Lab 1 - Introduction to Digital Oscilloscopes

Preliminary Work

1. Read and study the document Digital Oscilloscope Principles which is uploaded to Moodle.

2. For further information (optional) read the oscilloscope tutorial XYZs of Scopes. We shall be using a digital oscilloscope in the lab, and therefore in reading these tutorials pay attention to the sections on digital oscilloscopes.

3. There are more than one different model of oscilloscopes in the Lab. However, you can feel comfortable about the preliminary and Lab work since they are prepared model independent.

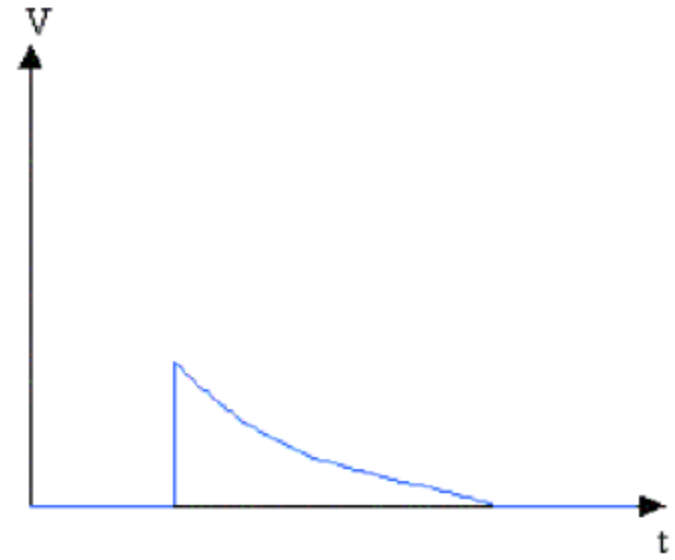
4. Prepare your "EEE102 - Preliminary Work Report for Lab 1" by answering the questions below.

i. What is ADC (analog to digital converter)? What is DAC (digital to analog converter)? Search the Internet and write a summary. Give some examples of applications for both. If I somehow measure the time interval between two successive digital outputs of ADC, how can I determine the sampling frequency (sample rate) of it?

ii. Explain the difference between a waveform point and a sample point.

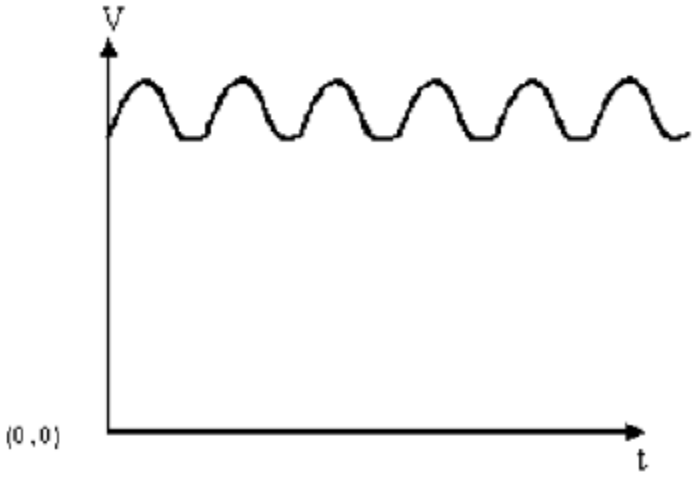
iii. Explain equivalent-time sampling mode of a digital oscilloscope. Why and when is it used?

iv. Explain the trigger mode to be used to capture and display an aperiodic signal of limited time duration as shown in the figure below.



v. Explain and draw how a square wave is displayed on the screen if the probe is properly compensated, under-compensated or over-compensated.

vi. Consider the following waveform:



Draw what you would see on the oscilloscope screen with AC coupling.

vii. In digital scopes, portion of the signal during the time before trigger event is displayed. How do these scopes achieve this result?

viii. Using the Edge-Triggering with a positive slope control and a level control of 4V (which means the trigger point is set to the 4V of rising edge of the signal) and set on *Normal Mode*, I am trying to observe a sinusoidal voltage signal (without any DC) on the oscilloscope. However, all I see is a blank screen. What do you think the problem might be? And with which one(s) of the following methods might I be able to see the voltage signal on the oscilloscope: **a)** decreasing voltage value of level control, **b)** using the negative slope control (falling edge), **c)** using *Auto* mode? Briefly explain.

Lab Work

1. Use the compensation signal of the oscilloscope and compensate your probes as explained in the above mentioned documents and tutorials. Explain in your report how you compensated your probes.

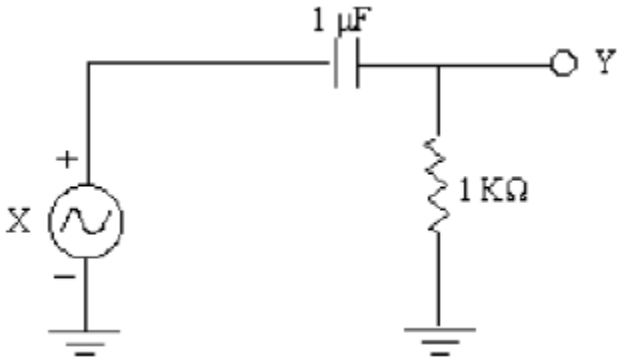
2. Using a signal generator apply a 5 Vp-p sinusoidal signal having a frequency of 1 kHz (Note that this signal should not have a DC component). First use positive edge triggering and draw what you see on the screen, then apply negative edge triggering and draw the corresponding figure. Explain the differences, in your report.

3. Apply 1 Vp-p 2 kHz triangular wave to the scope. Observe the effect of turning the trigger level knob on the oscilloscope, comment on your observations using triggering concept.

4. Apply 1 Vp-p 5 kHz square wave to channel 1 of the oscilloscope. Then try all of the acquisition modes (sample, peak detect, and average) and write down your observations including graphs.

5. Generate a sinusoidal signal with 2 Vp-p amplitude and 1 kHz frequency. Also apply a DC-Offset of 1 V. First, use DC coupling and draw what you see, then use AC coupling and draw the corresponding waveform. Comment on the differences.

6. Setup the following circuit on your breadboard:



Apply 2 Vp-p 1 kHz sinusoidal signal as the X signal and, observe and draw X and Y voltage waveforms. Apply a DC-Offset of 0 V. Use channel 1 for the X signal and channel 2 for the Y signal. You should use channel 1 as the trigger source. Measure delay and phase difference between X and Y signals. Then change the frequency to 100 Hz and repeat the above steps. Comment on the differences.

Note: The signal generator that you will be using in the lab may not have accurate controls. You cannot rely on the settings that you adjust using the knobs of the signal generator. In particular, if the signal generator is not terminated by an impedance of 50 Ohms but terminated by a load of high impedance then the output magnitude of the signal generator may be double the value set by the knobs.