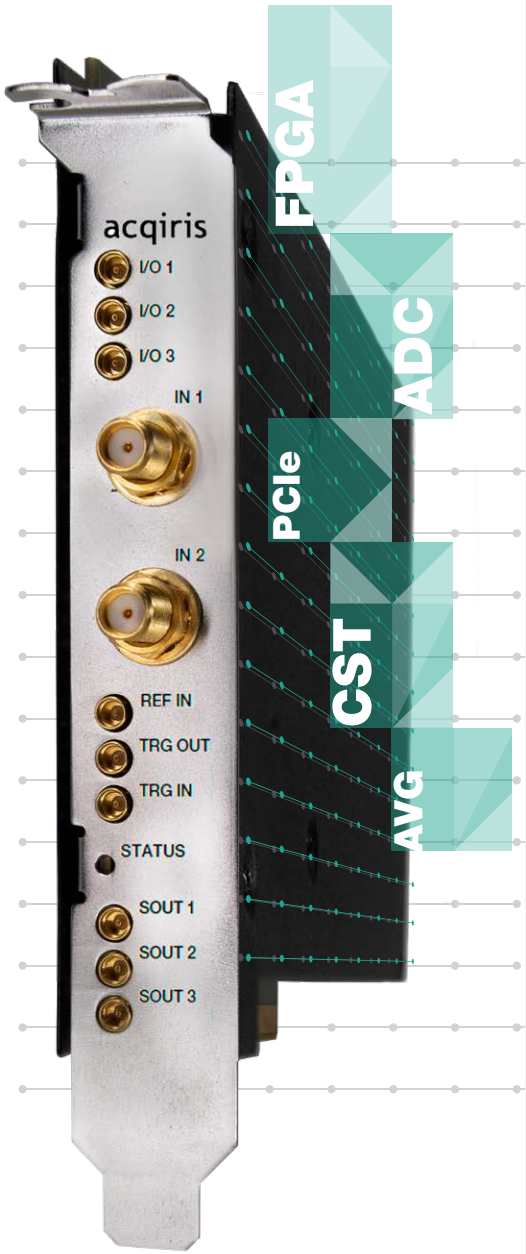
Acqiris SA120P
8-bit ADC Card, 1 GS/s to 2 GS/s, 2 channels
with FPGA signal processing

Preliminary datasheet



New generation of Signal Acquisition cards

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 SA120P is the 2 channels version of the SA1 product line, sampling from 500 MS/s up to 2 GS/s. This unique DC coupled 8-bit digitizer captures waveforms from DC up to 500 MHz.

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 PCIe Gen 3 interface enables low latency, high data transfer rate and streaming capabilities to the host computer at up to 6 GB/s.

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

Essential features

Accurate and precise measurement

- 8-bit resolution
- Sampling rate:
  - 500 MS/s or 1 GS/s on 2 channels
  - Up to 2 GS/s on 1 channel
- DC up to 500 MHz 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
- Minimizing signal distortion

Features depending on your application (options)

Increased recording time:

- Up to 4 GB memory allowing for 2 GSamples per channel
- Streaming capability up to 6 GB/s

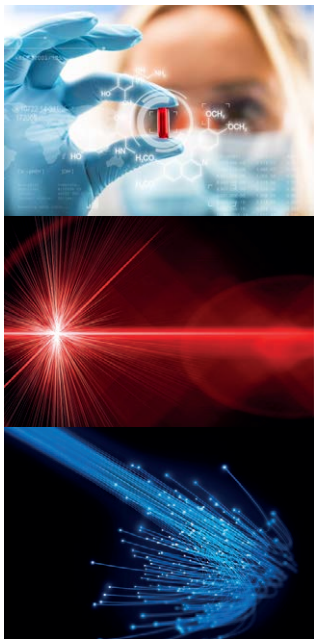
Real-time processing:

- Real-time averaging
- Simultaneous acquisition and readout, enabling streaming with high data throughput
- Pulse generation capability, synchronized with trigger.

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 SA120P 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 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 SA120P 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

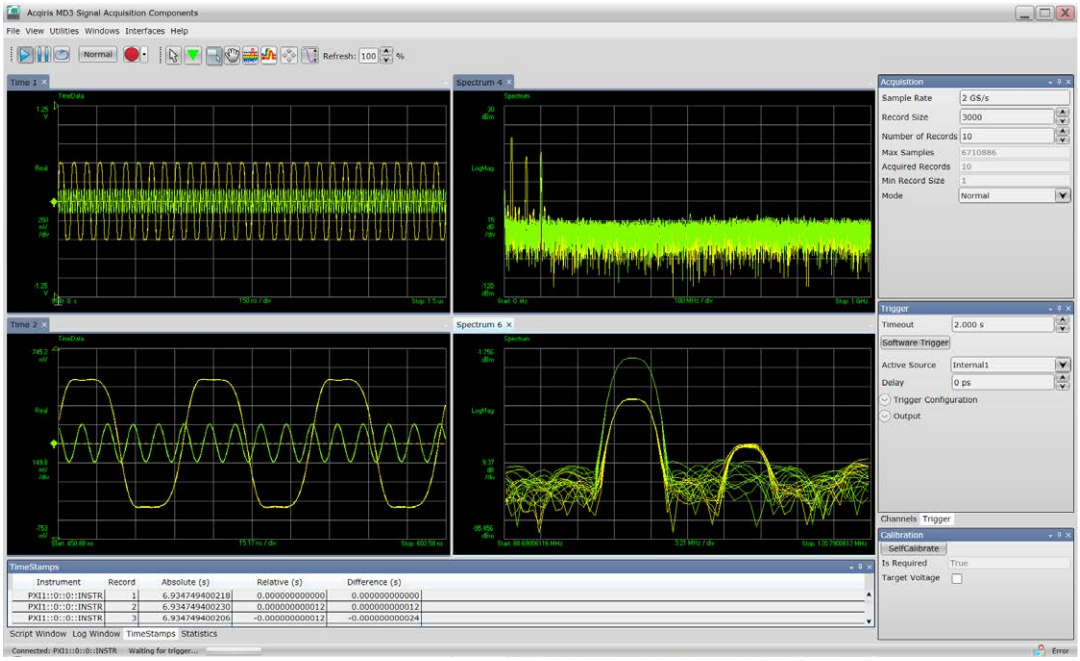


Figure 1. The software front panel (SFP) interface can display acquired data in time domain, frequency domain and provide additional useful information, such as the list of trigger time-stamps.

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

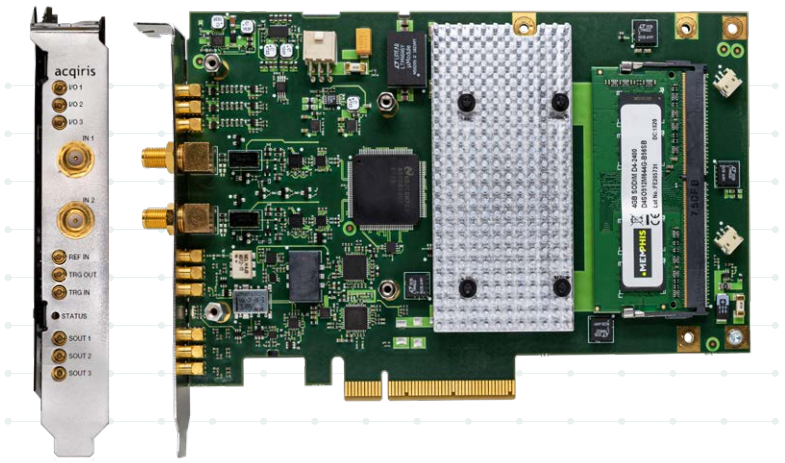


Figure 2. SA1 ADC card - Front panel, with analog inputs, multiple programmable I/O signals and unique synchronized I/Os. Open view.

Integration

In a host computer or externally, the SA120P 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 SA120P 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.

Block diagram

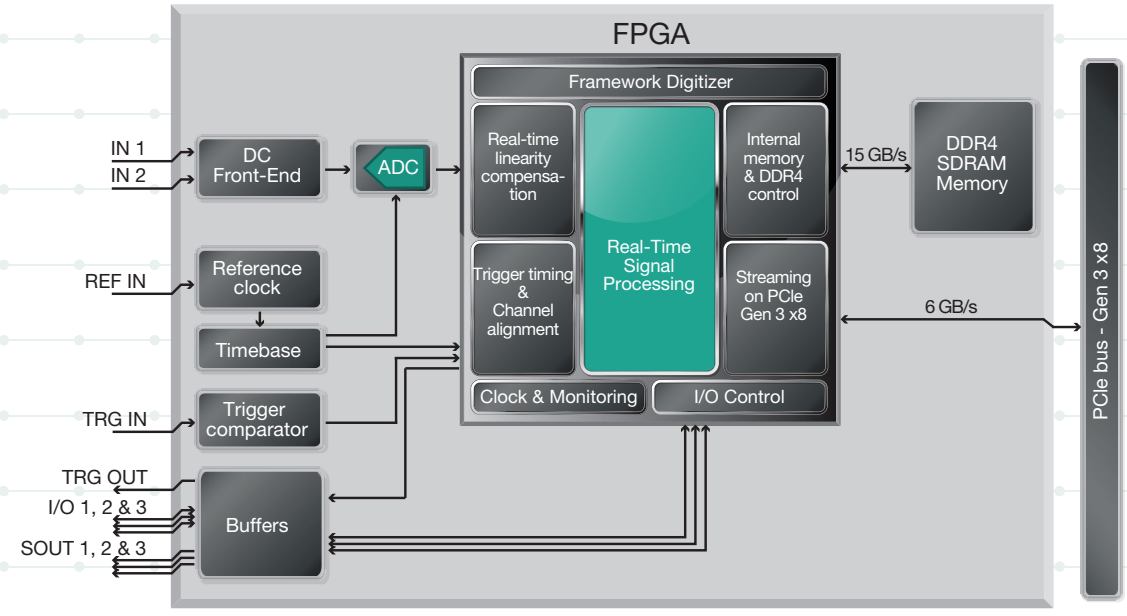


Figure 3. Top level block diagram of the SA120P PCIe ADC card, with on-board real-time processing.

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.
Optimized frequency response flatness enhancing measurement accuracy on a wide bandwidth.

Trigger

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

Programmable I/Os

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

Synchronized outputs

Synchronized pulse generation capability on 3 outputs.

1. See page 7 for full dimension with fan assembly.

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.

Benefitting from the PCIe Gen 3 interface, the SA120P sustains data transfer to the host at up to 6 GB/s.

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 SA120P 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, 8, 16 and 32 – enabling decimated sampling rates from 500 MS/s to 15.625 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 2 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 anti-aliasing low pass filters, enabling decimated sampling rates at 1 GS/s, 500 MS/s or 250 MS/s.

The streaming capability of the SA120P 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		2
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 *(nominal)* DC to 500 MHz *(nominal)*
Effective numbers of bits (ENOB)[2]	@ 100 MHz	6.8 *(nominal)*
Signal to noise distortion (SNR)	@ 100 MHz	43 dB *(nominal)*
Spurious free dynamic range (SFDR)	@ 100 MHz	50 dBc *(nominal)*
Total harmonic distortion (THD)	@ 100 MHz	-48 dB *(nominal)*

Digital conversion		
Resolution		8 bits
Acquisition memory	-MEA -MEB	2 GB (2 GSamples) *(default)* 4 GB (4 GSamples) *(optional)*
Sample clock source		Internal
Internal clock source		Internal, external reference
Real-time sampling rate	 -INT -LSR	1 GS/s 2 channels 2 GS/s 1 channel, 1 GS/s 2 channels 500 MS/s 2 channels
Sampling clock jitter[3]		500 fs *(nominal)*
Clock accuracy		± 1.5 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 SA120P 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-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.

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 2.6 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 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 consumption[4]

+ 3.3 V	Power on PCIe edge connector < 2.3 W *(nominal)*
+ 12 V	Power on PCIe edge connector < 22 W *(nominal, firmware dependent)*

Mechanical characteristics

Form factor		PCIe x8 standard
Size	Without fan[5]	21.5 W x 180.1 H x 126.3 D mm
	With rear fan[6]	21.5 W x 245.1 H x 126.3 D mm
	With rear fan and retainer	21.5 W x 351.3 H x 126.3 D mm
Weight		< 430 gr (< 0.95 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. 60 m^3/h airflow is required. The unit must be operated with the included fan.
6. Optional card retainer can be ordered to stabilize the PCIe card in the host computer.

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
SA120P	PCIe 8-bit ADC card with FPGA signal processing includes: – Fan assembled on module – 5-year standard warranty
Configurable options	
Additional Memory	
Sampling rate	
Full scale range	
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

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