

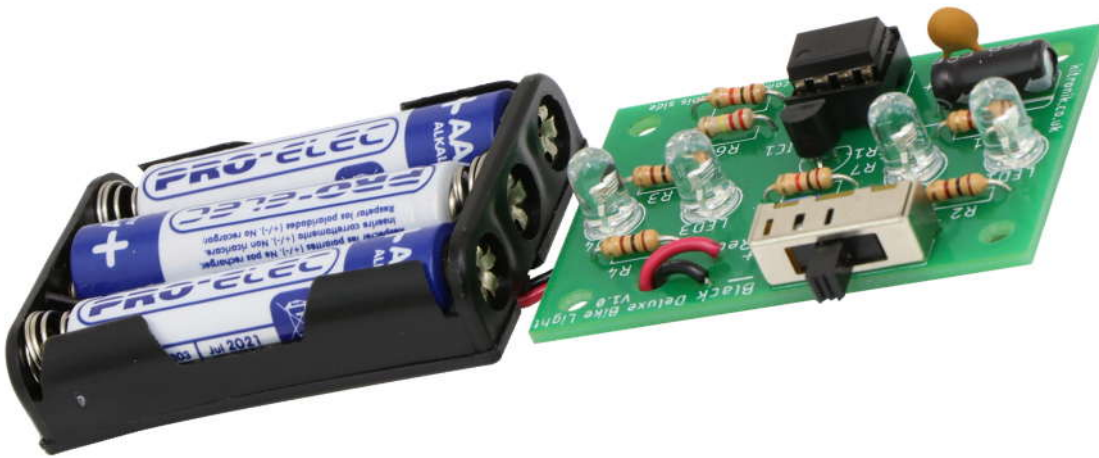


## ESSENTIAL INFORMATION

BUILD INSTRUCTIONS  
CHECKING YOUR PCB & FAULT-FINDING  
MECHANICAL DETAILS  
HOW THE KIT WORKS

INVEST IN BIKE SAFETY WITH THIS

# REAR DELUXE BIKE LIGHT KIT



## Build Instructions

Before you start, take a look at the Printed Circuit Board (PCB). The components go in the side with the writing on and the solder goes on the side with the tracks and silver pads.

### 1 PLACE RESISTORS

Start with the resistors. The text on the PCB shows where R1, R2 etc go. Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R1, R2, R3, R4	100Ω	Brown, Black, Brown
R5, R7	1kΩ	Brown, Black, Red
R6	220kΩ	Red, Red, Yellow



### 2 SOLDER THE CAPACITORS

Place the 1uF capacitor into the board where it is labelled C1. Make sure the negative leg is placed in the negative side. With the legs of the capacitor in the holes, bend the capacitor to match the outline on the PCB. Once the component is bent over, solder both legs of the capacitor.



Place the 10nF capacitor into the board where it is labelled C2. It does not matter which way around this component is fitted.



### 3 SOLDER THE FET

Place the 2N7000 FET into the board where it is labelled TR1. Make sure that the device is the correct way around. The shape of the device should match the outline on the PCB.



### 4 SOLDER THE DIODE

Place the BAT41 diode into the board where labelled D1. Make sure that the band on the component matches the outline on the PCB.



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## 5 SOLDER THE IC HOLDER

Solder the Integrated Circuit (IC) holder into U1. When putting it into the board, be sure to get it the right way around. The notch on the IC holder should line up with the notch on the lines marked on the PCB.



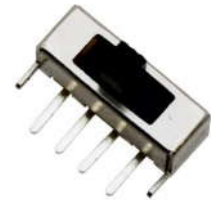
## 6 SOLDER THE LED

Place LEDs in to LED1, LED2, LED3 and LED4 making sure that the LED matches the outline on the PCB. The short leg (or flat section of the LED rim) will be on the switch edge.



## 7 SOLDER THE SWITCH

Place switch into outline of SW1. Making sure component is flat on the PCB, solder all pins of the switch.



## 8 ATTACH THE BATTERY CLIP

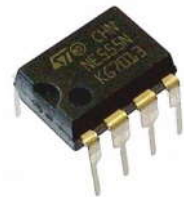
Now you must attach the battery clip. Start by feeding the leads through the strain relief hole on the right hand side.

The leads should be connected to the 'Power' terminals.

The red lead should be soldered to the '+' terminal (also marked with text 'red') and the black lead should be soldered to the '-' terminal (also marked with the text 'black').

## 9 INSERT THE IC INTO HOLDER

The 555 IC can now be put into the holder, ensuring that the notch on the chip lines up with the notch on the holder.



## Checking Your PCB

Check the following before you power up the unit:

### Check the bottom of the board to ensure that:

- All holes (except the large mounting holes) are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

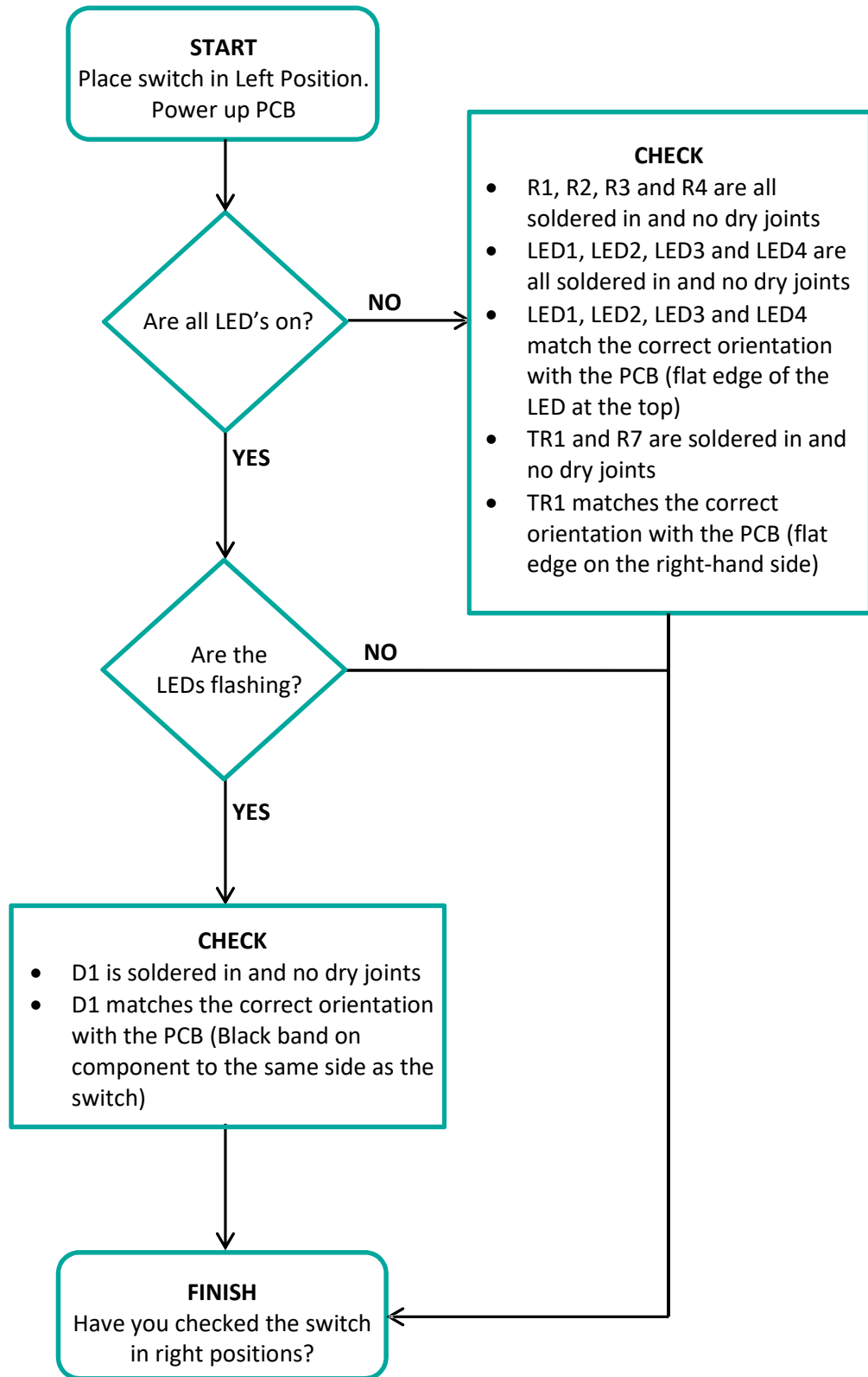
### Check the top of the board to ensure that:

- The notch on the 555 IC matches the outline on the PCB.
- The shape of the FET matches the outline on the PCB.
- C1 matches the outline on the PCB.
- The resistor bands on R1,R2,R3,R4 are Brown, Black, Brown
- The resistor bands on R5 and R7 are Brown, Black, Red
- The resistor bands on R6 are Red, Red, Yellow
- All flat edge of the LEDs match the outline on the PCB
- All the connecting leads are connected to the right part and that the power connection is the right way around.



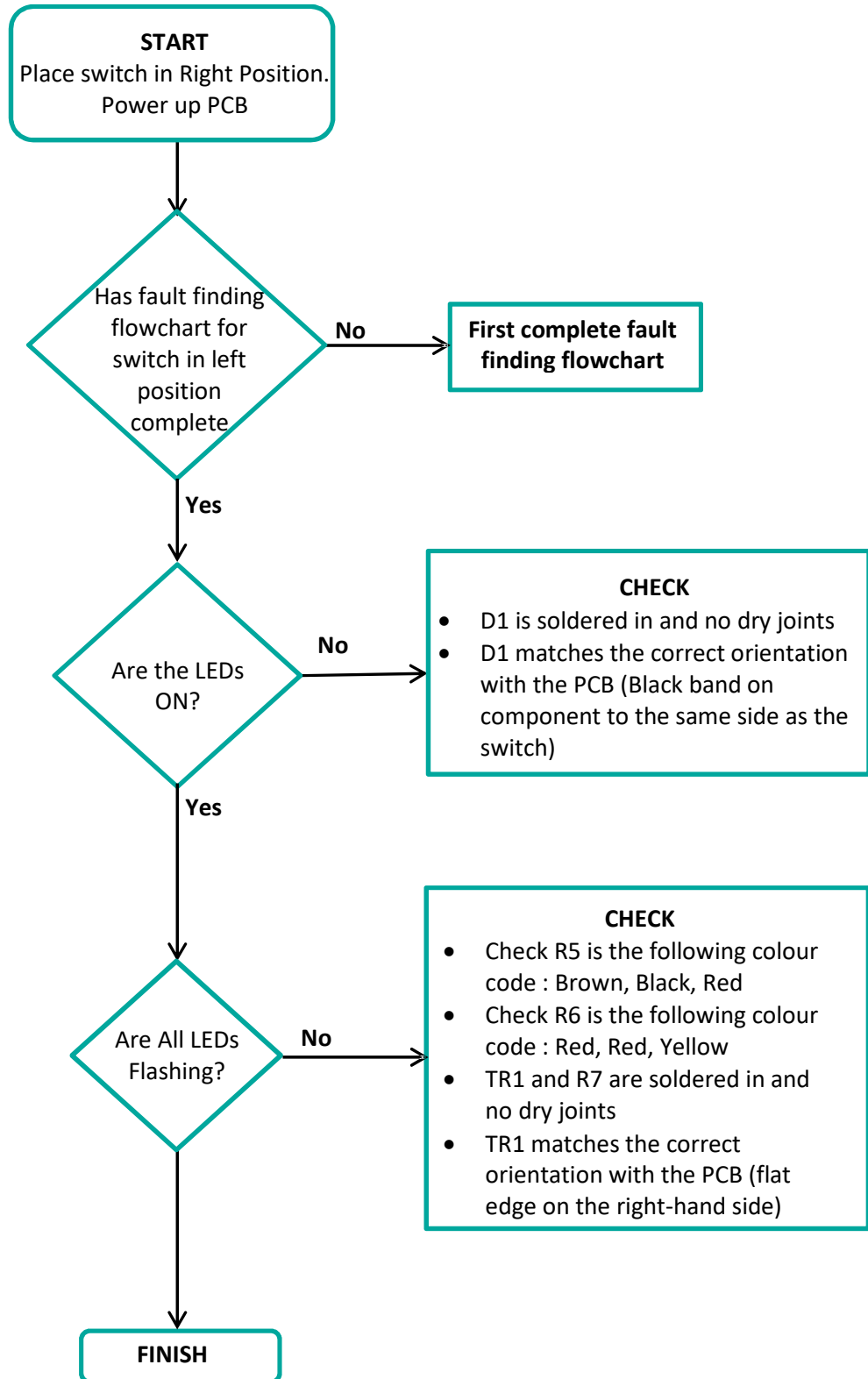
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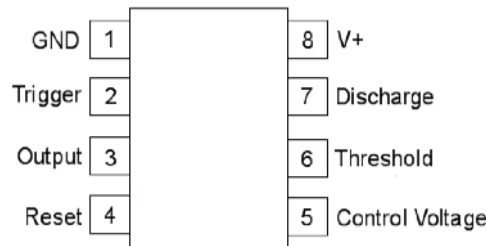


## 555 Timers

### Overview

The 555 integrated circuit is a highly accurate timing circuit which is capable of producing both time delays or oscillation.

### Pin Outs



### Pin Descriptions

- V+ = (Pin 8) Supply voltage.
- GND = (Pin 1) GND (0V) connection for supply voltage.
- Threshold = (Pin 2) Active high input pin that is used to monitor the charging of the timing capacitor.
- Control Voltage = (Pin 5) Used to adjust the threshold voltage if required.  
This should be left disconnected if the function is not required.  
A 0.01uF capacitor to GND can be used in electrically noisy circuits.
- Trigger = (Pin 2) Active low trigger input that starts the timer.
- Discharge = (Pin 7) Output pin that is used to discharge the timing capacitor.
- Out = (Pin 3) Timer output pin.
- Reset = (Pin 4) Active low reset pin. Normally connected to +V if the reset function is not required.

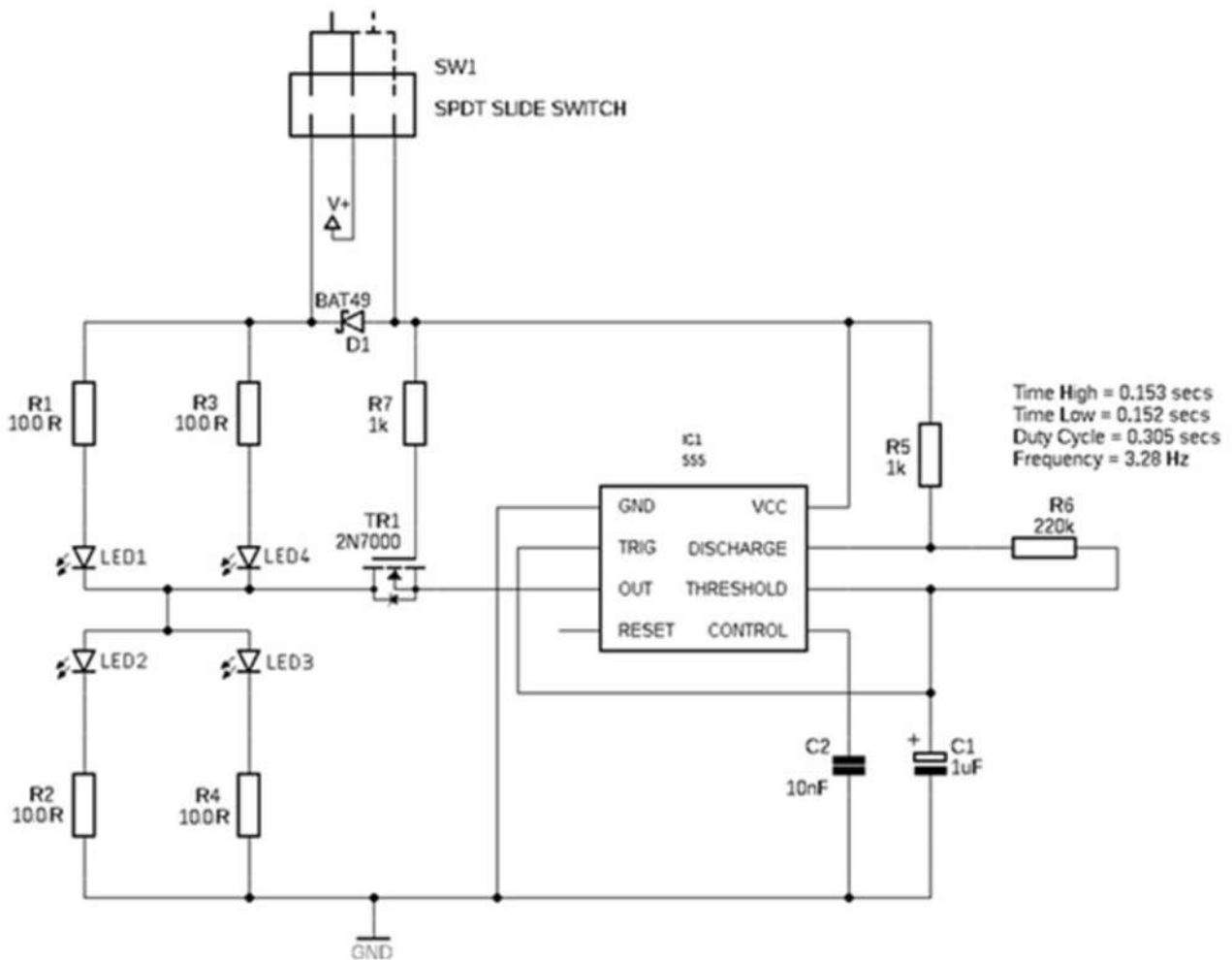
### Operating Overview

The 555 timer is a simple circuit. Inside there is a latch that can be set and reset from the trigger pin. By taking the trigger signal from high to low the latch is set. This causes the output to go high and the discharge pin to be released from GND (0V). The releasing of the discharge pin from GND causes an external capacitor to begin charging. When the capacitor is charged, the voltage across it increases. This results in the voltage on the threshold pin increasing. When this is high enough it will result in the threshold pin causing the latch to reset.

This causes the output to go low and the discharge pin is also taken back to GND. This discharges the external capacitor ready for the next time the device is triggered.



## How the Circuit Works



The circuit has two operating modes. Flashing LED and constant illumination LED. This is determined by the position of the switch.

With the switch in the left position. The diode (D1) blocks the supply to the timing circuit and the FET (TR1) does not allow the 555 to sink the common rail of the LED's down to ground due to the high impedance of the FET (the 555 has low impedance). The voltage flows through to the current limiting resistors R1, R2, R3, R4 and LED1, LED2, LED3, LED4. The circuit is a simple LED circuit.

With the switch in the right position. The supply goes to the 555 timer circuit and to the FET, as well as voltage to pass through the diode to give a voltage supply to the LEDs.

The 555 Timer is configured as an astable timer (like the circuit above) where the output is continuously alternating between high and low. In this configuration the 555 Timer re-triggers itself after each cycle, which results in the continuous alternating signal.

The frequency of the output is determined by the time taken to charge the capacitor C1. This capacitor charges through the resistors R1 and R2. When the output of the circuit (pin 3) goes high, C1 begins to charge until the voltage across it is high enough to activate the threshold input. This causes the output to go low and the capacitor





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now starts to discharge through R2. This continues until the voltage across C1 is low enough to activate the (active low) trigger input. The output now goes high and the process is repeated.

The time the output is 'High' compared to the time the output is 'Low' is known as the duty cycle. The duty cycle is determined by the ratio of these resistors. If the value of the two resistors is the same the duty cycle will be 50% and the output will be a square wave.

The 'High' output time is given by:  $t_1 = 0.693 \times (R_1 + R_2) \times C_1$

The 'Low' output time is given by:  $t_2 = 0.693 \times R_2 \times C_1$

Therefore, the total period is given by:  $T = t_1 + t_2 = 0.693 \times (R_1 + (2 \times R_2)) \times C_1$

The frequency of oscillation is given by:

$$f = 1/T = 1.44 / ((R_1 + R_2) \times C_1)$$

The output from the 555 goes to the FET. With the voltage supply always going to the gate of the FET (when the switch is in the right position), this acts like a switch is on and makes the connection between the 555 and the common track between the LEDs. This results in the common track of the LEDs matching that of the 555.

When the output of the 555 is High then LED 1 and 4 have no voltage across them, and so do not illuminate. At the same time LED 2 and 3 are driven by the 555 and illuminate. The 555 can drive 200mA, which is enough for this pair of LEDs.

When the output is low then there is no voltage across LEDs 2 and 3, and so they do not illuminate. LEDs 1 and 4 are now referenced to ground through the 555 and illuminate.

This cycle continues, and so the pairs of LEDs flash in sequence.

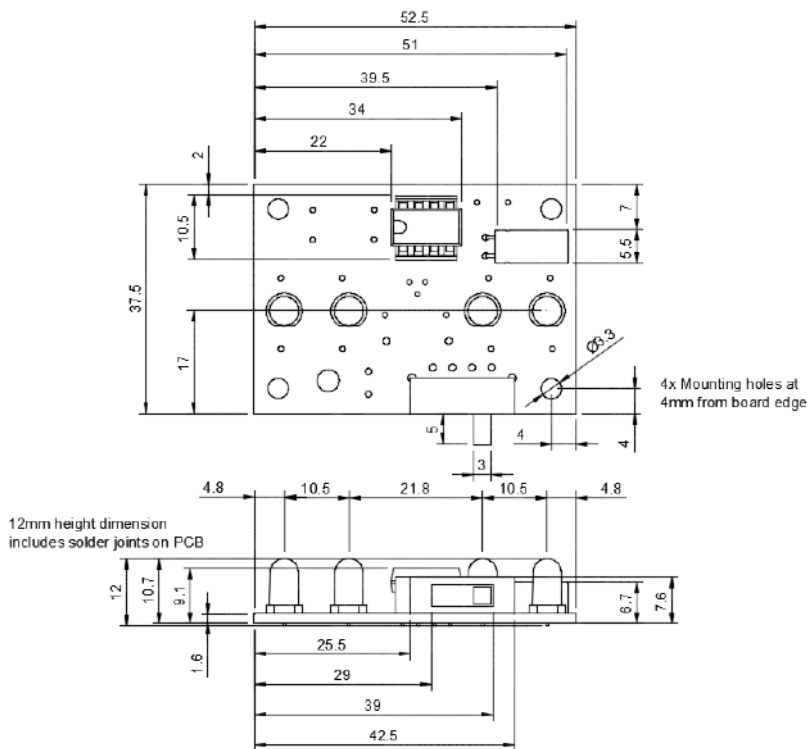


## Designing the Enclosure

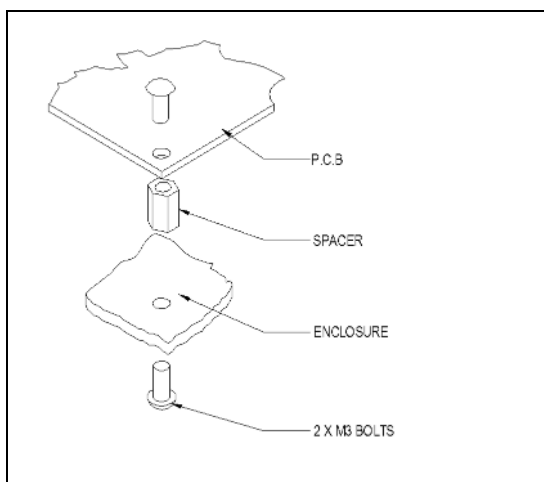
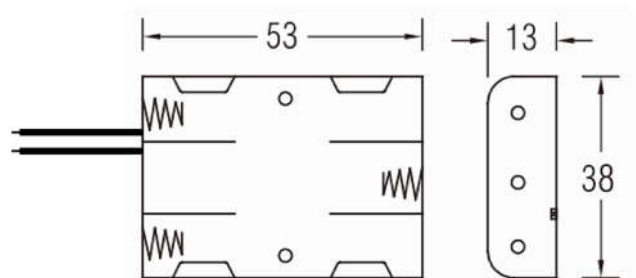
When you design the enclosure, you will need to consider:

- The size of the PCB (below left).
- Where the batteries will be housed.
- Where the switch will be mounted.
- Height of the components.

This technical drawing of the PCB and other components should help you to design your enclosure.



All dimensions are in mm. The PCB has four mounting holes 3.3mm in diameter. These holes are 4mm from the board edge



### Mounting the PCB to the enclosure

The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.

*Your PCB has four mounting holes designed to take M3 bolts.*



## Online Information

Two sets of information can be downloaded from the product page where the kit can also be reordered from. The 'Essential Information' contains all of the information that you need to get started with the kit and the 'Teaching Resources' contains more information on soldering, components used in the kit, educational schemes of work and so on and also includes the essentials. Download from:

[www.kitronik.co.uk/2167](http://www.kitronik.co.uk/2167)



This kit is designed and manufactured in the UK by Kitronik

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