Faital and Exodus Anarchy

By Vance Dickason

Test Bench is definitely my favorite part of *Voice Coil*, as each month gives me another chance to look at more new drivers and, I hope, learn something new that I haven't encountered before. And after 21 years as Editor of *Voice Coil*, I still have new things to learn. This month I received sample drivers from Faital Pro and Exodus Audio. From Faital, a new very high SPL 6.5″ pro sound line source woofer/midrange, the 6PR150, and from a fairly new company, Exodus Audio, a high excursion 6.5″ aluminum cone midwoofer, the W06-017R, retail name "Anarchy."

Faital Pro 6PR150

The 6PR150 (***Photo 1***) is part of the relatively new high performance Faital professional line. Its intended application is as a woofer in either a line source array or in a small two-way monitor, or even as a midrange in a high SPL three-way system.

PHOTO 1: Faital Pro 6PR150.

This woofer is built on a proprietary cast aluminum frame that includes a motor housing in which the driver is assembled from the front and both the neodymium motor and cone assembly drop in from the front of the woofer. Cooling is provided by 16-12 × 4mm vents located at the back of the motor/frame housing with 16 heatsink fins around the periphery of the motor housing. The cone assembly is unique and includes a coated curvilinear paper cone with a single roll coated cloth surround. Remaining compliance is provided by a 4″ diameter flat cloth spider.

What is so unusual about the cone assembly is the high-frequency "whizzer" cone that takes the place of a dust cap. Normally these vintage high-frequency radiators have a trumpet-shaped cone that has the edge of the cone not suspended with no attachment above the cone surface. The Faital "whizzer" cone has the outside diameter attached directly to the cone forming a single unit. Driving the assembly is a 2″ diameter (large for a 6.5″ device) glass fiber voice coil former wound with aluminum wire to keep the Mmd as low as possible.

I began analysis of the 6PR150 using the LinearX LMS analyzer and VIBox to generate 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. LEAP was unable to get a good curve fit on the 10V curves due to nonlinearity at that voltage, so I discarded these curves and uploaded only the 0.3-6V curves to LEAP 5. As has become the established protocol for Test Bench testing, I no longer use a single added mass measurement and instead used actual measured mass. This requires 50% of the surround, spider, and voice coil leads removed before putting the entire cone assembly (including the voice coil) onto a digital scale.

Next, I post-processed the ten 550 point stepped sine wave sweeps for each 6PR150 sample and divided the voltage curves by the current curves (admittance) to derive impedance curves, phase added by the LMS calculation method, and, along with the accompanying voltage curves, imported to the LEAP 5 Enclosure Shop program. Because most Thiele/Small data provided by OEM manufacturers is produced using either a standard model or the LEAP 4 TSL model, I also generated a LEAP 4 TSL parameter set using the 1V free-air curves. I selected the complete data set, the multiple voltage impedance curves for the LTD model (see ***Fig. 1*** for the 1V free-air impedance curve) and the 1V impedance curves for the TSL model in the transducer derivation menu in LEAP 5, and produced the parameters for the computer box simulations. ***Table 1*** compares the LEAP 5 LTD and TSL data and factory parameters for both Faital Pro samples.

LEAP LTD/TSL parameter calculation results for the

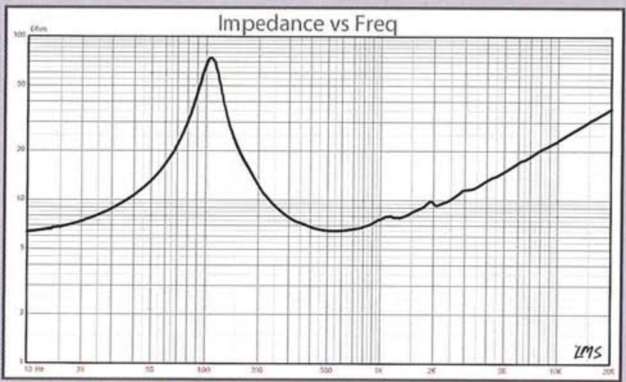

FIGURE 1: Faital Pro 6PR150 free-air impedance plot.

Table 1: Faital Pro 6PR150 woofer

	TSL model sample 1	TSL model sample 2	LTD model sample 1	LTD model sample 2	Factory
F_S	104.4Hz	98.0Hz	93.4Hz	102.9Hz	100Hz
R_{EVC}	5.64	5.57	5.64	6.64	5.5
Sd	0.0137	0.0137	0.0137	0.0137	0.0148
Q_{MS}	4.43	4.36	4.04	5.55	8.80
Q_{ES}	0.35	0.32	0.32	0.38	0.33
Q_{TS}	0.33	0.30	0.30	0.36	0.33
V_{AS}	4.56 ltr	5.18 ltr	5.70 ltr	4.74 ltr	5.80 ltr
SPL 2.83V	93.5dB	93.7dB	93.5dB	93.2dB	97dB
X_{MAX}	2.3mm	2.3mm	2.3mm	2.3mm	2.3mm

6PR150 were reasonably close to the factory data, with the exception of the less conservative Sd number used for factory data (my measurement includes 50% of the surround width). Despite the Sd variance, I began setting up computer enclosure simulations using the LEAP LTD parameters for Sample 1. I generated two vented box simulations, one a Qb3 type alignment ported enclosure and the other an EBS (Extended Bass Shelf) alignment.

This consisted of a 166 in^3 vented box tuned to 123Hz with 15% fiberglass fill material, and a second simulation, an EBS vented enclosure with 171 in^3 volume tuned to 111Hz, also with 15% fiberglass fill material. Note that the physical Xmax number used for this review is the one provided by Faital. Their criteria is different than the standard definition of physical Xmax, which is (coil height-gap height)/2. Faital takes that number and adds to this (gap height)/3.

Figure 2 shows the results for the 6PR150 in the two vented enclosures at 2.83V and at a voltage level high enough to increase cone excursion to Xmax + 15% (2.6mm). The resulting F3 frequency was 140Hz 116 in^3 vented enclosure and -3dB of 113Hz for the 171 in^3 vented box. Increasing the voltage input to the simulations until the maximum linear cone excursion was reached produced 103.5dB at 8V for the smaller ported box simulation and 103dB with an 8V input level for the larger vented enclosure (see ***Figs. 3*** and ***4*** for the 2.83V group delay curves and the 8V excursion curves).

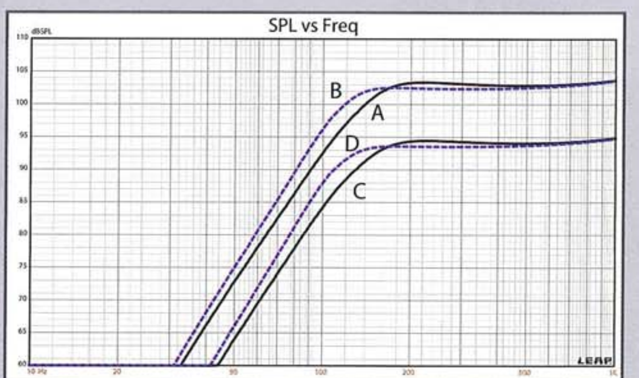

FIGURE 2: Faital Pro 6PR150 computer box simulations (A = vented 1 at 2.83V; B = vented 2 at 2.83V; C = vented 1 at 8V; D = vented 2 at 8V).

Klippel analysis for the 6PR150, which was performed by Pat Turnmire, Red Rock Acoustics (author of the SpeaD and RevSpeaD software), produced the Bl(X), Kms(X) and Bl and Kms Symmetry Range plots given in ***Figs. 5-8.*** (Patrick also offers in-depth analysis of the data and recommendations for improvement at extra cost—for contact info, visit www.redrockacoustics.com).

The Bl(X) curve for the Faital 6.5" woofer (***Fig. 5***) exhibits the typical narrow but symmetrical shape that comes with a moderate to short Xmax driver. In the Bl symmetry plot (***Fig. 6***), there is a very small coil-in Bl offset to the 6PR150 starting at about 0.24mm at rest, increasing to about 0.27mm at Xmax. ***Figures 7*** and ***8*** show the

Kms(X) and Kms symmetry range curves. The Kms(X) curve has some minor asymmetry in both directions, with a coil-in offset starting at about 0.73mm at the rest position and decreasing to a 0.42mm coil-in offset at 2.3mm of excursion (the driver physical Xmax).

For the Faital Pro woofer, displacement limiting numbers were XBl at 82%, Bl was 2.2mm, and for the compli-

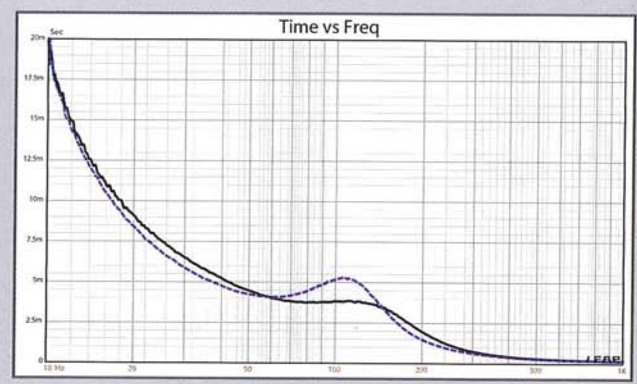

FIGURE 3: Group delay curves for the 2.83V curves in *Fig. 2.*

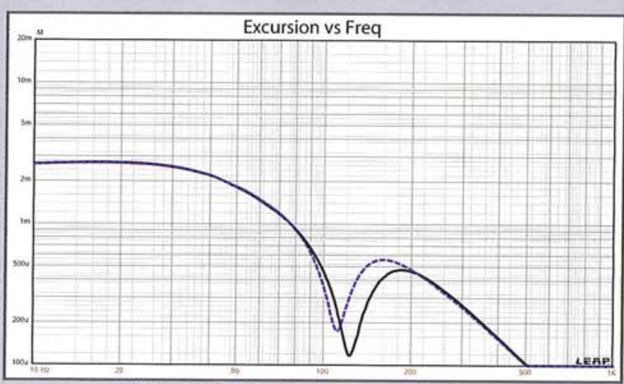

FIGURE 4: Cone excursion curves for the 8V curves in Fig. 2.

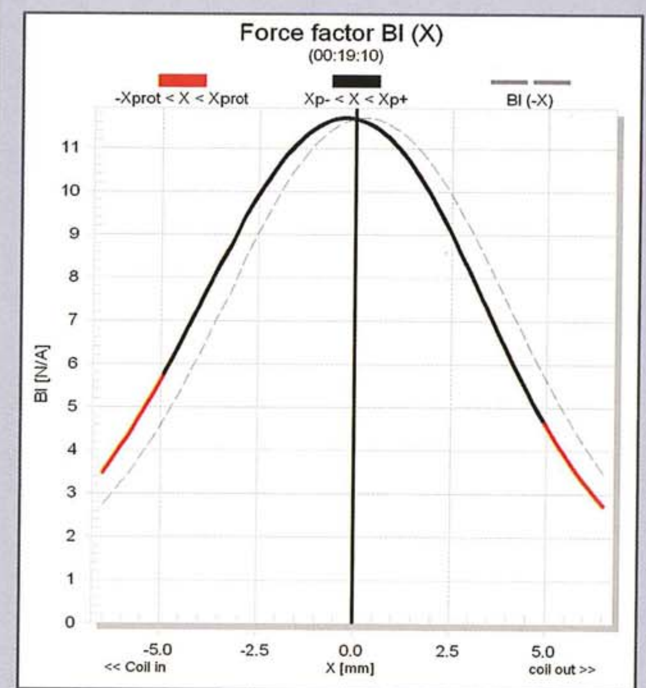

FIGURE 5: Klippel Analyzer Bl (X) curve for the Faital Pro 6PR150.

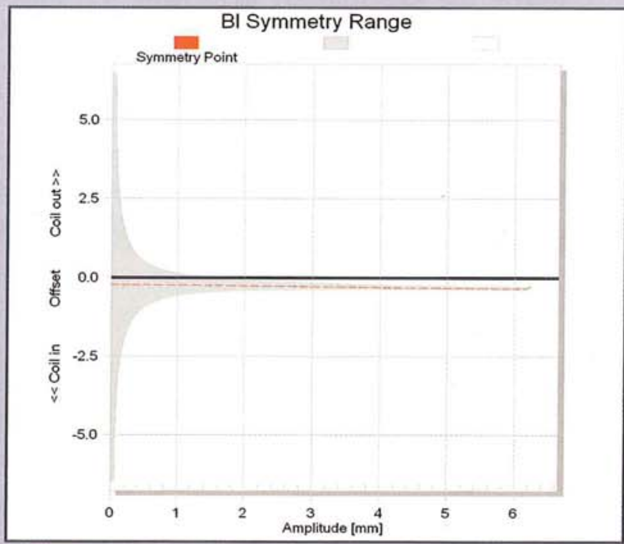

FIGURE 6: Klippel Analyzer Bl symmetry range curve for the 6PR150.

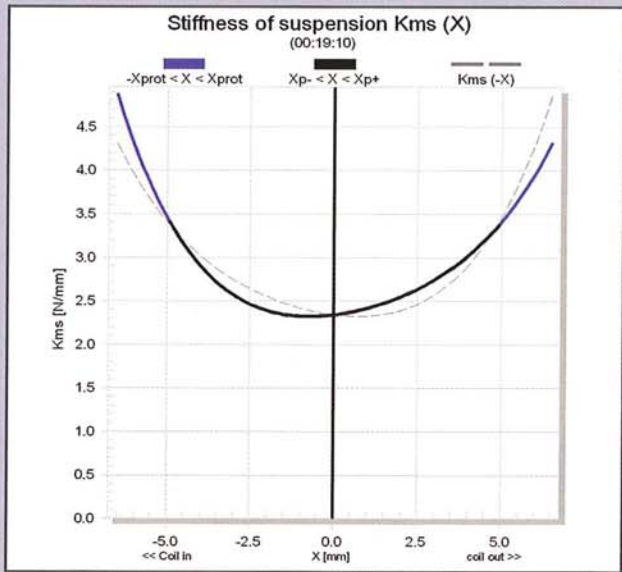

FIGURE 7: Klippel Analyzer mechanical stiffness of suspension Kms (X) curve for the Faital Pro 6PR150.

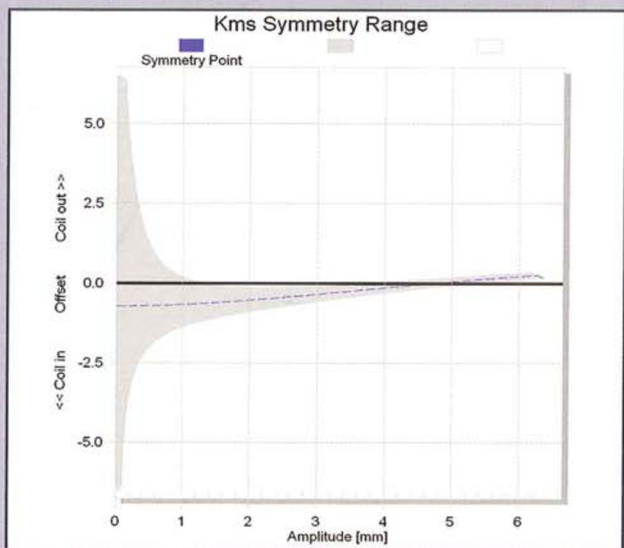

FIGURE 8: Klippel Analyzer Kms symmetry range curve for the 6PR150.

ance, XC at 75%, Cms was 4.3mm, which means that for the 6PR150 woofer, the Bl is the most limiting factor at the prescribed distortion level of 10%. Because the standard definition Xmax is only 0.3mm, the distortion performance is very good.

Figure 9 gives the inductance curve Le(X) for the 6PR150 woofer. According to the Faital literature, this unique motor configuration includes a demodulation ring (shorting ring). Given that, the inductance variance over the operating range is only 0.04mH, so there is practically no inductance change at all, which is important in producing an ultra-low distortion driver.

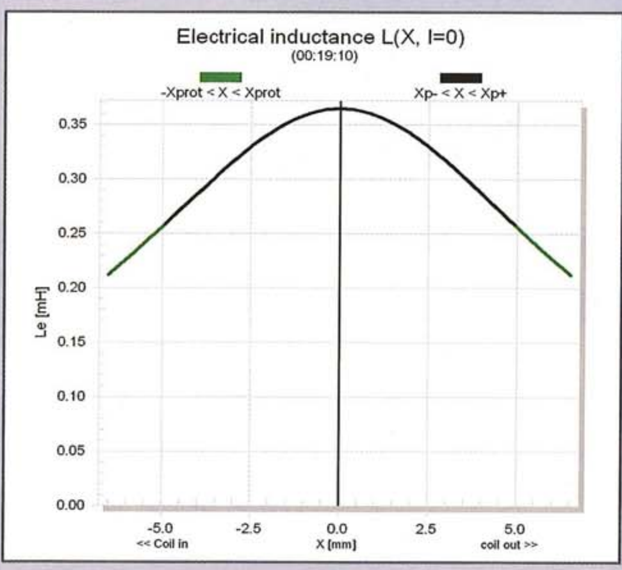

FIGURE 9: Klippel Analyzer Le(X) curve for the Faital Pro 6PR150.

Next I mounted the 6PR150 woofer in an enclosure which had a 14″ × 7″ baffle and was filled with damping material (foam) and then measured the driver on- and off-axis from 300Hz to 40kHz frequency response at 2.83V/1m using a 100-point gated sine wave technique. ***Figure 10*** gives the on-axis response showing a smooth mostly flat response rising to a typical (for a 6.5″) break point at 1.3kHz, declining in output about 4dB before beginning a series of breakup modes starting at 3.2kHz and continuing into the stop band of the driver's response. ***Figure 11*** illustrates the off-axis frequency response at 0, 15, 30, and 45°. -3dB at 30° with respect to the on-axis curve occurs at 2.1kHz, somewhat lower than most 6.5″ drivers, but cross point 2.1-3kHz or lower would be appropriate. And finally, ***Fig. 12*** gives the two-sample SPL comparisons for the 6.5″ Faital driver, showing a very close match throughout the operating range.

For the remaining group of tests, I set up the Listen Inc. SoundCheck analyzer (courtesy of Listen Inc.) to measure distortion and generate time frequency plots. For the distortion measurement, I mounted the Faital Pro woofer rigidly in free-air, and set the SPL to 104dB at 1m using a noise stimulus (10V), and then measured the distortion with the Listen Inc. microphone placed 10cm from the dust cap. This produced the distortion curves shown in ***Fig. 13***.

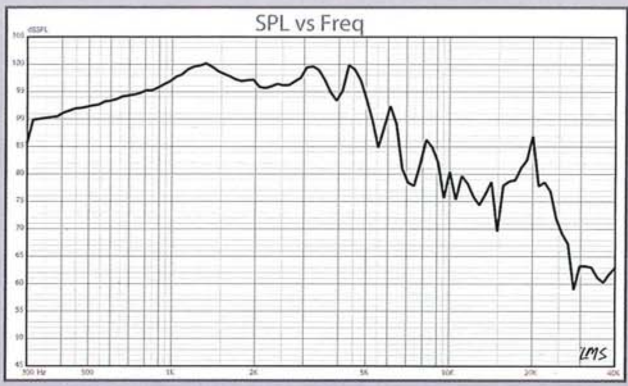

FIGURE 10: Faital Pro 6PR150 on-axis frequency response.

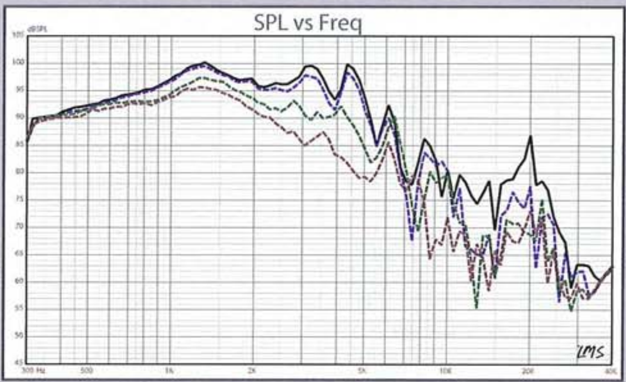

FIGURE 11: Faital Pro 6PR150 on- and off-axis frequency response.

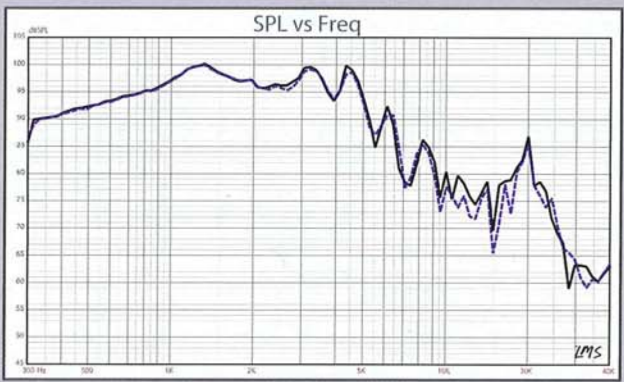

FIGURE 12: Faital Pro 6PR150 two-sample SPL comparison.

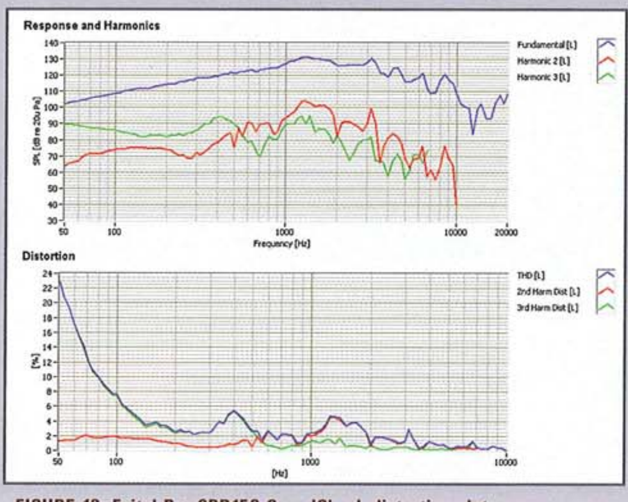

FIGURE 13: Faital Pro 6PR150 SoundCheck distortion plots.

I then used SoundCheck to get a 2.83V/1m impulse response for this woofer and imported the data into Listen Inc.'s SoundMap software. The resulting CSD (Cumulative Spectral Decay) waterfall plot is given in ***Fig. 14*** and the Wigner-Ville (for its better low-frequency performance) plot in ***Fig. 15***. For more information on this very low distortion high SPL 6.5″ driver, visit www.faitalpro.com.

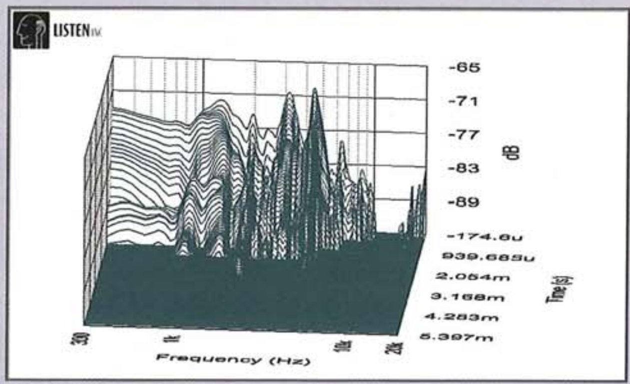

FIGURE 14: Faital Pro 6PR150 SoundCheck CSD waterfall plot.

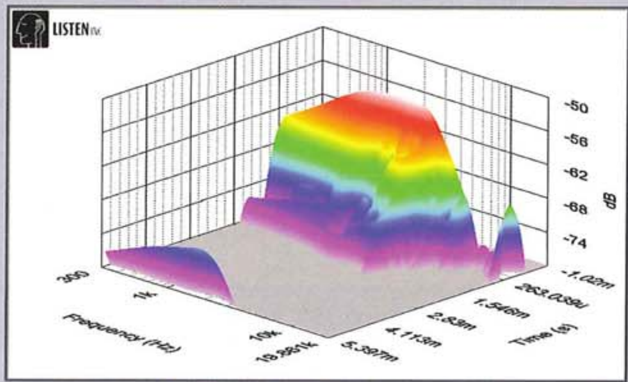

FIGURE 15: Faital Pro 6PR150 SoundCheck Wigner-Ville plot.