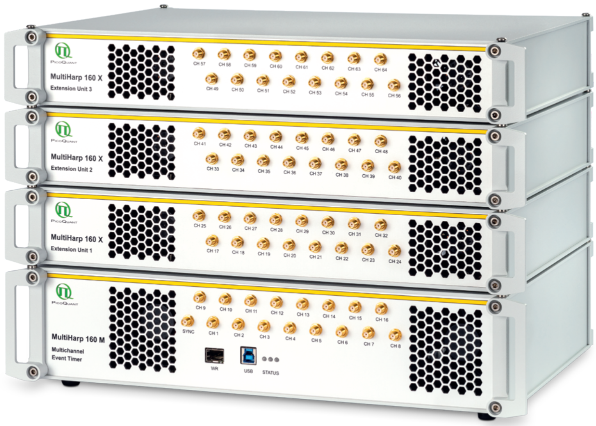
PicoQuant

MultiHarp 160

Scalable Multichannel Event Timer & TCSPC Unit

- Up to 64 independent input channels with 5 ps base resolution
- Scalable via extension units à 16 channels
- Common sync channel (up to 1.2 GHz sync rate)
- Ultrashort dead time (650 ps), no dead time across channels
- Hardware access to data stream via FPGA link
- White Rabbit ready
- Drivers and demo code for custom programming



Applications

- Coincidence Correlation
- Quantum Communication
- Quantum Key Distribution
- Linear Optical Quantum Computation
- Diffuse Optical Tomography
- LIDAR/Ranging/SLR
- Time-Resolved Fluorescence

The MultiHarp 160 is designed as a plug-and-play event timer and Time-Correlated Single Photon Counting (TCSPC) unit which is optimized for applications that require a large number of fast and precise timing channels. The high quality and reliability of the MultiHarp 160 is reflected by our unique 5-year limited warranty.

Scalable up to 64 input channels

The number of input channels can be scaled to your needs: the main unit (MultiHarp 160 M) provides 16 of them and can be expanded with up to three extension units (MultiHarp 160 X). Each extension unit adds 16 channels to the event timer, thus providing a choice of 16, 32, 48 or 64 synchronized input channels. The MultiHarp 160 M also features a synchronization channel as a timing reference for all 16 to 64 input channels. This synchronization channel supports sync rates of up to 1.2 GHz for periodic signals. The data from all input channels are combined into a single data stream that is accessible via the USB 3.0 interface. No additional synchronization tools are required.

All channels of the MultiHarp 160 – including the common sync input – can be used as detector inputs, e.g., for coincidence correlation or coincidence counting. The MultiHarp 160 is also perfectly suited for performing TCSPC with multiple detectors using forward start-stop operation. Here, the common sync channel allows for synchronization with the excitation source.

Fast and precise event timing

The MultiHarp 160's smartly designed time-to-digital converters (5 ps base resolution, <650 ps dead time) allow fully exploiting the count rate limits of TCSPC, without having to compromise on the time resolution for many modern single photon detectors. With its ultrashort dead time, multiple photons per excitation cycle can be detected even at the highest repetition rates achievable by modern picosecond pulsed lasers (requires a detector from the PMA Hybrid Series).

Each input channel also features easily accessible parameter settings, including the trigger parameters as well as programmable timing offsets and hold-off times.

Data interface for external FPGA boards

For applications with high count rates at multiple input channels, the data read-out speed and/or data processing speed by the computer is the major bottleneck. This bottleneck can be bypassed by reducing the data size that is sent to the computer. Such a data reduction is for example done in the histogramming mode of the MultiHarp 160, where TCSPC histograms sent to the computer are calculated out of the arrival times of the input signals by the unit's hardware itself.

To enable the greatest possible flexibility, the time tagging data stream of the MultiHarp 160 can be accessed by external FPGA boards via a dedicated FPGA interface. This way, the method of data preprocessing can be tailored to the specific application.

White Rabbit ready event timer

White Rabbit is a fully deterministic, Ethernet-based timing network which provides sub-nanosecond accuracy and precise synchronization of devices over large distances. Thanks to its White Rabbit interface, the MultiHarp 160 is ready to be integrated into set-ups that are using this emerging technology.

Easy-to-use software included, custom programming supported

The MultiHarp 160 comes with a Windows software package that providing all important functions such as setting measurement parameters, displaying results, loading/saving of measurement parameters and measurement curves. Important measurement data, including count rate, count maximum, position and peak width are continuously displayed. A comprehensive online help system eases the user into fully employing the capabilities of the MultiHarp 160. A library for custom programming, e.g., with C, C#, LabVIEW, Matlab, and Python is also included.

Specifications

Input Channels and Sync	**Constant level trigger on all inputs, software adjustable**
Number of detector channels (in addition to Sync input)	16 (main unit) 32 (main unit + first extension unit) 48 (main unit + first and second extension unit) 64 (main unit + first, second, and third extension unit)
Input voltage operating range (pulse peak into 50 Ohms)	-1200 mV to 1200 mV
Input voltage max. range (damage level)	± 2500 mV
Trigger edge	falling or rising edge, software adjustable
Input pulse width	> 0.4 ns (rise/fall time max. 20 ns)
Time to Digital Converters	
Minimum time bin width	5 ps
Timing precision / √2*	< 32 ps rms
Dead time	< 650 ps (can be increased via software up to 160 ns in steps of 1 ns)
Adjustable programmable time offset for each input channel	± 100 ns, resolution 10 ps
Differential non-linearity	< 10 % peak, < 1 % rms (over full measurement range)
Maximum sync rate (periodic pulse train)	1.2 GHz

Histogrammer	
Count depth	32 bit (4 294967295 counts)
Full scale time range	328 ns to 2.74 s (depending on chosen resolution: 5, 10, 20, …, 41943040 ps)
Maximum number of time bins	65536
Peak count rate per input channel	1.5 × 10^9 counts/sec for 2048 events
Total sustained count rate, sum over all input channels	MultiHarp 160 M: 332 × 10^6 counts/sec (166 × 10^6 counts/sec per row of 8 input channels) MultiHarp 160 X1, X2, X3: 332 × 10^6 counts/sec (166 × 10^6 counts/sec per row of 8 input channels)
TTTR Engine	
T2 mode resolution	5 ps
T3 mode resolution	5, 10, 20, …, 41943040 ps
FiFo buffer depth (records)	268 435 456 events
Peak count rate per input channel	1.5 × 10^9 counts/sec for 2048 events
Total sustained count rate, sum over all input channels**	80 × 10^6 counts/sec via USB 3.0 interface
FPGA data Interface	
Throughput T2/T3 mode	200 × 10^6 counts/sec
Throughput T2 Direct Mode	200 × 10^6 counts/sec per row of 8 input channels + 78 × 10^6 counts/sec for SYNC input
Latency T2 mode	4.5 µs to 5.0 µs
Latency T3 mode	4.5 µs to 5.5 µs
Latency T2 Direct Mode	SYNC: 1.7 µs to 1.8 µs others: 0.8 µs to 1.2 µs
Operation	
PC interface	USB 3.0
PC requirements	Dual Core CPU or better, min. 2 GHz CPU clock, min. 4 GB memory
Operating system	Windows 8/10
Power consumption	max. 150 W
Dimensions	
MultiHarp 160 M (main unit)	incl. feet and handles 285 × 425 × 100 mm
MultiHarp 160 X (extension unit)	incl. feet and handles 285 × 425 × 62 mm

* 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.

PicoQuant

PicoQuant GmbH
Rudower Chaussee 29 (IGZ)
12489 Berlin
Germany

Phone +49-(0)30-1208820-0
Telefax +49-(0)30-1208820-90
Email info@picoquant.com
Web www.picoquant.com