EE200 CIRCUIT LABORATORY

2021-2022 SPRING

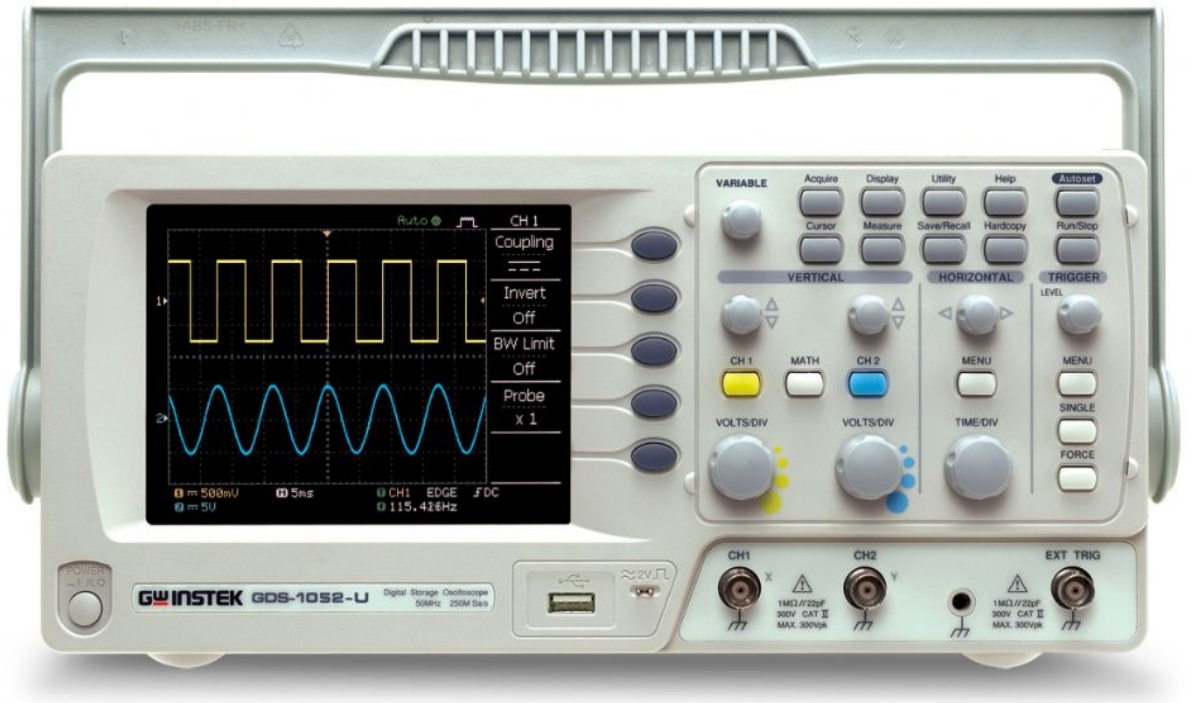
DEPARTMENT OF ELECTRICAL-ELECTRONICS ENGINEERING

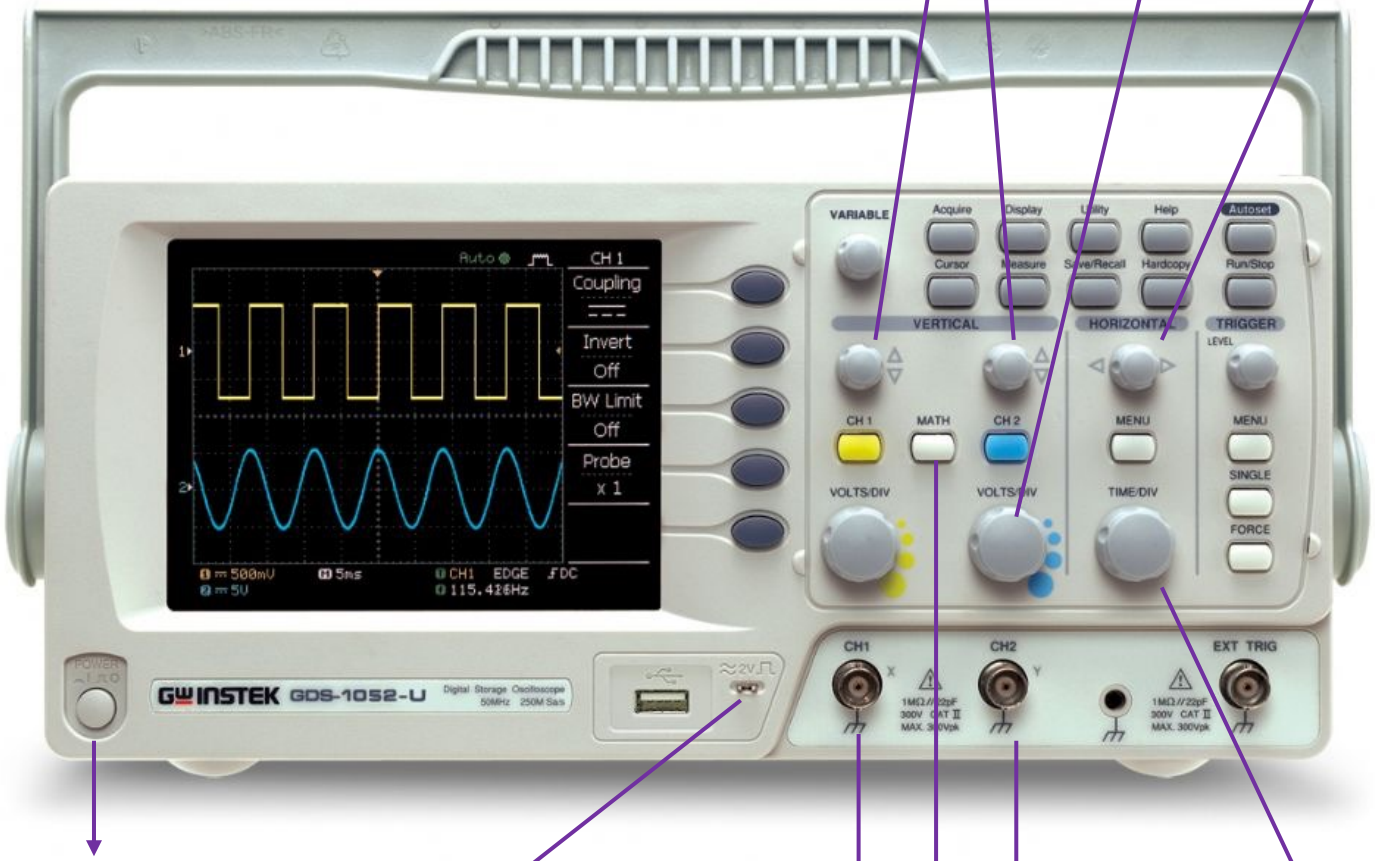
RES. ASST. ÖNEM YILDIZ

Oscilloscope

- An oscilloscope is a voltage sensing electronic instrument that is used to visualize certain voltage waveforms.

- An oscilloscope can display the variation of a voltage waveform in time on the oscilloscope's screen.







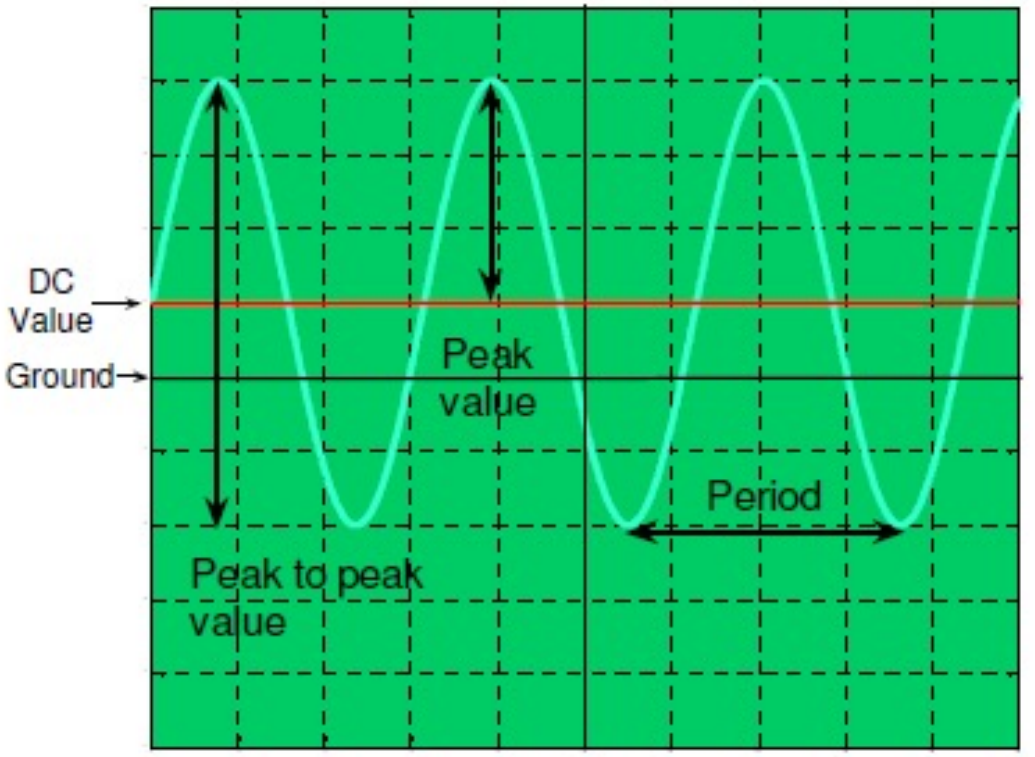
Oscilloscope shows the potential difference between the two terminals of the probe.

- The terminal ending with a hook is usually connected to the node in the circuit whose voltage is of interest.
- The other terminal is usually connected to the ground.

Oscilloscope Screen

For example;

- Peak Value (Vp) = 6 Volts
- Peak to peak value (Vpp) = 12 Volts
- DC Value (Average Value) (Vavg)= 2 Volts
- Period = 10 milliseconds
- $\text{Frequency} = \frac{1}{Period} = \frac{1}{10msec} = 0.1kHz = 100Hz$



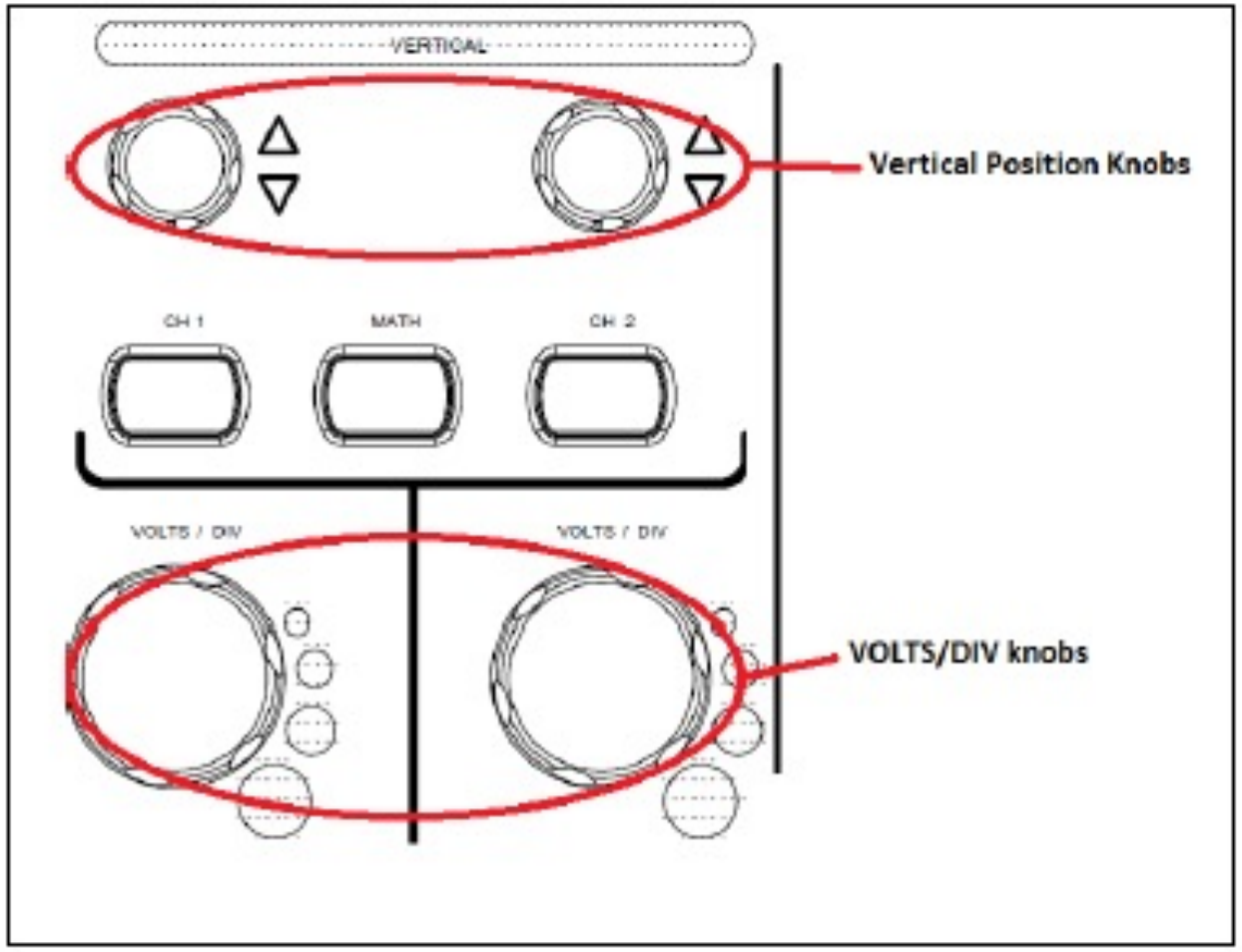
Note that the signal s(t), shown on the oscilloscope screen can be expressed as,

$$\begin{aligned} \mathrm{s(t)} &= V_p \sin(2\pi f t) + V_{DC} \\ &= 6\sin(2\pi 100t) + 2 \\ &= 6\sin(200\pi t) + 2\, Volts \end{aligned}$$

Position and Volts per Division Settings

- The position knob moves the waveform vertically.

- The scale knob varies volts per division (volts/div), which determines the voltage value corresponding to each vertical division on the oscilloscope's screen.
- As the volt/div value is altered, the size of the waveform on the screen changes.



Amplitude Measurement

For example;

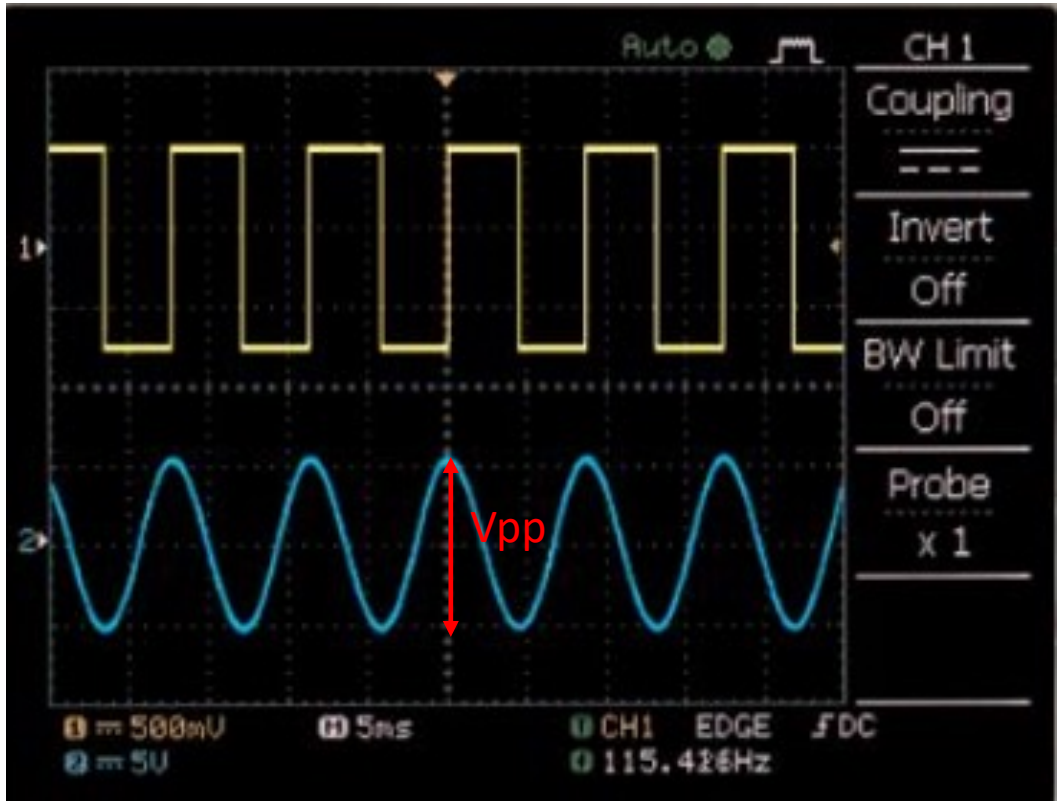
For CH2, VOLTS/DIV is 5V.

Blue signal covers approximately 2 squares in vertical axis (voltage axis).

Each square is corresponding to 5V, so the signal peak-to-peak voltage is:

Vpp = 5V *2 = 10V

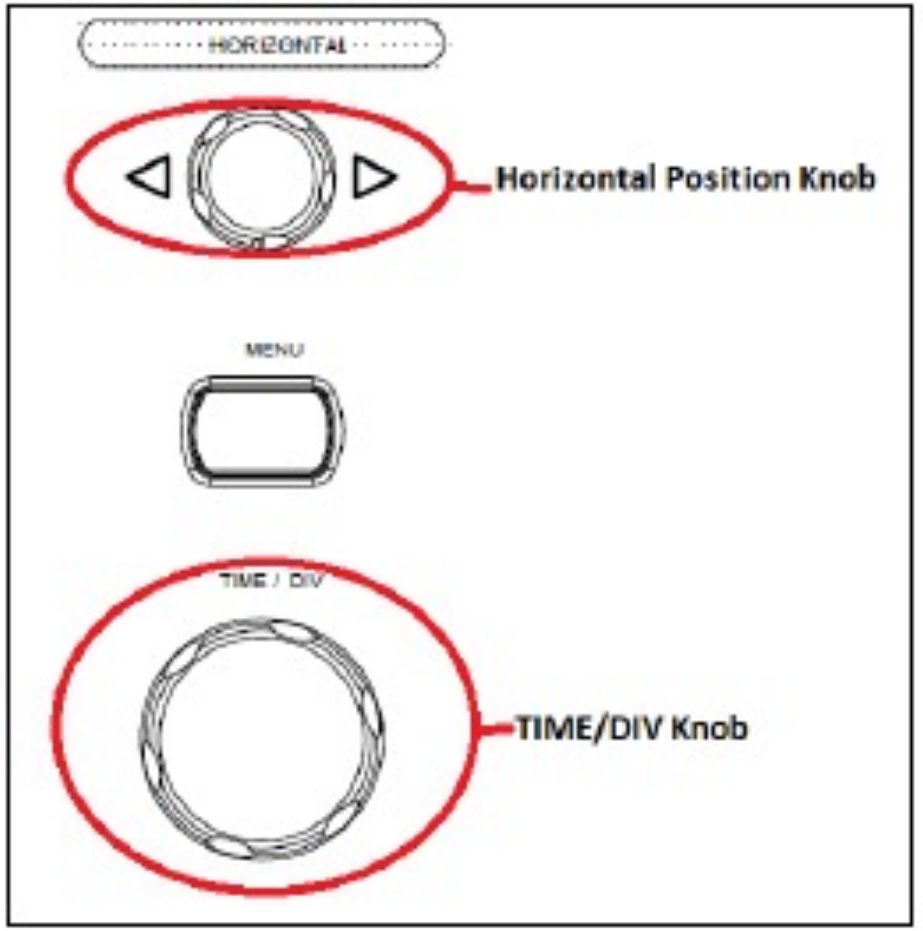
If Vpp = 10V, the signal amplitude or Vp = $\frac{Vpp}{2}$ = 5V



Horizontal Controls

- The horizontal position control (x-pos.) is used to move the waveform from left and right to exactly where you want it on the screen.

- The time per division (time/div) setting lets you select the rate at which the waveform is drawn across the screen.
- This setting is a scale factor.
- Changing the time/div setting lets you look at longer or shorter time intervals of the input signal.



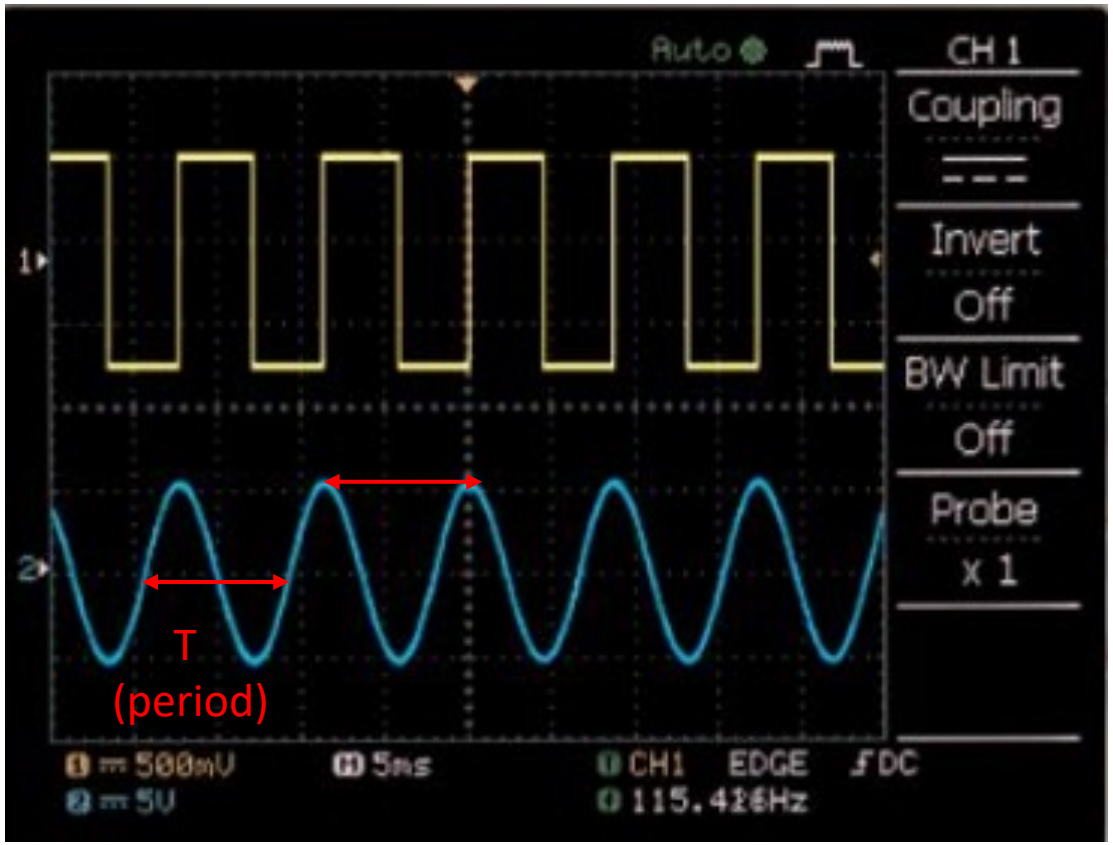
Period Measurement

For example;

The setting is 5 ms, each horizontal division represents 5 ms.

If a period covers 2 squares in horizontal axis;

Period T = 2 * 5ms = 10 ms

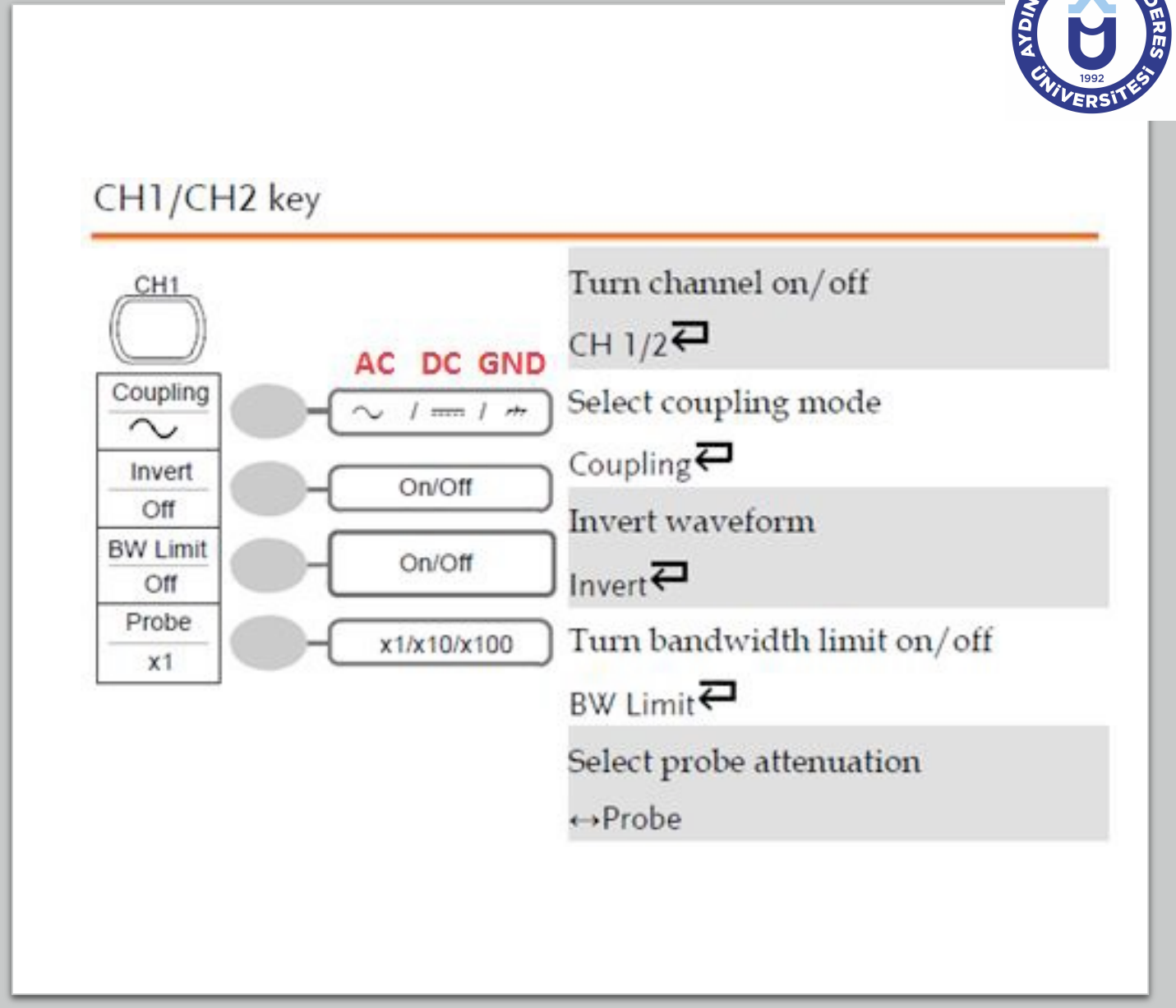


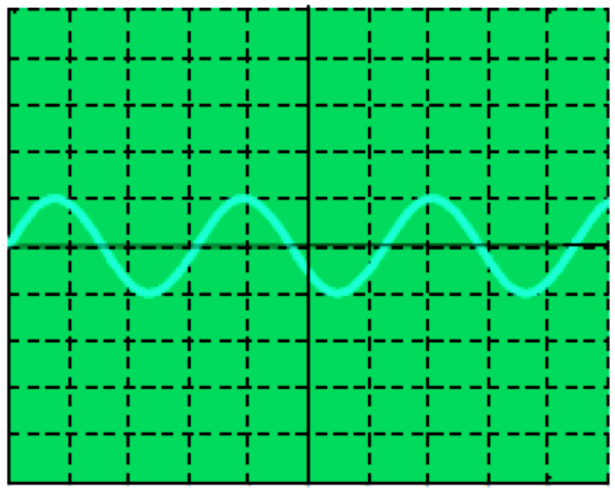
MENU (CH1/CH2)

- **Coupling** means the method used to connect an electrical signal from one circuit to another.

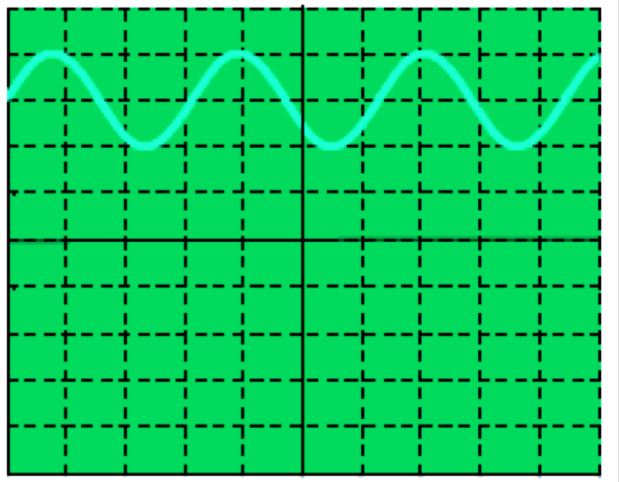
- In this case, the input coupling is the connection from your circuit to the oscilloscope.

- When the **INVERT** button of a channel is depressed, negative of the signal is displayed on DSO screen.





in **AC** mode.



in **DC** mode.

Input Coupling

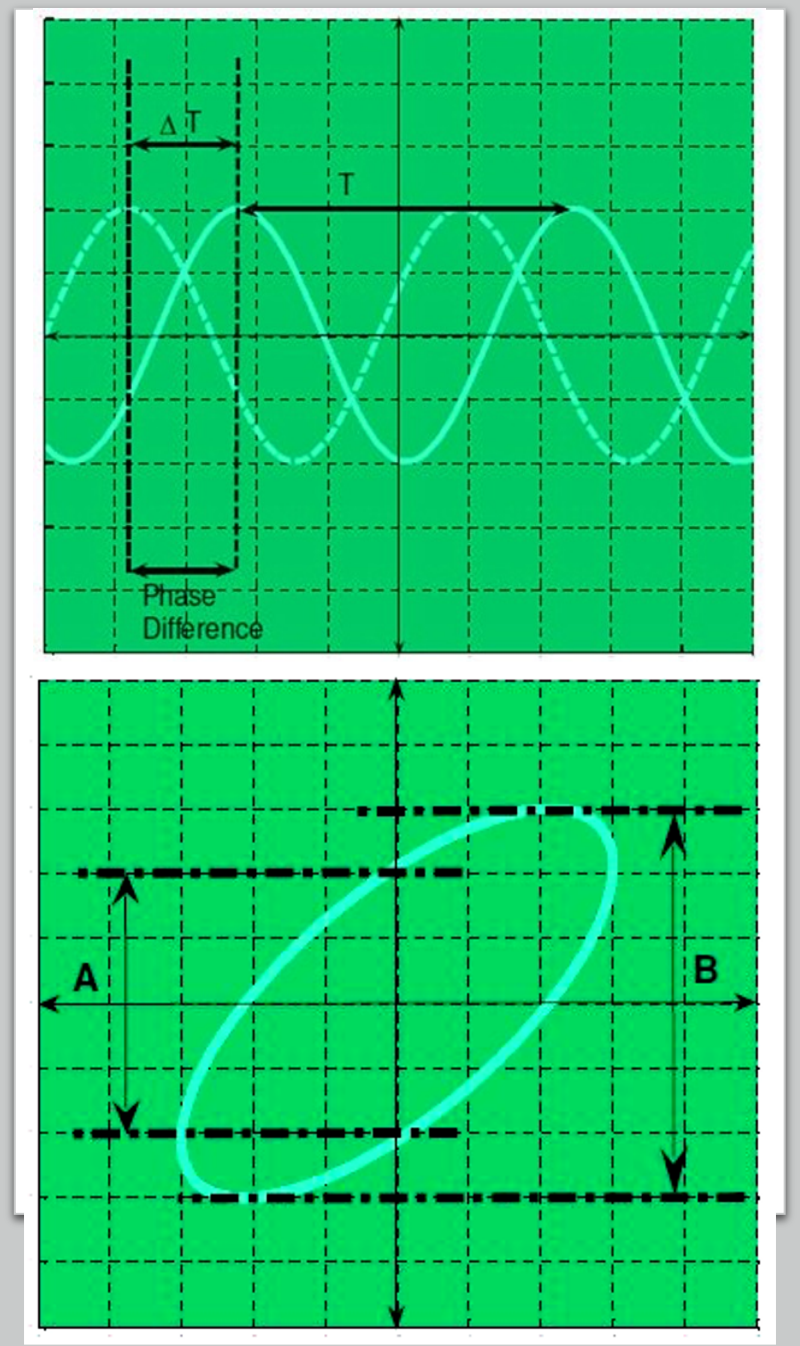
The coupling can be set to **DC**, **AC**, or **ground (GND)**.

By setting the coupling control to **AC,** the **DC offset** voltage is removed form the input waveform, so that you see the waveform centered at zero volts.

When **DC** coupling is selected, both **AC** and **DC** components of the input waveform are passed to the oscilloscope.

By selecting **AC** coupling, DC component is eliminated and only the signal of sin(wt) is shown on the screen.

The signal is $y(t) = 3 + \sin(wt)$ where 3 Volts is DC component and sin(wt) is AC component.



Phase Difference

ΔT = horizontal spacing of the peak values (or the zero crossings) of the two signals.
T = horizontal spacing for one period.

Then the phase difference, θ is;

$$\theta = \frac{\Delta T}{T} \times 360° \text{ (in degrees)}$$
$$\theta = \frac{\Delta T}{T} \times 2\pi \text{ (in radians)}$$

Phase difference is equal to,

$$\theta = \sin^{-1}\left(\frac{A}{B}\right)$$

THANKS

Res. Asst. Önem YILDIZ

onem.yildiz@adu.edu.tr