



GPS-2000HD series

12-Bit Digital Storage Oscilloscope

GPS-2104HD · GPS-2202HD · GPS-2204HD

Quick Start Guide

Issue 1

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1 Safety

Read this section before connecting anything to the instrument.

This oscilloscope must not be used for measurements on mains circuits, or on voltages beyond the ranges in this guide. The maximum additional transient voltage must not exceed 1300 V.

- Use only the supplied power cord, and make sure the instrument is earthed. It earths through the protective conductor of that cord, and the earth must be connected before anything is connected to the inputs or outputs. Interrupting the earth, inside or outside the instrument, is dangerous and prohibited.
- The outer shells of the four channel BNCs are connected to the chassis and so to earth, and so is the ground lead of every probe. Never connect a ground lead to anything that is not at earth potential, and do not connect a signal lead to a high voltage.
- Do not exceed 400 V peak on any input. Check the ratings of every terminal before connecting to it.
- Use only probe assemblies that meet the safety requirements for this instrument. Do not alter or replace any part of the instrument or its accessories except as authorised by GPS.
- Leave at least 15 cm clear at each side of the instrument, where the ventilation openings are. Do not block them, and do not let anything enter them.
- Use the instrument indoors in a clean, dry place. Do not operate it in damp, dusty or explosive surroundings, or with a cover removed, and keep its surface clean and dry.
- Keep the power plug easy to reach. The power key puts the instrument into standby and does not disconnect it from the mains. To isolate it completely, unplug the power cord, and unplug it if it will not be used for a long time.
- There are no operator-serviceable parts inside. Capacitors and other parts hold energy and are sensitive to static, so do not open the instrument; return it to GPS for service.
- Do not use the instrument if it is visibly damaged, has been through severe transport stress, or you suspect a fault. Have it checked first.
- Do not connect the instrument directly to a person, and do not use it for patient monitoring.

If the instrument is used in a way that is not specified here, the protection it provides may be impaired.

2 In the box

- GPS-2000HD oscilloscope (GPS-2104HD, GPS-2202HD or GPS-2204HD)
- One passive probe for each channel
- Power cord
- USB cable
- Quick start guide and certificate of calibration

Check the contents before you begin, and keep the packaging until you are satisfied the instrument works. The options, the logic probe, the waveform generator module and power analysis, are supplied separately and each needs a licence.

3 First power-on

Open the supporting legs under the front to tilt the instrument back for easier viewing, and connect the power cord to the socket on the rear panel. The instrument accepts 100 to 240 V at 50 or 60 Hz and adapts automatically: there is no voltage selector. It draws up to 80 W.

Press the power key at the bottom left of the front panel. The instrument starts and shows its main screen when the start-up checks finish. To switch off, press the power key again, or choose Utility > Shutdown. Either way the instrument goes to standby; it is only fully off when the power cord is unplugged.

Starting automatically

For a rack that is switched at the wall, turn on Auto Power On under Utility > Menu > System Settings. The instrument then starts as soon as the power cord is connected.

Language and options

Choose the language under Utility > Menu > System Settings > Language. System Info under Utility > Menu shows the software and hardware versions. A software option is unlocked with a licence, installed through the Utility menu.

Checking it works

Press Default. Connect a probe to channel 1, clip its ground lead to the ground terminal beneath the probe compensation output, and connect its tip to the output. Press Auto Setup. A steady square wave should appear.

Repeat on each of the other channels. If a square wave is not flat-topped, compensate that probe as described next.

4 The probe

More wrong measurements come from the probe than from the instrument, and both of the common reasons are avoidable.

The probe and the channel must agree

The channel dialog sets the probe attenuation factor, 1X, 10X, 100X or a custom value, and the instrument rescales the vertical scale to match. If the setting does not match the probe, every voltage is wrong by the difference and the display still looks reasonable. With a standard 10X probe that has a readout terminal, the instrument sets 10X by itself.

If a probe has a 1X setting, use 10X for general work. At 1X its bandwidth is far below the instrument's, and fast signals appear smaller and slower than they are.

There is no internal 50 Ω

Every input is 1 M Ω . For a measurement that needs 50 Ω , use an external feed-through terminator. The bandwidth, rise time and flatness figures are specified with one fitted.

Compensating the probe

Compensate a new probe, or one moved to another channel, to that channel; a poorly compensated probe adds measurement error.

- Connect the probe to a channel, its tip to the probe compensation output, and its ground clip to the ground terminal below it.
- Press Auto Setup and compare the square wave with the drawings below.
- Use a non-metallic tool to adjust the low-frequency compensation hole in the probe until the waveform matches the correct one.

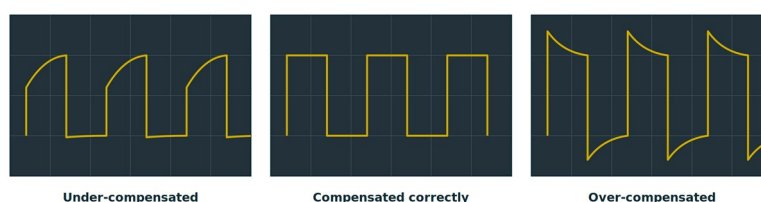


Figure 1 Probe compensation: under-compensated, correct, and over-compensated

Probe > Probe Check in the channel dialog guides you through the same check. Active probes do not need compensating.

5 The front panel

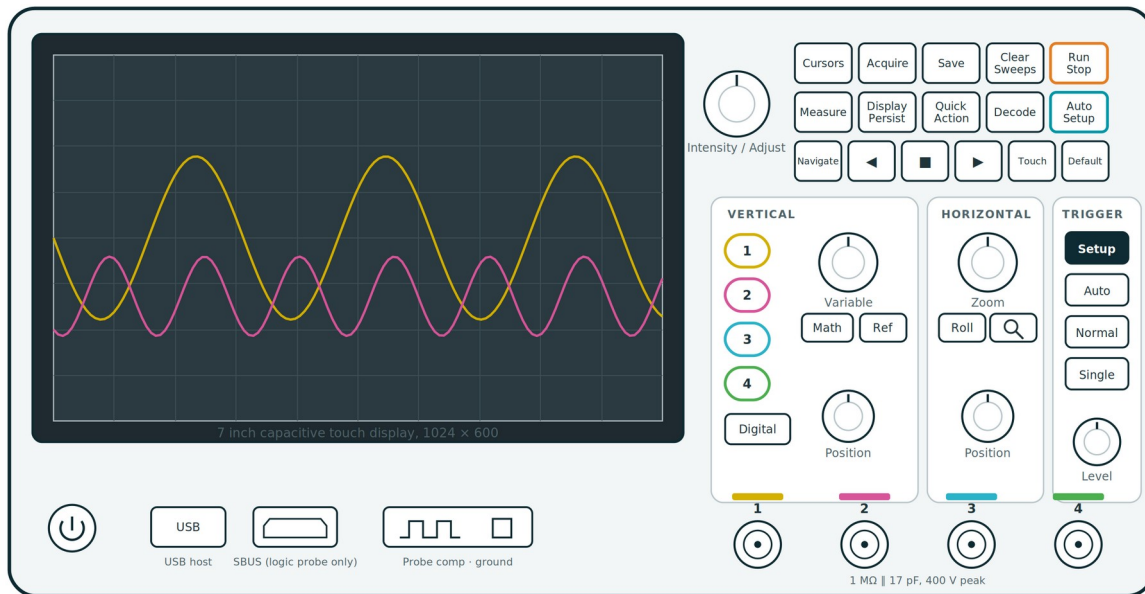


Figure 2 The front panel, schematic

Control	What it does
Touch display	7 inch capacitive touch screen, 1024 × 600. Touch, drag, pinch and spread; a mouse works the same way
Universal knob	Adjusts the highlighted parameter, and selects an option from a list when pressed. By default it adjusts the intensity of the traces
Cursors	Opens the cursors dialog. Turn the knob to move the selected cursor; press it to select another
Measure	Turns measurements on and off, and opens the measure dialog
Acquire	Opens the acquire dialog
Save	Quick save: a screenshot, or the currently selected file type, to the chosen path
Clear Sweeps	Clears persistence, measurement statistics, average sweeps and pass/fail statistics
Display / Persist	Opens the display dialog. A second press turns persistence on and lights the key; a third turns it off
Quick Action	Calls a preset function, set up in the Utility menu
Run/Stop	Starts and stops acquisition. Lit green while running and red when stopped
Auto Setup	Sets the vertical scale, horizontal scale and trigger level to suit the input
Decode	Turns bus operation on and opens the decode dialog; press again to turn it off

Control	What it does
Navigate	Opens the navigate dialog. The three keys beside it play backward, stop, and play forward
Touch	Switches the touch screen on and off. Its light shows that the touch screen is working
Default	Returns the instrument to its default configuration
Vertical	Channel keys 1 to 4, Digital, Math and Ref. One scale knob and one position knob act on whichever trace is active
Horizontal	Timebase knob (press to enable Zoom, and again to switch between the main and zoom windows), Roll key, Zoom key, and the delay knob (press to set zero)
Trigger	Setup opens the trigger dialog. Auto, Normal and Single set the mode. The Level knob sets the threshold; press it to set 50% of the waveform
Power	Switches the instrument between operation and standby
Inputs	Four BNC inputs, 1 M Ω , 400 V peak maximum
Probe compensation	A 1 kHz square wave of 0 to 3 V, with a ground terminal beneath it, for compensating probes
USB host	For a USB storage device, a mouse or a keyboard
SBUS	For the optional logic probe only

6 The rear panel

Connection	What it is for
LAN	10/100 Mbit/s network connection, for remote control
USB device	Connection to a PC, for remote control
USB host	For a USB storage device, a mouse or a keyboard
Auxiliary output	A trigger indicator, which can be used to measure the waveform capture rate. With mask test on, it outputs the pass/fail signal instead
AC power input	100 to 240 V, 50/60 Hz
Keyhole	For a security lock
Handle	For carrying the instrument

7 The touch screen

The whole display is a capacitive touch screen. Touch, drag, pinch and spread with your fingers, or use a USB mouse and keyboard, which work wherever touch does. Settings are made in a dialog box at the right of the screen, and most are also on the front panel, where they are quicker.

Area	What it shows
Menu bar	Drop-down menus along the top. Every function can be reached from here
Grid area	The traces, on an 8 × 10 grid. Drag a trace to move it; pinch or spread to rescale it
Channel descriptor boxes	Under the grid, one for each trace that is on: channel, math, reference, zoom or digital. Each shows coupling and impedance, vertical scale, offset, bandwidth limit and probe factor. Touch one to open its dialog
Timebase and trigger boxes	Trigger delay, timebase, number of samples and sample rate; and trigger source, coupling, mode, level, type and slope. Touch either to open its dialog
Dialog box	At the right: where the settings of the selected function are made. Touch its title bar to hide it, and again to bring it back
Trigger markers	A level marker beside the grid and a delay marker along it show where the trigger is

Gestures

Gesture	What it does
Drag a trace left or right	Moves it along the time axis
Pinch or spread horizontally	Rescales the timebase
Drag a trace up or down	Moves it on the vertical axis
Pinch or spread vertically	Rescales the vertical gain
Touch and drag a cursor	Moves it. Drag the cursor readout to move a pair together

Display > Menu > LCD Brightness sets the backlight. A few functions are reached only through the menu bar: Utility > Help, Utility > Save/Recall, Utility > Reboot and Display.

8 The controls you need first

Capturing a signal quickly

Connect the signal, press the channel key to turn the channel on, then press Auto Setup. The instrument sets the vertical scale, horizontal scale and trigger level to show the signal. Auto Setup will not work on every signal, especially bursts that vary with time and slow signals below 100 Hz. For those, set the vertical, horizontal and trigger controls by hand. Default returns the instrument to its default configuration when you want to start again.

Run/Stop and Single

Run/Stop starts and stops acquisition; the key is lit green while the instrument is running and red when it is stopped. Single captures one acquisition when the trigger conditions are met, then stops, which is what you want for an event that happens once.

The knobs, and what pressing them does

- Vertical scale sets volts per division for the active trace; press it to switch between coarse and fine adjustment.
- Vertical position moves the active trace; press it to set the offset to zero.
- Horizontal scale sets the timebase; press it to enable Zoom, and press again to switch between the main and zoom windows.

- Delay moves the trigger point; press it to set the delay to zero.
- Level sets the trigger threshold; press it to set 50% of the waveform, which stabilises most displays at once.
- The Universal knob adjusts whatever parameter is highlighted, and by default the intensity of the traces; press it to select an option from a list.

Channel settings you will use first

- Coupling: DC passes everything; AC blocks the DC component, so a small ripple on a large offset can be seen; GND shows the zero line.
- Bandwidth limit: full bandwidth, or a 20 MHz hardware limit that cleans up a low-frequency signal.
- Vertical scale: coarse or fine. Fine mode fills the screen as closely as possible and gives the best vertical accuracy, and the instrument switches to it by itself when you scale by touch.

Touch a channel descriptor box for a quick dialog with the scale and offset, or activate the channel for the full dialog, which also holds the probe factor, label, units, deskew, invert and trace.

Trigger mode

Auto sweeps even without a trigger, after a timeout, so the display always refreshes. It is the right choice while you look for a signal. Normal sweeps only when the input meets the trigger condition, and otherwise keeps showing the last waveform acquired. Single captures once and stops.

The trigger box shows the state. Arm means the pre-trigger buffer is filling and triggers are ignored; Ready means the instrument is waiting for a trigger; Trig'd means a trigger has been detected.

9 Channels share the sample rate and memory

The headline 2 GSa/s is available with one channel on. The sample rate and the memory depth both depend on how many channels are on, and this is the constraint most likely to surprise you.

Channels on	Sample rate	Memory per channel, GPS-2104HD	Memory per channel, GPS-2202HD and GPS-2204HD
One channel on	2 GSa/s	50 Mpts	100 Mpts
Two channels on	1 GSa/s	25 Mpts	50 Mpts
Four channels on	500 MSa/s	10 Mpts	25 Mpts (GPS-2204HD)

Switch off any channel you are not using: one left on halves or quarters the rate available to the ones that matter. With a channel active, press its key to turn it off.

The record length is chosen in the Acquire dialog, which also offers two ways to manage memory. Auto, the default, sets the sample rate and memory depth from the timebase: the sample rate is the number of samples divided by the time on screen, which is ten divisions. Fixed sample rate holds the rate you set and lets the depth follow; check that it is at least twice the highest frequency in the signal, or the display will alias.

At slow timebases the instrument lowers the sample rate to cover the time on screen. With the longest record the full rate holds to 5 ms/div on the 200 MHz models, and to 2.5 ms/div on the GPS-2104HD, or 2 ms/div with four channels on.

10 Making a first measurement

- Press Measure to turn measurements on and open the measure dialog. Choose the source and the parameters. There are more than 50, in four groups: vertical, horizontal, miscellaneous and delay.

- Statistics show each result's current value with its maximum, minimum, standard deviation and mean. A histogram shows how a parameter is distributed, and trend and track show its value against time. Clear Sweeps restarts the statistics.
- A measurement can be limited to a gated region, and can be made on math traces, reference waveforms and history frames.
- For a measurement you place yourself, press Cursors. Turn the knob to move the selected cursor and press it to select another, or drag a cursor by touch. The cursor types are manual, for time and voltage, track, and measure, which marks a chosen measurement.
- A hardware counter reads the frequency of a channel to seven digits.

11 Zoom, roll, history and sequence

Zoom

Press the horizontal knob or the Zoom key to split the screen. The main window takes about a third of the height and the zoom window the rest. Touch a window to make it active, then use the scale and position knobs, or pinch and drag, to size and move the zoomed area. Double-click a point in the main window to centre the zoom area on it. Zoom traces can be the source for measurements, math and mask tests.

Roll

At 50 ms/div and slower, Roll shows the waveform moving across the screen from right to left, like a strip chart, with the newest data at the right. There is no trigger in roll mode, and zoom works only after Stop.

History and sequence

The instrument keeps the frames it acquires, up to 80,000 depending on memory depth and timebase. Turn on history to recall any frame, with a time label for each, and to play them back automatically at an interval you choose.

Sequence mode divides the memory into up to 80,000 segments and stores one trigger event in each, with as little as 2 μ s between them. The display does not update until all the segments are acquired, and history lets you look at them one at a time. Search finds events you define within a frame, and navigate steps through them, by time or by history frame.

12 Serial decode

I²C, SPI, UART, CAN and LIN are triggered on and decoded as standard, and two buses can be decoded at once. Press Decode to open the decode dialog, choose the bus and the protocol, and set the source channels and thresholds. The decoded data is shown on a bus display, as binary, decimal, hexadecimal or ASCII, and listed in a table of events. Press Decode again to turn bus operation off.

To trigger on a bus condition, set the trigger type to serial in the trigger dialog. With the optional logic probe, the digital channels D0 to D15 can be used as sources as well as the analogue ones.

13 Saving, options and connecting to a PC

Saving

Connect a USB flash drive, FAT32 recommended, to a USB host port. The Save key saves a screenshot, or the currently selected file type, to the chosen path in one press. Utility > Save/Recall offers the full set of save and recall functions.

Remote control

Connect the LAN port to the network and set the address under Utility > Menu > I/O > LAN Config. The built-in web server then lets you control the instrument from a browser, and the instrument also accepts SCPI commands. For USB control, connect the USB device port to a PC. A USB mouse and keyboard can be connected to either USB host port.

Waveform generator module (option)

Activate the option, connect the module to any USB host port, and choose Utility > Wave Gen to set the waveform. The same module drives the Bode plot.

Logic probe (option)

Connect the logic probe to the SBUS socket and press Digital to turn on the digital channels. Before unplugging it, touch Remove Device in the digital menu and wait for the Digital Device Disconnected message.

The SBUS socket 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 If something is not right

The screen stays dark

Check the power cord and the socket, then switch on again. If the screen is still dark, contact GPS.

An alarm or error message appears

After start-up there should be no alarm or error message, and the trace should sweep freely from left to right. If a pop-up, alarm or error appears, read the message and restart the instrument. If the fault remains, do not use the instrument for measurements; contact GPS.

A signal is connected but no waveform appears

Check that the probe is firmly on its BNC and on the circuit, that the channel is on, and that the circuit is producing a signal. Then press Auto Setup. For slow signals and bursts, set the controls by hand.

Voltages read too high or too low

The probe and the channel's probe setting almost certainly disagree. See section 4.

The waveform will not hold still

Check that the trigger source is the channel carrying the signal, that the trigger type suits it, and that the level is within the signal; pressing the level knob sets it halfway. Holdoff steadies a signal that repeats irregularly.

Nothing appears in Normal or Single mode

The trigger level is probably outside the signal. Press the level knob, or switch the trigger mode to Auto.

The touch screen does not respond

The light on the Touch key shows whether the touch screen is on. Press the key to switch it on.

A USB drive is not recognised

Use a USB flash drive, FAT32 recommended, check that it works in another device, and try removing and reinserting it.

15 Specification

Item	Specification
Channels	4 (GPS-2104HD, GPS-2204HD) or 2 (GPS-2202HD)
Bandwidth	100 MHz (GPS-2104HD) • 200 MHz (GPS-2202HD, GPS-2204HD) • 20 MHz bandwidth limit
Resolution	12-bit • noise floor 70 μ V rms typical at 1 mV/div
Sampling	2 GSa/s on one channel, 1 GSa/s on two, 500 MSa/s on four
Memory per channel	GPS-2104HD: 50, 25 and 10 Mpts • GPS-2202HD and GPS-2204HD: 100, 50 and 25 Mpts, for one, two and four channels on
Vertical scale	0.5 mV/div to 10 V/div at probe 1X • DC gain accuracy $\pm$ 0.5% typical from 5 mV/div
Input	1 M Ω $\pm$ 2% in parallel with 17 pF $\pm$ 2 pF • 400 V peak maximum • DC, AC, GND • no internal 50 Ω
Timebase	2 ns/div (100 MHz) or 1 ns/div (200 MHz) to 1000 s/div • $\pm$ 25 ppm
Capture rate	Up to 80,000 wfm/s (100 MHz) or 120,000 wfm/s (200 MHz) • 500,000 wfm/s in sequence mode
Trigger	Fourteen types, from edge and pulse width to runt, dropout, setup/hold and serial • holdoff 8 ns to 30 s • I ² C, SPI, UART, CAN and LIN trigger and decode, two decoders, standard
Analysis	Search, navigate, history (80,000 frames), sequence (80,000 segments), mask test, counter, Bode plot, power analysis (option)
Measurement	50+ parameters with statistics, histogram, trend and track • four math traces with a 2 Mpts FFT
Display and interfaces	7 inch capacitive touch screen, 1024 $\times$ 600 • USB host $\times$ 2, USB device (USBTMC), LAN, auxiliary output (trigger out, pass/fail) • SCPI • web server
Options	16-channel logic probe • isolated 25 MHz waveform generator module • power analysis, each with a licence
Power	100 to 240 V, 50/60 Hz • 80 W maximum • 4 W in standby
Environment	0 $^{\circ}$ C to 40 $^{\circ}$ C operating • -30 $^{\circ}$ C to 70 $^{\circ}$ C storage • up to 3000 m • indoor use, IP20
Size and mass	312 $\times$ 132.6 $\times$ 151 mm (l $\times$ w $\times$ h) • 2.6 kg

16 Where to go next, care and warranty

This guide covers getting started. Every trigger type, the decode and measurement dialogs, math and FFT, mask test, Bode plot, power analysis, remote control and the SCPI command reference are in the full documentation, available from GPS on request.

- Unplug the instrument before cleaning. Wipe the outside only, with a soft damp cloth; no chemicals or abrasives, and keep moisture out.

One year warranty from purchase, subject to registration at www.gpslimited.com/register-product. Service, calibration and support: sales@gpslimited.com or +44 (0) 203 093 0914.