JOHN ATKINSON

Chord Electronics Qutest

D/A PROCESSOR

Back in the mid-1990s, I believed that the design of D/A processors was fundamentally a solved problem. The resistor-ladder, multi-bit DAC chips of the 1980s, with their linearity errors, had been replaced by sigma-delta types that had minimal linearity error down to the lowest signal levels. All that remained for the designers of PCM D/A chips was to increase resolution and dynamic range to the theoretical limits, and to improve the mathematical precision of oversampling digital filters to match the performance of the 20- and 24-bit recordings that had just begun to be released.

Twenty-five years later, nothing seems to have been resolved. The world of D/A processors has split into multiple warring factions. While sigma-delta DAC chips have indeed improved to an extraordinary degree, they are rejected by some hard-core audiophiles for failing to reproduce the force and attack of live music. Conversely, the digital processors featuring resistor-ladder DACs—which, their proponents argue, excel in these areas—can have linearity errors and levels of distortion that raise the eyebrows of conventional audio engineers, especially when those DACs are used without any reconstruction filter (such DACs are usually called "non-oversampling," or "NOS"[1]).

Chord's DAVE was one of the best-sounding DACs I've had in my system.

And even when the processor uses a digital reconstruc-

1 See the relevant section of my 2011 Audio Engineering Society lecture at https://tinyurl.com/ychpr9cl. in this issue (p.117).

SPECIFICATIONS

Description D/A processor with 10-element Pulse Array Design DAC and separate 5V power supply. Digital filter length: 49,152 taps operating at 16Fs. Digital inputs: USB Type B, 2 coaxial S/PDIF (BNC jacks), 1 TosLink S/PDIF. Analog outputs: 1 pair unbalanced (RCA). Maximum output: 3V, 2V, 1V, switchable. Frequency response: 20Hz–20kHz, ±0.2dB. Channel separation: 138dB at 1kHz. Dynamic range: 124dB (A-weighted). THD: 0.0001%, 1kHz at 2.5V into 300 ohms. Noise modulation: "none measurable." **Dimensions** 6.3" (160mm) W by 1.6" (41mm) H by 2.85" (72mm) D. Weight: 1.7 lb (0.77kg). **Finish** Black. **Serial number of unit reviewed** 37220. **Price** [redacted] Approximate number of dealers: 100. Warranty: 3 years. **Manufacturer** Chord Electronics Ltd., The Pumphouse, Farleigh Bridge, Farleigh Lane, East Farleigh, Kent ME16 9NB, England, UK. Tel: (44) (0)1622-721444. Fax: (44) (0)1622-721555. Web: www.chordelectronics.co.uk. US distributor: Bluebird Music Ltd., 275 Woodward Avenue, Buffalo, NY 14217. Tel: (416) 638-8207. Fax: (416) 638-8115. Web: www.bluebirdmusic.com

tion filter, arguments rage about whether that filter should be linear-phase or minimum-phase, and whether it should be short (have a very small number of coefficients or taps) or as long as possible. And that's without considering newer forms of lossless digital conversion. Single-bit DSD encoding, featured in the Super Audio CD medium, came out of left field at the end of 1990s. And even within PCM, there is the MQA format, which rejects Claude Shannon's 1948 thesis that the initial analog/digital conversion should be performed by eliminating *all* spectral content above half the sample rate, regardless of its level.

I recently spent some time with Aqua Acoustic Quality's Formula xHD, from Italy, which Jason Victor Serinus reviewed in June 2018,[2] and in June 2017 I reviewed the DAVE processor, from British company Chord Electronics.[3] Both are expensive—the DAVE costs $12,488, the Aqua $17,000—and each represents one side of the DAC debate: the Aqua is a NOS resistor-ladder design, while the Chord uses the longest, most complex digital filter available.

As you can read in our December 2018 issue (p.137), while I felt the Aqua DAC didn't commit any egregious sins, its sound quality was not totally to my taste.[4] By contrast, Chord's DAVE was one of the best-sounding DACs I've had in my system. I miss it still.

So when Chord announced a new DAC at a much lower price, the Qutest, featuring technology trickled down from the DAVE and identical to that used in Chord's Hugo$_2$,[5] I didn't need my arm twisted to agree to review it.

The baroque orchestra was unambiguously placed in space.

Describing

The Qutest is a small, black device wider than it is deep (6.3" *vs* 2.85") and housed in a case of machined aluminum. A circular glass window in the top panel illuminates to indicate the sample rate of the incoming data: red for 44.1kHz PCM data, through orange, yellow, green, blue, and violet as the sample rate increases to 768kHz; and white for DSD data up to DSD256 encoded as DoP.

Two spherical, polycarbonate buttons are inset in the front panel. The left button selects the reconstruction filter chosen, of which four are available: Incisive Neutral (button illuminates white), Incisive Neutral HF roll-off (green), Warm (orange), and Warm HF roll-off (red). The right button is used to select the source. On the rear panel are four digital inputs: two S/PDIF on BNC jacks (yellow and red button illumination, respectively), one S/PDIF optical on a TosLink jack (green), and a USB port (white). The USB port handles PCM data sampled at up to 768kHz, and DoP-formatted DSD data up to DSD256. No USB driver is needed for Macs; PCs require an ASIO driver, but can send native DSD data up to DSD512 (not that I'm aware of any music files available at that resolution). Unusually, the two coaxial S/PDIF inputs can be operated in parallel to cope

2 See www.stereophile.com/content/aqua-acoustic-quality-aqua-formula-xhd-da-processor.

3 See www.stereophile.com/content/chord-electronics-dave-da-processor.

4 See Herb Reichert's Follow-Up in this issue (p.117).

5 See www.stereophile.com/content/chord-hugo2-dacheadphone-amp and www.stereophile.com/content/chord-electronics-hugo-tt-da-headphone-amplifier.

MEASUREMENTS

I measured the Chord Electronics Qutest using my Audio Precision SYS2722 system (see the January 2008 "As We See It"[1]), using both the Audio Precision's optical and electrical digital outputs and USB data sourced from my MacBook Pro running on battery power with Pure Music 3.0 playing WAV and AIFF test-tone files.

Apple's USB Prober utility identified the Chord as "Qutest" from "Chord Electronics Ltd," with the serial number "413-001." The Qutest's USB port operated in the optimal isochronous asynchronous mode. Apple's Audio-MIDI utility revealed that, via USB, the Qutest accepted 32-bit integer data sampled at all rates from 32 to 768kHz. The optical input locked to datastreams with sample rates up to 96kHz (192kHz is listed in the specifications), the coaxial S/PDIF inputs to streams of up to 192kHz-sampled data.

A 1kHz digital signal at 0dBFS resulted in an output level of 3.01V into 100k ohms with the output level set to "3V," 2.01V with it set to "2V," and 1.01V with it set to "1V." (Except where indicated, all the measurements were taken with the maximum output level set to 3V.) The output impedance was an extraordinarily low 0.4 ohm at 20Hz and 1kHz, rising to 0.9 ohm at 20kHz, and the analog outputs preserved ab-

1 See www.stereophile.com/content/measurements-maps-precision.

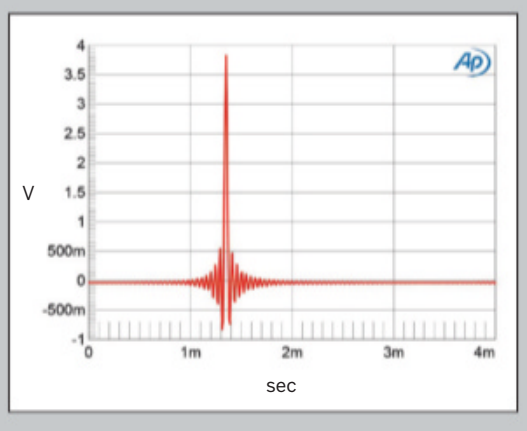


Fig.1 Chord Qutest, Incisive Neutral filter, impulse response (one sample at 0dBFS, 44.1kHz sampling, 4ms time window).

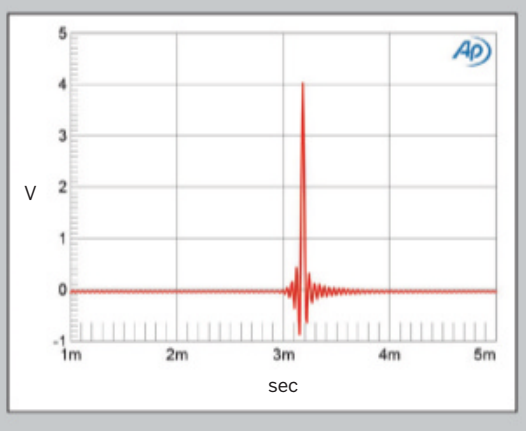


Fig.2 Chord Qutest, Warm filter, impulse response (one sample at 0dBFS, 44.1kHz sampling, 4ms time window).

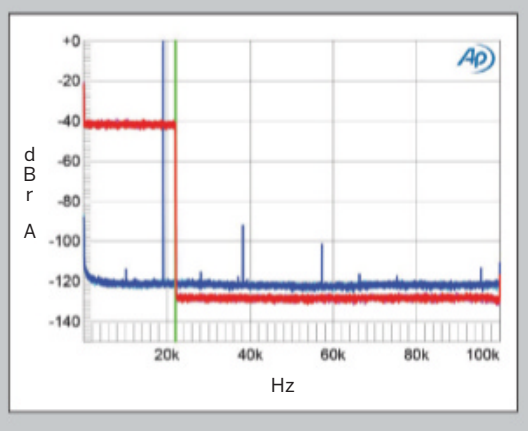


Fig.3 Chord Qutest, Incisive Neutral filter, wideband spectrum of white noise at –4dBFS (left channel red, right magenta) and 19.1kHz tone at 0dBFS (left blue, right cyan), with data sampled at 44.1kHz (20dB/vertical div.).

with 32-bit PCM data sampled at 352.8 and 384kHz from Chord's Blu Mk.2 transport.

The Qutest has a single pair of unbalanced analog outputs on RCA jacks. The maximum output level is fixed, but if the Filter and Source buttons are pressed simultaneously when the DAC is powered up, the level can be set to 3V, 2V, or 1V.

The Qutest is powered by an external 5V, 2A supply, this connected by a Micro USB port. The DAC is Chord's proprietary, 10-element Pulse Array Design type, designed by Rob Watts and implemented in a Field Programmable Gate Array (FPGA) chip. The oversampling digital reconstruction filter uses 45 208MHz DSP cores in the FPGA and operates at 16Fs. In keeping with Watts's philosophy (see my 2017 DAVE review for extracts from my interview with him) is very long, with 49,152 taps compared to the typical 128 or thereabouts.

Setting up

I connected one of the USB ports on my Roon Nucleus+ server to the Chord Qutest with a 6' AudioQuest Coffee USB link. After the Roon 1.5 app on my iPad mini had recognized the Qutest, I enabled the DAC as an audio player and set Roon to send it DSD data without first converting it to PCM. I used my Ayre Acoustics C-5xe^{MP} player as a CD transport, sending the Qutest S/PDIF data over an Esperanto coaxial link. (As the Ayre has only an AES/EBU digital output, I pressed into service a Z-Systems RDP-1 digital preamplifier, set to its bypass mode, to act as a format converter.) The only unbalanced interconnects I had that were long enough to reach the amplifiers in use were the 3m Canares I usually use in the test lab. As the Chord lacks a volume control, with the Lamm M1.2 Reference monoblocks I used a homemade passive volume control based on a stereo 10k ohm ALPS potentiometer.

Listening

I started my auditioning with the Qutest's Incisive Neutral filter. In my review of Chord's DAVE, I'd commented on the clarity with which it reproduced recorded detail. With the Incisive Neutral filter, I was strongly reminded of that description. In pianist Angela Hewitt's performance of Mozart's Piano Concert in c (16/44.1 ALAC file, Hyperion CA 68049), every instrument in the National Arts Center Orchestra was stably and clearly positioned behind the piano. Perhaps there wasn't quite the soundstage depth that I remember from the DAVE, but that was of minor concern, given the excellent sense of forward motion the Qutest lent to this music. Similarly, with Rachel Podger's performance of Vivaldi's *La Stravaganza* Concerto 6 in g for violin, strings, and continuo (24/96 FLAC file, Channel Classics CCS SA 19503), the baroque orchestra was unambiguously placed in space, with the theorbo, cello, and harpsichord continuo in the slow movement sounding particularly well-focused.

However, Ms. Podger's violin sounded a bit reedier than I was used to, as did Giuliano Carmignola's instrument in his performance of Bach's Violin Concerto in E with Concerto Köln (16/44.1 ALAC file, from Archiv 0289 479 2695 5), which sounded too thin. And when I played the *Queen Live at Wembley '86* CD (Hollywood Records HR-61104-2)—triggered by publicity for the movie *Bohemian Rhapsody*, which was being heavily promoted when I was preparing this review—Freddie Mercury's voice in "Bohemian Rhapsody" was, through the Chord's Incisive Neutral filter and for want of a better word, *incisive*. I changed to the Incisive Neutral HF roll-off filter, then the Warm filter, and finally

measurements, continued

solute polarity (ie, were non-inverting).

The Chord's impulse response with 44.1kHz data and the Incisive Neutral reconstruction filter (Filter button glows white, fig.1) indicates that this filter is a conventional linear-phase type, with a large amount of time-symmetrical ringing to either side of the single sample at 0dBFS. The Incisive Neutral HF roll-off filter's impulse (Filter glows green, not shown) was similar, while the Warm filter's impulse response (Filter glows orange) was still a linear-phase type, but with asymmetrical ringing (fig.2). The Warm HF roll-off filter (Filter glows red, not shown) was also asymmetrical, but with more ringing before the single high sample than after.

With 44.1kHz-sampled white noise[2] and the Incisive Neutral filter (fig.3, red and magenta traces), the Qutest's response rolled off extremely sharply above 20kHz, reaching full stop-band suppression by half the sample rate (vertical green line). An aliased image at 25kHz of a full-scale tone at 19.1kHz (blue and cyan traces) can't therefore

2 My thanks to Jürgen Reis of MBL for suggesting this test to me.

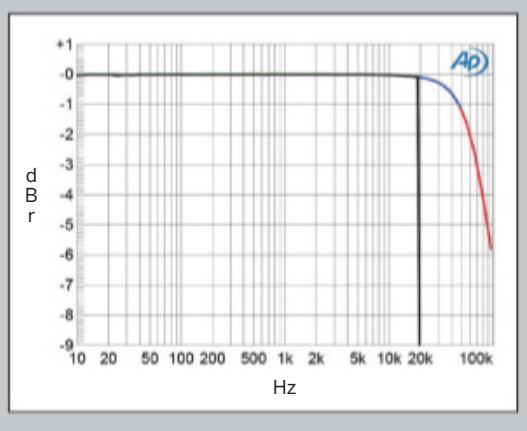


Fig.4 Chord Qutest, Incisive Neutral filter, frequency response at –12dBFS into 100k ohms with data sampled at: 44.1kHz (left channel green, right gray), 96kHz (left cyan, right magenta), 192kHz (left blue, right red) (1dB/vertical div.).

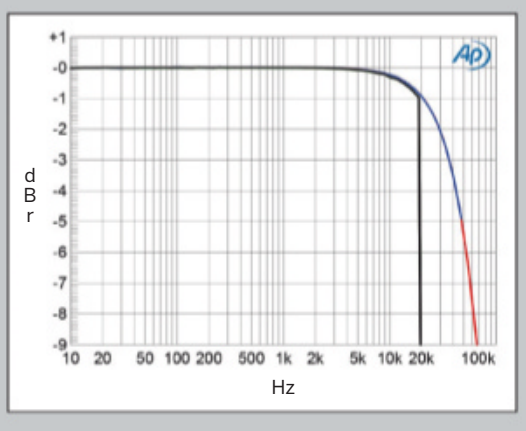


Fig.5 Chord Qutest, Warm HF roll-off filter, frequency response at –12dBFS into 100k ohms with data sampled at: 44.1kHz (left channel green, right gray), 96kHz (left cyan, right magenta), 192kHz (left blue, right red) (1dB/vertical div.).

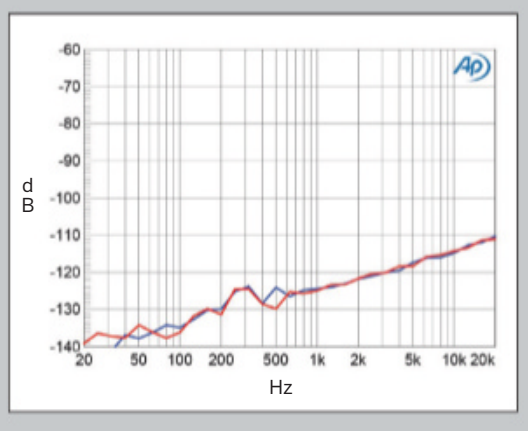


Fig.6 Chord Qutest, channel separation, ref. 3V into 100k ohms (L–R blue, R–L red, 5dB/vertical div.).

the Warm HF roll-off filter. The differences between these filters were subtle—"warm" and "HF roll-off" seemed exaggerated labeling—but the Warm HF roll-off filter was a touch more effective in rendering this admittedly aggressive-sounding recording acceptable.

Roger Taylor's drums on "We Will Rock You" from *Live at Wembley '86*, however, lost some of the essential sense of drive they'd had with the Incisive Neutral filter, and I settled on the Warm filter for my everyday listening. This filter brought out the best on the Mike Garson Trio's live *Wild Out West, Volume One* album (16/44.1 ALAC files ripped from CD, BluePort). Listening to the trio's imaginative arrangement of Miles Davis's "Nardis," I was transported back to 2006, to Piper's Opera House in Virginia City, Nevada. This filter also worked well with historic recordings. I have been working my way through *The Rise & Fall of Paramount Records, Volume 1 (1917–1927)* (Third Man Records) and after "Nardis" finished, Roon served up "Mr. Crump Don't Like It" by the Beale Street Sheiks (24/44.1, 320kbps MP3 file, transcribed from what was probably an acoustically recorded 78.) Yes, the surface noise on this recording is as loud as the two-stepping acoustic guitar and you can hear both the noise and guitar duck when the voice enters, but with the Qutest and its Warm filter this 90-year-old track sounded

measurements, continued

be seen. The second and third harmonics of the 19.1kHz tone are visible above the ultrasonic noise floor, though both are very low in level, at just below –90dB (0.003%) and –100dB (0.001%), respectively. Repeating this test with the other three filters gave identical results, though the Warm HF roll-off filter had a very slight droop in its white-noise response just before 20kHz (not shown).

When I examined the Chord's frequency response with S/PDIF data at 44.1, 96, and 192kHz, the 44.1kHz output dropped like a stone above 19.5kHz (fig.4, gray and green traces). The responses at the two higher sample rates followed the same shape, flat to 20kHz, with then a slow rolloff, disturbed by a sharp drop at each Nyquist frequency (cyan, magenta, blue, and red traces). With the two HF roll-off filters (fig.5), the output with all three sample rates was down by 1dB just below 20kHz. Channel separation was superb, at >120dB in both directions below 3kHz, and still 115dB at 20kHz (fig.6).

The low-frequency noise floor was both low in level and free from any power-supply–related artifacts (fig.7). When I increased the bit depth from 16 to 24 with a dithered 1kHz tone at –90dBFS (fig.8), the noise floor dropped by almost 30dB, meaning that the Qutest offers almost 21 bits' worth

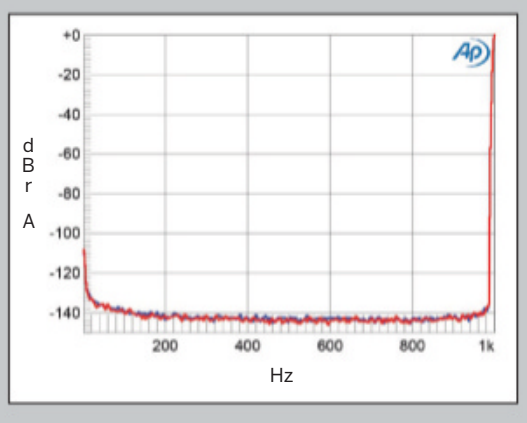


Fig.7 Chord Qutest, spectrum (0Hz–1kHz) of dithered 1kHz tone at 0dBFS (20dB/vertical div.).

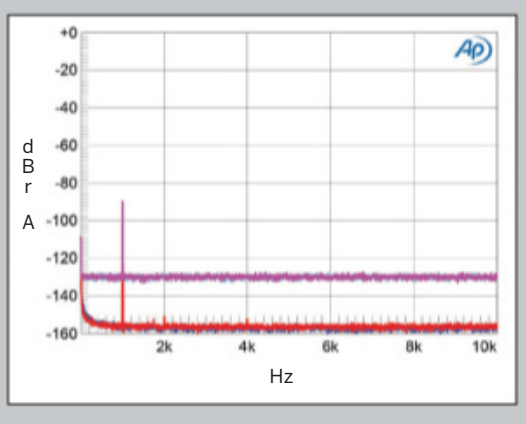


Fig.8 Chord Qutest, spectrum with noise and spuriae of dithered 1kHz tone at –90dBFS with: 16-bit data (left channel cyan, right magenta), 24-bit data (left blue, right red) (20dB/vertical div.).

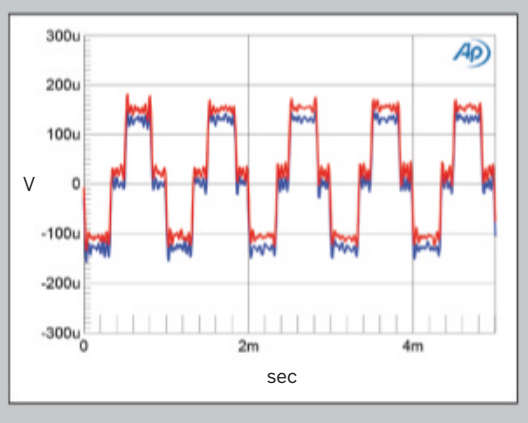
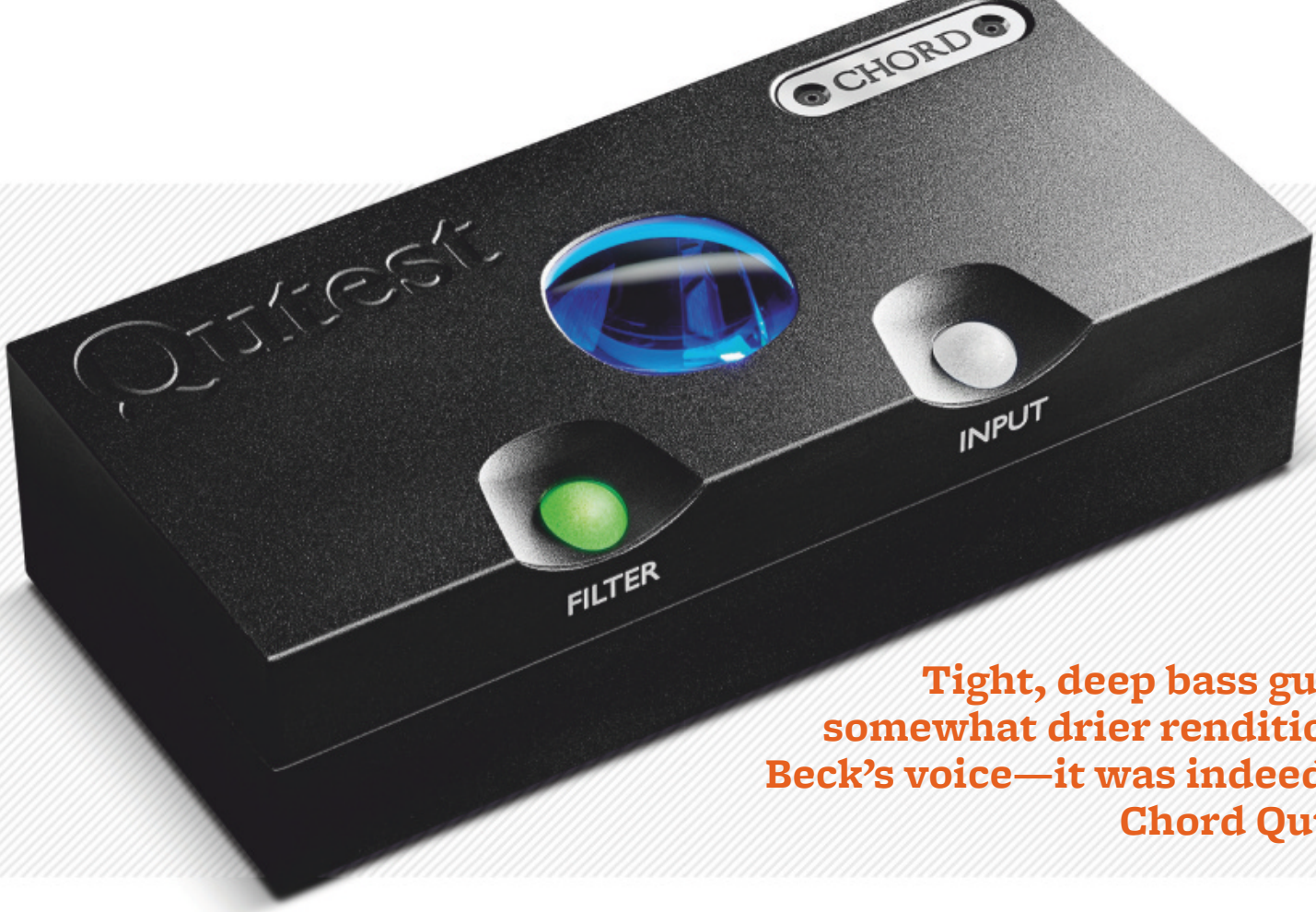


Fig.9 Chord Qutest, Incisive Neutral filter, waveform of undithered 1kHz sinewave at –90.31dBFS, 16-bit TosLink data (left channel blue, right red).



Tight, deep bass guitar, somewhat drier rendition of Beck's voice—it was indeed the Chord Qutest.

more compelling than I was expecting.

Having enjoyed living with the Qutest for some weeks, it was time to see how it matched up against some other good-sounding DACs.

Comparing

I used the Chord with its Warm filter for all the following tests. The first comparisons I performed were with PS Audio's PerfectWave DirectStream, which costs $6899 when fitted with the network bridge card. I had bought the PS Audio to be my long-term reference DAC. Roon's ability to stream the same music to more than one DAC—the PS Audio via the network, the Chord via USB—was a boon here. Listening to the Queen CD with levels matched at 1kHz, the PS Audio smoothed over the aggressive edges of Freddie Mercury's vocals without obscuring any of the detail. Guitarist Brian May's power chords at the start of "We Will Rock You" were better differentiated from the drums with the DirectStream DAC and the kick drum and bass guitar spoke with somewhat greater authority, as did Darek Oles' double bass on *Wild Out*

measurements, continued

of resolution, which is close to the state of the art. With undithered data representing a tone at exactly –90.31dBFS (fig.9), the three DC voltage levels described by the data were well resolved, the waveform was perfectly symmetrical, and the very low noise level allowed the filter's linear-phase ringing to be seen. With undithered 24-bit data, the result was a superbly clean sinewave (not shown).

Harmonic distortion was extremely low in level into the punishing 600 ohm load (fig.10). The second harmonic in this graph lies at a roots-of-the-universe –120dB (0.0001%) in both channels! Intermodulation distortion was similarly vanishingly low in level with all four filters (fig.11). Tested for its rejection of word-clock jitter with 16-bit TosLink data, the Qutest turned in superb performance: all odd-order harmonics of the LSB-level, low-frequency squarewave were at the correct levels (fig.12, sloping green line). With 24-bit J-Test data (not shown), no jitter-related sidebands were present.

Even without taking into account its small size, the fact that it's powered by a 5V wall wart, and its relatively affordable price, Chord's Qutest offers state-of-the-art measured performance. **—John Atkinson**

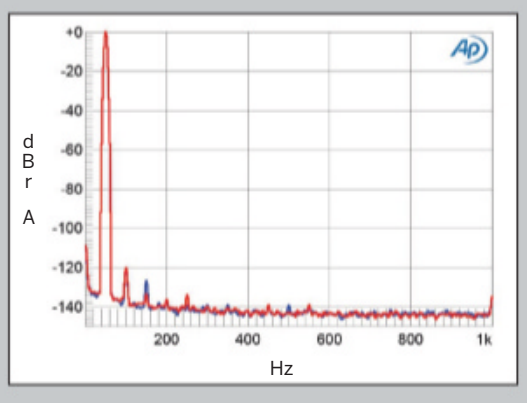


Fig.10 Chord Qutest, spectrum of 50Hz sinewave, DC–1kHz, at 0dBFS into 600 ohms (left channel blue, right red; linear frequency scale).

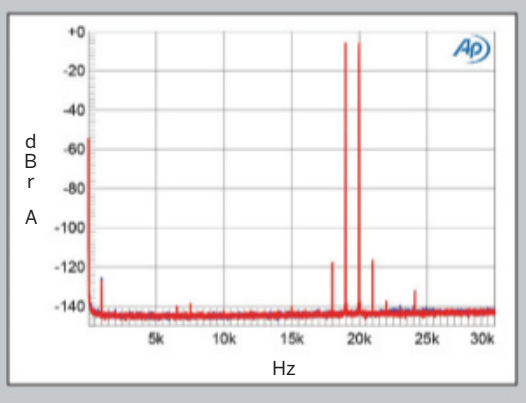


Fig.11 Chord Qutest, Incisive Neutral filter, HF intermodulation spectrum, DC–30kHz, 19+20kHz at 0dBFS into 100k ohms, 44.1kHz data (left channel blue, right red; linear frequency scale).

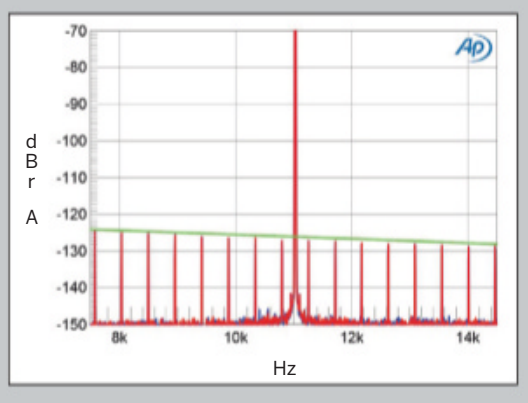


Fig.12 Chord Qutest, high-resolution jitter spectrum of analog output signal, 11.025kHz at –6dBFS, sampled at 44.1kHz with LSB toggled at 229Hz: 16-bit TosLink data (left channel blue, right red). Center frequency of trace, 11.025kHz; frequency range, ±3.5kHz.

West, Volume One. The leading edges of the bass's notes were a tad better defined with the Chord, however.

Overall, a win on points to the PS Audio, but of course, it *ought* to sound better than the Chord, given that it costs more than three times as much. I therefore reached for our review sample of the original Mytek Brooklyn, which Jim Austin reviewed in November 2016. The Brooklyn cost $100 more than the Qutest[6] but includes a phono preamp, volume control, and headphone output, as well as offering MQA decoding. For the comparisons I set the Brooklyn's reconstruction filter to MPh (Minimum Phase), which I felt dealt most gracefully with the overcooked Queen album. Even so, the Mytek's balance was slightly more forward than the Chord's, which meant it sounded a little louder despite the levels being matched.

Other than that, the two processors sounded very similar, though if I have to swear to it, the Brooklyn's low frequencies were a little leaner. The sound on Vladimir Ashkenazy's performance of Rachmaninoff's Piano Concerto 2, with Bernard Haitink conducting the Concertgebouw Orchestra (16/44.1 ALAC file ripped from CD, London 414 475-2) was typically mid-1980s Decca—vivid in the highs, powerful in the lows—but perhaps slightly warmer overall on the Chord. Peculiarly, I could reduce this difference between the two processors by inverting the Brooklyn's polarity, even though my measurements had indicated that both the Chord and the Mytek preserve absolute phase. The piano now sounded equally forceful, though with the Angela Hewitt Mozart concerto, there was a touch more air around the piano with the Chord.

It was a close-run thing with the Chord and Mytek processors. Next up was iFi Audio's Pro iDSD D/A processor ($2499), which Herb Reichert reviews elsewhere in this issue. The Pro iDSD is similar to the Mytek Brooklyn in that it has a volume control and headphone output, and will decode MQA data. It also has three different output modes, and a bewildering number of choices of reconstruction filter—to keep things manageable, I stuck with HR's preferred Bit Perfect non-oversampling mode and the Tube+ output.

Playing the Mike Garson Trio's "Nardis," with the Roon Nucleus+ server feeding both DACs data via USB and with levels matched using pink noise, the left-hand register of the piano was warmer-sounding on the iDSD. Yet the Qutest had somewhat better low-frequency definition, my Fender bass guitar on the channel ID tracks on *Editor's Choice* (CD, Stereophile STPH016-2) having a better balance between the leading edges of the notes I played and the body of the tone. This was also apparent on Van Morrison and Roger Waters' "Comfortably Numb" (24/44.1, 320kbps AAC file, from *Van Morrison at the Movies—Soundtrack Hits*, EMI), though the Chord did better at untangling the dense mix, this probably not helped by the AAC encoding. (I have no idea how a lossy version of this song ended up in my library—probably an iTunes purchase when I didn't want to buy the entire CD.)

Turning to a hi-rez file, Beck's "Heart Is a Drum" (24/96 ALAC file from *Morning Phase*, Capitol/HDtracks 3764975), the iFi offered a palpable midrange, but over-warm lows; the Chord's bass was tighter and deeper, but Beck's voice sounded less rounded. To ensure that I wasn't unduly influenced by Herb's review, or just hearing what I expected from the iDSD's tubes, I paused playback on Roon for both DACs and switched rapidly between the inputs on the Ayre EX-8 integrated amplifier until I had lost track of what was selected. I then started the file playing again and tried to identify which DAC was playing. Warm lows, palpable mids? Must be the iFi Pro iDSD. And it was. Repeated the procedure: tight, deep bass guitar, somewhat drier rendition of Beck's voice—it was indeed the Chord Qutest.

Frankly, however, I could live with either of these DACs. With messy, congested mixes like the Van Morrison "Comfortably Numb," I would take the Chord with its Incisive Neutral filter; with sparse arrangements dominated by a vocal, like David Ackles' classic "The Road to Cairo" from *David Ackles* (16/44.1 ALAC file, ripped from CD, Elektra), I would go for the iFi in its direct (Bit-Perfect) mode and the Tube+ output. Horses for courses.

ASSOCIATED EQUIPMENT

Digital Sources Roon Nucleus+ media server, iPad mini running Roon 1.5; Ayre Acoustics C-5xeMP disc player; iFi Audio Pro iDSD, Mytek Brooklyn, PS Audio PerfectWave DirectStream D/A processors; Z-Systems RDP-1 digital preamplifier (used as digital format converter).
Integrated Amplifiers Ayre Acoustics EX-8, Cambridge Audio Edge A.
Power Amplifiers Lamm M1.2 Reference monoblocks with external passive volume control.
Loudspeakers KEF LS50, Rogers LS3/5a, Wharfedale Diamond 11.2.
Cables Digital: AudioQuest Coffee (USB) & Vodka (Ethernet), generic 15' TosLink, Esperanto Audio (S/PDIF). Interconnect: Canare (unbalanced). Speaker: AudioQuest K2. AC: AudioQuest Dragon Source & High Current, manufacturers' own.
Accessories Target TT-5 equipment racks; Ayre Acoustics Myrtle Blocks; ASC Tube Traps, RPG Abffusor panels; Shunyata Research Dark Field cable elevators; AudioQuest Niagara 1000 & 5000 Low-Z Power/Noise-Dissipation Systems. AC power comes from two dedicated 20A circuits, each just 6' from breaker box. **—John Atkinson**

Concluding

You can read in this issue's "As We See It" (p.3) that there is a dichotomy between D/A processors that sound superb because they're faithful to the digital data they decode, and those that sound superb because they tell lies. Chord's Qutest is firmly in the former camp, especially with its Incisive Neutral filter, and for that, designer Rob Watts is to be commended.

As I wrote of Chord's Hugo TT D/A headphone amplifier in November 2015, the Qutest is an "extraordinarily well-engineered component." However, the important distinction is that while the Hugo TT costs , the Qutest costs only . Yes, it lacks a volume control, remote handset, Bluetooth capability, balanced outputs, MQA decoding, and a headphone jack—but it offers close to the state of the measured digital art *ca* 2019, and it sounds simply superb. It may not quite reach the sonic heights offered either by Chord's DAVE or by PS Audio's DirectStream DAC, but at less than one-sixth the price of the former and less than one-third the price of the latter, it can be strongly recommended. ■

6 The original Brooklyn DAC has been replaced by the Brooklyn DAC+, which costs $2195—see Jim Austin's April 2018 Follow-Up at https://tinyurl.com/y7anor6q—which I have not yet auditioned.