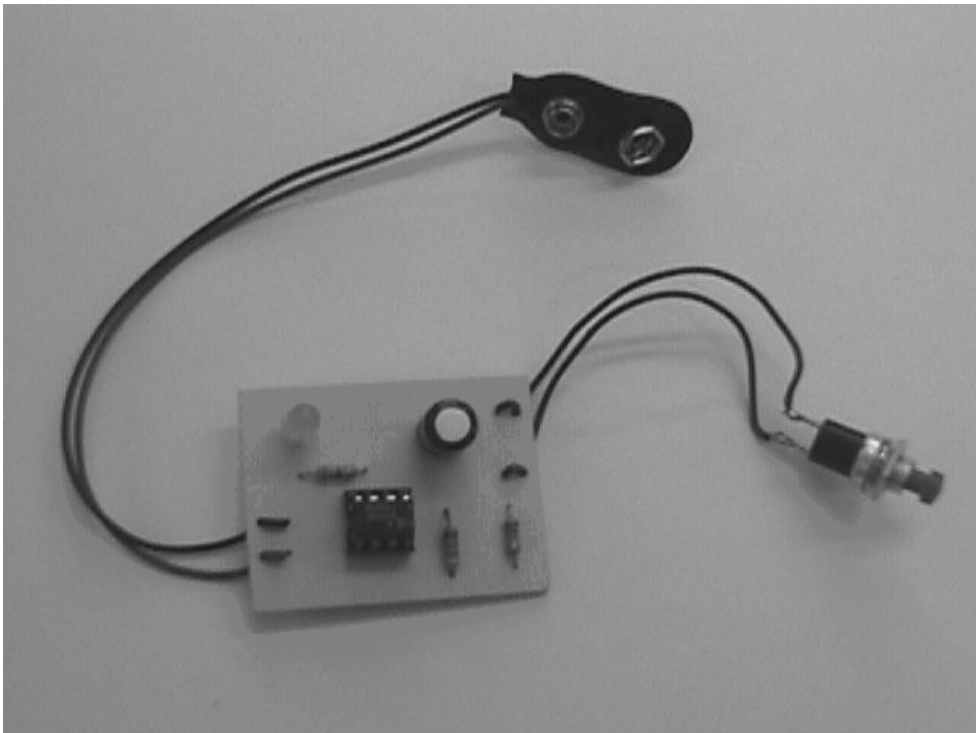


# Monostable Timer



Name \_\_\_\_\_

DT Group \_\_\_\_\_

# Monostable Timer

## Introduction

If you look around your home, you will be aware of a number of household appliances that require a start time and a finish time so as to be able to operate. Other products once activated, switch on, and after a period of time switch off. In the space below, list some electronic products that rely on timers to work.

Your list should have included a number of domestic household products as well as security based products.

## Design Brief

In all areas of Design and Technology we begin our problem solving by writing a **Design Brief**. This is simply, one or two sentences, stating what we are going to design and make, and what the solution does.

In the space below write your own Design Brief for a security light timer. You are to decide where the security light is to be based. It could be in your bedroom, or in a shed or garage. Include this in your brief.

To design and make ...

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## Research

At this stage you need to carry out some research or investigation in relation to the problem. This could involve consulting catalogues, visiting shops or carrying out a survey of user requirements. All the information you gather will help you build a specification for your product.

## Specification

The **Specification** needs to expand upon the **Design Brief** so as to provide the designer with enough information to be able to arrive at some ideas or possible solution. It provides the designer with a target, something to aim for. It must say what the design has to do or how the product should perform.

You will need to consider such things as the size of product (length, width and thickness or depth), power source (battery voltage and type), materials, appearance, ergonomics and finish in relation to the case. Safety and cost. What type of output device you are going to use (light or sound), and once activated, how long the product will be on for. In practice keep this time between 10 and 60 seconds.

A product's specification is used by consumers to compare the benefits or functions of one product against another. To help you with your specification, gather some examples of hi-fi systems from catalogues, and compare their specifications. You should see a number of areas that are common.,

In the space on the next page, list your specification based upon your **Design Brief**.

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| Area | Specification |
|------|---------------|
|      |               |

Ideas



Almost all our electronic circuits can be divided amongst these headings. The **input** part of the circuit collects or generates the electrical signal. The **process** part of the circuit uses or does something with the input signal. The **output** part of the circuit displays the signal in a way that we can interpret with our senses. (hearing, seeing etc)

In the space below, list the possibilities for input devices, process devices and output devices.

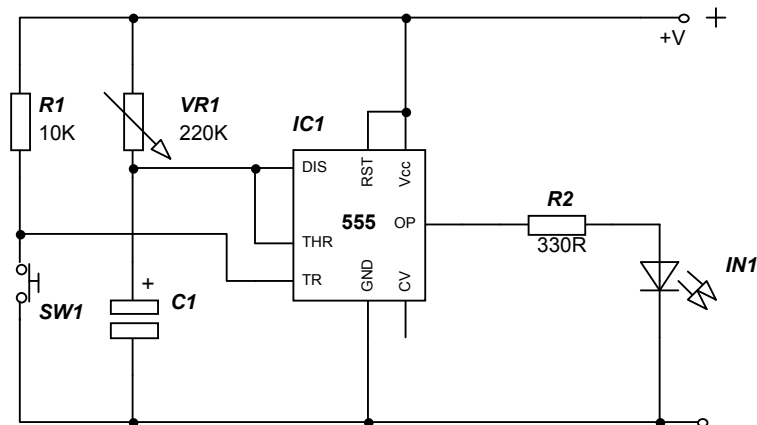
| Input | Process | Output |
|-------|---------|--------|
|       |         |        |

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## Solution

Looking through electronic component supplier's catalogues, a simple 8 pin integrated circuit, the NE555, would appear to provide a solution. If connected in monostable mode (single state), it can be made to switch on for a period of time and then switch off.

According to the manufacturers data sheet, by changing the value of a resistor and capacitor, the time interval can be altered. Electronics is not about designing circuits from scratch. It is about adapting circuits to solve problems. The circuit diagram is shown below.



## How does it work?

The circuit triggers on a negative-going input signal when the level reaches 1/3 of the supply voltage. (The supply voltage is 9v so the 1/3 value is 3v) Once triggered, the circuit remains in this state until the set time has elapsed, even if it is triggered again during this interval.

The duration of the output **High** (on) state is given by

$$t \text{ (seconds)} = C1 \text{ (farads)} \times VR1 \text{ (ohms)} \times 1.1$$

For the purpose of this project we can ignore the last part of the formula ( $\times 1.1$ ) as it does not make a lot of difference to the time calculated.

When a negative trigger pulse is applied to pin 2 (tr) by the closing of the switch (SW1), the flip-flop is set, releasing the switch, releases the short circuit across capacitor C1 and drives the output high.

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The voltage across the capacitor increases exponentially (not in a straight line) with the time constant  $t = R1 \times C1$

When the voltage across the capacitor equals 2/3 of the supply voltage (6v), the comparator resets the flip-flop, which then discharges the capacitor rapidly and drives the output to its Low state.

### You Are the designer

In your specification, you should have indicated how long you wanted your product to be on for. You are now going to determine the values for C1 and VR1. In the space below complete the calculations. From the parts list C1 = 100uf (0.0001f), you have already chosen a value for t. What you are trying to find out is the value in ohms that VR1 has to be set to.

$$t = VR1 \times C1$$

$$t \text{ (the value you have chosen in seconds)} = VR1 \times 0.0001 \text{ (100uf)}$$

$$VR1 = t \text{ (your value)} / 0.0001$$

$$VR1 = \underline{\hspace{2cm}} / 0.0001$$

$$VR1 = \hspace{2cm} \text{ Ohms}$$

### Helpful hint for converting units

When converting from uf to f, you have to move the decimal point 6 places to the left.

Starting value 100.uf

Stage 1 10.0 (the decimal point has moved 1 place to the left)

Stage 2 1.00 (the decimal point has now moved two places to the left since the start)

Stage 3 0.100 (the decimal point has moved three places to the left since the start)

Stage 4 0.0100 (the decimal point has moved four places to the left since the start)

Stage 5 0.00100 (the decimal point has moved five places to the left since the start)

Stage 6 0.000100 (the decimal point has moved six places to the left since the start)

You have now converted 100uf to 0.0001f. (you can ignore the zero's after the 1)

To convert from f to uf you do the opposite, i.e. you move the decimal point six places to the right.

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## Parts list

|      |   |
|------|---|
| R1   | 10K 0.25w resistor (Brown, black, orange, gold)   |
| R2   | 330R 0.25w resistor (Orange, Orange, Brown, Gold) |
| VR1  | 220K horizontal preset                            |
| C1   | 100uf 16v PC electrolytic capacitor               |
| IN1  | Green 5mm LED                                     |
| IC1  | NE555 IC  |
| SKT1 | 8 pin DIL socket                                  |
| SW1  | Push to make switch                               |
| Snap | PP3 battery snap                                  |
| Wire | 7/0.2mm connecting wire.                          |

## Prototyping (modelling)

Now that you have a possible solution, it is a good idea to make a prototype. You can do this either on breadboard using the components, or by using a computer circuit simulator program.

## Realisation (Construction or making)

Starting with the smallest components, carefully bend the leads of R1 and R2, and insert onto the PCB ensuring that the leads show through on the copper side. Then solder into place.

Next insert VR1 and solder, followed by SKT1. Note that the DIL socket has a notch to indicate the end nearest to pin 1. Make sure you insert the socket the right way round so as to assist in the correct insertion of the IC.

Next insert the wires for the switch. Each wire is inserted through the larger hole from the solder side, and then the bare wire is inserted into the smaller hole. Remember to solder on the copper side. Do exactly the same for the battery snap ensuring that the red wire goes to the + hole and the black wire goes to the – hole.

Solder the connecting wires onto the switch. It does not matter which wire goes to which side of the switch. Now insert the capacitor, making sure that the positive lead (longer lead) is nearest to the preset. The negative lead is the shorter lead.

Now solder the LED into place. The positive lead (anode) is the longer lead and must be inserted next to R2. The shorter lead (cathode) is the negative lead.

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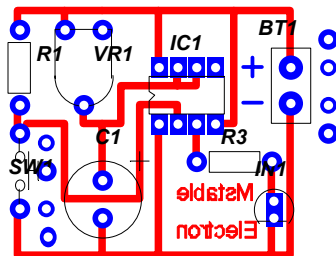
## 555 IC



Finally insert the IC into place ensuring that pin 1 is the correct way round. If you have soldered the socket correctly this will help you. Pin 1 can be found by the little dot as shown in the bottom left. There is also a notch cut into the IC on the left hand end.

All you have to do now is connect the battery, push the switch, and observe your LED come on, and after a period of time switch off.

## Component layout



## Testing

Once all the components have been soldered, it is worth spending a few moments checking to ensure that everything is in the correct place, and that certain components have been connected the right way round.

Also check all your solder joints to make sure that you have not joined any connections together by accident, especially around the IC.

If you are happy with your board, connect a PP3 battery. Initially, nothing should happen. The LED should be off.

Now press the switch and then release. The LED should be on. After a period of time the LED should go off.

If your circuit does not work, disconnect the battery and recheck all the components and solder joints. The circuit will not work if certain components have been put in the wrong way round, or if you have poor solder joints. Pay special attention to the joints around the IC.

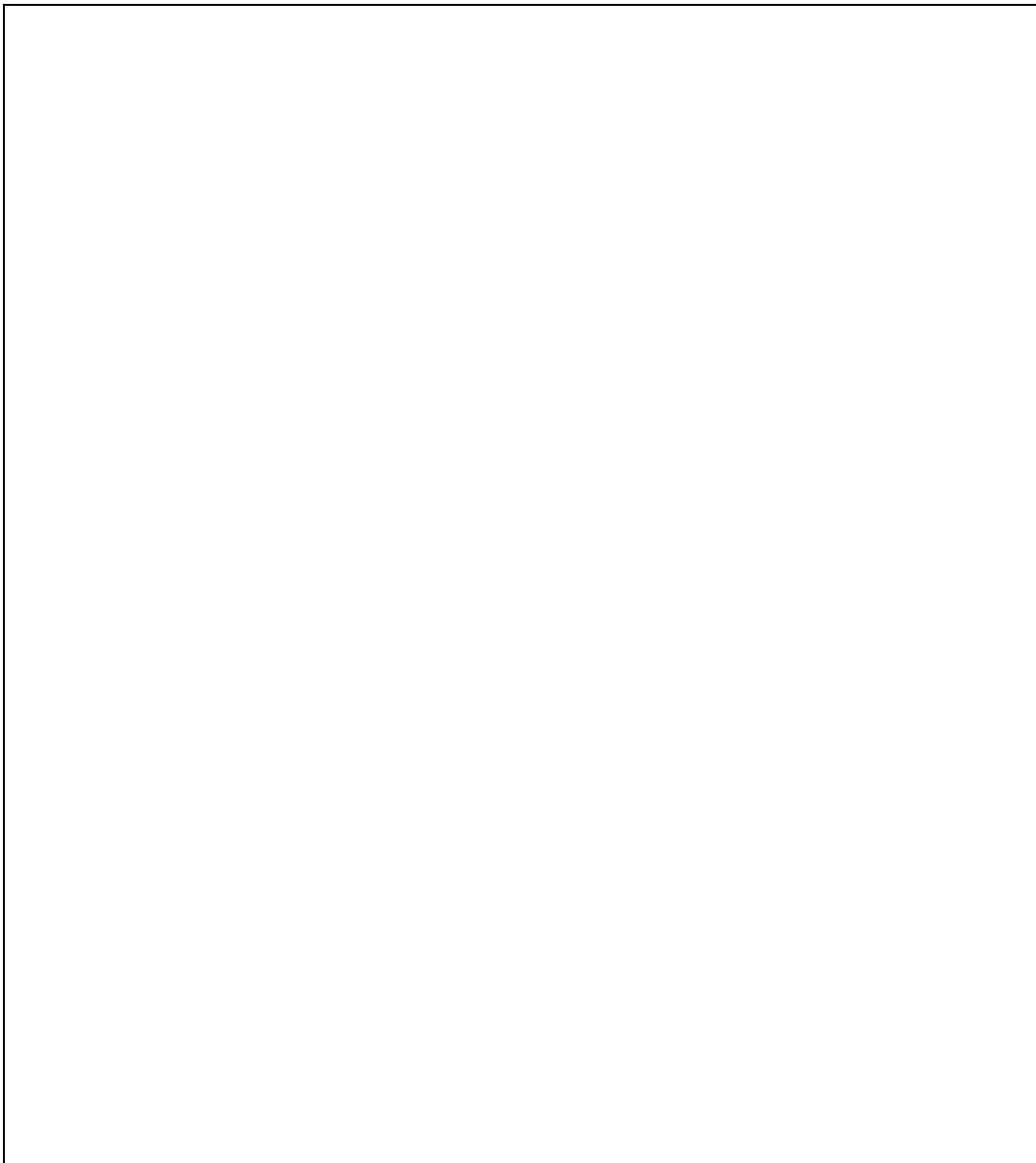
# Monostable Timer

## Case

All electronic circuits need to be mounted into a case. There are a number of reasons for this including protecting the components from the environment (where the product is to be placed), and providing an attractive finish for the product. You would not buy a hi-fi system if all the electronics were not in a case.

In the space on the next page, design a case for your monostable timer. Do ensure that you leave enough space to fit the battery in. A good starting point would be to measure your circuit board including height of the tallest components, along with a PP3 battery. Draw a rough sketch of each first.

Consider different materials and how you are going to make your case look interesting and colourful.



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## Evaluation

Having completed your product, it is a good idea to pause and look back at what you have done.

One of the first things you need to ask yourself is, does your finished product meet the **design brief**? Does it also meet the **specification**?

If it does, congratulations. If it does not, what would you do differently, so that it would meet, both the **design brief** and the **specification**?

From your point of view, what did you find easy about this project and what did you find difficult? If you were to start all over again, what would you do differently?

Record the outcome of your **evaluation** in the space below.

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## Teachers notes

### Who is the project aimed at?

A simple project aimed at KS3/KS4.

### Objectives

To introduce the student to the principle of timing, and how the timing period can be changed by a simple calculation. Secondly to introduce the design process to the student, so that when they reach KS4 and the major project, they will be familiar with this approach. By using the design process students can start to look at real problems and find a solution.

Other skills that can be developed using this project include the use of prototyping techniques such as breadboard, and computer circuit simulation programs. From a practical point there is an opportunity for the student to make their own PCB and improve their soldering skills.

### The circuit

The circuit is a robust design, and even if the IC is inserted the wrong way in most cases it will survive.

### Worksheets

The student worksheets are copyright of Electron Electronics. They can be photocopied for use in educational establishments only.

### Supply of components

Electron Electronics are able to supply a full kit of parts for this project. Each kit is presented in a labelled bag ready to be given to the student. All the student requires is a soldering iron, solder and PCB.

The PCB is available separately. As an alternative, a pack of masks can be purchased for those schools who wish to manufacture their own boards.

Electron Electronics can supply a full range of components and associated equipment for electronics in schools. Tel 01737 841568 Fax 01737 841608 or e-mail [sales@electronelec.co.uk](mailto:sales@electronelec.co.uk) for more details.