



Two-Channel Analog-to-Digital Converters (ADCs)

by Rob Tavaglione, 01.09.2010

In considering the controversies, skepticism, hype, and hoopla that can surround published analog-to-digital/digital-to-analog (AD/DA) converter testing or subjective “shootouts,” one may rightfully question which test methods are truly valid to such esoteric pursuits. There’s good reason for such uncertainty — tests with pre-recorded music certainly have their inherent advantages, as do live music recording tests, mixdown tests, “loop thru” tests, and good ‘ol concrete bench tests. Though each test has its own limitations, each can provide data worthy of consideration.

Thus, in our fifth installment of the *PAR* Session Trial — our ongoing series of in-depth, comparative and “real world” pro audio gear evaluations — we chose to cover all the bases. What follows is a deep study, going far beyond normal Session Trial parameters, of whether considerable aural differences exist in high-end analog-to-digital converter (ADC) choices and, if so, how the test units differ.

For this trial, we selected four ADC contenders, already notably endorsed by *PAR* reviewers — Benchmark Media’s ADC- 1, Lavry Engineering’s LavryBlack AD10, Mytek Digital’s Stereo96 ADC, and Prism Sound’s Dream AD-2 — for five different tests, including a full bench test by Frank Wells (beginning on page 46). In order to minimize variables in evaluation, we used the same playback environment in tests one through four (except in our final evaluation in our sidebar, “Epilogue: At Studio B Mastering, Charlotte NC,” on page 44). I divided the critical monitoring duties between my control room (with a MOTU 2408mk3 DAC representing the midline) and the top-shelf monitoring path at Studio B (with a Lavry Blue Series 4496 DAC) for final, definitive conclusions. It should be noted that ADC quality differences were quite audible in my studio and even more audible at Studio B, although the additional insight did not sway my findings, but actually reinforced them.



Benchmark DAC1 USB and ADC1 USB converters

Test One: Introduced Error/Inverse Sum

I commenced testing with a “classic standard” of a converter test that utilized each ADC with its matching DAC per manufacturer, introducing an additional variable, but still offering valuable insight. These included each ADC’s mate: Benchmark Media’s DAC- 1, Lavry Engineering’s LavryBlack DA10, Mytek Digital’s Stereo96 DAC, and Prism Sound’s Dream DA-2. This test would be used to measure latency, check polarity and to create an audible sample of each converter pair’s “introduced error” within the complete conversion process, by looping stereo audio (from digital source to the DAC then to the ADC and rerecording), then inverting the resulting file and summing it with the original file.



Lavry LavryBlack AD10 and DA10 converters

Here’s how it worked: For calibration, I played back a 1 kHz sine wave from my DAW at 44.1 kHz, outputting that signal via an AES digital output with Mogami digital cabling to each DAC. Each DAC was adjusted to output a +4 dB level of 1.227Vrms (all within 0.001 volts). The exception was the Lavry rig; with the steps in the DA10’s digital output level control, and no fine adjust or multi-turn analog trim pots, the closest I could get was an output

of 1.184 volts. I made up the difference in my DAW (boosting playback level to bring the loop to exactly unity gain). The only other difficulty in alignment was using the front panel-mounted knob on the Mytek converters which, though high quality with a solid feel and no unevenness from L to R channels in adjustment, is not precise enough for .001V precision. It can also be easily bumped. Fine adjustment of the Mytek ADC and DAC requires unscrewing the top panels to access jumpers to enable the internal 10-turn rotary trim pots. That, along with dealing with inadequate metering (a 4 LED indicator, marked at -60, -20, -3 and 0), made adjustment a bit tedious.

Self-clocking or re-clocking was selected rather than clocking via the incoming AES signal. This allowed listening to each converter set’s inherent clock differences, and not my DAWs, as recommended by the manufacturers. The analog output of each DAC was patched directly to the analog inputs of its companion ADC via very short runs of Mogami quad mic cable. Each ADC was calibrated to equal output and its AES output was recorded back into my DAW. I then checked each “looped” recording for correct polarity and measured the number of samples of latency introduced by the round trip. [*Latency difference can be measured by finding the identical audio event in the original and rerecorded file (sound start or snare hit) and measuring the time difference, in samples, between that event in the two files. — Ed.*]

Then I repeated this test, this time replacing the sine wave with a pop/rock mix. I used a test mix with stereo separation, full-bandwidth response, distinct transients and depth of field. After compensating for latency, I then polarity-inverted each looped recording and summed it with the original, creating a .WAV file of the difference between the original and the loop — a results file of each converter set's introduced error, if you will. All of our test systems canceled decently, around -46 dBFS or better, measured with the Roger Nichols Digital Inspector spectrum analyzer plug-in.



Mytek Digital Stereo96 ADC and Stereo96 DAC converters

The Mytek was the quietest inverse sum (IS) by a wide margin — around -54 dBFS, and offered the lowest latency at 99 samples (two thousandths of a second). This IS was not only quiet, it had a unique tone: one that was not full-bandwidth, showing a rounded off top end, very carved out middle-mids, strong emphasis at 80 Hz, and moderate emphasis around 6 kHz.

The Prism Sound loop IS was the second quietest of the group, at -50 dBfs average, and it exhibited the greatest latency at 180 samples (a mere four thousandths of a second). This IS was seemingly full bandwidth in its sound, with nearly flat response (for an IS) that didn't sound terribly different from the actual recording, only 50 dB quieter.

The Lavry tied for the loudest IS, with an average around -46 dBFS; its latency added 154 samples to the loop. This IS was full bandwidth and close to flat sounding except for a touch of highend emphasis at around 8 kHz. As mentioned above, there was a touch of DAW gain introduced into the Lavry loop.

Equally as loud as the Lavry, the Benchmark IS also averaged around -46 dBFS; its loop evidenced a 140-sample latency. Full bandwidth as well, the Benchmark IS offered noticeably carved out low mids, and lots of emphasis at 160 Hz and 8 kHz.

Test Two: Pop Mix

I was now curious to see how these four ADCs performed actually recording music, so I concocted a well-balanced mix, custom made for conversion evaluation. This mix came from a multitrack session in my DAW (recorded at 48 kHz) that employed automation, EQ, and light limiting. These tracks were mixed on my Soundcraft Ghost console, where some of them got a little more EQ and a touch of outboard reverb; bus compression was tastefully utilized across eight busses with four stereo compressors. I skipped my usual L/R compressor in favor of more punch and dynamics to feed our hungry ADCs. This mix test (in true *PAR* Session Trial fashion) was designed to see what these converters would do to my typical income creating work: the most meaningful data to me, at least.



Prism Sound Dream AD-2 and Dream DA-2 converters

Upon first listening with Blue Sky SAT8 (w/ SUB212) 3-way midfield monitors (starkly honest through the low-mids up to the high mids) at about 85 dB, I could tell only minimal differences from each ADC

to the next — differences that were best described as textural and not easily quantifiable.

I then picked four unique musical sections for looping: a drum intro; a section with acoustic guitar and harmonica; a section with electric guitars and male/female vocals; and a rousing loud rock section with vocals. With these samples, I found obvious and repeatable preferences after about three loops through each, although the differences were not major.

For my favorite, I could not decide between the Benchmark and Lavry ADCs. The Benchmark seemed livelier with more pronounced highs and thumpier lows: seemingly a slightest touch of “hype” that made my mix sound more finished and more “like a record.” Meanwhile, the Lavry sounded more “honest” and pure, so comparably lacking in any hype that it allowed louder listening to be more pleasant; it made me want to mix again, this time with possibly a bit more mix hype.

I really liked the way the Prism Sound treated my mix’s loud rock section: a “congealing” effect that sounded more finished without the extra sweetness of the Benchmark. Yet, with the Prism Sound, the mix’s more sensitive sections lacked a certain sheen, a sense of air and transparency, to my ears.

The Mytek Digital had the most detail of the bunch, an extra degree of top-end definition and a leanness of punchy bottom as well. This was a bit too much for my mix, though — sounding a bit clinical and even cold — although I don’t dare use words like “brittle” or “harsh,” as that would be overstating.

Although I picked my favorites, let me not exaggerate these differences; I could easily earn my keep with any of the four for pop mixing work, where texture, detail and sheen are not necessarily compared to reality. All four models offered signatures that I could use in my typical work.

Test Three: Live Orchestral Recording

No ADC test would be truly complete without some actual live music being recorded, so *PAR* reviews and features editor Strother Bullins and I visited the beautiful Stevens Center in downtown Winston-Salem, North

Carolina to record the Winston-Salem Symphony as it rehearsed pieces by Russell Peck (“Peace Overture”), Johannes Brahms (“Schicksalslied, op. 54”) and Andrew Lloyd Webber (“Requiem”). This scenario — recording a skillful orchestra in a sonically wonderful room — clearly called for world-class gear for the entire recording chain. First, we chose DPA Microphones: a matched pair of 4006-TL small-diaphragm omnidirectional condensers. We placed this pair 30 inches apart at eight feet off the ground and four rows back into the room at exact center. This placement was slightly wider than purist methods and, admittedly, a little closer to the floor than desired, yet it allowed a strong mono center and plenty of stereo information dancing around the sides — hopefully ideal material for hearing variances in imaging and depth.

From the DPA microphones, direct runs of Mogami quad cable connected directly to a Grace M201 two-channel preamp, which supplied 24 dB of gain per mic. This stereo output was split four ways to feed our ADCs by the Studio Technologies Model 82 distribution amp, which did its “two in/eight out” job very cleanly, requiring no calibration for unity throughput. Then, each ADC output AES format digital directly to four identical Sound Devices 702 portable digital audio recorders, each of which stored all this 24-bit, 96 kHz data on identical Compact Flash media cards.

Upon setup and our confirmation that all components were properly calibrated, our test recordings ensued. Later, back at my studio, the four recordings were confirmed as exactly equal in amplitude, then time aligned in my DAW for monitoring. Our purist recording methods — unlike typical modern, commercial classical recordings — offered results absent of all the inherent “evils” associated with multitracking, were subject to no previous digital conversion, and were free of any distortion due to multiple miking: completely honest in imaging/ soundstage and as clean a source as one might hope for in detailed ADC evaluation.

THE SUPPORTING CAST

CRUCIAL GEAR FOR *PAR* SESSION TRIAL:

Two-Channel Analog-to-Digital Converters (ADCs)

- ▶ **DPA MICROPHONES' 4006-TL OMNIDIRECTIONAL CONDENSER MATCHED PAIR:**
Small-diaphragm condensers with basically flat response down to 20 Hz (only -1 dB), ruler flat up to 10 kHz with a rise in response above there, great for distant or ambient microphone technique. Hearing a pair of these reveals what it was like to be there.
- ▶ **GRACE DESIGN'S M201 MICROPHONE PREAMPLIFIER:**
Two channels of pure gain with stepped input controls, flat frequency response, quick transient response, and tons of headroom. Such distortion-free amplification revealed microphone quality and minute details of mic placement differences.
- ▶ **STUDIO TECHNOLOGIES' MODEL 82 STEREO ANALOG DISTRIBUTION AMPLIFIER:**
The name says it all: one stereo in and four stereo out distribution amp without any hassles. Distro amps are supposed to be “invisible,” and this one was: It features great specs, precise unity gain across all I/O, and the
- ▶ **SOUND DEVICES' 702 PORTABLE DIGITAL AUDIO RECORDER:**
These two-channel recorders were actually pleasant to use in the field with the best ergonomics and most eye-friendly set of displays/meters I've ever seen. Considering their clock-ability, up to 192 kHz converters and miles-long feature set, they were shamefully under-utilized in this Session Trial; they are best suited for the rigors of high-end film, television, and location work.

ExactCal section [with 1 percent tolerance components].

Here's a sincere “thank you” to each of these manufacturers for their participation in, and support of, this *PAR* Session Trial. —*Rob Tavaglione*

The Winston-Salem Symphony with music director Robert Moody in dress rehearsal at the Stevens Center, at which Test 3 of this PAR Session Trial was conducted. Photo by Allen Aycock

Here, my favorite converter was a close decision between Lavry and Mytek. My eventual top pick, the Mytek, had the most animated top end, with profound attention to detailed transients and a realistic sheen to horns that was simply astounding. With the Mytek, bottom end was punchier with less roundness, but the details of low-end events seemed more exacting, if not particularly exciting; it didn't have all the room's "boom," as the others did.

The Lavry sound seemed the most "reference" to me, with an absence of hype or coloration that was admirably natural. Although completely lacking in harshness or smearing, I wished that the top end offered a little more detail and more air. The Lavry AD10 does offer three modes (tube, transformer and both) that couldn't be fairly tested here, but may offer ways to add more liveliness and nonlinearity, if so desired.

My third pick, the Benchmark, had the overall most pleasant sound: a robust bottom that swelled and rolled, balanced by a nice lively top end. I could hear the walls of the room and pick out individual secondary instruments, but the bottom end seemed sluggish at times and there was some smearing of detail up top.

The Prism Sound sounded a lot like the Benchmark in that it had a palpably strong bottom and similar transient attack. There was a nice sense of room and decay, and I liked the pleasing accuracy on higher end transients, especially because they never got rude or brittle. In fact, comparably, it sounded kind of like it had been "mastered" into more smoothness. My only complaint was an overall "mist" across the top end that sounded a little less than real, a factor that became more apparent with our piano recording — read on.

Test Four: Piano

Next, our portable "dream rig" (identically configured to the setup of Test Three) was carted over to Reflection Sound Studios in Charlotte for three good reasons: their room, their room, and their 7-foot 6-inch Yamaha C7 grand piano, which sounds great — grand even — in the 30 x 45 x 16-foot Studio A. Add classical pianist/theatrical composer Alex Mauldin for composition and chops, and I had the recipe for some ideal audio for evaluation in our final subjective test. Here, the DPA microphones were placed about 10 feet away from the inward curve of the piano, about six feet off the ground, about 24 inches apart, and aimed on axis.



Pianist/composer Alan Mauldin performs for Test 4 of this PAR Session Trial in Reflection Sound Studios' Studio A on a Yamaha C7 grand piano. Photo by Rob Tavaglione

I asked Alex to improvise a performance that would include some dramatic dynamic shifts (some gradual ones, too); some crescendos and some pianissimo levels; some heavy left hand and some slamming right as well; some sustain and a dramatic "stop" to hear some room reverb — all within

30 seconds or so.

Studio owner Wayne Jernigan warned the Yamaha might be out of tune. Of course, he was right, and I was foolish for not arranging tuning, but I got lucky. In our recordings, when Alex repeated a mid-keyboard arpeggio highlighting the range of those tuning inaccuracies, each converter responded to the resulting chorusing/dissonance in a slightly different, revealing, and interesting way.

Later, back at my studio, Alex and I listened on the Blue Sky monitors a number of times to each converter's interpretation of his performance. No differences were immediately apparent. Then I selected individual sections of his piece (e.g., just the crashing crescendo and subsequent downward shift, just the arpeggio runs, etc.) and repeated them, regularly switching between the recordings from the four converters, and we began to develop preferences. We confirmed our results with Grado headphones and more wholotake listens.

Alex and I both agreed the finest sound came from the Mytek; I chose it for its detail in the high end and the complete lack of "cellulite" in the low end (such distinct punch!), while Alex described what he heard with words like "realistic," "true," and the phrase, "that is exactly the way it sounded to me as I played it." We also both agreed that the Prism sounded very balanced and quite pleasant, but distinctly "less real" than the others. Alex chose adjectives like "plastic" and "electronic." To me, those words sounded too harsh; the Prism just sounded more "recorded" to me.

Alex gravitated to the Lavry for his second choice; he thought it sounded "less hyped" than the Benchmark. I thought the Lavry lacked some upper harmonic detail on sustained bell-like notes and preferred the slightly "analog-ish" color and low-end comfort of the Benchmark.

The businessman in me asked Alex if (hypothetically) he had to pay

EPILOGUE: At Studio B Mastering

Charlotte, NC

This PAR Session Trial wouldn't have been complete without a "head check" at a proper mastering studio, providing an ideal monitoring environment and another experienced set of ears (in blind testing) to assist with evaluation. Dave Harris and his Russ Berger-designed Studio B Mastering — a pro with plenty of critical listening experience through Dunlavy SC V monitors, Lavry Engineering Blue Series 4496 ADCs and DACs, a Crookwood custom mastering console, etc. — fit the bill perfectly.

First, I let Dave hear our IS (inverse sum) files to whet his appetite, and he was quite surprised at the differences, taken aback by how one file was so much quieter and lacking in high end (the Mytek). We both noticed the presence of sibilance, amounts of kick drum vs. bass guitar and frequency emphasis curves of the various IS files. We then mused for a long while on the content of the IS files, questioning what contributes most to audibility. Is it the DAC or the ADC, the attenuation of certain frequencies, the gain of frequencies, distortions of the time domain, or a blend of all of the above? Fun stuff.

Upon hearing the orchestral files, Dave expressed how much he wished he had a baseline to which he could compare these converters' recordings. Without the benefit of being present at the Stevens Center during recording, I asked Dave to choose a file based on what he would choose if mastering these options for a client. Within about eight listens total (a few repeats of two ideal one-minute sections and then repeats of smaller sub-sections), he decisively (but still blindly) picked out the Mytek as being the "fastest," "most articulated," and "snappier," even as he questioned whether its bottom was either thin or accurate, without a true reference. The Prism drew his second rank for opposite reasons: a "very nice" sound — heavy emphasis on the word "nice" — "mellowed," and "most finished."

Dave's third pick was the Lavry, which he called "drier" and with a "transient absence, as if limited." Unlike me, Dave was not pleased with the Benchmark, citing its coloration and "blurring." This environment did shed an exacting new light on such issues, and Dave reported hearing more differences than he expected.

for today's session would he accept any take other than via his fave converter, the Mytek. He adamantly refused, saying that once he heard "that kind of accuracy," no other would satisfy him. My, the implications...

Summary

What this evaluation means to me is that there are enough audible differences among these premium ADC converters to warrant careful

selection and detailed auditioning before making a purchase of any one of them. Although meaningful, the differences between models were not as profound as microphone choices, monitoring choices, and room acoustics. It was clear to me that in order to maximize stylistic preferences, I would consider owning more than one flavor of ADC.

Without a doubt, the most "fully-featured," close to "industry standard" status [again with the quotes], and industrially designed ADC of the group is the Prism Sound Dream AD-2. Its I/O panel's thoroughness and operation are masterful, and I found its sound to have a certain, polite signature. It's a good signature, mind you — one Alex Mauldin cited as "ideal for rock music" — and he may just be right. In my listening, certain program material did sound more desirably finished or congealed via the Prism rig, in direct comparison to the other three contenders.

I found the Lavry Engineering and the Benchmark Media ADCs to be very close competitors in many ways, even though their sounds were as different as any tested here. My closest descriptions for each would be "neutral" and "full-bodied," respectively, and both bring usable attributes to varied sources.

Personally, if choosing a converter like I do a mic preamp, I'd do more taming of harsh sources and delicate acoustic work with the Lavry, and more rock and pop through the vaguely "analog" handling and color of the Benchmark. Adherents to digital gain control (and its advantages) should consider the Lavry; proponents of multiple analog gain stages (and especially if you interface any -10 dB or consumer gear) might prefer the Benchmark.

Of the four, the Mytek Digital Stereo96 ADC achieved the most unique and desirable sound to my ears. It had the most accurate response to transients, whether they involved high frequencies or even super lows. The lack of smearing in the top end was evidenced by strong harmonic and internal detail and lack of harshness at peaks. At times, the low-end response was perfectly understated, punchy, and tight — pleasantly lean, but still extended. At other times (like in my pop mix), a little more oomph, roundness, and even blending in the lows would be welcome. Bottom line: The Mytek Digital preserved transient details better than the others, allowing me to tailor these events, while any deficiencies in the bottom could be corrected with EQ; I find this more desirable than the inverse.

At this point, Dave knew he liked "converter #3" the most (not knowing it was the Mytek), and his preference stayed the same for the piano evaluation. Very quickly this time, he declared his continued admiration of the Mytek, citing all the same exact reasons that Alex and I had. Again, Dave picked the Prism for his number two, again citing the warmth, the "nice-sounding loss of transients" and its finished qualities. He was largely ambivalent about the Lavry Engineering, calling it both the "most open" and "a little bland."

Dave hesitated at summarizing but called the four units "all pro and all usable." He stated there was not a winner or loser here: "It depends on what you're working with." He ultimately cited the Mytek for the most honest portrayal, the Prism as the "most finished and tamed," and the Lavry as "not unlike-able, not at all negative."

— Rob Tavaglione

Only after completing these evaluations did I finally allow myself to do some research and find the list prices of the tested units. It should be noted that price and value were not considerations in these evaluations, which concerned themselves with only sonic performance, functionality, and features.

Prices: \$995 (Mytek Digital Stereo96 ADC); \$1,480 (Lavry Engineering LavryBlack AD10); \$1,795 (Benchmark Media ADC1 USB); \$8,200 (Prism Sound Dream AD-2)

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