phase, compare impedance curves, and perform T/S parameter measurements using fixed Mmd, delta mass, or delta compliance (***Figs. 2*** and ***3***). Other features include the ability to measure impedance at multiple voltage levels as well as estimate the resistance in the cable fixture used to measure impedance. For more, visit www.loudsoft.com. ***VC***

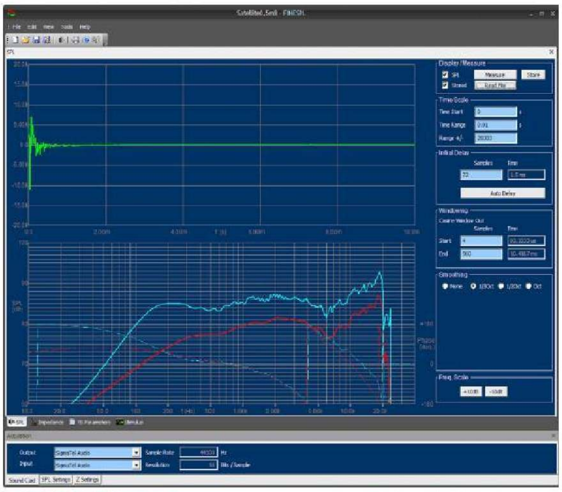

FIGURE 1: FINESPL frequency response magnitude and phase graph, plus you can also observe the impulse response at the top of the graph.

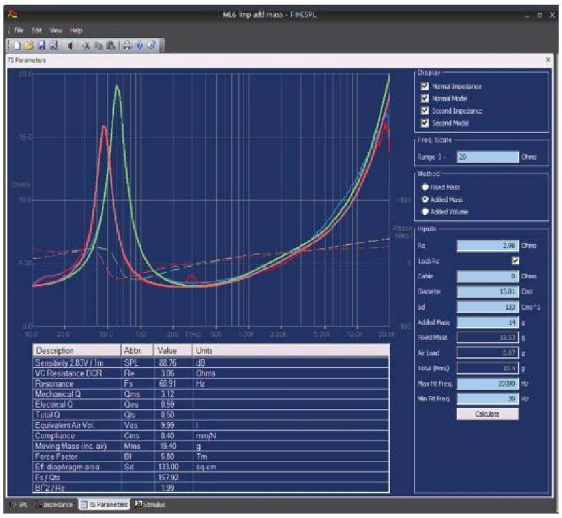

FIGURE 2: FINESPL T/S parameter screen.

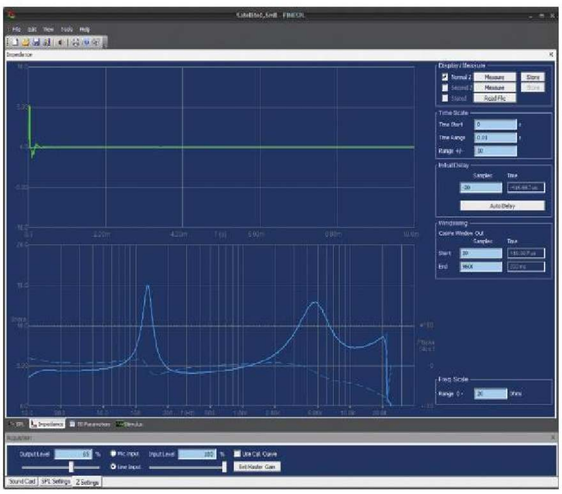

FIGURE 3: FINESPL impedance magnitude and phase graph.

Scan-Speak/B&C

By Vance Dickason

As I said last month, the Test Bench column remains my favorite part of writing *Voice Coil*, and this month is no exception. The samples that recently arrived came from two well-respected and outstanding OEMs, Scan-Speak and B&C. Scan-Speak, the Danish high-end home driver manufacturer sent the latest model from their neodymium motor Illuminator line, the 6.5″ aluminum cone 18WU/4747T00. And Italian Pro Sound OEM B&C offers a new neo motor coax, the 8″ 8CXN51.

Scan-Speak 18WU/4747T00

While new Scan-Speak Illuminator woofers were not intended as replacements for the Revelator 15W and 18W products, there is no question that the bar was set fairly high for their new high-end driver line to meet or exceed. I reviewed the 15W and 18W paper cone models in the February 2009 issue of *Voice Coil*, and like the paper cone versions, the new 18W4747T00 (***Photo 1***) looks impressive, both cosmetically and feature-wise. Optimized for use as a woofer in a three-way system, the 18WU departs immediately from the 15WU and 18WU models by incorporating a 6.5″ black anodized aluminum cone and 1.75″ diameter black anodized aluminum convex dustcap. You will also notice that Scan has incorporated the same cloverleaf pattern indent in the cone to suppress cone modes, as with the paper cone versions.

PHOTO 1: Scan-Speak 18WU.

From there, the 18WU4747T00 is similar to the previous reviewed Illuminator models, including the entirely new proprietary cast frame. This is a very "open" frame with all areas above and below the spider-mounting shelf as open for cooling as possible. The frame is also designed to accommodate the neodymium ring magnet underhung motor. The aluminum cone 18WU incorporates what appears to be the exact same motor structure as the paper cone versions, which means the same 42mm diameter four-layer voice coil wound with round wire on a polyimide vented former. Also like the paper cone versions, this driver has a gap height of 20mm and voice coil length of 8mm.

In terms of compliance, the 18WU uses a NBR rubber surround and flat 4.5″ diameter cloth spider. And last, the 18WU terminates the voice coil lead wires to a custom-molded terminal block with gold terminals.

I commenced testing the Scan-Speak 6.5″ 18WU using the LinearX LMS analyzer and VIBox to produce both voltage and admittance (current) curves with the driver clamped to a rigid test fixture in free-air at 0.3V, 1V, 3V, 6V, and 10V. I post-processed the ten 550-point stepped sine wave sweeps for each 18WU sample and divided the voltage curves by the current curves (admittance) to produce impedance curves, phase added using LMS calculation method, and along with the accompanying voltage curves, uploaded to the LEAP 5 Enclosure Shop software.

Besides the LEAP 5 LTD model results, I produced a LEAP 4 TSL model set of parameters using just the 1V free-air curves. I selected the final data, which includes the multiple voltage impedance curves for the LTD model (see ***Fig. 1*** for the 1V free-air impedance curve) and the 1V impedance curve for the TSL model, and produced the parameters order to perform the computer box simulations. ***Table 1*** compares the LEAP 5 LTD and TSL data and factory parameters for both 18WU samples.

Table 1: Scan-Speak 18WU/4747T00 Woofer

	TSL model		LTD model		Factory
	sample 1	*sample 2*	*sample 1*	*sample 2*	
F_S	37.9Hz	37.2Hz	34.5Hz	34Hz	32Hz
R_{EVC}	3.52	3.41	3.52	3.41	3.2
Sd	0.0152	0.0152	0.0152	0.0152	0.0154
Q_{MS}	4.35	4.45	4.72	4.64	3.42
Q_{ES}	0.45	0.44	0.45	0.42	0.30
Q_{TS}	0.41	0.40	0.41	0.42	0.28
V_{AS}	34.0 ltr	35.4 ltr	41.4 ltr	42.6 ltr	48.7 ltr
SPL 2.83V	88.0dB	88.1dB	87.6dB	87.8dB	88.1dB
X_{MAX}	6mm	6mm	6mm	6mm	6mm

LEAP parameter calculation results for the 18WU appear to be very different from the factory data; however, the Fs/Qt ratios were very close because when I programmed the factory data into a sealed box simulation with the same volume I used for the LEAP calculated LTD parameters, F3 was 60Hz for the factory data compared to F3 = 63Hz for the LEAP 5 LTD parameters. Given this, I proceeded setting 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 0.63ft^3 enclosure with 50% fiberglass fill material, and for the vented box, a 1.0ft^3 Chebychev/Butterworth type vented alignment with 15% fiberglass fill material and tuned to 34Hz.

Figure 2 illustrates the results for the 18WU in the sealed and vented boxes at 2.83V and at a voltage level high enough to increase cone excursion to Xmax + 15% (6.9mm). This yielded a F3 = 60Hz with a box/driver Qtc of 0.71 for the 0.63ft^3 sealed enclosure and –3dB = 47Hz for the 1.0ft^3 vented simulation. Increasing the voltage input to the simulations until the maximum linear cone excursion was reached resulted in 104dB at 14V for the sealed enclosure simulation and 106dB with a 16V input level for the larger vented box (see ***Figs. 3*** and ***4*** for

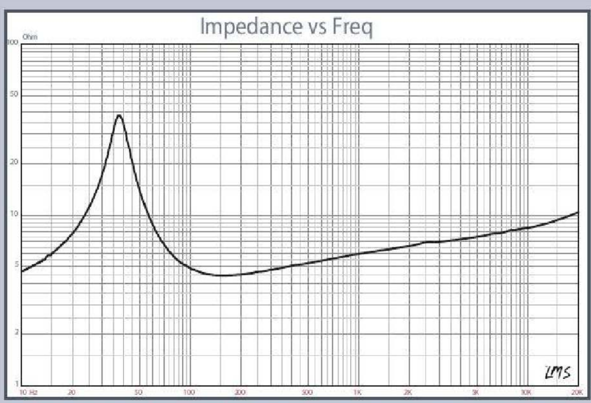

FIGURE 1: Scan-Speak 18WU4747T00 woofer free-air impedance plot.

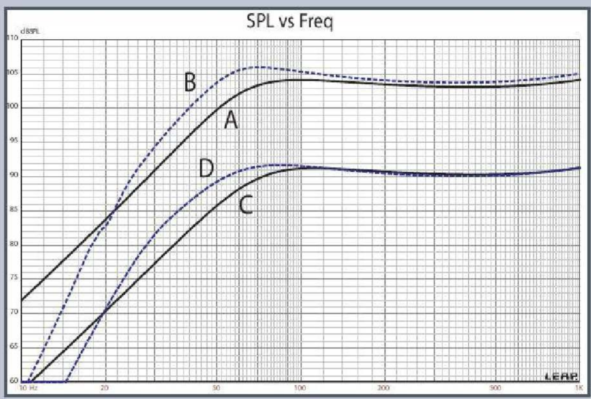

FIGURE 2: 18WU4747T00 computer box simulations (A = sealed 1 at 2.83V; B = vented 2 at 2.83V; C = sealed 1 at 14V; D = vented at 16V).

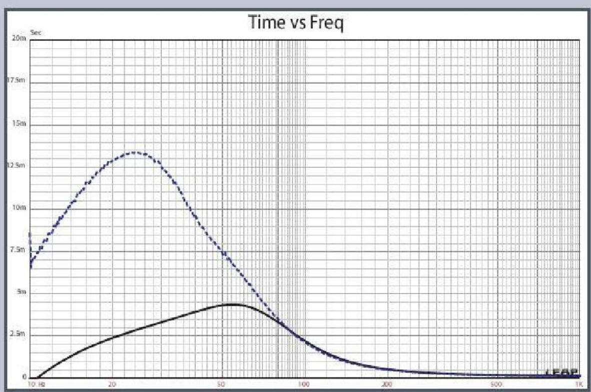

FIGURE 3: Group delay curves for the 2.83V curves in *Fig. 2*.

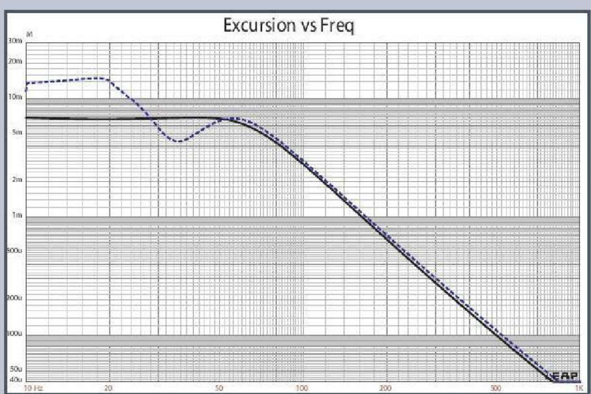

FIGURE 4: Cone excursion curves for the 14/16V curves in *Fig. 2*.

the 2.83V group delay curves and the 14/16V excursion curves).

Klippel analysis for the Scan-Speak 6.5″ woofer produced the Bl(X), Kms(X) and Bl and Kms symmetry range plots given in ***Figs. 5-8***. The Bl(X) curve for the 18WU (***Fig. 5***) is very broad and symmetrical, an affectation of the underhung configuration. The Bl symmetry plot (***Fig. 6***) shows a coil forward (coil out) offset at the rest position (obviously, the analyzer was again having trouble resolving this below 2.5mm) that goes to 0.8mm offset at about 6mm of excursion and then stays constant throughout the remainder of the operating range. This means that all the data above 7.5mm is pretty much what is occurring.

Note that the reason the Klippel can resolve this below about 6mm involves the large underhung gap. This motor

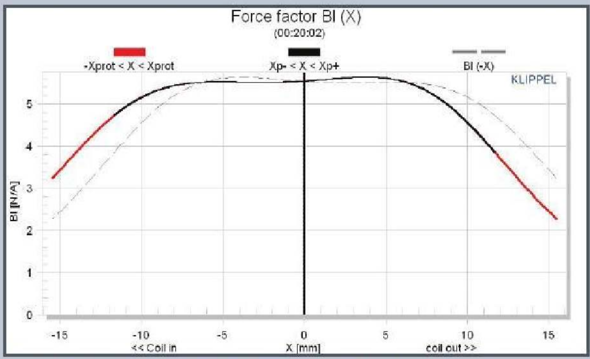

FIGURE 5: Klippel Analyzer Bl (X) curve for the 18WU4747T00.

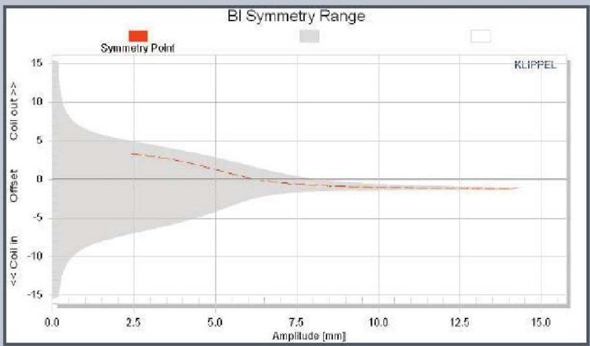

FIGURE 6: Klippel Analyzer Bl symmetry range curve for the 18WU4747T00.

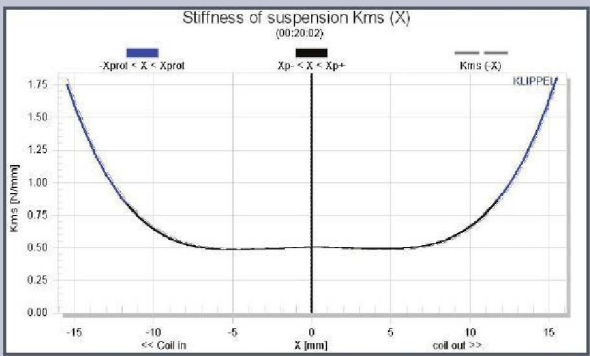

FIGURE 7: Klippel Analyzer mechanical stiffness of suspension Kms (X) curve for the 18WU4747T00.

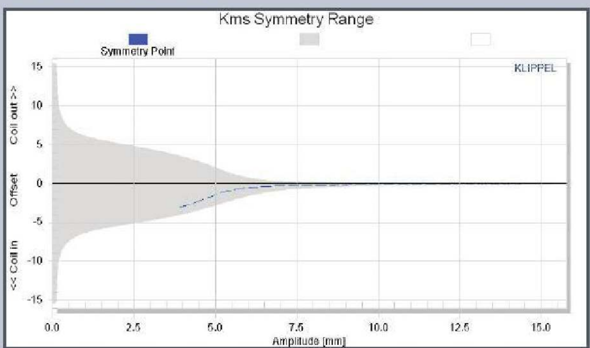

FIGURE 8: Klippel Analyzer Kms symmetry range curve.

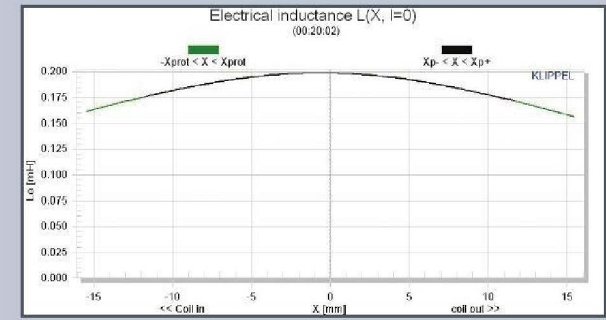

FIGURE 9: Klippel Analyzer L(X) curve for the 18WU4747T00.

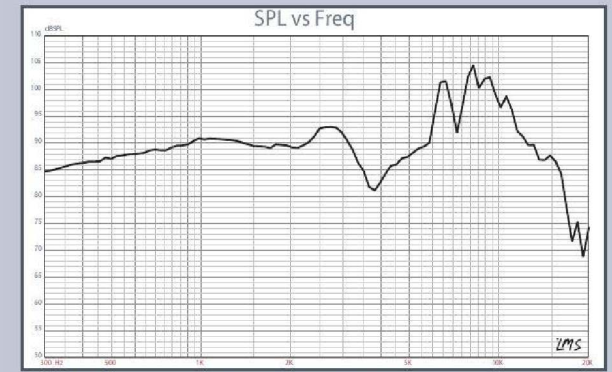

FIGURE 10: Scan-Speak 18WU4747T00 on-axis frequency response.

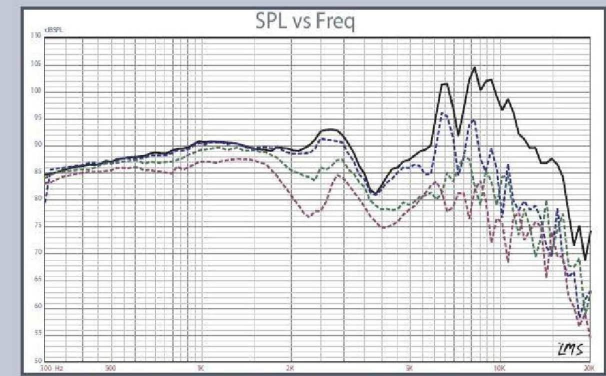

FIGURE 11: Scan-Speak 18WU4747T00 on- and off-axis frequency response.

FIGURE 12: Scan-Speak 18WU4747T00 two-sample SPL comparison.

runs linear for such a broad range that the analyzer can't detect what's going on (the analyzer depends on the coil getting to the edge of a gap area to reference motion in the gap). In a word, this driver looks outstanding in terms of the Bl and compliance balance. ***Figures 7*** and ***8*** give the Kms(X) and Kms symmetry range curves for the Scan-Speak 18WU.

The Kms(X) curve is very symmetrical in both directions with practically no offset above 6mm. Again, the Klippel was having trouble resolving the compliance below 6mm because of the large linearity range of the underhung coil. Displacement limiting numbers calculated by the Klippel analyzer for the 18WU were XBl at 82% Bl = 10mm, and for XC at 75% Cms minimum was also 10mm, which means that for the 18WU woofer, both BL and the compliance have the same limits for distortion level of 10%, but both are 4mm beyond Xmax! ***Figure 9*** gives the inductance curves L(X). The curve illustrates a decreasing inductance as the coil moves inward, the result of the copper shorting sleeve in this motor system as well as very minor change in inductance throughout the drivers operating range, a key to low distortion performance.

Following the Klippel testing, I mounted the 18WU/4747T00 woofer in an enclosure which had a 17″ × 8″ baffle and was filled with damping material (foam) and then measured the DUT on- and off-axis from 300Hz to 20kHz frequency response at 2.83V/1m using a 100-point gated sine wave sweep. ***Figure 10*** gives the 18WU's on-axis response displaying a very smooth rising response to about 2.75kHz, followed by an 11dB drop in SPL, the start of the aluminum breakup mode centered on about 8kHz. ***Figure 11*** has the on- and off-axis frequency response at 0, 15, 30, and 45°. -3dB at 30° with respect to the on-axis curve occurs at 1.8kHz, so a cross-point in that vicinity should be fine; however, as previously mentioned, this driver was optimized for a three-way system. It certainly would be possible to match it to a ribbon driver in a two-way at that frequency, but I think Scan-Speak was thinking more in terms of 1.5″ dome mid and 0.75″ tweeter as a likely scenario. The last SPL measurement is shown in ***Fig. 12*** and gives the two-sample SPL comparisons for the 6.5″ Scan-Speak driver, showing a close match up to 6kHz, with about 1dB variations above that frequency.

For the last group of tests, I employed the Listen Inc. SoundCheck analyzer (courtesy of Listen Inc.) to measure distortion and generate time frequency plots. Setting up for the distortion measurement consisted of mounting the woofer rigidly in free-air, setting the SPL to 94dB at 1m using a noise stimulus (SoundCheck has a software generator and SPL meter as two of its utilities), and then measuring the distortion with the Listen Inc. microphone placed 10cm from the dust cap. This produced the distortion curves shown in ***Fig. 13***.

Last, I employed the SoundCheck analyzer to get a 2.83V/1m impulse response for this driver and imported the data into Listen Inc.'s SoundMap Time/Frequency software. The resulting CSD waterfall plot is given in ***Fig. 14*** and the Wigner-Ville logarithmic surface map (for its better low-frequency performance) plot in ***Fig. 15***. Looking over all the data presented, this is a very well-designed driver, but you expect that from a company with Scan-Speak's reputation for excellence. For more information on these and the other new ScanSpeak Illuminator drivers, visit www.scan-speak.dk.

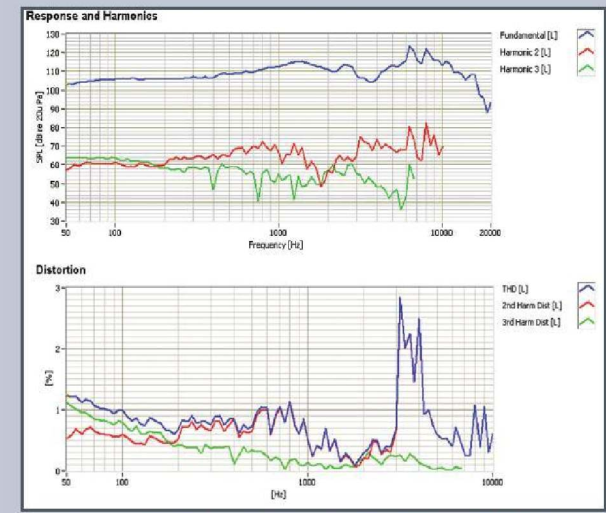

FIGURE 13: Scan-Speak 18WU4747T00 SoundCheck distortion plot.

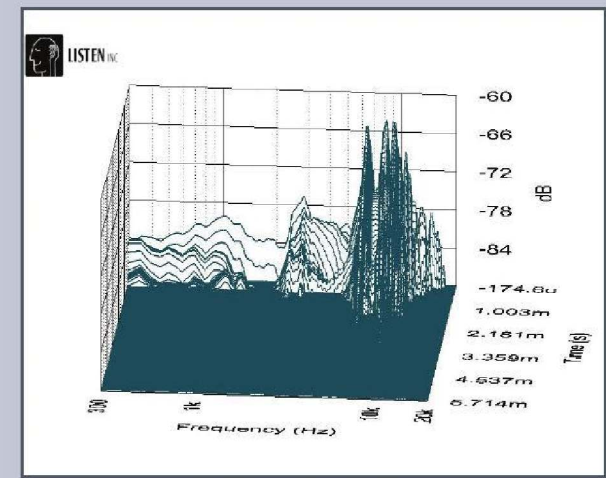

FIGURE 14: Scan-Speak 18WU4747T00 SoundCheck CSD waterfall plot.

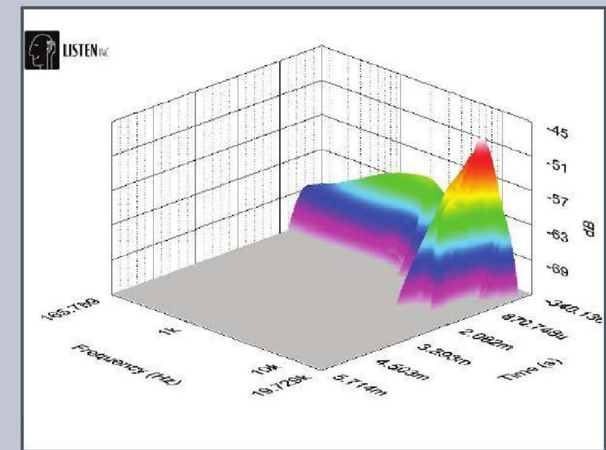

FIGURE 15: Scan-Speak 18WU4747T00 SoundCheck Wigner-Ville plot.