Model MCS6A, 64 Bit 5/(6) input 100 ps Multistop TDC, Multiscaler, Time-Of-Flight

Time range up to 20 days doesn't influence the resolution.

Versions available with 1, 2, 3, 4 and 5 input channels

Available time-resolutions: 100ps, 200ps, 400ps, 800ps

The MCS6A is a 5 input multiple-event time digitizer. It detects the time of the incidence of the stop signals (rising, falling or both edges) relative to the start signal with 100 ps time resolution.

Desription

The Model MCS6A 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 user-supplied 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 MCS6A can evaluate stop events at a rate of 10 GHz state changes/sec, in the pulse width mode at 5 GHz. The MCS6A 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 MCS6A 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 MCS6A 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 MCS6A 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 MCS6A - providing a powerful graphical user interface for setup, datatransfer and spectral data display.
Drivers for LINUX are optionally available .

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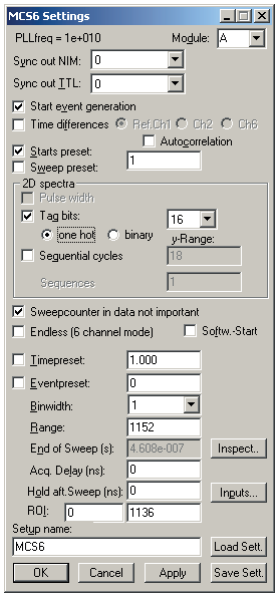

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Performance

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.

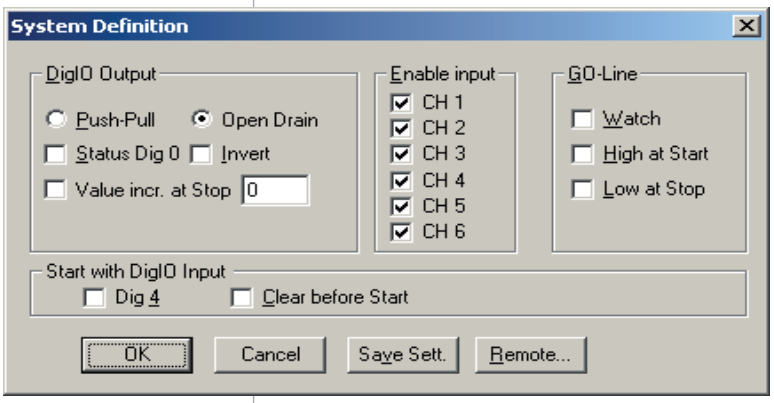
Time range per shot: Up to a total 2^{54} x100 ps = 20 days (less with TAG- and Status-words - ref. last page)

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



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

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

Features

- 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
- 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)
- 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

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Specifications Connectors

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

REAR PANEL:

Feature connector: 15-pin D-SUB HD (female), 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)

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)

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: 2.1 x 5.5 mm DC connector (center positive)

REFERENCE CLOCK:

10 MHz ovenized crystal oscilator, frequency stability: 0.03 ppm @ 0°C to +50°C

Power requirements: 12V DC / 4A

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 / 4A

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

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

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

- External power supply: IN: 90 - 264 V AC
Out: 12 V DC / 4,16 A
- Operating software on CD
- Operating software on Memory stick
- Handbook

Hardware options:

- FIFO memory increased to 2 GByte (from 1 GByte) for longer time buffering of data to be transferred to the computer (order number MCS6F2)
- Cesium atomic clock as reference oscillator (10MHz) for improved temperature stability (< 3x10^-8) (order number MCS6ATOM)

Software:

The 32 bit MPANT software for the MCS6A 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.
- MCDLAN 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 test-program will be optionally available.

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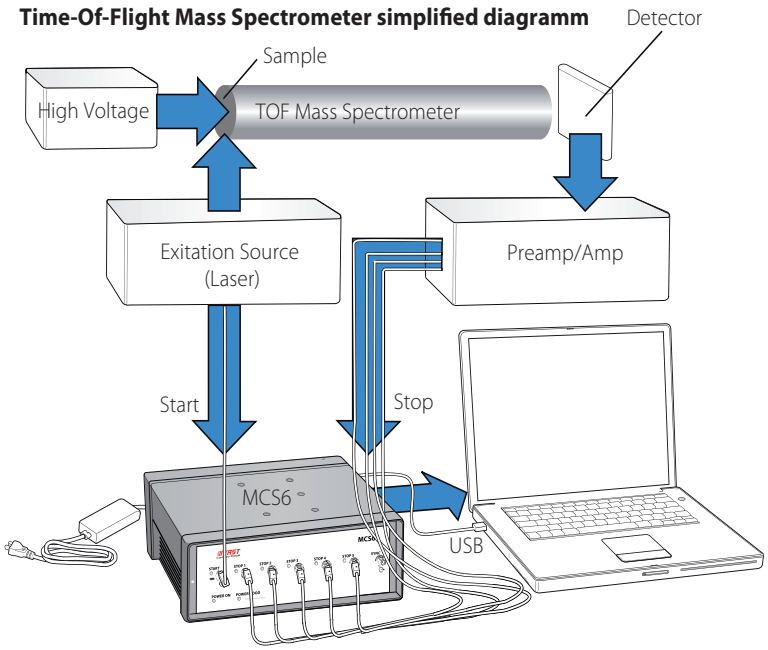
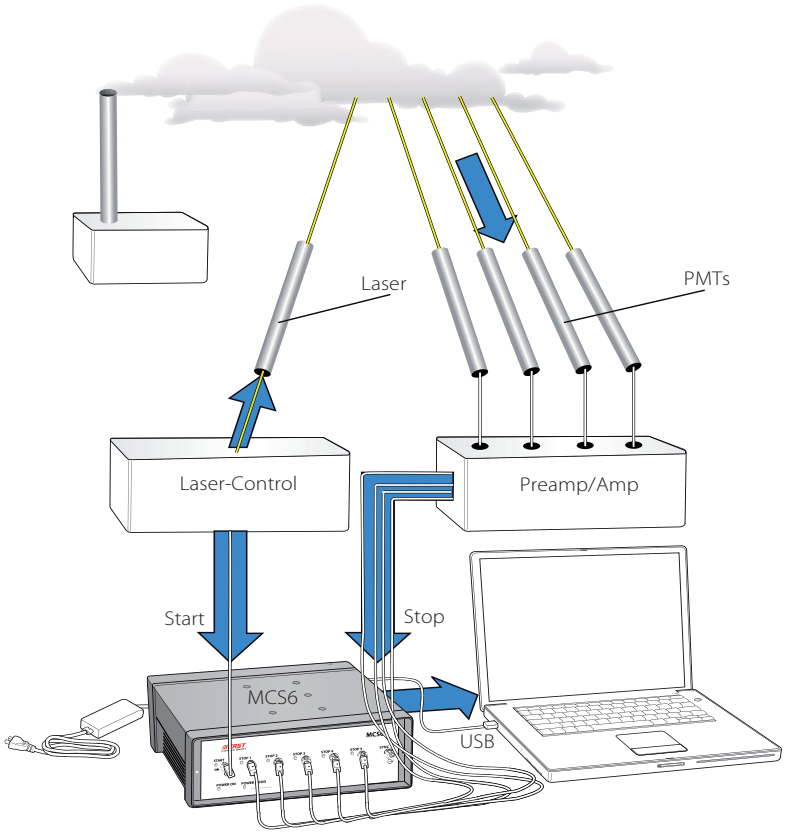
Typical Applications

Time-Of-Flight Mass Spectrometer simplified diagramm



A Simplified Diagram of a LIDAR Setup



Time-of-Flight Spectrometry

This application is specifically suited to the capabilities of the MCS6A. Because the MCS6A 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 MCS6A 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 MCS6A. Responses from repeated shots from the LASER are summed to improve the statistical precision.
The time range of the MCS6A from 12.8 ns to 20 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.

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 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

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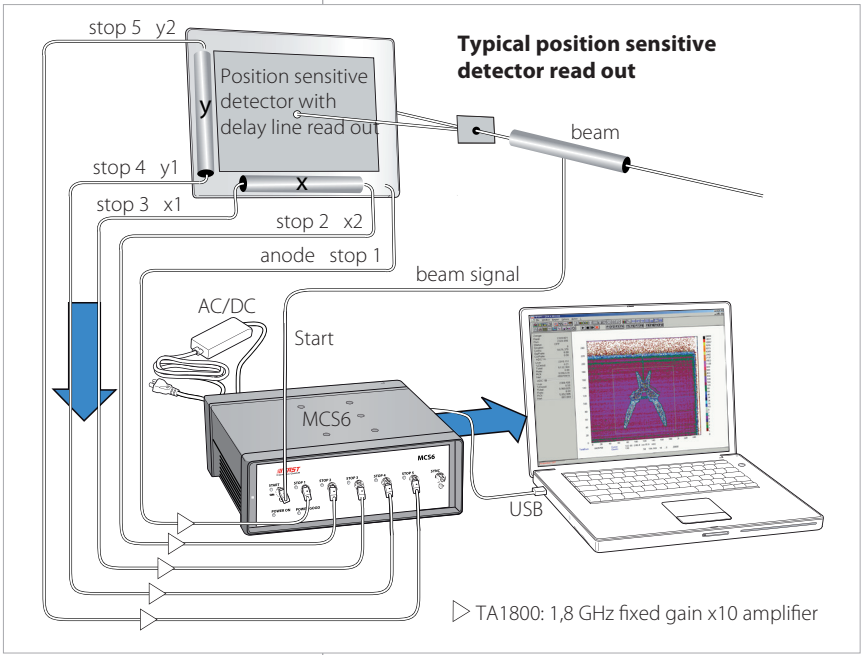

- LIDAR (1.5 cm spatial resolution)
- Six - channel ultra high speed and huge memory logic analyzer. Evaluation of logic circuits / search for spurious signals
- „Area measurement" in high energy physics by width measurement of pulses with constant shape
- Multiparameter / correlation / coincidence measurements

Position sensitive detector read out

This application is specifically suited to the capabilities of the MCS6A. Because the MCS6A has been optimized for the best pulse-pair resolving time while providing excellent time resolution one can easily record highest count-trates. Because of the multi-stop capability of the MCS6A stop events in all overlapping signals can be recorded - something practically impossible with analog-type instrumentation.

Order Information

Model	Description	Order No.
MCS6A-1	1+1 input 10GHz, 100ps, SW	MCS6A1
MCS6A-2	2+1 input 10GHz, 100ps, SW	MCS6A2
MCS6A-3	3+1 input 10GHz, 100ps, SW	MCS6A3
MCS6A-4	4+1 input 10GHz, 100ps, SW	MCS6A4
MCS6A	5+1 input 10GHz, 100ps, SW	MCS6A
MCS6A-1T2	1+1 input 10GHz, 200ps, SW	MCS6A1T2
MCS6A-2T2	2+1 input 10GHz, 200ps, SW	MCS6A2T2
MCS6A-3T2	3+1 input 10GHz, 200ps, SW	MCS6A3T2
MCS6A-4T2	4+1 input 10GHz, 200ps, SW	MCS6A4T2
MCS6A-5T2	5+1 input 10GHz, 200ps, SW	MCS6A5T2
MCS6A-1T4	1+1 input 10GHz, 400ps, SW	MCS6A1T4
MCS6A-2T4	2+1 input 10GHz, 400ps, SW	MCS6A2T4
MCS6A-3T4	3+1 input 10GHz, 400ps, SW	MCS6A3T4
MCS6A-4T4	4+1 input 10GHz, 400ps, SW	MCS6A4T4
MCS6A-5T4	5+1 input 10GHz, 400ps, SW	MCS6A5T4
MCS6A-2T8	2+1 input 10GHz, 800ps, SW	MCS6A2T8
MCS6A-3T8	3+1 input 10GHz, 800ps, SW	MCS6A3T8
MCS6A-4T8	4+1 input 10GHz, 800ps, SW	MCS6A4T8
MCS6A-5T8	5+1 input 10GHz, 800ps, SW	MCS6A5T8
MCS6-Fifo2	Option: 1GB Fifo (2GB total)	MCS6F2
MCS6-atom	Option: cesium atomic clock	MCS6ATOM
MCS6-50ps	Option: 50ps resolution	MCS650PS
MCS6-LINUX	LINUX driver for MCS6(A)	MCS6S2
MCS6-DLL32	DLL LabVIEW /"C"/ VB, 32bit	MCS6S1

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

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