PCI-5152 Specifications

2022-07-11

Contents

PCI-5152 Specifications

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 in this document are **Typical** 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
- Self-calibration is completed after warm-up period

- 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 chassis slot blockers and filler panels. For more information about cooling, refer to **Note to Users: Maintain Forced Air Cooling** on ni.com.

Vertical

Analog Input (Channel 0 and Channel 1)

Number of channels	Two (simultaneously sampled)
Connectors	BNC

Impedance and Coupling

Input Impedance (software-selectable)	
50 Ω	50 Ω ±1.5%
1 MΩ	1 MΩ ±0.75% in parallel with a nominal capacitance of 22 pF
Input coupling	Software-selectable: AC, DC, GND

Voltage Levels

Range (V_{pk-pk})	50 Ω Offset (V)	1 MΩ Offset (V)
0.1	±1	±1
0.2		
0.4		
1		
2	±6	±10
4	±5	

Range (V_{pk-pk})	50 Ω Offset (V)	1 MΩ Offset (V)
10	±2	

Table 1. Full Scale (FS) Input Range and Programmable Vertical Offset Range

Maximum input overload

50 Ω	7 V_{rms} with |Peaks| ≤10 V
1 MΩ	|Peaks| ≤42 V

Accuracy

Resolution	8 bits

DC accuracy, warranted[1][2]

0.1 V to 1 V input range	±(1.26% of Input + 1.0% of FS + 500 µV)
2 V to 10 V input range	±(1.26% of Input + 1.0% of FS + 5 mV)

Programmable vertical offset accuracy[2]	±0.9% of offset setting, warranted

DC Drift, nominal[3]

0.1 V to 1 V input range	±(0.052% of Input + 100 µV) per °C
2 V to 10 V input range	±(0.052% of Input + 1.0 mV) per °C

Crosstalk

CH 0 to/from CH 1[4]

10 MHz	<-80 dB

100 MHz	<-60 dB

Ext Trig to CH 0 or CH 1[5]

10 MHz	<-80 dB
100 MHz	<-80 dB

Bandwidth and Transient Response

Bandwidth (-3 dB), warranted[6], [7]

0.1 V input range

50 Ω	165 MHz, typical
	135 MHz minimum
1 MΩ	135 MHz, typical
	110 MHz minimum

All other input ranges

50 Ω	340 MHz, typical
	300 MHz minimum
1 MΩ	300 MHz, typical
	260 MHz minimum

Rise/fall time[8]

0.1 V input range

50 Ω	2.4 ns
1 MΩ	2.8 ns [9]

All other input ranges

50 Ω	1.2 ns
1 MΩ	1.4 ns [9]

Bandwidth limit filter	20 MHz noise filter

AC coupling cutoff (-3 dB)[10]

50 Ω	106 kHz
1 MΩ	12 Hz

Figure 1. PCI-5152 Frequency Response, 50 Ω, 1 V, Measured

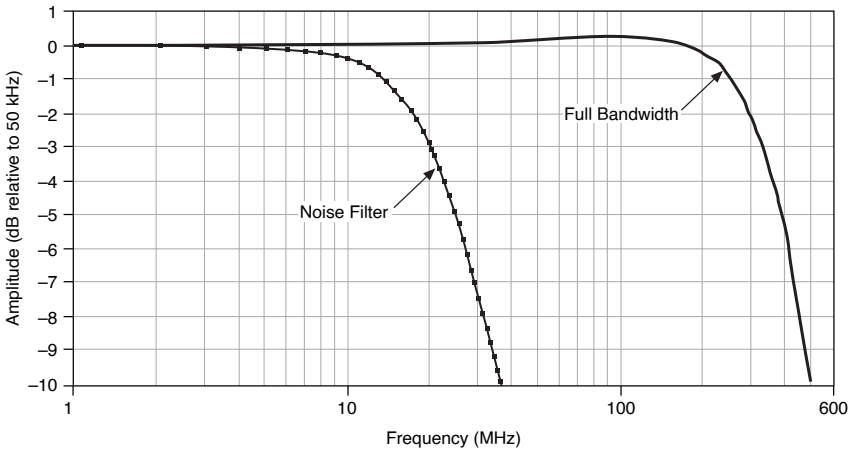


Figure 2. PCI-5152 Frequency Response, 50 Ω, 1 V Input Range, Measured

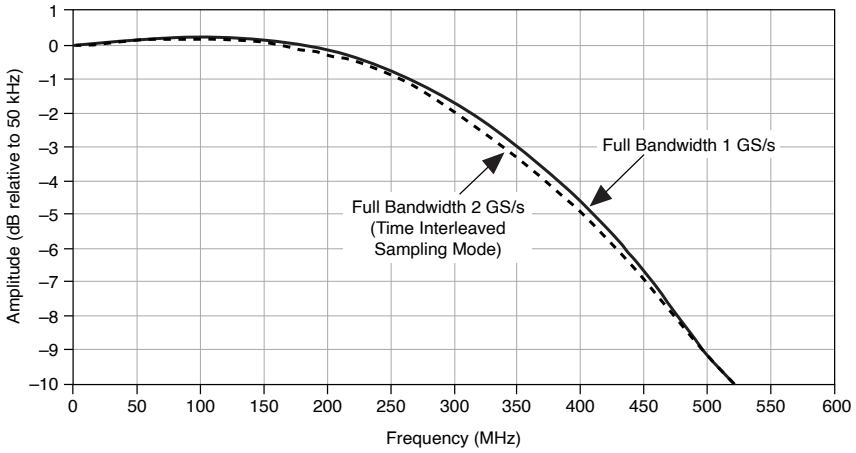


Figure 3. PCI-5152 Step Response, 50 Ω, 10 V_{pk-pk} through 0.2 V_{pk-pk} Input Range, Measured

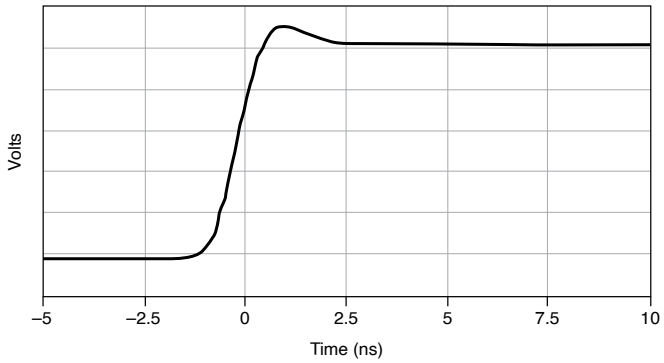
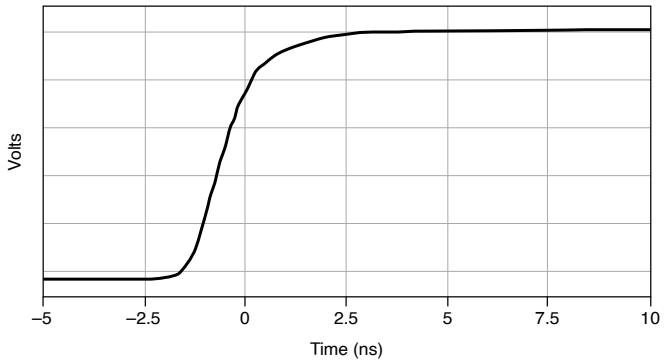


Figure 4. PCI-5152 Step Response, 50 Ω, 0.1 V_{pk-pk} Input Range, Measured



Spectral Characteristics

ENOB[11]

Noise filter on	7.3
Noise filter off	7.1

Signal to Noise and Distortion (SINAD)[11]	
Noise filter on	45 dB
Noise filter off	43 dB

Figure 5. PCI-5152 Dynamic Performance, 50 Ω, 1 V_{pk-pk} Range, 9.425 MHz, -1 dBFS Input Signal, Measured

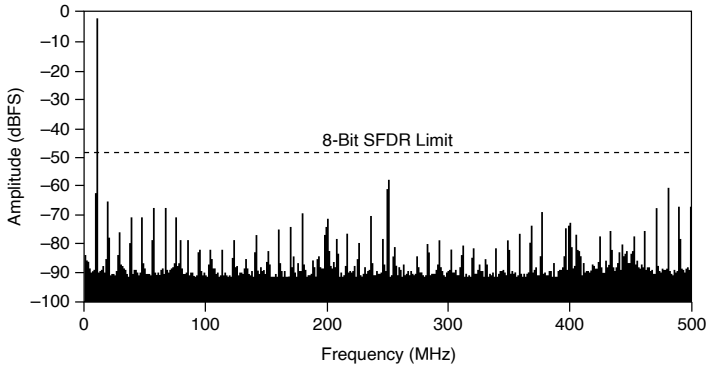
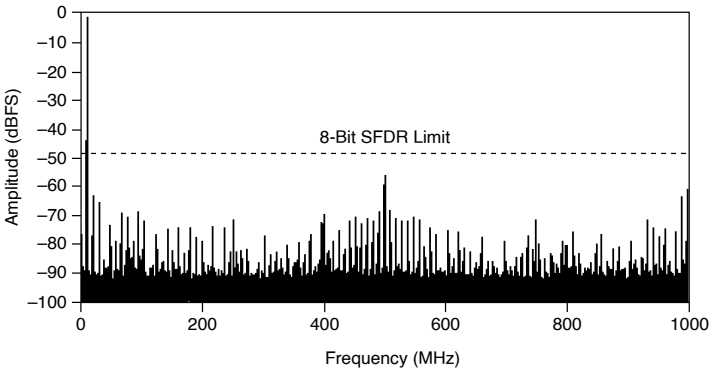


Figure 6. PCI-5152 TIS Dynamic Performance, 50 Ω, 1 V_{pk-pk} Range, 9.425 MHz, -1 dBFS Input Signal, Measured



Noise

Range (V_{pk-pk})	Noise Filter On	Noise Filter Off
0.1	240 μV_{rms} (0.24% FS)	320 μV_{rms} (0.32% FS)
0.2	480 μV_{rms} (0.24% FS)	600 μV_{rms} (0.30% FS)
0.4	960 μV_{rms} (0.24% FS)	1.12 mV_{rms} (0.28% FS)
1	2.4 mV_{rms} (0.24% FS)	2.6 mV_{rms} (0.26% FS)
2	4.8 mV_{rms} (0.24% FS)	6.0 mV_{rms} (0.30% FS)
4	9.6 mV_{rms} (0.24% FS)	11.2 mV_{rms} (0.28% FS)
10	24 mV_{rms} (0.24% FS)	26 mV_{rms} (0.26% FS)

Table 2. RMS Noise[12]

Channel-to-channel skew	<100 ps

Horizontal

Sample Clock

Sources	
Internal	Onboard clock (internal VCSO) [13]
External	PFI 0 (front panel SMB connector)

Onboard Clock (Internal VCSO)

Sample rate range	
Real-time sampling (single shot)[14]	15.26 kS/s to 1 GS/s
TIS[15] mode (single shot)	2 GS/s (single channel only)

Random interleaved sampling (RIS) mode[16]	2 GS/s to 20 GS/s in increments of 1 GS/s (repetitive waveforms only)

Timebase accuracy	
Not phase-locked to Reference clock	±30 ppm within ±3 °C of external calibration temperature, plus an additional ±7 ppm per °C outside of ±3 °C of external calibration temperature, warranted
Phase-locked to Reference clock	Equal to the Reference clock accuracy[17]

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[18]	350 MHz to 1 GHz
Duty cycle tolerance	45% to 55%

Phase-Locked Loop (PLL) Reference Clock

Sources	RTSI 7 PFI 0 (front panel SMB connector)
Frequency range[19]	1 MHz to 20 MHz, in 1 MHz increments

	Default: 10 MHz
Duty cycle tolerance	45% to 55%
Exported Reference clock destinations	RTSI <0..7> 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[20]	Edge Window Hysteresis Video Digital Immediate Software
Trigger sources	CH 0 CH 1 TRIG PFI <0..1> RTSI <0..6> Software

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[21]

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[22]	
CH 0, CH 1	100% FS
TRIG (External trigger)	±5 V

Voltage resolution	8 bits (1 in 256)

Trigger level accuracy[23]	
CH 0, CH 1	±5% FS up to 10 MHz, warranted

TRIG (External trigger)	±1 V (±10% FS) up to 10 MHz, warranted

Edge trigger sensitivity[22], warranted	
CH 0, CH 1	10% FS
TRIG (External trigger)	1.0 Vpp

Trigger jitter[23]	≤10 ps_{rms}, typical ≤20 ps_{rms}, maximum

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

Digital Trigger

Trigger type	Digital
Sources	RTSI <0..6> PFI <0..1> (front panel SMB connector)

External Trigger Input (Front Panel Connector)

Connector	BNC
Impedance	1 MΩ in parallel with a nominal capacitance of 22 pF

Coupling	AC, DC
AC coupling cutoff (-3 dB)	12 Hz
Input voltage range	±5 V
Maximum input overload	|Peaks| ≤42 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, nominal
V_{IH}	2.0 V
V_{IL}	0.8 V

Maximum input overload	-0.5 V to 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) Probe compensation[24]
Output impedance	50 Ω
Logic type	3.3 V CMOS
Maximum drive current	±24 mA
Maximum frequency	25 MHz

Waveform Specifications

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)
—	512 MB option (512 MS)

Table 3. Onboard Memory Size

Minimum record length	1 sample
Number of pretrigger samples	Zero up to full record length
Number of posttrigger samples	Zero up to full record length
Maximum number of records in onboard memory[26]	
8 MB per channel	32,768
64 MB per channel	100,000
256 MB per channel	100,000
512 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 VCSO and the voltage reference. 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.

Calibration Specifications

Interval for external calibration	2 years
Warm-up time[27]	15 minutes

Software

Driver Software

Driver support for the PCI-5152 was first available in NI-SCOPE 3.3.

NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the PCI-5152. 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-5152 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-5152 was first available via InstrumentStudio in NI-SCOPE and via the NI-SCOPE SFP in NI-SCOPE3.3. 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-5152. 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

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	500 ps
Skew after manual adjustment	≤5 ps
Sample clock delay/adjustment resolution	≤5 ps

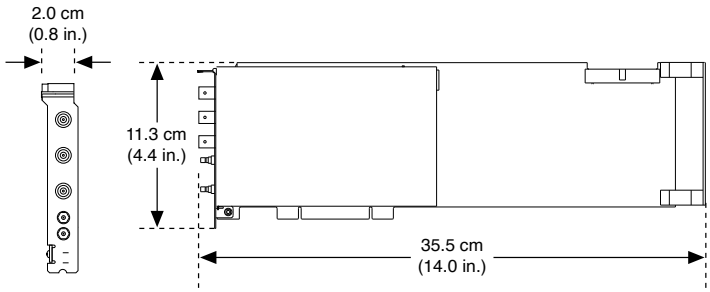
Power

Current draw	
+3.3 VDC	2.5 A
+5 VDC	2.4 A
+12 VDC	200 mA
-12 VDC	0 A
Total power	22.65 W

Physical

Dimensions	35.5 cm x 2.0 cm x 11.3 cm (14.0 in x 0.8 in x 4.4 in)
Weight	445 g (15.7 oz)

Figure 7. PCI-5152 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 45 °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.)

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 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.

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 **Engineering a Healthy Planet** 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.

EU and UK Customers

- Waste Electrical and Electronic Equipment (WEEE)—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 RoHS— NI 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 NI 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.)

[1] Programmable vertical offset = 0 V.

[2] Within ±5 °C of self-calibration temperature.

[3] Use DC drift to calculate errors when temperature changes more than ±5 °C since the last self-calibration.

[4] Measured on one channel with test signal applied to another channel, with same range setting on both channels.

[5] 10 V signal applied to external trigger channel. Applies to all ranges on CH 0 and CH 1.

[6] Bandwidth for 0 to 30 °C. Reduce by 0.25% per °C above 30 °C for all input ranges. Filter off for all input ranges.

[7] Normalized to 51 kHz.

[8] Filter off.

[9] 50 Ω terminator connected to front panel BNC connector.

[10] 50 Ω source assumed.

[11] 1 V input range, 10 MHz, -1 dBFS input signal. Includes the 2nd through the 5th harmonics.

[12] 50 Ω terminator connected to input.

[13] Internal Sample clock is locked to the Reference clock or derived from the onboard VCSO.

[14] Divide by **n** decimation used for all rates less than 1 GS/s.

[15] TIS is a type of real-time sampling that is sometimes called ping-pong.

[16] RIS is a type of equivalent-time sampling.

[17] Refer to your chassis specifications for the Reference clock accuracy.

[18] Divide by **n** decimation available where 1 ≤ **n** ≤ 65,535. For more information about the Sample clock and decimation, refer to the **NI High-Speed Digitizers Help**.

[19] The PLL Reference clock frequency must be accurate to ±50 ppm.

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

[21] Holdoff set to 0. Onboard Sample clock at maximum rate.

[22] DC to 300 MHz.

[23] Within ±5 °C of self-calibration temperature.

[24] 1 kHz, 50% duty cycle square wave. PFI 1 only.

[25] Single-record mode and multiple-record mode.

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

[27]