Theme 1:
BASICS CONCEPTS. USE OF THE EQUIPMENT.

- Introduction
- Basics concepts
- Connection between elements
- The wire
- The Breadboard
- The Power - supply source
- The Multimeter
- Resistors and capacitors colour coding

Introduction

- The aim of this document is to provide students with the basic information for the laboratory of fundamentals of computers technology
  - How to connect and power integrated circuits.
  - The Breadboard.
  - The Power Supply
  - The Multimeter.
  - The color coding of resistors.
- This is a quick guide that supports students in their first approach to the laboratory
- For more information see the annexes on the subject site where you can find manuals, power supply, multimeter, etc.

Basics Concepts

- **Continuous signals and variables:**
  - Continuous signal: It is said that a signal (voltage or current) is continuous when held constant over time
  - Variable signal: Takes different values over time**.**
- **Voltage supply**: Is the electric potential that acquires a charged body because of their electrical charge. This is associated with an electric field. We are interested in the potential difference between two points in a circuit.
  - Units: volts (V)
  - Ohm's Law
- **Electric current**: Quantity of electric charge that goes through a conductor section per unit time.
  - Units: Ampere (A) (Multiple)
- **Resistance**: Opposition to the passage of electric current.
  - Units: Ohm (Ω) (multiples))

Connecting elements

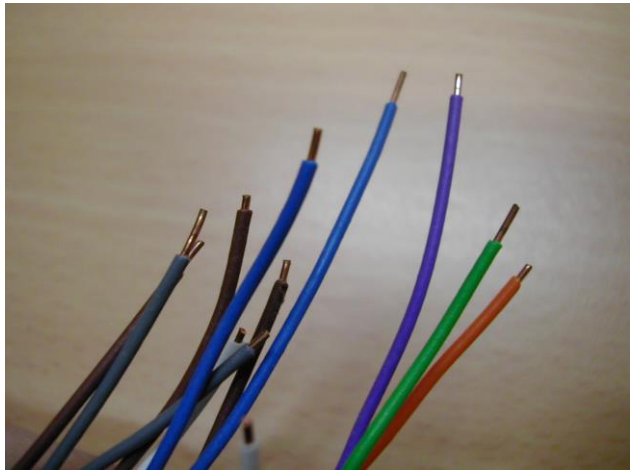
- We should ensure a reliable electrical contact through a metallic path between the elements.
  - To link the terminals we need cables and a breadboard.
- **Considerations:**
- We establish a reliable metalic path between the terminals avoiding other connections that may occur, for example, by touching the pin with two resistors nearby.
- **An output can never be connected directly to another output**.
  - The connection of two outputs may cause destruction of the circuits, while providing a wrong voltage value at that point.
- The outputs can be connected either directly to ground or Vcc because would damage the IC.

The Wire

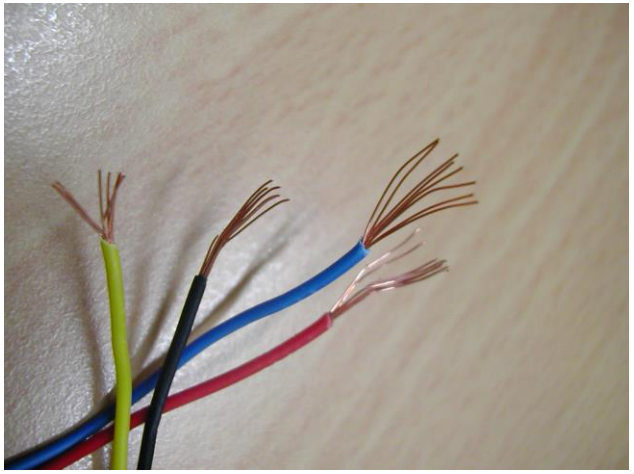
- **Solid wire** (no stranded wires) with the appropriate thickness

Figure 1: Example of wires:

- (a) suitable for use with breadboard (b) inadequate.



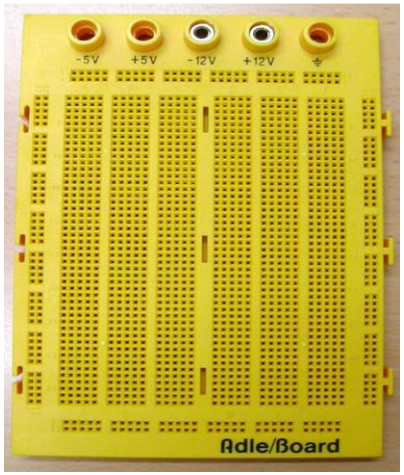
a)



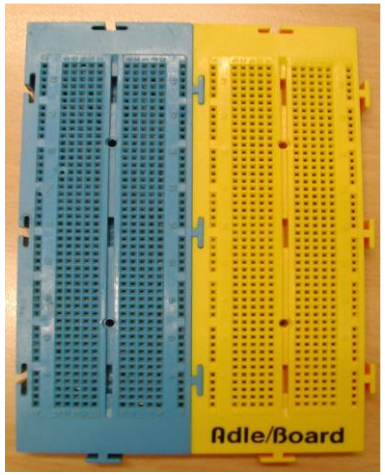
b)

The breadboard (I)

- The breadboard or protoboard is used to make up temporary circuits for testing
- It is the element that will be mounted on all integrated circuits, passive components and cables to make the right connections between them.
- Realization of prototypes. Simplicity of operation, ease of assembly, speed changes, etc.., But also unreliable.



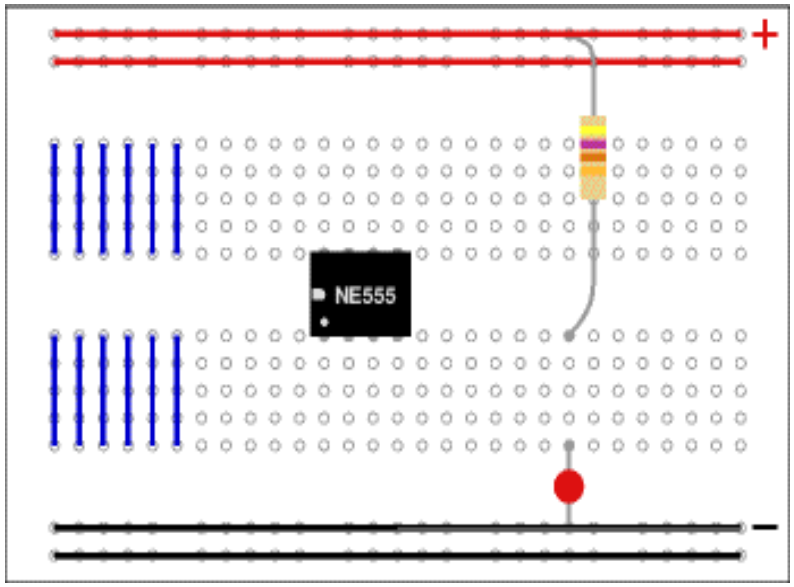
a)



b)

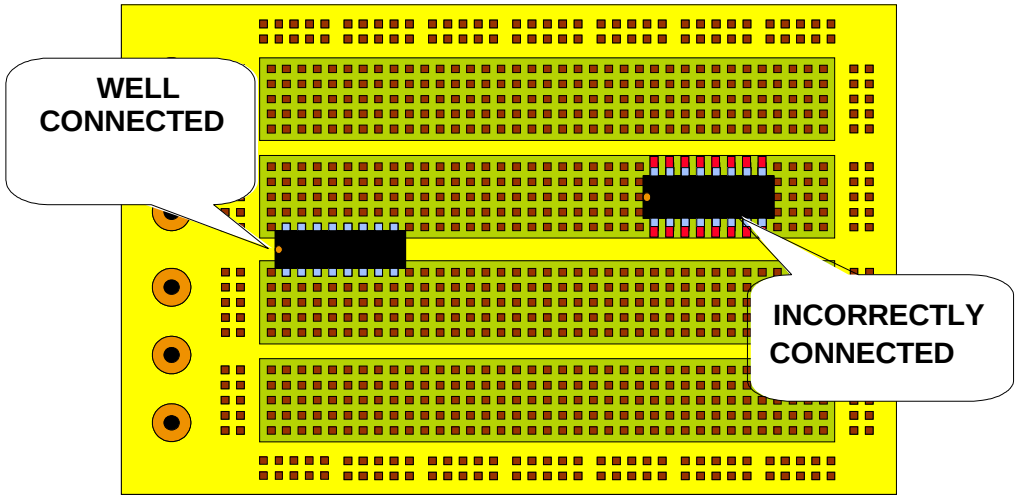
The breadboard (II)

- The distance between the holes is normalized so that the integrated circuits can click on any position of the breadboard.
- **The diagram shows how the breadboard holes are connected:**
- The top and bottom rows are linked horizontally all the way across as shown by the red and black lines on the diagram. The power supply is connected to these rows, + at the top and 0V (zero volts) at the bottom.
- The other holes are linked vertically in blocks of 5 with no link across the centre as shown by the blue lines on the diagram. Notice how there are separate blocks of connections to each pin of ICs.



The breadboard (III)

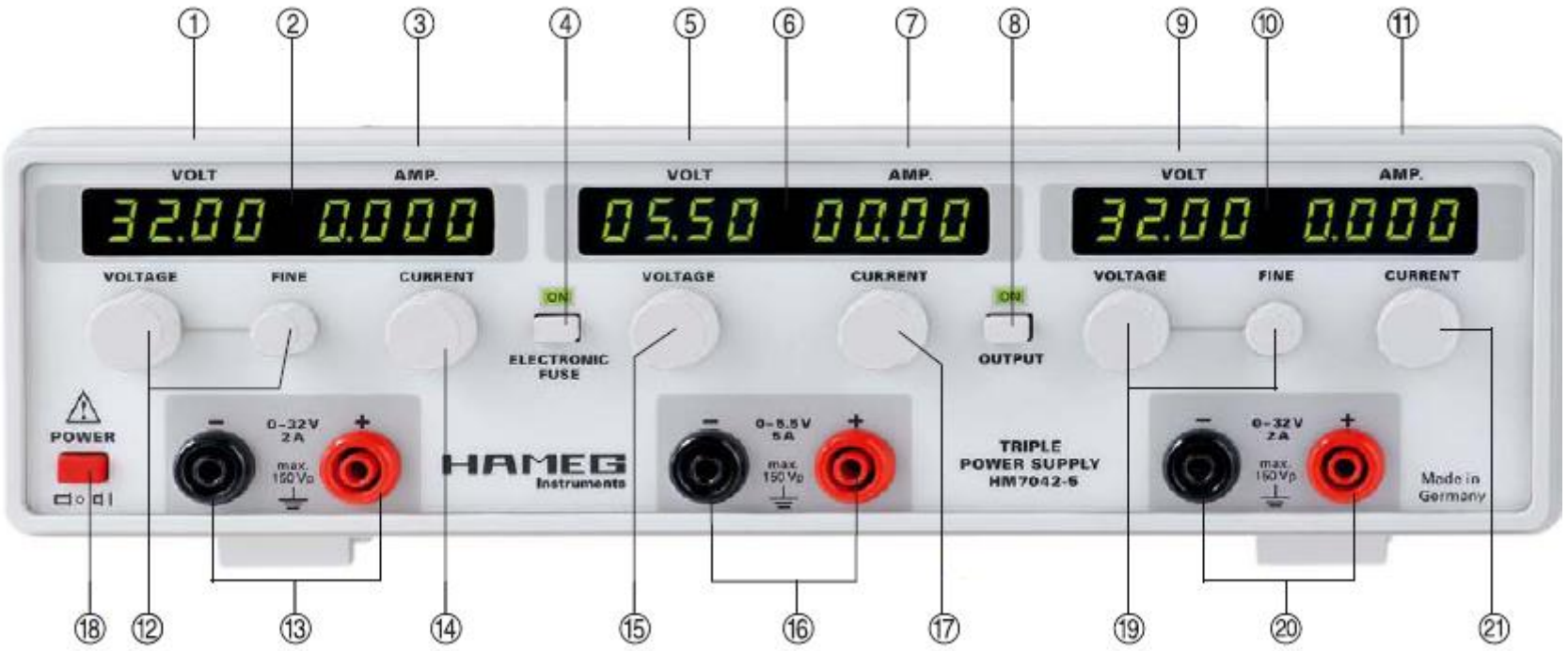
- The arrangement of the strips determines the components correct position.
- Integrated circuits must be put on the divisions between strips, otherwise the opposite pins would be connected, as shown Fig.



Power- supply source (I)

- Instrument capable of supplying a continuous signal (voltage or current).
- The laboratory has triple voltage source HM7402
- The maximum voltage ranges are available for separate configurations: 32v. V 5.5. And 32v.
- In current limitation is: 2 A. 5 A. and 2 A.
- Each of the sources can be controlled by adjusting their controls.
- Coarse and fine voltage
- The intensity controls indicate the current limit.

Power- supply source (II)



Power- supply source (III)

① ⑨ **VOLT**
4 digit displays (7 segment LEDs), of the actual values of all voltages, the resolution is 10 mV. The display are always operative, even when the outputs are disabled allowing presetting of all output voltages before the loads are connected to them. We recommend to follow always the procedure of setting the output voltages first and then turn the outputs on.

② ⑩ **LED**
These LEDs will light up if current limit is reached.

③ ⑪ **AMP.**
4 digit displays (7 segment LEDs) of the actual output currents, resolution 1 mA. We recommend to set the output current (I_{max}) before setting the output voltage and then turn on the outputs.

⑫ ⑲ **VOLTAGE/FINE**
Rotary controls for the coarse/fine adjustment of the 0 – 32 V outputs.

⑬ ⑳ **0 – 32V / 2A**
Outputs, 4 mm safety connectors

⑭ ㉑ **CURRENT**
Rotary controls for setting the maximum currents of the 0 – 32 V outputs. If a control is turned CCW to 0 A all outputs will be turned off immediately if the function "electronic fuse" was activated. In case "Current limit" was selected the LEDs Á É will light up, the voltage will drop to zero.

⑤ **VOLT**
3 digit displays (7 segment LEDs) of the actual output voltage, resolution 10 mV. This display will show the output voltage even if the output was switched off. We recommend to follow always the procedure of setting the output voltage first and then turn the output on.

⑥ **LED**
If the current limit I_{max} is reached this LED will light up.

⑦ **AMP.**
3 digit displays (7 segment LEDs) of actual output currents, resolution 10 mA. We recommend to set the output current I_{max} prior to turning on the output voltages.

⑮ **VOLTAGE**
Rotary control for setting the 0 – 5.5 V

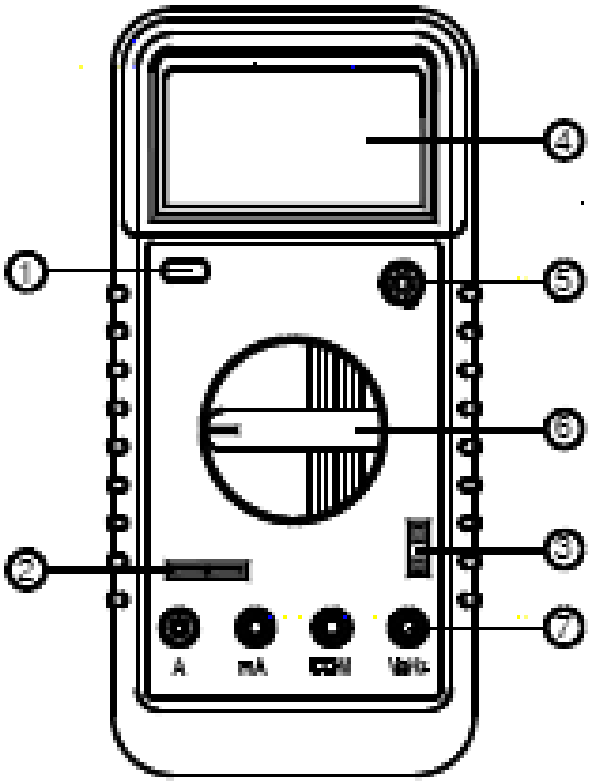
⑯ **0 – 5.5V / 5A**
Output, 4 mm safety connectors.

⑰ **CURRENT**
Rotary control for setting the maximum output current 0 – 5 A. If the control is turned CCW to 0 A all outpts will be turned

The Multimeter (I)

- Measuring instrument for different electrical quantities:
  - Voltage (DC and AC)
  - Current (DC and AC)
  - Resistance
  - capacitance
  - Diodes and transistors
  - Continuity Test
  - Temperature and frequency (some models)

The Multimeter (II)



1. POWER SWITCH
2. CAPACITOR MEASURING SOCKET
3. TEMPERATURE MEASURING SOCKET
4. LCD DISPLAY
5. TRANSISTOR TESTING SOCKET
6. ROTARY SWITCH
7. INPUT JACKS

The Multimeter (III)

- **Measurement voltage (voltmeter)**
- 1.Connect the two test leads one (black) wire to COM (common) and the other (red) wire to red v-Ω
- 2. Select or V = V ~ (DC or AC). In continuous, red indicates polarity +
- 3. Select the proper range. (if you know the order to choose the higher scale initially and then go down)

- Test leads are taken directly to the points where you want to measure the potential difference (in parallel).
- No need to interrupt the circuit

The Multimeter (IV)

- **Measure current (ammeter)**
- 1.Connect the two probes one (black) wire to COM (common) and the other (red) connector mA (maximum 200 mA) or Connector (20A peak)
- 2. Select A = or A ~ (DC or AC). In continuous, red indicates polarity +
- 3. Select the proper range. (If you know the order to choose the higher scale initially and then go down)

- **IMPORTANT:**
- **“Risk of damaging the instrument”**
- **We must break the circuit to insert the ammeter in series.**

The Multimeter (V)

- **Measuring resistance (ohmmeter)**
- 1.Connect the two probes in the COM (common) and v-Ω
- 2. Select the proper range. To obtain maximum resolution.

- **IMPORTANT:**
- **“Risk of damaging the instrument”**
- **Never measure resistance in circuit powered.**

Resistor color coding