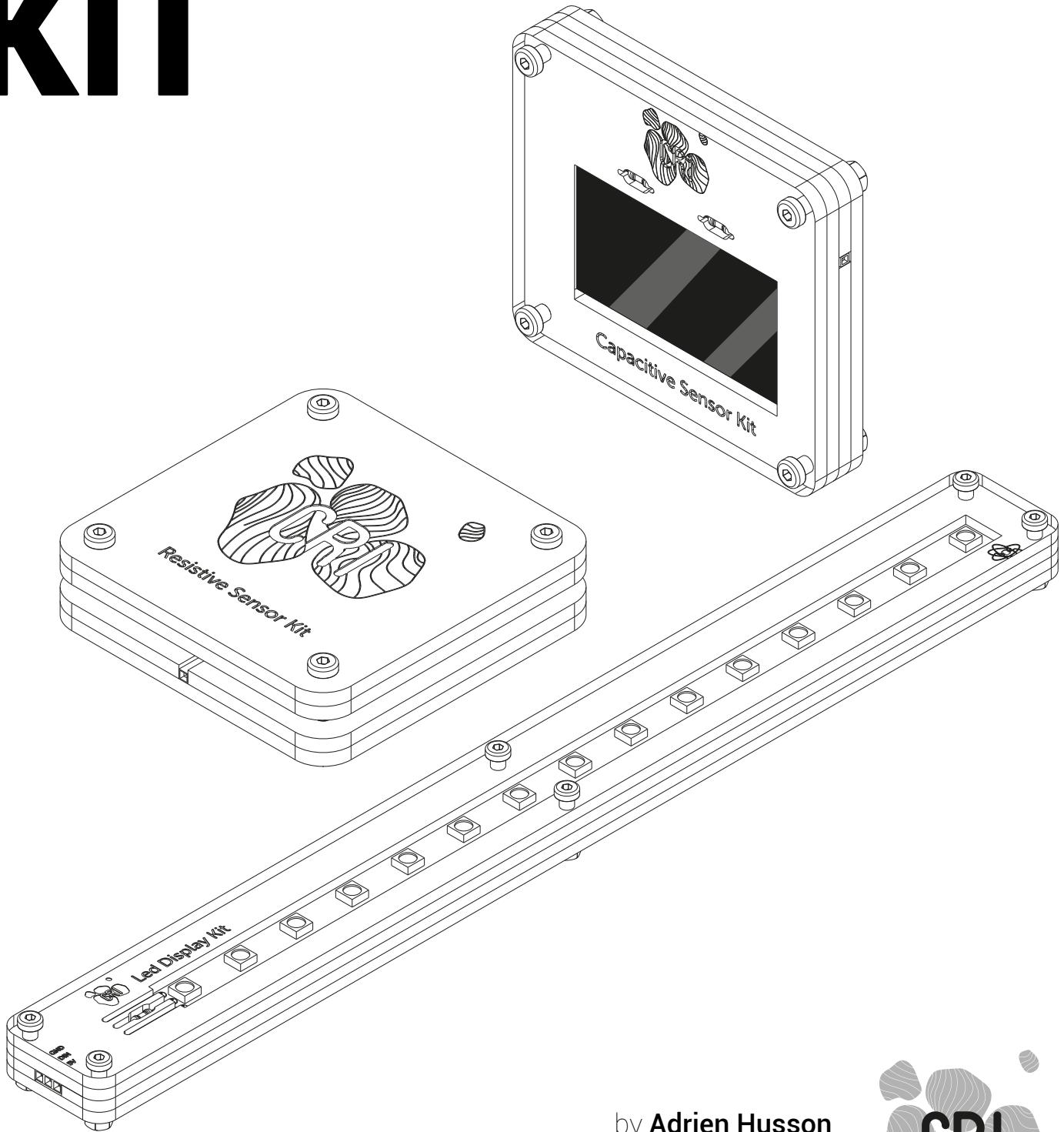
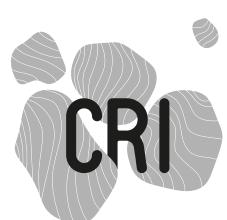
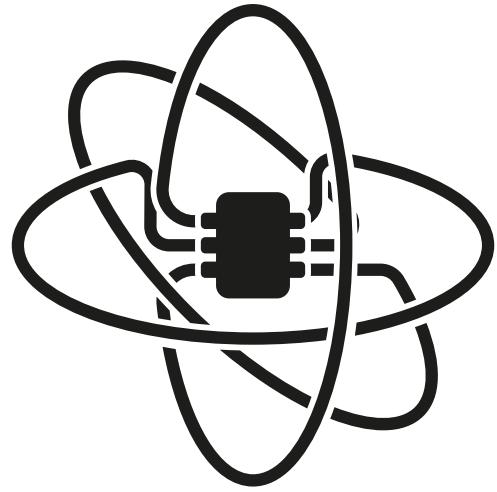


HOW TO BUILD SENSORS KIT



by Adrien Husson
for the

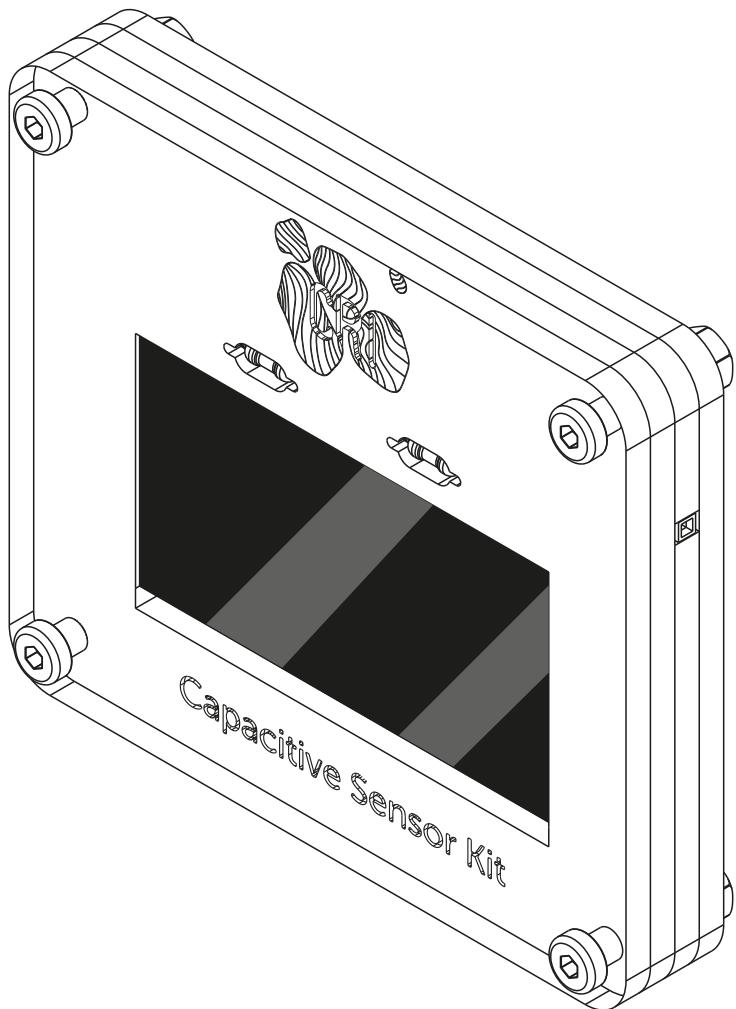




This manual refers to the **Sensors Kit** project and is part of
the **Movuino** documentation.

All files of the project can be found on:

<https://github.com/hssnadr/SensorsKit>

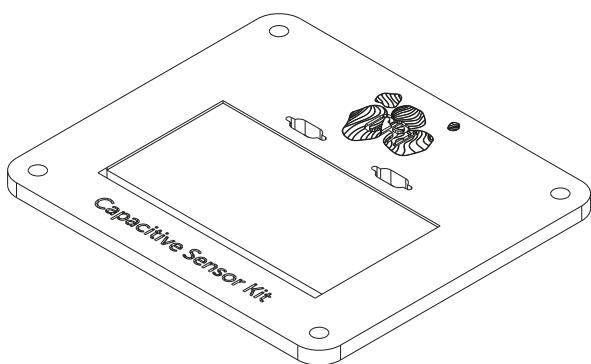


CAPACITIVE SENSOR

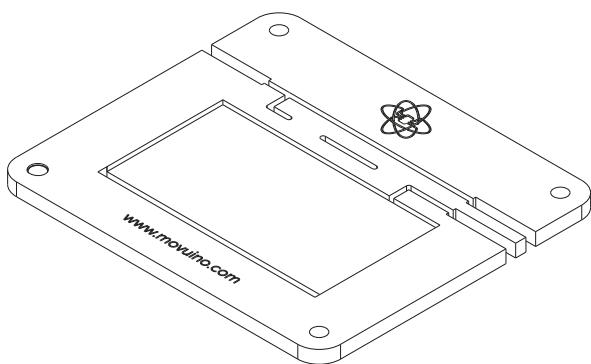
TO LASER CUT

• Plywood

3mm thick



A1 x1 Front panel



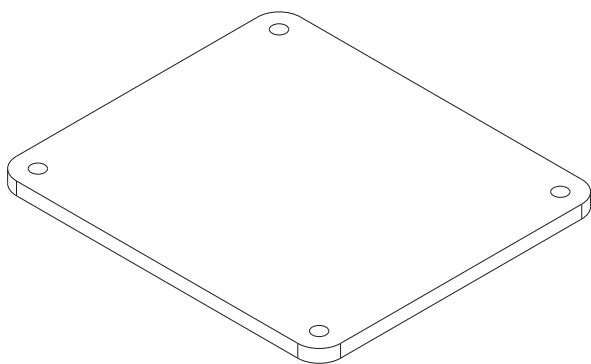
A2 x1 Back panel



SensorsKit/01_MakingRessources/CapacitiveSensor/CapacitiveSensor_LaserCut_Plywood.svg

• Plexyglass

3mm thick



B x2 Case

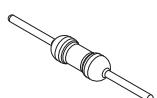


SensorsKit/01_MakingRessources/CapacitiveSensor/CapacitiveSensor_LaserCut_Plexyglass.svg

TO BUY



C1 x1 Copper tape



C2 x2 10kOhm resistors (R_{cap})



C3 x2 Female to female jumper wires



C4 x4 M3 16mm CHC screws



C5 x4 M3 Serrated washers

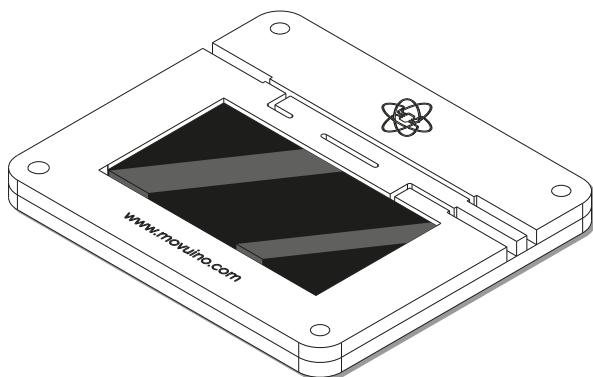
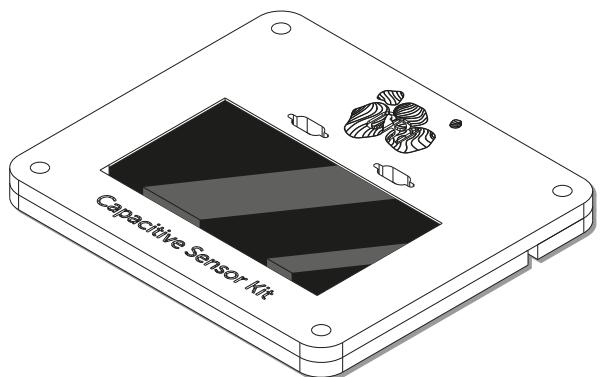
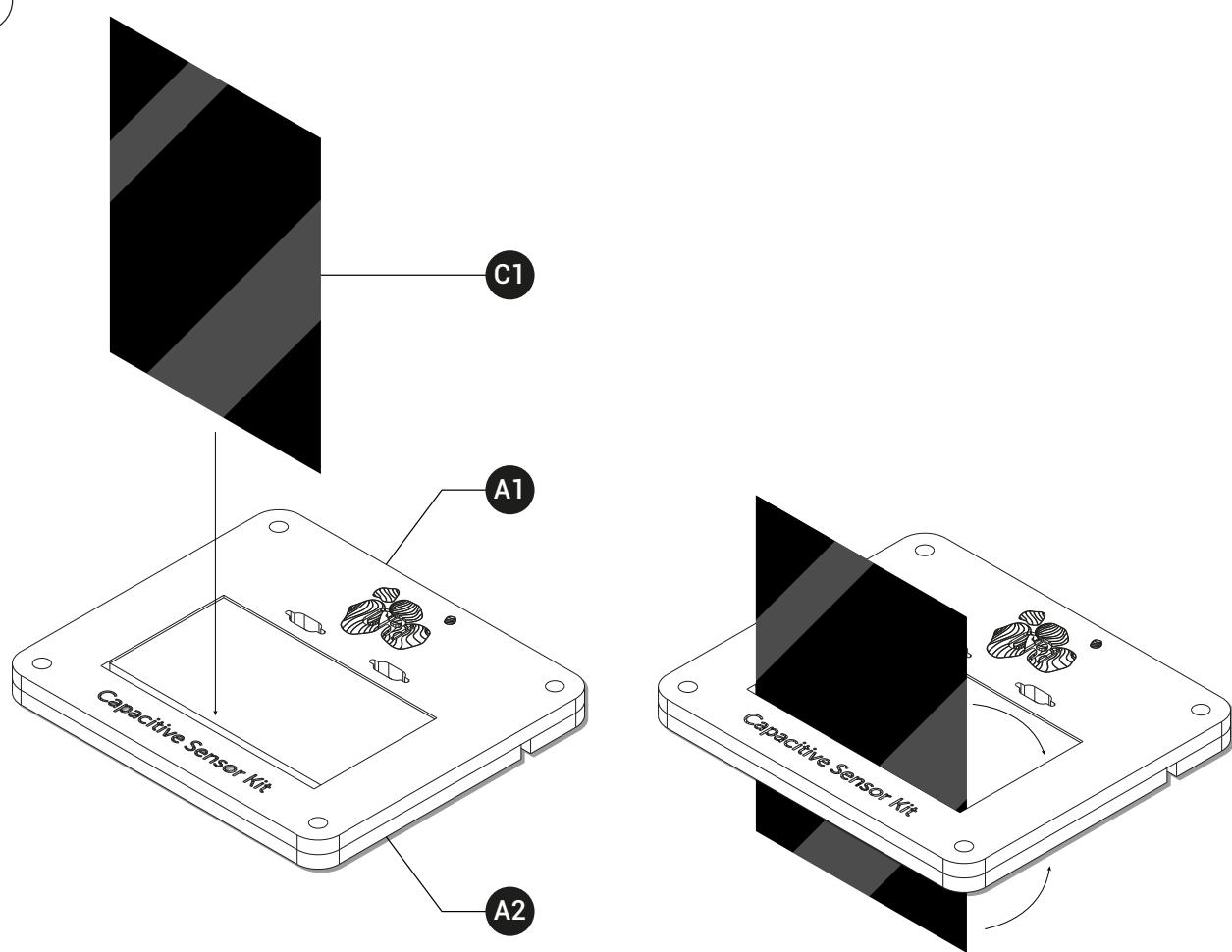


C6 x4 M3 Nuts

ASSEMBLY

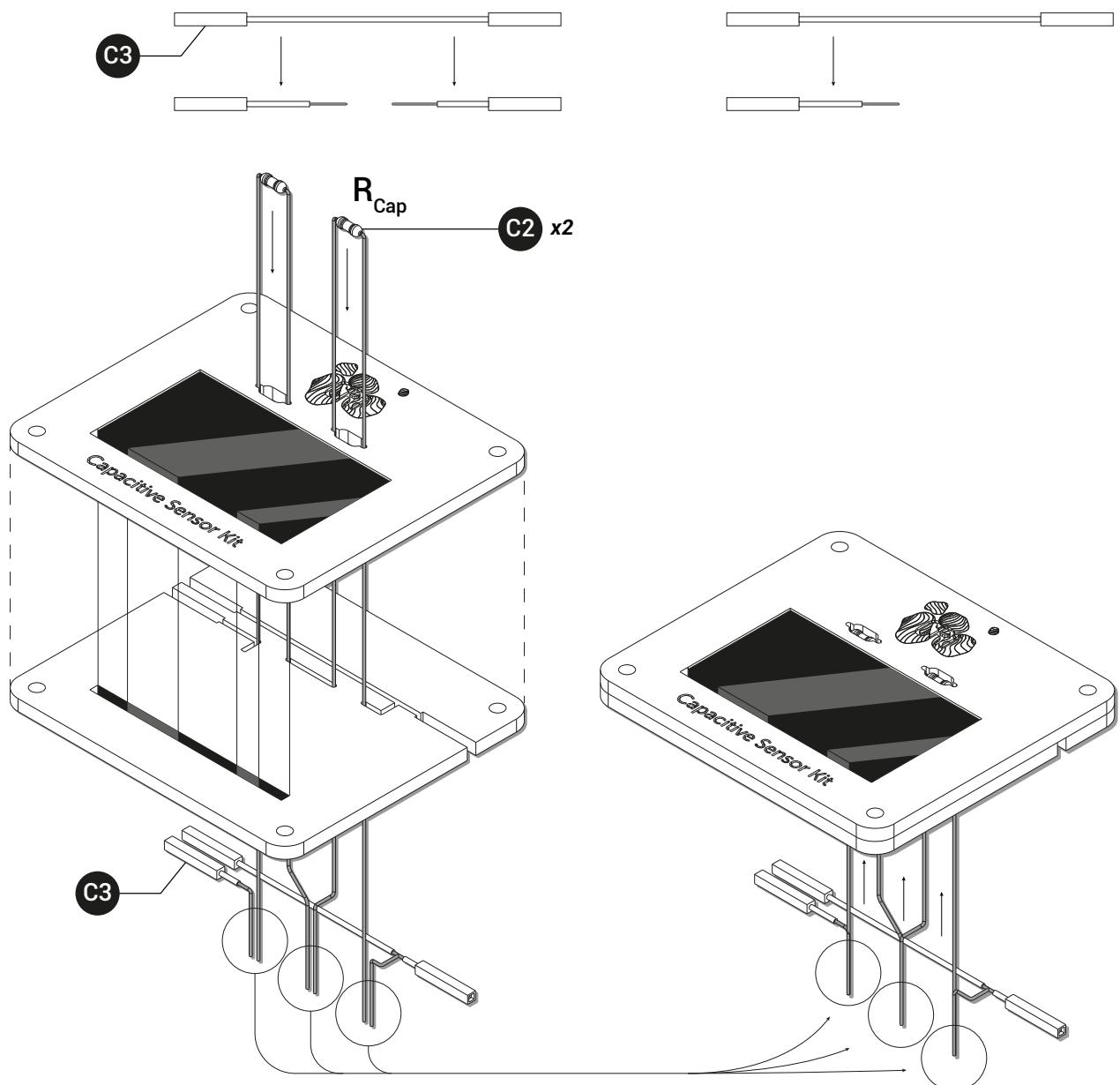
CAPACITIVE SENSOR

1



3

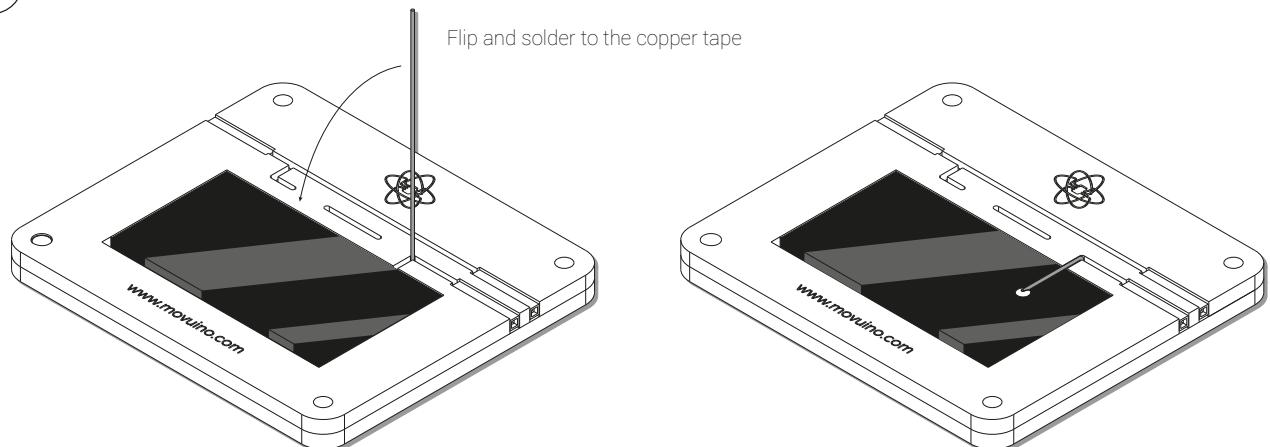
Cut the wires insulation to get the inner cables



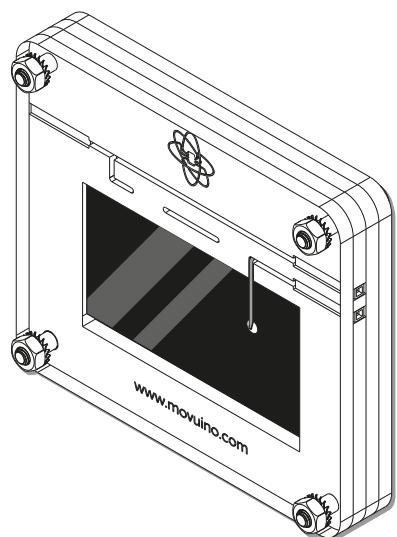
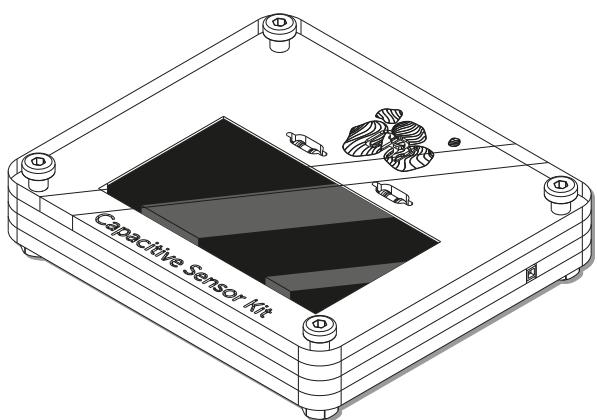
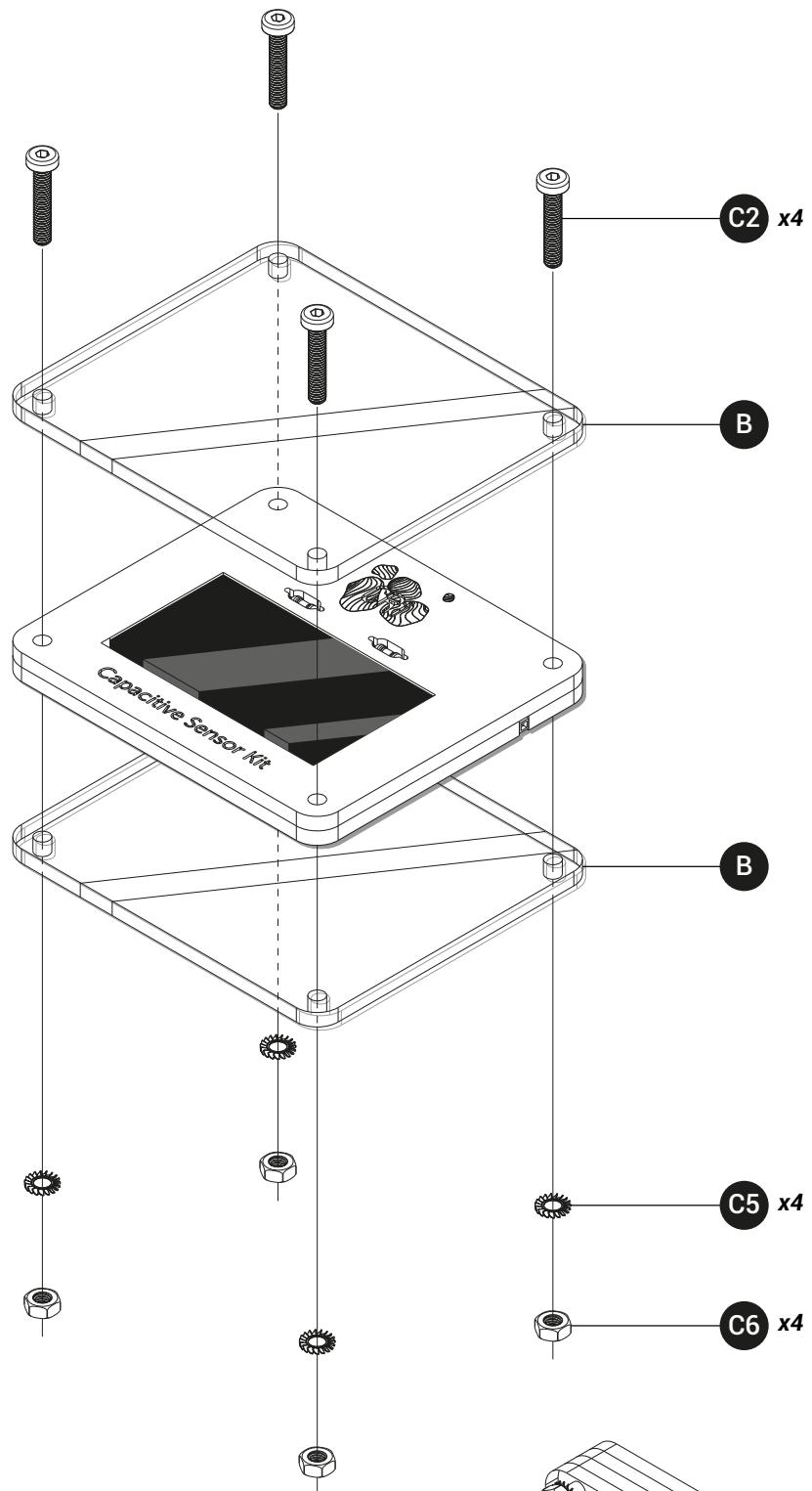
Solder wires together and fit into the case

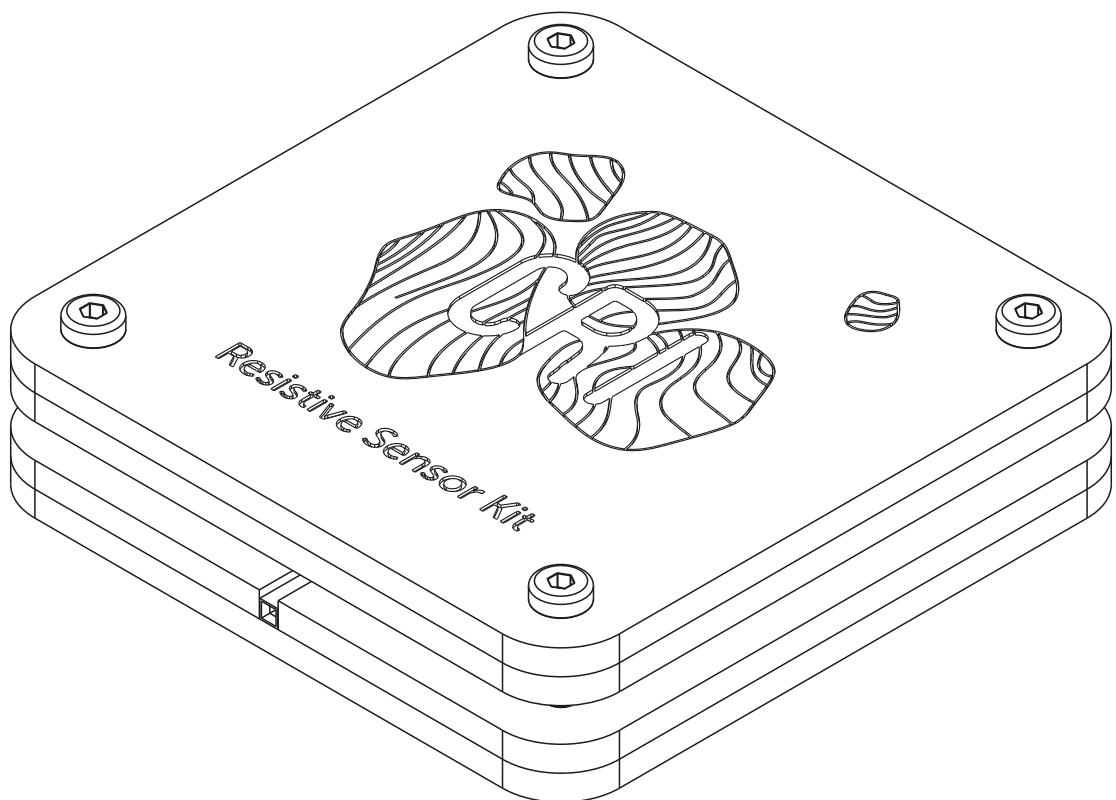
3

Flip and solder to the copper tape



5



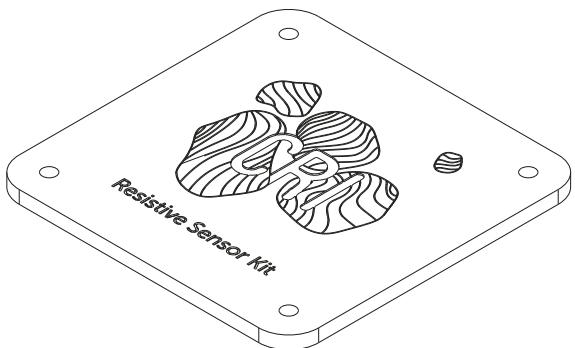


RESISTIVE SENSOR

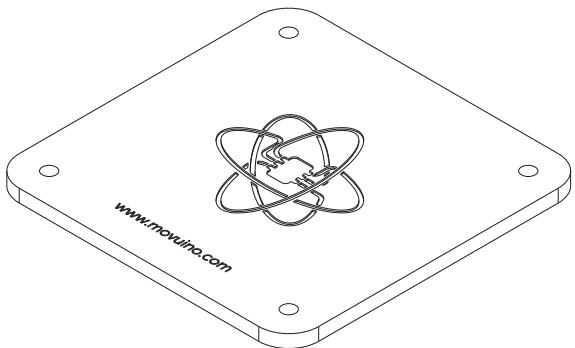
TO LASER CUT

• Plywood

3mm thick



A1 x1 Front panel

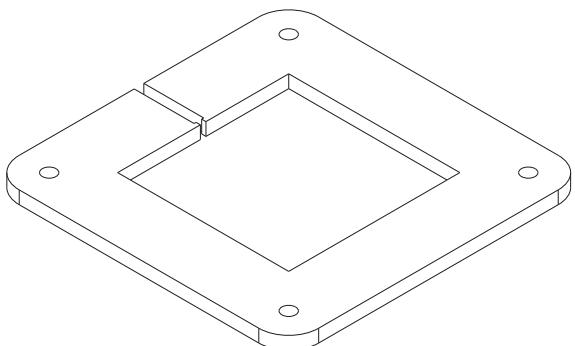


A2 x1 Back panel

📁 SensorsKit/01_MakingRessources/ResistiveSensor/ResistiveSensor_LaserCut_Plywood.svg

• Plexyglass

3mm thick



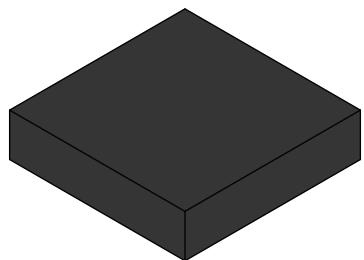
B x2 Footprint

📁 SensorsKit/01_MakingRessources/ResistiveSensor/ResistiveSensor_LaserCut_Plexyglass.svg

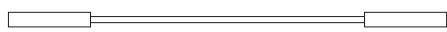
TO BUY



C1 x2 Copper tape



C2 x1 Conductive foam



C3 x1 Female to female Dupont wire



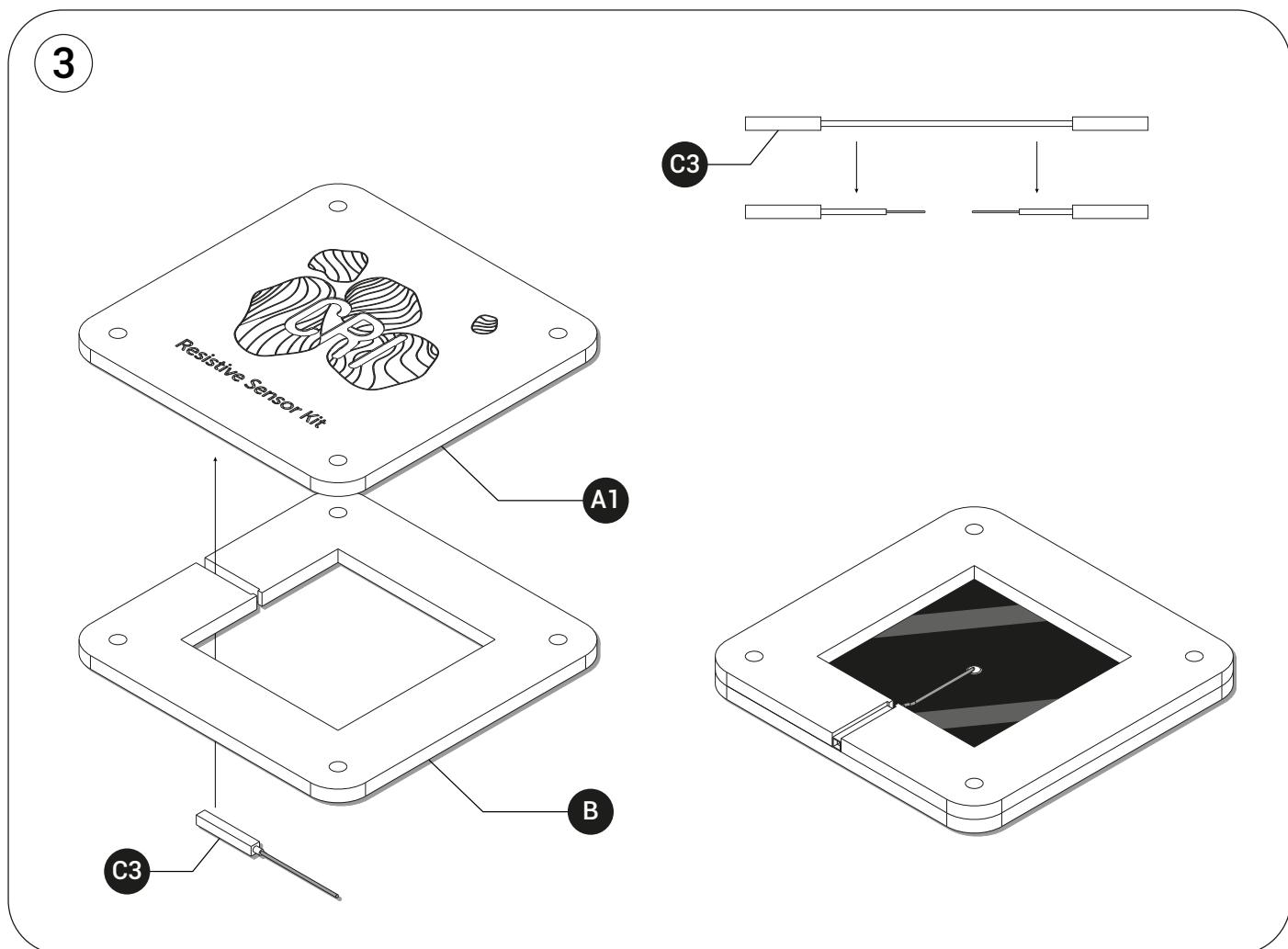
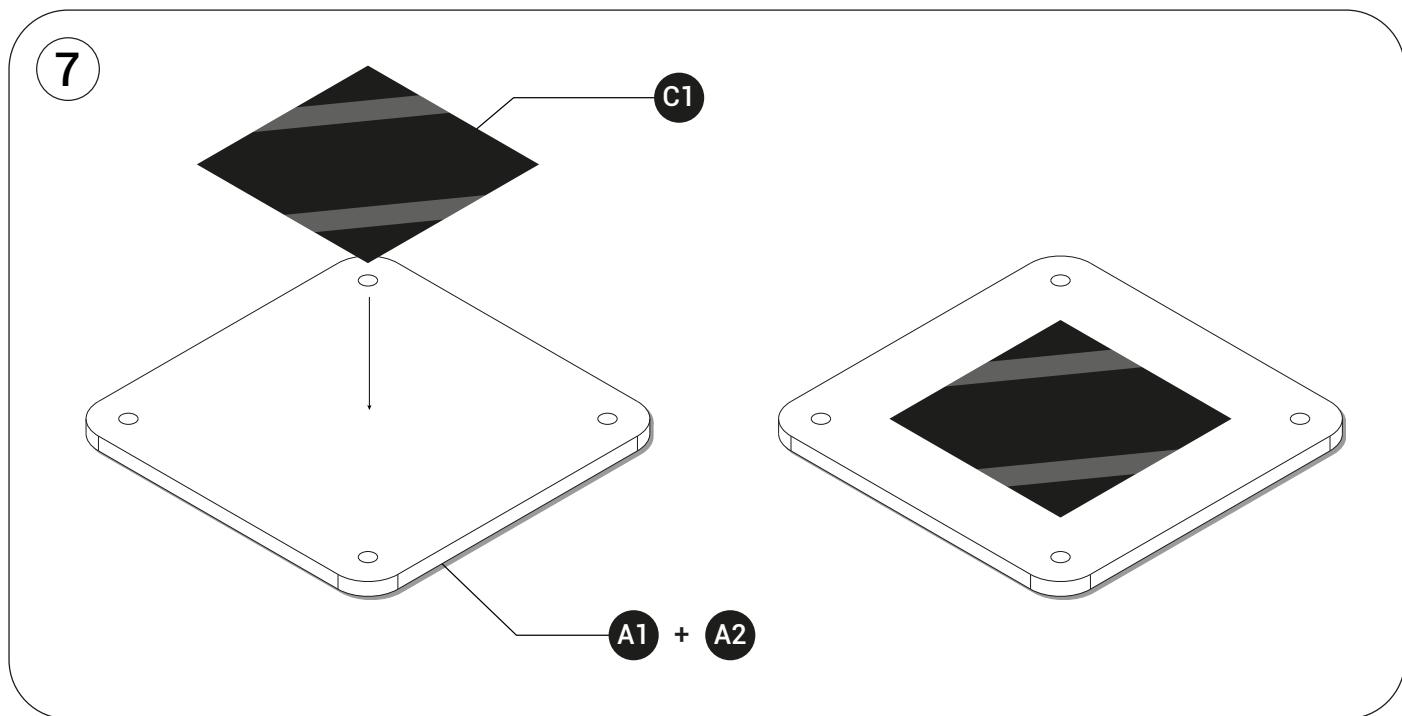
C4 x4 M3 20mm CHC screws

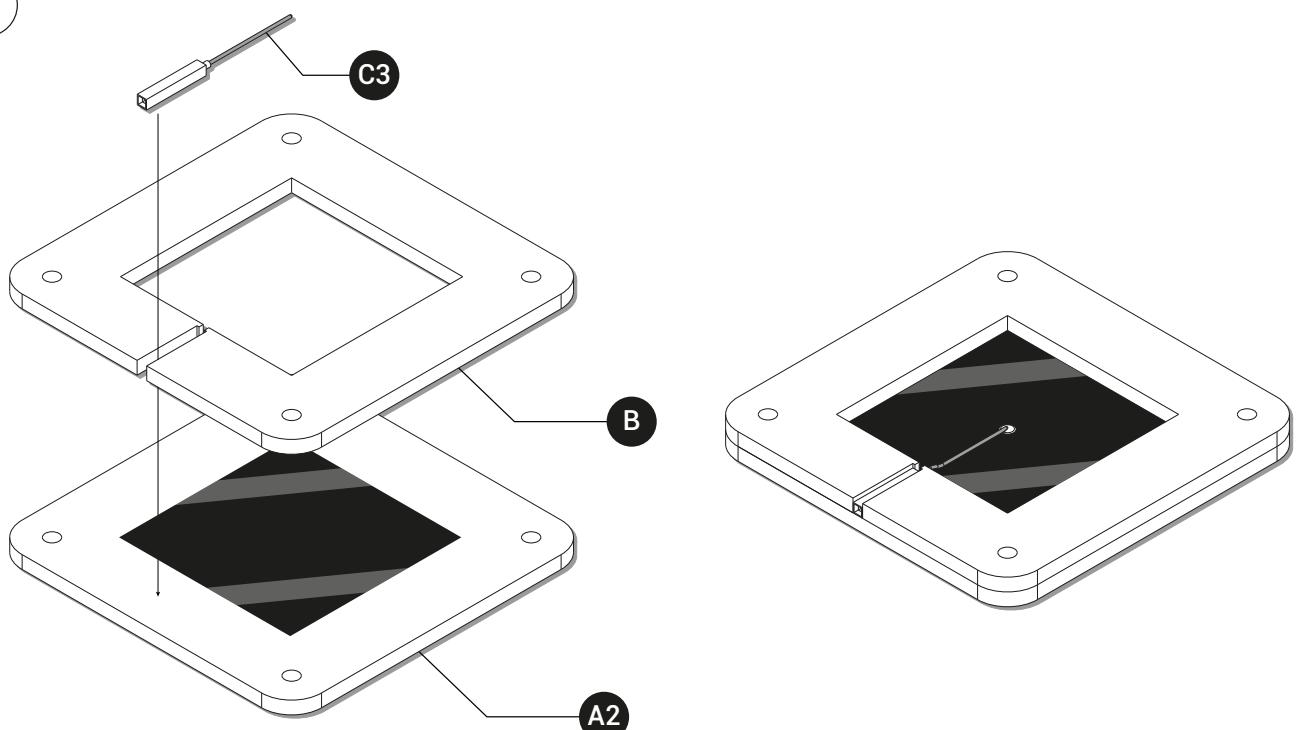
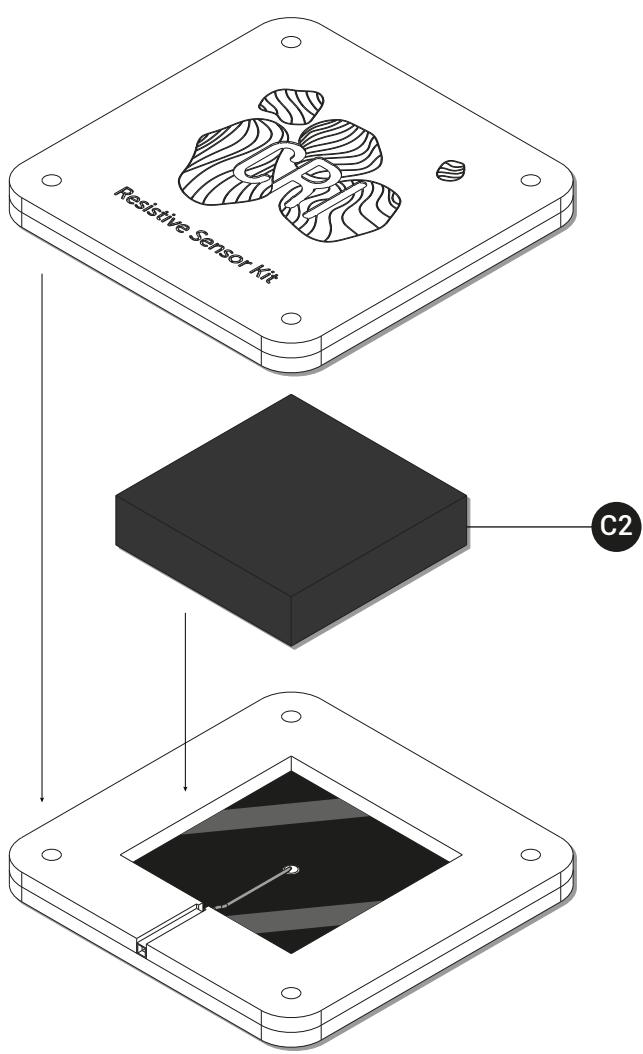


C5 x4 M3 Locknuts

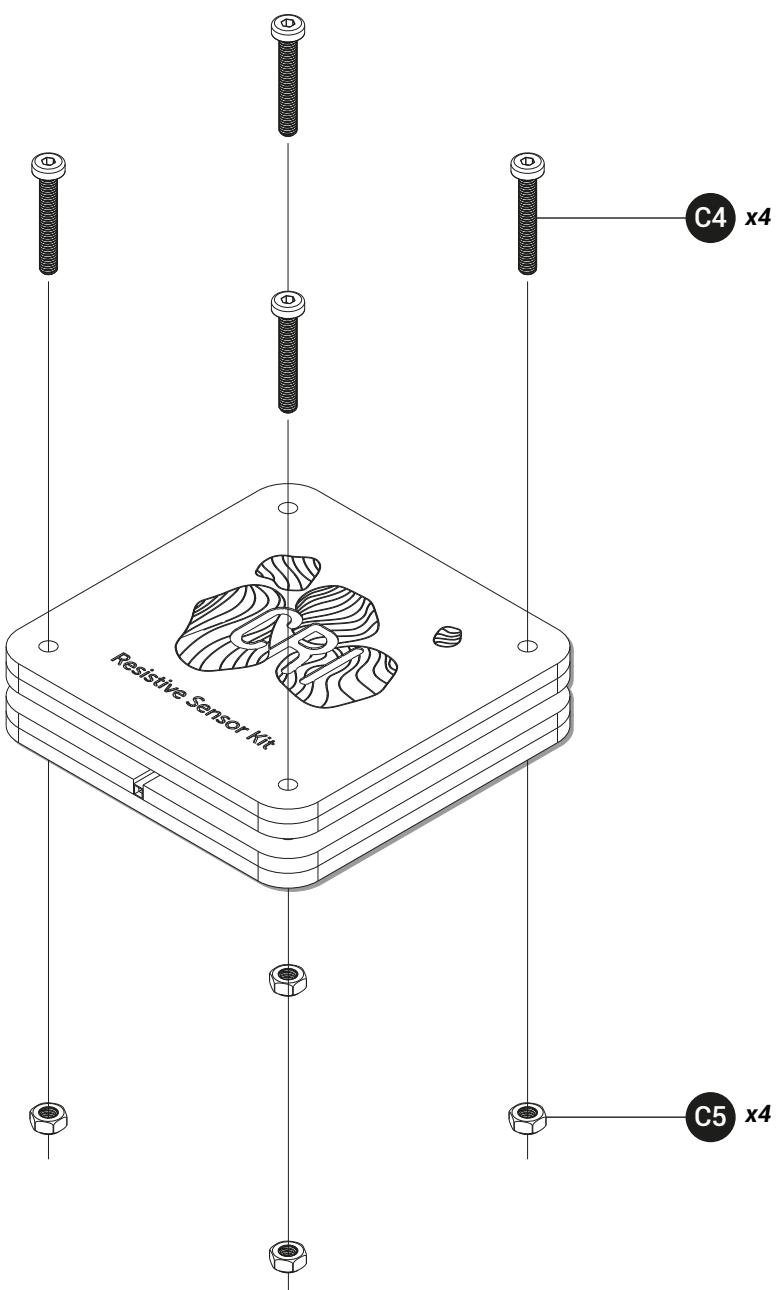
ASSEMBLY

RESISTIVE SENSOR

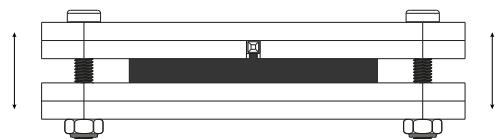
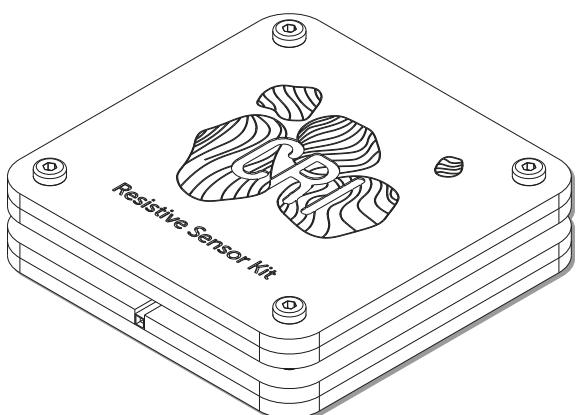


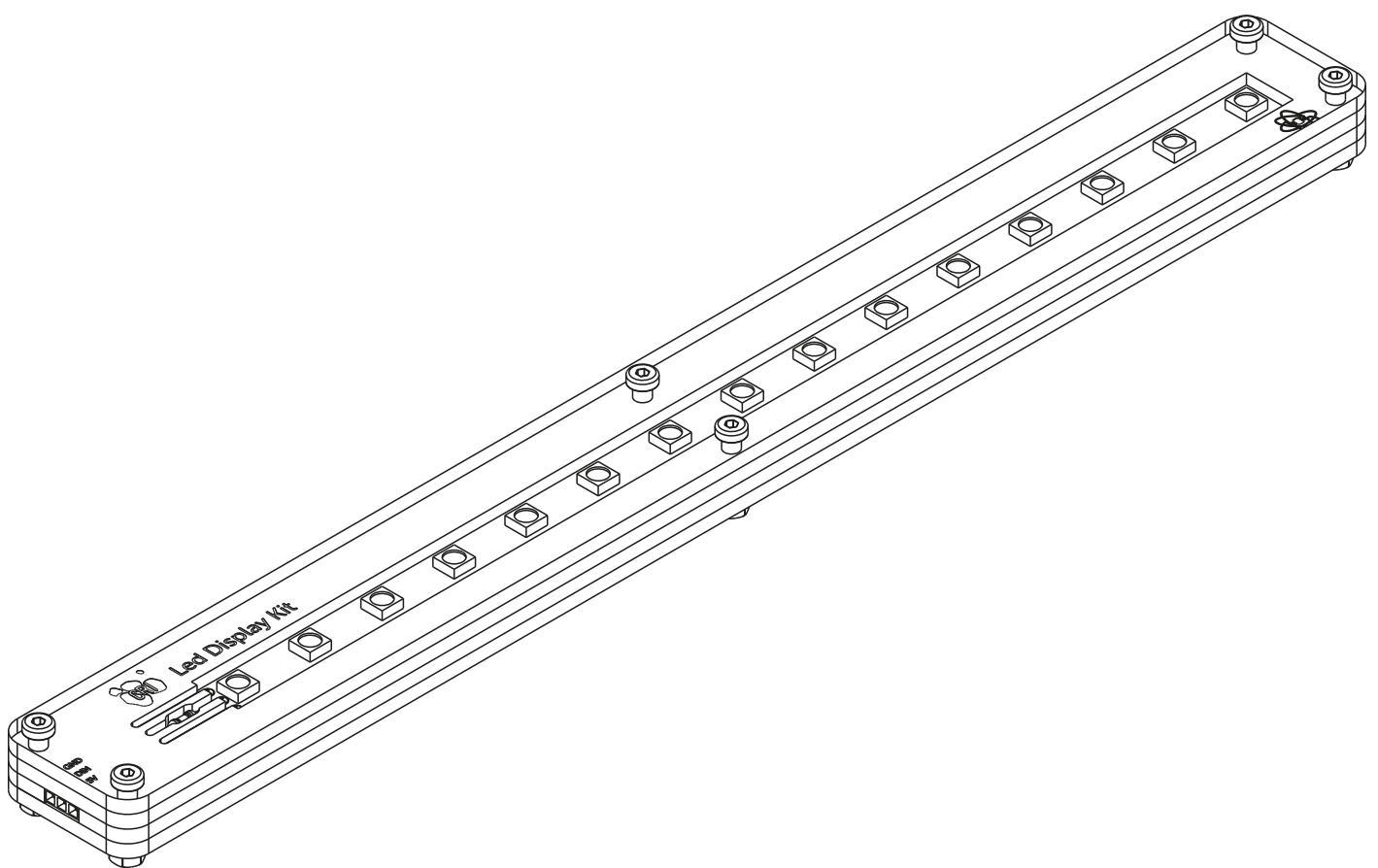
9**3**

3



Just screw the minimum to keep the system in place.
The conductive foam should act as a spring.



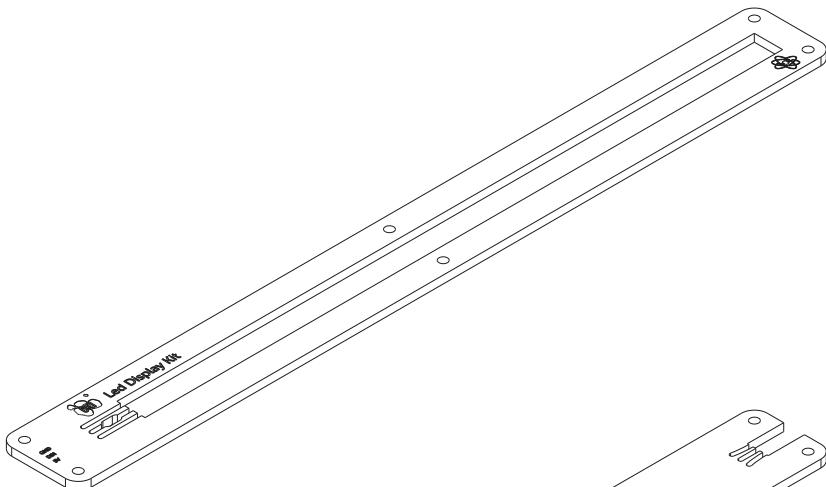


LED DISPLAY

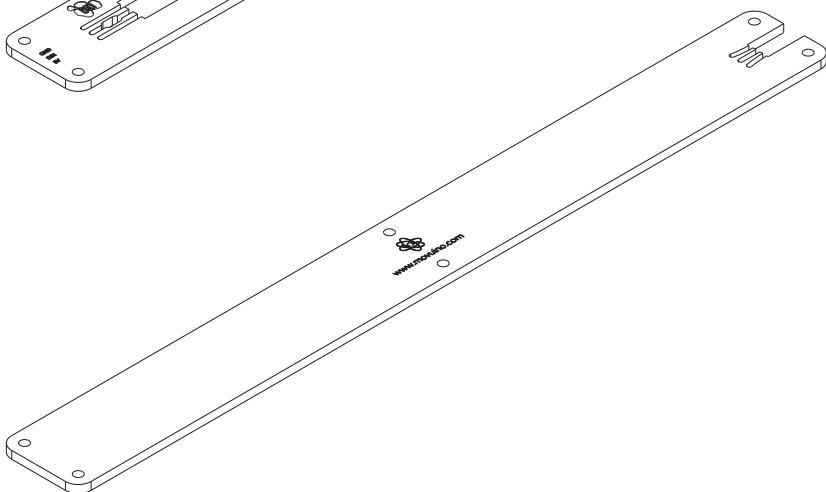
TO LASER CUT

• Plywood

3mm thick



A1 x1 Front panel



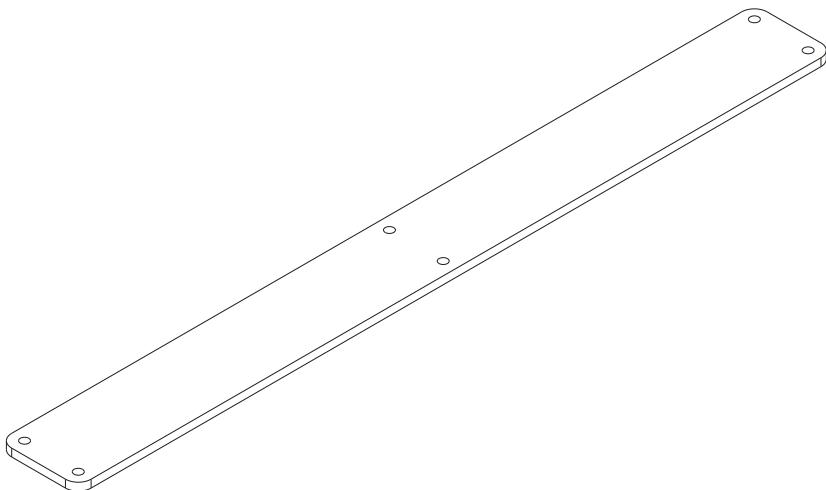
A2 x1 Back panel



SensorsKit/01_MakingRessources/LedDisplay/LedDisplay_LaserCut_Plywood.svg

• Plexyglass

3mm thick

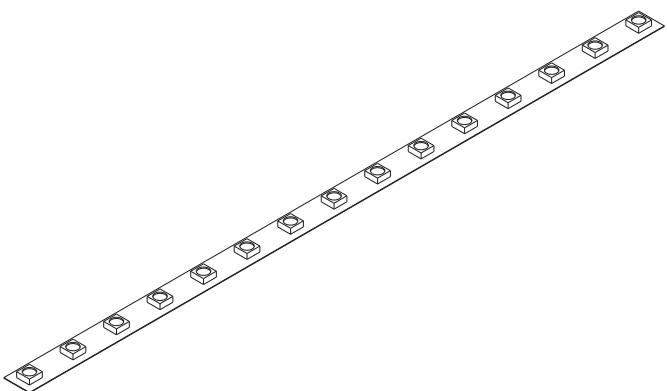


B x2 Case

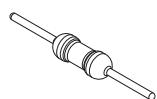


SensorsKit/01_MakingRessources/LedDisplay/LedDisplay_LaserCut_Plexyglass.svg

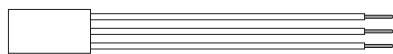
TO BUY



C1 x1 Neopixel RGB Led strip



C2 x1 470 Ohm resistor



C3 x1 3 female input jumper wire



C4 x4 M3 16mm CHC screws



C5 x4 M3 Serrated washers

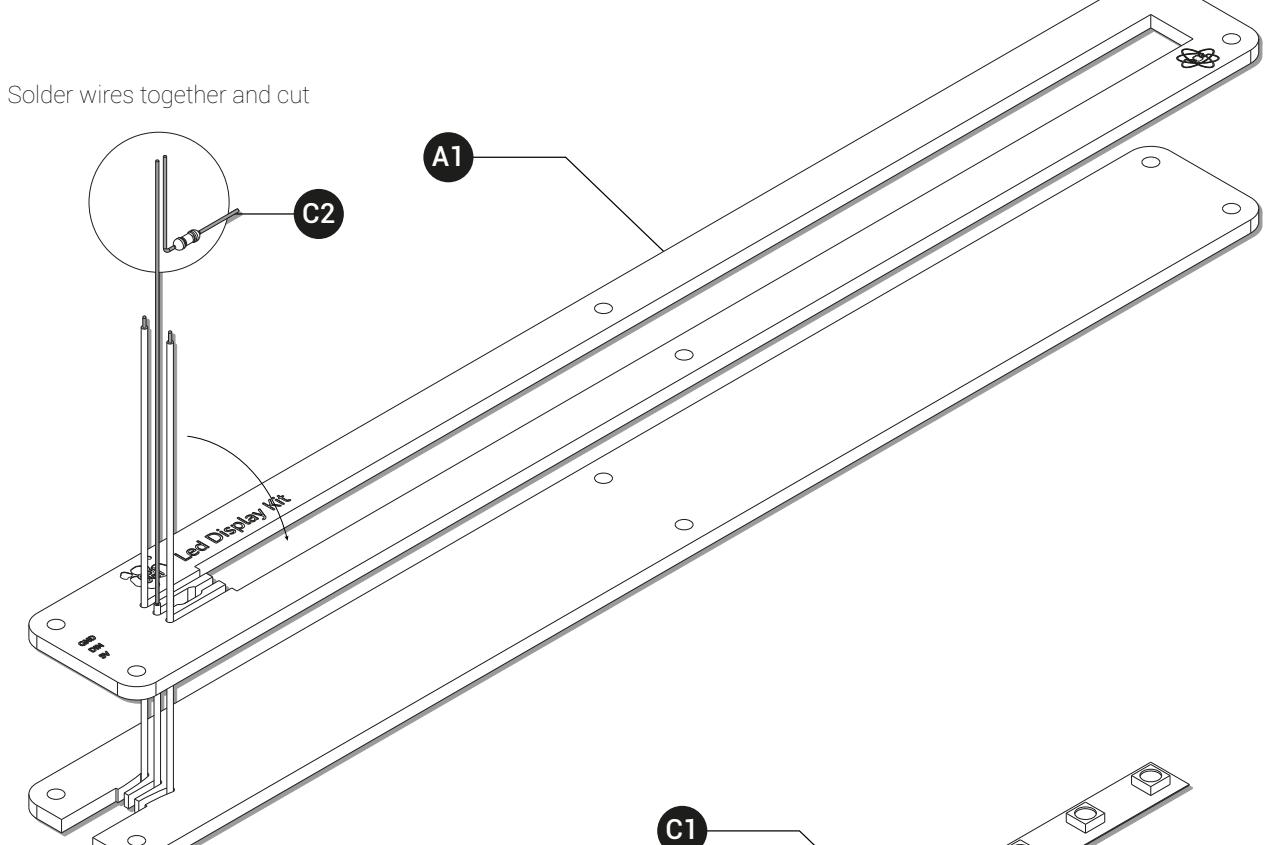


C6 x4 M3 Nuts

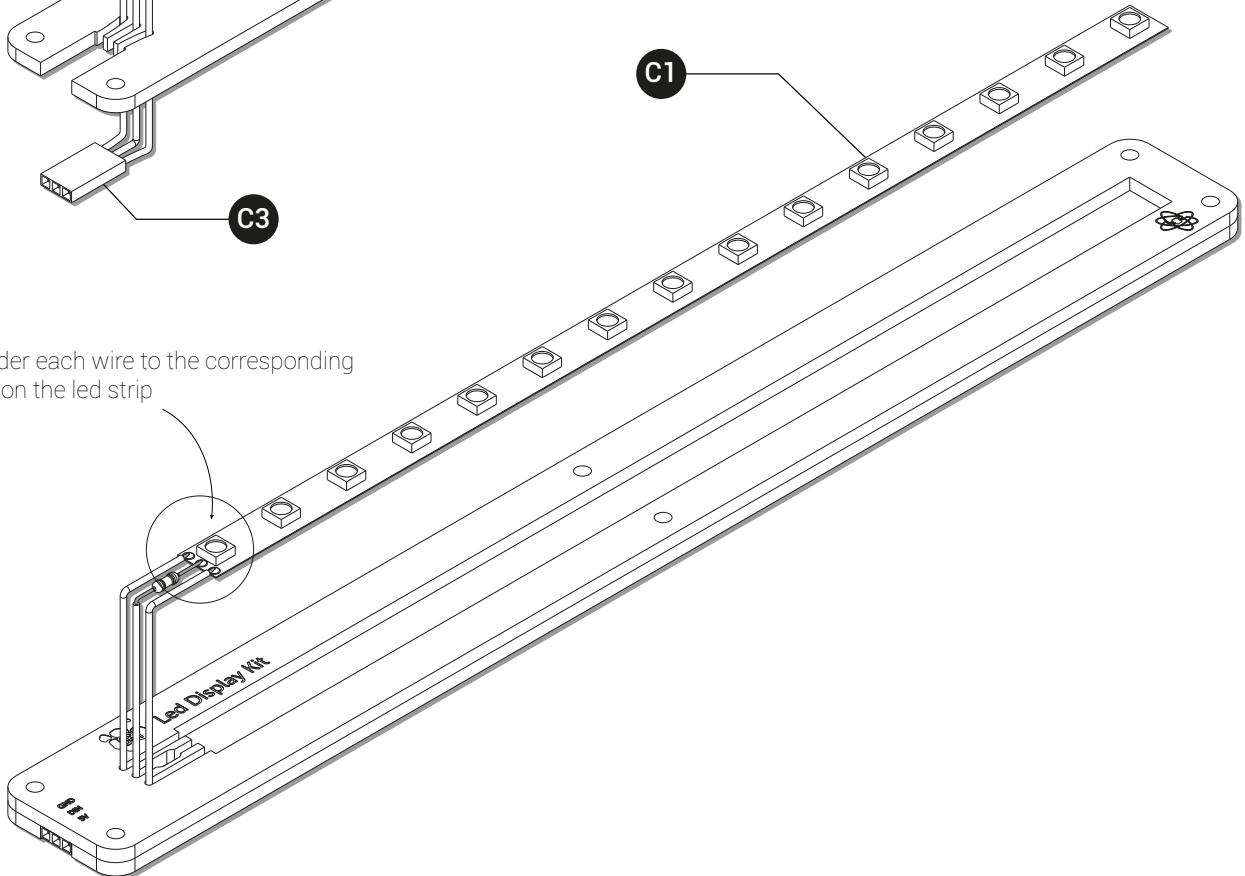
ASSEMBLY

LED DISPLAY

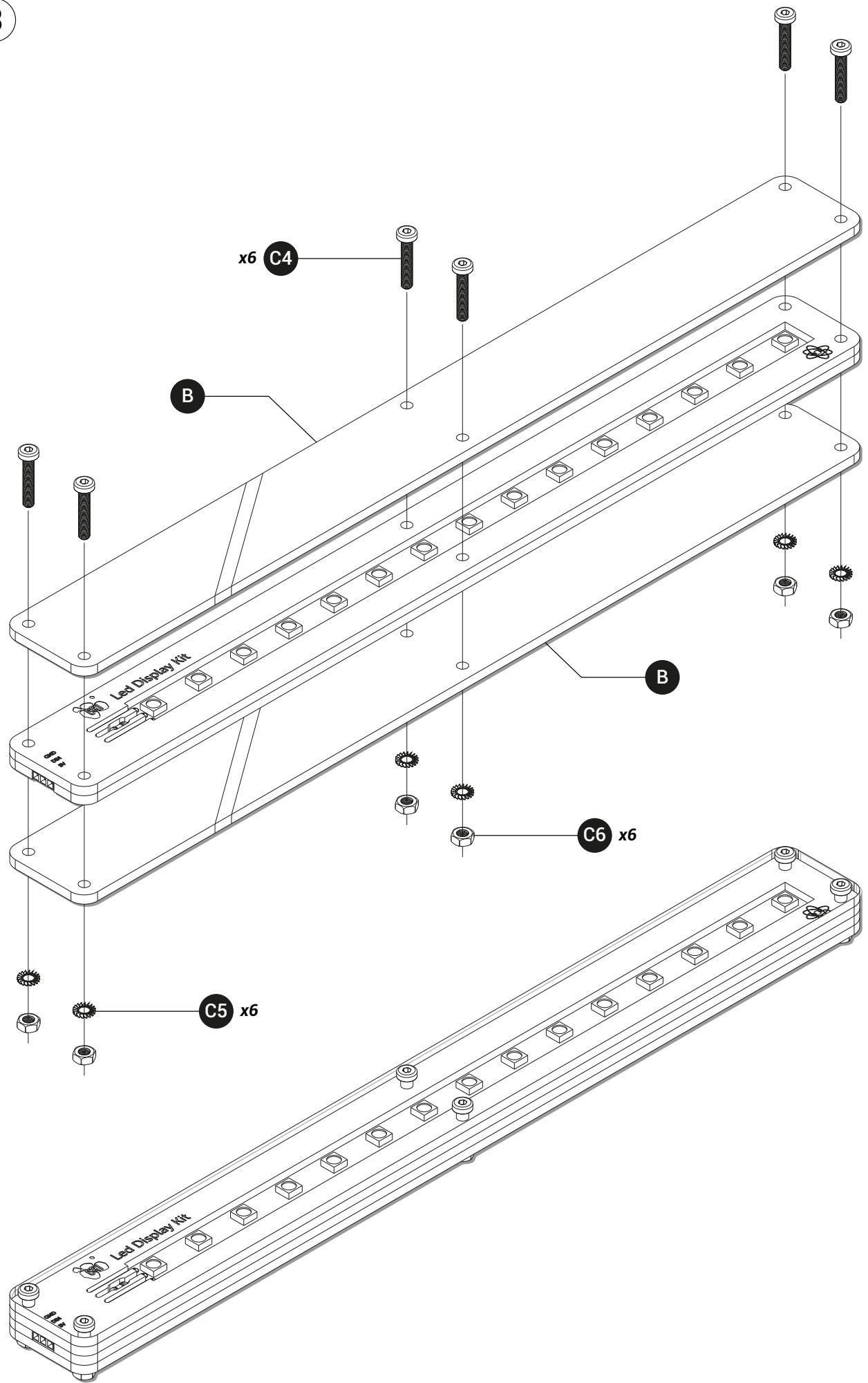
7



Solder each wire to the corresponding pin on the led strip

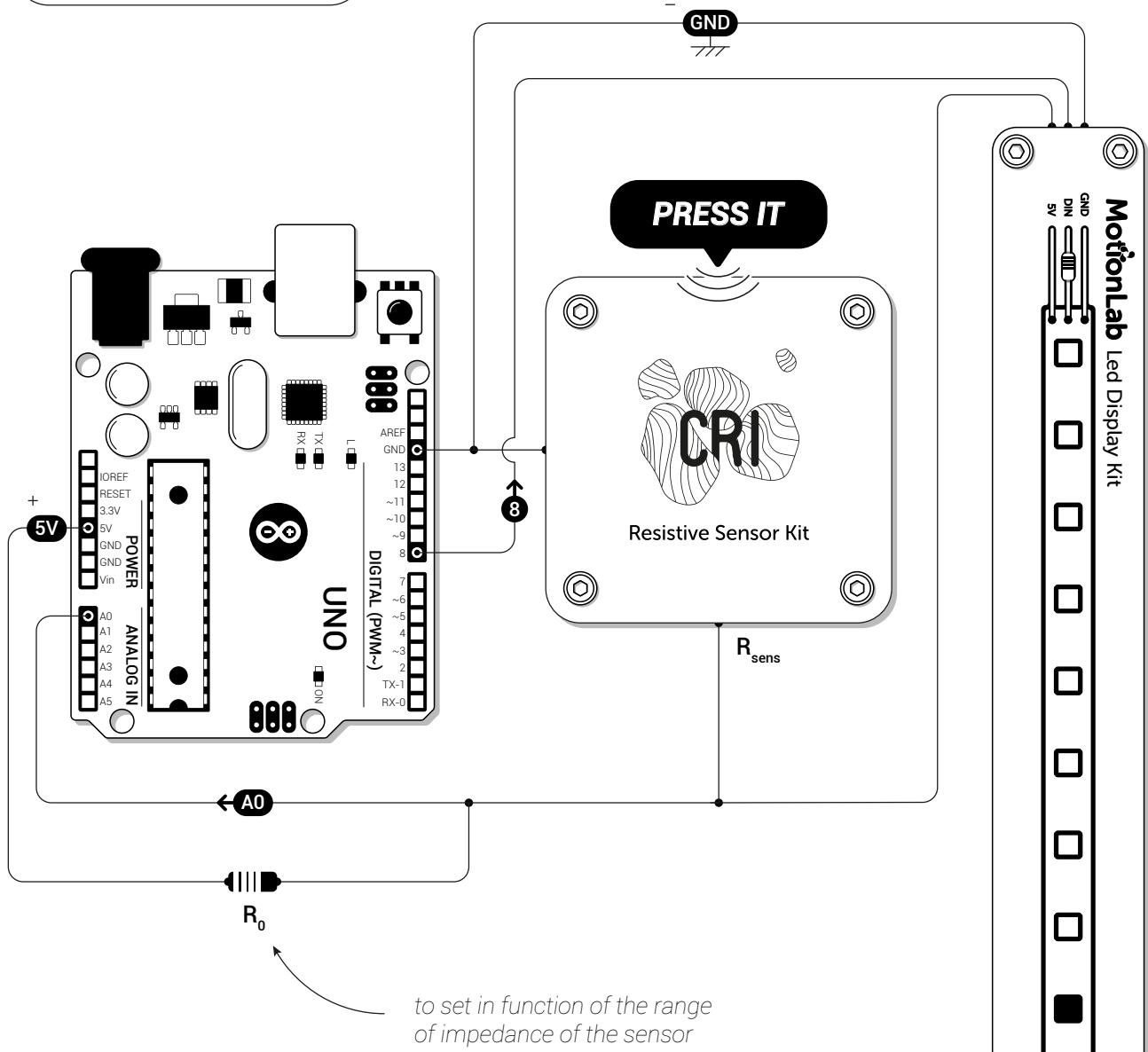


3



VOLTAGE DIVIDER

DEMO



Load Arduino program from...

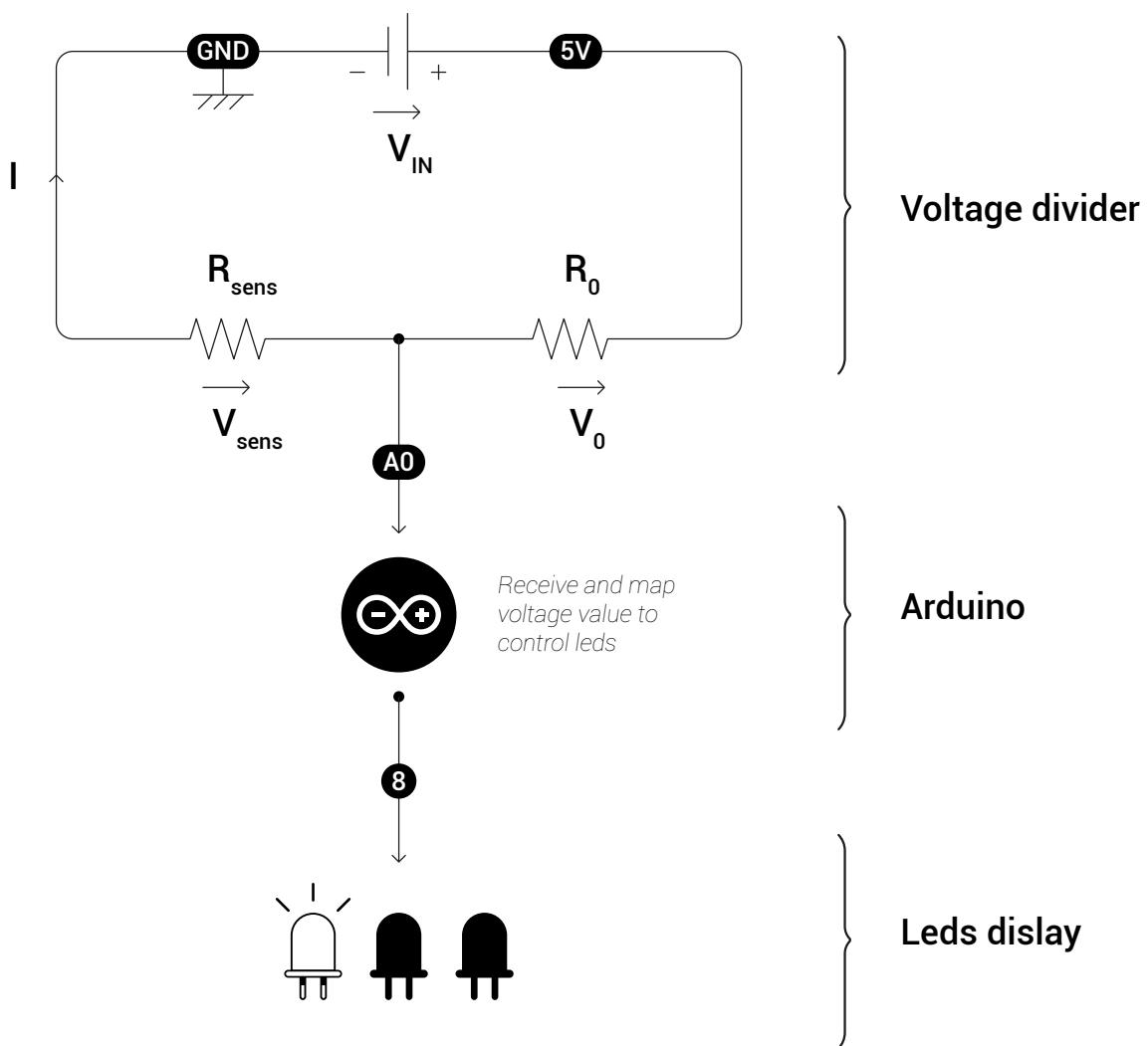
ElectricSensorsKit/02_ArduinoFirmware/ResistiveDisplay/ResistiveDisplay.ino

This program highlights **voltage divider**'s application.

By pressing the **Resistive Sensor Kit** with your hand, you see the led strip reacting in function of the amount of pressure you apply.

The **Resistive Sensor Kit** acts like a **variable resistance**, the more you press it, the more the current pass through the resistive foam and so the more its inner resistance decreases.

PRINCIPLE



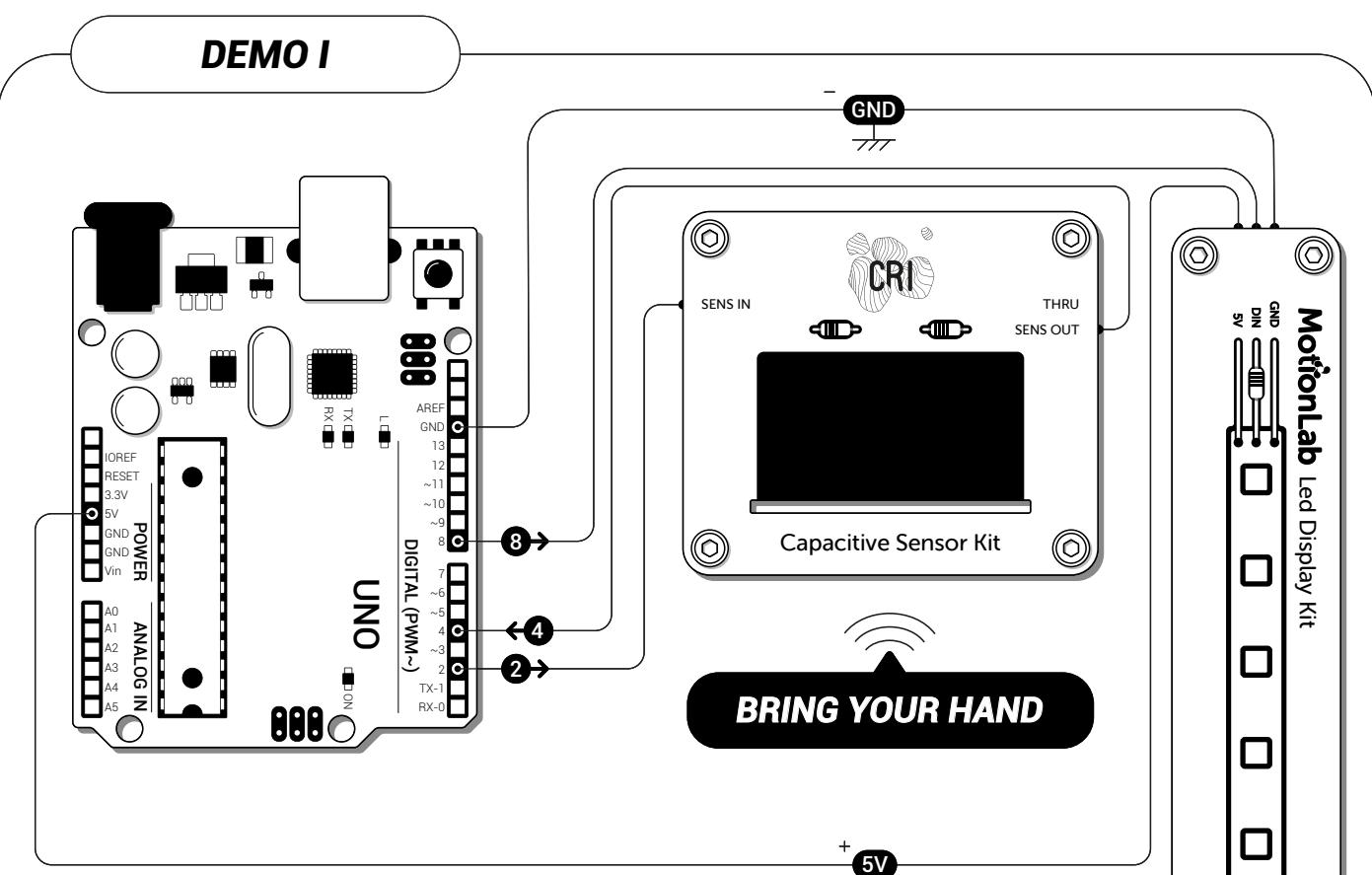
FORMULA

$$\left. \begin{aligned}
 V_{\text{IN}} &= V_0 + V_{\text{sens}} \\
 V_0 &= I_0 \cdot R_0 \\
 V_{\text{sens}} &= I_{\text{sens}} \cdot R_{\text{sens}} = A0 \\
 I &= I_{\text{IN}} = I_0 = I_{\text{sens}}
 \end{aligned} \right\} \Leftrightarrow A0 = \frac{R_{\text{sens}}}{R_0 + R_{\text{sens}}} \cdot V_0$$

$$\Leftrightarrow R_{\text{sens}} = \frac{V_{\text{IN}}}{A0} \cdot R_0 - R_0$$

RC CIRCUIT

DEMO I



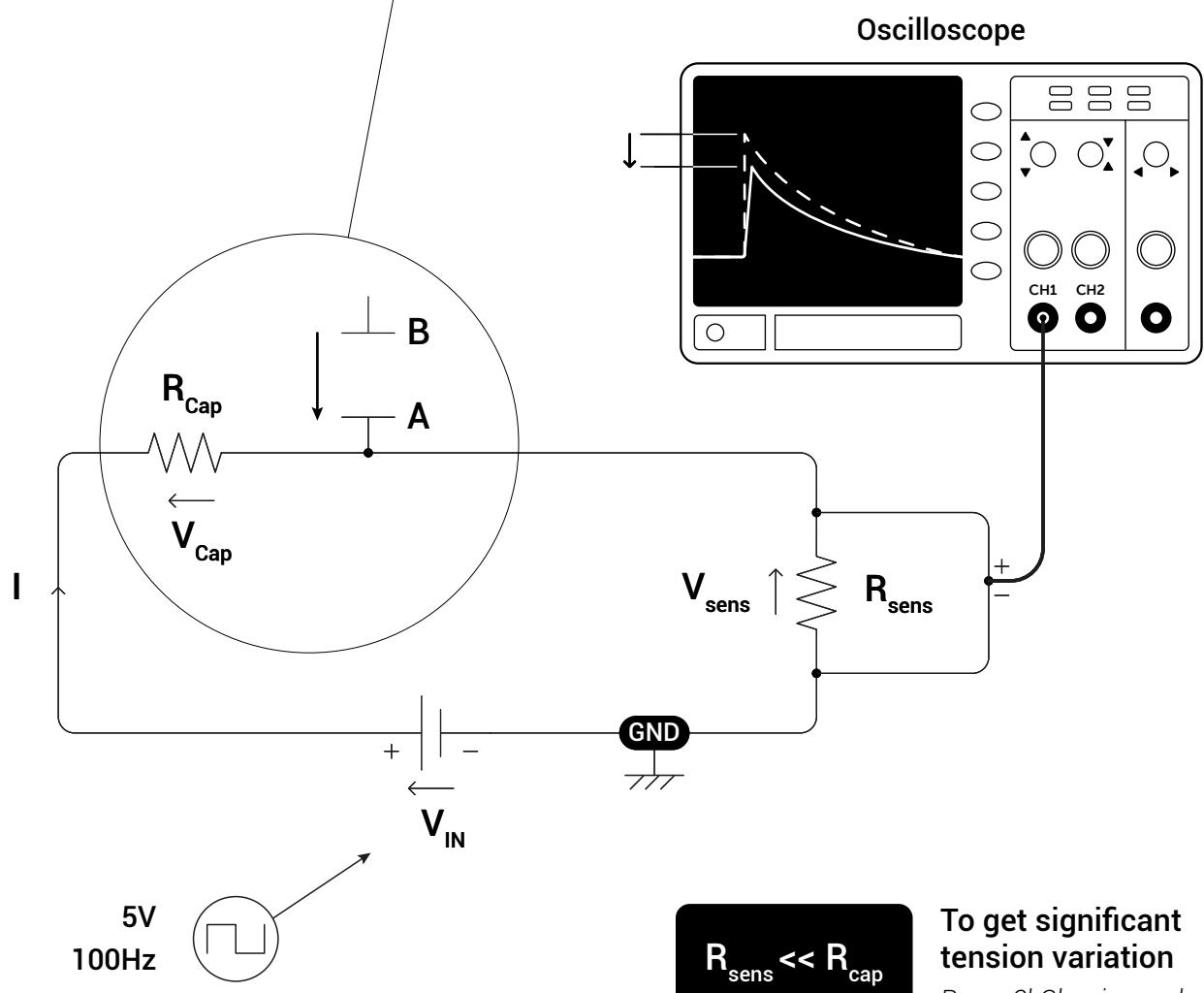
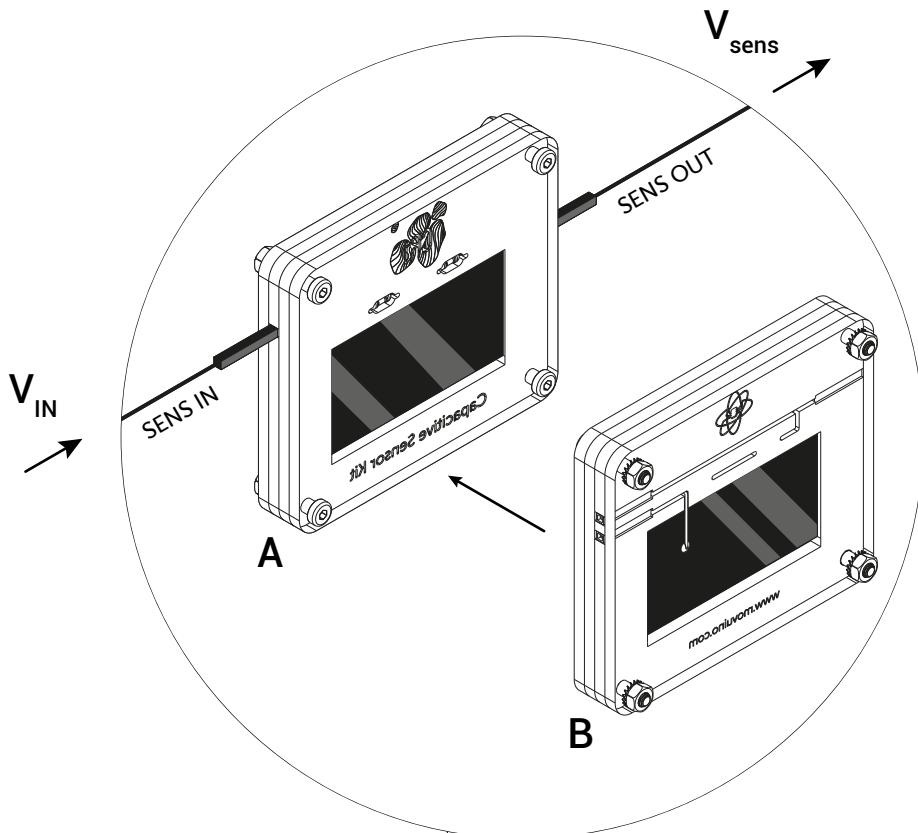
Load Arduino program from...

ElectricSensorsKit/02_ArduinoFirmware/CapacitiveDisplay/CapacitiveDisplay.ino

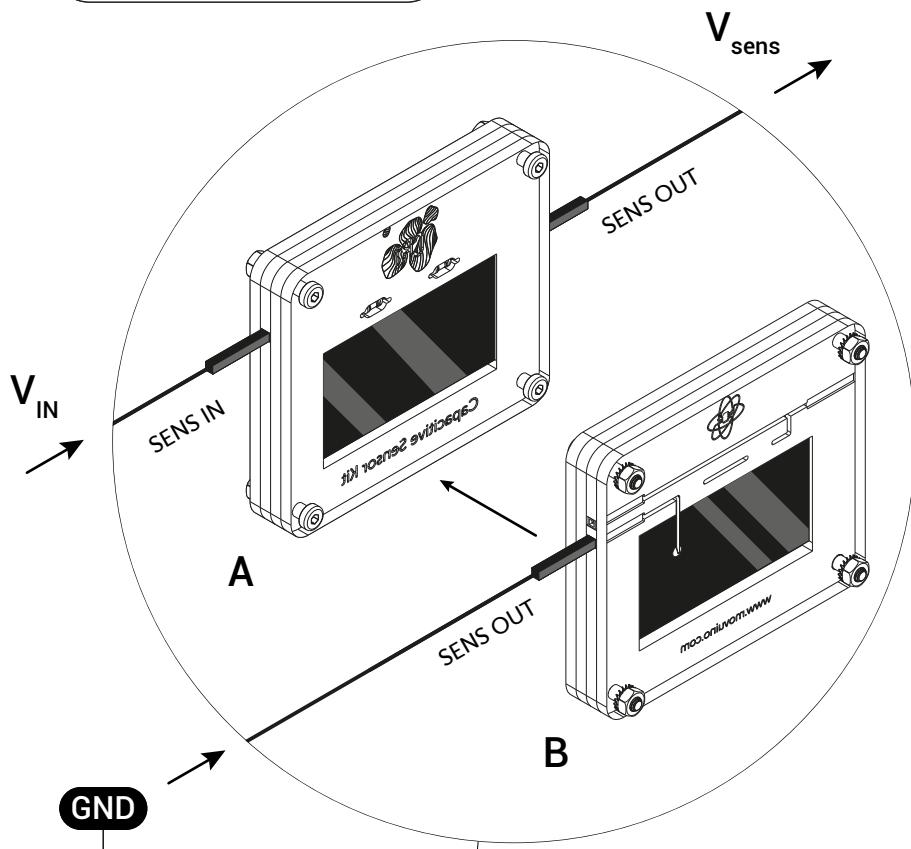
This program highlights **RC circuit**'s application.

By approaching the **Capacitive Sensor** with your hand, you see the led strip reacting in function of the distance to the sensor.

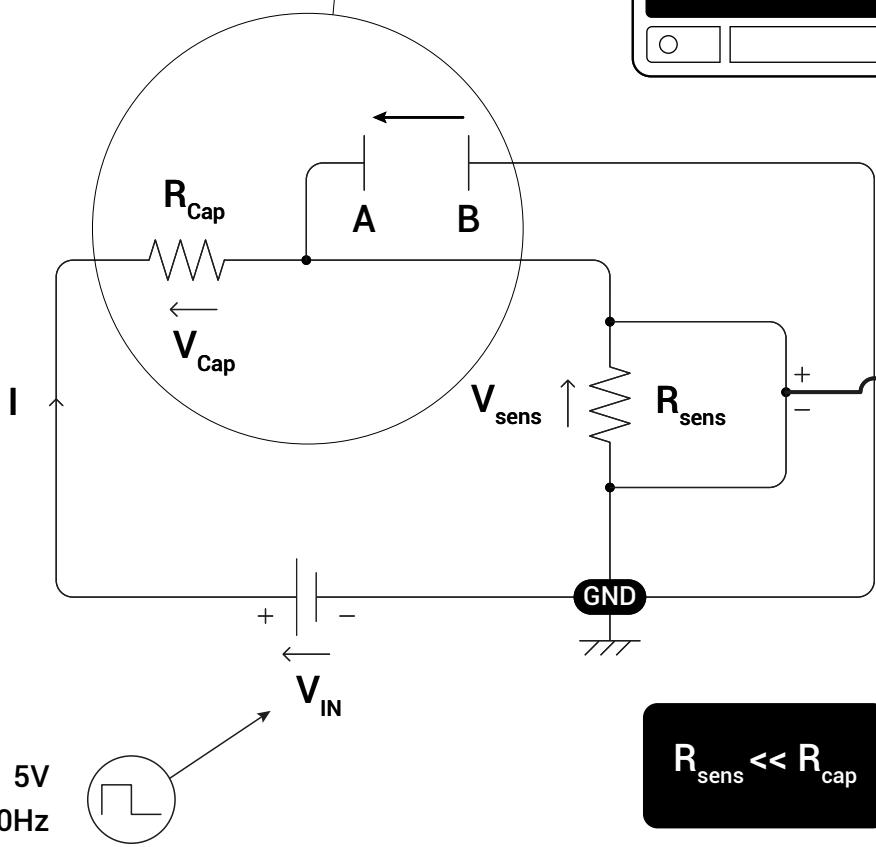
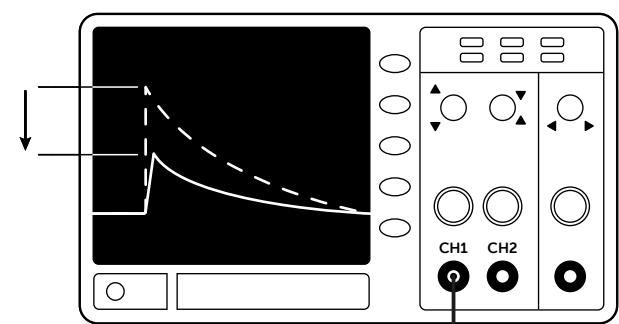
EXPERIENCE I



EXPERIENCE II



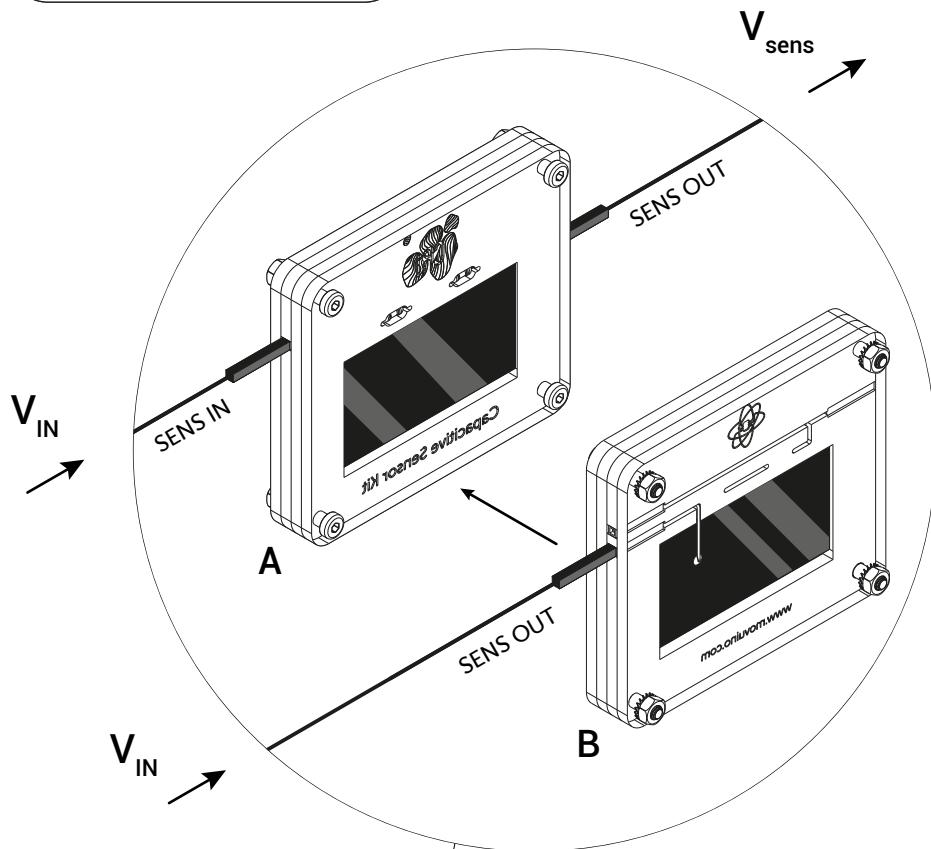
Oscilloscope



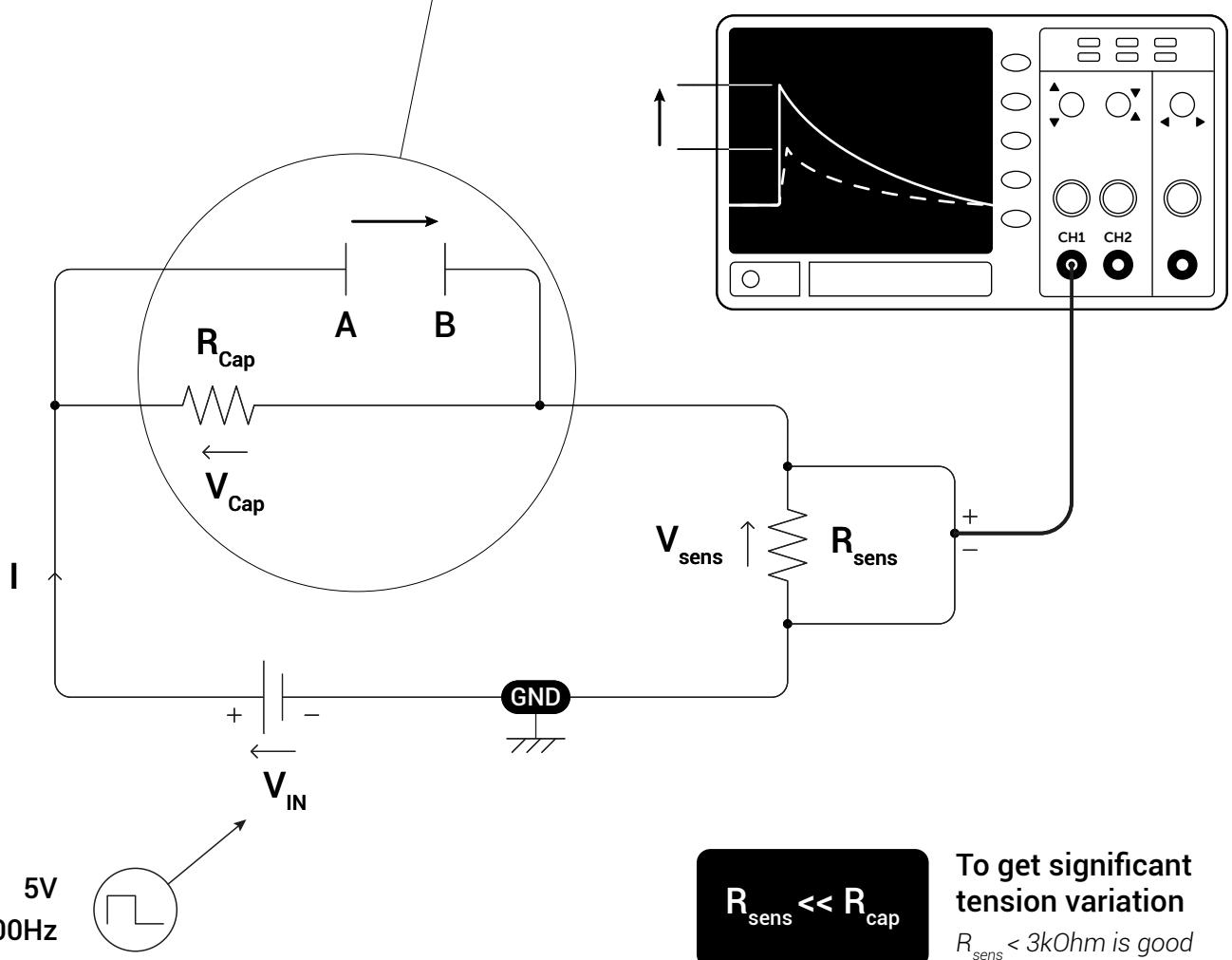
$$R_{\text{sens}} \ll R_{\text{cap}}$$

To get significant tension variation
 $R_{\text{sens}} < 3k\Omega$ is good

EXPERIENCE III



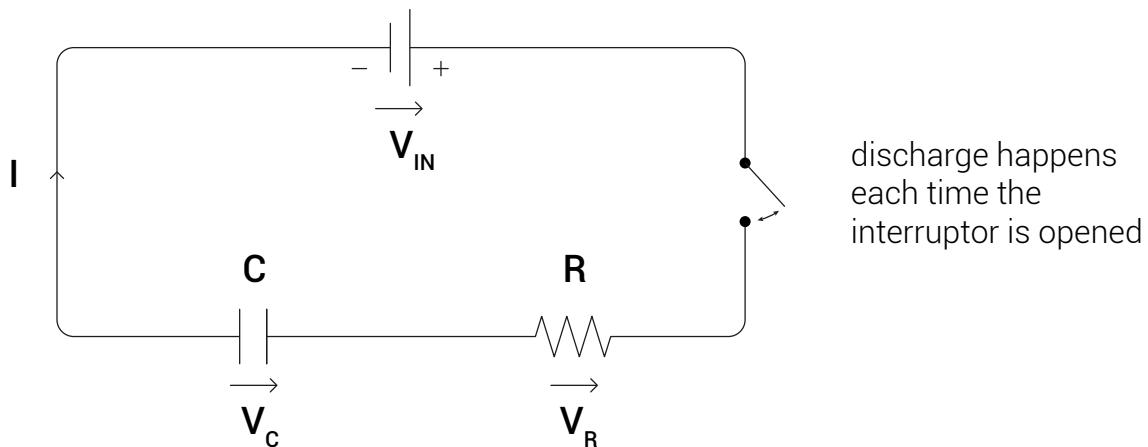
Oscilloscope



PRINCIPLE

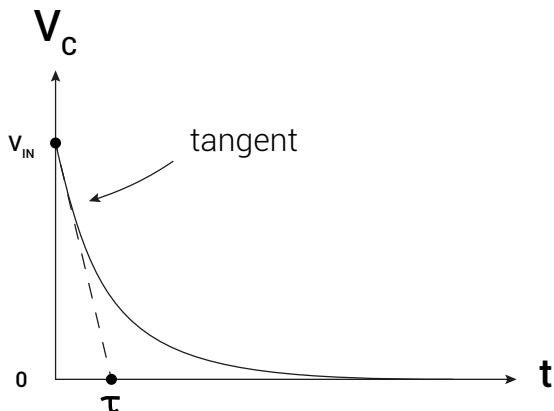
The principle behind those **Demo/Experiences** are based on the **capacitor charging/discharging** phena of an **RC circuit**.

In the **Experiences** part we illustrated the **capacitor discharge**, here are the classical schematic and the formulas related to this circuit.



$$V_c(t) = V_{IN} \cdot e^{-\frac{t}{\tau}}$$

with $\tau = R \cdot C$



The time to load/unload the capacitor is directly related to the **RC constant** of the circuit.

By varying the distance between the 2 capacitive sensors, this modify the **C** constant **which affects its load/unload time reaction**.

In the **Demo** part, the interruptor is replaced by the pin 2 which simulate a **square tension generator** as you can use in the **Experimente** part.

Then the **Arduino** calculates the time to reach a significant tension value on its pin 4 and thus can give an estimation of **C** variations reflecting the variations of distance between the 2 capacitive sensors.

