Direct Connect

Direct connection is a funky trick we use to connect the output of the GPS serial TTL UART directly to the usb-serial converter chip on an Arduino. This takes the Arduino out of the picture an can make it easy if you want to experiment sending commands directly, or using the Windows software (the Arduino would act like a USB->UART bridge)

Direct Connection Using the Switch (Uno/Mega)

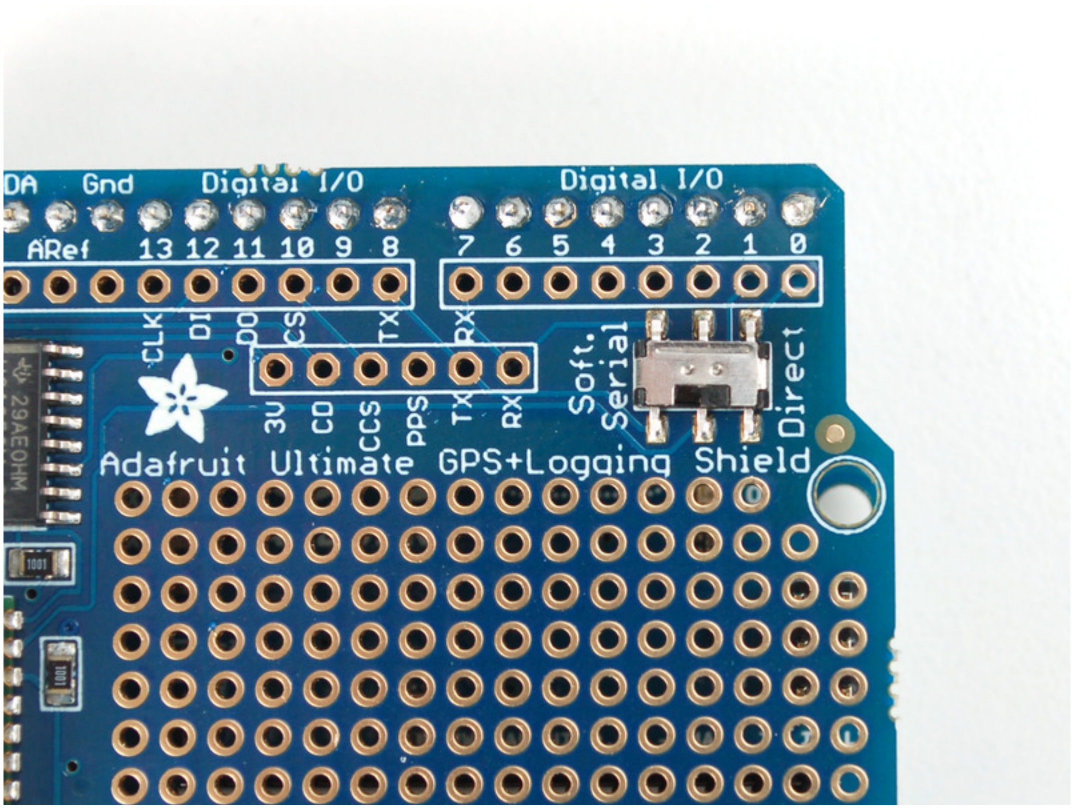
Direct Connection by flipping the switch on this shield only works if you're using an Uno/Duemilanove/Diecimila/compatible OR a Mega (any type). It will not work with a Leonardo (the Leonardo does not have a USB/Uart chip) or Due (haven't tested, but assume it doesn't)
First, load a 'blank' sketch into the Arduino:
Copy Code

```
// this sketch will allow you to bypass the Atmega chip
// and connect the GPS directly to the USB/Serial
// chip converter.

// Connect VIN to +5V
// Connect GND to Ground
// Connect GPS RX (data into GPS) to Digital 0
// Connect GPS TX (data out from GPS) to Digital 1

 void setup() {}
 void loop() {}
```

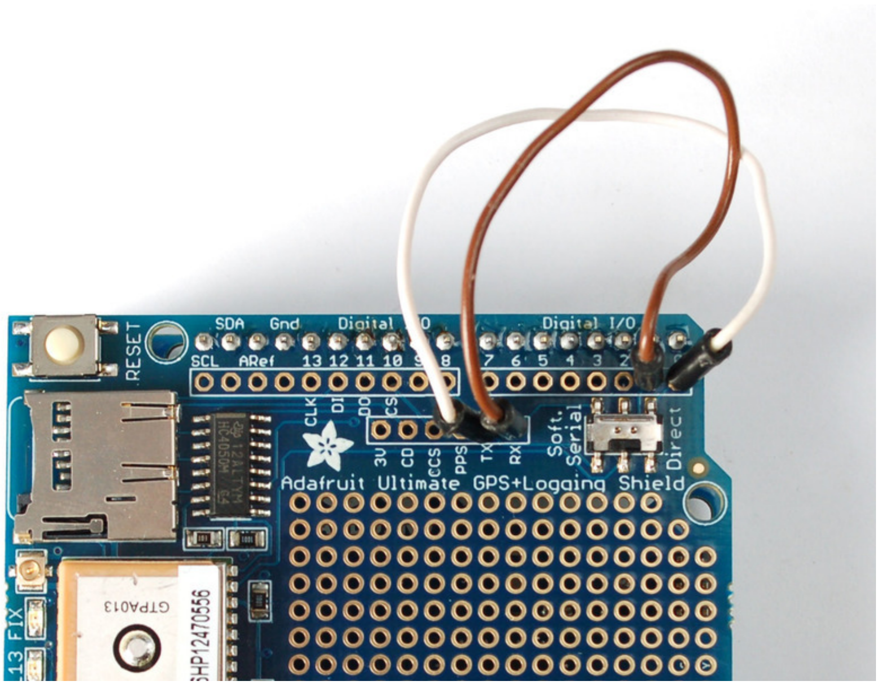
This is will free up the converter so you can directly wire and bypass the Arduino chip. Once you've uploaded this sketch, flip the switch on the shield to **Direct**



Direct Connection with Jumpers on Leonardo

If you have a Leonardo we have to do a funky trick where we swap the Direct connect wires (because the processor chip acts like the USB/Serial converter rather than having a seperate chip. The upshot is you'll need two wires. For basic testing as long as the wires touch the two sets of pads, you'll be able to continue with this very basic test. We don't suggest soldering them yet in since as long as the GPS works, you can go forward and use software serial if you prefer

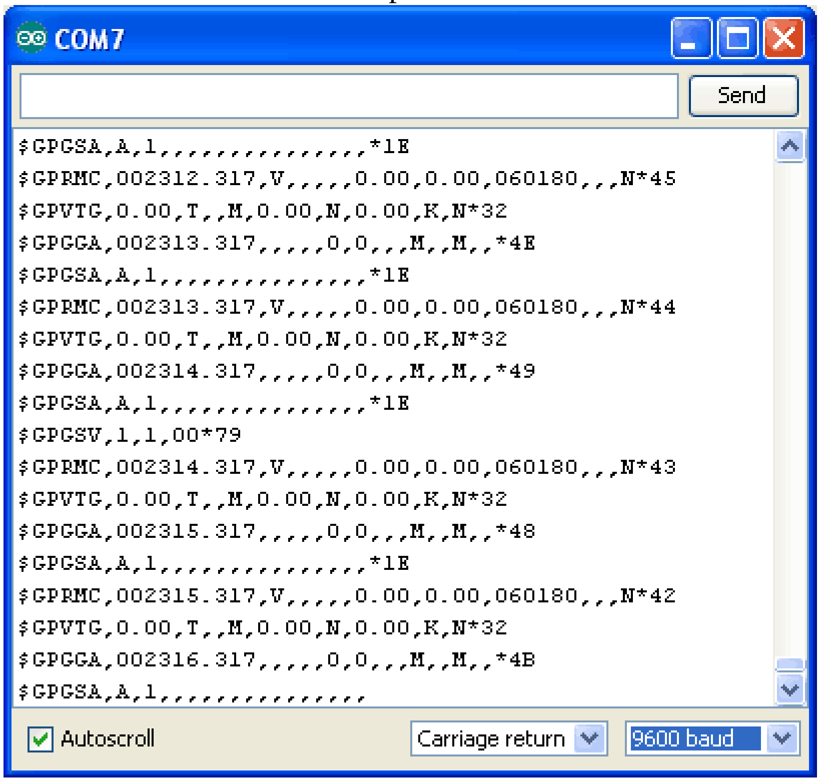
Select Software Serial on the switch. Connect a wire from the **TX** pad to digital **0** and a wire from the **RX** pad to digital **1**.



Finally upload the **Adafruit_GPS->leo_echo** sketch to the Leonardo, this will shuffle data from the GPS to the USB port

Testing Direct Connection

Now plug in the USB cable, and open up the serial monitor from the Arduino IDE and be sure to select **9600 baud** in the drop down. You should see text like the following:



```
$GPGSA,A,1,,,,,,,,,,,,,,,*1E
$GPRMC,002312.317,V,,,,,0.00,0.00,060180,,,N*45
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
$GPGGA,002313.317,,,,,0,0,,,M,,M,,*4E
$GPGSA,A,1,,,,,,,,,,,,,,,*1E
$GPRMC,002313.317,V,,,,,0.00,0.00,060180,,,N*44
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
$GPGGA,002314.317,,,,,0,0,,,M,,M,,*49
$GPGSA,A,1,,,,,,,,,,,,,,,*1E
$GPGSV,1,1,00*79
$GPRMC,002314.317,V,,,,,0.00,0.00,060180,,,N*43
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
$GPGGA,002315.317,,,,,0,0,,,M,,M,,*48
$GPGSA,A,1,,,,,,,,,,,,,,,*1E
$GPRMC,002315.317,V,,,,,0.00,0.00,060180,,,N*42
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
$GPGGA,002316.317,,,,,0,0,,,M,,M,,*4B
$GPGSA,A,1,,,,,,,,,,,,,,,
```

9600 baud

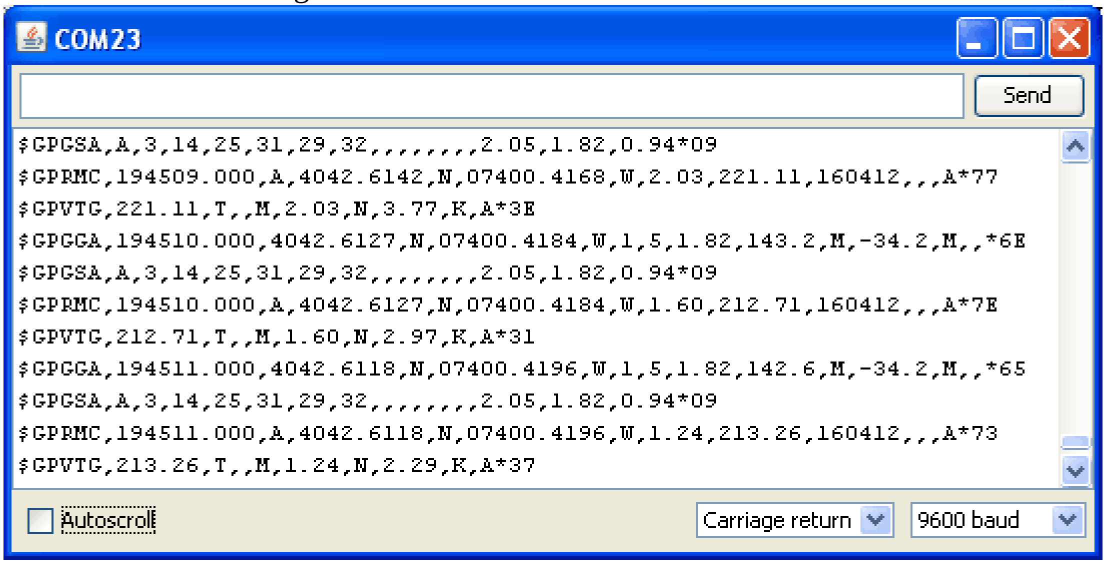
This is the raw GPS "NMEA sentence" output from the module. There are a few different kinds of NMEA sentences, the most common ones people use are the **$GPRMC** (**G**lobal

Positioning **R**ecommended**M**inimum **C**oordinates or something like that) and the **$GPGGA** sentences. These two provide the time, date, latitude, longitude, altitude, estimated land speed, and fix type. Fix type indicates whether the GPS has locked onto the satellite data and received enough data to determine the location (2D fix) or location+altitude (3D fix).

For more details about NMEA sentences and what data they contain, check out this site

If you look at the data in the above window, you can see that there are a lot of commas, with no data in between them. That's because this module is on my desk, indoors, and does not have a 'fix'. To get a fix, we need to put the module outside.

GPS modules will always send data EVEN IF THEY DO NOT HAVE A FIX! In order to get 'valid' (not-blank) data you must have the GPS module directly outside, with the square ceramic antenna pointing up with a clear sky view. In ideal conditions, the module can get a fix in under 45 seconds. however depending on your location, satellite configuration, solar flares, tall buildings nearby, RF noise, etc it may take up to half an hour (or more) to get a fix! This does not mean your GPS module is broken, the GPS module will always work as fast as it can to get a fix.
If you can get a really long USB cord (or attach a GPS antenna to uFL plug) and stick the GPS out a window, so its pointing at the sky, eventually the GPS will get a fix and the window data will change over to transmit valid data like this:



```
$GPGSA,A,3,14,25,31,29,32,,,,,,,,2.05,1.82,0.94*09
$GPRMC,194509.000,A,4042.6142,N,07400.4168,W,2.03,221.11,160412,,,A*77
$GPVTG,221.11,T,,M,2.03,N,3.77,K,A*3E
$GPGGA,194510.000,4042.6127,N,07400.4184,W,1,5,1.82,143.2,M,-34.2,M,,*6E
$GPGSA,A,3,14,25,31,29,32,,,,,,,,2.05,1.82,0.94*09
$GPRMC,194510.000,A,4042.6127,N,07400.4184,W,1.60,212.71,160412,,,A*7E
$GPVTG,212.71,T,,M,1.60,N,2.97,K,A*31
$GPGGA,194511.000,4042.6118,N,07400.4196,W,1,5,1.82,142.6,M,-34.2,M,,*65
$GPGSA,A,3,14,25,31,29,32,,,,,,,,2.05,1.82,0.94*09
$GPRMC,194511.000,A,4042.6118,N,07400.4196,W,1.24,213.26,160412,,,A*73
$GPVTG,213.26,T,,M,1.24,N,2.29,K,A*37
```

Look for the line that says
$GPRMC,194509.000,A,4042.6142,N,07400.4168,W,2.03,221.11,160412,,,A*77
This line is called the RMC (Recommended Minimum) sentence and has pretty much all of the most useful data. Each chunk of data is separated by a comma.

The first part **194509.000** is the current time **GMT** (Greenwich Mean Time). The first two numbers **19** indicate the hour (1900h, otherwise known as 7pm) the next two are the minute, the next two are the seconds and finally the milliseconds. So the time when this screenshot was taken is 7:45 pm and 9 seconds. The GPS does not know what time zone you are in, or about "daylight savings" so you will have to do the calculation to turn GMT into your timezone

The second part is the 'status code', if it is a **V** that means the data is **V**oid (invalid). If it is an **A** that means its **A**ctive (the GPS could get a lock/fix)

The next 4 pieces of data are the geolocation data. According to the GPS, my location is **4042.6142,N** (Latitude 40 degrees, 42.6142 decimal minutes North) & **07400.4168,W**. (Longitude 74 degrees, 0.4168 decimal minutes West) To look at this location in Google maps, type **+40° 42.6142', -74° 00.4168'** into the google maps search box . Unfortunately gmaps requires you to use +/- instead of NSWE notation. N and E are positive, S and W are negative.

People often get confused because the GPS is working but is "5 miles off" - this is because they are not parsing the lat/long data correctly. Despite appearances, the geolocation data is NOT in decimal degrees. It is in degrees and minutes in the following format: Latitude: DDMM.MMMM (The first two characters are the degrees.) Longitude: DDDMM.MMMM (The first three characters are the degrees.)

The next data is the ground speed in knots. We're going **2.03** knots

After that is the tracking angle, this is meant to approximate what 'compass' direction we're heading at based on our past travel

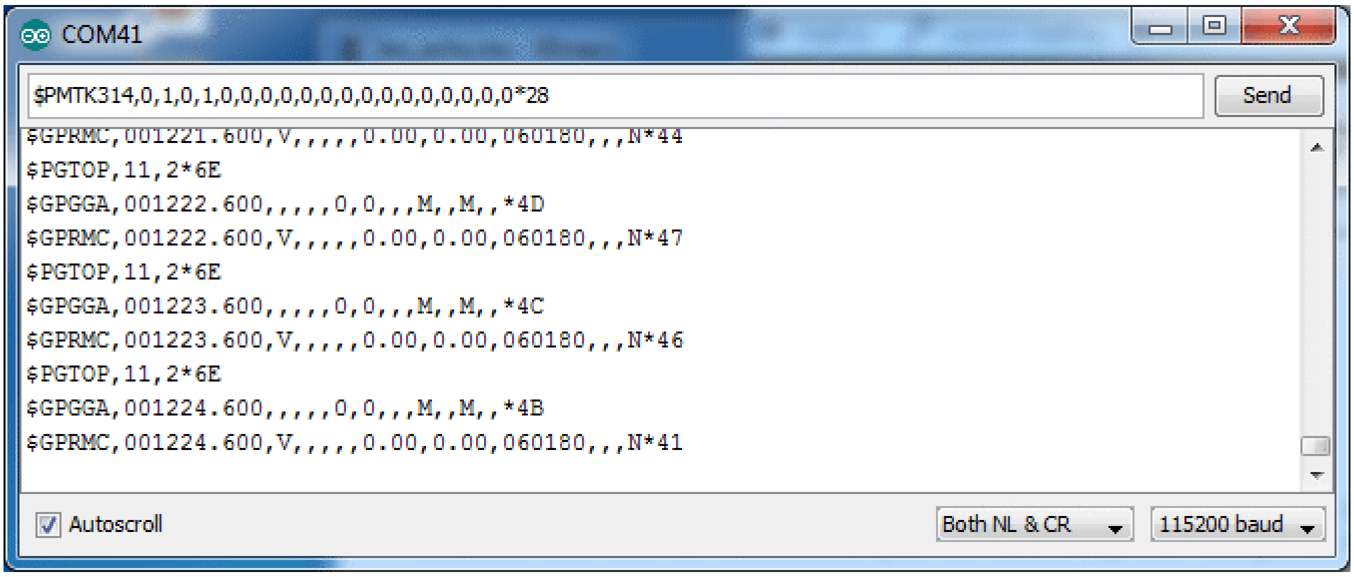
The one after that is **160412** which is the current date (16th of April, 2012).

Finally there is the ***XX** data which is used as a data transfer checksum

Once you get a fix using your GPS module, verify your location with google maps (or some other mapping software). Remember that GPS is often only accurate to 5-10 meters and worse if you're indoors or surrounded by tall buildings.

Sending NMEA Commands via Direct Connect

You can send $PMTK and other commands from the GPS module datasheet, just type into the serial monitor box. Don't forget you'll need to set **Both NL & CR** (new line and carriage return) next to the baud rate selection box)!



```
$PMTK314,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*28
```

```
$GPRMC,001221.600,V,,,,,0.00,0.00,060180,,,N*44
$PGTOP,11,2*6E
$GPGGA,001222.600,,,,,0,0,,,M,,M,,*4D
$GPRMC,001222.600,V,,,,,0.00,0.00,060180,,,N*47
$PGTOP,11,2*6E
$GPGGA,001223.600,,,,,0,0,,,M,,M,,*4C
$GPRMC,001223.600,V,,,,,0.00,0.00,060180,,,N*46
$PGTOP,11,2*6E
$GPGGA,001224.600,,,,,0,0,,,M,,M,,*4B
$GPRMC,001224.600,V,,,,,0.00,0.00,060180,,,N*41
```

Autoscroll [✓]
Both NL & CR
115200 baud