Adafruit FONA 3G Cellular + GPS Breakout

Created by lady ada

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# Guide Contents

Overview

For those who want to take it to *the next level* we now have a 3G Cellular Modem breakout! The FONA 3G has better coverage, GSM backwards-compatibility and even sports a built-in GPS module for geolocation & asset tracking. This all-in-one cellular phone module with that lets you add location-tracking, voice, text, SMS and data to your project in a single breakout.
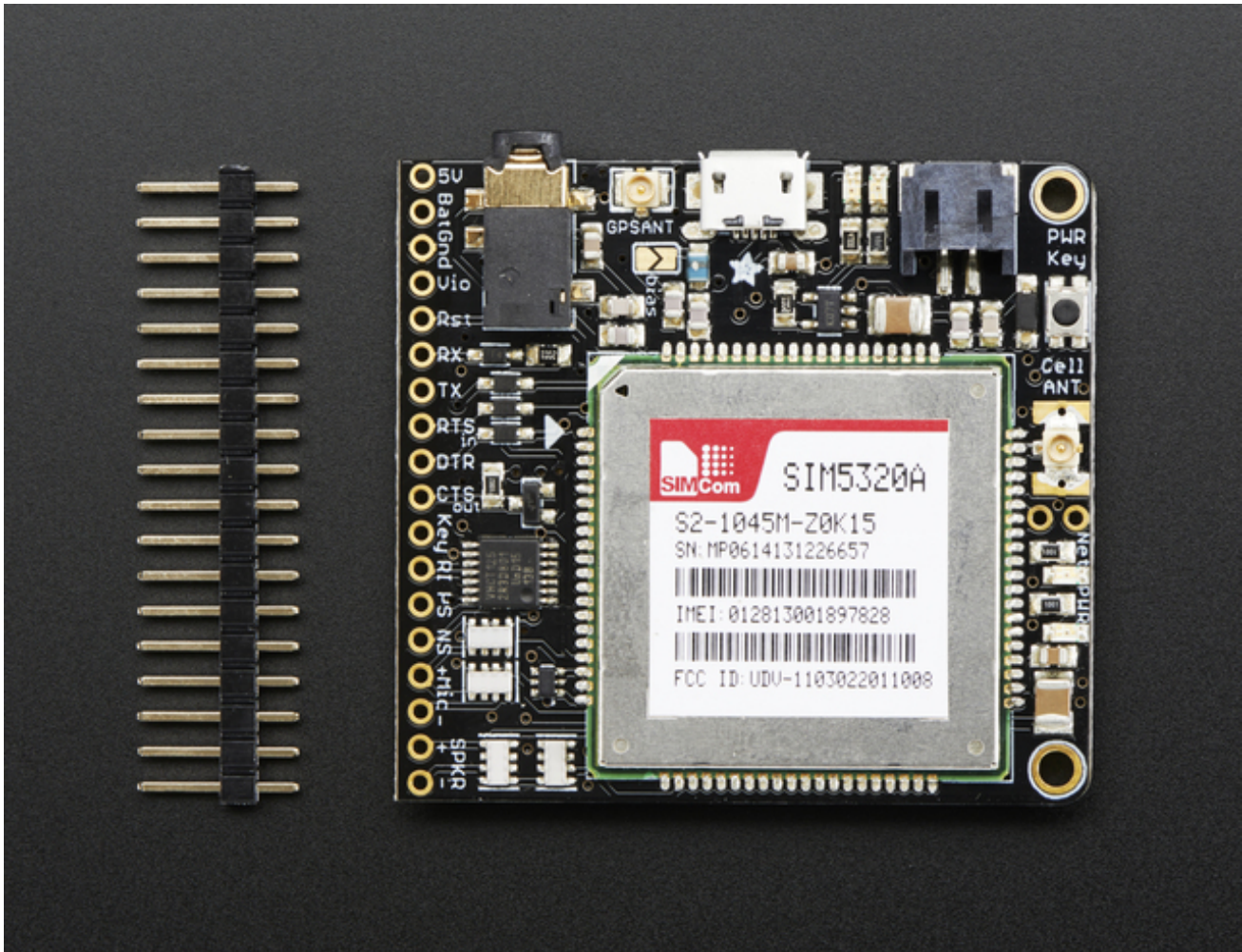
This module measure only 1.75"x1.6" but packs a surprising amount of technology into it's little frame. At the heart is a powerfull GSM cellular module (we use the latest SIM808) with integrated GPS. This module can do just about everything

- Quad-band 850MHz GSM, 900MHz EGSM, 1800MHz DCS, 1900MHz PCs - connect onto any global GSM network with any 2G SIM.
- **American Version** dual-band UMTS/HSDPA 850/1900MHz WCDMA + HSDPA
- **European Version** dual-band UMTS/HSDPA 900/2100MHz WCDMA + HSDPA
- Fully-integrated GPS (Qualcomm PM8015 GPS) that can be controlled and query over the same serial port
- Make and receive voice calls using a headset or an external 8Ω speaker + electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- AT command interface can be used with 300, 600, 1200, 4800, 9600, 19200, 39400, 57600, 115200, 230K, 461K, 961K, 3.2M, 3.7M and 4.0Mbps
- Native USB support - plug it into a computer and you'll get serial ports for AT commands, GPS NMEA as well as a modem (note we've only tried out the AT&NMEA ports on Windows)
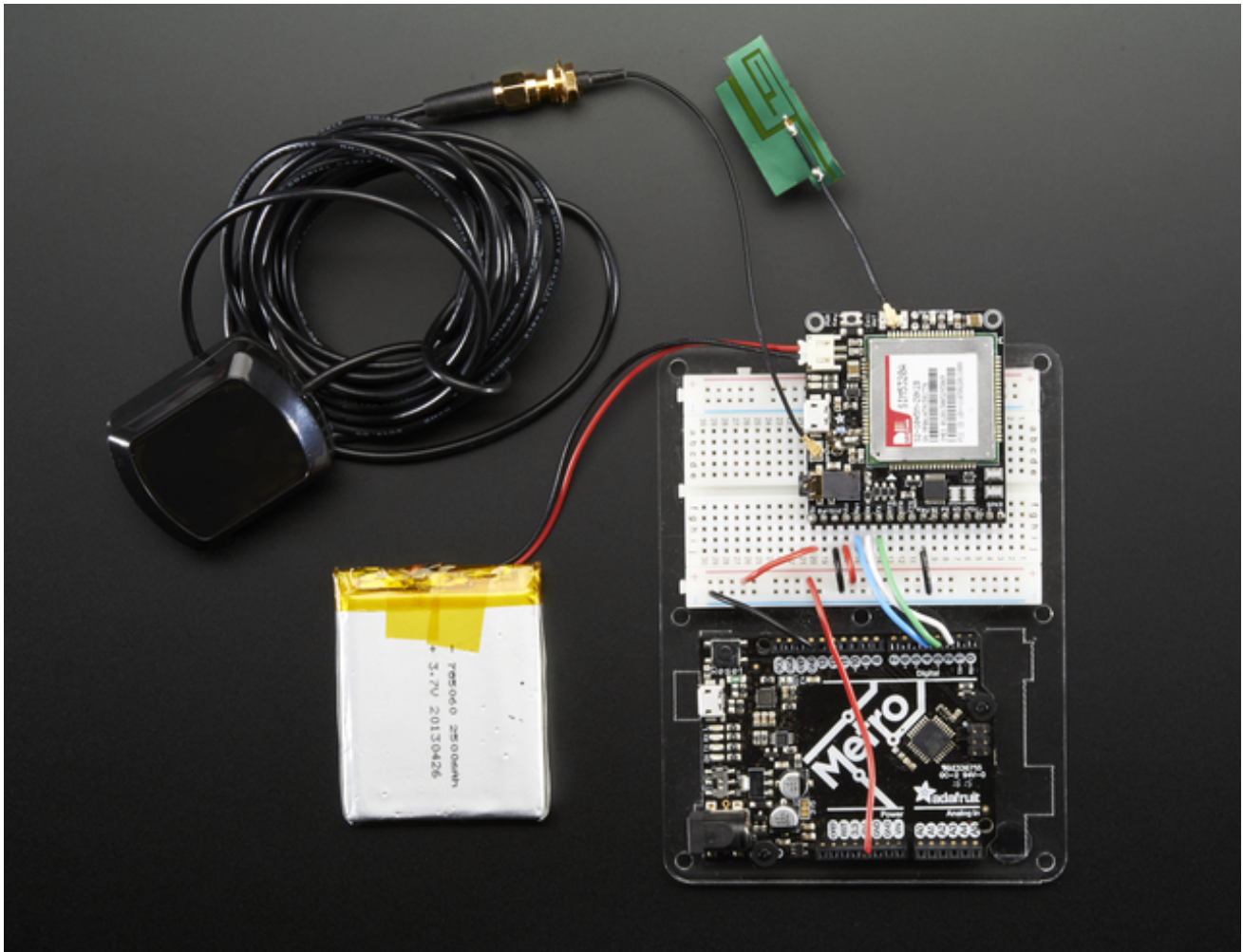
Here's the GPS specifications:

- 16 acquisition channels
- GPS L1 C/A code
- Sensitivity
  Tracking: -157 dBm
  Cold starts : -144 dBm
- Time-To-First-Fix
  Cold starts: 100s (typ.)
  Hot starts: 1s (typ.)
- Accuracy: approx 2.5 meters

We strongly recommend using an active antenna with the GPS (http://adafru.it/fTs), while we could get a fix with a passive antenna it took a long time.

Please note! We've had a lot of requests for a 3G cell module and we're happy to oblige but this module has many small differences between it and the FONA 800 and 808, so it is *not* a drop-in replacement! In particular the data functionality is not as easy to use. We are adapting our FONA

library to support the 3G chipset and right now we have SMS, calling, and basic functionality working but it will be a while until we get full GPRS TCP/IP and HTTP support. Also, the GPS is not as fast and low-power as the one on the FONA 808. **We recommend this module for people who are able to handle a more advanced experience**. Beginners will like our FONA 80x series more (http://adafru.it/fTt).
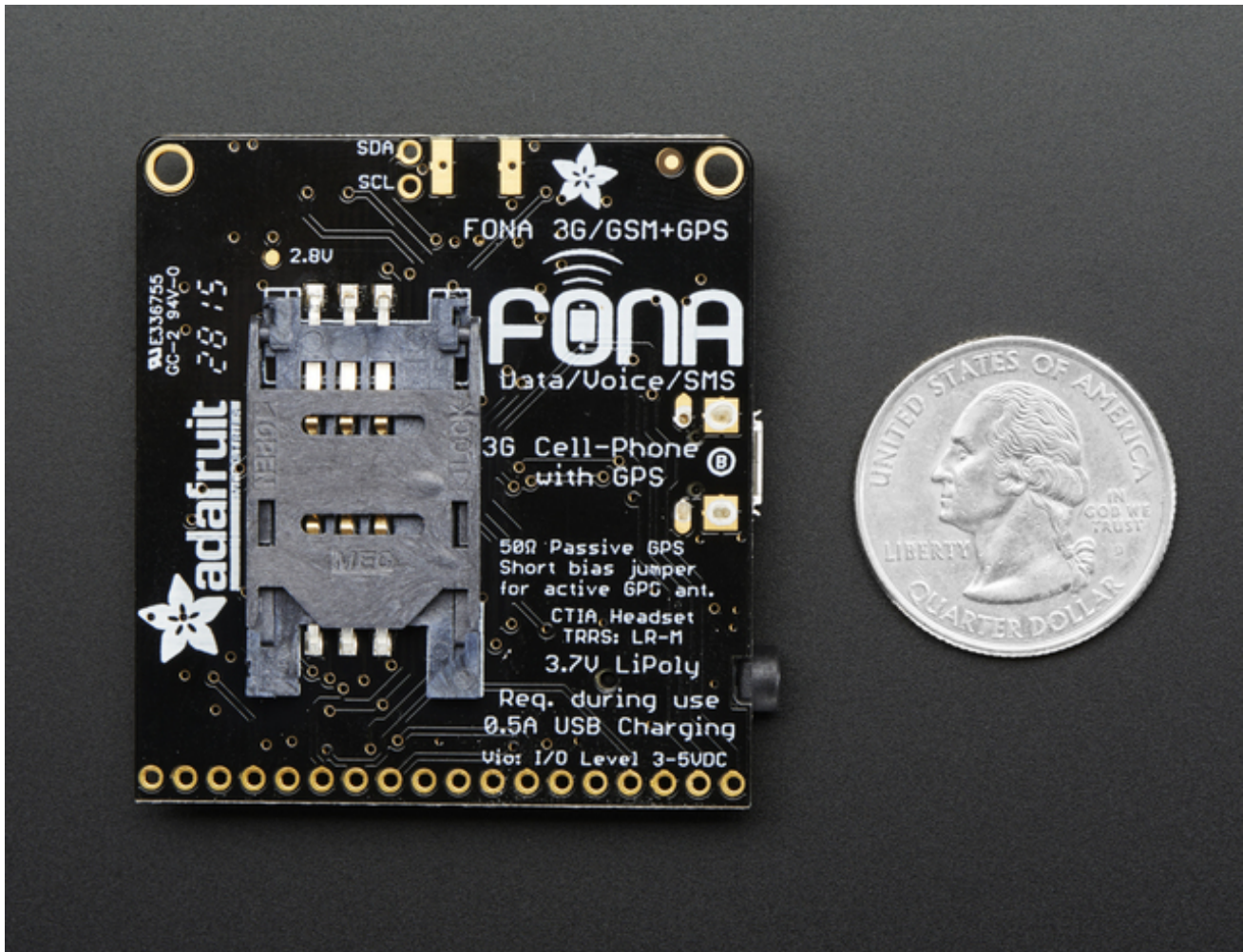
Sounds great, right? So we kitted out this fine module onto a little breakout with all the extras you need to make your next project shine

- Onboard LiPoly battery charging circuitry so you can take your project on the go. Use any 500mAh+ LiPoly or LiIon battery and recharge over the MicroUSB when necessary. Two LEDs let you know when its charging and done
- Standard 4-pole TRRS headphone jack. Use any 'Android' or 'iPhone'-compatible headset with mic
- Breakouts for external 8Ω speaker and electret mic if you don't want to use a headphone
- Level shifting circuitry so you can run it with 2.8V to 5V logic.
- uFL connections for external antennas
- Indicator LEDs for power and network connectivity

- Standard SIM slides into the back

On its own, this module can't do anything. It requires a microcontroller to drive it! We suggest and use an Arduino but any 3-5V microcontroller with a UART can send and receive commands over the RX/TX pins.

You will also need some required & recommended accessories to make FONA 3G work. **These are not included!**

- **SIM Card!** A 2G or 3G Mini SIM card is required to do anything on the cellular network. (http://adafru.it/fbO)
- **Lipoly Battery** - 500mAh or larger! This 1200mAh (http://adafru.it/258) will work great.
- **MicroUSB cable** for charging the battery and communicating with the module over USB
- **External uFL GSM Antenna** - this slim one works great (http://adafru.it/fbL).
- **(or, if you want to us an SMA antenna** - a uFL to SMA adapter cable. (http://adafru.it/851))
- **External Active GPS Antenna** (needs a uFL to SMA adapter too) - like this one! (http://adafru.it/fTs)
- **TRRS 4-Pole Headset** - Not required but it'll be tough to make a phone call without it. Any 'iPhone' or 'Android' compatible (but not iPhone original) should work. We tried about 10 different ones, and basically the more expensive once are more comfortable and louder but our official iPhone headset mic did not work.

Obtaining a SIM

In order to use the phone parts of FONA you will need a SIM card. Luckily, there's a phone store in every town in America! You can get a pre-paid **or** post-paid SIM but we kinda like the pre-paid kind.

A 2G or 3G Mini SIM card is **required** to use the module. Nearly any cell phone shop can sell you a SIM card. Luckily, every SIM we've seen is 2G or 3G so you are good to go!

MicroSIMs won't fit - so make sure its a "Mini" SIM. Sometimes these are just called plain "SIM" cards since the huge-size SIMs are rarely used. **Mini SIMs are 1" x 0.6" / 25mm x 15mm**. these are by far the most common size.

Adafruit now sells the TING SIM card, a 2G+3G SIM that works great with all FONAs, and has a great billing system as well, where you only pay what you use!

You do not need to bring in or show your FONA to the Cell Phone store. Just tell them you need a Mini SIM for a cellphone and it's at home.

Some suggestions from FONA users!

- I've had good luck using the FONA with a SIM from Walmart. Their 'Walmart Family Mobile' is a T-mobile reseller and you can pick up the SIM starter in store pretty easily (http://adafru.it/dEi). The service isn't the cheapest, it's $25 for the SIM and $30/month for unlimited talk+text or $40/month for unlimited talk+text+data but there's no contract as its all prepaid **-tdicola**
- Just want to let the Adafruit team know that it is possible to get pre-paided minutes on T-Mobile and its a pretty good deal. I was paying $100 for 1000 minutes (10c a minute 20 a sms) over the course of the year. (http://adafru.it/dEj) For me it in my usage came out to about $8 a month. Have found this is something that you have to ask for at the store. No evidence in advertising or website **-Paul B.**
- Telna has a good deal you may want to point people to for FONA. I used them for a previous GSM project and they worked great. $20 per year, includes 1000 free txt messages and a bunch of other nice features. (http://adafru.it/dEk)I had a lot more issues with T-Mobile (Their cards go inactive if not used in a month and you have to call to reactivate) **-Tyler C.**
- I pay 2 EUR (a bit less than $3 USD) for 2 hours, unlimited SMS and 50Mb of Data at http://mobile.free.fr/ (http://adafru.it/dEr) **-KTOWN**
- There are specialty "machine 2 machine" SIM sellers that have plans that are tuned for the short bursts of usage used by these kinds of modules. Check out these guys (http://adafru.it/dEA) for example, you can choose data, voice/sms or a combination for a pretty low price!

Pinouts

There's a lot packed into the FONA 3G lets go thru all the pins, buttons and indicators and what they do

Connectors

There's three external connectors along the left side, from the top, a mini JST 2-pin, a microUSB and a headphone jack.

- **JST 2-pin** - this is the battery input connector. It works with any of our Lipoly batteries but

since the charge rate is 500mA (and the cellular module can spike high current draw!) we suggest our 500mAh (http://adafru.it/drL) or 1200mAh (http://adafru.it/258)batteries. You can also connect a JST cable here if you have other plans. (http://adafru.it/261)

- **MicroUSB connector** - this is the LiPoly/LiIon battery charging port. The SIM808 has a USB interface but its ONLY for reprogramming the module with an expensive and unavailable IDE. So charge only! The charge rate is 500mA max.
- **Headset jack** - this is a 'standard' TRRS 3.5mm phone headset jack with stereo earphone and mono microphone. Any 'iPhone' or 'Android' compatible (but not iPhone original) should work. (http://adafru.it/fbK) We tried about 10 different ones, and basically the more expensive once are more comfortable and louder but our official iPhone headset mic did not work for unknown reasons. Sleeve is Mic+, first ring is ground, then the second ring and tip are for stereo audio. The module does not have stereo out so we just tied both together.

Antenna ports

Up top is the place where you can plug in your GSM antenna. **An antenna is required to use the module for any kind of voice or data communications as well as some SIM commands!**

You can either use a uFL GSM antenna like this (http://adafru.it/fbL), or use a uFL to SMA adapter (http://adafru.it/fbM) and then an SMA antenna (http://adafru.it/fbN)

On the left is a GPS antenna port. While you can connect a passive GPS antenna directly, we've found the performance is lacking. We recommend shorting the solder jumper labeled 'bias' and connecting an Active GPS antenna instead, such as the one we stock in the adafruit shop (http://adafru.it/fTs)
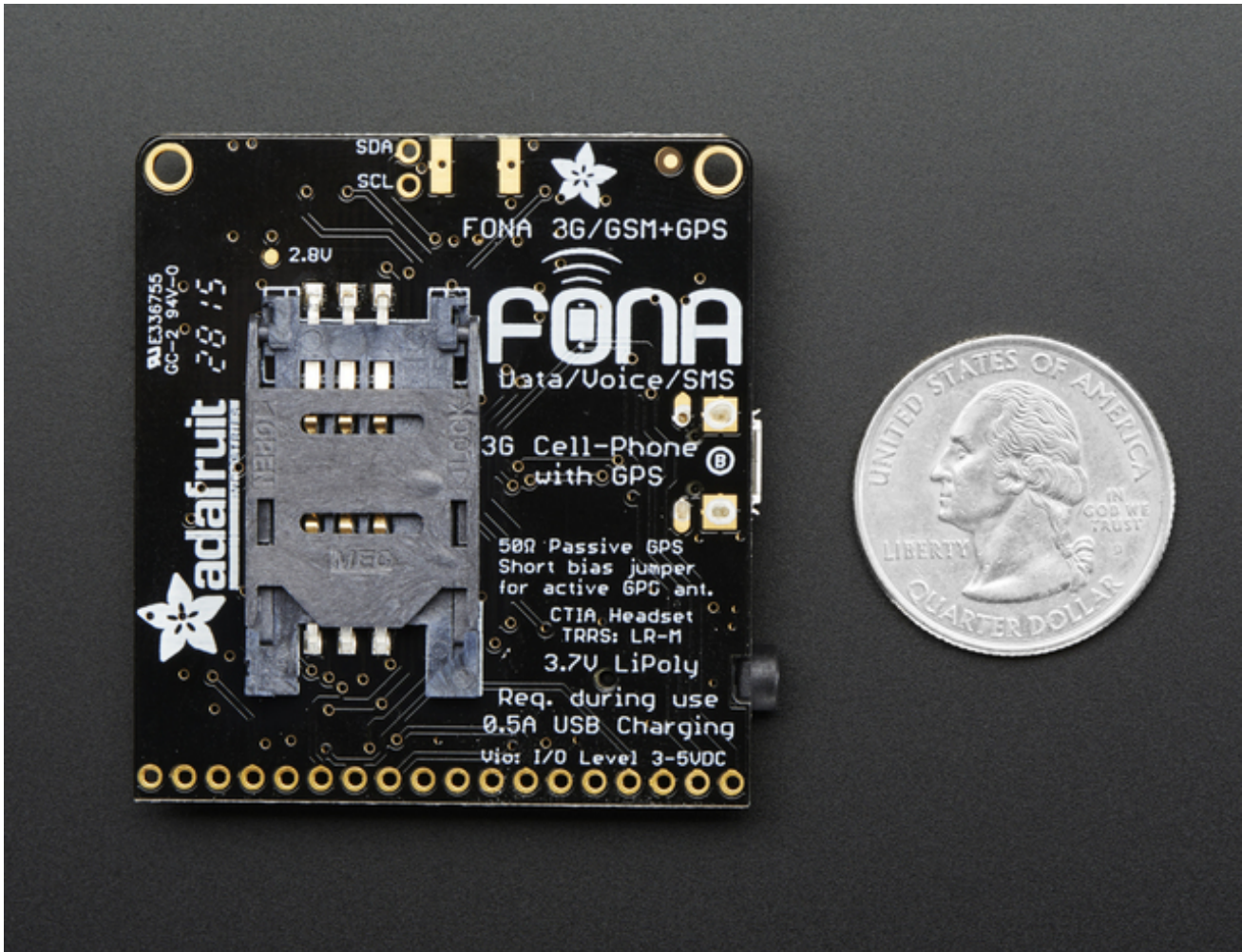
SIM Connector (on Back)

A 2G or 3G Mini SIM card is **required** to use the module. Nearly any cell phone shop can sell you a SIM card. For USA customers, we have a known-working TING SIM card which has a great billing system and works very well! (http://adafru.it/fbO)

MicroSIMs won't fit - so make sure its a "Mini" SIM. **Mini SIMs are 1" x 0.6" / 25mm x 15mm.** These are by far the most common size.

Most cards come with a voice and/or data plan. If you want to make phone calls and SMS's you'll need a voice plan. If you want to transmit data like fetching a webpage, you'll need a data plan.

Bottom Breakouts

The most important pins are broken out at the bottom of the board. Not all of these are required, but they are all hella useful

These are in rough order of most important (not in linear order like we usually do)

These pins are all 3-5V input safe and if they are an output, the logic level is whatever Vio is set to.

- **Vio** - **THIS IS THE MOST IMPORTANT PIN!** This is the pin that you MUST drive with an external voltage from 3V-5V to set the logic level converter. The converter also buffers the indicator LEDs so NOTHING will appear to work unless this pin is powered! You should set the voltage to whatever voltage your microcontroller uses for logic. A 5V micro (like Arduino) should have it be 5V, a 3V logic micro should set it to 3V.
- **Key** - This is also a super important pin (but not as important as Vio). This is the power on/off indicator. Its also tied to the button in the top left. Tie this pin to ground for 3 to 5 seconds to turn the module on or off. It's not a level signal so it isn't like "low is off, high is on" - instead you must pulse it for ~5 seconds to turn off/on. The module comes by default off. Tie this permanently to ground if you never want your micro to turn off the FONA for power saving
- **5V** - this is the USB 5V from the microUSB connector when its in and powered. Good if you need to know when the microUSB is plugged in and/or want to recharge the battery from an external plug.
- **PS** - this is the **P**ower **S**tatus pin. It is low when the module is off and high when the module has power. If you're using the **Key** button or pin, you can monitor this pad to see when the module's booted up. This is tied to the **Pwr** LED too.
- **NS** - this is the **N**etwork **S**tatus pin. It lights up/blinks to signal the current status of the module. This is also tied to the **Net** LED so for more detail see the LEDs section below.
- **Reset** - this is module hard reset pin. By default it has a high pull-up (module not in reset). If you absolutely got the module in a bad space, toggle this pin low for 100ms to perform a hard reset.
- **RX & TX** - OK now that I made you read all that you can actually use the UART pins. The module uses UART to send and receive commands and data. These pins are auto-baud so whatever baud rate you send "AT" after reset or boot is the baud rate is used. RX is **into** the module, TX is **out of** the module.
- **RTSin** - this is the hardware flow control pin. If you turn on flow control on the FONA you can use this pin to stop and start data transfer *from* the FONA 3G to your microcontroller
- **CTSout** - this is the hardware flow control pin. If you turn on flow control on the FONA you can use this pin to determine when the FONA 3G's serial buffer is full and you should stop and start data transfer *to* the FONA 3G from your microcontroller
- **DTR** - this is a hardware flow control pin, it can be used with the FONA 3G to hang up calls, control data/command mode for TCP/IP, ec.
- **RI** - this is the **R**ing **I**ndicator. It is basically the 'interrupt' out pin from the module. It is by default high and can be configured to go low when a call is received. It can also be configured to go low when an SMS is received.
- **SPK+ and -** : This is for connecting an external 8 ohm speaker. The two pins are differential so they don't have output DC blocking capacitors. **You cannot connect this to a stereo, powered speakers or other non-differential amplifier** without adding a 100uF+ blocking cap in series to the + pin and then not using the - pin. Instead, your amp should use GND for the - reference

- **MIC + and -**: this is for connecting an external electret microphone, it will bias the mic with 2V. Most electrets will work just fine. No extra circuitry is required for the mic such as a biaser or amplifier, just wire it up directly!

LEDs

- **PWR** - Green! Lit when the module is booted and running
- **NET** - Red! You can use this for checking the current state without sending an AT command:
  Always on - the module is running but hasn't made connection to the cellular network yet
  800ms on, 800ms off - the module has made contact with the cellular network and can send/receive voice and SMS
  200ms on, 200ms off - the GPRS data connection you requested is active
  By watching the blinks you can get a visual feedback on whats going on.
- **Charging** - Orange! This is next to the microUSB jack. Indicates the onboard lipo charger is charging
- **Done** - Green! This is next to the JST jack. Indicates that the battery charging is done and the battery is full

Assembly
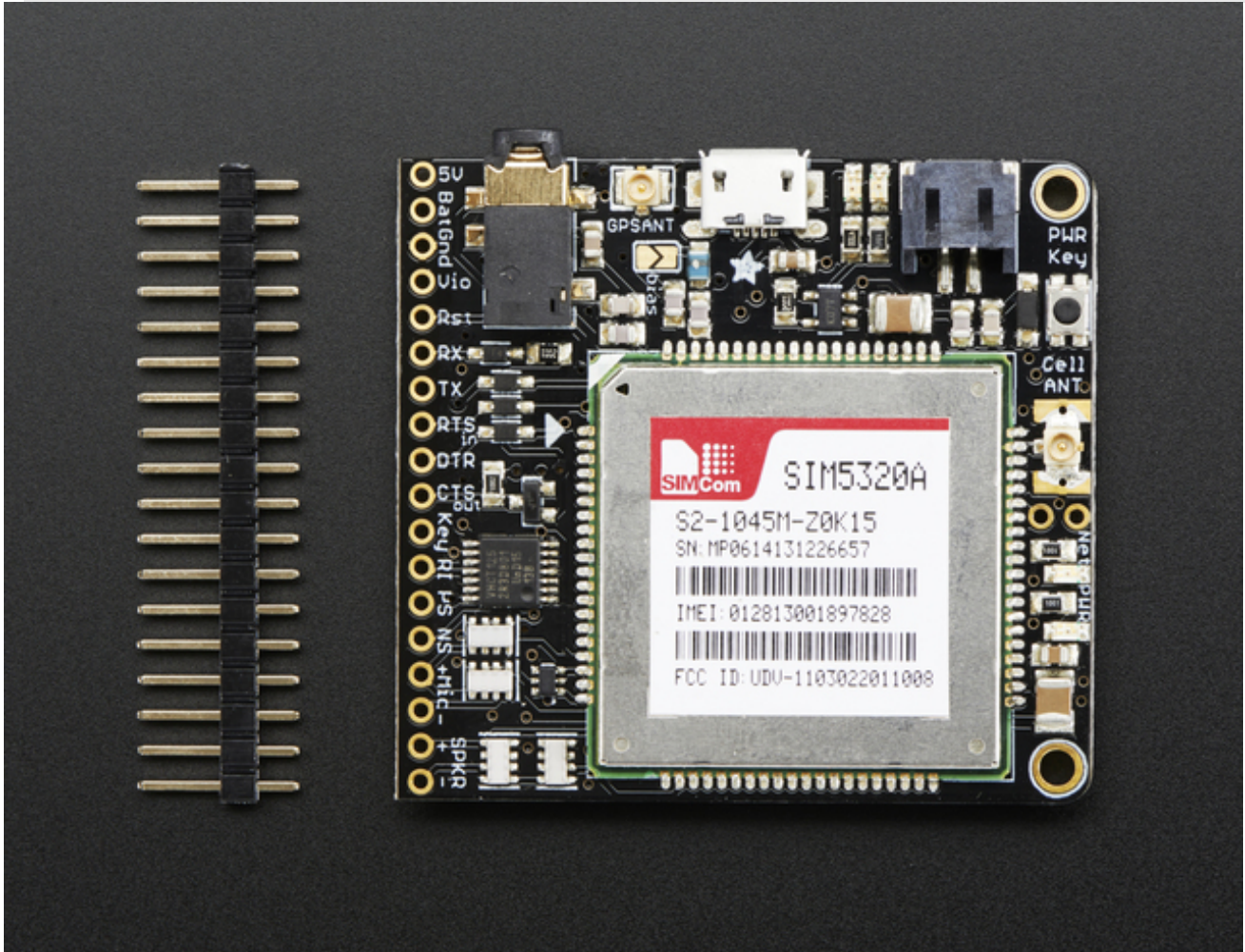
These photos show a FONA 808 but the overall techniques are identical!
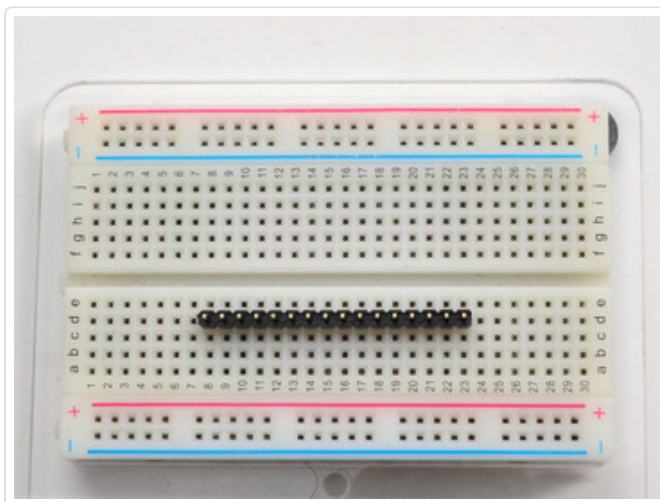
Prepare the header strip:

Cut the strip to length if necessary. It will be easier to solder if you insert it into a breadboard - **long pins down**
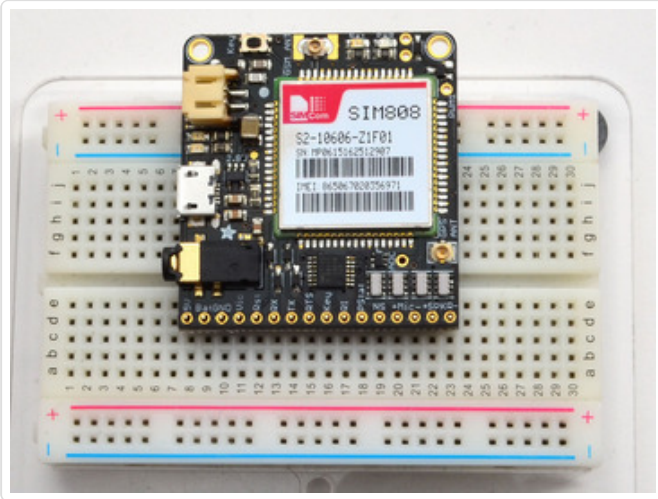
Add the breakout board:

Place the breakout board over the pins so that the short pins poke through the breakout pad
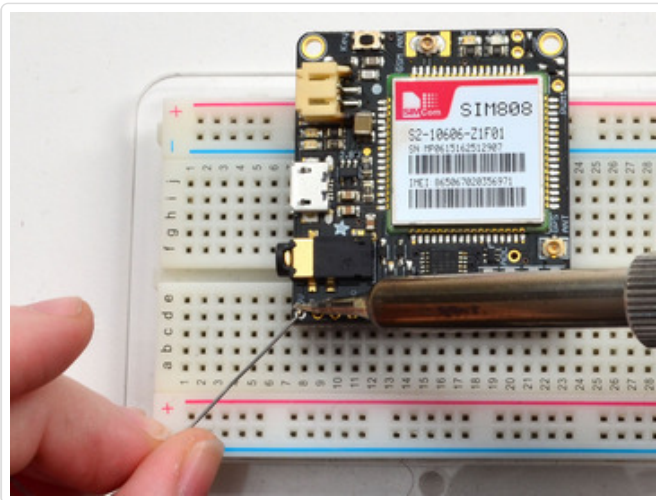
And Solder!

Be sure to solder all pins for reliable electrical contact.

(For tips on soldering, be sure to check out our Guide to Excellent Soldering (http://adafru.it/aTk)*).*
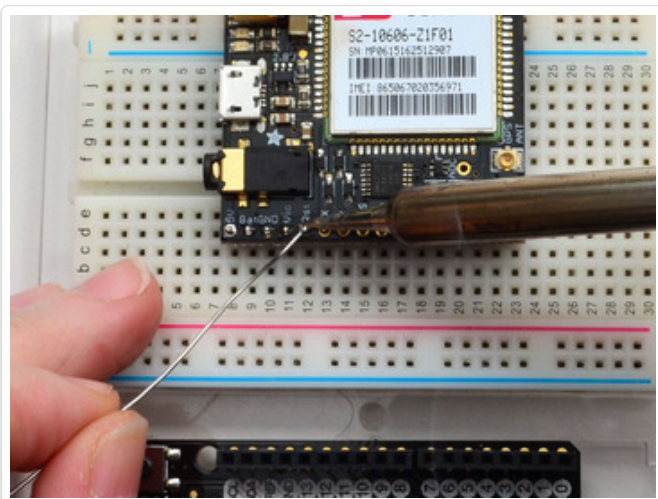
You're done! Check your solder joints visually and continue onto the next steps

Attaching Antenna & Battery

A battery, GPS antenna and GSM antenna is required! Use any Lipoly or LiIon 3.7V/4.2V battery
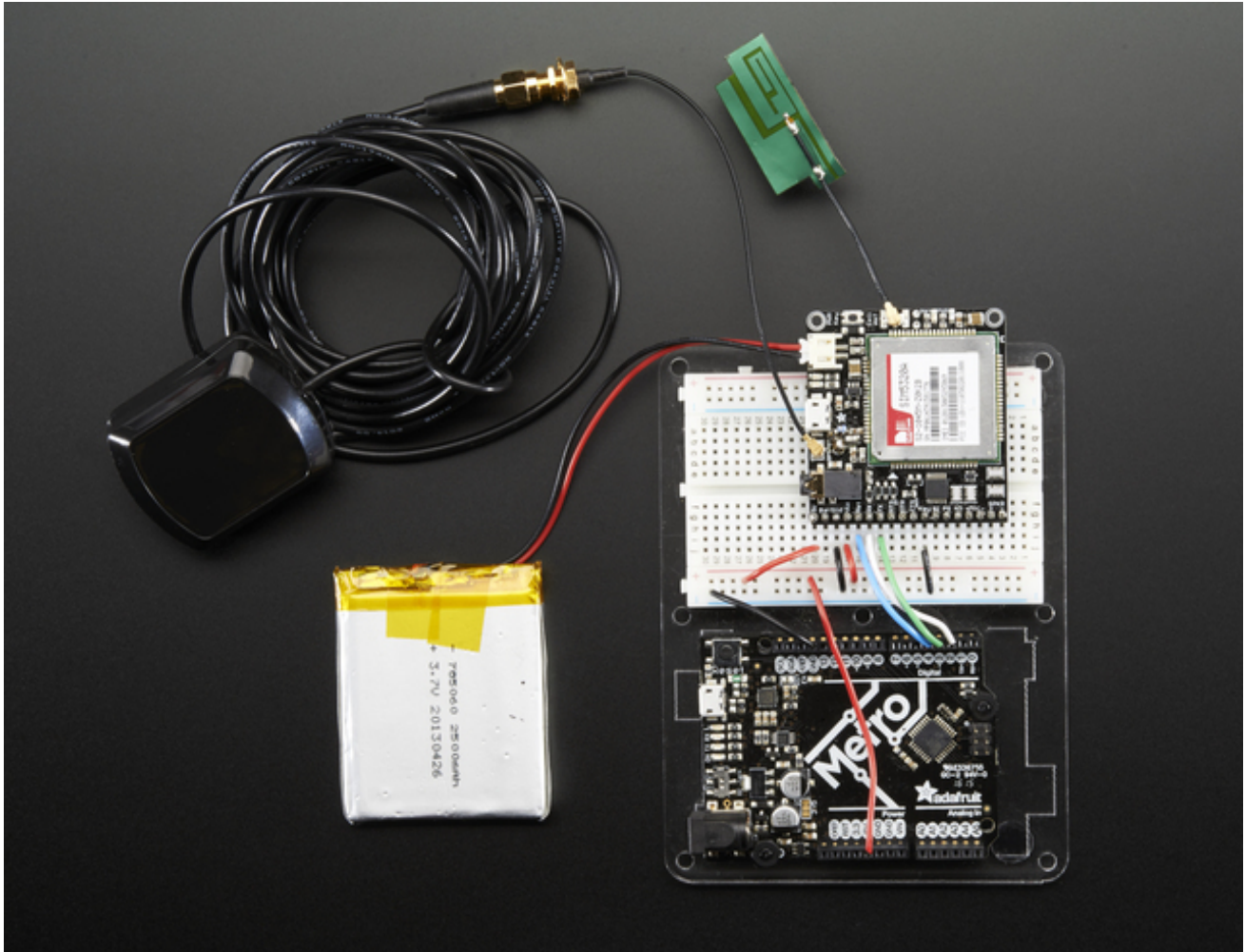
Check polarity for the battery!
Snap the uFL connector on, it will click when placed properly

SIM Card

You **must** insert a SIM card to do anything but the most basic tests. GPS does work without a SIM but of course you cannot send or receive texts, calls, etc!

The SIM card holder is on the back. It holds a very-standard "Mini SIM"
Micro SIMs will not work! Make sure you get a "Mini SIM"
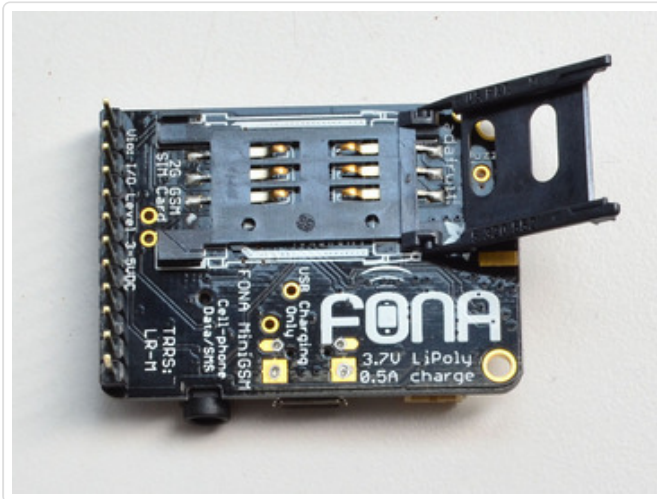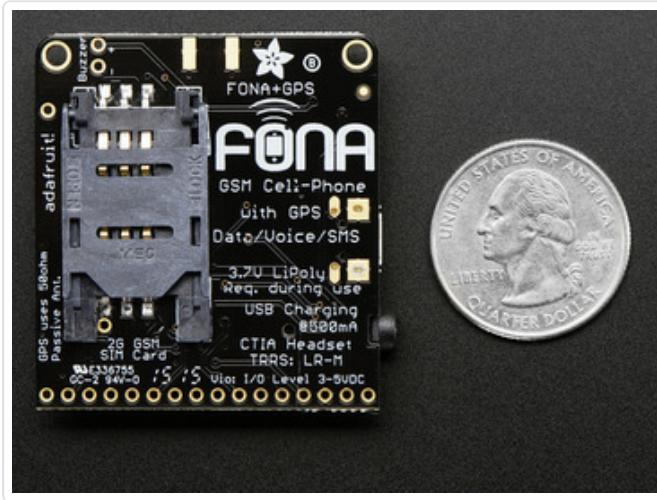
Open by sliding the cover towards the antenna

Insert the SIM with the gold pads facing up and the notch on the outer corner

Close the hinge down and slide the cover to lock it
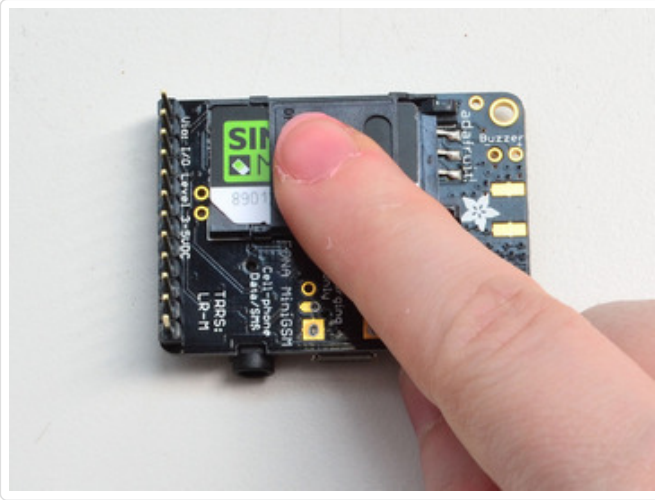
Direct USB Connection

If you'd like to use or test the FONA 3G you can do so right over the USB port, which is not just for charging, but is also a full interface to everything the module can do!

First up, you will still need a small Lithium Polymer battery to keep the power supply stable. You'll also likely want an antenna and SIM card. A microUSB cable is required. **We've tested this on a Windows 7 computer, other operating systems may vary!**

Insert the SIM card, connect the antenna(s) and plug in the micro USB cable from your computer to the FONA 3G
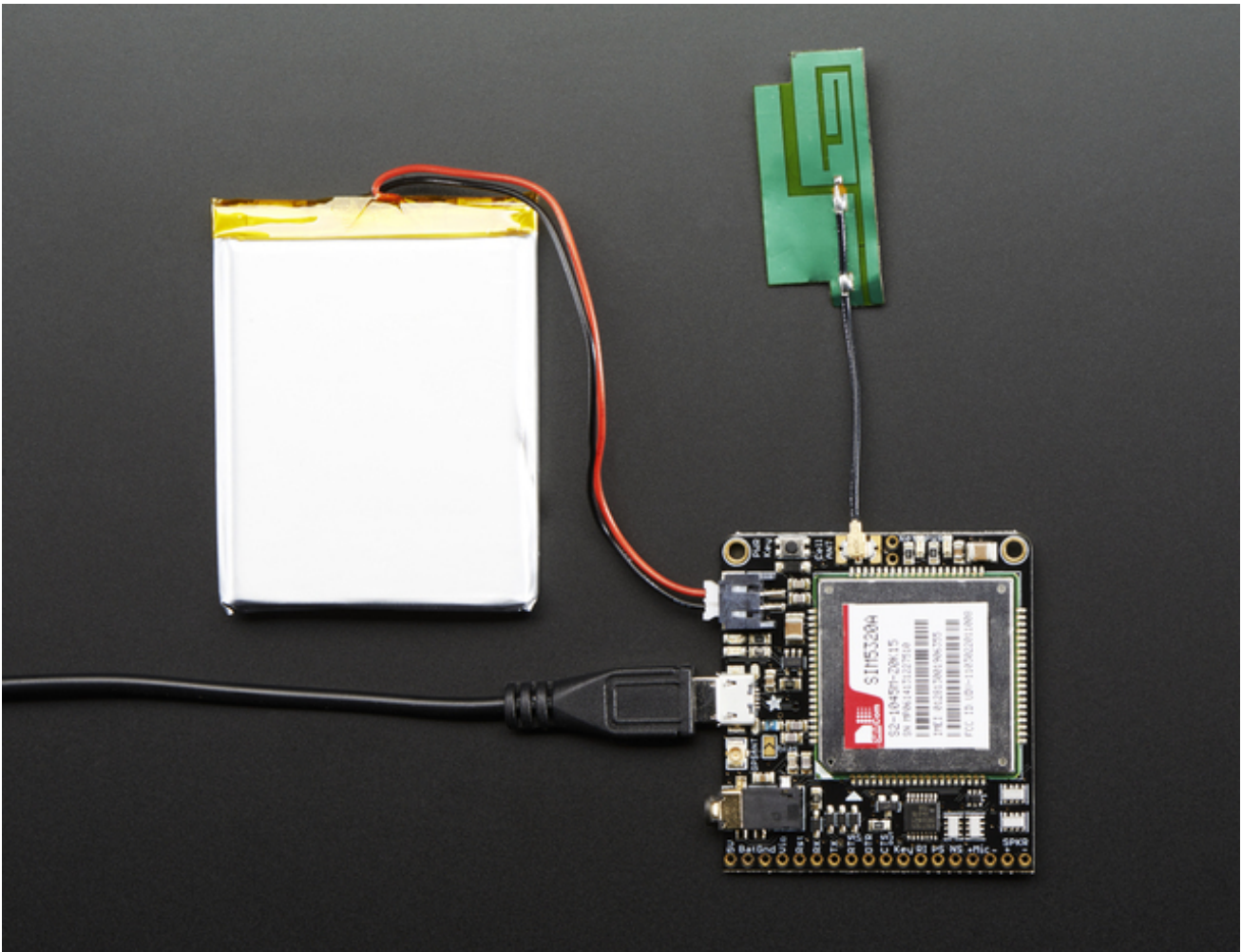
Then press the small **KEY** button next to the battery & cell antenna for 5 seconds. Then the computer will recognize a multi-type USB connection. Install the drivers (http://adafru.it/jFn)

There are 4 devices created

- A Modem device

- A USB diagnostics COM port
- A NMEA COM port (this is the raw GPS NMEA output)
- A USB AT port (this is how you can send commands to the module!)
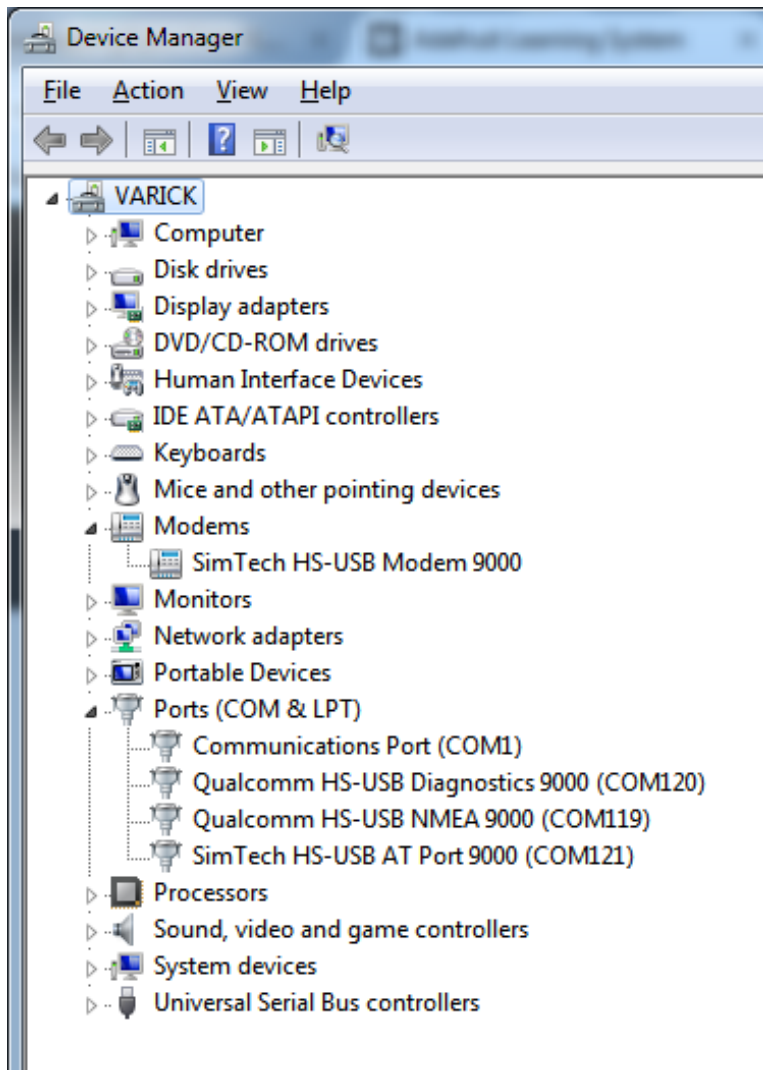
You can connect to the AT com port at any baud rate and send AT commands like normal. This makes it super easy to test out commands
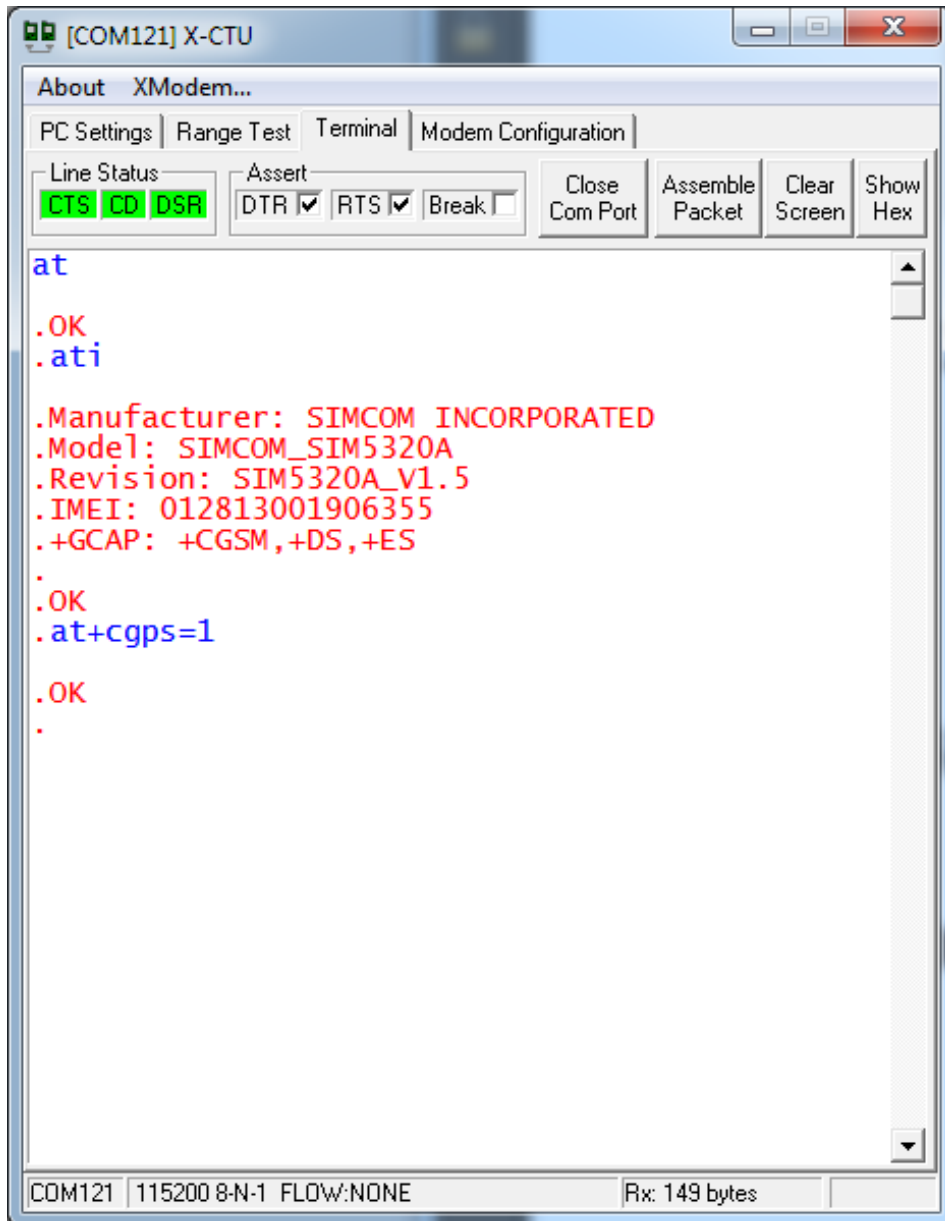
If you turn on the gps with the **at+cgps=1** command in the AT serial port you can then connect to the NMEA COM port and see GPS NMEA data

```
[COM119] X-CTU

About    XModem...

PC Settings | Range Test | Terminal | Modem Configuration

Line Status          Assert
CTS CD DSR    DTR ☑ RTS ☑ Break ☐    Close     Assemble   Clear   Show
                                      Com Port   Packet    Screen  Hex

.$GPGSV,4,3,16,24,,,,23,,,,22,,,,21,,,*7D
.$GPGSV,4,4,16,20,,,,19,,,,18,,,,17,,,*7B
.$GPGGA,,,,,,0,,,,,,,,,*66
.$GPVTG,,T,,M,,N,,K,N*2C
.$GPRMC,,V,,,,,,,,,,N*53
.$GPGSV,4,1,16,13,,,,32,,,,31,,,,30,,,*79
.$GPGSV,4,2,16,29,,,,28,,,,27,,,,26,,,*78
.$GPGSV,4,3,16,25,,,,24,,,,23,,,,22,,,*79
.$GPGSV,4,4,16,21,,,,20,,,,19,,,,18,,,*7E
.$GPGGA,,,,,,0,,,,,,,,,*66
.$GPVTG,,T,,M,,N,,K,N*2C
.$GPRMC,,V,,,,,,,,,,N*53
.$GPGSA,A,1,,,,,,,,,,,,,,*1E
.$GPGSV,4,1,16,13,,,,32,,,,31,,,,30,,,*79
.$GPGSV,4,2,16,29,,,,28,,,,27,,,,26,,,*78
.$GPGSV,4,3,16,25,,,,24,,,,23,,,,22,,,*79
.$GPGSV,4,4,16,21,,,,20,,,,19,,,,18,,,*7E
.$GPGGA,,,,,,0,,,,,,,,,*66
.$GPVTG,,T,,M,,N,,K,N*2C
.$GPRMC,,V,,,,,,,,,,N*53
.$GPGSA,A,1,,,,,,,,,,,,,,*1E
.$GPGSV,4,1,16,13,,,,32,,,,31,,,,30,,,*79
.$GPGSV,4,2,16,29,,,,28,,,,27,,,,26,,,*78
.$GPGSV,4,3,16,25,,,,24,,,,23,,,,22,,,*79
.$GPGSV,4,4,16,21,,,,20,,,,19,,,,18,,,*7E
.$GPGGA,,,,,,0,,,,,,,,,*66
.$GPVTG,,T,,M,,N,,K,N*2C
.$GPRMC,,V,,,,,,,,,,N*53
.$GPGSA,A,1,,,,,,,,,,,,,,*1E
.

COM119 | 115200 8-N-1  FLOW:NONE          Rx: 1447 bytes
```

We haven't tried out the Modem yet and the Diagostics USB port doesnt seem to respond (probably you need a special software package)

Arduino Test

Download Adafruit_FONA

To begin reading sensor data, you will need to download Adafruit_FONA Library from our github repository (http://adafru.it/dDC). You can do that by visiting the github repo and manually downloading or, easier, just click this button to download the zip

Download the Adafruit_FONA Library

http://adafru.it/dDD

Rename the uncompressed folder **Adafruit_FONA** and check that the **Adafruit_FONA** folder contains **Adafruit_FONA.cpp** and **Adafruit_FONA.h**

Place the **Adafruit_FONA** library folder your **arduinosketchfolder/libraries**/ folder.
You may need to create the **libraries** subfolder if its your first library. Restart the IDE.

We also have a great tutorial on Arduino library installation at:
http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use (http://adafru.it/aYM)

FONA 3G Baud Adjustment

If you have a FONA 3G, the first time you use it you may need to run the **FONA3G_setBaud** example to set the baud rate manually to 4800bps rather than 115200

Load Demo

Open up **File->Examples->Adafruit_FONA->FONAtest** and upload to your Arduino wired up to the module.

For Mega, Leonardo, or Micro, change the definition of FONA_TX to the pin you used!
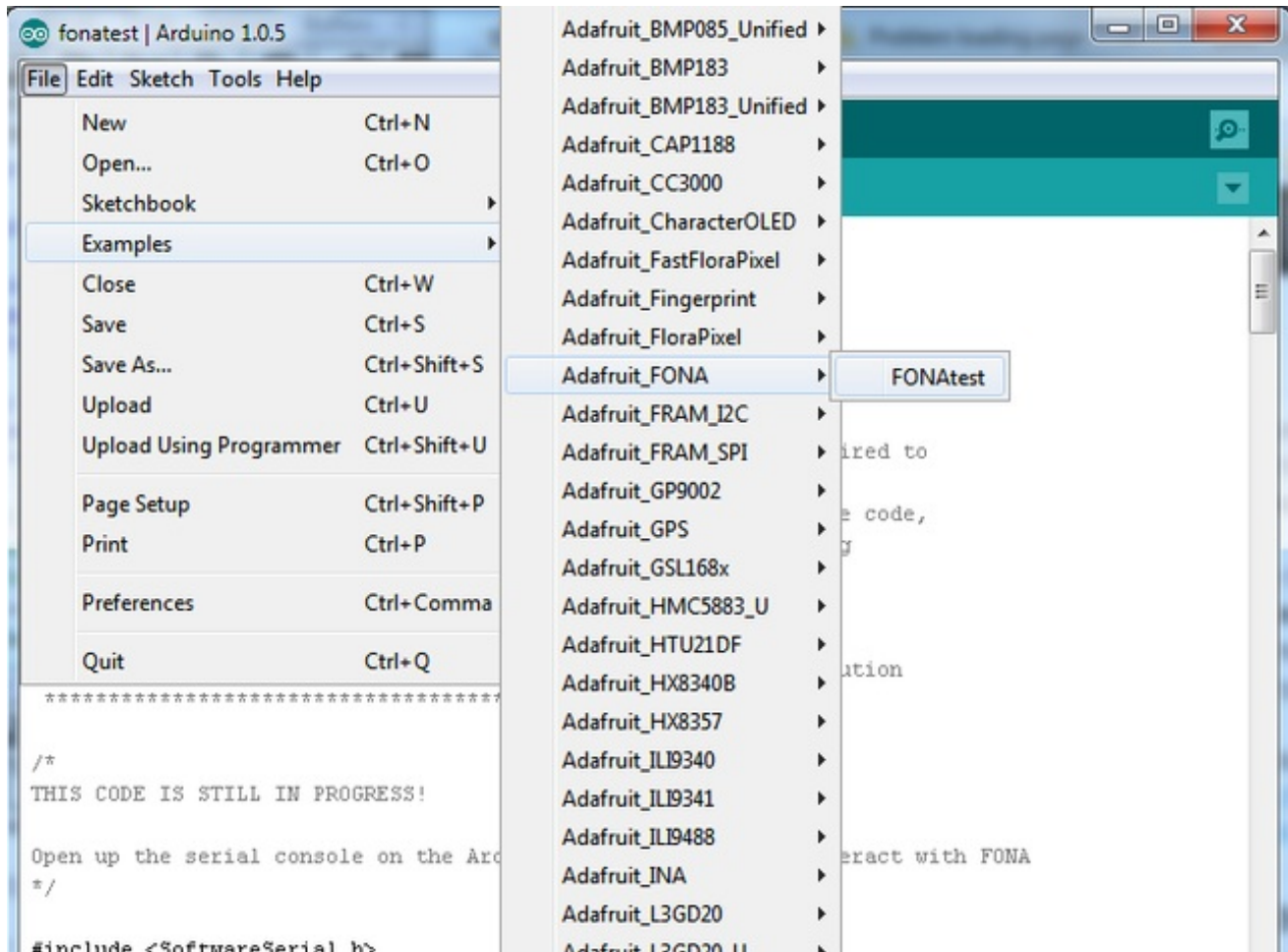
Make sure you have a charged 3.7/4.2V LiPoly or LiIon battery plugged into the JST and an antenna attached

https://learn.adafruit.com/adafruit-fona-3g-cellular-gps-breakout
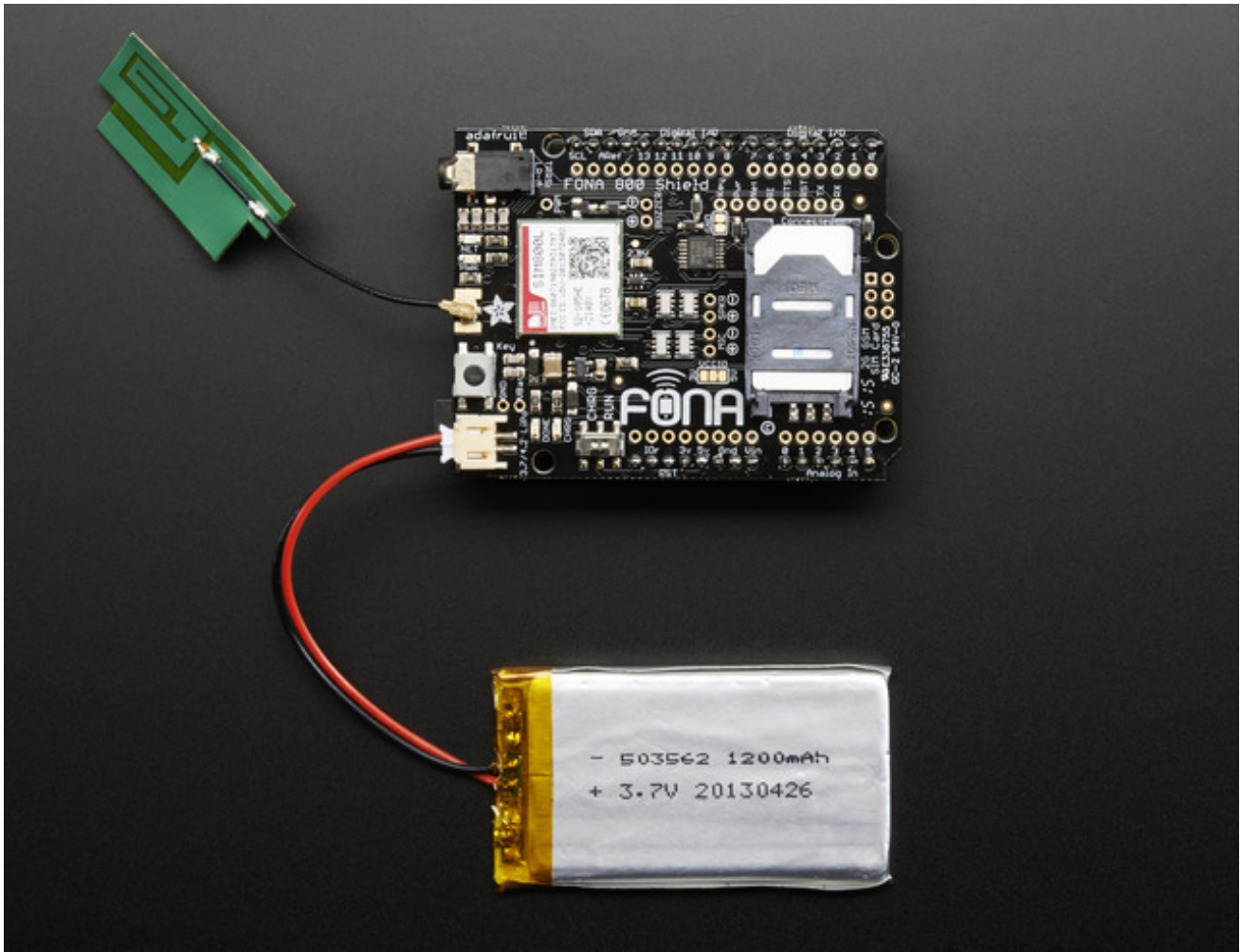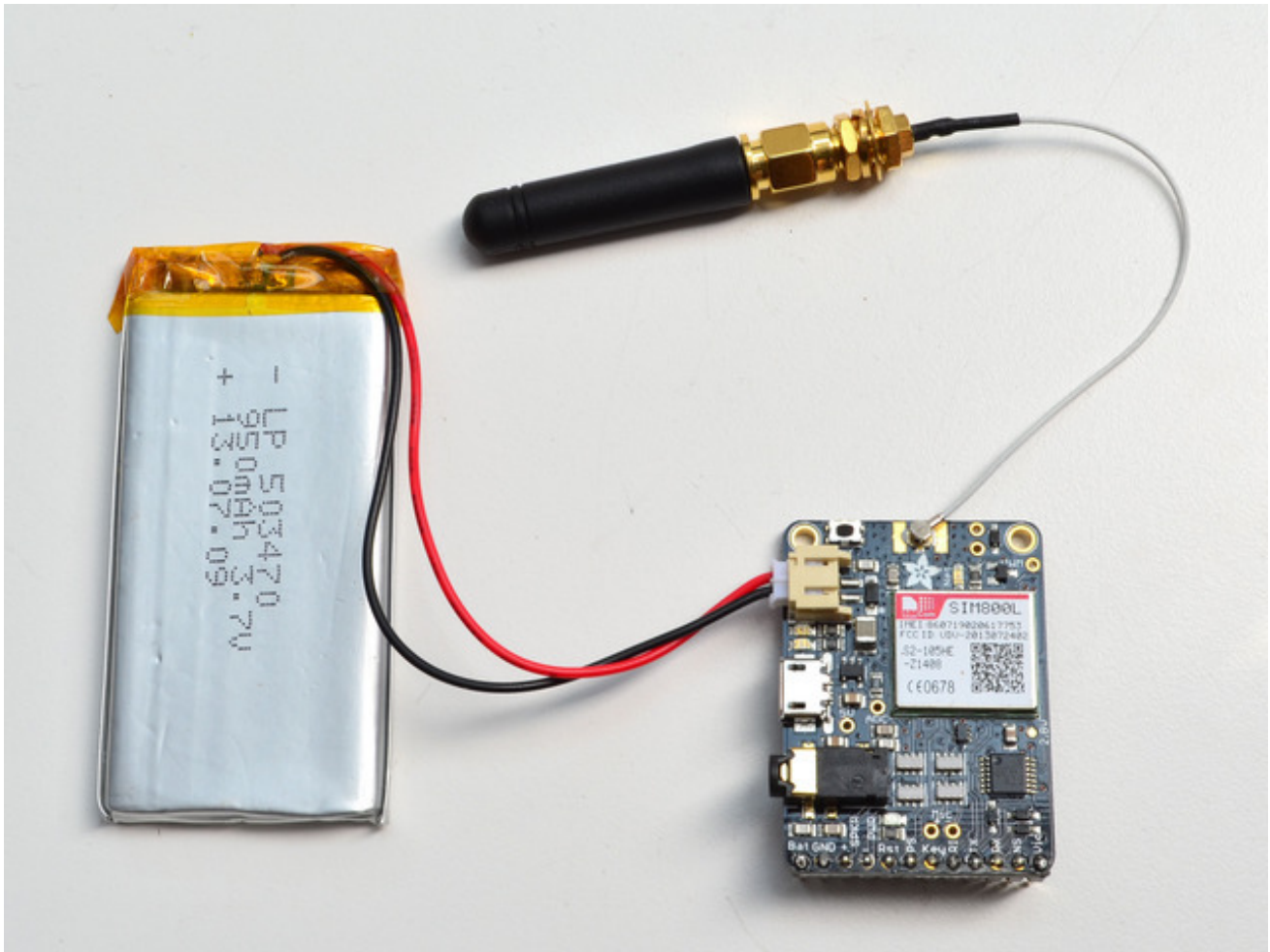
Once uploaded to your Arduino, open up the serial console at **115200 baud speed** to begin the tester sketch

```
FONA basic test
Initializing....(May take 3 seconds)
OK
-----------------------------------
[?] Print this menu
[a] read the ADC (2.8V max)
[b] read the Battery V
[C] read the SIM CCID
[i] read RSSI
[n] get Network status
[v] set audio Volume
[V] get Volume
[H] set Headphone audio
[e] set External audio
[T] play audio Tone
[f] tune FM radio
[F] turn off FM
[P] PWM/Buzzer out
[c] make phone Call
[h] Hang up phone
[N] Number of SMSs
[r] Read SMS #
[R] Read All SMS
[d] Delete SMS #
[s] Send SMS
[S] create Serial passthru tunnel
-----------------------------------

FONA>
```

Make sure you also have **Both NL & CR** for the serial command sender option. This means when you send data to the Arduino via the console, it will put a newline/return at the end.

Using the Test Sketch

The test sketch has a menu interface so you can test out just about everything the FONA can do. The menu may change slightly as we add more functionality and update code!

Battery voltage

Lets begin by reading the battery voltage. That's the lipoly battery. This is handy if you need to track when the battery is low! type **b** into the command window and hit **Send**
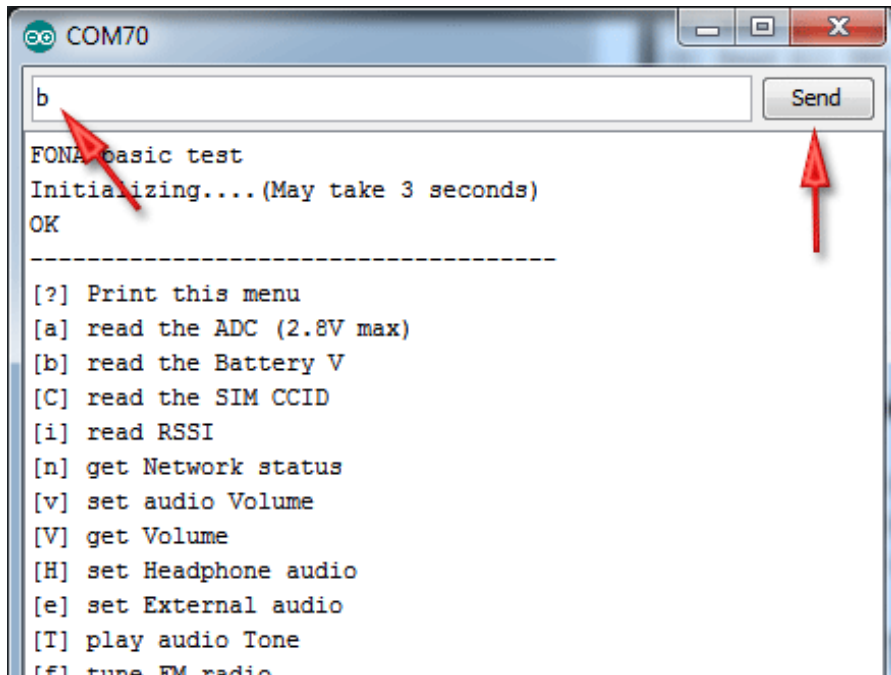
You'll see a print-out of the battery voltage in mV, so in this case its 3.726V
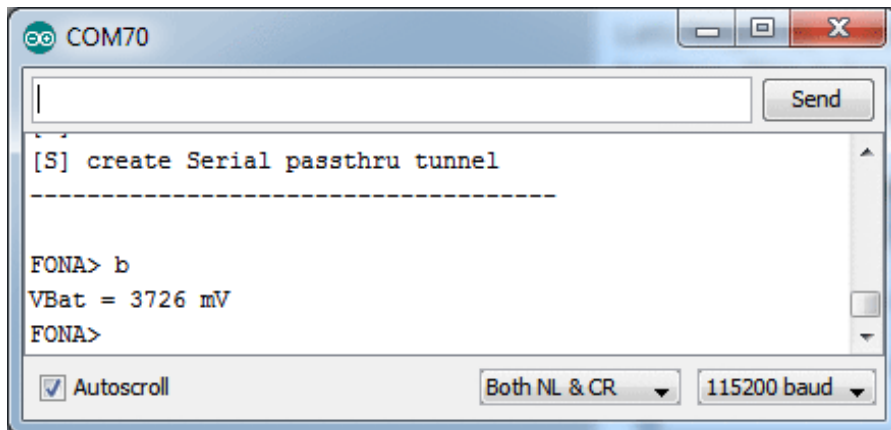
Check SIM CCID

You can verify that the SIM is inserted and correct by reading the CCID, which is the unique identifier printed on it with **C**

```
[S] create Serial passthru tunnel
------------------------------------

FONA> C
SIM CCID = 8901260743▮▮▮▮▮▮
FONA>
```
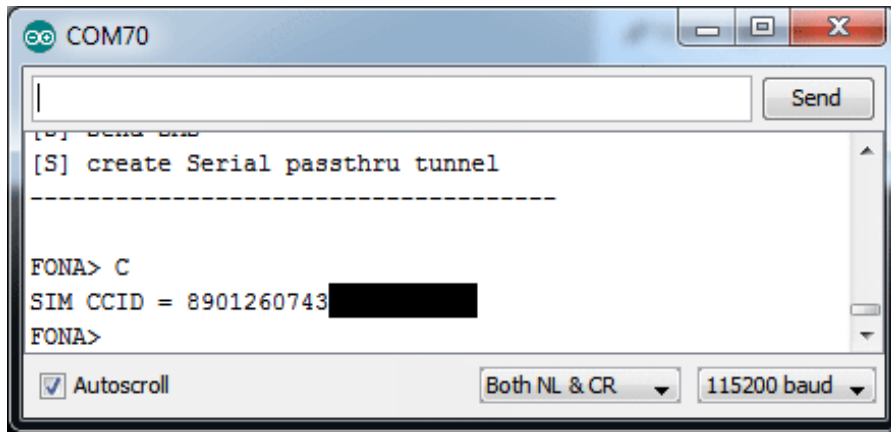
Check RSSI (network signal strength)

You can ask the FONA for the signal strength with the command **i**. The reply is a number, but you can convert it to dBm. Try to have the signal strength higher than 5 in order to make calls, SMSs, etc. In this case, I've got a 10


```
[S] create Serial passthru tunnel
------------------------------------

FONA> i
RSSI = 10: -94 dBm
FONA>
```
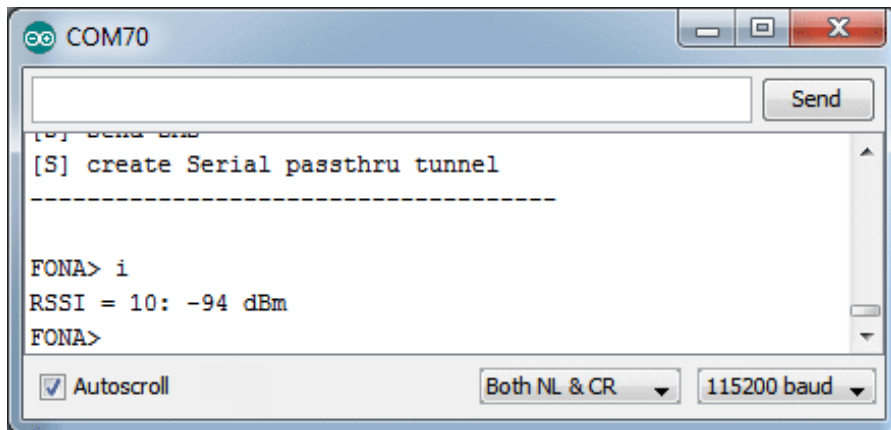
Checking Network Registration

If the FONA has good signal it will immediately try to locate a cell tower and register to it.
You can check the status of the network with **n**
Once it's Home Registered, give it like 5-10 more seconds before trying to access/send SMS's or phone calls.

```
FONA> n
Network status 4: Unknown
FONA> n
Network status 4: Unknown
FONA> n
Network status 2: Not registered (searching)
FONA> n
Network status 2: Not registered (searching)
FONA> n
Network status 2: Not registered (searching)
FONA> n
Network status 1: Registered (home)
FONA> n
Network status 1: Registered (home)
FONA>
```
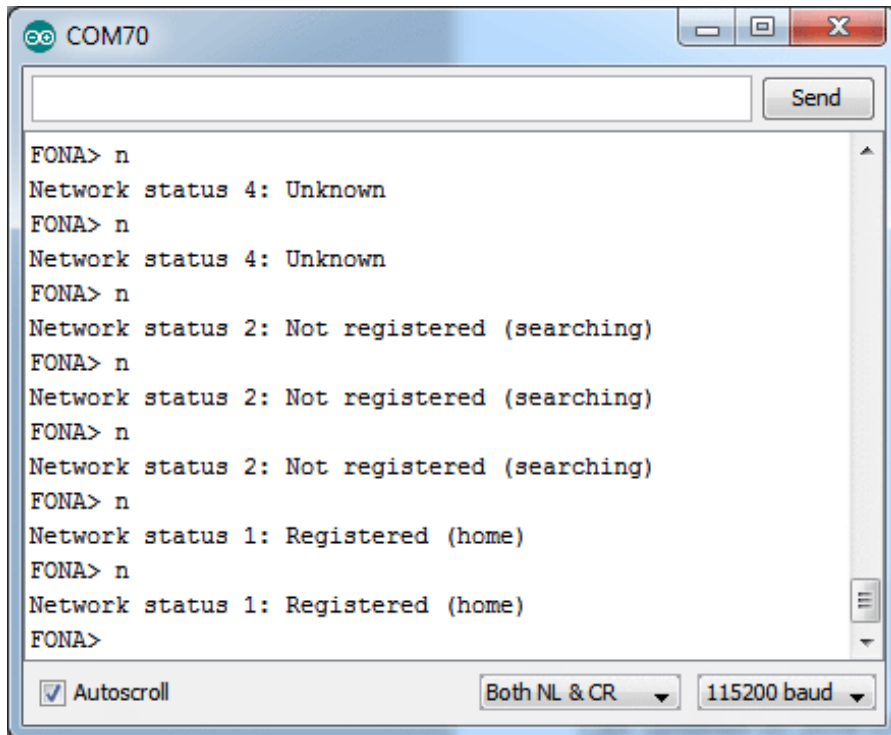
Set and Get audio volume

You can set the audio volume with **v** and retrieve it with **V** - its in % so ranges from 0 to 100

```
-----------------------------------

FONA> v
Set Vol %42
OK!
FONA> V
42%
FONA>
```
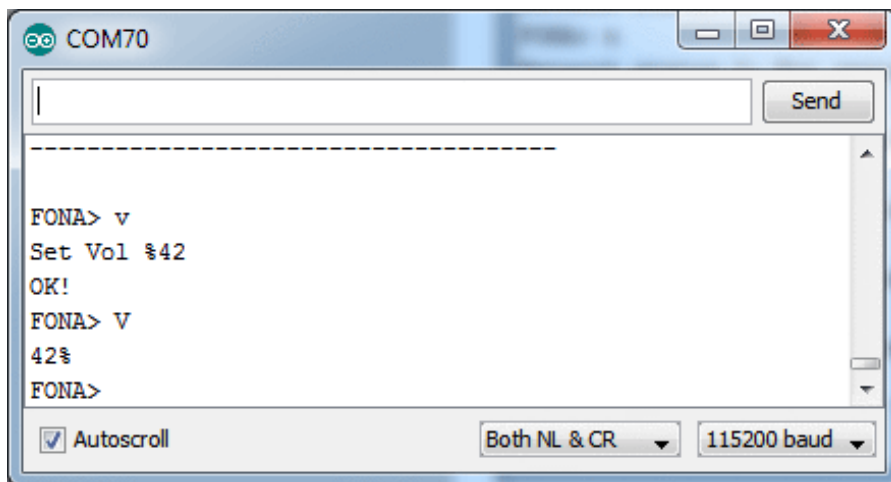
Setting Headset or External audio

There are two audio paths on the FONA. One is the headset, thru the 3.5mm audio jack. The other is "external" - using the two speaker and mic pins for wiring up external speaker and mic. FM audio, phone calls, tones, etc can be routed to one or the other.

To set the audio to headset, use the command **H**

To set the audio to external, use the command **e**

Note the FONA 808 only has Headset audio, so setting External audio wont do anything

```
COM70
[                                    ]  Send
42%
FONA> H
OK!
FONA> e
OK!
FONA>
☑ Autoscroll          Both NL & CR  ▼   115200 baud ▼
```
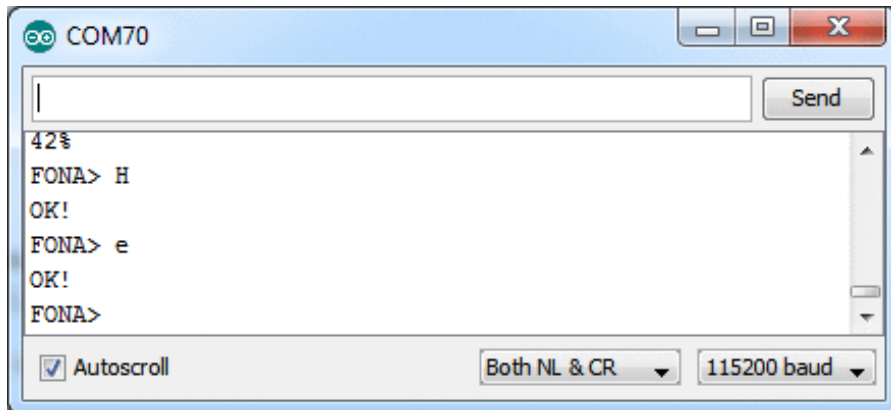
Playing Toolkit Tones

You can test the audio path with the toolkit tones. These are tones that mimic what some phone services sound like. For a full list of tones, you can check the **AT+STTONE** command in the AT command datasheet. We'll use tone #20 which is the American dial tone.
You can switch to headset mode, play a tone, then try it on the external audio mode. This is a very easy way to try out both speakers for debugging

```
COM70
[                                    ]  Send
FONA> H
OK!
FONA> T
Play tone #20
OK!
FONA> e
OK!
FONA> T
Play tone #20
OK!
FONA>
☑ Autoscroll          Both NL & CR  ▼   115200 baud ▼
```
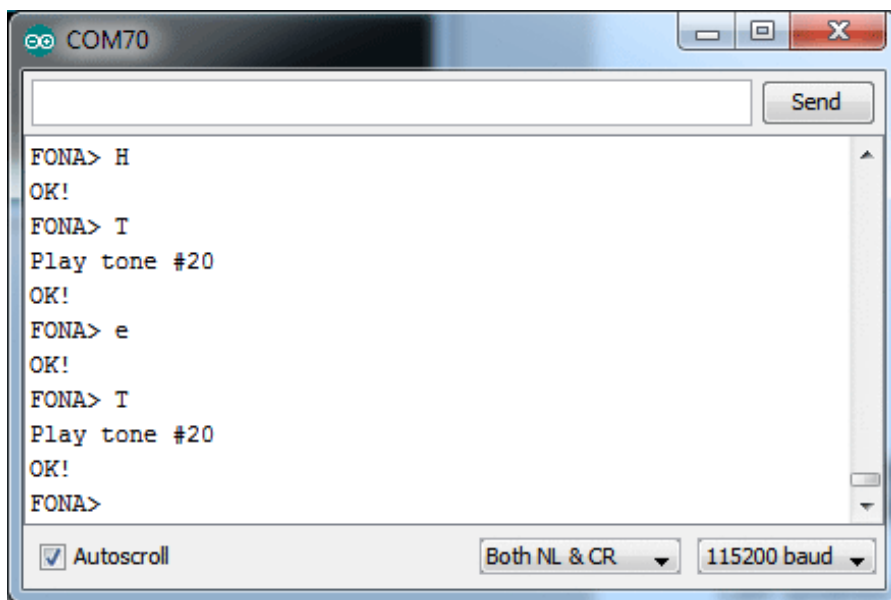
PWM/Buzzer

There is a single PWM output pin that you can use to control a Piezo or a vibrating motor. The datasheet is a little unclear on how to use it in 'PWM' mode where you have full frequency and duty cycle control. In the mode we're using it, you can set the frequency from 1-2000 Hz and it will have 50% duty cycle. The **PWM** pin is the straight-from-the-module output, 2.8Vpp. The **Buzzer** pins have a PNP driver, so you can use it with a motor buzzer and power from the lipoly battery.
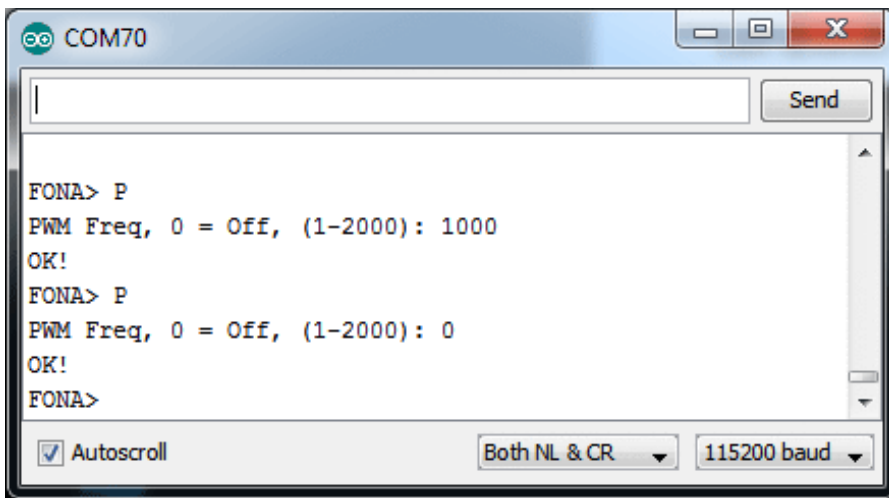
Make Phone Calls

OK now we're onto the good stuff. You can make a phone call with FONA pretty easily. Make sure you have the right audio interface selected (external or headset!) before you go forward

Make a call with **c** - the call happens in the 'background'. When you're done then you can hang up with **h**
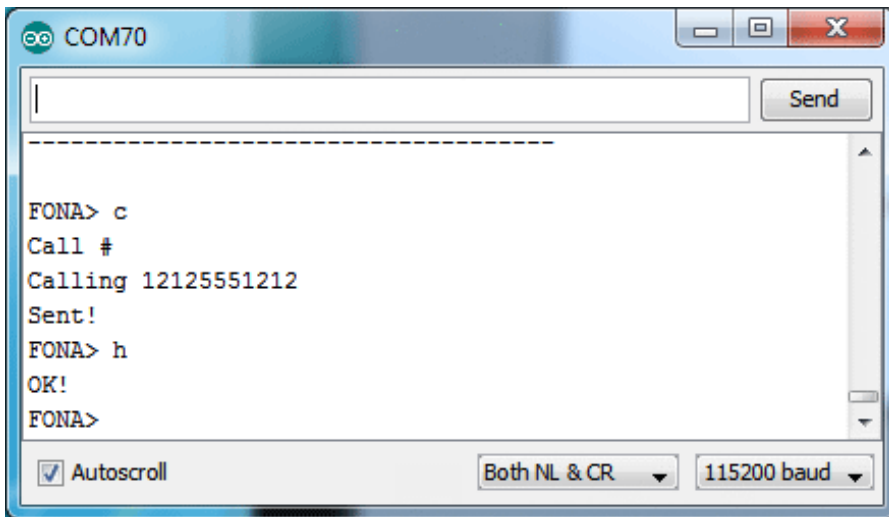
Send and Read SMS

Another easy thing you can do is send and receive SMS messages. Lets start by sending an SMS. We'll use twitter's 40404 short code, which will auto respond, making it easy to verify both sending and receiving

You *can* send multi-line SMS's using the library API but for this example, its easier to parse the data if its a single line!

```
FONA> s
Send to #40404
Type out one-line message (140 char): HELP
Sent!
FONA>
```
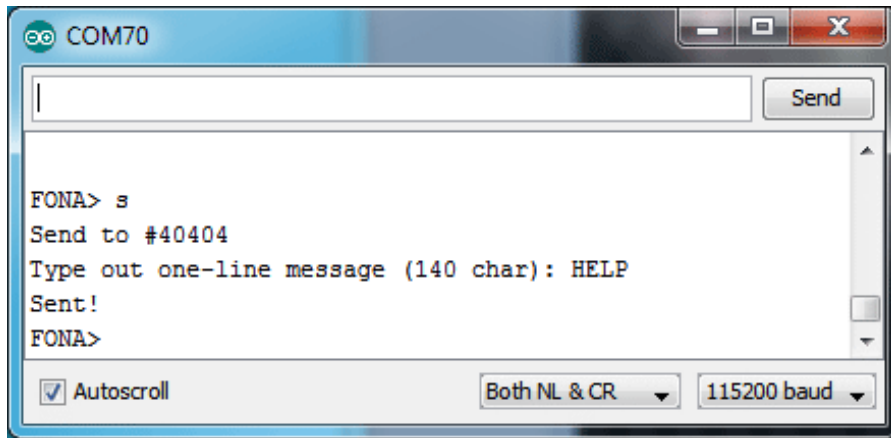
You can then ask the SIM how many SMS's it has with **N** and read all of them with **R**

Note that SMS's are referred to by slots but the number does not include empty slots. We'll show this in detail in a bit

```
© COM70                                                          ─  □  ✕

|                                                              [ Send ]

FONA> s
Send to #40404
Type out one-line message (140 char): HELP
Sent!
FONA> N
3 SMS's on SIM card!

OK
FONA> R

Reading SMS #1
***** SMS #1 (71) bytes *****
Thank you for choosing Simple Mobile. Your mobile number is 16463
*****

Reading SMS #2
***** SMS #2 (155) bytes *****
Text to this number to Tweet.
Reply w/ STOP to quit.
Reply w/ just the command for help.
http://support.twitter.com/sms for more.
Std msg/data rates apply.
*****

Reading SMS #3
***** SMS #3 (155) bytes *****
Text to this number to Tweet.
Reply w/ STOP to quit.
Reply w/ just the command for help.
http://support.twitter.com/sms for more.
Std msg/data rates apply.
*****

[✓] Autoscroll              Both NL & CR  ▾    115200 baud  ▾
```

You can read individual SMS's with **r**

```
oo COM70                                        —  ▢  X

|                                                    Send

FONA> r                                               ▲
Read #3
Reading SMS #3
***** SMS #3 (155) bytes *****
Text to this number to Tweet.
Reply w/ STOP to quit.
Reply w/ just the command for help.
http://support.twitter.com/sms for more.
Std msg/data rates apply.                             ≡
*****
FONA>                                                 ▼
◄           III                           ►

☑ Autoscroll              Both NL & CR  ▼  115200 baud ▼
```
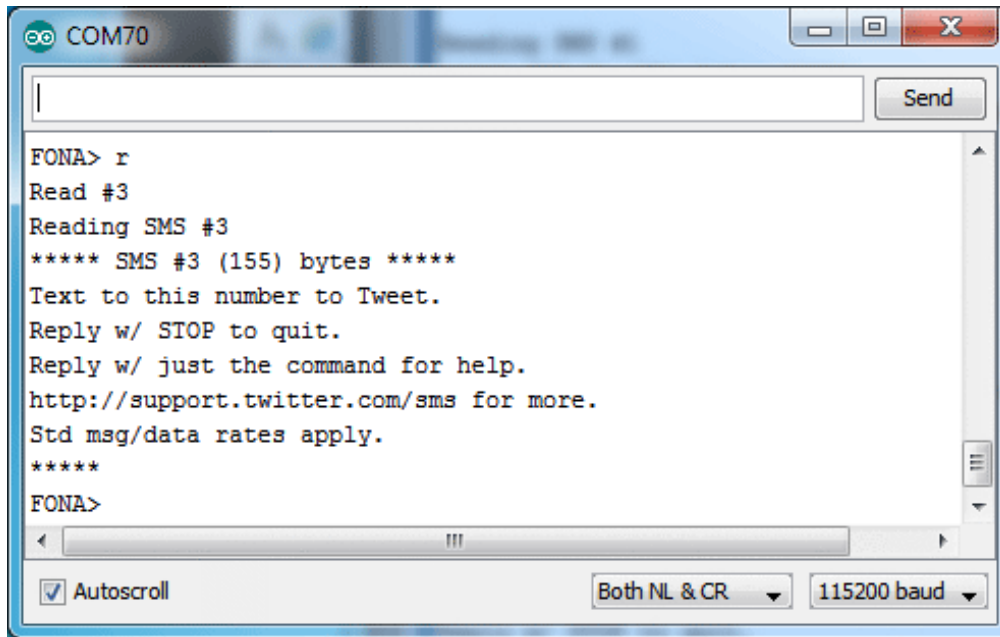
And delete SMS's by slot # with **d**

```
oo COM70                                        —  ▢  X

|                                                    Send

*****                                                 ▲
FONA> d
Delete #2
Deleting SMS #2
OK!
FONA>                                                 ▼
◄           III                           ►

☑ Autoscroll              Both NL & CR  ▼  115200 baud ▼
```
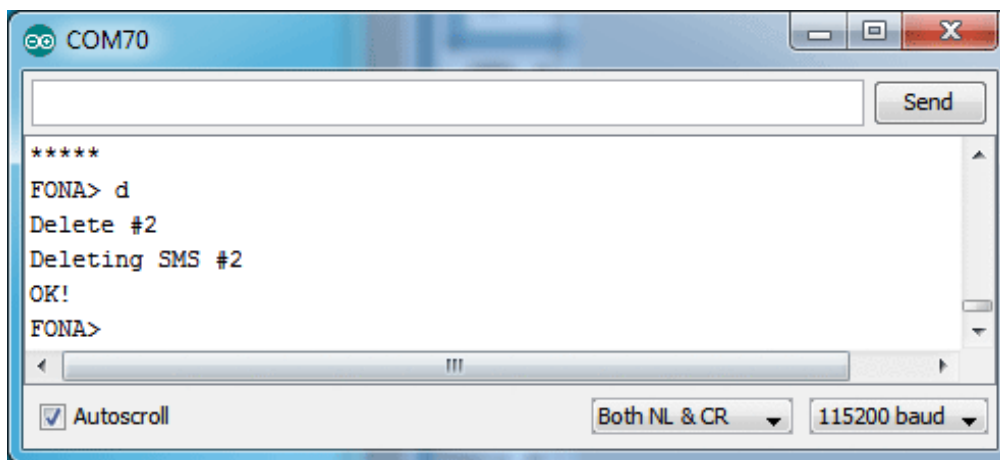
Note that before I deleted SMS #2, so if I read them again, that SMS # will be an empty slot. SMS number #3 doesn't "move slots"!

```
COM70                                                    ─ ◰ ✕

                                                            Send

FONA> d                                                      ▲
Delete #2
Deleting SMS #2
OK!
FONA> R

Reading SMS #1
***** SMS #1 (71) bytes *****
Thank you for choosing Simple Mobile. Your mobile number is 164637
*****

Reading SMS #2
[empty slot]

Reading SMS #3
***** SMS #3 (155) bytes *****
Text to this number to Tweet.
Reply w/ STOP to quit.
Reply w/ just the command for help.
http://support.twitter.com/sms for more.
Std msg/data rates apply.                                    ≡
*****
FONA>                                                        ▼
◀                        III                             ▶

☑ Autoscroll                      Both NL & CR  ▾  115200 baud ▾
```

FM Radio (FONA 800 only)

The FONA has an FM receive in it. It uses the headset as the 'antenna' but it works pretty well considering! The FM radio goes thru whatever audio path you have set up

You can open and tune to an FM frequency in units of 100KHz. So if you want to tune to 88.1MHz, type in 881. For 102.3, type in 1023.

Use the **f** command to open and tune, and **F** to close it

> FM radio tuning/listening is only for FONA 800, the 808 does not contain a tuner

```
⊙⊙ COM70                                    ▭ ▭ ✕

|                                          Send

FONA> f                                       ▲
FM Freq (eg 1011 == 101.1 MHz): 1011
Opened
Tuned
FONA> F
OK!
FONA>                                         ▼

☑ Autoscroll          Both NL & CR  ▾  115200 baud ▾
```
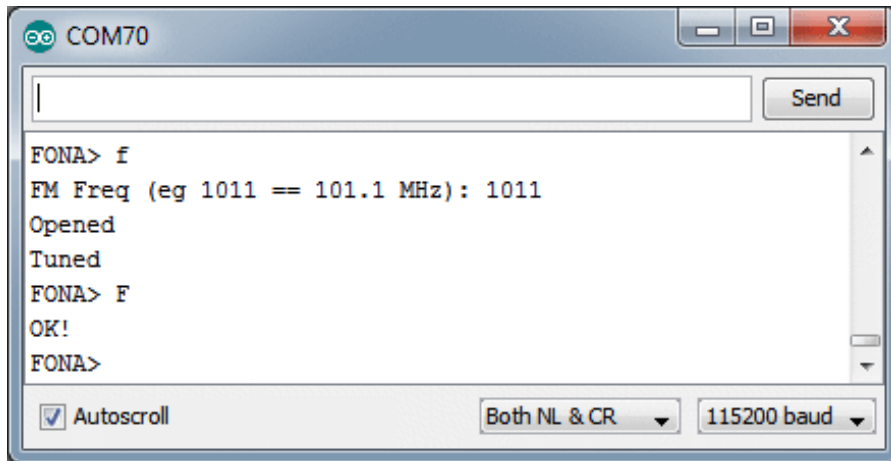
GPS Submodule (FONA 808 only)

The FONA 808 has a built in GPS module, you can use it for locating yourself in space! You will need to attach a GPS antenna to the uFL connector and make sure the GPS antenna is outside and pointing up to towards the sky

You can start out by turning on the GPS module with **O** (capital-o) and query the status of the 'fix' with **x**. It will take a minute or two to get a fix.

```
⊙⊙ COM16 (Arduino Uno)                       ▭ ▭ ✕

|                                          Send

FONA> O                                       ▲
        ---> AT+CGPSPWR?
        <--- +CGPSPWR: 0
        ---> AT+CGPSPWR=1
        <--- OK
FONA> x
        ---> AT+CGPSSTATUS?
        <--- +CGPSSTATUS: Location Not Fix
No fix
FONA> x
        ---> AT+CGPSSTATUS?
        <--- +CGPSSTATUS: Location 3D Fix
3D fix
FONA>                                         ▼

☑ Autoscroll          Both NL & CR  ▾  115200 baud ▾
```
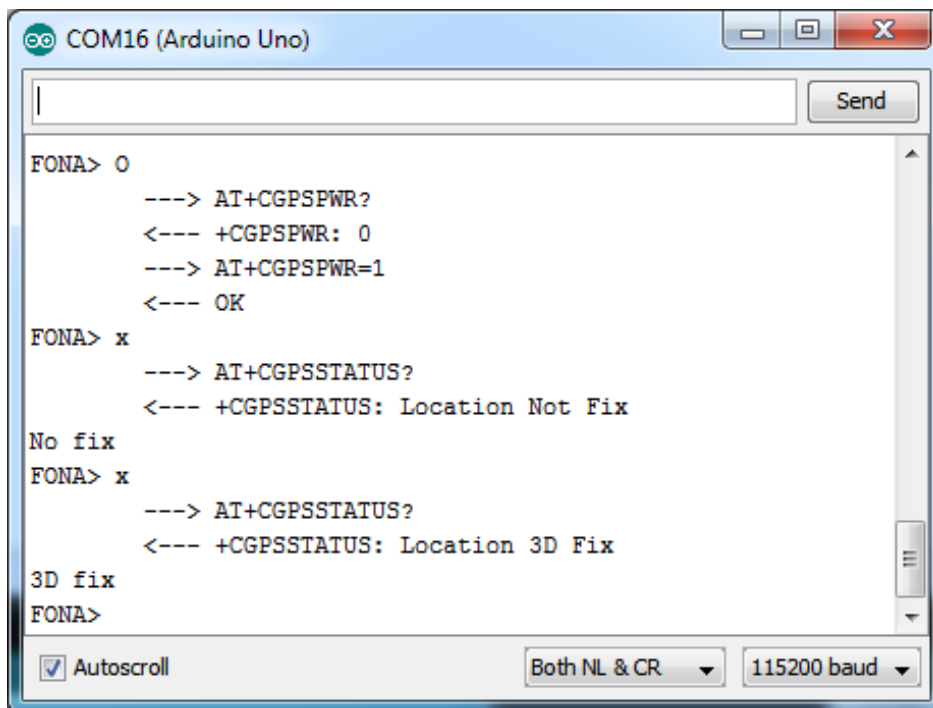
Once you have a fix you can query and get the location/time data with **L**

```
      <--- +CGPSSTATUS: Location Not Fix
No fix
FONA> x
      ---> AT+CGPSSTATUS?
      <--- +CGPSSTATUS: Location 3D Fix
3D fix
FONA> L
      ---> AT+CGPSINF=0
      <--- +CGPSINF: 0,4043.576433,7400.316980,58.647405,20150601201258.000,64,12,0.548363,100.442406
Reply in format: mode,longitude,latitude,altitude,utctime(yyyymmddHHMMSS),ttff,satellites,speed,course
0,4043.576433,7400.316980,58.647405,20150601201258.000,64,12,0.548363,100.442406
FONA>
```

The data is in a comma-seperated format:

0,4043.576433,7400.316980,58.647405,20150601201258.000,64,12,0.548363,100.442406

Can be parsed out to:

- 0 - this is the mode (will be 0)
- 4043.576433 - this is the longitude
- 7400.316980 - this is the latitude

> 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.)

- 58.647405 - this is the altitude in meters
- 20150601201258.000 - this is the UTC time in yyymmddHHMMSS.ms format. E.g. this is year 2015, month 06, date 01, 20 hour, 12 minute, 58 seconds. If you are not in UTC timezone you'll have to adjust this for your local time
- 64 - is the ttff, time to first fix, in seconds
- 12 - is the # of visible satelites
- 0.548363 - is the speed (in knots)
- 100.442406 - this is the best guess for 'course', e.g. which way you are heading, with 0 being 'north' and 180 being 'south' (we think)

If you want to get the 'raw NMEA' data for some reason, you can do that with **E** - you can send a number from 0-255 indicating which sentences you want emittted.

- 0 for disable output

- +2 for $GPGGA
- +4 for $GPGLL
- +8 for $GPGSA
- +16 for $GPGSV
- +32 for $GPRMC
- +64 for $GPVTG
- +128 for GPZDA

e.g. if you want to see GPRMC and GPGGA, add +32 and +2 = 34 and put in that number. Then you'll see the data stream out at 1Hz

```
COM16 (Arduino Uno)                                                    [Send]

0,4043.570455,7400.310900,90.047409,20130001201290.000,04,12,0.340909,100.442400
FONA> E
GPS NMEA output sentences (0 = off, 34 = RMC+GGA, 255 = all)255 ---> AT+CGPSOUT=255
        <--- OK
FONA> $GPGGA,201449.000,4043.5705,N,07400.2908,W,1,10,0.89,65.9,M,-34.2,M,,*62
$GPGLL,4043.570513,N,7400.290806,W,201449.000,A,A*71
$GPGSA,A,3,11,19,01,13,17,28,04,27,30,07,,,1.19,0.89,0.78*07
$GPGSV,3,1,12,07,67,198,12,11,65,146,44,30,63,289,21,04,52,114,29*77
$GPGSV,3,2,12,19,44,048,34,01,43,154,26,28,34,298,18,27,15,054,32*7C
$GPGSV,3,3,12,13,12,315,26,17,08,238,23,16,02,099,,09,02,203,*71
$GPRMC,201449.000,A,4043.5705,N,07400.2908,W,0.000,101.20,010615,,,A*43
$GPVTG,101.20,T,,M,0.000,N,0.000,K,A*3F
$GPZDA,201449.000,01,06,2015,00,00*5D
$GPGGA,201450.000,4043.5705,N,07400.2908,W,1,10,0.89,65.9,M,-34.2,M,,*6A
$GPGLL,4043.570513,N,7400.290806,W,201450.000,A,A*79
$GPGSA,A,3,11,19,01,13,17,28,04,27,30,07,,,1.19,0.89,0.78*07
$GPGSV,3,1,12,07,67,198,11,11,65,146,44,30,63,289,22,04,52,114,30*7F
$GPGSV,3,2,12,19,44,048,34,01,43,154,26,28,34,298,19,27,15,054,32*7D
$GPGSV,3,3,12,13,12,315,26,17,08,238,23,16,02,099,,09,02,203,*71
$GPRMC,201450.000,A,4043.5705,N,07400.2908,W,0.000,101.20,010615,,,A*4B
$GPVTG,101.20,T,,M,0.000,N,0.000,K,A*3F
$GPZDA,201450.000,01,06,2015,00,00*55
$GPGGA,201451.000,4043.5705,N,07400.2908,W,1,10,0.89,65.9,M,-34.2,M,,*6B
$GPGLL,4043.570513,N,7400.290806,W,201451.000,A,A*78
$GPGSA,A,3,11,19,01,13,17,28,04,27,30,07,,,1.19,0.89,0.78*07
$GPGSV,3,1,12,07,67,198,14,11,65,146,44,30,63,289,23,04,52,114,30*7B
$GPGSV,3,2,12,19,44,048,35,01,43,154,26,28,34,298,19,27,15,054,32*7C
$GPGSV,3,3,12,13,12,315,26,17,08,238,22,16,02,099,,09,02,203,*70
$GPRMC,201451.000,A,4043.5705,N,07400.2908,W,0.000,101.20,010615,,,A*4A
$GPVTG,101.20,T,,M,0.000,N,0.000,K,A*3F
$GPZDA,201451.000,01,06,2015,00,00*54

[ ] Autoscroll                                    [Both NL & CR ▼] [115200 baud ▼]
```

When done, you can type in **E** and **0** instead, which will turn off the output

```
$GPGGA,202929.000,4043.5903,N,07400.3191,W,1,9,1.04,97.4,M,-34.2,M,,*57
$GPRMC,202929.000,A,4043.5903,N,07400.3191,W,0.000,99.45,010615,,,A*79
$GPGGA,202930.000,4043.5903,N,07400.3191,W,1,9,1.04,97.4,M,-34.2,M,,*5F
$GPRMC,202930.000,A,4043.5903,N,07400.3191,W,0.000,99.45,010615,,,A*71
$GPGGA,202931.000,4043.5903,N,07400.3191,W,1,9,1.04,97.4,M,-34.2,M,,*5E
$GPRMC,202931.000,A,4043.5903,N,07400.3191,W,0.000,99.45,010615,,,A*70
$GPGGA,202932.000,4043.5903,N,07400.3191,W,1,9,1.04,97.4,M,-34.2,M,,*5D
$GPRMC,202932.000,A,4043.5903,N,07400.3191,W,0.000,99.45,010615,,,A*73
E
GPS NMEA output sentences (0 = off, 34 = RMC+GGA, 255 = all)0    ---> AT+CGPSOUT=000
         <--- OK
FONA>
```

Autoscroll   Both NL & CR ▾   115200 baud ▾

3G vs FONA 800 & 808

The FONA 3G adds 3G support but since it is a completely different chipset than the FONA 800/808 (Qualcomm not Mediatek) there are some significant differences between the two types of modules.

This is not an exhaustive list!

SMS

SMS's are indexed differently

FONA 800 & 808 start at 1 (one) where as the FONA 3G starts at 0 (zero)

SMS sending extra lines

After sending an SMS using `AT+CMGS` , the FONA 3G returns two sets of CRLF's that do not appear with the FONA 800 or 808.

SMS # query reply is different

If you request the # of SMS's on the SIM module with `AT+CPMS?` the FONA 800 & 808 reply starts with `+CPMS: "SM_P"` whereas the 3G starts with `+CPMS: "ME"`

Voice Calls

The hanging up command is `ATH0` on the FONA 800 and 808 and `ATH` on the FONA 3G. You'll also have to send the FONA 3G a `AT+CVHU=0` command to tell it to listen for the ATH command (it will say 'OK' but not actually hang up)

Misc

Battery voltage measurement with `AT+CBC` returns a 4-digit voltage in mV on the FONA 800 and 808. On the FONA 3G it's a floating point number in volts.

GPS

GSMLOC (location via triangulation of nearest cell towers) is supported by the FONA 800 and 808 but not 3G

Downloads

Datasheets

These are the datasheets for the cell module on the FONA 3G.

- SIM5320 AT Command set manual (http://adafru.it/fTl)
- SIM5320 Hardware Design (http://adafru.it/fTm)
- SIM5320 Specification (http://adafru.it/fTn)
- GPRS / TCP/IP App note (http://adafru.it/fTo)
- SIM5320 USB drivers (http://adafru.it/fTp) (We tried this on windows sucessfully, also looks like there's some sort of linux drivers)

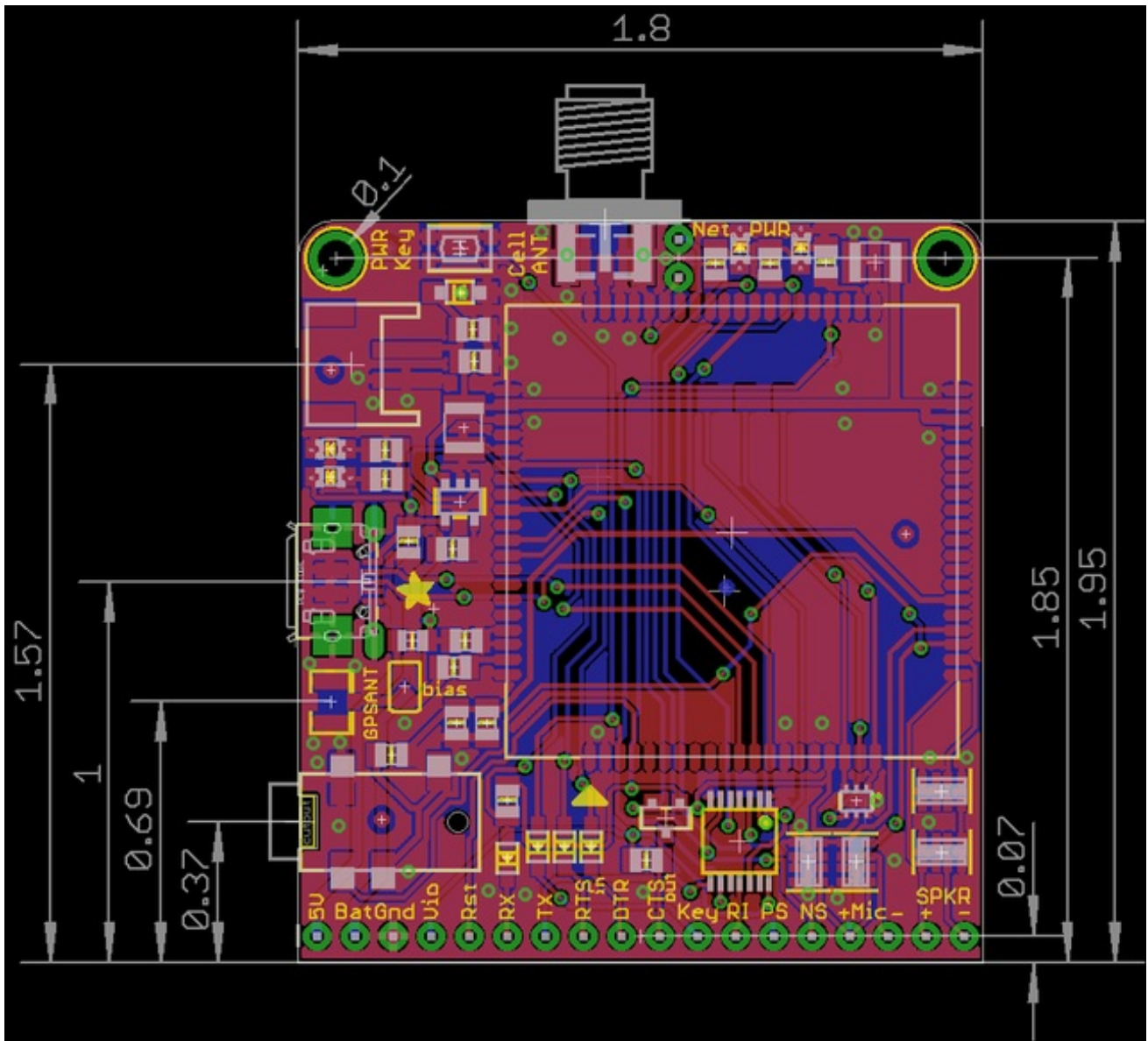Product page at SIMCOM (http://adafru.it/fTq)

Schematic

Click to enlarge
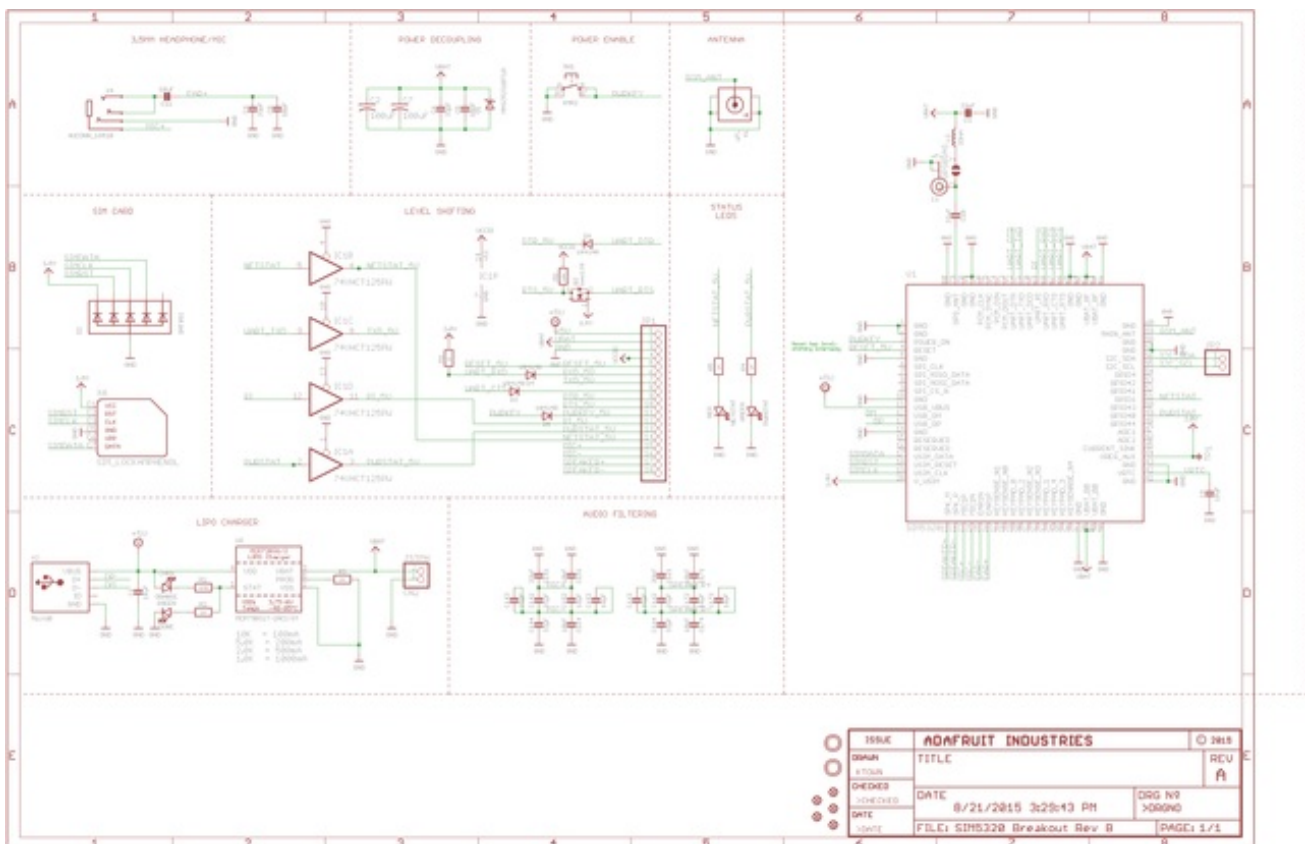
Fabrication Print

Dimensions in inches

F.A.Q.s

Ahh! My FONA was working fine then I sent it some command and its not working right anymore?
You can always factory reset the FONA by sending it the

ATZ

command. If you set an odd fixed baud rate (e.g. you cannot even get an **OK** when you send
AT), a USB serial console cable will be helpful it quickly changing baud rates in your terminal
software to get back to a working AT/OK setup!

I'm using FONA as a voice caller and the other person can't hear me!
Note that you do have to use a compatible headset. Not all CTIA headsets will work, the ones we
have in the shop are known to work (http://adafru.it/fbK) and so do many other Android but
iPhone headsets do not.

You can also use 'external' audio on the FONA (electret mic and speaker soldered to FONA) but
you cannot mix and match. Either you use headset or you use external audio. You cant use
external mic and headset speaker.

You also have to tell the FONA which audio you are using, it does not autodetect. You can use
our library and fona.setAudio() (http://adafru.it/j0e)

Is a Lipo Battery required? Can I run the FONA off of a power supply or just the microUSB port?
The microUSB is only used to charge the battery. Without a battery installed it will flicker on and
off so it cannot be used to power a FONA minus battery.

You *can* power the FONA directly with **3.4V-4.4V** voltage level. Its an odd voltage range (doesn't
cover the common 3.3 or 5V) If you want to do that, apply that voltage to VBat and do not plug
anything into the microUSB port.

Can I charge the battery and use FONA at the same time?
Yes! You can use the Lipoly as sort of a 'backup battery' - keep charging it via MicroUSB during
use. If the MicroUSB loses power, the FONA will keep going.

My FONA won't turn on/respond! Or it acts flakey and auto-shuts off sometimes!
We've noticed a lot of problems that are 'weird' that are a results of using batteries with the
wrong polarity.

All batteries from adafruit have the right wire colors/polarity for the FONA

**Batteries not from Adafruit are not guaranteed to have the right pinout! Using the wrong
pinout may damage the FONA and/or make it act 'odd'!**

FONA 800/808 requires a 2G SIM, does it work with a dual 2G-3G SIM?
  That will work fine, as long as the SIM can register to the 2G network at all, it is acceptable to use

Are you sure I can't use ATT for 2G service? I'm in a T-Mobile cold spot
  The AT&T GSM network is going to be live until January 2017. If you're reading this and it's 2017, you're outta luck. If not, you can try to get an AT&T SIM activated to the 2G GSM network but its not going to do that by default. You'll have to call up or talk to an AT&T rep and it may not go so well because they really don't want people to use their GSM network.

  You can also call up T-Mobile and say you can't get connected consistently - they may send you a free signal booster (http://adafru.it/dHk)

How long can FONA last on my battery?
  We haven't done extensive testing with FONA but from preliminary reports, the FONA draws about 20-25mA while running, up to 200mA+ while actually making a call/sending/receiving data, and has very small spikes of up to 2A. The spikes are short and are absorbed by the onboard capacitors.

  A 1200mAh battery can run the FONA on 'standby' for a day or two.

How do I set the Real Time Clock on the FONA SIM?
  Please see this forum post (http://adafru.it/aP1)!

I'm using a FONA 808 and the GPS commands aren't working
  The FONA 808 has two versions, due to a revision of the module itself. Version 1 has two barcodes on the front and is part #S2-10606-Z1F0**1**. Version 2 has a QR code on the front and is part #S2-10606-Z1F0**2**. V2 has a newer/better chipset (MT3337 instead of MT3336) but the commandset has changed. Which is annoying but adaptable!

  If you are using V1, use this GPS command document for how to interact with the GPS subsystem (http://adafru.it/fhm)

  If you are using V2, use this GNSS command document instead. (http://adafru.it/fVN)

On a FONA 3G I cant seem to read the SMS messages
  We're not sure exactly why you need to tell the FONA3G to look on the SIM specifically, but its easy to set up. In Adafruit_FONA.h uncomment

```
//#define FONA_PREF_SMS_STORAGE "SM"
```

  Then recompile and upload

I'm trying to reset the FONA with my microcontroller/computer and pulling the RESET pin low via a GPIO isnt working?

There's a superfluous level shifting diode that we put on the FONA and FONA 808 breakouts - it turns out it isn't necessary and for microcontrollers with weaker outputs it can keep the FONA from resetting.

You can 'bridge' this diode with a piece of wire, its perfectly safe and may give you a little more headroom. There's already level shifting inside the modules so there's no risk to this mod.

Simply solder a small wire between the two pads, or remove the diode and replace with a 0 ohm resistor or wire.