

GPS-2000HD series

Technical Datasheet

12-bit high resolution digital storage oscilloscopes, 100 and 200 MHz, 2 or 4 channels

GPS-2104HD • GPS-2202HD • GPS-2204HD

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The GPS-2000HD series are digital storage oscilloscopes with 12-bit analogue-to-digital converters, in 100 and 200 MHz bandwidths with two or four analogue channels. They sample at up to 2 GSa/s into a record of up to 100 Mpts, and the front end holds a noise floor of 70 μ V rms at 200 MHz bandwidth, so a small signal riding on a large one, such as ripple on a supply rail, is resolved rather than lost to quantisation.

Triggering covers fourteen types, five serial buses are decoded as standard, and the analysis tools include a hardware mask test, Bode plot and, as an option, power analysis. The seven inch display is a capacitive touch screen. This technical datasheet gives the complete specification; the standard datasheet summarises it.



Figure 1 The front panel, schematic

1 Models

	GPS-2104HD	GPS-2202HD	GPS-2204HD
Analogue channels	4	2	4
Bandwidth (–3 dB)	100 MHz	200 MHz	200 MHz
Rise time, typical	3.5 ns	1.8 ns	1.8 ns
Vertical resolution	12-bit	12-bit	12-bit
Sample rate, one channel on	2 GSa/s	2 GSa/s	2 GSa/s
Sample rate, two channels on	1 GSa/s	1 GSa/s	1 GSa/s
Sample rate, four channels on	500 MSa/s	—	500 MSa/s
Memory per channel, one on	50 Mpts	100 Mpts	100 Mpts
Memory per channel, two on	25 Mpts	50 Mpts	50 Mpts
Memory per channel, four on	10 Mpts	—	25 Mpts
Capture rate, normal mode	80,000 wfm/s	120,000 wfm/s	120,000 wfm/s
Capture rate, sequence mode	500,000 wfm/s	500,000 wfm/s	500,000 wfm/s
Fastest timebase	2 ns/div	1 ns/div	1 ns/div
Standard probes	Passive, one per channel	Passive, one per channel	Passive, one per channel
Part number	302104	302202	312204

Memory is per channel and depends on how many channels are on. A dash means the mode does not exist on that model. The 100 Mpts figure applies to the 200 MHz models only; the 100 MHz model offers 50 Mpts.

Where the full sample rate runs out

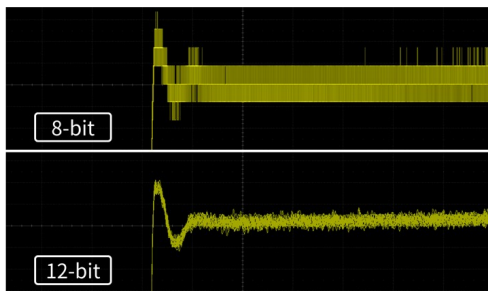
The record holds a fixed number of points, so at a slow enough timebase the instrument has to lower the sample rate to cover the time on screen. These are the slowest timebases at which the full sample rate for each mode is still held, calculated from the memory depths above.

Channels on	GPS-2104HD	GPS-2202HD, GPS-2204HD
One channel on	2.5 ms/div	5 ms/div
Two channels on	2.5 ms/div	5 ms/div
Four channels on	2 ms/div	5 ms/div (GPS-2204HD)

Calculated: memory per channel divided by sample rate is the time the record covers, and the screen is ten divisions wide.

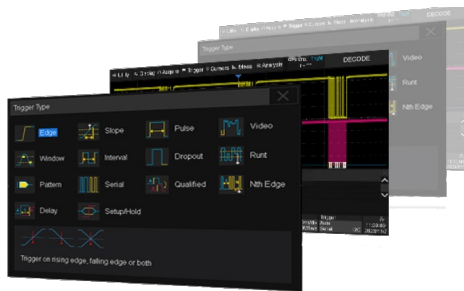
2 Key features

What sets the series apart, shown as the instrument shows it. Features marked option need extra hardware and a software licence.



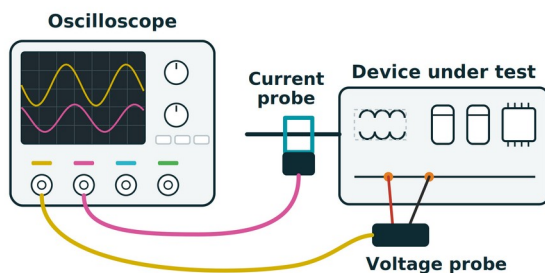
12-bit resolution

A step edge captured at 8 bits and at 12 bits. Sixteen times as many vertical levels resolve the overshoot and settling that the 8-bit trace quantises away. The front end adds a noise floor of 70 μV rms and 0.5% typical DC gain accuracy.



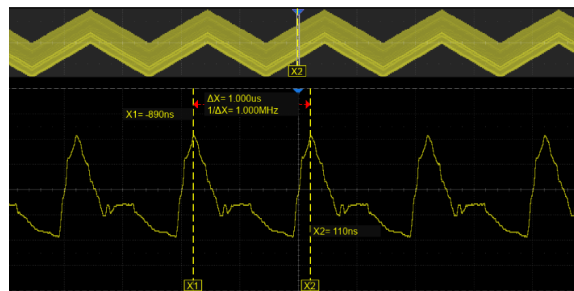
Triggering and decoding

Fourteen trigger types, from edge and pulse width to runt, dropout, setup/hold and serial, chosen from one menu. I²C, SPI, UART, CAN and LIN are triggered on and decoded as standard, with the decoded data shown beneath the waveform and as an event list.



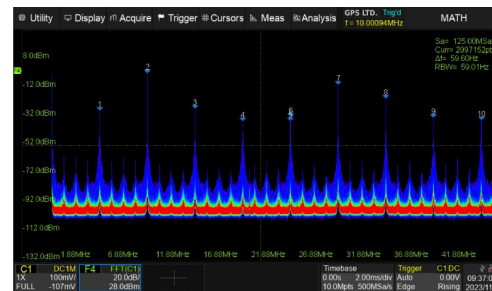
Power analysis (option)

Twelve measurement types, including power quality, current harmonics, inrush current, switching loss, output ripple, transient response and PSRR, with efficiency on the four-channel models. The setup is a voltage probe across the circuit and a current probe on a conductor.



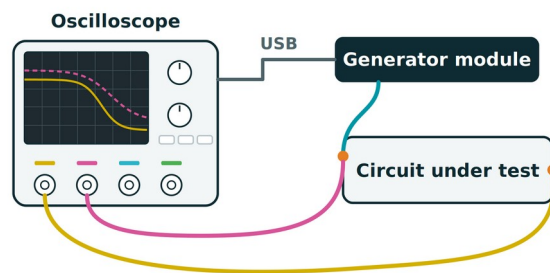
Deep memory

Up to 100 Mpts per channel on the 200 MHz models, and 50 Mpts on the 100 MHz model. Capture a slow event, then zoom in on a fast detail without lowering the sample rate: the upper trace is the whole record, the lower one the expanded section between the cursors.



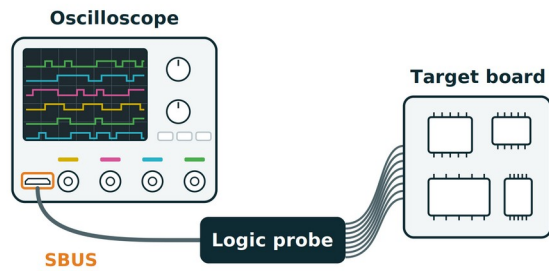
Math and FFT

Four math traces, a formula editor, and a hardware-accelerated FFT of up to 2 Mpts with five window functions. Automatic peak detection and numbered markers pick out the strongest components, as here.



Bode plot

Sweeps a circuit from 10 Hz to 120 MHz and plots gain and phase against frequency, with the optional waveform generator module supplying the stimulus. Cutoff frequencies, bandwidth, gain margin and phase margin are measured automatically.



16 digital channels (option)

The optional logic probe plugs into the SBUS socket and adds 16 digital channels at 1 GSa/s with 10 Mpts each, in two groups with separate thresholds. Mixed-signal acquisition, trigger and decode run alongside the analogue channels.

Also standard

- History: up to 80,000 earlier frames, time-stamped and replayed
- Sequence mode: up to 80,000 segments, 2 μ s apart
- Mask test: hardware, up to 80,000 frames/s
- Search and navigate, and a hardware counter
- 50+ automatic measurements with statistics
- Capacitive touch screen and web control over the LAN

The captures are from the instrument. The three setup drawings, for power analysis, the Bode plot and the digital channels, are schematic.

3 Acquisition

Item	Specification
Sample rate	One channel on: 2 GSa/s • two channels on: 1 GSa/s • four channels on: 500 MSa/s
Memory depth	Per channel, and shared as the table in section 1 shows. The maximum depth is selectable
Memory management	Auto, which sets sample rate and depth from the timebase, or a fixed sample rate with depth following the timebase
Waveform update rate	Normal mode up to 80,000 wfm/s (100 MHz) or 120,000 wfm/s (200 MHz) • sequence mode up to 500,000 wfm/s
Intensity grading	256 levels, with a colour temperature display mode
Acquisition modes	Normal and peak detect • average and enhanced resolution are available as maths functions
Peak detect	Shows all pulses wider than 2 ns
Sequence	Up to 80,000 segments • interval between triggers 2 μ s minimum
History	Up to 80,000 frames, each time-stamped
Interpolation	Sin(x)/x and linear

4 Vertical system

Specifications apply once the instrument is within its calibration period and has run continuously for at least 30 minutes at 18 °C to 28 °C.

Item	Specification
Channels	4 (GPS-2104HD, GPS-2204HD) or 2 (GPS-2202HD)
Bandwidth (–3 dB)	100 MHz (GPS-2104HD) • 200 MHz (GPS-2202HD, GPS-2204HD)

Item	Specification
Rise time, typical	3.5 ns (100 MHz) • 1.8 ns (200 MHz)
Flatness	DC to 10% of bandwidth: ± 1 dB • 10% to 50%: ± 2 dB • 50% to 100%: +2 dB / -3 dB
Resolution	12-bit
Effective number of bits	8.4 bits typical (24.99 MHz input, -0.25 dBFS, 20 mV/div, 50 Ω)
Noise floor	70 μ V rms typical at 1 mV/div, full bandwidth
Vertical range	8 divisions
Vertical scale	0.5 mV/div to 10 V/div at probe 1X
DC gain accuracy	0.5 mV/div to 4.95 mV/div: $\pm 1.5\%$ • 5 mV/div to 10 V/div: $\pm 0.5\%$ typical, $\pm 1\%$ maximum
Offset accuracy	$\pm$ (0.5% of the offset setting + 0.5% of full scale + 1 mV)
Offset range	± 1.6 V at 0.5 to 5 mV/div • ± 4 V at 5.1 to 10 mV/div • ± 8 V at 10.2 to 100 mV/div • ± 80 V at 102 mV to 1 V/div • ± 400 V at 1.02 to 10 V/div
Bandwidth limit	Hardware limit of 20 MHz, or full bandwidth
Low-frequency response	AC coupling, -3 dB at 2 Hz typical
Overshoot	10% typical, 150 ps edge
Coupling	DC, AC, GND
Input impedance	1 M Ω $\pm 2\%$ in parallel with 17 pF ± 2 pF
Maximum input voltage	400 V peak (DC + AC), DC to 10 kHz
Spurious-free dynamic range	35 dBc or better
Channel-to-channel isolation	Better than 40 dB, DC to full bandwidth
Probe attenuation	1X, 10X, 100X and custom

There is no internal 50 Ω termination: every input is 1 M Ω . Bandwidth, rise time, flatness and isolation are specified with an external 50 Ω feed-through termination.

5 Horizontal system

Item	Specification
Timebase range	2 ns/div to 1000 s/div (100 MHz) • 1 ns/div to 1000 s/div (200 MHz)
Screen range	10 divisions
Display modes	Y-T, X-Y and roll
Roll mode	At 50 ms/div and slower
Channel skew	Under 100 ps, channel 1 to channel 4
Timebase accuracy	± 25 ppm

6 Trigger

General

Item	Specification
Modes	Auto, normal, single
Level range	± 4.1 divisions from the centre of the screen
Holdoff	8 ns to 30 s in 8 ns steps
Coupling	DC, AC, LF reject, HF reject, with noise reject
Coupling response	DC passes all components • AC blocks DC and attenuates below 8 Hz • LF reject blocks DC and attenuates below 2 MHz • HF reject attenuates above 2.4 MHz
Accuracy	± 0.2 division typical
Sensitivity	0.6 division, DC to full bandwidth
Jitter	Under 100 ps
Displacement	Pre-trigger 0 to 100% of memory • delay trigger 0 to 10,000 divisions

Trigger types

Type	Source and settings	Limits and ranges
Edge	CH1 to CH4, AC line, D0 to D15 • rising, falling or alternating	—
Slope	CH1 to CH4 • rising or falling	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Pulse width	CH1 to CH4, D0 to D15 • positive or negative width	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Video	CH1 to CH4 • NTSC, PAL, 720p/50, 720p/60, 1080p/50, 1080p/60, 1080i/50, 1080i/60, custom • any or selected sync	On a line or on a field
Window	CH1 to CH4 • absolute or relative window	—
Interval	CH1 to CH4, D0 to D15 • rising or falling	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Dropout	CH1 to CH4, D0 to D15 • timeout on edge or on state • rising or falling	2 ns to 20 s in 1 ns steps
Runt	CH1 to CH4 • positive or negative	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Pattern	CH1 to CH4, D0 to D15 • each don't care, low or high • AND, OR, NAND, NOR	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Qualified	State, state with delay, edge, or edge with delay • qualifying and edge sources CH1 to CH4 • qualify state low or high • qualify edge rising or falling	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Nth edge	CH1 to CH4 • rising or falling	Idle time 8 ns to 20 s in 1 ns steps • edge number 1 to 65,535

Type	Source and settings	Limits and ranges
Delay	Sources A and B, CH1 to CH4 • rising or falling	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Setup / hold	Setup or hold • clock source CH1 to CH4 • clock slope rising or falling • data source CH1 to CH4 • data state low or high	Limits <, >, in range, out of range • 2 ns to 20 s in 1 ns steps
Serial	CH1 to CH4, D0 to D15 • I ² C, SPI, UART, CAN, LIN	See section 7

Digital channel sources, D0 to D15, need the optional logic probe.

7 Serial trigger and decode

Two serial buses can be decoded at the same time, each on any of the five protocols, from any analogue channel or, with the logic probe, from D0 to D15. The decoded data is shown beneath the waveforms and as an event list of 1 to 7 lines. The decode threshold is set within ± 4.5 divisions.

Protocol	Trigger conditions	Decode settings
I ² C	Start, stop, restart, no acknowledge, EEPROM read, address and data, data length	Signals SCL and SDA • 7-bit or 10-bit address
SPI	Data	Signals CLK, MISO, MOSI and CS • clock edge rising or falling • chip select active high, active low or clock timeout • bit order LSB or MSB
UART	Start, stop, data, parity error	Signals RX and TX • 5 to 8 data bits • parity none, odd, even, mark or space • stop bit 1, 1.5 or 2 • idle level low or high • bit order LSB or MSB
CAN	All, remote frame, ID, ID with data, error	—
LIN	Break, frame ID, ID with data, error	LIN 1.3 or 2.0 • baud rate 600, 1200, 2400, 4800, 9600, 19,200 bps or custom

8 Measurement and cursors

Item	Specification
Sources	CH1 to CH4, D0 to D15, Z1 to Z4, F1 to F4, reference, history
Modes	Simple and advanced
Range	The screen, or a gated region defined with separate gate cursors
Custom threshold	Upper, middle and lower
Vertical parameters	Max, Min, Pk-Pk, Top, Base, Amplitude, Mean, Cycle Mean, Stdev, Cycle Stdev, RMS, Cycle RMS, Median, Cycle Median, FOV, FPPE, ROV, RPPE, Level@Trigger

Item	Specification
Horizontal parameters	Period, Frequency, Time@max, Time@min, +Width, -Width, 10-90% rise time, 90-10% fall time, Rise time, Fall time, +Burst width, -Burst width, +Duty cycle, -Duty cycle, Delay, Time@Middle, Cycle-cycle jitter
Miscellaneous parameters	+Area@DC, -Area@DC, Area@DC, Absolute area@DC, +Area@AC, -Area@AC, Area@AC, Absolute area@AC, Cycles, Rising edges, Falling edges, Edges, Positive pulses, Negative pulses, Positive slope, Negative slope
Delay parameters	Phase, FRFR, FRFF, FFFR, FFFF, FRLR, FRLF, FFLR, FFLF, Skew, Tsu@R, Tsu@F, Th@R, Th@F
Statistics	Current, mean, min, max, Pk-Pk, standard deviation, count • histogram, trend and track • count unlimited, or 1 to 1024
Cursors, sources	CH1 to CH4, D0 to D15, F1 to F4, reference
Cursors, types	Manual: time X1, X2, X1-X2, 1/ΔT and vertical Y1, Y2, Y1-Y2 • track: time X1, X2, X1-X2 • measure: the value of a chosen parameter

Measurements can be made on analogue and digital channels, zoom and maths traces, reference waveforms and history frames.

9 Math and FFT

Item	Specification
Traces	Four, F1 to F4
Sources	CH1 to CH4, Z1 to Z4, F1 to F4
Operations	FFT, filter, +, -, ×, ÷, ∫dt, d/dt, √, identity, negation, absolute value, sign, e ^x , 10 ^x , ln, lg, interpolation, max hold, min hold, ERES, average, and a formula editor
FFT length	2 Mpts, 1 Mpts, 512 kpts, 256 kpts, 128 kpts, 64 kpts, 32 kpts, 16 kpts, 8 kpts, 4 kpts, 2 kpts, 1 kpts
FFT window	Rectangle, Blackman, Hanning, Hamming, Flattop
FFT display	Full screen, split, exclusive • modes normal, max hold, average • peak and marker tools

10 Analysis tools

Item	Specification
Search	Sources CH1 to CH4 and history • edge, slope, pulse, interval, runt • copy settings from or to the trigger
Navigate	By search event, by time, or by history frame
Mask test	Sources CH1 to CH4, Z1 to Z4 • mask created automatically or drawn in the mask editor • up to 80,000 frames/s
Counter	Sources CH1 to CH4 • 7-digit frequency resolution • totalizer counting edges, with gate and trigger

Item	Specification
Bode plot	Sources CH1 to CH4 • driven by the optional isolated waveform generator module over USB, or by a compatible GPS arbitrary waveform generator over USB or LAN • simple and vari-level sweeps • linear or logarithmic, 10 Hz to 120 MHz • measures upper and lower cutoff frequency, bandwidth, gain margin and phase margin
Power analysis (option)	Power quality, current harmonics, inrush current, switching loss, slew rate, modulation, output ripple, turn on and turn off, transient response, PSRR, SOA, and efficiency (four-channel models only)

11 Digital channels (option)

The optional 16-channel logic probe connects to the SBUS interface and adds digital acquisition, trigger and decode alongside the analogue channels, without affecting them. It needs a software licence.

Item	Specification
Channels	16, in two groups: D0 to D7 and D8 to D15, each with its own threshold
Maximum sample rate	1 GSa/s
Memory depth	10 Mpts per channel
Minimum detectable pulse	3.3 ns
Threshold range	-8 V to +8 V
Logic types	TTL, CMOS, LVCMOS 3.3 V, LVCMOS 2.5 V, custom
Skew	D0 to D15: ± 1 sampling interval • analogue to digital, triggered on digital: $\pm (1 \text{ sampling interval} + 1 \text{ ns})$ • digital to analogue, triggered on analogue: $\pm 4 \text{ ns}$
Connection	The SBUS interface on the front panel

12 Waveform generator (option)

The optional isolated waveform generator module connects to a USB host port and is controlled from the oscilloscope. It needs a software licence.

Item	Specification
Channels	1, with isolated output
Maximum output frequency	25 MHz
Sampling rate	125 MSa/s
Frequency resolution	1 μ Hz
Frequency accuracy	$\pm 50 \text{ ppm}$
Vertical resolution	14-bit
Amplitude range	-1.5 V to +1.5 V into 50 Ω • -3 V to +3 V into high impedance
Waveforms	Sine, square, ramp, pulse, DC, noise, and 45 arbitrary waveforms
Output impedance	50 $\Omega \pm 2\%$

Item	Specification
Protection	Over-voltage protection and current limit
Sine	1 μ Hz to 25 MHz • offset accuracy $\pm$ (1% of setting + 3 mVpp) at 10 kHz • amplitude flatness $\pm$ 0.3 dB against 10 kHz at 2.5 Vpp into 50 Ω
Sine, SFDR	DC to 1 MHz: -60 dBc • 1 to 5 MHz: -55 dBc • 5 to 25 MHz: -50 dBc
Sine, harmonic distortion	DC to 5 MHz: -50 dBc • 5 to 25 MHz: -45 dBc
Square and pulse	1 μ Hz to 10 MHz • duty cycle 1% to 99% • edge under 24 ns (10% to 90%) • overshoot under 3% typical (1 kHz, 1 Vpp) • pulse width over 50 ns • cycle-to-cycle jitter under 500 ps + 10 ppm
Ramp	1 μ Hz to 300 kHz • linearity under 0.1% of peak to peak typical (1 kHz, 1 Vpp, 50% symmetry)
DC	Offset $\pm$ 1.5 V into 50 Ω , $\pm$ 3 V into high impedance • accuracy $\pm$ (1% of setting + 3 mV)
Noise	Bandwidth (-3 dB) over 25 MHz
Arbitrary	1 μ Hz to 5 MHz • 16 kpts wave memory • 125 MSa/s • loaded from the PC editor software, from a USB drive, or directly from an analogue channel waveform

13 Interfaces and remote control

Item	Specification
Front panel	USB 2.0 host • SBUS logic probe connector • probe compensation output, 1 kHz 3 V square wave, with ground terminal
Rear panel	USB 2.0 host • USB 2.0 device (USBTMC) • LAN 10/100BASE-T (RJ45) • auxiliary output
Auxiliary output	Trigger out, 3.3 V LVCMOS • pass/fail out, 3.3 V TTL • the trigger output can be used to measure the waveform capture rate
Remote control	SCPI commands over USB (USBTMC) and LAN (VXI-11, Telnet and socket)
Web control	Built-in web server, for control from a browser over the LAN
Peripherals	External mouse and keyboard on the USB host ports • NTP time synchronisation

The SBUS socket on the front panel looks like an HDMI connector but is not one. Connect only the optional logic probe to it. Connecting anything else may damage the instrument.

14 Display

Item	Specification
Type	7 inch TFT-LCD with capacitive touch screen, multi-touch gestures
Resolution	1024 $\times$ 600
Contrast, typical	500:1
Backlight, typical	500 nit

Item	Specification
Grid	8 × 10 divisions
Trace display	Dots or vectors
Persistence	Off, 1 s, 5 s, 10 s, 30 s, infinite
Colour display	Normal, or colour temperature
Interface font	Large or small, for the instrument screen or for a remote display
Languages	10 interface languages, with built-in help in English

15 Power, environment and mechanical

Item	Specification
Supply	100 to 240 Vrms, 50/60 Hz • adapts automatically over 90 to 264 Vrms and 47 to 63 Hz
Power consumption	80 W maximum, 40 W typical, 4 W in standby
Operating temperature	0 °C to 40 °C
Storage temperature	–30 °C to 70 °C
Humidity	Operating 5% to 90% RH at 30 °C • non-operating 5% to 95%
Altitude	Operating up to 3000 m at 25 °C • non-operating up to 15,000 m
Conditions of use	Indoor use • pollution degree 2 • IP20 • mains supply installation (overvoltage) category II
Cooling	Forced air, with ventilation openings on both sides • leave 15 cm clear at each side
Dimensions	312 × 132.6 × 151 mm (l × w × h), including knobs and supporting legs
Mass	2.6 kg net • 3.8 kg packaged

Do not use the instrument for measurements on mains circuits, or on voltages beyond the ranges in this document. The maximum additional transient voltage must not exceed 1300 V. Use only probes that meet UL 61010-031 and CAN/CSA-C22.2 No. 61010-031.

The power switch puts the instrument into standby. It does not disconnect the mains: unplug the power cord to isolate the instrument completely.

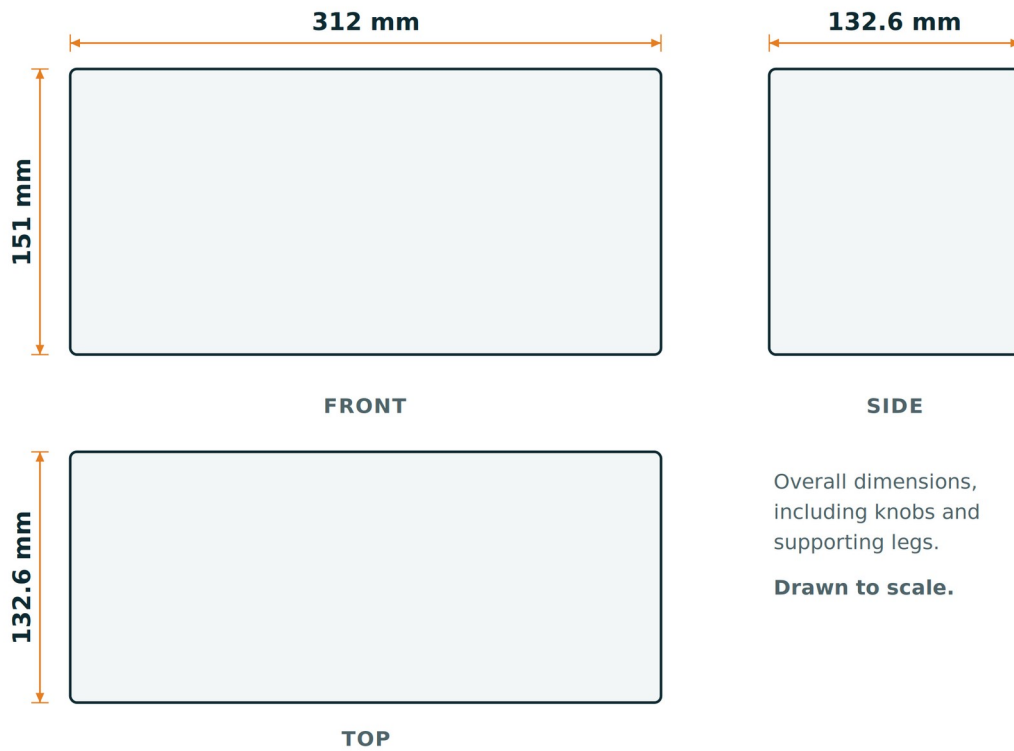


Figure 2 Overall dimensions, three views, to scale

16 Standards

Item	Specification
EMC	Meets the EMC directive 2014/30/EU • IEC 61326-1:2012 / EN 61326-1:2013 (basic)
Emissions	CISPR 11 / EN 55011 class A, group 1 • conducted 150 kHz to 30 MHz • radiated 30 MHz to 1 GHz
Immunity	ESD 4 kV contact, 8 kV air • RF field 10 V/m (80 MHz to 1 GHz), 3 V/m (1.4 to 2 GHz), 1 V/m (2.0 to 2.7 GHz) • fast transients 2 kV on AC power • surges 1 kV line to line, 2 kV line to earth • conducted RF 3 V, 0.15 to 80 MHz • voltage dips and interruptions
Safety	UL 61010-1:2012/R:2018-11 and UL 61010-2-030:2018 • CAN/CSA-C22.2 No. 61010-1:2012/A1:2018 and No. 61010-2-030:2018
RoHS	EU 2015/863

17 Ordering information

Models

Code	Description	Part number
GPS-2104HD	4 channels, 100 MHz, 2 GSa/s, 12-bit digital storage oscilloscope	302104
GPS-2202HD	2 channels, 200 MHz, 2 GSa/s, 12-bit digital storage oscilloscope	302202
GPS-2204HD	4 channels, 200 MHz, 2 GSa/s, 12-bit digital storage oscilloscope	312204

Supplied with the instrument

One passive probe per channel, matched to the model, a USB cable, a power cord, a quick start guide and a certificate of calibration.

Options

Option	What it adds	Notes
16-channel logic probe	Adds 16 digital channels through the SBUS interface, for mixed-signal acquisition, trigger and decode	Needs a software licence
Isolated waveform generator module	One channel, 25 MHz, 14-bit, isolated output, connected to a USB host port. Also drives the Bode plot	Needs a software licence
Power analysis	The power analysis suite described in section 10	Software licence

Option part numbers are available on request. Current, differential and high-voltage probes are available from GPS.

18 Warranty and service

One year warranty from the date of purchase, subject to product registration with GPS at www.gpslimited.com/register-product. Service and calibration are available; please contact GPS for more information.

For enquiries, pricing and technical support: +44 (0) 203 093 0914, sales@gpslimited.com.

Specifications are subject to change without notice.