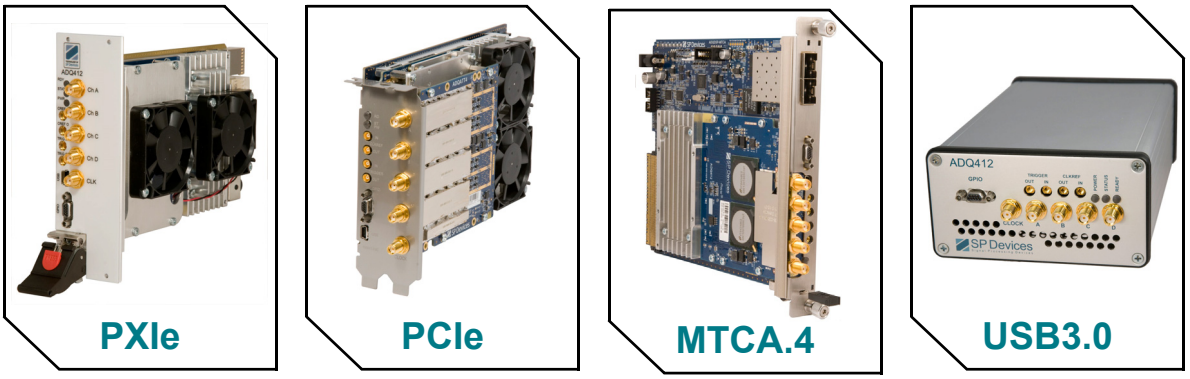
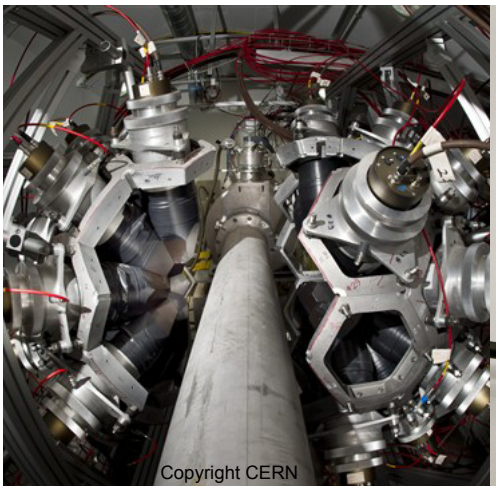
Operating ADQ412-4G at 8 GSPS for capturing fast pulses

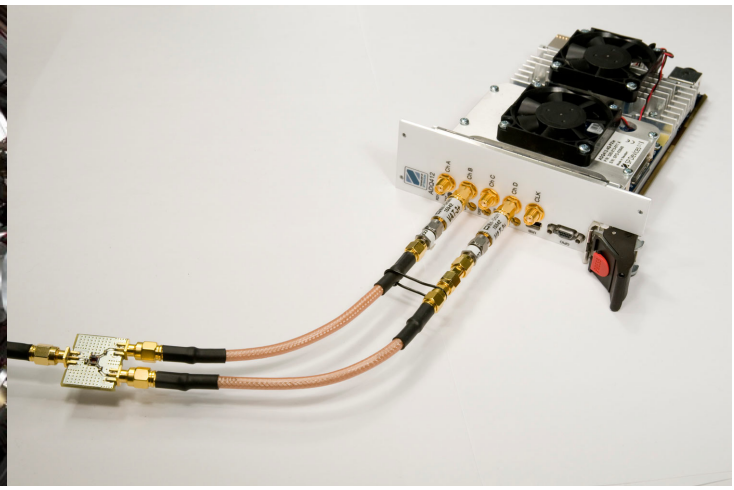


The ADQ412-4G is a leading 12-bit digitizer featuring 2 channels sampling at 4 GSPS each. This application note illustrates how to combine the 2 channels into a single channel sampling at 8 GSPS.

In a pulse data systems sample rate is the key parameter for the digitizer selection. The sample rate generally has to be high compared to the bandwidth of the pulse. Reaching 8 GSPS using the ADQ412-4G as in this application note would, for example, result in 4 samples per pulse from a detector with 1 GHz bandwidth (500 ps pulse duration).

Combining the 8 GSPS with the high dynamic range of the 12-bit ADQ412-4G results in a unique possibility for high performance feature extraction of the fast pulses.





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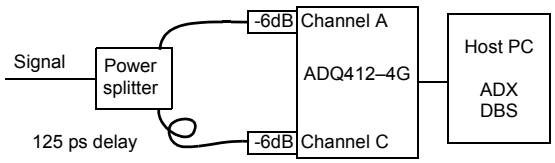
Reaching 8 GSPS with interleaving

The ADQ412-4G digitizer is provided with 2 channels sampling at 4 GSPS per channel. The digitizer is internally interleaved for high speed and benefiting from SP Devices' proprietary interleaving technologies, ADX and DBS. ADX and DBS are built into the firmware in the FPGA.

To reach 8 GSPS, the card is also interleaved externally and, in this experiment, the interleaving correction is executed off-line in the PC. The two inputs are sampled at 4 GSPS synchronously and the signal is connected to both inputs. To reach 8 GSPS, one of them has a delay of 1 / 8GSPS = 125 ps to emulate a phase shift of the clock on that channel. The delay is achieved with a cable length adjustment of 25 mm. The attenuators at the inputs of the ADQ412-4G is there only to reduce reflections in this specific lab set-up. A block diagram of the setup is shown in **Figure 1** and the performance is summarized in **Table 1**.



Timing accuracy[1]	< 10 ps
SFDR @ 200 MHz	59 dBc
ENOB @ 200 MHz	8.1 bits
THD @ 200 MHz	–64 dBc
Bandwidth	1 GHz (corresponds to 500ps pulse duration)

1. This is the deviation from the ideal sample timing. The deviation comes from the external splitter and is measured over the analog frequency band.

Figure 1: Experiment setup. See photo on page 1.

Table 1: Typical performance at 8 GSPS.

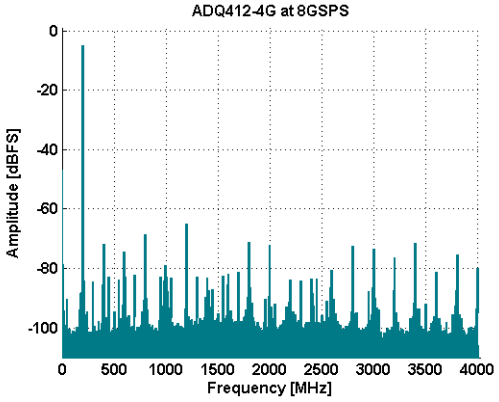
Interleaving technology

SP Devices' proprietary technology for time-interleaving of ADCs, ADX, enables unique performance in digitizers. ADX handles the typical artifacts, which are well known for interleaved digitizers. The performance with ADX is typically as good as the ADC components in itself, which means that the sample rate can be increased with maintained high dynamic range.

For pulse data systems, the baseline is a reference point in calculating timing and energy. SP Devices' proprietary technology Digital Baseline Stabilizer, DBS, is an interleaving technology for pulse data system, that tracks and adjusts the baseline with up to 22 bits precision.

Result

The interleaved result is shown in **Figure 2** and **Figure 3**. The result is a 12-bit digitizer at 8 GSPS. The high sample rate compared to the signal bandwidth is utilized in pulse data systems, where pulse data parameters requires many samples per pulse.



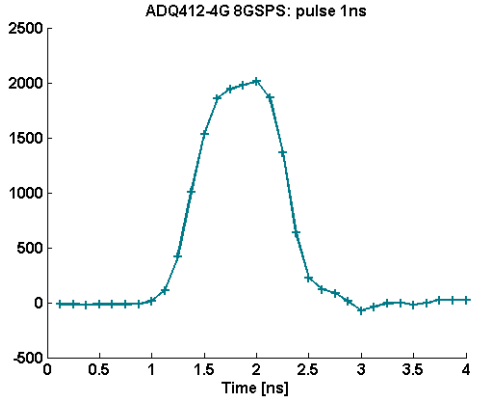


Figure 2: FFT: 200 MHz signal sampled a 8 GSPS.

Figure 3: 1ns duration pulse sampled at 8 GSPS.

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