



# GPS-1104XU

Digital Storage Oscilloscope

100 MHz · 4 channels · 1 GSa/s · 14 Mpts

## Operating Manual

Issue 1

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# 1 Safety

Read this section before connecting anything to the instrument. Every item in it is here because ignoring it can injure you or damage what you are working on.

**This oscilloscope is not rated for installation measurement. It must not be used for measurements in categories CAT II, CAT III or CAT IV, and must not be used on mains circuits.**

- Use only the supplied mains lead, and make sure the instrument is earthed. It earths through the protective conductor of that lead, and the earth must be in place 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 channel BNCs are connected to the chassis and so to earth. So is the ground lead of every probe. Never connect a probe ground lead to anything that is not at earth potential.
- Do not exceed 400 V peak on any input. Check the ratings of every terminal before connecting to it.
- Do not touch the metal of a probe tip while it is connected to a source, and check that the probe lead's insulation is sound before use. Use only probes that meet the instrument's specification; attenuating probes must be insulated from the circuit by double or reinforced insulation.
- Leave at least 10 cm clear beside, above and behind the instrument for the cooling fan, and keep the intake and exhaust free. Check them regularly.
- Use the instrument indoors in a clean, dry place. Do not operate it in damp conditions, in an explosive atmosphere, or with any cover removed.
- Protect it from overvoltage on the mains, such as a lightning surge, and from electrostatic discharge: ground yourself and the cable before connecting to a sensitive circuit.
- Place it so the mains plug stays easy to reach. To isolate the instrument completely, unplug it. Unplug it if it will not be used for a long time.
- There are no user-serviceable parts inside. If you suspect damage, have the instrument inspected before using it again.

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

## 2 Introduction

The GPS-1104XU is a four-channel digital storage oscilloscope with 100 MHz of bandwidth, sampling at up to 1 GSa/s with a record of up to 14 Mpts, on a 7 inch colour display. It uses an intensity-graded display with 256 levels, so a trace is brighter where the signal spends more of its time, and a digital trigger system with high sensitivity and low jitter.

Beyond the basics, it triggers on and decodes five serial buses, keeps a history of up to 80,000 earlier acquisitions, divides its memory into segments to capture bursts of events, makes 38 automatic measurements over the whole record, and runs a hardware pass/fail test against a mask at up to 40,000 decisions a second. It can be driven from a PC over USB or LAN.

*This manual covers operating the instrument. The SCPI command reference for programming is a separate document, available from GPS on request; section 16 covers the connection settings.*

## 3 Unpacking and setting up

### Inspection

Check the packaging for damage and keep it until the instrument has been checked. Check the instrument itself for damage, and check the accessories against the list below. Report anything missing or damaged to GPS.

- GPS-1104XU oscilloscope

- Four passive probes, 100 MHz, switchable 1X and 10X
- Mains lead
- USB cable
- Quick start guide and calibration certificate

## Position

Place the instrument on a firm, level surface with the clearance described in section 1. The feet under the front fold out to tilt the instrument back, which makes the display easier to see from a seated position.

## Mains

Connect the mains lead to the socket on the rear panel. The instrument accepts 100 to 240 V at 50 or 60 Hz, or 100 to 120 V at 400 Hz, and adapts to the supply automatically; there is no voltage selector. It draws up to 50 W.

## Switching on

Press the power key at the bottom left of the front panel. The instrument runs a series of self-tests, during which you will hear relays switching, and then shows its main screen.

## Connecting a probe

Push the probe's BNC onto a channel input and turn it to lock. Connect the probe tip to the point to be measured and the ground clip to the circuit's ground.

## Checking the instrument

- Press Default to return the instrument to its default setup.
- Set the switch on a probe to 10X and connect it to channel 1. Clip the ground lead to the ground terminal below the probe compensation output, and the tip to the output itself.
- Press Auto Setup. A steady square wave should appear.
- Repeat on channels 2, 3 and 4. If a square wave is not flat-topped, compensate that probe as described next.

## Compensating a probe

A probe used for the first time, or moved to a different channel, should be compensated to that channel. An uncompensated probe gives wrong readings on fast edges.

- With the probe at 10X on the compensation output and Auto Setup pressed, look at the top of the square wave.
- Compare it with the three drawings below. Adjust the trimmer in the probe body with a non-metallic tool until the top is flat and square.

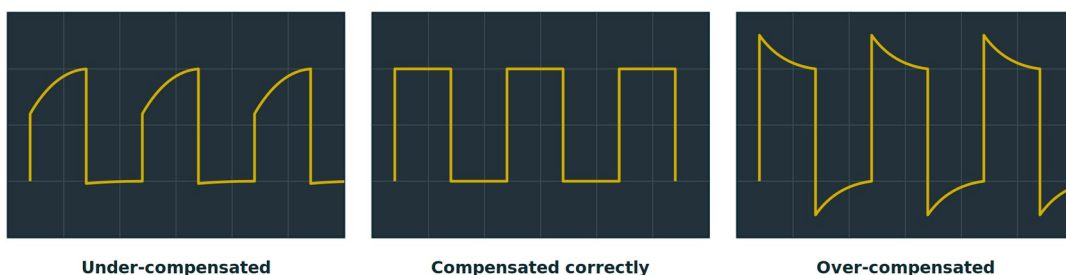


Figure 1 Probe compensation: under-compensated, correct, and over-compensated

## 4 The front panel

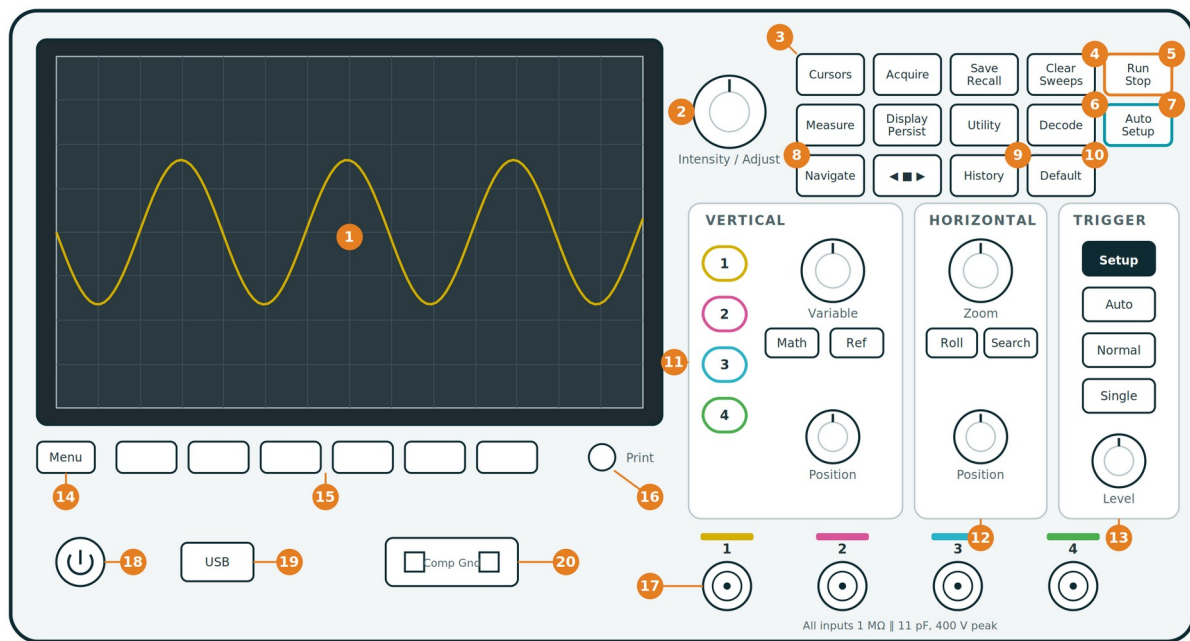


Figure 2 The front panel

| No. | Control        | What it does                                                                                        |
|-----|----------------|-----------------------------------------------------------------------------------------------------|
| 1   | Display        | 7 inch colour TFT, 800 × 480, with the menu for the current function along its foot                 |
| 2   | Universal knob | Selects menu items and changes values. Press it to confirm. Its light is on when the knob is active |
| 3   | Function keys  | Cursors, Acquire, Save/Recall, Measure, Display/Persist and Utility open their menus                |
| 4   | Clear Sweeps   | Clears persistence and restarts the measurement statistics count                                    |
| 5   | Run/Stop       | Starts and stops acquisition. Lit while acquiring, red when stopped                                 |
| 6   | Decode         | Opens the serial decode menu: I2C, SPI, UART/RS232, CAN and LIN                                     |
| 7   | Auto Setup     | Sets vertical scale, timebase and trigger for a stable display of the input                         |
| 8   | Navigate       | Turns navigation on and off, with the arrow keys stepping by time, search event or history frame    |
| 9   | History        | Opens the history of earlier acquisitions, up to 80,000 frames                                      |
| 10  | Default        | Returns to the default setup, which can be replaced with your own                                   |
| 11  | Vertical       | Channel keys 1 to 4, the Variable (scale) and Position knobs, Math and Ref                          |
| 12  | Horizontal     | The timebase (Zoom) and Position knobs, Roll and Search                                             |
| 13  | Trigger        | Setup, the Auto, Normal and Single mode keys, and the Level knob                                    |
| 14  | Menu on/off    | Shows or hides the on-screen menu                                                                   |
| 15  | Softkeys       | The six keys under the screen select the items of the menu above them                               |
| 16  | Print          | One-press save of the screen, or of whatever the Save/Recall menu has assigned to it                |

| No. | Control            | What it does                                                                                               |
|-----|--------------------|------------------------------------------------------------------------------------------------------------|
| 17  | Channel inputs     | Four BNC inputs, colour-coded to match the traces: 1 M $\Omega$ in parallel with 11 pF, 400 V peak maximum |
| 18  | Power              | Switches the instrument on and off                                                                         |
| 19  | USB host           | For a USB flash drive, to save and recall files                                                            |
| 20  | Probe compensation | A square-wave output and a ground terminal for checking and adjusting probes                               |

## 5 The rear panel

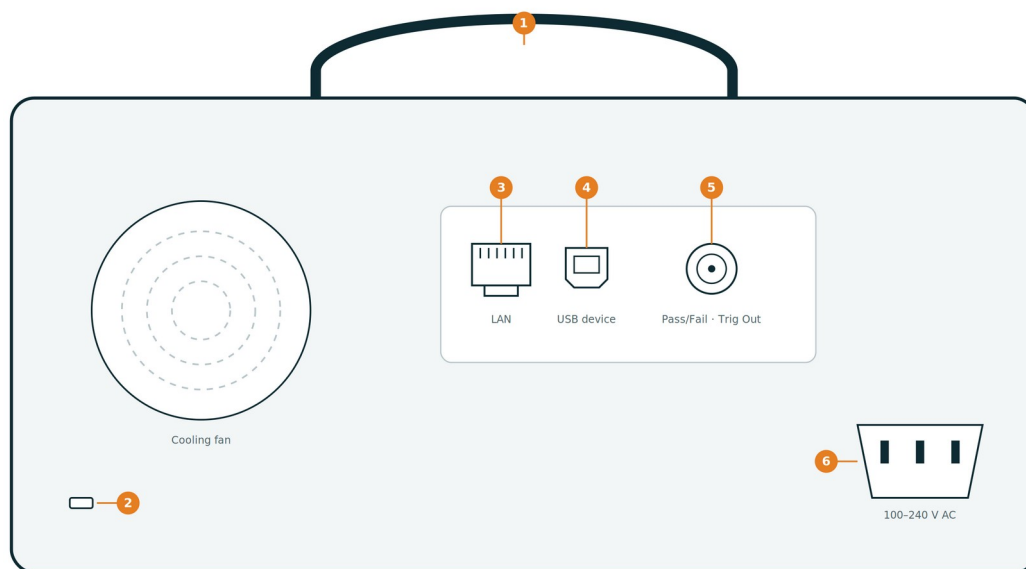


Figure 3 The rear panel

| No. | Connection               | What it is for                                                                                             |
|-----|--------------------------|------------------------------------------------------------------------------------------------------------|
| 1   | Handle                   | Pull up to carry the instrument; press down when it is not needed                                          |
| 2   | Security lock hole       | For a cable lock, bought separately, to secure the instrument to the bench                                 |
| 3   | LAN                      | Network connection for remote control                                                                      |
| 4   | USB device               | Connection to a PC for remote control. The instrument appears as a USBTMC device and accepts SCPI commands |
| 5   | Pass/Fail or Trigger Out | BNC output: a pulse at each trigger, or the result of a pass/fail test, at 3.3 V TTL                       |
| 6   | Mains socket             | 100 to 240 V at 50/60 Hz, or 100 to 120 V at 400 Hz. The instrument adapts automatically                   |

## 6 The display



Figure 4 The display and its status areas

| No. | Area                    | What it shows                                                                                    |
|-----|-------------------------|--------------------------------------------------------------------------------------------------|
| 1   | Logo                    | The instrument's mark                                                                            |
| 2   | Traces                  | Each channel's trace is drawn in the colour of its channel key and input                         |
| 3   | Trigger status          | Arm, Ready, Trig'd, Stop or Auto                                                                 |
| 4   | Timebase                | Time per horizontal division, set by the horizontal scale knob                                   |
| 5   | Delay                   | The trigger's offset from the centre of the screen, set by the horizontal position knob          |
| 6   | Trigger position marker | Marks the trigger point along the top of the graticule                                           |
| 7   | Frequency counter       | The hardware counter's reading of the trigger source                                             |
| 8   | Sample rate and memory  | Sa is the current sample rate, Curr the current record length                                    |
| 9   | Trigger settings        | Type, source, condition, coupling and level of the current trigger                               |
| 10  | Channel settings        | For each channel that is on: coupling, impedance, bandwidth limit if set, and volts per division |
| 11  | Trigger level marker    | Marks the trigger level at the right of the graticule, in the source channel's colour            |
| 12  | Interface status        | Shows whether the USB host and LAN are connected                                                 |
| 13  | Menu                    | The menu for the function last selected; the softkeys beneath select its items                   |

## Help on any key

Hold any key down for about two seconds and the instrument explains what it does, in the language it is set to. The submenus carry help as well.

## The Universal knob

The knob at the top of the control panel does whatever the current menu needs: selecting an item, changing a value, moving a cursor, choosing a file, or entering a character in a file name. Its light is on when it is active. Pressing it confirms.

# 7 The vertical system

## Switching a channel on and off

Press a channel key to switch that channel on. Its menu appears along the foot of the screen and its label at the right. Press the key twice to switch the channel off. Channels you are not using should be off, for the reason given in section 9.

## Scale

The Variable knob sets volts per division, from 1 mV/div to 10 V/div with the probe at 1X. Turned normally it steps in a 1-2-5 sequence. Press the knob to switch to fine steps, which let you fill the screen with a signal that falls between two coarse settings, and press it again to return to coarse. The channel menu's Adjust item does the same.

## Position

The Position knob moves the trace up and down. Press it to return the trace to the centre line. The available offset depends on the scale:  $\pm 2$  V up to 200 mV/div, and  $\pm 100$  V above that.

## Coupling

In the channel menu, Coupling selects DC, which passes the whole signal; AC, which blocks the DC component so a small ripple on a large offset can be seen; or GND, which shows the zero line for reference. The setting appears in the channel label.

## Bandwidth limit

BW Limit set to 20M attenuates everything above 20 MHz, which cleans up a noisy low-frequency signal. The label shows a B while it is on. Leave it at Full for anything fast.

## Probe factor

Probe sets the attenuation factor the instrument assumes, from 0.1X to 10000X, or a custom value. It must match the probe in use, or every reading is wrong by the difference. The factor appears in the channel label.

## Units, deskew, invert and labels

On the second page of the channel menu: Unit shows the channel in volts or amps, for a current probe. Deskew shifts the channel by up to  $\pm 100$  ns to correct for differing probe lengths. Invert flips the trace, and the measurements and maths that use it. Trace hides a channel's trace without switching the channel off.

# 8 The horizontal system

## Timebase

The horizontal scale knob sets time per division from 2 ns/div to 100 s/div. While the instrument is running, changing it changes the sample rate; when it is stopped, changing it zooms into the record already captured.

## Delay

The horizontal position knob moves the trigger point left or right, and the delay readout at the top of the screen shows how far the reference point is from the trigger. Press the knob to return the delay to zero. Negative delay shows what happened before the trigger.

## Roll

Press Roll for a strip-chart display at timebases of 50 ms/div and slower: the trace moves from right to left with the newest data at the right. There is no trigger in roll mode. Run/Stop freezes it and starts it again.

## Zoom

Press the horizontal scale knob to split the screen. The upper half shows the whole record with a box marking the part expanded in the lower half. The scale knob now sizes the box and the position knob moves it. Press the knob again to leave Zoom.

# 9 Acquisition

## Run, Stop and Single

Run/Stop starts and stops acquisition; the key is lit while the instrument is acquiring and red when it is stopped. Single clears the display, arms the trigger, captures one acquisition and stops, which is what you want for an event that happens once. Press it again for the next one.

## Sample rate and memory are shared between channels

The headline 1 GSa/s and 14 Mpts are available on one channel only. Both are shared between the channels that are switched on, and this is the constraint most likely to surprise you.

| Channels switched on      | Highest sample rate | Longest record |
|---------------------------|---------------------|----------------|
| One channel on            | 1 GSa/s             | 14 Mpts        |
| Two channels on           | 500 MSa/s           | 7 Mpts         |
| Three or four channels on | 250 MSa/s           | 3.5 Mpts       |

Switch off any channel you are not using. A channel left on halves or quarters the rate available to the ones that matter.

The record length is set from the Acquire menu, from 14 kpts to the maximum for the channels in use. The sample rate the instrument is using, and the current record length, are shown at the top right of the screen. The two are related by the timebase: record length equals sample rate multiplied by the time across the screen.

## Acquisition modes

- Normal samples at equal intervals and is right for most signals.
- Peak detect keeps the highest and lowest values in each interval, so a narrow glitch is not lost at a slow timebase. Noise appears larger.
- Average averages 4 to 1024 successive acquisitions to reduce random noise, at the cost of a slower response to change. It needs a repetitive signal.
- Enhanced resolution averages neighbouring samples within one acquisition. It works on single shots and does not slow the display, but it lowers the effective bandwidth.

## Interpolation

Between samples the instrument draws either straight lines (X) or a  $\sin(x)/x$  curve.  $\sin(x)/x$  reconstructs a sine or pulse faithfully when the sample rate is only a few times the signal frequency, and is the better default. X suits square edges.

## XY

XY in the Acquire menu plots channel 1 against channel 2 instead of against time, for phase comparison and Lissajous figures.

## Sequence

Sequence mode divides the record into up to 80,000 segments and captures one trigger event into each, with almost no dead time between them. It suits a burst of pulses that would otherwise be lost between acquisitions. The segments are replayed through History.

# 10 Triggering

The trigger decides which part of the signal is captured and held still on the screen. Press Setup in the trigger block to open its menu.

## Mode

Auto keeps the display updating even when no trigger occurs, which is right while you look for a signal. Normal updates only when the trigger condition is met, and holds the last acquisition otherwise. Single captures once and stops. The three keys in the trigger block set them directly.

## Source, level and coupling

Source is any of the four channels, or the AC line for mains-related work. The Level knob sets the threshold within  $\pm 4.5$  divisions of the centre; press it to set the level halfway up the signal, which stabilises most displays at once. Coupling is DC, AC, LF reject (removing components below about 2 MHz) or HF reject (removing components above about 1.2 MHz), and Noise Reject adds hysteresis for a noisy source.

## Holdoff

Holdoff disables the trigger for a set time after each acquisition, from 80 ns to 1.5 s. It steadies a signal that repeats irregularly, such as a pulse train with a gap in it, by letting the trigger fire only once per group.

## Trigger types

| Trigger type | What it triggers on                                                                                                |
|--------------|--------------------------------------------------------------------------------------------------------------------|
| Edge         | A rising, falling or either edge through the level, on any channel or the AC line                                  |
| Slope        | An edge whose rise or fall time meets a limit: less than, greater than, inside or outside a range of 2 ns to 4.2 s |
| Pulse width  | A positive or negative pulse whose width meets the same kind of limit, 2 ns to 4.2 s                               |
| Window       | The signal entering or leaving a band between two levels, set as absolute levels or relative to the signal         |
| Interval     | The time between two like edges meeting a limit, 2 ns to 4.2 s                                                     |
| Dropout      | No edge, or no change of state, for longer than a set time, 2 ns to 4.2 s. For catching a signal that stops        |
| Runt         | A pulse that crosses one of two levels but not the other, optionally with a width limit                            |
| Pattern      | A logical AND, OR, NAND or NOR of the channel states, each High, Low or ignored, optionally held for a time        |

| Trigger type | What it triggers on                                                                                  |
|--------------|------------------------------------------------------------------------------------------------------|
| Video        | NTSC, PAL and HDTV formats to 1080p, or a custom format; on a line, a field, or a chosen line number |
| Serial       | A condition on an I2C, SPI, UART/RS232, CAN or LIN bus; see section 11                               |

## 11 Serial trigger and decode

Two serial buses can be decoded at once, each on any of the five protocols, and the trigger can be set on a bus condition. Decoding is standard on this instrument.

### Setting up a bus

Press Decode, choose bus 1 or bus 2, and select the protocol. In its signal menu assign the source channel for each line of the bus and set the threshold for each, and the protocol settings listed in the table. Switch the decode on. The decoded data appears beneath the traces, and List shows it as a table of events, one to seven lines at a time.

### Triggering on a bus

Open the trigger menu, set the type to Serial, and choose the bus. The trigger takes its source channels and protocol settings from the decode menu, so the bus must be set up there first. Then choose the condition.

| Bus          | Trigger conditions                                                                                       | Set in the decode menu                                                                                                  |
|--------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| I2C          | Start, stop, restart, no acknowledge, an EEPROM read, a 7- or 10-bit address with data, or a data length | SCL and SDA sources and their threshold                                                                                 |
| SPI          | A data value of 4 to 96 bits, MSB or LSB first, with don't-care bits                                     | Clock, MISO and MOSI sources, clock edge, idle level, bit order                                                         |
| UART / RS232 | Start, stop, a data value, or a parity error                                                             | RX and TX sources, 5 to 8 data bits, parity, 1 to 2 stop bits, idle level, baud rate 600 to 115200 or custom 300 to 5 M |
| CAN          | Start, a remote frame, an ID, an ID with data, or an error, with 11- or 29-bit IDs                       | CAN_H or CAN_L source, threshold, baud rate 5 k to 1 Mbit/s                                                             |
| LIN          | Break, a frame ID, an ID with data, or a data error, to LIN 1.3 and 2.0                                  | Source and threshold, baud rate 600 to 19200 or custom 300 to 20 k                                                      |

## 12 Cursors, measurement and maths

### Cursors

Press Cursors. Manual cursors are placed by hand with the Universal knob: a pair of time cursors reads time, their difference and its reciprocal, and a pair of voltage cursors reads voltage and the difference. Track cursors follow the waveform, reading the voltage at each time position.

### Automatic measurements

Press Measure, choose the source and the parameter, and the reading appears at the foot of the screen. Four can be shown at once. The measurements use the whole record, up to 14 Mpts, rather than the pixels on the screen, so they are more accurate than reading the graticule.

- Statistics shows each measurement's current value with its mean, minimum, maximum, standard deviation and count. Clear Sweeps restarts the count.

- All Measure shows every parameter of one type for a channel together.
- Gate limits the measurement to a region of the record between two cursors, so a transient at the edge of the screen does not distort it.
- The hardware counter shows the frequency of the trigger source to six digits at the top of the screen.

| Group            | Parameters                                                                                            |
|------------------|-------------------------------------------------------------------------------------------------------|
| Vertical         | Max, Min, Pk-Pk, Ampl, Top, Base, Mean, Cmean, Stdev, Cstd, VRMS, Crms, FOV, FPRE, ROV, RPRE, Level@X |
| Horizontal       | Period, Freq, +Wid, -Wid, Rise, Fall, Bwid, +Dut, -Dut, Delay, Time@Level                             |
| Between channels | Phase, FRR, FRF, FFR, FFF, LRR, LRF, LFR, LFF, Skew                                                   |

## Maths and FFT

Press Math to add, subtract, multiply or divide two channels, or to differentiate, integrate or take the square root of one. The result is drawn as a separate trace with its own scale, set with the Universal knob.

FFT shows the spectrum of a channel, computed from up to 128k points, which gives fine frequency resolution. Choose the window to suit the signal: rectangular for a transient, Hanning or Hamming for general use, Blackman for the best dynamic range, flat-top for accurate amplitude. The spectrum can share the screen with the time trace or replace it, and peaks and markers can be read off directly.

## Reference waveforms

Press Ref to store a trace as a reference and display it alongside live signals for comparison, with its own scale and position. References survive switching the instrument off.

# 13 The display

Press Display/Persist. Type draws the trace as vectors, joining the samples, or as dots. Color turns on the colour temperature display, in which the parts of the trace that occur most often are drawn in warmer colours. Persist keeps earlier traces on screen for 1, 5, 10 or 30 seconds, or indefinitely, so an occasional glitch builds up where a single sweep would miss it; Clear Sweeps wipes it. Grid, Intensity and Transparency set the graticule, the trace brightness and how far the menus obscure the traces.

# 14 Saving and recalling

Press Save/Recall. The instrument stores setups, waveforms, screen images and data, internally or to a USB flash drive in the front socket.

- Setups record every control setting, so a measurement can be set up again exactly. Up to 20 are held internally, and any number on a drive.
- Waveforms can be saved as references for display on the instrument, or as binary, CSV or MATLAB files for analysis on a PC.
- Pictures save the screen as an image file.
- Default saves the current setup as what the Default key restores, so a shared bench always starts from your setup rather than the original one.

The Print key saves to the drive in one press whatever Save/Recall has assigned to it, a screen image by default. The menu also manages files and folders on the drive.

## 15 Utilities

Press Utility. Most of its items are set once and left.

- System Status shows the model, serial number, firmware version and options.
- Do Self Cal optimises the signal path. Disconnect every probe and lead from the inputs first, then follow the prompts. Run it once the instrument has warmed up, and again after a noticeable change in room temperature. Quick-Cal is a shorter version for routine use.
- Sound and Language set the key click and the display language.
- Pass/Fail builds a mask around a reference trace, with a clearance you set, and tests every acquisition against it: up to 40,000 decisions a second, with the result on screen and on the rear BNC as a 3.3 V TTL pulse. Masks can be saved and recalled.
- IO Set configures the USB device port and the LAN, including the IP address; see section 16.
- Update loads new firmware from a USB drive. Follow the instructions supplied with the firmware.
- Do Self-Test checks the screen, the keys and the key lights.
- Screen Saver blanks the display after 1 minute to 1 hour of inactivity, or never.
- Power On Line sets whether the instrument powers up when mains is applied, for a rack that is switched at the wall.
- Options shows what is installed, and installs a licence.

## 16 Remote control

The instrument accepts SCPI commands over USB and over LAN. The command reference is a separate document, available from GPS on request.

- USB: connect the USB device socket on the rear to a PC. The instrument appears as a USBTMC device and works with VISA-based software.
- LAN: connect the port on the rear to the network and set the address under Utility, IO Set, LAN, either from DHCP or by hand. The instrument answers over VXI-11, over Telnet on port 5024, and over a raw socket on port 5025.

The Pass/Fail or Trigger Out BNC on the rear also serves automation: as a trigger output it gives a pulse at each acquisition, which can synchronise other equipment to the oscilloscope.

## 17 If something is not right

### The screen stays dark

Check the mains lead and the socket, then switch on again. If the screen still stays dark, the fuse may have failed: contact GPS rather than replacing it yourself.

### 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 switched on, and that the circuit is producing a signal. Then press Auto Setup.

### Voltages read too high or too low

The probe's switch and the channel's Probe setting almost certainly disagree. See section 7.

### 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. If the signal repeats irregularly, increase the holdoff. A fast signal shown at too slow a timebase can also produce a plausible but false display: check the timebase.

### 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 waveform looks stepped

The timebase may be too slow to resolve the signal; choose a faster one. In vector display, lines drawn between widely spaced samples can look stepped; dot display shows the samples themselves.

### A USB drive is not recognised

Use a USB flash drive rather than a hard disk, check it works in another device, and try removing and reinserting it after restarting the instrument.

## 18 Specification

| Item         | Specification                                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Channels     | 4 analogue channels                                                                                                                               |
| Bandwidth    | 100 MHz (–3 dB) • rise time 3.5 ns typical • 20 MHz bandwidth limit                                                                               |
| Sampling     | 1 GSa/s on one channel, 500 MSa/s on two, 250 MSa/s on three or four                                                                              |
| Memory       | 14 Mpts on one channel, 7 Mpts on two, 3.5 Mpts on three or four                                                                                  |
| Vertical     | 8-bit • 1 mV/div to 10 V/div in a 1-2-5 sequence at probe 1X • offset $\pm 2$ V to 200 mV/div and $\pm 100$ V above                               |
| Accuracy     | DC gain $\leq \pm 3\%$ from 5 mV/div, $\leq \pm 4\%$ at 2 mV/div and below • timebase $\pm 25$ ppm • channel skew under 100 ps                    |
| Input        | 1 M $\Omega$ in parallel with 11 pF • 400 V peak maximum • DC, AC and GND coupling • probe factors 0.1X to 10000X and custom                      |
| Timebase     | 2 ns/div to 100 s/div • roll mode 50 ms/div to 100 s/div                                                                                          |
| Capture rate | Up to 100,000 waveforms a second, 400,000 in sequence mode • 256-level intensity grading and colour temperature display                           |
| Trigger      | Edge, slope, pulse width, window, runt, interval, dropout, pattern and video, including HDTV • level $\pm 4.5$ divisions • holdoff 80 ns to 1.5 s |
| Serial       | Trigger and decode for I2C, SPI, UART/RS232, CAN and LIN, two decoders, standard                                                                  |
| Acquisition  | Normal, peak detect, average of 4 to 1024, and enhanced resolution • sequence mode to 80,000 segments • history to 80,000 frames                  |
| Measurement  | 38 automatic parameters, 4 on screen at once, with statistics • manual and tracking cursors • 6-digit hardware counter                            |
| Maths        | Add, subtract, multiply, divide, differentiate, integrate, square root, and a 128k point FFT with five windows                                    |
| Display      | 7 inch TFT, 800 $\times$ 480, 24-bit colour • 8 by 14 divisions • dots or vectors                                                                 |

| Item                 | Specification                                                                                                          |
|----------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>Interfaces</b>    | USB host, USB device (USBTMC), LAN (VXI-11, Telnet and socket), pass/fail and trigger out • SCPI                       |
| <b>Power</b>         | 100 to 240 V at 50/60 Hz, or 100 to 120 V at 400 Hz • 50 W maximum                                                     |
| <b>Environment</b>   | Operating 0 °C to 40 °C • storage –20 °C to 60 °C • 85% RH at 40 °C • to 3000 m • indoor use, IP20, pollution degree 2 |
| <b>Size and mass</b> | 312 × 132.6 × 151 mm (l × w × h) • 2.6 kg                                                                              |

## 19 Care and maintenance

- Unplug the instrument before cleaning it. Wipe the case and the probes with a soft cloth, dry or barely damp, taking care not to scratch the display. Do not use solvents or chemical cleaners, and let the instrument dry fully before switching on.
- Do not leave the instrument or its probes in direct sunlight, fog or liquid for long periods.
- Keep the fan intake and exhaust clear and check them regularly.
- Recalibration and repair are available from GPS. Contact us with the model and serial number.

## 20 Warranty

One year from the date of purchase, subject to product registration with GPS. The warranty covers defects in materials and workmanship and does not cover damage caused by operation outside the rated conditions, by unauthorised repair, or by connection to a supply outside the stated input range.

For service, calibration or technical support contact GPS at [sales@gpslimited.com](mailto:sales@gpslimited.com) or +44 (0) 203 093 0914. Please quote the model and the serial number.