

Paradigm Reference Signature SUB 2 Subwoofer

JOHN E. JOHNSON, JR. NOVEMBER 15, 2010

SUBWOOFER



the Piano Black Premium finish.

Introduction

Paradigm, renown manufacturer of most categories of A/V products, has released their latest subwoofer line, called the SUB 1 and SUB 2. These two subwoofers are part of their Reference Signature line of speakers and subs. Both are hexagonal in shape, with six drivers (8" in the SUB 1 and 10" in the SUB 2), having two drivers arranged vertically on three of the six sides, alternating sides with drivers and sides without drivers. They are sealed enclosures, and both have amplifiers with power heretofore not seen in any subwoofers. The SUB 2 amplifier can be powered by 120 v AC or 240 v AC. At 120 v, the amplifier outputs 3,000 watts RMS, and at 240 v, it will output a whopping 4,500 watts RMS and 9,000 watts peak. The SUB 2, which is reviewed here, weighs 230 pounds. Its performance is truly magnificent, with a price tag worthy of its design: \$8,999 for Cherry or Black Ash finishes, and \$9,499 for

Specifications

- Design: Powered Subwoofer, Sealed Enclosure
- Drivers: Six 10" Polypropylene, Each with a 3" 10 Layer Voice Coil and 25.2 Pound Magnet
- Power: 3,000 Watts RMS with 120 Volts AC Connection, 4,500 Watts RMS with 240 Volts Connection (9,000 Watts Peak)
- MFR: 7 Hz – 250 Hz
- Low-Pass: 30 Hz – 150 Hz, Continuously Adjustable
- Phase Adjustment: 0° – 180°, Continuously Adjustable
- Inputs: XLR and RCA; Trigger and Auto On/Off; USB for Connection to Computer for Perfect Bass Kit EQ

- Input Sensitivity: 100 mV
- Input Impedance: 10 kOhms RCA, 20 kOhms XLR
- Dimensions: 24.5" H x 23.75" W x 22.3" D
- Weight: 230 Pounds
- Perfect Bass Kit (Software and Calibrated Microphone for EQ) Included
- MSRP: \$8,999 USA in Cherry or Black Ash, \$9,499 in Piano Black
- [Paradigm](#)

The Design

Paradigm set out to design the most powerful subwoofer that could be possible, within the constraints of what consumers would be able to physically place in their home theaters. In other words, it would be easy to build a dam busting subwoofer the size of a refrigerator, but to build such a product that is about the same size as previous top-of-the line, room-shaking subs, well, that is a different issue entirely.

To put things in perspective, the SUB 1 and SUB 2 have been on the drawing boards at Paradigm for years. The amplifier alone was a 10 year project. The outcome is a switching amplifier (Class D) that will produce 9,000 watts peak when powered by 240 v AC. Most consumers will probably opt to just plug it into their existing 120 v wall receptacle, and will be content with 3,000 watts RMS.

I obtained the 240 version of the SUB 2's, and had a 240 v line installed in the lab just to see what this thing can do (and eventually, I believe we will see more 240 v A/V products). For some of the listening tests, I connected the subs to a standard 120 v receptacle, and for others, I used the 240 v receptacle.

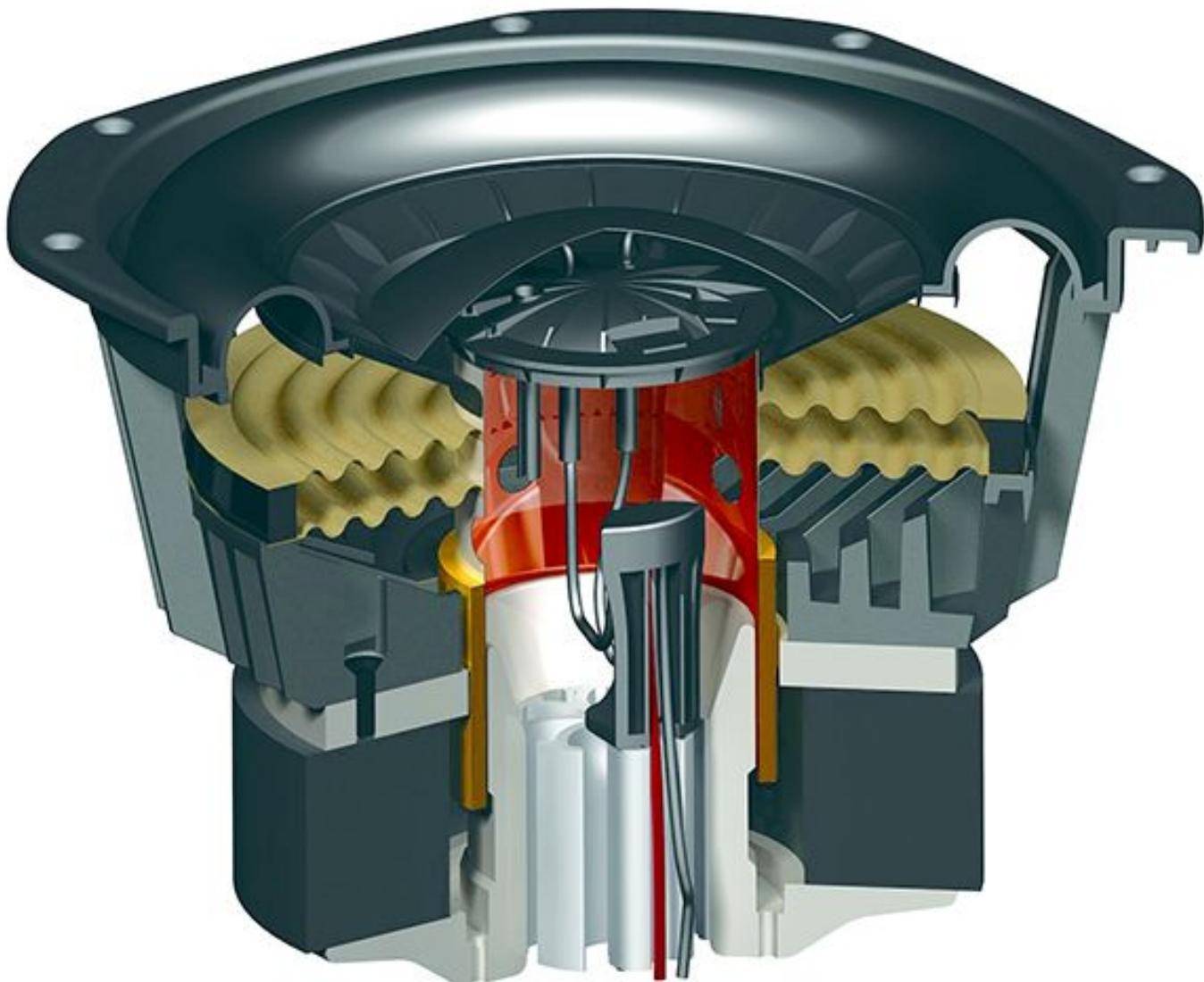
Note that the SUB 2 is configured so that it will accept either 120 v or 240 v, so you don't have to purchase the sub in a 120 v or 240 v version. It automatically recognizes which voltage you are using.

Here is a photo of the breaker box and wiring being installed for 240 v operation. It cost me \$3,600 to do this, and I suspect this is another reason why most consumers will just stick with their 120 v lines in their home theaters.

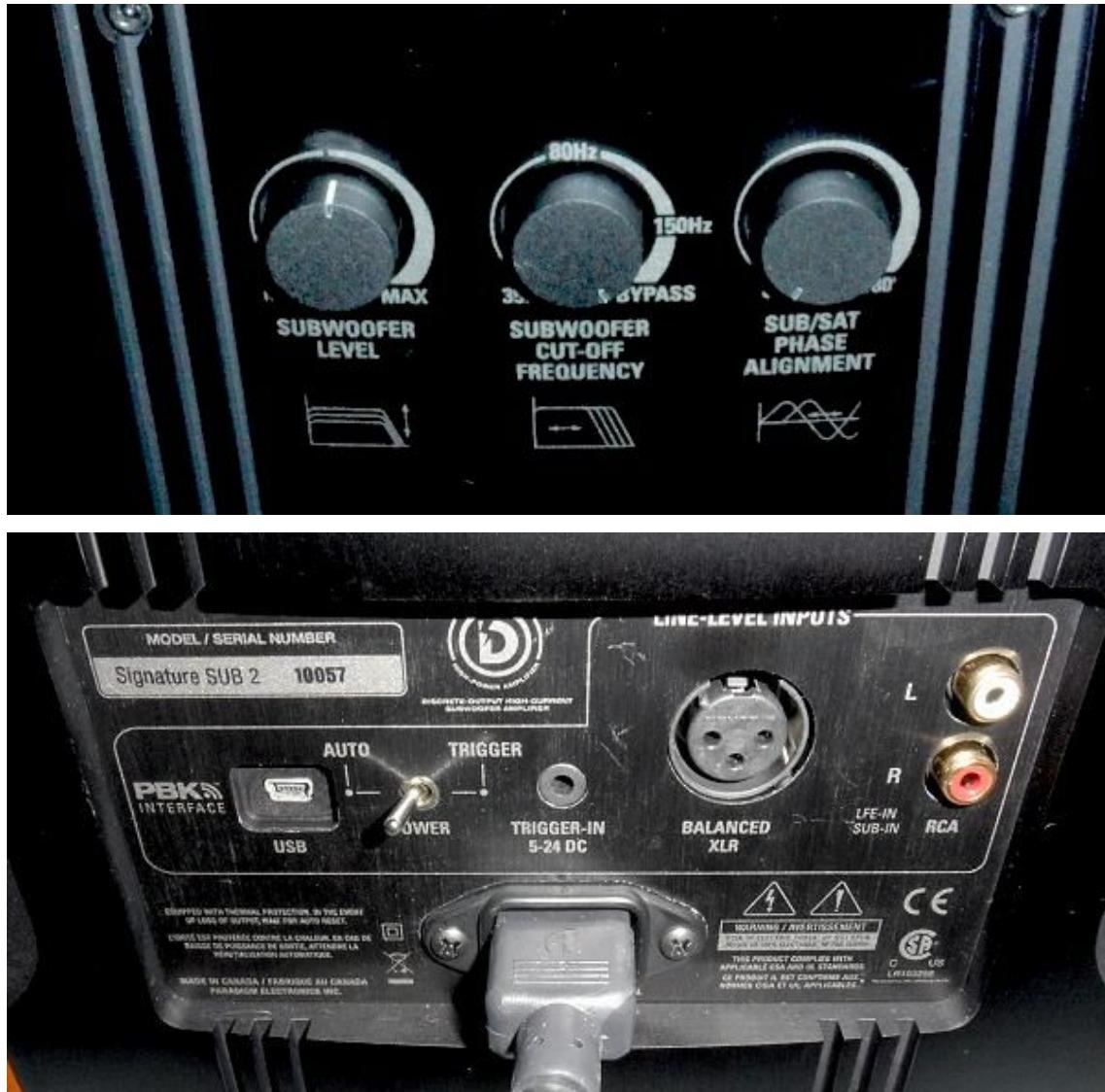


The second thing that Paradigm had to address was the drivers. How many to put in, and where to put them. Keeping in mind that 9,000 watts would make the driver(s) travel quite a distance forward and backward (called the “excursion”, and in calculations, called “Xmax”), they knew this meant that the enclosure would produce tremendous vibration unless they could design it in such a way that vibration would be kept to a minimum. Thus, was born the concept of the hexagon. This would let them put six drivers into the enclosure, two each on alternating sides, arranged vertically. In that manner, the forces on the enclosure of the cones moving in and out would be cancelled.

As to the driver itself, each one has a 3" voice coil, wound in 10 layers. The magnet structure is more than 25 pounds. The driver as a unit weighs about 32 pounds, so $6 \times 32 =$ a very heavy subwoofer, with just the drivers sitting there on the table. Add the enclosure and power amplifier, and there you have it: 230 pounds. Shown below is a cross sectional diagram of the driver. Notice that there are two spiders supporting the cone and keeping it centered so that the voice coil can travel a great distance without touching the sides of the magnet.



The amplifier panel is on one of the three sides that have no drivers (obviously). Its controls are simple: Volume, Phase, and Low-Pass Frequency (which can be bypassed by turning it full clockwise). At the bottom, you can set the sub to turn on automatically when it receives any musical signal, or to be triggered externally (such as the trigger output from your SSP or receiver when you turn it on). Shown below are the control panel, which is near the top of the sub, and the input panel, which is near the bottom.



The SUB 1 and SUB 2 are available in real Cherry, Black Ash, or Black Piano finish. I had the cherry version for review.

In Use

I think I improved my cardiovascular fitness just getting the SUB 2 out of the box. It is packed upside down, so what you have to do is first open the top of the box and fold the flaps out of the way, then turn the box upside down, keeping the flaps from getting underneath the box. Then you lift the box off the subwoofer.

Moving the sub into place is an experience in itself, but I managed. At that point, I took a break so I could get a cold drink and wipe the persperation off my face. Then, back to the lab.

Because the SUB 2 has drivers pointing in three directions, and so as not to color the test results with corner loading, I performed the bench tests with the sub sitting about 6 feet away from the nearest two walls. I put the test microphone 2 meters away from the subwoofer. Once I was done with the bench tests, I moved the sub into the left front corner (and then went back to the kitchen for a second cold drink).

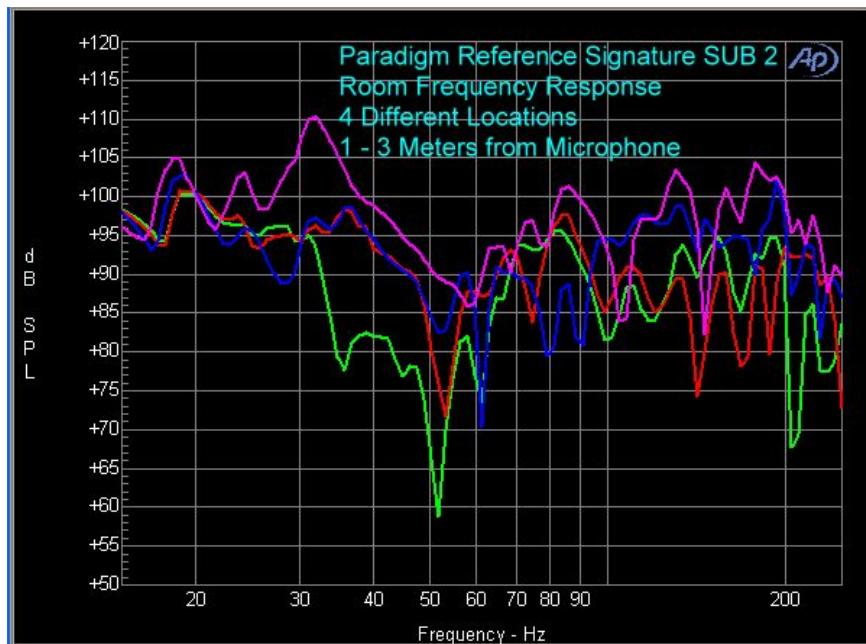
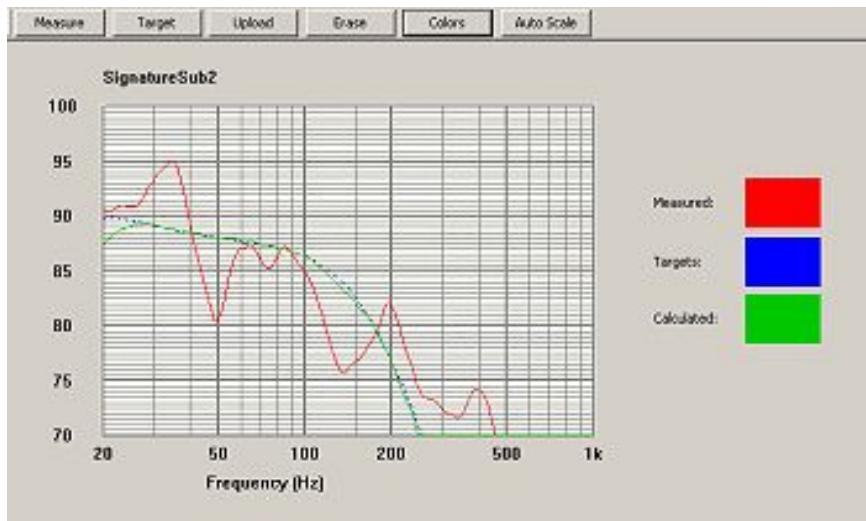
Music-wise, I pulled out every pipe organ SACD I had. But, before I listened to the music, I ran Paradigm's Perfect Bass Kit (PBK) software program. The kit consists of a software disc that you install on your computer, and two USB cables. One connects your computer to the included microphone that has specific calibration files for that microphone embedded in the software. The second USB cable connects the subwoofer to your computer. The USB jack is at the bottom of the amplifier panel.

Running the program is very simple. On the rear panel of the subwoofer, set the volume control to the middle position (12 o'clock), the cut-off frequency to Bypass, and the phase dial to 0o. Then, put the microphone on its included stand at listening level height, and point it at the ceiling. Boot the Perfect Bass Kit program and click "New Measurement". This procedure will step you through the measurements, and the minimum number of positions needed to perform the calculations is five, so you have to put the microphone in five different locations as it prompts you to do so. Once the five measurements are completed, the program calculates a room response curve (EQ) that will generally satisfy all five locations. You can save the EQ file, move the sub if you are not quite happy with the results, and do another run. If you like the first one better, move the sub back to its original location, run the software, and upload the first EQ file.

The resulting graph for my EQ with the sub in the front left corner is shown below (click on it to see the full size graph). The red graph line is a composite of the response in all five locations. There is an obvious 50 Hz suck-out, as well as a peak at about 35 Hz. The blue line is the "desired" target, i.e., the ideal EQ curve that the software wants to achieve. The green line (actually, the default color is different, but I set it to green so I could see it better) is the calculated EQ curve that the software was able to achieve. Note that this is not the response in each of the five locations. It is a curve that is "approached" in each location, but the actual response will vary slightly in each of those locations. You can see from the curve below that there is a roll-off below 30 Hz that the software placed in the EQ. The reason for this is that in some of the locations, the response actually rose below 30 Hz.

The second graph below shows the room response before EQ, with the sub in its original location six feet away from the nearest two walls, and the microphone set in four different spots. I set the volume in each microphone location so that 20 Hz was 100 dB. You can see that for three of the four locations, the response rose significantly below 30 Hz. All four curves cross the 20 Hz point at 100 dB, which is where I set the SPL for that frequency before I gathered the spectra. The Perfect Bass Kit compensates for this tendency by rolling off the bass as its generalized EQ compensation. After I

performed the EQ of the sub in the corner, I was able to get a maximum output of 110 dB at 20 Hz, at a distance of 20 feet, using the 240 Volt outlet.

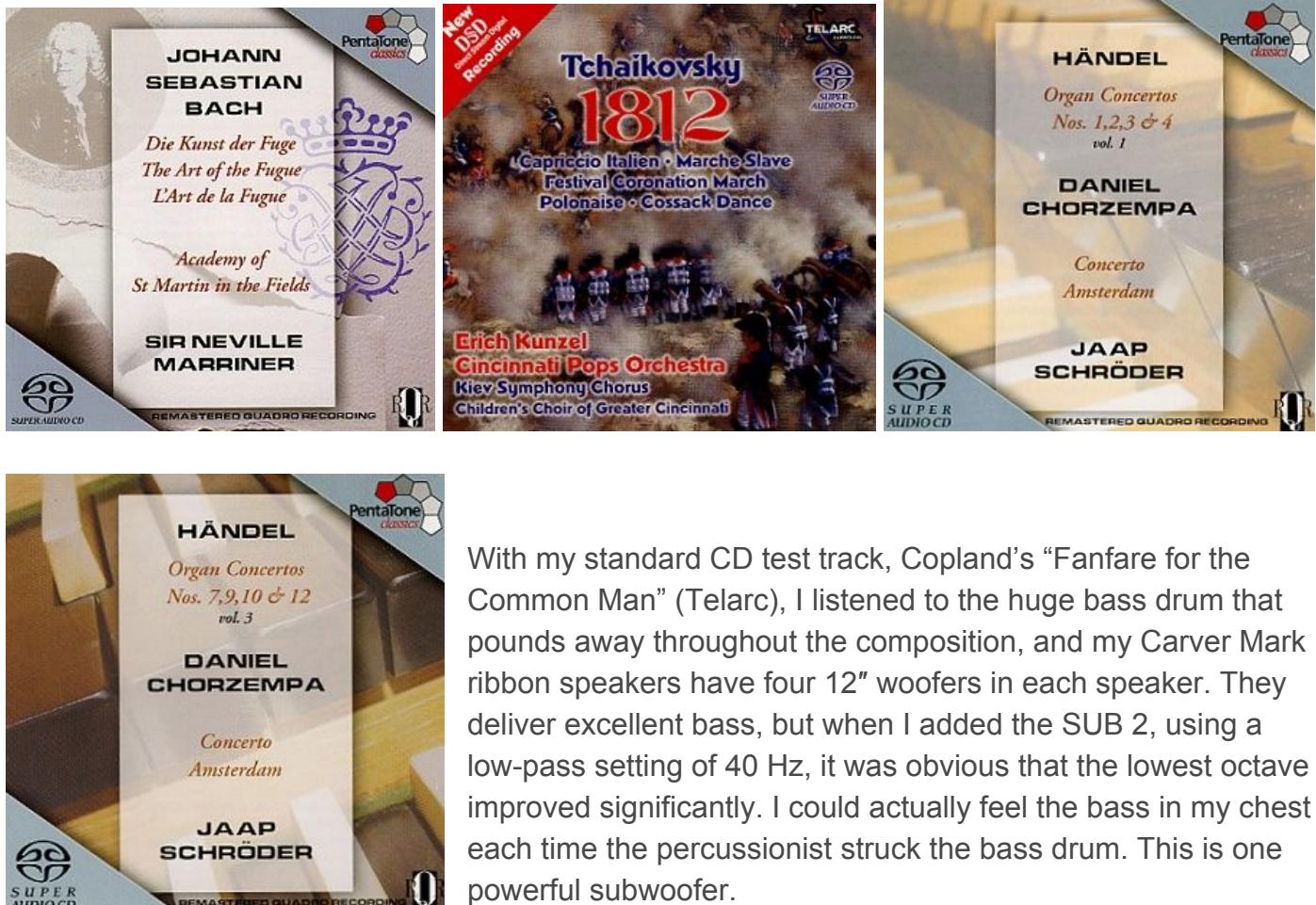


And now, on with the music. I tested the SUB 2 with an OPPO BDP-83SE/NuForce universal player, McIntosh MCD500 SACD player, Lamm LL1 preamplifier, Anthem D2v SSP, Classe CA-5200 power amplifier, Carver Mark IV ribbon speakers, and Final Sound electrostatic speakers. Cables were Legenburg, Emotiva, and Marc Audio.

During the listening, I tweaked the crossover, volume level control, and phase such that the deep bass from the SUB 2 blended with the rest of the audio system. Music listening was done with the SUB 2 plugged into either the 120 v outlet or the 240 v outlet. The result was that, at 240 v, extremely deep bass tones could be played at a louder level, such as the bass drum of Copland's *Fanfare for the Common Man*, and for movies like *Pearl Harbor*, the attack scenes were more explosive.

None of these albums could faze the SUB 2. After all, it responds down to 7 Hz, which is as low as any pedal tone on any pipe organ in the world. For the lowest notes, I could only feel the sound, not hear it, an indication of very low distortion.

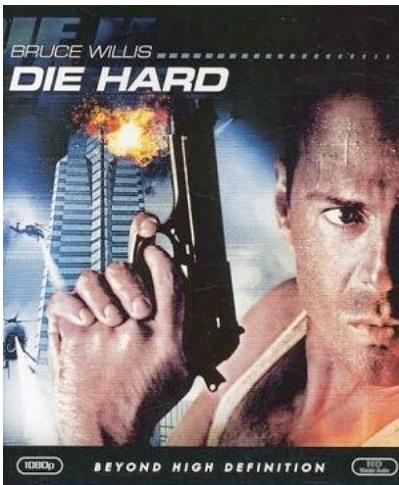
I don't know what the low frequency limit is on the canon shots in *The 1812 Overture*, but I thought the air conditioner was going to fall out of the window.



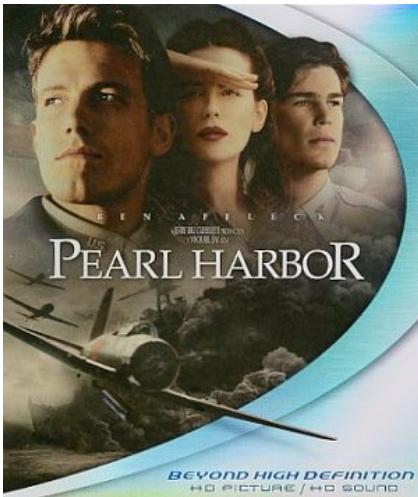
With my standard CD test track, Copland's "Fanfare for the Common Man" (Telarc), I listened to the huge bass drum that pounds away throughout the composition, and my Carver Mark IV ribbon speakers have four 12" woofers in each speaker. They deliver excellent bass, but when I added the SUB 2, using a low-pass setting of 40 Hz, it was obvious that the lowest octave improved significantly. I could actually feel the bass in my chest each time the percussionist struck the bass drum. This is one powerful subwoofer.

And for movies...

This movie made Bruce Willis a star, and John McTiernan one of my favorite directors. It has all the action any fan could desire, and plenty of firepower to loosen the cobwebs in the corners of your home theater. Although the SUB 2 delivered stunning deep bass, I put my hand on the enclosure and could feel almost nothing. That is due to the clever placement of the drivers so that their motion cancels out enclosure vibration.



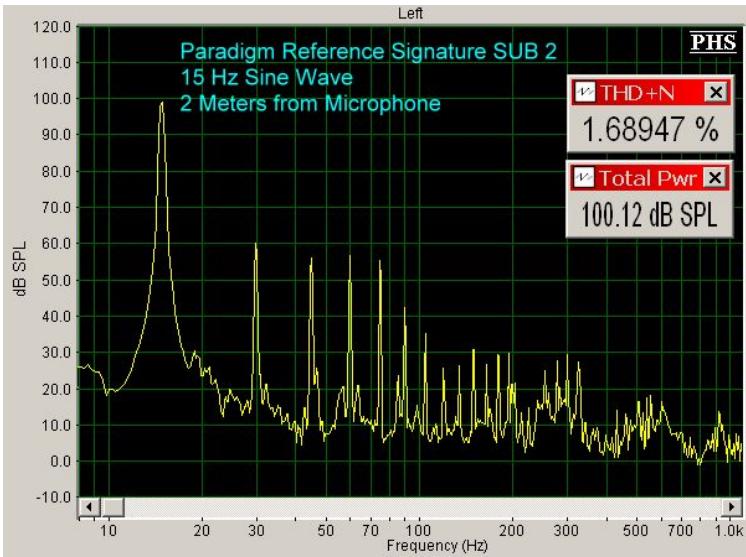
The attack scene in *Pearl Harbor* is one I always use to demonstrate my home theater to visitors, notwithstanding the poor acting (I think Ben Affleck is trying to switch over to directing). And, with the amazing SUB 2, I had occasional sensations that my feet were coming off the floor. The SUB 2 is a hexagonal box of thunder. The punch and slam of 50 caliber machine guns, combined with the rumble of bomb explosions made me feel some sympathy for those Navy men and women caught in the melee of December 7, 1941.



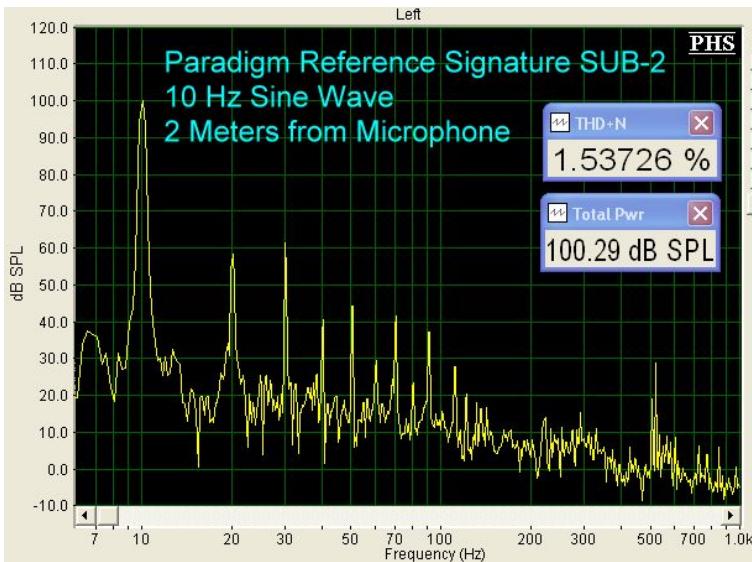
On the Bench

I ran the bench tests with the sub six feet away from the nearest walls, and at 240 v AC supply. I also ran these tests before EQ'ing the sub with the Perfect Bass Kit.

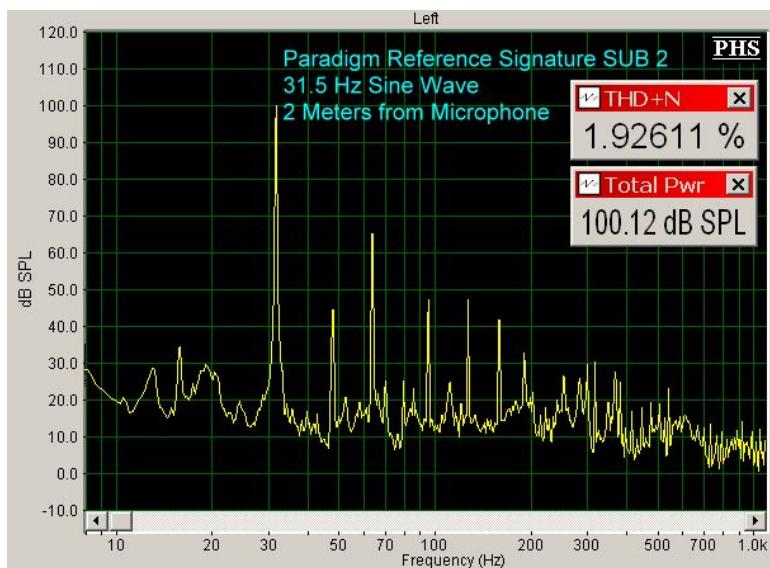
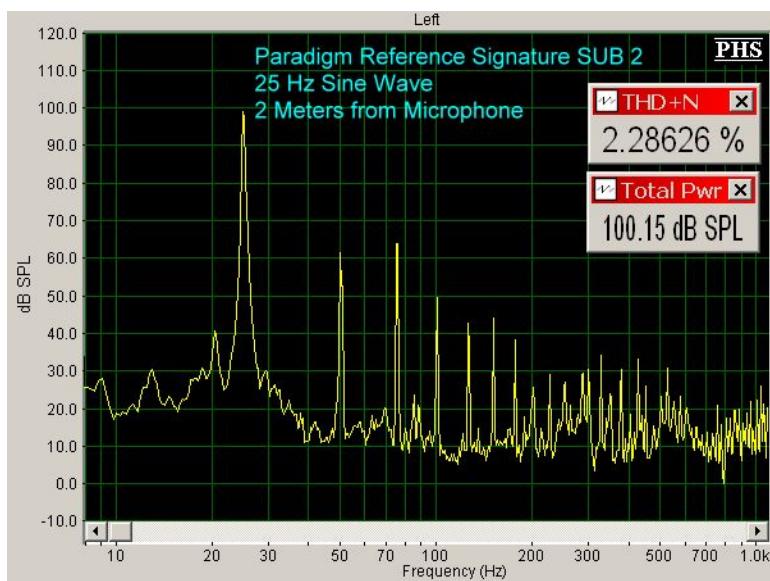
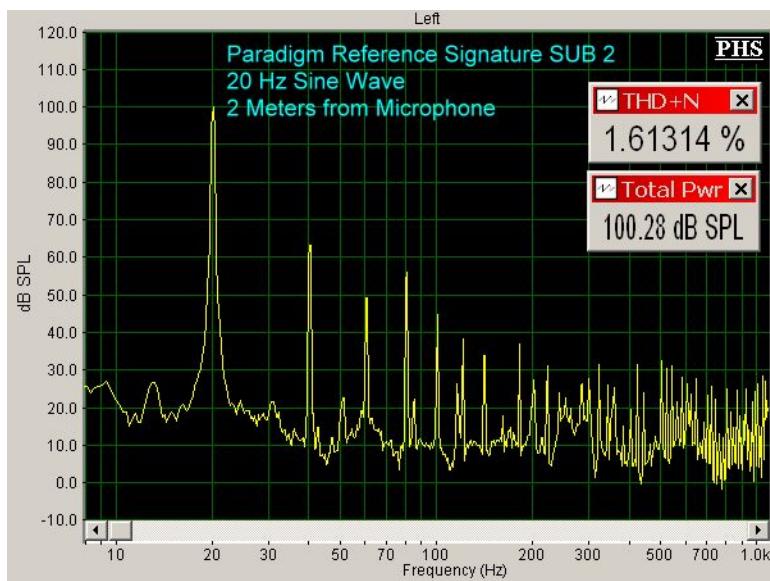
At 15 Hz and 100 dB output, with the microphone 2 meters away, distortion was less than 2%. That is a landmark result. But it gets better. At all measurements up to 50 Hz, 100 dB output, and the microphone 2 meters away, distortion never rose above 2% except at 25 Hz, where it was still only at 2.3%. I am speechless about these results, except for the word "Astonishing".

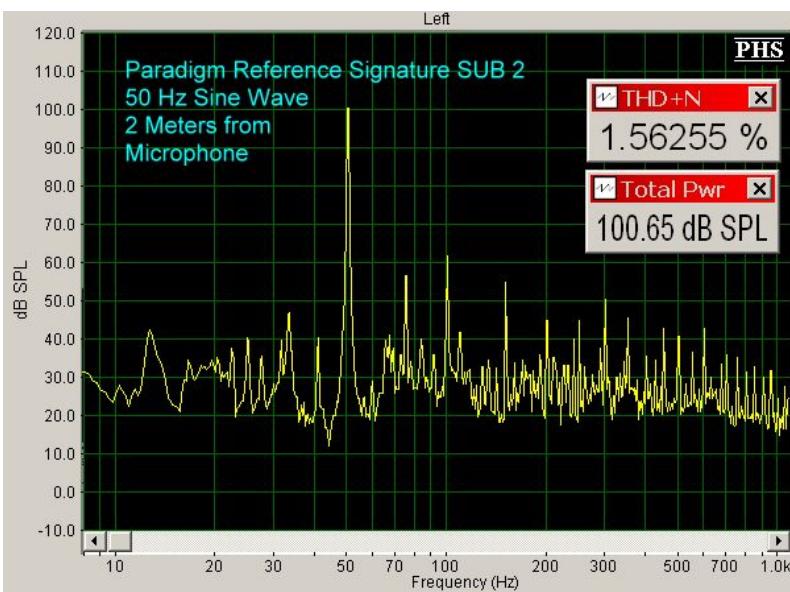
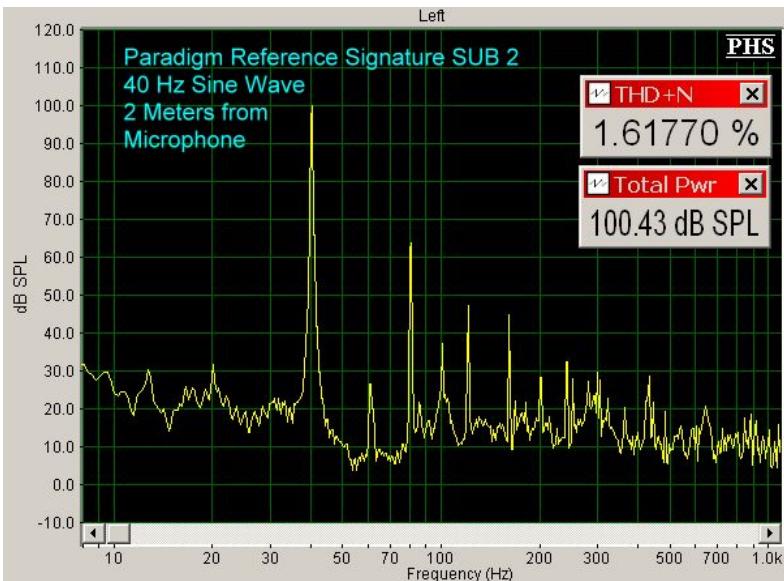


Five years later (September 3, 2015), I decided to go back and measure distortion at 10 Hz, as some new subs out there specify response down to that frequency. Here are the results. Pretty amazing!! I think one of the main reasons the SUB 2 performs so well is that it uses several smaller drivers (six 10") rather than one or two large drivers, and small drivers are easier to control because of the lower mass of the cone.



Here are the rest of the graphs from the November 15, 2010 publication date.





Conclusions

Paradigm has achieved their goal of designing the best subwoofer available on the market to date. I know there are some other manufacturers out there working on similar products. But for now, the SUB 2 is in position, ready and willing to take on all challengers.