

Oscilloscope Extends 12-bit Resolution To Lower Price Points

[Teledyne LeCroy's](#) WaveSurfer 4000HD High Definition Oscilloscope (HDO) is being introduced as the first in its class to feature 12-bit vertical resolution at all times, showing clean, crisp waveforms on a bright, 12.1-in. touch screen display. WaveSurfer 4000HD is available in bandwidths from 200 MHz to 1 GHz, with sample rates of up to 5 GS/s and up to 12.5 Mpts of acquisition memory on each channel (25 Mpts interleaved). It offers versatile built-in capabilities for embedded systems debug and is compatible with Teledyne LeCroy's comprehensive probe offerings (see the figure).

According to the company, design and test engineers have come to demand the signal detail and measurement accuracy that comes with a 12-bit HDO when debugging deeply-embedded systems in IoT, automotive, switch-mode power supply and other control system designs. However, other oscilloscopes on the market, which are claimed to have 10-bit or 12-bit resolution, lack low-noise and low-jitter components throughout their acquisition system, says Teledyne LeCroy, and those competing oscilloscopes require tradeoffs of channel count, bandwidth or sample rate to achieve high resolution and lower noise.

In contrast, the WaveSurfer 4000HD is described as a highly affordable instrument that leverages Teledyne LeCroy's HD4096 High Definition technology to deliver 12-bit resolution all the time. HD4096 technology utilizes a system design of high signal-to-noise input amplifiers, high sample rate 12-bit ADCs, and a low-noise system architecture to enable capture and display of waveforms with 16x more resolution than 8-bit oscilloscopes.

WaveSurfer 4000HD is said to deliver the best performance in its class, with prices starting at \$7,490. According to the vendor, scopes in this series demonstrate the lowest baseline noise— 2.5 times better than competitive oscilloscopes with 12-bit ADCs and 8 times better than competitive oscilloscopes with 10-bit ADCs — and highest accuracy — 0.5% versus competitors' 2.5% at 1 mV/div gain setting (see the table). Moreover, the company says that the WaveSurfer 4000HD's displayed waveforms are crisper, cleaner and provide visibility into signal details that are often lost in the noise on other oscilloscopes, including those with advertised 10-bit and 12-bit ADCs.

WaveSurfer 4000HD also integrates multiple instruments into one by offering an optional 16-channel mixed-signal oscilloscope (MSO), an arbitrary waveform generator (AWG), a frequency counter and a spectrum analyzer (available early 2020).

Available now, the WaveSurfer 4000HD oscilloscopes' standard software capabilities include a fast waveform update rate, MAUI with OneTouch, LabNotebook, History Mode and Pass/Fail testing, with several optional Protocol Analysis and Power Analysis packages available. Comprehensive probe support spans over 30 probes in nine product categories using Teledyne LeCroy's ProBus interface, which has been unchanged for over 20 years. For further information, contact Teledyne LeCroy at 1-800-553-2769 or visit the [WaveSurfer 4000HD product page](#).



Figure. With prices starting at \$7,490, the WaveSurfer 4000HD High Definition Oscilloscope (HDO) is described as the first in its class to feature 12-bit vertical resolution at all times, displaying clean, crisp waveforms on a bright, 12.1-in. touch screen. The HDO is available in bandwidths from 200 MHz to 1 GHz, with sample rates of up to 5 GS/s and up to 12.5 Mpts of acquisition memory on each of the four channels (25 Mpts interleaved).

Table. Select specifications for the different bandwidth options offered by the WaveSurfer 4000HD. Click [here](#) to see the rest of the datasheet.

	WaveSurfer 4024HD	WaveSurfer 4034HD	WaveSurfer 4054HD	WaveSurfer 4104HD
Vertical - Analog Channels				
Analog Bandwidth @ 50 Ω (-3 dB)	200 MHz	350 MHz	500 MHz	1 GHz
Rise Time (10–90%)	1.75 ns	1 ns	700 ps	450 ps
Input Channels	4			
Vertical Resolution	12 bits			
Effective Number of Bits (ENOB)	8.7	8.6	8.5	8.3
Vertical Noise Floor (rms, 50 Ω)				
1 mV/div	65 μ V	70 μ V	90 μ V	125 μ V
2 mV/div	65 μ V	70 μ V	90 μ V	125 μ V
5 mV/div	65 μ V	70 μ V	90 μ V	125 μ V
10 mV/div	70 μ V	75 μ V	95 μ V	130 μ V
20 mV/div	95 μ V	95 μ V	115 μ V	160 μ V
50 mV/div	160 μ V	175 μ V	210 μ V	280 μ V
100 mV/div	270 μ V	290 μ V	350 μ V	465 μ V
200 mV/div	960 μ V	925 μ V	1.10 mV	1.65 mV
500 mV/div	1.60 mV	1.75 mV	2.10 mV	2.75 mV
1 V/div	2.70 mV	2.90 mV	3.50 mV	4.70 mV
Sensitivity	50 Ω: 1 mV–1 V/div, fully variable; 1 MΩ: 1 mV–10 V/div, fully variable			
DC Vertical Gain Accuracy (Gain Component of DC Accuracy)	\pm 0.5% FS, offset at 0 V			
Channel-Channel Isolation	60 dB	60 dB up to 200 MHz 50 dB up to 350 MHz	60 dB up to 200 MHz 50 dB up to 500 MHz	60 dB up to 200 MHz 50 dB up to 500 MHz 40 dB up to 1 GHz
Offset Range	50 Ω: 1 mV to 4.95 mV: \pm 1.6 V; 5 mV to 9.9 mV: \pm 4 V; 10 mV to 19.8 mV: \pm 8 V; 20 mV to 1 V: \pm 10 V 1 MΩ: 1 mV to 4.95 mV: \pm 1.6 V; 5 mV to 9.9 mV: \pm 4 V; 10 mV to 19.8 mV: \pm 8 V; 20 mV to 100 mV: \pm 16 V; 102 mV to 198 mV: \pm 80 V; 200 mV to 1 V: \pm 160 V; 1.02 V to 10 V: \pm 400 V			
DC Vertical Offset Accuracy	\pm (1.0% of offset setting + 0.5% FS + 0.02% of max offset + 1 mV)			
Maximum Input Voltage	50 Ω : 5 Vrms, 1 M Ω : 400 V max (DC + Peak AC \leq 10 kHz)			
Input Coupling	1 M Ω : AC, DC, GND; 50 Ω : DC, GND			
Input Impedance	50 Ω : \pm 2.0%; 1 M Ω : \pm 2.0% 15 pF			
Bandwidth Limiters	20 MHz	20 MHz, 200 MHz	20 MHz, 200 MHz	20 MHz, 200 MHz
Rescaling	Electrical: Volts, Amps			
Horizontal - Analog Channels				
Acquisition Modes	Real-time, Roll, Average, Sequence (Segmented Memory up to 1000 segments with 1 μ s min. intersegment time)			
Timebases	Internal timebase common to 4 input channels			
Time/Division Range	500 ps/div to 100 s/div			
Clock Accuracy	\pm 2.5 ppm + 1.0 ppm/year from calibration			
Acquisition - Analog Channels				
Sample Rate (Single-Shot)	2.5 GS/s on 4 Ch, 5 GS/s on 2 Ch			
Standard Memory (4 Ch / 2 Ch)	12.5 Mpts / 25 Mpts			
Averaging	Summed averaging to 1024 sweeps			