC home-control systems is another big advantage, while some users will also value the support for voice control. For a more traditional approach, the Alpha iQ also offers IR learning capability for control with harmonized remotes. In a way, the Alpha iQ speakers epitomizes home speaker design values in 2023. **LIS**



Ideal for modern home environments, the new PSB Speakers Alpha iQ are the brand's first pair of wireless streaming bookshelf speakers that integrate control, source, and amplification. These affordable all-in-one wireless speakers were announced in September, just before CEDIA Expo 2022, where they made their debut with immediate acclaim. Not only are they relatively affordable for active speakers, but they expand the Lenbrook Bluesound wireless audio ecosystem, managed with the BluOS Controller app.



The Ultra Wide Band Alliance Fights for Spectrum Access

Co-Existence Is the Key to Driving Innovation in a Crowded Band



Since 2019, Ultra Wide Band (UWB) has been expanding into a mainstream consumer technology for smartphones, wearables, automotive, and industry, forecasted to drive sales volumes in excess of one billion devices annually by 2025. Building upon the standardization work performed by its staff and members within the Institute of Electrical and Electronics Engineers Standards Association (IEEE) on the 802.15.4z, the organization is focused on providing a favorable regulatory and spectrum management landscape to maximize UWB growth. This article is a collaborative effort written by members of the UWB Alliance.

The Ultra Wide Band (UWB) Alliance came to Washington, D.C. more than five years ago with one goal in mind: to ensure that all technology players operating in the ultra-wideband spectrum could be assured of access to that spectrum. In that time, the UWB Alliance has become the industry voice for regulatory advocacy, both nationally and internationally. Founded by RF engineers and legal experts, the UWB Alliance is led by Tim Harrington, Chairman Emeritus of IEEE 802.15.4z, and Ben Rolfe, Chairman of IEEE 802.15.4ab. An industry expert in both developing technical standards and working with regulators, Tim Harrington launched the UWB Alliance to ensure all voices could be heard so that innovation could flourish.

Spectrum Advocacy: If You're Not at the Table, You're on the Table.

Today's wireless consumer products and applications use a variety of technologies that access the RF spectrum to get the job done. The challenge that innovators run into is that there's only so much spectrum to go around, which means these services need to coexist with each other to prevent harmful interference. Governments, on the other hand, have their own unique problem: They need to block off swaths of this scarce spectrum for national security and emergency services. Regulators, like the FCC, are caught in the middle.

Fortunately, they do an excellent job in helping to bring fairness to spectrum access by creating rulesets that everyone can follow. There's a dilemma though: The flow of innovation

now outstrips almost all stakeholders' ability to keep up. This means that regulators now have the challenge of making sure spectrum regulation not only keeps up, but evolves at a pace that encourages and enables innovation, which in turn drives economic growth. To help guide spectrum policy, stakeholders routinely present information and arguments to regulatory bodies so they can make the best, most informed decisions about modifications to spectrum policy and the appropriate rulesets.

Naturally, the largest and most successful industry players can hire the best lawyers and lobbying firms to make their arguments to regulators on why they deserve increased access to spectrum resources. The problem with this is that it has the potential to stifle the voices of smaller, scrappier innovators who are on the cutting edge of technology but don't yet have the resources to go toe-to-toe with the big guys to argue for access to spectrum. This, in turn, creates an element of uncertainty for investors, further negatively impacting their support for new technologies.

Wireless Audio: A Use Case for Co-Existence.

Wireless operation is in high demand for many audio applications. Can you imagine large live music events or a Broadway musical if performers were all required to hold a microphone attached to a wire? How would the sound from inside a race car reach an excited audience if wires were attached? We are all enjoying the freedom of entertaining and informative content delivered to us anytime, anywhere on any

device. More than one type of wireless technology is required to capture and deliver that sort of flexibility. Audio devices for use in conjunction with home entertainment and gaming are much more satisfying when they can deliver real-time high-quality audio to multiple users in a shared space.

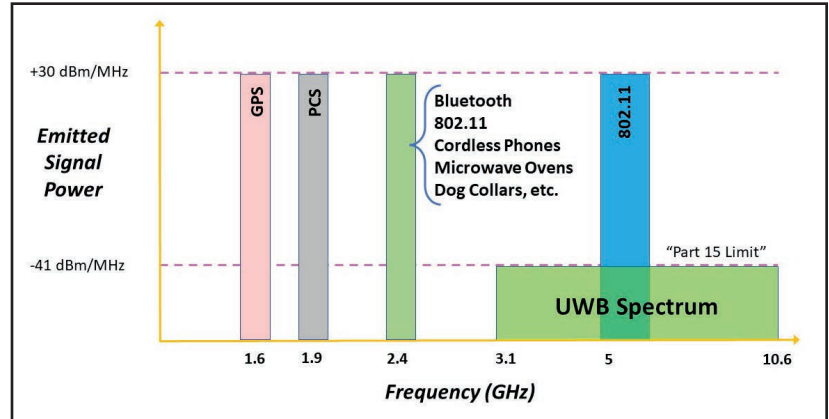
To accomplish the wireless device density now found in many settings, we must look to optimize each stage of the wireless delivery chain. No single wireless technology provides the best performance across a range of needs. When considering wireless audio, one must consider the number of devices that can operate in proximity without interfering with each other, the distance over which those devices can operate reliably, the quality of the sound, and whether the sound is real-time (low latency).

Why real time? For interactive applications, such as AR/VR or playing a video game, it is essential that the sound is coordinated (synchronized) very closely with the video. If sound and images are not lined up, it doesn't work. All these performance requirements must then fit into a device that is easy to use and maximizes battery life. Plus, the carbon footprint of a wireless device becomes more significant every year that battery-operated device use increases.

They're not making any more spectrum, so it's up to us to figure out how to use it better.

The good news is that technological innovations in efficient spectrum utilization have evolved over the years. This has the potential to unlock much-needed spectrum capacity that would enable more use cases. Instead of approaching spectrum allocation as winner takes all, the UWB Alliance postulates there is enough spectrum for everyone if we share it properly. While it is impossible to create more spectrum, it is possible to increase spectrum capacity by using it more efficiently. Efficient spectrum use enables coexistence among spectrum stakeholders, which allows stakeholders to work with each other instead of against each other.

Efficient spectrum utilization requires using the optimum wireless technology for the desired use case. When it comes to wireless technologies, one size does not fit all (use cases). For example, Bluetooth technology was originally designed for short-range communication between laptops, phones, and other portable devices. Bluetooth is an excellent fit for enabling use cases that require short-range communication at moderately low data rates and uses the spectrum efficiently for such cases. However, Bluetooth is not the best choice for use cases that require high data rates, precision locating capabilities, or low latency.



This graph shows a comparison of transmission power levels.

Take audio streaming for example. While Bluetooth audio devices have been on the market since 1999 and have become popular for consumer-grade audio devices, it trades quality for the convenience of wireless compared to simpler, cheaper connections such as a cord. Bluetooth is not the ideal technology for audio streaming when the goal is to optimize spectrum utilization and user experience in a real-time situation, where high resolution and very low latency are required. In contrast, UWB can stream audio over long distances with very low latency, and some implementations use a fraction of the power of Bluetooth, thus greatly reducing the carbon footprint of the device.

UWB delivers higher fidelity and dynamic range, allowing it to provide completely lossless audio transmissions. It also provides single-digit latency for the real-time use demanded by AR/VR and gaming. Does this mean that UWB is better than Bluetooth? Not in a general sense, because the answer depends on the use case. Each wireless technology (e.g., Wi-Fi, NFC, RFID, GPS, Infrared, Zigbee, and cellular networks) has inherent properties that make it more or less suitable for a given use case. Efficient spectrum utilization requires using the right technology for the right use case.

UWB is uniquely capable of delivering full professional audio quality with a very high device density, (more people can enjoy the wireless audio in the same space at the same time), achieving real-time latency numbers and long battery life due to low power consumption. UWB is also capable of real-time location and spatial adaptation of content. AI can be utilized to combine precision location and environment awareness with adaptive audio to deliver the perfect audio content to each and every user in a space.

Additionally, UWB operates at only a fraction of the transmit power levels of these other devices.

It does not show up where it is not wanted. UWB is the wireless “best neighbor.” There is an obvious benefit to keeping your wireless experience where it belongs. While you are finally experiencing the full freedom of an immersive wireless audio, AR/VR, or gaming experience without performance compromises, there is the added benefit of security. The extremely low transmit power levels and noise-like characteristics of the transmitted signal reduce the interference footprint of UWB.

Have you ever tried to connect a Bluetooth or Wi-Fi device and noticed your neighbor’s devices all showing up? The transmit power levels create a “sphere of influence,” an area affected by the radio signal, that can be substantially larger than is needed for a specific link. This impacts the overall capacity and efficiency in a given space when a large number of devices is needed.

Additionally, the limited bandwidth of Bluetooth requires compression of the original signal and a loss of fidelity. This is a fair trade-off for some uses. Compression may increase latency due to added processing. Again, a reasonable trade-off in some uses. UWB provides full audio resolution, and minimal latency when needed, without the need for high transmit power levels.

Everyone Loves Progress, But No One Likes Change.

Product designers are challenged to develop next-generation products quickly and inexpensively. They must constantly drive for faster data rates to satisfy the insatiable demand of new applications. This drive to turn the next generation into saleable products does not normally foster the innovative revolutionary changes needed to increase spectrum efficiency. Fast turns require more of the same, often leading to products that use more spectrum and more power. This results in conflicting requests for additional spectrum. It is perceived that getting permission to use more spectrum and power avoids the expense of changing existing products and resolving backward compatibility issues.

It’s easy to see how more established industries with deeper pockets have the resources to effectively lobby and shape spectrum policies in their favor. Smaller businesses that want to bring innovative products to market have a difficult time competing with larger stakeholder groups to shape spectrum policies in their favor. This is one reason why smaller businesses join specialized industry organizations like the UWB Alliance so that their collective voices can be heard among entities that shape spectrum policies.

Spectrum Advocacy Is Not a Zero-Sum Game.

Founded in 2018, the UWB Alliance is comprised of members that offer a wide range of innovative UWB products that enable a multitude of use cases. Its primary goal is to unlock innovation and expand the global market for use cases that are uniquely enabled by UWB technology. To achieve this goal, the UWB Alliance participates in shaping UWB technical standards (IEEE and ETSI) and presents evidence to stakeholder groups showing how UWB can effectively coexist with other wireless technologies without causing interference.

As one example of where participating in a membership organization is a force multiplier, the UWB Alliance works with government agencies and its members to conduct extensive coexistence testing where UWB and other wireless technologies are carefully examined to understand under which conditions they might affect each other. The UWB Alliance uses the empirical test results to educate stakeholders and regulators in supporting the argument that UWB can coexist peacefully with other wireless technologies.

Audio applications using UWB are a prime example of one of the efficient and high-performance technologies for which the UWB Alliance advocates. The combination of instantaneous access, high dynamic range, low power, and large bandwidth while being a good neighbor make it a natural fit. Many of the startups and smaller companies that are developing exciting new devices and systems are underrepresented. That’s where an industry group such as the UWB Alliance can be of unlimited value.

Additionally, the UWB Alliance works with spectrum governing agencies such as the FCC and ECC to foster rulesets that allow spectrum-efficient technologies to proliferate. We believe that spectrum-sharing is the key to the wireless future.

But the UWB Alliance cannot enable the UWB market on its own. That’s why it coordinates with other UWB industry organizations such as FiRa, the Car Connectivity Consortium (CCC), and omlox to help move the UWB industry in a direction that optimizes spectrum utilization while enabling innovative use cases that benefit consumers.

The UWB Alliance is the industry leader in advocating for strong co-existence rulesets that will enable the burgeoning UWB market to enjoy explosive growth. But we can’t do it alone: We need your voice. To add your use case to the argument for a more UWB-permissive spectrum, contact us now and find out how we can help get you a seat at the table.

For more information about the UWB Alliance or to become a member, visit uwballiance.org. **LIS**

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The audio world began its most progressive evolution since the invention of the loudspeaker when it began to explore integration of the digital and analog realms. Digital signal processing (DSP), which began as little more than a frequency equalizer, has now taken on many dimensions in crafting the listening experience. The Analog Devices A2B (Automotive Audio Bus) technology adds yet another dimension to the digital evolution in the audio realm—efficiency, cost savings, space savings, weight savings, and reduction of the carbon footprint caused by audio wiring.

Dan Foley is a longtime Audio & Loudspeaker Technologies International (ALTI) Association member and former President of the Association with a long and varied background in audio engineering and innovation. We asked Dan to address the topic of broad application of A2B.

—Barry Vogel, CEO ALTI Association

A2B — The New Standard

For Distributed Sound Applications

By
Dan Foley

(Founder of Do No Harm Music, LLC)

Distributed sound systems, also known as background music or public address (PA) systems, have been used in commercial applications for more than a century. The first known commercial distributed sound system was installed in the New York City subway in 1914, which used a series of loudspeakers to broadcast announcements and advertisements.

In the early 20th century, distributed sound systems were commonly used in department stores, restaurants, and other public spaces to provide background music and make announcements. These systems typically used a centralized amplifier and a network of speakers distributed throughout the space.

In the 1950s, the introduction of transistor technology made it possible to create smaller and more efficient amplifiers, which led to the development of decentralized distributed sound systems. These systems used multiple smaller amplifiers distributed throughout the space, each connected to a smaller number of speakers.

In the 1990s, advancements in digital signal processing (DSPs) and networking technologies led to the development of networked distributed sound systems. These systems use digital signal processors and networked audio devices to provide greater control and flexibility in routing and processing audio signals.

Regardless of when distributed sound systems were installed, including present day, they all typically require 18-gauge wire for the speaker cables. For long runs with constant-voltage systems (e.g., 70V), heavier gauge wire may be needed and transformers are used to adjust the power being delivered to the loudspeaker. For digitally based systems, such as Dante, Ethernet cabling is needed in addition to any speaker wiring. What this means is that today's distributed sound systems require a lot of copper as well as transformers.

Mining and refining copper is energy intensive, and has an adverse environmental impact. The annual carbon footprint associated with just copper mining equals the annual carbon footprint of New York City. The Analog Devices A2B (Automotive Audio Bus) technology offers a way to achieve distributed sound with a fraction of the wire required for current systems and no transformers are needed at each speaker location.

What is A2B Technology?

A2B technology is a digital audio networking protocol originally designed for in-vehicle audio applications. It was developed to provide high-quality audio transmission and control throughout the vehicle while greatly reducing complexity and cost when compared to the conventional ways multichannel audio is delivered. It uses an

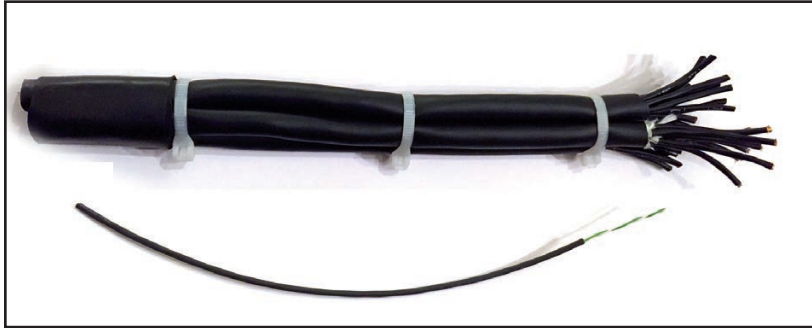


Photo 1: A conventional wire harness for multichannel audio vs. A2B, which uses an unshielded twisted pair (UTP) cable

unshielded, twisted pair (UTP) cable, where gauges can be 20 gauge or smaller. This technology allows up to 32 channels of uncompressed 24-bit, 48kHz sampled audio to be delivered to loudspeakers, multichannel amplifiers, and/or DSP. **Photo 1** shows a typical wiring harness for a multichannel automotive application where all wiring is point-to-point. With A2B, all of this wire is replaced with a single run of UTP.

A2B technology was first introduced in 2014 as a solution to the complex wiring harnesses required for automotive audio systems. It is a proprietary technology developed to replace traditional analog wiring with a single digital bus that connects audio sources, amplifiers, and speakers. This technology is now being made available for multichannel audio applications outside of the automotive industry and can offer major benefits for distributed-sound for commercial and consumer applications that are



Photo 2: Here is a loudspeaker with an integral power amplifier.

not possible using conventional technology.

A2B technology uses a master-slave architecture, with a central hub (the master) controlling multiple nodes (the slaves) connected in a daisy-chain configuration. An individual node can be as simple as a single loudspeaker/amplifier combination or more advanced such as a multichannel amplifier with integral DSP driving several loudspeakers at once. The hub (Master) synchronizes data transmission between nodes, which can include microphones, amplifiers, and speakers. Here are some details about the A2B network architecture:

Latency: A2B technology has a low latency of around 50 microseconds, making it suitable for real-time audio applications such as acoustic noise cancelling (ANC).

Microphone Beamforming: A2B technology supports microphone array beamforming, which enables the processing of audio signals from multiple microphones to improve voice-recognition accuracy in noisy environments.

Maximum Number of Nodes: A2B technology can support up to 32 nodes in a single daisy-chain network. This allows for a flexible and scalable architecture that can be adapted to different audio system designs.

Power Handling: A2B technology can handle power delivery to audio devices in the network. It provides up to 50W of power to each node, making it suitable for powering amplifiers and other audio devices.

Since A2B was originally developed for automotive applications, this technology has to adhere to stringent electromagnetic interference (EMI) requirements. Analog Devices designed A2B to be compliant with the CISPR25 Class 5 automotive EMI standard. Analog Devices A2B technology has superior electromagnetic interference (EMI) specifications compared to traditional multichannel audio architectures for several reasons:

Differential Signaling: A2B technology uses a differential signaling scheme, which reduces the impact of noise on the signal. Differential signaling transmits data using two complementary signals that are equal in amplitude and opposite in polarity. This reduces the effect of common-mode noise, which is the noise that appears equally on both signal lines, as the differential receiver only processes the difference between the two signals.

Single Twisted Pair Cable: A2B technology uses a single twisted pair cable for transmitting both power and data, which reduces the

number of wires and connectors required, and further improves EMI performance. Traditional multichannel audio architectures often require multiple cables for power and data, which can increase the likelihood of EMI.

Compliance with Automotive EMI Standards: A2B technology is designed to comply with the CISPR25 Class 5 automotive EMI standard. This standard specifies the maximum allowable electromagnetic emissions from electronic devices used in automotive applications. By complying with this standard, A2B technology ensures that it meets the required levels of EMI performance for in-vehicle and other audio applications.

Advanced Diagnostic Capabilities: A2B technology includes advanced diagnostic capabilities that can detect and isolate any EMI-related issues in the network, such as cable faults or signal integrity issues. This allows for easy troubleshooting and maintenance of the A2B network, which can help to reduce the impact of EMI.

Uses for A2B Technology

As previously mentioned, Power over A2B (PoA2B) provides up to 50W via a powered node to one or more downstream nodes. A powered node is defined as a node that has to obtain its power from an outside source. Using PoA2B for distributed sound applications, one can incorporate a small power amplifier chip, such as the many Class-D amps on the market, in a PC board physically attached to a loudspeaker (**Photo 2**). This is quite common with today's installed loudspeakers. However, the on-board electronics are typically all analog and thus one needs to be aware of the high-frequency roll-off effects that may occur with long cable runs. In addition, the ability to detect cable faults is minimal to non-existent. With an A2B network, the audio can be delivered directly to the amplifier digitally with no loss of fidelity or signal level. With the advanced diagnostics of A2B, any cable faults can be isolated quickly and efficiently.

An example of a distributed audio system using a single powered Master node is shown in **Figure 1**. In this example, a background music/paging system is shown where each speaker only needs 5W. Just one single-powered A2B node can then power up to 10 5W amplifier chips connected to each loudspeaker.

Besides incorporating an amplifier, the integral PC board can also include low-cost DSP thereby allowing individual speaker equalization. This enables a great deal of flexibility when tuning a system since one can tune individual or select groups of speakers. With many of today's

distribution amplifiers, speaker EQ is relegated to a zone and this individual speaker tuning is not possible.

Conclusion

In summary, A2B is a very low-latency, all-digital network where up to 32 nodes (devices) can be controlled from a single Master node. By using only UTP wiring, cable costs can drop considerably and transformers are no longer needed to be installed on each speaker.

The high immunity to EMI also ensures that audio delivered via A2B has minimal-to-no degradation with a 100% digital signal delivered to each loudspeaker. By providing up to 50W of power for each externally powered node, one powered node (Master or Slave). **LIS**

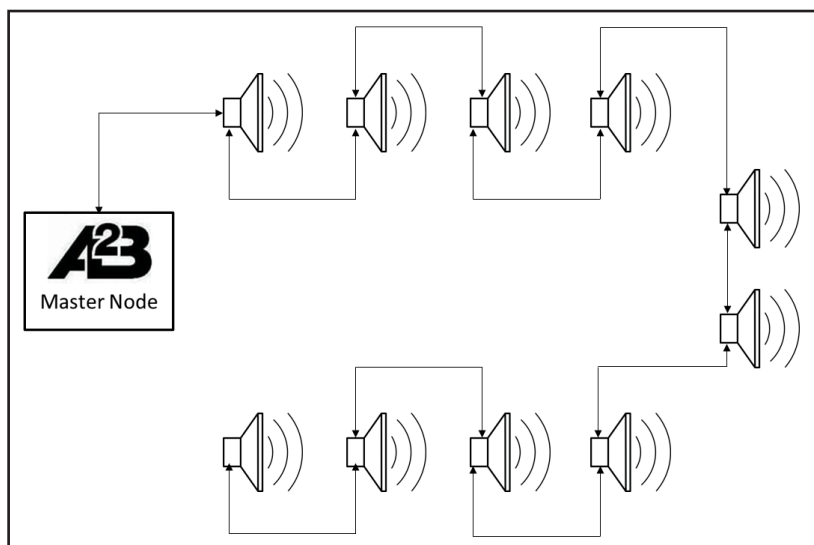


Figure 1: Here is a system with one Master node and 10 Slave nodes where the only connection between each node is UTP wiring.

About the Author

Dan Foley has more than four decades of experience in audio and acoustic/vibration test and measurement. Dan has worked in sales, marketing, and applications engineering for Brüel & Kjær, Listen Inc., and Prism Sound among others. Dan was also President of ALMA/ALTI from 2017 to 2020. He has authored several technical papers for the Audio Engineering Society, *audioXpress*, and the *Loudspeaker Industry Sourcebook*.



Dan is embarking on the next phase of his career as the Founder of Do No Harm Music, LLC. Do No Harm Music is focused on continuously improving the listening experience of recorded and live music through advanced techniques and technologies while ensuring that the musicians are properly compensated for their art. Dan is also Founder of Hapnetix, an engineering firm with more than a century of combined audio product design and testing experience. Hapnetix is focused on providing design expertise for the development of A2B-based audio products and systems that can also incorporate Analog Devices' DSP technology. Dan can be reached at Dan.Foley@DoNoHarmMusic.com. More information about Hapnetix can be obtained by emailing Info@Hapnetix.com.

A New Method for Transient Distortion Detection

By
Steve Temme
(Founder & President, Listen, Inc.)

Here, we introduce a new transient distortion measurement technique that is more accurate and reliable than current methods. As well as improved performance, this new algorithm also aids understanding of the correlation between measurement results and audibility, since it is possible to isolate and listen to just the transient distortion artifacts.

Transient distortion, or “loose particle” measurement, is a valuable quality control metric because it identifies non-periodic distortion, for example, rattling parts, separately from periodic distortion such as rubbing or buzzing parts. This facilitates troubleshooting of manufacturing issues. Although this analysis method was developed for measuring loose particles in loudspeaker drivers, it is also valuable for measuring rattling parts, such as buttons, fasteners, and loose wires on various audio devices, and measuring impulsive distortion or Buzz, Squeak and Rattle (BSR) in automotive audio applications.

What is Transient Distortion and Why Does it Matter?

Transient distortion is caused by random clicking, popping, and other noises in the time domain. In a speaker or headphone driver, this might be caused by foreign particles such as glue or magnet fragments trapped in the gap behind the diaphragm or dust cap. In a device such as a smart speaker, transient distortion might come from loose buttons that rattle when sound is played. In an automotive application, it could be characterized as buzz, squeak, and rattle from loose wires, screws, or fasteners. In all cases, the sound is undesirable, so devices that exhibit such faults should be identified and rejected.

In the recorded waveform, transient distortion faults appear as impulsive noises added on the stimulus wave. These impulses are not related to the frequency of the stimulus, but rather to the vibration caused by the displacement amplitude of the diaphragm. The transient distortion is more frequent and significant when the speaker is driven near or below its resonant frequency, where the displacement of the diaphragm is the greatest.

Although the sound—a random clicking, buzzing, or popping noise—can sometimes sound similar to higher-order harmonic distortion (Rub & Buzz), such defects are not clearly reflected in the frequency spectrum of the waveform. **Figure 1** shows a waveform with transient distortion, and the corresponding frequency spectrum. The vertical black line represents the stimulus frequency and the orange broadband noise spectrum indicates the transient distortion. Rub & Buzz distortion is best identified by the frequency at which it occurs, whereas transient distortion is best identified at the time the transients occur.

Prior Measurement Methods

Listen first introduced the concept of using time window analysis to measure transient distortion with its “Loose Particle” algorithm presented in 2003, which was refined and introduced into the SoundCheck software in 2004. [1,2]

This early model was based on time envelope analysis, a method widely used for detecting faulty bearings and gears in the machine industry. Listen was the first to use this technique for audio measurement and made several adaptations for this new application. The algorithm uses a sine sweep stimulus, and applies a tracking high-pass filter and RMS envelope analysis to the response waveform. Within this envelope, pulses are detected and counted. This was the first method to separate transient distortion from periodic distortion and is widely used on production lines, primarily for driver manufacturing. However, faults can be hard to discern under certain conditions, and it can be complex to configure and set limits with several variables that must be balanced to optimize results for each product and test environment.

Another approach to Loose Particle detection is Crest Factor analysis. This method uses a tracking high-pass filter and examines the peak to RMS ratio of the waveform. Sine waves have a low crest factor of 1.414, but transients typically have a crest factor greater than 10, making them easy to highlight. Harmonic distortion artifacts also have an elevated crest factor, and this method identifies both types of distortion together.

While the single distortion metric that this method produces can be useful for production line pass/fail testing, it does not reveal the precise failure mode. This is important as transient and periodic distortion are caused by very different mechanisms. In a speaker driver, periodic distortion, often known as Rub & Buzz, is caused by a rubbing component, such as an improperly centered voice coil. Transient distortion is caused by loose particles becoming trapped under the voice coil and rattling randomly with the excitation of the voice coil. Accurate failure mode analysis enables rapid troubleshooting of the specific problem causing the defect, reducing downtime and increasing yield.

Crest Factor analysis, as with many distortion measurements, is prone to interference from background noise. This is particularly challenging in a noisy factory where intermittent loud noises, such as a stamping machine or an air compressor, can trigger a false positive. It also requires significant care and effort to correctly establish limit curves for optimum performance.

The New Enhanced Loose Particle Algorithm

A new algorithm was developed to improve upon the accuracy of Listen's 2004 "Loose

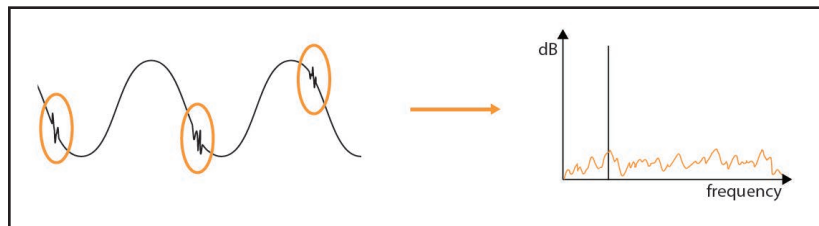


Figure 1: The loose particles visible in the waveform on the left (circled) are not indicated in the frequency spectrum of the waveform, but are seen as broadband noise.

Particle" method, as well as making it easier to use and set limits. It uses the same time envelope analysis, but rather than filtering and counting pulses, additional analysis is applied to measure the prominence, or impulsiveness, of the detected artifacts. Prominence is an established mathematical concept used in other branches of science, most commonly topography. In a topographic context, it describes the elevation of a summit relative to its surrounding terrain. This differs from its overall elevation, which measures the height of the summit above sea level.

Our research determined that the prominence of a peak in the waveform, calculated by comparing the magnitude of a peak relative to the surrounding minimums, reflects the impulsiveness

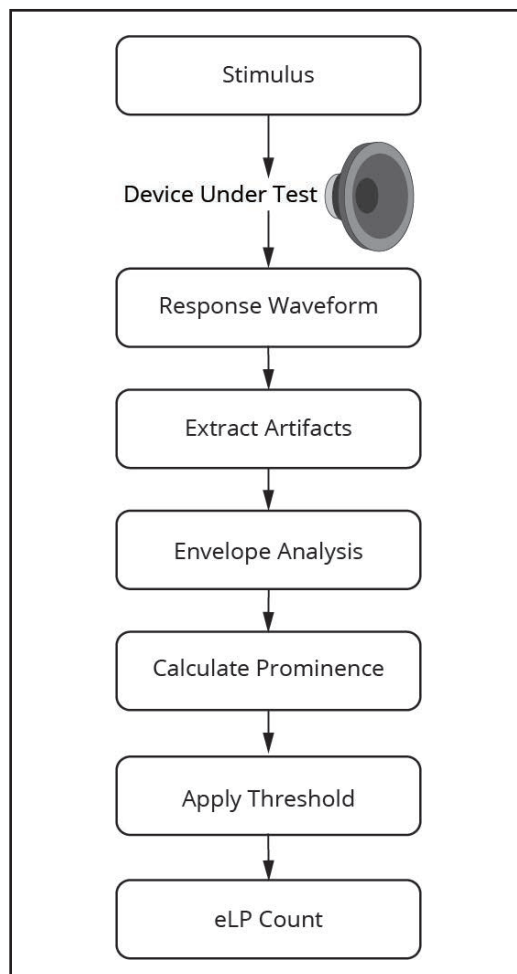


Figure 2: This diagram shows Listen's new enhanced Loose Particle (eLP) Algorithm.

of the artifact more accurately than the absolute magnitude of the peaks. Therefore, the new algorithm calculates the prominence of each

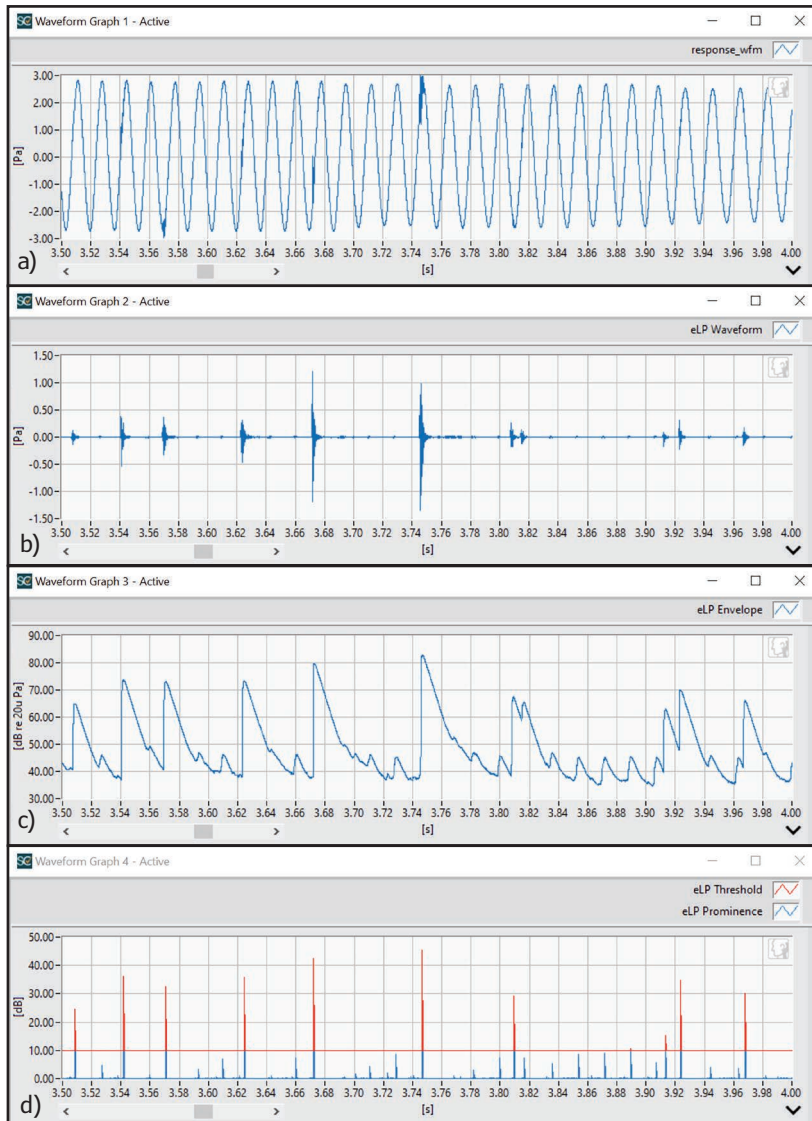


Figure 3: The Algorithm output is shown at each step.

About the Author

Steve Temme is the founder and President of Listen, Inc., manufacturer of the SoundCheck audio test system. Steve founded the company in 1995, and for the past 25 years the company has remained on the cutting edge of research in audio measurement, regularly introducing new measurement techniques, algorithms, and hardware to enable testing of all kinds of devices ranging from basic transducers to complex audio systems. In recent years, Listen's product development focus has been on creating the algorithms, interfaces, and test methods to measure today's many and varied wireless and cloud-communicating devices. Prior to founding Listen, Steve worked for many years as an acoustic test and measurement applications engineer at Brüel & Kjær, and also as a loudspeaker design engineer at Apogee Acoustics. He holds a BSME from Tufts University, has authored numerous papers on acoustic testing, and has lectured extensively throughout the world.



loose particle event. A user-defined prominence threshold determines at what level the peak will be counted, and a user-defined count of events over the time window determines the pass/fail threshold.

It is easy to relate objective results obtained by this method to subjective analysis as the user can listen to the recorded waveform with the fundamental removed, hearing only the loose particles. This enables the prominence threshold to easily be set based on defect audibility.

A factory background noise event typically only occurs once or twice during a measurement, whereas many loose particle transients will occur during the same time frame. The event count is also user-determined, and is set according to the background noise in the measurement environment. These are the only parameters that the user needs to define, so limit setting is simple, well correlated to audibility, and can be configured to give reliable results even when background noise is present.

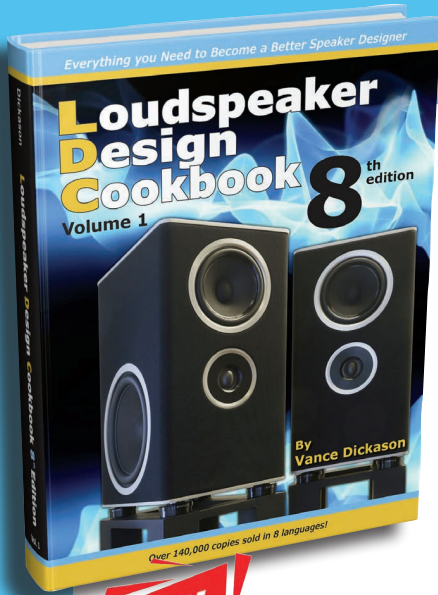
This algorithm offers three significant advantages over other methods. First, it differentiates random transient distortion from periodic harmonic distortion for rapid and efficient troubleshooting of production line defects. Second, since it relies on a cumulative event count rather than a single event triggering a fail, false positives due to background noise are minimized. Finally, since the measured metric is the number of loose particles greater than a certain threshold in a given time frame, limit setting is simple as it is not frequency dependent. Let's take a more in-depth look at the algorithm, outlined in **Figure 2**.

The measurement begins with our unique stepped sine stimulus STWEEP™, which has a smooth transition from one frequency step to the next. This avoids any transients introduced by changes in stimulus frequency that can sometimes occur when a continuous sine sweep is used. Since this is the same stimulus we generally use for other end-of-line tests, this measurement can be made alongside others with no increase in test time.

After playing the stimulus through the device under test (DUT), the resulting waveform is captured, and the artifacts are extracted from the waveform. **Figure 3a** shows the raw recorded acoustic waveform and **Figure 3b** shows the extracted artifacts (Loose Particle waveform). This Loose Particle waveform can be played through SoundCheck on a reference loudspeaker or headphone to listen to the recorded artifacts and enable correlation to the measured results.

Loudspeaker Design Cookbook

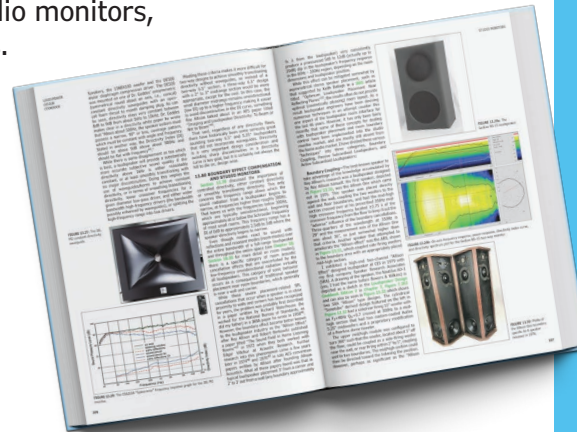
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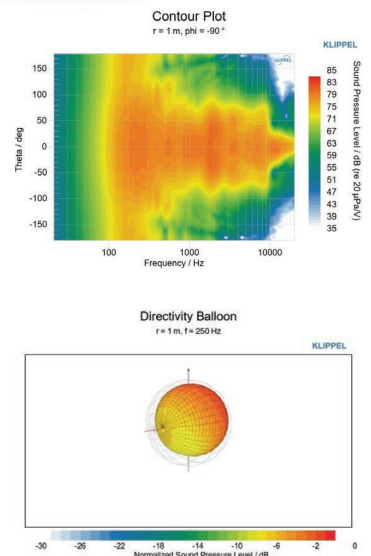
Learn to Design Professional Sounding Loudspeakers for:

- **Residential**
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Vance Dickason's top-selling *Loudspeaker Design Cookbook* is an essential must-read for serious speaker designers, audio engineers, and anyone looking to master speaker-building technology. With more than 140,000 copies in print, author Vance Dickason's *Loudspeaker Design Cookbook* is not only regarded as the loudspeaker engineering "bible," but the #1 resource on the construction of high-quality loudspeaker systems for two-channel, home theater, pro sound PA speakers, and studio monitors, as well as car audio applications.



- New Chapter 8 — "Loudspeaker Testing" has been substantially revised and includes specifics on the Fixed Mmd method for calculating cone assembly mass, a more complete definition of acoustic phase, an updated list of computer based TSP (Thiele Small Parameters) measurement hardware, plus a discussion of the various types of loudspeaker measurements and how they relate to driver quality and system design integrity.
- New Chapter 9 — "Computer Based Tools for Loudspeaker Development" has been completely revised to include current offerings of computer based loudspeaker measurement analyzers, as well as loudspeaker enclosure and crossover simulation software.
- New Chapter 10 — "Room Measurement Equipment and Room Correction Solutions", and includes a survey of room measurement analyzers, plus a discussion on room acoustics, room treatment and digital room correction devices.
- New Chapter 12 — "Home Theater Loudspeakers" and has been extensively revised, including details on Dolby Atmos and Immersive Audio.
- New Chapter 13 — "Studio Monitor Loudspeakers". This new chapter explores the difference between HIFI loudspeakers and studio monitors, professional criteria for studio monitor design, the constant directivity aspect of studio monitors, and a dissertation on zero phase in studio monitors.
- New Chapter 14 — "Hybrid Loudspeakers". This exciting new chapter explores the subject of hybrid active/passive and digital/analog loudspeaker development and includes a tutorial design example for an ultra high-end hybrid monitor loudspeaker.



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Next, envelope analysis is applied. A time domain measurement of the energy in the recorded waveform, plotted against time is shown in **Figure 3c**. Transient defects are revealed as a random burts of energy. The Prominence of each

peak is calculated, and a Prominence Threshold, the level above which an event will be counted, established. This is shown in **Figure 3d**; the horizontal red line indicates the Prominence Threshold, and events above the threshold are highlighted in red.

In our evaluation, we identified a threshold of around 10dB as a good starting point, although this may vary depending on various factors such as exactly what is being measured (for example, loose particles in a driver versus a rattling button) and the acceptable tolerance for the product. Finally, the number of events over the measurement duration is counted. This results in a numerical output upon which a pass/fail limit can be set.

Results

Let's compare the results obtained with this algorithm for a good speaker and one with known "Loose Particle" transient distortion defects. **Figure 4** shows both the response waveform and the enhanced Loose Particle metric (transient distortion) for a good speaker with no known defects. **Figure 5** shows the same data for a speaker with a significant transient defect. The defect is clearly visible on the response waveform, and the correlation between the magnitude of the distortion and the magnitude of the eLP prominence (red spikes) is clear.

Conclusion

This new Transient Distortion method, known as the "enhanced Loose Particle" algorithm, significantly improves the accuracy and reliability of transient distortion detection. It is more accurate than Listen's earlier algorithms and minimizes the risk of false positives due to background noise that is inherent with other measurement techniques. Furthermore, it distinguishes loose particle defects from periodic distortion, such as Rub & Buzz, facilitating troubleshooting both on the production line and in R&D applications.

The ability to play back just the loose particle recording and compare it to the visual representation facilitates understanding of the correlation between measurement results and audibility, and aids limit setting. Limit setting is simple as the user simply has to define the Prominence Threshold and the event count, and default values work well in the majority of cases. In addition to speaker and headphone driver testing, this method has applications including Buzz, Squeak, and Rattle (BSR) measurements in cars, and rattling components in audio devices. **LIS**

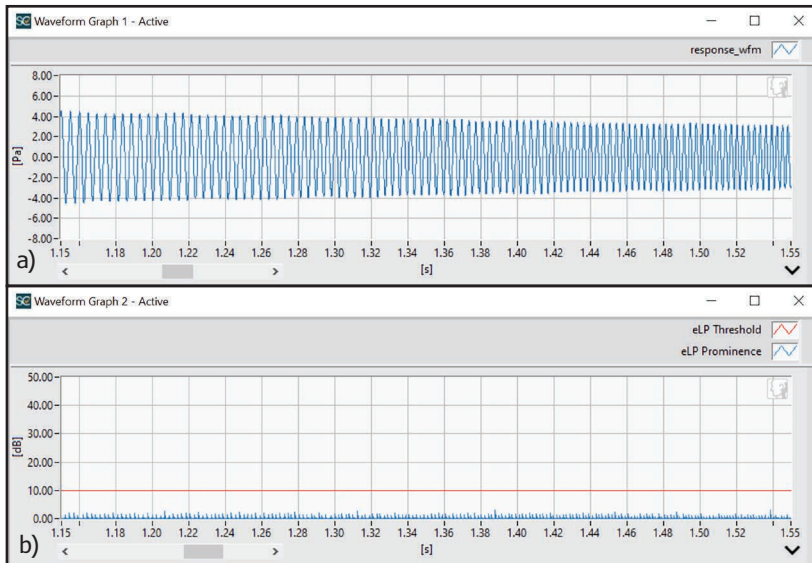


Figure 4: Response waveform (a) and corresponding transient distortion (b) for a good loudspeaker.

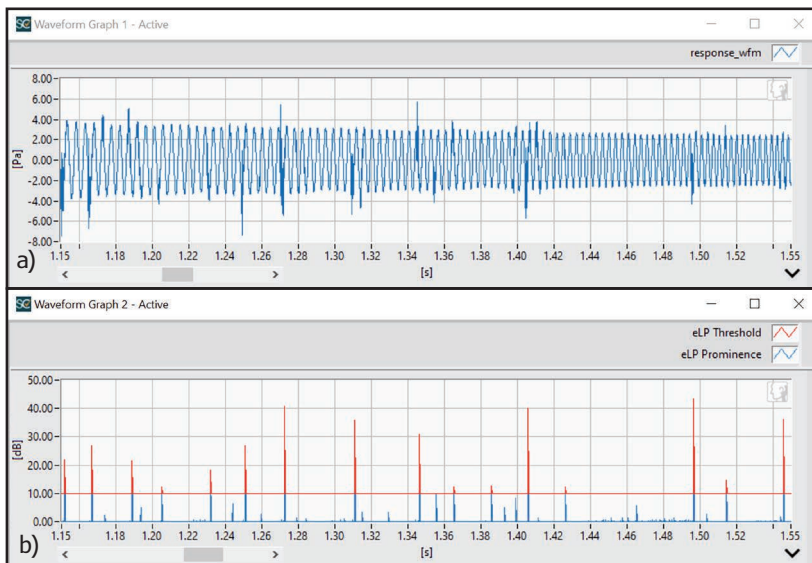


Figure 5: Response waveform (a) and corresponding transient distortion (b) for a loudspeaker with transient distortion.

References

- [1] P. Brunet, E. Chakroff, and S. Temme, "Loose Particle Detection in Loudspeakers," presented at the 115th Audio Engineering Society (AES) Convention, October 2003.
- [2] P. Brunet and S. Temme, "Enhancements for Loose Particle Detection in Loudspeakers," presented at the 116th Audio Engineering Society (AES) Convention, May 2004.

Why 2023 Is the Year to Upgrade Your Home Theater

By
Tony Ostrom
(President, WiSA Association)



Photo 1: Platin Audio's Monaco 5.1.2 speaker setup is just one example of a WiSA Certified home theater system. (Image Source: Platin Audio)

In the years since COVID-19, TVs have positioned themselves at the center of the home entertainment experience and in 2023, WiSA predicts the importance of great audio wrapped around these TVs will become a stronger focus because today's immersive A/V content demands big, beautiful screens and immersive, high-definition, three-dimensional audio.

Pre-pandemic, the thought of dedicating the space and money to a home theater might have seemed unnecessary to some. We have movie theaters, so why not go to the theater for your entertainment? When the pandemic forced theaters to shut down, people had to settle for in-home viewing. In the years since COVID-19, in-home entertainment has continued to skyrocket. According to S&P Global Market Intelligence, US Internet households own an average of 1.2 smart TVs as of early 2022 (**Figure 1**).

While the popularity of traditional HDTV and standard definition TV has decreased, smart TV ownership is on the rise. Smart TVs have more capabilities now than ever before. In a time where content streaming is preferred to traditional live television, home entertainment systems must have the ability to decode streaming platforms' audio and video precisely.

While there are many options for home entertainment, not every product is equipped to interconnect with smart TVs for seamless

audio and video. In recent years, Dolby Atmos has become a popular upgrade for home theater connoisseurs and music lovers alike. In 2022, we saw innovations for Dolby Atmos-capable products. With continued upgrades and state-of-the-art technology available, 2023 is the year to upgrade your home theater for an even more enjoyable entertainment experience.

2022: The Year of Innovation

As the consumer electronics (CE) industry continues to grow year by year, innovations from retailers and brands have expanded. Trade shows, such as CEDIA and CES, provide manufacturers with the opportunity to showcase new and improved products as well as keep a pulse on the trends of the industry. For example, at CEDIA 2022, popular TV brand LG showcased a new LX3 OLED screen, complete with HDMI 2.1, USB ports, a built-in microphone and the newest trend in audio—Dolby Atmos. Although Dolby Atmos was first introduced in 2012 and used exclusively in movie theater

speakers, the technology has risen in popularity for home audio solutions. Now, Dolby Atmos is considered a must-have for anyone to say they have a high-end home theater. Dolby Atmos is everywhere—even streaming services, such as Netflix and Hulu, have begun to offer Dolby Atmos audio for shows and movies. This increase has led to more retailers dabbling in Dolby Atmos, creating a flurry of cost-effective, widely available systems from which to choose.

Now getting the streaming content into your home is easy, you can have a real speaker system that sounds like a cinema, and you can do it very affordably. But what exactly is this technology?

Simply put, Dolby Atmos gives listeners the ability to listen to music, movies, TV, gaming, and more in immersive, three dimensional surround sound.

In September 2022, Wireless Audio and Speaker Association (WiSA) Technologies and Platin Audio launched Platin Monaco 5.1.2 with WiSA SoundSend, the first wireless audio system to incorporate true up-firing Dolby-Atmos speakers (**Photo 1**). The system offers more channels than any other wireless technology, with up to eight channels on 5.1.2. The award-winning system is compatible with all smart TVs thanks to the WiSA SoundSend, an audio transmitter that seamlessly connects speakers to your TV wirelessly.

According to Precedence Research, the video streaming market is on its way to \$623.34 billion in 2024. With the projection of the market growing by \$179 billion in the next year, we can expect to see continued moves toward streaming as one of the main forms of media consumption (**Figure 2**).

How Can You Upgrade Your Home Theater?

If you don't know where to start with your home theater, upgrades such as a soundbar or the WiSA SoundSend for wireless speaker connection like the Platin Monaco 5.1.2 system will vastly increase the entertainment value. The SoundSend is a low-cost, universal solution that opens the door to even more possibilities such as the addition of WiSA-Certified speakers from WiSA partners such as Bang and Olufsen, Dynaudio, Klipsch, and Enclave. All WiSA Certified speakers have been tested to work perfectly with any WiSA Certified transmitter, such as the WiSA SoundSend, guaranteeing seamless wireless compatibility.

On the more affordable end, the Klipsch R-4B II Sound Bar and Wireless Subwoofer starts at \$229. With Dolby decoding capabilities and an included optical cable to easily connect the soundbar to your TV, this system provides some of the most desirable aspects of a powerful home theater setup. Because of the lower price point, rear speakers are not included with this system and would need to be purchased separately.

For a middle price point, the Platin Milan 5.1 system with WiSA SoundSend starts at \$699. This system includes six speakers—two front satellite speakers, two back satellite speakers, a center-channel speaker, and a subwoofer—as well as the WiSA SoundSend to decode and wirelessly transmit audio (including Dolby Atmos and Dolby Atmos Music) for a crystal clear, synchronized listening experience. This sleek setup blends seamlessly into any home decor.

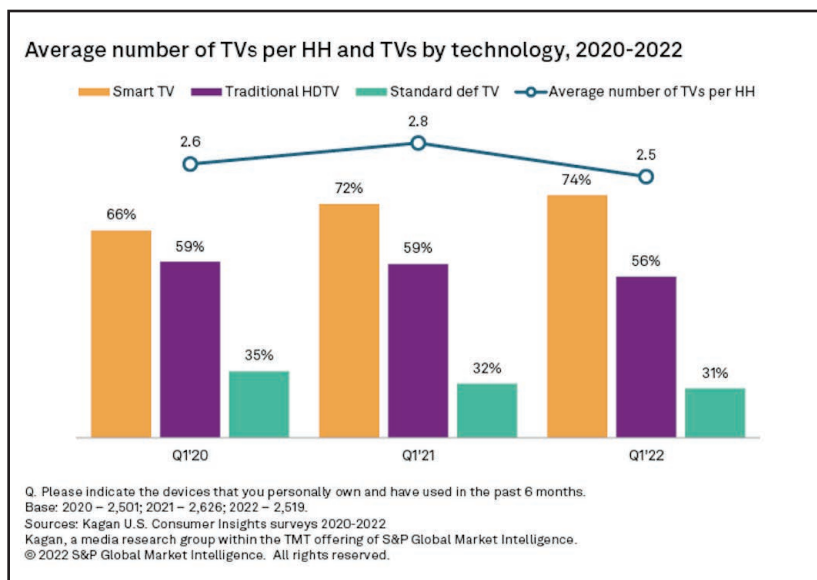


Figure 1: This is the percentage of TV types and average number of TVs by household. (Image Source: S&P Global Market Intelligence)

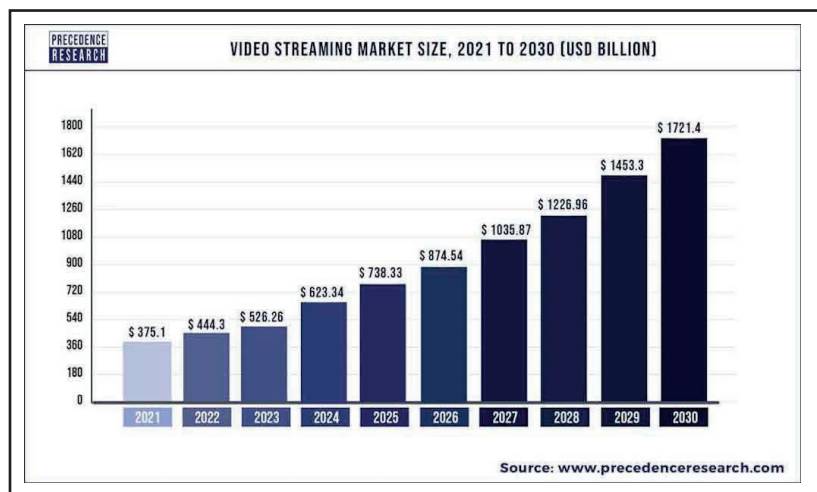


Figure 2: Video streaming's market size projections for 2021-2030. (Image Source: Precedence Research)

After selecting your ideal home theater system, it's time to set it up! WiSA-enabled systems are engineered to be plug-and-play with setup taking minutes not hours. Wireless connectivity from the WiSA SoundSend to each speaker makes it easy to properly position the speakers around the room creating a truly immersive cinema-like experience. Up-firing speakers such as those on the front left and right speakers of the Platin Audio Monaco 5.1.2 add Dolby Atmos capabilities, truly creating a three-dimensional listening environment and replicating the experience of modern cinemas.

What Can You Expect in Home Theater Innovation in 2023?

We think 2022 was just the beginning of a technological revolution for WiSA and home theater innovation. The increasing number of WiSA Certified speaker systems, more TVs and projectors achieving WiSA SoundSend Certification, and the Dolby-Atmos capable Monaco 5.1.2 are all setting a standard for high-quality, immersive audio.

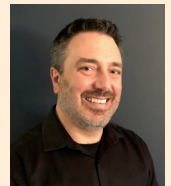
In 2023 we predict more interoperability between speakers, soundbars, and TVs. The proliferation of Dolby Atmos will continue with brands offering Dolby Atmos-capable products and

more available content to increase the need for Dolby Atmos-capable systems. TVs have positioned themselves at the center of the home entertainment experience and in 2023, the importance of great audio will become a stronger focus.

Today's immersive A/V content demands big, beautiful screens and immersive, high-definition, three-dimensional audio. No matter what the coming months bring, WiSA's core mission will stay the same: providing next-generation home entertainment systems and ensuring that spatial audio is an experience that everyone can enjoy. **LTS**

About the Author

Tony Ostrom is the President of the Wireless Audio and Speaker Association (WiSA). His 25-year career in the consumer electronics industry has been focused on product planning and development, consumer research, technology integration, go-to-market planning, marketing, training and sales. Prior to joining WiSA, Tony was the Vice President of Product Development at Klipsch Group where he managed multiple categories including Wireless Home Theater, Wireless Distributed Audio, Bluetooth, and Powered Audio Solutions. Prior to Klipsch, Tony played key roles in the global launches of Powermat Wireless Charging as well as the House of Marley audio and lifestyle brand. Tony was Director of Product Development and Marketing at Klipsch Group where he drove the Mass Retail and Personal Audio categories and he started his career at JL Audio where he was a Technical Director.



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AMP, DSP, NETWORK, AND WIRELESS MODULES

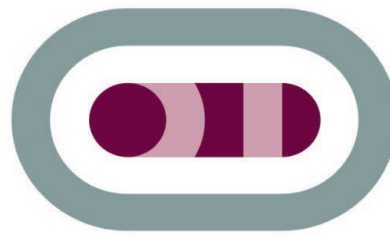


Digital Signal Processing Amplification Modules

	Wireless Connectivity	Network Processing	Digital Signal Processing	Amplification Modules
AUSTRALIA				
DEQX Pty., Ltd.	•	•	•	•
Eclipse Audio		•		
Soundlabs Group	•			
BELGIUM				
APEX	•	•	•	
The Innovators Lab Belgium (ILaB)		•		
BRAZIL				
Advanced Audio Technologies (AAT)	•			
AMCP Eletrônica	•			
Attack Audio System	•	•		
Magna Audio	•			
Newbox Acoustic	•	•	•	•
CANADA				
Harbottle Audio Co.	•	•		
Kravchenko-Audio	•	•		
Solen Electronique, Inc.	•	•	•	•
Sonavox	•	•	•	•
Space-Tech Lab, Ltd.	•	•		•

Digital Signal Processing Amplification Modules

	Wireless Connectivity	Network Processing	Digital Signal Processing	Amplification Modules
CHINA				
Eastech Holding Co., Ltd.			•	•
Fountek Electronics Co., Ltd.	•	•	•	•
Goertek	•	•	•	•
Hansong (Nanjing) Technology	•	•	•	•
MYIR Tech, Ltd.	•	•	•	•
Pana Sound Technology	•	•	•	•
Shenzhen Horn Audio Co., Ltd.	•	•	•	•
Telefield	•	•	•	•
Tonewinner (Guangzhou) Electronics	•	•	•	•
Tonly Electronics Holdings	•	•	•	•
Tristar Electronics	•	•	•	•
Vistron Audio Equipment	•	•	•	•
DENMARK				
ICEpower a/s	•	•	•	•
Lyd by Dissing	•	•	•	•
Pascal A/S	•			
Purifi Audio	•			
FRANCE				
Amplitude Audio	•	•	•	•
Exclusive Audio-Design	•			



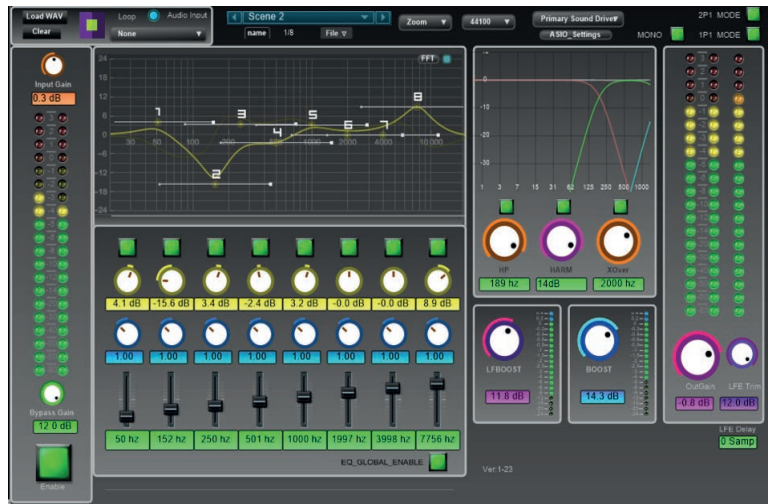
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Sound Quality Improvement:

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Full suite of effects



Audio Bandwidth
Restoration & Extension:

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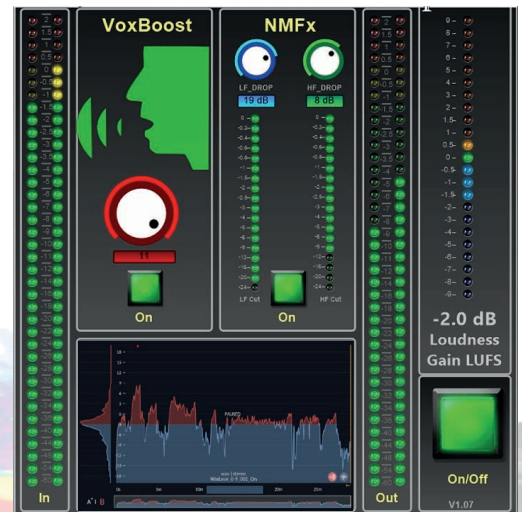
Improved Listening Experience

■ **NMFx & Vox Boost**

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Available for 1.0/1.1, 2.0/2.1 and multi-channel systems.

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AMP, DSP, NETWORK, AND WIRELESS MODULES

	Digital Signal Amplification Modules	Network Processing	Wireless Connectivity	
GERMANY				
Ascendo Immersive Audio			•	•
Audio Technology Engineering (ATE)	•	•	•	•
AudioChiemgau	•	•	•	•
Fraunhofer Institute for Digital Media Technology		•	•	•
Klippel GmbH	•	•		
MAAT Labs GmbH		•		
Riedel Communications GmbH & Co. KG			•	
Wolf von Langa	•			
HONG KONG				
Eastern Asia Technology (HK)	•			•
INNacoustic	•	•	•	•
miniDSP, Ltd.	•	•	•	
OCVACO Electronic, Ltd.	•	•	•	•
INDIA				
GM Audio Technics	•	•	•	
SFT Technologies				•

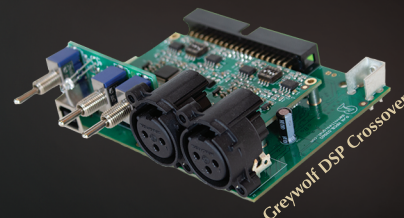
	Digital Signal Amplification Modules	Network Processing	Wireless Connectivity	
ISRAEL				
Alango Technologies, Ltd.			•	•
Thermoguide, Ltd.		•		
ITALY				
Axiomedia s.r.l.		•	•	•
Outline SRL			•	
Powersoft	•	•	•	
JAPAN				
Etani Electronics Co., Ltd.		•	•	
Final Co., Ltd.		•	•	
NETHERLANDS				
Aequo Audio		•	•	•
ELTIM audio BV	•			
Hypex Electronics	•	•		
PHILIPPINES				
Dai-ichi Electronics Manufacturing Corp.	•	•	•	•

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AMP, DSP, NETWORK, AND WIRELESS MODULES

	Digital Signal Amplification Modules	Network Processing	Wireless Connectivity	
SWEDEN				
Böhmer Audio		•	•	•
SWITZERLAND				
Weiss Engineering Ltd.		•	•	
TAIWAN				
AV Leader Corp.		•	•	•
ChiaPing Enterprise Co., Ltd.		•	•	•
Jazz Hipster Corp.	•	•	•	•
Jetvox Acoustic Corp.	•	•	•	•
Meiloon Industrial	•	•	•	•
Merry Electronics	•	•	•	•
Palm Garden Enterprise	•	•	•	•
Taiwan Solidex				•
TOONG IN Electronic Corp.	•	•	•	•
Turbo Tide Electronics Co., Ltd.	•	•	•	•
UKRAINE				
MAG Audio	•			

	Digital Signal Amplification Modules	Network Processing	Wireless Connectivity	
UNITED KINGDOM				
EuroTec International, PLC		•	•	
MJ Acoustics		•		•
Oxford Digital, Ltd.		•		
Profusion	•	•	•	•
Resolute Audio	•	•	•	•
Tectonic Elements	•			
UNITED STATES				
ADM Technology	•	•		
Area 52 R&D	•	•		
AtlasIED		•	•	
Audio Advisor, Inc.	•			
Axiim	•	•	•	•
Benchmark Media Systems	•	•		
Danville Signal Processing, Inc.	•	•	•	•
Digmoda	•	•		
Dragonfire Acoustics	•	•	•	•
DSP Concepts		•		

AMP, DSP, NETWORK, AND WIRELESS MODULES • AMP, DSP, N

MODULES FOR ACTIVE SPEAKERS

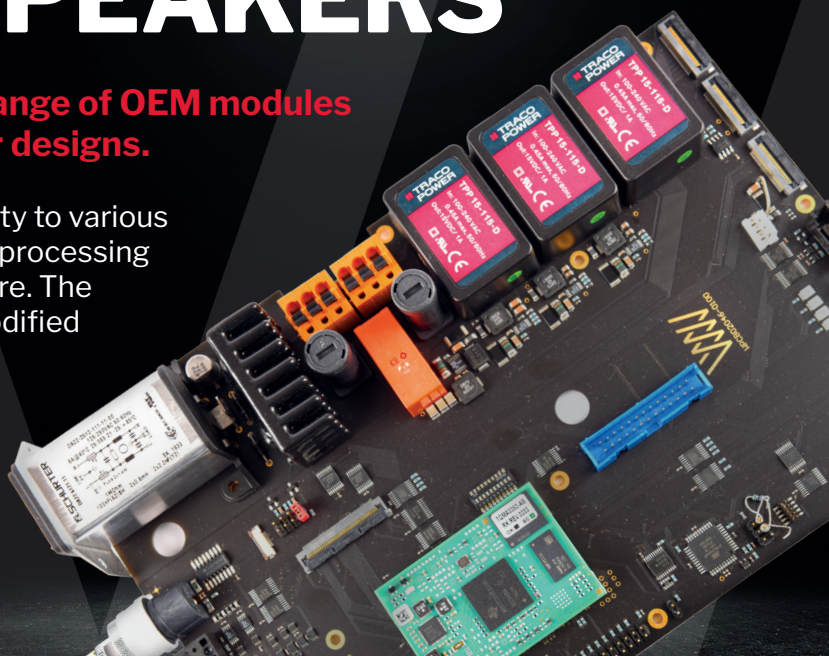


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AMP, DSP, NETWORK, AND WIRELESS MODULES

	Digital Signal Processing Amplification Modules	Network Connectivity	Wireless Connectivity
Emerald Physics		•	•
Fortemedia			•
Full Compass Systems, Ltd.		•	•
Globe Audio Design		•	•
JL Audio		•	•
Kramer Electronics		•	•
Lectrosonics			•
Linea Research USA		•	•
Linear Tube Audio		•	
Linkplay			•
Meyer Sound Laboratories, Inc.			•
MISCO		•	•
North American Solidex, LLC		•	•
Pro Flix Sales		•	•
RCF (USA)		•	•
RIVA Audio		•	•
Rogersound Labs		•	•
SensaSound USA		•	•
Senzar Acoustics, Inc.		•	•

	Digital Signal Processing Amplification Modules	Network Connectivity	Wireless Connectivity
Sonion		•	•
Sound Audio Manufacturing, LLC		•	•
SpeakerPower		•	•
Trulli Audio		•	•
US Enclosure Co.		•	•
Vintage King Audio		•	•
VTech		•	•
Weltronics Corp.		•	•
Wired 4 Sound, Inc.		•	•
VIETNAM			
Sound Corp.		•	•
Sun Acoustic Vina		•	•



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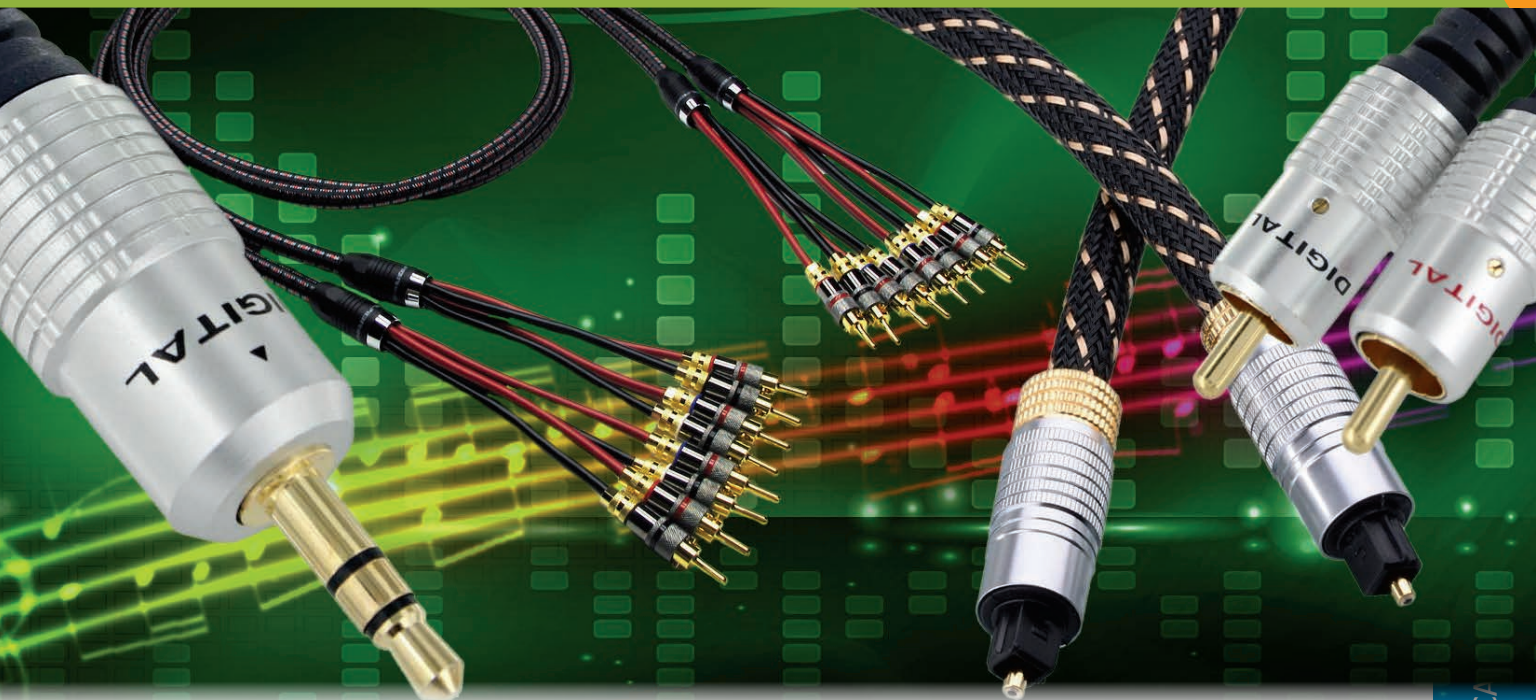
INDUSTRIAL DESIGN	WAREHOUSING
ENGINEERING	BUFFER STOCK
OPEN BOM	REWORK
QUOTING	STAGING
SOURCING	FULLFILLMENT
ASSEMBLY	DISTRIBUTION
KITTING	PRODUCT EVALUATIONS
INSPECTION/QC	



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	Wire Channels Connectors Cables		
AUSTRALIA			
Soundlabs Group	•	•	
Stone Sound Studio	•	•	
BRAZIL			
Attack Audio System	•	•	
Newbox Acoustic	•	•	•
CANADA			
Canadian Speaker Works	•	•	
Rutherford Audio	•		
Solen Electronique, Inc.	•	•	
CHINA			
BSWA Technology Co., Ltd.	•	•	•
Sound Technology Development, Ltd. (Factory)	•	•	•
Sun Technique Electric Co., Ltd.	•	•	•
DENMARK			
Duelund Coherent Audio	•		
estron a/s	•	•	
Jantzen Audio	•		
GERMANY			
CORDIAL GmbH Sound & Audio Equipment	•	•	
HiFi-Tuning	•	•	
Klippel GmbH	•		
Mundorf EB GmbH	•	•	

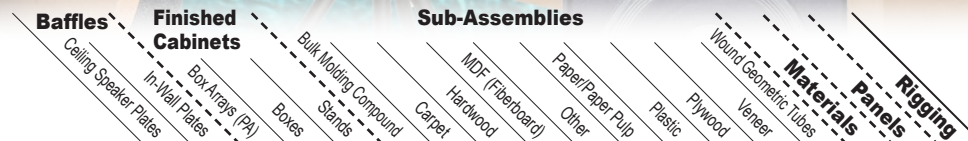
	Wire Channels Connectors Cables		
Voice Point	•	•	•
Wolf von Langa	•	•	•
HONG KONG			
dB Enterprises		•	
WCE Acoustics	•	•	
HUNGARY			
Bayz Audio	•		
INDIA			
Power Electronics & Technologies	•	•	
IRELAND			
CrossOver Filter App	•		
ITALY			
Axiomedia s.r.l.	•	•	
Yter Laboratorium s.r.l.	•	•	
JAPAN			
Etani Electronics Co., Ltd.	•	•	
Final Co., Ltd.	•	•	
Furutech Co., Ltd.	•	•	
MEXICO			
Aletheia AV	•		
NETHERLANDS			
Crystal Cable	•	•	
Diluvite	•	•	
ELTIM audio BV	•	•	

CABLES & CONNECTORS

	Cables	Connectors	Wire Channels
Good Hifi VOF		•	
Van den Hul	•	•	
SWEDEN			
Audio Pro, AB	•		
Ghielmetti Solutions AG	•	•	
Vovox AG	•	•	
TAIWAN			
AV Leader Corp.	•	•	•
Bennic Components	•		•
Huey Tung International Co., Ltd.	•	•	
Yung International	•	•	•
UKRAINE			
MAG Audio	•	•	
UNITED KINGDOM			
Arya Audio Labs	•		
EuroTec International, PLC	•	•	•
GRAS Sound & Vibration (UK)	•	•	
Hi-Fi Collective	•	•	•
MJ Acoustics	•		
Revolver Audio, Ltd.	•		
UNITED STATES			
ADI	•	•	
American Bass	•	•	
Audio Advisor, Inc.	•	•	
Audio Connection, Inc.	•	•	•
Avanti Audio	•	•	
B&H Foto & Electronics Corp.	•	•	
Belden, Inc.	•	•	
Blackmore Pro Audio	•	•	
Broad Bridge Audio, LLC	•		
Cardas Audio	•	•	•
Carvin Audio	•	•	
CE Distribution, LLC	•	•	•
Controlled Thermal Processing	•	•	•
DH Labs Silver Sonic	•	•	
DTV Installations, LLC	•	•	•
Earthquake Sound Corp.	•		
Elektrisola	•		•
Fingerprint Audio	•	•	
Front End Audio, LLC	•	•	
Full Compass Systems, Ltd.	•	•	
GR Research	•	•	

	Cables	Connectors	Wire Channels
GRAS Sound & Vibration (USA)	•	•	
HAVE, Inc.	•	•	•
Hosa Technology, Inc.	•	•	
Io Audio Technologies	•	•	•
JL Audio	•	•	
Kimber Kable	•	•	
Kramer Electronics	•	•	
Kubala-Sosna Research, Inc.	•	•	
Lamart Corp.	•	•	•
Madisound Speaker Components, Inc.	•		
Morrow Audio	•	•	
Nordost	•	•	
Parts Express	•	•	•
Pro Flix Sales	•	•	
ProCo Sound	•	•	
PRV Audio Brazil	•		
Radio Design Labs (RDL)	•	•	•
Redco Audio	•	•	•
Revolution Audio & Power	•	•	
Roderick Loudspeaker Service	•	•	
Schurter Electronic Components	•	•	
Sommer Cable America, Inc	•	•	
Sound Pure, LLC	•	•	
Sounddoctor	•	•	
Stillwater Designs KICKER	•		
Straight Wire, Inc.	•	•	•
SVS	•	•	
Sweetwater Sound	•	•	
Tonian Laboratories	•		
Transparent Audio, Inc.	•	•	
TRS Inovations, Inc.	•	•	
TSG Audio	•	•	
US Speaker	•	•	
VH Audio, Inc.	•	•	
Vidsonix Design Works	•	•	
Westlake Audio, Inc.	•	•	•
Wired 4 Sound, Inc.	•	•	•
Wireworld Cable Technology	•	•	
Yandas Music	•	•	
Zu Audio	•		
zZounds Music	•	•	
VIETNAM			
Sound Corp.	•	•	•

	Headphones	Earphones
UNITED STATES		
1MORE	•	•
American Bass	•	•
American Music & Sound	•	•
Audio Advisor, Inc.	•	•
Audio Connection, Inc.	•	•
AValive		•
B&H Foto & Electronics Corp.		•
BeStar Technologies, Inc.	•	•
Blackmore Pro Audio		•
Broad Bridge Audio, LLC	•	•
Christensen Audio, LLC		•
Dekoni Audio	•	•
Dinaburg Technology		•
Dragonfire Acoustics	•	•
Earthquake Sound Corp.	•	•
ESS Speakers USA		•
ESTec America	•	•
Front End Audio, LLC		•
Full Compass Systems, Ltd.	•	•
GraphAudio	•	•
HAVE, Inc.		•
Hearing Components, Inc. (Comply)	•	•
JJR Acoustics, LLC	•	•
Materion Corp.		•
Pacific Audio Consulting	•	•
Parts Express	•	•
Peerless by Tympany		•
PreSonus Audio Electronics, Inc.		•
Pro Flix Sales		•
Puro Sound Labs		•
RBH Sound	•	•
Revolution Audio & Power	•	
Saati	•	•
Shure	•	•
Sonion	•	•
Sound Pure, LLC		•
Sound Sources	•	•
Stillwater Designs KICKER	•	•
Tectonic Audio Labs		•
US Enclosure Co.	•	•
Vintage King Audio		•
VTech	•	•
W. L. Gore & Associates	•	•
Western Electric		•
Yandas Music	•	•
Zu Audio		•
zZounds Music		•

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ENCLOSURES & CABINETS

	Baffles		Finished Cabinets		Bulk Molding Compound		Sub-Assemblies							Wound Geometric Tubes		Materials		Panels		Rigging	
	Ceiling Speaker Plates	In-Wall Plates	Box Arrays (PA)	Boxes	Stands	Compound	Carpet	MDF (Fiberboard)	Hardwood	Paper/Paper-Pulp	Other	Plastic	Plywood	Veneer							
Rogersound Labs					•					•			•	•							
RSL Speaker Systems					•				•	•			•	•				•			
Saati																		•			
Shinjitsu Audio					•	•			•					•							
SoCal Sound Shop				•	•																
Sound Anchors						•															
Sound Sources		•	•	•	•	•		•													
SpeakersAndAmps.com				•	•																
SSI Manufacturing, Inc.				•	•					•				•							
Studio Electric, LLC				•	•				•	•					•						
T&T Shanghai Tianai Acoustics				•	•	•															
TMI Audio Engineering											•										
TRS Inovations, Inc.		•	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•		
Trulli Audio				•	•	•		•		•			•						•		
TSG Audio				•	•	•															
United Gasket Corp.		•	•					•				•					•				
US Enclosure Co.		•	•	•	•	•					•		•		•	•			•		
US Speaker				•	•	•															
Vidsonix Design Works					•					•											
VTech		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Wired 4 Sound, Inc.																					
Yandas Music					•	•															

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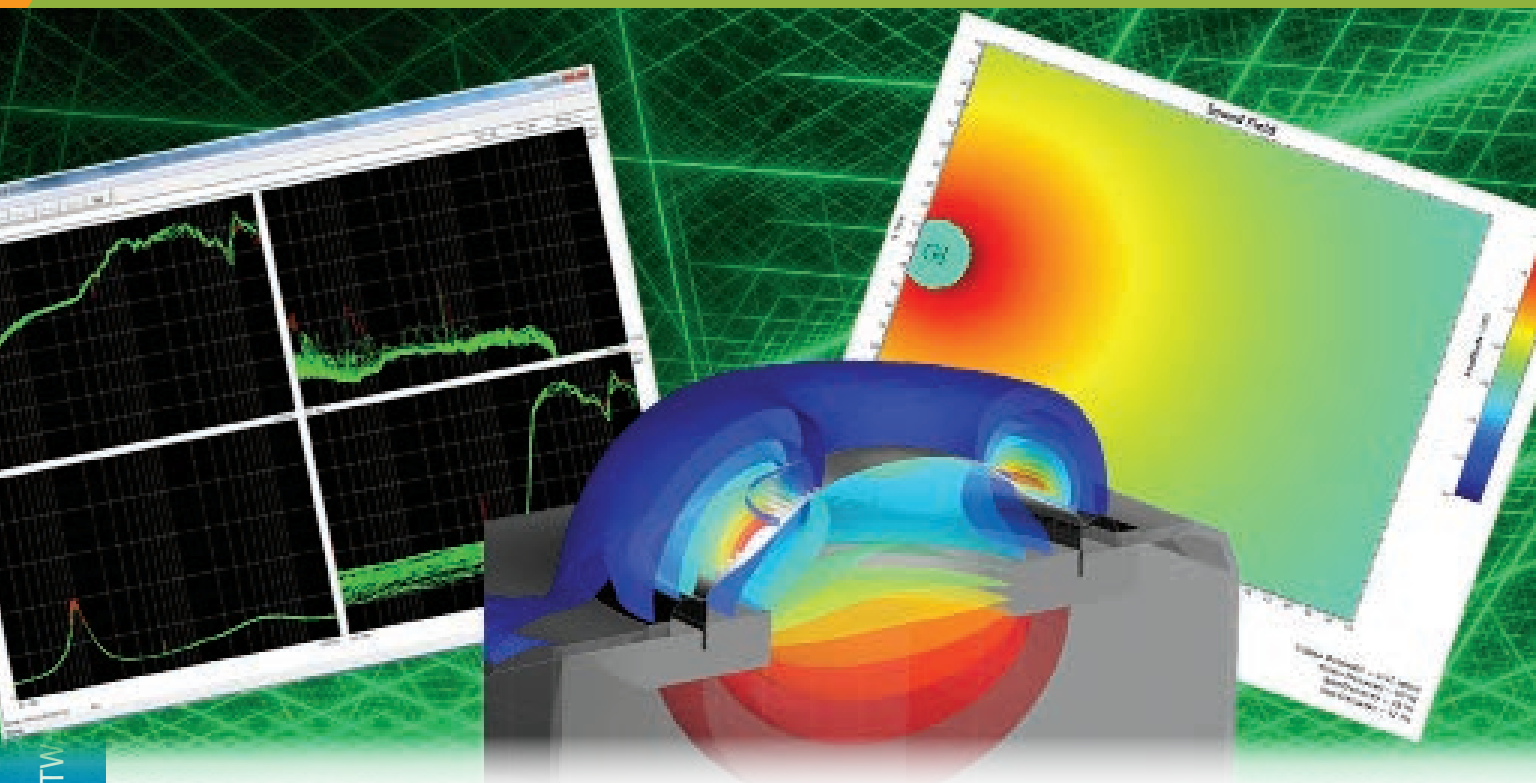
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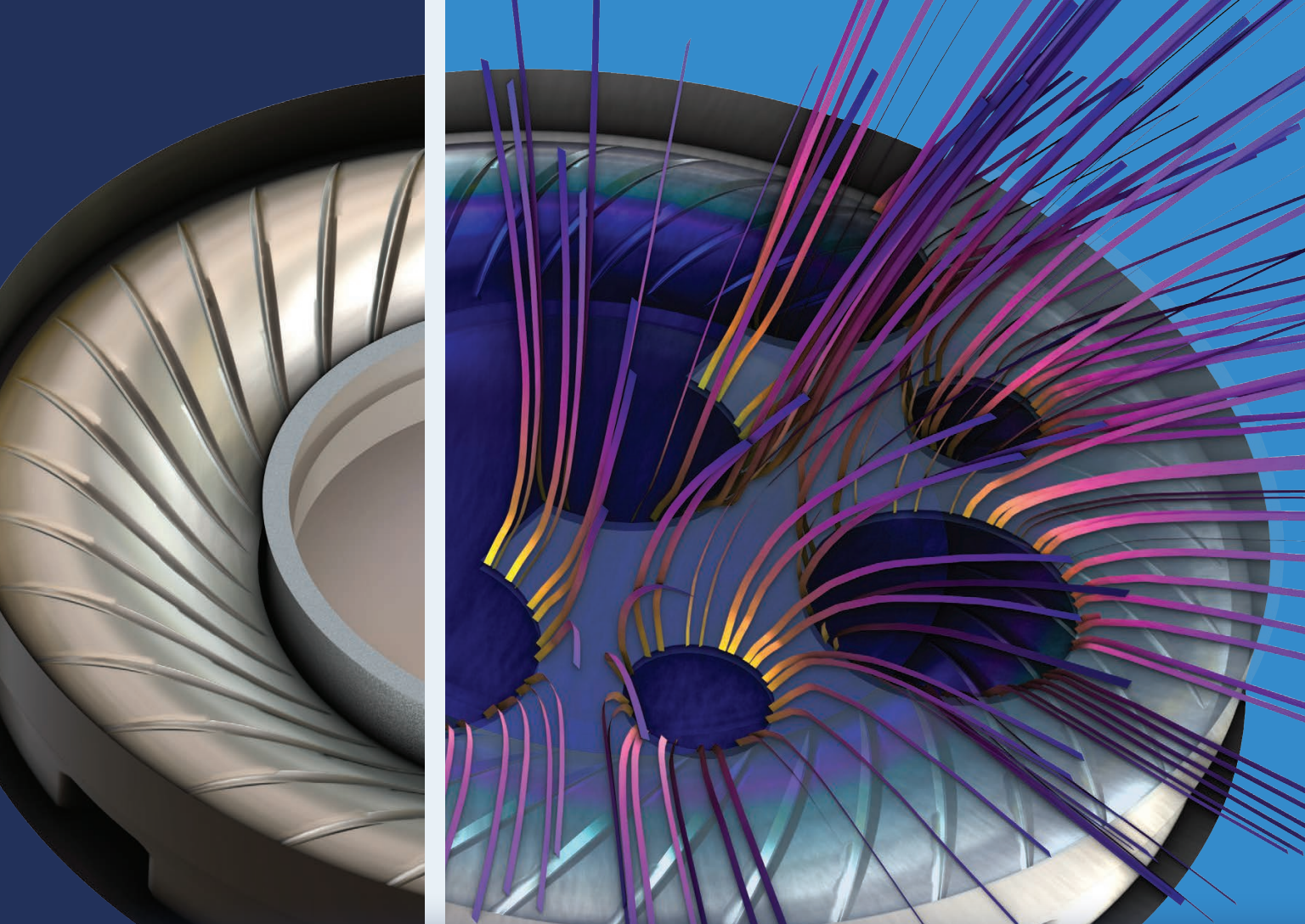
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	Acoustic Analysis	Crossover Design	Box Design	Network Optimizer	CAE or CAD
AUSTRALIA					
Audinate	•	•	•	•	•
Audiosoft	•	•	•	•	•
DEQX Pty., Ltd.	•			•	•
Eclipse Audio				•	
Stone Sound Studio	•	•	•	•	•
BELGIUM					
Donnet: Loudspeaker Repair	•	•	•		
BRAZIL					
Newbox Acoustic	•	•	•	•	•
CANADA					
Solen Electronique, Inc.	•	•	•		
Space-Tech Lab, Ltd.	•				
CHINA					
BSWA Technology Co., Ltd.	•				
Eastech Holding Co., Ltd.	•	•			•
Goertek	•	•	•	•	•
Hansong (Nanjing) Technology	•	•	•	•	•
Junhao Wood Cabinet Factory			•		
Kadeton Audio Co., Ltd.			•		•
Pana Sound Technology	•	•	•	•	•
Sound Technology Development, Ltd. (Factory)	•	•	•	•	•
Star Audio Co., Ltd.			•		
Sun Technique Electric Co., Ltd.	•	•	•	•	•

	Acoustic Analysis	Crossover Design	Box Design	Network Optimizer	CAE or CAD
DENMARK					
Trueanalog Strictly OEM		•			•
Xiamen Great Sound Technology		•			
FRANCE					
Kyu Systems		•		•	•
Seltech	•	•	•	•	•
GERMANY					
Audio Technology Engineering (ATE)	•	•	•	•	•
Klippel GmbH	•	•		•	•
Mvoid Technologies GmbH	•				•
R&D Team Software Development	•	•	•	•	•
Riedel Communications GmbH & Co. KG					•
Voice Point	•	•	•	•	•
HONG KONG					
Beautiful Enterprise	•	•	•	•	•
INNacoustic	•	•	•	•	•
Ocean Sound Technology, Ltd.	•	•			•
INDIA					
GM Audio Technics		•			
TurboSonic Pro Speakers					•
IRELAND					
CrossOver Filter App				•	



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	Acoustic Analysis	Box Design	Crossover Optimizer	Network Design	CAE or CAD
UNITED KINGDOM					
Electroacoustic Design, Ltd.					
EuroTec International, PLC					
Hill Acoustics					
PACSYS					
Spectral Measurement					
UNITED STATES					
A List Wood Works					
Audio Precision, Inc.					
Biamp					
COMSOL					
Danville Signal Processing, Inc.					
Digmoda					
Dragonfire Acoustics					
HEAD acoustics					
Hottinger Bruel & Kjaer Sound & Vibration North America					
HX Audio Lab, LLC					
Listen, Inc.					
Meliti Acoustics					
MSC Software					
NedLab					
Parts Express					
Portland Audio Lab					
QA Genesis					
Scantek, Inc.					
Sounddoctor					
Studio Six Digital					
True Technologies, Inc.					
Warkwyn					
VIETNAM					
Sound Corp.					

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- mike@menloscientific.com
- www.menloscientific.com



FINISHED SYSTEMS (OEM/ODM)



	Home Audio Car Audio	Marine Audio	Pro Audio
AUSTRALIA			
Lenard Audio		•	•
Stone Sound Studio	•	•	•
BELGIUM			
Donnet: Loudspeaker Repair	•	•	•
Premium Sound Solutions	•	•	•
BRAZIL			
Advanced Audio Technologies (AAT)		•	
AMCP Eletrônica		•	
Attack Audio System			•
Audiopax		•	
Harman of Brazil	•	•	•
Magna Audio		•	
Newbox Acoustic	•	•	•
CANADA			
Acora Acoustics Corp.		•	
Canadian Speaker Works			•
Divergent Technologies		•	
Eastporters Audio Video		•	
Focal North America	•	•	•
Gershman Acoustics		•	
Harbottle Audio Co.		•	•
Kravchenko-Audio		•	
LMH Loudspeakers	•	•	•
Newform Research		•	•
Planet10-HiFi		•	
Reference 3A		•	•
Solen Electronique, Inc.	•	•	•
Sonavox		•	
Space-Tech Lab, Ltd.		•	
Studio Reference Monitors			•
StudioLAB		•	
CHINA			
Audiostar Electronics	•	•	•
B.W. Audiovisual Solution Co., Ltd.			•

	Home Audio Car Audio	Marine Audio	Pro Audio
DML Exciters		•	
Eastech Holding Co., Ltd.		•	•
Enkor Electronics Co., Ltd.		•	
Fountek Electronics Co., Ltd.		•	•
Goertek		•	
Hansong (Nanjing) Technology		•	•
Junhao Wood Cabinet Factory		•	•
Lumi Audio		•	•
OBE Pro Audio Co., Ltd.			•
Shenzhen Horn Audio Co., Ltd.	•	•	
Sonos, Inc.		•	
Sound Technology Development, Ltd. (Factory)		•	•
Sun Technique Electric Co., Ltd.	•	•	•
Telefield		•	
Tonly Electronics Holdings	•	•	
Tristar Electronics		•	
Trueanalog Strictly OEM	•	•	•
Vistron Audio Equipment		•	
Weide Electronics		•	
Xiamen Great Sound Technology	•	•	•
Zeng Ben Industrial Corp., Ltd.	•	•	•
Zhongshan K-Mate General Electronics Co., Ltd.		•	
Zhuhai HiVi Technology	•	•	•
DENMARK			
Dynaudio		•	•
ICEpower a/s	•	•	•
Kvart & Bølge		•	
Lyd by Dissing		•	
Pascal A/S			•
FINLAND			
Genelec Oy		•	•
FRANCE			
Kyu Systems			•
Mulidine		•	
Seltech	•	•	•
Supravox		•	•



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- Project Management
- Industrial Design
- Rapid Prototyping
- Engineering

(DSP, Transducer, 3D Solidworks)

- Warehousing (80k+sq. ft.)
- Fulfillment (EDI, 3PL, etc...)



Join us in sunny southern California at any time during development to collaborate and evaluate the progress. We have state-of-the-art test equipment and facilities with idyllic listening rooms. We always make time for our OEM/ODM customers!

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- Transducer Mfg.
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- Direct Drop Ship

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FINISHED SYSTEMS (OEM/ODM)

	Home Audio Car Audio	Marine Audio	Pro Audio	
T&T Acoustic Loudspeakers		•		
Waterfall Audio		•		•
GERMANY				
Ascendo Immersive Audio		•		•
Audio Technology Engineering (ATE)	•	•	•	•
AudioChiemgau		•		
Eton GmbH	•	•		
HiFi-Tuning		•		•
ic audio			•	•
Mvoid Technologies GmbH	•	•		•
Quint Audio				•
Scherer Audio		•		
Voice Point		•	•	•
Wolf von Langa		•		•
HONG KONG				
Beautiful Enterprise		•		
dB Enterprises	•	•	•	•
Eastern Asia Technology (HK)	•	•	•	•
Fujikon Industrial Holdings	•	•	•	
INNacoustic	•	•		
miniDSP, Ltd.	•	•		•
Ocean Sound Technology, Ltd.		•		•
WCE Acoustics		•		
HUNGARY				
Bayz Audio		•		•
INDIA				
Decibelsaudio		•		
GM Audio Technics				•
Indiq Audio		•		
Laysant Audio Private, Ltd.	•	•		
Power Electronics & Technologies		•		•
INDONESIA				
SB Acoustics		•		
IRELAND				
CrossOver Filter App	•	•	•	•
ISRAEL				
Coby Speakers	•	•	•	•
Morel	•	•		
ITALY				
Powersoft				•
JAPAN				
Etani Electronics Co., Ltd.	•	•		•
MEXICO				
Aletheia AV		•		
NETHERLANDS				
Aequo Audio		•		
Diluvite	•	•	•	•

	Home Audio Car Audio	Marine Audio	Pro Audio	
ELTIM audio BV		•		•
Metaxas & Sins		•		•
Sound Projects				•
NEW ZEALAND				
Theophany Loudspeakers, Ltd.		•		
NORWAY				
Griffin Audio AS				•
SEAS Fabrikker AS		•		
PHILIPPINES				
Dai-ichi Electronics Manufacturing Corp.	•	•	•	•
POLAND				
Sveda Audio		•		•
ROMANIA				
Poweraudio Romania				•
SOUTH KOREA				
Suntel	•	•		•
SPAIN				
DAS Audio				•
Sottovoce Audio		•		•
SWEDEN				
Audio Pro, AB	•	•		•
SWITZERLAND				
Lange Loudspeakers SA		•		•
Weiss Engineering, Ltd.		•		•
TAIWAN				
AV Leader Corp.				•
Bennic Components	•	•	•	•
Cotron Corp.		•		
Huey Tung International Co., Ltd.	•	•		•
Jazz Hipster Corp.	•	•		•
Kingstate Electronics Corp.	•	•		
Meiloon Industrial	•	•	•	
TOONG IN Electronic Corp.		•		
Turbo Tide Electronics Co., Ltd.		•		
Vansonic Enterprise Co., Ltd.	•	•	•	
UKRAINE				
MAG Audio				•
UNITED KINGDOM				
Amina Technologies, Ltd. (UK)		•	•	
Arya Audio Labs	•	•		•
Electroacoustic Design, Ltd.	•	•	•	•
EuroTec International, PLC	•		•	•
Fane International, Ltd.				•
Ferguson Hill Studios, Ltd.		•		•
MJ Acoustics		•	•	•
Node Audio Research		•		

FINISHED SYSTEMS (OEM/ODM)

	Home Audio	Marine Audio	Pro Audio	
Precision Devices				•
Tectonic Elements	•	•		•
UNITED STATES				
Aempyrean	•	•		•
Ambiance Acoustics		•		•
American Bass	•			
American Music & Sound	•	•	•	•
Amina Technologies, Ltd. (USA)	•	•	•	
Analysis Audio USA		•		
Area 52 R&D		•		•
Arion Audio		•		
Audioengine		•		
AvileTech				•
B&H Foto & Electronics Corp.		•		•
Barefoot Sound				•
BassBoss				•
Benchmark Media Systems		•		
Blackmore Pro Audio		•		•
Broad Bridge Audio, LLC		•		
Carvin Audio		•		
CE Distribution, LLC			•	
Clear Lake Audio				•

	Home Audio	Marine Audio	Pro Audio	
CommonSense Audio			•	•
Creative Sound Solutions, LLC			•	
Danley Sound Labs				•
Dayton Audio		•		
dBTechnologies				•
DC Audio	•			
Digital Audio Labs				•
Digmoda		•		•
Dinaburg Technology	•	•	•	•
Earthquake Sound Corp.	•	•	•	•
Emerald Physics		•		
Eminence Speaker, LLC				•
ESS Speakers USA	•	•		
ESTec America	•	•	•	
Fluid Audio				•
Fulcrum Acoustic				•
Gauss Loudspeaker		•		•
GGECAmerica	•	•	•	•
Globe Audio Design		•		•
GoldenEar		•		
Halford Loudspeakers		•		•
Io Audio Technologies	•	•	•	•

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Vehicles



Home Theater



Consumer speaker



Speaker Driver

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Making good sound



Systems engineering

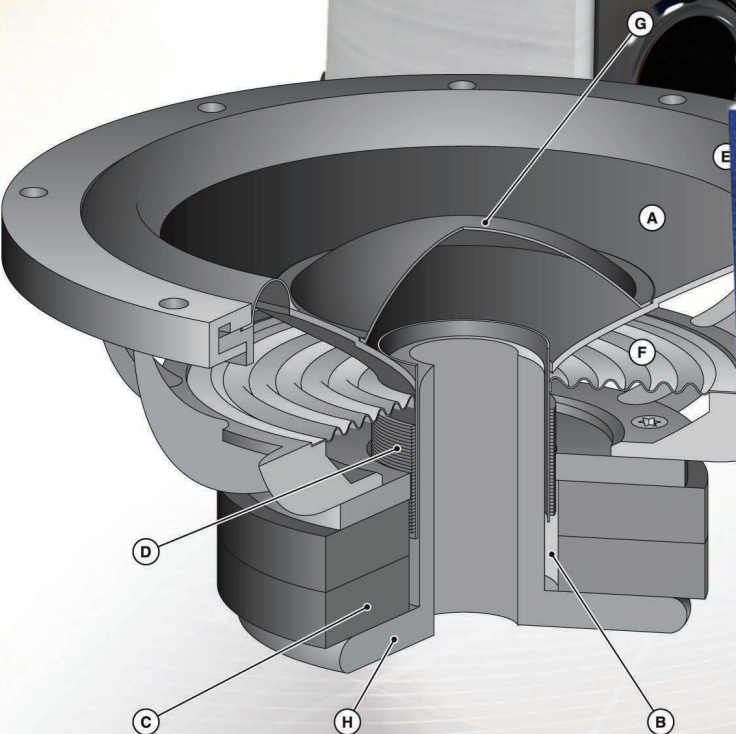


Voice product design

JAZZ HIPSTER

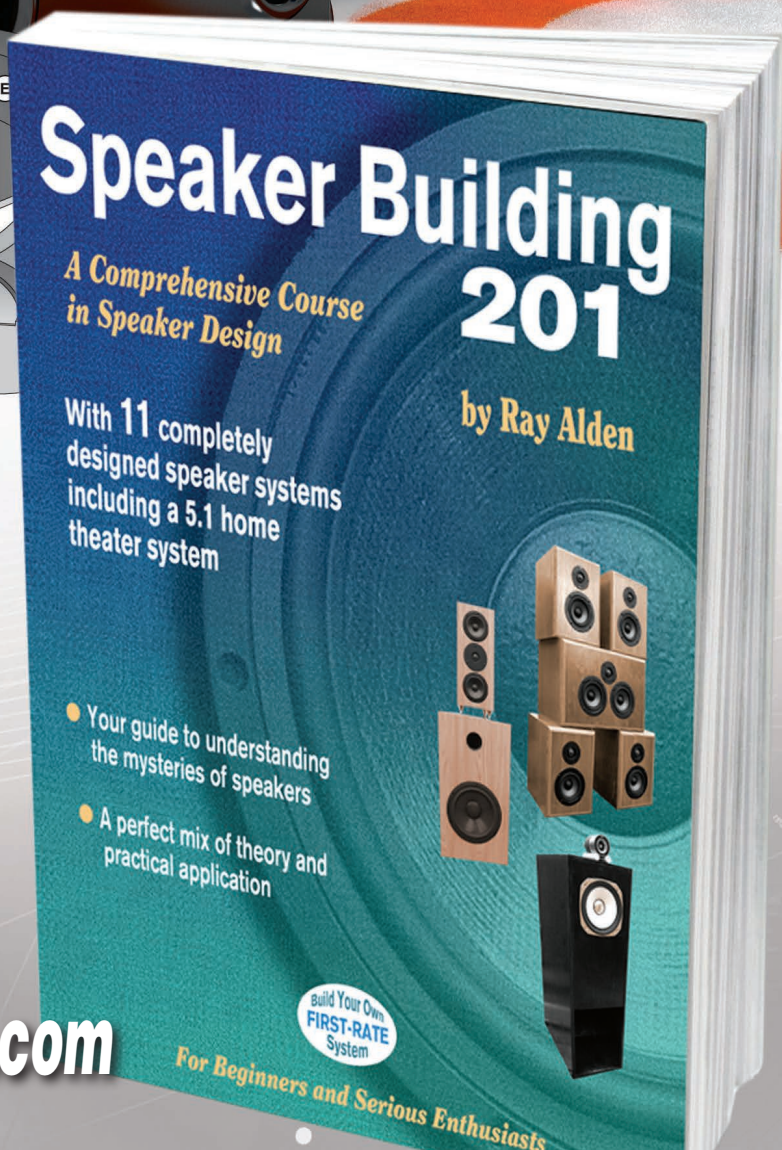
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the volume on a first-rate
system that you designed
and built yourself.**

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FINISHED SYSTEMS (OEM/ODM)

	Home Audio	Marine Audio	Pro Audio	Car Audio
JJR Acoustics, LLC	•	•	•	•
JL Audio	•	•	•	•
Linea Research USA				•
Lipinski Sound		•	•	•
Meliti Acoustics	•	•	•	•
Meyer Sound Laboratories, Inc.		•	•	•
MISCO		•	•	•
NHT Audio		•	•	•
North American Solidex, LLC		•	•	•
OAP Audio Products		•	•	•
Orca Design & Manufacturing Corp.	•	•	•	•
Parts Express	•	•	•	•
Pazandeh Audio Designs		•	•	•
Peerless by Tympany	•	•	•	•
Performance Audio				•
Portland Audio Lab	•	•	•	•
PQN Audio			•	•
PranaFidelity		•	•	•
Precision Transducer Engineering (PTE)		•	•	•
Pro Flix Sales			•	•
RBH Sound		•	•	•
RCF (USA)				•
REDCATT		•	•	•
RIVA Audio		•	•	•
Rock The Boat			•	•
Rogersound Labs	•	•	•	•
RSL Speaker Systems		•	•	•
Salk Sound		•	•	•
SensaSound USA		•	•	•
Senzar Acoustics, Inc.		•	•	•
SG Custom Sound		•	•	•
Shinjitsu Audio		•	•	•
SoCal Sound Shop	•	•	•	•
Sound Audio Manufacturing, LLC	•	•	•	•
Sound Lab		•	•	•
Sound Sources	•	•	•	•
Soundfield Audio		•	•	•
Sounds Unique	•	•	•	•
SpeakerPower		•	•	•
SpeakersAndAmps.com	•	•	•	•
SSI Manufacturing, Inc.		•	•	•
Studio Electric, LLC		•	•	•
T&T Shanghai Tianai Acoustics	•	•	•	•
TitanAudio, Ltd.		•	•	•
Tonian Laboratories		•	•	•
TRS Inovations, Inc.	•	•	•	•
Trulli Audio	•	•	•	•
TSG Audio	•	•	•	•
US Speaker	•	•	•	•
Vidsonix Design Works	•	•	•	•
VTech		•	•	•
Weltronics Corp.		•	•	•

	Home Audio	Marine Audio	Pro Audio	Car Audio
Westlake Audio, Inc.		•	•	•
Wired 4 Sound, Inc.		•	•	•
Wisdom Audio		•	•	•
Yandas Music		•	•	•
Zu Audio		•	•	•
VIETNAM				
Sound Corp.		•	•	•
Sun Acoustic Vina	•	•	•	•

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Founded in Vietnam since 1999, we are an experienced OEM/ODM company specialize in manufacturing wide range of audio products. With over 15,000 m2 of modern manufacturing site, allow us to produce the most of product's parts in our own factory. Base on those strong points, we can offer many kinds of completed loudspeakers and electronics products to our customer in term of high quality and reasonable price.



PRODUCTS CATEGORY

- High-Fidelity and Home AV Loudspeakers
- Professional and Karaoke Loudspeakers
- All Kinds of Active and Passive Subwoofers
- Battery Powered Portable Loudspeakers
- Car Audio drivers and Amplifiers



PRODUCTION PROCESS

- Loudspeaker Transducers/ Cabinets and Cross-overs
- Texture to High-gloss Spraying and Powder E-Coating
- Sheet Metal Process and Plastics Molding/ Injection
- SMT/ DIP PCB Assembly and Final Assembly/ Test Process
- Toroidal/ EI Transformers and Inductors/ Air-core Process



PARAMAX CORPORATION

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 US Sales Office: 2019 Whitby Drive Orlando, Florida 32839, USA Mobile: +1-321-666 5122
 Telephone: +84-909016277 Email: oem@paramaxcorp.vn
 www.paramaxcorp.vn Facebook: paramaxcorp.vn





Amplifiers for Powered Speakers
 High-Power Amplifier Modules
 DSP (Digital Signal Processing)
 Marine Audio Processing Modules
 Subwoofer Plate Amps
 Soundbars
 Wireless

AUSTRALIA

DEQX Pty., Ltd.	•	•	•	•	•
Eclipse Audio		•			
Lenard Audio	•				
Soundlabs Group	•	•	•		•
Stone Sound Studio	•	•	•		•

BELGIUM

Donnet: Loudspeaker Repair				•	•
The Innovators Lab Belgium (ILaB)		•			

BRAZIL

Advanced Audio Technologies (AAT)	•		•		•
Attack Audio System	•	•	•		
Harman of Brazil	•	•	•	•	•
Magna Audio	•			•	•
Newbox Acoustic	•	•	•	•	•

CANADA

Harbottle Audio Co.	•	•	•		•
Kravchenko-Audio	•	•	•		
Rutherford Audio	•		•		
Solen Electronics, Inc.	•	•	•	•	•
Sonavox	•	•	•	•	•
Studio Reference Monitors	•	•	•		
Tortech Sound	•	•			

CHINA

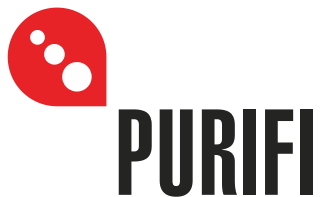
BOWI Industry Co., Ltd.		•			•
DML Exciters	•	•	•	•	•
Eastech Holding Co., Ltd.	•	•	•	•	•

Amplifiers for Powered Speakers
 High-Power Amplifier Modules
 DSP (Digital Signal Processing)
 Marine Audio Processing Modules
 Subwoofer Plate Amps
 Soundbars
 Wireless

Enkor Electronics Co., Ltd.					•	
Fountek Electronics Co., Ltd.	•		•	•		•
Gettop Acoustic	•		•	•		•
Goertek	•		•	•	•	•
Hansong (Nanjing) Technology	•		•	•	•	•
Lumi Audio	•	•	•		•	•
MYIR Tech, Ltd.			•			•
Ningbo Xiangyang						
Telecommunication Component		•				•
OBE Pro Audio Co., Ltd.	•	•	•		•	
Pana Sound Technology	•	•	•	•	•	•
Shenzhen Guannan						
Electronics Co., Ltd.		•				•
Shenzhen Horn Audio Co., Ltd.		•			•	•
Sound Technology						
Development, Ltd. (Factory)	•	•		•	•	•
Sun Technique Electric Co., Ltd.	•	•	•	•	•	•
Telefield	•	•	•	•	•	•
Tonewinner (Guangzhou)						
Electronics	•		•			•
Tonly Electronics Holdings		•			•	•
Tristar Electronics	•	•	•		•	•
Vistron Audio Equipment	•	•	•		•	•

DENMARK

ICEpower a/s	•		•			•
Kvart & Bølge	•					•
Pascal A/S			•			
Purifi Audio	•		•			



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FRANCE								
Amplitude Audio								
Exclusive Audio-Design								
Kartesian								
Kyu Systems								
GERMANY								
Audio Technology Engineering (ATE)								
AudioChiemgau								
ic audio								
Klippel GmbH								
Physical Lab								
Voice Point								
Wolf von Langa								
HONG KONG								
Beautiful Enterprise								
Eastern Asia Technology (HK)								
Fujikon Industrial Holdings								
INNacoustic								
miniDSP, Ltd.								
OCVACO Electronic, Ltd.								
WCE Acoustics								
INDIA								
Arul Sound Wood Industries								
Dakshin Speaker Manufacturing Private, Ltd. (DSMPL)								
Laysant Audio Private, Ltd.								
Power Electronics & Technologies								
TurboSonic Pro Speakers								
INDONESIA								
Premiere Wood Manufacturing (PWM)								
ISRAEL								
Alango Technologies, Ltd.								
Coby Speakers								
Thermoguide, Ltd.								
ITALY								
Axiomedia s.r.l.								
Boxal s.r.l.								
Outline SRL								
Powersoft								
Professional Audio								
JAPAN								
Etani Electronics Co., Ltd.								
MALAYSIA								
Shu Kae Industrial								

NETHERLANDS								
Aequo Audio		•						
ELTIM audio BV		•		•				
Hypex Electronics		•	•	•	•		•	
Stage Accompany		•		•	•			
Teijin Aramid			•				•	
PHILIPPINES								
Dai-ichi Electronics Manufacturing Corp.		•	•	•	•		•	•
POLAND								
Sveda Audio			•					
SOUTH KOREA								
Suntel			•					•
SPAIN								
Tecnare Sound Systems		•		•				
SWEDEN								
Audio Pro, AB				•	•		•	•
Böhmer Audio		•		•	•		•	•
SWITZERLAND								
Weiss Engineering, Ltd.				•				
TAIWAN								
AV Leader Corp.				•			•	•
ChiaPing Enterprise Co., Ltd.				•				•
Huey Tung International Co., Ltd.				•			•	
Jazz Hipster Corp.		•		•			•	•
Jetvox Acoustic Corp.				•				•
Kingstate Electronics Corp.		•	•				•	•
Meiloon Industrial		•		•			•	•
Merry Electronics				•				•
Palm Garden Enterprise				•				•
Poyun Electronics			•				•	
TOONG IN Electronic Corp.				•			•	•
Turbo Tide Electronics Co., Ltd.				•			•	•
Yung International		•					•	•
THAILAND								
A-TON Industrial			•				•	
UNITED KINGDOM								
BishopSound Manufacturing & Design, Ltd.			•				•	
EuroTec International, PLC		•		•	•		•	
Ferguson Hill Studios, Ltd.		•		•	•			•
Kleio Audio		•						
MJ Acoustics				•			•	
Revolver Audio, Ltd.		•						
Tectonic Elements		•						

	Amplifiers for Powered Speakers	DSP (Digital Signal Processing)	High-Power Amplifiers	Marine Audio Amplifier Modules	Subwoofer Plate Amps	Soundbars	Wireless
UNITED STATES							
ADM Technology	•		•	•	•	•	•
American Bass			•				•
Area 52 R&D	•	•	•	•			•
Arion Audio	•						
Audio Advisor, Inc.	•						
Avel Lindberg	•						
Axiim	•		•	•	•	•	•
Barefoot Sound	•		•	•			
Benchmark Media Systems	•		•				
Broad Bridge Audio, LLC	•				•		
Carvin Audio	•		•				•
CE Distribution, LLC	•		•				
CommonSense Audio	•	•					
Danville Signal Processing, Inc.	•		•	•	•		•
Dayton Audio	•	•	•	•	•	•	•
DC Audio	•		•				
Digital Audio Labs	•		•				

	Amplifiers for Powered Speakers	DSP (Digital Signal Processing)	High-Power Amplifiers	Marine Audio Amplifier Modules	Subwoofer Plate Amps	Soundbars	Wireless
Digmoda	•		•	•	•	•	•
Dragonfire Acoustics	•	•	•	•	•	•	•
DTV Installations, LLC	•		•		•	•	•
Dynavox Electronics, Inc.		•					•
Earthquake Sound Corp.	•			•			•
Elektrisola		•					•
Emerald Physics	•		•				•
Fortemedia			•				
Fulcrum Acoustic			•				
Globe Audio Design	•		•	•			•
JL Audio	•		•	•	•	•	•
Kramer Electronics	•		•	•			•
Lectrosonics							•
Linea Research USA	•		•	•			
Linear Tube Audio	•		•				
MISCO	•	•	•	•		•	
North American Solidex, LLC	•		•				•
OAP Audio Products	•		•	•			

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ENGINEERING	BUFFER STOCK
OPEN BOM	REWORK
QUOTING	STAGING
SOURCING	FULLFILLMENT
ASSEMBLY	DISTRIBUTION
KITTING	PRODUCT EVALUATIONS
INSPECTION/QC	

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INTEGRATED AUDIO

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	Amplifiers for Powered Speakers	High-Power Amplifier Modules	DSP (Digital Signal Processing)	Marine Audio Modules	Subwoofer Solutions	Soundbars	Plate Amps	Wireless
Parts Express	•			•	•		•	•
Peerless by Tympany	•			•	•		•	•
Pro Flix Sales	•							
PRV Audio Brazil		•						
Radio Design Labs (RDL)	•	•		•			•	
RBH Sound	•						•	
RCF (USA)	•	•	•	•				
RIVA Audio	•		•	•			•	•
Rogersound Labs	•		•		•		•	
RSL Speaker Systems	•		•				•	
SensaSound USA	•						•	
Senzar Acoustics, Inc.	•	•	•	•			•	
Sound Audio Manufacturing, LLC	•		•	•	•		•	
Sound Sources		•					•	
SpeakerAddict	•		•	•	•		•	
SpeakerPower	•		•	•			•	•
SpeakersAndAmps.com	•	•	•	•	•		•	
Stillwater Designs KICKER	•		•	•	•		•	•
TRS Innovations, Inc.	•	•		•	•		•	•

	Amplifiers for Powered Speakers	High-Power Amplifier Modules	DSP (Digital Signal Processing)	Marine Audio Modules	Subwoofer Solutions	Soundbars	Plate Amps	Wireless
Trulli Audio	•				•	•		•
TSG Audio	•		•	•		•	•	•
US Enclosure Co.	•	•	•	•		•	•	•
US Speaker	•							
Vidsonix Design Works					•			
VTech	•		•	•		•	•	•
Weltronics Corp.	•		•	•				
Western Electric	•							
Wired 4 Sound, Inc.	•		•			•		•
Wisdom Audio			•			•		•
VIETNAM								
Sound Corp.	•	•	•	•		•	•	•



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MANUFACTURING EQUIPMENT



	Adhesive Dispensers	Curing Ovens	Lead Out Wire Termination	Production Line Equipment	Magnetizers/Demagnetizers	Ultrasonic Assembly Equipment
AUSTRALIA						
Applied Measurement						•
Proactive Group						•
Stone Sound Studio						•
BRAZIL						
Attack Audio System	•	•	•	•	•	•
Newbox Acoustic					•	
CHINA						
OBE Pro Audio Co., Ltd.	•	•	•	•	•	•
Sound Technology Development, Ltd. (Factory)	•	•	•	•	•	•
Sun Technique Electric Co., Ltd.	•	•	•	•	•	•
DENMARK						
K & K Development					•	
Loudsoft, Ltd.					•	
GERMANY						
Klippel GmbH					•	
preeflow by ViscoTec Pumpen- u. Dosiertechnik GmbH	•					
Wolf von Langa						•
INDIA						
Cruxweld Industrial Equipments, Ltd.					•	
Lakshmi Metal Coils						•
JAPAN						
Etani Electronics Co., Ltd.					•	
SPAIN						
Tecnare Sound Systems					•	
SWEDEN						
Audio Pro, AB					•	
SWITZERLAND						
Kisling AG	•					
Megatec AG		•		•	•	•
TAIWAN						
Hurray Co.	•				•	
THAILAND						
Clarasonic (Thailand) Co., Ltd.	•	•	•			
UNITED KINGDOM						
EuroTec International, PLC	•	•	•	•	•	•
GRAS Sound & Vibration (UK)					•	

	Adhesive Dispensers	Curing Ovens	Lead Out Wire Termination	Production Line Equipment	Magnetizers/Demagnetizers	Ultrasonic Assembly Equipment
Hill Acoustics						•
Silcoms, Ltd.					•	
UNITED STATES						
3M (Industrial Adhesives & Tapes Division)				•	•	
Acoustic Design						•
Adrian Acoustics				•		•
Alliance LLC						•
Astro Machine Works					•	•
Bostik	•					
C.P. Moyon Co.	•					
Cotronics Corp.	•					
DELO Industrial Adhesives	•				•	
Delta H Technologies, LLC				•		
Dragonfire Acoustics						•
Dukane Corp.					•	•
Dymax Corp.	•					
Dynavox Electronics, Inc.						•
Eberhard Manufacturing Co.	•				•	
Elektrisola				•		
Ellsworth Adhesives	•					
EXACT Dispensing Systems	•				•	
Fisnar	•					
Fluid Metering, Inc.	•				•	
Glenro, Inc.				•		
Global Finishing Solutions, LLC				•		
Hernon Manufacturing	•	•	•		•	
Hottinger Bruel & Kjaer Sound & Vibration North America						•
Huntsman International, LLC	•				•	
Integrated Dispensing Solutions, Inc.	•				•	
Krayden, Inc.	•					
LEWCO, Inc.		•	•			
Marchand Electronics, Inc.					•	
Metzgar Conveyors				•		
Nordson Corp.	•					
Nordson EFD	•				•	
NTi Audio					•	
Parts Express	•					
PRV Audio Brazil					•	
The Eraser Co., Inc.					•	
Uni-Pak				•		
Valley Design Corp.					•	
Valves Only	•				•	
Wisconsin Oven					•	
WSF Industries, Inc.					•	

MEASUREMENT MICROPHONES



AUSTRALIA

DEQX Pty., Ltd.
RØDE Microphones

AUSTRIA

Austrian Audio

BRAZIL

Newbox Acoustic

CANADA

Solen Electronique, Inc.

CHINA

BSWA Technology Co., Ltd.
CRY Sound
Lumi Audio
Shenzhen Horn Audio Co., Ltd.
Sound Technology Development,
Ltd. (Factory)
Sun Technique Electric Co., Ltd.
Tonly Electronics Holdings

DENMARK

DPA Microphones
Jantzen Audio

FRANCE

Kyu Systems
Seltech

GERMANY

Klippel GmbH
Microtech Gefell GmbH
Voice Point

HONG KONG

miniDSP, Ltd.
WCE Acoustics

INDIA

GM Audio Technics

ISRAEL

Audio Pixels, Ltd.

JAPAN

Etani Electronics Co., Ltd.

LATVIA

Sonarworks

SINGAPORE

Virtins Technology

SOUTH KOREA

Suntel

SWEDEN

Audio Pro, AB

	Consumer	Field Mics	Measuring Mics	Professional
AUSTRALIA				
DEQX Pty., Ltd.				•
RØDE Microphones	•			• •
AUSTRIA				
Austrian Audio			•	•
BRAZIL				
Newbox Acoustic	•	•		• •
CANADA				
Solen Electronique, Inc.	•	•		•
CHINA				
BSWA Technology Co., Ltd.			•	• • •
CRY Sound			•	• • •
Lumi Audio	•	•		•
Shenzhen Horn Audio Co., Ltd.	•	•		
Sound Technology Development, Ltd. (Factory)				•
Sun Technique Electric Co., Ltd.	•	•	•	• •
Tonly Electronics Holdings	•	•		
DENMARK				
DPA Microphones			•	• •
Jantzen Audio	•			
FRANCE				
Kyu Systems			•	•
Seltech			•	

	Consumer	Field Mics	Measuring Mics	Professional
GERMANY				
Klippel GmbH			•	•
Microtech Gefell GmbH			•	• •
Voice Point	•	•	•	• •
HONG KONG				
miniDSP, Ltd.				•
WCE Acoustics	•			•
INDIA				
GM Audio Technics				•
ISRAEL				
Audio Pixels, Ltd.			•	• •
JAPAN				
Etani Electronics Co., Ltd.			•	• •
LATVIA				
Sonarworks				•
SINGAPORE				
Virtins Technology	•		•	• •
SOUTH KOREA				
Suntel	•	•	•	• •
SWEDEN				
Audio Pro, AB			•	•

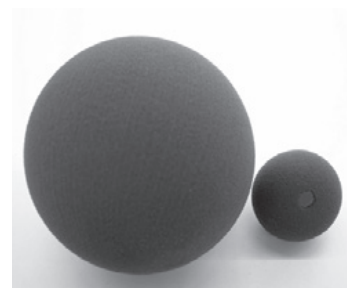
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Kingstate Electronics Corp.	•				
UNITED KINGDOM					
DBS Audio					•
EuroTec International, PLC				•	•
GRAS Sound & Vibration (UK)		•	•	•	•
Spectral Measurement				•	•
UNITED STATES					
ACO Pacific			•	•	•
Audio Precision, Inc.				•	•
Audix	•			•	•
AValive	•				•
B&H Foto & Electronics Corp.	•				•
Behringer				•	•
Dayton Audio	•	•	•	•	•
Earthworks Audio	•	•	•	•	•
Front End Audio, LLC	•	•	•	•	•
Full Compass Systems, Ltd.	•	•			•
GRAS Sound & Vibration (USA)	•	•	•	•	•

	Consumer	Field Mics	Lab Instruments	Measuring Mics	Professional
Hottinger Brüel & Kjær Sound & Vibration North America					
iSEMcon		•	•	•	•
JLI Electronics, Inc.		•	•	•	•
Lectrosonics					•
Listen, Inc.					•
NTi Audio				•	•
Parts Express	•	•	•	•	•
PCB Piezotronics	•	•	•	•	•
PreSonus Audio Electronics, Inc.					•
Scantek, Inc.		•	•	•	•
Sound Pure, LLC	•				•
Studio Six Digital				•	•
Sweetwater Sound	•				•
Vintage King Audio	•				•
Wired 4 Sound, Inc.	•	•			•
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zSounds Music					•
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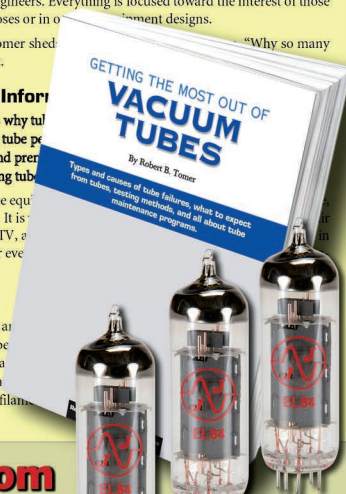
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- Predicting tube life
- Selected and preferred tube types
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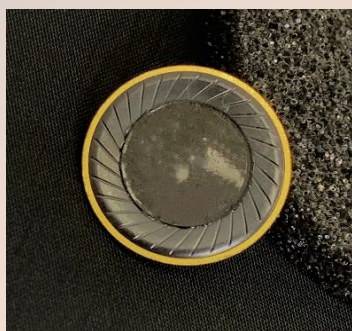
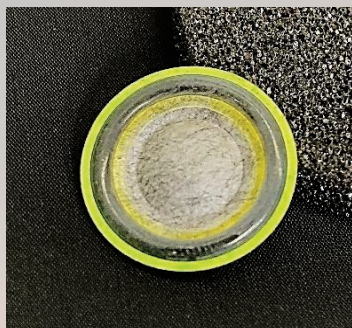
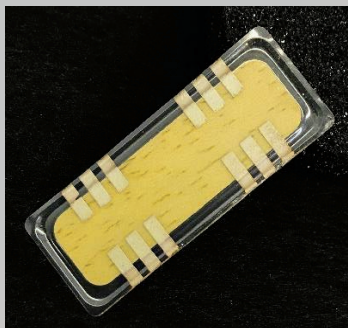
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GRAS Sound & Vibration (UK)					•
UNITED STATES					
ACO Pacific		•			
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Kingstate Electronics Corp.	•	•	•
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UNITED KINGDOM			
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UNITED STATES			
Adafruit Industries	•	•	•
BeStar Technologies, Inc.	•	•	•
Broad Bridge Audio, LLC	•	•	•
Dayton Audio	•	•	•
Dragonfire Acoustics	•	•	•
GGEC America	•	•	•
GraphAudio	•	•	•
Parts Express	•	•	•
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AUSTRIA		
USound	•	•
BELGIUM		
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BRAZIL		
Attack Audio System	•	•
Magna Audio		•
Newbox Acoustic	•	•
CANADA		
Canadian Speaker Works		•
Excelitas Canada		•
LMH Loudspeakers		•
Planet10-HiFi		•
Reference 3A		•
Solen Electronique, Inc.	•	•
Sonavox	•	•
Studio Reference Monitors		•
CHINA		
Audiostar Electronics	•	
B.W. Audiovisual Solution Co., Ltd.		•
DML Exciters	•	•
Eastech Holding Co., Ltd.	•	•
Enkor Electronics Co., Ltd.		•
Fountek Electronics Co., Ltd.		•
Goertek	•	•
Hansong (Nanjing) Technology	•	•
Junhao Wood Cabinet Factory	•	•
Kadeton Audio Co., Ltd.	•	•
Lumi Audio		•
M-Sound Electronics Co., Ltd.		•
OBE Pro Audio Co., Ltd.	•	•
Pana Sound Technology		•
Shenzhen Horn Audio Co., Ltd.	•	•
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Tristar Electronics	•	•
Trueanalog Strictly OEM	•	•
Vistron Audio Equipment	•	•
Vormag Electronics	•	•
Xiamen Great Sound Technology	•	•
Zhuhai HiVi Technology		•
DENMARK		
Lyd by Dissing		•
FRANCE		
Applications Acoustiques de Composites (AAC)		•
Audax		•
Kartesian	•	•
Kyu Systems	•	•
Seltech	•	•
GERMANY		
Audio Technology Engineering (ATE)	•	•
Wolf von Langa	•	•
HONG KONG		
BDNC (Holding), Ltd.	•	•
Beautiful Enterprise		•
dB Enterprises	•	•
Eastern Asia Technology (HK)	•	•
Fujikon Industrial Holdings	•	•
INNacoustic	•	•
Ocean Sound Technology, Ltd.		•
WCE Acoustics	•	•
INDIA		
GM Audio Technics	•	•
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INDONESIA		
SB Acoustics	•	•

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Audioengine		•
Barefoot Sound		•
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Danley Sound Labs		•
DC Gold Audio		•
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Fulcrum Acoustic		•
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MISCO		•
Monaero Engineering, Inc.		•
MSC Software	•	
North American Solidex, LLC		•
OAP Audio Products		•
Orca Design & Manufacturing Corp.	•	
Parts Express	•	•
Pierce Audio Inc.	•	•
Portland Audio Lab	•	
PQN Audio		•
PranaFidelity		•
Rapid Die and Molding Co.	•	
RCF (USA)	•	•
Rogersound Labs		•
SoCal Sound Shop		•
Sound Sources		•
SpeakersAndAmps.com		•
SSI Manufacturing, Inc.		•
Stereo Integrity		•
Stetron International, Inc.		•
Stillwater Designs KICKER		•
Studio Electric, LLC		•
SVS		•
T&T Shanghai Tianai Acoustics	•	•
Tectonic Audio Labs	•	•
Tone Tubby		•
TSG Audio		•
United Gasket Corp.	•	
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Premium Sound Solutions							•
BRAZIL							
Attack Audio System					•		
Newbox Acoustic		•	•	•	•	•	•
BULGARIA							
Oberton Professional Loudspeakers					•		•
CANADA							
Kravchenko-Audio		•					•
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Studio Reference Monitors					•		•
CHINA							
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Bozhen Acoustics Co., Ltd.					•		•
B.W. Audiovisual Solution Co., Ltd.					•		
Dayun							•
DML Exciters		•	•	•	•	•	•
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	Midrange	Tweeters	Woofers			
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Sound Technology Development, Ltd. (Factory)				•	•	•
Sun Technique Electric Co., Ltd.				•	•	•
Wavecor					•	•
Yuesheng Electronic				•	•	•
Zhuhai HiVi Technology					•	•
DENMARK						
Scan-Speak					•	•
FRANCE						
Audax				•	•	•
Kartesian	•	•		•	•	•
Kyu Systems				•	•	•
PHL Audio					•	•
Seltech					•	•
Supravox					•	•
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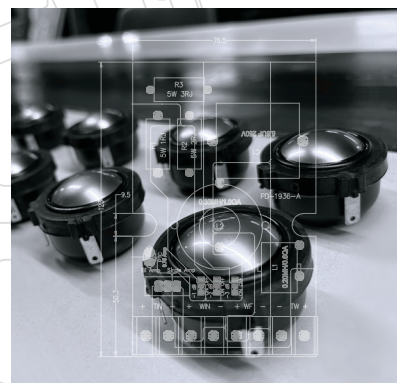
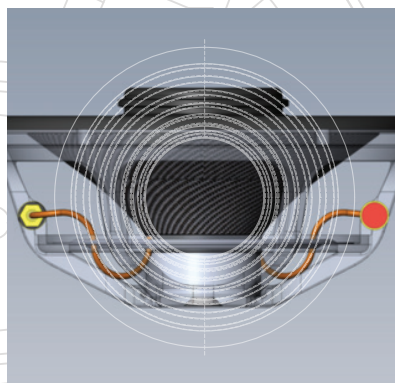


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Wolf von Langa		•	•		•	•	•
HONG KONG							
BDNC (Holding), Ltd.						•	
dB Enterprises						•	
Eastern Asia Technology (HK)					•	•	
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IWAI Electronics Pvt., Ltd.					•	•
TurboSonic Pro Speakers					•	•
INDONESIA						
SB Acoustics				•		•
ISRAEL						
Coby Speakers				•	•	•
Morel					•	
ITALY						
Audioxplus (AXP)				•	•	
Axiomedia s.r.l.				•	•	•
B&C Speakers				•	•	•
Ciare				•	•	•
Eighteen Sound				•	•	•
FaitalPRO				•	•	•
Lavoce Italiana				•	•	•
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Acustica Beyma				•		•
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	Midrange	Tweeters	Woofers					
UNITED STATES								
Acoustic Design						•		•
ADM Technology	•	•						
American Bass						•	•	•
American Music & Sound							•	
Analysis Audio USA	•	•						
Beyma America	•	•				•	•	•
Broad Bridge Audio, LLC	•	•						•
CE Distribution, LLC						•		•
CommonSense Audio								•
Danley Sound Labs								•
Dayton Audio						•		•
DC Gold Audio								•
Dinaburg Technology								•
Dragonfire Acoustics	•		•			•	•	
Dynavox Electronics, Inc.						•		•
Earthquake Sound Corp.						•		•
Eminence Speaker, LLC						•	•	•
ESS Speakers USA							•	
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	Midrange	Tweeters	Woofers					
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Io Audio Technologies	•	•	•	•	•	•	•	•
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Loudspeakers Plus						•	•	•
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NedLab							•	
North American Solidex, LLC						•	•	•
Parts Express	•	•		•	•	•	•	•
Peerless by Tympany						•	•	
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Radian Audio Engineering	•	•	•	•	•	•	•	•
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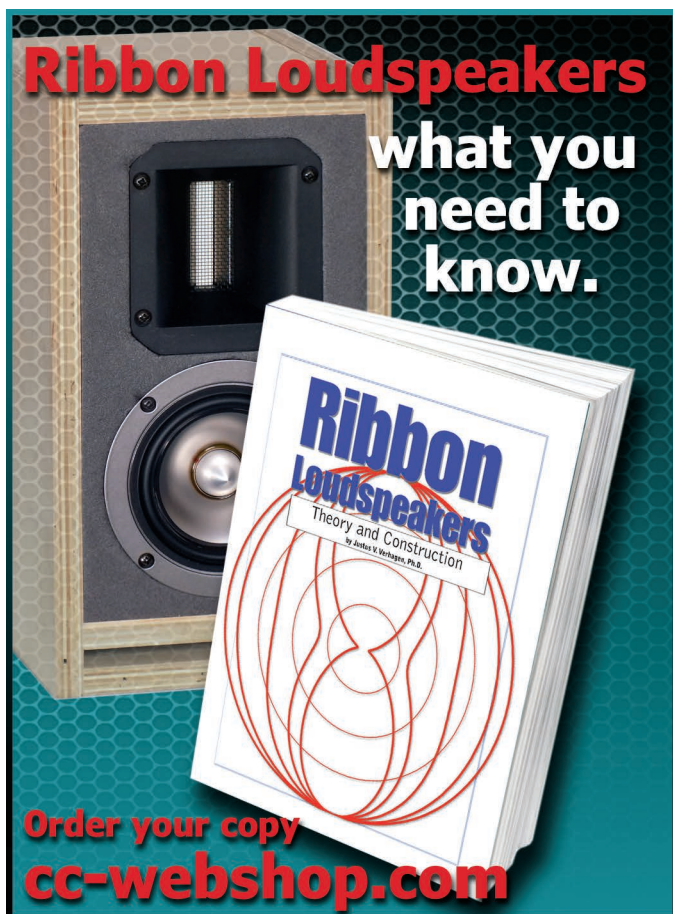
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OEM SPEAKERS & DRIVERS A-L

	Air Motion Transformers (AMTs)			Compression Drivers		Electrostatic	Full Range	Horns
	Midrange	Tweeters	Woofers					
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SpeakerAddict						•	•	•
SpeakersAndAmps.com						•		•
Stetron International, Inc.								•
Stillwater Designs KICKER						•		•
SVS								•
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	Midrange					Paging Horns		Siren/Voice Warning		Tweeters		Woofers	
	Cone	Dome	Electrostatic	Planar	Ribbon	Piezo	Planar	Warning	Cone	Dome	Electrostatic	Ribbon	
DENMARK													
Audio Technology, ApS	•											•	
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Purifi Audio	•	•										•	
Scan-Speak	•	•									•	•	
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Audax	•	•								•	•	•	
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Kyu Systems	•			•				•					
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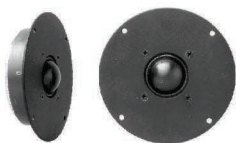
	Midrange					Tweeters					Woofers			
	Cone	Dome	Electrostatic	Planar	Ribbon	Siren/Voice	Piezo	Planar	Warning		Cone	Dome	Electrostatic	Ribbon
Eastern Asia Technology (HK)	•	•									•	•		•
Fujikon Industrial Holdings	•	•	•	•	•	•		•	•		•	•	•	•
Ocean Sound Technology, Ltd.	•	•									•	•		•
WCE Acoustics	•	•	•	•	•	•	•	•	•		•	•		•
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INDIA														
Audiotone Professional														•
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INDONESIA														
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ISRAEL														
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	Cone	Dome	Electrostatic	Planar	Ribbon	Piezo	Planar	Warning	Cone	Dome	Electrostatic	Ribbon	Woofers
Ciare													•
Eighteen Sound													•
FaitalPRO	•	•							•	•			•
Lavoce Italiana	•	•							•	•			•
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Dongguan Sheng-Yang Electronics												
Glass Acoustic Innovations Technology Co., Ltd. (GAIT)												
Hakken Enterprise												
Hi-Tech Sound System Co., Ltd.												
Huey Tung International Co., Ltd.												
Jazz Hipster Corp.												
Kingstate Electronics Corp.												
Ruhwa Electronic Co., Ltd.												
Taiwan Solidex												
TB Speaker												
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	Midrange					Siren/Voice		Tweeters		Woofers			
	Cone	Dome	Electrostatic	Planar	Ribbon	Horns	Piezo	Planar	Warning	Cone	Dome	Electrostatic	Ribbon
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MJ Acoustics													*
Precision Devices	*										*		
Volt Loudspeakers	*	*											*
UNITED STATES													
Acoustic Design			*										
ADM Technology										*	*		*
Aempyrean								*	*				
American Bass	*	*	*	*	*	*		*	*	*	*	*	*
American Music & Sound													*
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Analysis Audio USA					*			*	*				*
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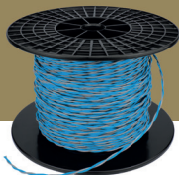
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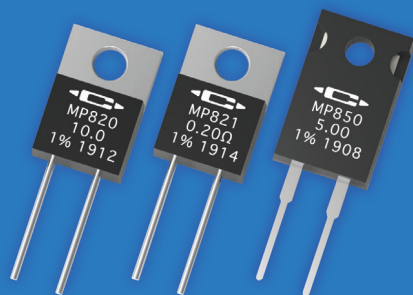
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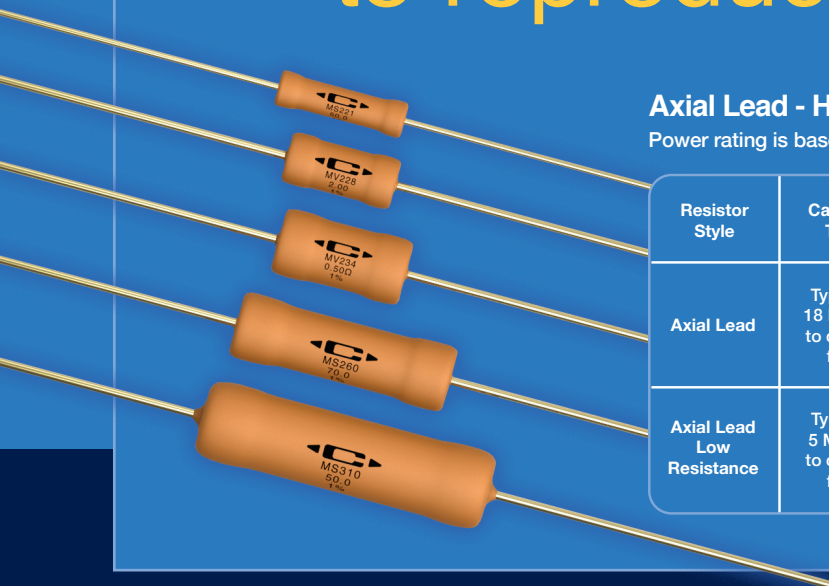


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Resistor Style	Model No.	Power Rating at +25°C Case Temp.	Resistance Range	Comments
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Aletheia AV														•
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Poweraudio Romania														•
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TAIWAN														
AV Leader Corp.														•
Bennic Components		•			•	•		•	•	•	•	•		•
Huey Tung International Co., Ltd.										•		•		•
Kingstate Electronics Corp.			•											•
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A-TON Industrial														•
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Charcroft Electronics, Ltd.			•		•	•				•				
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Hi-Fi Collective		•	•		•	•		•	•	•	•	•	•	•
Volt Loudspeakers							•	•						•
UNITED STATES														
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Avel Lindberg		•	•		•	•	•	•	•	•	•	•	•	•
Caddock Electronics, Inc.									•					
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Eminence Speaker, LLC						•								•
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PASSIVE COMPONENTS/CROSSOVERS/WIRING

	Passive Components						Wire & Wiring Harnesses			
	Attenuators	Capacitors		Driver Protection Devices	Inductors		Resistors	Solder	Terminal Plates	Transformers
		Ceramic	Electrolytic Non Polar		Film	Plugs & Jack Disks				
						Air Core	Iron Core			
ESS Speakers USA										
Full Compass Systems, Ltd.		•				•	•		•	•
Globe Audio Design										
GR Research				•		•		•		
Hearing Components, Inc. (Comply)	•									
Jupiter Condenser Co.				•	•	•		•	•	•
Kimber Kable								•	•	•
Lamart Corp.								•		•
Lowell Manufacturing Co.									•	
Madisound Speaker Components, Inc.				•	•	•	•	•		•
Meniscus Audio				•	•	•	•	•	•	•
NedLab										•
North American Solidex, LLC										•
Orban Audio										•
Orca Design & Manufacturing Corp.					•					
Parts Express	•	•	•	•	•	•	•	•	•	•
Quest Engines, LLC								•		
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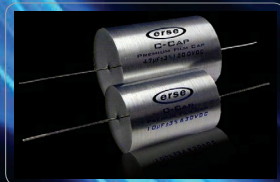
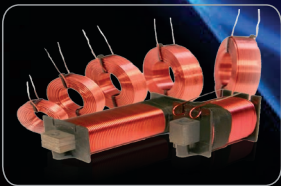
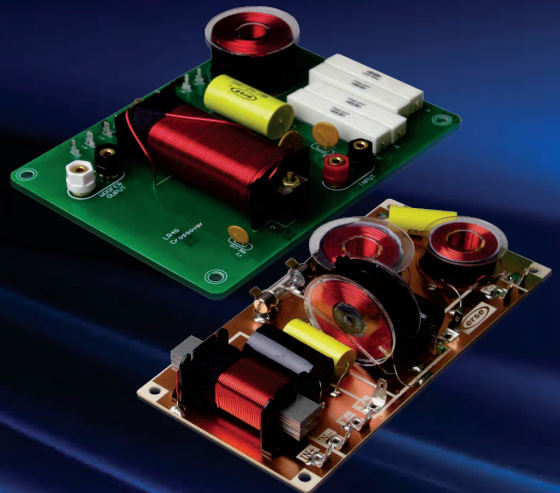
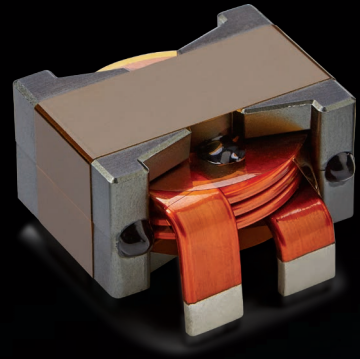
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PASSIVE COMPONENTS/CROSSOVERS/WIRING

	Passive Components										Wire & Wiring Harnesses			
	Attenuators	Capacitors			Inductors	Plugs & Jack Dishes		Resistors	Terminal Solder	Electronic Transformers	Finished Passive Crossover	Crossover Nets		
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Roderick Loudspeaker Service														
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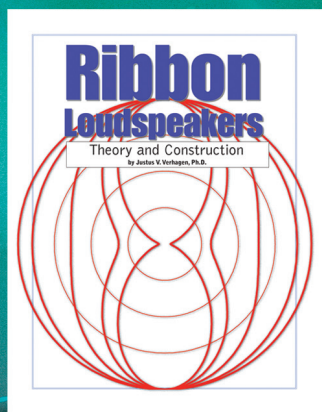
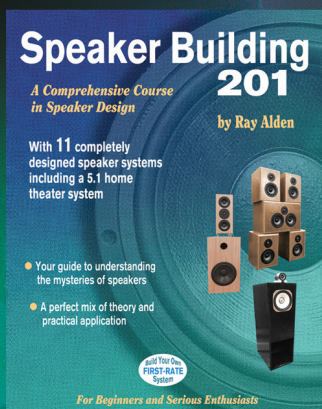
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Surrounds

Spiders

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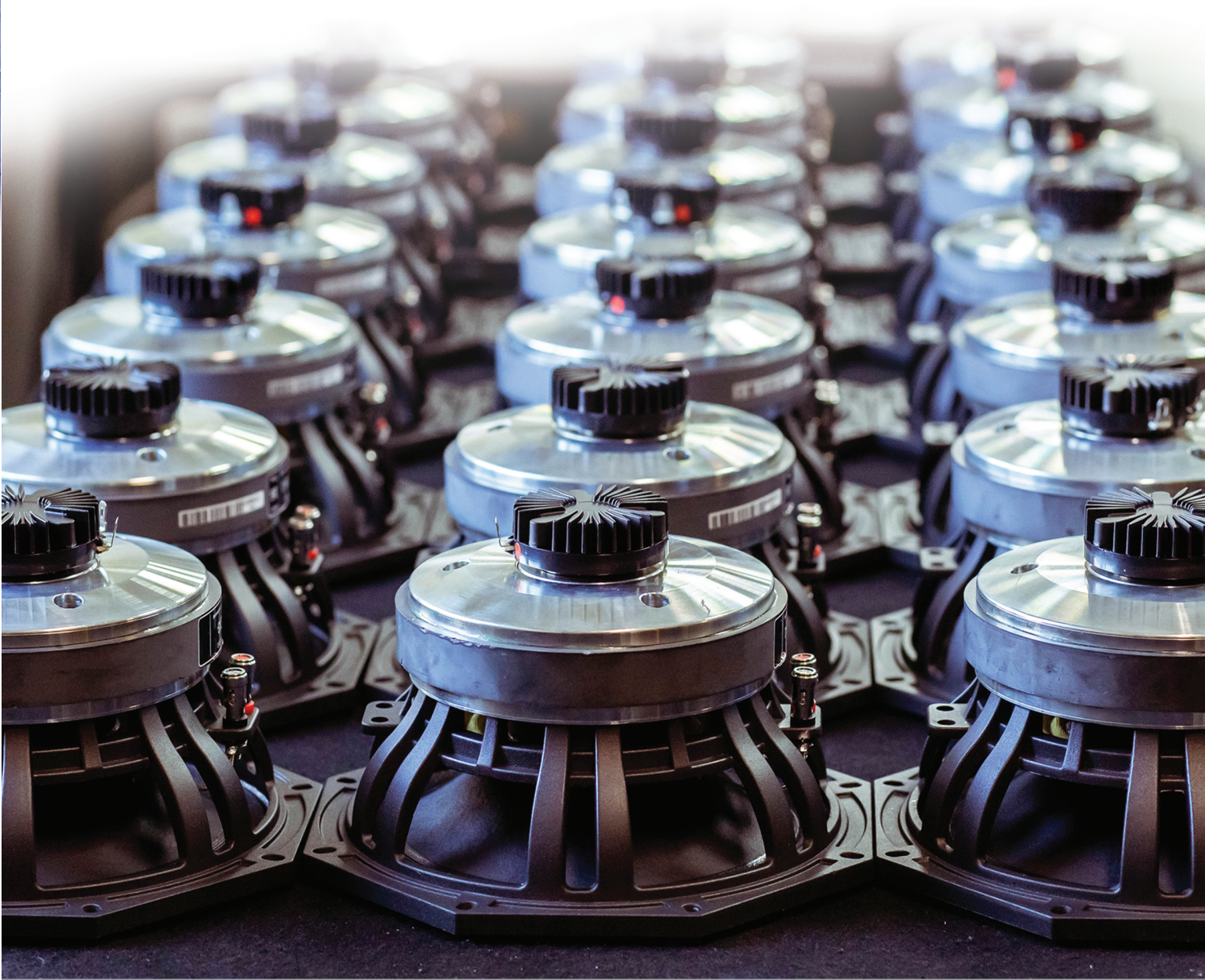
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SPEAKER PARTS A-E

	Adhesives & Glues			Cone Additives & Other Treatments			Cone & Suspension Components												
	Acrylic Adhesives	Epoxy	Infra-Red Cure	Water & Vinyl Based	Damping	Fire Resistance	Lacquers	Waterproofing	Wet Lock	Cones			Domes			Surrounds			
										Composite	Paper Pulp	Plastic	Aluminum/Titanium/Metal	Fabric/Mylar/Resin/Soft	Phenolic & Other Domes	Spiders	Fabric	Foam	Rubber
Good HiFi VOF																			
Stage Accompany																			
Teijin Aramid																			
NORWAY																			
Soundcare AS																			
PHILIPPINES																			
Dai-ichi Electronics Manufacturing Corp.																			
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	Adhesives & Glues		Cone Additives & Other Treatments				Cone & Suspension Components										Surrounds		
	Acrylic Adhesives	Epoxy	Instant Adhesives	Water & Vinyl Based	Damping	Fire Resistance	Lacquers	Waterproofing	Wet Lock	Cones			Domes		Phenolic & Other Domes	Spiders	Fabric	Foam	Rubber
										Composite	Paper/Pulp	Plastic	Aluminum/Titanium/Metal	Fabric/Mylar/Resin/Soft					
Parts Express																			
Permabond Engineering Adhesives																			
Pierce Audio Inc.																			
Quick Draw & Machining, Inc.																			
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	Frames & Baskets		Lead Out Wire				Termination/Crimps		Lead Out Wire
	Frame Gaskets	Cast Alloy	Stamped Steel	Range of Diameters	Double Bumped	Flat Strip	Beryllium Copper	Phosphor Bronze	
BELGIUM									
Donnet: Loudspeaker Repair									
BRAZIL									
Attack Audio System									
Newbox Acoustic									
CANADA									
Canadian Speaker Works									
Reference 3A									
CHINA									
BOWI Industry Co., Ltd.									
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Ningbo Xiangyang Telecommunication									
Component									
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FRANCE									
Kartesian									
Kyu Systems									
Seltech									
GERMANY									
Hubert Stüken GmbH									
Voice Point									
Wolf von Langa									

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	Frames & Baskets		Lead Out Wire				Termination/Crimps		
	Frame Gaskets	Cast Alloy	Stamped Steel	Damped Bumped	Double Bumped	Range of Diameters	Flat Strip	Beryllium Copper	Phosphor Bronze
NedLab	•	•							
New England Wire Technologies									
North Reading Engineering, LLC	•	•	•	•	•	•	•	•	•
Pierce Audio Inc.	•	•	•	•	•	•			
Quick Draw & Machining, Inc.	•	•		•	•	•			
Radian Audio Engineering	•	•	•	•	•	•			
Rapid Die and Molding Co.	•	•	•	•	•	•			
RDS Wire & Cable							•	•	•
Redco Audio									•
Roderick Loudspeaker Service			•				•		•
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TRS Inovations, Inc.	•	•	•	•	•	•			
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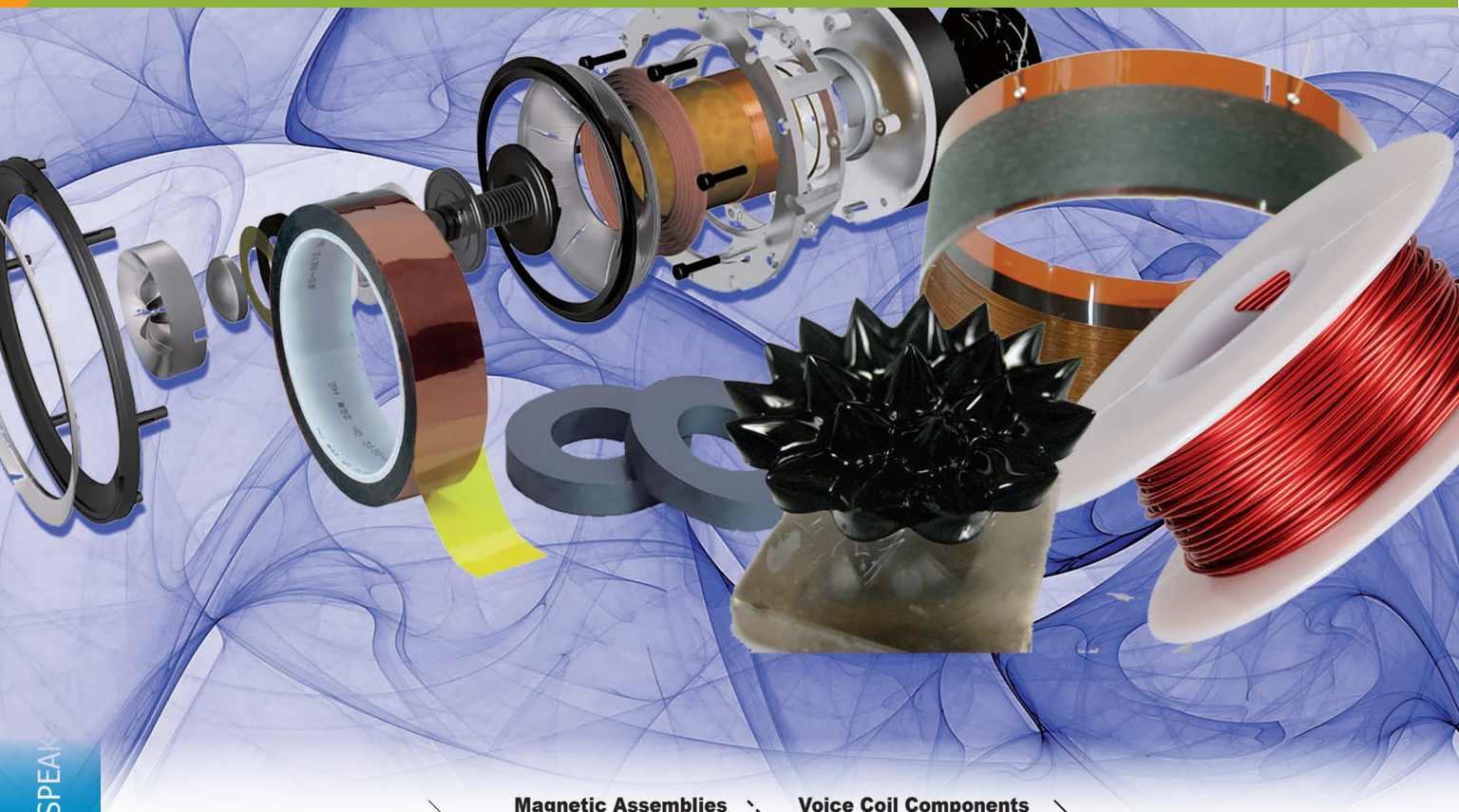


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	Magnetic Assemblies						Voice Coil Components					
	Magnets		Magnetic Fluids		T-Yokes Top Plates		Polyimide Tape for Collars		Voice Coil Assemblies		Voice Coil Sacks	
	Back Plates	Alnico	Neodymium	Ferrite	Pole Pieces	Bobbins/Formers	Magnet Wire	Collars	Flat Wire	Round Wire	Flat Wire	Round Wire
BRAZIL												
Newbox Acoustic	•	•	•	•	•	•	•	•	•	•	•	•
CANADA												
Canadian Speaker Works	•		•		•	•					•	
Reference 3A												
Solen Electronique, Inc.			•					•				
CHINA												
Audiostar Electronics							•	•	•	•	•	•
BOWI Industry Co., Ltd.	•	•	•	•	•	•	•	•	•	•	•	•
Changzhou Xiantong Magnetic Materials Co., Ltd.		•	•	•						•	•	•
Mingyang Electroacoustic Products Co., Ltd.							•	•		•	•	•
Ningbo Xiangyang Telecommunication Component							•	•	•	•	•	•
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Sun Technique Electric Co., Ltd.	•	•	•	•	•	•	•	•	•	•	•	•
Tianyi Electronic		•	•	•	•							
Trueanalog Strictly OEM	•					•						
Vormag Electronics		•	•	•					•			
Zeng Ben Industrial Corp., Ltd.						•						
Zenith Audio Electronics Co., Ltd.								•		•	•	•



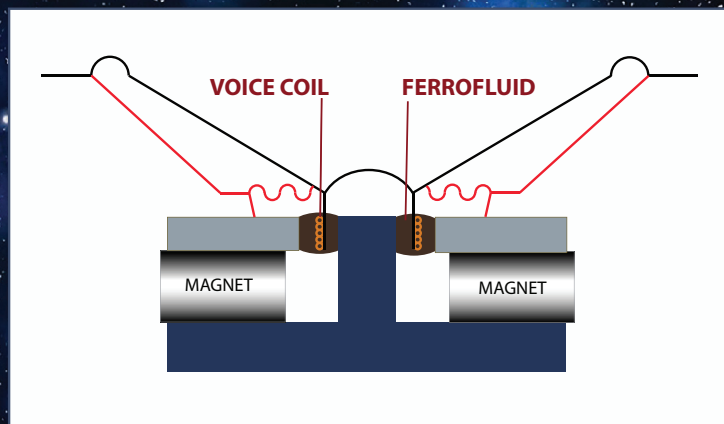
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Thermal Transfer

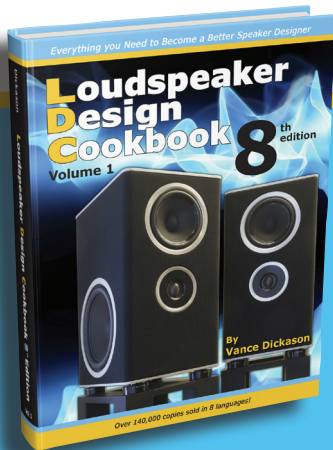
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Reduce/Eliminate Rub and Buzz



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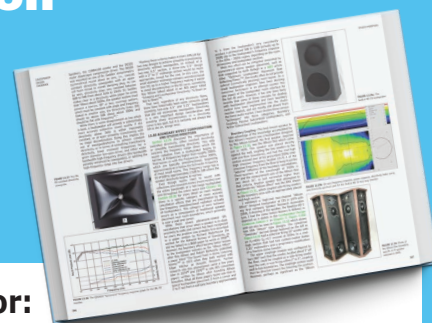
	Magnetic Assemblies				Voice Coil Components						
	Back Plates	Magnets	Magnetic Fluids	Pole Pieces	T-Yokes	Bobbins/Formers	Polyimide Tape for Collars	Magnet Wire	Voice Coil Assemblies	Voice Coil Stacks	
		Alnico	Neodymium							Flat Wire	Round Wire
FRANCE											
Kartesian			•	•		•	•	•		•	•
Kyu Systems	•			•	•	•	•	•	•	•	
GERMANY											
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Voice Point	•	•	•	•	•	•				•	•
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Audiotone Professional							•			•	•
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Lakshmi Metal Coils											•
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	Magnetic Assemblies			Voice Coil Components									
	Back Plates	Magnets	Magnetic Fluids	T-Yokes	Pole Pieces	Bobbins/Formers	Polyimide Tape for Collars	Magnet Wire	Voice Coil Assemblies	Voice Coil Collars	Voice Coil Stacks	Round Wire	Flat Wire
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	Magnetic Assemblies				Voice Coil Components						
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PHILIPPINES Dai-ichi Electronics Manufacturing Corp.							•	•	•	•	•
SOUTH KOREA Suntel							•	•	•	•	•
TAIWAN Huey Tung International Co., Ltd. Poyun Electronics Shining Jins Enterprise	•	•	•	•	•	•	•	•	•	•	•
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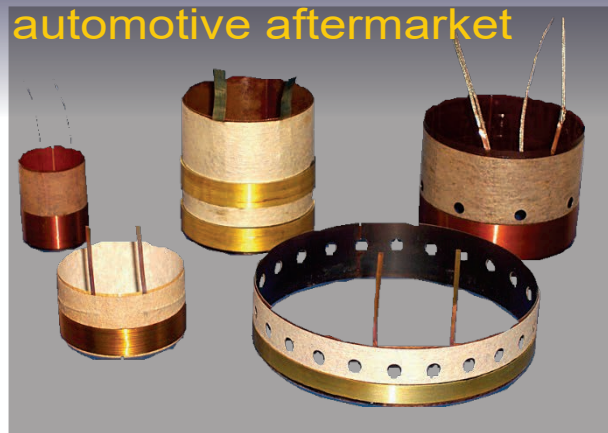


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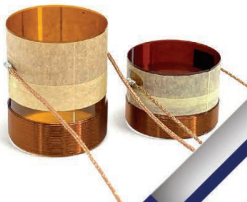


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	Magnetic Assemblies			Voice Coil Components						
	Back Plates	Magnets Alnico Ferrite	Magnetic Fluids Neodymium	T-Yokes Pole Pieces	Bobbins/Formers Top Plates	Polyimide Tape for Collars Collars	Voice Coil Assemblies Magnet Wire	Voice Coil Assemblies Flat Wire	Voice Coil Assemblies Round Wire	Voice Coil Assemblies Stacks
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Alliance LLC	•	•	•	•	•					
American Bass	•	•	•	•	•	•	•	•	•	•
Area 52 R&D	•		•	•	•	•				
Arnold Magnetic Technologies/ Precision Thin Metals		•	•	•						
CE Distribution, LLC							•			
Dragonfire Acoustics									•	•
Dynavox Electronics, Inc.	•	•	•	•	•	•	•	•	•	•
Elektrisola						•	•	•	•	•
FerroTec (USA) Corp.				•						
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Materion Corp.						•				
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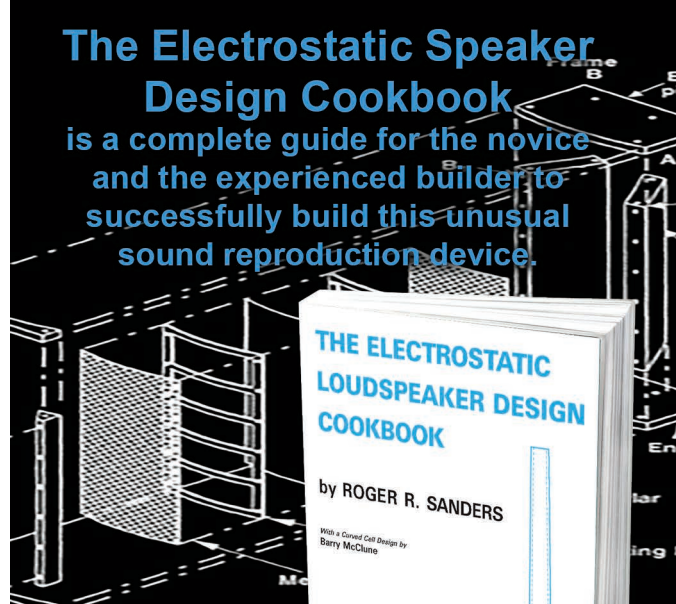
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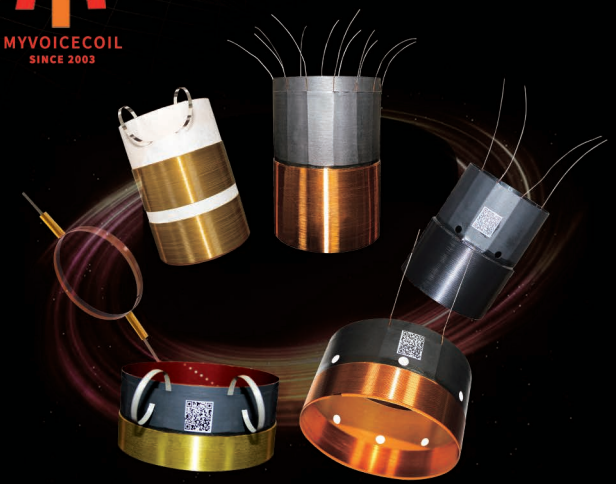
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Radian Audio Engineering		•	•	•	•	•	•						
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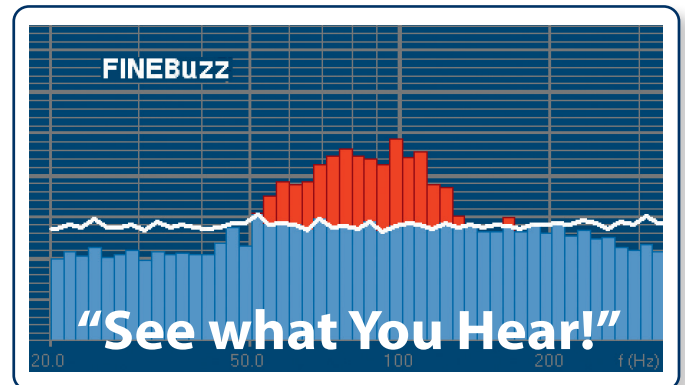
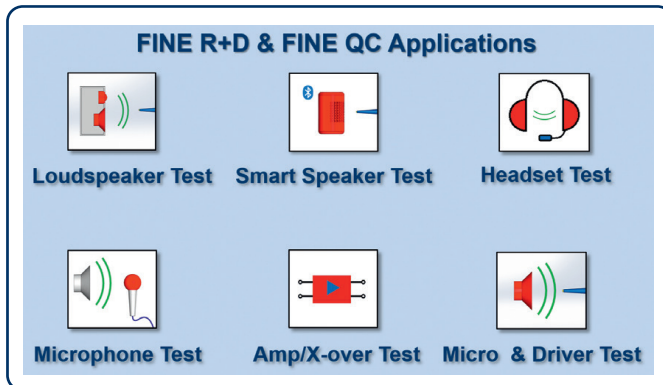
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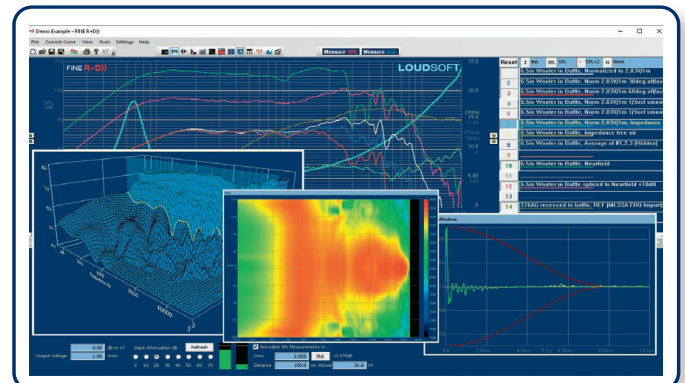
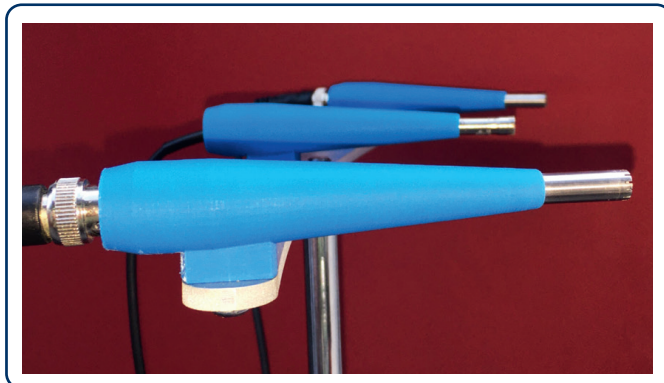
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	Anechoic Chambers	Accelerometers	Audio Analyzers	Gaussmeters	LCR Bridges	Multimeters	Oscilloscopes	Resistance Bridges	Sine/Square Wave Generators	Signal Bridges	Speaker Oscillators	Speaker Parts	Speaker Turntables	Spectrum Analyzers	1/3 Octave	Heliodyne	FFT	Stroboscopes	TDS	Testing Cabinets	Test Mics	Turns Counters
UNITED KINGDOM																						
DBS Audio			•		•																•	
EuroTec International, PLC				•	•			•	•	•		•	•	•		•	•				•	•
GRAS Sound & Vibration (UK)				•																	•	•
Hill Acoustics																					•	•
Spectral Measurement				•	•			•			•	•		•		•	•	•	•		•	•
UNITED STATES																						
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Amplitrex Audio Products					•																	
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Diamond Scientific															
Echo Test + Measurement															
ETS-Lindgren															
Fotronic Corp.															
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Meniscus Audio															
Meyer Sound Laboratories, Inc.															
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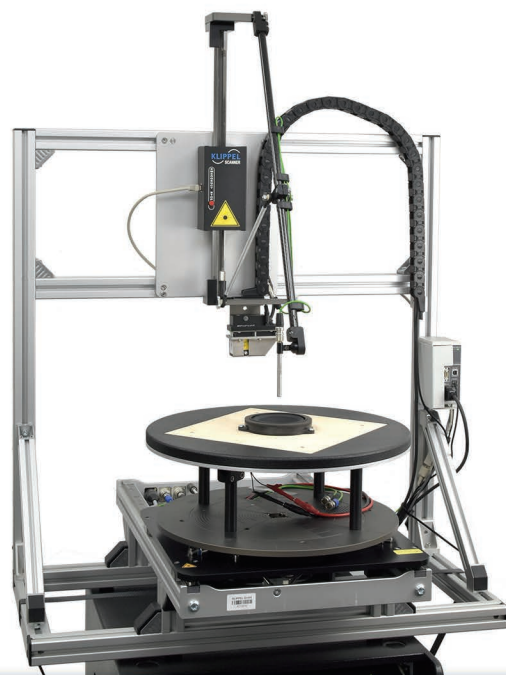
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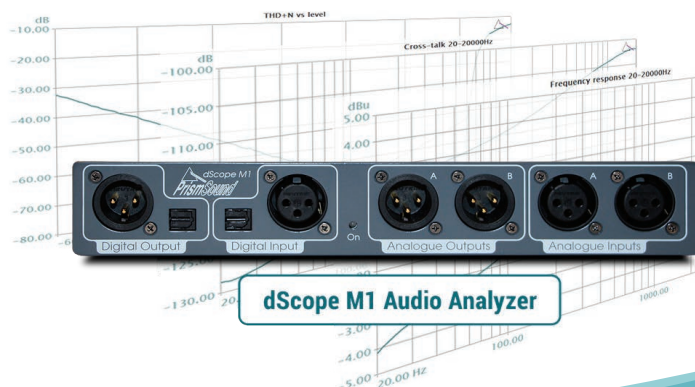


	Anechoic Chambers	Audio Analyzers	Gaussmeters	LCR Bridges	Multimeters	MLS	Resistance Bridges	Oscilloscopes	Signal Generators	Sine/Square Wave Oscillators	Spectrum Analyzers	Speaker Turntables	Speaker Parts	1/3 Octave	Heliodyne	FFT	Stroboscopes	TDS	Testing Cabinets	Turns Counters
Parts Express																				
PCB Piezotronics		•	•	•															•	•
Performance Audio				•							•								•	
PRV Audio Brazil												•								
Radio Design Labs (RDL)				•	•				•		•	•			•	•	•	•		
Redco Audio								•			•									
RS Americas, Inc.				•				•	•		•									
Scantek, Inc.		•													•	•				
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Studio Six Digital				•											•	•		•	•	
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Vidsonix Design Works				•																
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75 Years of the Audio Engineering Society and Loudspeakers

Harry Olson, Paul Klipsch, and Robert Ashley. Roy Allison, Ernest Benson, and Siegfried Linkwitz. Richard Heyser, Richard Small, and Neville Thiele. What do all these names mean to the world of loudspeakers? Everything.

By
Roger Shively



ROLA Model 30
Dynamic Power Loudspeaker

Their early technical writings appeared in the *Journal of the Audio Engineering Society* (JAES), writings that, among countless others, were discussed—at times, heatedly debated—at Audio Engineering Society (AES) conferences and conventions over the last 75 years. Yet, despite such impact, these names only represent the first 24 years of the AES. From that early foundation, the floodgates opened. The list of names grew exponentially—and the AES could barely contain them.

In 1953, the *Journal of the Audio Engineering Society* (JAES) began publication. Currently, there are more than 17,000 papers in the AES e-library [1]. There have been four *Loudspeakers* anthologies published by the AES, most recently in 1995. Nevertheless, if we go to the e-library and look at what loudspeaker papers were in the Top 10 from the last two conventions (at the bottom of the page), we see that progress is ongoing.

By the time I had graduated from college and started working as a young and inexperienced loudspeaker design engineer, two anthologies had been published, and their spines quickly broke with constant use. I was fortunate in my first days to sit next to the unassuming names I would find in the *Journal*. John King would tell me what I was doing wrong when I tried to use the Apple BASIC program for voice coil design, which was based on his work. Later, I would meet and talk with the other living voices that accompany those names listed at the beginning of this article. The education and mentorship they provided not only to a young engineer but also to a young industry

and science were invaluable for the higher quality of loudspeaker design that had been emerging around the globe, with researchers on nearly every continent.

The History of Loudspeakers and the Audio Engineering Society

Let's go back in time for a moment. In 1861, Johann Philipp Reis installed a speaker on his telephone that produced clear tones, but the sound came out muffled. In 1876, Alexander Graham Bell obtained a patent for the first loudspeaker (emphasis on "loud"), which produced intelligible speech.

Today, the history of loudspeakers is almost a generation away from its second-century mark, and the development of effective practical devices has been advancing for nearly 100 years. Without the loudspeaker, our entertainment industry would not be where it is today. It is also likely that the development of the phonograph would have taken a different direction entirely.

The widespread commercial growth after the end of the Second World War also pushed the wider application of higher-quality loudspeakers. This development was encouraged by improvements in direct-to-disc phonograph recordings and by the onset of VHF radio (and ultimately television) broadcasting. VHF broadcasting reduced the limitations on both bandwidth and dynamic range. In addition, both phonograph recording and broadcasting were influenced by the introduction of magnetic tape recording. This made the LP record commercially possible and reduced the dependence

on live performances in radio broadcasting. These developments influenced the loudspeaker's development, as the need grew for them to keep pace with improvements in the quality of program sources.

Before the World War II, most loudspeakers had a limited frequency bandwidth of 70Hz to 7,000Hz. They also had large physical dimensions, mainly due to the high sensitivity that was needed to operate with the tube amplifiers, which had an average continuous power of 10W to 15W. The loudspeaker also had very irregular amplitude frequency responses. In the decade from 1945 to 1955, attention was concentrated mainly on extending bandwidth by about one octave at each end of the range, increasing it to 35Hz to 15,000Hz.

High-quality loudspeakers were still very large and seldomly pleasant enough in appearance to overcome the resistance to them being included in a home setting. This changed quickly by the early 1950s with the introduction of "air suspension speakers" (i.e., a speaker in a box), which made a trade-off between sensitivity and internal air volume. It was now possible to reduce the overall size and bulk of a loudspeaker to about one fourth of the size it previously was.

In the decade of 1955–1965, these developments were given quite considerable encouragement by the advent of commercial stereo disc records, and by 1965 the majority of home loudspeakers were less than 2ft³ in volume, with low sensitivity and correspondingly wide bandwidth. Around this time, "high-fidelity" was still only a hobby. Soon afterward, there was an explosion of interest in home sound playback, and just as quickly it became big business on a global scale.

Throughout this period, beginning with the formation of the AES in 1948, the *JAES* published more than 160 papers on loudspeakers. The hobby quickly became a technology based on the results of scientific pursuit, bolstered by the industry that it fueled. Recognizing that much of the significance had appeared outside the pages of the *Journal*, the AES included reprints of papers from other related organizations. These were some of the more important papers that marked the significant stages in the development of loudspeaker technology as well as the very history of the subject. In retrospect, the AES and the *Journal* in its early years became a fitting monument to all those whose efforts had advanced the art and science of sound reproduction into the years that followed before the advent of computer-aided design and measurements.

During the first two-and-a-half decades of the *Journal*, when the increasingly focused attention

and availability of research funding inevitably led to the development of even better loudspeakers, the AES was poised to record and discuss what would come next. That period was marked by the introduction of new diaphragm materials and better methods for the construction of enclosures, as well as the publication of studies for improving the integration of sound in multi-way speaker systems. Along with these developments came radically new methods of measurement and evaluation made possible by advances in digital computer technology and associated industries. These new techniques were not only more accurate, but also considerably faster and therefore more convenient than conventional methods of measurement.

Few textbooks about loudspeakers have been published in the decades since the early rapid growth in the technical understanding of the loudspeaker. Progress was so quick that



ROLA speaker and advertisement in *Radio Retailing* from 1931 [2]



About the Author

Roger Shively is the owner of Shively Acoustics International in Seattle, WA. He has more than 35 years of experience in engineering research and development, with significant experience in product realization and in launching new products at OEM manufacturers around the world. Roger co-founded JJR Acoustics in 2011 and has been a principal since its founding. Before JJR Acoustics, Roger worked as Chief Engineer of Acoustic Systems as well as functional manager for North American and Asian engineering product development teams in the Automotive Division of Harman International Industries Inc., a journey that began in 1986.



Roger received his degree in Acoustical Engineering from Purdue University in 1983, and finished post-graduate work in the field of finite element analysis. He is a member of the Audio Engineering Society (AES), Acoustical Society of America (ASA), and Society of Automotive Engineering (SAE). He has published numerous research papers and articles in the areas of transducers, automotive audio, psychoacoustics, and computer modeling. Roger also holds US and International Patents related to the design of advanced acoustic systems and applications, particularly in the field of automotive audio. Roger is Co-Chair of the AES Automotive Audio Technical Committee.

textbooks could not keep pace with the advances in understanding, and the effort required to produce formally bound texts was an inefficient use of time for a practicing development engineer in a burgeoning industry. This remains a problem in

today's modern world, as digital editions of texts and articles not only are much quicker to produce, but also are a more desired format for the product design audience, unless a webinar or a podcast can take its place.

In the decades leading up to the one that just concluded, the engineering world had to rely increasingly on technical papers from specialized contributors, and those publications were more reliable than an all-encompassing text by a single author. Starting in the late 1970s and into the 1980s, the AES's *Journal* was filled with papers covering computer-aided design and measurement. There were descriptions of materials behavior for cones, the voice coil, and the suspensions. There were studies about the still ever-present horn behavior, and the first description of dome tweeter behavior appeared in the *Journal*. New materials and geometries were explored as well.

The advances from the 1970s to the 1980s revealed how scientists and engineers were now coming to grips with the fundamental nature of loudspeakers. There were many purely practical problems that remained to be solved, but here and there we can see where understanding penetrated to the theoretical heart of this extremely complex subject. With every year that passed, our insight

Pioneer CS-A77 Air Suspension speaker (late 1970s). Four-way speaker system with a 30cm woofer, a 12cm midrange, a 7.7cm tweeter, and a horn "super tweeter"—40Hz~14,000Hz, and 65W in a 75 liter box (17kg weight).



Timeline of Loudspeakers

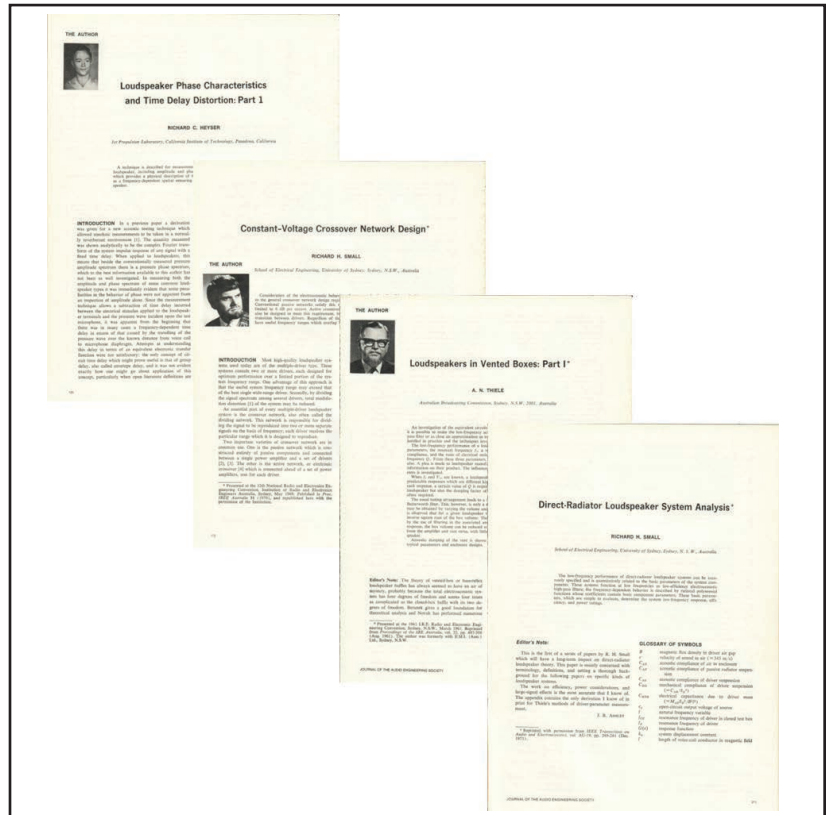
- 1861:** Johann Philipp Reis installs a speaker on his telephone producing clear tones, but with muffled sound.
- 1876:** Alexander Graham Bell obtains a patent for the first loudspeaker, capable of producing intelligible speech.
- 1877:** Werner von Siemens creates an electromagnetic coil-driven speaker based on Bell's design, that is ultimately unsuccessful.
- 1877:** Thomas Edison patents a system using compressed air to amplify sound in the early cylinder phonographs, using horns for amplification.
- 1898:** Horace Short patents a loudspeaker driven by compressed air that produces better sound than previous speakers.
- 1898:** Oliver Lodge develops the first experimental moving coil loudspeaker.
- 1915:** Peter L. Jensen and Edwin Pridham design the first practical moving coil loudspeakers.
- 1924:** Chester W. Rice of General Electric and Edward W. Kellogg of AT&T are the first to patent moving coil technology, using a permanent magnet and induction to move the coil and diaphragm to produce sound waves.
- 1924:** The Brunswick Balke Collender Co. introduces the first all-electric home phonograph with a dynamic loudspeaker.
- 1924:** Walter H. Schottky and Dr. Erwin Gerlach invent the first ribbon loudspeaker using diodes.
- 1930s:** Ribbon loudspeakers now have combined drivers to improve amplification.
- 1937:** Metro-Goldwyn-Mayer (MGM) introduces the Shearer Horn System, employing a single horn with two compression drivers for high-frequency sounds.
- 1943:** Altec Lansing invents duplex drivers and the 604 speaker, later known as the "Voice of the Theatre."
- 1954:** Edgar Villchur invents acoustic suspension for duplex drivers, producing a better bass response in smaller cabinets. The introduction of acoustic suspension was essential to developing stereo recording and reproduction, as recording high-definition songs with bass was hard to control. This process also led to experiments in speaker enclosure design and how they affected audio quality.
- 1955:** Hugh Knowles adapts the balanced armature loudspeaker design for hearing aids, improving the quality of miniature transducers.
- 1980:** Meyer Sound Laboratories releases an integrated active two-way loudspeaker system.
- 2012:** Robert Bosch GmbH files for the patent of a MEMS loudspeaker, awarded in 2016.

deepened until eventually the world of transducers matched the state of development that electronics had reached early on. The engineers at the heart of this development were, in addition to pushing ever outward the frontiers of human knowledge, also devoting their leisure time to communicating their ideas and experiences in the pages of the *Journal*.

From the mid-1980s to the late 1990s, the volume of content grew and expanded even more. Speaker systems, sophisticated crossover networks, as well as new measurement and evaluation methods were filling the publication, whose number of pages at times doubled that of previous issues. That increase represented the continued, rising interest and focus on all aspects of loudspeaker design, development, theory, and practice. The *Journal* material included not only the topic of loudspeakers and electronics, but also the wider topics of acoustics and psychoacoustics. We would be remiss in not mentioning the names that stood alongside those of loudspeaker developers. The names that tackled sound reinforcement system design and evaluation, feedback control and equalization, delay, loudspeaker cluster and array design, auditorium systems, and large outdoor venues. These are the names of David Klepper, Leo Beranek, Manfred Schroeder, Helmut Haas, Don Davis, and Don Keele, to name but a few.

Finally, the *JAES* has always supported and highlighted the precious few books available that are exclusively devoted to loudspeakers, in addition to numerous handbooks and encyclopedias encompassing the broad scope of audio topics that have been published, many of which include chapters on loudspeakers by excellent and knowledgeable contributors.

of microelectromechanical systems (MEMS) loudspeakers, the size of the listening device could also become inconsequential—and the Audio Engineering Society is there, recording it all. **LIS**



Seminal published works of Neville Thiele, “Loudspeakers in Vented Boxes: Part I” (1961); Richard Heyser, “Loudspeaker Phase Characteristics and Time Delay Distortion: Part 1” (1969); Richard Small, “Constant-Voltage Crossover Network Design” (1969) and “Direct-Radiator Loudspeaker System Analysis” (1971).

75 Years Today

The AES was there when CDs came onto the scene in the late 1980s, quickly eclipsing LP sales and by 1990 overtaking cassette sales. Microspeakers took on more importance due to the portable audio now available with cassettes and CDs. Through the first two decades of the 21st century, along with the growth of DVDs as a video and audio format, lossless compression and eventually high-quality streaming audio emerged as source formats. The playback device became inconsequential to how and where we consumed audio. With that freedom of choice and freedom of movement, the miniaturization of loudspeaker transducers continued for wired and wireless earbuds.

As smart speakers began populating our homes, offices, and cars, the *Journal* and the e-Library captured the design and measurement technologies for it all. Now, with the advent

References

[1] Audio Engineering Society (AES) e-library www.aes.org/e-lib

[2] ROLA Company was founded in 1924 by Bernard A. Enghorn in Seattle, WA. Production grew rapidly, initially manufacturing the then-standard horn speakers. In 1925, the company moved to Oakland, CA, where it developed a radically new product: the “field coil” cone speaker. In the 1930s, the company was reorganized as an Ohio corporation, and increasingly shares were owned by the Muttter Company of Chicago, eventually setting up the factory in Cleveland. In 1945, the year of Enghorn’s death, it became fully owned by Muttter. In the early 1970s, the brand also existed separately in the United Kingdom, where in 1930 the British Rola subsidiary was created. British Rola acquired Celestion in 1947 and renamed it Rola Celestion, producing under the brand name Celestion. In 1981, Sidney Harman bought Cleveland Electronics and moved its engineering and manufacturing to Martinsville, IN, and reformed it as Harman-Motive to compete with Bose in the branded OEM automotive audio industry. In 1986, Jensen shut down Rola Cleveland, and Harman-Motive recruited the automotive speaker design engineers who then went to work in Martinsville, IN. Along with them, came one piece: the ROLA 1926 version of the “field coil” cone speaker. In 2008, Harman International moved its operations from Indiana to Novi. A few years later, the speaker went along with one of the former members of the Harman automotive audio engineering team when they resettled in Seattle, the original home of ROLA, where the picture included in this article was taken.

AES70 — A Comprehensive Pro Audio Control Solution

By
Jeff Berryman
(Chair, OCA Alliance Technical Committee)



AES70 is an Audio Engineering Society (AES) standards suite for the remote control and monitoring of professional audio devices and systems via digital networks. Its focus excludes consumer and automotive applications. Nevertheless, if you're a consumer or automotive product designer or builder, you might find this article interesting.

In modern audio systems, a loudspeaker is the real, physical, analog ending point of a signal chain that's full of digital and digitally controlled analog signal processing. Except for the input and output ends, signals in the larger, newer pro systems are typically processed, stored, and communicated in digital form.

Even more, virtual audio processing and storage services are now emerging that exist only as software entities, running in processing clouds accessed via the internet, or perhaps in local servers.

Such systems need at least the following key networking technologies:

- **Digital Networks** to interconnect devices via a digital network, with efficient cabling, no signal degradation, and optimal system cost.
- **Media Transport** to transport digitally sampled audio seamlessly from one device to another in real time.
- **Device Control** to control (and monitor—the term “device control” includes monitoring) devices remotely, over networks, using software. Modern digital devices can be very complex, with hundreds or thousands of parameters, and can be located at some distance from system

operators. Controlling such devices via front-panel knobs and switches is not an option.

A complete networked audio system must include both media transport and device control methods. Media transport alone will not suffice. As we say in the OCA Alliance, “you can send audio from A to B, but what are you going to do with it when it gets there?”

Current Networking Standards and Practices

Pro audio media transport methods must adhere to industry norms—either formal standards or commonly accepted de facto specifications—so that users can send audio from a device to any other device with no special adapters, no special cabling, and no complex system setup processes.

Similarly, pro audio device control methods must adhere to industry norms, so that systems can combine devices from many manufacturers and manage them with common software.

Current networking norms for pro audio are as follows:

- **Digital Network.** For today's pro audio systems, the normal digital network solution is IP

protocols and wired Ethernet. Wireless solutions such as WiFi and Bluetooth are sometimes used for individual devices, but wired networks are required for industrial-strength applications. This may change in the future as wireless technology evolves.

- **Media Transport.** The dominant pro audio media transport technology is currently Dante, a complete, licensable audio streaming solution from Audinate of Sydney, Australia. Although it is a proprietary scheme, Dante is now integrated in many products and is a de facto standard for pro audio. Emerging alternatives are AES67, an Audio Engineering Society standard, and AES67's broadcast-industry version, SMPTE ST 2110-30. Finally, a new specialty media transport protocol named MILAN is being used by manufacturers of line-array products to facilitate ultra-precise time alignment of transducer signals.
- **Device Control.** At this time, pro audio device control is not universally standardized—proprietary approaches still dominate. The Audio Engineering Society's AES70 aspires to change that situation. AES70 is a full-function public control standard that's suitable for all professional applications, from the smallest to the largest. In the broadcast sector, new products are beginning to use NMOS, a set of public specifications that provide certain key device control functions. NMOS is popular, and is gaining functionality gradually, as its users demand. Historically, audio device remote control used MIDI. MIDI is a point-to-point control scheme, not a network protocol. It continues to be successful in non-network applications.

A network of devices with a media transport scheme and a device control scheme is called a media network. The concept is shown in **Figure 1**. Each of the elements are described next.

AES70

AES70 is an Audio Engineering Society standard first published in 2015. An update was published in 2018, and another update will be published later in 2023.

AES70 is the standardization of a technology named Open Control Architecture (OCA). OCA was developed by a trade association named the OCA Alliance, based on earlier work done in the Audio Engineering Society (AES) in the 1990s, and by various manufacturers since that time.

Today, the OCA Alliance continues to develop support tools and tutorial information for AES70,

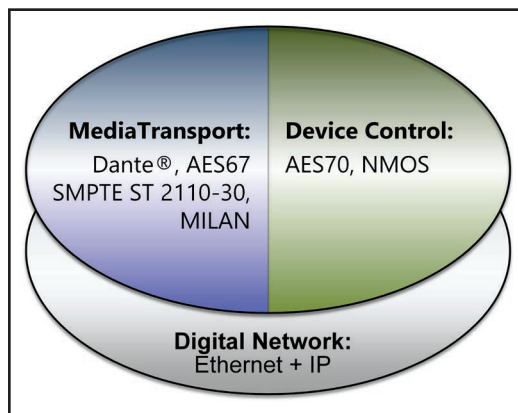


Figure 1: Media network concept, showing protocols mentioned in this article.

and to design future enhancements for the AES to include in future versions of AES70.

AES70 is currently a suite of three individual standards, labeled AES70-1, AES70-2, and AES70-3. The 2023 update will add three more, to make a total of six. Later in this article, we'll describe each one. Here's what AES70 is and isn't:

- AES70 is an architecture for comprehensive control and monitoring of media devices over networks.
- AES70 is not a media transport protocol. AES70 is not a device implementation software framework.
- AES70 is not a user interface specification.
- AES70 is not a controller implementation software framework.
- In other words, AES70 specifies what goes along the wire, but says nothing how the equipment at either end should be constructed.

AES70 is a free and open public standard published by the Audio Engineering Society (AES). No license is required to incorporate it in any commercial product. AES70 users need not belong to the AES or the OCA Alliance.

AES70 specification documents may be downloaded for a small fee from the Standards Store pages of the AES website: www.aes.org/publications/standards.

From the outset, AES70 has been designed to support a wide range of pro audio applications, from the smallest to the largest, most critical. AES70's primary design attributes are as follows:

Industrial Strength

- Professional applications
- Multivendor systems

Basic device function control & monitoring - Signal processing control & monitoring - Operational status monitoring	Datasets - Data block storage in device - Storage, management, & retrieval	Spatial location control/monitoring - Device physical location awareness - Support for spatial and object-based audio - Control of movable physical devices
Connection management - Media streams - Data streams - Multiple networks and types per device - Multiple codec support	Media files - Create & manage - Record & Play	Device structuring - Flexible control element hierarchies - Control element arrays and matrices - Control aggregation (masters/submasters, etc.)
Time and clocking management - Multiple time reference support - Multiple media clock support - Media clock management for internal signal paths	Logging - Device-generated logs - Controller retrieval	Device capability enumeration - Controller discovery of device capabilities - Controller discovery of internal device signal paths
Power supply management - Multiple power sources - Batteries - Failover features	Parameter value store & recall ("presets") - Entire device - Subsets	Reconfigurable DSP product management - Processing object construction/deletion - Internal signal path management

Figure 2: This graph describes the AES70 control and monitoring repertoire.

- Multicontroller systems
- Networks of all sizes up to thousands of nodes
- Ability to support mission-critical (including life-safety) applications
- Secure or insecure systems

Efficient

- Implementable in small processors with limited memories
- Low use of network bandwidth

Product-Friendly

- Rich set of ready-to-use functions

- Full support for proprietary extensions
- Fully protective of secret proprietary device features

Stable/Available

- Long service life, with engineered forward and backward compatibility
- Open public license-free standard
- Published and maintained by an accredited standards organization

AES70 Control Repertoire

AES70 operates on a fairly small set of principles but has many specific control and monitoring features for common audio and related functions. **Figure 2** contains a summary list of AES70's standard repertoire - these are the features built into AES70.

For cases where the standard functions aren't enough, AES70 contains mechanisms by which device makers can add their own elements gracefully.

AES70 accommodates a variety of network configuration options, as follows:

- **Network type.** Although IP networks are common, AES70 can be used over non-IP networks (e.g., USB chains) as well.
- **Network size.** AES70 will work over networks of any size, up to and including the Internet.
- **System complexity.** AES70 supports multiple controllers, multiple networks, and mixed network types per device.
- **Device implementation.** AES70 works with both physical and virtual (i.e., software-only) devices.
- **Security.** AES70 can be operated in either secure or nonsecure mode. In secure mode, all communications are encrypted.

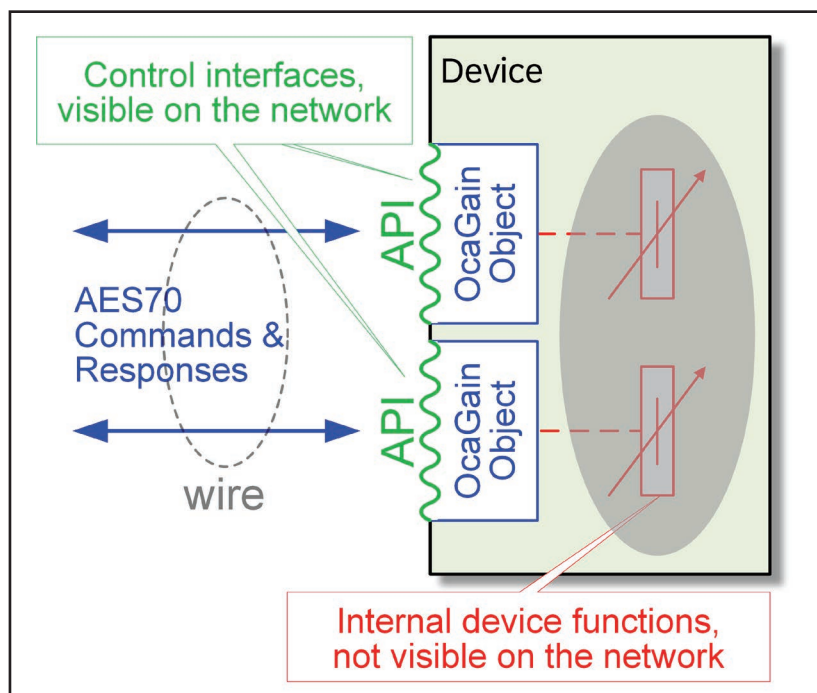


Figure 3: An example device is shown with two AES70 gain control objects.

- **Robustness.** AES70 supports redundant control networks, fast device failure detection, and a secure emergency reset mechanism.

How Does AES70 Work?

AES70 defines a device's control and monitoring interface in an object-oriented style. An AES70 control interface for a particular function is called an *object*. A template for making objects is called a *class*. The AES70 standard defines about 100 classes.

For example, when a device has an internal gain-control element, its setting may be controlled by defining an AES70 gain control object. That object defines a little network interface that system controllers can use to set the gain.

This is illustrated in **Figure 3**, which shows a device with two internal gain controls and an AES70 gain control object for each. Each gain control object is constructed according to the AES70 gain control template, a class named "OcaGain."

The AES70 Standards Family

When complete, the 2023 revision of AES70 will comprise six AES standards, see **Figure 4**. For product developers, the AES70 ecosystem includes various tools and libraries, both open-source and commercially licensable. With the help of these offerings, implementing an AES70 proof of concept is a straightforward process.

AES70 resources are available through the OCA Alliance websites and from Alliance member companies that support AES70 development. If you're interested, please consult those websites.

To get started developing AES70 products, visit <https://ocaalliance.com/adopting-aes70>. For personal contact with OCA Alliance members, please send a note to info@ocaalliance.com. There is also a LinkedIn group for AES70. To access it, open LinkedIn and search for "AES70". **LIS**

AES70-1	AES70 Framework. Defines basic AES70 concepts and mechanisms.
AES70-2	AES70 class structure. Defines AES70's control & monitoring repertoire.
AES70-3	AES70 binary protocol. Defines OCP.1, a binary AES70 protocol for IP networks.
AES70-4	AES70 JSON. Defines OCP.2, a JSON AES70 protocol for IP networks.
AES70-21	AES67 / ST 2110-30 Adaptation. Specifies the use of AES70 for controlling AES67 and SMPTE ST 2110-30 stream transport connections.
AES70-22	MILAN Adaptation. Specifies the use of AES70 connection management for controlling MILAN stream transport connections.

Figure 4: The AES70 standards family. Shaded items are new for 2023.

About the Author

Jeff Berryman is Senior Scientist at Bosch Communications Systems. Over the last 50 years, he has had a dual career in audio and information technology. His audio experience is in professional loudspeaker and sound reinforcement systems design, focusing on concert touring and theatre applications. His information technology experience is in operating system and network architecture. At Bosch, his responsibilities include technology strategy, technology prospecting, and future software, networks, and systems. He chairs several Audio Engineering Society standards teams working on media networking issues, and is chair of the Technical Group of the OCA Alliance.



Resources

For more information, please visit the following websites:

OCA Alliance main site. The OCA Alliance is the trade association that develops and maintains the AES70 specification for the AES. This site contains tutorial material, contact information, and other references | www.ocaalliance.com

For a list of current products that use AES70 | <https://ocaalliance.com/products>

OCA Alliance technical site. Resources for AES70 product and tool developers | <https://ocaalliance.github.io>

To purchase and download AES70 standards documents | www.aes.org/publications/standards

In addition, watch the Audio Engineering Society website for news of AES70 webinars, which will be happening several times per year | <https://aes2.org>

Loudspeaker Industry Sourcebook 2024

Interested in writing an article for the
2024 Loudspeaker Industry Sourcebook or taking part
in next year's Question & Answer section?

Contact Shannon Becker at sbecker@audioxpress.com

CONTACT INFORMATION

AUSTRALIA

Applied Measurement

<https://appliedmeasurement.com.au>

Audinate

<http://www.audinate.com>

Audiosoft

<http://www.users.on.net/~audiosoft/>

DEQX Pty., Ltd.

<http://www.deqx.com>

Eclipse Audio

<https://eclipseaudio.com>

Lenard Audio

<http://www.lenardaudio.com>

Proactive Group

<https://proactivegroupau.com.au>

RØDE

<http://www.rodete.com>

Soundlabs Group

<https://www.soundlabsgroup.com.au>

Stones Sound Studio

<http://www.stonessoundstudio.com.au>

AUSTRIA

Austrian Audio

<https://austrian.audio>

USound

<http://www.usound.com>

BELGIUM

APEX

<https://www.apex-audio.be>

Donnet: Loudspeaker Repair

<http://www.loudspeakerrepair.com>

Premium Sound Solutions

www.premiumsoundsolutions.com

The Innovators Lab Belgium (ILaB)

<http://www.eposaudio.com>

BRAZIL

Advanced Audio Technologies (AAT)

<http://www.aataudio.com.br>

AMCP Eletrônica

<http://www.amcp-xtend.com.br>

Attack Audio System

<http://attack.com.br>

Audiopax

<http://www.audiopax.com>

Harman of Brazil

www.harman.com/brasil/company

Magna Audio

<http://www.magnaaudio.com>

Newbox Acoustic

<http://newbox.com.br>

BULGARIA

Oberton Professional Loudspeakers

<http://www.oberton.com>

CANADA

Acora Acoustics Corp.

<http://www.acoraacoustics.com>

Arteluthe

<http://www.arteluthe.com>

Canadian Speaker Works

<http://www.cswpro.ca>

Divergent Technologies

<http://www.divergent-tech.com>

Eastporters Audio Video

<https://www.eastporters.com>

Excelitas Canada

<http://www.excelitas.com>

Focal North America

<https://www.focal.com/us>

Gershman Acoustics

<https://www.gershmanacoustics.com>

Harbottle Audio Co.

<http://www.harbottleaudio.com>

Kravchenko-Audio

<http://www.kravchenko-audio.com>

LMH Loudspeakers

www.lautsprecherhermanufaktur-heyder.de

Newform Research

<http://www.newformresearch.com>

ORA Graphene Audio, Inc.

<https://www.ora-sound.com>

Planet10-HiFi

<http://planet10-hifi.com>

Reference 3A

<http://www.reference3a.com>

Rutherford Audio

<http://rutherfordaudio.com>

Solen Electronique, Inc.

<http://solen.ca>

Sonavox

<http://sonavox.com>

Space-Tech Lab, Ltd.

<http://www.TheBestAmp.com>

Studio Reference Monitors

www.studio-reference-monitors.com

StudioLAB

<http://www.studiolab.ca>

Thompson by Design

<https://www.thompsonbydesign.com>

Tortech Sound

<http://www.tortechsound.com>

CHINA

Able-One Technology, Ltd.

<http://able-one.net>

Audiostar Electronics

<http://www.audiostar.cn/en>

BOWI Industry Co., Ltd.

<http://www.cn-bowico.com>

Bozhen Acoustics Co., Ltd.

<http://www.bzspeakers.com>

BSWA Technology Co., Ltd.

<http://www.bswa-tech.com>

B.W. Audiovisual Solution Co., Ltd.

<http://bwaudiovisual.en.china.cn>

Changzhou Xiantong Magnetic Materials Co., Ltd.

<http://www.xt-magnet.com>

Cosonic Acoustic Technologies Co., Ltd.

<http://www.cosonic.net>

CRY Sound

<http://www.crysound.com>

Dayun

(86) 755-27495982

DML Exciters

<http://www.exciters.cn>

Dong Guan Queen Voice Electronics

<http://www.queenvoice.com>

Dong Guan Yen Lung Electronics Co., Ltd.

(86) 769-83319302 (ext:806)

Dongguan Chao Tai Sponge Co., Ltd.

<http://www.chaotai88.com>

Dongguan Sheng-Yang Electronics

<https://www.dgsy.com>

Dongguan Sunwe Electronic Co., Ltd.

<https://sunwe.ecvery.com>

Dongguan Yuonyunn Membrane Co.

<https://www.yuonyunn.com>

Eastech Holding Co., Ltd.

<https://eastech.com>

Enkor Electronics Co., Ltd.

<http://www.inkor.com.cn>

Fountek Electronics Co., Ltd.

<http://www.fountek.net>

Gettop Acoustic

<http://www.gettopacoustic.com>

Goertek

<https://www.goertek.com>

Grand Will Enterprise

<http://www.grandwillcn.com>

Hansong (Nanjing) Technology

<http://www.hansongtechnology.com>

Junhao Wood Cabinet Factory

(86) 390-240-2730

Kadeton Audio Co., Ltd.

<http://www.kadeton-audio.com>

Lavoce, Co., Ltd.

www.facebook.com/LaVoceItaliana

Lumi Audio

<http://www.lumiaudio.cn>

MicW Audio

<http://www.micwaudio.com>

Mingyang Electroacoustic Products Co., Ltd.
<https://www.myvoicecoil.com>

M-Sound Electronics Co., Ltd.
<http://www.m-tweeter.com>

MYIR Tech, Ltd.
<http://www.myirtech.com>

Ningbo Xiangyang Telecommunication Component
<http://www.xiangyangchina.com>

OBE Pro Audio Co., Ltd.
<http://www.obeaudio.com>

One Magnet Electronics Co.
<http://www.one-magnet.com>

Pana Sound Technology
<http://www.panasoundtech.com>

Renyi Castings
<https://www.renyicastings.com>

Shenzhen Guangnan Electronics Co., Ltd.
<http://www.gonna.cc>

Shenzhen Horn Audio Co., Ltd.
<https://www.szhorn.com>

Shenzhen R-Foam Technology
<https://www.ranxigu.com>

Sonos, Inc.
<http://www.sonos.com>

Sound Technology Development, Ltd. (Factory)
<http://www.stech-sz.com>

Star Audio Co., Ltd.
<http://www.starcabinet.com>

Sun Technique Electric Co., Ltd.
<http://www.suntechnique.net>

Telefield
<https://www.telefield.com.hk>

Tianyi Electronic
<http://china-speaker.com>

Tonewinner (Guangzhou) Electronics
<http://www.tonewinner.com>

Tonly Electronics Holdings
<https://www.tcl.com>

TopOne Loudspeaker Cone
 (86) 2086788626

Tristar Electronics
<http://www.tristar-audio.com>

Trueanalog Strictly OEM
<http://www.trueanalog.com>

Vistron Audio Equipment
<http://www.vistron-audio.com>

Vormag Electronics
<http://www.vormag.cn>

Wavecor
<http://www.wavecor.com>

Weide Electronics
<http://www.weide96.com>

Xiamen Great Sound Technology
<http://www.gytsound.com>

Yuesheng Electronic
<http://www.yueshengdz.com>

Zeng Ben Industrial Corp., Ltd.
<http://www.zengben.com>

Zenith Audio Electronics Co., Ltd.
<http://www.audiovoicecoil.com>

Zhongshan K-Mate General Electronics Co., Ltd.
<http://www.k-mate.com>

Zhuhai HiVi Technology
<http://www.hivi.com>

CZECH REPUBLIC
Elfton
<https://www.elfton.cz>

DENMARK
Audio Technology, ApS
<http://www.audiotechnology.dk>

Danesian Audio
<http://www.danesian.dk>

DPA Microphones
<https://www.dpamicrophones.com>

Duelund Coherent Audio
<https://duelundaudio.com>

Dynaudio
<https://www.dynaudio.com>

estron a/s
<http://www.estron.dk>

Hiquphon
<http://www.hiquphon.eu>

ICEpower a/s
<http://www.icepower.dk>

Jantzen Audio
<http://www.jantzen-audio.com>

K & K Development
<http://www.kk-int.dk>

Kvart & Bølge
www.facebook.com/KVARTBOLGE

Loudsoft, Ltd.
<http://www.loudsoft.com>

Lyd by Dissing
<https://lydbydissing.com>

Pascal A/S
<http://www.pascal-audio.com>

PointSource Acoustics
<http://pointsource.dk>

Purifi Audio
<http://www.purifi-audio.com>

Scan-Speak
<https://www.scan-speak.dk>

FINLAND
Genelec Oy
<http://www.genelec.com>

FRANCE
Amplitude Audio
<http://www.amplitude-audio.com>

Applications Acoustiques de Composites (AAC)
<http://www.aac.fr>

Audax
<http://www.audax.com>

DXOMARK
<https://www.dxomark.com>

Exclusive Audio-Design
www.exclusive-audio-design.com

Florent Halgatte Consulting
www.linkedin.com/in/florenthalgatte

Kartesian
<https://www.kartesian-acoustic.com>

Kyu Systems
<http://www.kyu-systems.com>

Mulidine
<http://www.mulidine.com>

PHL Audio
<http://www.phlaudio.com>

Seltech
<http://seltech-international.com>

Supravox
<http://www.supravox.fr>

T&T Acoustic Loudspeakers
<http://www.t-and-t-enceintesacoustiques.fr>

Waterfall Audio
<http://www.waterfallaudio.com>

GERMANY
Ascendo Immersive Audio
<http://www.aia-cinema.com>

Audio Technology Engineering (ATE)
<http://www.ateaudio.de>

AudioChiemgau
<http://www.AudioChiemgau.de>

BMS Speakers GmbH
<http://www.bmsspeakers.com>

Centrotec Composites
<https://www.centrotec.de>

CORDIAL GmbH Sound & Audio Equipment
<http://www.cordial-cables.com>

Dr. Kurt Müller
<http://www.kurtmueller.com>

Eton GmbH
<http://www.eton-gmbh.com>

Fraunhofer Institute for Digital Media Technology
www.idmt.fraunhofer.de/en.html

Goya Acoustics
<http://www.goya-acoustics.de>

Henkel
<http://www.henkel-adhesives.com>

CONTACT INFORMATION

HiFi-Tuning

<http://www.hifi-tuning.com>

Hubert Stüken GmbH

<http://www.stueken.de>

ic audio

<https://www.ic-audio.com>

Iris Strassacker LautsprecherShop

<https://www.lautsprecherShop.de>

Jobst-Audio

<http://www.jobst-audio.de>

Klippel GmbH

<http://www.klippel.de>

MAAT Labs GmbH

<https://www.maat.digital>

Microtech Gefell GmbH

<https://www.microtechgefell.de>

Mundorf EB GmbH

<https://www.mundorf.com>

Mvoid Technologies GmbH

(49) 721-754076-0

Physical Lab

<https://www.physical-lab.com>

preeflow by ViscoTec Pumpen- u. Dosiertechnik GmbH

<https://www.preeflow.com/en>

Propex Fabrics

<http://www.curvonline.com>

Quint Audio

<https://www.quintaudio.com>

R&D Team Software Development

<http://www.randteam.de>

Riedel Communications GmbH & Co. KG

<https://www.riedel.net>

Rohde & Schwarz

<https://www.rohde-schwarz.com>

Scherer Audio

<https://hifi-products.com/Thomas-Scherer-Audio-Engineering-manufacturer-878.html>

Voice Point

<http://www.voicepoint.de>

Wolf von Langa

<https://wolfvonlanga.de>

HONG KONG

BDNC (Holding), Ltd.

<http://www.newbdnc.com>

Beautiful Enterprise

<http://www.beautiful.com.hk>

dB Enterprises

<http://www.db-ent.com>

Deep Blue Design

<https://www.deepbluedesign.net>

Eastern Asia Technology (HK)

<https://www.eastech.com>

Fujikon Industrial Holdings

<http://www.fujikon.com>

INNacoustic

<https://innovation.com.hk/en>

miniDSP, Ltd.

<https://www.minidsp.com>

Neutek International

<http://www.neutek-intl.com>

Ocean Sound Technology, Ltd.

<http://www.oceangroup.com.hk>

OCVACO Electronic, Ltd.

www.globalsources.com/ocvaco.co

Panson Audio Labs

<http://pansonaudio.com>

WCE Acoustics

<http://www.wce-acoustics.com>

HUNGARY

Bayz Audio

<http://www.bayz-audio.eu>

Viktorsound

<https://www.viktorsound.hu>

INDIA

Arul Sound Wood Industries

(91) 4242267757

Audiotone Professional

<http://www.audiotone.co.in>

Cruxweld Industrial Equipments, Ltd.

<http://www.cruxweld.com>

Dakshin Speaker Manufacturing Private, Ltd. (DSMPL)

(91) 44-22629111

Decibelsaudio

<https://cinebels.com>

Eight Audio International Pvt., Ltd.

www.eightaudiointernational.com

GM Audio Technics

<http://www.gmaudio.co.in>

Indiq Audio

<https://www.indiqaudio.com>

IWAI Electronics Pvt., Ltd.

<https://www.iwaispeakers.com>

Lakshmi Metal Coils

(91) 9581616296

Laysant Audio Private, Ltd.

<http://www.laysant.com>

Power Electronics & Technologies

<http://www.torvin.com>

Reliance Plastic Industries

<https://relianceplasticind.com>

SFT Technologies

(91) 22-6742-6600

TurboSonic Pro Speakers

<http://www.turbosonicSpeakers.com>

Venus Paper Cones

<http://www.venuspapercones.com>

Vidyut Teletronics, Ltd.

<http://www.vidyutwire.com>

Wizard India Private, Ltd.

<http://www.wizardindia.com>

INDONESIA

Premiere Wood Manufacturing (PWM)

<https://www.premierewood.com>

SB Acoustics

<http://www.sbacoustics.com>

IRELAND

CrossOver Filter App

<http://www.crossoverfilter.com>

ISRAEL

Alango Technologies, Ltd.

<http://www.alango.com>

Audio Pixels, Ltd.

<http://www.audiopixels.com.au>

Coby Speakers

<https://cobyusa.com>

Morel

<http://www.morelhifi.com>

Thermoguide, Ltd.

<http://www.servobass.com>

ITALY

Audiomatica s.r.l.

<http://www.audiomatica.com>

Audioxplus (AXP)

<http://www.axpaudio.com>

Axiomedia s.r.l.

<https://www.axiomedia.it>

B&C Speakers

<http://www.bcspeakers.com>

Boxal s.r.l.

<http://www.boxal.it>

Ciare

<http://www.ciare.com>

Eighteen Sound

<http://www.eighteensound.com>

FaitalPRO

<https://www.faitalpro.com>

Lavoce Italiana

<http://www.lavocespeakers.com>

OEB, SRL

<http://www.oeb.it>

Outline SRL

<https://www.outline.it>

Powersoft

<http://www.powersoft-audio.com>

Professional Audio

<http://www.professionalaudio.it>

RCF (Italy)

<http://www.rcf.it>

CONTACT INFORMATION

Sica Altoparlanti
<https://www.sica.it>

SpeakerLAB
<http://www.speakerlab.it>

Yter Laboratorium s.r.l.
<http://www.laboratorium-yter.com>

JAPAN

Etani Electronics Co., Ltd.
<https://www.etani.co.jp/en>

Final Co., Ltd.
<https://final-inc.com>

Furutech Co., Ltd.
<http://www.furutech.com>

LATVIA

Acoustic Power Lab
<http://aplaudio.com>

Sonarworks
<https://sonarworks.com>

LIECHTENSTEIN

Oerlikon Surface Solutions AG
<https://www.oerlikon.com>

MALAYSIA

Eternal Power
<http://www.eternalpower.net>

Shu Kae Industrial
<http://shukae.com>

U-Sonics Power Cone
<https://www.u-sonics.com>

MEXICO

Aletheia AV
<http://www.aletheia-av.com>

Oldman Sound
<https://www.oldmansound.com>

NETHERLANDS

Aequo Audio
<https://www.aequoaudio.com>

Audio Components
<http://www.audiocomponents.nl>

Audiofriends
<https://www.audiofriends.com>

Crystal Cable
<http://www.crystalcable.com>

Diluvite
<https://www.diluvite.com>

ELTIM audio BV
<https://www.eltim.eu>

Good HiFi VOF
<https://speakerrepairshop.nl>

Hypex Electronics
<http://www.hypex.nl>

Kamperman Engineering
<www.kamperman-engineering.nl>

Metaxas & Sins
<http://www.metaxas.com>

REC Sound
<http://www.recsound.nl>

Sound Projects
<http://www.soundprojects.com>

Stage Accompany
<https://www.stageaccompany.com>

Teijin Aramid
<https://www.teijinaramid.com>

Van den Hul
<https://www.vandenhul.com>

NEW ZEALAND

Asona
<http://www.asona.co.nz>

Theophany Loudspeakers, Ltd.
<http://www.theophany.co.nz>

NORWAY

Griffin Audio AS
<https://www.griffinaudio.no>

SEAS Fabrikker AS
<http://www.seas.no>

Soundcare AS
<http://www.soundcare.no>

PHILIPPINES

Dai-ichi Electronics Manufacturing Corp.
<www.daiichielectronics.com.ph>

POLAND

Sveda Audio
<http://www.sveda.pl>

PORTUGAL

Jocavi International
<http://www.jocavi.net>

Vicoustic
<http://www.vicoustic.com>

ROMANIA

Poweraudio Romania
<http://www.poweraudio.ro>

SINGAPORE

Virtins Technology
<http://www.virtins.com>

SOUTH KOREA

Bujeon Electronics Co., Ltd.
<http://www.bujeon.com>

SotM Audio
<https://www.sotm-audio.com>

Suntel
(82) 7077908311

SPAIN

Acustica Beyma
<http://beyma.com>

Brusi Acoustics
<http://www.brusi.com>

DAS Audio
<http://www.dasaudio.com>

Sottovoce Audio
<https://www.sottovoceaudio.com>

Tecnare Sound Systems
<https://www.tecnare.com>

SWEDEN

Audio Pro, AB
<http://www.audiopro.com>

Böhmer Audio
<http://www.bohmeraudio.com>

Ghielmetti Solutions AG
<http://www.ghielmetti.ch>

IJData
<http://www.ijdata.com>

Oxeon AB/Textreme
<http://www.textreme.com>

Vovox AG
<https://vovox.com>

SWITZERLAND

Acustronics Sound-Light-Systems
<http://www.acustronics.ch>

Kisling AG
<http://www.kisling.com>

Lange Loudspeakers SA
<https://www.langeloudspeakers.com>

Megatec AG
<http://www.megatec.ch>

Weiss Engineering, Ltd.
<https://www.weiss.ch>

TAIWAN

AV Leader Corp.
<http://www.avleader.com.tw>

Bennic Components
<http://www.bennic.com.tw>

BESTON Technology Corp.
<http://www.ribbonspeaker.com.tw>

ChiaPing Enterprise Co., Ltd.
<https://www.speaker-mart.com>

Chien-Yuan Electronic Co. (CYE)
<http://www.chien-y.com.tw>

Cotron Corp.
<https://www.cotron.com.tw/en-us>

Dongguan Sheng-Yang Electronics
<http://www.dgsy.com/en>

Fortune Grand Technology, Inc.
<http://www.forgrand.com>

Glass Acoustic Innovations Technology Co., Ltd. (GAIT)
<https://www.gai-tech.com>

Hakken Enterprise
<https://www.hakken.com.tw>

Hi-Tech Sound System Co., Ltd.
<http://www.hi-techsound.com>

Huey Tung International Co., Ltd.
<https://www.hueytung.com.tw>

Hurray Co.
<http://www.hurraysound.com>

Jetvox Acoustic Corp.
<https://www.jvovox.com.tw>

CONTACT INFORMATION

Kingstate Electronics Corp.
<http://www.kingstate.com.tw>

Maeden Innovation Co., Ltd.
<http://www.maeden.com.tw>

Meiloon Industrial
<http://www.meiloon.com.tw>

Merry Electronics
<https://www.merry.com.tw>

Palm Garden Enterprise
<http://www.palmgarden.com.tw>

Poyun Electronics
<https://www.poyun.com>

Ruhwa Electronic Co., Ltd.
<http://www.ruhwa.com>

Shining Jins Enterprise
<http://www.shiningjins.com>

Shiuh Sheng Electronics Factory
(886) 3-3802063

Sonic Electronic Co., Ltd.
886-2-26943949

Taiwan Solidex
<https://solidex.audio>

TB Speaker
<http://www.tb-speaker.com>

TOONG IN Electronic Corp.
<https://www.toongin.com>

Turbo Tide Electronics Co., Ltd.
<https://www.headphones-manufacturers.com>

Vansonic Enterprise Co., Ltd.
(886) 2-2267-2389

Yie Feng Technology Enterprise
<http://yiefeng.com>

Yung International
<http://www.yung.com.tw>

THAILAND
A-TON Industrial
(66) 2-811-8862

Clarasonic (Thailand) Co., Ltd.
<http://www.clarasonic.com>

FSK (Thailand) Co., Ltd.
<http://www.skt-bobbin.com>

UKRAINE

MAG Audio
<http://mag-audio.com>

UNITED KINGDOM

Amina Technologies, Ltd. (UK)
<https://www.aminasound.com>

Arya Audio Labs
<http://www.arya-audio.com>

Audiolux
<http://audiolux.co.uk>

BishopSound Manufacturing & Design, Ltd.
<http://www.bishopsound.com>

CE Electro-Acoustics
<http://www.christienellis.co.uk>

Celestion
<http://www.celestion.com>

Charcroft Electronics, Ltd.
<https://www.charcroft.com>

ClarityCap Audio Capacitors
<http://www.claritycap.co.uk>

DBS Audio
<https://www.dbsaudio.co.uk>

Electroacoustic Design, Ltd.
<www.electroacousticdesign.co.uk>

EuroTec International, PLC
<http://www.eurotec-intl.co.uk>

Fane International, Ltd.
<http://www.fane-international.com>

Ferguson Hill Studios, Ltd.
<http://www.fergusonhill.co.uk>

Freudenberg Sealing Technologies - Metflex
(44) 01254-881-779

GRAS Sound & Vibration (UK)
<http://www.gras.co.uk>

Hi-Fi Collective
<https://www.hificollective.co.uk>

Hill Acoustics
<http://www.hillacoustics.com>

Interfacio, Ltd.
<http://www.interfacio.com>

Kleio Audio
<http://www.kleioaudio.com>

MJ Acoustics
<http://www.mjacoustics.co.uk>

Node Audio Research
<https://www.node-audio.com>

Oxford Digital, Ltd.
<http://www.oxford-digital.com>

PACSYS
<http://pafecfe.com>

Precision Devices
<https://www.precision-devices.com>

Profusion
<http://www.profusionplc.com>

Resolute Audio
<http://www.resoluteaudio.com>

Revolver Audio, Ltd.
<http://www.revolveraudio.co.uk>

Silcoms, Ltd.
<www.silcoms.com/conveyor-chain-division>

Spectral Measurement
<www.spectralmeasurement.com>

Tectonic Elements
<http://www.tectonicelements.com>

Volt Loudspeakers
<http://www.voltloudspeakers.co.uk>

UNITED STATES

1MORE
<https://usa.1more.com>

3M (Industrial Adhesives & Tapes Division)
<https://www.3m.com/bonding>

A List Wood Works
<https://alistwoodworks.com>

Accurate Perforating Co.
<http://accurateperforating.com>

ACO Pacific
<http://www.acopacific.com>

AcousTex Fabrics
<http://www.acoustex.com>

Acoustic Design
(1) 270-444-0491

Acoustic Fields
<http://www.acousticfields.com>

Acoustics First Corp.
<http://www.acousticsfirst.com>

Acry-Tech Coatings, Inc.
<http://www.acrytech.com>

Adafruit Industries
<https://www.adafruit.com>

Addison Audio & Video
<https://www.addisonav.com>

ADI
<https://www.adiglobaldistribution.us>

ADM Technology
<http://www.rogersoundlabs.com>

Adrian Acoustics
<https://adrianacoustic.com>

Aempyrean
<http://www.lab4me8.wixsite.com/ibeam/speaker-series>

Alliance LLC
<https://allianceorg.com>

Ambiance Acoustics
<http://www.ambianceacoustics.com>

American Bass
<http://americanbassusa.com>

American Music & Sound
<www.americanmusicandsound.com>

Amina Technologies, Ltd. (USA)
<http://www.aminasound.com>

Amplitrex Audio Products
<https://amplitrex.com>

Analysis Audio USA
<http://www.analysisaudiousa.com>

CONTACT INFORMATION

Apollonio Consulting

(1) 562-445-4352

Area 52 R&D

(1) 740-223-6551

Arion Audio

<http://www.arionaudio.com>

Arizona Capacitors

<http://www.arizonacapacitors.com>

**Arnold Magnetic Technologies/
Precision Thin Metals**

<http://www.arnoldmagnetics.com/speakers-microphones>

Astro Machine Works

<http://www.astromachineworks.com>

AtlasIED

<http://www.atlasied.com>

**Audio & Loudspeaker Technologies
International (ALTI)**

<https://altiassoc.org>

Audio Advisor, Inc.

<http://www.audioadvisor.com>

Audio Connection, Inc.

<http://www.audioconnect.com>

Audio Precision, Inc.

<http://www.ap.com>

Audioengine

<http://www.audioengineusa.com>

Audix

<http://www.audixusa.com>

AValive

<http://www.avalive.com>

Avanti Audio

<https://avantiaudio.com>

Avel Lindberg

<http://www.avellindberg.com>

AvileTech

<http://www.aviletech.com>

Axiim

<http://www.axiim.com>

B&H Foto & Electronics Corp.

<http://www.bhphotovideo.com>

Barefoot Sound

<http://www.barefootsound.com>

BassBoss

<http://bassboss.com>

Behringer

<https://www.behringer.com>

Belden, Inc.

<https://www.belden.com>

Benchmark Media Systems

<http://www.benchmarkmedia.com>

BeStar Technologies, Inc.

<http://www.bestartech.com>

Beyma America

<http://beymaamerica.com>

Biamp

<https://www.biamp.com>

Blackmore Pro Audio

<http://blackmoremobile.com>

Bostik

<https://www.bostik.com/us>

Broad Bridge Audio, LLC

(1) 603-767-4360

C.P. Moyen Co.

<http://www.cpmoyen.com>

Caddock Electronics, Inc.

<http://www.caddock.com>

Campanella Associates & Acculab

<http://campanellaassociates.com>

Cardas Audio

<https://www.cardas.com>

Carl Tatz Design

<http://www.carltatzdesign.com>

Carvin Audio

<http://www.carvinaudio.com>

CE Distribution, LLC

<https://www.cedist.com>

CGN audio labs

<http://www.cgnaudiolabs.com>

Christensen Audio, LLC

<http://www.christensenaudioip.com>

CJS Labs

<http://www.cjs-labs.com>

Clear Lake Audio

<http://www.clearlakeaudio.net>

CommonSense Audio

<http://www.commonsenseaudio.com>

COMSOL

<https://www.comsol.com>

Controlled Thermal Processing

<http://ctpcryogenics.com>

Cotronics Corp.

<http://www.cotronics.com>

Creative Sound Solutions, LLC

<http://www.css-audio.com>

D. L. Adams Associates

<http://www.dlaa.com>

Danley Sound Labs

<http://www.danleysoundlabs.com>

Danville Signal Processing, Inc.

<http://www.danvillesignal.com>

Dayton Audio

<http://www.daytonaudio.com>

dB Design

<http://www.dbdesign.com>

dBTechnologies

<http://www.dbtechnologies.com>

DC Audio

<http://www.dcsoundlab.com>

DC Gold Audio

<http://www.dcgold.com>

Dekoni Audio

<https://dekoniaudio.com>

DELO Industrial Adhesives

<https://www.delo-adhesives.com>

Delta H Technologies, LLC

<http://delta-h.com>

DH Labs Silver Sonic

<https://silversonic.com>

Diamond Scientific

<https://diamondsci.com>

Digital Audio Labs

<http://digitalaudio.com>

Digmoda

<http://www.digmoda.com>

Dinaburg Technology

<http://dinaburgtech.com>

Dragonfire Acoustics

<http://www.dragonfireacoustics.com>

DSP Concepts

<http://www.dspconcepts.com>

DTV Installations, LLC

<https://www.dtv-installations.com>

Dukane Corp.

<http://www.dukane.com>

Dymax Corp.

<http://www.dymax.com>

Dynavox Electronics, Inc.

<https://www.dynavox.com>

Earthquake Sound Corp.

<http://www.earthquakesound.com>

Earthworks Audio

<http://www.earthworksaudio.com>

Eberhard Manufacturing Co.

<https://www.eberhard.com>

Echo Test + Measurement

<https://www.echotm.com>

Electro Mavin

<http://www.mavin.com>

Elektrisola

<http://www.elektrisola.com>

Ellsworth Adhesives

<http://www.ellsworth.com>

eMagineFactory, LLC

<http://www.eMagineFactory.com>

Emerald Physics

<http://www.emeraldphysics.com>

Eminence Speaker, LLC

<http://www.eminence.com>

Engineered Fibers Technology

<http://www.EFTfibers.com>

CONTACT INFORMATION

ERSE Audio

<http://www.erseinc.com>

ESS Speakers USA

<http://esslabsusa.com>

ESTec America

<http://www.estec.co.kr>

ETS-Lindgren

<http://www.ets-lindgren.com>

EXACT Dispensing Systems

<https://exactdispensing.com>

Excelsior Audio Labs

<http://excelsior-audio.com>

FerroTec (USA) Corp.

<http://www.ferrotec.com>

Fingerprint Audio

<http://www.fingerprintaudio.com>

Fisnar

<http://www.fisnar.com>

Fluid Audio

<https://www.fluidaudio.com>

Fluid Metering, Inc.

<http://www.fmipump.com>

Foam Speaker Grilles

<http://foamspeakergrilles.com>

Fortemedia

<https://www.fortemedia.com>

Fotronic Corp.

<http://www.testequipmentdepot.com>

Front End Audio, LLC

<http://www.frontendaudio.com>

Fulcrum Acoustic

<http://www.fulcrum-acoustic.com>

Full Compass Systems, Ltd.

<http://www.fullcompass.com>

Gauss Loudspeaker

<http://www.socalsoundshop.com>

GGEc America

<http://www.ggec.com>

GL Communications, Inc.

<http://www.gl.com>

Glenro, Inc.

<http://www.glenro.com>

Global Finishing Solutions, LLC

<http://www.globalfinishing.com>

Globe Audio Design

<http://www.globeaudiodesign.com>

Globe Plastics

<http://www.globecomposites.com>

GoldenEar

<http://www.goldenear.com>

GR Research

<https://gr-research.com>

GraphAudio

<https://www.graphaudio.com>

GRAS Sound & Vibration (USA)

<https://www.gras.us>

Guangzhou Istaray Trading Co., Ltd.

<http://www.istaray.com>

Halford Loudspeakers

<http://www.halfordloudspeakers.com>

Hartley Loudspeakers, Inc.

<http://www.hartleyloudspeakers.com>

HAVE, Inc.

<http://www.haveinc.com>

Hawley Products, Inc.

<http://www.hawleyproducts.com>

HEAD acoustics

<https://www.head-acoustics.com>

Hearing Components, Inc. (Comply)

<http://www.complyfoam.com>

Hendrick Manufacturing

<https://www.hendrickcorp.com>

Hernon Manufacturing

<http://www.hernon.com>

Hosa Technology, Inc.

<https://hosatech.com>

Hottinger Bruel & Kjaer Sound & Vibration North America

<https://www.bksv.com>

Huntsman International, LLC

<http://www.aralditeadhesives.com>

HX Audio Lab, LLC

<http://www.hxaudiolab.com>

IK Multimedia

<https://www.ikmultimedia.com>

Inlow Sound

<http://www.inlowsound.com>

Integrated Audio Technologies, LLC

<http://www.inautech.com>

Integrated Dispensing Solutions, Inc.

<https://www.dispensinglink.com>

Io Audio Technologies

<www.ioaudiotechnologies.com>

iSEMcon

<http://www.isemcon.com>

J&F Wood Products, Inc.

<http://www.jandfwood.com>

JJR Acoustics, LLC

<https://www.jjracoustics.com>

JL Audio

<http://www.jlaudio.com>

JLI Electronics, Inc.

<http://www.jlielectronics.com>

Josephson Engineering, Inc.

<https://www.josephson.com>

JP Electronics Design

<http://www.jpelectronicsdesign.com>

Jupiter Condenser Co.

<https://www.jupitercondenser.com>

Kimber Kable

<https://www.kimber.com>

Knowles Electronics, LLC

<http://KnowlesPremiumSound.com>

Kramer Electronics

<http://www.kramerus.com>

Krayden, Inc.

<http://www.krayden.com>

Kubala-Sosna Research, Inc.

<http://www.kscables.com>

Lamart Corp.

<http://www.lamartcorp.com>

Lectrosonics

<http://www.lectrosonics.com>

LEWCO, Inc.

<http://www.lewcoinc.com>

Linea Research USA

<https://linea-research.co.uk>

Linear Tube Audio

<http://www.lineartubeaudio.com>

Linkplay

<http://www.linkplay.com>

Lipinski Sound

<http://lipinkisound.com>

Listen, Inc.

<http://www.listeninc.com>

Loudspeaker Components, LLC

<www.loudspeakercomponents.com>

Loudspeakers Plus

<https://www.loudspeakersplus.com>

Lowell Manufacturing Co.

<http://www.lowellmfg.com>

Lowther Speakers USA

<http://www.lowtherspeakers.com>

Madisound Speaker Components, Inc.

<www.madisoundspeakerstore.com>

Marchand Electronics, Inc.

<https://www.marchandelec.com>

Markertek

<http://www.markertek.com>

Master Bond, Inc.

<http://www.masterbond.com>

Materion Corp.

<http://www.trueextent.com>

McKinney & Associates

<http://www.jandrewmckinney.com>

Meliti Acoustics

<http://www.melitiacoustics.com>

Meniscus Audio

<http://www.meniscusaudio.com>

CONTACT INFORMATION

Menlo Scientific, Ltd.
<https://www.menloscientific.com>

MetalEX
<http://industrial.metlx.com>

Metzgar Conveyors
<http://www.metzgarconveyors.com>

Meyer Sound Laboratories, Inc.
<http://www.meyersound.com>

Microphone-Parts.com
<http://microphone-parts.com>

Midwest Audio Club
<http://www.midwestaudioclub.com>

MISCO
<http://www.miscospeakers.com>

Monaero Engineering, Inc.
<https://www.monaero.com>

Morrow Audio
<https://www.morrowaudio.com>

MSC Software
<http://www.mssoftware.com>

NedLab
<http://www.Nedlab.com>

Neobits, Inc.
<http://www.neobits.com>

New England Wire Technologies
<http://www.newenglandwire.com>

NHT Audio
<http://www.nhthifi.com>

Nordost
<https://www.nordost.com>

Nordson Corp.
www.nordson.com

Nordson EFD
<http://www.nordsonefd.com>

North American Solidex, LLC
<http://www.solidexna.com>

North Reading Engineering, LLC
<http://www.northreadingeng.com>

NTi Audio
<http://www.nti-audio.com>

OAP Audio Products
<http://www.oapaudio.com>

Orban Audio
<https://orbanaudio.com>

Orca Design & Manufacturing Corp.
<http://www.orcadesign.com>

Pacific Audio Consulting
www.PacificAudioConsulting.com

Parts Express
<http://www.parts-express.com>

Pazandeh Audio Designs
 (1) 714-404-8340

PCB Piezotronics
<https://www.pcb.com>

Peerless by Tympany
<http://www.tympany.com>

Performance Audio
<http://www.performanceaudio.com>

Permabond Engineering Adhesives
<https://www.permabond.com>

Pierce Audio, Inc.
<https://pierceaud.io>

Planot
<http://www.planotspeaker.com>

Portland Audio Lab
<https://portlandaudiolab.com>

PQN Audio
<http://www.pqnterprises.com>

PranaFidelity
<https://pranafidelity.com>

Precision Converting (A Division of HISCO)
<http://www.precisionconverting.com>

Precision Econowind, LLC
<https://www.precisioneconowind.com>

Precision Sound Products
<http://www.psp-inc.com>

Precision Transducer Engineering (PTE)
<http://www.pteaoustics.com>

PreSonus Audio Electronics, Inc.
<http://www.presonus.com>

Pro Flix Sales
<http://www.proflixsales.com>

Pro Sound Testing
<http://prosoundtesting.com>

ProCo Sound
<https://www.procosound.com>

PRV Audio Brazil
<http://prvaudio.com>

PUI Audio
<http://www.puiaudio.com>

Puro Sound Labs
<http://www.purosound.com>

QA Genesis
<https://qagenesis.com>

Quest Engines, LLC
<http://www.questengines.com>

Quick Draw & Machining, Inc.
<http://quickdraw.com>

Radian Audio Engineering
<https://radianaudio.com>

Radio Design Labs (RDL)
<http://www.rdlnet.com>

Rapid Die and Molding Co.
<http://www.rdmco.com>

RBH Sound
<http://rbhsound.com>

RCF (USA)
<http://www.rcf-usa.com>

RDS Wire & Cable
<http://www.rdsWire.com>

RealTraps, LLC
<http://www.realtraps.com>

Recycled Sound
<http://www.recycledsound.net>

REDCATT
<https://www.redcatt.net>

Redco Audio
<http://www.redco.com>

Resonado Labs
<https://www.resonado.com>

Revolution Audio & Power
<http://www.revolutionpower.com>

RIVA Audio
<https://rivaudio.com>

Rock The Boat
www.rocktheboatmarinestereo.com

Roderick Loudspeaker Service
www.roderickloudspeakers.com

Rogersound Labs
<http://www.rogersoundlabs.com>

RS Americas, Inc.
<https://www.rs-online.com>

RSL Speaker Systems
<http://www.rslspeakers.com>

RTP Co.
<http://www.rtpcompany.com>

Saati
<https://www.saati.com/en>

Salk Sound
<http://www.salksound.com>

San Antonio Home Theater Pros
www.sanantoniohometheaterpros.com

Sanming Sound
<http://www.sanmingsound.com>

Scantek, Inc.
<http://www.scantekinc.com>

Schurter Electronic Components
<http://www.schurter.com>

SensaSound USA
<http://www.sensasound.com>

Senzar Acoustics, Inc.
<https://senzaracoustics.com>

SG Custom Sound
<https://www.sgcustomsound.com>

Sherwood Industries, Inc.
<http://sherwoodind.com>

Shinjitsu Audio
<http://www.shinjitsuaudio.com>

Editor's Note: For the Questions & Answers interviews, we sent several notable industry professionals a list of questions and asked them to respond. The following content contains the questions and their responses.



Rob Abbott

VP of Products, Nureva



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Abbott: As businesses find their footing in a new hybrid working environment, there has been a shift in focus from smaller, huddle-type rooms to larger, more flexible spaces. As the focus and investment in larger spaces has increased, so too has the expectations of IT managers. They expect similar ease of installation, deployment, and scalability in their larger spaces as they have in their smaller rooms. There has been a shift from an AV-first to an IT-first mentality, and this has led to significant growth in the adoption of easy-to-deploy UCC-certified room kits into larger spaces. In higher education, there has been growing demand for more integrated audio and video experiences that better support flexible learning modes. In reaction to this, there has been a lot of innovation in the use of sophisticated AI and sound-location-based data to support more intelligent and seamless cameras tracking and switching.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Abbott: We have not had to make any major supply chain adjustments in light of the pandemic. We had proactively diversified our manufacturing and were not as impacted as many AV manufacturers who were sole sourcing in China. While we had some electronic component shortages, we have been able to adjust as needed and were able to ship with normal lead times throughout the pandemic.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Abbott: There will continue to be an ongoing long-term trend toward geographical diversification of the world's supply chain, coupled with an increasing awareness of resource sustainability, and ethical labor and environmental practices. As an example, even before the pandemic, there were heavy tariffs placed on products imported into US markets that started to drive the search for

alternatives to a China-based supply. Many contract manufacturers started to set up satellite factories in other southeast Asia countries to try to get their products certified with a tariff-free country. This has ripple effects and will encourage the supply chain to evolve to provide components closer to the assembly locations to reduce transportation and labor costs. The challenge will be to see if suppliers can produce low-cost components in smaller batch quantities, in diverse geographic locations.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Abbott: The evolution of mass consumer behavior will continue to be a major catalyst in the audio industry. Convenience will continue to be a major driver, with significant advancements in product simplicity and automation. The move from a product-centric focus to experiential continues to shape how products become solutions that deliver an immersive and personalized experience. Situational awareness (adapting an audio experience to both the user and the world around them) will help shape those experiences, and AI will play an increasingly important role in that shaping. Personalization will not only provide audio tailored to your listening and collaboration preferences, but will take on a broader, holistic approach to include overall health and wellness. This will involve increasing use of sensor fusion and AI to interpret the subtle cues in and around us. Thoughtful industrial design and IoT + cloud integration will continue to merge audio experiences seamlessly into our daily journey, a world that will also increasingly merge augmented and virtual reality experiences. Finally, as a counterweight to the rapidly changing world of simulation meets reality, there will be an increasing desire for authenticity in our experiences, everything from using vintage ribbon mics for content creation, to music listening using vinyl and tube amplification. It's an exciting time we are in!

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Abbott: Interesting question. In general, I would say that one of the outcomes of hybrid working is that I'm listening to music more often and that music has become a more embedded part

of my life. Music is more likely to be on in the background in my home office than in my corporate office. In a home office you can experience music without the need for headphones, which is a very different, more organic experience. I also see a general acceptance of the importance of music to help with learning, concentration,

and mental health. As an example, my high school-aged son is allowed and even encouraged to listen to music during the non-lecture parts of classes. Additionally, like many in our company, I am an avid follower of both the latest in hi-res immersive sound and authentic listening. **LIS**



Ulderico Arcidiaco

CEO and Founder, Sfera Labs



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Arcidiaco: Our company designs, manufactures, and sells automation and control devices based on open, widely supported platforms such as Raspberry Pi and Arduino. During the last 12 months, we worked on incorporating the newest technologies from Raspberry Pi into our products: the new CM4S, the CM4, and the RP2040.

Exo Sense Pi, based on CM4, with its powerful CPU, has opened new frontiers for environmental sensors and sophisticated audio/noise analysis. A microphone is also embedded for audio processing and voice control purposes. Optional sensors include CO₂ monitoring, seismic monitoring (earthquake detection), and vibration measurement. Thanks to the Sound Eval software utility integrated into its kernel module (<https://github.com/sfera-labs/exo-sense-pi-kernel-module>), the Exo Sense Pi is a powerful tool for those who intend to develop or integrate software applications regarding sound level evaluation with Raspberry Pi.

On the microcontroller front, Iono RP and Iono RP D16, based on the RP2040, are two compact and powerful I/O modules combining a variety of digital and analog input and output lines with onboard memory and industry-standard interfaces. We see a lot of interest in these high-performance multi-core ARM-based controllers. The RP2040, with its distinctive programmable I/O blocks (PIO), can be used for interesting audio processing applications that are otherwise only feasible on DSPs or powerful CPUs.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Arcidiaco: From the very beginning, we at Sfera Labs have chosen to design and manufacture our products in Italy and Europe only. This way, we could maintain close quality control on manufacturing and produce smaller lots with a faster turnaround time.

For the last three years, we have purchased the most critical components in our boards directly from the manufacturers to ensure continuity in the production process, shortening the production chain, reducing the carbon footprint, and focusing on total quality. This process requires a sound financial structure and precise and attentive planning. Today, we are proud of our “Made in Italy” devices and to be one of the few companies that have consistently guaranteed reasonable lead times to their customers.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Arcidiaco: The current political situation brings in new instability scenarios. The long-term strategy is to avoid the concentration of manufacturing capacity and raw materials availability; while some preliminary steps have been made in this direction, plans will take a long time to be implemented. Meanwhile, companies must differentiate their sources, privileging suppliers based in countries with solid and reliable economies. This action plan won't be 100% feasible in the short term and will necessarily increase costs. Still, I believe it will result in improved quality and shorter and more reliable supply chains, reducing the carbon footprint of many industrial products.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Arcidiaco: The audio industry will be positively affected by the ever-increasing performance of core processors. Higher performance on general-purpose processors inevitably means improved quality on a broader range of devices. Thanks to the vast improvements in AI technologies and more powerful interactive assistant solutions, audio will become a dominating user interface in many areas, from home automation to cars. While audio has largely been associated with music consumption, it will

become relevant, if not predominant, as a pervasive interactive user interface for a large portion of human interaction with technology. Another interesting development of AI will be even better recommendation and content discovery tools on the more traditional front of music consumption. While often seen in a negative light, more advanced solutions in this area can potentially improve people's musical knowledge and their experience with less obvious and less mainstream content.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Arcidiaco: Most of the music I listen to is streamed from online platforms. I like how they employ algorithms to tailor the selection to my tastes, and I love having my music with me wherever I go, now all delivered in lossless compression formats. But I also am a Radio Amateur, and I have witnessed with some sadness the continuing and now almost final act of long and shortwave radio broadcasting. While this is the opposite of hi-fi, there was magic in listening to a distant radio station over AM or shortwave radio, with its limited but distinctive audio quality, and also being able to appreciate the effects of mother nature on those radio signals as they bounced up and down the Ionosphere. **LIS**



Ekin Binal

Director of Product Management,
AV Solutions, Crestron



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Binal: Even during this tumultuous time, it was exciting to see new technology and innovation hit the market. The main trend I see is the increasing rate of adoption of Audio-over-IP solutions. This is a trend that a lot of manufacturers have supported by building up portfolio solutions that help audio designs from either the source or endpoint perspective. At Crestron, we have been focused on building up a diverse offering of amplifiers with built-in digital signal processing, all intended to work in concert with our speakers. These support our flavor of AES67, Crestron DM NAX, and Audinate's Dante platform as well.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Binal: Crestron is unique in that we had already been well vested in building products in North America. The biggest challenge was sourcing components that everyone else in our industry—not to mention the automotive sector—were pursuing.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Binal: I do believe things are constantly getting better. After all, we went through a completely unprecedented time: A global

pandemic leading to factory closures, increased demand, and limited output.

It was sort of a perfect storm, and I think stabilization is coming by way of adapting. For example, we see more of our customers looking further out for planning and staging projects—it's become a necessity in the current economic and supply chain climate. There's a silver lining to that, though—greater planning at the outset of any project, especially regarding solutions such as distributed audio, makes for much more successful installations.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Binal: The most promising thing in the audio industry is that we are starting to see "smarts" in more and more products, it was at first limited to just the audio sources or processors in the rack, but now we're even seeing smart technology in the speakers that are used throughout a space. The best way to take advantage of these "smarts"—and, in my opinion, the real value of these developments—will be to help deploy and optimize the usage of all the components in a system. This could come by way of automatic room calibration or perhaps leveraging artificial intelligence and machine learning to determine and adapt to noise in the environment automatically. To fulfill its promise, all this newfangled technology just has to work together to improve the experience seamlessly. We need to lead the way with the user experience. In an ideal world, the technology is transparent to the end users: Things just work—and continue to work—better than ever.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Binal: As one might expect, I use a full stack of Crestron equipment to listen to music. Specifically, I use the Crestron Home platform with Crestron DM NAX amplifiers and Crestron

Ultimate Speakers (that we built in collaboration with Origin Acoustics). I rely on content from the various music service providers that we integrate with, and to my surprise, I do use all of these services on a regular basis; Apple Music, Qobuz, Pandora, SiriusXM, and Tidal. **LIS**



Espartaco Saez

Commercial Director of Beyma

beyma //

Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Saez: From our perspective, the greatest progress has occurred in the two patents that Beyma has presented in Compression Drivers at ISE Barcelona 2023, and on which we have been working over the last two years. Thanks to the VPEQ and DEPLOCX patents, we have made significant advances compared to what currently exists on the market.

In a few words: VPEQ provides a more linear extended response through variable pressure equalization and DEPLOCX allows us to maximize SPL, improving the unwanted effect of power compression by up to 15%, among other benefits.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Saez: All our product is basically made in Spain. It is true that several of the parts we use come from the far east (among other places). The pandemic with the consequent disruption of the supply chain has exposed some weaknesses, such as (for example) depending on a single supplier for certain key raw materials. This analysis has led us to launch diversification actions that have sometimes involved bringing supply sources closer to our factory in Spain. This is not an easy action, especially considering that we are not buying low price commodities, no matter where. Our raw material purchasing policy is based on long-term agreements with approved suppliers who are considered partners, rather than suppliers. It is like this because the quality and precision of the parts we use are essential in the Beyma value chain. Therefore, diversification decisions are neither easy nor quick.

China continues to have large clusters of industries that do not exist

in other parts of the world, but it is true that there is a sort of exodus to other parts of the planet that are beginning to be competitive in terms of manufacturing, and that are further away from the geopolitical tensions that are taking place there.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Saez: There is hope that once the pandemic is over, the supply chain will somehow return to the "old normality." In any case, what has happened in the last two years has led many companies (including ours) to rethink the way of doing things and where to do them, implying, as I said before, a diversification and strategic approach toward Europe.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Saez: In the coming years, immersive audio is going to be a driver for the audio industry in general and we see it as the main driving force for the pro-audio industry, where a multitude of high-precision transducers are required. This situation will create opportunities for many.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Saez: After two years of pandemic and a return to normality, it has been made clear that there is nothing comparable to the experience of live sound, hence the multitude of concerts happening and the massive attendance to concerts. In an era where virtual experiences do not stop growing, it has, once again, been proved that humans are social beings and there is no better musical experience that being surrounded by friends in front of your favorite band.... And that is why we are all here. **LIS**



Simon Godfrey

Sales Director,
Wharfedale Pro,
IAG Group



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Godfrey: From the market perspective, we have seen increasing excitement around immersive audio solutions. For many, this is probably the most exciting current system trend. First, from a performance side, immersive audio solutions are allowing creative minds to build amazing shows and installations. Second, from an audience perspective, immersive events are opening people's ears to the real potential that we have in professional audio. And, third, from a business perspective, it encourages the re-evaluation and on-going improvements of many fixed installations around the world.

Naturally, Artificial Intelligence (AI) is a huge technology step for humanity but it inevitably will also open many opportunities for the creative, technical and audience experiences in our industry. How that looks, when, and what the practical realities will bring are a different issue, but certainly AI will play a major role within our professional audio industry.

These are the big strategic advances that I see ahead of us but, my biggest excitement, which is happening right now, is to see our customers and partners face-to-face again as the world has re-opened.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Godfrey: We have been fortunate because of our manufacturing processes and our tight relationships with our direct component suppliers. Because Wharfedale Pro is part of the IAG Group of companies that includes many famous hi-fi brands, we have our own extensive factory in China, which employs our own staff. This helped us greatly with communication and workflows during the pandemic. In addition, our local relationships with our major component suppliers has also been strong and, as a result, we have been able to ensure that we have had suitable advance notice of any potential component level supply chain issues. With our own IAG Group factory, we have been able to re-engineer many Wharfedale Pro products when components have become in short supply. This re-engineering has improved product performance and cost effectiveness. Developing current and building new relationships has been a critical factor throughout the pandemic and continues to be vital for ongoing business growth.

But the component supply chain issues did provoke us to re-evaluate many of our ranges. That was something that needed to be done as, to be honest, over the years our portfolio had become too big. We therefore introduced a good/better/best philosophy, which reduced some series significantly and this simplification has resulted in a more understandable offering to the market and a more agile internal workflow.

Fundamentally the Wharfedale Pro strategy didn't change, but the pandemic certainly created many unique supply challenges, and we re-engineered several products where necessary. Simply put, Wharfedale Pro was in a very fortunate position as our internal teams and suppliers minimized the need for any major upheavals that could affect our customers.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Godfrey: As we move forward, we see some larger organizations consolidating their distribution activities through the use of fulfilment centres or dedicated online portals. However, for Wharfedale Pro we believe that the "local distributors" add extreme value and are needed in the supply chain. That local service, support, knowledge, passion and, ultimately locally held stocks are vital for us to grow as a business and as a brand into each corner of the world. By working closely with our trusted local distributors and partners, we have been able to forecast business accurately and this has helped greatly with the critical "continuity of supply."

We all know that business moves fast and that customers expect delivery on both products and services so for our Wharfedale Pro brand, we need to remain agile and to have the responsiveness to adapt to any changing conditions.

In the end, I anticipate that supply chain stability can return through those hard-earned and solid relationships throughout the chain. It's hard to speak about the global situation but from our side, it's important to know that everyone was involved, from product conception to final installation, which has helped stabilize our own effective supply situation.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Godfrey: I touched on this in the first question, but AI is without doubt the biggest potential innovation for our industry (and maybe for humanity). To make even the most complex audio systems easy to use and in addition, to be able to intelligently

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maximize the audio performance of the system. We can't ignore the potential of that technological innovation.

Everyone's lives are already full of "noise" and none of us have enough spare time... but through AI there is a great potential to make our lives easier. It's "into the unknown" but we are very conscious that information, applications, and systems need to be "easy" regardless of their underlying complexity. We owe that to our customers. AI will also bring the industry opportunities to achieve improved performance results for audio systems where operator skills are limited.

Combining Immersive Audio and Beam Steering technologies could be another interesting topic for discussion. For me, it's very exciting and I am looking forward to our strategic plans and where the future takes us...

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Godfrey: That's easy, I now listen to music through a well-known streaming platform and to have that instant access to any track I want to listen to has made my iPod and CDs very redundant!!!

But it's not all about recorded music—the growth of live performance is an experience and fantastic to see and hear. We all love our music, after all, it's why we are all here and why you are reading this, but to experience more bands performing and touring enables people to come together and there is strong evidence linked between music and mental wellbeing.

It seems artists can no longer rely on album sales due to increasing streaming platforms and that has become a plus for the live performance sector as more and more artists see live as their income source. A positive for our industry, and for me, LIVE IS BEST! **LIS**



Siamäk Naghian

Managing Director, Genelec

GENELEC®
the sonic reference

Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Naghian: Immersive audio, audio-over-IP, and digitalization have been the most important trends in recent years. While not "new" as such, new developments within these fields continue to emerge as the technologies and market are getting more and more mature.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Naghian: Unlike the majority of the industry, we have always carried out the research, development, and manufacturing of our products in Finland. Our strategy was an exception some years ago but time has shown that it was the right strategic path for us. Also, in terms of our supply chain our aim has always been to focus on long-term relationship building, which has served us very well over the years. Consequently, we have not seen any reason to change our approach as a result of the pandemic.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Naghian: There are many factors shaking the global supply chain: geopolitical and economic factors, logistics, transformation in different industries, etc. The macro-level factors are so significant that it will be very unlikely to see stabilization in the supply chain in the near future. I think the best approach to minimize the risk is to build long-term relationships with supplier networks.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Naghian: Immersive, audio-over-IP, and audio software will probably remain the most promising areas in the pro audio industry, as well as in the consumer market.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Naghian: These days, almost 100% of my listening happens via on-line or digital media as far as content is concerned. For reproduction and listening, I listen to music using headphones or high-quality loudspeakers, and there have been no changes for me in this regard over the last 12 months. **LIS**



Mathias Johansson

Chief Product Officer, Dirac



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Johansson: The industry push for immersive audio formats (i.e. multichannel formats) is the most obvious trend right now. Immersive audio formats are not easily accessible for most consumers, and consequently there is a strong push by major industry players such as Dolby to include immersive audio format support in several product categories—most notably in car sound systems where it is possible to realize quite stunning immersive experiences. We also see several wireless speakers including support for immersive audio formats although the form factor can be challenging.

Within automotive audio, there is a paradigm shift due to the electrification of cars and centralized architectures. With this shift, the traditional supplier system is reshaped, and car makers increasingly source different parts of the infotainment system, such as software and hardware, separately. The car audio system is quickly becoming software-centric rather than hardware-centric, and in many ways, car audio systems now lead the way in advanced audio processing for better sound experiences. Given the increasing consumer demand (as evidenced by a high willingness to pay) for better car audio systems, and the acoustically challenging car cabin, it is no surprise that car audio systems now adopt state-of-the-art digital signal processing systems for overcoming acoustic issues.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Johansson: Dirac has not really changed its strategy following the pandemic. The demand for software-defined audio systems is increasing and the demand for being less dependent on specific hardware components that may suddenly be in short supply, has led to an increased appreciation for our core value propositions.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Johansson: Any trend that is to persist long-term needs to be aligned with key consumer demands. The new features or technologies pushed by the audio industry are not always aligned with such consumer desires. Therefore, we need to take a user-centric perspective to predict long-term trends.

Consumers primarily desire higher sound quality in convenient form factors and with easy access to relevant content. Convenience, accessibility, and sound quality are very important to consumers. Hence the trend toward smaller speakers, the proliferation of streaming services, and the increasing use of digital sound quality optimization, whether it's

room correction for the end user or factory-calibrated audio systems utilizing the latest advances in electroacoustic optimization.

The popularity of Spotify is based on its convenience—ultra-fast access to the content that consumers love. The rise of the Wi-Fi speaker, at the expense of bulkier stereo systems, is also driven by convenience. Here we see a continuous drive for higher performance in terms of sound quality. Consumers care mostly about the traditional measures of sound quality and want a full-bodied speaker response in spite of small speaker sizes. They want improved voice intelligibility and overall transparency. Interestingly, and what would have been surprising to many in the industry just 10 years ago, streaming services increasingly adopt lossless and hi-res content. This is a trend that is here to stay.

Although the audio industry is pushing for new immersive audio formats, it is not immediately clear that this resonates with end users' desires for convenience and sound quality. Spatially rich (i.e., immersive) experiences could even sometimes be a distraction, since music listening is typically a background activity while the user is engaged with something else. Home audio systems today often consist of a single Wi-Fi speaker or Bluetooth speaker—that struggle even with reproducing stereo material. We are back to mono and, although users demand good sound quality from these mono devices, they are willing to sacrifice the spatial richness of stereo or multichannel content in their desire for reasonably sized sound systems.

Advanced car audio systems are able to reproduce immersive audio well if they use advanced digital optimization, and therefore the industry is focusing on this use case as a means of introducing the merits of immersive audio to consumers. As consumers are willing to pay a premium for high-end car audio systems, and as the additional speakers in a car don't take up valuable living room space, this is a good match. The question remains whether immersive formats will be the best way to achieve an immersive experience, keeping the user craving easy access to relevant content in mind. Most content is simply not yet available in multichannel formats and to manually remix content is laborious and costly. Perhaps automatic upmixing technologies that create immersive experiences from legacy content will be the mainstream option for immersive audio experiences while multichannel mixes become a more exclusive niche market?

What is clear is that the drive toward smaller and more conveniently packaged sound systems is here to stay. This is a trend driven by end user demand. Similarly, consumers want good sound quality in the traditional sense of the word. Therefore, it seems equally clear that the trend toward more advanced digital signal processing to optimize small speakers and improve the traditional sound quality measures will persist, and if anything, accelerate. More convenient room correction systems that create a clearly audible improvement will become mainstream for home audio systems. Digital control of transducers in earphones and speakers will be included from the factory and possibly offered as aftermarket upgrades. In related areas, active noise control will continue to improve and evolve into smarter and more selective control of disturbances and will merge into enhanced hearing systems.

The automotive audio space is increasingly taking the lead in pioneering sound experiences and using advanced audio technologies to their full

potential. Although high-end home audio systems have higher potential, more people are exposed to premium car audio systems. They are a great fit for immersive audio, and there is room for many speakers, as well as a high willingness to pay for premium sound. End users accustomed to great car audio systems will demand similar performance from their wireless speakers and headphones, and with the prevalence of high-quality media, we foresee higher-performance sound systems in all categories, driven by software-based technology that overcome the challenging form factors favored by end users.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Johansson: At home, we listen to wireless speakers in our kitchen and living room, and for high-end audio experiences I rely mostly on my Volvo's B&W sound system. While on business trips, I use digitally optimized in-ears that utilize very cautious "spatialization" to correct for the unnatural stereo imaging in headphones. My listening habits have remained stable and have not changed in the last 12 months. **LIS**



George Krampera, Jr. CEO, KV2 Audio



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Krampera: For us, the return to point source development and thinking by many of our competitors can be seen as a vindication of our decision to stick with our beliefs, and not simply follow the line array fashion of 20 years ago. The same for analog, which we have stayed firmly behind and which is making a real resurgence, particularly with a selection of faster more accurate components and operational amplifiers (op-amps), which raise the possibilities of audio reproduction to even greater heights.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Krampera: Because KV2 products require very critical levels of component tolerance, we were already working with lead times of around 18 months before the pandemic. Coupled with this requirement we were therefore holding very good stock levels on most key components. Certain transistors, to be manufactured in the way we need them, now require an order 3 to 4 years in advance, which is uncomfortable, but not that huge a change for us. We already manufacture as many parts as we can across Europe or internally, including winding our own toroidal transformers, and that makes a real difference to keeping things under control and maintaining the KV2 quality.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Krampera: I don't believe things are going to improve that much in the short term so companies need to change their approach and adopt a model that includes having a substantial inventory

of not only their own stock, but also the raw materials to build more. Obviously this may be at odds with an accountant's or investor's perspective, where raw materials can tie up cashflow, but the "just in time model" has led to many companies being unable to fulfil their order books over the last year with some still experiencing ongoing problems now.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Krampera: I think the industry will move toward a higher quality. There are a lot of engineers in schools and colleges currently being taught to create sound on a computer screen and not necessarily using their ears at the right time. This is, in many cases, leading to a mediocre concert experience across the world's stages and eventually audiences are going to sit up and demand more. Embracing point source technology and improving analog designs will help facilitate this improvement, but more careful deployment of immersive sound will also be required as it can become a less considered tool, sometimes focused on selling more speakers, rather than providing an enhanced or more real audio reproduction of the original source.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Krampera: The best way to listen to music is in its purest form, which is analog. This is often vinyl for us, certainly in testing our products, but care must be taken in selecting the source material as there are quite a few digital recordings simply pressed onto vinyl these days, giving you none of the real advantages of analog, just dust crackle and noise added to a digital recording. Digital obviously brings the convenience of control, streaming, and file organization but when the music or sound quality really matters, it has to be analog for us. **LIS**



Daniel Knighten

General Manager, Audio Precision



An Axiometrix Solutions Brand

Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Knighten: As ever, new digital audio interfaces continue to bring new features and new challenges. Bluetooth 5 and LE Audio promises to bring many new features but also many new challenges for product developers. I would also like to give a shout out to microelectromechanical systems (MEMS) speaker technology. It looks like MEMS base speakers are about to breakthrough into the mainstream.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Knighten: Audio Precision (AP) was better placed than most companies to handle the supply chain challenges created by the COVID pandemic. In particular, AP has always been a nearshore company having had a long-standing policy of working with manufacturing partners within 200 miles of our geographic location. In addition, we have always carried a relatively large inventory compared to companies who relied on just-in-time manufacturing.

The major shift for us has been that outside of manufacturing, a large amount of our workforce is able to work remotely, and that additional flexibility will be maintained going forward.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Knighten: Supply chains are trending back to normalcy or what they were prior to COVID. My prediction is that they will be more robust in the future as manufacturers at every level have learned the costs of being dependent on one supplier or even one geography. Companies are now thinking about what happens if the one factory that makes their ICs catches fire or if the one country where all their contract manufacturers are based shuts down. The result has been more strategic thinking about and greater diversity in supply chains. New factories

do not come online instantly, so it is taking some time, but I believe the ultimate result will be more robust and less fragile supply chains.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Knighten: Audio is a remarkably stable and steady industry, no doubt driven by the fact that the human ear and human audio perception is a relatively fixed proposition. Nonetheless, I am excited by several trends:

Individualized and customized head-related transfer function (HRTF) EQ curves built into devices: The work of Sean Olive and company has demonstrated that it is possible to determine what a good target frequency response is for any headphone. The next frontier are headphones that will measure a user's hearing response and develop a custom, per person, EQ curve that accounts for the natural variation in ear geometry of different people.

Over-the-counter (OTC) hearing aids or personal sound amplification peripherals (PSAPs): The dramatically lower cost of OTC hearing aids, and hearing-aid-like functions built into existing devices like the Apple AirPods, promise a dramatic improvement in quality of life for millions if not billions of people who suffer from some degree of hearing impairment, often without even realizing it.

Or to summarize the above, the ever-decreasing cost of digital signal processing and increasing battery capability make it possible to use DSP capabilities to greatly enhance the audio experience at an individual level. I believe that in the future, it will simply be a given that all audio reproduction systems will use embedded DSP to improve the performance of drivers and deliver a superior experience for each individual listener.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Knighten: Yes, having stopped going to record stores during the lockdown I finally made the switch over to online music streaming. Working from home for 2 years turned me into a much larger consumer of music as well. **LIS**



Jon Kiachian

President, MedTech & Specialty Audio, Knowles Corp.



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Kiachian: The audio industry experienced a crescendo of innovation over the past year, with more brands coming to market with competitive premium sound solutions—especially for high-res audio streaming. HD streaming services, improved Bluetooth codecs, and all-new driver and DSP innovations have upgraded the listening experience in the past 12 months.

As lossless streaming services proliferate and hearing health and premium audio converge, the team at Knowles has been hard at work to bring the best solutions to market. The audio engineers at Knowles invested significant time into understanding how to deliver the best possible listening experience for consumers—resulting in a study that bore the Knowles Preferred Listening Response Curve.

Concluding that treble boost and hearing personalization are pivotal to the listening experience, Knowles designed its KN2 reference design: the first set of earbuds tuned to the new Knowles curve. We've been excited to help fuel the expansion of premium sound through hybrid driver technology—both through the reference design and partnerships with leading in-ear monitor (IEM) and true wireless stereo (TWS) earphone brands. Following the highly anticipated FDA ruling to define an over-the-counter (OTC) hearing aid category, we've also been excited about new hearing health applications. We look forward to supporting more customers as they strive for more accessible hearing aids.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences of supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Kiachian: Knowles' dual manufacturing sites enable reliable supply chains for its components. Knowles has also invested in automation to optimize its in-house product manufacturing for high-volume balanced armatures. The company's long tenure in the premium audio market has enabled us to maintain high-quality, scalable custom product and process design with high supply reliability.

Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Kiachian: As technology companies explore new ways to deliver on product demand, we'll see more local sourcing and in-house development to combat long lead times and high demand. I also anticipate companies adjusting their product designs to take advantage of new high-volume manufacturing processes. At Knowles, we know from experience that having multiple proprietary manufacturing processes provides benefits in scalability, speed and flexibility, and we hope in the future to continue to help deliver high-demand solutions for our partners and their customers.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Kiachian: We are seeing consumers who want more personalized audio for an immersive experience. The availability of HD audio and hearing personalization options will fuel innovation in the premium audio market for years. Especially now that brands are racing to achieve high-res certification and deliver truly lossless streaming, we expect more designs to leverage the benefits of hybrid drivers—with a balanced armature and dynamic driver working in tandem to provide full-range, high-quality audio—over the next five years. In addition, the convergence of hearing technologies like earbuds, hearing aids, and wearables will make premium sound more accessible in the next five years. We expect OTC hearing aids will continue to broaden access to hearing aid adoption, reduce stigma, spur innovation, and accelerate the convergence of hearing augmentation and premium audio in the hearing health and earphone markets.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Kiachian: Everyone's hearing is different, so personalization is a game changer for optimizing sound quality. With the completion of the Knowles Preferred Listening Response Curve study, I've appreciated hearing personalization features and exploring how the extended treble range can upgrade my listening experience. I've also been taking advantage of HD versions of my favorite classics, like "Take Five" by the Dave Brubeck Quartet and The Eagles' "Hotel California." HD streaming rings each note, symbol hit and effect distinctly and clearly, restoring a vital part of the performance lost with older file versions. **LIS**



Claudio Lastrucci

R&D Director, Powersoft



Antonio Peruch

Production Engineering and
Cost Assessment Director,
Powersoft



Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Lastrucci: Alternative energy production and alternative energy storage were the most exciting innovations for us. The same patterns we have seen happening throughout history are repeating, with crisis—unfortunately—being the main driver for research funding and innovation. The tumultuous times we are witnessing have pushed research efforts to find new solutions for generating, storing, and using energy more efficiently.

Question 2 : How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?
Question 3: Do you have any predictions as far as the future of the world's supply chain and what can be done to stabilize it?

Peruch: Like most manufacturers in our industry, Powersoft has also been facing challenges to source raw materials and in particular chips. All of the supply chain is under pressure due to the fact that all the parts have increasing in terms of cost (metal, plastic, etc. and especially Silicium) where manufacturers and then dealers apply new prices on back order dated over one year. The incredible things of the moment are that the price increase but the deliveries do not arrive anyway. The forecast of this crisis does not see a light of the end of tunnel at the moment and we are now speaking about the end of next year.

We have been investing in components for many years. Thanks to good management of our working capital, we are able to purchase significant numbers of materials, which are essential for production. As a result, we are able to go through much longer difficult periods being less impacted.

We are of course being challenged by the industry shortage, but our laboratory constantly works on adapting and redesigning parts of the project with versioning, our electronic boards, partly smoothing this effect. Powersoft has total control of its technologies, and reaction times for decision-making are very short, as everything is managed

in-house. All the orders for components for 2023 have been placed; we are already working on the next years. This was already decided in the first half of 2021 when we realized the situation was not improving and was taking a new ramp which we define as “manual allocation.” We have full visibility and control of our production line. In recent years, we have also made significant investments to relocate the integration of the electronics in the mechanical part of our amplifier racks to our factory, following a lean production technique and strategy in the assembly and testing of all our products. We have supported our EMS with proper long-term planning to mitigate the risk of long component procurement times. Thanks to Powersoft's leadership, negotiation and purchase is increasingly directly with primary suppliers. We are also improving our processes for an increasingly correct estimation of the needs and demands of the market and the relative planning to satisfy them.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Lastrucci: Some of the most promising developments come from the convergence of AI and cloud-based technologies, which will allow us to optimize the efficiency of connected devices in real time on a scale that we have never seen before. We are increasing the power density of audio amplifiers to cope with demand, this not only makes for more efficient deployments but also greatly simplifies system designs. The advantages of high power-dense power devices are felt across the whole chain, from production, distribution, set-up, and use. Transducers are also becoming increasingly more efficient in order to cope with low energy impact demands, and physical design limitations can be overcome through deep merging between amplification, transducers, and processing.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Lastrucci: I listen to music pretty much everywhere: at home, in my car, at work, and when I play the piano. And my listening habits have not changed at all, still with my ears. **LIS**



Zami Schwartzman

CEO, Thermoguide, Ltd. — Servobass

THERMOGUIDE



SEROBASS
Motion Feedback

Question 1: What were the most exciting developments, technology innovations, and trends happening in your field of interest over the last 12 months?

Schwartzman: Spatial audio formats such as Dolby Atmos, Auro-3D, 360-Reality have evolved from expensive home theater gear to become affordable with small wireless smart speakers by some of the major brands. Other than virtual assistance features the audio quality has become a significant differentiator and specifically the bass reproduction quality because people use these products also for experiencing their favorite music in bedrooms, home office, and kitchen.

Question 2: How has your company changed its strategy following the pandemic? In light of the consequences associated with supply chain issues, have you made any major changes such as reshoring and/or moving production out of China?

Schwartzman: For many years Thermoguide has been focused on engineering services to pro audio software tool developers as a subcontractor. In the last three years our business suffered from the pandemic slowdown and we decided to move on to a new adventure and we invested most of the pandemic years in developing a new listening concept with our Desktop Subwoofers.

During our work with recording studios we discovered that many sound engineers and musicians cannot afford large studio monitors, thus not really hearing the bottom octave of their music. Also, most of the larger monitors use ported enclosures, leading to sustained, overhanded “boxy” bass notes. Sound engineers never liked subwoofers because they are large, sensitive to room modes, and difficult to place for acceptable sound. So we decided that small Desktop Subwoofers with small monitors on top of them would be the best solution for near-field listening in pro and home studios. We chose to bring back an old technology that was successfully implemented by Phillips in 1968—motion feedback (MFB).

With modern driver materials and components we successfully brought it back to life. Instead of 1968’s Class AB bipolar transistor amplifiers and ceramic accelerometers, we used a MEMS accelerometer, robust drivers, Class-D power amplifiers, switching power supplies, and smart control circuits that also protect the voice coil from overheating. With that design concept, we prototyped and demonstrated a powerful flat response of 30Hz to 300Hz with a 6” driver in a sealed box measuring only 20cm 20cm×20cm.

We then built 12 prototypes that were circulated among sound engineers, guitar players and drum machine players. The response

we received was outstanding and convinced us that we have a valid concept worth commercializing.

Now, Thermoguide is focused on finding business partners that will carry our concept through manufacturing to the consumer market. We are also open to licensing our MFB technology to manufacturers. (For details contact zami@servobass.com or visit www.servobass.com)

Question 3: Do you have any predictions as far as the future of the world’s supply chain and what can be done to stabilize it?

Schwartzman: As audio products get more sophisticated, they require up to date fast-evolving processing devices that have become difficult to source. That was a serious issue during the pandemic uncertainty years with factories shut down, order cancellations, traveling restrictions and high transportation costs. I think that manufacturers should be more focused on local component and technology providers they can effectively work with on fulfilling the frequently changing supply demands.

Question 4: What technology innovations and trends do you consider to be the most promising in the audio industry for the next five years?

Schwartzman: Smart audio processing algorithms and chips will probably dominate and continue the change of high-quality audio reproduction products. If 20 years ago we used turntables, CDs, and Class-AB transistor amplifiers wired to bass reflex speakers, that has changed to using wireless smart speakers, spatial immersive audio, built in virtual assistance features and endless music that can be sourced by voice commands. I think this trend will continue with even smarter AI-powered user interaction features and much better audio quality.

Question 5: How do you currently listen to music? Did your music listening habits change in the last 12 months?

Schwartzman: For many years I listened to my Electrostatic panel speakers using vinyl records and CDs while sitting in a sweet spot in my living room. In the last 12 months I started listening to web-sourced music in my home office while sitting in front of my desktop subwoofers setup without disturbing other family members. The sound quality is superb, I got much more sensitive to stereo image and bass quality. I discovered there are many high-quality recordings that I can enjoy now for many hours without fatigue while working in my office. I also enjoy watching movies in my office with extended high quality bass without disturbing others. **LIS**

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