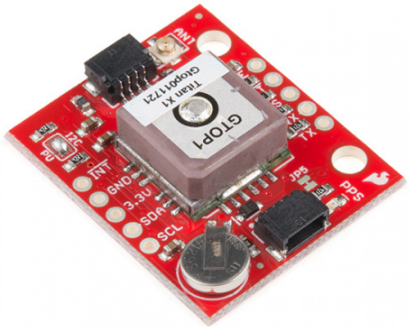
# SparkFun GPS Breakout - XA1110 (Qwiic) Hookup Guide

## Introduction

The XA1110 GPS module from GTOP is a rare bird indeed. GPS modules are hard to come by, but an I²C GPS+GLONASS module? Now we're cooking with peanut oil! This small module also utilizes the MediaTek MT3333 chipset, loaded with specialized SparkFun firmware that enables both I²C and Serial ports simultaneously. Using I²C means you won't have to tie up your serial port with GPS, leaving it open to other possibilities.




### SparkFun GPS Breakout - XA1110 (Qwiic)

GPS-14414

This module is configured with an on-board RTC battery that enables a warm-start functionality. (Giving the XA1110 just five seconds to first fix) A U.FL connector gives you the option to hook up an external antenna via a U.FL cable

This hookup guide will show you how to get started figuring out where on Earth you are. You'll also learn how to change the update rate of the GPS up to 10 Hz as well as change the baud rate.

## Required Materials

To get started, you'll need a microcontroller to, well, control everything.

SparkFun RedBoard - Programmed with Arduino
DEV-13975

SparkFun ESP32 Thing
DEV-13907

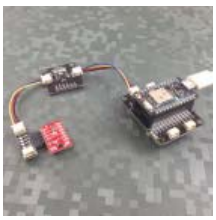
Raspberry Pi 3
DEV-13825

Particle Photon (Headers)
WRL-13774

Now to get into the Qwiic ecosystem, the key will be one of the following Qwiic shields to match your preference of microcontroller:

SparkFun Qwiic Shield for Arduino
DEV-14352

Qwiic Shield for Raspberry Pi
SPX-14292



**Qwiic Shield for ESP32**
SPX-14203

**Qwiic Shield for Photon**
SPX-14202

You will also need a Qwiic cable to connect the shield to your GPS module, choose a length that suits your needs.

**Qwiic Cable - 500mm**
PRT-14429

**Qwiic Cable - 50mm**
PRT-14426

**Qwiic Cable - 100mm**
PRT-14427

**Qwiic Cable - 200mm**
PRT-14428

## Suggested Reading

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

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

New!

**Qwiic Shield for Arduino & Photon Hookup Guide**
Get started with our Qwiic ecosystem with the Qwiic shield for Arduino or Photon.

## Hardware Overview

Below is a table listing all of the hardware features and specs for the XA1110.

| Characteristic | Range |
|---|---|
| Operating Voltage | 3.3V: **Regulated to 1.8V - 3.6V** |
| Current | 25 mA (typical) |
| Hot/Warm/Cold Start | 1/5/15 seconds |
| Update Rate | 1 Hz (default), 0.1-10 Hz |
| $I^2C$ Interface | 100kHz & 400kHz (3.3V) |
| $I^2C$ Address | 100kHz & 400kHz (3.3V) |
| UART | 9600 bps (default), 4800-115200 bps (3.3V) |
| Position Accuracy | <3.0m, <2.5m with SBAS enabled |
| Satellites | 99 during search, 33 during tracking |
| Sensitivity | -148dBm Acquisition, -165dBm Tracking |
| Max Altitude | 80km (the mesosphere) using the example configuration sketch to enable high-altitude balloon mode |
| RTC Battery | 5.5mAh, enables warm start for 15 days without power |

### Pins

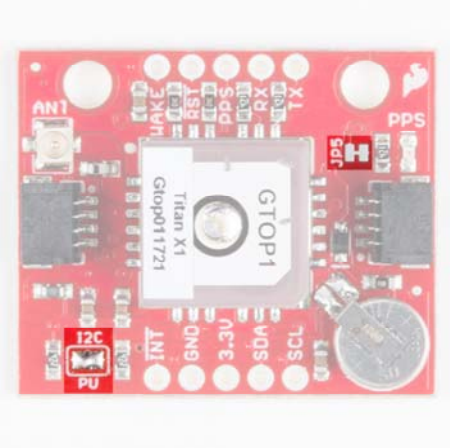
The following table lists all of the XA1110's pins and their functionality.

| Pin | Description | Direction |
|---|---|---|
| GND | Ground | In |
| 3.3V | Power | In |
| SDA | Data | In |

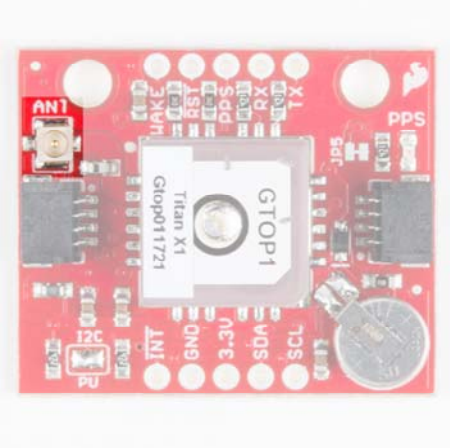
| | | |
|---|---|---|
| SCL | Clock | In |
| $\overline{\text{INT}}$ | Interrupt, goes low when NMEA data is ready, after packet is read, the pin pulls high | Out |
| Wake | Wake up | In |
| $\overline{\text{RST}}$ | Pulling low will reset the module | In |
| PPS | Provides one pulse-per-second signal | Out |
| RX | UART receiver; to receive commands | In |
| TX | UART transmitter; outputs GPS information | Out |

## Optional Features

The XA1110 breakout has several optional features. The first of which is the option to disable the pulse-per-second LED. This can be done by slicing the connection on the JP5 jumper with a hobby knife. The I²C pull-up resistors can also be disconnected by clearing the jumper labeled “I2C PU”. Both jumpers are shown in the below image.




There is also a U.FL connector on the board, outlined below, which can be used in conjunction with the U.FL cable to connect to an external antenna



## Hardware Assembly

If you haven't yet assembled your Qwiic Shield, now would be the time to head on over to that tutorial. With the shield assembled, Sparkfun's new Qwiic environment means that connecting the sensor could not be easier. Just plug one end of the Qwiic cable into the XA1110 breakout, the other into the Qwiic Shield and you'll be ready to upload a sketch and figure out where you are. It seems too easy, but thats why we made it this way!

## Library Overview

First, you'll need to download and install the Sparkfun I²C GPS library, this can be done using the button below or by using the Arduino Library Manager.

DOWNLOAD THE SPARKFUN I2C GPS LIBRARY `https://github.com/sparkfun/SparkFun_I2C_GPS_Arduino_Library/archive/master.zip`

**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.

Before we get started developing a sketch, let's look at the available functions of the library.

- `boolean begin(TwoWire &wireport = Wire, uint32_t i2cSpeed = I2C_SPEED_STANDARD);` — `begin()` is used to start the GPS, it runs sort of like this:
  - Starts running the I²C port at the given port and clock speed
  - Pings the module and checks for a response
  - Returns `TRUE` if the response is received, `FALSE` if not.
- `void check();` — Checks the module for new data.
- `uint8_t available();` — Returns the available number of bytes. Will call check() if zero is available.
- `uint8_t read();` — Returns the next available byte.
- `void enableDebugging(Stream &debugPort = Serial);` — Outputs various messages to assist in debugging.
- `void disableDebugging();` — Pretty self explanatory, turns off debugging.
- `boolean sendMTKpacket(String command);` — Can be used to send a command or configuration to the GPS module.
  - The input buffer on the MTK is 255 bytes, so strings must be shorter than 255 bytes.
  - After ending a transmission, give the module 10 ms to process the message.
- `String createMTKpacket(uint16_t packetType, String dataField);` — Creates a config sentence (String) from a packetType and any settings. See 'MTK NMEA Packet' datasheet for more info.

- `String calcCRCforMTK(String sentence);` — XORs bytes to create MTK packet.

> **Note:** Due to a new QZSS satellite recently launched by the Japanese, users in the Asia-Pacific region (Longitude 70 to -160 degrees East) can experience huge drifts in location over the course of 2 hours. In order to remedy this, two options are available. The first is to simply reset the module every 2 hours. The second option is to disable the QZSS feature entirely. To do this, simply use the following command in your setup loop. sendMTKpacket($PMTK352,1*2B);

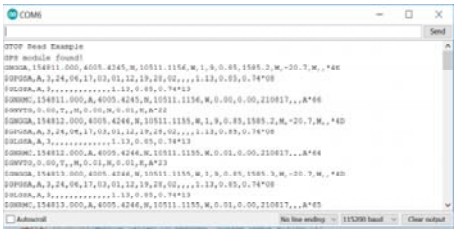
## Examples

You should have downloaded the SparkFun I²C GPS Library in the previous step, if not, go back and click the button to download it. Within should be contained the library along with five examples. We're going to get you started with the first two examples.

Upload the following example to the microcontroller of your choice.

```
#include "SparkFun_I2C_GPS_Arduino_Library.h"
I2CGPS myI2CGPS; //Hook object to the library

void setup()
{
  Serial.begin(115200);
  Serial.println("GTOP Read Example");

  if (myI2CGPS.begin() == false)//Checks for succesful initial
ization of GPS
  {
    Serial.println("Module failed to respond. Please check wir
ing.");
    while (1); //Freeze!
  }
  Serial.println("GPS module found!");
}

void loop() //Writes GPS data to the Serial port with a baud r
ate of 115200
{
  while (myI2CGPS.available()) //available() returns the numbe
r of new bytes available from the GPS module
  {
    byte incoming = myI2CGPS.read(); //Read the latest byte fr
om Qwiic GPS

    if(incoming == ') Serial.println(); //Break the sentences
onto new lines
    Serial.write(incoming); //Print this character
  }
}
```

This first example outputs the raw NMEA sentences. Which look something like this:




If your GPS doesn't have a satellite fix, you will simply get zeroes instead of numbers. These NMEA sentences may be a little hard to wrap your head around if you don't fluently speak GPS, so let's move onto the second example, which will take this data, and use the TinyGPS library to transform it into some sensible latitude and longitude data. The second example requires the TinyGPS library, which can be downloaded using the button below.

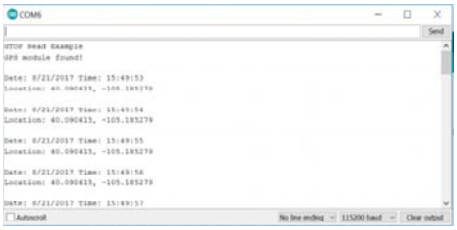
DOWNLOAD THE TINY GPS LIBRARY https://github.com/mikalhart/TinyGPSPlus/archive/master.zip

The below example code will take these NMEA sentences and use the `displayInfo()` function to output some nice and friendly latitude and longitude readings.

```
#include <SparkFun_I2C_GPS_Arduino_Library.h> //Use Library Manager or download here: https://github.com/sparkfun/SparkFun_I2C_GPS_Arduino_Library
I2CGPS myI2CGPS; //Hook object to the library

#include <TinyGPS++.h> //From: https://github.com/mikalhart/TinyGPSPlus
TinyGPSPlus gps; //Declare gps object

void setup()
{
  Serial.begin(115200);
  Serial.println("GTOP Read Example");

  if (myI2CGPS.begin() == false)
  {
    Serial.println("Module failed to respond. Please check wiring.");
    while (1); //Freeze!
  }
  Serial.println("GPS module found!");
}

void loop()
{
  while (myI2CGPS.available()) //available() returns the number of new bytes available from the GPS module
  {
    gps.encode(myI2CGPS.read()); //Feed the GPS parser
  }

  if (gps.time.isUpdated()) //Check to see if new GPS info is available
  {
    displayInfo();
  }
}

//Display new GPS info
void displayInfo()
{
  //We have new GPS data to deal with!
  Serial.println();

  if (gps.time.isValid())
  {
    Serial.print(F("Date: "));
    Serial.print(gps.date.month());
    Serial.print(F("/"));
    Serial.print(gps.date.day());
    Serial.print(F("/"));
    Serial.print(gps.date.year());

    Serial.print((" Time: "));
    if (gps.time.hour() < 10) Serial.print(F("0"));
    Serial.print(gps.time.hour());
    Serial.print(F(":"));
    if (gps.time.minute() < 10) Serial.print(F("0"));
    Serial.print(gps.time.minute());
    Serial.print(F(":"));
    if (gps.time.second() < 10) Serial.print(F("0"));
    Serial.print(gps.time.second());

    Serial.println(); //Done printing time
```

```
  }
  else
  {
    Serial.println(F("Time not yet valid"));
  }

  if (gps.location.isValid())
  {
    Serial.print("Location: ");
    Serial.print(gps.location.lat(), 6);
    Serial.print(F(", "));
    Serial.print(gps.location.lng(), 6);
    Serial.println();
  }
  else
  {
    Serial.println(F("Location not yet valid"));
  }
}
```

The output of this code in the serial monitor should look similar to the below image. If the module does not yet have a fix, you will see `Location not yet valid` instead of a latitude and longitude reading.



## Resources and Going Further

You've finally figured out where you are! Now it's time to take this GPS and incorporate it into your own project.

For a little more information, check the resources below:

- Schematic (PDF)
- Eagle Files (ZIP)
- Example Sketches (ZIP)
- Arduino Library GitHub Repo
- Qwiic System Landing Page
- GPS Module XA1110 Datasheet (PDF)
- NMEA over I2C Application Note (PDF)
- MediaTek Protocol and Packet Manual (PDF)
- The GitHub Repo will always have the latest design files.

For more GPS related fun, check out these other SparkFun tutorials.



### 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



### GPS Logger Shield Hookup Guide

How to assemble and hookup the SparkFun GPS Logger Shield. Never lose track of your Arduino again!

minimal effort, you can determine your position and time almost anywhere on the globe.



### 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.



### Building an Autonomous Vehicle: The Batmobile

Documenting a six-month project to race autonomous Power Wheels at the SparkFun Autonomous Vehicle Competition (AVC) in 2016.