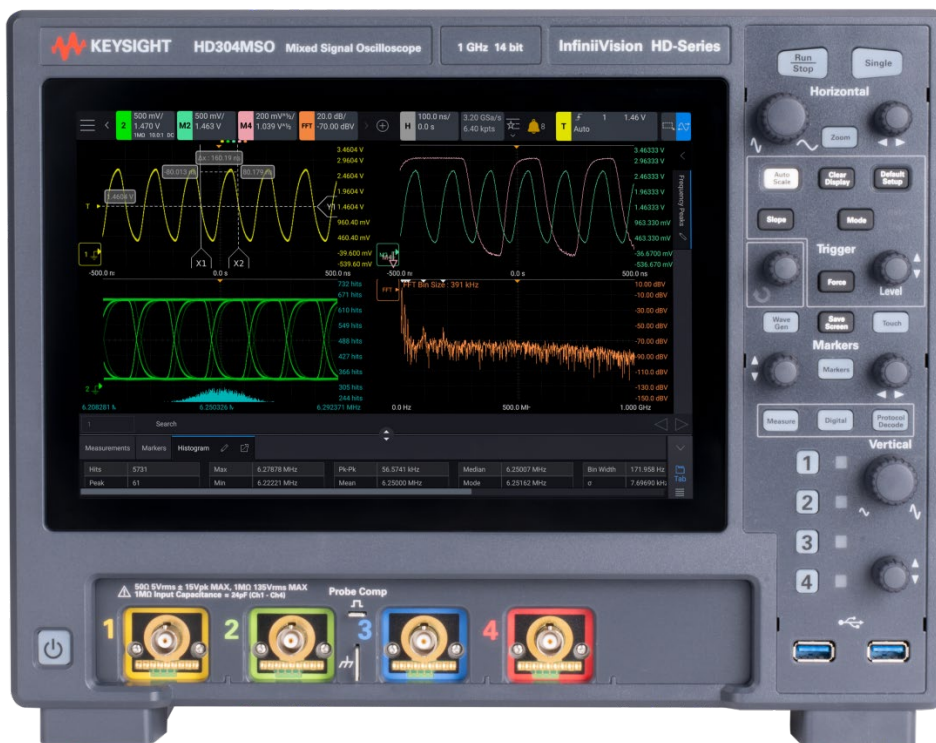


# InfiniiVision HD3 Series Oscilloscopes

Making precision portable

## Introduction

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 impressive resolution with four times the vertical accuracy with a 14-bit ADC and half the noise floor of other 12-bit scopes. Paired with our fast waveform update rate, digital trigger, and deep memory, the HD3 Series can capture small signals with high vertical resolution.



# Table of Contents

See What You've Been Missing with Portable Precision..... 3

See What You've Been Missing with Custom Technology..... 4

See What You've Been Missing with Versatile Functionality..... 4

All-New Custom ASIC: MegaZoom 5 ..... 5

Fault Hunter Software..... 5

Configuring Your Oscilloscope..... 6

Performance Characteristics..... 8

After-Purchase License-Only Upgrades ..... 15

See What You've Been Missing..... 17

# See What You've Been Missing with Portable Precision

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

With the all-new architecture of the HD3 (including a custom 14-bit ADC and low noise front end), you can analyze all signals in your design with high vertical accuracy. This ensures you make the 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 per-channel 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 zoom to 100  $\mu\text{V}/\text{div}$ .



**Figure 1.** The oscilloscope captures a 2  $\mu\text{V}$ , -100 dBm signal very clearly in our FFT. This same signal would not be viewable with a higher noise floor oscilloscope.

# See What You've Been Missing with Custom Technology

The HD3 Series uses custom components optimized specifically for oscilloscope measurements. Keysight's R&D team designed a brand-new 14-bit ADC, an all-new ASIC, other support components, and an entirely new architecture for the signal to flow through. Because Keysight designs these components rather than using off-the-shelf components, 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 four 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 have hardware-based functions such as zone trigger, serial decoding, and mask testing.

Custom hardware also makes it possible for us to create new custom software, such as the Fault Hunter software 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
- 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. This remains the case 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 has an all-new MegaZoom 5 ASIC that was built 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, the HD3 oscilloscopes can do things in hardware instead of 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 the HD3 Series to show the most realistic view of the signals inside your device.

## Fault Hunter Software

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 two 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 bandwidth upgrade

Bandwidth options

| Bandwidth (-3 dB)  | Calculated rise time (10 to 90%) | HD302MSO     | HD304MSO     |
|--------------------|----------------------------------|--------------|--------------|
| 200 MHz (standard) | 2.0 nsec                         | HD302MSO-200 | HD304MSO-200 |
| 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

Memory options

| Capture memory             | HD302MSO/HD304MSO |
|----------------------------|-------------------|
| 20 Mpts/channel (standard) | HD300MSO-020      |
| 50 Mpts/channel            | HD300MSO-050      |
| 100 Mpts/channel           | HD300MSO-100      |

## Step 4. Select system upgrades

System upgrade options

| Feature           | HD302MSO/HD304MSO |
|-------------------|-------------------|
| 100 MHz WaveGen   | HD3WAVEGEN        |
| Enhanced security | HD3SECURE         |

## Step 5. Select software upgrades

Software options

| License upgrade                        | Description                                                                                                         | Model number |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------|
| Embedded software package              | I <sup>2</sup> C, SPI, UART (RS232/422/485) serial trigger and decode                                               | HD300EMBA    |
| Automotive software package            | CAN, CAN FD, CAN XL (symbolic with .dbc file), SENT, and LIN (symbolic with .ldf file)                              | HD300AUTA    |
| Aerospace and defense software package | MIL-STD 1553 and ARINC 429 triggering and analysis                                                                  | HD300AERA    |
| Power analysis package                 | Power quality, current harmonics, switching loss, turn-on/off time, transient response, loop response, PSRR, & more | HD300PWRA    |
| Ultimate bundle software Package       | Enables HD300EMBA, HD300AUTA, HD300AERA, and HD300PWRA                                                              | HD300BDLA    |

## Step 6. Choose your accessories and additional productivity software

### Recommended accessories and PC software

| Model number | Description                                     |          |
|--------------|-------------------------------------------------|----------|
| 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>

### Recommended probes

| Model number | Description                                                                                    |                          |
|--------------|------------------------------------------------------------------------------------------------|--------------------------|
| N2843A       | Passive probe 500 MHz, 10:1, 1 M $\Omega$ , 11 pF                                              | Standard (1 per channel) |
| N2756A       | 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 M $\Omega$                                                        | Optional                 |
| N2795A       | 1.0 GHz 10:1 single-ended active probe, 1 M $\Omega$ / 1 pF, $\pm 8$ V                         | Optional                 |
| N2797A       | 1.5 GHz 10:1 single-ended active probe, 1 M $\Omega$ / 1 pF, $\pm 8$ V, extreme temperature    | Optional                 |
| N2790A       | 100 MHz 50:1/500:1 HV differential probe, 8 M $\Omega$ / 3.5 pF, $\pm 1,400$ V                 | Optional                 |
| DP0010A      | 250 MHz 17:1/85:1 differential probe, 1.7 M $\Omega$ / 1.5 pF, $\pm 42$ V                      | Optional                 |
| DP0011A      | 500 MHz 17:1/85:1 differential probe, 1.7 M $\Omega$ / 1.5 pF, $\pm 42$ V                      | Optional                 |
| DP0012A      | 1.0 GHz 17:1/85:1 differential probe, 1.7 M $\Omega$ / 1.5 pF, $\pm 42$ V                      | Optional                 |
| DP0013A      | 1.8 GHz 17:1/85:1 differential probe, 1.7 M $\Omega$ / 1.5 pF, $\pm 42$ 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 k $\Omega$ / 0.7 pF, $\pm 5$ V                 | Optional                 |
| N7020A       | 2 GHz 1:1 power rail probe, $\pm 24$ V offset range, 50 k $\Omega$ , $\pm 850$ 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 $\mu$ A to 5 A                                     | Optional                 |
| N2821A       | 1-channel high-sensitivity current probe 50 $\mu$ A to 5 A                                     | Optional                 |

# Performance Characteristics

## HD3 Series specification overview

|                                  |                                                    |          |          |          |
|----------------------------------|----------------------------------------------------|----------|----------|----------|
| Bandwidth <sup>1</sup> (-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              | 20, 40, 50, 100, 200, 350 MHz (selectable), per-channel<br>5, 10, 20, 40, 50, 100, 200, 350 MHz (selectable), global                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Input coupling                         | AC, DC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Input impedance                        | 50 Ω ± 1.5% <sup>2</sup><br>1 MΩ ± 1%    ~24pF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Input sensitivity range                | 50 Ω 100 uV/div to 1 V/div<br>1 MΩ 100 uV/div to 10 V/div                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Vertical resolution                    | 14 bits (16 bits using bandwidth limits)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Maximum input voltage                  | 1MΩ:<br>135 Vrms, 190 Vpk. Derate at 20dB/decade from 250 kHz to 10 MHz. Above 10 MHz: 5Vrms<br>50Ω:<br>≤ 104 mV/div: ±1.5 Vpk<br>> 104 mV/div: 5 Vrms, 15 Vpk<br>When using Keysight PP0001A, PP0002A, or PP0003A probes, input voltages at the oscilloscope are ≤ 30 Vrms<br>For the 1MΩ input, probing technology allows testing of higher voltages (for example, the included N2843A 10:1 probe supports testing up to 300Vrms).<br>Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV).<br>No transient overvoltage allowed |
| DC vertical gain accuracy <sup>1</sup> | ±1.5% full scale <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| DC voltage measurement accuracy        | Dual cursor: ± [(DC gain accuracy) + 0.16% full scale] <sup>1</sup><br>Single cursor: ± [(DC gain accuracy) + (offset accuracy) + 0.08% full scale]                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| DC vertical offset accuracy            | ± 0.1 div ± 1 mV ± 1.5% of offset setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Channel-to-channel isolation           | > 100:1 from DC to maximum specified bandwidth of each model<br>(measured with same V/div and coupling on channels)                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Offset range                           | 50Ω:<br>100uV/div to 100mV/div: ±1.5V<br>> 100mV/div to 1V/div: ±5V<br>1MΩ:<br>100uV/div to 100mV/div: ±1.5V<br>> 100mV/div to 1V/div: ±15V<br>> 1V/div to 10V/div: ±150V                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Noise density                          | Measured at 101 MHz, span 1 MHz and 15 kHz RBW<br>Range (dBm): Noise Density (dBm/Hz)<br>-38 dBm: -161.2 dBm/Hz<br>0 dBm: -141.5 dBm/Hz<br>6 dBm: -133.1 dBm/Hz                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signal-to-noise dynamic range          | 96 dB (0 dBm 100 MHz input carrier, 0 dBm input range (80 mV/div), 100 MHz CF, 50 MHz span, 15 kHz RBW, measurement at +15 MHz from CF)                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Spurious Free Dynamic Range (SFDR)     | 79 dB (0 dBm 100 MHz input carrier, 0 dBm input range (80 mV/div), 500 MHz span, 300 MHz CF, 150 kHz RBW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Amplitude accuracy                     | ±0.3 dB (0 to 1 GHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Deviation from linear phase            | 10° (0 to 1 GHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Vertical system digital channels

- 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 Valid for input voltage within ±8 divisions from offset setting.
- 3 Full scale is defined as 8 vertical divisions. 100 uV/div and 1 mV/div are a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 500 uV/div and 1 mV/div.

|                                 |                                                                                           |
|---------------------------------|-------------------------------------------------------------------------------------------|
| 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 <sup>1</sup> | ± (100 mV + 3% of threshold setting)                                                      |
| Maximum input dynamic range     | ± 10 V about threshold                                                                    |
| Minimum voltage swing           | 500 mVpp                                                                                  |
| Input impedance                 | 100 k $\Omega$ ± 2% at probe tip                                                          |
| Input capacitance               | ~8 pF                                                                                     |
| Vertical resolution             | 1 bit                                                                                     |

#### RMS noise floor ( $V_{RMS\ AC}$ ) on 50 $\Omega$ inputs

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

#### RMS noise floor ( $V_{RMS\ AC}$ ) on 1M $\Omega$ inputs

| Vertical setting     | 20 MHz | 100 MHz | 200 MHz | 350 MHz | 500 MHz |
|----------------------|--------|---------|---------|---------|---------|
| 500 uV/div, 2 mV/div | 21 u   | 34 u    | 50 u    | 76 u    | 96 u    |
| 5 mV/div             | 24 u   | 37 u    | 53 u    | 80 u    | 100 u   |
| 10 mV/div            | 31 u   | 46 u    | 64 u    | 92 u    | 112 u   |
| 20 mV/div            | 51 u   | 72 u    | 97 u    | 132 u   | 154 u   |
| 50 mV/div            | 150 u  | 146 u   | 198 u   | 263 u   | 295 u   |
| 100 mV/div           | 204 u  | 280 u   | 330 u   | 505 u   | 560 u   |
| 200 mV/div           | 454 u  | 686 u   | 947 u   | 1.29 m  | 1.51 m  |
| 500 mV/div           | 926 u  | 1.42 m  | 1.95 m  | 2.60 m  | 2.92 m  |
| 1 V/div              | 1.96 m | 2.77 m  | 3.78 m  | 5.01 m  | 5.58 m  |
| 2 V/div              | 4.42 m | 6.76 m  | 9.42 m  | 13.0 m  | 15.1 m  |
| 5 V/div              | 9.63 m | 14.2 m  | 19.5 m  | 26.1 m  | 29.2 m  |
| 10 V/div             | 20.2 m | 27.9 m  | 38.0 m  | 50.3 m  | 55.9 m  |

#### ENOB (normal sample mode 100 mV/div, 1M $\Omega$ ) on a 10 MHz 90% full-screen sine wave

| Input       | 20 MHz | 50 MHz | 100 MHz | 200 MHz | 350 MHz | 500 MHz | 1 GHz |
|-------------|--------|--------|---------|---------|---------|---------|-------|
| 50 $\Omega$ | 10.4   | 9.9    | 9.5     | 9.0     | 8.8     | 8.5     | 8.2   |
| 1M $\Omega$ | 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 <sup>1</sup> | ±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<br>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<br>Channel-to-channel: ± (time base accuracy x reading) ± (0.0016 x screen width) ±100 ps |
| Modes                           | Main, zoom, roll, XY                                                                                                                                                      |
| XY                              | On channels 1 and 2 only. Z blanking on ext trigger input, 1.4V threshold                                                                                                 |

### 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<br>50 Mpt with 50 Mpt memory license<br>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 per-channel or global bandwidth filters, resolution increases up to 16 bits for high definition. To adjust bandwidth, use the Channel Setup menu.                                                                                                                                                                                                                                                        |
| Acquisition mode                                    | Normal: Default mode<br>Peak detect: Capture glitches as narrow as 156.25 ps at all timebase settings<br>Averaging: Selectable from 2, 4, 8, 16, 64, ... to 65,536<br>Segmented: Segmented memory optimizes available memory for data streams that have long dead times between activity. Maximum segments = 2000. Re-arm time – 700 ns (minimum time between trigger events)<br>Manual: Allows independent selection of sample rate and memory depth |
| Time mode                                           | Normal: Default mode                                                                                                                                                                                                                                                                                                                                                                                                                                  |

### 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<br>Auto: Triggers automatically in absence of trigger event<br>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<br>Force: front panel button that forces a trigger |
| Trigger coupling      | DC: DC coupled trigger<br>AC: AC coupled trigger, cutoff frequency: < 10 Hz (internal); <50 Hz (external)<br>LF reject: Low frequency reject, cutoff frequency ~ 50 kHz<br>HF reject: High frequency reject, cutoff frequency ~50 kHz<br>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: 1 LSB resolution, subject to the noise floor of the measurement<br>1MΩ: 1 LSB resolution, subject to the noise floor of the measurement |
| External <sup>1</sup>       | 200 mVpp from DC to 100 MHz<br>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)       | <p>Trigger on user-defined zones drawn on the display. Up to four zones. A single zone can apply to any one analog channel at a time. Specify zones as either "must intersect" or "must not intersect." &gt; 300,000 scans/sec update rate</p> <p>Supported modes: normal, peak detect</p> <p>Also works simultaneously with the serial trigger and mask limit test</p>                                                                                                                                                                                                                                 |
| Edge                           | Trigger on a rising, falling, alternating or either edge of any source                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Edge-then-Edge                 | Trigger when the trigger edge occurs after an arming edge within the minimum and maximum delay times without any intervening arming or triggering edges (an edge followed by another edge)                                                                                                                                                                                                                                                                                                                                                                                                              |
| Pulse width                    | <p>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</p> <p>Minimum duration setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)</p> <p>Maximum duration setting: 10 s</p> <p>Range difference minimum: 5 ns</p>                                                                                                                                                                                                                                                                             |
| Runt                           | <p>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. Runt triggering can also be time-qualified (&lt; or &gt;) with a minimum time setting of 1 ns and maximum time setting of 10 s</p> <p>Minimum time setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz)</p> <p>10 ns (100 MHz)</p>                                                                                                                                                                                              |
| 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                 | <p>Trigger on rise-time or fall-time edge speed violations (&lt; or &gt;) based on user-selectable threshold</p> <p>Select from (&lt; or &gt;) and time settings range between</p> <p>Minimum: 500 ps (500 MHz, 1 GHz), 2 ns (350 MHz), 3 ns (200 MHz), 5 ns (100 MHz)</p> <p>Maximum: 10 s</p>                                                                                                                                                                                                                                                                                                         |
| Pattern                        | <p>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</p> <p>Minimum duration setting: 1 ns (500 MHz, 1 GHz), 4 ns (350 MHz), 6 ns (200 MHz), 10 ns (100 MHz)</p> <p>Maximum duration setting: 10 s</p> <p>Range difference minimum: 5 ns</p>                                                                                                                                                            |
| 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)                                                                                                                                                                                                                                                                                                                                                                                                                                |
| SENT (optional)                | Trigger on SENT bus. start of fast channel message, start of slow channel message, fast channel SC and data, slow channel message ID, slow channel message ID and data, tolerance violation, fast channel CRC error, slow channel CRC error, all CRC errors, pulse period error, successive sync pulses error (1/64)                                                                                                                                                                                                                                                                                    |

## Waveform measurements

|                               |                                                                                                                                                                                                                                                                        |  |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Markers                       | Single Marker accuracy: $\pm$ [DC vertical gain accuracy + DC vertical offset accuracy + 0.08% full scale]                                                                                                                                                             |  |
|                               | Dual Marker accuracy: $\pm$ [DC vertical gain accuracy + 0.16% full scale] <sup>4</sup>                                                                                                                                                                                |  |
|                               | Units: Seconds(s), Hz (1/s), phase (degrees), ratio (%)                                                                                                                                                                                                                |  |
|                               | Modes: Manual, Measure, Track Waveform, Binary, Hex                                                                                                                                                                                                                    |  |
| Automatic measurements        | Types: X1, X2, Y1, Y2, $\Delta$ X, $\Delta$ Y                                                                                                                                                                                                                          |  |
|                               | Measurements continuously updated with statistics. Cursors track last selected measurement. Select up to ten measurements from the list below:                                                                                                                         |  |
|                               | 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                                                                                                                                                                                                                                                 |  |
| Automatic measurement Gating  | Main, Zoom, Markers                                                                                                                                                                                                                                                    |  |
| 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 |
| 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 15 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)                           |
| Format                       | YT, color-graded XY, roll, and Bode                                     |
| 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          | 256 intensity levels                                                    |

<sup>4</sup> 500 uV/div and 1 mV/div is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 500 uV/div and 1 mV/div.

**WaveGen – Built-in function/Arbitrary waveform generator (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            | <p>Modulation types: AM, FM</p> <p>Carrier waveforms: sine, ramp, sine cardinal, exponential rise, exponential fall, and cardiac Modulation source: internal (no external modulation capability)</p> <table> <tr> <td>AM:</td><td> <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Depth: 0% to 100%</p> </td></tr> <tr> <td>FM:</td><td> <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Minimum carrier frequency: 10 Hz</p> <p>Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller</p> </td></tr> </table> | AM: | <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Depth: 0% to 100%</p> | FM: | <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Minimum carrier frequency: 10 Hz</p> <p>Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller</p> |
| AM:                   | <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Depth: 0% to 100%</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |                                                                                              |     |                                                                                                                                                                                                             |
| FM:                   | <p>Modulation: sine</p> <p>Modulation frequency: 1 Hz to 20 kHz</p> <p>Minimum carrier frequency: 10 Hz</p> <p>Deviation: 1 Hz to carrier frequency or (2e12 / carrier frequency), whichever is smaller</p>                                                                                                                                                                                                                                                                                                                                                                                      |     |                                                                                              |     |                                                                                                                                                                                                             |
| Sine                  | <p>Frequency range: 0.01 Hz to 100 MHz</p> <p>Amplitude flatness: <math>\pm 0.5</math> dB (relative to 1 kHz)</p> <p>Harmonic distortion: <math>-40</math> dBc</p> <p>Spurious (non-harmonics): <math>-40</math> dBc</p> <p>Total harmonic distortion: 1%</p> <p>SNR (50 <math>\Omega</math> load, 500 MHz BW): 40 dB (<math>V_{pp} &gt; 0.1</math> V); 30 dB (<math>V_{pp} &lt; 0.1</math> V)</p>                                                                                                                                                                                               |     |                                                                                              |     |                                                                                                                                                                                                             |
| Square wave/pulse     | <p>Frequency range: 0.01 Hz to 50 MHz</p> <p>Duty cycle: 20 to 80%</p> <p>Duty cycle resolution: Larger of 1% or 10 ns</p> <p>Pulse width: 10 ns minimum</p> <p>Rise/fall time: 2.5 ns (10 to 90%)</p> <p>Pulse width resolution: 5 ns</p> <p>Overshoot: <math>&lt; 10\%</math></p> <p>Asymmetry (at 50% DC): <math>\pm 1\% \pm 5</math> ns</p>                                                                                                                                                                                                                                                  |     |                                                                                              |     |                                                                                                                                                                                                             |
| Ramp/triangle wave    | <p>Frequency range: 0.3 Hz to 5 MHz</p> <p>Linearity: 1%</p> <p>Variable symmetry: 0 to 100%</p> <p>Symmetry resolution: 1%</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |                                                                                              |     |                                                                                                                                                                                                             |
| DC                    | <p>Precise (-1 to 1V) Hi Z</p> <p>Wide Range (-8 to 8V)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |     |                                                                                              |     |                                                                                                                                                                                                             |
| 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             | <p>Waveform length: 2 to 8,192 points</p> <p>Amplitude resolution: 14 bits (including sign bit)<sup>5</sup></p> <p>Repetition rate: 0.3 Hz to 12 MHz</p> <p>Sample rate: 400 MSa/s</p>                                                                                                                                                                                                                                                                                                                                                                                                           |     |                                                                                              |     |                                                                                                                                                                                                             |
| Frequency             | Sine wave accuracy: Timebase accuracy $\pm 1$ ppm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |                                                                                              |     |                                                                                                                                                                                                             |
| Amplitude             | <p>Range:</p> <p>2 mVpp to 10 Vpp into Hi-Z <sup>6,7</sup></p> <p>1 mVpp to 5 Vpp into 50 <math>\Omega</math> <sup>6,7</sup></p> <p>Resolution: 100 <math>\mu</math>V or 3 digits, whichever is higher</p> <p>Accuracy: 2% (frequency = 1 kHz)</p>                                                                                                                                                                                                                                                                                                                                               |     |                                                                                              |     |                                                                                                                                                                                                             |
| DC offset             | <p>Range: <math>\pm 8</math> V into Hi-Z <sup>6,7</sup>, <math>\pm 4</math> V into 50 <math>\Omega</math> <sup>6,7</sup></p> <p>Resolution: 100 <math>\mu</math>V or 3 digits, whichever is higher</p>                                                                                                                                                                                                                                                                                                                                                                                           |     |                                                                                              |     |                                                                                                                                                                                                             |
| Trigger output        | Trigger output available on Aux Out BNC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |                                                                                              |     |                                                                                                                                                                                                             |
| Main output           | <p>Impedance: 50 <math>\Omega</math> typical</p> <p>Isolation: Not available, main output BNC is grounded</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |                                                                                              |     |                                                                                                                                                                                                             |
| Output mode           | <p>Normal</p> <p>Single shot (arbitrary, sine, ramp, sine cardinal, exp rise/fall, cardiac, Gaussian pulse)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |     |                                                                                              |     |                                                                                                                                                                                                             |

<sup>5</sup> Full resolution is not available at output due to internal attenuator stepping.

<sup>6</sup> Gaussian Pulse, Sin, Cardiac: 4 Vpp maximum into Hi-Z; 2 Vpp maximum into 50  $\Omega$ .

<sup>7</sup> Maximum high level of 8V and minimum low level of -8V into Hi-Z (4V and -4V into 50  $\Omega$ ) of combined signal amplitude and offset.

**Digital voltmeter (typical)**

|                |                                                                                              |
|----------------|----------------------------------------------------------------------------------------------|
| Functions      | ACrms, DC, DCrms                                                                             |
| Resolution     | ACV/DCV: 3 digits                                                                            |
| Measuring rate | 100 times/second                                                                             |
| Autorangeing   | 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 (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                                                                                     |

**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, mouse, and keyboards |
|                | LAN (10/100/1000Base-T)                                                                                |
| Aux 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<br>Operating: 80% RH, non-condensing, up to +40 °C<br>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<br>CISPR 11/EN 55011<br>IEC 61000-4-2/EN 61000-4-2<br>IEC 61000-4-3/EN 61000-4-3<br>IEC 61000-4-4/EN 61000-4-4<br>IEC 61000-4-5/EN 61000-4-5<br>IEC 61000-4-6/EN 61000-4-6<br>IEC 61000-4-11/EN 61000-4-11 Canada: ICES-001:2004<br>Australia/New Zealand: AS/NZS |
| Safety                        | ANSI/UL Std. No. 61010-1:2012; CAN/CSA-C22.2 No. 61010-1-12<br>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)                                                                                                                                                                           |
|                              | 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.<br>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) downloadable from <a href="https://service.keysight.com/infoline/public/details.aspx?i=DOC">https://service.keysight.com/infoline/public/details.aspx?i=DOC</a> , 3-year calibration interval |  |
| 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                                                                                                                                             |  |
| Localized overlay                             | English, Chinese (simplified), Chinese (traditional), French, German, Italian, Japanese, Korean                                                                                                                                             |  |

## After-Purchase License-Only Upgrades

### Bandwidth upgrades

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

### Software upgrades

| License Upgrade                        | Description                                                                                                                                                      | Model number |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Embedded software package              | I <sup>2</sup> C, SPI, UART (RS232/422/485) serial trigger and decode                                                                                            | HD300EMBA    |
| Automotive software package            | CAN, CAN FD, CAN XL (symbolic with .dbc file), SENT, and LIN (symbolic with .ldf file)                                                                           | HD300AUTA    |
| Aerospace and defense software package | MIL-STD 1553 and ARINC 429 triggering and analysis                                                                                                               | HD300AERA    |
| Enhanced security                      | Add more stringent security features, including disabling non-volatile memory, disabling USB and LAN ports, disabling firmware upgrades, and password protection | HD3SECURE    |

## Memory upgrades

| Model number | Description                                 |
|--------------|---------------------------------------------|
| HD3MEM-050   | Memory Upgrade, 20 Mpts to 50 Mpts/Channel  |
| HD3MEM-100   | Memory Upgrade, 20 Mpts to 100 Mpts/Channel |
| HD3MEM-101   | Memory Upgrade, 50 Mpts to 100 Mpts/Channel |

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