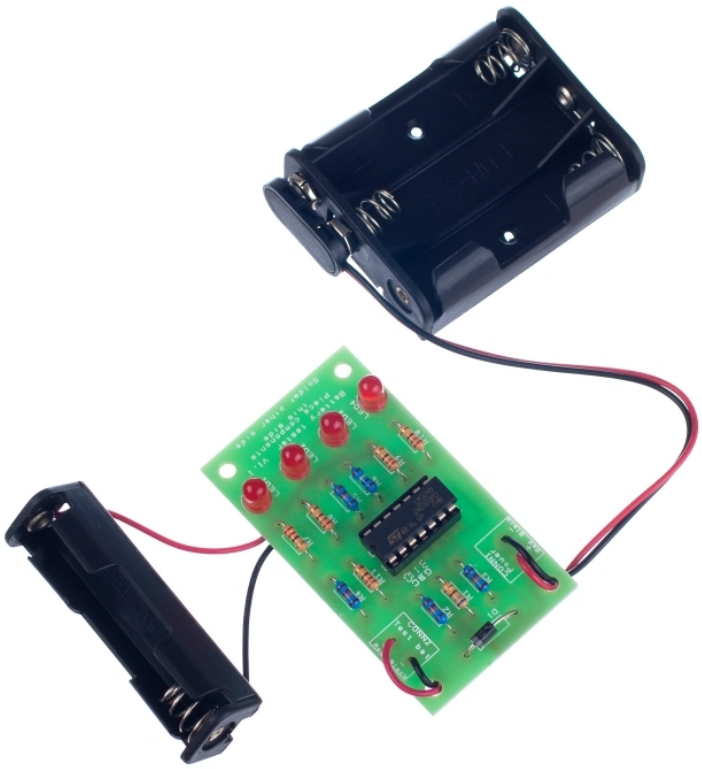
Kitronik

ESSENTIAL INFORMATION

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

MEASURE THE REMAINING CAPACITY OF AA BATTERIES WITH THIS

BATTERY TESTER KIT



Version 2.0

Battery Tester Essentials

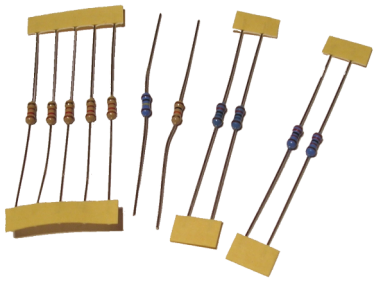
www.kitronik.co.uk/2102

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 eleven 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	680Ω	Blue, grey, brown
R2, R3, R4 & R5	22KΩ	Red, red, orange
R6	100KΩ	Brown, black, yellow
R7, R8, R9, R10 & R11	220Ω	Red, red, brown

5 band resistors

Some high tolerance resistors use 5 bands, not 4. These instructions relate to four band resistors. If your kit has 5 band resistors, it will have a black band in the centre and the multiplier band will be one colour lower.
i.e. 22K (tolerance not shown)
4 band = Red, red, orange
5 band = Red, red, black, red

2 SOLDER THE DIODE

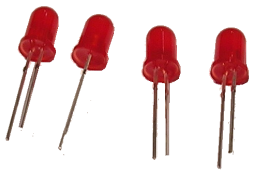
Place the diode into the PCB where it is labelled D1. The diode has to go in the correct way around. You will see that there is a silver line around one end. This matches the corresponding line on the PCB. Solder into place once you are happy that it's correct.

3 SOLDER THE IC HOLDER

Solder the Integrated Circuit (IC) holder into 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.

4 SOLDER THE LEDs

Solder the four Light Emitting Diodes (LEDs) into LED1 – LED4. It does not matter which goes where, but the battery tester 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 ATTATCH THE BATTERY CLIP

The battery connector should be soldered into the ‘CONN1 Power’ terminal. The red wire must go to the ‘+’ terminal and the black wire must go to the ‘–’ terminal.

6 ATTACH THE TEST BATTERY HOLDER

The single test battery holder should be soldered into the ‘CONN2 Test bat’ terminal. The red wire must go to the ‘+’ terminal and the black wire must go to the ‘–’ terminal.

7 INSERT 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.

Checking Your Battery Tester PCB

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) 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 and the IC holder are in the same orientation as the markings on the printed circuit board.
- All of the resistors are in the correct places.
- The four LEDs are in the right way around.
- The red wire on the battery connector goes to the '+' terminal on the power terminals and the black wire goes to the '-' terminal.
- The red wire on the test battery holder goes to the '+' terminal on the test battery terminals and the black wire goes to the '-' terminal.

Testing the PCB

Make sure that the battery tester is powered up. Using a power supply or the battery tester, clip the black lead onto the spring section of the test battery holder and the red lead to the other end. Start at zero Volts and vary the voltage upward to 1.5 Volts. Do not exceed 1.5 Volts. Check that the LEDs light at approximately the voltages listed in the table below. If this is not the case, use the fault finding flow chart to fix the problem.

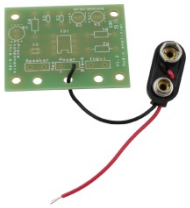
Voltage	Number of LEDs that light
0 – 0.9	1
0.9 – 1.1	2
1.1 – 1.3	3
1.3 – 1.5	4

Adding an On / Off Switch

If you wish to add a power switch, don't solder both ends of the battery clip directly into the board, instead:

1

Solder one end of the battery clip to the PCB, either black to '-' or red to '+'.



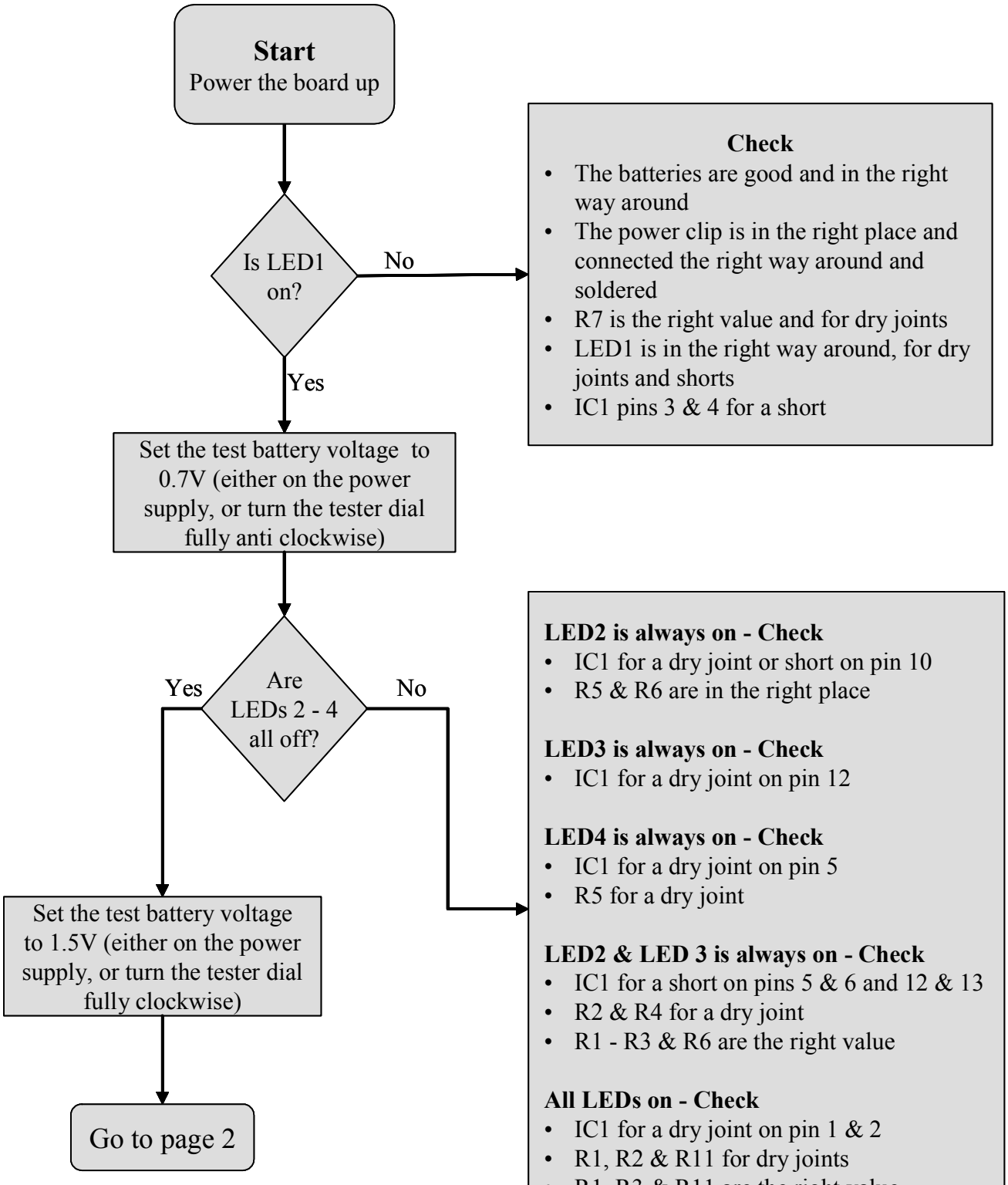
2

Solder the other end of the battery clip to the on / off switch.

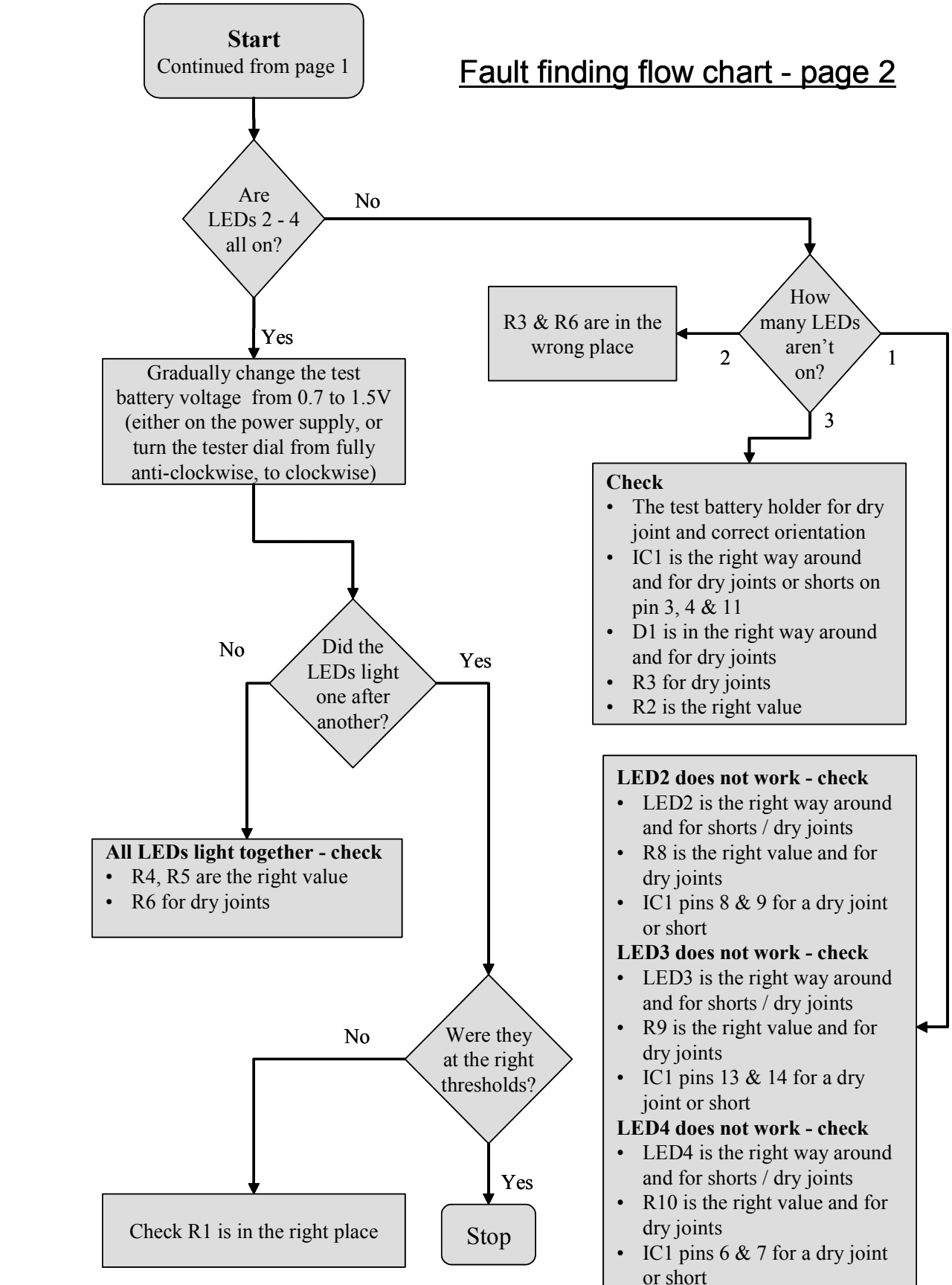
3

Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

Fault finding flow chart - page 1



Fault finding flow chart - page 2

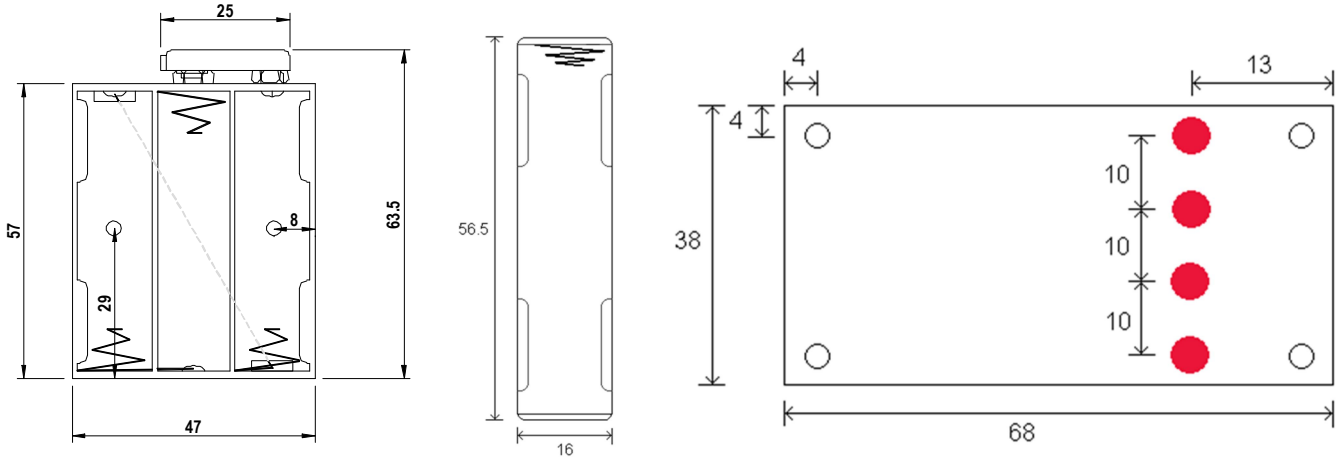


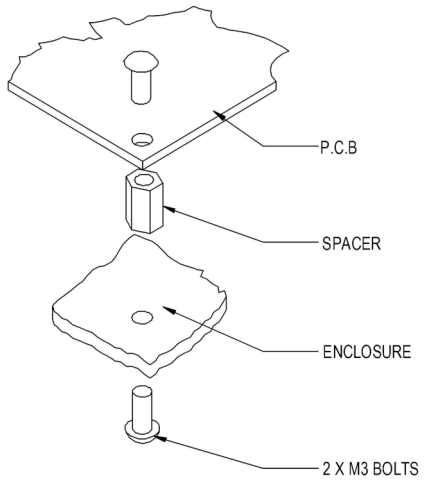
Designing the Enclosure

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

- The size of the PCB (below right, four mounting holes are 3.3mm).
- Where the LEDs are situated (diameter 5mm).
- Access to the batteries to allow them to be changed (below left).
- Where the battery holder for the test battery will be located (below centre).

Technical drawings of these items are illustrated on this page, which should help you to design your enclosure. All dimensions are in mm. The depth of both battery holders is 14mm.



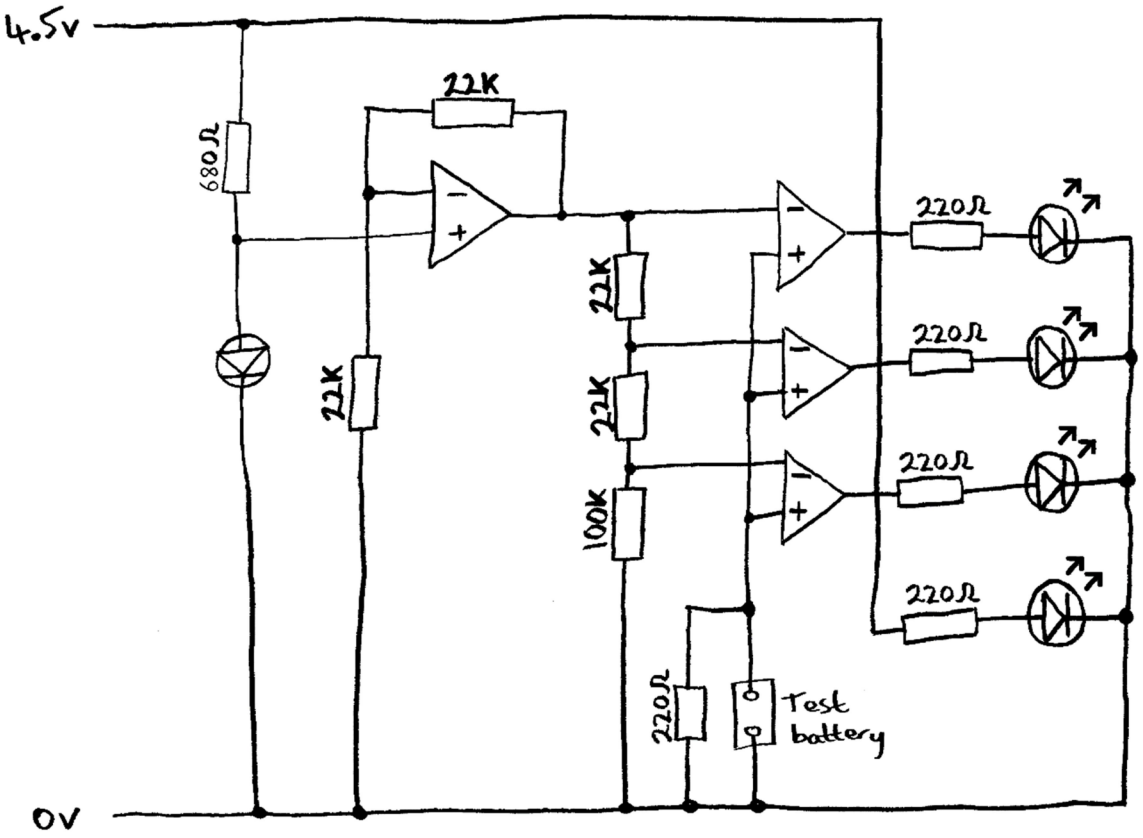


Mounting the PCB to the enclosure

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 Battery Tester Works



Comparators are used to compare one signal to another. They have two inputs: one labelled with a '-' and the other with a '+'. If the voltage on the '+' input is greater than that on the '-', then the output (the point of the triangle) will be 4.5V. If the signal on the '-' input is larger than the '+' input, then the output becomes zero.

Each of the three operational amplifiers (op amps) on the right of the diagram are operating as comparators as described above. The '+' input to each comes directly from the battery under test. The '-' inputs are held at pre-determined levels that equate to the different stages of decay in battery voltage. As the battery gets flatter, the voltage falls. As this becomes lower than the pre-determined levels, the corresponding LED goes out.

To produce the pre-determined levels, you require a consistent voltage reference. This is produced as follows. The diode and 680Ω resistor on the left of the diagram produce a reference voltage of 0.65V (which is the drop over the diode). This is fed into the '+' input on the op amp (on the left). The gain or amplification of the op amp in this circuit is 2 (given by, 1+ (22K÷22K)). Therefore the output of the op amp will be at 2 x 0.65V = 1.3V.

This 1.3V is the first pre-determined level. The other (lower) levels are produced by applying a potential divider across this 1.3V and 0V.

The 220Ω between the op amp and the LEDs limit the flow of electricity into the LED. This controls the brightness and stops the LED from burning out.

Instruction Manual

Your electronic battery tester is going to be supplied with some user instructions. Using the information below, and anything else that you feel should be included, write a set of instructions that will allow someone else to use your battery tester design. Try to make the instruction clear and easy to follow.

You may wish to collect a number of example instruction manuals. This will allow you to decide what style of instructions you feel are simple to follow.

Using the battery tester

- To turn the battery tester on, connect the battery holder to the battery clip (unless you have added an on/off switch).
- When the battery tester is turned on, LED1 will light up.
- The test battery should be placed in the 'test battery' holder.
- The LEDs will light to indicate the state of the battery as follows.
    - LED 1 only = very flat
    - LED 1 + LED 2 = battery capacity low
    - LED 1 + LED 2 + LED 3 = battery capacity above half
    - All LEDs = battery full
- The circuit will gradually flatten the batteries even when it is not being used to test a battery so the batteries should be left unconnected when not in use.

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/2102


This kit is designed and manufactured in the UK by Kitronik

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