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VOICE COIL

THE PERIODICAL FOR THE LOUDSPEAKER INDUSTRY

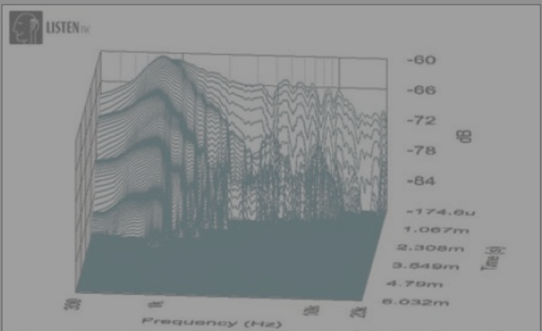

Figure 9: The SoundCheck CSD waterfall plot shows the Wavecor TW030WA09 (4 Ω).

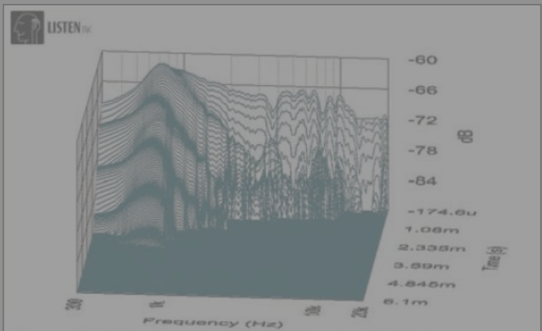

Figure 10: The SoundCheck CSD waterfall plot shows the Wavecor TW030WA10 (8 Ω).

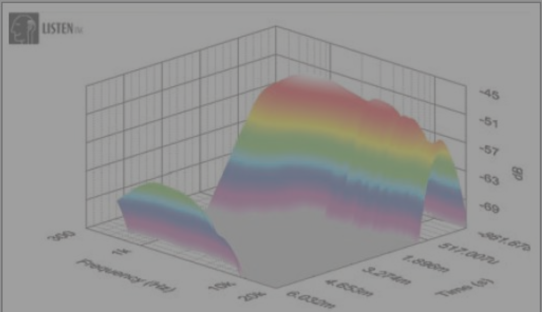

Figure 11: The SoundCheck STFT surface intensity plot is shown for the Wavecor TW030WA09 (4 Ω).

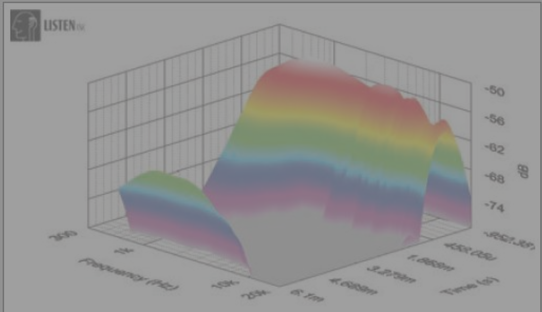

Figure 12: The SoundCheck STFT surface intensity plot is shown for the Wavecor TW030WA10 (8 Ω).

ScanSpeak 18W/8545-01

The subject of this review is the recently released ScanSpeak 18W/8545-01, which is an improved version of the Scan 18W/8545-00 (see **Photo 2**). The original ScanSpeak 18W/8545-00 was not discontinued and is still available as part of ScanSpeak's Classic series of drivers. It is a true high-end audio classic. Probably the most visible high-end loudspeaker, the 18W/8545, was incorporated into (at least a version of the 18W) Wilson Audio's Watt/Puppy, now known as the Sasha W/P. The Wilson Audio Watt/Puppy was a self-contained, two-way design using a focal inverted titanium dome tweeter in conjunction with the 18W/8545 6.5" midbass woofer (the Watt), and combined with two 8" drivers in a sort of subwoofer/speaker stand (the Puppy). According to Wilson Audio, the Watt/Puppy was introduced in 1986, and during its 23-year life span sold more than 23,000 units, and is considered perhaps the most successful $10,000-plus speaker ever to grace the audiophile market. This really is an outstanding sounding driver, and I used the Kevlar version of the 18W in the studio monitor design

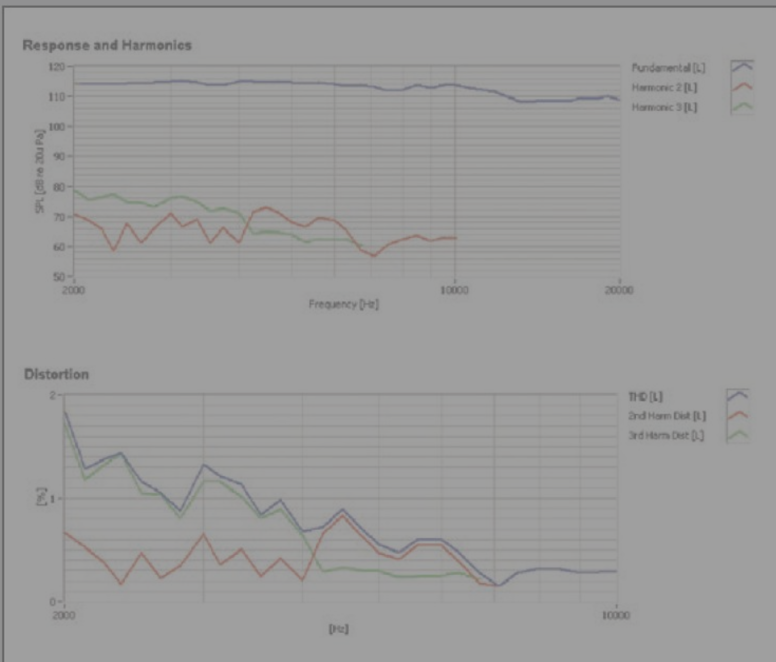

Figure 13: The SoundCheck distortion plots are shown for the Wavecor TW030WA09 (4 Ω).

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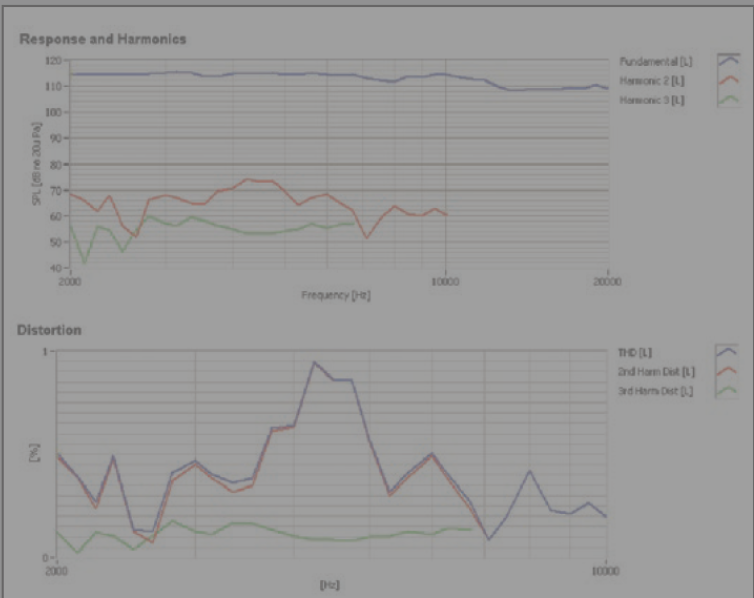

Figure 14: The Wavecor TW030WA10 (8 Ω) SoundCheck distortion plots are shown.

Photo 2: This is the ScanSpeak 18W/8545-01 driver.

example featured in the 6th edition of the *Loudspeaker Design Cookbook* released in 2000.

As expected, the feature set for the 18W/8545-01 is similar to the original 18W. This includes the similar, but updated, slim-profile, cast-aluminum frame, an updated version of the original coated, air-dried paper/carbon-fiber cone (the one with that rough "paper mache" look); a 2.25″-diameter inverted carbon-fiber paper dust cap; a 42-mm diameter voice coil wound on an aluminum former; an SD-1 patented symmetric drive motor structure with a 124-mm × 24-mm ceramic ferrite magnet (the symmetric drive motor uses an extended vented pole with an angled chamfer on the pole top section and three copper shorting rings, one centered on the gap, one located above, and one located below the cap area); and a T-yoke. Compliance is provided by a low-damping SBR rubber surround and a new updated 3.5″-diameter elevated cloth spider. Lastly, the voice coil is terminated to a pair of solderable terminals.

I began testing the ScanSpeak 6.5″ 18W/8545-01 using the LinearX LMS analyzer and VIBox to create both voltage and admittance (current) curves with the driver clamped to a rigid test fixture in free-air at 0.3 V, 1 V, 3 V, 6 V, and 10 V. The 10 550-point stepped sine wave sweeps for each 18WU sample were post-processed and the voltage curves were divided by the current curves (admittance) to create impedance curves. Phase was added using LMS calculation method, and along with the accompanying voltage curves, it was uploaded to the LEAP 5 Enclosure Shop software. In addition to the LEAP 5 LTD model results, I used the 1-V free-air curves to created a LEAP 4 TSL model set of parameters. The final data, which includes the multiple voltage impedance curves for the LTD model (see **Figure 15** for the 1-V free-air impedance curve) and the 1-V impedance curve for the TSL model, were selected and the parameters were created to perform the computer box simulations. **Table 1** compares the LEAP 5 LTD and TSL data and for both of the 18W/8545-01 samples, as well as the factory parameters (Factory 1). I also included the factory data on the original 18W/8545-00 (Factory 2). LEAP parameter calculation results for the 18W had some variance with the published specification, which often occurs with new drivers and preliminary specs. However, it appears that the intention with the new version of the 18W was to lower the Q_{TS} and increase the V_{AS}. Given this, I then set up computer enclosure simulations using the LEAP LTD parameters for Sample 1. I set up two box simulations, one sealed and one vented. For the closed-box simulation, I used a 0.25 ft^3 enclosure with 50% fiberglass fill material. For the vented box, I used a 0.43 ft^3 QB3 type vented alignment with 15% fiberglass fill material and tuned to 39 Hz.

Figure 16 shows the results for the ScanSpeak 18W

	TSL model		LTD model		Factory 1	Factory 2
	Sample 1	Sample 2	Sample 1	Sample 2		
F_S	26.0 Hz	26.0 Hz	26.0 Hz	26.0 Hz	25 Hz	28.0 Hz
R_{EVC}	5.52	5.48	5.52	5.48	6.2	5.5
Sd	0.0147	0.0147	0.0147	0.0147	0.0145	0.0145
Q_{MS}	1.86	1.81	1.67	1.61	1.55	2.30
Q_{ES}	0.29	0.29	0.29	0.31	0.22	0.30
Q_{TS}	0.25	0.26	0.25	0.26	0.20	0.27
V_{AS}	64.3 ltr	64.3 ltr	65.4 ltr	66.3 ltr	68.6 ltr	47.6
SPL 2.83 V/1 m	87.8 dB	87.6 dB	87.7 dB	87.4 dB	88.0 dB	88.0 dB
X_{MAX}	6.5 mm	6.5 mm	6.5 mm	6.5 mm	6.5 mm	6.5 mm

Table 1: This table shows a comparison of the Leap 5 TSL and LTD models for the ScanSpeak 18W/8545-01.

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in the sealed and vented boxes at 2.83 V and at a voltage level high enough to increase cone excursion to X_{MAX} + 15% (7.5 mm for the 18W). This yielded a F3 = 74 Hz

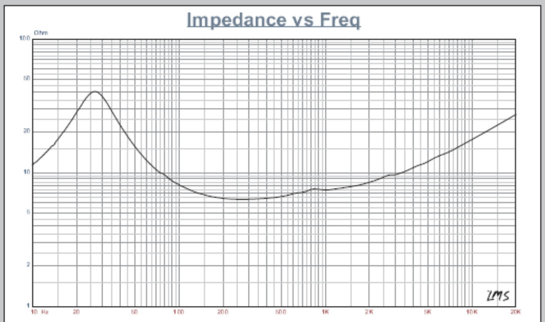

Figure 15: The free-air impedance plot is shown for the ScanSpeak 18W/8545-01.

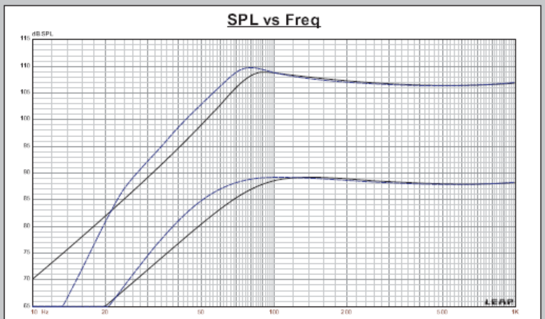

Figure 16: The computer box simulations (black solid = vented @ 2.83 V; blue dash = vented @ 2.83 V; black solid = vented @ 31.5 V; blue dash = vented @ 32 V) are shown for the ScanSpeak 18W/8545-01.

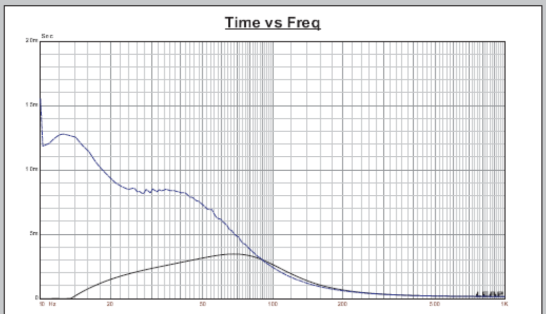

Figure 17: The plot shows the group delay curves for the 2.83-V curves in Figure 16.

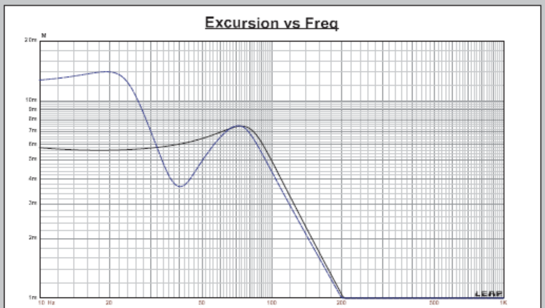

Figure 18: The plot shows the cone excursion curves for the 31.5/32-V curves in Figure 16.

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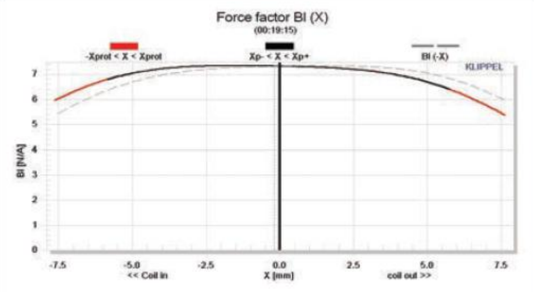

Figure 19: This is the Klippel analyzer Bl (X) curve for the ScanSpeak 18W/8545-01.

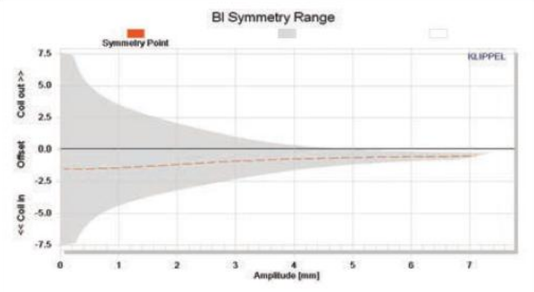

Figure 20: This is the Klippel analyzer Bl symmetry range curve for the ScanSpeak 18W/8545-01.

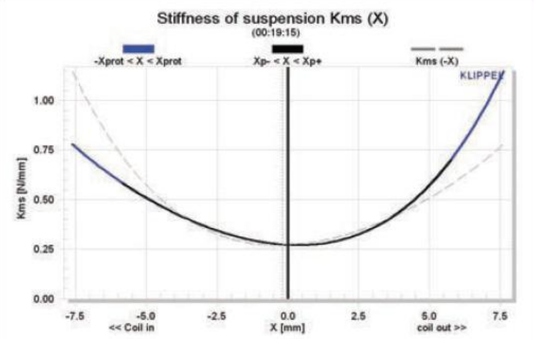

Figure 21: The plot shows the Klippel analyzer mechanical stiffness of suspension Kms (X) curve for the ScanSpeak 18W/8545-01.

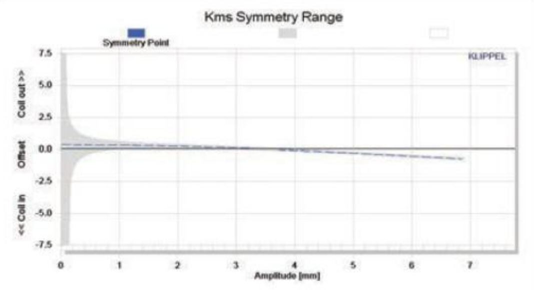

Figure 22: This plot shows the Klippel analyzer Kms symmetry range curve for the 18W/8545-01.

with a box/driver QTC of 0.7 for the 0.25 ft^3 sealed enclosure (appropriate for a home theater LR/CTR sat) and –3 dB = 55.5 Hz for the 0.63 ft^3 vented QB3 simulation. Increasing the voltage input to the simulations until the maximum linear cone excursion was reached resulted in 109 dB at 31.5 V for the sealed enclosure simulation and 110 dB with an 32-V input level for the larger vented box. (see **Figure 17** and **Figure 18** for the 2.83-V group delay curves and the 31.5-V/32-V excursion curves.) Overall, the parameter changes for the new 18W look perfect for a standalone two-way product.

Klippel analysis for the ScanSpeak 6.5" woofer produced the Bl(X), Kms(X), Bl and Kms symmetry range plots shown in **Figures 19–22**. The Bl(X) curve for the 18W (see **Figure 19**) is very broad and symmetrical

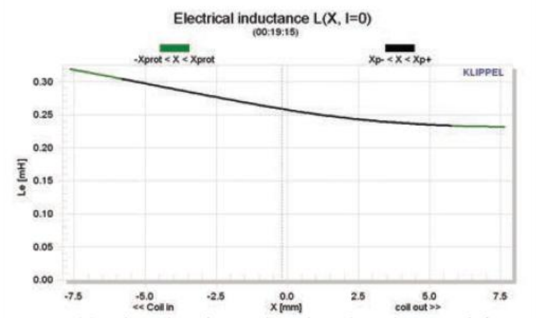

Figure 23: This plot shows the Klippel analyzer Le(X) curve for the ScanSpeak 18W/8545-01.

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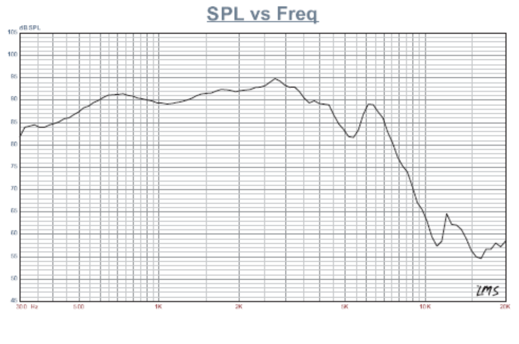

Figure 24: This is the ScanSpeak 18W/8545-01 on-axis frequency response.

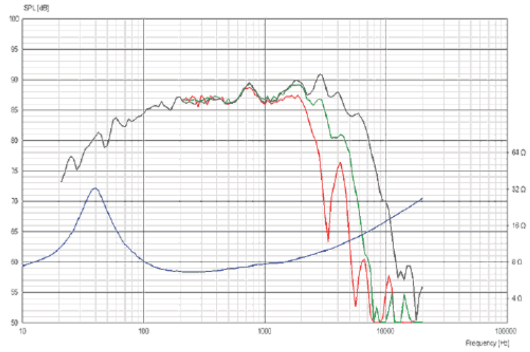
Figure 25: This plot shows the ScanSpeak Classic 18W/8545-00 factory on-axis frequency response.

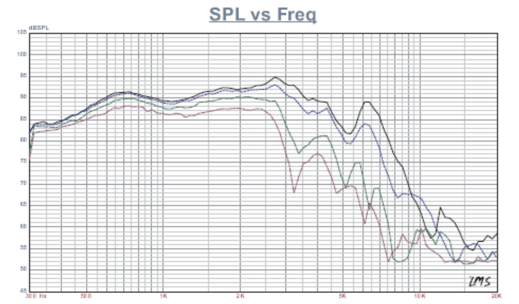

Figure 26: This is the ScanSpeak 18W/8545-01 horizontal on- and off-axis frequency response (0° = solid; 15° = dot; 30° = dash; 45° = dash/dot).

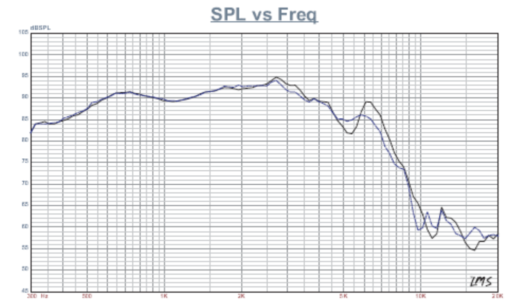

Figure 27: This shows the two-sample SPL comparison for the ScanSpeak 18W/8545-01.

with some offset. Looking at the Bl symmetry plot shown in **Figure 20**, this curve shows a coil rearward (coil in) offset at the rest position of 1.5 mm that goes to 0.5 mm offset at the 6.5-mm physical X_{MAX} of the woofer. Note that the data at rest has a fair degree of uncertainty (the expanding gray area indicates the level of uncertainty of the graph) at rest, but a high degree of certainty at the 6.5-mm position.

Figure 21 and **Figure 22** show the Kms(X) and Kms symmetry range curves for the ScanSpeak 18WU. The Kms(X) curve is also symmetrical in both directions with small offsets in either the coil-in or coil-out positions. Displacement-limiting numbers calculated by the Klippel analyzer for the 18W were XBl at 82% Bl = 5.7 mm and for XC at 75% CMS minimum was also 2.8 mm, which means for the 18W woofer, the compliance was the limiting factor for a distortion level of 10%.

Figure 23 shows the inductance curves L(X) for the 18W. The curve indicates an increasing inductance as the coil moves inward; however, there is only a minor change in inductance throughout the driver's operating range, a key to low-distortion performance. Inductance change from the rest position to XMAX coil-in position was only 0.078 mH, and even less, 0.024 mH, to the X_{MAX} coil-out position.

Following the testing, I mounted the 18W/8545-01 woofer in an enclosure that had a 17″ × 8″ baffle filled with damping material (foam) and measured the DUT on- and off-axis from 300 Hz to 20 kHz frequency response at 2.83 V/1 m using a 100-point gated sine wave sweep. **Figure 24** shows the 18W's on-axis response displaying a smooth rising response to about 2.75 kHz, followed by a 13 dB drop in SPL to a peak at 6 kHz. For comparison, **Figure 25** shows the factory on-axis response of the original 18W/8525-00.

Figure 26 shows the on- and off-axis frequency response at 0°, 15°, 30°, and 45°. With respect to the on-axis curve, −3 dB at 30° occurs at 2.3 kHz, so a crosspoint in that vicinity should work well for a reasonable power response. The last SPL measurement shows the two-sample SPL comparisons for the 6.5″

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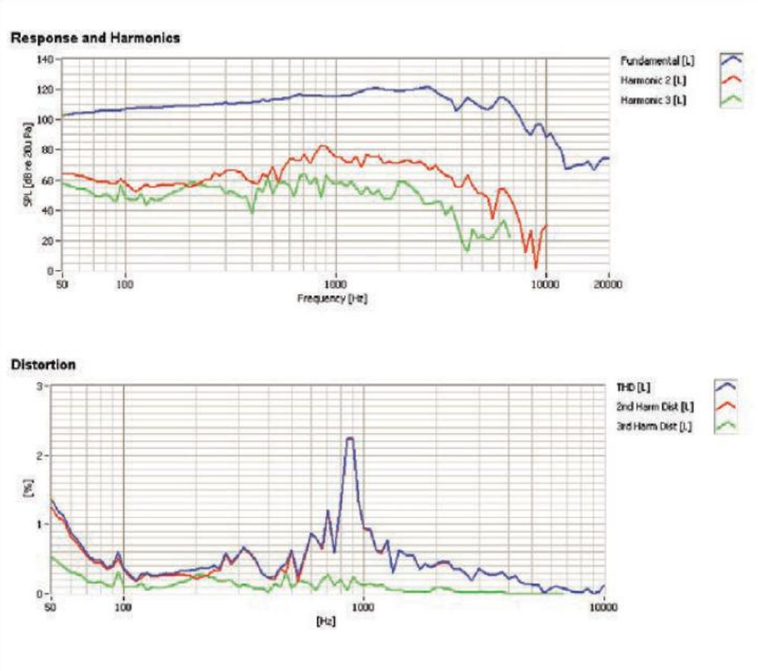

Figure 28: These are the ScanSpeak 18W/8545-01 SoundCheck distortion plots.

ScanSpeak driver, with a close match up to 2.7 kHz, and about 1-dB variations above that frequency (see **Figure 27**).

For the last group of tests, I used the SoundCheck analyzer and SCM-2 microphone to measure distortion and generate time-frequency plots. Setting up for the distortion measurement consisted of mounting the woofer rigidly in free air, and setting the SPL to 94 dB at 1 m (1.795 V) using a noise stimulus (two of SoundCheck's utilities are a software generator and an SPL meter), and measuring the distortion with the microphone placed 10 cm from the dust cap. This produced the distortion curves shown in **Figure 28**.

Finally, I used the SoundCheck analyzer to get a 2.83-V/1-m impulse response for this driver and imported the data into the SoundMap time/frequency software. The resulting CSD waterfall plot is shown in **Figure 29.** The Wigner-Ville logarithmic surface map (for its better low-frequency performance) plot is shown in **Figure 30**. Reviewing the data, this is a well-designed driver and a worthy upgrade from the Classic 18W/8545-00. For more information, visit www.scan-speak.dk. ***VC***

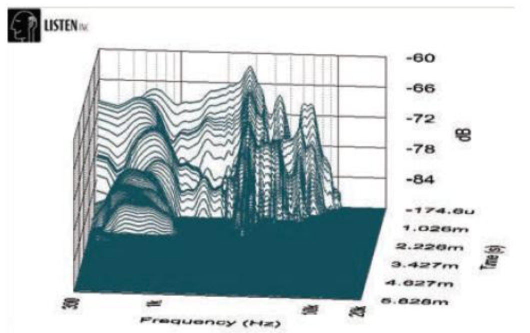

Figure 29: This shows the SoundCheck CSD Waterfall plot for the ScanSpeak 18W/8545-01.

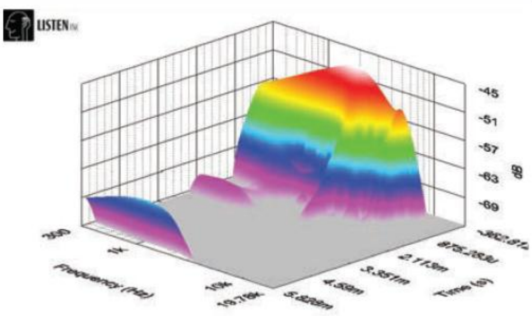

Figure 30: The shows the SoundCheck Wigner-Ville plot for the ScanSpeak 18W/8545-01.