Acqiris SA230E
14-bit ADC Module, 4 GS/s, 1 channel with FPGA signal processing

DATASHEET

Preliminary

FPGA

ADC

FMCK

LDNA

AVG

+12V ⎓ 8A max
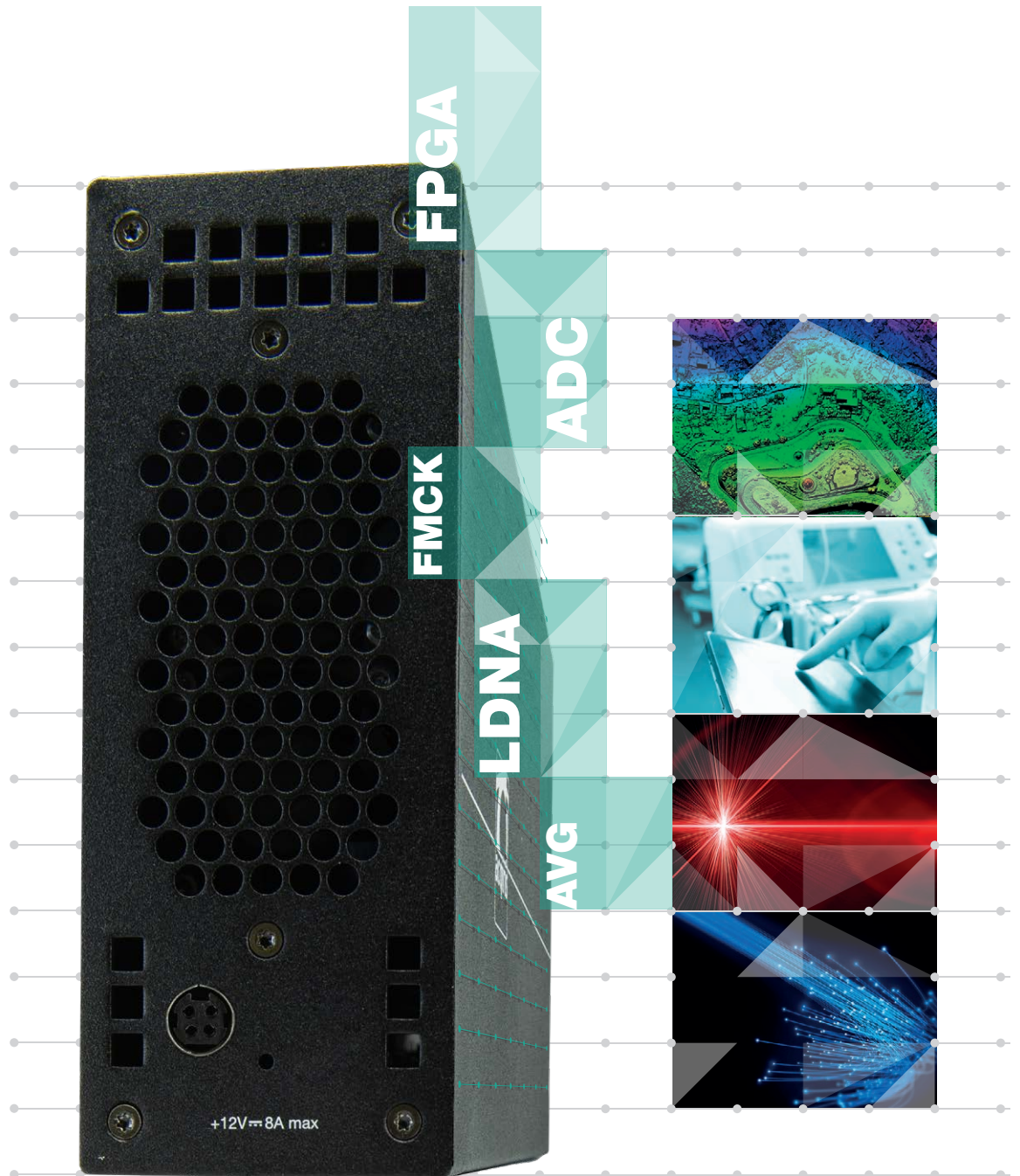
See deeper and sharper than before

Figure 1. SA230E ADC module with USB-C Thunderbolt 3 interface

New generation of Signal Acquisition cards and modules

The SA2 is Acqiris's high-performance 14-bit ADC card platform, performing fast signal acquisitions from 1 GS/s up to 10 GS/s, with excellent signal fidelity across a wide bandwidth. This new generation focuses on addressing unique OEM application needs.

The SA230E is the 4 GS/s serial module version of the SA2 product line, offering flexibility and modularity. This unique DC coupled 14-bit digitizer captures waveforms from DC up to 2 GHz.

Features depending on your application (options)

Increased recording time:
- Up to 8 GB memory allowing for 4 GSamples
- Streaming capability up to 2 GB/s

Real-time processing:
- High digitized data throughput thanks to Thunderbolt 3 connection
- Kintex UltraScale FPGA for on-board signal processing
- Custom real time-processing

Essential features

Accurate and precise measurement

- 14-bit resolution
- 4 GS/s sampling rate on 1 channel
- DC up to 2 GHz bandwidth
- DC coupled, 50 Ω input impedance
- 500 mV or 2.5 V, selectable full scale range
- Programmable DC offset ($\pm$ FSR/2)

Signal fidelity

- Low noise density and low distortion
- Optimized frequency response flatness
- Excellent and flat SFDR over a large analysis bandwidth (70 dBc)
- Optimized response allows few hundred picoseconds pulse analysis.
- Unique 15 ps RMS trigger time interpolator precision.

Product description

All the ADC cards from the SA2 generation implement a proprietary low noise front-end enabling undisputed spurious-free dynamic range (SFDR) and signal noise ratio (SNR) performances in high frequencies.

This makes the ADC modules ideal for OEM applications requiring digitizer sampling at wide bandwidth and very high dynamic range, especially at 500 mV full scale range.

The USB-C Thunderbolt 3 link enables high data transfer rate and streaming capabilities to the remote computer at up to 2 GB/s.

The SA230E offers modularity and high performance in a small footprint.

For information on specific application please contact us: support@acqiris.com.

Integration in your system

Benefit from responsive signal acquisition solutions for your application.

Applications

Because each OEM project is unique, we develop data acquisition cards and modules based on standard platform that can be fine-tuned to address your particular challenges.

We propose signal acquisition solutions easy to integrate in your system, fitting your actual requirements, and including only what you need.

The SA230E includes on-board FPGA offering real-time signal processing capability such as waveform averaging or peak listing. We also propose to open the FPGA for custom real-time processing.

More than a digitizer, the ADC module's programmable I/O signals allow for system control.

This data acquisition module with advanced real-time processing capabilities is specially designed for embedded OEM applications in a variety of challenging measurements, imaging and processing systems, including:

- Analytical time-of-flight (TOF)
- Ultrasonic non-destructive testing
- Medical research and imaging instrumentation
- Environmental monitoring using laser scanning (LiDAR)
- Distributed strain and temperature sensors (DSTS)

Overall performance of the SA230E enables deeper, faster and more accurate measurement and analysis for final products.
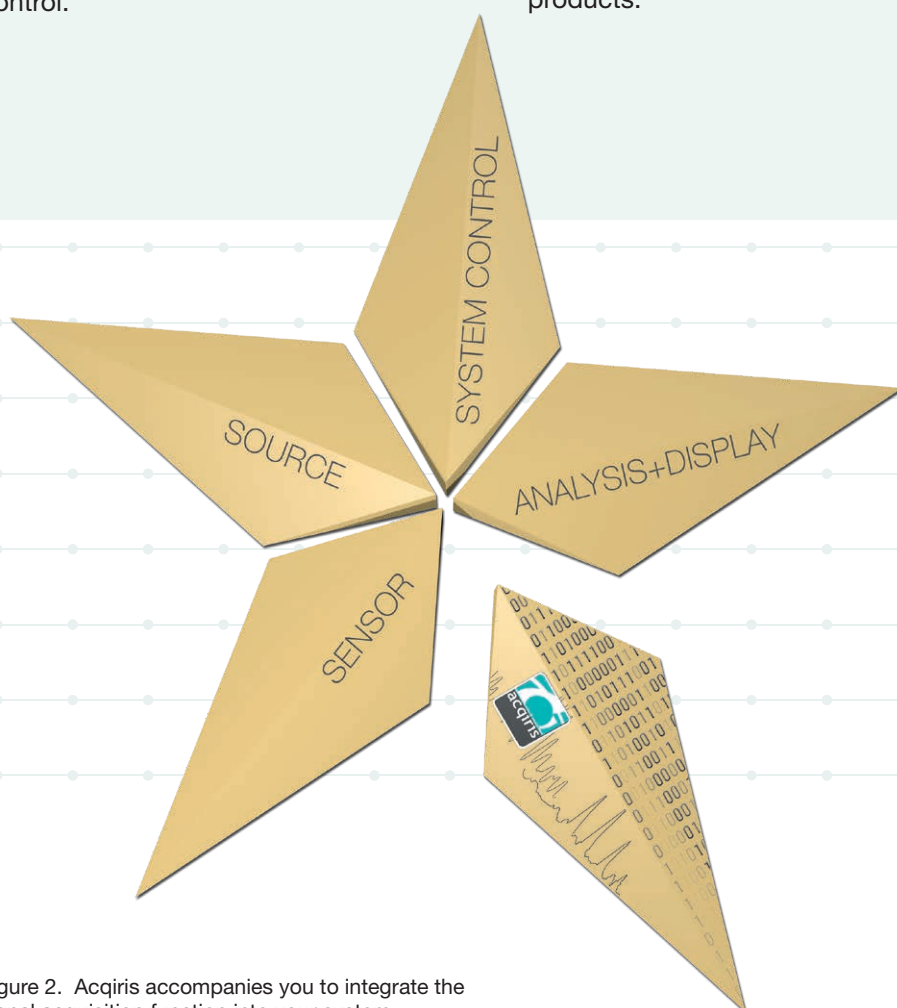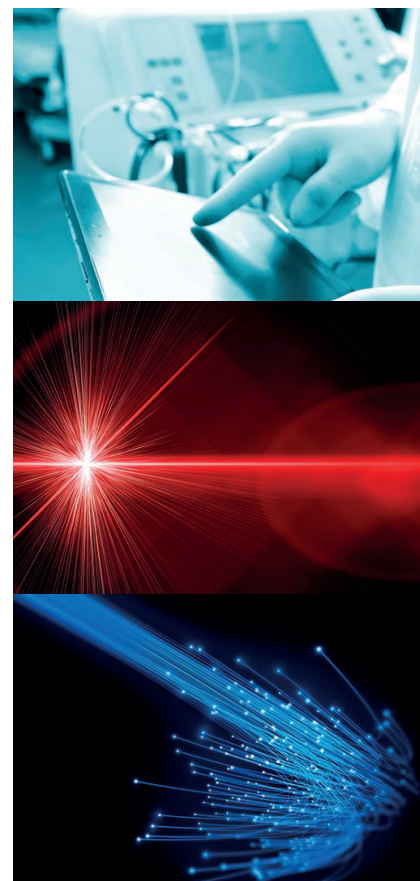
Easy software integration

The ADC cards and modules of the SA2 family are supplied with a comprehensive portfolio of module drivers, documentation, examples, and software tools to assist you to quickly develop your system with your software platform of choice.

Additionally, our integration experts are there to help you.

Compliance

Designed to benefit from fast data interface, the product uses a Thunderbolt 3 link.

Figure 2. Acqiris accompanies you to integrate the signal acquisition function into your system. Our data acquisition solutions aim at improving the overall performances of your end-product.

Hardware platform

Figure 3. SA230E signal connectors, with analog inputs and multiple programmable I/O signals.

Integration

Connected to a Thunderbolt 3 compatible laptop, embedded host, mini PC or workstation, the SA230E signal acquisition module enables a compact system and can be easily recombined with different remote computers.

Unique proprietary technology

Our engineering team developed exclusive proprietary integrated circuits enabling excellent signal performances.

Indeed, the SA230E incorporates:

- a low noise and low distortion signal conditioning amplifier to drive interleaved ADCs

- a specific clock distribution, minimizing the clock jitter and spurious.

On-board real-time processing

At the heart of the SA230E ADC module is a data processing unit (DPU) based on the Xilinx Kintex UltraScale FPGA. This DPU controls the digitizer functionality by implementing digitization of the signal, data storage in the DDR4 SDRAM memory and transfer through the Thunderbolt 3 connection to the computer.

Moreover, this powerful feature allows real time signal processing and data reduction to be carried out on-board, minimizing transfer volumes and speeding-up analysis.

Full scale range

The SA230E allows to select the full-scale range (FSR) by software: 500 mV or 2.5 V.

Block diagram

Trigger

The trigger source can be a signal level acquired on any of the two input channels (IN 1 or IN 2), or an external signal applied on TRG IN, or a software trigger.

Trigger precision and resolution

The trigger time interpolator technology achieves a unique trigger resolution of < 1 ps *(nominal)* and a precision of 15 ps *(nominal)*.

Programmable I/Os

Three programmable I/Os are available for your system control and optimization.
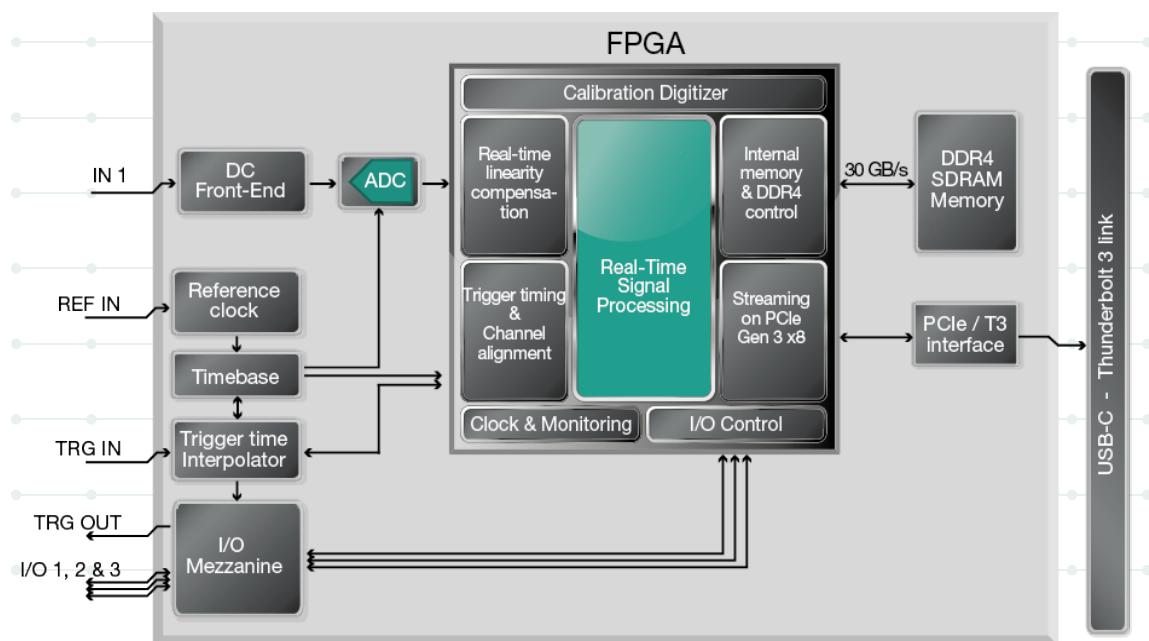

Figure 4. Top level block diagram of the SA230E ADC module with USB-C interface, with on-board real-time processing.
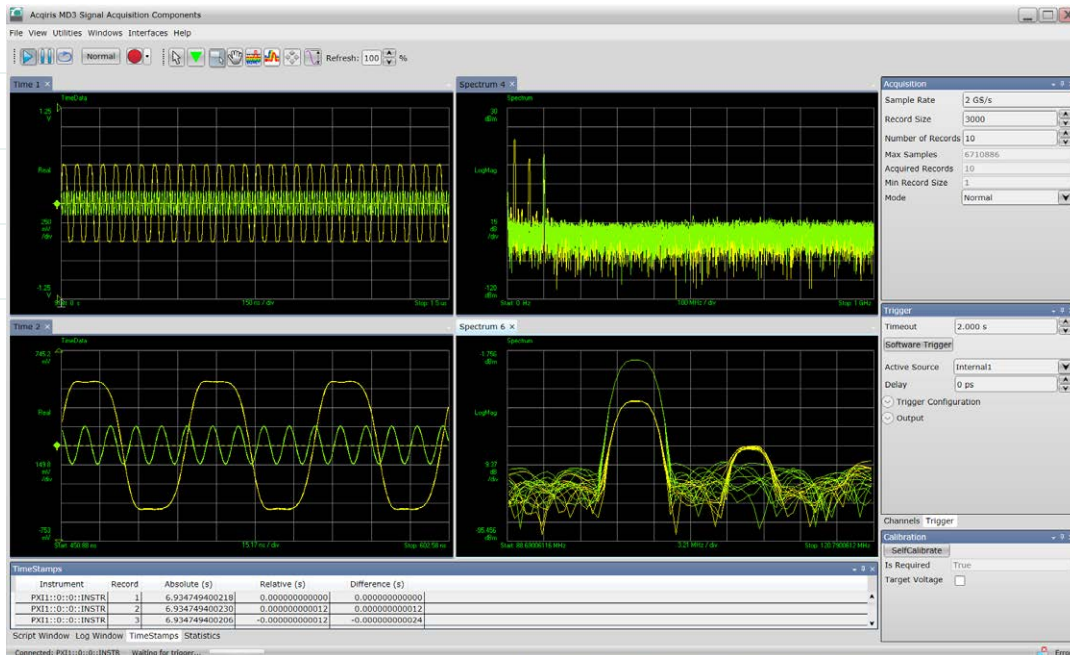
Software platform

Figure 5. The software front panel (SFP) interface can display acquired data in time domain, frequency domain and provide additional useful information, such as the list of trigger time-stamps.

Drivers

The module comes with Windows or Linux drivers that work in the most popular development environments, to make easier the integration in your system.

Software information

Supported operating systems and remote computers	See system requirements on page 11.
Standard compliant drivers	Standard compliant drivers IVI-C, IVI.NET, LabVIEW
Supported application development environments (ADE)	VisualStudio (VB.NET, C#, C/C++)

Software applications

In addition, all the SA2 family products include the soft front panel (SFP) graphical user interface.

This software application can be used to initially explore the ADC module main capabilities and as a debugging tool during the development phase.

It serves as a friendly and convenient tool for capturing and displaying the acquired data in time or frequency domain.

For further integration in your application, our experts can help by providing code snippet.

Application options

Figure 6. The SA230E is a fully shielded module, maximizing both ESD and EMI protection.

Firmware features

Accurate trigger timing

When using an external trigger, the digitizer accurately measures and stores the time of each trigger. This information is essential to determine the precise relation between the trigger and the signal digitized samples. The trigger time interpolator (TTI) is a high-precision integrated time-to-digital converter that guarantees trigger time-stamp measurement accuracy.

Easy mode switch

A simple call to the configuration function allows to automatically switch from the digitizer to the average mode.

Simultaneous acquisition and readout - Streaming records (CST)

Combined either with the digitizer, averaging or peak-listing mode, this function enables continuous simultaneous acquisition and readout. Compared with standard mode, it allows longer acquisition duration, and is especially dedicated to applications requiring no trigger loss.

Real-time processing matching your system needs

The firmware in the ADC card's FPGA enables real-time signal processing. Each firmware an have different acquisition modes themselves having various features, including data compression or noise reduction. This results in fine-tuned FPGA firmware allowing the on-board processing to be optimized for your specific applications.

Main ADC card modes:
• Digitizer (DGT)
• Real-time averaging (AVG option)
• Real-time peak-listing (PKL option)

Additional features:
• Simultaneous acquisition and readout - Streaming records (CST)

Digitizer mode (DGT)

The digitizer firmware allows standard data acquisition, including:

• Digitizer initialization
• Setting of the acquisition
• Management of channel triggering for best synchronization
• Distortion reduction
• Baseline stabilization and digital offset
• Storing data in the internal memory
• Transferring data to the host computer

The multi-record functionality allows to capture successive triggered events occurring within a very short time. The very fast trigger rearm time of the SA230E is a crucial feature to achieve low dead time. To increase trigger flexibility, a pre- or post-trigger delay can also be applied to the trigger position at picoseconds resolution.

Furthermore, the binary decimation can be used to reduce the amount of data, lowering the sample rate by a factor of 2, 4, or 8 – enabling decimated sampling rates at 2 GS/s, 1 GS/s, or 500 MS/s.

Real-time averaging mode (AVG option)

Averaging signals reduces random noise effects, improving the signal-to-noise ratio as well as increasing resolution and dynamic range.

This mode enables synchronous real-time sampling and accumulation at up to 4 GS/s, featuring:

• Accumulation from 1 to > 65 000 triggers
• Effective acquisition length up to 1M samples
• Noise suppressed accumulation (NSA)
• Self-trigger mode for minimal synchronous noise
• Baseline stabilization and digital offset
• Decimation factors of 2, 4, or 8 with associated low pass filters, enabling decimated sampling rates at 2 GS/s, 1 GS/s, or 500 MS/s.

Besides, the streaming capabilities of the SA230E allows to readout previously averaged record while performing a new accumulation. The averaging firmware enables multiples and successive averaging sequences without missing any trigger.

Real-time peak-listing (PKL option)

This firmware allows to select and analyze the signal of interest, capturing signal peaks and providing their characteristics.

Each waveform pulse that verifies user criteria is recorded and analyzed in real-time. Lastly, computed parameters such as time-stamp, peak amplitude, centroid position are provided in output.

The acquisition and analysis of a signal record can be performed while reading the result of the previous one, minimizing dead time between successive peak analysis.

Technical specifications and characteristics

Analog input (IN - SMA connectors)

Number of channels		1
Impedance		50 Ω ± 2 % *(typical*
Coupling		DC
Full scale range (FSR)	default	500 mV and 2.5 V (selectable by software)
Maximum input voltage	500 mV FSR 2.5 V FSR	± 600 mVpk ± 3 Vpk
Input voltage offset		± FSR/2
Input frequency range (-3 dB bandwidth)		DC to 2 GHz *(typical)*
Bandwidth limit filters (BWL)		20 MHz, 200 MHz, 700 MHz *(nominal)*
Effective numbers of bits (ENOB)[1]	@ 625 MHz	8.9 *(nominal)*
Signal to noise distortion (SNR)	@ 625 MHz	54 dB *(nominal)*
Spurious free dynamic range (SFDR)	@ 625 MHz	70 dBc *(nominal)*

Calibration

The SA230E is factory calibrated and delivered with a certificate of calibration.

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1. Measured for a –1 dBFS input signal in internal clock mode at 4 GS/s.

Technical specifications and characteristics

Digital conversion		
Resolution		14 bits
Acquisition memory	-MEA	4 GB (2 GSamples) *(default)*
	-MEB	8 GB (4 GSamples) *(optional)*
Sample clock source		Internal
Internal clock source		Internal, external reference
Real-time sampling rate		4 GS/s
Sampling clock jitter[1]		100 fs *(nominal)*
Clock accuracy		± 1 ppm *(nominal)*
External reference clock (REF IN - MMCX connector)		
Impedance		50 Ω *(nominal)*
Frequency range		10 MHz ± 1 kHz
		100 MHz ± 1 kHz
Signal level		-3 dBm to +3 dBm *(nominal)*
Coupling		AC
Acquisition modes		Single record, Multi-record, Streaming

Trigger	
Trigger mode	Positive or negative edge
Trigger source	External, Channel, Software
Channel trigger frequency range	DC to 2.5 GHz *(nominal)*
Trigger time interpolator resolution	< 1 ps *(nominal)*
Trigger time interpolator precision	15 ps RMS *(nominal)*
Rearm time (deadtime)	< 0.5 µs *(nominal)*
External trigger (TRG IN - MMCX connector)	
Coupling	DC
Impedance	50 Ω
Level range	± 5 V
Minimum amplitude	0.5 V pk-pk
Frequency range	DC to 3 GHz
Trigger out (TRG OUT - MMCX connector)	1 (programmable), 50 Ω source, LVCMOS 3.3 V

1.   Jitter figure based on phase noise integration from 100 Hz to 100 MHz in internal reference.

Programmable IO (I/O 1, 2 and 3 - MMCX connectors)

Output functions		Acquisition active
		Trigger is armed
		Trigger accept re-synchronization
		Reference clock out
	-AVG	Self-trigger
	-AVG	Accumulation active
Output level range		DC coupling, 50 Ω source, LVCMOS 3.3 V
Input function	-AVG	Accumulation enable
Input level range		DC coupling, LVCMOS 3.3 V, max. voltage +5 V

System requirements[1]

Topic	Windows	Linux
Operating systems	Windows 10 (32-bit and 64-bit), All versions Windows 7 (32-bit and 64-bit), All versions	Linux Kernel 2.6 or higher (32 or 64-bit), Debian 9, Ubuntu-16.04, Ubuntu-18.04, CentOS-7
Processor speed	1 GHz 32-bit (x86), 1 GHz 64-bit (x64), no support for Itanium 64	As per the minimum requirements of the chosen distribution
Available memory	1 GB minimum	As per the minimum requirements of the chosen distribution
Available disk space	1.5 GB available hard disk space, includes 1 GB for Microsoft .NET Framework	100 MB
Display	Minimum of 1024 x 768, 96 or 120 DPI	No display required
Temperature range	Check upon environment requirement. It might not allow to go as high as ADC card allows.	

Definitions for specifications

Specifications describe the warranted performance of calibrated cards that have been stored for a minimum of 2 hours within the operating temperature range of 0 to 50 °C, unless otherwise stated, and after a 45-minute warm-up period. Data represented in this document are specifications unless otherwise noted.

Characteristics describe product performance that is useful in the application of the product, but that is not covered by the product warranty. Characteristics are often referred to as Typical or Nominal values.

- Typical describes usual performance, which 80 % of cards will meet when operated over a 20 to 30 °C temperature range. Typical performance is not warranted.

- Nominal describes representative performance that is useful in the application of the product when operated over a 20 to 30 °C temperature range. Nominal performance is not warranted.

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1. Contact support@acqiris.com for a list of recommended host computers.

Technical specifications and characteristics

Quality

Samples of this product have been type tested and verified to be robust against the environmental stresses of Storage, Transportation and End-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude and power line conditions.

Environmental and physical		
Usage		Indoor use recommended (outdoor use is possible, provided the ADC module is within an environment that guarantees indoor conditions)
Pollution degree		2
Temperature range	Operating[1]	0 to +50 °C (sea-level to 6,562 feet)
	Non-operating	-40 to +70 °C
Altitude		Up to 6,562 feet (2 000 meters)
Relative humidity range	Operating[2]	10 % to 90 % RH, non-condensing
	Non-operating[2]	5 % to 95 % RH, non-condensing
Electro-magnetic compliance		Complies with European EMC Directive 2014/30/EU EN 61326-1:2013 (industrial) EN 55011:2016 Group 1, Class A And with international standards : IEC 61326-1:2012 CISPR 11:2015 / AMD1:2016 USA: CFR 47 Part 15, Subpart B, Class A Australia/New Zealand: AS/NZS CISPR 11:2011 Canada: ICES/NMB-001:2006
Safety		The product was tested and found to be in conformity with: IEC 61010-1:2010 IEC 61010-1:2010 / AMD1:2016 And National differences: - EU Group Differences - EU Special National Conditions - EU A-Deviations - AU, CA, KR, US Complies with European LVD Directive 2014/35/EU EN 61010-1:2010
Environmental		Directive 2015/863/EU (RoHS 3) EN 50581 :2012
Acoustic		Acoustic noise emission LpA < 60 dB (nominal) Operator position, Normal operation mode

Power dissipation[3, 4]	
+ 12 V	Power at SA230E DC input connector < 5 A (60 W)

Power supply	
Voltage Range	100-240 VAC +/-10%
Frequency Range	50/60 Hz
AC Current (typ.)	1.3 A

Mechanical characteristics	
Size	15.3 x 27.4 x 5.8 cm (6.02 x 10.8 x 2.3 in.)
Weight	< 2.5 kg (< 5.5 lbs)

1. Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.
2. Tested in accordance with IEC 60068-2-30 and IEC 60068-2-78.
3. Power measured in digitizer mode.
4. When operated, the airflow input and output of the unit should not be obstructed, and a 60 m³/h minimum airflow is required.

Ordering information

Model	Description
SA230E	14-bit ADC module with USB-C, Thunderbolt 3 interface and FPGA signal processing includes: – Power supply – Thunderbolt 3 cable, 50 cm – Thunderbolt lock – 5-year warranty
Configurable options	
Additional Memory	
Firmware and application options	

Accessories

Model	Description
U5300A-101	MMCX male to SMA male cable, 1 m
U5300A-102	MMCX male to BNC male cable, 1 m
U5300A-117	Mounting brackets for ADC module, 4 pieces

This information is subject to change without notice.

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Contacts

Headquarters

Acqiris SA
Chemin des Aulx 12
1228 Plan-les-Ouates / Geneva
Switzerland
+41 22 884 32 90

Acqiris Americas
contact-americas@acqiris.com

Acqiris Asia-Pacific
contact-asia-pacific@acqiris.com

Acqiris Europe
contact-emea@acqiris.com

Acqiris Japan
contact-japan@acqiris.com

Support
support@acqiris.com