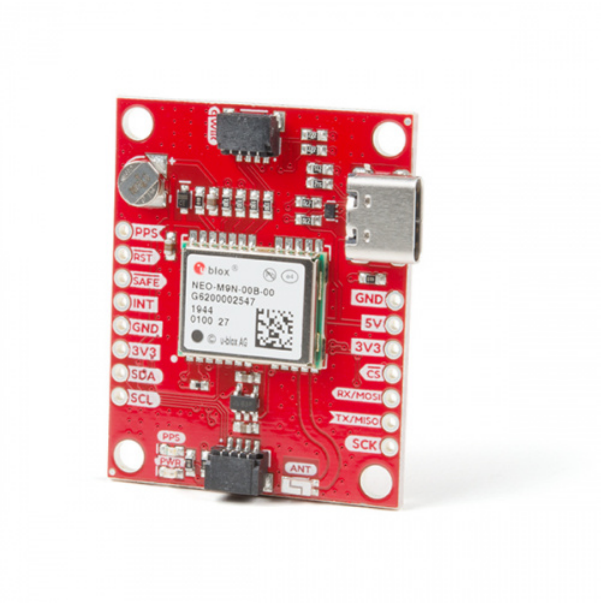
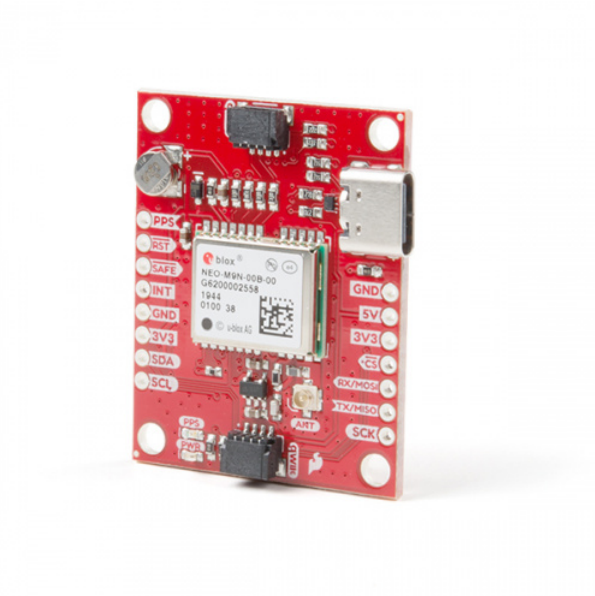
SparkFun GPS NEO-M9N Hookup Guide

Introduction

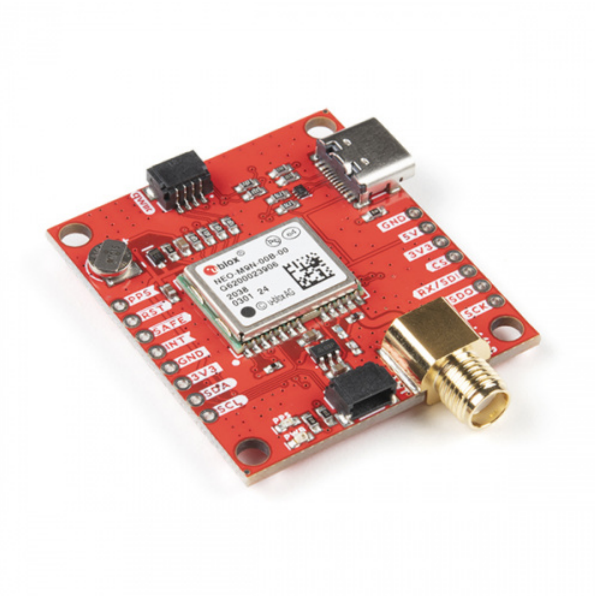
The SparkFun GPS NEO-M9N is the next iteration of u-blox's GPS offerings! We've developed three flavors of the board: one with a small chip antenna, u.FL connector, and SMA connector so that you can select an antenna of your choosing.



SparkFun GPS Breakout - NEO-M9N, Chip Antenna (Qwiic)
GPS-15733



SparkFun GPS Breakout - NEO-M9N, U.FL (Qwiic)
GPS-15712



SparkFun GPS Breakout - NEO-M9N, SMA (Qwiic)
GPS-17285

Product Showcase: SparkFun GPS Breakout NEO-M9N

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 RedBoard Qwiic
DEV-15123

Qwiic Cable - 100mm
PRT-14427

USB micro-B Cable - 6 Foot
CAB-10215

Additional GPS Antenna Options

Below are some other GPS Antenna options. Make sure to get the u.FL to SMA cable if you decide to use the one with the u.FL connector. Link for that is below in the GPS accessories.

GNSS Multi-Band Magnetic Mount Antenna - 5m (SMA)
GPS-15192

GPS/GNSS Magnetic Mount Antenna - 3m (SMA)
GPS-14986

GPS/GNSS Embedded Antenna - 1m (SMA)
GPS-14987

GPS Embedded Antenna SMA
GPS-00177

GPS Antenna Accessories

Interface Cable SMA to U.FL
WRL-09145

GPS Antenna Ground Plate
GPS-15004

Other Qwiic Cable Accessories

SparkFun Qwiic Cable Kit
KIT-15081

Qwiic Cable - 100mm
PRT-14427

Qwiic Cable - 50mm
PRT-14426

Qwiic Cable - 200mm
PRT-14428

Heads up! If you are using the RedBoard **without** a Qwiic connector, we recommend getting the Qwiic Shield for Arduino.

SparkFun Qwiic Shield for Arduino
DEV-14352

Suggested Reading

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

Qwiic Connect System

We would also recommend taking a look at the following tutorials if you aren't familiar with them.

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

Three Quick Tips About Using U.FL

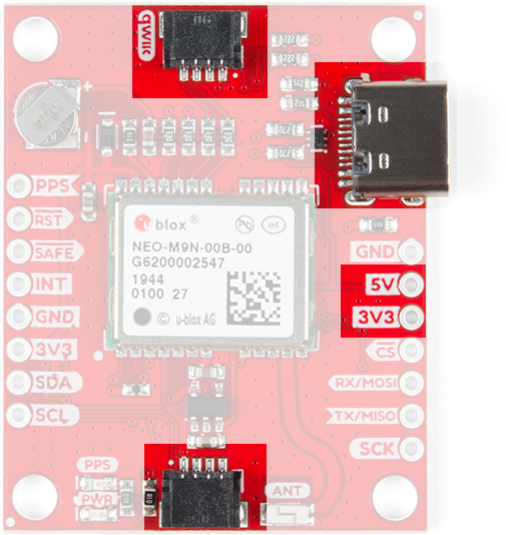
Learn the tips and tricks to use the u-blox software tool to configure your GPS receiver.

Quick tips regarding how to connect, protect, and disconnect U.FL connectors.

Hardware Overview

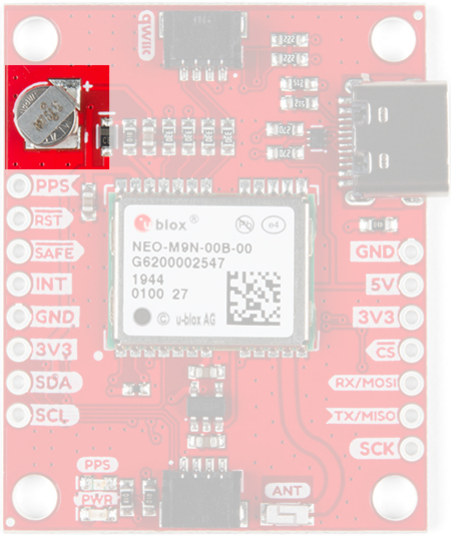
Power

Power for this board is **3.3V** and we have provided multiple power options. This first and most obvious is the **USB-C connector**. Secondly, are the **Qwiic Connectors** on the top and bottom of the board. Thirdly, there is a **5V pin** on the PTH header along the side of the board that is regulated down to **3.3V**. Make sure that power your provide to this pin does *not* exceed 6 volts. Finally, just below the 5V pin is a **3.3V** pin that should only be provided a clean 3.3V power signal.



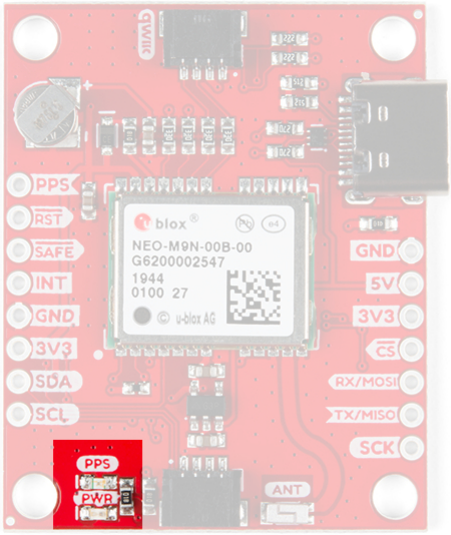
Battery

The small metal disk in the upper left corner 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.



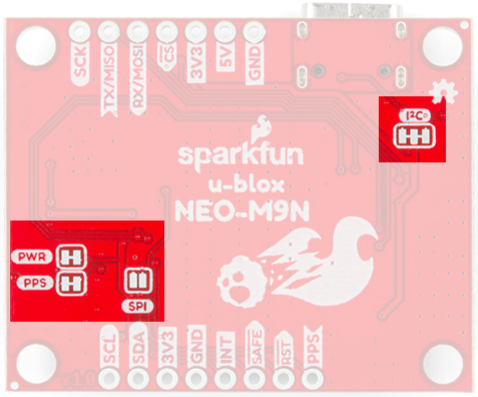
LEDs

There's is a red power LED just to the left of the bottom Qwiic connector and near the board's edge to indicate that the board is powered. There is another LED just above the power LED labeled `PPS` that 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.



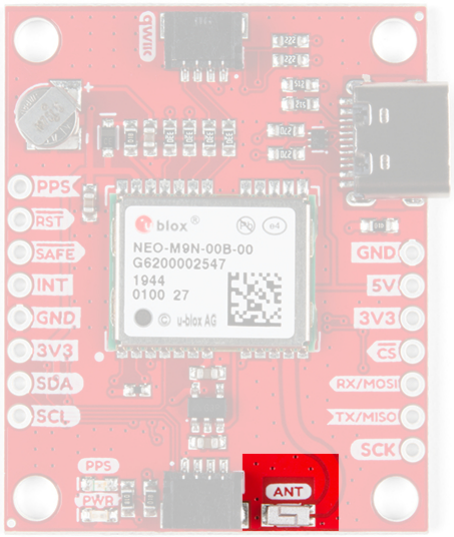
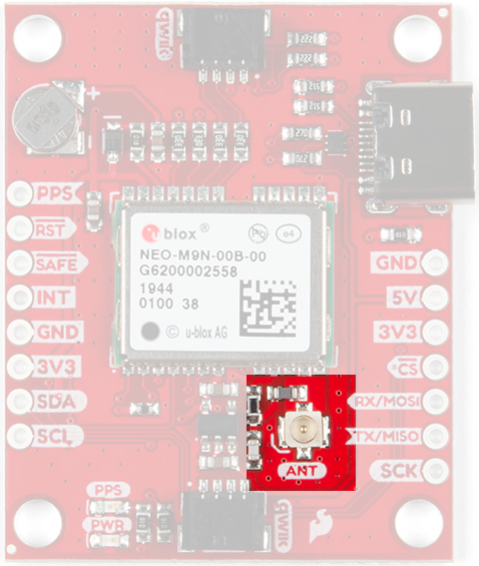
Jumpers

There are four jumpers on the underside of the product, each labeled with its function. At the upper right of the picture is a three way jumper labeled `I²C` that 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. On the left side of the board is a jumper labeled `PWR` . If you cut this trace it will disconnect the **Power** LED. Just below is the `PPS` jumper that when cut disconnects the **PPS** LED. Finally, there's a jumper labeled `SPI` which enables the SPI data bus thus disabling the UART functions on those lines. For more information, check out our tutorial on working with jumper pads and PCB traces.



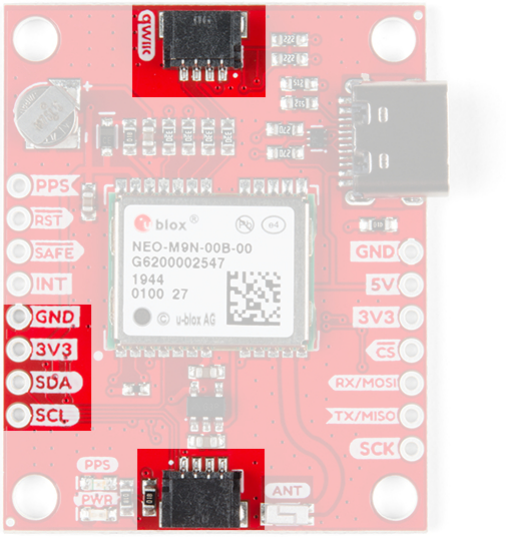
Chip Antenna, U.FL, or SMA

The SparkFun GPS NEO-M9N with Chip Antenna has a GNSS antenna near its left Qwiic connector while its cousins have either a U.FL and SMA connector in which you can connect a patch antenna.

		
Chip Antenna	**U.FL**	

Qwiic and I^{2}C

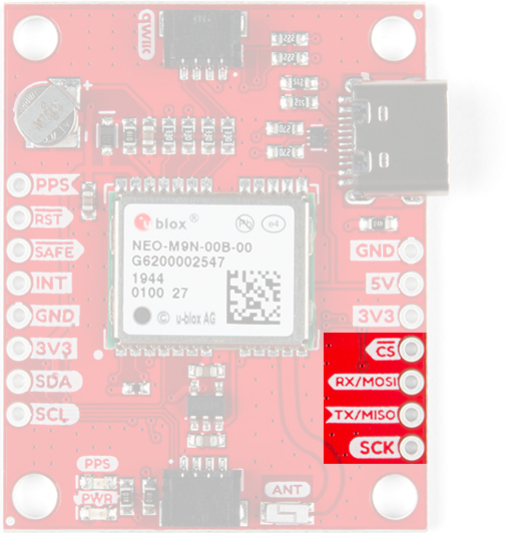
There are two pins labeled `SDA` and `SCL` which indicates the I^{2}C data lines. Similarly, you can use either of the Qwiic connectors to provide power and utilize I^{2}C. The Qwiic ecosystem is made for fast prototyping by removing the need for soldering. All you need to do is plug a Qwiic cable into the Qwiic connector and voila!



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.

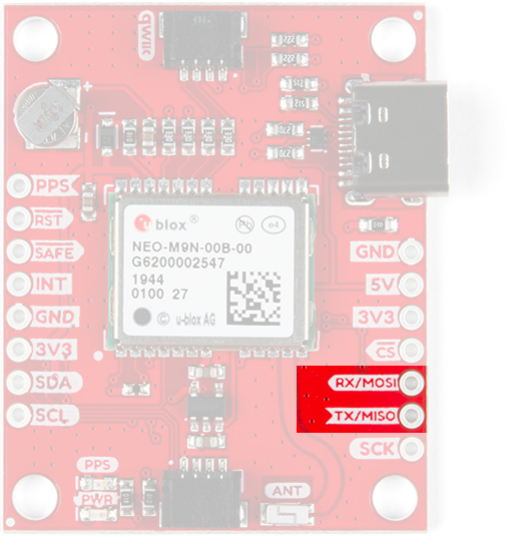
SPI

There are four pins on the right most header that are labeled with their corresponding SPI functionality. As mentioned in the jumpers section, you'll need to close the `SPI` jumper on the underside to enable SPI.



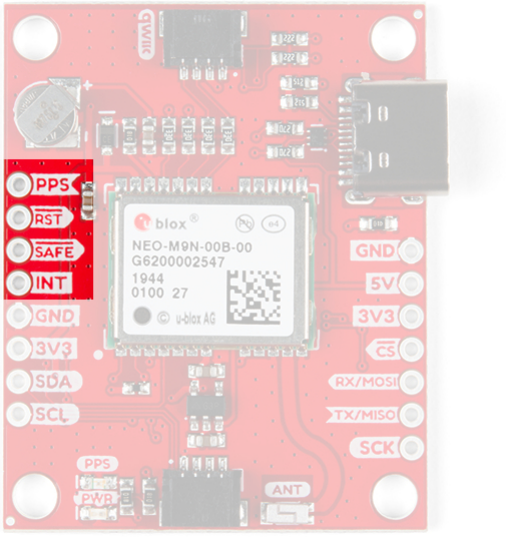
UART

There are two pins on the right most header labeled for their UART functionality.



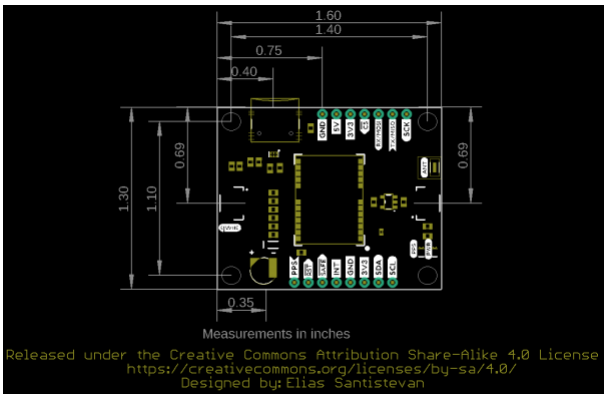
Broken Out Pins

There are four other pins broken out: Pulse per second (`PPS`), Reset (`RST`), Safeboot (`SAFE`), and finally the interrupt pin (`INT`). The first pin `PPS` , outputs pulse trains synchronized with the GPS or UTC time grid. The signal defaults to once per second but is configurable over a wide range. Read the **u-blox Receiver Protocol Specification** in the Resources and Going Further tab for more information. The reset pin resets the chip. The next pin, `SAFE` 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. The final pin `INT` can be used to wake the chip from power save mode.

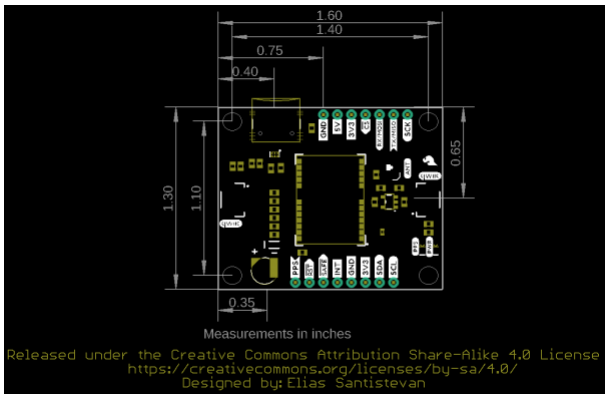


Board Dimensions

Overall, the boards are 1.30"x1.60". The location of a majority of the components are the same with the exception of the SMD chip antenna and the u.FL connector.



Chip Antenna Version



u.FL Version

Click on image for a closer view.

GPS Capabilities

The SparkFun 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.

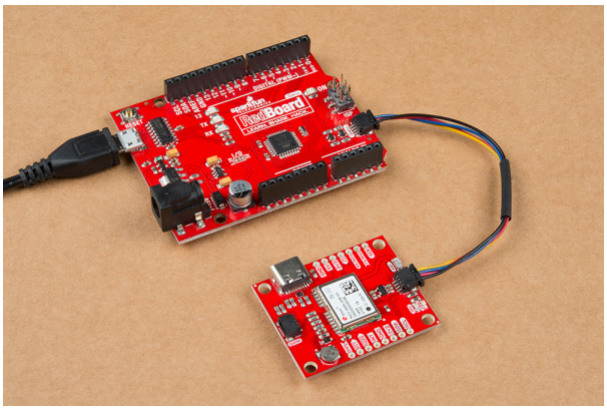
Constellations		**GPS+GLO+GAL+BDS**	**GPS+GLONASS+GAL**	**GPS+GLO**	**GPS+BDS**
Horizontal Position Accuracy		2m	2m	2m	2m
Max Navigation Update Rate	PVT	25Hz	25Hz	25Hz	25Hz
Time-To-First-Fix	Cold Start	24s	25s	26s	28s
	Hot Start	2s	2s	2s	2s
Sensitivity	Tracking and Navigation	-167dBm	-167dBm	-167dBm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

For this example, I used a Qwiic capable RedBoard and associated USB cable. connecting the boards with Qwiic cable, the assembly is very simple. Plug a Qwiic cable between the RedBoard and the SparkFun NEO-M9N with chip antenna and that's it! Just as easily I could have used the version with the U.FL connector and plugged in one of our patch antennas to the GPS board. If you need tips on plugging in the U.FL connector, then check out our U.FL tutorial. If you're going to be soldering to the through hole pins for I^{2}C functionality, then just attach lines to power, ground, and the I^{2}C data lines to a microcontroller of your choice.



SparkFun U-Blox Library

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 our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide.

All of our u-blox based GPS boards share the same library: these two boards, 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 Ublox**' or you can grab the zip here from the GitHub repository to manually install.:

SPARKFUN U-BLOX ARDUINO LIBRARY (ZIP)

There are 13 example sketches provided 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.

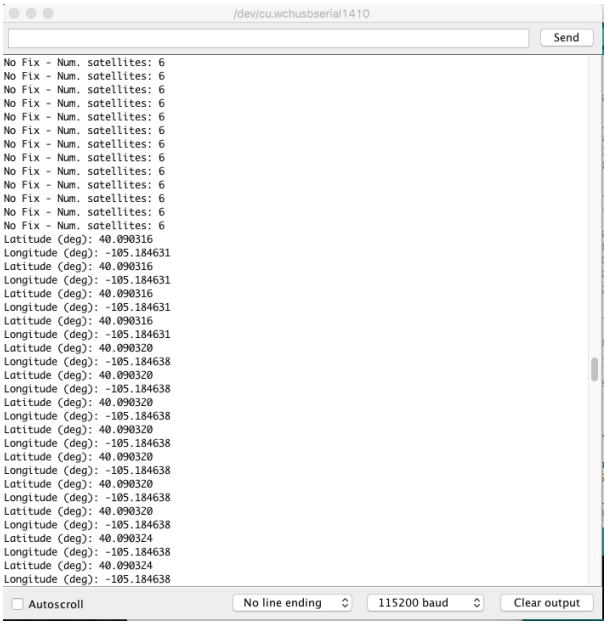
MICRONMEA ARDUINO LIBRARY (ZIP)

Example Code

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_Ublox_Arduino_Library.h" //Click here to get the library: http://librarymanag
er/All#SparkFun_Ublox_GPS
SFE_UBLOX_GPS myGPS;

void setup()
{
  Serial.begin(115200);
  Serial.println("SparkFun Ublox Example");

  Wire.begin();

  if (myGPS.begin() == false)
  {
    Serial.println(F("Ublox GPS not detected at default I2C address. Please check wiring. Freezi
ng."));
    while (1);
  }

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

void loop()
{
  myGPS.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 ~29s 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

Resources and Going Further

Now that you've successfully got your GPS receiver up and running, it's time to incorporate it into your own project! For more information, check out the resources below:

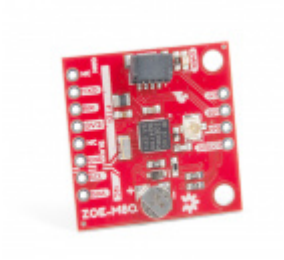
- **SparkFun u-Blox NEO-M9N with Chip Antenna**
  - Schematic (PDF)
  - Eagle Files (ZIP)
  - Board Dimensions
- **SparkFun u-Blox NEO-M9N with U.FL Connector**
  - Schematic (PDF)
  - Eagle Files (ZIP)
  - Board Dimensions
- **SparkFun u-Blox NEO-M9N with SMA Connector**
  - Schematic
  - Eagle Files
  - Board Dimensions
- **u-blox Module Documentation**
  - NEO-M9N Datasheet (PDF)
  - Protocol Summary (PDF)
  - Integration Manual (PDF)
  - u-blox Protocol Specification (PDF)
  - u-center Software
- **GitHub**
  - Product Repo
  - SparkFun u-blox Arduino Library
  - SFE Product Showcase

Are you looking for a GPS receiver with an *insane* 10mm 3D accuracy, then check out the two other u-Blox based GPS boards by SparkFun (ZED-F9P and NEO-M8P-2) on the left below. Need a smaller more compact GPS unit but don't need as high of a refresh rate, check out the ZOE-M8Q and SAM-M8Q on the right.

SparkFun GPS-RTK2 Board - ZED-F9P (Qwiic)
GPS-15136

SparkFun GPS-RTK Board - NEO-M8P-2 (Qwiic)
GPS-15005

SparkFun GPS Breakout - Chip Antenna, SAM-M8Q (Qwiic)
GPS-15210



SparkFun GPS Breakout - ZOE-M8Q (Qwiic)
GPS-15193

Need some inspiration for your next project? Check out some of these related tutorials:

Getting Started with the GeoFence
How to get started using the GeoFence GPS Boundary Widget and GeoFence Software.

HX1 APRS Transmitter Hookup Guide
The HX1 is a low-power amateur radio transmitter that can be used to send data to the Automatic Packet Reporting System (APRS) network.

What is GPS RTK?

Learn about the latest generation of GPS and GNSS receivers to get 14mm positional accuracy!

GPS Geo-Mapping at the Push of a Button

Let's ramp up our GPS tracking skills with KML files and Google Earth. We'll make a tracker that logs location and allows us to visualize our steps with Google Earth.