Kitronik

## ESSENTIAL INFORMATION

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

CREATE SOOTHING LIGHTING EFFECTS WITH THIS

# USB DARK ACTIVATED COLOUR CHANGING NIGHT LIGHT KIT

Version 1.0

# USB Dark Activated Night Light Essentials

www.kitronik.co.uk/2184

## 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 THE RESISTOR

Start with the 220Ω resistor, which has red, red, brown coloured bands. Solder this resistor into the board where it is labelled R4.

### 2 PLACE THE TRANSISTORS

Place the two transistors into the board where it is labelled Q1 and Q2. It is important that they are inserted in the correct orientation. Ensure that the shape of the device matches the outline printed on the PCB. Once you are happy, solder the devices into place.

### 3 SOLDER THE VARIABLE RESISTOR

Solder the variable resistor into R1. It will only fit in the holes in the board when it is the correct way around.

### 4 SOLDER THE PHOTODETECTOR

Solder the Photodetector into the circle indicated by the text R2. This is next to the ‘dark’ text. Make sure the phototransistor flat edge is towards the Output connections end of the PCB.

### 5 ADD A WIRE LINK

The colour changing LED used in this kit doesn’t need a current limit resistor as it is a 5V LED. **Therefore we need to add a wire link.** Take a piece of wire (the lead you have just cut off another component is perfect) and solder it into the board where it is marked R3.

### 6 SOLDER THE LED

Solder the Light Emitting Diode into LED1. The LED won’t work if it doesn’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.

### 7 ATTACH THE USB LEAD

Now you must attach the USB lead. It needs to be connected to the terminals marked ‘Power’. The red lead should be soldered to the ‘+’ terminal also marked ‘red’ and the black lead should be soldered to the ‘-’ terminal also marked ‘black’.

# Checking Your Night Light PCB

Check the following before you connect power to the board:

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

- All these leads are soldered.
- Pins next to each other are not soldered together.

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

- The body of the two transistors matches the outline on the PCB.
- The flat edge on the LED lines matches the outline on the PCB.
- The flat edge on the Phototransistor is towards the Output connections end of the PCB
- The red wire on the USB lead goes to the connection marked ‘red’ and the black wire to the connection marked ‘black’.

# Testing the PCB

You might need to adjust the variable resistor R1. It won’t be far wrong if you start with the resistor pointing at the middle of the text ‘components’.

- When the sensor is covered (so that it is dark) the LED should be on.
- When the sensor is light the LED should be off.

If this is not the case, recheck your board following the instructions at the top of this page.

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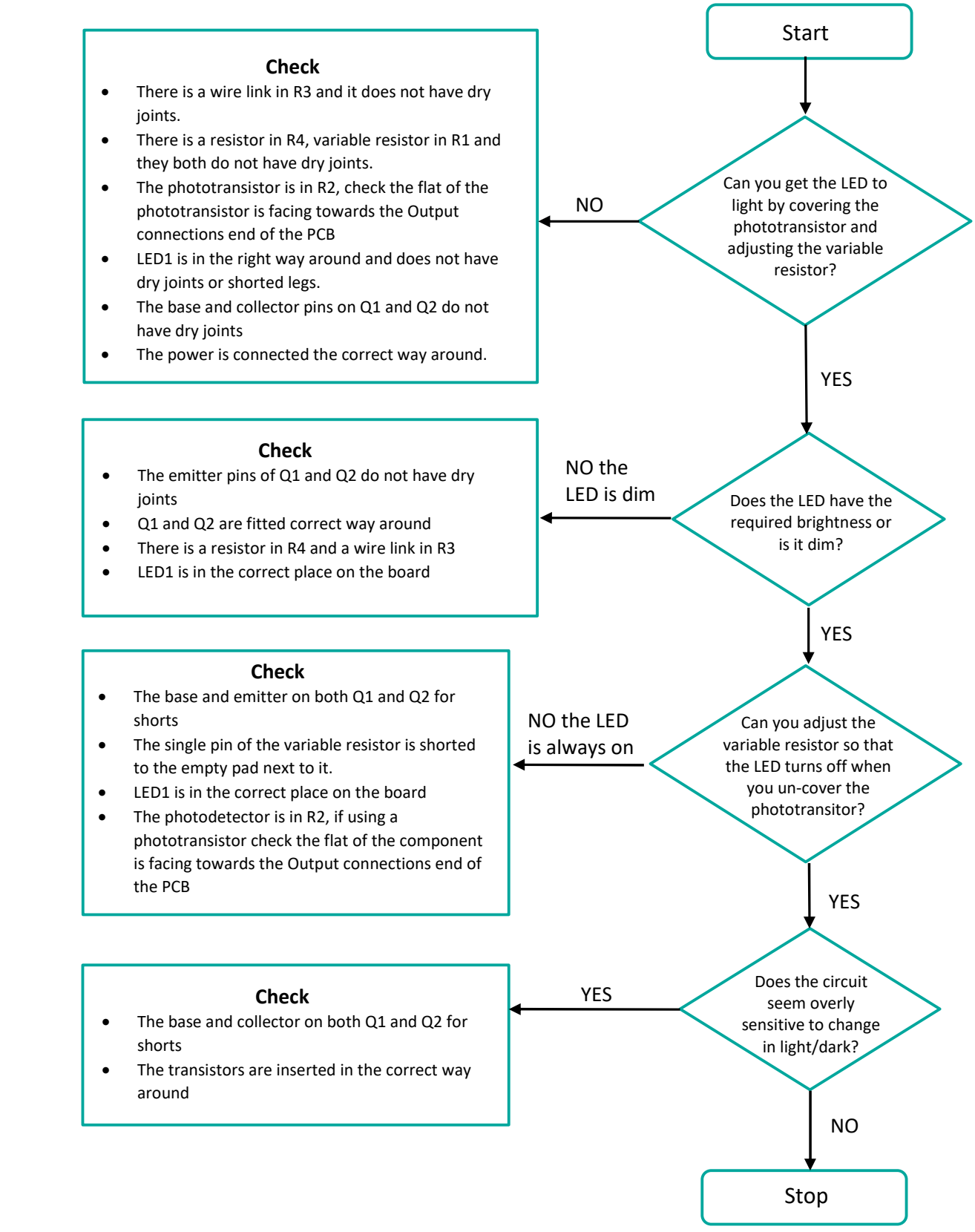


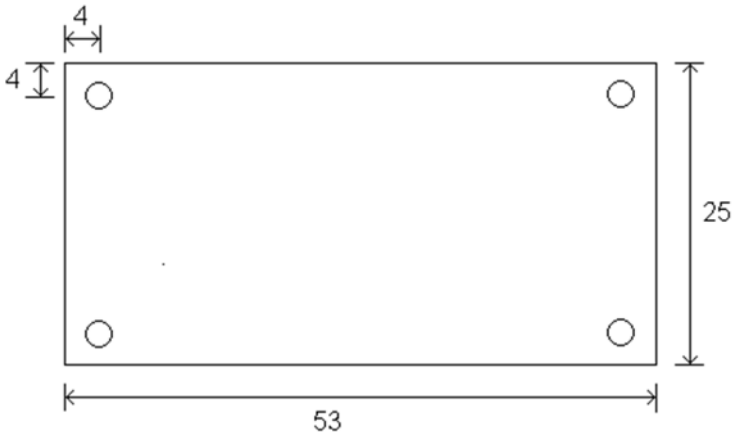
# Designing the Enclosure

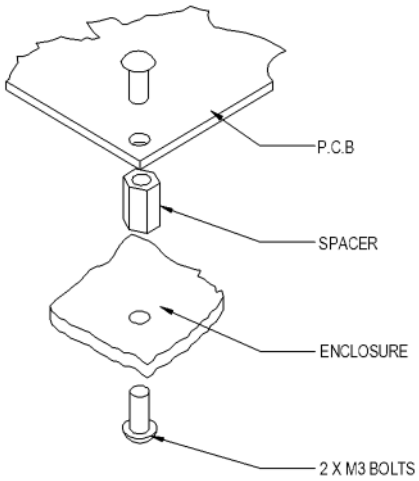
When you design the enclosure, you will need to consider:

- The size of the PCB (below left).
- The need to plug the USB lead in

This technical drawing of the PCB should help you to plan this.

All dimensions in mm
x4 holes 3.3mm diameter



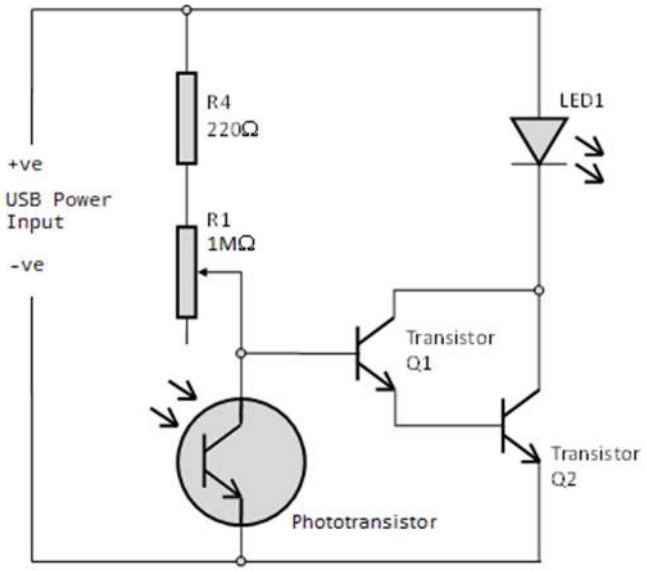




**Mounting the PCB to the enclosure**

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.*

# How the Dark Activated Switch Works




The circuit operation is very simple. When the input to the transistor Q1, which is fed from the connecting point of R1 and the Phototransistor, is greater than 1.4V, the output is turned on. Normally it requires 0.7V to turn on a transistor but this circuit uses two transistors in a Darlington Pair, meaning that it requires 2 x 0.7V = 1.4V to turn on both transistors.

When the Phototransistor detects a brighter light level it conducts. Current flows through the component down to ground, thus pulling the voltage down at the transistor and turning it off.

When the phototransistor detects a darker light level, the phototransistor conducts less, so that the voltage at Q1 is pulled towards the supply voltage by the resistor R1 and R4. When this voltage is at 1.4V or higher transistor Q1 turns on. R4 is present to protect the transistor Q1 should the variable resistor be set to zero.

It is also worth noting that the output, when turned on, will be around 0.9V lower than the supply voltage V+. This is because of the voltage drop across the collector and emitter pins of the Darlington Pair of transistors. Therefore if the supply voltage is 5V, then the output voltage will be around 4.1V.

## *Adjusting the trigger level*

The point at which the circuit is triggered is set by the 1MΩ variable resistor. By varying the value of this resistor, the ratio of current flow of R1 and the phototransistor can be varied to a point where a centre voltage (trip point) of 1.4V is achieved at the desired light level.

## *LED*

When the board switches on the output, the LED will turn on. With a normal LED you would need a resistor to limit the current flowing into the LED to ensure that it isn't damaged and to control the brightness. This would be resistor R3. With the colour changing LED, this is built into the LED itself. This is why when you built the kit, R3 has been replaced with a simple wire link.

# 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:
http://www.kitronik.co.uk/2184

This kit is designed and manufactured in the UK by Kitronik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