

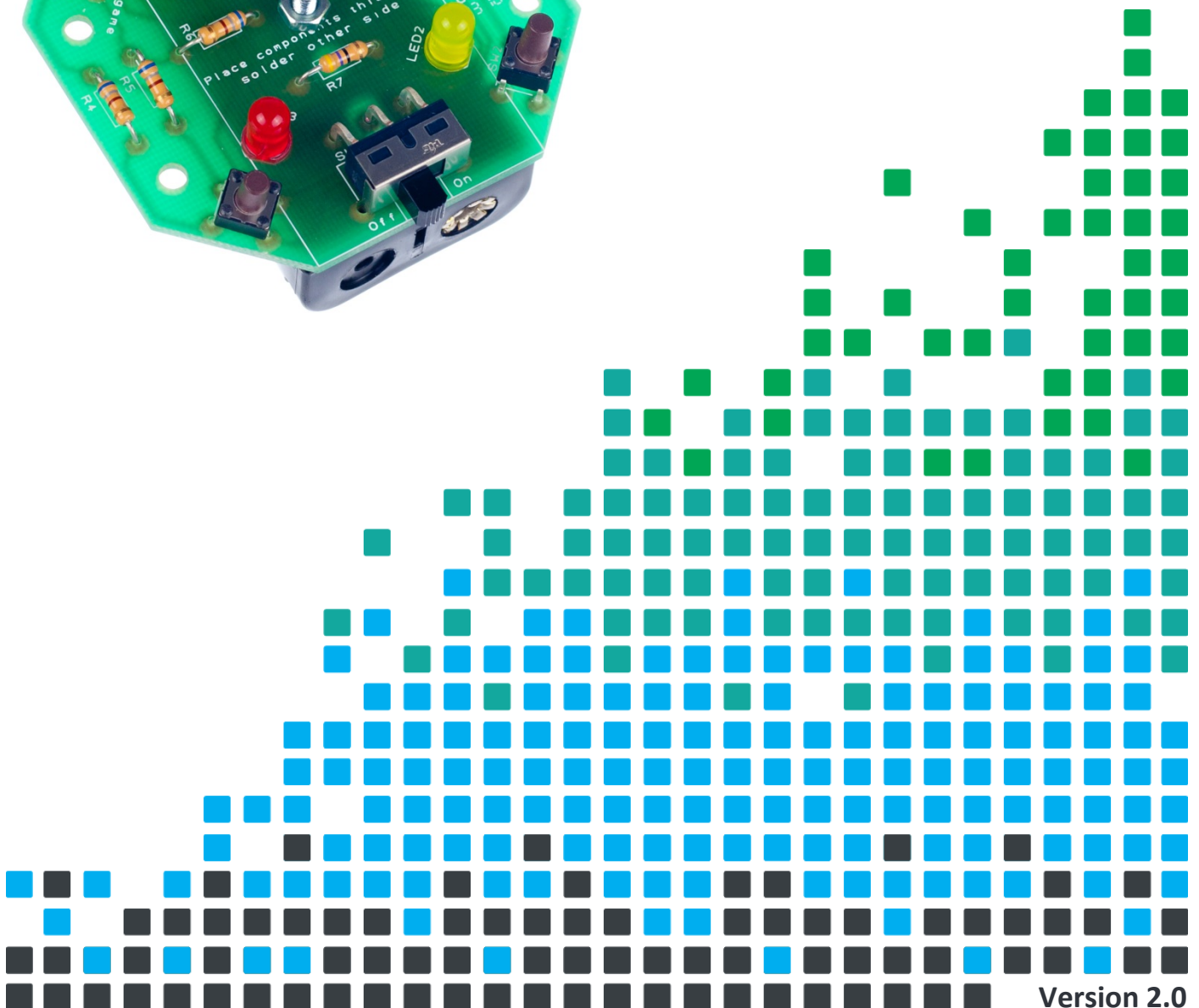


# ESSENTIAL INFORMATION

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

BUILD YOUR OWN MEMORY & REACTIONS

# ELECTRONIC GAME KIT



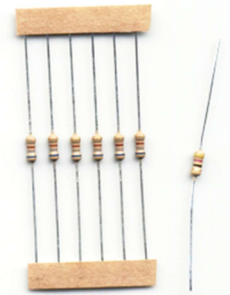
## Build Instructions

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

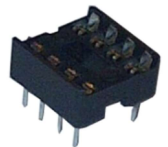
Start with the three resistors:  
The text on the PCB shows where R1, R2 etc go.  
Ensure that you put the resistors in the right place (i.e. the 47Ω goes in to R7).

PCB Ref	Value	Colour Bands
R1 – R6	680Ω	Blue, grey, brown
R7	47Ω	Yellow, purple, black



### 2 SOLDER THE IC HOLDER

Solder the Integrated Circuit (IC) holder in to IC1. When putting this 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.



### 3 SOLDER THE SWITCHES

Solder the four switches into the board where it is labelled SW1, SW2, SW3 & SW4. Once you have got the pins lined up with the holes, they can be pushed firmly into place.



### 4 SOLDER THE LEDs

Solder the four Light Emitting Diodes (LEDs) into LED1 – LED4. It does not matter which colour goes where but the game won't work if they don't go in the right way around. If you look carefully one side of the LED has a flat edge, which must line up with the flat edge on the lines on the PCB.



### 5 SOLDER THE SWITCH

Solder the PCB Mount Right Angled On / Off Switch into SW5. The row of three pins that exit the back of the switch must be soldered, but it doesn't matter too much if you can't solder the other two pins.



### 6 FIT THE BATTERY HOLDER

Finally place the battery holder into the board so that it sticks out off the edge of the board. This part should be soldered with the holder raised off from the board with 5mm of lead going through to the back of the board.



7

## FIT THE IC INTO THE HOLDER

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

8

## SECURING THE BATTERY HOLDER

Check that the board works before folding the battery holder under the board and fixing in place with the M3 nut and bolt.

## Checking Your Game PCB

Check the following before you insert the batteries:

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

- All holes (except the 5 large 3 mm 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 IC holder / IC is near the edge of the board.
- The flat edge of each of the LEDs is next to the switch.
- The colour bands on R7 are yellow, purple, black.

## Testing the PCB

The software on the microcontroller has been specially designed to allow easy testing of the PCB.

When the batteries are inserted and SW5 is in the on position, the game will:

- Illuminate LED1, LED2, LED3 & LED4 in sequence for one second each.
  - If the LEDs don't light in order, stop testing and look at the LED fault finding flow chart.
- Once the LEDs have gone out, pressing any of the four buttons will cause the LED next to it to light.
  - Check that all four buttons work, if this is not the case look at the switch fault finding flow chart.
- Turn the game off using SW5.
- If all four buttons tested OK, next time the game is turned on it will work normally.



## Using the Game

- SW5 can be used to turn the game on and off (as indicated on the PCB).
- When the game is turned on LED1 & LED4 flash rapidly to indicate that a game should be selected. Press SW1 for the memory game or SW4 for the reactions game (both are marked on the PCB).
- If you wish to change the game you are playing turn the game off and back on and select the other game.
- Don't forget to switch it off when you're not playing otherwise you will flatten the batteries.

### **Memory game**

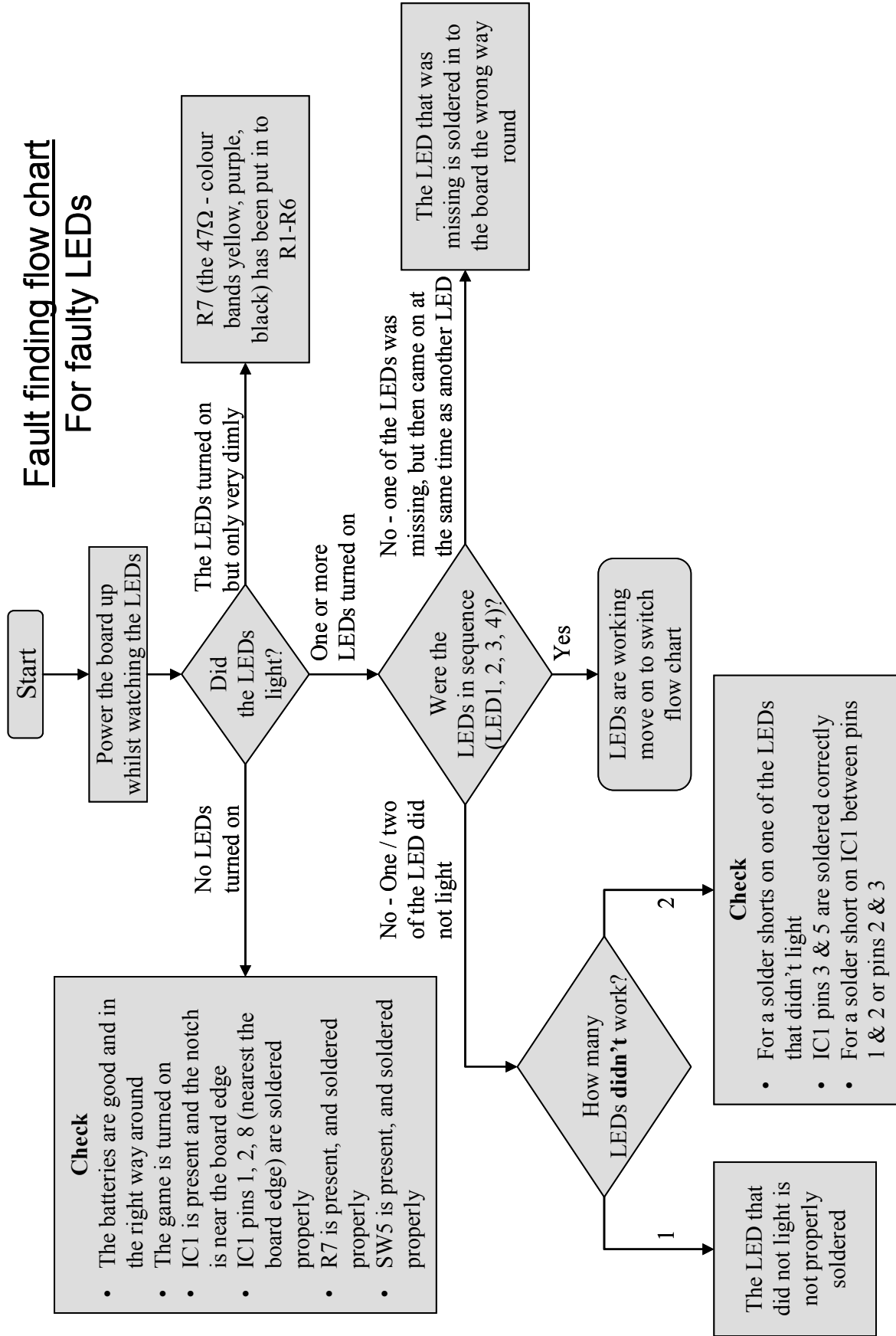
- The LEDs will flash a sequence. Simply copy this sequence.
- If you get it correct the LEDs will quickly flash in turn before the sequence is shown again with an extra LED on the end.
- When you do get it wrong the LEDs quickly flash in turn three times then your score is shown. The more LEDs you light the better you have done!

### **Reactions game**

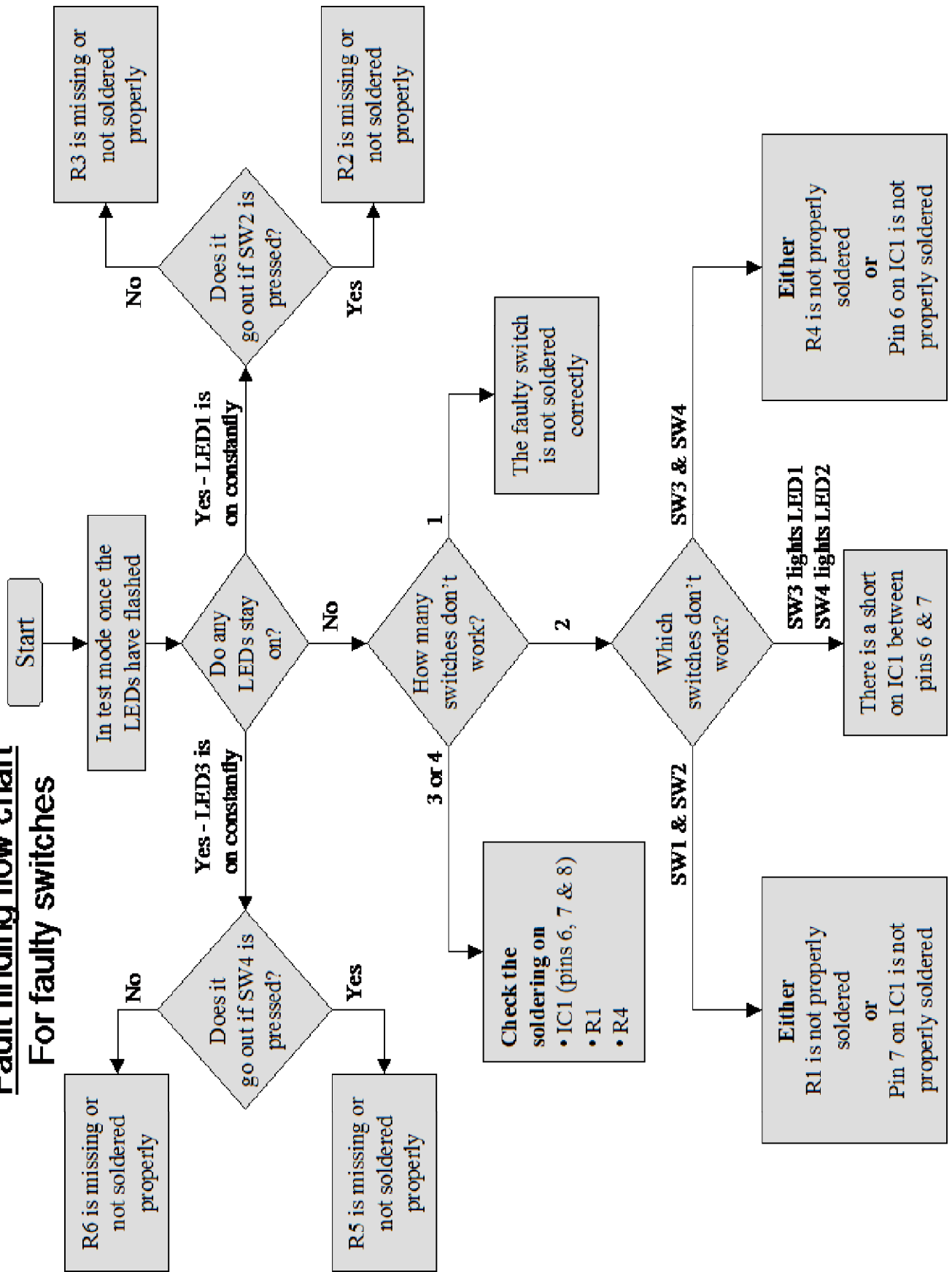
- After a random amount of time one of the four LEDs will be illuminated. Simply press the button next to the LED before the LED goes off.
- If you have pressed the button fast enough then a short while later a new LED will turn on but you have less time to press the button to stay in the game.
- When you don't manage to press the LED fast enough the LEDs quickly flash in turn three times then your score is shown. The more LEDs you light, the better you have done!



## Fault finding flow chart For faulty LEDs



## Fault finding flow chart For faulty switches



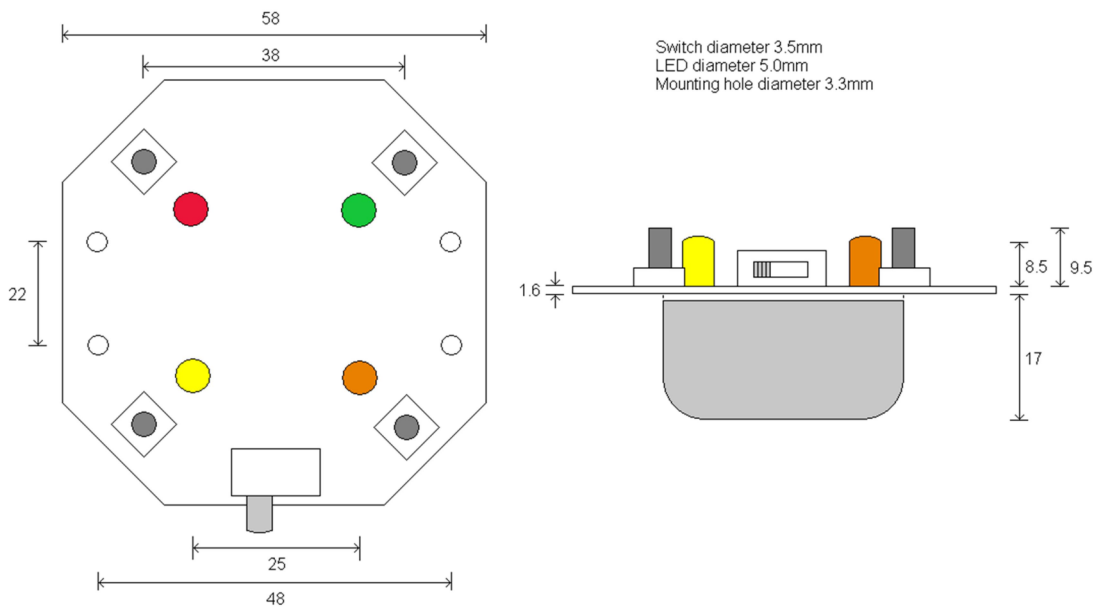
## Designing the Enclosure

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

- The size of the PCB
- Where the LEDs are mounted and how big they are
- Where the switches are mounted and their size

Note: The PCB is symmetrical and, therefore, its length and the position of the LEDs and switches is the same in the vertical direction as well as the horizontal dimensions shown below.

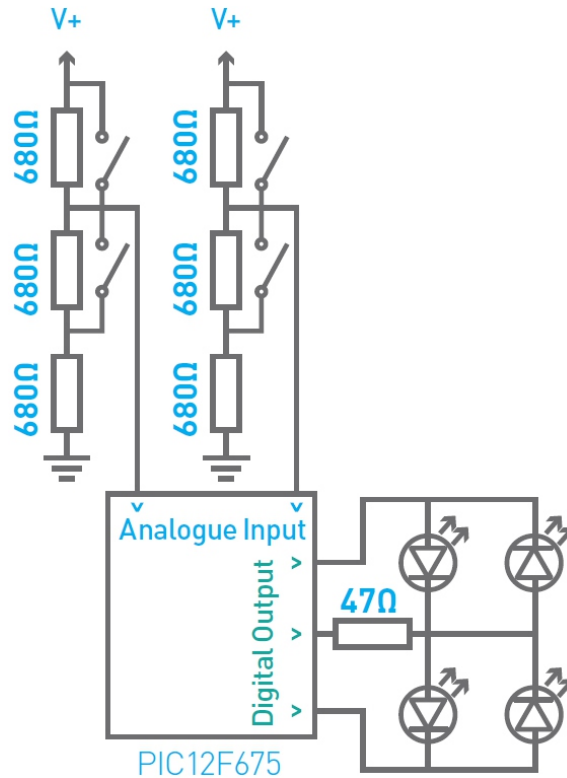
This technical drawing of the game should help you to plan this.  
All dimensions are in mm.



<p>P.C.B</p> <p>SPACER</p> <p>ENCLOSURE</p> <p>2 X M3 BOLTS</p>	<p><b>Mounting the PCB to the enclosure</b></p> <p>The drawing to the left shows how a hex spacer can be used with two bolts to fix the PCB to the enclosure.</p> <p>Your PCB has four mounting holes designed to take M3 bolts.</p>
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## How the Game Works



At the heart of the electronic circuit is a microcontroller. A microcontroller is, in effect, a small computer. The circuit uses a clever design to allow four switches and four LEDs to be connected to only five input / outputs.

The switches are connected to an analogue to digital converter so that it gets a digital representation of the voltage on the input. A set of three resistors is used to make up a potential divider. As each of the resistors is the same value, an equal amount of voltage is present across each of these resistors. The top two resistors also have a switch across them. When the switch is pressed, the voltage across the resistor will become zero. So depending upon which of the two switches is pressed will depend upon what the voltage is at the point where it is fed into the PIC microcontroller. This allows the microcontroller to work out which button is pressed. The third resistor is used to prevent the batteries being rapidly flattened should both switches be pressed at the same time. The other two switches on the board work in the same way. This may sound overly complicated however it uses less input pins than switches with individual pull up resistors.

The LEDs are driven by three outputs. Because the LED only works when current flows through it in one direction, the four LEDs can be turned on by changing the outputs to make one high whilst another is low. More than one LED can be turned on if a little dimmer by taking it in turns to turn the LEDs on hundreds of times a second. The 47Ω resistor limits the current that can flow through the LED's. This protects the LED and controls the brightness.





## 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/2103](http://www.kitronik.co.uk/2103)



This kit is designed and manufactured in the UK by Kitronik

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