



SPECTRUM

SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

MX.47xx - 8 channel 16 bit A/D up to 500 kS/s

- **PXI 3U / CompactPCI 3U format**
- **8 channels with 16 bit resolution per card**
- **Versions with 100 kS/s up to 500 kS/s**
- **Simultaneously sampling on all channels**
- **Separate ADC and amplifier per channel**
- **complete on-board calibration**
- **8 input ranges: ± 50 mV up to ± 10 V**
- **Up to 64 MSample (128 MByte) on-board memory**
- **Sustained streaming mode up to 100 MB/s**
- **Window, pulse width, re-arm, spike trigger**
- **OR/AND trigger combinations possible**
- **Synchronization possible**



Product range overview

Model	1 channel	2 channel	4 channel	8 channel
MX.4710	100 kS/s	100 kS/s	100 kS/s	100 kS/s
MX.4720	250 kS/s	250 kS/s	250 kS/s	250 kS/s
MX.4730	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Software/Drivers

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

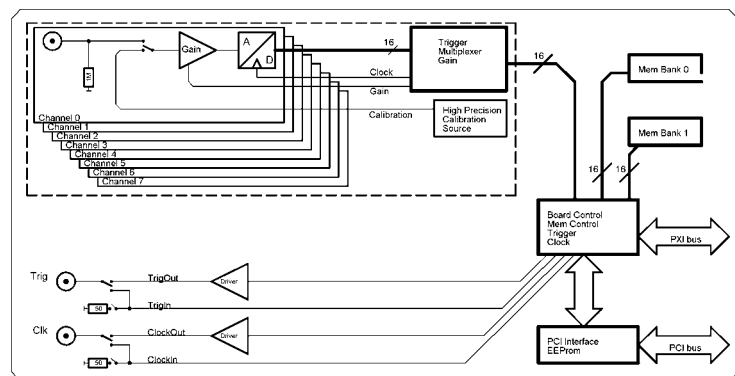
- Windows 98/ME/NT/2000/XP/Vista/7 drivers
- Linux 32bit and 64bit drivers
- SBench 5.x for Windows
- SBench 6.x Base version for Windows and Linux
- Visual C++/Borland C++ Builder examples
- Borland Delphi examples
- Microsoft Visual Basic examples
- Microsoft Excel examples
- LabWindows/CVI examples
- 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.47xx for the first time offers full 16 bit resolution synchronously on eight channels at high sampling rates. Every channel has its own amplifier and A/D converter. This eliminates the problems known from multiplexed systems like phase error between the channels or high crosstalk. Every input channel can be offset and gain calibrated by software using a high-precision onboard calibration source.

Three different models are available, each in a different speed grade. These versions are working with sampling rates of 100 kS/s, 250 kS/s or 500 kS/s. The boards can also be updated to a multi-channel system using the PXI backplane signals.

Hardware block diagram



Software programmable parameters

Sampling rate	1 kS/s to max sampling rate, external clock, ref clock, PXI clock
Input range	± 50 mV, ± 100 mV, ± 250 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V
Clock mode	internal PLL, internal quartz, external, external divided, external reference clock, PXI 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, Spike, PXI Line[5..0], PXI Startrigger
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

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 possible to connect several Spectrum cards with each other as well as to connect a Spectrum card with cards of other manufacturers.

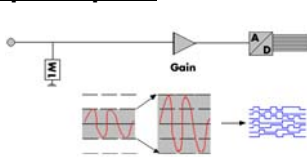
PXI reference clock

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 fed in the on-board PLL. This feature allows the cards to run with a fixed phase relation.

PXI trigger

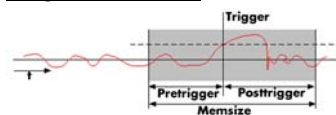
The Spectrum cards support star trigger as well as the PXI trigger bus. Using a simple software command one or more trigger lines can be used as trigger source. This feature allows the easy setup of OR connected triggers from different cards.

Input Amplifier



The analog inputs can easily be adapted to real world signals using settings that are individual for each channel. By using software commands one can select a matching input range.

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 into a ring buffer there are also samples prior to the trigger event visible: Pretrigger = Memsiz - Posttrigger.

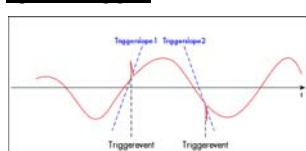
FIFO mode

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 can be combined with the pulsewidth trigger. This makes it possible to trigger on signal errors like too long or too short pulses.

Spike trigger



When using the spike trigger mode, the difference between two samples is checked whether being higher than the programmed limit or not. This can be useful to trigger e.g. on noise

coming from a power supply.

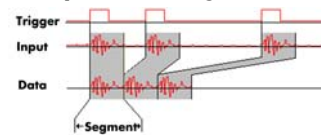
External trigger I/O

All boards 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

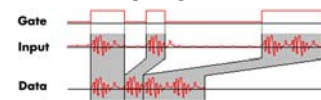
Defines the minimum or maximum width that a trigger pulse must have to generate a trigger event. Pulse width can be combined with channel trigger, pattern trigger and external trigger.

Multiple Recording



The Multiple Recording option 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

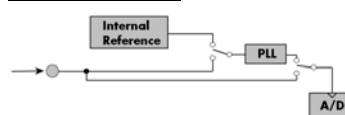


The Gated Sampling option allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a programmed level.

External clock I/O

Using 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 synchronise external equipment to this clock.

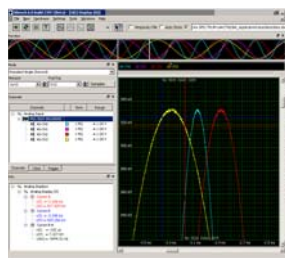
Reference clock



The option to use a precise external reference clock (normally 10 MHz) is necessary to synchronize 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 in this way.

The driver automatically generates the requested sampling clock from the fed in reference clock.

SBench 6



A base licence of SBench 6 the easy-to-use graphical operating software for the Spectrum cards is included in the delivery. Using the base license it is possible to test the card and to show acquired data. There are also some basic measurement functions included in the base license. The card comes with a demo license for the professional version giving the user the opportunity to test the features of the professional version with the new hardware. Existing customers have the opportunity to request a demo license for the professional version at Spectrum. The professional version contains several new measurement functions, FFT, import and export (including MATLAB and ASCII) as well as the streaming modes. The data streaming modes allow to continuously acquire data to hard disk. SBench 6 has been optimized to handle data files of several GByte. More details on SBench 6 are found in the dedicated SBench 6 data sheet. The version 6 is running under Windows as well as under Linux (KDE and GNOME). A test version of SBench 6 is freely available in the internet. This test version will also operate with demo cards and can be tested as Professional version without any hardware installed.

Technical Data

Analog Inputs

Resolution	16 bit (± 32000 values)
Differential non linearity (DNL)	± 1 LSB (ADC)
Integral non linearity (INL)	± 3 LSB (ADC)
Offset error (full speed)	$\leq 0.1\%$ of range (after warm-up and calibration)
Gain error (full speed)	$\leq 0.1\%$ (after warm-up and calibration)
Fixed input mode	bipolar
Crosstalk: all ranges 100 kHz signal	-100 dB
Analog Input impedance	1 MOhm against GND
Over voltage protection	± 30 V all ranges (activated card)
Aliasing filter	Butterworth filter 2nd order

Connector (analog)	MMCX female
Connector (trigger/clock)	3 mm SMB male

Power consumption (max speed)	3.3 V	5 V	-12 V	+12 V	Total
MX.47x0 (8 MS memory)	1.0 A	1.6 A	-	-	11.3 W
MX.4731 (64 MS memory), max power	1.4 A	1.6 A	-	-	12.6 W

Trigger input: Standard TTL level	Low: $-0.5 > \text{level} < 0.8$ V High: $2.0 \text{ V} > \text{level} < 5.5$ V Trigger pulse must be valid ≥ 2 clock periods.
Trigger output	Standard TTL, capable of driving 50 Ohm. Low < 0.4 V (@ 20 mA, max 64 mA) High > 2.4 V (@ -20 mA, max -48 mA) One positive edge after the first internal trigger

Ext. clock: delay to internal clock 42 ns \pm 2 ns

Trigger

Multi: Trigger to 1st sample delay	fixed
Multi: Recovery time	< 20 samples
ext. Trigger accuracy	1 Sample
int. Trigger accuracy	1 Sample
input signal with 50 ohm termination	max 5 V rms
Trigger output delay	1 Sample

Environmental and Physical details

Dimension	160 mm x 100 mm (Standard 3U)
Width (standard board)	1 slot
Warm up time	10 minutes
Operating temperature	0°C - 50°C
Storage temperature	-10°C - 70°C
Humidity	10% to 90%

Certifications and Compliances

EMC Immunity	Compliant with CE Mark
EMC Emission	Compliant with CE Mark

Clock input: Standard TTL level	Low: $-0.5 \text{ V} > \text{level} < 0.8$ V High: $2.0 \text{ V} > \text{level} < 5.5$ V Rising edge. Duty cycle: 50% \pm 5%
Clock output	Standard TTL, capable of driving 50 Ohm Low < 0.4 V (@ 20 mA, max 64 mA) High > 2.4 V (@ -20 mA, max -48 mA)

Dynamic Parameters

	MX.4710	MX.4720	MX.4730
max internal or external clock	100 kS/s	250 kS/s	500 kS/s
-3 dB bandwidth	> 50 kHz	> 125 kHz	> 250 kHz
RMS zero noise level ($\geq \pm 500$ mV)	< 0.7 LSB	< 0.8 LSB	< 0.9 LSB
RMS zero noise level ($< \pm 500$ mV)	< 6 μ V	< 7 μ V	< 10 μ V
Test - sampling rate	100 kS/s	250 kS/s	500 kS/s
Test signal frequency	10 kHz	10 kHz	10 kHz
SNR (typ)	91.5 dB	90.6 dB	88.7 dB
THD (typ)	-101.3 dB	-100.5 dB	-92.5 dB
SFDR (typ), excl. harm.	108.8 dB	106.7 dB	104.5 dB
ENOB (based on SNR)	14.9 bit	14.7 bit	14.4 bit
ENOB (based on SINAD)	14.7 bit	14.6 bit	14.3 bit

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

Versions	Order no.	Standard mem	1 channel	2 channels	4 channels	8 channels
	MX.4710	8 MSample	100 kS/s	100 kS/s	100 kS/s	100 kS/s
	MX.4720	8 MSample	250 kS/s	250 kS/s	250 kS/s	250 kS/s
	MX.4730	8 MSample	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Memory	Order no.	Option
	MX.4xxx-16M	Memory upgrade to 16 MSample (32 MB) of total memory
	MX.4xxx-32M	Memory upgrade to 32 MSample (64 MB) of total memory
	MX.4xxx-64M	Memory upgrade to 64 MSample (128 MB) of total memory
	MX.4xxx-up	Additional fee for later memory upgrade

Options	Order no.	Option
	MX.4xxx-mr	Option Multiple Recording
	MX.4xxx-gs	Option Gated Sampling

Cables	Order no.	Option
	Cab-1m-9m-80	Adapter cable MMCX male to BNC male, 80 cm (for analog inputs)
	Cab-1m-9f-80	Adapter cable MMCX male to BNC female, 80 cm (for analog inputs)
	Cab-1m-9m-200	Adapter cable MMCX male to BNC male, 200 cm (for analog inputs)
	Cab-1m-9f-200	Adapter cable MMCX male to BNC female, 200 cm (for analog inputs)
	Cab-1m-9f-5	Adapter cable MMCX male to BNC female, 5 cm (short cable especially for oscilloscope probes)
	Cab-3f-9m-80	Adapter cable SMB female to BNC male, 80 cm (for clock and trigger I/O)
	Cab-3f-9f-80	Adapter cable SMB female to BNC female, 80 cm (for clock and trigger I/O)
	Cab-3f-3f-80	Adapter cable SMB female to SMB female, 80 cm (for clock and trigger I/O)
	Cab-3f-9m-200	Adapter cable SMB female to BNC male, 200 cm (for clock and trigger I/O)
	Cab-3f-9f-200	Adapter cable SMB female to BNC female, 200 cm (for clock and trigger I/O)
	Cab-3f-3f-200	Adapter cable SMB female to SMB female, 200 cm (for clock and trigger I/O)

Drivers	Order no.	Option
	MATLAB	MATLAB driver for all MI/MC/MX/PCI cards
	MX.47xx-lv	LabVIEW driver for all MX.47xx cards
	MX.47xx-dl	DASyLab driver for all MX.47xx cards
	MX.47xx-vee	Agilent VEE driver for all MX.47xx cards

Technical changes and printing errors possible