SPECTRUM
SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

# MX.40xx - 14 bit PXI transient recorder

- **PXI 3U / CompactPCI 3U format**
- **Fastest 14 bit A/D converter board**
- **Models with 20 MS/s or 50 MS/s**
- **1 or 2 channels acquisition**
- **Simultaneous sampling on all channels**
- **6 input ranges: ±200 mV up to ± 10 V**
- **Up to 64 MSample memory**
- **FIFO mode**
- **Window and pulsewidth trigger**
- **Input offset up to ±200%**
- **Synchronization possible**
- **Windows program SBench 5.x included**



## Product range overview

| Model | 1 channel | 2 channels | 4 channels |
|---|---|---|---|
| MX.4020 | 20 MS/s | | |
| MX.4021 | 20 MS/s | 20 MS/s | |
| MX.4030 | 50 MS/s | | |
| MX.4031 | 50 MS/s | 50 MS/s | |

## Software/Drivers

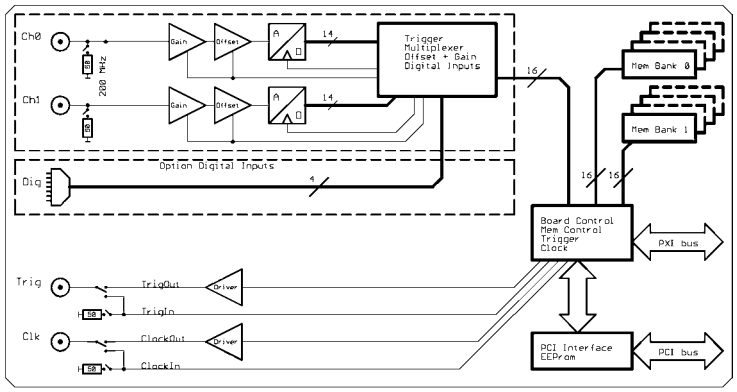
A large number of drivers and examples are delivered with the board or are available as an option:

- Windows 98/ME/NT/2000/XP - drivers
- Linux - drivers
- SBench 5.2
- Streaming Software SPviewIT 6.2(as option)
- Microsoft Visual C++ examples
- Borland Delphi examples
- Microsoft Visual Basic examples
- Microsoft Excel examples
- LabWindows/CVI examples
- FlexPro support with SBench
- LabVIEW - drivers (as option)
- DASYLab - drivers (as option)
- MATLAB - drivers (as option)
- Agilent VEE - drivers (as option)

## General Information

The MX.40xx is best suitable for applications that need high samplerates as well as a maximum signal dynamic. These boards offer a resolution 4 times higher than 12 bit boards. On the MX.40xx every channel has its own amplifier and A/D converter. Each input channel could be adapted to a wide variety of signal sources. This is done by software selecting a matching input range, an input impedance and an individual input offset. The user will find easily a matching solution from the six offered models. These versions are working with samplerates of 20 MS/s or 50 MS/s and have one or two channels and could also be updated to a multi-channel system using the internal synchronization bus. Data is written in the internal 8 MSamples up to 64 MSample large memory. This memory could also be used as a FIFO buffer. In FIFO mode data could be transferred on-line directly into the PC RAM or to hard disk.

## Hardware block diagram




## Software programmable parameters

| | |
|---|---|
| Samplerate | 1 kS/s to max samplerate, external clock, ref clock, PXI clock |
| Input Range | ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V |
| Input impedance | 50 Ohm / 1 MOhm |
| Input Offset | ±200% in steps of 1% |
| Clock mode | internal PLL, internal quartz, external, external divided, external reference clock, PXI reference clock |
| Clock impedance | 50 Ohm / 1 MOhm |
| Trigger impedance | 50 Ohm / 1 MOhm |
| Trigger mode | Channel, External, Software, Auto, Windows, Pulse, PXI Line[5..0], PXI Startrigger |
| Trigger level | 1/1024 to 1023/1024 of input range (10 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 |

SPECTRUM SYSTEMENTWICKLUNG MICROELECTRONIC GMBH · AHRENSFELDER WEG 13-17 · 22927 GROSSHANSDORF · GERMANY
PHONE: +49 (0)4102-6956-0 · FAX: +49 (0)4102-6956-66 · E-MAIL: info@spec.de · INTERNET: http://www.spec.de

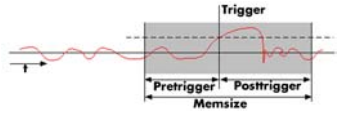
## Possibilities and options

### PXI bus
The PXI bus (PCI eXtension for instrumentation) offers a variety of additional normed possibilities for synchronising different components in one system. It is posible to connect several Spectrum cards with each other as well as to connect a Spectrum card with cards of other manufacturers.

### PXI reference clock
The card is able to use the 10 MHz reference clock that is supplied by the PXI system. Enabled by software the PXI reference clock is feeded in the on-board PLL. This feature allows the cards to run with a fixed phase relation.

### PXI trigger
The Spectrum cards support star trigger as well as the PXI trigger bus. using a simple software commend one or more trigger lines can be used as trigger source. This feature allows the easy setup of OR connected triggers from different cards.

### Input impedance
All inputs could individually be switched by software between 50 Ohm and 1 MOhm input impedance. If using fast signals and high sampling rates or have 50 Ohm cable impedance the use of the 50 Ohm termination is recommended to minimise noise and signal reflections. If using weak signal sources or standard probes the use of the 1 MOhm termination is helpful.

### Ring buffer mode


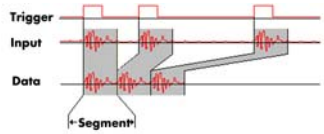
The ring buffer mode is the standard mode of all oscilloscope boards. Data is written in a ring memory of the board until a trigger event is detected. After the event the posttrigger values are recorded. Because of this continuously recording in a ring buffer there are also samples prior to the trigger event visible: Pretrigger = Memsize - Posttrigger.

### 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.

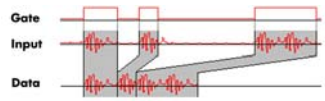
### Channel trigger
The data acquisition boards offer a wide variety of trigger modes. Besides the standard signal checking for level and edge as known from oscilloscopes it's also possible to define a window trigger. All trigger modes could be combined with the pulsewidth trigger. This makes it possible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

### External trigger I/O
All boards could be triggered using an external TTL signal. It's possible to use positive or negative edge also in combination with a programmable pulsewidth. An internally recognised trigger event could - activated by software - routed to the output connector to start external instruments.

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

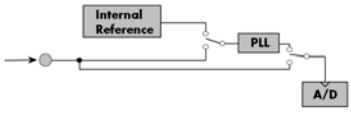
### Multiple Recording


The Multiple Recording option allows the recording of several trigger events without restarting the hardware. With this option very fast repetition rates could 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.

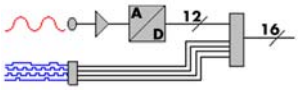
### Gated Sampling


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

### External clock I/O
Using an external connector a sampling clock could be fed in from an external system. It's also possible to put out the internally used sampling clock to synchronise external equipment to this clock.

### Reference clock


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

### Digital inputs


This option acquires additional synchronous digital channels phase-stable with the analog data. When the option is installed there are 2 additional digital inputs for every analog A/D channel.

### Cascading
The cascading option synchronises up to 4 Spectrum boards internally. It's the simpliest 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.

## Technical Data

| | | | |
|---|---|---|---|
| Resolution | 14 bit | Dimension | 160 mm x 233 mm (Standrad 6U) |
| Differential linearity error | ± 0.5 LSB typ. (ADC) | Width (Standard) | 1 slot |
| Integral linearity error | ± 1 LSB typ (ADC) | Width (with digital inputs) | 2 slots |
| Multi: Trigger to 1st sample delay | fixed | Width (with star hub option) | 2 slots |
| Multi: Recovery time | < 20 samples | Analogue Connector | 3 mm SMB male |
| ext. Trigger accuracy | 1 Sample | Digital Connector | 40 pol half pitch (Hirose FX2 series) |
| int. Trigger accuracy | 1 Sample | Digital Inputs delay to analog sample | -6 samples |
| Ext. clock: delay to internal clock | 42 ns ± 2 ns | Overvoltage protection (range ≤ ±1 V) | ±5 V |
| input signal with 50 W termination | max 5 V rms | Overvoltage protection (range > ±1 V) | ±50 V |
| Trigger output delay | 1 Sample | Warm up time | 10 minutes |
| Input impedance | 50 Ohm / 1 MOhm \|\| 25 pF | Operating temperature | 0°C - 50°C |
| Crosstalk 1 MHz sine signal 50 Ohm | < -80 dB | Storage temperature | -10°C - 70°C |
| Crosstalk 1 MHz sine signal 1 MOhm | < -65 dB | Humidity | 10% to 90% |
| Min internal clock | 1 kS/s | Zero offset error | adjustable by user |
| Min external clock | 500 kS/s | Gain error | < 1 % of full scale |
| | | Power consumption 5 V @ full speed | max. 2.6 A (13.0 Watt) |
| | | Power consumption 5 V @ power down | max. 1.8 A (9.0 Watt) |
| Trigger input:Standard TTL level | Low: -0.5 > level < 0.8 V<br>High: 2.0 V > level < 5.5 V<br>Trigger pulse must be valid ≥ 2 clock periods. | Clock input: Standard TTL level | Low: -0.5 > level < 0.8 V<br>High: 2.0 V > level < 5.5 V<br>Rising edge is used.<br>Required duty cycle: 50% ± 5% |
| Trigger output | Standard TTL, capable of driving 50 Ohm.<br>Low < 0.4 V (@ 20 mA, max 64 mA)<br>High > 2.4 V (@ -20 mA, max -32 mA)<br>One positive edge after the first internal trigger | Clock output | Standard TTL, capable of driving 50 Ohm<br>Low < 0.4 V (@ 20 mA, max 64 mA)<br>High > 2.4 V (@ -20 mA, max -32 mA) |

| | MX.4020<br>MX.4021 | MX.4030<br>MX.4031 |
|---|---|---|
| max internal clock | 20 MS/s | 50 MS/s |
| max external clock | 20 MS/s | 50 MS/s |
| -3 dB bandwidth | > 10 MHz | > 25 MHz |
| Zero noise level at 50 Ohm | < 2.1 LSB rms | < 2.9 LSB rms |

## Dynamic Parameters

| | MX.4020<br>MX.4021 | MX.4030<br>MX.4031 |
|---|---|---|
| Test - Samplerate | 20 MS/s | 50 MS/s |
| Testsignal frequency | 1 MHz | 1 MHz |
| SNR (typ) | > 69.7 dB | > 66.9 dB |
| THD (typ) | < -71.5 dB | < -70.8 dB |
| SFDR (typ), incl harm. | > 79.8 dB dB | > 73.8 dB |
| SINAD (typ) | > 67.5 dB | > 65.4 dB |
| ENOB (based on SINAD) | > 10.9 | > 10.6 |

Dynamic parameters are measured at ± 1 V input range and 50 Ohm 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 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

| Order No | Description | Order No | Description |
|---|---|---|---|
| MX4020 | MX.4020 with 8 MSample memory and drivers/SBench 5.x | MX4xxx-16M | Option: 16 MSample memory instead of 8 MSample standard mem |
| MX4021 | MX.4021 with 8 MSample memory and drivers/SBench 5.x | MX4xxx-32M | Option: 32 MSample memory instead of 8 MSample standard mem |
| MX4030 | MX.4030 with 8 MSample memory and drivers/SBench 5.x | MX4xxx-64M | Option: 64 MSample memory instead of 8 MSample standard mem |
| MX4031 | MX.4031 with 8 MSample memory and drivers/SBench 5.x | MX4xxx-up | Additional handling costs for later memory upgrade |
| MX4xxx-mr | Option Multiple Recording: Memory segmentation | MX40xx-dl | DASYLab driver for MX.40xx series |
| MX4xxx-gs | Option Gated Sampling: Gate signal controls acquisition | MX40xx-hp | VEE driver for MX.40xx series |
| MX40xx-dig | Additional 4 synchronous digital inputs per channel, incl. cable | MX40xx-lv | LabVIEW driver for MX.40xx series |
| | | MATLAB | MATLAB driver for all MI.xxxx, MC.xxxx and MX.xxxx series. |
| Cab-3f-9m-80 | Adapter cable: SMB female to BNC male 80 cm | Cab-3f-9f-80 | Adapter cable: SMB female to BNC female 80 cm |
| Cab-3f-9m-200 | Adapter cable: SMB female to BNC male 200 cm | Cab-3f-9f-200 | Adapter cable: SMB female to BNC female 200 cm |

**technical changes and printing errors possible**