Test Bench

Scan-Speak's New 15W/8534T00 Classic Line 5.5" Woofer

By Vance Dickason

The first transducer explication this month comes from Scan-Speak's Classic line, which consists of seven midbass drivers and seven tweeters—all either original transducer "hits" from years past or improved versions of the same. This month, Scan-Speak sent the new 15W/8534T00 (**Photo 1**), which sort of fills the gap in the Classic family for a compact high-performance 5.5" (15cm) midbass driver. It is based on the design principles of the popular 18W/8545 continuing the tradition with a slim-frame aluminum chassis, a Symmetrical Drive (SD) motor system, a low loss linear rubber suspension, and is updated with a brand-new cone material called Phenomax.

Features include a lightweight and unique curved-profile Phenomax composite cone with an inverted paper dust cap. The Phenomax cone is made of five layers with different properties. This multilayer structure incorporates alternating hard and damping thin films (Kevlar/Carbon-Fiber Mix) combined with Resin Layers and has a rear coating. Other features include a proprietary cast-aluminum frame that uses six tapered (18mm×16mm) spokes to minimize reflections back into the cone, plus 60W IEC 18.4 power handling capacity (100W long-term IEC 18.2).

Cooling is provided by a 0.46" (18.6mm) diameter flared pole-type vent (**Photo 2**). Compliance is controlled by a 14mm wide NBR low-loss (high Qm) surround that has a very shallow transition to the cone, and a by a 3.25" diameter elevated cloth spider.

The motor assembly is powered by a FEA-optimized motor design utilizing a 90mm diameter 17mm thick Ferrite ring magnet sandwiched between the milled and polished 5mm thick front plate and T-yoke with a 5mm bump out. The motor assembly also incorporates both aluminum and copper shorting rings (Faraday shields) as portrayed in the **Figure 1** drawing. Driving the cone assembly is a voice coil that consists of a 38mm (1.5") diameter vented titanium former wound with round copper wire. Voice coil tinsel lead wires terminate to a pair of solderable gold-plated terminals.

Testing began with the driver clamped to a rigid test fixture in free-air and using the Physical LAB IMP Box (the same type of fixture as a LinearX VI Box) produced both voltage and admittance (current) curves at 0.3V, 1V, 3V, 6V, and 10V. The 10V curves were close to making a useful curve fit, however, were discarded. I post-processed the remaining eight 10Hz to 20kHz 550-point stepped sine wave curve pairs for each sample and divided the voltage curves by the current curves, creating the five impedance curves. The impedance curves each had the LMS phase calculation procedure applied, and along with the voltage curve for each sweep, all eight curves were imported to the LEAP 5 Enclosure Shop CAD software.

Since most Thiele-Small (T-S) data provided by OEM manufacturers is produced employing either a standard T-S model or the LinearX LEAP 4 TSL model, I additionally created a LEAP 4 TSL model using the 1V free-air curves. Please note, that even though LinearX is no longer in business after the unfortunate passing of its chief engineer and founder Chris Strahm seven years ago, LEAP 5 is still one of the best driver parameter generators ever devised,

Photo 1: The new Scan-Speak 15W/8534T00 midbass driver.

Photo 2: Close-up view of the Scan-Speak 15W/8534T00 motor and neck joint.

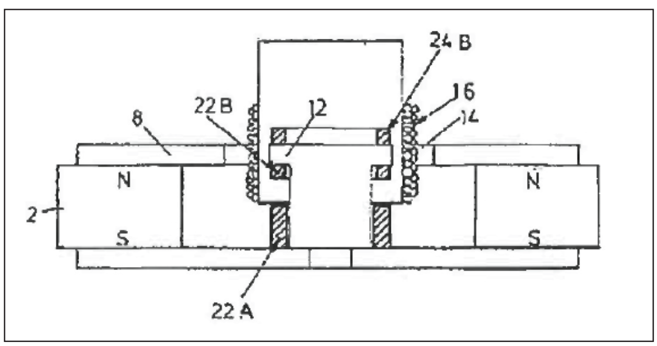

Figure 1: Diagram of Scan-Speak's patented Symmetrical Drive (SD) motor system.

and I will continue to use it in Test Bench until I find some other software that is as accurate at predicting high voltage excursion as Chris Strahm's multi-voltage LTD model.

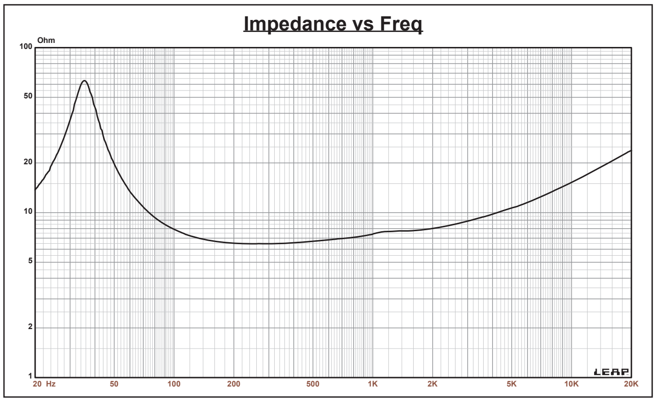

Figure 2: Scan-Speak 15W/8534T00 1V free-air impedance plot.

	TSL Model		LTD Model		Factory
	Sample 1	Sample 2	Sample 1	Sample 2	
F_S	34.4Hz	35.1Hz	30.0Hz	35.2Hz	32.0Hz
R_{EVC}	5.78	5.78	5.78	5.78	5.80
Sd cm^2	100.3	100.3	100.3	100.30	98.0
Q_{MS}	4.42	4.40	4.47	4.47	3.6
Q_{ES}	0.44	0.43	0.49	0.43	0.43
Q_{TS}	0.40	0.40	0.44	0.39	0.39
V_{AS}	27.8 ltr	26.7 ltr	30.0 ltr	26.7 ltr	30.0 ltr
SPL 2.83 V	86.0dB	86.1dB	85.3dB	86.2dB	85.5dB
X_{MAX}	5.0mm	5.0mm	5.0mm	5.0mm	5.0mm

Table 1: Comparison data for the Scan-Speak 15W/8534T00 driver.

I selected the complete curve set, the multiple voltage impedance curves derived from the LTD model and the 1V impedance curves for the TSL model in the transducer derivation menu in LEAP 5. Next, I created the parameters for the computer box simulations. **Figure 2** shows the 1V free-air impedance curves. **Table 1** compares the LEAP 5 LTD and TSL data and factory parameters for both Scan-Speak 15W/8534T00 samples.

T-S parameter results for the Scan-Speak Classic Series 5.5" midwoofer were nicely close to the factory data. That said, I followed my standard protocol and proceeded to program computer enclosure simulations using the LEAP LTD parameters for Sample 1. I used LEAP 5 Enclosure Shop

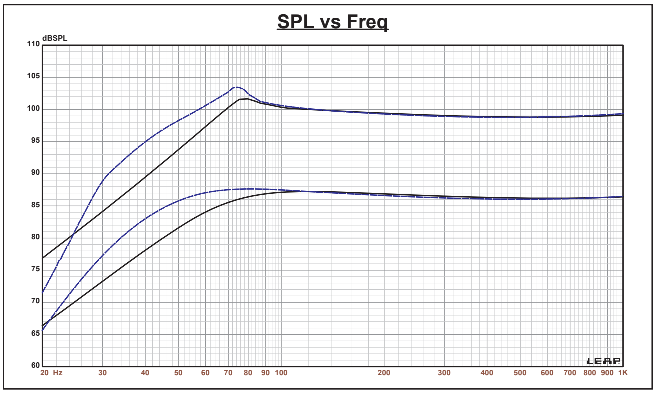

Figure 3: Scan-Speak 15W/8534T00 computer box simulations (black solid=sealed @ 2.83V; blue dash=vented @ 2.83V; black solid=sealed @ 15V; blue dash=vented @ 15V).

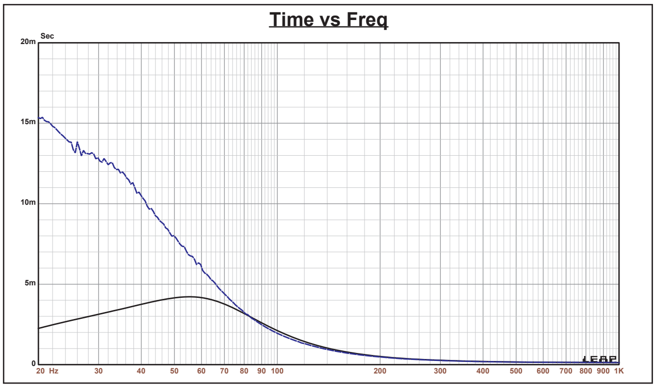

Figure 4: Group delay curves for the 2.83V curves shown in Figure 3.

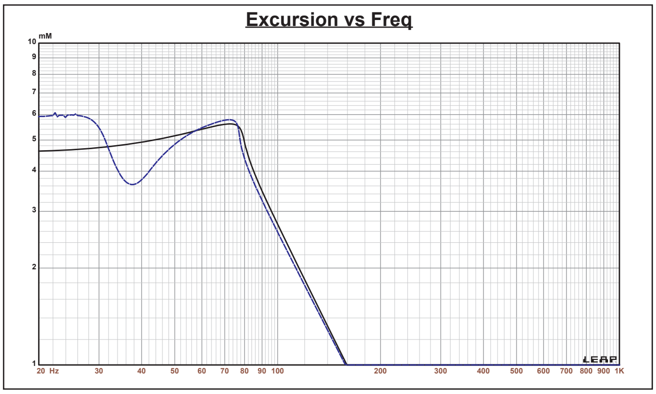

Figure 5: Cone excursion curves for the 15V curves shown in Figure 3.

to generate enclosure volumes estimated by the LEAP 5 Quick Design unit. The first is a 0.37ft^3 Butterworth sealed box with 50% fiberglass fill material, plus an QB3-type vented alignment using 0.61ft^3 box tuned to 36Hz and with 15% fiberglass fill material.

Figure 3 depicts the results for the 15W/8534T00 in the sealed and vented boxes at 2.83V and at a voltage level sufficiently high enough to increase cone excursion to Xmax+15% (5.75mm for the 15W). This enclosure simulation resulted in an F3 frequency of 61Hz (F6=48Hz)

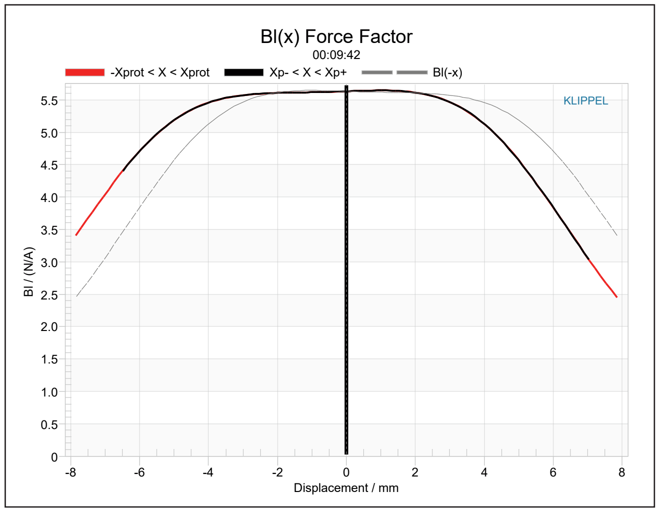

Figure 6: Klippel analyzer Bl(X) curve for the Scan-Speak 15W/8534T00.

with a Qtc=0.69 for the 0.37ft^3 sealed enclosure and −3dB=45Hz (F6=37Hz) for the 0.61ft^3 vented QB3 box simulation. Increasing the voltage input to both simulations until the maximum linear cone excursion was reached resulted in 102dB at 15V for the smaller sealed enclosure and 103.5dB at 15V input level for the larger vented box. **Figure 4** shows the 2.83V group delay curves. **Figure 5** shows the 15V excursion curves.

Klippel analysis for the Scan-Speak 15W/8534T00 produced the Bl(X), Kms(X), and Bl and Kms symmetry range plots given in **Figures 6-9**. The Klippel data this month was performed by Patrick Turnmire at Redrock Acoustics using the Klippel DA2 analyzer (courtesy of Klippel GmbH). Please note, if you do not own a Klippel analyzer and would like to generate this type of data on any transducer, Redrock Acoustics is available to perform this and a myriad of other measurement and design consulting services.

The Bl(X) curve for the Scan-Speak 15W/8534T00 5.5" woofer (Figure 6) is moderately broad and symmetrical as you would expect for a moderate Xmax (5.0mm) 5.5" driver. Looking at the Bl symmetry plot (Figure 7), this

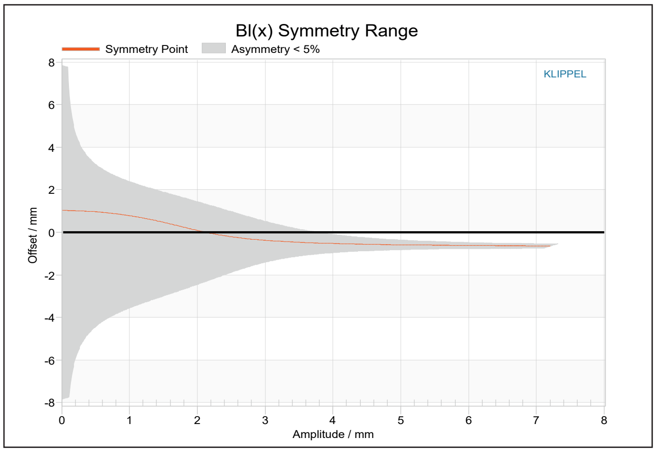

Figure 7: Klippel analyzer Bl symmetry range curve for the Scan-Speak 15W/8534T00.

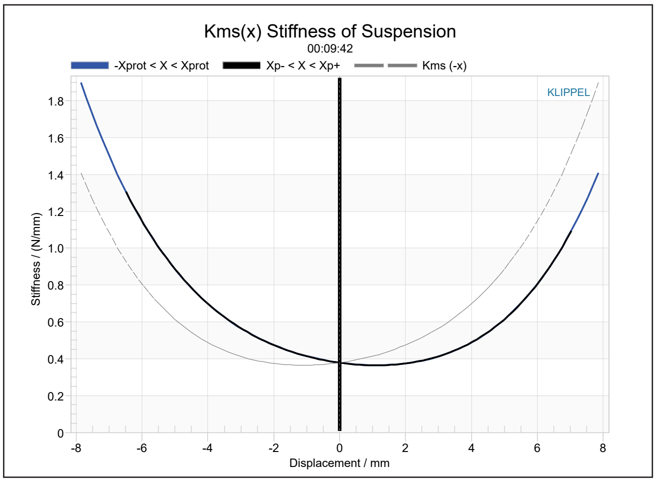

Figure 8: Klippel analyzer mechanical stiffness of suspension Kms(X) curve for the Scan-Speak 15W/8534T00.

curve is offset to a rather small 0.37mm coil-in (coil rearward) at the position of reasonable certainly (3mm) and mutating to 0.58mm coil-in offset at the 5mm physical Xmax of the driver.

Figure 8 and Figure 9 give the Kms(X) and Kms symmetry range curves for the 5.5″ midbass transducer. The Kms(X) curve (Figure 8) is fairly symmetrical, and with a relatively small amount of coil-out (forward) offset. Looking at the Kms symmetry range curve (Figure 9), there is 1.1mm coil-out offset at the 1mm point (high certainty) and decreases to 0.73mm at the physical Xmax of the driver. Displacement limiting numbers calculated by the Klippel analyzer for the Scan-Speak 15W/8534T00 was XBl @ 82% Bl=4.9mm (pretty much the physical Xmax of the 15W) and for XC @ 75%, Cms minimum was 2.4mm, which means that for the Scan-Speak 15W/8534T00, the compliance was the most limiting factor at the prescribed distortion level of 10%. Using the less conservative 20% criteria, XBl @ 70% is Bl=5.9mm and XC @50% is 4.3mm.

Figure 10 gives the inductance curve L(X) for the Scan-Speak 15W/8534T00 5.5″ midwoofer. Inductance will typically increase in the rear direction from the zero-rest

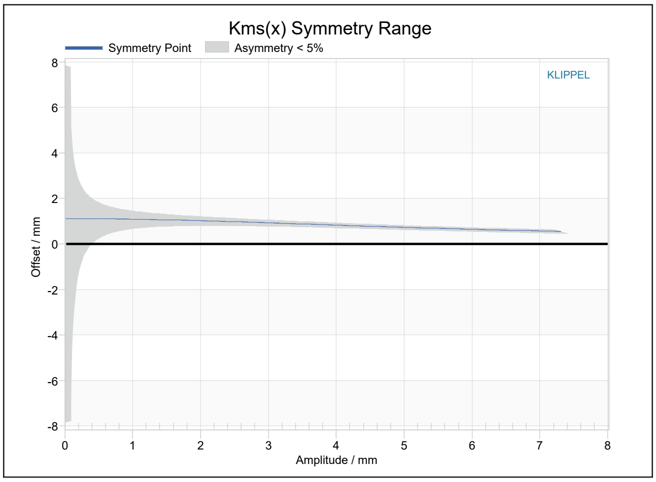

Figure 9: Klippel analyzer Kms symmetry range curve for the Scan-Speak 15W/8534T00.

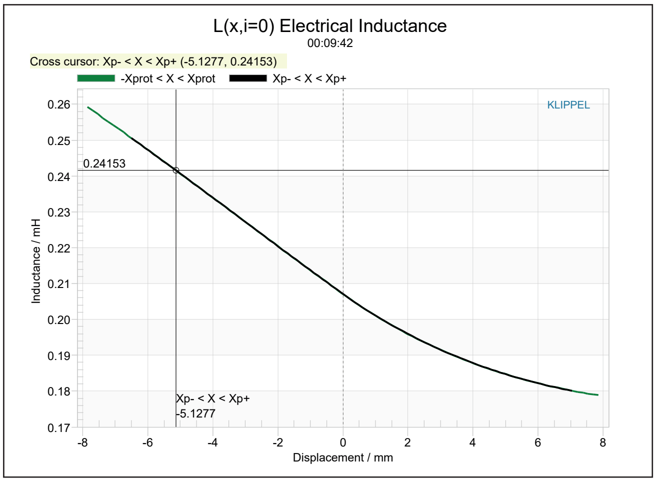

Figure 10: Klippel analyzer L(X) curve for the Scan-Speak 15W/8534T00.

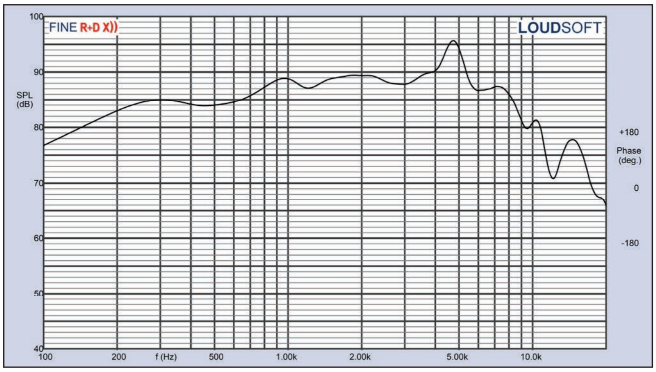

Figure 11: Scan-Speak 15W/8534T00 on-axis frequency response.

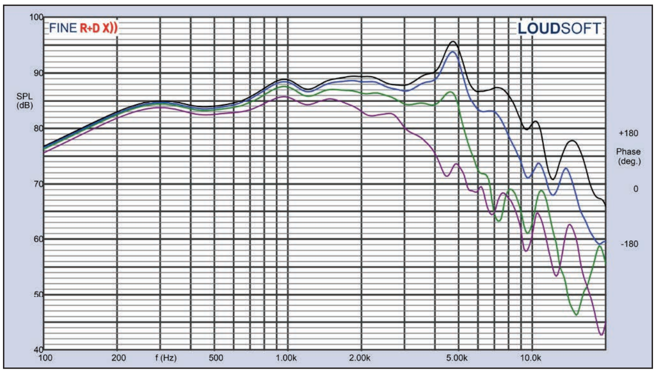

Figure 12: Scan-Speak 15W/8534T00 horizontal on- and off-axis frequency response (0°=black; 15°=blue; 30°=green; 45°=purple).

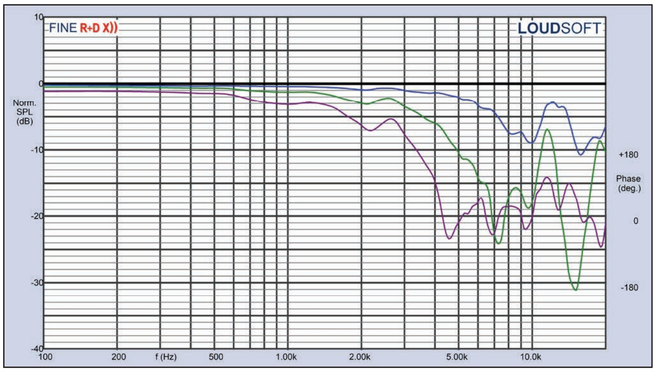

Figure 13: Scan-Speak 15W/8534T00 normalized on- and off-axis frequency response (0°=black; 15°=blue; 30°=green; 45°=purple).

position as the voice coil covers more pole area, which is what you see in the inductance graph. However, the inductance swing is only 0.057mH from Xmax in to Xmax out, which is Scan-Speak's patented Symmetric Drive dual shorting ring system doing its job, providing very good inductive performance.

For the remaining series of SPL measurements, I mounted the Scan-Speak 15W/8534T00 in an enclosure with a 15"x7" baffle area and foam damped inside volume. Then, I measured the driver frequency response using the Loudsoft FINE R+D analyzer and the GRAS 46BE microphone (courtesy of Loudsoft and GRAS Sound & Vibration) both on- and off-axis from 300Hz to 20kHz with a 1/6 octave smoothing (to simulate the 100-point LMS resolution that

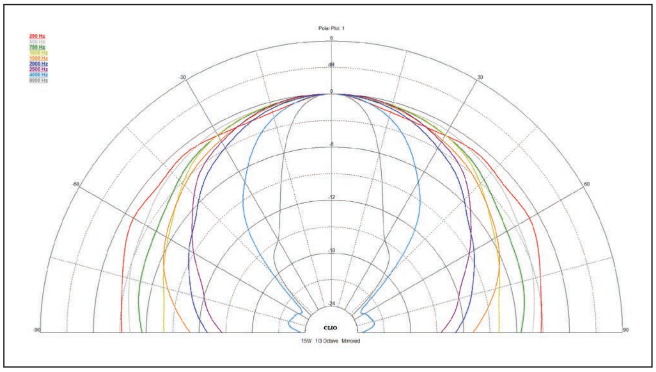

Figure 14: Scan-Speak 15W/8534T00 180° horizontal plane CLIO polar plot (in 10° increments).

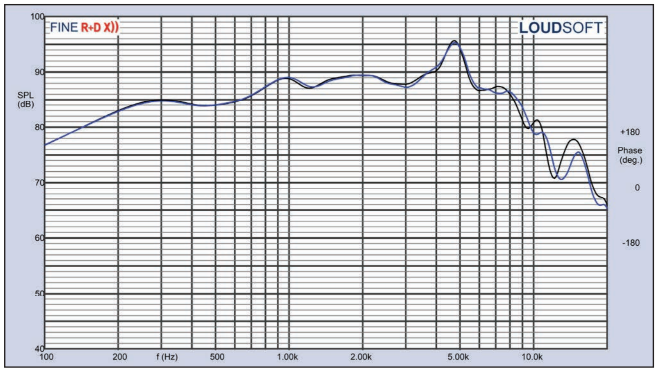

Figure 15: Scan-Speak 15W/8534T00 two-sample SPL comparison.

I've used for years in this column) at 2V/0.5m (normalized to 2.83V/1m), using the cosine windowed FFT method. **Figure 11** depicts the Scan-Speak 15W on-axis response, yielding a very smooth rising response from about 200Hz to 4kHz that when contoured flat should yield a ±2dB response. This is followed by a 5.5dB peak just prior to the transition to the transducer's second-order asymptotic slope.

Figure 12 illustrates the on- and off-axis frequency response at 0°, 15°, 30°, and 45°. The -3dB at 30° with respect to the on-axis curve occurs at 2.8kHz, which suggests a likely crossover point of 2.0kHz to 2.8kHz would be appropriate for the Scan-Speak 15W. **Figure 13** gives the normalized version of Figure 12. **Figure 14** shows the CLIO Pocket-generated horizontal plane polar plot (in 10° increments with 1/3 octave smoothing applied), with the CLIO Pocket provided courtesy of Audiomatica SRL. And

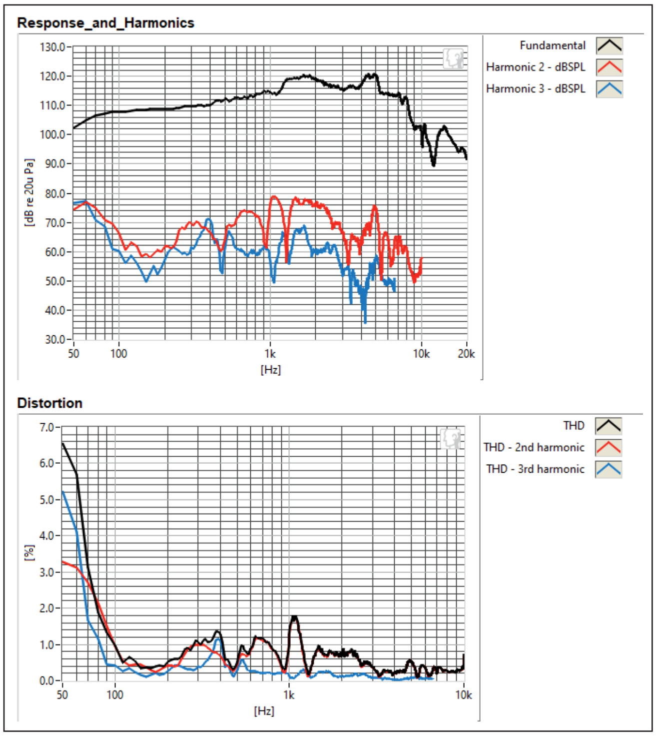

Figure 16: Scan-Speak 15W/8534T00 SoundCheck distortion plot.

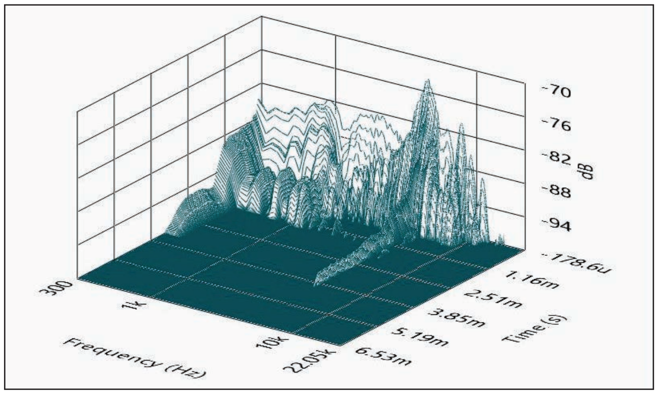

Figure 17: Scan-Speak 15W/8534T00 SoundCheck CSD waterfall plot.

last, **Figure 15** gives the two-sample SPL comparisons for the Scan-Speak Classic Series 5.5" driver, showing both samples very closely matched ≤0.5dB throughout the operating range of the driver.

Next, I fired up the Listen SoundCheck analyzer using Soundcheck 21 software and the AudioConnect interface along with the ¼" SCM measurement microphone (provided courtesy of Listen, Inc.). I set them up for distortion measurements with the SPL at 1m for the 15cm Scan-Speak woofer mounted in free-air, using a noise stimulus set to 94dB (7.16V) at 1m, my standard for home audio devices. The Scan-Speak 15W/8534T00 produced the distortion curves shown in **Figure 16**.

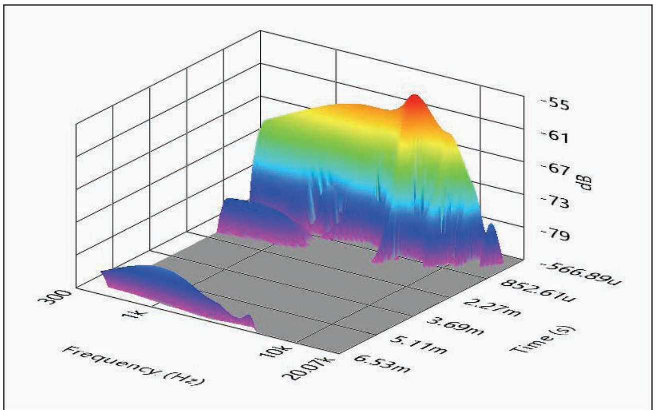

Figure 18: Scan-Speak 15W/8534T00 SoundCheck Wigner-Ville plot.

Next, I mounted the driver in the same enclosure baffle used for the frequency response measurements and performed the time-domain measurements. This was imported into Listen's SoundMap software, windowed to remove the room reflections. **Figure 17** shows the cumulative spectral decay (CSD) waterfall plot. **Figure 18** shows the Wigner-Ville plot.

Given the application of the new Phenomax cone along with all the measured data, Scan-Speak's new 15W/8534T00 looks like a nice addition to the company's Classic line of transducers. For more information, visit www.scan-speak.dk. ***VC***

Submit Samples to Test Bench

Test Bench is an open forum for OEM driver manufacturers in the loudspeaker industry and all OEMs are invited to submit samples to *Voice Coil* for inclusion in the monthly Test Bench column.

Send samples in pairs and addressed to:

Vance Dickason Consulting
4330 Imperial Drive
West Linn, OR 97068
(503-557-0427) | vdconsult@comcast.net

All samples must include any published data on the product, patent information, or any special information necessary to explain the functioning of the transducer. This should include details regarding the various materials used to construct the transducer. For woofers and midrange drivers, please include the voice coil height, gap height, RMS power handling, and physically measured Mmd (complete cone assembly including the cone, surround, spider, and voice coil with 50% of the spider, surround and lead wires removed).