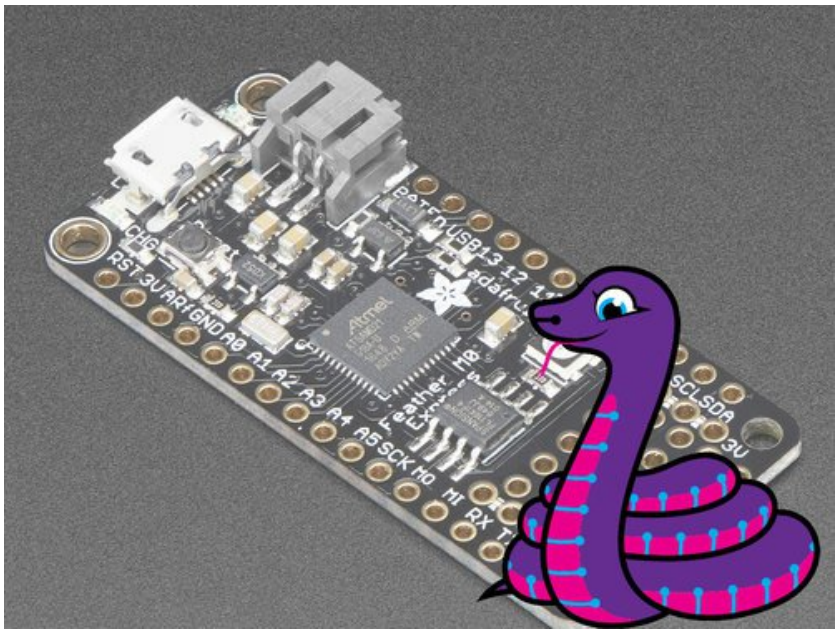
Adafruit Feather M0 Express - Designed for CircuitPython

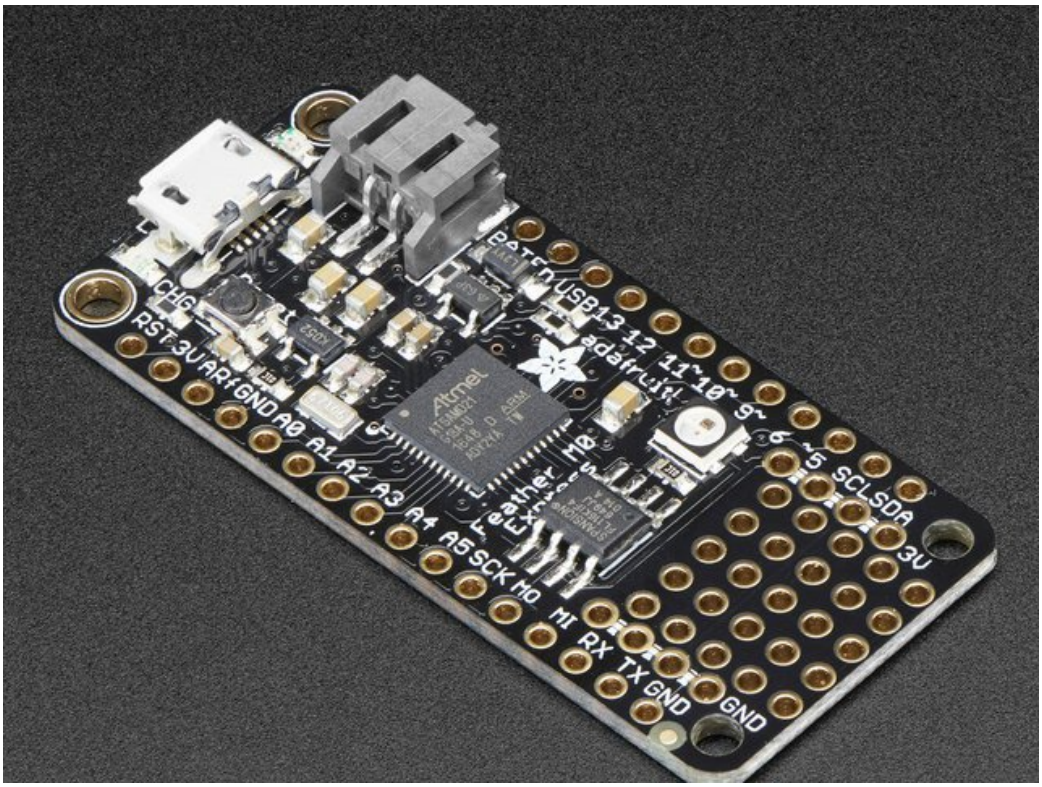
Created by lady ada



Last updated on 2017-04-28 07:20:06 PM UTC

Guide Contents

Overview



We love all our Feathers equally, but this Feather is very special. It's our first Feather that is*specifically* designed for use with CircuitPython! CircuitPython is our beginner-oriented flavor of MicroPython - and as the name hints at, its a small but full-featured version of the popular Python programming language specifically for use with circuitry and electronics.

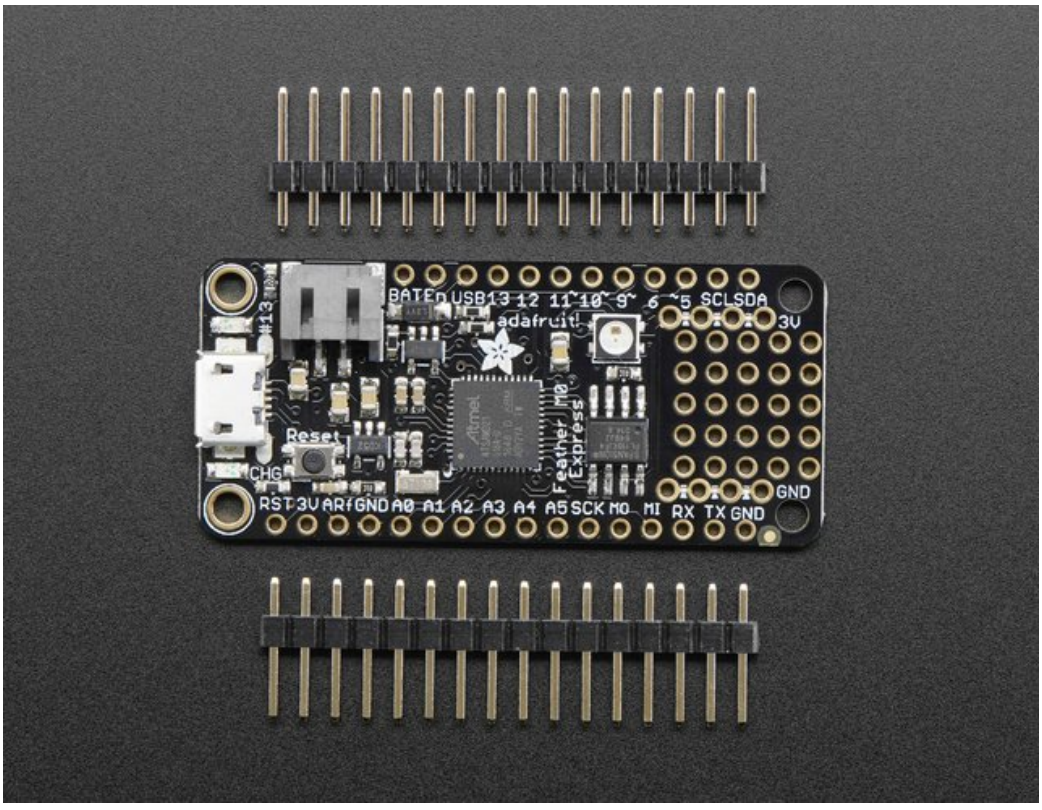
Please note, CircuitPython is still in *beta* and we're working hard to make it awesome!Please pick up one of these Feather M0 Expresses if you want to try it out - maybe even help us find bugs and make improvements!

That doesn't mean you cant *also* use it with Arduino IDE! At the Feather M0's heart is an ATSAMD21G18 ARM Cortex M0+ processor, clocked at 48 MHz and at 3.3V logic, the same one used in the new Arduino Zero (http://adafru.it/2843). This chip has a whopping 256K of FLASH (8x more than the Atmega328 or 32u4) and 32K of RAM (16x as much)! This chip comes with built in USB so it has USB-to-Serial program & debug capability

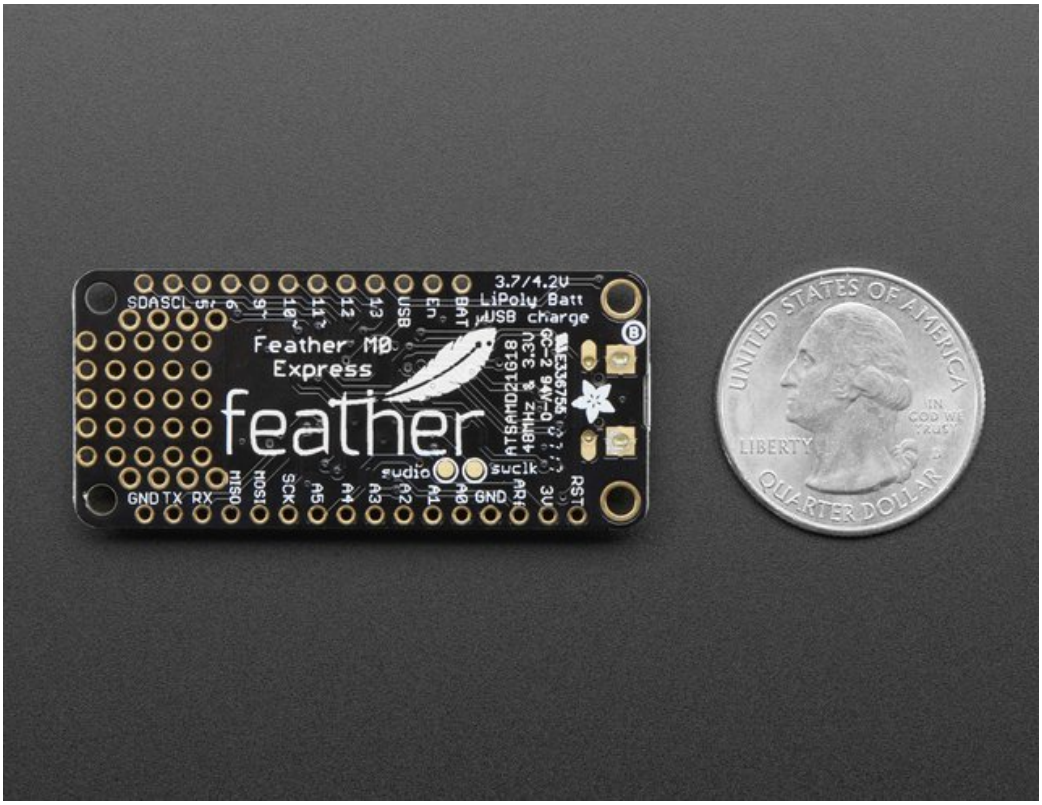
built in with no need for an FTDI-like chip.

Here's some handy specs!

- Measures 2.0" x 0.9" x 0.28" (51mm x 23mm x 8mm) without headers soldered in
- Light as a (large?) feather - 5 grams
- ATSAMD21G18 @ 48MHz with 3.3V logic/power
- 256KB of FLASH + 32KB of RAM
- No EEPROM
- 32.768 KHz crystal for clock generation & RTC
- 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
- PWM outputs on all pins
- 6 x 12-bit analog inputs
- 1 x 10-bit analog ouput (DAC)
- Built in 100mA lipoly charger with charging status indicator LED
- Pin #13 red LED for general purpose blinking
- Power/enable pin
- 4 mounting holes
- Reset button



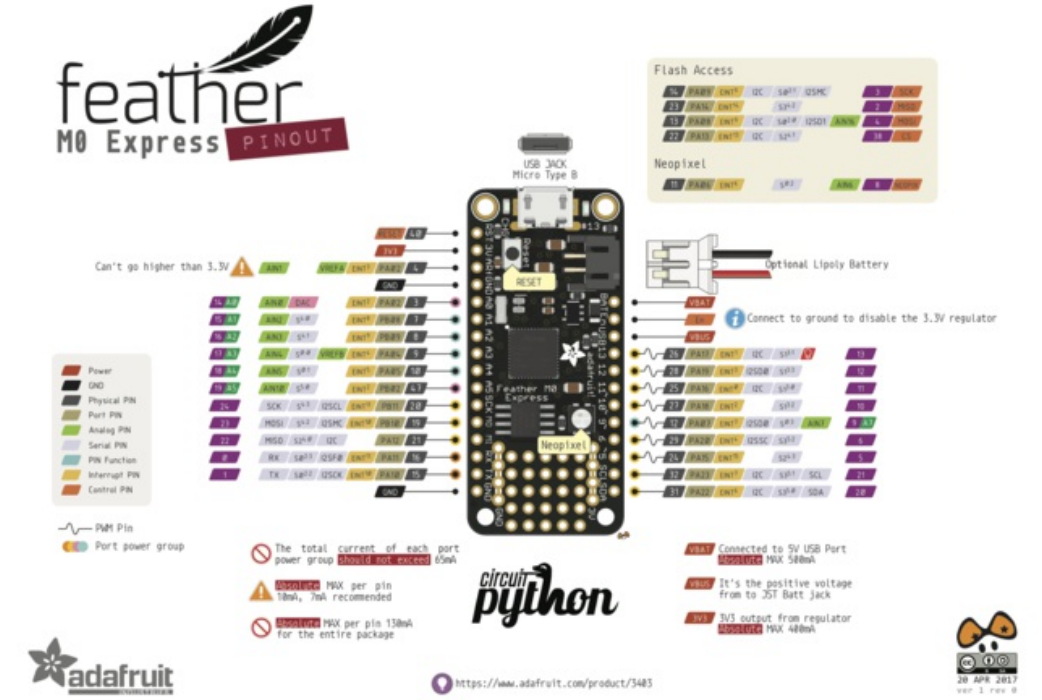
The **Feather M0 Express** uses the extra space left over to add a**Mini NeoPixel**, **2 MB SPI Flash** storage and a little prototyping space. You can use the SPI Flash storage like a very tiny hard drive. When used in Circuit Python, the 2 MB flash acts as storage for all your scripts, libraries and files. When used in Arduino, you can read/write files to it, like a little datalogger or SD card, and then with our helper program, access the files over USB.

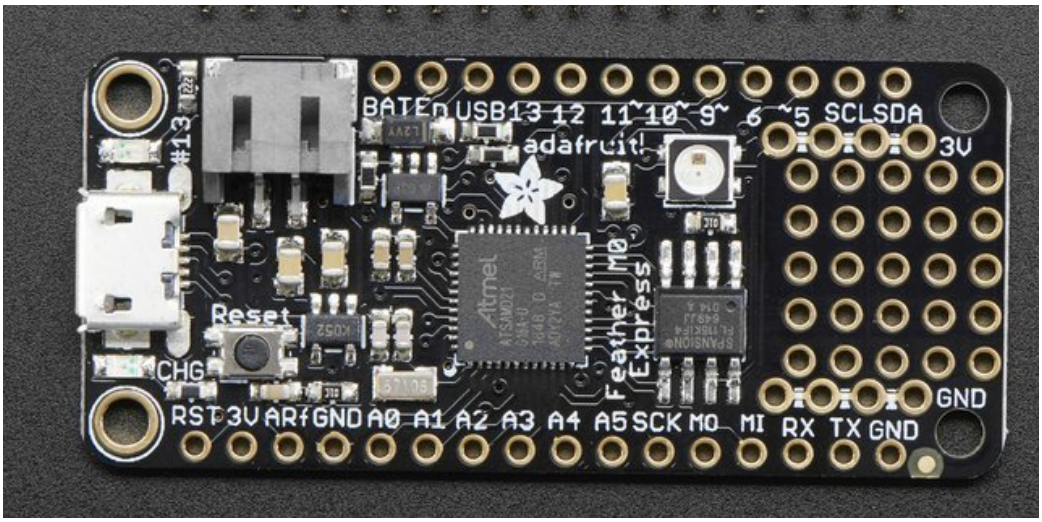


Comes fully assembled and tested, with a USB bootloader that lets you quickly use it with the Arduino IDE or for loading Circuit Python. We also toss in some header so you can solder it in and plug into a solderless breadboard.

Lipoly battery and USB cable not included (but we do have lots of options in the shop if you'd like!)

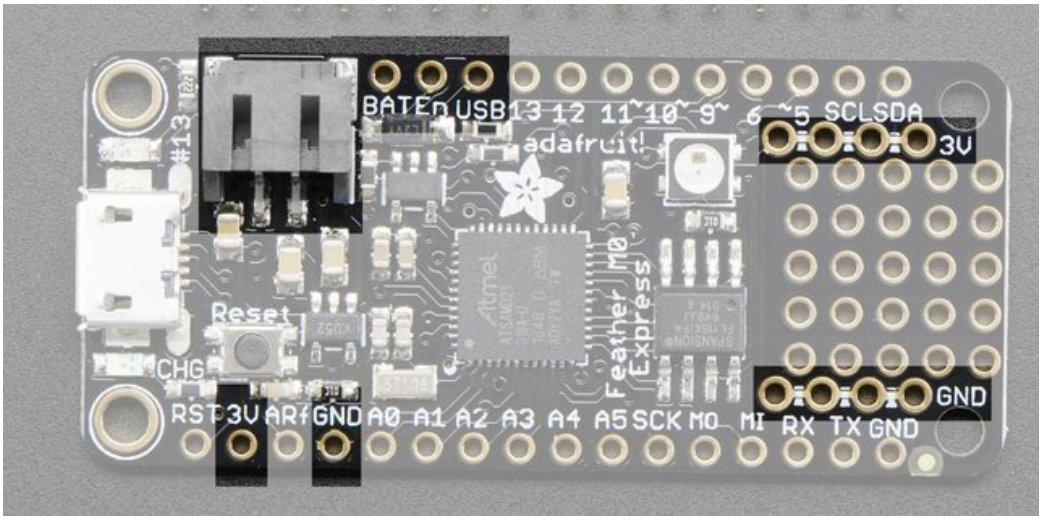
Pinouts





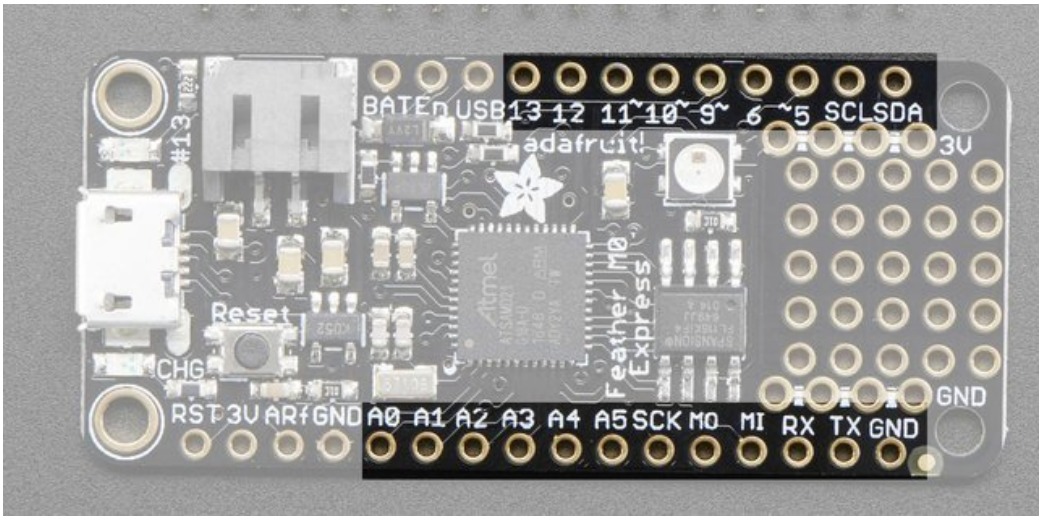
The Feather M0 Basic is chock-full of microcontroller goodness. There's also a lot of pins and ports. We'll take you a tour of them now!

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
- **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
Most pins can do PWM output
All pins can be interrupt inputs

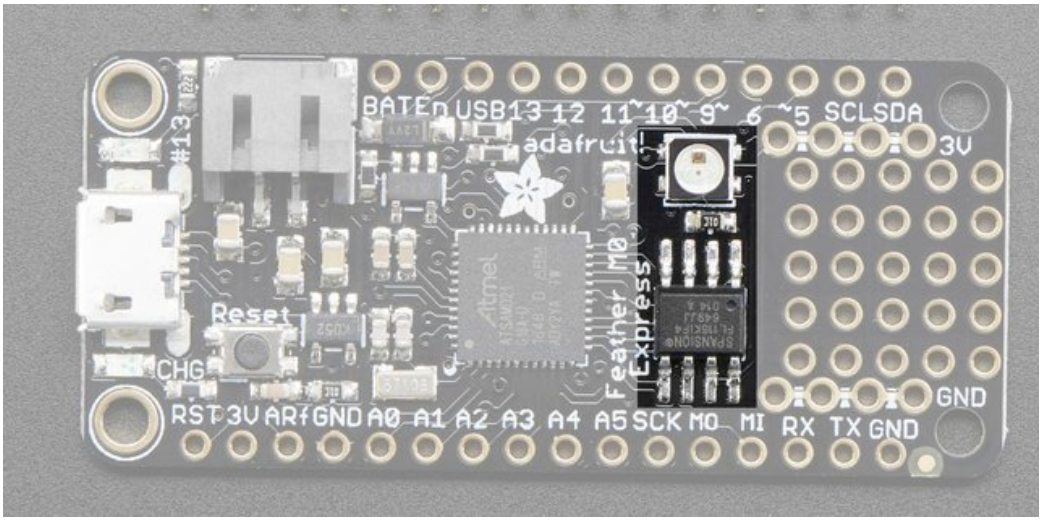
- **#0** / **RX** - GPIO #0, also receive (input) pin for**Serial1** (hardware UART), also can be analog input
- **#1** / **TX** - GPIO #1, also transmit (output) pin for**Serial1**, also can be analog input
- **SDA** - the I2C (Wire) data pin. There's no pull up on this pin by default so when using with I2C, you may need a 2.2K-10K pullup.
- **SCL** - 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.
- **#5** - GPIO #5

- **#6** - GPIO #6
- **#9** - GPIO #9, also analog input **A7**. This analog input is connected to a voltage divider for the lipoly battery so be aware that this pin naturally 'sits' at around 2VDC due to the resistor divider
- **#10** - GPIO #10
- **#11** - GPIO #11
- **#12** - GPIO #12
- **#13** - GPIO #13 and is connected to the **red LED** next to the USB jack
- **A0** - This pin is analog *input* **A0** but is also an analog *output* due to having a DAC (digital-to-analog converter). You can set the raw voltage to anything from 0 to 3.3V, unlike PWM outputs this is a true analog output
- **A1 thru A5** - These are each analog input as well as digital I/O pins.
- **SCK**/**MOSI**/**MISO** - These are the hardware SPI pins, you can use them as everyday GPIO pins (but recommend keeping them free as they are best used for hardware SPI connections for high speed.)

These pins are available in CircuitPython under the board module. Names that start with # are prefixed with D and other names are as is. So **#0** / **RX** above is available as board.D0 and board.RX for example.

SPI Flash and NeoPixel

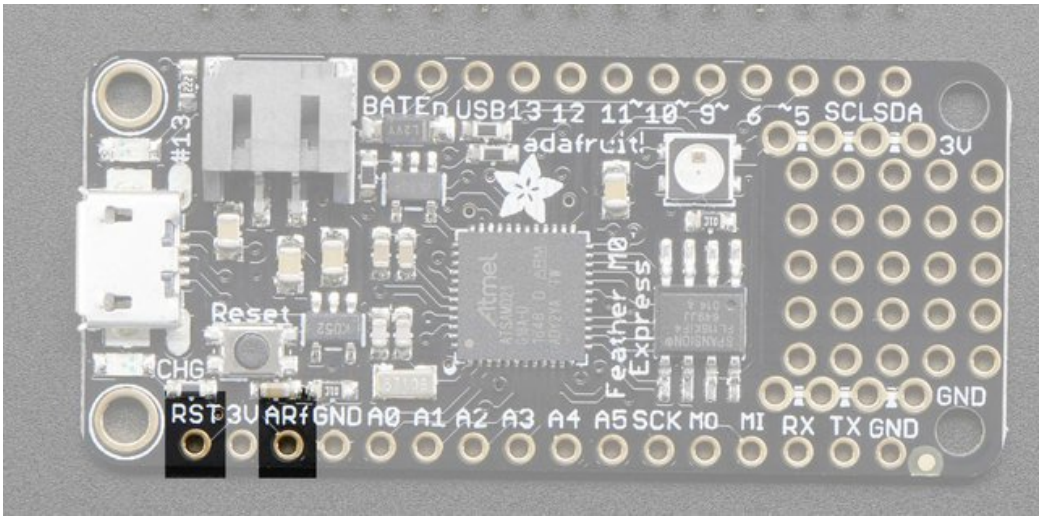
As part of the 'Express' series of boards, this Feather is designed for use with CircuitPython. To make that easy, we have added two extra parts to this Feather M0: a mini NeoPixel (RGB LED) and a 2 MB SPI Flash chip



The **NeoPixel** is connected to pin #8 in Arduino, so just use our NeoPixel library (http://adafru.it/dhw) and set it up as a single-LED strand on pin 8. The NeoPixel is powered by the 3.3V power supply but that hasn't shown to make a big difference in brightness or color. The NeoPixel is also used by the bootloader to let you know if the device has enumerated correctly (green) or USB failure (red). In CircuitPython, the LED is used to indicate the runtime status.

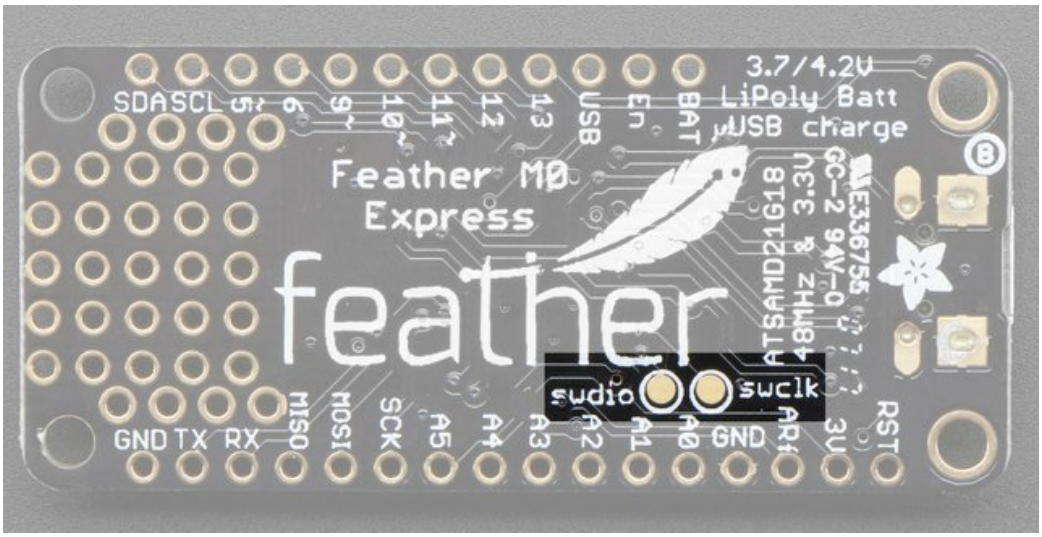
The SPI Flash is connected to 4 pins that are not brought out on the GPIO pads. This way you don't have to worry about the SPI flash colliding with other devices on the main SPI connection. Under Arduino, the FLASH **SCK** pin is #3, **MISO** is #2, **MOSI** is #4, and **CS** is #38. If you use **Feather M0 Express** as your board type, you'll be able to access the Flash SPI port under **SPI1** - this is a fully new hardware SPI device separate from the GPIO pins on the outside edge of the Feather. In CircuitPython, the SPI flash is used natively by the interpretter and is read-only to user code, instead the Flash just shows up as the writeable disk drive!

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!

- **SWCLK & SWDIO** - These pads on the bottom are used to program the chip. They can also be connected to an SWD debugger.

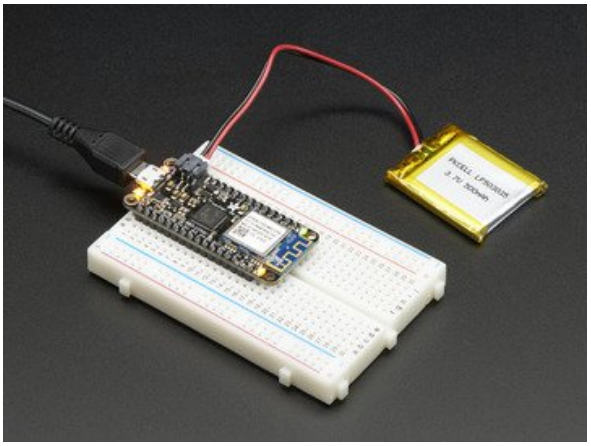
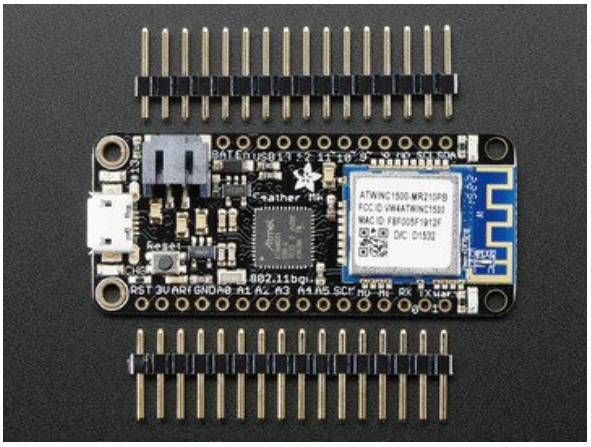


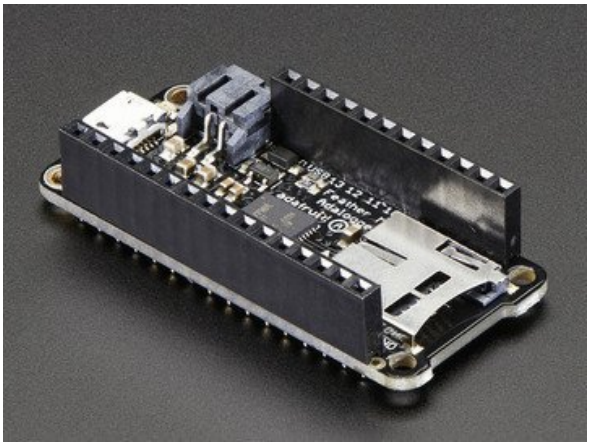
Assembly

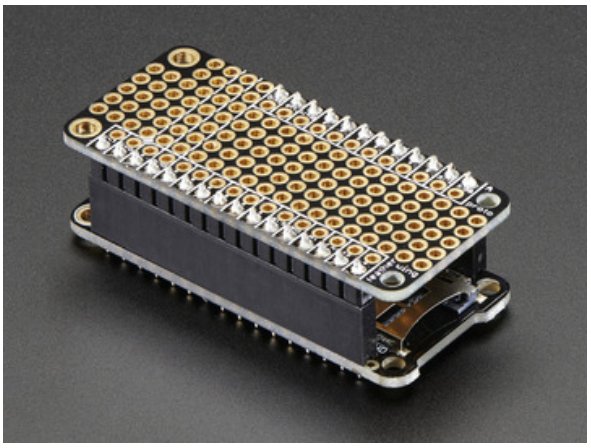
We ship Feathers fully tested but without headers attached - this gives you the most flexibility on choosing how to use and configure your Feather

Header Options!

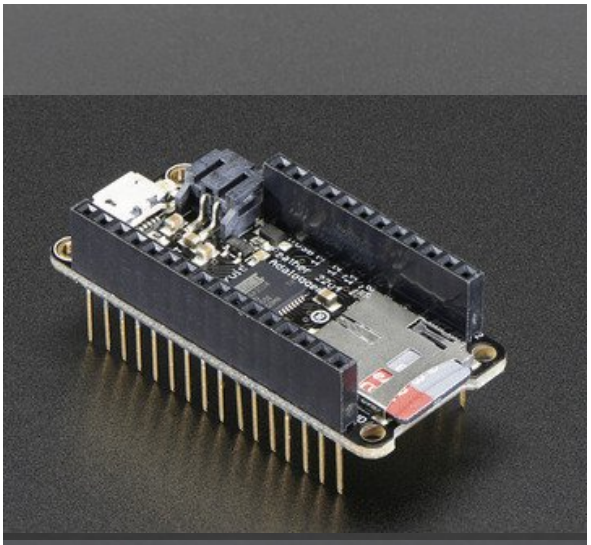
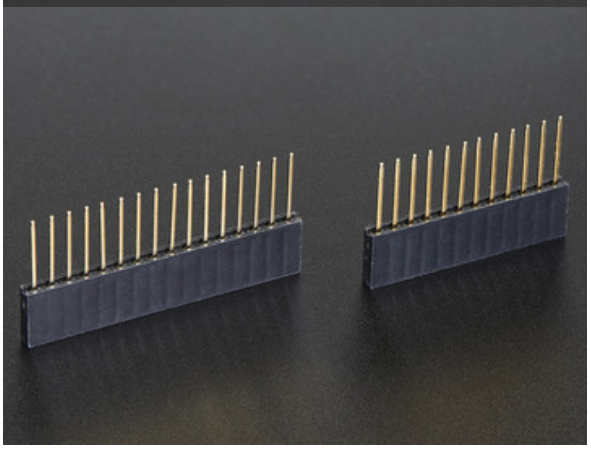
Before you go gung-ho on soldering, there's a few options to consider!

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

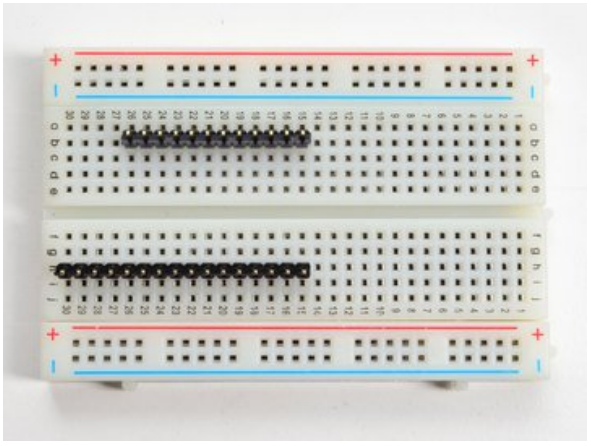
- 

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

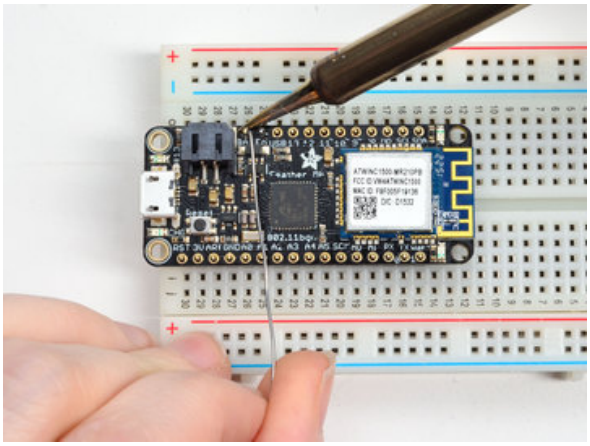
- 
- Finally, there's the "Stacking Header" option. This one is sort of the best-of-both-worlds. You get the ability to plug into a solderless breadboard *and* plug a featherwing on top. But its a little bulky
- 

Soldering in Plain Headers

- 

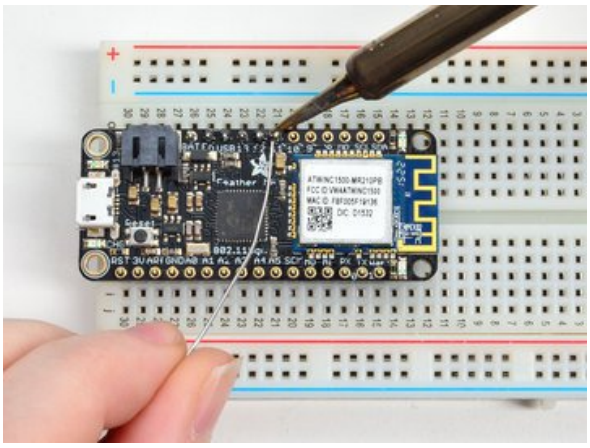
Prepare the header strip:

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:

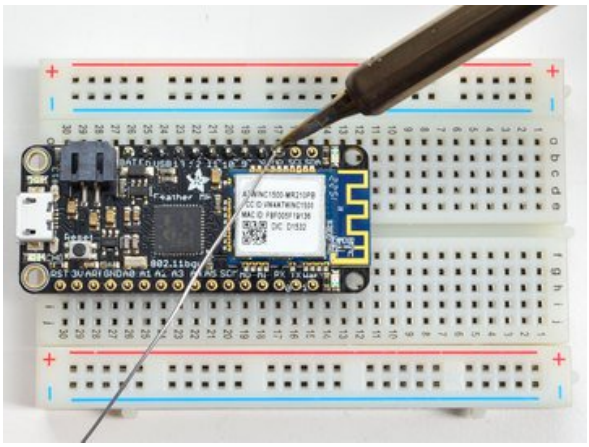
Place the breakout board over the pins so that the short pins poke through the breakout pads

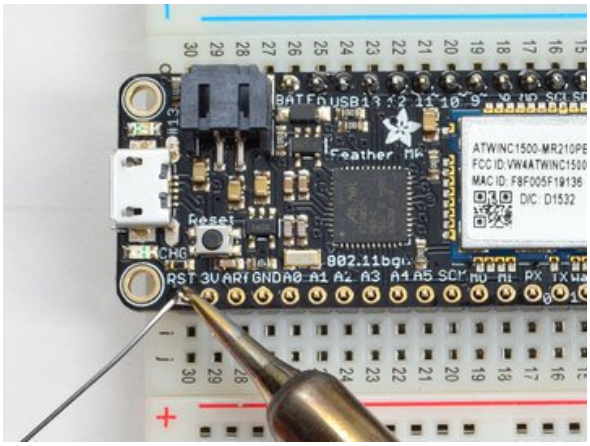
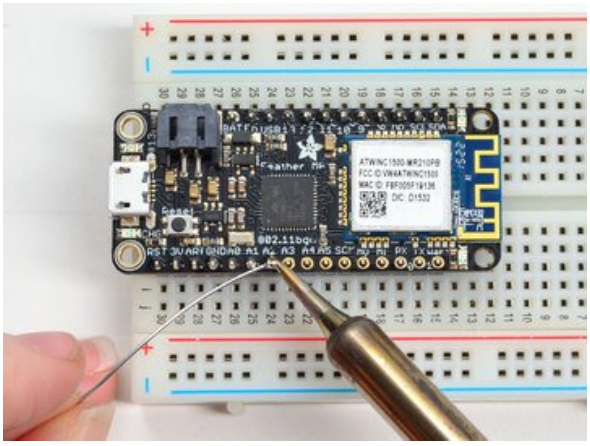
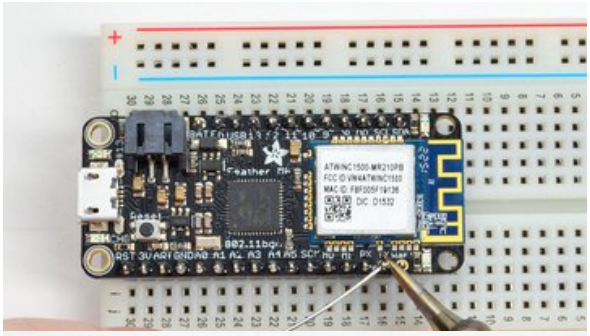
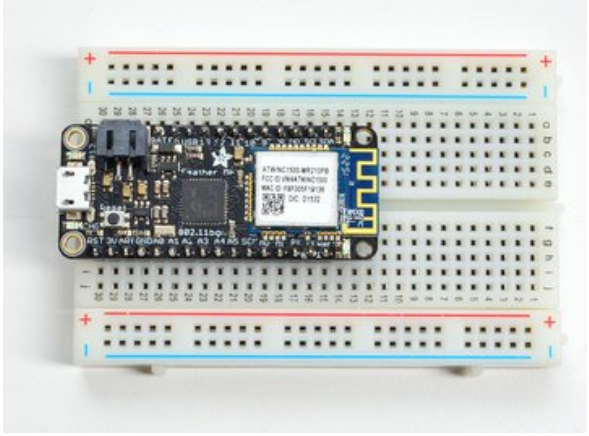
- 

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)).

- 

-  Solder the other strip as well.
- 
- 
- 
- You're done! Check your solder joints visually and continue onto the next steps

Soldering on Female Header

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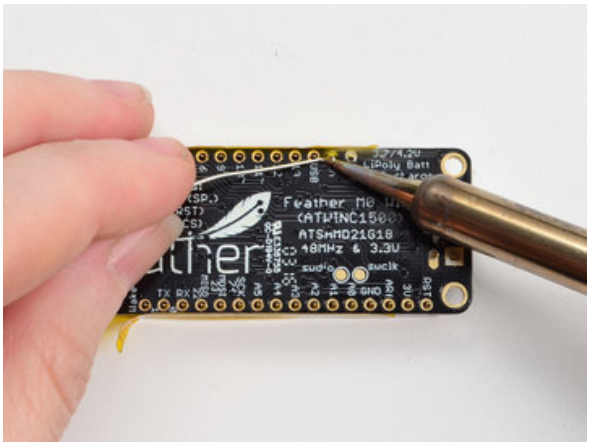
Tape In Place

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

- 
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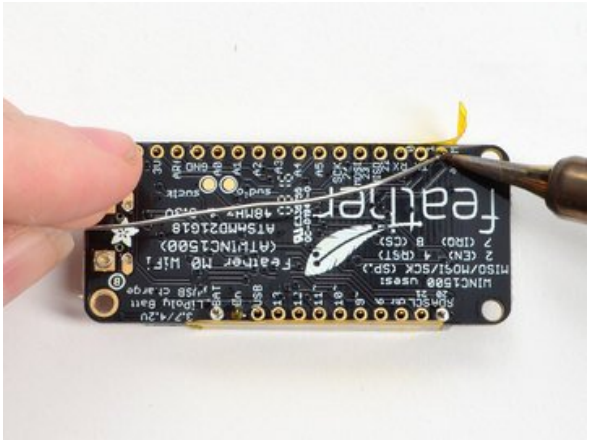
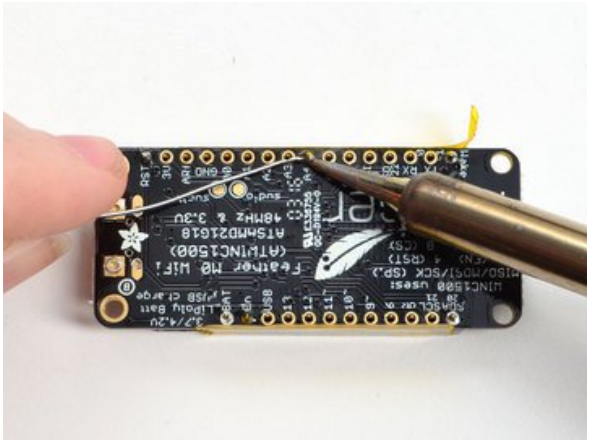
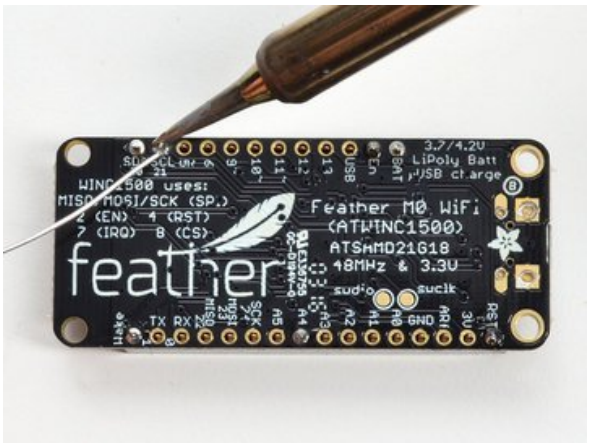
- 

Flip & Tack Solder

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

- 
- 
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And Solder!

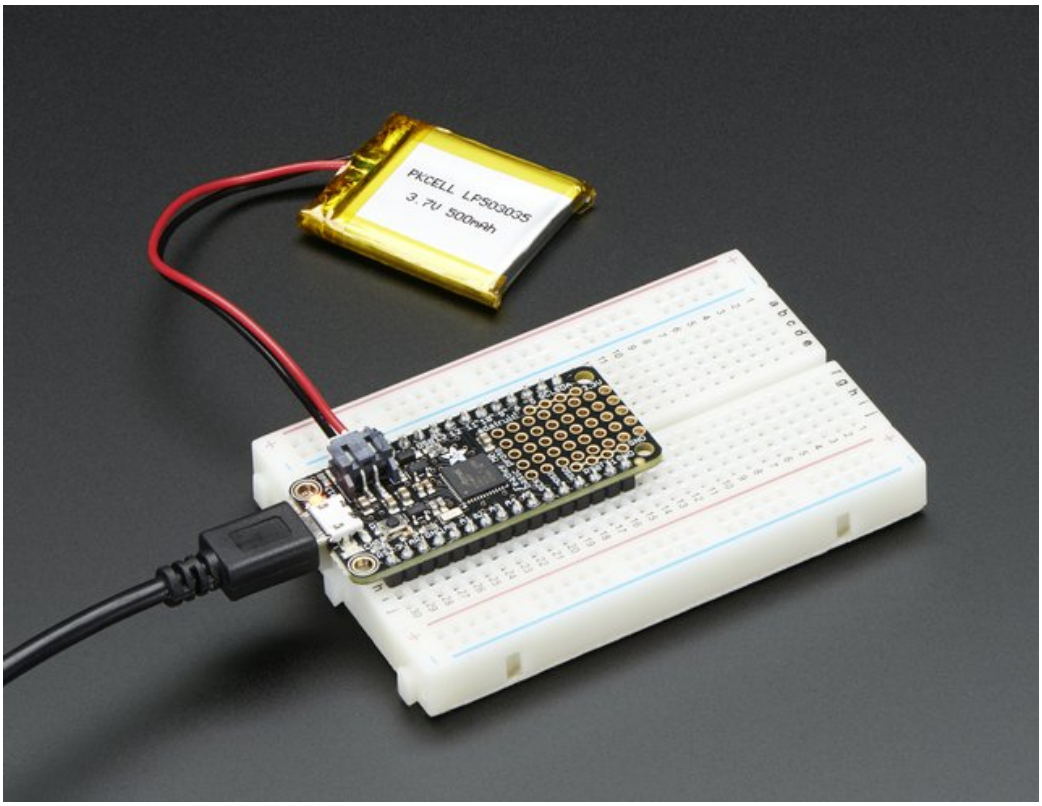
Be sure to solder all pins for reliable electrical contact.

(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

- 
3.7/4.2V
LiPoly Batt
/USB charge
WINC1500 uses:
MISO/MOSI/SCK (SPI)
2 (EN) 4 (RST)
7 (IRQ) 8 (CS)
Feather M0 WiFi
(ATWINC1500)
ATSAMD21G18
48MHz & 3.3V
feather
TX RX
GND
RST
- 

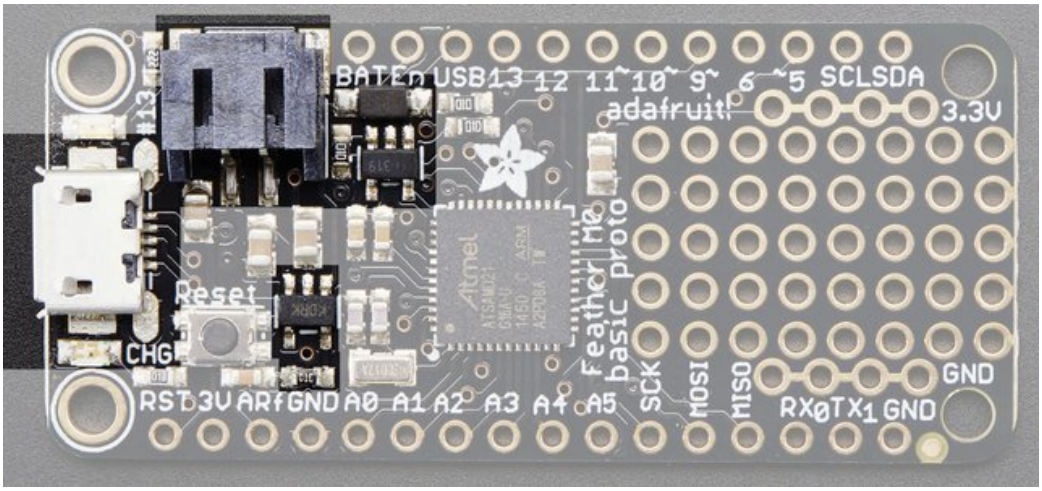
Power Management



Battery + USB Power

We wanted to make the Feather easy to power both when connected to a computer as well as via battery. There's **two ways to power** a Feather. You can connect with a MicroUSB cable (just plug into the jack) and the Feather will regulate the 5V USB down to 3.3V. You can also connect a 4.2/3.7V Lithium Polymer (Lipo/Lipoly) or Lithium Ion (LiIon) battery to the JST jack. This will let the Feather run on a rechargable battery. **When the USB power is powered, it will automatically switch over to USB for power, as well as start charging the battery (if attached) at 100mA.** This happens 'hotswap' style so you can always keep the Lipoly connected as a 'backup' power that will only get used when USB power is lost.

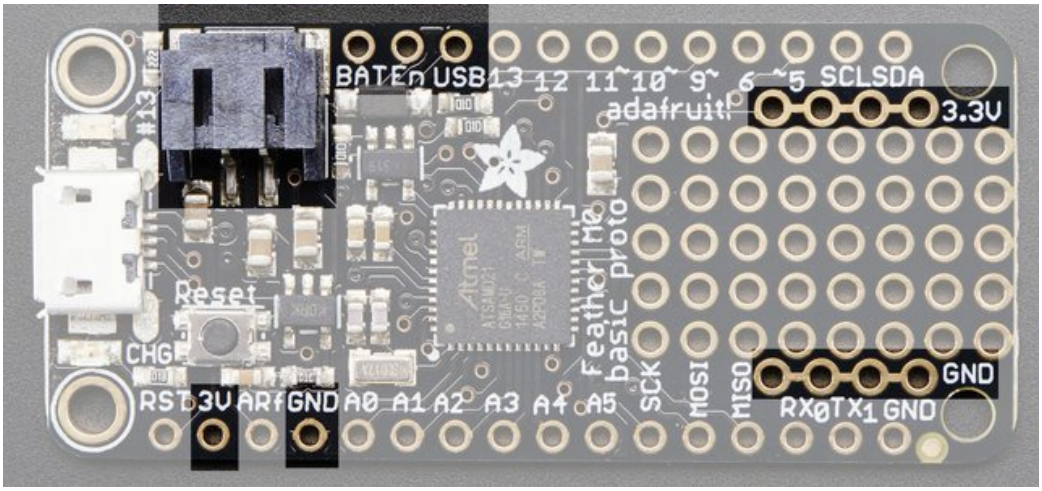
The JST connector polarity is matched to Adafruit LiPoly batteries. Using wrong polarity batteries can destroy your Feather



The above shows the Micro USB jack (left), Lipoly JST jack (top left), as well as the 3.3V regulator and changeover diode (just to the right of the JST jack) and the Lipoly charging circuitry (to the right of the Reset button). There's also a **CHG** LED, which will light up while the battery is charging. This LED might also flicker if the battery is not connected.

Power supplies

You have a lot of power supply options here! We bring out the **BAT** pin, which is tied to the lipoly JST connector, as well as **USB** which is the +5V from USB if connected. We also have the **3V** pin which has the output from the 3.3V regulator. We use a 500mA peak regulator. While you can get 500mA from it, you can't do it continuously from 5V as it will overheat the regulator. It's fine for, say, powering an ESP8266 WiFi chip or XBee radio though, since the current draw is 'spikey' & sporadic.



Measuring Battery

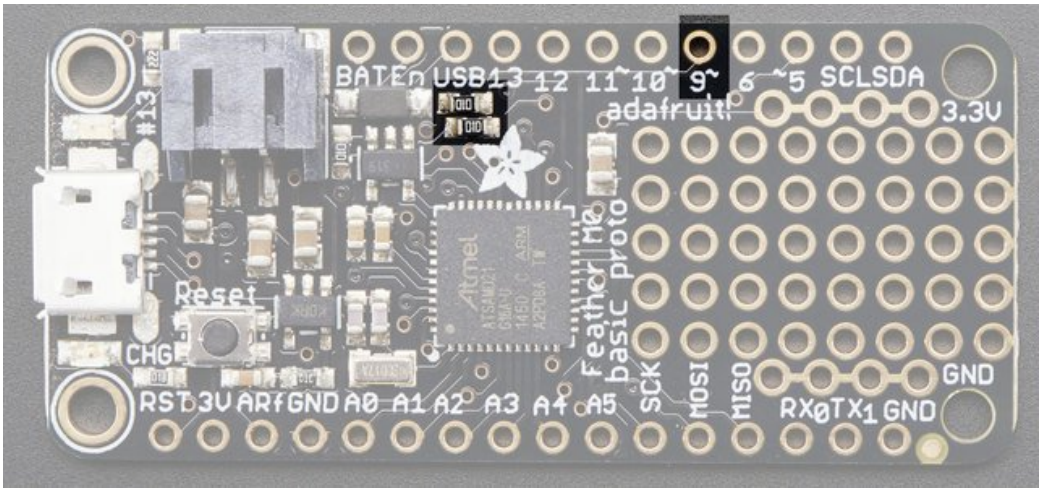
If you're running off of a battery, chances are you wanna know what the voltage is at! That way you can tell when the battery needs recharging. Lipoly batteries are 'maxed out' at 4.2V and stick around 3.7V for much of the battery life, then slowly sink down to 3.2V or so before the protection circuitry cuts it off. By measuring the voltage you can quickly tell when you're heading below 3.7V

To make this easy we stuck a double-100K resistor divider on the **BAT** pin, and connected it to **D9** (a.k.a analog #7

A7). You can read this pin's voltage, then double it, to get the battery voltage.

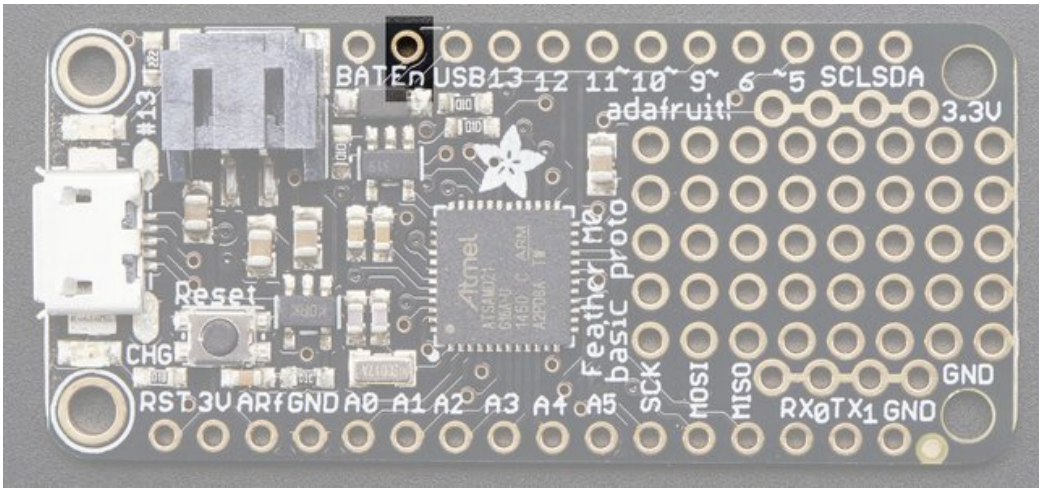
```
#define VBATPIN A7

float measuredvbat = analogRead(VBATPIN);
measuredvbat *= 2;    // we divided by 2, so multiply back
measuredvbat *= 3.3;  // Multiply by 3.3V, our reference voltage
measuredvbat /= 1024; // convert to voltage
Serial.print("VBat: " ); Serial.println(measuredvbat);
```



ENable pin

If you'd like to turn off the 3.3V regulator, you can do that with the**EN**(able) pin. Simply tie this pin to**Ground** and it will disable the 3V regulator. The **BAT** and **USB** pins will still be powered



UF2 Bootloader

Adafruit Express boards feature an improved bootloader that makes it easier than ever to flash different code onto the microcontroller. This bootloader makes it easy to switch between Microsoft MakeCode, CircuitPython and Arduino.

Instead of needing drivers or a separate program for flashing (say,bossac, jlink or avrdude), one can simply ***drag a file onto a removable drive***.

The format of the file is a little special. Due to 'operating system woes' you cannot just drag a binary or hex file (trust us, we tried it, it isn't cross-platform compatible). Instead, the format of the file has extra information to help the bootloader know where the data goes. The format is called UF2 (USB Flashing Format). Microsoft MakeCode generates UF2s for flashing and CircuitPython releases are also available as UF2. You can also create your own UF2s from binary files using uf2tool, available here. (http://adafru.it/vPE)

The bootloader is ***also BOSSA compatible***, so it can be used with the Arduino IDE which expects a BOSSA bootloader on ATSAMD-based boards

For more information about UF2, please check out the UF2 file format specification(http://adafru.it/vPE) and to build your *own* bootloader for ATSAMD-based boards, visit Microsoft UF2-SAMD github repository (http://adafru.it/vPF).

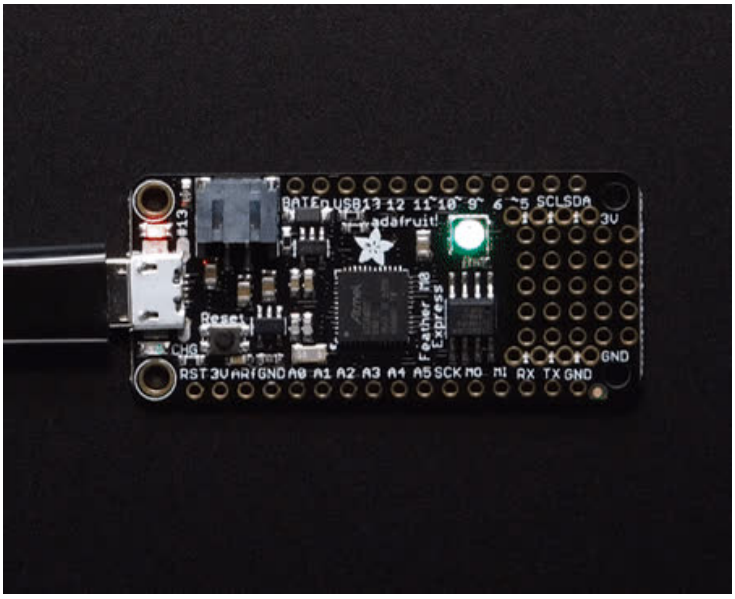
The bootloader is not needed when changing your CircuitPython code. Its only needed when upgrading the CircuitPython core or changing between CircuitPython, Arduino and Microsoft MakeCode.

Entering Bootloader Mode

The first step to loading new code onto your board is triggering the bootloader. It is easily done by double tapping the reset button. Once the bootloader is active you will see the small red LED fade in and out and a new drive will appear on your computer with a name ending in **BOOT**. For example, feathers show up as**FEATHERBOOT** while the new CircuitPlayground shows up as **CPLAYBOOT**.

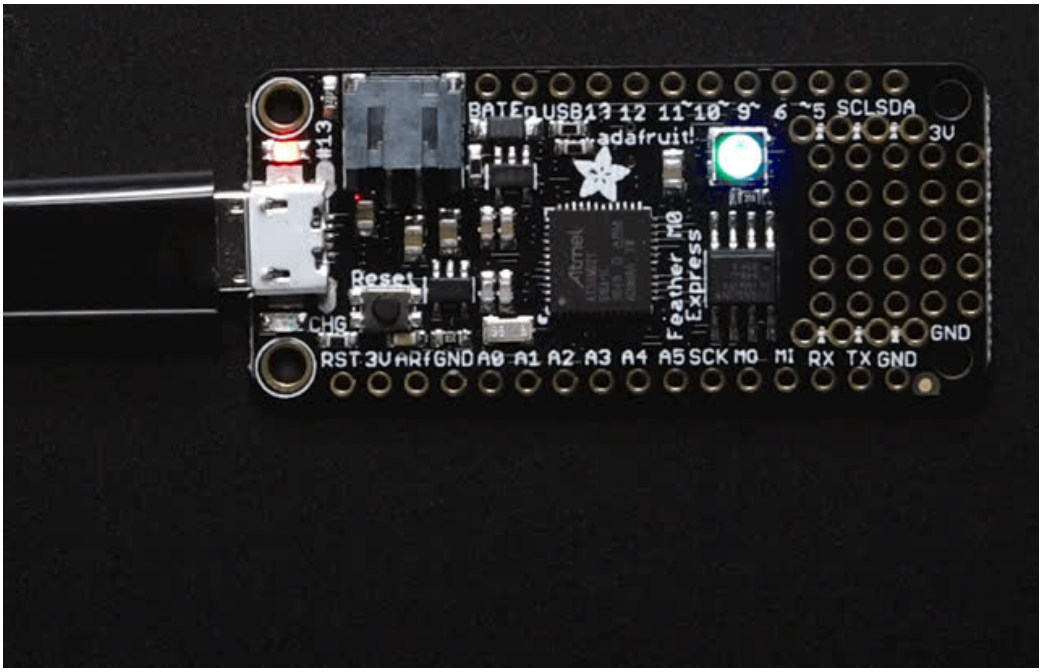
Furthermore, when the bootloader is active, it will change the color of one or more onboard neopixels to indicate the connection status, red for disconnected and green for connected. If the board is plugged in but still showing that its disconnected, try a different USB cable. Some cables only provide power with no communication.

For example, here is a Feather M0 Express running a colorful Neopixel swirl. When the reset button is double clicked (about half second between each click) the NeoPixel will stay green to let you know the bootloader is active. When the reset button is clicked once, the 'user program' (NeoPixel color swirl) restarts.



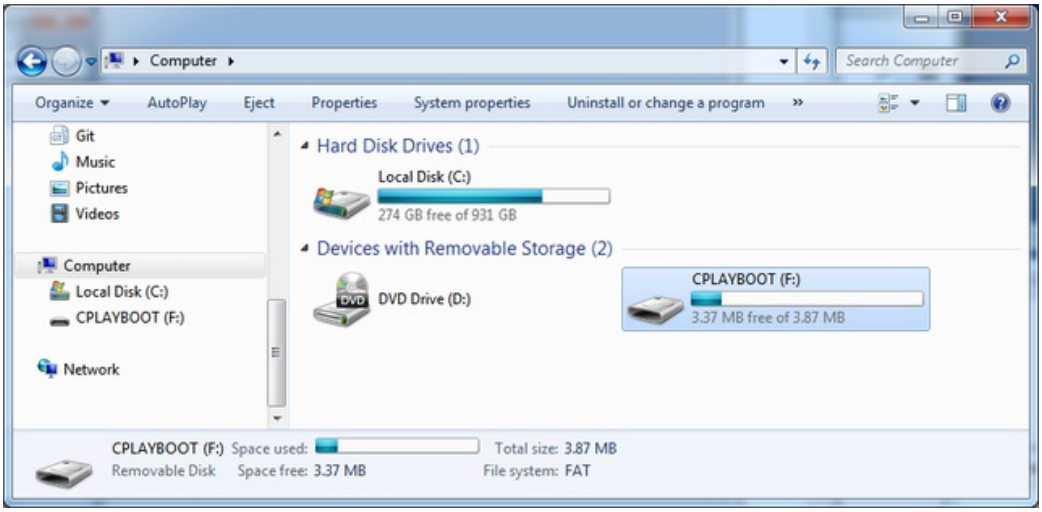
If the bootloader couldn't start, you will get a red NeoPixel LED.

That could mean that your USB cable is no good, it isn't connected to a computer, or maybe the drivers could not enumerate. Try a new USB cable first. Then try another port on your computer!



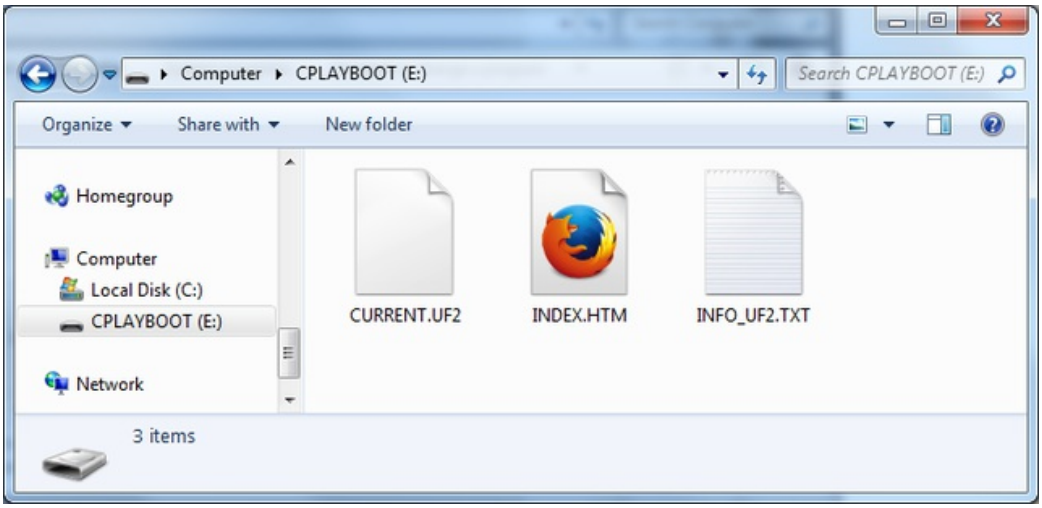
The first versions of the Feather M0 Express have a bootloader that may be unreliable, especially when used through a USB Hub. If the board doesn't connect through a USB hub or connects but then disconnects, then please update the bootloader with the instructions below.

Once the bootloader is running, check your computer. You should see a USB Disk drive...



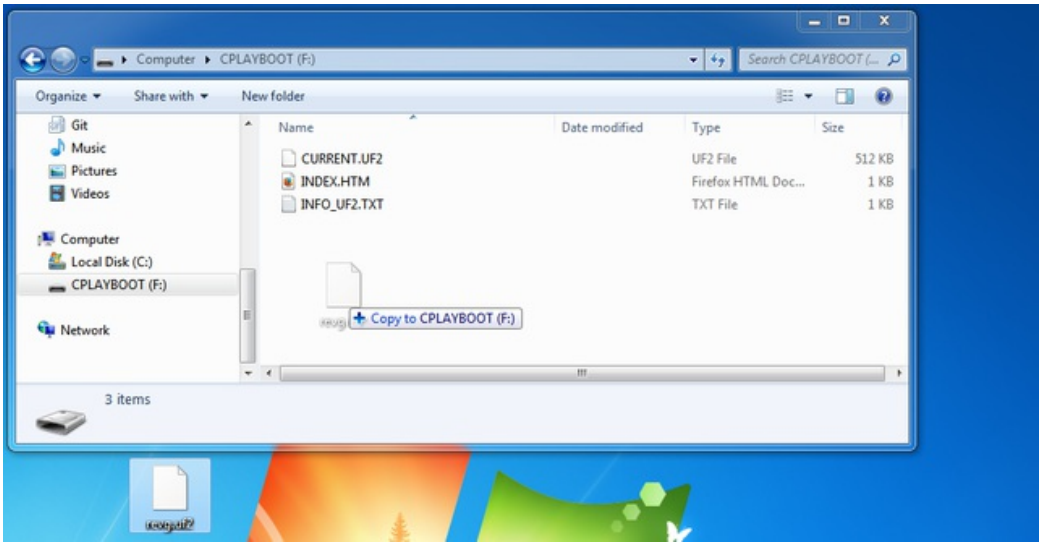
Once the bootloader is successfully connected you can open the drive and browse the virtual filesystem. This isn't the same filesystem as you use with CircuitPython or Arduino. It should have three files:

- **CURRENT.UF2** - The current contents of the microcontroller flash.
- **INDEX.HTM** - Links to Microsoft MakeCode.
- **INFO_UF2.TXT** - Includes bootloader version info. Please include it on bug reports.

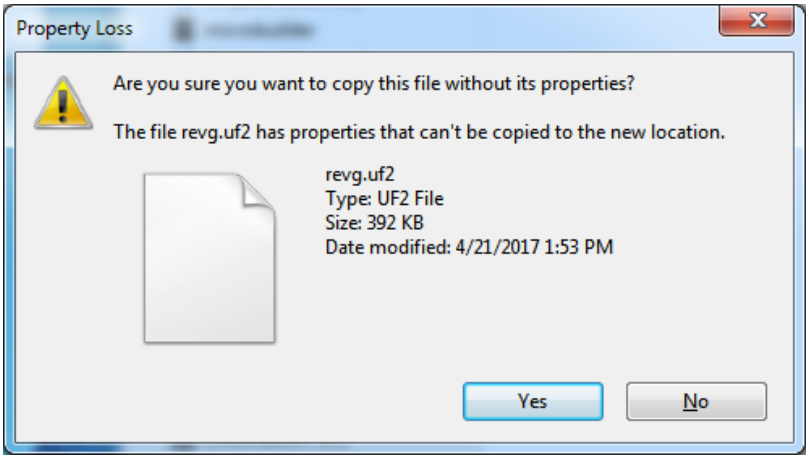


Using the Mass Storage Bootloader

To flash something new, simply drag any UF2 onto the drive. After the file is finished copying, the bootloader will automatically restart. This usually causes a warning about an unsafe eject of the drive. However, its not a problem. The bootloader knows when everything is copied successfully.



You may get an alert from the OS that the file is being copied without it's properties. You can just click **Yes**



You may also get get a complaint that the drive was ejected without warning. Don't worry about this. The drive only ejects once the bootloader has verified and completed the process of writing the new code

Using the BOSSA Bootloader

As mentioned before, the bootloader is also compatible with BOSSA, which is the standard method of updating boards when in the Arduino IDE. It is a command-line tool that can be used in any operating system. We won't cover the full use of the **bossac** tool, suffice to say it can do quite a bit! More information is available at ShumaTech (http://adafru.it/vQa).

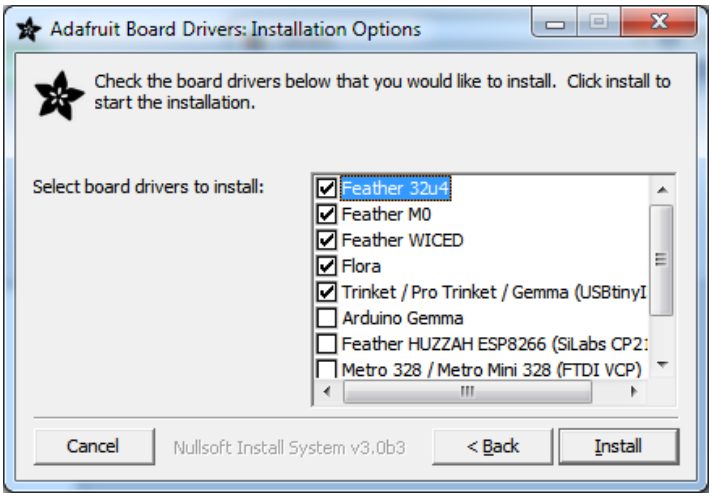
Windows 7 Drivers

If you are running Windows 7 (or, goodness, something earlier?) You will need a Serial Port driver file. Windows 10 users do not need this so skip this step.

You can download our full driver package here:

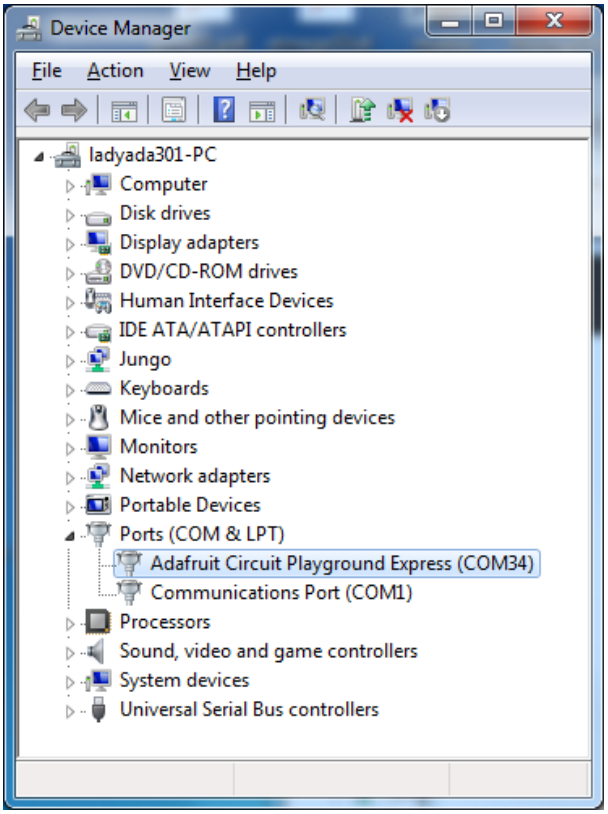
Download Adafruit Driver Installer v1.1
http://adafru.it/vA7

Download and run the installer. We recommend just selecting all the serial port drivers available (no harm to do so) and installing them.

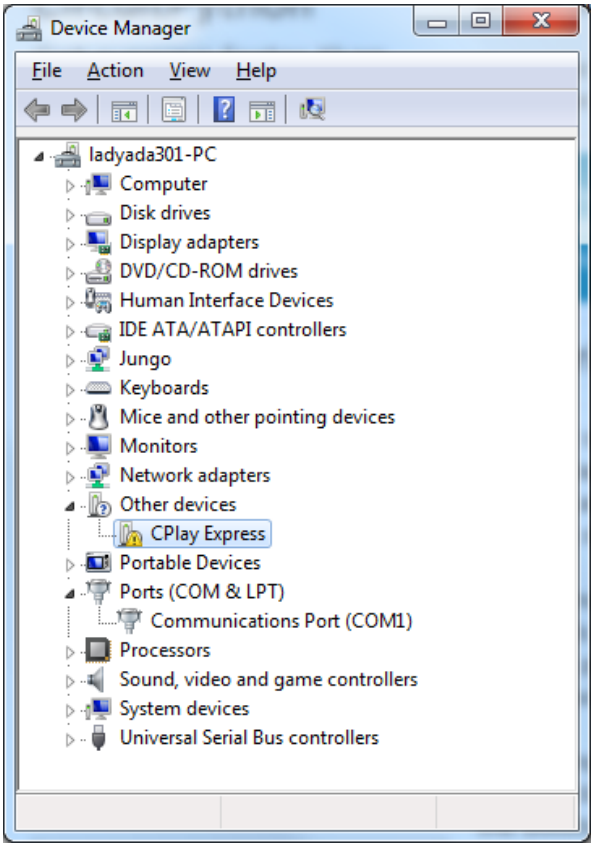


Verifying Serial Port in Device Manager

If you're running Windows, its a good idea to verify the device showed up. Open your Device Manager from the control panel and look under **Ports (COM & LPT)** for a device called **Feather M0** or **Circuit Playground** or whatever!



If you see something like this, it means you did not install the drivers. Go back and try again, then remove and re-plug the USB cable for your board



Running bossac on the command line

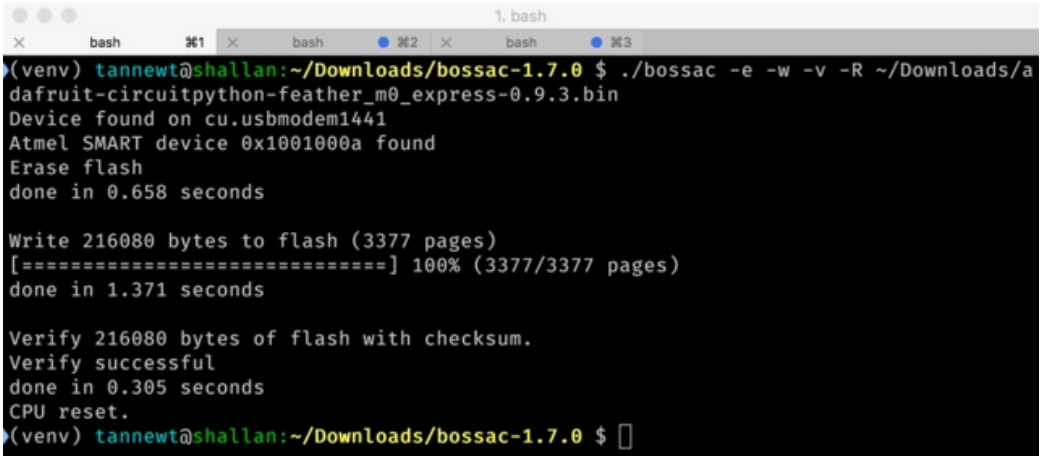
If you are using the Arduino IDE, this step is not required. But sometimes you want to read/write custom binary files, say for loading CircuitPython or your own code. We recommend using bossac v 1.7.0 (or greater), which has been tested. The Arduino branch is most recommended (http://adafru.it/vQb).

You can download the latest builds here.(http://adafru.it/s1B) The mingw32 version is for Windows, apple-darwin for Mac OSX and various linux options for Linux. Once downloaded, extract the files from the zip and open the command line to the directory with bossac

For example here's the command line you probably want to run:

```
bossac -e -w -v -R ~/Downloads/adafruit-circuitpython-feather_m0_express-0.9.3.bin
```

This will -erase the chip, -write the given file, -verify the write and -Reset the board. After reset, CircuitPython should be running. Express boards may cause a warning of an early eject of a USB drive but just ignore it. Nothing important was being written to the drive. A hard power-reset is also recommended after **bossac**, just in case.



Updating the bootloader

The UF2 bootloader is still in beta, and while we've done a ton of testing, it may contain bugs. Usually these bugs effect reliability rather than fully preventing the bootloader from working. If the bootloader is flaky then you can try updating the bootloader itself to potentially improve reliability.

Updating the bootloader is as easy as flashing CircuitPython, Arduino or MakeCode. Simply enter the bootloader as above and then drag the *update bootloader uf2* file below. This uf2 contains a program which will unlock the bootloader section, update the bootloader, and re-lock it. It will overwrite your existing code such as CircuitPython or Arduino so make sure everything is backed up!

After the file is copied over, the bootloader will be updated and appear again. The**INFO_UF2.TXT** file should show the newer version number inside.

For example:

UF2 Bootloader v1.20.0 SFHR
Model: Adafruit Feather M0
Board-ID: SAMD21G18A-Feather-v0

Lastly, reload your code from Arduino or MakeCode or flash thelatest CircuitPython core (http://adafru.it/tBa).

The latest updater for Feather M0 Express:

v1.21.0 feather m0 update uf2
http://adafru.it/vXf

Getting Rid of Windows Pop-ups

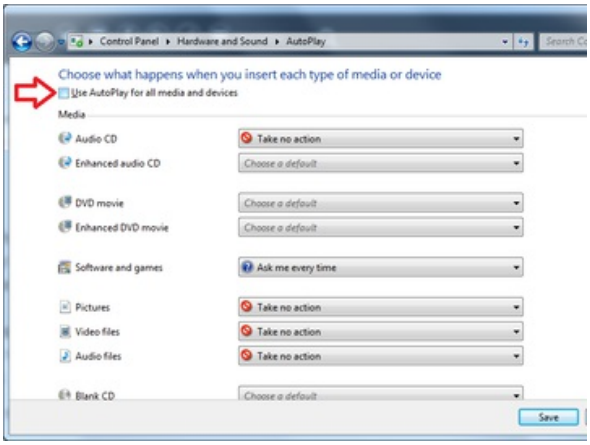
If you do a *lot* of development on Windows with the UF2 bootloader, you may get annoyed by the constant "Hey you inserted a drive what do you want to do" pop-ups.

- 

Go to the Control Panel. Click on the **Hardware and Sound** header

- 

Click on the **Autoplay** header

- 

Uncheck the box at the top, labeled **Use Autoplay for all devices**

Making your own UF2

Making your own UF2 is easy! All you need is a .bin file of a program you wish to flash and the Python conversion script (http://adafru.it/vZb). Make sure that your program was compiled to start at 0x2000 (8k) because the bootloader takes the first 8k. CircuitPython's linker script (http://adafru.it/vZc) is an example on how to do that.

Once you have a .bin file, you simply need to run the Python conversion script over it. Here is an example from the

directory with uf2conv.py:

```
uf2conv.py -c -o build-circuitplayground_express/revg.uf2 build-circuitplayground_express/revg.bin
```

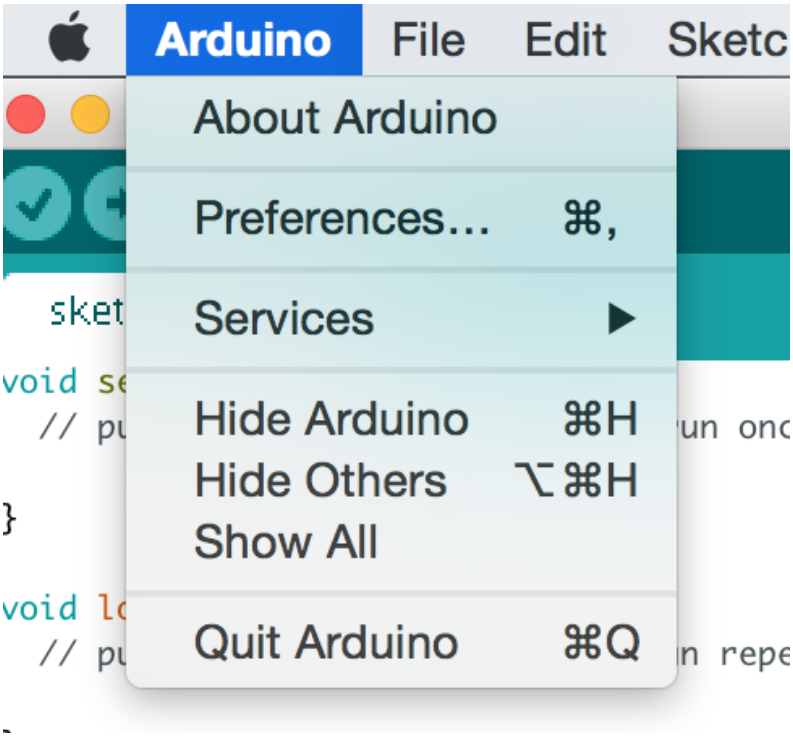
This will produce a revg.uf2 file in the same directory as the source revg.bin. The uf2 can then be flashed in the same way as above.

Arduino IDE Setup

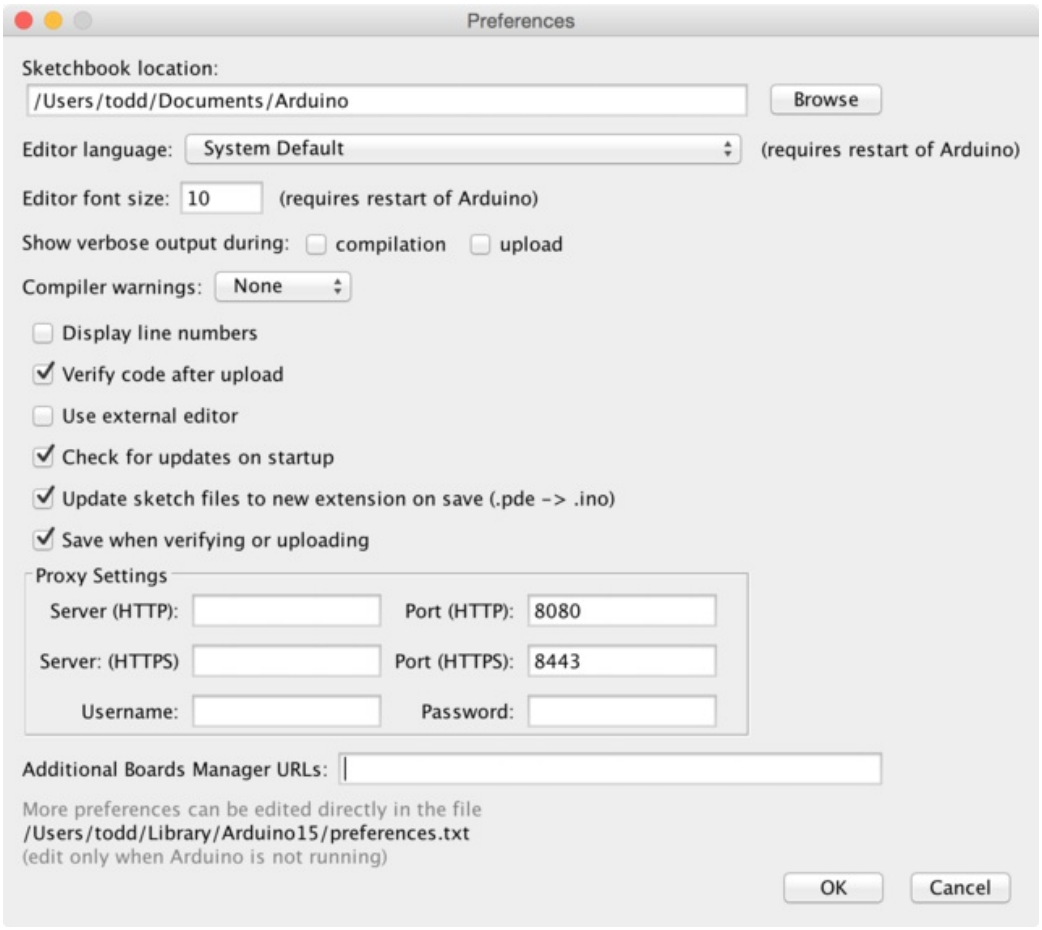
The first thing you will need to do is to download the latest release of the Arduino IDE. You will need to be using **version 1.6.4** or higher for this guide.

Arduino IDE v1.6.4+ Download
http://adafru.it/f1P

After you have downloaded and installed **v1.6.4**, you will need to start the IDE and navigate to the **Preferences** menu. You can access it from the **File** menu in *Windows* or *Linux*, or the **Arduino** menu on *OS X*.



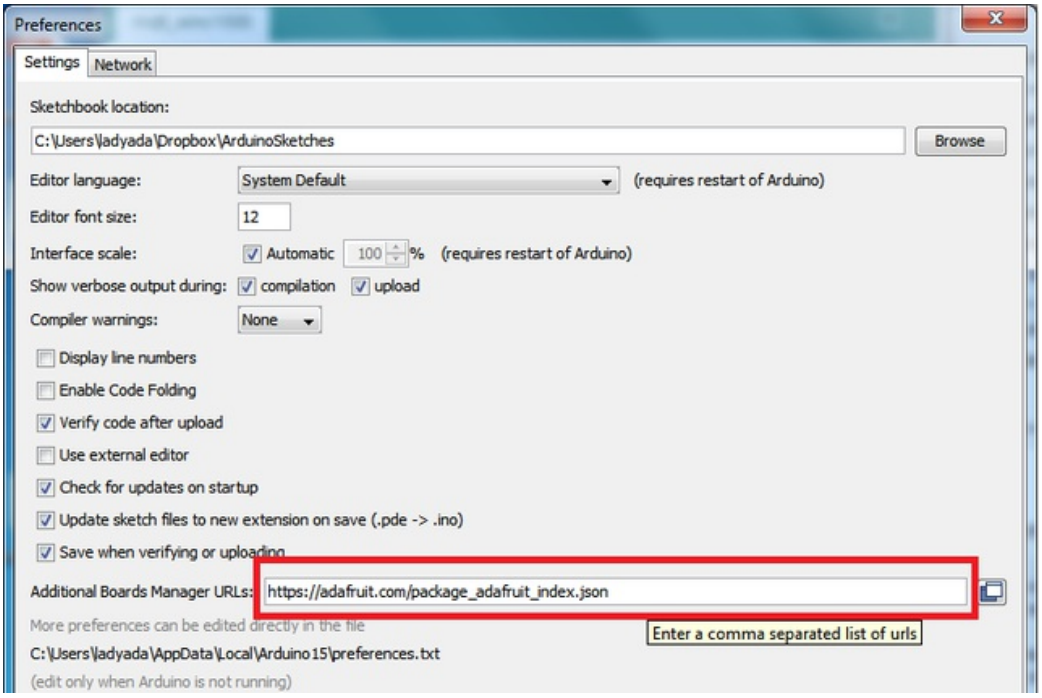
A dialog will pop up just like the one shown below.



We will be adding a URL to the new **Additional Boards Manager URLs** option. The list of URLs is comma separated, and *you will only have to add each URL once.* New Adafruit boards and updates to existing boards will automatically be picked up by the Board Manager each time it is opened. The URLs point to index files that the Board Manager uses to build the list of available & installed boards.

To find the most up to date list of URLs you can add, you can visit the list of third party board URLs on the Arduino IDE wiki (http://adafru.it/f7U). We will only need to add one URL to the IDE in this example, but ***you can add multiple URLS by separating them with commas***. Copy and paste the link below into the **Additional Boards Manager URLs** option in the Arduino IDE preferences.

https://adafruit.github.io/arduino-board-index/package_adafruit_index.json



Here's a short description of each of the Adafruit supplied packages that will be available in the Board Manager when you add the URL:

- **Adafruit AVR Boards** - Includes support for Flora, Gemma, Feather 32u4, Trinket, & Trinket Pro.
- **Adafruit SAMD Boards** - Includes support for Feather M0
- **Arduino Leonardo & Micro MIDI-USB** - This adds MIDI over USB support for the Flora, Feather 32u4, Micro and Leonardo using the arcore project (http://adafru.it/eSI).

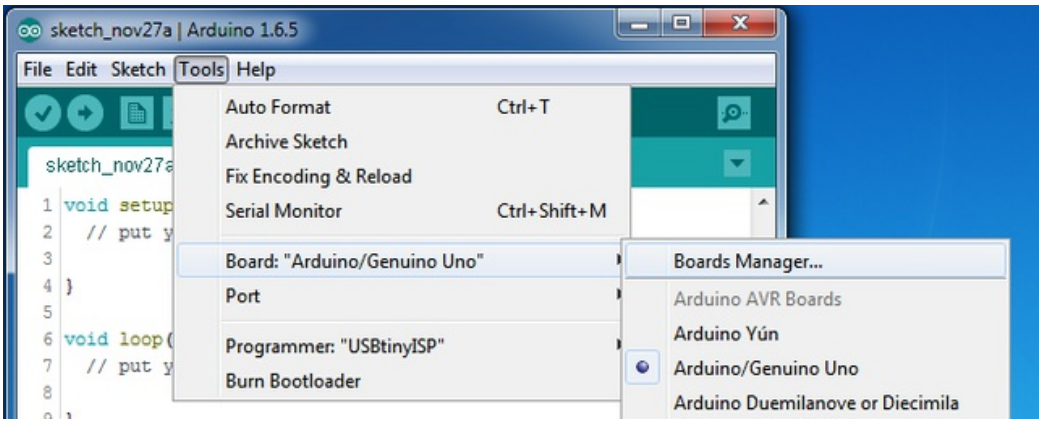
If you have multiple boards you want to support, say ESP8266 and Adafruit, have both URLs in the text box separated by a comma (,)

Once done click **OK** to save the new preference settings. Next we will look at installing boards with the Board Manager.

Using with Arduino IDE

Since the Feather M0 uses an ATSAMD21 chip running at 48 MHz, you can pretty easily get it working with the Arduino IDE. Most libraries (including the popular ones like NeoPixels and display) will work with the M0, especially devices & sensors that use i2c or SPI.

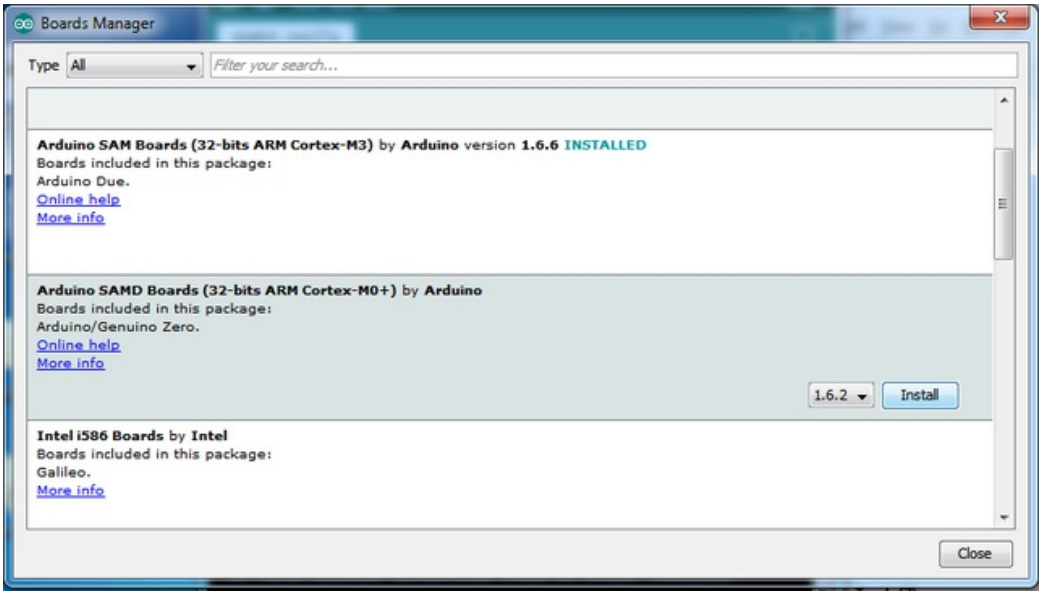
Now that you have added the appropriate URLs to the Arduino IDE preferences, you can open the **Boards Manager** by navigating to the **Tools->Board** menu.

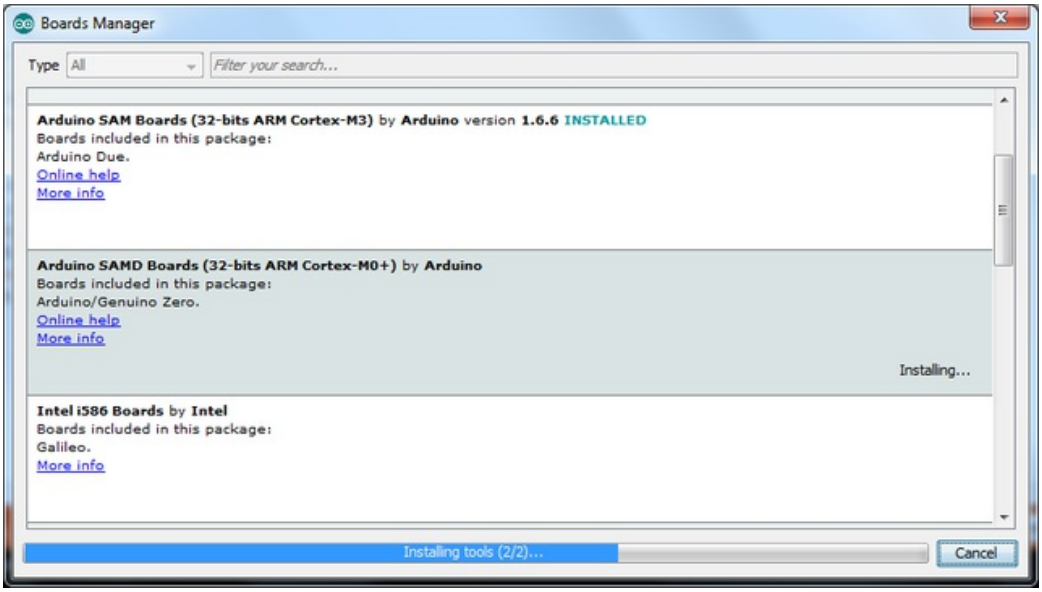


Once the Board Manager opens, click on the category drop down menu on the top left hand side of the window and select **Contributed**. You will then be able to select and install the boards supplied by the URLs added to the prefrences.

Install SAMD Support

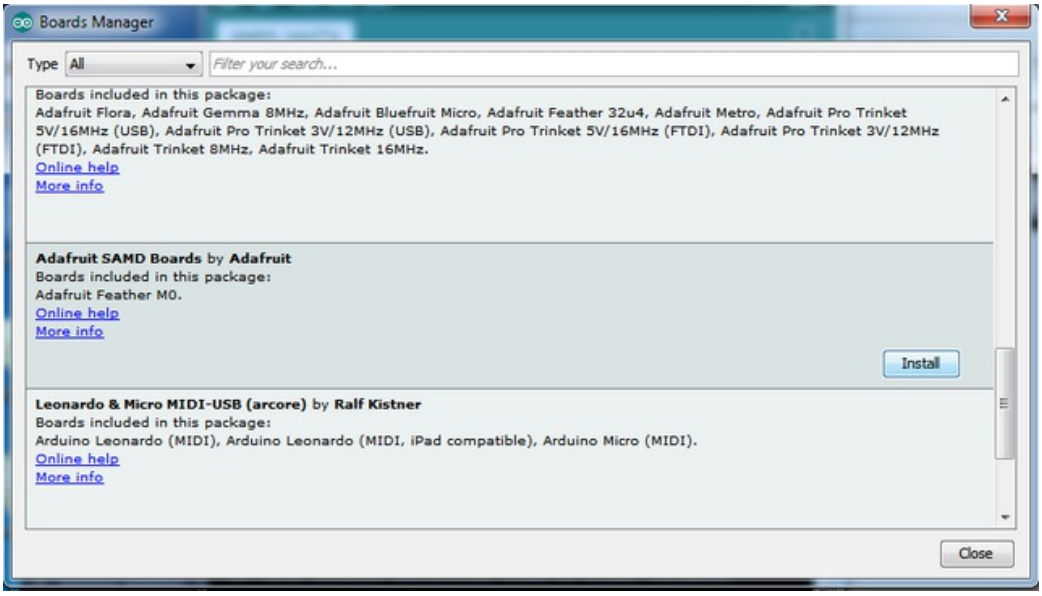
First up, install the **Arduino SAMD Boards** version **1.6.2** or later





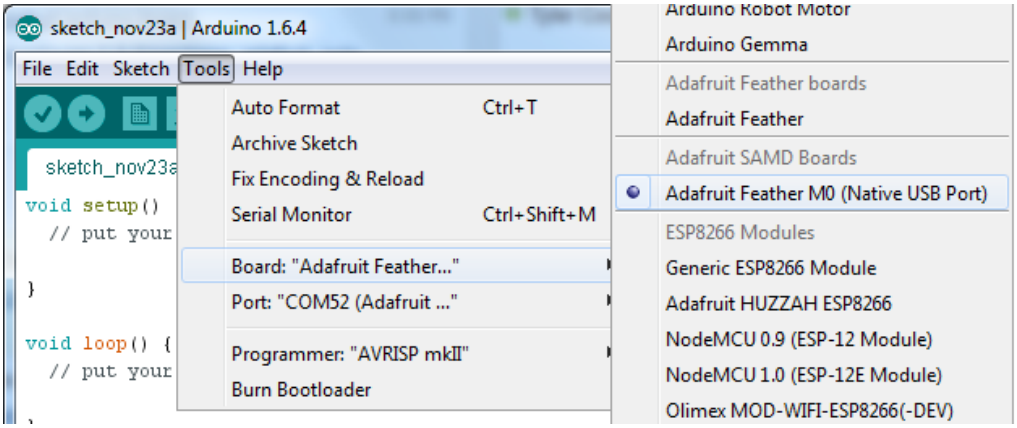
Install Adafruit SAMD

Next you can install the Adafruit SAMD package to add the board file definitions



Even though in theory you don't need to - I recommend rebooting the IDE

Quit and reopen the Arduino IDE to ensure that all of the boards are properly installed. You should now be able to select and upload to the new boards listed in the **Tools->Board** menu.



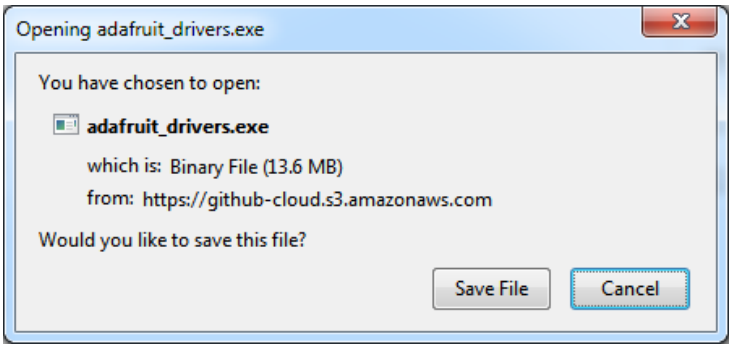
Install Drivers (Windows Only)

When you plug in the Feather, you'll need to possibly install a driver

Click below to download our Driver Installer

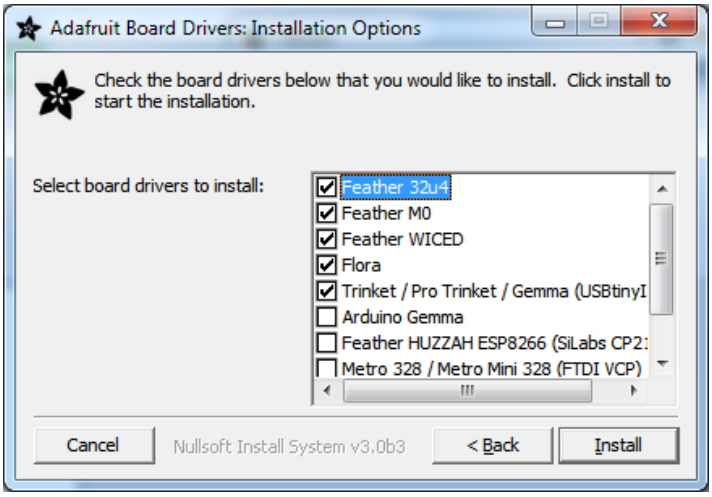
[Download Adafruit Driver Installer v1.1](http://adafru.it/vA7)
http://adafru.it/vA7

Download and run the installer

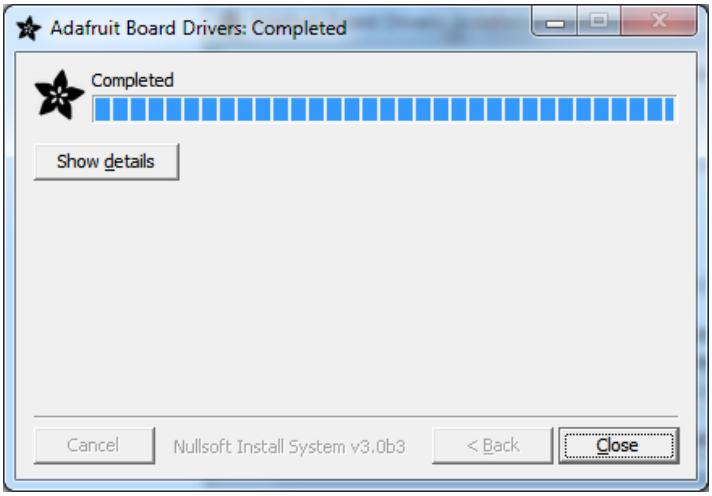


Run the installer! Since we bundle the SiLabs and FTDI drivers as well, you'll need to click through the license

Select which drivers you want to install:



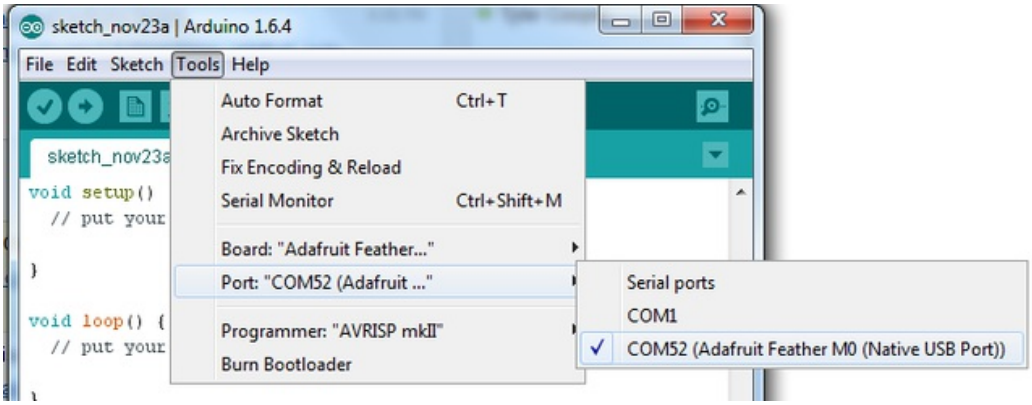
Click **Install** to do the installin'



Blink

Now you can upload your first blink sketch!

Plug in the Feather M0 and wait for it to be recognized by the OS (just takes a few seconds). It will create a serial/COM port, you can now select it from the dropdown, it'll even be 'indicated' as Feather M0!



Now load up the Blink example

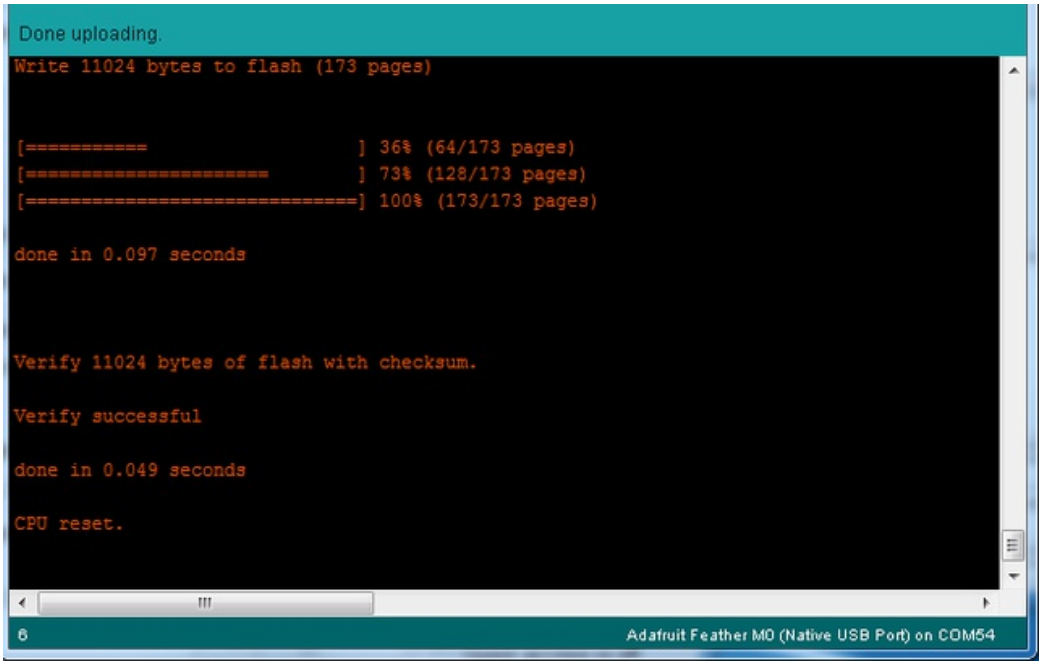
```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

And click upload! That's it, you will be able to see the LED blink rate change as you adapt the **delay()** calls.

Sucessful Upload

If you have a successful upload, you'll get a bunch of red text that tells you that the device was found and it was programmed, verified & reset

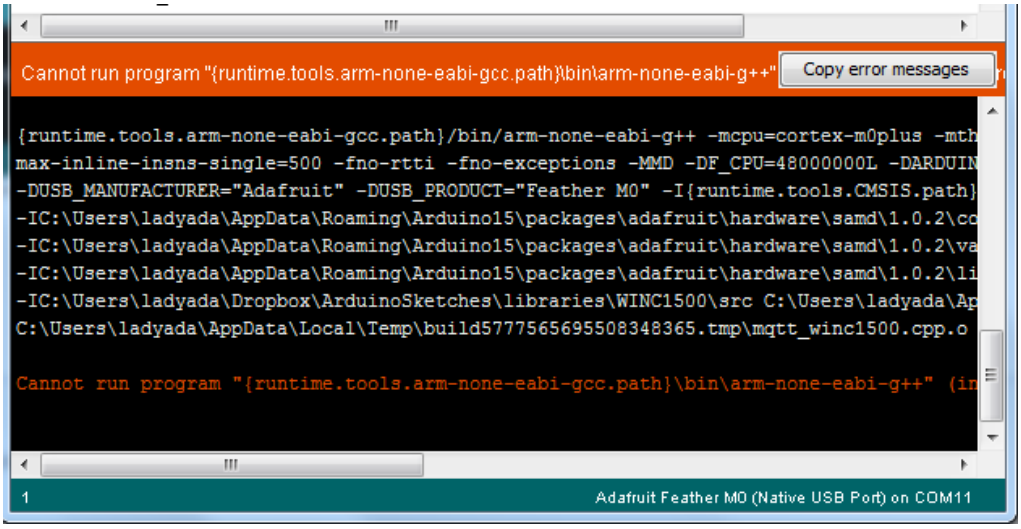


Compilation Issues

If you get an alert that looks like

Cannot run program "{runtime.tools.arm-none-eabi-gcc.path}\bin\arm-non-eabi-g++"

Make sure you have installed the **Arduino SAMD** boards package, you need *both* Arduino & Adafruit SAMD board packages

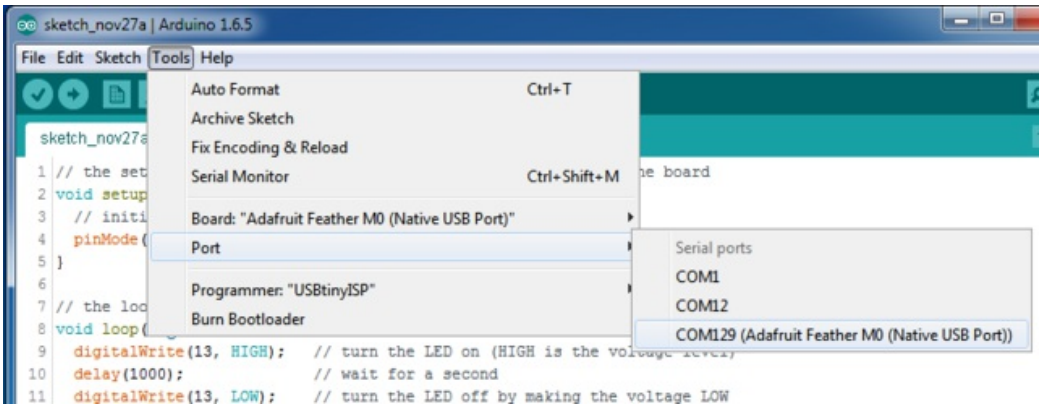


Manually bootloading

If you ever get in a 'weird' spot with the bootloader, or you have uploaded code that crashes and doesn't auto-reboot into the bootloader, click the **RST** button **twice** (like a double-click)to get back into the bootloader.

The red LED will pulse, so you know that its in bootloader mode.

Once it is in bootloader mode, you can select the newly created COM/Serial port and re-try uploading.



You may need to go back and reselect the 'normal' USB serial port next time you want to use the normal upload.

Ubuntu & Linux Issue Fix

Note if you're using Ubuntu 15.04 (or perhaps other more recent Linux distributions) there is an issue with the modem manager service which causes the Bluefruit LE micro to be difficult to program. If you run into errors like "device or resource busy", "bad file descriptor", or "port is busy" when attempting to program then [you are hitting this issue.](http://adafru.it/sHE)

The fix for this issue is to make sure Adafruit's custom udev rules are applied to your system. One of these rules is made to configure modem manager not to touch the Feather board and will fix the programming difficulty issue. [Follow the steps for installing Adafruit's udev rules on this page.](http://adafru.it/iOE)

Adapting Sketches to M0

The ATSAMD21 is a very nice little chip but its fairly new as Arduino-compatible cores go**Most** sketches & libraries will work but here's a few things we noticed!

Analog References

If you'd like to use the**ARef** pin for a non-3.3V analog reference, the code to use is`analogReference(AR_EXTERNAL)` (it's AR_EXTERNAL not EXTERNAL)

Pin Outputs & Pullups

The old-style way of turning on a pin as an input with a pullup is to use

```
pinMode(pin, INPUT)
digitalWrite(pin, HIGH)
```

This is because the pullup-selection register is the same as the output-selection register.

For the M0, you can't do this anymore! Instead, use

```
pinMode(pin, INPUT_PULLUP)
```

which has the benefit of being backwards compatible with AVR.

Serial vs SerialUSB

99.9% of your existing Arduino sketches use**Serial.print** to debug and give output. For the Official Arduino SAMD/M0 core, this goes to the Serial5 port, which isn't exposed on the Feather. The USB port for the Official Arduino M0 core, is called **SerialUSB** instead.

In the Adafruit M0 Core, we fixed it so that Serial goes to USB when you use a Feather M0 so it will automatically work just fine.

However, on the off chance you are using the official Arduino SAMD core & you want your Serial prints and reads to use the USB port, use **SerialUSB** instead of Serial in your sketch

If you have existing sketches and code and you want them to work with the M0 without a huge find-replace, put

```
#if defined(ARDUINO_SAMD_ZERO) && defined(SERIAL_PORT_USBVIRTUAL)
  // Required for Serial on Zero based boards
  #define Serial SERIAL_PORT_USBVIRTUAL
#endif
```

right above the first function definition in your code. For example:

AnalogWrite / PWM

After looking through the SAMD21 datasheet, we've found that some of the options listed in the multiplexer table don't exist on the specific chip used in the Feather M0.

For all SAMD21 chips, there are two peripherals that can generate PWM signals: The Timer/Counter (TC) and Timer/Counter for Control Applications (TCC). Each SAMD21 has multiple copies of each, called 'instances'.

Each TC instance has one count register, one control register, and two output channels. Either channel can be enabled and disabled, and either channel can be inverted. The pins connected to a TC instance can output identical versions of the same PWM waveform, or complementary waveforms.

Each TCC instance has a single count register, but multiple compare registers and output channels. There are options for different kinds of waveform, interleaved switching, programmable dead time, and so on.

The biggest members of the SAMD21 family have five TC instances with two 'waveform output' (WO) channels, and three TCC instances with eight WO channels:

- TC[0-4],WO[0-1]
- TCC[0-2],WO[0-7]

And those are the ones shown in the datasheet's multiplexer tables.

The SAMD21G used in the Feather M0 only has three TC instances with two output channels, and three TCC instances with eight output channels:

- **TC[3-5],WO[0-1]**
- **TCC[0-2],WO[0-7]**

Tracing the signals to the pins broken out on the Feather M0, the following pins can't do PWM at all:

- **Analog pin A5**

The following pins can be configured for PWM without any signal conflicts as long as the SPI, I2C, and UART pins keep their protocol functions:

- **Digital pins 5, 6, 9, 10, 11, 12, and 13**
- **Analog pins A3 and A4**

If only the SPI pins keep their protocol functions, you can also do PWM on the following pins:

- **TX and SDA (Digital pins 1 and 20)**

Missing header files

there might be code that uses libraries that are not supported by the M0 core. For example if you have a line with

```
#include <util/delay.h>
```

you'll get an error that says

```
fatal error: util/delay.h: No such file or directory
  #include <util/delay.h>
                       ^
compilation terminated.
Error compiling.
```

In which case you can simply locate where the line is (the error will give you the file name and line number) and 'wrap it' with #ifdef's so it looks like:

```
#if !defined(ARDUINO_ARCH_SAM) && !defined(ARDUINO_ARCH_SAMD) && !defined(ESP8266) && !defined(ARDUINO_ARCH_STM32F2)
 #include <util/delay.h>
#endif
```

The above will also make sure that header file isn't included for other architectures

If the #include is in the arduino sketch itself, you can try just removing the line.

Bootloader Launching

For most other AVRs, clicking **reset** while plugged into USB will launch the bootloader manually, the bootloader will time out after a few seconds. For the M0, you'll need to *double click* the button. You will see a pulsing red LED to let you know you're in bootloader mode. Once in that mode, it wont time out! Click reset again if you want to go back to launching code

Aligned Memory Access

This is a little less likely to happen to you but it happened to me! If you're used to 8-bit platforms, you can do this nice thing where you can typecast variables around. e.g.

```
uint8_t mybuffer[4];
float f = (float)mybuffer;
```

You can't be guaranteed that this will work on a 32-bit platform because **mybuffer** might not be aligned to a 2 or 4-byte boundary. The ARM Cortex-M0 can only directly access data on 16-bit boundaries (every 2 or 4 bytes). Trying to access an odd-boundary byte (on a 1 or 3 byte location) will cause a Hard Fault and stop the MCU. Thankfully, there's an easy work around ... just use memcpy!

```
uint8_t mybuffer[4];
float f;
memcpy(f, mybuffer, 4)
```

Floating Point Conversion

Like the AVR Arduinos, the M0 library does not have full support for converting floating point numbers to ASCII strings. Functions like sprintf will not convert floating point. Fortunately, the standard AVR-LIBC library includes the dtostrf function which can handle the conversion for you.

Unfortunately, the M0 run-time library does not have dtostrf. You may see some references to using **#include <avr/dtostrf.h>** to get dtostrf in your code. And while it will compile, it does **not** work.

Instead, check out this thread to find a working dtostrf function you can include in your code:

http://forum.arduino.cc/index.php?topic=368720.0 (http://adafru.it/IFS)

How Much RAM Available?

The ATSAMD21G18 has 32K of RAM, but you still might need to track it for some reason. You can do so with this handy function:

```
extern "C" char *sbrk(int i);

int FreeRam () {
  char stack_dummy = 0;
  return &stack_dummy - sbrk(0);
}
```

Thx to http://forum.arduino.cc/index.php?topic=365830.msg2542879#msg2542879 (http://adafru.it/m6D) for the tip!

Storing data in FLASH

If you're used to AVR, you've probably used **PROGMEM** to let the compiler know you'd like to put a variable or string in flash memory to save on RAM. On the ARM, its a little easier, simply add **const** before the variable name:

const char str[] = "My very long string";

That string is now in FLASH. You can manipulate the string just like RAM data, the compiler will automatically read from FLASH so you dont need special progmem-knowledgeable functions.

You can verify where data is stored by printing out the address:
Serial.print("Address of str $"); Serial.println((int)&str, HEX);

If the address is $2000000 or larger, its in SRAM. If the address is between $0000 and $3FFFF Then it is in FLASH

Feather HELP!

My Feather stopped working when I unplugged the USB!

A lot of our example sketches have a

```
while (!Serial);
```

line in setup(), to keep the board waiting until the USB is opened. This makes it a lot easier to debug a program because you get to see all the USB data output. If you want to run your Feather without USB connectivity, delete or comment out that line

My Feather never shows up as a COM or Serial port in the Arduino IDE

A vast number of Feather 'failures' are due to charge-only USB cables

We get upwards of 5 complaints a day that turn out to be due to charge-only cables!

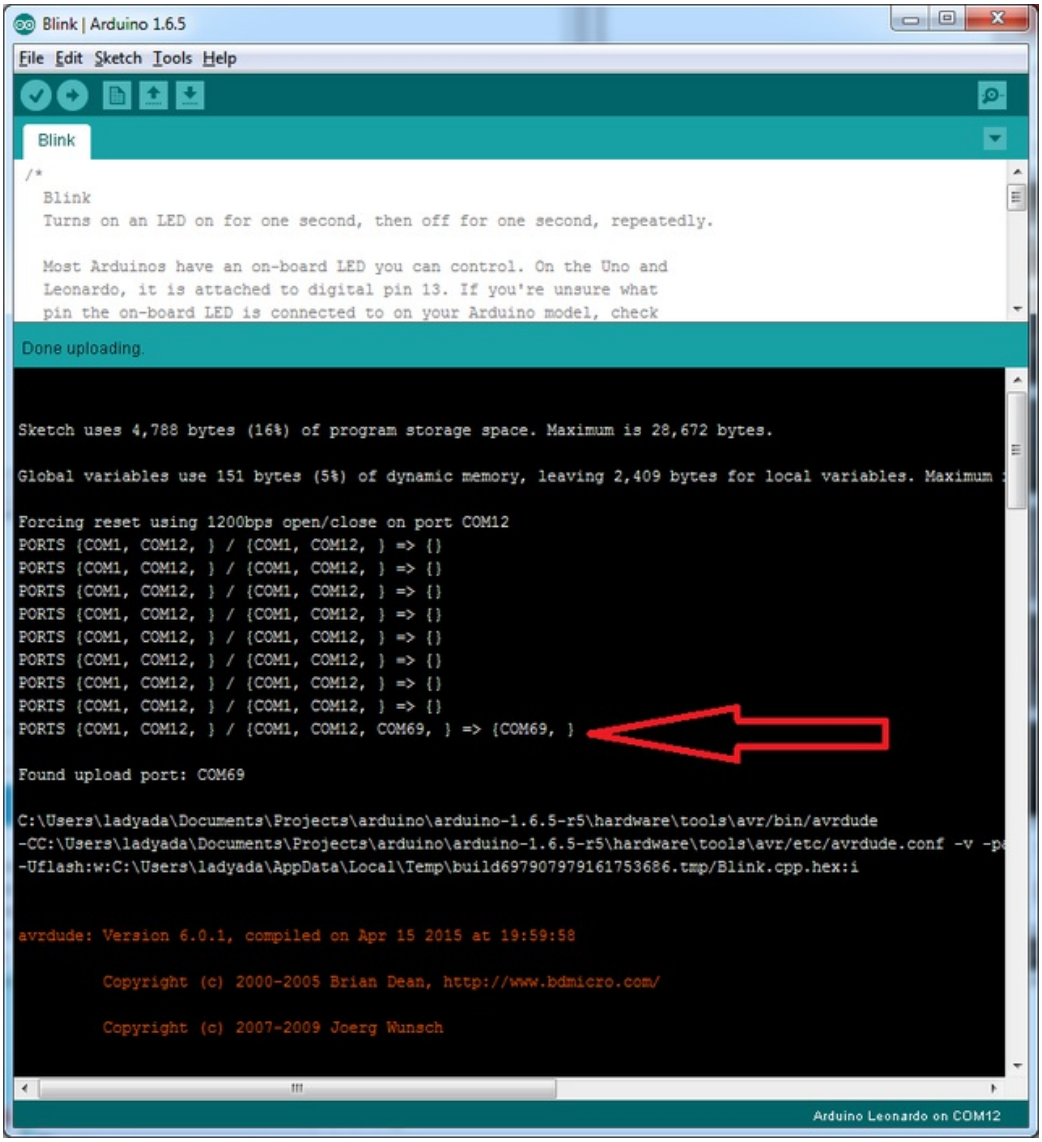
Use only a cable that you **know** is for data syncing

If you have any charge-only cables, cut them in half throw them out. We are serious! They tend to be low quality in general, and will only confuse you and others later, just get a good data+charge USB cable

Ack! I "did something" and now when I plug in the Feather, it doesn't show up as a device anymore so I cant upload to it or fix it...

No problem! You can 'repair' a bad code upload easily. Note that this can happen if you set a watchdog timer or sleep mode that stops USB, or any sketch that 'crashes' your Feather

1. Turn on **verbose upload** in the Arduino IDE preferences
2. Plug in feather 32u4/M0, it won't show up as a COM/serial port that's ok
3. Open up the Blink example (Examples->Basics->Blink)
4. Select the correct board in the Tools menu, e.g. Feather 32u4 or Feather M0 (check your board to make sure you have the right one selected!)
5. Compile it (make sure that works)
6. Click Upload to attempt to upload the code
7. The IDE will print out a bunch of COM Ports as it tries to upload **During this time, double-click the reset button, you'll see the red pulsing LED that tells you its now in bootloading mode**
8. The Feather will show up as the Bootloader COM/Serial port
9. The IDE should see the bootloader COM/Serial port and upload properly



I can't get the Feather USB device to show up - I get "USB Device Malfunctioning" errors!

This seems to happen when people select the wrong board from the Arduino Boards menu.

If you have a Feather 32u4 (look on the board to read what it is you have) Make sure you select **Feather 32u4** for ATMega32u4 based boards! Do not use anything else, do not use the 32u4 breakout board line.

If you have a Feather M0 (look on the board to read what it is you have) Make sure you select **Feather M0** - do not use 32u4 or Arduino Zero

I'm having problems with COM ports and my Feather 32u4/M0

Theres **two** COM ports you can have with the 32u4/M0, one is the **user port** and one is the **bootloader port**. They are not the same COM port number!

When you upload a new user program it will come up with a user com port, particularly if you use Serial in your user program.

If you crash your user program, or have a program that halts or otherwise fails, the user com port can disappear.

When the user COM port disappears, Arduino will not be able to automatically start the bootloader and upload new software.

So you will need to help it by performing the click-during upload procedure to re-start the bootloader, and upload something that is known working like "Blink"

I don't understand why the COM port disappears, this does not happen on my Arduino UNO!

UNO-type Arduinos have a *seperate* serial port chip (aka "FTDI chip" or "Prolific PL2303" etc etc) which handles all serial port capability seperately than the main chip. This way if the main chip fails, you can always use the COM port.

M0 and 32u4-based Arduinos do not have a seperate chip, instead the main processor performs this task for you. It allows for a lower cost, higher power setup...but requires a little more effort since you will need to 'kick' into the bootloader manually once in a while

I'm trying to upload to my 32u4, getting "avrdude: butterfly_recv(): programmer is not responding" errors

This is likely because the bootloader is not kicking in and you are accidentally**trying to upload to thewrong COM port**

The best solution is what is detailed above: manually upload Blink or a similar working sketch by hand by manually launching the bootloader

I'm trying to upload to my Feather M0, and I get this error "Connecting to programmer: .avrdude: butterfly_recv(): programmer is not responding"

You probably don't have Feather M0 selected in the boards drop-down. Make sure you selected Feather M0.

I'm trying to upload to my Feather and i get this error "avrdude: ser_recv(): programmer is not responding"

You probably don't have Feather M0 / Feather 32u4 selected in the boards drop-down. Make sure you selected Feather M0 (or Feather 32u4).

CircuitPython Setup

CircuitPython is a derivative of MicroPython designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no upfront desktop software downloads. Simply download CircuitPython and drag it onto the drive that appears (only available on Express boards currently). Once installed, simply copy and edit files on the drive to iterate.

Downloading

The latest builds of CircuitPython are available from the GitHub release page. Binaries for different boards will be listed under the Downloads section. Pick the one that matches your board such as adafruit-circuitpython-feather_m0_express-0.9.3.bin for the new Feather M0 Express. Files that end with .bin can be flashed with esptool.py or bossac. Files ending in .uf2 can be flashed onto a virtual drive when in bootloader mode.

Click here to see the latest CircuitPython Releases
http://adafru.it/vIF

You will see a list of all available *flavors* of CircuitPython. Since we support a lot of different hardware, we have a long list of available downloads!

See below for which file to download!

Flashing

Flashing is the process of updating the CircuitPython core. It isn't needed for updating your own code.**There are two available methods: UF2 and bossac** UF2 flashing is only available on Express boards, they have a UF2-capable beta bootloader. Flashing via bossac is possible with both the Express bootloader and the original "Arduino" one. We recommend using UF2 if you can. If UF2 fails, or is not available, try bossac.

Regardless of what method you use, you must first get the board into the bootloader mode. This is done by double clicking the reset button. The board is in bootloader mode when the red led fades in and out. Boards with the status neopixel will also show USB status while the red led fades. Green means USB worked while red means the board couldn't talk to the computer. The first step to troubleshooting a red neopixel is trying a different USB cable to make sure its not a charge-only cable.

Flashing UF2

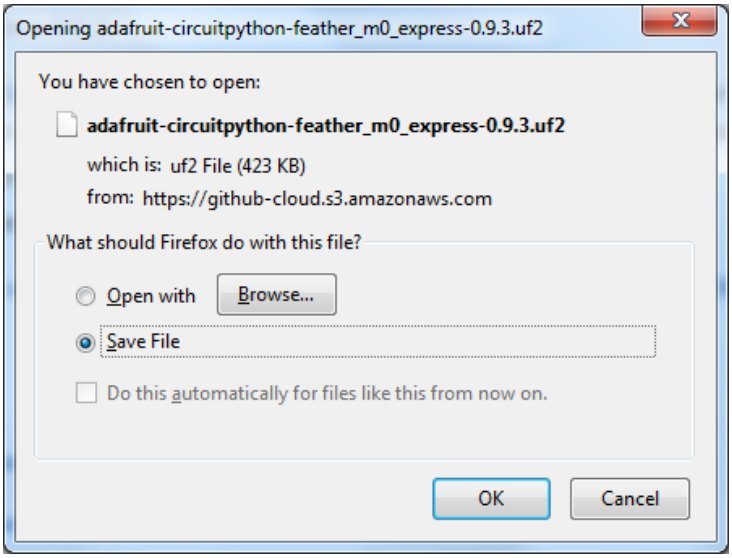
Adafruit Express boards come with a new beta bootloader called UF2 that makes flashing CircuitPython even easier than before. This beta bootloader allows you to drag so-called ".uf2" type files onto the BOOT drive. For more information, check out our UF2 bootloader page. (http://adafru.it/vQd)

Start by double-clicking the reset button while it is plugged into your computer. You should see a new disk drive 'pop up' called **FEATHERBOOT** or similar, and the NeoPixel on your board glow green.

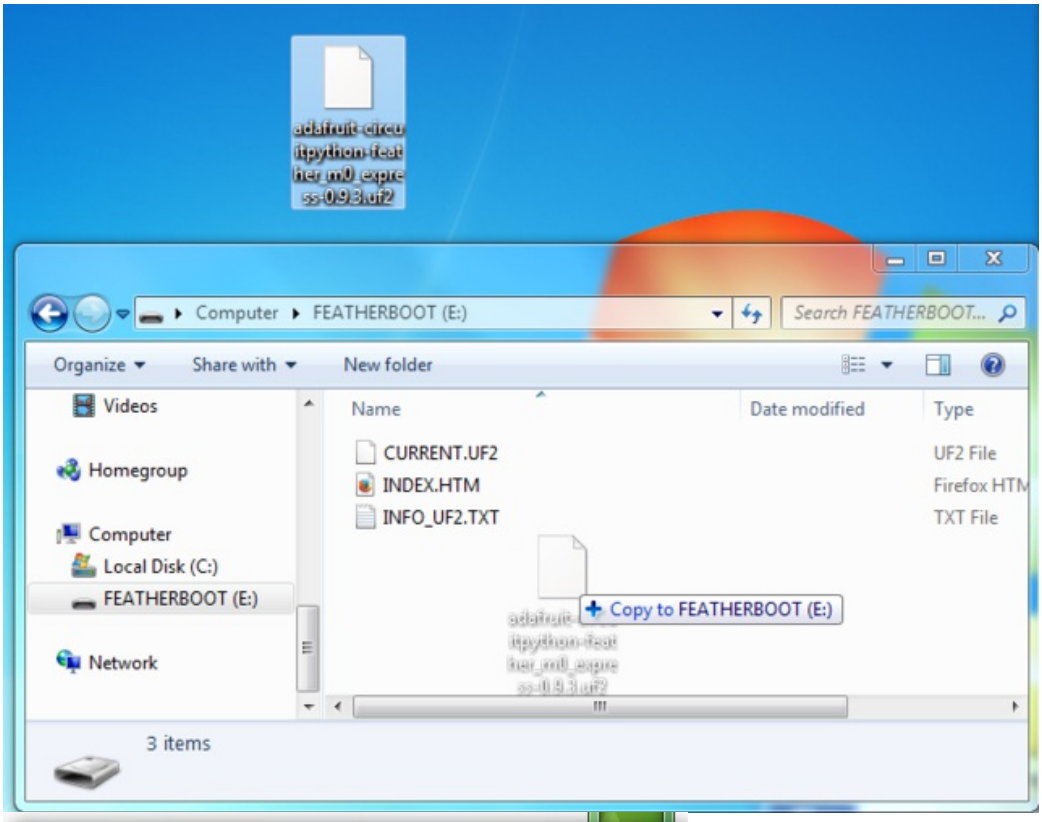
The drive will contain a few files. If you want to make a 'backup' of the current firmware on the device, drag-off and save the **CURRENT.UF2** file. Other that that you can ignore the index.htm and info_uf2.txt files. They cannot be deleted and are only for informational purposes.

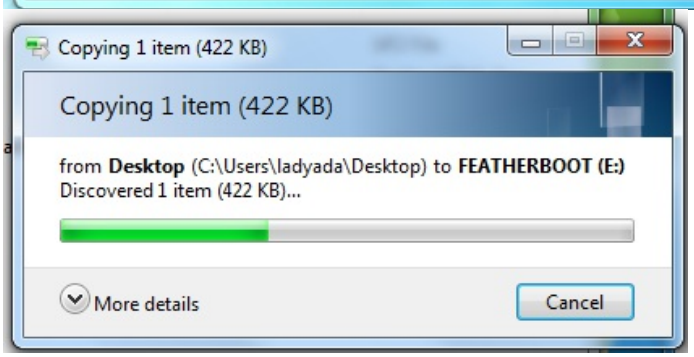
Next up, find the **Feather M0 Express UF2** file in the github downloads list:

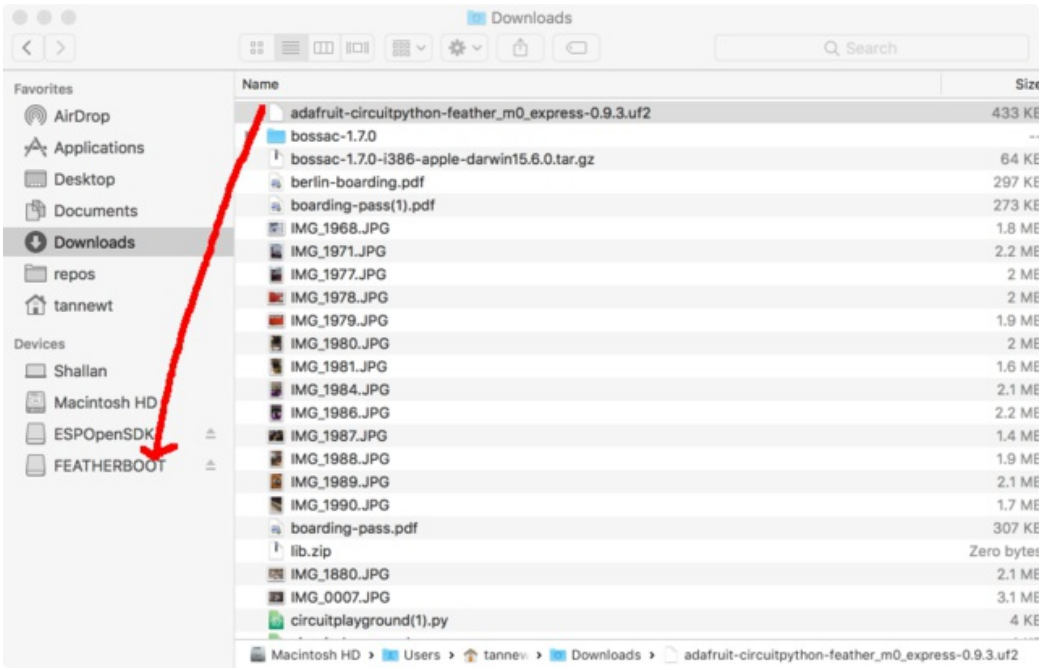
Click to download and save the file onto your Desktop or somewhere else you can find it



Then drag the **uf2** file into the BOOT drive







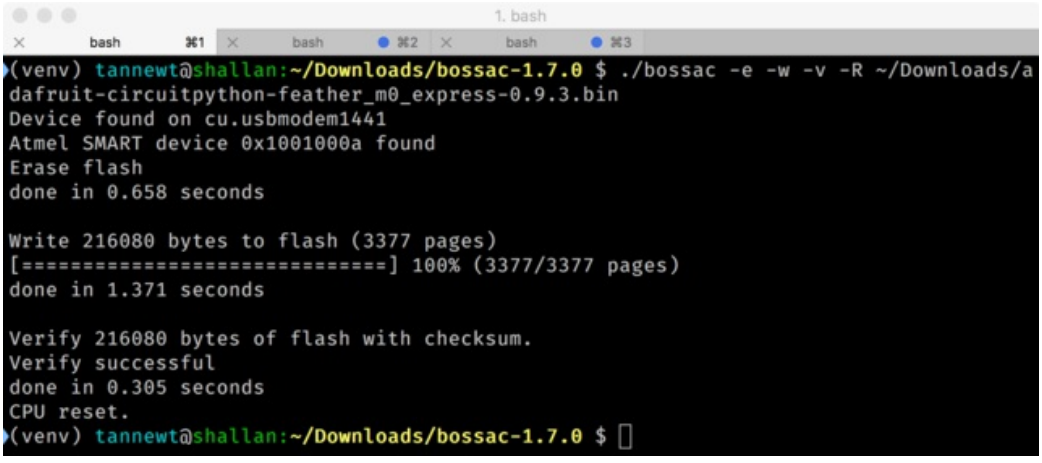
Once the full file has been received, the board will automatically restart into CircuitPython. Your computer may warn about ejecting the drive early, if it does, simply ignore it because the board made sure the file was received ok.

Flashing with BOSSAC

To flash with bossac (BOSSA's command line tool) first download the latest version fromhere. The mingw32 version is for Windows, apple-darwin for Mac OSX and various linux options for Linux. Once downloaded, extract the files from the zip and open the command line to the directory with bossac.

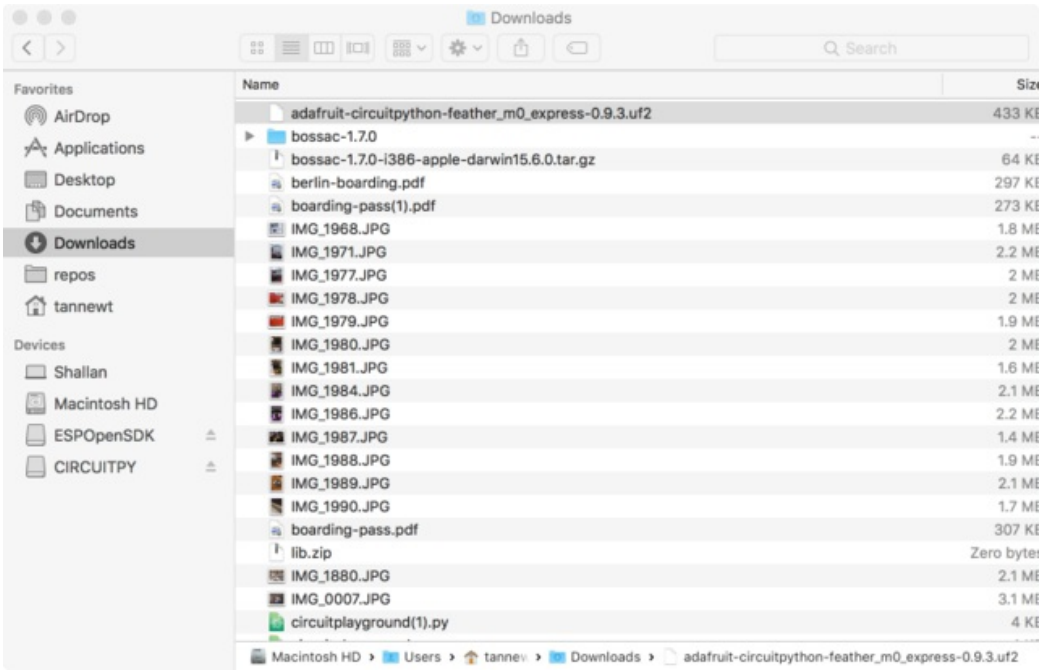
```
bossac -e -w -v -R ~/Downloads/adafruit-circuitpython-feather_m0_express-0.9.3.bin
```

This will erase the chip, write the given file, verify the write and Reset the board. After reset, CircuitPython should be running. Express boards may cause a warning of an early eject of a USB drive but just ignore it. Nothing important was being written to the drive.



After flashing

After a successful flash by bossac or UF2 you should see a CIRCUITPY drive appear.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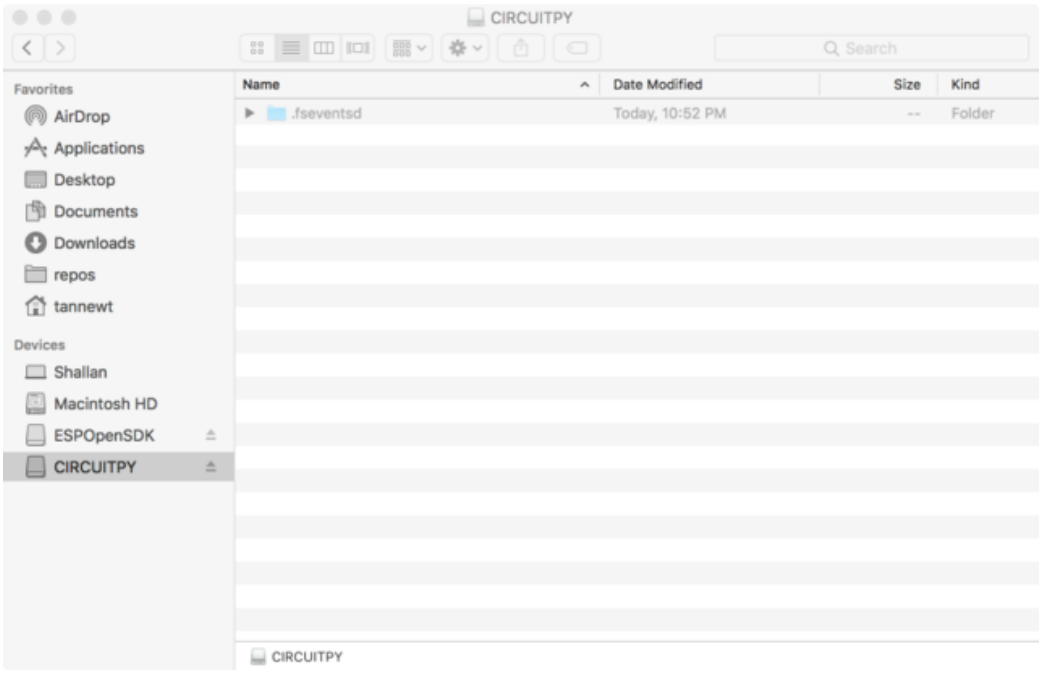
IMG_0007.JPG 3.1 MB
circuitplayground(1).py 4 KB
Macintosh HD › Users › tannew › Downloads › adafruit-circuitpython-feather_m0_express-0.9.3.uf2

CircuitPython Blinky

Let's get blinky going with CircuitPython to explore the way we can write code and confirm everything is working as expected.

code.py

After plugging in a board with CircuitPython into your computer a CIRCUITPY drive will appear. At first, the drive may be empty but you can create and edit files on it just like you would on a USB drive. On here, you can save a code.py (code.txt and main.py also work) file to run every time the board resets. This is the CircuitPython equivalent of an Arduino sketch. However, all of the compiling is done on the board itself. All you need to do is edit the file.



So, fire up your favorite text editor, such as Notepad on Windows, TextEdit on Mac ordownload Atom (my favorite), and create a new file. In the file copy this:

```
import digitalio
import board
import time

led = digitalio.DigitalInOut(board.D13)
led.switch_to_output()
while True:
    led.value = not led.value
    time.sleep(0.5)
```

Now, save the file to the drive ascode.txt (code.py also works). After a brief time, the board's red LED should begin to flash every second.

Status LED

While code.py is running the status neopixel will be solid green. After it is finished, the neopixel will fade green on

success or flash an error code on failure. Red flashes happen when data is written to the drive.

Debugging

Did the status LED flash a bunch of colors at you? You may have an error in your code. Don't worry it happens to everyone. Python code is checked when you run it rather than before like Arduino does when it compiles. To see the CircuitPython error you'll need to connect to the serial output (like Arduino's serial monitor).

See this guide for detailed instructions.

If you are new to Python try googling the error first, if that doesn't find an answer feel free to drop by the support forum.

Libraries

Using libraries with CircuitPython is also super easy. Simply drag and drop libraries onto the CIRCUITPY drive or into a lib folder on the drive to keep it tidy.

Find CircuitPython libraries on GitHub using the topic and through our tutorials.

Make sure the libraries are for CircuitPython and not MicroPython. There are some differences that may cause it to not work as expected.

More info

- Guides and Tutorials
- API Reference
- Adafruit forum
- Libraries

Downloads

Datasheets

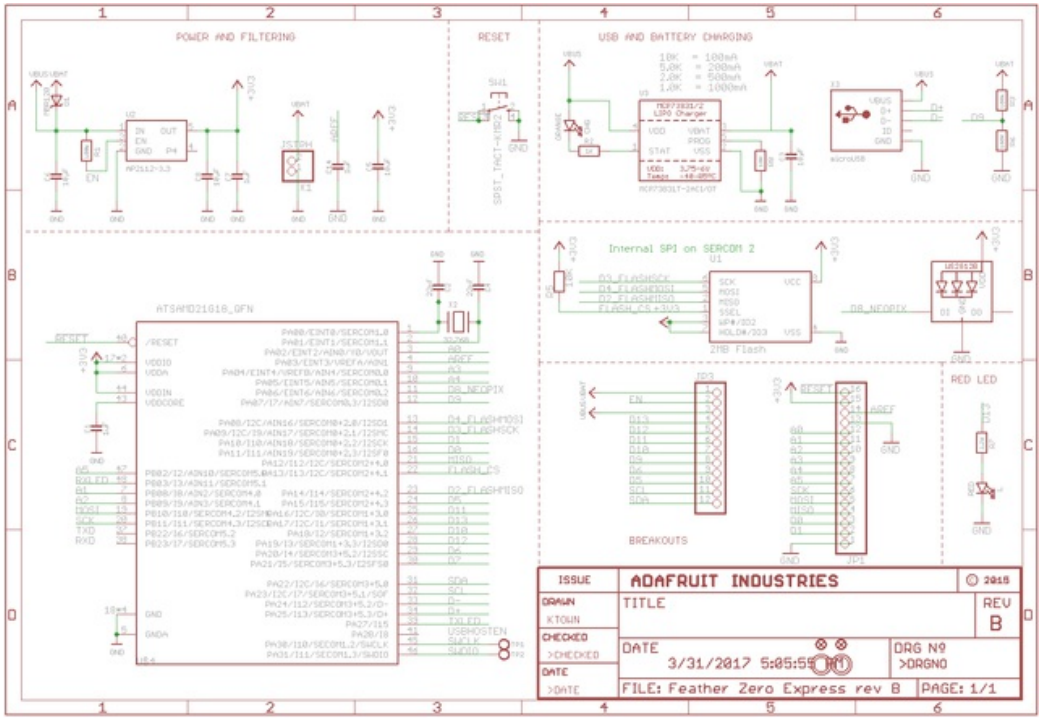
- ATSAMD21 Datasheet (http://adafru.it/kUf) (the main chip on the Feather M0)
- Fritzing object in the Adafruit Fritzing Library (http://adafru.it/aP3)
- EagleCAD PCB files in GitHub (http://adafru.it/vfS)

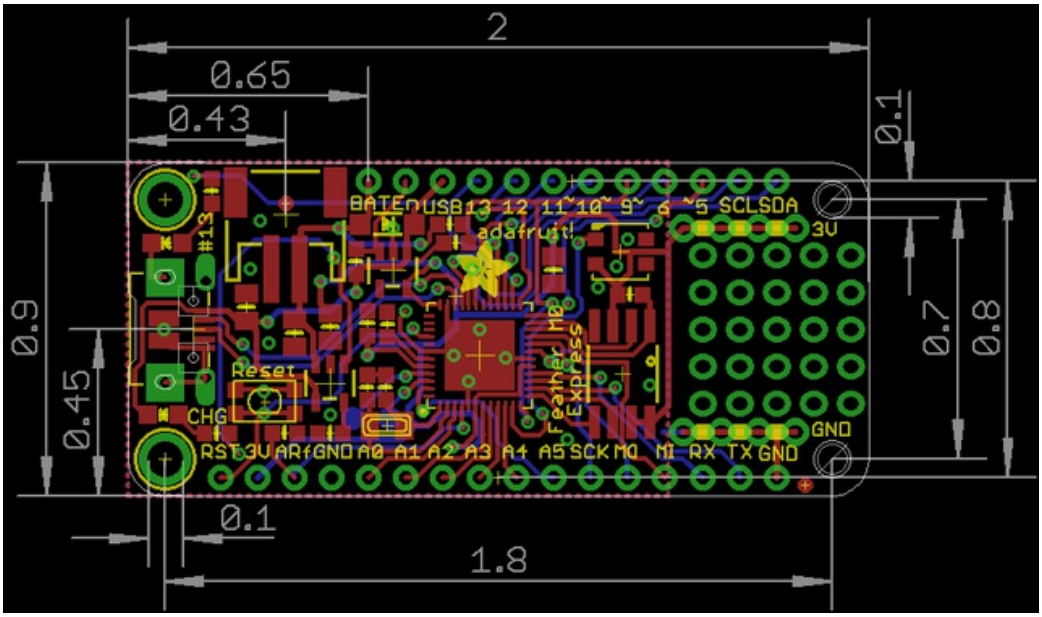
Feather M0 Express Pinout Diagram
http://adafru.it/vWd

Firmware

'Classic' Feather M0 Bootloader - You'll need to program it in using an ST-Link, JLink or other SWD-capable programmer. HEX available in the github repo (http://adafru.it/kFh)

Schematic & Fabrication Print

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