



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



□

## Adafruit FONA 3G Cellular + GPS Breakout

Created by lady ada



Last updated on 2017-01-05 06:10:15 PM UTC

## Guide Contents

Guide Contents	2
Overview	4
Obtaining a SIM	9
Some suggestions from FONA users!	10
Pinouts	12
Connectors	12
Antenna ports	13
SIM Connector (on Back)	14
Bottom Breakouts	14
LEDs	16
Assembly	17
Prepare the header strip:	17
Add the breakout board:	18
And Solder!	19
Attaching Antenna & Battery	20
SIM Card	21
Direct USB Connection	24
Arduino Wiring	28
Wire up	28
Arduino Test	30
Download Adafruit_FONA	30
FONA 3G Baud Adjustment	30
Load Demo	30
Using the Test Sketch	34
Hardware Test	36
Battery voltage	36
Check SIM CCID	36
Network Test	38
Check RSSI (network signal strength)	38
Checking Network Registration	38
Audio Settings & Test	40

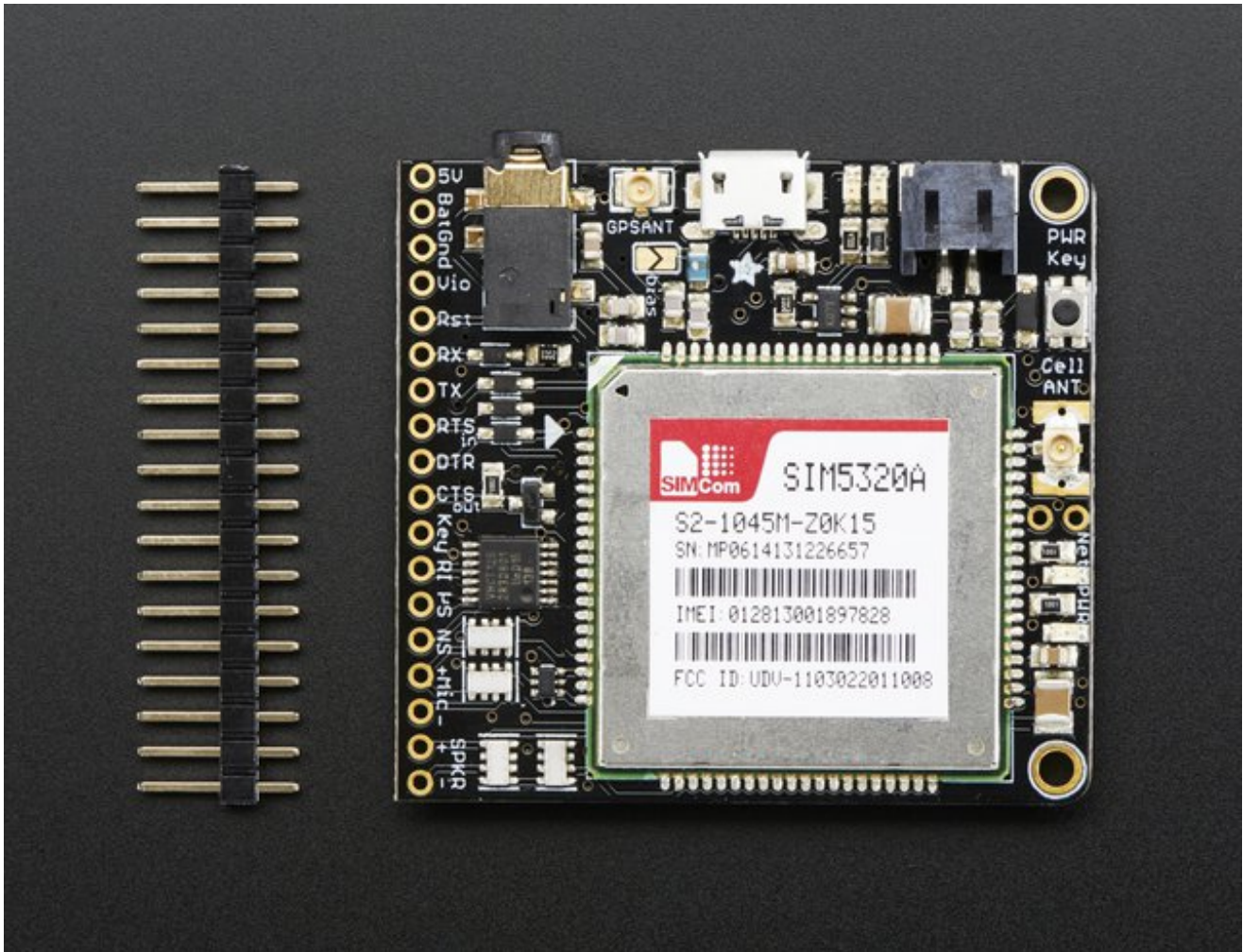


Set and Get audio volume	40
Setting Headset or External audio	40
Playing Toolkit Tones	41
Phone Calls	42
Make Phone Calls	42
SMS	43
Send and Read SMS	43
3G vs FONIA 800 & 808	47
SMS	47
SMS's are indexed differently	47
SMS sending extra lines	47
SMS # query reply is different	47
Voice Calls	47
Misc	47
GPS	48
Downloads	49
Datasheets & Files	49
Schematic	49
Fabrication Print	50
F.A.Q.s	52
FONA 3G Tips	57
Large file transfer	57
AT&T vs T-Mobile 3G	57
Usage In Australia	57

# 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.

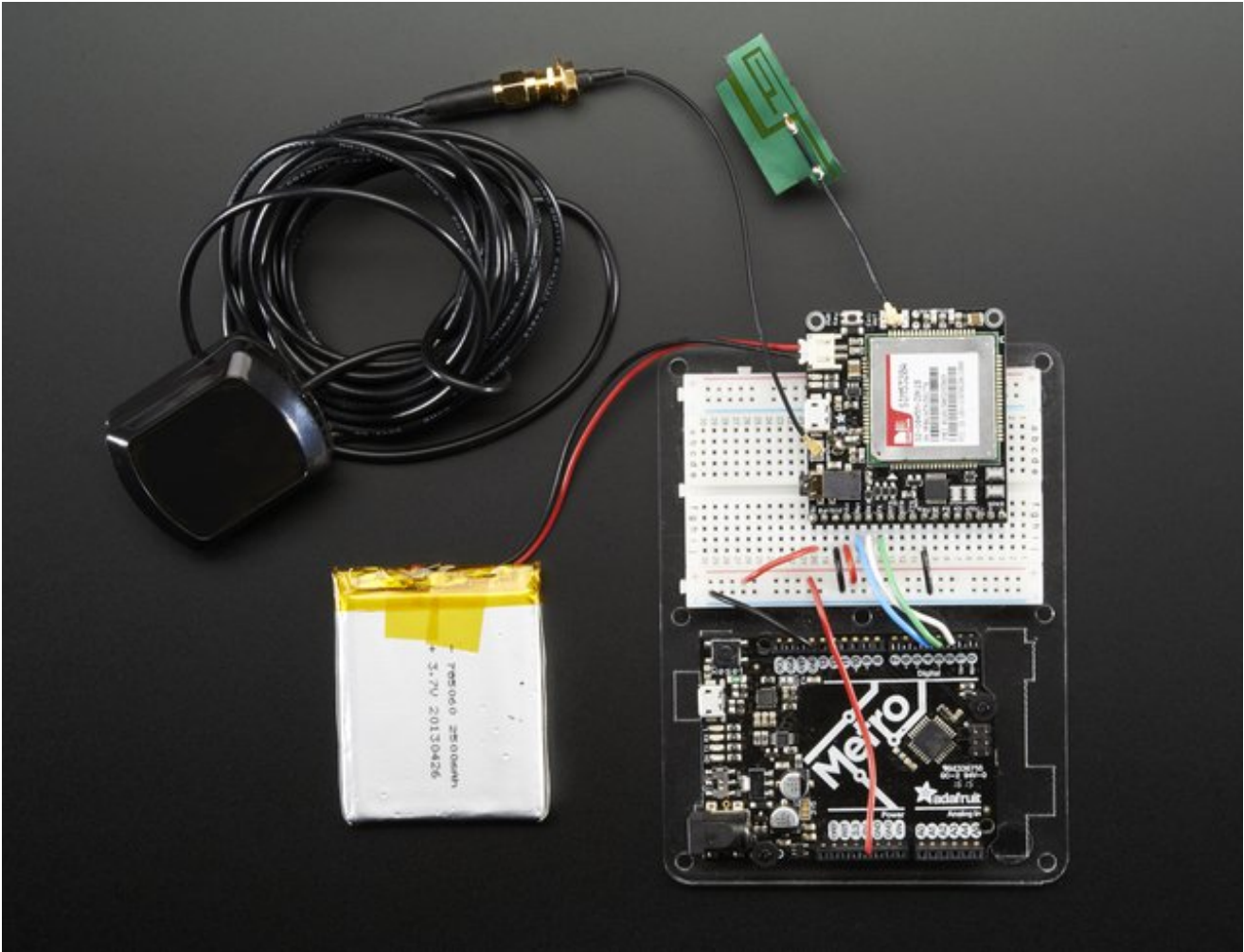


This module measure only 1.75"x1.6" but packs a surprising amount of technology into it's little frame. At the heart is a powerfull GSM cellular module (we use the latest SIM5320) with integrated GPS. This module can do just about everything

- 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)



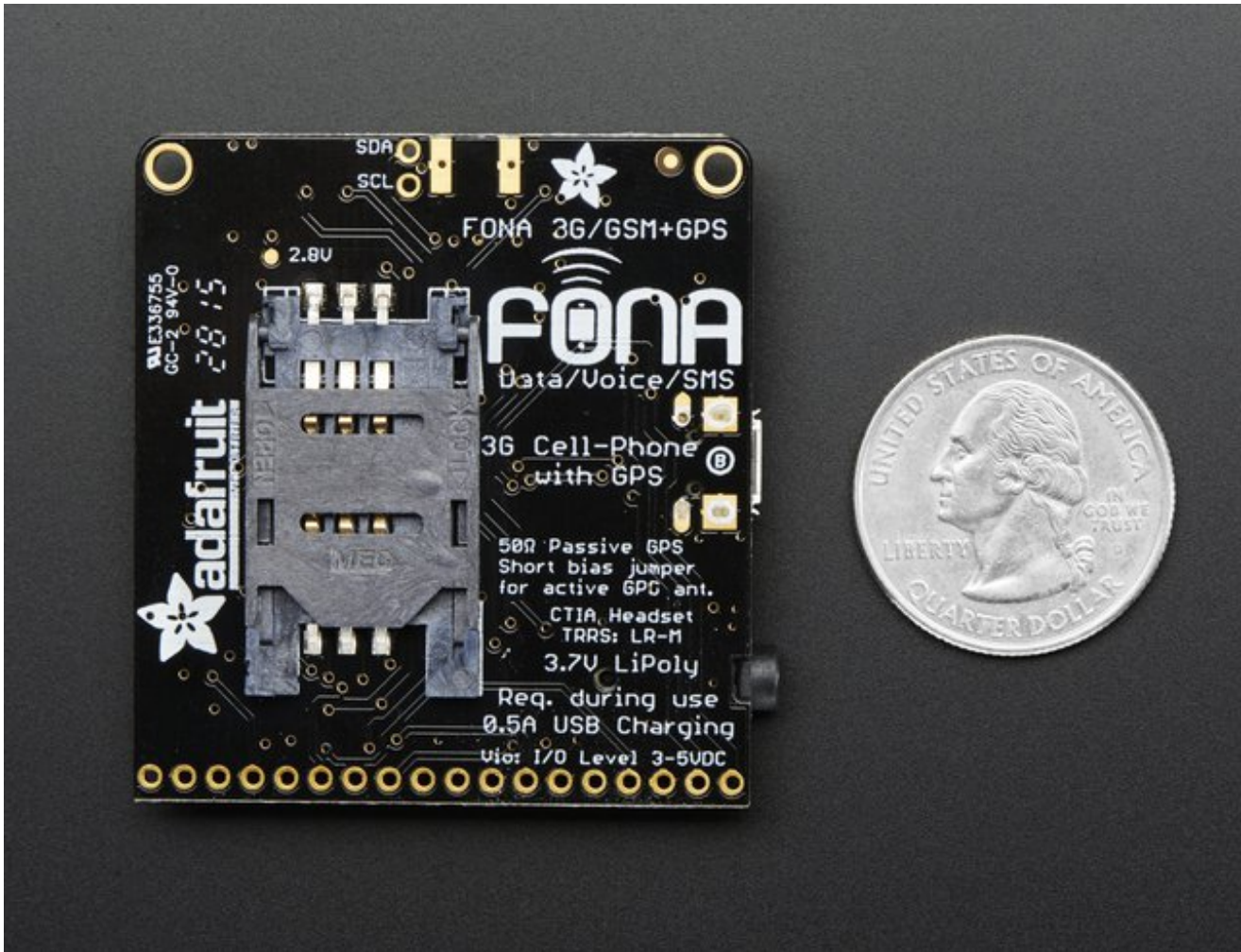
Here's the GPS specifications:

- 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)(<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 \(http://adafru.it/fTt\).](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 Lilon 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. \(http://adafru.it/fbO\)](http://adafru.it/fbO)
- **Lipoly Battery** - 500mAh or larger! [This 1200mAh \(http://adafru.it/258\)](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 \(http://adafru.it/fbL\)](http://adafru.it/fbL).
- (or, if you want to us an **SMA antenna**- [a uFL to SMA adapter cable. \(http://adafru.it/851\)](http://adafru.it/851))
- **External Active GPS Antenna** (needs a uFL to SMA adapter too) - [like this one! \(http://adafru.it/fTs\)](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 FONAs 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!

**The FONAs 800 and 808's use a 2G SIM only. Make sure you're using a SIM that can do 2G.** In the USA, that's a T-Mobile or reseller

**The FONAs 3G can use either 2G or 3G. These modules will only work with AT&T in 3G mode.** Unfortunately, AT&T is deprecating its 2G network, so you will only be able to use this module in 3G mode with AT&T. If you want to use it with 2G, use T-Mobile

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 \(http://adafru.it/dEi\)](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 it's all prepaid **-tdicola**
- Just want to let the Adafruit team know that it is possible to get pre-paid minutes on T-Mobile and it's a pretty good deal. [I was paying \\$100 for 1000 minutes \(10c a minute 20 a sms\) over the course of the year. \(http://adafru.it/dEj\)](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. \(http://adafru.it/dEk\)](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/tdt) (<http://adafru.it/tdt>) 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 \(http://adafru.it/drL\)](http://adafru.it/drL) or [1200mAh \(http://adafru.it/258\)](http://adafru.it/258) batteries. [You can also connect a JST cable here if you have other plans. \(http://adafru.it/261\)](http://adafru.it/261)
- **MicroUSB connector** - this is the LiPoly/Lilon 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. \(http://adafru.it/fbK\)](http://adafru.it/fbK) We tried about 10 different ones, and basically the more expensive ones 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.

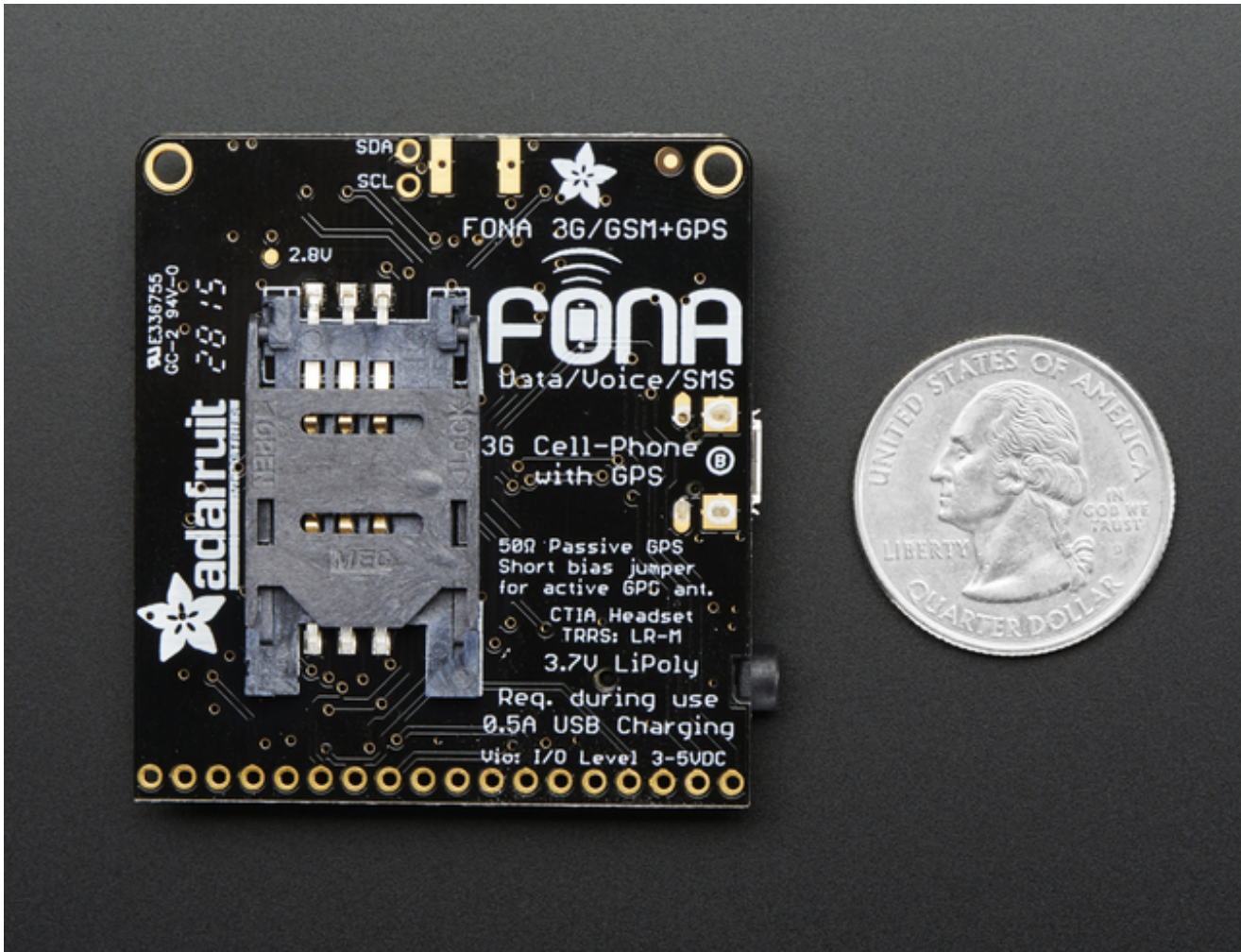
## Antenna ports

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 \(http://adafru.it/fbL\)](http://adafru.it/fbL), or use a [uFL to SMA adapter \(http://adafru.it/fbM\)](http://adafru.it/fbM) and [then an SMA antenna \(http://adafru.it/fbN\)](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 \(http://adafru.it/fTs\)](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) (<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 **Power Status** 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 **Network Status** 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.
- **RTS<sub>in</sub>** - 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
- **CTS<sub>out</sub>** - 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

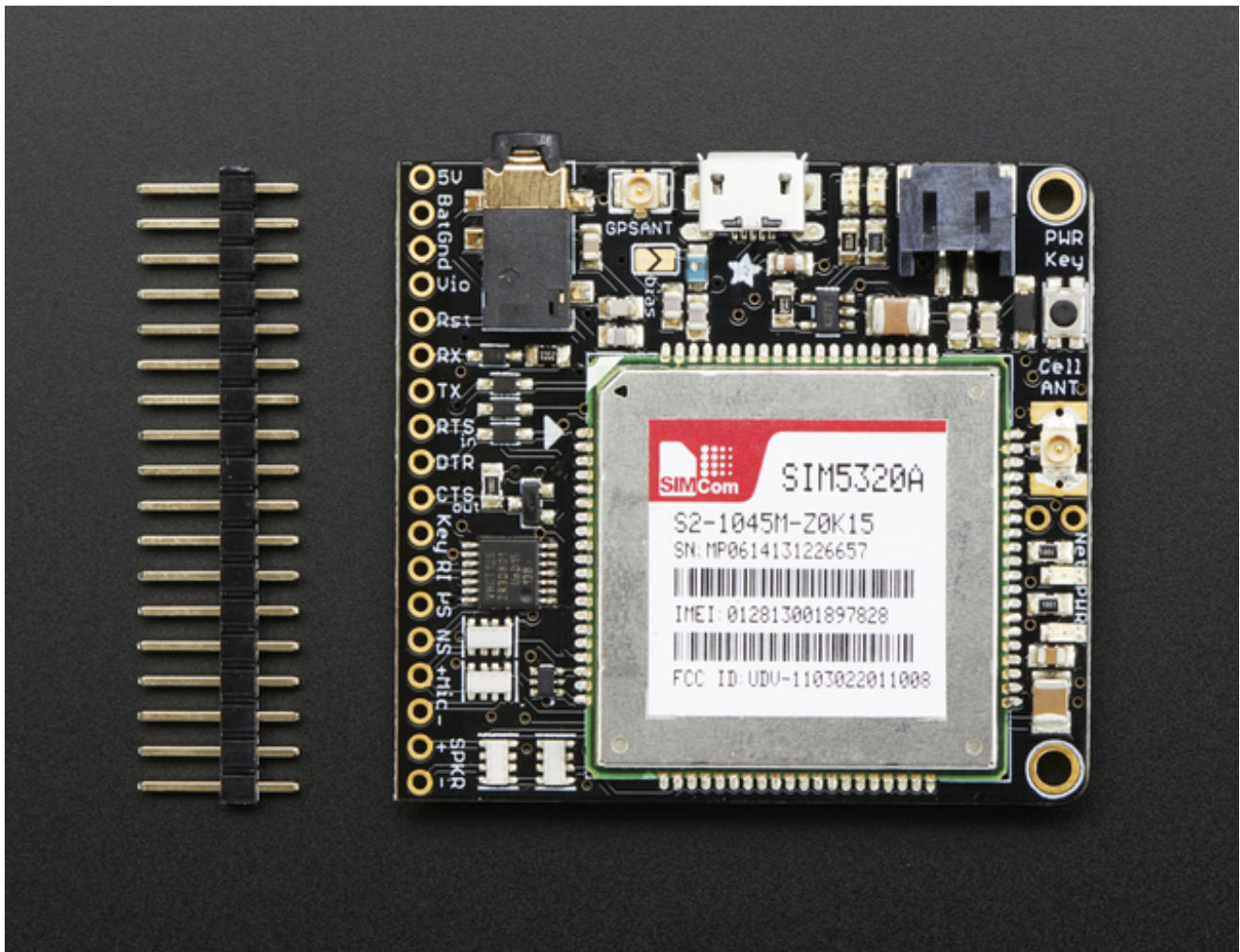
- **DTR** - this is a hardware flow control pin, it can be used with the FONA 3G to hang up calls, control data/command mode for TCP/IP, ec.
- **RI** - this is the **R**ing Indicator. It is basically the 'interrupt' out pin from the module. It is by default high and can be configured to go low when a 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

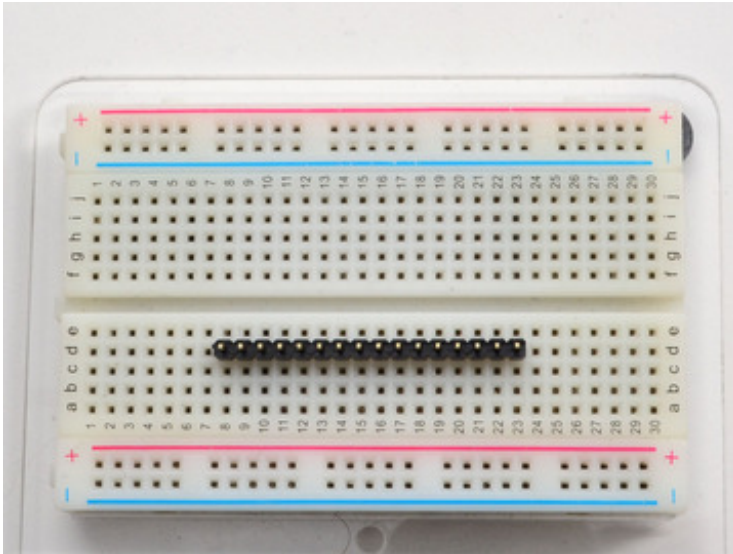


# Assembly

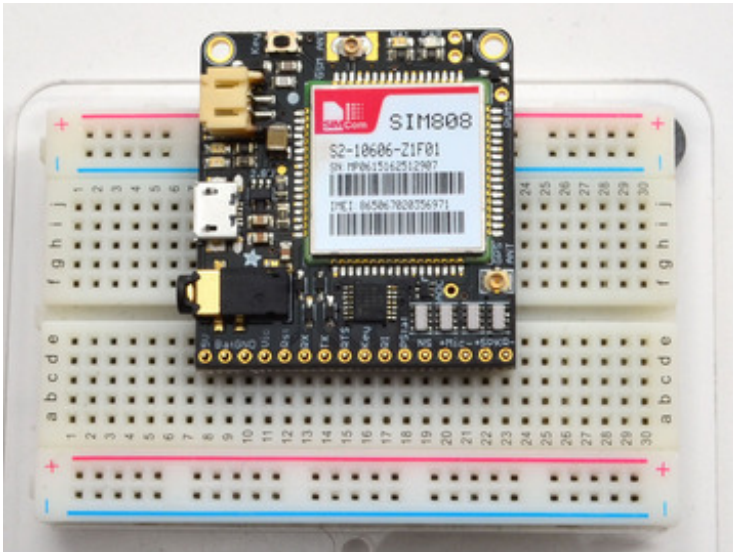


These photos show a FONA 808 but the overall techniques are identical!

**Prepare the header strip:**



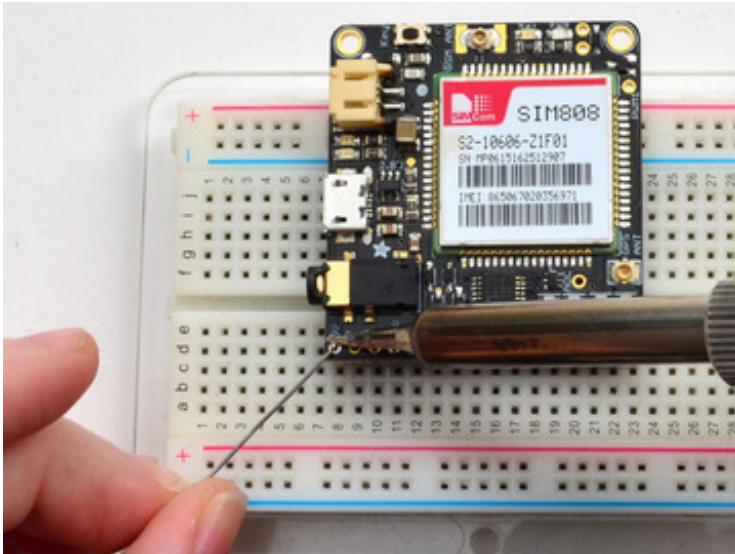
Cut the strip to length if necessary. It will be easier to solder if you insert it into a breadboard - **long pins down**



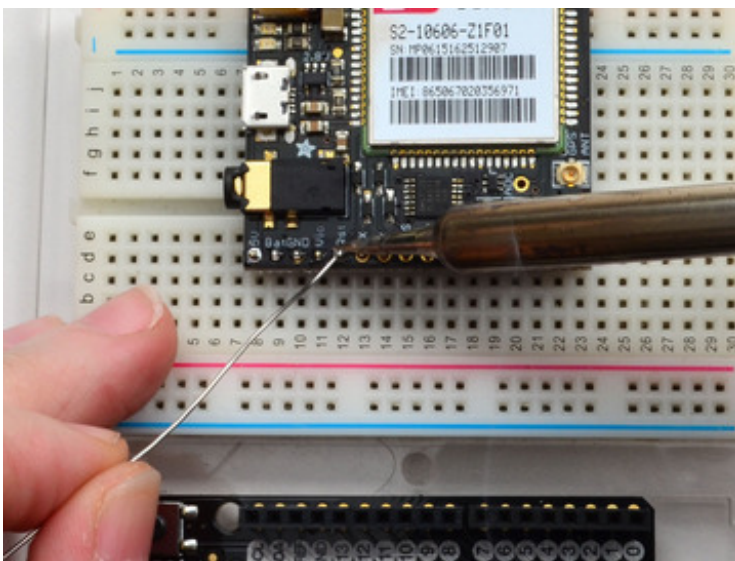
**Add the breakout board:**

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

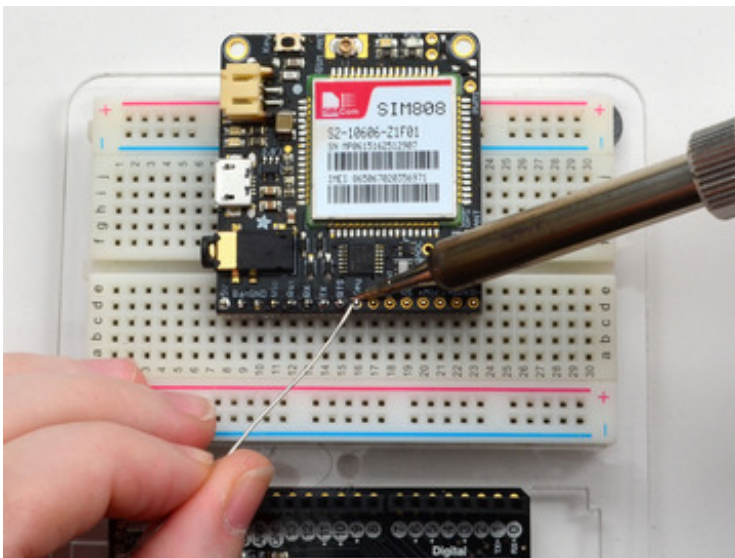




•



•



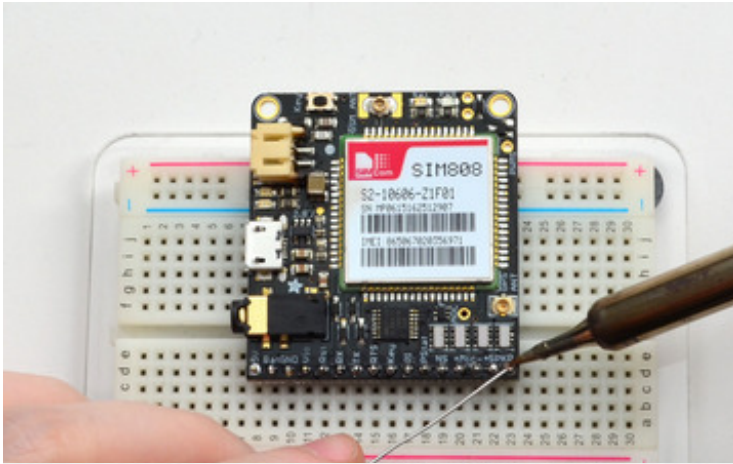
•

## 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://adafruit.it/aTk) (<http://adafruit.it/aTk>)).*



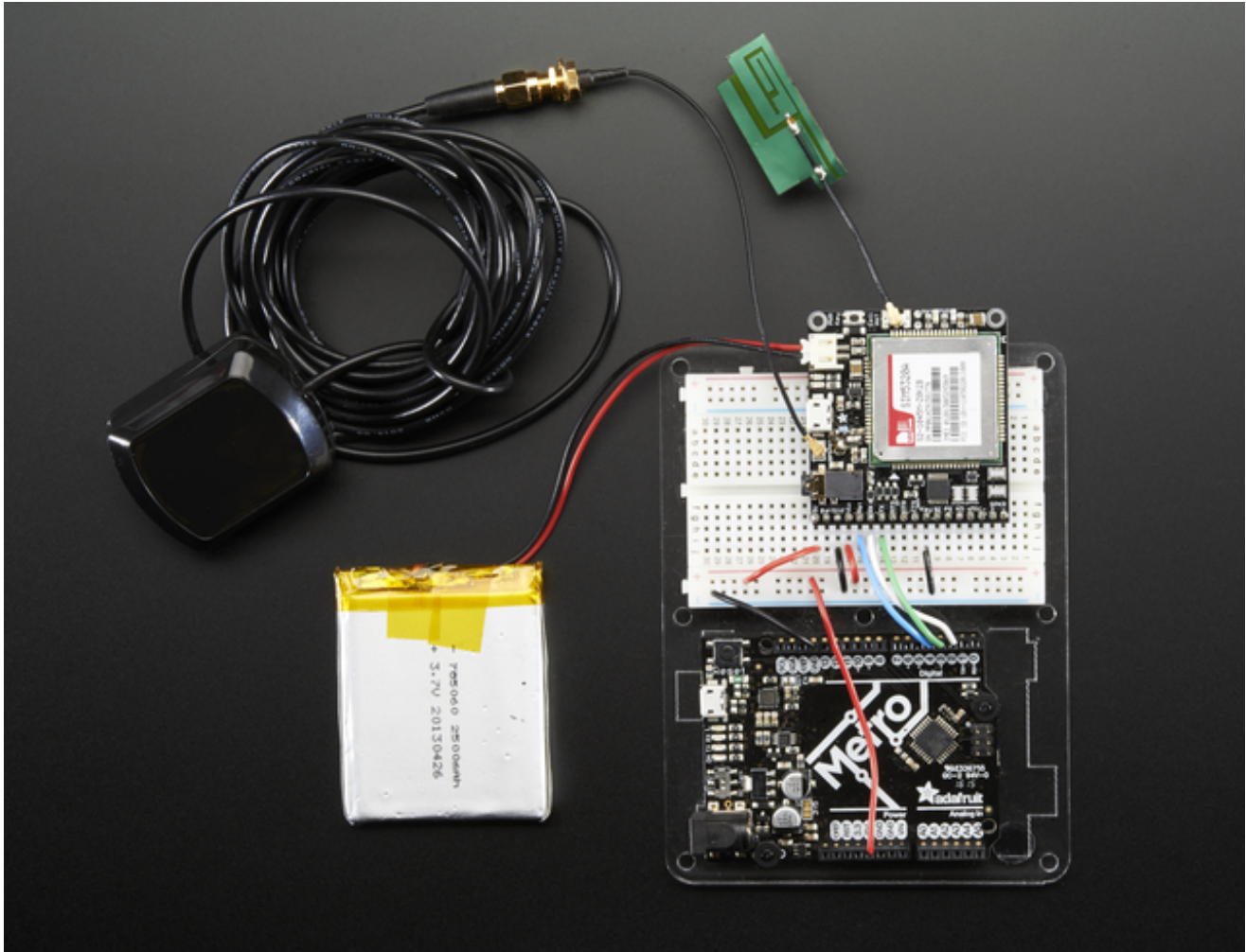


You're done! Check your solder joints visually and continue onto the next steps

## Attaching Antenna & Battery

A battery, GPS antenna and GSM antenna is required! Use any Lipoly or Lilon 3.7V/4.2V

battery



**Check polarity for the battery!**

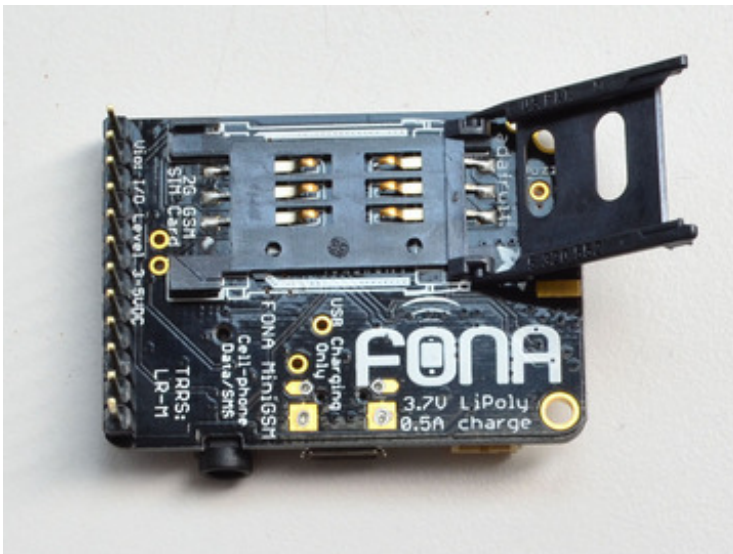
Snap the uFL connector on, it will click when placed properly

## 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!



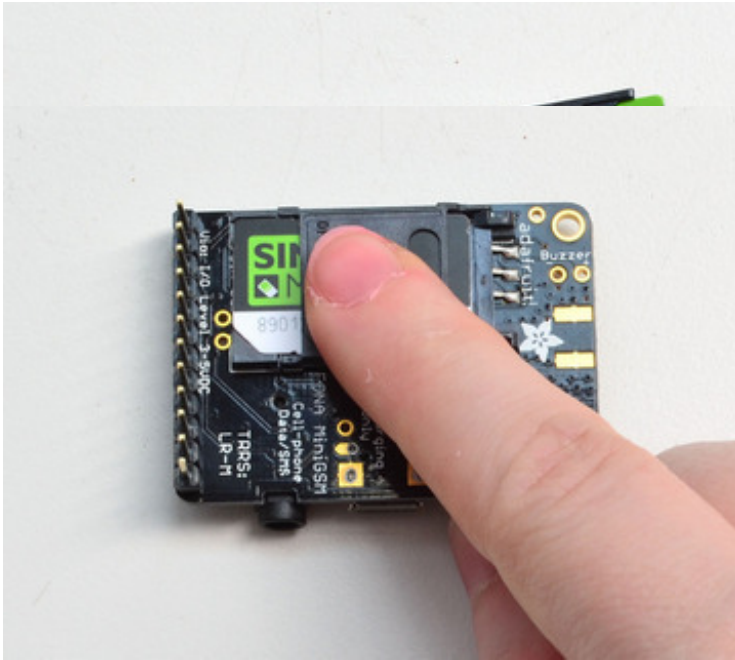
The SIM card holder is on the back. It holds a very-standard "Mini SIM"  
 Micro SIMs will not work! Make sure you get a "Mini SIM"



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 in place

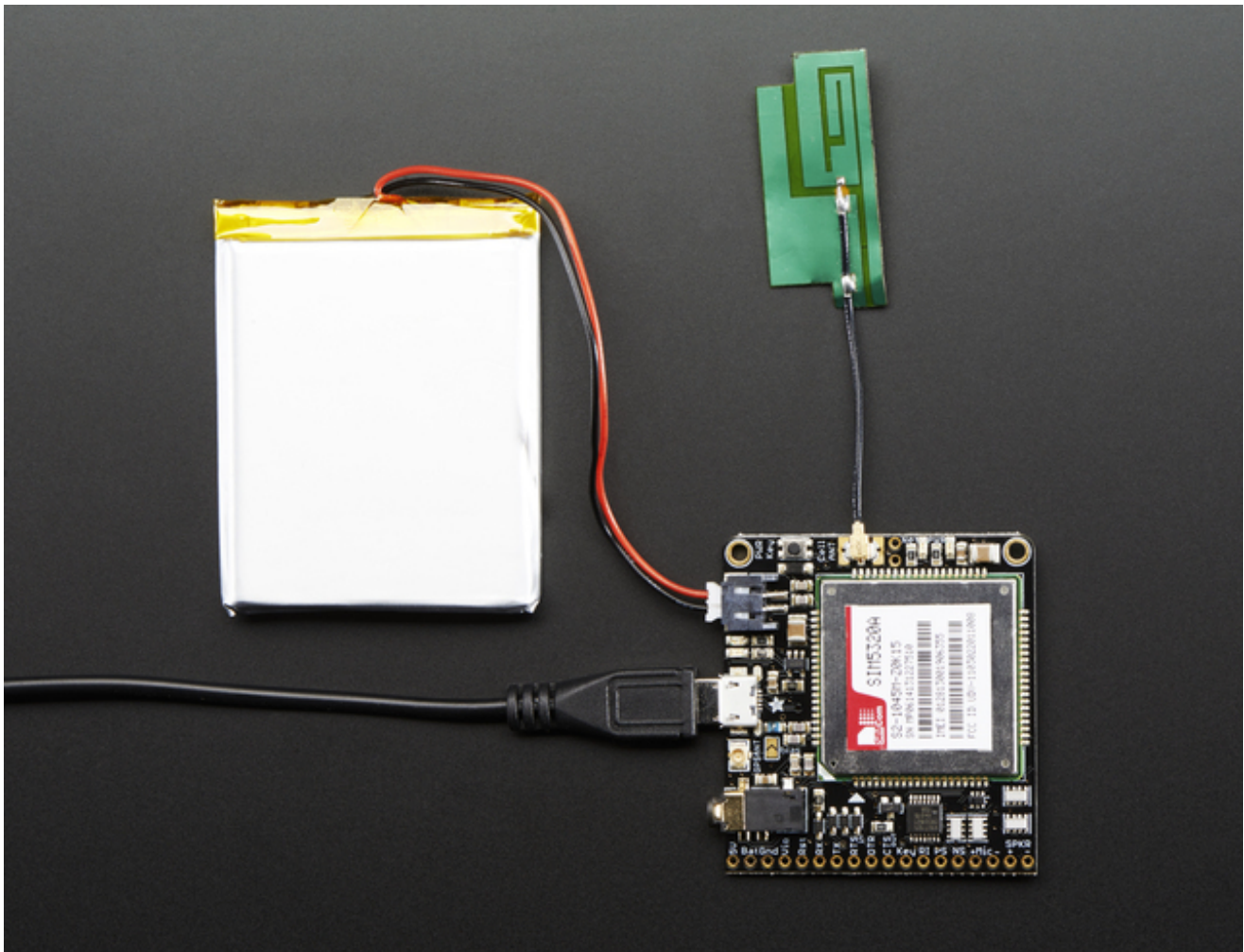
- 
-

# 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!**

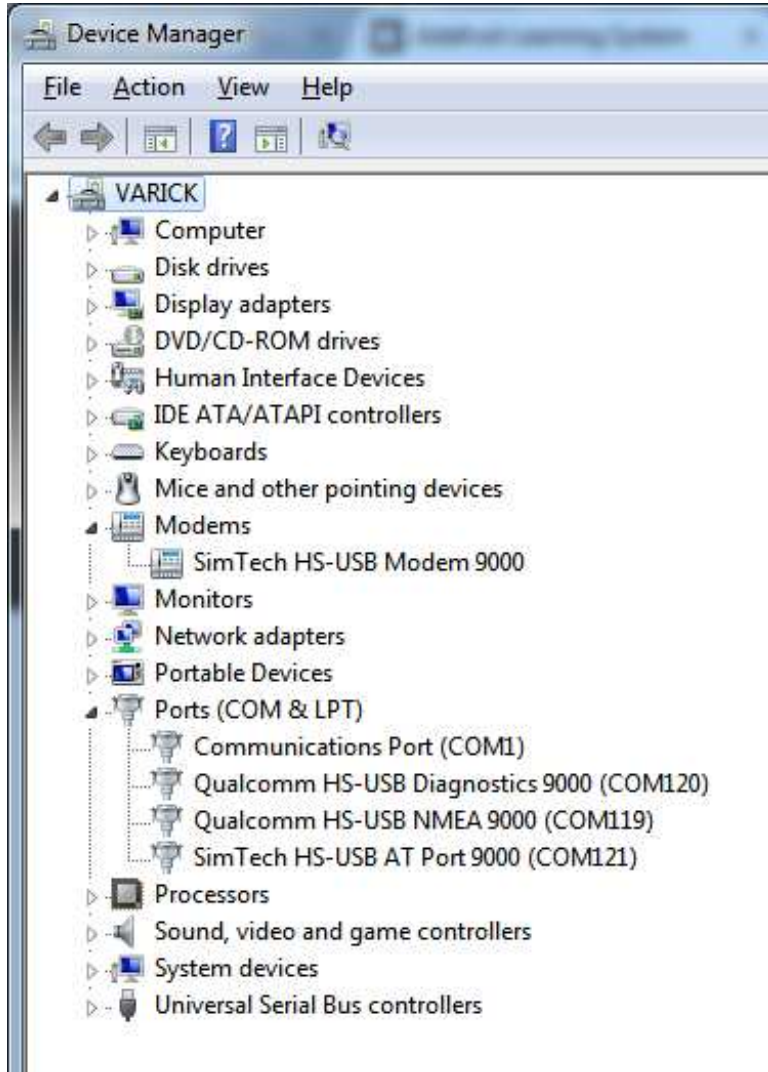
Insert the SIM card, connect the antenna(s) and plug in the micro USB cable from your computer to the FONA 3G



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 \(http://adafru.it/jFn\)](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