quTAG MC - Multi Channel

Multi channel variant of the quTAG family.

Key Features

- 1 ps digital resolution
- Up to 32 stop channels in one device
- Timing jitter < 20 ps RMS
- USB 3.0 interface
- Synchronization of multiple devices
- Cost-sensitive, modular versions

Applications

- Time-correlated Single Photon Counting (TCSPC)
- Quantum Optics / Information / Communication
- Quantum Key Distribution / Quantum Cryptography
- Fluorescence Lifetime Imaging (FLIM)
- Fluorescence Correlation Spectroscopy (FCS)
- Foerster Resonance Energy Transfer (FLIM-FRET)
- Single Photon Emitter Characterization
- Light Detection and Ranging (LIDAR)

quTAG MC Specifications

Time to Digital Converters	
Digital resolution	1 ps
Timing jitter*1 RMS / FWHM	20 ps / 50 ps
Max. event rate per channel	100 Mcps
Sustained throughput rate	100 Mcps (USB3.0)
Delay range	-50 ... +50 ns
Delay resolution	1 ps
Min. pulse to pulse separation	10 ns
Differential non-linearity	<1 %

Input channels	
Number of channels	1 start / 8, 16, 32 stop
Input connectors	SMA
Signal levels	-5 ... +3.5 V
Threshold level resolution	0.15 mV
Edge	rising, falling
Min. input pulse width	1 ns
Impedance	50 Ohms

Output Channels	
Number of channels	2
Signal levels	LVTTL
Delay resolution	10 ps
Connector	D-Sub

Marker Inputs	
Number of channels	4
Digital resolution	5 ns
Signal level	LVTTL (5V tolerant)
Timing Jitter	2-5 ns
Connector	D-Sub

Clock Input	
Frequency	10 MHz ± 100 ppm *2
Signal level	-6 ... +6 V
Impedance	50 Ohms
Connector	SMA

Sync Output	
Frequency	10 MHz ± 100 ppm
Signal level	LVTTL
Impedance	50 Ohms
Connector	SMA

Operation	
Interface	USB 3.0
Supplied software	GUI, Python, LabView, DLL, command line
Dimensions 1U / 2U	445 x 330 x 50 / 95 mm

*1: see measurement method, *2: various frequencies, see user defined clock input feature

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quTAG MC variant

The time taggers of the quTAG family are available with a wide range of timing resolution and channel numbers.

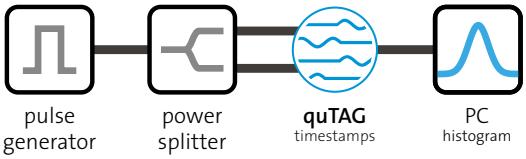
The quTAG MC variant is a multi channel device with up to 32 input and 2 output channels. The sync output gives the possibility to synchronize multiple devices to its clock.

The following table shows all quTAG MC versions with varying number of input channels and heights in rack units (U).

Versions	Input Channels	
MC-20/8	8	5 displays, 1 U
MC-20/16	16	10 displays, 2 U
MC-20/32	*32*	10 displays, 2 U

How we measure the jitter

In order to measure the jitter, we generate an electrical pulse with steep edges. This pulse gets split into two by a power splitter and sent into two different inputs of the quTAG (i.e. start and stop-X or stop-X and stop-Y).



Then we use the quTAG software to generate a start-stop-histogram. We fit a Gaussian function to this histogram and determine RMS and FWHM. The single channel jitter corresponds to $\sigma/\sqrt{2}$ from this two channel measurement, assuming equal Gaussian contributions from both signals. The FWHM can be obtained by the standard deviation with the relation $\mathrm{FWHM} = 2\sqrt{2\ln 2}\,\sigma \approx 2.35\sigma$.

Available quTAG MC extensions

Cross-correlation software extension

The software extension calculates the correlation function needed in Hanbury Brown-Twiss experiments or fluorescence correlation spectroscopy.

Lifetime software extension

The software add-on enables analyzing lifetime measurements on the fly. The software calculates histograms and fits exponential decreases.

Filters & virtual channels

The device allows to enable virtual channels or user-defined filters. The filtering is based on hardware and happens inside the device to save USB bandwidth.

Marker inputs

The device features marker inputs, inserting timestamps in the timeline. Marker inputs are needed e.g. to read a pixel or line clock in a lifetime microscope setup.

Output channels

The two programmable outputs enable conditional measurements, state preparation, gating of detectors, control of shutters and more to synchronize events.

Device Synchronization

Devices can be synchronized by the Sync-Out SMA connector via 10 MHz. If an external clock is connected, the Sync-Out signal is phase locked to the input.

External clock

The quTAG can be synchronized to an external 10 MHz clock signal via a SMA connector to allow more precise long-term accuracy.

User defined external clock

The external clock frequency can be changed from 1 – 100 MHz to phase lock external devices.

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