

z4441
Digital Storage Oscilloscope
PXI, PXIe



Port Descriptions



Front Panel

Label	Type	Description
CH1 CH2	BNC	Channel N input
PRB 1 PRB 2	Custom	Channel N accessory connector
EXT IN	SMB	External input for trigger or reference
EXT OUT	SMB	External output for trigger, reference or event

Acquisition

Sample Rate 20 kS/s to 400 MS/s, non-interleaved and real-time
 800 MS/s, interleaved real-time or equivalent-time
 800 MS/s to 40 GS/s, equivalent-time
 80 GS/s, interleaved equivalent-time
 Any sample rate that is an integer multiple of an available sample rate can be created using interpolation.

Mode(s)	Sample Rate
Non-Interleaved Real-Time	20 kS/s
	25 kS/s
	40 kS/s
	50 kS/s
	100 kS/s
	200 kS/s
	250 kS/s
	400 kS/s
	500 kS/s
	1 MS/s
	2 MS/s
	2.5 MS/s
	4 MS/s
	5 MS/s
	10 MS/s
	20 MS/s
	25 MS/s
	40 MS/s
	50 MS/s
	100 MS/s
200 MS/s	
400 MS/s	
Interleaved or Equivalent-Time	800 MS/s
Equivalent Time	1.6 GS/s
	2.4 GS/s
	4 GS/s
	8 GS/s
	16 GS/s
	20 GS/s
	40 GS/s
Interleaved Equivalent-Time	80 GS/s

Specification	Value
Non-Interleaved Acquisition	2 channels @ up to 400 MS/s real-time
Interleaved Acquisition	1 channels @ up to 800 MS/s real-time
Sampling Modes	Normal: single-shot acquisition Average: multiple-capture acquisition Envelope: multiple-capture minimum & maximum detection Equivalent Time: multiple-capture high-rate reconstruction Peak Detect: single-shot 10x over-sampling envelope detection High Resolution: single-shot 10x over-sampling averaging Fast: Multiple acquisitions
Multiple-Capture Count	2 to 65536 waveforms in powers of 2
Acquisition Re-Arm Time	≤ 5 μs
Total Memory	256 MiSamples
Maximum Record Length Non-Interleaved Interleaved	128 MiSamples 256 MiSamples
Minimum Waveform Size	10 Samples
Maximum Waveform Size Normal or Fast Acquisition Mode All other modes	Maximum Record Length (above) 512 KiSamples
Segmented Memory	View & compare history of previous waveforms in memory. View component waveforms when averaging.
Maximum Segments	32 Ki waveforms @ ≤ 4 KiSamples

Vertical

Input Channels

Specification	Value
Number of Channels (interleaved acquisition) (non-interleaved acquisition)	Quantity 1 Quantity 2
Connectors	BNC
Maximum Input (50 Ω)	±5 V (DC + peak AC), CAT I Input load protection at ±6 VDC
Maximum Input (1 MΩ)	±210 V [DC + peak AC (<100 kHz)], CAT I Peak AC, de-rated 20 dB/decade above 100 kHz
Typical RMS Noise 50 Ω (full bandwidth) 50 Ω with 20 MHz Filter 1 MΩ (full bandwidth) 1 MΩ with 20 MHz Filter	0.05% of full scale range + 75 μV 0.025% of full scale range 0.05% of full scale range + 1 mV 0.025% of full scale range + 500 μV
Digitizer Resolution	14 bits (0.006% of full scale) Up to 32 bits with averaging

Full Scale Input Range & Offset Adjust¹

Impedance	Range ²	Full Scale	Offset	Maximum Range + Offset
1 M Ω	5 V/div	50 V _{pp}	0V	±25 V
	2.5 V/div	25 V _{pp}	±12.5 V	±25 V
	1 V/div	10 V _{pp}	±10 V	±15 V
	500 mV/div	5 V _{pp}	±10V	±12.5 V
	200 mV/div	2 V _{pp}	±2 V	±3 V
	100 mV/div	1 V _{pp}	±2 V	±2.5 V
	40 mV/div	400 mV _{pp}	±400 mV	±600 mV
	20 mV/div	200 mV _{pp}	±400 mV	±500 mV
	10 mV/div	100 mV _{pp}	±400 mV	±450 mV
	5 mV/div	50 mV _{pp}	±400 mV	±425 mV
	2.5 mV/div	25 mV _{pp}	±400 mV	±412.5 mV
	1.25 mV/div	12.5 mV _{pp}	±400 mV	±406.25 mV
50 Ω	1 V/div	10 V _{pp}	0 V	±5 V
	500 mV/div	5 V _{pp}	±2.5 V	±5 V
	200 mV/div	2 V _{pp}	±2 V	±3 V
	100 mV/div	1 V _{pp}	±2 V	±2.5 V
	40 mV/div	400 mV _{pp}	±400 mV	±600 mV
	20 mV/div	200 mV _{pp}	±400 mV	±500 mV
	8 mV/div	80 mV _{pp}	±80 mV	±120 mV
	4 mV/div	40 mV _{pp}	±80 mV	±100 mV
	2 mV/div	20 mV _{pp}	±80 mV	±90 mV
	1 mV/div	10 mV _{pp}	±80 mV	±85 mV

¹ Magnification is used below 4mV/div range for 50 Ω . Full-scale range for accuracy specifications is defined as 40 mV. Magnification is used below 20 mV/div range for 1 M Ω . Full-scale range for accuracy specification is defined as 200 mV.

² Full-scale range assumes 10 divisions

Inputs

Specification	Value
Analog Bandwidth	DC to 300 MHz typical, 250 MHz minimum Due to an impedance mismatch between the signal generator and the oscilloscope, passing this test with a 200 MHz signal verifies 250 MHz performance on the 1 M Ω path.
Analog Bandwidth, Probe Z6103 Passive x10 ³	DC to 300 MHz typical, 250 MHz minimum
Rise Time ⁴	1.15 ns
Slew Rate	2 kV/ μ s
Impedance	1 M Ω 12 pF or 50 Ω \pm 1% accuracy
Input Bias 50 Ω 1 M Ω	\leq \pm 10 μ A \leq \pm 1 nA
DC Gain Accuracy	< \pm 0.25% full scale range
DC Offset Accuracy (+25°C) 50 Ω 1 M Ω	< \pm (0.25% full scale range + 0.5% offset + 1 mV) < \pm (0.25% full scale range + 0.5% offset + 5 mV)
DC Offset Drift (per °C)	< \pm (0.01% full scale range)
Input VSWR (50 Ω)	\leq 1.3:1, DC to 250 MHz
Coupling	DC or AC
AC Coupling 50 Ω 1 M Ω	200 kHz high-pass ⁵ 10 Hz high-pass
Analog Filter	20 MHz or Bypass Filter Stopband Rejection: approx. 3 dB @ 20 MHz
Probe Attenuation	0.9 to 1000:1
Channel-to-Channel Isolation DC to 100 MHz 100 MHz to 250 MHz	\geq 60 dB \geq 50 dB

³ See Probe Manual for detailed specification on all probes

⁴ Rise time is calculated from $t_r = 0.35 / \text{bandwidth}$

⁵ When driven by a generator with 50 Ω source impedance, the combined 100 Ω impedance causes a 100 kHz AC cutoff frequency

Dynamic Range (500 MS/s, 10.7 MHz (typical))

50 Ω Input Range	Signal-to-Noise Ratio (SNR)	Total Harmonic Distortion (THD)	Signal-to-Noise + Distortion (SINAD)	Spurious Free Dynamic Range (SFDR)
10 V _{pp}	61.2 dBc	-62.8 dBc	58.9 dBc	65.0 dBc
5 V _{pp}	59.0 dBc	-64.3 dBc	57.9 dBc	65.0 dBc
2 V _{pp}	60.0 dBc	-62.8 dBc	58.2 dBc	65.0 dBc
1 V _{pp}	58.2 dBc	-64.3 dBc	57.3 dBc	65.0 dBc
400 mV _{pp}	55.7 dBc	-64.1 dBc	55.1 dBc	65.0 dBc
200 mV _{pp}	50.5 dBc	-64.9 dBc	50.4 dBc	63.3 dBc
80 mV _{pp}	49.4 dBc	-63.9 dBc	49.3 dBc	55.5 dBc
40 mV _{pp}	43.5 dBc	-63.1 dBc	43.4 dBc	48.9 dBc

Horizontal

Specification	Value
Sweep Time Range ⁶	12.5 ns to 100 s (1.25 ns/div to 10 s/div)
Sweep Time Resolution	10 ns to 10 ms dependent on sweep points and sample rate
Horizontal Position Pre-Trigger Post-Trigger	0 to 100% of acquisition window 0 to 10,000*Gate Resolution
Channel-to-Channel Skew Channels 1-to-2	Channels at same input settings ≤ 100 ps
Skew Adjust	± 10 μ s channel-to-channel skew adjustment 1 sample interval resolution ± 1 sample interval accuracy
Timebase Reference	10 MHz
Timebase Reference Source	Internal TCXO, External Input, Backplane (PXI)
Internal TCXO Timebase	± 2.5 ppm accuracy
Timebase Output	External Output

⁶ Horizontal time range assumes 10 divisions for horizontal axis

Trigger

Specification	Value
Sweep Modes	Auto or Normal triggered
Trigger Source	Channels 1 to 4, External Input, Pattern, Software, TTL Trigger 0-7, Star Trigger
Trigger Slope/Polarity	Positive or Negative
Trigger B	Qualify trigger on second source for edge trigger event
Trigger A Holdoff	Programmable delay after trigger A before recognizing next trigger A event
Trigger B Holdoff	Programmable delay after trigger A before recognizing trigger B event
Trigger A/B Holdoff Range	0 to 100 seconds
Trigger A/B Event Counter	Qualify trigger on Nth Trigger event, N=1 to 65536
Trigger A Modes	Edge, Pattern, State, Pulse Width, Video
Trigger B Modes	Edge, Pattern
Pattern Trigger Mode	Pattern match true or false
Pattern Sources	Channels 1 to 4, External Input, TTL Trigger 0-7, Star Trigger
State Trigger Mode	Edge event when pattern match true or false. Pattern source used as Arm qualifier
Pulse Width Trigger Mode	Trigger on pulse width greater than, less than, within, or outside limits < Limit 1, > Limit 1, Limit 1 < width < Limit 2, Limit1 > width > Limit 2
Pulse Width Limits	10 ns to 500 ms 5 ns resolution ±5 ns accuracy
Pulse Width Minimum	2 ns pulse width captured for < Limit1
Video Trigger Mode	PAL (50 Hz), NTSC (60Hz), SECAM (50 Hz) Standard, Field, Line selectable
Trigger Timestamp	100 ns resolution, 1 second rollover

Trigger, Analog Input

Specification	Value
Analog Input Triggers	Channels 1 to 2
Trigger Level	(offset - full scale range/2) to (offset + full scale range/2)
Trigger Hysteresis	2.5% (overdrive required)
Trigger Level Resolution	0.025% of full scale range
Trigger Level Accuracy	$\pm(2\% \text{ full scale range} + 5 \text{ mV} + \text{offset accuracy})$
Trigger Sensitivity DC to 100 MHz > 100 MHz	5% of full scale range 10% of full scale range
Trigger Bandwidth	DC to 300 MHz typical, 250 MHz minimum
Glitch Detection	$\geq 500 \text{ ps}$ glitch captures in edge trigger mode

Arm

Specification	Value
Functionality	Arm to qualify Trigger Event
Source	External Input, TTL Trigger 0-7, Star Trigger, Software
Polarity	Positive or Negative

External Input (front panel)

Specification	Value
Functionality	Trigger Input, Timebase Reference Input, External Arm
Absolute Maximum Input (no damage)	$\leq \pm 5 \text{ V}$ (DC + peak AC), CAT I
Input Trigger Level Adjustment	-2 V to +2 V 0.5 mV resolution $\leq 20 \text{ mV}$ accuracy 20 mV overdrive (input hysteresis)
Input Bandwidth (-3 dB)	$\geq 250 \text{ MHz}$
Input Impedance	$1 \text{ M}\Omega \parallel 30 \text{ pF}$ or 50Ω $\leq \pm 2\%$ accuracy
Connector	SMB

External Output (front panel)

Specification	Value
Functionality	Trigger Output, Timebase Reference Output, Event Output, Programmable Clock Output, Programmable Pulse Output, Constant Level, and Probe Compensation Output
Output Event Source	Arm Event, Trigger A Event, Trigger B Event, Trigger Complete Event, Capture Complete Event, Operation Complete Event, Master Summary Status Event, Limit Test Successful Event
Polarity	High or Low Truth
Programmable Event Pulse Width	50 ns to 163 ms
Programmable Clock	Period: 26.667 ns to 100 seconds 50% Duty Cycle
Programmable Pulse Pulse Repetition Interval Pulse Width	26.667 ns to 100 seconds 26.667 ns
Probe Compensation	10 kHz Clock which can be used to compensate probes
Limit Test Successful	Event pulse after each capture upon limit or mask test success
Output Level	TTL Compatible into $\geq 200 \Omega$ $\geq \pm 24$ mA Output Drive
Output Enable	Tri-State Output Capability
Connector	SMB

Backplane Triggers

Specification	Value
Functionality	Multi-Instrument Synchronization Trigger, Event Output Signals
Triggers	TTL Trigger 0-7
Direction	Input or Output
Source	Arm Event, Trigger A Event, Trigger B Event, Trigger Complete Event, Capture Complete Event, Operation Complete Event, Master Summary Status Event, Constant Level
Polarity	High or Low Truth
Programmable Event Pulse Width	50 ns to 163 ms

Backplane Triggers

Specification	Value
Measurements	AC RMS, Amplitude, Average, Cycle Average, Cycle Frequency, Cycle Period, Cycle RMS, DC RMS, Duty Cycle High, Duty Cycle Low, ENOB, Number of Falling Edges, Fall Crossing Time, Fall Overshoot, Fall Preshoot, Fall time, Frequency, High, Low, Maximum, Mid, Minimum, Peak-to-Peak, Period, Phase, Pulse Width Positive, Pulse Width Negative, Number of Rising Edges, Rise Crossing Time, Rise Overshoot, Rise Preshoot, Rise Time, SFDR, SINAD, SNR, Standard Deviation, THD, Time of Maximum, Time of Minimum
Edge Measurements	N th edge selectable, N = 1 to 65535
Maximum Measurements	N th maximum selectable, N = 1 to 100, Applies to Maximum and Time of Maximum
Measurement Methods	Entire waveform, Gated by Time, Gated by Points, Gated by Frequency, Gated by Cursors
Measurement Levels	Low, Mid, High reference levels for edge measurements set in absolute voltages or relative percentages
Cursors	Quantity 2 Horizontal & vertical axis location markers X, Y, X, Y Measurements
Measurement Lists	Quantity 4 Up to 8 measurements per list that are performed upon acquisition Stored for rapid measurement setup
Measurement Trending	Historic buffer of measurement data stored in Calculate channel (see Calculations)
Measurement Accuracy Delta DC Voltage Absolute DC Voltage Time Frequency	±DC gain accuracy ±(DC gain accuracy + offset accuracy) ±time resolution ±(1/period of applied signal ± time resolution) Note: time resolution = one sample interval, one equivalent-time sample interval, or one interpolated-time sample interval (depending upon acquisition mode)

Reference Waveforms

Specification	Value
Reference Channels	Quantity 4
Reference Storage	Non-volatile memory storage
Reference Data	32 KiSample maximum waveform size 32-bit resolution

Calculations

Specification	Value
Calculate Channels	Quantity 4
Calculate Data	512 KiSample maximum waveform size 32-bit resolution
Calculate Functions	Add, Subtract, Multiply, Copy, Invert, Integral, Derivative, Absolute Value, Limit Test, Mask Test, Frequency Transform, Time Transform, Histogram, Measurement Trending
Limit Test	Measurement limit range testing or waveform mask testing
Limit Test Reporting	Measurement maximum, minimum, average, current value, pass count and fail count
Frequency Transform	FFT Magnitude
FFT Windowing	Rectangular, Hamming, Hann, Blackman, Flattop
FFT Data Format	Linear Magnitude, Logarithmic Magnitude, Phase, Real, Imaginary
Time Transform	Digital Infinite Impulse Response (IIR) filter
IIR Filter Type	Auto-generate: Low-pass, 2 to 40 data point smoothing
Histogram	65536 bins for up to 16-bit histogram horizontal resolution
Measurement Trending	Historical waveform of measurement data. Provides trend data of 1 measurement point per capture.

Data Processing & Download

Specification	Value
Self-Calibration	DC Offset Adjust Scale Factor
Auto-Scale	Automatic adjust to input signals: Input Range, Offset, Sample Rate, Trigger Source and Trigger Level
Waveform Data Formats	16-bit or 32-bit signed integer 32-bit or 64-bit floating point Intel or Motorola Byte Order
Waveform Download Mode Normal Decimated Interpolated	Every real-time data point Every N th real-time data point (N = 2 to 100,000) N points for every real-time point (N = 2 to 100)
Waveform Interpolation Modes	None, First Order (linear), or sin(x)/x (sinc)

Instrument Stored States

Specification	Value
Functionality	Non-volatile storage of instrument setup configuration
Stored States	30 State 0 is Reset State Power-On State programmable

LED Indicators

Specification	Value
RDY (Ready)	OFF: Hardware Failure ON: Unit has passed power-up self-diagnostics TOGGLE: Unit has an error pending in error queue
HST/LAN (Host)	OFF: Interface fault ON: Normal interface operation TOGGLE: Device identify enabled
TRG (Trigger)	OFF: Trigger event not detected ON/PULSE: Trigger complete event detected
ACT (Active)	OFF: Instrument Idle ON/PULSE: Data acquisition initiated

PXI Interface

Specification	Value
PXI Slot Compatibility	PXI Standard Slot and PXIe Hybrid Slot Compatible
PXI Timing & Triggering Signals (XJ4 Connector)	PXI_TRIG[0:7] input/output PXI_STAR input PXI_CLK10 input

PXIe Interface

Specification	Value
PXIe Slot Compatibility	PXIe Standard Slot and PXIe Hybrid Slot Compatible
PXIe Timing & Triggering Signals (XJ3 Connector)	PXIe_DSTARA input PXIe_CLK100 input PXIe_SYNC100 input

Status Reporting

Specification	Value
IEEE-488.2 Device Status	Reporting Structure including Status Byte, Standard Event Registers, Questionable Registers, Operation Registers and Self-Test Status Registers

Power & Cooling

Power Supplies

Model	Platform	Voltage	Typical Current	Maximum Current
z4441	PXI	+3.3 VDC +5 VDC +12 VDC -12 VDC	3.37 A 1.23 A 0.02 A 0.01 A	4.19 A 1.80 A 0.02 A 0.01 A

Total Cooling & Power Consumption

Model	Platform	Typical Cooling & Power	Maximum Cooling & Power
z4441	PXI	17.6 W	23.2 W

Physical & Environmental

Size & Weight

Specification	Value
PXI Physical Size	Single-Wide 3U CompactPXI Instrument 8.25" x 0.79" x 5.25" (L x W x H) 20.96 cm x 2.01 cm x 13.34 cm (L x W x H)
PXI Weight	12.3 oz or 349 g

Temperature Range

Specification	Value
Operating	0°C to +50°C ambient
Storage	-40°C to +75°C
Over-Temperature	Automatic shutdown if internal temperature exceeds +70°C
Calibration Range	+20°C to +30°C ambient, after a 20 minute warm-up period, to meet all calibration specification accuracies

Relative Humidity

Specification	Value
Operating or Storage	10 to 90 non-condensing, up to +40°C

Altitude

Specification	Value
Operating	Up to Up to 3 km Up to 5 km with maximum input (1M Ω) of ± 100 V
Storage	Up to 15 km

Terminology

Numeric Prefixes

When referring to numeric values, this document will use SI (International System of Units) and IEC (International Electrotechnical Commission) standard prefixes. Prefix definitions are in the following table.

Prefix	Multiplier
n (nano)	1/(1000x1000x1000)
μ (micro)	1/(1000x1000)
m (milli)	1/1000
k/K (kilo)	1000
M (Mega)	1000x1000
G (Giga)	1000x1000x1000
Ki (Kibi)	1024
Mi (Mebi)	1024x1024
Gi (Gibi)	1024x1024x1024

Differential Outputs

Single-Ended is used to refer to the output on either the + or – output pin

Differential is used to refer to the output between the + and- output pins

Vd indicates Volts differential

Vppd indicates Volts peak-to-peak differential

Safety

This product is designed to meet the requirements of the following standard of safety for electrical equipment for measurement, control and laboratory use: EN 61010-1

Electromagnetic Compatibility

CE Marking EN 61326-1:1997 with A1:1998 and A2:2001 Compliant

FCC Part 15 (Class A) Compliant

Emissions

EN 55011	Radiated Emissions, ISM Group 1, Class A, distance 10 m, emissions < 1 GHz
EN 55011	Conducted Emissions, Class A, emissions < 30 MHz Immunity
EN 61000-4-2	Electrostatic Discharge (ESD), 4 kV by Contact, 8 kV by Air
EN 61000-4-3	RF Radiated Susceptibility, 10 V/m
EN 61000-4-4	Electrical Fast Transient Burst (EFTB), 2 kV AC Power Lines
EN 61000-4-5	Surge
EN 61000-4-6	Conducted Immunity
EN 61000-4-8	Power Frequency Magnetic Field, 30 A/m
EN 61000-4-11	Voltage Dips and Interrupts

CE Compliance

This product meets the necessary requirements of applicable European Directives for CE Marking as follows:

73/23/EEC Low Voltage Directive (Safety)

89/336/EEC Electromagnetic Compatibility Directive (EMC)

See Declaration of Conformity for this product for additional regulatory compliance information.





Copyright © 2014 LitePoint, A Teradyne Company.

All rights reserved

RESTRICTED RIGHTS LEGEND

No part of this document may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, electronic, mechanical, magnetic, optical, chemical, manual, or otherwise, without the prior written permission of LitePoint Corporation.

DISCLAIMER

LitePoint Corporation makes no representations or warranties with respect to the contents of this manual or of the associated LitePoint Corporation products, and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose. LitePoint Corporation shall under no circumstances be liable for incidental or consequential damages or related expenses resulting from the use of this product, even if it has been notified of the possibility of such damages.

If you find errors or problems with this documentation, please notify LitePoint Corporation at the address listed below. LitePoint Corporation does not guarantee that this document is error-free. LitePoint Corporation reserves the right to make changes in specifications and other information contained in this document without prior notice.

TRADEMARKS

LitePoint and the LitePoint logo are registered trademarks of LitePoint Corporation. z4441 is a trademark of LitePoint Corporation. All other trademarks or registered trademarks are owned by their respective owners.

CONTACT INFORMATION

LitePoint Corporation
965 W. Maude Ave.
Sunnyvale, CA 94085-2803
United States of America

Telephone: +1.408.456.5000

LITEPOINT TECHNICAL SUPPORT

www.litepoint.com/support
Telephone: +1.408.456.5000
Available: weekdays 8am to 6pm,
Pacific Standard Time.
E-mail: support@litepoint.com

Doc: 1075-1001-001
March 2014 Rev 1