ADQ14OCT Datasheet

ADQ14OCT is a 14-bit high-performance data acquisition platform for Swept-Source Optical Coherence Tomography applications. It is designed to meet the most challenging measurement situations. ADQ14OCT features:

- *14-bit resolution*
- *10 MHz to 1000 MHz variable clock input*
- *Sustained streaming of up to 1 billion wavelengths / s*
- *Embedded fundamental OCT processing*
- *2 GByte on-board memory*

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ADQ14OCT Datasheet

Features

- 500 MHz OCT analog input bandwidth
- 10 to 1000 MHz variable clock input
- 14 bits vertical resolution
- A-scan external trigger input
- B-scan external trigger input
- 2 GBytes data memory
- Data interface PXIe / PCIe / USB3.0
- Embedded reconfigurable real-time FFT
- Embedded, real-time amplitude and logarithm computations

Applications

- Swept-source optical coherence tomography

Advantages

- 14-bit resolution for OCT images free of artifacts.
- USB3.0 form factor for compact systems.
- PCIe form factor for fast acquisition.
- Variable frequency K-clock input within the wide range of 10 MHz to 1000 MHz.
- Embedded real-time wide FFT configurable up to 32768 points.
- Programmable and flexible scan triggers and input signal ranges for easy integration.
- Instantaneous recovery from vanishing or weak K-clock electric signal.
- Back-to-back A-scan triggering capability for maximum acquisition speed.

1 Block Diagram and output options

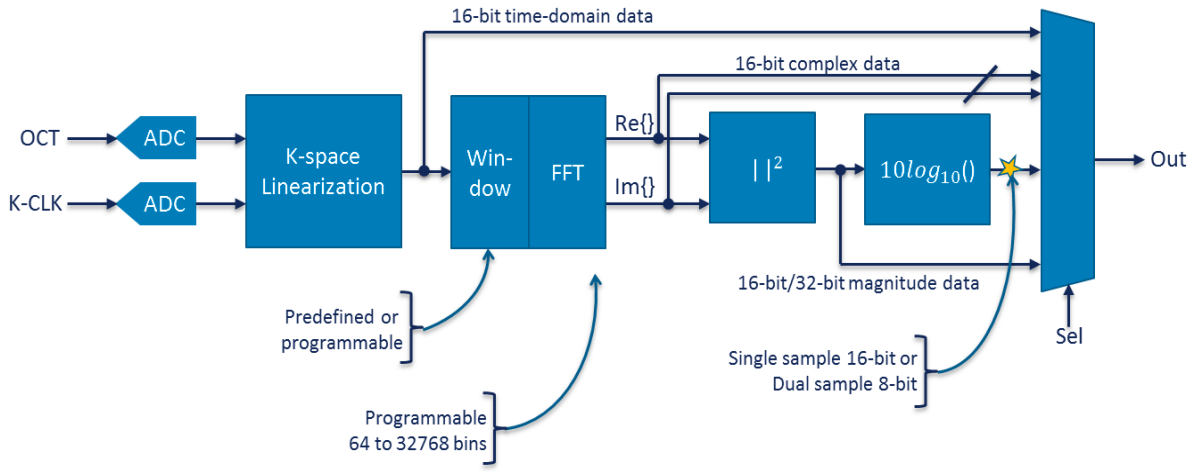


Figure 1: Block diagram showing the ADQ14OCT embedded signal processing. The output signal can be taken from various internal nodes providing flexibility of use.

2 Interfaces and Environment[1]

Table 1: General parameters

GENERAL PARAMETERS		
Key parameters		
OCT Channels		1
Minimum Input Clock Frequency	[MHz]	10
Maximum Input Clock Frequency	[MHz]	1000
Resolution	[bits]	14
SFDR @ -1dBFS (typical)	[dBFS]	75
Data memory[1]	[GByte]	2
Power		
Power supply	[V]	12
Power dissipation	[W]	36

1. The data memory is shared between data (2 bytes per sample) and record headers.

Table 2: Analog input

ANALOG INPUT		
OCT signal input		
Coupling		DC
Input Impedance	[Ω]	50
Input range[1]	[mV_{pp}]	500
Adjustable offset	[mV]	-250 to +250
Full power bandwidth	[MHz]	500
Connector		SMA, single-ende
Overvoltage protection		
Recommended max voltage	[mV]	50 above maximum input range

1. 1000 mVpp and 2000 mVpp are available. Please contact Signal Processing Devices regarding custom input range configurations.

Table 3: Input clock

K-CLOCK		
K-clock input signal		
Coupling		AC
Minimum frequency[1]	[MHz]	10
Maximum frequency	[MHz]	1000
Signal level (Range 1)[2]	[mVpp]	100 to 1000 (-16 to +4.5 dBm)
Signal level (Range 2)	[mVpp]	300 to 3000 (-6 to +14 dBm)
DC-level range	[V]	-5 to +5
Impedance	[Ω]	50
Connector		SMA, single-ended

1. ADQ14OCT recovers instantaneously after fading or disrupted K-clock signals.
2. Programmable K-clock input range. Lower signal levels available on request.

1. All values are typical unless otherwise noted.

Table 4: Trigger

TRIGGERS		
A-trig (A-scan trigger)		
Maximum A-scan rate PCIe	[MHz]	977kHz @ 1024 points/scan[1]
Maximum A-scan rate USB3.0[2]	[MHz]	150kHz @ 1024 points/scan
Voltage range	[V]	–0.3 to 3.3
Threshold	[V]	Programmable 0.5 and 3.0
Polarity	[V]	Programmable rising or falling edge
Impedance	[Ω]	Programmable 50 / 500
Connector		SMA, single-ended
B-trig (B-scan trigger)		
Voltage range	[V]	–0.3 to 3.3
Threshold	[V]	Programmable 0.5 and 3.0
Polarity	[V]	Programmable rising or falling edge
Impedance	[Ω]	Programmable 50 / 10k
Connector		SMA, single-ended

1. 122kHz @ 8192 points/scan, 30kHz @ 32768 points/scan e t c.
2. 300kHz is achievable for USB3.0 with post-logarithm truncation to 8 bit per sample representation.

Table 5: Environment

INTERFACE TO HOST PC OPTION		USB3.0 –USB	PCI EXPRESS –PCIE	PXI EXPRESS –PXIE
Data rate				
Standard		USB3.0	Gen2 by 8 lanes	Gen2 by 8 lanes
Data rate sustained[1]	[MBytes/s]	300	3200	3200
Mechanical				
Box size	[mm^3]	191 x 108 x 62	–	–
Weight	[g]	750	–	–
Bus width mechanical	[lanes]	–	16[2]	–
Board width	[slot]	–	2	2
Board length		–	half-length	–
Electrical				
Power supply		External[3]	6-pin ATX power	From chassis
Bus width electrical	[lanes]	–	8	8
Temperature range				
Operation	[^{o}C]	0 to 45	0 to 45	0 to 45
Compliances				
CE		✓	✓	✓
RoHS2		✓	✓	✓

1. This is depending on the capacity of the complete system including the host computer.
2. The wide contact is required to support the weight of the board.
3. Use only the power supply which is included in the delivery of ADQ14OCT–USB.

Table 6: Software

Operating systems	
Windows 7 32b and 64b	✓
Windows 8 / 8.1	✓
Windows 10	✓
Linux[1]	Kernel 2 and 3, main distributions
Application	
MATLAB[2]	API, examples
C/C++	API, examples
.Net (C#, Visual Basic)	API, examples
Python	Example scripts
LabVIEW	DLL import

1. Contact SP Devices sales representative for information about distributions.
2. Windows only.

3 Absolute maximum ratings

Exposure to conditions exceeding these ratings may reduce lifetime or permanently damage the device.

The ADQ14OCT has a built-in fan to cool the device. The built-in temperature surveillance unit will protect the ADQ14OCT from overheating by temporarily shutting down parts of the device in an overheat situation.

The SMA connectors have an expected life time of 500 operations. For frequent connecting and disconnecting of cables, connector savers are recommended.

Table 7: Absolute Maximum Ratings

Analog		
Signal level (with overvoltage protection)		See Table 2
Signal level (w/o overvoltage protection)		500 mVpp
Power supply		
Voltage to GND (min)	[V]	–0.4
Voltage to GND (max)	[V]	14
Temperature		
Operating (min)	[^{o}C]	0
Operating (max)	[^{o}C]	45
A-scan trigger		
Voltage to GND (min)	[V]	–2.3
Voltage to GND (max)	[V]	5
B-scan trigger		
Voltage to GND (min)	[V]	–0.5
Voltage to GND (max)	[V]	3.8
K-clock		
Absolute input current (max)	[mA]	100

4 Functional overview

4.1 Overview

The digitizer includes an analog front-end with signal conditioning, A/D conversion, OCT processing, and a digital back-end for data flow control, triggering and host communication.

This section describes functions included in the standard data acquisition firmware package

4.2 Data recording

There are several methods for data recording to serve different use cases:

- Continuous multi-record recording to on-board DRAM for very long records.
- Triggered streaming for fast data transfer and long measurement time.

To support data recording, there is on-board DRAM of 2 GBytes. See application note about data acquisition modes for more details.

4.3 Signal processing

There is support for real-time signal processing on the digitizer:

- Fast Fourier Transform of OCT signals.
- Amplitude and Logarithm computation of frequency-domain data.

4.4 Trigger

There are several trigger modes:

- A-scan and B-scan trigger for synchronized operation.
- Software for user's control.

The trigger timing relative the data is controlled by a pre-trigger and post-trigger delay parameters.

The main mode of operation is to let the A-scan and B-scan triggers control the data-flow.

At each A-scan trigger a pre-defined number of samples (record length) are acquired. Each sample is taken on the rising/falling edge of the K-clock signal.

4.5 K-Clock

The digitizer is clocked with a variable frequency via the K-clock input.

4.6 CLK Reference

An input port typically used only during factory calibration and test.

4.7 A-scan and B-scan triggers

The A-scan and B-scan triggers (A-trig and B-trig, respectively) are intended for synchronizing data acquisition with external equipment.

5 Software tools

5.1 Operating systems

The software package includes drivers for the main operating systems.

5.2 Software development kit (SDK)

The ADQ14OCT digitizer is easily integrated into the application by using the software development kit. The SDK is included with the ADQ14OCT.

The SDK includes programming examples and reference projects for C/C++ and MATLAB. The ADQAPI user's guide describes all functions in detail. Many examples and application notes simplify the integration process.

Using the SDK enables rapid custom processing of large amounts of data and real-time control of the digitizer.

6 Embedded signal processing firmware

The standard firmware supplied with the ADQ14OCT will extract the OCT signal and transfer it to the host PC for visualization. Further, fundamental OCT signal processing is provided within the FPGA on the digitizer which will offloads the host PC computations. These operations include a Fast Fourier Transform (FFT) and logarithm computations. The embedded real-time FFT core has an FFT-size that is programmable between 64 and 32k bins.

7 Data interface options

Stand-alone operation with USB3.0 interface (–USB)

The SuperSpeed USB3.0 interface is intended for stand-alone operation and allows the ADQ14OCT to be integrated with the laser and photo-detector rather than the host PC. The USB box includes flanges for fastening of the box and screw attachment of the USB cable.

With the USB3.0 interface, the digitizer is easily connected to any computer.

Systems integration with PCIe interface (–PCIE)

The PCIe form factor is for integration into the host PC. The high speed PCIe interface can handle data rates up to 3.2 GBytes/s. This is specially useful when combining the digitizer with heavy computation in, for example, a GPU in the same PC. The board is half length to enable compact solutions.

Modular instrumentation with cPCIe / PXIe (–PXIE)

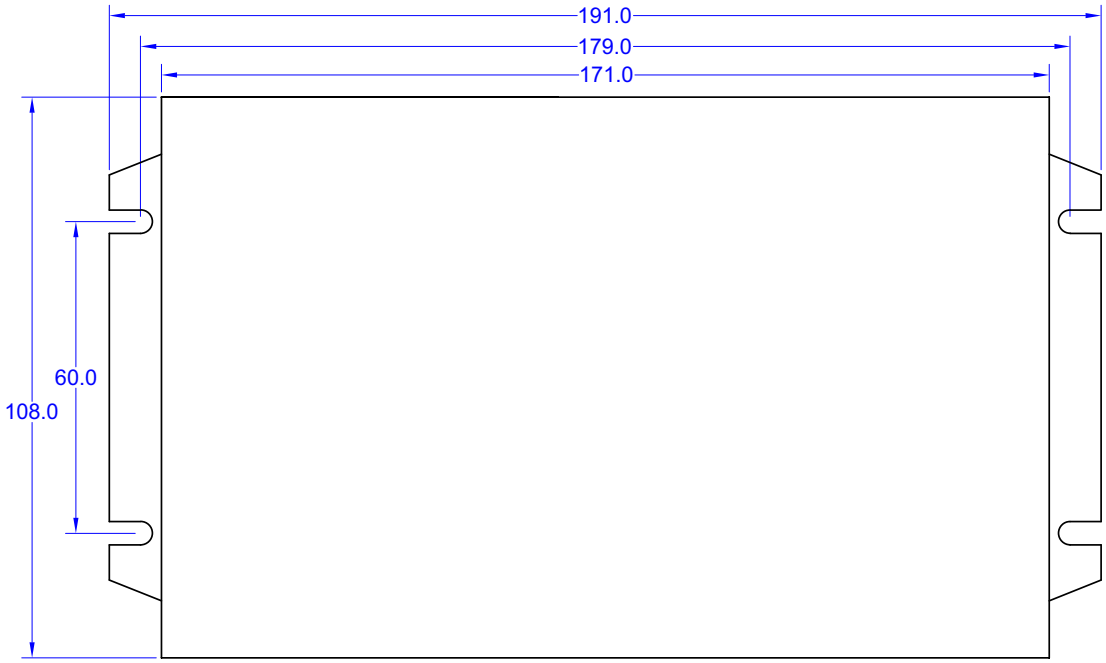
The cPCIe / PXIe form factor is intended for integration into a chassis for modular instrumentation or large scale acquisition. The ADQ14OCT can operate in Compact PCI Express or PXI Express chassis. Using the multi-unit sync function, multi-channels systems can be achieved.

Use peer-to-peer streaming at up to 3.2 GBytes/s for sending data to disk or additional computational FPGA cards (ADQDSP).

In a PXI Express chassis, the clock reference from the backplane can be used as clock reference for the digitizer.

8 Appendix

8.1 USB fastening



8.2 Cable attachment

All cables have lock function so that no cable should fall out unintentionally.

FUNCTION	CONNECTOR	–USB	–PCIE	LOCK FUNCTION
OCT data	SMA	✓	✓	Screw
Triggers	SMA	✓	✓	Screw
K-Clock	SMA	✓	✓	Screw
Clock reference	SMA	✓	✓	Screw
Power	DIN	✓		Snap lock
Power	Backplane		✓	Screw attached board in chassis
Data/control	USB3.0	✓		Screw attachment vision USB standard[1]

1. Optional cable solution. Not included in standard shipment.

8.3 LED definitions

COLOR	NAME	FUNCTION	STATE
Green	Power	Power on	On: Power on and FPGA is operating
Yellow	Ready	Waiting for trigger	The ADQ14OCT is set up to accept trigger and waiting for the trigger
Red	Status	Overheat	Flashing means overheating or fan fault.
Blue	User	Custom	On during initialization of the board.

Ordering information

ORDERING INFORMATION	
ADQ14OCT	ADQ14OCT
AVAILABLE OPTIONS	
Host PC interface	–USB, –PCIE, –PXIE
RELATED PRODUCTS	
USB3.0 cable with screw lock	108-002-006

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