



Non-oversampling Digital filter-less DAC Concept

We read with great interest the interview Mr. Kusunoki gave to TNT-Audio http://www.tnt-audio.com/intervis/kusunoki_e.html.

Mr. Kusunoki wrote an excellent description of the process implemented here on his website <http://www.sakurasystems.com/articles/Kusunoki.html>.

During the development of our D/A converter, we also intended to implement CD playback without a digital filter using our **Linear Analog Oversampling Technology (LIANOTEC®)**.

In the charts below, we would like to explain in a little more detail why we came to the conclusion that omitting digital oversampling makes sense only at sampling rates of 192 kHz/24 bits and 176.4 kHz/24 bits.

CD 44.1kHz/16bit, 48kHz/16bit

At a sampling rate of 48 kHz, there are simply too few sampling points to reproduce a normal 10 kHz sinusoidal signal. Figure 1 compares the output signal of a D/A converter with and without digital oversampling.

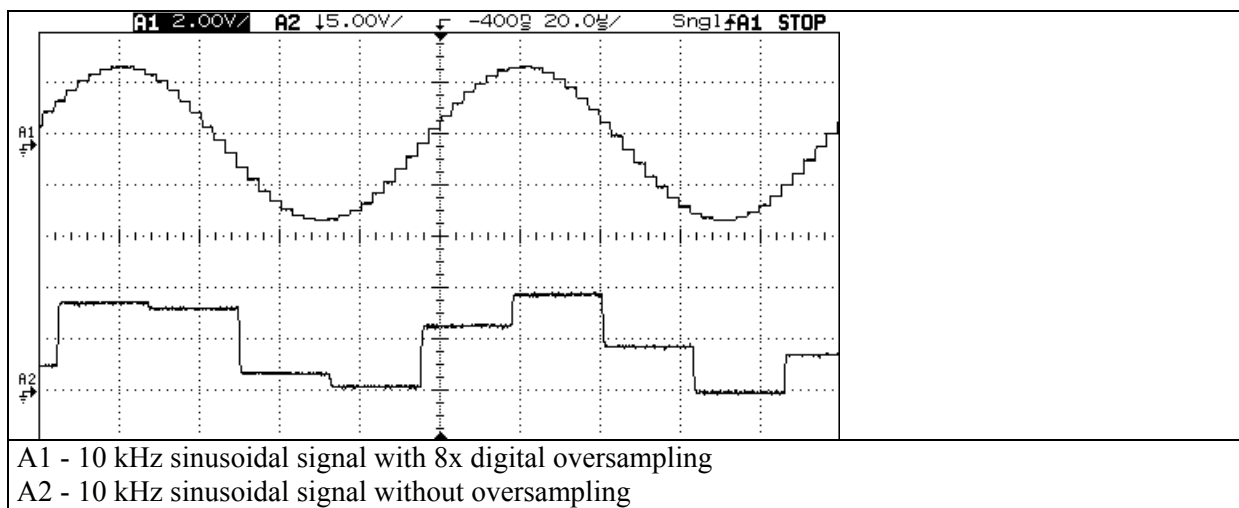


Figure 1

Even with "LIANOTEC®", it is impossible to generate a low-distortion 10 kHz sinusoidal signal from only 5 sampling points. Figure 2 shows the output signal from the TRINITY® DAC when a sampling rate of 48 kHz is applied without an additional digital filter.

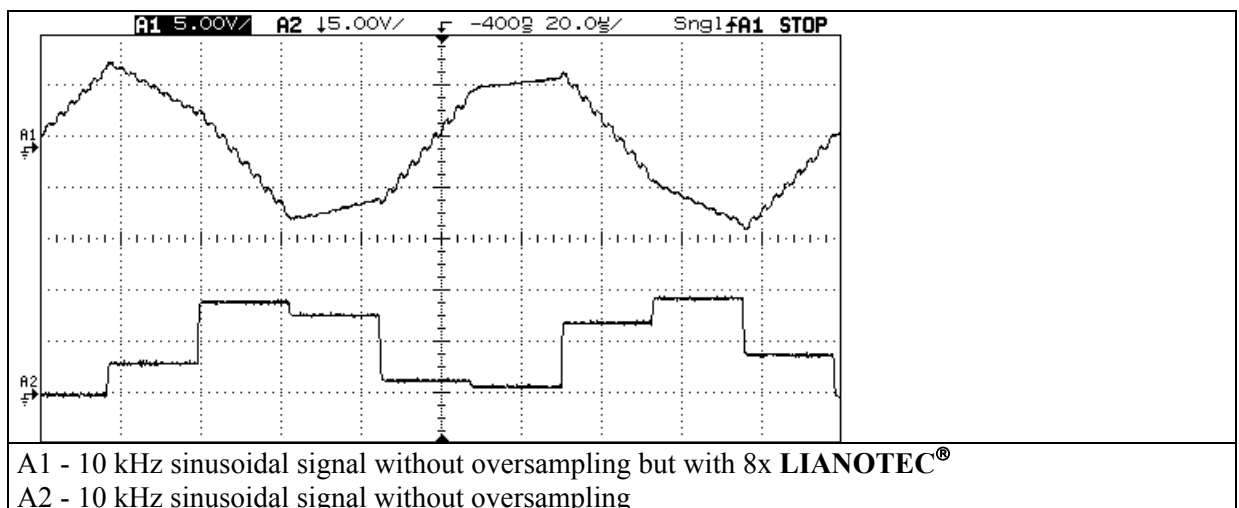


Figure 2



Although the output signal already looks much better, we still decided to use LIANOTEC® for data streams of 32 kHz through 96 kHz only in connection with an 8x digital oversampling. Figure 3 shows the output signal of the TRINITY® DAC downstream of the digital filter with additional 8-fold analog interpolation.

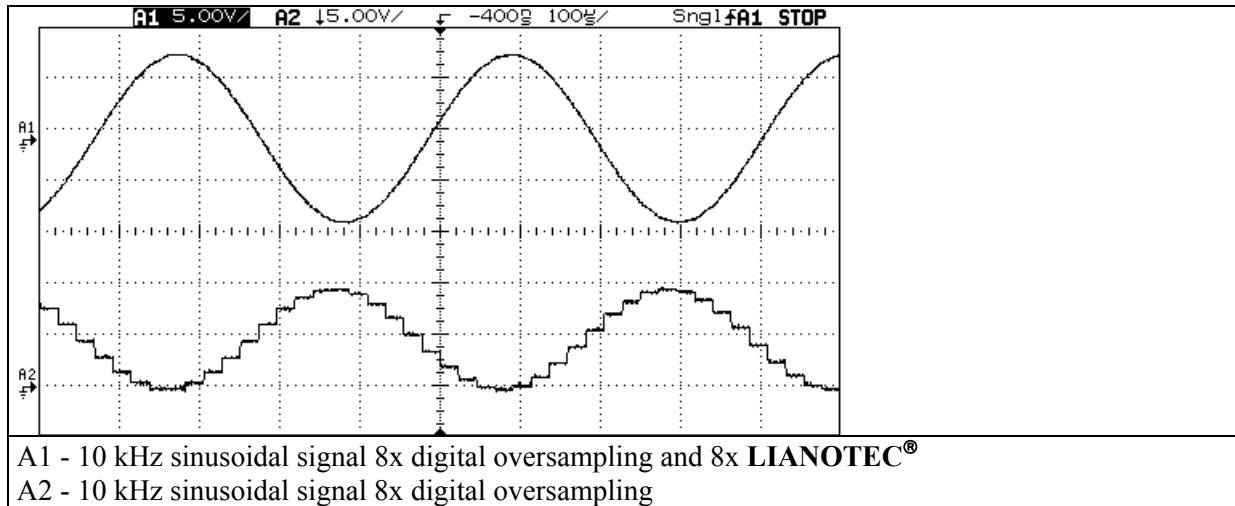


Figure 3

Here, you can clearly see why it is possible to omit the sound-distorting analog filter when additional analog oversampling is used.

Since linear oversampling provides an ideal impulse response, the impulse response of the digital filter is retained.

Figure 4 shows the impulse response of the digital filter with additional 8-fold analog oversampling.

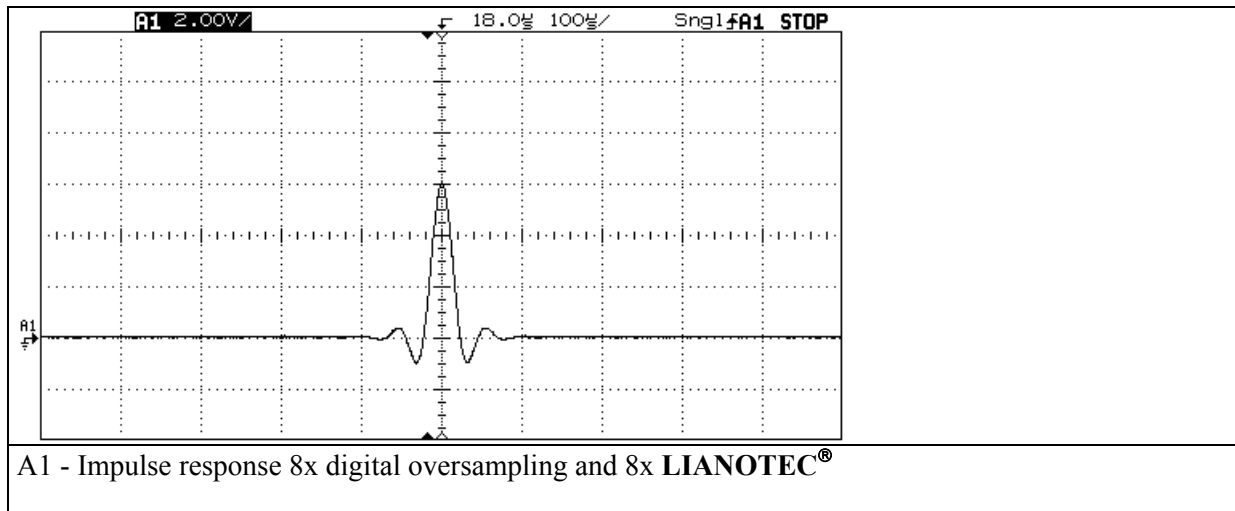


Figure 4



DVD-Audio 192kHz/24bit

It makes sense to omit the digital filter for DVD audio data streams at a sampling rate of 192 kHz. Figure 5 shows a 5 kHz square-wave signal (R&S Professional TEST DVD Vol.3 192 kHz sample frequency/38 = 5.052 kHz at 0 dBFS) at the output of the TRINITY[®] DAC.

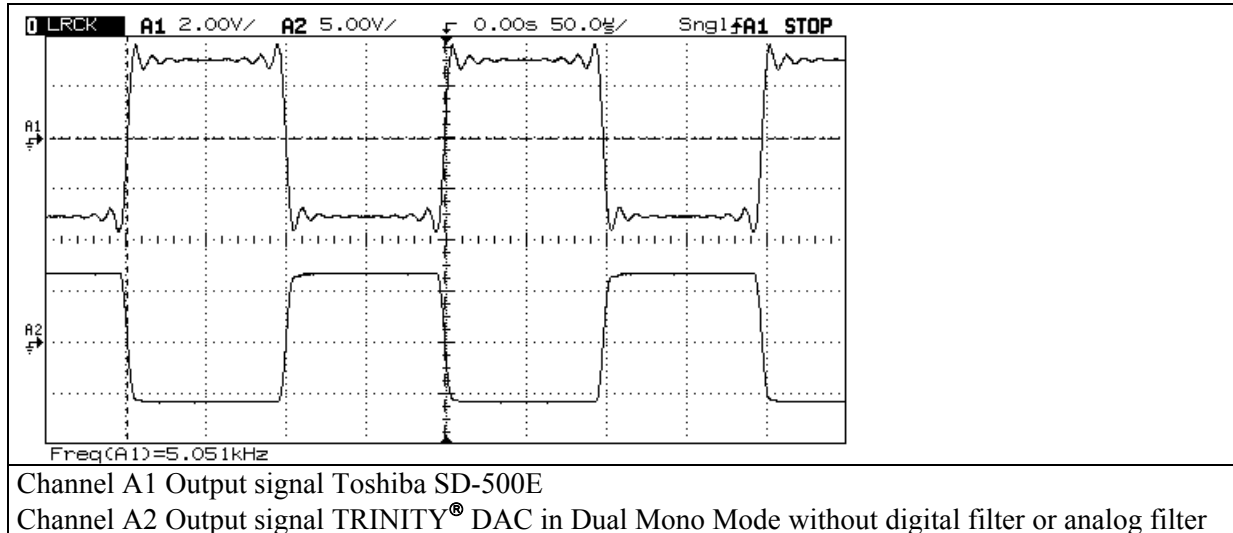


Figure 5

The leading-edge and trailing edge overshoots that are usually caused by digital filtering are missing.

Of course, then we asked ourselves what the sound quality would be like.

To find out, we first had to make some modifications to a DVD-A player. For more details on this, please visit our website at <http://www.gte-audio.de/de/service.htm> under "DVD Audio".

The effort was worthwhile, since we can now enjoy 192 kHz recordings without digital or analog filters.

Meanwhile, we have compiled various DVD-A tracks (<http://www.gte-audio.de/pdf/dvd-audio.pdf>) that permit a comparison of various sampling rates and formats. Unfortunately, the selection of 192 kHz recordings is still very small, but we are continuously searching for new releases in this format.

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