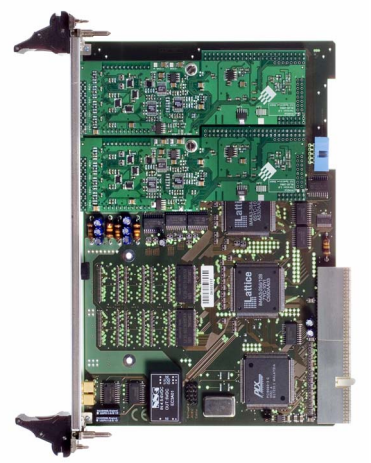
MC.49xx - 8 channel 16 bit high-speed A/D

- **CompactPCI 6U format**
- **4 or 8 channels with 16 bit resolution per card**
- **Versions with 10 MS/s up to 50 MS/s**
- **Simultaneously sampling on all channels**
- **Software selectable single-ended or differential inputs**
- **Separate ADC and amplifier per channel**
- **Complete on-board calibration**
- **6 input ranges: ±200 mV up to ±10 V**
- **Up to 256 MSample (512 MByte) on-board memory**
- **Sustained streaming mode up to 100 MB/s**
- **Window, pulse width trigger**
- **Programmable input offset of ±100% V**
- **Synchronization option available for up to 16 cards**



Product range overview

Model	1 channel	2 channels	4 channels	8 channels
MC.4911				
SE	10 MS/s	10 MS/	10 MS/s	
DIFF	10 MS/s	10 MS/s		
MC.4912				
SE	10 MS/s	10 MS/	10 MS/s	10 MS/s
DIFF	10 MS/s	10 MS/s	10 MS/	
MC.4931				
SE	25 MS/s	25 MS/s	25 MS/s	
DIFF	25 MS/s	25 MS/s		
MC.4932				
SE	25 MS/s	25 MS/s	25 MS/s	25 MS/s
DIFF	25 MS/s	25 MS/s	25 MS/s	
MC.4963				
SE	50 MS/s	50 MS/	25 MS/s	
DIFF	50 MS/s	50 MS/s		
MC.4964				
SE	50 MS/s	50 MS/	50 MS/s	25 MS/s
DIFF	50 MS/s	50 MS/s	50 MS/	

SE = Single Ended Input
Diff = True Differential Input

Software/Drivers

A large number of drivers and examples are delivered with the board:

- Windows NT/2000 32 bit drivers
- Windows XP/Vista/7/8/10, 32 and 64 bit driver
- Linux 32bit and 64bit drivers
- SBench 6.x Base version for Windows and Linux
- Visual C++/Borland C++ Builder examples
- Borland Delphi examples
- Microsoft Visual Basic & Excel examples
- Python examples
- LabWindows/CVI examples
- LabVIEW - drivers and examples
- MATLAB - drivers and examples
- Other 3rd party drivers (e.g. VEE,DASYLab) are partly available upon request

General Information

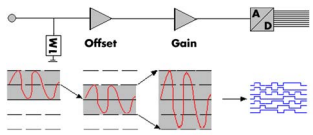
The MC.49xx cards allow recording of up to eight channels with sampling rates of 25 MS/s or either four, two or one channels with sampling rates of 50 MS/s. These cards offer outstanding A/D features both in resolution and speed for Compact PCI. The cards can be switched between Single-Ended inputs with a programmable offset and true differential inputs. If used in differential mode each two inputs are connected together reducing the number of available channels by half.
The 16 bit vertical resolution has four times the accuracy compared to 14 bit cards and sixteen times the accuracy compared with a 12 bit card.
All boards of the MC.49xx series may use the whole installed on-board memory of up to 256 MSamples, completely for the currently activated number of channels.

Software programmable parameters

Sampling rate	10 kS/s to max sampling rate, external clock, ref clock
Input range	±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
Input Offset (single-ended)	programmable to ±100% in steps of 1%
Input type	Single-ended, true differential
Clock mode	internal PLL, internal quartz, external reference clock
Clock impedance	50 Ohm / high impedance (> 4 kOhm)
Trigger impedance	50 Ohm / high impedance (> 4 kOhm)
Trigger mode	Channel, External, Software, Auto, Window, Pulse
Trigger level resolution	14 bit
Trigger edge	rising edge, falling edge or both edges
Trigger pulsewidth	1 to 255 samples in steps of 1 sample
Memory depth	32 up to installed memory in steps of 32
Posttrigger	32 up to 128 M in steps of 32
Multiple Recording segmentsize	32 up to installed memory / 2 in steps of 32

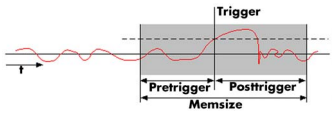
Possibilities and options

Input Amplifier



The analog inputs can be adapted to real world signals using a wide variety of settings that are individual for each channel. By using software commands one can select a matching input range and the signal offset can be compensated.

Ring buffer mode



The ring buffer mode is the standard mode of all oscilloscope instruments. Digitized data is continuously written into a ring memory until a trigger event is detected. After the trigger, post-trigger samples are recorded and pre-trigger samples can also be stored. The number of pre-trigger samples available simply equals the total ring memory size minus the number of post trigger samples.

FIFO mode

The FIFO mode is designed for continuous data transfer between measurement board and PC memory (up to 100 MB /s) or hard disk (up to 50 MB/s). The control of the data stream is done automatically by the driver on interrupt request.

Channel trigger

The data acquisition boards offer a wide variety of trigger modes. Besides the standard signal checking for level and edge as known from oscilloscopes it's also possible to define a window trigger. All trigger modes can be combined with the pulsewidth trigger. This makes it possible to trigger on signal errors like too long or too short pulses.

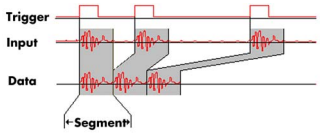
External trigger I/O

All instruments can be triggered using an external TTL signal. It's possible to use positive or negative edge also in combination with a programmable pulse width. An internally recognised trigger event can - when activated by software - be routed to the trigger connector to start external instruments.

Pulse width

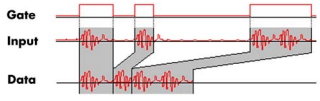
Defines the minimum or maximum width that a trigger pulse must have to generate a trigger event. Pulse width can be combined with channel trigger, pattern trigger and external trigger.

Multiple Recording



The Multiple Recording mode allows the recording of several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided in several segments of same size. Each of them is filled with data if a trigger event occurs.

Gated Sampling

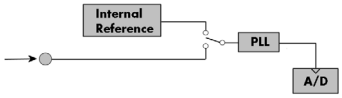


The Gated Sampling mode allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a programmed level.

External clock output

Using a dedicated connector it is possible to output the internally used sampling clock to synchronize external equipment to this clock.

Reference clock



The option to use a precise external reference clock (normally 10 MHz) is necessary to synchronize the instrument for high-quality measurements with external equipment (like a signal source). It's also possible to enhance the quality of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

Cascading

The cascading option synchronises up to 4 Spectrum boards internally. It's the easiest way to build up a multi channel system. There is a phase delay between two boards of about 500 pico seconds when this synchronisation option is used.

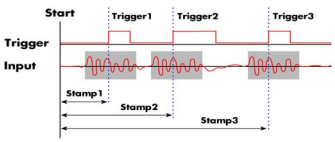
Star-Hub

The star-hub is an additional module allowing the phase stable synchronisation of up to 16 boards. Independent of the number of boards there is no phase delay between all channels. The star hub distributes trigger and clock information between all boards. As a result all connected boards are running with the same clock and the same trigger.

Extra I/O

The Extra I/O module adds 24 additional digital I/O lines and 4 analog outputs on an extra connector. These additional lines are independent from the standard function and can be controlled asynchronously. There is also an internal version available with 16 digital I/Os and 4 analog outputs that can be used directly at the rear board connector.

Timestamp



The timestamp function writes the time positions of the trigger events in an extra memory. The timestamps are relative to the start of recording, a defined zero time, externally synchronized to a radio clock, an IRIG-B a GPS receiver. Using the external synchronization gives a precise time relation for acquisitions of systems on different locations.

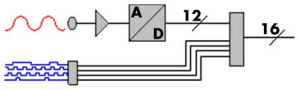
Differential inputs

With a simple software command the inputs can individually be switched from single-ended (in relation to ground) to differential by combining each two single-ended inputs to one differential input. When the inputs are used in differential mode the A/D converter measures the difference between two lines with relation to system ground.

Automatic on-board calibration

All of the channels are calibrated in factory before the board is shipped. To compensate for different variations like PC power supply, temperature and aging, the software driver provides routines for an automatic onboard offset and gain calibration of all input ranges. All the cards contain a high precision on-board calibration reference.

Digital inputs

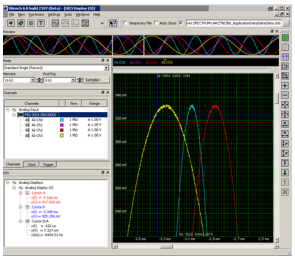


This option acquires additional synchronous digital channels phase-stable with the analog data. When the option is installed there are 16 additional digital inputs on 4 channel A/D instruments and 32 digital inputs on A/D instruments with 8 and more channels.

The digital inputs can be mulitplexed into the analog data by software command using many different formats:

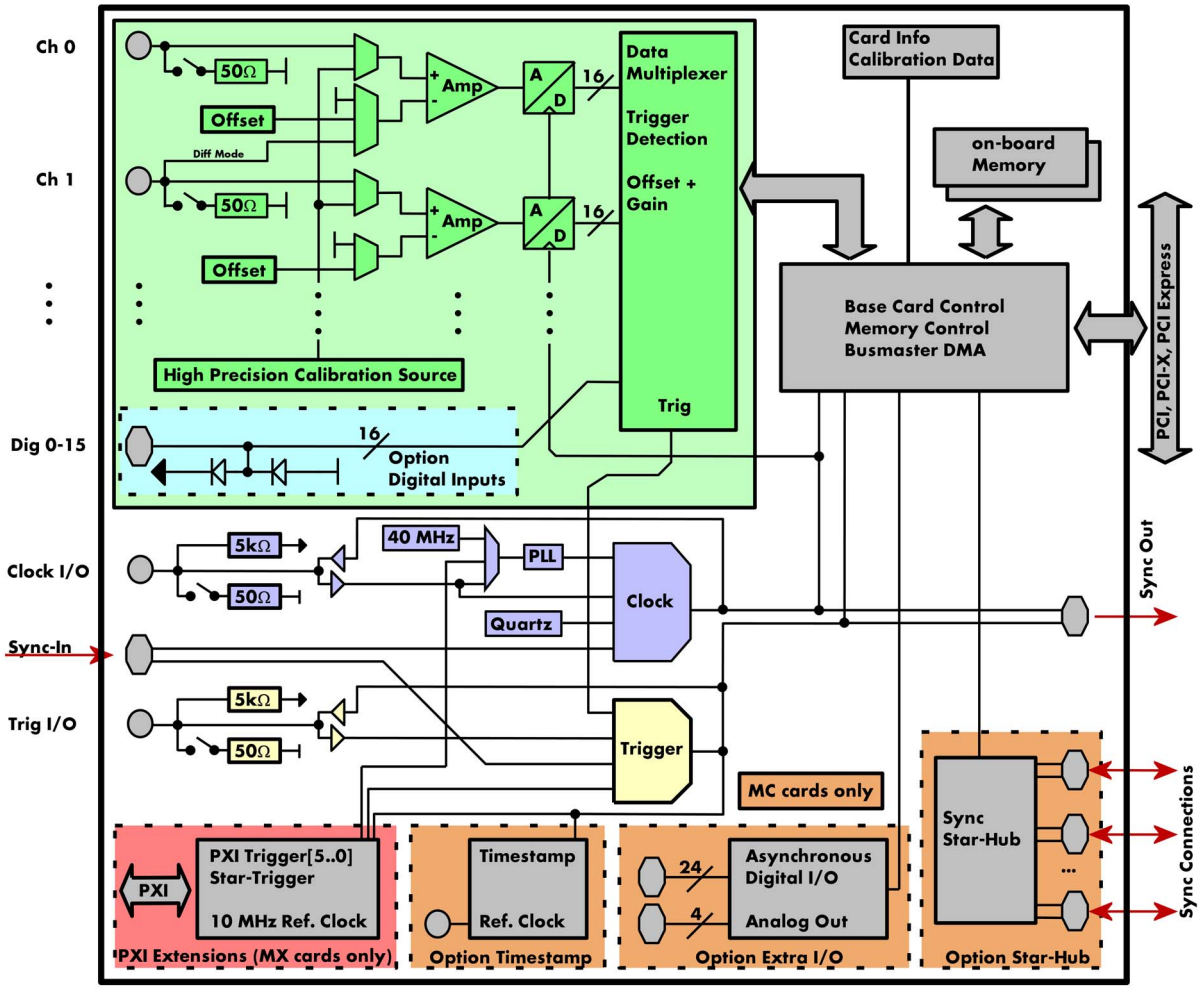
- Each 16 digital inputs can replace one analog channel.
- Each 2 digital inputs can be multiplexed into an analog channel with a resolution reduced to 14 bit.
- Each 4 digital inputs can be multiplexed into an analog channel with a resolution reduced to 12 bit.

SBench 6



A base license of SBench 6, the easy-to-use graphical operating software for Spectrum cards, is included in the delivery. The base license makes it is possible to test the card, display acquired data and make some basic measurements. It's a valuable tool for checking the card's performance and assisting with the unit's initial setup. The cards also come with a demo license for the SBench 6 professional version. This license gives the user the opportunity to test the additional features of the professional version with their hardware. The professional version contains several advanced measurement functions, such as FFTs and X/Y display, import and export utilities as well as support for all acquisition modes including data streaming. Data streaming allows the cards to continuously acquire data and transfer it directly to the PC RAM or hard disk. SBench 6 has been optimized to handle data files of several GBytes. SBench 6 runs under Windows as well as Linux (KDE, GNOME and Unity) operating systems. A test version of SBench 6 can be downloaded directly over the internet and can run the professional version in a simulation mode without any hardware installed. Existing customers can also request a demo license for the professional version from Spectrum. More details on SBench 6 can be found in the SBench 6 data sheet.

Hardware block diagram



Technical Data

Analog Inputs

Resolution		16 bit (can be reduced to acquire simultaneous digital inputs)
Input Range	software programmable	±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
Input Type	software programmable	Single-ended or True Differential
Input Offset (single-ended)	software programmable	programmable to ±100% of input range in steps of 1%
ADC Differential non linearity (DNL)	ADC only	491x + 493x: ±1.2 LSB; 496x: ±1.4 LSB
ADC Integral non linearity (INL)	ADC only	491x + 493x: ±5.5 LSB; 496x: ±6.5 LSB
Offset error (full speed)	after warm-up and calibration	≤ 0.1%
Gain error (full speed)	after warm-up and calibration	≤ 0.1%
Crosstalk: Signal ≤ 1 MHz, 50 ohm	range ≤ ±1V	≤ 100 dB on adjacent channels (all card types)
Crosstalk: Signal ≤ 1 MHz, 50 ohm	range ≥ ±2V	≤ 58 dB on adjacent channels (M2i.491x, M2i.493x, M2i.4963, M2i.4964)
Crosstalk: Signal ≤ 1 MHz, 50 ohm	range ≥ ±2V	≤ 80 dB on adjacent channels (M2i.4960, M2i.4961)
Analog Input impedance	software programmable	50 Ohm / 1 MOhm || TBD pF
Analog input coupling	fixed	DC
Over voltage protection	range ≤ ±1V	±5 V
Over voltage protection	range ≥ ±2V	±40 V
CMRR (Common Mode Rejection Ratio)	range ≤ ±1V	100 kHz: 80 dB, 1 MHz: 59 dB, 10 MHz: 41 dB
CMRR (Common Mode Rejection Ratio)	range ≥ ±2V	100 kHz: 59 dB, 1 MHz: 53 dB, 10 MHz: 52 dB
Channel selection (single-ended inputs)	software programmable	1, 2, 4 or 8 channels (maximum is model dependent)
Channel selection (true differential inputs)	software programmable	1, 2 or 4 channels (maximum is model dependent)

Trigger

Available trigger modes	software programmable	Channel Trigger, External, Software, Window, Pulse, Re-Arm, Spike, Or/And, Delay
Trigger level resolution	software programmable	14 bit
Trigger edge	software programmable	Rising edge, falling edge or both edges
Trigger pulse width	software programmable	0 to [64k - 1] samples in steps of 1 sample
Multi, Gate: re-arming time		< 20 samples
Pretrigger at Multi, ABA, Gate, FIFO		Fixed value depending on channel settings and sampling rate
Posttrigger	software programmable	[32 / channels] up to [128M / channels] in steps of [32 / channels]
Memory depth	software programmable	[32 / channels] up to [memory / channels] samples in steps of [32 / channels]
Multiple Recording segment size	software programmable	[32 / channels] up to [installed memory / 2 / channels] samples in steps of [32 / channels]
Trigger output delay		One positive edge after internal trigger event
Internal/External trigger accuracy		1 sample
External trigger type (input and output)		3.3V LVTTL compatible (5V tolerant)
External trigger input		Low ≤ 0.8 V, High ≥ 2.0 V, ≥ 8 ns in pulse stretch mode, ≥ 2 clock periods all other modes
External trigger maximum voltage		-0.5 V up to +5.7 V (internally clamped to 5.0V, 100 mA max. clamping current)
Trigger impedance	software programmable	50 Ohm / high impedance (> 4kOhm)
External trigger output levels		Low ≤ 0.4 V (@ 20 mA, max 64 mA), High ≥ 2.4 V (@ -20 mA, max -48 mA), TTL compatible
External trigger output drive strength		Capable of driving 50 ohm load

Clock

Clock Modes	software programmable	internal PLL, internal quartz, external reference clock, sync
Internal clock range (PLL mode)	software programmable	1 kS/s to max using internal reference, 50kS/s to max using external reference clock
Internal clock accuracy		≤ 50 ppm
Clock Divider Value for external divided mode	software programmable	1, 2, 4, 8, 10, 16, 20, 40, 50, 80, 100, 200, 400, 500, 800, 1000, 2000
External reference clock range	software programmable	≥ 1.0 MHz and ≤ 125.0 MHz
External clock impedance	software programmable	50 Ohm / high impedance (> 4kOhm)
External clock type/edge		3.3V LVTTL compatible, rising edge used
External clock input		Low level ≤ 0.8 V, High level ≥ 2.0 V, duty cycle: 45% - 55%
External clock maximum voltage		-0.5 V up to +3.8 V (internally clamped to 3.3V, 100 mA max. clamping current)
External clock output levels		Low ≤ 0.4 V, High ≥ 2.4 V, TTL compatible
External clock output drive strength		Capable of driving 50 ohm load
Synchronization clock divider	software programmable	2 up to [8k - 2] in steps of 2

Digital Inputs Option

Digital data acquisition modes	software programmable	per channel: ADC 16 bit, ADC 14 bit + 2 DI, ADC 12 bit + 4 DI, replace ADC with 16 DI
Digital inputs delay to analog sample		0 Samples
Input Impedance		> 4,7 kOhm with Bus-Hold circuity, unused inputs can be left floating, override current ≥ 500 µA
Maximum voltage		-0.3 V up to +5.5 V (internally clamped to 3.3V and ground, 200 mA max. clamping current)
Input voltage		Low ≤ 0.8 V, High ≥ 2.0 V (TTL compatible)

Connectors

Analog Inputs		3 mm SMB male (one for each single-ended input)	Cable-Type: Cab-3f-xx-xx
Trigger Input/Output	programmable direction	3 mm SMB male (one connector)	Cable-Type: Cab-3f-xx-xx
Clock Input/Output	programmable direction	3 mm SMB male (one connector)	Cable-Type: Cab-3f-xx-xx
Option Digital Inputs		40 pole half pitch (Hirose FX2 series)	Cable-Type: Cab-d40-xx-xx

Environmental and Physical Details

Dimension (PCB only)	320 mm x 100 mm (Standard 6U)
Width (Standard)	1 slot
Width (with option Digital Inputs)	additionally extra bracket on neighbour slot
Warm up time	10 minutes
Operating temperature	0°C to 50°C
Storage temperature	-10°C to 70°C
Humidity	10% to 90%

Certification, Compliance, Warranty

CompactPCI bus slot type	32 bit 33 MHz
EMC Immunity	Compliant with CE Mark
EMC Emission	Compliant with CE Mark
Product warranty	5 years starting with the day of delivery
Software and firmware updates	Life-time, free of charge

Power Consumption

Max Power Consumption @ 3.3V	4.5 A
Max Power Consumption @ 5V	1.4 A

MTBF

MTBF	TBD

Dynamic Parameters

	MX.4911 MC.4911 MC.4912	MX.4931 MC.4931 MC.4932	MX.4963 MC.4963 MC.4964
Min internal clock (PLL)	10 kS/s	10 kS/s	10 kS/s
Min internal clock (Quartz)	50 kS/s	50 kS/s	50 kS/s
Max sampling rate	10 MS/s	25 MS/s	50 MS/s
Min external reference clock	1 MHz	1 MHz	1 MHz
Min external reference clock	125 MS/s	125 MS/s	125 MS/s
-3 dB bandwidth	>5 MHz	>15 MHz	>30 MHz
Zero noise level (Range ±200 mV and ±2V)	< 5.0 LSB rms	< 5.5 LSB rms	< 7.0 LSB rms
Zero noise level (all other ranges)	< 4.0 LSB rms	< 4.5 LSB rms	< 5.0 LSB rms
Test - sampling rate	10 MS/s	25 MS/s	50 MS/s
Test signal frequency	1 MHz	1 MHz	1 MHz
SNR (typ)	≥ 76.3 dB	≥ 76.0 dB	≥ 75.6 dB
THD (typ)	≤ -80.5 dB	≤ -80.5 dB	≤ -80.0 dB
SFDR (typ), excl. harm.	≥ 92.4 dB	≥ 92.0 dB	≥ 92.0 dB
ENOB (based on SNR)	≥ 12.3 LSB	≥ 12.2 LSB	≥ 12.2 LSB
ENOB (based on SINAD)	≥ 12.2 LSB	≥ 12.2 LSB	≥ 12.1 LSB

Dynamic parameters are measured at ±5 V input range (if no other range is stated) and 1 MOhm termination with the sampling rate specified in the table. Measured parameters are averaged 20 times to get typical values. Test signal is a pure sine wave of the specified frequency with > 99% amplitude. SNR and RMS noise parameters may differ depending on the quality of the used PC. SNR = Signal to Noise Ratio, THD = Total Harmonic Distortion, SFDR = Spurious Free Dynamic Range, SINAD = Signal Noise and Distortion, ENOB = Effective Number of Bits. For a detailed description please see application note 002.

Order Information

The card is delivered with 32 MSample on-board memory and supports standard mode (Scope) and FIFO mode (streaming). Operating system drivers for Windows/Linux 32 bit and 64 bit, examples for C/C++, LabVIEW (Windows), MATLAB (Windows), LabWindows/CVI, Delphi, Visual Basic, Python and a Base license of the oscilloscope software SBench 6 are included. Drivers for other 3rd party products like VEE or DASYLab may be available on request.

Adapter cables are not included. Please order separately!

Versions

Order no.	Standard mem	1 channel	2 channels	4 channels	8 channels
MC.4911	32 MSample	10 MS/s	10 MS/s	10 MS/s	
MC.4912	32 MSample	10 MS/s	10 MS/s	10 MS/s	10 MS/s
MC.4931	32 MSample	25 MS/s	25 MS/s	25 MS/s	
MC.4932	32 MSample	25 MS/s	25 MS/s	25 MS/s	25 MS/s
MC.4963	32 MSample	50 MS/s	50 MS/s	25 MS/s	
MC.4964	32 MSample	50 MS/s	50 MS/s	50 MS/s	25 MS/s

Memory

Order no.	Option
MC.4xxx-64M	Memory upgrade to 64 MSample (128 MB) of total memory
MC.4xxx-128M	Memory upgrade to 128 MSample (256 MB) of total memory
MC.4xxx-256M	Memory upgrade to 256 MSample (512 MB) of total memory
MC.4xxx-up	Additional fee for later memory upgrade

Options

Order no.	Option
MC.4xxx-cs	Option Cascading: Synchronization of up to 4 cards (one option needed per system)
MC.4xxx-smod (1)	Option Star-Hub:Synchronization of up to 16 cards (one option needed per system)
MC.4xxx-time (1)	Option Timestamp: Recording of trigger timestamps in an extra memory
MC.xxxx-xmf (1)	Option Extra I/O with external connector, 24 digital I/O + 4 analog outputs. Including one cable Cab-d40-idc-100.

Cables

		Order no.				
for Connections	Length	to BNC male	to BNC female	to SMA male	to SMA female	to SMB female
Analog Inputs	80 cm	Cab-1m-9m-80	Cab-1m-9f-80	Cab-1m-3mA-80	Cab-1m-3fA-80	Cab-1m-3f-80
Analog Inputs	200 cm	Cab-1m-9m-200	Cab-1m-9f-200	Cab-1m-3mA-200	Cab-1m-3fA-200	Cab-1m-3f-200
Probes (short)	5 cm		Cab-1m-9f-5			
Trigger/Clock I/O	80 cm	Cab-3f-9m-80	Cab-3f-9f-80	Cab-3f-3mA-80	Cab-3f-3fA-80	Cab-3f-3f-80
Trigger/Clock I/O	200 cm	Cab-3f-9m-200	Cab-3f-9f-200	Cab-3f-3mA-200	Cab-3f-3fA-200	Cab-3f-3f-200

Software SBench6

Order no.	
SBench6	Base version included in delivery. Supports standard mode for one card.
SBench6-Pro	Professional version for one card: FIFO mode, export/import, calculation functions
SBench6-Multi	Option multiple cards: Needs SBench6-Pro. Handles multiple synchronized cards in one system.
Volume Licenses	Please ask Spectrum for details.

(1) : Just one of the options can be installed on a card at a time.
(2) : Third party product with warranty differing from our export conditions. No volume rebate possible.

Technical changes and printing errors possible