ATST352-OEM

500 MS/s 12-Bit Thunderbolt 3 Digitizer

- Thunderbolt™ 3 (USB type C) connectivity -- No embedded PC required!
- 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
- ±100 mV to ±4 V input range
- Optional On-FPGA FFT
- AlazarDSO® oscilloscope software
- Software Development Kit supports C/C++, C#, Python, MATLAB®, LabVIEW®
- Support for Windows® & Linux®

RoHS 3 COMPLIANT
2015/863/EU

Thunderbolt 4 Compatible

Product	Bus	Operating System	Channels	Max. Sample Rate	Bandwidth	Memory Per Channel	Resolution
ATST352	Thunderbolt 3	64-bit Windows & 64-bit Linux	2	500 MS/s on 2 channels	250 MHz	256 Megasamples	12 bits

Overview

AlazarTech ATS®T352 is a 12-bit, 500 MS/s waveform digitizer card with Thunderbolt 3 connectivity, capable of acquiring data into its on-board memory or streaming to PC memory. Thunderbolt 3 connectivity allows data streaming at rates up to 1.6 GB/s.

From a software perspective, ATST352 looks exactly like the PCI Express based ATS9352. This means that any software developed for ATS9352 will work seemlessly with ATST352, giving customers an easy option to migrate to this Thunderbolt 3 based waveform digitizer.

There are two A/D converters on the ATST352 board, each running at 500 MS/s. Unlike other products on the market, ATST352 does not use interleaved sampling. Each input has its own 12-bit, 500 MSPS ADC chip.

The variable frequency external clock allows operation from 500 MHz down to 30 MHz, making ATST352 an ideal waveform digitizer for OCT applications.

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.

ATST352 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 ATST352 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.

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

Connect ATST352-OEM directly to your computer using a Thunderbolt 3 cable

Thunderbolt 3 Interface

ATST352 interfaces to the host computer using the Thunderbolt 3 bus that runs at 40 Gbps.

ATST352 is also compatible with the Thunderbolt 4 bus. It is essential that customers use certified Thunderbolt 3 or Thunderbolt 4 cables for optimal performance.

ATST352 is a self-powered device and not bus powered, which means the customer must provide a separate 18~24V DC power to the ATST352 for it to operate.

The AlazarTech® **1.6 GB/s** benchmark was done on an HP® ZBook laptop. Similar results were obtained using the optional Thunderbolt 3 port on an HP Z4 workstation.

Software Portability

The biggest advantage of using Thunderbolt 3 over other serial connections is that any code developed for AlazarTech's PCIe boards can be ported over seamlessly to AlazarTech Thunderbolt 3 devices.

Analog Input

An ATST352 features two analog input channels with extensive functionality. Each channel has up to 250 MHz of full power analog input bandwidth.

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

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.

Optional Low-Frequency Analog Input

ATST352 also features an optional third analog input channel capable of sampling at 200 KS/s (order number ATST352-009). 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 ATST352 is labeled AN IN on the face plate.

Acquisition System

ATST352 Thunderbolt 3 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 ATST352, 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

ATST352 provides 256 Million samples per channel of on-board dual-port memory that can be used for signal storage.

This on-board memory is used as a very deep FIFO to temporarily store acquired ADC data before transferring it to motherboard memory using proprietary DMA engines. This on-board buffer allows loss-less data transfer even if the computer is temporarily interrupted by other tasks.

Maximum Sustained Transfer Rate

Data throughput across Thunderbolt 3 connection is highly dependent on the quality of the cable being used. Customers must use a certified Thunderbolt 3 cable to achieve the maximum sustained transfer rate of 1.6 GB/s.

ATST352 users can quickly determine the maximum sustained transfer rate for their motherboard by connecting their ATST352 to the Thunderbolt 3 or Thunderbolt 4 port of their laptop or desktop computer and running the bus benchmarking tool provided in AlazarDSO for Windows or AlazarFrontPanel for Linux.

Recommended PCs

We recommend the use of certified Thunderbolt 3 or Thunderbolt 4 laptops or desktop computers with ATST352.

Recommended Thunderbolt 3 Cables

While Thunderbolt 3 uses the same USB C connector as USB 3.x, the unique electrical requirements of Thunderbolt 3 require the use of special cables that have been certified by an accredited laboratory.

According to Thunderbolt 3 specification, the maximum cable length for passive cables is 0.8 meters. Longer lengths require active cables.

AlazarTech supplies one 0.7 meter passive cable with the digitizer. We have also tested the Corning® 25 meter optical cable model# COR-AOC-CCU6JPN025M20.

Power Connectors

ATST352 is a self-powered Thunderbolt 3 device. Users must supply the necesssary power to the digitizer for it to operate.

ATST352 features two power connectors: a DC-jack that is used with an external AC-DC power supply; and a 2 pin locking Molex MiniFit 39-29-9029 connector that can be used in applications that require a more robust connection in OEM applications.

Recommended AC-DC Power Supply

If you wish to use the DC jack, the power supply must be ordered separately (order number ATST3PS-001). Customers may opt to order the Phihong USA PSAC60M-240 power supply and AC30MNA power cord directly from Digi-Key (part numbers 993-1136-ND and 993-1037-ND respectively).

The following Phihong USA power supplies have also been tested by AlazarTech: PPL65U-240 (65W) and PSAC30U-240L6 (30W).

Please note that power supplies purchased from AlazarTech will come with a type B (NEMA 5-15P) plug. Customers who require a different power cord plug type are encouraged to source one of the above tested power supplies and a suitable power cord from from their preferred electronic component supplier.

In order to obtain safety certification for the ATST364, AlazarTech cannot include a power supply with the digitizer. Though the recommended power supplies have all the necessary compliance marks, our Safety test lab insisted on reviewing the power supply schematics and bill of materials, which were not shared by the power supply manufacturer.

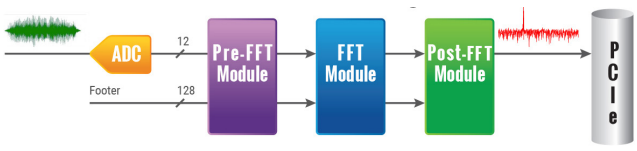
The power supplies specified above have undergone testing at our factory and are the recommended power supplies for AlazarTech Thunderbolt 3 digitizers.

OEM Power Supply

If OEMs wish to use the Molex MiniFit connector, the design of the power supply and related cabling is their responsibility. The power supply must comply with the requirements as specified in the Power Requirements section on page 8.

Optional FPGA-Based FFT Processing

ATST352 On-FPGA FFT option provides the ability to do real-time FFT signal processing using the ATST352 on-board FPGA*. Note that only one input can be processed.



Up to 2048-point FFT length is supported. A user programmable complex windowing function can be applied to the acquired data before FFT calculation.

The complex FFT output is converted to magnitude in single precision floating-point format. A logarithmic output is also available.

Based on customer feedback, output formats of on-FPGA FFT have been reduced to:

- 10 * Log of amplitude^2
- Square Root of amplitude^2

These outputs provide more than sufficient image resolution in typical OCT applications.

If other outputs, such as phase or multiple channel FFT, are required, ATS-GPU-OCT or ATS-GPU-NUFFT can be used.

It is also possible to DMA both frequency and time domain data. This allows users to verify FPGA-based FFT operation during algorithm development.

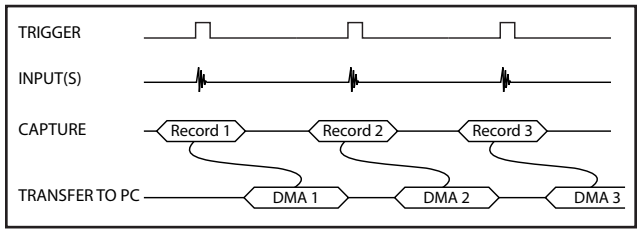
ATST352 can perform 100,000 2048-point FFTs per second.

FPGA-based FFT is ideal for customers in the Optical Coherence Tomography (OCT) field.

*Order part number ATST352-010 for optional FPGA Firmware. Firmware version 19.08 or later, and ATSApi library and driver version 7.6.4 or later are required. If ordered after digitizer delivery, customer will have to perform the firmware update. Furthermore, if the update is for an ATST352 that is no longer under warranty, AlazarTech requires that a series of tests be performed to validate that the digitizer is in working condition.

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.

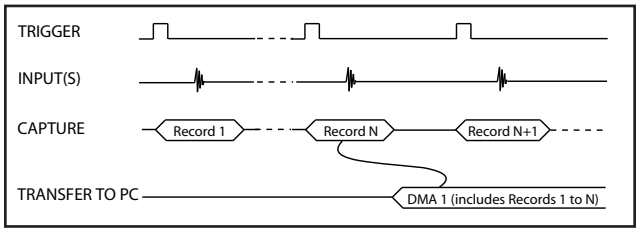
While Traditional AutoDMA can acquire data to PC host memory at the maximum sustained transfer rate of the motherboard, a BUFFER_OVERFLOW can occur if more than 512 triggers occur in very rapid succession, even if all the on-board memory has not been used up.

ATST352 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.

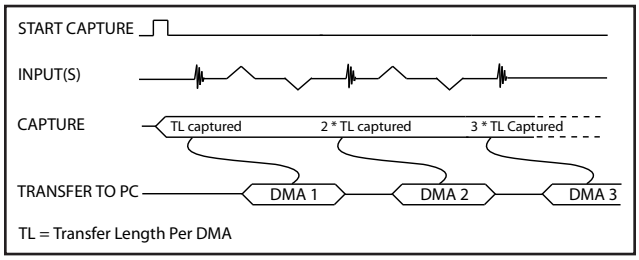
More importantly, a BUFFER_OVERFLOW flag is asserted if the on-board memory overflows, i.e. the amount of memory that has been written into but not not read out to Thunderbolt 3 bus exceeds the on-board memory size.

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 Thunderbolt 3 bus as soon as the ATST352 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.

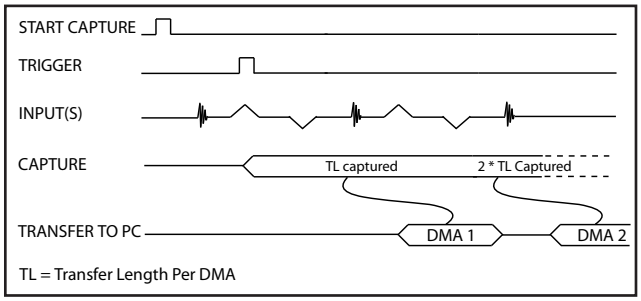
A BUFFER_OVERFLOW flag is asserted only if the entire on-board memory is used up.

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.

Multi-board Systems using ATS 4X1G

ATST352: Sync 4X1G is a device that allows simultaneous sampling across multiple independent ATST352 waveform digitizers. This is achieved by providing common clock and trigger signals to each digitizer.

Sync 4X1G supports Trigger Enable and Trigger Disable so that users can delay triggering until all digitizers are armed; this is a distinct advantage over passive signal splitters.

ATS Sync 4X1G comes with a software library that allows user software to control it.

Sync 4X1G interfaces to AlazarTech digitizer cards using a proprietary high-frequency cable. The provided cable terminates in a ganged micro-miniature RF

connector, which is used to connect to the Sync 4X1G.

The other end of the cable terminates in male SMA and BNC connectors, which are used to connect to the digitizer External Clock and External Trigger respectively.

Sync 4X1G connects to the host computer using a provided USB cable. Please refer to the ATS Sync 4X1G datasheet for full specifications.

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, ATST352 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, ATST352 data comes out as unsigned binary, where code 0 represents the negative full scale, code (2^n-1) represents the positive full scale with zero being 2^{n-1}.

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-1}-1) and negative full scale is represented by (2^{n-1}).

Triggering

ATST352 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, ATST352 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 ATST352 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 ATST352 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

ATST352 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 ATST352 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.

ATST352 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 9, must be respected.

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

ATST352 supports two types of External Clock:

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

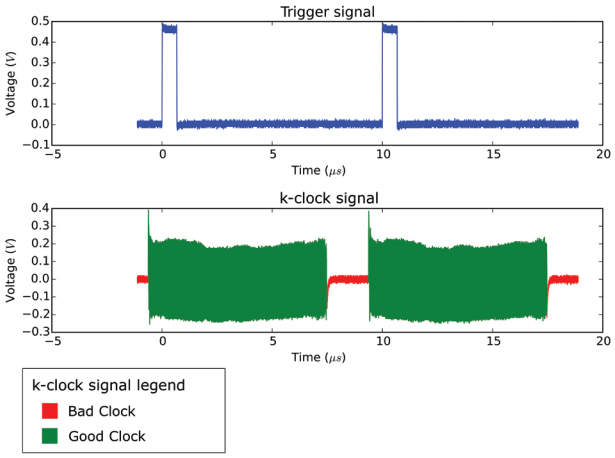
It is possible to generate the sampling clock based on an external 10 MHz reference input. This is useful for RF systems that use a common 10 MHz reference clock.

ATST352 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 ATST352 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.



Users must set the trigger source to be External Trigger input (TRIG IN) when using OCT Ignore Bad Clock. The External Trigger must be set in TTL input range. If these two conditions are not met, the OCT Ignore Bad Clock circuitry will not function.

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

AUX Connector

ATST352 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 ATST352 Trigger signal, allowing users to synchronize their test systems to the ATST352 Trigger.

When combined with the Trigger Delay feature of the ATST352, 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 ATST352 digitizer is factory calibrated to NIST- and CNRC-traceable standards. To recalibrate an ATST352, the digitizer must be shipped back to the factory.

Test Reports

AlazarTech thoroughly tests every digitizer that leaves the factory; each board must pass hundreds of tests before it is shipped to a customer.

In addition to an 8-hour burn-in, each digitizer undergoes a full Performance Verification Test (PVT) where functionality such as external trigger, internal & external clock are tested, and characteristics such as frequency response and bandwidth are measured to ensure that they are within specification.

Customers can obtain test reports for their AlazarTech digitizer (for a fee) by adding the following order number to their digitizer order: *TestReport*. When ordering test reports after the digitizer order, use: *TestReport-AO*.

On-Board Monitoring

Adding to the reliability offered by ATST352 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

ATST352 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 ATST352 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 ATST352 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 ATST352 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 Thunderbolt 3 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.

Version 23.1.0 and higher of ATS-GPU-BASE includes a Boxcar Averaging example kernel that provides the ability to perform real-time boxcar averaging on signals acquired by AlazarTech waveform digitizers. It uses optimized GPU routines that allow raw data acquisition rates up to 6.9 GB/s. This signal processing module can lead to a major improvement of signal-to-noise ratio without using CPU resources and without doing FPGA programming.

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 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 ATST352 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 ATST352 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/atst352/634/

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. 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 ATST352-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

AlazarTech is known for its world-class technical support. Customers receive free technical support on hardware products that are under warranty.

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 not 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 ATST352 includes a standard one (1) year parts and labor warranty. AlazarTech hardware parts and labor warranty should be maintained to ensure uninterrupted access to technical support and warranty repair services.

Customers may extend their warranty by ordering the Extended Warranty (order number ATST352-061). This must be purchased before expiration of the standard warranty (or before expiration of an Extended Warranty).

If the warranty lapses, renewal at a later date will be subject to a reinstatement fee, to cover the administrative costs of warranty reinstatement, and a 6-month waiting period for repair claims. Furthermore, warranty must be extended at least 6 months past the current date.

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*, ATST352 is currently not controlled for export from Canada. Its export control classification is N8, which is equivalent to ECCN EAR99.

ATST352 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 ATST352, 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

ATST352 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.

REACH Compliance

AlazarTech verifies its supply chain against the latest REACH requirements. A compliance statement is usually available within 6 months of release of the European Chemicals Agency (ECHA) updated substance of very high concern (SVHC), Authorizations, and Restrictions lists.

EC Conformity

ATST352 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:
EN 61000-4-2:2009, EN 61000-4-4:2012, EN 61000-4-5:2006, EN 61000-4-6:2009, EN 61000-4-11:2004.

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

ATST352 also follows the provisions of the following directives: 2014/35/EU (Low Voltage Equipment); 2014/30/EU (Electromagnetic Compatibility).

FCC & ICES-003 Compliance

ATST352 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 Thunderbolt 3 or Thunderbolt 4 port, (must be a certified Thunderbolt 3 or Thunderbolt 4 port to achieve full data throughput), 128 GB RAM, 100 MB of free hard disk space.

Power Requirements

Input voltage:	+20 V to +24 V
Voltage ripple:	240 mV_{P-P}, max
Current consumption:	1 A at 24 Vdc input

Power Connectors

Connector types:	
DC (Barrel Plug)	2.1mm I.D. x 5.5mm O.D. x 9.5mm
Molex (for OEM use)	MiniFit 39-29-9029

Physical

Size
(excluding the connectors protruding from the front panel)

In enclosure:	6.5 inches x 8.16 x 2.7 inches
OEM version:	6.57 inches x 5.5 inches

Weight

In enclosure:	721 g
OEM version:	286 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, ambient
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
AC-coupled, 50 Ω	100 kHz - 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 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, CH B, and TRIG IN only without external attenuation)

Optional 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	±1.5 V, single-ended
DC accuracy	±2% of full scale
Input coupling	DC
Input impedance	50 Ω ±1%
Absolute max. amplitude	±5 V

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 ATST352. 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	53.69 dB
SINAD	53.49 dB
THD	-66.85 dB
SFDR	70.83 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 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-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

For ATST352 (ATST352-001):
- ATST352 Thunderbolt 3 Digitizer card in enclosure
- ATSTxxx 0.7m Thunderbolt 3 passive 1x screw lock cable
- ATST352 Install Disk on USB flash drive

For ATST352-OEM (ATST352-101):
- ATST352 Thunderbolt 3 Digitizer card
- ATSTxxx 0.7m Thunderbolt 3 passive 1x screw lock cable
- ATST352 Drivers & user manual as downloadable content

Certification and Compliances

RoHS 3 (Directive 2015/863/EU) Compliance

REACH Compliance

CE Marking — EC Conformity

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

All specifications are subject to change without notice

ORDERING INFORMATION

ATST352 (with enclosure)	ATST352-001
ATST352-OEM (without enclosure)	ATST352-101
ATST352: Low-Frequency Analog Input	ATST352-009
ATST352: On-FPGA FFT	ATST352-010
ATST352: One Year Extended Warranty	ATST352-061
ATSTXXX: DC Power Supply	ATST3PS-001
Test reports ordered with board	TestReport
Test reports ordered after board order	TestReport-AO
ATST352: Sync 4X1G	ATST352-025
ATS Sync xX1G: AC Wall Adapter	SYNC-X1G-PWR
ATS Sync 4X1G: GRF1-SMA/BNC cable	SYNC-4X1-CBL
SYNC-4X1G: One Year Extended Warranty	SYNC-4X1-061
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

Manufactured By:

Alazar Technologies, Inc.

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DATASHEET REVISION HISTORY

Changes from version 1.1D (Feb 2024) to version 1.2	Section, Page
Added section	Test Reports, pg. 6
Corrected specifications: Full scale input range (was -0.5 V to +2.5 V, fixed), DC accuracy (was ±2% of full scale in all ranges), Absolute max. amplitude (was 5 V_{p-p}); Removed *Input protection* (covered under *Absolute max. amplitude*)	Optional Low-Frequency Analog Input, pg. 9
Added test report order numbers	Ordering Information, pg. 11

Changes from version 1.1C (Dec 2023) to version 1.1D	Section, Page
Updated section name and added order number ATST352-009	Optional Low-Frequency Analog Input, pg. 2
Added section on ATST352: Sync 4X1G	Multi-board Systems using ATS 4X1G, pg. 4
Modified warranty reinstatement fee information	Extended Warranty, pg. 8
Specified that Operating temperature is ambient	Environmental, pg. 9
Updated section name	Optional Low-Frequency Analog Input, pg. 9
Added Low-Frequency Analog Input: ATST352-009 Added Sync 4X1G, its accessories and extended warranty: ATST352-025, SYNC-X1G-PWR, SYNC-4X1-CBL, SYNC-4X1-061	Ordering Information, pg. 11

Changes from version 1.1B (Aug 2023) to version 1.1C	Section, Page
Corrected unsigned binary positive full scale to 2^n-1 (was incorrectly stated as 2^{n-1}-1), corrected signed binary positive full scale to 2^{n-1}-1 (was incorrectly stated as 2^{n-2}-1) and negative full scale 2^{n-1} (was incorrectly stated as 2^{n-2}).	Output Data Format, pg. 5
Added note about trigger source	OCT Ignore Bad Clock, pg. 5
Modified to include new warranty reinstatement policy	Extended Warranty, pg. 7

Changes from version 1.1A (Feb 2023) to version 1.1B	Section, Page
Added two additional models of tested power supplies Added note about the power supply's type B (NEMA 5-15P) plug	Recommended AC-DC Power Supply, pg. 3
Added new Boxcar averaging example kernel available with ATS-GPU-BASE 23.1.0+	ATS-GPU, pg. 6
Added section for REACH Compliance	REACH Compliance, pg. 8
Added section for EC Conformity	EC Conformity, pg. 8
Added section for FCC & ICES-003 Compliance	FCC & ICES-003 Compliance, pg. 8
Corrected input voltage and current consumption	Power Requirements, pg. 9
Added REACH compliance	Certification and Compliances, pg. 10

Changes from version 1.1 (Feb 2023) to version 1.1A	Section, Page
Corrected data throughput rate to 1.6 GB/s	Global change
Corrected power supply order number to ATST3PS-001	Recommended AC-DC Power Supply, pg. 3