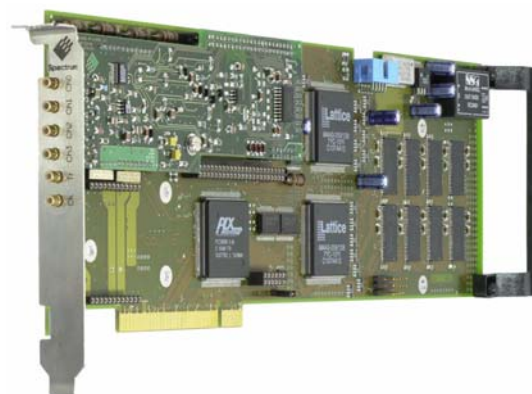


MI.60xx - 14 bit 125 MS/s Arbitrary Waveform Generator

- Standard PCI format
- Fast 14 bit arbitrary waveform generator
- Models with 20 MS/s, 60 MS/s or 125 MS/s
- 1, 2 or 4 channel versions
- Simultaneously sampling on all channels
- Output up to ± 3 V in 50 Ohm
- Offset and amplitude programmable
- 3 software selectable filters
- Up to 256 MSample memory
- FIFO mode
- Bank Switching mode
- Synchronization possible



Product range overview

Model	1 channel	2 channels	4 channels
MI.6011	20 MS/s	20 MS/s	
MI.6012	20 MS/s	20 MS/s	20 MS/s
MI.6021	60 MS/s	60 MS/s	
MI.6022	60 MS/s	60 MS/s	60 MS/s
MI.6030	125 MS/s		
MI.6031	125 MS/s	125 MS/s	
MI.6033	125 MS/s	60 MS/s	
MI.6034	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:

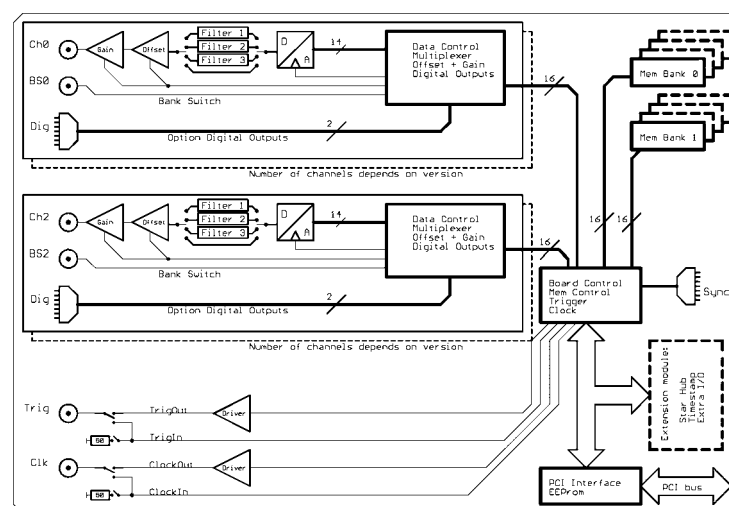
- Windows 98/ME/NT/2000/XP - drivers
- Linux - drivers
- SBench 5.2
- Microsoft Visual C++ examples
- Borland Delphi examples
- Microsoft Visual Basic examples
- Microsoft Excel examples
- LabWindows/CVI examples
- FlexPro support with SBench
- LabVIEW - drivers (as option)
- DASYLab - drivers (as option)
- MATLAB - drivers (as option)
- Agilent VEE - drivers (as option)

General Information

The MI.60xx series offers 8 different versions of arbitrary waveform generators for the PCI bus. With these boards it is possible to generate free definable waveforms on several channels synchronously. There are up to four channels on one board with a maximum samplerate of 125 MS/s. The internal standard Sync-bus allows the setup of synchronous multi channel systems with higher channel numbers. It is also possible to combine the arbitrary waveform generator with other boards of the MI product family like analogue or digital acquisition boards.

With the up to 256 MSample large on-board memory long waveforms could be generated even with high samplerates. The memory could also be used as a FIFO buffer to make continuously data transfer from PC memory or hard disk.

Hardware block diagram



Software programmable parameters

Samplerate	1 kS/s to max samplerate, external clock, ref clock
Output amplitude	± 100 mV up to ± 3 V in 1 mV steps
Output offset	± 3 V selectable in 1 mV steps
Filters	no filter or one of 3 different filters as defined in technical data section
Mode	Singleshot, Continuous, Standard, Bank Switching
Clock impedance	50 Ohm / 1 MOhm
Trigger impedance	50 Ohm / 1 MOhm
Trigger mode	External, Software
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

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.

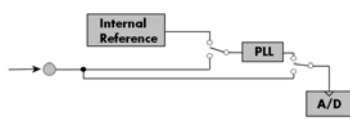
External trigger I/O

All boards could be triggered using an external TTL signal. It's possible to use positive or negative edge also in combination with a programmable pulsewidth. An internally recognised trigger event could - activated by software - routed to the output connector to start external instruments.

External clock I/O

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

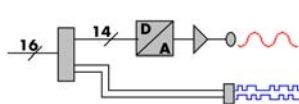
Reference clock



The option to use a precise external reference clock (normally 10 MHz) is necessary to synchronise the board for high-quality mea-

surements with external equipment (like a signal source). It's also possible to enhance the quality of the sampling clock this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

Digital outputs



This option outputs additional synchronous digital channels phase-stable with the analog data. When this option is installed there are 2 additional digital out-

puts for every analog D/A channel.

Bank Switching

In bank switching mode two different signals of the same length are written in the on-board memory. Controlled by an external bank signal that is individually available for every channel one of the signals is selected for output. The user can define whether the signal should switch immediately or whether the complete signal should be generated up to the end.

Cascading

The cascading option synchronises up to 4 Spectrum boards internally. It's the simplest 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.

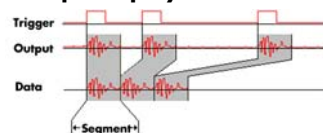
Star hub

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 could be controlled asynchronously. There is also an internal version available with 16 digital I/Os and 4 analog outputs that could be used directly at the rear board connector.

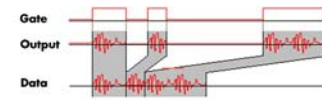
Multiple Replay



The Multiple Replay option allows the fast repetition output on several trigger events without restarting the hardware. With this option very fast repetition rates could be achie-

ved. The on-board memory is divided in several segments of same size. Each of them is generated if a trigger event occurs.

Gated Replay



The Gated Sampling option allows data replay controlled by an external gate signal. Data is only replayed if the gate signal has a program-

med level.

Singleshot output

When singleshot output is activated the data of the on-board memory is replayed exactly one time. As trigger source one can use the external TTL trigger or the software trigger.

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.

Technical Data

Resolution (MI.60xx)	14 bit	Dimension	312 mm x 107 mm
Integral linearity (DAC)	± 1.5 LSB typ.	Width (Standard)	1 full size slot
Differential linearity (DAC)	± 1.0 LSB typ.	Width (with digital outputs)	1 full size slot and 1 half size slot
Output resistance	< 1 Ohm	Width (with star hub option)	2 full size slots
Max output swing in 50 Ohm	± 3 V (offset + amplitude)	Analogue connector	3 mm SMB male
Max slew rate (no filter)	> 0.9 V/ns	Digital connector	40 pol half pitch (Hirose FX2 series)
Multi: Trigger to 1st sample delay	fixed	Warm up time	10 minutes
Multi: Recovery time	< 20 samples	Operating temperature	0°C - 50°C
Ext. clock: delay to internal clock	42 ns ± 2 ns	Storage temperature	-10°C - 70°C
Trigger output delay	1 Sample	Humidity	10% to 90%
Crosstalk @ 1 MHz signal ±3 V	< -80 dB	Offset stepsize	< 2 mV
		Amplitude stepsize	< 1 mV
Min internal clock	1 kS/s	Power consumption 5 V @ full speed	max 3.7 A (18.5 Watt)
Min external clock	DC	Power consumption 5 V @ power down	max 2.3 A (11.5 Watt)

	MI.6011 MI.6012	MI.6021 MI.6022	MI.6030 MI.6033	MI.6031 MI.6034
max internal clock	20 MS/s	60 MS/s	125 MS/s	125 MS/s
max external clock	20 MS/s	60 MS/s	125 MS/s	125 MS/s
-3 dB bandwidth no filter	> 10 MHz	> 30 MHz	> 60 MHz	> 60 MHz

Dynamic Parameters

	MI.6011 MI.6012	MI.6021 MI.6022	MI.6030 MI.6033	MI.6031 MI.6034
Test - Samplerate	20 MS/s	60 MS/s	125 MS/s	125 MS/s
Filter 1				
Characteristics	4th order Butterworth		5th order Butterworth	
-3 dB bandwidth	5 MHz	10 MHz	25 MHz	25 MHz
SNR ±1 V in 50 ohm			-49 dB	
THD ±1 V in 50 ohm			-42 dB	
Filter 2				
Characteristics	4th order Butterworth		4th order Butterworth	
-3 dB bandwidth	1 MHz	2 MHz	5 MHz	5 MHz
SNR ±1 V in 50 ohm			-42 dB	
THD ±1 V in 50 ohm			-67 dB	
Filter 3				
Characteristics	4th order Butterworth		4th order Butterworth	
-3 dB bandwidth	100 kHz	200 kHz	500 kHz	500 kHz
SNR ±1 V in 50 ohm			-72 dB	
THD ±1 V in 50 ohm			-54 dB	

Dynamic parameters are measured at ± 1 V output level and 50 Ohm termination with a spectrum analyser. The samplerate selected is the maximum possible samplerate. Signal frequency is equal to the cut-off frequency of the filter. SNR and RMS noise parameters may differ depending on the quality of the used PC. SNR = Signal to Noise Ratio, THD = Total Harmonic Distortion

Order information

Order No	Description	Order No	Description
MI6011	MI.6011 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-16M	Option: 16 MSample memory instead of 8 MSample standard mem
MI6012	MI.6012 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-32M	Option: 32 MSample memory instead of 8 MSample standard mem
MI6021	MI.6021 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-64M	Option: 64 MSample memory instead of 8 MSample standard mem
MI6022	MI.6022 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-128M	Option: 128 MSample memory instead of 8 MSample standard mem
MI6030	MI.6030 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-256M	Option: 256 MSample memory instead of 8 MSample standard mem
MI6031	MI.6031 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-up	Additional handling costs for later memory upgrade
MI6033	MI.6033 with 8 MSample memory and drivers/SBench 5.x		
MI6034	MI.6034 with 8 MSample memory and drivers/SBench 5.x	MI6xxx-mr	Option Multiple Replay: Memory segmentation
MI6xxx-smod	Star Hub: Synchronisation of 2 - 16 boards, one option per system	MI6xxx-gs	Option Gated Sampling: Gate signal controls replay
MIxxxx-xio	Extra I/O, internal connector: 16 DI/O, 4 Analog out	MI60xx-dig	Additional 2 synchronous digital outputs per channel, incl. cable
MIxxxx-xmf	Extra I/O, external connector: 24 DI/O, 4 Analog out, incl. cable	MI6xxx-cs	Synchronisation of 2 - 4 boards, one option per system
Cab-3f-9m-80	Adapter cable: SMB female to BNV male 80 cm	MI60xx-dl	DASYLab driver for MI.60xx series
Cab-3f-9m-200	Adapter cable: SMB female to BNV male 200 cm	MI60xx-hp	VEE driver for MI.60xx series
Cab-3f-9f-80	Adapter cable: SMB female to BNV female 80 cm	MI60xx-lv	LabVIEW driver for MI.60xx series
Cab-3f-9f-200	Adapter cable: SMB female to BNV female 200 cm	MATLAB	MATLAB driver for all MI.xxxx, MC.xxxx and MX.xxxx series.

technical Changes and printing errors possible