XO-NANO Smartfoam Pressure Sensor Demo v1

XO-NANO Smartfoam

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Introduction

XO-NANO's Smartfoam pressure sensors are piezo-impedance sensors that are designed to measure loads in locations where load cells and other pressure transducers are not practical or desired. The additives in Smartfoam can be transferred to any type of foam, and XO-NANO defaults to use microcellular foams because of their robust and repeatable material properties. It is important to note that depending on the foam chosen, a different calibration will be required due to the change in material and electrical properties, therefore, this demo will only function with the foam provided. These instructions are valid for the following demo boards: XOS1_v3, XOS2_v2.

The image below shows the demonstration pieces that will be sent to you, and the demo's specifications are outlined in table 1. A description of the foam sample is given followed by a quick instruction guide to get data from the system. Finally, some notes for using the sensors are given. Please contact Max Tree if any questions arise.

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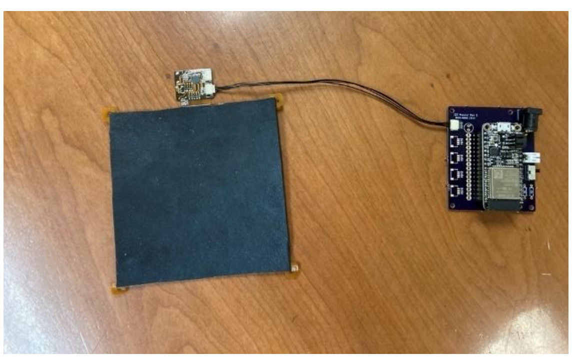


Figure 1 XO-NANO Pressure sensing demo comprising the XOS1_v3 measurement PCB, 6" I2C cable and a master PCB.

Items in Figure 1 include:

- Measurement PCB (XOS1_v3)
- Master PCB (ESP-32 microcontroller)

- 6” I2C cable

XOS1_v3 Specifications

Table 1 XOS1_v3 specifications.

Specification	Value
Range	0-5psi
Number of Sensors	9
Sensor size	$1\frac{3}{16}\text{in}^2$
Refresh Rate*	3Hz

*The rate at which all 9 sensors have updated to a new value.

Foam Sample Description

The foam used in this demo is XO-NANO Smartfoam’s 3mm Performance foam. The foam was adhered to the PCB and should not be removed. This Performance foam also comes in 2mm and 1mm thicknesses. These other thinner foams and softer foams are available for product design. Each foam selection comes with specific schematic and calibration profiles which means the foam isn’t interchangeable on the XO-NANO flex PCB carrier.

Instructions for Gathering Data

There are two ways to gather and visualize data. The first method outlined is via the XO-NANO app, and the second method is via serial communication. The master PCB is programmed to communicate via both mediums.

XO-NANO app

1. Obtain an iOS device. (iPad is preferred for the best graphics).
2. Download Test Flight app ( ) from the Apple App Store.
3. Download the XO-NANO app ( ) for the XOS1_v3 set up via this link:
    a. If Test Flight isn’t installed it will not install the XO-NANO App.
4. Open the XO-NANO app.
5. Connect XOS1_v3 and the master PCB (purple board) with the I2C cable as shown in figure 1. This may already be done for you.
6. Connect the ESP32 to a PC via a cable that goes from an available PC port (or other 5V source) to the USB micro (Figure 2) connection of the ESP32 (master microcontroller connected to the purple PCB).

Figure 2 USB micro connector needed to interface with the ESP32 aboard the master PCB.

7. The screen presents live data once the app connects to the master via bluetooth and can be used for instant feedback experiments.
8. Use the record button to record to the File app on your iOS device for more precise experiments.
9. If the demo does not seem to be working, try restarting the app and or the microcontroller.

Serial Communication

1. Connect XOS1_v3 and the master PCB (purple board) with the I2C cable as shown in figure 1. This may already be done for you.
2. Connect the ESP32 to a PC via a data capable cable that goes from an available PC port to the USB micro (Figure 2) connection of the ESP32 (master microcontroller connected to the purple PCB).
3. Download the driver for your PC to recognize the ESP32.
4. Unzip the driver folder.
5. Open Device Manager (Windows).
6. Right click the unrecognized device in “Other devices.”
7. Click “Update Driver.”
8. Choose to update the driver manually.
9. In the window that pops up, go to the folder where the ESP32 drivers are saved and finish the installation.
10. The ESP32 should be recognized and be assigned a COM port automatically.
11. The ESP32 is designed to continuously send the output voltage via serial communication that is related to the amount of load placed on the Smartfoam sensor. At this point, the user can create a custom Python script, use PuTTY, or any other serial communication capable application to record and visualize data. I recommend PuTTY as a quick and easy visualization tool.

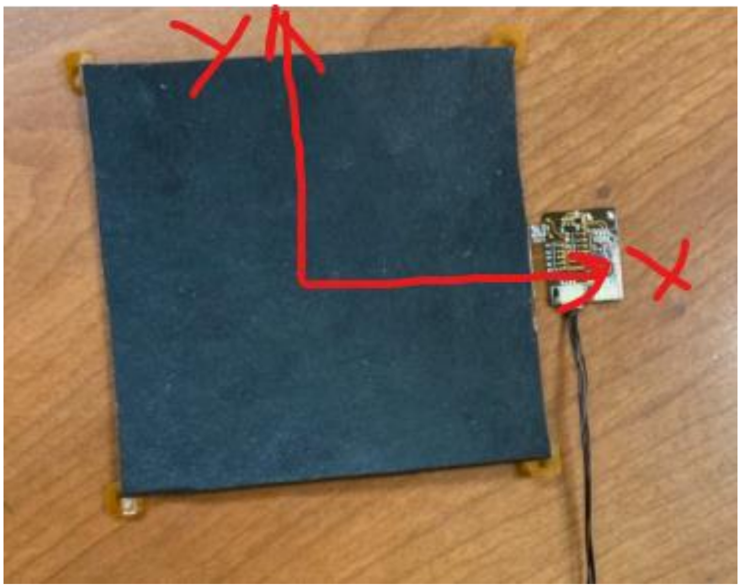
PuTTY Instructions

1. Download PuTTY from the Microsoft Store or another source

2. Install PuTTY.
3. Open PuTTY.
4. Change Connection type to Serial.
5. Enter COM port number in Serial line.
6. Change Speed to 115200.
7. At this point clicking open will open a window that continuously updates with the voltage from the Measurement PCB.
8. To save data click on Logging in the Category section.
9. Change Session Logging to “All session output.”
10. Change the output file name and choose its location to save.
11. Be sure to note the file extension and use this in a custom Python, C++, or other language script to visualize and analyze saved data.

Notes for Sensor Use

- There is no sensor shielding and there is only basic filtering on the measurement PCB; so, if you apply pressure with your hand, then you can expect to see a lot more noise in the output than if you apply pressure with an insulative material. The body acts like an antenna and the body to sensor capacitance and resistance will introduce noise into the measurements. A more advanced set up is required to compensate for this effect. For the reported accuracy, use an insulative material to apply the pressure.
- The demo was calibrated for 5psi maximum. In order to avoid damaging the foam and to keep the calibration valid, please ensure the pressure applied to the foam never exceeds 10psi. While XO-NANO Smartfoam can be calibrated for pressures as high as 50psi, this particular demo is only valid between 0-5psi.
- The demo was calibrated using a platen that covered the entire piece of foam and applied the pressure evenly across the surface. Applying the pressure to an individual sensor will increase error due to edge effects of the foam. Applying pressure in an uneven way will also increase error due to nonlinear effects of the foam.
- If you are going to run tests with the FPCB bent, please avoid bending around the x axis in the image below. The Flex PCB was not designed to allow bending in that direction, the flex PCB’s design will cause the adhesive on the foam to come undone.



- Do not crease the Flex PCB because traces will be compromised.