# mail

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#### Adafruit Feather 32u4 FONA

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### **Overview**

Feather is the new development board from Adafruit, and like its namesake it is thin, light, and lets you fly! We designed Feather to be a new standard for portable microcontroller cores.

This is the **Adafruit Feather 32u4 FONA** - our take on an 'all-in-one' Arduino-compatible + audio/sms/data capable cellular with built in USB and battery charging. Its an Adafruit Feather 32u4 with a FONA800 module (http://adafru.it/1946), ready to rock! We have other boards and accessories in the Feather family, check'em out here (http://adafru.it/17B).



At the Feather 32u4's heart is at ATmega32u4 clocked at 8 MHz and at 3.3V logic, a chip setup we've had tons of experience with as <u>it's the same as the Flora (http://adafru.it/dVI)</u>. This chip has 32K of flash and 2K of RAM, with built in USB so not only does it have a USB-to-Serial program & debug capability built in with no need for an FTDI-like chip, it can

also act like a mouse, keyboard, USB MIDI device, etc.



Since you'll be taking this on the road, we added a connector for any of our 3.7V Lithium polymer batteries and built in battery charging. **A 500mAh+ Lipoly battery is required for use**, it keeps the cellular module happy during the high current spikes. Plug the Feather into microUSB to charge at 500mA.



#### Here's some handy specs! Like all Feather 32u4's you get:

- Measures 2.4" x 0.9" x 0.28" (51mm x 23mm x 8mm) without headers soldered in
- Light as a (large?) feather 8.2 grams
- ATmega32u4 @ 8MHz with 3.3V logic/power
- 3.3V regulator with 500mA peak current output
- USB native support, comes with USB bootloader and serial port debugging
- You also get tons of pins 20 GPIO pins
- Hardware Serial, hardware I2C, hardware SPI support
- 8 x PWM pins
- 10 x analog inputs
- Built in 500mA lipoly charger with charging status indicator LED
- Pin #13 red LED for general purpose blinking
- Power/enable pin for the 3.3V regulator
- 4 mounting holes
- Reset button



Connect your Feather to the Internet or make phone calls with our trusted-and-tested FONA module. 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 an external  $8\Omega$  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)
- AT command interface with "auto baud" detection
- Pair-able Bluetooth client interface with SPP (for controlling the module) as well as audio.



You will also need some required accessories to make Feather FONA work. These are not included!

- SIM Card! <u>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 (TING, SIMPLE mobile, etc) that uses the T-Mobile network. (http://adafru.it/2505)</u>
- Lipoly Battery 500mAh or larger! This <u>500mAh</u> (http://adafru.it/drL)battery, <u>or this</u> <u>1200mAh</u> (http://adafru.it/258) will work great.
- <u>MicroUSB cable</u> (http://adafru.it/592) for charging the battery.
- External Antenna We like this slim sticker-type (http://adafru.it/1991), which plugs right in. Alternatively, this straight SMA one (http://adafru.it/1859) or this right-angle SMA one will work (http://adafru.it/1858) but you'll also need a uFL to SMA adapter cable (http://adafru.it/851) so you can connect to your SMA antenna
- External Mic & Speaker If you want to make phone calls, you'll also need this electret mic (http://adafru.it/dDa) and mini 8 ohm speaker (http://adafru.it/dDb)



### **Pinouts**



The Feather 32u4 FONA is chock-full of microcontroller goodness. There's also a lot of pins and ports. We'll take you a tour of them now!



#### **Power Pins**



- GND this is the common ground for all power and logic
- BAT this is the positive voltage to/from the JST jack for the optional Lipoly battery
- USB this is the positive voltage to/from the micro USB jack if connected
- **EN** this is the 3.3V regulator's enable pin. It's pulled up, so connect to ground to disable the 3.3V regulator. Note that the cellular module is powed by VBAT so this will only disable the microcontroller
- 3V this is the output from the 3.3V regulator, it can supply 500mA peak

# Logic pins

This is the general purpose I/O pin set for the microcontroller. All logic is 3.3V

- **#0** / **RX** GPIO #0, also receive (input) pin for**Serial1** and Interrupt #2
- #1 / TX GPIO #1, also transmit (output) pin forSerial1 and Interrupt #3
- **#2** / **SDA** GPIO #2, also the I2C (Wire) data pin. There's no pull up on this pin by default so when using with I2C, you may need a 2.2K-10K pullup. Also Interrupt #1
- **#3** / **SCL** GPIO #3, also the I2C (Wire) clock pin. There's no pull up on this pin by default so when using with I2C, you may need a 2.2K-10K pullup. Can also do PWM output and act as Interrupt #0.
- **#5** GPIO #5, can also do PWM output. Also connected to the FONA's DTR pin if you want to use it for powersaving functionality, which is not enabled by default
- **#6** GPIO #6, can also do PWM output and analog input**A7**. Also connected to FONA RTS in case you want to use flow control, which is not enabled by default
- #9 GPIO #9, connected to FONA RXD.
- **#10** GPIO #10, also analog input A10 and can do PWM output.
- **#11** GPIO #11, can do PWM output.
- **#12** GPIO #12, also analog input **A11** and can do PWM output.

- #13 GPIO #13, can do PWM output and is connected to thered LED next to the USB jack
- A0 thru A5 These are each analog input as well as digital I/O pins.
- SCK/MOSI/MISO These are the hardware SPI pins. Also used to reprogram the chip with an AVR programmer if you need.

## **Cellular Module**



Now to the fun part, the cellular module. There's a few pins that are used to control the module. It uses SoftwareSerial to communicate with the microcoller

- **#8** used as the FONA**TXD** (data out from module to AVR)
- **#9** used as the FONA**RXD** (data out from AVR to module)
- **#7** used as the FONA**RI** (ring interrupt) pin, you can use this to alert you when an SMS or phone call comes in
- **#4** used as the FONA **Reset** pin. You can pulse this pin low to reset the FONA, handy when starting up

Optional pins:

- **#5** This pin is available on the breakout and is also connected to the FONA's DTR pin if you want to use it for powersaving functionality, which is not enabled by default
- **#6** This pin is available on the breakout and is connected to FONA RTS in case you want to use flow control, which is not enabled by default

# **Other Pins!**



- **RST** this is the Reset pin, tie to ground to manually reset the AVR, as well as launch the bootloader manually
- **ARef** the analog reference pin. Normally the reference voltage is the same as the chip logic voltage (3.3V) but if you need an alternative analog reference, connect it to this pin and select the external AREF in your firmware. Can't go higher than 3.3V!
- **Key** this is by default tied to ground, cut the trace on the bottom and wire to a microcontroller pin to manually turn the module on and off. (Pulse low for a few seconds to change from on to off) This is the only way to truly disable the cellular module.
- Mic+ and Mic- connections for attaching an electret microphone for audio applications (external audio interface)
- **Spk+ and Spk-** connections for attaching a 8 ohm 1W speaker for audio applications (external audio interface)

# **FONA connections & LEDs**



All the way to the right we have the cellular-only connection parts. Up top is a standard uFL connector, you attach your GSM antenna here

Below that is the bluetooth antenna (small white rectangle with red marking)

At the bottom are the two cell-status LEDs.

The middle **PWR** LED will light up green whenever the cellular module is active and has good power.

The **NET** LED will blink in blue let you know the status of the cellular connection 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



On the bottom is a microSIM push-push holder. Slot your microSIM in here and press in until it clicks

There's also a spot you can solder an antenna if you want to use the FM receiver capability.

Above that is nicely labeled Mic/Speaker pads

At the very bottom is the jumper for the **KEY** pad - cut this to let you control the module's on/off key manually. By default KEY is tied to ground so the module is always powered and on.

# Assembly

We ship Feathers fully tested but without headers attached - this gives you the most flexibility on choosing how to use and configure your Feather

# **Header Options!**

Before you go gung-ho on soldering, there's a few options to consider!



The first option is soldering in plain male headers, this lets you plug in the Feather into a solderless breadboard



Another option is to go with socket female headers. This won't let you plug the Feather into a breadboard but it will let you attach featherwings very easily



We also have 'slim' versions of the female headers, that are a little shorter and give a more compact shape

Finally, there's the "Stacking Header" option. This one is sort of the best-of-both-worlds. You get the ability to plug into a



solderless breadboard *and* plug a featherwing on top. But its a little bulky

# 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 <u>Guide to Excellent</u> <u>Soldering</u> (http://adafru.it/aTk)).







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

# **Soldering on Female Header**



#### Tape In Place

For sockets you'll want to tape them in place so when you flip over the board they don't fall out



#### Flip & Tack Solder

After flipping over, solder one or two points on each strip, to 'tack' the header in place