Berkeley Audio Design Alpha DAC Reference Series 3P and Alpha USB Reference Series USB Interface

Perfected, Indeed

Robert Harley

The digital products from Berkeley Audio Design have always been extreme overachievers. The company's DACs deliver fabulous sound quality at prices that, while not inexpensive, are downright reasonable when compared to what other manufacturers charge for lesser performance.

Berkeley offers just three products—the Alpha DAC Series 3 priced at $10,995 (reviewed in Issue 320), the Alpha DAC Reference Series 3 at $28,000 (reviewed in Issue 298), and the Alpha USB Series 2 Noise Isolation Device at $2495 (reviewed in Issue 214). The DACs are now in their third generation and the Alpha USB in its second.

The company has upgraded its Reference DAC platform over the years, with each new version improving the product's sound quality (I've reviewed all three models). Until the Wadax Reference DAC came along, the Alpha DAC Reference had been my DAC of choice for nearly a decade. But considering that the Wadax is about six times the Berkeley price, that's quite a testament to the Alpha DAC Reference 3's sound quality.

But how much more performance can Berkeley squeeze out of the Alpha Reference platform? And aren't such upgrades necessarily incremental in nature?

The surprising answer is that Michael "Pflash" Pflaumer, the design genius at Berkeley, has developed new techniques and software that catapults the Reference DAC's performance into the very top echelon of digital-to-analog converters, regardless of price. This new version, called the Alpha DAC Reference Series 3P (the "P" is for "Perfected"), delivers an increase in musical performance that exceeds all the previous upgrades combined. Indeed, it sounds almost like a new DAC that competes in the top tier of digital converters regardless of price.

The Alpha DAC Reference Series 3P costs $34,000, a $6k bump from the Reference Series 3. Owners of the Reference Series 3 can upgrade to the 3P for $7000, either through their dealer or working directly with the factory. The original Alpha DAC Reference Series and Alpha DAC Reference Series 2 cannot be upgraded. The turnaround time is typically a week, and the customer pays shipping both ways.

Before considering this new upgrade, let's review the Alpha DAC Reference platform. The unit is housed in a solidly built milled-aluminum enclosure. A row of buttons and a front-panel alpha-numeric display control the unit, from selecting the input, choosing one of four digital filters (including MQA rendering and HDCD decoding), and adjusting the

Specs & Pricing

Alpha DAC Reference Series 3P
Input sampling rate: 32kHz–192kHz
Input word length: 24-bit
Inputs: AES/EBU, SPDIF on BNC (x2), TosLink
Outputs: Balanced on XLR jacks, unbalanced on RCA jacks
Output level: Variable: 6.15Vrms at 0dBFS (balanced); 3.25Vrms at 0dBFS (unbalanced)
Digital volume control and balance: 0.1dB steps, 0.05dB L/R balance, 60dB range
Remote control: Volume, balance, input selection, absolute polarity reversal
Digital filter: Custom, user selectable
THD+N: <–110dBFS at maximum output
Firmware: Upgradable through signal inputs
Dimensions: 17.5" x 3.5" x 12.5"
Weight: 30 lbs.
Price: $34,000

Alpha USB Reference Series Noise Isolation Device
Type: USB-to-S/PDIF converter
Input: High-speed USB 2.0, Type B jack
Output: Switch selectable—coaxial SPDIF on BNC, balanced AES on XLR
Supported sampling rates: 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, 192kHz
Supported word lengths: Up to 24-bit
Supported operating systems: Apple Macintosh, Microsoft Windows, and Linux
Mains power: 100 or 120 or 240VAC, 50/60Hz, IEC power input connector
Power consumption: 3 Watts line, 1.5 Watts USB, designed for continuous operation
Dimensions: 10.5" x 2.88" x 5.38" (including feet)
Weight: 2.5 lbs.
Price: $5,995

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Associated Equipment
Loudspeakers: Stenheim Ultime 2 SX (under review); Wilson Audio Specialties Chronosonic XVX with two Wilson SubSonic subwoofers and ActivXO crossover
Analog source: Basis Audio A.J. Conti Transcendence turntable with SuperArm 12.5 tonearm; Air Tight Opus cartridge; Moon 810LP phonostage; DS Audio ST-50 stylus cleaner
Amplification: CH Precision L10 linestage, CH Precision M10 power amplifiers
AC Power: Shunyata Everest 8000 conditioner, 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, Ayra Audio RevOpods isolation
Cables: AudioQuest Dragon interconnects and AudioQuest Dragon Zero and Dragon Bass loudspeaker cables
Digital cables: Shunyata Omega-X Ethernet, Omega-X USB, Omega-X AES/EBU
Acoustics: Acoustic Geometry Pro Room Pack 12
Room: Purpose-built ASC Iso-Wall construction

volume. A remote control duplicates all the front-panel functions and adds a balance control. The Alpha DAC Reference's variable output level, along with a robust analog output section, allows the Berkeley to drive a power amplifier directly with no need for a preamplifier (if you have no analog sources). Analog outputs are on RCA and XLR jacks. Digital inputs are limited to SPDIF on BNC (x2), AES/EBU, and TosLink. Reflecting Berkeley's "no sonic compromise" approach, SPDIF is offered on only BNC jacks, the termination that, unlike an RCA jack, provides the correct interface impedance. The Alpha DAC Reference can be thought of as a stripped-down sports car that maximizes performance over features. It has no networking capability, doesn't decode DSD, and is not a Roon Endpoint.

Similarly, the Alpha DAC Reference lacks a USB input. Berkeley asserts that including a USB input in a DAC compromises performance by introducing noise into the DAC. Computers and servers are noisy devices, and that noise appears on their USB outputs, no matter how good their design. To use a USB source with the Alpha DAC Reference, you'll need Berkeley's Alpha USB. This small box takes in USB from a computer or music server and outputs SPDIF (on BNC) or AES/EBU to your DAC. As its name suggests, the Alpha USB Noise Isolation Device isolates your DAC from noise in your server or computer. It also reclocks the signal for greater timing precision. It has a "dirty" side with the USB input, and a "clean" side that outputs SPDIF or AES/EBU. The two circuits within the Spartan chassis are isolated from each other.

Although avoiding USB altogether is generally a good practice if you don't have an Alpha USB, I've found the best performance from a digital front end is with USB output from the server feeding the Alpha USB and then running AES/EBU out to the DAC. The Alpha USB has improved the performance of every server/DAC combination I've tried, except the Wadax with its proprietary Akasa bi-directional optical interface. I know a set-up expert who tours the world working on some very high-end systems. He travels with an Alpha USB and uses it regardless of what DAC is in the system.

Simultaneously with the release of the Alpha DAC Reference Series 3P, Berkeley has introduced a "Reference" version of the Alpha USB Noise Isolation Device. It was developed in tandem with the Series 3P DAC and should be considered essential to realizing the 3P's performance. It sells for $5995. This is a big cost increase over the $2495 Alpha USB Series 2, but the Alpha USB Reference Series is an entirely different animal than the Series 2. Among the upgrades for the USB Reference Series are two of the expensive proprietary clocks that were developed by Berkeley for their Reference DAC, along with new software.

The Reference Series DAC is packed with specialized knowledge gained over nearly 40 years of researching distortion mechanisms in digital audio. In the early 1990s, Michael Pflaumer was a co-founder of Pacific Microsonics, the company formed to develop HDCD. Co-founders Keith Johnson and Pflaumer conceptualized the encode-decode techniques and Pflaumer realized those techniques by writing the DSP code. He and Johnson designed what was undoubtedly the best-sounding analog-to-digital converter extant, the Pacific Microsonics Model One and later, the Model Two. Today, Berkeley Audio Design brings Pflaumer together with Michael Ritter, another of the three Pacific Microsonics founders.

The Berkeley Reference Series DAC incorporates this deep history in its design. A paramount goal is keeping noise out of the circuitry. This noise isn't what we conventionally think of as hiss in the analog output signal, but noise that degrades the audio signal's time-domain coherence by introducing phase noise (timing imprecision or jitter) in the clock that controls the critical digital-to-analog conversion step (see sidebar). The clock signal is highly susceptible to noise impinging on it, decreasing the timing precision of the reconstruction of digital samples into music.

It turns out that the human ear/brain mechanism is exquisitely sensitive to even astonishingly low levels of clock phase noise. In addition, clock phase noise sets a threshold below which no information can be resolved. That is, information encoded in the digital bitstream doesn't appear in the analog output waveform if that information is below the resolution threshold determined by the level of phase noise on the clock. This resolution threshold in digital is very different from what we think of as noise and resolution in the analog domain. Consider a magnetic tape recording in which we can resolve signals that are 20dB below the tape hiss. This phenomenon simply doesn't occur in the digital domain—information below a certain threshold disappears. It's not that we can't hear that information; it just doesn't exist in the analog output signal. It's a common mistake to apply analog-audio concepts that we've internalized for decades to the digital domain.

This is why Berkeley refuses to include a USB input on its DACs; that USB input, no matter how well implemented, will inevitably degrade performance by adding phase noise to the clock. It's also why all the code running the Berkeley DAC, including its proprietary digital filter, is written in assembly language.

Assembly language is equivalent in processing overhead to machine language raw binary code of ones and zeros that execute instructions. High level computer programming languages (BASIC, Pascal, FORTRAN, C, etc.) were developed so that humans could write code in a way that made sense to human concepts. The programming language is an intermediary between the human code writer and the machine. These programming languages translate human-understandable code into the raw binary bitstream that executes the instruction. The translation process for high level computer languages increases the amount of code, and thus the number of processing cycles, by roughly a factor of five. Unfortunately, processing cycles create noise, and the greater the number of processing cycles, the greater the noise generated inside the DAC's chassis.

Programming languages are necessary because humans generally can't understand and write raw machine code. But Pflaumer, who started writing code as a teenager in the 1960s before programming languages were widely available, had the skill and patience to write the Alpha DAC Reference's code in assembly language. By reducing the amount of processor activity, and thus the amount of processing noise impinging on the clock, Berkeley discovered that sound quality improved. Pflaumer even rewrote the code several years ago to more evenly spread out the density of processing cycles to avoid noise spikes.

In the quest for lower and lower clock phase noise, Berkeley spent hundreds of hours optimizing the Reference DAC's circuit board layout. (Pflaumer has specific expertise in this area: I visited the Pacific Microsonics laboratory in the early 1990s and saw Pflaumer and Keith Johnson working on a circuit built in three dimensions rather than on a flat circuit board so that they could study the effects of noise radiation and magnetic interaction between components.) Berkeley knew that lowering the noise inside the Alpha DAC Reference would increase resolution, but the circuit board layout couldn't be improved further. So, Pflaumer came up with a novel solution; an RF (radio frequency) waveguide. This is a physical structure of precise size, shape, material, and location that channels noise away from the critical circuitry. RF waveguides are used in a variety of applications, and their design is a science in itself.

The new Alpha DAC Reference Series 3P incorporates this specially designed waveguide, which can be retrofitted to the Alpha DAC Reference Series 3. The 3P also features new software that takes advantage of the lower clock phase noise. The upgraded DAC is then completely tested by a technician and sent to another location for realignment and critical listening tests. The unit is warmed up for 24 hours before the critical listening evaluation.

The default 44.1kHz digital filter is now a standard filter rather than one optimized for HDCD decoding, which had 6dB of headroom built in for HDCD's "peak expansion" feature. With this change, all the filters output the same analog output level. You can still select the HDCD decoding filter (1.16) for 44.1kHz recordings but must do so from the front panel.

Earlier, I compared the Alpha DAC Reference to a stripped-down sports car designed for performance rather than creature comforts or features. I'll take that analogy a step further by comparing it to a specific sports car, the iconic Porsche 911. Introduced in 1964, Porsche has been refining the 911 platform for more than 60 years, building upon its accumulated specialized knowledge.

Listening

I installed the Alpha DAC Reference Series 3P in my system along with the Alpha USB Reference Series in parallel with an Alpha DAC Reference Series 3 and Alpha USB Series 2, allowing me to easily compare them and hear exactly how the 3P differed from its predecessor. I also evaluated each component separately, comparing it to its predecessors. All the Berkeley components were driven by Aurender's top-of-the-line two-chassis N30SA Server. The USB cable, AES/EBU cable, and Ethernet cable were Shunyata's superb new Omega-X. Shunyata's digital cables are in my view the pinnacle of performance, but this new Omega-X series takes the sound quality a step further. They are expensive, but worth the price in a high-end system.

Having reviewed every generation of Alpha DAC Reference Series, I was expecting to hear a similar incremental advance in sound quality with the new "P" version. In the past, I've heard greater clarity and focus, a larger soundstage, and higher resolution within the context of Berkeley's familiar overall sonic presentation.

The "P" upgrade followed that familiar pattern but also brought with it a step function in sound quality, realism, and musical expression. The Series 3P had all the hallmarks of Berkeley's DACs—high resolution, expansive soundstage, realistic tone color—but this new version brought something extra special to the table. The 3P didn't just deliver the familiar Berkeley virtues but instead took the sound quality to a new and different level.

The term "resolution" is often thought of as a more incisive rendering—a forward presentation of sharper transient information and greater vividness. Taken to the extreme, the resolving component can become "ruthlessly revealing," rendering the sound clinical or analytical. The Alpha DAC Reference Series 3P has much higher resolution than its predecessor, but that resolution is manifested in an entirely different way from the stereotype of a high-resolution sound. The 3P's resolution is subtle and sophisticated, revealing a new level of realism in instrumental timbres by presenting with utter clarity the ultra-fine micro-details of the instrument's dynamic structure and harmonic complexity, as well as the space surrounding those instruments.

The result is a startling sense of immediacy, not from sounding forward, but rather from the sheer realism of instrumental timbre and transient structure. The sound is at once highly detailed yet relaxed, revealing the inherent beauty of the music. Concomitantly, I heard a reduction in edge and grain, which were already extremely low in the previous generation Alpha DAC Reference Series 3. Any trace of metallic patina overlaying timbres was banished. Amplifying these characteristics was a startling increase in transparency, as though a scrim had been removed between me and the music. Even the air between instruments fostered an impression of absolute crystalline clarity.

Take the human voice, for example. Through the 3P, vocals became smoother, more liquid, and less sibilant. More importantly, however, there was a heightened sense of presence and realism, as though the vocalist were right there in the room between the loudspeakers. The timbre was richer and denser in color. Concomitantly, there was a powerful impression of air around the image and of the vocal existing in space, distinct from the instrumental accompaniment. In this ability to separate instruments from each other, and resolve the air and space between them, greatly added to the sense of realism. The sound was the antithesis of a flat canvas, becoming more three dimensional.

A big part of the Alpha DAC Reference Series 3P's more lifelike presentation is due to the increase in transient fidelity. Snare drum had noticeably more "snap," jumping out of the mix with startling presence. Transient information seemed "tighter" in time with faster attacks (and greater amplitude on the attacks) and faster decays. Moreover, transient-rich instruments popped out of deeper silence and with a more precise spatial location, adding to the vibrancy. This improved transience performance infused music with more dynamic energy, life, verve, and an engaging upbeat quality.

The 3P's bass was tighter and more tuneful, but also denser in texture and more dynamic. In fact, the improvement in the bass was startling. Kick drum was much better defined dynamically, with a clearer portrayal of attack and decay. The entire bottom end was more dynamic, impactful, and precise sounding, like pulling taut a slack trampoline. By comparison, the previous generation sounded a bit muddled in the bottom end. With the 3P, it was easier to hear pitch in bass guitar. On acoustic bass, the 3P better conveyed the starts and stops of notes, the dynamics of string attack, and the instrument was more textured.

The way the 3P resolves the bloom around instruments is simply phenomenal. Take Dexter Gordon's tenor on the beautiful ballad "I Guess I'll Hang my Tears Out to Dry" from his 1962 masterpiece *Go*. Through the 3P, you can hear the dynamic envelope expand outward around the instrument, just as a sax sounds in life. The sense of air and bloom adds to the impression of a real-life person playing an instrument in a room, rather than sounding like a canned reproduction. Moreover, this track revealed the 3P's timbral liquidity and lack of metallic artifact. The density of tone color on Gordon's tenor was also remarkable, with a deep, rich, and warm hue. While we're talking about this track, Billy Higgins' delicate cymbal work was rendered with a tremendous degree of finely filigreed inner detail. Rather than sounding like bursts of white noise, the cymbals were resolved in micro-fine detail, all the way down to the shimmer into silence.

Another factor that greatly added to the sense of realism was the way the 3P resolved the very fine timbral structure of instruments, infusing them with a lifelike quality. I could clearly hear the mechanism by which the instrument created sound. Lately I've been listening to a lot of Latin jazz. The way the 3P rendered percussion sounds really brought this music to life. Each percussion instrument was differentiated from the others in dynamics, timbre, and location in space. What had sounded a bit confused and jumbled was now rendered with a clarity that was musically engaging. On the jazz classic "Tin Tin Deo" from Eddie Palmieri's album *Listen Here!* there's an extended break with multiple percussion instruments. The Alpha DAC Reference Series 3P's ultra-high resolution of each instrument's transient structure, spatial separation, complete lack of blurring, and lifelike portrayal of the mechanism by which the instrument created the sound was nothing short of thrilling. The sense of energy and rhythmic drive of this track is easily diluted, but the Berkeley reproduced it with coherence in the way all the parts of the music fit together.

Although these upgraded products carry a higher price (particularly the Alpha USB Reference Series) they are nonetheless a stone bargain in today's world of mega-priced DACs.

Note that this description is of the Alpha DAC Reference Series 3P with the Alpha USB Reference Series. The latter is essential to realizing this performance. The 3P is still a big upgrade with the Alpha USB Series 2, but you are leaving some performance on the table. Similarly, the Alpha USB Reference Series, which I auditioned separately, is significantly better than the Alpha USB Series 2.

Finally, I would like to call out the excellent Aurender N30SA server for its role in achieving this level of performance. It is a step above the W20SE that I used as a reference for many years.

Conclusion

It would be easy to think of this "P" version of the Alpha DAC Reference Series 3 as an incremental upgrade to an established platform and thus downplay its potential. But the improvement in sound quality is a step function, both objectively in terms of specific sonic criteria but more importantly in the gestalt of how these sonic improvements translate to experiencing musical expression.

The Alpha USB Reference Series is similarly impressive, rendering improvements in sound quality commensurate with those of the "P" version of the DAC. Using the two products together produces a synergy that is greater than the sum of the individual components.

Although these upgraded products carry a higher price (particularly the Alpha USB Reference Series) they are nonetheless a stone bargain in today's world of mega-priced DACs. In my view, they deliver the highest price-to-performance ratio of any digital front end I've heard. The Alpha DAC Reference Series 3P and Alpha USB Reference Series combination is competitive with the world's best digital conversion but without the six-figure price tag.

Clock Phase Noise

CLOCK PHASE NOISE and jitter are two ways of looking at the same phenomenon—timing imprecision in the clock that controls *when* the DAC converts a digital sample to an analog value. Jitter is a time-domain measurement, and phase noise is a frequency-domain measurement.

Each digital sample represents the analog waveform's amplitude at the instant the sample was taken by the analog-to-digital converter. The sample consists of 16 bits (or 20 bits, or 24 bits), and in standard resolution digital audio, there are 44,100 samples per second.

Each digital sample must be converted back to an analog value to recreate the original analog waveform. The clock signal inside a DAC controls the timing of this conversion. If the samples are reconstructed into an analog waveform with anything less than perfect timing precision, a specific type of distortion is created. That distortion is manifested as hardness in the treble, exaggerated edge on transients, loss of low-level detail, flatter imaging, reduced transparency, and wooly bass. At the dawn of the digital age, no one could have envisioned that such timing precision in the reconstruction of digital audio would be so critical.

To realize the timing precision required for state-of-the-art digital conversion is a daunting task. The first prerequisite is an ultra-precise clock. Rather than rely on off-the-shelf crystal oscillators, Berkeley designed its own elaborate and expensive clock. But a precise clock is just the beginning. What matters is not the clock's precision at its output, but the clock's precision at the DAC. The clock signal is so delicate and prone to degradation that getting the clock from the clock module to the DAC chip is a feat in itself. Noise impinges upon the clock signal and modulates the clock in the time domain, reducing coherence and raising the threshold below which no information can be resolved.

This explains why Berkeley rejects incorporating a USB input on its DAC, built a chassis from a machined aluminum billet with separate isolating chambers, developed its own ultra-precise clock, wrote the code in assembly language, spent 100s of hours on circuit-board layout to minimize noise, and now, developed a RF waveguide to capture and direct any remaining noise away from critical circuitry. tas