of the Monarchy and the Benchmark DAC1 USB, without the bright tonal balance of the Benchmark.

The Digital Link III provides reference-quality performance at an amazingly low price. As such, it's one of today's best values in audio. It is easily my favorite of the DACs I've auditioned over the past two years and has found a permanent place in my system. PS Audio is also funding a website called The Audiophile Wiki (www.audiophilewiki.org), which is designed as a knowledge base for audio topics, and is well worth a visit. ■

Table 1 Reference Recordings

CDs

Dukas: *The Sorcerer's Apprentice.* Boston Symphony Orchestra conducted by Charles Munch. RCA Victor Living Stereo 68978-2.

Ravel: *Alborada del Gracioso*. L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London 433 717-2.

Rimsky-Korsakov: *Scheherezade*, Op. 35. Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victor Living Stereo 68568-2 (UV22-Encoded Limited Edition Gold CD version of 68168-2).

Mussorgsky/Ravel: *Pictures at an Exhibition*, especially track 2, "Gnomus." Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victor Living Stereo 68571-1 (UV22-Encoded Limited Edition Gold CD version of 61958-2).

Schoenberg: *Five Pieces for Orchestra*, Op. 16. London Symphony Orchestra conducted by Antal Dorati. Mercury Living Presence 432 006-2).

Respighi: *The Birds*. London Symphony Orchestra conducted by Antal Dorati. Mercury 432 007-2.

Wagner: *Der Ring des Nibelungen*, especially "Siegfried's Death and Funeral March" from *Götterdämmerung* (CD 4, Tr. 10-11), and the "Forging Scene" from *Siegfried* (CD 2, Tr. 3-5). Birgit Nilsson, Wolfgang Windgassen, et al. Vienna Philharmonic Orchestra conducted by Georg Solti. Decca 455 555-2.

Stravinsky: *Le Sacre du Printemps*. The Cleveland Orchestra conducted by Lorin Maazel. Telarc SACD-60563 (DSD transfer of 1979 Soundstream digital recording; CD layer only).

DVDs

Rachmaninoff: *Symphonic Dances*, Op. 45. Dallas Symphony Orchestra conducted by Donald Johanos. Classic Records DAD 1004. (96kHz, 24-bit PCM transfer of 30-ips analog tape, or possibly a 15-ips copy, engineered by David Hancock.)

Wagner: *Die Walküre*—Wotan's Farewell and Magic Fire Music. Houston Symphony Orchestra conducted by Leopold Stokowski. Classic Records HDAD 2029. (192kHz/24-bit DVD-Audio transfer of original Everest 35mm 3-track tape.)

PS Audio DLIII DAC Measurements

By Chuck Hansen

SETUP

I used an RCA-terminated S/PDIF coax cable between my Alesis ML-9600 Masterlink recorder digital output and the PS Audio DLIII DAC AES/SPDIF 75Ω RCA input. The default AutoScan mode properly illuminated the COAX LED on the left side of the front panel. In order to provide a suitable warm-up before testing, I played over one hour of 16-bit and 24-bit digital audio test tracks.

The DLIII DAC easily locked onto 16-bit 44.1kHz digital signals, as well as 48kHz, 88.2kHz, and 96kHz with 16-bit to 24-bit-depth signals (I don't have any 192kHz digital test data). There is no indication of the received data bit-depth or sample rate on the front panel, just the one LED that indicates "LOCKED."

The RCA jack analog output signal has inverted polarity with respect to the digital data, positive-going test signals appearing negative-going on my analog oscilloscope. The analog outputs produced a rather high 2.736V RMS (L) and 2.759V RMS (R) with a 1kHz 0dB digital test signal, or a significant 2.79dB maximum above the Red Book standard of 2.0V RMS. The balanced XLR outputs produced 5.485V RMS (L) and 5.530V RMS (R). Again, the analog output signal has inverted polarity using the convention of pin 2 as the signal hot connection.

The output impedance of the RCA jack analog outputs measured 99Ω over the audio band, while the balanced XLR outputs measured 196Ω over the audio band. Hum and noise measured -87dB relative to 2V RMS, and -96dB A-weighted. The analog outputs had a negligible DC offset of 2.7mV. Separation between the stereo channels was excellent at -127dB at 10kHz.

RESPONSES

I recorded the frequency response shown in **Fig. 1** from the RCA analog outputs into a 100k load, using 16-bit/44.1kHz Red Book data, as well as 24/96kHz data into 100k. The 0dB line in this graph is representative of the higher 2.759V RMS output level. The DLIII DAC response drops off by -0.40dB at 20kHz (44.1kHz data), and -1.07dB at 43kHz (96kHz data), with a slight 0.04dB rise at 10Hz with all digital data formats. When I decreased the analog output load (44.1kHz data) to a difficult 600Ω, the frequency response fell by -1.32dB at 1kHz.

Figure 2 shows the deviation from flat response when pre-emphasized Red Book 16/44.1kHz digital data from Gary Galo's detailed De-emphasis Test CD is fed to the digital input. The de-emphasis curve is displaced by -2dB from its normal measured values for clarity. You can see that the DLIII produces a nearly ideal de-emphasis response, unlike many CD players and DACs these days that ignore the de-emphasis bit.

The THD+N versus frequency for the DLIII analog output using 16/44.1kHz and 96kHz digital data is shown in **Fig. 3**. I used the steep distortion test set 22kHz low-pass filter to remove out-of-band noise. The THD+N is essentially flat over the entire audio band. Decreasing the load from 100k to 600Ω (dashed line) showed only a slight increase in THD+N above 1kHz. Switching the upsampling frequency between 96kHz and 192kHz did not produce any noticeable change in the THD versus frequency measurements.

Figure 4 shows THD+N versus output voltage for the analog output at 1kHz, for both 100k and 600Ω loads. I found it interesting that the THD initially decreases from the 0dB point, reaching a minimum about -4dB. This is about 0.63V RMS below the maximum output measured with a 0dB test signal, so there is a slight penalty for running the maximum analog output signal so much higher than the Red Book 2.0V RMS.

On the other hand, because music rarely peaks at the maximum digital 0dB, perhaps the PS Audio engineers set their minimum distortion point at a more desirable average level based on subjective listening. Below that -4dB level the THD+N level increases in a straight line as the output level decreases, up to the 0.5% vertical axis limit in my graph. Again, cycling the upsampling frequency push button between 96kHz and 192kHz did not produce any measurable change in the THD versus output.

The DLIII output spectrum of a 50Hz sine wave at 0dBfs into 100k is shown in **Fig. 5**, from zero to 1.3kHz. The THD+N measures 0.0224%, with only the subjectively benign 2nd and 3rd harmonics showing above the -100dB noise floor. There are also no discernible AC power line artifacts. Raising the frequency to 1kHz and expanding the spectrum range to 20.5kHz shows a similar result (**Fig. 6**), where the THD+N measured 0.0239%. Decreasing the load to 600Ω left the THD+N level at both frequencies essentially unchanged despite the -1.32dB drop in analog output.

The distortion residual waveform for a 0dBfs 1kHz sine wave into a 100k load, taken after the distortion test

set notch filter (**Fig. 7**), shows mainly the aforementioned 2nd- and 3rd-order distortion harmonics, with no observable noise.

Figure 8 shows the DLIII output spectrum reproducing a combined 11kHz + 12kHz intermodulation distortion (IMD) signal at 0dBfs into 100kΩ. The 1kHz IMD product is -83dB (0.0071%), with additional products at 9kHz (0.0022%), 10kHz (0.0126%), 13kHz (0.0141%), and 14kHz (0.0025%).

Repeating the test with a 19kHz + 20kHz CCIF IMD test signal (**Fig. 9**) resulted in a -84dBfs 1kHz product (0.0063%). As with the 11kHz + 12kHz IMD test, additional products make their appearance at 2kHz, 3kHz, 17kHz, 18kHz, 21kHz, and 22kHz (the latter is off the right side of the graph).

I applied a 1kHz square wave at 0dBfs, 16/44.1kHz digital data to the DLIII and monitored the resulting scope trace at the analog output (**Fig. 10**). The Gibbs phenomenon ringing is exactly what I would expect, except the peak level of 3.9V is well above the 2.83V peak for Red Book performance. This signal is upsampled to 96kHz, and graphically demonstrates that the upsampling process does not increase the maximum native 22.05kHz frequency content.

Increasing the digital data to 24/96kHz (**Fig. 11**) shows the higher Gibbs phenomenon square wave ringing

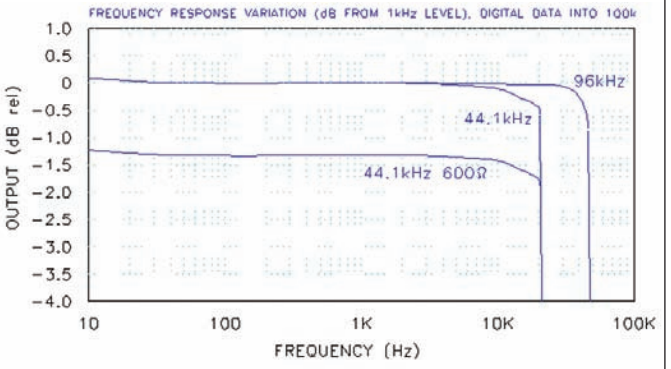

FIGURE 1: Frequency response.

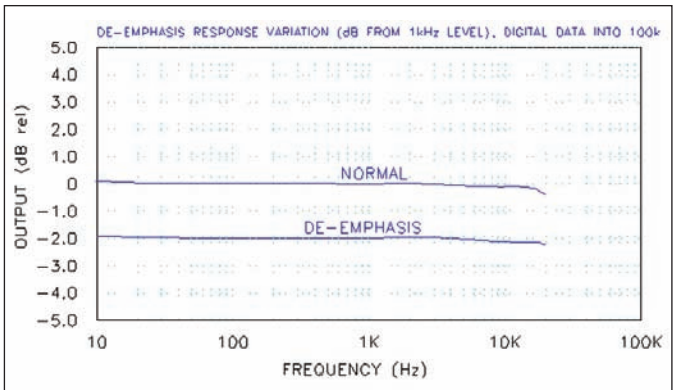

FIGURE 2: De-emphasis error.

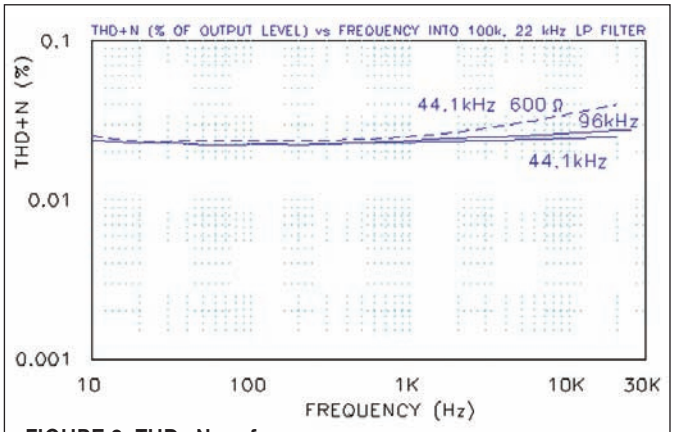

FIGURE 3: THD+N vs. frequency.

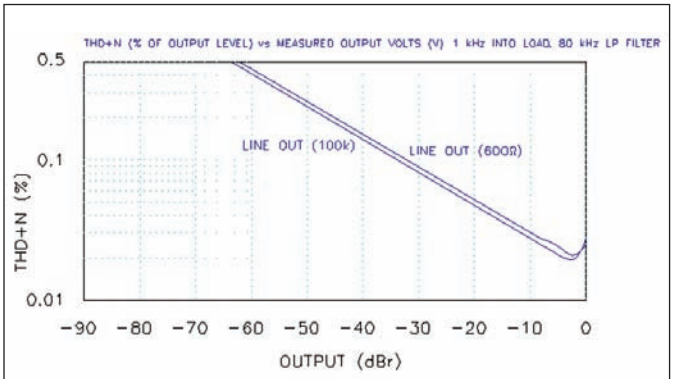

FIGURE 4: THD+N vs. output.

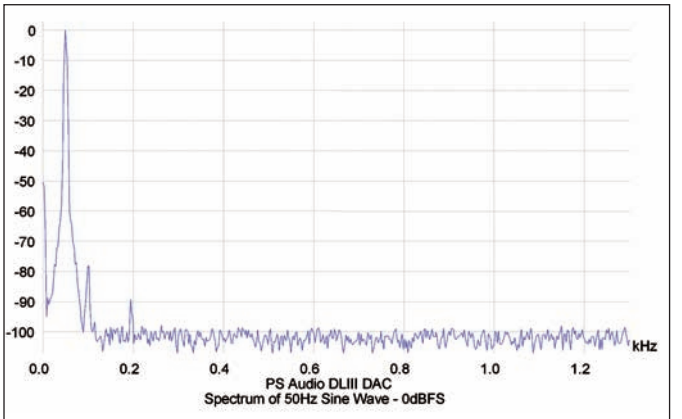

FIGURE 5: Spectrum of 50Hz sine wave, upsampled to 96kHz.

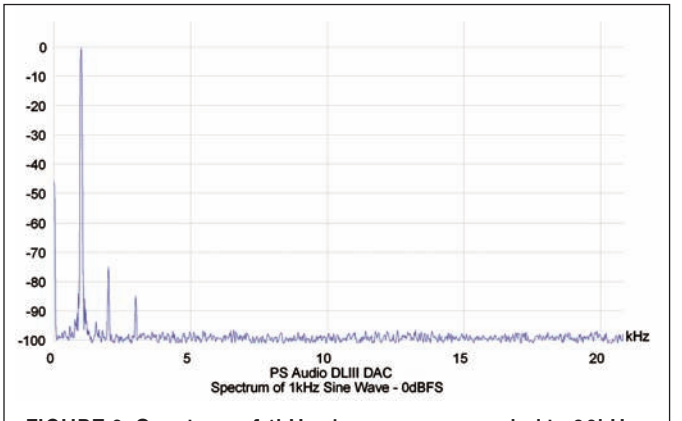

FIGURE 6: Spectrum of 1kHz sine wave, upsampled to 96kHz.

frequency, and also shows a bit of rolloff on the leading edges. This is reflected by the faster rolloff in the 96kHz analog response curve in **Fig. 1**. This signal was upsampled to 192kHz by the DLIII.

The reproduction of a dithered 1kHz sine wave at -90.3dBfs with 16/44.1kHz data is shown in **Fig. 12**. The sine wave at this ±1 bit signal level should appear as three distinct levels, but it is a bit indistinct and shows the dithering riding on top. I also applied undithered -90.3dBfs digital sine wave data to the DLIII (**Fig. 13**) and it similarly lacks the three discrete voltage levels. Increasing the data resolution to 24/96kHz at -90.3dBfs produces the much nicer sinusoidal shape shown in **Fig. 14**. This signal was also upsampled to 192kHz by the DLIII.

I could not include my usual comparison table of measured data to the manufacturer's specifications because neither the owner's reference manual nor the website provided any specifications. However, the PS Audio DLIII DAC did produce a fine set of measurements, with what appears to be a bit of 2nd-order harmonic enhancement, probably at the discrete analog output stage. This backs up Gary Galo's favorable impression during his audition.

Manufacturer's Response:
From everyone at PS Audio, we thank

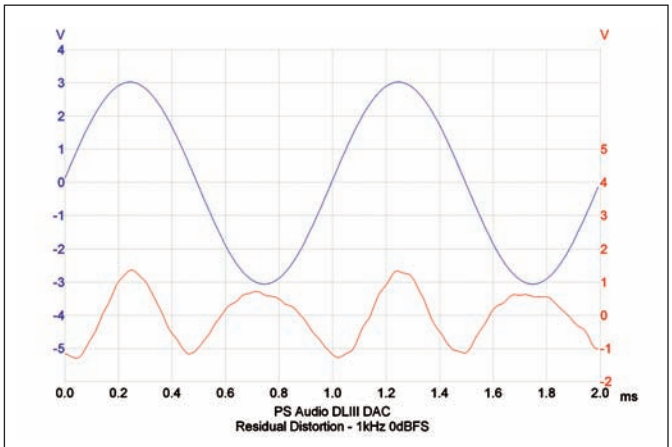

FIGURE 7: Residual distortion of 1kHz sine wave, upsampled to 96kHz.

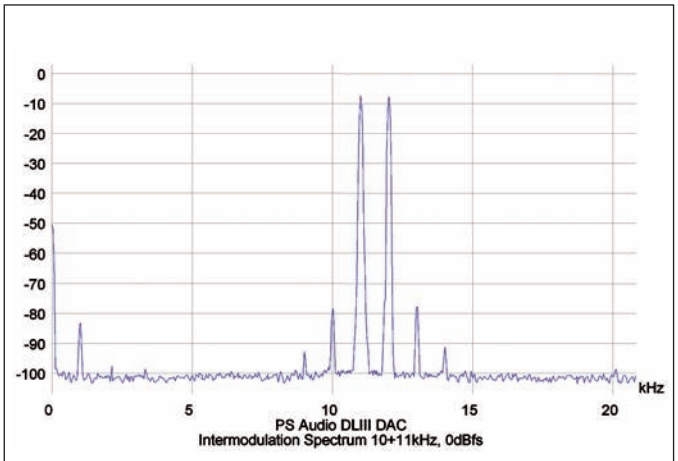

FIGURE 8: 11kHz + 12kHz intermodulation distortion.

Mr. Galo and Mr. Hansen for the thorough and thoughtful effort they put into this review. We are thrilled that Mr. Galo enjoyed the product so much that he purchased it after his extensive listening.

Please note that our new top-line D/A converter, the PerfectWave DAC, does not have the analog outputs in reverse polarity. However, absolute polarity is switchable from the front panel so listeners may easily decide which they like best.

Again, thank you very much for the great review!

Dave Kakenmaster
Vice President of Sales and Marketing
PS Audio
aX

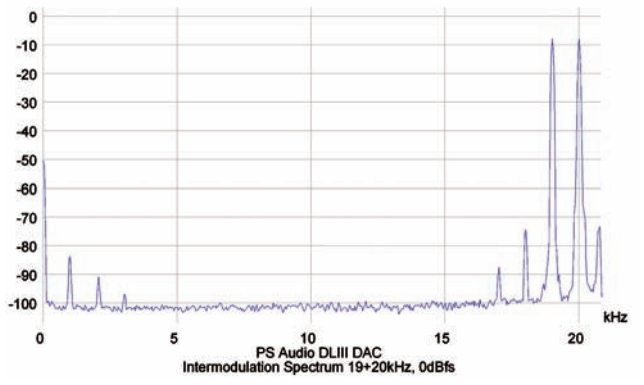

FIGURE 9: 19kHz + 20kHz intermodulation distortion.

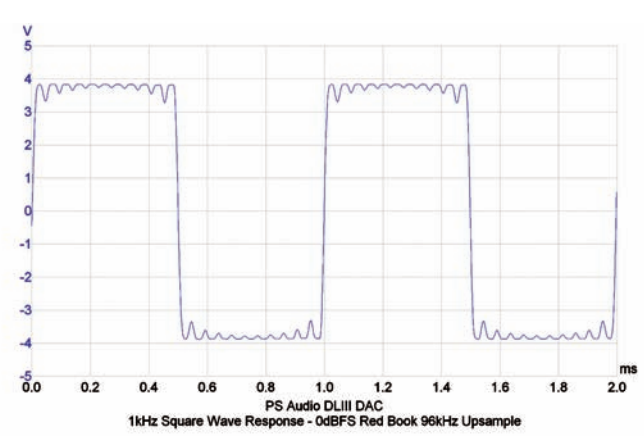

FIGURE 10: 1kHz square wave, 16/44.1 data, upsampled to 96kHz.

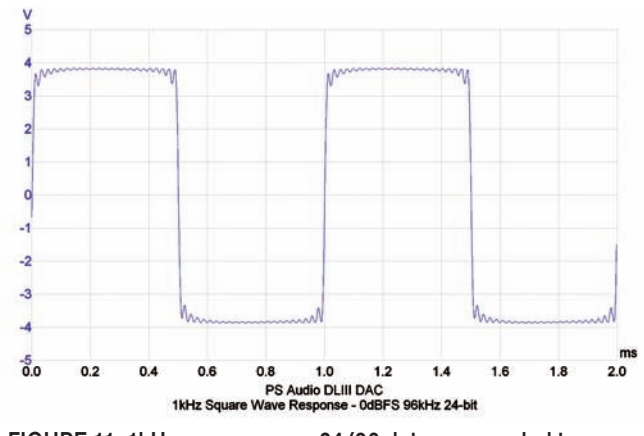

FIGURE 11: 1kHz square wave, 24/96 data, upsampled to 192kHz.

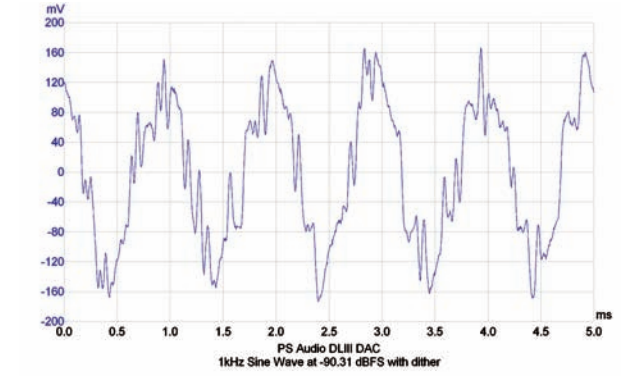

FIGURE 12: 1kHz dithered sine wave at -90.3dBfs with 16/44.1 data, upsampled to 96kHz.

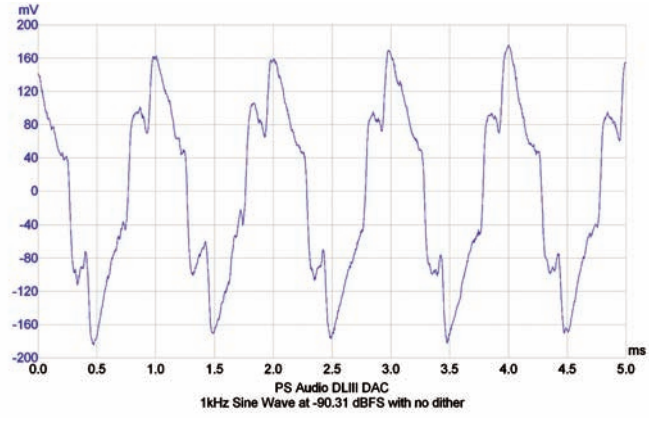

FIGURE 13: 1kHz undithered sine wave at -90.3dBfs with 16/44.1 data, upsampled to 96kHz.

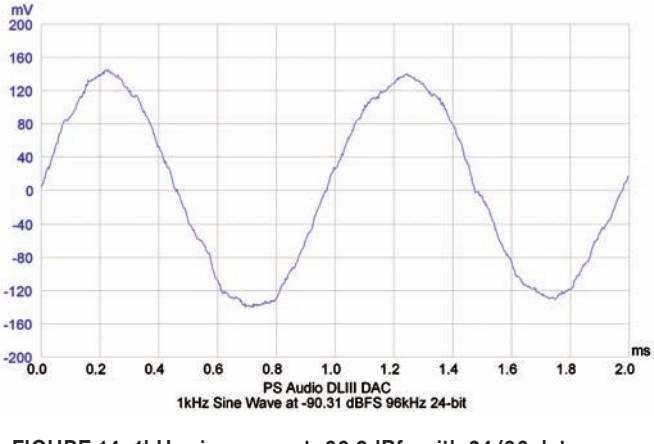

FIGURE 14: 1kHz sine wave at -90.3dBfs with 24/96 data, upsampled to 192kHz.