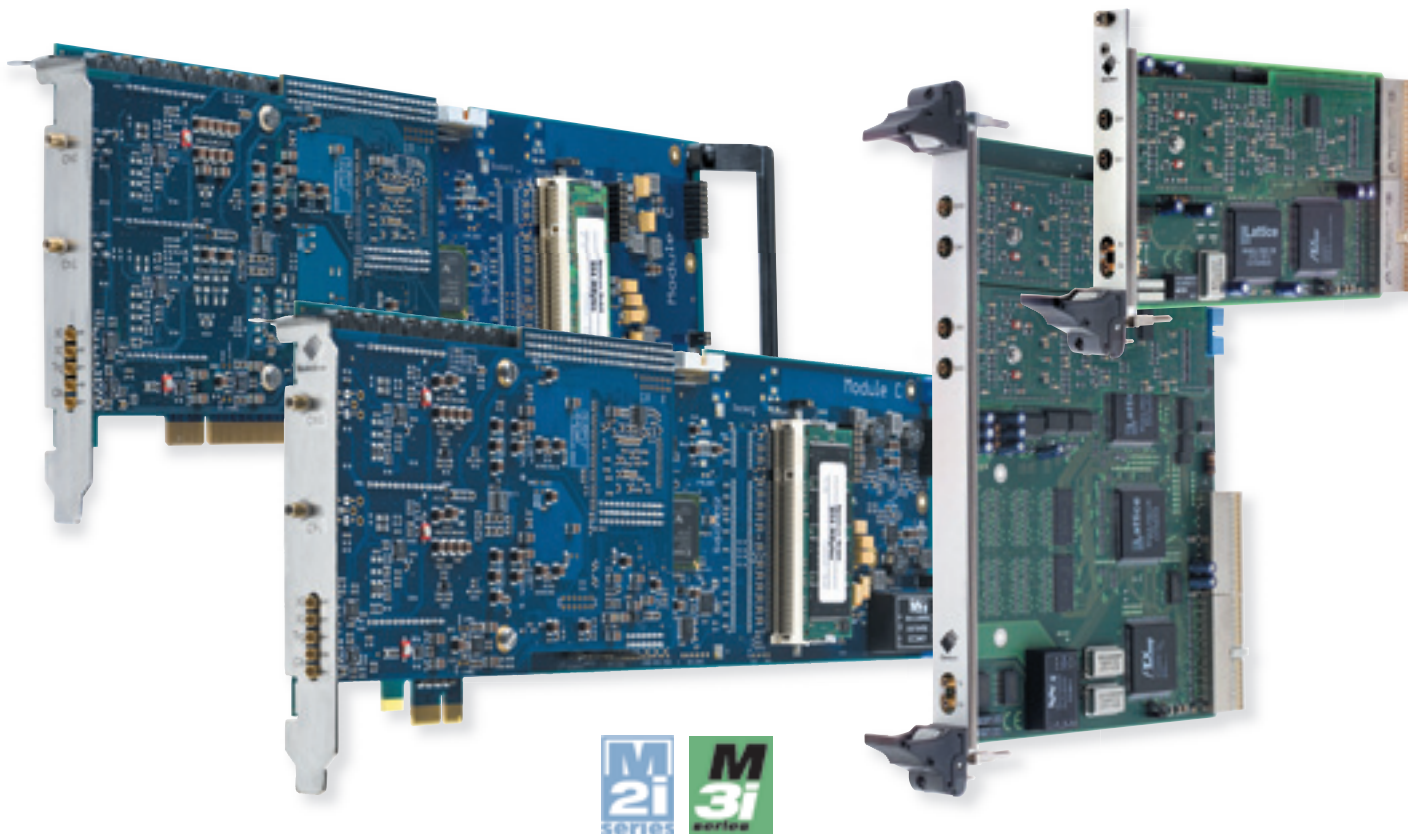


# P C I N S T R U M E N T A T I O N

for PCI, PCI-X, PCI Express, PXI and CompactPCI



Volume 16



**SPECTRUM**  
SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

100 kS/s up to 1 GS/s, up to 256 synchronous channels



## Preface by the Managing Director

Judging when a technical solution works well can only be known when the results can be read in precise data. This idea and its practical application is the subject of our ambition.

Precision needs on one hand accurately fitting technology, whilst on the other precise communication. Therefore the sixteenth volume of our catalog is produced in its new format for the second time – with coloured structuring for the benefit of higher clarity, providing an overview of soft and hardware possibilities combined with comprehensive technical details, as well as easy handling – just like the usability of the products.

What is our aim? Not only to have satisfied and well informed readers, but also provide the basis of research in finding the best optimised solutions for you.

Finding the best solution is not just about technology. First of all it's all about communication! We want to stimulate communication between Spectrum and its business partners. It's our customers demands that stimulates our ambition to find the best solution to your requirements! Take our product-offers as an invitation to ask for more, it is you who help us to keep standards up and improve. So once more: Any requests, suggestions and comments are welcome!

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Gisela Hassler  
Managing Director

## Preface by the Technical Director

In 2010 the Spectrum M3i product line (14 bit 400 MS/s, 12 bit 500 MS/s and 8 bit 1 GS/s) got into full production. All M3i products can now be ordered with SMA connection to enhance the high frequency signal quality even more and to simplify the interconnection between high frequency components. November 2010 the fourth M3i series was released, a high speed high resolution 16 bit digitizer with up to 180 MS/s of sampling speed.

As all Spectrum cards of the last years each version of the M3i.48xx series is available as PCI/PCI-X version as well as PCI Express version for the same price. We advise customers to check carefully their use of PCI cards as the PC market has discontinued PCI slots and already standard systems with PCI slots are becoming rare. Don't bind your future to a manufacturer that can only deliver PCI components!

The measurement software SBench 6 is now supporting all Spectrum products that have been released in the last 10 years. SBench 6 allows to acquire and replay analog and digital data from memory and from hard disks. The software has proven its unique design showing sustained throughput of several hundred MB/s from and to hard disk.

Our software development team is permanently improving SBench 6 and a new version with new features and improvements is released monthly. Licensed users have access to this new version without any upgrade fees. Simply download and install the new release to have access to all features.

A full running demo version is available – please feel free to test the software with your hardware or even with simulated hardware to get to know the new powerful and easy-to-use features.

  
Oliver Rovini  
Technical Director



### Editor

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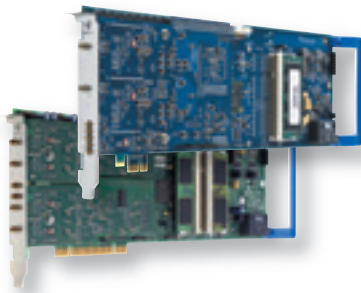
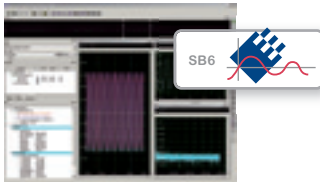
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Adaptations and changes to the products that are necessary for the technical development are possible. We take no liability for faulty values or printing errors.

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[www.spectrum-instrumentation.com](http://www.spectrum-instrumentation.com) – extensive homepage service

Our web page informs you 24 hours the day about hardware, software, options and new products. You have a full-text search engine as well as a parametric search.



## Your Benefits – Good Service!

### We are here for you – indeed!

We have always given the customer our highest priority. Handling inquiries and orders on the same day is a matter of course for us. Since the testing, configuration and commissioning always occurs on our premises with process optimisation and our design engineers are constantly developing new or refined product lines, we achieve high standards of service and quality. With all of the specialised departments concentrated under one roof on the basis of competencies, we can flexibly implement our customers' wishes. Short delivery periods and technical adaptations due to special customer specifications are examples of this.



### Call center? No thank you!

You get free-of-charge support and technical advice directly from our local partners. For any more extensive questions and support issues, our design and production team in Grosshansdorf, Germany is ready to assist you and answer your inquiries.

### "Made in Germany"

All of the products from Spectrum are "Made in Germany" – from design to production! – fulfilling the highest quality standards.

### Lifetime Updates

Software updates are available free of charge for a lifetime. The current version is available for download on our homepage.

### 2 Years of Product Warranty

A shorter warranty period would be possible for business-to-business. But we trust in our product quality, so we offer a two-year warranty that begins with the delivery of our products. In order to meet customer project requirements, we also offer a warranty extension for a period of up to 5 years.

### Product Availability

As long as requested. We still sold ISA boards that were developed in 1991 until 2008, even though we have not included them for years in our catalogue or on our homepage.

## History

- 1989 Company founded with the business objective of developing custom-built instrumentation
- 1991 Began developing own product line and created the first ISA card
- 1993 First 200 MS/s 8 bit ISA DAQ card released
- 1993 Office relocation from Hamburg to Schleswig-Holstein
- 1994 High-speed 8-bit 400 MS/s ISA card developed
- 1995 First Arbitrary Waveform Generator card released
- 1996 Prototype card of the new bus standard PCI is completed
- 1997 First PCI DAQ card was created
- 1998 First 12 bit DAQ card with 80 MS/s
- 1999 First digital I/O card – still sold to OEM customers
- 2000 Fastest 8 bit digitizer with 500 MS/s and 512 MByte of memory



## Introduction

A PC instrumentation board, be it PCI, PCI-X, PCI Express, PXI or CompactPCI, transforms a standard PC to a universal powerful instrument. Compared to a stand-alone solution there are several advantages:

- Best flexibility
- Data is rapidly available for calculation
- A wide range of available software solutions
- Software programmable hardware settings for ease of use and highest performance
- Easy combination of different hardware possible
- Scalable memory size
- Excellent price-performance ratio
- Processing power is not limited by the instrument but can simply be increased by updating the host PC

Setting up a mixed mode system or stimulus-response test benches is no problem combining the wide range of multi channel A/D, D/A and Digital I/O cards with the internal card synchronisation. In contrast to stand-alone instruments which only have one fixed function, the modular instruments from Spectrum can turn into any kind of virtual instrument using the latest PC processing technology.

Spectrum has focused its business on the high-speed A/D, D/A and Digital I/O range with sampling rates between 100 kS/s and 1 GS/s. Fast amplifiers and high-quality converters allow the acquisition and replay of high-frequency signals. As a result of the substantial on-board memory even fast signals may be recorded over a long time period with a high precision. The modular product line first introduced in 2001 has a host of advantages compared to earlier product lines:

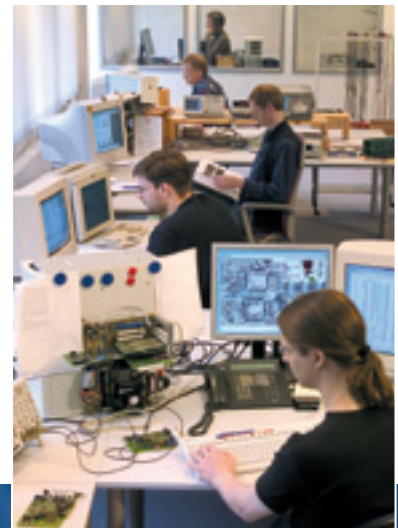
- Wide range of products available for different bus systems
- Universal, easy-to-program driver
- On-board memory standardised at 256 MBytes (16 MBytes for MC and MX)
- Standard on-board memory expandable to 4 GBytes (depending on card family)
- Continuous data transfer up to 245 MBytes/s in PCI-X/PCI-66 slots
- Continuous data transfer up to 125 MBytes/s in PCI slots
- Thousands of installations world-wide stand for best quality and reliable products

The cards are also available in a completely installed system. We offer a wide range of standard systems, 19" industrial systems or mobile PCs. For the mobile use together with a notebook, a range of high-performance docking stations that can hold up to three PCI boards is also available.

## Application Areas

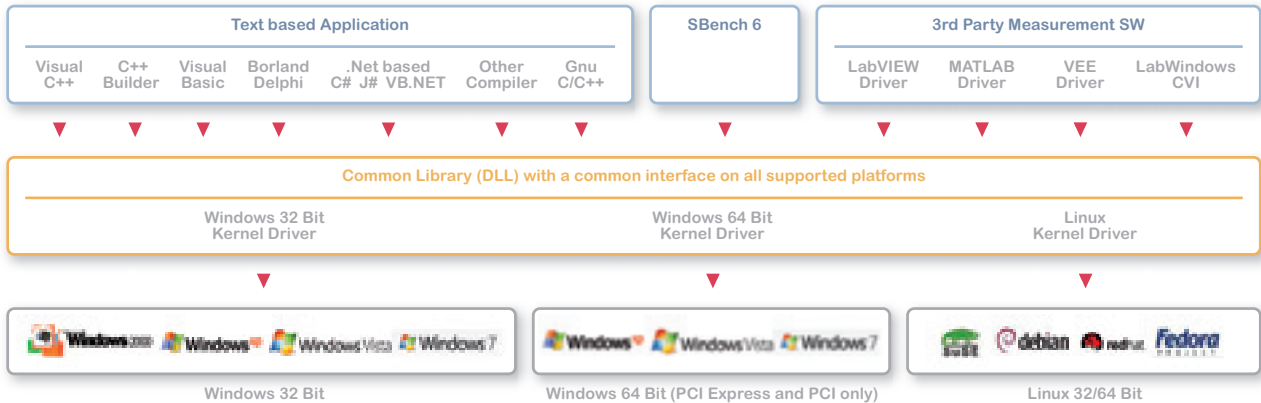
- Sonar
- Radar
- Laser
- Acoustics
- Ultrasound
- LDA/PDA
- Medical equipment
- Automation
- Production tests
- Chip test
- Research and development
- Automotive
- Laboratory equipment
- Spectroscopy
- Quality control
- Long-time data streaming
- Instrument development
- Prototype development
- ATE
- and many more

- 2001 Launch of MI series, the first modular PCI cards
- 2002 12 bit digitizer of the MI.30xx series reach 200 MS/s
- 2003 First 14 bit fast DAQ card with sampling rate of 50 MS/s
- 2004 MC and MX cards allow MI to go industrial
- 2004 Expansion – move to new and bigger office building
- 2005 More than 70 different PCI based cards available
- 2006 Delivery of the first M2i cards – a new generation of modular instruments
- 2007 All M2i cards available as PCI Express version
- 2009 Launch of the first M3i card with 500 MS/s 12 bit A/D
- 2009 SBench 6, the new measurement software, is ready
- 2010 First 1 GS/s digitizer released
- 2010 16 bit high-speed digitizer



The connecting link between the user and the hardware is always the software. The wide range of software products supported by Spectrum allows the user to choose the software that he wants. There are four different ways to use the high-end PC instruments from Spectrum:

- Easy-to-use software SBench 6 (Windows and Linux) either as stand-alone application or in combination with further analysis software like MATLAB, FlexPro or Diadem
- Classical text based programming with C/C++, Visual Basic, Delphi, C#, J# or VB.NET languages
- Advanced text based programming with MATLAB or LabWindows/CVI
- Graphical programming with LabVIEW or Agilent VEE



### ▶ Operating System Drivers



The standard driver is available for different operating systems and is programmed everywhere in the same way. This allows an easy change from one operating system to another without major changes in the source code.

This standard driver is included in the card delivery and it is possible to get the newest driver version free of charge from our homepage at any time. There are no additional SDK fees for the classical text-based programming. All boards are delivered with drivers for Windows 2000, Windows XP, Windows Vista and Windows 7 as well as drivers for a huge variety of Linux systems.

The driver has a unique interface for all boards within one series allowing an easy switch from one card type to another without big changes in the software. The different functionality of the boards is realised with the help of board specific software registers.

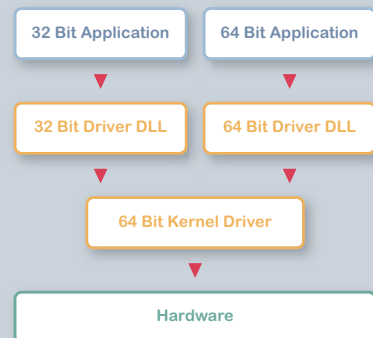
Programming examples for Microsoft Visual C++, Borland C++ Builder, Gnu C++ (CygWin), Borland Delphi, Microsoft Visual Basic, C#, J#, VB.Net, Python and LabWindows/CVI are delivered with the driver. Due to the simple interface of the driver, the integration in other programming languages or special measurement software is an easy task.

The number of examples is continuously increasing giving more detailed programming examples that allow an easy start with the Spectrum cards.

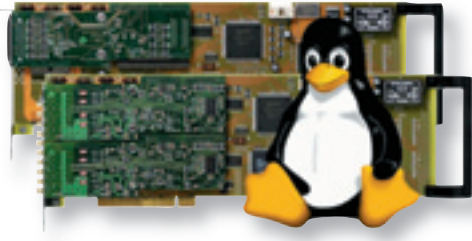
### 64 Bit Systems

Today's data acquisition cards offer up to 4 GByte of on-board memory. Handling such a lot of data on a 32 bit operating system which normally has a maximum of 2 GB of free available memory, limits the usage in all directions. Spectrum therefore offers full 64 bit support for Windows and Linux for M2i and M3i series (PCI and PCI Express) and full Linux 64 bit support for all card series. All drivers and libraries are available as 64 bit versions opening the huge 64 bit address range for data acquisition and streaming applications.

When using Windows 64 bit it is still possible to run 32 bit applications using the so-called WOW64 (Windows on Windows 64 Bit) extension, a Windows operating system component. As shown in the drawing any application whether 32 bit or 64 bit can access the hardware using a dedicated library that accesses the low level 64 bit kernel driver.



## ▶ Linux Support



- Full Linux support included with no extra costs
- More than 50 different pre-compiled kernel driver modules
- Support of latest Suse, Fedora and Debian versions
- Kernel driver sources available against NDA
- Linux control center for card maintenance and updates
- SBench 6 Linux version – powerful data acquisition software

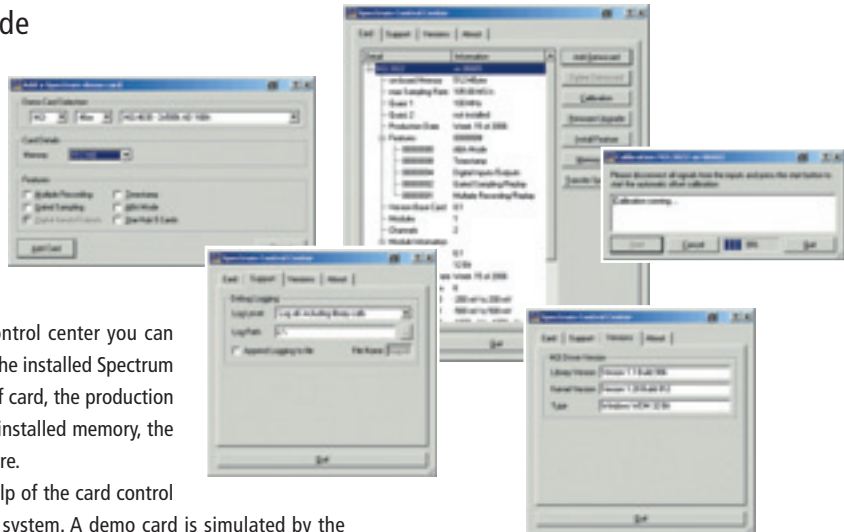
In many areas Linux has itself proven as a high-quality alternative to Windows. Also the instrumentation market uses more and more Linux-based systems. Spectrum delivers loadable Linux modules for the common Linux distributions with all products for years now. But also less common Linux versions are supported. For this the source code of the driver module and the required makefiles are available from Spectrum. The user can then compile a perfectly matching version for his Linux installation.

Linux driver delivery contains driver modules for more than 50 different Linux distribution versions over a number of years, including the latest version of openSUSE, Fedora and Debian, each as 32 bit and 64 bit kernel module.

Besides the Linux drivers Spectrum is giving full Linux support for all current cards. The Linux version of the Spectrum control center allows all card maintenance including firmware updates, calibration and test programs. Using the Linux versions of SBench 6 provides a fully functional data acquisition and streaming application under Linux. Both programs are made from the same source code as the Windows version giving Linux users full features and functions on the same level as Windows users. There's no development or porting delay between versions.

## ▶ Control Center and Demo Mode

A special card control center is available for the Spectrum M2i/M3i driver as a stand-alone application and add-on for the drivers. This powerful tool is delivered with the cards and available under Windows and Linux and groups together all hardware maintenance functions:



- **Hardware information:** Through the control center you can easily get the main information about all the installed Spectrum hardware: Basic information as the type of card, the production date and its serial number as well as the installed memory, the hardware revisions or the installed firmware.
- **Installation of demo cards:** With the help of the card control center one can install demo cards in the system. A demo card is simulated by the Spectrum driver including data generation for acquisition cards. As the demo card is simulated on the lowest driver level all software can be tested including SBench, own applications and drivers for third-party products like LabVIEW.
- **Debug logging:** The setup of the card, driver and firmware version, all command sequences and other information can be logged to an ASCII file and can then be used for support cases.
- **Features and Software license:** SBench 6 software licenses as well as all optional features of the M2i/M3i cards, that do not require any hardware modifications, can be installed on fielded cards. The customer will get a personalised upgrade code for installation.
- **Firmware upgrade:** All M2i and M3i cards can have a later firmware upgrade to install new functions and to fix bugs. Firmware upgrade runs under Windows and Linux.
- **Calibration:** The card control center also provides an easy way to access the automatic card calibration routines of the Spectrum A/D converter cards. Depending on the used card family this can affect offset calibration only or also might include gain calibration.
- **Memory test:** The complete on-board memory of the Spectrum M2i/M3i cards is tested with randomised data for proper functionality. Any read or write errors are documented.
- **Transfer speed test:** Measures the bus transfer speed of an installed Spectrum card in the specific system. This gives you a performance index of the system and shows which sustained data rates can be reached.
- **Continuous memory:** Setup of the desired continuous memory buffer for the next system start.

### Continuous Memory

A special feature of the driver allows to allocate continuous memory at boot time to speed up the data transfer by up to 30%.

All modern operating systems use a very complex memory management strategy that strictly separates between physical memory, kernel memory and user memory, a particular result of this is a memory management based on memory pages. This will lead to the circumstance that although a user program allocated a larger memory block (as an example 1 MByte) and it sees the whole 1 MByte as a virtual continuous memory area, this memory is physically located as 4 kByte pages, spread all over the physical memory.

The DMA engine of any hardware can only access physical addresses. As a result the DMA engine has to access each 4 kByte page separately by using a Scatter-Gather list. For each transferred memory page of data it is necessary to also load one Scatter-Gather entry and do a new bus arbitration.

The Spectrum drivers allow removal of this limitation by allocating a continuous memory buffer at boot time. Getting rid of the need for a Scatter-Gather list speeds up the transfer between 10% and nearly 30% compared to standard DMA transfers.

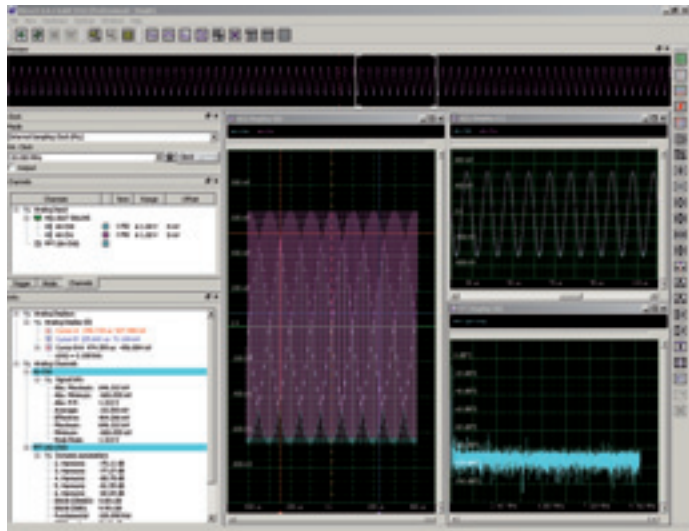
## ► SBench 6



Comfortable and fast data acquisition, replay and analysis of GByte of analog and digital data together with powerful export functions.

SBench 6 is a powerful and intuitive interactive measurement software. Besides the possibility to commence the measuring task immediately, without programming, SBench 6 combines the setup of hardware, data display, oscilloscope, transient recorder, waveform generator, analysing functions, import and export functions under one easy-to-use interface. All current Spectrum cards M3i, M2i, MC and MX analog and digital data acquisition, arbitrary waveform generator and pattern generator cards as well as the former MI series are supported.

- Available for Windows 2000 / XP / Vista / Windows 7
- Available for Linux KDE / GNOME
- Fast data acquisition supporting RAID disk arrays
- Designed to acquire and handle GBytes of data
- Display of analog data, digital data and frequency spectrum
- Integrated analysis functions
- Import and export filter
- Enhanced cursor functions
- Fast data preview function
- State-of-the-art drag-and-drop technology
- Thread based program structure, optimized to run with todays multi processor technology
- Easy usage with docking windows and context menus



The software is available for Windows and Linux. Both versions are based on the same source code to ensure that the Windows and the Linux version are equally provided for. The software development is based on a common API that is available for Windows, KDE and GNOME still providing the look and feel of the specific window manager.

SBench 6 is a completely new concept and has been adapted to the increased needs. Spectrum can easily and fast adopt new card series or new features to the software due to the modular structure of SBench 6.

### Data Storage

The SBench 6 engine controls the complete data transfer whether into the PC RAM or onto hard disk. This software component has been designed for fast and continuous data transfer. Data is stored in an intelligent and fast data format allowing maximum system performance. As the acquired data is directly stored to disk without first sending to GUI nor being resorted, one will get the same average streaming speed that is also possible with plain C++ programming. Data storage speed with > 200 MB/s is easily achieved using todays hard disks with RAID arrays.

The streaming engine supports different binary formats that can directly be used for data storage. This eliminates all time-consuming conversion jobs after the end of the acquisition. Data files can automatically be split into smaller pieces even while writing data.

The strict separation between display layer and the hardware control provides maximum performance for data acquisition and replay. SBench 6 has been optimized for the work with multi GBytes data files. With this technology it is possible to work within SBench 6 with data from up to 4 GBytes on-board memory as well as hard disk recordings of several GBytes.

### Setup Windows

All hardware settings can be reached using sophisticated tabbed setup windows for every aspect of the card hardware. All setup windows can be docked wherever it is required to have full overview of the setup. If more than one card is used (option SBench6-Multi required) each can be set up individually by the user either for a reduced sampling clock on one card or different memory settings on another.

Input signals can be scaled and given an individual unit to show real world measured values by compensating sensor re-scaling. This scaling and unit is used throughout the complete SBench software be it in the display screen or in the calculation results.

The look and feel of SBench 6 can be individually set-up by locating setup widgets wherever necessary and by individual configuration of toolbars and shortcuts. The layout can be stored separately in a user file that can be used for all sessions of SBench 6.



## Acquisition and Replay

SBench 6 is able to act as a recorder as well as a generator front-end. The software is able to replay GBytes of either analog or digital data from various sources. Data can be imported from different file formats as well as using previously acquired data. SBench 6 automatically rescales and converts data to allow the mixed use of acquisition and replay cards of different resolutions and channels counts.

## Calculation Routines and Measuring Results



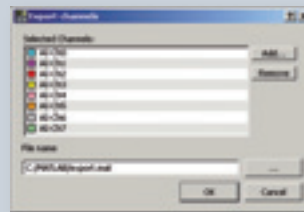
A special info window shows extended information on the current cursor positions within the display windows. Each cursor can be locked on a signal showing the precise values for this signal. By utilising both cursors it is already possible to obtain some simple measurement functions. The current cursor values are also shown in the display window directly at the cursor.

With only one mouse click it is possible to use additional calculation routines on any signal. The signal used as calculation base can be any acquired signal, any loaded signal or even a freshly calculated signal like FFT allowing to run nested calculations. The calculation area can be selected to be the whole signal, just the area that is shown inside the display window, or the segment defined by the two cursor positions. Please see the list of current available calculation routines further below. Suggestions for new calculation routines are always welcome.

## Using SBench 6 to get data into MATLAB

The SBench 6 software allows to acquire data in a very comfortable way without any programming. The SBench 6 software package (Professional version) contains a powerful MATLAB export filter. Using SBench 6 together with MATLAB gives you an easy and powerful access to the data without any further programming needs for the acquisition.

This also gives the opportunity to use MATLAB for Linux to work with the high-precision Spectrum data acquisition cards, as SBench 6 has full Linux support included.

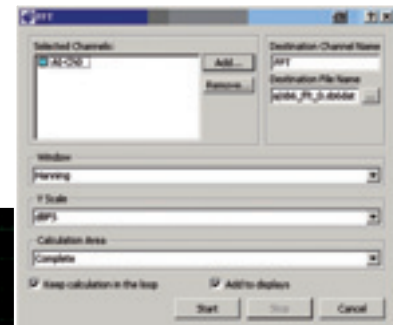
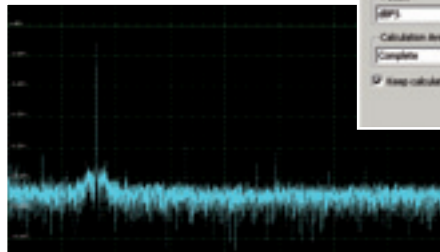


## FFT Analysis and Display (Professional Version)

Using the FFT calculation turns the oscilloscope like software to a Spectrum analyzer. Using the FFT analysis shows the frequency domain information of the signal. The input signal can be weighted by different window functions like Hanning, Hamming, Blackman and some more. The resulting FFT plot is shown as dBc, dBFS, dBuV, dBm or plain Voltage giving the best suitable view on the data.

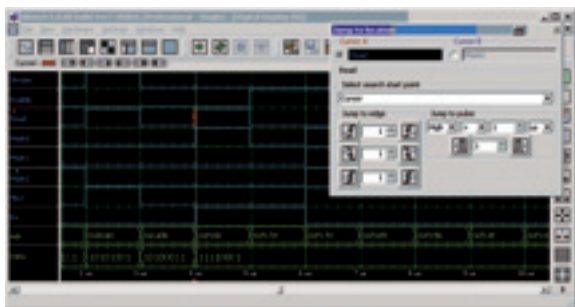
The resulting FFT signal can be used for further calculations like SNR, THD, MAX value or others.

A harmonics cursor is available for FFT display in addition to the standard measurement cursor. This cursor shows a programmable number of harmonics based on the current cursor position.



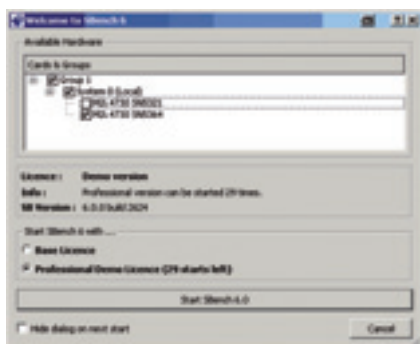
### Digital Data Display (Logic Analyzer)

Besides the acquisition and display of analog data SBench 6 also contains a powerful digital data display allowing to group signals to a bus and to navigate through data by edge detection and pulse measurements. The digital data display is available for pure digital acquisition cards as well as for additional digital inputs of an analog data acquisition card. Analog data can be converted to digital data and vice versa to combine different signals into a mixed mode display. Digital displays and analog displays can be synchronized to have cursor and zoom settings automatically synchronous between different displays.



### Licenses and Features

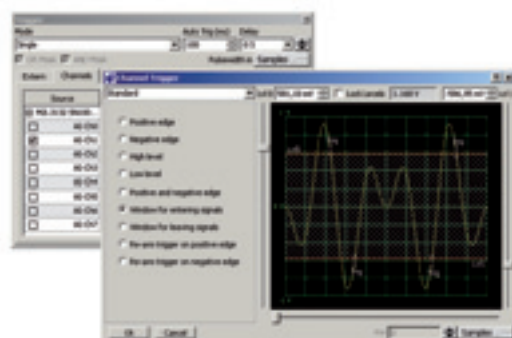
The following table lists all cards and features/options that are currently supported by SBench 6. Supported features are depending on the installed software license. This list is valid at the time when printed. SBench 6 is under permanent development – please check the latest version of the data sheet in the internet to see which new features have been added.



The base license of SBench 6 is available free of charge and is included in every card delivery. This license allows to test the cards with all features and to examine acquired data. It can also be used to check proper card functionality when doing own programming.

The Professional license is available for single and multiple cards and is installed on the hardware itself. Using the Professional license adds a huge variety of features to the software allowing to stream data with high-speed, use a lot of measurement and calculation functions or use one of the universal export formats. To test all Professional features a full working demo license is installed on each delivered hardware.

When using multiple cards only one SBench6-Multi license is needed no matter whether one uses two or 16 cards in one system. Once set up, a system can be extended by new cards without any further costs.



### Supported Cards

<input type="checkbox"/> M3i.21xx + M3i.21xx-Exp series	<input type="checkbox"/> M2i.47xx + M2i.47xx-Exp series	<input type="checkbox"/> MX.45xx + MC.45xx + MI.45xx series
<input type="checkbox"/> M3i.32xx + M3i.32xx-Exp series	<input type="checkbox"/> M2i.60xx + M2i.60xx-Exp series	<input type="checkbox"/> MX.46xx + MC.46xx series
<input type="checkbox"/> M3i.41xx + M3i.41xx-Exp series	<input type="checkbox"/> M2i.61xx + M2i.61xx-Exp series	<input type="checkbox"/> MX.47xx + MC.47xx series
<input type="checkbox"/> M3i.48xx + M3i.48xx-Exp series	<input type="checkbox"/> M2i.70xx + M2i.70xx-Exp series	<input type="checkbox"/> MX.60xx + MC.60xx + MI.60xx series
<input type="checkbox"/> M2i.20xx + M2i.20xx-Exp series	<input type="checkbox"/> M2i.72xx + M2i.72xx-Exp series	<input type="checkbox"/> MX.61xx + MC.61xx + MI.61xx series
<input type="checkbox"/> M2i.30xx + M2i.30xx-Exp series	<input type="checkbox"/> MX.20xx + MC.20xx + MI.20xx series	<input type="checkbox"/> MX.70xx + MC.70xx + MI.70xx series
<input type="checkbox"/> M2i.31xx + M2i.31xx-Exp series	<input type="checkbox"/> MX.30xx + MC.30xx + MI.30xx series	<input type="checkbox"/> MX.72xx + MC.72xx + MI.72xx series
<input type="checkbox"/> M2i.40xx + M2i.40xx-Exp series	<input type="checkbox"/> MX.31xx + MC.31xx + MI.31xx series	
<input type="checkbox"/> M2i.46xx + M2i.46xx-Exp series	<input type="checkbox"/> MX.40xx + MC.40xx + MI.40xx series	

## Supported Features for different Licenses

	Base License	Professional License		Base License	Professional License
<b>Operating Systems</b>			<b>Setup Functions</b>		
Windows XP/Vista/Windows 7	Supported	Supported	Channel Setup	Included	Included
Linux + KDE Environment	Supported	Supported	Clock Setup	Included	Included
Linux + Gnome Environment	Supported	Supported	Trigger Setup	Included	Included
<b>Card + Configuration</b>			<b>Display Functions</b>		
Single Card	Supported	Supported	Mode + Memory Setup	Included	Included
Multiple Cards (one system)	n.a.	Option –Multi required	Streaming Setup	n.a.	Included
Licensing fee	Free	Purchase	Preview Display	Included	Included
Configuration Load/Store	Supported	Supported	Analog Waveform Display	Included	Included
<b>Modes and Features</b>			<b>Display Functions</b>		
Standard Acquisition / Replay	Supported	Supported	Digital Waveform Display	Included	Included
FIFO Acq of several GS / Replay	n.a.	Supported	History Mode	Included	Included
Multiple Recording	Simple display	Segmented Display	FFT Display	n.a.	Included
Gated Sampling	Simple display	Segmented Display	FFT Signal Harmonics Cursor	n.a.	Included
ABA Mode	n.a.	Segmented Display	Cursor Measurement Functions	Included	Included
Timestamp	n.a.	Supported	Physical Units	n.a.	Included
Digital Inputs	Supported	Supported	Layout/Auto Layout Functions	Included	Included
BaseXIO trigger lines	n.a.	Supported	Define Shortcuts	Fixed set	Configurable
			Individual Toolbars	Included	Included

## Calculation Functions

License	License	License
<b>File Functions</b>		
Auto Storage	Prof	
Split Files	Prof	
<b>Acquisition Format</b>		
SBench 6	Base + Prof	
Wave File (*.wav)	Prof	
Pure Binary File	Prof	
<b>Export Functions</b>		
Screenshot	Prof	
SBench 6	Base + Prof	
MATLAB	Prof	
SBench 5	Prof	
ASCII	Prof	
Wave File (*.wav)	Prof	
Pure Binary File	Prof	
Signal cut-off	Prof	
<b>Import Functions</b>		
SBench 6	Base + Prof	
SBench 5	Prof	
ASCII	Prof	
Wave File (*.wav)	Prof	
Pure Binary File	Prof	
<b>Cycle based Calculations</b>		
Number of Cycles	Prof	
Frequency/Period	Prof	
Duty Cycle	Prof	
Pos/Neg Width	Prof	
Cycle Min/Max	Prof	
Cycle Average	Prof	
Cycle Peak-Peak	Prof	
Cycle Effective	Prof	
Cycle Rise/Fall Time	Prof	
<b>Basic Calculations</b>		
Min/Max	Base + Prof	
Average	Base + Prof	
Peak-Peak	Base + Prof	
Effective	Base + Prof	
Signal Info	Base + Prof	
<b>Math Signals</b>		
ADD/SUB/MUL/DIV	Prof	
AND/OR/XOR	Prof	
NAND/NOR/XNOR	Prof	
Copy as Reference	Prof	
Conversion A to D	Prof	
Conversion D to A	Prof	
Signal Averaging	Prof	
Multi Averaging	Prof	
<b>Frequency Calculations</b>		
FFT	Prof	
SNR/THD/SINAD	Prof	
SFDR, ENOB	Prof	
<b>Enhanced Calculations</b>		
RMS Noise	Prof	
Histogram	Prof	

## Order Information

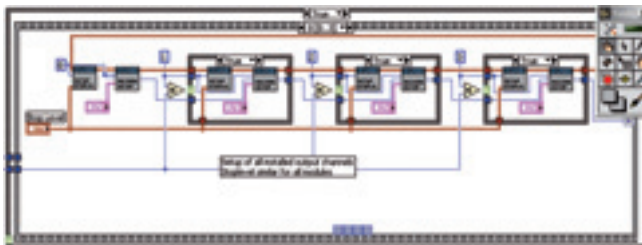
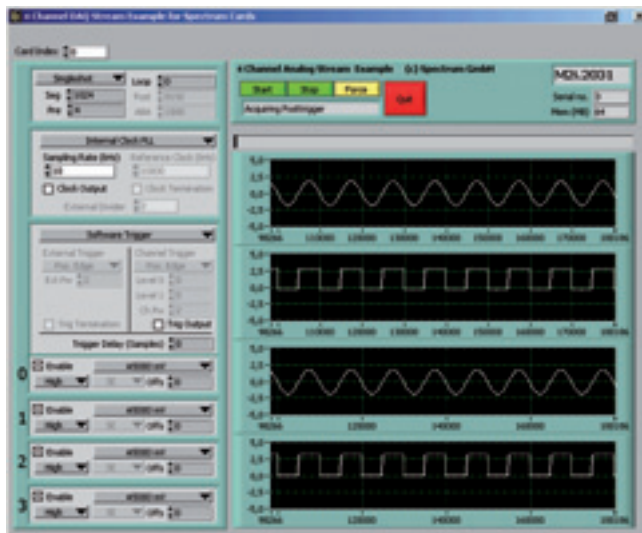
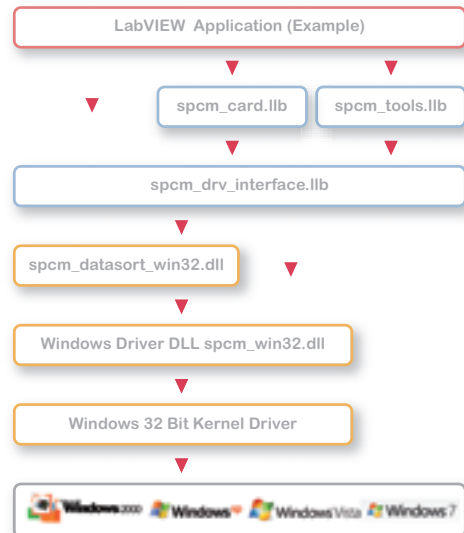
- SBench6 Base version which supports standard mode for one card
- SBench6-Pro Professional version for one card: FIFO mode, export/import, calculation functions
- SBench6-Pro3 3 professional licenses, each for one card
- SBench6-Pro5 5 professional licenses, each for one card
- SBench6-Pro10 10 professional licenses, each for one card
- SBench6-Multi Option multiple cards: Needs professional version. Handles multiple synchronised cards in one system.
- SBench6-Mul3 3 licenses of option multiple cards
- SBench6-Mul5 5 licenses of option multiple cards
- SBench6-Mul10 10 licenses of option multiple cards

## ▶ LabVIEW

LabVIEW – the most common graphical programming language for measurement applications – is excellently supported by the Spectrum cards with the use of dedicated LabVIEW drivers. These drivers are based on the proven standard drivers of Spectrum. They combine different functions into functional blocks and make them available within LabVIEW. The drivers delivered include the basic LabVIEW diagrams allowing the user to change them to match his special needs and to understand how the programming of the hardware works. The LabVIEW driver package consists of several different dynamic libraries (LLBs) and some example VIs showing the use of the driver.

The LabVIEW driver supports all versions starting with version 6 up to the current version. All new product releases are installed on our test systems and all examples are checked against the new version immediately.

Matching the up-to-date features of the M2i and M3i card series has required to renew the LabVIEW driver completely and provides easier operation. The libraries consist of dedicated VIs grouping card functions for easy access. Besides this, a powerful library is included implementing time consuming functions like data sorting or recalculation of digital values to analog voltage levels for fast applications. Using these speed-optimized functions it is possible to reach the same data throughput between card and memory that can also be reached by plain C++ programming.

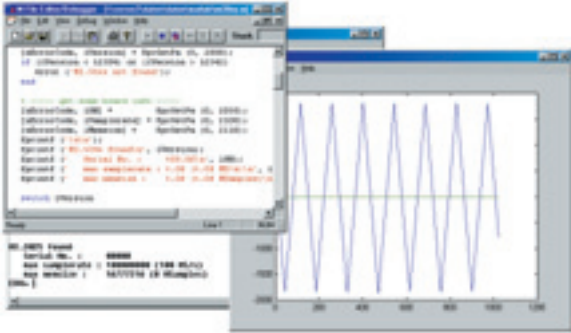


The LabVIEW driver is completed by a number of fully executable LabVIEW examples suitable as a base for programming your own LabVIEW applications. The following examples amongst others are available:

- Oscilloscope
- Data recorder with on-line display
- Hard disk streaming utility
- Block orientated access to several GByte of acquisition memory
- Signal generator
- Multiple Recording/Gated Sampling with Timestamps
- ABA mode with Timestamps
- Complex trigger examples
- Synchronisation of analog cards
- Synchronisation of digital cards

Besides the libraries delivered with the drivers all driver functions can also be directly called. Due to the carefully designed interface based on software registers, access to all card features is possible.

## ▶ MATLAB



The math software packet MATLAB from The Mathworks Inc. is supported with the help of a universal driver for all boards of one series. The driver supports MATLAB starting with version 5.0. The MATLAB driver itself consists of a set of DLLs (Mex-files on newer MATLAB versions) converting the functionality of the Windows driver to MATLAB. These DLLs only act as a link between MATLAB and the driver to allow complete access to the functionality of the board without any restriction. For each kind of board an m-language example is delivered with the MATLAB driver. This example may be used as a base for user programming. The interface also offers an easy way to use the Spectrum cards with Simulink.

For the usage of the cards under MATLAB only the base version of the software package is necessary, no additional software options like the data acquisition toolkit are necessary.

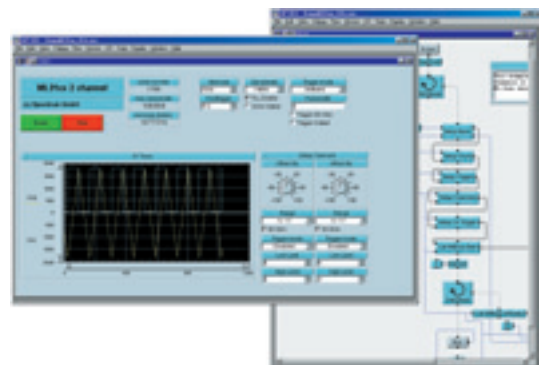
The MATLAB driver for the M2i and M3i card series includes a complete library of functions allowing the access to certain function areas of the card with an easy interface. These library functions are also written in the m-language and are included in the delivery of the MATLAB driver along with universal examples showing different aspects of the cards.

The data handling has been optimised for the M2i/M3i version including a special library. This library can perform fast data sorting as well as recalculation of digital data to real-world voltage levels.

The MATLAB drivers run on Windows 2000, Windows XP, Windows Vista and Windows 7, all 32 bit and 64 bit (except CompactPCI and PXI cards) versions. The Spectrum MATLAB drivers have been verified to run with MATLAB version 5.0 (R8) up to 7.11 (R2010b).

## ▶ VEE

Spectrum drivers support the graphical programming language VEE and VEEPro from Agilent. The VEE driver consists of a few functions offering the functionality of the basic Spectrum driver. The examples that are delivered with the driver can be directly used as a stand-alone oscilloscope application (shown in the picture) or as a streaming application. All VEE drivers are delivered as editable diagrams. That allows the user to adopt the different function blocks and the example diagrams exactly to his needs.



## ▶ LabWindows / CVI



LabWindows/CVI offers an easy-to-use mixture of graphical elements for controlling of hardware and display of measured data and a universal C-compiler. For a fast start with the Spectrum boards there are some universal examples showing how to include the Spectrum driver. There are some example applications integrated like a universal oscilloscope program and a universal signal generator. All programs are available as source code. LabWindows/CVI offers a fast way to develop graphical measurement applications including the performance of a C-compiler.