SparkFun GPS Breakout (ZOE-M8Q and SAM-M8Q) Hookup Guide

CONTRIBUTORS: ELIAS THE SPARKIEST

Introduction

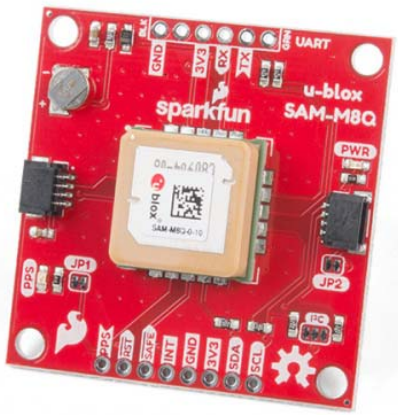
The SparkFun ZOE-M8Q and SAM-M8Q are two similarly powerful GPS units but with different project applications. They both have a 2.5m horizontal accuracy!

SparkFun GPS Breakout - ZOE-M8Q (Qwiic)

GPS-15193

$44.95

★★★★½ 5



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

GPS-15210

$39.95

★★★★½ 2

Product Showcase: SparkFun GPS & GNSS Boar...

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

Qwiic Cable - 100mm

DEV-15123
$19.95
★★★★½ 5

PRT-14427
$1.50

Molex Flexible GNSS Antenna - U.FL (Adhesive)
GPS-15246
$3.95

Additional GPS Antenna Options

Below are some other GPS Antenna options. Some of the options below have an SMA connector, so make sure to get the u.FL to SMA cable if you decide to use those. Link for that is below in the GPS accessories. If you want to try different chip antennas, then try the GNSS Antenna Evalutation Board listed below and make sure to get the u.FL to u.FL connector in the accessories.

GPS/GNSS Magnetic Mount Antenna - 3m (SMA)
GPS-14986
$12.95
★★★★★ 2

GPS/GNSS Embedded Antenna - 1m (SMA)
GPS-14987
$59.95

SparkFun GNSS Chip Antenna Evaluation Board

GPS Embedded Antenna SMA

GPS-15247
$24.95
★★★★★ 1

GPS-00177
$11.95

GPS Antenna Accessories

Interface Cable SMA to U.FL
WRL-09145
$4.95
★★★★½ 3

GPS Antenna Ground Plate
GPS-15004
$4.95

U.FL to U.FL Mini Coax Cable - 200mm
WRL-15114
$1.95

Other Qwiic Cable Accessories

SparkFun Qwiic Cable Kit
KIT-15081
$7.95
★★★★½ 7

Qwiic Cable - 100mm
PRT-14427
$1.50

Qwiic Cable - 200mm
PRT-14428
$1.50

Qwiic Cable - 50mm
PRT-14426
$0.95

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
$6.95
4

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

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.

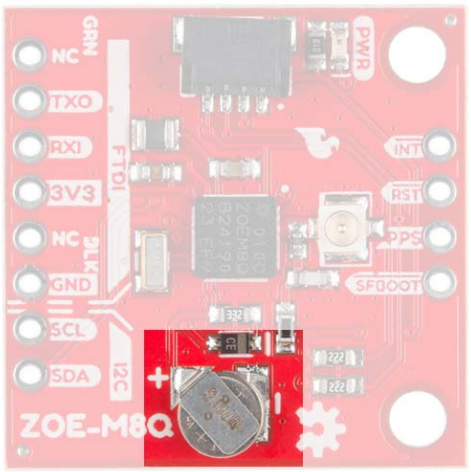
SparkFun ZOE-M8Q Hardware Overview

Power

Power for this board should be **3.3V**. There is a 3.3V pin on the PTH header along the side of the board, but you can also provide power through the Qwiic connector.

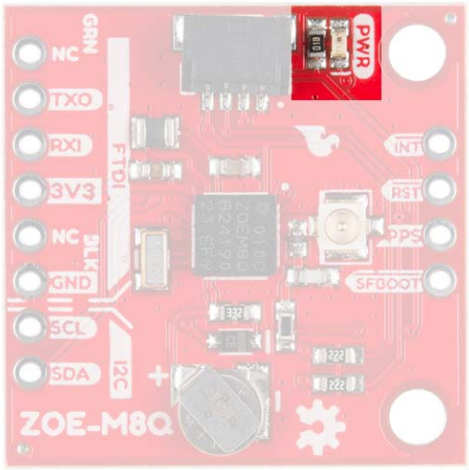
Battery

The small metal disk opposite of the Qwiic connector 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 the product has a lock, that battery will allow for a **one 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.



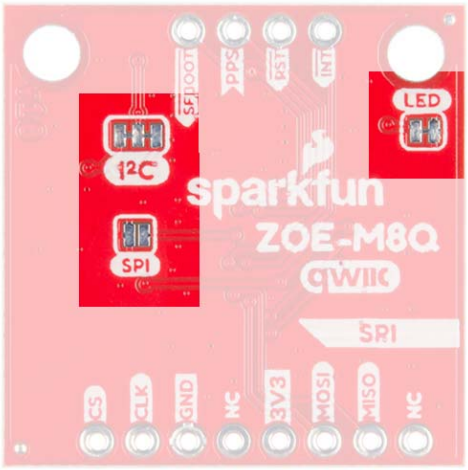
LEDs

There's a single red power LED just above the Qwiic connector to indicate that the board is powered.



Jumpers

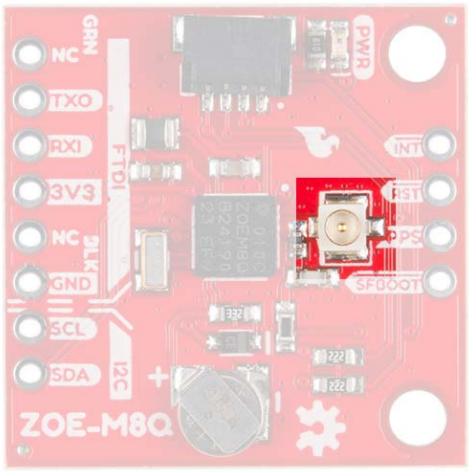
There are three jumpers on the underside of the product, each labeled with its function. The first in the top left of the picture is a three way jumper labeled `I²C` that connects two pull-up resistors to the I^{2}C data lines. If you have many devices on your I^{2}C data lines, then you may consider cutting these. To the right of that jumper at the very edge of the board is the `LED` jumper. If you cut this trace it will disconnect the **Power** LED on the topside of the board. Finally, at the lower left is the `SPI` jumper that when closed enables **SPI** communication. The board defaults to I^{2}C and Serial so close that if you'd rather get your NMEA data over SPI.



U.FL Connector

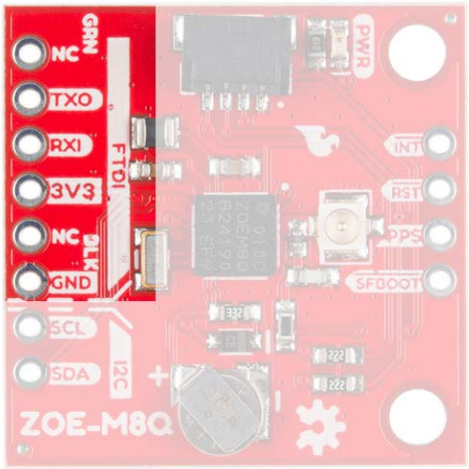
The U.FL connector on the board is where you will plug in your antenna. This is a compact connector for RF antennas, that has the same function as the traditional SMA connector. You may be more familiar and even own some antennas that use SMA connectors; never fear, we carry a U.FL to SMA cable adapter. Check out our tutorial on using U.FL connectors, if this

be your first.



FTDI Header

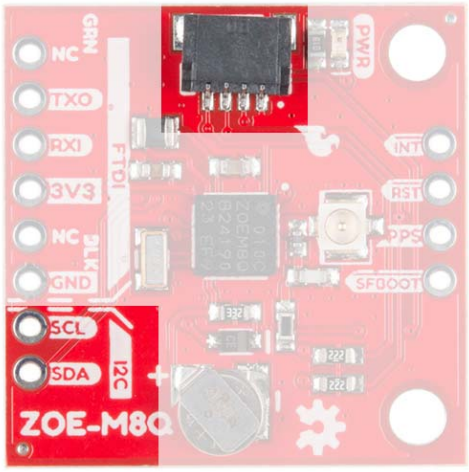
At the bottom of the board we have the traditional pinout for an FTDI header. Make sure that the FTDI that you use is **3.3V** and not 5V!



Qwiic and I^{2}C

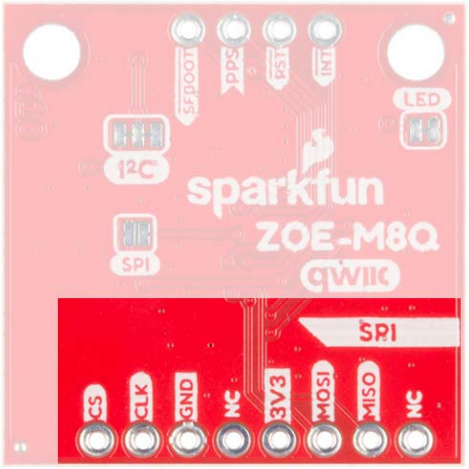
Next to the FTDI header at the bottom of the board. There are two pins labeled `SDA` and `SCL` which indicates the I^{2}C data lines. Similarly you can just use the Qwiic connector on the left side of the picture. The Qwiic ecosystem is made for fast prototyping by removing the need for soldering. All 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.



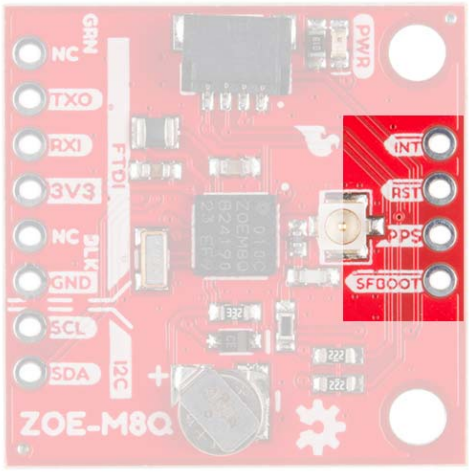
SPI Header

This sets the ZOE-M8Q apart from the SAM-M8Q. On the underside of the product as mentioned above, is a jumper that can be closed to allow for SPI communication. The header is labeled for the pinout for SPI.



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 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. The final pin `INT` can be used to wake the chip from power save mode.



GPS Capabilities

The ZOE-M8 is able to connect to up to three different GNSS constellations at a time making it very accurate for its size. Below are the listed capabilities of the GPS unit.

	GNSS	GPS and GLONASS	GPS	GLONASS	BeiDou	Galileo
Horizontal Position Accuracy		2.5m	2.5m	4m	3m	---
Max Navigation Update Rate	ROM	10Hz	18Hz	18Hz	18Hz	18Hz
	Flash	5Hz	10Hz	10Hz	10Hz	10Hz
Time-To-First-Fix	Cold Start	26s	29s	30s	34s	45s
	Hot Start	1s	1s	1s	1s	1s
Sensitivity	Tracking and Navigation	-167dBm	-166dBm	-166dBm	-160dBm	-159dBm
	Reacquisition	-160dBm	-160dBm	-156dBm	-157dBm	-153dBm
	Cold Start	-148dBm	-148dBm	-145dBm	-143dBm	-138dBm
	Hot Start	-157dBm	-157dBm	-156dBm	-155dBm	-151dBm

Velocity Accuracy	0.05m/s
Heading Accuracy	0.3 degrees

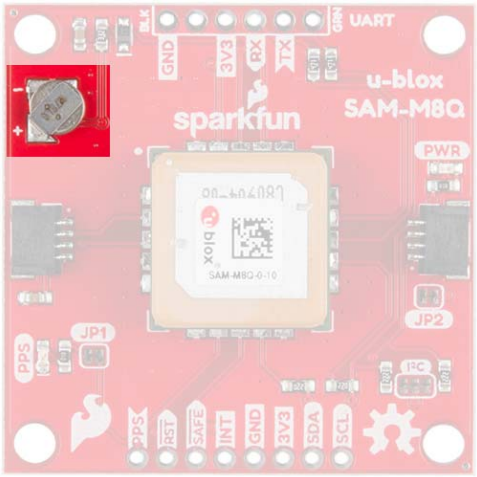
SparkFun SAM-M8Q Hardware Overview

Power

Power for this board is **3.3V**. There is a 3.3V pin on the PTH header along the side of the board, but you can also provide power through the Qwiic connector.

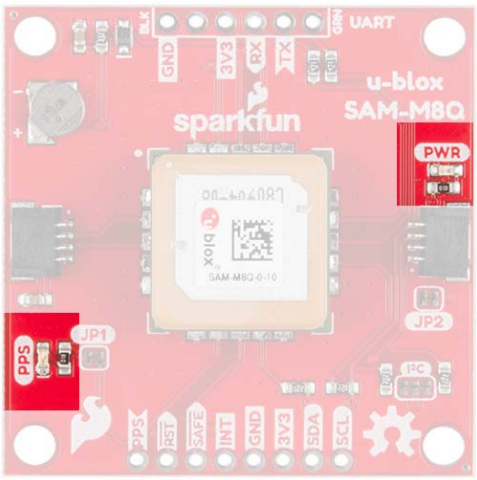
Battery

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 **one 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.



LEDs

There's a single red power LED just above the Qwiic connector to indicate that the board is powered. There is another LED labeled `PPS` that is connected to the *Pulse Per Second* line on the GPS chip. 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

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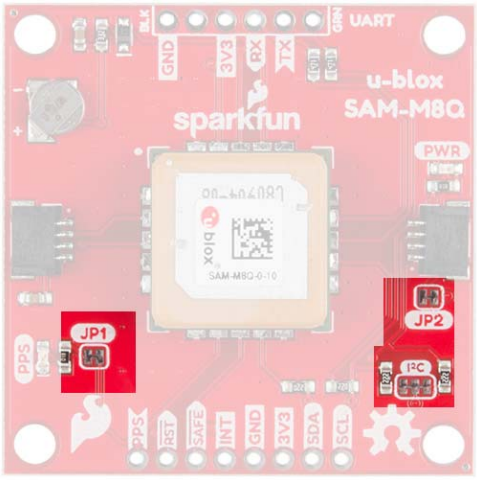
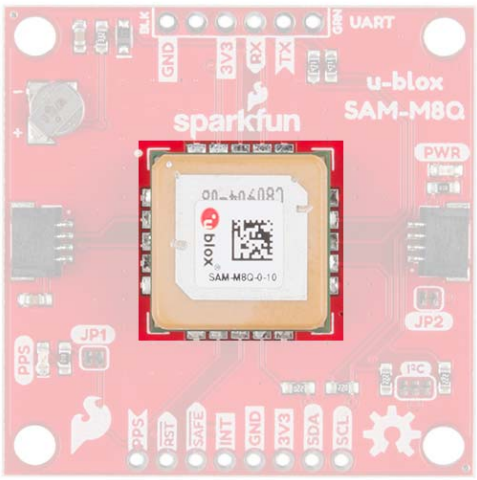


Chip Antenna

This GPS unit at the center of the PCB may look a bit funky to you. In fact you may be thinking, "Wow, that looks suspiciously like a GNSS Antenna....". That's very astute dear hookup guide peruser. This GPS IC is actually built into the antenna giving you an all-in-one GPS solution.



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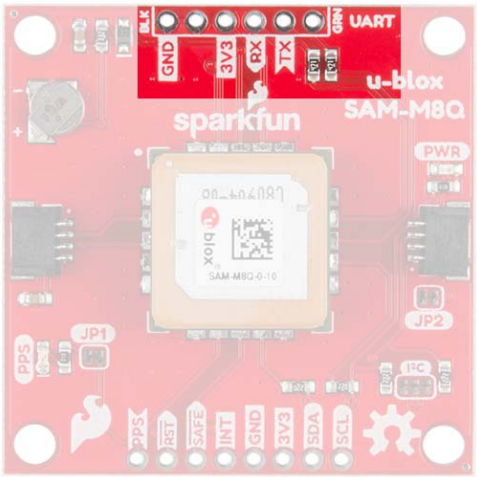

Qwiic and I^{2}C

At the opposite side of the board. 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!

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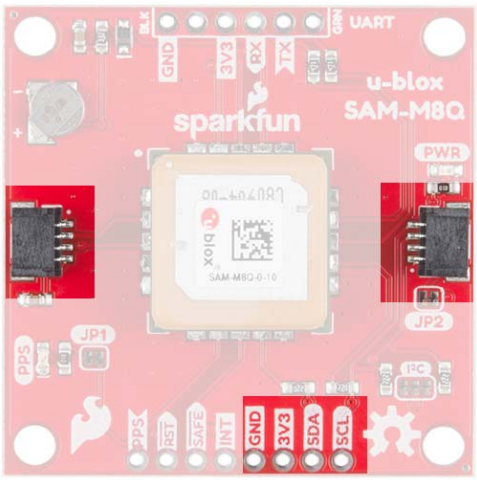

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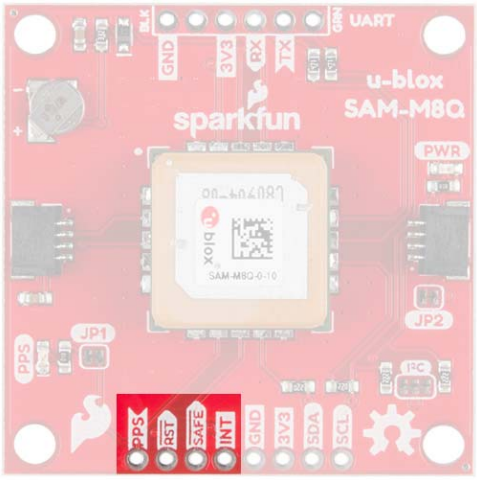

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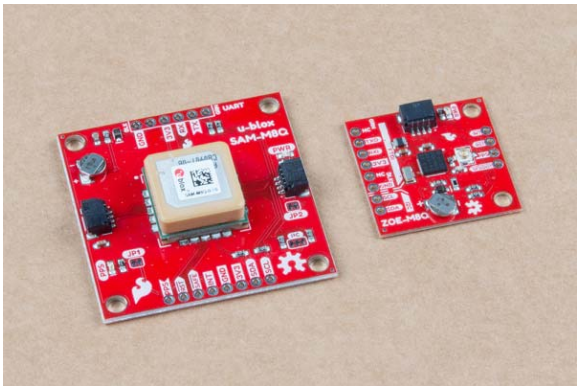
Time-To-First-Fix	Cold Start	26s	29s	30s	---
	Hot Start	1s	1s	1s	---
Sensitivity	Tracking and Navigation	-165dBm	-164dBm	-164dBm	-157dBm
	Reacquisition	-158dBm	-158dBm	-154dBm	-151dBm
	Cold Start	-146dBm	-146dBm	-143dBm	-136dBm
	Hot Start	-155dBm	-155dBm	-154dBm	-149dBm
Velocity Accuracy	0.05m/s				
Heading Accuracy	0.3 degrees				

Which GPS Unit Do I Pick?!

Size and GNSS Antenna

In each of the Hardware Overview sections we laid out the characteristics of the two GPS boards. Let's begin with the more obvious differences between the boards. The SAM-M8Q is a larger board with dimensions of 1.6 x 1.6 inches. The relative larger size of the board helps to enhance the product's GNSS antenna that houses the GPS unit *inside*. The ZOE-M8Q is 1 x 1 inch board that does *not* have an onboard GNSS antenna, and instead has a U.FL connector to connect to an external one. This gives you the option to use something that can be attached outside while the GPS unit is inside connected to your microcontroller. If you want to try out a number of different antenna shapes and sizes, we have a GNSS Evaluation Board for the purpose of finding the best antenna that works for your project.

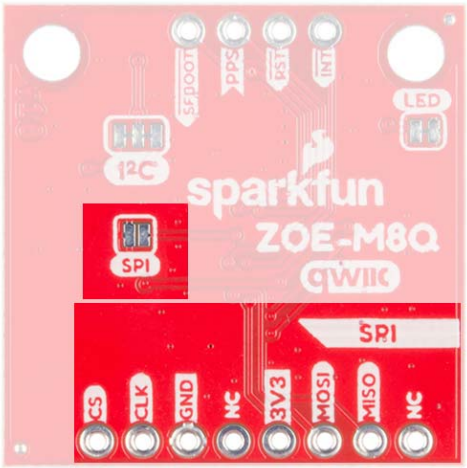


GPS Capability Comparison

These two GPS units are so similar in their capabilities that the difference is negligible. The one difference between the two is that the SAM-M8Q does not connect to the Chinese GNSS constellation BeiDou.

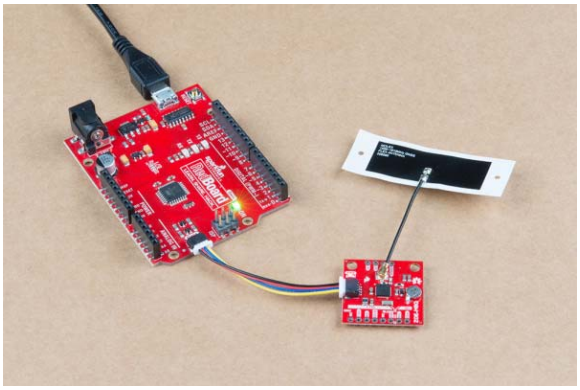
NMEA Data

Both have I^{2}C and serial capabilities to receive your NMEA data, but only the ZOE-M8Q has SPI capabilities. Enable SPI by closing the jumper on the underside of the product labeled `SPI`.

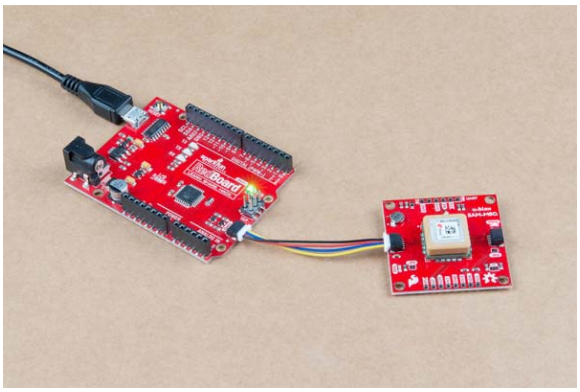


Hardware Assembly

For this example, I used a Qwiic capable RedBoard and associated USB cable. With that and a Qwiic cable, the assembly is very simple. Plug a Qwiic cable between the RedBoard and the GPS unit, and attach the antenna to the U.FL connector. 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, then just attach lines to power, ground, and the I^{2}C data lines to the microcontroller of your choice. Of course, if you're using the SAM-M8Q then you don't need an antenna since it already has one.



RedBoard Qwiic and the ZOE-M8Q with attached Adhesive Antenna



RedBoard Qwiic and the SAM-M8Q

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.

Both the SAM-M8Q and ZOE-M8Q share the same library. These two also share a library with their other u-BLOX higher precision 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:

SPARKFUN U-BLOX ARDUINO LIBRARY (ZIP)

There are 13 example sketches provided to get you up and receiving messages from space.

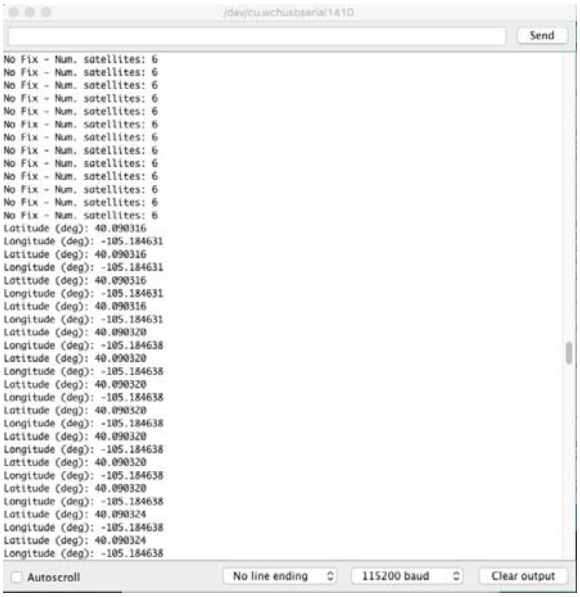
Example Code

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 ge
t the library: http://librarymanager/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 ad
dress. Please check wiring. Freezing."));
    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 ZOE-M8Q/SAM-M8Q 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 ZOE-M8Q
    - Schematic (PDF)
    - Eagle Files (ZIP)
    - Datasheet (PDF)
    - Integration Manual (PDF)
    - Product Summary (PDF)
    - u-blox Protocol Specification (PDF)
    - u-center Software
    - GitHub
        - Product Repo
        - SparkFun Ublox Arduino Library
        - SFE Product Showcase
- SparkFun u-Blox SAM-M8Q
    - Schematic (PDF)
    - Eagle Files (ZIP)
    - Datasheet (PDF)
    - Integration Manual (PDF)
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    - u-center Software
    - GitHub
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        - SFE Product Showcase

Are you looking for a GPS receiver with an *insane* 10mm 3D accuracy?
Then check out these other u-Blox based GPS boards by SparkFun below.

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

GPS-15136

$219.95

20

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

GPS-15005

$199.95

6

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

Copernicus II Hookup Guide

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

GPS Mouse - GP-808G Hookup Guide

Get started with the GP-808G GPS Mouse. This GPS module is great for advanced projects such as autonomous vehicles.

LS20031 5Hz (66 Channel) GPS Receiver Hookup Guide

In this tutorial, we will solder headers to the surface mount pads of the LS20031 GPS receiver and read the output using an Arduino!

Getting Started with the GeoFence

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

Or check out this blog post for more ideas:

Using u-blox GPS for Greater Precision

JULY 14, 2020