Nanomade Lab

CapaForce© Kit

user manual

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Make All Materials Smart

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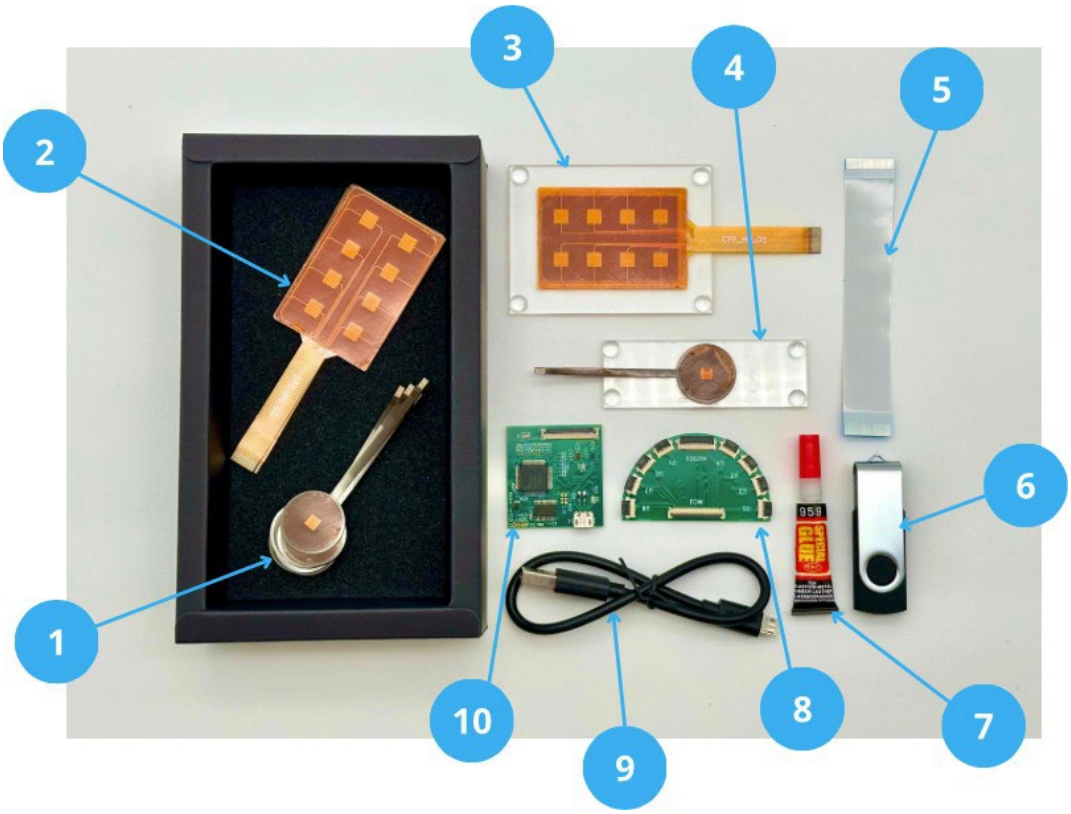
Table of content

1. Package contents

The CapaForce© kits contains 4 non-integrated single sensors, 2 non-integrated matrix sensors, 2 sensors (single and matrix) integrated under a wood trim panel, one electronic board to drive the sensor with its USB cable, a ZIF Hub and its connector, and one USB key containing this user manual, the sensor datasheet, the electronic board drivers and the software to display and control the sensor output.



1 - Nanomade single CapaForce© sensor (x10)

2 - Nanomade matrix CapaForce© sensor (x2 double-sided)

3 – Integrated matrix sensor on PMMA plate

4 - Integrated single sensor on PMMA plate

5 - ZIF Connector

6 – USB device including User Manual and Software

7 – Cyanoacrylate glue

8 – ZIF Hub

9 – USB A – micro USB Cable

10 – Nanomade electronic board

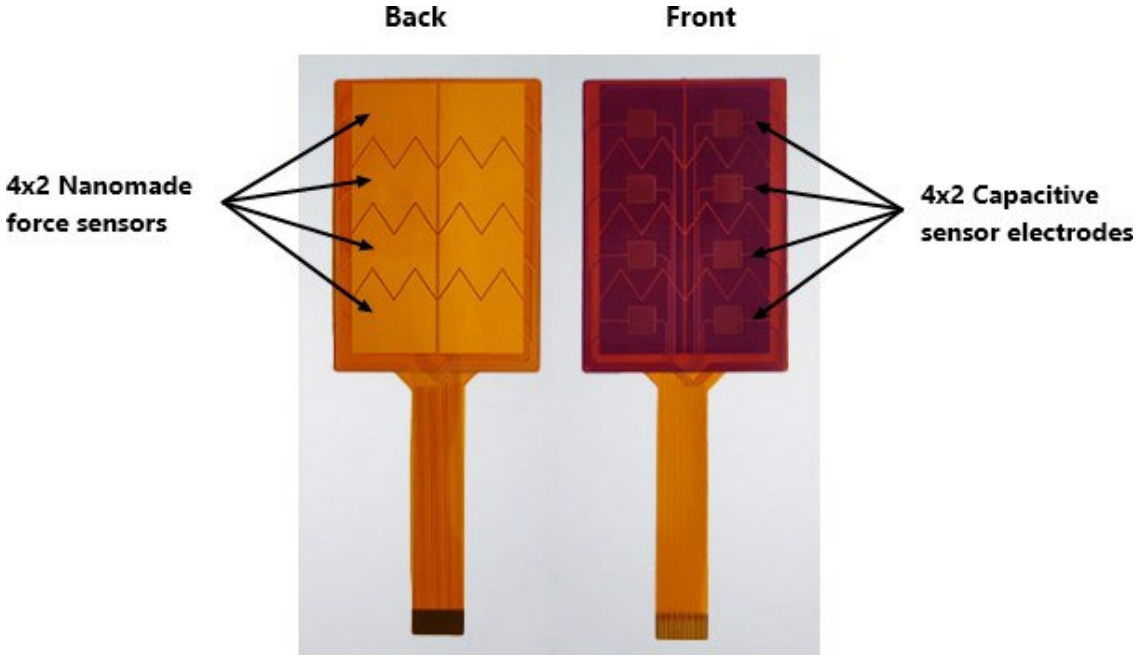
2. Sensors description

The Capaforce© sensor combines a standard capacitive sensor with a Nanomade force sensor. It allows soft touch detection and force touch with a single, thin, flexible sensor. Capaforce© is available in single or matrix version described above.

- **Capaforce© monolayer single sensor:**

This sensor is composed of only one copper layer on polyimide substrate. Both capacitive and force sensors electrodes are designed on each side of this unique layer.

Capaforce© matrix sensor:

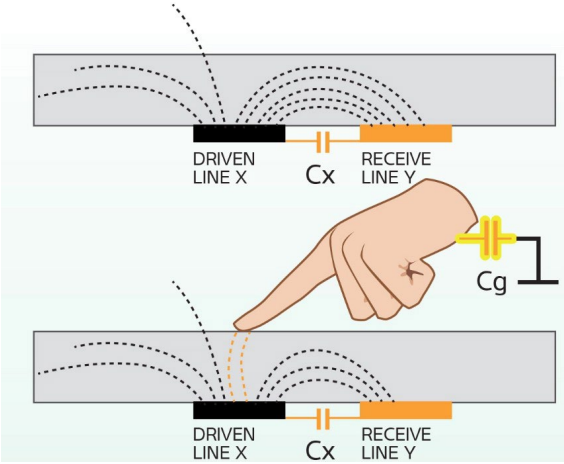


This sensor is designed on a double side FPC. There are 8 electrodes for capacitive sensor on the upper layer and 8 force sensors on the bottom layer. This configuration allows multipoint touch and force sensing.

This configuration can be adapted to larger surfaces with very high number of sensors.

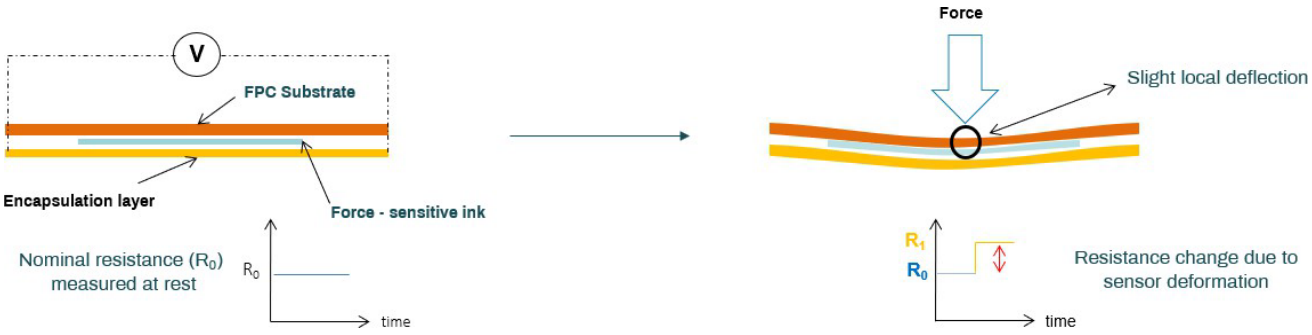
2.1 The capacitive sensor:

It is a proximity sensor that detects nearby objects by their effect on the electrical field created by the sensor. The sensor electrode is connected to a measurement circuit and the capacitance is measured periodically. The output capacitance will increase if a conductive object touches or approaches the sensor electrode. The measurement circuit will detect the change in the capacitance and converts it into a trigger signal.

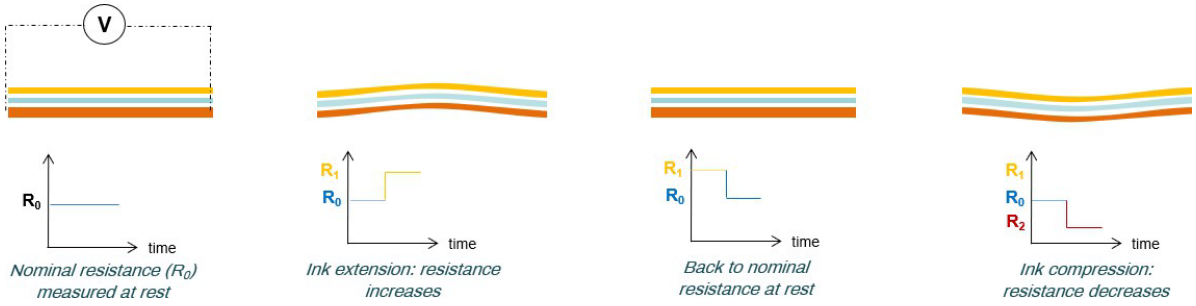


2.2 Nanomade force sensor

Nanomade force sensor works as a very highly sensitive strain gauge, i.e. the sensor nominal resistance varies with the applied force. Its properties rely on a proprietary force-sensitive ink printed on a Flexible Printed Circuit (FPC) substrate.



When a strain is applied, a measurable change in the electrical resistance of the sensor is detected. The higher the pressure applied, the higher the resistance changes.



Nanomade Capaforce© sensors can be used as-is or integrated with other materials. The integration step is critical to get the best of Nanomade's Capaforce© sensors.

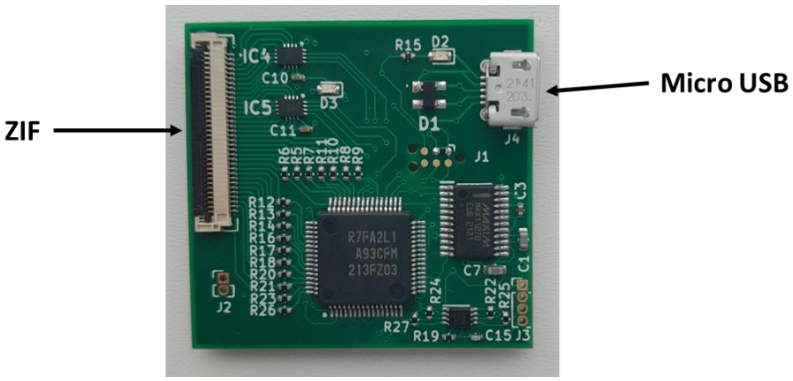
Detailed guidelines can be found in the **Sensor integration** section.

3. Connections to the electronic board

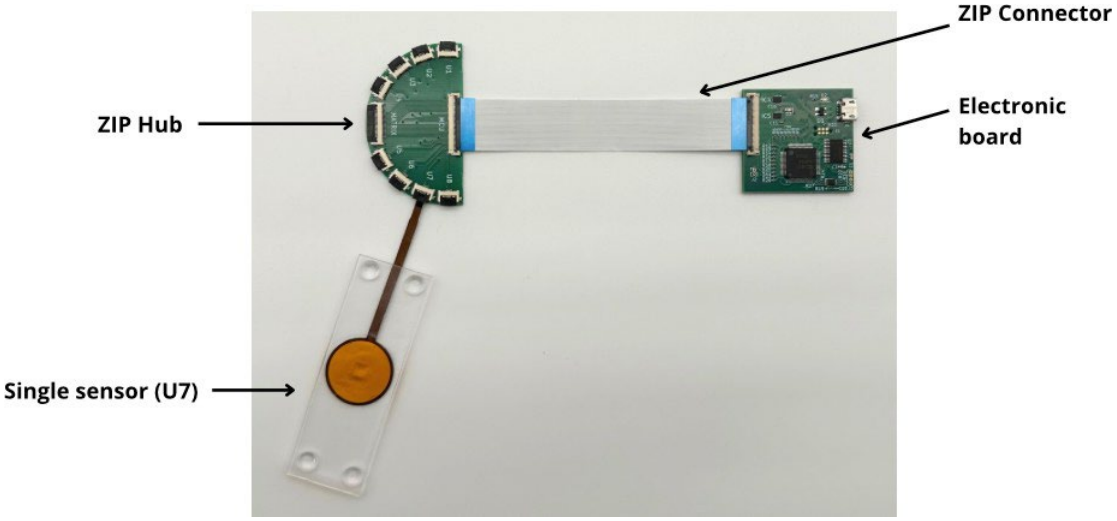
In order to start the evaluation, integrated sensors are provided in these kits. We recommend that users familiarize themselves with the kit by using these integrated sensors first.

3.1 Connecting the sensor to the electronic board

The CapaForce© electronic board is composed of a micro-USB port and a ZIF port.



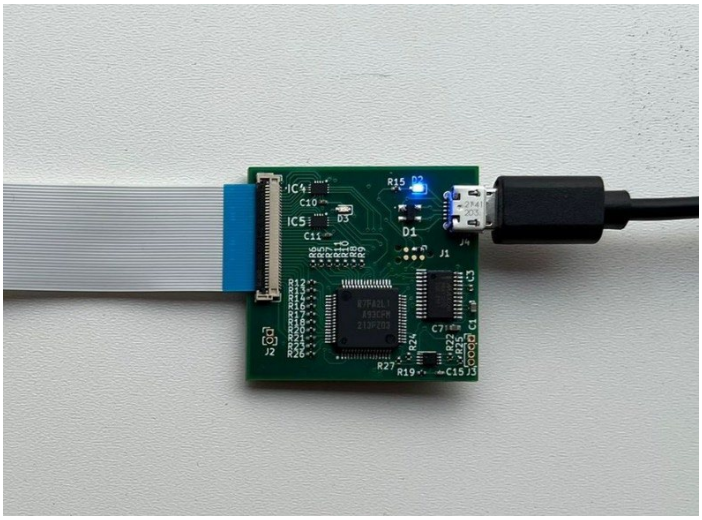
To connect the sensors, the ZIF Hub must first be connected to the electronic board using the connector provided. Then the single sensors can be connected to the ZIF ports U1 to U8 and the matrix to the ZIF matrix port as shown below.



3.2 Connecting the electronic board to a computer

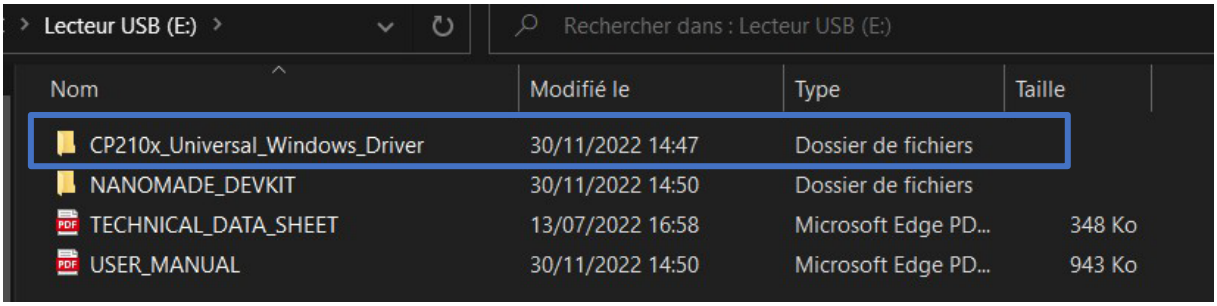
To connect the electronic board to the computer, plug the USB cable into the micro-usb connector at the top of the board on one side and into an available USB port on your computer on the other side.

A blue LED lights up on the card if it is well connected.



The electronic board is compatible with Windows 10 and 11.

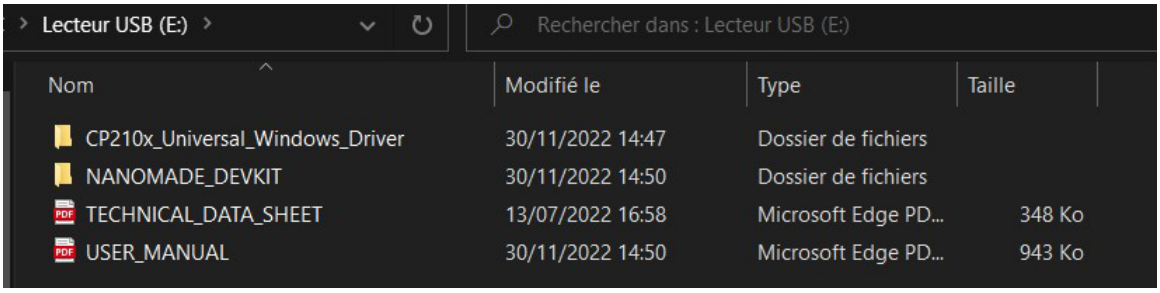
At the first connection, the electronic board should be recognized as a Silicon Lab COM Port. If it's not the case, you can install the drivers provided on the USB key (*CP210x_Universal_Windows_Driver*).

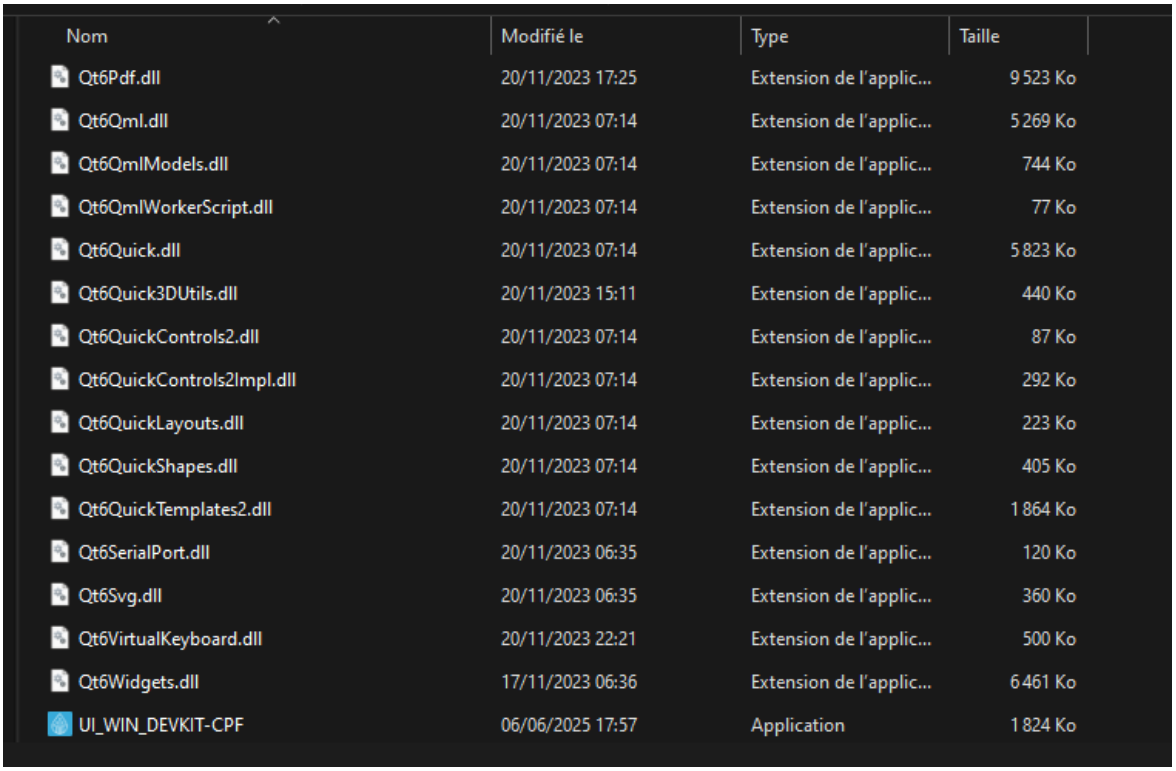


To do so, open the device manager and if the electronic board is not correctly recognized, update the drivers by indicating the folder on the USB key as the search folder.

4. Software control

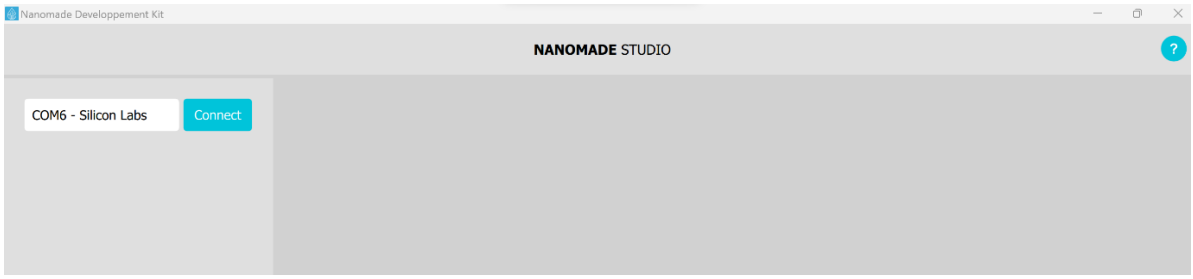
After connecting the sensor to the electronic board and the USB cable to the electronic board and to the computer, you can open the software folder from the USB key. In this key you will find the user manual, the Windows drivers, and the software in the file NANOMADE_DEVKIT. Double click on "***UI_WIN_DEVKIT-CPF***" to launch the software.





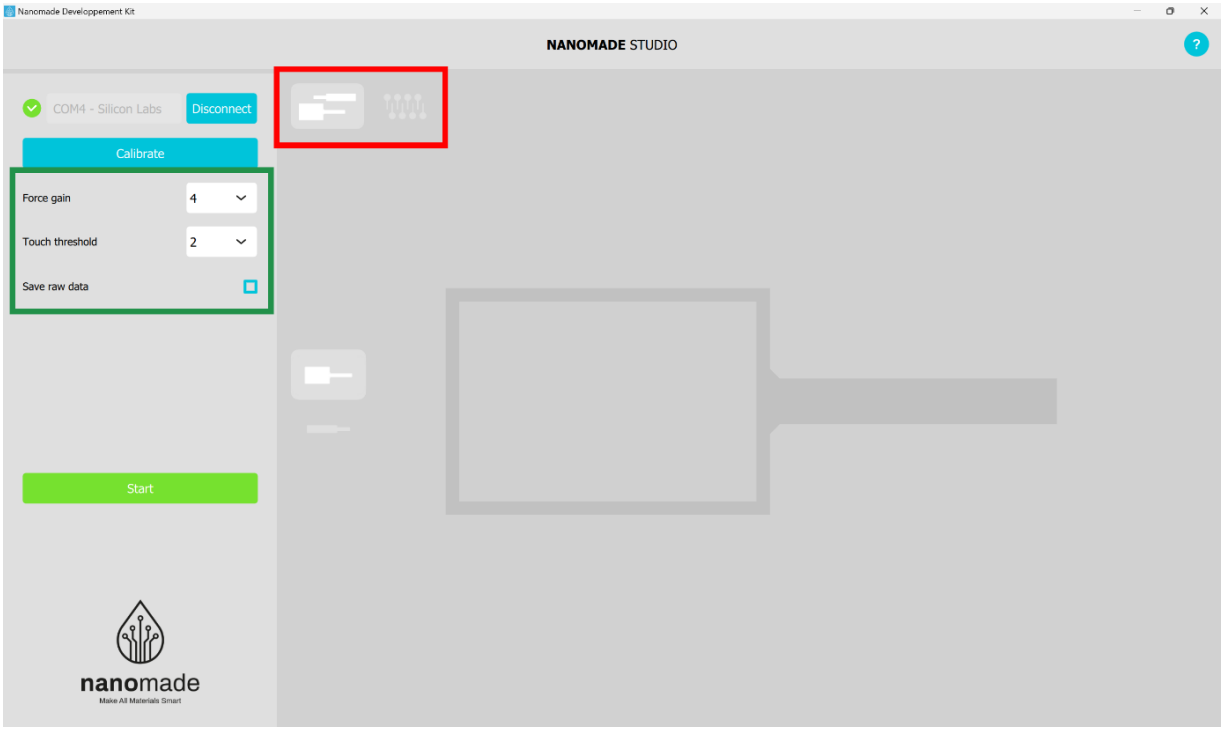
The software opens on this screen recognizing the card under the name "COM6 - Silicon Labs". If you have more than one DevKit connected at the same time, a drop-down list will be available to choose which one you want to use. If you have any questions, don't hesitate to

click on the question mark at the top right of the page to access the after-sales service telephone number.



Click on "Connect" to go to the next step. Calibrate the sensors by clicking on the "Calibrate" button.

You will then arrive at the main control panel. The software recognizes whether you have connected one or more unit sensors, a matrix or both. This is indicated by the valid tabs (circled in red). Here for the example a single sensor and a matrix were connected simultaneously.



On this screen, the three main possible actions appear (framed in green). You can adjust the gain of your sensors by a drop-down menu between 1 and 128. You can set the touch

threshold between 1 and 8 and finally you can save the raw data on your PC. Here is the description of the parameters.

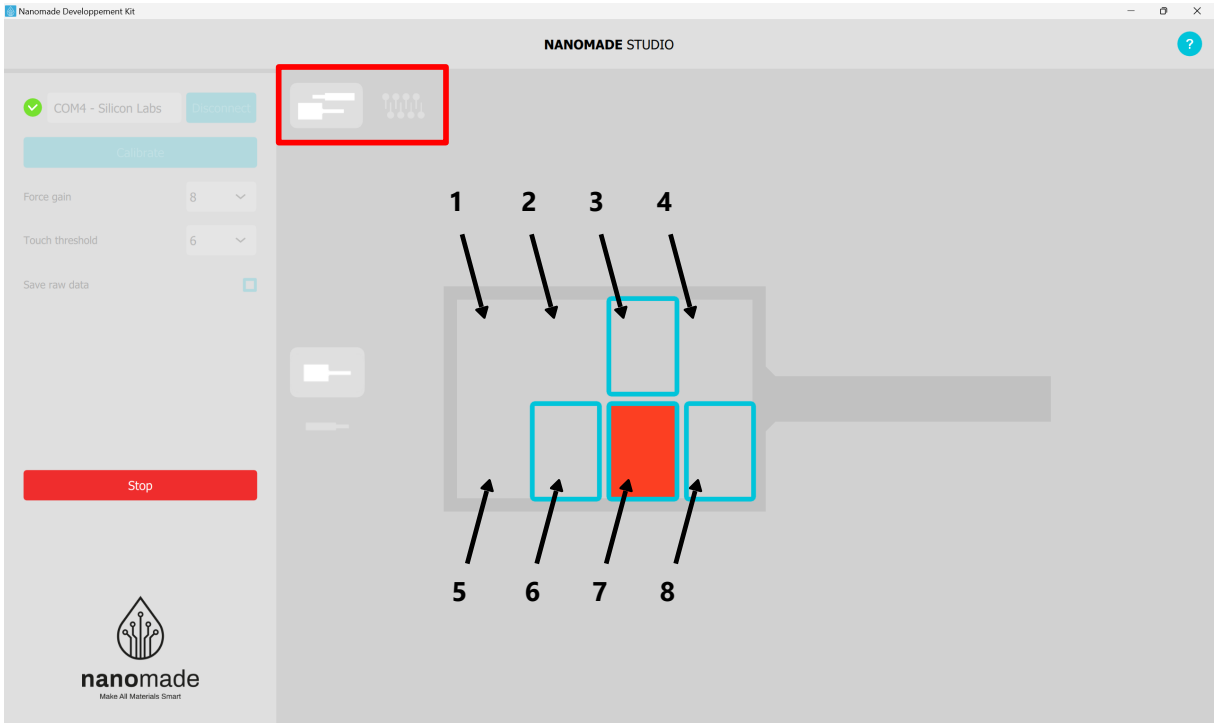
- **The force gain:** you can select a value between 1 and 128; a higher value will increase the signal magnitude; the force variations depends on the properties of the material between the finger and the sensor and have to be tuned accordingly of it.
- **The touch threshold:** This is the activation threshold of the capacitive sensor.

For sensors integrated in the PMMA : since the matrix and the units do not have the same thresholds, if only units are connected, the Touch threshold is set to 5 and FORCE gain to 8. If only one matrix is connected, the Touch threshold is set to 4 and FORCE to 16. If both are connected, by default these are the thresholds of the matrix.

When you have set the parameters to the desired values, start the test by pressing the "Start" button. If you wish to adjust the values of these parameters you will have to stop the measurement with the "Stop" button, change the parameters, and then restart it.

If you make any changes to the ZIF connectors (i.e. connect/disconnect one or more sensors) it is imperative to recalibrate the software by clicking on the "Calibrate" button.

You can navigate between observing the behaviour of matrix and unit sensors with the buttons circled in red in the figures. In general, the colour of the active sensor(s) varies from green to red depending on the pressure applied for the matrix sensor. For unit sensors the percentage will vary accordingly to the gauge scale.



In the window dedicated to the unitary sensors, only the connected ZIF terminals are active. You can change the full scale of the gauge for each unit sensor. Set its value in mV under each gauge.

To save the raw data of your tests, check the dedicated box before starting them. A window will open to save the excel file in the folder of your choice. Note that the raw data is filtered to arrive at the recordable .raw file.

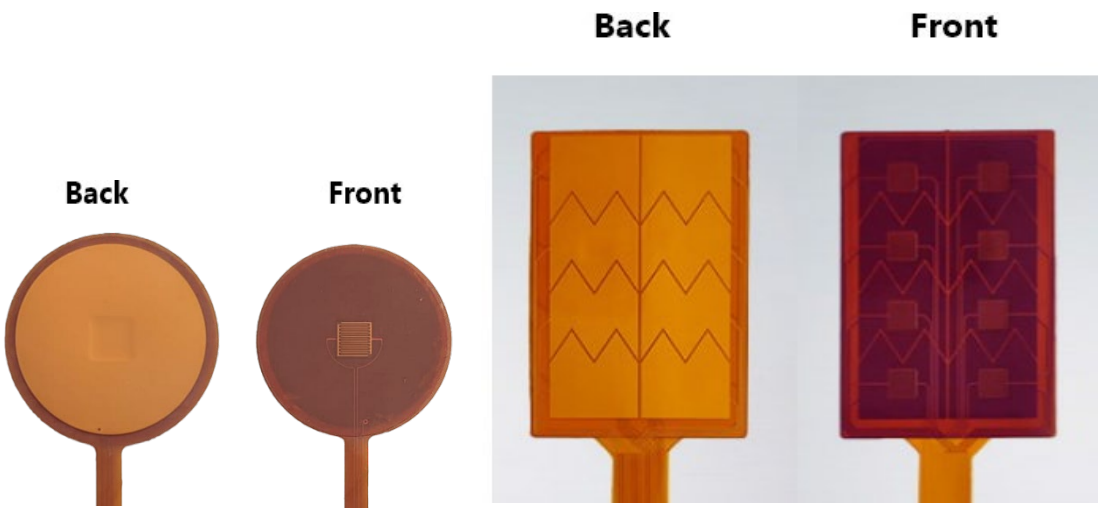
The excel file consists of 32 columns each indicating the force or capacity values of the different sensors. They are each referenced. Columns M_F_1 to M_F_8 indicate the force values of the 8 active zones in the matrix as shown in the previous figure. The columns U_F_1 to U_F_8 indicate in the same way the force values of the 8 unit sensors accordingly to their ZIF port number. If a sensor is not active (or not connected) its force value is fixed at 3299 throughout the test. Columns M_C_1 to M_C_8 indicate in a binary way the capacity value of the active zones of the matrix. Finally, columns U_C_1 to U_C_8 indicate the capacity values of the individual sensors.

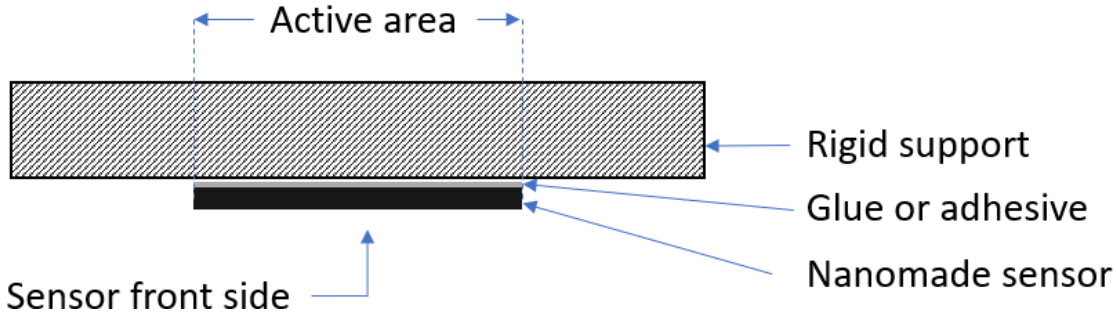
5. Sensor integration

Nanomade sensor is a very highly sensitive strain gauge, which means that, sensor nominal resistance will vary with deformation.

The sensor must be glued under the piece of material the user wants to make touch and force sensitive. Any small and high deformations induced by the pression of a finger, for example, on the active area, will be translated into a change in the sensor resistance.

The sensor is placed directly behind the piece of material and glued to it by its back side as shown in the picture below:





The higher the deformation transmitted to the sensor, the higher the variations of the sensor signal output. To glue the sensors to the surface adapted to your needs it is strongly

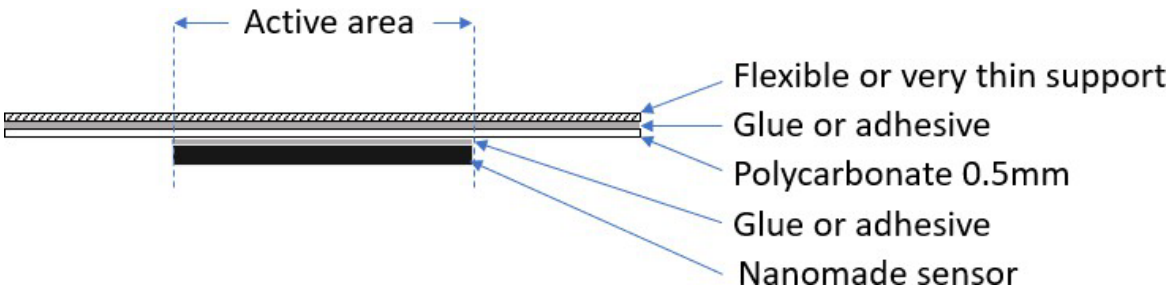
recommended to use a rigid glue. The following three glues have been tested and are valid for your tests, the references are given in the table below.

Glue Technology	Reference
Cyanoacrylate	LOCTITE 401
Acrylic UV	LOCTITE AA 3921
Two-component epoxy	3M Scotch-Weld DP 460

Sensors can also be fixed with transfer tape adhesive. As flexible adhesive will absorb strain transmission, it will slightly reduce sensor response compared to a rigid adhesive. However, as Nanomade sensors are highly sensitive, it can be enough function of the final use case. In the table below some already tested references.

Adhesive Transfert Tape
3M™ VHB™ F9460PC
DuploCOLL® 101 HCR

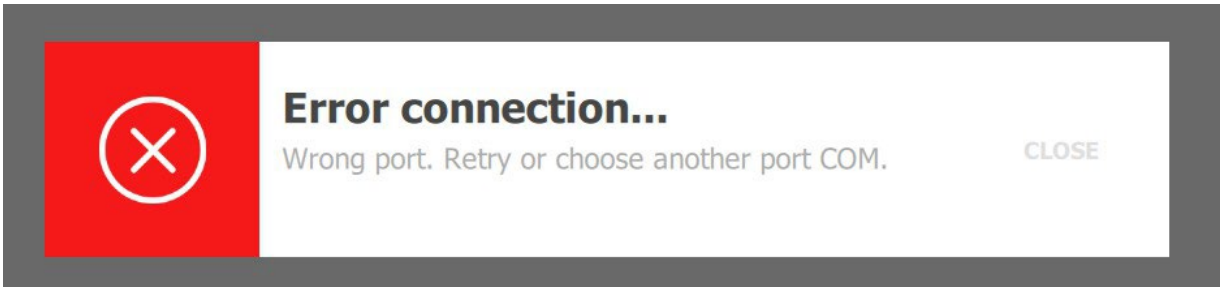
In the case of very thin or semi rigid material like leather or wood, sensor can be glued on a thin intermediate substrate as polycarbonate 0.5mm or more:



6. Troubleshooting

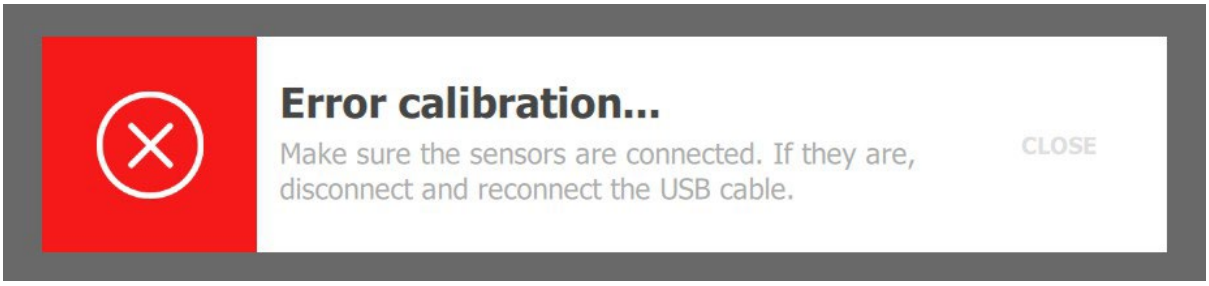
The software integrates an error detection system for using the development kit.

Error connection



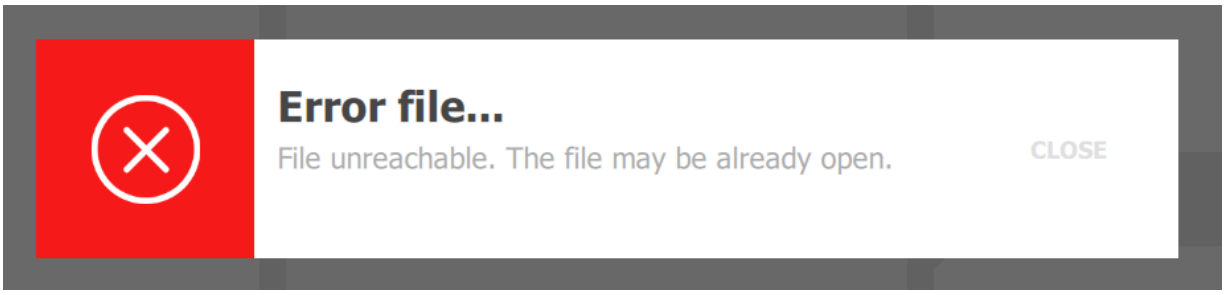
This error indicates that the selected port is incorrect. Try unplugging and plugging in the USB cable and make sure the blue LED is lit.

Error calibration



This error indicates that the sensors are probably not connected or wrongly connected. To fix it, disconnect and connect the sensors as well as the USB cable.

Error file



This error indicates that the chosen file is unreachable. This error may occur when the file is used in another program. To solve it, just close this program.

7. Contact

Thank you for purchasing our products and trusting our company.

Don’t hesitate to contact us for any questions on this product and other solutions via the options below:

NANOMADE LAB

2 place Pierre Potier

31100 TOULOUSE – France

Tel: +33(0)9 72 53 58 04

Email: support@nanomade.com

Website: www.nanomade.com