

DEVICE SPECIFICATIONS

NI VB-8012

NI VirtualBench™ All-In-One Instrument

These specifications are for the National Instruments VirtualBench VB-8012 only. These specifications are valid following 30 minutes of warmup and are typical at 25 °C, unless otherwise noted. For feature differences between the VirtualBench application for Windows and iPad, go to ni.com/info and enter `vbfeatures`.

Mixed Signal Oscilloscope

Analog Channels

Vertical System

Number of channels	2 single-ended, non-isolated
Bandwidth (-3 dB) ¹	100 MHz
Resolution	8 bits
Accuracy ²	±2% of input ±1% full scale (V_{pk-pk})
Input coupling	DC, AC
Vertical sensitivity (range)	10 mV/div (100 mV _{pk-pk}) 20 mV/div (200 mV _{pk-pk}) 50 mV/div (400 mV _{pk-pk}) 100 mV/div (1 V _{pk-pk}) 200 mV/div (2 V _{pk-pk}) 500 mV/div (4 V _{pk-pk}) 1 V/div (10 V _{pk-pk}) 2 V/div (20 V _{pk-pk}) 5 V/div (40 V _{pk-pk})
Input impedance	1 M Ω 20 pF

¹ Bandwidth using the accessory oscilloscope probe in 10X mode.

² Indicates warranted specifications valid at $T_{cal} \pm 5$ °C. Temperature coefficients are calculated using the temperature change from last external calibration.

Table 1. DC Offset Range

Range	Programmable Offset Range
10 mV/div, 20 mV/div, 50 mV/div	±5 V
100 mV/div, 200 mV/div, 500 mV/div, 1 V/div, 2 V/div, 5 V/div	±20 V

Acquisition modes	Sample, peak detect, averaging
-------------------	--------------------------------

Horizontal System

Maximum sample rate	1 GS/s single channel, 500 MS/s/channel, dual channel
Maximum record length	1 MS/channel

Digital Channels/Logic Analyzer

Vertical System

Number of channels	34
Maximum input frequency	100 MHz
Input voltage	0 V to 5 V
Input current	≤50 μA



Note Mixed signal oscilloscope digital channels are designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. They are not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

Input threshold	Programmable, 0 V to 2.0 V
Threshold accuracy	350 mV
Input impedance	100 kΩ 7.5 pF pulled to -2.0 V to +6.5 V, varies with the input threshold setting
Additional/internal channels	Digital I/O lines, function generator start, external trigger (TRIG), power line frequency

Horizontal System

Timing mode sample rate ³	1 GS/s (down to ~15 kS/s)
Maximum external sample clock rate	100 MHz
Record length	
Typical	1 MS
Minimum ⁴	4 kS
Decimation	External Sample Clock, 1:1, 2:1, and n*4:1 where n is an integer
Maximum sample compression	2 ¹⁵ to 1

Triggering

Trigger modes	Normal, Auto, Force, Single ⁵
Trigger sources	Oscilloscope analog channels, oscilloscope digital channels, function generator start, digital I/O lines, external trigger (TRIG), power line frequency
Trigger types	
Analog	Edge with hysteresis
Digital	Edge, pattern, glitch, level ⁶
Trigger resolution	
Analog/oscilloscope	667 ps
Digital/logic analyzer	1 ns
Trigger export	Available through external trigger (TRIG)

³ Indicates warranted specifications valid at $T_{cal} \pm 5$ °C. Temperature coefficients are calculated using the temperature change from last external calibration.

⁴ Under most conditions, the logic analyzer can acquire 1 MS of data. Under some conditions with very high sustained activity on multiple inputs, the logic analyzer may only capture 4 kS of data.

⁵ Single trigger mode is only available in the VirtualBench application.

⁶ Glitch and level triggers are only available with the NI VirtualBench driver.

Waveform Measurements

Oscilloscope time ⁷	Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width, rise time, fall time, rise rate, fall rate
Oscilloscope voltage ⁷	High, low, amplitude, maximum, minimum, peak-to-peak, overshoot, undershoot, RMS, mean, cycle RMS, cycle mean
Logic analyzer time ⁷	Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width

Waveform Math

Operations ⁸	A + B, A - B, A * B, A/B, FFT
-------------------------	-------------------------------

Function Generator (FGEN)

Waveforms	Sine, square, ramp/triangle, DC, arbitrary ⁹
Update rate	125 MS/s
Resolution	14 bits
Number of channels	1
Output impedance	50 Ω
Switchable filter ¹⁰	36 MHz lowpass, 7-pole, elliptical
Sine	
Maximum frequency	20 MHz
Total Harmonic Distortion (THD)	
1 MHz	-55 dBc
10 MHz	-50 dBc
Spurious Free Dynamic Range (SFDR)	-70 dB at 1 MHz (non-harmonic)
Phase noise (1 MHz)	-115 dBc/Hz at 10 kHz offset

⁷ Waveform measurements are only available in the VirtualBench application.

⁸ Waveform math is only available in the VirtualBench application.

⁹ Arbitrary waveforms are only available with the NI VirtualBench driver.

¹⁰ Switchable filters are only available with the NI VirtualBench driver. The VirtualBench application automatically enables the lowpass filter in sine mode.

Square

Maximum frequency	5 MHz
Rise/fall time	<20 ns (10% to 90%)
Overshoot	<5%
Jitter	8 ns cycle-to-cycle
Ramp/triangle maximum frequency	1 MHz
Accuracy (with >10 k Ω load)	
Amplitude (1 kHz sine)	$\pm(1\%$ of output value ± 5 mV)
DC	$\pm(1\%$ of output value ± 5 mV)
Output range	
50 Ω	± 6 V
Hi-Z (>10 k Ω)	± 12 V
DC offset	
50 Ω	± 6 V
Hi-Z (>10 k Ω)	± 12 V



Note The combination of signal amplitude and DC offset cannot exceed the output range specifications. The impedances listed are the loads applied by the user to the FGEN output.

Frequency

Accuracy	≤ 100 ppm
Resolution	1 μ Hz
Arbitrary waveform	
Points	1 MS
Sample rate	125 MS/s
Flatness	± 0.3 dB to 20 MHz
Protection	Short-circuit protected

Triggering

Trigger types	Start of buffer ¹¹
Trigger resolution	8 ns
Trigger export	Available through external trigger (TRIG)

¹¹ The function generator can only produce a trigger.

Digital I/O

Number of channels	8
Direction control	Input or output, software-selectable
Logic level	5 V compatible TTL input, 3.3 V LVTTTL output
Drive strength	4 mA
Input voltage	0 V to 5 V



Note Digital I/O lines are designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. They are not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

DIO channel pull resistors	10 k Ω , pull-down on dig/<0..7>, 10 k Ω , configurable pull-up to 3.3 V on dig/<6,7>
----------------------------	--

External Power

3.3 V output	
Voltage	3.3 V \pm 10%
Current	20 mA

Digital Multimeter

Functions	DC voltage, AC voltage, DC current, AC current, resistance, diode, continuity ¹²
Resolution	5½ digits
Sample rate	5 S/s



Caution Do not use this device for connection to signals or for measurements within Measurement Categories III or IV. For more information about Measurement Categories, refer to the [Safety Voltages](#) section.

Input protection	
Resistance, diode	Up to 300 V DC
DC and AC voltage	Up to 300 V DC or 265 V AC _{rms} , 400 V AC peak

¹² Continuity is only available in the VirtualBench application.

DC and AC current

DMM A current connector fuse	Internal ceramic fuse, 10 A 250 V, time-delay, 5 × 20 mm, T 10A H 250V (Bussmann part number S505H-10-R at www.cooperindustries.com)
DMM mA current connector fuse	Internal ceramic fuse, 1.25 A 250 V, time-delay, 5 × 20 mm, T 1.25A H 250V (Bussmann part number S505H-1.25-R at www.cooperindustries.com)



Caution Fuses are located on bottom of device underneath door. Use Phillips #1 screwdriver for removal. Ensure all hazardous voltages are disconnected from the device prior to removal of door.



Fuse When this fuse symbol is marked on a device, take proper precautions.

Maximum common-mode voltage 300 V DC or AC_{rms}

DC

Table 2. DC Voltage Accuracy

Range	Input Impedance	1-Year Accuracy ¹³ ± (% of Reading + % of Range)	Temperature Coefficient ¹³ ± (% of Reading + % of Range)/°C
100 mV*	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
1 V	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
10 V	>10 GΩ, 10 MΩ	0.015 + 0.005	0.001 + 0.0005
100 V	10 MΩ	0.035 + 0.005	0.005 + 0.0005
300 V	10 MΩ	0.035 + 0.005	0.005 + 0.0005

* Add 15 μV if not immediately following offset null.

¹³ Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

Effective Common-Mode Rejection Ratio >100 dB
(CMRR), 1 kΩ resistance in LO lead

Normal-Mode Rejection Ratio (NMRR), >100 dB
50/60 Hz ±0.1%

Overrange 105% of range except 300 V

AC

Table 5. AC Voltage Accuracy

Range (rms)	Peak Voltage	Frequency	1-Year Accuracy ¹⁵ ± (% of Reading + % of Range)	Temperature Coefficient ¹⁵ ± (% of Reading + % of Range)/°C
100 mV, 1 V, 10 V, 100 V, 265 V	±210 mV, ±2.1 V, ±21 V, ±210 V, ±400 V	20 Hz to 45 Hz	0.91 + 0.10	0.01 + 0.005
		45 Hz to 65 Hz	0.30 + 0.05	0.01 + 0.005
		65 Hz to 1 kHz	0.21 + 0.05	0.01 + 0.005
		1 kHz to 5 kHz	0.12 + 0.05	0.01 + 0.005
		5 kHz to 20 kHz	0.35 + 0.05	0.01 + 0.005

Table 6. AC Current Accuracy

Range (rms)	Peak Current	Burden Voltage (rms)	Frequency	1-Year Accuracy ¹⁵ ± (% of Reading + % of Range)	Temperature Coefficient ¹⁵ ± (% of Reading + % of Range)/°C
5 mA	±10.5 mA	<0.02 V	20 Hz to 1 kHz	0.20 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.60 + 0.01	
50 mA	±105 mA	<0.2 V	20 Hz to 1 kHz	0.20 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.50 + 0.01	
500 mA	±1.05 A	<0.02 V	20 Hz to 1 kHz	0.15 + 0.01	0.01 + 0.005
			1 kHz to 5 kHz	0.50 + 0.01	

¹⁵ Indicates warranted specifications valid at T_{cal} ±5 °C. Temperature coefficients are calculated using the temperature change from last external calibration.

Table 6. AC Current Accuracy (Continued)

Range (rms)	Peak Current	Burden Voltage (rms)	Frequency	1-Year Accuracy ¹⁵ ± (% of Reading + % of Range)	Temperature Coefficient ¹⁵ ± (% of Reading + % of Range)/°C
5 A	±10.5 A	<0.2 V	20 Hz to 1 kHz	0.25 + 0.03	0.01 + 0.005
			1 kHz to 5 kHz	0.60 + 0.03	



Caution The input terminals of the DMM are not protected for electromagnetic interference. As a result, the DMM may experience reduced measurement accuracy or other temporary performance degradation when connected to unshielded test leads in an environment with radiated or conducted radio frequency electromagnetic interference.

Input impedance

10 MΩ || 200 pF

CMRR, 1 kΩ resistance in LO lead

>70 dB (DC to 60 Hz)

DC Power Supply

Outputs

0 V to +6 V/0 A to 1 A,

0 V to +25 V/0 mA to 500 mA (isolated),

0 V to -25 V/0 mA to 500 mA (isolated)



Note The +25 V and -25 V channels are bank isolated from ground but not from each other.

Table 7. DC Accuracy/Resolution

Output	Type	+6 V	+25 V	-25 V
DC output ¹⁶	Voltage	0 V to +6 V	0 V to +25 V	0 V to -25 V
	Current ¹⁷	1 A	500 mA	500 mA
Programming accuracy ^{16,17} ± (% of reading + offset)	Voltage	0.1% + 5 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.2% + 10 mA	0.15% + 4 mA	0.15% + 4 mA

¹⁶ Indicates warranted specifications valid at $T_{cal} \pm 5^\circ\text{C}$. Temperature coefficients are calculated using the temperature change from last external calibration.

¹⁷ Minimum programmable current limit is 1% of range.

Table 7. DC Accuracy/Resolution (Continued)

Output	Type	+6 V	+25 V	-25 V
Readback accuracy ^{16,18} ± (% of reading + offset)	Voltage	0.1% + 5 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.2% + 10 mA	0.15% + 4 mA	0.15% + 4 mA
Programming resolution	Voltage	1.7 mV	6.5 mV	6.5 mV
	Current	0.30 mA	0.15 mA	0.15 mA
Readback resolution	Voltage	0.41 mV	1.7 mV	1.7 mV
	Current	70 µA	35 µA	35 µA
Load regulation ¹⁹ ± (% of reading + offset)	Voltage	0.01% + 25 mV	0.03% + 5 mV	0.03% + 5 mV

Overvoltage protection 30 V (25 V channels) and 10 V (6 V channel)

Reverse voltage protection Reverse clamp diode, protected by self-resetting fuse

External Trigger (TRIG)

Direction control Input or output, software-selectable

Logic level 5 V compatible TTL input,
3.3 V LVTTTL output

Drive strength 4 mA

Input voltage 0 V to 5 V



Note The external trigger line is designed to withstand accidental overvoltage from signals on the VB-8012 or similar devices. It is not recommended for use with signals likely to exceed 0 V to 5 V in normal operation.

Connectivity

Wired USB Interface

USB specification USB 2.0 Hi-Speed

¹⁸ Programming and readback accuracy specified at no load.

¹⁹ Change in output voltage for any load within range.

Wireless Interface

Table 8. Network Protocols and Ports Used

Port	Protocol	Function
Port 80/TCP	HTTP	Device configuration (web, MAX)
Port 443/TCP	HTTP	Device configuration (web, MAX)
Port 3580/TCP	Service locator	Device configuration (web, MAX)
Port 9090/TCP	Configuration only	VirtualBench instrument protocol
Port 5353/UDP	Multicast DNS	Device discovery

Network IP configuration	IPv4, DHCP Client/Server
Radio mode	IEEE 802.11 b,g,n
Wireless modes	AP mode (default), client mode
Frequency band	2.4 GHz ISM
Channel width	20 MHz
Channels	USA 1-11, International 1-13 (12 and 13 client mode only)
TX power	+10 dBm maximum (10 mW)
Security	Open, WPA, WPA2, WPA2-Enterprise
Enterprise security EAP types	EAP-TLS, EAP-TTLS/MS-CHAPv2, PEAPv0/MS-CHAPv2
Antenna	External RP-SMA omnidirectional dipole

Power Requirements



Caution The protection provided by the VirtualBench hardware can be impaired if it is used in a manner not described in the *NI VB-8012 Safety, Environmental, and Regulatory Information* document.

Voltage input range	100 VAC to 240 VAC, 50/60 Hz
Power consumption	100 W maximum

Power input connector	IEC C13 power connector
Power disconnect	The AC power cable provides main power disconnect. Do not position the equipment so that it is difficult to disconnect the power cable. Depressing the front panel power button does not inhibit the internal power supply.

Calibration

Calibration cycle (digital multimeter, mixed signal oscilloscope, function generator, DC power supply)	1 year
Specified temperature	$T_{cal} \pm 5 \text{ }^{\circ}\text{C}$
Warmup time	30 minutes

Physical Characteristics

Dimensions

Enclosure	25.40 cm × 19.05 cm × 7.77 cm (10.00 in. × 7.50 in. × 3.06 in.)
Enclosure with connectors and antenna	25.40 cm × 23.37 cm × 14.40 cm (10.00 in. × 9.20 in. × 5.67 in.)



Note Use the VirtualBench instrument in a horizontal orientation. Allow at least 10.16 cm (4.0 in.) of clearance in front and behind the VirtualBench instrument for USB, power, and common connector cabling.

Weight	2.05 kg (4 lb 8.3 oz)
Connectivity	
Mixed signal oscilloscope	BNC
Logic analyzer	2x20 shrouded IDC header
External trigger	BNC
Function generator	BNC

Digital I/O	
Type	Pluggable screw terminal, 3.5 mm (14 position)
Screw terminal wiring	0.1 to 2.0 mm ² (30 to 14 AWG)
Torque	0.25 N · m (2.2 lb · in.)
Digital multimeter	4 mm banana jacks
DC power supply	
Type	Pluggable screw terminal, 3.81 mm (6 position)
Screw terminal wiring	0.1 to 2.0 mm ² (30 to 14 AWG)
Torque	0.25 N · m (2.2 lb · in.)
Security cable slot	1, complies with Kensington security slot dimensions

If you need to clean the device, wipe it with a dry towel.

Safety Voltages

Connect only voltages that are within these limits.

DMM Isolation Voltages



Hazardous Voltage This icon denotes a warning advising you to take precautions to avoid electrical shock.

Channel-to-earth ground

Continuous	300 V, Measurement Category II
Withstand	3,000 V _{RMS} , verified by a 5 s dielectric withstand test

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example, 115 V for U.S. or 230 V for Europe.



Caution Do not connect the VirtualBench hardware to signals or use for measurements within Measurement Categories III or IV.

DC Power Supply Isolation Voltages

+25 V and -25 V-to-earth ground, continuous 60 VDC, Measurement Category I



Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Environmental

Operating temperature	0 °C to 40 °C
Storage temperature	-20 °C to 70 °C
Operating humidity	10% to 90% RH, noncondensing DMM full accuracy at 10% to 80%
Storage humidity	5% to 95% RH, noncondensing
Cooling	Forced air circulation (positive pressurization) through a fan. Fan speed automatically adjusts according to operating conditions. Intake and exhaust locations are on rear of device. Ensure that the intake and exhaust locations are not obstructed.
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

Shock and Vibration

Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g _{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g _{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1



Note For UL and other safety certifications, refer to the product label or the [Online Product Certification](#) section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use; for radio equipment; and for telecommunication terminal equipment:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note For EMC declarations and certifications, and additional information, refer to the [Online Product Certification](#) section.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2014/53/EU; Radio Equipment Directive (RED)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国 RoHS）



中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

Refer to the *NI Trademarks and Logo Guidelines* at ni.com/trademarks for information on NI trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering NI products/technology, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patent Notice* at ni.com/patents. You can find information about end-user license agreements (EULAs) and third-party legal notices in the readme file for your NI product. Refer to the *Export Compliance Information* at ni.com/legal/export-compliance for the NI global trade compliance policy and how to obtain relevant HTS codes, ECCNs, and other import/export data. NI MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN AND SHALL NOT BE LIABLE FOR ANY ERRORS. U.S. Government Customers: The data contained in this manual was developed at private expense and is subject to the applicable limited rights and restricted data rights as set forth in FAR 52.227-14, DFAR 252.227-7014, and DFAR 252.227-7015.

© 2014—2016 National Instruments. All rights reserved.

371527D-01 Jan16