

# ZT412VXI Specifications

Digital Storage Oscilloscope

14-bit, 500 MS/s, 250 MHz, 4Ch

16-bit, 400MS/s, 250 MHz, 4Ch



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# Analog Input

Channels	Quantity 4
Bandwidth	DC to 250 MHz typical, 200 MHz minimum (50 Ω) DC to 125 MHz typical, 100 MHz minimum (1 MΩ)
Slew Rate	4000 V/μs (50 Ω) 800 V/μs (1 MΩ)
Maximum Input (50 Ω)	±5 V (DC + peak AC) Input load protection @ ±6 VDC
Maximum Input (1 MΩ)	±25 V [DC + peak AC (<10 MHz)] Peak AC, de-rated 20 dB/decade above 10 MHz

## Full Scale Input Range & Offset Adjust

Impedance	Range	Offset
1 MΩ	50 Vpp	0V
	25 Vpp	±12.5V
	10 Vpp	±5V
	5 Vpp	±5V
	2.5 Vpp	±5V
	1.25 Vpp	±5V
	0.5 Vpp	±5V
	0.25 Vpp	±5V
	50Ω	10 Vpp
5 Vpp		±2.5V
2 Vpp		±1V
1 Vpp		±1V
0.5 Vpp		±1V
0.25 Vpp		±1V
0.1 Vpp		±1V
0.05 Vpp		±1V

DC Gain Accuracy	< ±0.25% full scale range (50 Ω) < ±0.25% full scale range (1 MΩ)
Zero DC Offset	< ±(0.25% full scale range + 1 mV) @ +25 °C (50 Ω) < ±(0.25% full scale range + 5 mV) @ +25 °C (1 MΩ)
Zero DC Offset Drift	< ± 0.05% maximum offset adjust/°C
Offset Adjust Accuracy	< ± 1%
Impedance	1 MΩ    12 pF or 50 Ω

Impedance Accuracy	± 1%
Input VSWR (50 Ω)	≤ 1.3:1, DC to 50Ω Bandwidth
Input Bias (50 Ω)	≤ ±25 μA (50 Ω) ≤ ±1 nA (1 MΩ)
Coupling	DC or AC
AC Coupling	200 kHz high pass (50Ω)☒ 10 Hz high pass (1 MΩ)
Probe Attenuation	0.9 to 1000:1
RMS Noise	≤ (0.1% of range + 200 μV) (50 Ω) ≤ (0.1% of range + 1.25 mV) (1M Ω)
Connectors	BNC

## Analog-to-Digital Converter

Sample Rate	10 kS/s to 200 MS/s in 1, 2.5, 4, and 5 steps 250 MS/s (ZT412-20 only) 400 MS/s, 1 channel interleaved 500 MS/s, 1 channel interleaved (ZT412-2X only)
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### Resolution & Maximum Sample Rate

Product Option	ADC Resolution	1 Channel Maximum Sample Rate	2 Channel* Maximum Sample Rate	3 Channel Maximum Sample Rate	4 Channel Maximum Sample Rate
ZT412-2X	14-bit	500 MS/s	500 MS/s	250 MS/s	250 MS/s
ZT412-5X	16-bit	400 MS/s	400 MS/s	200 MS/s	200 MS/s

\*If the two enabled channels are 1 & 2 or 3 & 4, the max sample rate will be halved.  
Note: the ZT412 manual is unclear regarding this information.

### Acquisition Time Range

Product Option	Minimum Acquisition Time	Maximum Acquisition Time
ZT412-2X	200 ns	3,355 seconds
ZT412-5X	250 ns	3,355 seconds

Channel-to-Channel Skew ≤ 100 ps difference with channels at same input settings

Skew Adjust -300 ps to +300 ps in 10 ps steps (Channels: 1-and-2 to 3-and-4)

## Dynamic Range

10.7 MHz (Typical)

50Ω Input Range (Vpp)	Signal-to Noise Ratio (SNR)	Total Harmonic Distortion (THD)	Signal-to-Noise + Distortion (SINAD)
1.0 to 10.0	74.5 dBc	70.2 dBc	68.8 dBc
0.5	70.5 dBc	70.2 dBc	67.3 dBc
0.25	64.5 dBc	70.5 dBc	63.5 dBc
0.1	56.5 dBc	70.9 dBc	56.3 dBc
0.05	50.5 dBc	70.9 dBc	50.5 dBc

## 60.1 MHz (Typical)

50Ω Input Range (Vpp)	Signal-to Noise Ratio (SNR)	Total Harmonic Distortion (THD)	Signal-to-Noise + Distortion (SINAD)
1.0 to 10.0	74.5 dBc	50.1 dBc	50.1 dBc
0.5	70.5 dBc	50.1 dBc	50.0 dBc
0.25	64.5 dBc	50.5 dBc	50.3 dBc
0.1	56.5 dBc	50.8 dBc	49.8 dBc
0.05	50.5 dBc	50.8 dBc	47.6 dBc

Note: Dynamic range for interleaved sample rates is degraded by 4 dB for input channels 2 & 4.

## Waveform Memory

Total Memory	Up to 8M samples/channel Up to 16M samples/channel (2 channel interleaved)
Memory Options	2M samples total (ZT412-X0) 32M samples total (ZT412-X1)

## Acquisition Modes

Types	Normal, Average, Envelope, and Equivalent-Time
Channels	Normal & Equivalent-Time: Quantity 4 inputs simultaneous Average & Envelope: Quantity 2 inputs simultaneous
Waveform Size	100 samples to total memory (Normal) 100 samples to 32k samples (Average, Envelope, Equivalent-Time)
Waveform Count	2 to 65535 waveforms
Averaging	16-bit waveform averaging resolution
Envelope	Minimum and Maximum Envelope

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Equivalent-Time High sample rate waveform reconstruction

Equivalent-Time Points 2 to 100 equivalent-time points per real-time point  
2 to 100 times equivalent-time sample rate

## Trigger

Trigger Source Channels 1 to 4, External Trigger, ECLTRG0-1, TTLTRG0-7\*, External Arm, Pattern, Software

Trigger Slope/Polarity Positive or Negative

Trigger Position 0% to 100% of waveform time + trigger delay  
±1 sample interval position accuracy

Post-Trigger Delay 0 to 655 seconds

Pre-Trigger Delay 0 to waveform time

Trigger Holdoff Programmable delay after trigger before recognizing next trigger event

Holdoff Range 0 to 655 seconds

Trigger B Second edge trigger event qualifier

Pattern Trigger Pattern match true or false

Pattern Sources Channels 1 to 4, External Trigger, External Arm, ECLTRG0-1

Event Trigger Event Counter: 1 to 65535 trigger events

Trigger Modes Edge, Pulse Width, Video

Edge Trigger Mode Rising or Falling Edge

Pulse Width Trigger Mode Triggers on pulse width greater than, less than, or between limits

Pulse Width Type < limit1, > limit1, < limit1 & > limit2

Pulse Width Range 20 ns to 655 seconds

Pulse Width Resolution 10 ns

Video Trigger Mode PAL (50 Hz), NTSC (60 Hz), SECAM (50 Hz)  
Standard, Field, Line selectable

Ch 1–4 Trigger Level	(offset – full scale/2) to (offset + full scale/2)
Ch 1–4 Trigger Sensitivity	5% of full scale (DC to 75 MHz)
Ch 1–4 Trigger Bandwidth	≥ 200 MHz
Ch 1–4 Trigger Hysteresis	5% (overdrive required)
Ch 1–4 Level Resolution	0.025% of full scale
Ch 1–4 Level Accuracy	±(2% full scale + 5 mV + offset accuracy)
Trigger Timestamp	100 ns resolution, 1 second rollover

## External Trigger Input

Maximum Input	±5V, no damage
Threshold Input	±1V
Threshold Accuracy	±20 mV
Threshold Resolution	0.5 mV
Input Impedance	50 Ω ±2%
Connector	BNC

## Trigger Outputs

Functionality	Event Output Signals
Outputs	TTLTRG0–7*, ECLTRG0–1
Source	Trigger Event, Arm Event, OPC, Constant

## Reference Output

Functionality	reference voltage, ground, trigger event, arm event, 10 MHz clock, 500 Hz probe compensation, 10 ns pulse @ 1 ms rate
Reference Voltage Output	+8 V ± 1% into 10 kΩ load
Logic Output (all other types)	TTL Compatible

Connector BNC

## Arm

Functionality Arm to qualify trigger event

Source External Trigger, External Arm, ECLTRG0-1, TTLTRG0-7\*, Software

Polarity Positive or Negative

## External Arm Input

Maximum Input 0V to 5V, no damage

Nominal Level TTL Compatible

Input Impedance 1 k $\Omega$   $\pm$ 2%, pull-up to +5V

Connector BNC

## External Sampling Clock Input

Function External Sampling Clock bypasses Phase Locked Loop,  
All ADC channels synchronized to external clock

Clock Rates 40 MHz to maximum external clock frequency  
1 channel enabled: sample at external frequency  
2 channels enabled: sample at half external frequency

Product Option	Maximum Ext Clock Frequency	1 Channel Maximum Sample Rate	2 Channel Maximum Sample Rate
ZT412-2X	500 MHz	500 MS/s	250 MS/s
ZT412-5X	400 MHz	400 MS/s	200 MS/s

Maximum Input  $\pm$ 5V, no damage

Input Signal Level 500 mVpp to 1 Vpp, sine or square wave

Input Impedance AC coupled, 50 $\Omega$   $\pm$ 2%

Connector BNC

# 10 MHz Time Base Reference

Clock Source Internal TCXO, VXI Backplane CLK10

Internal TCXO  $\pm 2.5$  ppm accuracy

## Data Processing

Auto Scale Automatic adjust to input signals: Input Range, Offset, Sample Rate, Trigger Source, and Trigger Level

Self-Calibration Automatic internal calibration: Input DC Offset Zero, Input DC Offset Adjust Gain, ADC leveling

## Measurements

Measurements Min, Max, Low, High, Mid, Average, Amplitude, Peak-to-Peak, DC RMS, AC RMS, +Width, -Width, Period, Frequency, +Duty, -Duty, Phase, Rise Time, Rise Overshoot, Rise Preshoot, Rise Crossing Time, Fall Time, Fall Overshoot, Fall Preshoot, Fall Crossing Time, Time of Maximum, Time of Minimum, Cycle Average, Cycle RMS, Cycle Frequency, Cycle Period, AC High-Precision, DC High-Precision, SNR, THD, SINAD, ENOB, SFDR

Measurement Methods Entire Waveform, Gated by Time, Gated by Points

Measurement Levels Low, Mid, High reference levels for edge measurements set in absolute voltages or relative percentages

Measurement Accuracy

Delta DC Voltage  $\pm$  (DC gain accuracy)

Absolute DC Voltage  $\pm$  [(DC gain accuracy)+(offset accuracy)]

Time  $\pm$  (time resolution)

Frequency  $\pm$  [1/(time resolution)]

Note: time resolution = one sample interval or one ETS sample interval (for ETS acquisition)

## Reference Waveforms

Reference Channels Quantity 4

Reference Storage Non-volatile memory storage

Reference Size 32k maximum waveform size

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# Calculations

Calculate Channels	Quantity 2
Calculate Size	32k maximum waveform size
Calculate Functions	Add, Subtract, Multiply, Copy, Invert, Integral, Derivative, Absolute Value, Limit Test, Mask Test, Frequency Transform, Time Transform
Limit Test	Measurement Limit Range Testing or Waveform Mask Testing
Limit Test Reports	Measurement maximum, minimum, average, current value, pass/fail counts
Frequency Transform	FFT Magnitude
FFT Windowing	Rectangular, Hamming, Hanning, Blackman
Time Transform	Infinite Impulse Response (IIR) filtering
IIR Filter Count	2 to 40 data points

# Instrument Setup Storage

Reset	Non-volatile storage of default instrument setup configuration
Save & Recall	Non-volatile storage of 31 instrument setup configurations

# Data Interface

VXIbus Connection	Standard P1 and P2 interface
Command Interface	A16 SCPI message-based
Interrupt Operation	Programmable interrupter, Level 1–7
Data Interface	64MB A32 register-based
Manufacturer ID	3712 (E80 <sub>16</sub> )
Model Code	412 (19C <sub>16</sub> )

# VXIbus P2 Trigger & Clock Pin Usage

Pin A1	ECLTRG0	(ECL level bidirectional)
Pin A3	ECLTRG1	(ECL level bidirectional)

Pin A23	TTLTRG0*	(TTL level bidirectional)
Pin A24	TTLTRG2*	(TTL level bidirectional)
Pin A26	TTLTRG4*	(TTL level bidirectional)
Pin A27	TTLTRG6*	(TTL level bidirectional)
Pin C1	CLK10+	(ECL level input)
Pin C2	CLK10-	(ECL level input)
Pin C23	TTLTRG1*	(TTL level bidirectional)
Pin C24	TTLTRG3*	(TTL level bidirectional)
Pin C26	TTLTRG5*	(TTL level bidirectional)
Pin C27	TTLTRG7*	(TTL level bidirectional)

## LED Indicators

READY	Unit has passed power-up self-diagnostics. Toggles when unit has an error pending in error queue.
VXI	VXI access occurring or VXIbus MODID asserted
TRG	Flashes when trigger event occurs
BUSY	Unit is busy with one of the following operations: auto-scale, self-calibration, self-test, data capture, download or storage

# DC Power

## Total Cooling & Power Consumption

Product Option	Typical Cooling & Power	Maximum Cooling & Power
<b>ZT412-20</b>	55.4 W	68.5 W
<b>ZT412-21</b>	69.8 W	82.9 W
<b>ZT412-50</b>	57.0 W	70.1 W
<b>ZT412-51</b>	71.4 W	84.5 W

## Power Supplies

Product Option	Voltage	Typical Current	Maximum Current
<b>ZT412-20</b>	+5V	9.44A	11.46A
	+12V	0.45A	0.52A
	+24V	0.0A	0.0A
	-2V	0.05A	0.08A
	-5.2V	0.51A	0.92A
	-12V	0.0A	0.0A
	-24V	0.0A	0.0A
<b>ZT412-21</b>	+5V	12.32A	14.34A
	+12V	0.45A	0.52A
	+24V	0.0A	0.0A
	-2V	0.05A	0.08A
	-5.2V	0.51A	0.92A
	-12V	0.0A	0.0A
	-24V	0.0A	0.0A
<b>ZT412-50</b>	+5V	9.76A	11.78A
	+12V	0.45A	0.52A
	+24V	0.0A	0.0A
	-2V	0.05A	0.08A
	-5.2V	0.51A	0.92A
	-12V	0.0A	0.0A
	-24V	0.0A	0.0A
<b>ZT412-51</b>	+5V	12.64A	14.66A
	+12V	0.45A	0.52A
	+24V	0.0A	0.0A
	-2V	0.05A	0.08A
	-5.2V	0.51A	0.92A
	-12V	0.0A	0.0A
	-24V	0.0A	0.0A

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# Physical

Physical size                      Single-Wide C-size VXIbus

Weight                                3.5 lbs. or 1.59 kg

## Temperature Range

Operating                            0 °C to +40 °C Ambient

Storage                                -40 °C to +75 °C

Calibration Range                +20 °C to +30 °C Ambient, after a 20 minute warm-up period, to meet all calibration specification accuracies.

## Relative Humidity

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

## Altitude

Operating                            Up to 2,000 m

Storage                                Up to 15,000 m