SPECIFICATIONS

NI VB-8012

NI VirtualBench™ All-In-One Instrument

Français	Deutsch	日本語	한국어	简体中文
ni.com/manuals				

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

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

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

NATIONAL INSTRUMENTS™

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 MΩ || 20 pF

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 to 5 V

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 to 5 V in normal operation.

Input threshold.....Programmable, 0 to 2.0 V[3]

Threshold accuracy.....350 mV

Additional/internal channels.....Digital I/O lines, function generator start, external trigger (TRIG), power line frequency

Horizontal System

Timing mode sample rate[2].....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

[3] Programmable input threshold is only available with the NI VirtualBench driver. The VirtualBench application has an input threshold of 1.65 V.

[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.

Triggering

Trigger modes.....Normal, Auto, Single, Force

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, glitch[5], level, pattern

Trigger resolution

- 1 GS/s mode.....1 ns
- 500 MS/s mode.....2 ns
- Trigger export.....Available through external trigger (TRIG)

Waveform Measurements

Oscilloscope time[5].....Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width, rise time, fall time, rise rate, fall rate

Oscilloscope voltage[6].....High, low, amplitude, maximum, minimum, peak-to-peak, overshoot, undershoot, RMS, mean, cycle RMS, cycle mean

Logic analyzer time[6].....Period, frequency, positive duty cycle, negative duty cycle, positive pulse width, negative pulse width

Waveform Math

Operations[7].....A + B, A - B, A * B, FFT

[5] Glitch triggers are only available with the NI VirtualBench driver.
[6] Waveform measurements are only available in the VirtualBench application.
[7] Waveform math is only available in the VirtualBench application.

Function Generator (FGEN)

Waveforms.....Sine, square, ramp/triangle, DC, arbitrary[8]

Update rate.....125 MS/s

Resolution.....14 bits

Number of channels.....1

Output impedance.....50 Ω

Switchable filter[9].....36 MHz lowpass, 7-pole, elliptical

Sine

- Maximum frequency.....20 MHz
- Total harmonic distortion
  - 1 MHz.....-55 dBc
  - 10 MHz.....-50 dBc
- Spurious free dynamic range.....-70 dB at 1 MHz (non-harmonic)
- Phase noise (1 MHz).....-115 dBc/Hz at 10 kHz offset

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.....150 kHz

Accuracy (with >10 kΩ load)

- Amplitude (1 kHz sine).....±(1% of setting + 5 mV)
- DC.....±(1% of setting + 5 mV)

Output range

- 50 Ω.....±6 V
- Hi-Z (>10 kΩ).....±12 V

DC offset

- 50 Ω.....±6 V
- Hi-Z (>10 kΩ).....±12 V

Note The combination of signal amplitude and DC offset cannot exceed the output range specifications.

[8] Arbitrary waveforms are only available with the NI VirtualBench driver.

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

Frequency

- Accuracy.....≤100 ppm
- Resolution.....1 µHz

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[10]

Trigger resolution.....8 ns

Trigger export.....Available through external trigger (TRIG)

Digital I/O

Number of channels.....8

Direction control.....Input or output, software-selectable

Logic level.....5 V compatible LVTTL input,
3.3 V LVTTL output

Drive strength.....4 mA

Input voltage.....0 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 to 5 V in normal operation.

DIO channel pull resistors.....10 kΩ, pull-down

External Power

3.3 V output

- Voltage.....3.3 V ±10%
- Current.....20 mA

[10] The function generator can only produce a trigger.

Digital Multimeter

Functions.....DC voltage, AC voltage, DC current, AC current, resistance, diode, continuity

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
- 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 (Cooper Bussmann part number S505H-10-R at `www.cooperbussmann.com`)
  - DMM mA current connector fuse.....Internal ceramic fuse, 1.25 A 250 V, time-delay, 5 × 20 mm, T 1.25A H 250V (Cooper Bussmann part number S505H-1.25-R at `www.cooperbussmann.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[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% 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.			

Table 3. DC Current Accuracy

Range	Burden Voltage	1-Year Accuracy[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% of Reading + % of Range)/°C
10 mA	<0.03 V	0.070 + 0.020	0.0035 + 0.0010
100 mA	<0.3 V	0.070 + 0.003	0.0020 + 0.0010
1 A	<0.03 V	0.130 + 0.025	0.0065 + 0.0010
10 A*	<0.3 V	0.130 + 0.004	0.0045 + 0.0010
* 30 seconds on, 30 seconds off. Add 300 ppm/A for currents >2.2 A. After measuring >5 A, wait two minutes to get full accuracy in the 1 A range.			

Table 4. DC Resistance Accuracy (2-Wire)*, 1 V Open Circuit Voltage

Range	Short-Circuit Current	1-Year Accuracy[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% of Reading + % of Range)/°C
100 Ω	170 µA	0.018 + 0.050	0.0010 + 0.0005
1 kΩ	170 µA	0.018 + 0.005	0.0010 + 0.0005
10 kΩ	70 µA	0.018 + 0.005	0.0010 + 0.0005

Table 4. DC Resistance Accuracy (2-Wire)*, 1 V Open Circuit Voltage (Continued)

Range	Short-Circuit Current	1-Year Accuracy[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% of Reading + % of Range)/°C
100 kΩ	10 µA	0.018 + 0.005	0.0010 + 0.0005
1 MΩ	1.1 µA	0.035 + 0.005	0.0040 + 0.0005
10 MΩ	1.1 µA	0.085 + 0.005	0.0100 + 0.0005
100 MΩ	1.1 µA	1.3 + 0.005	0.1000 + 0.0005
* Perform offset nulling.			

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.

DC continuity accuracy range[11] .....100 Ω

DC diode test range.....2 V

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

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

Overrange.....105% of range except 300 V

[11] DC continuity is only available in the VirtualBench application.

AC

Table 5. AC Voltage Accuracy

Range (rms)	Peak Voltage	Frequency	1-Year Accuracy[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% 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[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% 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	

Table 6. AC Current Accuracy (Continued)

Range (rms)	Peak Current	Burden Voltage (rms)	Frequency	1-Year Accuracy[2] ± (% of Reading + % of Range)	Temperature Coefficient[2] ± (% of Reading + % of Range)/°C
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	
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 to +6 V/0 to 1 A,
0 to +25 V/0 to 500 mA (isolated),
0 to -25 V/0 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[2]	Voltage	0 to +6 V	0 to +25 V	0 to -25 V
	Current[12]	1 A	500 mA	500 mA
Programming accuracy[2,12] ± (% 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
Readback accuracy[2,13] ± (% 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 ± (% of reading + offset)[14]	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.....400 mV

External Trigger (TRIG)

Direction control.....Input or output, software-selectable

Logic level.....5 V compatible LVTTL input,
3.3 V LVTTL output

Drive strength.....4 mA

Input voltage.....0 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 to 5 V in normal operation.

[12] Minimum programmable current limit is 1% of range.
[13] Programming and readback accuracy specified at no load.
[14] Change in output voltage for any load within range.

Connectivity

Wired Interface

USB specification.....USB 2.0 Hi-Speed

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 max (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 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} ± 5 °C

Warmup time.....30 minutes

Physical Characteristics

Dimensions

- Enclosure: 25.40 cm × 19.05 cm × 7.39 cm (10.00 in. × 7.50 in. × 2.91 in.)
- Enclosure with connectors and antenna: 25.40 cm × 23.37 cm × 13.97 cm (10.00 in. × 9.20 in. × 5.50 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.....60 VDC, Measurement Category I continuous

Note Measurement Categories CAT I and CAT O (Other) are equivalent. The input circuits are not intended for direct connection to the MAINs building installations of Categories CAT II, CAT III, or CAT IV.

Environmental

Operating temperature.....0 to 40 °C

Storage temperature.....-20 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 to 500 Hz, 0.3 g_{rms}
- Nonoperating.....5 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 meets the requirements of the following standards of safety for electrical equipment 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 radio equipment and for telecommunication terminal equipment:

- EN 61000-6-4 (IEC 61000-6-4): Emissions
- EN 61000-6-2 (IEC 61000-6-2): Immunity
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 22: Class A emissions

- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note For EMC declarations, certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)
- 1995/5/EC; Radio and Telecommunications Terminal Equipment (R&TTE) Directive

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`.)

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