BIRZEIT UNIVERSITY
Physics Department
Physics 112

Experiment No. 6
Digital Storage Oscilloscope (DSO)

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Section:

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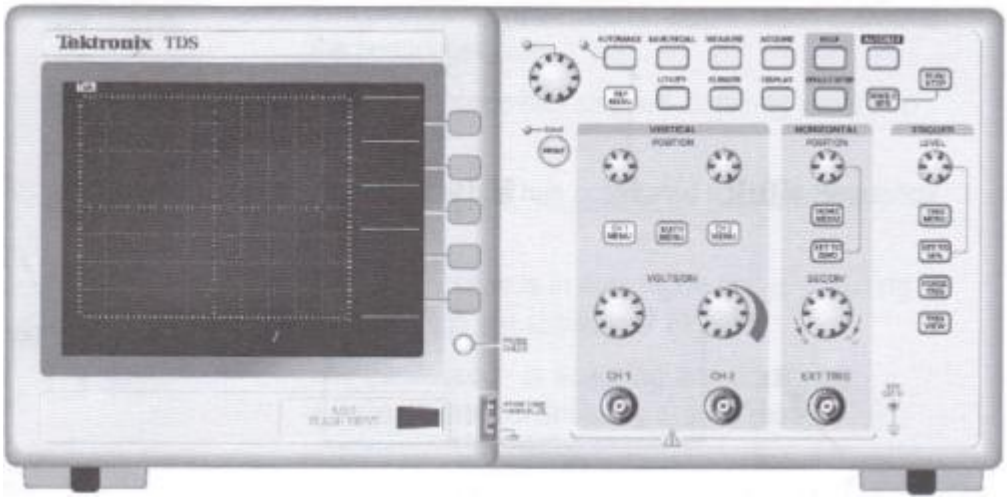
INTRODUCTION

Oscilloscopes are tools that allow us to view signals graphically. The oscilloscope displays the signals as a plot of magnitude versus time; it can provide measurements of amplitudes, frequencies and phase differences.

There are two types of oscilloscopes: analog and digital. Analog oscilloscopes use a cathode ray tube and display the signal much like a television set displays an image. Digital oscilloscopes sample the signals digitally and are more flexible in how they display, manipulate, and store the signals.

The oscilloscope in this lap is a dual channel one, you can use one or both of them. In brief the front panel consists of:



INPUT CONNECTORS:

1) CH1 and CH2: For waveform display.

2) EXT TRIG: For an external trigger source.

VERTICAL CONTROLS:

1) The VOLT/DIV knobs one for CH1 and the other for CH2: Select vertical scale factor.

2) Above them, three colored buttons:

Yellow (for CH1), blue (for CH2): Display the vertical menu selections.

and the pink MATH MENU: Display math operations menu.

3) Above them, POSITION knobs: Move the wave up and down, the left for CH1 and the right for CH2

HORIZONTAL CONTROLS:

1) The SEC/DIV knob, which is common for the two channels: Select horizontal time/div scale factor.

2) The SET TO ZERO button: Set the horizontal position to zero.

3) The HORIZ MENU button: Displays the horizontal menu.

4) The horizontal POSITION knob: moves the wave right and left.

TRIGGER CONTROLS:
LEVEL knob, TRIG MENU, SET TO 50%, FORCE TRIG., and TRIG VIEW.
MENU and CONTROL
DISPLAY MENU

TAKING MEASURMENTS

There are several ways to take measurements:

- By counting the major and minor divisions involved and multiplying by the scale factor.
- The cursors method: by moving the cursors, which always appears in pairs, and reading their numeric value from the display readout. You can choose the amplitude (horizontal) cursors to measure vertical parameters or the time (vertical) cursers to measure both horizontal and vertical parameters.
- The automatic method: by choosing this option from the MEASURE menu. You can take up to five automatic measurements.

START WORKING

A. Calibrating the probe:

The provided oscilloscope probes are switchable between 1X and 10X. When set to 1X, the oscilloscope will display the actual signal to scale. When set to 10X, the oscilloscope reading will be one tenth of the actual signal.

1) Push the power button **ON** (This button is located on the top left side). Wait till the DSO loads its program. Now you can see a single horizontal yellow line, or a single horizontal blue line, or both.
2) If you want to see the single yellow line, then press the button of DEFAULT SETUP in the functions group.
3) Take a probe to start measuring and connect it to CH1, and to the internal source (on the bottom of the right side of the screen), which provides an AC square wave with 5 volts and 1 KHz.
4) Move the knob on the probe to IX. Now you can see a square wave on the screen on CH1. If the wave is running then press the RUN/STOP button to catch a full screen fixed wave.
5) Press MEASURE Menu. Then press CH1 to display the wave.
6) The TYPE button indicates the type of measurement you will do. Press it to change the state from None to Freq (frequency). The value of the frequency should be written down the display with a value 1.000 KHz, which agrees with the frequency of the internal source.
7) Press again to change from Freq to period. That should be 1ms.
8) Press more to find the Pk-Pk value of the voltage which must be 5.00 volts.

B. DC voltage(vertical) measurements:

1) Adjust the oscilloscope for a horizontal trace centered vertically on major line. Set the **volts/div** knob at 2 V/div, and the COUPLING to DC.
2) Connect a DC power supply, set to about 5V, to DSO input (CH1 or CH2) and observe the vertical movement on the screen trace.
3) Measure the DC voltage with the DSO and assure that it agrees with the setting of the power supply.
4) Reverse the connections to the power supply and observe that the vertical line is opposite to that observed in previous step.
5) Switch the COUPLING from DC to AC and observe the results.

C. AC voltage (vertical) measurements:

Vertical measurements are often made in units of peak to peak volts, which could be converted into peak volts by dividing by two.

The peak voltage can be converted to RMS voltage by dividing by $\sqrt{2}$ (for a sinusoidal signal) see your lab manual for the meaning of RMS.

Thus the AC voltage could be represented by peak-voltage or RMS-voltage

1) Adjust the oscilloscope for a horizontal trace centered vertically on major line. And Set the **volts/div** knob at 1 V/div, and the COUPLING to AC.
2) Connect a function (signal) generator to the DSO and set a sinusoidal output with frequency 5 KHz.
3) Change the amplitude of the signal until it 4 units Peak to Peak.
4) Using the cursor measure the peak to peak voltage
5) Change the TYPE button to RMS, and measure the RMS-voltage.
6) Use the DMM to measure RMS-voltage.
7) Write down in the table your measurements.

V_{p-p} (units)	V_{p-p}(volts) (divisions)	V_p(volts), (divisions)	V_{rms}(volts), using DSO	V_{rms}(volts), calculated	V_P(volts), cursor	V_{rms}(volts), DMM

D. Measurements of frequency and period (horizontal measurements):

1) Leave the previous connection the same.
2) Use the cursor to measure the period (by changing the cursor to horizontal).
3) Use the automatic measurements to measure the frequency.
4) write down your data

Freq(Khz), SG	Period(ms), cursor	Freq=1/T, cursor	Period(ms), automatic	Freq(Khz), automatic.

E. Measuring the voltage on different components

1) Connect the circuit shown in fig1.

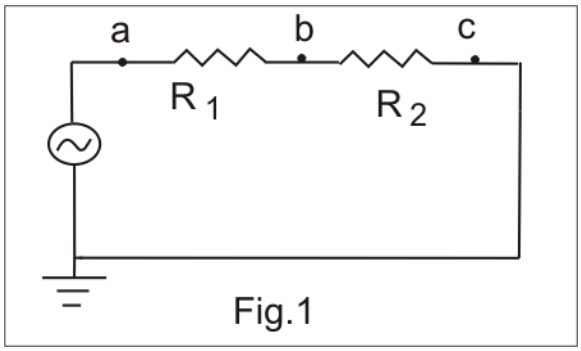


Fig.1

2) Use the Automatic menu to measure peak-voltage on points a,b and c. Wright down your measurements

V_p(at point a), volts	V_p(at point b), volts	V_p(at point c), volts

3) Change the places of R_1 and R_2 and use the DSO to fill the table

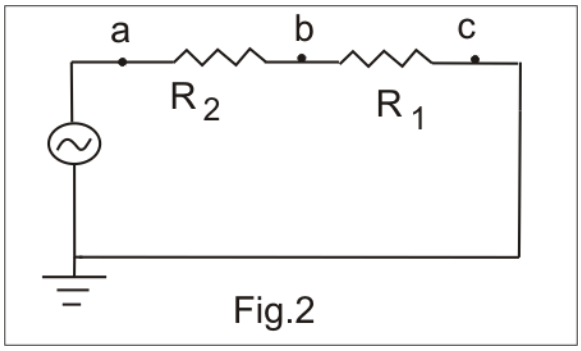


Fig.2

V_p(at point a), volts	V_p(at point b), volts	V_p(at point c), volts

4) Assure that:

The input V_p (point a) = V_p (on R_1, point b fig.2)+ V_p(on R_2, point b fig.1)

5) Use the DMM to measure RMS-voltages on R_1, R_2 and the input. Wright down your measurements:

V_{RMS}(input), volts	V_{RMS}(R_1), volts	V_{RMS}(R_2), volts

6) Verify that:

$V_{RMS}(input)=V_{RMS}(R_1)+V_{RMS}(R_2)$

F. Measuring two signals(optional)

1) Connect the circuit shown in fig.3

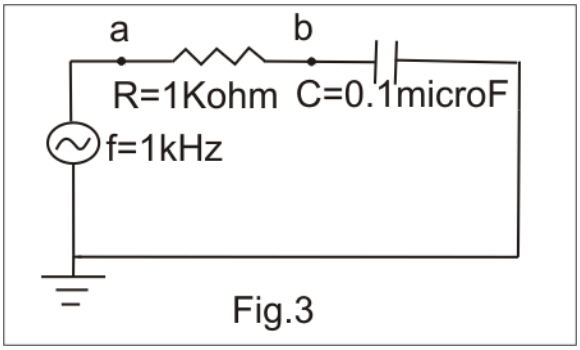


Fig.3

2) Connect point a to CH1 and point b to CH2.

3) Display the two waves on the screen. (They will be with a phase shift (φ) about 30^0).

4) Use the cursor to measure the time interval (Δt) between the two signals.

Δt=

5) Note that the $\varphi=2\pi f\Delta t$.

φ=