Acqiris SA248P
14-bit ADC Card, 8 GS/s, 1 channel with FPGA signal processing

DATASHEET

See deeper and sharper than before

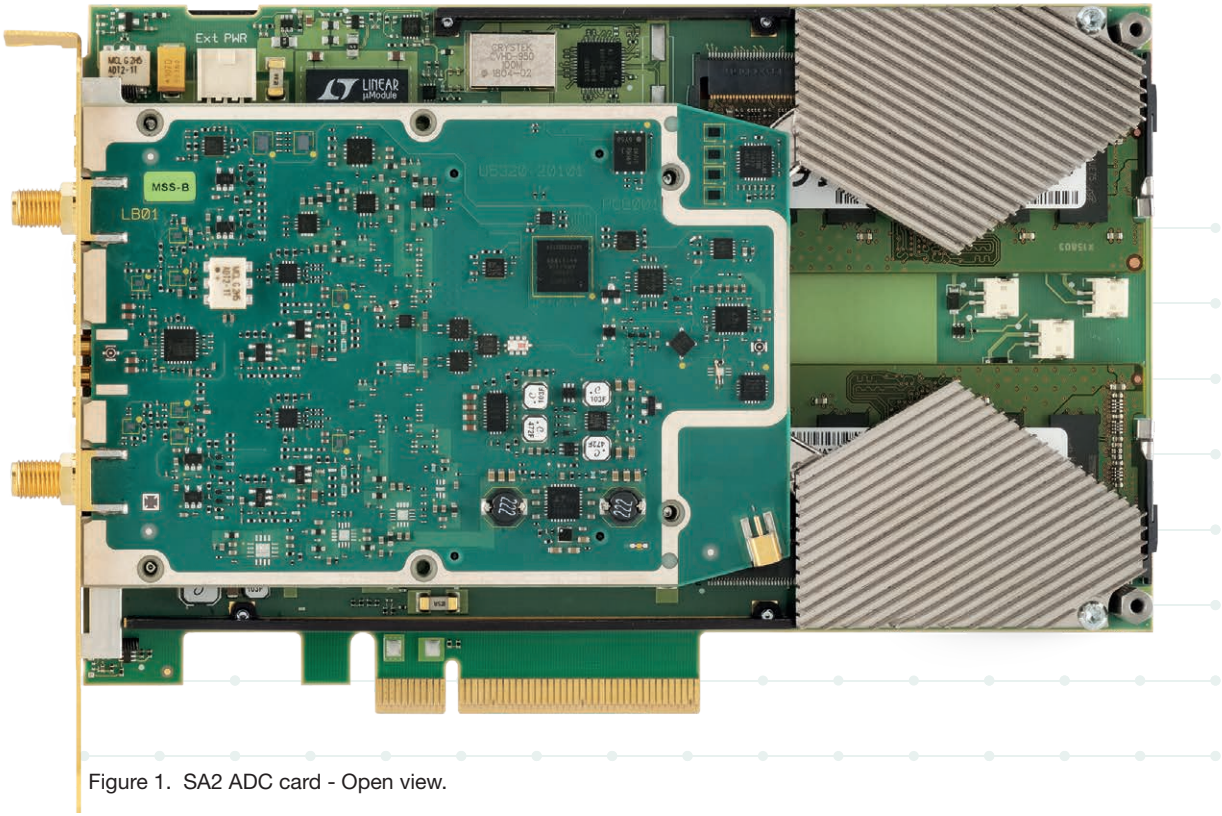

Figure 1. SA2 ADC card - Open view.

New generation of Signal Acquisition cards

The SA2 is Acqiris's high-performance 14-bit ADC card platform, performing fast signal acquisitions from 2 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 SA248P is one of the top-line model of the SA2 product line, enabling 8 GS/s. This unique DC coupled 14-bit digitizer captures waveforms from DC up to 3 GHz.

Essential features

Accurate and precise measurement

- 14-bit resolution
- 8 GS/s sampling rate on 1 channel
- DC up to 2.5 GHz bandwidth (default)
- DC up to 3 GHz bandwidth (special mode)
- DC coupled, 50 Ω input impedance
- 1 V full scale range
- Programmable DC offset (± FSR/2)

Signal fidelity

- Low noise density and low distortion
- Optimized frequency response flatness
- Excellent and flat SFDR over a large analysis bandwidth (> 62 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 cards ideal for OEM applications requiring digitizer sampling at wide bandwidth and very high dynamic range.

The PCIe Gen 3 interface enables high data transfer rate and streaming capabilities to the host computer at up to 6.5 GB/s.

This ADC card occupies a single PCIe slot, offering high performance in a small footprint.

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

Features depending on your application (options)

Increased recording time:

- Up to 8 GB memory allowing for 4 GSamples
- Streaming capability up to 6.5 GB/s

Real-time processing:

- Very high digitized data throughput thanks to PCI Express Gen 3
- Kintex UltraScale FPGA for on-board signal processing
- Custom real time-processing

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 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 SA248P includes on-board FPGA offering real-time signal processing capability such as waveform averaging. We also propose to open the FPGA for custom real-time processing.

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

This PCIe card 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 SA248P enables deeper, faster and more accurate measurement and analysis for final products.

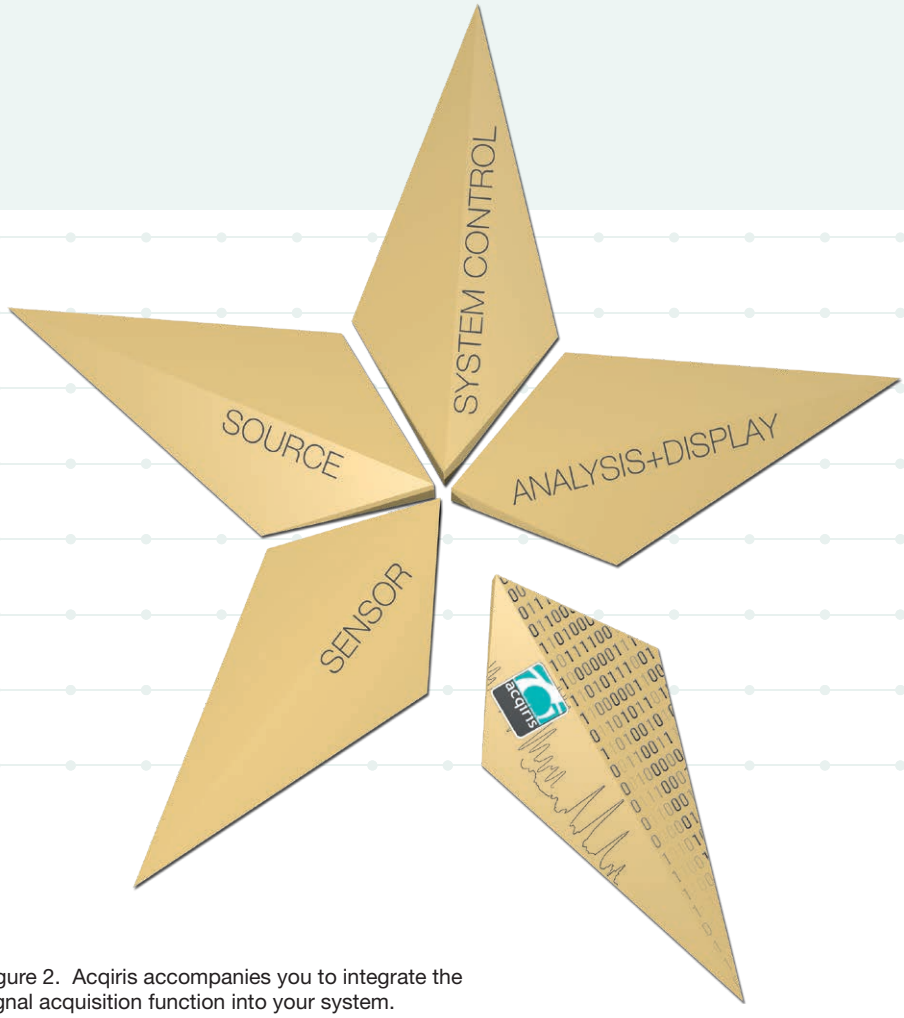

Figure 2. Acqiris accompanies you to integrate the signal acquisition function into your system. Our data acquisition solutions aim at improving the overall performances of your end-product.

Easy software integration

The ADC cards 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 very fast data interface, the product is compliant with PCI Express 3.0 x8 standard.

Hardware platform

Figure 3. SA248P front panel, with analog inputs and multiple programmable I/O signals.

Integration

In a host computer or externally, the SA248P signal acquisition card occupies a single half-length PCIe x8 slot, and, additionally, a fan assembly[1] is attached to the rear for effective cooling.

On-board real-time processing

At the heart of the SA248P ADC card 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 PCIe connection to the host 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.

Unique proprietary technology

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

The SA248P incorporates:

- Low noise and low distortion signal conditioning amplifier IC to drive interleaved ADCs
- Specific clock distribution, minimizing the clock jitter and spurious
- Optimized frequency response flatness enhancing measurement accuracy on a wide bandwidth.

Full scale range

The SA248P standard version enables up to 8 GS/s sampling rate on one channel with 1 V full-scale range (FSR).

Trigger

The trigger source can be a signal level acquired on the input channel (IN), 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)*.

Differential trigger out

For application requiring very accurate triggering through their system, the differential trigger out reduces jitter and enables higher performance.

Programmable I/Os

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

Block diagram

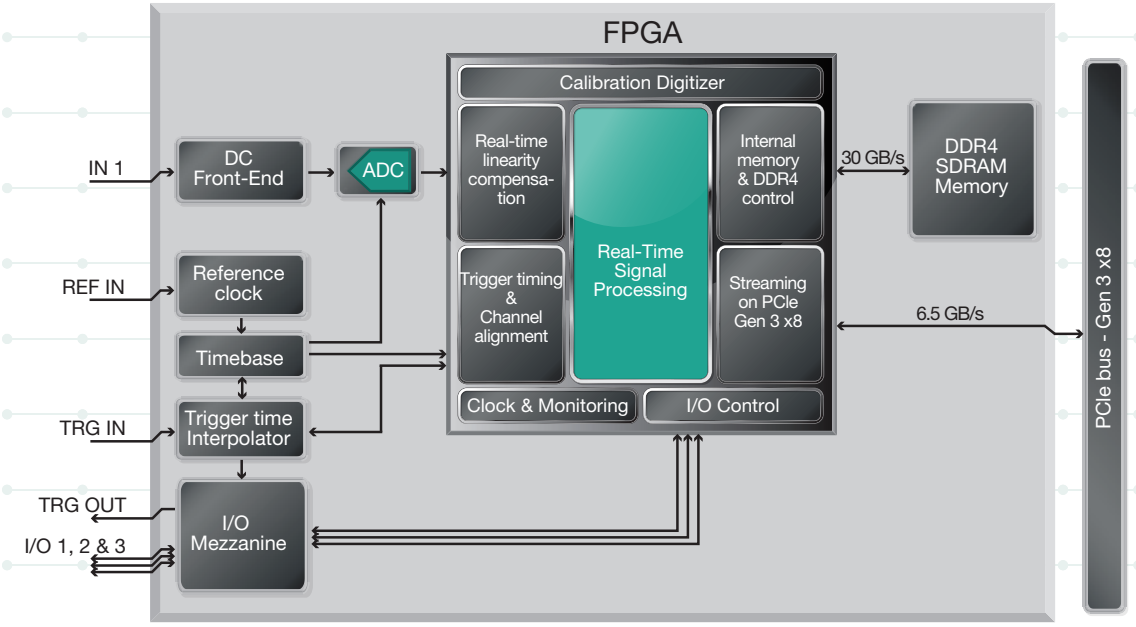

Figure 4. Top level block diagram of the SA248P PCIe ADC card, with on-board real-time processing.

1. See page 10 for full dimension with fan assembly.

Software platform

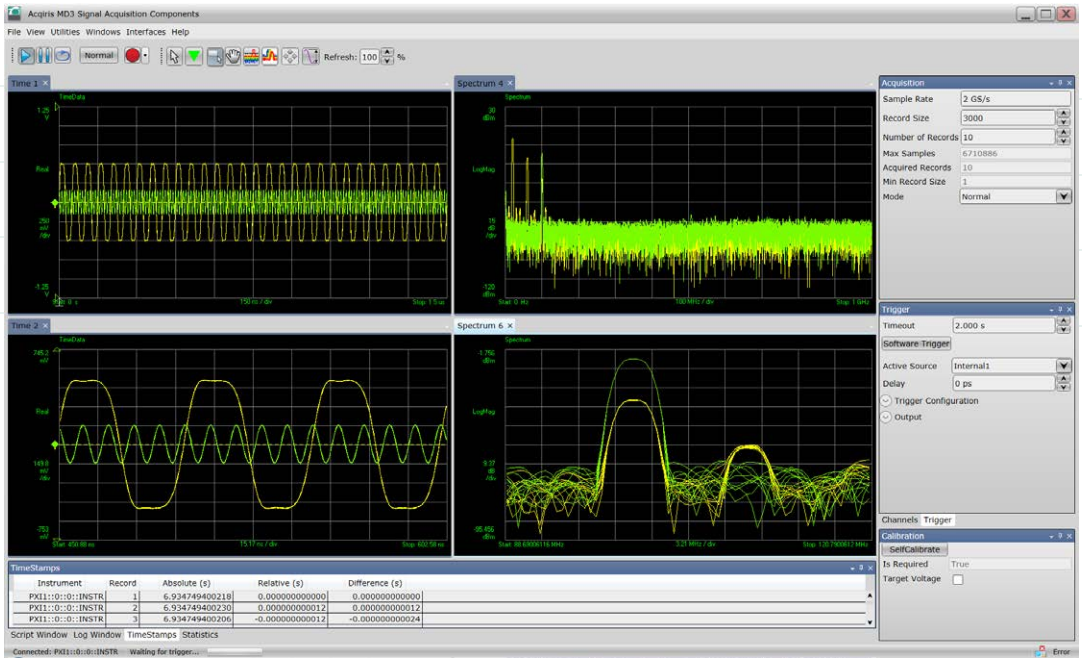

Figure 5. The software front panel (SFP) interface can display acquired data in time domain, frequency domain and provide additional useful information, such as the list of trigger time-stamps.

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 host computers	See system requirements on page 10.
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 cards include the soft front panel (SFP) graphical user interface.

This software application can be used to initially explore the ADC card 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 SA248P is a fully shielded PCIe Card 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.

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)

Optional feature:
- Simultaneous acquisition and readout (CST option)
- Zero suppress - Thresholding (ZS1 option)

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 and frequency equalization
- 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 SA248P 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 4 GS/s, 2 GS/s, and 1 GS/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 8 GS/s, featuring:
- Accumulation from 1 to > 65 000 triggers
- Effective acquisition length up to 1 MSamples
- Noise suppressed accumulation (NSA)
- Self-trigger mode for minimal synchronous noise
- Baseline stabilization algorithm and digital offset
- Decimation factors of 2, 4, or 8 with associated low pass filters, enabling decimated sampling rates at 4 GS/s, 2 GS/s, and 1 GS/s.

Besides, the streaming capabilities of the SA248P 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.

Simultaneous acquisition and readout - Streaming records (CST option)

Combined either with the digitizer or the averager 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.

In a standard digitizer mode, acquisition and readout are sequential, i.e. the readout of the data is performed after the acquisition has stopped; whereas, with simultaneous acquisition and readout, the acquired records are streamed to the host computer while the next records are acquired and processed. Supporting triggered acquisitions and multiple records of same length, this feature allows gaps between the records.

The firmware manages the streaming of 14-bit raw output data. Using raw data output, the trigger position is known with the accuracy of a sample. For applications requiring trigger position at sub-sample, the information is available on a separated marker stream providing absolute trigger position.

There is no maximum duration of the acquisition: the continuous acquisition and streaming can be sustained endlessly without overflow. The maximum trigger rate and record size depend on the readout data throughput.

Benefitting from the PCIe Gen 3 interface, the SA248P sustains data transfer to the host at up to 6.5 GB/s.

Zero suppress - Thresholding (ZS1 option)

The zero-suppress is a data reduction mode allowing to select data above a user-defined threshold, as depicted on figure below.

The threshold allows to identify the signal of interest. Data not complying with user selected criteria are suppressed and only the relevant data are stored and transferred to computer.

Particularly efficient when combined with the streaming records feature (CST) the zero-suppress feature performs data compression and allows a larger time window to be captured, assuming a regular occurrence of the trigger condition which periodically segments the continuous data acquisition.

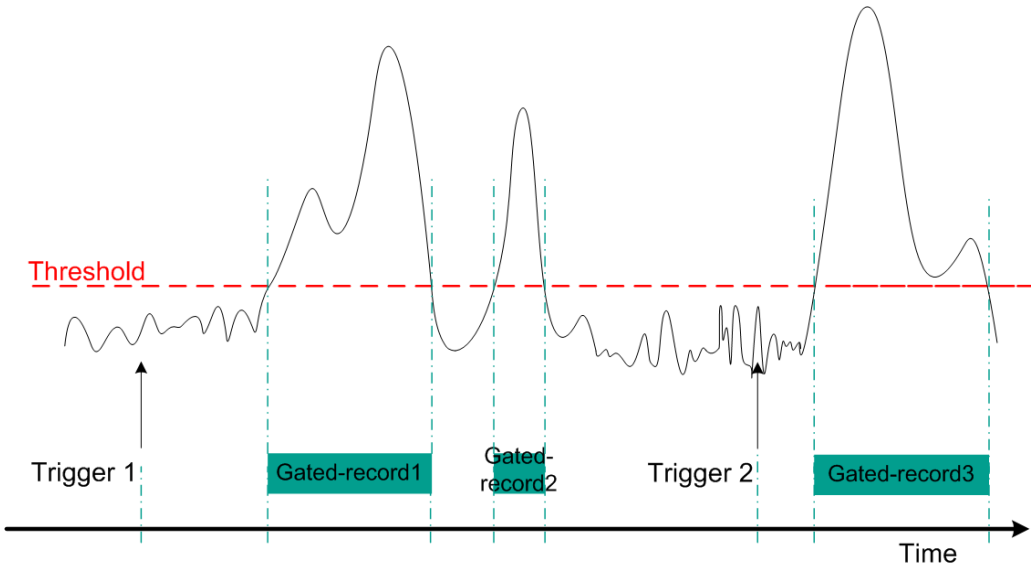

Figure 7. Zero-Suppress compression concept. A gated-record designates the waveform samples selected based on the user-defined threshold criteria.

Technical specifications and characteristics (preliminary)

Figure 8. Open view of the SA248P.

Analog input (IN SMA connectors)		
Number of channels		1
Impedance		50 Ω ± 2 %
Coupling		DC
Full scale range (FSR)		1 V
Maximum input voltage		± 1.2 Vpk
Input voltage offset		± FSR/2
Input frequency range (-3 dB bandwidth)		DC to 2.5 GHz *(typical)* DC to 3 GHz *(typical)* with Custom Equalization Filter [1]
Effective numbers of bits (ENOB)[2]	@ 1 GHz	8.7 *(preliminary)*
Signal to noise distortion (SNR)	@ 1 GHz	53 dB *(preliminary)*
Spurious free dynamic range (SFDR)	@ 1 GHz	> 62 dBc *(preliminary)*

Digital conversion		
Resolution		14 bits
Acquisition memory	-MEA -MEB	4 GB (2 GSamples) *(default)* 8 GB (4 GSamples) *(optional)*
Sample clock source		Internal
Internal clock source		Internal, external reference
Real-time sampling rate		8 GS/s
Sampling clock jitter[3]		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

Calibration

The SA248P is factory calibrated and delivered with a certificate of calibration.

1. Available for units shipped after August 2022. Please contact support to check the status of units shipped earlier.
2. Measured for a –1 dBFS input signal in internal clock mode at 8 GS/s.
3. Jitter figure based on phase noise integration from 100 Hz to 100 MHz in internal reference.

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
(Optional) Differential Trigger (CJT RF connector)		Differential 100 Ohms, CML Level

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 4 or higher (32 or 64-bit), Debian, Ubuntu, CentOS
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.	

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

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.

Technical specifications and characteristics (preliminary)

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.

Test Methods are aligned with IEC 60068-2-1 and IEC60068-2-2 and levels are similar to MIL-PRF-28800F Class 3.

Environmental and physical		
Usage		Indoor use recommended (outdoor is possible provided the ADC card is within an environment that guarantee indoor conditions)
Pollution degree		2
Temperature range	Operating[1, 2]	0 to +50 °C (sea-level to 10,000 feet)
		0 to +45 °C (10,000 to 15,000 feet)
	Non-operating	-40 to +70 °C
Altitude		Up to 15,000 feet (4 572 meters)
Relative humidity range	Operating[3]	10 % to 90 % RH, non-condensing
	Non-operating[3]	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[4]		
+ 3.3 V /+ 12 V		Power on PCIe edge connector < 25 W *(nominal)*
+ 12 V		Power on additional power cable[5] < 45 W *(nominal, firmware dependent)*
Mechanical characteristics		
Form factor		PCIe x8 standard
Size	Without fan[6]	17.6 W x 126.3 H x 169.5 D mm
	With rear fan[7]	40.6 W x 126.3 H x 244.1 D mm
Weight		< 1.24 kg (< 2.73 lbs)

1. Host computer internal ambient temperature at intake of the digitizer's fan.
2. Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.
3. Tested in accordance with IEC 60068-2-30 and IEC 60068-2-78.
4. Power measured in digitizer mode.
5. Additional power cable mandatory to ensure adequate power distribution as per PCIe standard.
6. 60 m^3/h airflow is required. The unit must be operated with the included fan.
7. Optional rail guide can be ordered to stabilize the PCIe card in the host computer.

Configuration and ordering information

Ordering information

Model	Description
SA248P	PCIe 14-bit ADC card with FPGA signal processing includes: – Fan assembled on module – 5-years standard warranty – Power cable
Configurable options	
Additional Memory	
Firmware and application options	
Card retainer (recommended if the card is assembled horizontally or in harsh environment)	

Accessories

Model	Description
U5300A-101	MMCX male to SMA male cable, 1 m
U5300A-102	MMCX male to BNC male cable, 1 m
U5300A-001	Card Retainer
U5300A-003	Short card retainer

This information is subject to change without notice.

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