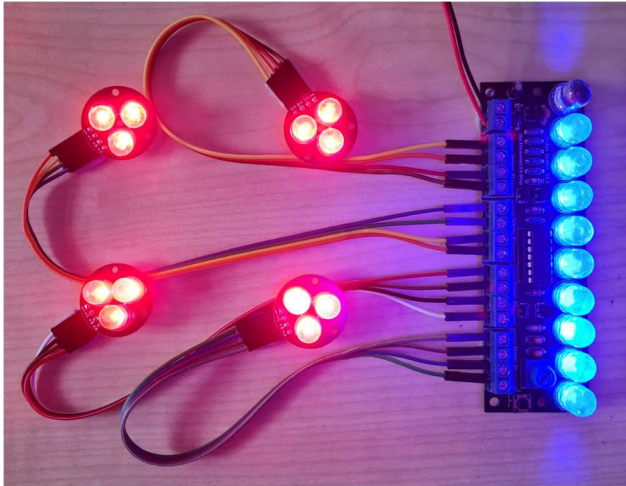


# Build your Ghostbusters Inspired Proton Pack Lighting Chaser Kit



You'll be super proud to have these amazing lights in your Ghostbusters themed cosplay!

Designed in the UK, this fabulous electronic kit comes with all components, complete with a PCB (Printed Circuit Board) for the Main Controller and four circular PCBs for the Cyclotron Lights, and has a preprogrammed real microcontroller containing the Proton Pack Lights software

On the rectangular Main Controller PCB are ten bright blue massive 10mm diameter LEDs which progress upwards and show the Power Cell charging lights. You can choose to mount the LEDs on the front, or back, or side of the PCB to best suit your backpack project. You could also mount the LEDs away from the PCB on flying leads if you wish. The PCB measures 112mm x 35mm and has four handy M3 mounting holes. The Mode pushbutton lets you select in which direction the LEDs will “fill-up”, so you can mount the PCB either way up in your backpack.

Each of the four circular Cyclotron Lights PCBs has three large 8mm diameter red LEDs which can either be statically lit or optionally show a spinning effect, and each Cyclotron Light PCB illuminates in turn as the Power Cell cycles. The PCBs are 25mm diameter and have two M2 mounting holes.

Your project comes with wires for each of the Cyclotron Lights, and a choice of connectors for them so you can mount and wire them for whatever is best for your backpack. The Main Control PCB has screw terminal wiring connections, so once you have built it there's no need for soldering to wire up your backpack. Your project is powered from a 9V PP3 battery (not included).

This really is a remarkable authentic looking project.

***Please read through all of these instructions before starting to construct your project.***

YouTube step-by-step assembly video:

[https://youtu.be/AmU\\_16Q4NnU](https://youtu.be/AmU_16Q4NnU)

Electronics, PCB and software all designed in Britain by *The Electronics Kit Shop*.



**The Electronics Kit Shop**



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**Visit Site**

# General Project Information

	<p><b>CHOKING HAZARD</b> Contains small parts, not suitable for small children. If children might use the finished project they must be supervised at all times.</p>
	<p><b>Persons with Photosensitivity</b> Contains flashing bright lights</p>

## Required Skills

The project requires the basic ability to solder and to follow assembly instructions.


Assembly of the project must be carried out by a competent adult or person under adult supervision.

## Intended Use

The project is for educational or home domestic hobby environments for fun and amusement. The project is **not** for use in or near industrial, safety-related, medical devices, automotive or aviation.

## Environmental

The finished project is intended for a clean, dry environment. Don't expose the project to direct sunlight and sources of ultraviolet light (UV).

	<p>The project and associated waste must be disposed of in an environmentally friendly manner at a designated facility, and not be disposed of in household waste.</p>
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## Power Supply

The project is intended to be supplied from a 9V PP3 alkaline battery. **Under no circumstances exceed 16V.** Excessive voltage or unstable supplies can damage components or pose a heat or combustion hazard.

## Electrostatic Discharge

Some components are sensitive to static electricity "electrostatic discharge" (ESD), which can damage or destroy them. It is recommended that you ground yourself by wearing an anti-static wrist strap connected to a grounded surface or by safely touching a grounded surface when handling these components.

Use of an anti-static work mat is recommended.

## Working Practices

Do not work on the project when it is connected to a power source.

Follow the instructions for assembling the project and ensure that all components are fitted as specified. Some components such as electrolytic capacitors can be a heat or combustion hazard if not fitted correctly.

Work in a well-ventilated area and observe all soldering safety precautions while assembling your project.

Avoid touching hot components.

Wear personal protective equipment for example gloves and eye protection where necessary.

Do not use bleaches, harsh cleaning agents, or solvents on your project or immerse your project in fluids.

Some projects contain bright LEDs; avoid looking directly into the LEDs when illuminated.

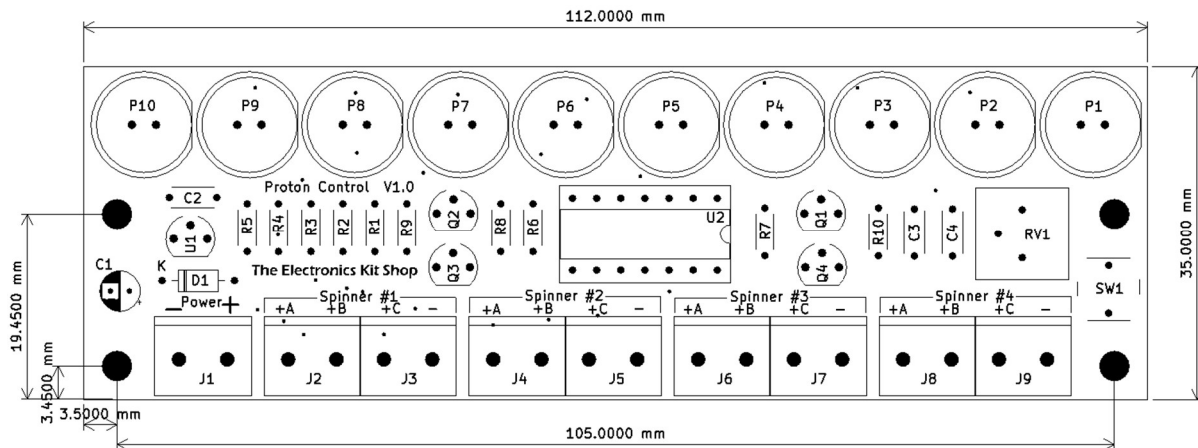
Ensure nothing conductive can touch the components or PCB while the project is in use.

Immediately disconnect the project from the power source if there are any signs of heat, odours, smoke, or discoloration of components or the PCB.

# Project Dimensions and Features

## Control PCB

### Dimensions



The four mounting holes are 3.2mm diameter (suits M3 screws).

### Component Mounting Options

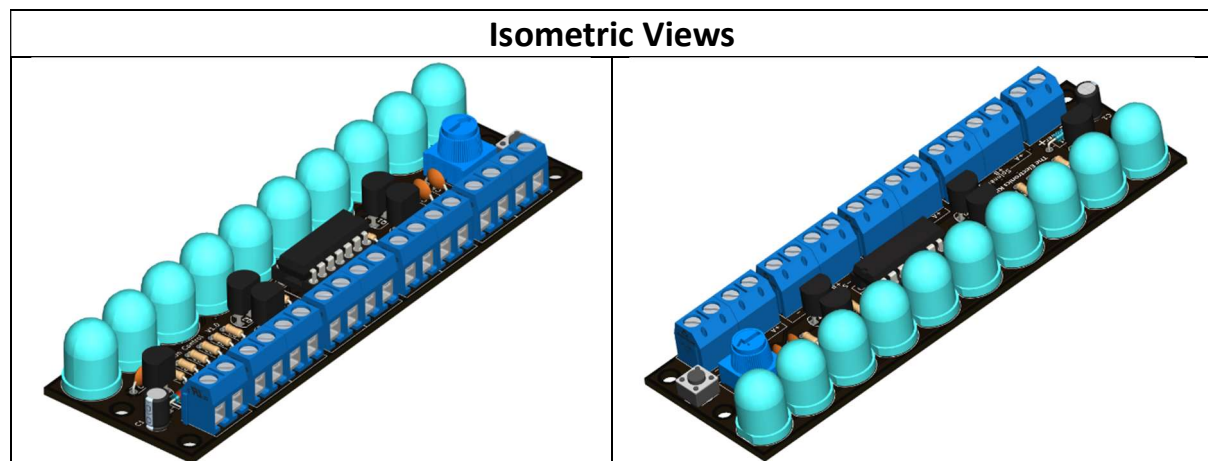
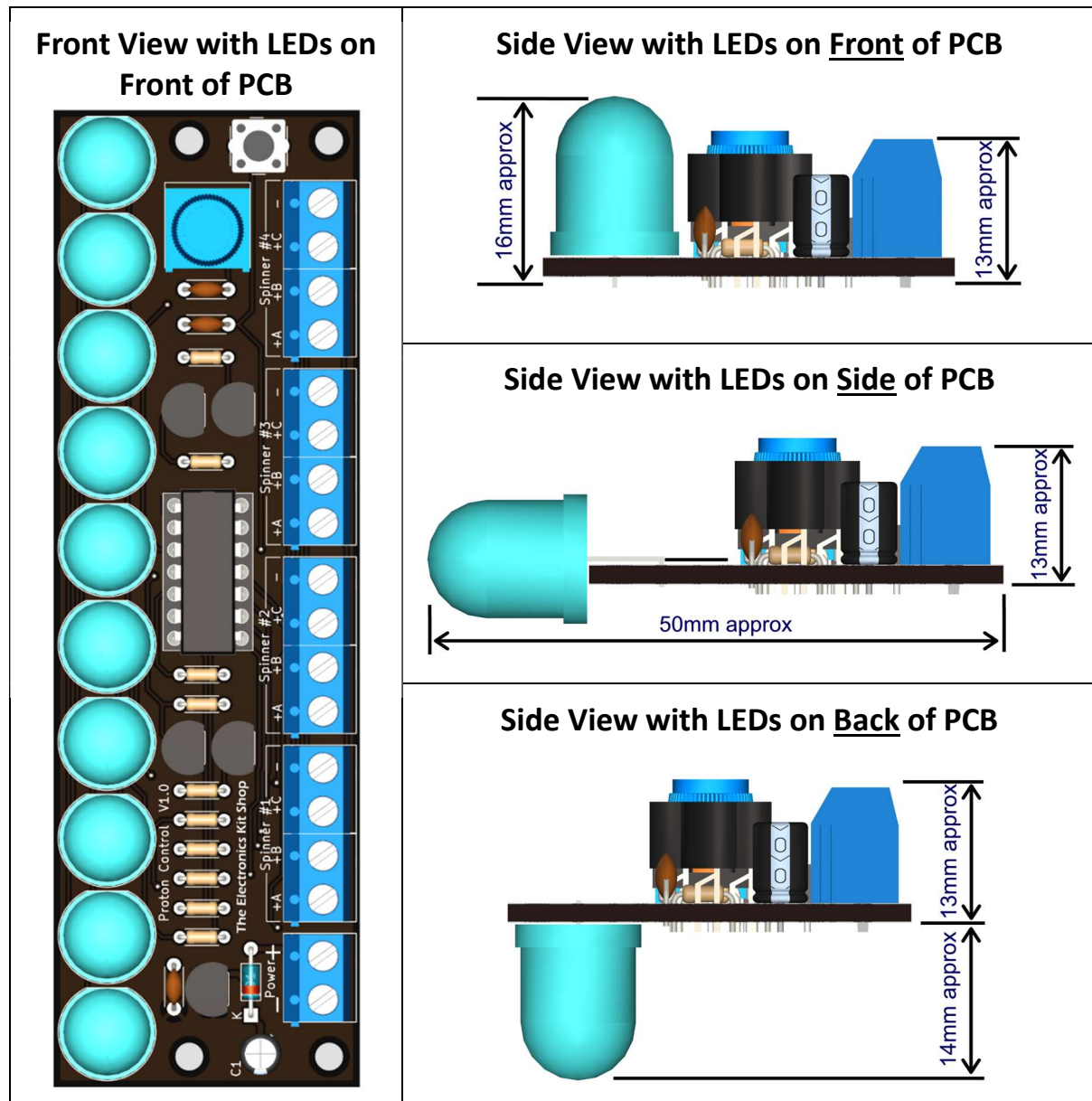
Component	Front of PCB	Back of PCB	To the Side	Flying Leads
Mode Pushbutton <b>SW1</b>	✓	✓	✗	✗
Speed Control <b>RV1</b>	✓	✓	✗	✗
Screw Terminal Blocks <b>J1</b> thru <b>J9</b>	✓	✓	✗	✓
Blue LEDs <b>P1</b> thru <b>P10</b>	✓	✓	✓	✓

You can fit the Mode Pushbutton, Speed Control, and Screw Terminal Blocks on either side of the PCB. If you wish, you can omit the Screw Terminal Blocks and solder the wires directly to the PCB.

The blue LEDs can be fitted on either side of the PCB, or can be fitted at 90 degrees so they face outwards to the side of the PCB, or on flying leads. The blue LEDs are approx. 14mm tall.

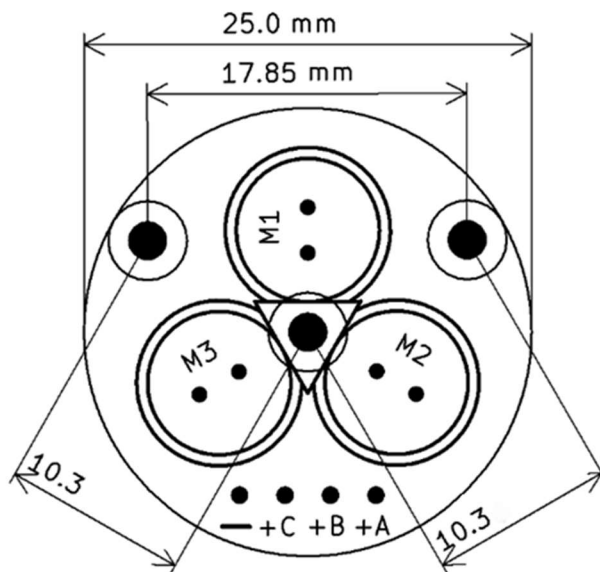
**Note:** The Mode Pushbutton allows you to choose in which direction the LEDs “fill up”, so you can mount the Control PCB either way up.

Constructed Views



## Cyclotron PCB

### Dimensions



There are 4 Cyclotron PCBs in your project which each have 3 red LEDs. These have a “spinning” effect when they are activated.

The two mounting holes on the outside are 2.2mm diameter (suits M2 screws).

The centre 2.2mm diameter hole can be used if you want, but note that it is too close to the LEDs to fit a standard M2 screw head.

The 3 LEDs are mounted on the front of the PCB, and the wiring connectors onto the back of the PCB.

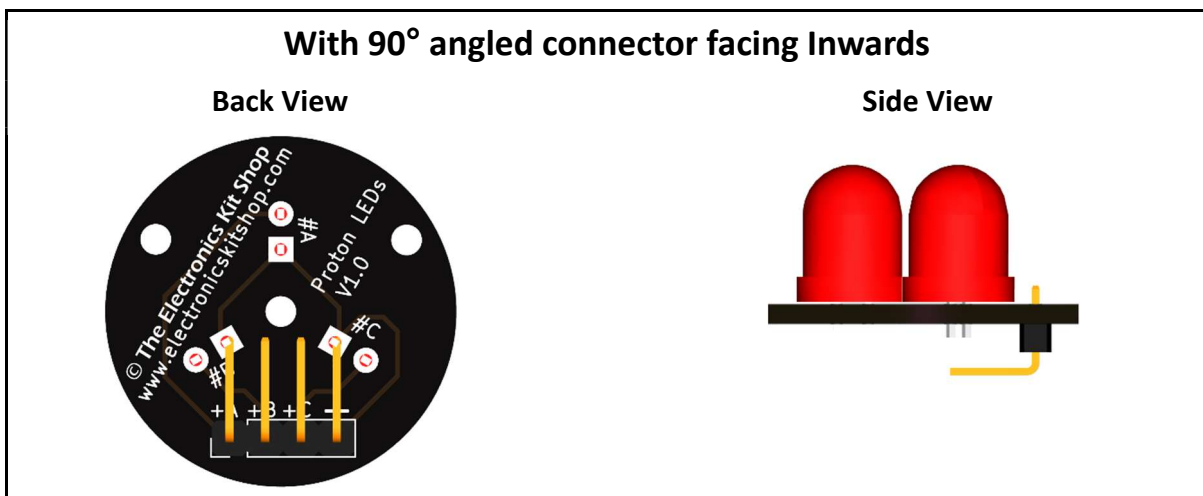
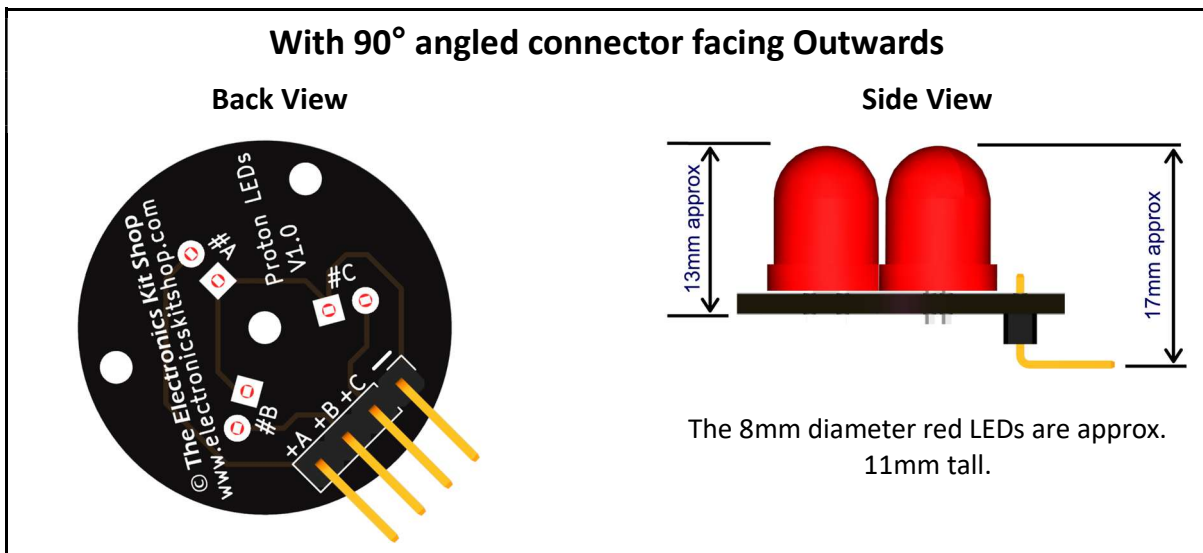
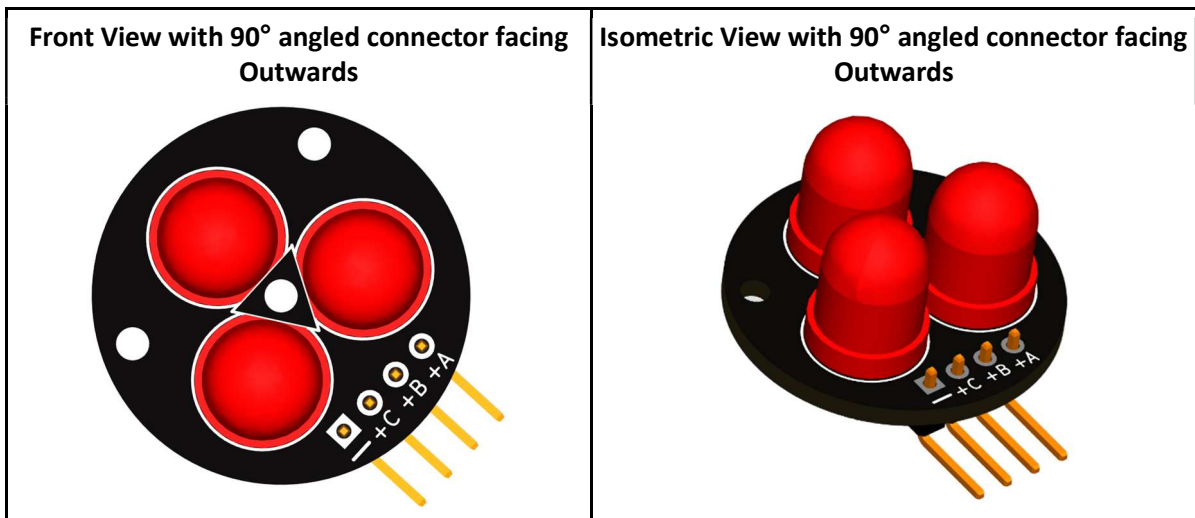
### Component Mounting Options

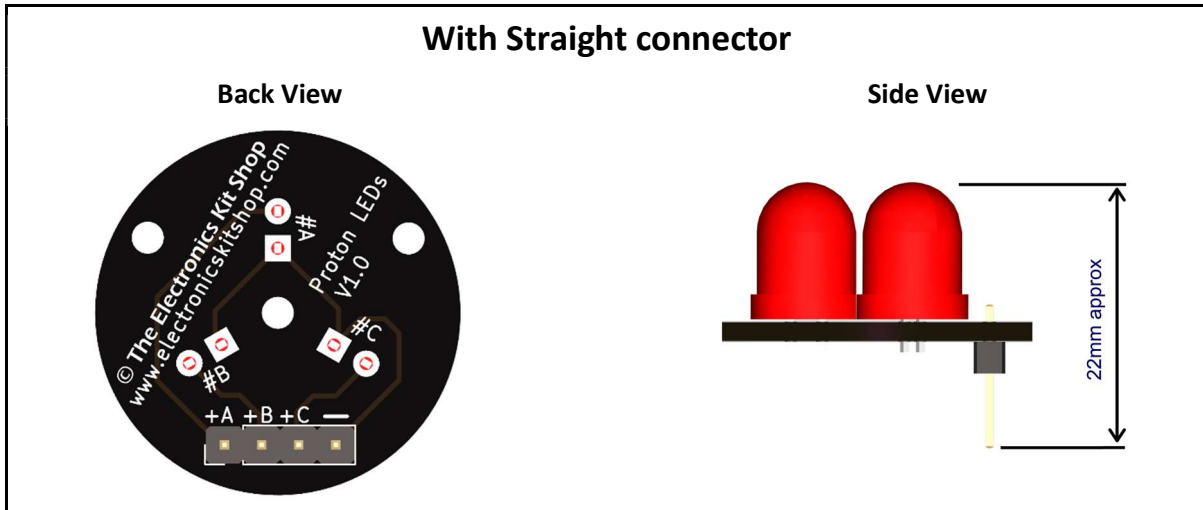
Component	Front of PCB	Back of PCB	To the Outside	To the Inside
Straight wiring connector	✗	✓	✗	✗
90 degrees angled wiring connector	✗	✓	✓	✓
Directly soldered wires	✓	✓	✓	✓
Red LEDs <b>M1</b> thru <b>M3</b>	✓	✗	✗	✗

You can choose a straight wiring connector, or a 90 degrees angled wiring connector, or you can omit the connectors and solder the wires directly through the PCB holes instead.

The red LEDs always stand upright on the front of the PCB.

Constructed Views





# Learn about your Project

## The Microcontroller



The microcontroller is the heart of your project. It is a very small self-contained computer with its own in-built memory and which runs its own software. It's just like your PC, laptop, tablet or mobile phone – but many times smaller and simpler, and with limited capabilities.

There are many different types and sizes of microcontroller. The microcontroller in your project is called the PIC16F18325 and is manufactured by Microchip Inc of the USA (you can get the datasheet from the Microchip website).

### What does the Microcontroller do in my Project?

The microcontroller's job is to read the Mode and Speed inputs, and to activate the LED outputs. There is no direct electrical connection between the Mode and Speed inputs and the LED outputs. The microcontroller decides what to do with the LED outputs according to how it has been programmed, with its "Software".

The software is already programmed into the microcontroller's permanent memory, which is called "Flash Memory". This memory is like an SD card or a hard disk – when you remove power it does not forget. So next time you power on your project, it knows exactly what to do.

The microcontroller also contains "RAM" memory for remembering information that changes while it runs the software, for example which LEDs are showing now and which LEDs are to be shown next. RAM memory forgets when you remove power, but it doesn't matter, because the important software is permanently in the "Flash" memory.

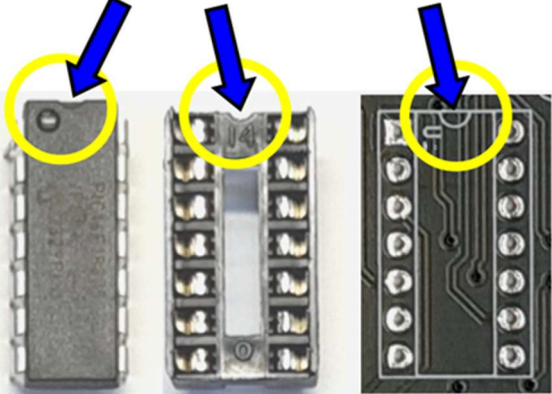
Inside the microcontroller is another type of memory called "Non-Volatile" memory. This special memory is like RAM, so can be used to remember things that change, but it does not forget when power is removed. In this project the Non-Volatile memory is used to remember which Mode you have selected, so next time you power your project, the previous Mode is automatically started.

### What do I have to be aware of with the Microcontroller?

The microcontroller has metal pins around the outside which connect it to the project circuit. The pins are numbered starting at **Pin 1** at the **top left** of the microcontroller body, and are numbered clockwise downwards on the left, then upwards on the right of the body.

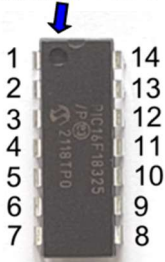
The microcontroller must be fitted the **correct way around**, else its pins would not go to the correct places in the circuit. It is important to know where **Pin 1** is. If plugged in the wrong way around, it could be destroyed.

Because it is possible to damage microcontrollers by **heat**, for example by soldering, the microcontroller in this project also has a socket to plug it into. The socket is soldered to the PCB first, then the microcontroller can be fitted last of all. It is best to do some testing of the PCB before fitting the microcontroller – see later in this document.

<p><b>Notch means Pin 1</b></p> 	<p>You can tell which way around to fit the microcontroller and socket by locating a <b>Notch</b> which tells you where <b>Pin 1</b> is.</p> <p>The notch in the socket aligns with the notch in the printing on the PCB.</p> <p>The notch (and little dot) on the microcontroller tells you where <b>Pin 1</b> is, and this aligns with the socket and PCB.</p>
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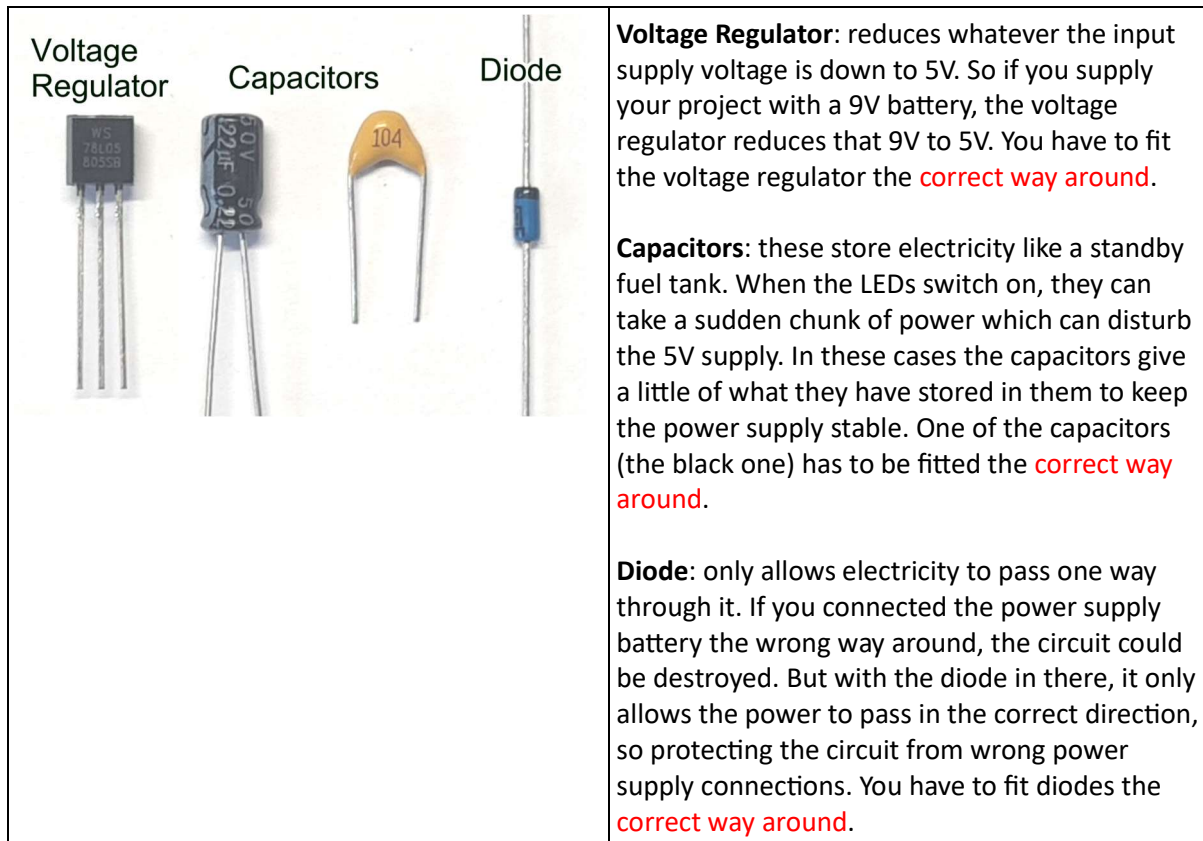
Microcontrollers are also sensitive to **static electricity** which can damage them. The microcontroller is supplied in the project plugged into some static safe foam and contained inside a static safe bag. If you have an “Earthing Wrist Strap” you should use that when handling static sensitive devices such as the microcontroller. If you don’t have an Earthing Wrist Strap, it is worthwhile getting one, or (safely) touch something ‘electrically grounded’ while handling static sensitive devices.

### What do the Microcontroller Pins Do?

<p><b>Notch and Dot means "Pin 1"</b></p> 	<p>The Microcontroller in this project has 14 pins.</p> <p>Two of the pins supply power to the microcontroller.</p> <p>The microcontroller has two ‘input’ pins which detect when you press the Mode button and when you adjust the Speed.</p> <p>It also has 10 ‘output’ pins which drive all of the LEDs on and off.</p> <p>The software inside the microcontroller tells it to read the Mode button and Speed inputs, and what to do with the LED outputs.</p>
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## The Power Supply

The microcontroller can only be supplied with 5V or less; greater than 5V would destroy the microcontroller. So we have a little Power Supply in the circuit that reduces the power input voltage down to the 5V that the microcontroller needs.



## The Inputs and Outputs

All electronic projects have:

- At least one output
- Either no inputs, or one input, or more than one input

Look at any electronic device and you'll see that it has at least one output and often has inputs. Your mobile phone's outputs are the visible screen and the speakers. Its inputs are the touchscreen and the side buttons.

Your Proton Pack project has two inputs and 22 outputs.



**Pushbutton Input:** is wired to the microcontroller so it can detect when you press this button, and the software then changes the Mode to the next Mode. This type of input is called a “Digital” input. The button can either be pressed on or not pressed; there’s no “half pressed”.

Your project has several **Modes**:

1. Power Cell LEDs cycling from **Bottom to Top** with spinning Cyclotrons
2. Power Cell LEDs cycling from **Top to Bottom** with spinning Cyclotrons
3. Power Cell LEDs cycling from **Bottom to Top** with statically lit (light bulb) Cyclotrons
4. Power Cell LEDs cycling from **Top to Bottom** with statically lit (light bulb) Cyclotrons
5. Power Cell LEDs cycling from **Bottom to Top** with fading light bulb Cyclotrons
6. Power Cell LEDs cycling from **Top to Bottom** with fading light bulb Cyclotrons
7. **Test Mode** - all LEDs lighting up one after another to test them

In your Proton backpack you would only use one of the first six cycling modes, and which one you use depends upon which way up you will be mounting the Control PCB and how you would like the Cyclotrons to be shown. You can try all of them and see which you like best.

The **Test Mode** is *only* for checking that all the LEDs are connected and are working correctly.

The microcontroller remembers which mode you selected so it always starts in that mode when you next switch on.

The Mode pushbutton can be fitted on either side of the PCB, whichever is best for your use of the project.

**Speed Control Input:** is wired to a separate input so the microcontroller can tell the Speed at which you want the LEDs to operate. This control is connected to an input type called an “Analog” input. Analog inputs can be any value, not just on or off like a button, but any value inbetween. In this case the control produces a voltage depending upon how far it is turned, and the microcontroller reads that voltage and converts it to a speed. In this project the Speed Control also has its own capacitor to smooth out the voltage that the microcontroller reads.

Similarly as with the Mode pushbutton, you can fit the Speed Control on either side of the PCB, whichever is best for your use of the project. You can turn the control knob to slow down or increase the animation speed of the LEDs. In the Ghostbusters movies the Power Cell cycles from bottom to top about once per second.

# Constructing your Project

Your project has three main areas:

- The **Control PCB**, containing the blue cycling Power Cell LEDs, Screw Terminal Blocks, Microcontroller, and all other components associated with wiring and controlling your project
- The **Cyclotron PCBs** (in this project also called the “**Cyclotron Spinners**”) containing the red LEDs, and are fitted remotely from the Control PCB via wiring
- The **wiring** for the whole project

We'll look at constructing each of these areas one after another.

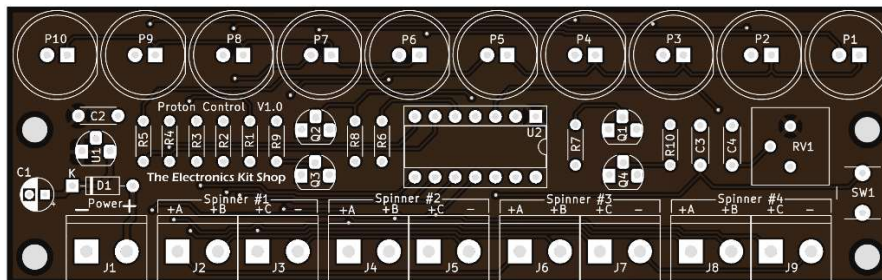
## Constructing the Control PCB

### Control PCB Component Placement

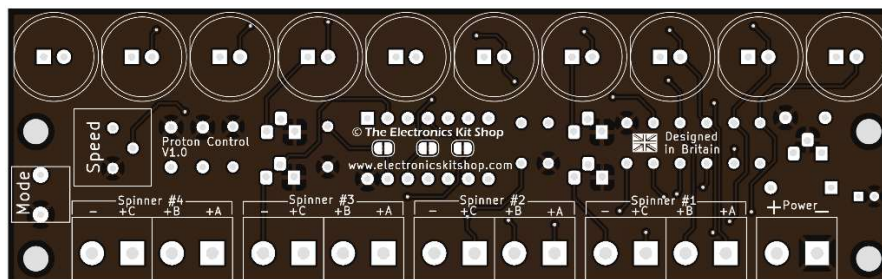
The Control PCB has printing on it to show you where the components are fitted. The letters and numbers on the PCB are “Component References” to tell you which components go into that place on the PCB.

Components generally go on the front of the PCB, but you can fit the Mode pushbutton, Speed Control, LEDs, and Screw Terminal Blocks on either side of the PCB to suit your project.

Front of Control PCB










Back of Control PCB



## Control PCB Components List

Note that some components in your kit may come in separate little packages.

Qty	Reference	Value	Function	
1		C1	Electrolytic capacitor 0.47uF or 22uF	Power supply (PSU) smoothing
3		C2, C3, C4	Ceramic capacitor 100nF (marked '104')	PSU smoothing, analog filtering
1		D1	Diode BAT48	Reverse supply protection
1		J1	Screw Terminal Block	Power supply input connection
4		J2 thru J9	Screw Terminal Block	Cyclotron output connections
10		P1 thru P10	10mm blue LED	Power Cell display
4		Q1 thru Q4	2N7000 Transistor	LED drives. Be sure not to mix this up with the Voltage Regulator – they look the same
6		R1 thru R6	Resistor 150R Ohms	LED current limiting

4		R7 thru R10	Resistor 10K Ohms	Keeps transistors (and LEDs) off while the microcontroller is starting up
1		RV1	Potentiometer 10K	Speed Control
1		SW1	Pushbutton	Mode selection
1		U2	PIC16F18325	Microcontroller
1		U1	Voltage regulator 78L05 or 805Z	5V power supply regulator. Be sure not to mix this up with the Transistors – they look the same
1		DIL socket	14 pins	Microcontroller socket
1		PCB	Proton Pack PCB	Printed circuit board

## .... if you are an experienced electronics constructor

For those constructors who are knowledgeable and experienced in constructing electronic kits, you might not need the detailed information in the following explanatory notes and are quite happy to construct your project based upon the Components List above, coupled with your experience. In which case you could skip past much of the next section on the detailed assembly.

## Control PCB Detailed Assembly

### Please be aware

Almost all components can be **damaged by heat**. They can be melted visibly externally or they can be damaged invisibly internally – so they look OK but actually are melted inside. When soldering only

use as much heat and solder as is needed to hold the component and give a good electrical contact. Too much heat almost always damages components.

### Before applying power to your project

Always check for faults before applying power, and especially before fitting the microcontroller into its socket. See later in this document for a suggested test procedure.

## Construction Order

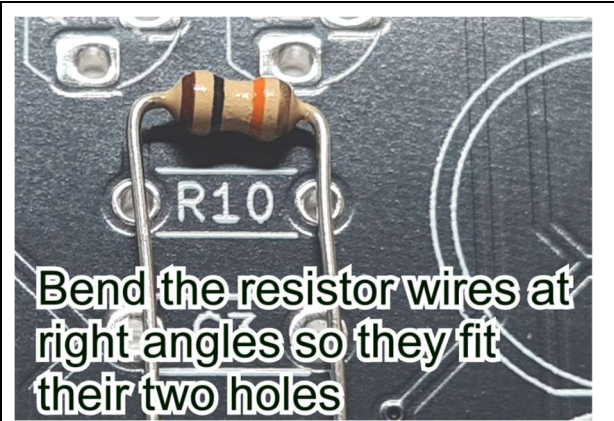
For the Control PCB we'll assemble generally in order of component height, with the lowest height components being fitted to the PCB first.

A good order for construction is:

- Lowest height components such as the resistors and diode
- Microcontroller socket
- Pushbutton
- Ceramic capacitors (the yellow ones)
- Voltage regulator and Transistors
- Screw Terminal Blocks
- Speed Control adjuster
- Electrolytic capacitor (the black cylinder one)
- LEDs
- Then **after** initial testing, fit the microcontroller

## The Resistors

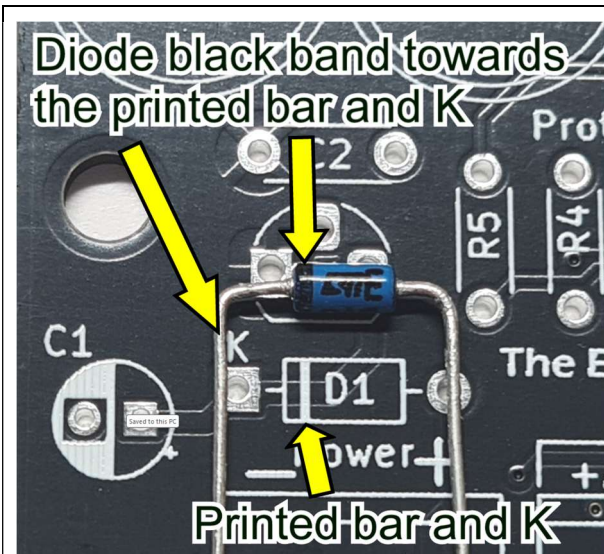
The LEDs of course need power, but LEDs operate at only about 2V to 3V, so they could be damaged by our 5V power supply. So to reduce the voltage and current that the LEDs are supplied with, we have resistors in-line with the LEDs. Resistors reduce the voltage and current similar to how standing on a garden hose restricts the water flow.

 <p>Bend the resistor wires at right angles so they fit their two holes</p>	<p><b>Resistors:</b> don't care which way around they are fitted.</p> <p>Resistors in your project have <b>different values</b>. Make sure not to mix them up.</p> <p>Bend the resistor wires at right angles so they fit into their two holes in the PCB.</p>
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The resistors lay flat in their two holes on the PCB.

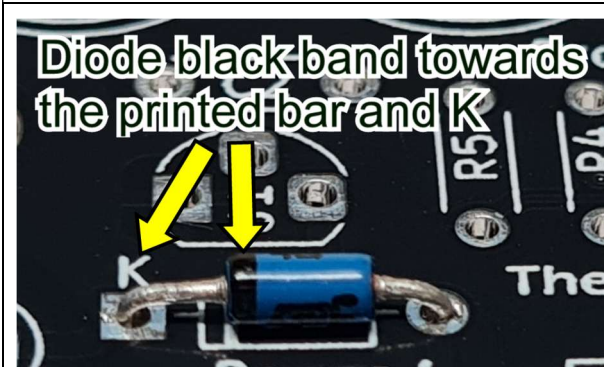
## The Diode



The diode has two wires and one of them is called the 'K' connection. The diode has to be fitted the **correct way around** with the K wire going to the right place – that shows which way the electricity is allowed to flow.

The body of the diode has a **black band** around it where the K connection wire is.

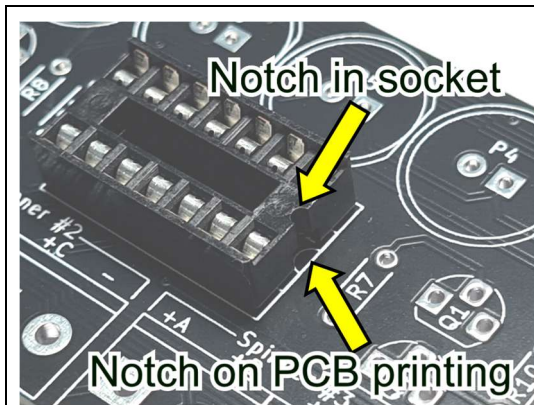
The PCB has a 'K' and a **bar** printed on it to show you which way around to fit the diode.



Bend the diode wires at right angles so the wires align with their two PCB holes, and fit the diode so the **black band** wire goes to where the **bar** and 'K' is printed on the PCB.

The diode lays flat in its two holes on the PCB.

## The Microcontroller Socket



Because the microcontroller is sensitive to heat and to static electricity, we first fit a socket that we will plug the microcontroller into when we've built the rest of the Control PCB.

The socket has a **notch** that aligns with the printed **notch** (looks like a semicircle) on the PCB, which is next to the printed "U2" and "R7".

The socket fits flat with its 14 pins going through the corresponding 14 PCB holes.

Remember - **don't plug the microcontroller into it yet.**

## The Mode Pushbutton



The pushbutton has two legs and is pushed through the PCB so it lays flat.

You can fit the pushbutton on either side of the PCB.

## The Ceramic Capacitor

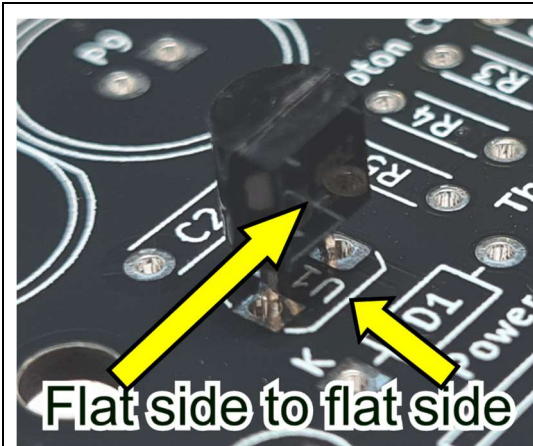


The ceramic capacitors are the small yellow ones, and this type of capacitor does not care which way around it is fitted.

Capacitors come in many shapes, sizes and values. The 104 printed on the capacitor tells you its value. In this case 104 means value "100nF".

The ceramic capacitors stand up in their two holes close to the PCB.

## The Voltage Regulator



**Voltage Regulator:** has 3 legs, and is curved on one side and flat on the other side. You fit the **flat side** on the regulator to align with the **flat side** on the PCB printing.

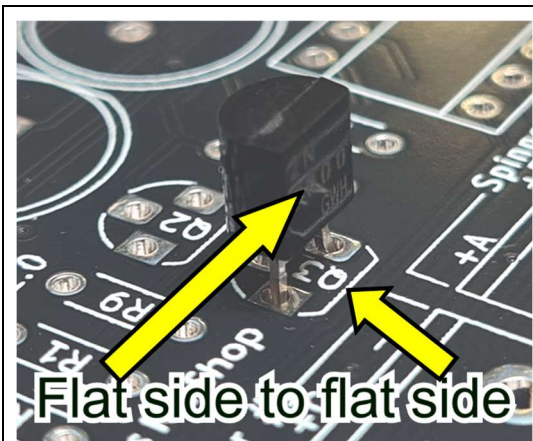
**IMPORTANT:** the Voltage Regulator **looks exactly the same as the four Transistors** which are also part of this project. It is **essential** not to get them mixed up.

The Voltage Regulator has the number **78L05** or the number **805Z** printed somewhere on its flat face (there might be other numbers and letters too).

## The Transistors

In the printed wiring on the PCB, the LEDs are grouped together in groups of six and they are switched on by the microcontroller when it needs them to be on. But the groups of LEDs take a lot of electrical current, in fact they take more current than the microcontroller can handle. So in our project we have four *Transistors*. These transistors act as high current switches, a bit like relays. The microcontroller only needs to provide a small current to switch the transistors on, and when switched on the transistors can supply much bigger currents.

The transistors **look exactly the same as the Power Supply Voltage Regulator** – **it is vital not to get them mixed up** – they have very different internals and do very different jobs.



**Transistor:** has 3 legs, and is curved on one side and flat on the other side. You fit the **flat side** on the transistor to align with the **flat side** on the PCB printing.

Remember – the **transistors look exactly the same as the Voltage Regulator**. It is **essential** not to fit them in the wrong places.

The **Transistors have the number 2N7000** printed on their flat face (there might be other letters and numbers too).

## The Wiring Screw Terminal Blocks



The Screw Terminal Block connectors can be fitted to the front or the back of the PCB, whatever is best for your project.

J1 is the power input and is 2 pins wide.

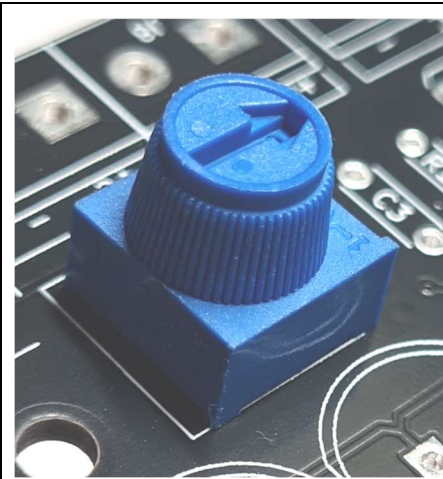
The rest of the screw terminal blocks are 4 pins wide and feed the Cyclotron Spinner PCBs.

The screw terminal blocks in your project might come separately as 'twos' or in ready-joined pairs of 'fours'.

The wire fitting holes face outwards towards the side of the PCB.

Optionally you can choose not to fit the screw terminals and instead solder wires directly into the PCB holes.

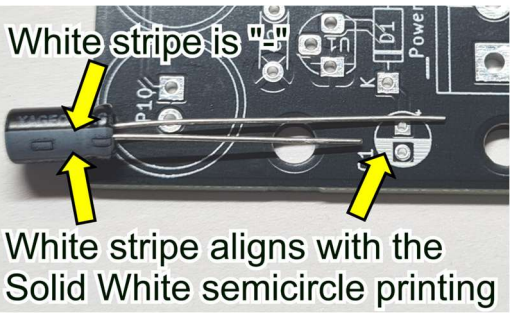

## The Speed Control



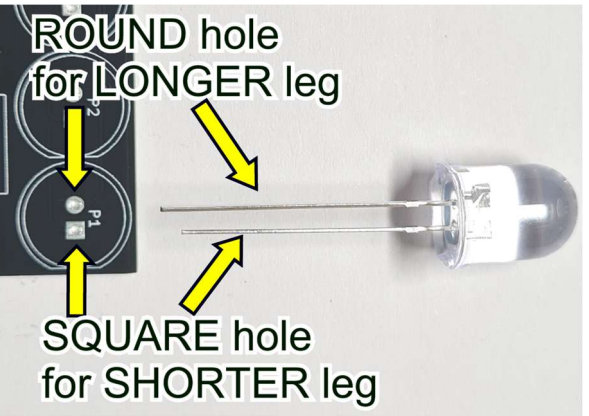
The speed control has three legs forming a triangle and is pushed through the PCB so it lays flat.

You can fit the speed control on either side of the PCB.

## The Electrolytic Capacitor

 <p>White stripe is</p> <p>White stripe aligns with the Solid White semicircle printing</p>	<p>The electrolytic capacitor is black and cylinder shaped, and has '+' and '-' connection wires. It has to be fitted the correct way around. The body of the capacitor has a <b>White Stripe</b> where the '-' connection wire is. You align that with the <b>Solid White</b> semicircle printed hole on the PCB.</p> <p>It is <b>vital</b> to fit electrolytic capacitors the <b>correct way around</b>.</p> <p><b>Check again</b> – before soldering – that it is the right way around.</p>
 <p>White stripe</p> <p>Printed Solid White semicircle</p>	<p>The electrolytic capacitor stands up in its two holes on the PCB.</p> <p>For clarity this picture shows the capacitor spaced from the PCB. When you fit the capacitor, you can push it closer against the PCB.</p> <p>The PCB solder pads for the capacitor are quite close together; take care not to create a solder short circuit between them.</p>

## The LEDs

 <p>ROUND hole for LONGER leg</p> <p>SQUARE hole for SHORTER leg</p>	<p><b>10 blue Power Cell LEDs:</b> each LED is wired to the microcontroller so that it can control them separately.</p> <p>LEDs have to be fitted the <b>correct way around</b>. The LEDs have a <b>LONGER</b> leg and a <b>SHORTER</b> leg, which tells you which way around to fit them.</p>
<p>The PCB has two hole pads for each LED, and the hole pads are different shapes:</p> <ul style="list-style-type: none"> <li>• The <b>LONGER</b> LED leg goes into the <b>ROUND</b> hole</li> <li>• The <b>SHORTER</b> LED leg goes into the <b>SQUARE</b> hole</li> </ul>	

The LEDs won't work at all if they are fitted the wrong way around. Check them - and check again - before soldering them.



The LEDs can be fitted on either side of the PCB, whichever is best for your use of the project.

You can fit them flat against the PCB, or standing-off a little, or you can bend them at an angle so they face outwards to the side.

You can also have the LEDs on some flying lead cables and place them where you need in your project.

**In all cases** – the SHORTER leg goes into the SQUARE pad hole.

# Testing your Control PCB

It is advisable to test with a multimeter – this is a most valuable tool for project constructors.

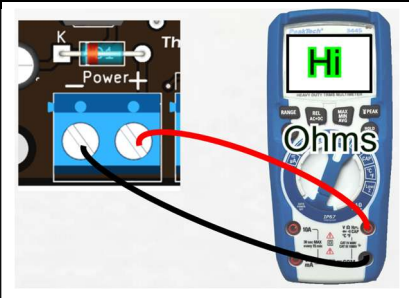
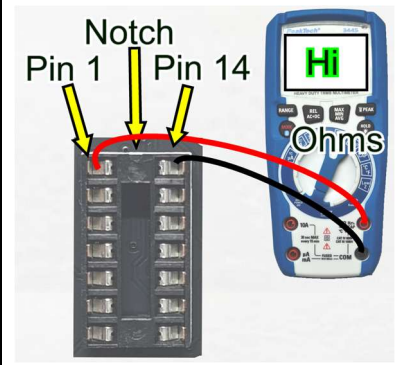
## *First visually inspect the PCB*

**Before** inserting the microcontroller into the socket and applying any power, visually check the PCB, so for example:

- Are all the solder joints good
- Are any components loose
- Are all components in their correct places
- Are they all the correct way around
- Are there no metal parts of components touching each other
- Are there no visible short circuits between the holes (pads) on the PCB
- Are there any tiny pieces of metal or solder which could cause short circuits

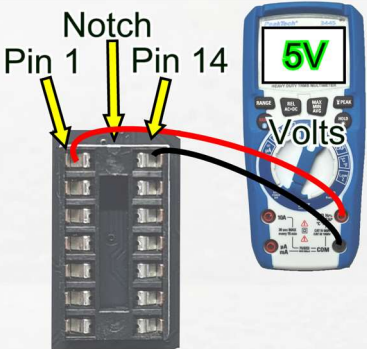
## Testing with a Multimeter

### *Check for power supply short circuits*

	<p>Set your meter for “Ohms” then check the resistance between the “+” and “-” pins on the power input terminal <b>J1</b>.</p> <p>There should be very <b>high</b> resistance, and this indicates that there is no short circuit on the PCB power input.</p> <p>Any short circuits need to be found and fixed before moving on with the testing.</p>
	<p>Set your meter for “Ohms” then check the resistance on the microcontroller socket between pin <b>1</b> (left of notch) and pin <b>14</b> (right of notch). These are the circuit power pins and are the output of the 5V power supply regulator.</p> <p>There should be <b>high</b> resistance, and this indicates there are no shorts on the circuit power supply.</p> <p>Any short circuits need to be found and fixed before applying power to the PCB.</p>

### *Check that the 5V power supply is working*

If there are no short circuits, the PCB can be tested with power applied. Do this initially with the microcontroller **not** in its socket.



Set your meter to measure **DC** Volts (*not AC volts*), and connect battery power to your project via the Power Input terminal **J1**, remembering:

- J1 pin “+” is the positive power
- J1 pin “-” is the negative power

Now check the **DC** voltage seen between the microcontroller pins **1** and **14**. It should be very close to **5V** (likely it won't be exactly 5V but that is OK).

**If there is no 5V at all** – remove the power, and first check that you had your meter set for **DC Volts** and *not AC Volts*. Then check that the diode is fitted the correct way around (remember, diodes can block electricity if they are the wrong way). If the diode is correctly fitted, check again for short circuits. Some short circuits are extremely small and difficult to spot. Any short circuits need to be fixed before going further.

**If approximately 5V is there** – excellent. You can fit the microcontroller and try your project.

### Fit the Microcontroller

Fit the microcontroller with the **power disconnected**. As the microcontroller is static sensitive, it is best to fit it while wearing an antistatic “Earthing Wrist Strap”. If you don't have an Earthing Wrist Strap, it is worthwhile getting one, or (safely) touch something ‘electrically grounded’ while handling static sensitive devices.



Very carefully align the microcontroller with its socket, **making sure pin 1 is in the right place**. Pin 1 is to the **top right** of the socket (when viewed with the LEDs along the top like in this picture). The notch and dot on the microcontroller aligns with the notch on the socket and on the PCB printing.

Then, making sure all pins go into their respective socket holes, gently and evenly push the microcontroller down into its socket.

Then check again that:

- The microcontroller is the correct way around
- All pins are in their socket holes

Now you can connect power and check that the microcontroller is working.

### ***Connect Power and check it works***

Connect the power to the PCB, taking care to get the '+' and '-' wires the correct way around, and switch on the power. All being well, the microcontroller will come to life and the blue LEDs will begin to show activity – and that's great! If you turn the Speed control knob, the LEDs move faster or slower, and if you press the Mode pushbutton, the LEDs Mode changes.

If there is no LED activity, remove the power and:

- Check that the power was connected the correct way around
- Check that the power source is OK – e.g. that the battery has good charge remaining
- Check the microcontroller is fitted correctly and that all pins are in their holes
- Check there are no short circuits
- Check that the LEDs are the correct way around
- Check that the resistors and transistors are correctly fitted

If there is still no LED activity, please contact ***The Electronics Kit Shop*** (via ebay, etsy, or the email address at the end of this document) for technical help.

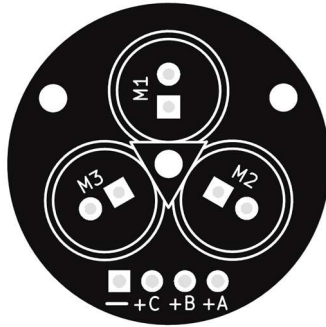
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# Cyclotron Spinner PCBs Assembly

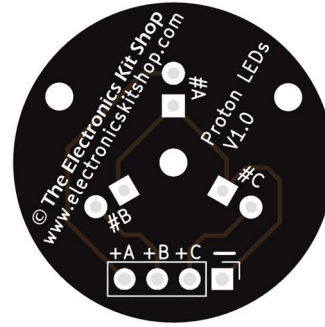
## Cyclotron Spinner Component Placement

The LEDs go on the front of the PCB and the connectors on the back.

Front of Cyclotron PCB



Back of Cyclotron PCB



## Cyclotron PCB Components List

Note that some components in your kit may come in separate little packages.

Qty	Reference	Value	Function
3	M1, M2, M3	8mm red LEDs	Spinning Cyclotron display
1		4 pin Straight connector	Connections to the Control PCB.
1		4 pin Angled connector	Fit either one of these, or omit both if you want to wire directly into the PCB holes.
1	PCB	Cyclotron PCB	

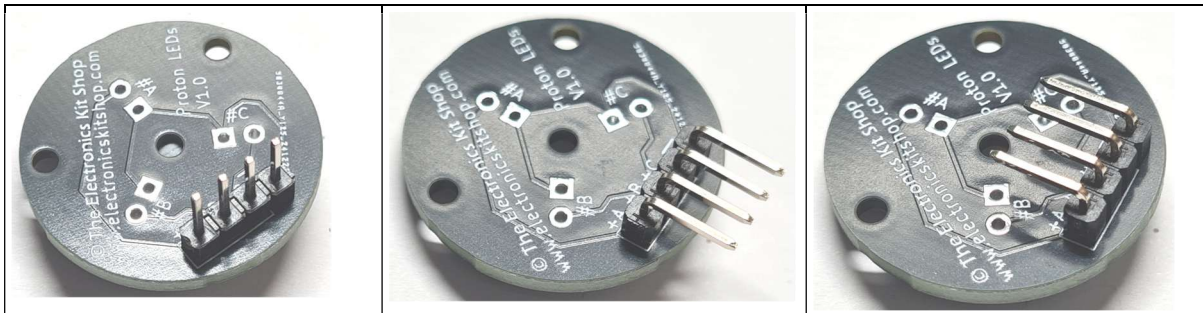
## Cyclotron PCBs Detailed Assembly

The Cyclotron Spinner PCBs are much simpler to construct, they have only:

- The connectors

- The LEDs

## The Wiring Connector



The connector is fitted to the back of the PCB on the opposite side to the LEDs.

You have a choice of three connector orientations, or to not use the connectors at all and to solder the wires directly onto the PCB.

There's a black plastic surround on one side of the connector pins. The black plastic surround of the connector lays flat against the PCB, like in the pictures.

## The LEDs

	<p><b>3 red Spinning Cyclotron LEDs:</b> each LED is wired to the microcontroller so that it can control them separately.</p> <p>LEDs have to be fitted the <b>correct way around</b>. The LEDs have a <b>LONGER</b> leg and a <b>SHORTER</b> leg, which tells you which way around to fit them.</p>
	<p>The LEDs are fitted into the front of the PCB.</p> <p>The PCB has two hole pads for each LED, and the hole pads are different shapes:</p> <ul style="list-style-type: none"> <li>• The <b>LONGER</b> LED leg goes into the <b>ROUND</b> hole</li> <li>• The <b>SHORTER</b> LED leg goes into the <b>SQUARE</b> hole</li> </ul> <p>The LEDs won't work at all if they are fitted the wrong way around. Check them - and check again - before soldering them.</p>

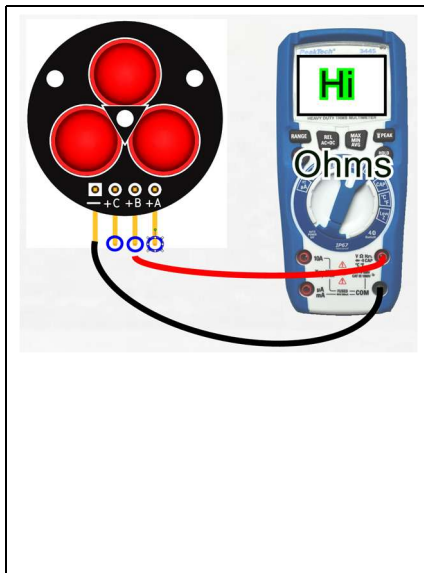
## Testing your Cyclotron Spinner PCBs

### *First visually inspect the PCB*

Visually check the PCB, so for example:

- Are all the solder joints good
- Are any components loose
- Are all components in their correct places
- Are they all the correct way around
- Are there no metal parts of components touching each other
- Are there no visible short circuits between the holes (pads) on the PCB
- Are there any tiny pieces of metal or solder which could cause short circuits

### *Check for short circuits*



Set your meter for “Ohms” then check the resistance between the “-” pin and each of the “+A”, “+B” and “+C” pins in turn.

There should be extremely **high** resistance between the “-” pin and each of the “+” pins, and this indicates that there is no short circuit on the PCB drives to the LEDs.

During this test you might or might not see the LEDs glow a little because your multimeter is feeding them enough small power to get them slightly on; this is normal.

Any short circuits need to be found and fixed before moving on.

If there are no short circuits – great!

# Wiring up your Project

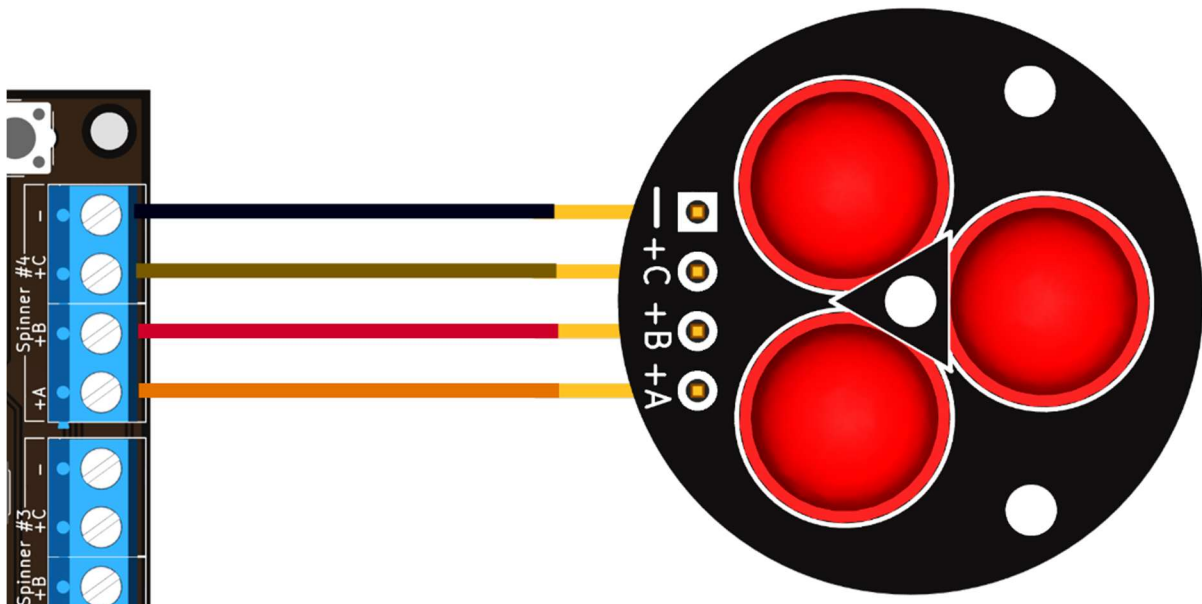
## Wiring the Cyclotron Spinners

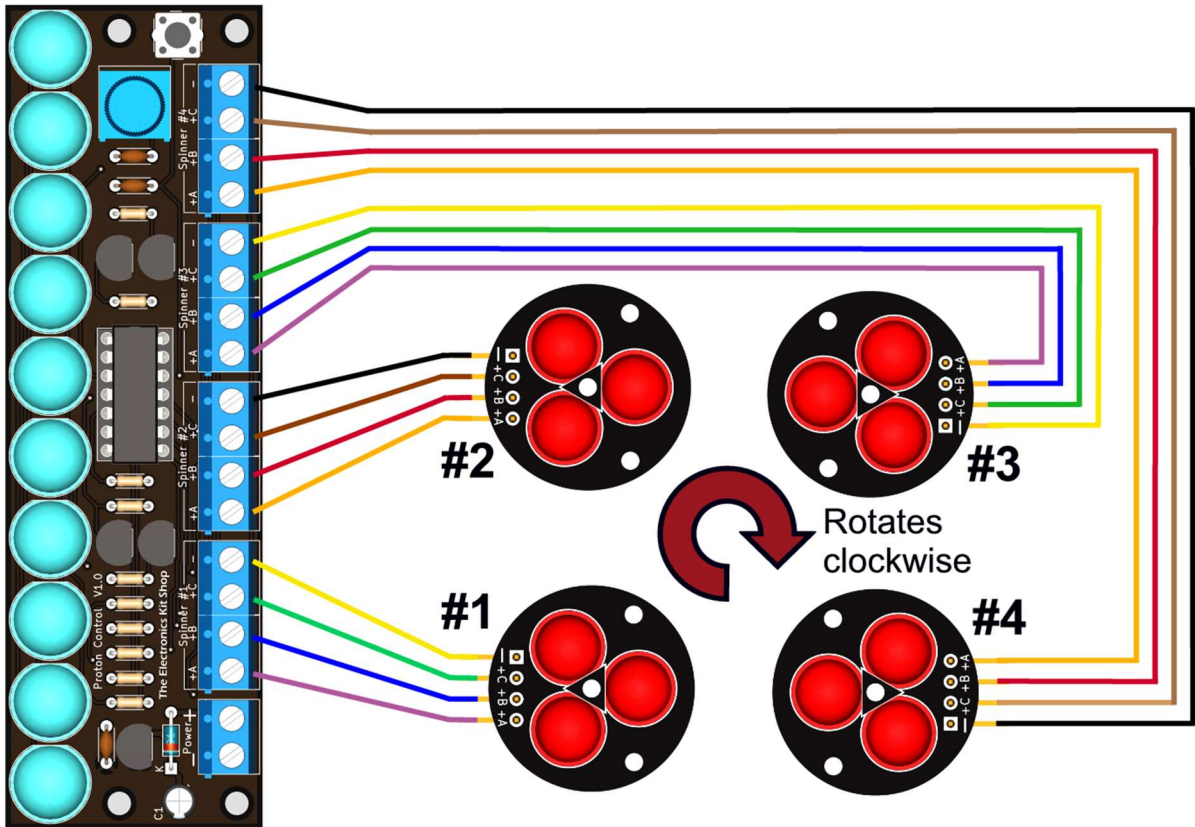
Every Cyclotron Spinner is wired with four direct wires.

For each Cyclotron Spinner, on the Control PCB and on the Cyclotron PCBs are printed:

- +A
- +B
- +C
- - (a minus sign)

The Control PCB **+A** is wired directly to the Cyclotron PCB **+A** ..... and so on.





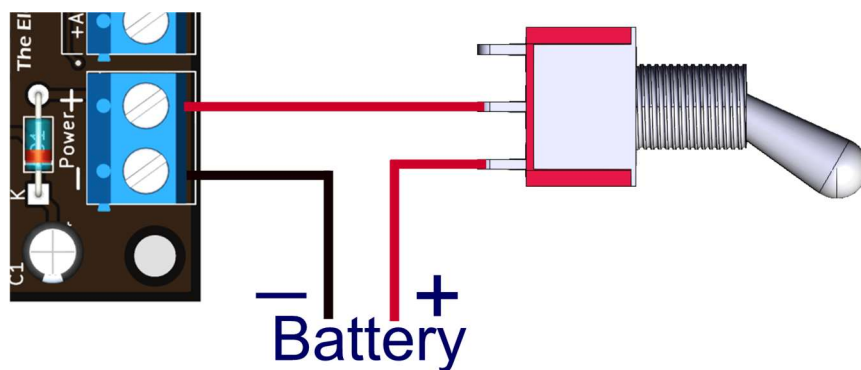
The colours of the wires are not important. Your kit might contain many different colours of wires and this will help you to identify where all the different wires in your backpack are going. The important thing is that they go to the right places.

The Cyclotron Spinners illuminate in turn from #1 thru #4 in a clockwise direction.

You can use the Mode pushbutton if you want to mount your Control PCB the other way up and have the blue LEDs still filling from bottom to top. The Cyclotron Spinners will always go in the same direction from #1 thru #4.

## Wiring the Battery Supply

Wire your Control PCB to the battery connector via a switch, in-line with the '+' terminal.



# Testing Your Whole Project

First do the testing for the Control PCB and for each of the Cyclotron PCBs as described above.

Wire the Cyclotron PCBs to the Control PCB, then connect the power.

You should now see activity on the blue Power Level LEDs and also on the Cyclotron Spinner LEDs!

Your project has a built-in Test Mode: press the Mode pushbutton until the blue Power Cell LEDs are lighting up just one at a time, and the Cyclotron Spinner LEDs also light up just one at a time. This lets you check that every LED is separately working.

Press the Mode pushbutton again to exit the Test Mode and go to one of the normal cycling operating modes.

---

## Using your Project

### Mode Pushbutton

When you press this button the next operating Mode is selected. When you have pressed the button to reach the end of the available Modes, it cycles back to the first Mode again.

Your project has several **Modes**:

1. Power Cell LEDs cycling from **Bottom to Top** with spinning Cyclotrons
2. Power Cell LEDs cycling from **Top to Bottom** with spinning Cyclotrons
3. Power Cell LEDs cycling from **Bottom to Top** with statically lit (light bulb) Cyclotrons
4. Power Cell LEDs cycling from **Top to Bottom** with statically lit (light bulb) Cyclotrons
5. Power Cell LEDs cycling from **Bottom to Top** with fading light bulb Cyclotrons
6. Power Cell LEDs cycling from **Top to Bottom** with fading light bulb Cyclotrons
7. **Test Mode** - all LEDs lighting up one after another to test them

In your Proton backpack you would only use one of the first six cycling modes, and which one you use depends upon which way up you will be mounting the Control PCB and how you would like the Cyclotrons to be shown. Try them all and see which mode you like the best.

The microcontroller remembers which Mode you selected so it always starts in that Mode when you next switch on.

### Speed Control

You can turn the Speed Control knob to set the speed of the LED animation to be whatever is best for your project.

In the Ghostbusters movies the Power Cell cycles from bottom to top about once per second.

---

## General Usage

Please note that this project:

- Contains **flashing lights**
- **Is not suitable for small children due to small parts**
- Has bright LEDs; don't stare directly into them
- Must be used only for the purposes of fun and amusement
- Is for occasional UK hobby use and must not be used near sensitive electronic or medical equipment
- Must be protected from extremes of temperature, rain and moisture
- Is inspired by the Ghostbusters movie props and is in no way connected with those movies or their producers

If the LEDs on the project begin to dim, or the project begins to malfunction or no longer comes on at all when you connect power, it is likely the battery needs to be replaced.

And for the environment - always dispose of electrical waste in the proper facilities.

## And finally....

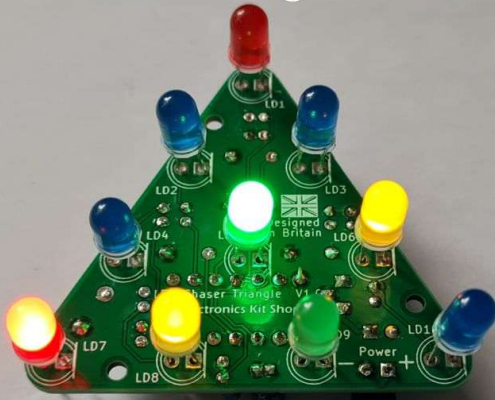
You have successfully constructed your project, now to enjoy it.

## There are 15 Great Chasers in the range

Many chasers can be customised for your choice of LED colours and design of customised patterns – often free of charge! Please contact *The Electronics Kit Shop* with how you would like your chaser customised.



10 LED Triangle Chaser



10 LED Chaser



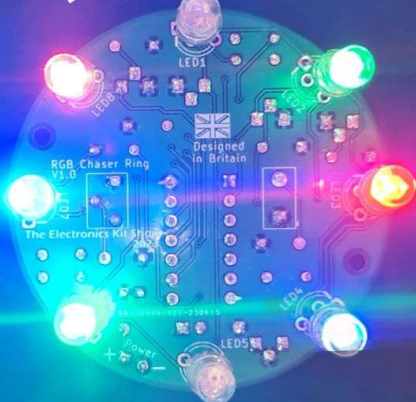
10 LED Chaser Ring



15 LED Star Chaser



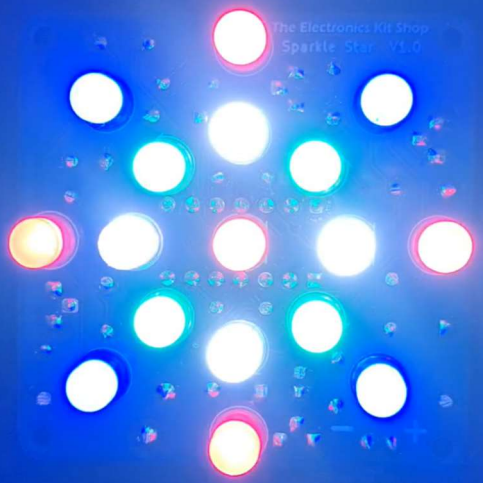
8 RGB LED Chaser Ring  
Every RGB LED can show  
Red, Green and Blue



8 RGB LED Chaser  
Every LED can show  
Red, Green and Blue



### 17 LED Sparkle Star



### 5 LED Super-Mini Chaser Kit



25mm - same as 10p coin!

### 8 LED UFO Mega-Mini Chaser Kit



25mm - same as 10p coin!

### 12 LED UFO Mega Mini Chaser Kit



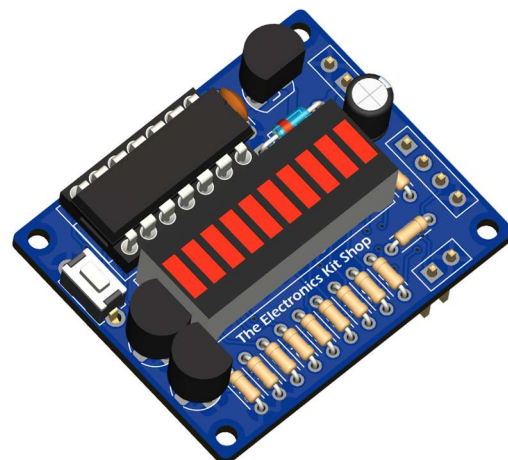
28mm - same as 50p coin!

### New for 2025

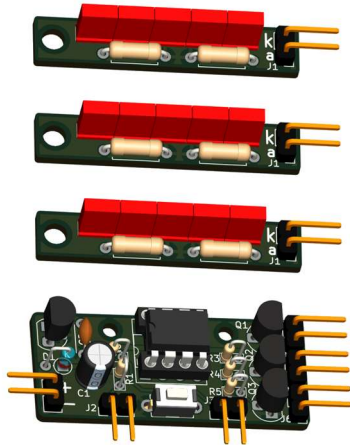
#### Ghostbusters Proton Pack Lighting Electronic Kit



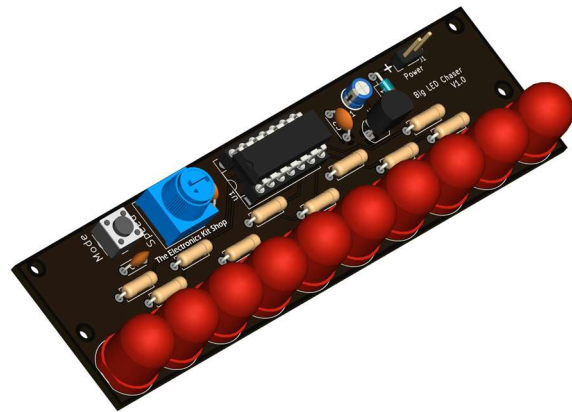
### Coming Winter 2025 Ghostbusters Ghost Trap Lighting



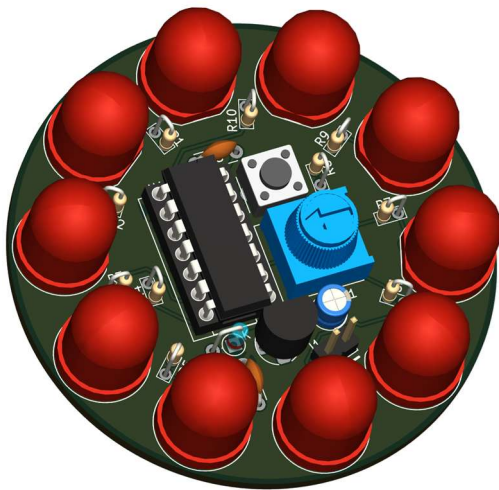
**Coming Winter 2025  
Darth Vader Chest Plate Lighting**



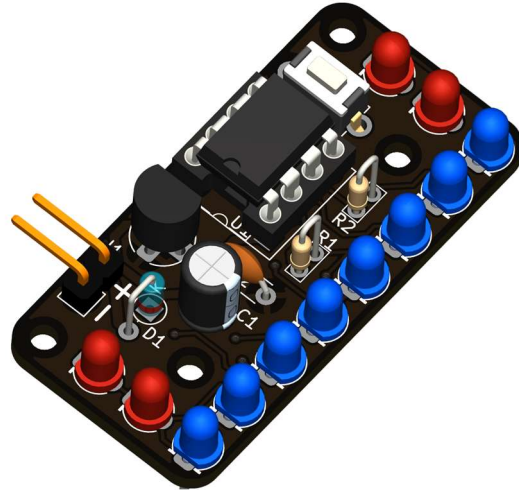
**Coming Winter 2025  
Massive 10mm LED Chaser**



**Coming Winter 2025  
Massive 10mm LED UFO**



**Coming Winter 2025  
12 LED Miniature Chaser**



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**The Electronics Kit Shop**

**Warwickshire UK**

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