# MicroMod GNSS Function Board - NEO-M9N Hookup Guide

## Introduction

The u-blox NEO-M9N is a powerful GPS unit that now comes populated on a MicroMod Function Board! In this tutorial, we will quickly get you set up using it with the MicroMod ecosystem and Arduino so that you can start reading the output.


SparkFun MicroMod GNSS Function Board - NEO-M9N
GPS-18378

Product Showcase: SparkFun MicroMod GNSS Function Boards

## Required Materials

To follow along with this tutorial, you will need the following materials. You may not need everything though depending on what you have. Add it to your cart, read through the guide, and adjust the cart as necessary.

SparkFun MicroMod GNSS Function Board - NEO-M9N

GPS-18378

Reversible USB A to C Cable - 2m

CAB-15424

SparkFun MicroMod Main Board - Single

DEV-18575

SparkFun Mini Screwdriver

TOL-09146

SparkFun MicroMod Artemis Processor

DEV-16401

## MicroMod Main Board

To hold the processor board and function board, you will need one Main Board. Depending on your application, you may choose to have one or two additional function boards.

SparkFun MicroMod Main Board - Single
DEV-18575

SparkFun MicroMod Main Board - Double
DEV-18576

## MicroMod Processor Board

There are a variety of MicroMod Processor Boards available to choose from. We recommend getting the ones that are Arduino compatible.

SparkFun MicroMod Teensy Processor
DEV-16402

SparkFun MicroMod SAMD51 Processor
DEV-16791

SparkFun MicroMod ESP32 Processor
WRL-16781

SparkFun MicroMod Artemis Processor
DEV-16401

## MicroMod Function Board

To add additional functionality to your Processor Board, you'll want to include one or two function boards when connecting them to the Main Board. Besides the NEO-M9N, you could add an additional function board for your project if you have the Main Board - Double.

SparkFun MicroMod GNSS Function Board - NEO-M9N

GPS-18378

SparkFun MicroMod LoRa Function Board

WRL-18573

SparkFun MicroMod Environmental Function Board

SEN-18632

SparkFun MicroMod WiFi Function Board - ESP32

WRL-18430

## Tools

You will need a screw driver to secure the Processor and Function boards.

SparkFun Mini Screwdriver

TOL-09146

Pocket Screwdriver Set

TOL-12891

MicroMod Screwdriver

TOL-19012

## Suggested Reading

If you aren't familiar with the MicroMod ecosystem, we recommend reading here for an overview.

MicroMod

*MicroMod Ecosystem*

If you aren’t familiar with the following concepts, we also recommend checking out a few of these tutorials before continuing. Make sure to check the respective hookup guides for your processor board and function board to ensure that you are installing the correct USB-to-serial converter. You may also need to follow additional instructions that are not outlined in this tutorial to install the appropriate software.

### GPS Basics

The Global Positioning System (GPS) is an engineering marvel that we all have access to for a relatively low cost and no subscription fee. With the correct hardware and minimal effort, you can determine your position and time almost anywhere on the globe.

### Serial Peripheral Interface (SPI)

SPI is commonly used to connect microcontrollers to peripherals such as sensors, shift registers, and SD cards.

I2C
An introduction to I2C, one of the main embedded communications protocols in use today.

How to Work with Jumper Pads and PCB Traces
Handling PCB jumper pads and traces is an essential skill. Learn how to cut a PCB trace, add a solder jumper between pads to reroute connections, and repair a trace with the green wire method if a trace is damaged.

Getting Started with U-Center for u-blox
Learn the tips and tricks to use the u-blox software tool to configure your GPS receiver.

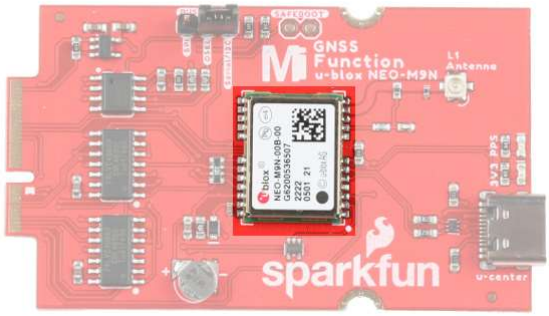
Three Quick Tips About Using U.FL
Quick tips regarding how to connect, protect, and disconnect U.FL connectors.

Getting Started with MicroMod
Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

MicroMod Main Board Hookup Guide
The MicroMod Main Board - Single and Double are specialized carrier boards that allow you to interface a Processor Board with a Function Board(s). The modular system allows you to add an additional feature(s) to a Processor Board with the help of a Function Board(s). In this tutorial, we will focus on the basic functionality of the Main Board - Single and Main Board - Double.

## Hardware Overview

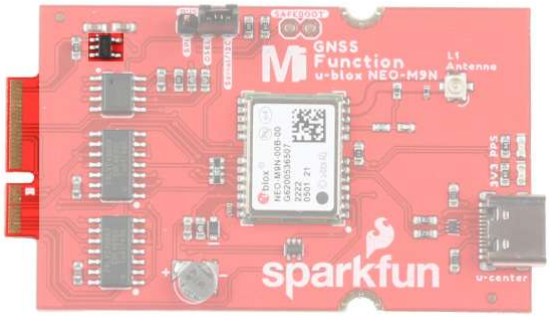
We've taken the u-blox NEO-M9N and broken the board out to a MicroMod Function Board! In this section, we will go over the main features of the Function Board.




For a detailed overview of the module, these integrated systems and how to use them, refer to the datasheet and integration manual linked in the Resources and Going Further.

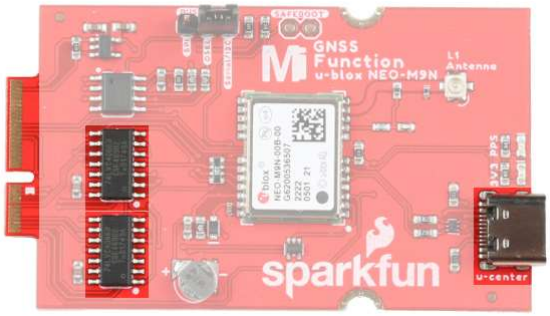
## Power

To power the board, you will need to apply power to a SparkFun Main Board. Power applied from the M.2 connector VCC line will be regulated down with the 3.3V/600mA AP2112K voltage regulator.




## Communication Ports

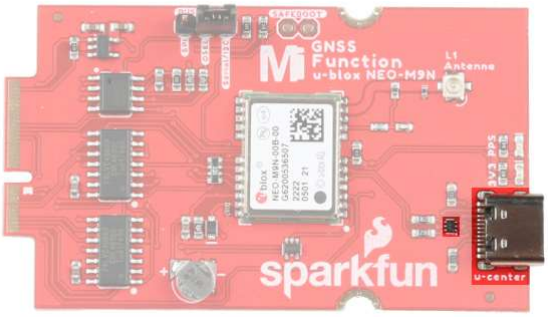
The NEO-M9N has four communication ports. You can read NMEA data over $I^2C$ while you send configuration commands over the UART and vice/versa. The only limit is that the SPI pins are mapped onto the $I^2C$ and UART pins so it's either SPI or I2C+UART. You will need select the port with the BUS SELECT jumper. The USB port is available at all times. There is a bilateral switch between the M.2 connector and the NEO-M9N's Serial, SPI, and $I^2C$ ports. The switch connects the appropriate port depending on the on the jumper position.




**Note:** With the MicroMod M.2 connector, the NEO-M9N's UART, SPI, $I^2C$ ports are available without soldering! Other SparkFun NEO-M9N offerings have this capability, but only after you solder hookup wires appropriately.

## USB

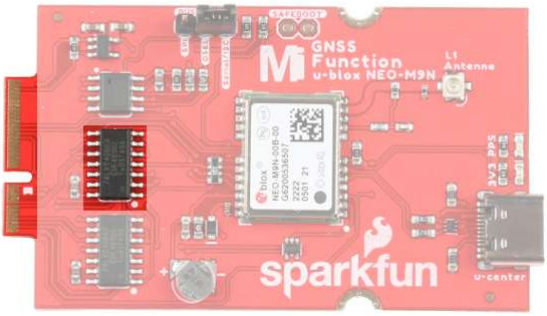
The USB C connector is available for those that are interested in using the u-center software on a computer. There is a TVS diode between the USB port and NEO-M9N's USB data pins for protection.




> **Note:** Power is not connected to the rest of the board to avoid conflicting voltages from the MicroMod system. Make sure to connect a separate power source to the MicroMod Main Board so that the MicroMod GNSS Function Board can be powered through the M.2 connector.

## I$^2$C (a.k.a DDC)

The u-blox NEO-M9N has a “DDC” port which is really just an I$^2$C port (without all the fuss of trademark issues). These pins are shared with the SPI pins. Connecting the `DSEL` pin to the `Serial/I2C` with the 2-pin jumper disables the SPI data bus while keeping the UART and I$^2$C interface available.

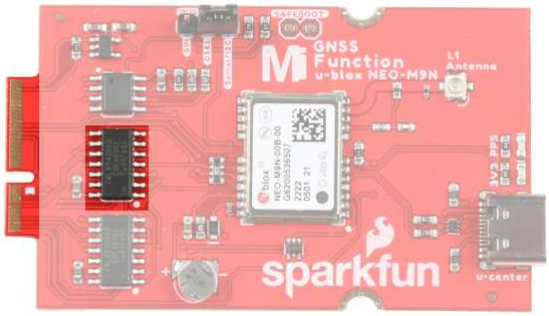



> The only I$^2$C address for this and all u-Blox GPS products is **0x42**, though each can have their address changed through software.

## UART/Serial

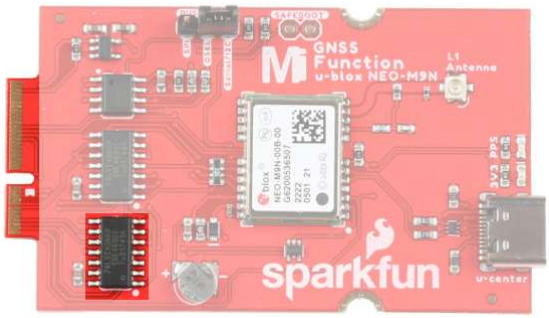
The classic serial pins are available on the NEO-M9N but are shared with the SPI pins. Connecting the `DSEL` pin to the `Serial/I2C` with the 2-pin jumper disables the SPI data bus while keeping the UART and I$^2$C interface available.

- TXO/SDO = TX out from NEO-M9N
- RXI/SDI = RX into NEO-M9N



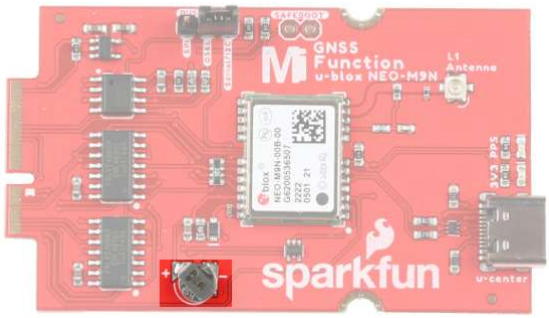

## SPI

The NEO-M9N can also be configured for SPI communication. Connecting the `DSEL` pin to the `SPI` with the 2-pin jumper enables the SPI data bus thus disabling the UART functions on those lines. This also disables $I^2C$ interface.



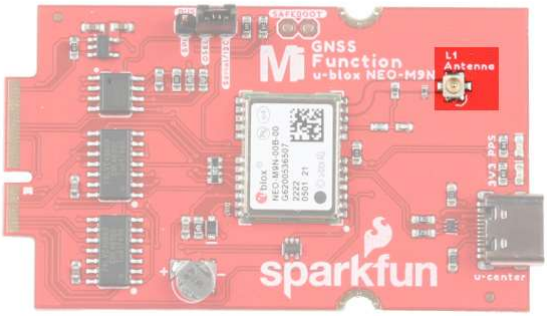

## Backup Battery

The small metal disk is a small lithium battery. This battery does not provide power to the IC like the 3.3V system does, but to relevant systems *inside* the IC that allow for a quick reconnection to satellites. The time to first fix will about **~29 seconds**, but after it has a lock, that battery will allow for a **two second** time to first fix. This is known as a **hot start** and lasts for four hours after the board is powered down. The battery provides over a years worth of power to the backup system and charges slowly when the board is powered. To charge it to full, leave your module plugged in for 48 hours.



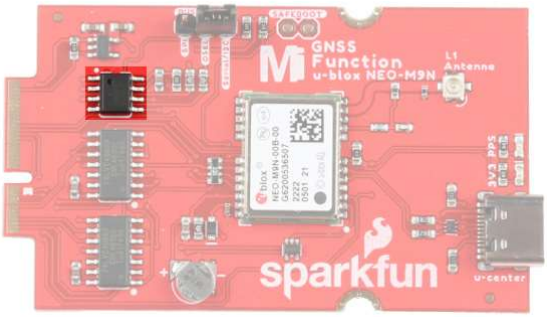

## u.FL Connector

The MicroMod GNSS Function Board includes a u.FL connector for a secure connection with a patch antenna. Depending on the antenna, you may need a u.FL adapter to connect. The u.FL connector was added as a design choice for users that decide to place the MicroMod Main Board with the GNSS Function Board in an enclosure. With the u.FL adapter, the SMA connector can be mounted to the enclosure. For more information on working with u.FL connectors, we recommend checking out our tutorial about using u.FL connectors.




## EEPROM

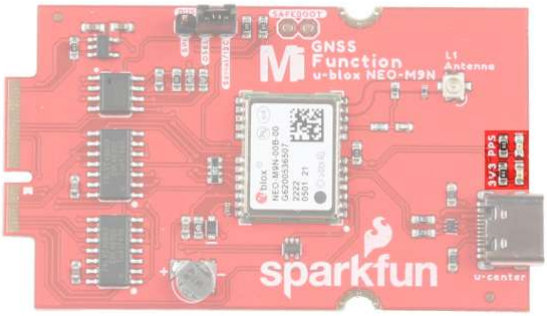
The board includes an I$^2$C EEPROM. Unfortunately, this is not available for the user and was meant to hold board specific information.




## LEDs

The board includes two status LEDs.

- **3V3**: The `3V3` LED indicates when the board is powered. This LED is connected to the 3.3V line.
- **PPS**: The `PPS` LED is connected to the *Pulse Per Second* line. When connected to a satellite, this line generates a pulse that is synchronized with a GPS or UTC time grid. By default, you'll see one pulse a second.

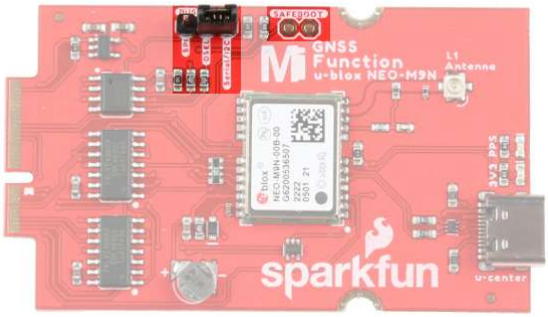



## Jumpers

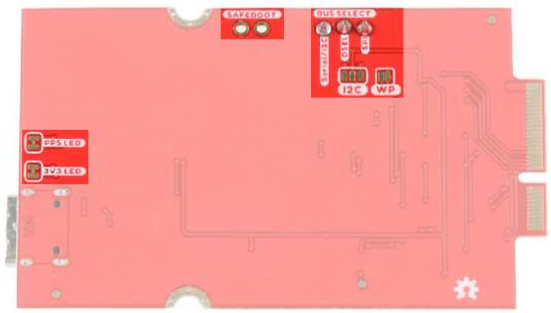
The board includes a few jumpers to configure the NEO-M9N module. For more information, check out our tutorial on working with jumper pads and PCB traces.

- **I$^2$C Pull-up Resistors** - This three way jumper labeled `I²C` connects two pull-up resistors to the I$^2$C data lines. If you have many devices on your I$^2$C data lines, then you may consider cutting these.
- **WP** - Adding solder to the jumper pad will disable write protect for the EEPROM.
- **3V3** - The jumper on the opposite side of the board with the label `3V3` is connected to the **3V3** LED. Cutting this jumper will disable the LED.

- **PPS -** The jumper on the opposite side of the board with the label `PPS` is connected to the **PPS** LED. Cutting this jumper will disable the LED.
- **Bus Select**
  - **SPI** - Connecting the `DSEL` pin to the `SPI` with the 2-pin jumper enables the SPI data bus thus disabling the UART functions on those lines. This also disables I$^2$C interface.
  - **DSEL -** This pin is connected to the NEO-M9N's D_SEL pin to select the interface. Connecting this pin to either side will select the communication protocol.
  - **Serial/I2C -** Connecting the `DSEL` pin to the `Serial/I2C` with the 2-pin jumper disables the SPI data bus while keeping the UART and I$^2$C interface available. The UART and I$^2$C can also be enabled if the DSEL pin is open and not connected to either side. We recommend keeping the 2-pin jumper connected to avoid misplacing the component.
- **SAFEBOOT** - The PTH pads labeled as `SAFEBOOT` is used to start up the IC in safe boot mode, this could be useful if you somehow manage to corrupt the module's Flash memory. Breakaway a row of 2-pins from the header, solder the pins to the board, and connect a 2-pin jumper to enable the mode.




*Jumpers (Top View)*




*Jumpers (Bottom View)*

## GPS Capabilities

The SparkFun GNSS Function Board NEO-M9N is able to connect to up to four different GNSS constellations at a time making it very accurate for its size. Below are the listed capabilities of the GPS unit when connecting to *multiple* GNSS constellations and when connecting to a *single* constellation.

| **Constellations** | | **GPS+GLO+GAL+BDS** | **GPS+GLONASS+GAL** | **GPS+GLO** | **GPS+BDS** |
|---|---|---|---|---|---|
| **Horizontal Position Accuracy** | | 2m | 2m | 2m | 2m |
| **Max Navigation Update Rate** | PVT | 25Hz | 25Hz | 25Hz | 25Hz |
| **Time-To-First-Fix** | Cold Start | 24s | 25s | 26s | 28s |
| | Hot Start | 2s | 2s | 2s | 2s |
| **Sensitivity** | Tracking and Navigation | -167dBm | -167dBm | -167dBm | -1667dBm |

| | | | | | |
|---|---|---|---|---|---|
| | Reacquisition | -160dBm | -160dBm | -160dBm | -160dBm |
| | Cold Start | -148dBm | -148dBm | -148dBm | -148dBm |
| | Hot Start | -159dBm | -159dBm | -159dBm | -159dBm |
| **Velocity Accuracy** | | 0.05m/s | 0.05m/s | 0.05m/s | 0.05m/s |
| | | | | | |
| **Heading Accuracy** | | 0.3deg | 0.3deg | 0.3deg | 0.3deg |

When using a **single GNSS constellation**:

| **Constellation** | | **GPS** | **GLONASS** | **BEIDOU** | **Galileo** |
|---|---|---|---|---|---|
| **Horizontal Position Accuracy** | | 2m | 4m | 3m | 3m |
| **Max Navigation Update Rate** | PVT | 25Hz | 25Hz | 25Hz | 25Hz |
| **Time-To-First-Fix** | Cold Start | 29s | 27s | 32s | 42s |
| | Hot Start | 2s | 2s | 2s | 2s |
| **Sensitivity** | Tracking and Navigation | -166dBm | -164dBm | -160dBm | -159dBm |
| | Reacquisition | -160dBm | -155dBm | -157dBm | -154dBm |
| | Cold Start | -148dBm | -145dBm | -145dBm | -140dBm |
| | Hot Start | -159dBm | -156dBm | -159dBm | -154dBm |
| **Velocity Accuracy** | | 0.05m/s | 0.05m/s | 0.05m/s | 0.05m/s |
| **Heading Accuracy** | | 0.3deg | 0.3deg | 0.3deg | 0.3deg |

## Hardware Pinout

Depending on your window size, you may need to use the horizontal scroll bar at the bottom of the table to view the additional pin functions. Note that the M.2 connector pins on opposing sides are offset from each other as indicated by the bottom pins where it says (Not Connected)*. There is no connection to pins that have a "-" under the primary function.

**MICROMOD GNSS FUNCTION BOARD - NEO-M9N PINOUT TABLE**

MICROMOD GENERAL PINOUT TABLE

MICROMOD GENERAL PIN DESCRIPTIONS

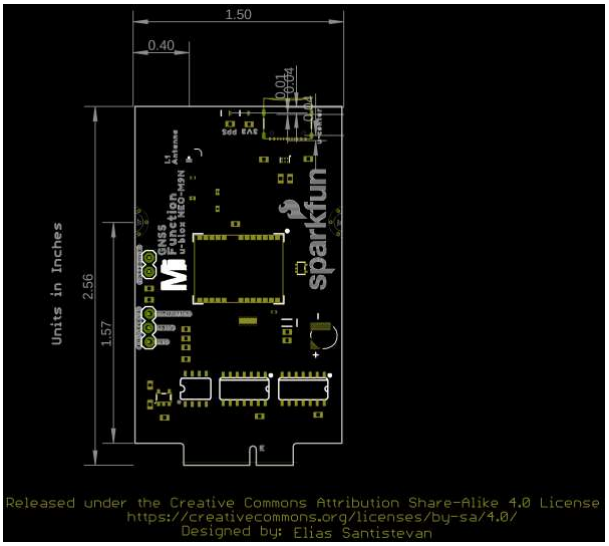
| AUDIO | UART | GPIO/BUS | $I^2C$ | SDIO | SPI0 | Dedicated |
|---|---|---|---|---|---|---|

| Function | | Bottom Pin | Top Pin | Function | |
|---|---|---|---|---|---|
| | (Not Connected) | | 75 | GND | |
| | VIN | 74 | 73 | 3.3V | |
| | VIN | 72 | 71 | Power EN | |
| | - | 70 | 69 | - | |
| | - | 66 | 65 | - | |
| | - | 64 | 63 | - | |
| | - | 62 | 61 | - | |
| | - | 60 | 59 | - | |
| | - | 58 | 57 | - | |
| | - | 56 | 55 | - | |
| | - | 54 | 53 | INT | |
| | - | 52 | 51 | RESET | |
| | - | 50 | 49 | SPI_CS0 | |
| | - | 48 | 47 | PPS | |
| | - | 46 | 45 | GND | |
| | - | 44 | 43 | - | |
| | - | 42 | 41 | - | |
| | EEPROM_WP | 40 | 39 | GND | |
| | - | 38 | 37 | - | |
| | EEEPROM_A0 | 36 | 35 | - | |
| | EEEPROM_A1 | 34 | 33 | GND | |

| | | | | | |
|---|---|---|---|---|---|
| | EEEPROM_A2 | **32** | **31** | Module Key | |
| | Module Key | **30** | **29** | Module Key | |
| | Module Key | **28** | **27** | Module Key | |
| | Module Key | **26** | **25** | Module Key | |
| | Module Key | **24** | **23** | - | |
| | - | **22** | **21** | I2C_SCL | |
| | - | **20** | **19** | I2C_SDA | |
| | - | **18** | **17** | - | |
| | - | **16** | **15** | UART_RX | |
| | - | **14** | **13** | UART_TX | |
| | - | **12** | **11** | - | |
| | - | **10** | **9** | - | |
| | - | **8** | **7** | SPI_SDO | |
| | - | **6** | **5** | SPI_SDI | |
| | - | **4** | **3** | SPI_SCK | |
| | - | **2** | **1** | GND | |

## Board Dimensions

The board uses the standard MicroMod Function Board size which measures about 1.50"x2.56".



## Hardware Assembly

If you have not already, make sure to check out the Getting Started with MicroMod: Hardware Hookup for information on inserting your Processor and Function Boards to the Main Board.

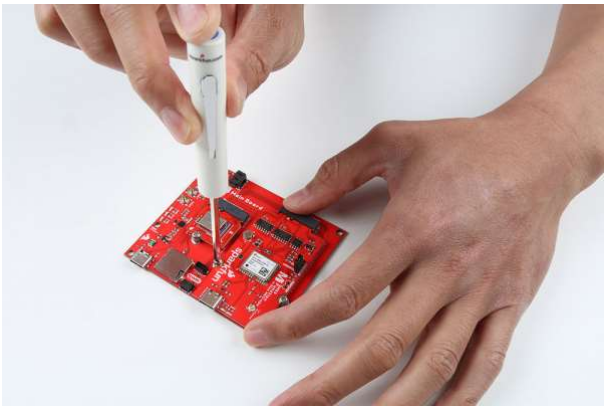
### Getting Started with MicroMod

OCTOBER 21, 2020

Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

Insert your chosen Processor and GNSS Function board at an angle into the M.2 connector. The Processor Board will stick up at an angle (at around 25°).

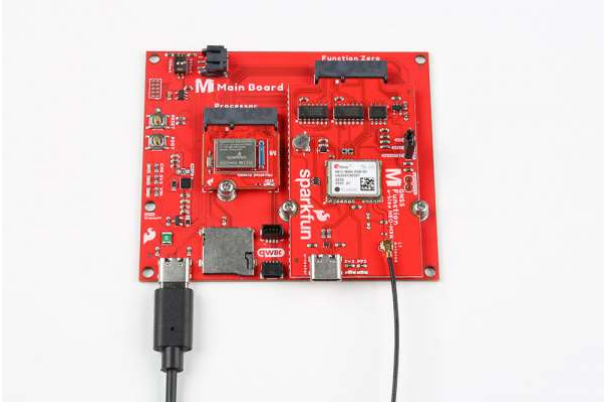
Hold down each board, insert the screws, and to tighten.



After securing the Processor and Function Board to the Main Board, your setup should look like the image below.

Insert the u.FL adapter to the MicroMod GNSS Function Board. Connect the patch antenna to the other end of the u.FL adapter. The SMA connector just needs to be finger tight to secure the antenna to the adapter..

Connect a USB Type C Cable to power and program your Processor Board. In this case, we used the MicroMod Main Board - Single and MicroMod Artemis Processor. This will also power the MicroMod GNSS Function Board.




For users that want to connect the NEO-M9N to u-blox's u-center, insert a second USB Type C cable to the MicroMod GNSS Function Board's USB C connector.


## Software Installation

**Note:** This example assumes you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review the following tutorials.

- Installing the Arduino IDE
- Installing Board Definitions in the Arduino IDE
- Installing an Arduino Library

### Arduino Board Definitions and Driver

We'll assume that you installed the necessary board files and drivers for your Processor Board. In this case, we used the MicroMod Artemis Processor Board which uses the CH340 USB-to-serial converter. If you are using a Processor Board, make sure to check out its hookup guide for your Processor Board.

### Installing Board Definitions in the Arduino IDE

SEPTEMBER 9, 2020

How do I install a custom Arduino board/core? It's easy! This tutorial will go over how to install an Arduino board definition using the Arduino Board Manager. We will also go over manually installing third-party cores, such as the board definitions required for many of the SparkFun development boards.

## MicroMod Artemis Processor Board Hookup Guide

OCTOBER 21, 2020

Get started with the Artemis MicroMod Processor Board in this tutorial!



## How to Install CH340 Drivers

AUGUST 6, 2019

How to install CH340 drivers (if you need them) on Windows, Mac OS X, and Linux.

### Arduino Library

All of our u-blox based GPS boards share the same library: this board, their predeccesors and the higher precision u-blox cousins. The SparkFun u-blox Arduino library can be downloaded with the Arduino library manager by searching '**SparkFun u-blox GNSS**' or you can grab the zip here from the GitHub repository to manually install:

**SPARKFUN U-BLOX ARDUINO LIBRARY (ZIP)**

There are several example sketches provided that utilize the $I^2C$ bus to get you up and receiving messages from space. We'll go over one of the examples in this tutorial.

**Note:** Example 2 uses the '**MicroNMEA**' library by **Steve Marple**. Make sure to install the library as well by searching for it in the Arduino library manager. You could also grab the zip here from the GitHub repository to manually install.

**MICRONMEA ARDUINO LIBRARY (ZIP)**

## Main Board Example - Pin Connection Table

For NEO-M9N specific pins, here is the mapping between the function board and main board's processor pins. For the following examples, we are using the Artemis Processor Board.

| AUDIO | UART | GPIO/BUS | I²C | SDIO | SPI | Dedicated |
|---|---|---|---|---|---|---|

| NEO-M9N Function Board Pin Name | I/O Direction | Main Board's Processor Pin | |
|---|---|---|---|
| | | Slot 0 | Slot 1 |
| VCC | I | VCC | VCC |
| EN | O | PWR_EN0 | PWR_EN1 |
| GND | - | GND | GND |
| SPI_SCK | O | SPI_SCK | SPI_SCK |
| SPI_POCI | I | SPI_POCI | SPI_POCI |
| SPI_PICO | O | SPI_PICO | SPI_PICO |
| I2C_SCL | I/O | I2C_SCL | I2C_SCL |
| I2C_SDA | I/O | I2C_SDA | I2C_SDA |
| RX | O | TX1 | TX2 |
| TX | I | RX1 | RX2 |
| PPS | I/O | D0 | D1 |
| SPI_CS | I/O | CS0 | CS1 |
| RESET | I/O | PWM0 | PWM1 |
| INT | I/O | G0 | G5 |
| EEPROM_A0 | I/O | - | - |
| EEPROM_A1 | I/O | - | - |

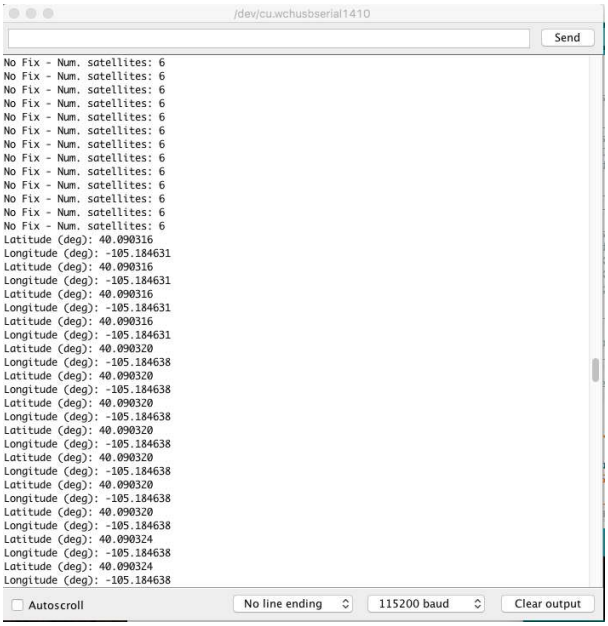
| | | | |
|---|---|---|---|
| EEPROM_A2 | I/O | - | - |
| EEPROM_WP | I/O | - | - |

## Arduino Example

We're just going to look at example two (i.e. "**Example2_NMEAParsing.ino**") which in my opinion, makes it clear the awesomeness of these GPS receivers. That is to say, talking to satellites and finding out where in the world you are.

```
#include <Wire.h> //Needed for I2C to GPS

#include "SparkFun_u-blox_GNSS_Arduino_Library.h" //Click here to get the library: http://librar
ymanager/All#SparkFun_u-blox_GNSS
SFE_UBLOX_GNSS myGNSS;

void setup()
{
  Serial.begin(115200);
  Serial.println("SparkFun u-blox Example");

  Wire.begin();

  if (myGNSS.begin() == false)
  {
    Serial.println(F("u-blox GNSS module not detected at default I2C address. Please check wirin
g. Freezing."));
    while (1);
  }

  //This will pipe all NMEA sentences to the serial port so we can see them
  myGNSS.setNMEAOutputPort(Serial);
}

void loop()
{
  myGNSS.checkUblox(); //See if new data is available. Process bytes as they come in.

  delay(250); //Don't pound too hard on the I2C bus
}
```

When you upload this code you'll have to wait ~24s to get a lock onto any satellites. After that first lock, the backup battery on the board will provide power to some internal systems that will allow for a **hot start** the next time you turn on the board. The **hot start** only lasts four hours, but allows you to get a lock within one second. After you get a lock the serial terminal will start listing longitude and latitude coordinates, as seen below. Make sure to set the serial monitor to **115200 baud**.




*These are the coordinates for SparkFun HQ*

## Troubleshooting

**Not working as expected and need help?**

If you need technical assistance and more information on a product that is not working as you expected, we recommend heading on over to the SparkFun Technical Assistance page for some initial troubleshooting.

**SPARKFUN TECHNICAL ASSISTANCE PAGE**

If you don't find what you need there, the SparkFun Forums are a great place to find and ask for help. If this is your first visit, you'll need to create a Forum Account to search product forums and post questions.

**CREATE NEW FORUM ACCOUNT** **LOG INTO SPARKFUN FORUMS**

## Resources and Going Further


Ready to get hands-on with GPS?

We've got a page just for you! We'll walk you through the basics of how GPS works, the hardware needed, and project tutorials to get you started.

**TAKE ME THERE!**

Now that you've successfully got your MicroMod GNSS Function Board - NEO-M9N up and running, it's time to incorporate it into your own project! For more information, check out the resources below.

### Hardware Documentation

- Schematic (PDF)
- Eagle Files (ZIP)
- Board Dimensions (PNG)
- Building a GPS System
- u-blox NEO-M9N Documents & Resources
  - Datasheet (PDF)
  - Product Summary (PDF)
  - Integration Manual (PDF)
  - u-blox Protocol Specification (PDF)
  - u-blox ECCN (PDF)
  - u-center Software
- SparkFun u-blox GNSS Arduino Library
- GitHub Hardware Repo
- SFE Product Showcase

### MicroMod Documentation

- Getting Started with MicroMod
- Designing with MicroMod
- MicroMod Info Page
- MicroMod Forums

Or check out other tutorials related to GPS and GNSS:



### Copernicus II Hookup Guide

A guide for how to get started with the Copernicus II GPS module.



### ESP32 Thing Motion Shield Hookup Guide

Getting started with the ESP32 Thing Motion Shield to detect movements using the on-board LSM9DS1 IMU and adding a GPS receiver. Data can be easily logged by adding an microSD card to the slot.



### Advanced Autonomous Kit for Sphero RVR Assembly Guide

Get your Advanced Autonomous Kit for the Sphero RVR built up with this hookup guide!



### Artemis Global Tracker Hookup Guide

The SparkFun Artemis Global Tracker combines the Artemis processor with an Iridium 9603N satellite transceiver, ZOE-M8Q GNSS transceiver, and MS8607 PHT sensor. With a clear view of the sky, this board allows you to send and receive short data messages from anywhere in the world including remote locations far beyond the reach of WiFi and GSM networks. Follow this guide to get started with the Artemis Global Tracker.