SPECTRUM
INSTRUMENTATION

MX.70xx - 32 bit fast digital I/O with TTL levels

- **PXI 3U / CompactPCI 3U format**
- **1, 2, 4, 8, 16 bit or 32 bit digital I/O**
- **1 kS/s up to 125 MS/s at 16 bit**
- **1 kS/s up to 60 MS/s at 32 bit**
- **110 Ohm input impedance selectable**
- **Inputs 3.3 V and 5 V TTL compatible**
- **Outputs 3.3 V TTL compatible**
- **Up to 128 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
MX.7005	125 MS/s	125 MS/s	125 MS/s	
MX.7010		125 MS/s	125 MS/s	
MX.7011		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 MX.70xx series of fast digital I/O boards offer a
resolution between 1 bit and 32 bit with a maximum
sampling rate of 125 MS/s (60 MS/s). The channels
of the board can be either programmed for input or
output. The on-board memory of up to 128 MByte can
be completely used for recording or replaying digital
data. Alternatively the MX.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 MX.xxxx
boards. Therefore the MX.70xx board can be used as
an enlargement to analogue boards.

Hardware block diagram
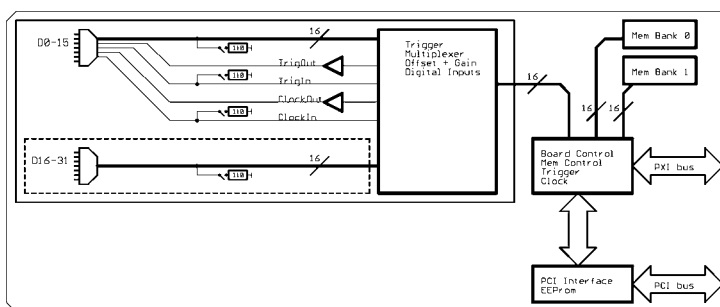
Software programmable parameters

sampling rate	1 kS/s to max sampling rate, external clock, ref clock, PXI clock
Direction	Input/Output for each module
Input impedance	110 Ohm / 50 kOhm for each channel
Clock mode	internal PLL, internal quartz, external, external divided, external reference clock, PXI reference clock
Clock impedance	110 Ohm / 50 kOhm
Trigger impedance	110 Ohm / 50 kOhm
Trigger pulsewidth	1 to 256 samples in steps of 1
Trigger mode	Pattern and mask, edge, external TTL, software, PXI Line[5..0], PXI Startrigger
Pattern and mask	32 bit / 64 bit wide: 0 pattern, 1 pattern, 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 Recording 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

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 posible 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 commend one or more trigger lines can be used as trigger source. This feature allows the easy setup of OR connected triggers from different cards.

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.

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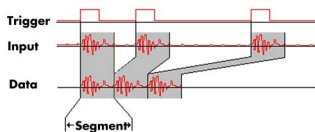
The Multiple Recording mode allows the recording of several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided in several segments of same size. Each of them is filled with data if a trigger event occurs.

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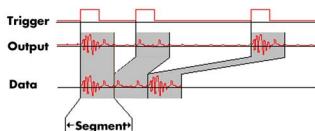
The Multiple Replay mode allows the fast output generation on several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved. The on-board memory is divided into several segments of the same size. Each segment can contain different data which will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

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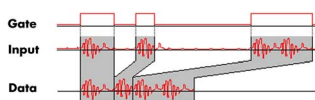
The Gated Sampling mode allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a programmed level.

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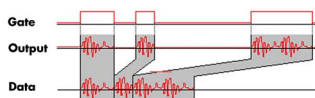
The Gated Sampling mode allows data replay controlled by an external gate signal. Data is only replayed if the gate signal has attained a programmed level.

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
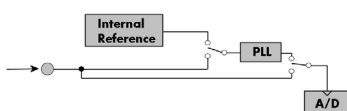
The option to use a precise external reference clock (typically 10 MHz) is necessary to synchronize the instrument for high-quality measurements with external equipment (like a signal source). It's also possible to enhance the stability of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

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.

SBench 6
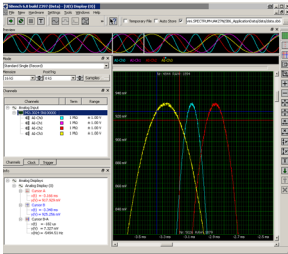
A base license of SBench 6, the easy-to-use graphical operating software for Spectrum cards, is included in the delivery. The base license makes it is possible to test the card, display acquired data and make some basic measurements. It's a valuable tool for checking the card's performance and assisting 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

Internal samplerate	1 kS/s up to 125 MS/s		Dimension	160 mm x 233 mm (Standard 3U)
External samplerate	DC up to 125 MS/s		Width (MX.7005, MX.7010)	1 slot
Input impedance	110 Ohm / 50 kOhm || 15 pF		Width (MX.7011)	2 slots
110 Ohm termination voltage	2.5V		Connector	40 pole half pitch (Hirose FX2 series)
Signal level (data, trigger, clock)	3.3 V/ 5 V TTL compatible		Operating temperature	0°C to 50°C

	0.0 V	3.3 V	5.0 V		
Data input current sink				Storage temperature	-10°C to 70°C
(no termination)	-1.0 µA	+1.0 µA	+20.0 µA	Humidity	10% to 90%
				MTBF	200000 hours

Clock / trigger input current sink   ± 1.0 µA
(no termination)

Multi: Trigger to 1st sample delay   fixed
Multi: Recovery time   < 20 samples (16 - 64 bit)

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

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
MX.7005 (16 bit output @ 125 MS/s in 110 Ohm)	1.18 A (3.9 W)	0.81 A (4.1 W)	0 A	0 A
MX.7010 (16 bit output @ 125 MS/s in 110 Ohm)	1.18 A (3.9 W)	0.81 A (4.1 W)	0 A	0 A
MX.7011 (32 bit output @ 60 MS/s in 110 Ohm)	1.70 A (5.6 W)	0.81 A (4.1 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.

Delay time	External Clocking Mode		
	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
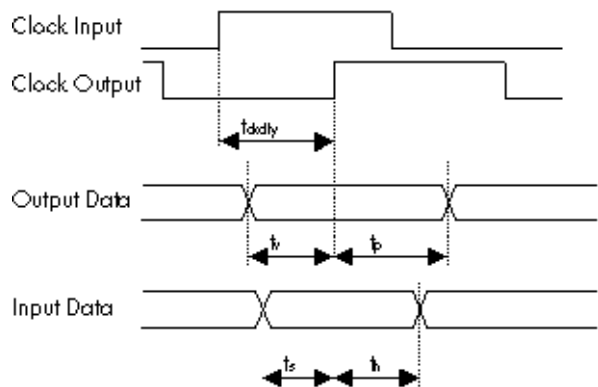
Order Informations

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
MX.7005	125 MS/s	125 MS/s	125 MS/s	125 MS/s	125 MS/s	
MX.7010	-	-	-	125 MS/s	125 MS/s	
MX.7011	-	-	-	125 MS/s	125 MS/s	60 MS/s

Memory

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

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.