MC.40xx - 14 bit transient recorder

- **CompactPCI 6U format**
- **Fastest 14 bit A/D converter board**
- **Models with 20 MS/s or 50 MS/s**
- **1, 2 or 4 channels acquisition**
- **Simultaneously sampling on all channels**
- **6 input ranges: ±200 mV up to ± 10 V**
- **Up to 256 MSample memory**
- **FIFO mode**
- **Window and pulsewidth trigger**
- **Input offset up to ±200%**
- **Software SBench for Windows included**
- **Software SBench for Linux included**

Product range overview

Model	1 channel	2 channels	4 channels
MC.4020	20 MS/s		
MC.4021	20 MS/s	20 MS/s	
MC.4022	20 MS/s	20 MS/s	20 MS/s
MC.4030	50 MS/s		
MC.4031	50 MS/s	50 MS/s	
MC.4032	50 MS/s	50 MS/s	50 MS/s

Software/Drivers

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

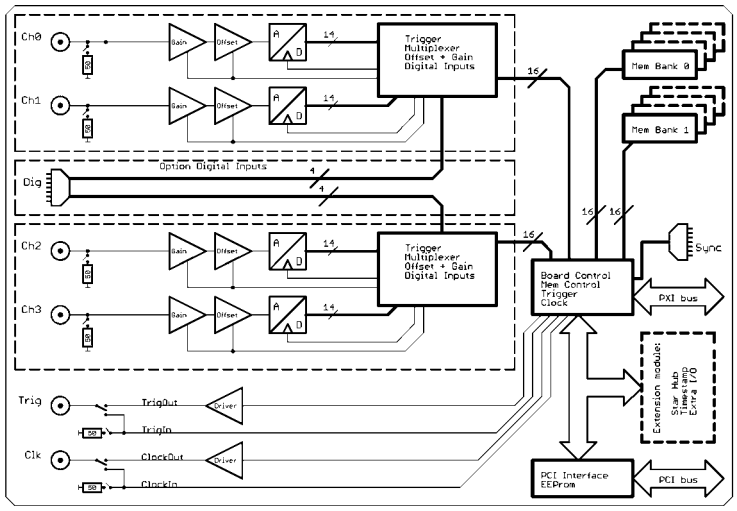
- Windows NT/2000 32 bit drivers
- Windows XP/Vista/7/8/10, 32 and 64 bit driver
- Linux 32bit and 64bit drivers
- SBench 6.x Base version for Windows and Linux
- Visual C++/Borland C++ Builder examples
- Borland Delphi examples
- Microsoft Visual Basic & Excel examples
- Python examples
- LabWindows/CVI 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.40xx is best suitable for applications that need high sampling rates as well as a maximum signal dynamic. These boards offer a resolution 4 times higher than 12 bit boards. On the MC.40xx every channel has its own amplifier and A/D converter. Each input channel can 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 sampling rates of 20 MS/s or 50 MS/s and have one, two or four channels and can also be updated to a multi-channel system using the internal synchronization bus.

Data is written in the internal 8 MSamples up to 256 MSample large memory. This memory can also be used as a FIFO buffer. In FIFO mode data can be transferred on-line directly into the PC RAM or to hard disk.

Hardware block diagram



Software programmable parameters

sampling rate	1 kS/s to max sampling rate, external clock, ref 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, 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	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

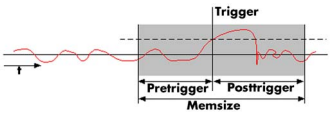
SPECTRUM INSTRUMENTATION GMBH · AHRENSFELDER WEG 13-17 · 22927 GROSSHANSDORF · GERMANY
PHONE: +49 (0)4102-6956-0 · FAX: +49 (0)4102-6956-66 · E-MAIL: info@spec.de · INTERNET: www.spectrum-instrumentation.com

Possibilities and options

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 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.

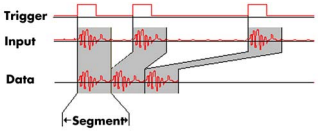
External trigger I/O

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

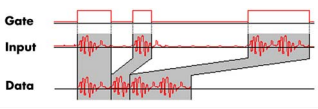
Defines the minimum or maximum width that a trigger pulse must have to generate a trigger event. Pulse width can be combined with channel trigger, pattern trigger and external trigger.

Multiple Recording



The Multiple Recording mode 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

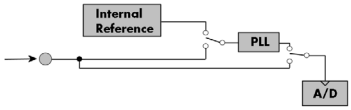


The Gated Sampling mode allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a programmed level.

External clock I/O

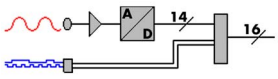
Using a dedicated connector a sampling clock can be fed in from an external system. It's also possible to output the internally used sampling clock to synchronise external equipment to this clock.

Reference clock



The option to use a precise external reference clock (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.

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 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.

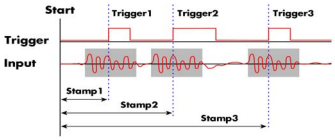
Star-Hub

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

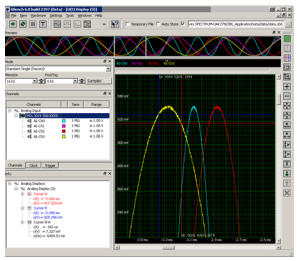
The Extra I/O module adds 24 additional digital I/O lines and 4 analog outputs on an extra connector. These additional lines are independent from the standard function and can be controlled asynchronously. There is also an internal version available with 16 digital I/Os and 4 analog outputs that can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

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 ohm 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 to 50°C
Crosstalk 1 MHz sine signal 50 Ohm	< -80 dB	Storage temperature	-10°C to 70°C
Crosstalk 1 MHz sine signal 1 MOhm	< -65 dB	Humidity	10% to 90%
		MTBF	200000 hours
Min internal clock	1 kS/s	Zero offset error	adjustable by user
Min external clock	500 kS/s	Gain error	< 1 % of current value
		Power consumption 3.3 V @ full speed	max. 1.57 A (5.2 Watt)
		Power consumption 5 V @ full speed	max. 1.91 A (9.6 Watt)
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.	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 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	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)

	MC.4020 MC.4021	MC.4022	MC.4030 MC.4031	MC.4032
max internal clock	20 MS/s	20 MS/s	50 MS/s	50 MS/s
max external clock	20 MS/s	20 MS/s	50 MS/s	50 MS/s
-3 dB bandwidth	> 10 MHz	> 10 MHz	> 25 MHz	> 25 MHz
Zero noise level at 50 Ohm	< 2.1 LSB rms	< 2.6 LSB rms	< 2.9 LSB rms	< 3.6 LSB rms

Dynamic Parameters

	MC.4020 MC.4021	MC.4022	MC.4030 MC.4031	MC.4032
Test - Samplerate	20 MS/s	20 MS/s	50 MS/s	50 MS/s
Testsignal frequency	1 MHz	1 MHz	1 MHz	1 MHz
SNR (typ)	> 70.3 dB	> 70.1 dB	> 67.1 dB	> 65.5 dB
THD (typ)	< -73.0 dB	< -73.0 dB	< -72.8 dB	< - 72.8 dB
SFDR (typ), excl harm.	> 82.8 dB dB	> 82.3 dB	> 75.8 dB	> 75.2 dB
SINAD (typ)	> 68.4 dB	> 68.3 dB	> 66.1 dB	> 64.8 dB
ENOB (based on SINAD)	> 11.1	> 11.1	> 10.7	> 10.5

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

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.	1 channel	2 channels	4 channels
MC.4020	20 MS/s		
MC.4021	20 MS/s	20 MS/s	

Versions

Order no.	1 channel	2 channels	4 channels
MC.4022	20 MS/	20 MS/	20 MS/
MC.4030	50 MS/s		
MC.4031	50 MS/s	50 MS/s	
MC.4032	50 MS/s	50 MS/s	50 MS/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.40xx-dig	Additional synchronous digital inputs (2 per analog channel) including Cab-d40-idc-100
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.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.					
for Connections	Length	to BNC male	to BNC female	to SMA male	to SMA female	to SMB female	
Analog/Clock/Trigger	80 cm	Cab-3f-9m-80	Cab-3f-9f-80	Cab-3f-3mA-80	Cab-3f-3fA-80	Cab-3f-3f-80	
Analog/Clock/Trigger	200 cm	Cab-3f-9m-200	Cab-3f-9f-200	Cab-3f-3mA-200	Cab-3f-3fA-200	Cab-3f-3f-200	
Probes (short)	5 cm		Cab-3f-9f-5				
		to 2x20 pole IDC	to 40 pole FX2				
Digital signals (option)	100 cm	Cab-d40-idc-100	Cab-d40-d40-100				

Amplifiers

Order no.	Bandwidth	Connection	Input Impedance	Coupling	Amplification
SPA.1841 (2)	2 GHz	SMA	50 Ohm	AC	x100 (40 dB)
SPA.1801 (2)	2 GHz	SMA	50 Ohm	AC	x10 (20 dB)
SPA.1601 (2)	500 MHz	BNC	50 Ohm	DC	x10 (20 dB)
SPA.1412 (2)	200 MHz	BNC	1 MOhm	AC/DC	x10/x100 (20/40 dB)
SPA.1411 (2)	200 MHz	BNC	50 Ohm	AC/DC	x10/x100 (20/40 dB)
SPA.1232 (2)	10 MHz	BNC	1 MOhm	AC/DC	x100/x1000 (40/60 dB)
SPA.1231 (2)	10 MHz	BNC	50 Ohm	AC/DC	x100/x1000 (40/60 dB)
Information	External Amplifiers with one channel, BNC/SMA female connections on input and output, manually adjustable offset, manually switchable settings. An external power supply for 100 to 240 VAC is included. Please be sure to order an adapter cable matching the amplifier connector type and matching the connector type for your A/D card input.				

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