SPECIFICATIONS

PCI-5922

24-Bit, Flexible Resolution PCI Oscilloscope Device

Contents

Definitions....2
Conditions....2
Vertical....2
- Analog Input....2
- Impedance and Coupling....3
- Voltage Levels....3
- Accuracy....3
- Bandwidth and Transient Response....4
- Spectral Characteristics....6
- Skew, Input Bias Current....9
- Settling Time....10

Horizontal....11
- Sample Clock....11
- Onboard Clock (Internal VCXO)....11
- Phase-Locked Loop (PLL) Reference Clock....12

Trigger....13
- Reference (Stop) Trigger....13
- External Trigger....14
- PFI 0 and PFI 1 (Programmable Function Interface, AUX Front Panel Connectors)....14

Waveform Specifications....15
Calibration....16
Software....16
- Driver Software....16
- Application Software....16
- Interactive Soft Front Panel and Configuration....16
- TClk Specifications....17

Power....17
Physical....17
Environment....18
- Operating Environment....18
- Storage Environment....18

Compliance and Certifications....18
- Safety Compliance Standards....18
- Electromagnetic Compatibility....19
- CE Compliance....19

NATIONAL INSTRUMENTS

Product Certifications and Declarations..... 19
Environmental Management..... 19

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty. Warranted specifications account for measurement uncertainties, temperature drift, and aging. Warranted specifications are ensured by design or verified during production and calibration.

Characteristics 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.
- *Measured* specifications describe the measured performance of a representative model.

Specifications are *Typical* unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Full operating temperature range
- All impedance selections
- All sample rates
- Source impedance ≤50 Ω

Specifications are valid under the following conditions unless otherwise noted:

- Ambient temperatures of 15 °C to 35 °C

Vertical

Analog Input

Number of channels	Software-selectable: two simultaneously sampling, single-ended or unbalanced differential channels or one differential channel
Connector	BNC

Impedance and Coupling

Input impedance	Software-selectable: 50 Ω ±2.0% or 1 MΩ ±2.0% in parallel with a nominal capacitance of 60 pF
Input coupling	AC, DC, GND

Voltage Levels

Full-scale (FS) input range	±1 V (2 V_{pk-pk}) ±5 V (10 V_{pk-pk})
Maximum input overload	
50 Ω	7 V RMS with |Peaks| ≤10 V
1 MΩ	|Peaks| ≤42 V

Accuracy

Table 1. PCI-5922 Resolution

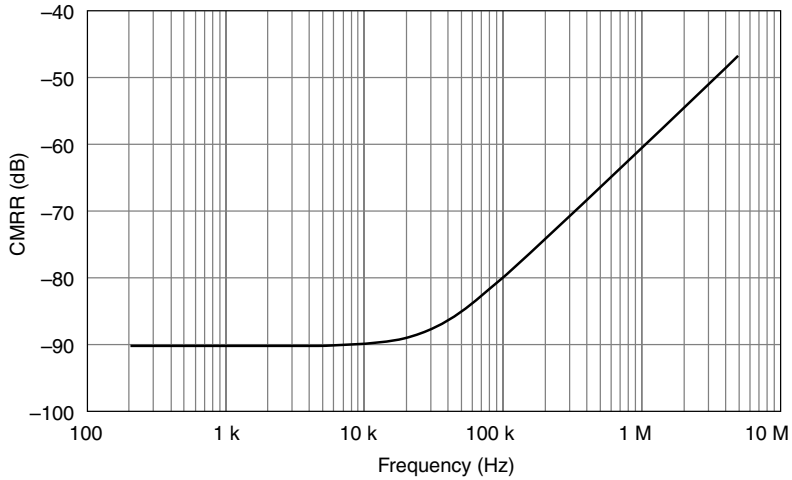
Sample Rate	Resolution
50 kS/s	24 bits
500 kS/s	24 bits
1 MS/s	22 bits
5 MS/s	20 bits
10 MS/s	18 bits
15 MS/s	16 bits

DC accuracy[1]	
2 V_{pk-pk} range	±(0.05% of input + 50 µV), warranted
10 V_{pk-pk} range	±(0.05% of input + 100 µV), warranted
DC drift[2]	
2 V_{pk-pk} range	±(0.002% of input + 5 µV per °C), nominal
10 V_{pk-pk} range	±(0.002% of input + 10 µV per °C), nominal

[1] 1 MΩ input impedance; within ±5 °C of self-calibration temperature.
[2] 1 MΩ input impedance.

AC amplitude accuracy	0.06% at 1 kHz[3]
Crosstalk[4]	
At 100 kHz	≤-110 dB
At 1 MHz	≤-100 dB
At 6 MHz	≤-80 dB
Common-mode rejection ratio (CMRR)	50 dB up to 1 kHz[5]

Figure 1. PCI-5922 CMRR with Differential Terminal Configuration, Measured



Bandwidth and Transient Response

Alias-free bandwidth	0.4 × *Sample Rate*

Table 2. Alias Protection[6]

Sample Rate	Attenuation
<5 MS/s	100 dB
5 MS/s	96 dB

[3] 1 MΩ input impedance; within ±5 °C of self-calibration temperature.
[4] CH 0 to/from CH 1, External Trigger to CH 0 or CH 1.
[5] Unbalanced differential input terminal configuration.
[6] Input frequencies ≥ 0.6 × *Sample Rate*.

Table 2. Alias Protection[6] (Continued)

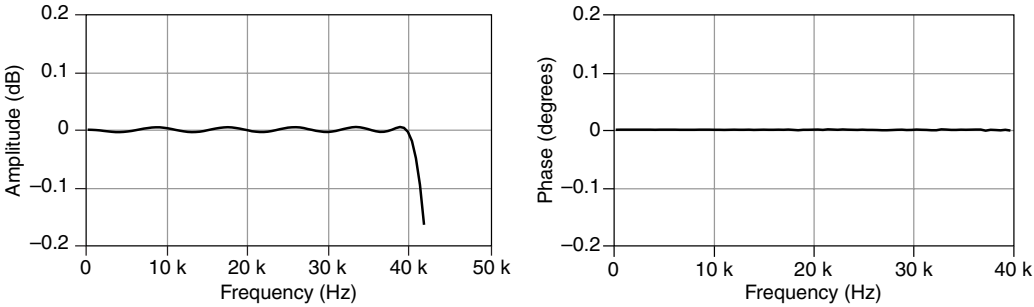
Sample Rate	Attenuation
(5 MS/s, 7.5 MS/s)	90 dB
[7.5 MS/s, 15 MS/s]	80 dB

AC coupling cutoff (-3 dB) 90 Hz

Table 3. Passband Flatness[7]

Sample Rate	50 Ω and 1 MΩ
1 MS/s	0.03 dB
5 MS/s	0.06 dB
10 MS/s	0.15 dB
15 MS/s	0.3 dB

Figure 2. 100 kS/s Frequency Response, Measured



[6] Input frequencies ≥ 0.6 × *Sample Rate*.
[7] Referenced to DC; input frequencies up to 0.4 × *Sample Rate*.

Figure 3. 1 MS/s Frequency Response, Measured

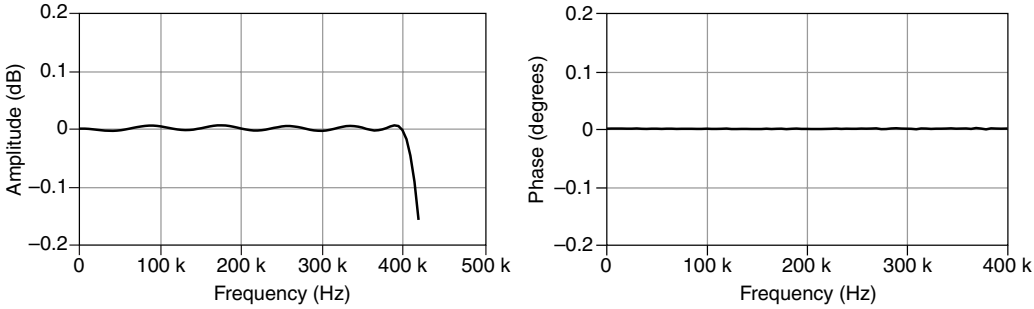
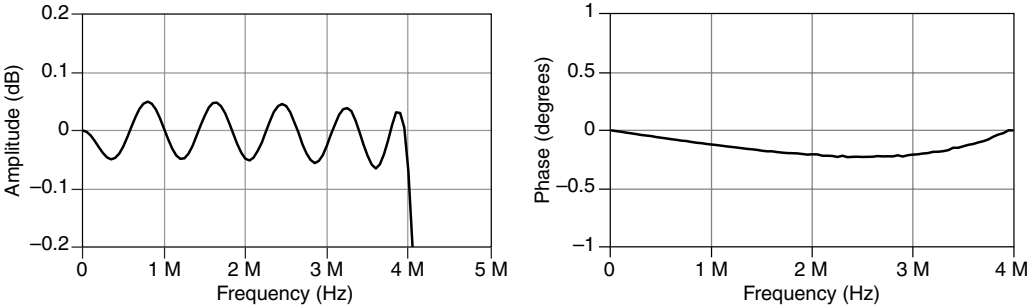


Figure 4. 10 MS/s Frequency Response, Measured



Spectral Characteristics

Table 4. Spurious-Free Dynamic Range (SFDR)[8]

Input Frequency	Range	
	10 V_{pk-pk}	**2 V_{pk-pk}**
10 kHz	114 dBc	109 dBc
100 kHz	110 dBc	103 dBc
1 MHz	96 dBc	92 dBc

[8] -1 dBFS input signal; *Sample Rate* is 10 × input frequency; within ±2 °C of self-calibration temperature.

Figure 5. PCI-5922 Dynamic Performance with 10 kHz Input Signal, Measured,1 MΩ, 10 V_{pk-pk} Range, 500 kS/s, Unbalanced Differential, 10,000-Point FFT with 10 Averages

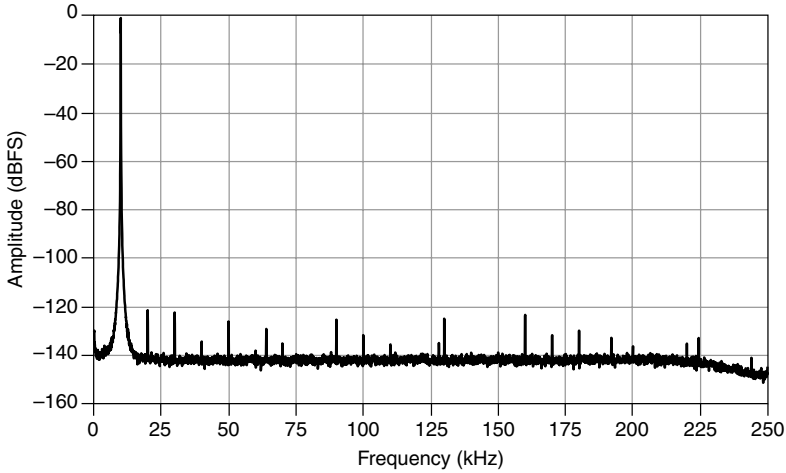


Figure 6. PCI-5922 Dynamic Performance with 10 kHz Input Signal, Measured, 1 MΩ, 2 V_{pk-pk} Range, 100 kS/s, Unbalanced Differential, 10,000-Point FFT with 10 Averages

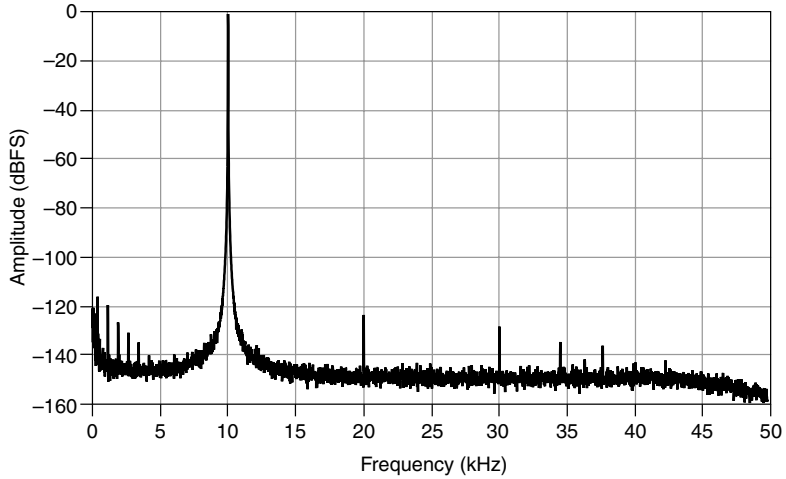


Table 5. Total Harmonic Distortion (THD)[9]

Input Frequency	Range	
	10 V_{pk-pk}	**2 V_{pk-pk}**
10 kHz	-112 dBc	-107 dBc
100 kHz	-108 dBc	-101 dBc
1 MHz	-94 dBc	-90 dBc

Table 6. Signal-to-Noise and Distortion (SINAD)[10]

Sample Rate	Range	
	10 V_{pk-pk}	**2 V_{pk-pk}**
1 MS/s	105 dB	99 dB
10 MS/s	89 dB	87 dB

Table 7. Signal-to-Noise Ratio (SNR) without Harmonics[11]

Sample Rate	Range	
	10 V_{pk-pk}	**2 V_{pk-pk}**
1 MS/s	108 dB	104 dB
10 MS/s	91 dB	90 dB

[9] -1 dBFS input signal; includes the second through the fifth harmonics; within ±2 °C of self-calibration temperature .

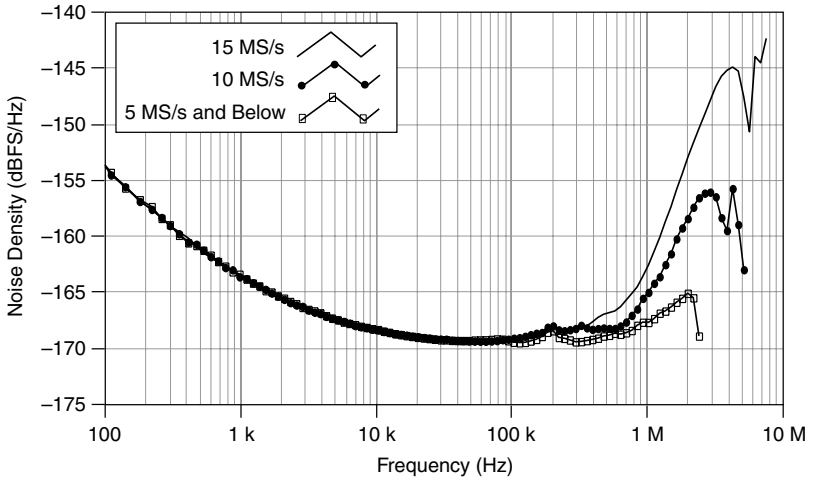
[10] -1 dBFS input signal; input frequency is 0.1 × *Sample rate*; within ±2 °C of self-calibration temperature; calculated from THD and RMS noise.

[11] -1 dBFS input signal; input frequency is 0.1 × *Sample rate*; within ±2 °C of self-calibration temperature; calculated from SINAD and THD.

Table 8. RMS Noise, Warranted[12]

Sample Rate	Range			
	10 V_{pk-pk}		2 V_{pk-pk}	
	dBFS	μV_{rms}	dBFS	μV_{rms}
50 kS/s	-120	3.4	-110	2.2
100 kS/s	-118	4.3	-110	2.2
1 MS/s	-108	13	-104	4.2
5 MS/s	-101	31	-98	8.7
10 MS/s	-91	92	-91	20
15 MS/s	-79	401	-79	80

Figure 7. PCI-5922 Noise Density, Measured



Skew, Input Bias Current

Channel-to-channel skew[13]	≤500 ps
Input bias current[14]	≤500 nA, warranted

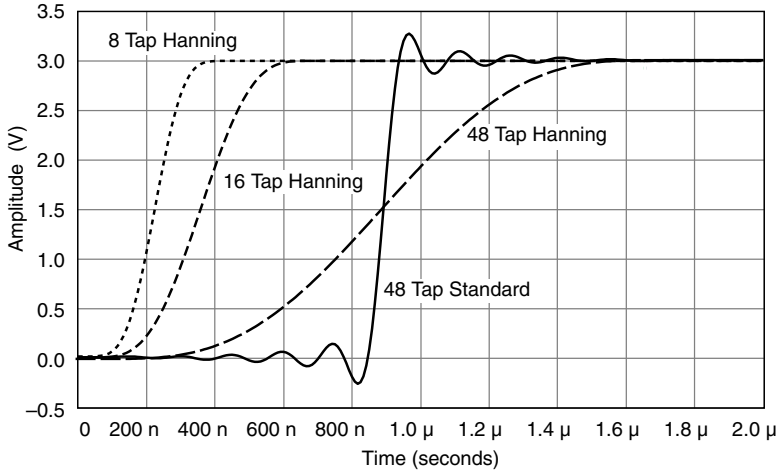
[12] 100 Hz to 0.4 × *Sample rate*; DC coupling; input 50 Ω terminated.
[13] 1 MHz input, 5 MS/s sample rate.
[14] Within ±5 °C of self-calibration temperature.

Settling Time

Table 9. Settling Time[15]

Filter Type[16]	1%	0.01%
48 Tap Standard	800 ns	2.5 µs
48 Tap Hanning	700 ns	1.5 µs
16 Tap Hanning	300 ns	1.4 µs
8 Tap Hanning	200 ns	1.3 µs

Figure 8. PCI-5922 Step Response Using Different Filter Types, Measured[17]

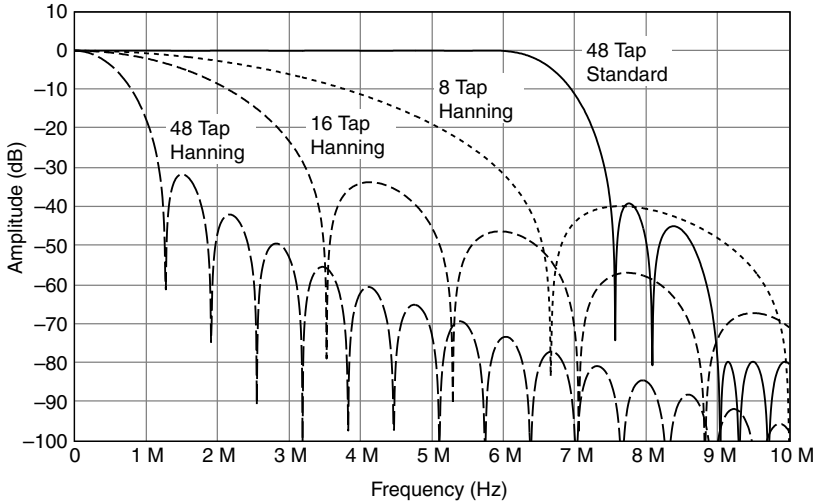


[15] For a 3 V step from 0 V DC, excluding noise; time referenced to 1.5 V (50%) trigger; applies to 15 MS/s sample rate only.

[16] To set or change the filter type, use the **Flex FIR Antialias Filter Type** property or the `NISCOPE_ATTR_FLEX_FIR_ANTIALIAS_FILTER_TYPE` attribute.

[17] Time (t= 0) represents the actual time the edge arrived at the BNC connector on the NI 5922.

Figure 9. PCI-5922 Frequency Response Using Different Filter Types, Measured



Horizontal

Sample Clock

Sources	Internal onboard clock (internal VCXO)[18]

Onboard Clock (Internal VCXO)

Sample rate range, real-time sampling (single shot)[19]	50 kS/s to 15 MS/s
Phase noise density (5 MHz input signal)	
At 10 kHz	<-133 dBc/Hz
At 100 kHz	<-145 dBc/Hz
Sample clock jitter[20]	≤3 ps RMS (100 Hz to 1 MHz)
Timebase frequency	120 MHz

[18] Internal Sample clock is locked to the Reference clock or derived from the onboard VCXO.

[19] Available rates are (60 MS/s) /*n* where *n* is an integer value from 4 to 1200. The Sample clock period is n/(60MS/s).

[20] Includes the effects of the converter aperture uncertainty and the clock circuitry jitter; excludes trigger jitter.

Timebase accuracy	
Not phase-locked to Reference clock	±50 ppm, warranted
Phase-locked to Reference clock	Equal to the Reference clock accuracy
Sample clock delay range	±1 Sample clock period
Sample clock delay resolution	400 ps

Phase-Locked Loop (PLL) Reference Clock

Reference clock sources	RTSI 7 CLK IN (front panel SMB connector)
Frequency range	1 MHz to 20 MHz in 1 MHz increments[21]; must be accurate to ±50 ppm
Duty cycle tolerance	45% to 55%
Exported Reference clock destinations	CLK OUT (front panel SMB connector) PFI <0..1> (front panel 9-pin mini-circular DIN connector) RTSI <0..7>

CLK IN (Reference Clock Input, Front Panel Connector)

Input voltage range	Square wave: 0.2 V_{pk-pk} to 1 V_{pk-pk}
Maximum input overload	7 V RMS with |Peaks| ≤10 V
Impedance	50 Ω
Coupling	AC

CLK OUT (Reference Clock Output, Front Panel Connector)

Output impedance	50 Ω
Logic type	5 V CMOS
Maximum drive current	±50 mA

[21] The default value is 10 MHz.

Trigger

Reference (Stop) Trigger

Trigger types	Edge Window Hysteresis Digital Immediate Software
Trigger sources	CH 0 CH 1 TRIG PXI_Trig <0..6> PFI <0..1> PXI Star Trigger RTSI <0..6> Software
Time resolution	Sample clock period
Rearm time	144 × *Sample clock period*[22]
Holdoff	Up to (2^{32} - 1) × *Sample clock period*

Related Information

Refer to the NI High-Speed Digitizers Help for more information about the sources available for each trigger type.

Analog Trigger

Trigger types	Edge Window Hysteresis
Sources[23]	CH 0 (front panel BNC connector) CH 1 (front panel BNC connector) TRIG (front panel BNC connector)
Trigger level range	100% FS

[22] Holdoff set to 0.
[23] TRIG is an analog edge trigger only.

Edge trigger sensitivity	
CH 0, CH 1	2% FS
TRIG (external trigger)	0.3 V_{pk-pk} up to 1 MHz
Jitter	Sample clock period

Digital Trigger

Trigger type	Digital
Sources	RTSI <0..6> PFI <0..1> (front panel 9-pin DIN connector)

External Trigger

Source	TRIG (front panel BNC connector)
Impedance	100 kΩ in parallel with 52 pF, nominal
Input voltage range	±2.5 V
Coupling	DC
Level accuracy	±0.3 V up to 100 kHz
Maximum input overload	|Peaks| ≤42 V

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

Connector	9-pin mini-circular DIN
Direction	Bidirectional

As an Input (Trigger)

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

As an Output (Event)

Sources	Start trigger (acquisition arm) Reference (stop) trigger End of Record Done (end of acquisition)
Output impedance	50 Ω
Logic type	3.3 V CMOS
Maximum drive current	±24 mA
Maximum frequency	20 MHz

Waveform Specifications

Onboard memory size	
8 MB/channel	2 MS/channel
32 MB/channel	8 MS/channel
256 MB/channel	64 MS/channel
Minimum record length	1 Sample
Number of pretrigger samples	0 up to full Record Length for both single-record mode and multiple-record mode
Number of posttrigger samples	0 up to full Record Length for both single-record mode and multiple-record mode
Maximum number of records in onboard memory[24]	
8 MB/channel	13,107
32 MB/channel	52,428
256 MB/channel	100,000
Allocated onboard memory per record	(*Record Length* × 4 bytes/S) + 400 bytes, rounded up to next multiple of 128 bytes or 640 bytes, whichever is greater

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

Calibration

Self-calibration	Self-calibration is done on software command. The calibration corrects for gain and offset for all input ranges, input bias current, and nonlinearities in the ADCs.
External calibration (factory calibration)	The external calibration calibrates the VCXO and the voltage reference. Appropriate constants are stored in nonvolatile memory.
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 3.0.

NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the PCI-5922. 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
- Microsoft Visual C/C++
- .NET (C# and VB.NET)

Interactive Soft Front Panel and Configuration

When you install NI-SCOPE on a 64-bit system, you can monitor, control, and record measurements from the PCI-5922 using InstrumentStudio.

InstrumentStudio is a software-based front panel application that allows you to perform interactive measurements on several different device types in a single program.

Note InstrumentStudio is supported only on 64-bit systems. If you are using a 32-bit system, use the NI-SCOPE–specific soft front panel instead of InstrumentStudio.

Interactive control of the PCI-5922 was first available via InstrumentStudio in NI-SCOPE 18.1 and via the NI-SCOPE SFP in NI-SCOPE 2.2. InstrumentStudio and the NI-SCOPE SFP are included on the NI-SCOPE media.

NI Measurement & Automation Explorer (MAX) also provides interactive configuration and test tools for the PCI-5922. MAX is included on the driver 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

Specifications are valid under the following conditions:

- Any number of PXI modules installed in one NI PXI-1042 chassis.
- All parameters set to identical values for each SMC-based module.
- Sample clock set to 15 MS/s and all filters disabled.

Skew[25]	500 ps
Average skew after manual adjustment	<10 ps
Sample clock delay/adjustment resolution	≤5 ps

Power

Current draw	
+3.3 V DC	2.0 A
+5 V DC	2.5 A
+12 V DC	450 mA
-12 V DC	0 A
Total power	24.5 W

Physical

Dimensions	35.5 cm × 2.0 cm × 11.3 cm (14.0 in × 0.8 in × 4.4 in)
Weight	415 g (14.6 oz)

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

Environment

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

Indoor use only.

Note To ensure that the PCI-5922 cools effectively, make sure that the chassis in which it is used has active cooling that provides at least some airflow across the PCI card cage. To maximize airflow and extend the life of the device, leave any adjacent PCI slots empty. Refer to the *Maintain Forced-Air Cooling Note to Users* included in the kit or available at *ni.com/manuals* for important cooling information. The PCI-5922 is intended for indoor use only.

Operating Environment

Ambient temperature range	0 °C to 45 °C
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

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.)

Compliance and Certifications

Safety Compliance Standards

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 *Product Certifications and Declarations* 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
- 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 *Product Certifications and Declarations* 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)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit *ni.com/product-certifications*, search by model number, and click the appropriate link.

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 *Commitment to the Environment* 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`.)

374049J-01 August 15, 2019