

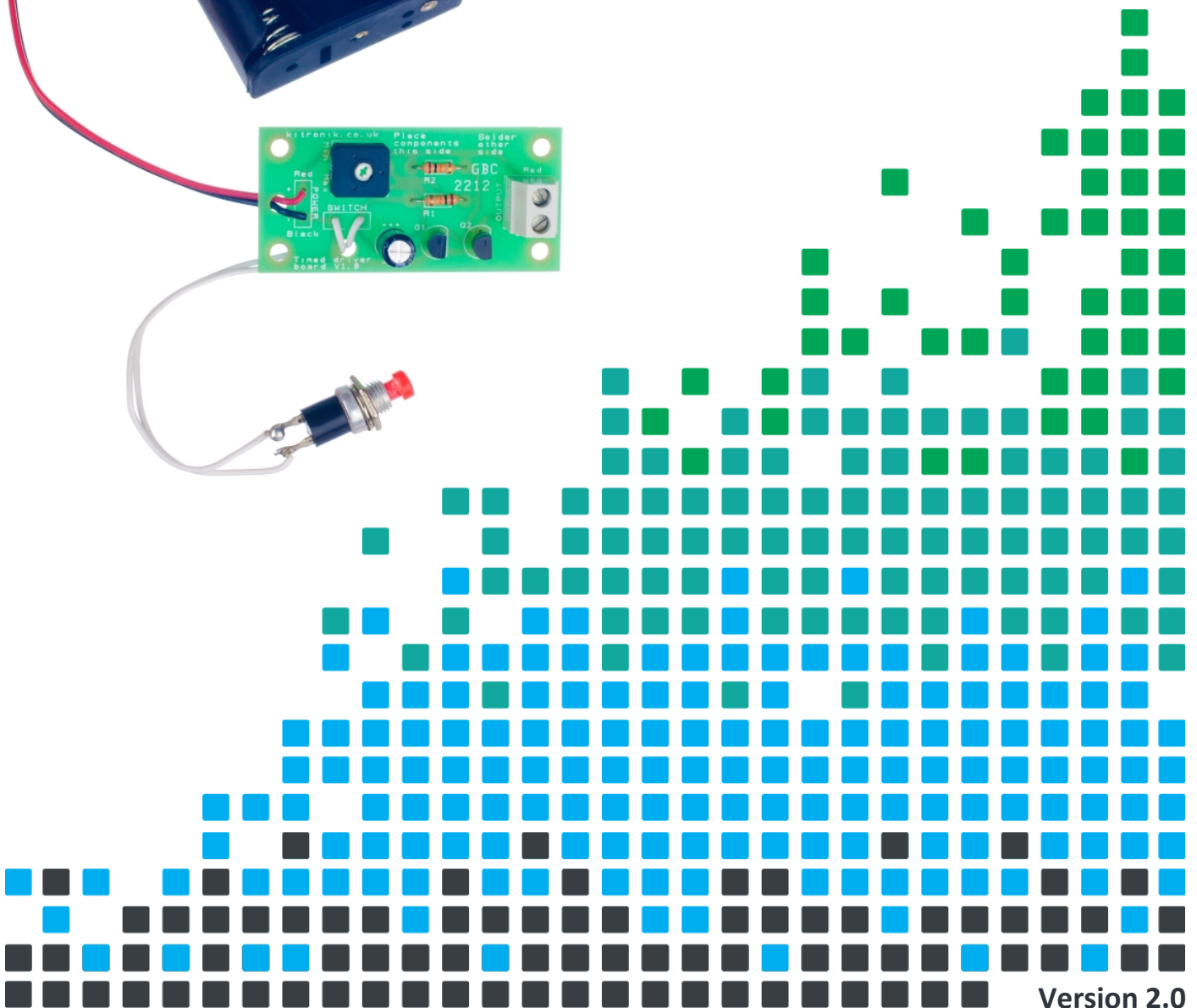
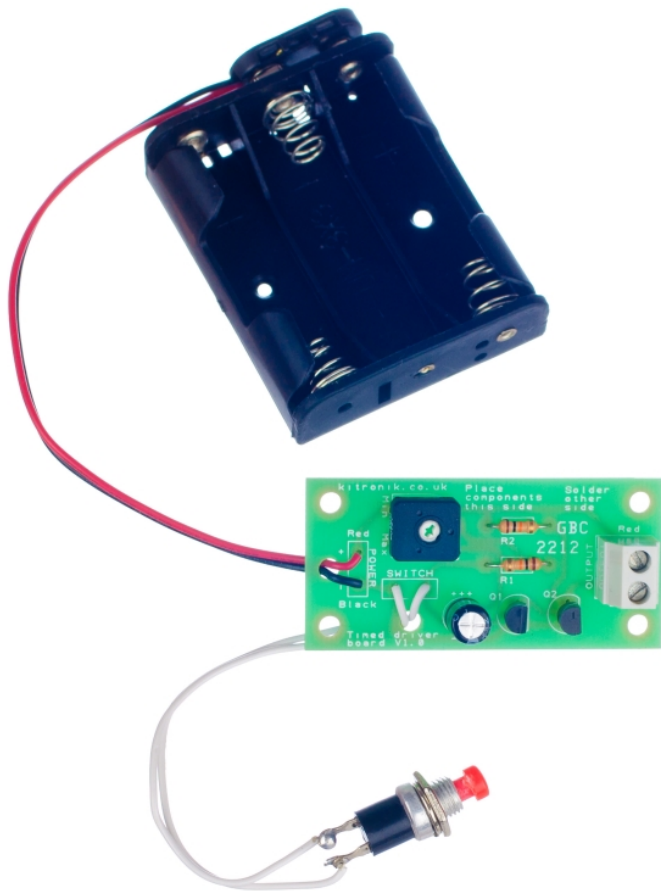


# ESSENTIAL INFORMATION

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

MAKE A DISPLAY OF YOUR MOST TREASURED PHOTOGRAPH WITH THIS

# LED PICTURE FRAME 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 two resistors:  
The text on the PCB shows where R1 and R2 go.  
Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R1	10K	Brown, black, orange
R2	10K	Brown, black, orange



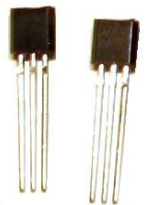
### 2 SOLDER THE VARIABLE RESISTORS

Solder the variable resistor into R3. It will only fit in the holes in the board when it is the correct way around.



### 3 SOLDER THE FETs

The two FETs should be placed into Q1 & Q2. Both are the same type but 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.



### 4 SOLDER THE ELECTROLYTIC CAPACITOR

The capacitor C1 is an electrolytic capacitor and needs to be put into the board the correct way around. The capacitor has a '-' sign marked on it, which should match the same sign on the PCB. Now solder the capacitor.



### 5 SOLDER THE 2-WAY TERMINAL BLOCK

Solder the 2-way terminal block into the 'OUTPUT' connection. The terminal connections should face the edge of the board.



### 6 ATTACH THE BATTERY CLIP

Now you must attach the battery clip. It needs to be connected to the terminals marked 'POWER'. First feed the pair of wires up through the hole next to the power connection. The red lead should be soldered to the '+' terminal, which is also marked 'red', and the black lead should be soldered to the '-' terminal which is also marked 'black'.



## 7 SOLDER THE SWITCH

To attach the start switch, first cut and strip two short lengths of the wire supplied. Solder one to each of the two terminals on the switch. Now take the other end of the wires and feed them through the strain relief next to the connection marked 'SWITCH'. Solder the wires to the 'SWITCH' pads. It does not matter which way around the two wires go.



## Checking Your LED Picture Frame PCB

Carefully check the following before you insert the batteries:

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

- All holes (except the 4 large (3mm) holes in the corners) are filled with the lead of a component.
- All these leads are soldered.
- Pins next to each other are not soldered together.

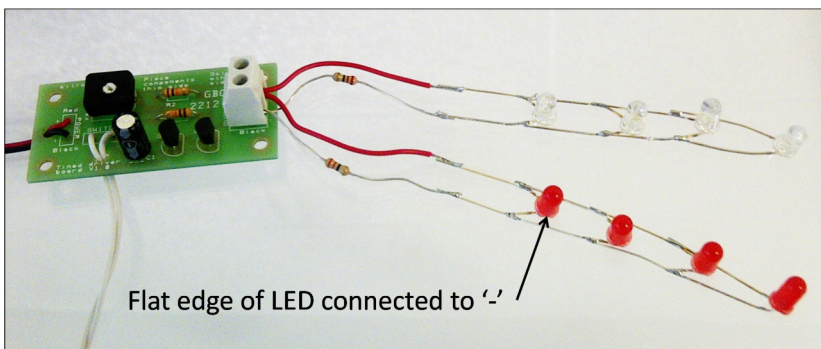
### Check the top of the board to ensure that:

- The red and black wires on the battery clip match the red and black text on the PCB.
- The '-' on the capacitor match the same marks on the PCB.
- The 'D' shape of Q1 & Q2 match the outline on the PCB.

## Connecting LEDs to the Board

The output terminals have about 4.5 Volts on them when the button is pressed, most LEDs require a lower voltage than this. This means that a current limit resistor will be required. In theory, every LED should have its own current limit resistor. In practice, if the LEDs that are being used are from the same batch and the LEDs aren't high power LEDs, then it is possible to share one current limit resistor between a number of LEDs. When this is done the resistor value will be smaller than the resistor that is used with a single LED. When different types of LEDs are used, a separate resistor is required for each type of LED.

Suppose a red LED and a white LED is going to be positioned in each corner of a picture frame, then the four red LEDs would be connected in parallel and the four white LEDs in parallel. Each then shares a current limit resistor. The picture below shows these connections. This example is connected to make it easy to see how to do the connections; in reality longer wires would be needed.



Current limit resistor for <b>four</b> LEDs	
3504 Standard red	33Ω
3505 Standard green	33Ω
3506 Standard yellow	33Ω
3542 Standard white	22Ω
3543 Standard blue	22Ω
3507 Ultra bright red	33Ω
3524 Ultra bright white	68Ω
3537 Ultra bright blue	68Ω



## Testing the Board

Connect the PP3 clip to the 3x AA battery cage. **Do not use with 9V.**

To test the board, turn the trimmer potentiometer to 'Min' and then turn it back slightly. When the button is pressed the LEDs should turn on for a few seconds. The required duration can now be set with the potentiometer.

## Fault Finding Information

There are only a few things that can happen if there is a mistake on the board. Generally nothing will happen, however the LED may function incorrectly. Find the description that best describes what fault is present and then check the items listed below the heading.

### Nothing happens

Check the following:

- The batteries are good and in the holder the right way around.
- The LEDs are connected to the board the right way around.
- The power connection is the right way around and have dry joints.
- Check the switch for dry joints (on the switch & PCB).
- Check capacitor C1 for a solder short.
- A short or dry joint on the centre pin on Q1.
- Q1 is in the right way around.
- Check Q2 for a short or dry joint.
- Check R2 for dry joints.

### The LED is on before the switch is pressed and stays on

Check:

- Q1 for a short.
- Q1 for dry joints on the edge two pins.
- Q2 for a short (if the LEDs go off when the button is pressed, this will be the fault).
- Q2 is the right way around (if the LEDs get brighter when the button is pressed, this will be the fault).

### The LEDs are on only whilst the button is pressed

There is a dry joint on the capacitor C1.

### The LEDs go on when the button is pressed but then never turns off

There is a dry joint on R1 or R3.

### The LEDs flicker on power up

There is a solder short on Q1.

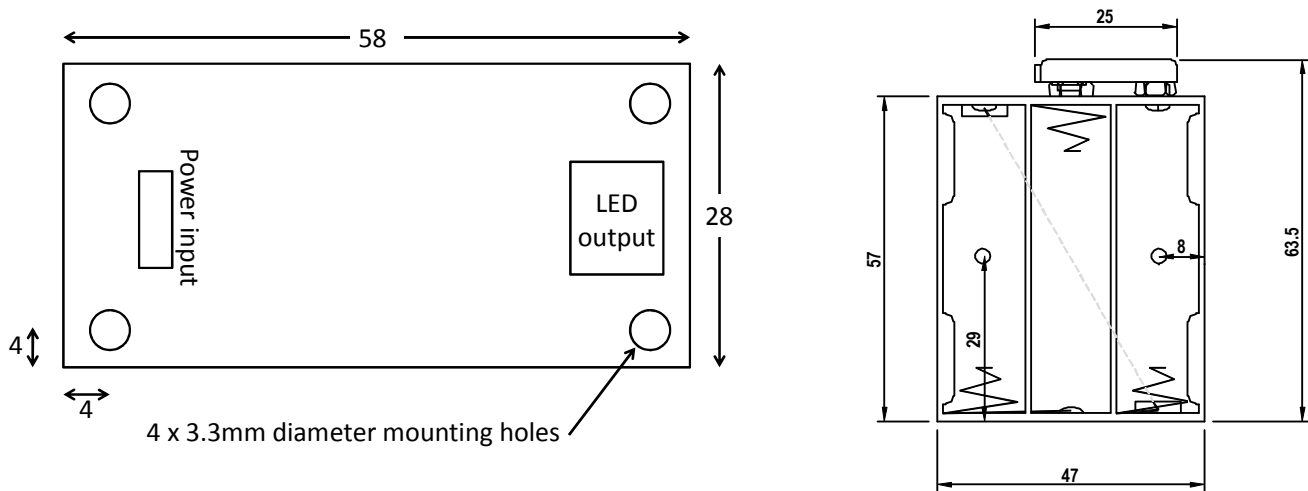


## Designing the Frame

When you design the picture frame, you will need to consider:

- The size of the PCB (below left, height including components = 15mm).
- How big the batteries are (below right, height = 16mm).
- Where on the picture frame you want the LEDs positioning.

The technical drawings of the PCB & battery case should help you to plan this.

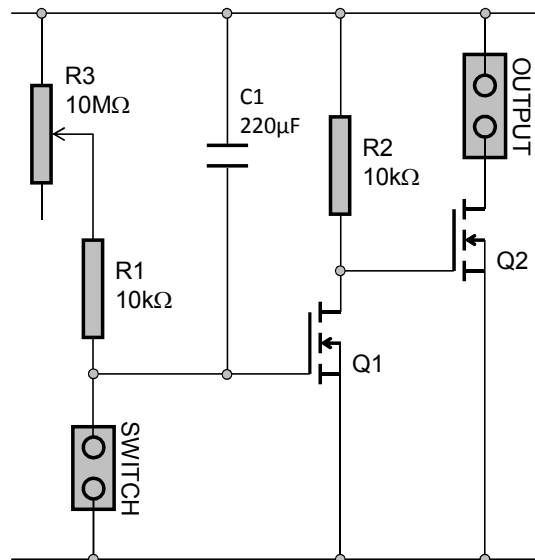


All dimensions in mm

<p>P.C.B SPACER ENCLOSURE 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><i>Your PCB has four mounting holes designed to take M3 bolts.</i></p>
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## How the LED Picture Frame Works



The circuit is triggered when the switch is pressed. At this point, current flows through the switch and charges the capacitor C1. When the switch is released the capacitor will still be full of charge and starts to discharge through R1 / R3. As the capacitor discharges there is less and less voltage across it, as this happens the voltage on the gate of the FET (Q1) gets closer to the positive voltage of the circuit.

The FET operates like a switch: when voltage is present on the gate, current can flow through the FET. So in this circuit, when the capacitor is charged there is no voltage on the gate but as it discharges, the voltage at the gate increases. When this gets to approximately 2 Volts the FET switches on.

When the capacitor is charged and Q1 is off, the gate of Q2 is held high by the pull up resistor R2. Since a voltage is present on the gate of Q2, the output will be on and the LEDs that are connected to it will be on. As the capacitor discharges and a voltage becomes present on the gate of Q1, the FET Q1 turns on taking the gate of Q2 low and the LEDs turn off.

Although the switching point on FETs is a lot sharper than on a transistor, when there is a gradual change in voltage on the gate input the output gradually turns off. This is noticeable when different LEDs are used that have a different forward voltage as they can be seen turning off at different times. By adding the second FET, the circuit output goes from on (having full Volts on it) to off (no Volts) instantly.



## 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/2146](http://www.kitronik.co.uk/2146)



This kit is designed and manufactured in the UK by Kitronik

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