DN2.33x - high performance 12 bit Ethernet Digitizer with 10 GS/s

- **Up to 10 GS/s on one or 5 GS/s on two channels**
- **Versions with 10 GS/s, 6.4 GS/s and 3.2 GS/s**
- **Up to 4.7 GHz signal bandwidth**
- **4 input ranges: ±200 mV up to ±2.5 V**
- **2 GiSamples on-board memory**
- **8 GiSamples optional on-board memory**
- **Features: Single-Shot, Streaming, Multiple Recording, Timestamps, optional Average (Standard and Threshold defined)**
- **complete on-board calibration**

Speed	SNR	ENOB
10.0 GS/s	52.3 dB	8.3 ENOB
6.4 GS/s	54.0 dB	8.7 ENOB
3.2 GS/s	54.5 dB	8.8 ENOB

FPGA Options:

- Block Average up to 1MiS with selective averaging for TOFMS
- Digital Pulse Generator with 4 independent pulse channels



- Ethernet Remote Instrument
- LXI Core 2011 compatible
- GBit Ethernet Interface
- Sustained streaming mode up to 100 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 7 (SP1), 8, 10, 11 Server 2008 R2 and newer • Linux 2.6 and newer • Windows/Linux 32 and 64 bit	• Acquisition, Generation and Display of analog and digital data • Calculation, FFT • Documentation and Import, Export	• LabVIEW, MATLAB • Python, C/C++, C#, Java, Julia • IVI

Model	Resolution	1 channel	2 channels	Bandwidth
DN2.336-02	12 Bit	10 GS/s	5.0 GS/s	4.7 GHz
DN2.336-01	12 Bit	10 GS/s		4.7 GHz
DN2.335-02	12 Bit	10 GS/s	5.0 GS/s	3 GHz
DN2.335-01	12 Bit	10 GS/s		3 GHz
DN2.333-02	12 Bit	6.4 GS/s	3.2 GS/s	2 GHz
DN2.333-01	12 Bit	6.4 GS/s	-	2 GHz
DN2.332-02	12 Bit	3.2 GS/s	3.2 GS/s	1 GHz

General Information

The high-performance DN2.33x digitizerNETBOX series gives outstanding performance with the combination of high resolution, high sampling rate and high bandwidth, all in a small and portable chassis. The DN2.33x series is based on the common API from Spectrum and uses the same software interface like all Spectrum products released since 2005.
The digitizerNETBOX can be installed anywhere in the company LAN and can be remotely controlled from a host PC.

Software Support

Windows Support

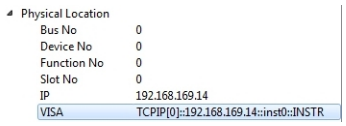
The digitizerNETBOX/generatorNETBOX/hybridNETBOX can be accessed from Windows 7, Windows 8, Windows 10, Windows 11 (either 32 bit or 64 bit). Programming examples for Visual C++, C++ Builder, LabWindows/CVI, Delphi, Visual Basic, VB.NET, C#, Julia, Python, Java and IVI are included.

Linux Support



The digitizerNETBOX/generatorNETBOX/hybridNETBOX 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++, Python, Julia 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.

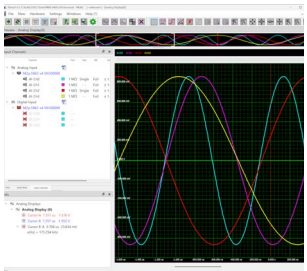
Discovery Protocol



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, generatorNETBOX and hybridNETBOX 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 7 and newer and Linux Kernel 2.6 and newer
- 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.

NETBOX hardware features and options

LXI Instrument



The digitizerNETBOX and generatorNETBOX are fully 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.

Chassis features



The chassis is especially designend for usage in different application arreas and has some advanced features for mobile and shared usage:

- stable metal chassis
- 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 standard COTS Ethernet cabling. 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/hybridNETBOX can be equipped with an internal DC power supply which replaces the standard AC power supply. This power supply options is available with an input range of nominal 24 V. Contact the sales team if other DC levels are required.

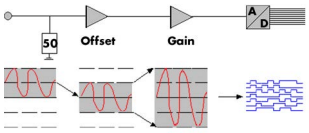
Using the DC power supply the device can be used for mobile applications together with a Laptop in automotive or airborne applications.

Boot on Power Option

The digitizerNETBOX/generatorNETBOX can be factory configured to automatically start and boot upon availability of the input power rail. That way the instrument will automatically become available again upon loss of input power.

Digitizer hardware features and options

Input Amplifier



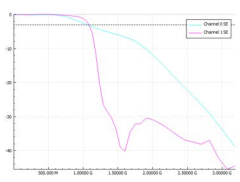
The analog inputs can be adapted to real world signals using a wide variety of settings that are individual for each channel. By using software commands one can select a matching input range and the signal offset can be compensated by programmable AC coupling or offset shifting.

Calibration on-board/factory/ISO/IEC 17025

All of the channels are calibrated in factory before the board is shipped. To compensate for different variations like PC power supply, temperature and aging, the software driver provides routines for an automatic on-board offset and gain calibration of all input ranges. All the cards contain a high precision on-board calibration reference.

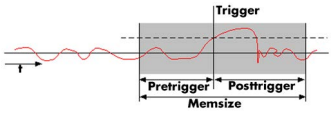
Depending on the QM needs the card can shipped to factory for a complete re-calibration against external traceable calibration sources. As an option a ISO/IEC17025-compliant certificate is available with new cards and after recalibration.

M5i.3321/DNx.332-xx Time Domain Response Optimization



This option is only available for the M5i.3321-x16 and DNx.332-xx (3.2 GS/s 12 Bit Digitizer with 1 GHz bandwidth). This option changes the hardware input filter of the card. The -inptd option optimizes the input stage for time domain measurement with a modified filter characteristic to minimize overshoot and undershoot on step response. The standard filter is optimized for frequency domain measurements with a very steep cut-off frequency. This steep cut-off frequency results in some overshoot/undershoot and ringing when feeding the system with step signals.

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.

8 bit Sample reduction (low-resolution) mode

The digitizer of the 33xx series allow to optionally reduce the resolution of the A/D samples from their native 12 bit resolution down to 8 bit resolution, such that each sample will only occupy one byte in memory instead of the standard two bytes required. This does not only enhance the size of the on-board memory from 2 GiSamples (8 GiSamples optionally) to effectively 4 GiSamples (16 GiSamples optionally), but also reduces the required bandwidth over the PCIe bus and also to the storage devices, such as SSD or HDD. Using the 8 bit mode it is possible to stream data over the PCIe bus with 10 GS/s continuously!

12 bit packed data storage mode

As default the digitizers of the 33xx series store their native 12 bit A/D samples as signed, 16 bit words in twos-complement format, for using the samples “as is” in any numerical calculation in post-processing. Optionally the card can instead store the 12 bit A/D samples in a packed fashion, without filling up the upper four bits with sign extension. Whilst this likely necessitates un-packing the samples again before processing, this reduces the amount of bytes needed for sample storage without reducing the native 12 bit A/D converter resolution. Since two samples now occupy only 3 bytes instead of 4 bytes, this not only enhances the size of the on-board memory from 2 GiSamples (8 GiSamples optionally) to effectively 2.66 GiSamples (10.66 GiSamples optionally), but also reduces the required bandwidth over the PCIe bus and to the storage devices, such as SSD or HDD.

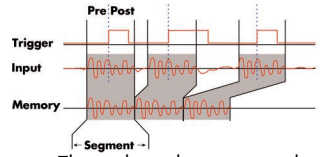
Channel trigger

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

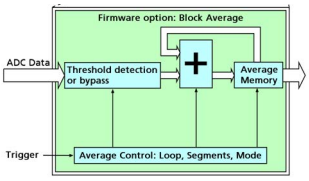
All boards can be triggered using an external analog or digital signal. The external trigger input has one comparator that can be used for standard edge and level triggers.

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.

Firmware Option Block Average

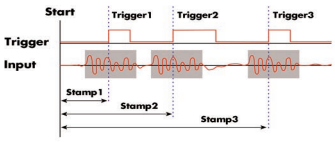


The Block Average Module improves the fidelity of noisy repetitive signals. Multiple repetitive acquisitions with very small dead-time are accumulated and averaged.

Random noise is reduced by the averaging process improving the visibility of the repetitive signal. Additionally, synchronous noise can be reduced with a sample selection based on threshold detection prior to accumulation, for applications such as time of flight mass spectrometry (TOFMS).

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.

Timestamp

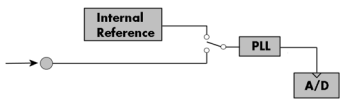


The timestamp function writes the time positions of the trigger events in an extra memory. The timestamps are relative to the start of recording, a defined zero time, externally synchronized to a radio clock, an IRIG-B a GPS receiver. Using the external synchronization gives a precise time relation for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

External clock input and output

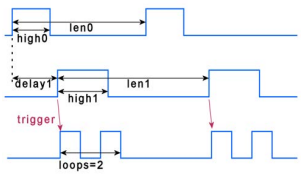
Using a dedicated connector a sampling clock can be fed in from an external system. Additionally it's also possible to output the internally used sampling clock on a separate connector to synchronize external equipment to this clock.

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.

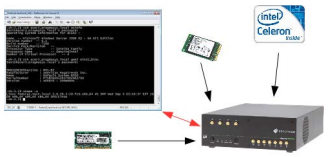
Firmware Option Digital Pulse Generator



The digital pulse generator option adds 4 internal independent digital pulse generators with programmable duty cycle, output frequency, delay and number of loops. These digital pulse generators can be triggered by software, hardware trigger or can trigger each other allowing to form complex pulse schemes to drive external equipment or experiments. The digital pulse generators can be output on the existing multi-XIO lines (X0, X1, ...) or can be used to trigger other pulse generators internally. Time resolution of the pulse generator depends on the cards type and the selected sampling rate and can be found in the technical data section.

The pulse generator option is a firmware option and can be later installed on all shipped cards.

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 Amplifiers



For the acquisition of extremely small voltage levels with a high bandwidth a series of external amplifiers is available. Each of the one channel amplifiers is working with a fixed input impedance and allows - depending on the bandwidth - to select different amplification levels between x10 (20 dB) up to x1000 (60 dB). Using the external amplifiers of the SPA series voltage levels in the uV and mV area can be acquired.

DN2 / DN6 Technical Data

Definitions

Specifications (spec)
Figures are valid for products stored for at least 2 hours inside the specified operating temperature range, after a 30 minute warm-up, after running an on-board calibration and with properly cooled products. Data published in this document are specifications (spec) only where specifically indicated. Figures marked with (spec) are calibrated to the specification during production and during factory calibrations.

Typical (typ)
Figures marked with (typ) are a characteristic performance that most of the manufactured instruments will meet due to design. Typical figures are measured during production but cannot be calibrated.

Measured (meas)
A figure measured during development to communicate expected performance. The figure is measured in lab environment with an environmental temperature between 20°C and 25°C and an altitude of less than 100 m.

Nominal (nom)
The value of this figure is determined by design and is not measured nor calibrated.

Analog Inputs

Resolution (nom)		12 bit (can be switched by software to 8 bit to reduce data throughput)
Input Range (nom)	software programmable	±200 mV, ±500 mV, ±1 V, ±2.5 V
Input Type	fixed	Single-ended
Input Offset (nom)	software programmable	programmable to ±100% of input range in steps of 1%
ADC Differential non linearity (nom)	DNL, ADC only	±0.3 LSB
ADC Integral non linearity (nom)	INL, ADC only	±2.5 LSB
Offset error (full speed), DC signal (spec)	after warm-up and calibration	< 0.5% of range
Gain error (full speed), DC signal (spec)	after warm-up and calibration	< 0.5% of reading
Crosstalk: Signal 10 MHz, 50 Ω (meas)	any range, any channel	< -110 dB
Crosstalk: Signal 100 MHz, 50 Ω (meas)	any range, any channel	< -103 dB
Analog Input impedance (nom)	fixed	50 Ω
Analog input coupling (nom)	fixed	DC
Over voltage protection (nom)	input range ±200 mV	1.4 Vrms (16 dBm),max ±2.0 V peak input voltage
Over voltage protection (nom)	input range >= ±500 mV	5 Vrms (27 dBm),max ±7.5 V peak input voltage
Anti-Aliasing Filter (standard)		fixed at specified bandwidth (see table below)
Channel selection (single-ended inputs)	software programmable	1 or 2 channels (maximum is model dependent)
Calibration	Internal	Self-calibration is done on software command and corrects against the on-board references. Self-calibration should be issued after warm-up time.
Calibration	External	External calibration calibrates the on-board references used in self-calibration. All calibration constants are stored in non-volatile memory. Optional ISO/IEC17025-compliant certificate. A yearly external calibration is recommended.

	Input Range	M5i.336x-x16 DNx.336-xx	M5i.335x-x16 DNx.335-xx	M5i.333x-x16 DNx.333-xx	M5i.3321-x16 DNx.332-xx
lower bandwidth limit	all ranges	0 Hz (DC)	0 Hz (DC)	0 Hz (DC)	0 Hz (DC)
-3 dB bandwidth (typ)	all ranges	≥4.7 GHz	≥3.0 GHz	≥2.0 GHz	≥1.0 GHz
-3 dB bandwidth (average)	all ranges	4.8 GHz	3.1 GHz	2.2 GHz	1.1 GHz
Flatness within ±0.5 dB (meas)	all ranges	2.0 GHz	1.8 GHz	1.1 GHz	0.8 GHz

Trigger

Available trigger modes	software programmable	Channel Trigger, External, Software, Window, Re-Arm, Or/And, Delay	
Channel trigger level resolution		12 bit	
Trigger edge	software programmable	Rising edge, falling edge or both edges	
Trigger delay	software programmable	0 up to (256 GiS - 32) in steps of 32	
Trigger holdoff (for Multi)	software programmable	0 up to (256 GiS - 32) in steps of 32	
Multi re-arming time (meas)	1 channel mode 2 channel mode	352 samples (+ programmed pretrigger) 176 samples (+ programmed pretrigger)	
Pretrigger at Multi, FIFO	software programmable	32 up to (32 KiSamples / channels) in steps of 32	
Posttrigger at Standard Single	software programmable	32 up to (256 GiS - 32) in steps of 32	
Memory depth	software programmable	64 up to (Installed memory / channels) in steps of 32	
Multiple Recording segment size	software programmable	64 up to (Installed memory / channels) in steps of 32	
Internal/External trigger accuracy		1 sample	
Timestamp modes	software programmable	Standard, Startreset, external reference clock (e.g. PPS from GPS, IRIG-B)	
Data format		Std., Startreset:	64 bit counter, increments with sample clock (reset manually or on start)
		RefClock:	24 bit upper counter (increment with RefClock) 40 bit lower counter (increments with sample clock, reset with RefClock)
Extra data	software programmable	none, acquisition of X0/X1/X2/X3 inputs at trigger time, trigger source (for OR trigger)	
Size per stamp		128 bit = 16 bytes	
External trigger		**Ext**	**X0, X1, X2, X3**
External trigger type		single level comparator	3.3V LVTTL logic inputs

Trigger edge	software programmable	Rising edge, falling edge or both edges	
External trigger impedance (typ)	software programmable	50 Ω or 3 kΩ	For electrical specifications refer to „Multi Purpose I/O lines“ section.
External trigger input level (nom)		±5 V	
External trigger over voltage protection (nom)	50 Ω termination 3 kΩ termination	±20 V 7 Vrms	
External trigger sensitivity, min signal swing (nom)		200 mVpp	
External trigger level (nom)	software programmable	±5 V with a stepsize of 10 mV	
External trigger bandwidth (typ)	50 Ω 3 kΩ 10 kΩ	DC to 2 GHz DC to 750 MHz n.a.	DC to 125 MHz n.a. DC to 125 MHz
Minimum external trigger pulse width		≥ 2 samples	≥ 2 samples
Minimum pause between external triggersh		≥ 2 samples	≥ 2 samples
Resulting max. detectable trigger frequency		[Current Samplerate]/4	[Current Samplerate]/4

Multi Purpose I/O lines (front-plate)

Number of multi purpose lines		four, named X0, X1, X2, X3
Input: available signal types	software programmable	Logic Trigger, Asynchronous Digital-In, Synchronous Digital-In (Digitizer only), Timestamp Reference Clock (Digitizer only)
Input: impedance (nom)	software programmable	10 kΩ to 3.3 V or 50 Ω to GND
Input: maximum voltage level (nom)		-0.5 V to +4.0 V
Input: signal levels (nom)		3.3 V LVTTL (Low ≤ 0.8 V, High ≥ 2.0 V)
Input: bandwidth (typ)		125 MHz
Output: available signal types	software programmable	Asynchronous Digital-Out, Trigger Output, Run, Arm, System Clock, Synchronous Digital-Out (AWG only)
Output: impedance (nom)		50 Ω
Output: signal levels (nom)		3.3 V LVTTL
Output: type (nom)		3.3 V LVTTL, TTL compatible for high impedance loads
Output: drive strength (nom)		Capable of driving 50 Ω loads, maximum drive strength ±48 mA
Output: internal update rate	M5i.332x, M5i.333x, DNx.332-xx, DNx.333-xx	Current sampling clock ≤ 3.2 GS/s: 1/4 of sampling clock Current sampling clock > 3.2 GS/s: 1/8 of sampling clock
Output: internal update rate	M5i.335x, M5i.336x, DNx.335-xx	Current sampling clock ≤ 5.0 GS/s: 1/4 of sampling clock Current sampling clock > 5.0 GS/s: 1/8 of sampling clock
Output: internal update rate	M5i.63xx, DNx.63xx DNx.63x-xx	Current sampling clock ≤ 5.0 GS/s: 1/4 of sampling clock Current sampling clock > 5.0 GS/s: 1/8 of sampling clock
Output: min high/low time (nom)		4 ns
Output: max signal frequency (typ)		125 MHz

Option M5i.xxxx-PulseGen

Number of internal pulse generators	4
Number of pulse generator output lines	4 (Existing multi-purpose outputs X0 to X3)
Time resolution of pulse generator	Pulse generator’s sampling rate is derived from instrument’s sampling rate and value can be read out. Pulse generator update rate are: 33xx: Base Sampling Rate x Channels / 32 (max 10 GS/s x 1 ch / 32) = 312.5 MS/s (3.2 ns) 63xx: Sampling Rate x Channels / 32 (max 10 GS/s x 1 ch / 32) = 312.5 MS/s (3.2 ns)
Programmable output modes	Single-shot, multiple repetitions on trigger, gated
Programmable trigger sources	Software, Card Trigger, Other Pulse Generator, XIO lines.
Programmable trigger gate	None, ARM state, RUN state
Programmable length (frequency)	2 to 4Gi samples in steps of 1 (32 bit)
Programmable width (duty cycle)	1 to 4Gi samples in steps of 1 (32 bit)
Programmable delay	0 to 4Gi samples in steps of 1 (32 bit)
Programmable loops	0 to 4Gi samples in steps of 1 (32 bit) with 0 = infinite loops
Output level of digital pulse generators	Please see section of multi-purpose I/O lines.

Clock

Clock Modes	software programmable	internal PLL, external reference clock, star-hub synchronization clock
Internal clock accuracy (spec)		≤ ±1 ppm
Clock setup range		base frequency or divided base frequency
Clock setup base frequencies	M5i.3321, DNx.332-xx	3.2 GS/s, 2.5 GS/s, 2.0 GS/s
	M5i.333x, DNx.333-xx	6.4 GS/s, 5.0 GS/s, 4.0 GS/s
	M5i.335x, DNx.334-xx	10.0 GS/s, 8.0 GS/s, 6.4 GS/s
	M5i.336x, DNx.336-xx	10.0 GS/s, 8.0 GS/s, 6.4 GS/s
Clock setup divider	M5i.3321, DNx.332-xx	power of 2: 2, 4, 8, 16, 32, ... , 524288, 1048576
	All other models	power of 2: 2, 4, 8, 16, 32, ... , 524288, 1048576, 2097152
Clock setup examples		Combination of any base frequency with any divider up to [max sample rate]/[max divider]:
	M5i.3321, DNx.332-xx	3.2, 2.5, 2.0, 1.6, 1.25, 1.0, 0.8 GS/s, ... 3.2 kS/s
	M5i.333x, DNx.333-xx	6.4, 5.0, 4.0, 3.2, 2.5, 2.0, 1.6. 1.25, 1.0, 0.8 GS/s, ..., 3.2 kS/s
	M5i.335x, DNx.334-xx	10.0, 8.0, 6.4, 5.0, 4.0, 3.2, 2.5, 2.0, 1.6, 1.25, 1.0 GS/s, ..., 5 kS/s
	M5i.336x, DNx.336-xx	10.0, 8.0, 6.4, 5.0, 4.0, 3.2, 2.5, 2.0, 1.6, 1.25, 1.0 GS/s, ..., 5 kS/s
External reference clock range (nom)	software programmable	≥ 2 MHz and ≤ 750 MHz in steps of 2 MHz
External reference clock input impedance (nom)		50 Ω fixed
External reference clock input coupling (nom)		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 (nom)	min	200 mVpp
	max	3 Vpp
External reference clock input max DC voltage (nom)		±10 V (with max 3.0 V difference between low and high level)
External reference clock input duty cycle (nom)		45% to 55%
Clock setup granularity when using reference clock		divider: maximum sampling rate divided by: TBD
Internal reference clock output type		Single-ended, AC-coupled, LVPECL, 720 mVpp (typ)
Internal reference clock output frequency	M5i.3321, DNx.332-xx	clock setup base frequency / 64 (example: clock 3.2 GS/s -> output 50.000 MHz)
	All other models	clock setup base frequency / 128 (example: clock 4.0 GS/s -> output 31.25 MHz)
Star-Hub synchronization clock modes	software programmable	Internal clock, External reference clock
Channel to channel skew on one card (meas)		<12 ps
Skew between star-hub synchronized cards (meas)	software programmable	skew adjustable up to 200 ps (10 GS/s models) or 312 ps (6.4 GS/s and 3.2 GS/s models)

Block Average Signal Processing Option M5i.33xx/DNx.33x

Averaging/Accumulation Modes	Software programmable	Standard or threshold defined averaging (TDA) for positive or negative pulses
Minimum Waveform Length		64 samples
Minimum Waveform Stepsize		32 samples
Maximum Waveform Length	1 channel active	1 MiSamples
Maximum Waveform Length	2 channels active	512 KiSamples
Minimum Number of Averages		2
Maximum Number of Averages		1024
Data Output Format	fixed	32 bit signed integer
Re-Arming Time between waveforms (meas)	1 channel mode	352 samples (+ programmed pretrigger)
	2 channel mode	176 samples (+ programmed pretrigger)
Re-Arming Time between end of average to start of next average (nom)		Two times the programmed segment length's (L) acquisition time: t = 2 * SegmentLen * ActiveChannels / Samplerate

Connectors

Analog Inputs (one for each single-ended input)	33x		SMA female	Cable-Type: Cab-3mA-xx-xx
Analog Outputs (two for each differential output)		63x	SMA female	Cable-Type: Cab-3mA-xx-xx
Clock Input	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
Clock Output	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
Trg0 Input	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
X0	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
X1	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
X2	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx
X3	33x	63x	SMA female	Cable-Type: Cab-3mA-xx-xx

Connection Cycles

All connectors have an expected lifetime as specified below. Please avoid to exceed the specified connection cycles or use connector savers

SMA connector	500 connection cycles
Power connecctor	500 connection cycles
LAN connector	500 connection cycles

Option digitizerNETBOX/generatorNETBOX embedded server (DN2.xxx-Emb, DN6.xxx-Emb)

CPU	Intel Quad Core 2 GHz	
System memory	4 GiByte RAM	
System data storage	Internal 128 GByte SSD	
Development access	Remote Linux command shell (ssh), no graphical interface (GUI) available	
Accessible Hardware	Full access to Spectrum instruments, LAN, front panel LEDs, RAM, SSD	
Integrated operating system	OpenSuse 12.2 with kernel 4.4.7.	
Internal PCIe connection (PCIe bus connection is shared amongst all internal digitizer/generator modules)	DN2.20, DN2.46, DN2.47, DN2.49, DN2.60, DN6.46, DN6.49:	PCIe x1, Gen1
	DN2.59, DN2.65, DN2.80, DN2.81, DN6.59, DN6.65:	PCIe x1, Gen1
	DN2.22, DN2.33, DN2.44, DN2.63, DN2.66, DN2.96, DN2.82:	PCIe x1, Gen2
	DN6.22, DN6.33, DN6.44, DN6.63, DN6.66, DN6.96:	PCIe x1, Gen2

Ethernet specific details

LAN Connection		Standard RJ45	
LAN Speed		Auto Sensing: GBit Ethernet, 100BASE-T, 10BASE-T	
LAN IP address	programmable	DHCP (IPv4) with AutoIP fall-back (169.254.x.y), fixed IP (IPv4)	
Sustained Streaming speed (typ)		DN2.20, DN2.46, DN2.47, DN2.49, DN2.60	up to 70 MByte/s
		DN6.46, DN6.49	
		DN2.59, DN2.65, DN2.22, DN2.33, DN2.44, DN2.63, DN2.66, DN6.59, DN6.65, DN6.22, DN6.33, DN6.44, DN6.63, DN6.66	up to 100 MByte/s
Used TCP/UDP Ports		Webserver: 80 VISA Discovery Protocol: 111, 9757 Spectrum Remote Server: 1026, 5025	mDNS Daemon: 5353 UPNP Daemon: 1900

AC Power connection details (default configuration)

Mains AC power supply	Input voltage: 100 to 240 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)

DC 24 V Power supply details (DN2 only, option DN2.xxxx-DC24)

Input Voltage	18 V to 36 V
Power supply connector	screw terminal
Power supply cord	no cord included

Serial connection details

Serial connection (RS232)	DN2 with hardware ≥ V11 DN6 with hardware ≥ V10	For diagnostic purposes only. Do not use, unless being instructed by a Spectrum support agent.

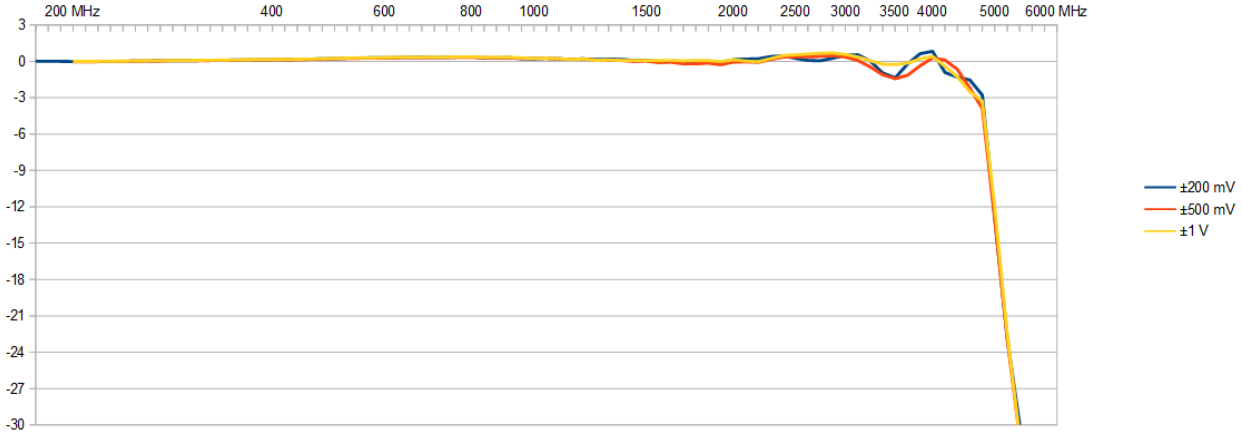
Certification, Compliance, Warranty

Conformity Declaration	EN 17050-1:2010	General Requirements
EU Directives	2014/30/EU	EMC - Electromagnetic Compatibility
	2014/35/EU	LVD - Electrical equipment designed for use within certain voltage limits
	2011/65/EU	RoHS - Restriction of the use of certain hazardous substances in electrical and electronic equipment
	2006/1907/EC	REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals
	2012/19/EU	WEEE - Waste from Electrical and Electronic Equipment
	2006/66/EC	On batteries and accumulators and waste batteries and accumulators
Compliance Standards	EN 61010-1: 2010	Safety regulations for electrical measuring, control, regulating and laboratory devices - Part 1: General requirement
	EN 61187:1994	Electrical and electronic measuring equipment - Documentation
	EN 61326-1:2021	Electrical equipment for measurement, control and laboratory use
	EN 61326-2-1:2021	EMC requirements - Part 1: General requirements EMC requirements - Part 2-1: Particular requirements - Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications
	EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
Product warranty	5 years starting with the day of delivery	
Software and firmware updates	Life-time, free of charge	

Frequency Response Plots

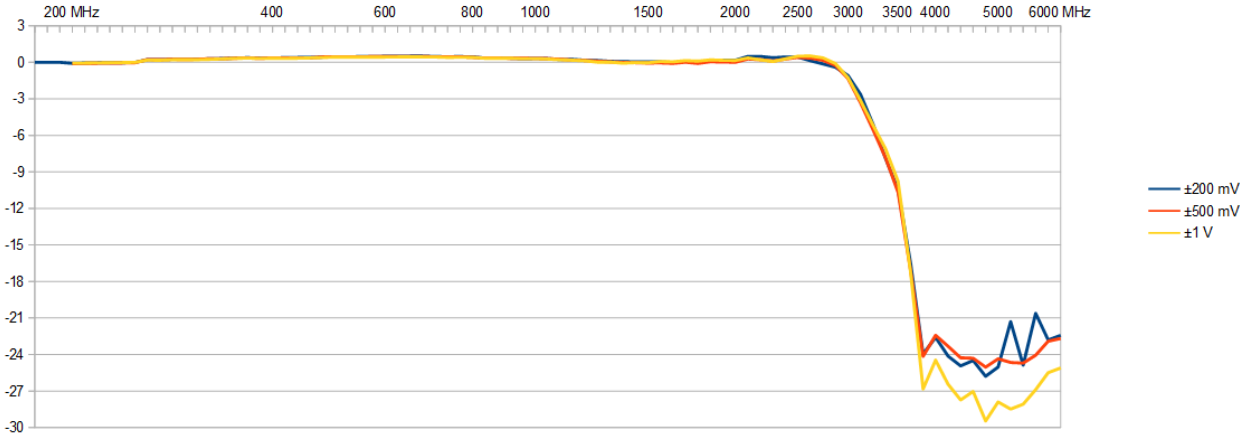
Frequency Response M5i.3360-x16, M5i.3367-x16, DNx.336-xx (meas)

Sampling Rate: 10 GS/s, Bandwidth 4.7 GHz
50 Ω, DC coupling, no offset, no external filter



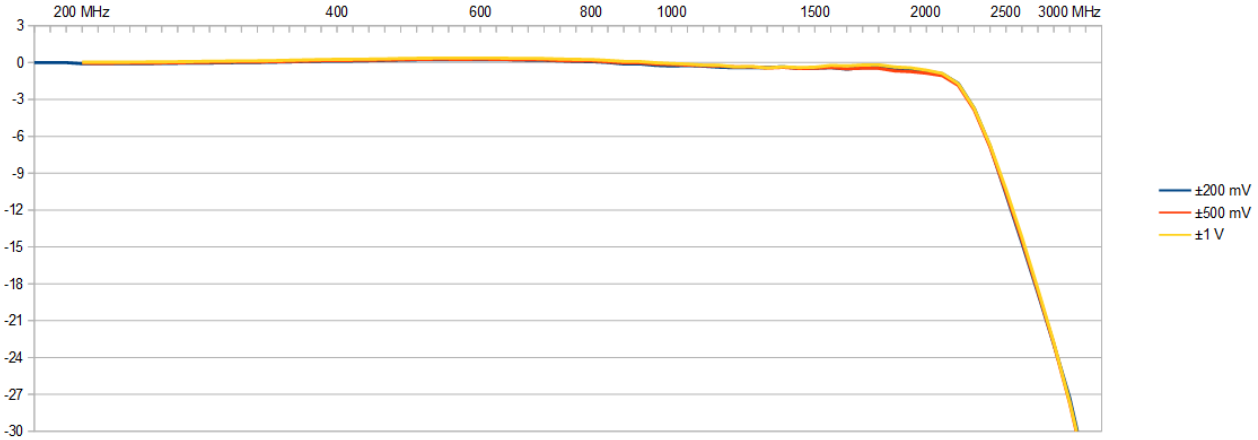
Frequency Response M5i.3350-x16, M5i.3357-x16, DNx.335-xx (meas)

Sampling Rate: 10 GS/s, Bandwidth 3.0 GHz
50 Ω, DC coupling, no offset, no external filter



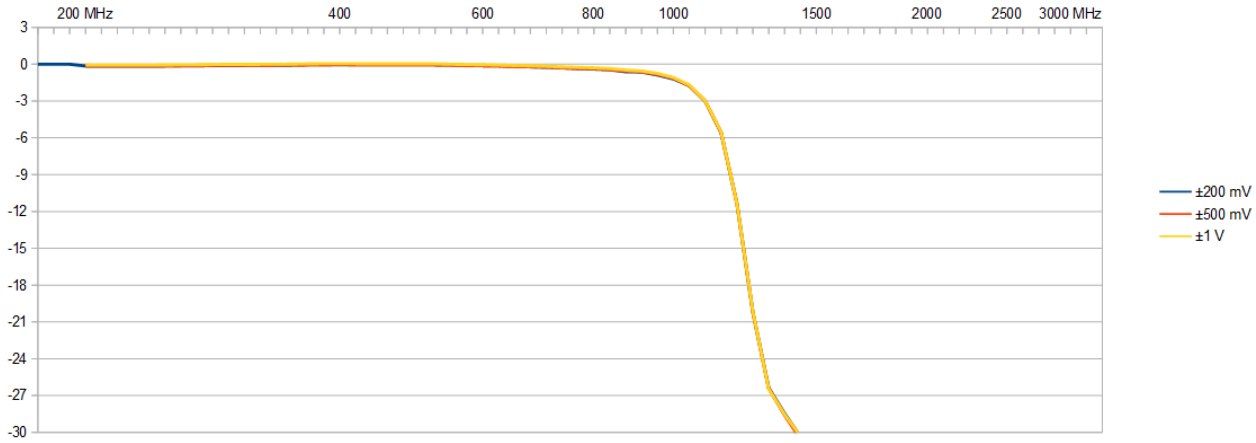
Frequency Response M5i.3330-x16, M5i.3337-x16, DNx.333-xx (meas)

Sampling Rate: 6.4 GS/s, Bandwidth 2.0 GHz
50 Ω, DC coupling, no offset, no external filter



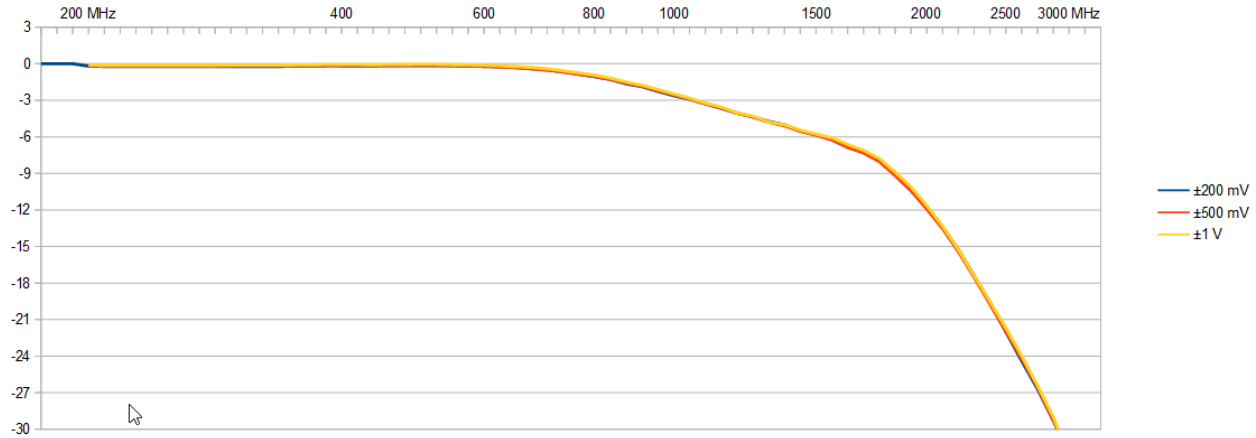
Frequency Response M5i.3321-x16, DNx.332-xx Standard (meas)

Sampling Rate: 3.2 GS/s, Bandwidth 1.0 GHz
50 Ω, DC coupling, no offset, no external filter
Standard Filter



Frequency Response M5i.3321-x16, DNx.332-xx with option -inptd (meas)

Sampling Rate: 3.2 GS/s, Bandwidth 1.0 GHz
50 Ω, DC coupling, no offset, no external filter
Option -inptd (input time domain optimization) Filter



Dynamic Parameters 10.0 GS/s 4.7 GHz models

	M5i.3360-x16/M5i.3367-x16/DNx.336-xx - 12 Bit 10 GS/s (channel 0)											
Input Range	±200 mV						±500 mV					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	50.9 dB	50.3 dB	50.6 dB	50.0 dB	50.4 dB	50.9 dB	51.8 dB	51.5 dB	51.2 dB	50.9 dB	51.4 dB	50.8 dB
THD (typ)	-65.9 dB	-67.4 dB	-69.6 dB	-60.0 dB	-53.7 dB	-57.4 dB	-70.6 dB	-69.1 dB	-65.5 dB	-61.4 dB	-58.8 dB	-57.8 dB
SFDR incl. harm. (typ)	59.7 dB	57.6 dB	59.6 dB	58.1 dB	55.1 dB	57.9 dB	61.2 dB	59.3 dB	58.8 dB	58.2 dB	60.5 dB	58.4 dB
SFDR excl. harm. (typ)	59.7 dB	57.6 dB	59.6 dB	58.1 dB	60.7 dB	61.4 dB	61.2 dB	59.3 dB	58.8 dB	58.2 dB	63.9 dB	60.1 dB
SINAD/THD+N (typ)	50.8 dB	50.3 dB	50.6 dB	49.6 dB	48.7 dB	50.0 dB	51.7 dB	51.4 dB	51.1 dB	50.6 dB	50.7 dB	50.0 dB
ENOB/SINAD (typ)	8.2 LSB	8.1 LSB	8.1 LSB	8.0 LSB	7.8 LSB	8.0 LSB	8.3 LSB	8.2 LSB	8.2 LSB	8.1 LSB	8.1 LSB	8.0 LSB
ENOB/SNR (typ)	8.2 LSB	8.1 LSB	8.1 LSB	8.0 LSB	8.1 LSB	8.2 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.1 LSB	8.2 LSB	8.1 LSB

	M5i.3360-x16/M5i.3367-x16/DNx.336-xx - 12 Bit 10 GS/s (channel 0)											
Input Range	±1 V						±2.5 V					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	51.3 dB	51.4 dB	51.3 dB	51.0 dB	51.3 dB	50.9 dB	51.3 dB	51.4 dB	51.3 dB	51.0 dB	51.3 dB	50.9 dB
THD (typ)	-70.0 dB	-67.3 dB	-68.9 dB	-61.1 dB	-58.3 dB	-57.4 dB	-70.0 dB	-67.3 dB	-68.9 dB	-61.1 dB	-58.3 dB	-57.4 dB
SFDR incl. harm. (typ)	59.4 dB	60.4 dB	58.9 dB	58.9 dB	59.1 dB	57.9 dB	59.4 dB	60.4 dB	58.9 dB	58.9 dB	59.1 dB	57.9 dB
SFDR excl. harm. (typ)	59.4 dB	60.4 dB	58.9 dB	58.9 dB	62.3 dB	61.4 dB	59.4 dB	60.4 dB	58.9 dB	58.9 dB	62.3 dB	61.4 dB
SINAD/THD+N (typ)	51.3 dB	51.3 dB	51.1 dB	50.6 dB	50.6 dB	50.1 dB	51.3 dB	51.3 dB	51.1 dB	50.6 dB	50.6 dB	50.1 dB
ENOB/SINAD (typ)	8.2 LSB	8.2 LSB	8.2 LSB	8.1 LSB	8.1 LSB	8.0 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.1 LSB	8.1 LSB	8.0 LSB
ENOB/SNR (typ)	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.2 LSB

Dynamic Parameters 10.0 GS/s 3.0 GHz models

	M5i.3350-x16/M5i.3357-x16/DNx.335-xx - 12 Bit 10 GS/s (channel 0)											
Input Range	±200 mV						±500 mV					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	51.5 dB	52.0 dB	51.3 dB	51.0 dB	50.9 dB	50.8 dB	52.0 dB	52.0 dB	51.2 dB	52.3 dB	51.5 dB	51.3 dB
THD (typ)	-66.8 dB	-65.3 dB	-65.2 dB	-65.4 dB	-55.7 dB	-54.8 dB	-65.5 dB	-63.1 dB	-65.9 dB	-65.2 dB	-58.6 dB	-58.8 dB
SFDR incl. harm. (typ)	56.0 dB	55.7 dB	54.6 dB	54.8 dB	55.6 dB	55.0 dB	55.7 dB	64.7 dB	54.3 dB	58.9 dB	59.6 dB	52.5 dB
SFDR excl. harm. (typ)	56.0 dB	55.7 dB	54.6 dB	54.8 dB	55.6 dB	55.6 dB	55.7 dB	67.0 dB	54.3 dB	58.9 dB	59.6 dB	52.5 dB
SINAD/THD+N (typ)	51.3 dB	51.8 dB	51.2 dB	50.9 dB	49.6 dB	49.4 dB	51.8 dB	51.9 dB	51.1 dB	52.2 dB	50.7 dB	49.2 dB
ENOB/SINAD (typ)	8.2 LSB	8.3 LSB	8.2 LSB	8.2 LSB	8.0 LSB	7.9 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.4 LSB	8.1 LSB	7.9 LSB
ENOB/SNR (typ)	8.3 LSB	8.3 LSB	8.2 LSB	8.2 LSB	8.2 LSB	8.0 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.4 LSB	8.2 LSB	8.2 LSB

	M5i.3350-x16/M5i.3357-x16/DNx.335-xx - 12 Bit 10 GS/s (channel 0)											
Input Range	±1 V						±2.5 V					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	51.7 dB	52.0 dB	51.7 dB	51.6 dB	51.2 dB	51.2 dB	52.0 dB	52.0 dB	51.2 dB	52.3 dB	51.5 dB	51.0 dB
THD (typ)	-66.4 dB	-66.5 dB	-66.5 dB	-64.7 dB	-58.5 dB	-60.5 dB	-65.5 dB	-63.1 dB	-65.9 dB	-65.2 dB	-58.6 dB	-64.4 dB
SFDR incl. harm. (typ)	55.8 dB	63.6 dB	55.9 dB	54.9 dB	59.5 dB	57.7 dB	55.7 dB	64.7 dB	54.3 dB	58.9 dB	59.6 dB	60.4 dB
SFDR excl. harm. (typ)	55.8 dB	63.7 dB	55.9 dB	54.9 dB	60.0 dB	57.7 dB	55.7 dB	67.0 dB	54.3 dB	58.9 dB	59.6 dB	60.4 dB
SINAD/THD+N (typ)	51.6 dB	51.9 dB	51.7 dB	51.5 dB	50.5 dB	51.2 dB	51.8 dB	51.9 dB	51.1 dB	52.2 dB	50.7 dB	50.9 dB
ENOB/SINAD (typ)	8.3 LSB	8.3 LSB	8.3 LSB	8.3 LSB	8.1 LSB	8.2 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.4 LSB	8.1 LSB	8.1 LSB
ENOB/SNR (typ)	8.3 LSB	8.3 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.2 LSB	8.3 LSB	8.3 LSB	8.2 LSB	8.4 LSB	8.2 LSB	8.2 LSB

Dynamic Parameters 6.4 GS/s models

	M5i.3330-x16/M5i.3337-x16/DNx.333-xx - 12 Bit 6.4 GS/s (channel 0)											
Input Range	±200 mV						±500 mV					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	53.1 dB	53.1 dB	53.0 dB	52.6 dB	51.9 dB	50.1 dB	53.8 dB	53.2 dB	53.4 dB	53.0 dB	52.4 dB	50.3 dB
THD (typ)	-63.8 dB	-63.8 dB	-62.0 dB	-62.3 dB	-56.9 dB	-56.7 dB	-61.6 dB	-62.1 dB	-61.6 dB	-61.6 dB	-59.8 dB	-59.8 dB
SFDR incl. harm. (typ)	62.0 dB	61.6 dB	62.4 dB	62.5 dB	59.7 dB	57.2 dB	62.5 dB	64.2 dB	60.7 dB	62.2 dB	58.1 dB	60.0 dB
SFDR excl. harm. (typ)	62.0 dB	61.6 dB	62.6 dB	62.6 dB	64.5 dB	58.7 dB	65.0 dB	66.3 dB	60.6 dB	65.1 dB	58.1 dB	60.1 dB
SINAD/THD+N (typ)	52.8 dB	52.6 dB	52.3 dB	52.5 dB	51.6 dB	49.6 dB	53.4 dB	53.6 dB	52.8 dB	53.0 dB	51.9 dB	50.0 dB
ENOB/SINAD (typ)	8.5 LSB	8.5 LSB	8.4 LSB	8.4 LSB	8.3 LSB	8.0 LSB	8.6 LSB	8.6 LSB	8.5 LSB	8.6 LSB	8.3 LSB	8.0 LSB
ENOB/SNR (typ)	8.5 LSB	8.6 LSB	8.6 LSB	8.5 LSB	8.3 LSB	8.0 LSB	8.7 LSB	8.6 LSB	8.6 LSB	8.6 LSB	8.5 LSB	8.0 LSB

	M5i.3330-x16/M5i.3337-x16/DNx.333-xx - 12 Bit 6.4 GS/s (channel 0)											
Input Range	±1 V						±2.5 V					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	53.4 dB	53.6 dB	53.3 dB	53.4 dB	52.5 dB	50.3 dB	53.5 dB	52.9 dB	53.5 dB	53.4 dB	51.9 dB	52.3 dB
THD (typ)	-63.8 dB	-63.5 dB	-63.5 dB	-62.6 dB	-59.9 dB	-59,7 dB	-64.0 dB	-61.0 dB	-61.2 dB	-60.9 dB	-58.9 dB	-59.5 dB
SFDR incl. harm. (typ)	62.0 dB	63.3 dB	65.1 dB	58.1 dB	60.4 dB	53.0 dB	62.2 dB	60.9 dB	63.6 dB	62.2 dB	58.7 dB	58.8 dB
SFDR excl. harm. (typ)	62.0 dB	63.4 dB	66.3 dB	58.1 dB	60.8 dB	53.0 dB	62.2 dB	53.9 dB	63.5 dB	63.0 dB	59.4 dB	58.9 dB
SINAD/THD+N (typ)	53.0 dB	53.2 dB	53.1 dB	52.6 dB	51.8 dB	49.6 dB	53.1 dB	52.9 dB	53.1 dB	52.9 dB	51.6 dB	51.5 dB
ENOB/SINAD (typ)	8.5 LSB	8.5 LSB	8.6 LSB	8.4 LSB	8.3 LSB	8.0 LSB	8.5 LSB	8.5 LSB	8.6 LSB	8.5 LSB	8.3 LSB	8.3 LSB
ENOB/SNR (typ)	8.6 LSB	8.6 LSB	8.6 LSB	8.6 LSB	8.5 LSB	8.1 LSB	8.6 LSB	8.6 LSB	8.6 LSB	8.6 LSB	8.3 LSB	8.4 LSB

Dynamic Parameters 3.2 GS/s models

	M5i.3321-x16/DNx.332-xx - 12 Bit 3.2 GS/s									
Input Range	±200 mV					±500 mV				
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz
SNR (typ)	54.1 dB	54.4 dB	54.7 dB	54.5 dB	54.5 dB	54.8 dB	55.0 dB	54.8 dB	54.6 dB	54.9 dB
THD (typ)	-64.3 dB	-63.4 dB	-62.3 dB	-61.1 dB	-59.5 dsB	-61.5 dB	-62.0 dB	-66.5 dB	-61.7 dB	-57.5 dB
SFDR incl. harm. (typ)	64.7 dB	65.4 dB	63.5 dB	61.9 dB	61.8 dB	72.9 dB	64.9 dB	65.6 dB	62.1 dB	60.3 dB
SFDR excl. harm. (typ)	65.1 dB	73.8 dB	71.6 dB	72.5 dB	69.7 dB	65.6 dB	72.8 dB	65.8 dB	69.1 dN	67.7 dB
SINAD/THD+N (typ)	53.7 dB	53.9 dB	54.0 dB	53.6 dB	53.3 dB	54.0 dB	54.2 dB	54.6 dB	53.9 dB	52.9 dB
ENOB/SINAD (typ)	8.6 LSB	8.7 LSB	8.7 LSB	8.5 LSB	8.6 LSB	8.7 LSB	8.7 LSB	8.8 LSB	8.7 LSB	8.5 LSB
ENOB/SNR (typ)	8.7 LSB	8.7 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB

	M5i.3321-x16/DNx.332-xx - 12 Bit 3.2 GS/s									
Input Range	±1 V					±2.5 V				
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz
SNR (typ)	55.3 dB	55.3 dB	54.8 dB	54.8 dB	54.9 dB	54.8 dB	55.3 dB	54.8 dB	54.8 dB	54.9 dB
THD (typ)	-63.8 dB	-63.8 dB	-59.5 dB	-62.5 dB	-57.8 dB	-63.4 dB	-63.8 dB	-59.5 dB	-62.5 dB	-57.8 dB
SFDR incl. harm. (typ)	64.5 dB	66.3 dB	60.7 dB	63.5 dB	60.4 dB	62.5 dB	66.3 dB	60.7 dB	63.5 dB	60.4 dB
SFDR excl. harm. (typ)	65.3 dB	73.2 dB	67.4 dB	71.0 dB	68.9 dB	62.7 dB	73.2 dB	67.4 dB	71.0 dB	68.9 dB
SINAD/THD+N (typ)	54.2 dB	54.8 dB	53.6 dB	54.1 dB	53.1 dB	54.2 dB	54.8 dB	53.6 dB	54.1 dB	53.1 dB
ENOB/SINAD (typ)	8.7 LSB	8.8 LSB	8.6 LSB	8.7 LSB	8.5 LSB	8.7 LSB	8.8 LSB	8.6 LSB	8.7 LSB	8.5 LSB
ENOB/SNR (typ)	8.9 LSB	8.9 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.8 LSB	8.9 LSB	8.8 LSB	8.8 LSB	8.8 LSB

Dynamic Parameters 10.0 GS/s 4.7 GHz models (8-bit Mode)

The below dynamic parameters are measured using the 8-bit mode which reduces the resolution in hardware from 12 bit to 8 bit to save memory and data transfer bandwidth. Due to the hardware resolution being below the ENOB of all models, the dynamic parameters are similar for all models when switched to the 8-bit mode.

	M5i.3360-x16/M5i.3367-x16/DNx.336-xx - 8 Bit 10 GS/s (channel 0)											
Input Range	±200 mV						±500 mV					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	46.8 dB	46.7 dB	46.6 dB	46.5 dB	46.5 dB	46.3 dB	46.8 dB	47.0 dB	46.8 dB	46.8 dB	46.9 dB	46.7 dB
THD (typ)	-65.2 dB	-66.1 dB	-67.0 dB	-60.6 dB	-54.3 dB	-54.0 dB	-65.4 dB	-66.2 dB	-65.3 dB	-60.6 dB	-58.9 dB	-56.7 dB
SFDR incl. harm. (typ)	55.3 dB	54.0 dB	55.2 dB	56.8 dB	55.6 dB	55.0 dB	56.1 dB	57.0 dB	53.5 dB	54.3 dB	56.2 dB	56.7 dB
SFDR excl. harm. (typ)	55.3 dB	54.0 dB	55.2 dB	56.8 dB	55.6 dB	56.4 dB	56.1 dB	57.0 dB	53.5 dB	55.3 dB	56.2 dB	56.7 dB
SINAD/THD+N (typ)	46.8 dB	46.7 dB	46.6 dB	46.3 dB	46.0 dB	45.7 dB	46.9 dB	47.0 dB	46.7 dB	46.7 dB	46.7 dB	46.5 dB
ENOB/SINAD (typ)	7.5 LSB	7.5 LSB	7.5 LSB	7.4 LSB	7.4 LSB	7.3 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.4 LSB
ENOB/SNR (typ)	7.5 LSB	7.5 LSB	7.5 LSB	7.4 LSB	7.4 LSB	7.4 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB

	M5i.3360-x16/M5i.3367-x16/DNx.336-xx - 8 Bit 10 GS/s (channel 0)											
Input Range	±1 V						±2.5 V					
Test signal frequency	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz	10 MHz	40 MHz	70 MHz	240 MHz	600 MHz	1.2 GHz
SNR (typ)	47.0 dB	46.9 dB	46.9 dB	46.8 dB	46.9 dB	46.7 dB	46.8 dB	47.0 dB	46.8 dB	46.8 dB	46.9 dB	46.7 dB
THD (typ)	-65.6 dB	-65.8 dB	-66.5 dB	-61.9 dB	-58.9 dB	-57.9 dB	-65.4 dB	-66.2 dB	-65.3 dB	-60.6 dB	-58.9 dB	-56.7 dB
SFDR incl. harm. (typ)	56.1 dB	55.2 dB	55.2 dB	55.9 dB	54.7 dB	56.2 dB	56.1 dB	57.0 dB	53.5 dB	54.3 dB	56.2 dB	56.7 dB
SFDR excl. harm. (typ)	56.1 dB	55.2 dB	55.2 dB	55.9 dB	54.7 dB	56.2 dB	56.1 dB	57.0 dB	53.5 dB	55.3 dB	56.2 dB	56.7 dB
SINAD/THD+N (typ)	47.0 dB	46.9 dB	46.9 dB	46.7 dB	46.7 dB	46.5 dB	46.9 dB	47.0 dB	46.7 dB	46.7 dB	46.7 dB	46.5 dB
ENOB/SINAD (typ)	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.4 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.4 LSB
ENOB/SNR (typ)	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB	7.5 LSB

Dynamic parameters are measured at ±1 V input range (if no other range is stated) and 50 Ω 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 generated by a signal generator and a matching bandpass filter. Amplitude is >99% of FSR. 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.

RMS Noise Level (Zero Noise)

	DC, fixed 50 Ω, typical							
Input Range	±200 mV		±500 mV		±1 V		±2.5 V	
Voltage resolution (1 LSB)	97 uV		244 uV		488 uV		1.22 mV	
One channel operation*								
M5i.336x @ 10 GS/s (typ)	3.9 LSB	381 uV	3.8 LSB	928 uV	4.3 LSB	2.1 mV	4.3 LSB	5.3 mV
M5i.335x @ 10 GS/s (typ)	3.9 LSB	381 uV	3.8 LSB	928 uV	4.3 LSB	2.1 mV	4.3 LSB	5.3 mV
M5i.333x @ 6.4 GS/s (typ)	3.7 LSB	361 uV	3.0 LSB	732 uV	3.8 LSB	1.9 mV	3.5 LSB	4.3 mV
Two channel operation								
M5i.336x @ 5 GS/s (typ)	4.1 LSB	398 uV	3.4 LSB	830 uV	3.6 LSB	1.8 mV	3.4 LSB	4.1 mV
M5i.335x @ 5 GS/s (typ)	4.0 LSB	391 uV	3.3 LSB	806 uV	3.6 LSB	1.8 mV	2.9 LSB	3.5 mV
M5i.333x @ 3.2 GS/s (typ)	3.0 LSB	293 uV	2.8 LSB	684 uV	3.0 LSB	1.5 mV	2.7 LSB	3.3 mV
M5i.332x @ 3.2 GS/s (typ)	2.8 LSB	273 uV	2.3 LSB	562 uV	2.3 LSB	1.1 mV	2.9 LSB	3.5 mV
8-bit sample reduction mode*								
M5i.336x @ 10 GS/s (typ)	0.5 LSB	780 uV	0.5 LSB	1.95 mV	0.5 LSB	3.9 mV	0.5 LSB	9.8 mV

* in one channel or 8-bit operation mode, channel 0 is used, because the channel 0 of the DAC is optimized for running at full speed.

DN2 specific Technical Data

Environmental and Physical Details DN2.xxx

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 (1 internal acquisition/generation module)		6.3 kg, with rack mount kit: 6.8 kg
Weight (2 internal acquisition/generation modules)		6.7 kg, with rack mount kit 7.2 kg
Weight (DN2.33x or DN2.63x)		5.9 kg, with rack mount kit 6.4 kg
Warm up time (meas)		30 minutes
Operating temperature (nom)		0°C to 40°C
Storage temperature (nom)		-10°C to 70°C
Humidity (nom)		10% to 90%
Dimension of packing (single DN2)	L x W x H	470 mm x 390 mm x 180 mm
Volume weight of Packing (single DN2)		7.0 kg

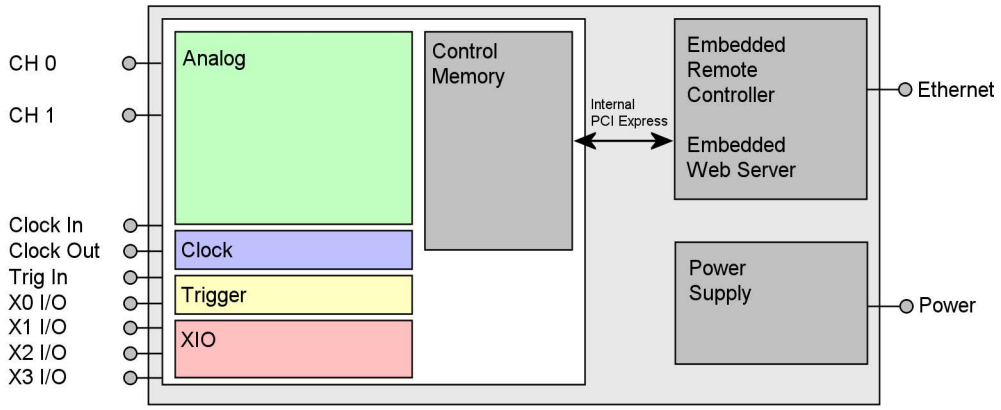
Power Consumption

	230 VAC		**12 VDC (obsolete)**		**24 VDC**	
1 channel versions (meas)	0.33 A	76 W	TBD	TBD	TBD	TBD
2 channel versions (meas)	0.33 A	77 W	TBD	TBD	TBD	TBD

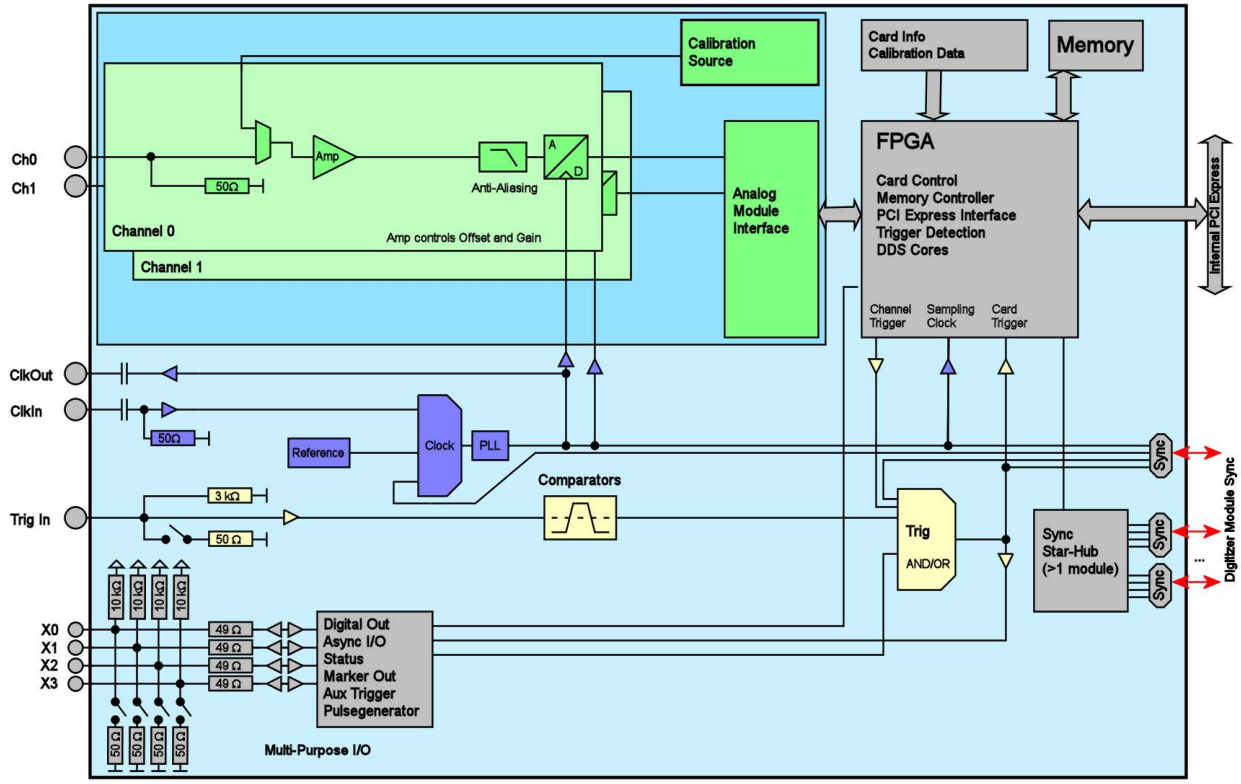
MTBF

MTBF (typ)	TBD

Block diagram of digitizerNETBOX DN2



Block diagram of digitzerNETBOX module DN2.33x



Order Information

The digitizerNETBOX is equipped with a large internal memory for data storage and supports standard acquisition (Scope), FIFO acquisition (streaming), Multiple Recording, Optionally Block Average and Timestamps. Operating system drivers for Windows/Linux 32 bit and 64 bit, drivers and examples for C/C++, Python, IVI (Scope and Digitizer class), LabVIEW (Windows), MATLAB (Windows and Linux), .NET, Java, Julia and a Professional license of the oscilloscope software SBench 6 are included.

The system is delivered with a connection cable meeting your countries power connection. Additional power connections with other standards are available as option.

digitizerNETBOX DN2 - Ethernet/LXI Interface

Order no.	Bandwidth	Installed memory	Optional memory	1 channel	2 channels
DN2.332-01	1 GHz	2 GiSamples	8 GiSamples	3.2 GS/s	3.2 GS/s
DN2.333-01	2 GHz	2 GiSamples	8 GiSamples	6.4 GS/s	
DN2.333-02	2 GHz	2 GiSamples	8 GiSamples	6.4 GS/s	3.2 GS/s
DN2.335-01	3 GHz	2 GiSamples	8 GiSamples	10.0 GS/s	
DN2.335-02	3 GHz	2 GiSamples	8 GiSamples	10.0 GS/s	5.0 GS/s
DN2.336-01	4.7 GHz	2 GiSamples	8 GiSamples	10.0 GS/s	
DN2.336-02	4.7 GHz	2 GiSamples	8 GiSamples	10.0 GS/s	5.0 GS/s

Options

Options

Order no.	Option
M5i.xxxx-MEM8GS	Optional memory extension to 8 GiSamples (16 GiBytes)
M5i.3321-inptd	M5i.3321-x16/DNx.332-xx input stage optimized for time domain measurments with smooth step response. Option for a single digitizer
DN2.xxx-Rack	19" rack mounting set for self mounting
DN2.xxx-Emb	Extension to Embedded Server: CPU, more memory, SSD. Access via remote Linux secure shell (ssh)
DN2.xxx-DC24	24 VDC internal power supply. Replaces AC power supply. Accepts 18 V to 36 V DC input. Screw terminals

Firmware Options

Order no.	Option
M5i.xxxx–spavg	Signal Processing Firmware Option: Block Average with TDA (later firmware-upgrade available). License for a single digitizer
M5i.xxxx-PulseGen	Firmware Option: adds 4 freely programmable digital pulse generators that use the XIO lines for output (later installation by firmware-upgrade available)

Services

Order no.	Option
DN2.xxx-Recal	Recalibration of complete digitizerNETBOX/generatorNETBOX/hybridNETBOX DN2 including calibration protocol
DN2.Prot-17025	ISO 17025 Calibration Certificate for one DN2; add-on for new cards or for recalibration

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 BNC female	to SMB female	to MMCX male	to SMA male	
All	SMA male	80 cm	Cab-3mA-9m-80	Cab-3mA-9f-80	Cab-3f-3mA-80	Cab-1m-3mA-80	Cab-3mA-3mA-80	
All	SMA male	200 cm	Cab-3mA-9m-200	Cab-3mA-9f-200	Cab-3f-3mA-200	Cab-1m-3mA-200	Cab-3mA-3mA-200	
Probes (short)	SMA male	5 cm		Cab-3mA-9f-5				

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

Technical changes and printing errors possible

SBench, digitizerNETBOX, generatorNETBOX and hybridNETBOX are registered trademarks of Spectrum Instrumentation GmbH. Microsoft, Visual C++, Windows, Windows 98, Windows NT, Window 2000, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10 and Windows 11 are trademarks/registered trademarks of Microsoft Corporation. LabVIEW, DASYLab, Diadem and LabWindows/CVI are trademarks/registered trademarks of National Instruments Corporation. MATLAB is a trademark/registered trademark of The Mathworks, Inc. Delphi and C++ Builder are trademarks/registered trademarks of Embarcadero Technologies, Inc. IVI is a registered trademark of the IVI Foundation. Oracle and Java are registered trademarks of Oracle and/or its affiliates. Python is a trademark/registered trademark of Python Software Foundation. Julia is a trademark/registered trademark of Julia Computing, Inc. PCIe, PCI Express and PCI-X and PCI-SIG are trademarks of PCI-SIG. LXI is a registered trademark of the LXI Consortium. PICMG and CompactPCI are trademarks of the PCI Industrial Computation Manufacturers Group. Intel and Intel Core i3, Core i5, Core i7, Core i9 and Xeon are trademarks and/or registered trademarks of Intel Corporation. AMD, Opteron, Sempron, Phenom, FX, Ryzen and EPYC are trademarks and/or registered trademarks of Advanced Micro Devices. Arm is a trademark or registered trademark of Arm Limited (or its subsidiaries). NVIDIA, CUDA, GeForce, Quadro, Tesla and Jetson are trademarks/registered trademarks of NVIDIA Corporation.