

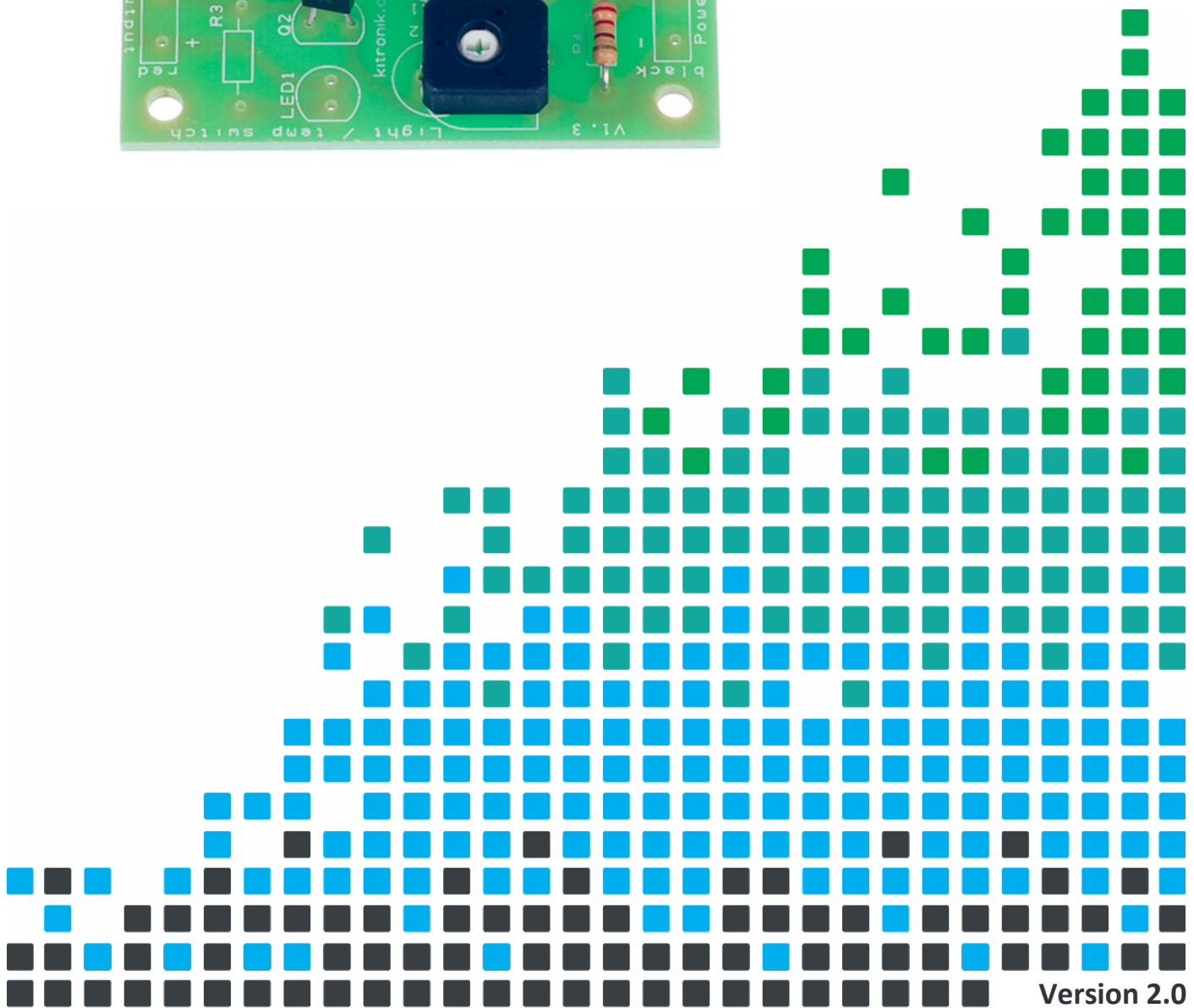
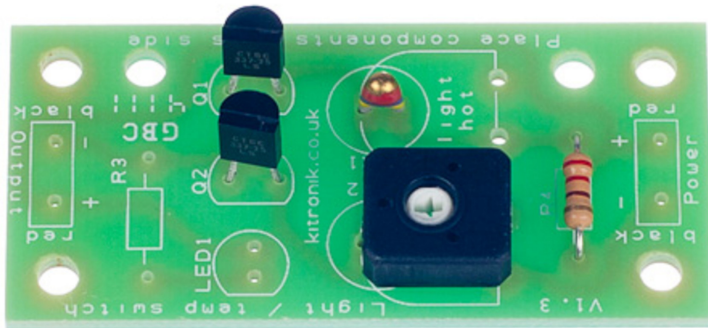


# ESSENTIAL INFORMATION

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

REACT TO THE TEMPERATURE WITH THIS

# HEAT ACTIVATED SWITCH KIT



## Build Instructions – Cold activated

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 RESISTORS

Start with the resistor:

The text on the PCB shows where R1, go.

Ensure that you put the resistors in the right place.

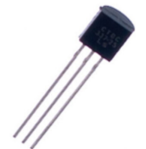
PCB Ref	Value	Colour Bands
R4	220 $\Omega$	Red, red, brown



2

### Place the Transistors

Now place the two transistors. They should be placed into Q1 and Q2. It is important that they are inserted in the correct orientation. Ensure the shape of the device matches the outline printed on the PCB. Once you are happy solder the devices into place.



3

### Place the variable resistor

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



4

### Place the thermistor

Solder the thermistor in to the circle indicated by the text R2. This is next to the 'cold' text. It does not matter which way around it is inserted.



## Connecting power

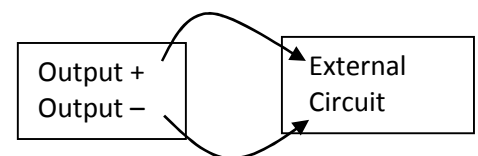
There are two power terminals on the PCB to allow power to be connected. These are identified by the text 'power' on the PCB.

- The positive power connection should be connected to the terminal indicated by the text '+' and 'red'
- The negative power connection should be connected to the terminal indicated by the text '-' and 'black'

## Connecting an LED

The circuit can be used to turn on a LED. The LED should be soldered into the LED1 on the PCB. A current limit resistor must also be placed in the R3 on the PCB. The value of R3 will depend on the LED used and the supply voltage. For a standard LED and a 5V supply voltage a 220 $\Omega$  would be suitable. Connecting an external circuit to the boards output

The circuit can be used to control another device. To do this the device that is to be controlled should be connected to the terminals labelled output. When the circuit is activated the output turns on and can be used to turn on the device to which it is connected.



Note: This output will be around 0.9V lower than that connected to the PCB.



## Build Instructions – Heat activated

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 RESISTORS

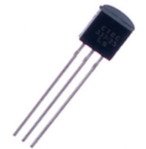
Start with the resistor:  
The text on the PCB shows where R1, go.  
Ensure that you put the resistors in the right place.

PCB Ref	Value	Colour Bands
R4	220Ω	Red, red, brown



### 2 Place the Transistors

Now place the two transistors. They should be placed into Q1 and Q2. It is important that they are inserted in the correct orientation. Ensure the shape of the device matches the outline printed on the PCB. Once you are happy solder the devices into place.



### 3 Place the thermistor

Solder the thermistor in to the circle indicated by the text R1. This is next to the 'hot' text. It does not matter which way around it is inserted.



### 4 Place the variable resistor

Place the variable resistor into R2. It will only fit in the holes in the board when it is the correct way around.



## Connecting power

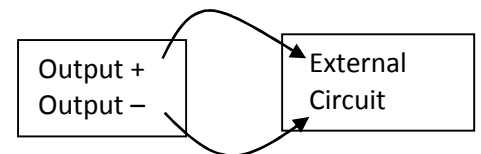
There are two power terminals on the PCB to allow power to be connected. These are identified by the text 'power' on the PCB.

- The positive power connection should be connected to the terminal indicated by the text '+' and 'red'
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## Connecting an LED

The circuit can be used to turn on a LED. The LED should be soldered into the LED1 on the PCB. A current limit resistor must also be placed in the R3 on the PCB. The value of R3 will depend on the LED used and the supply voltage. For a standard LED and a 5V supply voltage a 220Ω would be suitable. Connecting an external circuit to the boards output

The circuit can be used to control another device. To do this the device that is to be controlled should be connected to the terminals labelled output. When the circuit is activated the output turns on and can be used to turn on the device to which it is connected.



Note: This output will be around 0.9V lower than that connected to the PCB.



## Checking Your Heat Activated Switch Board

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 match the outline on the PCB

## Testing the PCB

### ***Cold activated circuit***

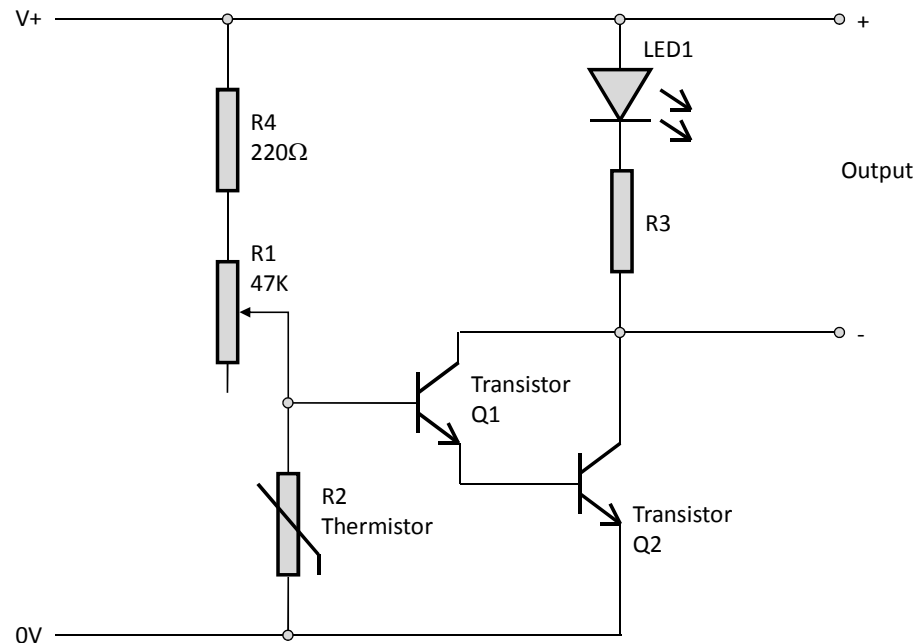
- Turn the variable resistor R1 fully clockwise (high resistance = 47K $\Omega$ ). At this point the output should be off (and the LED if fitted).
- Now turn the variable resistor R1 anti-clockwise until the output turns on (and the LED if fitted).
- Turn the variable resistor R1 back clockwise. Note the point at which the output (and the LED if fitted) turns back off. This is the trip point for the current temperature.
- If you want the circuit to trip at a lower temperature then adjust R1 forward in the clockwise direction.
- If you want the circuit to trip at a higher temperature then adjust R1 back in the anti-clockwise direction.
- Some experimentation maybe required to set the correct trip point.

### ***Heat activated circuit***

- Turn the variable resistor R2 fully clockwise (high resistance = 47K $\Omega$ ). At this point the output should be on (and the LED if fitted).
- Now turn the variable resistor R2 anti-clockwise until the output turns off (and the LED if fitted).
- Turn the variable resistor R2 back clockwise. Note the point at which the output (and the LED if fitted) turns back on. This is the trip point for the current temperature.
- If you want the circuit to trip at a lower temperature then adjust R2 forward in the clockwise direction.
- If you want the circuit to trip at a higher temperature then adjust R2 back in the anti-clockwise direction.
- Some experimentation maybe required to set the correct trip point.



## How the heat activated switch works – Cold activated



The circuit operation is very simple. When the input to the transistor Q1, which is fed from the connecting point of R1 and R2, is greater than 1.4V the output is turned on. The voltage at the join of R1 and R2 is determined by the ratio of the two resistors. This is known as potential divider.

Voltage at the join of R1 and R2 = The supply Voltage x (R1/(R1+R2))

Normally it requires 0.7V to turn on a transistor but this circuit uses two resistors in a Darlington Pair meaning it requires 2 x 0.7V = 1.4V to turn on both transistors.

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.

R4 is present to protect the transistor should the variable resistor be set to zero.

### Adjusting the trigger level

The point at which the circuit is triggered is set by the 47KΩ variable resistor. By varying the value of this resistor the ratio of the resistance of R1 and R2 can be varied to a point where a centre voltage (trip point) of 1.4V is achieved at the desired light level.

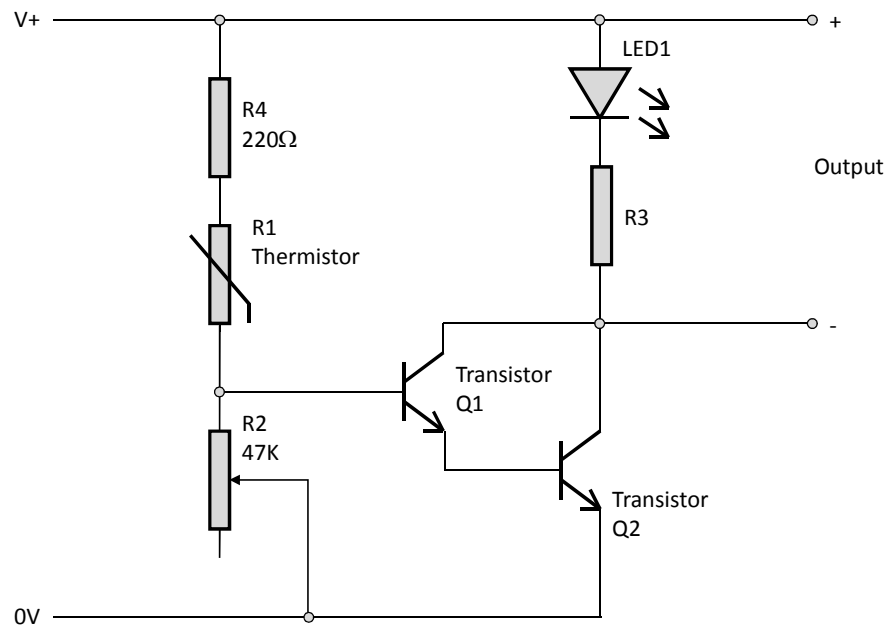
### LED (if fitted)

If LED1 and R3 are fitted the LED will light at this point. The value of R3 should be selected for the relevant supply voltage on LED used. A standard LED would require around 10mA (0.01A) producing a normal brightness. As stated a 5V supply would give 4.1V across LED1 and R3. The LED1 would use 1.9V leaving around 2.2V (4.1V-1.9V) across R3.

Using  $R = V/I$      $R3 = 2.2 / 0.01$      $R3 = 220\Omega$



## How the heat activated switch works – Heat activated



The circuit operation is very simple. When the input to the transistor Q1, which is fed from the connecting point of R1 and R2, is greater than 1.4V the output is turned on. The voltage at the join of R1 and R2 is determined by the ratio of the two resistors. This is known as potential divider.

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Note: R4 is only present to protect the transistor in the cold activated version (when the variable resistor is set to zero).

### Adjusting the trigger level

The point at which the circuit is triggered is set by the 47KΩ variable resistor. By varying the value of this resistor the ratio of the resistance of R1 and R2 can be varied to a point where a centre voltage (trip point) of 1.4V is achieved at the desired light level.

### LED (if fitted)

If LED1 and R3 are fitted the LED will light at this point. The value of R3 should be selected for the relevant supply voltage on LED used. A standard LED would require around 10mA (0.01A) producing a normal brightness. As stated a 5V supply would give 4.1V across LED1 and R3. The LED1 would use 1.9V leaving around 2.2V (4.1V-1.9V) across R3.

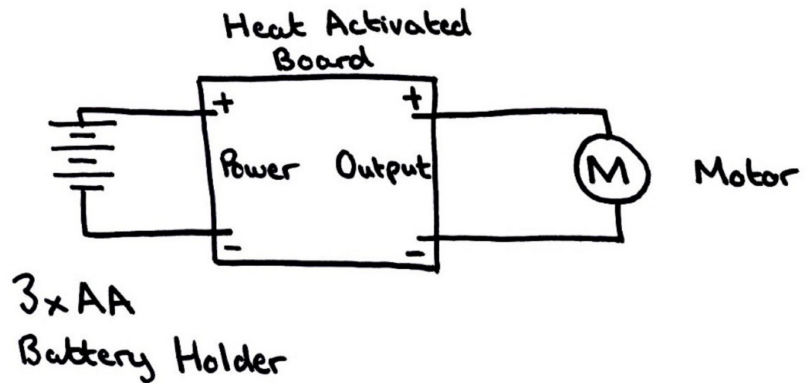
$$\text{Using } R = V/I \quad R3 = 2.2 / 0.01 \quad R3 = 220\Omega$$



## Applications

### Heat activated fan/cooler

By using a temperature activated board built in the heat activated option and the addition of motor it is possible to make a heat activated fan (shown right). The fan can be set up to come on at a desired temperature by adjusting the variable resistor.



Parts list to build 100 heat activated fans:

Part no.	Description	Qty
2113	Temperature activated switch	100
2234-25	3 x AA battery cage with clip, pack of 25	4
2238-25	PP3 Battery clip lead, pack of 25	4
2501	Pack of 10 motors	10
2503	Pack of 10 motor clips	10
2201-40	Zinc Chloride AA batteries, box of 40	8

### Babies bath over temperature indicator

By using a temperature activated board built in the heat activated option it is possible to make a simple babies bath too hot indicator. The 'too hot' state can be indicated by an LED that light by the addition of the 150Ω resistor (in R3) and red LED (in LED1).

The thermistor should be mounted on separate flying leads as the PCB should not be immersed in water.

Parts list to build 100 babies bath over temperature indicators:

Part no.	Description	Qty
2113	Temperature activated switch	10
2234-25	3 x AA battery cage with clip, pack of 25	4
2238-25	PP3 Battery clip lead, pack of 25	4
3003-150R	150ohm resistor, pack of 100	1
3504	Red 5mm LED, pack of 50	2
2201-40	Zinc Chloride AA batteries, box of 40	8



## 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/2113](http://www.kitronik.co.uk/2113)



This kit is designed and manufactured in the UK by Kitronik

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