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soundInnovations: the manufacturer's view

The Horn-Loaded Coaxial Loudspeaker Revisited

Equator Q Series Powered Reference Monitors

by Ted Keffalo

The upcoming AES Convention in New York is the coming-out party for Equator Audio Research and our trio of biamplified reference monitors, the Q10, Q12, and Q15 (10-, 12- and 15-inch woofers, respectively). Based on our proprietary Digitally Controlled Transducers, the Q series sports innovative DSP capabilities to maximize monitoring clarity and accuracy and to compensate for acoustic anomalies in the listening environment. Here's their story...

I've been involved in monitor development for over 20 years, and in and around studios far longer than that. I've been with some great companies, including Alesis through its heyday, and Event Electronics (which I co-founded). When I left Event and started Equator Audio Research, my goal was to create a coaxial system that delivered that huge "shock and awe" studio sound, but with more clarity and a smaller footprint than previous coax designs. And I wanted coaxial precision—that focus and precise imaging you get when the sound emanates from a single-point source (what we trademarked as "Zero-Point Reference").

Equator's Q10 reference monitor

Out of the chute, I enlisted Walter Dick to help design the transducers. Walter had cut his teeth on the Altec 604—one of the greatest coaxial designs of all time. He had done amazing work at Gauss and as chief scientist at JBL. Walter joined Alesis to design the Monitor One transducers, and when Event was formed, came on board as the company's premier transducer engineer.

Walter and I knew there were going to be challenges with my proposed monitor design, both technical and sonic (the latter because my ears were accustomed to silk tweeters and fourth-order crossovers, not coax horns). How to address them? With serious DSP, that's how. Ultimately, that led to the creation of our Digitally Controlled Transducers.

The impact of that breakthrough technology was immediately apparent in the overall development process. In the pre-Equator days, Walter would design transducers along with a cabinet, crossover, port tube, and so on. He'd then test the design, review the computerized measurements, and make changes to fix whatever problems he saw. Each change required another prototype, which meant waiting for a sample to be manufactured, followed by a new test, more changes, and so on. It was a long, laborious process.

Fast forward to spring 2007. We took a prototype Q12 equipped with the new transducers to a prominent acoustic test lab originally built for NASA. We placed it in their anechoic measurement chamber; an arc of 19 microphones, each spaced successively off-axis in 5-degree increments, hovered above. We played the test signal through the Q12, then analyzed the readout. Our lead DSP engineer grabbed his laptop and typed a new set of coefficients based on the test results. His code was downloaded via USB into the Q12, where the monitor's onboard CPU made adjustments according to the new values. We went back into the control room and performed the test again. More analysis, more code. The readout at the end of the day: *flat*—on axis and off. The lab's engineer wanted to know "what just happened?" "Well," our DSP guru grinned, "we essentially completely rebuilt the system." The engineer was stunned. We did in one afternoon what used to take months to accomplish.

Tight adherence to specification is another huge benefit of the new transducer technology. In speaker manufacturing, no two transducers come off an assembly line exactly alike—ever. Most pro speaker companies "pass" a transducer if its performance is within +/-2 dB of spec. But even with two "passed" transducers, you could wind up with a left/right pair having a 2 dB peak on one side and a 2 dB dip on the other. That's a 4 dB problem.

Digitally Controlled Transducers allow us to eliminate that problem. And each of our transducers is digitally adjusted not only to compensate for manufacturing tolerances, but also to precisely match its performance with that of every other transducer in the system, from stereo through 8.2 setups.

As each transducer comes off our line, its response data (its "DNA") is captured and stored in a database, along with its serial number. If there's ever a problem in the field, the DNA can be loaded in to bring the system back to perfect, cohesive operation.

About the crossover: Equator Q Series monitors do not incorporate traditional crossovers, such as second-order or fourth-order filters. Instead, the speaker's internal CPU creates a digitally controlled, seamless transition from low to high. Yes, the "curve" starts at one frequency and ends at another, but it follows no predetermined slope. Rather, precise adjustments are made as needed throughout the crossover range, allowing signals from the low- and high-frequency drivers to blend without the phase distortion normally associated with traditional crossover designs.

OK. We have a digitally controlled monitor performing superbly, and we put it into an average room. Now what? We all know that every room has sonic anomalies, and even the direct or near-field listening position can be affected by them. So we developed a proprietary system that automatically addresses these problems. Simply plug in the calibrated Equator microphone, press a button, and the software analyzes the room and adjusts the speaker's output. The system corrects for room modes in three dimensions (front to back, side to side, and floor to ceiling) and for placement/boundary conditions (e.g., monitors near a wall, free-standing, placed asymmetrically, etc.). It even compensates for secondary reflections from computer monitors, consoles, and the like. Comb filter problems, long ignored, are finally brought under control.

And if your clients want to listen from a couch in the back, or from the producer's desk, the software can automatically adjust the system for optimal playback at these locations. Multiple listening positions can be stored and instantly recalled.

I'll end by saying that I'm very proud of what this outstanding engineering group has accomplished. The goal was to provide a new level of monitoring clarity by overcoming known issues with monitors and monitoring environments. Listen to the Q series, and I'm confident you'll agree we succeeded.

If you're at the AES Convention, come see us in Demo Room 2D13.

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Equator Audio Research
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