Laboratory 0: Exploring Instruments

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Lab instruments

In this experiments, you will be briefly exploring instruments such as Two channel Oscilloscope, DC three channel power supply, and Signal generator. Although we may not end up exploring all the functionalities of these instruments, we will go over some of the important ones. The Oscillscope user manual is uploaded in the dropbox and LMS. The signal generator manual and power supply manuals will be provided to you during the lab hours.

Submitting lab reports

Your lab reports needs to be submitted a week after the experiment is performed. Only for the first lab, you have an exception to submit by one more week. The lab report will include only plots/figures with proper legend, labels, symbols, and captions. You can either use LaTex or Word processor to complete the lab reports.

Inapprpriate figures with no labels, legends, symbol types will be outright rejected.

Oscilloscope

- Switch on the Oscilloscope and wait for some time for the instrument to boot.
- Do a functional check of the oscilloscope channel-1 using the BNC cable, provided to you. Your instructor will indicate the steps to do functional check of the Oscilloscope. If you are unable to this please raise hand and either instructor or the lab incharge will help you in this. You can check the Oscilloscope user guide document and do the functional check. Before measuring any signal in the Oscilloscope, you should follow this procedure. You should observe a gate voltage (square wave) of 3.12 Vp-p. Change the vertical position knob and vertical scale knob and get the output in readable form. Read the manual and find out how to measure Voltage peak to peak. Your instructor might ask you this question during the demo at the end of this lab.
- Repeat the same for channel-2. This Oscilloscope has two channels, which will help you to compare two signals at an instant.
- Make sure that you are now proficient in switching off/on channel-1 signal and channel-2 signal. Your instructor might ask you to show channel-1 signal and remove channel-2 signal, you should be able to demonstrate.

- Check whether you are able to do Vertical coarse and fine control from the vertical scale knob.
- Check whether you are able to do Horizontal coarse and fine control from the Horizontal scale knob. Measure the frequency. What is the minimum and maximum time/division scale achievable using our Oscilloscope ?
- What happens when you press the horizontal and vertical position knob instead of turning it around ?
- The BNC physical probe provides a switch to 10X. Switch on the button to 10X and measure the voltage. Switch it back to 1X option in the probe.
- Check whether the square signal measured is AC or DC coupled ? Your instructor will explain the meaning of AC and DC coupling of your signal. You can find the coupling type by pressing the Channel-1 menu button. On the right hand side, you should be able to see the Coupling type. Justify the difference. Make sure you capture the images of AC and DC coupled using any USB compliant device. For capturing the waveform, you will save the waveform in Comma separated value (CSV) format file and replot it using any of the softwares: MS-Excel, libreoffice, gnuplot your lab reports. Make sure that your lab reports are readable. You can press the STORAGE button and navigate for CSV option to save your image.
- Measure all the volatges, time, frequency using the menu buttons in the oscilloscopes. You should be able to find DISPLAY ALL option in the channel number selected.
- Use Cursor (pair of cursors) option on Time and Voltage domain to find the Time period and voltage level of the signal shown in Oscilloscope screen.
- For your lab report, capture the gate signal in CSV format and replot the data in readable graph. You may have to save the signal in CSV format in your USB drive. This should be your first plot in the lab report. Put a readable and understandable caption to this plot in the report.

Connecting signal generator to Oscilloscope

- Connect another BNC cable having aligator clips to the signal generator. Look at the signal generator and mention the number of sources/channels in your lab reports. Switch on the signal generator and be patient for sometime. Similar to your computer, these electronic instruments will take time to boot.
- Connect the aligator clips to the Oscilloscope probe. Your instructor will show the connection.
- Provide an input of triangle wave of 1 KHZ frequency with an amplitude of 4 Vp-p. Check the Signal generator manual for the specified amplitude and frequency. Check the waveform in your Oscilloscope. Adjust the time/div and volt/div scale and level to bring the waveform within your window.
- What is the minimum and maximum frequency range of this signal generator ? Frequency is the inverse of Time period of a periodic signal. Demonstrate this to your instructor before proceeding further.
- Measure the frequency differance in signal generator and Oscilloscope. What is the accuracy for the measured frequency from the Oscilloscope. Does it remain same for different signals and different frequencies ?
- Check the coupling type in the Oscilloscope.
- What does the sweep button do in the signal generator ? [HINT: Observe the time-period of the signal when you operate sweep with speed and width knob in the signal genertor.] Restore the sweep position.
- Apply the Offset in the signal generator. What does the offset button do in the signal generator ? Vary the amplitude level below the offset and observe the signal in the Oscilloscope.

- What does -20dB do in the signal generator ? If we press both the -20 dB buttons how much attenuated signal do we see ? Can you do the calculation and check out the error in readings in percentage ? Release both the -20 dB buttons.
- Save the image of triangle wave on to your USB slot in CSV format. Plot the triangle wave in your lab report.
- Change to Sine wave and check/capture the same in Oscillscope.

Connecting power supply to Oscilloscope

- We have three channel power supply. Check the voltage range of all three channel power supplies.
- Connect one of the banana plug to channel-B (middle one) of the power supply. Channel-B represents 4-6 V power supply. This means that we can modify the voltage from 4 to 6V. Set the voltage to 4 V by turning the knobs close to channel B. See a small button labelled as *B*. Press this button after the connections are done; this will allow your voltage to be applied to the input side of your circuit. In this lab, you will apply it to Oscilloscope instrument.
- You are providing a DC signal to the Oscilloscope and hence you should observe a striaght line shifted from the original X-axis in your Oscilloscope.
- Connect the other channel of Oscilloscope with the BNC probe and further connect the other side of the BNC probe to the signal generator and check the connections with your instructor.
- Now do some MATH operations such as A + B, A - B and A $\times$ B and save all the three signals (Channel-1, Channel-2 and MATH). Make sure that you save these MATH operative images in BMP format. Getting in CSV format is not possible in Oscilloscope MATH mode. Check the Oscilloscope manuals for navigating the MATH operations.
- Remember that there should be overall six plots in your first lab report.

Quiz questions for next week

The quiz for next week will be a team based quiz. Two students should complete one quiz. You will have 10 minutes to complete the quiz. Also you will have Oscilloscope, Signal generators, Power supply's infront of the table. You are free to operate the instruments to get the answers to the quiz questions. The quiz questions will include the actions performed on the instruments. Few more actions/navigations stated below will be included in the quiz. You are free to operate the instruments under the lab incharge/TA's supervision. The instrument manuals will provide further help in understanding the operations.

- What is GND coupling, DC and AC coupling in the Oscilloscope ?
- What is RMS, average and peak-to-peak volatge and where can you find this in Oscilloscope ?
- Where can you find the frequency of a signal in Oscilloscope ?
- What is BW limit and can you show a demo of BW limit by applying high frequency and low frequency signal ?