

Worth the Wait

Benchmark ADC1 A/D Converter

by Frank Wells with Jim Kaiser

The Benchmark ADC1 A/D converter has literally been years in the making. The companion to the hugely successful DAC1 D/A converter, the ADC1 is a reference-quality, 24-bit, 192 kHz-capable, 2-channel converter in a half-rack width, 1U package. The DAC1 set a high standard for reasonably priced, high-performance D/A conversion. Well worth the wait, the ADC1 is poised to do the same for A/D conversion.

The package is straightforward yet full-featured, and flexible with balanced and unbalanced AES outputs, a second unbalanced output that can be switched to a dithered 16-bit mode and a TosLink optical

port that can be employed in AES or ADAT mode. Balanced analog input is via XLR connectors. There's also word clock input (WC, Super Clock, AES) and word clock out on BNC. Sample rates are selected on the front panel, where there are also two channels of 9-segment LED metering (switchable to a 6 dB/LED or 1 dB/LED resolution). Input levels are controlled by a 3-position range switch and either the detented rotary controls or recessed precision trimmers.

It's always been a treat to put Benchmark gear on the test bench. The ADC1 did not disappoint; in fact, it dazzled me. Pulling up old test files of other manufacturer's gear as a starting point, the performance of the last device measured is visible on my test gear's computer display. Running the same test on the ADC1 consistently produced results that were much better than those of a broad array of previously tested gear, so much so that I often had to adjust the display parameters to even see an entire sweep.

Frequency response is razor flat (± 0.01 dB across the audio band), with a sharp cutoff just below the Nyquist point. Dynamic range is excellent, and the ADC1 measures perfectly linear to well below -90 dB below full output, and within a half dB to -130 dBFS. Crosstalk measurements are excellent, and the noise floor is clear of any discernable artifacts. Harmonic distortion plus noise (THD+N) numbers are simply remarkable (in the 0.000x percent range) under almost all in-

put conditions below clipping. That's close to unprecedented in my experience, certainly so at the ADC1's price point. Intermodulation distortion test results are also very impressive.

The bench results predict an excellent sonic performance, transparent to the source. PSN turned to mastering engineers, Hank Williams

and Ken Love, and director of technology, Jim Kaiser of MasterMix mastering studios in Nashville for critical listening tests. The trio compared the ADC1 to their high-dollar, "house standard" converter package. They set up in the "neutral" listening environment of their surround mastering suite (listening only in 2-channel, of course), using an EMM Switchman II analog controller which drove the Nova Applause S/Threshold main monitors and Bryston-driven Bag End dual 10-inch subwoofers.

The listening source was a 1-inch, 2-track, 15 ips analog master from a new Sony Nashville artist, played on a Mike Spitz ATR-102 using the ARIA electronics. The song selection was a medium-tempo, solo vocal w/ an acoustic-oriented, light rhythm section. All converters were calibrated to a reference level of +4 dBv = -14 dBFS, and no program "peaks" exceeded -6 dBFS. This listening was not performed "double-blind"; however, the mastering engineers did not know which converter was being selected to relate to the source.

Williams was first up. At 44.1 kHz/24-bit, he found it "easy" to reliably differentiate between various converters and the source, and to "identify" each converter's character. Hank described the Benchmark as "a bit laid back in the midrange" compared to the source and reference converter. Williams found that switching to 88.2 kHz/24-bit "closes the gap" between the

source and converters. At that point, he remarked, "The Benchmark is very true to the source and my reference."

The setup was changed to have the choice of the ADC1 or MasterMix's reference A/D driving their reference D/A, and Love joined the party. Listening first at 88.2 kHz/24-bit,



Williams felt that "the gap slightly widened" between source and in this configuration. Love commented that the ADC1 was "slightly more constricted" than the reference, with "slightly less definition." However, both agreed that the differences were minute. At 44.1 kHz/24-bit, Kaiser reported the differences to be more obvious, "as one would expect."

In conclusion, both Williams and Love described the differences that they heard as "very subtle" and "difficult to describe, as they are so slight." Williams said he "really enjoyed the Benchmark ADC1/DAC1 combination at 88.2/24-bit, and would have no problem using this equipment on a similar project." He actually used the word "shocked" to describe how close the packages sounded at higher sampling rates, especially considering the price differences.

I predict the Benchmark ADC1 will match the success of the DAC1. It's a great package at any price, and a spectacular package at its moderate actual price.

Product information

ADC1 2-Channel A/D Converter: \$1,775
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The Drawing Board

John Siau, director of engineering for Benchmark Media Systems, says the clean, consistent electrical performance of the ADC1 comes in part from meticulous optimization of each gain stage: "There are a lot of calculations that have gone into each stage, as far as currents, as far as the types of components that are used—and all those things contribute."

An AKM package was eventually chosen for the converter stage. "We did a lot of evaluation on all the available parts," explains Siau. The AKM part was selected in part for its low distortion, and in part for its filter characteristics. "We're not happy with some of the things a couple of other manufacturers have done in terms of digital filtering. Particularly at 192 kHz, they've taken a lot of shortcuts in the DSP processing."

Like the DAC1, the ADC1 employs Benchmark's UltraLock anti-jitter circuitry, based around a novel use of an Analog Devices sample-rate converter package, for a claimed 100 percent rejection of jitter from the clocking circuits. "One of the things that that does," says Siau, "is it gives us consistent performance. No matter how good or how poor your master clock system is, or whether or not you're running from an internal clock source, or running locked to an external studio reference, the performance is the same."

Siau says he's particularly pleased with the "very wide sweet spot" that the ADC1 exhibits across its range of gain settings. "You'll achieve the signal-to-noise numbers, you'll achieve the distortions numbers, at a very wide range of gain settings," he elaborates.

The linear power supply in the ADC1 is also built to perform under even extreme conditions. "We have a lot of immunity to what's going on in the power supply rails. I can do some pretty terrible things to those power supply rails...and the ADC1 is still clean."

Siau also points to the circuit board layout as critical to the ADC1's performance, "a 6-layer, inside-out construction." Benchmark's isolation techniques were developed to prevent crosstalk between channels, between channels and the power supplies, and between the analog and digital circuitry. "That's a big part of keeping clock noise out of the audio, and keeping all the digital trash out of the audio."