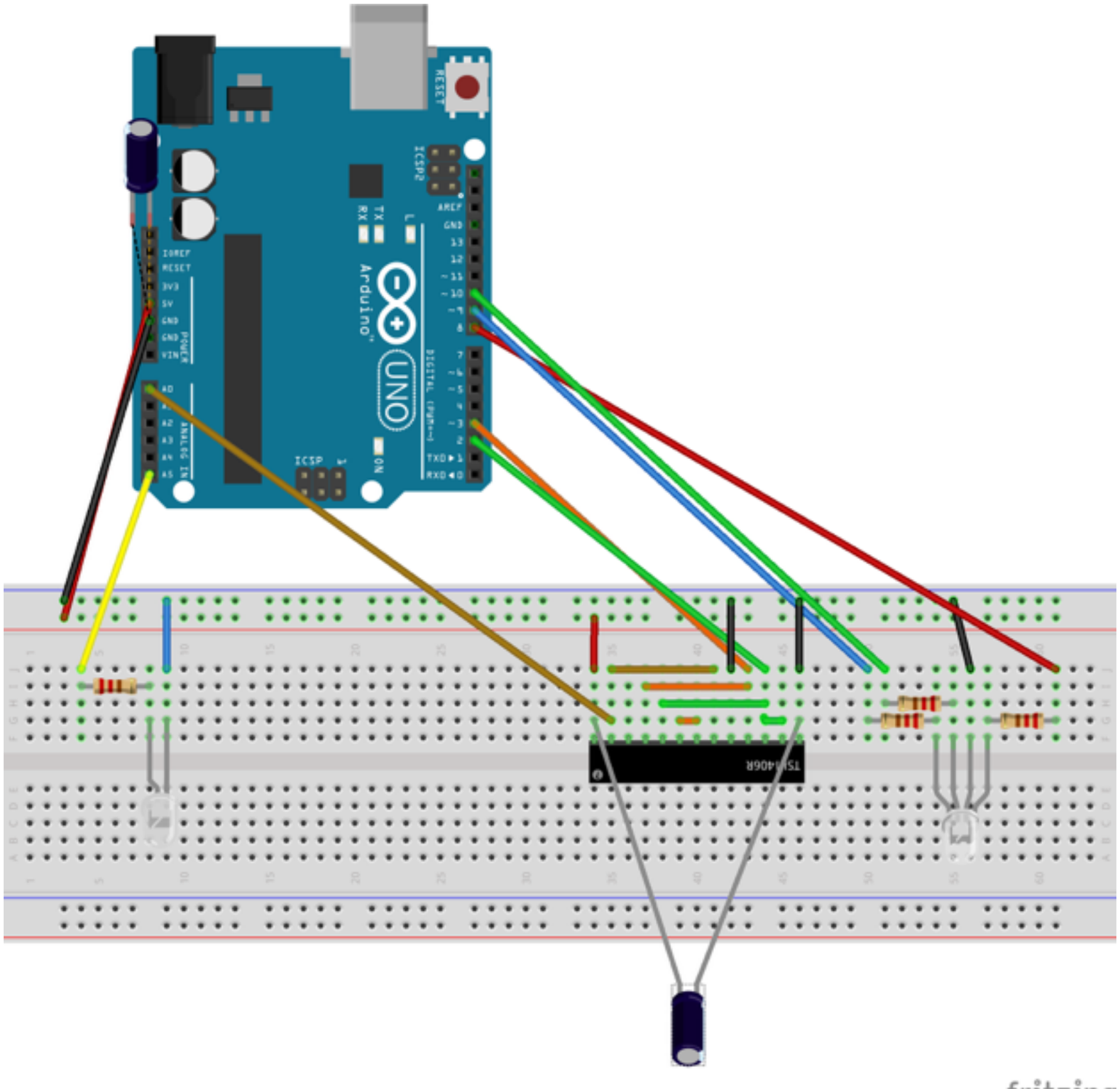
waag society

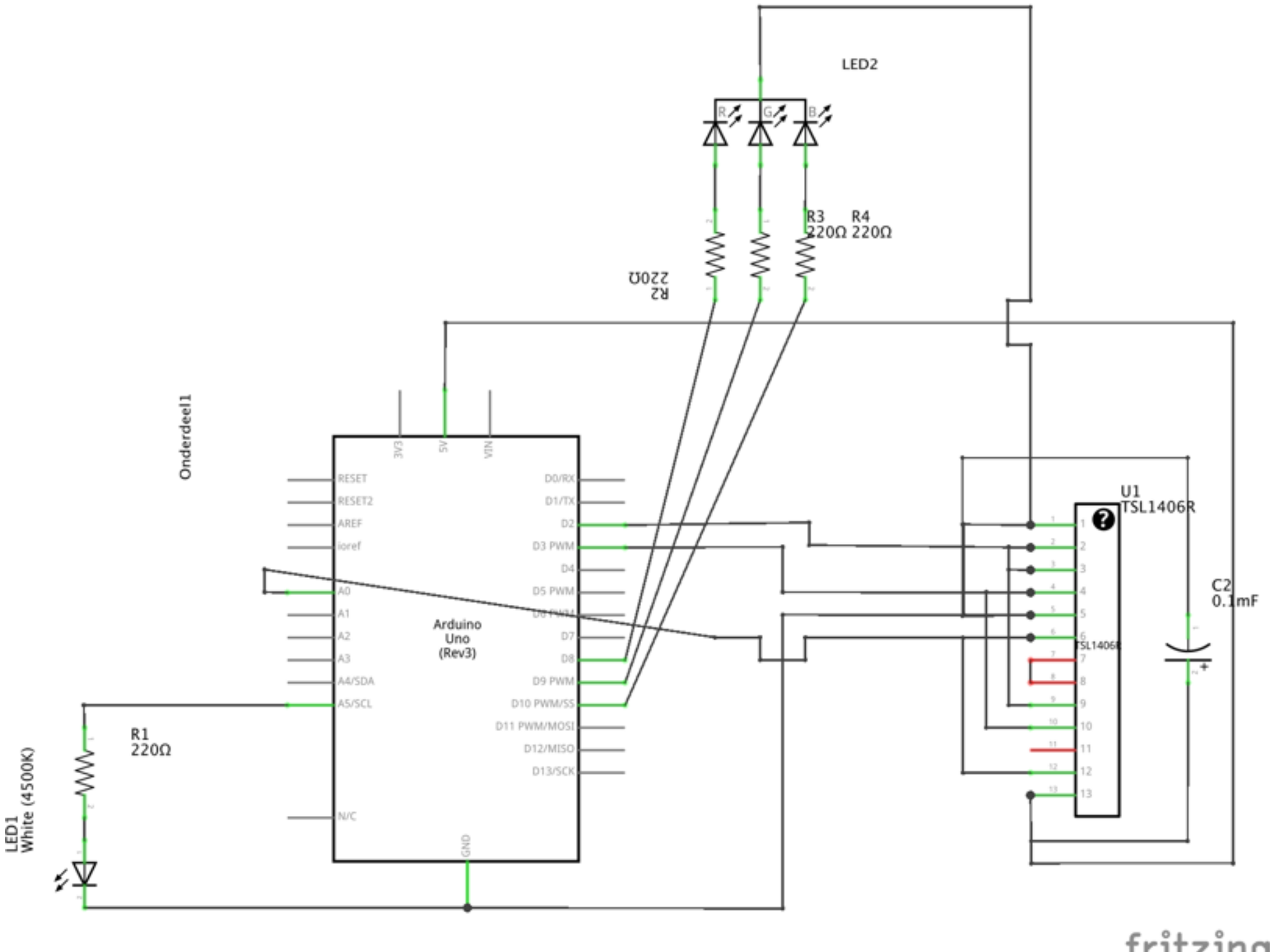
institute for art, science and technology

Spectrometer Assembly

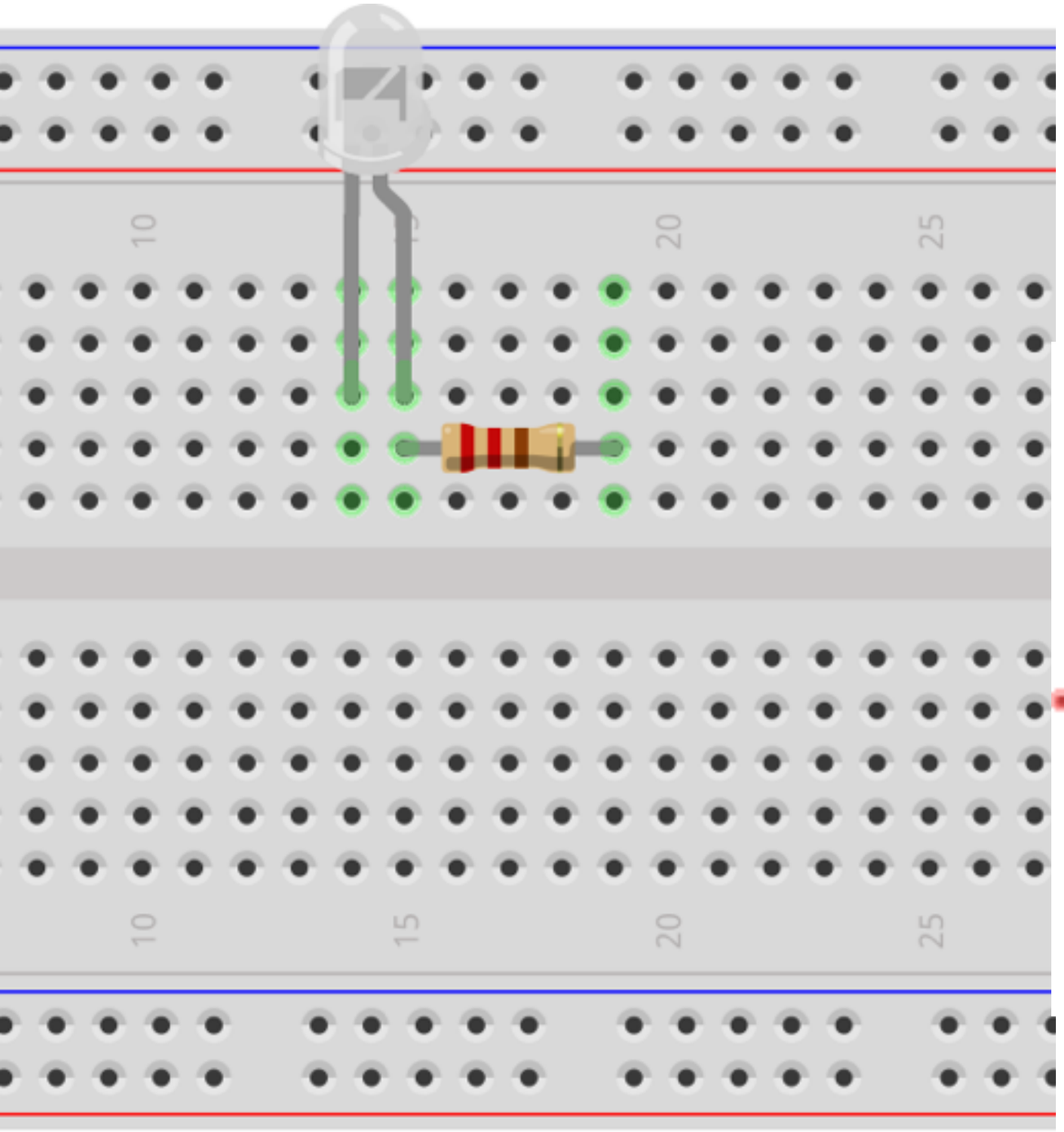
Wiring

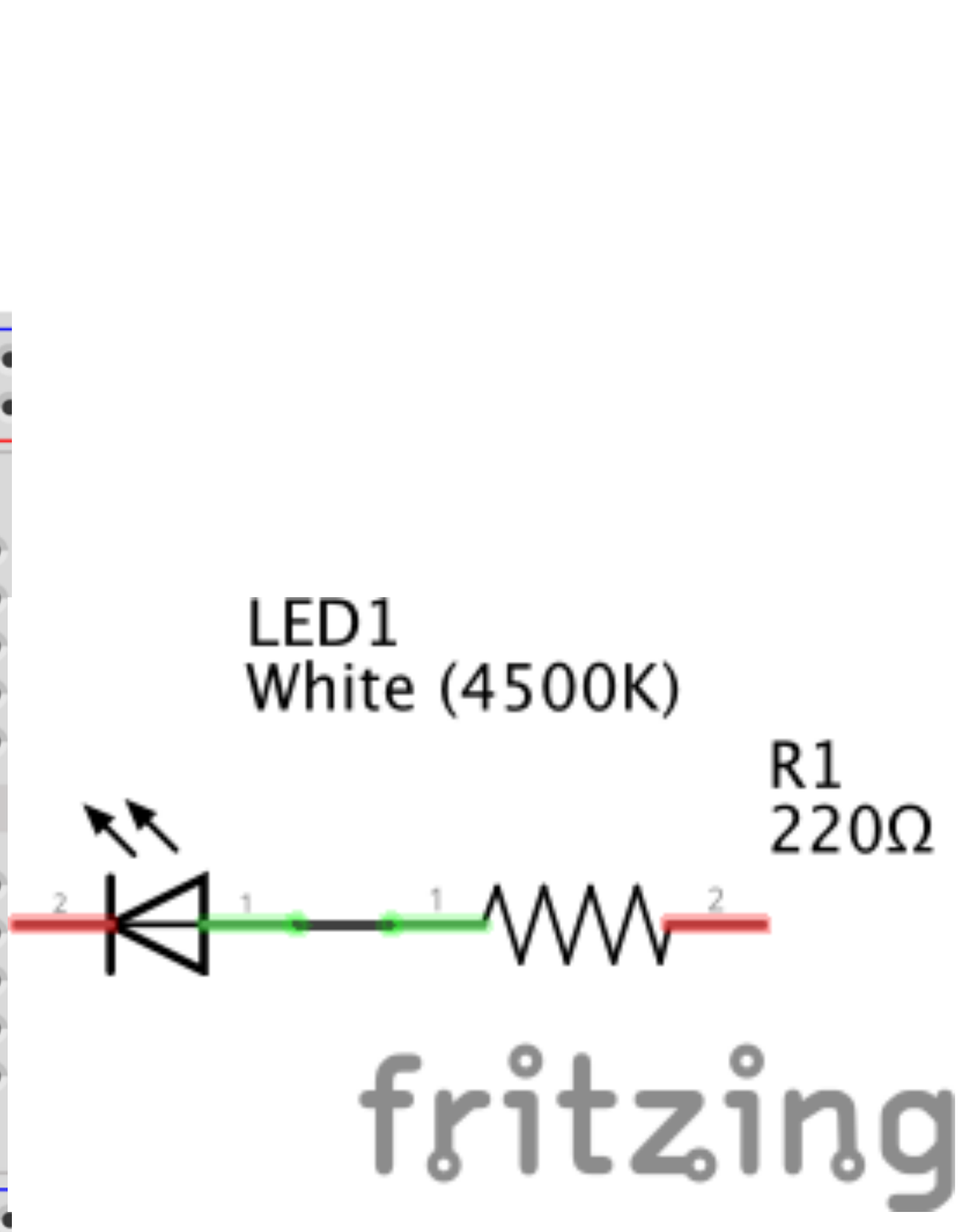

RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
TX
RX
L
Arduino
UNO
ON
ICSP
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
TSM1406R
fritzing

Schematic


LED2
R
G
B
R3
220Ω
R4
220Ω
R2
220Ω
Onderdeel1
3V3
5V
VIN
RESET
RESET2
AREF
ioref
A0
A1
A2
A3
A4/SDA
A5/SCL
N/C
GND
D0/RX
D1/TX
D2
D3 PWM
D4
D5 PWM
D6 PWM
D7
D8
D9 PWM
D10 PWM/SS
D11 PWM/MOSI
D12/MISO
D13/SCK
Arduino
Uno
(Rev3)
U1
TSL1406R
TSL1406R
C2
0.1mF
R1
220Ω
LED1
White (4500K)
fritzing

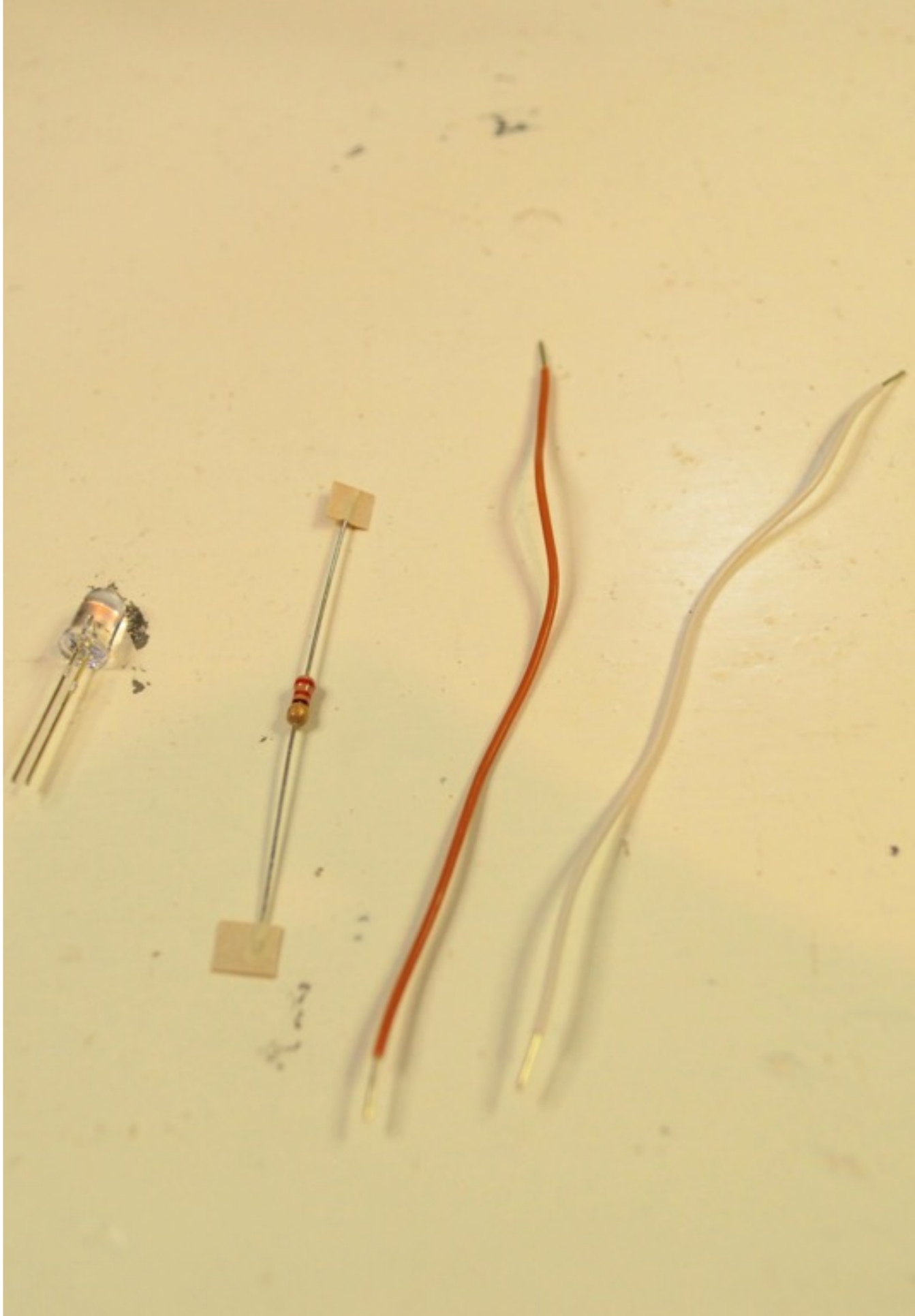
1) LED



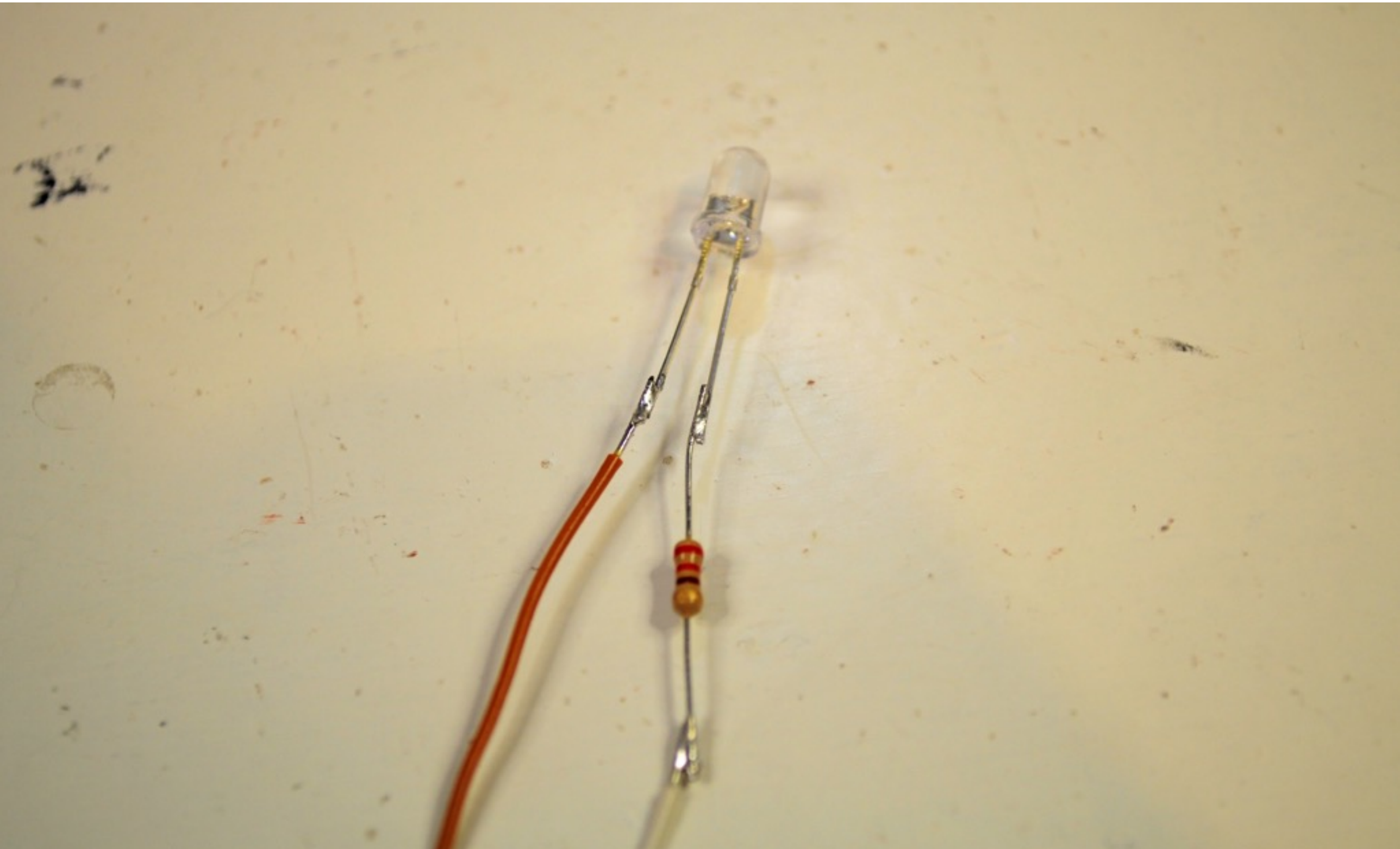


Assembly

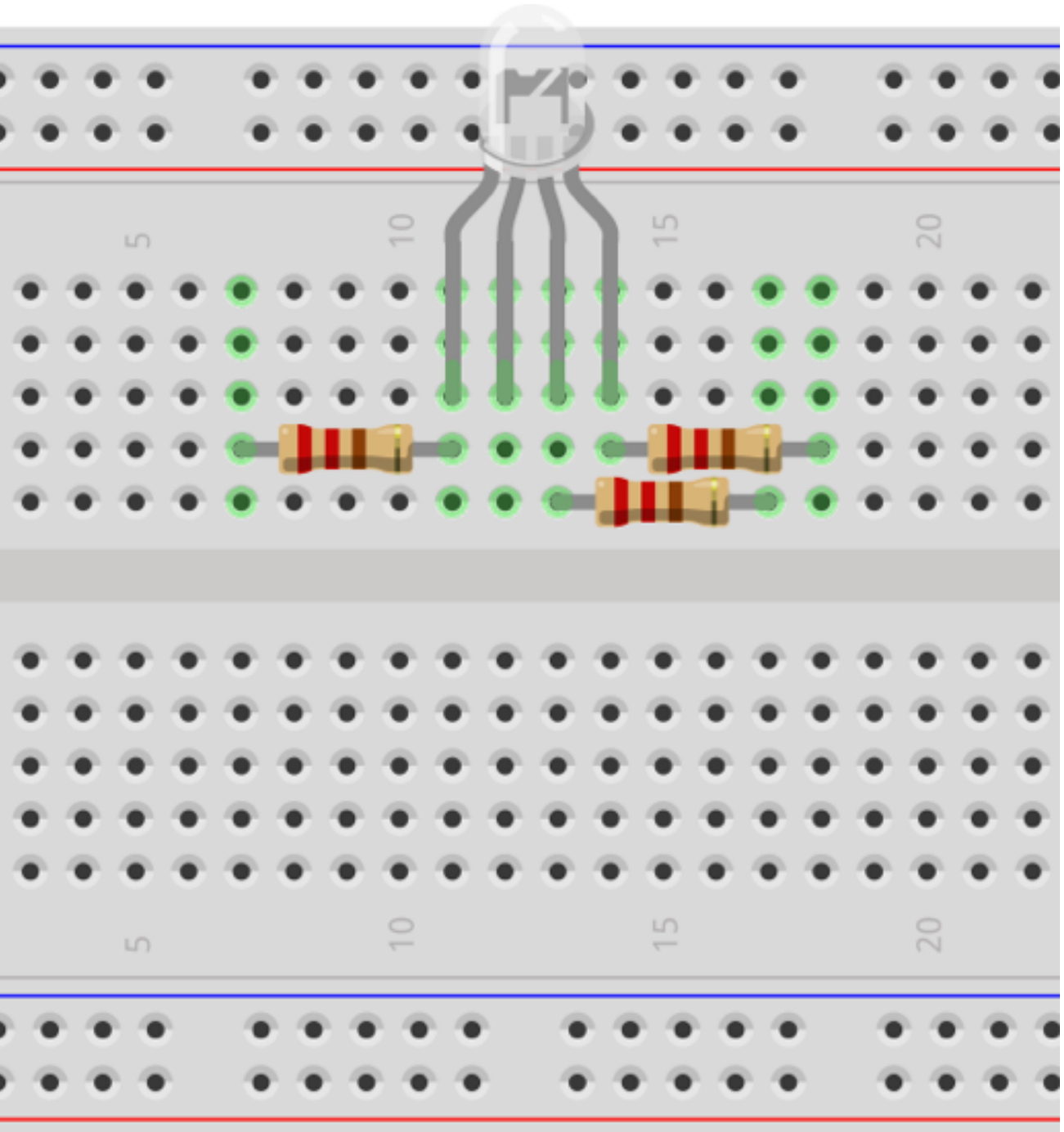
- 2x 10 cm wire
- White LED
- 220 Ohm resistor
  - Shorten the leads

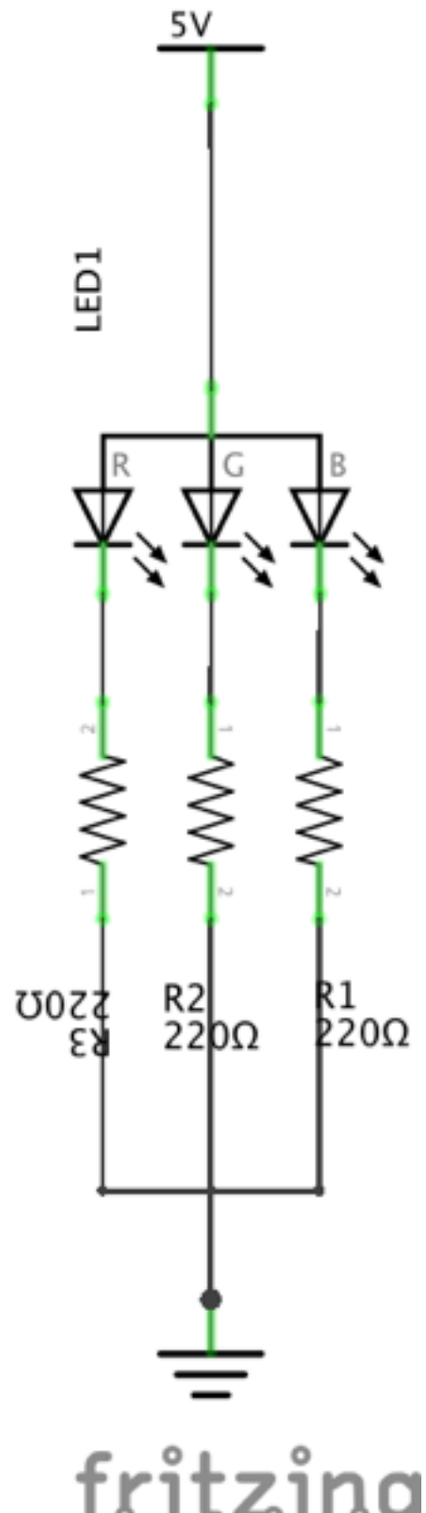


Done



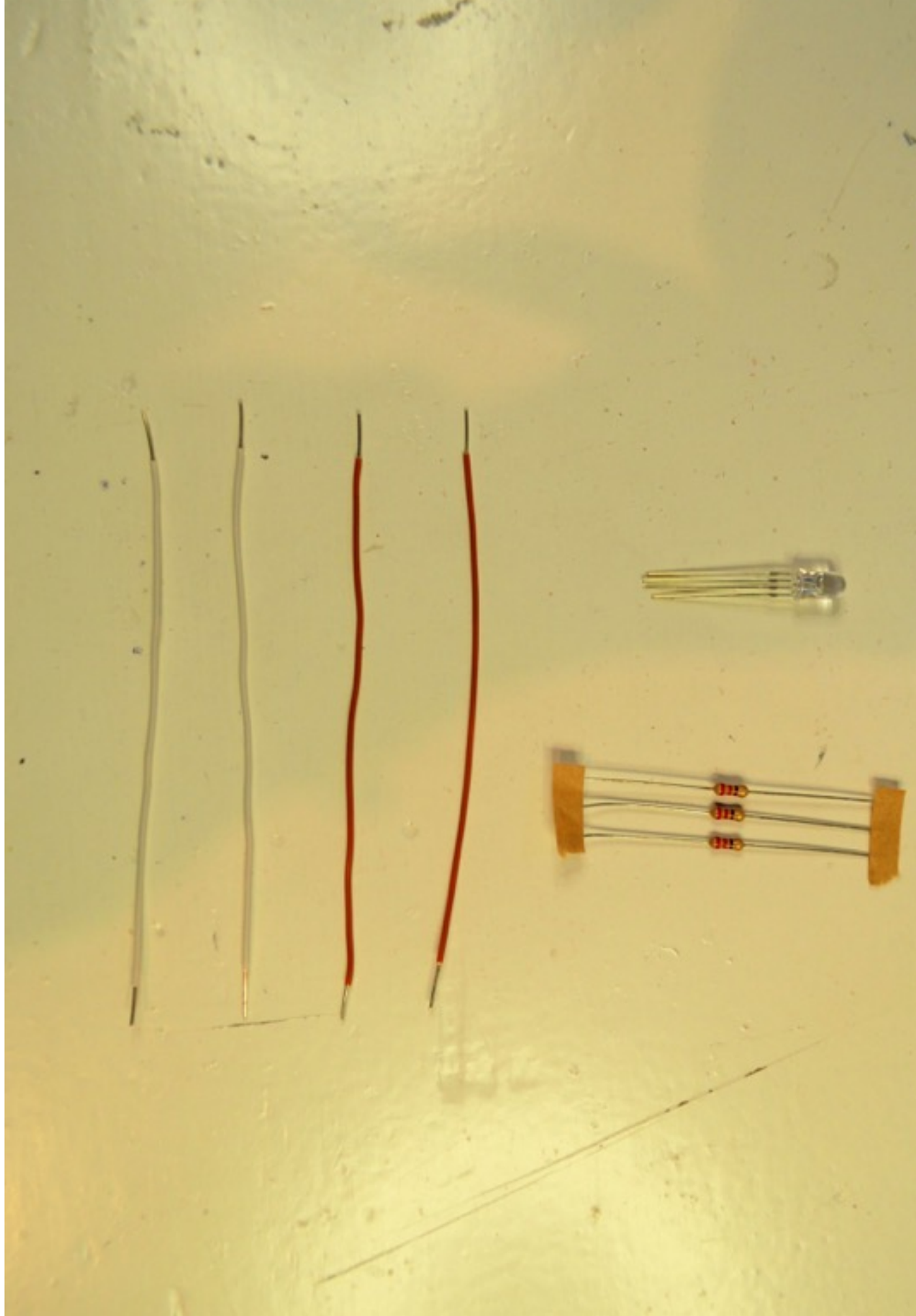
2) RGB LED



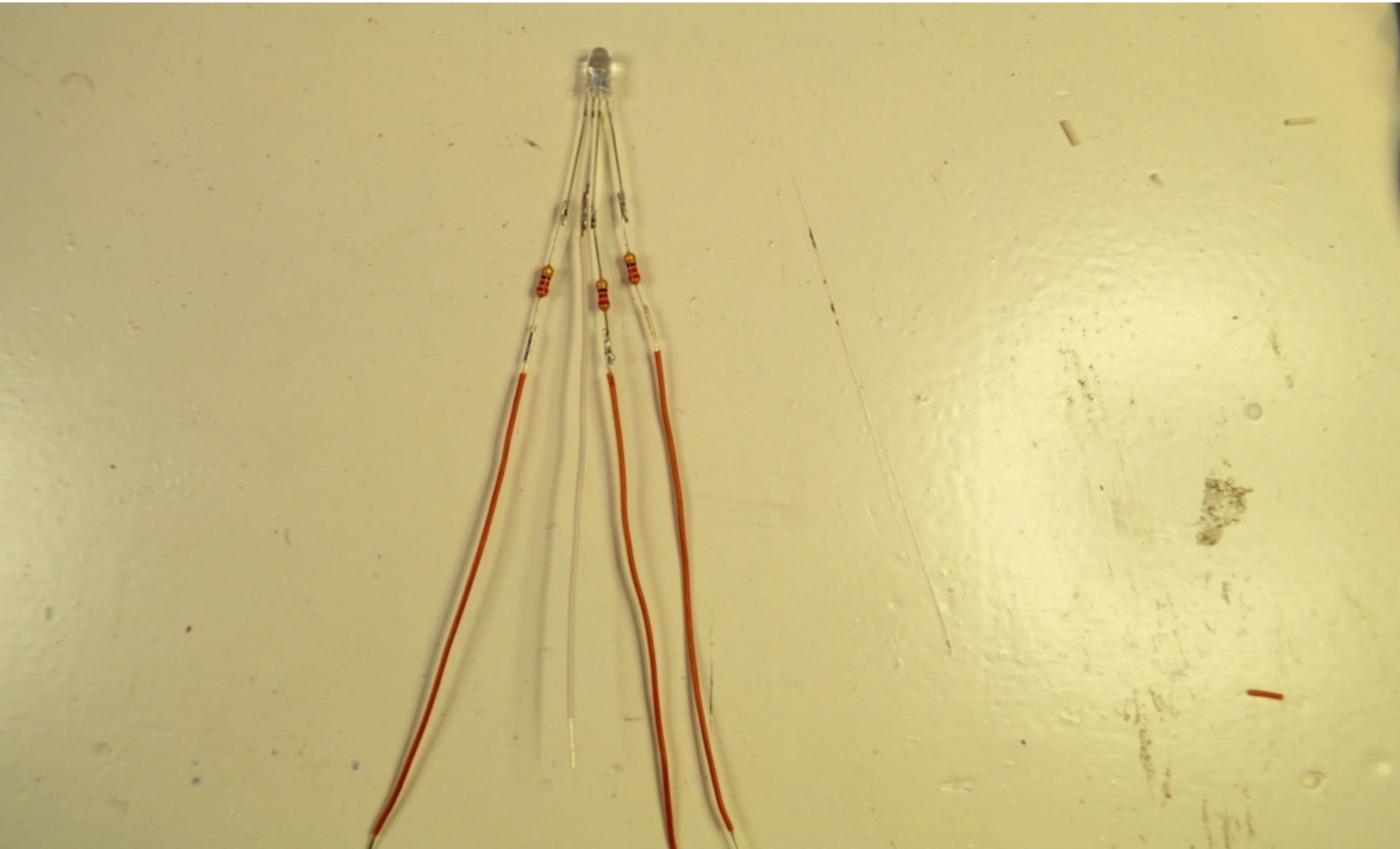


Assembly

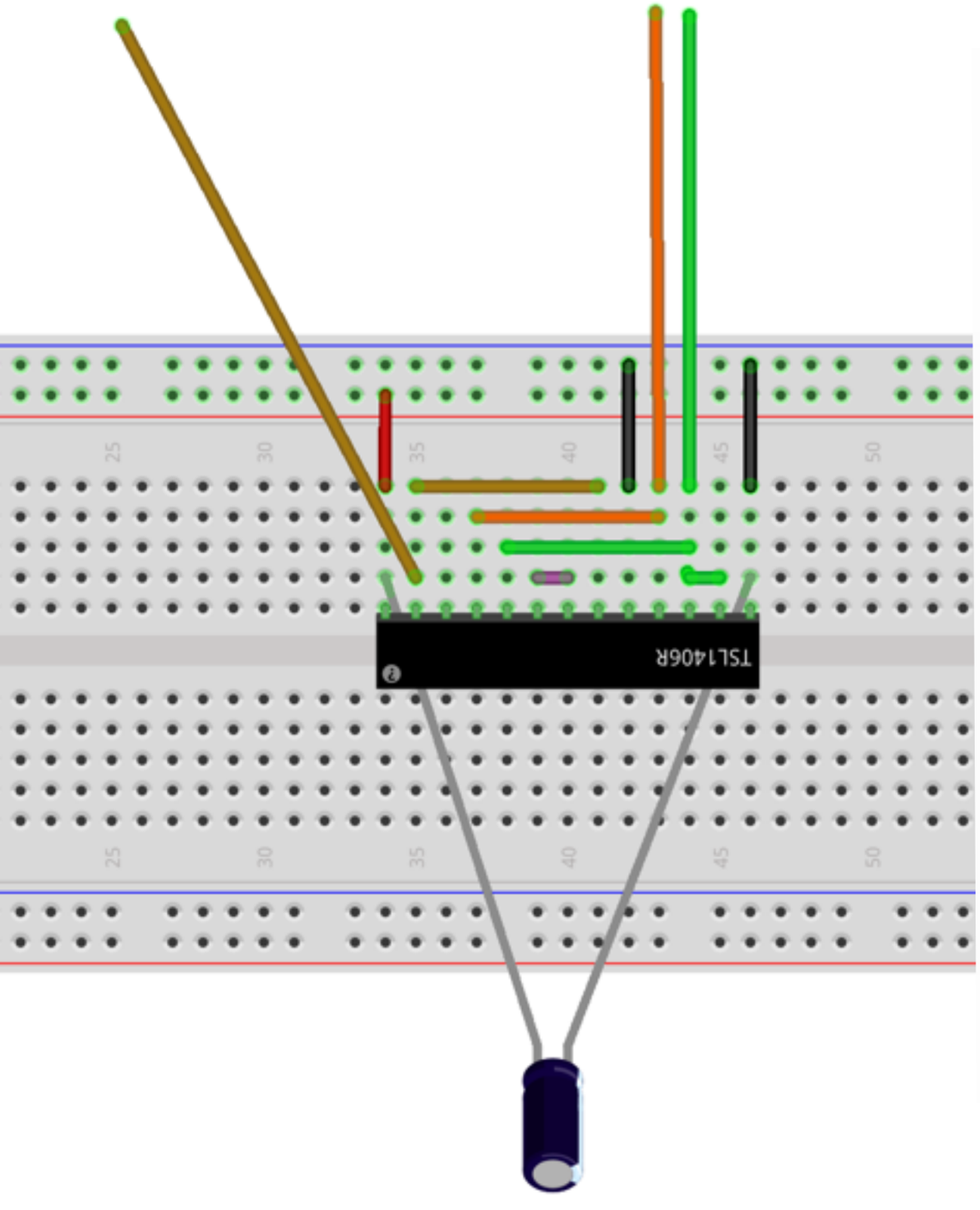
- 4x 10 cm wire
- 1x RGB LED
- 3x 220 Ohm resistor
  - Shorten the leads

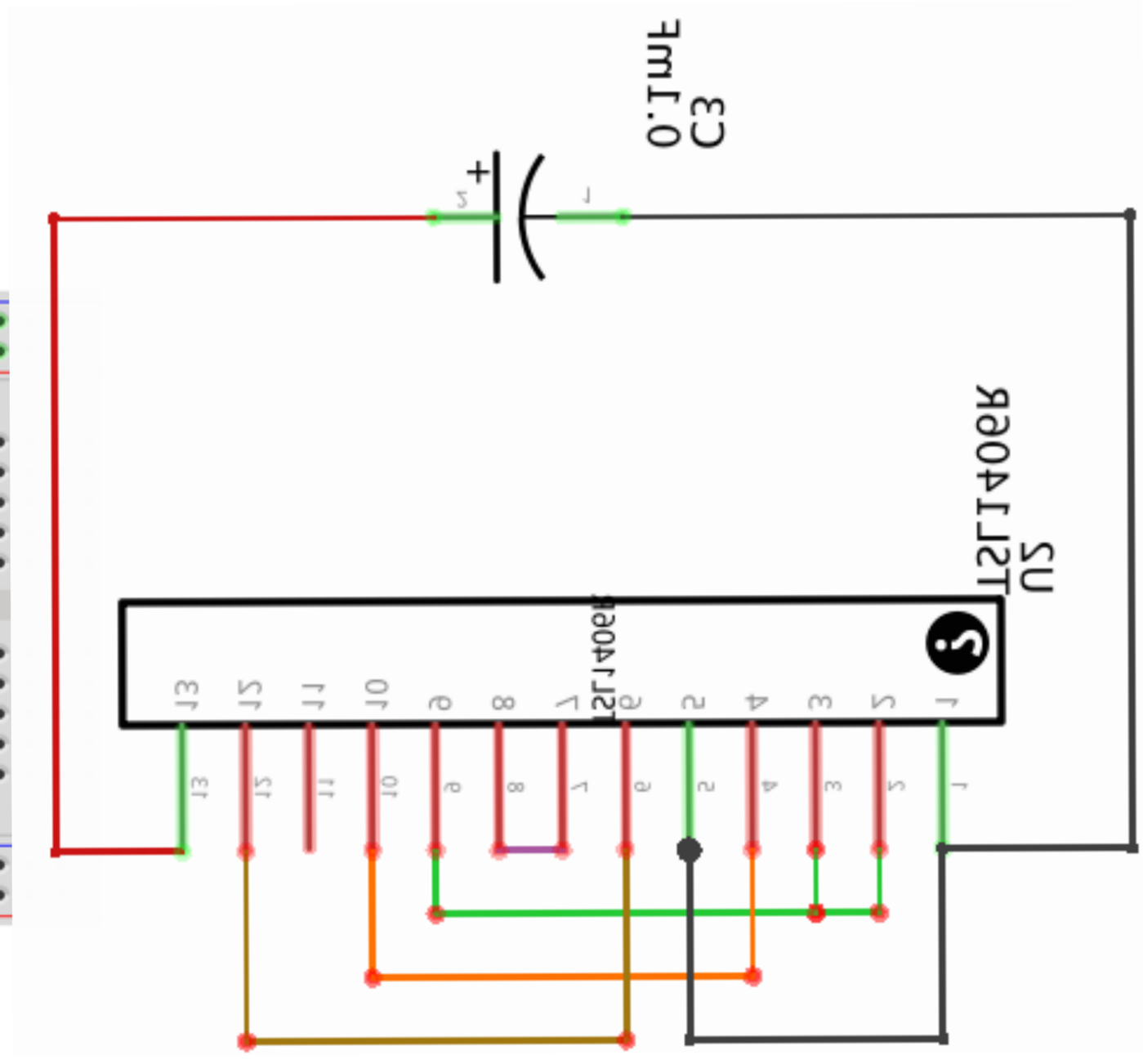


Done

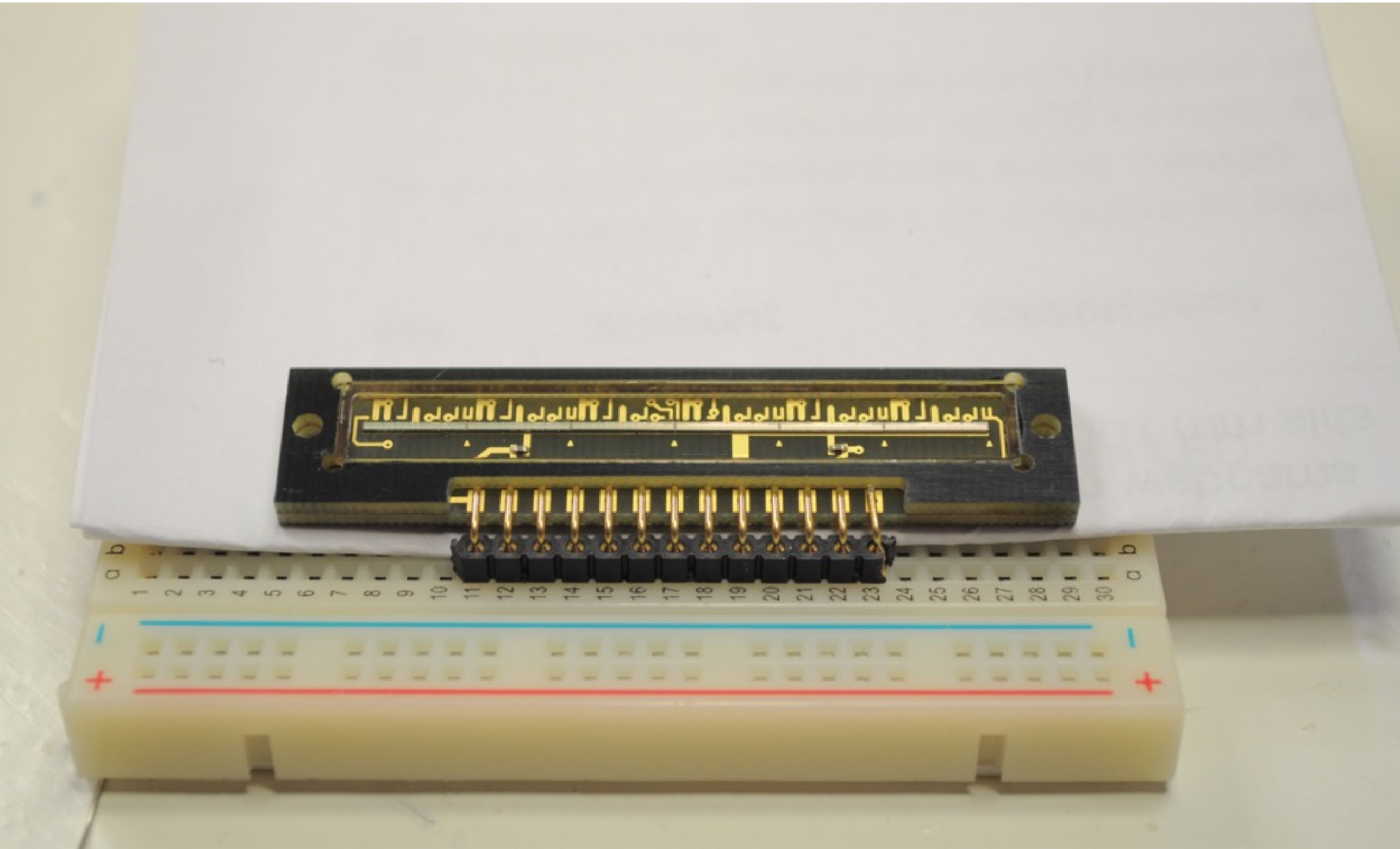


3) CCD Array





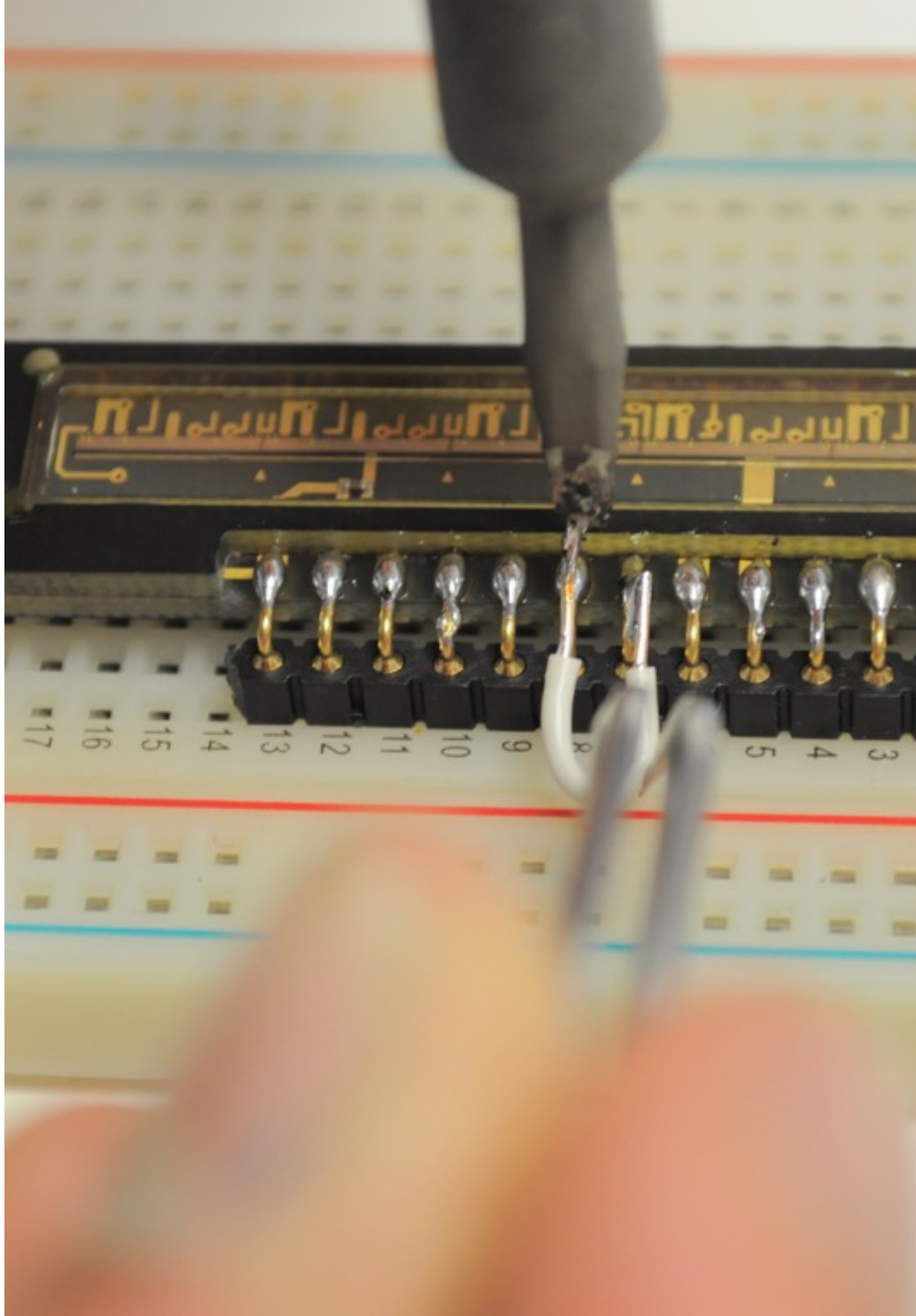
Start with soldering the header pins



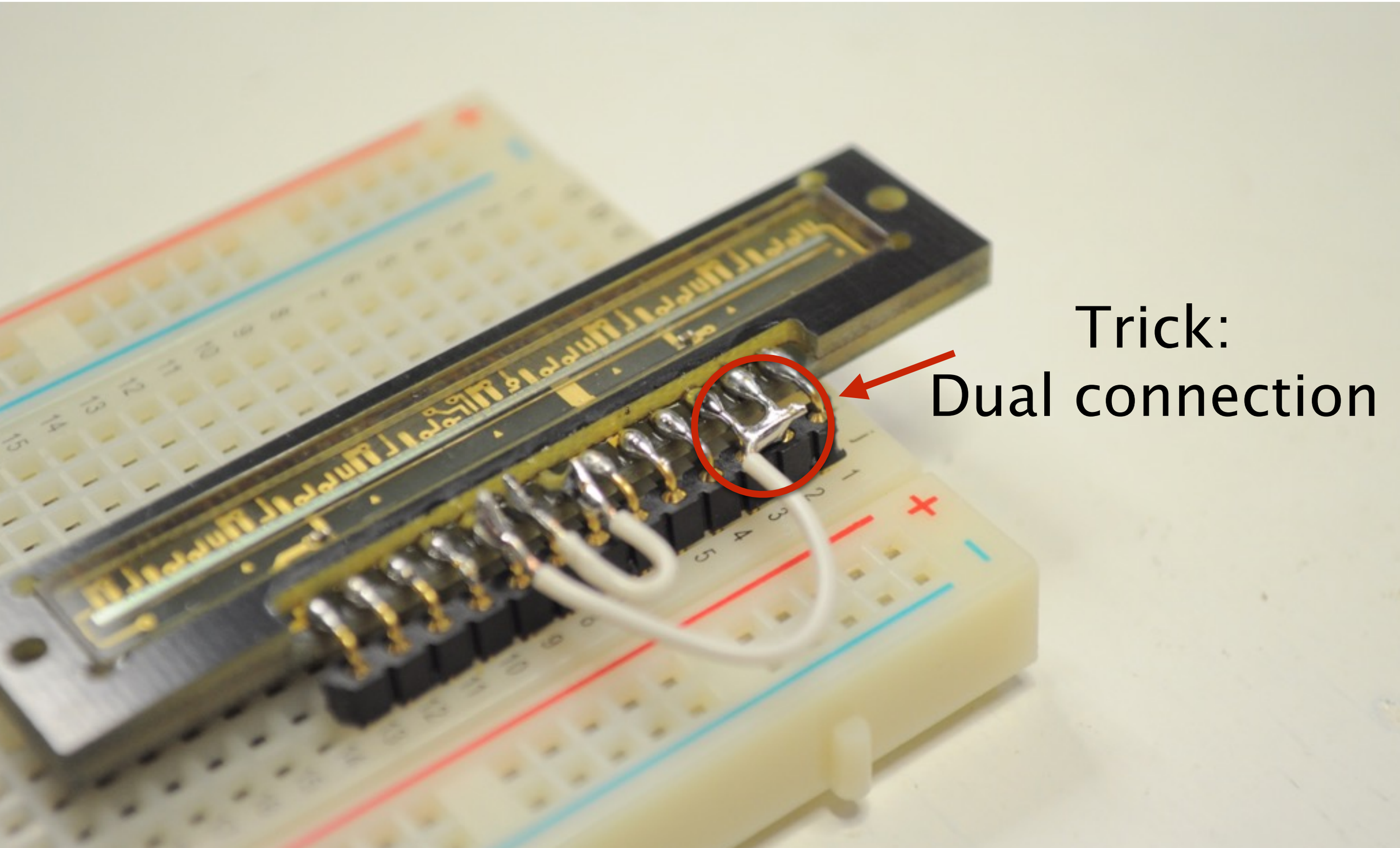
Assembly

- 2x short wire
- 3x medium wire
- 5x 20 cm wire

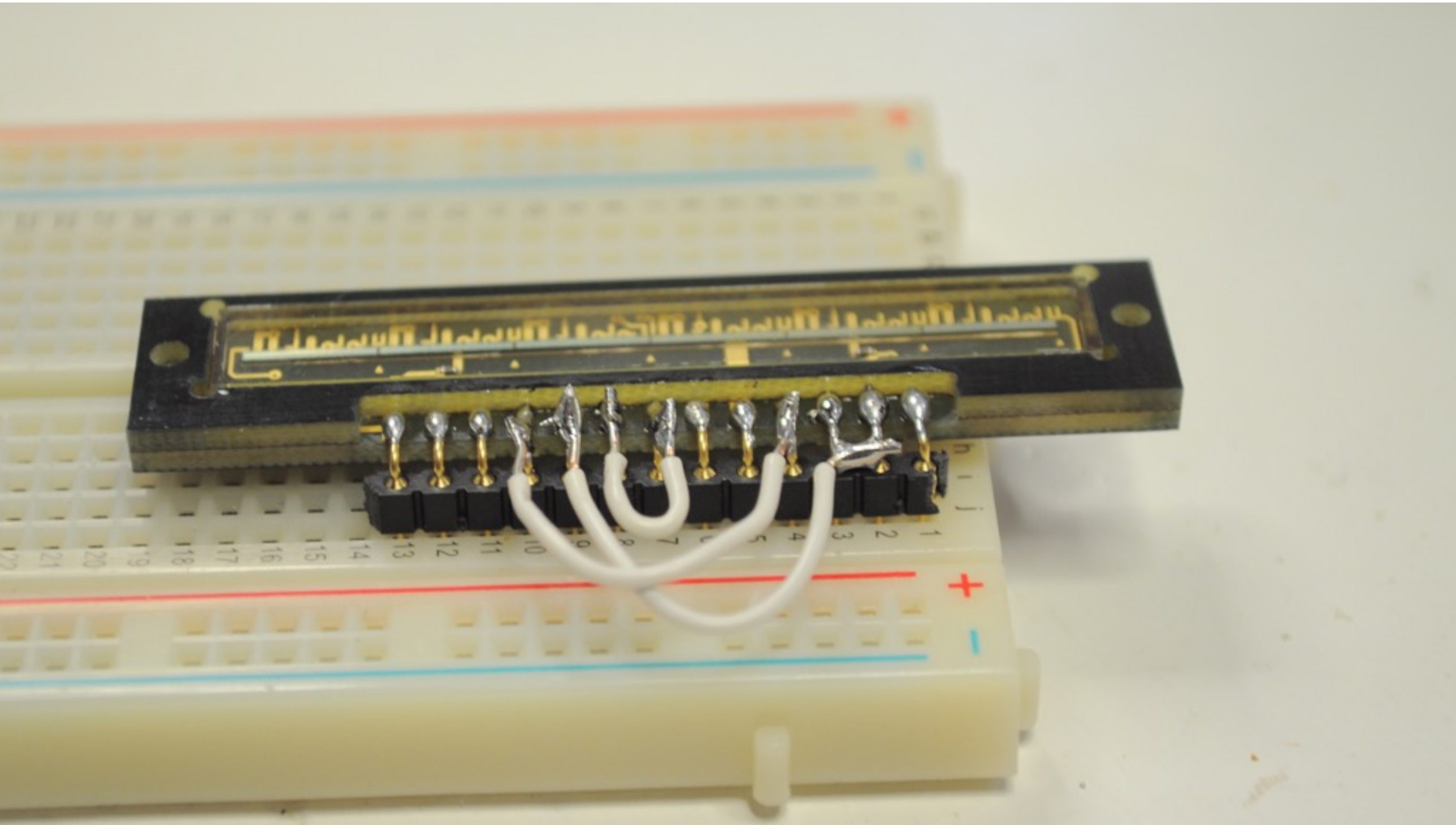
- Start with connecting
  - 7 and 8



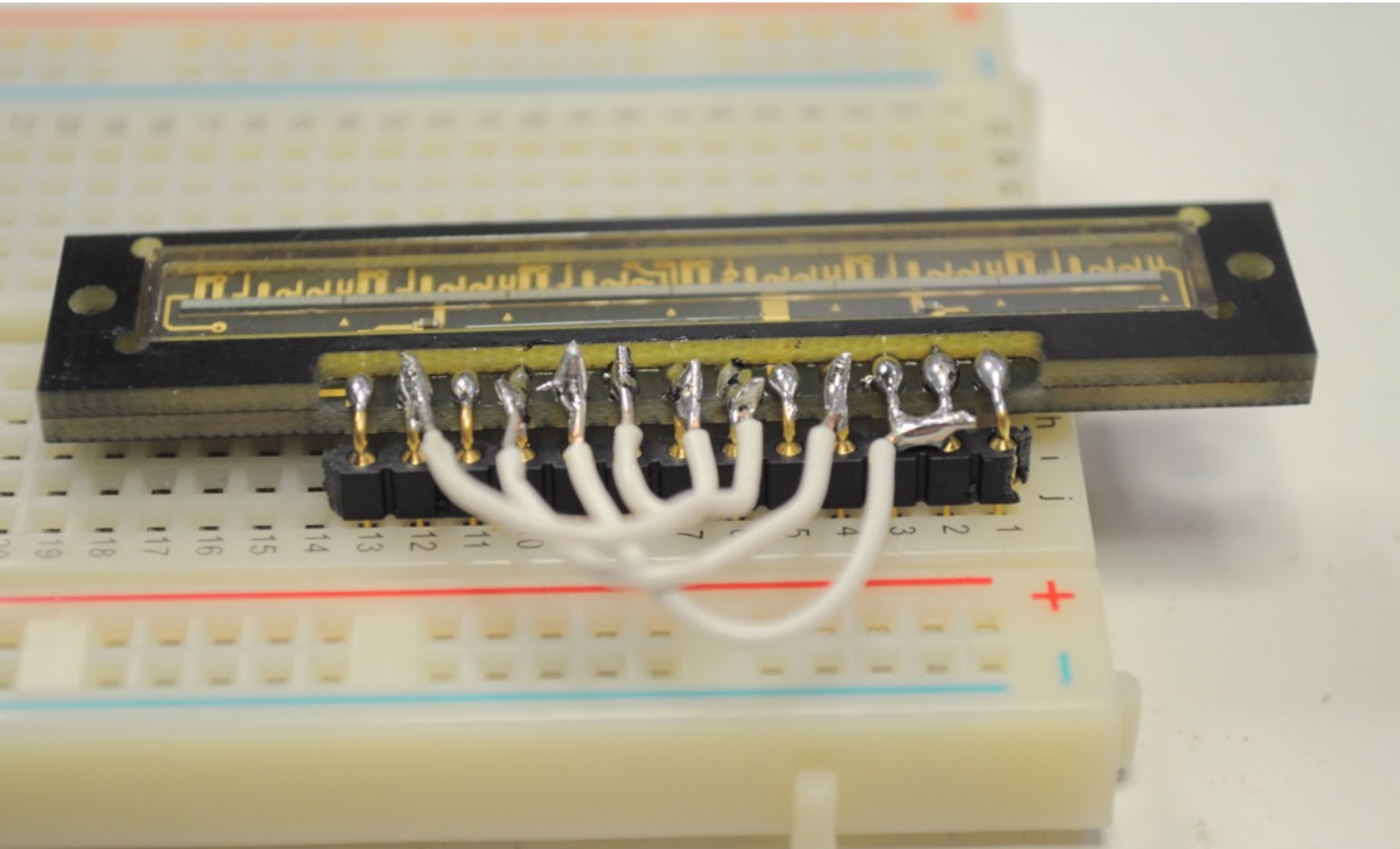
Connect 2, 3 and 9



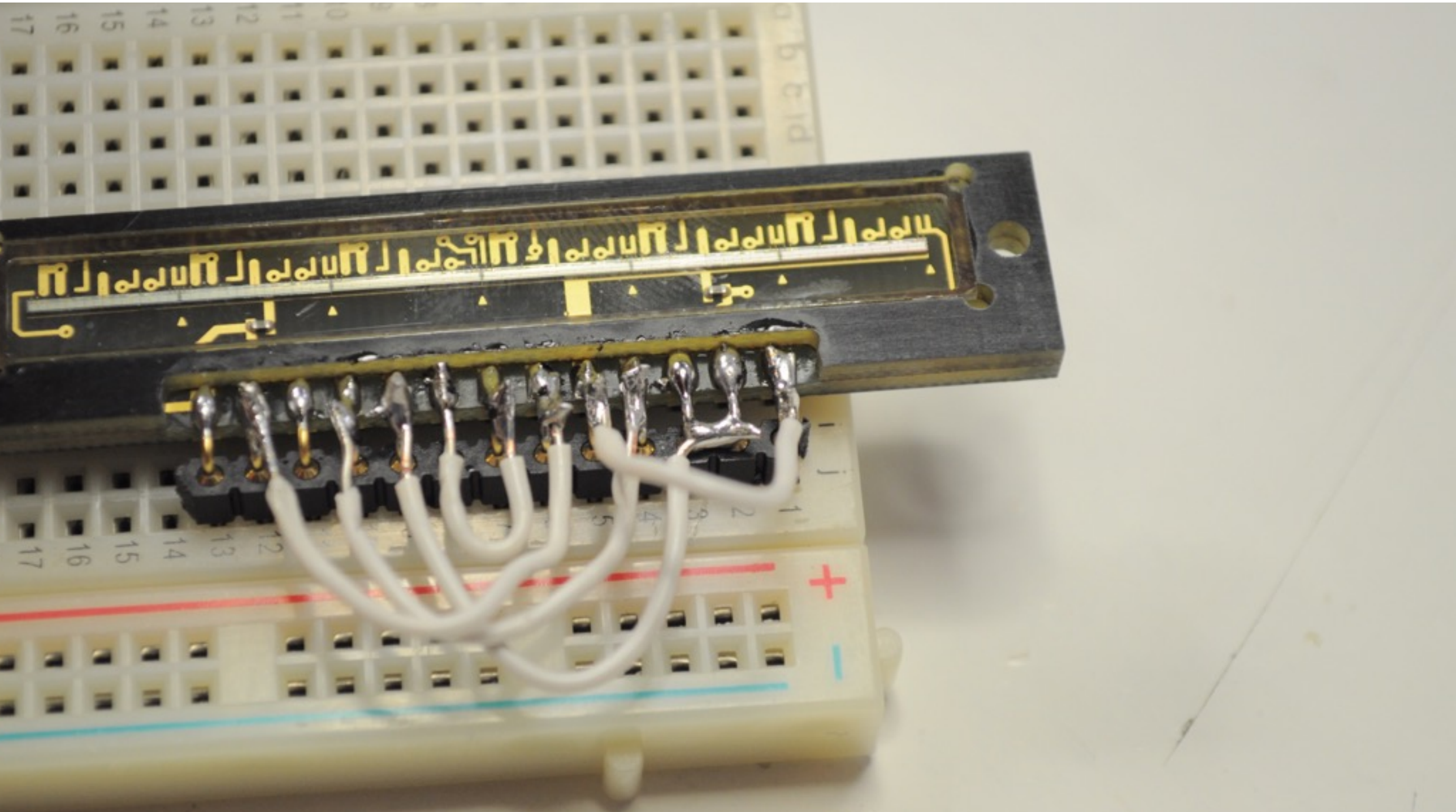
Connect 4 and 10



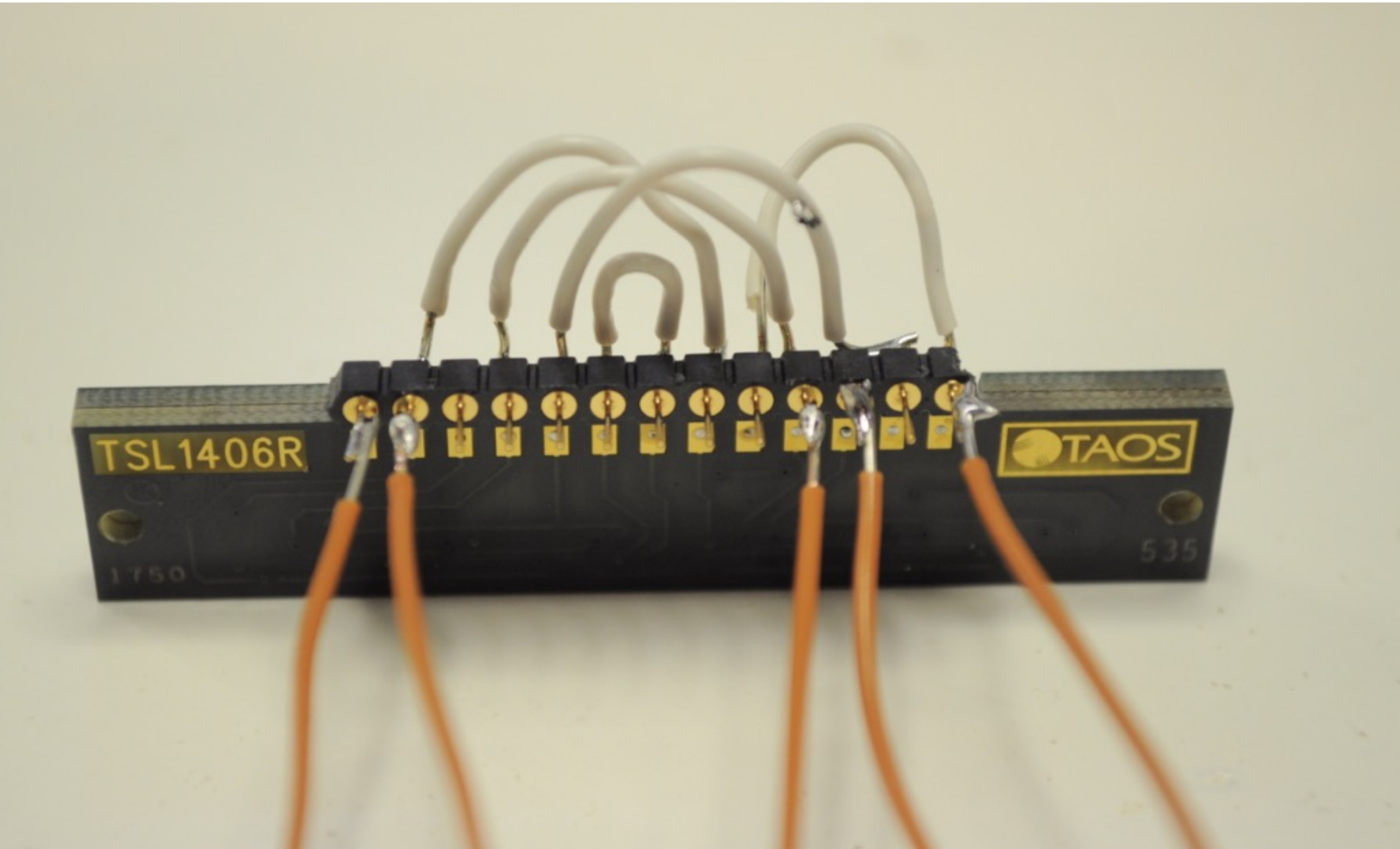
Connect 6 to 12



Connect 1 to 5

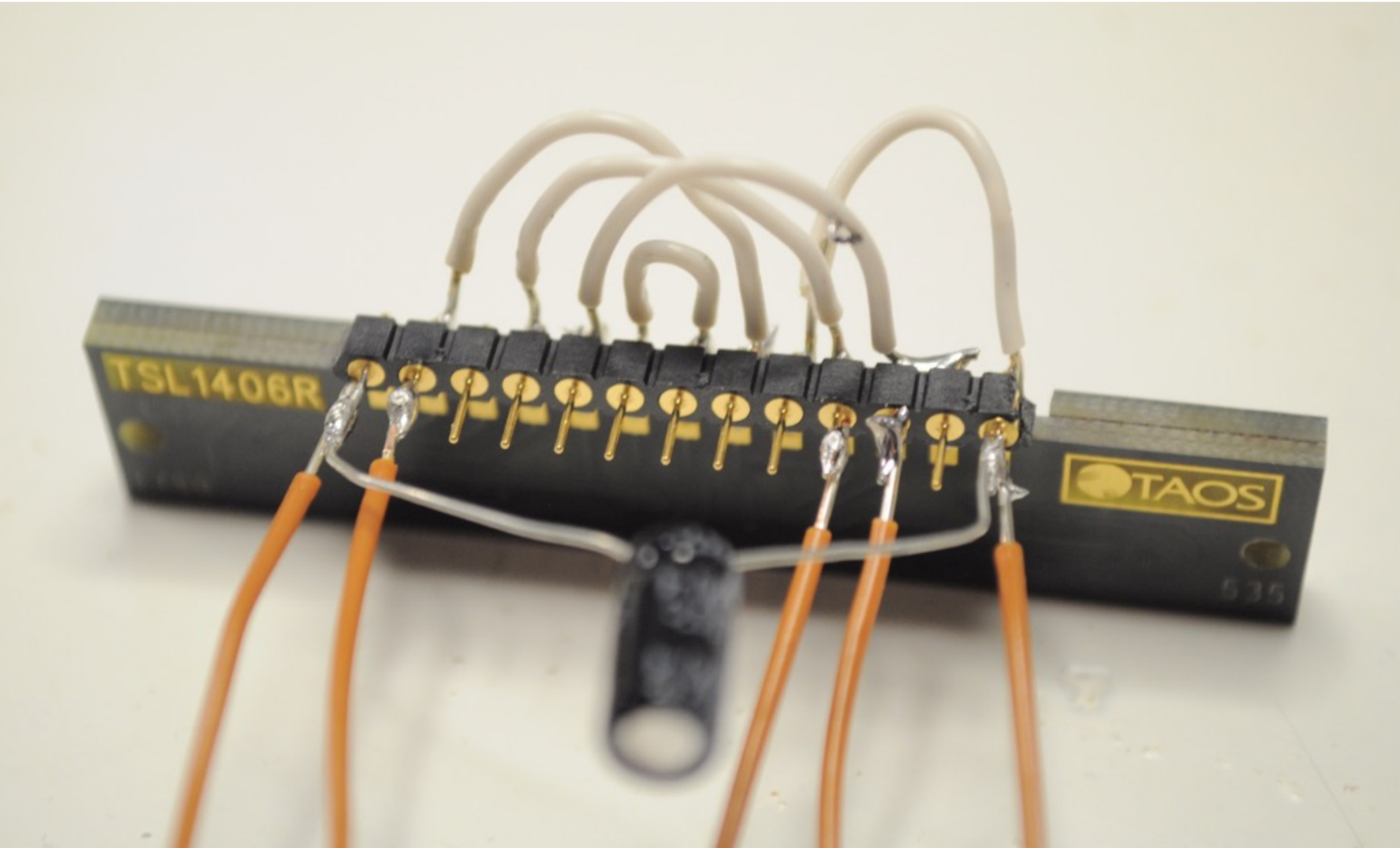


Connect long wires to 1, 3, 4, 12 & 13



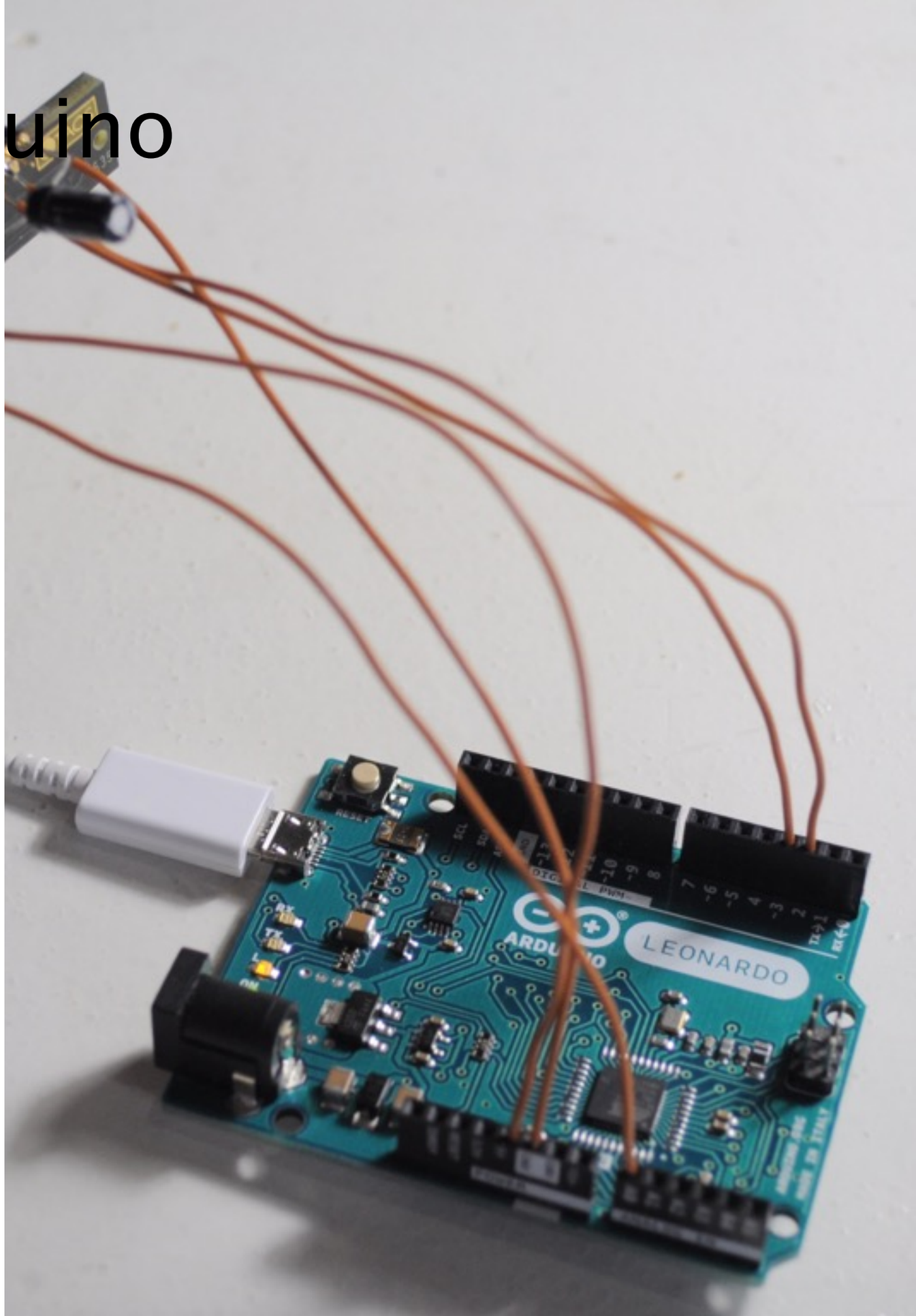
Connect the capacitor between 1 & 13

Make sure the white mark of the capacitor is facing pin 1



Connect to Arduino

- 1 to GND (–)
- 13 to Vcc (+)
- 3 to Arduino 2
- 4 to Arduino 3
- 12 to Arduino A0



Upload Arduino Code

Spectrophotometer

```
/*
        This file is part of Waag Society's BioHack Academy Code.

        Waag Society's BioHack Academy Code is free software: you can
        redistribute it and/or modify it under the terms of the GNU
        General Public License as published by the Free Software
        Foundation, either version 3 of the License, or (at your option)
        any later version.

        Waag Society's BioHack Academy Code is distributed in the hope
        that it will be useful, but WITHOUT ANY WARRANTY; without even
        the implied warranty of MERCHANTABILITY or FITNESS FOR A
        PARTICULAR PURPOSE.  See the GNU General Public License for more
        details.

        You should have received a copy of the GNU General Public License
        along with Waag Society's BioHack Academy Code. If not, see
        <http://www.gnu.org/licenses/>.
*/

/* ********************************************************
/  LED pin
*/
#define LED_PIN A5
#define RLED_PIN 8
#define BLED_PIN 9
#define GLED_PIN 10
/* ********************************************************
*/

/*
TSL1406R readout method:

The TSL1406 is an array of sensors. Each sensor has a capacitor that is filled by the sensor photodiode, and one that is used as buffering capacitor.
Whenever the HOLD is set HIGH, the buffering capacitor takes over the charge from the sensing capacitor

In order to control exposure time of this sensor, the following method is used:
- Set SI/HOLD on high, moving the charges to the holding capacitors
- Send 769 clock ticks, during which integration starts after the 18th tick.
- Wait X amount of time for integration, allowing for light to be received by the sensor
- Set SI/HOLD on high again. The holding capacitors now contain the charge that we want to know about
```

Done uploading.

```
Sketch uses 8,644 bytes (30%) of program storage space. Maximum is 28,672 bytes.
Global variables use 239 bytes (9%) of dynamic memory, leaving 2,321 bytes for local variables. Maximum is 2,560 bytes.
```

Test SpectrumDisplay

SpectrumDisplay

BioHackAcademy Spectrophotometer

U=decrease exposure, I=increase exposure

Exposure time: 1 ms

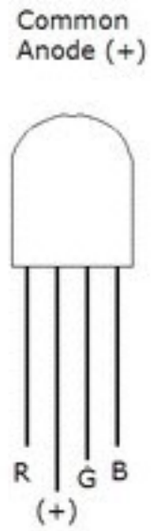
D=set dark measurement
W=set white measurement (no sample)

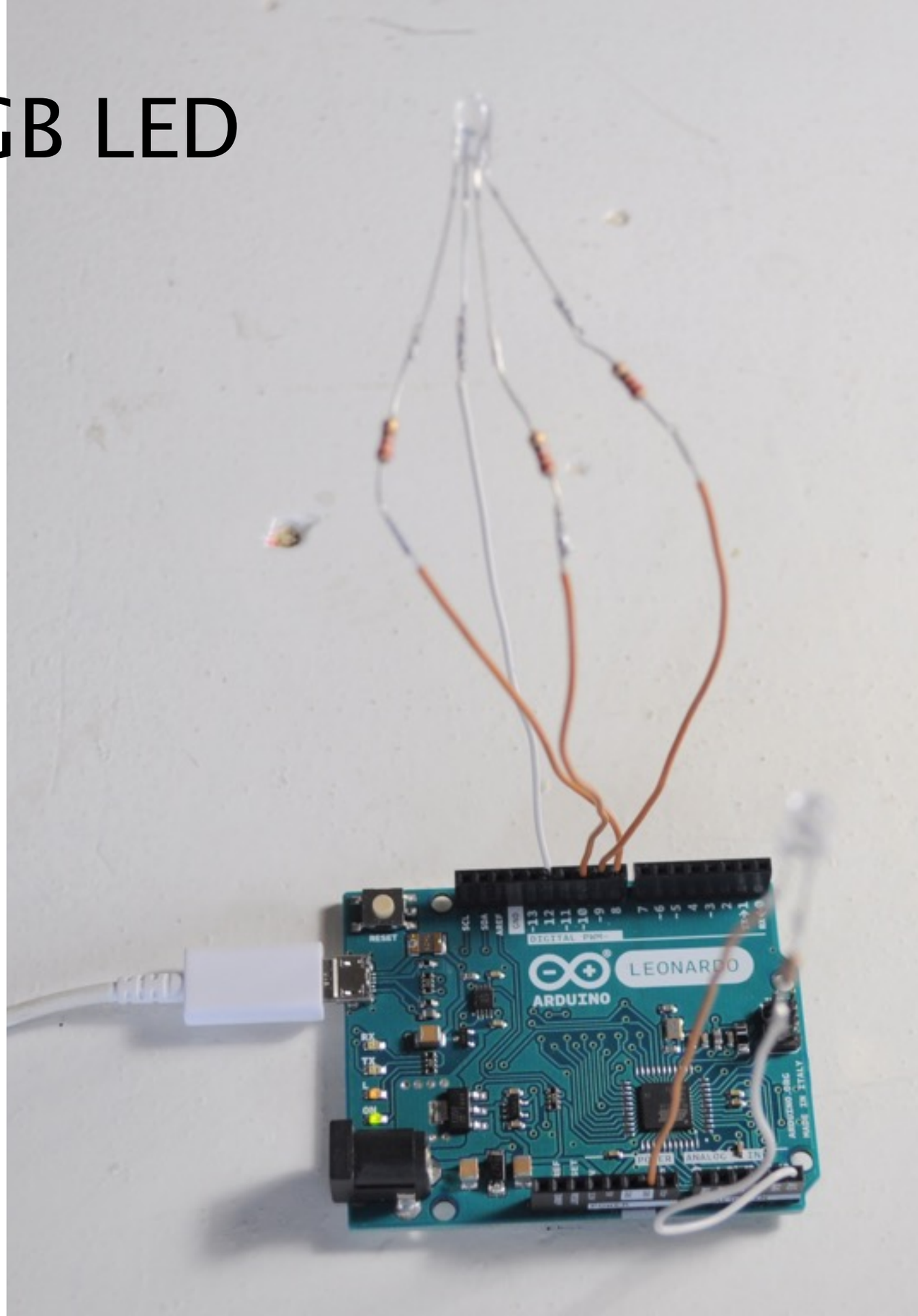
LED = C
L, R, G,
RLED =
GLED =
BLED =

Measurements: 156 nm: 610 MaxValue: 0.87109375 At mouse: 0.86816406

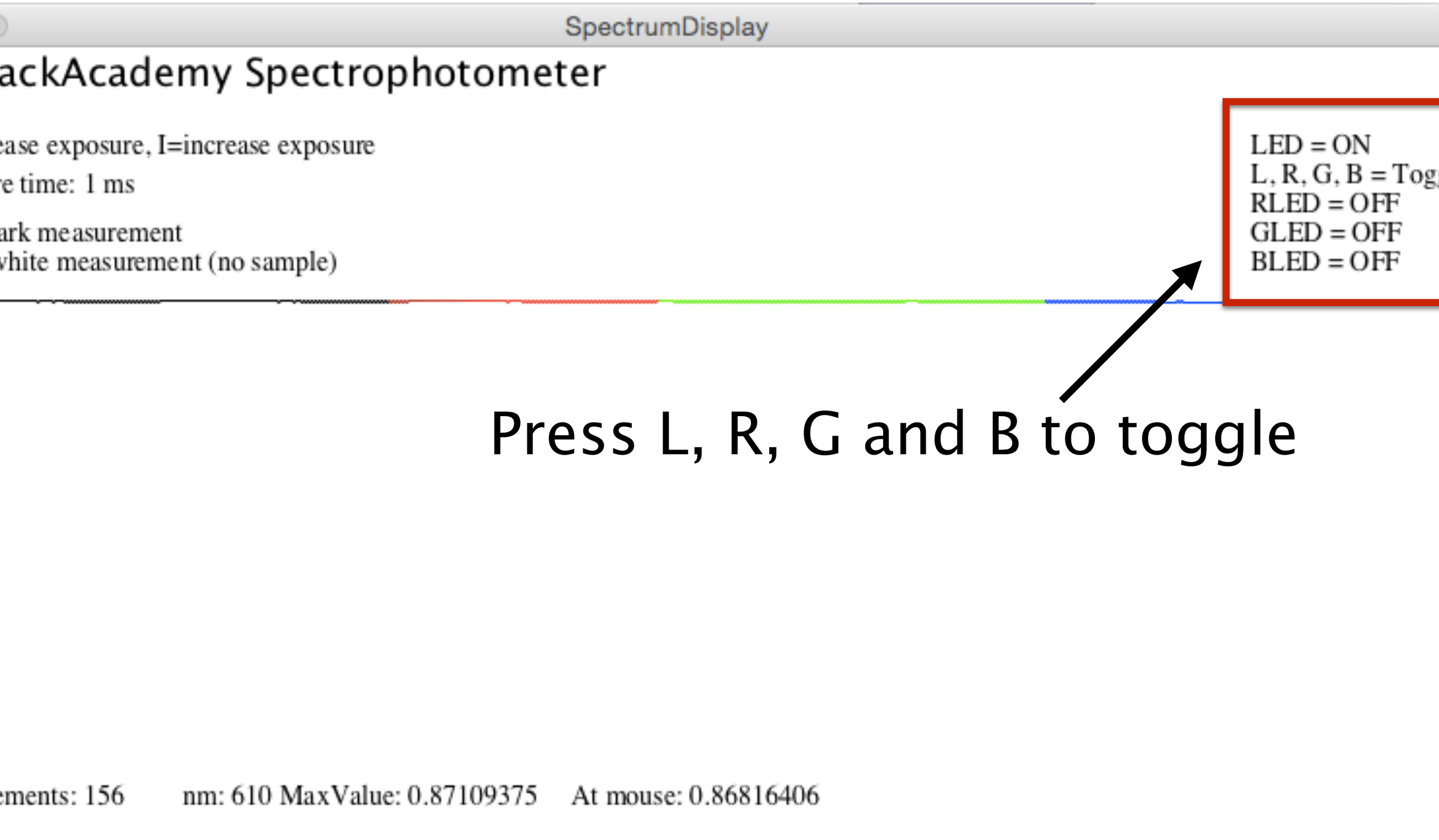
Connect the RGB LED

B to 9
G to 10
R to 8
+ to pin 12

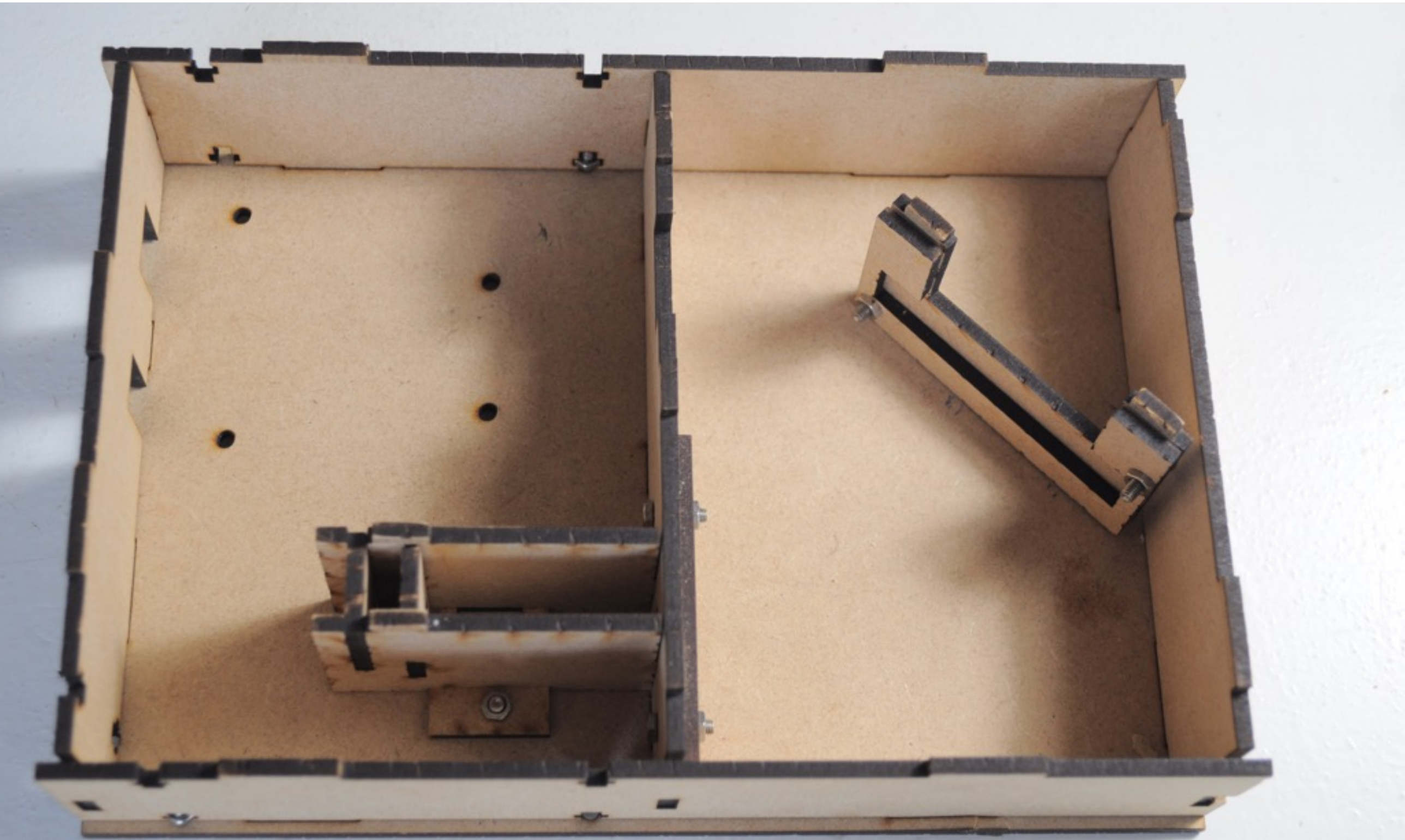




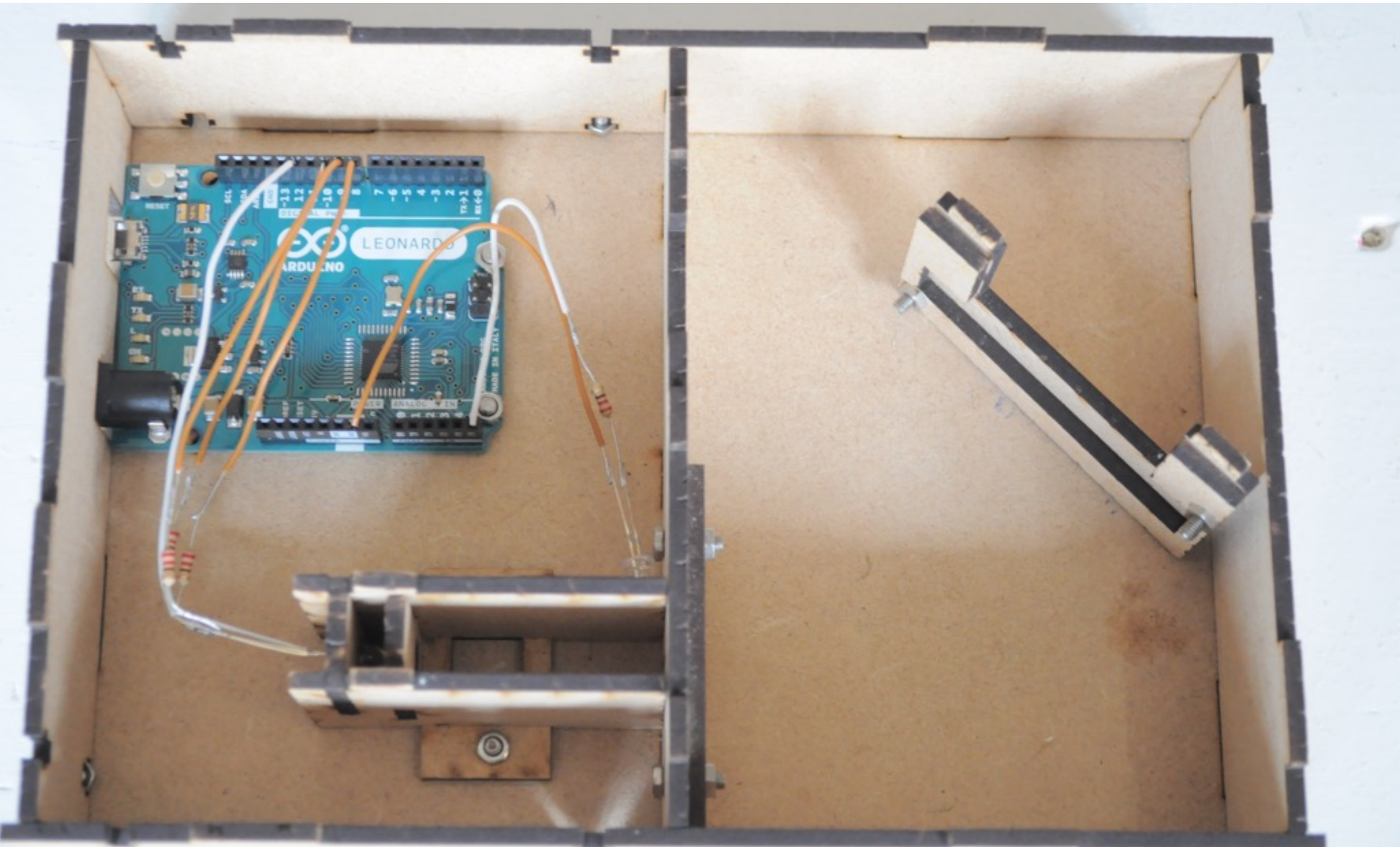
Test SpectrumDisplay



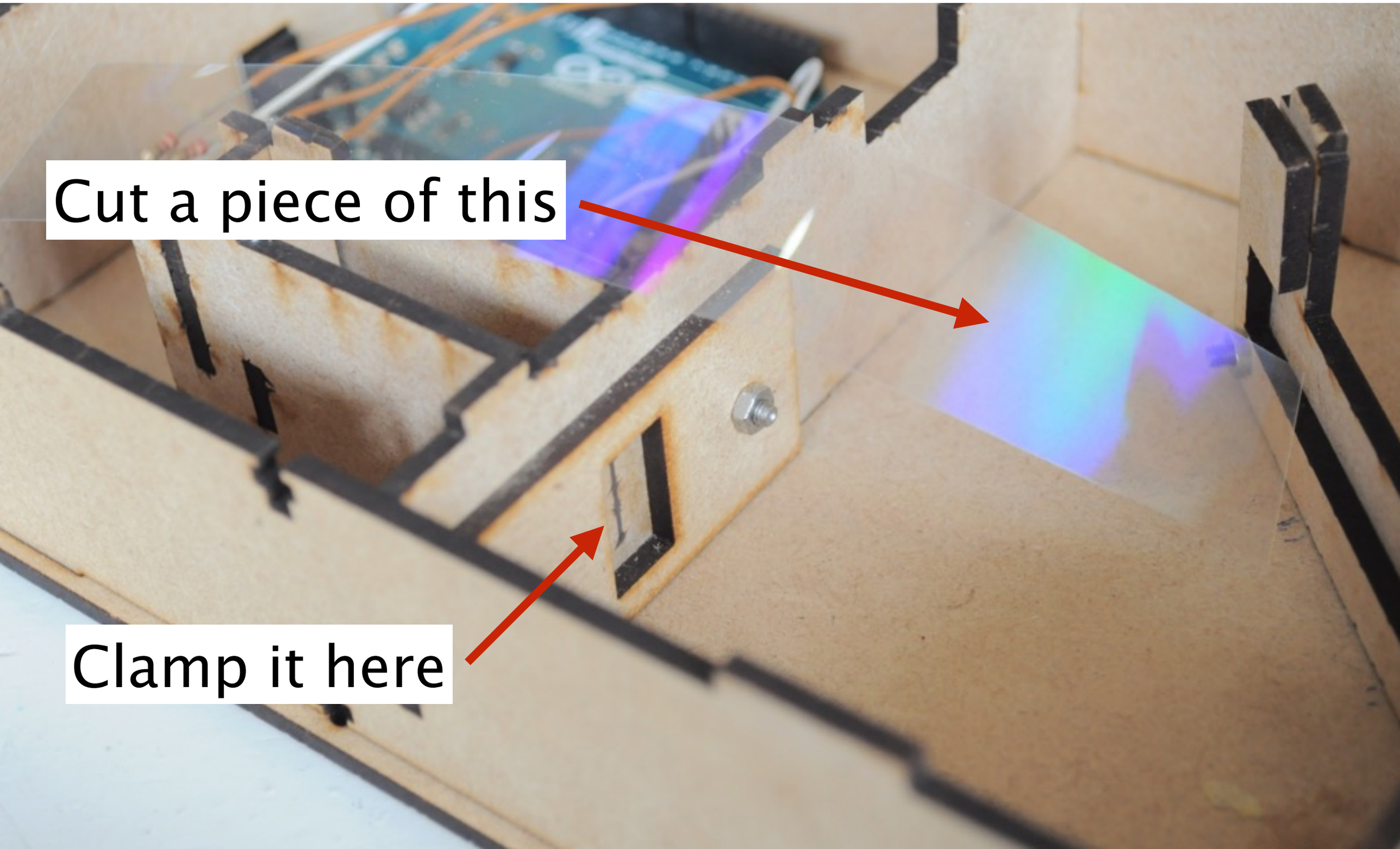
Lasercut and assemble the box



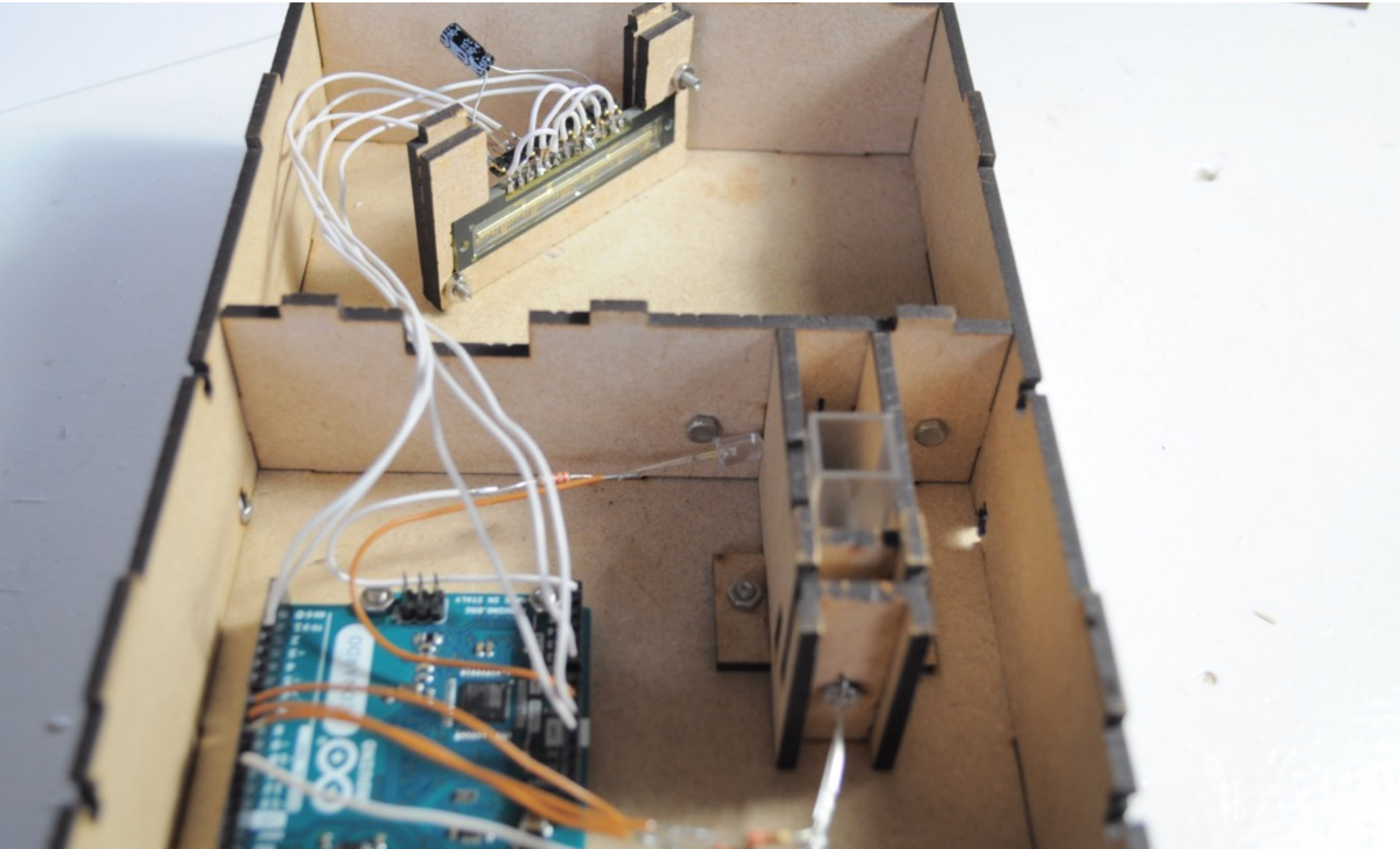
Mount the electronics



Cut and place the grating foil



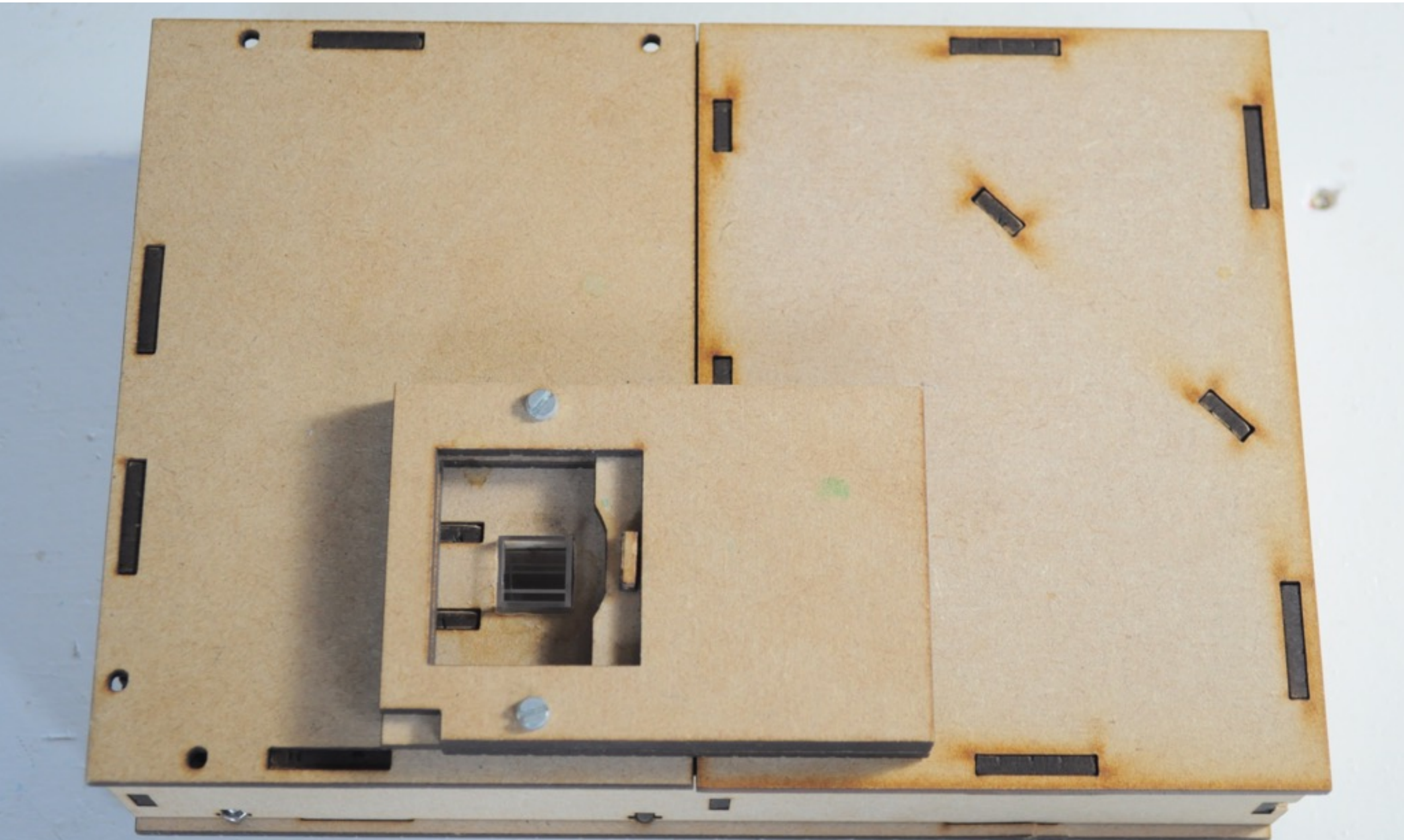
Mount the CCD array



Place the cuvette and lid

Make sure it all fits

Seal the box



Ready to measure!