



SPECTRUM

SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

MX.45xx - two channel 16 bit high-speed A/D

- **PXI 3U / CompactPCI 3U format**
- **Fast 16 bit A/D converter board**
- **Models with 200 kS/s, 500 kS/s or 1 MS/s**
- **Simultaneously sampling on both channels**
- **4 input ranges: ± 1 V up to ± 10 V**
- **Differential / single-ended selectable**
- **Up to 64 MSample memory**
- **FIFO mode**
- **Window and pulsewidth trigger**
- **Input offset up to $\pm 100\%$**
- **Synchronization possible**
- **Software SBench for Windows included**
- **Software SBench for Linux included**



Product range overview

Model	1 channel	2 channels
MX.4520	200 kS/s	200 kS/s
MX.4530	500 kS/s	500 kS/s
MX.4540	1 MS/s	1 MS/s

Software/Drivers

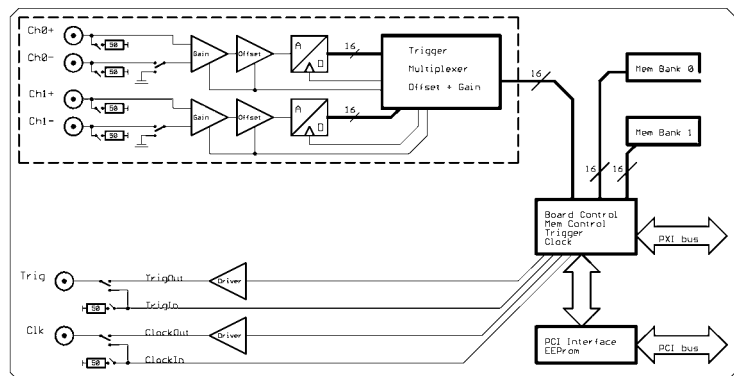
A large number of drivers and examples are delivered with the board or are available as an option:

- Windows 98/ME/NT/2000/XP/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.45xx for the first time offers full 16 bit resolution synchronously on two channels at very 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 calibrated using the software. The user will find easily a matching solution from the three offered models. These versions are working with sampling rates of 200 kS/s, 500 kS/s or 1 MS/s. The boards can also be updated to a multi-channel system using the internal synchronization bus.

Hardware block diagram



Software programmable parameters

sampling rate	1 kS/s to max sampling rate, external clock, ref clock, PXI clock
Input Range	± 1 V, ± 2 V, ± 5 V, ± 10 V
Input impedance	50 Ohm / 1 MOhm
Input type	Single-ended, differential
Input Offset	$\pm 100\%$ in steps of 1%
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, Windows, Pulse, PXI Line[5..0], PXI Startrigger
Trigger level	1/2048 to 2047/2048 of input range
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.

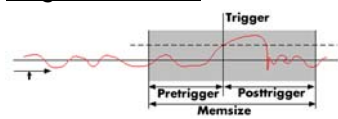
PXI reference clock

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 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 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.

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

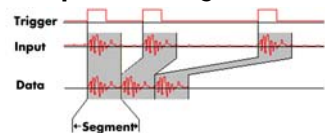
External trigger I/O

All 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.

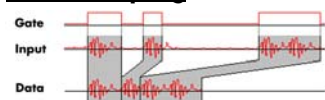
Multiple Recording



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



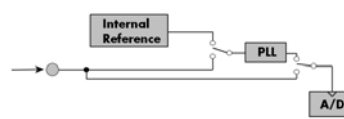
The Gated Sampling option allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a pro-

grammed 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 mea-

surements 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.

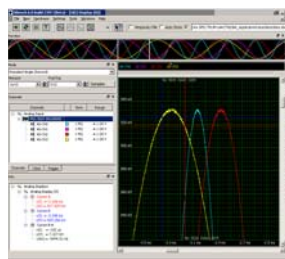
Input impedance

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.

Differential inputs

With a simple software command the inputs can individually be switched from single-ended (in relation to ground) to differential, without loosing any inputs. When the inputs are used in differential mode the A/D converter measures the difference between two lines with relation to system ground.

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 ist 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 oportunity to request a demo license for the professional version at Spectrum. The professional version contains several new measurement functions, FFT, import and exporr (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 shett. 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

Resolution	16 bit	Dimension	160 mm x 100 mm (Standard 3U)
Differential linearity error	< 1 LSB (ADC)	Width (Standard board)	1 full size slot
Integral linearity error	< 2.5 LSB (ADC)	Connector	3 mm SMB male
Multi: Trigger to 1st sample delay	fixed	Inputs	Differential / Single Ended
Multi: Recovery time	< 20 samples	Input impedance	50 Ohm / 1 MOhm 25 pF
ext. Trigger accuracy	1 Sample	Overvoltage protection	±40 V
int. Trigger accuracy	1 Sample	Warm up time	10 minutes
input signal with 50 ohm termination	max 5 V rms	Operating temperature	0°C - 50°C
Trigger output delay	1 Sample	Storage temperature	-10°C - 70°C
Offset error	< 1 LSB, adjustable by user	Humidity	10% to 90%
Gain error	< 1%	MTBF	100000 hours
Noise @ full speed, 50 ohm termination	< 2.5 LSB rms	Power consumption -12 V	max. 50 mA (600 mWatt)
Crosstalk @ 20 kHz	< -95 dB	Power consumption +12 V	max. 50 mA (600 mWatt)
Ext. clock: delay to internal clock	42 ns ± 2 ns	Power consumption 5 V @ full speed	max. 0.73 A (2.4 Watt)
		Power consumption 5 V @ power down	max. 0.50 A (2.5 Watt)
Max common mode voltage	±8 V (differential inputs)	Clock input: Standard TTL level	Low: -0.5 V > level < 0.8 V High: 2.0 V > level < 5.5 V Rising edge. Duty cycle: 50% ± 5%
Trigger input: Standard TTL level	Low: -0.5 V > level < 0.8 V High: 2.0 V > level < 5.5 V Trigger pulse must be valid ≥ 2 clock periods.	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) One positive edge after the first internal trigger
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		

	MX.4520	MX.4530	MX.4540
Min internal clock	1 kS/s	1 kS/s	1 kS/s
Max internal clock	200 kS/s	500 kS/s	1 MS/s
Min external clock	DC	DC	1 kS/s
Max external clock	200 kS/s	500 kS/s	1 MS/s
-3 dB bandwidth	>100 kHz	>250 kHz	>500 kHz

Dynamic Parameters

	MX.4520	MX.4530	MX.4540
Test - Samplerate	200 kS/s	500 kS/s	1 MS/s
Testsignal frequency			
SNR (typ)			
THD (typ)			
SFDR (typ), incl harm.			
SINAD (typ)			
ENOB (based on SINAD)			

Dynamic parameters are measured at ± 1 V input range (if no other range is stated) 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
MX4520	MX.4520 with 8 MSample memory and drivers/SBench 5.x	MX4xxx-16M	Option: 16 MSample memory instead of 8 MSample standard mem
MX4530	MX.4530 with 8 MSample memory and drivers/SBench 5.x	MX4xxx-32M	Option: 32 MSample memory instead of 8 MSample standard mem
MX4540	MX.4540 with 8 MSample memory and drivers/SBench 5.x	MX4xxx-64M	Option: 64 MSample memory instead of 8 MSample standard mem
MX4xxx-mr	Option Multiple Recording: Memory segmentation	MX4xxx-up	Additional handling costs for later memory upgrade
MX4xxx-gs	Option Gated Sampling: Gate signal controls acquisition		
Cab-3f-9m-80	Adapter cable: SMB female to BNC male 80 cm	MX45xx-dl	DASYLab driver for MX.45xx series
Cab-3f-9m-200	Adapter cable: SMB female to BNC male 200 cm	MX45xx-hp	VEE driver for MX.45xx series
Cab-3f-9f-80	Adapter cable: SMB female to BNC female 80 cm	MX45xx-lv	LabVIEW driver for MX.45xx series
Cab-3f-9f-200	Adapter cable: SMB female to BNC female 200 cm	MATLAB	MATLAB driver for all MI.xxxx, MC.xxxx and MX.xxxx series.

Technical changes and printing errors possible