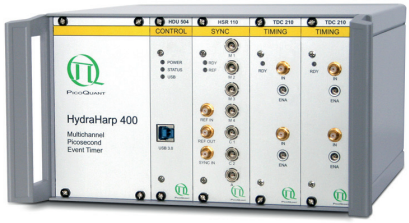
HydraHarp 400

Multichannel Picosecond Event Timer and TCSPC Module with USB Interface

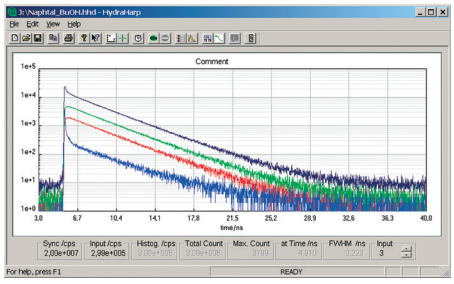
- Compact box with modular, scalable design (patented)
- Up to eight identical synchronized but independent input channels
- Common sync for all input channels
- Count rate up to 12.5 million counts/sec per channel
- 65536 histogram bins per channel, minimum width 1 ps, 32 bits deep
- Multi-stop capability for efficiency at slow repetition rates
- Histogrammer measurement range from 65 ns to 2.19 s
- Time-Tagged Time-Resolved (TTTR) mode
- External marker signals for imaging or other experiment control
- USB 3.0 interface



Applications

- Diffuse Optical Tomography (DOT) and molecular imaging
- Coincidence correlation
- Time-resolved fluorescence and luminescence spectroscopy
- Fluorescence Lifetime Imaging (FLIM)
- Single molecule spectroscopy
- Quantum optics
- Time-of-Flight (TOF) measurements, LIDAR and ranging

The HydraHarp 400 is a high-end, easy to use, plug and play Time Interval Analyzer (TIA) and Time-Correlated Single Photon Counting (TCSPC) system with scalability for multiple channels. Dependent on the chosen frame size, up to 4 or up to 8 channels can be installed. It is connected to a PC through a USB 3.0 interface (covered by patent DE 10 2008 004 549). It provides identical synchronized but independent input channels. They can be used as detector inputs for coincidence correlation experiments or as independent stop inputs for TCSPC. A dedicated common sync input is provided for TCSPC with fast excitation sources. This allows forward start-stop operation at the full repetition rate of mode locked lasers with stable repetition rate up to 150 MHz. Experiments with low repetition rate benefit from the HydraHarp's multi-stop capability.



The design allows high measurement rates up to 12.5 million counts/sec per channel and provides a highly stable, crystal calibrated time resolution of 1 ps. Optionally, an external time base can be used. The instrument's timing resolution is well matched to SPAD detectors of the PDM Series or microchannel plate Photomultiplier Tubes (MCP). All input channels are equipped with Constant Fraction Discriminators (CFD), sensitive on the falling edge. A time-tagged mode for recording of individual photon events with their arrival time on all channels allows the most sophisticated offline analysis of the photon dynamics. Time-Tagged Time-Resolved (TTTR) data can also be correlated in real-time for monitoring of FCS experiments. In TTTR mode, the device can be synchronized with other hardware

such as scanners.
The HydraHarp software 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 comprehensive online help function shortens the users' learning curve. A library for custom programming e.g. with LabVIEW™ is also provided, both for Windows™ and Linux™.

Options

a) Small/large frame for up to 4/8 channels, b) Data analysis software

Specifications

Input Channels and Sync	**Constant Fraction Discriminator (CFD)**
Input voltage range	0 mV to -1000 mV, optimum: -100 mV to -500 mV
Trigger point	falling edge
Trigger pulse width	0.5 to 30 ns
Trigger pulse rise/fall time	2 ns max.
External Reference Clock	
Input	10 MHz, min. 200 mV, max. 1 V pp, 50 Ohms, AC coupled
Output	10 MHz, 300 mV pp, 50 Ohms, AC coupled
Time to Digital Converters	
Minimum time bin width	1 ps
Timing precision*	< 12 ps rms
Timing precision / √2*	< 8.5 ps rms
Full scale range - histogram mode	65 ns to 2.19 s (depending on chosen resolution)
Full scale range - time-tagged mode	infinite
Maximum count rate per input channel	12.5×10^6 counts/sec
Maximum sync rate	150 MHz
Sustained throughput** (sum of all channels)	Typ. 40×10^6 events/sec
Dead time	< 80 ns
Differential non-linearity	< 2 % peak, < 0.2 % rms
Histogrammer	
Count depth per time bin	4.294.967.296 (32 bit)
Maximum number of time bins	65536
Collection time	1 ms to 100 hours
Operation	
PC interface	USB 3.0
PC requirements	1 GHz min. CPU clock, 1 GB memory
Operating system	Windows™ 8/10
Power consumption	small frame < 50 W, large frame < 100 W at 100 to 240 VAC

* 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.

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