CO221: Digital Design

Lab 01 - Getting familiar with lab equipment

Goals and Objectives

The purpose of this lab is to familiarize you with most commonly used lab equipment such as signal generator, oscilloscope, power supply and analog multimeter.

Read the instructions and complete the exercises. Please refer to the how-to guidelines provided when using the equipment.

Signal Generator

Also known as the function generator, this equipment is used to generate different voltage signals, such as Sine, Pulse, Square, Ramp, etc. The most commonly required signals in electronic circuits are Sine and Pulse. Sine waves signals are used mostly in Analog circuits, such as amplifiers, filters, etc. Square signals are useful in testing the time response of circuits and also as Clock signals in digital circuits.

Exercise:

Generate following signals in the signal generator

1. Sine wave with 2.5 MHz frequency and 4.0 Vpp amplitude.
2. Square wave with 1.85 kHz frequency and 5.0 Vpp amplitude.
3. Sine wave with 100 ms period and 4.0 Vpp amplitude.

Oscilloscope

Oscilloscope is an instrument capable of displaying or measuring variety of signals. This equipment is used in almost all electronic circuit design and testing applications.

You will be using a dual channel oscilloscope in the lab. A dual channel oscilloscope has an ability to measure two input signals simultaneously. The two input connectors, CH1 and CH2 are used to connect the input signal to the oscilloscope.

Exercise:

1. Generate following signals using the signal generator.
    a. Sine wave of 1 kHz frequency and 4 Vpp amplitude.
    b. Square wave of 5 ms period and 2 Vpp amplitude.
2. Feed the output of the signal generator to CH1 input terminal of the oscilloscope.
3. Using the oscilloscope, measure and write down the following values.

Signal a	Signal b
Period: ……	Period: ……
Amplitude: ……...	Amplitude: ……...
Frequency: ……..	Frequency: ……..

Power Supply and Multimeter

Caution:

Before connecting the power supply to test circuit, switch off the output of the power supply, set the current setting of the power supply to minimum and then connect to the test circuits.

Never connect your circuit before getting it inspected by an Instructor.

You must have a rough idea about the current that will be drawn by the circuit. Once the circuit is inspected, current limit is set to minimum and voltage is set to correct value, switch on the circuit. At that time the current output should be clipped (folded down) because we set the current setting to minimum. Then slowly raise the current limit while observing the current drawn. Do not exceed the maximum possible current.

Never leave the probes connected to current input of the multimeter. When you use current input of the multimeter, remove the probes immediately and connect to voltage inputs. Because you may use it to measure voltages while the probes are connected to current input thus destroying the multimeter.

Exercise:

1. Connect the following circuit given in Figure 1. (R1=1k, R2=potentiometer, Vin = 5.0 v)
2. Using the multimeter, measure Vout for 3 values of R2.
   - i. R2: …… Vout: ……...
   - ii. R2: …… Vout: ……...
   - iii. R2: …… Vout: ……...
3. Now connect the multimeter such that it measures the current drawn by the power supply.
4. Measure the current (Iout) for 3 values of R2.
   - i. R2: …… Iout: ……...
   - ii. R2: …… Iout: ……...
   - iii.R2: …… Iout: ……...

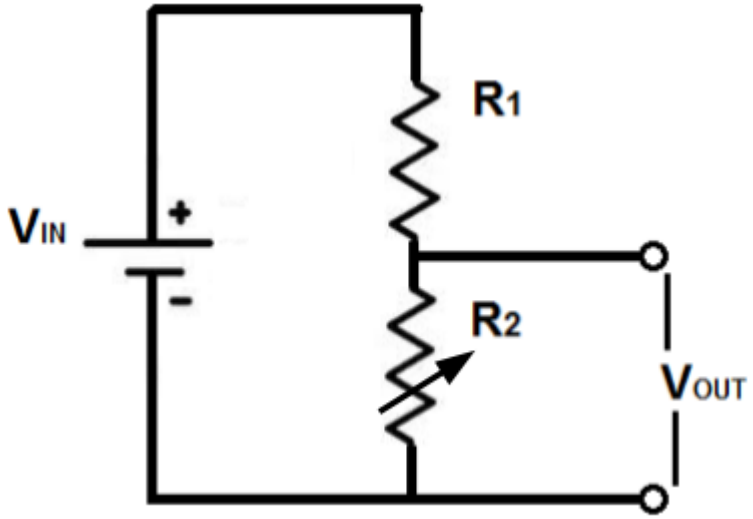
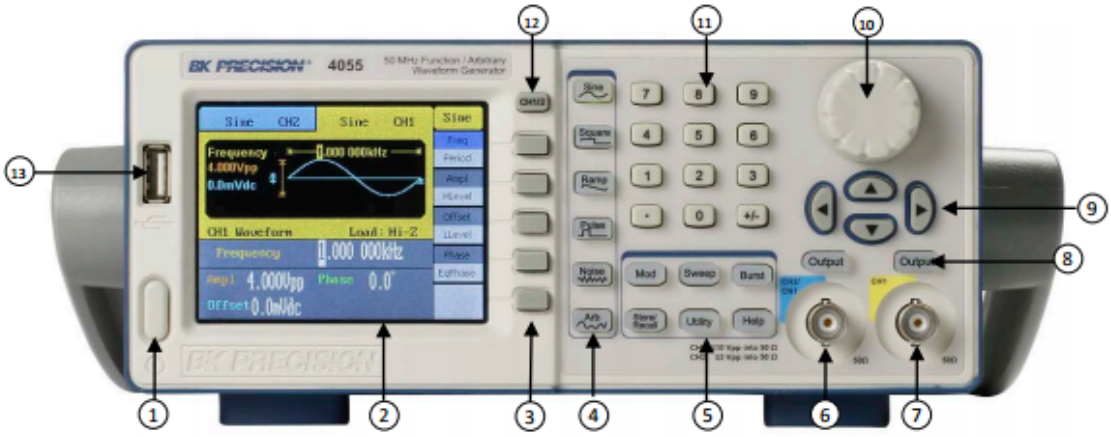


Figure 1

Signal Generator : How-To Guide

Controls:



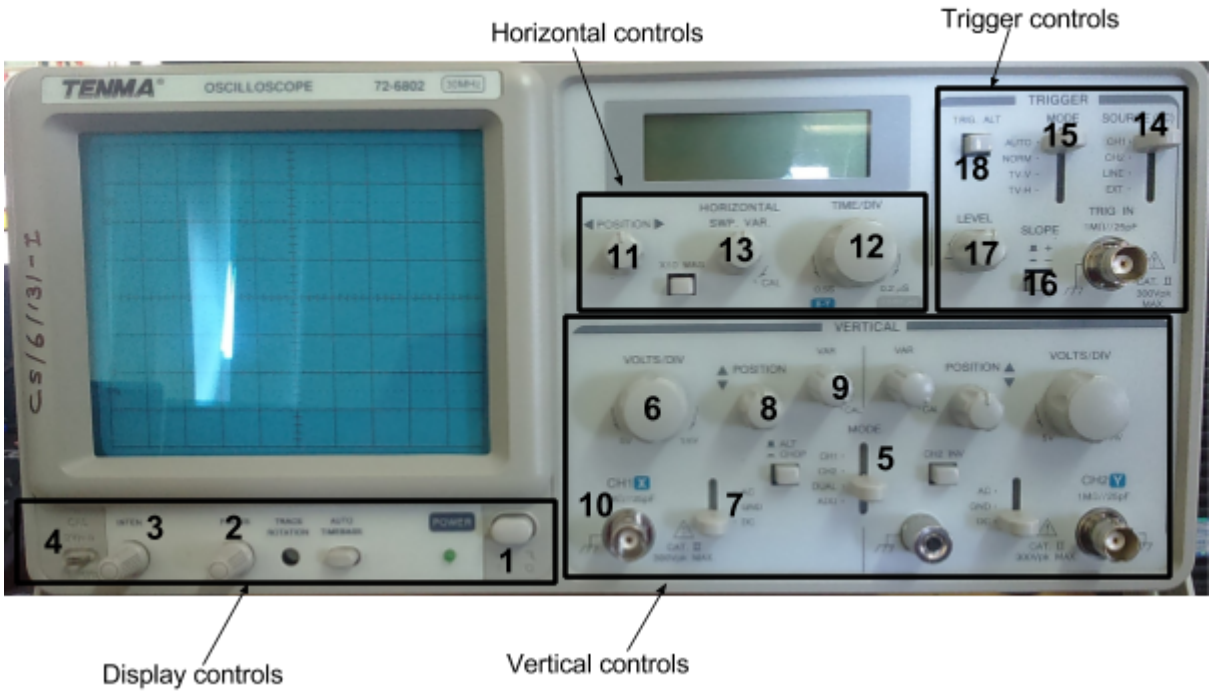
1. Power On/Off switch	8. Channel 1 and 2 output On/Off buttons
2. TFT LCD color display	9. Arrow keys
3. Menu function keys	10. Rotary dial knob
4. Waveform buttons	11. Numeric keypad
5. Modulation/Sweep/Burst/Store-Recall/Utility/Help menu buttons	12. Channel selection button
6. Channel 2 output BNC / Counter input	13. USB host port / *USB-to-GPIB adapter interface
7. Channel 1 output BNC	

How to use the Signal generator:

1. Switch on the signal generator.
2. Select CH1 as the output channel.
3. Use the waveform buttons (4) to select the waveform of the signal you want to generate.
4. To change properties of the signal, first select the property you want to change using the menu function keys (3).
5. Then use the dial knob (10) and arrow keys (9) to change the values. You can also use the numeric keypad (11) directly. If you use the keypad, make sure you select the unit properly using the menu function keys (3) again.
6. If you need to give the generated signal as an output, press channel output button (8).

Oscilloscope: How-To Guide

Controls:



a. Display controls

1. Power Switch - Turns on/off the oscilloscope.
2. Focus Knob - Controls sharpness of the waveform.
3. Intensity Knob - Controls the brightness of a light spot or trace in the display.
4. CAL Output - Generates the probe compensation signal.

b. Vertical controls

5. Vertical MODE switch - Selects which channel to be displayed.
6. VOLTS/DIV Knob - Controls the CH1/CH2 vertical scale from 1mV/DIV to 5V/DIV in 12 steps.
7. AC/GND/ DC Switch - Selects the coupling mode for the input signal.
8. Vertical POSITION Knob - Controls the vertical position of the waveform for CH1/CH2.
9. VAR Knob - Adjusts the vertical scale.
10. CH 1 (X) Input Terminal - Accepts input signal at CH1.

Similar set of controls are available for CH2 as well.

c. Horizontal controls

11. Horizontal POSITION Knob - Controls the horizontal position of the waveform.
12. TIME/DIV Knob - Controls the horizontal scale from 0.2 µs/div to 0.5 s/div in 20 steps.
13. SWP VAR Knob - Adjusts the horizontal scale.

d. Trigger controls

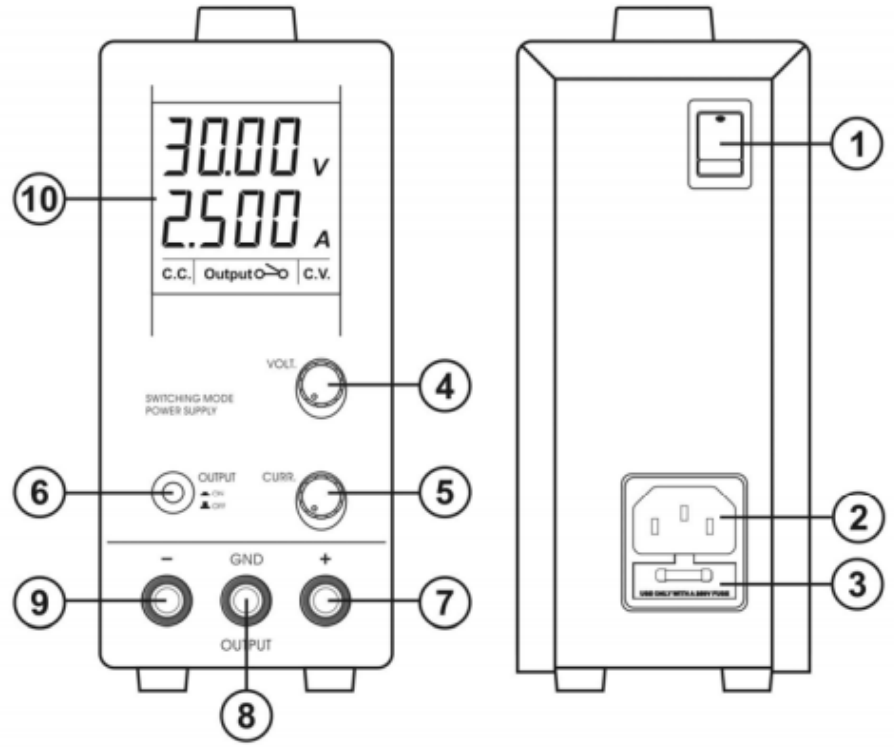
14. Trigger SOURCE Switch - Selects which channel (CH1/CH2) becomes the trigger source.
15. Trigger MODE Switch - Selects when the oscilloscope responds to the trigger conditions.
16. Trigger SLOPE Switch - Selects the triggering slope (Rising edge/falling edge).
17. Trigger LEVEL Knob - Changes the trigger level (starting position of the signal) vertically.
18. Trigger ALT Switch - Used to trigger signals from both CH1 and CH2.

How to use the oscilloscope:

1. Switch on the oscilloscope.
2. **Important!**
   - Make sure SWP VAR knob (13) and the two VAR knobs (9) are set at the rightmost point marked as CAL at all times.
   - All the buttons should be released (not pressed).
   - The AC/GND/DC switch (7) should be set at DC.
   - Check whether probe attenuation factors are 1x.
3. Connect the output from the signal generator to the oscilloscope through the input terminals of a channel (10). The proper mode should be selected using MODE switch (5).
4. Adjust the position of the trace using vertical and horizontal POSITION knobs (8)(11).
5. On the LCD display, the time and voltage values shown are the values of one large square (which is again divided into 5 smaller sections) on the scale of the main display. Use VOLTS/DIV Knob (6) and TIME/DIV Knob (12) to adjust those values accordingly.
6. Trigger controls can be used to stabilize the signal so that you can observe signal characteristics clearly. Set SOURCE Switch (14) to the channel you are using and set MODE Switch (15) at ‘Auto’. Using the SLOPE switch (16) and LEVEL knob (17), adjust the starting position of the signal as you wish.

Power Supply: How-To Guide

Controls:



1. Power	6. Activates supply output
2. Input power jack	7. Positive supply output (red)
3. Fuse holder	8. Ground terminal (green)
4. Output voltage adjustment	9. Negative supply output (black)
5. Current limit adjustment	10. LCD panel

How to use the power supply:

1. Switch on the power supply.
2. Adjust the voltage you want to supply using the VOLT. knob (4). To move between digits you can also press the VOLT. knob.
3. **Important!** - Using the CURR. knob (5), set the lowest possible value as the current drawn by the circuit.
4. Connect two probes in positive supply output (7) and negative supply output (9), and connect the other ends of the probes to the circuit as necessary.
5. Press Output supply button (6) to supply voltage to the circuit.
6. After connecting, if the circuit is drawing more than the set current limit, gradually increase the current until it is stable. Make sure that current does not exceed maximum possible current of the circuit.