Electronic Circuits I – Laboratory 01

Introducing ELoTrain System by LN

#	Student ID	Student Name	Grade (10)	Instructor signature
1				
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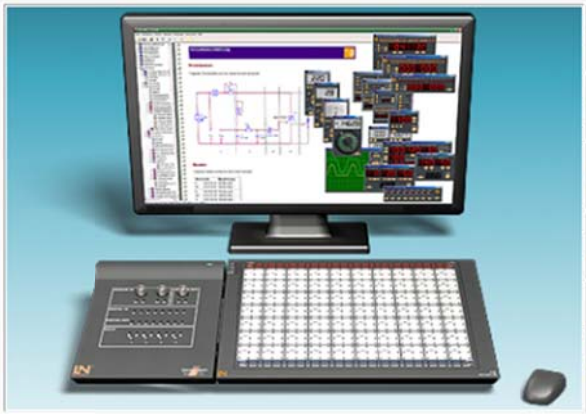
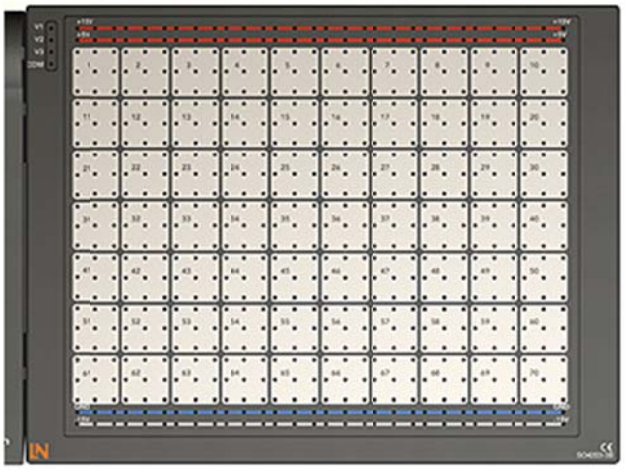
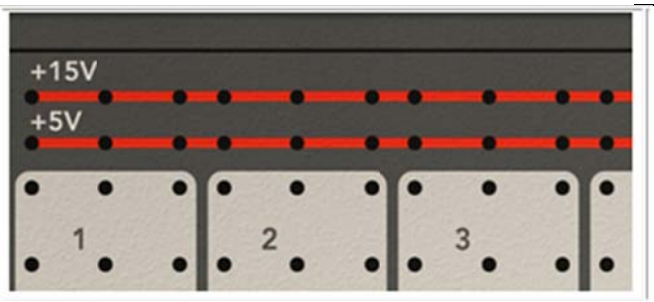
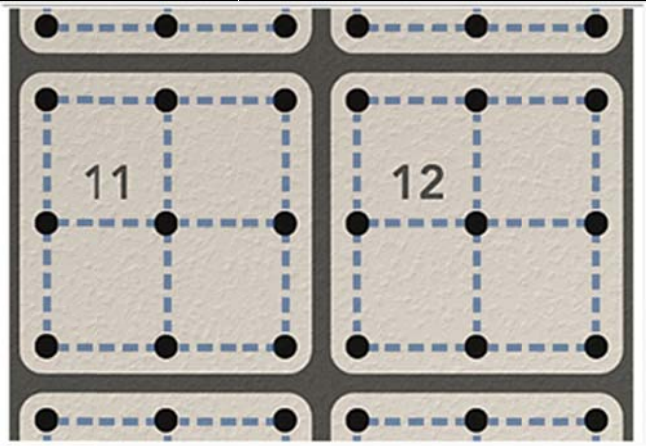
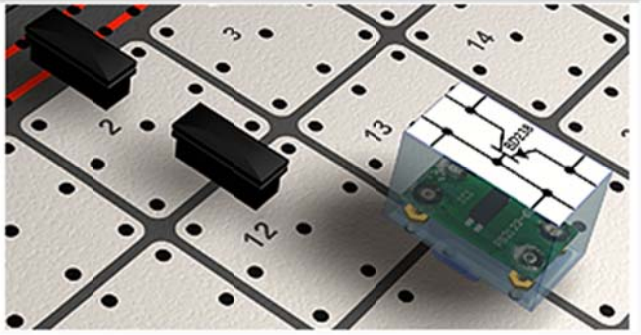
Delivery Date	

Equipment

	UniTrain-I Interface
	EloTrain 2-mm Experimenter
	Connecting leads and jumpers
	Multimeter
	Various EloTrain components (specified for each course)

Patch panel and jumpers

	All experiments are based on the EloTrain system, which provides a firm mounting and establishes secure electrical contact between the plug-in modules and the patch panel's "nodes".
	The bus lines are intended to minimise the number of jumpers needed to supply the numerous points on the patch panel with a voltage.

	Each node consists of nine 2-mm sockets connected electrically to one another. The nodes are electrically isolated from each other.
	Contact between individual nodes or bus lines is established in each case by means of a 2-mm jumper (with a pin spacing of 7.5 mm). Alternatively, a suitable connecting lead can be used.

Set of plug-in modules

A wide variety of plug-in modules is available within the EloTrain plug-in system. The component kit for electrical engineering/electronics courses contains equipment optimised for conducting numerous experiments.

Experiment 01

Objectives

After conducting this experiment, students should be able to:

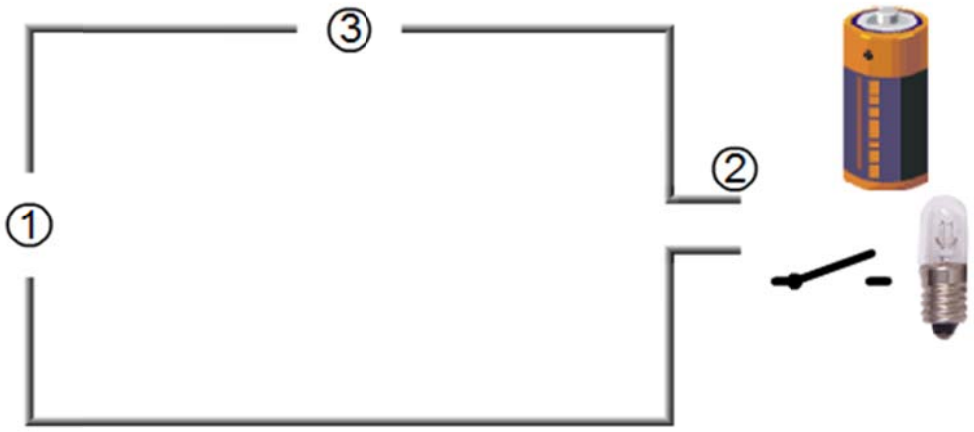
- Assemble circuits in accordance with defined circuit diagrams
- Understand the operation of simple circuits

Introduction

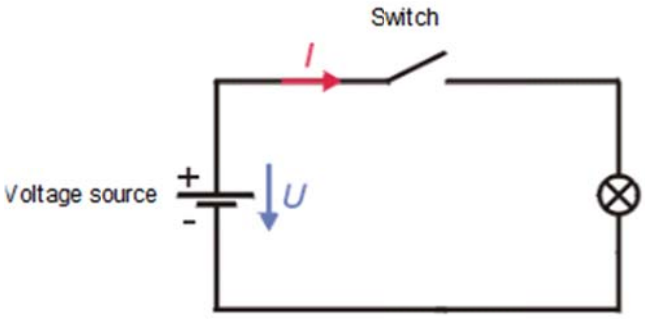
A simple electrical circuit consists of the components listed below.

- Power source (e.g. battery or power supply unit)
- Consumer or load (e.g. light bulb)
- Conductors (e.g. wires) connecting the power source to the consumer
- A switch for opening and closing the electric circuit (not compulsory)

Illustrated below is the layout of a simple electrical circuit with a voltage source (battery), switch and consumer (lamp). If the lamp is connected to the voltage source by means of the leads and the switch is closed, this closes the circuit as well. As a result, a current flows from the battery's positive pole through the consumer and back to the battery's negative pole.

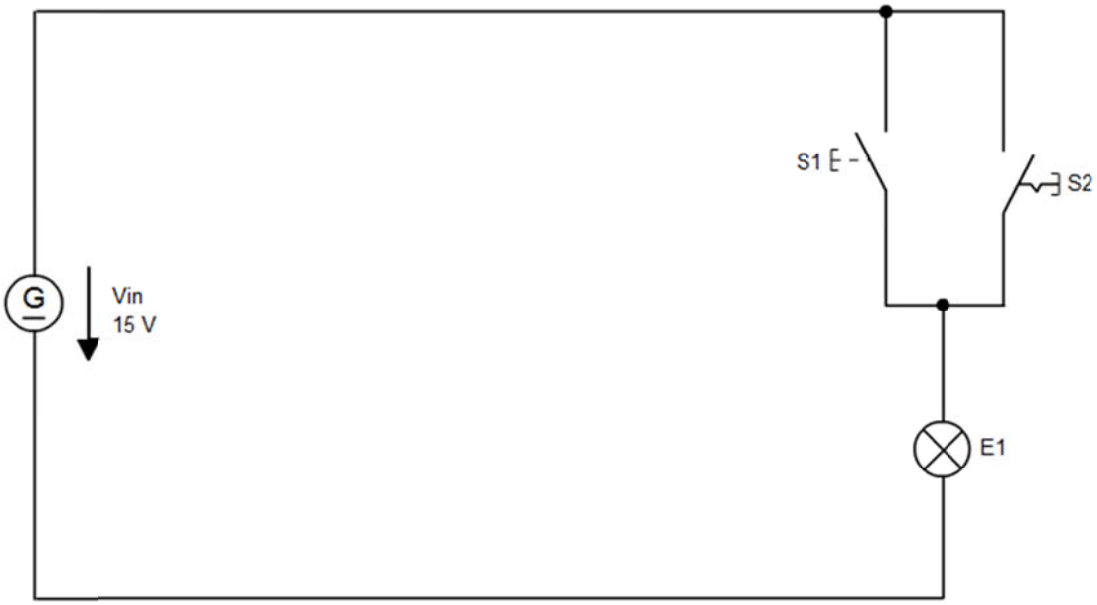


In electrical engineering, electric circuits are usually represented in the form of circuit diagrams in which a standardised symbol is assigned to each circuit component. Illustrated next is the circuit diagram of the electric circuit outlined above. Also shown here are the reference arrows for the source voltage U (more commonly represented as V in English-speaking countries) and conductor current I.

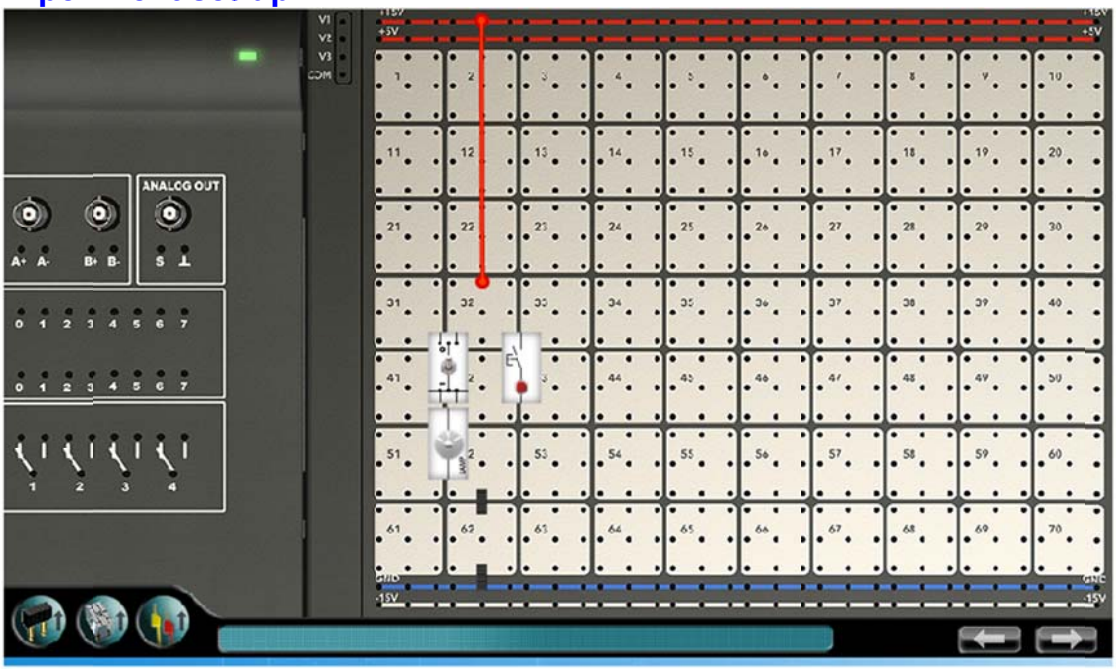


Circuit diagrams

This experiment is set up according to the circuit diagram shown below.



Experiment set-up



Procedure and exercises

Ascertain the conditions under which the lamp shines. Set the switch to position I.
Move the switch back to position 0 and push the button.
Ascertain the combinations which cause the lamp to shine.

When does the incandescent lamp shine?	
A	Always
B	Never
C	Only when the switch is set to position I and the button is pushed.
D	Only when the switch is set to position I.
E	When the switch is set to position I or the button is pushed.
F	Whenever the switch is set to position 0.

Experiment 02

Objectives

After conducting this experiment, students should be able to:

- Measure voltage and amperage in circuits
- Assess the effect of where the measurement is made on the value measured
- Assess the influence of the measuring instrument itself

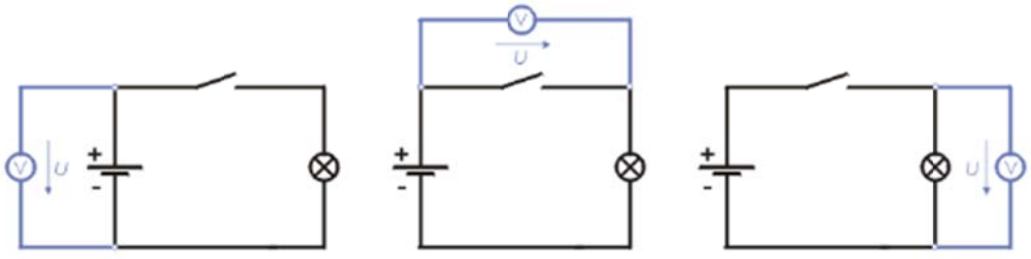
Voltage measurement

Voltage is measured by means of a *voltmeter*.

		
Graphic symbol for a voltmeter	Analog voltmeter, used to indicate battery voltage in automobiles, for example.	Standard commercial multimeter used, for example, to measure voltage, usually over a number of selectable ranges.

To measure voltage, the voltmeter needs to be connected into the relevant circuit. Voltage is always considered to exist *between* two particular points, e.g. the terminals of a voltage source or a consumer/load. Accordingly, the voltmeter is connected in *parallel* with the component across which the voltage is to be determined.

The circuit diagrams below show how to connect a voltmeter to measure voltages in the simple circuit previously considered. The left-hand circuit diagram shows how to connect the voltmeter to measure the source voltage, the centre diagram shows how to connect it for measuring the voltage across the switch and the right-hand circuit diagram shows how to connect it for measuring the load voltage.

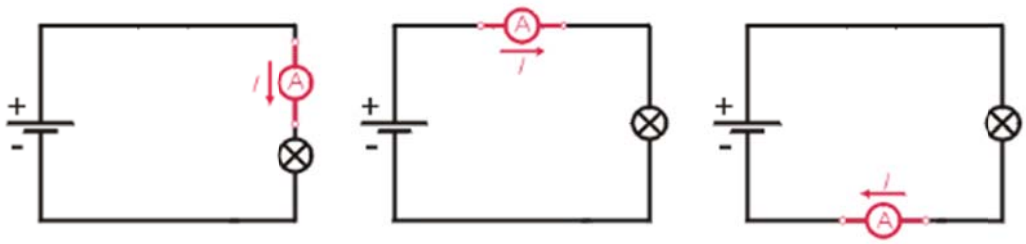


Ideally, no current should flow through a voltmeter, so as not to influence the electric circuit or measurements of it.

Current measurement

The value of electric current (i.e. amperage) is measured with an *ammeter*. Illustrated below is the graphic symbol for an ammeter. Besides a voltage measurement mode, standard commercial multimeters usually also offer a current measurement mode incorporating a number of measuring ranges.

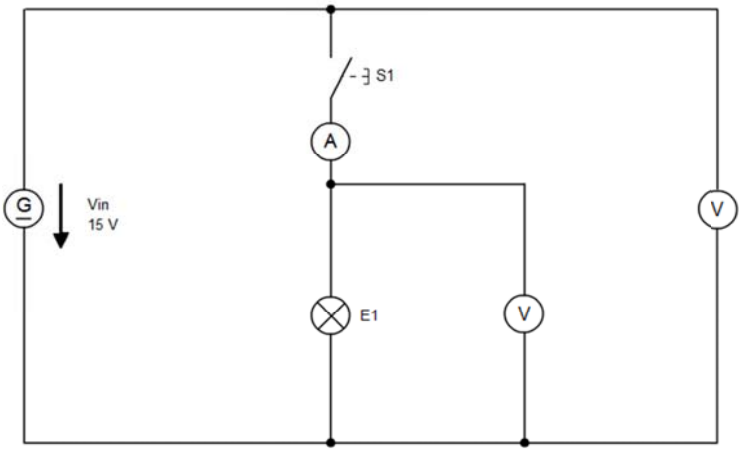
For its amperage to be measured, the current under examination needs to flow through the ammeter. For this purpose, the electric circuit is interrupted at a suitable point, and the ammeter connected into the circuit at that point. In contrast to the voltmeter, the ammeter is connected in *series* into the branch where the current is to be measured. The diagrams below show various ways of installing an ammeter in the simple circuit previously considered. Because this circuit consists of just one branch, so that the amperage at all its points is the same, it does not matter where the ammeter is looped into the circuit



Because the current to be measured needs to flow through the ammeter, it must be connected in series with the consumer/load. The ammeter's internal resistance must be minimal, so as to minimise the influence on the current being measured and the consequential voltage drop across the measuring device.

Circuit diagram

This experiment is set up according to the circuit diagram shown below.

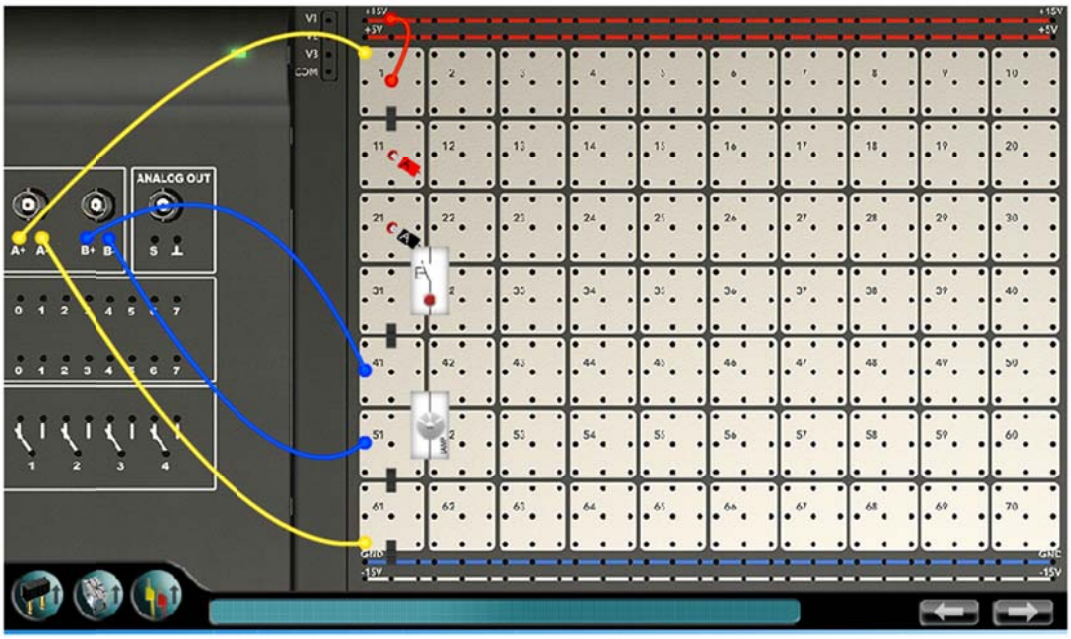


Instruments

The instruments needed for this experiment are shown below.

Instrument	Settings	
	Black lead	Ground
	Red lead	400 mA input
	Selector knob	mA =
		Insert the red and black probes into the designated sockets.
	Positive input	A+
	Negative input	A-
	Selector knob	AV
	Positive input	B+
	Negative input	B-
	Selector knob	AV

Experiment set-up



Experiment procedure and voltage measurement exercise

Push the button and determine the voltage across the lamp. Enter the value obtained into the field below.

Voltage	……..……

How does the reading on the voltmeter change when its red and black leads are swapped over?	
A	The voltage remains unchanged.
B	The voltage rises.
C	The voltage drops.
D	Only the sign of the voltage changes.

What are the voltages across the lamp when the button is not pressed? Enter your results into the field below.

Voltage across the lamp	……..…… ……..

Procedure and current measurement exercises

Push the button and read the current I which then flows through the ammeter. Enter the value in the field below.

I (ma)	……..…… ……..

How does the ammeter reading change when the red and black leads are swapped over?	
A	The current does not change.
B	The current rises.
C	The current drops.
D	Only the sign of the current changes.