Vanatoo Transparent Zero Powered Speakers

Photo 1: The Transparent Zeros' shape is a bit... unusual.

During the AXPONA 2017 show in Chicago, IL, Stuart Yaniger visited the Vanatoo room and was greatly impressed with the small and inexpensive proposition of the Transparent Zero powered speakers. As he noted in his report for our *Audio Voice* newsletter, they "seemed to punch far out of their weight class. I'd love to get a pair into my lab for extended listening and measurement." That's precisely what he did, and accounts for here.

By
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Transparent Zero Wireless Speakers
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The Vanatoo Transparent Zero wireless speaker is an exemplar of the old saying, "Good engineering costs no more than poor engineering."

Before diving into the review and measurements, I'll wax philosophical a bit. The notion that in the audio reproduction chain the loudspeaker and the amplifier are a system, with the performance of each locked into the characteristics of the other, is a long-known truism. Ideally, the amp and the speaker would be sold as an integral unit (in an electrical sense), with the amplifier designed specifically for the requirements of the loudspeaker driver(s) with which it's paired. That's basic engineering logic, but the market hasn't traditionally worked that way.

Through most of the past 50 years or so that I've been involved in audio, the audiophile consumer has demanded separates, with the random mixing and matching of the speaker and the amp generally not optimized. To do it right, a consumer would need to know the optimal amplifier source impedance for the speakers, the speaker's dynamic (large signal) impedance curves, the amplifier drive limits with load variation (real and imaginary parts), and the corresponding speaker drive limits (excursion and thermal). Although this is necessary to know to properly do the job, in reality this is something that can't possibly be done correctly by a non-engineer who isn't even armed with the needed data. The best one could reasonably do is to buy components that were at least engineered under the same aegis (and thus, the popularity of all-Quad or all-McIntosh systems with the carriage trade back in the day).

Nearly all attempts at integration by audio manufacturers resulted in market failures—

audiophiles wanted the sense of participation resulting from swapping amps, preamps, cables, and speakers to get the "sound" (or the illusion of the "sound") that they sought. This was all part of the entertainment end of the audio industry, which forced speaker designers to engineer with a particular paradigm of what the power amps were likely to be. Likewise, power amp designers had to balance off cost and complexity vs. universality. For example, should the amp take into account the occasional badly engineered high-end speaker having impedance dips to 1 Ω? Should the amp be designed to be unconditionally stable irrespective of the load reactance, and what's the cost of doing so to the 99% of users for whom that's not an issue?

In recent years, the traditional component audio market has devolved into a niche which, judging from audio show attendance, mostly caters to older audiophiles who are still set in their ways. But from a technical perspective, things are getting better—several major sociological changes have pushed the market toward the more rational integrated solutions. The advent of computer audio and smartphones, music streaming and downloads, the availability of efficient and inexpensive digital signal processing (DSP), and Class-D amplification have all contributed to a veritable "Great Leap Forward" in performance with a concomitant reduction in cost. This has been achieved by ignoring tradition and integrating amplification and custom DSP into complete speaker systems (in the truest sense of the word "system"). There are now dozens of fine examples on the market that have achieved technical and commercial success.

The Speakers

All of this came to mind for me during this year's AXPONA show in Chicago. As I went from room to room, I heard a lot of expensive mediocrity, marinated in pretension and six figure price tags. Only a few things really stood out, but one of them was the sound I heard in the Vanatoo room, with two models of inexpensive active speakers that sounded far better than their price tags implied. After talking with Rick Kernen, the electrical engineer who is also one of Vanatoo's two partners (the other being mechanical engineer Gary Geschellen), about the basics of the designs, I arranged for a pair of their least expensive ($359 per pair) speakers, the Transparent Zeros, for review. A couple weeks later, a small box arrived with two speakers, a power brick suitable for either 120 or 220 VAC, a remote control, and an Ethernet cable to connect the right and left speakers together. There was also a laser-printed manual, which I actually took the trouble to read—and it was a good thing I did! The Quick Start guide will get you through the basics, but some time spent with the available options will pay off in getting the sound from "well, it's there" to "surprisingly good." I should also mention that the package includes some thin foam rubber pads to isolate the speakers and prevent them from rattling against whatever hard surface they're placed on (TV stand, desktop, or speaker stands).

The Transparent Zeros are a two-way system with a 4.5" bass-midrange cone driver, a similarly sized passive radiator, and a 1" soft dome tweeter, all housed in an enclosure smaller than a lunchbox. The enclosure is oddly shaped in a roughly trapezoidal manner (see **Photo 1**), and includes a plastic frame member that doubles as a prop for the speakers when they're used on stands to allow the passive radiator to do its thing unimpeded. They are set up to be used on a desktop for computer sound, next to TV sets for home theater sound, and on stands as free-standing mini-monitors, depending on the orientation and the DSP settings. On a desktop (see **Photo 2**), the passive radiator points up, and the plastic prop can be used as a handle—or removed if the esthetics bother you. For mounting on stands, the passive radiator points down, with the prop giving it space to emit.

There's a ton of features and flexibility packed in here, so I hope you're sitting down and comfortable before reading through this.

The speakers have no passive crossovers, but are each bi-amped with D2Audio DAE3 Class-D digital input amps. These are described as "direct digital," meaning that the amplifier runs in the digital domain right up to the output of the PWM drive. The speakers' analog input is fed to an A-to-D converter, and the optical and Bluetooth are fed directly into the amps' digital input. DSP is built into the D2Audio amp, with processing at 24 bit and 48 kHz. All signals coming

Photo 2: For desktop or TV stand use, the speakers are oriented with the passive radiator pointing up.

About the Author

Stuart Yaniger has been designing and building audio equipment for nearly half a century, and currently works as a technical director for a large industrial company. His professional research interests have spanned theoretical physics, electronics, chemistry, spectroscopy, aerospace, biology, and sensory science. One day, he will figure out what he would like to be when he grows up.

into the amp get converted to and processed at this resolution.

In the speaker pair, one side (by default the Left speaker, though this can be changed by the user) contains all the electronics and sends analog signals to the Right speaker. A nice detail is that the Right speaker without the electronics has a solid plug in it so that the volumes (and hence bass alignments) of the two sides are equal. The back panel of the active side (see **Photo 3**) is a bit busy, but it has the amp/DSP inputs (analog and optical), a button to activate Bluetooth pairing, and a power input jack to go with the supplied power brick. The Ethernet connector is not used for any digital signals, but rather it is used to run a supplied RJ50 cable carrying the woofer and the tweeter analog signals from the electronics in the Left speaker to the drivers of the Right speaker. One can use a standard RJ45 cable if you need a longer run than the approximately 3 m provided, but the higher resistance could cause audible imbalance between the channels. Vanatoo offers a 7 m RJ50 cable as an option, and I'd recommend springing for it.

The V-T-B switch selects the function of the control knob: volume, treble, or bass. Generally, you'll set Volume to its maximum, then use either the source player or the supplied remote control to adjust volume. But here's where the complexity sets in: In order to take advantage of the DSP's flexibility and the other speaker modes, you have to do a little dance with combinations of Volume knob, V-T-B switch power, and the Bluetooth pairing button. For example, to switch from Shelved response to Flat response, you unplug the power, set the Volume knob to the three dot position, set the V-T-B switch to V, hold down the pairing button, then plug the power back in and wait a few seconds before releasing the pairing button. Vanatoo provides a chart of all the button and knob combinations for parameter adjustment (I taped it to the side of the active speaker), but this is not a simple process, and cries out for a smartphone app with a control panel. Likewise, using the Remote to change any parameters requires a similar sort of button sequence and timing. I suppose the price of flexibility is complexity.

Photo 3: The rear panel of the Transparent Zero contains all of the I/O connections and switches and knobs for programming.

Inside the Speakers

Moving on to the internals, the crossover is done in the digital domain, and is an eighth-order Linkwitz-Riley (L-R) at 2,200 Hz, unusually low for such a small speaker. This is made possible by the certainty that you have with an active crossover, very steep slopes—which effectively keep low-frequency signals out of the tweeter—and the fine-grained control of the DSP. This low crossover point also enables the woofer to cross over below the frequency where it starts to become directional.

During the design phase, Vanatoo measured the average listening window of multiple pre-production woofers and tweeters to know what to expect in production. The average of these determined the low-pass and high-pass eighth-order responses. L-R crossovers are well behaved in the vertical off-axis, and the steep crossover makes for a narrow transition zone. With the low crossover point assuring good horizontal off-axis behavior, the combination would be expected to act pretty closely as a point source at any reasonable listening distance.

The woofer motor is underhung, with a 4 mm coil and an 8 mm gap. There's also an aluminum shorting ring to reduce distortion from eddy currents. The goal of these design elements is relatively low distortion for moderate cone displacements.

The DSP has limiters built in. The limiters are enabled by default, but can be turned off by the user. They only kick in at the last 3 dB of signal, so the overall sound has no limiting until the speaker starts to get near the system limits. When the limiters activate, it only dulls the peaks a little to keep things under control, so its effect is relatively subtle. No damage will occur to the system with the limiters off. They primarily protect the power supply from

reaching its current limit, which can happen on occasion with the limiters off. This is a "soft failure," as the power supply will cycle and the system will normally resume playing music in about 10 to 15 seconds. Presumably an informed user should realize that if the protection circuit cuts off the sound, they need to turn it down a little.

A subwoofer output is available and can be configured for an 80 Hz or 125 Hz crossover point. The output is low-pass filtered with a fourth-order L-R, and the appropriate high-pass filter for the Transparent Zeros is automatically activated when the subwoofer is connected.

The Setup

Used with our TV set, connected via the Analog input and set to Shelf mode, the Transparent Zeros nearly disappeared sonically, giving a good localization of images. What really struck us was how revealing they were of the different microphone signatures and choices made for signal processing by various TV shows, ranging from compressed and hot to remarkably realistic. The use of faders and pan pots during football games was particularly noticeable, which may or may not be a good thing! We never felt the need for a subwoofer, but admittedly, we don't watch blockbuster movies, for which a subwoofer could be a real asset. I don't think of TV as a true hi-fi source, so I adjusted my expectations accordingly—nonetheless, the Transparent Zeros received a high compliment when, after I took them downstairs to my basement lab for critical listening and measurement, my wife wanted to know when I was bringing them back up.

Next up, in the same mode, I hooked the Transparent Zeros to my laptop via the USB connection. This gave a most satisfactory sound when I played well-recorded music through them, and I ended up using them for mastering monitors for home recordings. I've seen some gamers complain that the Transparent Zeros lacked "excitement," and I can absolutely see that—the basic sound was clean and uncolored, so for gaming use, an equalizer or similar plug-in might come in handy if the Transparent Zeros' tone controls aren't adequate.

There's no question that the Transparent Zeros are good enough to beg for use as "serious" hi-fi speakers, which means putting them on speaker stands, setting the Mode to Flat, and experimenting with room positioning. Being a relatively non-fancy person, I used some non-fancy "universal" stands I purchased from Amazon, which were pretty typical, comprising a steel base, an adjustable height pole, and a top plate with clamps to secure the speakers. Here's where I ran into some issues, though solvable ones.

The Transparent Zeros' odd cabinet shape and the plastic props means that conventional speaker stand clamps won't work. Nor can you rest the speakers on the stands unless the top plate is exceptionally deep. At the suggestion of Vanatoo, I jury-rigged a solution: I took some 0.5" wood slats, cut them to the same width and depth as the Vanatoo rubber pads, and then clamped the slats to the speaker stands. The rubber pads and the speakers then rested on the slats. This worked from a sonics point of view, nothing rattled or moved around, but the lack of secure clamping means that in a household with pets or children, the speakers' security is a precarious thing, and a crash to the floor is not an "if" but a "when and how bad." After a close call with the swinging tail of our Great Pyrenees, I decided that these were not for living room use in our household, and moved them downstairs to the dog-free lab. Some redesign of the plastic props, or the inclusion of alternate props for stand mounting would be a blessing to those of us who want to use the Transparent Zeros as serious hi-fi speakers.

Sound

With the physical setup complete, I hooked these up to do some listening. Initially, I used an optical connection between an RME ADI-2 Pro DAC that I was finishing up reviewing, then once that was sent back, I connected to my laptop via Bluetooth and to my lab computer via USB. The lack of a coaxial connection

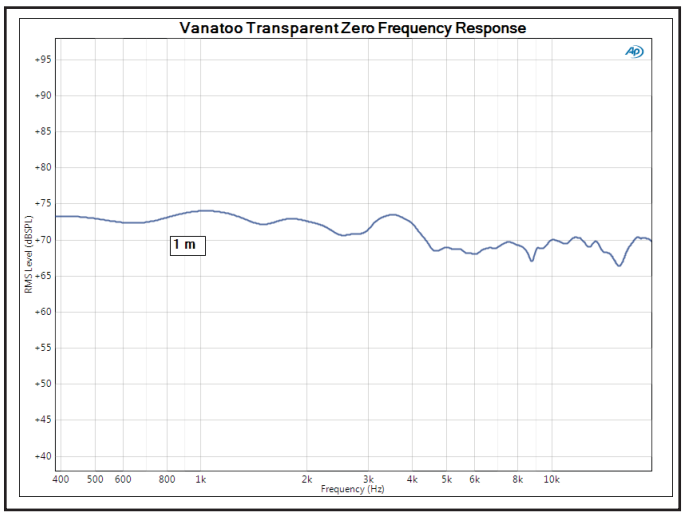

Figure 1: The on-axis frequency response of the Transparent Zero is reasonably flat, other than a 2 dB treble shelf and a notch in the tweeter response at about 8.5 kHz.

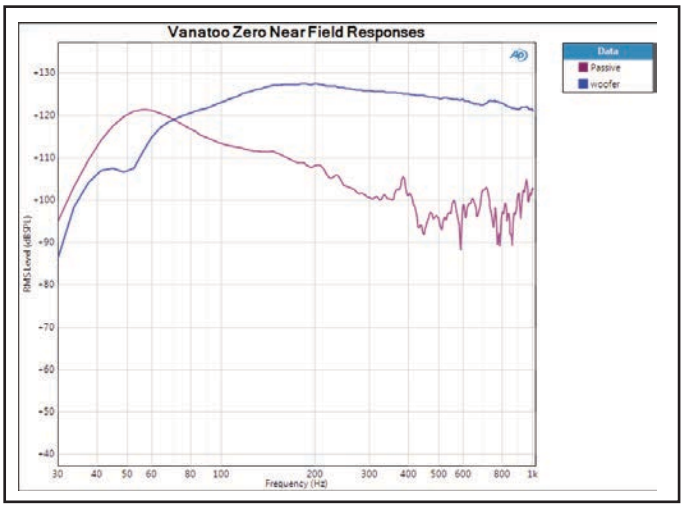

Figure 2: The near-field response of the Transparent Zero woofer and passive radiator indicate a smooth response and good damping.

remained a sore point for me, since neither computer had an optical connection, and the long USB cable that was needed was considerably more conspicuous and less flexible than the thin optical cable. Bluetooth is satisfactory, but comparatively still somewhat compromised because of the lossy compression.

My carping aside, the sound was what counted, and the Transparent Zeros delivered. I experimented with the setup, and ended up adjusting the stand height to 31" (about 80 cm), spacing them 7' (2.1 m) apart, and toeing them in so that I was on-axis at my listening position. Much like my first encounter with them, I was struck by the remarkable soundstage and imaging. Really solid and three dimensional, with the speakers almost completely disappearing. The tonal balance was slightly soft, which could be partially ameliorated with the treble control. But emphasize the word "slightly." It was quite subtle, and most noticeable when switching between the Transparent Zeros and my reference system. With the limiters set to Off, the dynamics were excellent, with the plucked string transients in my home recording of Lee Barber having a realistic snap, and the percussion and tenor sax on Clifford Jordan's "Live At Ethell's" (Mapleshade CD) having a delightful jump factor and transient edge. I had just done a live recording of renowned Chicago session artists LJ Slavin and Greg Hirte on vocals/harmonica and violin, respectively, and with their tonality fresh in my memory, I was impressed at how well it was reproduced by the Transparent Zeros.

As you might expect, deep bass wasn't there, but what bass was present seemed very clear and distortion-free, with an absence of lumpiness. The Transparent Zeros do not sound in any way lightweight, nor do they have the bass plumpness of mini monitors like the classic LS3/5A, but don't expect floor-shaking or pants-

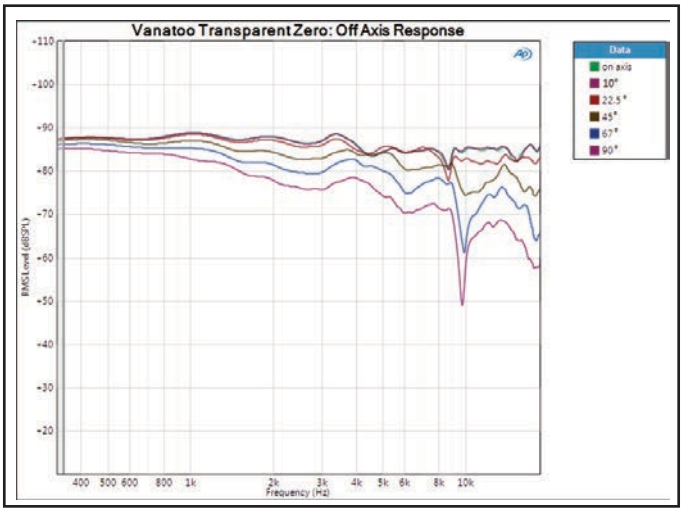

Figure 3: The Transparent Zero's horizontal off-axis response shows wide dispersion and a relatively smooth treble rolloff. Note that these curves are not normalized to the on-axis response and are unsmoothed.

flapping unless you use a subwoofer. With some use of the bass control, you can warm things up, if that's your preference, but that comes with the inevitable trade-off of bass definition.

The subwoofer option was quite convenient. I ran this two different ways, with a powered inexpensive subwoofer (a rescued Klipsch KSW-12) and with my reference subwoofers, driven by a pair of Sunfire 500 W plate amps. The latter was obviously higher quality, though it seemed incongruous to use them as accessories for a pair of speakers that cost a fraction of what one driver alone in the subwoofers cost. Nonetheless, in both cases, integration was easy thanks to the sharp and well-defined bass cutoff of the Transparent Zeros DSP crossover. With the subwoofers in place, rocking commenced, with the music of my youth transporting my imagination back to the live venues.

Now lest this come off as an unqualified rave, allow me to qualify. When compared to the reference system, the Transparent Zeros fell short in clarity, transparency, and a difficult-to-describe quality of refinement. And of course, they don't have the bottom 1-1/2 octaves, nor will they play as loudly. But to be fair, there's about a 20:1 ratio in price, and the Transparent Zeros certainly get the basics (tonality, dynamics, and imaging) right. If you want headbanging levels, they may not be the first choice. When I cranked up some Primus, the protection circuit shut things down before my ears gave out. But for reasonable volume out of acoustic sources in a medium-size room, the Transparent Zeros will easily reach a realistic volume without overt signs of stress.

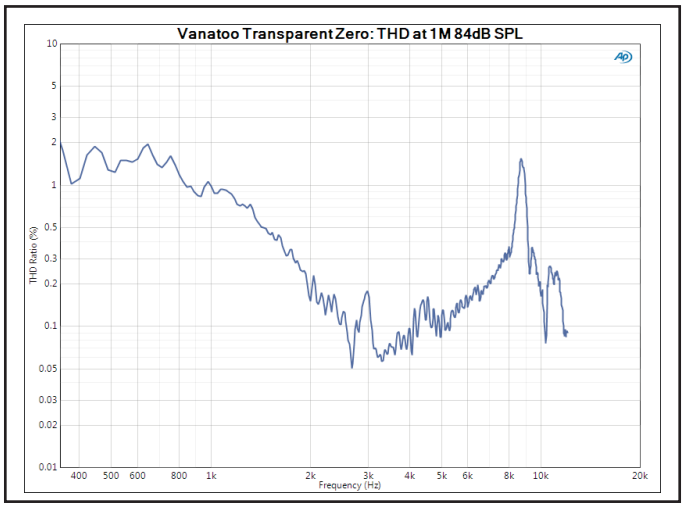

Figure 4: The distortion vs. frequency at 84 dB SPL and 1 m distance is moderately low.

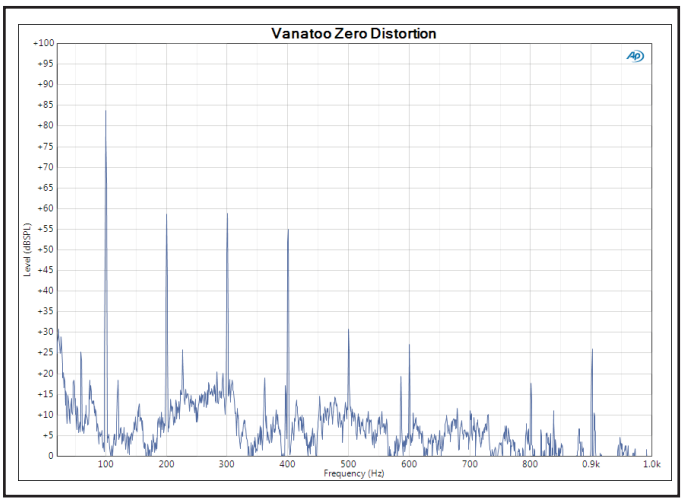

Figure 5: The spectrum of a 100 Hz tone shows that the distortion is dominated by low-order (second and third harmonic) components.

Measurements

As usual, the measurement system that I used was an Audio Precision APx515, with the speakers driven via the optical output at 24 bits and a 48 kHz sample rate. The AP1701 transducer interface was used to supply phantom power to PCB Piezotronics 376A33 (0.5") and 376A31 (0.25") condenser microphones for the acoustic measurements.

Figure 1 shows the unsmoothed quasi-anechoic frequency response on axis at 1 m with all tone controls set to Flat. This was obtained by running a chirp signal, deriving the impulse response,

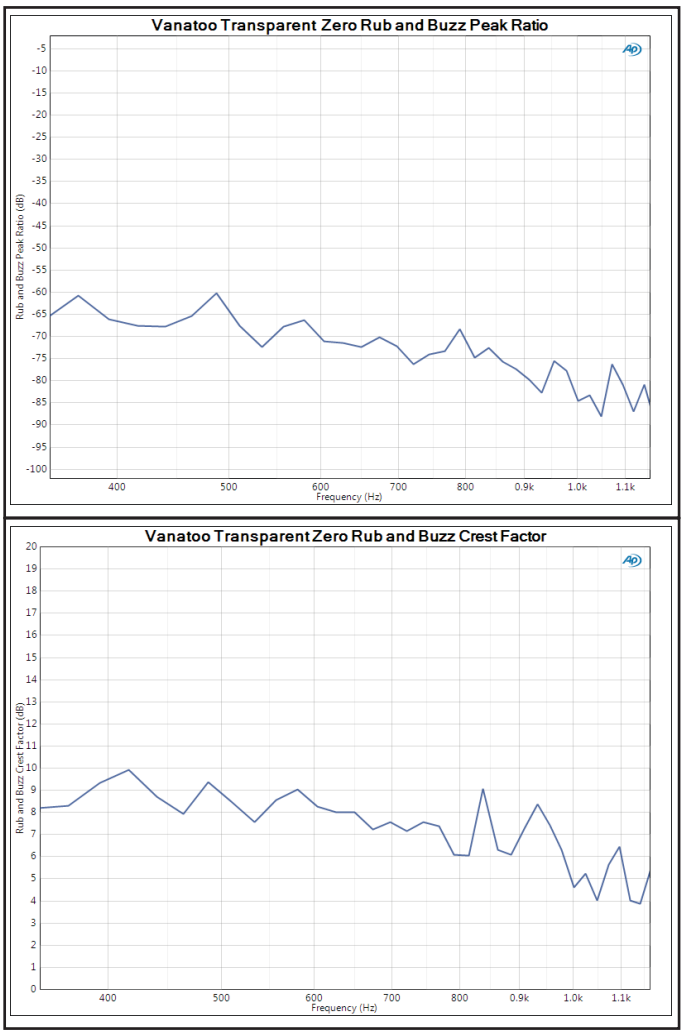

Figure 6: Rub and Buzz testing shows an absence of sonically annoying components.

then gating out the first reflection. As can be seen, the response is reasonably flat, other than a step-down shelf in the treble, which correlates with my impression of the sound being slightly soft. There's a notch at about 8.5 kHz, which persists regardless of microphone position, suggesting that it's an artifact of the tweeter rather than a diffraction notch. Other than these two observations, the frequency response is quite flat, which is unsurprising given the subjective impression of good tonal neutrality. **Figure 2** is a near-field measurement of both the woofer and the passive radiator, which confirms the specified 55 Hz woofer cutoff, and is free of ripple and shows good damping, again confirming the subjective observation of clean and well-defined bass.

The quasi-anechoic frequency response with varying horizontal angle is shown in **Figure 3**, and is very even, with treble rolling off smoothly with increasing angle, and no signs of the midrange

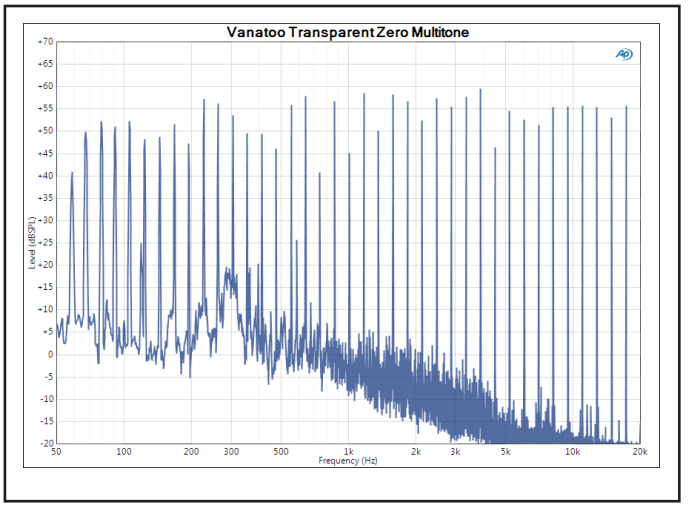

Figure 7: A 42-tone spectrum is relatively clean but does show some anharmonic noise in the lower midrange. This is a very extreme test!

Photo 4: The Transparent Zeros are a fully integrated system, offering built-in bi-amplification and digital signal processing from analog and digital inputs, including Bluetooth.

dip and flare seen in the off-axis response of systems with less capable crossover design. At extreme angles, an interference notch appears at about 10 kHz, which may also contribute to the slightly soft aspect of the in-room sound. In my experience, this sort of well-controlled polar behavior in a small speaker correlates with excellent imaging, which was certainly one of the Transparent Zeros' striking attributes.

Figure 4 shows total harmonic distortion (THD) vs. frequency at 84 dB SPL and 1 m distance. It's not exceptionally low, but it is dominated by second- and third-order components as indicated in the spectrum of a 100 Hz sine wave (see **Figure 5**). Note that in the THD graph there's a distortion peak at about 8.5 kHz, corresponding to the frequency response notch. This is one of those places where the low cost of the tweeter shows. There's also some small but noticeable anharmonic noise in the lower midrange.

Arguably, THD doesn't correlate well with listening tests, so I also ran Audio Precision's proprietary Run and Buzz tests (designed to highlight audibly annoying distortions) from Audio Precision, the results of which are shown in **Figure 6**. These plots show a reasonably low level of distortion with none of the peaks one sees with less-than-capable drivers.

Lately, I've also started running multitone tests on loudspeakers. **Figure 7** shows the results for the Transparent Zeros at 84 dB SPL and 1 m, on axis. The variation in tone height occurs because, unlike a standard frequency response, the measurement here includes room reflections. Interestingly, the anharmonic noise seen in the distortion spectrum of Figure 5 reappears here, and may be some of the reason I thought that the Transparent Zeros fell short on clarity compared to the much more expensive competition. As I collect more data like this from other speakers, we'll see if this measurement provides a way to objectively test for this perceived sonic quality.

Conclusion

This has been a rather long exposition on some relatively inexpensive speakers, but I think the engineering is enough to merit the high ratio of words to price. In the tradition of the killer small speakers of yore (e.g., BBC LS3/5A, NHT's Super Zeros, and Fulton FMI-80s), the Vanatoo Transparent Zeros offer users a way to get 80% of the performance of ultra-expensive systems at a fraction of their cost (see **Photo 4**).

When you consider that preamplification, power amplification, and signal processing are built in, the cost goes from "bargain" to "unbelievable." For under $1,000, a music lover can assemble a complete system (source, amplification, speakers, stands, and subwoofers) that will provide years of satisfaction and outperform lots of the high-priced stuff sold on the basis of prestige rather than performance. Yes, I'm keeping these.

Resource

Vanatoo, www.vanatoo.com