ASSEMBLY MANUAL FOR THE NOVADUINO® ENVIRONMENTAL SENSOR DEMONSTRATION KIT

KIT005

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1.0 Environment Sensor Kit005

Keep track of your surroundings using this advanced sensor kit, perfect for creating smart home setups or DIY weather stations. Instantly view the carbon dioxide levels in your room along with various Volatile Organic Compounds (VOCs), such as ethanol, toluene, hydrogen, and other oxidizing gases. These readings are combined to give you an Air Quality Index (AQI) indicator ranging from 1 to 5 where 1 is "Best" and 5 "Worst". The kit also measures temperature, humidity, and barometric pressure, displaying all results on the Novaduino® 2.4" touchscreen color display powered by open-source software on an Arduino-compatible Feather* processor. Because the system is open source, you can add more sensors and personalize the display. The kit comes with high-accuracy* sensors and offers optional 3D-printed enclosures for a sleek look.

With provided assembly instructions and free Arduino software, getting started is straightforward.

You'll need to download Arduino C code from GitHub and do some soldering and mechanical assembly. You'll also need to do 3D printing of the Case and other items or alternatively you can purchase a 3D printed Case on our website.

*This developmental hardware and software are provided as uncalibrated and are not intended for use in critical applications. The Environmental Sensor is not designed for safety-related, medical, or end-product purposes. It is offered solely for educational and experimental use, with no warranty or guarantee for any other application.
The AQI, VOC, and eCO2 sensors require at least 48 hours of burn in before values are stable.

Kit005 Includes:

- **Novaduino™ Display Kit001**
- **Bosch BME280 Sensor** and Qwiic cable. (Temperature, Humidity, and Barometric Pressure)
- **ScioSense ENS160 Sensor** and Qwiic cable. (Air Quality Index (AQI), estimated eCO2, Volatile Organic Compounds (VOC))
- **Rotary Encoder and 3 Buttons and**

Options:

- **Internal USB Programming Cable Kit**
  - Connects the external usb-c connector to the Feather usb-b micro connector so you can re-program the Feather without disassembling the case.
- **3D Printed Case Kit**
  - Includes 40mm vented case, front Bezel, Front Panel (w/ all holes), sensor cover, and 4 screws

2.0 KIT005 Contents

Item No.	sub elements	Quant	Product
KIT005			**Novaduino Environment Sensor Kit**
KIT001	A01	1	**Novaduino(tm) Display PCBA**
	A02	1	Display Module
	A03	1	LCD Spacer
	A04	2	Headers for Feather Proc 16 pin and 12 pin, female 2.54 mm pitch
	A05	1	On/Off Switch
	C20	2	light pipes for Front Panel 3MM PMLP FLAT REVMT WC .188"L
	A09	1	Rotary Encoder
	A10	1	Rotary Encoder knob

	3	Tact Switch
	3	Cap for Tact Switch
D02	1	Adafruit Feather M0 Express - ATSAMD21 Cortex M0
	2	Stacking Headers for Feather Processor
F02	1	BME280: Temp.,Humidity, Pressure Sensor w/ Qwiic connectors
F08	6	self-tapping screw #2 Thread Size, 1/4" Length
F03	1	ENS160: TVOC, eCO2 and AQI Sensor, w/ Qwiic connectors
H03	2	Qwiic to Qwiic, Flexible, 100 mm
C16	4	#6-32 5/8-inch machine screws, Front Panel attach
C18	4	E-Z LOK, 6-32 thread
C19	1	Double Sided Sticky Pads, white 2mm thick
C30	1	STL File Kit

3.0 General Instructions and Precautions

3.1 Tools and Materials Required:

- Soldering iron with small tip
- Solder
- wire cutters
- wire strippers
- Philips screwdriver
- Flat head screwdriver
- Breadboard
- small needle nose pliers and/or tweezers
- small hammer
- properly grounded ESD mat with wrist strap

It is advisable to perform soldering in a well-ventilated environment or to utilize an air filtration system, such as the Hakko FA-400.

A PCB vise may also be very helpful while soldering certain components.

3.2 Electrostatic Discharge:

This kit includes Electrostatic Discharge (ESD) sensitive components. Please use a properly grounded ESD mat connected to an ESD wrist strap. Please wear the ESD wrist strap when handling or touching the components contained in this kit.

Electrostatic discharges can induce very high voltages into these sensitive components that can destroy them or cause latent or intermittent damage.

3.3 Soldering:

Soldering of through-hole components to a printed circuit board is required for assembling this kit.
-- Soldering of surface mount components is not required.

If you are not familiar with soldering electronics equipment, please watch and follow one of these fine tutorials before soldering this kit. Also, we recommend that you practice soldering on something else before attempting to solder this kit

Tools | Adafruit Guide To Excellent Soldering | Adafruit Learning System

And/or:

(3129) SparkFun How to Solder with David Stillman - YouTube

Please be careful if you decide to clean any residual flux from the PCB once you are done soldering. We have found that cleaning flux from the PCB can possibly contaminate the tact switches and/or the rotary encoder or any other switches resulting in intermittent operation. If your switches are acting strange, you may need to clean them or replace them.

4.0 Discussion of Feather Processor Mounting Options

You can attach the Feather processor to the Novaduino® Display board using several methods. The board comes without pre-soldered headers to provide you with greater design flexibility. Female Headers for method 1 are included in this Kit.

Methods to mount the Feather Processor to the Novaduino® Display PCB:

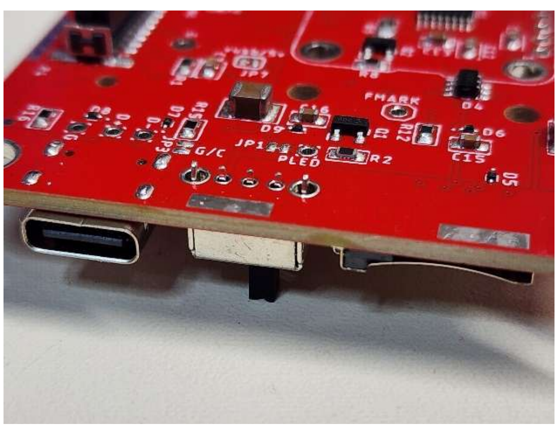
1. Solder female headers (16-pin and 12-pin) onto the Display board and stacking headers on the Feather Processor.
2. Solder the Feather Processor directly to the Display board with 16-pin and 12-pin male headers.
3. Use a female header on the Display board and male headers on the Feather Processor.
4. Mount any compatible processor to the Novaduino® Proto Expansion Card (see KIT002), which supports display and key interfaces over the backplane.
5.

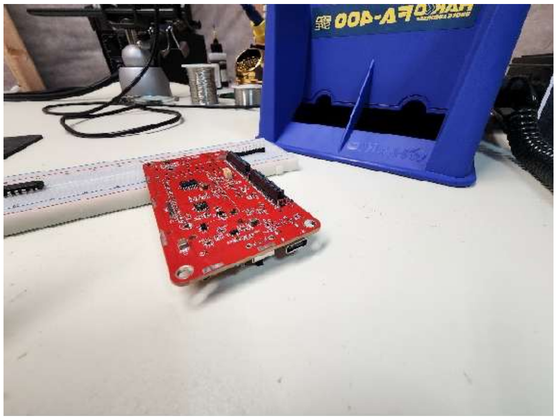
For more details and images, refer to the Novaduino® Display User Manual pdf. This document can be found at [Products - Nova Radio Labs].

5.0 Assemble the Novaduino® Display PCBA

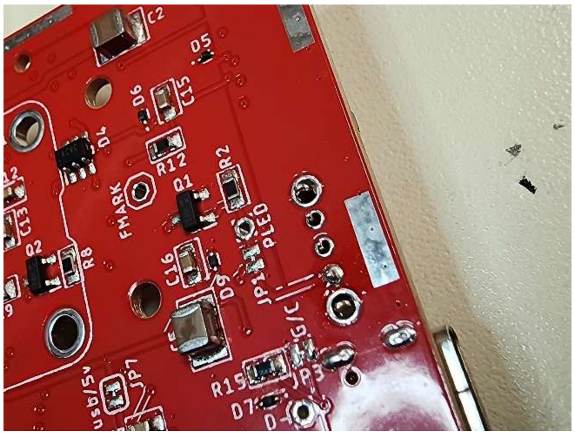
This section provides directions for Feather attachment method 1.

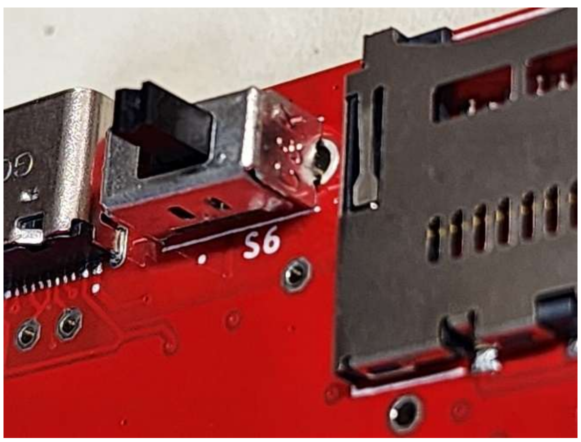
<u>**Step 1.** Solder the on/off switch to the Novaduino® Display PCBA.</u>





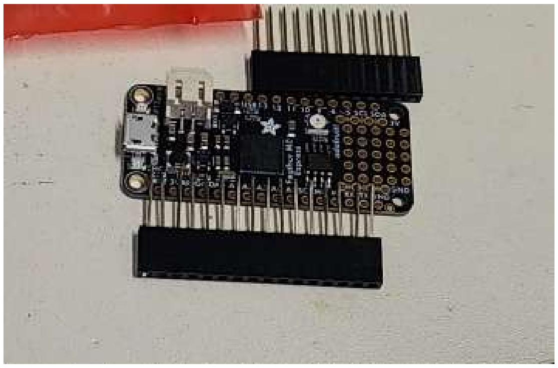
Hold the enable switch in place. We prop the opposite end of the PCBA up to about the same height of the on/off switch using a bread board, but you can use anything that is similar in height. Gravity holds the PCB and the switch in place.





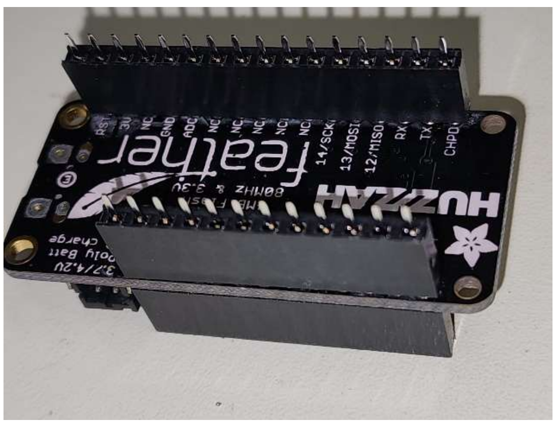
Solder one pin of the on/off switch then make sure that the switch is flush with the PCB. If the switch is not flush against the PCB, heat the solder up again while pushing the switch so that it is flush. Next, solder all the other pins of the enable switch.

<u>Step 2.</u> <u>Solder the 12 pin and 16 pin female stacking headers</u> (with <u>long pins)</u> to the Feather Processor module.

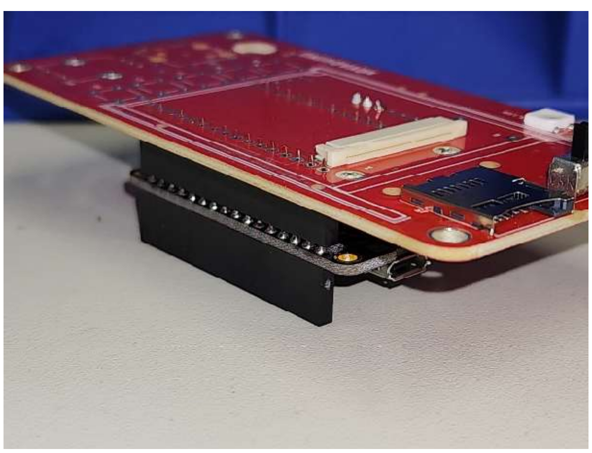


Insert the stacking header pins from the top side of the Feather processor and solder on the bottom side.

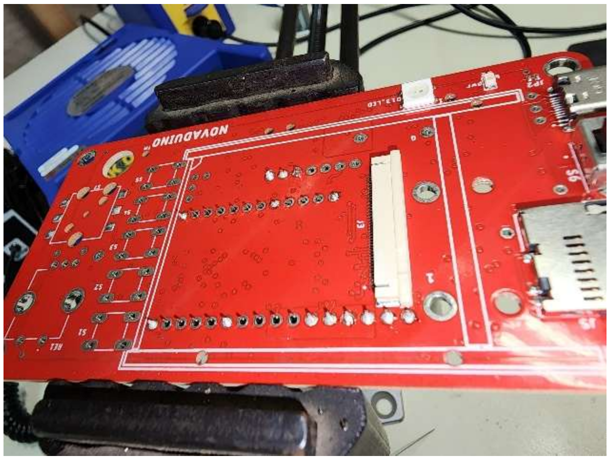
<u>Step 3.</u> <u>Solder the 12 pin and 16 pin female headers with short leads to the Novaduino® PCBA.</u>



Use the Feather processor with the long header pins to hold the 16 pin and 12 pin short female headers in place.

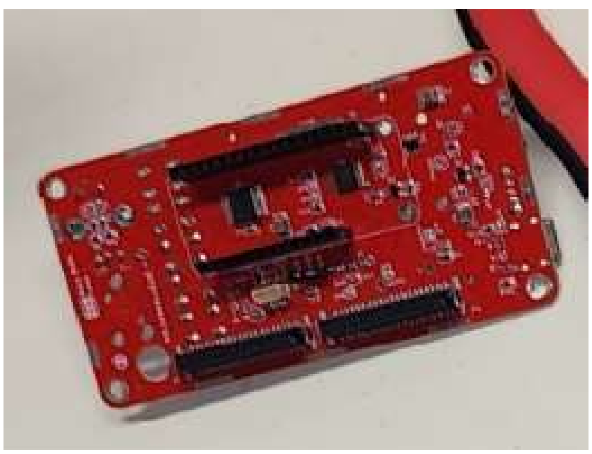


Place the Novaduino® PCBA onto the processor header pins with the front side of the Display PCB facing up.



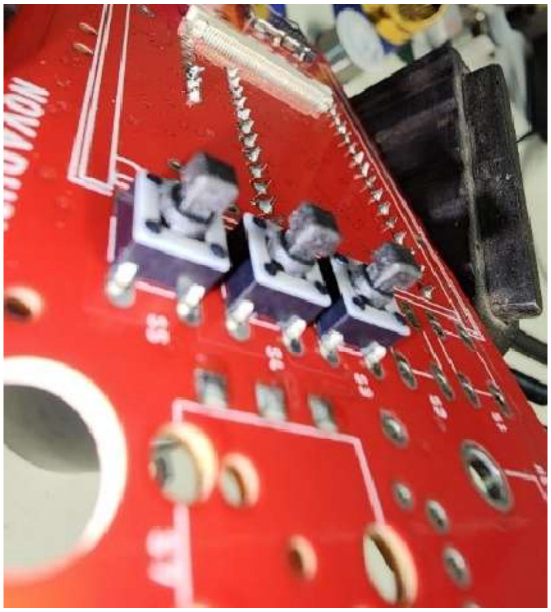
Solder one or two pins on each of the headers to hold them in place. Be especially careful to not melt the Flat-PC (FPC) connector while soldering near it.

Next, remove the processor from the headers that you are soldering to prevent it from overheating, then solder all the other pins.

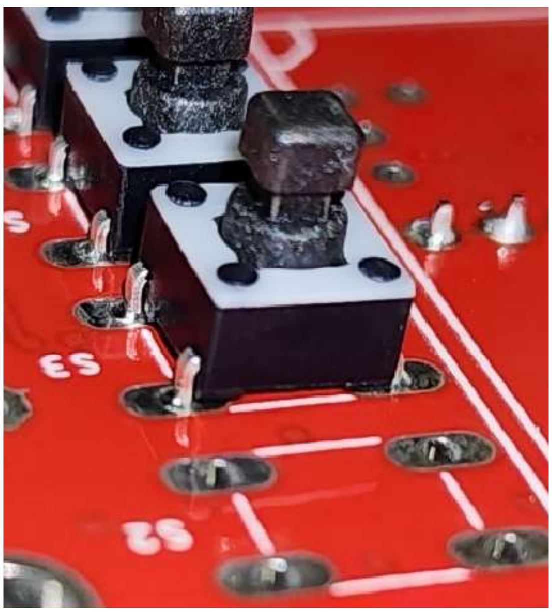


This picture shows the Feather headers mounted on the back side of the Novaduino® Display PCBA.

Step 4. Solder the optional Tact Switches to the Novaduino® Display PCBA.



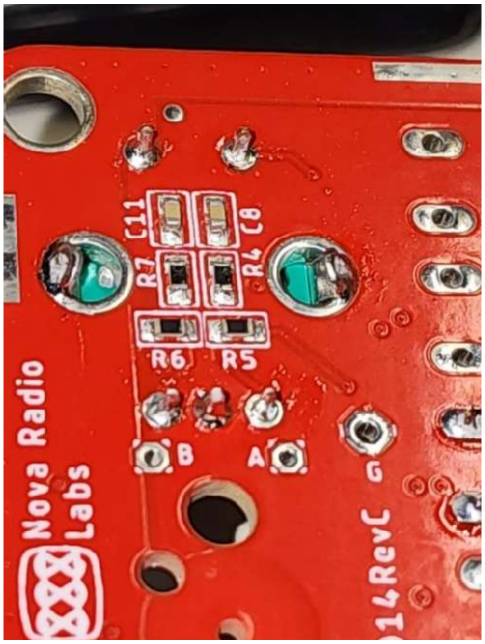
Insert the tactile switches into the front side of the Novaduino® Display PCBA, assure they are all the way against the PCB.



Before soldering the tactile switches, assure they are completely flush with the PCB. Double check before soldering because once soldered it is very difficult to fix the alignment. This picture shows a switch that was not flush with the PCB. We had to cut the switch out and install a new one to fix it.

Solder the switch leads on the back side only.

<u>**Step 5.** Solder the Rotary Encoder to the Novaduino® Display PCBA.</u>

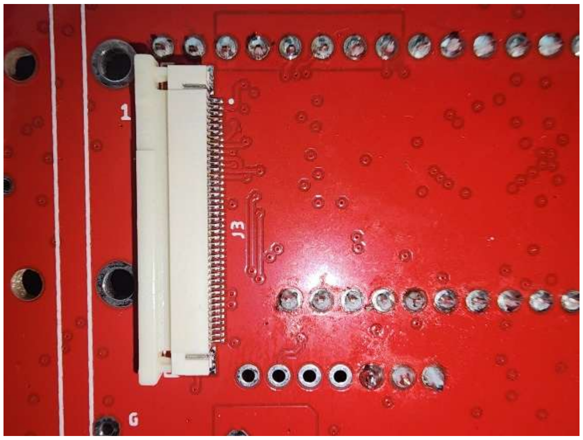


Insert the rotary encoder on the front side of the Novaduino® Display and solder on the back side.

6.0 Assemble the LCD and Novaduino® Display PCBA

Before attaching the LCD Display module, please note whether it uses the ILI or ST driver chip. The one shown in these pictures uses the ILI driver chip.

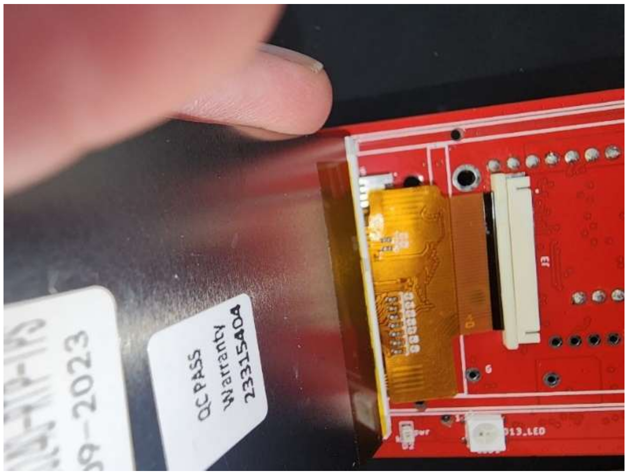
<u>**Step 6.** Attach the Display Module</u>



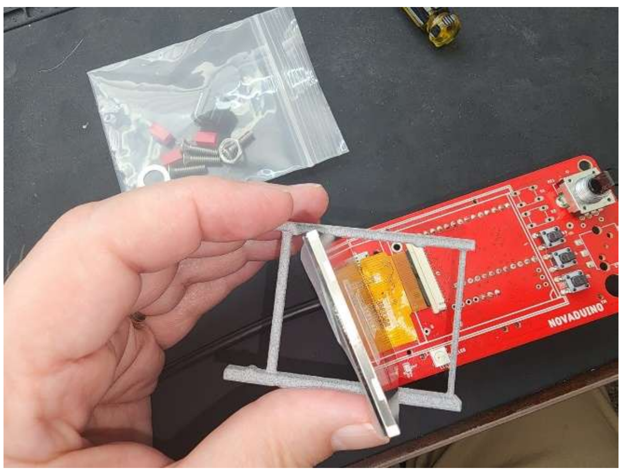
Gently open the Flat PC connector with a small flathead screwdriver. Use the screwdriver to alternately push at the top and the bottom of the connector.

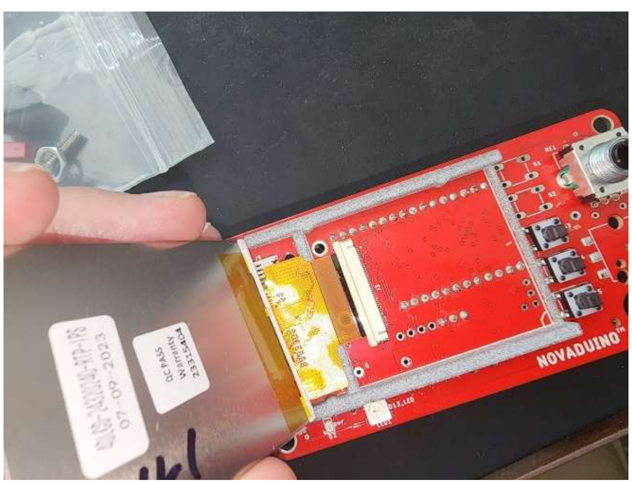
Gently insert the display FPC ribbon into the open FPC connector. Make sure it is all the way in as pictured above.

Use a small flat head screwdriver to close the top part of the FPC connector, followed by the bottom part. It may be necessary to alternate between both sides several times to fully close the connector. Take care not to touch the FPC ribbon with the screwdriver.



This shows the Flat-PC cable correctly mounted in the FPC connector.





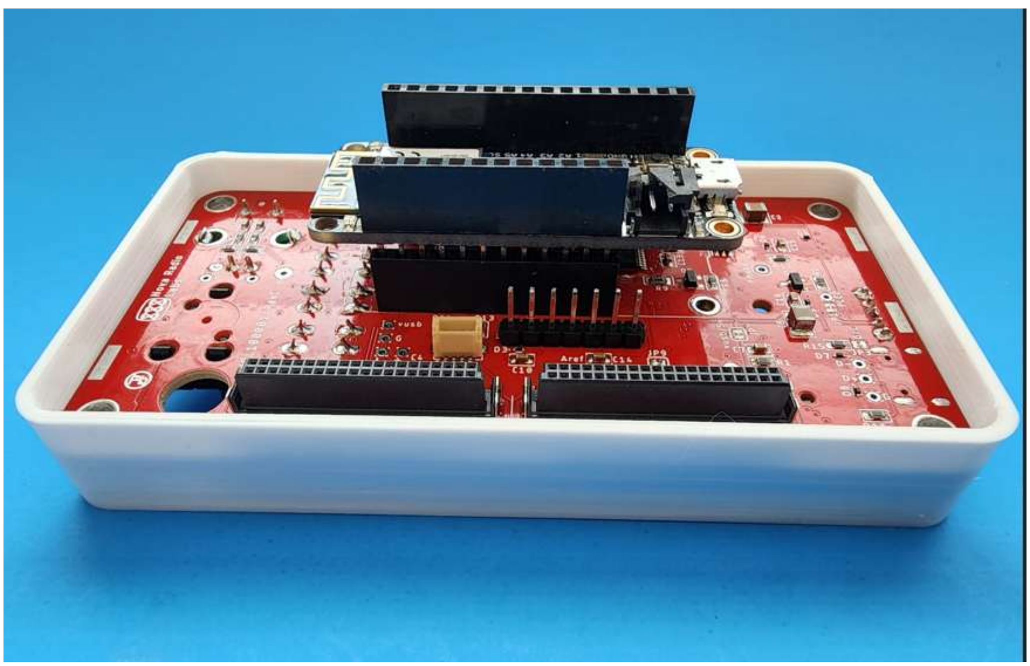
Next slide the LCD Spacer over the LCD as shown. Then snap it into the 3 small holes on the Novaduino® Display PCB.

Fold the Display down into the LCD-holder.

If you decide not to install the Novaduino® Display in a case with a faceplate, the LCD Module can be secured to the PCBA/LCD-holder by cutting a small piece of the included double-sided adhesive foam and applying it to the bottom of the display module and the top of the vertical cross member on the LCD-holder near the tactile switches. Typically, this step is unnecessary when using a case, as the faceplate provides adequate support to hold the display module in place.

Step 7. Attach the Processor Module.

Plug the Feather processor into the 12 and 16 pin headers on the Novaduino® Display as shown below.



7.0 Print the 40 mm Display case, Sensor enclosure, Front Bezel, and Faceplate

Step 8. 3D print or purchase an optional Case, Front Bezel, Faceplate, and Sensor Enclosure.

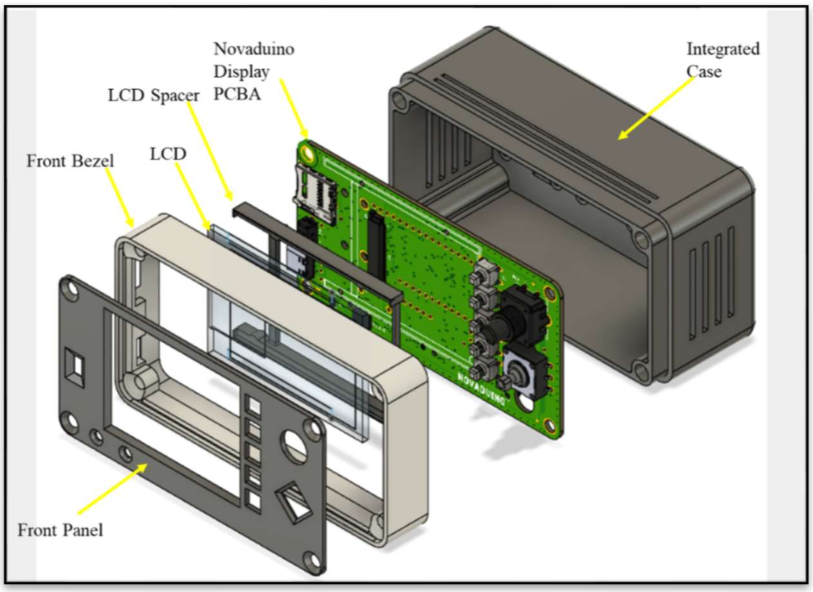
1.	Faceplate	PLA	0.2 mm layer height	No Support Needed
2.	Front Bezel	PLA	0.2 mm layer height	Some Support Suggested
3.	40 mm UltraGA Case	PLA	0.2 mm layer height	No Support Needed
4.	Sensor Enclosure	PLA	0.2 mm layer height	Some Support Suggested

3D-print the STL files provided with KIT005. We use PLA but you may print in other materials. If the size of mounting holes and other parts are too small or too large you may need to scale the STL model in your slicer software. We have printed each file many times with the layer heights listed above on our Bambu Lab P1S printer with good success. You may need to experiment a bit.

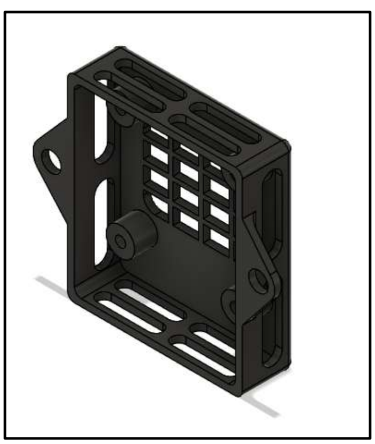
We provide STL, STP and F3D (Autodesk Fusion model) files for the Faceplate so that you can customize it to your liking.

You may also purchase these 3D-printed items from our web store.

Please remember that the final assembled device with a case, although appearing professional, is not a certified product that can be re-sold as one. These 3D-print files are for your own limited and educational use. Also please note that this sensor is not for any safety, medical or finished product usage. We're selling it for hobby education & experimentation and don't guarantee it for *any other* purpose!

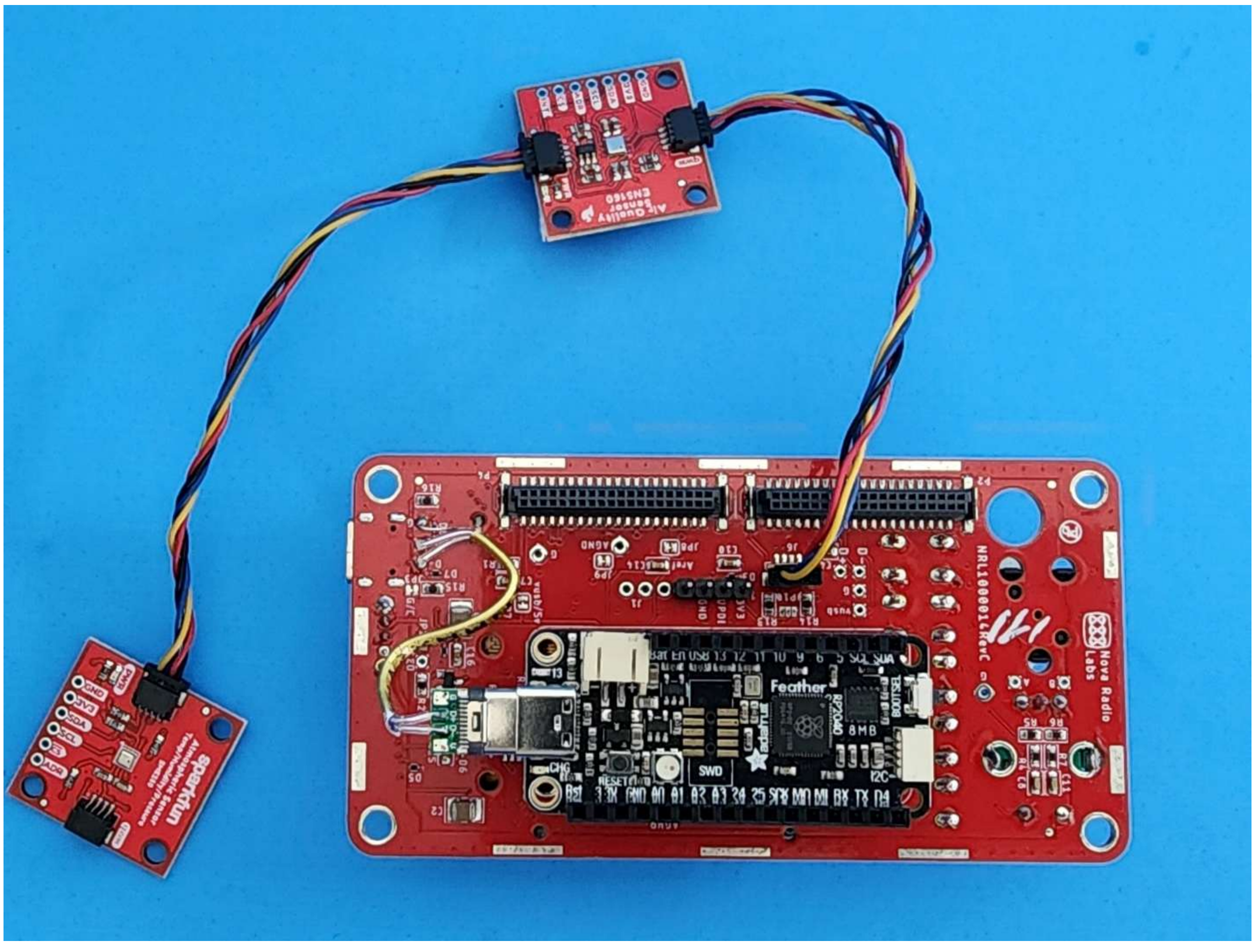


Novaduino® 3D Printed Case



8.0 Assemble the Sensors and Cables

<u>**Step 9.** Attache the ENS160 and the BME280 sensors to the Novaduino® circuit card using the two 100mm Qwiic cables in preparation for testing in a later step.</u>



This shows both the BME280 sensor and the ENS160 sensor connected to the Novaduino® Display PCBA. This example uses the Adafruit Feather RP2040 processor with the optional USB internal jumber cable.

9.0 Load the Software

Step 10. Install the Arduino IDE and load the software.

9.1 Download and Set up the Arduino IDE

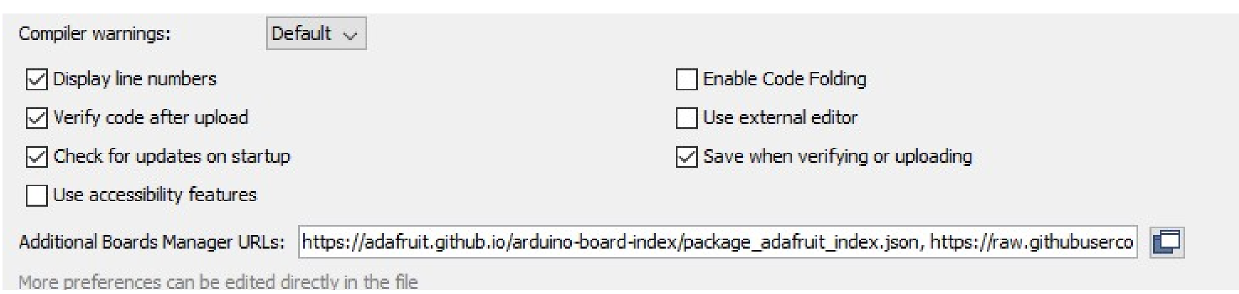
We use the Classic Arduino IDE that can be downloaded at www.arduino.cc. You may try the web version or the version 2, but we have not tested those with the provided program.
Download and install the Arduino IDE.

9.2 Adding Adafruit and SparkFun Board Scripts to the Properties tab

Open the Arduino IDE and go to the preferences under File>Preferences and see the "Settings" tab.
Note the location of your Sketchbook, you'll need to know that later.
We suggest turning-on line numbers.
In the editable one-line block labeled "Additional Boards Manager URLs:" add the following lines for board managers for Adafruit Feather boards and for SparkFun Thing Plus boards, separated by commas as shown:

https://adafruit.github.io/arduino-board-index/package_adafruit_index.json,

https://raw.githubusercontent.com/sparkfun/Arduino_Boards/main/IDE_Board_Manager/package_sparkfun_index.json



9.3 Adding Libraries

9.3.1 Adafruit Libraries

Go to the Libraries tab at Tools>Manage Libraries. Make sure "Type" is set to All and "Topic" is set to All, then in the 3rd box (search box) type Adafruit. This will search for Adafruit libraries only.

Install the following Adafruit Libraries at a minimum:
1. Adafruit GFX Library
2. Adafruit BusIO Library
3. Adafruit ILI9341 Library
4. Adafruit ST7735 and ST7789 Library
5. Adafruit NeoPixel Library
6. Adafruit TSC2007 Library
7. Adafruit TouchScreen
8. Adafruit Zero DMA Library
9. SdFat - Adafruit Fork

If, during installation the library manager suggests other libraries, go ahead and install those too.

9.3.2 SparkFun Libraries

Now in the 3rd box (search box) replace Adafruit with SparkFun.
Install the following SparkFun Libraries at a minimum:

1. SparkFun BME280 Library
2. SparkFun ENS160 Libarary

9.4 Add the Environmental Sensor software to your Arduino folder

The current software is on Github at:

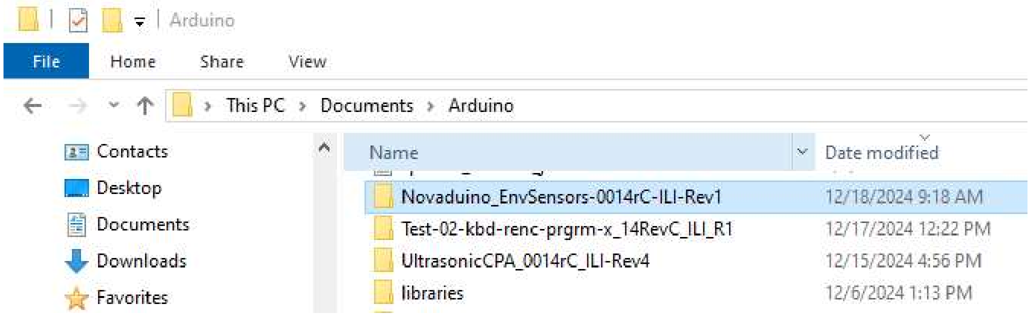
https://github.com/NovaRadioLabs/Novaduino_Environment_Sensors/tree/main

"Novaduino_EnvSensors-RevXXX.ino"

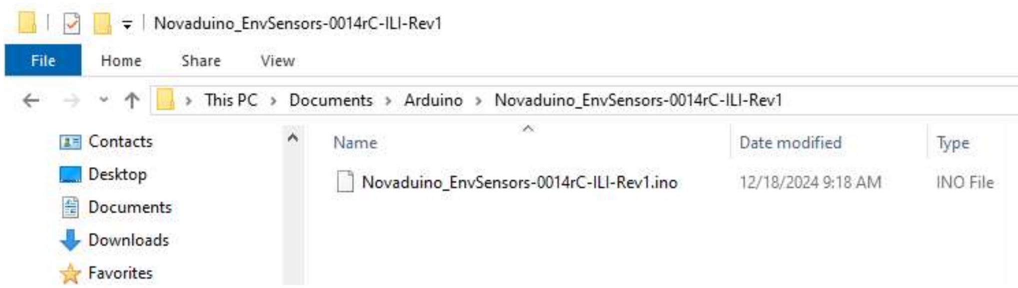
The name may be slightly different.

The classic Arduino IDE requires the *.ino file to be placed in a folder of the exact same name (minus the .ino extension) and then the folder is placed in the Arduino Sketch folder that you noted earlier while setting up Preferences.

It looks like this on my computer.



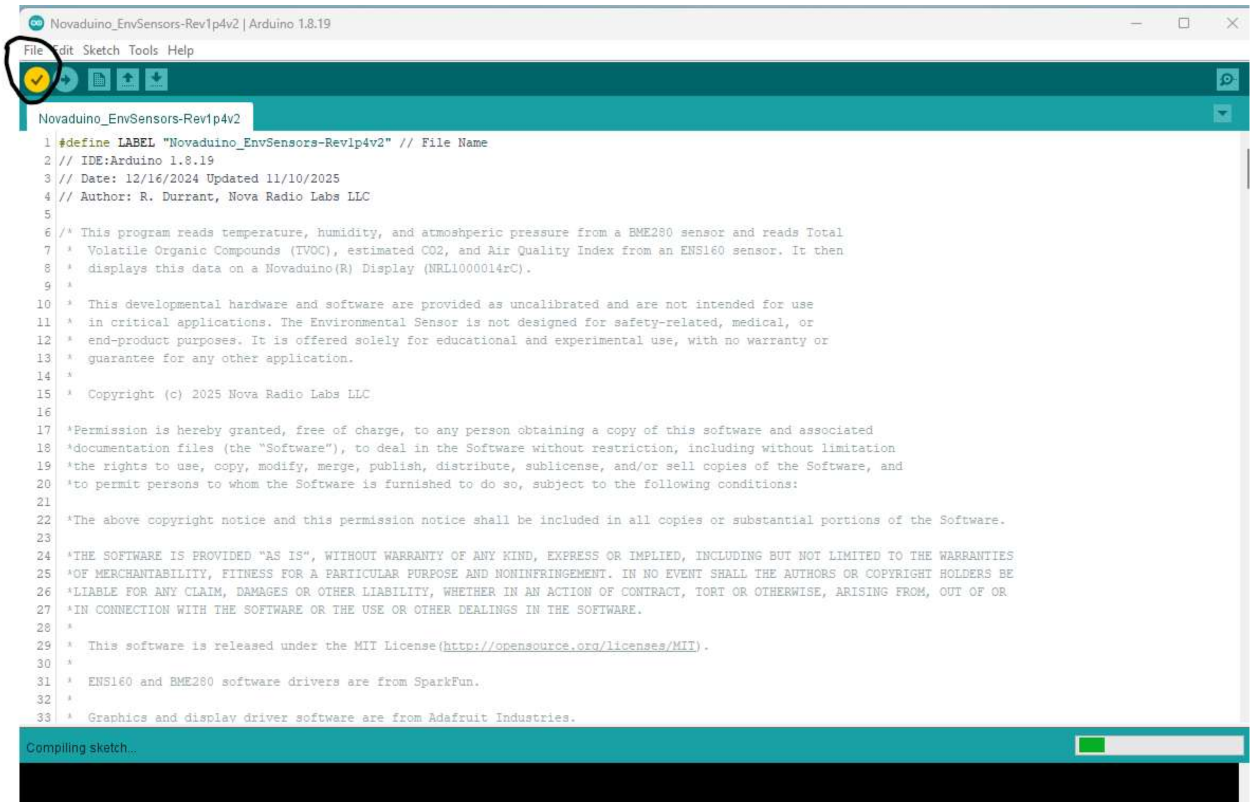
Now open the program file by going to File>Open and select the folder matching the EnvSensors folder that you were provided with. See the screenshot above.



Next open the Novaduino_EnvSensors-RevXXX.ino software by left clicking on it. See the screenshot above.

```

// The following are calibration factors that may or may not be accurate and sufficient.
// Please do your own calibration and determination of sufficiency of these cal algorithms.
#define MYALTITUDE 4005  // enter your altitude (in feet) here to display Sea Level Barometric Pressure
#define TEMPCAL -2.2     // enter temperature calibration data (in degrees F)
#define HUMIDCAL 5.0     // enter humidity calibration data (in %)
//#define LCLPRESS 29.90   // enter local pressure here inHg from reliable source like NOAA.[future release]
#define PRCAL 0.28       // calibration factor for the Barometric Pressure (inHg)

//*******10********20********30********40********50********60********70*******80********90*******100
//***************LCD Drivers************************************************************************
                              // --------------HERE-----------------------------------
#define ILI9341               // either ILI9341 or ST7789. must correspond to the display you have

#include "SPI.h"              // by Arduino.cc
#include "Adafruit_GFX.h"     // graphics library by Adafruit https://www.adafruit.com/product/3787

#if defined(ST7789)
  #include <Adafruit_ST7789.h> // library for ST7789 by Adafruit
#endif

#if defined(ILI9341)
  #include "Adafruit_ILI9341.h"  // library for ILI9341 by Adafruit
```

Note: the first batch of LCDs provided to us by 4D Systems contained the ILI9341 graphics driver chip while later batches contained the ST7735 driver chip. The ILI or ST in the software name as shown above Must correspond to the LCD Display that was provided to you. Your display model number should be indicated on your packing slip paperwork. Change the code right after the "#define" directive shown highlighted above at line 51 to match your display.



Now that the Arduino IDE is all set up with the software and libraries it should compile properly. Try compiling the software by clicking on the check mark as shown above.

9.5 Load the Environmental Sensor .ino software onto the Feather Processor

Make sure that the enable switch on the Novaduino® is off and connect your Feather Processor (it should already be mounted to the Novaduino® Display board) to your computer via a USB cable.

Once that is done, we'll need to select the board.

9.5.1 For Adafruit Feather SAMD Processors:

Go to Tools>Board: Adafruit SAMD(32 bit…)boards and in the dropdown menu select your Feather Processor type. In this case it is "Adafruit Feather M0 Express (SAMD21)"

Also change lines 69 to 71 to match the code below if it does not already match:

```
61   #include "Adafruit_ILI9341.h"  // library for ILI9341 by Adafruit
62 #endif
63
64 //**********************initialize LCD pin Control***************************************************
65
66 // on NRT1000014rC, CS is on D5, DC(Data/Command) is on D6
67 // and Disp_RST(Display Reset) is on A5
68
69 #define TFT_CS        5  // 5 for Arduino and SAMD21 and SAMD51/ D5 for RP2040 <<<------- HERE-----
70 #define TFT_RST       A5 // use A5 for SAMD21 and SAMD51, (use D25 for RP2040) <<<------- HERE-----
71 #define TFT_DC        6  // 6 for Arduino and SAMD21 and SAMD51/ D6 for RP2040 <<<------- HERE-----
72
73 //**********************initialize LCD Driver**********************************************************
74
75 #if defined(ST7789)
```

9.5.2 For SparkFun Thing Plus SAMD51 Processors

Go to Tools>Board: Sparkfun SAMD (32 bit ARM…) boards and in the dropdown menu select your Feather Processor type. In this case it is “SparkFun SAMD51 Thing Plus.”

Also change lines 69 to 71 to match the code below if it does not already match:

```
61   #include "Adafruit_ILI9341.h"  // library for ILI9341 by Adafruit
62 #endif
63
64 //**********************initialize LCD pin Control***************************************************
65
66 // on NRT1000014rC, CS is on D5, DC(Data/Command) is on D6
67 // and Disp_RST(Display Reset) is on A5
68
69 #define TFT_CS        5  // 5 for Arduino and SAMD21 and SAMD51/ D5 for RP2040 <<<------- HERE-----
70 #define TFT_RST       A5 // use A5 for SAMD21 and SAMD51, (use D25 for RP2040) <<<------- HERE-----
71 #define TFT_DC        6  // 6 for Arduino and SAMD21 and SAMD51/ D6 for RP2040 <<<------- HERE-----
72
73 //**********************initialize LCD Driver**********************************************************
74
75 #if defined(ST7789)
```

9.5.3 For Adafruit Feather RP2040 Processors:

Go to Tools>Board: Raspberry Pi RP2040 boards and in the dropdown menu select your Feather Processor type. In this case it is “Adafruit FeatherRP2040”

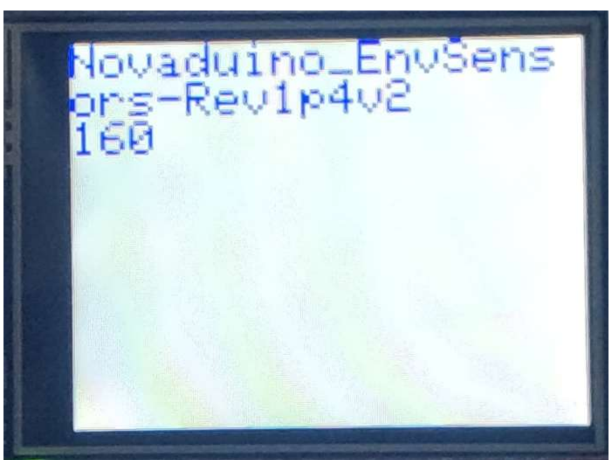
Also change lines 69 to 71 to match the code below if it does not already match:

```
//**********************initialize LCD pin Control*****************************************************

// on NRT1000014rC, CS is on D5, DC(Data/Command) is on D6
// and Disp_RST(Display Reset) is on A5

#define TFT_CS        D5  // 5 for Arduino and SAMD21 and SAMD51/ D5 for RP2040 <<<------- HERE-----
#define TFT_RST       D25 // use A5 for SAMD21 and SAMD51, (use D25 for RP2040) <<<------- HERE-----
#define TFT_DC        D6  // 6 for Arduino and SAMD21 and SAMD51/ D6 for RP2040 <<<------- HERE-----

```

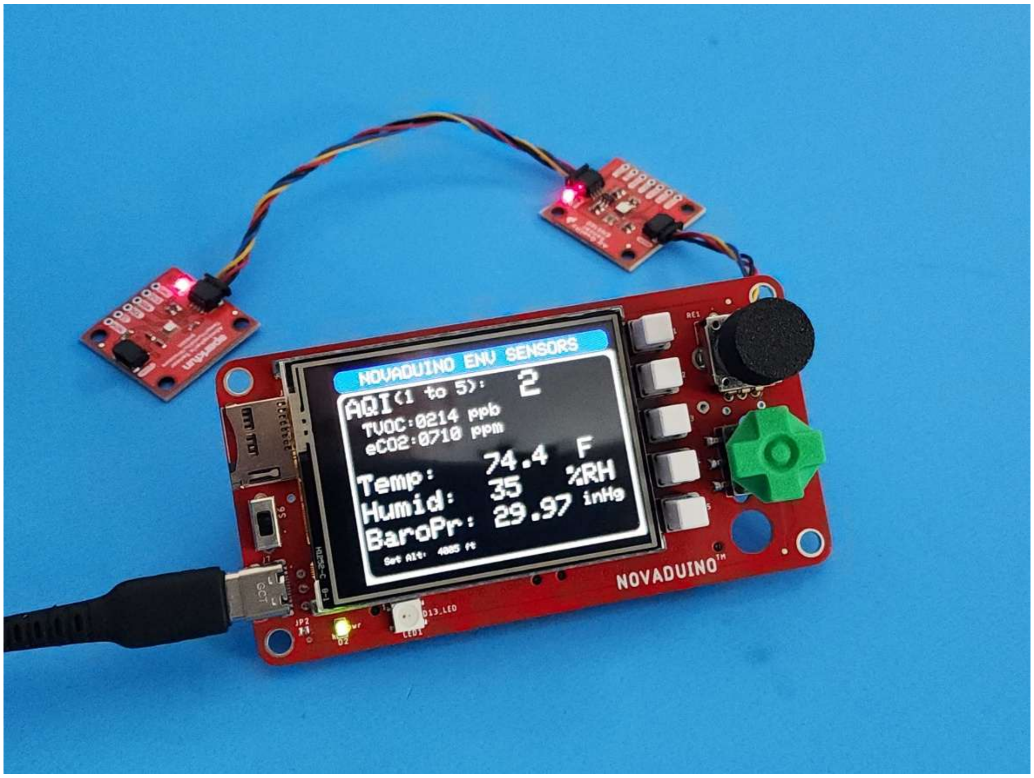
Next, push the enable switch on the Novaduino® to “on” and then double press the reset button located on the Processor board itself. You should hear the computer chime and a new window may pop up. Ignore the new window and go to Tools>Port and select the comm port that shows the name of your Feather board next to it.

To verify that the Feather Processor is connected and working properly, go to Tools>GetBoardInformation. If all is working, then you should see a small popup window showing the name of the board, the USB VID and PID numbers and the serial number of the board. Click okay to dismiss this window.

Now we are ready to upload the Novaduino® Environmental Sensor ino software to the Feather Processor. Left click on the right pointing arrow key icon in the upper left corner of the Arduino IDE and wait for the program to upload to the processor.



Once the software is uploaded, the processor will reboot and then the flash screen will be shown for 3 seconds. (your version may be newer than the one shown here)



The Novaduino® Environmental Sensor with the software loaded and the sensors connected. This Novaduino® Display PCBA has all the optional tactile switches and the optional Navigation switch installed.

9.6 Adjust Altitude for Barometric Pressure Reading

To display Barometric Pressure at equivalent sea level, you need to adjust MYALTITUDE in the software to match your actual altitude above sea level (in feet). This can be found on the internet by doing a search for “what is my elevation.” We have used whatismyelevation.com to successfully determine out altitude at 4005 feet which is why the MYALTITUDE is set to this.

You can also set MYALTITUDE to 0.0 to determine the actual Barometric Pressure at your location. Weather stations, however, typically provide equivalent sea level Barometric readings.

We plan to add the ability to set the MYALTITUDE variable via the rotary encoder in a future release of the software.

You should probably also calibrate your barometer reading. We have provided a PRCAL variable for this purpose, but it is not guaranteed to be the best method of calibration as it is only a linear calibration. Actual calibration may not be linear, we have not determined this, so it is up to you to determine.

Please do not use this Barometer for any critical applications, we do not guarantee its accuracy.

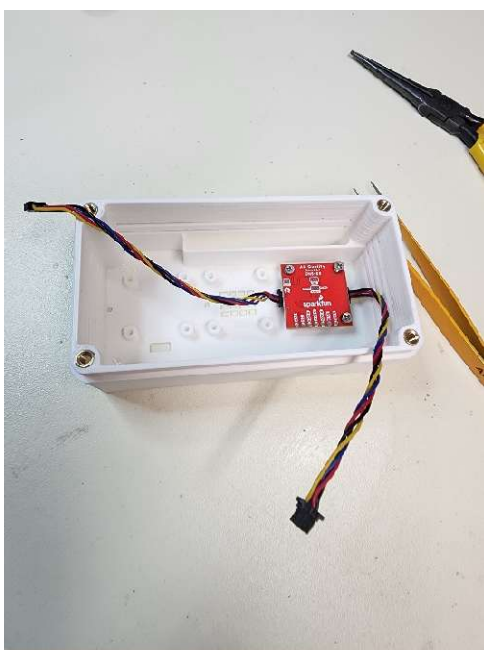
10.0 Final Assembly

10.1 Assemble the Case

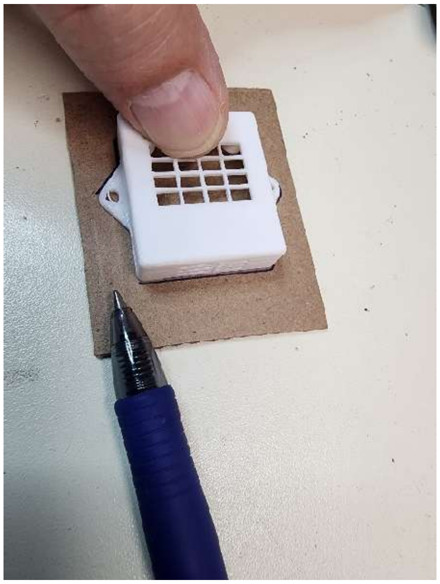
Step 11. Insert the EZ-LOKs into the main case

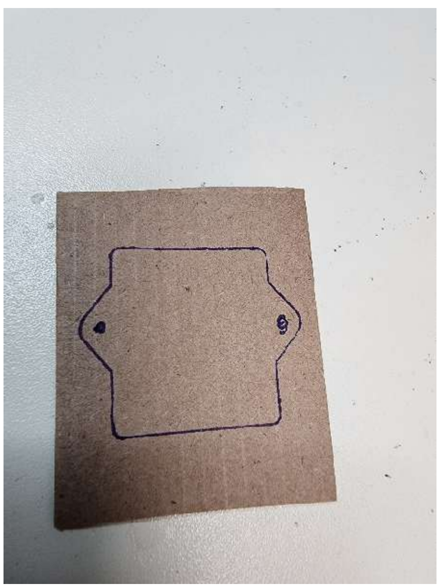
Press the EZ-Lok-inserts into the main case as shown with the open slot down, and then tap until flush with the case using a small hammer.

Step 12. Mount the Sensors to the Case

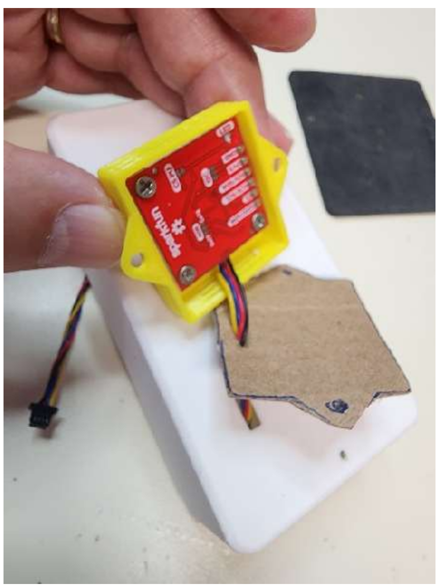


Mount the ENS160 sensor as shown here with the 2 Qwiic cables attached.


Trace an outline of the Sensor Enclosure on a piece of cardboard as shown here.


Cut along the traces on the cardboard to make an insulating gasket for the BME280 sensor.

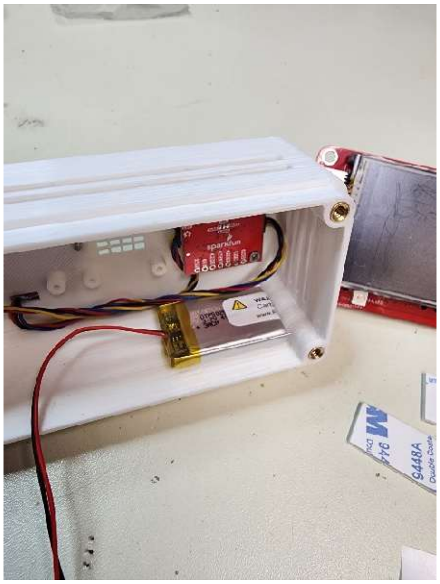
Also poke holes for the screws and cut a wide slit for the Qwiic connector as shown here.



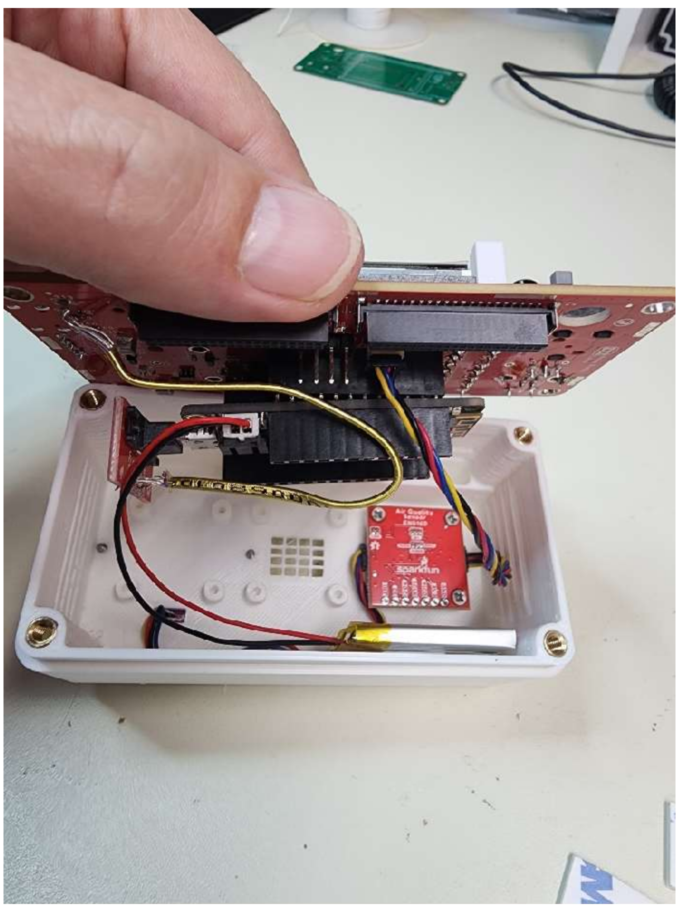
1st attach the Qwiic cable to the BME280 sensor and then attach the BME280 sensor to the Sensor Enclosure with 3 of the ¼” #2 self-tapping screws. Next pass the Qwiic connector through the cardboard insulator and the small rectangular hole in the case as shown here.

Attach the Sensor Enclosure to the Case with 2 of the ¼" #2 self-tapping screws as shown here.

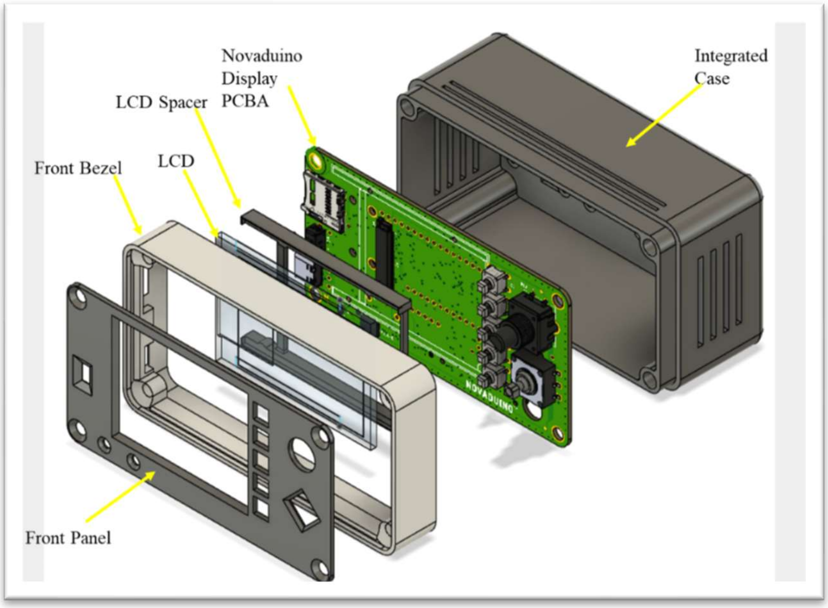
Plug the Qwiic cable from the BME280 into the ENS160 Qwiic jack as shown here.



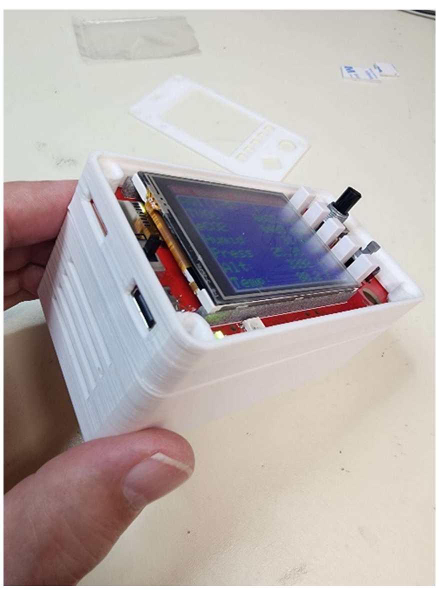
Optional: if you have purchased a Lithium Ion battery, attach it as shown here using the double sided sticky pad.



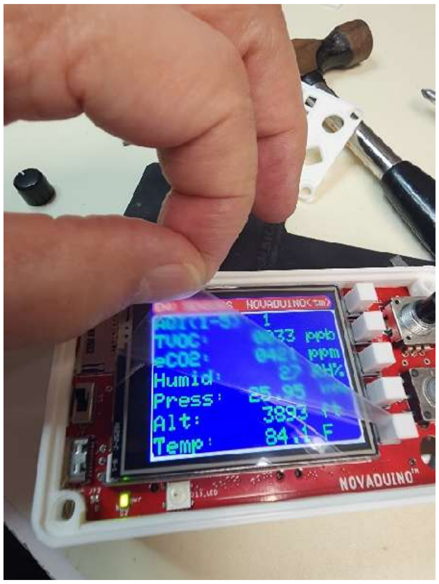
Plug the Qwiic cable into the Novaduino PCBA as shown here. Also plug the optional battery into the Feather.



Assembly overview



Mount the Novaduino PCBA into the Front Bezel as shown here and assemble with the case.



Remove the screen protector.


Attache the light pipes to the Faceplate. We suggest using a little bit of glue to hold them in.

The finished Novaduino Environmental Sensor Kit.

11.0 Software Adjustments and Customization

The open-source code for the Novaduino® Environmental Sensor Kit has several adjustments and customizations that may be made with very little effort.

Please save the code to a new file name so that no one will confuse it with the code that you downloaded from our GitHub site and so that you can easily go back to that code if needed.

Locations where you can easily make changes are marked like this: ---------HERE---------.

Please re-compile the code to make sure you have not made any errors before loading it onto your processor.

11.1 Adjust the top banner text:

Personalize your device by putting your name or anything else in the top banner text.

```
  tft.setTextColor(TOPTEXT);
  tft.setTextSize(2);
  tft.println("  NOVADUINO ENV SENSORS ");  // change this to whatever you would like<<----HERE-----

//SETUP******draw the Large DataBox  ****************************************************************

// this box is 316 pixels wide by 24 pixels tall, at the top of the screen.
```

11.2 Add more colors to the color map:

You can define more colors for the Color Map. Both ST7789 and ILI9341 color displays that we use in the Novaduino® Display use the same RGB565 serial word format for color. That's 5bits Red/6 bits Green/5 bits Blue expressed in a 4 digit Hexadecimal number as in the code below. Search online for "RGB565 color picker." We have used: [RGB565 Color Picker - Barth Development] successfully for this purpose.

We created a Color Map so that the code works with either display driver, otherwise we would need to switch between colors such as ST77XX_WHITE or ILI9341_BLUE for example whenever a different display driver chip is used.

```
// Color Map that works with both display drivers

#define BLACK   0x0000
#define BLUE    0x001F
#define RED     0xF800
#define GREEN   0x07E0
#define CYAN    0x07FF
#define MAGENTA 0xF81F
#define YELLOW  0xFFE0
#define WHITE   0xFFFF
#define GREY    0xCE79
#define LIGHTGREY 0xDEDB

//*****-------------Item Colors --------------------
```

11.3 Adjust the color scheme:

You may experiment with the background color, text colors, top banner colors etc… using the definitions shown below. The ALTTEXT definition is not currently used and is for future use when we add code to adjust various values using the keys and/or the rotary encoder. You can use the colors from the Color Map, or you could use colors from the display drivers such as ST77XX_WHITE or ILI9341_BLUE for example.

```

//*****-------------Item Colors ------------------------------HERE-------
#define TOPBOX BLUE
#define TOPTEXT WHITE
#define BACKGROUND BLACK
#define TEXT WHITE
#define ALTTEXT GREEN

```

11.4 Adjust Your Elevation:

We have already discussed this earlier, but you can adjust your elevation using the MYALTITUDE definition. This will make the Barometric Pressure readout show your equivalent sea level pressure which is what weather stations normally provide. We have had success using the website: www.whatismyelevation.com. Also, adjust this to 0 if you would like to display the true pressure where you are.

```

// The following are calibration factors that may or may not be accurate and sufficient.
// Please do your own calibration and determination of sufficiency of these cal algorithms.
#define MYALTITUDE 4310  // enter your altitude (in feet) here to display Sea Level Barometric Pressure
#define TEMPCAL -2.2     // enter temperature calibration data (in degrees F)
#define HUMIDCAL 5.0     // enter humidity calibration data (in %)
//#define LCLPRESS 29.90   // enter local pressure here inHg from reliable source like NOAA.[future rel
#define PRCAL 0.25       // calibration factor for the Barometric Pressure (inHg)

//*******10********20********30********40********50********60********70*******80********90*******100
```

11.5 Adjust Temperature, Humidity, and Pressure Calibration:

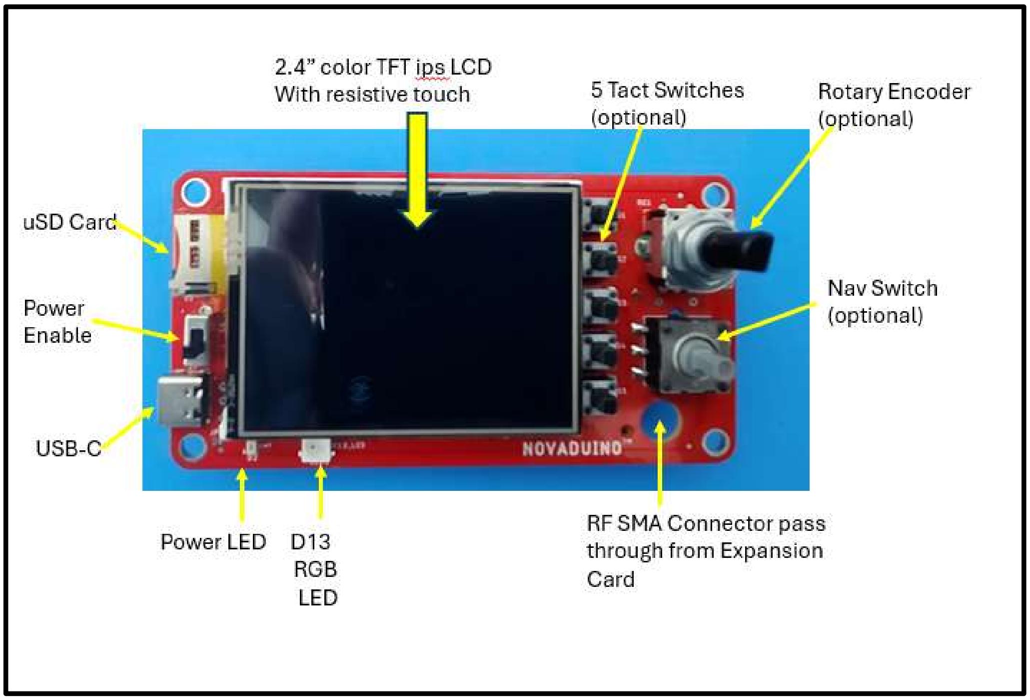
See the code snippet above. These calibration values are simply added to the Temperature or Humidity or Pressure measurements and may not be sufficient to calibrate these values at all the conditions that you may encounter.

You may want to come up with your own calibration algorithms if you need better accuracy. Or you can also change the sensors for more accurate sensing if you desire. You can even add our “Prototype Expansion Card” to add additional circuitry for larger sensors or more signal conditioning.

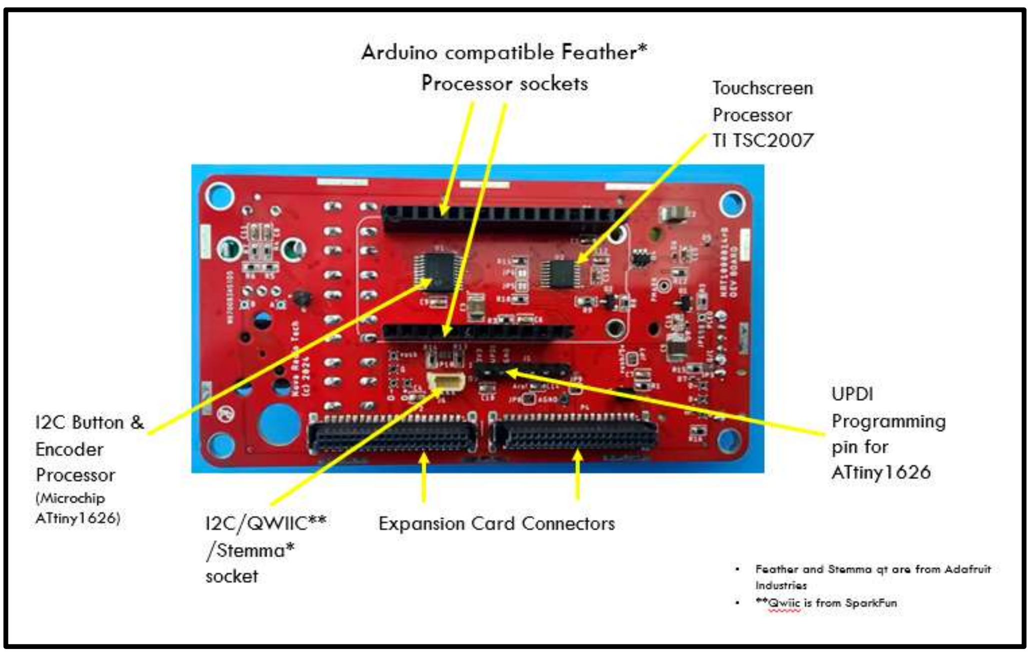
12.0 Appendix

Feather Processors support Arduino programming, microPython, CircuitPython*, or other languages supported by the processor manufacturer. Processors that may be used with the Novaduino® Display PCBA include:

Processor	Supplier	Part number	Processor/Clock speed	note
Feather M0	Adafruit	2772 or 3403	Cortex®M0/48 MHz	stocked by Nova Radio Labs
Thing Plus SAMD51	SparkFun	DEV-14713	Cortex®M4+/120 MHz	stocked by Nova Radio Labs
Feather M0 WiFi	Adafruit	3044	Cortex®M0/48 MHz Supports: 2.4 GHz Wi-Fi	stocked by Nova Radio Labs
Feather M4	Adafruit	3805	Cortex®M4+/120 MHz	stocked by Nova Radio Labs
Feather RP2040	Adafruit	4884		Works with Novaduino, soon to be stocked by Nova Radio Labs
Thing Plus RP2040	SparkFun	DEV-17745	two Cortex®-M0+/ up to 133MHz	Still in test, but should work with Novaduino™
Thing Plus STM32	SparkFun	DEV-17712	Cortex®-M4/up to 168 MHz	Still in test, but should work with Novaduino™
Thing Plus - ESP32-S2 WROOM	SparkFun		LX7/up to 240 MHz Supports: 2.4 GHz Wi-Fi	Still in test, but should work with Novaduino™
Thing Plus ESP32-C6	DEV-22924	WRL-15663	RISC-V/up to 160 MHz Supports: 2.4 GHz WiFi 6, Bluetooth® 5.3, Zigbee and Thread (802.15.4),	Still in test, but should work with Novaduino™
Most any Feather form factor processor that has the Feather pinout should work. See the Novaduino Users Guide for technical details.				
Raspberri Pi				Many versions can be mounted to the Novaduino™ Proto Expansion Card and drive the Display and controls



Assembled Novaduino® Display top side



Assembled Novaduino® Display bottom side

13.0 Notes and Disclaimers

*Please note that while the final assembled device with its enclosure may appear professional, it is not a certified product. This Environmental Sensor Kit is intended solely for educational purposes and as a demonstration of Novaduino® technology only. Nova Radio Technologies assumes no liability for any use or misuse of this educational product. The Environmental Sensor Kit is strictly for personal, non-commercial, and instructional use.

*We do not guarantee the Accuracy of the ENS160 sensor nor the BME280 sensor. Please see the manufacturers data sheets for these sensors for information on their accuracy and how to calibrate them. We offer some calibration variables in the open-source code for this Environmental Sensor purely as educational information and we do not guarantee their effectiveness nor their accuracy.

*The 3D print files for the Novaduino® Environmental Sensor Demonstration Kit includes STL files for the Front Bezel, the Vented Case, the Sensor Enclosure, and the Faceplate/Front Panel with 3 buttons and rotary encoder. These files as well as additional files may be sold for a small fee and are for your limited personal use only. The 3D print file kit also includes the Faceplate STL, STP and F3D files so that you can customize the front panel however you like.

* These are Trademarks for Arduino, Adafruit Industries, Feather, SparkFun Electronics, Thing Plus, ARM Cortex, Hammond, 4D Systems, etc…

*Novaduino® is a registered trademark of Nova Radio Labs LLC

*The Novaduino® Display PCBA and Expansion Proto Card PCBA are Development Boards. They have been designed with lead-free components, materials, and PCB processes. They are not yet RoHS, UL, FCC, nor CE certified.