

dCS Vivaldi APEX

Lockdown afforded dCS's engineers the time and space to look at the implementation of its iconic Ring DAC afresh. The APEX upgrade is tested here in its flagship Vivaldi DAC
 Review: **Andrew Everard & Paul Miller** Lab: **Paul Miller**

You know that old saying about the devil making work for idle hands? While the periods of lockdown over the past couple of years left a lot of hands idle in the hi-fi industry, the wisest turned this fallow period to good use, regrouping and rethinking. That's certainly the case with the engineers at Cambridgeshire-based Data Conversion Systems, better-known as dCS.

Not content with having its own world-class digital-to-analogue conversion system – the famous Ring DAC – the company has now revisited and revised the technology, creating the new Ring DAC APEX solution that's being rolled out across at least two ranges of dCS digital products. These include the flagship Vivaldi APEX DAC we have here, selling for £33,000, as well as the £25,500 Rossini APEX DAC, and the £28,000 Rossini APEX Player. There's also an upgrade service available for existing Vivaldi and Rossini units – this costs £6000, and bookings are now open.

RECONFIGURED REFERENCE

Under the bonnet, there's an element of 'if it ain't broke' going on: the Ring DAC concept may be more than three decades old, but it has been refined over the years, and still sets a sufficiently high standard to act as the 'reference' in the *HFN* listening room. The APEX update is its most significant to date, for while the DSP core and Ring DAC resistor matrix are unchanged, the main board on which it sits is entirely reconfigured with new output devices, power supply filtering and regulation [see PM's boxout, p47].

Outwardly there's nothing new to see in the Vivaldi DAC [*HFN* Feb '13], or indeed the other 'new' dCS models. The company's high-quality alloy fascia, complete with its swooping swage-line, minimal control buttons and single rotary – which here

adjusts volume when the unit is used to drive a power amp directly – is unchanged. Nor is there anything on the panel or display to indicate its APEX status.

However, beyond that apparent simplicity is a comprehensive menu system, enabling detailed setup of the Vivaldi APEX DAC. Press the menu button then the two arrow keys, and you can scroll through numerous settings, right from the Mapping – the way incoming data is presented to the DAC matrix – to a range of master clock options. It's also possible to defeat the default data-buffering, for example when using the Vivaldi with video sources and where picture synchronisation is vital.

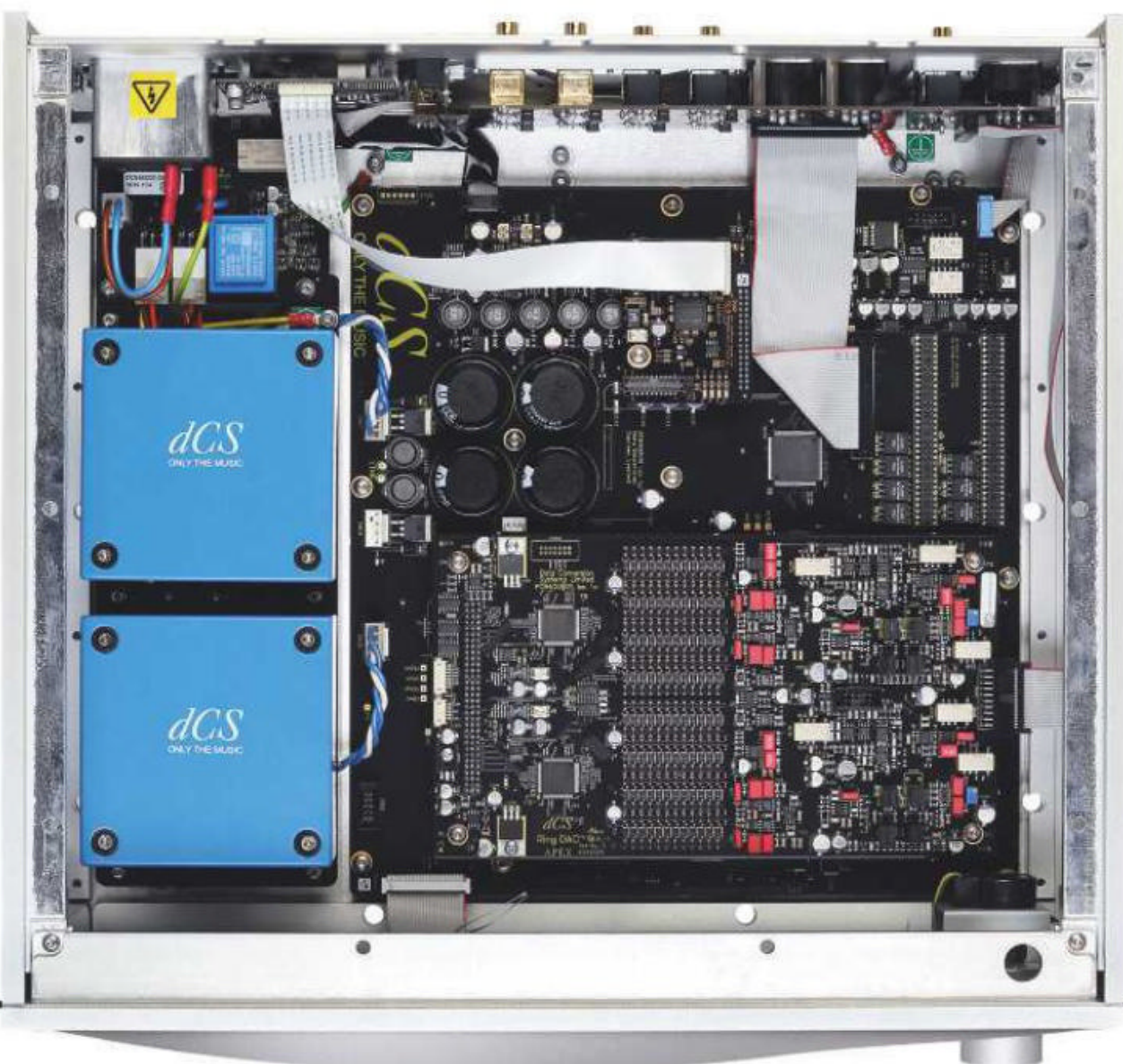
You can also set a range of output options, these going beyond the simple selection of RCA or balanced XLR out, and fixed and variable level. The full-scale output can be set to 6V, 2V, 0.6V or 0.2V, for matching with your amplification,

while phase can be inverted and channels swapped left to right. There's a useful signal generator to allow channels to be checked, and it's also possible to switch the volume control to balance adjustment.

Similarly, the rear panel remains just as comprehensive, with its array of digital inputs – one optical and three coaxial, four AES/EBU (configurable as two pairs), and one asynchronous USB for computer audio up to 384kHz/24-bit PCM and DSD128 in DoP. There are also three Word-Clock inputs/one output on BNCs for synchronising the Vivaldi DAC with other digital components, including the £36,000 Vivaldi CD/SACD transport, the £17,000 outboard Vivaldi Master Clock and £21,000 Vivaldi upsampler.

Also unchanged are the means of controlling the Vivaldi DAC, including the company's large, heavy and immaculately finished remote handset, complete with

RIGHT: The 96 current sources (a 2x48 matrix) that comprise the Ring DAC core are visible here with the two driving FPGAs sitting alongside [see also p49]. The balanced analogue output [lower RH corner] has its own regulated PSU [left]





a further rotary volume control, and the well-sorted and remarkably flexible Mosaic app. This is available for iOS and Android, and can also bring a range of streaming solutions, including online services and Roon, to a dCS digital system. It can also access all the options found in the Vivaldi APEX DAC's menus, meaning you never have to leave your seat!

MORE... HUMAN

I started my auditioning from a position of familiarity, as I've been listening to the dCS Vivaldi One [HFN Feb '18] in PM's listening room for some years now, and with a wide range of partnering equipment. Fed from the Melco music library [HFN Jun '16] – also part of this system – it has been used both as a pure digital source into preamps and integrations, as well as a DAC/preamp into many power amplifiers, on the end of

which have sat a huge number of speakers (many of which have also been huge!). So I think I've got a pretty good idea of what the 'old' Vivaldi does, or did...

And to be honest I've always considered it to be an excellent piece of equipment, particularly when used as an analytical tool in the HFN demo room – as befits a product from a brand with its roots in the professional world. However, to my ears there's been something slightly too precise about its sound – if that's not a contradiction of the whole hi-fi thing – and a marginal reluctance to let rip and tingle the spine. It's very easy to appreciate all the good things it does, in terms of resolution, detail and so on, but there have also been occasions when it's just felt a little too, well, *academic*.

Or perhaps that feeling's just a reaction to what the new Vivaldi APEX DAC can

ABOVE: The Vivaldi's flowing curves are milled from a substantial slab of alloy. It can be controlled via the rotary and row of buttons, but dCS's huge IR remote [p51] and Mosaic control app are more convenient

deliver. I came to this review simply expecting more of the same, or even just marginal improvements, but after only a brief period of listening to the new model, I started to realise that what I was hearing was all the technically accomplished bits of the old Vivaldi, but with a new sense of enjoyment, of delivering the spirit of what was being played. Simply, the Vivaldi APEX DAC was sounding more natural, more organic, more... human. ➡

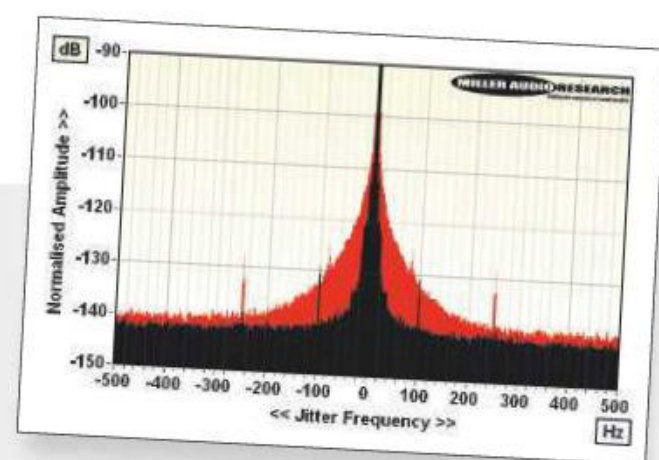
THE 'APEX' RING DAC

Announced by dCS back in 1991, its Ring DAC converter is now a highly evolved and practical technology, combining the pure monotonic conversion of a genuine 'single-bit' DAC with the operation of a PWM bitstream-style converter. The current Ring DAC hosts all its custom DSP, including the six digital filters that are unchanged here, on Xilinx Spartan 6 processors. The proprietary code truncates incoming LPCM data (and converts DSD) to an average wordlength of 4.6 bits and these 24 (or $2^{4.6}$) possible values are then mapped across 48 'identical' current sources that comprise the Ring DAC. This matrix of current source/resistor elements is clearly visible in our pictures [p46 and p49], as are the Xilinx processors and fully balanced analogue output stages.

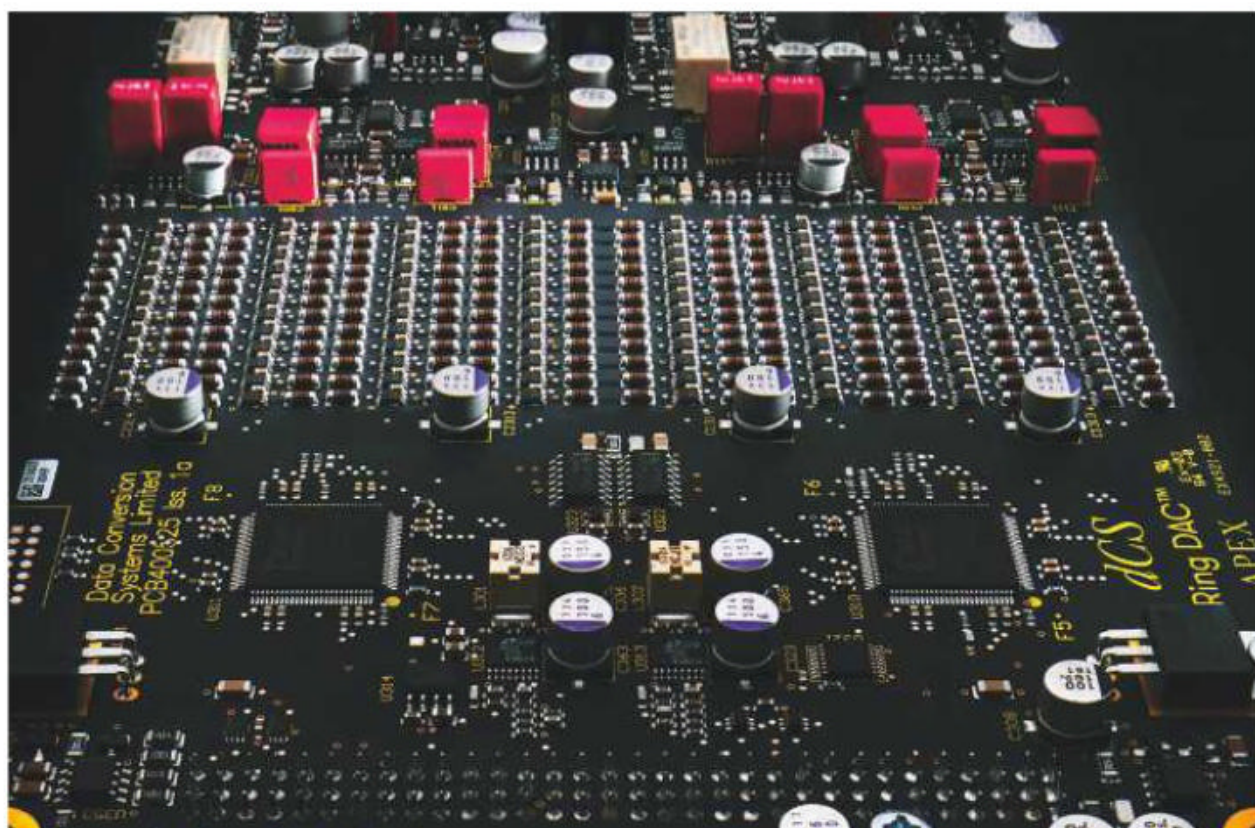
In practice the Ring DAC approach differs from traditional PWM/bitstream/hybrid DACs that would use these bits to control the length of *time* a single current source is held open or closed. However, for the Ring DAC to be truly monotonic – like a pure 1-bit DSD DAC – its 48 current sources would need to be absolutely identical in size. Even with laser-trimmed chip resistors, this is not practical so dCS randomises the mapping of bits to its current sources. Clever

thinking – so fixed errors, that would otherwise appear as harmonic distortions, are thus traded for an inaudible increase in noise.

Although all the APEX upgrades are 'analogue' some still impact on the DAC's *digital* performance. This doesn't include the thermally matched compound transistor pairs now used in the output – these influence analogue noise and distortion only [see Lab Report, p51]. However, dCS has focused particular attention on the latches that address the matrix, tightening up the clocking and reducing the source impedance of the reference PSU, resulting in a real, and measurable, reduction in low-level phase noise. The uncorrelated noise 'skirt' seen with the previous Vivaldi [red trace, inset Graph] is reduced in the APEX variant [black trace] and although the difference is at a very low level – this is a very high-resolution/zoom jitter spectrum – it is nonetheless proof of generational gain. PM



OUTBOARD DAC



ABOVE: Overview of the latest APEX PCB with one Xilinx DSP [bottom] and matrix of 48 resistor current sources [centre] per channel, and analogue output stages [top, into distance]

As ever, the range of digital filters are there to be played with [see PM's Lab Report, p51], and provide the chance to do very subtle 'tone-tuning' of the sound. However, what's striking is that, whichever filter you choose, this sense of greater involvement is maintained, not just across a range of file formats, but independent of the musical genre you choose to play.

Thus even with the live McCoy Tyner/Freddie Hubbard set from back in 1986 at Fabrik, Hamburg [Jazzline D7710], there was a fine sense of presence from what has no pretensions to being an audiophile recording. Rather, this extended document of 'Round Midnight' had a sultry warmth to it, and wonderful dynamics both in the solo instrument and the backing musicians. There were glorious timbres on offer too, notably in Hubbard's trumpet and the superb Avery Sharpe bass solo, not to mention Tyner's exuberant piano. It drew me in, and held my attention so that the music seemed to pass all too quickly.

A DATE WITH THE DAME

On a different scale, Mitsuko Uchida's wonderful reading of Beethoven's *Diabelli Variations* [Decca 4852731; 192kHz/24-bit] – where the pianist gives a simply dazzling display of virtuosity and illuminates these challenging, yet sublime, little pieces as they combine into a fabulous whole – showed the Vivaldi APEX DAC at its best. Yes, it did the technical stuff supremely well, placing the piano on the stage in

'Above all, it makes the track a blast to listen to'

the Snape Maltings acoustic. But more to the point, the DAC's performance proved utterly captivating as Dame Mitsuko made relatively light work of what's often described as 'the Everest of piano', playing through the 33 variations with superb assurance and scintillating expression.

Things got a little grubbier with the edgy funk of The Rolling Stones' 'Fingerprint File', the closing track of *It's Only Rock 'N Roll* [Rolling Stones Records UIGY-9069; DSD64]. Here the Vivaldi APEX DAC did all the promised discrimination of massed instruments in the loping shuffle, from Jagger's mannered vocal to the chugging backing driven by Bill Wyman's bass and Charlie Watts' crisp percussion. But, above all, it made the track a blast to listen to, thanks to its tight control of rhythms and the way little details such as the smallest keyboard figures were illuminated.

BLAZING A TRAIL

dCS makes great claims for the ability of the new APEX implementation when it comes to the opening up of works involving swathes of instruments. And the revamped Vivaldi DAC lives up to this promise with the growing complexities of everything from Britten's 'Young Person's Guide To The Orchestra', this time from the composer's own 1963 recording with the London Symphony Orchestra [Decca 417 509-2], to John Williams' 'all guns blazing' march from Steven Spielberg's film *1941*, performed by the Dallas Winds under Jerry

CHRIS HALES

'Our Ring DAC has been part of the dCS DNA since the early '90s', says Director of Product Development Chris Hales. Although the technology has been refined over the last 30 years, this is the first occasion that dCS has actively promoted an iterative change, without calling it a 'mk2'. 'We did enhance the resolution of the Ring DAC for the Vivaldi about ten years ago [HFN Feb '13] by increasing the number of current sources [resistor elements] from 44 to 48 per side. At the same time we changed the mapping function from a ROM to an FPGA, allowing us to more easily issue software updates'.

The 'mapping' defines how bits are assigned to individual current sources, optimising low-level THD and linearity against noise. 'It's not truly random', confirms Chris, 'so we offer users the ability to experiment with these trade-offs for themselves – Mapper 2 is identical to that used in the original Vivaldi while Mappers 1 and 3 use different, double-speed (6MHz) algorithms'.

Confirming that every cloud really does have a silver lining, the APEX upgrades were born of the Covid epidemic when Chris was effectively 'locked in' and took the opportunity to dive into the implementation of the Ring DAC afresh. The result was enhancements to the power supply regulation, linearity of the output stages and clocking of data to the latches [pictured above left, and see boxout, p47]. 'The APEX improvements are also being offered to owners of the Vivaldi One player / DAC', says Chris. PM



LAB REPORT



ABOVE: Four S/PDIF inputs (one optical and three coaxial) are offered alongside four AES/EBU inputs (or two pairs), one asynchronous USB (to 384kHz/24-bit PCM, DSD128 in DoP), three Word-Clock inputs/one output (on BNCs) and both single-ended (RCA) and balanced (XLR) fixed/variable audio outputs

Junkin [*At The Movies*, Reference Recordings RR-142; DSD64].

Both revealed an ability to resolve the finest detail while conveying all the character of instruments. This from the crisp rhythms and sweeping strings of the LSO under Britten's baton – beautifully measured, as you might expect, if not as bombastic as some more recent versions – in Kingsway Hall almost six decades ago. I also heard the same in the growing power of the Dallas ensemble as it developed from a simple woodwind tune to full-on brass and drums thunder in the Williams piece.

The Vivaldi APEX DAC delivered a lovely swing in Britten's dancing tunes for the various sections of the orchestra, a delicious blare to the brass, real snap to the tuned percussion and serious impact from the big drums, while with Williams'

composition it was simply hilarious 'shall we turn it up a bit more?' fun – just as it should be. And that sense of enjoyment extends even to playback of decidedly scruffy recordings. There's never any sense that the oh-so-refined dCS electronics is turning its nose up at what it's being asked to handle.

The Clash's
'London Calling',

LEFT: dCS's universal remote control covers off volume, input, filter and absolute phase for the Vivaldi APEX DAC

opening the British band's *Hits Back* compilation [Epic 88725442362], both slammed hard and sounded wide open, raw and anthemic. Even the considered mayhem of The KLF's 'America: What Time Is Love?' [KLF Communications KLF USA 4CD] found the Vivaldi APEX DAC able to dig deep into a 30-year-old recording that's almost the definition of dense, unearthing detail while keeping all nine minutes of the track charging along in unstoppable, screaming fashion.

NEW LEASE OF LIFE

So yes, there is more refinement here, and for those who like their existing Vivaldi products, the new Ring DAC APEX technology will offer even more of what they appreciate. But more to the point is that, in opening up all sorts of aspects of the technology's performance, dCS appears to have given new life to what was always a very technically accomplished design. And that sheer added enjoyment may just overshadow all the other gains. 🎧

HI-FI NEWS VERDICT

Whatever your impression of dCS's earlier Ring DAC, in this latest APEX implementation it's rediscovered a sense of fun, making the new Vivaldi not just a highly accomplished piece of high-end hi-fi, but an absolute pleasure to listen to. Calling it APEX may seem ambitious – and perhaps leaves the designers nowhere to go next? – but on this showing the Vivaldi APEX DAC has certainly hit peak performance.

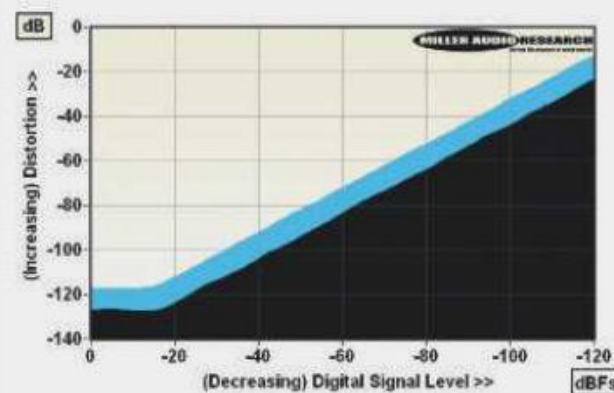
Sound Quality: 90%



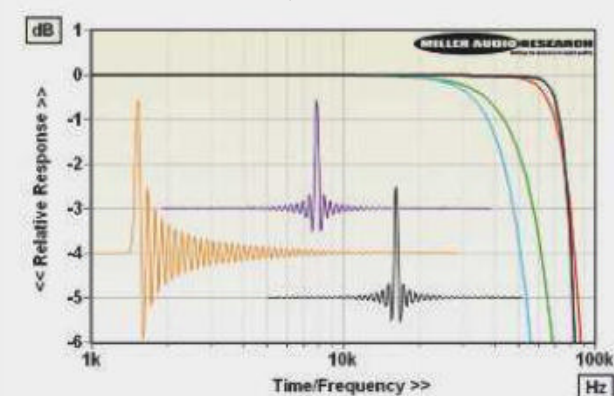
DCS VIVALDI APEX

Comparisons with the full Vivaldi 'stack' [HFN Feb '13] and Vivaldi One [HFN Feb '18] show small, steady improvements in the evolution of dCS's Ring DAC and analogue technology. The analogue output buffer still has a fabulously low, cable-agnostic 480mohm source impedance and offers a maximum variable output up to 5.88V – ideal for driving power amplifiers directly. The A-wtd S/N ratio is now fractionally higher at 117.1dB and low-level resolution good to $\pm 0.3\text{dB}$ at -120dB . Distortion remains as low as ever through bass/midrange at $<0.00009\%$ over the top 20dB of its dynamic range and is even fractionally lower in the APEX at 20kHz where THD falls between 0.0001-0.0003% over the top 30dB [see Graph 1, below, and note the expanded 0-140dB Y scale]. Correlated jitter looks to have *increased* to 120psec (48kHz/24-bit data) but that is only because the $\pm 5\text{Hz}$, $\pm 7\text{Hz}$, $\pm 9\text{Hz}$, etc, sidebands are now exposed by the elimination of random jitter/phase noise [see boxout, p47].

Channel separation is >120dB (20Hz-20kHz) while the frequency response(s) depend on your choice of filter, all six delivering a ruler-flat $\pm 0.05\text{dB}$ (20Hz-20kHz) with CD media albeit with variable stopband attenuation (108dB, 57dB, 17dB and 7.3dB, Filters 1-4, respectively). Filter 5 is a minimum phase type with significant post-ringing and Filter 6 a linear phase type with lower amplitude, but more extended, pre/post ringing [orange/purple traces, Graph 2]. Filters 1-4 are linear phase for all sample rates and offer responses of $-22\text{dB}/45\text{kHz}$, $-0.7\text{dB}/45\text{kHz}$, $-29\text{dB}/39\text{kHz}$ and $-10.6\text{dB}/45\text{kHz}$, respectively, with 96kHz media and $-13\text{dB}/90\text{kHz}$, $-7.3\text{dB}/90\text{kHz}$, $-23\text{dB}/77\text{kHz}$ and $-17.9\text{dB}/90\text{kHz}$ [black, red, cyan and green traces, Graph 2], respectively, with 192kHz files. **PM**



ABOVE: Dist. vs. 48kHz/24-bit digital signal level over a 120dB dynamic range (1kHz, black; 20kHz, blue)



ABOVE: Frequency/impulse Filter responses [Filter 1, black; 2, red; 3, cyan; 4, green; 5, orange; 6, purple]

HI-FI NEWS SPECIFICATIONS

Maximum output level / Impedance	5.885Vrms / 480mohm (XLR)
A-wtd S/N ratio (LPCM / DSD)	117.1dB / 116.8dB
Distortion (1kHz, 0dBfs/−30dBfs)	0.00004% / 0.00009%
Distortion & Noise (20kHz, 0dBfs/−30dBfs)	0.00025% / 0.00025%
Freq. resp. (20Hz-20kHz/45kHz/90kHz)	+0.0 to −0.04dB/−0.0dB/−13dB
Digital jitter (48kHz/96kHz)	120psec / 10psec
Resolution @ −100dB/−120dB	±0.1dB / ±0.3dB
Power consumption	21W (1W standby)
Dimensions (WHD) / Weight	444x151x435mm / 16.2kg