



BOENICKE W5 SE

LOUDSPEAKERS

The arrival of the Boenicke W5 (SE) speakers reminded me of the ancient parable concerning the number of teeth in a horse's mouth. A group of Greek philosophers in a tavern were arguing about the number of teeth in a horse's mouth, each claiming a different number and offering scientific arguments as to why they were correct, such as stating how many teeth might be required for grinding, how many for biting, the necessity to fit a long tongue within and so on.

While they argued, an Arab who had been drinking in a corner of the tavern went out the front door, only to return five minutes later and declare loudly that they were all incorrect, and that the correct answer was that a horse had 40 teeth. *'What logic did you use to deduce that, and how can we be sure that you're right?'* they challenged him. To which the Arab replied. *'I am correct, and to prove it, you only need do what I just did: go around to the stable at the back of this tavern and count them.'*†

If this seems like a strange start to a review, I was reminded of this parable because of the

extraordinary amount of philosophising on internet forums about Boenicke's stated use of what it refers to as an 'electromechanical parallel resonator' inside the W5 SE (and other Boenicke models). Various bloggers and forum members have proposed that it refers to elements in the crossover network, and others that it refers to the design of the bass reflex port, with arguments flitting back and forth and, as internet arguments are wont to do, getting more and more heated with every new post. So the very first thing I did when the review samples arrived was disassemble one to 'count its teeth'.

Inside my W5 SE I discovered two very strange contraptions, which could only have been the fabled 'electromechanical parallel resonators'. Each 'resonator' is in point of fact a small length (92mm) of stiff wire (surrounded by a piece of plastic tubing) one end of which is soldered to the negative speaker terminal and the other end of which is free to vibrate, should some mechanical stimulus be applied to it. Think of the resonator as being a bit like a tuning fork, except that when I 'twanged' it with my finger, the sound was more like a 'sprong' than a pure tone.

Each 'resonator' is a small length (92mm) of stiff wire surrounded by a piece of plastic tubing...

I decided to confirm my thesis by asking the editor to check whether I was correct, and he forwarded me an email response from Aleksandar Maksimovic of Audio Magic, Boenicke's Australian distributor, which stated—and I quote verbatim: *'The resonators are the funny antennas you can see at the drivers. They resonate in an extremely defined way, shifting resonance energies and frequencies to exactly defined frequencies that our brain seems to handle in a very different way than resonance frequencies outside that grid.'*

While the driver was removed, revealing the internal layout of the cabinet, I also searched in vain for another 'feature' that is supposed to be one of the major differentiators between the standard W5 model and the W5 SE, that 'feature' being Boenicke's 'acoustic phase linearisation network', supposedly proprietary to Boenicke. Search as I might, I could not locate it, or anything that looked even remotely like what I imagined an 'acoustic phase linearisation network' might be, so it was back to the editor who in turn got back to Audio Magic and subsequently forwarded their emailed response, which I again quote verbatim: *'It is that capacitor/resistor network you can also see in the pdf.†† It bends the acoustic phase in a way that yields a more natural imaging. Sibilants otherwise are always projected too much forward—as almost every speaker does. The correction takes the sibilants back in position, not in amplitude. You simply have more image depth, as well, and truer colours.'*

The pdf††, which was a review of the much-larger Boenicke W8, shows the W8's crossover network, which is different from that used in the W5 SE (and also different to the crossover in the standard W5), but the fact that it was a 'capacitor/resistor' network was all I needed to know and means that Boenicke, in common with thousands of other loudspeaker manufacturers, is simply using *electronic* (not *acoustic*) phase correction components in its crossover network. This means that one resistor, one capacitor and one 'electromechanical parallel resonator'

are what account for the \$1,778 price differential between the standard W5 and the more expensive Boenicke W5 SE.

THE EQUIPMENT

The W5 SE is a quite unusual bass-reflex design. It has a side-firing paper-coned bass driver that's run full-range (that

is, it is connected directly to the speaker terminals, effectively by-passing the crossover network), an aluminium-coned full-range driver on the front panel, and a super-tweeter that's mounted on the speaker terminal plate on the rear panel, so that it fires backwards.

Starting at the 'bottom' (so to speak) the side-firing bass driver is a Tang Band W5 1138SME, which is a '5-inch' (127mm) paper-coned driver with a rubber suspension that has an extraordinarily long throw ($x_{max}=9.25mm$) and a very large (32mm) voice-coil. Although it has a paper cone, the cone has a very large dish-shaped section of polypropylene glued to it which acts both as a dust-cap and the main driving surface, which makes the driver very pistonic. (This Tang Band unit is a superb driver: I recently bought four of them, at \$45 each, for a sub-woofer project I'm working on.)

The Thiele/Small diameter of the Tang Band's cone is 107mm, which puts the effective cone area (S_d) at $94cm^2$. The magnet is centre-vented, and the chassis to which it's attached is stamped from steel. Boenicke's 'electromechanical parallel resonator' is soldered to the negative terminal of this driver.

The front-firing full-range driver is made for Boenicke by Fountek, and appears to be a derivative of its model FR88EX, except that instead of using the neodymium magnet with which this model is usually supplied, Boenicke has instead specified a large ferrite magnet instead.

The use of such a large ferrite magnet 'blocks' the airflow from the rear of the cone, which would in turn affect the driver's frequency response. The driver's aluminium cone is driven by a 25mm diameter voice-coil wound from copper wire. The frame of this driver is die-cast. This, too, is an excellent driver. In my own speaker designs I prefer to use Eton's 3-400, but at less than \$US49 (with the neo magnet), the FR88EX is 'way more cost-effective than the Eton.'

As with the bass driver, another 'electromechanical parallel resonator' is soldered to its negative terminal. I was surprised the resonator appeared to be identical to the one fitted to the bass driver, because since the drivers would resonate at different frequencies, I would have expected either the thickness or length (or both) of the resonators to be different.

The rear-firing tweeter is another Tang Band model (13-1761S) which, like all Tang Band drivers, is made in China. (Tang Band is a Taiwanese company that used to manufacture its products in Taiwan, but moved production to China a few years ago.) In this case, the first two model numbers indicate

The tiny rear-firing tweeter is another Tang Band model (13-1761S) which, like all Tang Band drivers, is made in China. It was specifically designed for use in co-axial drivers intended for in-car use.



the tweeter's diameter, which is 13mm (except that the tweeter's fabric diaphragm is actually 13.28mm in diameter.) This tweeter has a neodymium magnet. Boenicke's application is interesting, because this driver was specifically designed as a low-cost unit for use in co-axial drivers intended for in-car use, which is why it's small enough to fit on the pole-piece of a driver with a voice-coil 20mm or larger in diameter. However, because of its relatively smooth frequency response above 10kHz, some hi-fi speaker manufacturers use it to 'take over' from tweeters whose own performance above 10kHz is too, let us say, 'peaky'. In this case, Boenicke seems to be using the tweeter to provide 'ambience' rather than to contribute to the on-axis sound.

[Editor's Note: It appears that Boenicke has previously used different drivers in earlier W5 SE models, for example sourcing the bass driver from Peerless rather than Tang Band, and using a Fountek FE85 full-range model rather than a modified FE88. Nothing wrong with continuous development processes requiring different drivers, but it does mean you can't compare one review of a W5 SE with any other review unless you know precisely what drivers were in the models reviewed, because the two different reviewers might have been listening to two completely different models, using different drivers, even though both bore the identical 'W5 SE' model number.]

The crossover uses extremely high-quality components to provide a 500Hz high-pass filter for the front-firing full range driver and a 6.5kHz high-pass filter for the rear-firing ambience tweeter. There are three audio-ophile-grade capacitors, two resistors (one wire-wound), and a single air-cored inductor made by Mundorf. All components are hard-wired using their own fly-leads or a combination of fly-lead and 0.52mm diameter single-strand copper wire. This same 0.52mm single-strand copper wire is also used to link the crossover network to the rear speaker terminals and to the drivers.

The bass reflex port that exits at the bottom of the rear panel (through a rectangular slot) is, like the rest of the W5 SE, carved from solid wood. It 'dives' down and runs underneath the main internal chamber (itself carved from solid wood, as I will describe in more detail shortly) then 're-surfaces' inside the cabinet just behind the front baffle.

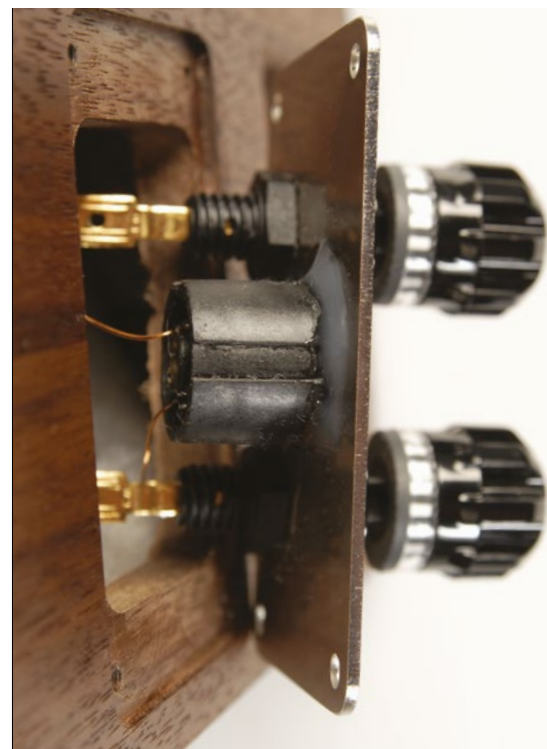
I would have thought the Boenicke W5 SE took its model number from the Tang Band W5 bass driver, but according to Audio Magic, the 'W' stands for 'wood' and is meant to emphasise the fact that the W5 SE's cabinet is made from real wood, not from MDF or ply, so when you make your choice between walnut, oak, ash tree and cherry, you're ordering from a real tree. In order to manufacture the

cabinet, Boenicke uses machinery (including CNC cutters) to 'carve' voids from planks of solid wood, after which these planks are laminated together to create the cabinet. This is an extraordinarily expensive and time-consuming way to build a loudspeaker cabinet, but according to the founder, designer and owner of Boenicke, Sven Boenicke, the reason he does it is very simple. He says: *'If you mount a speaker driver on a certain mass of a particular material such as solid wood (or MDF or aluminium, just to name other examples), the material-inherent sound properties of that material will strongly affect the way the speaker driver itself sounds. This is a fact, but virtually no-one seems to know about it or take it into consideration when building a speaker driver or an entire loudspeaker. Secondly there is no such thing as a non-resonant enclosure, so in reality some degree of sound energy is always being dissipated by the enclosure itself. It seems evident that a body of solid wood with a thin oil or wax coating will resonate in a more natural (less damped!) way than the same body made from MDF with a plastic coating.'*

According to Boenicke's website, every Boenicke speaker is made by the designer himself. Here's an extract: *'The founder, head and owner of Boenicke Audio, Sven Boenicke, is the only person in the company who acoustically designs, assembles and brings to sonic life every unit that leaves our house.'* The finish of the Boenicke W5 SEs was not as high as I might have expected from an expensive hand-crafted product, with one of the laminated joints not completely smoothed and slight misfits between the full-range driver chassis and the rear terminal plate and the cabinet recessed cut for them. However, since this is a hand-made product, every single speaker is going to be slightly different. No grilles are provided, which didn't bother me, but may you.

LISTENING SESSIONS

The Boenicke W5 SEs don't come standard with stands, but local distributor Audio Magic supplied a pair of Boenicke stands for this review. They're extremely unusual, because once assembled, they are anything but 'solid' and thus the thin metal vertical support rod allows the speakers to move—and oscillate—equally easily in all directions. The result is that any wind movement in the room—or any bass-heavy music played at decent volume—causes the speakers to move. According to Sven Boenicke, the ability for a speaker cabinet to move is a desirable attribute. For example, he also manufactures a 'swing base' that apparently allows several of his models to move freely. The 'Tech Talk' section on the Boenicke website has a graph that purports to show the technical benefits of this swing



The side-firing paper-coned bass driver is run full-range (that is, it is connected directly to the speaker terminals, effectively bypassing the crossover network). All internal wiring is via single strand 0.52mm diameter copper wire.

base. However although the relevant graph is titled 'frequency response', it is not a frequency response at all: it's actually showing cabinet vibration as measured by an accelerometer attached to the speaker terminals. The W5 SE stands (which retail in Australia for \$841 per pair) elevate the speakers only 482mm off the floor, but the tilted baffle means that even at this low height the full-range driver on the front panel will point at your ears for most sensible listening positions.

Side-firing bass drivers always have me baffled as to which way they should be faced (both inwards, facing each other, or both outwards, facing away from each other) so I was pleased to discover that Sven Boenicke personally recommends that if the W5 SEs are less than two metres apart the side-mounted woofers should be faced outwards, but if the speakers are spaced more than two metres apart, they should be faced inwards. However, personal preferences and room acoustics should always be the final arbiters. I placed the speakers three metres apart for my listening sessions and thought they sounded their best with the drivers facing each other.

The first thing I noted about the Boenicke W5 SE's is that they are extraordinarily inefficient. I discovered this at the outset simply because I'd pre-set the volume level on my amplifier to my usual auditioning level, and

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walked back to my chair before firing up my SACD player (the first of several sources I used during my auditions). To my surprise, when I pressed 'play', the volume level from the speakers was so low I thought I'd blown up my amplifier. I hadn't: I just had to crank the volume control 'way up to get my usual sound pressure levels. (I was amused to find a person on a hi-fi forum who'd auditioned the Boenicke W5 SEs using an NAD C162 in combo with an Odyssey Khartago Plus commented: *'I could play at max volume [NAD was pointing 12 o'clock] without any issues.'* If the Khartago was delivering maximum power in this set-up, we're talking 110-watts per channel, so there was an issue, which would be that despite all the power being applied, the speakers obviously were not playing all that loudly!)

My experience was that I needed lots of power to drive the Boenicke W5 SEs to my preferred listening levels, but at the same time it was fairly easy to overdrive them by turning the amplifier up too high. Don't get me wrong... you'll be able to cover a goodly range of real world volume levels but it's unlikely that 'super loud' will be one of them.

I was, however, stunned by how good the Boenicke W5 SEs sounded with all music genres—jazz, folk, rock, popular... the full gamut. That said, I was already predisposed to like the sound, because I've always been a huge fan of full-range loudspeakers playing this material, both because of the way the sound 'knits' together across the frequency range and because of the lack of crossover-induced artefacts. In this case the full-range driver isn't being operated full-range, being rolled off below 500Hz, but since the bass driver is operated full-range, it means there's not much in the way of a crossover to get in the way of the sound. I would have preferred not to have any phase compensation at all in the crossover, but I guess that since two different drivers in different physical locations are sharing a large part of the frequency range, it was necessary.

I was particularly impressed by the depth

of the Boenicke W5 SE's bass delivery, which really digs down deep towards the bottom octave... although not effortlessly, so that although I could 'hear' notes in the bottom octave, I could not 'feel' them, even at high playback levels. This lack of bass extension is somewhat papered-over by a slightly forward upper bass, one that's just forward enough to let the ear infer the deeper bass fundamental from the second harmonic, but not forward enough to sound 'plummy'.

As I said previously, I am a huge fan of full-range loudspeakers and you'll hear why when you listen to the midrange from the Boenicke W5 SE. It may not be studio-monitor-flat, but it's superbly clean and unbelievably detailed. One could imagine that if you played a recording of a bunch of pins being dropped, you'd not only hear each one hit the ground, but be able to tell whether it landed on its point or its head.

Contradictorily, at the same time there was also a very likeable warmth to the sound that I enjoyed immensely, while not thinking it totally accurate, whereby sounds that should have been pure seemed to have been endowed with rich harmonic qualities, almost as if the speakers were 'multi-tracking' those sounds, yet at the same time the final sound still managed to maintain its sonic authenticity.


The treble I heard from the Boenicke W5 SEs was a little bright. Initially I thought this might have been the rear 'ambience' tweeter reflecting from the rear wall, so I moved the speakers even further from the wall which removed some of it, but some remained. I then covered the rear tweeters completely with sonic absorbers, which removed more—but not all—of it.

I finally tweaked the treble control on my pre-amp down a notch, which balanced the spectrum to my liking. That said, when I took the opportunity of a family reunion to get second opinions on the sound from my musically-trained siblings, all three thought my preferred setting was too muted: they preferred the original.

In my opinion the Boenicke's Achilles' heel is that they're not overly well-suited to orchestral classical music (that is, works in which a full orchestra is used, either on its own, or behind a soloist, such as a piano concerto) played loudly, because I found the sound started to harden (compress) before I could get my playback levels high enough to be truly satisfying. But if I kept the volume down, however, I had no issues.

Although you could certainly use the Boenicke W5 SEs on their own as desktop monitors, or as main speakers in a smaller room, I would recommend you use them with subwoofer. The sub would not only deliver the deep bass, it would also remove some of the low-frequency load from the W5 SE's bass driver in order to make better use of your amplifier's power output across the upper part of the audio spectrum... and here I'd personally recommend a minimum amplifier power output of 150-watts per channel (into 8Ω) to ensure there is no clipping on peaks.

CONCLUSION

If you want a pair of small speakers that will make your music sound fabulous, the Boenicke W5 SEs will amaze you with their ability to do just that!  Daniel Stiel

Readers interested in a full technical appraisal of the performance of the Boenicke W5 SE Loudspeakers should continue on and read the LABORATORY REPORT published on the following pages.

REVIEW NOTES

† Some say the 'Arab' in this story was actually the Greek philosopher Aristotle, others that this story isn't ancient at all but an invention of Francis Bacon (1561–1626). We'll never really know, but what we do know is that whether or not it was a wise Arab or Aristotle, his answer was only true for adult male horses. Younger male horses and mares can have as few as 36 teeth.

†† www.boenicke-audio.ch/W8_english.pdf

CONTACT DETAILS

Brand: Boenicke

Model: W5 SE

RRP: \$8,342 per pair*

Warranty: Five Years

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(*Also see panel on page titled 'Boenicke W5 Speaker Variations' to see prices of variants)



- Tiny size
- Sound quality



- Grille
- Finish

LABORATORY TEST RESULTS

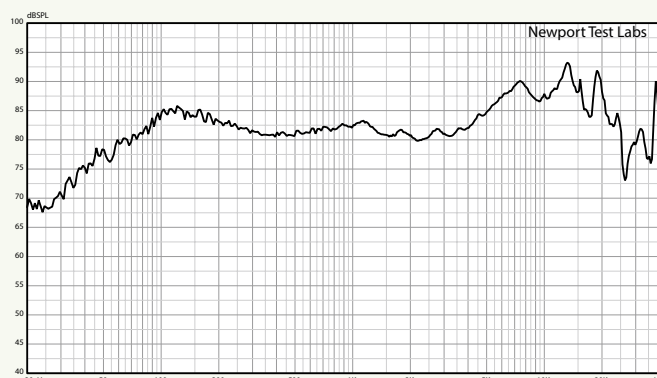
The frequency response of the Boenicke W5 SEs was not particularly flat, as you can see from Graph 1, where *Newport Test Labs* has spliced two traces together: the pink noise trace from Graph 5 and the high-frequency trace from Graph 2. You can see that the trace is admirably uniform from about 58Hz up to 5.5kHz, where it's only $\pm 3\text{dB}$ but above 5.5kHz it rises to $+7.5\text{dB}$ at 7.5kHz, then to $+11\text{dB}$ at 13kHz. Although this rise starts at a frequency that's above that of the highest note on a piano keyboard (which is 4.1kHz), I would expect that this speaker would sound bright, due to this rise's effect on harmonics. I would also expect some audible effects from the wideband lift in the frequency response between 80Hz and 250Hz.

The low-frequency response is shown in greater detail in Graph 3, using a near-field acquisition technique that simulates the response that would be obtained in an anechoic chamber. You can see that the low-frequency response starts rolling off fairly steeply at 100Hz.

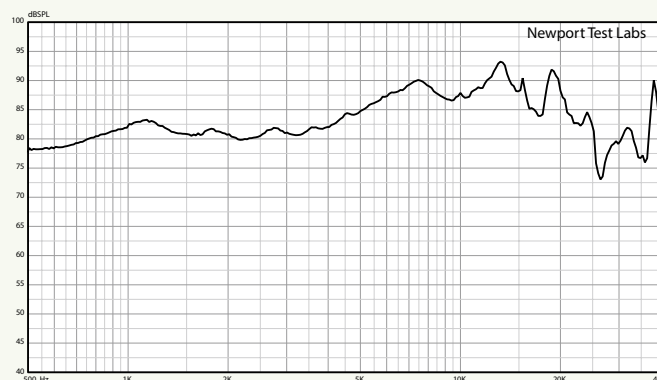
The impedance modulus (Graph 4) shows the cabinet has been tuned to 55Hz, so response will roll off very steeply below this frequency and the glitches in the trace at around 160Hz, 400Hz and 2.8kHz would suggest tiny resonances of some kind, but they're so small I can't imagine there would be any audible effect. (You should ignore the glitches at 100Hz, 1kHz and 10kHz: these were caused by the test equipment's range-switching circuitry.) The impedance is mostly below 8Ω and drops all the way down to 2.3Ω at 6kHz. This should not cause any issues, as the phase angle is 0° at this frequency. Also, at the frequency at which the phase angle is most severe (62°) the impedance is a comfortable 6.5Ω . Boenicke puts the 'nominal' impedance at 4Ω , but it should really be stated as 2.8Ω , or at least 3Ω . The differences in the impedance traces measured of the left and right speakers show that the driver matching is not of the highest standard.

Graph 5 shows the frequency response of the Boenicke W5 SE measured using wideband pink noise, where the trace shown is the averaged result of nine sweeps measured on a grid three metres on-axis from the front-firing driver. The trace above 1kHz

Graph 1. Frequency response. Trace below 1kHz is the pink noise in-room trace from Graph 5. Trace above 1kHz is the gated high-frequency response, an expanded view of which is shown in Graph 2. [Boenicke W5 SE Loudspeaker]



Graph 2. High-frequency response, expanded view. Test stimulus gated sine. Microphone placed at three metres on-axis with front-firing wide-range cone driver. Lower measurement limit 500Hz. [Boenicke W5 SE Loudspeaker]



Graph 3. Low-frequency response of side-firing bass driver (black trace), and rear-firing bass reflex port (red trace). Nearfield acquisition. Port/woofer levels not compensated for differences in radiating areas. [Boenicke W5 SE Loudspeaker]



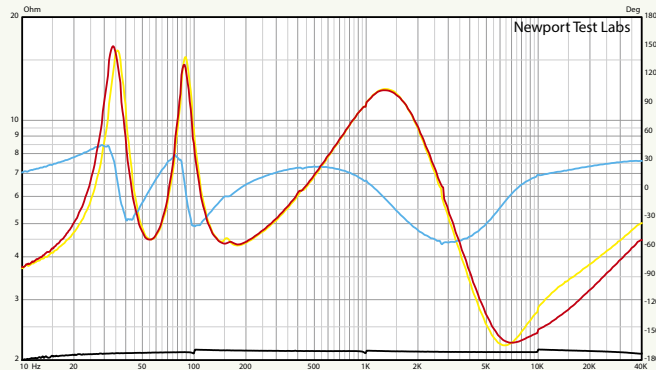
shows more how the human ear would perceive the high frequency response, eliminating the sharp peaks and dips shown in Graph 1 and Graph 2, which were obtained using a gated measurement to ensure measurement accuracy beyond that which the human ear is capable of discriminating. This graph shows the overall frequency response as extending from 58Hz to 20kHz $\pm 5\text{dB}$.

Graph 6 is a composite that shows individual measurements of the various drivers. You can see the response of the full-range front-firing driver (light blue) rolls off very steeply below about 180Hz. The response of the rear-firing ambience tweeter (pink trace) is very smooth, extending from 6kHz to 28kHz $\pm 2.5\text{dB}$. Note that the level at

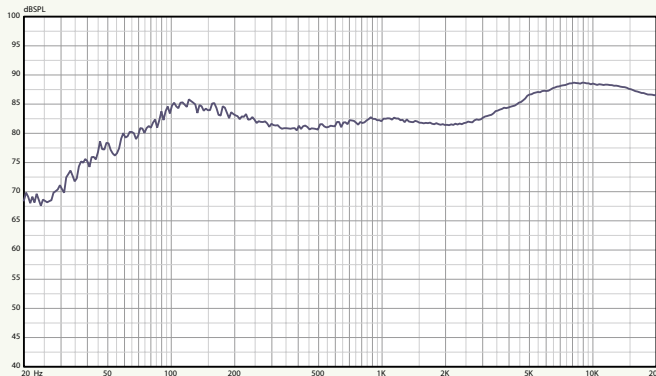
which the trace is shown on the graph is not referenced to the other traces: it's just been positioned there for clarity. This graph also extends the measurement of the rear-firing bass reflex port, and you can see there's some unwanted output between 450–800Hz and also at around 1.5kHz.

Newport Test Labs measured the sensitivity of the Boenicke W5 SE using its standard wideband averaging methodology, which is always tough on small speakers because of their limited low-frequency response, and using this technique, the lab measured sensitivity at 79dB SPL at one metre, for a 2.83Veq input. This is the lowest sensitivity ever measured by the laboratory, and also 8dB lower than Boenicke's specification of 87dB SPL/w/m.

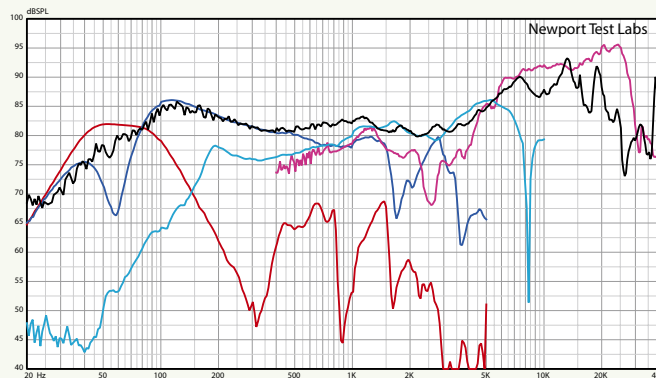
Graph 4. Impedance modulus of left (red trace) and right (yellow trace) speakers plus phase (blue trace). Black trace under is reference 2 ohm precision calibration resistor. [Boenicke W5 SE Loudspeaker]



Graph 5. In-room frequency response using pink noise test stimulus with capture unsmoothed. The trace shown is the averaged result of nine individual frequency sweeps measured at three metres, with the central grid point on-axis with the front-firing driver. [Boenicke W5 SE] SLoudspeaker]




Graph 6. Composite response plot. Red trace is output of bass reflex port. Dark blue trace is anechoic response of bass driver. Light blue trace is anechoic response of widerange driver. Pink trace is simulated anechoic response of rear tweeter (not scaled). Black trace is same as Graph 1.



Although there will always be minor differences due to different measurement techniques, and I have learned that manufacturers always publish the most 'optimistic' sensitivity figures, I had to wonder how Boenicke arrived at its result, given that Tang Band specs the bass driver with a sensitivity of 82dB SPL and Fountek specs the sensitivity of its full-range driver at 84.3dB SPL. The low sensitivity also means that whereas you'd only need 32-watts of power to drive a speaker of industry-average sensitivity to over 100dB SPL, you'll need 130-watts of amplifier power to drive the Boenicke W5 SE to the same sound pressure level.

The Boenicke W5 SE demonstrated an impressively-extended bass response for such a small loudspeaker. Its midrange response, although not smooth, is acceptably flat. Despite having a minor rise in the high-frequency response the laboratory was still able to measure an overall frequency response of 58Hz to 20kHz \pm 5dB.

The very low efficiency combined with low impedance will, however, make amplifier matching crucial in extracting the best performance from this design. 

Stephen Holding

Results mentioned, tabulated in performance charts and/or displayed using graphs and/or photographs should be construed as applying only to the specific sample tested.

BOENICKE W5 LOUDSPEAKER VARIATIONS

Currently, Boenicke makes three different versions of its model W5 loudspeakers, all of which are available in Ash, Oak, Cherry, or Walnut finishes. The differences between the three versions, according to Boenicke, are as follows:

Standard Version (\$6,564 per pair)

- 133mm (5.25-inch) long-throw bass driver, tuned to 65Hz, 1st-order crossover
- 75mm (3-inch) full-range with electromechanical parallel resonator fitted, 1st-order high-pass filter.
- Internal wiring orientation-optimised silk-wrapped high-frequency stranded Litz

SE Version: (\$8,342 per pair)

- Longer-stroke bass driver running without crossover, tuned to 50Hz, fitted with electromechanical parallel resonator
- Different crossover layout
- Even higher-quality crossover components

SE+ Version (\$11,881 per pair)

- Added electromechanical series resonators to both drivers, all parallel and series resonators of Stage II type
- Added proprietary acoustic phase linearisation network #