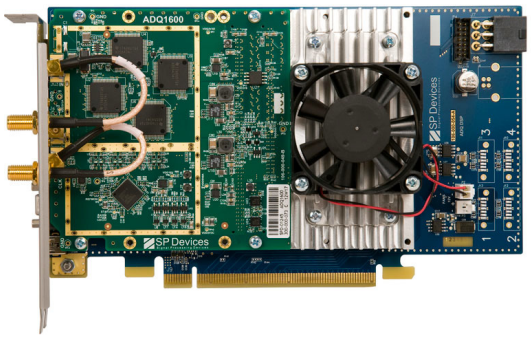

Application Note: Acquisition modes

The ADQ series of digitizers supports several modes of acquisition to serve a large variety of measurement situations.

This document is an overview of the acquisition modes. Deviations may occur on specific digitizer models.

1 Introduction

The ADQ series of digitizers supports several acquisition modes. The application note intend to give understanding on how these modes work.

See also the trigger application note for more information about the trigger options. The Data transfer application note gives more information on how to move data from the digitizer to the PC. Also information on how to partition the entire signal chain is in the Data transfer application note.

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2 Definitions

#	NAME	DESCRIPTION
1	Record	A sequence of samples
2	Sample	One single data value from the A/D converter
3	ADQ DRAM	DRAM on the digitizer (also SDR14)
4	PC DRAM	RAM in the host PC
5	FPGA RAM	Ram in the FPGA on the digitizer
6	Waveform	See Record

Table 1: Definitions

3 Summary of acquisition modes

REF	NAME	DESCRIPTION	PARAMETERS
4.1	Single-record	One record is collected at the trigger. This is a special case of Multi-record mode	Number of records Record length Pre-trigger Trigger hold-off
4.2	Multi-record	One record is collected at each trigger. The records are stored in ADQ DRAM. Read out is performed after acquisition completed.	Number of records Record length Pre-trigger Trigger hold-off
4.3	Read out while recording	The same as Multi-record, but the read out can start before acquisition is completed.	Number of records Record length Pre-trigger Trigger hold-off
4.4	Continuous multi-record.	The same as Multi-record, but the read out can start at the same time as acquisition. Instead of filling the ADQ DRAM and then read out the data (as for multi-record), the ADQ DRAM is used a circular buffer in a continuous operation.	Record length Pre-trigger Trigger hold-off
4.5	Triggered streaming	At each trigger, a record is collected and sent directly to the host PC.	Record length Pre-trigger Trigger hold-off
4.6	Continuous streaming	At a trigger, a continuous stream of data starts.	Custom

Table 2: Acquisition modes

4 Description of the acquisition modes

4.1 Single-record

This is a special case of Multi-record, **Section 4.2**, where the number of records is set to 1.

4.2 Multi-record

Multi-record mode is the method for acquiring sets very large records.

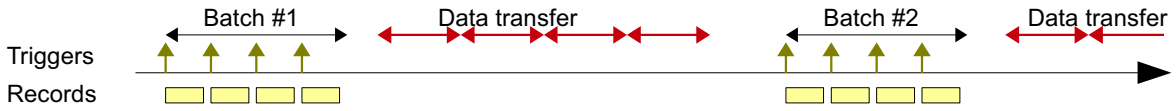
Set up a record size and a number of records. The trigger position is controlled via pre-trigger and trigger hold-off parameters. A header is added to each record with trigger information and time stamp. Data is stored in ADQ DRAM and read out is performed when the entire acquisition has completed.

Multi-record mode is preferred when

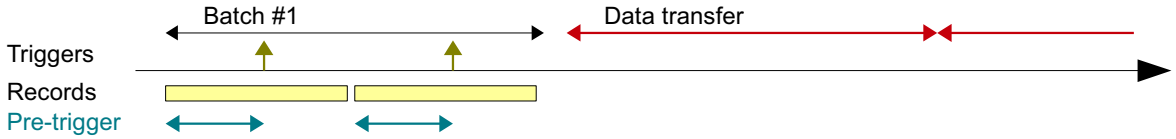
- Large records, up to millions of samples
- Dense triggers, that is high data rate
- Trigger bursts, that is high average data rate

Limitations to multi-record are

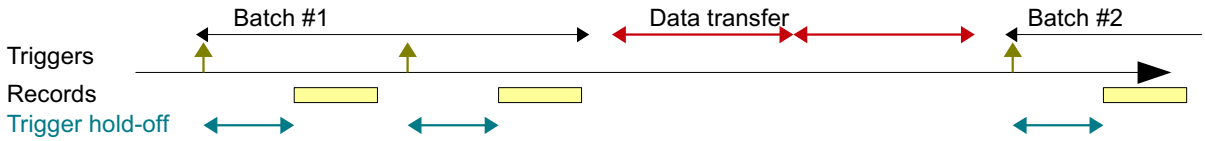
- Total data set must be kept below ADQ DRAM size.



(a) Multi record



(b) Multi record with pre-trigger



(c) Multi record with trigger hold-off (trigger delay)

Figure 1: Multi-record.

4.3 Read out while recording[1]

Read out while recording is an extension of multi-record that speeds up the read out process.

After setting up a multi-record acquisition, **Section 4.2**, the read-out is started as soon as the first record has been stored in the ADQ DRAM. This feature puts high requirements on the ADQ DRAM since the ADQ DRAM has to alternate between read and write operations. The real time recording of data from the ADCs is always scheduled with higher priority than the read operation. For high data rate operations, there is not sufficient time for reading data.

The advantage of the read out while recording mode is visible if the triggers are sparse. Then most of the memory content is read out at the end of the batch and the dead time to the next batch can be reduced compared to standard multi-record mode.

Read out while recording multi-record mode is preferred when

- Large records, up to millions of samples
- Sparse triggers, that is the total time for acquiring all records is long.

Limitations to read out while recording multi-record are

- Data rate writing to ADQ DRAM has to leave time for readout.

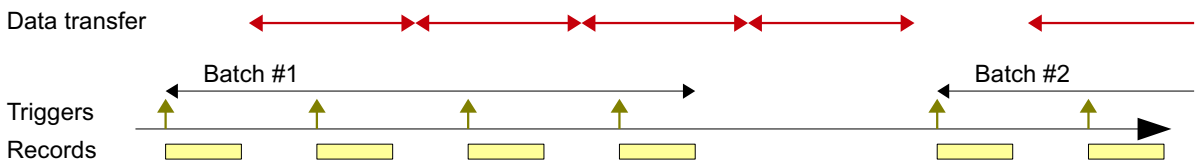


Figure 2: Multi-record with simultaneous read out.

1. This is sometimes referred to as simultaneous read out and acquire (SAR)

4.4 Continuous Multi-record.

Continuous multi-record enables never-ending acquisition of very large of records.

Continuous multi-record is a further extension of multi-record, **Section 4.2**, with read-out while acquire, **Section 4.3**. In the continuous multi-record mode, the trigger rate and the record size is set up to generate a data rate that is lower than the read out speed. The ADQ DRAM is set up to start again from address 0 when full as to provide a cyclic data acquisition. This is a variant of triggered streaming, **Section 4.2**, which allows very long records.

Continuous multi-record mode is preferred when

- Large records, up to millions of samples
- Long pre-trigger
- Sparse triggers
- The total data set is larger than the ADQ DRAM

Limitations continuous multi-record are

- Average data rate to the ADQ DRAM has to be smaller than the speed of the read out process.

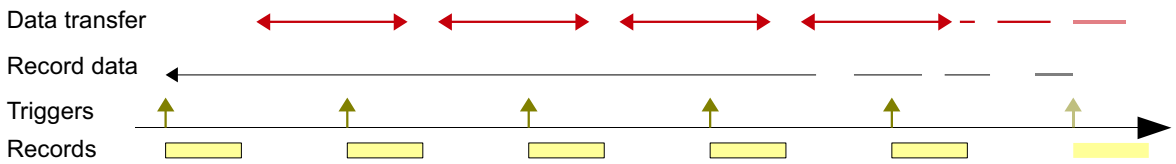


Figure 3: Continuous Multi-record.

4.5 Triggered streaming

Triggered streaming is the method for acquiring very many small records, **Figure 4**.

Triggered streaming also enables individual triggering of the channels[1], **Figure 5**.

Triggered streaming do not store data on the ADQ DRAM. All records are recorded in the FPGA FIFO and directly transfered to the host PC. The acquisition is set up with trigger position and record length. A header with time stamp and trigger information is added to each record.

Triggered streaming is preferred when

- Small records, up to kilo samples
- Short re-arm time
- Individual channel trigger and data transfer
- Sparse triggers
- The total data set is larger than the ADQ DRAM

1. Available on ADQ412 only.

Limitations continuous multi-record are

- Average data rate has to be kept below the speed of the read out process.
- Record size has to be smaller than FPGA FIFO

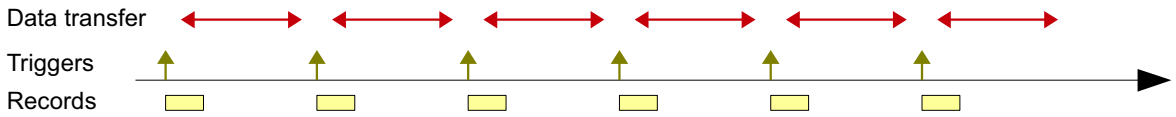


Figure 4: Triggered streaming

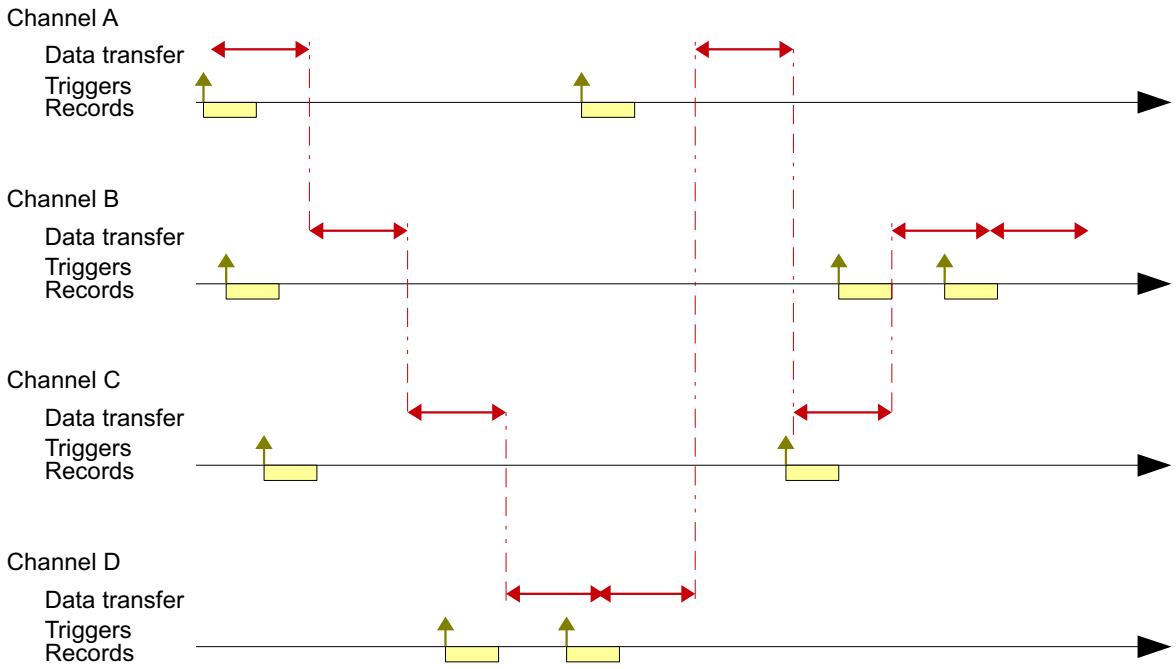


Figure 5: Triggered streaming with individual level trigger on ADQ412

4.6 Continuous streaming

Continuous streaming is the method for recording a continuous signal.

At the first trigger (e.g. software command), a continuous stream of data to the host PC is started. The FIFO buffer on the FPGA is limited. One have to make sure that the data rate is reduced to a level at which the host PC can read it. Custom data reduction can be implemented using the ADQ Development Kit. There is no header.

Continuous streaming is preferred when

- There is no records, only streaming data

Limitations continuous multi-record are

- Average data rate has to be limited in the FPGA to match the read out process.

Figure 6: Continuous streaming

5 Summary of available modes (as per 2014-04-14)

ADQ	MULTI RECORD	READ OUT WHILE RECORDING	CONTINUOUS MULTI RECORD	TRIGGERED STREAMING	CONTINUOUS STREAMING
ADQ112	YES	NO	NO	NO	YES
ADQ114	YES	NO	NO	Option	YES
ADQ212	YES	NO	NO	NO	YES
ADQ214	YES	NO	NO	Option	YES
ADQ108	YES	YES	YES	Option	YES
ADQ208	YES	YES	YES	Option	YES
ADQ208D	YES	YES	YES	Option	YES
ADQ1600	YES	YES	YES	Option	YES[1]
ADQ412-1G	YES	YES	YES	YES	YES
ADQ412-3G	YES	YES	YES	YES	YES
ADQ412-4G	YES	YES	YES	YES	YES
SDR14	YES	YES	YES	Option	YES[2]

Table 3: Acquisition modes on each product[3]

1. Custom data reduction required. Use ADQ1600 Development Kit.
2. Custom data reduction required. Use SDR14 Development Kit.
3. Contact an SP Devices' sales representative for information about optional configurations.

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