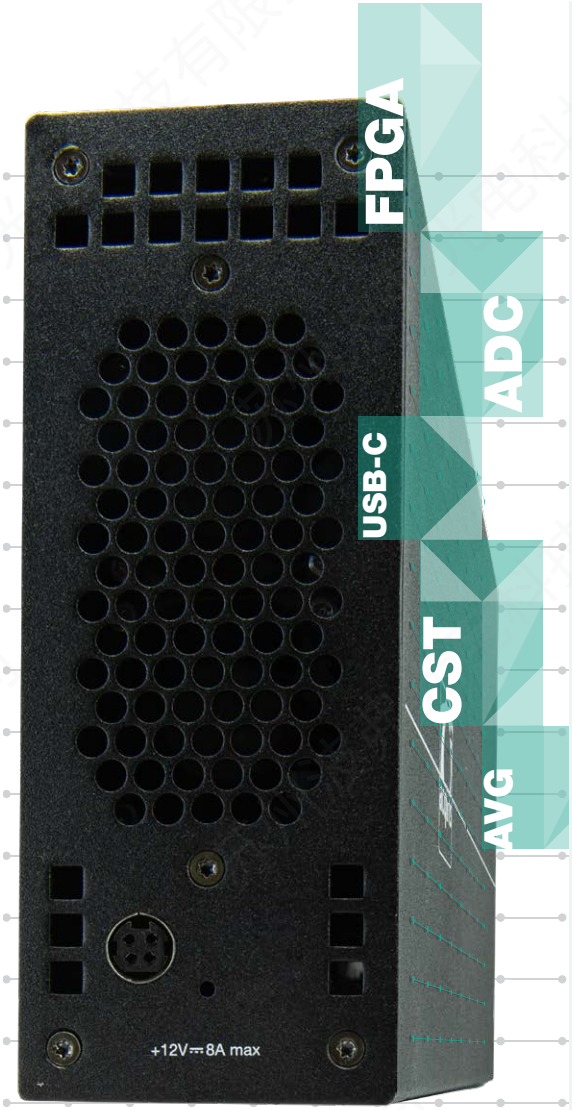
Acqiris SA108E
8-bit ADC Module, up to 1 GS/s, 1 channel with FPGA signal processing

Preliminary datasheet



New generation of Signal Acquisition cards and modules

The SA1 is Acqiris's low-power, low footprint 8-bit ADC card platform, performing fast signal acquisitions from 500 MS/s up to 2 GS/s, with advanced on-board signal processing capability. This new generation of ADC card focuses on addressing unique high-volume OEM application needs.

The SA108E is the single channel, up to 1 GS/s version of the SA1 product line. This new 8-bit ADC card provides a DC-Coupled front-end with multiple programmable low full scale range and the ability to synthesize 3 synchronized outputs for a tight instrument control.

Product description

All the ADC cards from the SA1 generation implement a proprietary low noise front-end and a Xilinx Ultrascale FPGA allowing a low-power implementation of advanced custom real-time processing algorithms.

This makes the SA1 ADC cards ideal for OEM applications requiring a reliable, stable and cost effective signal acquisition solution.

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 SA108E offers modularity and high performance in a small footprint.

Essential features

Accurate and precise measurement

- 8-bit resolution
- Up to 1 GS/s sampling rate on 1 channel
- DC up to 500 MHz analog bandwidth
- DC coupled, 50 Ω input impedance
- Two input voltage range version:
  - Standard full scale range: from 250 mV to 5 V
  - Low voltage range (-LVR): 50 mV to 1V
- Programmable DC offset (± 0.6 * FSR)
- 10MHz / 100MHz external reference support

Signal fidelity

- Low noise density and low distortion
- Minimizing signal distortion

Features depending on your application (options)

Increased recording time:

- Up to 4 GB memory allowing for 4 GSamples acquisition memory
- Streaming capability up to 2 GB/s

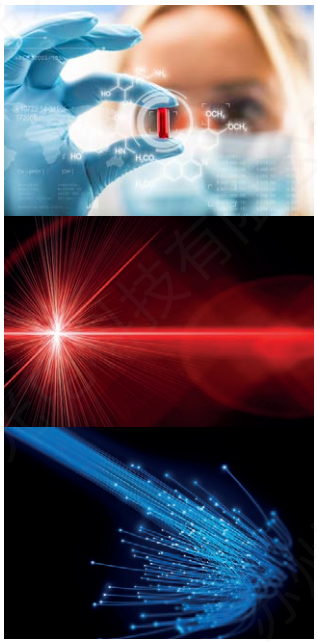
Real-time processing:

- Real-time averaging
- Simultaneous acquisition and readout, enabling streaming with high data throughput

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 based on standard platform that can be fine-tuned to address your particular challenges.

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

The SA108E includes an 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 combined with SOUT capability allow for a tight 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 SA108E enables deeper, faster and more accurate measurement and analysis for final products.

Software platform

Easy software integration

The ADC cards of the SA1 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 Gen3 x8 standard.

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.

Standard compliant drivers:
IviDigitizer class-compliant IVI-C and IVI.NET drivers

Supported application development environments (ADE):
- VisualStudio (VB.NET, C#, C/C++)
- any ADE supporting C or .NET APIs

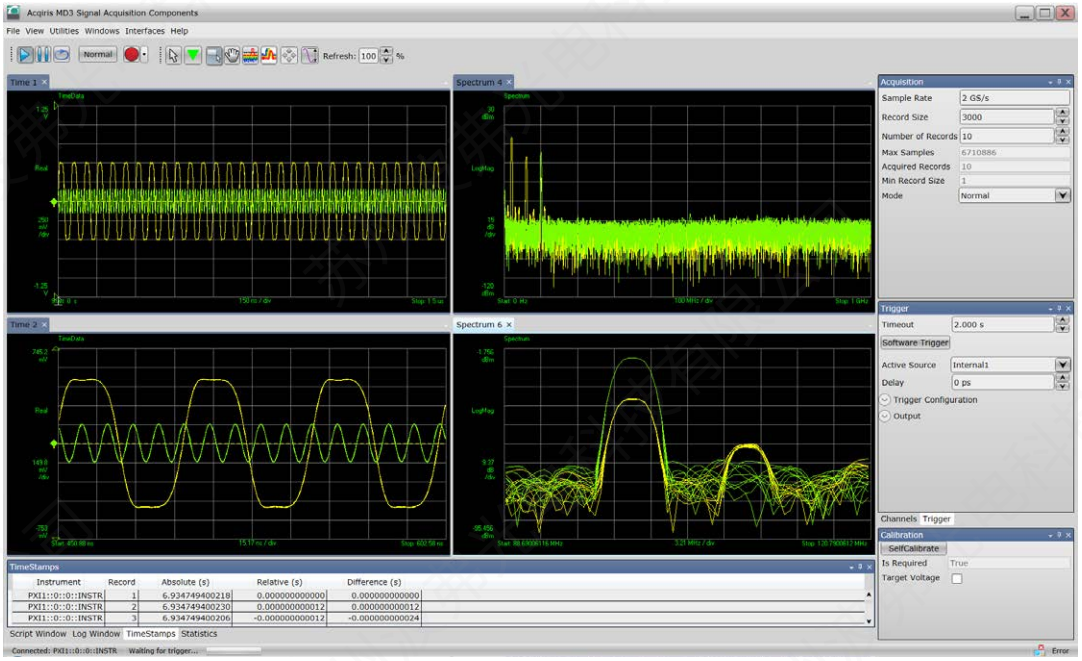


Figure 1. The software front panel (SFP) interface can display acquired data in time domain, frequency domain and provide additional useful information, such as the list of trigger time-stamps.

Software applications

In addition, all the SA1 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 user-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 snippets.

Hardware platform

Figure 2. SA1 ADC module with USB-C Thunderbolt 3 interface

Integration

Connected to a Thunderbolt 3 compatible laptop, embedded host, mini PC or workstation, the SA108E signal acquisition module enables a compact system and can be easily recombined with different remote computers.

On-board real-time processing

At the heart of the SA108E 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 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.

Block diagram

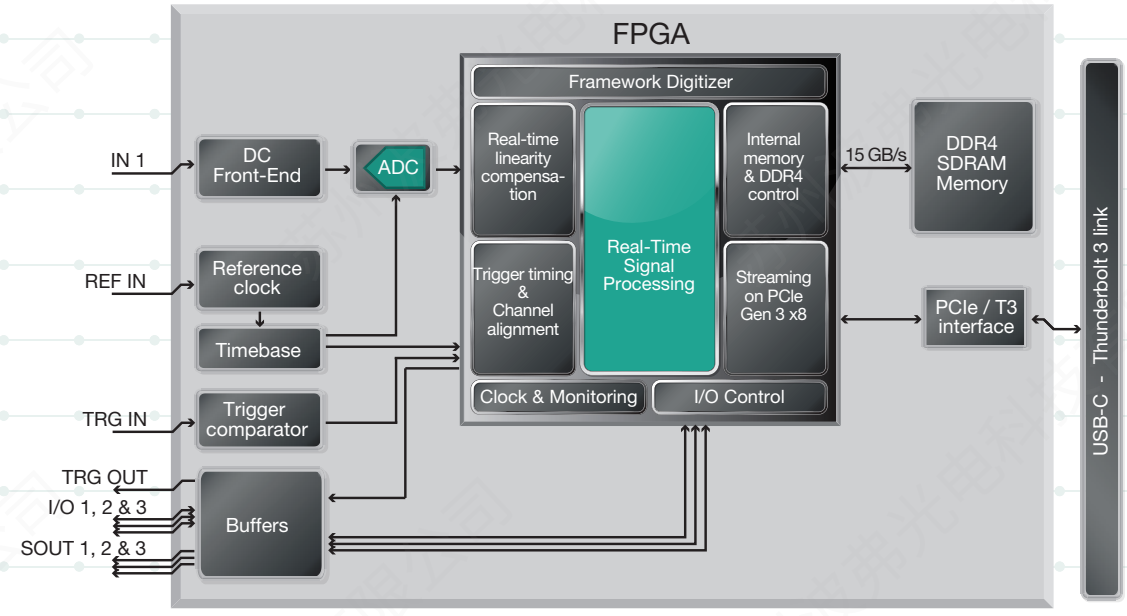


Figure 3. Top level block diagram of the SA108E ADC module, with on-board real-time processing.

Firmware (FPGA)

The firmware in the ADC card's FPGA enables real-time signal processing. Each firmware has different acquisition modes themselves having various features, including data compression or noise reduction.

Input channel

The full scale range (FSR) of the input channel can be selected by software from 50 mV to 1V.

Trigger

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

Programmable I/Os

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

Synchronized outputs

Synchronized pulse generation capability on 3 outputs.

Application options

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 or averaging mode, this function allows to perform simultaneously: signal acquisition, real-time processing and readout of acquired and processed data.

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 has 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)

Optional feature:
- Simultaneous acquisition and readout - Streaming records (CST 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
- 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 SA108E 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 picosecond resolution.

Furthermore, the binary decimation can be used to reduce the amount of data, lowering the sample rate by a factor of 2, 4, 8, and 16 – enabling decimated sampling rates from 500 MS/s to 31.125 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 1 GS/s, featuring:

- Accumulation from 1 to > 65 000 triggers
- Effective acquisition length up to 524288 Samples
- Noise suppressed accumulation (NSA)
- Self-trigger mode for minimal synchronous noise
- Decimation factors of 2, 4, 8, 16 or 32 with associated anti-aliasing low pass filters, enabling decimated sampling rates at 500 MS/s, 250 MS/s, 125 MS/s, 62.5 MS/s or 31.25 MS/s.

The streaming capability of the SA108E allows to readout previously averaged record while performing a new accumulation. The averaging firmware enables multiple and successive averaging sequences without missing any trigger.

Technical specifications and characteristics

Analog input (IN - SMA connectors)

Number of channel		1
Impedance [1]		50 Ω ± 2 % *(typical)*
Coupling		DC
Full scale range (FSR) (selectable by software)	 -LVR	250 mV, 500 mV, 1 V, 2.5 V, and 5 V 50 mV, 100 mV, 200 mV, 500 mV, and 1 V
Maximum input voltage		± 1.4 V DC
Input voltage offset		± 0.6 * FSR
Input frequency range (-3 dB bandwidth)	-F03 -F05	DC to 300 MHz *(typical)* DC to 500 MHz *(typical)*
Effective numbers of bits (ENOB)[2]	@ 100 MHz	6.8 *(typical)*
Signal to noise distortion (SNR)	@ 100 MHz	43 dB *(typical)*
Spurious free dynamic range (SFDR)	@ 100 MHz	50 dBc *(typical)*
Total harmonic distortion (THD)	@ 100 MHz	-48 dB *(typical)*

Digital conversion

Resolution		8 bits
Acquisition memory	-MEA -MEB	1 GB (1 GSamples) *(default)* 4 GB (4 GSamples) *(optional)*
Sample clock source		Internal
Internal clock source		Internal, external 10 MHz or 100 MHz reference
Real-time sampling rate	 -LSR	1 GS/s 500 MS/s
Sampling clock jitter[3]		500 fs *(nominal)*
Clock accuracy		± 1.5 ppm *(typical)*
External reference clock (REF IN - MMCX connector)		
Impedance		50 Ω *(typical)*
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 SA108E is factory calibrated and delivered with a certificate of calibration.

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-minutes 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.

1. Input impedance is 150 Ω during the self-calibration process.
2. Measured for a –1 dBFS input signal in internal clock mode at 1 GS/s.
3. Jitter figure based on phase noise integration from 100 Hz to 100 MHz in internal reference.

Technical specifications and characteristics

Trigger

Trigger mode	Positive or negative edge
Trigger source	External, Channel, Software
Channel trigger frequency range	DC to 500 MHz *(nominal)*
Trigger time interpolator precision	35 ps RMS *(nominal)*
Rearm time (deadtime)	< 250 ns *(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 1 GHz
Trigger out (TRG OUT - MMCX connector)	1 (programmable), 20 Ω source, 2.2 V typ on 50 Ω charge

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

Serial Outputs (SOUT 1, 2 and 3 - MMCX connectors)

Output coupling	DC coupling, 20 Ω source
Output voltage	3.0 V DC (Without charge)

System requirements[1]

Topic	Windows	Linux
Operating systems	Windows 10 (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.

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 B, industrial environment And with international standards : IEC 61326-1:2012 CISPR 11:2015 / AMD1:2016 USA: CFR 47 Part 15, Subpart B, Class B, digital device Australia/New Zealand: AS/NZS CISPR 11:2011 Canada: ICES/NMB-001:2006
Safety		The product was tested and is 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 consumption[4, 5]

+ 12 V	Power at SA108E DC input connector < 2.5 A (30 W)

External ACDC Power Adapter Specification

Voltage Range	120-240 VAC +/- 10%
Frequency Range	50/60 Hz
Efficiency	90%

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. 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. When operated, the airflow input and output of the unit should not be obstructed, and a 60 m^3/h minimum airflow is required.

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.

Configuration and ordering information

Ordering information

Model	Description
SA108E	PCIe 8-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 standard warranty
Configurable options	
Additional Memory	
Sampling rate	
Full scale range	
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

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