TimeHarp 260

TCSPC and MCS board with PCIe interface

- One or two independent input channels and common sync channel (up to 100 MHz)
- Two models with either 25 ps (PICO) or 250 ps (NANO) base resolution
- "Long range mode" option for PICO model with 2.5 ns base resolution Ultrashort dead time (< 25 ns for PICO model, < 2 ns for NANO model)
- Time tagging with sustained count rates up to 40 Mcps
- 32768 histogram channels
- Adjustable delay on each channel with 25 ps (PICO model) or 250 ps (NANO model) resolution in a range of ± 100 ns
- Multi-stop capability for high counting efficiency at slow repetition rates
- Programmable trigger output
- External synchronization signals for (fluorescence lifetime) imaging or other control events for modules with two detection channels

Applications

- Time-resolved fluorescence and luminescence spectroscopy
- Coincidence correlation, antibunching
- FLIM, FRET, FCS, ...
- Single Molecule Spectroscopy (SMS)
- Quantum optics
- Time-of-Flight (ToF) measurements, LIDAR
- Diffuse optical molecular imaging, optical tomography

The TimeHarp 260 is a compact, easy to use, Time-Correlated Single Photon Counting (TCSPC) and Multi-Channel Scaling (MCS) board for the PCIe interface. It is based on a custom TDC design that offers an ultrashort dead time even at high temporal resolutions. The board is available in two versions with base resolutions of either 25 ps (PICO model) or 250 ps (NANO model). Each version is available with either one or two independent detection channels and an additional common sync input. Each input has an internal adjustable delay with ±100 ns range at either 25 ps resolution (PICO model) or 250 ps resolution (NANO model). All channels including the sync can be used as independent timing channels for coincidence correlation experiments. Alternatively, the common sync input can be used for TCSPC with fast excitation sources in forward start-stop operation at repetition rates up to 100 MHz.

The TimeHarp 260 PICO features a digital resolution of 25 ps and a timing jitter < 20 ps and is therefore well matched to the timing resolution of the majority of common photon detectors. The ultrashort dead time of the TimeHarp 260 PICO of < 25 ns allows very high measurement rates. The histogramming time range of the TimeHarp 260 PICO can be extended up to seconds with an optional "long range mode". In this mode, the base resolution of the board is switched to 2.5 ns and the dead time reduces to < 2.5 ns. This permits to study dynamics from picoseconds up to seconds with just a single board.

The TimeHarp 260 NANO is designed for ultimately short dead time at a moderate time resolution. Exactly like the PICO model, it can be used for coincidence correlations across all inputs or for TCSPC with light source trigger connected to the sync input. Because of the short dead time and the long histogram range it is particularly suited for classical Multi-Channel Scaler (MCS) applications.

A Time-tagged mode for recording of individual photon events with their arrival time on all channels is available for all models. This mode allows the most sophisticated offline analysis of the photon dynamics. In addition, external marker signals can be included in the data stream to synchronize the device with other hardware such as scanners for e.g. Fluorescence Lifetime Imaging (FLIM), (only supported by versions with two detection channels).
The TimeHarp 260 software for Windows provides functions such as the setting of measurement parameters, display of results, loading and saving of measurement parameters and measurement curves. Important measurement characteristics such as count rate, count maximum, position and peak width are displayed continuously. A library for custom programming, e.g. with LabVIEW is also available as an option. Software upgrades for extended functionality will be available with further product development.

Specifications

	TimeHarp 260 PICO	**TimeHarp 260 NANO**
Input Channels and Sync	Constant Fraction Discriminator (CFD)	Constant level trigger
Number of detector channels (in addition to sync)	1 (SINGLE) or 2 (DUAL)	1 (SINGLE) or 2 (DUAL)
Input voltage range (pulse peak into 50 Ohms)	0 mV to -1200 mV optimum: -100 mV to -200 mV	-1200 mV to 1200 mV
Input voltage max. range (damage level)	±1500 mV	±2500 mV
Trigger edge	falling edge	falling or rising edge, software adjustable
Trigger pulse width	0.5 to 30 ns	> 0.5 ns
Trigger pulse required rise/fall time	2 ns max.	--
Time to Digital Converters		
Minimum time bin width	25 ps in optional „long range mode“: 2.5 ns	250 ps*
Timing precision**	< 20 ps rms in optional „long range mode“: < 1 ns rms	< 250 ps rms**
Timing precision / √2**	< 14 ps rms in optional „long range mode“: < 710 ps rms	< 180 ps rms**
Dead time	< 25 ns in optional „long range mode“: <2.5 ns	< 2 ns
Peak count rate per input channel	40 × 106 counts/sec in optional „long range mode“: 400 × 106 counts/sec for bursts of up to 128 events	1000 × 106 counts/sec for bursts of up to 96 events
Sustained count rate (per channel)	40 × 10^6 counts/sec	40 × 10^6 counts/sec
Maximum sync rate (periodic pulse train)	100 MHz	100 MHz
Adjustable delay range for each input channel	±100 ns, resolution 25 ps	±100 ns, resolution 250 ps*
Differential non-linearity	< 2% peak, <0.2% rms (over full measurement range)	< 2% peak, <0.2% rms (over full measurement range)

	TimeHarp 260 PICO	TimeHarp 260 NANO
Histogrammer		
Count depth	32 bit (4 294 967 296 counts)	32 bit (4 294 967 296 counts)
Maximum number of time bins	32 768	32 768
Full scale time range	819 ns to 1.71 s (depending on chosen resolution: 25 ps, 50 ps, 100 ps, ..., 52.42 µs) in optional „long range mode“: 81.92 µs to 171 s (depending on chosen resolution: 2.5 ns, 5 ns, 10 ns, ..., 5242 ms)	8.19 µs to 17.1 s (depending on chosen resolution: 250 ps, 500 ps,..., 524.2 µs)**
Acquisition time	1 ms to 100 hours	1 ms to 100 hours
Sustained throughput (sum of all channels)***	typ. 30×106 events/sec (depending on host PC configuration and performance)	typ. 30×106 events/sec (depending on host PC configuration and performance)
TTTR Engine		
T2 mode resolution	25 ps in optional „long range mode“: 2.5 ns	250 ps*
T3 mode resolution	25 ps, 50 ps, 100 ps, ..., 52.42 µs in optional „long range mode“: 2.5 ns, 5 ns, 10 ns, ..., 5242 ms	250 ps, 500 ps, 1 ns, [...], 524.2 µs**
FiFo buffer depth (records)	8 388 608	8 388 608
Acquisition time	1 ms to 100 hours	1 ms to 100 hours
Sustained throughput (sum of all channels)***	typ. 40×106 events/sec	typ. 40×106 events/sec
Trigger Output		
	only available along with optional long range mode	always enabled
Period	programmable, 0.1 µs to 1678 s (0.596 Hz to 10 MHz)	programmable, 0.1 µs to 1678 s (0.596 Hz to 10 MHz)
Pulse width (typical)	10 ns	10 ns
Baseline level (typical)	0 V	0 V
Active level (pulse peak)	-0.7 V	-0.7 V
External marker inputs		
Number	4 (only available in models with 2 detection channels)	4 (only available in models with 2 detection channels)
Input type	TTL, < 10 ns rise/fall time, > 50 ns pulse width	TTL, < 10 ns rise/fall time, > 50 ns pulse width

	TimeHarp 260 PICO	TimeHarp 260 NANO
Operation		
PC requirements	Dual Core CPU (x86 chipset), min. 1.5 GHz CPU clock, min. 1 GB memory	Dual core CPU (x86 chipset), min. 1.5 GHz CPU clock, min. 1 GB memory
Operating system	Windows 8.1/10/11****	Windows 8.1/10/11****
Power consumption	≤ 15 W (from PC internal power supply)	≤ 15 W (from PC internal power supply)

* Applies to TimeHarp 260 Nano with base resolution = 250 ps (shipped after 2015). Earlier boards have a resolution of 1 ns but can be returned for an upgrade to 250 ps upon request.

** In order to determine the timing precision it is necessary to repeatedly measure a time difference and to calculate the standard deviation (rms error) of these measurements. This is done by splitting an electrical signal from a pulse generator and feeding the two signals each to a separate input channel. The differences of the measured pulse arrival times are calculated along with the corresponding standard deviation. This latter value is the rms jitter which we use to specify the timing precision. However, calculating such a time difference requires two time measurements. Therefore, following from error propagation laws, the single channel rms error is obtained by dividing the previously calculated standard deviation by sqrt(2). We also specify this single channel rms error here for comparison with other products.

*** Sustained throughput depends on configuration and performance of host PC.

**** AMD processor chips recommended.

PicoQuant GmbH
Rudower Chaussee 29 (IGZ)
12489 Berlin
Germany

Phone +49-(0)30-1208820-0
Email info@picoquant.com
Web www.picoquant.com