

# High-resolution audio playback using an iPad and DAC1

By Elias Gwinn  
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Apple's iPad has become a favorite device for many people - to surf the web, watch videos and movies, read the news, etc. However, only a few have used it as a source for high-quality digital audio. This is about to change.

A simple USB adaptor made by Apple can enable the iPad to connect directly to a DAC1 USB, DAC1 PRE, or DAC1 HDR. The USB adaptor is called the 'Camera Connection Kit.' It connects to the iPad via the dock connector. This \$35 adaptor can be purchased here:

<http://store.apple.com/us/product/MC531ZM/A>

Using this adaptor, the iPad can transparently stream high-resolution digital audio to the USB input of DAC1 converters. Even more remarkable, the iPad is able to wirelessly stream a 96-kHz, 24-bit audio file via Wi-Fi without losing sonic

quality. (Wireless streaming is achieved using iTunes 'Home Sharing' - a mechanism that enables media to be streamed between multiple devices on a common Wi-Fi network. Read more information about this below.)

This revelation is very exciting for many reasons. This setup has no sonic degradation or tradeoffs. Setup is instantaneous, and requires no drivers. It is a low-cost alternative to buying another computer to act as a music server. And now, with the recent announcement of Apple's iCloud, the capabilities of this setup will expand to encompass more of your media experience.

Sonically speaking, this setup will stand up to even the most discerning audiophile scrutiny. We've done significant testing to verify the audio quality when using this adaptor. Our tests show that:

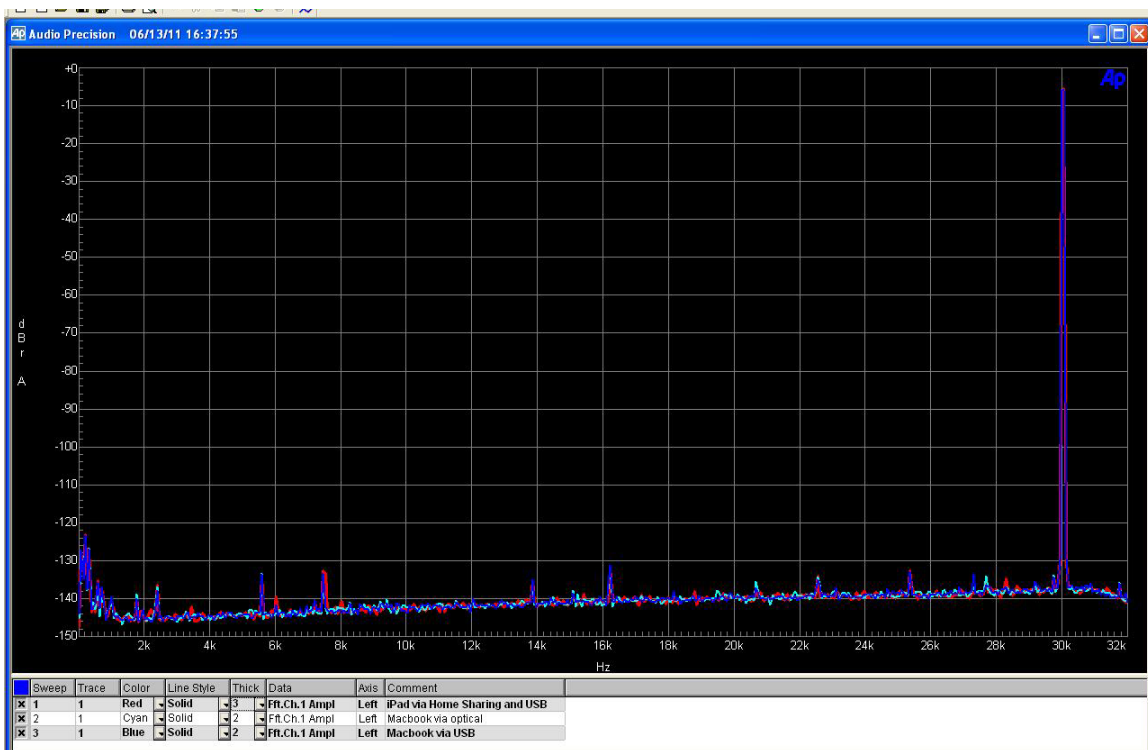
- there is no evidence of signal processing
- there is no evidence of word-length reduction



- there is no evidence of sample-rate conversion
- there is no evidence of data compression
- it is capable of streaming up to 96 kHz, 24 bits
- streaming via Wi-Fi is also transparent up to 96 kHz, 24 bits

To demonstrate that the stream was not being down-sampled, we used a 30 kHz audio test tone (-5 dBFS amplitude, 96-kHz sample rate, 24-bit resolution). If the iPad was down-sampling to 48 kHz, the cutoff (Nyquist) frequency would drop to 24 kHz. In this case, the 30 kHz tone would disappear. Our tests show that the 30 kHz tone is properly reproduced.

Here is the graph from our test:



In this graph, there are three measurements of the same 30 kHz digital tone going through the DAC1 USB. The red measurement is the 30 kHz tone coming from the iPad. The cyan measurement is from the Macbook via optical. The blue measurement is from the Macbook via USB. As you can see, they each perform identically, achieving full 96-kHz, 24-bit performance.

In all three cases, it is also evident that Benchmark's UltraLock™ jitter-immunity system is very effective against any jitter coming from these devices. As can be seen from the measurements above, no jitter-induced sidebands could be detected. (This test is capable of resolving jitter-induced distortion at levels as low as 140 dB below peak output levels.)

Remarkably, this connection requires almost no setup configuration. You simply insert the USB adaptor into the iPad's dock connector and connect it to the DAC1 via a normal USB cable. That's it! Now you can play audio from any application on your iPad and achieve the high quality digital-to-analog conversation of the DAC1. Benchmark's driverless AdvancedUSB™ system makes this possible.

The user may notice that the iPad's volume control is disabled when using this setup. This is ideal, as the highest dynamic range will be achieved using the analog volume control of the DAC1 rather than a digital volume control. ([This whitepaper](#) explains why dynamic range is maximized when using the DAC1's analog volume control versus a digital volume control:

<http://www.benchmarkmedia.com/discuss/feedback/newsletter/2009/07/2/volume-control-technologies>)

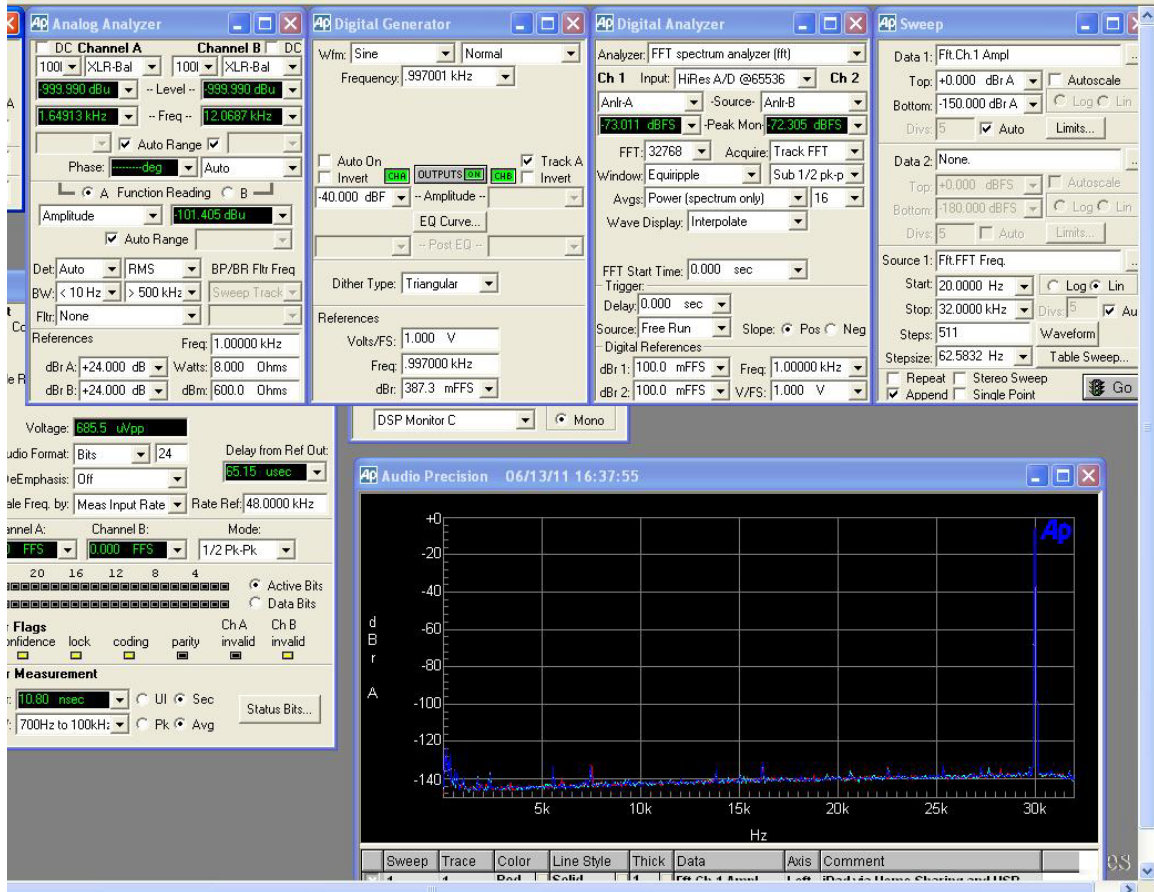
To setup wireless streaming from a computer to the iPad, you must engage 'Home Sharing'. To do this, the computer and the iPad must be on the same Wi-Fi network. Follow this link to read detailed step-by-step setup instructions:

<http://support.apple.com/kb/HT4557>

The equipment used for testing is as follows:

- DAC1 HDR
- iPad 2 (iOS 4.3.2)
- Macbook 1.83 GHz Intel Core Duo (OS X 10.6.7)
- AP System 2 Cascade
- Netgear Rangemax router (model: WPN824 v3)

The AP measurements were made using a 32,000 point FFT with 16x power averaging and Equiripple windowing. Other details of the AP setup can be seen in the image below.



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