Model MPA4T, 8 ch aquisition system with 6 ns time tagging + 64 Bit 5/(6) input 100 ps Multistop TOF
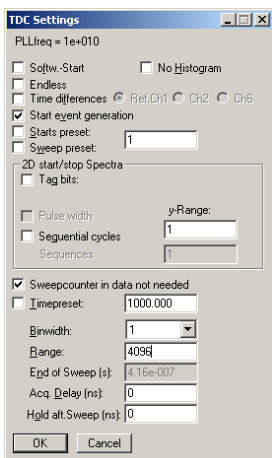
Time range up to 20 days doesn't influence the resolution.

High precision long term time measurement and correlated amplitude evaluation in one device

The MPA4T is a combination of a high resolution Multistop TOF System (1 START, 5 STOPS, 54 bit dynamic range) with a Multiparameter Data Aquisition System (4 or 8 channels).

Description: 100 ps multiple-event time digitizer (TDC)

In operation the sweep is started by a usersupplied start (trigger) pulse. Then subsequent events detected at the stop inputs are recorded, each in a specific time bin corresponding to the time of arrival relative to the start pulse. peak (burst) input rates of up-to 10 Gbit/s.

The Model MPA4T is a 100 ps per time bin, multiple-event time digitizer (TDC). It can be used in ultra-fast Multi-scaler/ TOF systems, in Time-of-Flight mass-spectrometry and time-resolved single ion- or photon counting.
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.
In operation the sweep is started by a usersupplied start (trigger) pulse. Then subsequent events detected at the stop inputs are recorded, each in a specific time bin corresponding to the time of arrival relative to the start pulse. Compared to non-multi-hit devices, the MPA4T can evaluate stop events at a rate of 10 GHz state changes/sec, in the pulse width mode at 5 GHz. The MPA4T 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.
The MPA4T has been optimized for the best possible pulse pair resolving while providing state-of-the-art time resolution available in digital designs. Six 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 20 days (54 bit setting) or 30 min (44 bit setting with 16 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 enable the MPA4T to continuously transfer data at rates of approx. 35MB/second.
Selection of data width per event in steps of 16bit (16, 32, 48 or 64 bit) allows for optimized FIFO and USB bandwidth usage.
For experiments requiring repetitive sweeps the spectral data obtained from each sweep can be summed in the PC enabling very high sweep repetition rates.
In endless / wrap-around mode sweep repetitions with zero end-of-sweep dead time can be accommodated.
The MPA4T 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 MPA4T - providing a powerful graphical user interface for setup, datatransfer and spectral data display.
Drivers for LINUX are optionally available .

Description: Multiparameter System (4 or 8 channels)
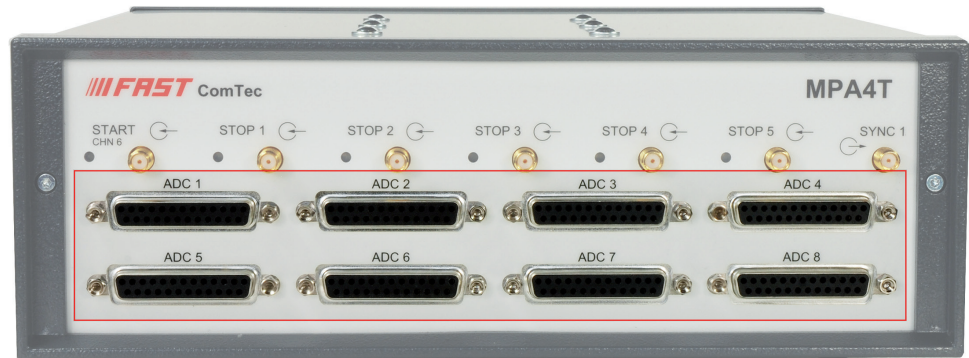
The MPA4T Multiparameter System is designed as an ultra fast list mode system with input ports for 4 or 8 ADCs, multiscalers or time-of-flight devices. 16-bit Ports can be combined to 32- or even 64-bit ports. For dependent single- and multiparameter acquisitions coincidence resolving times from approx. 20 ns (in steps of 20ns) to more than 1.3 ms can be selected. Eight 100 MHz 32-bit scalers are optionally available.

In „single mode" a 64 bit event word is inserted for each ADC. It can contain in addition to the ADC data the time in units of 6.4 ns (32 bits) and the sweep number (9 bits) for correlations with the TOF part. This mode is very interesting also for multiparameter applications as the time for each individual ADC event is available separately.

In „coincident" mode the event word has a variable length of multiples of 64 bit. It contains the ADC data of valid conversions within the coincidence time window, and may contain in addition the time of the event with 6.4 ns resolution (up to 48 bit), the sweep counter (up to 48 bit) and counter data of up to three scalers. It is possible to select special event patterns to drop unwanted events and reduce the amount of list data.

A 1 kHz timer word is inserted every millisecond. It is used for counting the real- and live time for each ADC. A Realtime preset using this timer is implemented in the hardware. The timer word can contain in addition the sweep number (16 bits) and the scaler #1 data.

Three auxiliary inputs/outputs are available, either as inputs to start a coincidence time window or mark events, or as outputs to monitor selected signals. One of them can be used to reject events.

Eight 32-bit 100 MHz Scalers are optionally included. All are presettable and can be gated individually and by a common gate. The presets can be loaded via software or external input. Precise start and stop simultaneously with ADC's and TDC inputs and external devices is assured by use of GO-Line.
Two scalers can be used as up/down counters with extern controllable count direction. Carry outputs on two scalers enable 64 bit preset capability.

The MPA4T software is a 32-bit operating program developed to run under Microsoft Windows-XP/Vista/7 (32 or 64 bit). It is possible to define several single- and dual parameter spectra which can be simultaneously acquired and displayed. Calculated parameters can be defined to do evaluation of position-dependent detectors or any other applications.
One can accumulate single and multiparameter spectra in the RAM of the PC. Multiple windows of single and dual parameter spectra can be simultaneously displayed. List data can be stored on the local hard disk device or any other directly addressable storage device. Replay software for evaluation of list files is already implemented in the software and for pure TOF data available without extra cost.graphical user interface for setup, datatransfer and spectral data display.

Drivers for LINUX are optionally available .

Performance

Number of Time Bins: 128 to 2^{54} selectable in steps of 64. Transfer of acquired data in List-Mode to RAM or Hard-Disk.

Time range per shot: Up to a total 2^{54} x100 ps = 20 days (less with TAG- and Status-words - ref. last page)

Memory: 1024 x 6.4 ns fast FIFO, capable of recording at least 6.4 µsec at full burst rate, plus a 1GB USB-interface FIFO (2GB opt.).

Time Resolution: 72 ps FWHM, typical mass line resolution after Gauss-fit measured at a distance of 10 µs after a trigger

Min. Pulse Width (pos. or neg.): 100 ps

Pulse Width resolution: 100 ps

Max. Input counting rate: 10 Gbit/s (400mV input amplitude) (10 G state changes/sec.)

Bin-width: 100 ps, independent of selected range.

Deadtime: No deadtime between time bins.

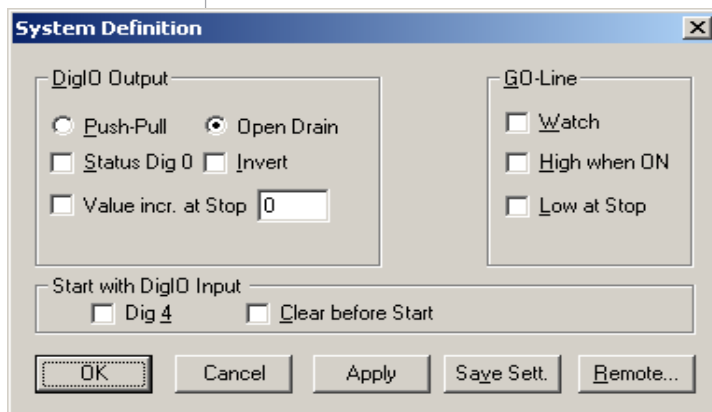End-of-sweep Deadtime: 100ns or 0 in wrap-around mode

Count Rate: The burst count rate to the FIFO can be recorded with no loss of stop pulses for at least 6.4 µsec, the average continuous data throughput is up to 35MB/sec to the computer memory.

No Double Counting ! No loss of counts ! prevented by the proprietary input logic used. Differential linearity <<+/-1%

Data Reduction: by recording stop-events only (no „0" events as recorded by transient digitizers) significantly increases the sweep repetition rate capabilities. Selection of bits/event in steps of 16bit (16, 32, 48 or 64 bit) for optimum FIFO and USB bandwidth usage.

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

Sweep Counter: hardware sweep counter (48 bit) with programmable preset. Optional Start-of-Sweep marker insertion in the list mode data stream

Deadtime: No deadtime between time bins. End-of-sweep Deadtime: 100ns or 0 in wrap-around mode

Features

Multiple-event Time Digitizer (TDC)

• Exceptionally high count rate Time Spectrometry System with 100 ps time resolution

• 5 (6) input channels (START input can be used like a 6th STOP channel)

• Time range from nanoseconds to 20 days with 100 ps time resolution (54 bit dynamic range)

• 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

• „Constant fraction" evaluation of input pulses - interpolates between falling and rising edge

• Minimum time between rising and falling edge is 100 ps

• Maximum input rates up to 10 Gbit/s

• High data transfer rate to PC by dual USB bus

• Six operating modes: Stop after sweep, sequential, multi start recording, 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-Inputs via built-in –2…+3V discriminators (threshold +/-1.5V adjustable in steps of 183µV)

• No dead time between time bins, No missed events, No double counting

• On-board 1024 x 6.4ns fast FIFO for ultra fast data acquisition. Secondary 1GB FIFO (2GB opt.) to buffer list-mode or on-line histogramming data transfer into the PC

• Simultaneous acquisition & data transfer to PC

• On-line sweep summing

• Two versatile, software configurable Sync-outputs for triggering of external devices (FAST NIM, TTL)

Features

- Tag inputs (16) with 6.4 ns time resolution (i.e. for sequential data acquisition, multi-detector configurations, etc.
- Presettable 48 bit sweep counter; programmable acquisition delay, programmable number of time bins and programmable trigger hold-off after sweep
- User configurable „GO"-line for experiment synchronisation (compatible with other FAST ComTec devices
- 8-bit digital I/O port

**Ultra fast Multiparameter Multichannel Analyzer**

- Different versions allow the flexible configuration of 4 or 8 parameter systems
- Large 2 GB FIFO enables extraordinary high burst count rates and buffering data without without any loss at a continuous throughput of 35 MB/sec.
- Parallel interfaces for (16 bit) ADCs and/or other compatible frontends like Multiscalers, Position Analyzers, Time-of-Flight devices etc.
- 16-bit Ports can be combined to 32- or even 64-bit ports.
- TDC inputs and ADC inputs can be used simultaneoulsy. ADC data are then recorded only during a sweep is running. This enables new experiments that were not possible before.
- Single mode ADC data with time in units of 6.4 ns (32 bits) and sweep number (9 bits) for correlations with the TDC part
- 1 kHz timer word is inserted every millisecond for counting the real- and live time for each ADC.
- A Realtime preset using this timer is implemented in the hardware.
- The timer word can contain in addition the sweep number (16 bits) and the scaler #1 data.
- Coincidence mode with resolving times from approx. 20 ns (in steps of 20ns) to more than 1.3 ms
- Coincidence data may contain the time of the event with 6.4 ns resolution (up to 48 bit), the sweep counter (up to 48 bit) and counter data of up to three scalers, and two signal bits from auxiliary inputs.
- Each ADC and two auxiliary inputs can be enabled seperately to start a coincidence time window or not.

- It is possible to select special event patterns to drop unwanted events and reduce the amount of list data.
- Three auxiliary inputs/outputs are available, either as inputs to start a coincidence time window or mark events, or as outputs to monitor selected signals.
- One of them can be used to reject events.
- Eight 32-bit 100 MHz Scalers (option), all presettable. Individual and common gate. Preset load by external input possible (option).
- Precise start and stop simultaneously with ADC's, TDC inputs and external devices by use of GO-Line.
- Scalers #2 and #3 can be used as up/down counters with extern controllable count direction.
- Carry out on Scalers #1 and #2 for 64-bit preset capability

Sophisticated MPANT Windows software

- 32-bit operating program developed to run under Microsoft Windows-XP/Vista/7 (32 or 64 bit).
- For each parameter a single- parameter spectra is automatically defined and displayed.
- It is possible to define several single- and dual parameter spectra in addition which can be simultaneously acquired and displayed.
- Calculated parameters can be defined to do evaluation of position-dependent detectors or any other applications.
- ROIs in single- and dualparameter spectra can be defined and evaluated.
- Rectangular, polygonal, circular and ring ROIs in dualparameter spectra.
- Projections and slices
- Conditions can be set on events inside or outside an ROI, conditions can be combined.
- Replay software for evaluation of list files is already implemented in the software and for pure TDC data available without extra cost.

Specifications Connectors
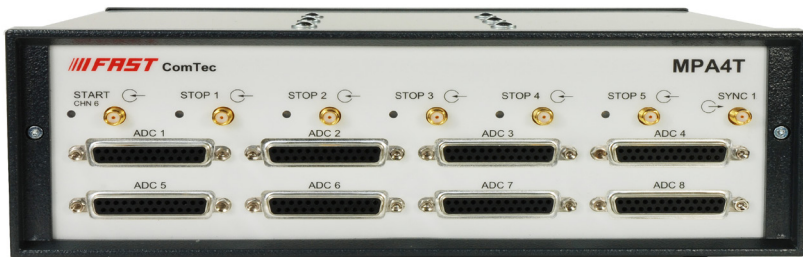
Frontside of the MPA4T

FRONT PANEL:

Start Input: SMA-connector , Zin = 50 Ohm (optional usable as a 6th STOP input)

Stop Inputs: 5x SMA-connector,-2V…+3V input range, rising and falling edge sensitive, programmable threshold +/-1.5V in steps of 183µV, Zin = 50 Ohm

Sync output 1: SMA-connector outputs FAST NIM pulses (neg.: 0V -> -0.7V), Z = 50 Ohm backterminated, user selectable signals

D-Sub 25: 4x or 8x 25 pin D-SUB (female) for data input and control lines for external ADC)

Rearside of the MPA4T

REAR PANEL:

AUX 1, AUX 2, AUX 3: BNC (female) bidi-rectional TTL I/O several functions can be programmed.

TAG Inputs: 37- pin D-SUB (female), 16-bit TTL, TAG Clk out (6.4 ns periode), impedance 100 Ohms. 6.4 ns time resolution. , +5V power (fused)

COUNTER inputs: 37- pin D-SUB (female),

Feature connector: 15-pin D-SUB HD (fe-male), 8-bit user configurable digital I/O port (TTL compatible), GO-line, Sync output 2, +5V power (fused), DAC out: 0...2.5V (14 bit)

Gate inputs: 15-pin D-SUB HD (female),

GO-line connector: BNC connector, open drain (wired-AND), 22k Ohm pull-up

Reference clock: BNC connector, I/O, TTL compatible, (10 MHz), input: AC- coupled

Powerconnector: KPJ-4S-S
4 pin high current connector

GPS-Antenna: TNC connector (opt.)

INTERNAL:

TAG Inputs: 68- pin HD-connector (male)(ERNI type 114807 SMC 68m), 16-bit LVDS, TAG Clk out (6.4 ns periode), impedance 100 Ohms. 6.4 ns time resolution. , +5V power (opt.)

Reference clock:
10 MHz ovenized crystal oscillator, Frequency stability 0.03 ppm @ 0 to 50 °C,

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

Power Requirements: 12V / 6A

Physical: aluminum case,
260mm x 93mm x 265mm, 3.1 kg

Shipping case: 470 x 370 x 160mm, 6.9 kg

Accessories:

• USB 2.0 AB cable 3m (2x)

• Input cable: RG316 (PTFE), 2m, SMA + BNC connector (6 x)

• External power supply: IN: 90 - 264 V AC Out: 12 V DC / 8.4 A

• Operating software on CD

• Operating software on Memory stick

• Handbook

Options:

• TA1800, TA1000, TA2000, TA2400: DC coupled preamplifiers, (x10 / 1.8 GHz, x5 / 2.4 GHz)

Software:

The 32 bit MPANT software for the MPA4T consists of a hardware-dependent server program with DLL and a general graphics program that controls the hardware via the DLL. List file recording can be done simultaneously with histogramming. A replay function for evaluation of list files is included. The spectra data can be saved into a single data file using different formats like binary and ASCII, single spectra can be extracted. Handling of 2d histograms enable sequential acquisition of seperated sweeps into rows of 2d histograms as well as spectra marked by tag bits or a 2d view of pulse width versus time. Even coincidence acquisition of dualparameter histograms is possible, for example for using position dependent detectors. MACRO commands enable automatic execution of scripts for acquisition and evaluation.

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

To support the programming of MS-Windows based customer-specific user interfaces in a laboratory automation environment, we optionally deliver documentation such as sourcecode and example programs for Visual Basic, LabVIEW, C and Delphi - see separate datasheet.

• External Control Software

Optional MCDLAN software enables remote control via Local Area TCP/IP Network or RS232.

• Linux driver software

A Linux driver and library with console testprogram will be optionally available.

| Order Information		
Model	**Description**	**Order No.**
MPA4-4	Multiparameter-4 system, 4 ADC interfaces, 1GB Fifo, USB, MPA-NT Software	MPA44
MPA4-8	Multiparameter-4 system, 8 ADC interfaces, 1GB Fifo, USB, MPA-NT Software	MPA48
MPA4T-4	Multiparameter-4 system, 4 ADC interfaces, RTC, 5+1 Input 10GHz TOF-Multiscaler, 100ps, 1GB Fifo, USB interfaces, MPA-NT Software	MPA4T4
MPA4T-8	Multiparameter-4 system, 8 ADC interfaces, RTC, 5+1 Input 10GHz TOF-Multiscaler, 100ps, 1GB Fifo, USB interfaces, MPA-NT Software	MPA4T8
MPA4-FIFO2	Option 1GB Fifo extra (2GB total)	MPA4F2
MPA4RTC	Real Time Clock for ADC ports, 48 bits, 6.4 ns resolution	MPA4RTC
MPA4COUNT	Octal Counter / Scaler option for MPA4 / MPA4T, 32 bit, 8 channels, 100 MHz	MPA4C
MPA4UP-DN	Dual UP / DOWN option for MPA4 / MPA4T, requires MPA4COUNT	MPA4UD
MPA4TAG	TAG bit option for MPA4T, 16 bits, 6.4 ns resolution	MPA4TAG
MPA4RPlay	MPA4 / MPA4T Replay software for off-line reconstr. of spectra from listmode, internal	MPA4S5
MPA4RPlayEx	MPA4 / MPA4T Replay software for off-line reconstr. of spectra from listmode, Dongle	MPA4S6
MPA4RPlay+Ex	MPA4 / MPA4T Replay software for off-line reconstruction, Dongle, int.	MPA4S7
MPA4DLL32	DLL for LabVIEW /"C"/ Visual Basic (32 bit) for the MPA4	MPA4S1
MPA4TDLL32	DLL for LabVIEW /"C"/ Visual Basic (32 bit) for the MPA4T	MPA4S3
MPA4LINUX	LINUX drivers for MPA4 - ask for delivery time	MPA4S2
MPA4TLINUX	LINUX drivers for MPA4T - ask for delivery time	MPA4S4

Time-of-Flight Spectrometry

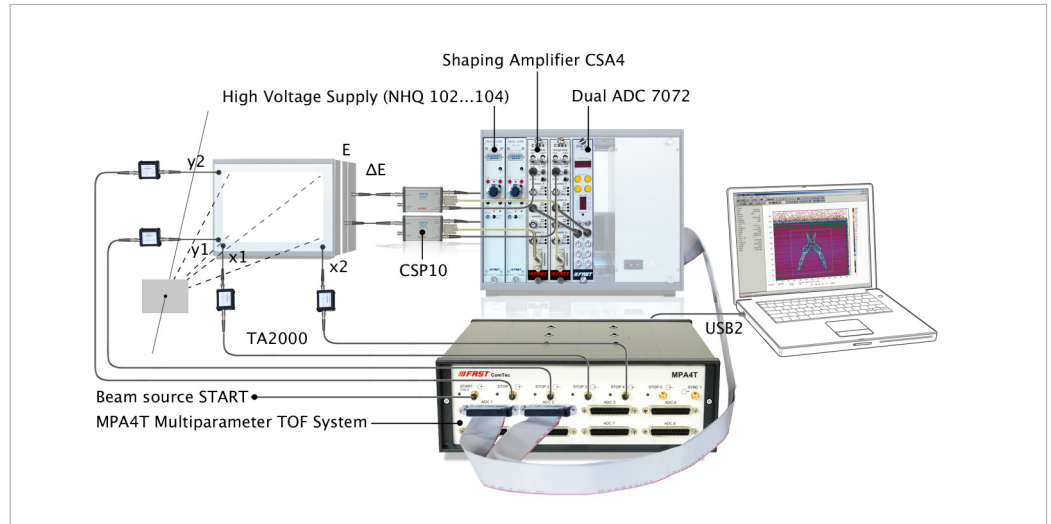This application is specifically suited to the capabilities of the MPA4T. Because the MPA4T has been optimized for the best pulse-pair resolving time while providing excellent time resolution one can easily record mass lines that are very closely spaced. Because of the multistop capability of the MPA4T stop events in all mass lines can be recorded during a single shot - something practically impossible with analog-type instrumentation.

Typical applications are:
• TOF Time-of-Flight Spectrometry with exceptional dynamic-range and 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

Time-Of-Flight Mass Spectrometer simplified diagramm
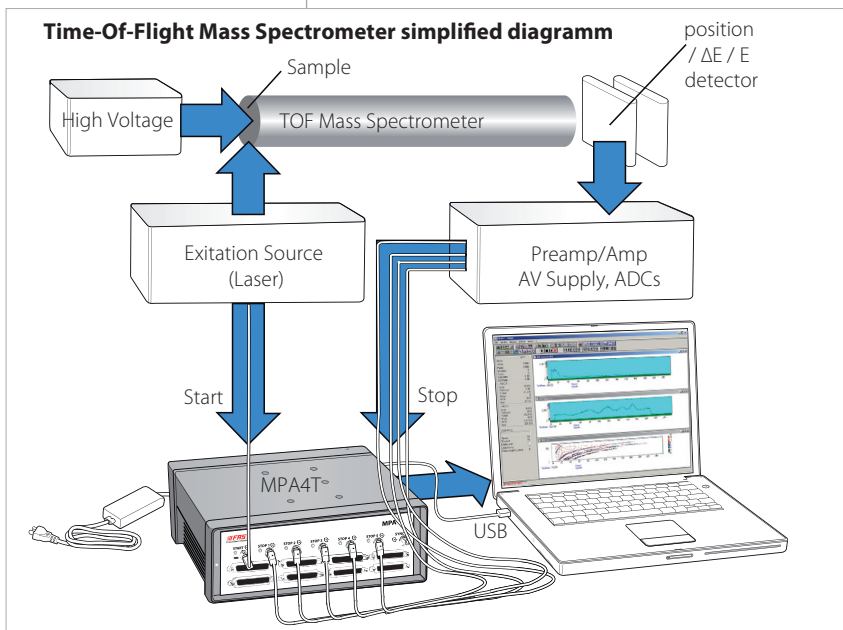
Typical Applications

solid state samples

- Single photon / single molecule counting
- Multi-level measurements e.g.for mass spectroscopy with very strong (pile up) lines by pairing input channels
- LIDAR (1.5 cm spatial resolution)
- Six - channel ultra high speed and huge memory logic analyzer. Evaluation of logic circuits / search for spurious signals
- „Area measurement" in high energy physics by width measurement of pulses with constant shape
- Multiparameter / correlation / coincidence measurements

Position sensitive detector read out with energy

This application is specifically suited to the capabilities of the MPA4T. Because the MPA4T has been optimized for the best pulse-pair resolving time while providing excellent time resolution one can easily record highest countrates. Because of the multi-stop capability of the MPA4T stop events in all overlapping signals can be recorded - something practically impossible with analog-type instrumentation.

Examples of time range settings

time bits	tag bits	sweep counter	Max. Sweep length	Data word length
54	5	0	20.8 days	64 bit
44	16	0	30 minutes	64 bit
36	16	7	6.8 seconds	64 bit
28	16	16	27 msec	64 bit
44	0	0	30 minutes	48 bit
36	8	0	6.8 seconds	48 bit
36	0	7	6.8 seconds	48 bit
28	16	16	27 msec	48 bit
28	0	0	27 msec	32 bit
20	0	8	105 μsec	32 bit
12	0	0	0.4 μsec	16 bit

Options

Version	ADC ch	TDC ch	RTC 6.4ns	TAG	Counter (8)	UP/DN input	Sync out	Digital I/O	2 GB FIFO	Replay	Oven osc.
MPA4T-8	8	5	x	o	o	o	x	x	o	o	x
MPA4T-4	4	5	x	o	o	o	x	x	o	o	x
MPA4-8	8	-	o	-	o	o	-	x	o	o	o
MPA4-4	4	-	o	-	o	o	-	x	o	o	o
MPA4-2	2	-	o	-	o	o	-	x	o	o	o
MCS6A	-	5	-	x	-	-	x	x	o	-	x
MCS6A2	-	2	-	o	-	-	x	x	o	-	x
o option			**-** not possible			**x** installed					