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KSC Digmoda DSP/Amplifiers and D-Pro Software

I featured KSC’s Digmoda Pro sound DSP programmable digital amplifiers in the March 2008 issue of *Voice Coil* in the ALMA Symposium article (KSC exhibited at the 2008 ALMA Symposium). However, this month I received one of KSC’s Digmoda 500 series amplifiers, the DDC-552 (**Photos 2-4**), along with the D-Pro software. Each of the Digmoda amplifiers uses B&O IcePower amplifier modules plus the proprietary KSC DSP module. There are three models in the Digmoda 500 series, each using the KSC DPS module, but with different amplifier configurations.

In terms of power output into a 4Ω load, the bi-amp DDC-520 has two 200W amplifiers, the bi-amp DDC-550

has a 500W amplifier and a 250W amplifier, and the DDC-552 is a tri-amp model with two 500W amplifiers and a single 250W amplifier. These are the currently available Digmoda products. However, KSC will be releasing three single amplifier subwoofer models (DDC-200SW, DDC-500SW, and DDC-1000SW), three more bi-amp models (DDC-220, DDC-1050, and DDC1100), and two more tri-amp models (DDC-222 and DDC-1055). If your company would rather use your own amplifiers, KSC is also making available two DSP engines (with D-Pro software): the DP-130 (mono I/O 1 in, 3 out), and the DP-240 9 (stereo I/O 2 in, 4 out).

The DDC-552 is actually the third DSP engine/amplifier combo with its own proprietary software that has been featured in *Voice Coil*. I examined the D2 Audio Evaluation Kit in the July 2005 issue and the DEQX PDC 2.6 in the February 2005 issue. Both of these products combined a digital amp with a proprietary DSP engine along with their own user programmable software, which is, of course, what the DDC-552 provides. For me, the really fascinating part is the software. KSC’s proprietary DSP engine programming software is titled D-Pro GUI.

D-Pro talks to the dual DSP engines built into the DDC-552 via a USB cable. Two DSP sections give D-Pro six channels to work with. **Figure 1** shows the opening block diagram for channels 1-3. For the tri-amp DDC-552, channels 1 and 2 are linked together, channel two being for side chain processing. As you can see in the diagram, they have a ganged compressor/limiter. In this configuration, channel three is not used. **Figure 2** shows the identical layout for channels 4-6. Channels 1-2 are used for the low frequency driver, while the second pair 4-5—also linked by a ganged compressor limiter—is used for the midrange. Channel 6 is designated for the high-frequency driver.

Crossover design takes place in the Biquad filter section. By clicking on this block, it brings up the filter screen shown in **Fig. 3**. At the left top of the screen you have a SPL graph that will display the filter transfer function magnitude and phase, the raw driver response magnitude and phase, the combined filter and driver magnitude and phase, and finally, the summed magnitude and phase.



PHOTO 2: KSC’s Digmoda.



PHOTO 3: Rear view of Digmoda.

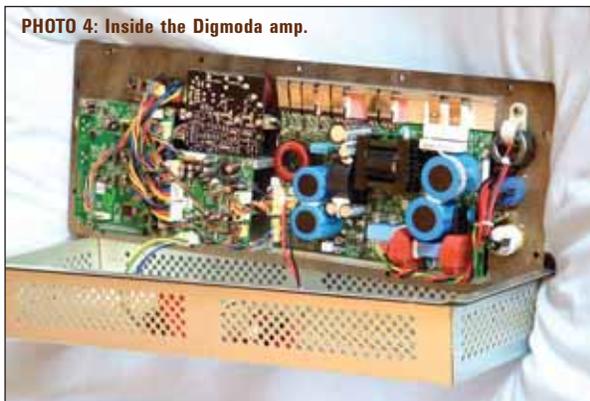


PHOTO 4: Inside the Digmoda amp.

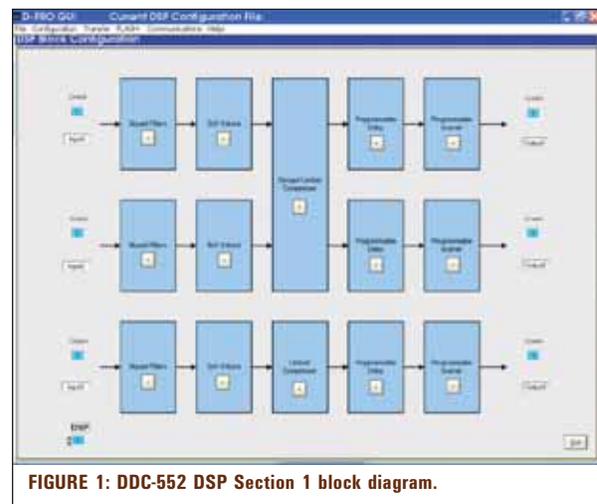


FIGURE 1: DDC-552 DSP Section 1 block diagram.

What you see in **Fig. 3** is the basic low-pass, bandpass, and high-pass filter transfer functions prior to any driver response being loaded. The bottom of the screen contains the list of filter parameters. Each channel has 16 filter positions that can be turned on. It is possible to bring up different channels by clicking on the Biquad block for that channel, or by scrolling through the channel number selector at the bottom left of the screen. As you can see, this filter list is in the form of a spreadsheet such that you can copy and paste information from one channel to the next, a necessary function with the side chain channels.

Each of the 16 filter positions has seven possible selections. These are disabled (no filter), low-pass, high-pass, bandpass, all-pass, parameter EQ, bass shelf (low frequency shelving), and treble shelf (high frequency shelving). Low-pass, high-pass, and all-pass filters can be designated either 1st- or 2nd-order, and are further defined by gain, corner frequency, and filter Q. Bandpass and parametric EQ filters add the control readout of bandwidth in Hz and in octaves. However, the parametric EQ filters can also be toggled between constant bandwidth, or constant Q. Bass and treble shelf filters also have the choice of 1st- or 2nd-order, and allow adjustment of gain and cutoff frequency only.

All of these parameters can be typed in manually, or by

using the mouse cursor to “pull” the response shape. In the case of high-pass and low-pass filter, you can use the mouse to quickly change the corner frequency and gain (**Fig. 4**). With the band-pass and parametric EQ filters, you also have graph points that will allow you to change not only gain and frequency, but filter Q as well. Using the mouse cursor to adjust filter parameters is an outstanding feature and makes altering network values very easy and intuitive.

At the right side of the Biquad filter screen are plot and cursor controls. The cursor is a free-floating type and cannot be “attached” to any of the line types; however, the lower right hand section has readouts that give its frequency and gain/phase values. The controls above this are display controls that allow you to view either the single filter type being worked on, or the composite of all the filters on that channel. You can select each of the 16 filter positions by using the scroll window located in the center of the plot control box.

Before giving a worked example of a complete network design using imported SPL data, I want to cover the remaining blocks in **Fig. 1**. The block to the right of the Biquad filter block is the Soft Volume block displayed in **Fig. 5**. This block allows you to individually set the amplifier volume for each channel and then gang them together. Next is the Limiter/Compressor block (ganged Limiter/Compressor in

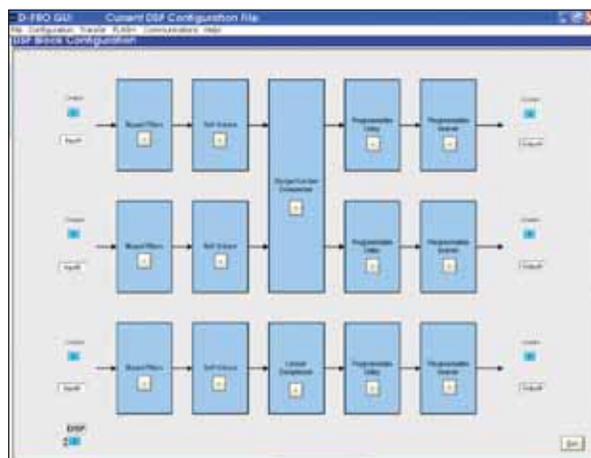


FIGURE 2: DDC-552 DSP Section 2 block diagram.

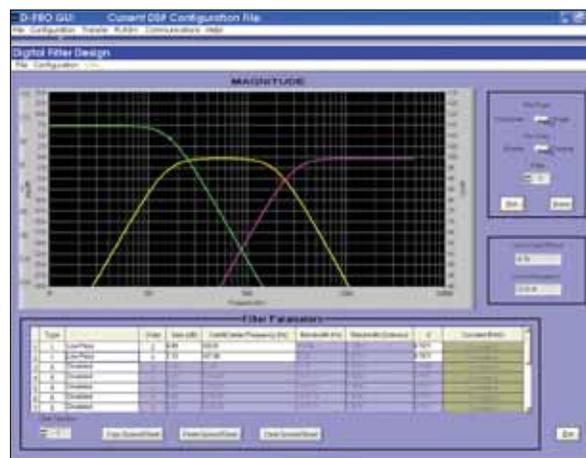


FIGURE 4: D-Pro Biquad digital filter design screen showing low-pass change using the mouse cursor.

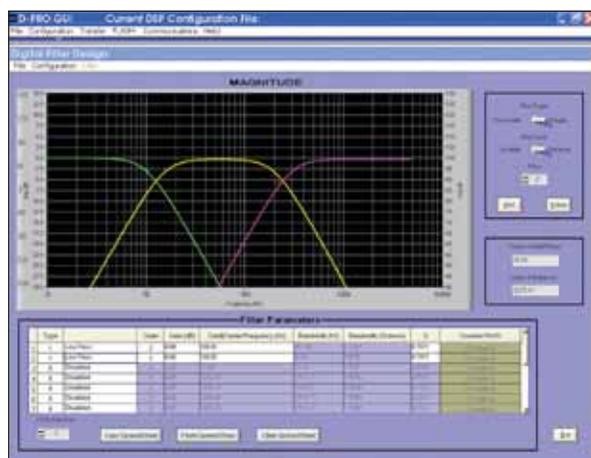


FIGURE 3: D-Pro Biquad digital filter design screen.

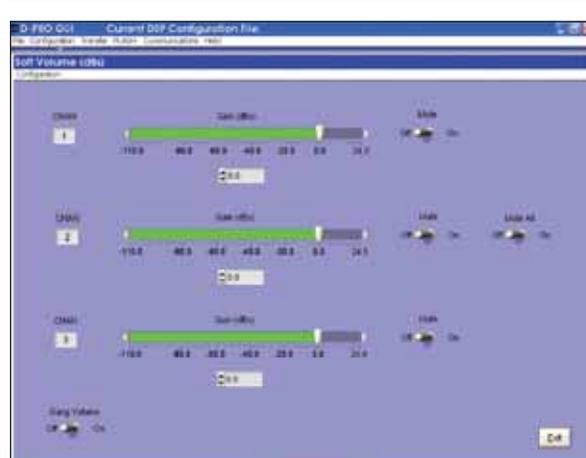


FIGURE 5: D-Pro soft volume screen.

the case of channels 1-2 and 4-5), depicted in **Fig. 6**. Here you have all the basic functions of a three-region compressor, with Ratio, Gain Off-set, and Threshold controls as well as RMS Averaging Time, Attack Time, and Decay Time controls. This section can also be bypassed using the switch at the bottom of the control panel. The remaining two blocks are self-explanatory. **Figure 7** illustrates the Programmable Decay which can be set for each channel and has a memory usage meter, while **Fig. 8** gives the Programmable Inverter screen for reversing the polarity of any of the six channels.

The best way to illustrate the utility of D-Pro is to view a worked example. D-Pro will load SPL files from most analyzers, including the LinearX LMS, Audiomatica CLIO, DRA MLSSA, Liberty Praxis, and the Listen Inc. SoundCheck analyzer. For this example, I took the LMS SPL curves from a recent project for one of my customers: in this case, a three-way center channel speaker (see the woofer, midrange, and tweeter curves in **Fig. 9**). Because the D-Pro software was new to me as well, I e-mailed the curves to KSC Technical Sales Director Dean Rivera, and asked him to set up the filters to produce a flat response with crossover frequencies set at 450Hz and 3.5kHz, the same as I used in this three-way passive crossover for this project. **Figure 10** shows the result of the passive filter I designed, which, for passive filters, was a nice ± 2 dB response with a modest tilt from low to high frequency (part of the subjective voicing for this product).

I received the D-Pro filter configuration file from Dean, loaded the configuration into D-Pro, and then loaded in the three LMS SPL files and the results are shown in **Fig. 11**.

As you can see, Dean's file produced a very flat (± 0.75 dB) response using D-Pro, which would be the response if I had downloaded the filter file to the amplifier and taken a measurement (unfortunately, that prototype was not available for measurement). Here is a list of filters that were used to produce this response:

Woofer section

LP	2 nd -order	0dB	450Hz	Q = 0.5
LP	2 nd -order	0dB	450Hz	Q = 0.5
HP	2 nd -order	0dB	40Hz	Q = 0.707
PEQ		-0.87dB	169Hz	Q = 2.65

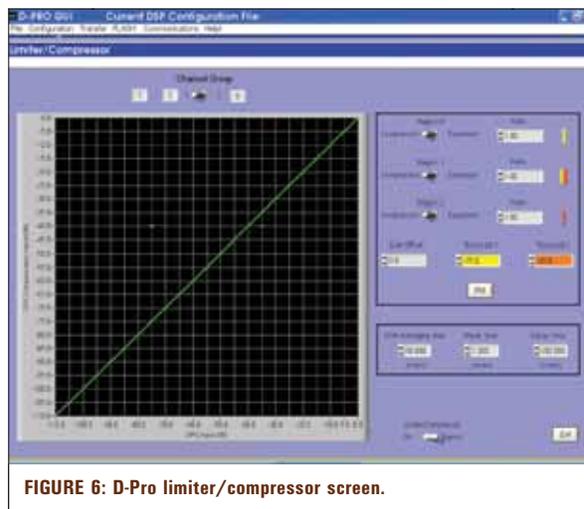


FIGURE 6: D-Pro limiter/compressor screen.

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Midrange section

HP	2 nd -order	0dB	450Hz	Q = 0.5
HP	2 nd -order	0dB	450Hz	Q = 0.5
PEQ		3.25dB	507Hz	Q = 2.8
PEQ		-3.7dB	1578Hz	Q = 3.3
PEQ		4.75dB	2310Hz	Q = 1.45
LP	2 nd -order	0dB	3500Hz	Q = 0.5
LP	2 nd -order	0dB	3500Hz	Q = 0.5
PEQ		-9.98dB	7396Hz	Q = 16
PEQ		-1.62dB	2669Hz	Q = 4.8
PEQ		-1.37dB	1224Hz	Q = 1.16
PEQ		1.25dB	3083Hz	Q = 2.15

Tweeter section

HP	2 nd -order	0dB	3500Hz	Q = 0.5
HP	2 nd -order	0dB	3500Hz	Q = 0.5
PEQ		2.13dB	4115Hz	Q = 3.45
PEQ		-3.12dB	2953Hz	Q = 3.45
PEQ		-4dB	13444Hz	Q = 1.90
PEQ		2.5dB	24000Hz	Q = 2.62
PEQ		-1.5dB	8229Hz	Q = 2.87

The D-Pro software is quite impressive and very straightforward and easy to use, and if I hadn't been so close to this month's publishing deadline, I would have gone ahead and done the network design myself. However, it was helpful to me to see this completed by an experienced user, plus the fact that KSC offers this as a service. It is also interesting to note that D-Pro has a LiveUpdate function and allows you to actually make changes in real-time using program material or noise as the signal source. While these changes are not permanent, you can make them permanent by selecting "Flash" which downloads the file to the DSP section of the amplifier. This is definitely an exciting new product for KSC. For more, visit the KSC website www.kscind.com. **VC**

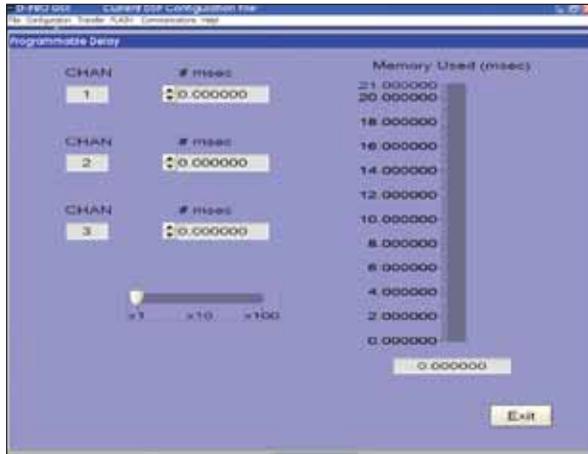


FIGURE 7: D-Pro programmable delay screen.

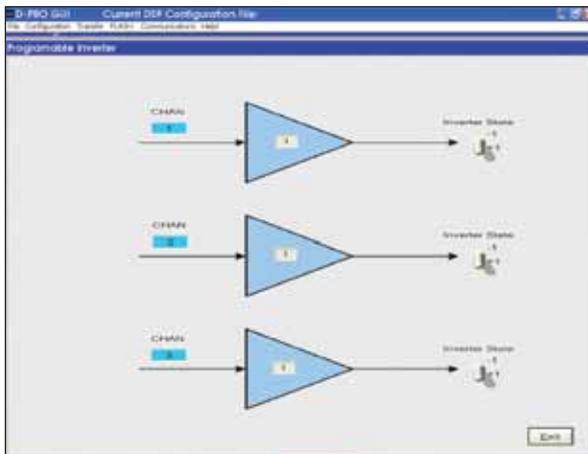


FIGURE 8: D-Pro programmable inverter screen.

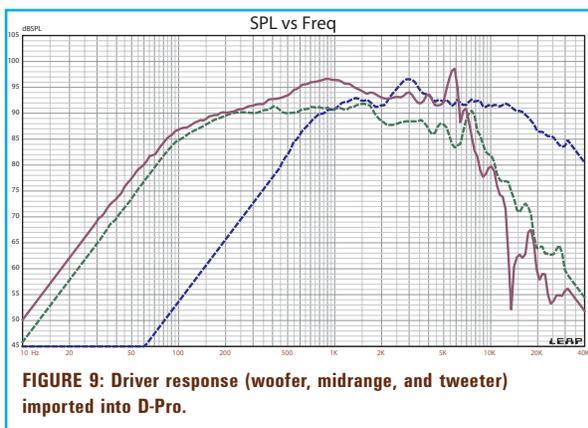


FIGURE 9: Driver response (woofer, midrange, and tweeter) imported into D-Pro.

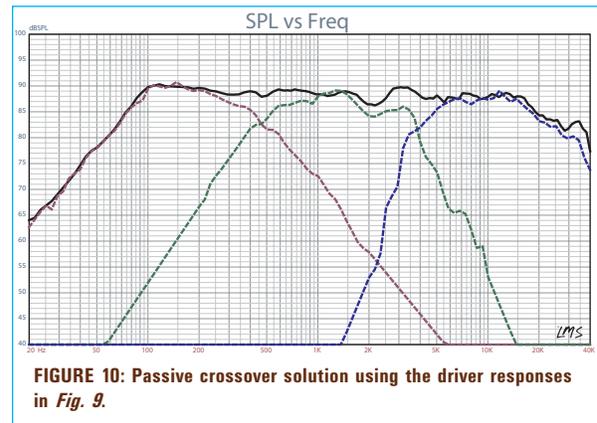


FIGURE 10: Passive crossover solution using the driver responses in Fig. 9.

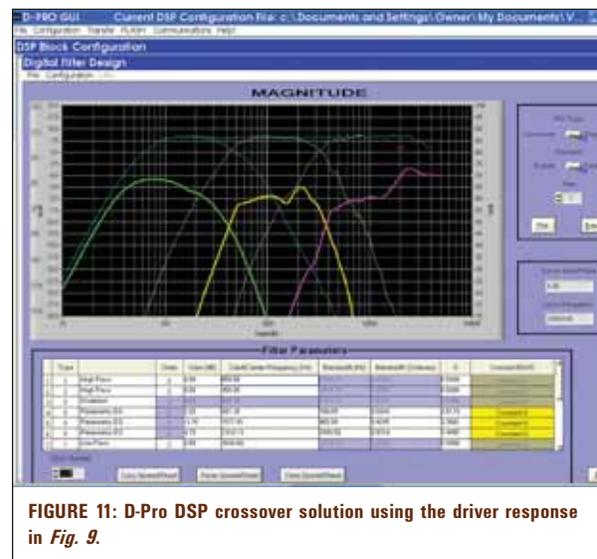


FIGURE 11: D-Pro DSP crossover solution using the driver response in Fig. 9.