ATS9872

1 GS/s 8-Bit PCI Express Digitizer

- 1.6 GB/s PCIe Gen 2 (4-lane) interface
- 2 channels sampled at 8-bit resolution
- 1 GS/s simultaneous real-time sampling rate on each input
- 512 Megasamples of on-board acquisition memory per channel
- ±100 mV to ± 4 V input range
- Asynchronous DMA device driver
- AlazarDSO® oscilloscope software
- Software Development Kit supports C/C++, C#, Python, MATLAB®,and 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
ATS9872	PCIe x4 Gen 2	64-bit Windows & 64-bit Linux	2	1 GS/s	450 MHz	512 Megasamples	8 bits

Overview

AlazarTech ATS®9872 is a 4-lane PCI Express Gen 2 (PCIe x4), dual-channel, high-speed, 8-bit, 1 GS/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 deep on-board dual-port acquisition memory buffer of 512 Megasamples.

Unlike other products on the market, ATS9872 does not use interleaved sampling. Each input has its own 8-bit, 1 GSPS ADC chip.

Users can capture data from one trigger or a burst of triggers. Users can also stream very large datasets continuously to PC memory or hard disk.

ATS9872 allows users to build real-time data acquisition systems even under the Windows or Linux operating systems, as users are allowed to read acquired data even while the next acquisition is in progress.

ATS9872 PCI Express digitizers are an ideal solution for cost sensitive OEM applications that require a digitizer to be embedded into the customer's equipment.

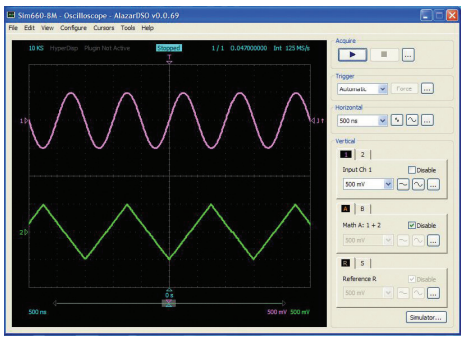
ATS9872 is supplied with AlazarDSO software that lets the user get started immediately without having to go through a software development process.

Users who need to integrate the ATS9872 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

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

ATS9872 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, ATS9872 requires at least one free 4-lane, 8-lane, or 16-lane slot on the motherboard.

Electrically, ATS9872 is compatible with Gen 1, Gen 2 and Gen 3 slots. Note that data throughput will be halved if ATS9872 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® ROG STRIX X570-E 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 ATS9872 features two analog input channels with extensive functionality. Each channel has 450 MHz of full power analog input bandwidth.

With software-selectable attenuation, you can achieve an input voltage range of ±100 mV to ± 4V.

It must be noted that input impedance of both channels is fixed at 50 Ω. Software-selectable AC or DC coupling further increases the signal measurement capability.

Acquisition System

ATS9872 PCI Express digitizers use state-of-the-art 1 GSPS, 8-bit ADCs to digitize the input signals. The real-time sampling rate ranges from 1 GS/s down to 1 KS/s. The two channels are guaranteed to be simultaneous, as they share the exact same 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 ATS9872, 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 64 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

ATS9872 provides 512 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 * 1 GS/s * 1 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.

ATS9872 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.

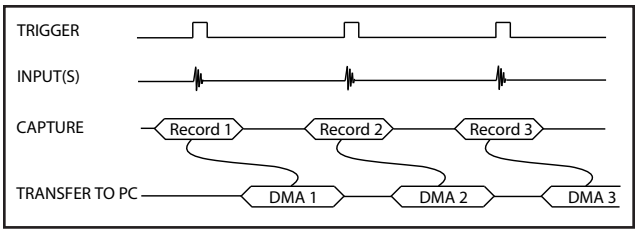
ATS9872, which is equipped with dual-port on-board memory, will be able to achieve this maximum sustained transfer rate.

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 (as high as 1.6 GB/s for PCIe Gen 2 x4) 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.

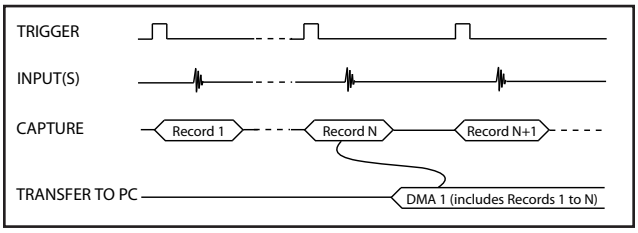
While Traditional AutoDMA can acquire data to PC host memory at the maximum sustained transfer rate of the motherboard, a BUFFER_OVERFLOW can occur if more than 512 triggers occur in very rapid succession, even if all the on-board memory has not been used up.

ATS9872 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.

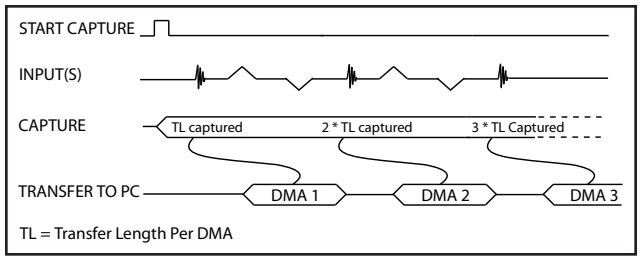
More importantly, a BUFFER_OVERFLOW flag is asserted if the on-board memory overflows, i.e. the amount of memory that has been written into but not not read out to PCIe bus exceeds the on-board memory size.

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 ATS9872 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.

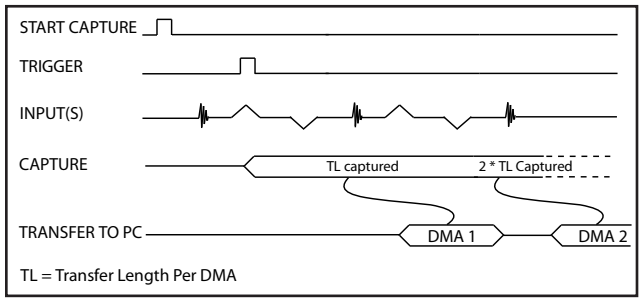
A BUFFER_OVERFLOW flag is asserted only if the entire on-board memory is used up.

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, ATS9872 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.

Output Data Format

By default, ATS9872 data comes out as unsigned binary, where code 0 represents the negative full scale, code (2^{n-1}-1) represents the positive full scale with zero being 2^{n-2}.

It is possible to change the data format to signed binary using an API call. In signed binary format, zero is represented by code 0, positive full scale is represented by (2^{n-2}-1) and negative full scale is represented by (2^{n-2}).

Triggering

The ATS9872 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, ATS9872 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 ATS9872 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 ATS9872 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

ATS9872 timebase can be controlled either by on-board low-jitter VCO or by an external 10 MHz reference clock. On-board low-jitter VCO uses an on-board 10 MHz TCXO as a reference clock.

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.

ATS9872 uses an on-board low-jitter VCO to generate the 1 GHz high-frequency clock used by the ADC. This 1 GHz sampling clock can then be decimated by a factor of 1, 2, 4 or any other integer value that is divisible by 4.

AUX Connector

ATS9872 provides an AUX (Auxiliary) BNC connector that is configured as a Trigger Output connector by default.

When configured as a Trigger Output, AUX BNC connector outputs a 5 Volt TTL signal synchronous to the ATS9872 Trigger signal, allowing users to synchronize their test systems to the ATS9872 Trigger. Note that the Trigger output is synchronized to a divide-by-4 clock (dual channel mode) or divide-by-8 clock (single channel mode).

When combined with the Trigger Delay feature of the ATS9872, 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.

Real-time CPU-based DSP

One of the unique features of AlazarTech's waveform digitizer product line is that acquired data is available for real-time signal processing by the host CPU.

What makes this very powerful is the fact that most modern CPUs have multiple cores, which can be used to do real-time signal processing using parallel processing principles.

If your algorithm can be written to take advantage of parallel processing, this may be a very cost-effective solution for signal processing applications.

AlazarTech has been able to demonstrate that a 2.4 GHz, quad-core CPU can do real-time averaging

of acquired data at 1.5 GB/s while using up only 25% of CPU cycles. A faster CPU or a CPU with more cores can do signal processing even faster.

Calibration

Every ATS9872 digitizer is factory calibrated to NIST- and CNRC-traceable standards. To recalibrate an ATS9872, the digitizer must be shipped back to the factory.

On-Board Monitoring

Adding to the reliability offered by ATS9872 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

ATS9872 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 easy-to-use software development kits for customers who want to integrate the ATS9872 into their own software.

A Windows-compatible software development kit, called ATS-SDK, includes headers, libraries and source code sample programs written in C/C++, C#, Python, MATLAB, and LabVIEW.

A Linux-compatible software development kit, called ATS-devel, includes headers, libraries and source code sample programs written in C++ and Python.

These programs can fully control the ATS9872 and acquire data in user buffers.

The purchase of an ATS-SDK license includes a subscription that allows users to download ATS-SDK updates from the AlazarTech website for period of 12 months from the date of purchase.

Customers who want to download new releases beyond this 12 month period should purchase extended 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 ATS9872 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.

FFTs can be done on triggered data or on continuous gapless stream of data. It is also possible to do spectral averaging. Our benchmarks showed that it was possible to do 520,000 FFTs per second when capturing data in dual-channel mode and using a NVIDIA® Quadro® P5000 GPU.

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 wavelength does not vary linearly in time, a fixed sampling rate results in data that is non-uniformly distributed 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 ATS9872 includes Windows 11, 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.

Only 64-bit Windows operating systems are supported.

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 ATS9872 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 and associated library for their specific distribution here:
www.alazartech.com/en/linux-drivers/ats9872/622/

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, which demonstrate how to acquire data programmatically using a C compiler. Note that example programs are only provided for Python and C++.

Based on a minimum annual business commitment, the Linux driver source code license (order number ATS9872-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.

Upgrading Your Digitizer in The Field

It is always recommended to get upgrades installed at the factory with the initial digitizer purchase.

If the digitizer is still under warranty, it may be possible to add certain upgrades in the field, but there is a small chance that the upgrade will not work, in which case the digitizer would need to be returned to the factory to complete the upgrade.

If the digitizer is no longer under warranty, the upgrade must be done at the factory and there will be a minimum service charge in addition to the cost of the upgrade. This is so that AlazarTech can verify that the digitizer meets basic performance levels prior to any upgrade.

Technical Support

Effective immediately, AlazarTech will only provide free technical support on in-warranty hardware products.

AlazarTech digitizers come with a standard one (1) year parts and labor warranty. This warranty can be extended for a fee (more information can be found in the *Extended Warranty* section below).

If your waveform digitizer is out of warranty, you will no longer be eligible for free technical support on AlazarTech hardware or software products and you will need to purchase technical support hours (order number SUPPORT-HR5) to obtain assistance.

In addition, any necessary repairs to your out-of-warranty hardware products will carry a minimum bench charge.

Extended Warranty

The purchase of an ATS9872 includes a standard one (1) year parts and labor warranty. Customers may extend their warranty by ordering the Extended Warranty (order number ATS9872-061).

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/.

Export Control Classification

According to the *Export Controls Division of the Government of Canada*, ATS9872 is currently not controlled for export from Canada. Its export control classification is N8, which is equivalent to ECCN EAR99. ATS9872 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 ATS9872, 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

ATS9872 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

ATS9872 conforms to the following standards:

Electromagnetic Emissions:
CISPR 32:2015/AMD1:2019/EN 55032:2015/A11:2020 (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/A11:2020:
Multimedia Equipment (MME) Immunity characteristics — Limits and methods of measurement.

Safety:
IEC 62368-1:2018/EN IEC 62368-1:2020+A11:2020:
Audio/video, information and communication technology equipment — Part 1: Safety requirements.

ATS9872 also follows the provisions of the following directives: 2014/35/EU (Low Voltage Equipment); 2014/30/EU (Electromagnetic Compatibility).

FCC & ICES-003 Compliance

ATS9872 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 Oct 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	1.1 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

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

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	8 bits
Bandwidth (-3 dB)	
DC-coupled, 50 Ω	DC - 450 MHz
AC-coupled, 50 Ω	100 kHz - 450 MHz
Number of channels	2, simultaneously sampled
Maximum sample rate	1 GS/s
Minimum sample rate	1 KS/s (internal clock)
Full scale input ranges	
50 Ω input impedance:	±100 mV, ±200 mV, ±400 mV, ±1 V, ±2 V, and ±4 V, software-selectable
DC accuracy	±2% of full scale in all ranges
Input coupling	AC or DC, software-selectable
Input impedance	50 Ω ±1%
Absolute maximum input	
50 Ω	±4 V (DC + peak AC for CH A and CH B only without external attenuation)

Acquisition Memory System

Acquisition Memory/ch	512 Million samples per channel
Record length	Software-selectable with 64-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 10 MHz Reference
Internal sample rates	1 GS/s, 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 CHA of a randomly selected ATS9872. Input signal was provided by a Rohde & Schwarz (SMB 100A), followed by a 9-pole, 20 MHz band-pass filter (TTE Q36T-20M-2M-50-720BMF). Input frequency was set at 20 MHz and output amplitude was 796 mVpp, which was approximately 99% of the full scale input. Input range was set to 400mV. Input was not averaged and bandwidth limiting filter was disabled.

SNR	46.34 dB
SINAD	44.44 dB
THD	-48.95 dBc
SFDR	51.44 dBc

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

10 MHz Reference PLL Input

Signal level	500 mV_{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.	1 GHz

Triggering System

Mode	Edge triggering with hysteresis
Comparator type	Digital comparators for internal (CH A, CH B) triggering and analog comparators 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, EXT, 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. 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	450 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 impedance	50 Ω
Bandwidth (-3 dB)	
DC-coupled	DC - 450 MHz
Input range	±5 V
DC accuracy	±10% of full scale input
Absolute maximum input	±8 V (DC + peak AC without external attenuation)
Coupling	DC

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 absolute max. input	±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 absolute max. input	-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-8 clock (dual channel mode) or divide-by-16 clock (single channel mode)
Input	
Amplitude:	3.3 Volt TTL (5 Volt-compliant)
Input coupling:	DC

Materials Supplied

ATS9872 PCI Express Card

ATS9872 Installation Disk (on USB Flash Drive)

All specifications are subject to change without notice

ORDERING INFORMATION

ATS9872	ATS9872-001
ATS9872: One Year Extended Warranty	ATS9872-061
ATS-SDK purchased with a digitizer board or ATS-GPU: License + 1 Year Subscription (Supports C/C++, Python, MATLAB, and LabVIEW)	ATS-SDK
ATS-SDK purchased separately: License + 1 Year Subscription + 5 hours of technical support (Supports C/C++, Python, MATLAB, and LabVIEW)	ATS-SDK-WOD
ATS-GPU-BASE: GPU Streaming Library License + 1 Year Subscription	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
5 Hours of technical support	SUPPORT-HR5

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DATASHEET REVISION HISTORY

Changes from version 1.4 (Nov 2022) to version 1.4A	Section, Page
Corrected AC-coupled bandwidth from "AC - 450 MHz" to "100 kHz - 450 MHz"	Acquisition System, pg. 8

Changes from version 1.3A (July 2022) to version 1.4	Section, Page
Removed 32-bit Windows	Feature Table, pg. 1
Added new section to specify default output data format is unsigned binary and that it can be changed to signed binary via an API call.	Output Data Format, pg. 4
Separate description for Linux SDK to detail supported programming languages	Software Development Kits, pg. 5
Noted that only 64-bit Windows is supported	Support for Windows, pg. 5
Updated download link for the Linux driver and associated library, and added note: ATS-SDK example programs are only provided for Python and C++	Linux Support, pg. 6
Added new section to detail AlazarTech's upgrade policy	Upgrading Your Digitizer in The Field, pg. 6

Changes from version 1.3 (Nov 2021) to version 1.3A	Section, Page
Changes to maintenance subscription inclusions: removed technical support	Software Development Kits, pg. 5
Added Windows 11	Support for Windows, pg. 5
Added new section to specify how AlazarTech handles technical support: Customers receive free technical support on hardware products that are under warranty. Out-of-warranty support requires the purchase of support hours.	Technical Support, pg. 6
Updated specification name from *Input protection* to *Absolute maximum input* Actual value did not change.	Acquisition System, pg. 7
Added and updated specifications: Updated (labels and values): (*Analog) bandwidth*, *(Analog) input range* Added TTL specifications	TRIG IN (External Trigger) Input, pg. 9
Updated name for product *Software Development Kit* Now called: *ATS-SDK purchased with a digitizer board or ATS-GPU*	Ordering Information, pg. 9
Added products ATS-SDK-WOD and SUPPORT-HR5	Ordering Information, pg. 9

Changes from version 1.0a (April 2021) to version 1.3	Section, Page
Updated support status for Windows 8.x and Windows Server versions 2012 R2, 2016, 2019	Support for Windows, pg. 5
Updated Linux Support (RHEL)	Linux Support, pg. 6
Specified number of extended warranties that users may purchase	Extended Warranty, pg. 6
Added section *EC Conformity*	EC Conformity, pg. 6
Added section *FCC & ICES-003 Compliance*	FCC & ICES-003 Compliance, pg. 6

Changes from version 1.0 (April 2021) to version 1.0A	Section, Page
Replaced External Clock with 10 MHz Reference Clock	Global change
Updated Timebase description	Timebase pg. 4
Updated System Requirements	System Requirements pg. 7