EDUCATIONAL MODULES

For LEARNING and to PRACTICE the ELECTRONICS

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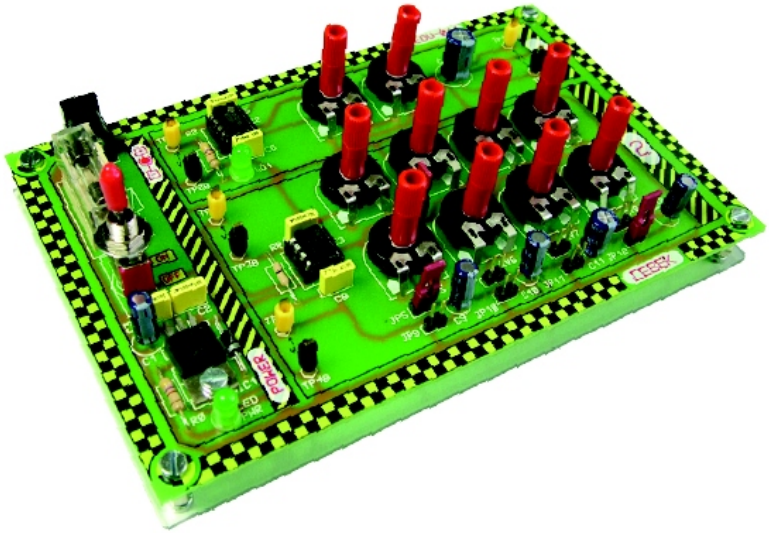
EDU-014. Astable Ne555



The EDU is a mini composed by two NE in astable configuration with the necessary components to experiment without external elements the different variables and concepts indicated in the documentation and the practices
The EDU exhibits the operating mode and answer of a free oscillation multivibrator based on the " " Experimenting through the practices the description of its internal structure operating answer and characteristics of its astable configuration Impulse width operating time frequency operating cycle charge and discharge graphics configuration of external components and output answer

Practice Description of the astable NE Capacitor charge and discharge PCS and PCI switching levels Observation output wave forms and the capacitor

Practice Timing Importance of the resistor value in the impulse width and the period

Practice Resolution of Capacitor and R and R values according the required impulse width period and frequency

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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. Voltage Yellow
TP. Current Blue
TP Without current or TP AC. White
Union terminal between points Aluminium, without colour

Conmutator / Switch.
According to the colour of the switch, you can control the voltage, the current or

Power supply Red
Current Blue
Voltage Yellow
Logical Green

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

Important Point.
Point with special importance,
To remember.

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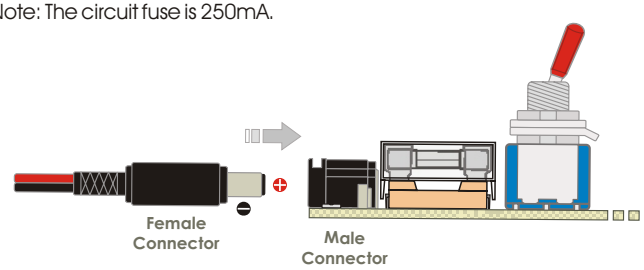
Before to start...

Before to start a practice,
Before to start a practice, it is very important to carefully read its instructions manual as well as corresponding indications.
You have to correctly make connections concerning indicated contact points, otherwise measures depending on these connections will be confuses or incorrects.
Do not make any connection or short-circuits no specified in this manual, to avoid to damage the module.
If the illumination Led indicated as "PWR" doesn't light on or if its function is suddenly stopped, you have to immediately disconnect the devise from the power supply and to check if there is no short-circuit as well as the fuse state.
Even if you can make this practice following instructions described into this manual, we suggest you to make this practice under the supervision of a teacher allowing to consult, to increase or to help regarding concepts described herewith.
On the circuit, each practice will be delimited by a rectangle with the corresponding number. One or several experiments could be reported to this practice.

Module's power supply.

The module is supplied at 12 V DC. You have to use a laboratory stabilised power supply like our Cebek FE-113. The circuit's feeding is done through the male connector inserted on the board, do not inject signal on any other terminal placed on the circuit. Once supplied, the circuit offers necessaries voltages to make experiments with each practice. To connect the power supply, the module includes a cable with a male connector at one extremity and wires at the other extremity.

Respecting the connector polarity, you have to connect each terminal to the corresponding and respective terminal of the power supply. Then, you could insert it on the module.
Note: The circuit fuse is 250mA.



Required Material.

You won't need any additional material or components to experiment with this module. You only need basis measure instruments to obtain and to compare obtained values from this practice. For this module, you will need one or several multimeters with their voltmeter, ammeter or ohmmeter functions. If you have an oscilloscope, you could also use it to substitute the voltmeter.

Bibliography.

- With Google: NE555
- With Google: Ne555 Fairchild
- Electronics Principles, (Mc Graw Hill)

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The " "

The " " maintains today several characteristics that make it ideal in innumerable applications mainly as accurate timer

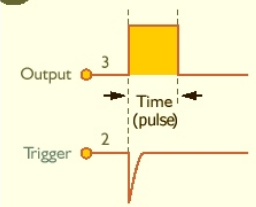
Distributed by different manufacturers according to its origin it is denominated NE LM CA MC etc It is also available the version which encapsulates in a same integrated two NE the NE

Among its characteristics it emphasizes its high accuracy which it can reach as timer even if it is submitted to voltage and temperature variations It can be supplied with voltages between and V D C and its stability in frequency by each Celsius degree os of
More over it requires the use of few external components and it can supply a maximum output current up to mA

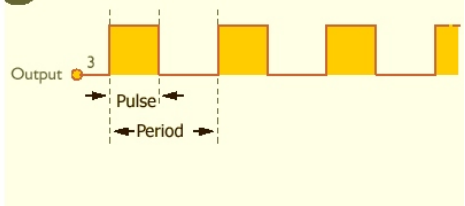
NE 555's pins

The NE can mainly operate in two different configurations as monostable multivibrator or as astable multivibrator

Monoestable 555



Astable 555



In Astable mode it generates a constant square signal composed by a impulse at high level followed by another one at low level where the width of the pulse at high level can be adjusted as well as the part of the cycle at low level
In Monoestable mode the NE produces a single accurate impulse which can be established from microseconds up to hours

Practice Practice s Internal structure and description

The drawing of the NE s internal structure also shows that through the connection of the two external resistors R and R and the C capacitor connections to configure the in astable mode
Internally the NE is basically structured by a voltage division with three resistors of the same value two comparators a RS flip flop a NPN and a Reset
The three internal resistors constitute two levels that determine the switching points on the comparators the superior PCS Vdc and the inferior PCI Vdc

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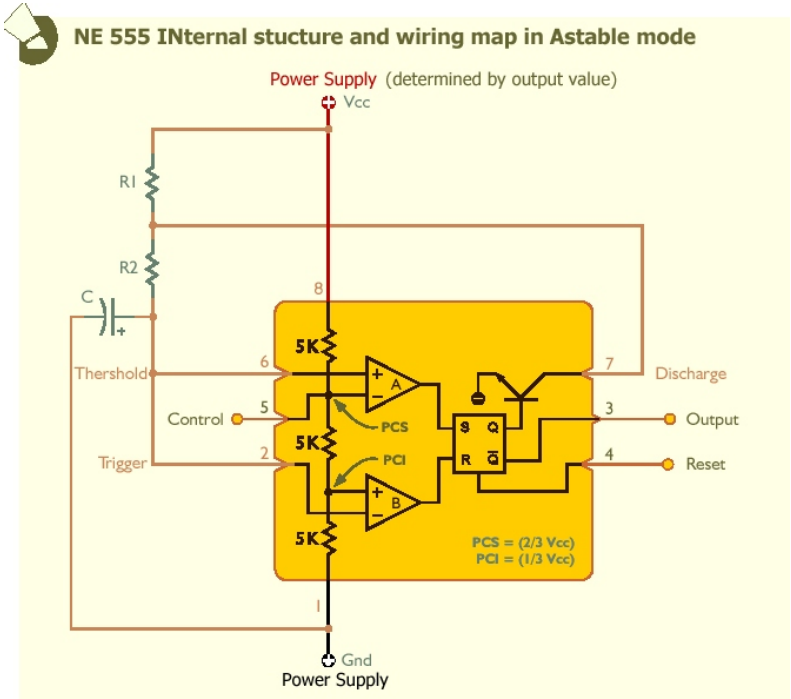
Practice 0. NE555 Internal structure and description,(Part II)



Threshold Pin the threshold It also acts on the comparators in this case on the A When the applied voltage is superior to PCS the comparator goes to high level

Output Pin goes to high level during the output impulse In astable mode it supply a rectangular signal

Reset Pin When it is connected to the ground it reset the output Output and inhibits the intregrated opering

Control Pin is connected to the ground through a capacitor and it avoids voltage fluctuations In other s configurations like the impulse modulation it acts as corrector of PCS allowing the modification of the impulse width

Discharge Pin executes the capacitor discharge

Practice NE Operating in astable mode

The NE acting in astable mode cannot indefinitely remain in any stable state awaiting an activation signal for this reason it doesn t require to be externally shot to offer an answer From the starting of its feed it constantly oscillates generating a rectangular signal on the output

Practice shows the NE operating mode as free oscillation multivibrator astable as how the configuration and the value of involved external components determine the impulse width and the period of the rectangular signal and consequently the timing of high and low level impulses

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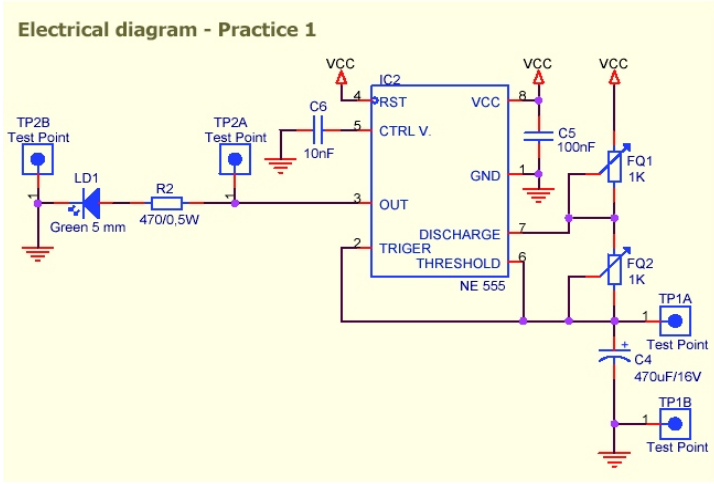
Practice NE Operating in astable mode part II

More over of the practice assembling it is also necessary to monitor the circuit operating mode through two oscilloscope channels

A channel is applied to visualize the output waveform between TP A and TP B and the second channel will follow capacitor charge discharge between TP A and TP

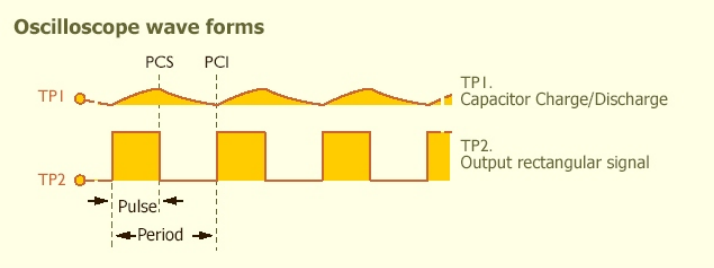
The oscilloscope must be configured for a dual visualization



Observing the internal structure when the NPN is in cut position pin discharge allows the C capacitor charge through R and R

When the capacitor voltage overpasses the threshold one in pin determined by PCS it will be the A comparator which will change the output returning to activate the flip flop and restoring Q at high level to allow NPN leads and place pin to ground discharging now the capacitor through R

As the B comparator inverter input is connected pin trigger to the capacitor When its charge slightly decreases regarding the PCI value the B comparator output will switch again to Q state at low level constantly repeating the capacitor constant charge discharge vicious circle between Vcc PCI and of Vdc PCS



The objective of this practice is to verify through an oscilloscope as inferior and superior switching points correspond to the impulse width and the period

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Exercise Operating cycle and configuration resistors

The capacitor s charge constant is determined by R and R being equal to R R C The discharge is done through R for this reason the constant is R C

As both time constants are different according to the R and R value the operating cycle will be established between and

See now the R R and C translation to the practice Corresponding FQ FQ and C The two resistors are in this case variables allowing of establish different oscillation frequencies

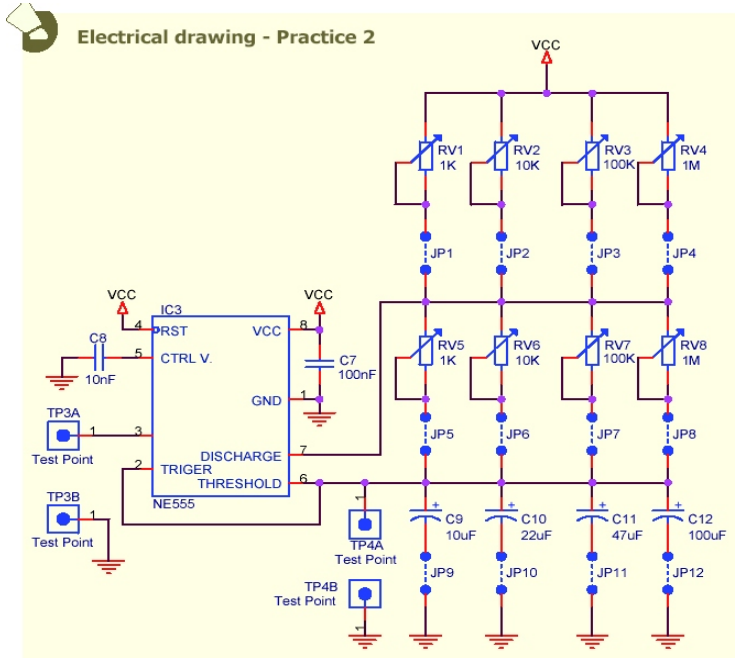
When FQ is superior to FQ the operating cycle is nearing to and the LED blinks at a lower speed with a lighton and light off cycle very similar

At the opposite if FQ is superior to FQ the operating cycle is practically equal to and the LED is almost completely fixe with a short blinking few perceptible

Note In order to check this PQ point do not completely place it at the minimum but leave it in a lower possible value

The minimum and maximum in both resistors is different from one to the other The objective of the exercise is to identify in which position left or right have been placed each one considering the influence of both resistors in the result of the operating cycle and oscillation of the LED

Practice Impulse width period and frequency



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Practice Impulse width period and frequency Part II

From charge and discharge constants it can be determined formulas to calculate the impulse width the period and consequently the frequency and the operating cycle

Formula to calculate Astable NE

W T second f Hertzs D R R en ohms C en Farades

Impulse width	W	**W**		**R**	**R**	
Period	T		**T**	**R**	**R**	**C**
Frequency	f		**f**	**R**	**R**	**C**
Operating cycle	D	**D**	**R**	**R**	**R**	**R**

invert regarding period one

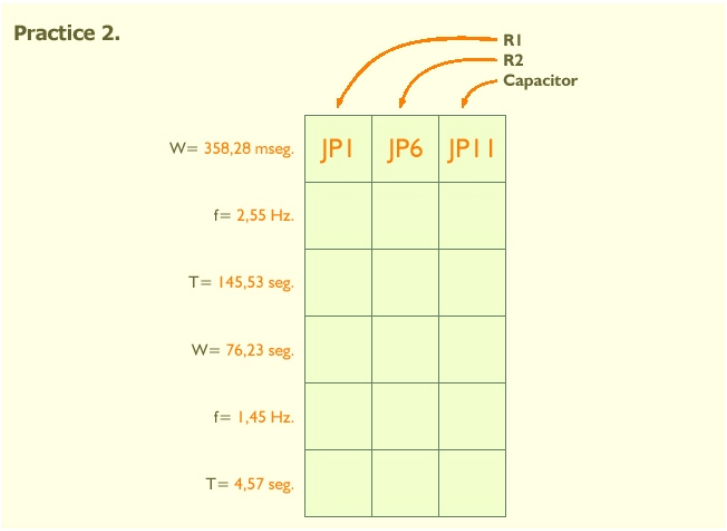
Impulse width Period

Practice allows to configure different combinations from “R ” “R ” and “C” through the closure of the corresponding jumpers and with the consistent impulse period and frequency difference

R can be RV RV RV or RV closing the corresponding JP JP JP or JP jumpers

R is selectable between RV RV RV and RV through the closing of one of JP JP JP and JP jumpers

C will obtain the C C C or C value according to the corresponding closure of JP JP JP or JP jumpers

For instance for a K R a K R and a uF capacitor you have to close JP JP and JP And it is the same thing RV RV and C will be selected

The exercise will consist in writing in each square the combination of jumpers which would configure necessary R R and capacitor to obtain the indicated value as well as the operating cycle monitoring through the oscilloscope