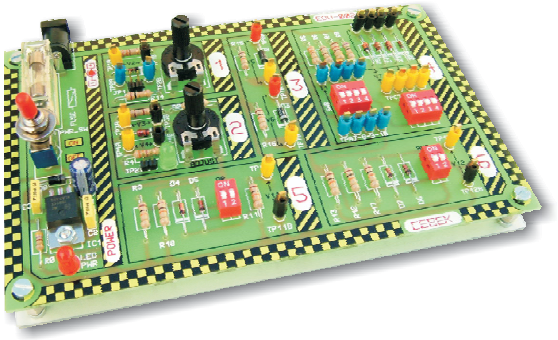
EDUCATIONAL MODULES

For LEARNING and to PRACTISE the ELECTRONICS

www.cebek.com

EDU-002. Diodes and Zeners Module.



The EDU-002 is composed by 6 practices allowing to understand and to compare principles of the diode and the zener. On the 6 practices, 4 are based on the diode and 2 on the zenner. You will only need a power supply for the module and a multimeter in order to make each experiment.
The original technical documentation supplied by manufacturer of the diode and the zenner is included; it will allow to familiarize the student with control parameters and the components' conception.

- **Pratice 1.** Diode Elbow voltage. Break Zone.
- **Pratice 2.** Intensity Vs Input Voltage in Zener power supply.
- **Pratice 3.** Kinds of Diodes voltage drop, in Shocky and Silice.
- **Pratice 4.** Resistor calculus for constant current with different Zeners.
- **Pratice 5.** Diodes Properties. In D.C. OR Logical Door.
- **Pratice 6.** Diodes Properties. In D.C. AND Logical Door.

EDU-002

EDU-002. Diodes and Zeners Module.

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.

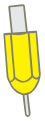
To make easier the identification and for a single rule as concern different practices and educational Cebek modules, all common elements will answer to colour code and to a shape.

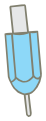
Test Point. (TP).

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.…

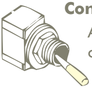

TP. + circuit
Red


TP. − circuit
Black


TP. Tension
Yellow


TP. Courant
Blue


TP Without current or TP AC.
White



Conmutator / Switch.

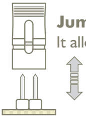
According to the colour of the switch, you can conrol the voltage, the current or the power supply.


Power supply
Red


Current
Blue


Voltage
Yellow


Logical
Green



Jumper.

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

EDU-002

EDU-002. Diodes and Zeners Module.

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.

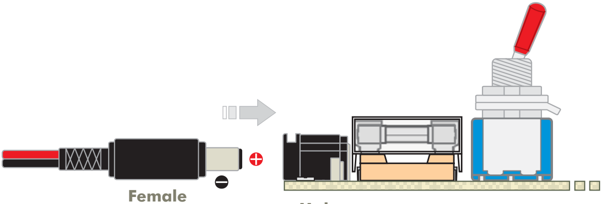
Do not make connections not indicated in the instruction manual to avoid to damage the circuit.
If the Led of the power supply "PWR" doesn't light on or if its function suddenly stops, you have to quickly disconnect the power supply for the device and check there is any short-circuit as well as the fuse's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



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 or ampermeter 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: 1N4003 | 1N4148 | Zenner

EDU-002. Diode and Zener Module.

Pratic 1. Diode elbow voltage. Break zone.

The following figure indicates the electrical symbol of the diode, “P”, corresponding to the anode and “N” to the cathode. An easy mode to remember the diode's current way is to observe the way indicated by the arrow of the symbol which represents it. Physically, the cathode of the diode is indicated by a line on one of the extremities.

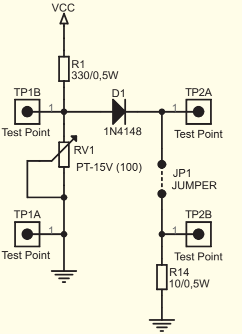
Electrical Symbol — Real Diode

The basic function of the diode is to allow the current to go by from the anode to the cathode and to avoid the inverse way. This polarisation is called “direct polarisation” and it is indicated on the drawing by the corresponding polarisation.

The practice N°1 allows to verify the diode’s threshold voltage, into a direct polarisation of the diode.
The goal of this practice is to elaborate a table and a graphic similar to the graphic presenting the practice relating to the values obtained from the voltage vs current of the diode.

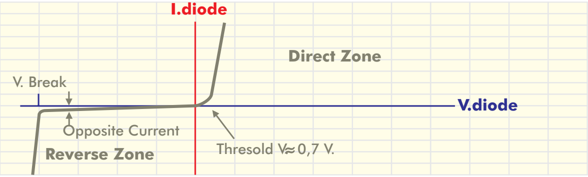
First of all, you have to place a voltmeter between test points TP1A and TP1B. At this indicated point and with a voltage divisor composed by Rv1 and R1 resistors, you could apply on the diode an approximate voltage from 0 till 0,8 V.
To check the current that you allow to go by into the diode through R14, you have to install an ampermeter between TP2A and TP2B, and to remove the JP1 Jumper to allow the ampermeter's connection in serial.

For silicon diodes, the more popular, the threshold voltage is at 0,7 V, From this voltage, the current will increase through the diode according to an exponential mode. From 0 till 0,5 0,65 V, the escape current that the diode allows to go by is minimal.



Electrical Diagram - Practice N’1

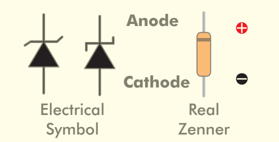
In the inverse area, there is almost no inverse current, except if the inverse voltage reaches the break limit; from this moment there is a sudden voltage increase and the diode destruction.



EDU-002. Diodes and Zeners Module.

Pratice 2. Intensity Vs Input Voltage in Zener power supply.

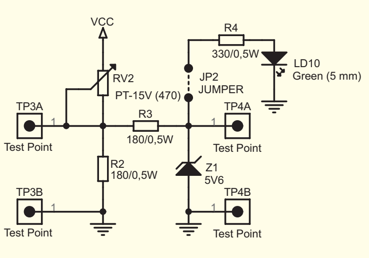
The electrical indication of the zenner diode can be done in two different modes: both modes being correct (See Fig.). As for the diode, a line at the extremity of the component will indicate the cathode.



In spite of the classic diode is directly polarized, the zenner diode obtains its potential in the break area. The main function of the zenner diode is to act as source of constant voltage, regarding a variable voltage input. See the polarity on the drawing.

The practice consists in making two experiments, and to verify how the zenner diode will maintain a constant voltage even if we apply on it a variable voltage, as well as the repercussion on the zenner's current.

First experiment: You have to remove, (open) the JP2 jumper. Then you have to place a voltmeter between test points (TP) TP3A and TP3B to obtain the voltage input value on the zenner diode (V, input), which is determined by the voltage divisor composed by Rv2 and R2. A second voltmeter has to be placed between test points TP4A and TP4B, to record the zenner voltage value (V, zenner).



Electrical Diagram - Practice N'2

Thanks to the potentiometer adjustment, the voltage supplied to the zenner will increase from 2 up to 9V. Till the break point of the zenner diode (5,6V), the input voltage will be equal than the zenner voltage. When the input voltage will have a value between 5,6 and 9V, the zenner's voltage will be maintained at 56,V.

Second experiment: You have to place (close), the JP2 jumper. For this experiment, you won't need any measure apparatus. The Led will allow to visually appreciate the concept of this practice, according the Rv2 potentiometer adjustment.
As the internal resistance of the zenner diode is almost null, when the zenner diode will act into the break area, the load voltage will be determined by the limitation resistor (indicated as R3 on the drawing). In spite of the V zenner is maintained stable; the increase of the input voltage will have repercussions on a current more intense through the R3 as well as an increase of the luminosity of the Led. The R4 function is to limit the maximum current value into the load.
For a design, you have to take in account the required current for the load regarding maximum and minimum input voltage values on the zenner diode. More over, is IZ=IS-IL, we will obtain the necessary parameter to calculate the power and to calibrate the corresponding zenner diode.

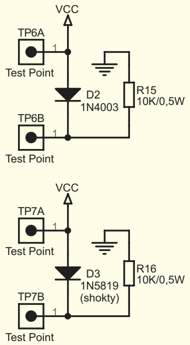
EDU-002. Diodes and Zener Module.

Pratice 3. Kinds of Diodes. Voltage drop, in Shockty and Silice.

The practice N°1 allows to experiment on the threshold voltage of the diode. Nevertheless, all diodes don't have the same value. For instance a germanium diode has an approximate threshold voltage of 0,3V but a silicon diode has 0,7V and a shockty diode has 0,1V.
The electrical performance for all different types of diodes is similar, the basic and main parameter being the threshold voltage; Then the voltage which falls into the diode during a direct polarization.

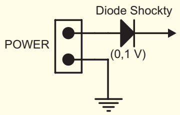
The practice N°3 allows to check the diode's thresholdvoltage, on a silicon diode sample (1N4004) and a shockty diode, (1N5819).

Place a voltmeter between TP6A and TP6B, if you have a second voltmeter or an other measure instrument as an oscilloscope, etc…More over, you have to place a measure probe between TP7A and TP7B, otherwise the measure of corresponding TP can be done in two times. Thanks to R15 and R16 resistors, the same current will circulate in each diode. Nevertheless, the voltage fall in D2 (standard silicon), is approximately about 0,6 or 0,7V but in D3 (schockty) it is about 0,1V. We note different threshold voltages according to the diode, but the same physical performance.



Electrical Diagram - Pratice N'3

The importance to correctly calibrate the diode on a drawing (design) for a correct protection against polarity inversion is proved in this real and simple application. In a power supply with D.C, if we place in serial with the positive of diode directly polarised, it is established a protection against polarity inversion. Nevertheless, if the power supply depend on batteries, which we usually require the maximum level they can offer, a diode voltage fall about 0,7V could be too important. For this amplification, the solution could be to use a shockty diode, with a only fall about 0,1 V.



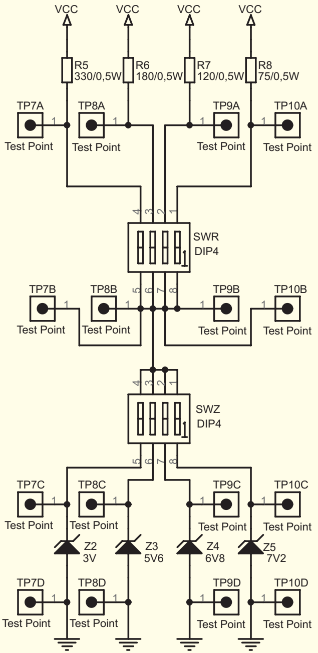
How to protect against polarity inversion using the Shockty Diode.

Pratie 4. Resistor calculus for constant current with different zeners.

As it is described in the practice N°1, the current of the zenner diode has to be limited using a resistor in serial, otherwise the diode will be destroyed.
To calculate or to calibrate the resistor, you have to take in account: the maximum input voltage, the minimum current, the load current and the power that the zenner diode has to dissipate.

The practice consists in calculate the necessary resistor in serial to limit the current in each of the four zenner with different break voltages (3V; 5,6V; 6,8V; 7,2V), for a same voltage 18 mA, then verifying the current and the break voltage in different zenner.
To easily calculate, you don't have to forget that the maximum and minimum voltages have to be the same: 9V, and the load current has to be zero.

The practice has to be done with each individual zenner diode, following this process:
1.- Calculate the necessary resistor in serial to obtain a voltage of 18 mA which circulates into each zenner. The practice is supplied with resistors offering commercial values the most close to the calculus.
2.- Thanks to the SWZ dips battery, the dip corresponding to the zenner on which you want to make the experiment has to be in ON position.
3.- Then, you have to select among the four supplied resistors with the practice, the serial resistor for the zenner and to put in ON position the dip of the SWZ battery which will correspond at the resistor with the calculated value.
4.- verify the voltage of the zenner using a voltmeter.
5.- Using an ampermeter, you have to firstly put the dip corresponding to the resistor in OFF position, and then to place the ampermeter's terminals between test points of the resistor. Then you will obtain a read of the zenner's current and you can verify that correspond to the 18 mA indicated on the drawing.
6.- To finish, you have to repeat this process for the others zenner diodes of the practice.



Electrical Diagram - Practice N'4

Remember !. $Rz = \frac{Vi - Vz}{Is}$

Rz= Zener Resistance
Vi= Input Voltage
Is= Serial Intensity.
Vz= Zener Voltage.

EDU-002. Diode and Zener Module.

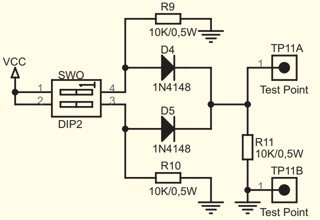
Logical Doors with Diodes.

As we have described it in previous practices relating D.C, the diode allows or blocks the passage of the current. This function also allows to make simple doors Or and AND, with so much inputs as used diodes, in situation where an integrated circuit will be unsuitable.

Pratice 5. OR Logical Door with diodes.

This practice allows to experiment and to evaluate the performance of both diodes configured as OR door, and then to easily obtain the corresponding true table.

You have to start this practice placing a voltmeter between test points TP11A and TP11B, where you will obtain the output and the result of the OR function. Both OR inputs correspond to the dip 1 and to the dip 2 from the SWO battery. In OFF position, the corresponding input will be forced through R9 and R10 (according to the used dip), to the negative. 0 Logical. When a dip is placed in ON position, the input will remain connected to the positive of the practice (9V) 1 Logical. You can verify on the output that the 1 logical is 8,3V instead of 9V, because of the diode's voltage fall (0,7V).

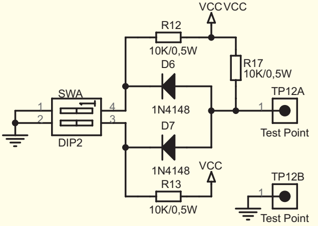


Electrical Diagram - Practice N'5

Pratice 6. AND Logical Door with diodes.

This practice will allow to experiment the performance of both diodes configured as AND door, and then to obtain by the real read the true table.

Place a voltmeter between TP12A and TP12B, where you will obtain the output and the result of the AND function. Both AND inputs correspond to the dip 1 and to the dip 2 from the SWA battery. In OFF position, the corresponding input will be forced through R12 and R13 (according to the used dip), to the negative. 1 Logical. When a dip is placed in ON position, the input will remain connected to the negative. You can verify, like for the output, that the 0 logical is approximately 0,7V, the diode's voltage fall, instead of absolute 0.



Electrical Diagram - Practice N'6

For these two practices N°5 and N°6, logical levels won't be affected, because the voltage difference regarding the 0 or the 1 absolute logical is not enough. In practical operating modes, they will be considered as a logical common door.