Quick Start guide to Digital Storage Oscilloscopes (DSOs)

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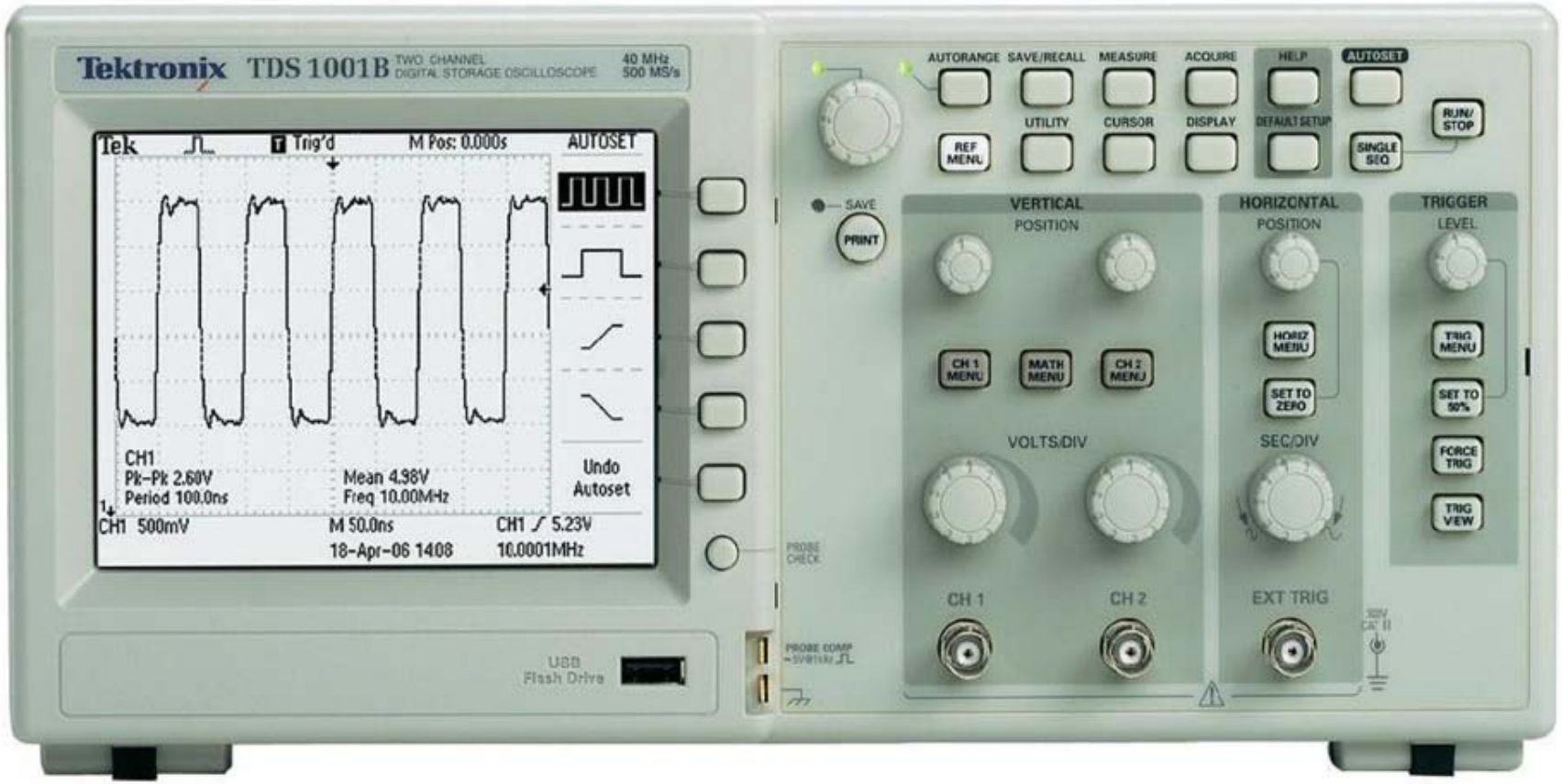


Digital Storage Oscilloscope (DSO)

First Step:

- Connect the probe to the probe check pins and a nice square wave of 0V to 5V should be observed on the screen.

If **not,** press the ‘auto-set’ button on the DSO panel for the very first and the very **last** time !!!

Note: During the learning process in case if the signal display goes out of the display window, use the scaling and positioning knobs as will be discussed in the next 4 slides.

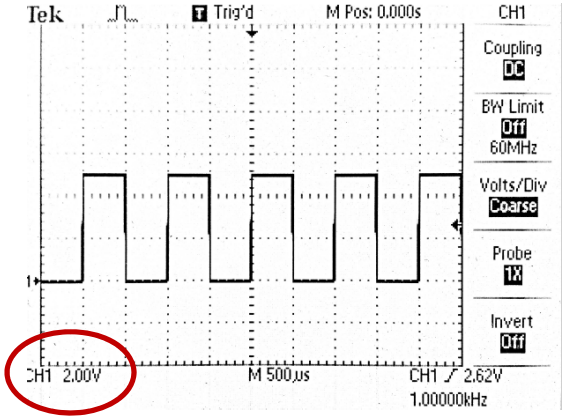
What do the knobs do?

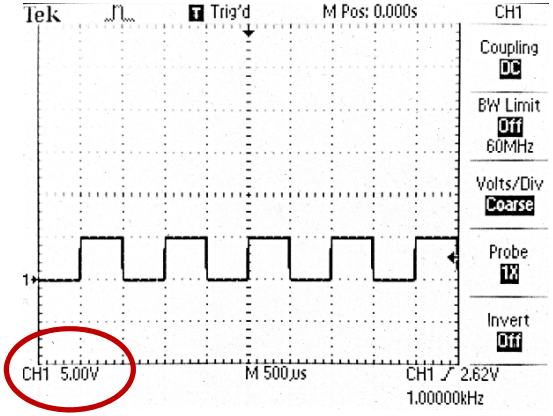
Volt/div knob :-

It varies the scaling of the vertical axis/voltage axis. As one rotates the knob on the left, volt/div increases hence vertical zooming out shall be observed keeping the magnitude of the signal same. And vice versa on rotating it on the right. This knob is specific to the channel and hence number of these knobs is equal to the number of channels available on the DSO.

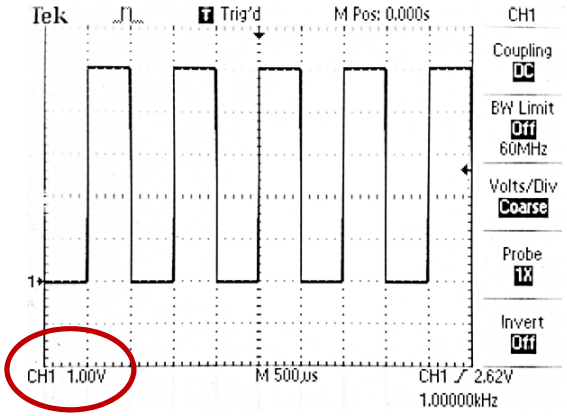
Video

Scale value →





knob rotated left
(scaling increased)



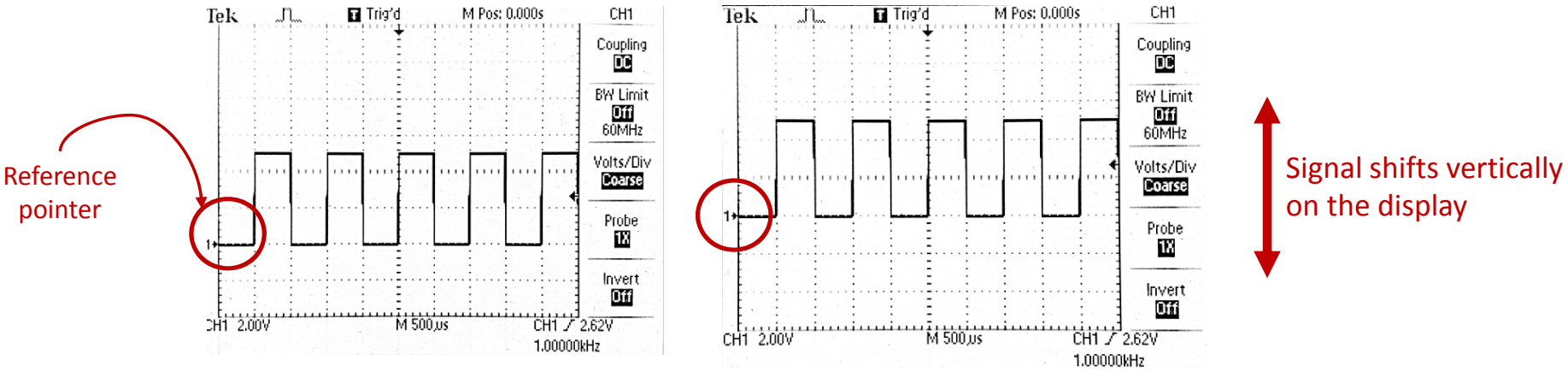
knob rotated right
(scaling decreased)

What do the knobs do?

Vertical Position knob :-

It varies the vertical positioning of the signal on the screen. On rotating this knob both the signal as well as the reference value moves vertically on the signal display window. This knob is also channel specific as that of volt/div knob.

Video

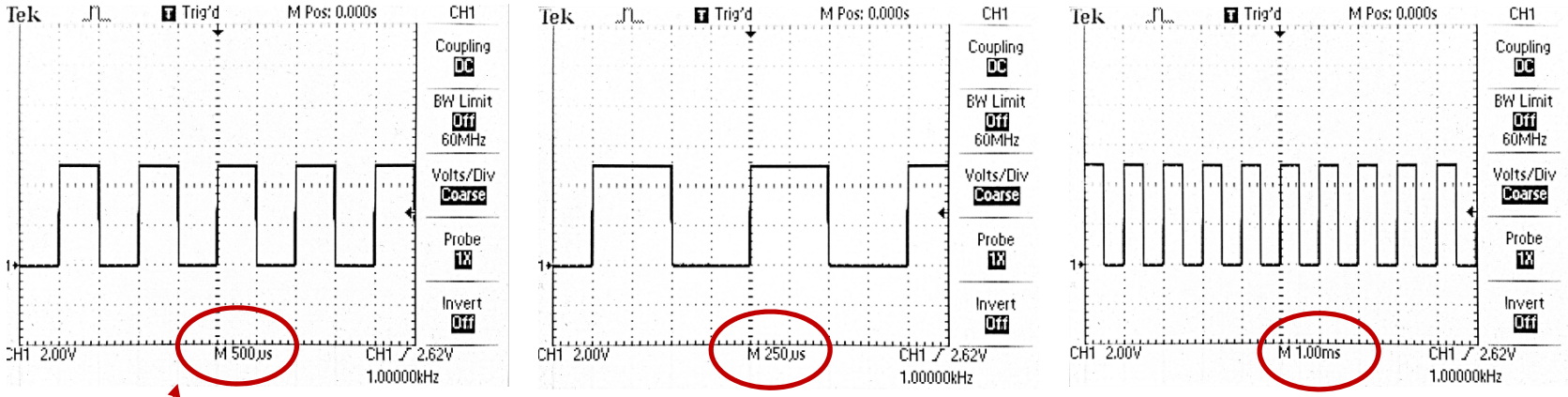


What do the knobs do?

Sec/div knob :-

It varies the scaling of the time axis or the horizontal axis. On rotating left the time/div increases and hence more number of oscillations would be observed within the same division. And vice versa on rotating it right. This knob is not channel specific and will be used for all the channels simultaneously.

Video



Note: On increasing the time per division to a large value near or above 100 msec (persistence of vision) one could observe the signal actually traveling in time on the screen.

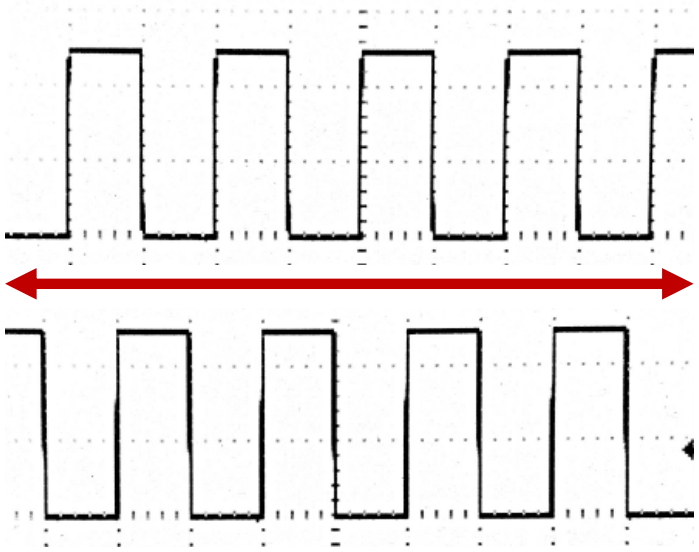
What do the knobs do?

Horizontal Position knob :-

It varies the horizontal positioning of the signals on the screen. On rotating in left the signal display will move on the left and on rotating right signal will more on the right.

This knob is channel non specific as that of sec/div knob.

Video



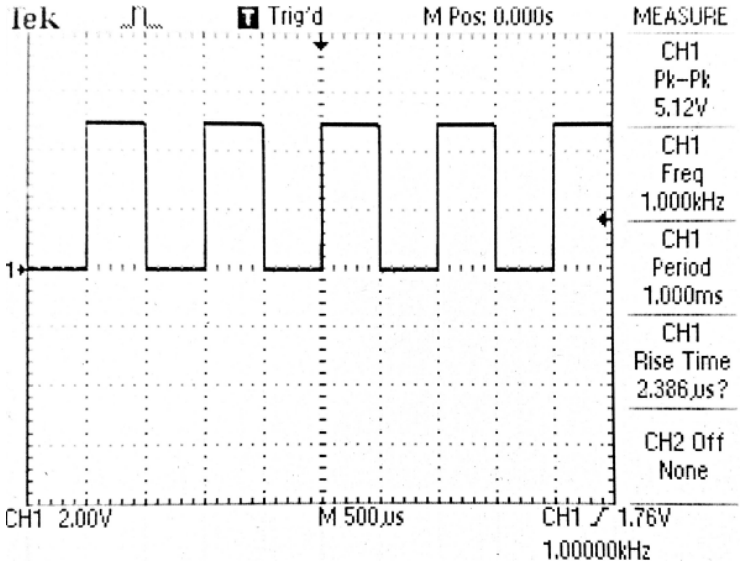
Signal shifts horizontally on the display

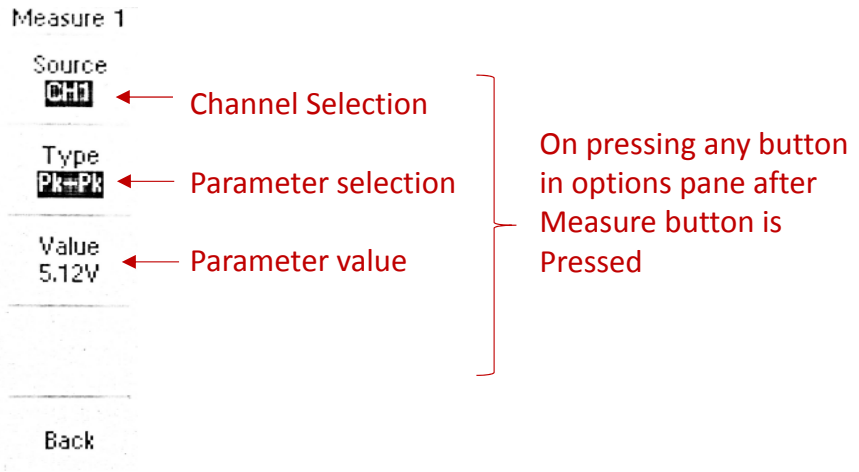
What does the *Measure* button do?

This displays various parameters of the connected signal. On pressing this button, one has to select the channel and the parameter to be determined through the options pane. Parameters available are pk-pk, mean, rms, max, min, freq, period, rise time, fall time, positive width and negative width.

Most of these values could be vaguely determined from the display itself by counting the divisions and subdivisions and multiplying it with the scaling factor.

Video



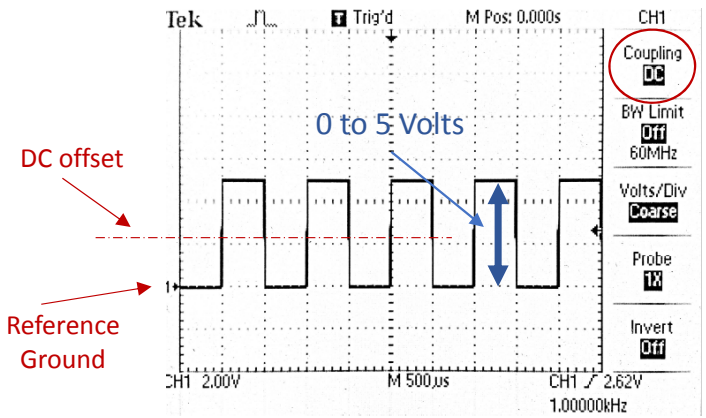


What does the *Channel Menu* button do?

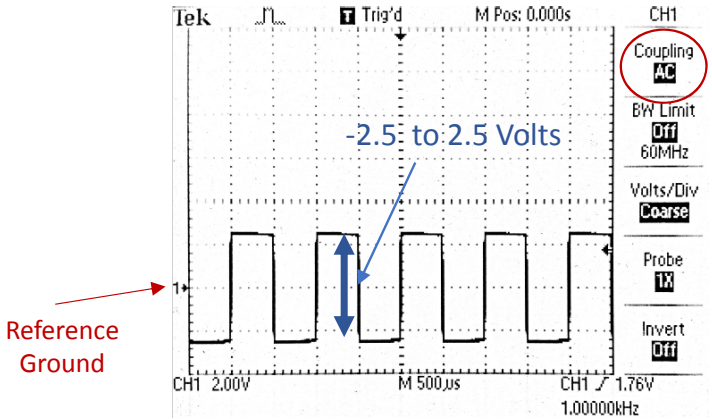
Its first basic operation is to turn on/off the channel display on the screen. These buttons are channel specific. It has a set of options visible in the options pane on the display.

Option 1: Coupling – DC/AC/Ground

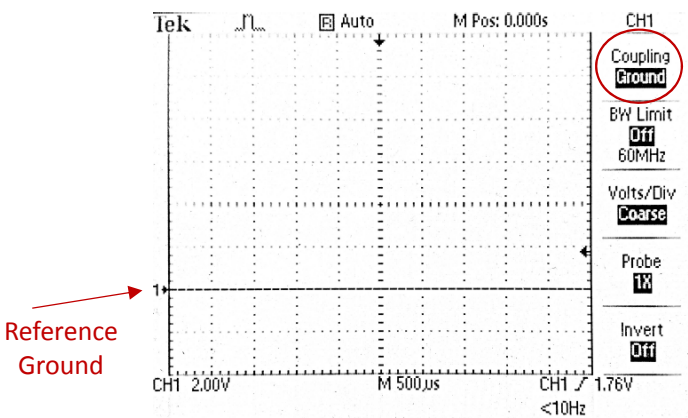
- DC coupling – complete signal is represented on the display.
- AC coupling – only the AC part of the signal is displayed and the DC part of the signal is removed.
- Ground Coupling – horizontal line appears on the screen representing the reference line for that particular channel connecting the reference pointer on the left.



DC coupling



AC coupling



Ground coupling

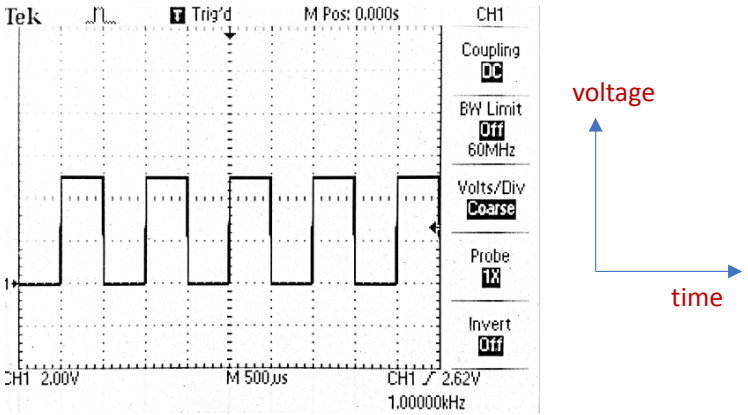
What does the *Channel Menu* button do?

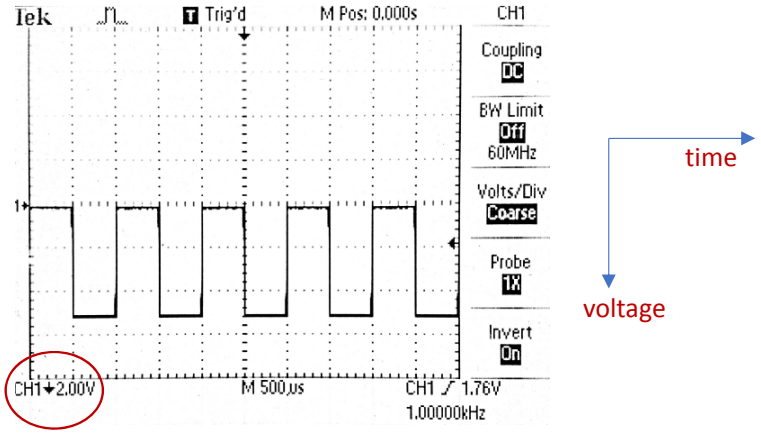
Option 2: Bandwidth Limit (off/on) – limits the bandwidth of the signal to be viewed on the screen. This is used to remove high frequency noise (in tens of MHz) from the signal.

Option 3: Volt/div knob setting – This is used for setting the volt/div knob scaling as coarse or fine tuned. Coarse setting is default and in this setting rotating volt/div knob scaling varies in discrete steps whereas in case of fine setting this scaling varies very smoothly (used for precision purpose).

Option 5: Invert – This option inverts the vertical axis and hence signal also inverses.

(Used for better presentation of negative valued signals)



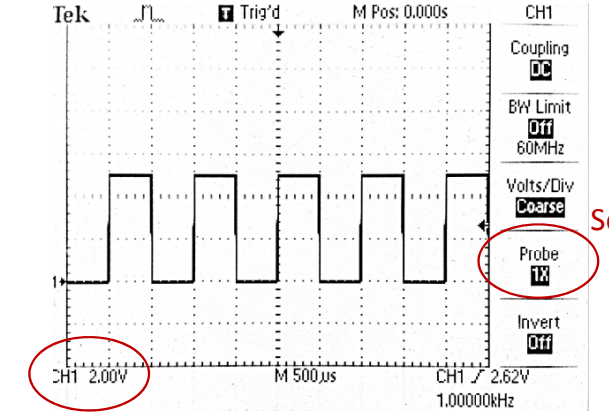


Down arrow representing axis inversion

What does the *Channel Menu* button do?

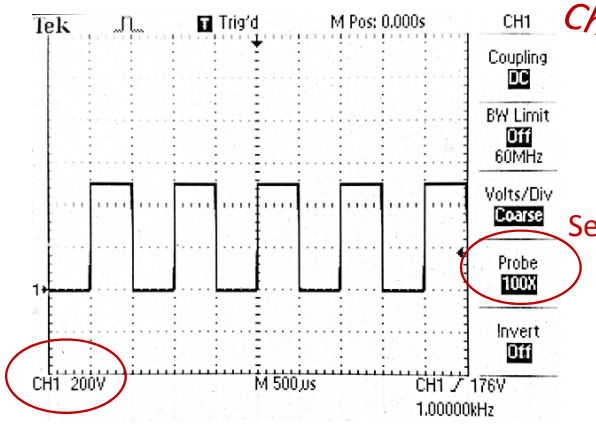
Option 4: Probe multiplier setting – Used for multiplying the signal by appropriate factor. (Only the display magnitude changes but the actual signal remains intact). This option is meant for better interaction of the represented signal to the user.

Video



Setting :1x

Scale : 2V/div



Setting :100x

Scale : 200V/div

Only signal scaling Changes while keeping the signal display same.

Eg, Let the probe is used at an attenuation of 10x, the measured signal is divided by 10 and this signal with altered magnitude is displayed. But in order to view the actual value multiplier of 10 could be used for compensating the effect of probe attenuation.

Another feature in newer versions is to set the display setting to current instead of voltage that shall be found to be useful while measuring currents as the current sensors give current values in terms of voltages.

What does the *Acquire* button do?

This specifies the data acquiring type used for displaying the signal on the screen.

Option 1: Sample – Displays the signal with samples equal to sampling rate of the DSO.

Option 2: Peak Detect

Option 3: Average – Displays the signal after averaging the number of samples specified by the fourth option. Averaging sometimes is used for removing the noise from the signal.

Option 4: Samples for Average – 4/16/64/128

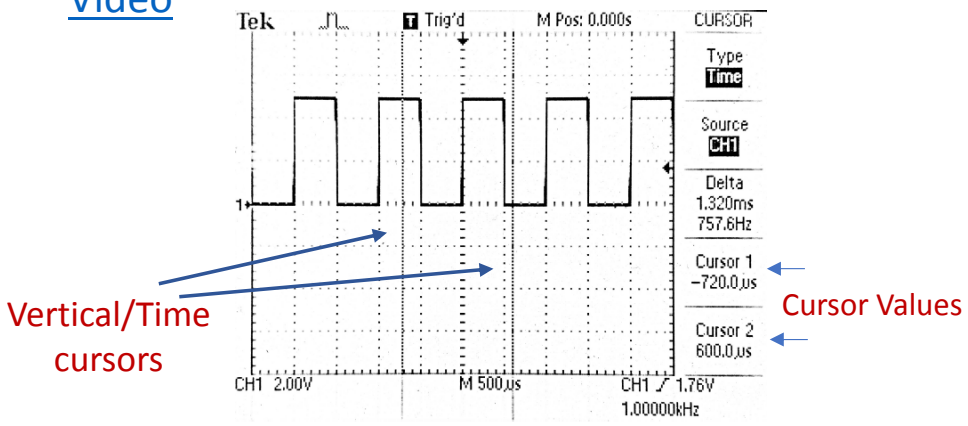
What does the *Cursor* button do?

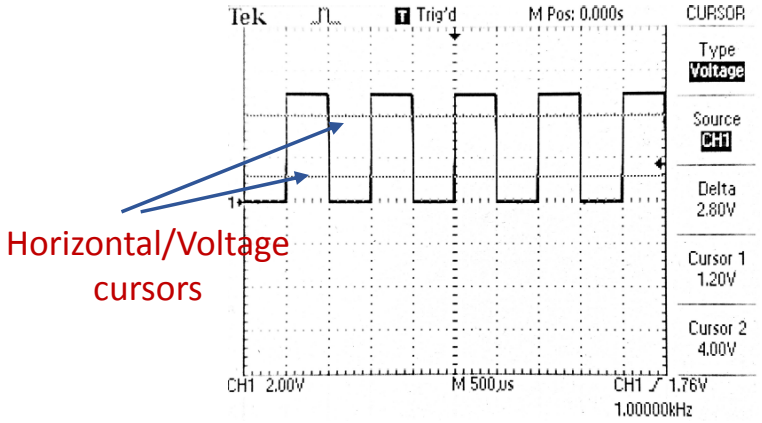
It turns on/off the cursors on the screen. Any point on a 2-Dimensional display could be displayed by a x and y value which are time and voltage values respectively.

First option is to turn on/off the cursors .

- Amplitude or the voltage cursor are two horizontal cursors observed on the screen. Voltage cursors are specific to the channel and will represent value depending upon the corresponding channel scaling.
- Time cursors are two vertical cursors observed on the screen. These are channel non specific and represent values depending upon the sec/div scaling.

Video





The cursor positions could be altered by using vertical position knobs in the older models while using the big multipurpose knob in the newer versions.

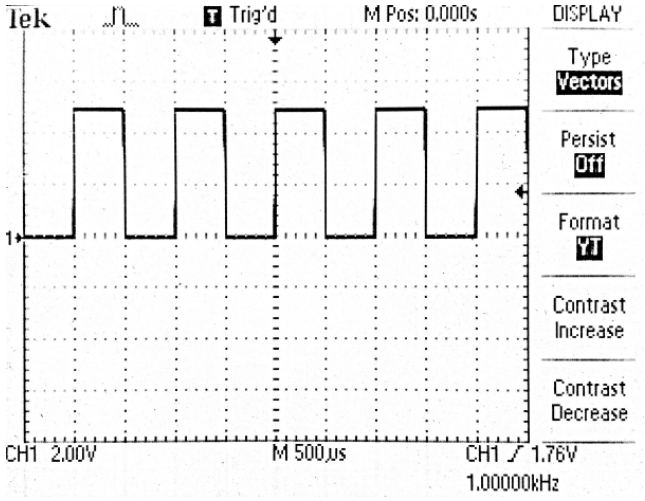
What does the *Display* button do?

This is used for varying the presentation of the display.

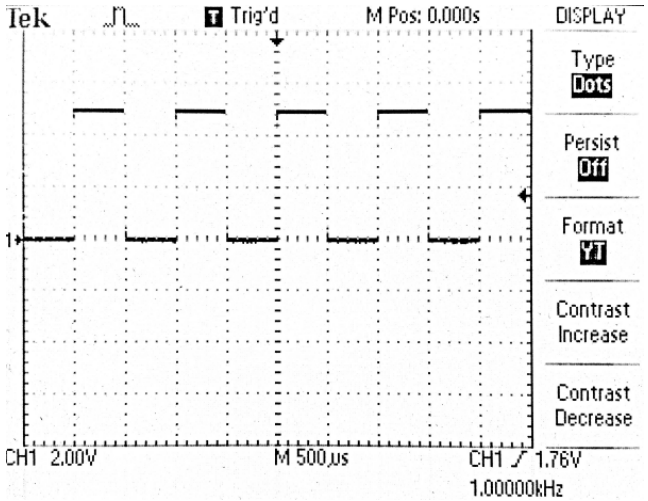
Option 1: Type

- Vectors – It is the default setting.
- Dots – In this the signal is represented by 3200 dots on the display. Vectors are formed by connecting these dots by straight lines.

These could be distinguished only if slope of the signal at certain points in the signal is very high.



Vector type display

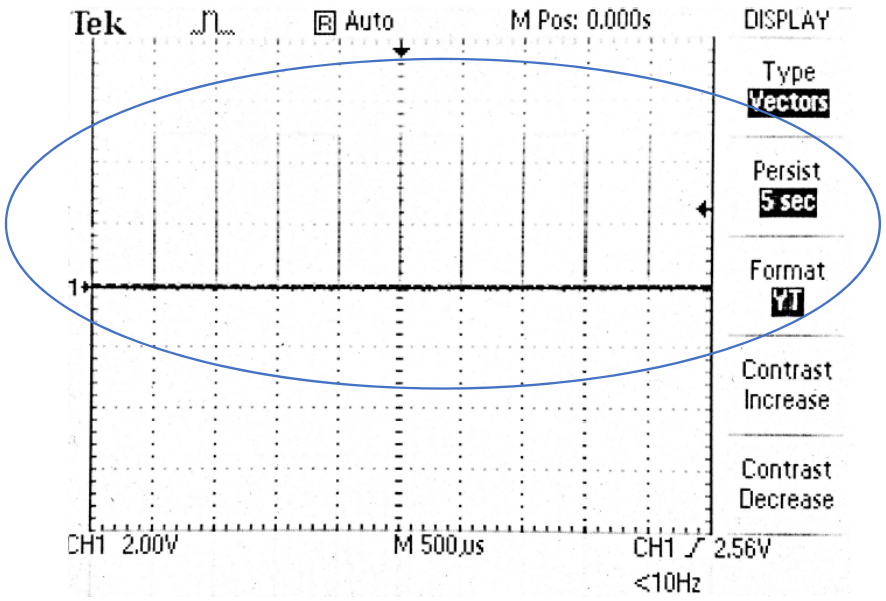


Dots type display

What does the *Display* button do?

Option 2: Persist – This allows the signal to persist or stay on the screen for the defined amount of time even after the probe pin is connected to a different signal. The initial signal gradually blurs out.

One could try this out by setting the persist option to say 5 sec. Remove the probe pin from the probe check and the square wave gradually blurs out.



Signal disappearing gradually

What does the *Display* button do?

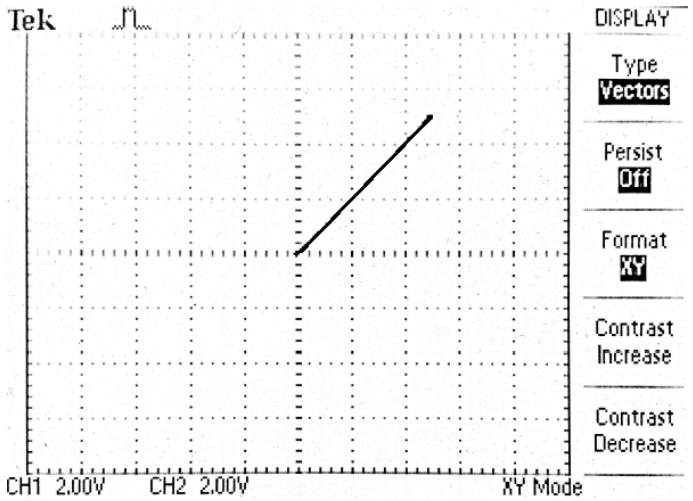
Option 3: Format

- YT format – The signal will be displayed with respect to time.
- XY format – The signals will be displayed with respect to each other i.e. one channel represent the horizontal axis and other channel represent the vertical axis.

For XY format it is advised to keep both the channel scaling equal and keep the references of both the signals at the vertical centre of the screen for better inference from the observed shape on the display. This format generates patterns commonly referred as Lissajous patterns.

Video

This could be tried out by putting two probes connected to the probe check option and a straight line with slope x=y from point (0,0) to (5,5) shall be observed.

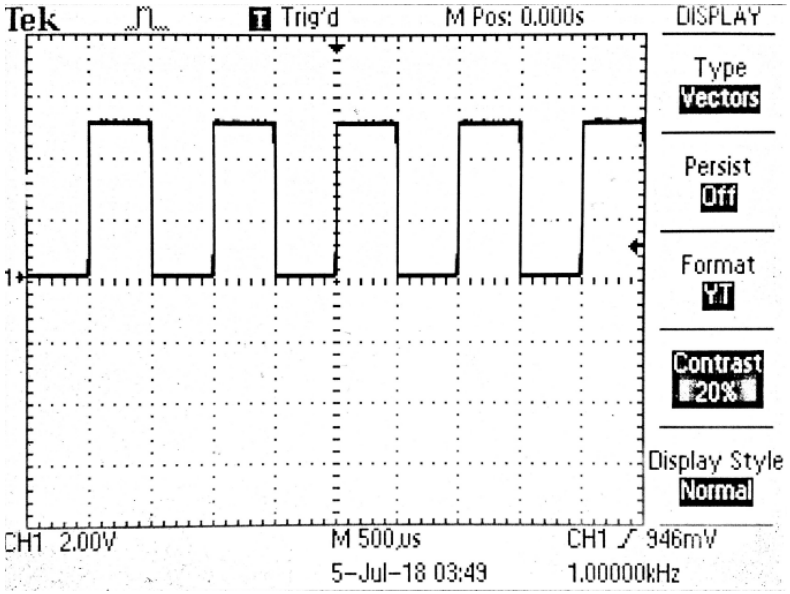


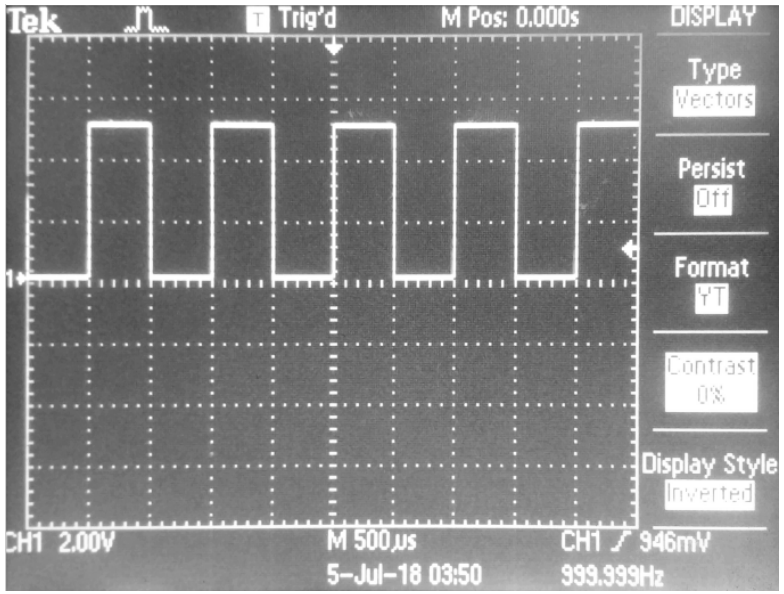
What does the *Display* button do?

Option 4: Contrast – For varying the contrast of the display.

Option 5: Display style

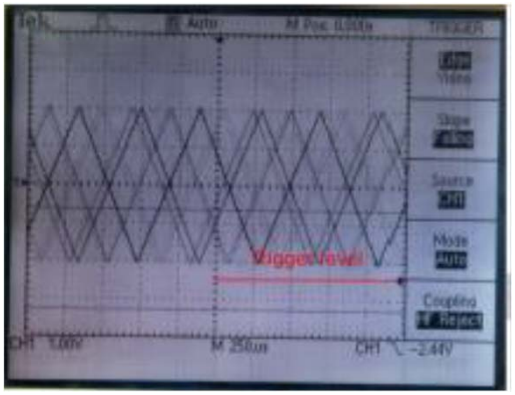
- Normal – Black text and figures in white background.
- Invert – White text and figures in the black background.



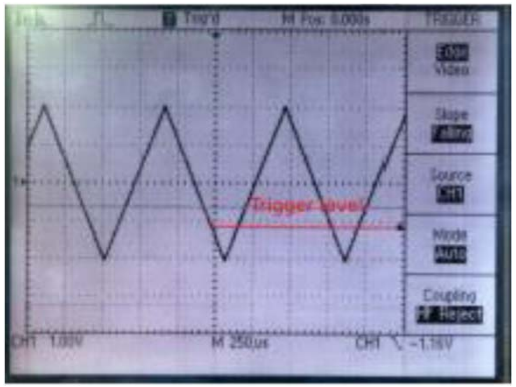


Triggering

The oscilloscope's trigger function synchronizes the horizontal sweep at the correct point of the signal, to result in stable waveforms. The trigger makes waveforms appear static on the oscilloscope display by repeatedly displaying the similar portion of the input signal for analysing the waveform quantitatively by allowing measurements. Without proper triggering, one can expect multiple waveforms on the screen that would result as each sweep starts from a different point on the signal!



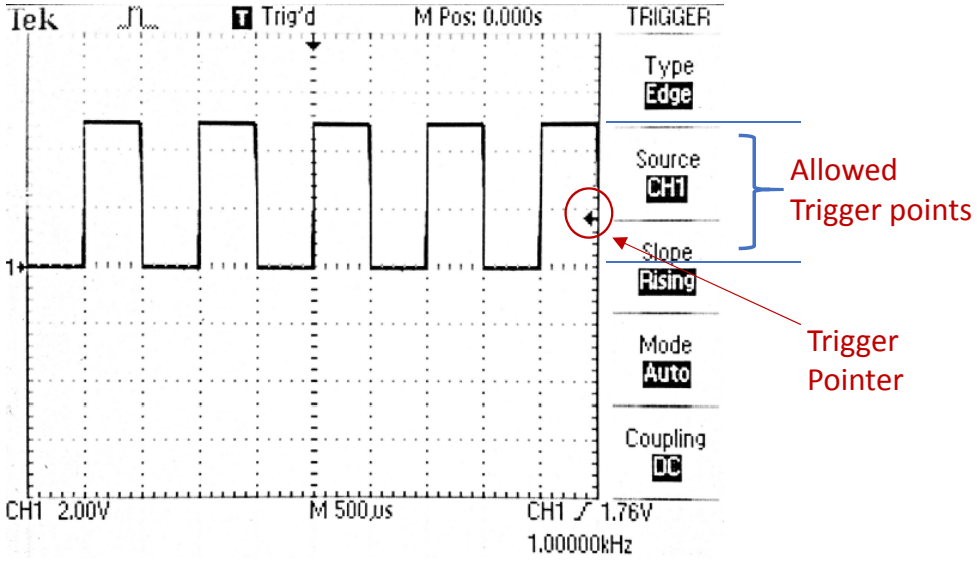
Untriggered Waveform

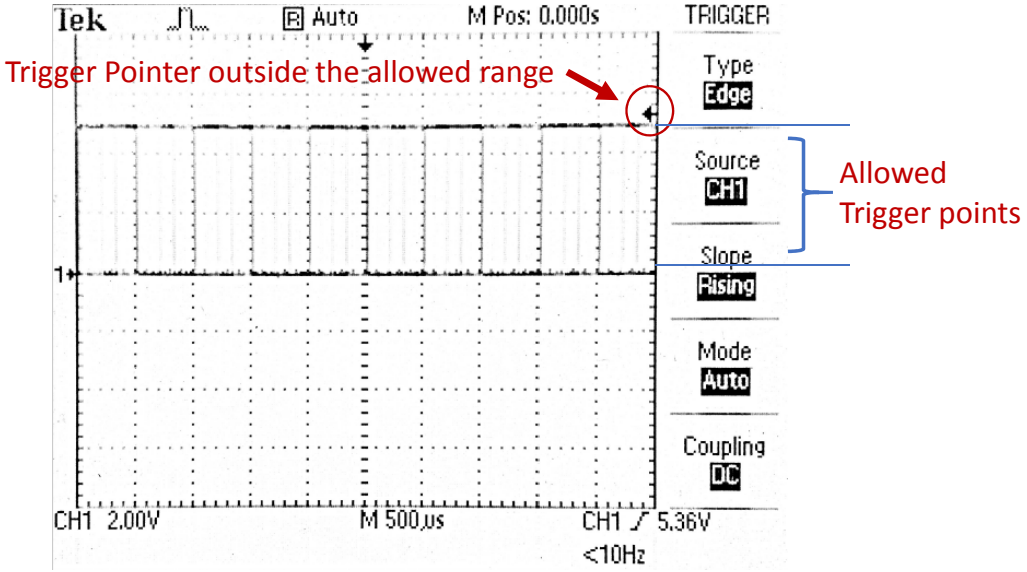


Triggered Waveform

Trigger panel options - Trigger Level knob

It sets the trigger value. On rotating this knob, the trigger level moves vertically and is represented by the trigger pointer. The corresponding trigger level value could be viewed on the bottom right side of the screen. If the pointer goes out of the signal peak to peak (or allowable level) triggering won't occur and multiple displays of the signal will appear on the screen (due to persistence of vision).





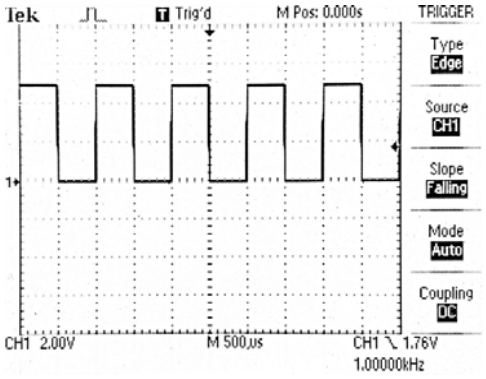
Trigger panel options -Trigger menu button

Option 1: Trigger type – By default it is set to edge (used generally) we shall be limiting to this type now. Other types could be explored later using the help button.

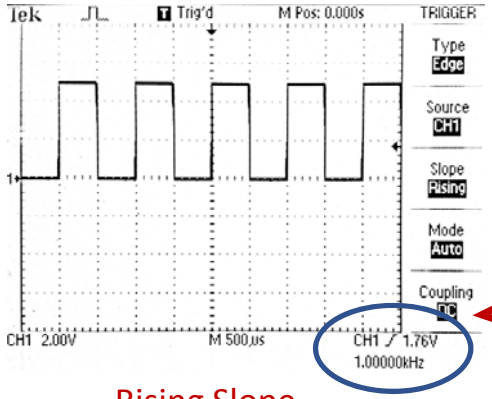
Option 2: Trigger Source - Various sources are available for triggering purpose. All the channels available, mains, external signals could be used for triggering. Using mains the triggering is performed using the ac supply required to power the DSO. External signal for triggering could be provided using the external trigger BNC connector. Presently keep the triggering source to the channel corresponding to the signal connected (as only one channel is working).

Option 3: Slope - As discussed in triggering phenomenon slope could be selected to rising or falling.

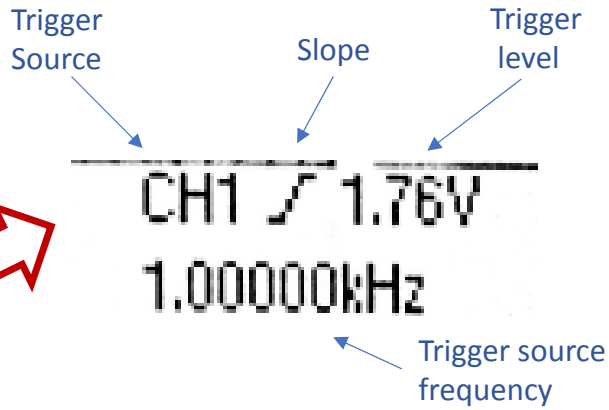
Video



Falling Slope



Rising Slope



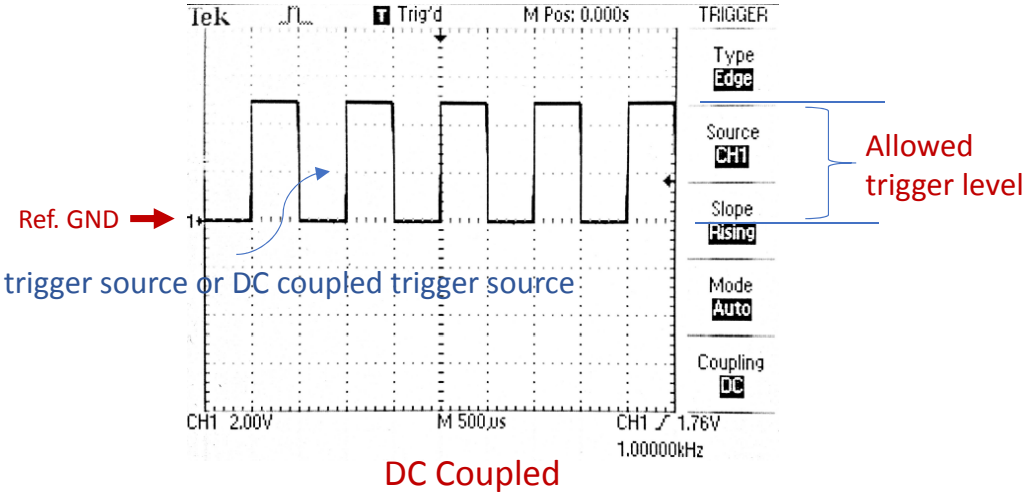
Trigger panel options -Trigger menu button

Option 4: Mode-

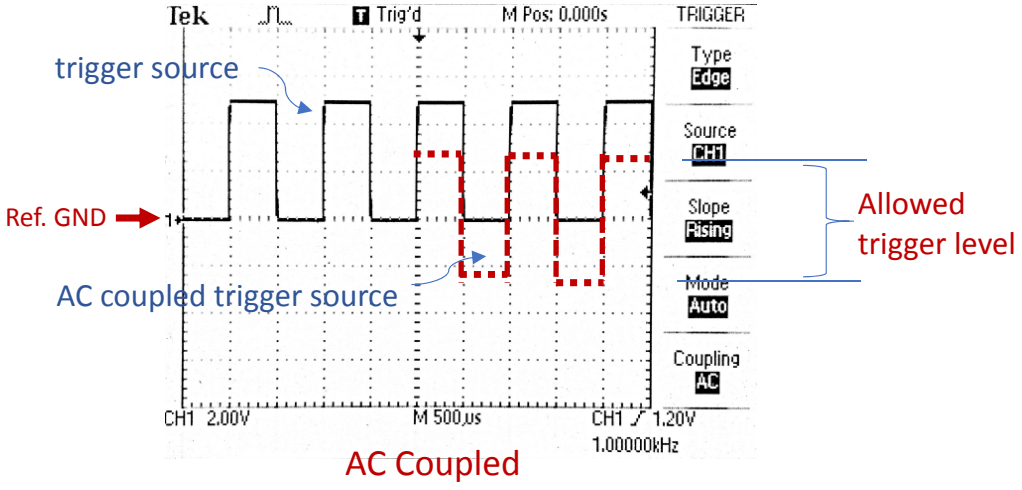
By default the mode is auto. In Normal mode the signal and triggering remains the same but in case when the signal goes out of

Option 5: Coupling-

- DC coupling – default mode of coupling. Acceptable trigger level lies between the max and min value of the signal.
- AC coupling – the acceptable trigger level lies between max and min value of the signal with DC part removed from it. (This could be realized as if the channel is AC coupled.)
- HF reject, LF reject, etc – could be explored further.



DC Coupled



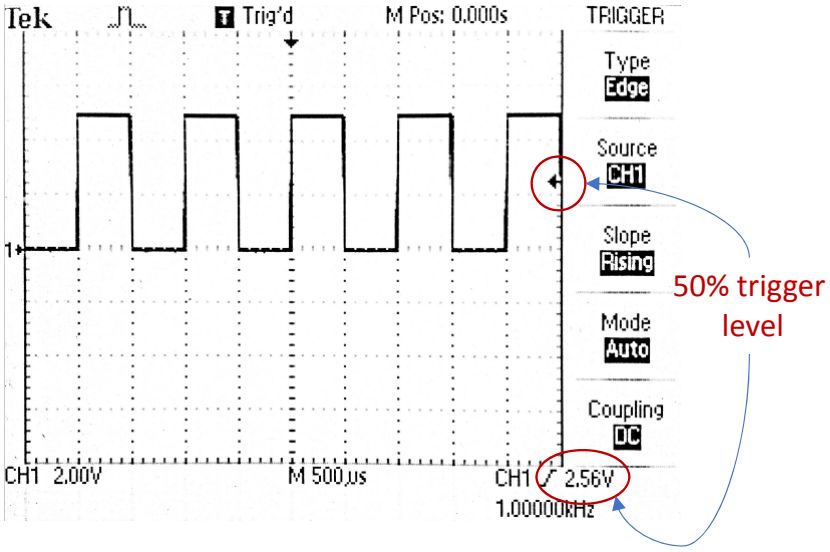
AC Coupled

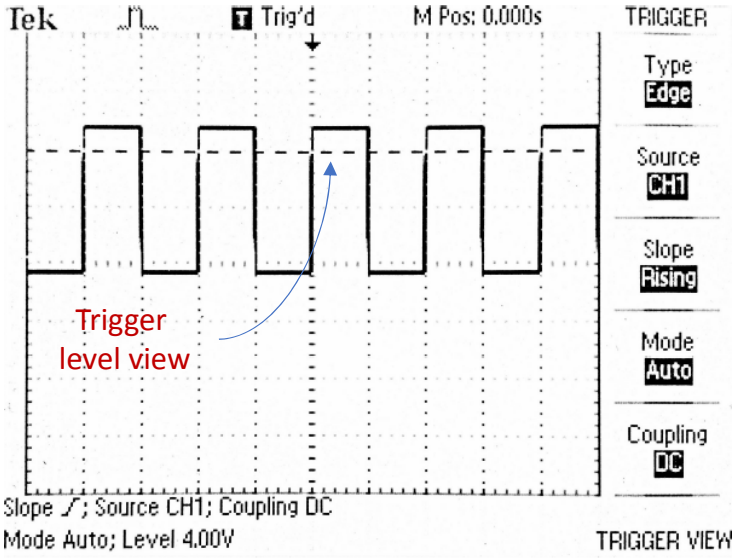
Trigger panel options - 50% trigger

It locates the trigger pointer or the trigger level to exactly 50% value or mid value of the signal.

Trigger panel options – Trigger View

It is used to display the trigger level by a dashed horizontal line on the display joining the trigger pointer. The line appears only when the button is pressed and vanishes on release.





Try out yourself

- Apply different signals of same frequency on different channels and vary different options as discussed.
- Try out different signals on XY display mode and observe various patterns and justify the figure using the electrodes configuration (vertical and horizontal) for displaying the signal.
- Try out different signals of different frequencies and trigger properly.
- Explore out remaining buttons on the panel.