Analysis and Measurement Tools

Oscilloscope and LF Generator

Instructions

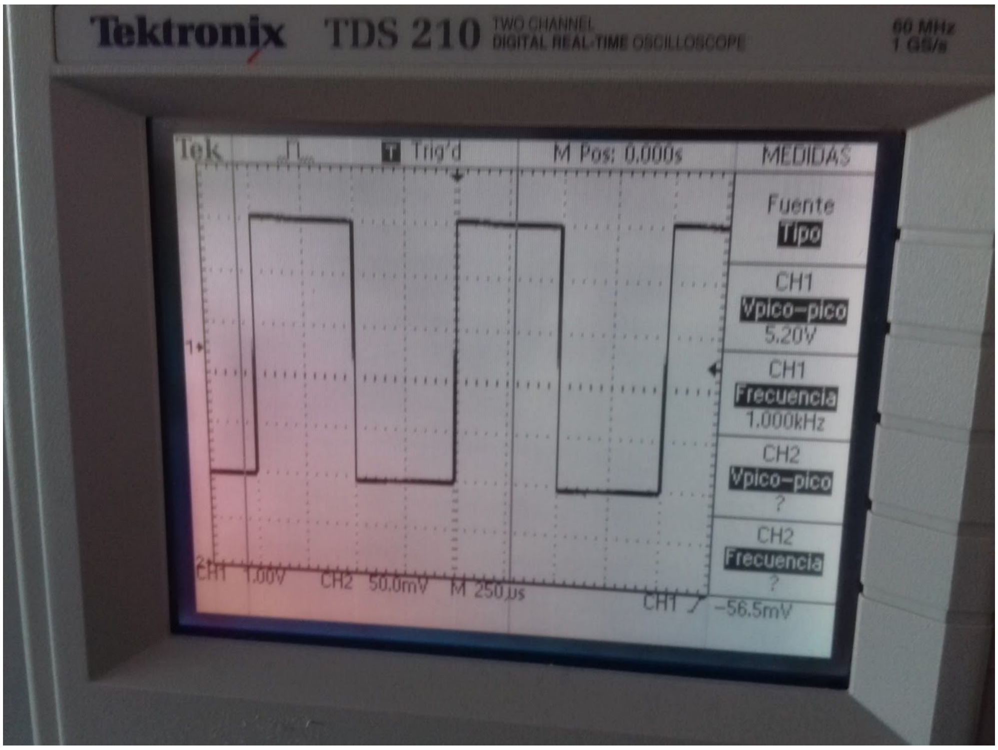
In order to do these exercises, it is necessary only an oscilloscope probe and a BNC to banana cable. You should be careful that the probe configuration (x1, x10) is the same as the one programmed in the oscilloscope; otherwise, the amplitude measurements will be incorrect.

You should also notice that in some generators the tension selected is peak-peak (Vpp) while in others is just peak (Vp). The important thing is that the levels asked for in the task must be seen in the OSCILLOSCOPE.

For each exercise is necessary to capture a screenshot of the oscilloscope (or a photo) that shows the required configuration. In addition, it is also possible to add a photo of the signal generator that shows the signal configurations (if applicable).

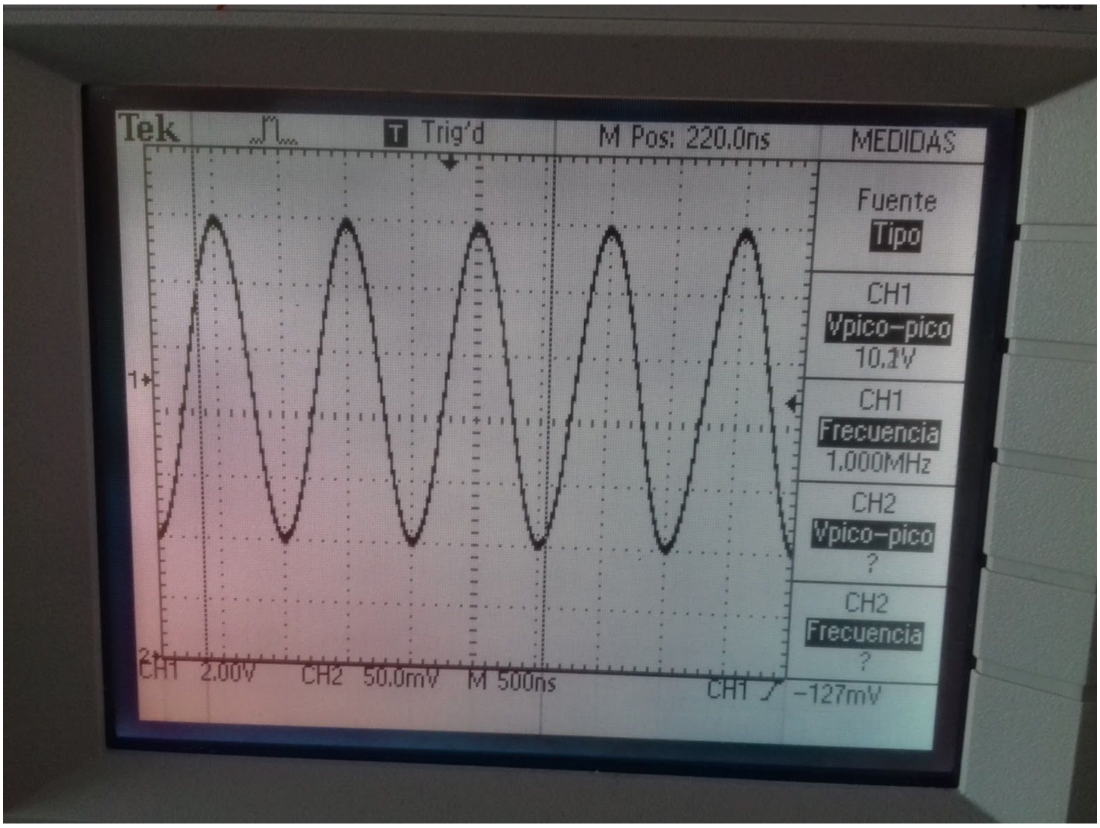
Exercises

1. Connect the probe to the output of the calibration signal of the oscilloscope. Push the AUTO button and observe the wave. Configure the oscilloscope so that each period of the wave takes up 4 divisions, and the wave has 5 divisions of height. Measure the frequency and amplitude of the signal and make sure that it matches the specified in the oscilloscope.



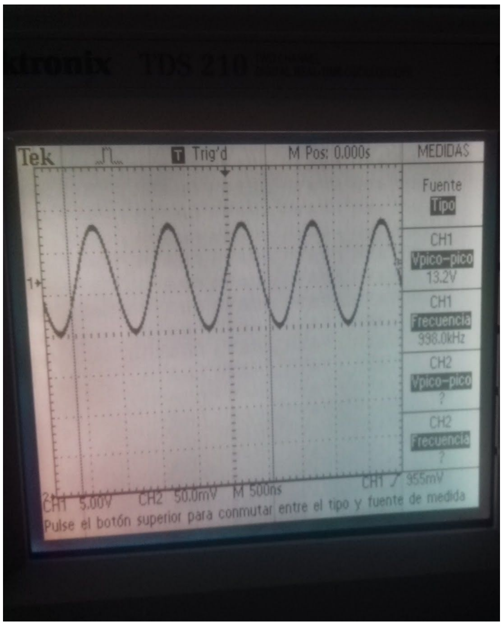
As expected, the Vpp is around 5 V and de frequency is 1 kHz.

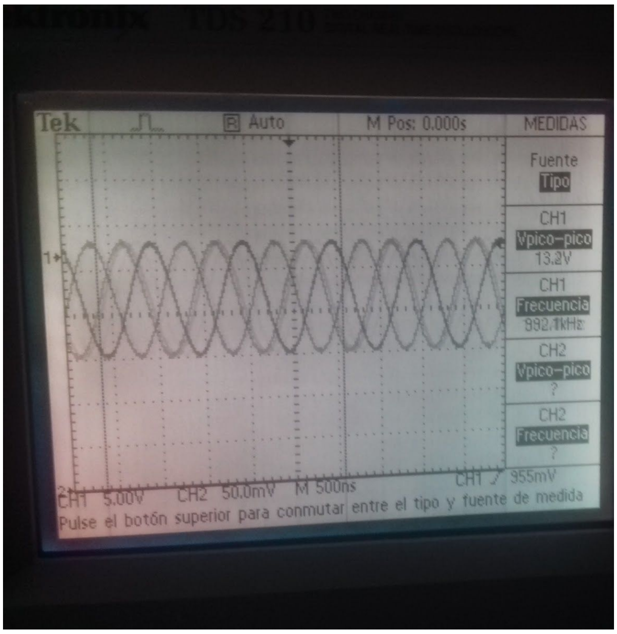
2. Generate a sinusoidal wave of 1 MHz and 10 Vpp of amplitude. Configure the oscilloscope so that each period takes up 2 divisions, and the wave has 4 divisions of height. Measure the frequency and the amplitude using oscilloscope cursors.



As set in the signal generator, the Vpp is equal to 10 V, and the frequency is 1 MHz.

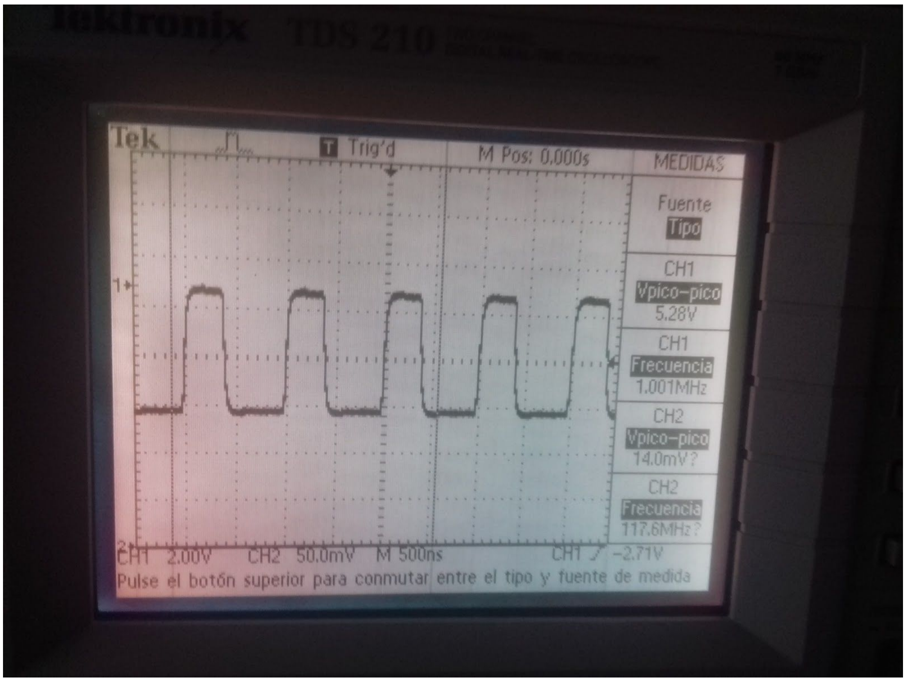
3. Add 5 V of direct current to the previous signal. Configure the oscilloscope's input changing alternately from direct current coupling to alternating current coupling, and explain the changes you observe.





The 5 V of DC are added by changing the offset of the signal generator. As the images show, the Vpp is increased when DC current is applied. Also the wave is pushed upwards and its offset changes while changing the coupling.

4. Generate a square wave of 1 MHz and 5 Vpp of amplitude. Modify the signal offset so that it is valid as input to a digital TTL circuit ('0' is 0 Volts, and '1' is 5 Volts)

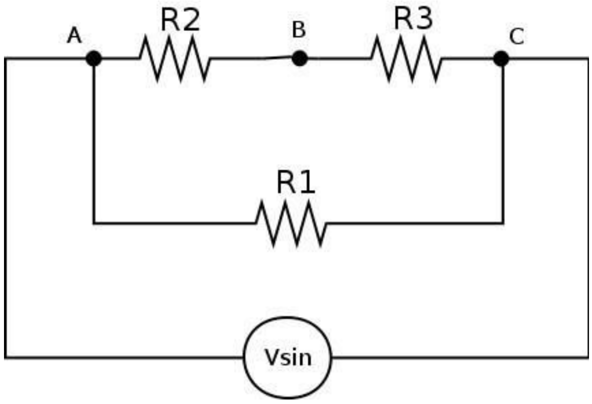


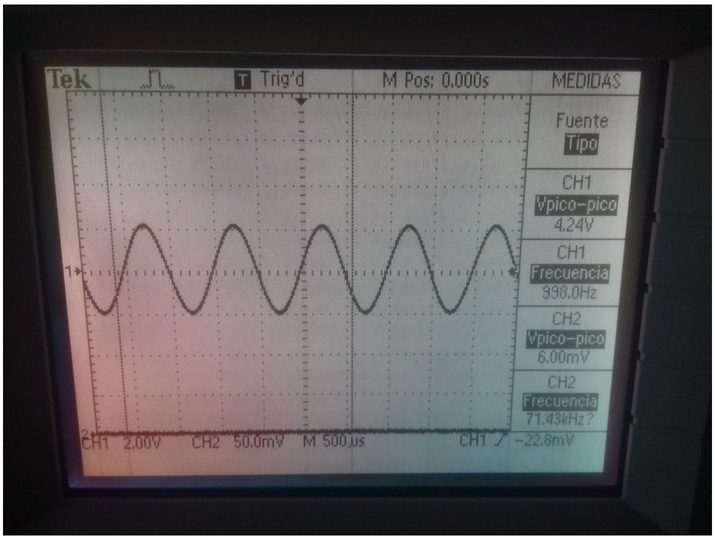
As the image shows, the Vpp is almost 5 V and the frequency is 1 MHz, by changing the offset in the signal generator we get that the logic ‘1’ is set when the wave is on 5 V.

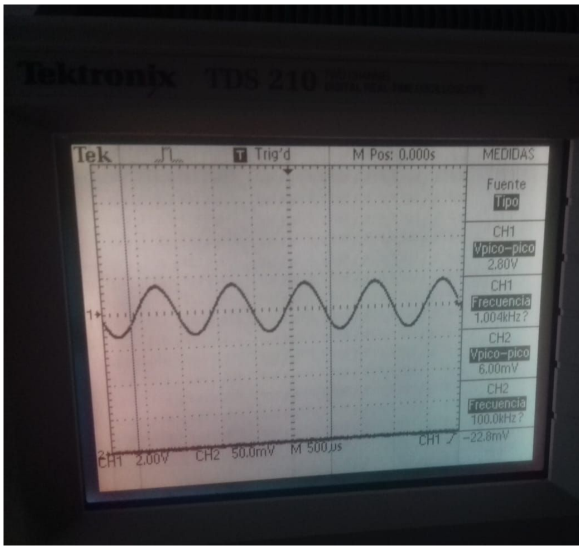
5. Modify the "duty cycle" of the previous signal so that it is 20%; that is, it is on '1' for 200 ns and on '0' for 800 ns.

Each square of the oscilloscope corresponds to 250 ns, therefore, as the wave is high (‘1’) for less than a square and low (‘0’) for a bit more than 3 squares, that means that is high for 200 ns and low for 800 ns (the duty cycle is at 20%).

6. In the following circuit, the generator Vsin is a sinusoidal signal of 1KHz and 5V peak to peak, and the resistors are the same from the previous task. Connect the oscilloscope probe (channel 1) between points A and B, display the signal and get the peak to peak value. Repeat the same steps between B and C. What is the variation of the peak to peak values between A and C, A and B and B and C? What does happen with the frequency? Provide the theoretical explanation of the results.







Peak to Peak value between A-B 4.24V
Peak to Peak value between B-C 2,8V
Peak to Peak value between A-C 4,48V

As we can observe, the peak to peak value is higher between A-C than A-B and B-C.

The frequency is always the same, 1.0 kHz as it only depends on the time and is not affected by resistance.

The peak to peak voltage depends on the input voltage and, following ohm's law, it also depends on resistance.
As it can be shown in the images, the value of the amplitude of the wave changes as we make the wave pass through the different resistors.

Following the RMS law: $RMS=Vpp/2\sqrt{2}$:

A-B: $1{,}5=Vpp/2\sqrt{2}$ ----> Vpp=4,24V
B-C: $0{,}99=Vpp/2\sqrt{2}$ ----> Vpp=2,8V
A-C : $1{,}58=Vpp/2\sqrt{2}$ -----> Vpp=4,48V