

Paul Miller
Editor

Technician and writer on all things audio for over 25 years, Paul Miller took over the editor's chair in 2006. He invented the QC Suite, used across the audio industry

USB audio's wow factor

In the third of his occasional series focusing on the foibles of USB audio, **Paul Miller** is inspired by a fellow contributor to try out a new test that identifies a hidden 'sub-class' of digital jitter

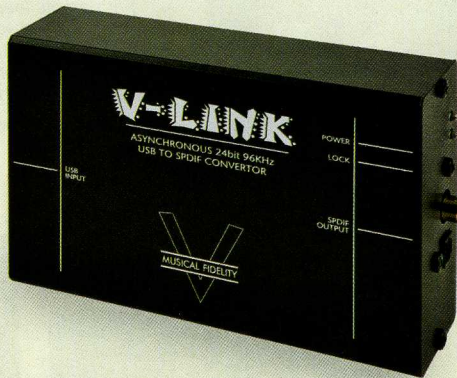
My inspiration for this month's column was provided by our very own Jim Lesurf and his research into USB interface timing issues. So before you read any further, may I suggest you adjourn to p100, read what Jim has to say and then please remember to turn back here!

On the face of it, Jim's treatment of timing variations in USB audio as 'wow & flutter' is not new. Indeed, the sidebands we see every month in the jitter plots that accompany *HFN's* reviews of CD/SACD players and DACs of every description (S/PDIF, USB and networked) are just that – jitter being the digital equivalent of W&F in analogue tape decks and record players.

LATERAL THINKING

The real genius of Jim's measurement is its focus on very low-rate, near-DC timing variations, caused by 'clock hopping' or beating between near-coincident clocks. These are almost the equivalent of 'drift' in turntable speak rather than wow (typically 1-10Hz) or flutter (>10Hz). These forms of frequency or intermodulation distortion can be subjectively debilitating, particularly at 4Hz or so.

'With USB audio captured by MF's V-Link, all such jitter vanishes'



ABOVE: Musical Fidelity's V-Link – asynchronous USB in to S/PDIF out offers measurable benefits

However, when Julian Dunn first proposed the J-Test signal in the early '90s he also remarked upon the likely audibility threshold of sampling jitter. At 400Hz, he suggested, psychoacoustic masking would theoretically obscure any jitter below 20nsec (20,000psec), the threshold increasing almost exponentially at progressively lower frequencies. Nevertheless, in my experience, low frequency sources of jitter such as PSU transformer hum and rectifier pulses can have an impact on subjective bass performance at levels of a few hundred psec, not tens of thousands. But near-DC jitter? How high does this have to be before it becomes significant?

ZOOMING IN

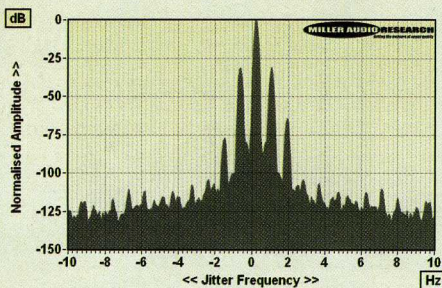
Jim's graph [p100] shows demodulated signals lying between DC–2Hz, rolling off very steeply above 2Hz. I would suggest we are seeing only those components that are inadequately suppressed by the buffering and resampling within Cambridge Audio's DACMagic. Even a high-Q PLL (phase-locked loop) with a crystal oscillator, or other clock recovery circuit, will have a finite

bandwidth below which it is ineffective. In this case it's clearly below about 2Hz.

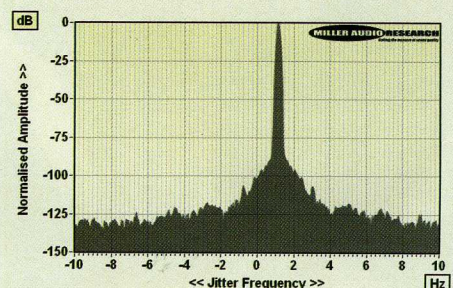
That we see a clear improvement when data is delivered to the DACMagic as S/PDIF via the Halide Bridge is not surprising. The Halide's asynchronous USB interface provides the master clock which regulates the flow of USB packets from the PC/Mac while the DACMagic uses isochronous packet transfer directed by the host PC instead. Moreover, the DACMagic's USB interface downsamples all data to 48kHz/16-bit and offers a far lower intrinsic S/N ratio than realised by the same data transmitted via S/PDIF. So S/PDIF sounds better than USB.

To test this theory I repeated Jim's experiment with my own software and with Musical Fidelity's V-Link in place of the Halide Bridge. My test yielded a discrete and very obvious $\pm 0.9\text{Hz}$, $\pm 1.8\text{Hz}$ (etc) jitter from a 12kHz signal at just -30dB [Graph, below left]. If this were a turntable it would equate to a peak W&F figure of just 0.0005% but treated as Type 1 jitter it comes out as a massive 1680nsec (1680,000psec). With the same USB audio captured first by the V-Link's asynchronous input and then transferred to the DACMagic as S/PDIF, all such jitter vanishes [Graph, below].

So, along with our standard jitter tests and care over galvanic isolation, I suggest we now add 'digital wow' to *Hi-Fi News'* analytical toolbox. ☺



ABOVE: Substantial jitter sidebands at $\pm 0.9\text{Hz}$ from USB audio transfer to DACMagic



ABOVE: As left, but with USB captured by V-Link then handed to DACMagic as S/PDIF