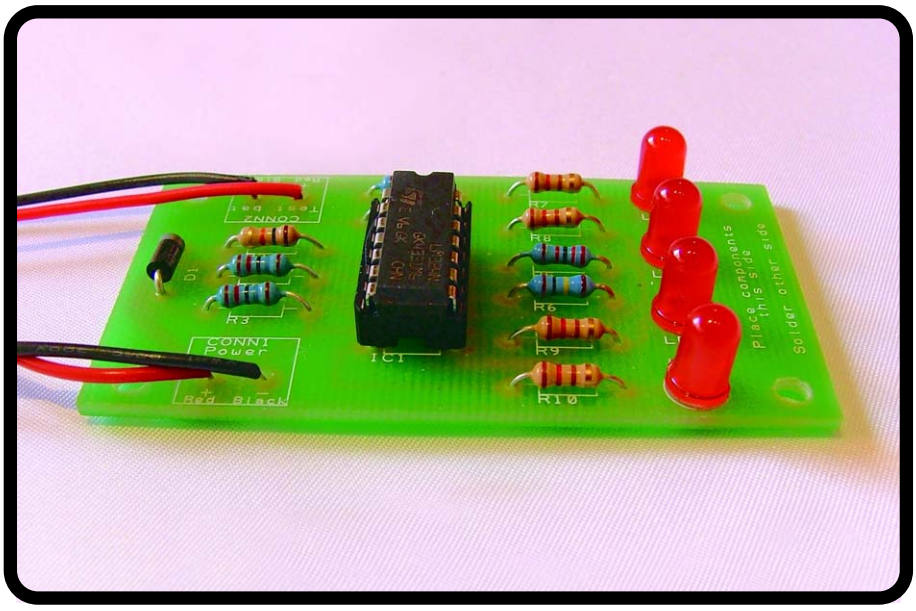
ACTIVE ROBOTS
Quality Robotics & Electronics

Battery Tester



Build Instructions

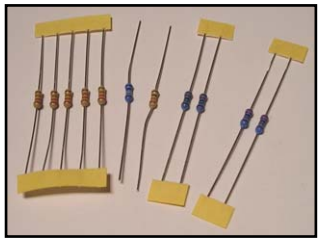
Issue 1.2

Build Instructions

Before you put any components in the board or pick up the soldering iron, just 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.

You will find it easiest to start with the small components and work up to the taller larger ones. If you've not soldered before get your soldering checked after you have done the first few joints.

Step 1
Start with the eleven resistors (shown right):
R1 = 680Ω (blue, grey, brown coloured bands)
R2 – R5 = 22KΩ (red, red, orange coloured bands)
R6 = 100KΩ (brown, black, yellow coloured bands)
R7-R11 = 220Ω (red, red, brown coloured bands)



The text on the board shows where R1, R2, etc go. Make sure that you put the resistors in the right place.

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 center and the multiplier band will be one colour lower.

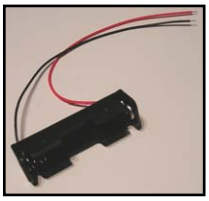
i.e. 22K (tolerance not shown)
4 band = Red, red, orange
5 band = Red, red, black, red

Step 2
Place the diode (shown left) into the PCB where it is labeled 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 it's correct.

Step 3
Solder the Integrated Circuit (IC) holder (shown right) 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.

Step 4
Solder the four Light Emitting Diodes (LED), as shown left, 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.

Step 5
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.



Step 6
The test battery holder should be soldered in to the 'CONN2 Test bat' terminal. The red wire must go to the '+' terminal and the black wire must go to the '–' terminal.

Step 7
The IC can be put into the holder ensuring the notch on the chip lines up with the notch on the holder.

Adding an on / off switch

- Solder one end of the power clip to the PCB, either black to '-' or red to '+'.
- Solder the other end of the power clip to the on / off switch.
- Using a piece of wire, solder the remaining terminal on the on / off switch to the remaining power connection on the PCB.

Checking Your PCB

Check the following before you insert the batteries:

Check the bottom of the board to ensure that:

- All holes (except the 4 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:

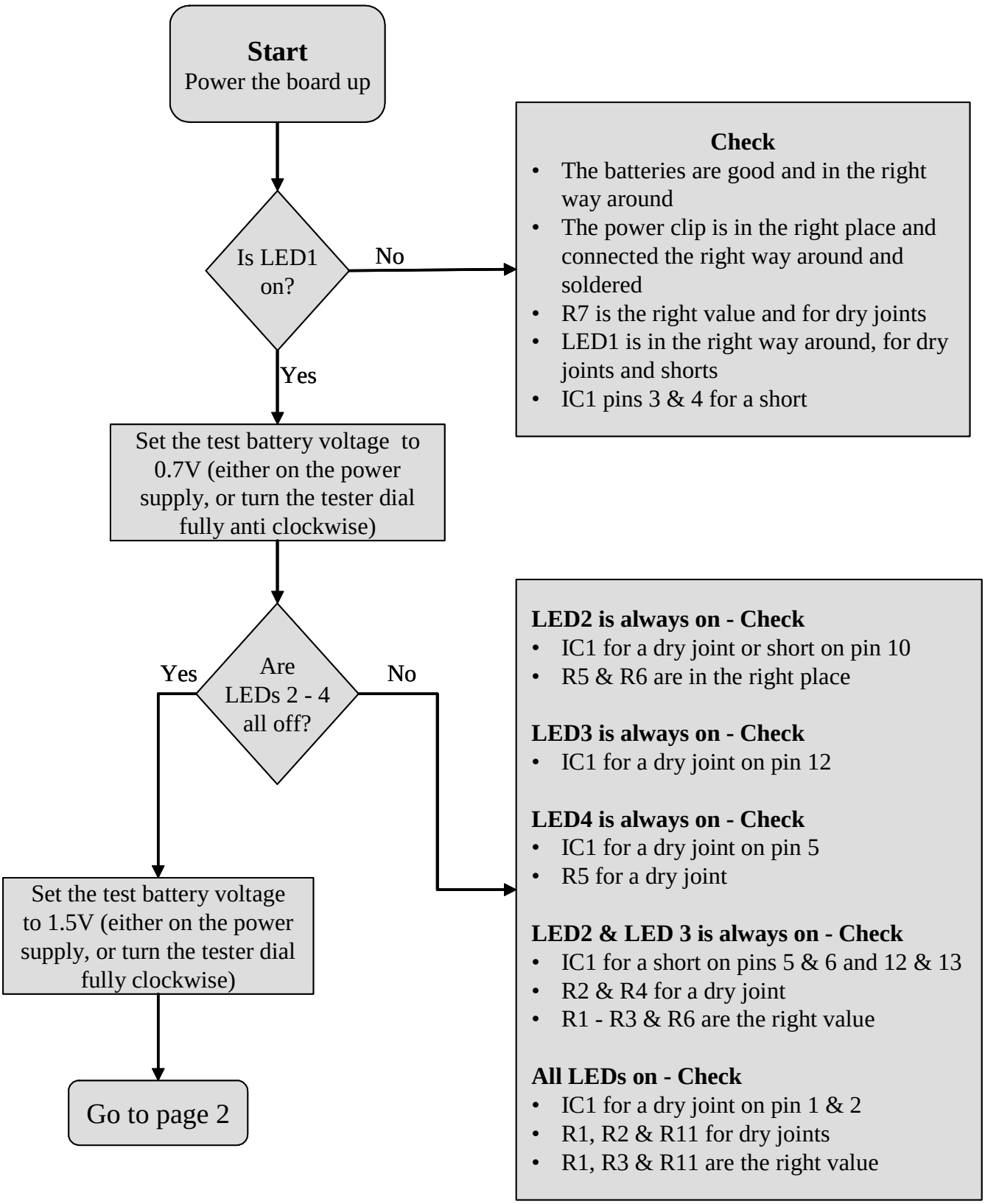
- The notch on the IC and the IC holder are in the same orientation as the markings on the printed circuit board.
- All the resistors are in the correct places.
- The four LEDs are in the right way around.
- The red wire on the battery connector goes to the + terminal on the power terminals and the black 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 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 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 light
0 – 0.9	1
0.9 – 1.1	2
1.1 – 1.3	3
1.3 – 1.5	4

Fault finding flow chart - page 1



Fault finding flow chart - page 2

Start
Continued from page 1

Are LEDs 2 - 4 all on?

No

How many LEDs aren't on?

2

R3 & R6 are in the wrong place

1

3

Check
- The test battery holder for dry joint and correct orientation
- IC1 is the right way around and for dry joints or shorts on pin 3, 4 & 11
- D1 is in the right way around and for dry joints
- R3 for dry joints
- R2 is the right value

Yes

Gradually change the test battery voltage from 0.7 to 1.5V (either on the power supply, or turn the tester dial from fully anti-clockwise, to clockwise)

Did the LEDs light one after another?

No

Yes

All LEDs light together - check
- R4, R5 are the right value
- R6 for dry joints

Were they at the right thresholds?

No

Yes

Check R1 is in the right place

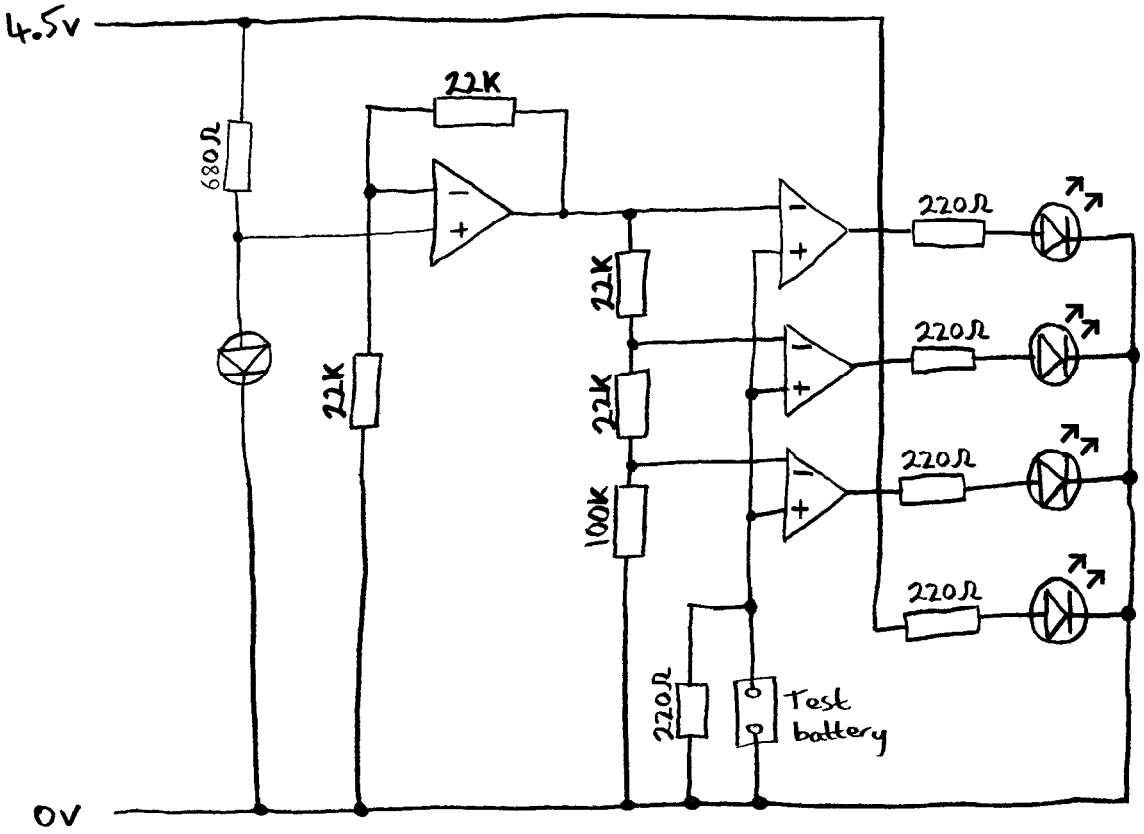
Stop

LED2 does not work - check
- LED2 is the right way around and for shorts / dry joints
- R8 is the right value and for dry joints
- IC1 pins 8 & 9 for a dry joint or short

LED3 does not work - check
- LED3 is the right way around and for shorts / dry joints
- R9 is the right value and for dry joints
- IC1 pins 13 & 14 for a dry joint or short

LED4 does not work - check
- LED4 is the right way around and for shorts / dry joints
- R10 is the right value and for dry joints
- IC1 pins 6 & 7 for a dry joint or short

How the Battery Tester Works



Comparators are used to compare one signal to another. They have two inputs, one labeled 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.