

Equipment Report



CH Precision I1 V2.2 Firmware Upgrade

New DAC, No Charge

Alan Taffel

Digital technology evolves rapidly. That immutable fact means that audiophiles investing in a good DAC will eventually pine for an upgrade. Yet, for the preponderance of DACs on the market there *is* no upgrade path. That's because those DACs are built around off-the-shelf chipsets. I don't mean to demean such chips; some of them are excellent and can be found in very good DACs, such as those from Japan's Esoteric. But when the next generation of chips come out, the upgrade-seeking DAC-owner has no choice but to sell his hardware and buy the new model based on the new chips.

Then there are the handful of DACs that permit upgrades via firmware updates. Obviously, this is a far more convenient arrangement. The problem is that for most of these units, the "core" DAC functions (e.g., dCS' proprietary Ring DAC) are implemented in hardware. Therefore, the firmware update can only tinker around the edges, so to speak. A slightly revised filter, for example. This explains why dCS, having developed an improved Ring DAC architecture, had to release a new APEX product series, with a hardware upgrade at the factory for existing owners to reap APEX's benefits.

But what if you could have a brand-new, completely re-designed DAC without spending a dime or incurring the hassle of a hardware swap? That ideal situation would be possible only with a DAC whose digital machinations were implemented entirely in software. Sounds simple, right? But in practice this approach requires that the product be based on very powerful, flexible, yet fully programmable (and *re*-programmable) hardware. Generally speaking, that points to the use of Field Programmable Gate Arrays (FPGAs), which are not only expensive but require specialized coding skills.

CH Precision is one of the few companies that has been willing to go this route. The reason why is clear: CH has long been committed to easy, inexpensive field upgradeability for all its products. This philosophy explains the company's use of modular card-cage construction and user-swappable function boards.

But the strategy reaches its zenith when it comes to the DAC functions of the I1 integrated amp, D1.5 disc transport, and C1.2 digital controller. Here, the use of powerful DSP and FPGAs on the DAC card allows for virtually unlimited upgrades—even complete rewrites, theoretically—with zero hardware costs and zero hassle. Further, CH Precision offers the firmware updates for free.

Theory Meets Reality

Those of you who read my review of the Metronome DSC know that, to my chagrin, it sonically clobbered

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my own CH Precision I1. In the process, the Metronome won a Golden Ear Award and became my new reference DAC/streamer.

However, unbeknownst to me, the restless folks at CH Precision were already working on a significant upgrade to the DAC within the C1 digital controller, which they would soon transfer to the I1 and D1.5. Their goals were twofold: 1) dramatically improve sonic performance via a wholesale revision of the DAC code; and 2) implement full MQA support. CH has now released the new I1 firmware, dubbed version 2.2.

This update is most decidedly not a case of tinkering around the edges. Among other things, the DAC now uses fixed-point rather than floating-point arithmetic. (See "A Conversation with Mr. C and Mr. H of CH Precision" for details about what changed and why.) Full MQA support is now so thoroughly implemented that, just as there is an assignable front-panel display color for analog and digital sources, there's now a new color for MQA sources.

I got a preview of the new firmware at the 2022 Munich show. There, a system featuring all-CH electronics and Rockport Lyra speakers—playing Red Book CDs, no less—won my Best Sound of the Show Award. However, I

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had no idea how much of that fabulously realistic sound was due to the Rockports, the 10-Series CH components (which now form the heart of Robert Harley's reference system), or the DAC firmware. The only way to find out was to try the upgrade in my own system.

A/B comparisons are highly elucidating when you can go back and forth at will. However, in this scenario, once I upgraded the firmware from "A" to "B," as it were, there'd be no going back to A. The next best thing would be to establish an independent reference point, "X," to which both A (before update) and B (after update) could be compared. Handily enough, I had the ideal "X" in the Metronome DSC.

I began by revisiting the comparison between the Metronome and the pre-upgraded I1. Consistent with my original review, the differences were not subtle. The first track I played was one of those that had impressed me so much in Mu-

nich, "True Love Ways" from the Buddy Holly CD *From the Masters*. Compared to the DSC, the I1 sounded dynamically and spatially flat. Flat, too, were the images, which on the Metronome had a holographic quality. In addition, bass was comparatively meager through the I1, and the CH didn't deliver the richness that makes this track so seductive.

Similarly, on my standard test track, Michael Wolff's "The Conversation," the I1 again sounded compressed, and timbres had a sameness up and down the piano keyboard and at different volumes. This was in stark contrast to the timbral variety and vivacity delivered by the Metronome.

Having confirmed my original impressions of the I1's DAC, it was time for the firmware upgrade. I was anxious to discover whether the changes it wrought were subtle, as such firmware upgrades on other DACs tend to be, or on the scale promised by the I1's architecture.

The upgrade process itself was simple. I downloaded the new firmware from the CH website to my computer, copied it to a thumb drive, plugged the drive into the USB service port on the back of the I1, and selected Upgrade Firmware from the CH's menu. Some moments of suspense followed as I waited for the process to complete. Then I listened.

What I heard was no minor change. In fact, if I hadn't done the upgrade myself, I never would have believed I was listening to the same DAC card in the same I1. This was a *completely* new DAC with an entirely different—and much better—sound. The I1, previously anemic sounding, now manifested the richness of the Metronome. "The Conversation" was transformed, with mesmerizing timbral diversity, fleshed-out images, and dynamics that were everything you'd expect from a CH component. Bass in the I1 DAC had gone from a liability to a strength. Indeed, the two DACs now sounded far more similar than different. Both were stellar.

Over time, as I listened more deeply, I found a few more minor differences between the two units. The Metronome, as you might expect from its name, has marginally better timing resolution, and its uniquely quiet background gives it a smidge more dynamic range. On the other hand, the post-upgrade CH has the edge when it comes to top-end smoothness, and its bass is more powerful and better defined. Preference will come down to personal taste and even the type of music one favors.

Conclusion

By now it should be apparent that CH's first major DAC firmware upgrade is an unqualified success. Sonically, this new DAC is not only much improved; it goes toe-to-toe with the best DAC I've had in my system. And it cost me nothing! All this is thanks to CH's forward-thinking, upgrade-minded architecture. Anyone with a CH integrated amp, transport, or digital controller should, if he hasn't done so already, immediately download the latest firmware. He'll be shocked at the upgrade he just received for nothing, with no hardware change required either. I only wish all DACs could do that.

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A Conversation with Mr. C and Mr. H of CH Precision

What are the feature/capabilities differences between the old and new DACs?

Florian Cossy: The main change in terms of features and capabilities is that the I1, C1.2, and D1.5 are now fully MQA compatible. They support both replaying streamed/downloaded material and MQA-encoded discs played by an MQA-capable transport such as the D1.5. There are a considerable number of MQA downloads in existence, and our experience with MQA-CD discs has been very positive.

What are the technology and design differences between the old and new DACs?

Thierry Heeb: On the software side, the major change between the old DAC and the new DAC is the inclusion of our new-generation PEtER (Polynomial Equations to Enhance Resolution) synchronous upsampling/filtering algorithm. Compared to the previous generation, the key improvements are:

- New spline-based filtering kernel. The new filtering kernel allows for minimal, symmetrical time-spread of the resulting upsampling filter impulse response. Even at 44.1kHz, the digital-domain time-spread of the impulse response does not exceed 0.3ms.
- New spline kernel computation method that offers enhanced numerical precision.
- Fixed-point computation throughout the signal chain. Floating-point computation may seem appealing at first, due to its ability to handle very wide dynamic ranges. But it has some inherent drawbacks with respect to signal integrity—such as when adding a very small number to a very large one—due to the normalization step (to align operands) required before addition. In the I1 (and other CH products with the corresponding firmware), we have moved away from floating point to take a fixed-point approach with an 80-bit accumulator. This allows us to keep full signal integrity up to the final stage where it is dithered down to match the DAC's capabilities.

These principles are used for both PCM and DSD digital data, as well as MQA-encoded signals.



Most DACs that permit firmware upgrades tend to make only minor changes. Your upgrade is essentially a complete re-design. Was there something about the hardware technology of the I1/D1.5/C1 that made it possible for you to do this where others can't?

FC: Our hardware might be considered a toolbox, and we have chosen a toolbox in which the tools can be used in different ways. It is the software (and firmware) that decides how the tools are used. In that sense, the critical thing on the hardware side is choosing a toolbox—DSP and FPGA—that offers enough power, flexibility, and configurability to respond to improved software. It's because of these elements that changes of this extent can be made without the need to upgrade hardware.

Was it an explicit goal that this upgrade could be made in the field, by the user, and in most cases without any hardware changes?

FC: Product upgradability and longevity are key goals of every CH Precision product. We want to protect the customer's investment. You can see that in the card-cage design and expandable system topology. Wherever possible, upgrades are backward compatible, and they're always as affordable as we can make them.

Sometimes a field upgrade isn't feasible. For example, in the case of the D1 to D1.5 evolution, it wasn't possible to update older machines to the new standard due to physical incompatibility between the older chassis and the new Morse transport mechanism. In that case, we offered D1 owners a generous, factory-guaranteed trade-in allowance.

On other occasions, a field upgrade is possible but is hardware-related. For instance, the recent upgrade to the Clock-Sync card is a simple hardware replacement that owners can do in the field. (We even give them the necessary tools in the standard accessory pack that comes with each product.) Again, there was a generous factory-defined trade-in deal offered for existing cards.

In the case of this I1 DAC upgrade, it is purely firmware-related, so we can make it available as a free download—a big performance improvement and a nice present for everyone who has invested in the product.

Do you believe the hardware in these models will permit further DAC upgrades, or have you taken it as far as it will go?

TH: There is certainly room for future upgrades! We have already started to work on further improvements to the PEtER upsampling/filtering algorithm. In particular, we are working on how upsampling/filtering techniques interact with musical transients and how time-smearing of transients or musical impulses affects audio perception and musical quality. This demands fundamental research into the human hearing system and dynamic, adaptive filtering. We have already made considerable progress; but, given the nature of the challenge, please don't expect to see practical results too soon! **tas**