InfiniiVision HD3 Series Oscilloscopes

Making Precision Portable

The HD3 Series brings Keysight's industry-leading capabilities from high-performance oscilloscopes to the high-volume level, making precision portable from 200 MHz to 1 GHz. Leveraging custom hardware technology from the UXR Series, the HD3 boasts the most impressive resolution on the market with 4x the vertical accuracy with a 14-bit ADC and up to 10x less noise than the competition. Paired with our fast, uncompromised waveform update rate and 25x more memory, the HD3 Series can capture signals that you can't even see on other oscilloscopes.

KEYSIGHT TECHNOLOGIES

See What You've Been Missing with **Portable Precision**

Meet the new generation of Keysight's industry leading InfiniiVision oscilloscopes, the HD3 Series. The HD3 was created with high performance technology leveraged from our high speed UXR Series oscilloscopes, now making precision availble in a much more portable form factor.

With the all new architecture of the HD3, you can analyze all signals in your design with the highest accuracy in class. With a custom 14-bit ADC and the lowest noise front-end, you will see the highest vertical resolution in this segment of oscilloscopes. This ensures you make most accurate measurements possible and have the most realistic view into the signals inside your device.

You can achieve even greater accuracy (5x better) with up to 16 bits of resolution using the built-in bandwidth filters. Need to use the full bandwidth to 1 GHz? You will still get extremely high accuracy at the full bandwidth, with the ability to zoon to 500 uV/div.
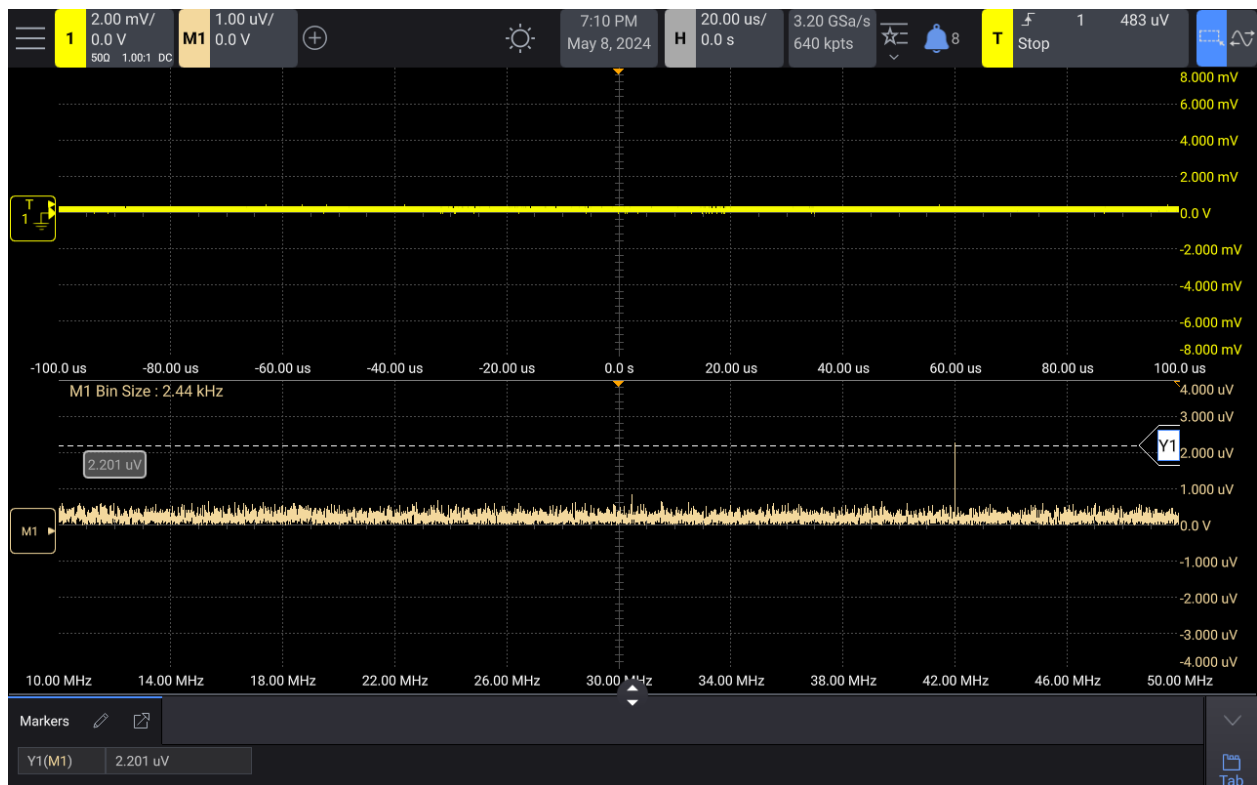
Figure 1. The oscilloscope is capturing a 2uV, -100dBm signal very clearly in our FFT. Connecting this same signal to a competitor's scope, you would not be able to see it at all because their noise floor is just too high

See What You've Been Missing with **Custom Technology**

The HD3 Series is created of completely custom components optimized specifically for oscilloscope measurements. Keysight's R&D team spent a lot of time designing a brand-new 14-bit ADC, an all-new ASIC, the other support components, and an entirely new architecture for the signal to flow through. Because Keysight designs these components ourselves rather than using off-the-shelf components like our competitors, our hardware works much faster and more efficiently since it is designed specifically for oscilloscopes.

Part of this new architecture also includes deep memory with dedicated memory chips for every channel (100 Mpts). This means there is no interleaving between channels. You can have all 4 channels turned on and still get the maximum memory and sample rate on every channel.

Our new custom ASIC (MegaZoom 5) enables the HD3 to be the only oscilloscope in this class to have hardware-based functions such as zone trigger, serial decoding, and mask testing. Competitors in this segment at all doing these functions in software so they run over 1,000x slower than the HD3.

Lastly, custom hardware also makes it possible for us to create new custom software that the competitors don't have, such as the industry's first Fault Hunter application. Simply run fault hunter and detect any glitches or errors on your signal!

See What You've Been Missing with **Versatile Functionality**

Dive deeper than ever before with more flexibility in the InfiniiVision user interface. Not only did we leverage the hardware from our high-performance oscilloscopes, but we also took some of the more advanced user interface capabilities and added them to the new InfiniiVision user interface. With more menus and user customization, you can set up the scope to be customized to your exact testing requirements. The custom grid display, favorites bar, and automatic actions make it even easier to dive deep into your characterization and view results quickly.

All models can be upgraded in bandwidth or memory using immediate license upgrades. There are no returns to factory required for any upgrades. All models are also already equipped with these standard functions that typically cost thousands of dollars:

- Frequency Response Analysis
- Fault Hunter
- Zone Trigger
- Segmented Memory
- MSO License
- Mask Testing
- Histograms
- FFT, and more!

All-New Custom ASIC: MegaZoom 5

Traditionally, CPU processing was the major bottleneck for oscilloscope waveform update rate and responsiveness. And it still is with many of our competitors. When the CPU handles things like interpolations, logic channel plotting, serial bus decoding, measurements and more, and the waveform update rate, memory, and sample rate drop dramatically as these features are turned on.

The InfiniiVision HD3 Series consists of an all-new ASIC. Though we call it the MegaZoom 5, it is completely new from the ground up with **none** of the same architecture or components in our MegaZoom 4 in our previous InfiniiVision scopes. With this new custom ASIC, we can do things in hardware that our competitors are running in software through their CPU. With these functions being performed in hardware, the HD3 requires minimum support from a CPU. MegaZoom includes hardware serial decoders and hardware mask limit testing capability, plots analog and digital data directly to the display, supports GUI operation, and integrates additional instruments like the WaveGen function/arbitrary waveform generator.

The new features enabled by MegaZoom 5 combined with the supporting architecture around it enables us to product the most realistic view of the signals inside your device.

Industry-First Software: Fault Hunter

Fault Hunter is an innovative, expert system for inspecting digital systems. It automatically evaluates your signal's characteristics against user-definable criteria, quickly finding and saving errors for your review. It's flexible, and you can define the test duration from a few minutes up to 2 days. Set up your device under test on a Friday afternoon and return Monday morning with a full test report to review, with billions of tests complete.
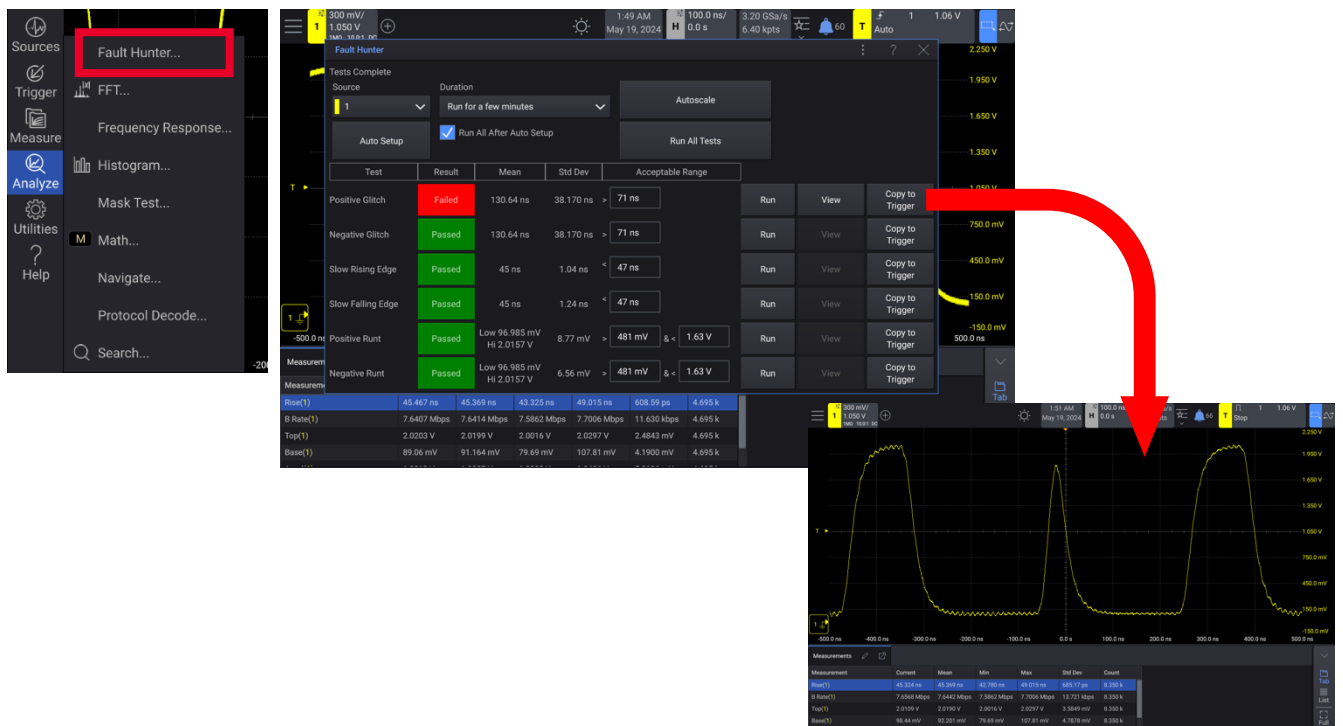
Configuring Your Oscilloscope

Step 1

Choose Model with number of analog channels
All models come standard with a minimum 200 MHz bandwidth and MSO interface enabled.

HD3 Series Specification Overview		
	HD302MSO	**HD304MSO**
Bandwidth (–3 dB)	200 MHz	
Calculated rise time (10 to 90%)	≤ 3.5 ns	
Input channels Analog	2	4
Digital	16	16

Step 2
Choose your additional bandwidth with a license upgrade

Bandwidth (-3dB)	Calculated Rise time (10 to 90%)	HD302MSO	HD304MSO
200 MHz	2.0 nsec	standard	standard
350 MHz	1.3 nsec	HD302MSO-350	HD304MSO-350
500 MHz	900 psec	HD302MSO-500	HD304MSO-500
1 GHz	450 psec	HD302MSO-01G	HD304MSO-01G

Step 3
Select Memory upgrades

Capture memory	HD302MSO/HD304MSO
20 Mpts/channel	standard
50 Mpts/channel	HD3MEM-050
100 Mpts/channel	HD3MEM-100

Step 4
Select System upgrades

Feature	HD302MSO/HD304MSO
100 MHz WaveGen	HD3WAVEGEN
Enhanced security	HD3SECURE

Step 5
Select software upgrades

License Upgrade	Description	Model Number to Order
Embedded software package	I^{2}C, SPI, UART (RS232/422/485) serial trigger and decode	HD3EMBA
Automotive software package	CAN, CAN FD, CAN XL (symbolic with .dbc file), and LIN (symbolic with .ldf file)	HD3AUTA

Step 6

Choose your accessories and additional productivity software

Recommended Accessories and PC Software		
HD3COVER	Front panel cover for InfiniiVision HD3 Series	Optional
HD3CASE	Soft carrying case for InfiniiVision HD3 Series	Optional
HD3RACK	Rack mount kit for InfiniiVision HD3 Series	Optional

Step 7

Choose your probes

For a complete list of compatible probes, visit https://www.keysight.com/us/en/lib/resources/selection-guides/oscilloscope-probes.html

Probes		
N2843A	Passive probe 500 MHz, 10:1, 1 MΩ, 11 pF	Standard (1 per channel)
HD3MSO	16 digital channel MSO cable	Optional
PP0001A	Performance Hi-Z probe for up to 1 GHz, 300Vrms, <4pF	Optional
PP0002A	Performance Hi-Z probe for up to 800 MHz, 1200Vrms, <2pF	Optional
PP0003A	Performance Hi-Z probe for up to 1 GHz, 30Vrms, <4pF, MMCX connector	Optional
N2870A	Passive probe 35 MHz, 1:1, 1 MΩ	Optional
10076C	Passive probe 500 MHz 100:1 attenuation (4 kV)	Optional
N2795A	1.0 GHz 10:1 single-ended active probe, 1 MΩ / 1 pF, ± 8 V	Optional
N2797A	1.5 GHz 10:1 single-ended active probe, 1 MΩ / 1 pF, ± 8 V, extreme temperature	Optional
N2790A	100 MHz 50:1/500:1 HV differential probe, 8 MΩ /3.5 pF, ± 1,400 V	Optional
DP0010A	250 MHz 17:1/85:1 differential probe, 1.7 MΩ / 1.5 pF, ± 42 V	Optional
DP0011A	500 MHz 17:1/85:1 differential probe, 1.7 MΩ / 1.5 pF, ± 42 V	Optional
DP0012A	1.0 GHz 17:1/85:1 differential probe, 1.7 MΩ / 1.5 pF, ± 42 V	Optional
DP0013A	1.8 GHz 17:1/85:1 differential probe, 1.7 MΩ / 1.5 pF, ± 42 V	Optional
DP0021A-009	Automotive sub-DB9 accessory for DP001xA differential active probes	Optional
N2750A	1.5 GHz 2:1/10:1 differential active probe, 200 kΩ / 0.7 pF, ± 5 V	Optional
N7020A	2 GHz 1:1 power rail probe, ± 24 V offset range, 50 kΩ, ± 850 mV ripple range	Optional
1147B	50 MHz, 15 Amp AC/DC current probe	Optional
N2893A	100 MHz, 15 Amp AC/DC current probe	Optional
N7026A	150 MHz, 40 Amp AC/DC high-sensitivity current probe	Optional
N2820A	2-channel high-sensitivity current probe 50 µA to 5 A	Optional
N2821A	1-channel high-sensitivity current probe 50 µA to 5 A	Optional

Performance Characteristics

HD3 Series Specification Overview

Bandwidth[1] (–3 dB)	200 MHz	350 MHz	500 MHz	1 GHz
Calculated rise time (10 to 90%)	≤ 2.0 ns	≤ 1.3 ns	≤ 900 ps	≤ 450 ps
Maximum sample rate	3.2 GSa/s per channel			
Maximum memory depth	100 Mpts per channel			
Display size and type	10.1-inch capacitive touch gesture-enabled display			
Waveform update rate	Uncompromised > 1,300,000 waveforms per second			

Vertical System Analog Channels

Hardware bandwidth limits	5, 10, 20, 50, 100, 200, 350 MHz, (selectable) Global 40 MHz Each Channel
Input coupling	AC, DC
Input impedance	50 Ω ± 1.5% [3] 1 MΩ ± 1% ‖ ~24pF
Input sensitivity range	50 Ω 500 uV/div to 1 V/div
	1 MΩ 500 uV/div to 10 V/div
Vertical resolution	14 bits (16 bits using bandwidth limits)
Maximum input voltage	135 Vrms; 190 Vpk
	Probing technology allows testing of higher voltages. For example, the included N2843A 10:1 probe supports testing up to 300 Vrms
	Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). No transient overvoltage allowed
DC vertical gain accuracy[1]	±1.5% full scale [2]
DC voltage measurement accuracy	Dual cursor: ± [(DC gain accuracy) + 0.16% full scale] [1] Single cursor: ± [(DC gain accuracy) + (offset accuracy) + 0.08% full scale]
DC vertical offset accuracy	± 0.1 div ± 1mV ± 1.5% of offset setting
Channel-to-channel isolation	> 100:1 from DC to maximum specified bandwidth of each model (measured with same V/div and coupling on channels)

Offset range	50Ω:
	   500uV/div to 100mV/div: ±1.5V
	   >100mV/div to 1V/div: ±5V
	
	 1MΩ:
	   500uV/div to 100mV/div: ±1.5V
	   > 100mV/div to 1V/div: ±15V
	   >1V/div to 10V/div: ±150V

1. Denotes warranted specifications, all others are typical.
   Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.
2. Full scale is defined as 8 vertical divisions. 500uV/div and 1 mV/div are a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 500uV/div and 1mV/div.
3. Valid for input voltage within ± 8 divisions from offset setting.

Vertical System Digital Channels

Digital input channels	16 digital (D0 to D15. pod 1: D3 ~ D0, Pod 2: D7 ~ D4, Pod 3: D11 ~ D8, Pod 4: D15 ~ D12)
Thresholds	Threshold per pod
Threshold selections	TTL (+1.4 V), 5 V CMOS (+2.5 V), ECL (–1.3 V), user-defined (selectable by pod)
User-defined threshold range	± 8.0 V in 10 mV steps
Maximum input voltage	± 40 V peak
Threshold accuracy [1]	± (100 mV + 3% of threshold setting)
Maximum input dynamic range	± 10 V about threshold
Minimum voltage swing	500 mVpp
Input impedance	100 kΩ ± 2% at probe tip
Input capacitance	~8 pF
Vertical resolution	1 bit

RMS Noise Floor ($V_{RMS\ AC}$) on 50 Ω inputs

Vertical Setting	20 MHz	100 MHz	200 MHz	350 MHz	500MHz	1 GHz
500 uV/div, 2 mV/div	13u	20u	26u	30u	35u	48u
5 mV/div	16u	25u	33u	38u	44u	59u
10 mV/div	24u	35u	49u	56u	67u	87u
20 mV/div	44u	63u	89u	104u	124u	159u
50 mV/div	92u	141u	202u	239u	286u	366u
100 mV/div	189u	278u	399u	474u	568u	723u
200 mV/div	442u	638u	898u	1.06m	1.26m	1.60m
500 mV/div	942u	1.41m	2.03m	2.41m	2.88m	3.66m
1 V/div	1.78m	2.82m	4.04m	4.79m	5.74m	7.26m

RMS Noise Floor ($V_{RMS\ AC}$) on 1M Ω inputs

Vertical Setting	20 MHz	100 MHz	200 MHz	350 MHz	500MHz
500 uV/div, 2 mV/div	21u	34u	50u	76u	96u
5 mV/div	24u	37u	53u	80u	100u
10 mV/div	31u	46u	64u	92u	112u
20 mV/div	51u	72u	97u	132u	154u
50 mV/div	105u	146u	198u	263u	295u
100 mV/div	204u	280u	380u	505u	560u
200 mV/div	454u	686u	947u	1.29m	1.51m
500 mV/div	926u	1.42m	1.95m	2.60m	2.92m
1 V/div	1.96m	2.77m	3.78m	5.01m	5.58m
2 V/div	4.42m	6.76m	9.42m	13.0m	15.1m
5 V/div	9.63m	14.2m	19.5m	26.1m	29.2m
10 V/div	20.2m	27.9m	38.0m	50.3m	55.9m

ENOB (Normal Sample Mode 100mV/div, 1M Ohm) on a 10MHz 90% Full-screen Sine Wave							
Input	20 MHz	50 MHz	100 MHz	200 MHz	350 MHz	500MHz	1 GHz
50 Ω	10.4	9.9	9.5	9.0	8.8	8.5	8.2
1M Ω	10.3	9.9	9.5	8.9	8.8	8.4	N/A

Horizontal System Analog Channels

Time base range		500 ps/div to 50 s/div
Time base accuracy [1]		± 1.6 ppm + aging factor (1 year: ± 0.5 ppm, 2 years: ± 0.7 ppm, 5 years: ± 1.5 ppm, 10 years: ± 2.0 ppm)
Time base delay time range	Pre-trigger	Maximum of 20M/sample rate, no more than 200s
	Post-trigger	Up to 500 sec
Channel-to-channel deskew range		± 100 ns
Δ Time accuracy (using cursors)		Same channel: ± (time base accuracy x reading) ± (0.0016 x screen width) ± 50 ps Channel-to-channel: ± (time base accuracy x reading) ± (0.0016 x screen width) ± 100 ps
Modes		Main, zoom

Horizontal System Digital Channels

Minimum detectable pulse width	5 ns
Channel-to-channel skew	2 ns (typical); 3 ns (maximum)

Acquisition System

Maximum analog channels sample rate		3.2 GSa/s all channel
Maximum analog channels record length every channel		20 Mpt with standard license 50 Mpt with 50 Mpt memory license 100 Mpt with 100 Mpt memory license
Maximum digital channels sample rate		1.6 GSa/s all pods
Maximum digital channels record length		20 Mpt
High Resolution		As bandwidth is decreased using the built-in global bandwidth filters, resolution increases up to 16 bits for high definition. To adjust bandwidth, use the "Acquire" menu.
Acquisition mode	Normal	Default mode
	Peak detect	Capture glitches as narrow as 156.25 ps at all time base settings
	Averaging	Selectable from 2, 4, 8, 16, 64, ... to 65,536
	Segmented	Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 2000. Re-arm time – 1 us (minimum time between trigger events)
	Manual	Allows independent selection of sample rate and memory depth
Time mode	Normal	Default Mode

1. Denotes warranted specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ± 10 °C from firmware calibration temperature.

Trigger System	
Trigger sources	Analog channel (1 ~ 4), digital channel (D0 ~ D15), line, external
Trigger modes	Normal (triggered): Requires trigger event for scope to trigger
	Auto: Triggers automatically in absence of trigger event
	Single: Triggers only once on a trigger event, press **[Single]** again for scope to find another trigger event, or press **[Run]** to trigger continuously in either Auto or Normal mode
	Force: front panel button that forces a trigger
Trigger coupling	DC: DC coupled trigger
	AC: AC coupled trigger, cutoff frequency: < 10 Hz (internal); <50 Hz (external)
	LF reject: Low frequency reject, cutoff frequency ~ 50 kHz
	Noise reject: Selectable OFF or ON, decreases sensitivity 2x
Trigger holdoff range	60 ns to 10.00 s

Trigger Sensitivity	
Internal (noise reject off)	50Ω: 0.35 divisions
	1MΩ: 0.35 divisions
External [1]	200 mVpp from DC to 100 MHz
	350 mVpp 100 MHz to 500 MHz

Trigger Level Range	
Any channel	± 6 div from center screen
External	± 5 V

Trigger Type Selections	
Zone (HW zone qualifier)	Trigger on user-defined zones drawn on the display. Applies to one analog channel at a time. Specify zones as either "must intersect" or "must not intersect." Up to four zones. > 300,000 scans/sec update rate
	Supported modes: normal, peak detect, high resolution
	Also works simultaneously with the serial trigger and mask limit test
Edge	Trigger on a rising, falling, alternating or either edge of any source
Pulse width	Trigger on a pulse on a selected channel, whose time duration is less than a value, greater than a value, or inside a time range
	Minimum duration setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range difference minimum: 5 ns
Runt	Trigger on a positive runt pulse that fails to exceed a high-level threshold. Trigger on a negative runt pulse that fails to exceed a low-level threshold. Trigger on either polarity runt pulse based on two threshold settings. Runt triggering can also be time-qualified (< or >) with a minimum time setting of 1 ns and maximum time setting of 10 s
	Minimum time setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz)
	10 ns (100 MHz)
Setup and hold	Trigger and clock/data setup and/or hold time violation. Setup time can be set from 0 to 10 s. Hold time can be set from 0 s to 10 S. Setup and hold window can be 3ns minimum.
Rise/fall time	Trigger on rise-time or fall-time edge speed violations (< or >) based on user-selectable threshold
	Select from (< or >) and time settings range between
	Minimum: 500 ps (500 MHz, 1 GHz), 2 ns (350 MHz), 3 ns (200 MHz), 5 ns (100 MHz)
	Maximum: 10 s

Trigger Type Selections

Pattern	Trigger when a specified pattern of high, low, and don't care levels on any combination of analog, digital, or trigger channels is [entered | exited]. Pattern must have stabilized for a minimum of 2 ns to qualify as a valid trigger condition
	Minimum duration setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)
	Maximum duration setting: 10 s
	Range difference minimum: 5 ns
Or	Trigger on any selected edge across multiple analog or digital channels
I2C (optional)	Trigger at a start/stop condition or user defined frame with address and/or data values. Also trigger on missing acknowledge, address with no ack, restart, EEPROM read, and 10-bit write
SPI (optional)	Trigger on SPI (Serial Peripheral Interface) data pattern during a specific framing period. Supports positive and negative Chip Select framing as well as clock Idle framing and user-specified number of bits per frame. Supports MOSI and MISO data
RS-232/422/485/UART (optional)	Trigger on Rx or Tx start bit, stop bit or data content or parity error
CAN, CAN FD, CAN XL (optional)	Trigger on CAN (controller area network) version 2.0A, 2.0B, and CAN-FD (Flexible Data-rate) signals. Trigger on the start of frame (SOF), the end of frame (EOF), data frame ID, data frame ID and data (non-FD), data frame ID and data (FD), remote frame ID, remote or data frame ID, error frame, acknowledge error, from error, stuff error, CRC error, spec error (ack or form or stuff or CRC), all errors, BRS Bit (FD), CRC delimiter bit (FD), ESI bit active (FD), ESI bit passive (FD), overload frame., message, message and signal (non-FD), message and signal (FD, first 8 bytes only)
LIN (optional)	Trigger on LIN (Local Interconnect Network) sync break, sync frame ID, or frame ID and data, parity error, checksum error, frame (symbolic), frame and signal (symbolic)

Waveform Measurements

Markers	Single Marker accuracy: ± [DC vertical gain accuracy + DC vertical offset accuracy + 0.08% full scale]
	Dual Marker accuracy: ± [DC vertical gain accuracy + 0.16% full scale] [1]
	Units: Seconds(s), Hz (1/s), phase (degrees), ratio (%)
Automatic measurements	Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to eight measurements from the list below:
	Snapshot All: Measure all single waveform measurements (31)
	Vertical: Peak-to-peak, maximum, minimum, amplitude, top, base, overshoot, pre-shoot, average- N cycles, average- full screen, DC RMS- N cycles, DC RMS- full screen, AC RMS- N cycles, AC RMS- full screen (std deviation), ratio- N cycle, ratio- full screen, Y at X
	Time: Period, frequency, counter, T at edge, + width, - width, burst width, +duty cycle, -duty cycle, bit rate, rise time, fall time, delay, phase, X at min Y, X at max Y,
	Count: Positive pulse count, negative pulse count, rising edge count, falling edge count
	Mixed: Area- N cycles, area- full screen, slew rate
	Power: Channel power, occupied bandwidth, adjacent power ratio, total harmonic distortion
Automatic measurement logging	Available via BenchVue
Counter (A, B)	Built-in frequency counters
	Source: On any analog or digital channel or Trigger Qualified Event (non-Edge Trigger Modes)
	Resolution: 8 digits
	Maximum frequency: Bandwidth of scope

Waveform Math

Number of math functions		Four Math
Arithmetic		Add, subtract, multiply, divide, differentiate, integrate, FFT, Ax + B, squared, square root, absolute value, common logarithm, natural logarithm, exponential, base 10 exponential, low pass filter, high pass filter, averaged value, smoothing, envelope, magnify, max hold, min hold, measurement trend, chart logic bus (Timing or State), chart serial signal (CAN, CAN FD, LIN, and SENT)
Enhanced FFT	Record size	Up to 64 kpts resolution default, can be extended to 32 Mpts
	Window types	Hanning, Flat Top, Rectangular, Blackman-Harris, Bartlett
	Time gated FFT	Gate the time range of data for FFT analysis in the zoom view. For time and frequency domain correlated analysis.
	Waveforms	FFT, max hold, min hold, average
	Peak search	Max 11 peaks, threshold and excursion control

Search, Navigate, and Lister

Type		Edge, pulse width, rise/fall, runt, frequency peak, serial bus 1, serial bus 2
Copy		Copy to trigger, copy from trigger
Frequency peak	Source	Math functions
	Max # of peaks	15
	Control	Results order in frequency or amplitude
Result display		Event lister or navigation. Manual or auto scroll via navigation or touch event lister entry to jump to a specific event

Display Characteristics

Display	10.1 inch color 1280x800 (WXGA, TFT-LCD)
Resolution	1280 (H) x 800 (V) pixel format (screen area)
Graticules	8 vertical divisions by 10 horizontal divisions with intensity controls
Maximum waveform update rate	> 1,300,000 waveforms/sec
Persistence	Off, infinite, variable persistence (100 ms to 60 s)
Intensity gradation	16 intensity levels

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1. 500uV/div and 1 mV/div is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 500uV/div and 1mV/div.

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical)

WaveGen out	Rear-panel BNC connector
Waveforms	Sine, Square, Ramp, Pulse, DC, Noise, Sine Cardinal (Sinc), Exponential Rise, Exponential Fall, Cardiac, Gaussian Pulse, and Arbitrary
Modulation	Modulation types: AM, FM, FSK
	Carrier waveforms: sine, ramp, sine cardinal, exponential rise, exponential fall, and cardiac Modulation source: internal (no external modulation capability)
	AM: Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Depth: 0% to 100%
	FM: Modulation: sine, square, ramp Modulation frequency: 1 Hz to 20 kHz Minimum carrier frequency: 10 Hz Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller
Sine	Frequency range: 0.01 Hz to 100 MHz
	Amplitude flatness: ± 0.5 dB (relative to 1 kHz)
	Harmonic distortion: –40 dBc
	Spurious (non-harmonics): –40 dBc
	Total harmonic distortion: 1%
	SNR (50 Ω load, 500 MHz BW): 40 dB (Vpp > = 0.1 V); 30 dB (Vpp < 0.1V)
Square wave /pulse	Frequency range: 0.01 Hz to 50 MHz
	Duty cycle: 20 to 80%
	Duty cycle resolution: Larger of 1% or 10 ns
	Pulse width: 20 ns minimum
	Rise/fall time: 2.5 ns (10 to 90%)
	Pulse width resolution: 10 ns or 5 digits, whichever is larger
	Overshoot: < 6%
	Asymmetry (at 50% DC): ± 1% ± 5 ns
Ramp/triangle wave	Frequency range: 0.3 Hz to 5 MHz
	Linearity: 1%
	Variable symmetry: 0 to 100%
	Symmetry resolution: 1%
DC	Precise (-1 to 1V) Hi Z
	Wide Range (-8 to 8V)
Noise	Bandwidth: 150 MHz typical
Sine Cardinal (Sinc)	Frequency range: 0.3 Hz to 5 MHz
Exponential Rise/Fall	Frequency range: 0.3 Hz to 5 MHz
Cardiac	Frequency range: 0.3 Hz to 200.0 kHz
Gaussian Pulse	Frequency range: 0.3 Hz to 5.0 MHz
Arbitrary	Waveform length: 2 to 8,192 points
	Amplitude resolution: 14 bits (including sign bit) [1]
	Repetition rate: 0.3 Hz to 12 MHz
	Sample rate: 400 MSa/s

1.   Full resolution is not available at output due to internal attenuator stepping.

WaveGen – Built-in Function/Arbitrary Waveform Generator (specifications are typical) (continued)

Frequency	Sine wave accuracy: Timebase accuracy ± 1 ppm
	Square wave and pulse accuracy: Timebase accuracy ± 3 ppm
Amplitude	Range:
	2 mVpp to 10 Vpp into Hi-Z [1,2]
	1 mVpp to 5 Vpp into 50 Ω [1,2]
	Resolution: 100 µV or 3 digits, whichever is higher
	Accuracy: 2% (frequency = 1 kHz)
DC offset	Range:
	± 8 V into Hi-Z [1,2]
	± 4 V into 50 Ω [1,2]
	Resolution: 100 µV or 3 digits, whichever is higher
Trigger output	Trigger output available on Trig out BNC
Main output	Impedance: 50 Ω typical
	Isolation: Not available, main output BNC is grounded
Output mode	Normal
	Single-shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)

Digital Voltmeter (specifications are typical)

Functions	ACrms, DC, DCrms
Resolution	ACV/DCV: 3 digits
Measuring rate	100 times/second
Autoranging	Automatic adjustment of vertical amplification to maximize the dynamic range of measurements
Range meter	Graphical display of most recent measurement, plus extrema over the previous 3 seconds

Precision Counter/Totalizer (specifications are typical)

Counter	Source	Any analog channel or trigger qualified event (non-edge trigger modes)
	Resolution	8 digits maximum
	Max frequency	1 GHz (any analog channel)
	Trig qual events	1/(trigger hold off time) for trigger qualified events (max 25 MHz, minimum dead time of 40 ns)
Measurement		Frequency, period, totalize
Totalizer	Counter size	64-bit
	Edge	Rise or fall

1. Gaussian Pulse, Sin, Cardiac: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50 Ω.
2. Maximum high level of 8V and minimum low level of -8V into Hi-Z (4V and -4V into 50 Ω) of combined signal amplitude and offset

Connectivity

Standard ports	One USB 2.0 hi-speed device port on rear panel. Supports USBTMC protocol
	Two USB 3.0 super-speed host ports, front and rear panel. Support memory devices, printers, and keyboards
	LAN (10/100/1000Base-T)
	DVI video out
Trigger out	BNC connector on the rear panel. Supported modes: triggers, mask, and waveform generator sync pulse

General and Environmental Characteristics

Power line consumption	Max 275 W
Power voltage range	100 to 120 V, 50/60/400 Hz; 100 to 240 V, 50/60 Hz
Environmental rating	0 to 50 °C with 3000m max Operating: 80% RH, non-condensing, up to +40°C Non-operating: 95% RH, non-condensing, up to +40°C; decreasing linearly to 50% RH at +65°C
Electromagnetic compatibility	Meets EMC directive (2004/108/EC), meets or exceeds IEC 61326-1:2012/EN 61326-1:2013 CISPR 11/EN 55011 IEC 61000-4-2/EN 61000-4-2 IEC 61000-4-3/EN 61000-4-3 IEC 61000-4-4/EN 61000-4-4 IEC 61000-4-5/EN 61000-4-5 IEC 61000-4-6/EN 61000-4-6 IEC 61000-4-11/EN 61000-4-11 Canada: ICES-001:2004 Australia/New Zealand: AS/NZS
Safety	ANSI/UL Std. No. 61010-1:2012; CAN/CSA-C22.2 No. 61010-1-12
	ANSI/UL Std. No. 61010-2-030:2012; CAN/CSA-C22.2 No. 61010-2-030-12
Vibration	Meets IEC60068-2-6 and MIL-PRF-28800; class 3 random
Shock	Meets IEC 60068-2-27 and MIL-PRF-28800; class 3 random; (Operating 30 g, ½ sine. 11 ms duration, 3 shocks/axis along major axis, total of 18 shocks)
Dimensions (W x H x D)	33.5 cm (13.2 in) x 26.2 cm (10.3 in) x 16.8 cm (6.6 in)
Weight	Net: 5.25 kg (11.6 lbs)

Nonvolatile Storage

Reference waveform display		Two internal waveforms or USB thumb drive.
Data/file save	Setup/image	Setup (*.scp 24-bit Bitmap image (*.bmp), PNG 24-bit image (*.png)
	Waveform data	CSV data (*.csv), ASCII XY data (*.csv), Binary data (*.bin), Lister data (*.csv), Reference waveform data (*.h5), multi-channel waveform data (*.h5), Arbitrary Waveform data (*.csv)
	Application data	Mask (*.msk), Power harmonics data (*.csv), USB signal quality (*.html & *.bmp)
	Analysis results (*.csv)	Cursor data, measurement results, mask test statistics, search, segmented timestamps
Max USB flash drive size		Supports industry standard flash drives
Internal data storage		Up to 10 GB open for data storage of oscilloscope files. Secure Erase and save control are available with HD3SECURE
Set ups with USB flash drive		Limited by size of USB drive

Included Standard with Oscilloscope

Calibration	Soft copy of Certificate of Calibration (CoC) with measurement results downloadable from https://service.keysight.com/infoline/public/details.aspx?i=DOC, 3-year calibration interval
Probes	
N2843A Passive probe 500 MHz 10:1 attenuation	1 per channel
Interface and built-in help language support	English, Chinese (simplified), Chinese (traditional), French, German, Italian, Japanese, Korean – more coming in future releases
Localized overlay	English, Chinese (simplified), Chinese (traditional), French, German, Italian, Japanese, Korean – more coming in future releases

After-Purchase License-only Upgrades

Bandwidth Upgrades

Bandwidth upgrade	Software model
2channel HD302MSO from 200 MHz to 350 MHz	HD3BW-001
2channel HD302MSO from 200 MHz to 500 MHz	HD3BW-002
2channel HD302MSO from 200 MHz to 1 GHz	HD3BW-003
2channel HD302MSO from 350 MHz to 500 MHz	HD3BW-004
2channel HD302MSO from 350 MHz to 1 GHz	HD3BW-005
2channel HD302MSO from 500 MHz to 1 GHz	HD3BW-006
4channel HD304MSO from 200 MHz to 350 MHz	HD3BW-007
4channel HD304MSO from 200 MHz to 500 MHz	HD3BW-008
4channel HD304MSO from 200 MHz to 1 GHz	HD3BW-009
4channel HD304MSO from 350 MHz to 500 MHz	HD3BW-010
4channel HD304MSO from 350 MHz to 1 GHz	HD3BW-011
4channel HD304MSO from 500 MHz to 1 GHz	HD3BW-012

Software Upgrades

License Upgrade	Description	Model Number to Order
Embedded software package	I^{2}C, SPI, UART (RS232/422/485) serial trigger and decode	HD300EMBA
Automotive software package	CAN, CAN FD, CAN XL (symbolic with .dbc file), and LIN (symbolic with .ldf file)	HD300AUTA

Hardware Upgrades

Model Number	Description
HD3MSO	MSO upgrade: Add 16 digital timing channels
HD3SECURE	Enhanced security option

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