CEBEK®
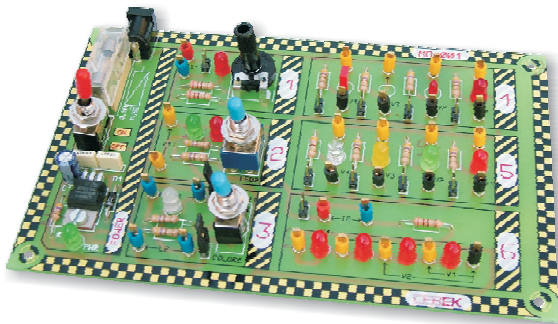
EDUCATIONAL MODULES
For LEARNING and to PRACTISE the ELECTRONICS

www.cebek.com

⊕ EDU-001. Led Diode.

⊕ The EDU-001 module is composed by 6 practices allowing to start with different parameters like control, operating, Led diode design. Leds with different characteristics are included, to show to the student the wide range of leds. To make these different practices you will only need a power supply to supply the module and a multimeter. The rest of operations is done with elements from the circuit. Some technical references are included to allow to the student to go more deeply into each experimental area.

⊕ **Practice 1**. Led's current and control of the luminosity.

⊕ **Practice 2**. Behaviours when the current change its way.

⊕ **Practice 3**. Bicolour Led's control and behaviour.

⊕ **Practice 4**. Leds' forms and types. Voltage and Control current.

⊕ **Practice 5**. Different colours leds. Voltage fall and control current.

⊕ **Practice 6**. Direct voltage and Current in serial configuration.

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⊕ Warranty and Do not forget.

Cebek educational modules included in the EDU serial offer several practices to analyse, experiment and to learn basic knowledge on the studied theme. Nevertheless, their function is not to make a mini-class on each theme, but to complete and to be used as basis, as well as to allow to experiment on the theoretical theme evocated by the teacher. For this reason, we suggest you to use modules form the EDU serial under the supervision and the direction of a teacher.

Cebek doesn't offer a consulting service as concern the theoretical or the operating principles concerning the theme deal with the module. It only offers a technical assistance regarding questions and problems coming from the circuit's internal operating mode.

All Cebek modules included in the EDU serial have a warranty of 3 years as concerning components and labour man. All damages provoked by external causes (from the circuit), as well as wrong connections or installations or due to an operating mode no indicated into the module's documentation won't be covered by the warranty. More over, all wrong or incorrect handling won't be excluded from the warranty. For any claim, you have to present the corresponding invoice.

To contact our technical department, you can send a message to sat@cebek.com, or a fax :Nº+34.93.432.29.95 or a mail to the following address: CEBEK, c/Quetzal, 17-21, 08014 Barcelona (SPAIN).
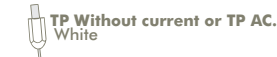
◐ Rules and Identification of the EDU serial elements.

To make easier the identification and for a single rule as concern different practices and educational Cebek modules, all common elements will answer to colour code and to a shape.

Test Point. (TP).

It allows to connect oscilloscope's or multimeter extremities to read parameters relating to the practice. According to its colour, it will indicate that the Test Point (TP) is connected to the positive or to the negative of the circuit, as well as reads concerning current, voltage, load, etc….
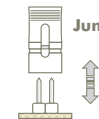
TP. ⊕ circuit Red   **TP. ⊖ circuit** Black   **TP. Tension** Yellow   **TP. Courant** Blue

TP Without current or TP AC. White

Conmutator / Switch.

According to the colour of the switch, you can control the voltage, the current

Power supply Red   **Current** Blue   **Voltage** Yellow   **Logical** Green

Jumper.

It allows to close or open a signal or an electrical circuit

Important Point

Important Point: Part to remind.

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Before to start...

Before to start a practice, it is very important to carefully read its instruction manual as well as corresponding indications.

You have to do correctly connections in indicated contact points, otherwise measures depending on these connections will be confuses or wrong.

Do not make connections not indicated in the instruction manual to avoid to damage the circuit.
If the Led of the power supply "PWR" doesn't light on or if its function suddenly stops, you have to quickly disconnect the power supply for the device and check there is any short-circuit as well as the fuse's status.

Even if described practices can be done following instruction manual, we recommend you to use it under the supervision of a teacher who can advise and bring you a support (an help) concerning described concepts.

In the circuit, each practice will be delimited by a rectangle with the corresponding number. One or several experiment(s) can be reported and referenced to this practice.

Module's power supply.

The module is supplied at 12 V DC. You have to use a stabilized power supplied or our Cebek FE-113 power supply. The circuit's supply is only do through male connector inserted on the PCB, **do not inject signal on any other terminal of the circuit.**
Once supplied, the circuit offers voltages necessary to experiment with each practice.
For the power supply connection, the module includes a cable with a male connector at an extremity and wires at the other extremity.
Connect each terminal respecting the connector polarity to the corresponding output of the power supply. Then you could insert it on the module.
Note: The circuit's fuse is 200 mA.

Female Connector

Male Connector
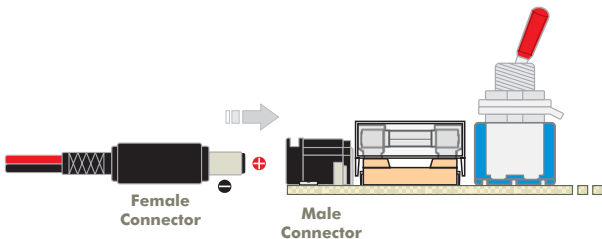
Required Material.

You won't need any other material or additional component to experiment with this module. You will only need basic measure instruments to obtain and to compare values of practices. For this module, you will need one or several multimeters with their voltmeter, ampermeter or ohmmeter functions. If you have an oscilloscope, you also could use it to substitute the voltmeter.

Bibliography.

.- Electronics principles E. McGraw-Hill. Author: Albert Paul Malvino.
.- With Google: Led diode.

EDU-001

EDU-001. Led diode.

Practice 1. Principle. Voltage fall and Luminosity Control.

To recognize the anode and the cathode in a led diode, you have to see its pins' length. The longer correspond to the positive (anode) and the shorter will indicate the negative (cathode). The following figure shows the polarity and the electrical symbol of a Led.

Anode

Cathode

Electrical Symbol

Real Led Diode
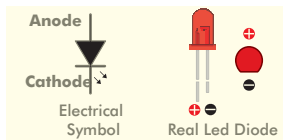
The electrical function is identical to the silicon diode one; this function is to allow the current pass from the anode to the cathode and to avoid it to flow in the contrary way. When the current cross the led this way, in minimal proportion indicated by the manufacturer, the Led will

The Led, doesn't matter its dimension, its colours, its form, will answer to specifics voltage and control current values indicated by the manufacturer who insure an optimal luminosity. Normally, in a standard design, you have to adapt your circuit voltage and current to the required one by the Led.

Led Technical characteristics: The manufacturer communicates more important parameters to select a diode according to the following terminology:

Part No.	Dice		Lens Type	Iv (mcd) @ 10mA		Viewing Angle
				Min.	Typ.	2Ø1/2
L-1503ID	HIGH EFFICIENCY RED (GaAsP/GaP)		REDDIFFUSED	8	30	60°

Symbol	Parameter	Device	Typ.	Max.	Units	Test Conditions
peak	Peak Wavelength	High Efficiency Red	627		nm	IF=20mA
D	Dominant Wavelength	High Efficiency Red	625		nm	IF=20mA
DI1/2	Spectral Line Halfwidth	High Efficiency Red	45		nm	IF=20mA
C	Capacitance	High Efficiency Red	15		pF	VF=0V;f=1MHz
VF	Forward Voltage	High Efficiency Red	2.0	2.5	V	IF=20mA
IR	Reverse Current	High Efficiency Red		10	uA	VR = 5V

- **beijing angle**. Indicate the led's view or emission angle.
- **forward Voltage**. Led's Direct voltage value or Voltage fall.
- **DC Forward Current**. Maximum constant current accepted by the Led. Square or multiplexed.
- **mcd**. Luminous power indicated in milicandles.

Characteristics of the Led from the practice 1 Model L-1503ID from **Kingbright.**

To start the practice, you have to place an ammeter between test tips TP1A and TP1B and remove the Jp1jumper. If the "Current" potentiometer is adjusted to completely to the left, the resulting resistance (RV1 + RV2 + RV3), will be approximately 48K and provokes a current circulation near to uA, highly insufficient to light the Led. With the potentiometer adjusted to the right, the resistance between Vdc and the Led
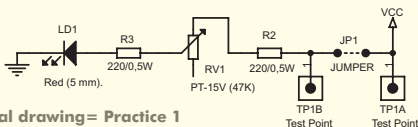
Electrical drawing= Practice 1

EDU-001. Led diode.

⊙ **Practice 1. Principle. Voltage fall ....** (Second part).

will be reduced to the sum of R2 + R3, approximately 440 Ohms, and the resulting current (16 mA) will allow to light the Led.

As you can see on the component's characteristics, the typical voltage which has to fall into the led is 2V, and the necessary current to suitably insure it slighting has to be 30 mA. Nevertheless, the available power supply in the module (VDC) is 9V. The solution to obtain operating values required by the component is to insert a "limiter" resistor. Applying the Ohm law, the resistance will correspond to the result of the difference between Vdc and the fall voltage of the led, divided by its current.

Therefore, the resistor would be = 9V - 2V / 30 mA = 233,33 Ohms (220 Ohms)

Note: The practice 1 shows 440 Ohms with the concrete goal to limit to the half the led's consumption.

⊙ **Practice 2**. **Behaviours when the current change its way.**

The led's intrinsic behaviour is the same than the classic diode one. Directly polarised, it lights on and inversely polarised it remains light of. For this reason, it can be used as witness to indicate the current way. The practice N°2 shows the leds' behaviour installed in parallel and how they react to a constant polarity change; more over this practice identify the difference between the voltage fall with two leds of different colours.

⊙ The JP2 jumper's function is to allow or to refuse to supply of the practice 2; then it has to maintained closed during experiments described in this practice.

As it is indicated on the drawing, Ld2 (Red) and Ld3 (Green) are connected in parallel, with their respective limiter resistors, but inverted one in relation to the other. Their common points are controlled through the double SW2 switch, which will independently open or close both circuits at the same time, supplying in each point, positive or negative according to the slide position.

When the green led lights on, on the A point it will be injected the signal negative, and on the B point the positive one. The Led3 will be directly polarised. At the opposite, the Led2 remains light of because of its inverse polarisation.

Therefore, if the negative is injected on the B point and the positive on the A point, the red led will be directly polarised and the green led remains inversely polarised.
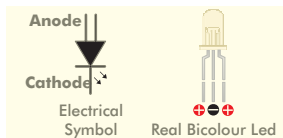

Electrical Drawing Practice 2

Connect a voltmeter between TP2A and TP2B o between TP2C and TP2D according to the activated led. You can see a different voltage fall even with identical limiter resistors. According to the colour, the voltage fall indicated by the manufacturer can be different on two leds with similar characteristics.

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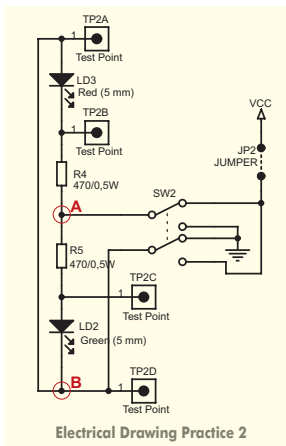
Practice 3. Bicolour Led.

The bicolour Led is composed by two leds with different colour into the same capsule, reducing the pins quantity to only three terminals. According to the model, the anode and the cathode become common to a single point, the two others pins correspond to the independent pole of each led.

Anode

Cathode

Electrical Symbol

Real Bicolour Led

Concerning the electrical matter, its drawing can be represented as it is indicated the picture or as two independent leds. The real picture corresponds to the Led of the practice, where the cathode is the common

There are many advantages to use this led. Firstly, you can reduce the number of components on the board, increasing the available surface. The control is maintained only through two register signals. The reference indication is establish on a single point with two states or colours.

At the beginning of this practice, you have to install two ammeters between test tips TP3A and TP3B and between TP4A and TP4B. You also have to remove respective M3A and M3B jumpers in order to let readers connected in serial and to obtain the corresponding measure. If you don't have an ammeter, you can also use it on TP3A and TP4 according to the activated led.

As it is indicated on the drawing, each anode is electrically and independently controlled, establishing the common cathode to directly connect to the ground.

The SW3 switch alternatively polarises one or the other internal led's section, injecting Vdc (9V) to the corresponding anode and obtaining the red or green colour according to the case.

The practice shows how the current only flows in the anode cathode polarisation of each led, obtaining approximately 15mA when it conducts and zero when it is the other part of the led which conducts.

Note that the current value is basically identical for both colours.

Electrical Drawing Pracice 3
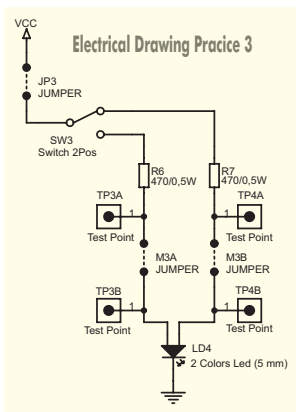
Taking in account the bicolour led operating mode, which is the result if we polarise at the same time both segments?

Indicate your choice:

- .- Only one will light on, prevailing again the other.
- .- Any of both leds will light due to the produced short-circuit.
- .- Both leds will light, offering an "oranged" colour

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Pracice 4. Leds' forms and types.

There are different types of forms for the led. Its usual form is circular and its more frequent dimensions are 0.3 and 0.5 mm. Nevertheless, we can find many alternative forms, normally associated to concrete applications like triangular leds used to indicate directions, etc…

Among all these forms, the more standardised are utilised in this practice. Normally, even with different forms, all leds maintain similar polarisation values, like voltage fall and excitation current. Nevertheless, when you use different led in a same board or panel, you have to suitably consider minimum and maximum parameters communicated by the manufacturer, to coincide in a same luminous intensity of all leds, personalising the limiter resistor value.

Electrical Drawing Pracice 4

You will obtain the voltage fall value applying a voltmeter to the test tips of each led, and closing the corresponding jumper to supply the led circuit.

You can note that each one offers a value slightly different, and assembling resistors with same value, the current is different as well as the luminosity.
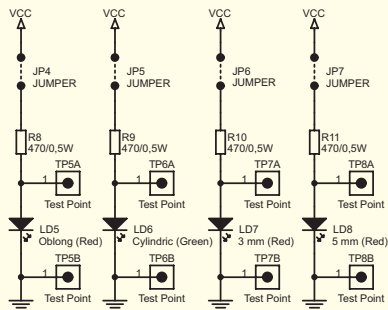
Practice 5. Different colours leds.

The most popular colours for a Led are red, green, yellow, orange, white and blue. Its tonality is due to the wave's length produced by the current when it circulate through the semiconductor material of the Led (GaAs, GaAsP,o GaP), according to the colour and the manufacturer. Apply a voltmeter to the test points of each led, closing the corresponding jumper in each case.

The read of the voltage fall for each led will be clearly different between components, especially for the white Led, necessary to obtain each specific colour.
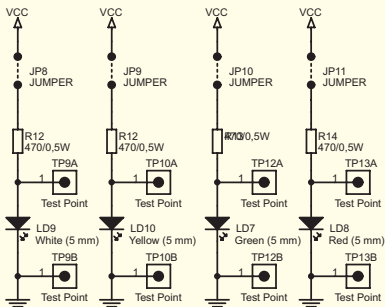

Electrical Drawing Practice 5

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EDU-001. Led diode.

Practice 6. Direct voltage and Current in serial configuration.

The introduction of segments' configurations or group of leds in serial is frequent. Contrary to a configuration in parallel, where each led is controlled through a limiter resistor, the configuration in serial allows a higher importance to the supply voltage.

To start the practice, you have to maintain closed the Jumper JP12 and to apply a voltmeter between TP15A and TP15B to obtain the V1 voltage read.

Electrical Drawing - Practice 6
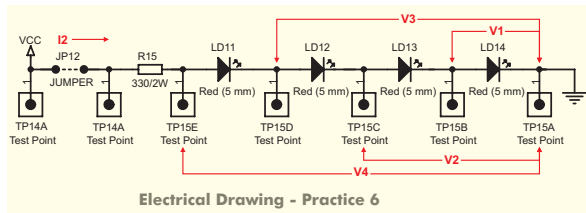
Then, repeat this operation of V2 (TP5A and TP5C), for V3 (TP5A and TP5D) and finally for V4 (TP5A and TP5E).

The voltage in V1 corresponding to the voltage fall of the led is approximately 1,85 V. As leds from the practices are identical, V2 will be two times higher than V1, V3 three times higher than V1 and V4 will be also four times than V1, and at the same time the total voltage which falls in the four leds in serial.

When several leds are configured in serial, the total voltage fall is determinant to calculate the common limiter resistor and also because this last mustn't never be superior to the supply voltage (VDC).

To calculate the resistor is quite easy, if we consider that in a circuit in serial the current which flows is the same for all components, you only need a common resistor.

Supposing that you need a current (I2), of 7 mA, applying values from the practice to the Ohm Law: R16=VDC (V1x4) / 0.007A 228,5 Ohms.

The resistor value, equivalent to the nearest commercial value is 220 Ohms.

Applying an ammeter between TP1A and TP1B and removing JP12, to maintain this

Resistance for Leds in Serial.

$$Rleds = \frac{Vcc - (Vled \times n^{\circ} leds)}{Iled}$$

Rleds= Common R. for leds in serial
Vcc= V. Supply
Vled = Led voltage fall
Iled = Led current.

one in serial, you can obtain the real I2 value and to also verify that using the resistor with the calculated value, you obtain the calculated current.

When the supply voltage (VDC) will be equal to the addition of voltage falls of leds, any limiter resistor will be necessary. Indeed, the value in each led will correspond to the direct voltage accepted by the component.

This characteristic can be verified, deactivating the power supply of the circuit and applying a 7,4V (1,85 x 4) voltage between TP1E and TP5A, with the corresponding polarity.