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Introduction to Digital Oscilloscopes

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EEE-102-Section 1

1) Purpose of experiment:

The experiment's goal is to become acquainted with lab equipment such as digital oscilloscopes, oscilloscope probes, breadboards, and jumper cables by thoroughly investigating various periodic signals.

2) Equipment:

- Digital Oscilloscope(Agilent Technologies, DSO-X 2002A)
- Digital Oscilloscope(Tektronix TDS 2002)
- Oscilloscope probe
- Breadboard
- Jumpers
- Capacitor(1)
- Resistor(1)

Note: brand of the oscilloscope was changed because of the unstable electric of the lab.

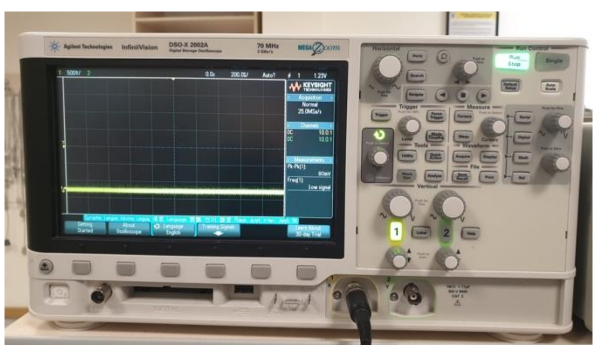

Figure 1: Digital Oscilloscope (Agilent Technolojies, DSO-X 2002A)

3) Methodology and Results:

The experiment was divided into 6 parts.

Part 1:

First of all, the oscilloscope's (TDS 2002) channel 1 was linked to the oscilloscope probe (with a 10X attenuation factor), the compensation signal was connected to the probe tip, and ground was connected to the alligator clamp. Then, at 5 volts and 1 kHz, some square waves were obtained. However, overcompensation (square corners pointing upwards) (figure 2) and undercompensation (square corners pointing downwards) (figure 3) occurred. After the probe is properly compensated, we fix the corners and get smooth square waves (Figure 4).

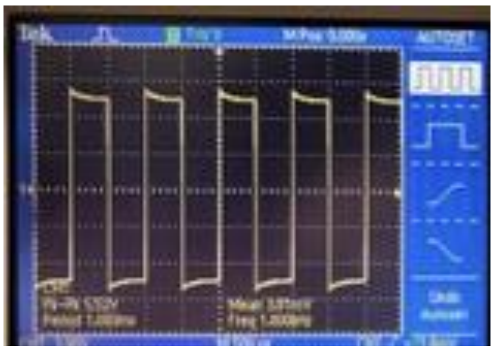

Figure 2: Overcompesation situlation

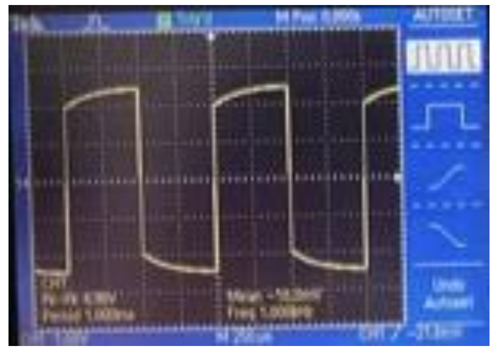

Figure 3: Undercompesation situlation

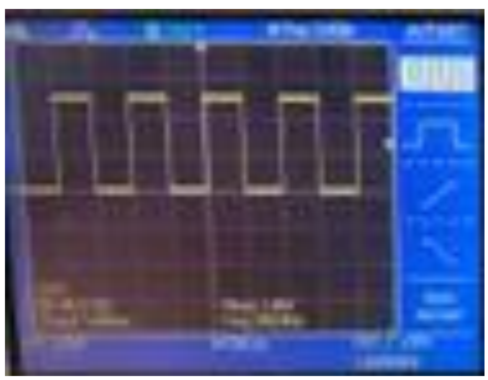

Figure 4: Correctly compensated

Part 2:

In the second part, after compensating, the probe was connected to an oscilloscope (DSO 2002A (changing the oscilloscope due to the electric outrage)), and a 5 V_{pp} sinusoidal signal with a 1 kHz frequency was produced. The voltage trigger level was set to 0 volts, and the time trigger point was chosen to be in the horizontal center of the screen. First, positive edge triggering was used, and the sin(t) function was created (figure 5). The sin(-t) function was created using the negative edge trigger (figure 6).

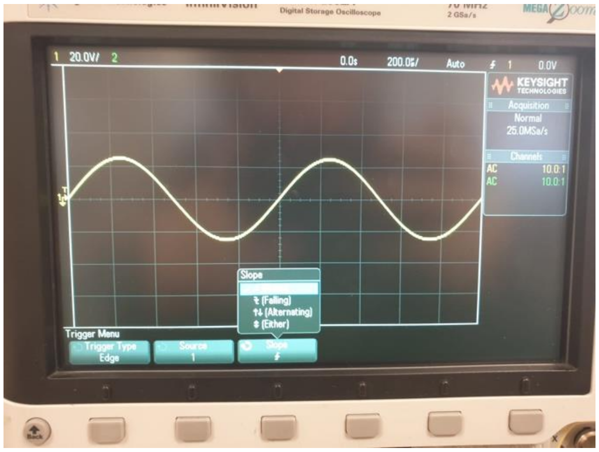

Figure 5: positive edge triggering

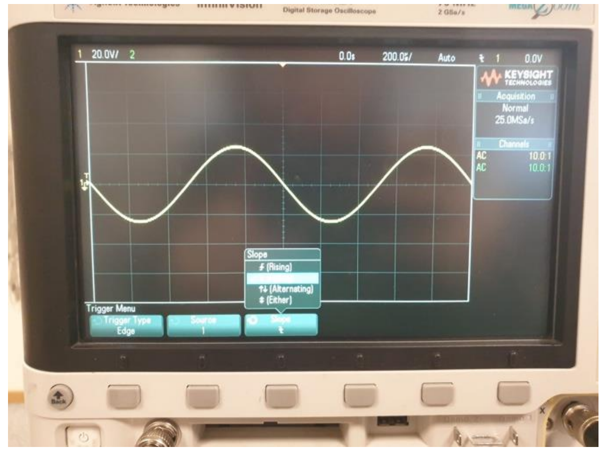

Figure 6: negative edge triggering

Part 3:

In this part, a triangular wave is created with 1 V_{pp} and 2 kHz frequency, and edge triggering is utilized and observed. triggering, allowing us to create perfect overlap and preventing the flickering and hard-to-observe signal. Thus, waves can be easily observed and studied. In the experiment, after creating a triangular wave, when pushing up the trigger, the voltage level raised (Figure 7). When pushing down the trigger, the voltage level decreased (Figure 8). Pushing the trigger higher or lower than the amplitude of the wave causes an unstable display on the screen (Figure 9).

Figure 7: High voltage trigger level

Figure 8: Low voltage trigger level

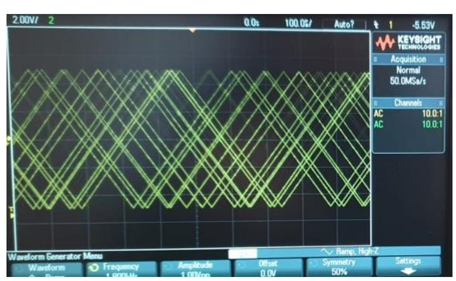

Figure 9: trigger level not in amplitude range

Part 4:

In this part, there are a few questions to be answered, and the experiment continues.

ADC stands for analog to digital converter, which helps us convert analog signals into digital signals. And DAC means the opposite, which helps us convert digital signals to analog signals.

In continuation of Part 4, square waves with 1 V pp and 5 kHz frequency were generated. The signal was observed at different acquisitions. In sample mode, there was noise in the upper and lower parts of the wave (Figure 10). In the peak detect mode, which is used to detect the tight, small pulse, pulses can be seen on the screen (figure 11). In the average mode, most of the noise is prevented. So smooth wave displayed at screen(figure 12).

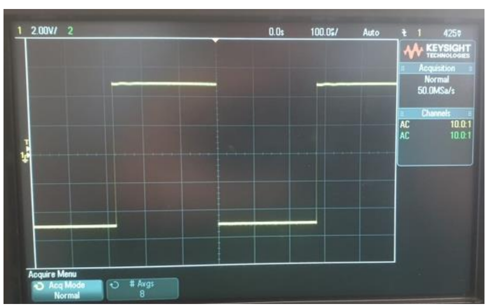

Figure 10: Square wave with normal mode

Figure 11: Square wave with peak detect mode

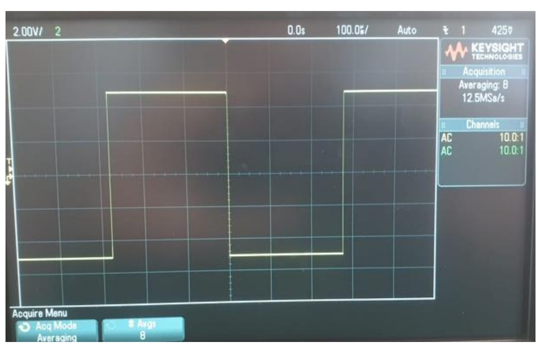

Figure 12: Square with averaging mode

Part 5:

In this part, the oscilloscope was set to a 2 V_{pp} and 1 kHz frequency with a 1 V DC offset. When DC coupling is used, 1V is included on the screen. As a result, the DC signal raises the vertical axis (Figure 13). However, there was no offset in the AC coupling. As a result, it was discovered in its default vertical position (Figure 14).

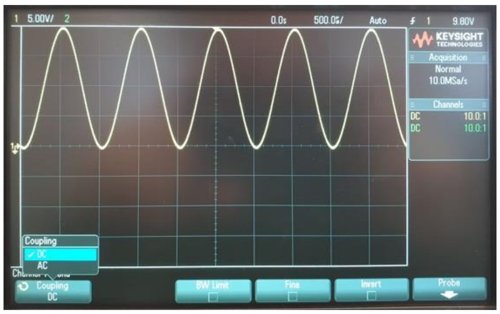

Figure 13: Signal at DC coupling

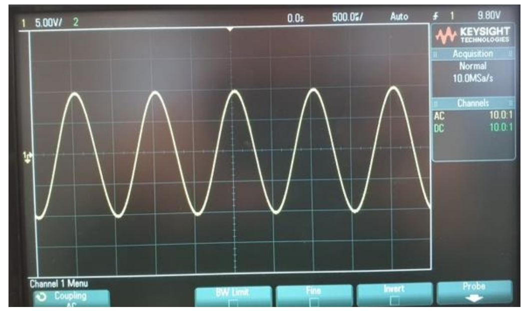

Figure 14: Signal at AC coupling

Part 6:

Breadboards are tools of various types for creating simple and reusable circuits without fixing the circuit elements with something like solder. multi-hole columns and the 5-hole rows have conductivity between their holes. Thus, series and parallel circuits can be established with jumpers and other similar elements.

In this part, a sinusoidal signal is created with 2 V_{pp} and 1 kHz frequency. Then the circuit whose diagram is given is set up on the breadboard (Figure 15). 2. An oscilloscope probe is connected to channel 2, and both probes are connected to the necessary points in the circuit, with their ground clamps connected to ground.The delays of the two signals at 1 kHz and 100 kHz are 36.84 us (Figure 16) and 51 ns (Figure 17), respectively.

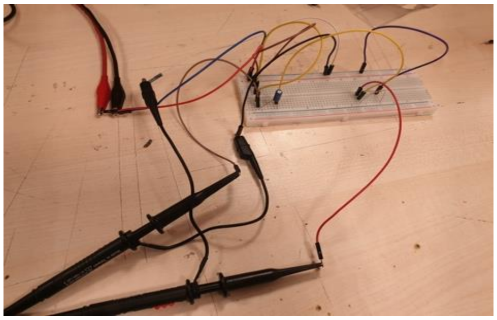

Figure 15: Circuit on breadboard

Figure 16: Signals with 1kHz frequency

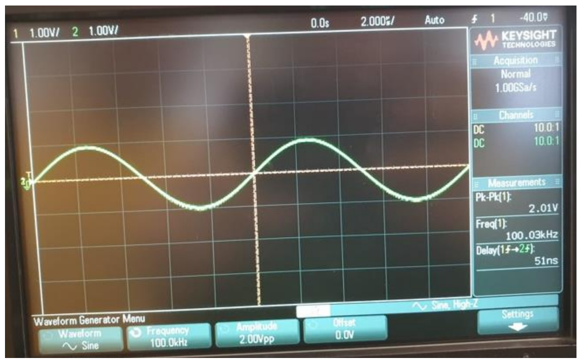

Figure 17: Signals with 100 kHz frequency

4) Conclusion:

The goal of this experiment was to familiarize to the lab tools such as oscilloscopes and breadboard with a studing various signals. The probe was correctly compensated after displaying overcompensation and undercompensation. Oscilloscope triggered with pozitive and negative edge triggering. Sample, peak detect and average acquisitions are observed and used to display different waveforms. The difference between AC and DC coupling are demonstrated. A given circuit is set up to breadboard then signals are measured on the 2 different point of circuits to compare them for phase differance. So experiment is successful.