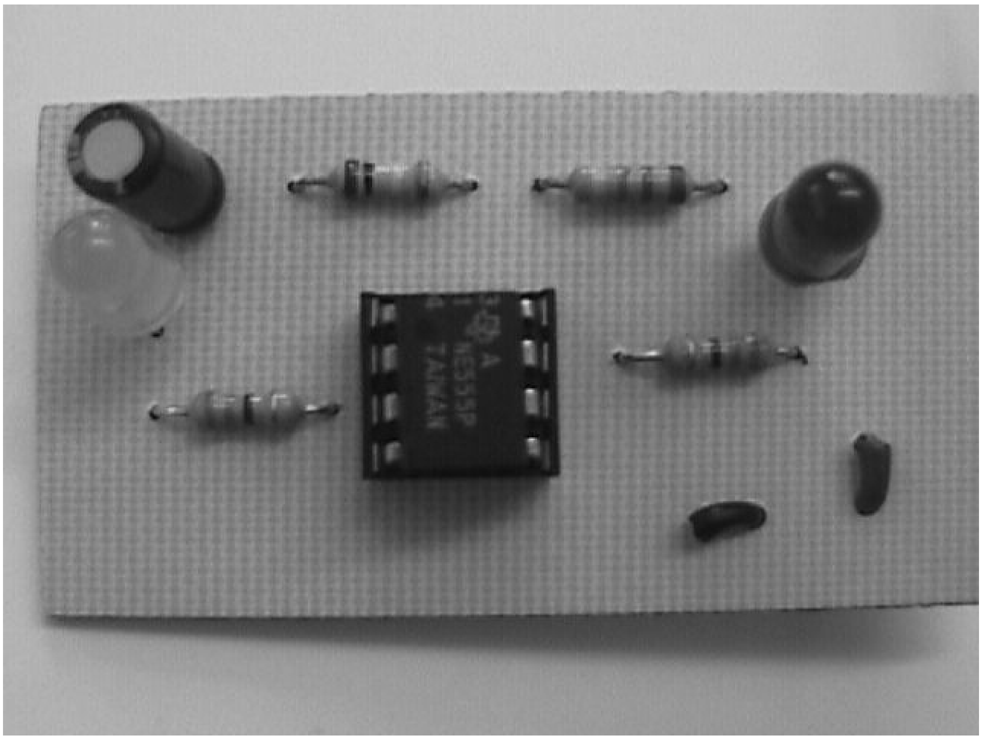
Astable Timer



Name ______________________________

DT Group ___________________________

Astable Timer

Introduction

There are many products around us that have lights that flash on and off. In most cases these are used for warning purposes. In the space below, list as many products that have flashing warning lights.

Your list could have included a number of products that relate to roads and motoring.

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 flashing warning light. You are to decide where the warning light is to be based and what it is warning of. Include this in your brief.

To design and make …

Astable Timer

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**.

Astable Timer

Area	Specification

Ideas

Input ⇨ Process ⇨ Output

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.

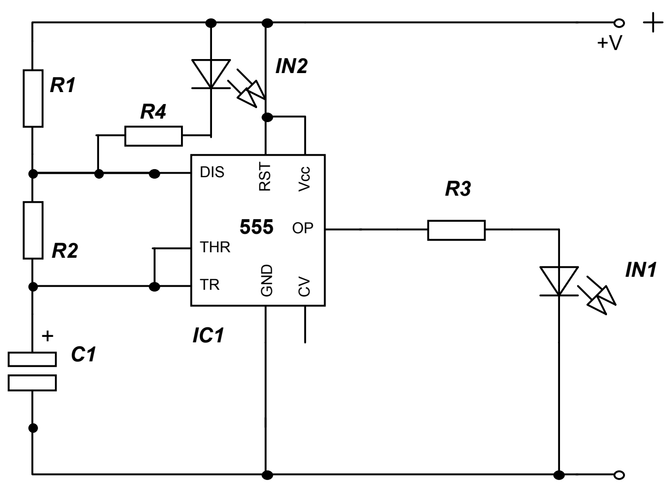
Input	**Process**	**Output**

Astable Timer

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 Astable mode (multi-state), it can be made to switch on, then off, and on again, then off and so on. It will continue like this until the power source is disconnected.

According to the manufacturers data sheet, by changing the values of the resistors R1 and R2 and the capacitor, the time interval from on to off to on again 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?

When the circuit is connected to a power source it triggers itself and free runs as a multivibrator. The capacitor C1 charges through R1 and R2 and discharges through R2 only. The duty cycle may be precisely set by the ratio of these resistors.

C1 charges and discharges between 1/3 Vcc and 2/3 Vcc (If Vcc is 9V then the two values are 3V and 6V).alue is 3v)

The charge time (output **High** (on) state) is given by:

t1 (seconds) = **0.693** x **(R1 + R2)** x **C1** (farads)

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The discharge time (Output **Low** (off) state) is given by:

t2 (seconds) = **0.693 x (R2) x C1** (farads)

Thus the total period T is given by:

T = **t1 + t2** = **0.693** x **(R1 x 2R2)** x **C1**

The frequency of oscillation is then:

F = **1/T** = **1.44/ ((R1 +2R2)** x **C1)**

You are the designer

In your specification you should have indicated the frequency of oscillation. In other words the time from on to off, and then on again and so on. In the space below calculate the frequency if R1 is , R2 is , and C1 is .

F = **1/T** = **1.44/ ((R1 +2R2)** x **C1)**
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 10.uF Stage 1 1.0 (the decimal point has moved 1 place to the left) Stage 2 0.10 (the decimal point has now moved two places to the left since the start) Stage 3 0.010 (the decimal point has moved three places to the left since the start) Stage 4 0.0010 (the decimal point has moved four places to the left since the start) Stage 5 0.00010 (the decimal point has moved five places to the left since the start) Stage 6 0.000010 (the decimal point has moved six places to the left since the start) You have now converted 10uF to 0.00001F. (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.

Parts list

R1 47K 0.25w resistor (yellow, violet, orange, gold)
R2 100K 0.25w resistor (brown, black, yellow, gold)
R3 330R 0.25w resistor (orange, orange, brown, gold)
R4 330R 0.25w resistor (orange, orange, brown, gold)

C1 10uF 16v PC electrolytic capacitor

IN1 5mm red LED
IN2 5mm red LED
IC1 NE555 IC
SKT1 8 pin DIL socket

Snap PP3 battery snap

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, R2, R3 and R4, and insert onto the PCB ensuring that the leads show through on the copper side. Then solder into place.

Next insert 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 battery snap ensuring that the red wire goes to the + hole and the black wire goes to the 0v hole. Each wire is inserted through the larger hole from the component side first, then through the hole from the solder side, and then the bare wire is inserted into the smaller hole. Remember to solder on the copper side.

Now solder C1 making sure that the positive leg is connected to R2. Then solder the LED’s into place. The positive lead (anode) is the longer lead and must be inserted to the positive side of the circuit. The shorter lead (cathode) is the negative lead.

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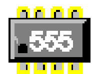
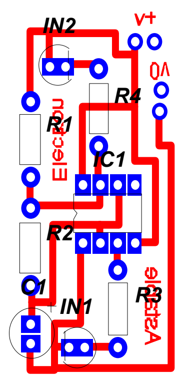
555 IC



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 to connect the battery and observe your LED come on and go 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. One LED should light and then go off. If you are using a second LED this should now light and then go off. The first LED will again light and so on.

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.

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 Astable 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.

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.

Teachers notes

Who is the project aimed at?

A simple project aimed at KS4.

Objectives

To introduce the student to the principle of multi-timing, and how the frequency can be found from 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 photo copied 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 manufacturer 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 for more details.