The Ultimate GPS Logger Shield – GPS

LaACES Student Ballooning Course

Introduction

- Now that you've learned about the Global Positioning System, it's time to learn about the GPS receiver you'll be using - the Adafruit Ultimate GPS Logger Shield
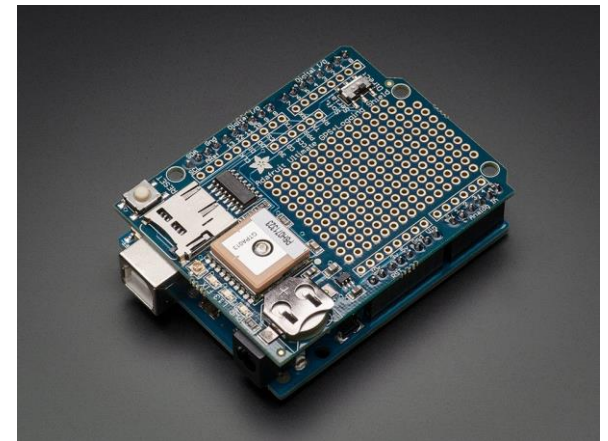
Figure 1: Shown is the Adafruit Ultimate GPS Logger Shield. It is stacked on an Arduino Uno

Adafruit Ultimate GPS Logger Shield Overview

- This is the Arduino Ultimate GPS Logger Shield. It comes with
    - microSD socket
    - Connector for external antenna
    - Antennae and GPS unit
    - Coin cell holder
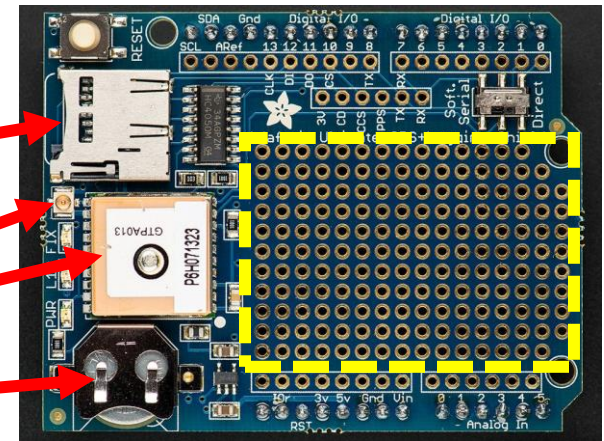   - Prototyping Area (Yellow)

Figure 2: Shown is the Adafruit Ultimate GPS Logger Shield. From top to bottom, the red arrows show the microSD socket, the external antenna connector, the GPS unit, and the coin cell battery holder. The yellow dashed square designates the prototyping area

Antenna

- The GPS shield has a built-in patch antenna. For the MegaSat, this antenna will suffice

- Payload shielding or sensitivity requirements may require an external antenna.
  - Most GPS antennas will have an SMA connector, so a SMA to uFL connector will be required

- The GPS shield detects external antennas and uses them automatically

- Some NMEA sentences provide antenna status (internal, external, or that a problem exists)
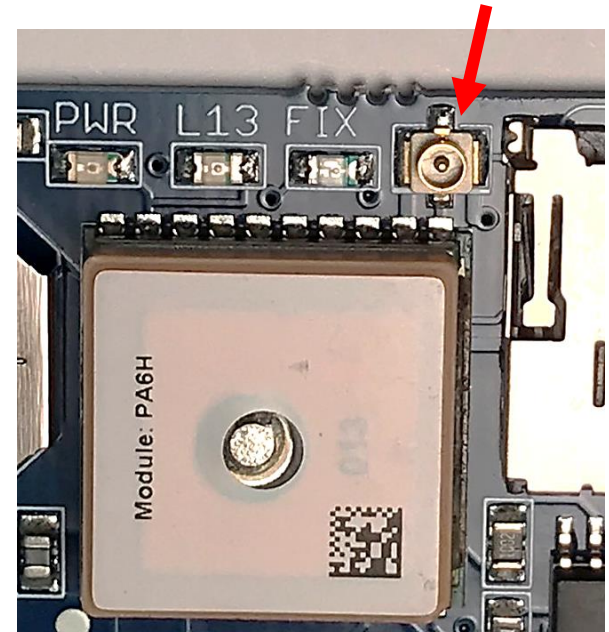

Figure 3: The red arrow is pointing to the Adafruit Ultimate GPS Logger Shield's external antenna connector. It is located between the microSD socket and the FIX LED.

Real Time Clock (RTC)

- A Real Time Clock (RTC) is a computer clock that keeps the current time

- When the GPS has a fix, the RTC sets itself to the current UTC time
  - If the GPS loses power, this ensures the GPS will keep the correct time

- The GPS has a built-in RTC, but not a built-in battery. A coin cell battery is needed to ensure the clock does not reset on power loss
  - Also allows a "hot start", if the GPS knows its old time and position it can find a fix more quickly

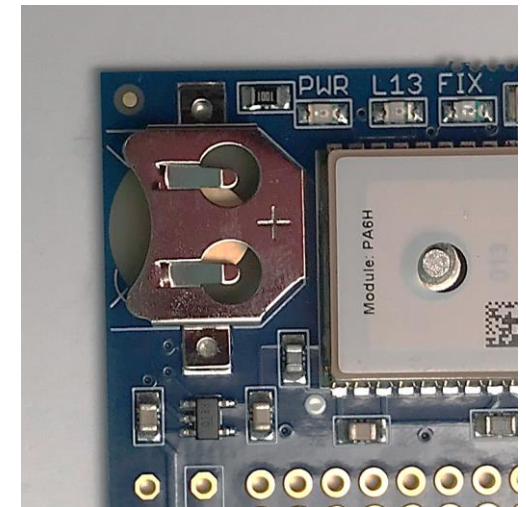- A new battery can run the RTC for 7+ years

Figure 4: Shown is the Adafruit Ultimate GPS Logger Shield's coin cell battery holder. When inserting a coin cell battery, ensure the positive side is facing up, away from the Shield

LEDs on GPS Shield

- There are 3 different LEDs on the GPS shield
  - Green (PWR)
    - Power LED. If it's not on, the shield doesn't have power
  - Yellow (L13, SD card access)
    - Solid when Arduino is bootloading
    - Flickers when SD card is being accessed
  - Red (FIX)
    - Blinking every second, GPS does not have a fix
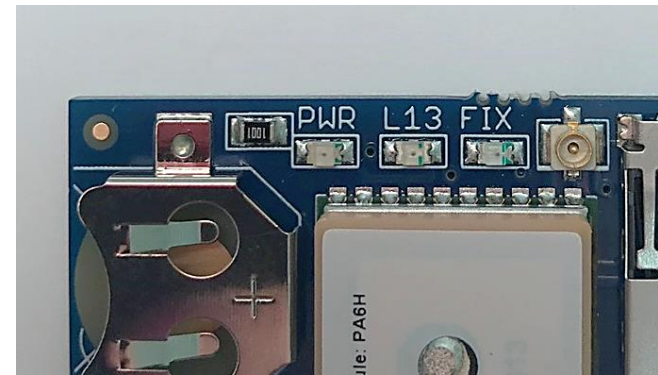   - Blinking once every 15 seconds, GPS has a fix

Figure 5: Shown are the three LEDs on the Adafruit Ultimate GPS Logger Shield. They are located next to the external antenna connector. From left to right, there is the power LED (lit when the Shield has power), the L13 LED (lit when the Arduino is bootloading and flickers when the SD card used), and the FIX LED (blinks at different frequencies corresponding to the GPS fix quality)

Prototyping and Breakout Areas

- There is a prototyping area on the GPS shield, see Figure 6

- Next to the Prototyping area are six breakouts
  - 3V: Outputs 3.3 volts
  - CD: Card-detect output from the microSD socket. It is shorted to ground if there is not a card inserted
  - CCS: Card chip select line. It is connected to digital 10
  - PPS: This is a pulse per second output when the GPS has a fix
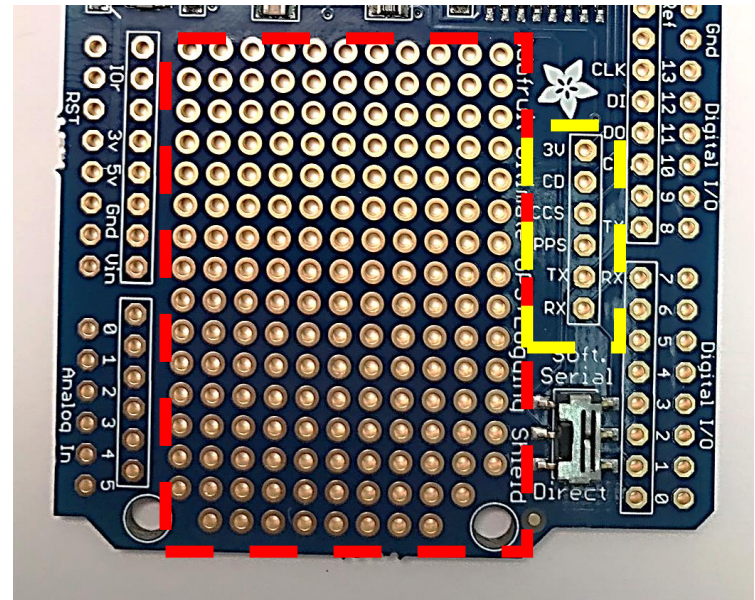 - TX: GPS transmit line
  - RX: GPS receive line

Figure 6: Shown is the prototyping and breakout areas on the Adafruit Ultimate GPS Logger Shield. The red dashed box is surrounding the prototyping area. The yellow dashed box surrounds the breakout area. The RX and TX breakout pins are used for Software Serial communication

Direct Connect/Software Serial Switch

- A switch on the selects which pins the GPS is connected to

- Direct Connect connects the Shield to the Arduino's Serial 0 channel(TX0, RX0)
    - In general, we want to use TX0, RX0 for communicating with Arduino
    - Direct connect does allow us to communicate directly with GPS on the Serial Monitor

- Software Serial connects the GPS to pins 7 and 8 of the Arduino and TX and RX on the breakout
    - We will install jumpers that allow us to connect this output to Serial1, Serial2, or Serial 3
    - Despite its name the Software Serial does not change anything in the software, just where the GPS is connected
    - This is based on an Arduino UNO which only has one Hardware serial port

Communication: Direct Connect

- Direct Connect connects the GPS serial Arduino's USB-serial converter chip

- To directly monitor GPS output:
  - Start with the switch on Soft Serial to upload a blank sketch
  - Then flip the switch down (Figure 7)
  - NMEA sentences will start showing up on the Serial Monitor

- **While using Direct Connect, you cannot upload sketches to the Arduino!** The programming UART is being used by the GPS shield
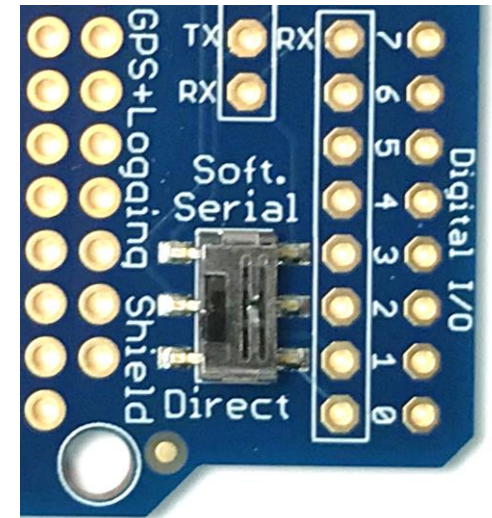

Figure 7: Shown is the communication switch on the Adafruit Ultimate GPS Logger Shield. In this position, the Shield is communicating via Direct Connect. This method has the Shield using the main Arduino UART to communicate with the computer. Because of this, sketches cannot be uploaded while using Direct Connect

Communication: Software Serial

- Software Serial allows sketches to be uploaded using the Arduino's main UART because a different UART is used for GPS communication

- The Shield switch should be on Soft Serial. Jumpers will be used to connect GPS TX and RX pins to one of the Mega other serial ports (Serial1, Serial2, Serial3).

- Note that we want the TX of the GPS to RX of the Arduino and the RX of the GPS to the TX of the Arduino. A very common mistake is to have the TX and RX switched on one end
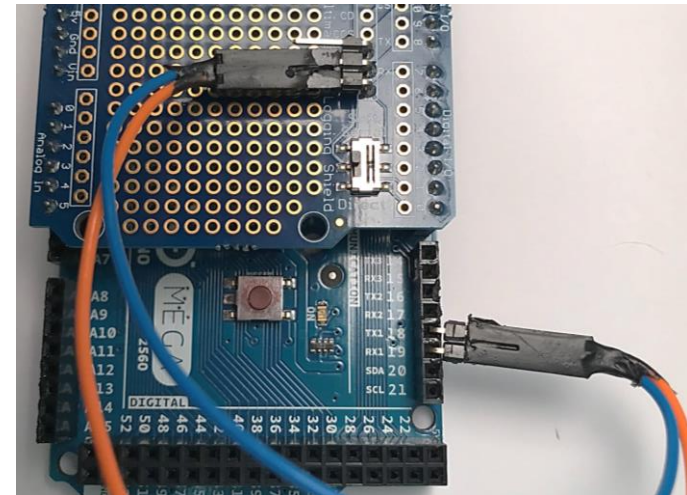

Figure 8: Shown is the communication switch on the Adafruit Ultimate GPS Logger Shield and jumpers connecting the RX and TX breakout pins to Arduino pins 18 and 19, respectively.