

Using enhanced trigger accuracy in MATLAB

1 Enhanced trigger accuracy

In a standard set-up, the time stamp of a data is set only by the sampling clock. The time resolution is then only $1/f_s$, that is 2.5 ns for $f_s = 400$ MSps. The trigger in ADQ214 is however sampled by $4 \times f_s$. The trigger resolution is thus 625 ps. This enhanced trigger accuracy can be used to align data vectors from a set of measurements where the trigger is not phase locked to the sampling clock.

The enhanced timing information is accessed by reading register 17. Register bit 10 and 11 is the offset between the trigger event and the sampling clock, [Table 1](#).

Table 1: Trigger offset code

Bit 10	Bit 11	Trigger offset [Sample period]
0	0	0
0	1	1/4
1	0	2/4
1	1	3/4

The alignment of data can be done by adjusting the time scale for each vector, [\(1\)](#).

$$\text{adjusted time} = \text{original time} + \text{trigger offset.} \quad (1)$$

Trigger offset is from [Table 1](#). The units in [\(1\)](#) is sample index.

Another method is to interpolate data to corrected sampling times, [\(2\)](#).

$$\text{adjusted data } (n) = \text{data } (n+1) - \text{trigger offset } (\text{data } (n+1) - \text{data } (n)) \quad (2)$$

The interpolation is illustrated in [Figure 4](#).

2 Example code

The MATLAB example code `ADQ214_accurate_trigger.m` illustrates how to use the enhanced trigger accuracy. The example contains code for read out of the trigger offset information. The wave forms are adjusted according to [\(1\)](#) and [\(2\)](#). The example also contains a trigger analysis, see [Section 3](#).

3 Trigger analysis set up

A **typical** measurement set-up is shown in [Figure 1](#). Signal source is a square wave generator. High precision instrument is not required. 10 kHz is only an example of frequency setting. The amplitude has to be large enough to trig the ADQ214 even after the power splitter. The signal generator must **not** be locked to the sampling clock. The evaluation rely on the pseudo time noise generated by two drifting oscillators. The filter on the signal to channel B generates a ramp of the trigger edge. The ramp is locked in time to the trigger event. The timing of the ramp can be accurately determined and thus the time of the trigger event can be analyzed.

The result of the analysis shows that the trigger uncertainty is reduced by a factor of 4. The original data in [Figure 2](#) spreads across an entire sampling period in time. The accurate trigger information is used for adjusting the time scale [\(1\)](#), which gathers the curves to within 1/4 of a sampling period, [Figure 3](#). The interpolation in [\(2\)](#) yield the same result, [Figure 5](#).

4 Compatibility

This application note is applicable on ADQ214 P/N 310-000-000 Rev A.

5 Reference

MATLAB code `ADQ214_accurate_trigger.m` is available on the software CD.

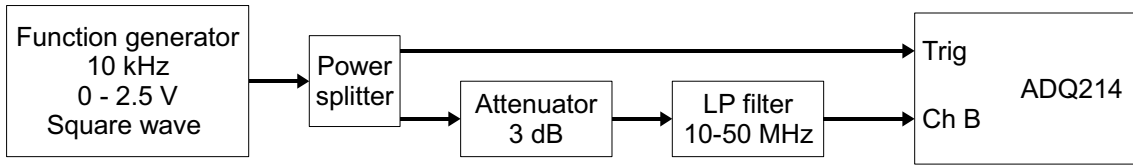
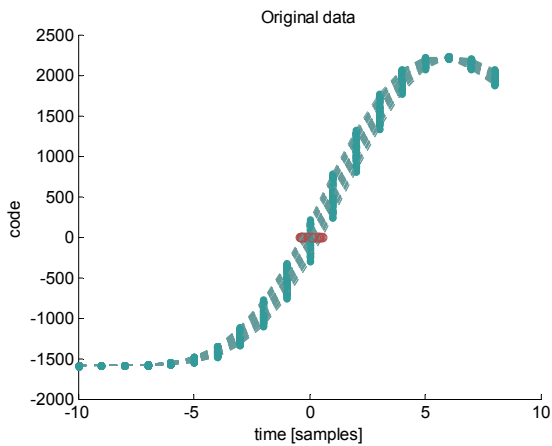
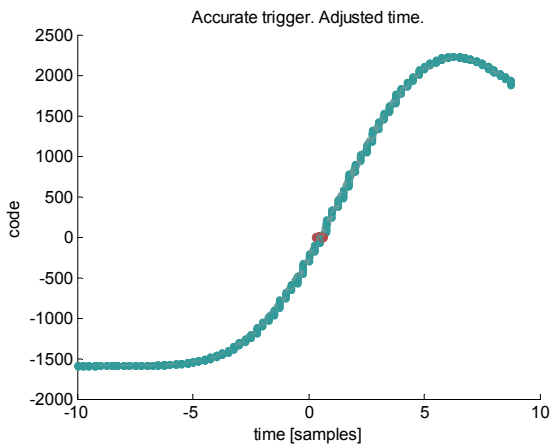


Figure 1: Measurement set-up. Example is for channel B. Channel A is equivalent.



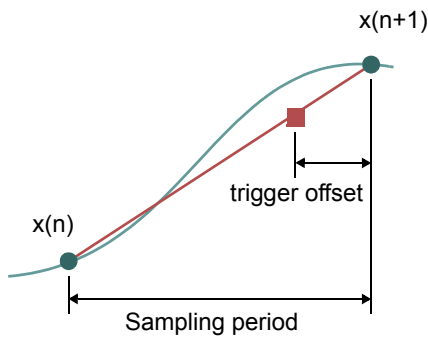
Spread +/- 0.5 samples
Standard deviation 0.28

Figure 2: Original data



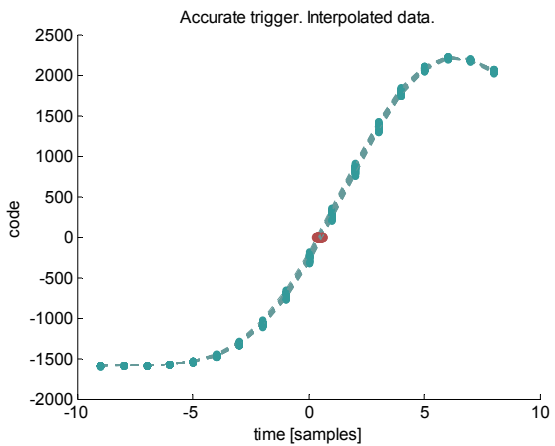
Spread +/- 0.125 samples
Standard deviation 0.069

Figure 3: Adjusted time vector



trigger offset	Accurate trigger data
x	Data vector
n	Time index

Figure 4: Interpolation principle



Deviation +/- 0.125 samples
Standard deviation 0.066

Figure 5: Interpolated data.