M2i.20xx - 8 bit transient recorder up to 200 MS/s

- Up to 200 MS/s on 2 channels, 100 MS/s on 4 channels
- Simultaneously sampling on all channels
- Separate ADC and amplifier per channel
- 7 input ranges: ±50 mV up to ±5 V
- Up to 2 GSample on-board memory
- 512 MSample standard memory installed
- Window, pulse width, re-arm, OR/AND trigger
- Programmable input offset of ±400%
- Synchronization of up to 16 cards per system and up to 271 cards with system sync
- ABA mode: combination of data logger and fast digitizer on trigger
- Versatile software support for Windows and Linux

- 66 MHz 32 bit PCI-X interface
- 5V / 3.3V PCI compatible
- 100% compatible to conventional PCI > V2.1
- Sustained streaming mode up to 245 MB/s

- 2.5 GBit x1 PCIe Interface
- Works with x1/x4/x8/x16* PCIe slots
- Software compatible to PCI
- Sustained streaming mode up to 160 MB/s

### Operating Systems
- Windows 7 (SP1), 8, 10, Server 2008 R2 and newer
- Linux Kernel 2.6, 3.x, 4.x, 5.x
- Windows/Linux 32 and 64 bit

### Recommended Software
- Visual C++, Delphi, C++ Builder,
- GNU C++, VB.NET, C#, J#, Java,
- Python
- SBench 6

### Drivers
- MATLAB
- LabVIEW
- LabWindows/CVI
- IVI

#### General Information
The cards of the M2i.20xx series are designed for the fast and high quality data acquisition. Each of the up to four input channels has its own A/D converter and its own programmable input amplifier. This allows to record signals on all channels with 8 bit resolution without any phase delay between them. The inputs can be selected to one of seven input ranges by software and can be programmed to compensate for an input offset of ±400% of the input range. The extremely large on-board memory allows long time recording even with highest sampling rates. All four cards of the M2i.20xx series may use the whole installed on-board memory completely for the currently activated number of channels. A FIFO mode is also integrated on the board. This allows the acquisition of data continuously for online processing in the PC or for data storage on hard disk.

<table>
<thead>
<tr>
<th>Model</th>
<th>1 channel</th>
<th>2 channels</th>
<th>4 channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2i.2020</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
</tr>
<tr>
<td>M2i.2021</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
</tr>
<tr>
<td>M2i.2030</td>
<td>200 MS/s</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
</tr>
<tr>
<td>M2i.2031</td>
<td>200 MS/s</td>
<td>200 MS/s</td>
<td>100 MS/s</td>
</tr>
</tbody>
</table>

*Some x16 PCIe slots are for the use of graphic cards only and can not be used for other cards.
Software Support

Windows drivers
The cards are delivered with drivers for Windows 7, Windows 8 and Windows 10 (32 bit and 64 bit). Programming examples for Visual C++, C++ Builder, LabWindows/CVI, Delphi, Visual Basic, VB.NET, C#, J#, Python, Java and IVI are included.

Linux Drivers
All cards are delivered with full Linux support. Pre compiled kernel modules are included for the most common distributions like Fedora, Suse, Ubuntu LTS or Debian. The Linux support includes SMP systems, 32 bit and 64 bit systems, versatile programming examples for GNU C++, Python as well as the possibility to get the driver sources for your own compilation.

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 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.

Third-party products
Spectrum supports the most popular third-party software products such as LabVIEW, MATLAB or LabWindows/CVI. All drivers come with detailed documentation and working examples are included in the delivery. Support for other software packages, like VEE or DaqLab, can also be provided on request.

Hardware features and options

PC/PCI-X
The cards with PCI/PCI-X bus connector use 32 Bit and up to 66 MHz clock rate for data transfer. They are 100% compatible to Conventional PCI > V2.1. The universal interface allows the use in PCI slots with 5 V I/O and 3.3 V I/O voltages as well as in PCI-X or PCI 64 slots. The maximum sustained data transfer rate is 245 MByte/s per bus segment.

PCI Express
The cards with PCI Express use a x1 PCIe connector. They can be used in PCI Express x1/x4/x8/x16 slots, except special graphic card slots, and are 100% software compatible to Conventional PCI > V2.1. The maximum sustained data transfer rate is 160 MByte/s per slot.

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 the input termination can be changed between 50 Ohm and 1 MOhm, one can select a matching input range and the signal offset can be compensated for.

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 245 MB/s on a PCI-X slot, up to 125 MB/s on a PCI slot and up to 160 MB/s on a PCIe slot) or hard disk. The control of the data stream is done automatically by the driver on interrupt request. The complete installed on-board memory is used for buffer data, making the continuous streaming extremely reliable.

Channel trigger
The data acquisition instruments 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. In addition to this a re-arming mode (for accurate trigger recognition on noisy signals) the AND/OR conjunction of different trigger events is possible. As a unique feature it is possible to use deactivated channels as trigger sources.

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 recognized 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 with an extremely short re-arming time. The hardware doesn’t need to be restarted in between. The on-board memory is divided in several segments of the same size. Each of them is filled with data if a trigger event occurs. Pre- and posttrigger of the segments can be programmed. The number of acquired segments is only limited by the used memory and is unlimited when using FIFO mode.

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. In addition a pre-area before start of the gate signal as well as a post area after end of the gate signal can be acquired. The number of gate segments is only limited by the used memory and is unlimited when using FIFO mode.

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.

ABA mode

The ABA mode combines slow continuous data recording with fast acquisition on trigger events. The ABA mode works like a slow data logger combined with a fast digitizer. The exact position of the trigger events is stored as timestamps in an extra memory.

External clock I/O

Using a dedicated connector a sampling clock can be fed in from an external system. It’s also 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 (typically 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 stability of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

Star-Hub

The star-hub is an additional module allowing the phase stable synchronisation of up to 16 boards in one system. 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. All trigger sources can be combined with OR/AND allowing all channels of all cards to be trigger source at the same time. The star-hub is available as 5 card and 16 card version. The 5 card version doesn’t need an extra slot.

271 synchronous cards with the System Star-Hub

With the help of multiple system star-hubs it is possible to link up to 17 systems phase synchronous with each other. Each system can then contain up to 16 cards (master only 15). In total 271 cards can be used fully synchronously in a bunch of systems. One master system distributes clock and trigger signal to all connected slave systems.

BaseXIO (Asynchronous I/O, enhanced trigger)

The BaseXIO option offers 8 asynchronous digital I/O lines on the base card. The direction can be selected by software in groups of four. This allows external equipment control or status monitoring. Two of these lines can also be used as additional external trigger sources. This allows the building of complex trigger conjunctions with external gated triggers as well as AND/OR conjunction of multiple external trigger sources like, for example, the picture and row synchronisation of video signals. In addition one of the I/O lines can be used as reference clock for the Timestamp counter.

External Amplifiers

For the acquisition of extremely small voltage levels with a high bandwidth a series of external amplifiers is available. Each of the one channel amplifiers is working with a fixed input impedance and allows - depending on the bandwidth - to select different amplification levels between x10 (20 dB) up to x1000 (60 dB). Using the external amplifiers of the SPA series voltage levels in the uV and mV area can be acquired.
**Technical Data**

### Analog Inputs

- **Resolution:** 8 bit
- **Input Range:** software programmable
  - ±50 mV, ±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V
- **Input Mode:** fixed
  - bipolar, single-ended
- **Input Offset:** software programmable
  - ±400% of input range in steps of 1%
- **ADC Differential non linearity (DNL):** ADC only ±0.5 LSB
- **ADC Integral non linearity (INU):** ADC only ±0.5 LSB
- **Offset error (full speed):** after warm-up and calibration ±0.1% of range
- **Gain error (full speed):** after warm-up and calibration ≤ 2%
- **Crosstalk:** 1 MHz Signal, 50 Ω termination ≤ -62 dB on adjacent channels
- **Analog input impedance:** software programmable
  - 50 Ω or 1 MΩ || 25 pF
- **Analog input coupling:** fixed DC
- **Over voltage protection (active card):** ranges ≤ ±500 mV ±5 V
- **Over voltage protection (active card):** ranges > ±500 mV ±50 V
- **Input signal with 50 Ω termination:** max 5 V rms
- **Channel selection:** software programmable
  - 1, 2 or 4 (maximum is model dependent)

### Trigger

- **Available trigger modes:** software programmable
  - Channel Trigger, External, Software, Window, Pulse, Re-Arm, Or/And, Delay
- **Trigger level resolution:** software programmable
  - 8 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
- **Trigger delay:** software programmable
  - 0 to [64k - 1] samples in steps of 1 sample
- **Multi, Gate, rearming time:** software programmable
  - ≤ 4 samples (+ programmed pretrigger)
- **Pretrigger at Multi, ABA, Gate, FIFO:** software programmable
  - 8 up to [16382 Samples / number of active channels] in steps of 8
- **Postrigger:** software programmable
  - 4 up to [BG - 4] samples in steps of 4 (defining pretrigger in standard scope mode)
- **Memory depth:** software programmable
  - 8 up to [installed memory / number of active channels] samples in steps of 4
- **Multiple Recording/ABA segment size:** software programmable
  - 8 up to [installed memory / 2 / active channels] samples in steps of 4
- **Trigger output delay:** software programmable
  - ≤ 100 MS/s
- **Internal/External trigger accuracy:** software programmable
  - ≤ 100 MS/s
- **Internal/External trigger accuracy:** software programmable
  - > 100 MS/s ≤ 1 sample
- **External trigger type (input and output):** 3.3V LVTTL compatible (5V tolerant with base card hardware version > V20)
- **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 output maximum voltage:** 50 Ohm / high impedance (> 4kOhm)
- **Trigger output maximum voltage:** 50 Ohm / high impedance (> 4kOhm)
- **Trigger impedance:** software programmable
  - 50 Ohm / high impedance (> 4kOhm)
- **External trigger output type:** 3.3 V LVTTL
- **External trigger output levels:** Low ≤ 0.4 V, High ≥ 2.4 V, TTL compatible
- **External trigger output drive strength:** Capable of driving 50 ohm load, maximum drive strength ±128 mA

### Clock

- **Clock modes:** software programmable
  - internal PLL, internal quartz, external clock, external divided, 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:** ≤ 20 ppm
- **Internal clock setup granularity:** ≤ 1% of range (100M, 10M, 1M, 100k...): Examples: range 1M to 10M: stepsize ≤ 100k
- **External reference clock range:** software programmable
  - ≤ 1.0 MHz and ≤ 125.0 MHz
- **External clock range:** software programmable
  - 50 Ohm / high impedance (> 4kOhm)
- **External clock range:** software programmable
  - see “Dynamic Parameters” table below
- **External clock delay to internal clock:** 5.4 ns
- **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:** 3.3 V LVTTL
- **External clock output type:** 3.3 V LVTTL
- **External clock output levels:** Low ≤ 0.4 V, High ≥ 2.4 V, TTL compatible
- **External clock drive strength:** Capable of driving 50 ohm load, maximum drive strength ±128 mA
- **Synchronization clock divider:** 2 up to [8k - 2] in steps of 2

### BaseXIO Option

- **BaseXIO modes:** software programmable
  - Async digital I/O, 2 additional trigger, timestamp reference clock, timestamp digital inputs
- **BaseXIO direction:** software programmable
  - Each 4 lines can be programmed in direction
- **BaseXIO input:** TTL compatible: Low ≤ 0.8 V, High ≥ 2.0 V
- **BaseXIO input impedance:** 4.7 kOhm towards 3.3 V
- **BaseXIO input maximum voltage:** 0.5 V up to ±5.5 V
- **BaseXIO output type:** 3.3 V LVTTL
- **BaseXIO output levels:** TTL compatible: Low ≤ 0.4 V, High ≥ 2.4 V
- **BaseXIO output drive strength:** 32 mA maximum current, no 50 Ω loads
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/Outputs
40 pole half pitch (Hirose FX2 series) Cable-Type: Cab-d40-xx-xx

Option BaseXIO
8 x 3 mm SMB male on extra bracket, internally 8 x MMCX female

Environmental and Physical Details

Dimension (PCB only)
312 mm x 107 mm (full PCI length)

Width (Standard or with option star-hub 5)
1 full size slot

Width (star-hub 16)
additionally back of adjacent neighbour slots

Width (with option BaseXIO)
additionally extra bracket on neighbour slot

Width (with option -digin, -digout or -60xx-AmpMod)
additionally half length of adjacent neighbour slot

Weight (depending on version)
290g (smallest version) up to 460g (biggest version with all options, including star-hub)

Warm up time
10 minutes

Operating temperature
0°C to 50°C

Storage temperature
-10°C to 70°C

Humidity
10% to 90%

PCI/PCI-X specific details

PCI / PCI-X bus slot type
32 bit 33 MHz or 32 bit 66 MHz

PCI / PCI-X bus slot compatibility
32/64 bit, 33-133 MHz, 3,3 V and 5 V I/O

Sustained streaming mode
> 245 MB/s (in a PCI-X slot clocked at 66 MHz or higher)

PCI Express specific details

PCle slot type
x1 Generation 1

PCle slot compatibility
x1/x4/x8/x16 (Some x16 PCle slots are for graphic cards only and can not be used)

Sustained streaming mode
> 160 MB/s

Certification, Compliance, Warranty

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

<table>
<thead>
<tr>
<th>M2i.2020 (312 MSample memory)</th>
<th>PCI / PCI-X</th>
<th>Total</th>
<th>PCI EXPRESS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 V</td>
<td>2.2 A</td>
<td>0.5 A</td>
<td>9.8 W</td>
<td>0.4 A</td>
</tr>
<tr>
<td>5 V</td>
<td>2.8 A</td>
<td>0.8 A</td>
<td>13.2 W</td>
<td>0.4 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M2i.2021 (512 MSample memory)</th>
<th>max power</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 V</td>
<td>3.9 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M2i.2030 (4 GSample memory)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 V</td>
<td>max power</td>
</tr>
<tr>
<td></td>
<td>4.2 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M2i.2031</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 V</td>
<td>max power</td>
</tr>
<tr>
<td></td>
<td>4.5 A</td>
</tr>
</tbody>
</table>

MTBF

MTBF
500000 hours

Dynamic Parameters

<table>
<thead>
<tr>
<th></th>
<th>M2i.2020</th>
<th>M2i.2021</th>
<th>M2i.2030</th>
<th>M2i.2031</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DN2 203.02</td>
<td>DN2 203.04</td>
<td>DN2 203.06</td>
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</tr>
<tr>
<td>min internal clock</td>
<td>1kS/s</td>
<td>1kS/s</td>
<td>1kS/s</td>
<td>1kS/s</td>
</tr>
<tr>
<td>max internal clock</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
</tr>
<tr>
<td>min external clock</td>
<td>1 MS/s</td>
<td>1 MS/s</td>
<td>1 MS/s</td>
<td>1 MS/s</td>
</tr>
<tr>
<td>max external clock</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
</tr>
<tr>
<td>-3 dB bandwidth ≤50 mV</td>
<td>DC to 25 MHz</td>
<td>DC to 25 MHz</td>
<td>DC to 60 MHz</td>
<td>DC to 60 MHz</td>
</tr>
<tr>
<td>-3 dB bandwidth ≥100 mV</td>
<td>DC to 25 MHz</td>
<td>DC to 25 MHz</td>
<td>DC to 80 MHz</td>
<td>DC to 80 MHz</td>
</tr>
<tr>
<td>-3 dB bandwidth ≥200 mV</td>
<td>DC to 25 MHz</td>
<td>DC to 25 MHz</td>
<td>DC to 90 MHz</td>
<td>DC to 90 MHz</td>
</tr>
<tr>
<td>Zero noise level (≤100 mV)</td>
<td>≤0.6 LSB</td>
<td>≤0.9 LSB</td>
<td>≤1.5 LSB</td>
<td>≤2.0 LSB</td>
</tr>
<tr>
<td>Zero noise level (&gt;100 mV)</td>
<td>≤0.6 LSB</td>
<td>≤0.7 LSB</td>
<td>≤1.3 LSB</td>
<td>≤1.5 LSB</td>
</tr>
<tr>
<td>Test - sampling rate</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
<td>100 MS/s</td>
</tr>
<tr>
<td>Test signal frequency</td>
<td>1 MHz</td>
<td>4 MHz</td>
<td>1 MHz</td>
<td>4 MHz</td>
</tr>
<tr>
<td>SNR (typ)</td>
<td>47.5 dB</td>
<td>47.5 dB</td>
<td>46.8 dB</td>
<td>46.5 dB</td>
</tr>
<tr>
<td>THD (typ)</td>
<td>56.0 dB</td>
<td>55.5 dB</td>
<td>55.5 dB</td>
<td>51.5 dB</td>
</tr>
<tr>
<td>SFDR (typ), excl. harm.</td>
<td>61.3 dB</td>
<td>60.3 dB</td>
<td>59.0 dB</td>
<td>57.0 dB</td>
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<tr>
<td>ENOB (based on SNR)</td>
<td>7.6 bit</td>
<td>7.6 bit</td>
<td>7.5 bit</td>
<td>7.4 bit</td>
</tr>
<tr>
<td>ENOB (based on SFDR)</td>
<td>7.5 bit</td>
<td>7.5 bit</td>
<td>7.3 bit</td>
<td>7.3 bit</td>
</tr>
</tbody>
</table>

Dynamic parameters are measured at ±1 V input range (if no other range is stated) and 50Ω termination with the samplerate specified in the table. Measured parameters are averaged 20 times to get typical values. Test signal is a pure sine wave generated by a signal generator and a matching bandpass filter. Amplitude is >99% of FSR. 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.
Hardware block diagramm

Ch 0
Ch 1
Ch 2
Ch 3

Clock I/O
Sync-In
Trig I/O
8 x BaseXIO

10 MHz
PLL
Synth

Data Multiplexer
Trigger Detection
Offset + Gain

Card Info Calibration Data
on-board Memory

Base Card Control
Memory Control
Busmaster DMA

Trigger

8 x BaseXIO
Option BaseXIO

Timestamp Ref
Async XIO
Additional Trigger

Option Star-Hub

Sync Connections

Sync Out

PCL, PCI, PCI Express
Order Informations
The card is delivered with 512 MSample on-board memory and supports standard acquisition [Scope], FIFO acquisition [streaming], Multiple Recording, Gated Sampling, ABA mode and Timestamps. Operating system drivers for Windows/Linux 32 bit and 64 bit, examples for C/C++, LabVIEW [Windows], MATLAB [Windows and Linux], LabWindows/CVI, IVI, .NET, Delphi, Java, 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!

### PCI Express (PCIe)

<table>
<thead>
<tr>
<th>PCI Express</th>
<th>PCI/PCI-X</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2i.2002-exp</td>
<td>M2i.2020</td>
</tr>
<tr>
<td>M2i.2002</td>
<td>M2i.2021</td>
</tr>
<tr>
<td>M2i.2003-exp</td>
<td>M2i.2030</td>
</tr>
<tr>
<td>M2i.2003</td>
<td>M2i.2031</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard mem</th>
<th>1 channel</th>
<th>2 channels</th>
<th>4 channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>512 MByte</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
<td>50 MS/s</td>
</tr>
<tr>
<td>512 MByte</td>
<td>200 MS/s</td>
<td>100 MS/s</td>
<td></td>
</tr>
<tr>
<td>512 MByte</td>
<td>200 MS/s</td>
<td>200 MS/s</td>
<td>100 MS/s</td>
</tr>
</tbody>
</table>

### Memory

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2i.xxx-1GB</td>
<td>Memory upgrade to 1 GB of total memory</td>
</tr>
<tr>
<td>M2i.xxx-2GB</td>
<td>Memory upgrade to 2 GB of total memory</td>
</tr>
</tbody>
</table>

### Options

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2i.xxx-SHS</td>
<td>Synchronization Star-Hub for up to 5 cards, only 1 slot width</td>
</tr>
<tr>
<td>M2i.xxx-SH16</td>
<td>Synchronization Star-Hub for up to 16 cards</td>
</tr>
<tr>
<td>M2i.xxx-SSHM</td>
<td>System-Star-Hub Master for up to 15 cards in the system and up to 17 systems, PCI 32 Bit card, sync cables and extra bracket for clock and trigger distribution included</td>
</tr>
<tr>
<td>M2i.xxx-SSHMMe</td>
<td>System-Star-Hub Master for up to 15 cards in the system and up to 17 systems, PCI Express card, sync cables and extra bracket for clock and trigger distribution included</td>
</tr>
<tr>
<td>M2i.xxx-SSHS5</td>
<td>System-Star-Hub Slave for 5 cards in one system, one slot width all sync cables + bracket included</td>
</tr>
<tr>
<td>M2i.xxx-SSHS16</td>
<td>System-Star-Hub Slave for 16 cards in system, two slots width, all sync cables + bracket included</td>
</tr>
<tr>
<td>M2i.xxx-bxio</td>
<td>Option BaseXIO: 8 digital I/O lines usable as asynchronous I/O, timestamp ref-clock and additional external trigger lines, additional bracket with 8 SMB connectors</td>
</tr>
<tr>
<td>M2i-upgrade</td>
<td>Upgrade for M2i.xxx: later installation of option: M2i.xxx-2GB, SH5, SH16 or bxio</td>
</tr>
</tbody>
</table>

### Services

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Recal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recalibration at Spectrum incl. calibration protocol</td>
</tr>
</tbody>
</table>

### Cables

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Connections</th>
<th>Length</th>
<th>to BNC male</th>
<th>to BNC female</th>
<th>to SMA male</th>
<th>to SMA female</th>
<th>to SMB male</th>
<th>to SMB female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog/Clock/Trigger</td>
<td>80 cm</td>
<td>Cab-3f9m-80</td>
<td>Cab-3f9m-80</td>
<td>Cab-3f9m</td>
<td>Cab-3f9m</td>
<td>Cab-3f9m-80</td>
<td>Cab-3f9m-80</td>
<td></td>
</tr>
<tr>
<td>Analog/Clock/Trigger</td>
<td>200 cm</td>
<td>Cab-3f9m-200</td>
<td>Cab-3f9m-200</td>
<td>Cab-3f9m-200</td>
<td>Cab-3f9m-200</td>
<td>Cab-3f9m-200</td>
<td>Cab-3f9m-200</td>
<td></td>
</tr>
<tr>
<td>Probes (short)</td>
<td>5 cm</td>
<td>Cab-3f9m-5cm</td>
<td>Cab-3f9m-5cm</td>
<td>Cab-3f9m-5cm</td>
<td>Cab-3f9m-5cm</td>
<td>Cab-3f9m-5cm</td>
<td>Cab-3f9m-5cm</td>
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</table>

### Amplifiers

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Bandwidth</th>
<th>Connection</th>
<th>Input Impedance</th>
<th>Coupling</th>
<th>Amplification</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPA.1412 PI</td>
<td>200 MHz</td>
<td>BNC</td>
<td>1 MOhm</td>
<td>AC/DC</td>
<td>x10/x100 (20/40 dB)</td>
</tr>
<tr>
<td>SPA.1411 PI</td>
<td>200 MHz</td>
<td>BNC</td>
<td>50 Ohm</td>
<td>AC/DC</td>
<td>x10/x100 (20/40 dB)</td>
</tr>
<tr>
<td>SPA.1232 PI</td>
<td>10 MHz</td>
<td>BNC</td>
<td>1 MOhm</td>
<td>AC/DC</td>
<td>x100/x1000 (40/60 dB)</td>
</tr>
<tr>
<td>SPA.1231 PI</td>
<td>10 MHz</td>
<td>BNC</td>
<td>50 Ohm</td>
<td>AC/DC</td>
<td>x100/x1000 (40/60 dB)</td>
</tr>
</tbody>
</table>

### Software SBench6

<table>
<thead>
<tr>
<th>Order no.</th>
<th>SBench6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base version included in delivery. Supports standard mode for one card.</td>
</tr>
</tbody>
</table>

### Software Options

<table>
<thead>
<tr>
<th>Order no.</th>
<th>Software Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBench6-Pro</td>
</tr>
<tr>
<td></td>
<td>Professional version for one card: FIFO mode, export/import, calculation functions</td>
</tr>
<tr>
<td></td>
<td>SBench6-Multi</td>
</tr>
<tr>
<td></td>
<td>Option multiple cards. Needs SBench6-Pro. Handles multiple synchronized cards in one system.</td>
</tr>
<tr>
<td></td>
<td>Volume Licenses</td>
</tr>
</tbody>
</table>

### Technical changes and printing errors possible

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