

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 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	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	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	500 kS/s
MC.4731	500 kS/s	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Software/Drivers

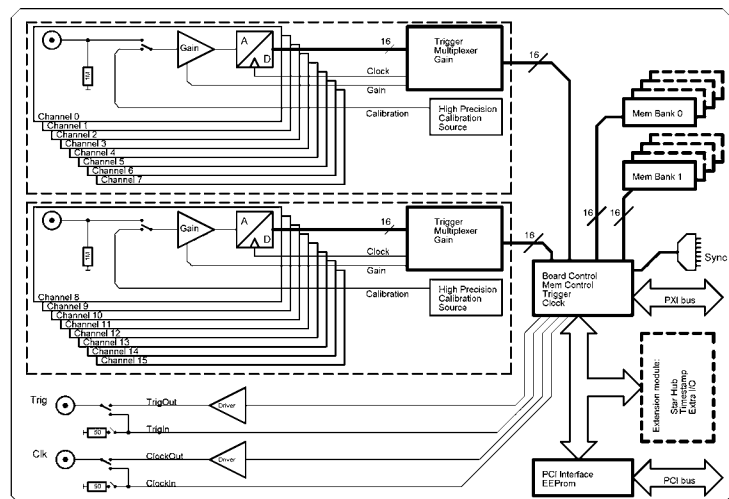
A large number of drivers and examples are delivered with the board:

- Windows NT/2000 32 bit drivers
- Windows XP/Vista/7/8/10, 32 and 64 bit driver
- Linux 32bit and 64bit drivers
- SBench 6.x Base version for Windows and Linux
- Visual C++/Borland C++ Builder examples
- Borland Delphi examples
- Microsoft Visual Basic & Excel examples
- Python examples
- LabWindows/CVI examples
- LabVIEW - drivers and examples
- MATLAB - drivers and examples
- Other 3rd party drivers (e.g. VEE, DASYLab) are partly available upon request

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

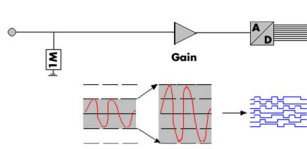


Software programmable parameters

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
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

Input Amplifier

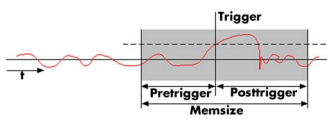


The analog inputs can easily be adapted to real world signals using settings that are individual for each channel. By using software commands one can select a matching input range.

Automatic on-board calibration

All of the channels are calibrated in factory before the board is shipped. To compensate for different variations like PC power supply, temperature and aging, the software driver provides routines for an automatic onboard offset and gain calibration of all input ranges. All the cards contain a high precision on-board calibration reference.

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 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 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 recognised trigger event can - when activated by software - be routed to the trigger connector to start external instruments.

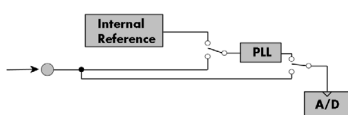
Pulse width

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 (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.

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.

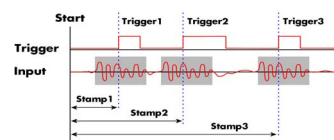
Star-Hub

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

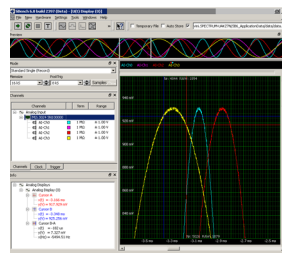
The Extra I/O module adds 24 additional digital I/O lines and 4 analog outputs on an extra connector. These additional lines are independent from the standard function and can be controlled asynchronously. There is also an internal version available with 16 digital I/Os and 4 analog outputs that can be used directly at the rear board connector.

Timestamp



The timestamp 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 or a GPS receiver. Using the external synchronization gives a precise time relation for acquisitions of systems on different locations.

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.

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
MC.47x0 (32 MS memory)	1.0 A	1.7 A	-	-	11.8 W
MC.47x1 (32 MS memory)	1.1 A	2.9 A	-	-	18.1 W
MC.4731 (256 MS memory), max power	2.7 A	2.9 A	-	-	23.4 W

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 233 mm (Standard 6U)
Width (standard board)	1 slot
Width (with star hub)	2 slots

Warm up time	10 minutes
Operating temperature	0°C to 50°C
Storage temperature	-10°C to 70°C
Humidity	10% to 90%
MTBF	80000 hours

Certifications and Compliances

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

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.
 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

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% \pm 5%
 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)

Trigger output

Clock output

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 ($\geq \pm 500$ 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 μ V	< 7 μ V	< 7 μ V	< 8 μ V	< 10 μ V	< 13 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	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

The card is delivered with 32 MSample on-board memory and supports standard mode (Scope) and FIFO mode (streaming). Operating system drivers for Windows/Linux 32 bit and 64 bit, examples for C/C++, LabVIEW (Windows), MATLAB (Windows), LabWindows/CVI, Delphi, Visual Basic, 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!

Versions

Order no.	Standard mem	1 channel	2 channels	4 channels	8 channels	16 channels
MC.4710	32 MSample	100 kS/s	100 kS/s	100 kS/s	100 kS/s	
MC.4711	32 MSample	100 kS/s	100 kS/s	100 kS/s	100 kS/s	100 kS/s
MC.4720	32 MSample	250 kS/s	250 kS/s	250 kS/s	250 kS/s	
MC.4721	32 MSample	250 kS/s	250 kS/s	250 kS/s	250 kS/s	250 kS/s
MC.4730	32 MSample	500 kS/s	500 kS/s	500 kS/s	500 kS/s	
MC.4731	32 MSample	500 kS/s	500 kS/s	500 kS/s	500 kS/s	500 kS/s

Memory

Order no.	Option
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-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.4xxx-xmf (1)	Option Extra I/O with external connector, 24 digital I/O + 4 analog outputs. Including one cable Cab-d40-idc-100.

Cables

for Connections	Length	Order no.				
		to BNC male	to BNC female	to SMA male	to SMA female	to SMB female
Analog Inputs	80 cm	Cab-1m-9m-80	Cab-1m-9f-80	Cab-1m-3mA-80	Cab-1m-3fA-80	Cab-1m-3f-80
Analog Inputs	200 cm	Cab-1m-9m-200	Cab-1m-9f-200	Cab-1m-3mA-200	Cab-1m-3fA-200	Cab-1m-3f-200
Probes (short)	5 cm		Cab-1m-9f-5			
Trigger/Clock I/O	80 cm	Cab-3f-9m-80	Cab-3f-9f-80	Cab-3f-3mA-80	Cab-3f-3fA-80	Cab-3f-3f-80
Trigger/Clock I/O	200 cm	Cab-3f-9m-200	Cab-3f-9f-200	Cab-3f-3mA-200	Cab-3f-3fA-200	Cab-3f-3f-200

Software SBench6

Order no.	
SBench6	Base version included in delivery. Supports standard mode for one card.
SBench6-Pro	Professional version for one card: FIFO mode, export/import, calculation functions
SBench6-Multi	Option multiple cards: Needs SBench6-Pro. Handles multiple synchronized cards in one system.
Volume Licenses	Please ask Spectrum for details.

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

⁽²⁾ : Third party product with warranty differing from our export conditions. No volume rebate possible.

Technical changes and printing errors possible

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