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Find the *National Instruments PXI-5153* at our website: *Click HERE*

SPECIFICATIONS

PXI-5153

500 MHz Bandwidth, 2 GS/s, 8-Bit PXI Oscilloscope

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Definitions

Caution If the module has been in use, it may exceed safe handling temperatures and cause burns. Allow the module to cool before removing it from the chassis.

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

The following characteristic specifications describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- *Typical* specifications describe the performance met by a majority of models.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications in this document are Warranted unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- All filter settings
- All impedance selections
- Sample clock set to 1 GS/s
- Real-Time Interleaved Sampling (TIS) mode provides a 2 GS/s real-time sample rate for a single channel
- The module is warmed up for 15 minutes at ambient temperature
- Calibration cycle is maintained
- The PXI/PCI chassis fan speed is set to HIGH, the foam fan filters are removed if present, and the empty slots contain slot blockers and filler panels. For more information about cooling, refer to the *Maintain Forced-Air Cooling Note to Users*.

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Vertical

Analog Input (Channel 0 and Channel 1)

Number of channels	Two (simultaneously sampled)
Connectors	BNC

Impedance and Coupling

Input impedance	50 Ω ± 2 Ω, typical
Voltage Standing Wave Ratio (VSWR)	1.2, typical DC to 500 MHz, typical
Input coupling	AC, DC, GND

Voltage Levels

Full scale (FS) input ranges (V_{pk-pk})	0.1 V 0.2 V 0.5 V 1 V 2 V 5 V
Maximum input overload	7 V_{rms} with |Peaks| ≤10 V

Accuracy

Resolution	8 bits
DC accuracy[1]	
0.1 V to 1 V input range	±(1.0% of input + 1.3% of FS), typical ±(2.2% of input + 1.8% of FS), maximum
2 V to 5 V input range	±(1.4% of input + 1.3% of FS), typical ±(2.9% of input + 1.8% of FS), maximum
DC drift[2]	±(0.14% of input + 0.05% of FS) per °C

[1] For typical values: at 23 °C. 23 °C assumed to be room temperature and ambient temperature during external calibration. For maximum values: within ±3 °C of self-calibration temperature.

[2] At 23 °C. 23 °C assumed to be room temperature and ambient temperature during external calibration.

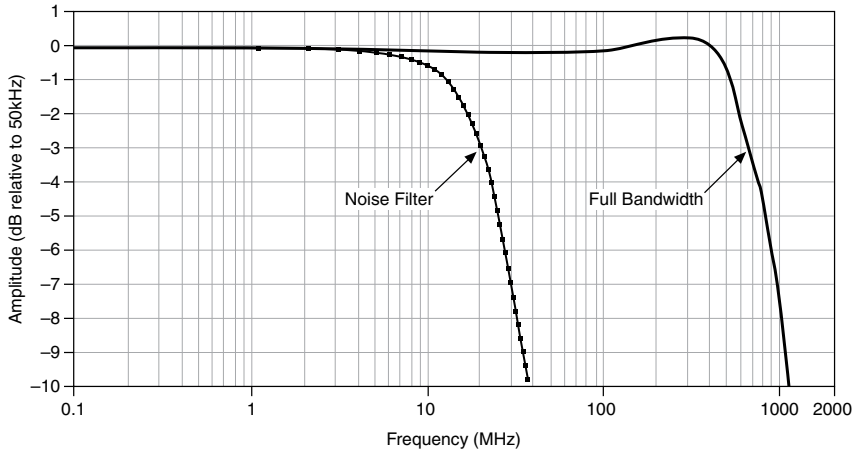
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Crosstalk	
CH 0 to/from CH 1[3]	<-80 dB at 10 MHz, typical <-60 dB at 100 MHz, typical
External trigger to CH 0 or CH 1[4]	<-80 dB at 10 MHz, typical <-70 dB at 100 MHz, typical

Bandwidth and Transient Response

Bandwidth (-3 dB)[5]	500 MHz minimum
Rise/fall time[5]	600 ps, typical
Bandwidth limit filter	20 MHz noise filter
AC coupling cutoff (-3 dB)[6]	114 kHz, typical

Figure 1. PXI-5153 Frequency Response, 5 V_{pk-pk} through 0.1 V_{pk-pk} Input Ranges (Typical)



[3] Measured on one channel with test signal applied to another channel, with same range setting on both channels.
[4] 10 V signal applied to external trigger channel. Applies to all ranges on CH 0 and CH 1.
[5] Filter off.
[6] 50 Ω source assumed.

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Figure 2. PXI-5153 Frequency Response, 5 V_{pk-pk} through 0.1 V_{pk-pk} Input Ranges (Typical)

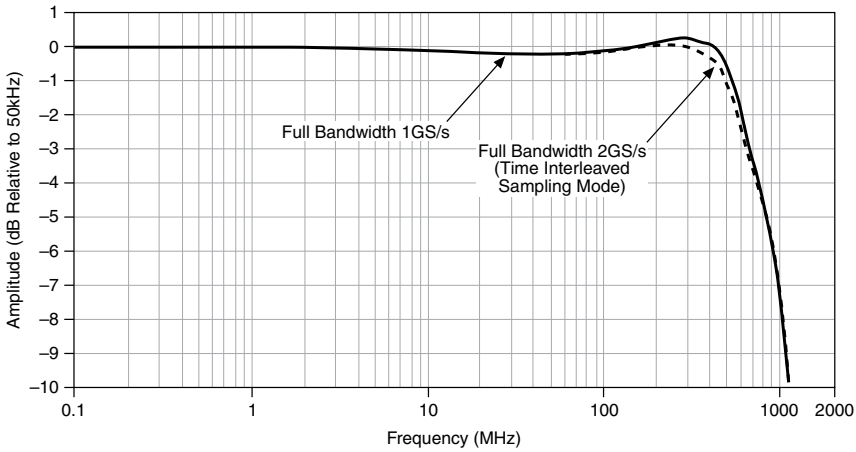
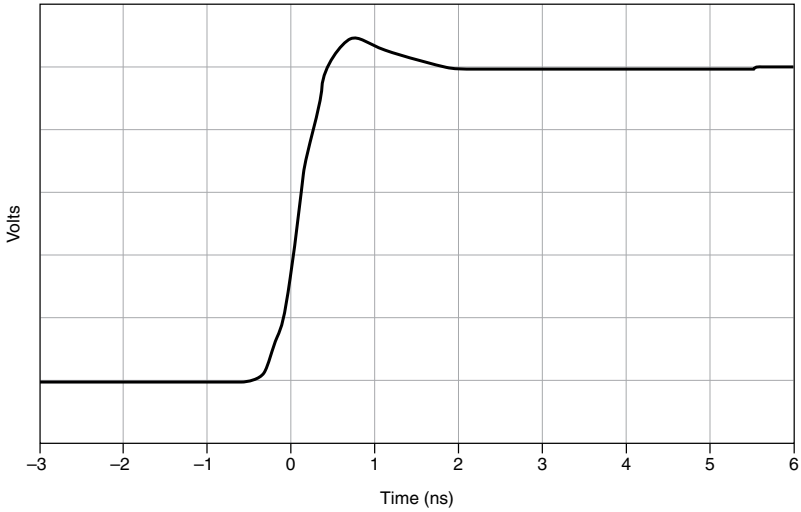


Figure 3. PXI-5153 Step Response, 5 V_{pk-pk} through 0.1 V_{pk-pk} Input Ranges (Typical)

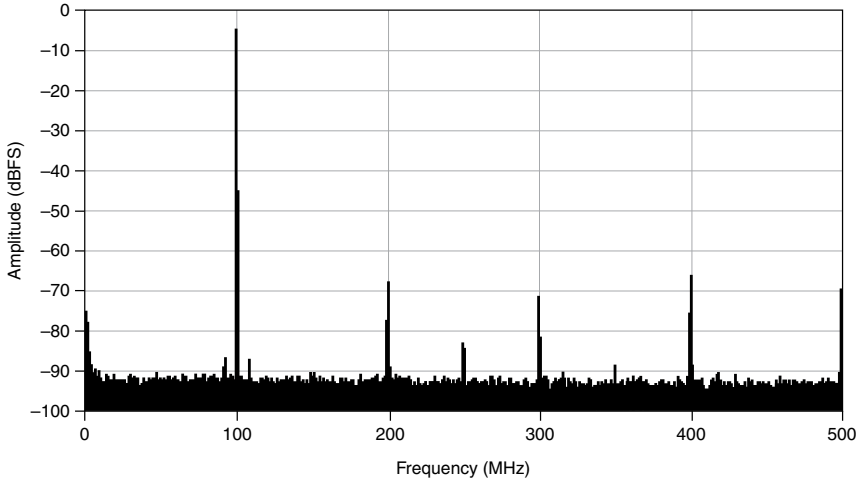


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Spectral Characteristics

ENOB[7]	
Noise filter on	7.3
Noise filter off	6.7
Signal to noise distortion (SINAD)[7]	
Noise filter on	45 dB, typical
Noise filter off	41 dB, typical

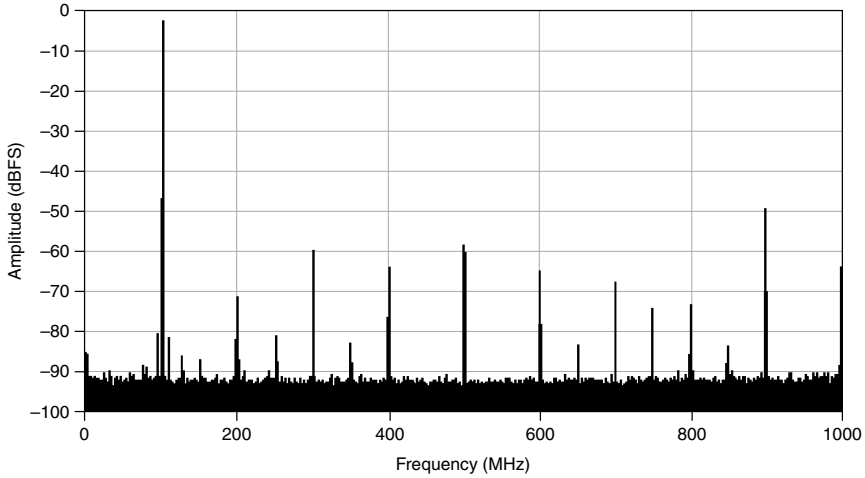
Figure 4. PXI-5153 Dynamic Performance, 2 V_{pk-pk} Input Range, 100 MHz Input Signal (Typical)



[7] 1 V input range, 10 MHz, -1 dBFS input signal. Includes the 2nd through the 5th harmonics.

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Figure 5. PXI-5153 TIS Dynamic Performance, 2 V_{pk-pk} Input Range, 100 MHz Input Signal (Typical)



Noise

Table 1. RMS Noise, Typical[8]

Range (V_{pk-pk})	Noise Filter On	Noise Filter Off	Noise Filter On TIS Mode	Noise Filter Off TIS Mode
0.1	0.37% FS	0.44% FS	0.41% FS	0.71% FS
0.2 to 5	0.32% FS	0.32% FS	0.41% FS	0.41% FS

Channel-to-channel skew	<140 ps, typical

Horizontal

Sample Clock

Sources	
Internal	Onboard clock (internal VSCO)[9]
External	PFI 0 (front panel SMB connector)

[8] 50 Ω terminator connected to input.
[9] Internal Sample clock is locked to the Reference clock or derived from the onboard VSCO.

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Timebase frequency	1 GHz[10]

Onboard Clock (Internal VCSO)

Sample rate range	
Real-time sampling (single shot)[11]	15.26 kS/s to 1 GS/s
TIS[12] mode (single shot)	2 GS/s (single channel only)
Random interleaved sampling (RIS) mode[13]	2 GS/s to 20 GS/s in increments of 1 GS/s (repetitive waveforms only)
Timebase accuracy	
Not phase-locked to Reference clock	1 GHz ±30 ppm within ±3 °C of external calibration temperature
Phase-locked to Reference clock	Equal to the Reference clock accuracy[14]
Timebase drift	
Not phase-locked to Reference clock	±7 ppm per °C
Phase-locked to Reference clock	Equal to Reference clock drift
Sample clock delay range	±1 Sample clock period
Sample clock delay/adjustment resolution	≤5 ps

External Sample Clock

Sources	PFI 0 (front panel SMB connector)
Frequency range[15]	350 MHz to 1 GHz
Duty cycle tolerance	45% to 55%

Phase-Locked Loop (PLL) Reference Clock

Sources	PXI_CLK10 (PXI backplane connector) PFI 0 (front panel SMB connector)
Frequency range[16]	1 MHz to 20 MHz in 1 MHz increments Default: 10 MHz

[10] When not using external Sample clock.
[11] Divide by *n* decimation used for all rates less than 1 GS/s.
[12] TIS is a type of real-time sampling that is sometimes called ping-pong.
[13] RIS is a type of equivalent-time sampling.
[14] Refer to your chassis specifications for the Reference clock accuracy.
[15] Divide by *n* decimation available where $1 \leq n \leq 65{,}535$. For more information about the Sample clock and decimation, refer to the *NI High-Speed Digitizers Help*.
[16] The PLL Reference clock frequency must be accurate to ±50 ppm.

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Duty cycle tolerance	45% to 55%
Exported Reference Clock destinations	PXI_Trig <0..7> (backplane connector) PFI 1 (front panel SMB connector)

Sample Clock and Reference Clock Input (PFI 0, Front Panel Connector)

Input voltage range	Sine wave: 0.65 V_{pk-pk} to 2.8 V_{pk-pk} (0 dBm to 13 dBm)
Maximum input overload	7 V_{rms} with |Peaks| ≤10 V
Impedance	50 Ω
Coupling	AC

Reference Clock Output (PFI 1, Front Panel Connector)

Output impedance	50 Ω
Logic type	3.3 V CMOS, except when exporting 5 V
Maximum drive current	±24 mA

Trigger

Trigger types[17]	Edge Window Hysteresis Video Digital Immediate Software
Trigger sources	CH 0 CH 1 TRIG PFI <0..1> RTSI <0..6> Software

[17] Refer to the following sources and the *NI High-Speed Digitizers Help* for more information about which sources are available for each trigger type.

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Time resolution	
Onboard clock, time-to-digital conversion circuit (TDC) on	5 ps
Onboard clock, TDC off	1 ns
External clock, TDC off	External clock period
Minimum rearm time[18]	
TDC on	8 µs
TDC off	1 µs
Holdoff	From rearm time up to [(2^{32} - 1) × Sample clock period]
Trigger delay	From 0 up to [(2^{35} - 1) - Posttrigger samples] × (1/Sample rate), in seconds

Analog Trigger

Trigger types	Edge Window Hysteresis
Sources	CH 0 (front panel BNC connector) CH 1 (front panel BNC connector) TRIG (front panel BNC connector)
Trigger level range	
CH 0, CH 1	100% FS
TRIG (External trigger)	±5 V
Voltage resolution	8 bits (1 in 256)
Edge trigger sensitivity: CH 0, CH 1, TRIG (External trigger)	10% FS DC to 500 MHz
Trigger level accuracy	
CH 0, CH 1	±5% FS up to 10 MHz, typical
TRIG (External trigger)	±1 V (±10% FS) up to 10 MHz[19], typical
Trigger jitter[20]	≤14 ps_{rms}, typical ≤20 ps_{rms} maximum

[18] Holdoff set to 0. Onboard Sample clock at maximum rate.
[19] At 23 °C.
[20] Within ±3 °C of self-calibration temperature.

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Trigger filters	
Low frequency (LF) reject	50 kHz, typical
High frequency (HF) reject	50 kHz, typical

Digital Trigger

Trigger type	Digital
Sources	PXI_Trig <0..6> (backplane connector) PFI <0..1> (front panel SMB connectors) PXI Star Trigger (backplane connector)

External Trigger Input (Front Panel Connector)

Connector	BNC
Impedance	2.25 kΩ
Coupling	DC
Input voltage range	±5 V
Maximum input overload	|Peaks| ≤10 V

PFI 0 and PFI 1 (Programmable Function Interface, Front Panel Connectors)

Connector	SMB jack
Direction	Bidirectional

As an Input (Trigger)

Destination	Start trigger (acquisition arm) Reference (stop) trigger Arm reference trigger Advance trigger
Input impedance	150 kΩ
V_{IH}	2.0 V
V_{IL}	0.8 V
Maximum input overload	-0.5 V to 5.5 V
Maximum frequency	25 MHz

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As an Output (Event)

Sources	Ready for Start Start trigger (acquisition arm) Ready for Reference Reference (stop) trigger End of Record Ready for Advance Advance trigger Done (end of acquisition) Probe Compensation[21]
Output impedance	50 Ω
Logic type	3.3 V CMOS
Maximum drive current	±24 mA
Maximum frequency	25 MHz

Waveform Specifications

Table 2. Onboard Memory Size

Real-Time and RIS Modes	Real-Time TIS Mode
8 MB standard (8 MS per channel)	8 MB standard (8 MS)
64 MB option (64 MS per channel)	64 MB option (64 MS)
256 MB option (256 MS per channel)	256 MB option (256 MS)

Minimum record length	1 sample
Number of pretrigger samples	Zero up to full record length[22]
Number of posttrigger samples	Zero up to full record length

[21] 1 kHz, 50% duty cycle square wave. PFI 1 only.
[22] Single-record mode and multiple-record mode.

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Maximum number of records in onboard memory[23]	
8 MB per channel	32,768
64 MB per channel	100,000
256 MB per channel	100,000
Allocated onboard memory per record	[(Record length × 1 byte/sample) + 400 bytes] rounded up to next multiple of 128 bytes

Calibration

External Calibration

External calibration calibrates the onboard references used in self-calibration and the external trigger levels. All calibration constants are stored in nonvolatile memory.

Self-Calibration

Self-calibration is done on software command. The calibration corrects for gain, offset, triggering, and timing errors for all input ranges, excluding External Trigger input channel.

Calibration Specifications

Interval for external calibration	2 years
Warm-up time	15 minutes

Software

Driver Software

Driver support for this device was first available in NI-SCOPE 3.5.

NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the PXI-5153. NI-SCOPE provides application programming interfaces for many development environments.

Application Software

NI-SCOPE provides programming interfaces, documentation, and examples for the following application development environments:

- LabVIEW
- LabWindows™/CVI™
- Measurement Studio

[23] It is possible to exceed these numbers if you fetch records while acquiring data. For more information, refer to the *High-Speed Digitizers Help*.

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- Microsoft Visual C/C++
- .NET (C# and VB.NET)

Interactive Soft Front Panel and Configuration

The NI-SCOPE Soft Front Panel (SFP) allows interactive control of the PXI-5153.

Interactive control of the PXI-5153 was first available in NI-SCOPE SFP version 3.5. The NI-SCOPE SFP is included on the NI-SCOPE media.

NI Measurement Automation Explorer (MAX) also provides interactive configuration and test tools for the PXI-5153. MAX is included on the NI-SCOPE media.

TClk Specifications

You can use the NI TClk synchronization method and the NI-TClk driver to align the Sample clocks on any number of supported devices, in one or more chassis. For more information about TClk synchronization, refer to the *NI-TClk Synchronization Help*, which is located within the *NI High-Speed Digitizers Help*. For other configurations, including multichassis systems, contact NI Technical Support at *ni.com/support*.

Intermodule SMC Synchronization Using NI-TClk for Identical Modules

Synchronization specifications are valid under the following conditions:

- All modules are installed in one NI PXI-1042 chassis
- The NI-TClk driver is used to align the Sample clocks of each module.
- All parameters are set to identical values for each module.
- Modules are synchronized without using an external Sample clock.
- Sample clock set to 1 GS/s and all filters are disabled.

Note Although you can use NI-TClk to synchronize non-identical SMC-based modules, these specifications apply only to synchronizing identical modules.

Skew[24]	500 ps, typical
Skew after manual adjustment	≤5 ps, typical
Sample clock delay/adjustment resolution	≤5 ps, typical

Power

Current draw	
+3.3 VDC	1.7 A
+5 VDC	1.8 A

[24] Caused by clock and analog path delay differences. No manual adjustment performed.

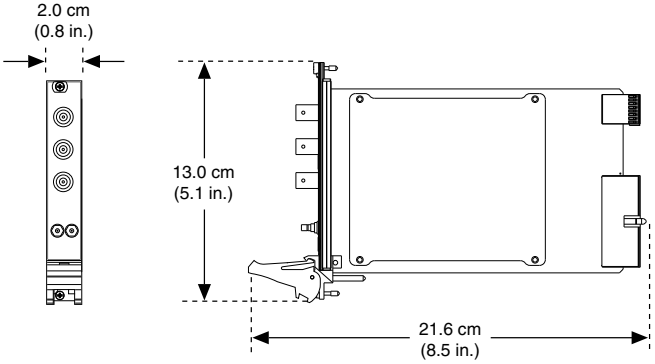
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+12 VDC	520 mA
-12 VDC	200 mA
Total power	23.25 W

Physical

Dimensions	3U, one-slot, PXI module 21.6 cm × 2.0 cm × 13.0 cm (8.5 in × 0.8 in × 5.1 in)
Weight	481 g (16.97 oz)

Figure 6. PXI-5153 Dimensions



Environment

Environment

Maximum altitude	2,000 m (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

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Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

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, 0.31 g_{rms} (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.46 g_{rms} (Tested in accordance with IEC 60068-2-64. Test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Compliance and Certifications

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 C22.2 No. 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:

- 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

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- 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, 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:

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

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*.

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