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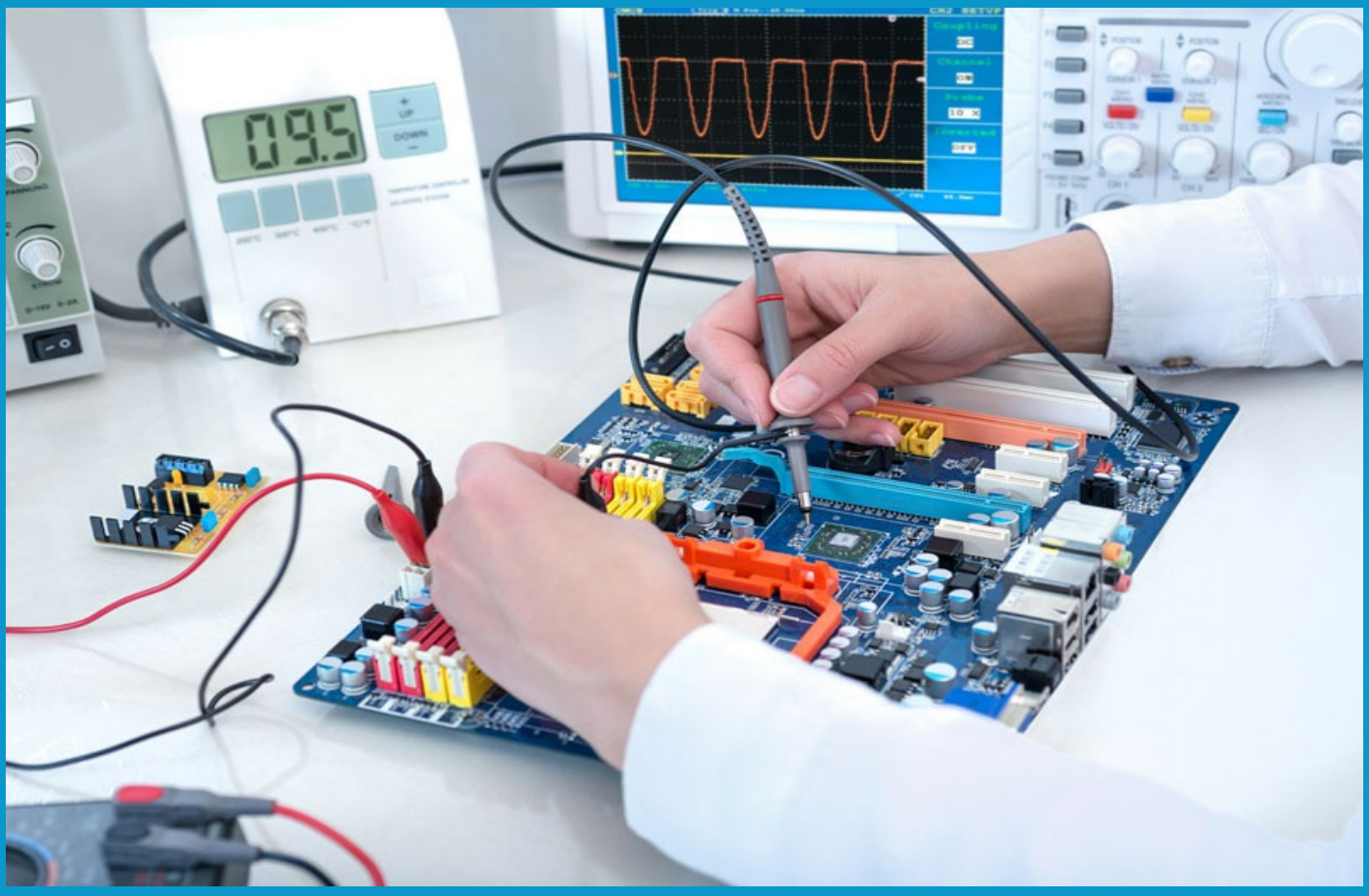
Electronics Course

Handbook Level I



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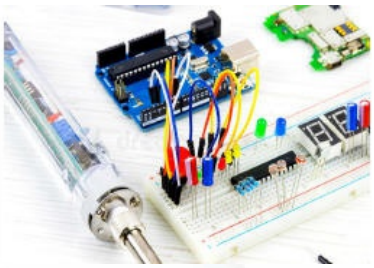
AUTOMATION and ELECTRONICS TECHNICIAN

Course: EEE0120

Electronics with Microcontrollers Programming



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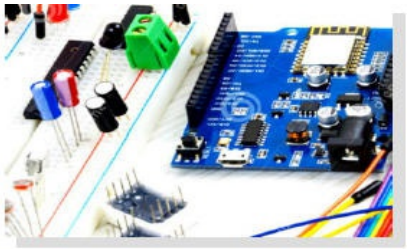
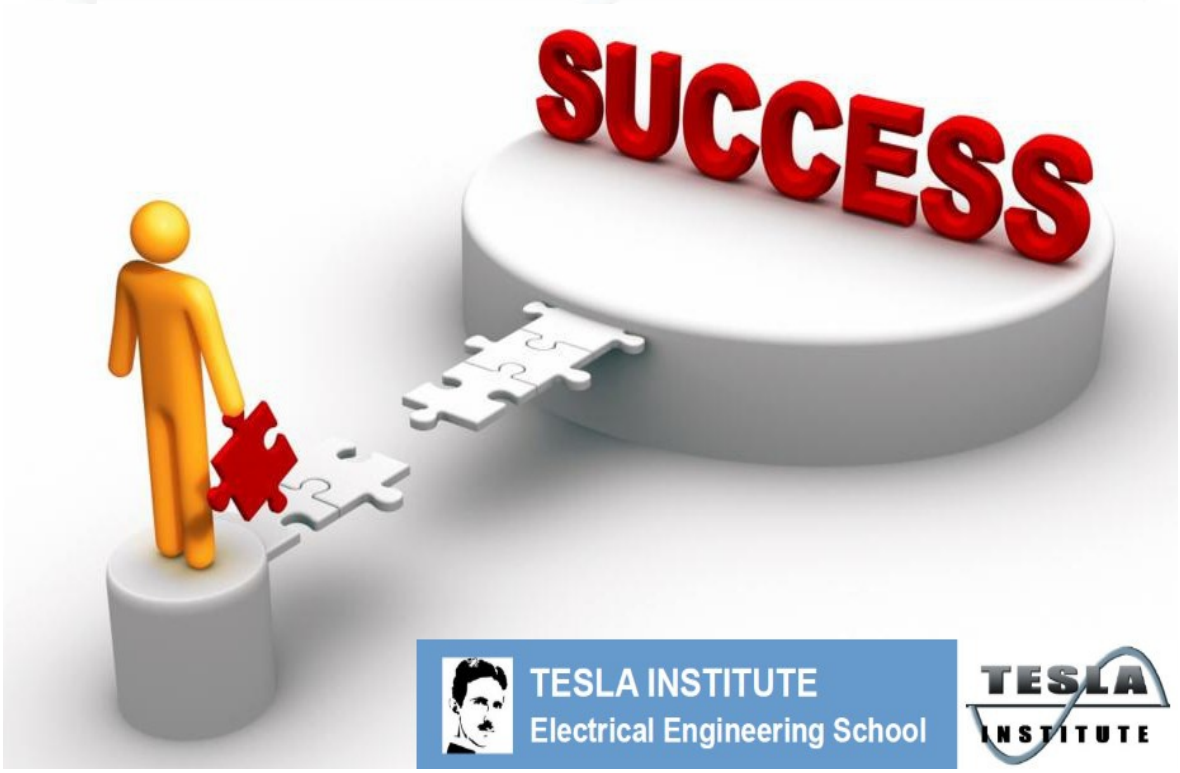


Course: EE02100

Introduction to Programmable Logic Controllers (PLC)



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Foreword

Electronics course from scratch is a series of guides, thanks to which thousands of people has already been convinced that electronics can be an engaging activity.
Get to know the world of resistors, transistors and diodes, **do practical exercise** and start building electronic devices yourself.

What is the basic course of electronics ?
This course was prepared by enthusiast and practitioner who wanted to infect other people's passion for electronics. There is no unnecessary theory and boring lectures - everything leads to contact with elements in practice, because only this is possible understand what's really going on.

The main goal of the course is to familiarize beginners with the basic ones elements and a gentle introduction into the world of electronics.

This course discusses **only the most important information** thanks to which you can later move freely on other electronic issues.
After completing the exercises in this course you can take care of the construction of practical projects, which have been described in continuation of this course or in our other corses discussing e.g. basics of Arduino or Raspberry Pi.

Other courses were also created, which are a **continuation of this education**. After getting to know the basics many people go to Electronic Course - Level II , Course Arduino , or Soldering Course, Raspberry Pi course.

Who is this course for ? Has anyone helped ?
The course was prepared for beginners. So far, they have used it it's already **pupils,**

students, hobbyists and even retirees. Thanks to this series Many people have started their adventure with electronics, even those that are completely they could not understand this issue before.

Will I be able to do the exercises ?

Yes, you can do it - there was not a person who could not cope with it this course. Remember that you can always ask teacher for help.

You will get help from the teacher of the course or another person who has already done it exercises from this course.

You do not need to be able to solder or read schematics.

Everything is left described in an accessible language. Each example is thoroughly discussed, and in If there are problems with performing the exercise, many illustrations will help pictures that show exactly the elements that they are part of sets.

Remember that **learning without exercises does not make sense** - electronics can not be recognized without self-testing the acquired knowledge in practice. This is not a simple, formal school where you have to listen to a lecture, stick to the material, pass tests and forget about it.

The idea of this course is to understand the problem in practice and remember it.

Part 1. Voltage, current, resistance, power supply

More and more people are beginning to treat electronics as an interesting activity additional or skill that will be useful in your future work.
Let's start with learning the basic concepts and principles that govern the world electronics.
It's time to finally understand what's going on. Let's start with learning about the most important concepts that will appear from now on everywhere. At this stage (at least in theory) you do not know any yet electronic components, so we will not be including this information yet for specific systems - this will be dealt with in the next part.

Do not try to connect or measure anything until the course appears specific exercise. You can accidentally damage components or the meter.

The most important quantities in electronics

Electronics is based on physics, therefore the rules in force are (on happiness) unambiguous, there is no room for guesses and your own theories. First, the fundamental skill is to understand the three basic concepts:

1. voltage,
2. electricity,
3. resistance (resistance).

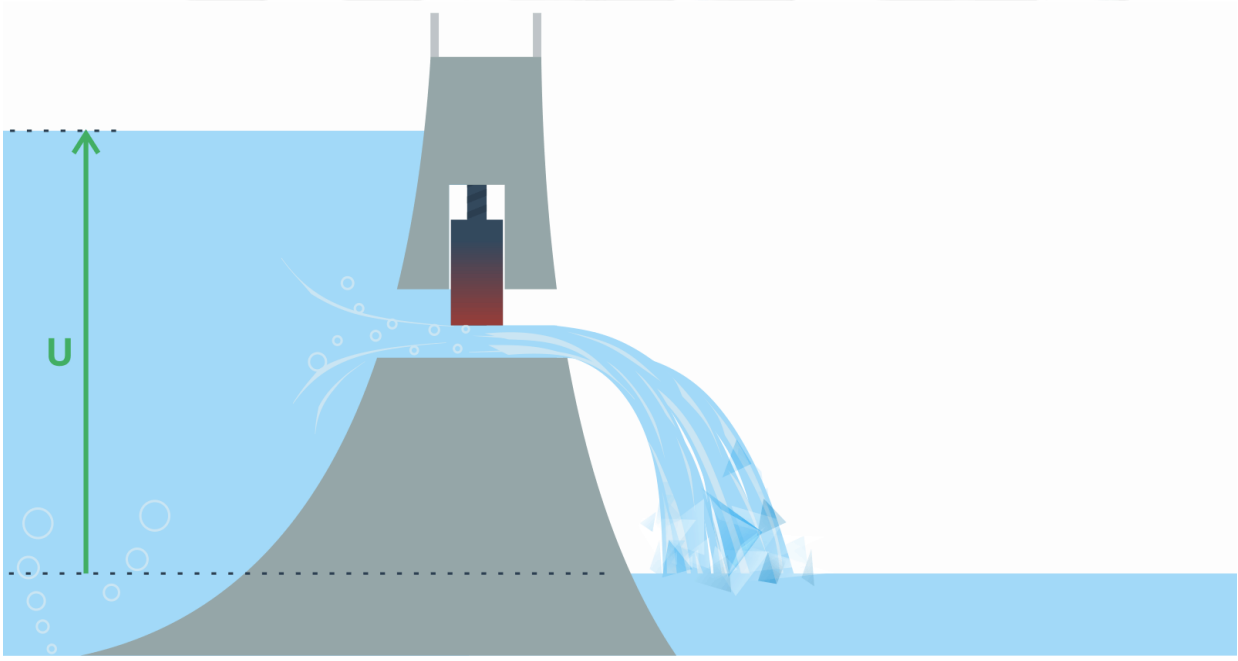
What is tension ?

Tension is a measure of the strength with which the electric charge carriers want to get to each other approach. This is a certain simplification, but it reflects the form of things. The bigger voltage, the greater this strength. If the voltage is zero, then this force does not no.

*The voltage is always **measured between two points**. As it is measured for example, the height of the mountains relative to the sea level. You must have two points and eat them compare.*

In electronics, we often use the **water analogy**. It means that for easier understanding of the world of electronics we compare everything to flowing water that is more "tangible". Thanks to this understanding some phenomena are easier.

The voltage can be compared to the water collected in front of the dam:



The height of the water in front of the dam can symbolize the voltage in the systems electronic

The water level (voltage) is measured between two contractual points. Just now you can see that the more water there is, the faster it will flow out through the lock in

dam (we'll come back to that later).

Constant and variable voltage

The voltage can be: **constant or variable**. In our case, we will be deal only with constant voltage, because it is used mainly during DIY, play with Arduino and Raspberry Pi. All batteries and batteries are just a source of constant voltage. The second type, alternating voltage, it has a more complex nature and **will not be described in more detail here.**

We advise against beginners to experiment with tension variable eg in the socket. A possible error may result in **loss of health or life** - it's not fun! Therefore, it's better to focus on the ones described here experiments that are completely safe.

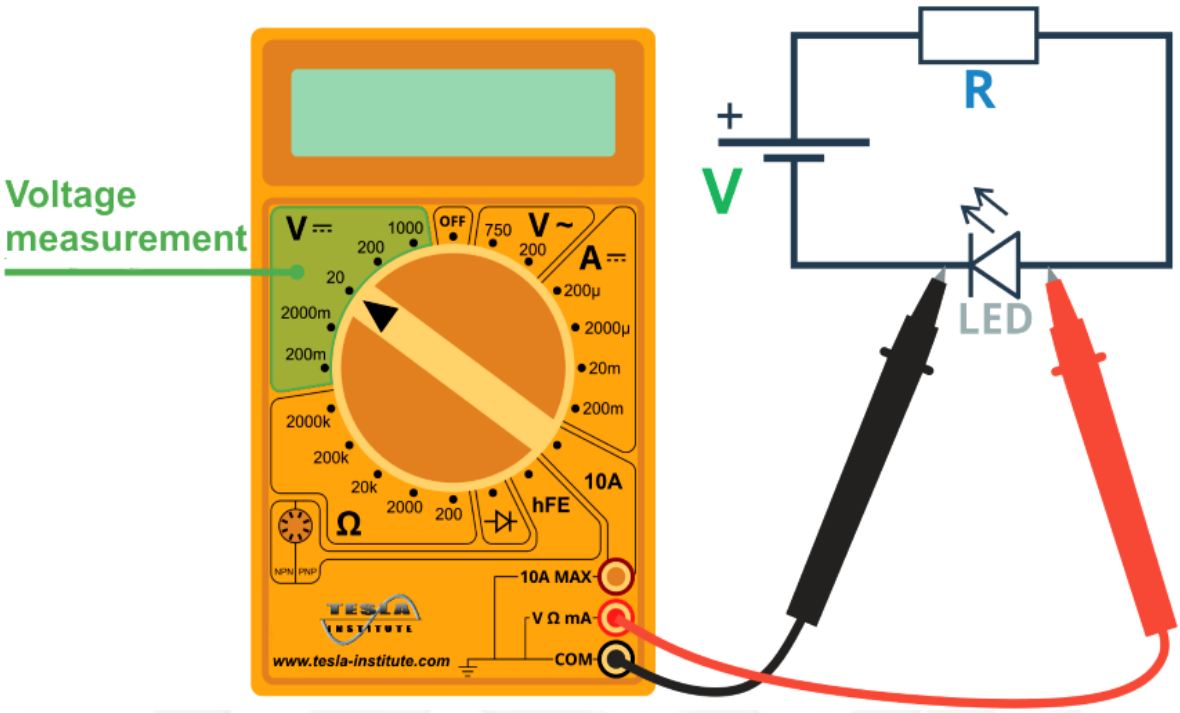
The unit of voltage is **volt** , which is marked with the letter **V.** The voltage can characterize the battery. The one we use in the course should be 9 volts, which is we read as "9 volts **that** ". In our experiments, we will work with safe for health with voltages ranging from 0 to 9V.

How to measure voltage ?

It's time for your first meter measurement. Let's check if the battery attached to the set has actually 9V. To do this, set the meter dial to measure voltage and select range 20V - it will be information for the meter that the maximum the measured voltage will not exceed 20V.

We should always carry out measurements on the smallest possible range - this ensures the best measurement precision. So, for example, we measure the 9V battery on the 20V range, but the power supply that would give 21V would already be measured at 200V range.

We **always** measure voltage **in parallel** ! So, for example, to measure voltage drop on the light diode should be connected as shown this is below.



An example of parallel connection of the meter and measurement of voltage drop at the diode

Do not worry if you do not understand this scheme yet. We'll be back to such measurements in the next article. **Now we want to measure only tension battery** , so we connect the meter in parallel to it. Remember to probe Measuring (because these are called colorful cables with sharp tips) plug in appropriate sockets:

- **black** wire to the COM socket,
- a **red** wire to the socket, which in the description has V.

Then place the two measuring tips on the battery. Red to plus, a black to minus. There is no difference if you touch the battery terminals from below, from top or side - **watch out only to avoid short circuits!** Sample measurement it is visible below:

Voltage measurement on a 9V battery using a universal meter

We hold the measuring probes for the plastic components of the housing. Do not touch metal tips. It could falsify the results, and for some measurements could result in loss of health or life by a person making a measurement (but we will not even try to get such large values here measure and you will not meet with them).

We read the **9.71V** value from the meter , i.e. we did not get **9V** , which we wrote is on the battery. Does it mean that it is damaged ? **No, everything is well!**

You have to get used to the fact that in the world of electronics there is a big difference between theoretical and actual values. Your results may be different. This is due to many reasons, but more on that later.

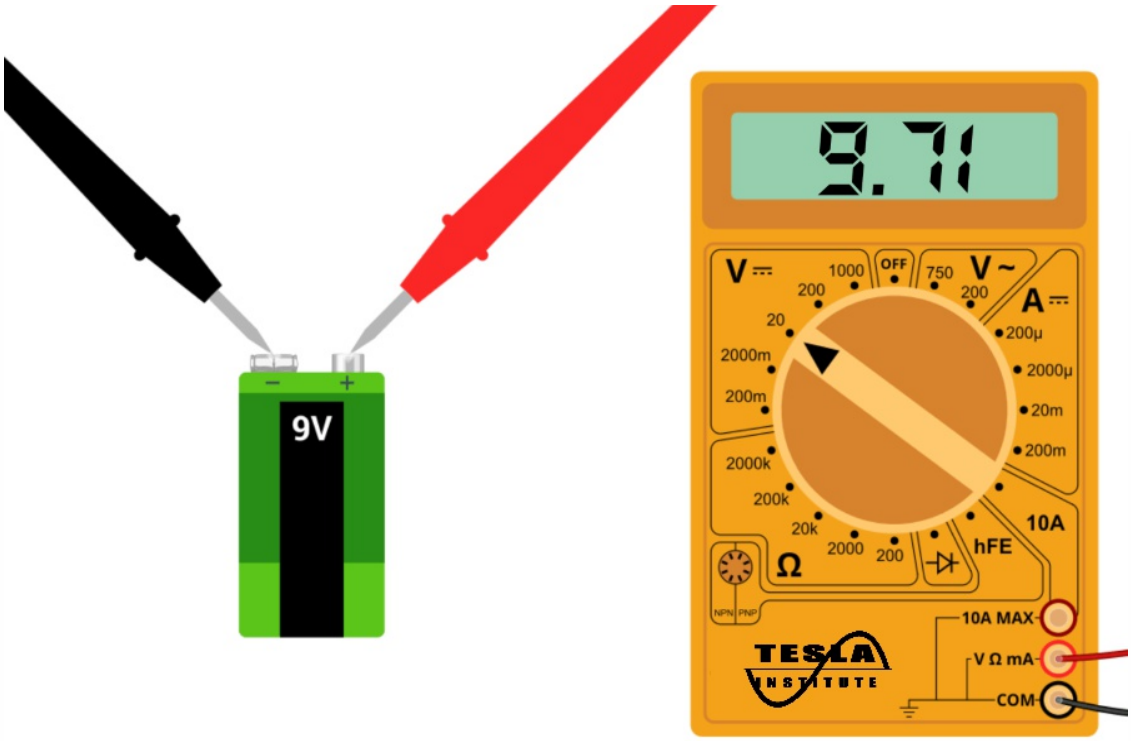
In any case, a new battery (probably for sure) will have more than 9V - from sometimes this value will drop (after doing different exercises).

Sometimes we will put photos in the course, and sometimes we will use them illustrations (as below). Immediately the answer to a frequent question: graphics were

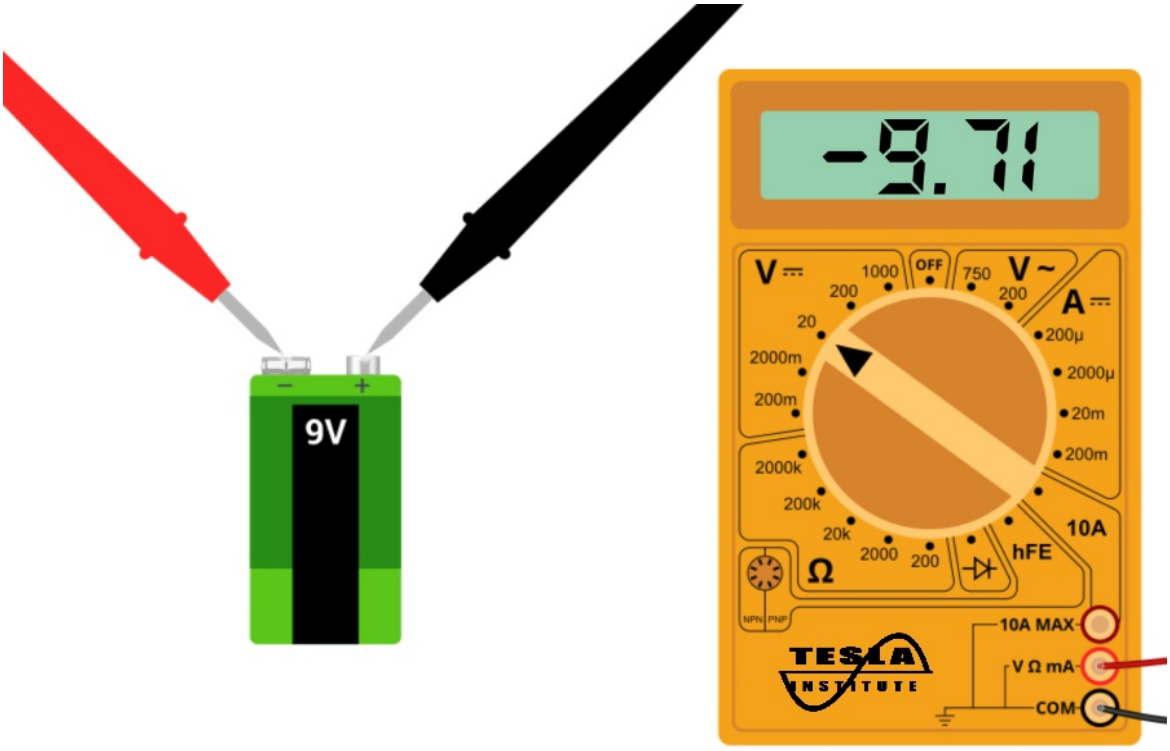
prepared with the partial help of a free program Fritzing.

however, most of the used libraries and non-standard additions have been made alone in Corelu. As a result, the elements shown in the graphs electronic devices are practically identical to the parts that are in our sets.

Let's check what happens if you measure the voltage with the red probe we will touch the minus of the battery, and the black plus - calmly, nothing will damage:



Battery measurement with "correct" probe connection



Battery measurement with reverse probe connection

As you can see, the minus sign appears on the display. This is for us signal that the probes have been connected to the battery vice versa, but this is not harmful (neither for batteries nor for the meter). Now, for the test, measure the battery when the meter is **set to the range up to 200V**.

Measurements on a larger range will never damage the meter, however they do affect negatively on the precision of this particular measurement.