Upsizing

David Price auditions the mighty four box version of dCS's high end Paganini DAC, with Transport, MasterClock and Upsampler...

dCS have a legitimate claim to being the maker of the world's best digital to analogue convertors. I shall not state that they categorically are, because I haven't heard every other top DAC under like-for-like conditions, but I don't think anyone would say it was presumptuous to describe the likes of the Paganini DAC, which we reviewed back in the October 2009 issue of *Hi-Fi World*, as *not* one of the best. So then, where do you go from here?

The 'stock' dCS Paganini DAC is now a trifling £9,799, putting it in the stratosphere for most of us as far as affordability is concerned, but that of course is merely an entry level product (the Scarlatti DAC is £13,299). However, given that it sports the same Ring DAC of their more expensive machine, it's certainly the bargain of the company's roster and as such has won many friends. So what happens when you've decided that it's simply not good enough for you anymore? Well, in the shape of this vast four box system they have the answer...

The basic Paganini DAC is more like a digital to analogue converting computer; it has an awful lot of power and massive flexibility. Its two boards (one main one onto which the RIng DAC board piggybacks) of course contain a master clock and DSP sections. But dCS has found that taking these functions off the board and housing them in separate boxes improves the sound. It's mainly the superior dedicated power supplies that each box gets, along with its lack of RFI interference, that brings

the improvement from the offboard MasterClock (£4,599) and Upsampler (£6,299). The result is that with its matching CD/SACD Upsampling Transport (£9,449), the Paganini system can run up to four boxes and cost the princely sum of £30,196 as reviewed here!

I am not in the habit of having anything in my house worth this much, let alone a CD player, so needless to say I wasn't sure how I could make any meaningful assessment of the value for money offered by a consumer durable such as this. After much agonising, wondering if I could justify it to myself or anybody else, I simply gave up! The dCS Paganini four box system is what it is, does what it does, and the simple task for me was to try to convey this in the best way I possibly could.

The key feature of the dCS Paganini is of course its Ring DAC. As Chris Hales, dCS's director of product development explains, it's "completely different to a standard DAC using an off-the-shelf IC. There are some parallels in the internal workings of both, but the Ring DAC is inherently more complex and by being discrete in its design gives us access to (and responsibility for) a far greater number of circuit elements". In fact, it uses around forty integrated circuits, none of which are DAC chips. Instead, the circuitry uses Field Programmable Gate Array (FPGA) chips, Digital Signal Processing (DSP) chips and a microcontroller system, all of which run code developed and maintained by dCS. This means that the Ring DAC is essentially custom software 'stamped' into programmable memory chips, rather than a box full of mass produced integrated circuits.

The system has the same 5bit, 64 times oversampling arrangement as used in the original dCS Elgar DAC, albeit substantially refined and capable of 24bit, 386kHz and DSD operation. Data presented to the Ring DAC is oversampled to the DAC's native 5 bit format, at about 3MHz, and this is decoded to drive 32 balanced current sources, each of which makes the same contribution to the output. The drive to the current sources is rotated randomly (hence the 'Ring' terminology), meaning that any mismatch in the DAC circuitry appears as noise rather than distortion of the original data word, thus improving linearity. As well as this, a sophisticated multi-mode phase locked loop (PLL) is used to significantly reduce clock jitter.

Because the workings of the DAC aren't stamped into a particular silicon chip, but held in a number of programmable chips, the software (or firmware, to be more accurate) is updatable. Andy McHarg, dCS's head of software development explains that the main dCS software architecture is heterogeneous, with the control board, assorted clocks, microcontroller subsystem, filtering DSPs, FPGAs (used for S/PDIF decoding/encoding, DSD processing and the Ring DAC modulator) and a discrete Phase Locked Loop *all* running their own code developed in-house. "This means an awful lot of code on lots of different architectures, so making sure these disparate elements fit together seamlessly is probably the major challenge from the software design point of view", he told me.

The majority of the "heavy lifting", as Andy puts it, is done in the audio processing FPGA, "where any small problems here quickly show up in things like jitter performance, noise floor modulation, etc. Then it's the DSP, and finally the microcontroller which doesn't touch any of the audio itself".

The Ring DAC has been evolving for "getting on seventeen years", whereas the Paganini DAC itself "has probably had a couple of thousand man-hours" of coding spent on it, "but that would be on top of over a hundred thousand man hours over the evolution of the Ring DAC technology". Code updates come around "a couple of times a year". The key point here is because FPGAs are used, updating firmware is effectively like fitting a new piece of hardware, as the new code is burned into the chip ("FPGAs are effectively programmable hardware"), he says.

The Paganini MasterClock takes the job of clocking the DAC to a separate box, and this is done for several reasons. By putting the clock in a separate box, with better isolation from electrical and mechanical noise, as well as its own dedicated power supplies, the idea is that the performance of the Paganini can be significantly raised.

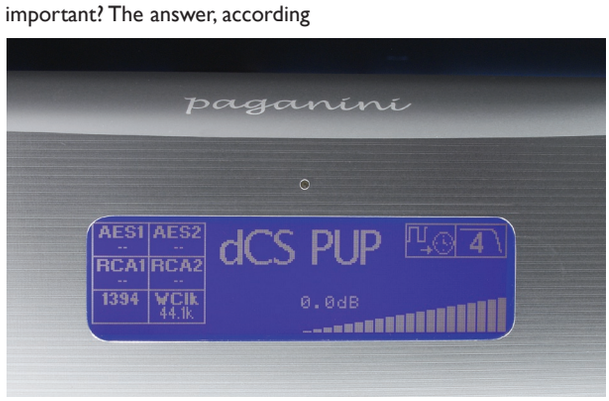
The other key benefit is to lock every part of the digital system to one common reference point, as Chris Hales explains. "The point about the master clock is that it enables several units to be synchronised to the same clock source – in this sense it's more of a clock distribution unit. As you know, accurate timing is crucial for digital audio and a stable, accurate clock that synchronises all the digital components in a system is critical to getting the very best out of your system".

> "now you can hear what 16bit, 44.1kHz Red Book CD is capable of when given the audio equivalent of a full facelift and the maximum allowable dose of steroids..."

Whilst the dCS Paganini transport has upsampling built in, there's also the option of the Paganini Upsampler, again in a separate box. Chris Hales takes up the story again. "Our upsampling algorithms have been developed in-house and require a substantial amount of processing power. In principle we could (and do) incorporate upsampling into other products, but given the amount of signal processing required for the Ring DAC, for example, we cannot offer the flexibility and number of options that we are able to in a standalone unit. There are IC sample rate convertors available, but their performance has not been optimised for high-end applications and of course there is no flexibility for improving performance or adding features by means a software update."

dCS also wanted to make the Upsampler their 'gateway' to the dCS DAC from computer audio sources, so putting full USB connectivity into a separate unit "made sense", as it's best practice to isolate electrically noisy computers from DACs as much as possible.

As both the MasterClock and Upsampler can be added to the Paganini DAC and/or transport separately, the obvious question that poses itself is, which is more important? The answer, according



to Hales, is, "this is a very difficult question. The consensus among our customers is that they both make hugely positive differences to a system. If I was forced to choose between one or the other, my personal opinion is that the upsampler makes the greater difference to a system. The upsampler actively processes the audio data and although the mechanism by which this additional processing improves the subjective sonic performance is not fully understood it is clear that the resulting change in frequency and time domain response is beneficial. In musical terms, our customers report that an upsampler adds more texture on the harmonics and seems

to provide more detail". However, other dCS staff I've spoken to have answered differently, so it seems it's very much a matter of personal taste. In theory of course the logical place to start would be the clock (as it's closest to the source) if you follow the 'garbage in, garbage out' principle, but ultimately the only way is for the customer to make their own mind. This won't stop me voicing an opinion, however!

The Paganini system is finished to a standard that reflects its premium price. The sculpted fascias are beautifully machined from a thick chunk of aluminium, and sport crisp blue backlit dot-matrix LC displays. The DAC has its own volume control knob, so it can be used both as a DAC and a line level digital preamplifier. Maximum output is switchable between two and six volts, and the DAC sports a choice of balanced XLRs or RCA phono outputs, live at the same time. At 460x400x110mm, the units are not small, and four of them are an imposing sight in any room.

The connectivity options are too extensive to go into here (see www.dcsltd.co.uk), but suffice to say the different permutations afforded by the four boxes are myriad. Whilst a clear wiring diagram is provided with the excellent documentation, I'd expect a dCS dealer or importer to come round to a customer's house and set the system up.

SOUND QUALITY

Whilst last year's few weeks spent with Paganini gave me a good idea of what I should expect when the dCS DAC came back into my system, I wasn't expecting such a change with its new upsampling and clock appendages. Before I go into the intricacies of each, just to recap on the basic sound of the cooking Paganini DAC. Here you have the Ring DAC arguably in its purest form, with most of the ancillary work (i.e. clocking) done on the same board, and even this way it's a blinding performer...

Kicking off with The Pet Shop Boys' 'Being Boring' on CD, and the stock Paganini transport and DAC came over beautifully, as one might expect considering the near £20,000 price tag. The system served up a cavernous depth to the acoustic, with Neil Tennant's silky vocal strains sounding like the living embodiment of Bailey's Irish Cream. Behind this, an energetic drum pattern bounced along behind, with Johnny Marr's 'wah wah' guitars providing percussive relief. The icing on the cake were those sumptuous analogue synth pads, gliding the song along from verse to chorus. The dCS combo unlocked all this with effortless ease, providing a creamy rendition of a relatively middling recording, yet making it compulsively engaging. I found myself being pulled in ever deeper, connecting more and more with the song and able to admire its beauty.

Switching the clock in made a subtle difference at first, but the more I listened the more I realise it was - at a fundamental musical level - quite profound. It was like pulling a whole layer of murk from the bottom of the recording; right at the back of the recorded acoustic (such as it is with processed pop like this) suddenly things tidied up, slotted into place and gained a significance to the musical picture where they'd previously been almost incidental, if indeed they were audible at all. Of course, there were obvious headline points too; treble seemed to snap into focus and bass assumed a more defined envelope. Imaging seemed fractionally more solid, as if someone had mapped out exactly where the centre of the mix was and measured where every element was to be located with millimetric precision.

There were other changes too, such as better rhythmic flow; the dCS combo wasn't exactly mechanical in two box form, but the extra MasterClock sounded more like analogue open reel tape running at high speed; the music just 'bristled' off the disc and out of my speakers in an effortless way. To my ears, only the very best direct drive turntables can offer such a combination of pin-point precision and effortless ease.

In my system, adding the Upsampler made even more of a difference. The fun thing about this system is that you can easily switch between the Upsampler box and the upsampling being done in the transport (if it's wired up accordingly), and this was a wonderful "now you hear it, now you don't" moment. With the transport doing the initial number crunching, the result was a big, bold, bombastic bass and a pointed, sparkly treble. Fascinatingly, moving to the Paganini Upsampler box caused a subtle diminution in the bass. It wasn't as if the level had been reduced, but it seemed to have less overhang. Close listening revealed the texture of bass guitars, for example, was subtly changing with the offboard upsampling. It was more accurately rendered, with less boom and more 'feel'. Likewise, at the other end of the frequency spectrum, cymbals seemed a little less bright but a touch more natural. Whereas before there had been a slight 'zing' to hi hats, now it was more of a glint, and at the same time, the whole patina of the instrument was better rendered. The same went across the midband, where I found myself hearing 'into' the mix, basking in the tonality of voices and instruments (something vinylistas love but digiphiles don't get a chance to do with 16/44.1). Harmonics on electric pianos, for example, sounded so much more natural, at once richer and more fruity yet less overblown and jarring.

Predictably then, the full four box complement of Paganinis proved a stunning performer. Not having heard the Scarlatti in serious review conditions I can't speculate about that, but certainly the top Paganini system, dCS's 'entry level high end' option, is breathtaking. For the first time, you can hear what 16bit, 44.1kHz is capable of when given the audio equivalent of a full facelift and the maximum allowable dose of steroids. The dCS system still tells you there's a lot not good about CD; never completely managing to shake

off that ever so slightly hard upper mid and tizzy treble, but you can also hear into what's good about ye olde Red Book, namely the solidity of the bass, the precision of instruments within the recording and that (I'll say it again) mastertape like ease. Just a shame you have to spend the cash equivalent of a new Jaguar XF to get it, is what I say!

The great thing about the system is that it's so agnostic about music; it worships its majestic beauty but doesn't mind what denomination it's asked to practice. To wit, classic reggae such as Gregory Isaacs' 'Night Nurse', which is normally dire via digital, came over brilliantly. The dCS, properly warmed through, will push out bass that you'd only get in a nightclub via a Technics SL1200 spinning a late seventies 45RPM twelve inch. The song sounded incredibly sumptuous and yet brilliantly timed, with wonderful texture to this classic analogue recording. Aside from all the lovely hi-fi stuff it did (massive bass guitar sound, sweet and silky hi-hats), the dCS went straight into the recording's vocal booth and beamed its four corners out through my speakers. It gave an eerie sense of being there that I just haven't heard from CD before.

Propaganda's 'Duel' on SACD was an ear opener. This is one of those very early Sony PCM-F1 recordings (courtesy of ZTT/Trevor Horn, at SARM studios) at 44.056kHz no less. The conventional wisdom is that this is an appalling era for pop music recording (ever wondered why Madonna's 'Get into the Groove' sounded so fuzzy, now you know!). But on SACD via the dCS, things didn't seem so grim. There's a basic 'cleanliness' to the recording that I'd only heard via LP before, along with a wonderful texturality than is simply missed via most CD or SACD players. You can hear the fuzz to be from the effects pedals and early digital sampling keyboards, rather than that ancient Sony digital recorder as I'd previously thought. Better still, the dCS provided a fantastically enjoyable rendition; it's dramatic, gripping even, with far more emotion than you'd have thought for what I'd assumed to be a heavily compressed early digital recording.

The eighties digital techno pop of 'Duel' is not exactly as warm as, say, an early seventies Stax recording of Isaac Hayes' 'Hot Buttered Soul', but via the dCS system it really does assume a new life, this DAC really putting the passion back into things. At the same time, it's wonderfully smooth, with Claudia Brucken's icy vocals carried beautifully. The filigree detailing is suddenly there too; I could actually hear Roland 808 hi-hats looping away in the background of the song's bridge, hidden away like cash buried under the mattress since 1985. Meanwhile that sampled bass guitar line acquired a new poignancy, investing the song with a wonderful urgency.

Several weeks spent with the dCS Paganini system has seen it getting ever better. I've upgraded the Upsampler firmware so I can enjoy 24/96 via USB from my MacBook Pro (you'll have to tell it to output audio to USB in Audio MIDI setup in the Applications folder); Portico Quartet's 'November' sounding sublime in hi res. It's done a sterling job with DVD movies and has transformed the sound of my library of twenty year old 16bit, 48kHz DATs, upsampling them to frequencies never before dreamt of! It made Linn's recording of Handel's The 'Messiah' on DSD SACD sound like no other classic recording I've yet heard off digital disc, and I am looking forward to porting the digits out of my Apple iPod Classic direct via Wadia iTransport and upsampling them to 24/352.8! So the CD transport is just half the fun of this system, and as the future progresses will prove ever less so, I suspect.

CONCLUSION

It's hard to come to any worthwhile conclusion about the value for money this offers, as short of that elusive Euromillions win, I am unlikely to be in the market for one. But were I to find myself in that happy position, it would be one of the very first things on my shopping list. The clarity, poise, effortlessness and insight it gives to digital audio is quite unlike anything I've ever heard to date. But it's not just superb technically; the most remarkable thing it does is to make digital music enjoyable in an unselfconscious way, just like an excellent analogue system. A shame really, as it shatters some long held prejudices of mine about digital; I once loved to hate it, but sadly I can no longer! Products such as this show that there's music in them there ones and noughts, if only you know how to extract it!

REFERENCE SYSTEM
Musical Fidelity AMS35i integrated amplifier
Yamaha NS1000M loudspeakers

PRICES:

dCS Paganini DAC	£9,799
dCS Paganini MasterClock	£4,599
dCS Paganini Upsampler	£6,299
dCS Paganini Transport	£9,449

HI-FI WORLD

VERDICT
A seminal digital audio replay system, what this does to a string of ones and noughts has not been heard before.

DCS PAGANINI SYSTEM
as tested £30,196
DCS Ltd.
+44 (0)1799 531999
www.dcsltd.co.uk

FOR
- exuberant musicality
- breathtaking focus
- exceptional dynamics
- design, engineering, build

DISLIKES
- price
- size
- complexity

MEASURED PERFORMANCE

Frequency response with CD measured ruler-flat from 2Hz to 20.6kHz through the DAC with Filters 1, 2 and 3, but 4 exhibits a small roll off, bringing the -1dB limit to 20.3kHz. Our analysis shows both characteristics. The Upsampler also has four filters but all measure flat in-band, even if their cut off above 21kHz gets progressively slower. Switching these filters in, in addition to those of the DAC, has little measurable in-band effect, even with Upsampler Filter 4 in conjunction with DAC Filter 4, the 'slowest' roll offs on both units. So the filters can be 'stacked' without undue interference. Frequency response with SACD extends to 66kHz and rolls off gently above that frequency. The four filter options progressively reduce supersonic output in order to reduce noise, but even Filter 4 gives output to 28kHz (-1dB) and roll off is gentle above the roll off point.

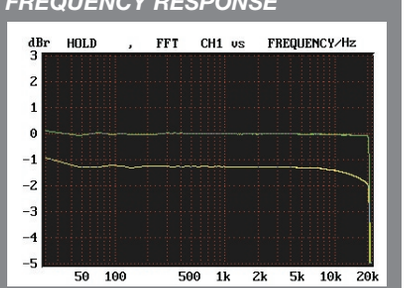
Distortion from CD was low, measuring 0.18% at -60dB via either the DAC alone, or via the Upsampler, via all filters. Results from SACD were spectacular, distortion at -60dB measuring 0.017%, as our analysis shows. This is the lowest figure we have ever measured, 0.04% being common and 0.02% being the previous best from SACD at -60dB. The Paganini easily resolved a -100dB signal and distortion was just 0.19%, comprising mostly noise. SACD does not produce quantisation noise and products like PCM and the Paganini shows a clean, clean result right down to the lowest signal levels with this sadly now little used format.

Jitter from the transport's digital output hovered around a very low noise floor of 5pS or so for random components and even a -60dB tone at 1kHz provoked a very low 10pS result, so the Master Clock does seem to have measurable effect.

The dCS four-box Paganini system measured very well both with CD and SACD, returning class leading figures. NK

Frequency response (-1dB)	2Hz-20.6kHz
Distortion	
0dB	0.0004
-6dB	0.0004
-60dB	0.18
-80dB	2.5.
Separation (1kHz)	125dB
Noise (IEC A)	-108dB
Dynamic range	98dB
Output	2 / 6V

FREQUENCY RESPONSE



DISTORTION