Aqua Acoustic Quality LinQ Network Interface, La Diva M2 CD Transport, and Formula xHD Rev.2 DAC

The Purist Approach to Digital

Robert Harley

Audio has a long history of abandoning certain technologies in the name of progress only to have those "antiquated" technologies find a following decades later. Vacuum tubes, LP records, belt-drive turntables, loudspeakers with paper-pulp cones—these are just a few examples of older technologies that have enjoyed a renaissance years after their putative obsolescence.

To that list we can add the R/2R ladder DAC. I explain this technology in the sidebar, but know that the R/2R DAC is the first and simplest conversion architecture. The R/2R DAC, which dates to the initial CD players of the early-to-mid 1980s, was abandoned decades ago as a technological dead end. But some listeners find that the technique has sonic merit, perhaps due to its simplicity. Consequently, R/2R DACs are being reimagined with modern sophisticated parts and design. Moreover, this simplest of all DACs is being coupled with another antediluvian technology—the analog low-pass filter in place of an oversampling digital filter. Think of this combination as the purist approach to digital-to-analog conversion.

There's no better example of this trend than the Formula DAC from Italy's Aqua Acoustic Quality. The DAC's conversion stage is based on an R/2R ladder architecture realized not with an inexpensive off-the-shelf chip, but with discrete resistors driven by a field-programable gate array (FPGA) running proprietary software, all within a very tweaky implementation. In this review we'll take a close look at the Formula and consider the renaissance of the R/2R ladder DAC and the non-oversampling filter. Joining the Formula DAC in this review are the company's LinQ Network Interface and La Diva M2 CD transport.

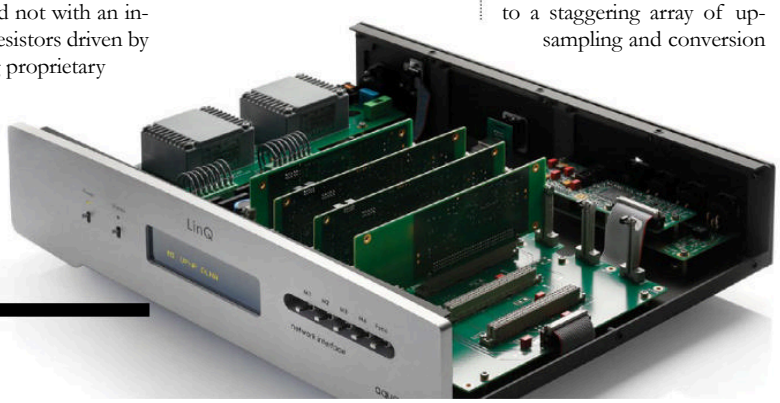
I was eager to explore the merits of these products as well as revisit an older DAC technology with which I had much experience in the late 1980s and throughout the 1990s. (I estimate that between 1989 and 2000, I reviewed about 100 DACs and CD players.) In addition, the Formula, LinQ, and La Diva M2 are packed with innovative design techniques rather than being just more "me-too" products.

The three components, all hand-made in Milan, Italy, are very nicely built but with casework that eschews the lavish execution that drives up a product's price. Consequently, I thought that the prices of these products were eminently reasonable considering the technology inside—$17,600 for the DAC, $6500–$7850 for the LinQ (depending on configuration), and $9800 for the La Diva CD transport. The company also offers two lower-priced DACs.

LinQ Network Interface

The LinQ connects to the internet and allows you to stream music to the DAC. It is unlike any other streamer I know of in that its modular design allows you to configure the hardware according to your needs as well as upgrade to future technologies as they become available. This upgradability is realized with four slots on a motherboard, each of which can accept a streaming module or renderer. Each streaming module is powered by its own power supply.

The LinQ includes the third-party software HQPlayer embedded in one of the modules. HQPlayer is a high-quality music player that typically runs on a PC connected to the network but here runs internally on one of the LinQ's modules. The software handles all the audio signal processing, which ranges from simply passing the signal to the output with the highest possible quality to a staggering array of upsampling and conversion



Specs & Pricing

LinQ Network Interface
Type: Modular multi-processor network streamer
Input: RJ-45 Ethernet
Outputs: I²S on RJ-45 jack; dual-wire AES/EBU; AES/EBU; SPDIF on BNC; SPDIF on RCA
Display: 2x20 OLED
Dimensions: 450mm x 100mm x 370mm
Weight: 9kg
Price: $6500–$7850, depending on configuration

La Diva 2 CD Transport
Type: Top-loading CD transport
Outputs: I²S on RJ-45 jack; SPDIF on BNC; SPDIF on RCA; AES/EBU, AT&T ST-type glass fiber; word clock on BNC jack
Dimensions: 450mm x 100mm x 370mm
Weight: 10kg
Price: $9800

Formula xHD Rev.2 DAC
Type: Digital-to-analog converter
Formats: PCM up to 384kHz; native DSD to DSD512
Conversion: R/2R ladder DAC, no digital filtering, custom FPGA processor
Inputs: I²S on RJ-45 jack; dual-wire AES/EBU; AES/EBU; SPDIF on BNC; SPDIF on RCA; USB Type B
Outputs: Balanced on XLR jacks, unbalanced on RCA jacks
Dimensions: 450mm x 100mm x 370mm
Weight: 9kg
Price: $17,600

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Associated Equipment
Loudspeakers: Wilson Audio Chronosonic XVX, Vandersteen Audio Model Seven XTRM
Analog source: Basis Audio A.J. Conti Transcendence turntable with SuperArm 12.5 tonearm; Air Tight Opus cartridge; CH Precision P1 phonostage with X1 power supply; DS Audio ST-50 stylus cleaner, DS Audio ES-001 Eccentricity Detection Stabilzer, Levin record brush, Degritter ultrasonic LP cleaner
Amplification: CH Precision L10 Dual Monaural linestage; CH Precision M10 Dual Monaural power amplifiers
AC Power: Shunyata Everest 8000 conditioner, Shunyata Omega and Sigma NR V2 power cords; Shunyata AC outlets, five dedicated 20A lines wired with identical length 10AWG
Support: Critical Mass Systems Olympus equipment racks and Olympus amplifier stands; CenterStage2 isolation, Arya Audio RevOpods isolation
Cables: AudioQuest Dragon interconnects, AudioQuest Dragon Zero and Dragon Bass loudspeaker cables
Grounding: Shunyata Altaira grounding system
Accessories: The Chord Company GroundArray noise reduction
Acoustics: Acoustic Geometry Pro Room Pack 12, ASC 16" Round Tube Traps
Room: Purpose-built; Acoustic Sciences Corporation Iso-Wall System

options. In the LinQ, the embedded HQPlayer works in conjunction with Roon; HQPlayer handles the audio signal, while Roon functions only as the music-management interface. The presence of the HQPlayer is transparent to the user once the LinQ is set up. The HQPlayer license is incorporated in the LinQ's module, saving you the purchase cost as well as obviating the need to hassle with downloading and configuring the software to work with the LinQ and Roon. You'll still need to run the Roon Server (formerly called "Roon Core") on a computer connected to the network. To recap, Roon Server is the part of Roon that does all the heavy lifting behind the scenes. Your tablet or phone runs only the interface ("Roon Remote") controlling the Roon Server. If you're not a Roon user, the LinQ's modular nature allows you to order the unit with other plug-in modules including UPnP, Squeezelite, and Tidal Connect. Of course, you can change the configuration at any time simply by adding or swapping modules.

The LinQ offers all the conventional digital outputs you'd expect on a streamer (AES/EBU, SPDIF, etc.) but also provides its digital output signal on an I²S port via an RJ-45 jack. I²S (pronounced "I squared S") is a bi-directional interface protocol originally developed for internal signals in CD players. It is a much better interface than AES/EBU, SPDIDF, optical, or USB (especially USB) for several reasons, most notably for its bi-directional ability. AES/EBU and SPDIF are uni-directional; a digital signal representing the audio data is embedded within the clock, with one-way transmission from the source to the DAC. The DAC then must generate a new clock based on the incoming clock, a process that, even when implemented with great precision, introduces timing errors (jitter) in that clock. By contrast, in a source and DAC connected via I²S, the DAC becomes the master clock to which the source must lock. The DAC generates its own high-precision clock that serves as the timing reference for the critical D/A conversion rather than a jittered clock transmitted down the interface. In addition, the clock and data travel on separate lines.

If you use the LinQ with a DAC lacking I²S input, the AES/EBU and SPDIF outputs are no afterthoughts; they have been implemented with a custom FPGA for improved performance.

Everything about the LinQ's design is tweaky, from the separate power supplies for each module, to the custom-built internal LAN switch, to the galvanic isolation between sub-sections, to the FPGA digital output driver, to the modular construction, to the I²S output, to the inclusion of the HQPlayer software. Clearly, this is a machine built for sound quality.

La Diva M2 CD Transport

The Compact Disc is still an important format in many parts of the world. Moreover, some listeners claim that physical media sounds better than streaming (see Jonathan Valin's review of the Kalista DreamPlay XC in Issue 345, for example). For those who want to spin silver discs, Aqua Acoustic Quality offers the La Diva M2, a top-loading transport. Although the La Diva M2 shares a name with its predecessor (La Diva), the La Diva M2 is no mere refresh; it is entirely new in every way. The transport mechanism is a modified Philips CD Pro-8S controlled by a digital servo system. La Diva is built with the same level of innovation as the other products, including galvanic isolation between subsections, a modular multi-board system to allow future upgrades, multi-stage voltage regulation, a mechanically isolated subchassis for the transport mechanism, and a FPGA running proprietary code to generate the output signals. These outputs not only include the usual formats but also AT&T ST-Type optical, an interface popular in the early 1990s but largely abandoned. La Diva also offers I²S, the interface of choice if you have a DAC with an I²S input.

Unusually, the transport controls are toggle switches rather than buttons. A large display shows track information. A metal door on the top pane slides open to reveal the transport mechanism. After placing a CD on the spindle, a small magnetic clamp secures the disc. A hefty and comprehensive remote control is included.

Formula xHD Rev.2 DAC

Now we come to the Formula DAC (actually, the Formula xHD Rev.2 DAC, but we'll call it simply the Formula). The Formula features a custom 24-bit digital-to-analog conversion circuit based on an R/2R ladder architecture and built with discrete components rather than an off-the-shelf chip. But before we get into that, let's look at the Formula in practice.

The DAC is housed in the same-sized chassis as the LinQ and La Diva M2. The front panel has no display, only LEDs that indicate the sample frequency being decoded, the input selected, power, and mute. All controls (power, mute, input) are toggle switches. The rear panel houses six input jacks, which include the usual types as well as two I²S inputs. The analog output appears on both RCA and XLR jacks. The DAC can decode PCM up to 768kHz and DSD up to DSD512.

Before the modern interest in R/2R ladder DACs, an R/2R DAC's entire circuitry was incorporated in a chip. The "ladder" is a series of resistors that convert the digital input code into an analog value. Each "rung" on the ladder is formed by a resistor. A 16-bit converter has 16 of these "rungs." These resistors—the precision of which is crucial—were created by a photolithographic process on a single piece of silicon along with the rest of the DAC circuitry. Consequently, the resistors exhibited wide tolerances in their resistance values, introducing linearity error in the analog output signal. Linearity error is a deviation between what the analog output voltage should be for a given digital input code and what it actually is (see the sidebar for details).

Incorporating the entire DAC circuitry on a chip and accepting the resulting linearity error was unavoidable given the technology of the day and the demand for mass-market-priced CD players. But what if a designer wasn't bound by these constraints and was free to create a ladder DAC not from integrated circuits but from high-precision discrete resistors in a no-compromise implementation? That's exactly what Aqua Acoustic Quality has done in the Formula. The company calls its DAC circuit Optologic, and it starts with processing the digital datastream with a field-programmable gate array. An FPGA is an integrated circuit that can be thought of as a blank canvas that is software-driven to perform a wide range of functions. Aqua Acoustic Quality has written this software specifically for the Formula, creating a pair of datastreams (per channel) from the FPGA that will drive an array of discrete high-precision resistors in the DAC's 24-bit ladder.

R/R2 Ladder DACs—How They Work

The following text in quotes is excerpted from my book The Complete Guide to High-End Audio, sixth edition.

"A COMMON TYPE OF DAC is the multibit 'ladder' or 'R/2R' DAC, both names describing the same operating principle. Multibit ladder DACs have 'rungs' of resistors, each rung corresponding to one bit in the digital code. A 16-bit DAC will thus have 16 resistor rungs, which allow 65,536 (2^{16}) possible input codes. These 16 bits form one sample, a digital representation of the audio signal's amplitude at the moment the sample is taken. Each sample is input to the ladder (one bit per rung), which converts the digital code to an analog value, with the process repeated 44,100 times per second (in a non-oversampling, 44.kHz, 16-bit system).

"The effective resistor value of each rung is twice the value of the adjacent resistor, thus the name 'R/2R' ladder. (In practice, only two resistor values are used, but their configuration results in an effective doubling of resistance in each successive rung.) The input data act as switches on the rungs; a binary '1' closes the switch at that particular bit and allows current to flow through the resistor, while a binary '0' opens the switch and no current flows. The DAC's output current is thus proportional to the audio signal's amplitude represented by the digital input code.

"Because each rung has an effective resistor value half that of the adjacent rung, the ladder rung and the resistor precision determine how much 'weight' the bit has by determining how much current flows through the switch. The least significant bit (LSB) has the lowest weight, the most significant bit (MSB) the highest. Each bit upward from the LSB should produce a precise doubling of current, in the binary progression 1, 2, 4, 8, 16, 32, 64, 128, 256, and so on, up to 524,288 in a 20-bit DAC. The LSB has a value of 1, the MSB a value of 524,288 (in a 20-bit DAC). When the MSB value of 524,288 is combined with the 19 lower bits, a 20-bit DAC can accommodate up to 1,048,576 input codes.

"The precision of these resistor values is crucial: Any deviation from a doubling of resistance causes that bit to have a higher or lower value than it should. These so-called 'bit-weighting errors' result in poor linearity. That is, the analog output level doesn't precisely track the digital input code. A perfectly linear DAC will produce an analog output at exactly the level represented by the digital input. For example, if the DAC is driven by the code representing a –90dB dithered sinewave, the analog output should be exactly 90dB below full scale. A nonlinear DAC would produce an output level of perhaps –93dB or –86dB. Linearity errors generally occur at very low signal levels."

Many early CD players and DACs featured the Philips TDA 1541 chip, which was notorious for its linearity errors. The company offered several grades based on their linearity performance. The "Relaxed" (TDA1541R) version had a linearity error of 2 least-significant bits; the standard version had a linearity error of 1 LSB, and the "S" or "Select" (stamped with a crown symbol) had the lowest linearity error.

A significant improvement of the R/2R ladder DAC was invented by Burr-Brown in 1992, called the "sign-magnitude" DAC, the architecture used in the Formula. In this scheme, one of the bits is used to indicate whether the sum of the current at the ladder output is positive or negative. The sign-magnitude bit toggles from one to zero, or from zero to one, at the analog waveform's zero-crossing point. This technique improves low-level resolution. You can also think of sign magnitude as roughly analogous to a push-pull amplifier; negative and positive signals are handled by separate circuits working together. The technique greatly improves low-level linearity but requires double the resistor-ladder circuitry. As mentioned, the Formula DAC has four separate DACs, two for each channel.

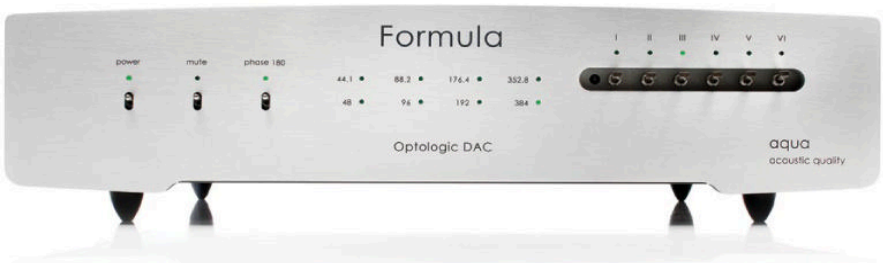
All the chip manufacturers abandoned R/2R ladder DACs long ago as a technological dead-end, largely because the architecture's resolution was limited, and linearity was dependent on the precision of the resistor values.

But by using very high-precision discrete metal-film resistors in the DAC ladder, Aqua has eliminated the linearity error that plagued chip-based DACs.

The Formula DAC uses a technique called "sign magnitude" that was invented by Burr-Brown in 1992 and led to the near-instant adoption of the Burr-Brown PCM1704 chip by virtually every high-end manufacturer, starting around 1993. Sign-magnitude conversion is a technique that improves the performance of the R/2R ladder DAC as explained in the sidebar. But sign-magnitude conversion requires two separate ladder DACs per channel, which in the Formula are composed of very tiny, discrete, high-precision, metal-film surface-mount resistors. I popped the Formula DAC's top panel for a peek and saw four separate identical DAC boards, each with rows of tiny resistors. Until recently, resistors of this size and precision simply didn't exist.

A digital-to-analog converter requires a filter to remove unwanted energy above half the sample rate. With R/2R ladder DACs, this filtering is typically performed in the digital domain with an oversampling digital filter. The off-the-shelf digital filters in the 1980s and 1990s were typically 8x oversampling types. That is, they increased the sampling frequency by eight times before D-A conversion. No new information is created by oversampling; the technique simply shifts the spurious energy higher in frequency where it is more easily filtered.

Aqua Acoustic Quality has taken the opposite approach, eschewing the digital filter entirely in favor of a simple analog low-pass filter *after* D-A conversion. I describe the advantages and disadvantages of digital filters in the sidebar, but for now consider this: Aqua's approach is the only way that the bits created by the analog-to-digital converter when the recording was made are ex-



actly the same bits that are converted to analog by the DAC. All other methods process and manipulate the signal so that the bits being converted to analog are not exactly the same bits that were created by the analog-to-digital converter. Removing the digital filter has other benefits as described in the sidebar.

While looking inside the chassis, I saw how the Formula was built with a modular construction, allowing any of the sub-sections to be upgraded in the future. Two separate power transformers are dedicated to the analog and digital sections respectively, and except for the main electrolytic filter capacitors, all other caps are expensive esoteric types. The voltage regulators are all custom discrete circuits, not noisier IC-based regulators. Much effort went into isolating the subsections from each other to prevent noise coupling, including galvanic isolation realized with opto-couplers between the FPGA and DAC. This optical coupling led to the company naming their DAC conversion technology "Optologic."

The output stage is single ended, with the balanced output created with a transformer. The output amplifier is based on a discrete circuit realized with JFETs and bi-polar transistors in a direct-coupled circuit. Overall, the Formula incorporates a host of design techniques and parts that signal its intention as a sound-quality-first product.

Listening

In one of the sidebars, I draw a broad conceptual analogy between R/2R ladder DACs and single-ended triode amplification. Both have the advantage of simplicity and very little signal manipulation, along with a reputation for delivering good sound despite their markedly inferior technical performance. I formed that analogy before listening to the Aqua products.

That analogy turned out to be surprisingly prescient in many ways. That's because the Aqua stack has an unmistakable sonic characteristic that is very much like that of an SET amplifier—a directness of expression, a sense of vividness and presence through the midband, a naturalness of timbre, and the sense of a scrim being removed between you and the music. I heard this quality seconds into the first track; it's not something you have to listen for attentively. Vocals simply had an immediacy and palpability, not just in the feeling of physical presence but also in how the Aqua system seemed to reveal nuances of expression and subtle inflections that more powerfully conveyed a lyric's meaning, as well as the rich textural details that revealed the harmonic complexity and beauty of a vocalist's timbre. The Aqua system fostered an immediate intimacy with the singer, as though she was revealing some part of herself only to you—and for the first time. In this way, the Aqua sounds different from other digital. The Aqua system sounds organic and natural, like tasting a lovingly grown tomato just picked from a garden compared to a store-bought tomato.

I had this impression over a wide range of performers and styles, from Samara Joy's readings from the great American songbook to Madeleine Peyroux's rendition of Leonard Cohen's "Dance Me to the End of Love," to Diana Krall, to, well, just about everyone. I wouldn't call the Aqua system

R/2R Ladder DACs: The Single-Ended Triodes of Digital Conversion

THE R/2R LADDER DAC'S TECHNICAL APPEAL is its simplicity; think of it as the single-ended triode of digital converters. Just as the SET amplifier is realized with only a few parts, the R2/R ladder DAC's operation involves very little digital signal processing or manipulation. It directly converts each audio sample (the sample is a 16, 20, or 24-bit "word" that represents the original analog signal's amplitude when the sample was taken) directly; each bit in the word opens or closes a switch on a resistor ladder. The currents through all the ladder rungs are summed, with that value closely approximating the original analog signal's amplitude. This process occurs 44,100 times per second when decoding 44.1kHz datastreams.

By contrast, today's modern delta-sigma converters rely on extensive digital signal processing. A full description of delta-sigma DACs is beyond the scope of this review, but in short, a delta-sigma modulator first massively increases the sampling frequency but lowers the amplitude resolution, applies noise shaping, and then decimates the output word length. This technique has its advantages (such as superb low-level linearity) but introduces a considerable amount of digital processing. The contrast between an R/2R ladder DAC's simplicity and the delta-sigma DAC's complexity is stark.

The conceptual analogy continues with the fact that R/2R ladder DACs have demonstrably worse technical performance than today's sophisticated delta-sigma converters in every performance parameter, just as SET amplifiers have laughably poor measured performance compared with modern transistor amplifiers. But just as there are adherents to the SET approach, some believe that the R/2R ladder DAC has a more organic, engaging, and musical sound despite its poorer technical performance.

overly forward through the midrange, a characteristic that can emphasize vocals. Rather, the midrange rendering was more subtle, richly detailed, and sophisticated. It was aided by a tangible bloom around image outlines, the vocalist existing in three-dimensional space with air around and behind the image. It was the kind of presentation that can't help but draw you immediately into the performance. It reminded me of hearing vocals from a live microphone feed—high praise, indeed.

The textural realism heard on vocals extended to other instruments, which had a naturalness of timbre that eludes most digital. There was simply an immediacy and sense of life that were the antitheses of dark, closed-in, veiled, or thick. This vibrant quality gave the sound an "illuminated from within" character (Jonathan Valin's evocative phrase) that produced a close approximation of instruments and voices appearing in the listening room. Listen to the gentle trumpet solo on Melody Gardot's "If You Love Me" from her recent album *Sunset in the Blue*. The trumpet had a burnished golden character that one hears from the live instrument, almost sounding like a flugelhorn. The trumpet's image was surrounded by a halo of air that expanded with each note's dynamic envelope, further adding to the sense of realism.

The Aqua's openness and air were especially evident, and welcome, on tracks with multiple Latin percussion instruments; music always sounded alive and upbeat. Try the beautiful composition "Ella Nunca Tiene Una Ventana" from Jimmy Haslip's outstanding release *Red Heat* or "Corazón Espinado" from Carlos Santana's *Supernatural*. The layers of Latin percussion were beautifully rendered in texture, transient fidelity, and spatial realism.

The tonal balance leaned slightly toward openness and transparency, adding a touch of upper harmonics to harmonic-rich instruments such as saxophone and slightly emphasizing vocal sibilance. The upper-midrange to lower-treble region had a bit of extra life and sparkle, which contributed to my impression of openness and immediacy. Although lively sounding, I wouldn't characterize the sound as bright. Still, if you have bright speakers or electronics, the Aqua products won't tilt the system back toward neutral.

The Aqua stack's bass reproduction was fabulous—deep, powerful, and extended without a hint of bloat or thickness.

The Aqua stack's bass reproduction was fabulous—deep, powerful, and extended without a hint of bloat or thickness. It managed to sound full and weighty yet still be light on its feet dynamically. Big bass-drum whacks in orchestral music (*The Arnold Overtures* on Reference Recordings in 176/24) were reproduced with startling impact. But the bass quality went beyond the usual checklist; it had a density of tone color and warmth rarely heard from digital. Acoustic bass simply had a richness of timbre that conveyed a sense of realism, with resolution of the fine detail that transforms the reproduced sound from low-frequency energy to a convincing illusion of the instrument appearing between the loudspeakers. I also enjoyed the way the Aqua stack beautifully conveyed music's rhythmic flow, whether the gentle loping of Neil Young's "Harvest Moon," or the incomparable swinging of Ray Brown on *Duke's Big Four*, or the high-octane fusion bass line on "Electric Man" from Billy Cobham's *Drums and Voice, Vol. 3*. No matter the style of music, the Aqua sys-

Removing the Digital Filter

EVERY DIGITAL-TO-ANALOG CONVERTER must have a low-pass filter to remove unwanted energy above half the sampling frequency. This filtering is virtually always performed in the digital domain before digital-to-analog conversion. The digital filter increases the sampling frequency, typically by eight times ("8x oversampling") so that the spurious energy is shifted higher in frequency, allowing a higher filter cutoff frequency and a gentler slope. This description is of filters for R/2R ladder DACs, not modern delta-sigma types.

Aqua has dispensed with the digital filter, opting instead for a steep analog filter *after* D-A conversion. The company believes that the problems introduced by digital filters outweigh their benefits. One of these problems is that digital filters "ring" when a signal is input to them. That is, they spread out the signal's energy over time, distorting the music's transient nature and adding hardness and glare to timbres. No digital filter equals no time smearing of musical transients.

Oversampling digital filters are also prone to a phenomenon called "intersample overs." This occurs when a recording has been made or mastered at a very high level and some of the peaks clip. The oversampling filter creates sample points between the actual samples, some of which can exceed full-scale (0dBFS). As a result, the reconstructed analog waveform exceeds 0dB, introducing a series of tiny distortion spikes at the intersample overs. Again, no digital filter equals no distortion from intersample overs.

The downside of removing the digital filter is that the design must add an analog low-pass filter after D/A conversion that has a very steep slope. The filter should ideally exhibit no attenuation at 20kHz and 90dB or more attention before 22.05kHz, which is half the sampling frequency (for 44.1kHz). Such steep analog filters introduce phase shift and are difficult to implement, which is why they were abandoned long ago in favor of upsampling digital filters.

But, as mentioned in the review body, Aqua's approach of an analog filter and conversion with an R/2R ladder DAC is the only architecture that provides conversion of an unaltered bitstream—the samples converted to analog are the same samples created by the A/D converter when the recording was made. No other conversion technique can make that claim.

tem's combination of bass weight, dynamic agility, pitch definition, and most importantly, timbral realism, never failed to deliver musical satisfaction.

Finally, I compared the sound of CDs with the same tracks streamed from Qobuz. It's difficult to draw conclusions from such comparisons because one doesn't know the provenance of the streamed file, specifically if it is identical to the file used to make the CD. Nonetheless, I found a few examples that appear to be from the same master. In all cases, the CD gets the nod for its slightly more natural and relaxed sound. The streamed file sounded just a bit drier, flatter, and with a very slight added glare in the upper midrange. The bass on the CD was also more tuneful and propulsive. Overall, the difference wasn't significant, particularly in relation to streaming's massive convenience factor. Plus, with streaming you can spend more time listening and less time looking for and loading CDs. The difference wasn't enough to make me go back to buying CDs.

If you're in the market for a digital front end, these exceptional products from Italy should be on your shortlist.

Conclusion

The Aqua Acoustic Quality LinQ Network Player, Diva 2 CD Transport, and Formula DAC possess a naturalness and realism that make them sound different, and in many ways better, than other digital. I speculate that these qualities are largely the result of the Formula DAC's R/2R ladder architecture and analog filter in place of an oversampling digital filter—an architecture that was supplanted decades ago by delta-sigma DACs and powerful DSP. The Aqua products make a convincing argument that the simple R/2R ladder DAC, coupled with a non-oversampling filter, has many sonic merits despite its theoretical inferiority to modern conversion methods. I'm reminded of the great audio aphorism: "An audio signal is like a fine pastry; the less it is handled the better the result."

The Aqua stack's achievement is all the more remarkable considering the products' reasonable prices. The Formula DAC, at under $20k, is a great bargain. It meshed synergistically with the LinQ and Diva 2, particularly because the three products can be connected via the superior I²S digital interface. I like the fact that the build budget went into parts that make a sonic difference, not elaborate chassis work. Moreover, the products' design is very clever, with enlightened techniques and parts that improve sound quality while not costing a fortune. These products were designed not by throwing money at them but through innovative thinking.

If you're in the market for a digital front end, these exceptional products from Italy should be on your shortlist. They made an indelible impression on me, and I suspect that they will on you, as well. tas