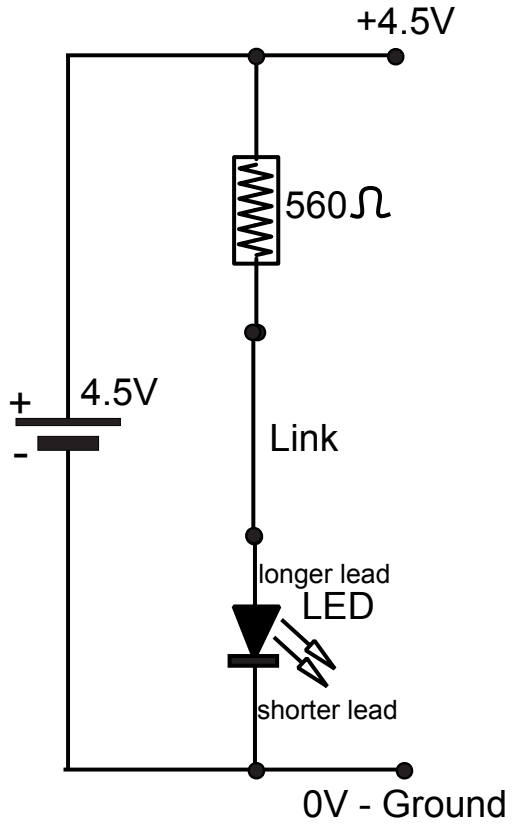
The T-Exchange

Notes for first electronics workshop 15th March 2012

As many of our members are new to both electronics and soldering, the aim of this workshop, firstly, is to assemble a simple LED (light emitting diode) circuit on a small piece of strip-board apply a battery and cause the LED to switch on. Secondly, after this all works is to add a few other components including a transistor to enable the LED to turn on slowly. A small kit of the necessary components is easily assembled.

Circuit 1



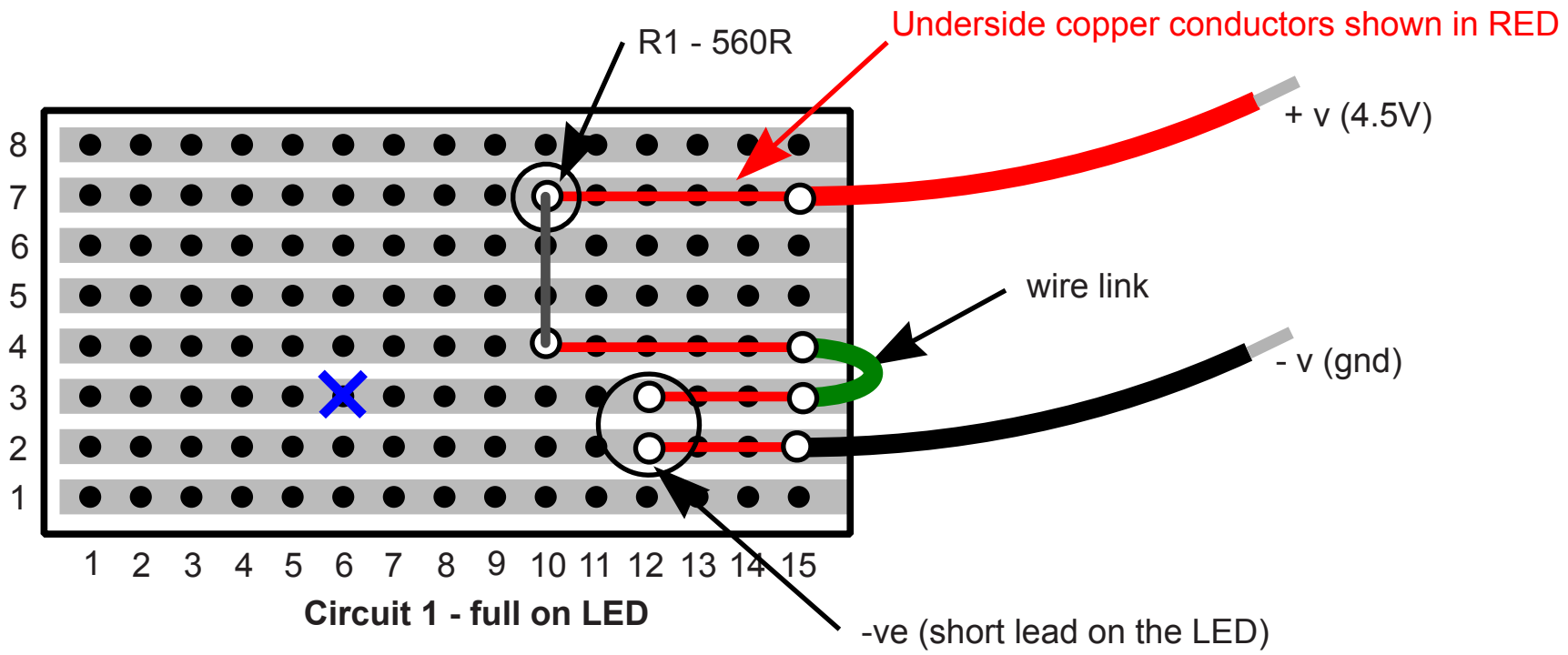
Basic LED circuit

Operation

The 560 Ohm resistor is connected in series with the LED. The connection is made via a wire link, which can be cut for the second circuit.

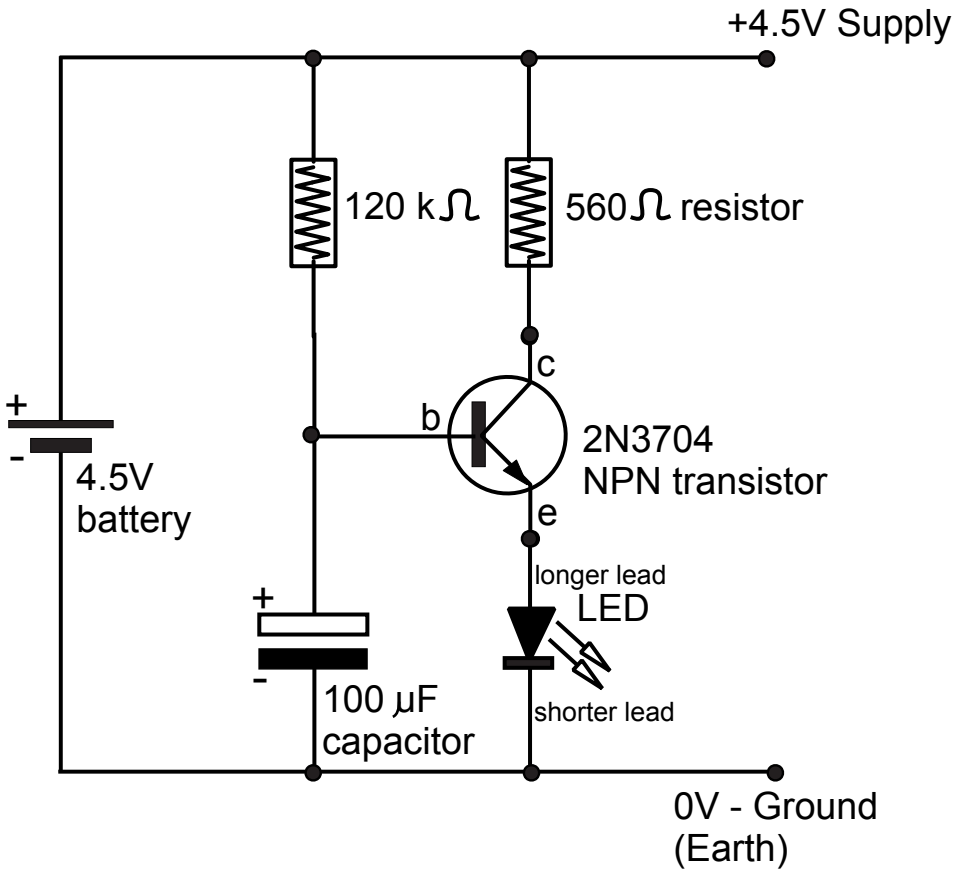
When the battery is connected, the 4.5 volts pushes a current through the resistor and the same current through the LED, which lights up. The LED requires the current provided by about 2 Volts resulting about 2.5 Volts "dropped" across the resistor. According to Ohm's law (V = I x R) this means that the current through the resistor and the LED will be 2/560 Amps or 3.6 mAmps (mA). Since Watts is the product of Volts times Amps, this same current passing through the LED will provide 2 Volts x 3.6 mA ie. 7.2 mWatts (mW). This demonstrates the very low power required to light up the LED and why they are now being used for domestic lamps.

The stripboard and component arrangement for this basic circuit is shown on the next page.



NOTE This is a **TOP** view of the strip-board. The blue X is a point where the copper track on the underside of the board needs to be cut for the second circuit.

You will need to be aware that the underside view is **NOT** the same as the topside view and, therefore, checking that the components are correctly placed **before** soldering is **essential.**



Soft start LED circuit

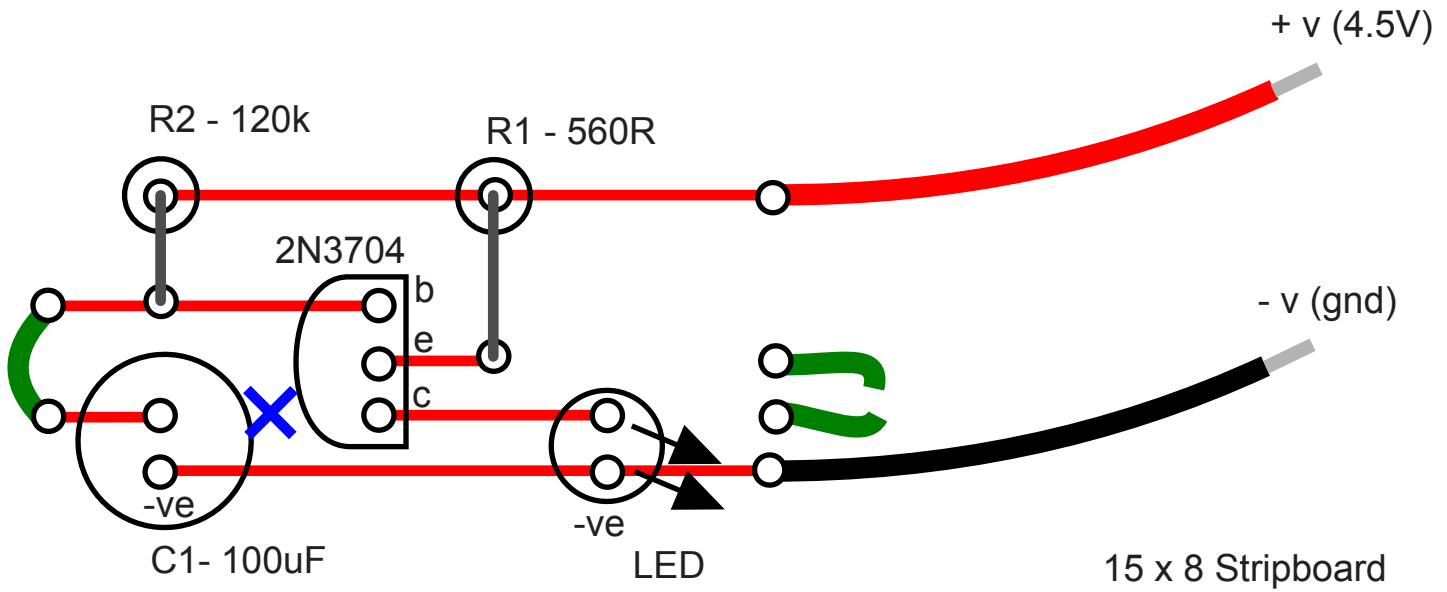
Operation

In this circuit the link between the 560 Ohm resistor and the LED has been replaced by a transistor. The transistor has three legs. These connections are called the collector (c) the base (b) and the emitter (e). The collector is connected to the 560 Ohm resistor and the emitter to the positive side of the LED. With the battery connected at this point no current will flow through the transistor and the LED will not light.

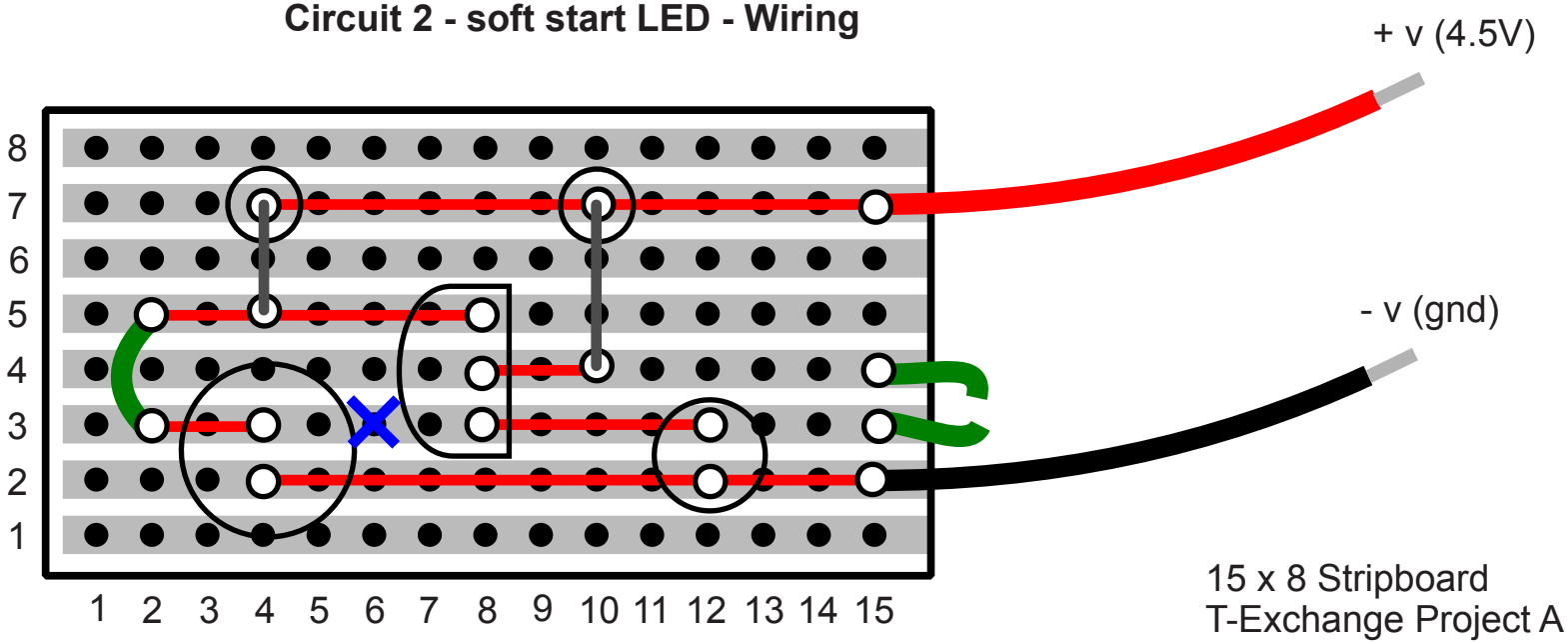
However, if a 120,000 Ohm resistor (120k) is connected to the base (b), a very small current will flow through the base and the transistor will instantly turn full ON just as if a switch had been closed joining the collector and emitter. The LED will immediately light up as in circuit 1.

If a capacitor, which is a component that can be imagined as a jar the holds electricity, is added to the circuit the behaviour changes. When the battery is connected the capacitor is empty (discharched) and both the positive and negative sides are at 0 Volts (ground). a small current then flows through the 120k resistor and starts to charge the capacitor with electricity. AS the capacitor starts to fill up the voltage at its positive side starts to rise and after a short time will reach the 4.5 Volts of the battery positive side. The time taken to do this is given (roughly) by t = 0.7 x R x C. t is in seconds, R is in Ohms and C is in Farads, which is the measure of capacitance. The usual measure is in micro Farads as shown in the diagram. t is called the time constant of the circuit. See if you can work out is value.

As the voltage at the junction between the capacitor positive and the 120k resistor rises it naturally takes the voltage at the transistor base with it. This particular arrangement of the transistor is called an emitter follower because, as the base voltage rises so does the emitter following slightly behind. This increases the voltage across the LED gradually turning it ON. You can try different values of R and C to see the effect.



Circuit 2 - soft start LED - Wiring



Circuit 2 - soft start LED TOP view of stripboard