Model P7889, 64 Bit PCI - based TDC, 100 ps Multistop TDC, Multiscaler, TOF

The Model P7889 is a 100 ps time bin, multiple-event time digitizer It can be used in ultra-fast Multiscaler systems, in Time-of-Flight mass-spectrometry and time-resolved single ion- or photon counting.

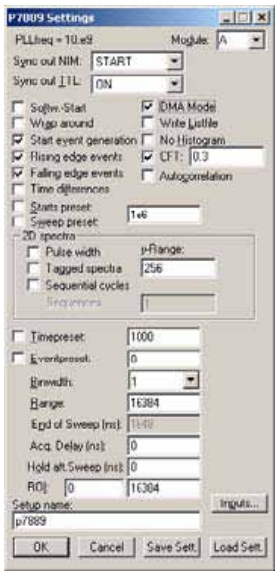
Desription

NEW !! Pulse-width evaluation with 100 ps precision enables the user to calculate the area, the pulse height of the detector pulse but also if multiple events have occured - multiple events have a broader pulse width than single pulses.
The P7889 has been optimized for the best possible pulsepair resolving while providing state-of-the-art time resolution available in digital designs. Two built-in discriminators can be adjusted for a wide range of signal levels.
The single sweep time range enables the user to take data of up to 58 years (64 bit setting) or 1 day (46 bit setting with 10 TAG bits enabled), with a time resolution of 100 ps.
Optionally a reference input for high stability clock sources such as a GPS or rubidium disciplined oscillator will be offered.
The FIFO memory buffers and the fast 64 bit PCI-bus interface enables the P7889 to continuously transfer data at rates of approx. >22.000.000 events/second. For experiments requiring repetitive sweeps the spectral data obtained from each sweep can be summed in the PC enabling very high sweep repetition rates.
The P7889 is designed with „state-of-the-art“ components which offer excellent performance and reliability.
The high-performance hardware is matched by a sophisticated WINDOWS-based software delivered with each P7889 - providing a powerful graphical user interface for setup, datatransfer and spectral data display.
Drivers for LINUX are optionally available.

Performance

Number of Time Bins: 128 to 264 selectable in steps of 64. Transfer of recorded data in List-Mode to RAM or Harddisk.
Time range per shot: Up to a total 264 x100 ps = 58 years (less with with TAG- and Status-words) - see last page
Memory: 1024 x 6.4 ns fast FIFO plus 32k x 64 bit PCIinterface FIFO, capable of recording at least 6.4 usec at full burst rate.
Time Resolution: 72 ps FWHM, typical mass line resolution after Gauss-fit measured at a distance of 10 us after a trigger
Min. Pulse Width (pos. or neg.): 100 ps
Pulse Width resolution: 100 ps
Max. Input counting rate: 10 Gbit/s (0.8V inp. ampltude) (10 G state changes/sec.)
Bin-width: 100 ps, independent of selected range.
Deadtime: No deadtime between time bins.

In operation the sweep is started by a user-supplied start (trigger) pulse. Then subsequent events detected at the stop input are recorded, each in a specific time bin corresponding to the time of arrival relative to the start pulse. Compared to non-multihit devices, the P7889 can evaluate stop event at a rate of 10 GHz state changes/sec, in the pulse width mode at 5 GHz. The P7889 is designed with fully digital circuitry capable of accepting at least 65.000 events at peak (burst) input rates of up-to 10 Gbit/s.



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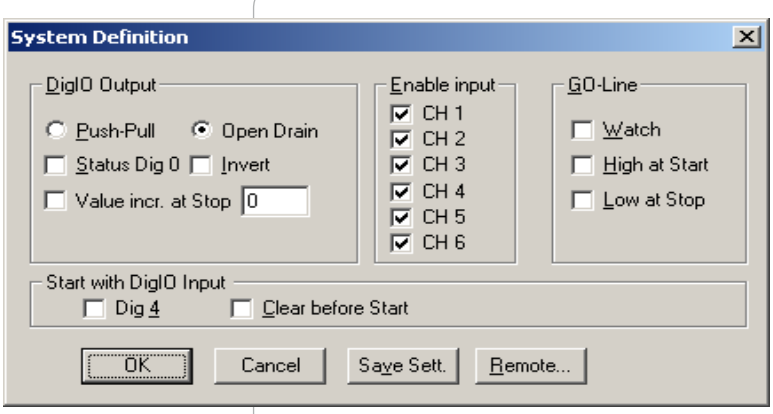

Deadtime: No deadtime between time bins.

Count Rate: The burst count rate to the FIFO can be recoded with no loss of stop pulses for up-to 6.4 usec, the average continuous data throughput is >30,000,000 stops/ sec. to the computer memory (using a computer with a 66 MHz PCI slot).

No Double Counting ! No loss of counts ! prevented by the proprietory input logic used.

Linearity: Differential linearity <<+/-1%
Data Reduction: by recording stop-events only (no „0" events as recorded by transient digitizers) significantly increases the sweep repetition data rate capabilities.

Operating Modes: Continuous, end after sweep, sequential (by software), time interval, pulse width and time over threshold

Sweep Counter: hardware sweep counter (64 bit) with programmable preset. Optional Start-of-Sweep marker insertion in the list mode data stream

Features

- Exceptionally high count rate Time Spectrometry System with 100 ps time resolution
- Time range from nanoseconds to 58 years with 100 ps time resolution
- Stop pulses are evaluated either for rising, falling edge or both at 10 GHz. For the first time this allows to obtain data on pulse-width with 100 ps precision
- Minimum time between rising and falling edge is 100 ps
- Maximum input rates up to 10 Gbit/s
- Exceptionally high data transfer rate to PC by using a 64 bit, 66MHz, 528 MByte/sec. PCI-bus interface (3.3V version)
- Five operating modes: Stop after sweep, sequential, pulse width (TOT - time over threshold and TUT - time below threshold) and time interval. (Autocorrelation optional)
- Fully digital design, no software corrections required
- Start- and Stop-Input via built-in +/-1.2V discriminators (adjustable in steps of 1 mV)
- No dead time between time bins, No missed events, No double counting
- On-board 1024 x 6.4 ns fast FIFO for ultra fast data transfers. Secondary 32k x 64 bit PCI FIFO for approx. >22,000,000 continuous stop events/sec. to the PC for data storage in list-mode or on-line histogramming
- Simultaneous acquisition and data transfer to PC
- On-line sweep summing
- Two versatile, software configurable Sync-outputs for triggering of external devices P7889 & P7889SYS 16102006
- Tag inputs (16) with 13 ns time resolution (i.e. for sequential data acquisition, multi-detector configurations, coincidence studies, etc.
- Presettable 32 bit sweep counter; programmable acquisition delay, programmable number of time bins and programmable trigger hold-off after sweep
- Up to four P7889 can be operated in one PC
- User configurable „GO"-line for experiment synchronisation (compatible with other FAST ComTec devices
- 8-bit digital I/O port
- Two Sync outputs (FAST NIM and TTL)

Typical Applications

TOF Time-of-Flight Spectrometry with exceptional dynamic-range & time resolution

- Position Sensitive Detectors (delay line type: start, 2 x 2 delay signals, time / anode)
- Multi-scaling with very high burst count rates
- Pulse width evaluation with 100 ps precision
- Static TOF SIMS secondary electron Mass-spectrometry - used for example in analyzing molecules from biological samples
- Quantum Cryptography research
- Laser-induced fluorescence spectroscopy in biological samples
- Laser-induced photo-electron spectrometry to analyze the electronic state of gas and solid state samples
- Single molecule counting
- Single photon counting
- LIDAR (1.5 cm spatial resolution)
- Multiparameter / correlation / coincidence measurements

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Specifications Connectors (mounting brackets)

Start Input: SMA-connector , Z_{in} = 50 Ohm

Stop Input: SMA-connector,+/-1V, rising and falling edge

sensitive, programmable threshold in steps of 1mV, Z_{in} = 50 Ohm

Sync output 1: SMA-connector outputs FAST-NIM pulses, Z = 50 Ohm, user selectable signals

Start, Stop inputs, Sync out 1 are located on the board mounting bracket.

I/O port connector: 16 pin header cable connected to 15-pin D-SUB (female, bracket mounted), TTL compatible, 8-bit user configurable digital I/O port, GO-line, Sync output 2, +5V power, 10 MHz reference clock I/O

TAG Inputs: 16-bit TTL or LVDS inputs, default impedance 100 Ohms. 13 ns time resolution.

GO-line connector: 2-pin header on the PCB, open drain (wired-AND), 100k Ohm pull-up

Operating Temperature Range: 0°C to +50°C

Power Requirements:

TBD

Physical: full size 64-bit PCI board, 66MHz, 3.3V version

Shipping weight: 1.8 kg (net 0.75 kg)

Options:

- Ovenized crystal oscillator: Frequency stability 0.03 ppm @ 0 to 50 °C,
- GPS disciplined oscillator
- Rubidium disciplined oscillator
- LW800, 800 MHz discriminator with fiber optical isolation

Software:
DLL and VI's for LabVIEW, C and Visual Basic

- MS-Windows based customer-specific user interfaces can be easily made using supplied documentation, libraries and examples
- Example program in Visual Basic
- Example LabVIEW application and library containing basic LabVIEW VI's
- Automatic execution through MACRO commands
- Local Area TCP/IP Network support for remote control via optional MCDLAN software

The 32 bit MCDWIN software for the P788x family consists of a hardware-dependent server program with DLL and a general graphics program that controls the hardware via the DLL. Any other Windows application can also control the hardware via the DLL. To support the programming of such customer-specific user interfaces, we optionally deliver documentation such as sourcecode and example programs for Visual Basic and LabVIEW, laboratory automation environment with example programs for LabVIEW, Visual Basic and „C" - see separate datasheet.

LINUX Drivers:

- LINUX Driver to control up to four P7889 boards.
- Library and Sample program with Source code are included.
- Function library with source code allows to set and get all acquisition parameters, start, halt, erase, get status, sweep.
- Control of the Digital Input / Output and the thresholds of the input discriminators.
- Sample console-program with source code contains command interpreter, can be easily expanded by the user to implement customer-specific features.
- The driver source for the actual LINUX Kernel versions 2.6.x on the x86 platform is included.
- DMA and Multithreading is implemented.

Version P7889SYS

The P7889 can also be delivered as a complete PC-based Data Acquisition System (DAS) where the P7889 including the software is delivered fully installed and operational.

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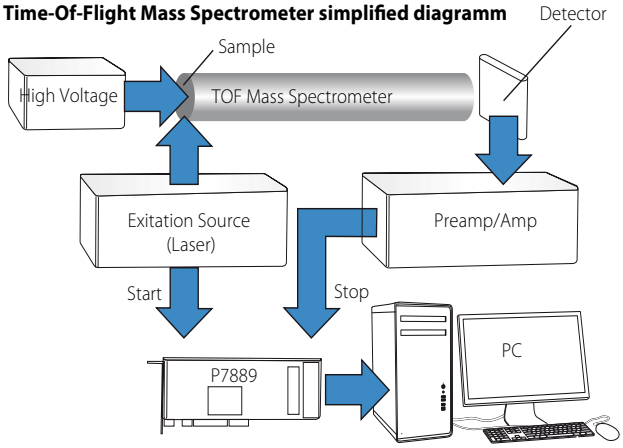
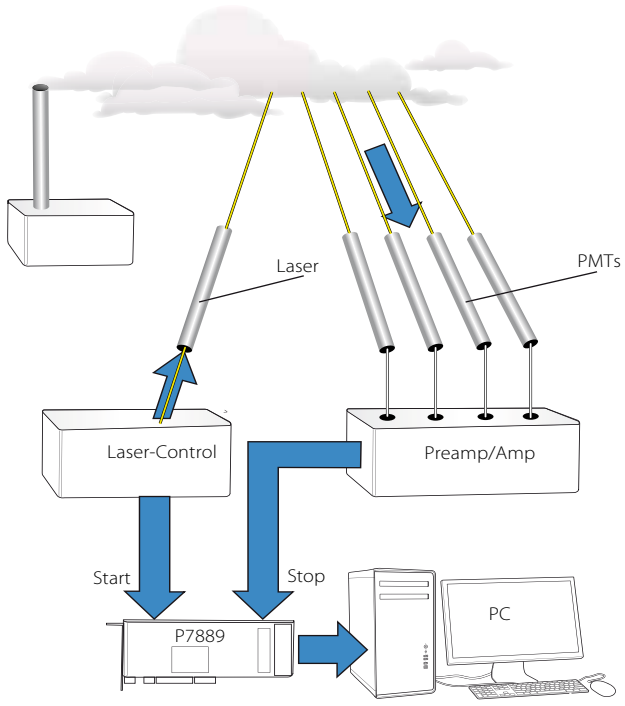
Typical Applications

Time-Of-Flight Mass Spectrometer simplified diagramm



A Simplified Diagram of a LIDAR Setup



Examples of time range settings
62 time bits = 14.6 years
59 time bits and 3 tag bits = 1.8 years
53 time bis, 6 tag bits and 3 card ID bits = 10.4 days
53 time bits and 9 tag bits = 10.4 days
49 time bits, 13 tag bits = 1.3 days
49 time bits, 10 tag bits and 3 card ID bits = 1.3 days
46 time bits, 16 tag bits = 117 minutes

Time-of-Flight Spectrometry

This application is specifically suited to the capabilities of the P7889. Because the P7889 has been optimized for the best pulse-pair resolving time while providing excellent time resolution one can easily record mass lines that are very closely spaced. Because of the multistop capability of the P7889 stop events in all mass lines can be recorded during a single shot - something practically impossible with analog-type instrumentation.

LIDAR

The beam of a pulsed LASER is aimed at an object from as close as a plume of a smoke stack to as far as a cloud or the exhaust vapor of a Jet engine flying at high altitudes.
The reflected beam is detected, for example with a PMT and the photons are counted as stop pulses by the P7889.
Responses from repeated shots from the LASER are summed to improve the statistical precision. The time range of the P7889 from 32 ns to 83 days can be used to measure objects from close range up to distances far exceeding the useful range of a LIDAR System. The spatial resolution is 1.5 cm - uniformly over the entire selected range.
Very important in LIDAR applications is the multistop capability of the P7889 which will produce a full spectrum with relatively few shots. Therefore the P7889 is ideally suited to analyze transient phenomena such as exhaust plumes of fast moving objects at very high altitudes.

Lifetime measurements

Time resolved Single-Molecule detection: the P7889 can record decay schemes with multiple decay time constants. Due to the zero deadtime between recording of events at up to 5 GHz count rates the fast components will not be distorted - i.e. no correction of the accumulated (raw) data is required.

Ordering Information

P7889 including the operating software, three input cables SMA to BNC, D-SUB15 I/O connector Order No. TOFP89
P7889SYS The P7889 is delivered installed in a 19" Data Acquisition System with 19" TFT Monitor.
Options: P7889 TAG connector cable and bracket TOFP89T
Ovenized crystal oscillator TOFP89O
GPS disciplined oscillator (ask factory)
Rubidium disciplined oscillator TOFP89R

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