Installing a proximity sensor using a diode and external pull-up.

Step 1 is to supply the sensor with 6V-36V

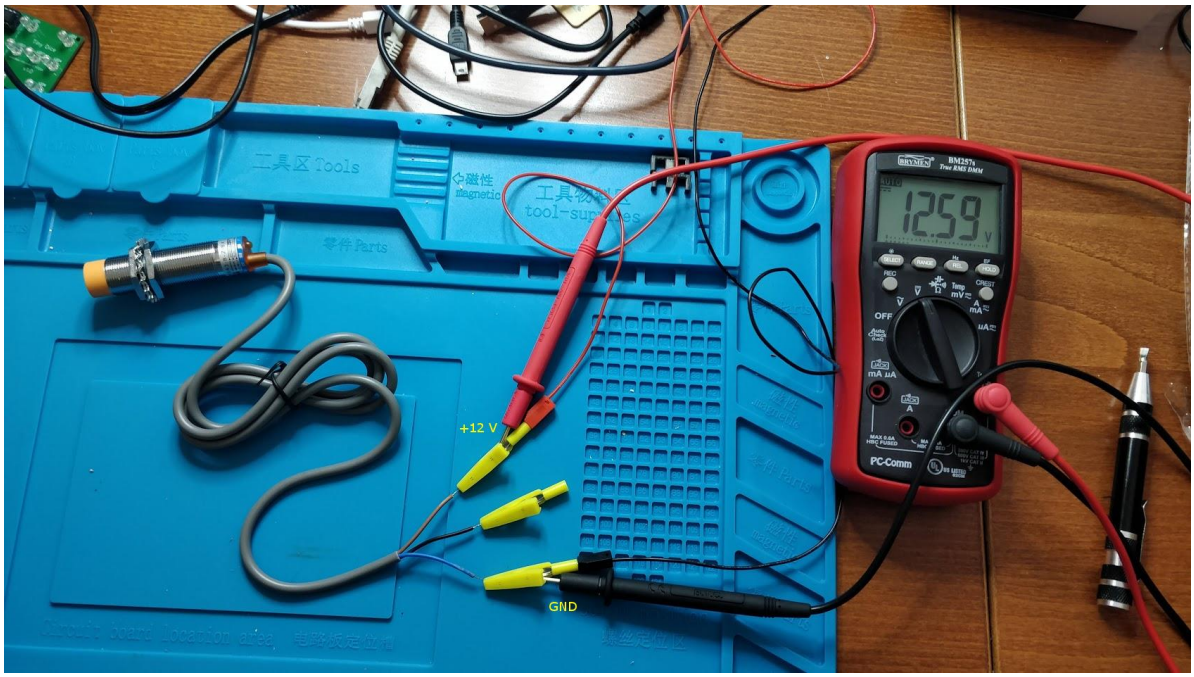

Figure 1 Supplying approximately 12V in this example

It is a NPN NO type sensor so the signal wire should measure approximately the input voltage of 12.6V when it is not triggered.

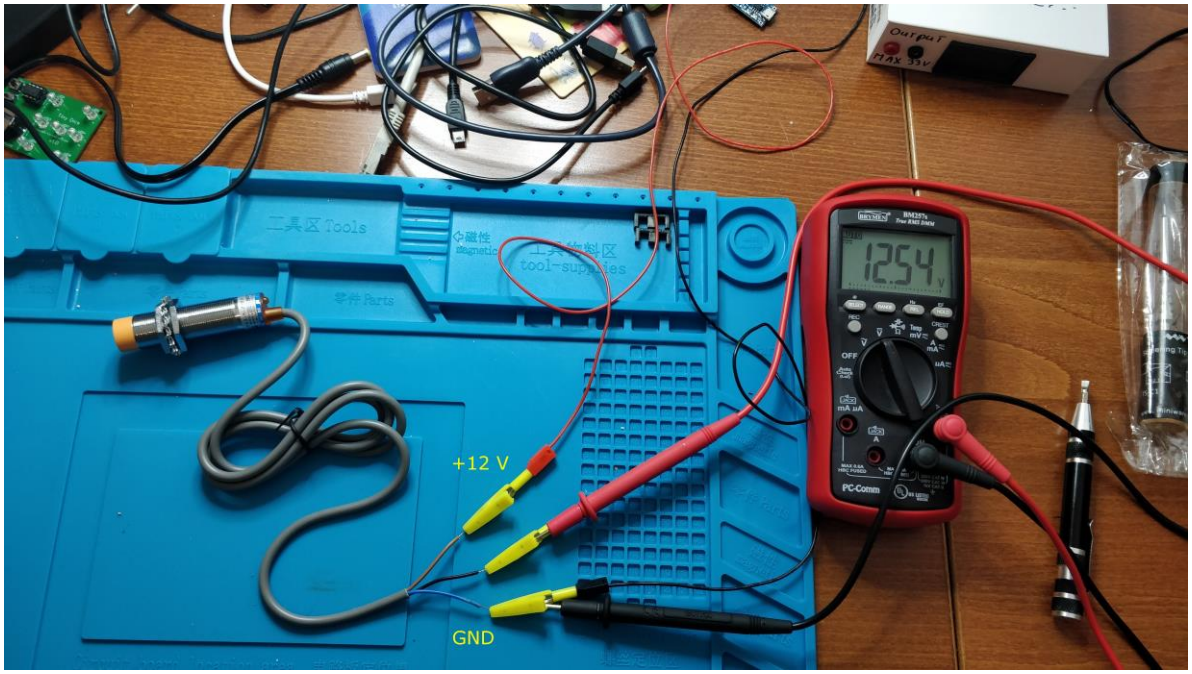

Figure 2 Measuring the signal wire when not triggered results in approximately the input voltage

If the sensor is triggered we expect to measure only the forward voltage (Vf) of the sensor.

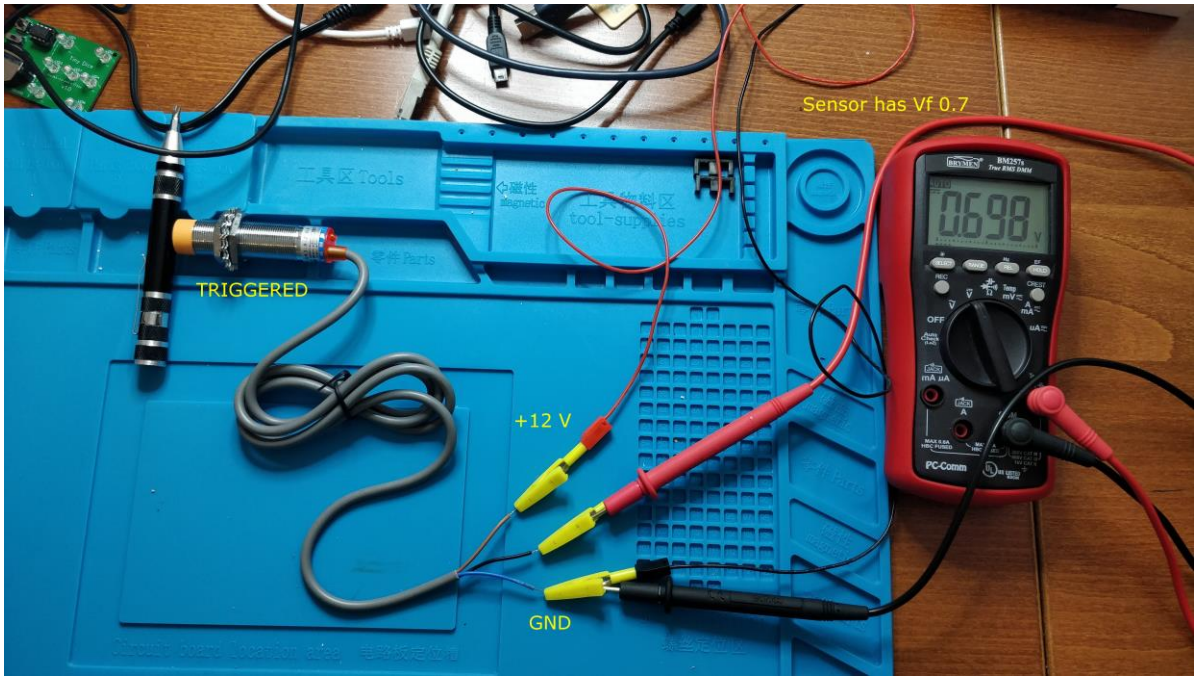

Figure 3 Measuring a forward voltage of 0.7V when triggered indeed

To prevent a voltage of 12V at the signal wire we can add a diode to block current flow towards the signal wire. In Figure 2 we saw the input voltage at the signal wire, but with a diode in place we measure nothing (except a negligible 0.055V from leakage of the diode). The marked leg of the diode is towards the sensor.

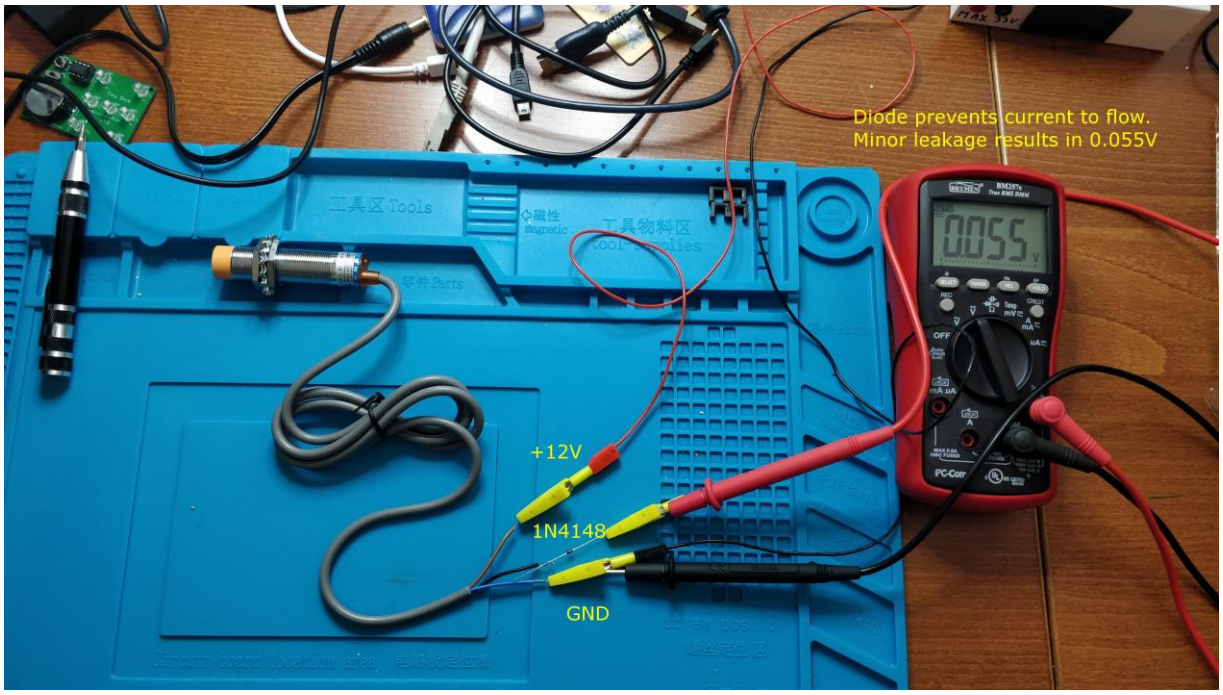

Figure 4 A diode blocks current flow towards signal pin

The problem is of course that we now cannot measure a non-triggered state! We can use a pull-up (towards an Atmega safe 5V) to help us out here. The pull-up can either be a so called **internal** one, which is enabled inside the firmware of your 3D printer or an **external** one by connecting the signal PIN to 5V with a resistor (4.7kOhm and 10kOhm are commonly used).

> As a side note: Some 3D printer boards actually already have external hardware pull-ups on the signal wires. You can find out if that is the case, by measuring the Voltage between GND and your signal PIN. If it reads a steady 5V even though you do not have pull-ups enabled in your firmware, you have externa hardware pull-ups.

As we are working with pictures here… I will show you how it works with an external pull-up. So let's continue our journey towards the solution and add a pull-up.

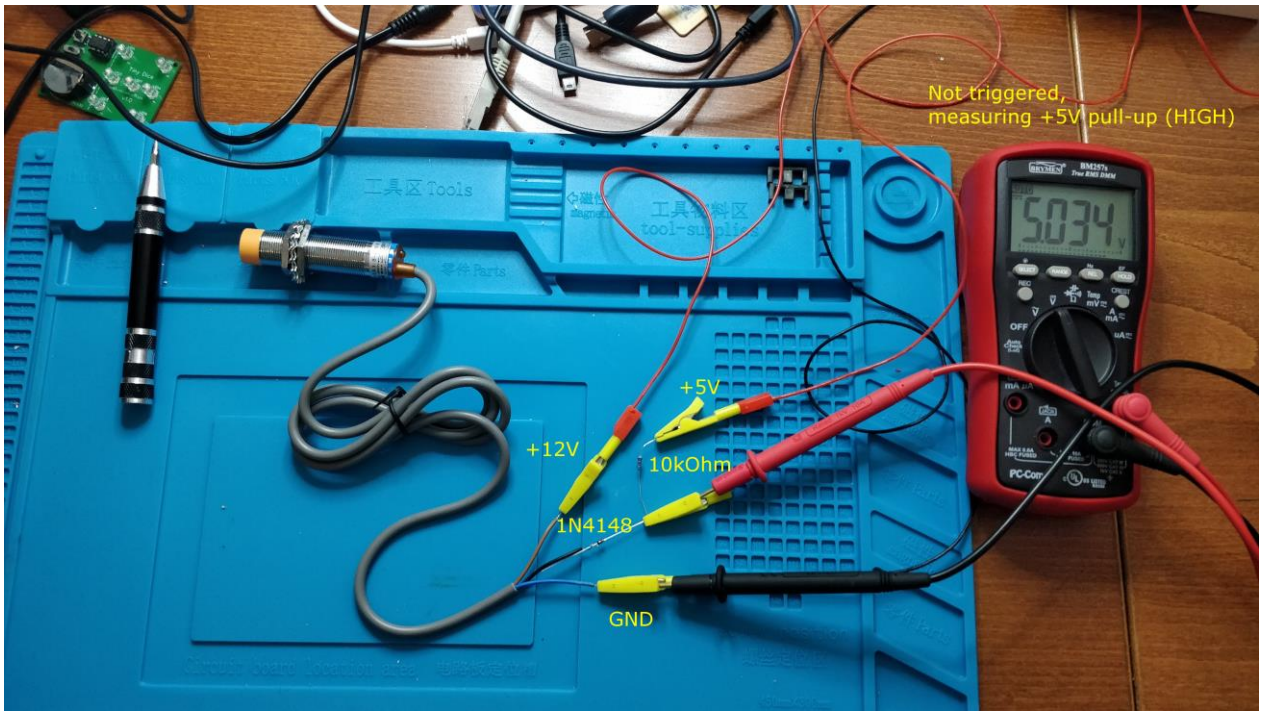

Figure 5 After adding a resistor between 5V and the "signal PIN" we measure 5V when the sensor is not triggered.

We measure 5V which is a perfectly valid HIGH state when the sensor is NOT triggered.

But what would happen when the sensor is triggered? We already saw that the signal wire will then be “connected” to ground and all that is left was the 0.7 V Vf of the sensor.

The diode we added does not prevent current to flow towards GND so that should still work. The diode does have its own Vf of 0.6V however.

This leaves us with a total Vf of 0.7V + 0.6V = 1.3V.

The resistor between 5V and the signal PIN prevents it from being a short circuit between 5V and GND so all should work. Let’s see:

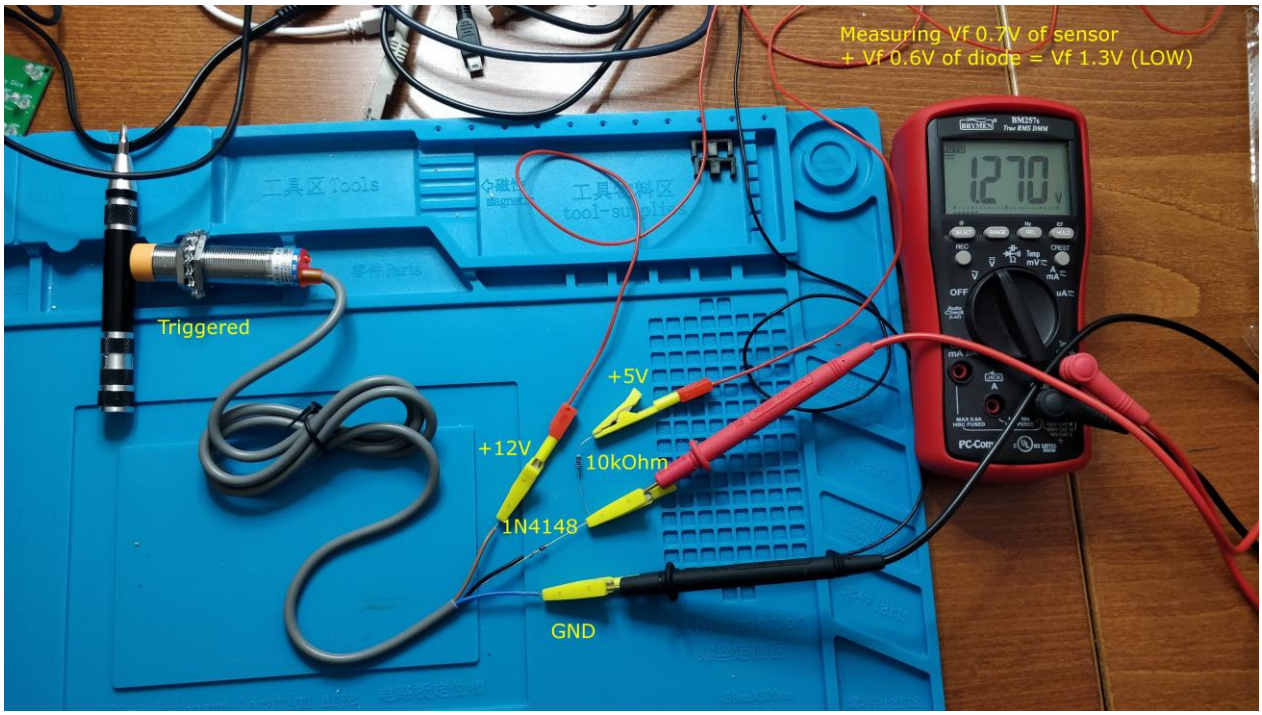

Figure 6 When triggered we measure the combined Vf of 1.3V indeed.

1.3V reeds as a digital low on the Atmega so it all works now.

On not triggered we have 5V on triggered we have 1.3V!

Enjoy!