

# 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  $\pm 100$  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  $\pm 100$  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
<b>Input Channels and Sync</b> .....	Constant Fraction Discriminator (CFD).....	Constant level trigger
Number of detector channels .....	1 or 2 (plus sync) .....	1 or 2 (plus sync)
Input voltage range .....	0 mV to -1200 mV .....	-1200 mV to 1200 mV
	optimum: -100 mV to -200 mV	
Trigger point .....	falling edge .....	falling or rising edge
Trigger pulse width .....	0.5 to 30 ns (rise time max. 2 ns) .....	$> 0.5$ ns
<b>Time to Digital Converters</b>		
Time bin width (adjustable) .....	25 ps, 50 ps, [...], 52.42 $\mu$ s .....	250 ps, 500 ps, 1 ns, [...], 524.2 $\mu$ s*
	in "long range mode": 2.5 ns, 5 ns, [...], 5.242 ms	
Electrical time resolution .....	$< 20$ ps rms .....	$< 250$ ps (rms)*
	in "long range mode": $< 1$ ns (rms)	
Dead time .....	$< 25$ ns .....	$< 2$ ns
	in "long range mode": $< 2.5$ ns	
Sustained count rate (per channel) .....	$40 \times 10^5$ counts/sec .....	$40 \times 10^5$ counts/sec
Differential non-linearity .....	$< 2$ % peak, $< 0.2$ % rms .....	$< 2$ % peak, $< 0.2$ % rms
Maximum sync rate .....	100 MHz .....	100 MHz
<b>Histogrammer</b>		
Count depth .....	32 bit (4.294.967.296).....	32 bit (4.294.967.296)
Full scale range .....	819 ns to 1.71 s .....	8.19 $\mu$ s to 17.1 s*
	in "long range mode": 81.92 $\mu$ s to 171 s	
Maximum number of time bins .....	32768 .....	32768
<b>TTTR Engine</b>		
T2 mode resolution: .....	25 ps .....	250 ps
T3 mode resolution: .....	25 ps, 50 ps, [...], 52.42 $\mu$ s .....	250 ps, 500 ps, 1 ns, [...], 524.2 $\mu$ s
	in "long range mode": 2.5 ns, 5 ns, [...], 5.242 ms	
<b>Operation</b>		
PC interface .....	PCIe 1.1	
PC requirements .....	Dual Core CPU, min. 1.5 GHz CPU clock, min. 1 GB memory	
Operating system .....	Windows™ 7 / 8 / 10	
Power consumption .....	$< 15$ 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.		

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