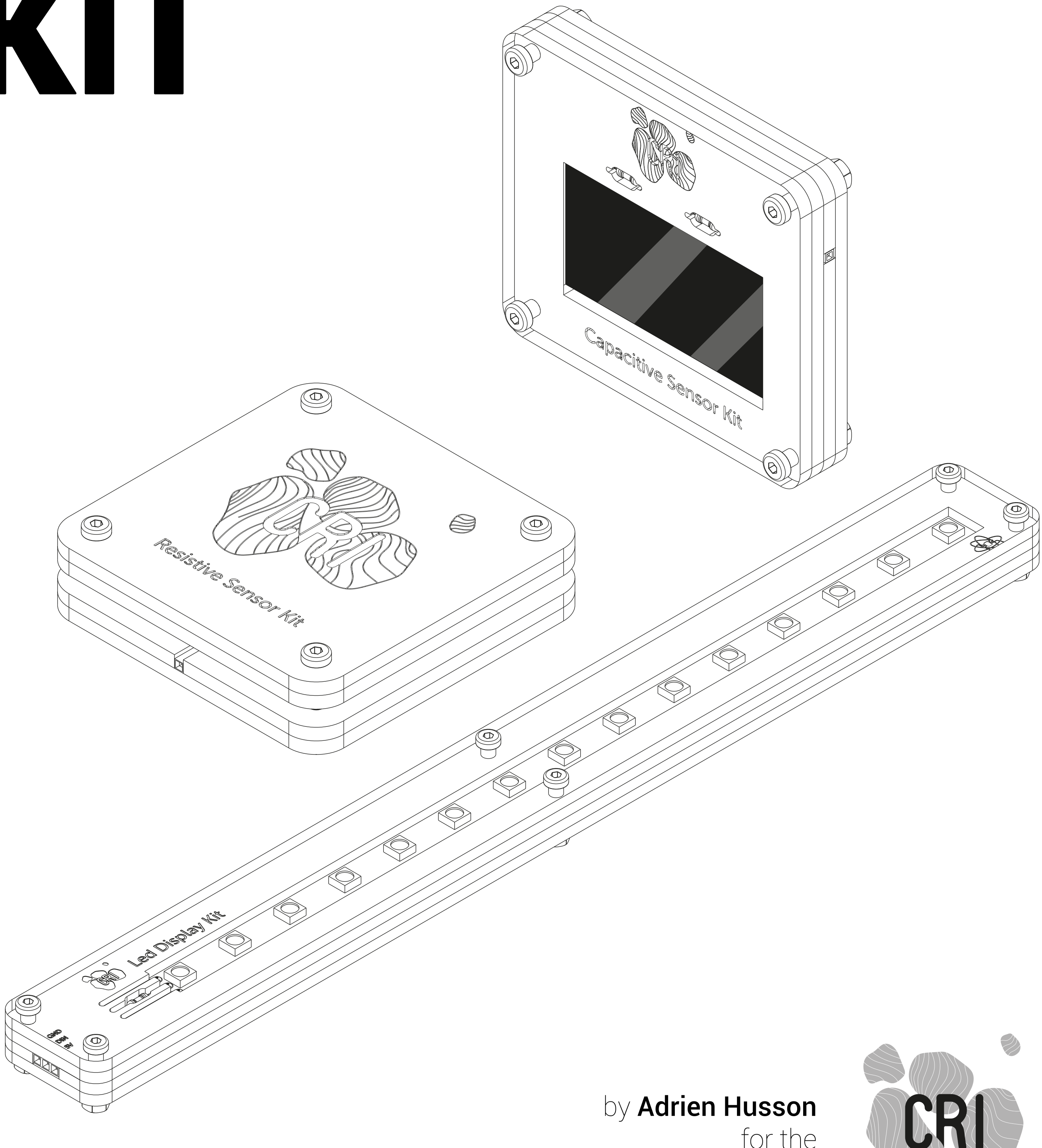
HOW TO BUILD

SENSORS KIT



by **Adrien Husson**
for the CRI

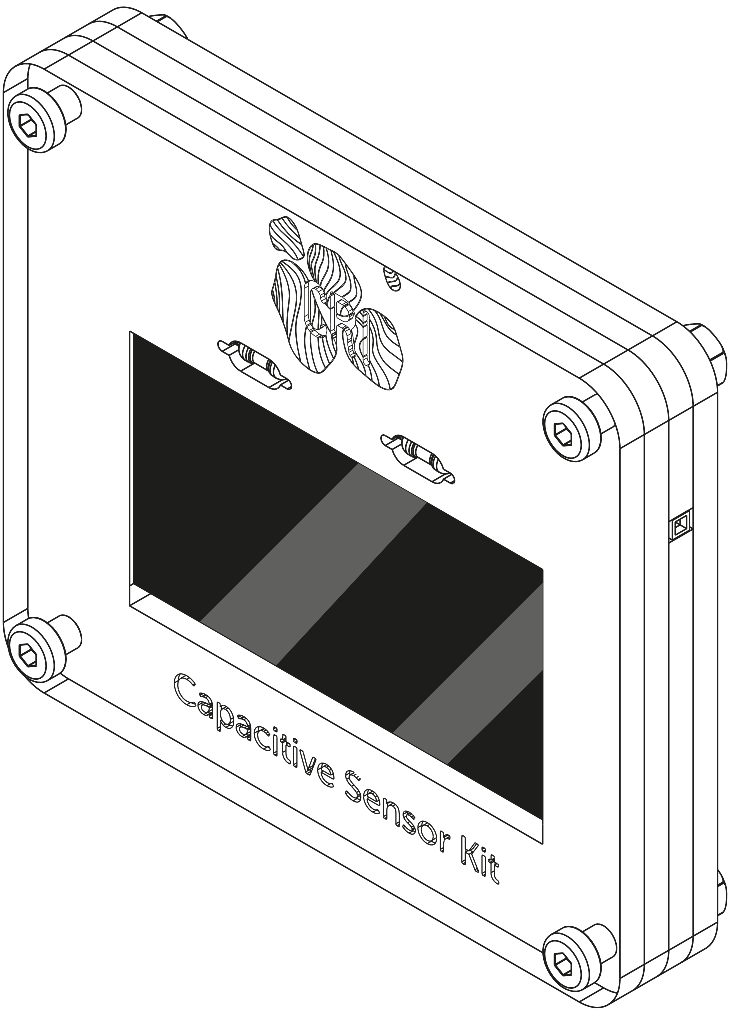
This manual refers to the **Sensors Kit** project and is part of the **Movuino** documentation.

Project presentation:

http://www.movuino.com/index.php/portfolio/sensors-kit/

All files of the project can be found on:

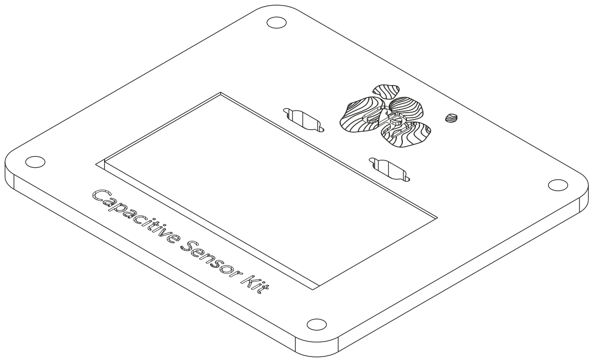
https://github.com/hssnadr/SensorsKit



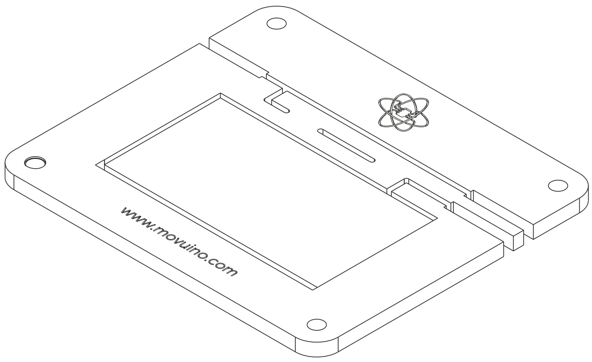
CAPACITIVE SENSOR

TO LASER CUT

Plywood — 3mm thick



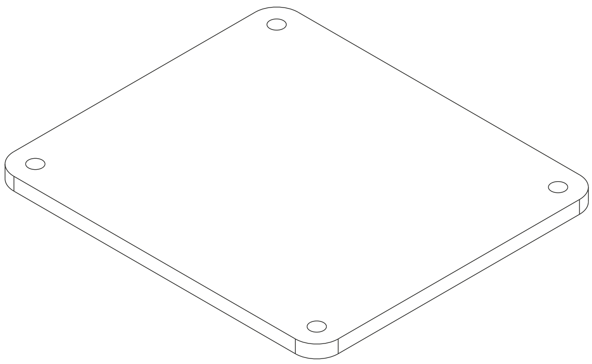
A1 ***x1*** **Front panel**



A2 ***x1*** **Back panel**

SensorsKit/01_MakingRessources/CapacitiveSensor/CapacitiveSensor_Plywood.svg

Plexyglass — 3mm thick

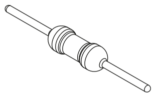


B ***x2*** **Case**

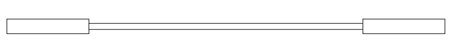
SensorsKit/01_MakingRessources/CapacitiveSensor/CapacitiveSensor_Plexyglass.svg

TO BUY

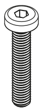
C1 ***x1*** Copper tape



C2 ***x2*** 10kOhm resistors (R_{cap})



C3 ***x2*** Female to female jumper wires



C4 ***x4*** M3 16mm CHC screws

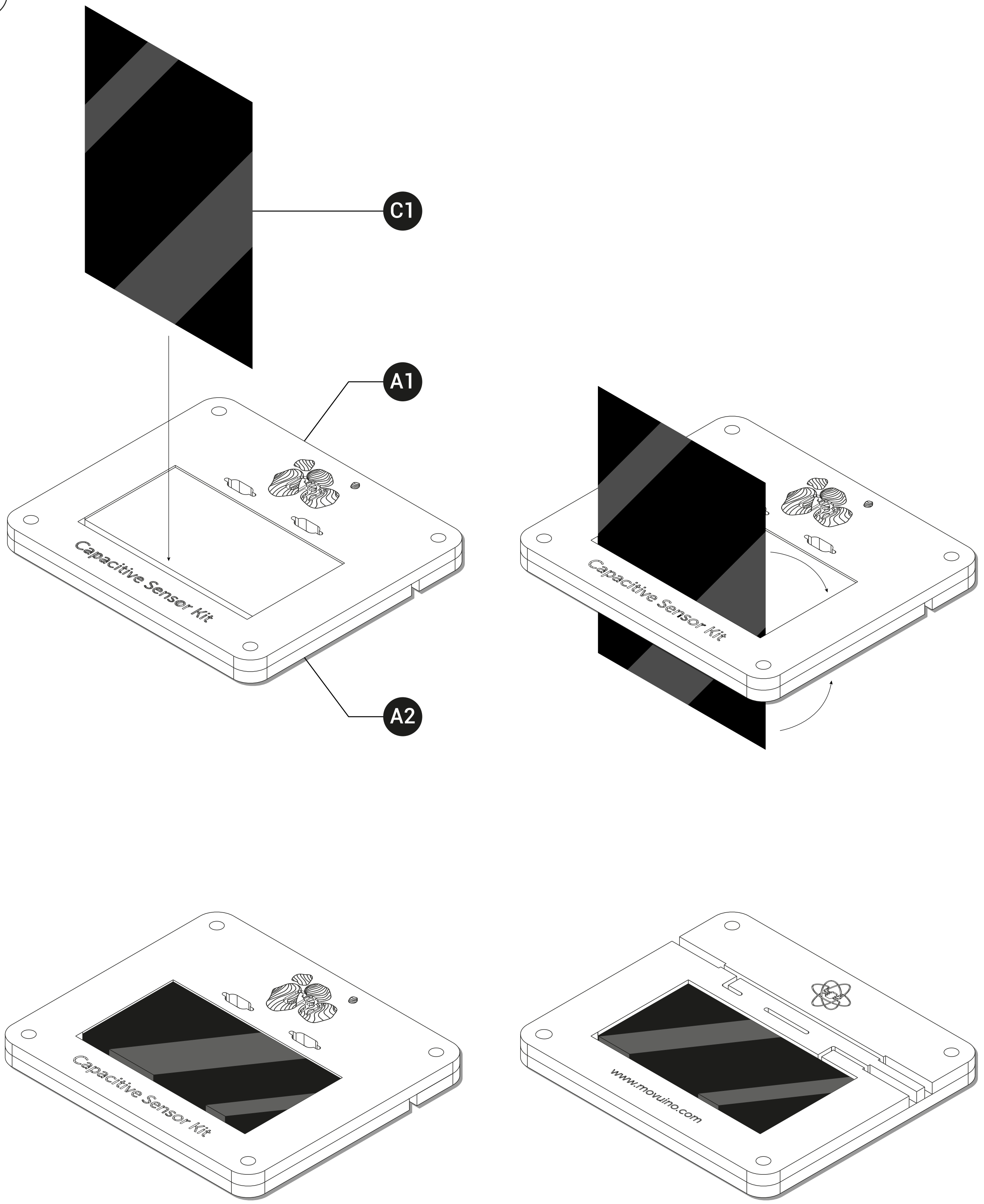
C5 ***x4*** M3 Serrated washers

C6 ***x4*** M3 Nuts

ASSEMBLY

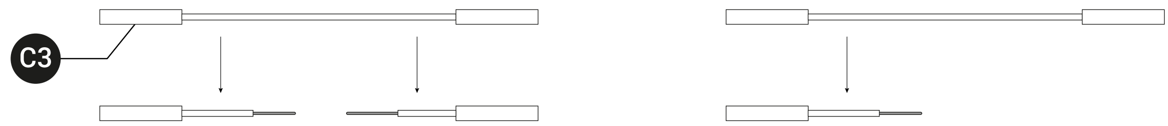
CAPACITIVE SENSOR

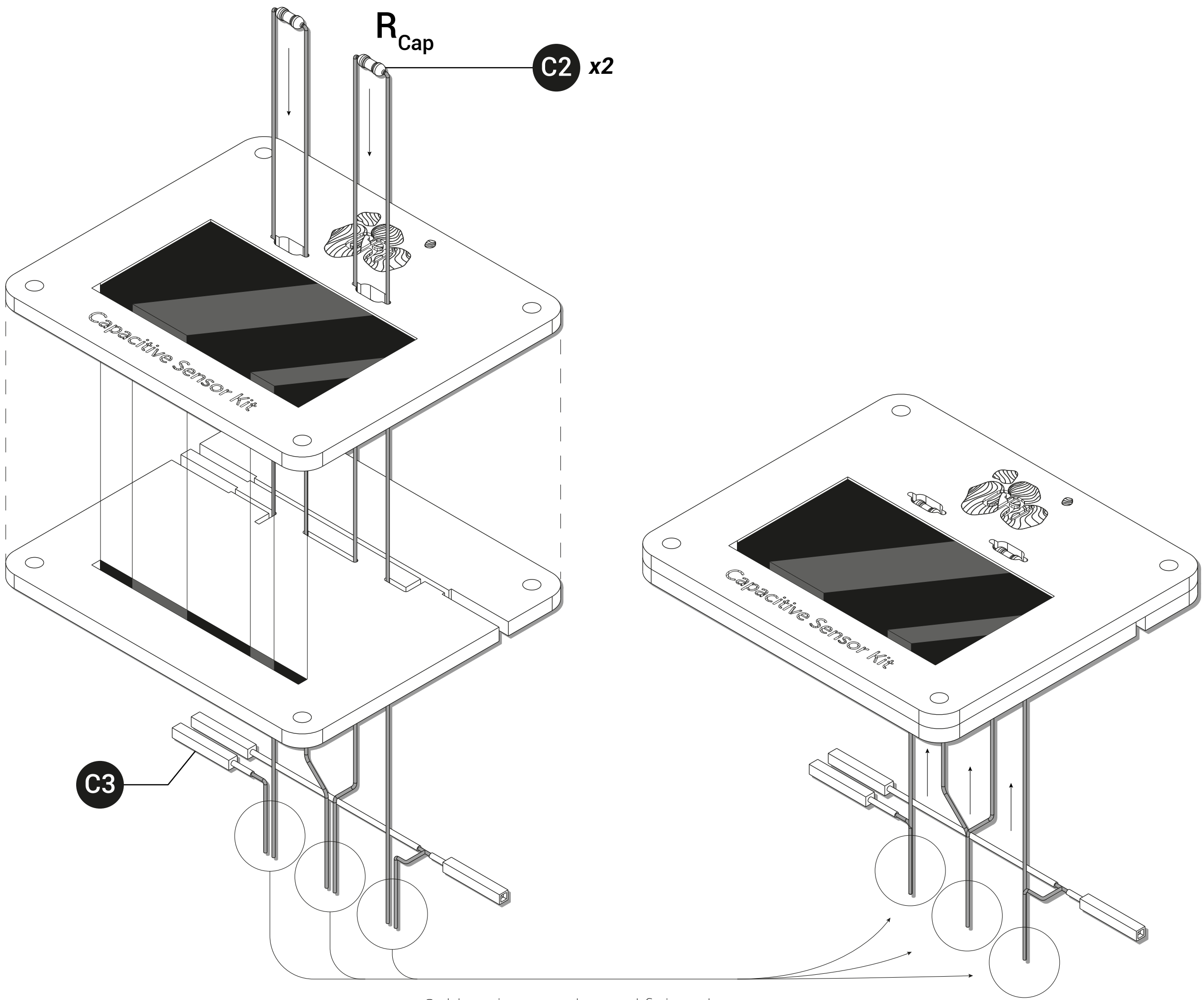
1



2

Cut the wires insulation to get the inner cables

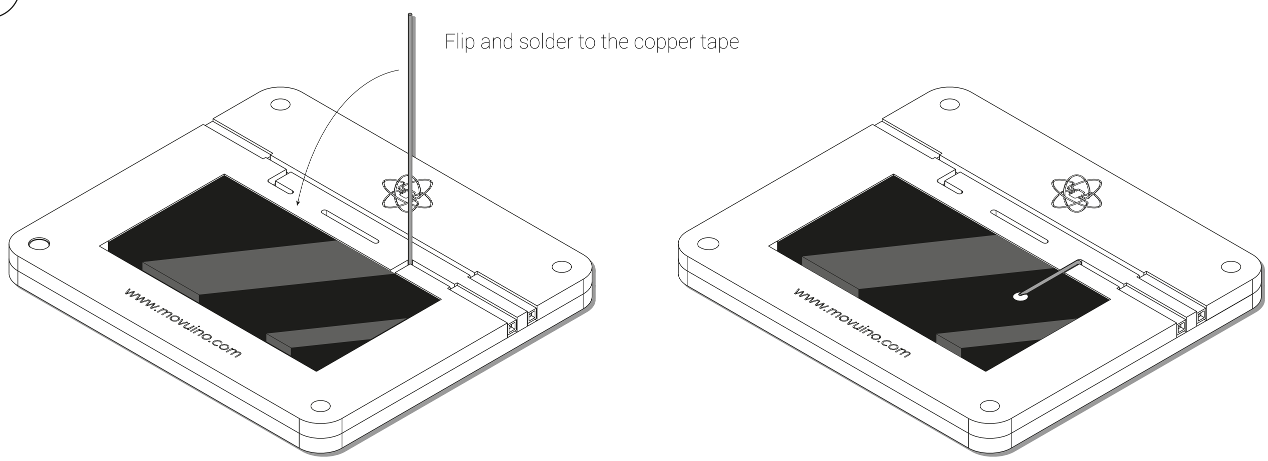


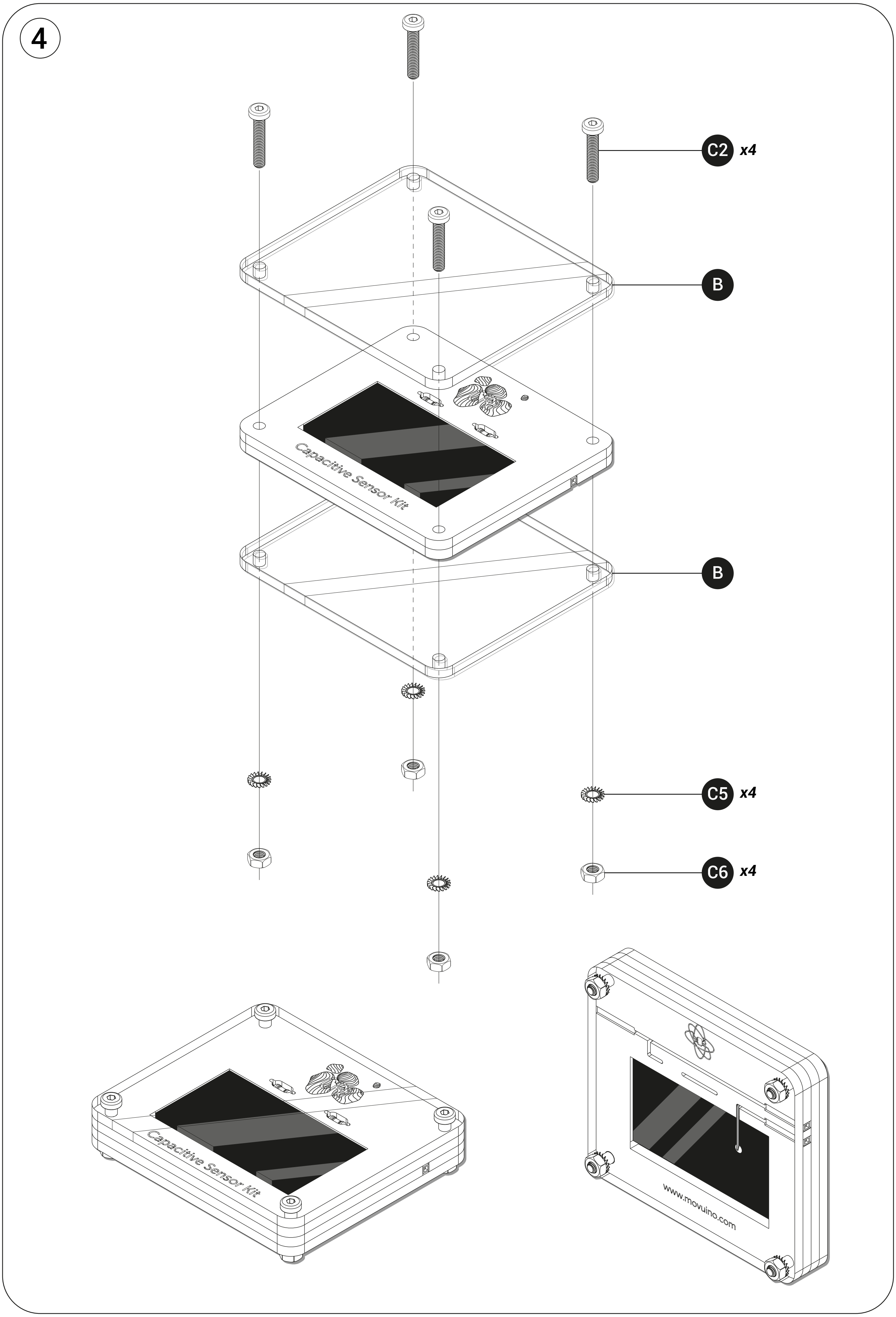


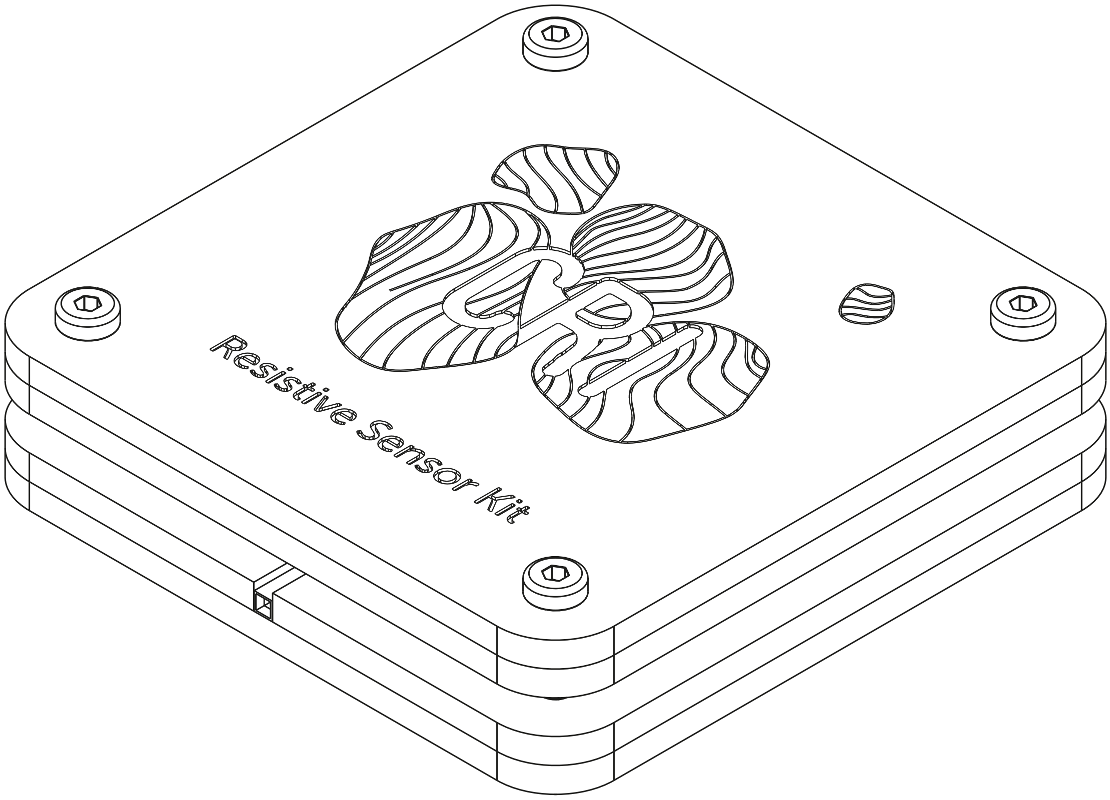
Solder wires together and fit into the case

3

Flip and solder to the copper tape



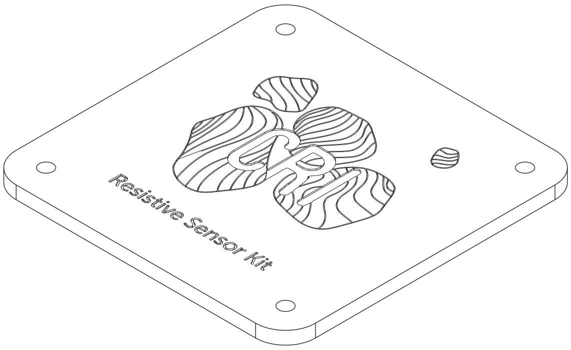

4
C2 x4
B
B
C5 x4
C6 x4
Capacitive Sensor Kit
Capacitive Sensor Kit
www.movuino.com



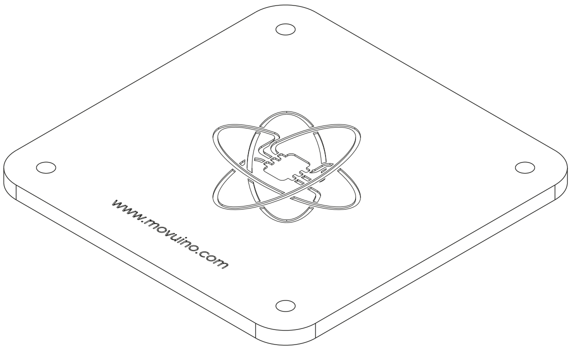
RESISTIVE SENSOR

TO LASER CUT

Plywood — 3mm thick



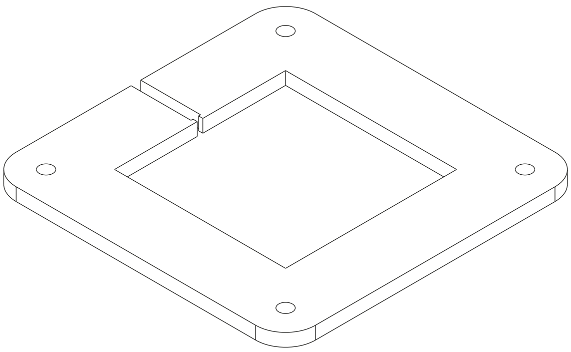
A1 ***x1*** **Front panel**



A2 ***x1*** **Back panel**

SensorsKit/01_MakingRessources/ResistiveSensor/ResistiveSensor_Plywood.svg

Plexyglass — 3mm thick

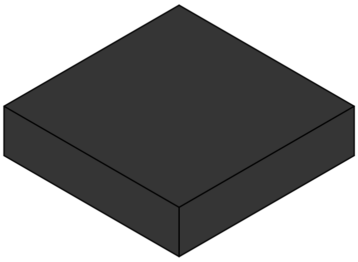


B ***x2*** **Footprint**

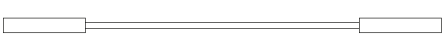
SensorsKit/01_MakingRessources/ResistiveSensor/ResistiveSensor_Plexyglass.svg

TO BUY

C1 *x2* Copper tape



C2 *x1* Conductive foam



C3 *x1* Female to female Dupont wire

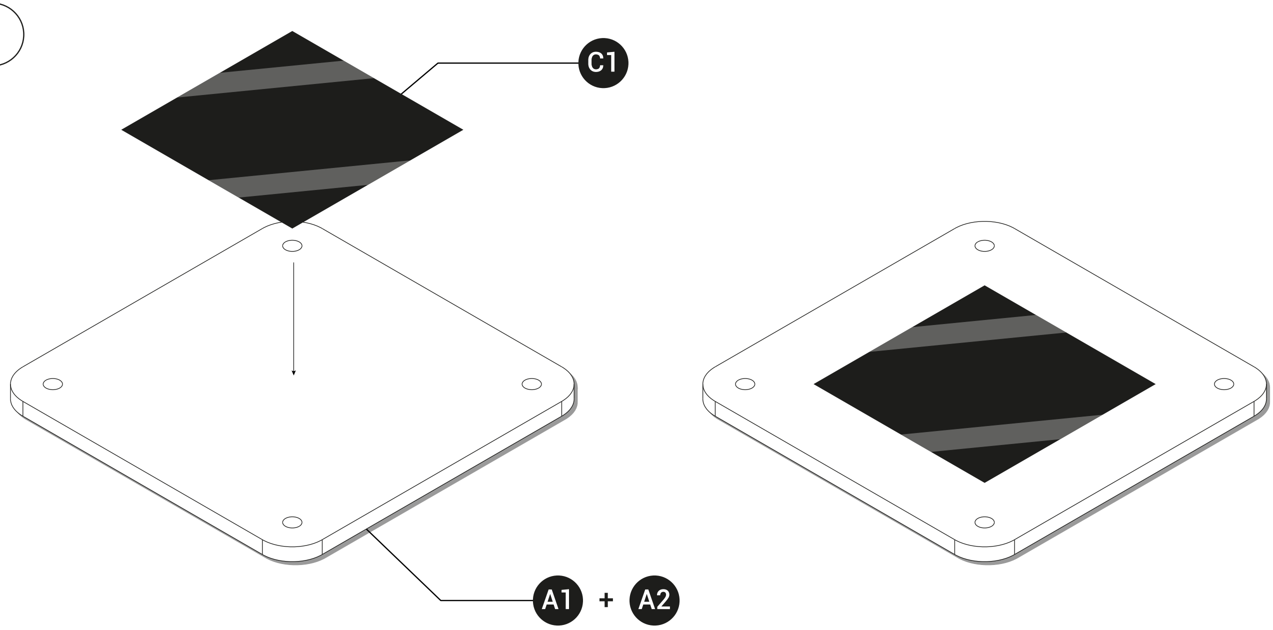
C4 *x4* M3 20mm CHC screws

C5 *x4* M3 Locknuts

ASSEMBLY

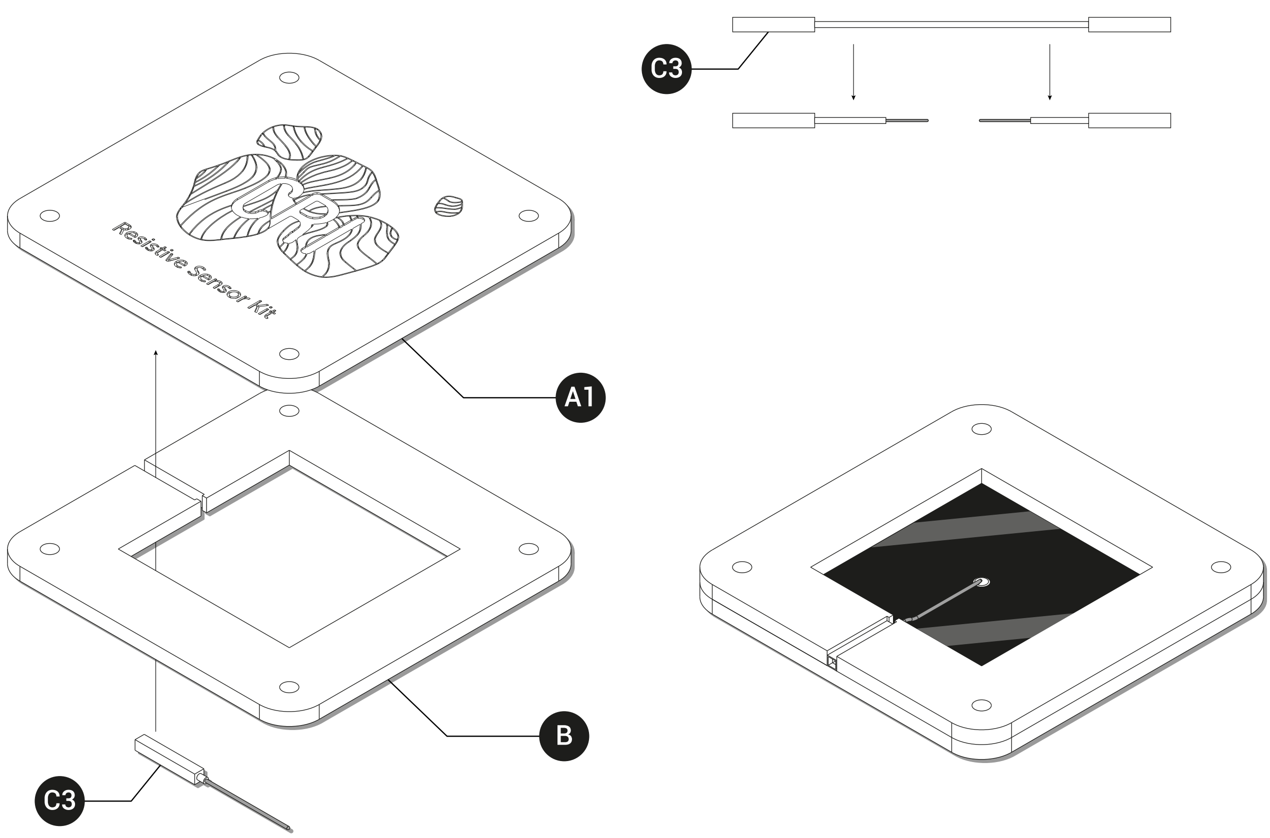
RESISTIVE SENSOR

1

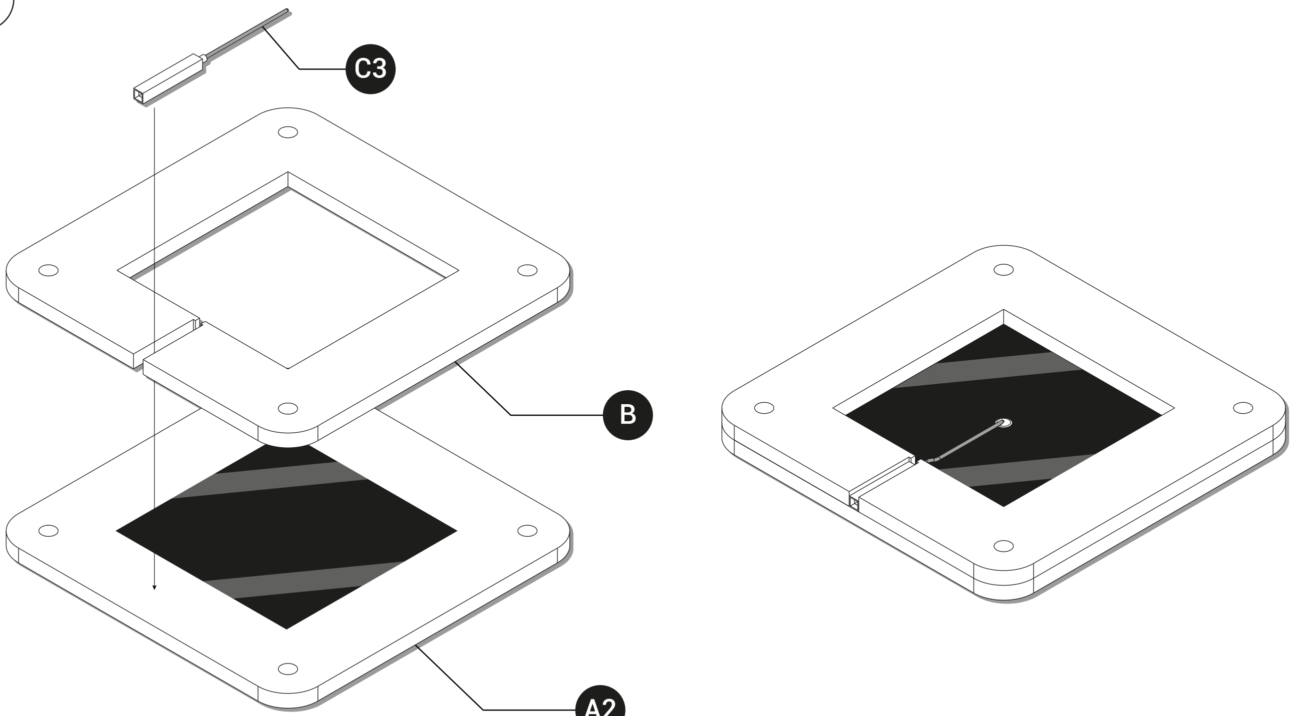


2

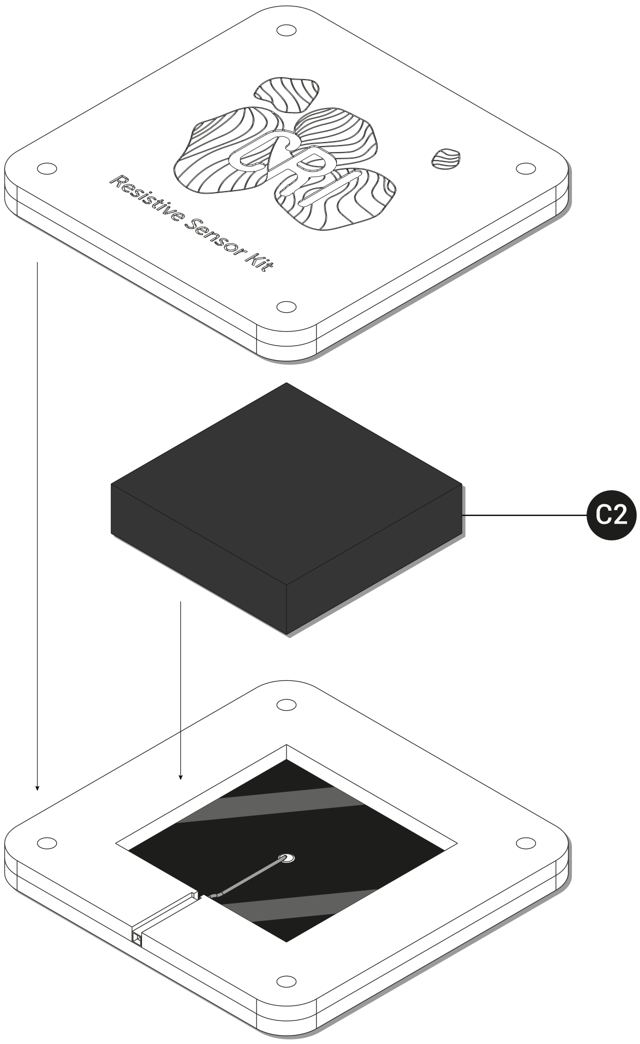
Cut the wires insulation to get the inner cables



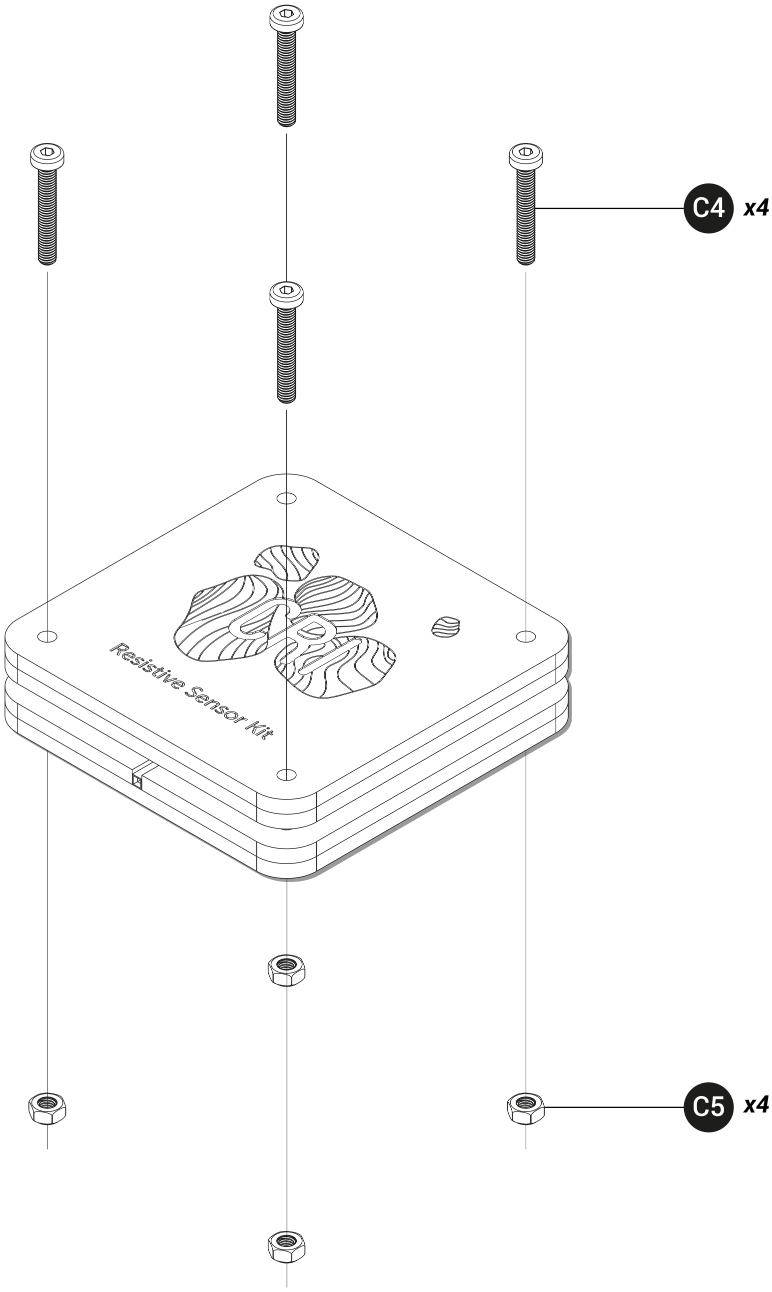
3

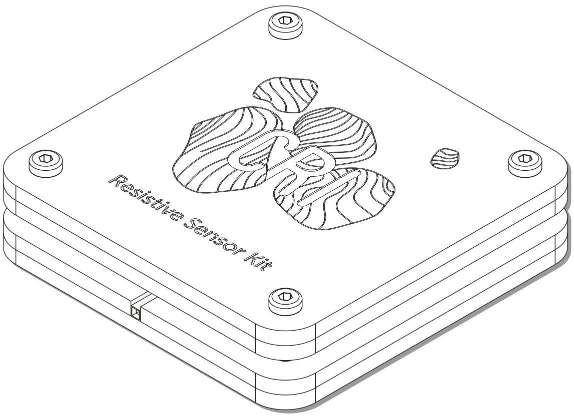


4

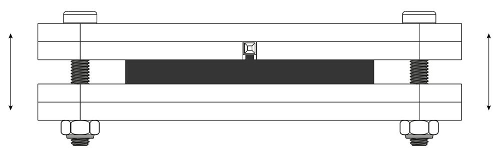


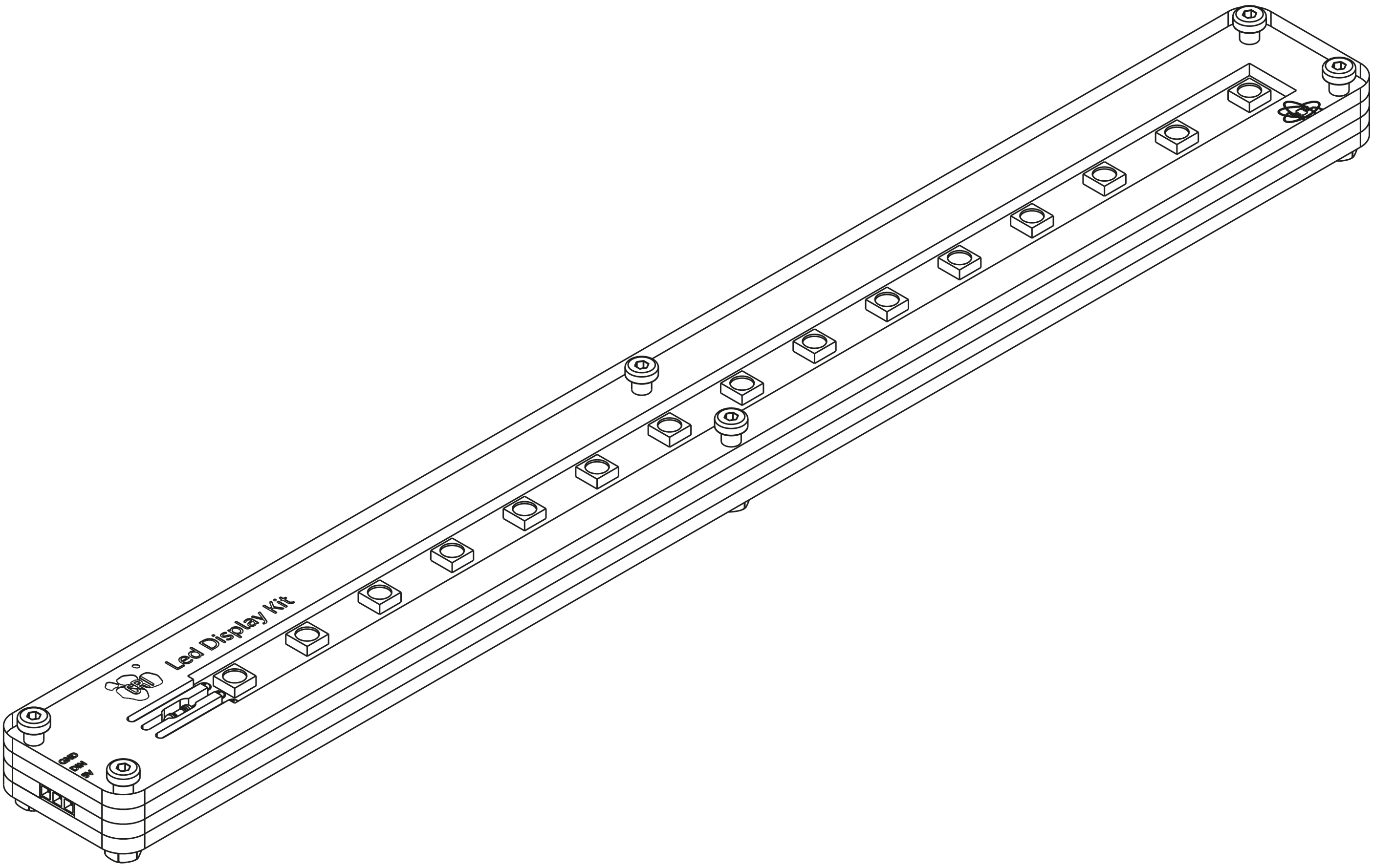
5





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

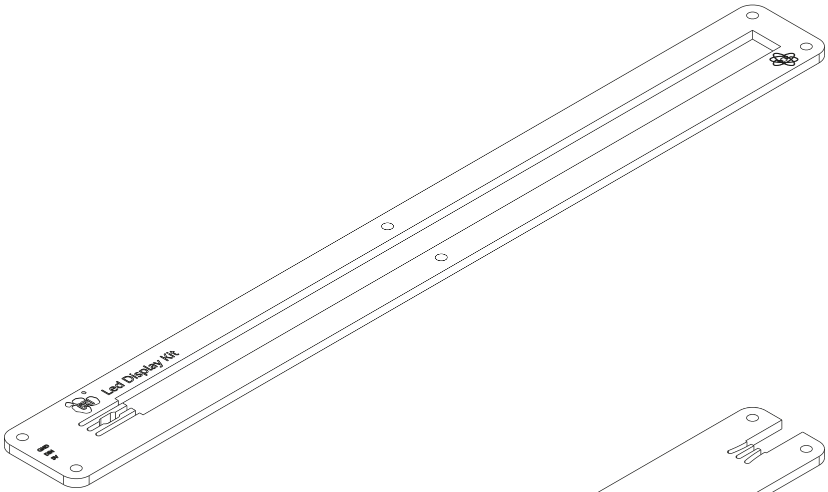




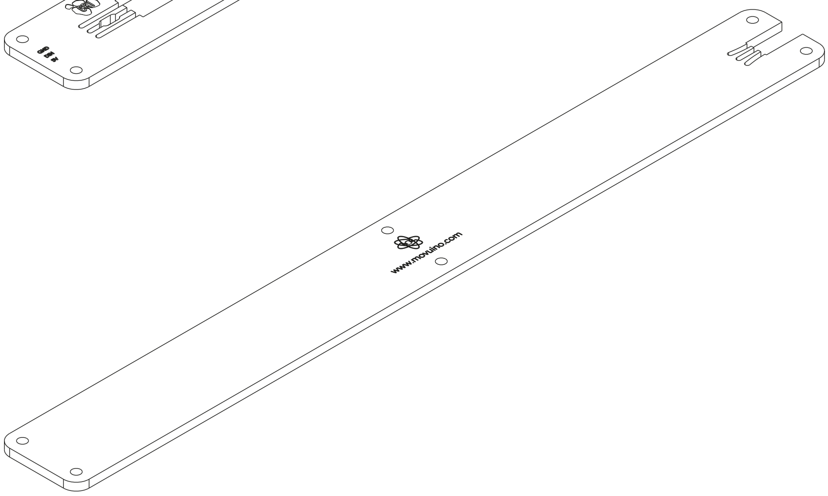
LED DISPLAY

TO LASER CUT

Plywood — 3mm thick



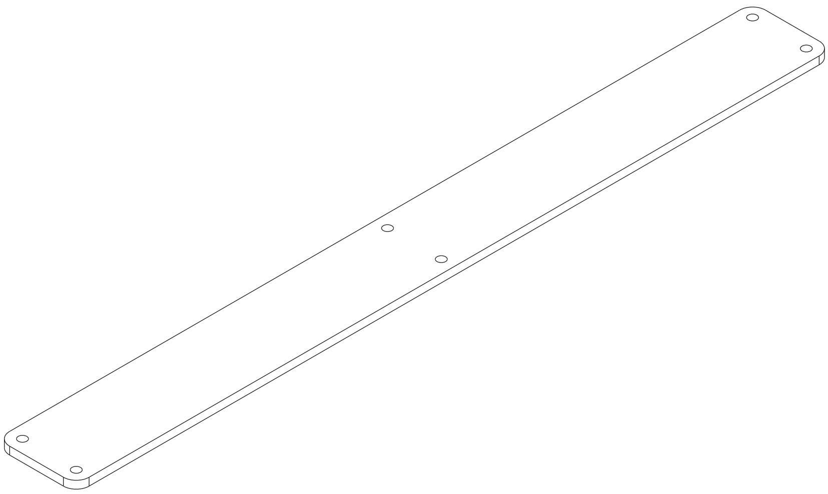
A1 ***x1*** **Front panel**



A2 ***x1*** **Back panel**

SensorsKit/01_MakingRessources/LedDisplay/LedDisplay_Plywood.svg

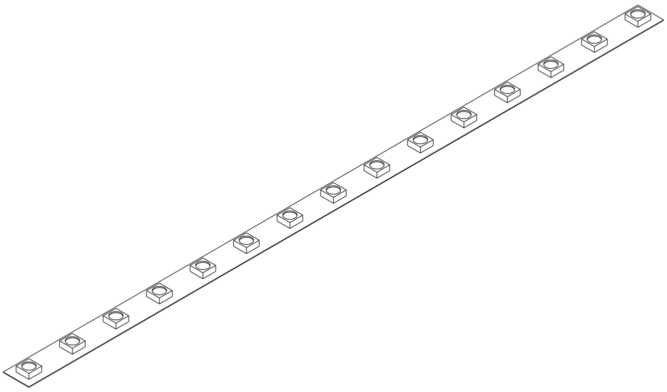
Plexyglass — 3mm thick



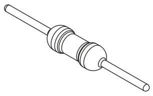
B ***x2*** **Case**

SensorsKit/01_MakingRessources/LedDisplay/LedDisplay_Plexyglass.svg

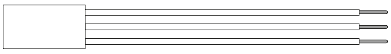
TO BUY



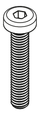
C1 *x1* Neopixel RGB Led strip



C2 *x1* 470 Ohm resistor



C3 *x1* 3 female input jumper wire



C4 *x4* M3 16mm CHC screws

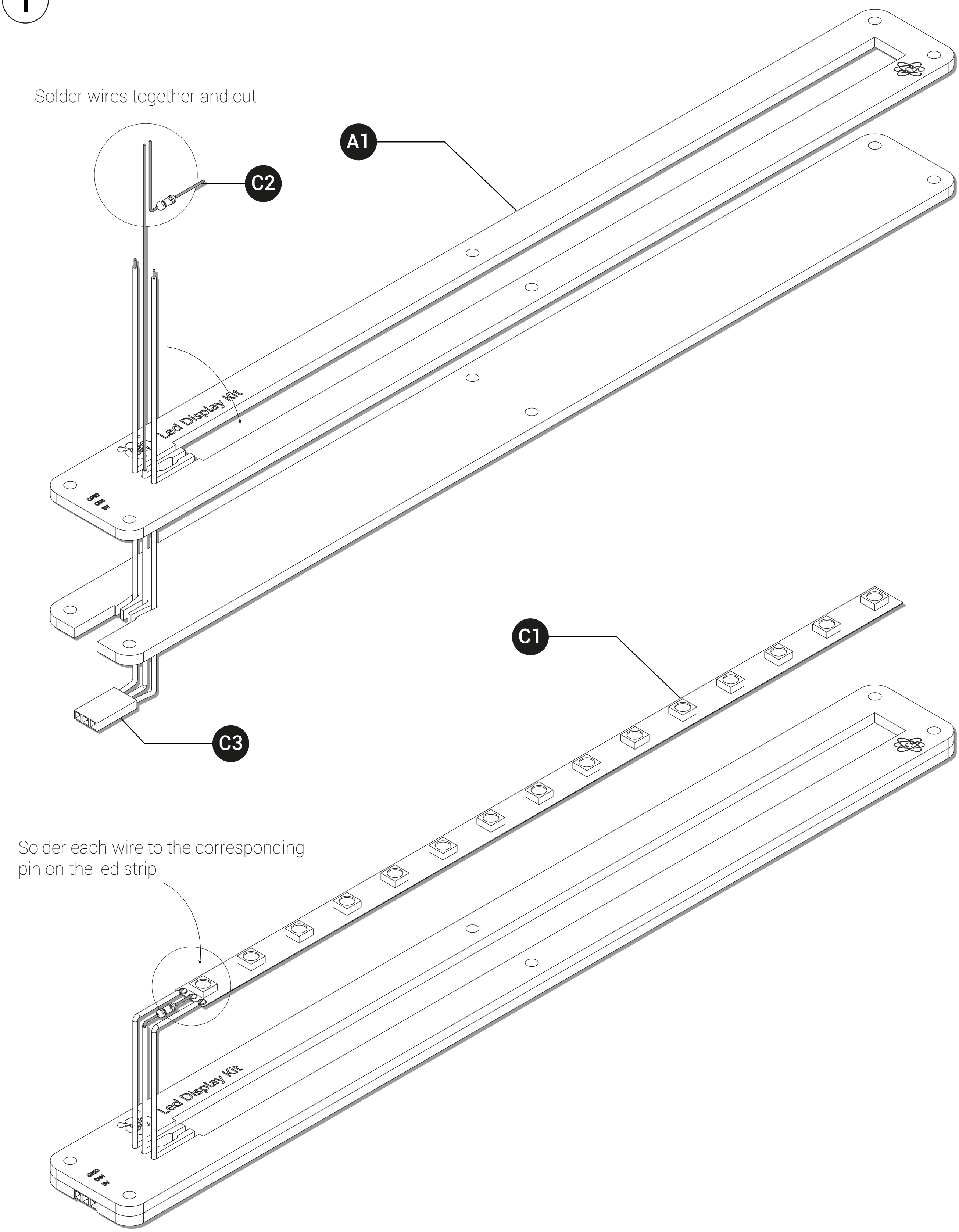
C5 *x4* M3 Serrated washers

C6 *x4* M3 Nuts

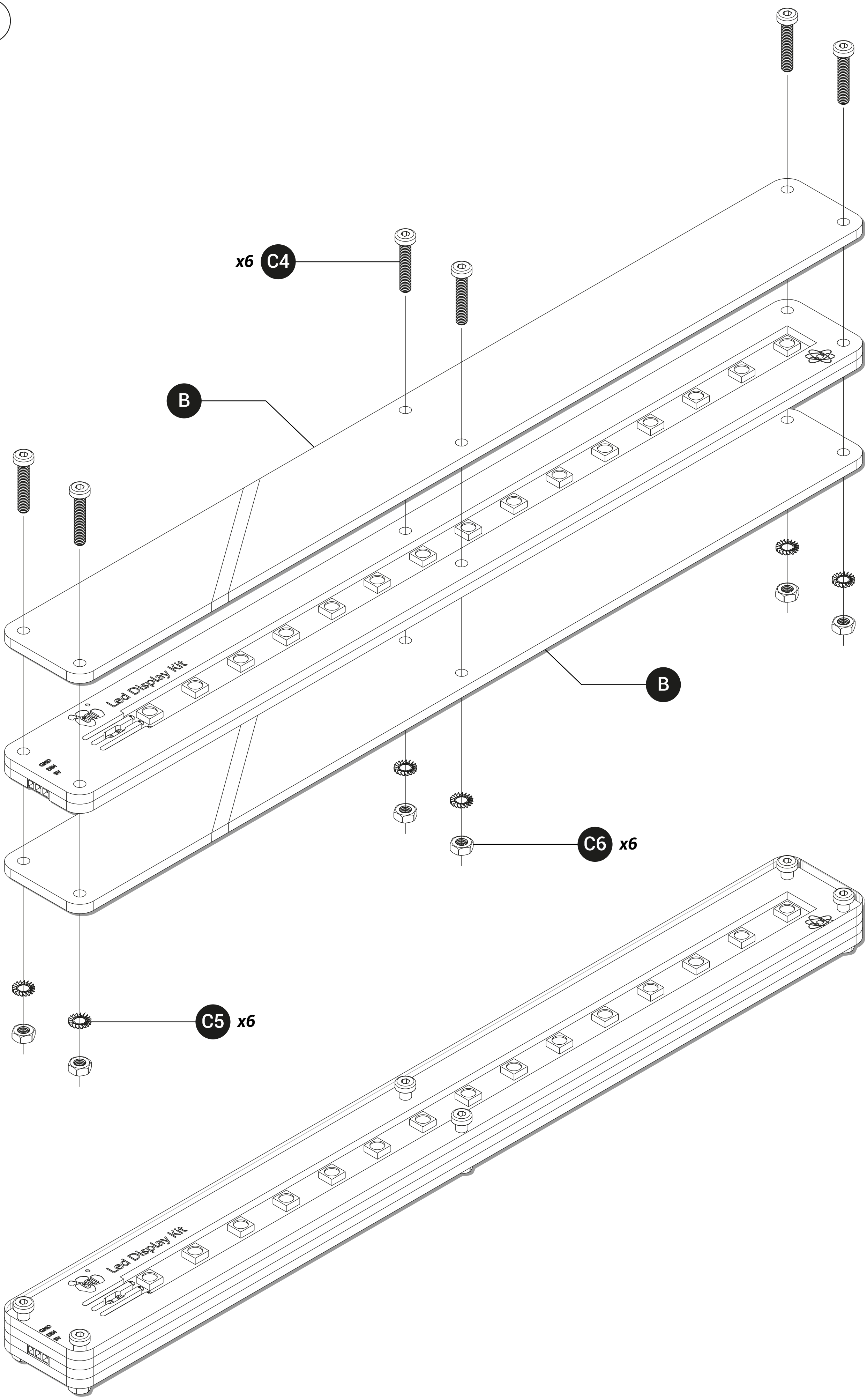
ASSEMBLY

LED DISPLAY

1

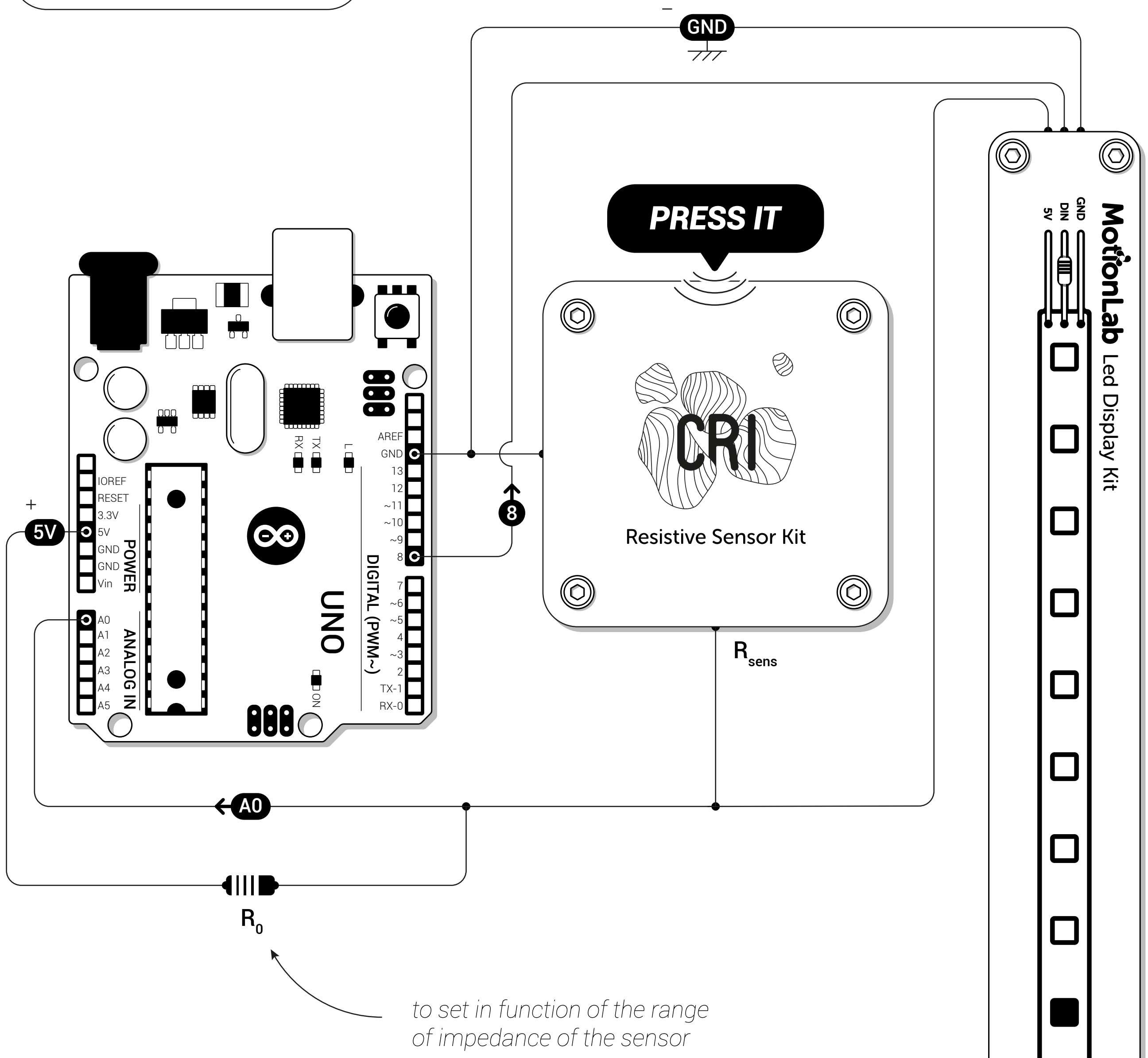


2



VOLTAGE DIVIDER

DEMO



Load Arduino program from...

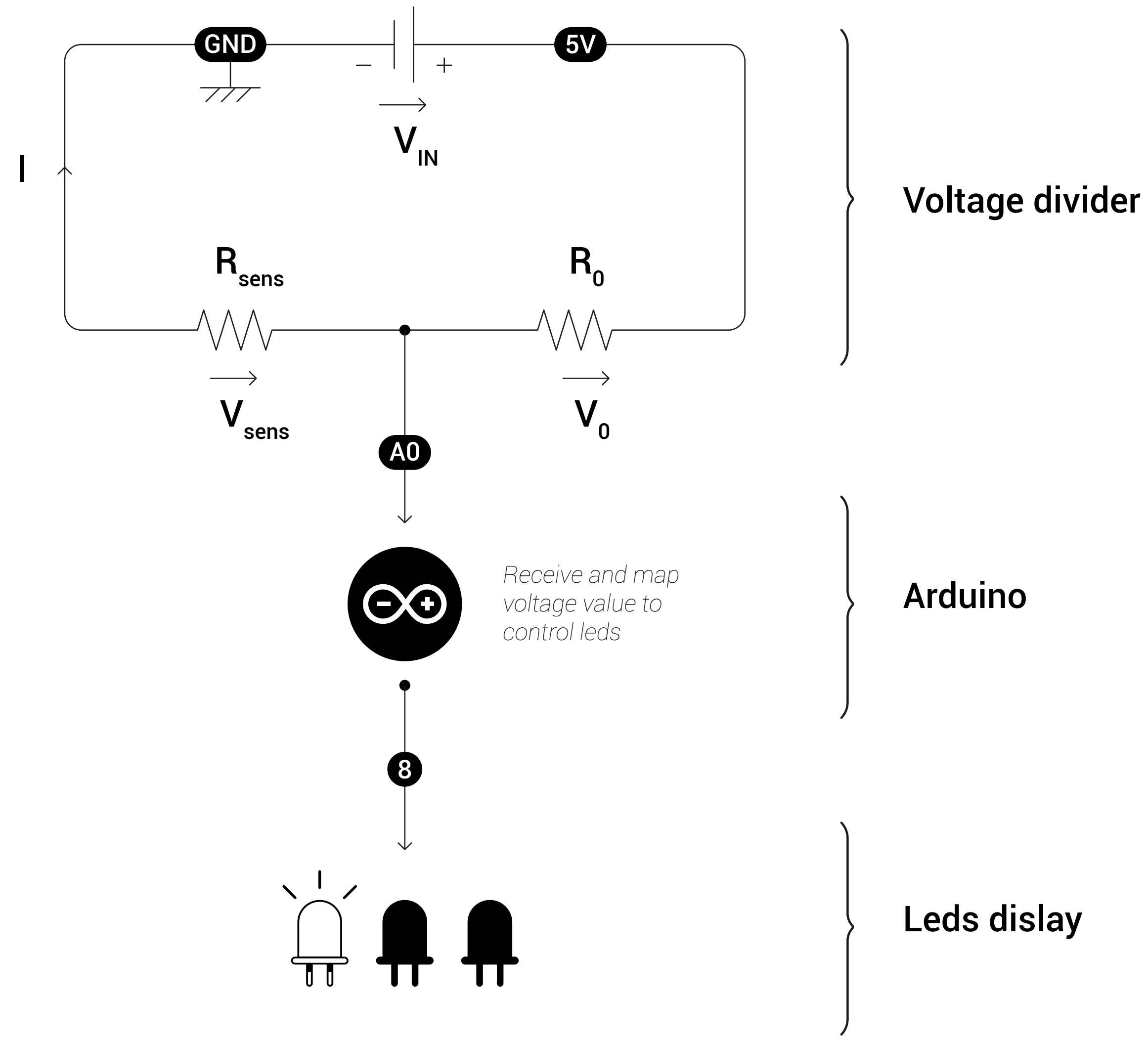
ElectricSensorsKit/02_ArduinoFirmware/ResistiveDisplay/ResistiveDisplay.ino

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

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

The **Resistive Sensor** 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 descreases.

PRINCIPLE



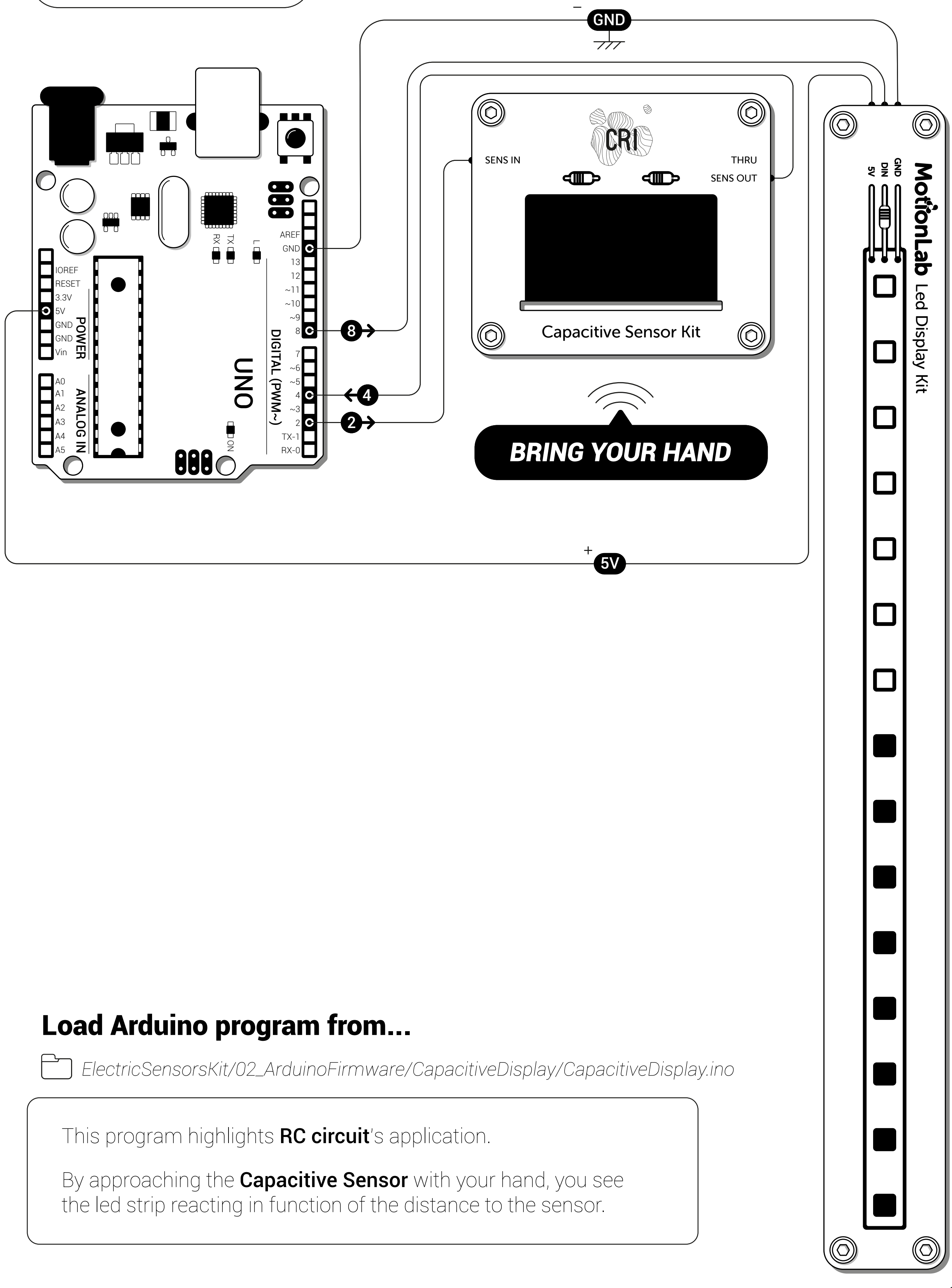
FORMULA

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

$$\Longleftrightarrow \boxed{R_{sens} = \frac{V_{IN}}{A0} \cdot R_0 - R_0}$$

RC CIRCUIT

DEMO I



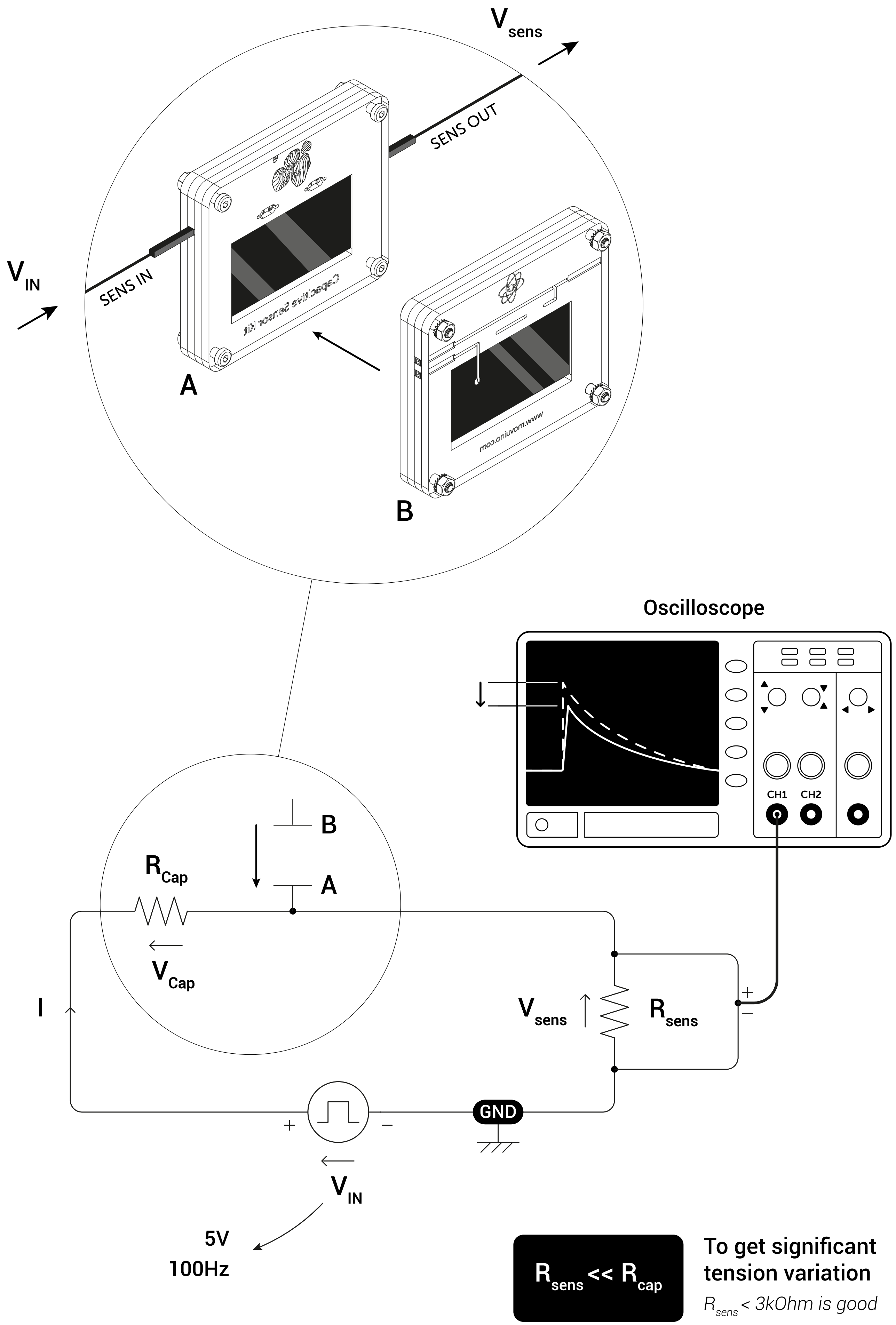
Load Arduino program from...

ElectricSensorsKit/02_ArduinoFirmware/CapacitiveDisplay/CapacitiveDisplay.ino

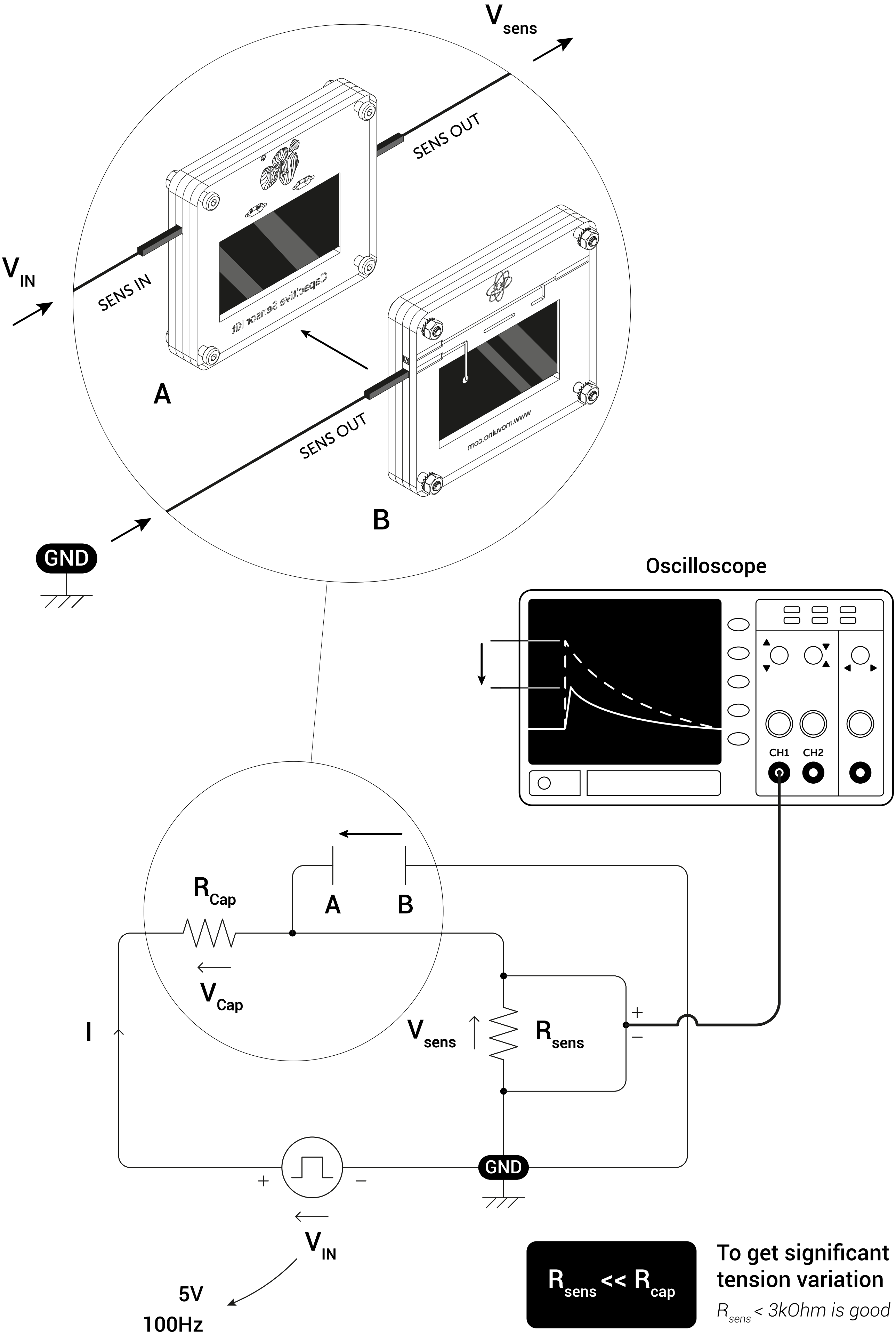
This program highlights **RC circuit**'s application.

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

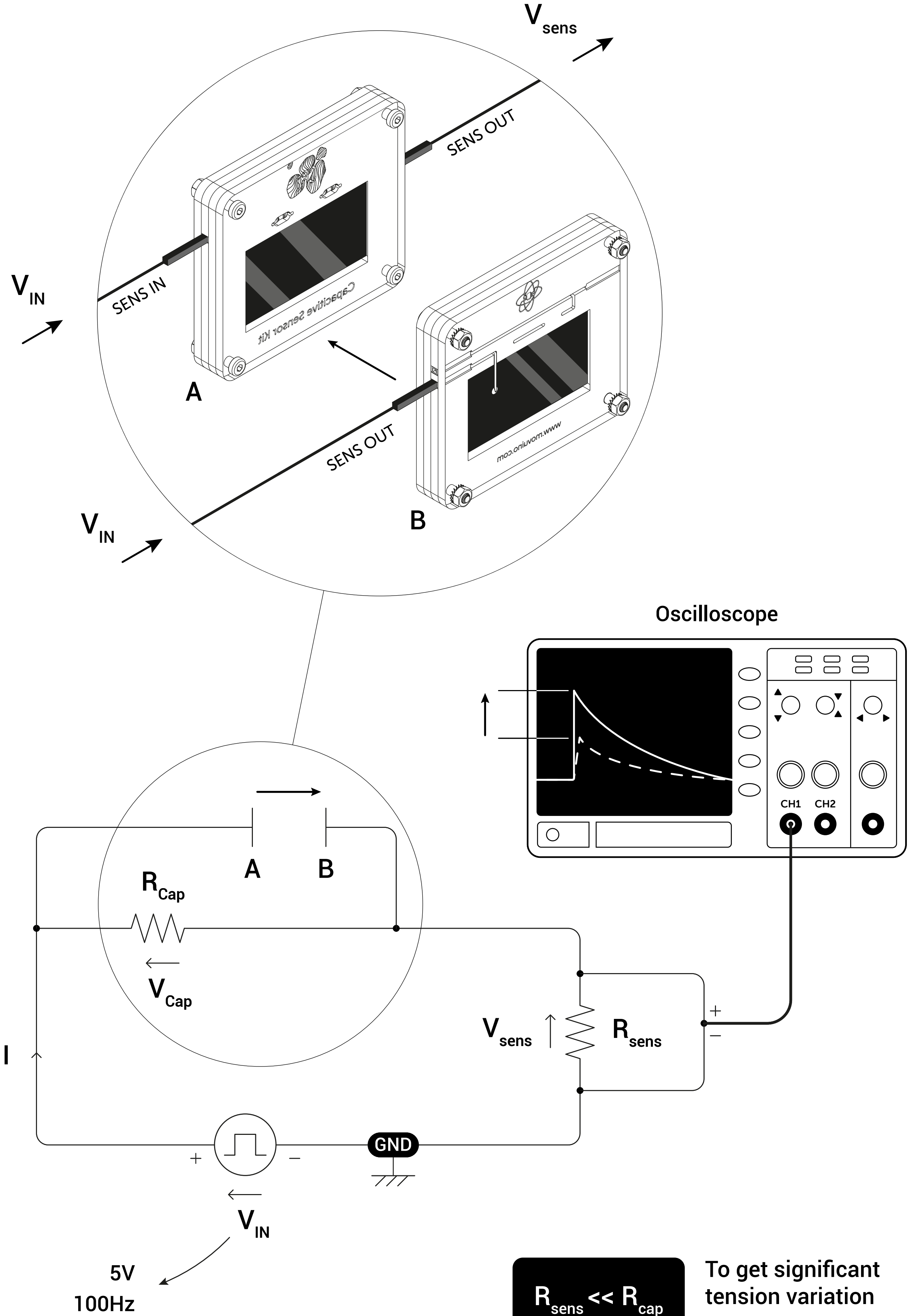


$R_{sens} << R_{cap}$

To get significant tension variation

R_{sens} < 3kOhm is good

EXPERIENCE III



$R_{sens} << R_{cap}$

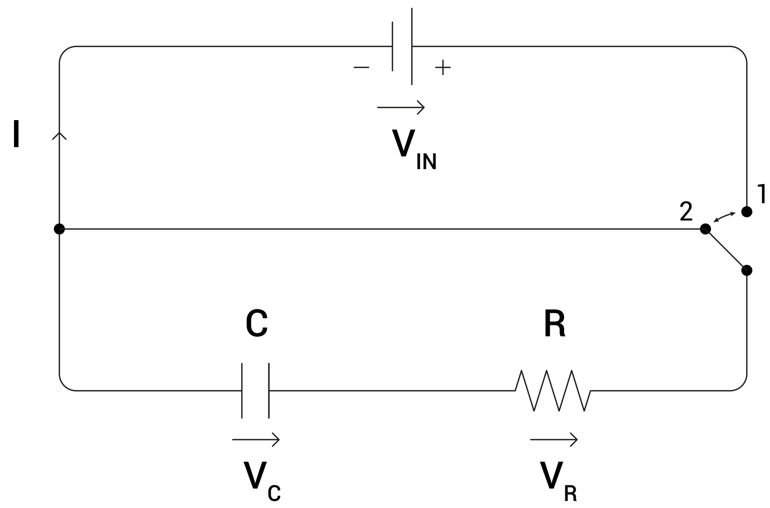
To get significant tension variation

R_{sens} < 3kOhm is good

PRINCIPLE

The principle behind those ***Demo/Experimences*** are based on the **capacitor charging/discharging** phenoma 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.

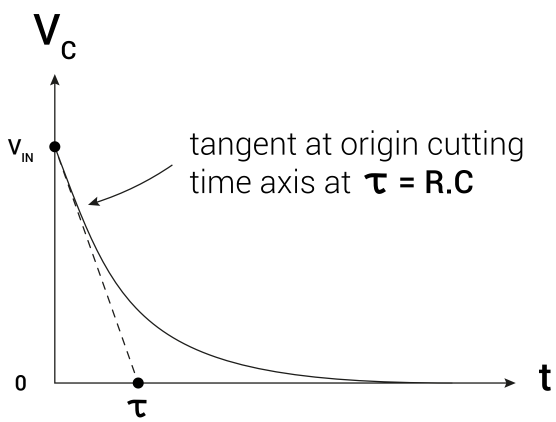


On position 1 the capacitor is charging

It discharges into the resistor each time it switches to position 2

Following V_C over time reveals the characteristic equation of an RC circuit during the discharge

$$V_C(t) = V_{IN}.e^{-\frac{t}{\tau}}$$



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 interuptor is replaced by the pin 2 of the **Arduino** which simulate a **square tension generator** as you can use in the ***Experiences*** 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 **distance variations** between the 2 capacitive sensors.