SPECTRUM
SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

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

- **CompactPCI 6U format**
- **8 or 16 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 256 MSample (512 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 option available for up to 16 cards**

Product range overview

All boards of the MC.47xx series may use the whole installed on-board memory completely for the currently activated number of channels.

Model	1 channel	2 channel	4 channel	8 channel	16 channel
MC.4710	100 kS/s	100 kS/s	100 kS/s	100 kS/s	
MC.4711	100 kS/s	100 kS/s	100 kS/s	100 kS/s	100 kS/s
MC.4720	250 kS/s	250 kS/s	250 kS/s	250 kS/s	
MC.4721	250 kS/s	250 kS/s	250 kS/s	250 kS/s	250 kS/s
MC.4730	500 kS/s	500 kS/s	500 kS/s	500 kS/s	
MC.4731	500 kS/s	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Software/Drivers

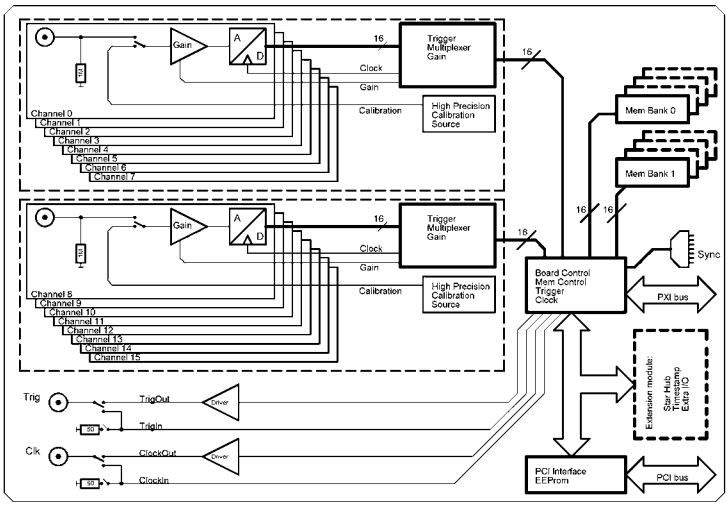
A large number of drivers and examples are delivered with the board or are available as an option:

- Windows 98/ME/NT/2000/XP - drivers
- Linux - drivers
- SBench 5.2
- Streaming Software SPviewIT 6.2 (as option)
- 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 MC.47xx series allows recording of one, two, four, eight or sixteen channels with sampling rates of 100 kS/s up to 500 kS/s. These cards offer outstanding A/D features both in resolution and speed for CompactPCI. They are available in several versions and different speed grades making it possible for the user to find an individual solution. The installed memory of up to 256 MSample can be used for fast data recording or sustained data streaming. The enhanced FIFO engine is capable of streaming even 16 channels with 500 kS/s sustained to memory or hard disk.

Hardware block diagram



Software programmable parameters

Sampling rate	1 kS/s to max sampling rate, external clock, ref clock
Input range	±50 mV, ±100 mV, ±250 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
Clock mode	internal PLL, int.quartz, external, ext. divided, ext. 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, Spike
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

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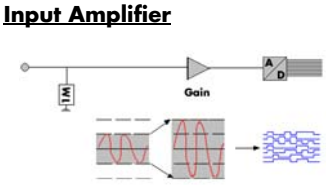
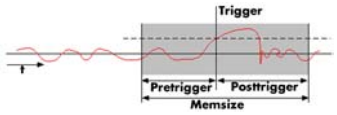
Possibilities and options

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 = Memsize - Posttrigger.

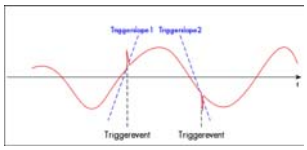
FIFO mode

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.

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.

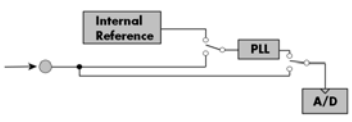
Pulse width

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.

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 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 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.

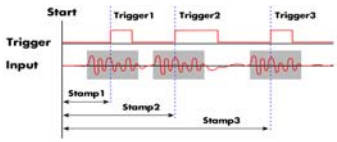
Star-Hub

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 option 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 synchronised to a radio clock, or a GPS receiver. With this option acquisitions of systems on different locations can be set in a precise time relation.

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)	≤ 0.1% of range (after warm-up and calibration)
Gain error (full speed)	≤ 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**
MC.47x0 (8 MS memory)	TDB	TDB	TDB	TDB	TDB
MC.47x1 (8 MS memory)	TDB	TDB	TDB	TDB	TDB
MC.4731 (256 MS memory),max power	TDB	TDB	TDB	TDB	TDB

Trigger input:Standard TTL level	Low: -0.5 > level < 0.8 V High: 2.0 V > 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 ± 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 233 mm (Standard 6U)
Width (standard board)	1 slot
Width (with star hub)	2 slots
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 V > level < 0.8 V High: 2.0 V > level < 5.5 V Rising edge. Duty cycle: 50% ± 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

	MC.4710	MC.4711	MC.4720	MC.4721	MC.4730	MC.4731
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 (≥ ±500 mV)	< 0.7 LSB	< 0.8 LSB	< 0.8 LSB	< 0.9 LSB	< 0.9 LSB	< 1.0 LSB
RMS zero noise level (< ±500 mV)	< 6 uV	< 7 uV	< 7 uV	< 8 uV	< 10 uV	< 13 uV
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	91.2 dB	90.6 dB	90.5 dB	88.7 dB	88.5 dB
THD (typ)	-101.3 dB	-101.2 dB	-100.5 dB	-100.5 dB	-92.5 dB	-92.5 dB
SFDR (typ), excl. harm.	108.8 dB	108.9 dB	106.7 dB	106.8 dB	104.5 dB	104.3 dB
ENOB (based on SNR)	14.9 bit	14.8 bit	14.7 bit	14.7 bit	14.4 bit	14.4 bit
ENOB (based on SINAD)	14.7 bit	14.6 bit	14.6 bit	14.6 bit	14.3 bit	14.2 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.	1 channel	2 channels	4 channels	8 channels	16 channels
MC.4710	100 kS/s	100 kS/s	100 kS/s	100 kS/s	
MC.4711	100 kS/s	100 kS/s	100 kS/s	100 kS/s	100 kS/s
MC.4720	250 kS/s	250 kS/s	250 kS/s	250 kS/s	
MC.4721	250 kS/s	250 kS/s	250 kS/s	250 kS/s	250 kS/s
MC.4730	500 kS/s	500 kS/s	500 kS/s	500 kS/s	
MC.4731	500 kS/s	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Memory

Order no.	Option
MC.4xxx-16M	Memory upgrade to 16 MSample (32 MB) of total memory
MC.4xxx-32M	Memory upgrade to 32 MSample (64 MB) of total memory
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-vhdci	Option 68 pole VHDCI connector instead of MMCX/SMB connectos. 1 connector per module.
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.	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/MX/MC cards
MC.47xx-lv	LabVIEW driver for all MC.47xx cards
MC.47xx-dl	DASYLab driver for all MC.47xx cards
MC.47xx-vee	Agilent VEE driver for all MC.47xx cards

(1) : Just one of the options can be installed on a card at a time.

technical changes and printing errors possible