

Time range up to 8.3 days

Versions available with 80ps, 100ps, 200ps, 400ps and 800 ps resolution



The MCS8A-1 is a 1+1 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 80 ps time resolution.

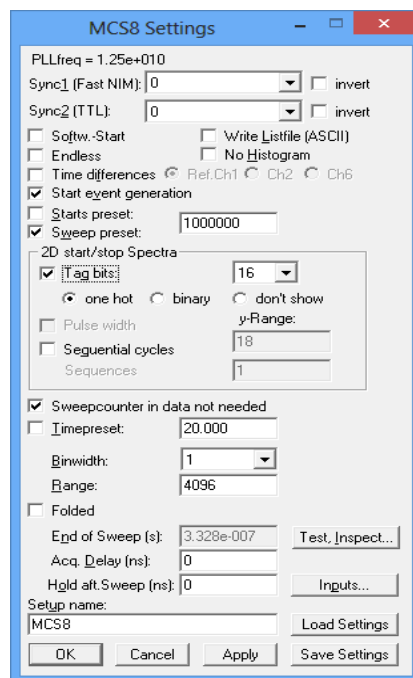
Description:

The Model MCS8A-1 is a 80 ps per time bin, multiple-event time digitizer (TDC) with zero dead time. It can be used in ultra-fast Multiscaler/ TOF systems, in Time-of-Flight mass spectrometry and timeresolved single ion- or photon counting. Pulse-width evaluation with 80 ps precision enables the user to calculate the area, the pulse height of the detector pulse but also if multiple events have occurred – 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 MCS8A-1 can evaluate stop events at a rate of 12.5 GHz state changes/sec, in the pulse width mode at 6.25 GHz. The USB 3.0 interface enables a permanent throughput of 240 MB/s. The MCS8A-1 has been optimized for the best possible pulse pair 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 8.3 days (53 bit setting) or 6 min (42 bit setting with 16 TAG bits enabled), with a time resolution of 80 ps.

An oven-stabilized clock is optional, an external clock input enables using high stability clock sources such as a GPS or rubidium disciplined oscillator. The FIFO memory buffers enable the MCS8A-1 to continuously transfer data at rates of approx. 240 MB/second. Selection of data width per event of 32 bit 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 MCS8A-1 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 MCS8A-1 - providing a powerful graphical user interface for setup, datatransfer and spectral data display. Using Wine it is possible to run the Windows software on LINUX systems.

**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 12.5 Gbit/s. Subsequent events at the start input are also recorded (multiple start).**



## Performance

**Number of Time Bins:** 128 to  $2^{53}$  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  $2^{53} \times 80$  ps = 8.3 days (less with TAG- and Status-words - ref. last page)

**Memory:** 4k x 2.56 ns fast FIFO, capable of recording at least 10.5  $\mu$ sec at full burst rate, plus a 1 GB USB-interface FIFO (2 or 4 GB opt.).

**Time Resolution:** 58 ps FWHM, typical mass line resolution after Gauss-fit measured at a distance of 10  $\mu$ s after a trigger

**Min. Pulse Width (pos. or neg.):** 80 ps  
Pulse Width resolution: 80 ps

val, 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 80 ps time resolution

- 1 + 1 input channels (START input can be used like a 2nd STOP channel)
- Time range from nanoseconds to 8.3 days with 80 ps time resolution (53 bit dynamic range)

- Stop pulses are evaluated either for rising, falling edge or both at 12.5 GHz. This allows to obtain data on pulse-width with 80 ps precision

- Minimum time between rising and falling edge is 80 ps

- Maximum burst input rates up to 12.5 GHz
- Maximum permanent sum count rate up to 300 MHz

- High data transfer rate to PC by USB 3.0

- Six operating modes: Stop after sweep, sequential, multi start recording, pulse width (TOT - time over threshold and TUT - time below threshold) and time interval.

- Fully digital design, no software corrections required

- Start- and Stop-Inputs via built-in  $-2...+3V$  discriminators ( $-1...+1.5V$  threshold adjustable in steps of 1mV)

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

- On-board 4k x 2.56 ns fast FIFO on each input for ultra fast data acquisition.

- Secondary 1GB FIFO (2GB, 4GB opt.) to buffer list-mode or on-line histogramming data transfer into the PC

- On-line sweep summing

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

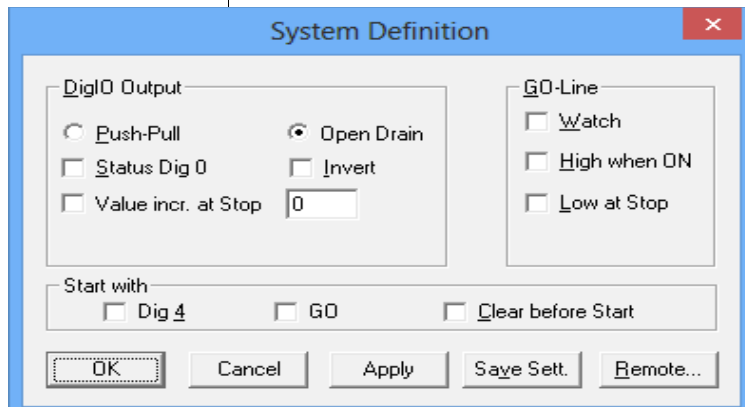
- Tag inputs (16) with 5.12 ns time resolution (i.e. for sequential data acquisition, multi-detector configurations, etc.

- Presettable 48 bit sweep counter; programmable acquisition delay, programmable number of time bins and programmable trigger holdoff after sweep

- User configurable „GO“-line for experiment synchronisation (compatible with other FAST ComTec devices

- 8-bit digital I/O port

- Optional six 200 MHz counters for monitoring



**Max. Input counting rate:** 12.5 Gbit/s (400mV input amplitude) (12.5 G state changes/ sec.)

Bin-width: 80 ps, independent of selected range.

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

**Count Rate:** The burst count rate to the FIFO can be recorded with no loss of stop pulses for at least 10.5  $\mu$ sec, 300 MHz permanent count rate in sum on all inputs until the large FIFO is full, the average continuous data throughput is up to 240 MB/sec to the computer memory.

No Double Counting! No loss of counts! prevented by the proprietary input logic used. Differential linearity  $\ll \pm 1\%$

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

**Operating Modes:** Continuous, end-after sweep, sequential (by software), time inter-

## Specifications

### FRONT PANEL:

**Start / Stop Inputs:** 2 x SMA-connector ,  
Zin = 50 Ohm, -2V...+3V max. input range,  
+/-2V max. relative to threshold,  
rising and falling edge sensitive,  
threshold -1V...+1.5V programmable in 1 mV steps

**Sync output 1:** SMA-connector, outputs FAST NIM (CML) 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)

**TAG Inputs:** 37- pin D-SUB (female), 16-bit TTL, TAG Clk out (5.12 ns periode), impedance 50 Ohms. 5.12 ns time resolution. , +5V power (fused)

**Reference clock:** BNC connector, I/O, TTL compatible, output 10 MHz, input: 5...100 MHz, input: AC- coupled

**Power connector:** 2.1 x 5.5 mm DC connector (center positive)

### REFERENCE CLOCK:

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

**Power requirements:** 12V DC / 0.95 A

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

**Physical:** aluminum case, 275mm x 260mm x 48mm, 1.8 kg

**Shipping case:** 440mm x 350mm x 170mm, 5.5 kg

**Accessories:** Input cable: RG316 (PTFE), 2m, SMA + BNC connector (8 x)

- External power supply: IN: 90 - 264 V AC Out: 12 V DC

- Operating software on CD

- Handbook

### Hardware options:

- FIFO memory increased to 2 or 4 GByte (from 1 GByte) for longer time buffering of data to be transferred to the computer (order number MCS8FIFO2, MCS8FIFO4)

### Software:

The MPANT Windows software for the MCS8 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. MACRO commands enable automatic execution of scripts for acquisition and evaluation.

### Software options:

- DLL and VI's for LabVIEW, C , Visual Basic - see separate datasheet.

## Order Information

Model	Description	Order No.
MCS8A-1Ty	1+1 input, y=0,1,2,4,8 (80, 100, 200, 400, 800 ps), MPANT Software; USB 3.0	MCS8A1Ty
MCS8D-1Ty	1+1 input, y=0,1,2,4,8 (80..800 ps), 1GB Fifo, no TAG, no oven	MCS8D1Ty
MCS8-FIFO2	FIFO expansion to 2 GB (included in all „A“ models)	MCS8FIFO2
MCS8-FIFO4	FIFO expansion to 4 GB	MCS8FIFO4
MCS8TAG	16bit TAG input option (included in all „A“ models)	MCS8TAG
MCS8UP	Additional cost for in-field upgrade	MCS8UP
MCS8OVX	OPTION oven controlled oscillator for „D“ models, included in all „A“ models	MCS8OVX
MCS8DLL	DLL for LabVIEW/„C“/Visual Basic (32 + 64 bit) for MCS8	MCS8DLL
MCS8COUNT	6 x 200 MHz counter (48 bit)	MCS8COUNT
MCS8REM	Remote Control option TCP/IP (LAN) for MCS8	MCS8S03
WAR	Warranty extension (material + workmanship), per year (up to 5 more years)	WAR

