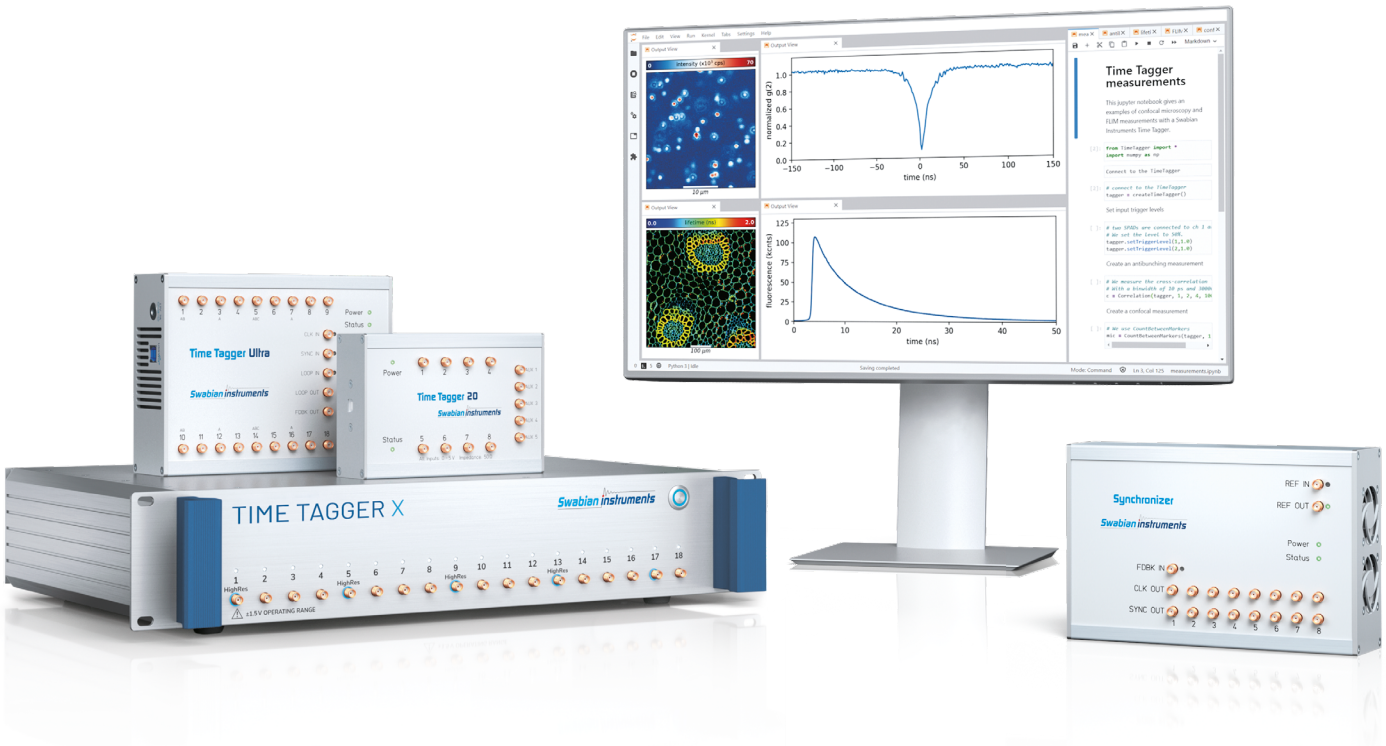
Swabian instruments

Time Tagger Series

Streaming time-to-digital converters



TIME TAGGER SERIES

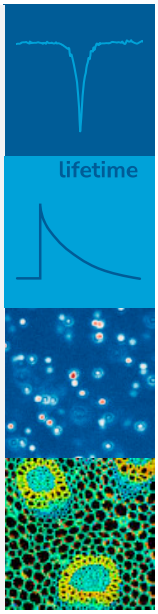
Streaming time-to-digital converters

Swabian Instruments' Time Taggers are streaming time-to-digital converters with a unique data processing architecture that makes them the preferred choice for Time-Correlated Single-Photon Counting (TCSPC), time-interval counting, coincidence counting, and digital protocol analysis.

The new standard in Time-Correlated Single Photon Counting.

The Time Tagger Series provides endless capabilities for single-photon counting and you unleash them with no efforts. Whether you use the Time Taggers' powerful Software or derive from extensive code examples in Python, Matlab, LabVIEW, or C#/C++ - you get your experiments up and running within minutes.

- antibunching
- coincidence counting
- laser scanning microscopy
- multidimensional histograms
- supports SNSPDs, APDs, SPADs, PMTs, SiPMs



Timing & Synchronization made easy.

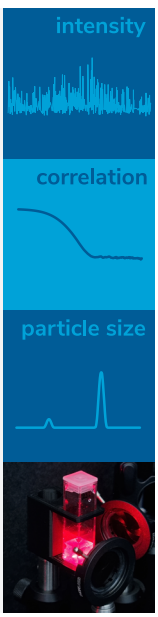
Are you looking for a versatile frequency counter or continuous time interval analyzer (CTIA)? Do you perform Allan Deviation, Modified Allan Deviation, or Hadamard Deviation measurements? Or do you test synchronization of 1 PPS signals? The Time Tagger Series lets you do this easier than ever.

- ADEV 4E-13 at 1 s, TDEV 1E-13 at 1 ms
- realtime ADEV, MDEV, HDEV, phase and frequency error measurements
- up to 160 inputs simultaneously
- input frequencies from 1 Hz to 700 MHz
- easy 1 PPS testing and logging
- log and post process your raw data

Take Dynamic Light Scattering to the next level.

Unsurpassed timing resolution paired with unlimited logarithmic histograms on a multitude of detectors. These are the Time Tagger's capabilities for dynamic light scattering.

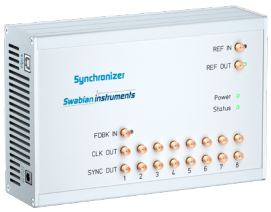
- measure simultaneously at up to 18 different scattering angles
- remove intensity spikes on-the-fly and in post processing with advanced data filtering tools
- calculate particle size distributions with Cumulants and CONTIN analysis
- resolve down to picoseconds



Endless processing capabilities.

Learn more at

TIME TAGGER USER MANUAL

Time Tagger 20	Time Tagger Ultra	Time Tagger X	Synchronizer
			
Compact. USB powered.	**Flexible. Powerful.**		**X-treme resolution. X-treme interfaces.**	**Large scale systems. Combined into one.**
	Value	Performance		
34 ps RMS jitter	42 ps RMS jitter	8 ps RMS jitter	2 ps RMS jitter	0.8 ppb clock stability over 24 h
9 MTags/s USB 2.0 to PC	90 MTags/s USB 3.0 to PC		90 MTags/s USB 3.0 to PC	1.2 GTags/s QSFP+ to FPGA	combine up to 8 Time Tagger Ultra and X
8 input channels	min 4 and up to 18 input channels		min 4 and up to 20 input channels	up to 160 input channels total
	Over-the-air upgradable		Over-the-air upgradable	
	+ High Resolution (3 ps)		+ High Resolution (1.5 ps)	+ Rack mount kit
	+ Additional input channels		+ Additional input channels	
	+ Value to Performance		+ 300 MTags/s SFP+ to PC	

Implement your ideas within minutes

What makes our Time Taggers unique is their powerful software engine that offers effortless data processing capabilities. You will implement your measurement ideas within minutes - promised.

High timing resolution

The low instrument jitter down to 1.5 ps RMS (3.5 ps FWHM) combined with exceptionally short dead time down to 1.5 ns makes sure that you achieve the highest timing resolution for your application.

Versatile onboard event filter

A unique onboard event filter enables you to increase the effective time tag rate way beyond the streaming bandwidth by filtering out unneeded time tags right on the hardware.

Unlimited network capabilities

You can use the Time Tagger's software engine to cast your Time Tag Streams into a network. On client computers you can fire up virtual Time Taggers and work with them as if they were physically attached to your computer, providing the full measurement and data processing capabilities of a hardware Time Tagger.

Maximum flexibility

Run measurements independently using any combination of your input channels. You can take data simultaneously from independent physical setups and run multiple measurements on the same channels at the same time.

High data transfer rate

To transfer to the computer, use USB 3.0 or SFP+ (up to 90 and 300 MTags/s, respectively) and process huge amounts of events on-the-fly. The SFP+ and QSFP+ can also serve to transfer to a secondary FPGA (300 and 1200 MTags/s). Check our FPGA reference design to get started.

Native software libraries

Run your measurements in your preferred programming language with our included native software libraries, covering Python, MATLAB, LabVIEW, C#, and C++.

Low latency output generation

For fast-feedback, low-latency experiments, the Time Tagger X (TTX) offers 2 direct programmable outputs (< 100 ns latency). For endless processing capabilities, transfer to a secondary FPGA (< 10 µs latency) via SFP+ and QSFP+ (300 and 1200 MTags/s) and set up your custom closed-loop system.

Specifications

Timing precision	Time Tagger 20	Time Tagger Ultra		Time Tagger X
RMS jitter (typical)	34 ps	42 ps (Value)	8 ps (Performance)	2 ps
RMS jitter (typical, HighRes)	-	3 / 4 / 6 ps (2 / 4 / 8 HighRes channels)		1.5 ps (5 HighRes channels)
FWHM jitter (typical)	80 ps	100 ps (Value)	19 ps (Performance)	4.7 ps
FWHM jitter (typical, HighRes)	-	7 / 10 / 14 ps (2 / 4 / 8 HighRes channels)		3.5 ps (5 HighRes channels)
digital resolution	1 ps	1 ps		1 ps
Processing capabilities				
input channels	8	4 to 18		4 to 20
dead time	6 ns	2.1 ns		1.5 ns
data rate (USB to PC)	9 MTags/s	90 MTags/s		90 MTags/s
data rate (SFP+ to PC)	-	-		up to 300 MTags/s
data rate (SFP+, QSFP+ to FPGA)	-	-		300, 1200 MTags/s
burst memory	8 MTags	512 MTags		512 MTags
max input frequency per channel	167 MHz	475 MHz		700 MHz
Input signals				
input impedance	50 Ω	50 Ω		50 Ω / 1 MΩ
input signal range	-0.3 to 5 V	-5 to 5 V		-3 to 3 V
recommended input signal range	0 to 3 V	-3 to 3 V		-1.5 to 1.5 V
trigger level range	0 to 2.5 V	-2.5 to 2.5 V		-1 to 1 V
minimum pulse width	1000 ps	500 ps		350 ps
minimum pulse height	100 mV	100 mV		100 mV
External clock input				
frequency	-	10 MHz or 500 MHz		10 MHz or 500 MHz
coupling	-	AC, 50 Ω		AC, 50 Ω
amplitude	-	1 to 3 Vpp		0.5 to 4 Vpp
General parameters				
data interface	USB 2.0	USB 3.0		USB 3.0, SFP+, QSFP+
size (L x W x H) in mm	145 x 100 x 50	190 x 140 x 60		380 x 480 x 90 (2U)

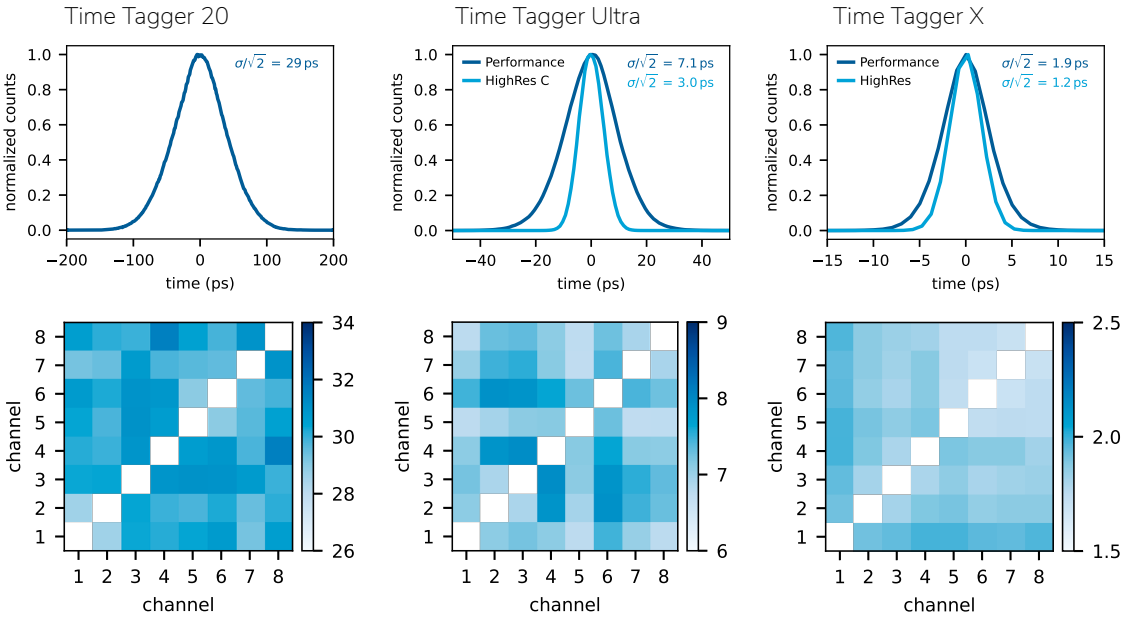
Typical performance

Instrument response

1 MHz square wave, 1 Vpp, 1 ns rise, applied to two input channels, trigger 50%. The standard deviation σ of the distribution measures the jitter of two input channels. The RMS jitter of each individual channel is σ/√2. The FWHM jitter of each channel is 2.35 σ/√2.

RMS Jitter

The plots show the RMS jitter obtained from instrument response measurements with all pairs of the first 8 input channels.



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