Experiment 2

Equipment and Instruments in the Lab

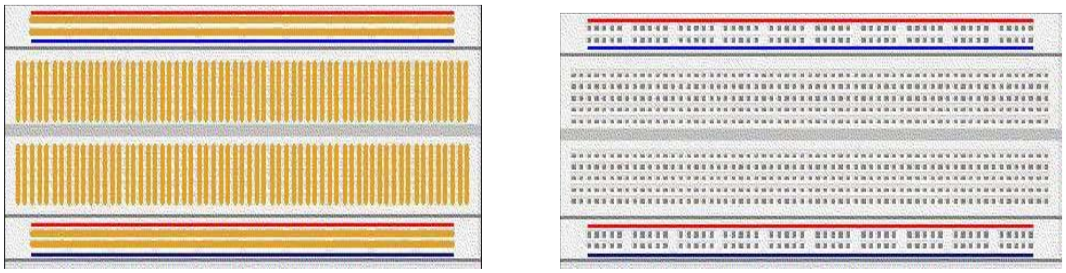
Objectives:

In this experiment you will learn the following:

- How to connect circuits using the bread-board.
- How to use the Tektronix PS 280 power supply.
- How to use the Agilent 33120A function generator.
- How to use the Fluke 45 digital multimeter.
- How to use the Tektronix TDS 220 oscillo-scope.

❶ Breadboard:

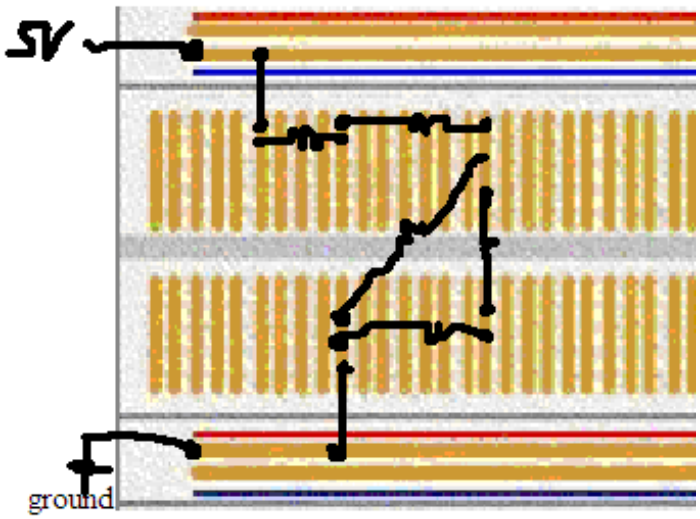
The breadboard is a plastic perforated board on which you will build your circuits. The breadboard has many strips of metal (usually copper), which run underneath the board. The metal strips are laid out as shown in the figure below:



- **The yellow lines show how the metals are connected.**
- **The metal strips connect the holes on the top of the board.**

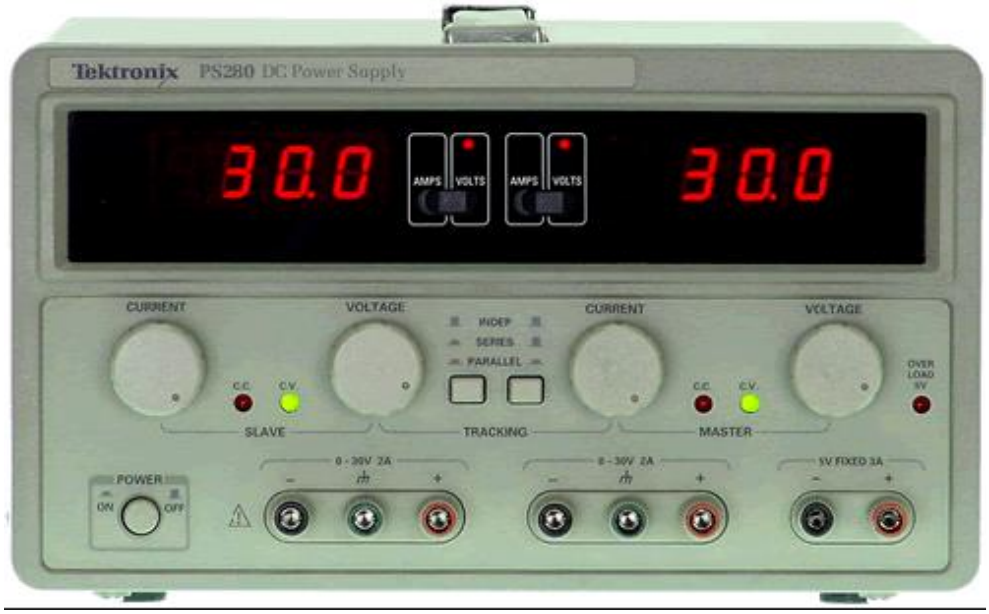
- **To use the breadboard, the legs of components are placed in the holes (the sockets). Each hole is connected to one of the metal strips running underneath the board.**
- **Each wire forms a *node*. A node is a point in a circuit where two components are connected. Connections between different components are formed by putting their legs in a common node. On the breadboard, a node is the row of holes that are connected by the strip of metal underneath.**

Note: The long top and bottom row of holes are usually used for power supply connections.



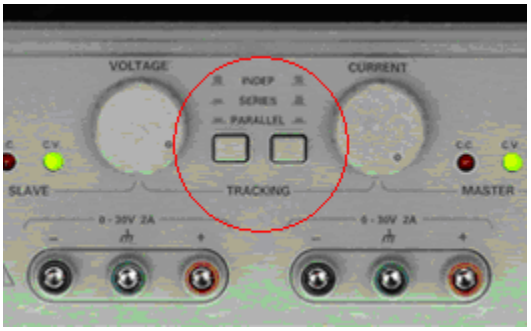
❷ Power Supply:

The Tektronix PS 280 power supply provides one fixed 5 Volt DC supply and two variable DC power supplies: a master output on the right hand side and a salve output on the left hand side. The voltages and the currents of the variable outputs are adjustable.



- **5V fixed: because all digital circuits and microprocessors operate at 5V.**
- **2 variable DC supply: (left-one: the Slave) and (right-one: the Master).**
- **CV: voltage control**
- **If the connection is in series then only the master is working.**
- **When using the variable supplies, you can adjust the voltage with the voltage knob and the current limit with the current knob for both supplies.**

Note: The variable power supplies can operate in three modes:
• Independent, when both push buttons in the middle are depressed.
• In series, when the left button is pressed and the right button is depressed.
• In parallel when both push buttons are pressed.



❸ Digital Multimeter (DMM):

The Fluke 45 DMM can measure AC and DC voltages and currents. Moreover, the DMM can measure resistance and diode voltage drop.

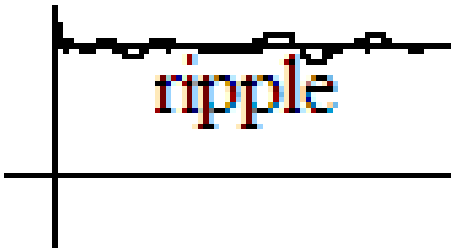
Note: **Current measurement is done *in series* whereas voltage measurement is done *in parallel*.**

V_{dc}: measure the DC voltage component. If we apply an AC signal it will measure the mean, average or the DC component of the signal.

Offset: DC component= mean =average.

V_{ac}: gives the RMS value of the peak for the alternative.

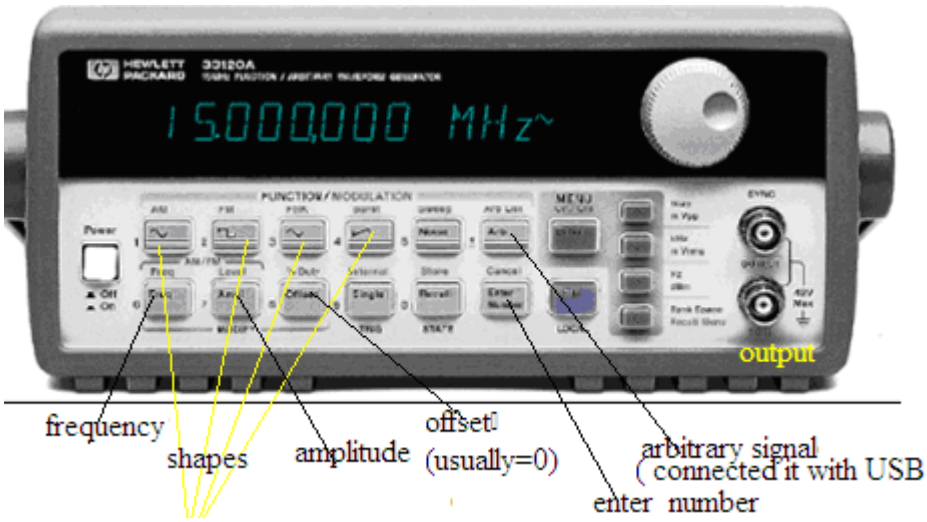
If we give it a DC value we get RMS value of the RMS (not ideally) and 0(ideally)



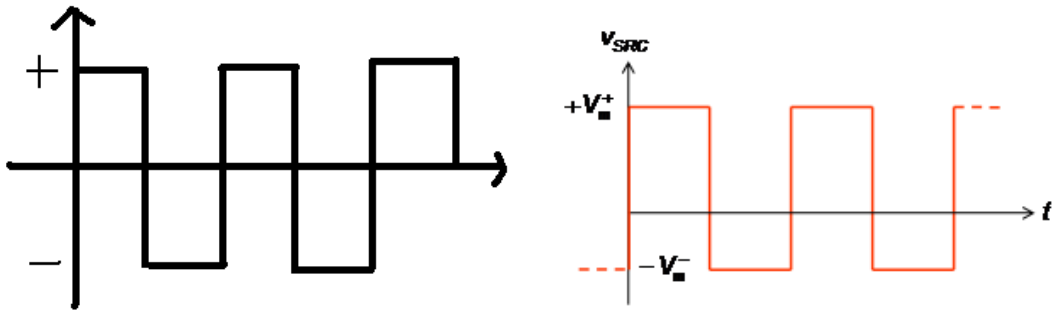
- $V_{(Peak\ to\ Peak)} = 2\sqrt{2}\ V_{rms}$

❹ Function Generator:

The function generator (HP Agilent 33120A) is a source of time-varying signals. It is capable of supplying three types of signals (square, triangle, and sine waves) with a variable frequency and a variable peak-to-peak voltage. It can also add to the signal a DC offset voltage, and can provide unequal duty cycles.



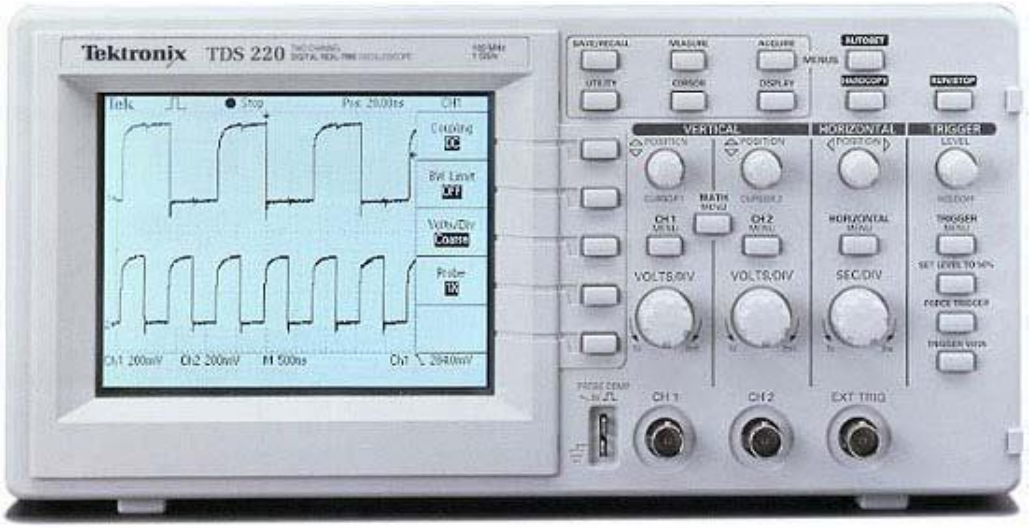
- **Duty cycle= % of time where the signal is high (when we vary the duty, we vary the average) (to control the speed of the motor, if increase duty cycle, speed motor increases)**
- **Duty cycle in a function generator only applies for a square wave.**
- **We usually consider a 50% duty cycle by default**



• Plug the output cable in the lower BNC connector labeled "OUTPUT".
• Select the desired signal type by pressing the appropriate key (sin, square, and triangle.)
• Adjust the frequency, amplitude, and DC offset by selecting the appropriate key; adjust the duty cycle by pressing shift then DC offset.
• Numeric values can be changed either using the rotating knob on the screen, (or use the arrows up-down / left-right for the cursor) or directly by pressing enter number and then enter (we enter # and unit)

❺ Oscilloscope:

The Tektronix TDS220 oscilloscope is the device that can display the signals in the time domain. It can also provide a number of measurements related to the signal you are trying to analyze.



coupling: DC,AC
DC= DC and AC+offset
AC= only AC, blocking
offset

• The scope is equipped with an auto set feature that will automatically set the scope for proper signal measurement.
• Pressing the channel menu will allow you to change the coupling (DC, AC, Ground) as well as the probe gain setting (1x, 10x, 100x, 1000x).
• Turning the VOLTS/DIV knob for each channel can change the y or voltage scale. The scale appears at the bottom of the screen.
• Turning the SEC/DIV knob will change the x or time scale for both channels. The time scale appears at the bottom of the screen.

- **The auto set of the oscilloscope regulated everything**

• The measure function will allow you to directly take a reading from the screen without the need to count the squares and to multiply by the scale.

The following measurement can be made:

- **Peak-to-peak**
- **RMS**
- **Frequency**
- **Period**
- **Mean.**

• The scope is equipped with an auto set feature that will automatically set the scope for proper signal measurement.