54622A Oscilloscope

Handy Hints:

(1) Solving general problems with the oscilloscope

If there is no trace display
- Check the power, the front-panel power switch and the INTENSITY knob
- Check the oscilloscope probe and that the circuit under test is powered on
- Press the Autoscale key

Reset the oscilloscope
- To reset the entire oscilloscope, press and hold any softkey and switch the oscilloscope power on. (Release the softkey when the display appears.)

If you cannot see a channel
- Check the oscilloscope probe and that the probe clips make good contact
- Check that the circuit under test is powered on
- Check that the desired oscilloscope channels are turned on. (Press the analog channel key until it is illuminated.)
- Press the Autoscale key

If the trace display is unusual or unexpected
- Check the Horizontal time/division setting. (It may be that when the time/division setting is slower than 1 ms/div, the oscilloscope is sampling too slowly to capture all of the transitions on the waveform.)
- Check the oscilloscope probe and that the ground lead on the cable is securely connected to ground in the circuit under test. (For high-speed measurements, each probe’s individual ground lead should also be connected to a ground point closest to the signal point in the circuit under test.)
- Check that the trigger setup is correct. (A correct trigger setup is the most important factor in helping you capture the data you desire.)
- Check that infinite persistence in the Display menu is turned off, then press the Clear Display softkey.
- Press the Autoscale key

(2) To run the internal self-tests

Self Test performs a series of internal procedures to verify that the oscilloscope and any attached module are operating properly. It is recommended that you run the Self Test after experiencing abnormal operation or for additional information to better describe an oscilloscope failure.

Successfully passing Self Test does not guarantee 100% of the oscilloscope’s functionality. Self Test is designed to provide an 80% confidence level that the oscilloscope is operating properly.

1 Press the Utility key, then press the Service softkey.
2 Begin the internal self tests by pressing the Self Test softkey.
   a The oscilloscope will display the message “Running self tests” on the screen.
   b The oscilloscope will then display one of the following messages on the screen indicating the status of the self-tests: • Self Tests Passed or • Self Tests Failed.
(3) To verify basic oscilloscope operation

1 Connect an oscilloscope probe to Channel 1.
2 Attach the probe to the Probe Comp output on the lower-right side of the front panel of the oscilloscope. (Use a probe retractable hook tip so you do not need to hold the probe.)

3 Press the Save/Recall key on the front panel, then press the Default Setup softkey under the display.

The oscilloscope is now configured to its default settings.

The major default settings are:
- **Horizontal** main mode, 100 us/div scale, 0 s delay, center time reference
- **Vertical** Channel 1 on, 5 V/div scale, dc coupling, 0 V position, (probe factor to 1.0 if an AutoProbe probe is not connected to the channel)
- **Trigger** Edge trigger, Auto sweep mode, 0 V level, channel 1 source, dc coupling, rising edge slope, 60 ns holdoff time
- **Display** Vectors on, 20% grid intensity, infinite persistence off
- **Other** Acquire mode normal, Run/Stop to Run, cursors and measurements off

4 Press the Autoscale key on the front panel.

You should then see a square wave with peak-to-peak amplitude of about 5 divisions and a period of about 4 divisions.

**Autoscale automatically configures the oscilloscope to best display the input signal by analyzing any waveforms connected to the external trigger and channel inputs.**

Autoscale finds, turns ON, and scales any channel with a repetitive waveform with a frequency of at least 50 Hz, a duty cycle greater than 0.5%, and an amplitude of at least 10 mV peak-to-peak.

Any channels that do not meet these requirements are turned OFF.

The trigger source is selected by looking for the first valid waveform starting with external trigger, then continuing with the highest number analog channel down to the lowest number analog channel.

During Autoscale, the delay is set to 0.0 seconds, the sweep speed setting is a function of the input signal (about 2 periods of the triggered signal on the screen), and the triggering mode is set to edge.

Vectors remain in the state they were before the Autoscale.

**Undo Autoscale**

Press the Undo Autoscale softkey to return the oscilloscope to the settings that existed before you pressed the Autoscale key.

This is useful if you have unintentionally pressed the Autoscale key or do not like the settings Autoscale has selected and want to return to your previous settings.

The Channels softkey selection determines which channels will be displayed on subsequent Autoscales.

- **All Channels** - The next time you press Autoscale, all channels that meet the requirements of Autoscale will be displayed.
- **Only Displayed Channels** - The next time you press Autoscale, only the channels that are turned on will be displayed. (This is useful if you only want to view specific active channels after pressing Autoscale.)
(4) **To compensate your analog probe**

You should compensate your analog probes to match their characteristics to the oscilloscope. A poorly compensated probe can introduce measurement errors.

To compensate a probe, follow these steps:

1. Connect the probe from channel 1 to the **Probe Comp** signal on the lower right corner of the front panel.
2. Press **Autoscale**.
3. Use a nonmetallic tool to adjust the trimmer capacitor on the probe for the flattest pulse possible.

---

(5) **Important oscilloscope considerations**

**Using Single vs. Run/Stop**

The oscilloscopes have a **Single** key and a **Run/Stop** key. When you press **Run** (key is illuminated in green), the trigger processing and screen update rate are optimized over the memory depth.

Single acquisitions always use the maximum memory available — at least twice as much memory as acquisitions captured in Run mode — and the scope stores at least twice as many samples. At slow sweep speeds, the oscilloscope operates at a higher sample rate when Single is used to capture an acquisition, as opposed to running, due to the increased memory available.

**Using Auto trigger mode vs. Normal trigger mode**

Normal trigger mode requires a trigger to be detected before an acquisition can complete. If you only want to acquire specific events as specified by the trigger settings, use Normal trigger mode.

In many cases, a triggered display is not needed to check signal levels or activity. For these applications, use Auto trigger mode.

**Holdoff operating hints (Trigger Mode/Coupling menu)**

Holdoff keeps a trigger from occurring until after a certain amount of time has passed since the last trigger. This feature is valuable when a waveform crosses the trigger level multiple times during one period of the waveform.

Without holdoff, the scope could trigger on each of the crossings, producing a confusing waveform. With holdoff set correctly, the scope always triggers on the same crossing.

The correct holdoff setting is typically slightly less than one period. Set the holdoff to this time to generate a unique trigger point. This action works even though many waveform periods pass between triggers, because the holdoff circuit operates on the input signal continuously.

Changing the time base settings does not affect the holdoff number. (In contrast, the holdoff in analog oscilloscopes is a function of the time base setting, making it necessary to re-adjust the holdoff each time you change the time base setting.)

With Agilent's MegaZoom technology, you can press **Stop**, then pan and zoom through the data to find where it repeats. Measure this time using the cursors, then set holdoff to this number.
Viewing signal detail with **Acquire mode**

**Normal mode** Normal acquire mode is the acquisition mode that you will probably use for acquiring samples most of the time. It compresses up to 2 million acquisition points per channel into a 1,000-pixel column display record. The 200 MSa/s sampling speed specification means that samples are taken every 5 ns.

At the faster sweep speeds, the **running** display is built from many individual triggers. If you press the **Stop** key, and **pan and zoom** through the waveform by using the Horizontal and Vertical knobs, **only the last** trigger's acquisition will be displayed.

Whether the oscilloscope is stopped or running, you see more detail as you zoom in, and less as you zoom out. **Zoom** means you expand the waveform using either the main or delayed sweep window. **Panning** the waveform means you use the Horizontal Delay time knob to move it horizontally.

To keep from losing detail as you zoom out, switch to the **Peak Detect** acquisition mode.

**Peak Detect mode** In Peak Detect acquisition mode, any noise, peak, or signal wider than 5 ns will be displayed, regardless of sweep speed.

Using Peak Detect and **infinite persistence** together is a powerful way to find spurious signals and glitches.

**Average mode** Averaging is a way to pull a repetitive signal out of noise. Averaging works better than either a brightness control or a bandwidth limit because the bandwidth is not reduced (except when in high resolution mode (number of averages=1) is selected).

The simplest averaging is **High-RESolution mode** (number of averages = 1). For example, the sample rate at a Time/Div setting of 2 ms/div allows the extra 5-ns samples to be smoothed together, smoothing the data into one sample, which is then displayed.

Averaging (number of averages > 1) needs a stable trigger, because in this mode multiple acquisitions are averaged together.

**Realtime mode** In Realtime acquire mode, the oscilloscope produces the waveform display from samples collected during one trigger event. The sample rate is 200 MSa/s for single channel or 100 MSa/s with channel pairs 1 and 2.

When less than 1000 samples can be collected in the time spanned by the screen, a sophisticated **reconstruction filter** is used to fill in and enhance the waveform display.

To accurately reproduce a sampled waveform, the sample rate should be at least four times the highest frequency component of the waveform. If not, it is possible for the reconstructed waveform to be distorted or aliased. (Aliasing is most commonly seen as jitter on fast edges.)

When Realtime mode is off, the oscilloscope produces the waveform display from samples collected from multiple triggers, when on fast sweep speeds. In this case, the reconstruction filter is not used. When the trigger is stable, this produces the highest fidelity waveform.

Realtime mode is only necessary at sweep speeds of 200 ns/div and faster, since on these ranges <1000 samples can be collected on each trigger. While the effective bandwidth of the channel is reduced slightly, Realtime mode produces a complete waveform for each trigger.

Realtime can be turned **on** when any other acquisition mode is turned on. Use Realtime to capture infrequent triggers, unstable triggers, or complex changing waveforms.
Using **vectors** (Display menu)

One of the most fundamental choices you must make about your display is whether to draw vectors (*connect the dots*) between the samples, or simply let the samples fill in the waveform. To some degree, this is a matter of personal preference, but it also depends on the waveform.

- You will probably operate the oscilloscope most often with vectors **on**. Complex analog signals like video and modulated signals show **analog-like intensity** information with vectors on.
- Turn vectors **off** when the maximum display rate is required, or when highly complex or **multi-valued waveforms** are displayed. (Turning vectors off may aid the display of multi-valued waveforms such as eye diagrams.)

**Delayed sweep**

Delayed sweep is a simultaneous display of the waveform at two *different* sweep speeds. Because of the deep memory in the MegaZoom technology, it is possible to capture the main display at 1 ms/div, and redisplay the *same* trigger in the **delayed** display at any desired **faster** time base.

There is no limit imposed on the zoom ratio between the main and delayed displays. There is, however, a **useful limit** when the samples are spaced so far apart that they are of little value.

**Post acquisition processing**

In addition to changing display parameters **after** the acquisition, you can do all of the measurements and math functions after the acquisition.

**Measurements and math** functions will be **recalculated** as you pan and zoom and turn channels on and off. As you zoom in and out on a signal using the horizontal sweep speed knob and vertical volts/division knob, you affect the resolution of the display.

*Because measurements and math functions are performed on displayed data, you affect the resolution of functions and measurements.*

If the analog channel or math function is **clipped** (not fully displayed on screen), the resulting displayed math function will also be clipped.

(6) **Making automatic measurements**

**Quick Meas** makes automatic measurements on any channel source or any running math function. Quick Meas also makes measurements on stopped waveforms when you are panning and zooming.

The results of the *last three* measurements selected are displayed on the dedicated line above the softkeys, or in the display area when menus are selected. Cursors are turned **on** to show the portion of the waveform being measured for the most recently selected measurement (right-most on the measurement line).

If your displayed signal is noisy for any reason, try using **Average** to clean it up.

*Only channels or math functions that are displayed are available for measurements.*

If a portion of the waveform required for a measurement is not displayed or does not display enough resolution to make the measurement, the result will display “No Edges”, “Clipped”, “Low Signal”, “< value”, or “> value”, or a similar message to indicate that the measurement may not be reliable.

**Counter measurement**

The Counter measurement counts trigger level crossings at the selected trigger slope and displays the results in Hz. The **gate time** for the measurement is automatically adjusted to be 100 ms or twice the current time window, which ever is longer, up to 1 second. Any channel except Math may be selected for the source. Only one Counter measurement may be displayed at a time.

The Y cursor shows the edge threshold level used in the measurement. The Counter measurement can measure frequencies up to 125 MHz. The minimum frequency supported is 1/(2 X gate time).
(7) Math operating hints

The vertical scaling and offset of each math function can be adjusted (Settings softkey) for ease of viewing and measurement considerations.

Offset is represented by the center graticule of the display.

Any time the currently displayed math function definition is changed, the function is automatically scaled for optimum vertical scale and offset. If you manually set scale and offset for a function, select a new function, then select the original function, the original function will be automatically rescaled.

If the analog channel or math function is clipped (not fully displayed on screen), the resulting displayed math function will also be clipped.

Units for each input channel can be set to Volts or Amps using the channel Probe Units softkey. Scale (units/ = units/div) and offset (units) for the selected math function:

- FFT: dB**(decibels)
- 1 * 2: V^2, A^2 or W (Volt-Amp)
- 1 – 2: V (Volts) or A (Amps)
- d/dt: V/s or A/s (V/second A/second)
- \(\int dt\): Vs or As (V-seconds or A-seconds)

** When the FFT source is channel 1 or 2, FFT units will be displayed in dBV when channel units is set to Volts. FFT units will be displayed as dB for all other FFT sources or when a source channel's units has been set to Amps.

Note: U (undefined) will be displayed for 1-2, and for d/dt or \(\int dt\) when 1-2 or 1+2 is the selected source if channel 1 and channel 2 are set to dissimilar units (in the channel Probe Units softkey).

Each function can be measured in the Cursors and Quick Meas menus.

Once the function is displayed, the analog channel(s) may be turned off for better viewing. In Delayed sweep horizontal mode, the FFT, d/dt and \(\int dt\) function does not display in the delayed portion of the display.

WEB site: http://www.agilent.com
Test & Measurements > Basic & General Purpose Instruments >
Oscilloscopes > 54600 Bench-top Portable > 54622A Portable DSO >
In the Library:
Service Guide Publication Number 54622-97037 Dec 2002

Agilent Technologies