Swabian Instruments

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.

down to **4 ps** RMS jitter

up to **70 M tags/s** data rate

4 to **144** input channels

Implement your ideas within minutes

What makes our Time Taggers unique is their powerful software engine that offers extensive data-processing capabilities. Correlations, single- and multi-dimensional histograms, and multi-order coincidence rates.

High timing resolution

The low instrument jitter down to 4 ps RMS (9 ps FWHM) combined with exceptionally low dead time down to 2 ns ensure that you achieve the highest timing resolution in your application.

Versatile on-board event filter

A unique on-board 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.

Maximum flexibility

The Time Tagger Series enables you to run independent measurements using any combinations 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 rate

The high streaming bandwidth of up to 70 M tags/s enables you to minimize your measurement time. The Time Tagger will maintain its full on-the-fly processing capabilities at this high bandwidth.

Native software libraries

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

Time Tagger 20

SPADs

Moderate count rates

34 ps
RMS jitter

8.5 M tags/s
data transfer rate

8
input channels

Time Tagger Ultra

SPADs PMTs SNSPDs

High count rates

Performance Ed.
9 ps
RMS jitter

Value Ed.
42 ps
RMS jitter

70 M tags/s
data transfer rate

4+
input channels

Time Tagger Ultra upgrades

+ large scale systems

up to **144** input channels in one system with a Synchronizer

+ High Resolution option

4 / 5 / 7 ps RMS jitter
with **2 / 4 / 8** input channels

+ more input channels

up to **18** input channels on one Time Tagger Ultra

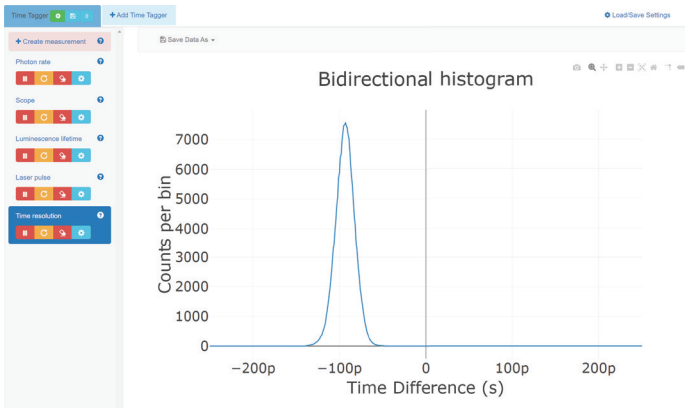
Software

A versatile multi-threaded time-tag-stream processing engine enables you to create an unlimited number of independent measurements simultaneously. As an example, you can run four fully independent HBT setups on one single Time Tagger 20.

We are committed to providing you with the most versatile TCSPC technology available today. This includes extensive software libraries. As a user of a Time Tagger, you receive our complete software tools with lifelong free updates. Learn more about the Time Tagger's software features on our website.

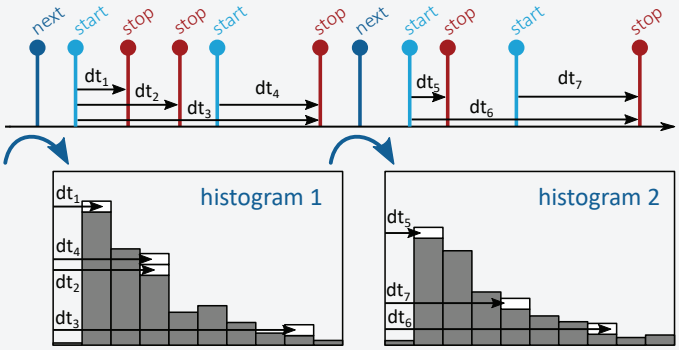
www.swabianinstruments.com

Modern GUI



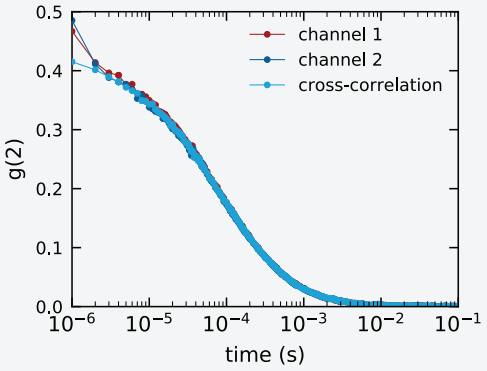
A feature-rich GUI based on modern web technology gives you fast and easy access to your Time Tagger.

Arrays of histograms



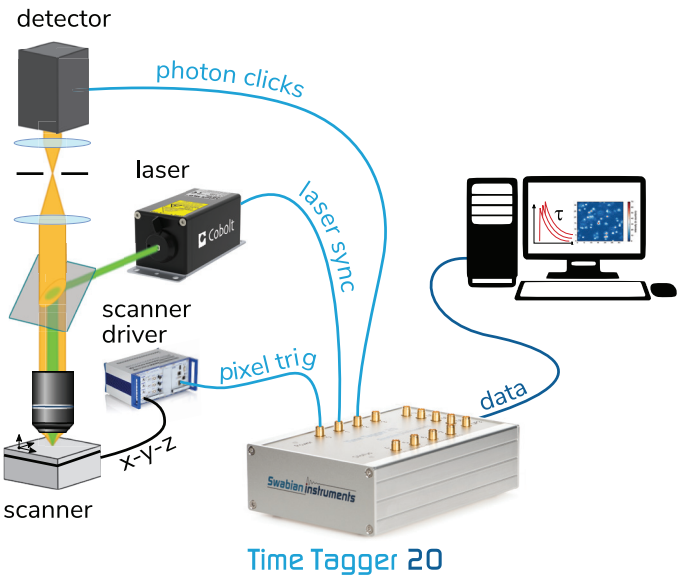
Arrays of histograms enable a wide range of applications such as time-of-flight spectroscopy and pulsed quantum control of solid state defects and quantum dots. You can use custom trigger inputs to step through such arrays in a user-defined and hardware-timed fashion.

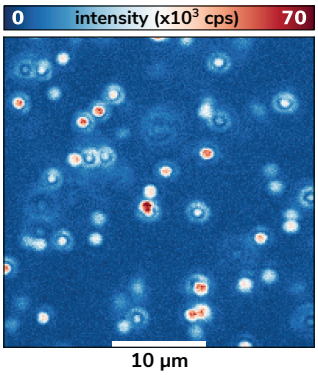
High-performance logarithmic histograms



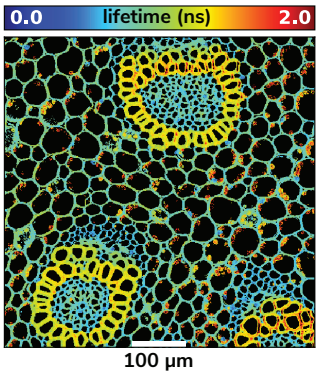
Logarithmic multiple-start-multiple-stop histograms with exceptional performance enable live acquisition of auto- and cross-correlation measurements on any time scale at data rates of up to 70 M tags/s.

Laser-scanning microscopy and fluorescence lifetime imaging





NV centers in diamond, Zeiss 0.95 NA air objective.



Convallaria, FLIM with fast galvo scanning.

Laser-scanning microscopy uses a pixel clock from a piezo- or galvo scanner (optionally, line and frame clocks). Fluorescence lifetime imaging uses a sync trigger from a pulsed excitation laser to deliver time-resolved microscopy, with a fluorescence lifetime curve encoded in each pixel. We provide complete open source GUI examples for you in LabVIEW and Python.

Specifications

Timing precision	Time Tagger 20	Time Tagger Ultra	
RMS jitter	34 ps	9 ps (Performance Ed.)	42 ps (Value Ed.)
		4 / 5 / 7 ps (High Resolution Modes)	
FWHM jitter	80 ps	22 ps (Performance Ed.)	100 ps (Value Ed.)
		9 / 12 / 15 ps (High Resolution Modes)	
digital resolution	1 ps	1 ps	

Processing capabilities		
input channels	8	4 to 18
dead time	6 ns	2 ns
data transfer rate	8.5 M tags/s	70 M tags/s
burst memory	8 M tags	512 M tags
maximum input frequency	167 MHz	500 MHz

Input signals		
input impedance	50 Ω	50 Ω
input signal range	0 to 3 V	-3 to 3 V
maximum input level (no damage)	-0.3 to 5 V	-5 to 5 V
trigger level range	0 to 2.5 V	-2.5 to 2.5 V
minimum pulse width	1 ns	500 ps
minimum pulse height	100 mV	100 mV

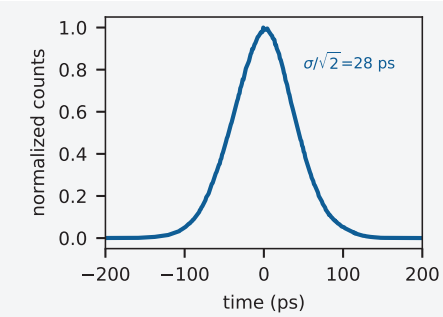
External clock input		
frequency	-	10 MHz or 500 MHz
coupling	-	AC, 50 Ω
amplitude	-	1 Vpp

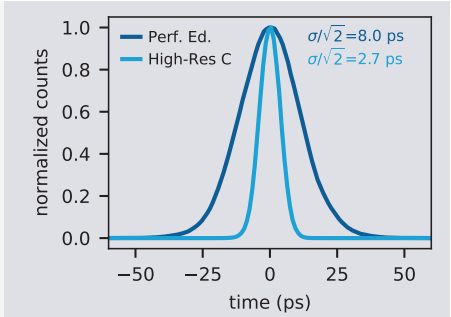
General parameters		
data interface	USB 2.0	USB 3.0
size (L x W x H) in mm	145 x 100 x 50	190 x 140 x 60

Typical performance

Instrument response

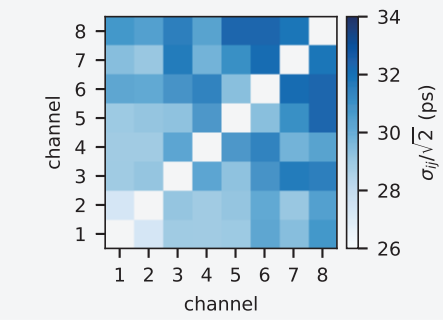
1 MHz square wave, 3 Vpp, 2 ns rise, applied to two input channels, trigger 50%. The standard deviation σ of the measured distribution probes the jitter of both input channels. The RMS jitter of each input channel is approximately $\sigma/\sqrt{2}$. The distribution is approximately Gaussian such that the FWHM jitter of each channel is ≈ 2.35 $\sigma/\sqrt{2}$.

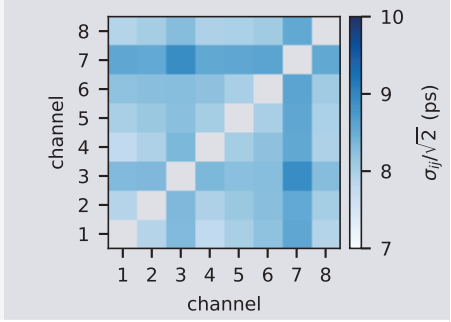




RMS Jitter

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





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