



NOVADUINO[®] DISPLAY USER MANUAL

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Rev1.2

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Table of Contents

1.0	Novaduino® Display User Manual.....	3
2.0	Novaduino® Display PCBA Overview (NRL1000014rC)	3
3.0	Novaduino® Display Features and Interfaces	4
4.0	Novaduino® Display Block Diagram	6
5.0	Feather Socket and Power	7
5.1	Feather Processor and Socket	7
5.2	Processor Software	8
5.3	Processor Mounting Options	8
5.4	Power Supply	10
5.5	LCD BACKLIGHT	12
5.6	VREF strap, Chassis/Ground straps, and 5v Vusb straps	13
6.0	USB Data Interface	13
7.0	Color TFT IPS Resistive Touch 240x320 Display	14
8.0	Touch Controller	15
9.0	Key-Scan and Encoder Processor	16
10.0	Micro-SD Card	17
11.0	Expansion Capability	18
12.0	Novaduino® Display Demonstration Software	21
12.1	Download and Set up the Arduino IDE	22
12.2	Adding Adafruit and SparkFun Board Scripts to the Properties tab	22
12.3	Adding Libraries	23
12.3.1	Adafruit Libraries	23
12.3.2	Now in the 3 rd box replace Adafruit with SparkFun.	23
12.4	Add the Display Demo software to your Arduino folder	23
12.5	Load the “Demo_Test-A_NovaduinoDisplayRevC_V1p1.ino” software onto the Feather Processor 26	
12.5.1	For Adafruit Feather Processors:.....	26
12.5.2	For SparkFun Thing Plus SAMD51 Processors	26
13.0	3D Printed Case and other Options	28
13.1	Customizable Faceplate	28
13.2	Front Bezel	28
13.3	40 mm case w/integrated back panel.....	29
13.4	120mm case	30

13.4.1	Back Panel.....	30
13.5	Nav Switch Cap	31
13.6	Sensor Cover	31
14.0	3D Printed Case Assembly	32
15.0	Appendix	33
16.0	Disclaimers	33

1.0 Novaduino® Display User Manual

This manual outlines the interfaces and electrical design of the Novaduino® Display, enabling users to develop software or enhance hardware capabilities for creating customized electronic devices.

2.0 Novaduino® Display PCBA Overview (NRL1000014rC)

Novaduino® is a powerful, customizable platform for creating microcontroller-based Color Display projects. It works with a Feather*-compatible processor (not included) and includes a Graphic 2.4-inch Color LCD with a resistive-touch panel as well as files for 3D-printing your own case. Optional control buttons, a multi-directional navigation switch, and a rotary encoder may also be added.

The platform is also built for easy expansion: the display board connects to additional components via two sturdy 40-pin connectors and a large 100mm x 120mm Proto Expansion Card (see KIT002). Design details are also available so that you can design your own expansion card.

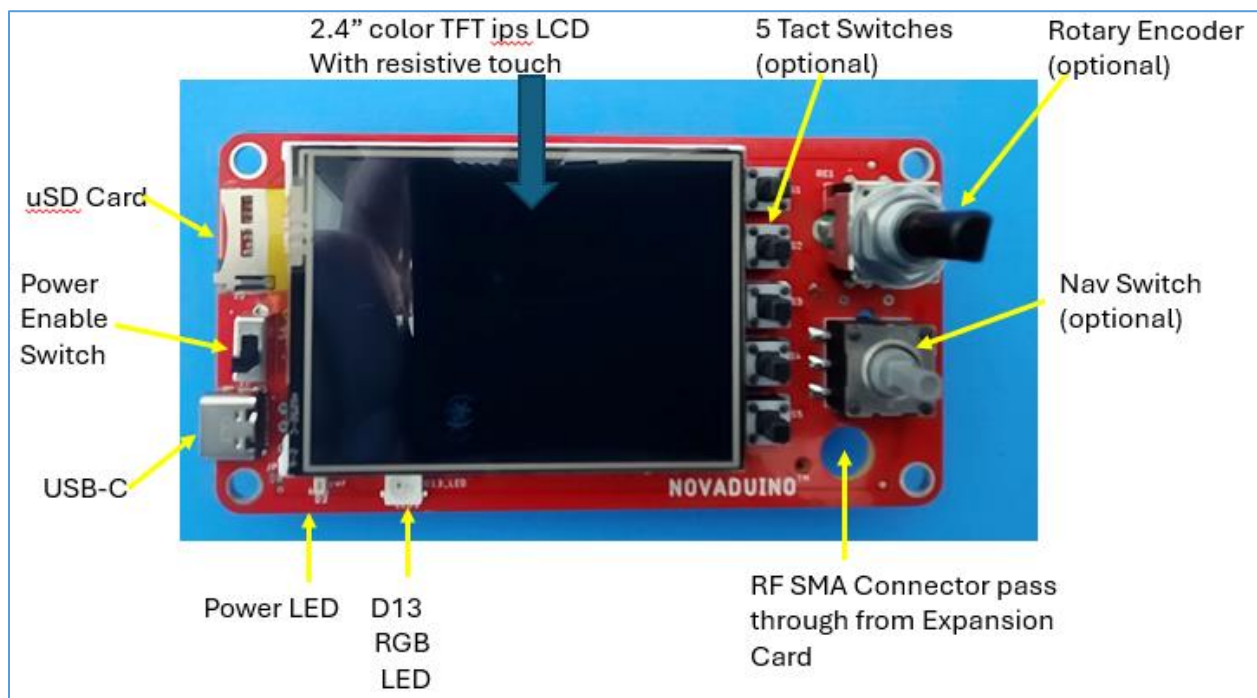
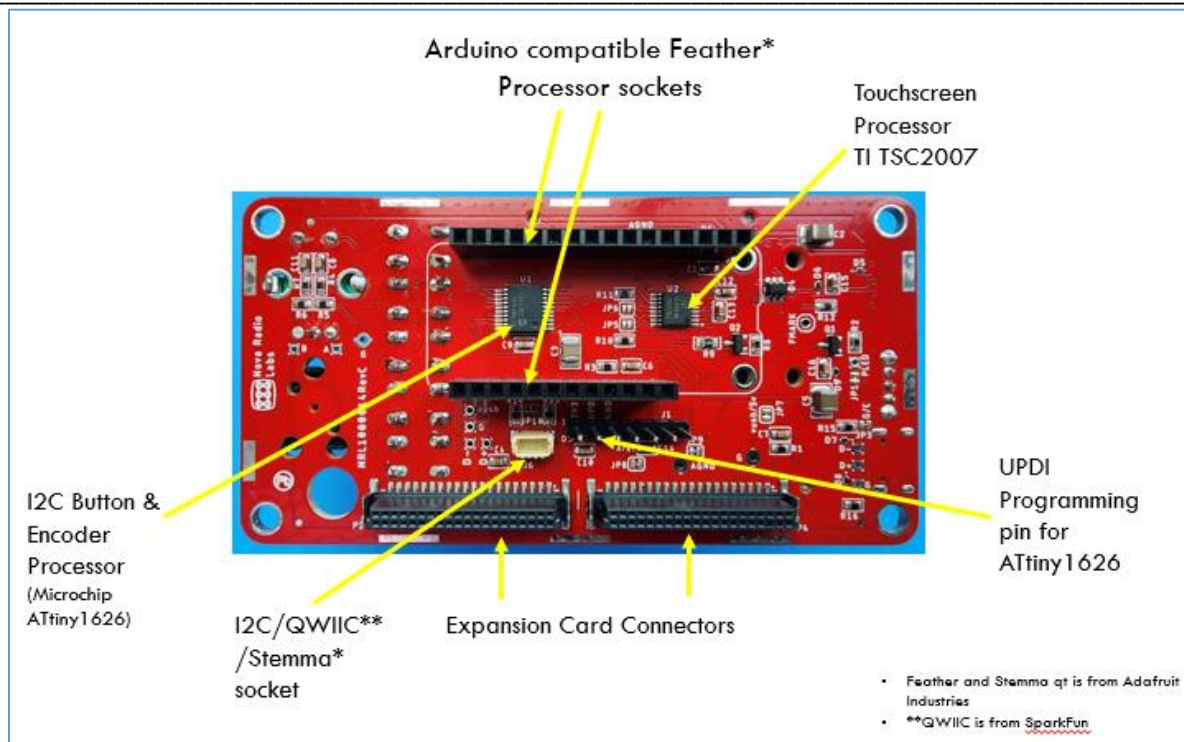


Figure 1. Novaduino® Display front view with all optional controls installed



3.0 Novaduino® Display Features and Interfaces

Key Features of NRL100014RevC Novaduino® Display PCBA

- **A 2.4-inch TFT LCD 320x240 IPS Display with Resistive Touchscreen**
 - [4DLCD-24320240-ips-rtp from 4D Systems]
- **Modular Expansion** via 2x40 pin reliable connectors and a 100 mm wide expansion PCB assembly. The Prototype Expansion Card is available for bread boarding your circuits.
 - [KIT002 or NRL100013RevB from Nova Radio Labs LLC]
- **Customizable Controls** with up to 5 front panel buttons, a rotary encoder, and a 5-way multi-directional navigation switch. All are high quality components. These are optional components that are available from Nova Radio Labs or other sources.
 - [TL1105SPF160Q Tact Switch from E-Switch]
 - [PEC12R-3220F-S0024 Encoder w/ 24 detent and SPST center button from Bourns]
 - [JS5208 multi-directional 5-way navigation switch from E-Switch]
- **Micro-SD Card Socket** connected to the Feather Processor via SPI bus for additional storage.
- **USB-C Interface** Connector for power and optionally also for data. For Data connection to the USB connector on the front panel please purchase one of the following:
 - [“USB micro-B Jumper Kit” if your Feather has a USB micro-B connection]
 - [“USB-C Jumper Kit” if your Feather has a USB-C connection]
- **Support for your choice of Feather Processor**, including Adafruit Feather and Spark Fun Thing Plus - processor modules that can be programmed in Arduino, microPython, CircuitPython and

other languages. (KIT001 does not include a Feather Processor, this must be purchased separately)

- Support for Wi-Fi, Bluetooth, and LoRa radio through selection of Feather form-factor modules.
- Support for Li-Ion Batteries via the Feather processor. Most Feather processors also provide Li-Ion Battery charging.
- **A Key-Scan and Rotary Encoder Processor** that provides key scanning for all the tact switches, the 5-way navigation switch, as well as the rotary encoder reading so that you don't need to worry about skipped or multiple-count increments. The ATtiny1626 processor is pre-programmed and provides its reading to the Feather processor via the TWI(I2C) bus whenever it detects a change. [at TWI/I2C address 0x40]
- **On board resistive touch controller** with TWI(I2C) bus interface to the Feather Processor.
 - [TSC2007 from Texas Instruments at TWI(I2C) address 0x48]
- **Power Enable Switch**
- **I2C/TWI/QWIIC*/Stemma-QT* connector** allows easy connection to a wide choice of sensors and compatible hardware modules. The included TWI(I2C) bus pull-up resistors can be solder bridged-in if needed.
- **Power LED.** This LED can be disconnected and repurposed to a GPIO pin if desired.
- **Red/Green/Blue LED** connected to D13 on the Feather Processor.
 - [WS2812]
- **Front Panel Pass-through** hole – accommodates an RF SMA connector on the Proto Expansion Card. May also be used for other types of connectors mounted to an Expansion Card.
- **3D-Printable Case Options** and compatibility with Hammond metal enclosures.
 - **Front Bezel** STL file for 3D printing or a pre-printed Front Bezel may be purchased.
 - **40 mm case w/integrated back panel** STL file for 3D printing or a pre-printed case may be purchased.
 - **120mm case** STL file for 3D printing or a 1455N12xx metal case from Hammond may be purchased.
 - **Back Panel** STL file for 3D printing or a pre-printed Back Panel may be purchased. This fits either the 120mm 3D printed case or the Hammond case
 - **Nav Switch Cap** STL file for 3D printing or a pre-printed Nav Switch Cap may be purchased.
 - **Sensor Cover** STL file for 3D printing or a pre-printed Sensor Cover may be purchased. This holds a 1" x 1" or smaller module onto the back of the 40 mm case. We use it to isolate the temperature/humidity/pressure sensor from the internal electronics.
 - **Customizable Faceplate** – both STL and f3d files are provided so that you can completely customize a Faceplate with your own design, labels, logos, and name as you desire. CNC, laser engrave, 3D-print or add your own graphics.
- **Circuit Design Features** also include: ESD protection diodes, Isolatable Chassis and ground system, Chassis/shield connection to metal cases, all lead free components, and a 4-layer PCB with EMC design in mind (not yet certified.)

4.0 Novaduino® Display Block Diagram

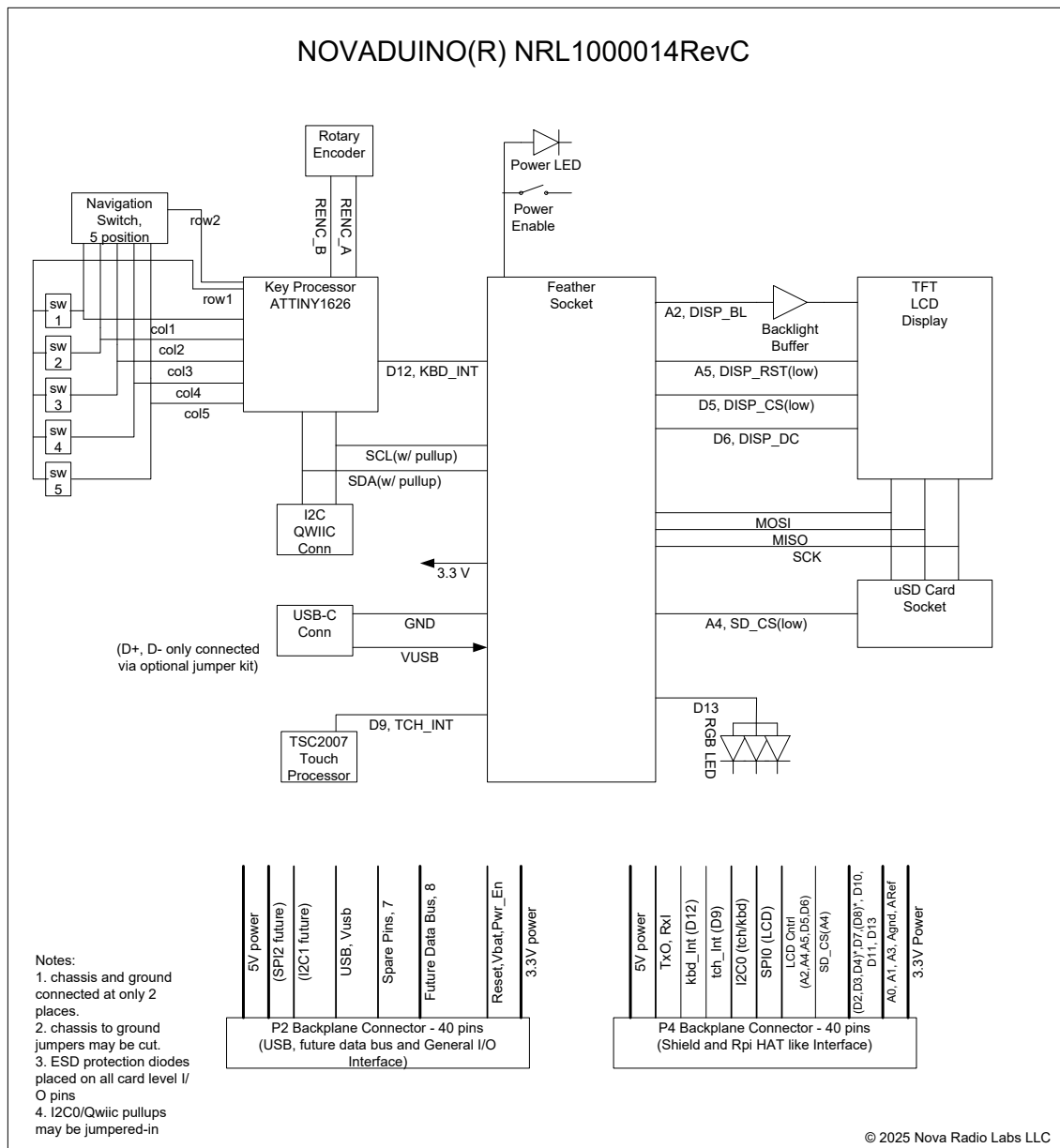


Figure 3. Novaduino® Display Block Diagram

5.0 Feather Socket and Power

5.1 Feather Processor and Socket

The Feather Processor system from Adafruit was chosen for Novaduino® because of the wide variety of processors that are available. Novaduino® has been tested with the Adafruit SAMD21 Feather M0 processor running at 48 MHz, the Adafruit SAMD51 Feather M4 processor running at 120 MHz, and with the SparkFun Thing Plus SAMD51 processor running at 120 MHz. Future testing is planned with the processors shown in the table below.

Table 1. Feather Processor Modules

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	two Cortex®-M0+/ up to 133MHz	Not tested yet, but should work with Novaduino®
Thing Plus RP2040	SparkFun	DEV-17745	two Cortex®-M0+/ up to 133MHz	Not tested yet, but should work with Novaduino®
Thing Plus STM32	SparkFun	DEV-17712	Cortex®-M4/up to 168 MHz	Not tested yet, but should work with Novaduino®
Feather STM32F405	Adafruit	4382	Cortex®-M4/up to 168 MHz	Not tested yet, but should work with Novaduino®
Feather RP2350	Adafruit	6000	Dual M33 core/up to 150 MHz	Currently in Test
Thing Plus - ESP32-S2 WROOM	SparkFun		LX7/up to 240 MHz Supports: 2.4 GHz Wi-Fi	Not tested yet, 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),	Not tested yet, but should work with Novaduino®
Adafruit ESP32 Feather V2 with w.FL Antenna	Adafruit	5438	ESP32 Dual core 240MHz Xtensa® processor. Integrated 802.11b/g/n HT40 Wi-Fi. Integrated dual mode Bluetooth (classic and BLE)	Not tested yet, but should work with Novaduino®

-Most any Feather form-factor processor that has the Feather pinout should work. Software changes may be required.
-Almost any processor can be mounted to the Novaduino® Proto Expansion Card and drive the Display and controls through the backplane connectors. Logic level translators may be required.
-Nova Radio Labs is not responsible for Processor performance and reliability.

5.2 Processor Software

Feather Processors support Arduino programming, C/C++, MicroPython, CircuitPython*, or other languages supported by the processor manufacturer. We provide demonstration code written in Arduino C. Please see the software section later in this document or see <https://github.com/NovaRadioLabs> .

5.3 Processor Mounting Options

There are several methods for attaching the Feather processor to the Novaduino® Display board. We do not provide the Display board with pre-soldered headers to ensure you have maximum flexibility in your design.

1. The most typical mounting method involves soldering female headers (one 16-pin and one 12-pin) onto the Display board and stacking headers on the Feather processor.

Other methods for mounting the Feather processor to the Display board include:

2. Utilizing a 16-pin and a 12-pin male header to solder the Feather processor permanently to the Display board.
3. Using a female header on the Display board and male headers on the Feather processor.
4. Mounting any compatible processor to the Novaduino® Proto Expansion Card, which can drive the display and key interfaces over the backplane.

The first method provides maximum flexibility by allowing direct connections to the Feather processor using breadboard jumper wires or by stacking Feather Wings directly onto the processor.

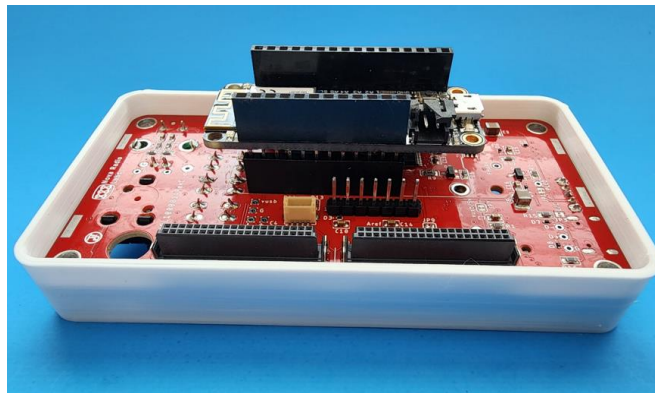


Figure 4. Feather mounting method 1, most flexible but tallest option

The second method offers a minimum height solution for a compact device but makes changing the Feather processor very challenging. However, components or wires can still be soldered to the Feather pins if necessary. Feather Wings will need to be mounted to the Novaduino® Proto Expansion Card or a custom Expansion Card.

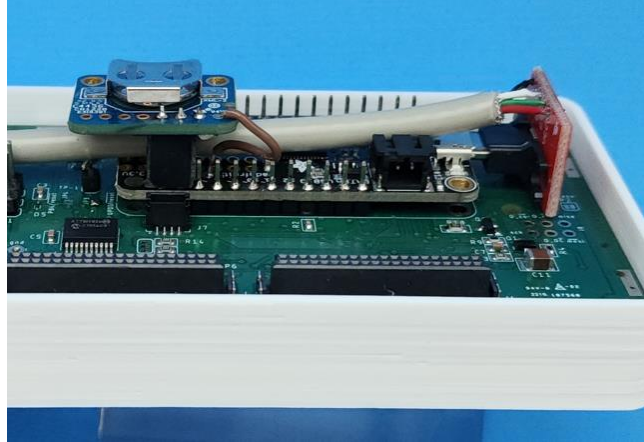


Figure 5. Mounting method 2, also showing a Real Time Clock module and a USB data cable kit

The third method reduces some height while allowing easy replacement of the Feather processor, though it restricts direct connections to soldering components or wires to the Feather pins, as in the second method. Additional circuitry, including Feather Wings, can always be incorporated using the Novaduino® Proto Expansion Card or a custom Expansion Card.

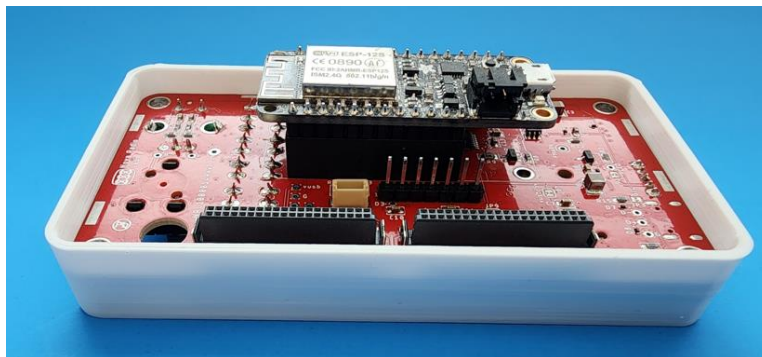


Figure 6. Mounting method 3, male headers on Feather module

The fourth approach entails leaving the processor slot on the Novaduino® Display PCBA unpopulated and instead installing a processor onto a Novaduino® Proto Expansion Card. This configuration accommodates a wide range of processors, including Feather processors, Raspberry Pi running Linux OS, ESP32, Teensy processors operating at speeds up to 600 MHz, or even a Single Board Computer. Additionally, as the Display PCBA does not host a Feather processor to step down voltage from 5 volts to 3.3 volts, it is necessary to provide a 3.3-volt supply to the Display PCBA via the expansion connectors from the Expansion Card.

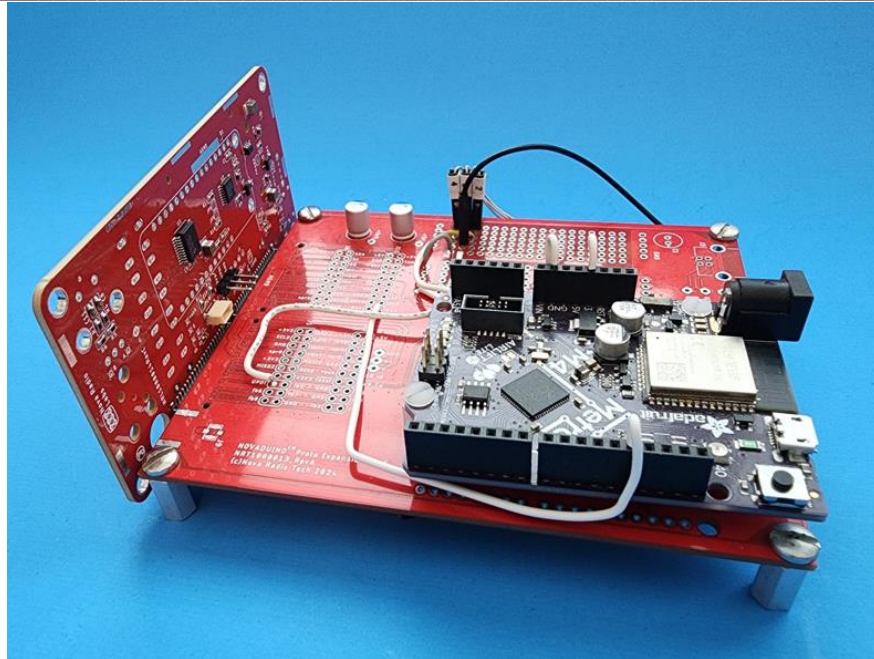


Figure 7. Mounting method 4 using a Novaduino® Prototype Expansion Card with a processor

5.4 Power Supply

The Novaduino® Display board provides 5 Volt power to the Feather module through the USB-C connector. The Feather module's regulator IC then provides 3.3 volts back to the Novaduino® Display board and all its components. The Feather module can also be connected to a LiPo battery that will power the Feather and the Novaduino®. The LiPo battery is charged through the Feather charging circuitry whenever power is provided through the Novaduino® USB-C connector.

Power can also be provided to the Novaduino® Display PCBA and the Feather through the native Feather USB connector. This is usually only used during programming of the Feather processor. Never connect both USB connectors at the same time.

Most Feather processor boards can deliver up to 500 mA at 3.3 V (please verify your own chosen Feather's capability). The TFT LCD display uses about 100 mA with full brightness of the backlight and consumes less current when the backlight is dimmed using a PWM port from the processor. Be careful not to exceed the 500 mA limit.

If more than 500 mA is required, 5 Volt power can be supplied to the Novaduino® Display board (and subsequently to the Feather Module) through the backplane connectors J2 and/or J4. The optional Novaduino® Expansion Prototype Card (KIT002) can be populated with a USB-B connector to supply 5 Volts to the entire system. Or a custom power supply circuit can be built onto an Expansion Card.

For interface purposes, the Novaduino® uses 3.3 Volt interfaces, not 5 Volts. Do not connect 5-volt signals to the Feather interfaces to avoid failure of the Feather module and the LCD display. If a 5-volt

interface signal is needed, use a level shifter IC. Some examples are the 74LVC245 or the bi-directional level shifter chip with 4 channels TXB0104 (see Adafruit 1875 or SparkFun BOB-11771) or with 8 channels TXB0108 (see Adafruit 395 or SparkFun BOB-19626). These are not recommendations, please do your own research.

The power-enable switch disconnects the Feather EN line from ground to enable the voltage regulator on the Feather processor module. This same signal is also connected to an N-channel MOSFET (Q1) that turns on when the PWR_EN signal goes high and thus allows current to flow through the Power indicator LED turning it on. The PWR_EN signal line may be cut at JP1 to allow the user to connect the D2 LED buffer to a GPIO pin on the processor to use for other purposes. After cutting the JP1 jumper, connect the PLED pad on the PCB to a free digital pin on the Feather processor.

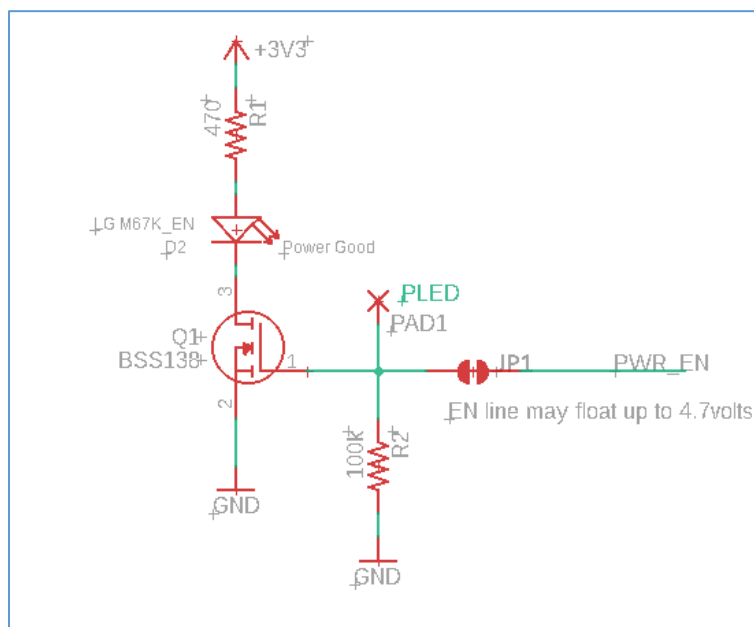


Figure 8. Power LED can be re-purposed by cutting JP1

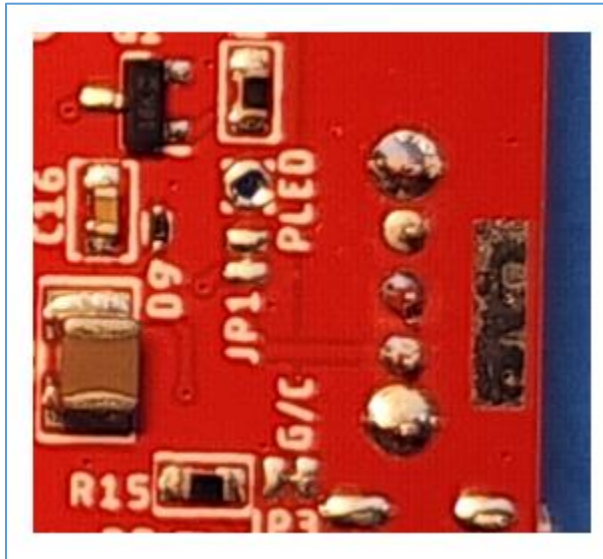


Figure 9. To use the power LED for other purposes, cut JP1 and connect to PLED pad

The Color RGB LED is a WS2812B device with a single wire serial interface connected to Arduino Pin D13. Code examples for driving this RGB LED are discussed below in the Software section.

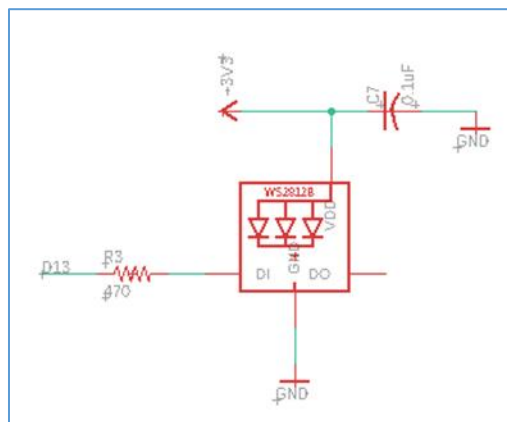


Figure 10. RGB LED circuit

5.5 LCD BACKLIGHT

The 2.4-inch TFT LCD has 4 backlight LEDs in parallel that are buffered from the Feather processor by an N-channel MOSFET. The input to the backlight buffer is connected to Arduino Feather pin A2. Pin A2 can be used like a digital pin simply by asserting it High to turn the backlight on or low to turn the backlight off. Or pin A2 can be used as a PWM analog pin to vary the brightness and power consumption of the TFT LCD. The LCD is the major power-consumer on the Novaduino® Display board, when full on it consumes about 100 mA from the 3.3-volt supply. This can limit battery life if not moderated by reducing the brightness with a PWM signal.

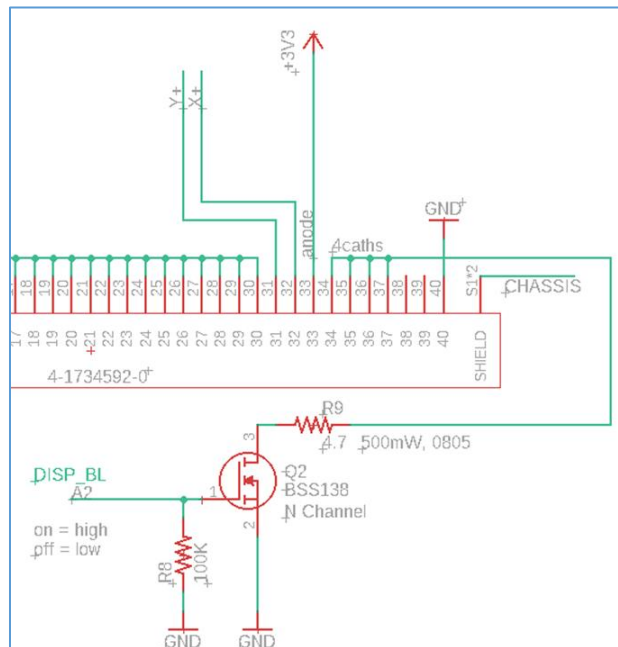


Figure 11. LCD Display Backlight Buffer

5.6 VREF strap, Chassis/Ground straps, and 5v Vusb straps

Jumpers are provided on the PCB to allow customization of the VREF voltage that is currently connected to the 3.3 Volt supply, or chassis to ground connections for optimizing EMC issues, or separating the 5V supply lines from the Vusb supply line connections if desired. All these jumpers are connected by default but may be cut as needed.

6.0 USB Data Interface

Power is supplied to the Feather processor via the USB-C connector on the Novaduino® Display as explained earlier, however USB data pins are not connected through the Novaduino® PCB. This allows maximum flexibility in selecting the USB data source options.

If programming through the Novaduino® Display board USB-C connector is desired or if an application requires a USB data connection, an optional USB jumper cable kit may be purchased. This twisted-pair jumper cable connects the USB serial data signal to the Feather USB connector. The jumper can be connected to either 1) the Novaduino® Display USB-C connector (via the D+ and D- pads near the USB-C connector) or 2) the USB connector on the optional Novaduino® Expansion Prototype Card (via the D+ and D- pads near the USB-B connector).

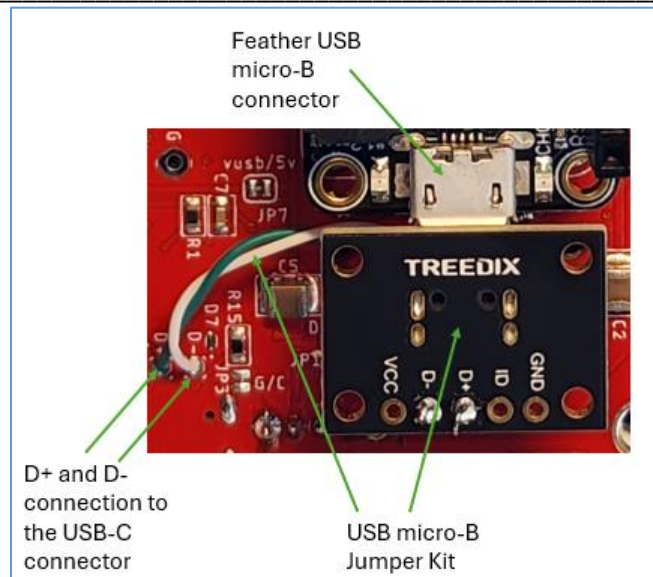


Figure 12. The USB Jumper Cable Kit installed for USB data

A 3rd method of connecting USB data to the Feather mounted on the Novaduino® Display board is through 2 jumpers and over the backplane. Connect the first jumper on the Prototype Expansion Card between the D+/D- pads near the USB-B connector and the D+/D- pads near J10 that is connected internally to backplane connector J2. Next connect a USB male Jumper Kit to the D+/D- pads on the Novaduino® Display board above the P2 connector. This method provides USB data through the USB-B connector on the Prototype Expansion Card.

7.0 Color TFT IPS Resistive Touch 240x320 LCD Display

The 2.4-inch TFT LCD used in the Novaduino® NRT1000014RevC is a 4DLCD-24320240-RTP-IPS from 4D Systems. Cheaper displays are available, but these displays have reliability testing behind them and have good availability.

The display is connected to the Feather socket and to the backplane connector J2 via the SPI_0 bus. The SPI bus is also used for the uSD card socket and may also be used with other applications on Expansion Cards by multiplexing through additional CS (chip select) signals.

Dedicated LCD control lines are connected as shown in the Table below.

Table 2. LCD Connections

Name	Schematic name	Feather (Arduino) Pin	Logic Levels	Comment
Back Light	DISP_BL	A2	high = on, low = off (into buffer, Q1)	May Pulse Width Modulate to lower power consumption
Display Chip Select	DISP_CS!	D6	Low = selected, high = not selected	The display is selected for communication over the SPI bus when this is asserted low.
Display Reset	DISP_RST!	A5	Low = reset	It is important that the LCD driver software reset the LCD during initialization. (A5 is used like a digital port rather than analog)
Data/Command	DISP_DC	D5	Low = Data High = Command	The D/C signal tells the driver IC whether the incoming data is a command or is display data. The display driver code takes care of this.

The 4DLCD-24322400-RTP-IPS TFT LCD from 4D Systems uses the ST7789V driver IC, however earlier versions of this display module were delivered with the ILI9341 driver chip instead. All our software examples have a #define variable at the top of the program listing that should be set to the proper driver chip number.

A complete command and data sequence for initializing the display is provided in the 4DLCD-24322400-RTP-IPS data sheet, however one of the advantages of using the Arduino Core software is access to its great library system that contains ST7789V and ILI9341 display drivers. We use the Adafruit display drivers as can be seen in our code examples. This driver gets the display up-and-running but additional software is needed to draw text and objects onto the display, we use the Adafruit GFX software for this purpose. Code examples will be shown later.

8.0 Touch Controller

The Novaduino® Display board uses the TI TSC2007 Resistive Touch Controller IC. This IC is connected to the X and Y lines of the resistive touch screen on the LCD. The IC provides a small source voltage to the resistive touch screen and senses the output voltage from the resistive voltage divider that is formed when one touches the screen. This voltage is digitized by Analog to Digital converters on the IC and then the converted 12-bit values are sent to the main processor (the Feather Processor) whenever a “touch” is sensed. When a “touch” is sensed by the IC it notifies the main processor by lowering the signal on PENIRQ! which is connected to digital pin D9 on the processor. The main processor can either poll pin D9

continuously looking for this low signal or it can sense an “interrupt” when this signal goes low. In either case, when D9 goes low, the main processor uses the TWI(I2C) bus to read the X and Y and Touch-Pressure(Z) values from the TSC2007 chip at default address **0x48**. One may change the address to 0x49 by soldering jumper JP5 (A0), or to 0x4A by soldering jumper JP6(A1), or to 0x4B by soldering both JP5 and JP6.

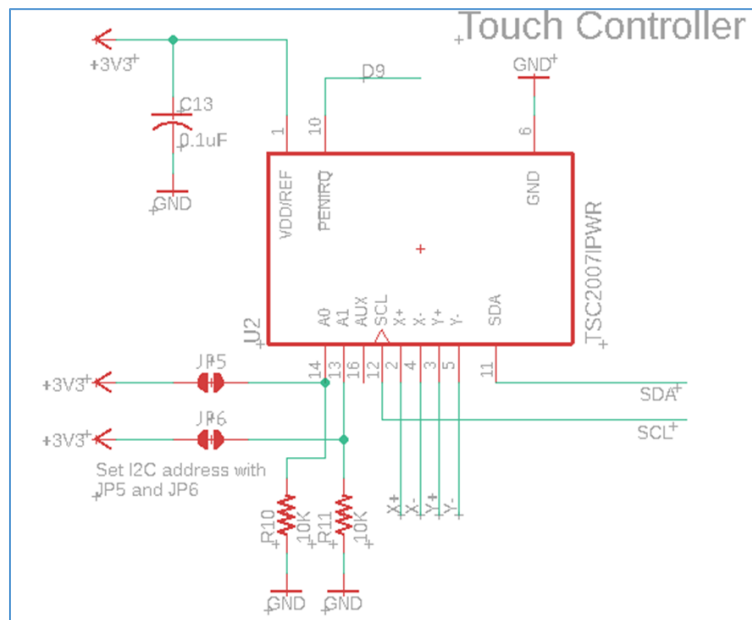


Figure 13. Resistive Touch Screen controller

Software demonstrations and examples of how to read the touch screen values are discussed in the Software section below.

9.0 Key-Scan and Encoder Processor

The 5 buttons (SW1, SW2, SW3, SW4, and SW5), the rotary encoder, and the multi-directional navigation switch are all scanned by the Keyscan Processor, an ATtiny1626 on the Novaduino® Display board. When a key press or encoder rotation is sensed, the pre-programmed Keyscan Processor performs switch de-bouncing, reads the button number or rotation direction and stores the value in a 4 Byte buffer. The key processor then sends a 500 microsecond positive pulse on the KBD_INT line connected to the main processor pin D12 to indicate that the key buffers are ready to be read over the TWI(I2C) bus at **address 0x40**.

In response to the Keyscan Processor interrupt signal, KBD_INT, on pin D12, the Feather processor reads the 4 bytes of buffered data over the TWI(I2C) interface. Keyscan data is buffered in four 8-bit integer (int8_t) buffers. The first 2 buffers contain the button number repeated in both buffers. The second 2 buffers contain either a +1 for a right rotation or a -1 for a left rotation of the encoder repeated in both buffers. The data is currently just repeated across the 2 buffers to allow a small degree of error checking of the data if desired. In future releases of the Keyscan software we may add a CRC for

error checking the data. Each time a button is pressed, the button number (1 to 11) is captured in each of the 1st two buffers and the rotary encoder value is reset to zero in the 2nd two buffers, and then the interrupt line is pulsed. When the rotary encoder is sensed, the left(-1) or right(+1) value is captured in the 2nd two buffers and the 1st two buffer values are cleared, and then the interrupt line is pulsed.

Code examples are provided and discussed in the Software section.

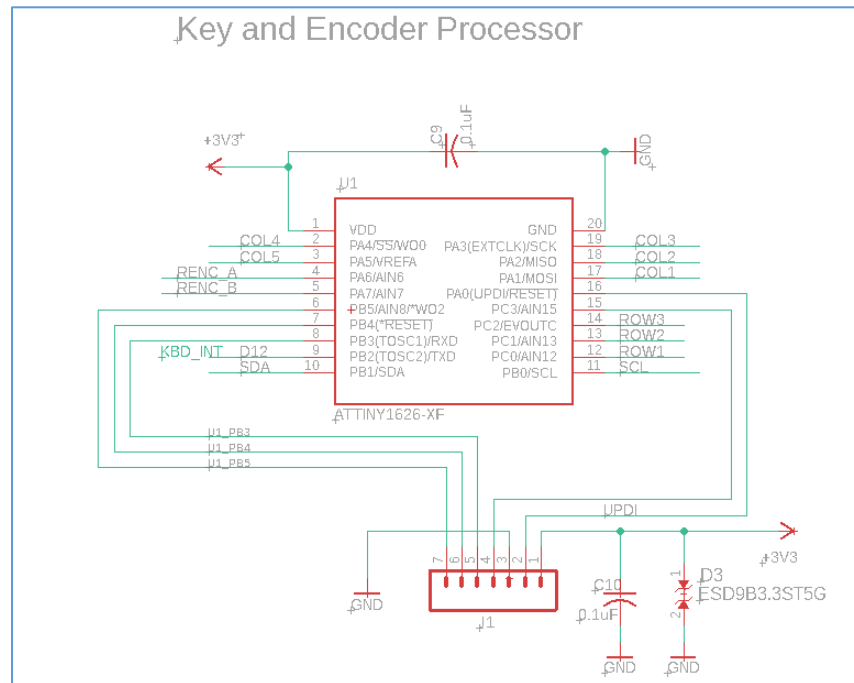


Figure 14. Novaduino® Keyscan and Rotary Encoder Interface Processor Circuit

10.0 Micro-SD Card

The micro SD socket accepts a standard micro SD card. The card is written to and read over the same SPI bus used for the LCD Display but has its own chip select line connected to the Feather Processor pin A4.

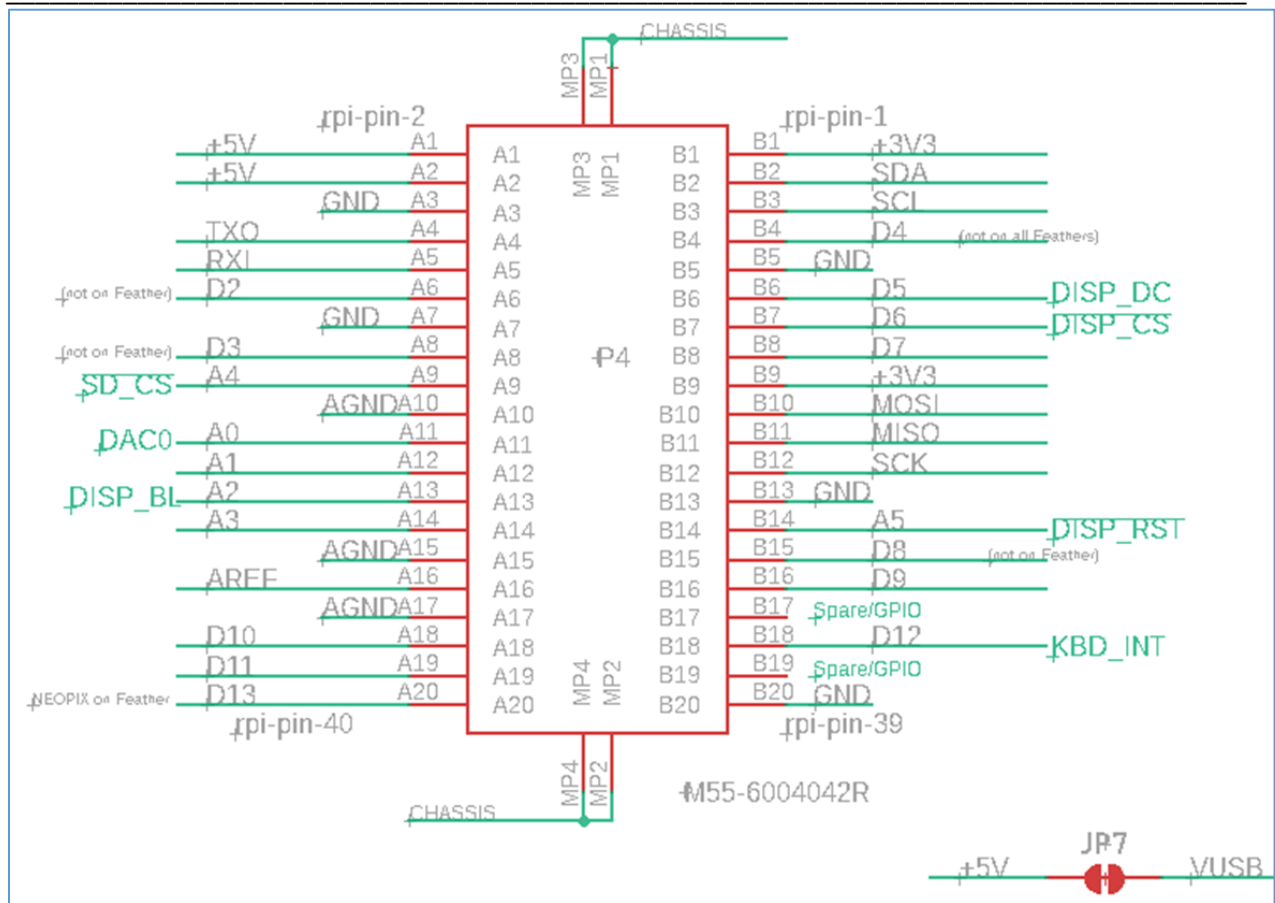


Figure 16. P4 Backplane Connections

The P2 connector on the backplane Expansion Card interface provides USB connections, Feather power and control lines, and future SPI_2 bus, I2C_2 bus, and GPIO lines. The added power pins also reduce IR drops for higher current applications. 8 pins are also set aside for a high-speed bus on future Novaduino® designs. These 8 pins may, for example, accommodate Ethernet, PCIe, QSPI, I2S, etc....

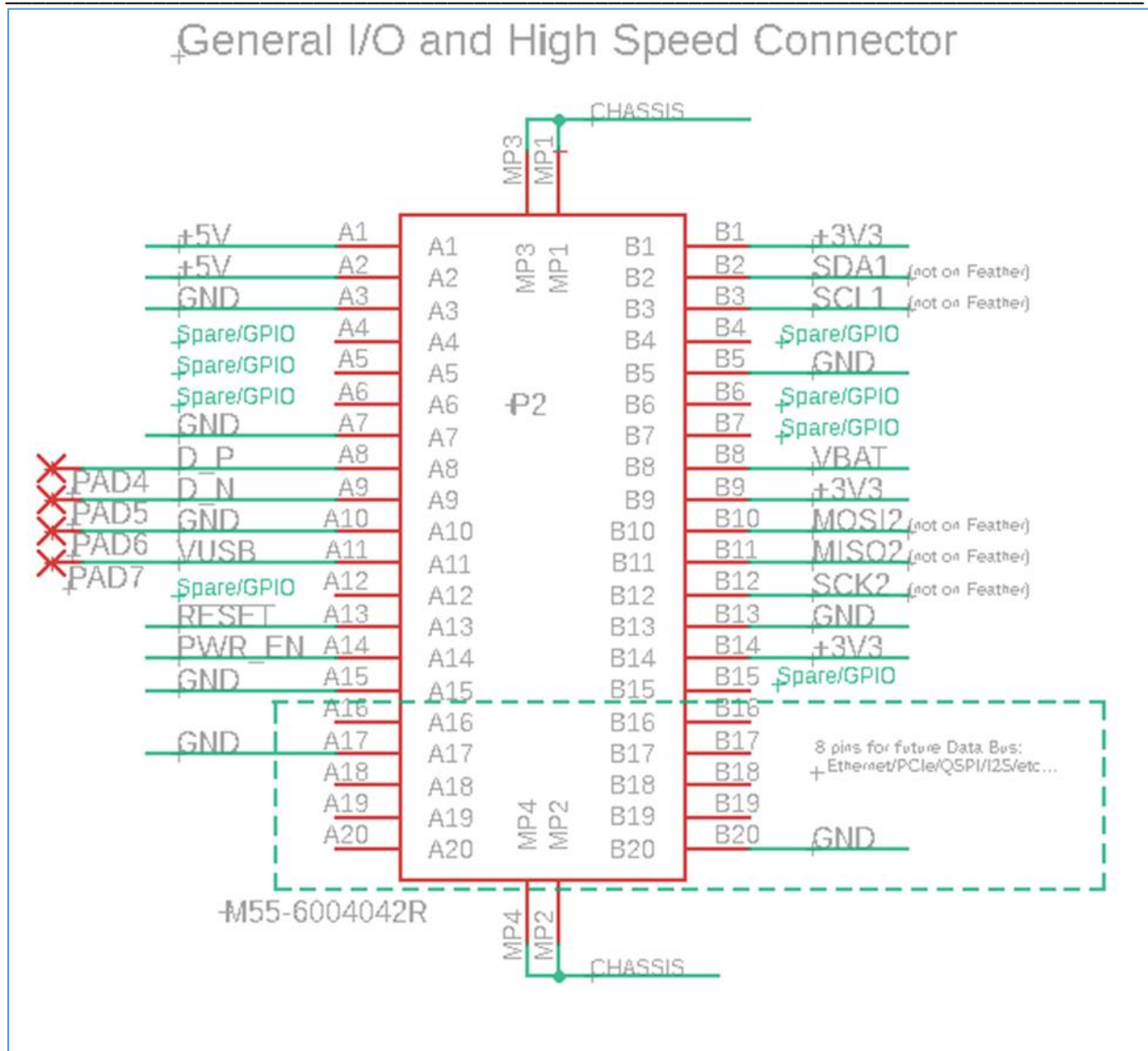


Figure 17. P2 Backplane Connections

A Prototype Expansion Card is available (KIT002 from Nova Radio Labs) for use with Novaduino® Display PCBA via P2 and P4 connectors. It also supports Arduino boards, Feather modules, and breadboard circuits and integrates nicely with the 120 mm case options.

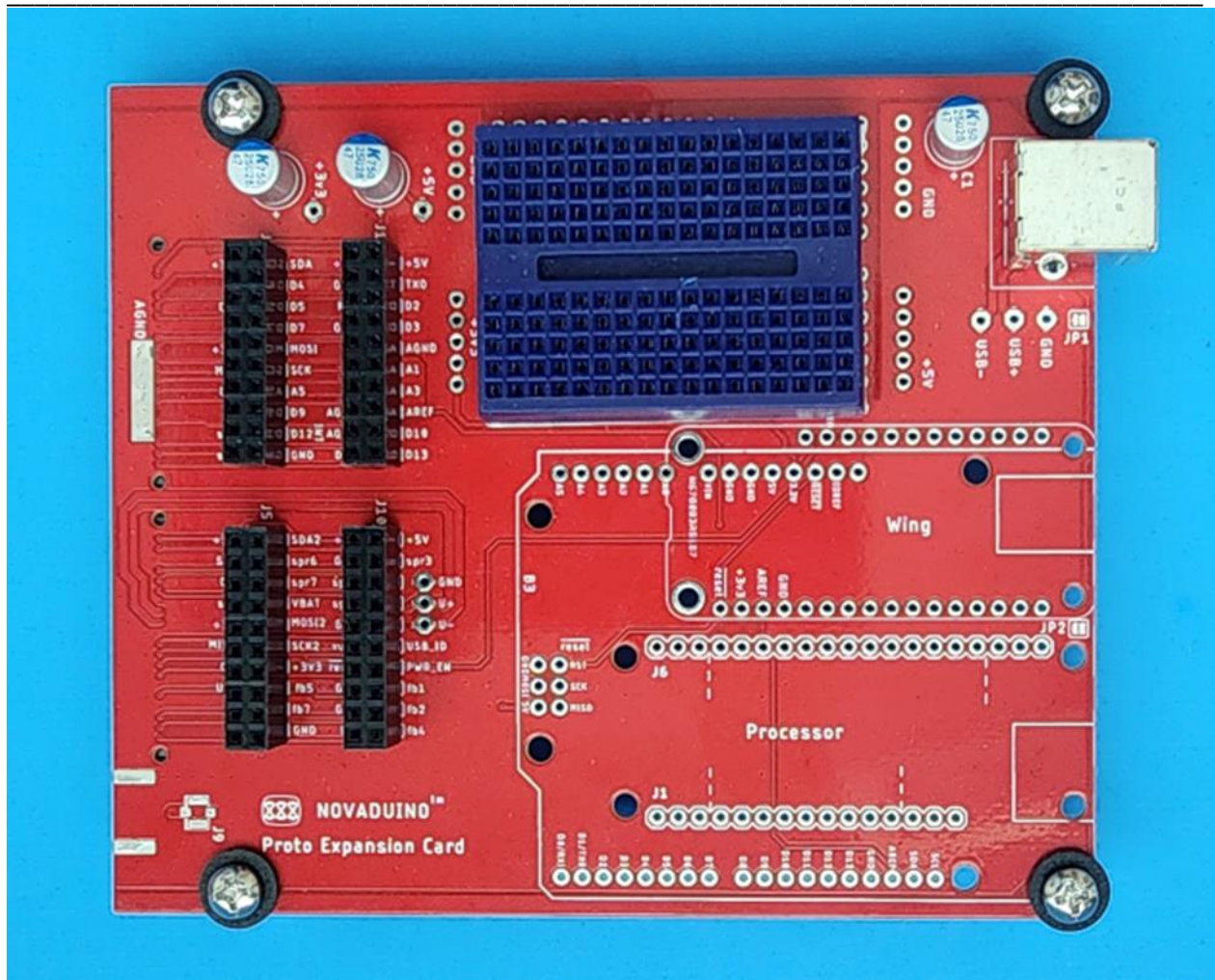


Figure 18. Novaduino® Prototype Expansion Card, see KIT002. Accommodates an Arduino board or Feather devices and breadboard circuits.

12.0 Novaduino® Display Demonstration Software

To get you up-and-running with the Novaduino® Display board, we have written a demonstration program that provides Open Source (under the MIT Software License (<http://opensource.org/licenses/MIT>)) code examples. This code exercises the LCD Display, the touchscreen controller, an interrupt interface to the Keyscan Processor, the RGB LED, and the micro-SD card. This code is available on GitHub at [NovaRadioLabs/Demo-A Novaduino Display](https://github.com/NovaRadioLabs/Demo-A_Novaduino_Display).

You may also want to download and try out our other code examples for the Novaduino® Environment Sensor Kit or the Novaduino® Ultrasonic Car Parking Assistant Kit available at the same GitHub location. You can expand your Novaduino® Display to make these kits by simply adding the corresponding

sensors. Or you can purchase the Novaduino® Environment Sensor KIT005 or the Novaduino® Ultrasonic Car Parking Assistant KIT006 from our website.

12.1 Download and Set up the Arduino IDE

We use the Classic Arduino IDE, version 1.8.19, that can be downloaded at www.arduino.cc. You can try the web version or the version 2.0 Arduino IDEs, but we have not tested those with the provided program code.

__ Download and install the Arduino IDE.

12.2 Adding Adafruit and SparkFun Board Scripts to the Properties tab

Our demonstration code draws from libraries from both Adafruit and SparkFun as well as several of the built in Arduino libraries. The following is the procedure for installing these libraries.

__ 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

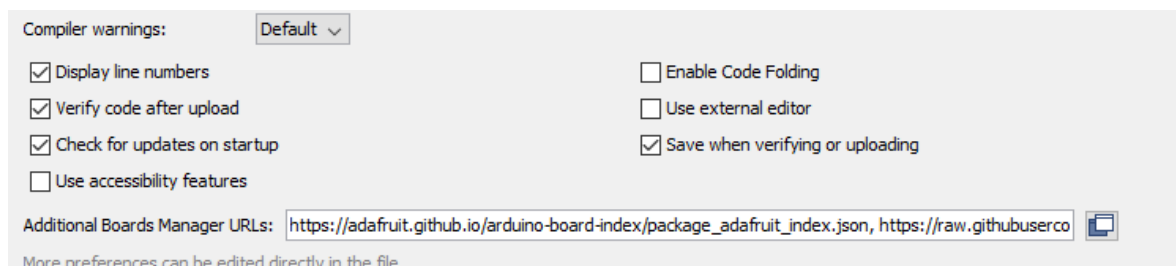


Figure 19. Adding board scripts to the Arduino IDE

12.3 Adding Libraries

12.3.1 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 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.

12.3.2 Now in the 3rd box replace Adafruit with SparkFun.

Install the following Adafruit Libraries at a minimum:

1. (No SparkFun libraries needed for the Display Example software)

12.4 Add the Display Demo software to your Arduino folder

The Display Demonstration software is on Github at [NovaRadioLabs/Demo-A_Novaduino_Display](https://github.com/NovaRadioLabs/Demo-A_Novaduino_Display).

“Demo-A_NovaduinoDisplayRevC_V1.ino”

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:

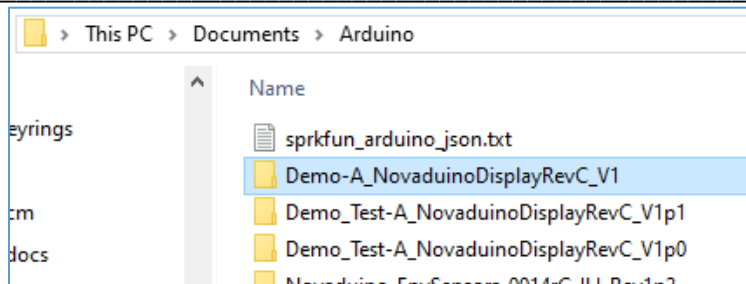


Figure 20. Example of sketch folder

Open the program file by selecting File > Open, then choose the provided Ultrasonic CPA folder. See the screenshot above.

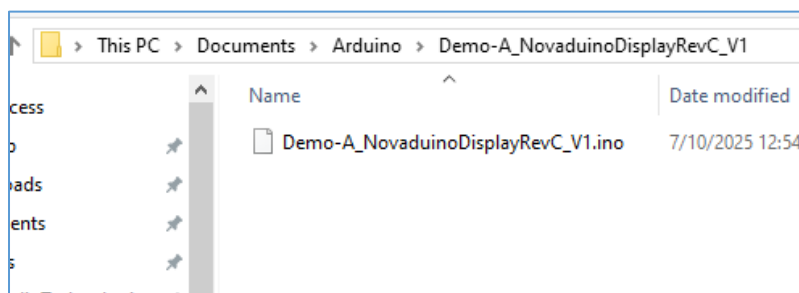


Figure 21. Example of sketch file

Next open the “Demo-A_NovaduinoDisplayRevC_V1.ino” (it may have be a higher Version number) by left clicking on it. See the screenshot above.

```

43 *OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
44 *
45 * This software is released under the MIT License (http://opensource.org/licenses/MIT).
46 *
47 * Graphics and display and other driver software is from Adafruit Industries. Thank you Adafruit.
48 * Other software contained herein is from other sources as noted.
49 * * Feather form factor is from Adafruit.
50 *
51 */
52 //*****10*****20*****30*****40*****50*****60*****70*****80*****90*****100
53 //*****LCD Drivers*****
54
55 #define ST7789           // either ILI9341 or ST7789. must correspond to the display you have
56 #include <SPI.h>        // by Arduino.cc
57 #include <Adafruit_GFX.h> // graphics library by Adafruit https://www.adafruit.com/product/3787
58
59 #if defined(ST7789)
60 #include <Adafruit_ST7789.h> // library for ST7789 by Adafruit
61 #endif
62
63 #if defined(ILI9341)
64 #include <Adafruit_ILI9341.h> // library for ILI9341 display by Adafruit
65 #endif
66
67 #define SPISPEED 16000000 // in Hz
68
69 #define TFT_CS      5 // CS is on D5
70 #define TFT_RST     A5 // Disp_RST(Display Reset) is on A5
71 #define TFT_DC      6 // DC(Data/Command) is on D6
72
73 #if defined(ST7789)
74 // For the 2.4" TFT with ST7789 Driver Chip
75 // instantiate the Adafruit_ST7789 object: tft (if using ST7789 then un-comment the following line)
76   Adafruit_ST7789 tft = Adafruit_ST7789(TFT_CS, TFT_DC, TFT_RST); //instantiate tft.
77 #endif
78
79 #if defined(ILI9341)
80 // For the 2.4" TFT with ILI9341 Driver Chip
81 // instantiate the Adafruit_ILI9341 object: tft (if using ILI9341 then un-comment the following line)

```

Figure 22. Arduino IDE listing of the Demo-A_Novaduino_Display Software

The first batch of LCD modules provided to us by 4D Systems contained the ILI9341 graphics driver chip while later batches contained the ST7789 driver chip. Please check the driver chip specified in the first #define statement (at line 55 here but it may be a different line number in a newer version) and change it to either ILI9341 or ST7789 corresponding to the LCD module that you have.

Now that the Arduino IDE is all set up with the software provided and libraries it should compile properly. Compile the software by clicking on the check mark symbol at the top left of the Arduino IDE window.

12.5 Load the software onto the Feather Processor

Now make sure that the “enable” switch on the Novaduino® is off then 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 in the “boards manager”.

12.5.1 For Adafruit Feather Processors:

Go to Tools>Board: Adafruit “SAM(D)32 bit...boards” and in the dropdown menu select your Feather Processor type. It might be: “Adafruit Feather M0 Express (SAM(D)21)” or

12.5.2 For SparkFun Thing Plus SAM(D)51 Processors

Go to Tools>Board: Sparkfun “SAM(D) 32 bit ARM...boards” and in the dropdown menu select your Feather Processor type. In this case it is “SparkFun SAM(D)51 Thing Plus.”

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 “Demo_Test-A_NovaduinoDisplayRevC_V1.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.



Figure 23. The flash screen shows the file name

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)



Figure 24. Novaduino® Display Demonstration Software

The Display Demonstration software is well documented in the .ino file and shows how to:

- Initialize and set up the LCD display
- Display data to the LCD
- Initialize and set up the touch screen TSC2007 IC
- Read and display touch screen data
- Initialize and set up the RGB LED
- Send colors to the RGB LED
- Initialize and set up the micro-SD card reader
- Read and display data from a micro-SD card
- Initialize and set up the Keyscan processor
- Use an interrupt to detect key presses and rotary encoder changes
- Display data from the Keyscan processor

This provides you with examples of how to get you up-and-running with Novaduino® coding but there is so much more that can be done with Novaduino®. Almost any Arduino project that needs a display may be adapted to run on Novaduino®. Please visit our website (novaradiolabs.com) to see additional information as it is added.

13.0 3D Printed Case and other Options

13.1 Customizable Faceplate

The Novaduino® Display KIT001 includes STL and f3d files for full customization of a 3D printed Faceplate, allowing you to add your own designs, labels, or logos. You can CNC, laser engrave, 3D-print, or apply graphics overlays. The kit also provides two light pipes for Power and RGB LEDs, ensuring a professional finish.

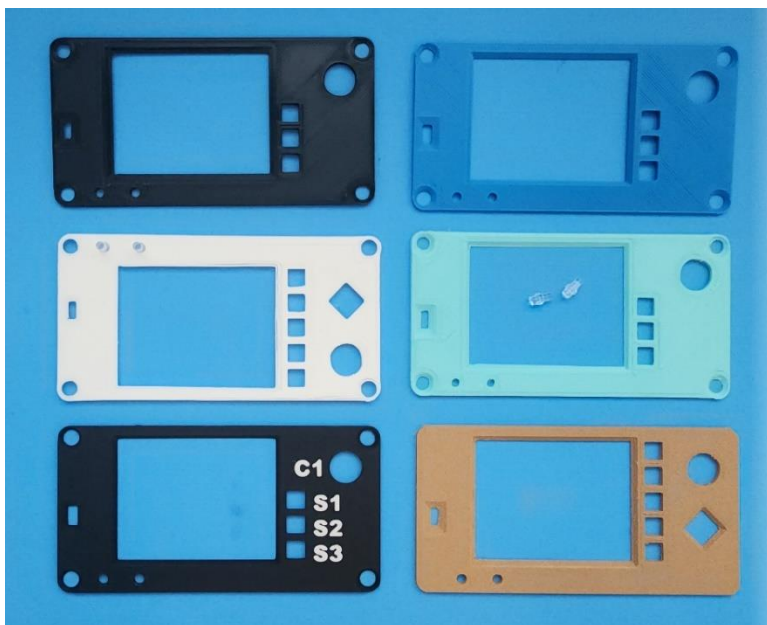


Figure 25. 3D Printed Faceplate Examples

13.2 Front Bezel

The Novaduino® Display KIT001 includes an STL file for the Front Bezel for 3D printing. The Front Bezel is specifically designed to smoothly integrate the Novaduino® Display and Faceplate with either the 40mm 3D printed Case, the 120 mm 3D printed Case, or the Hammond 1455N12xx metal case.



Figure 26. 3D Printed Front Bezel Examples

13.3 40 mm case w/integrated back panel

The Novaduino® Display KIT-001 includes an STL file for the 40 mm deep case. This Case includes mounting posts and vent holes for various sensors or other items.



Figure 27. 3D Printed 40mm deep Novaduino® Case Examples

13.4 120mm case

An STL file for 3D printing your own 120 mm deep case or you may purchase a Hammond 1455N12xx metal case separately. The 120 mm deep cases require a separate 3D printed Back Cover.

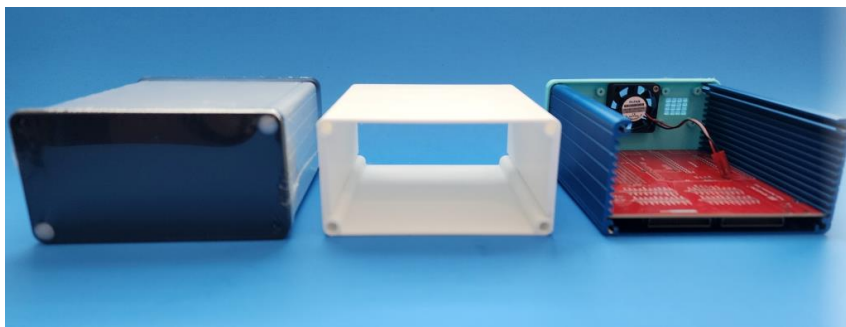


Figure 28. Examples of 120 mm long Cases

In the figure above, the middle 120 mm case is 3D printed from an STL file, while the two end cases are metal Hammond cases. The Hammond cases feature a removable top for easy access to your circuit.

13.4.1 Back Cover

When you purchase an STL file for printing a 120 mm Case or when you purchase a Hammond 1455N12xx metal case from us, we provide an STL file for the Back Cover. One of the Back Panel designs can accommodate a small 5 Volt Pi-Fan for cooling your project if needed. The Back Panel also accommodates the USB-B connector on the Prototype Expansion Card.

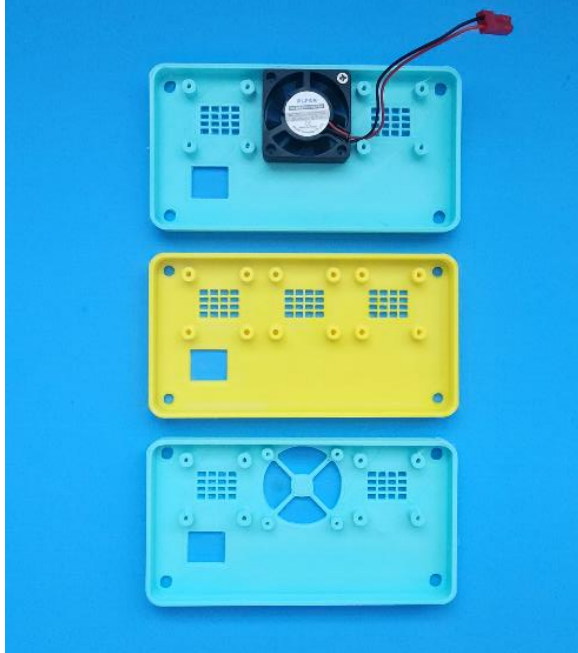


Figure 29. 3D Printed Back Cover examples

13.5 Nav Switch Cap

The Novaduino® Display KIT001 includes an STL file for 3D printing the Nav Switch Cap.



Figure 30. 3D Printed Navigation Switch Caps

13.6 Sensor Cover

The Novaduino® Display KIT001 includes an STL file for 3D printing the Sensor Cover. This holds a 1" x 1" or smaller PCB module onto the back of the 40 mm case. We use it in the "Environmental Sensor KIT005" to isolate the temperature/humidity/pressure sensor from the heat of internal electronics.



Figure 31. 3D Printed Sensor Cover Examples

14.0 3D Printed Case Assembly

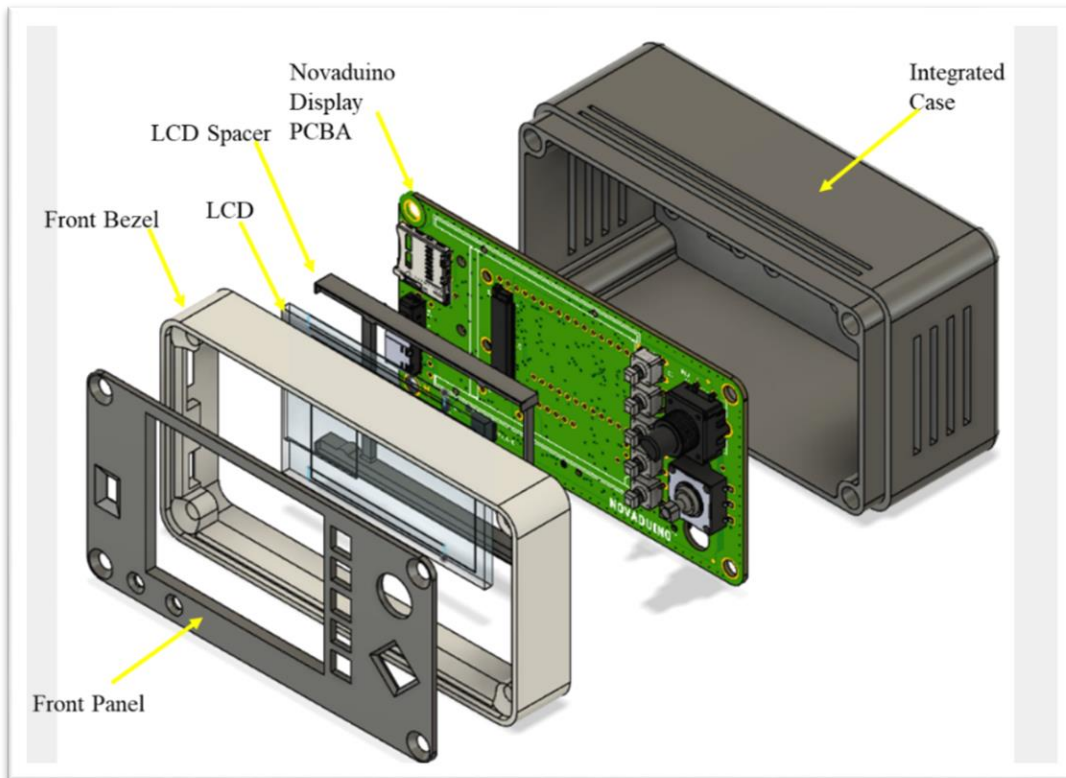


Figure 32. 3D Printed Case Assembly

15.0 Appendix

16.0 Disclaimers

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

*Novaduino® is a trademark of Nova Radio Labs LLC

*Novaduino® technology is patent pending

*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 certified.

The STL and f3d 3D print and design files for Novaduino® are normally sold for a fee and are for your personal limited use. If you are interested in the commercial use of these files and designs, please contact us.

All programs/code is for example and demonstration only. Nova Radio Labs does not guarantee nor warrantee the software.