SPECTRUM
SYSTEMENTWICKLUNG MICROELECTRONIC GMBH

DN2.44x - 8 channel 14/16 bit digitizerNETBOX up to 500 MS/s

- **2, 4 or 8 channels with 130 MS/s up to 500 MS/s**
- **Simultaneously sampling on all channels**
- **Separate ADC and amplifier per channel**
- **complete on-board calibration**
- **6 input ranges: ±200 mV up to ±10 V**
- **4 GSample/2 GSample standard acquisition memory**
- **Window, re-arm, hysteresis, OR/AND trigger**
- **Features: Single-Shot, Streaming, ABA mode, Multiple Recording, Gated Sampling, Timestamps**

New digitizerNETBOX V2
- Bumpers
- Stackable
- Handle
- GND Screw

FPGA Options:
- Block Average up to 128k
- Block Statistics/Peak Detect

- Ethernet Remote Instrument
- LXI Core 2011 compatible
- GBit Ethernet Interface
- Sustained streaming mode up to 70 MB/s
- Direct Connection to PC/Laptop
- Connect anywhere in company LAN
- Embedded Webserver for Maintenance/Updates
- Embedded Server option for open Linux platform

Operating Systems	**SBench 6 Professional Included**	**Drivers**
• Windows XP, Vista, 7, 8, 10 • Linux Kernel 2.6, 3.x, 4.x • Windows/Linux 32 and 64 bit	• Acquisition, Generation and Display of analog and digital data • Calculation, Documentation and Import, Export	• LabVIEW, MATLAB • IVI LabWindows/CVI • C/C++, GNU C++, Borland Delphi, VB.NET, C#, J#, Python

Model	Resolution	1 channel	2 channels	4 channels	8 channels
DN2.445-08	14 Bit	500 MS/s	500 MS/s	500 MS/s	500 MS/s
DN2.445-04	14 Bit	500 MS/s	500 MS/s	500 MS/s	
DN2.445-02	14 Bit	500 MS/s	500 MS/s		
DN2.442-08	16 Bit	250 MS/s	250 MS/s	250 MS/s	250 MS/s
DN2.442-04	16 Bit	250 MS/s	250 MS/s	250 MS/s	
DN2.442-02	16 Bit	250 MS/s	250 MS/s		
DN2.441-08	16 Bit	130 MS/s	130 MS/s	130 MS/s	130 MS/s
DN2.441-04	16 Bit	130 MS/s	130 MS/s	130 MS/s	
DN2.441-02	16 Bit	130 MS/s	130 MS/s		

General Information

The digitizerNETBOX DN2.44x series allows recording of up to 8 channels with sampling rates of 500 MS/s. These Ethernet Remote instruments offer outstanding A/D features both in resolution and signal quality. The combination of high sampling rate and resolution makes these digitizers the topof-the-range for applications that require high quality signal acquisition
The digitizerNETBOX can be installed anywhere in the company LAN and can be remotley controlled from a host PC.

SPECTRUM SYSTEMENTWICKLUNG MICROELECTRONIC GMBH · AHRENSFELDER WEG 13-17 · 22927 GROSSHANSDORF · GERMANY 12.5.16
PHONE: +49 (0)4102-6956-0 · FAX: +49 (0)4102-6956-66 · E-MAIL: info@spec.de · INTERNET: http://www.spectrum-instrumentation.com

Software Support

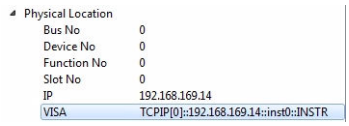
Windows Support

The digitizerNETBOX/generatorNETBOX can be accessed from Windows XP, as well as Vista, Windows 7, Windows 8,Windows 10 (each 32 bit and 64 bit). Programming examples for Visual C++, Borland C++ Builder, LabWindows/CVI, Borland Delphi, Visual Basic, VB.NET, C#, J#, Python and IVI are included.

Linux Support

The digitizerNETBOX/generatorNETBOX can be accessed from any Linux system. The Linux support includes SMP systems, 32 bit and 64 bit systems, versatile programming examples for Gnu C++ as well as drivers for MATLAB for Linux. SBench 6, the powerful data acquisition and analysis software from Spectrum is also included as a Linux version.

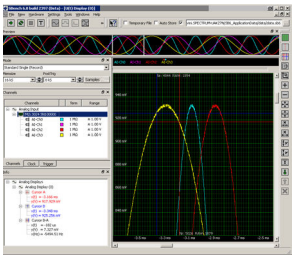
Discovery Protocol



The Discovery function helps you to find and identify any Spectrum LXI instruments, like the digitizerNETBOX and generatorNETBOX, available to your computer on the network. The Discovery function will also locate any Spectrum card products that are managed by an installed Spectrum Remote Server somewhere on the network.

After running the discovery function the card information is cached and can be directly accessed by SBench 6. Furthermore the qualified VISA address is returned and can be used by any software to access the remote instrument.

SBench 6 Professional



The digitizerNETBOX can be used with Spectrum's powerful software SBench 6 – a Professional license for the software is already installed in the box. SBench 6 supports all of the standard features of the instrument. It has a variety of display windows as well as analysis, export and documentation functions.

- Available for Windows XP, Vista, Windows 7, Windows 8 and Linux
- Easy to use interface with drag and drop, docking windows and context menus
- Display of analog and digital data, X-Y display, frequency domain and spread signals
- Designed to handle several GBytes of data
- Fast data preview functions

IVI Driver

The IVI standards define an open driver architecture, a set of instrument classes, and shared software components. Together these provide critical elements needed for instrument interchangeability. IVI's defined Application Programming Interfaces (APIs) standardize common measurement functions reducing the time needed to learn a new IVI instrument.

The Spectrum products to be accessed with the IVI driver can be locally installed data acquisition cards, remotely installed data acquisition cards or remote LXI instruments like digitizerNETBOX/ generatorNETBOX. To maximize the compatibility with existing IVI based software installations, the Spectrum IVI driver supports IVI Scope, IVI Digitizer and IVI FGen class with IVI-C and IVI-COM interfaces.

Third-party Software Products

Most popular third-party software products, such as LabVIEW, MATLAB or LabWindows/CVI are supported. All drivers come with examples and detailed documentation.

Embedded Webserver

The integrated webserver follows the LXI standard and gathers information on the product, set up of the Ethernet configuration and current status. It also allows the setting of a configuration password, access to documentation and updating of the complete instrument firmware, including the embedded remote server and the webserver.

Hardware features and options

LXI Instrument

The digitizerNETBOX/generatorNETBOX is a full LXI instrument compatible to LXI Core 2011 following the LXI Device Specification 2011 rev. 1.4. The digitizerNETBOX/generatorNETBOX has been tested and approved by the LXI Consortium.

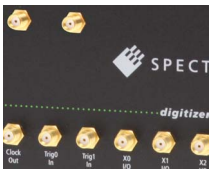
Located on the front panel is the main on/off switch, LEDs showing the LXI and Acquisition status and the LAN reset switch.

digitizerNETBOX/generatorNETBOX chassis version V2

The chassis version V2 got a complete re-design to allow some new features that improve the handling especially for mobile and shared usage:

- 8 bumper edges protect the chassis, the desk and other components on it. The bumper edges allow to store the chassis either vertically or horizontally and the lock-in structure allows to stack multiple chassis with a secure fit onto each other. For 19" rack mount montage the bumpers can be unmounted and replaced by the 19" rack mount option
- The handle allows to easily carry the chassis around in juts one hand.
- A standard GND screw on the back of the chassis allows to connect the metal chassis to measurement ground to reduce noise based on ground loops and ground level differences.

Front Panel



Standard SMA connectors are used for all analog input signals and all trigger and clock signals. No special adapter cables are needed and the connection is secure even when used in a moving environment.

Custom front panels are available on request even for small series, be it BNC, LEMO connectors or custom specific connectors.

Ethernet Connectivity

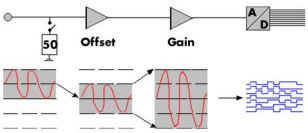
The GBit Ethernet connection can be used with COTS Ethernet cabling as well as special industrial grade Buccaneer Ethernet cables. The integration into a standard LAN allows to connect the digitizerNETBOX/generatorNETBOX either directly to a desktop PC or Laptop or it is possible to place the instrument somewhere in the company LAN and access it from any desktop over the LAN.

DC Power Supply Option

The digitizerNETBOX/generatorNETBOX can be equipped with an internal DC power supply which replaces the standard AC power supply. Two different power supply options are available that range from 9V to 36V. Contact the sales team if other DC levels are required.

Using the DC power supply the digitizerNETBOX/generatorNETBOX can be used for mobile applications together with a Laptop in automotive or airborne applications.

Input Amplifier



The analog inputs can be adapted to real world signals using a wide variety of settings that are individual for each channel. By using software commands the input termination can be changed between 50 Ohm and 1 MOhm, one can select a matching input range and the signal offset can be compensated by programmable AC coupling.

Software selectable input path

For each of the analog channels the user has the choice between two analog input paths. The „Buffered" path offers the highest flexibility when it comes to input ranges and termination. A software programmable 50 Ohm and 1 MOhm termination also allows to connect standard oscilloscope probes to the card. The „50 Ohm" path on the other hand provides the highest bandwith and the best signal integrity with a fewer number of input ranges and a fixed 50 Ohm termination.

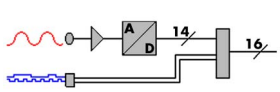
Software selectable lowpass filter

Each analog channel contains a software selectable low-pass filter to limit the input bandwidth. Reducing the analog input bandwidth results in a lower total noise and can be useful especially with low voltage input signals.

Automatic on-board calibration

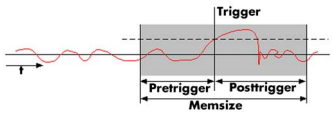
Every channel of each card is calibrated in the factory before the board is shipped. However, to compensate for environmental variations like PC power supply, temperature and aging the software driver includes routines for automatic offset and gain calibration. This calibration is performed on all input ranges of the "Buffered" path and uses a high precision onboard calibration reference.

Digital inputs



This option acquires additional synchronous digital channels phase-stable with the analog data. A maximum of 3 additional digital inputs are available on the front plate of the card using the multi-purpose I/O lines.

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 remote instrument and PC memory or hard disk. The control of the data stream is done automatically by the driver on interrupt request. The complete installed on-board memory is used for buffer data, making the continuous streaming extremely reliable.

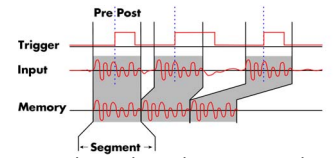
Channel trigger

The data acquisition instruments 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. In addition to this a re-arming mode (for accurate trigger recognition on noisy signals) the AND/OR conjunction of different trigger events is possible. As a unique feature it is possible to use deactivated channels as trigger sources.

External trigger input

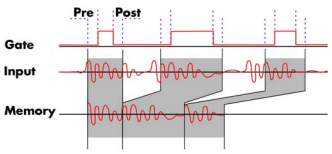
All boards can be triggered using up to two external analog or digital signals. One external trigger input has two analog comparators that can define an edge or window trigger, a hysteresis trigger or a rearm trigger. The other input has one comparator that can be used for standard edge and level triggers.

Multiple Recording



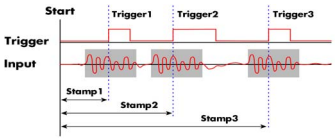
The Multiple Recording mode allows the recording of several trigger events with an extremely short re-arming time. The hardware doesn't need to be restarted in between. The on-board memory is divided in several segments of the same size. Each of them is filled with data if a trigger event occurs. Pre- and posttrigger of the segments can be programmed. The number of acquired segments is only limited by the used memory and is unlimited when using FIFO mode.

Gated Sampling



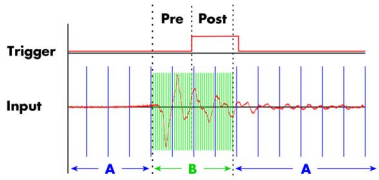
The Gated Sampling mode allows data recording controlled by an external gate signal. Data is only recorded if the gate signal has a programmed level. In addition a pre-area before start of the gate signal as well as a post area after end of the gate signal can be acquired. The number of gate segments is only limited by the used memory and is unlimited when using FIFO mode.

Timestamp



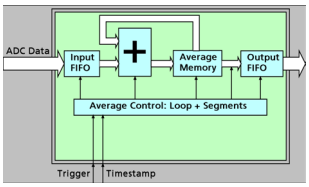
The timestamp function writes the time positions of the trigger events in an extra memory. The timestamps are relative to the start of recording, a defined zero time, externally synchronised to a radio clock, an IRIG-B a GPS receiver. Using the external synchronization gives a precise time relation for acquisitions of systems on different locations.

ABA mode



The ABA mode combines slow continuous data recording with fast acquisition on trigger events. The ABA mode works like a slow data logger combined with a fast digitizer. The exact position of the trigger events is stored as timestamps in an extra memory.

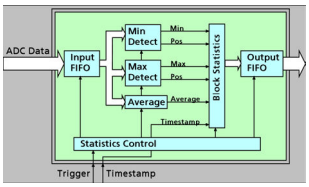
Firmware Option Block Average



The Block Average Module improves the fidelity of noisy repetitive signals. Multiple repetitive acquisitions with very small dead-time are accumulated and averaged. Random noise is reduced by the averaging process improving the visibility of the repetitive signal. The complete averaging process is done inside the FPGA of the digitizer generating no CPU load at all. The amount of data is greatly decreased as well as the needed transfer bandwidth is heavily reduced.

Please see separate data sheet for details on the firmeware option.

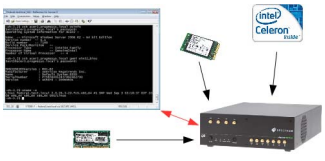
Firmware Option Block Statistics (Peak Detect)



The Block Statistics and Peak Detect Module implements a widely used data analysis and reduction technology in hardware. Each block is scanned for minimum and maximum peak and a summary including minimum, maximum, average, timestamps and position information is stored in memory. The complete averaging process is done inside the FPGA of the digitizer generating no CPU load at all. The amount of data is greatly decreased as well as the needed transfer bandwidth is heavily reduced.

Please see separate data sheet for details on the firmeware option.

Option Embedded Server



The option turns the digitizerNETBOX/generatorNETBOX in a powerful PC that allows to run own programs on a small and remote data acquisition system. The digitizerNETBOX/generatorNETBOX is enhanced by more memory, a powerful CPU, a freely accessable internal SSD and a remote software development access method.

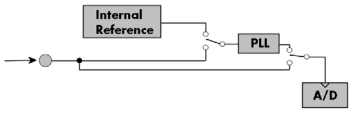
The digitizerNETBOX/generatorNETBOX can either run connected to LAN or it can run totally independent, storing data to the internal SSD. The original digitizerNETBOX/generatorNETBOX remote instrument functionality is still 100% available. Running the embedded server option it is possible to pre-calculate results based on the acquired data, store acquisitions locally and to transfer just the required data or results parts in a client-server based software structure. A different example for the digitizerNETBOX/generatorNETBOX embedded server is surveillance/logger application which can run totally independent for days and send notification emails only over LAN or offloads stored data as soon as it's connected again.

Access to the embedded server is done through a standard text based Linux shell based on the ssh secure shell.

External clock input and output

Using a dedicated connector a sampling clock can be fed in from an external system. Additionally it's also possible to output the internally used sampling clock on a separate connector to synchronize external equipment to this clock.

Reference clock



The option to use a precise external reference clock (normally 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 quality of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

Technical Data

Analog Inputs

Resolution		16 bit (M4i/M4x/DN2.441x, M4i/M4x/DN2.442x), 14 bit (M4i/M4x/DN2.445x)	
Input Type		Single-ended	
Programmable Input Offset		not available	
ADC Differential non linearity (DNL)	ADC only	±0.5 LSB (14 Bit ADC), ±0.4 LSB (16 Bit ADC)	
ADC Integral non linearity (INL)	ADC only	±2.5 LSB (14 Bit ADC), ±10.0 LSB (16 Bit ADC)	
ADC Bit Error Rate (BER)	sampling rate 500 MS/s	10^{-12}	
Channel selection	software programmable	1, 2, or 4 (maximum is model dependent)	
Bandwidth filter	activate by software	20 MHz bandwidth with 3rd order Butterworth filtering	
Input Path Types	software programmable	**50 Ω (HF) Path**	**Buffered (high impedance) Path**
Analog Input impedance	software programmable	50 Ω	1 MΩ || 25 pF or 50 Ω
Input Ranges	software programmable	±500 mV, ±1 V, ±2.5 V, ±5 V	±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V
Input Coupling	software programmable	AC/DC	AC/DC
Offset error (full speed)	after warm-up and calibration	< 0.1%	< 0.1%
Gain error (full speed)	after warm-up and calibration	< 1.0%	< 0.5%
Over voltage protection	range ≤ ±1V	2 Vrms	±5 V
Over voltage protection	range ≥ ±2V	6 Vrms	±30 V
Max DC voltage if AC coupling active		±30 V	±30 V
Relative input stage delay		0 ns	3.8 ns
Crosstalk 1 MHz sine signal	range ±1V	≤96 dB	≤93 dB
Crosstalk 20 MHz sine signal	range ±1V	≤82 dB	≤82 dB
Crosstalk 1 MHz sine signal	range ±5V	≤97 dB	≤85 dB
Crosstalk 20 MHz sine signal	range ±5V	≤82 dB	≤82 dB

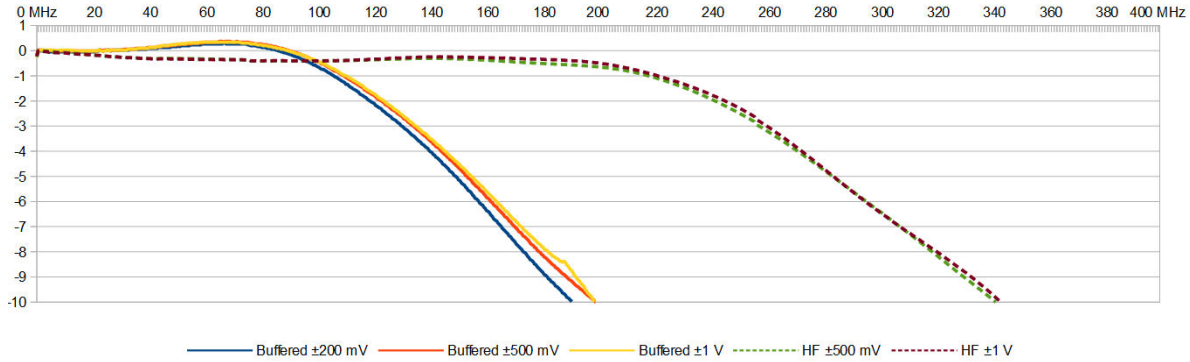
	M4i.441x M4x.441x DN2.441-xx	M4i.442x M4x.442x DN2.442-xx	M4i.445x M4x.445x DN2.445-xx
lower bandwidth limit (DC coupling)	0 Hz	0 Hz	0 Hz
lower bandwidth limit (AC coupled, 50 Ω)	< 30 kHz	< 30 kHz	< 30 kHz
lower bandwidth limit (AC coupled, 1 MΩ)	< 2 Hz	< 2 Hz	< 2 Hz
-3 dB bandwidth (HF path, AC coupled, 50 Ω)	65 MHz	125 MHz	250 MHz
Flatness within ±0.5 dB (HF path, AC coupled, 50 Ω)	40 MHz	80 MHz	160 MHz
-3 dB bandwidth (Buffered path, DC coupled, 1 MΩ)	50 MHz	85 MHz	85 MHz (V1.1) 125 MHz (V1.2)
-3 dB bandwidth (bandwidth filter enabled)	20 MHz	20 MHz	20 MHz

Trigger

Available trigger modes	software programmable	Channel Trigger, External, Software, Window, Re-Arm, Or/And, Delay	
Trigger level resolution	software programmable	14 bit	
Trigger edge	software programmable	Rising edge, falling edge or both edges	
Trigger delay	software programmable	0 to (8GSamples - 16) = 8589934576 Samples in steps of 16 samples	
Multi, Gate: re-arming time		40 samples (+ programmed pretrigger)	
Pretrigger at Multi, ABA, Gate, FIFO	software programmable	16 up to [8192 Samples in steps of 16)	
Posttrigger	software programmable	16 up to 8G samples in steps of 16 (defining pretrigger in standard scope mode)	
Memory depth	software programmable	32 up to [installed memory / number of active channels] samples in steps of 16	
Multiple Recording/ABA segment size	software programmable	32 up to [installed memory / 2 / active channels] samples in steps of 16	
Internal/External trigger accuracy		1 sample	
Minimum external trigger pulsewidth		≥ 2 samples	
External trigger		**Ext0**	**Ext1**
External trigger impedance	software programmable	50 Ω /1 kΩ	1 kΩ
External trigger coupling	software programmable	AC or DC	fixed DC
External trigger type		Window comparator	Single level comparator
External input level		±10 V (1 kΩ), ±2.5 V (50 Ω),	±10 V
External trigger sensitivity (minimum required signal swing)		2.5% of full scale range	2.5% of full scale range = 0.5 V
External trigger level	software programmable	±10 V in steps of 1 mV	±10 V in steps of 1 mV
External trigger maximum voltage		±30V	±30 V
External trigger bandwidth DC	50 Ω /1 kΩ	DC to 200 MHz / 150 MHz	DC to 200 MHz
External trigger bandwidth AC	50 Ω	20 kHz to 200 MHz	n.a.

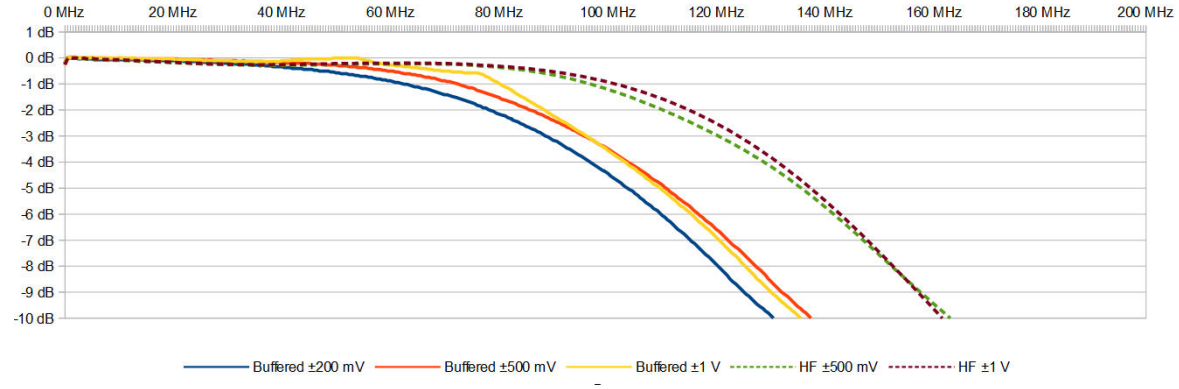
Frequency Response M4i.445x, M4x.445x and DN2.445-xx

Sampling Rate 500 MS/s
HF Path 50 Ω, AC coupling, no filter
Buffered Path 1 MΩ, AC Coupling, no filter



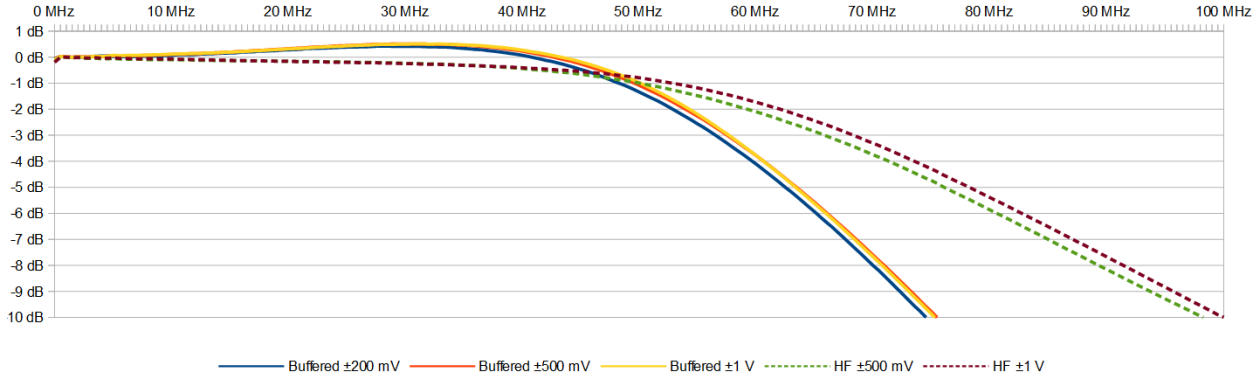
Frequency Response M4i.442x, M4x.442x and DN2.442-xx

Sampling Rate 250 MS/s
HF Path 50 Ω, AC coupling, no filter
Buffered Path 1 MΩ, AC Coupling, no filter



Frequency Response M4i.441x, M4x.441x and DN2.441-xx

Sampling Rate 130 MS/s
HF Path 50 Ω, AC coupling, no filter
Buffered Path 1 MΩ, AC Coupling, no filter



Clock

Clock Modes	software programmable	internal PLL, external reference clock, sync
Internal clock accuracy		≤ ±20 ppm
Internal clock setup granularity	standard clock mode	divider: maximum sampling rate divided by: 1, 2, 4, 8, 16, ... up to 131072 (full gain accuracy)
Internal clock setup granularity	special clock mode only	1 Hz (reduced gain accuracy when using special clock mode)
Clock setup range gaps	special clock mode only	unsetable clock speeds: 70 MHz to 72 MHz, 140 MHz to 144 MHz, 281 MHz to 287 MHz
External reference clock range	software programmable	≥ 10 MHz and ≤ 1 GHz
External reference clock input impedance	software programmable	50 Ω fixed
External reference clock input coupling		AC coupling
External reference clock input edge		Rising edge
External reference clock input type		Single-ended, sine wave or square wave
External reference clock input swing		0.3 V peak-peak up to 3.0 V peak-peak
External reference clock input max DC voltage		±30 V (with max 3.0 V difference between low and high level)
External reference clock input duty cycle requirement		45% to 55%
Internal ADC clock output type		Single-ended, 3.3V LVPECL
Internal ADC clock output frequency	standard clock mode	Fixed to maximum sampling rate (500 MS/s, 250 MS/s or 130 MS/s depending on type)
Internal ADC clock output frequency	special clock mode	ADC clock in the range between 80 MS/s and 500 MS/s
Star-Hub synchronization clock modes	software selectable	Internal clock (standard clock mode only), External reference clock
ABA mode clock divider for slow clock	software programmable	16 up to (128k - 16) in steps of 16

	M4i.441x M4x.441x DN2.441-xx	M4i.442x M4x.442x DN2.442-xx	M4i.445x M4x.445x DN2.445-xx
ADC Resolution	16 bit	16 bit	14 bit
max sampling clock	130 MS/s	250 MS/s	500 MS/s
min sampling clock (standard clock mode)	3.814 kS/s	3.814 kS/s	3.814 kS/s
min sampling clock (special clock mode)	0.610 kS/s	0.610 kS/s	0.610 kS/s

Block Average Signal Processing Option M4i.44xx/M4x.44xx/DN2.44x Series

		Firmware ≥ V1.14 (August 2015)	**Firmware < V1.14**
Minimum Waveform Length		32 samples	32 samples
Minimum Waveform Stepsize		16 samples	16 samples
Maximum Waveform Length	1 channel active	128 kSamples	32 kSamples
Maximum Waveform Length	2 channels active	64 kSamples	16 kSamples
Maximum Waveform Length	4 or more channels active	32 kSamples	8 kSamples
Minimum Number of Averages		2	2
Maximum Number of Averages		65536 (64k)	65536 (64k)
Data Output Format	fixed	32 bit signed integer	32 bit signed integer
Re-Arming Time between waveforms		40 samples (+ programmed pretrigger)	40 samples (+ programmed pretrigger)
Re-Arming Time between end of average to start of next average		Depending on programmed segment length, max 100 µs	40 samples (+ programmed pretrigger)

Block Statistics Signal Processing Option M4i.44xx/M4x.44xx/DN2.44x Series

Minimum Waveform Length		32 samples
Minimum Waveform Stepsize		16 samples
Maximum Waveform Length	Standard Acquisition	2 GSamples / channels
Maximum Waveform Length	FIFO Acquisition	2 GSamples
Data Output Format	fixed	32 bytes statistics summary
Statistics Information Set per Waveform		Average, Minimum, Maximum, Position Minimum, Position Maximum, Trigger Timestamp
Re-Arming Time between Segments		40 samples (+ programmed pretrigger)

Multi Purpose I/O lines (front-plate)

Number of multi purpose lines		three, named X0, X1, X2
Input: available signal types	software programmable	Asynchronous Digital-In, Synchrounous Digital-In, Timestamp Reference Clock
Input: impedance		10 kΩ to 3.3 V
Input: maximum voltage level		-0.5 V to +4.0 V
Input: signal levels		3.3 V LVTTL
Output: available signal types	software programmable	Asynchronous Digital-Out, Trigger Output, Run, Arm, PLL Refclock, Marker Output
Output: impedance		50 Ω
Output: signal levels		3.3 V LVTTL
Output: type		3.3V LVTTL, TTL compatible for high impedance loads
Output: drive strength		Capable of driving 50 Ω loads, maximum drive strength ±48 mA

Connectors

Analog Inputs		SMA male (one for each single-ended input)	Cable-Type: Cab-3fa-xx-xx
Clock Input		SMA male	Cable-Type: Cab-3fa-xx-xx
Clock Output		SMA male	Cable-Type: Cab-3fa-xx-xx
Trg0 Input		SMA male	Cable-Type: Cab-3fa-xx-xx
Trg1 Input		SMA male	Cable-Type: Cab-3fa-xx-xx
X0/Trigger Output/Timestamp Reference Clock	programmable direction	SMA male	Cable-Type: Cab-3fa-xx-xx
X1	programmable direction	SMA male	Cable-Type: Cab-3fa-xx-xx
X2	programmable direction	SMA male	Cable-Type: Cab-3fa-xx-xx

Environmental and Physical Details

Dimension of Chassis without connectors or bumpers	L x W x H	366 mm x 267 mm x 87 mm
Dimension of Chassis with 19" rack mount option	L x W x H	366 mm x 482.6 mm x 87 mm (2U height)
Weight (4 and 8 channels version)		6.3 kgs, with rack mount kit: 6.8 kgs
Weight (16 channels version)		6.7 kgs, with rack mount kit 7.2 kgs
Warm up time		10 minutes
Operating temperature		0°C to 50°C
Storage temperature		-10°C to 70°C
Humidity		10% to 90%

Option digitizerNETBOX/generatorNETBOX embedded server (DN2.xxx-Emb)

CPU	Intel Quad Core 2 GHz
System memory	4 GByte RAM
System data storage	Internal 128 GByte SSD
Development access	Remote Linux command shell (ssh), no grphical GUI available
Accessible Hardware	Full access to Spectrum instruments, LAN, front panel LEDs, RAM, SSD
Integrated operating system	OpenSuse 12.2 with kernel 3.4.6.

Ethernet specific details

LAN Connection	Standard RJ45 or Ethernet Buccaneer(R) for screw connection
LAN Speed	Auto Sensing: GBit Ethernet, 100BASE-T, 10BASE-T
Used LAN Ports	Webserver: 80 mDNS Daemon: 5353 VISA Discovery Protocol: 111, 9757 UPNP Daemon: 1900 Spectrum Remote Server: 1026, 5025

Power connection details

Mains AC power supply	Input voltage: 90 to 264 VAC, 50 to 60 Hz
AC power supply connector	IEC 60320-1-C14 (PC standard coupler)
Power supply cord	power cord included for Schuko contact (CEE 7/7)

Certification, Compliance, Warranty

EMC Immunity	Compliant with CE Mark
EMC Emission	Compliant with CE Mark
Product warranty	2 years starting with the day of delivery
Software and firmware updates	Life-time, free of charge

Power Consumption

	230 VAC		12 VDC		24 VDC	
2 channel versions, standard memory	0.30 A	65 W	TBD	TBD	TBD	TBD
4 channel versions, standard memory	0.33 A	73 W	TBD	TBD	TBD	TBD
8 channel versions, standard memory	0.50 A	110 W	TBD	TBD	TBD	TBD

MTBF

MTBF	100000 hours

RMS Noise Level (Zero Noise), typical figures

M4i.445x, M4x.445x and DN2.445-xx, 14 Bit 500 MS/s

Input Range	±200 mV		±500 mV		±1		±2 V		±2.5 V		±5 V		±10 V	
Voltage resolution (1)	12.2 µV		30.5 µV		61.0 µV		122.0 µV		152.6 µV		305.2 µV		610.4 µV	
HF path, DC, fixed 50 Ω			<1.9	<58 µV	<1.9	<116 µV			<1.9	<290 µV	<1.9	<580 µV		
Buffered path, full bandwidth	<3.8	<47 µV	<2.7	<83 µV	<2.1	<128 µV	<3.8	<464 µV			<2.7	<824 µV	<2.0	<1.2 mV
Buffered path, BW limit active	<2.2	<27 µV	<2.0	<61 µV	<2.0	<122 µV	<3.2	<391 µV			<2.3	<702 µV	<2.0	<1.2 mV

M4i.442x, M4x.442x and DN2.442-xx, 16 Bit 250 MS/s

Input Range	±200 mV		±500 mV		±1		±2 V		±2.5 V		±5 V		±10 V	
Voltage resolution (1)	3.0 µV		7.6 µV		15.3 µV		30.5 µV		38.2 µV		76.3 µV		152.6 µV	
HF path, DC, fixed 50 Ω			<6.9	<53 µV	<6.9	<106 µV			<6.9	<264 µV	<6.9	<527 µV		
Buffered path, full bandwidth	<11	<34 µV	<7.8	<60 µV	<7.1	<109 µV	<12	<367 µV			<8.1	<618 µV	<7.1	<1.1 mV
Buffered path, BW limit active	<7.9	<25 µV	<7.0	<54 µV	<6.9	<106 µV	<9.8	<300 µV			<7.2	<550 µV	<7.1	<1.1 mV

M4i.441x, M4x.441x and DN2.441-xx, 16 Bit 130 MS/s

Input Range	±200 mV		±500 mV		±1		±2 V		±2.5 V		±5 V		±10 V	
Voltage resolution (1)	3.0 µV		7.6 µV		15.3 µV		30.5 µV		38.2 µV		76.3 µV		152.6 µV	
HF path, DC, fixed 50 Ω			<5.9	<45 µV	<5.9	<90 µV			<5.9	<225 µV	<5.9	<450 µV		
Buffered path, full bandwidth	<8.5	<26 µV	<6.5	<50 µV	<5.9	<90 µV	<11	<336 µV			<7.0	<535 µV	<6.1	<931 µV
Buffered path, BW limit active	<7.0	<22 µV	<6.1	<47 µV	<5.9	<90 µV	<9.6	<293 µV			<6.7	<512 µV	<6.1	<931 µV

Dynamic Parameters

M4i.445x, M4x.445x and DN2.445-xx, 14 Bit 500 MS/s

Input Path	HF path, AC coupled, fixed 50 Ohm						Buffered path, BW limit			Buffered path, full BW		
Test signal frequency	10 MHz				40 MHz	70 MHz	10 MHz			10 MHz	40 MHz	70 MHz
Input Range	±500mV	±1V	±2.5V	±5V	±1V	±1V	±200mV	±500mV	±1V	±500mV	±500mV	±500mV
THD (typ) (dB	<-75.9 dB	<-75.8 dB	<-75.2 dB	<-74.8 dB	<-72.5 dB	<-67.4 dB	<-71.4 dB	<-72.1 dB	<-68.6 dB	<-65.0 dB	<-58.6 dB	<-54.4 dB
SNR (typ) (dB)	>67.8 dB	>67.9 dB	>68.0 dB	>68.0 dB	>69.5 dB	>67.5 dB	>67.5 dB	>68.0 dB	>68.1 dB	>67.3 dB	>65.8 dB	>65.6 dB
SFDR (typ), excl. harm. (dB)	>88.1 dB	>88.6 dB	>85.2 dB	>85.3 dB	>88.0 dB	>87.8 dB	>87.3 dB	>88.4 dB	>87.5 dB	>89.0 dB	>88.9 dB	>88.8 dB
SFDR (typ), incl. harm. (dB)	>80.1 dB	>80.0 dB	>77.4 dB	>77.3 dB	>74.0 dB	>69.9 dB	>78.1 dB	>73.5 dB	>69.8 dB	>67.5 dB	>60.8 dB	>56.0 dB
SINAD/THD+N (typ) (dB)	>67.2 dB	>67.2 dB	>67.2 dB	>67.2 dB	>67.7 dB	>64.4 dB	>66.5 dB	>66.6 dB	>65.3 dB	>63.9 dB	>57.9 dB	>54.0 dB
ENOB based on SINAD (bit)	>10.9 bit	>10.9 bit	>10.9 bit	>10.9 bit	>10.9 bit	>10.4 bit	>10.7 bit	>10.8 bit	>10.6 bit	>10.3 bit	>9.3 bit	>8.7 bit
ENOB based on SNR (bit)	>11.0 bit	>11.0 bit	>11.0 bit	>11.0 bit	>11.0 bit	>10.9 bit	>10.9 bit	>11.0 bit	>11.0 bit	>10.9 bit	>10.6 bit	>10.6 bit

M4i.442x, M4x.442x and DN2.442-xx, 16 Bit 250 MS/s

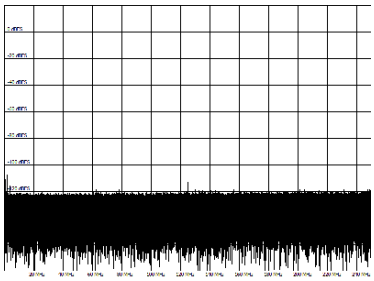
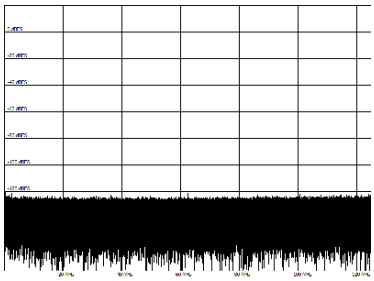
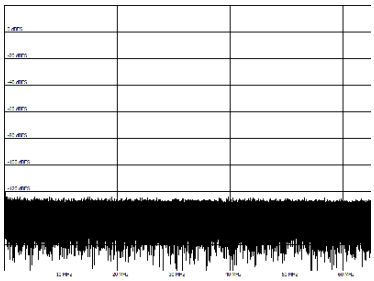
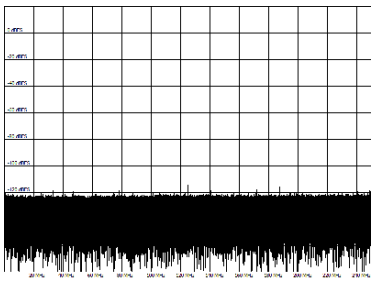
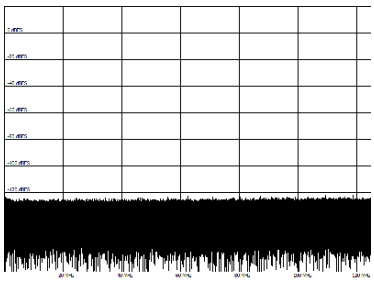
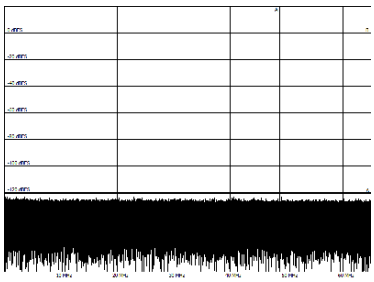
Input Path	HF path, AC coupled, fixed 50 Ohm						Buffered path, BW limit			Buffered path, full BW		
Test signal frequency	1 MHz	10 MHz				40 MHz	10 MHz			1 MHz	10 MHz	40 MHz
Input Range	±1V	±500mV	±1V	±2.5V	±5V	±1V	±200mV	±500mV	±1V	±500mV	±500mV	±500mV
THD (typ) (dB	<-73.1 dB	<-74.0 dB	<-74.1 dB	<-74.1 dB	<-74.1 dB	<-62.9 dB	<-73.2 dB	<-71.5 dB	<-69.0 dB	<-72.2 dB	<-67.5 dB	<49.8 dB
SNR (typ) (dB)	>71.9 dB	>71.5 dB	>71.5 dB	>71.6 dB	>71.6 dB	>71.8 dB	>69.8 dB	>71.0 dB	>71.2 dB	>71.7 dB	>71.0 dB	>69.0 dB
SFDR (typ), excl. harm. (dB)	>92.1 dB	>90.4 dB	>90.8 dB	>90.1 dB	>89.7 dB	>90.2 dB	>92.1 dB	>92.0 dB	>92.1 dB	>90.0 dB	>91.4 dB	>92.5 dB
SFDR (typ), incl. harm. (dB)	>74.4 dB	>75.4 dB	>75.5 dB	>75.5 dB	>75.5 dB	>64.5 dB	>75.0 dB	>73.1 dB	>69.8 dB	>74.7 dB	>67.8 dB	>50.0 dB
SINAD/THD+N (typ) (dB)	>69.8 dB	>69.6 dB	>69.6 dB	>69.6 dB	>69.6 dB	>62.2 dB	>68.5 dB	>68.2 dB	>67.0 dB	>68.8 dB	>66.4 dB	>48.9 dB
ENOB based on SINAD (bit)	>11.3 bit	>11.2 bit	>11.2 bit	>11.3 bit	>11.3 bit	>10.0 bit	>11.1 bit	>11.0 bit	>10.8 bit	>11.1 dB	>10.7 bit	>7.8 bit
ENOB based on SNR (bit)	>11.7 bit	>11.6 bit	>11.6 bit	>11.6 bit	>11.6 bit	>11.6 dB	>11.3 bit	>11.5 bit	>11.5 bit	>11.6 dB	>11.5 bit	>11.2 bit

M4i.441x, M4x.441x and DN2.441-xx, 16 Bit 130 MS/s

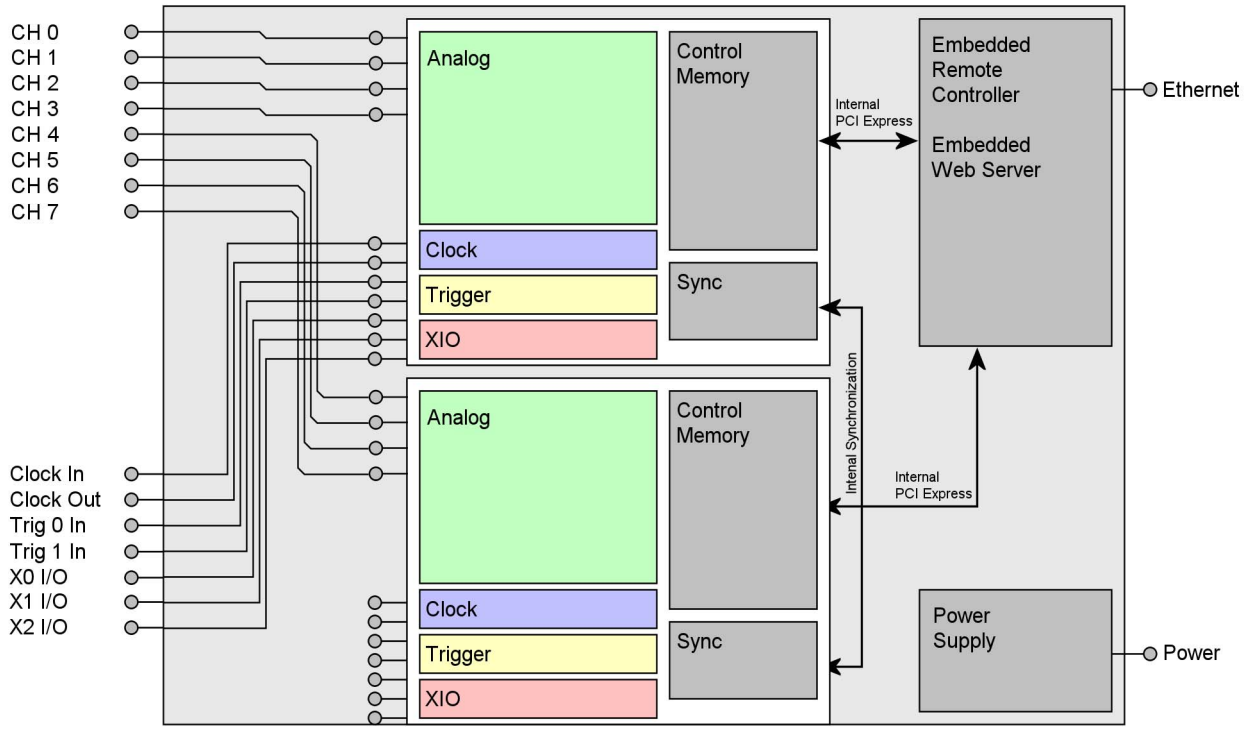
Input Path	HF path, AC coupled, fixed 50 Ohm						Buffered path, BW limit			Buffered path, full BW		
Test signal frequency	1 MHz	10 MHz					10 MHz			1 MHz	10 MHz	
Input Range	±1V	±500mV	±1V	±2.5V	±5V		±200mV	±500mV	±1V	±500mV	±500mV	
THD (typ) (dB	<-72.6 dB	<-77.8 dB	<-77.5 dB	<-77.3 dB	<-77.1 dB		<-74.5 dB	<-73.9 dB	<-70.1 dB	<-73.5 dB	<73.4 dB	
SNR (typ) (dB)	>72.2 dB	>71.8 dB	>71.9 dB	>72.0 dB	>72.0 dB		>69.8 dB	>71.2 dB	>71.3 dB	>71.1 dB	>71.0 dB	
SFDR (typ), excl. harm. (dB)	>92.4 dB	>97.0 dB	>96.0 dB	>95.2 dB	>94.8 dB		>89.0 dB	>94.0 dB	>94.5 dB	>88.8 dB	>93.5 dB	
SFDR (typ), incl. harm. (dB)	>73.7 dB	>78.6 dB	>78.2 dB	>75.2 dB	>75.1 dB		>77.6 dB	>77.8 dB	>71.5 dB	>74.7 dB	>73.1 dB	
SINAD/THD+N (typ) (dB)	>69.4 dB	>70.8 dB	>70.8 dB	>70.9 dB	>70.8 dB		>69.0 dB	>69.7 dB	>68.2 dB	>69.2 dB	>69.2 dB	
ENOB based on SINAD (bit)	>11.2 bit	>11.5 bit	>11.5 bit	>11.5 bit	>11.5 bit		>11.2 bit	>11.3 bit	>11.0 bit	>11.2 bit	>11.2 bit	
ENOB based on SNR (bit)	>11.7 bit	>11.6 bit	>11.6 bit	>11.6 bit	>11.6 bit		>11.3 bit	>11.5 bit	>11.5 bit	>11.6 bit	>11.6 bit	

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.

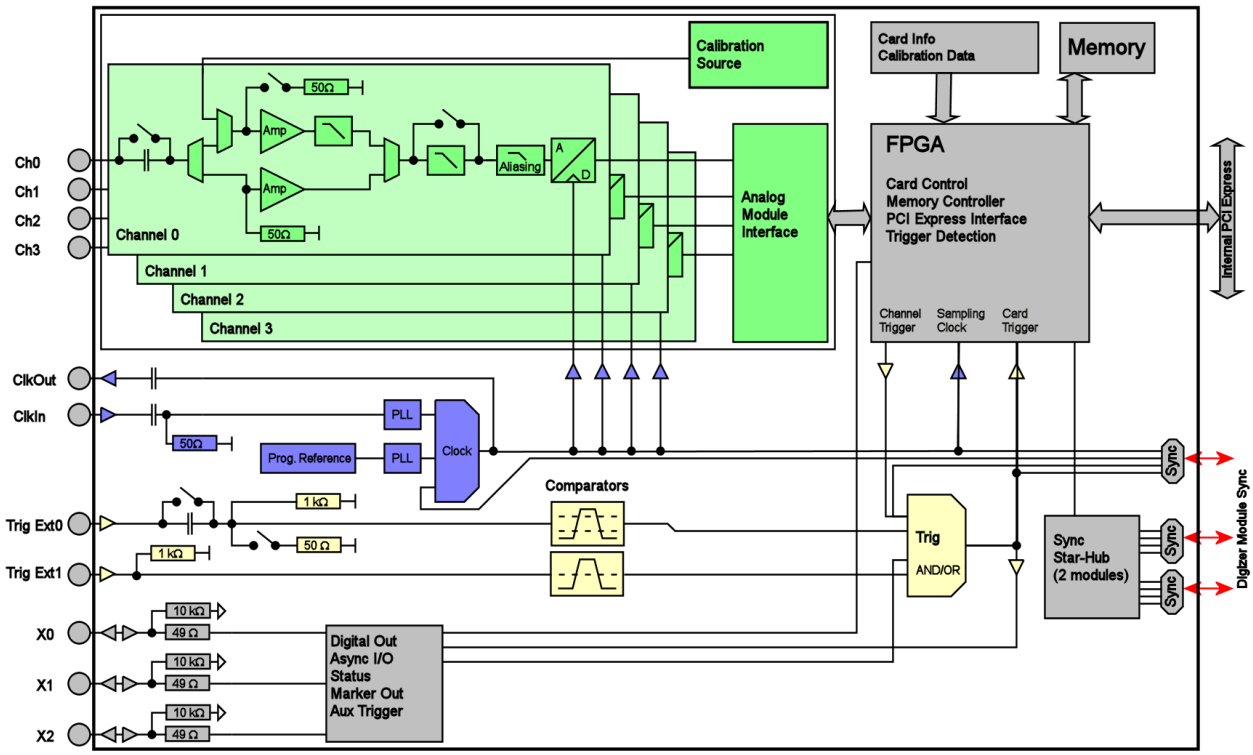
Noise Floor (open inputs)

	M4i.445x, M4x.445x and DN2.445-xx Sampling Rate 500 MS/s	**M4i.442x, M4x.442x and DN2.442-xx** Sampling Rate 250 MS/s	**M4i.441x, M4x.441x and DN2.441-xx** Sampling Rate 130 MS/s
Buffered Path **1 MΩ, AC** **±1 V range**			
HF Path **50 Ω, AC** **±500 mV**			

Block diagram of digitizerNETBOX DN2



Block diagram of digitzerNETBOX module DN2.44x



Order Information

The digitizerNETBOX is equipped with a large internal memory for data storage and supports standard acquisition (Scope), FIFO acquisition (streaming), Multiple Recording, Gated Sampling, ABA mode and Timestamps. Operating system drivers for Windows/Linux 32 bit and 64 bit, drivers and examples for C/C++, IVI (Scope and Digitizer class), LabVIEW (Windows), MATLAB (Windows and Linux), LabWindows/CVI, .NET, Delphi, Visual Basic, Python and a Professional license of the oscilloscope software SBench 6 are included.

The system is delivered with a connection cable for Schuko (CEE7/VII) for the Central Europe power connection system. Other power connections are available as option.

digitizerNETBOX DN2 - Ethernet/LXI Interface

Order no.	A/D Resolution	Bandwidth	Single-Ended Channels	Differential Channels	Sampling Speed	Installed Memory
DN2.441-02	16 Bit	65 MHz	2 channels	-	130 MS/s	1 x 2 GS
DN2.441-04	16 Bit	65 MHz	4 channels	-	130 MS/s	1 x 2 GS
DN2.441-08	16 Bit	65 MHz	8 channels	-	130 MS/s	2 x 2 GS
DN2.442-02	16 Bit	125 MHz	2 channels	-	250 MS/s	1 x 2 GS
DN2.442-04	16 Bit	125 MHz	4 channels	-	250 MS/s	1 x 2 GS
DN2.442-08	16 Bit	125 MHz	8 channels	-	250 MS/s	2 x 2 GS
DN2.445-02	14 Bit	250 MHz	2 channels	-	500 MS/s	1 x 2 GS
DN2.445-04	14 Bit	250 MHz	4 channels	-	500 MS/s	1 x 2 GS
DN2.445-08	14 Bit	250 MHz	8 channels	-	500 MS/s	2 x 2 GS

Options

Order no.	Option
DN2.xxx-Rack	19" rack mounting set for self mounting
DN2.xxx-Emb	Extension to Embedded Server: CPU, more memory, SSD. Access via remote Linuxs secure shell (ssh)
DN2.xxx–spavg	Signal Processing Firmware Option: Block Average (later installation by firmware - upgrade available)
DN2.xxx-spstat	Signal Processing Firmware Option: Block Statistics/Peak Detect (later installation by firmware - upgrade available)
DN2.xxx-DC12	12 VDC internal power supply. Replaces AC power supply. Accepts 9 V to 18 V DC input. Screw terminals.
DN2.xxx-DC24	24 VDC internal power supply. Replaces AC power supply. Accepts 18 V to 36 V DC input. Screw terminals
DN2.xxx-BTPWR	Boot on Power On: the digitizerNETBOX automatically boots if power is switched on.

Calibration

Order no.	Option
DN2.xxx-Recal	Recalibration of complete digitzerNETBOX DN2 including calibration protocol

Standard SMA Cables

The standard adapter cables are based on RG174 cables and have a nominal attenuation of 0.3 dB/m at 100 MHz and 0.5 dB/m at 250 MHz. For high speed signals we recommend the low loss cables series CHF

for Connections	Connection	Length	to BNC male	to SMB female	to MMCX male	to SMA male	
All	SMA male	80 cm	Cab-3mA-9m-80	Cab-3mA-3f-80	Cab-1m-3mA-80	Cab-3f-3mA-80	
All	SMA male	200 cm	Cab-3mA-9m-200	Cab-3mA-3f-200	Cab-1m-3mA-200	Cab-3f-3mA-200	

Low Loss SMA Cables

The low loss adapter cables are based on MF141 cables and have an attenuation of 0.3 dB/m at 500 MHz and 0.5 dB/m at 1.5 GHz. They are recommended for signal frequencies of 200 MHz and above.

Order no.	Option
CHF-3mA-3mA-200	Low loss cables SMA male to SMA male 200 cm
CHF-3mA-9m-200	Low loss cables SMA male to BNC male 200 cm

AC Power Cable Options

Order no.	Option
Cab-Pwr-001	Additional AC power cable for Central Europe with Schuko (CEE 7/VII) connection, 180 cm long, one power cable included in delivery
Cab-Pwr-002	AC power cable for US, Canada, Japan, Taiwan and others with NEMA5-15P connector, 180 cm long
Cab-Pwr-003	AC power cable for United Kingdom and Hong Kong with BS 1363A connector, 180 cm long
Cab-Pwr-004	AC power cable for Switzerland with SEV type 12 connector, 180 cm long
Cab-Pwr-005	AC power cable for Australia, mainland China, New Zealand and others with AS 3112 connector, 180 cm long
Cab-Pwr-006	AC power cable for India and South Africa with 83-B1 connector, 180 cm long
Cab-Pwr-007	AC power cable for Denmark with SR 107-2-D connector, 180 cm long
Cab-Pwr-008	AC power cable for Israel with SI 32 connector, 180 cm long

Technical changes and printing errors possible