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THE 2025 TECHNOLOGY & INNOVATION AWARDS

THE GREATEST TECHNOLOGIES AND INNOVATORS IN HIGH-END AUDIO.

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TECHNOLOGY OF THE YEAR: DIGITAL SOURCE

Wadax Reference System

BY ROBERT HARLEY

THE Wadax Reference System, comprising the Reference DAC, Reference Server, Reference Transport, Reference PSU, and Reference DC Cables, pushes forward the state of the art with a whole host of innovative technologies executed at the very highest level.

This massive six-chassis system (DAC and two outboard power supplies, server and optional outboard power supply, and CD/SACD transport) is remarkable not just for its spectacular sound quality, but also for opening a window into the mysterious world of digital-audio conversion through its unique technology. The Wadax system is brimming with innovative ideas that elevate the sound quality of digitally reproduced music to new heights.

The first of these innovations is Wadax's "MusIC" integrated circuit. This chip is a feed-forward error-correction circuit that removes distortions created in the digital-to-analog conversion process. Wadax mapped the specific distortions that occur in D/A conversion and then programmed into the MusIC an inverse signal that counteracts these known distortions. The idea was first developed in 2004, but the process is so computationally intensive it required 32 dedicated general-purpose DSP chips to execute at the time. As computing power increased and shrunk in size, Wadax was able to run the process on a cell-based ASIC (application-specific integrated circuit).

A second proprietary Wadax technology that has greatly improved the sound of digital is the Akasa digital interface. This is a bi-directional optical interface in which the DAC is the master clock. This precise clock is the timing reference for the digital-to-analog conversion stage. This clock is also sent back to the source components so that the source components lock to the DAC. The Akasa interface converts electrical signals to optical for transmission, and then back to electrical at the receiving end. This technique not only removes a source of waveform distortion as electrical signals travel down copper wire, but it also eliminates galvanic coupling between components and completely isolates the DAC from noise.

THE WADAX SYSTEM IS BRIMMING WITH INNOVATIVE IDEAS THAT ELEVATE THE SOUND QUALITYOF DIGITALLY REPRODUCED MUSIC TO NEW HEIGHTS

The next, and most intriguing, Wadax technology is the waveform controls on the Wadax Reference Server. The four rotary knobs and accompanying front-panel display of their settings compensate for and correct digital waveform distortion that occurs in the interface. These controls change the rise time and gain of digital signals leaving the server as well as the return signals from the DAC to the server. Although the data remains the same, the digital waveform's characteristics are different, resulting in an analog-like variability to sound quality.

These innovative technologies are implemented with extraordinary design and build-quality in the Reference products. Consequently, the full Wadax digital front end occupies six massive chassis, costs nearly half a million dollars, and weighs approximately 400 pounds. This obviously puts it out of reach for most music lovers, but this cost-no-object realization of the company's innovations nonetheless demonstrates what is possible when a digital front-end is built from such innovative and original thinking. tas

Javier Guadalajara

Founder, Wadax

BY ROBERT HARLEY

Robert Harley: Why did you choose to focus your career and company on digital audio?

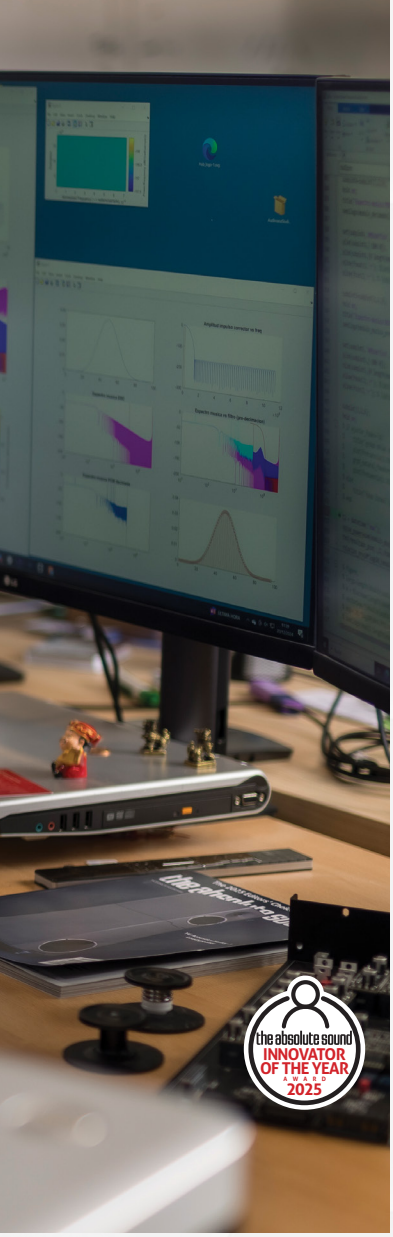
Javier Guadalajara: My beginnings were deeply inspired by my father and his multidisciplinary engineering approach. It wasn't out-of-the-box thinking; there simply was no box to refer to in the way he generated new ideas. He applied this philosophy to electroacoustic and electronic design. His way of thinking became his legacy, my foundation, and ultimately, the underlying philosophy for my company and career.

Early on, I envisioned a dream: reproducing music as closely as possible to a live performance. It was clear to me that digital signal processing would be essential in overcoming the various performance limitations inherent across the entire playback chain—from the media source to the pressure waves reaching the listener. I cannot envision a state-of-the-art music playback system without effectively combining digital and analog technologies. Since digital processing was a necessary ingredient from the very beginning, as well as for current and future projects, the logical first step was to develop a digital-to-analog converter. One that conveys the emotion inherent in music while remaining accurate and realistic, rather than delivering super-accurate but sterile results—or the opposite.

RH: The highest level of the Wadax Reference digital playback system comprises six chassis and weighs more than 400 pounds. Why did you decide to develop products at this level rather than more conventional products?

JG: Every day involves making choices, and I chose long ago to engage in projects where overcoming performance barriers is the main challenge. Each achievement, in turn, becomes the stepping stone for a new challenge. Fifteen years ago, our first product was a single-chassis unit. Then it evolved into a two-chassis system, then three, and continued from there. Many factors influenced this decision, such as component isolation, the number of parts, practical size considerations, and mechanical characteristics that directly affect performance. If we tried to incorporate all the components of a Wadax Reference System Level 8 into a single chassis, it would be as large as a midsize car and offer significantly lower performance—simply unmanageable.

"WE ARE EXPLORERS, AND I DEEPLY ENJOY THE PATH I'VE CHOSEN."



INNOVATOR OF THE YEAR

Javier Guadalajara/Wadax

RH: Are you surprised by the continuing discovery of distortion mechanisms in digital audio? Some of those distortion mechanisms seem improbable in theory until you listen and hear the difference. Examples include the DC cables between the power supply and DAC, the ear's sensitivity to infinitesimally small amounts of clock jitter, and how the shape of the digital waveform exerts an analog-like variability on the sound.

JG: We are explorers, and I deeply enjoy the path I've chosen. As we advance and find solutions to overcome performance barriers, we inevitably discover new obstacles in our quest for the most realistic and musical playback possible. For example, our DWC technology [*Digital Waveform Control*] allows users to fine-tune musical performance by altering bit shapes in terms of rise-time, droop, and other characteristics. To my knowledge, there are no engineering papers—either from IEEE, AES, nor advanced engineering studies—that extensively examine the correlation between bit shape/regeneration and the analog output of digital-to-analog conversion circuits. This isn't because such correlations couldn't be discovered through analysis, but because they seem insignificant outside the context of high-end music playback.

This is just one example among many that underlie our technology and products. Our ideas lab operates constantly, leading to new core technologies and improvements that emerge at the right time. Occasionally, our exploration still brings excitement and surprises, often unexpectedly.

RH: The Reference system includes several proprietary Wadax technologies, including the MusIC chip in the DAC, the Akasa bi-directional optical interface, and the Reference Server's ability to change the parameters of the digital waveform through front-panel controls. Tell us a little about each of these technologies.

JG: The MusIC process digitally corrects analog errors occurring from the digital-to-analog converter to the output socket. Throughout this path, deterministic time and amplitude errors occur under various load conditions. These errors are mapped, and the MusIC process intercepts and modifies the digital audio stream before reaching the DAC, effectively canceling out the natural errors inherent in analog circuitry. To my knowledge, no other company in our niche follows this unique approach.

The Akasa bi-directional optical interface began as a four-year project aimed at overcoming the limitations of standard USB interfaces used for digital audio. It required groundbreaking innovations in mechanics, optics, electronics, and coding—a multidisciplinary approach that opened new doors, leading us to further opportunities and discoveries.

The digital waveform control via front-panel buttons was a fascinating project, seemingly defying traditional engineering assumptions. Typically, it's assumed that storing and later retrieving digital data removes disturbances in a digital stream. However, this assumption does not hold true in music playback systems, where even minor variations in bit shape significantly affect the output signal. This technology enables users to fine-tune multiple aspects of musical performance.

RH: How much more is there to learn about digital audio?

JG: As our exploration continues, the more we discover—the more we realize how little we actually know. Sometimes I envision myself standing in an endless corridor lined with closed doors, similar to scenes from a dystopian movie. Each door, though seemingly ordinary, opens to a different reality. Behind any given door might lie a transformational discovery. I feel we still have numerous doors left to open, and some doors will require the unlocking of previous ones.

An example is our new PSU technology, recently developed and first applied in the Studio Player Collection as the Studio PSU. Despite substantial advancements in PSU technology over the years, we initially thought further improvements would yield minimal impact on analog output quality—until this new door opened. This latest PSU advancement significantly reduced sensitivity to digitally induced artifacts across the entire digital-to-analog conversion chain. A similar breakthrough occurred with our next-generation clocking technology, first implemented in the Studio Clock.

In short, I believe we have at least another decade of notable advancements ahead in digital audio. tas