VOICE COIL

DEQX PDC 2.6 User Report

By Vance Dickason

The DEQX DSP products, which include the subject of this report, the PDC 2.6P Professional Digital Calibration preamp and the DEQX OEM crossover/EQ modules, were featured in the August and September 2004 issues of *Voice Coil*. Although the DEQX (Digital EQualization and X-over) PDC 2.6P is really designed as a consumer-level product, I believe it is also a tremendous development tool for speaker engineers—the ultimate speaker geek Xbox.

In terms of functionality, the PDC 2.6P is a self-contained DSP stereo three-way crossover that includes a 10-band parametric equalizer for room correction and a log sweep stimulus FFT analyzer. This can be configured in a number of ways from a single wide range driver with room correction, a passive two-way speaker with a subwoofer, or a full three-way triamped system (as NHT did in its recently released DEQX powered Xd home speaker system and the pro audio M-60/80XD monitors which you can check out at www.nhthifi.com).

Configuration of the PDC 2.6P is extremely flexible. Each side of the triamp crossover section has parametric EQ for each driver, time adjustment for each driver, followed by switches for each of the three network sections. This allows each of the three individual network sections to be either bypassed, include the crossover filter and the eq/phase correction, include the crossover only, bypass with limit filters (which are intended as high-pass filters to protect the various drivers during the testing procedure or low-pass filters used in conjunction with subwoofers), or disable the channel completely. Additionally, the output polarity (phase) of each channel can be set to 0° or reversed at 180°.

Setting up the DEQX is a simple process: after all, it is intended for consumer use (although I should think an advanced audio hobbyist may be the most likely consumer). Physically, the DEQX 2.6P is a rack-sized 1U chassis that has five pushbutton controls on the front panel. Features include an I/O button to switch between analog and digital inputs, a volume control, and three switches to select any one of the three crossover/EQ profiles. This is a very important feature, because the 2.6P can store up to three "designs," which means that conceivably you could use the 2.6P to develop crossovers very quickly (the process takes less than five minutes to complete a design) for different driver configurations and very easily A/B the various combinations to make decisions on driver combinations in any design. Besides the simple front-panel control section, the 2.6P also has a remote that you can use to select inputs, adjust room EQ, adjust the volume, or select any one of the three available speaker "profiles," or bypass them entirely.

FIGURE 1: DEQX program control panel screen.

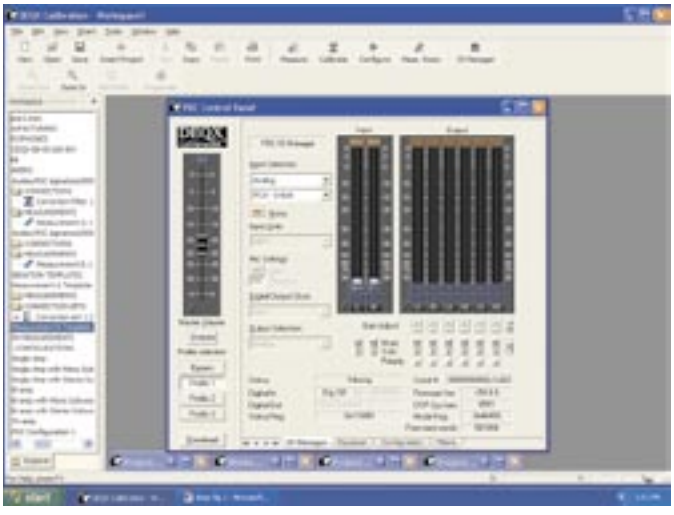
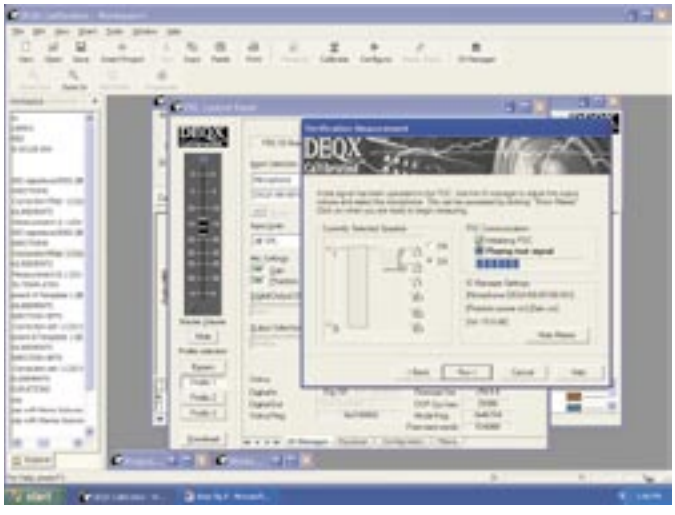


FIGURE 2: DEQX verification test signal screen.



Inputs and outputs on the rear panel of the 2.6P also allow for much flexibility. There are two digital audio inputs, a coax RCA type and an AES/EBU XLR type, both intended for digital source inputs for program material. For analog audio inputs, the unit has left and right (remember, this is a stereo device) balanced XLR jacks as well as left and right unbalanced RCA inputs. For the measurement part of the process, there is an XLR microphone input for the Behringer ½" ECM8000 measurement microphone that is included with the DEQX 2.6P. Computer inputs include the preferred USB device output jack plus a pair of RS-232 outputs if you haven't made it into the 21st century yet. Audio out for the DEQX 2.6P consists of two sets of three gold RCA jacks, one set for left and one for the right channels marked Low, Mid, and High for the low-pass, band-pass and high-pass crossover output sections.

The software for the DEQX 2.6P, called DEQX Calibrated, is impressive. I've reviewed a lot of software over the years for *Voice Coil*, and the DEQX software ranks among the very best. Obviously, with a goal of being used by consumers with various levels of speaker knowledge and various levels of computer skills, the software needs to be very clearly written and the wizard process as foolproof as possible, with the emphasis on the word "fool." Despite that factor, my first impression was that this is just about the ultimate speaker engineer video game. You go from initializing the software to a complete crossover design so fast, you'll be wondering whether you did something wrong, but you didn't.

Since the process is so straightforward, the actual design time is fairly short. The measurement protocol is about the same as any other design exercise, so a chamber is totally ideal, but locating the DUT on a stand 60" off the floor with the nearest reflecting object at least 60" away and the microphone at 1m is more than adequate for this process. It starts by calling up the Measurement Wizard calibration software; you choose the Tools menu and click on the Measure button. You then specify the configuration, either single amp, bi-amp, tri-amp, or subwoofer. Measurement signal details include the signal source (log sweep in this

FIGURE 3: DEQX measurement sequence menu.

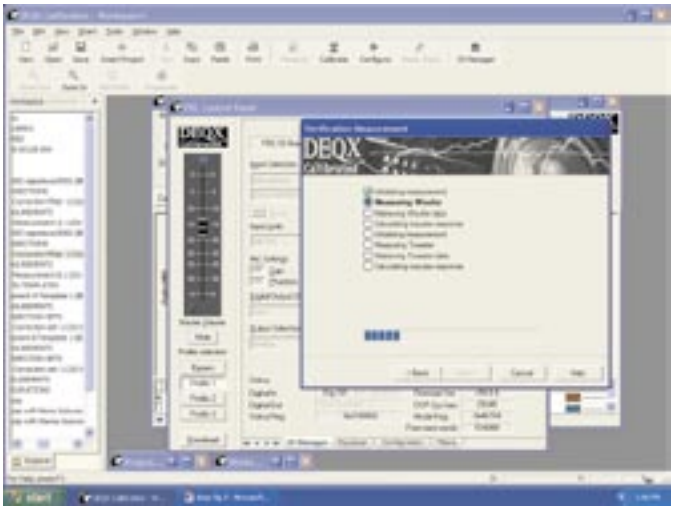


FIGURE 5: DEQX zoom shot of impulse response graph.

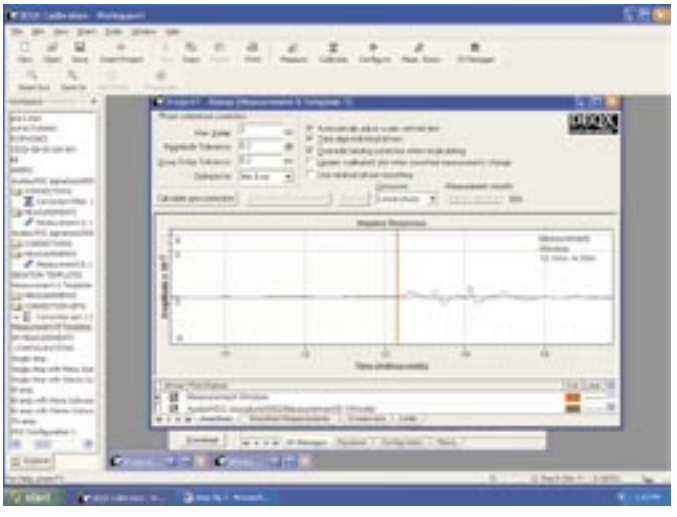


FIGURE 4: DEQX impulse response graph.

FIGURE 6: DEQX raw driver response graph.

case) and the number of averages (the default is 18).

Next, specify the measurement's physical details, microphone distance, angle, and height off the floor. The software will then prompt you to enable a high-pass filter for tweeter protection followed by asking for a serial number for the speaker project. With this done, you then graphically select which channel is being used.

At this point the 2.6P automatically initializes its test signal for the purpose of setting the microphone gain for the FFT analyzer. Hitting the button marked "Show Meters" brings up the PDC Control Panel shown in *Fig. 1*. You merely adjust the master volume control until the input meters read between 80–90dB and then hit the Run button (*Fig. 2*). From here the DEQX 2.6P takes over the process and automatically measures each driver and processes the data (*Fig. 3*). When this process is completed, the software displays the raw responses and, if appropriate, you hit accept. By hitting the finish button the option to run the Calibration Wizard appears.

FIGURE 7: DEQX driver response with superimposed network response graph.

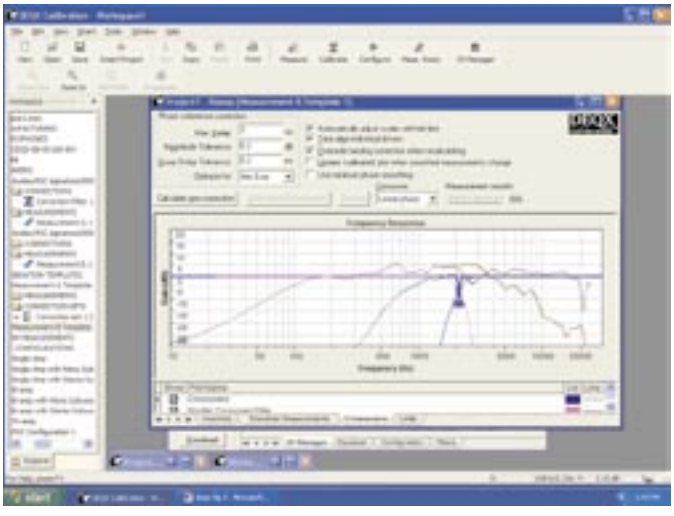
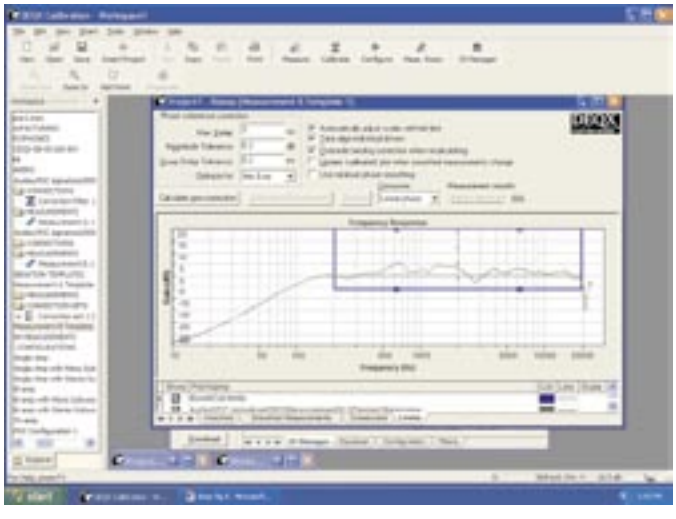


FIGURE 8: DEQX network limit set graph.



The Calibration Wizard in the crossover is actually designed. Besides adding the crossover, the Wizard will correct the driver frequency; phase and group delay response as well as time-adjustment between the drivers. The first step is producing a measurement calibration template. This consists of specifying the configuration, applying a smoothing algorithm, specifying the crossover slope and frequency.

If you are using the correction filters, Linear Phase is the only option and with a slope that is at least 48dB/octave. However, if you are using the DEQX for quick crossover design of different driver combinations, lower slope Linkwitz-Riley (6dB Butterworth) and Butterworth filter types are also available. The last items on the template are the correction filter boost/cut limits and the number of bands, along with the maximum group delay plus group delay and magnitude tolerances.

Hitting finish takes you out of the Calibration Wizard and brings up the impulse response shown in *Fig. 4*. As with any impulse response, you must then set the response window by moving a vertical cursor, which is easily facilitat-

FIGURE 9: DEQX driver correction graph.

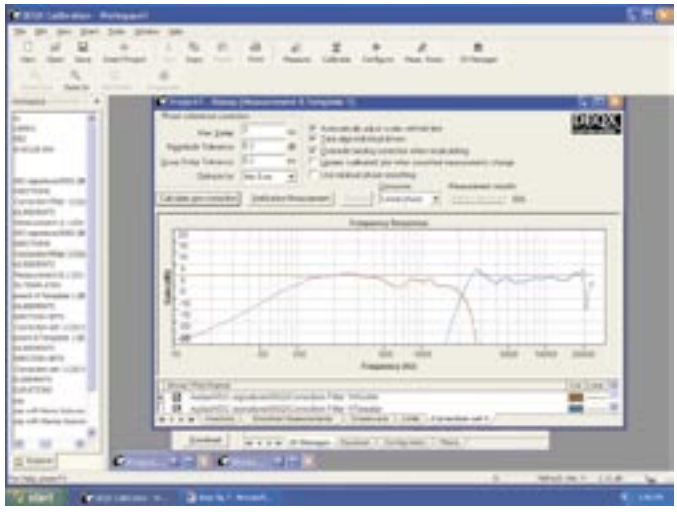


FIGURE 10: DEQX final response graph.

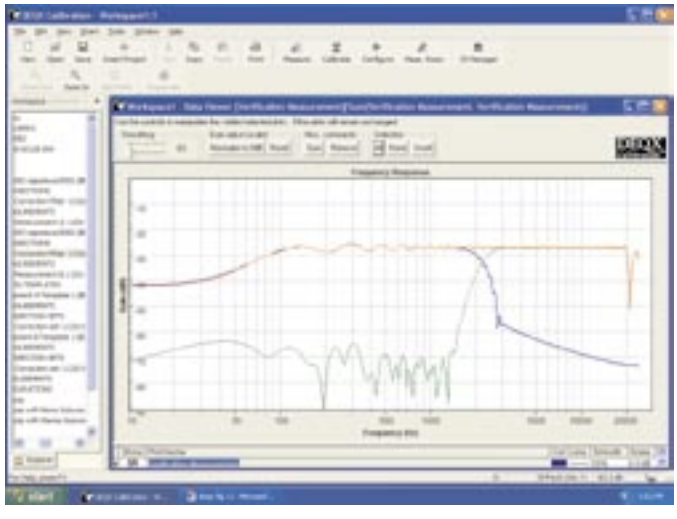
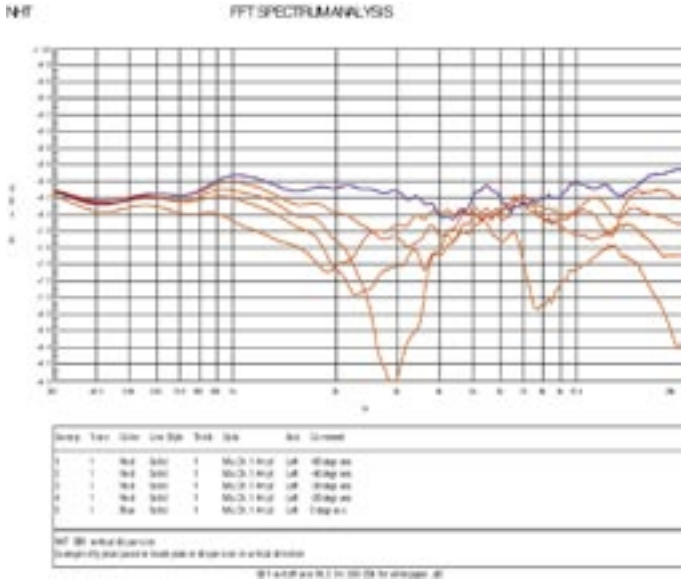


FIGURE 11: Vertical axis frequency response of NHT speaker with passive network.



ed by the zoom function (*Fig. 5*). If you hit the Smoothed Measurements tab, you bring up the individual driver response shown in *Fig. 6*. Hitting the Crossover tab displays the network and crossover frequency you selected (*Fig. 7*). After you check this out, hit the Limits tab. Here you can adjust the focus of the filter design process. Typically you will want the lowest frequency to be at the lowest SPL level in the woofer, as shown in *Fig. 8*.

By hitting the Calculate New Correction button, you can bring up the correction filters used to EQ your individual woofer and tweeters, as seen in *Fig. 9*. Following this, the last step is to perform a final measurement hitting the Verification Measurement button. The resulting response is shown in *Fig. 10*.

My original plan was to show the measurements of the two-way speaker that I used for this test both before with the passive network and after with the DEQX network (the speaker was a two-way I designed some years ago for Audax as part of a Vance Dickason Signature Series DIY projects booklet). Unfortunately, you can't use the LMS gated methodology to measure through the 2.6P. This is neither the fault of DEQX nor LMS, it's just that the gated response measurement system in LMS uses a timing algorithm that just will not function with the small amount of latency in the DSP filters. If you were to use a standard non-gated sweep in a chamber, it would not be a problem, or if you were to use a noise-based analyzer such as CLIO or MLSSA, the measurement would also not be a problem.

I would have used the CLIO analyzer that I have on-loan from my friends at Audiomatica, but I ran out of time prior to publication to do this. As a result, I asked my other friends at NHT to supply graphs of this same situation, the same drivers with a passive network and using the DEQX filters. Chris Byrne of NHT graciously agreed to supply this data, as seen in *Figures 11* and *12*. These graphs show the frequency response measured vertically at 0, 20, 30, 40, and 60°. The speaker was the new XdS DEQX'd product in Fig. 12 and the same SEAS 5.25″ and 1″ tweeter with a passive network in *Fig. 11*.

The difference is quite pronounced due to the 110dB filter at 2kHz in *Fig. 12* with the DEQX unit versus the 4th-order optimized passive filter at 3kHz depicted in *Fig. 11*. The interaction in the vertical plane due to the overlap of the passive filter is significant. I heard the XdS speaker demonstrated by Kim Ryrie, CEO of DEQX, and Jay Doherty, Acoustical Engineering Manager for NHT at this year's CEDIA show. The most pronounced subjective effect that I immediately noticed was the coherency of the sound field. The stereo image stayed very solid from almost any position in the room, and the overall effect was very impressive.

Please bear in mind that all of this excludes a very cool 10 band parametric EQ for room correction that I won't address in this report. Altogether, whether you plan to sell a product with a DEQX module or make use of the DEQX 2.6P as a product development tool, this is a seriously exciting piece of equipment. For more specifics on DEQX products or DEQX contact information, visit the DEQX website at www.deqx.com. *VC*

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FIGURE 12: Vertical axis frequency response of NHT speaker with DEQX processor.