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Adafruit FONA

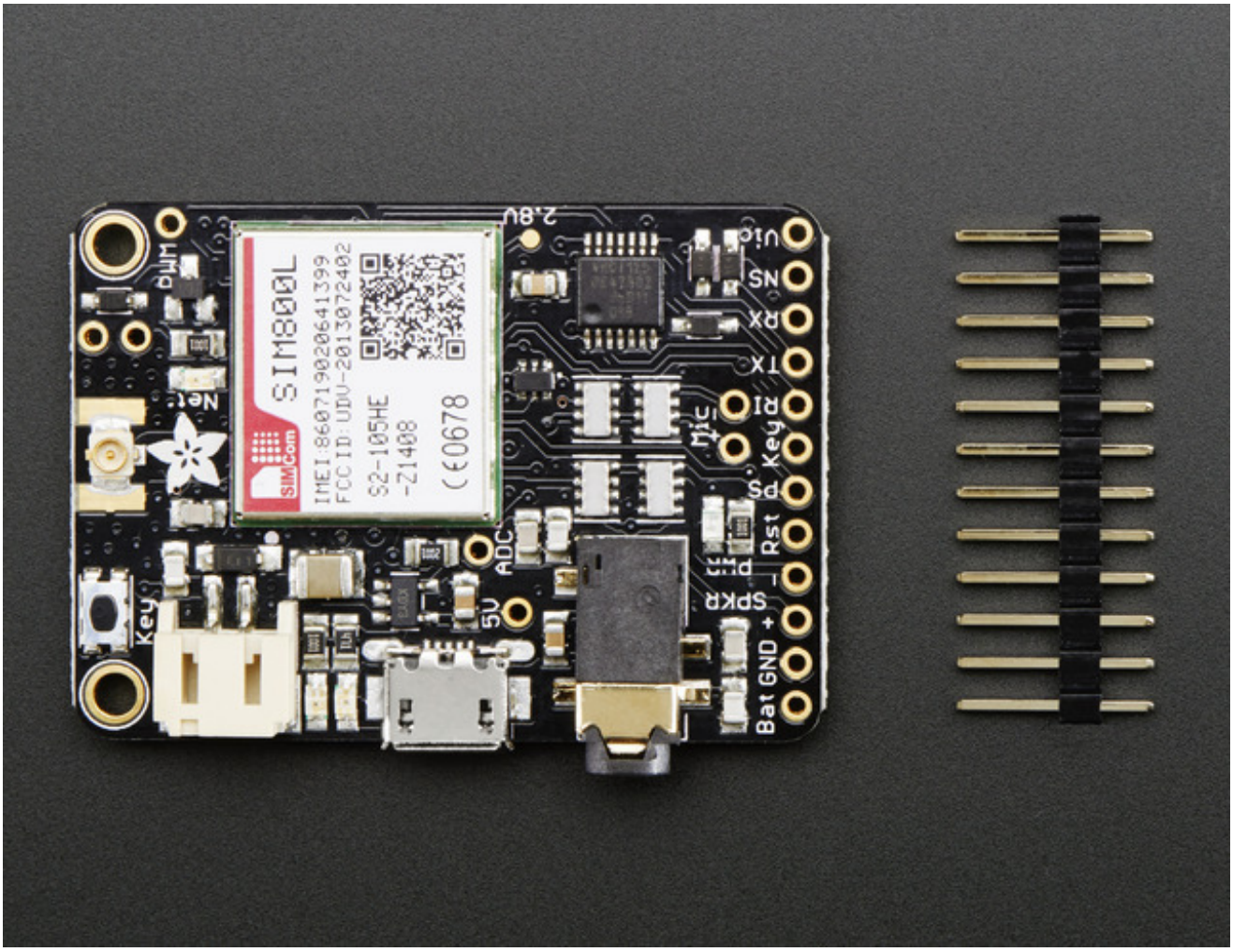
Created by lady ada

Last updated on 2017-04-27 05:36:19 PM UTC

Guide Contents

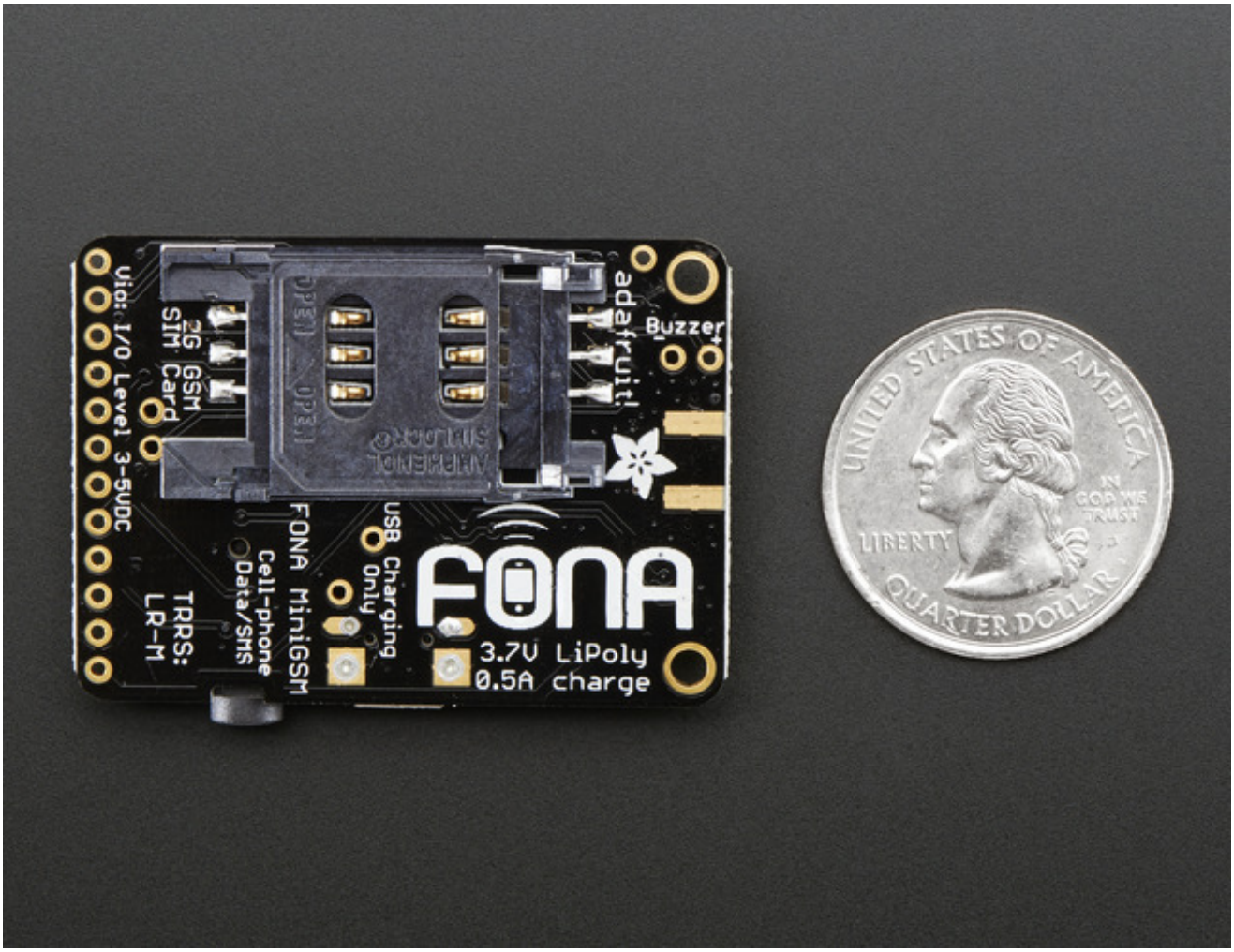
Overview

Ring, Ring! Who's that callin'? It's your breadboard! Introducing Adafruit FONA MiniGSM, an adorable all-in-one cellular phone module that lets you add voice, text, SMS and data to your project in an adorable little package.



This module measures only 1.75"x1.25" but packs a surprising amount of technology into it's little frame. At the heart is a GSM cellular module (we use the latest SIM800) the size of a postage stamp. This module can do just about everything

- Quad-band 850/900/1800/1900MHz - connect onto any global GSM network with any 2G SIM (in the USA, T-Mobile is suggested)
- 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.)
- Scan and receive FM radio broadcasts (yeah, we don't exactly know why this was included but it works really well)
- PWM/Buzzer vibrational motor control
- AT command interface with "auto baud" detection



Sounds delicious, right? So we plated 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.
- Vibrational motor (buzzer) driver so you can have noiseless notifications
- uFL or SMA connections for external antenna
- Indicator LEDs for power and network connectivity
- Standard SIM slides into the back

This is our Release Candidate for hackers and advanced makers. We're still adding library support for all the various things the FONA can do but there may be updates as FONA is used around the world!

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 accessories to make FONA work.**These are not included!**

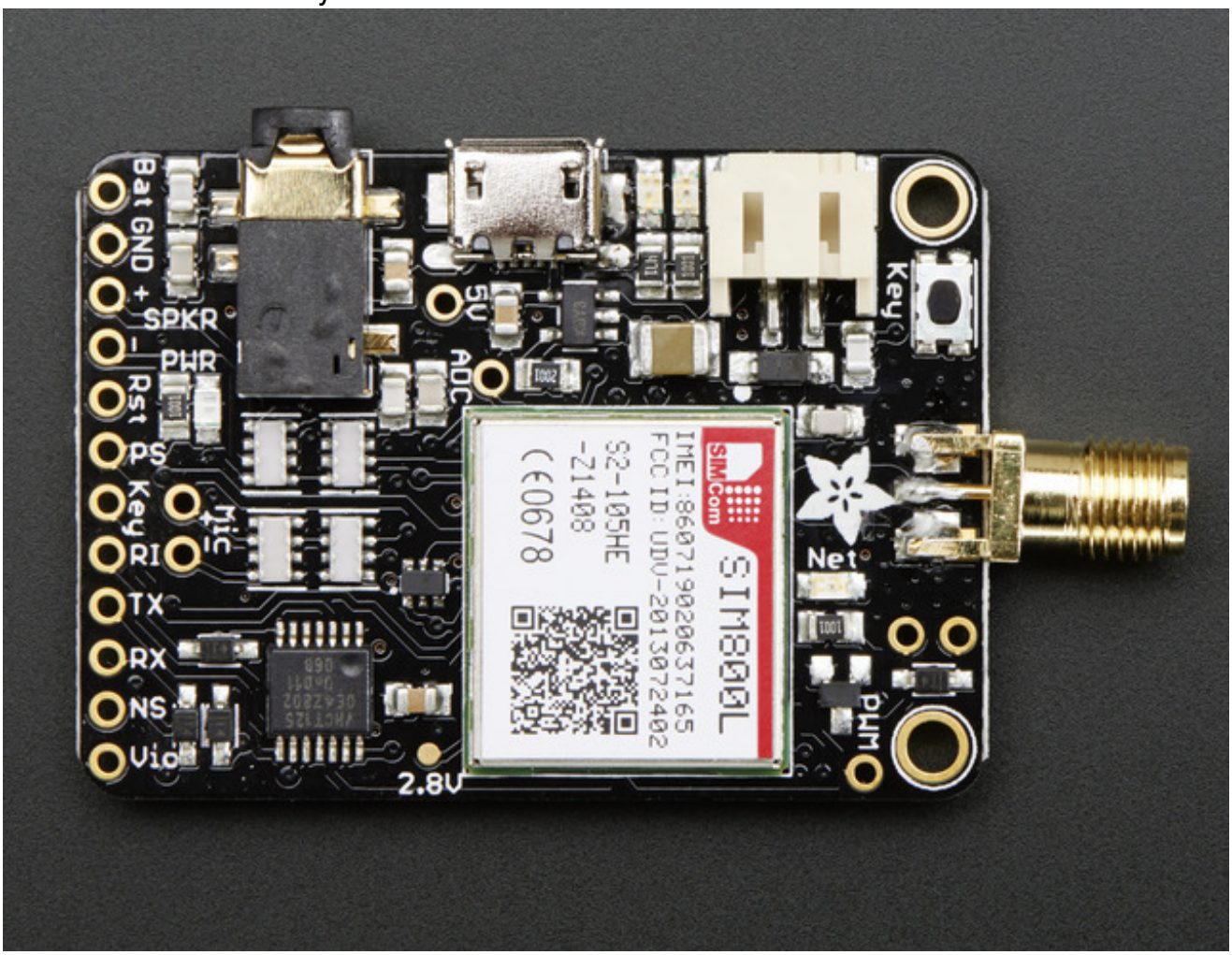
- **SIM Card!** A 2G Mini SIM card is required to do anything on the cellular network. US AT&T no longer sells 2G SIMs and will shut off their 2G network, so for American customers we recommend any T-Mobile or reseller (SIMPLE mobile, etc) that uses the T-Mobile network.
- **Lipoly Battery** - 500mAh or larger! This 500mAh (http://adafru.it/drL)battery, or this 1200mAh (http://adafru.it/258) will work great.
- **MicroUSB cable** for charging the battery.
- **External Antenna** - this straight one (http://adafru.it/1859) or this right-angle one will work well (http://adafru.it/1858).
- **If you have the FONA with uFL connector**- a uFL to SMA adapter cable. (http://adafru.it/851)

There's also some recommended accessories. They are not required but chances are you'll want them!

- **TRRS 4-Pole Headset** - 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.
- **External Mic & Speaker** - If you want to talk directly to your FONA,an electret mic (http://adafru.it/dDa) and mini 8 ohm speaker (http://adafru.it/dDb) will do quite nicely.
- **Vibrating motor** - the FONA can drive this directly,just solder a mini vibrating motor disc in! (http://adafru.it/dDc)
- **USB console cable** - the microUSB connector is for chargingonly, but you can wire up a console cable for direct-connection to the module (http://adafru.it/dDd)if you want to send commands from a terminal (great for testing and tweaking)

Pinouts

There's a lot packed into the FONA MiniGSM, 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. See the cable photo for polarity, red is + and black is gnd. (http://adafru.it/261)

- **MicroUSB connector** - this is the LiPoly/LiIon battery charging port. The SIM800 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.

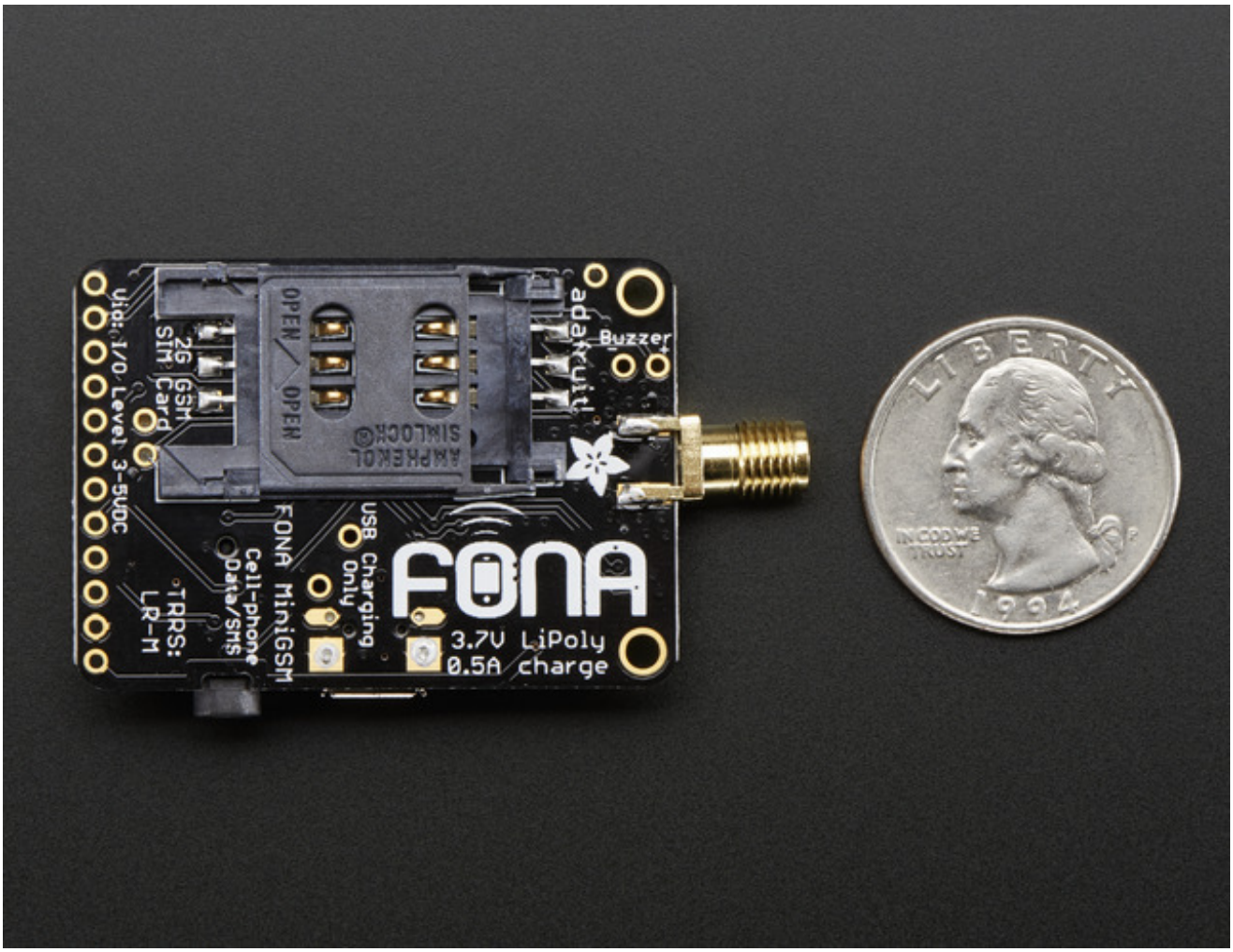
Antenna port

Up top is the place where you can plug in your antenna.**An antenna is required to use**

the module for any kind of voice or data communications as well as some SIM commands!

We have both SMA and uFL versions. 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)

If you have an SMA version, you can connect an SMA antenna directly (http://adafru.it/fbN). We suggest a quad band GSM/GPRS antenna, but if you're savvy and know what frequencies are used in your area you can get a single or dual band antenna that's just for your required frequency



SIM Connector (on Back)

A 2G Mini SIM card is **required** to use the module. Nearly any cell phone shop can sell you a SIM card. It must be a 2G GSM card. AT&T in the US does not sell these anymore! They

are shutting down their GSM network, and only T-mobile sells and supports a GSM network. If you are in another country, chances are you can just ask for a GSM 2G 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.
- **VBAT & GND** - these are the same pins as the 2-pin JST connector. Connect to a 3.7V/4.2V Lipoly/LiIon battery. Do not power from a power supply or LDO. Use only a battery, at least 500mA, 1000mAh+ is best since there can be 2A spikes of current
- **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 2 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 2 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
- **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 pulses 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.
- **RI** - this is the **R**ing **I**ndicator. It is basically the 'interrupt' out pin from the module. It is by default high and will pulse low for 120ms when a call is received. It can also be configured to pulse when an SMS is received.
- **SPK+ and -** : This is for connecting an external 8 ohm speaker, max 1W. You can configure the module to route calls and FM radio to the headset *or* the external audio. 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** - Blue! Lit when the module is booted and running
- **NET** - Red! You can use this for checking the current state without sending an AT command:
  64ms on, 800ms off - the module is running but hasn't made connection to the cellular network yet
  64ms on, 3 seconds off - the module has made contact with the cellular network and can send/receive voice and SMS
  64ms on, 300ms 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

Other Breakout Pins

We scattered a few other breakouts around the board.

- **Buzzer and PWM** (Top right) - These are tied to the PWM output of the module! The PWM capability is quite nice, it can set any frequency and duty cycle. The **PWM** pin is directly output from the module and is 0-2.8Vpp. The **Buzzer** output has a NPN drive transistor so it can run a small vibration motor. Bz+ is the VBat voltage, Bz- is toggled on and off to ground.
- **ADC** (left middle) - the SIM800 has an ADC that can read 0-2.8VDC from this pin, referenced to ground. It also has an internal battery ADC so you can use this for a sensor or something. You can query the voltage from the UART. 2.8V max, people!
- **5V** (left middle) - 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.
- **2.8V test point** - We have a test point for the 2.8V internal regulator, its off to the right.

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 Mini SIM card is **required** to use the module. Nearly any cell phone shop can sell you a SIM card. It must be a 2G GSM card. AT&T in the US does not sell these anymore! They are shutting down their GSM network, and only T-mobile sells and supports a GSM network. If you are in another country, chances are you can just ask for a GSM 2G card.

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.

The only thing to watch for is you need to have a 2G GSM-compatible SIM

In the US, AT&T no longer sells 2G SIMs! We suggest T-Mobile or T-Mobile "distributors" If you have an *older* AT&T SIM it *may* work. AT&T announced in 2012 that they would shut down their 2G network January 1, 2017. The vast majority of M2M (machine-to-machine) cellular devices use GSM, so the 5 year lead time was to give people plenty of time to migrate from AT&T.

You can read an interesting whitepaper from Aeris about this below:
AT&T 2G GSM Network Sunset Whitepaper
http://adafru.it/dEh

T-Mobile & TING

T-Mobile does not have any announcement that they will sunset GSM. We can't speak for them but we expect at least 5 years warning as well, probably they will never fully sunset since there's millions of machines with GSM connectivity.

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

If you don't want to use TING, there are dozens of T-Mobile resellers such as Walmart, SIMPLEMOBILE, etc! Just ask the seller if its AT&T or T-Mobile network. If they get cagey just say your apartment has no AT&T coverage.

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 GSM phone and it's at home.

Some suggestions from FONA users!

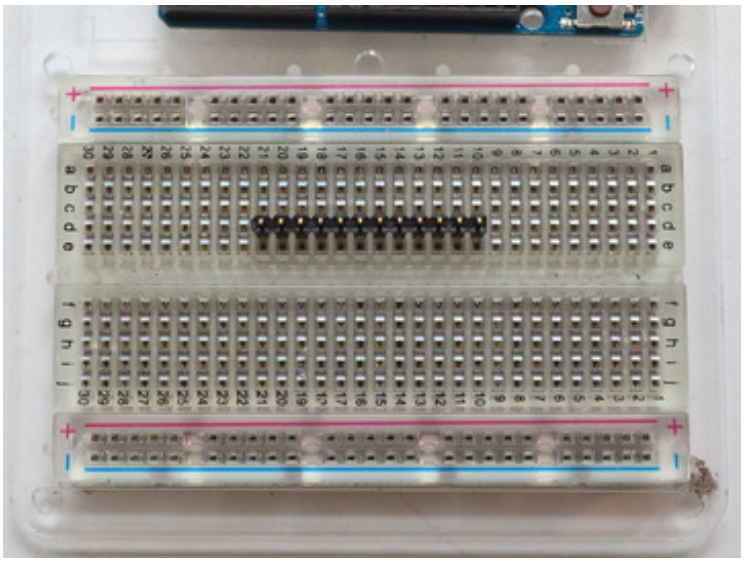
- I've had good luck using the FONA with a SIM from Walmart.Their 'Walmart Family Mobile' is a T-mobile reseller and you can pick up the SIM starter in store pretty easily (http://adafru.it/dEi). The service isn't the cheapest, it's $25 for the SIM and $30/month for unlimited talk+text or $40/month for 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/vQA) for example, you can choose data, voice/sms or a combination for a pretty low price!
- Hi, just a update to let you know I have just begun to use the Fona, SIM from ROGERS, which is 2G, 3G, ang 4G. I pulled my sim out of my phone, and it works well. So if you have Canadians that want to use that product, let them know it works on the west coast ! You can go to Rogers website and see the coverage map and services. **- Steve C**

We haven't tried all of these SIMs so you may need to try it out. For other countries, GSM is very common so you should be able to buy a SIM from any cell phone store.

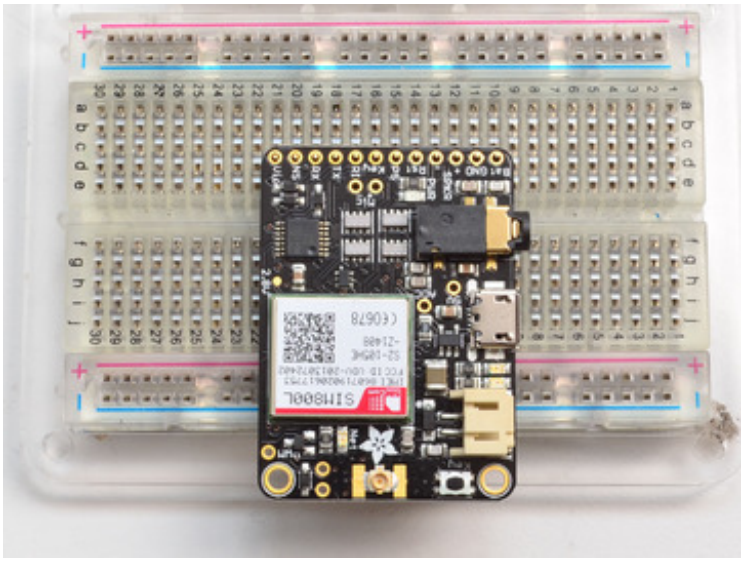
Assembly

Attaching Header

- 

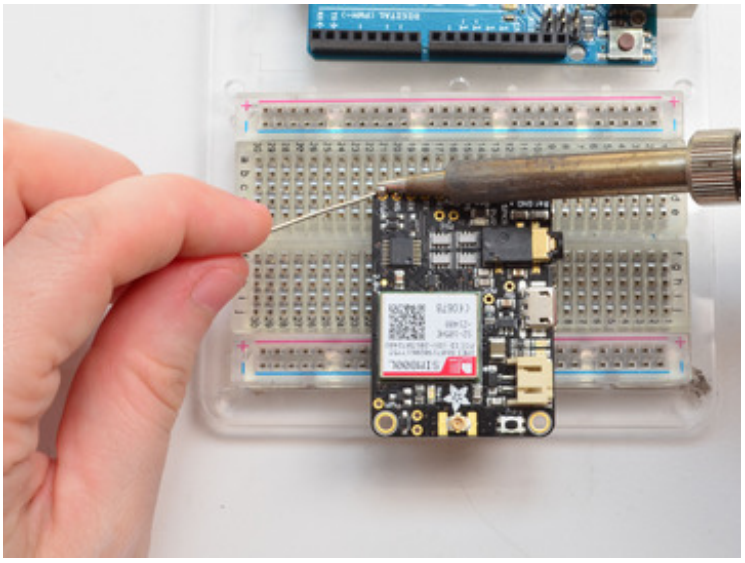
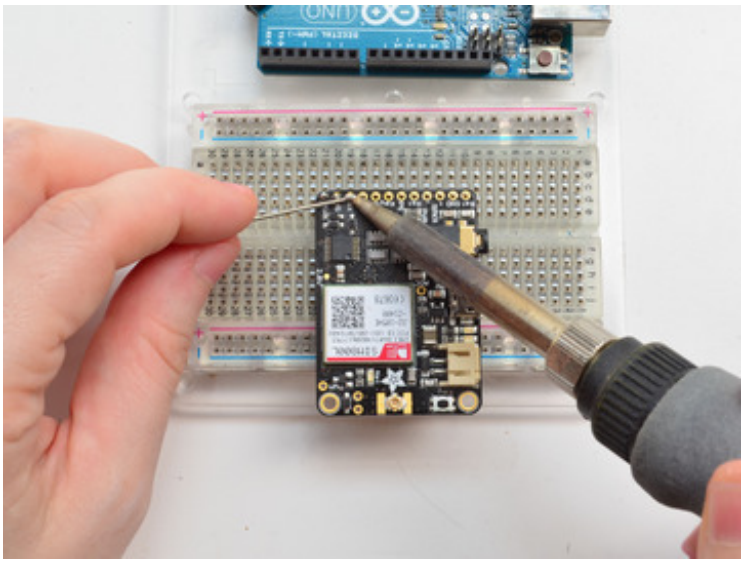
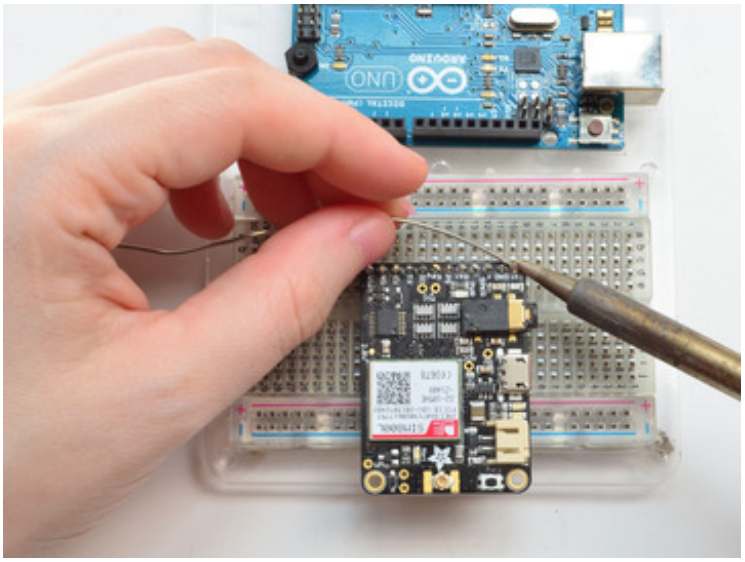
Prepare the header strip:

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 pads

- 
- 
- 

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)).

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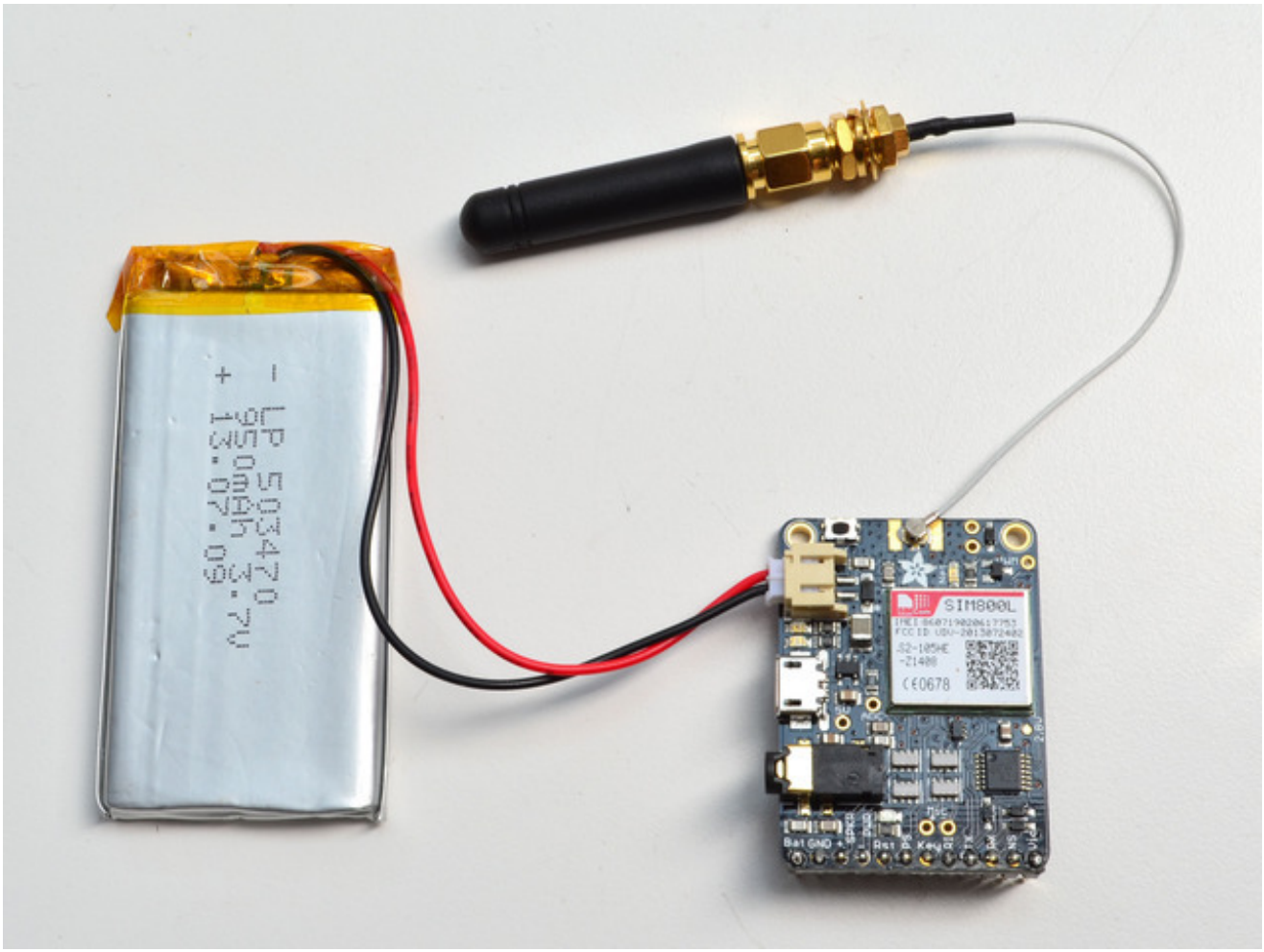
You're done! Check your solder joints visually and continue onto the next steps

Attaching Antenna & Battery

A battery and antenna is required! If you have a uFL FONA, a uFL->SMA cable may be required to connect the antenna. Use any Lipoly or LiIon 3.7V/4.2V battery

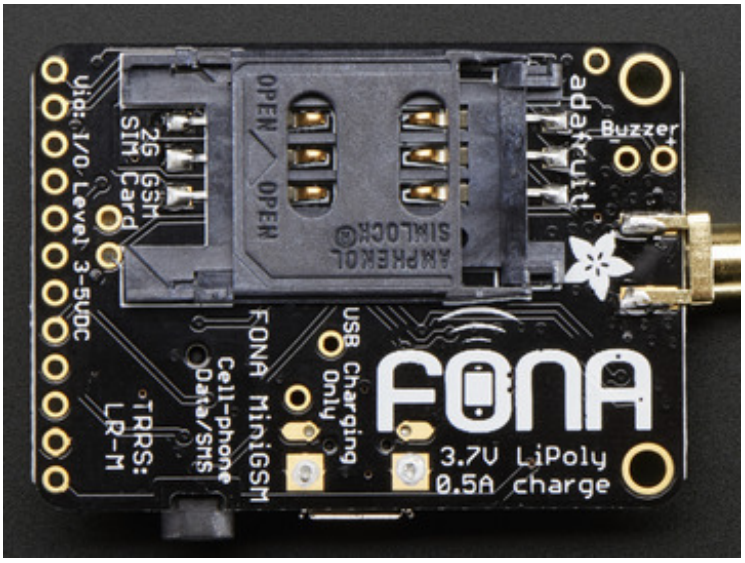


Check polarity for the battery!
Snap the uFL connector on, it will click when placed properly

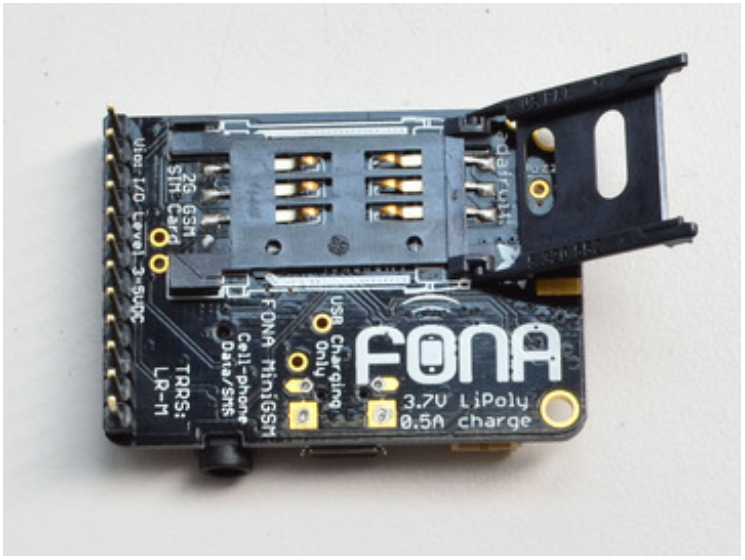
SIM Card

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

The SIM card holder is on the

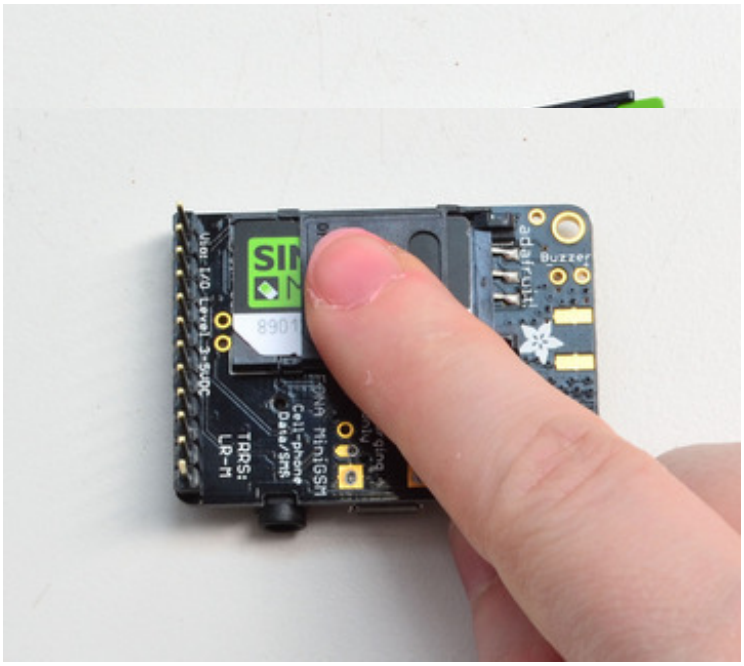
- 

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
-

Wiring to USB

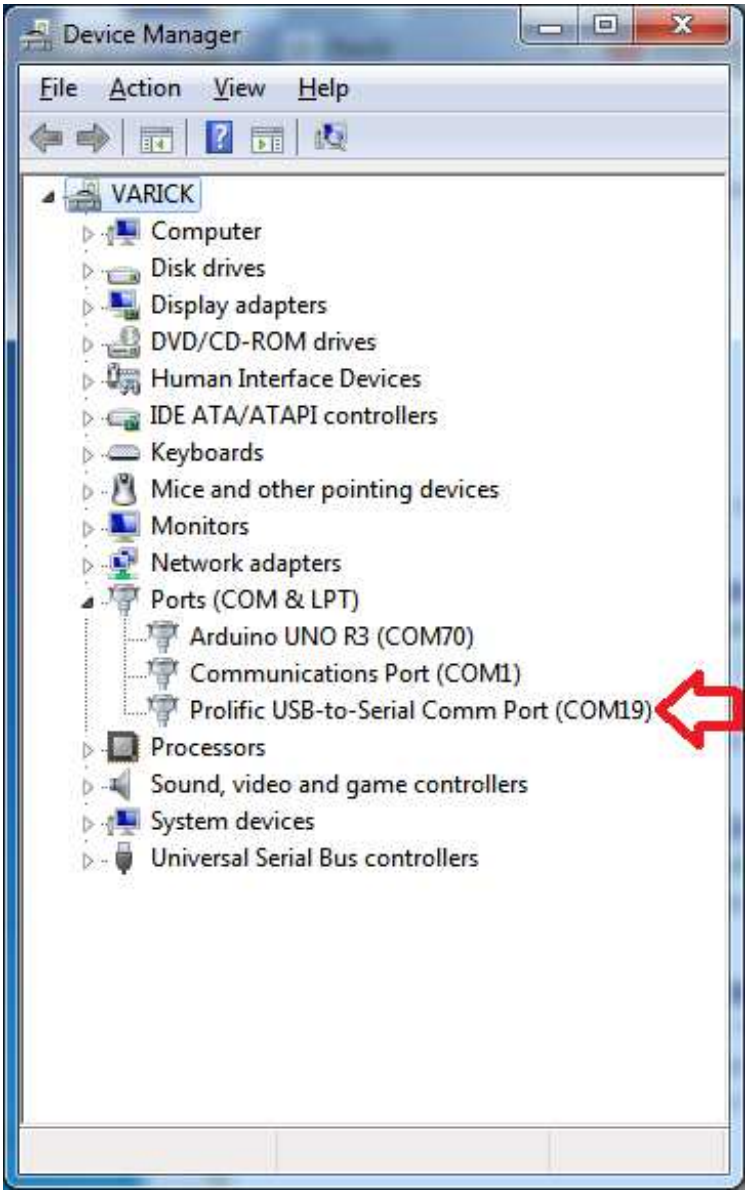
If you have a USB console cable you can wire it up directly and send commands using any Terminal software

For Windows, we suggest Putty (http://adafru.it/aUb)- it's free and open source!

Wire it up

In this example, we're using our USB console cable.

You will have to install the PL2303 driver and determine the COM port before you continue.



Connect to that COM port at 8N1 (8-bit, no parity bit, 1 stop bit) at 9600 baud. You can actually use any baud rate and it will autodetect but 9600 is supported by any terminal program!