Amateur Electronics Laboratory

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Introduction

In the world of electronics and electricity, the ability to make and test ideas and concepts is mandatory. This is one reason why a place capable of realizing those, makes the life of an engineer or hobbyist much easier. Thus, an electronic laboratory is the most important “tool” a maker, inventor can own. An idea can be realized physically, only at the quality and the precision of the tools that make it, and the experience of the inventor. Designing and simulating a circuit in a variety of the cases isn’t enough, due to a couple of factors as: the nonideality of the real electronic components that don’t exactly follow the lumped model, the thermal parameters that might differ according to the exterior medium, the simulation doesn’t always include the limitations of the real components, etc. The main goal of creating circuits is to serve a purpose in a real-life system or to solve a problem, that’s why testing and experimenting is recommended and necessary. In an electronic laboratory this can be achieved.

. Due to external reasons I had to move the laboratory to a different location and that’s why the pictures might differ.

Essential Elements

Any decent electronic laboratory should include equipment to design, test, and build electronic circuits. Thus, there is some equipment that is necessary, in order to achieve those qualities. The equipment can be classified according to some basic criteria: testing, making.

The testing tools should provide power, signals or other parameters and should provide a way to measure and graph parameters of the tested circuit. To provide power a test bench power supply is the ideal way to go, but in special cases other voltage or current sources can be used. To provide a clock signal for a digital circuit or an input sinewave signal for an analogic circuit, the ideal equipment to be used is a signal generator, also modules or special circuits can be used if needed. To measure voltages, currents, resistances, and others a multimeter is used. To visualize any signal or analyze a spectrum, an oscilloscope is the only tool that must be used.

For a proper measurement setup, the components of the circuit must be placed in such a way that they won’t disconnect during testing or operation. For the first set of measurements a breadboard setup is the easiest way to go. After all the essential tests, a circuit can be brought to the next level by making a perfboard or a PCB (printed circuit board). Tools as a soldering station or a reflow station can be used to mount the components on the boards. Any kind of circuit board improves the noise and parasitic characteristics.

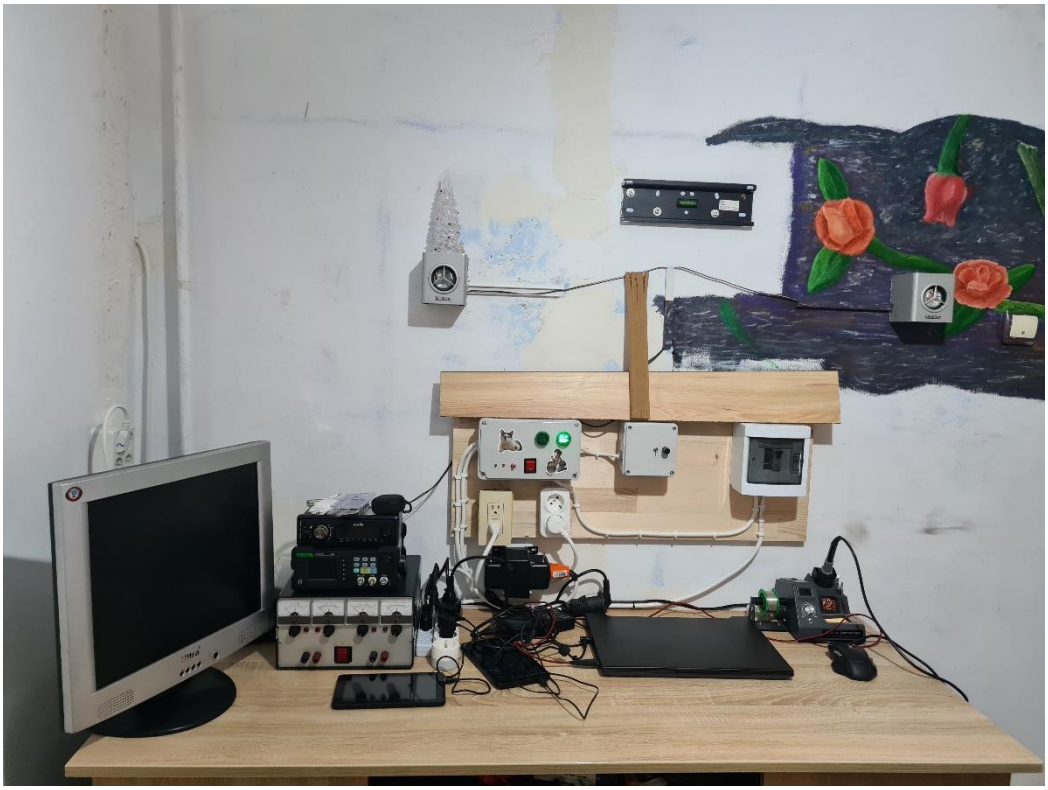
Role of the Laboratory

The laboratory that I've made is a simple implementation of a proper (way too expensive) electronic laboratory. The role of the laboratory is to help beginners and advanced people in electronics to build and test their ideas. It uses rather unexpensive equipment and tools that work just good enough for the kind of circuits that are going to be made there. It was made for strictly educational purposes, and the usage of it is in the science and engineering fields.

This laboratory doesn't compete with any other university or private company laboratories, simply because of the budget that they own, and their ability to always upgrade them. This very lab is made to help myself and other people to develop their ideas.

The Structure of the Laboratory (Last Version)

It is structured into several sections that are intended to work one with each other, but also work somehow independently. Every section has its own advantages and disadvantages, that I'm going to describe in their description.



The Main Panel

The main panel is made of the principal building blocks of the whole laboratory. The board is a “Polita lemn rasinoase, calitatea B, 800 x 300 x 18 mm” without any oil applied because the only use of it will be indoor. On it almost all the other blocks are placed.

It can be divided into 2 main blocks, based on the operating voltage of the equipment. Part of them was bought in the United States of the America, and they work on the American mains voltage that has a value of 120V rms, that being very different from the European (Romanian) mains voltage of 230V rms. Most of the tools came with a linear power supply inside them, so simply hooking them to an outlet by an adapter was not possible. The solution that I came up with was to convert the mains 230V to 120V by using a powerful stepdown transformer. So, the panel is divided into the section that deals with the “regular” 230V directly from the mains and the section that controls the 120V circuits and all the consumers.

230V Circuits

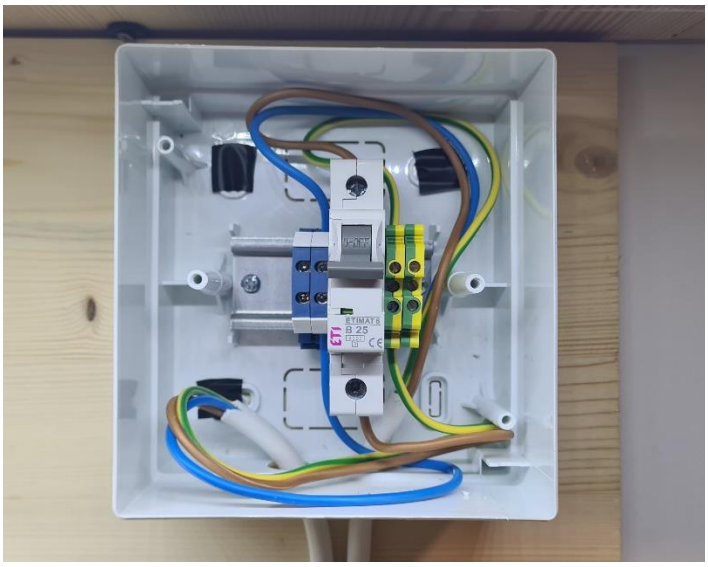
This main section mostly consists of the electrical infrastructure where all the equipment that works on the mains can be plugged in. This electrical system was built by respecting the Romanian code regarding electrical infrastructures, the “I9-2011”. The cross-section area of the conductors used for the circuits that consist in outlets and the main circuit breakers is 2.5mm2, a 3 conductor wire was used. And for the light circuits, a cable made from 3 conductors with their cross-section area of 1.5mm2. There are used not only stranded wires but also solid ones, the main reason for using both was their ease of use. For the sockets the wire that fitted the best was the solid one, because it fits the best in the sockets screw terminals, and it can stay in place. On the other hand, for the connections in the electrical panel and the connection between the electrical panel and the other junction boxes, the stranded wire worked the best because of its flexibility.

Only one double socket is always connected to the main board and the power for the other equipment is delivered through a high-quality extension cord, “Prelungitor schuko 16A 5P 5M IP20 3X1,5Mm Legrand”.

The electrical protection

This consists in the usage of an automatic circuit breaker, curve B with the nominal current of 25A, this makes sure to protect the consumers against short circuit or overcurrent. To ensure protection of the user, unfortunately, it must rely on the differential protection of the electrical installation that's plugged in.

Improvements: addition of a differential protection with or without overcurrent protection (RCCB or RCBO).



The light system

It consists of a source of light and a circuit that drives that source of light. The light can dim, but also just be turned on or off for different brightness. The circuit is connected directly to the mains and can be disconnected by a switch placed on the phase wire.