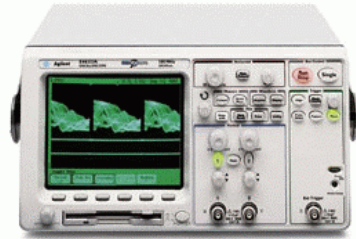# 54622A Oscilloscope
Handy Hints:

(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 <u>major</u> 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.
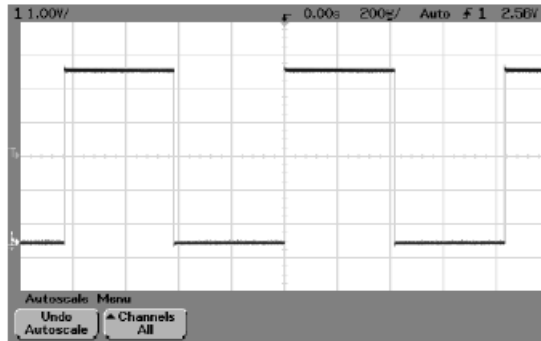
Autoscale finds, turns **ON**, and scales any channel with a **repetitive** waveform with a frequency of <u>at least 50 Hz</u>, a <u>duty cycle greater than 0.5%</u>, and an amplitude of <u>at least 10 mV peak-to-peak</u>.
Any channels that do not meet these requirements are turned **OFF**.

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 <u>edge</u>.
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**.)

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(4) To compensate your analog **probe**

You should compensate you 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 lowerright corner of the front panel.

2 Press **Autoscale**.

3 Use a *nonmetallic tool* to adjust the trimmer capacitor <u>on the probe</u> for the flattest pulse possible.

Perfectly compensated

Over compensated

Under compensated

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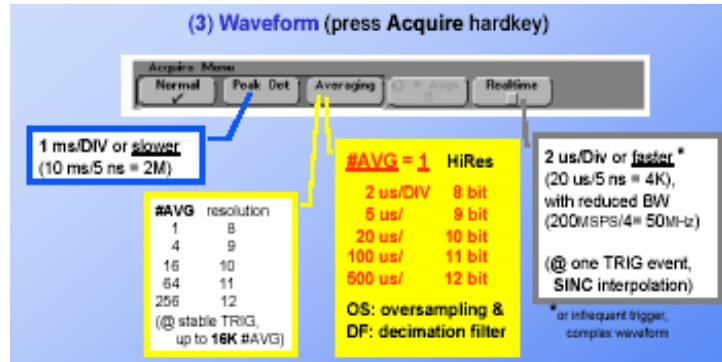
> At the faster sweep speeds, the **running** display is built from many individual triggers. If you press the **Stop** key, and *pan and zoom* through the waveform by using the Horizontal and Vertical knobs, *only* the *last* trigger's acquisition will be displayed.

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.

> In Normal acquisition mode, at sweep speeds faster than **1 ms/div**, you would see a 5-ns peak, so peak detect has no effect at weep speeds faster than 1 ms/div.

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 <u>scaling</u> and <u>offset</u> 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.

<u>Units</u> 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)
∫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.

<u>Note</u>: **U** (undefined) will be displayed for 1-2, and for d/dt or ∫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 ∫dt function does **not** display in the delayed portion of the display.

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WEB site: **http://www.agilent.com**

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In the Library:

User's Guide Publication Number 54622-97036 Sept 2002

Service Guide Publication Number 54622-97037 Dec 2002

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