ATS9353

500 MS/s 12-Bit PCIe OEM Digitizer

- 1.6 GB/s PCIe Gen 2 (4-lane) interface
- 2 channels sampled at 12-bit resolution
- 500 MS/s real-time sampling rate
- Variable frequency external clocking
- 256 Megasamples of on-board acquisition memory per channel
- Low noise ±400 mV fixed input range
- Asynchronous DMA device driver
- AlazarDSO® oscilloscope software
- Software Development Kit supports C/C++, C#, Python, MATLAB®, LabVIEW®
- Support for Windows® & Linux®

RoHS 3 COMPLIANT
2015/863/EU

CE

Product	Bus	Operating System	Channels	Max. Sample Rate	Bandwidth	Memory Per Channel	Resolution
ATS9353	PCIe x4 Gen 2	32-bit/64-bit Windows & 64-bit Linux	2	500 MS/s	250 MHz	256 Megasamples	12 bits

Overview

AlazarTech ATS®9353 is 4-lane PCI Express Gen 2 (PCIe x4), dual-channel, 12-bit, 500 MS/s waveform digitizer card capable of streaming acquired data to PC memory at rates up to 1.6 GB/s or storing it in its on-board dual-port acquisition memory buffer of 256 Megasamples.

Unlike other products on the market, ATS9353 does not use interleaved sampling. Each input has its own 12-bit, 500 MSPS ADC chip.

The main difference between ATS9352 and ATS9353 is that ATS9353 has a fixed gain input amplifier that allows analog signals to be captured with a higher signal to noise ratio compared to ATS9352.

Target customers for ATS9353 are those who have control over the output amplitude of their sensor and can match it to the full scale input range of ATS9353.

For customers who need variable input gain, we recommend using the ATS9352.

The variable frequency external clock feature allows operation from 500 MHz down to 30 MHz, making ATS9353 an ideal waveform digitizer for OCT applications.

ATS9353 is supplied with AlazarDSO software that lets the user get started immediately without having to go through a software development process.

Users who need to integrate the ATS9353 in their own program can purchase a software development kit, ATS-SDK, for C/C++, C#, Python, MATLAB, and LabVIEW for both Windows and Linux operating systems.

All of this advanced functionality is packaged in a low-power, half-length PCI Express card.

Applications

Optical Coherence Tomography (OCT)

Ultrasonic & Eddy Current NDT/NDE

Radar/RF Signal Recording

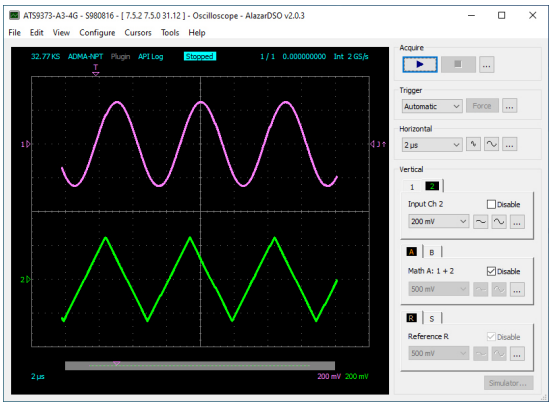
Terabyte Storage Oscilloscope

High-Resolution Oscilloscope

Lidar

Spectroscopy

Multi-Channel Transient Recording



PCI Express Bus Interface

ATS9353 interfaces to the host computer using a 4-lane PCI Express bus. Each lane operates at 5 Gbps (Gen 2).

According to PCIe specification, a 4-lane board can be plugged into any 4-lane, 8-lane or 16-lane slot, but not into a 1-lane slot. As such, ATS9353 requires at least one free 4-lane, 8-lane, or 16-lane slot on the motherboard.

Electrically, ATS9353 is compatible with Gen 1, Gen 2 and Gen 3 slots. Note that data throughput will be halved if ATS9353 is plugged into a Gen1 slot.

The physical and logical PCIe x4 interface is provided by an on-board FPGA, which also integrates acquisition control functions, memory management functions and acquisition datapath. This very high degree of integration maximizes product reliability.

The AlazarTech® 1.6 GB/s benchmark was done using an ASUS® WS X299 SAGE motherboard.

The same performance can be expected from virtually all other motherboards.

Users must always be wary of throughput specifications from manufacturers of waveform digitizers. Some unscrupulous manufacturers tend to specify the raw, burst-mode throughput of the bus. AlazarTech, on the other hand, specifies the benchmarked sustained throughput. To achieve such high throughput, a great deal of proprietary memory management logic and kernel mode drivers have been designed.

Analog Input

An ATS9353 features two analog input channels with extensive functionality. Each channel has up to 250 MHz of full power analog input bandwidth with fixed DC-coupling and ±400 mV input range.

The fixed gain analog front-end electronics allows ATS9353 to provide over 6 dB improvement in signal to noise ratio compared to the ATS9352.

It must be noted that input impedance of both channels is fixed at 50 Ω.

Additional Low-Frequency Analog Input

ATS9353 also features a third analog input channel capable of sampling at 200 KS/s. It allows users to acquire the value of an analog input signal each time the waveform digitizer is triggered.

The main application for this low-frequency analog input is in OCT systems where tracking or feedback signals need to be monitored in real time.

The acquired value of the third analog input is embedded into a Footer that is appended at the end of each record, so software can easily correlate all three channels.

The low-frequency analog input on the ATS9353 is labeled AN IN on the face plate.

Acquisition System

ATS9353 PCI Express digitizers use state of the art 500 MSPS, 12-bit ADCs to digitize the input signals. The real-time sampling rate ranges from 500 MS/s down to 1 KS/s for internal clock and 2 MS/s for external clock.

The two channels are guaranteed to be simultaneous, as the two ADCs use a common clock.

An acquisition can consist of multiple records, with each record being captured as a result of one trigger event. A record can contain both pre-trigger and post-trigger data.

Infinite number of triggers can be captured by ATS9353, when it is operating using dual-port memory.

In between the multiple triggers being captured, the acquisition system is re-armed by the hardware within 256 sampling clock cycles.

This mode of capture, sometimes referred to as Multiple Record, is very useful for capturing data in applications with a very rapid or unpredictable trigger rate. Examples of such applications include medical imaging, ultrasonic testing, OCT and NMR spectroscopy.

On-Board Acquisition Memory

ATS9353 provides 256 Million samples per channel of on-board dual-port memory that can be used for signal storage.

There are two distinct advantages of having on-board memory:

First, a snapshot of the ADC data can be stored into this acquisition memory at full acquisition speed of 2 ch * 500 MS/s * 2 bytes per sample = 2 Gigabytes per second, which is higher than the maximum PCIe Gen 2 x4 bus throughput of 1.6 GB/s.

Second, and more importantly, on-board memory can also act as a very deep FIFO between the Analog-to-Digital converters and PCI Express bus, allowing very fast sustained data transfers across the bus, even if the operating system or another motherboard resource temporarily interrupts DMA transfers.

Maximum Sustained Transfer Rate

PCI Express support on different motherboards is not always the same, resulting in significantly different sustained data transfer rates. The reasons behind these differences are complex and varied and will not be discussed here.

ATS9353 users can quickly determine the maximum sustained transfer rate for their motherboard by inserting their card in a PCIe slot and running the bus benchmarking tool provided in AlazarDSO for Windows or AlazarFrontPanel for Linux.

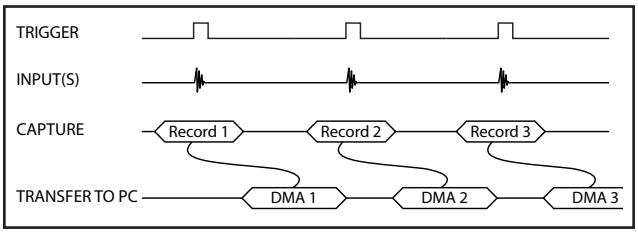
ATS9353, which is equipped with dual-port on-board memory, will be able to achieve this maximum sustained transfer rate.

Recommended Motherboards or PCs

Many different types of motherboards and PCs have been benchmarked by AlazarTech. The ones that have produced the best throughput results are listed here: www.alazartech.com/images-media/2246-AlazarTechRecommendedMotherboards.pdf.

Traditional AutoDMA

In order to acquire both pre-trigger and post-trigger data in a dual-ported memory environment, users can use Traditional AutoDMA.



Data is returned to the user in buffers, where each buffer can contain from 1 to 8192 records (triggers). This number is called RecordsPerBuffer.

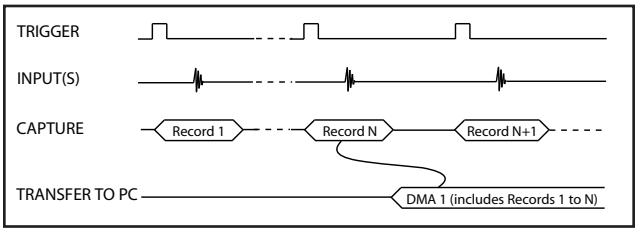
While Traditional AutoDMA can acquire data to PC host memory at the maximum sustained transfer rate of the motherboard, a BUFFER_OVERFLOW can occur if more than 512 triggers occur in very rapid succession, even if all the on-board memory has not been used up.

ATS9353 features a high-performance memory management firmware that allows much faster data throughput in Traditional mode than previous generation digitizers.

No Pre-Trigger (NPT) AutoDMA

Many ultrasonic scanning and medical imaging applications do not need any pre-trigger data: only post-trigger data is sufficient.

NPT AutoDMA is designed specifically for these applications. By only storing post-trigger data, the memory bandwidth is optimized.



Note that a DMA is not started until RecordsPerBuffer number of records (triggers) have been acquired and written to the on-board memory.

NPT AutoDMA buffers do not include headers, so it is not possible to get trigger time-stamps.

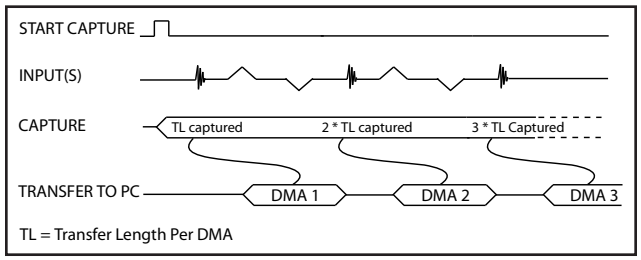
More importantly, a BUFFER_OVERFLOW flag is asserted if the on-board memory overflows, i.e. the amount of memory that has been written into but not not read out to PCIe bus exceeds the on-board memory size.

NPT AutoDMA can easily acquire data to PC host memory at the maximum sustained transfer rate of the motherboard without causing an overflow.

Continuous AutoDMA

Continuous AutoDMA is also known as the data streaming mode.

In this mode, data starts streaming across the PCIe bus as soon as the ATS9353 is armed for acquisition. It is important to note that triggering is disabled in this mode.



Continuous AutoDMA buffers do not include headers, so it is not possible to get trigger time-stamps.

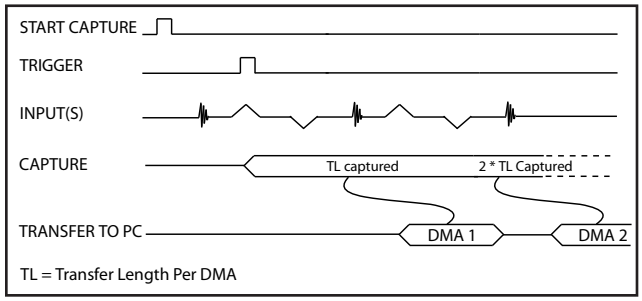
A BUFFER_OVERFLOW flag is asserted only if the entire on-board memory is used up.

The amount of data to be captured is controlled by counting the number of buffers acquired. Acquisition is stopped by an AbortCapture command.

Continuous AutoDMA can easily acquire data to PC host memory at the maximum sustained transfer rate of the motherboard without causing an overflow. This is the recommended mode for very long signal recording.

Triggered Streaming AutoDMA

Triggered Streaming AutoDMA is virtually the same as Continuous mode, except the data transfer across the bus is held off until a trigger event has been detected.



Triggered Streaming AutoDMA buffers do not include headers, so it is not possible to get trigger time-stamps.

A BUFFER_OVERFLOW flag is asserted only if the entire on-board memory is used up.

As in Continuous mode, the amount of data to be captured is controlled by counting the number of buffers acquired. Acquisition is stopped by an AbortCapture command.

Triggered Streaming AutoDMA can easily acquire data to PC host memory at the maximum sustained transfer rate of the motherboard without causing an overflow. This is the recommended mode for RF signal recording that has to be started at a specific time, e.g. based on a GPS pulse.

Asynchronous DMA Driver

The various AutoDMA schemes discussed above provide hardware support for optimal data transfer. However, a corresponding high-performance software mechanism is also required to make sure sustained data transfer can be achieved.

This proprietary software mechanism is called Async DMA (short for Asynchronous DMA).

A number of data buffers are posted by the application software. Once a data buffer is filled, i.e. a DMA has been completed, ATS9353 hardware generates an interrupt, causing an event message to be sent to the application so it can start consuming data. Once the data has been consumed, the application can post the data buffer back on the queue. This can go on indefinitely.

One of the great advantages of Async DMA is that almost 95% of CPU cycles are available for data processing, as all DMA arming is done on an event-driven basis.

To the best of our knowledge, no other supplier of waveform digitizers provides asynchronous software drivers. Their synchronous drivers force the CPU to manage data acquisition, thereby slowing down the overall data acquisition process.

Triggering

ATS9353 is equipped with sophisticated digital triggering options, such as programmable trigger thresholds and slope on any of the input channels or the External Trigger input.

While most oscilloscopes offer only one trigger engine, ATS9353 offers two trigger engines (called Engines J and K).

The user can specify the number of records to capture in an acquisition, the length of each record and the amount of pre-trigger data.

A programmable trigger delay can also be set by the user. This is very useful for capturing the signal of interest in a pulse-echo application, such as ultrasound, radar, lidar etc.

External Trigger Input

The external trigger input on the ATS9353 is labeled TRIG IN on the face plate.

By default, the input impedance of this input is 50 Ω and the full scale input range is ±3 Volts. The trigger signal is treated as an analog signal in this situation and a high-speed comparator receives the signal.

It is also possible to trigger the ATS9353 using a 3.3 V TTL signal. Input impedance is approximately 6.3 kΩ in this mode. This is very useful in imaging applications that use a trigger signal that cannot drive a 50 Ω load.

Timebase

ATS9353 timebase can be controlled either by on-board low-jitter VCO or by External Clock.

On-board low-jitter VCO uses an on-board 10 MHz TCXO as a reference clock.

External Clock

While the ATS9353 features low-jitter VCO and a 10 MHz TCXO as the source of the timebase system, there may be occasions when digitizing has to be synchronized to an external clock source.

ATS9353 External Clock feature provides an SMA input for an external clock signal, which should have a high slew rate. Signal levels, specified in detail on page 8, must be respected.

Input impedance for the External Clock input is fixed at 50 Ω. External clock input is always AC-coupled.

There are two types of External Clock supported by ATS9353. These are described below.

Fast External Clock

A new sample is taken by the on-board ADCs for each rising edge of this External Clock signal.

In order to satisfy the clocking requirements of the ADC chips being used, Fast External Clock frequency must always be higher than 30 MHz and lower than 500 MHz.

This is the ideal clocking scheme for OCT applications.

10 MHz Reference Clock

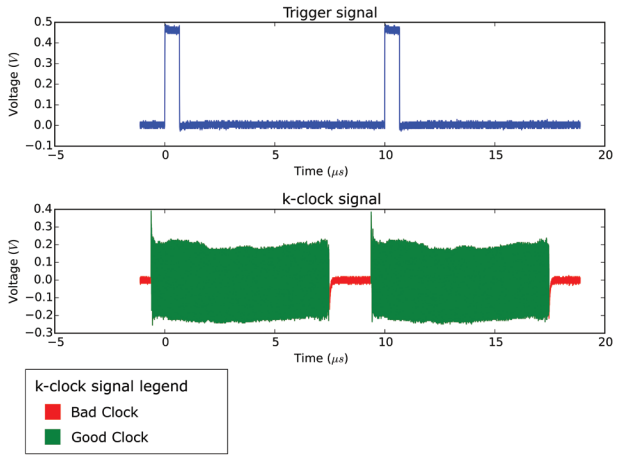
It is possible to generate the sampling clock based on an external 10 MHz reference input. This is useful for RF systems that use a common 10 MHz reference clock.

ATS9353 uses an on-board low-jitter VCO to generate the 500 MHz high-frequency clock used by the ADC. This 500 MHz sampling clock can then be decimated by a factor of 1, 2, 5, 10 or any other integer value that is divisible by 5.

OCT Ignore Bad Clock

The ADCs used on the ATS9353 require the external clock frequency to be above 150 MHz and lower than 500 MHz. In OCT applications, these limits cannot always be respected due to the nature of the optical source.

AlazarTech's *OCT Ignore Bad Clock* technology, allows safe operation with these out-of-specification clocks without requiring the use of a dummy clock in the source.



See www.alazartech.com/en/technology/oct-ignore-bad-clock/ for more information on this technology.

AUX Connector

ATS9353 provides an AUX (Auxiliary) SMA connector that is configured as a Trigger Output connector by default.

When configured as a Trigger Output, AUX SMA connector outputs a 5 Volt TTL signal synchronous to the ATS9353 Trigger signal, allowing users to synchronize their test systems to the ATS9353 Trigger.

When combined with the Trigger Delay feature of the ATS9353, this option is ideal for ultrasonic and other pulse-echo imaging applications.

AUX connector can also be used as a Trigger Enable Input, or "Frame Start" input, which can be used to acquire complete frames, or B-scans, in imaging applications. In fact, this is the most popular use of the AUX connector in OCT applications.

Calibration

Every ATS9353 digitizer is factory calibrated to NIST- and CNRC-traceable standards. To recalibrate an ATS9353, the digitizer must be shipped back to the factory.

On-Board Monitoring

Adding to the reliability offered by ATS9353 are the on-board diagnostic circuits that constantly monitor over 20 different voltages, currents and temperatures. LED alarms are activated if any of the values surpass the limits.

AlazarDSO Software

ATS9353 is supplied with the powerful AlazarDSO software that allows the user to setup the acquisition hardware and capture, display and archive the signals.

The Stream-To-Memory command in AlazarDSO allows users to stream a large dataset to motherboard memory.

AlazarDSO software also includes powerful tools for benchmarking the computer bus and disk drive.

Software Development Kits

AlazarTech provides an easy-to-use software development kit for customers who want to integrate the ATS9353 into their own software.

A Windows and Linux compatible software development kit, called ATS-SDK, includes headers, libraries and source code sample programs written in C/C++, C#, Python, MATLAB, and LabVIEW. These programs can fully control the ATS9353 and acquire data in user buffers.

The purchase of an ATS-SDK license includes a subscription that provides the following benefits for a period of 12 months from the date of purchase:

- Download ATS-SDK updates from the AlazarTech website;
- Receive technical support on ATS-SDK.

Customers who want to receive technical support and download new releases beyond this 12 month period should purchase extended support and maintenance (order number ATS-SDK-1YR).

ATS-GPU

ATS-GPU is a software library developed by AlazarTech to allow users to do real-time data transfer from ATS9353 to a GPU card at rates up to 1.6 GB/s.

Interfacing waveform digitizers to GPUs involves creating a software mechanism to move data from one to the other and back to user buffers. The standard techniques used most often can get the job done, but feature very low data throughput due to software overheads.

AlazarTech designed ATS-GPU to eliminate this software bottleneck so that data can be moved from AlazarTech digitizers to GPUs and from GPUs to user buffers at full PCIe bus speeds. Once the data is available in GPU memory, many types of digital signal processing (DSP) can be done on this data at near-hardware speeds.

ATS-GPU-BASE is supplied with an example user application in source code. The application includes GPU kernels that use ATS-GPU to receive data, do very simple signal processing (data inversion), and copy the processed (inverted) data back to a user buffer. All this is done at the highest possible data transfer rate.

Programmers can replace the data inversion code with application-specific signal processing kernels to develop custom applications.

ATS-GPU-OCT is the optional OCT Signal Processing library for ATS-GPU. It contains floating-point FFT routines that have also been optimized to provide the maximum number of FFTs per second. Kernel code running on the GPU can do zero-padding, apply a windowing function, do a floating-point FFT, calculate the amplitude and convert the result to a log scale. It is also possible to output phase information.

ATS-GPU-NUFFT is an extension of ATS-GPU-OCT that allows non-uniform FFTs to be performed on data acquired uniformly in time domain using a fixed sampling rate. For SS-OCTs where the wave-length does not vary linearly in time, a fixed sampling rate results in data that is non-uniformly dis-tributed in frequency domain. ATS-GPU-NUFFT allows linearized FFTs to be performed on such data.

ATS-GPU supports 64-bit Windows and 64-bit Linux for CUDA®-based development.

Support for Windows

Windows support for ATS9353 includes Windows 10, Windows Server® 2019, and Windows Server 2016. As Windows Server 2019 and 2016 are seldom used by our customers, they are expected to work but are not regularly tested with each software release. If there are issues related to Windows Server 2016 or 2019, tech support may not be as rapid as for other operating systems.

Microsoft mainstream support ended in 2018 for Windows 8.1 and Windows Server 2012 R2. As such, AlazarTech has ceased development on these operating systems. Current software and driver releases may work with these operating systems but they are not officially supported.

Due to lack of demand and due to the fact that Microsoft no longer supports these operating systems, AlazarTech no longer supports Windows 8, Windows 7, Windows XP, Windows Vista, Windows Server 2012, Windows Server 2008 R2, and Windows Server 2008.

Linux Support

AlazarTech offers ATS9353 Dynamic Kernel Module Support (DKMS) drivers for the following Linux distributions: Ubuntu, Debian, and RHEL®.

AlazarTech DKMS drivers may work for other Linux distributions but they have not been tested and technical support may be limited.

Users can download the DKMS driver for their specific distribution by choosing from the available drivers here:

ftp://release@ftp.alazartech.com/outgoing/linux

Only 64-bit Linux operating systems are supported.

A GUI application called AlazarFrontPanel that allows simple data acquisition and display is also provided.

ATS-SDK includes source code example programs for Linux that demonstrate how to acquire data programmatically using a C compiler.

Based on a minimum annual business commitment, the Linux driver source code license (order number ATS9353-LINUX) may be granted to qualified OEM customers for a fee. For release of driver source code, a Non-Disclosure Agreement must be executed between the customer's organization and AlazarTech.

All such source code disclosures are made on an as-is basis with limited support from the factory.

Extended Warranty

The purchase of an ATS9353 includes a standard one (1) year parts and labor warranty. Customers may extend their warranty by ordering the Extended Warranty (order number ATS9353-061).

This must be purchased before expiration of the standard warranty (or before expiration of an Extended Warranty). Extended Warranties can only be purchased while there is a valid warranty in place.

Users can purchase up to 4 (four) additional years of warranty extensions for a maximum total of 5 years of warranty.

Get your warranty end date by registering your product at: www.alazartech.com/en/my-account/my-products/.

OEM Packaging

ATS9353 is available in OEM quantities. All OEM-quantity orders are delivered in a single shipment (no partial shipments allowed). OEM-quantity orders (order numbers ATS9353-110, ATS9353-125, ATS9353-150, ATS9353-200) come in OEM packaging, which does not include software and documentation on USB flash drive.

Software and documentation must be downloaded from www.alazartech.com/en/downloads/.

Export Control Classification

According to the *Export Controls Division of the Government of Canada*, ATS9353 is currently not controlled for export from Canada. Its export control classification is N8, which is equivalent to ECCN EAR99.

ATS9353 can be shipped freely outside of Canada, with the exception of countries listed on the *Area Control List* and *Sanctions List*. Furthermore, if the end-use of ATS9353, in part or in its entirety, is related to the development or deployment of weapons of mass destruction, AlazarTech is obliged to apply for an export permit.

RoHS Compliance

ATS9353 is fully RoHS compliant, as defined by Directive 2015/863/EU (RoHS 3) of the European Parliament and of the Council of 31 March 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

All manufacturing is done using RoHS-compliant components and lead-free soldering.

EC Conformity

ATS9353 conforms to the following standards:

Electromagnetic Emissions:
EN 55032:2012/AC:2013 (Class A):
Multimedia Equipment (MME). Radio disturbance characteristics. Limits and method of measurement:
EN 61000-3-2:2014, EN 61000-3-3:2013.

Electromagnetic Immunity:
EN 55035:2017:
Multimedia Equipment (MME) Immunity characteristics — Limits and methods of measurement.

Safety:
IEC 62368-1:2014/EN 62368-1:2014+A11:2017:
Information technology equipment — Safety — Part 1: General requirements.

ATS9353 also follows the provisions of the following directives: 2014/35/EU (Low Voltage Equipment); 2014/30/EU (Electromagnetic Compatibility).

FCC & ICES-003 Compliance

ATS9353 has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15, subpart B of the FCC Rules, and the Canadian Interference-Causing Equipment Standard ICES-003 Issue 7 October 2020.

System Requirements

Personal computer with at least one free x4, x8, or x16 PCI Express (v2.0) slot, 8 GB RAM, 16 GB of free hard disk space.

Power Requirements

+12 V	1.2 A, typical
+3.3 V	0.5 A, typical

Physical

Size	Single slot, half length PCI Express card (4.377 inches x 6.5 inches excluding the connectors protruding from the front panel)
Weight	250 g

I/O Connectors

ECLK, CH A, CH B, TRIG IN, AN IN, AUX I/O	SMA female connectors

Environmental

Operating temperature	0 to 55 degrees Celsius
Storage temperature	-20 to 70 degrees Celsius
Relative humidity	5 to 95%, non-condensing

Acquisition System

Resolution	12 bits
Bandwidth (-3 dB)	
DC-coupled, 50 Ω	DC - 250 MHz
Number of channels	2, simultaneously sampled
Maximum sample rate	500 MS/s single shot
Minimum sample rate	1 KS/s single shot for internal clocking
Full scale input range	±400 mV
DC accuracy	±2% of full scale in all ranges
Input coupling	DC
Input impedance	50 Ω ±1%
Input protection	
CH A, CH B	±1 V (DC + peak AC without external attenuation)
TRIG IN	±4 V (DC + peak AC without external attenuation)
AUX I/O	-0.7 V to +5.5 V

Additional Low-Frequency Analog Input

Bandwidth (-3 dB)	
DC-coupled, 50 Ω	DC - 100 kHz
Maximum sample rate	200 KS/s single shot
Full scale input range	-0.5 V to +2.5 V, fixed
DC accuracy	±2% of full scale in all ranges
Input coupling	DC
Input impedance	50 Ω ±1%
Input protection	±3 V
Absolute max. amplitude	5 V_{P-P}

Acquisition Memory System

Acquisition Memory/ch	256 Million samples per channel
Record length	Software-selectable with 32-point resolution. Record length must be a minimum of 256 points. There is no upper limit on the maximum record length.
Number of records	Software-selectable from a minimum of 1 to a maximum of infinite number of records
Pre-trigger depth	From 0 to 4080 for single channel From 0 to 2040 for dual channel
Post-trigger depth	Record Length – Pre-Trigger Depth

Timebase System

Timebase options	Internal Clock or External Clock
Internal sample rates	500 MS/s, 250 MS/s, 100 MS/s, 50 MS/s, 20 MS/s, 10 MS/s, 5 MS/s, 2 MS/s, 1 MS/s, 500 KS/s, 200 KS/s, 100 KS/s, 50 KS/s, 20 KS/s, 10 KS/s, 5 KS/s, 2 KS/s, 1 KS/s
Internal clock accuracy	±2 ppm

Dynamic Parameters

Typical values measured on the 400 mV range of CH A of a randomly selected ATS9353. Input signal was provided by a Rohde & Schwarz SMB100A signal generator, followed by a 9-pole, 10 MHz band-pass filter (TTE Q36T-10M-1M-50-720BMF). Input frequency was set at 9.9 MHz and output amplitude was 270 mV rms, which was approximately 95% of the full scale input.

SNR	60.26 dB
SINAD	59.22 dB
THD	-65.95 dB
SFDR	69.76 dBc

Note that these dynamic parameters may vary from one unit to another, with input frequency and with the full scale input range selected.

ECLK (External Clock) Input

Signal level	250 mV_{P-P} to 2 V_{P-P}
Input impedance	50 Ω
Input coupling	AC
Maximum frequency	500 MHz for Fast External Clock
Minimum frequency	30 MHz for Fast External Clock
Sampling edge	Rising

10 MHz Reference PLL Input

Signal level	200 mV_{P-P} to 2 V_{P-P}
Input impedance	50 Ω
Input coupling	AC
Input frequency	10 MHz ± 0.1 MHz
Maximum frequency	10.1 MHz
Minimum frequency	9.9 MHz
Sampling clock freq.	500 MHz

Triggering System

Mode	Edge triggering with hysteresis
Comparator type	Digital comparators for internal (CH A, CH B) triggering and software-selectable analog comparators or TTL gate for TRIG IN (External) triggering
Number of trigger engines	2
Trigger engine combination	Engine J, engine K, J OR K, software-selectable
Trigger engine source	CH A, CH B, TRIG IN, Software or None, independently software-selectable for each of the two Trigger Engines
Hysteresis	±5% of full scale input, typical
Trigger sensitivity	±10% of full scale input range, except for TTL triggering for External Trigger. This implies that the trigger system may not trigger reliably if the input has an amplitude less than ±10% of full scale input range selected
Trigger level accuracy	±5%, typical, of full scale input range of the selected trigger source
Bandwidth	250 MHz
Trigger delay	Software-selectable from 0 to 9,999,999 sampling clock cycles
Trigger timeout	Software-selectable with a 10 µs resolution. Maximum settable value is 3,600 seconds. Can also be disabled to wait indefinitely for a trigger event

TRIG IN (External Trigger) Input

Input type	Analog or 3.3 V TTL, software-selectable
Input coupling	DC only
Analog input impedance	50 Ω
Analog bandwidth (-3 dB)	DC - 250 MHz
Analog input range	±3 V
Analog DC accuracy	±10% of full scale input
Analog input protection	±8 V (DC + peak AC without external attenuation)
TTL input impedance	6.3 kΩ ±10%
TTL min. pulse width	32 ADC sampling clocks
TTL min. pulse amplitude	2 Volts
TTL input protection	-0.7 V to + 5.5 V

Auxiliary I/O (AUX I/O)

Signal direction	Input or Output, software-selectable. Trigger Output by default
Output types:	Trigger Output, Pacer (programmable clock) Output, Software-controlled Digital Output
Input types:	Trigger Enable Software readable Digital Input

Output

Amplitude:	5 Volt TTL
Synchronization:	Synchronized to a clock derived from the ADC sampling clock. Divide-by-4 clock (dual channel mode) or divide-by-8 clock (single channel mode)

Input

Amplitude:	3.3 Volt TTL (5 Volt compliant)
Input coupling:	DC

Materials Supplied

ATS9353 PCI Express card

ATS9353 Installation Disk (on USB Flash Drive)‡

Certification and Compliances

RoHS 3 (Directive 2015/863/EU) Compliance

CE Marking — EC Conformity

FCC Part 15 Class A / ICES-003 Class A Compliance

All specifications are subject to change without notice

‡ *Only applies to order number ATS9353-001. USB flash drive is not provided for OEM-quantity orders (order numbers ATS9353-110, ATS9353-125, ATS9353-150, and ATS9353-200). For OEM-quantity orders, software must be downloaded from www.alazartech.com/en/downloads/.*

ORDERING INFORMATION

ATS9353 (single unit)	ATS9353-001
ATS9353: One Year Extended Warranty	ATS9353-061
ATS9353 (10-24 units)	ATS9353-110
ATS9353 (25-49 units)	ATS9353-125
ATS9353 (50-99 units)	ATS9353-150
ATS9353 (100+ units)	ATS9353-200
Software Development Kit License + 1 Year Subscription (Supports C/C++, Python, MATLAB, and LabVIEW)	ATS-SDK
ATS-GPU-BASE: GPU Streaming Library License + 1 Year Subscription (requires ATS-SDK)	ATSGPU-001
ATS-GPU-OCT: Signal Processing Library License + 1 Year Subscription (requires ATSGPU-001)	ATSGPU-101
ATS-GPU-NUFFT: ATS-GPU-OCT Extension for fixed-frequency sampled data License + 1 Year Subscription (requires ATSGPU-001 & ATSGPU-101)	ATSGPU-201

Manufactured By:

Alazar Technologies, Inc.

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DATASHEET REVISION HISTORY

Changes from version 1.1c (Oct 2021) to version 1.3	Section, Page
Specified number of extended warranties that users may purchase	Extended Warranty, pg. 6

Changes from version 1.1b (April 2021) to version 1.1c	Section, Page
Updated motherboard used for benchmarking	PCI Express Bus Interface, pg. 2
Updated support status for Windows 8.x and Windows Server versions 2012 R2, 2016, 2019	Support for Windows, pg. 6
Updated Linux Support (RHEL)	Linux Support, pg. 6
Updated Electromagnetic Emissions (added limits and method of measurement)	EC Conformity, pg. 7

Changes from version 1.1a (Mar 2021) to version 1.1b	Section, Page
Updated minimum external clock frequency from 25 MHz to 30 MHz	Global change
Updated EC Conformity standards	EC Conformity, pg. 7
Updated System Requirements	System Requirements pg. 8

Changes from version 1.1 (Sept 2020) to version 1.1a	Section, Page
Updated on-board acquisition memory depth from 128 MS per channel to 256 MS per channel	Global change
Updated links to AlazarTech website: new website has a different URL structure	Global change
Updated supported Windows versions - removed Windows 7 & Windows Server 2008 R2	Support for Windows, pg. 6
Corrected standards for Electromagnetic Emissions, Electromagnetic Immunity, and Safety; Corrected Low Voltage Equipment and Electromagnetic Compatibility directives	EC Conformity, pg. 7
Corrected ICES-003 standard from ICES-003:2004 to ICES-003 Issue 7 October 2020	FCC & ICES-003 Compliance, pg. 7
Updated descriptions for ATS-SDK, ATSGPU-001, ATSGPU-101, ATSGPU-201	Ordering Information, pg. 8