

AUDIO RESEARCH DAC8

ASYNCHRONOUS USB 2.0 HS

There are five possible solutions for streaming audio over a USB interface. Each of these solutions has advantages and disadvantages depending on cost and the audio quality desired. Of the five known USB audio interfaces, Audio Research has chosen the fastest, lowest jitter and lowest latency solution to maintain sonic superiority for the two-channel audio and video experience:

Best Solution (USB audio class compliant 2.0 HS 480Mb/s bandwidth):

- Local fixed DAC dual master audio clock, asynchronous to PC clock. Slaves the PC clock to the audio clock. Benefit: eliminates all USB interface jitter.
- Isochronous data transfer on USB bus. Benefit: guarantees bandwidth & low latency. Low latency is important so music is in sync with video when playing music videos via the PC or Mac.
- Clock regeneration in the PC guarantees low & constant latency, predictable processor load.
- Global “reference clock” on all devices, multiple device support, accurate play-out synchronization; synch with audio/video playback.
- Compound streams as defined in ISO-61883 standard.
- Capable of transferring stereo, 192kHz sample rate, 24bit audio with no dropouts.

Very Good Solution (USB audio class compliant 2.0 FS 12Mb/s bandwidth):

- Local fixed DAC audio clock, asynchronous to PC clock lowers jitter.
- Isochronous data transfer on USB bus guarantees bandwidth & low latency.
- Capable of transferring stereo, 96kHz sample rate, 24bit audio with no dropouts.

Good Solution (USB audio class compliant 1.1/2.0 FS 12Mb/s bandwidth):

- This is the solution often employed by USB DACs using the TAS1020B device.
- Local fixed DAC audio clock, asynchronous to PC clock lowers jitter.
- Bulk data transfer competes with hard drives, printers, etc. for priority; can cause dropouts if computer is not fast enough to keep up.
- Capable of transferring stereo, 96kHz sample rate, 24bit audio with no dropouts.

Not as good Solution (USB audio class compliant 1.0):

- Adaptive DAC audio clock PLL is regenerated from PC audio clock; much more jitter but is easy to implement.
- Isochronous data transfer on USB bus.
- This is the solution used by most low cost USB DACs or playback devices.

Bad Solution (USB audio class compliant 1.0):

- Adaptive DAC audio clock, no PLL, control is via packet duplication, omission, low physical jitter but unacceptable audio quality.
- Isochronous data transfer on USB bus.



Many options exist for interfacing a DAC to a computer via a USB interface. Audio Research implemented the most advanced methods so our customers can play reference-quality 192KHz/24bit recordings with astonishing sonic results. To accomplish these goals required our taking the next step in USB interface evolution; we wanted to make sure our USB interface would seamlessly interface in the high end audio/video room, requiring low latency, as well as in the two-channel sound room, requiring low jitter and high resolution.

The USB interface developed in the DAC8 is a high performance asynchronous implementation, accurately slaving the PC (and Mac) to our Ultra-stable Dual Master Clock, with constant and guaranteed latency. We do **not** use the PC clock and do **not** regenerate the clock with a PLL.

In addition, the PC Audio system is synchronized to the Dual Audio Master Clock in the DAC8 plus we use synchronous mode transfer on the USB bus, which gives us the guaranteed bandwidth required for low latency and no drop-outs. Consequently, no other device on the USB bus, such as ultra fast Hard Drives, can disrupt the music flow.

Unlike previous implementations (and the original USB audio spec.) both channels are perfectly aligned, within our FPGA (*Field Programmable Gate Array*). None of the system clocks (PC, USB interface, USB clock) have any influence on the audio performance. The dual master audio clock generation is done completely independent from the USB interface in the DAC8. In fact, the clock generator on the board has zero interaction and connectivity to the streaming USB interface audio. The advantage of this design is we could move the clock generation into our perfectly stable analog conversion domain, reducing the jitter to a few picoseconds.

In summation, the DAC8 raises the bar to a level not achieved by USB Audio DACs before:

1. The DAC8 has refined and developed a faster Asynchronous USB interface so Reference level 192kHz/24bit recordings can be enjoyed without a professional level SPDIF to computer interface.
2. Custom ASIO drivers to reduce Latency to microseconds instead of milliseconds.
3. Dual low jitter Master Oscillators to guarantee no quantization errors which lowers intermodulation distortion (IMD).
4. Quad 24 bit mono-DACs for unparalleled detail and a 3dB lower noise floor than found in dual DAC systems.
5. True differential, direct coupled audio amplification with 90kHz bandwidth.
6. Sample Rate Measurement function so you always know exactly which sample rate is being decoded by the DAC8.
7. Galvanically isolated digital inputs to eliminate ground loops and lower jitter even further.
8. R-Core power transformer with 7 levels of regulation to further lower the analog noise floor.

Each of these features work together in the DAC8 to give our customers an unparalleled sonic experience.

