

Lab Manual

CYSL – Embedded System Security Lab

Topic: Basic Introduction of Lab Equipment

Class: **BSCYS**

Semester: **IV**

Session: **Spring, 2022**

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Objectives

In this lab, you will learn:

- Basic components used in the lab.
- Their demonstration
- How to use them in projects/experiments

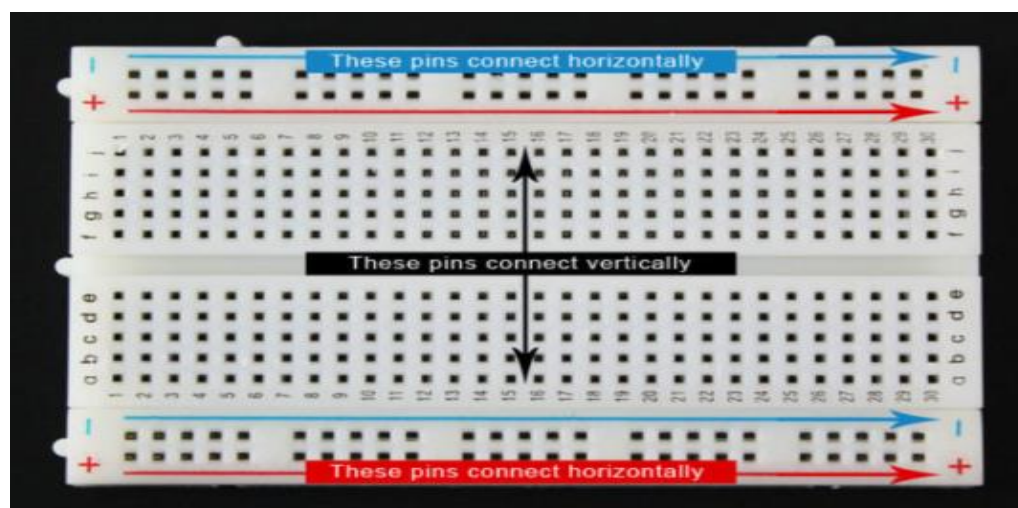
1. PURPOSE

Understanding of the basic lab equipment is indispensable before we start any of our project/experiment. Therefore, this lab briefly introduces them, their working scenario and finally how we will use them in our projects.

2. DESCRIPTION OF EQUIPMENT

Breadboard

Breadboards are an essential tool for prototyping and building temporary circuits. These boards contain holes for inserting wire and components. Because of their temporary nature, they allow you to create circuits without soldering. The holes in a breadboard are connected in rows both horizontally and vertically as shown below.



Digital Multimeter

As its name suggests a multimeter is a device that's used to measure (but not restricted to)

- Electric current (amps)
- AC/DC voltages (volts)
- Resistance (ohms)
- Continuity (whether a circuit is broken or not)

Depending on the model, values from capacitors, diodes, and transistors can also be measured. All multimeters come with a pair of test leads (i.e., probes), one black and one red. Black denotes the negative terminal (ground), while red denotes the positive terminal. To check the voltage difference between node A and node B, one should connect red probe to node A and black probe to node B.

Measurement of current using a multimeter might be a little tricky. The multimeter should be connected in series with the wire whose current will be observed while the circuit is powered.

DC Power Supply

The UTP3305 DC power supply in the lab is able to provide 2 independent variable voltages ranging from 0V to up to 32V and a fixed voltage supply of 5V. Each voltage output block consists of positive terminal (red) and a negative terminal (black). The voltage being supplied by the power supply is essentially the voltage of the positive terminal with respect to the negative terminal. To generate positive voltages, the negative terminal is shorted with the ground of the circuit and voltage is obtained from the positive terminal. To generate negative voltages, the positive terminal is shorted with the ground of the circuit and voltage is obtained from the negative terminal.

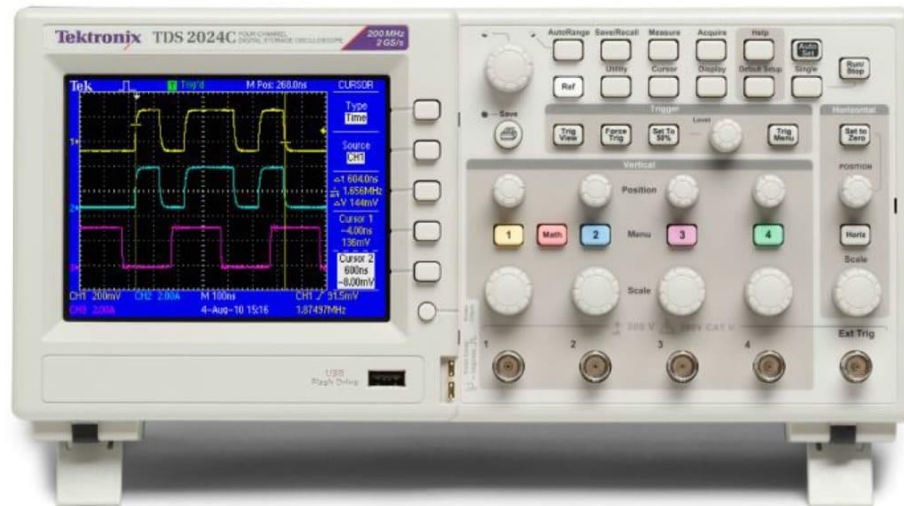




The Oscilloscope

An oscilloscope is a laboratory instrument commonly used to display and analyze the waveform of electronic signals. In effect, the device draws a graph of the instantaneous signal voltage as a function of time.

A typical oscilloscope can display alternating current (AC) or pulsating direct current (DC) waveforms with a frequency as low as approximately 1 Hertz (Hz) or as high as several Megahertz (MHz). High-end oscilloscopes can display signals with frequencies up to several Gigahertz (GHz). The display is broken up into so-called horizontal divisions and vertical divisions. Time is displayed from left to right on the horizontal scale. Instantaneous voltage appears on the vertical scale.



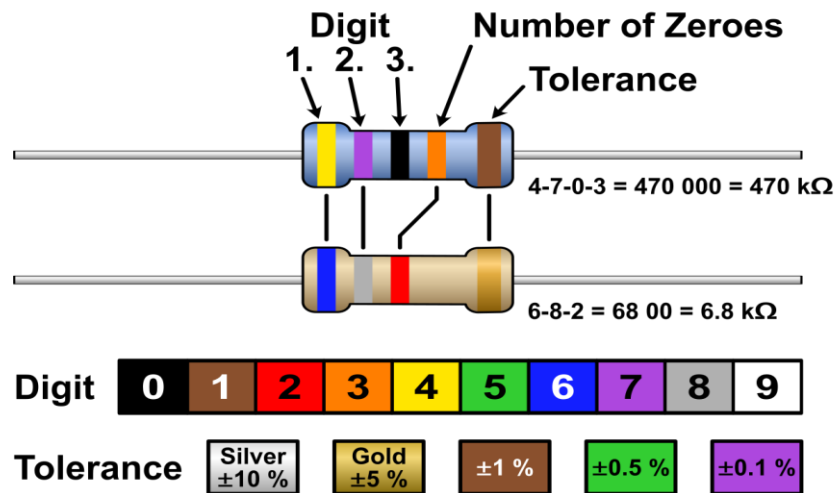
The Function Generator

A function generator is a device that can produce various patterns of voltage at a variety of frequencies and amplitudes. It is used to test the response of circuits to common input signals. The electrical leads from the device are attached to the ground and signal input terminals of the device under test.

Most function generators provide the **square wave**, **sine wave** and **triangle wave**.

Resistor

Resistors are used to resist the flow of current or to control the voltage in a circuit. The amount of resistance that a resistor offers is measured in Ohms. Resistors have colored stripes on the outside and this code will tell you its value of resistance. You can also use a multimeter to determine the value of a resistor.



Variable Resistor

A variable resistor is also known as a **potentiometer**. When you turn the shaft of a potentiometer the resistance changes in the circuit.



Light-Dependent Resistor (LDR)

A light-dependent resistor is also a variable resistor but is controlled by the light versus turning a knob. The resistance in the circuit changes with the intensity of the light. These are often found in exterior lights that automatically turn on at dusk and off at dawn.



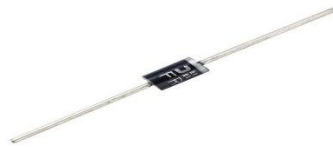
Capacitor

Capacitors store electricity and then discharges it back into the circuit when there is a drop in voltage. A capacitor is like a rechargeable battery and can be charged and then discharged. Capacitors blocks the DC current and allow the AC current to pass. The value is measured in F (Farad), nano Farad (nF) or pico Farad (pF) range.



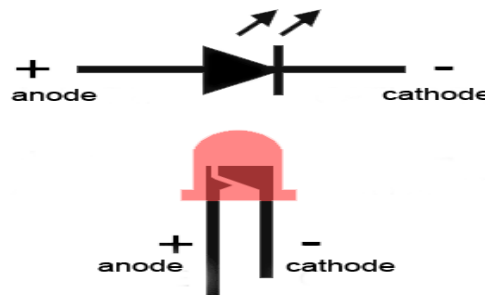
Diode

A diode allows electricity to flow in one direction and blocks it from flowing the opposite way. The diode's primary role is to route electricity from taking an unwanted path within the circuit.



Light-Emitting Diode (LED)

A light-emitting diode is like a standard diode in the fact that electrical current only flows in one direction. The main difference is an LED will emit light when electricity flows through it. Inside an LED there is an anode and cathode. Current always flows from the anode (+) to the cathode (-) and never in the opposite direction. The longer leg of the LED is the positive (anode) side.



Transistor

Transistor are tiny switches that turn a current on or off when triggered by an electric signal. In addition to being a switch, it can also be used to amplify electronic signals. A transistor is similar to a relay except with no moving parts.

