MC.70xx - 64 bit fast Digital I/O with TTL levels

- **CompactPCI 6U format**
- **1, 2, 4, 8 or16 bit, 32 bit or 64 bit digital I/O**
- **1 kS/s up to 125 MS/s at 16 and 32 bit**
- **1 kS/s up to 60 MS/s at 32 and 64 bit**
- **110 Ohm input impedance selectable**
- **Inputs 3.3 V and 5 V TTL compatible**
- **Outputs 3.3 V TTL compatible**
- **Up to 512 MByte memory**
- **FIFO mode for input and output**
- **Pattern/Edge/Pulsewidth trigger**
- **Synchronization possible**
- **Software SBench for Windows included**
- **Software SBench for Linux included**

Product range overview

Model	1-4 bit	8 bit	16 bit	32 bit	64 bit
MC.7005	125 MS/s	125 MS/s	125 MS/s		
MC.7010		125 MS/s	125 MS/s		
MC.7011		125 MS/s	125 MS/s	60 MS/s	
MC.7020		125 MS/s	125 MS/s	125 MS/s	
MC.7021		125 MS/s	125 MS/s	125 MS/s	60 MS/s

Software/Drivers

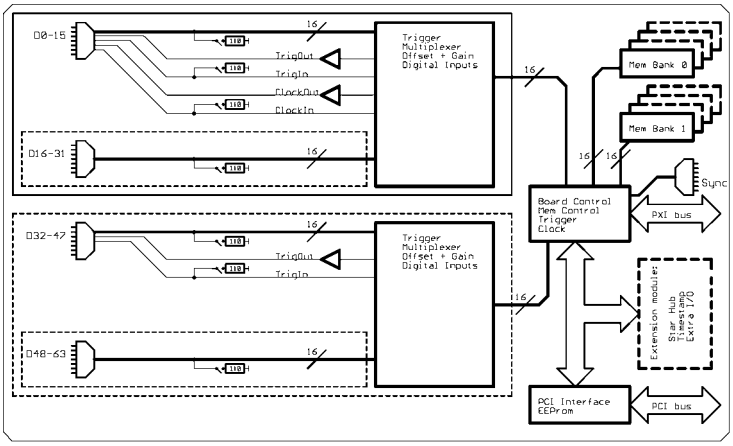
A large number of drivers and examples are delivered with the board or are available as an option:

- 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 (recording only)
- Microsoft Visual C++ 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.70xx series of fast digital I/O boards offer a resolution between 1 bit and 64 bit with a maximum sampling rate of 125 MS/s (60 MS/s). Every 16 bit / 32 bit of the board can be separately programmed for input or output. The on-board memory of up to 512 MByte can be completely used for recording or re-playing digital data. Alternatively the MC.70xx can be used in FIFO mode. Then data is transferred on-line to PC memory or hard disk. The internal standard synchronisation bus allows synchronisation of several MC.xxxx boards. Therefore the MC.70xx board can be used as an enlargement to analogue boards.

Hardware block diagram



Software programmable parameters

sampling rate	1 kS/s to max sampling rate, external clock, ref clock
Direction	Input/Output for each module
Input impedance	110 Ohm / 50 kOhm for each channel
Clock mode	internal PLL, int.quartz, external, ext. divided, ext. reference clock
Clock impedance	110 Ohm / 50 kOhm
Trigger impedance	110 Ohm / 50 kOhm
Trigger pulsewidth	1 to 256 sanples in steps of 1
Trigger mode	Pattern and mask, edge, external TTL, software
Pattern and mask	32 bit / 64 bit wide: 0 pattern, 1 patterm, don't care or edge
Memory depth	32 up to installed memory in steps of 32
Posttrigger	32 up to 128 M in steps of 32
Multiple Replay segmentsize	32 up to installed memory / 2 in steps of 32

Application examples

Semiconductor test	Production test	Pattern generator
A/D data acquisition	Logic analyser	Pattern recognition

Possibilities and options

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.

Pattern trigger

For every bit of the digital input the pattern trigger defines individually the expected level or sets the bit to „don't care". In combination with pulsewidth counter and edge detection the pattern trigger could be used to recognise a huge variety of trigger events.

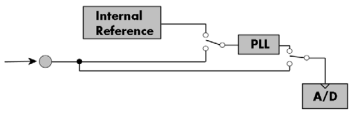
External trigger I/O

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.

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.

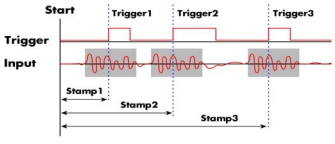
Star-Hub

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.

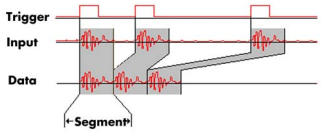
Timestamp



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 a GPS receiver.

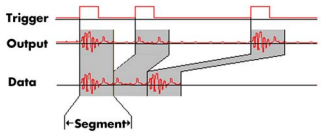
Using the external synchronization gives a precise time relation for acquisitions of systems on different locations.

Multiple Recording



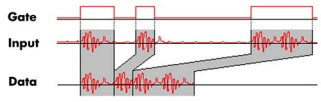
The Multiple Recording mode allows the recording of several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided in several segments of same size. Each of them is filled with data if a trigger event occurs.

Multiple Replay



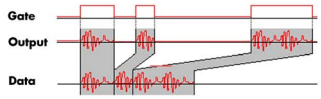
The Multiple Replay mode allows the fast output generation on several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided into several segments of the same size. Each segment can contain different data which will then be played with the occurrence of each trigger event.

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.

Gated Replay



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

Singleshot output

When singleshot output is activated the data of the on-board memory is played exactly one time. The trigger source can be either one of the external trigger inputs or the software trigger. After the first trigger additional trigger events will be ignored.

Continuous output

When continuous output is activated the data of the on-board memory is replayed continuously until a stop command is executed. As trigger source one can use the external TTL trigger or the software trigger.

1-4 bits mode

On the model 7005 it is also possible to use just 1, 2 or 4 bits for acquisition or replay. In 1 bit mode the 8 times higher memory is then available, at 2 bits mode it is 4 times higher and at 4 bits mode it is double. This enlarges the recording/replay time in on-board memory and it reduces the transfer rate when using FIFO mode. The data is stacked internally to 8 bit samples. Therefore all information on memory/segment/pre and posttrigger sizes and steps can be up to 8 times higher.

Technical Data

Internal samplerate	1 kS/s up to 125 MS/s						
External samplerate	DC up to 125 MS/s						
Input impedance	110 Ohm / 50 kOhm || 15 pF						
110 Ohm termination voltage	2.5V						
Signal level (data, trigger, clock)	3.3 V/ 5 V TTL compatible						
	LOW		HIGH				
Data input current sink (no termination)	0.0 V -1.0 µA	3.3 V +1.0 µA	5.0 V +20.0 µA				
Clock / trigger input current sink (no termination)	± 1.0 µA						
Multi: Trigger to 1st sample delay	fixed						
Multi: Recovery time	< 20 samples (16 - 64 bit)						

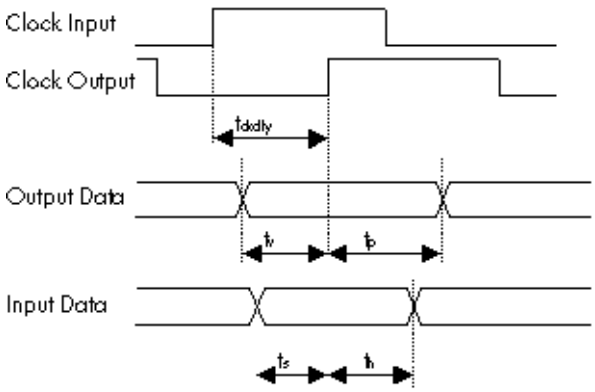
	64 bit	32 bit	16 bit	8 bit	4 bit	2 bit	1 bit
ext. Trigger accuracy (samples)	1	1	1	2	4	8	16
int. Trigger accuracy (samples)	1	1	1	2	4	8	16

Dimension	160 mm x 233 mm (Standard 6U)		
Width (MC.7005 MC.701x, MC.7020)	1 slot		
Width (MC.7021)	2 slots		
Connector	40 pole half pitch (Hirose FX2 series)		
Operating temperature	0°C to 50°C		
Storage temperature	-10°C to 70°C		
Humidity	10% to 90%		
MTBF	200000 hours		
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)

Power consumption (maximum value)	Full speed			
	+3,3 V	+5 V	+12 V	-12 V
MC.7005 (16 bit output @ 125 MS/s in 110 Ohm)	1.25 A (4.2 W)	0.91 A (4.6 W)	0 A	0 A
MC.7010 (16 bit output @ 125 MS/s in 110 Ohm)	1.25 A (4.2 W)	0.91 A (4.6 W)	0 A	0 A
MC.7011 (32 bit output @ 60 MS/s in 110 Ohm)	1.77 A (5.8 W)	0.91 A (4.6 W)	0 A	0 A
MC.7020 (32 bit output @ 125 MS/s in 110 Ohm)	2.29 A (7.6 W)	1.30 A (6.5 W)	0 A	0 A
MC.7021 (64 bit output @ 60 MS/s in 110 Ohm)	2.31 A (7.6 W)	1.27 A (6.4 W)	0 A	0 A

For detailed information on the different modes for external clocking- please refer to the dedicated chapter in the hardware manual for the boards of the 70xx series.

	External Clocking Mode		
Delay time	SINGLE	BURST_S	BURST_M
t_{ckdly}	20 ns	30 ns	< 1 ns
t_v	> 350 ns	> 150 ns	> 2.5 ns
t_p	> 2.5 ns	> 2.5 ns	> 2.5 ns
t_s	≤ 3.0 ns	≤ 3.0 ns	≤ 3.0 ns
t_{Vh}	≤ 1.0 ns	≤ 1.0 ns	≤ 1.0 ns



Order Information

The card is delivered with 64 MByte on-board memory and supports standard mode (Scope), FIFO mode (streaming), Multiple Recording/Replay and Gated Sampling/Replay. 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.

One digital connecting cable Cab-d40-idc-100 is included in the delivery for every digital connection (each 16 channels).

Versions

Order no.	1 Bit	2 Bit	4 Bit	8 Bit	16 Bit	32 Bit	64 Bit
MC.7005	125 MS/s	125 MS/s	125 MS/s	125 MS/s	125 MS/s		
MC.7010	-	-	-	125 MS/s	125 MS/s		
MC.7011	-	-	-	125 MS/s	125 MS/s	60 MS/s	
MC.7020				125 MS/s	125 MS/s	125 MS/s	
MC.7021				125 MS/s	125 MS/s	125 MS/s	60 MS/s

Memory

Order no.	Option
MC.7xxx-128M	Memory upgrade to 128 MB of total memory
MC.7xxx-256M	Memory upgrade to 256 MB of total memory
MC.7xxx-512M	Memory upgrade to 512 MB of total memory
MC.7xxx-up	Additional fee for later memory upgrade

Options

Order no.	Option
MC.7xxx-cs	Option Cascading: Synchronization of up to 4 cards (one option needed per system)
MC.7xxx-smod (1)	Option Star-Hub:Synchronization of up to 16 cards (one option needed per system)
MC.7xxx-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.

Cable

Order no.	Option
Cab-d40-idc-100	Flat ribbon cable 40 pole FX2 for digital connector to 2x20 pole IDC connector, 100 cm
Cab-d40-d40-100	Flat ribbon cable 40 pole FX2 for digital connector to 40 pole digital FX2 connector, 100 cm

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