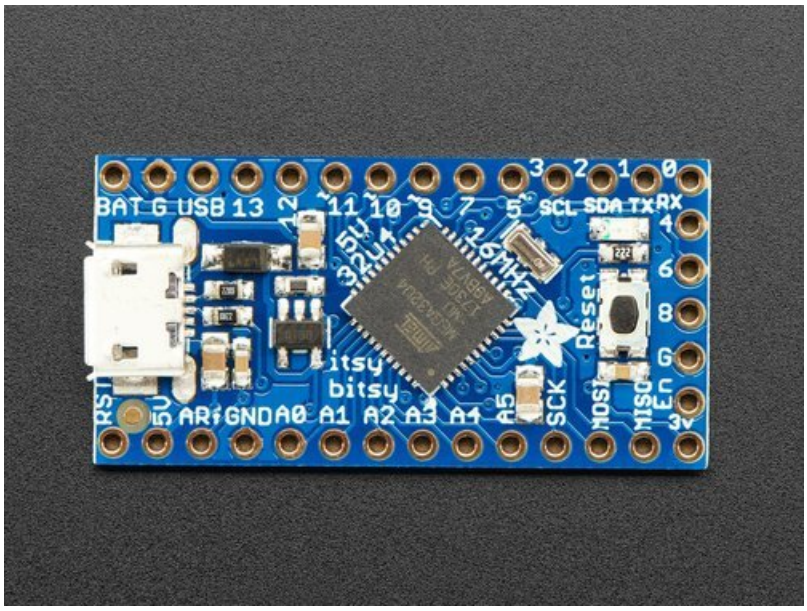
adafruit learning system

Introducing ItsyBitsy 32u4

Created by lady ada



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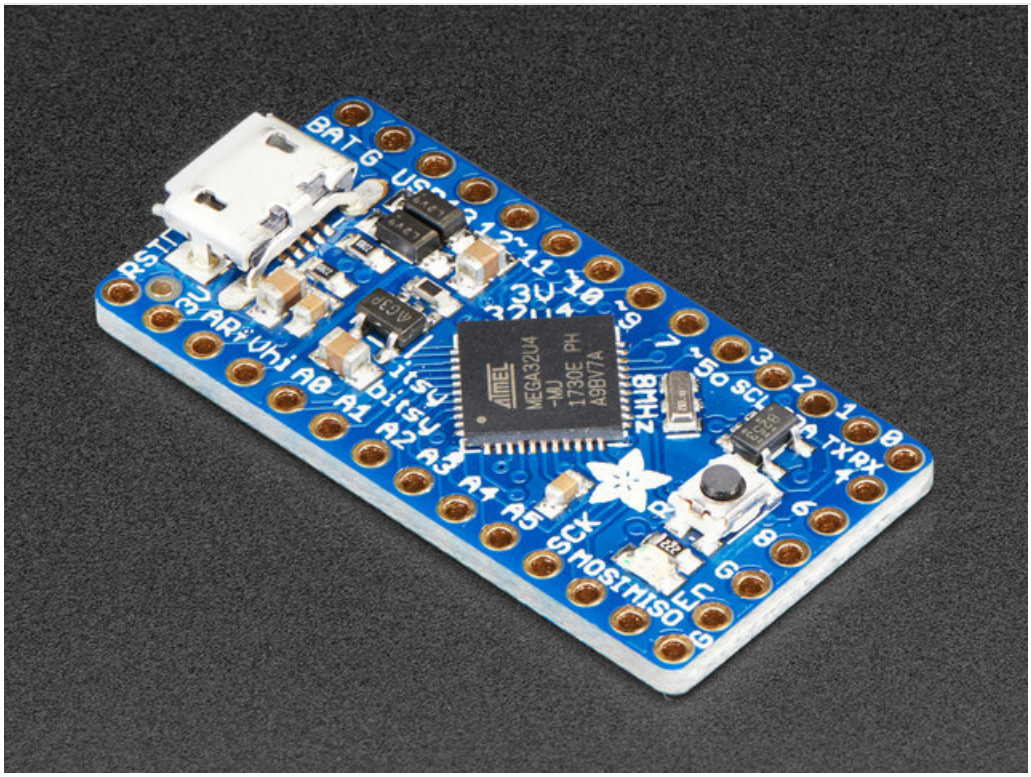
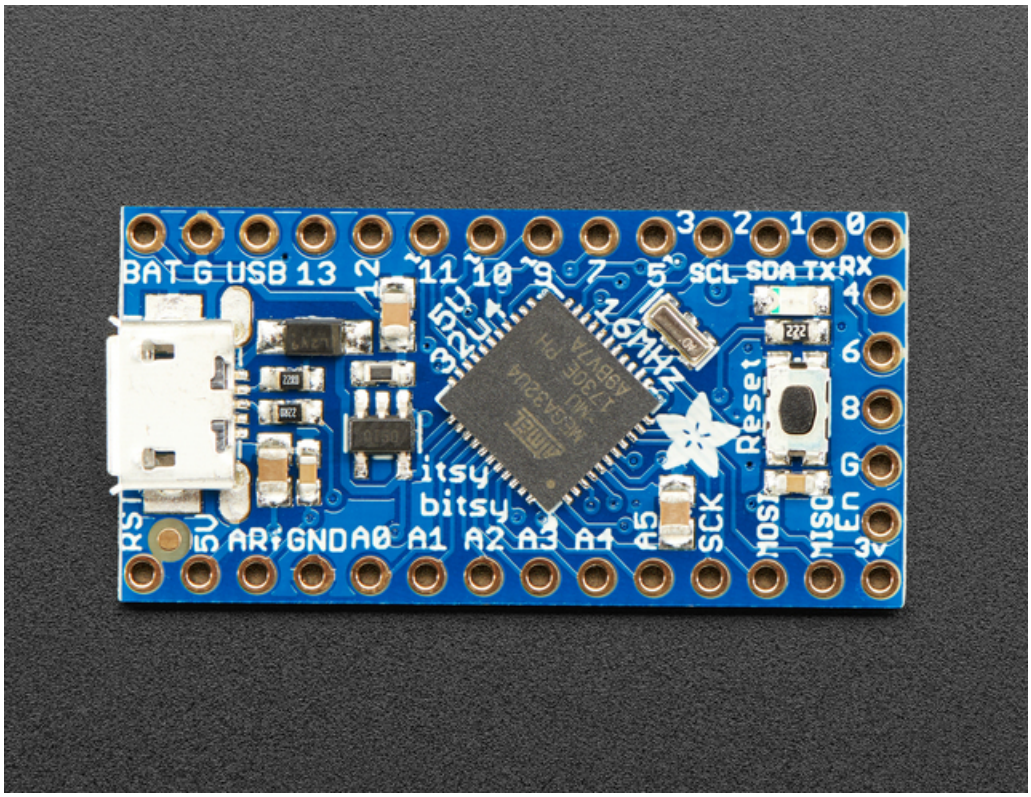
Overview



What's smaller than a Feather but larger than a Trinket? It's an ItsyBitsy! Small, powerful, Arduino-compatible - this microcontroller board is perfect when you want something very compact, but still with a bunch of pins.

ItsyBitsy 32u4 is only 1.4" long by 0.7" wide, but has 6 power pins, 6 analog & digital pins and 17 digital pins. It packs much of the same capability as an Arduino UNO. So it's great once you've finished up a prototype on a bigger Arduino, and want to make the project much smaller.



The **ItsyBitsy 32u4** uses the Atmega32u4 chip, which is the same core chip in the Arduino Leonardo as well as the same chip we use in our Feather 32u4. The **5V 16 MHz** It runs at the same speed and voltage of an Arduino UNO or Leonardo. The **3V 8 MHz** version is the same speed and voltage as a Feather 32u4. So you'll be happy to hear that not only is Itsy Bitsy programmable using the Arduino IDE as you already set up, but a vast number of Arduino projects will work out of the box!

We recommend this as an upgrade from the Pro Trinkets (https://adafru.it/dUf) because this has native USB so it will work with all computers, USB serial debugging, and a more reliable bootloader. You can even use the Pro Trinket LiPo backpack with this board to add recharge-able battery. (https://adafru.it/e0w)

Here's some handy specifications:

- ATmega32u4 onboad chip in QFN package
- USB bootloader with a nice LED indicator, AVR109 compatible (same as Flora, Feather 32u4, Leonardo, etc)
- Micro-USB jack for power, USB uploading and debugging, you can put it in a box or tape it up and use any Micro USB cable for when you want to reprogram.
- Can act as a USB HID Keyboard, Mouse, MIDI or plain USB 'CDC' serial device (default)
- Power with either USB or external output (such as a battery) into VBAT pin - it'll automatically switch over
- On-board red pin #13 LED
- 23 GPIO total - 6 analog in, 1x SPI port, 1x I2C port, 1x Hardware Serial port and 10 more GPIO, 4 of which have PWM
- Can drive NeoPixels, connect to sensors, servos, etc.
- Reset button for entering the bootloader or restarting the program.

For the 5V version:

- 5V power and logic, 16MHz clock rate, 2KB RAM and 28K FLASH
- On-board 5.0V power regulator with 150mA output capability and ultra-low dropout. Up to 16V input, reverse-

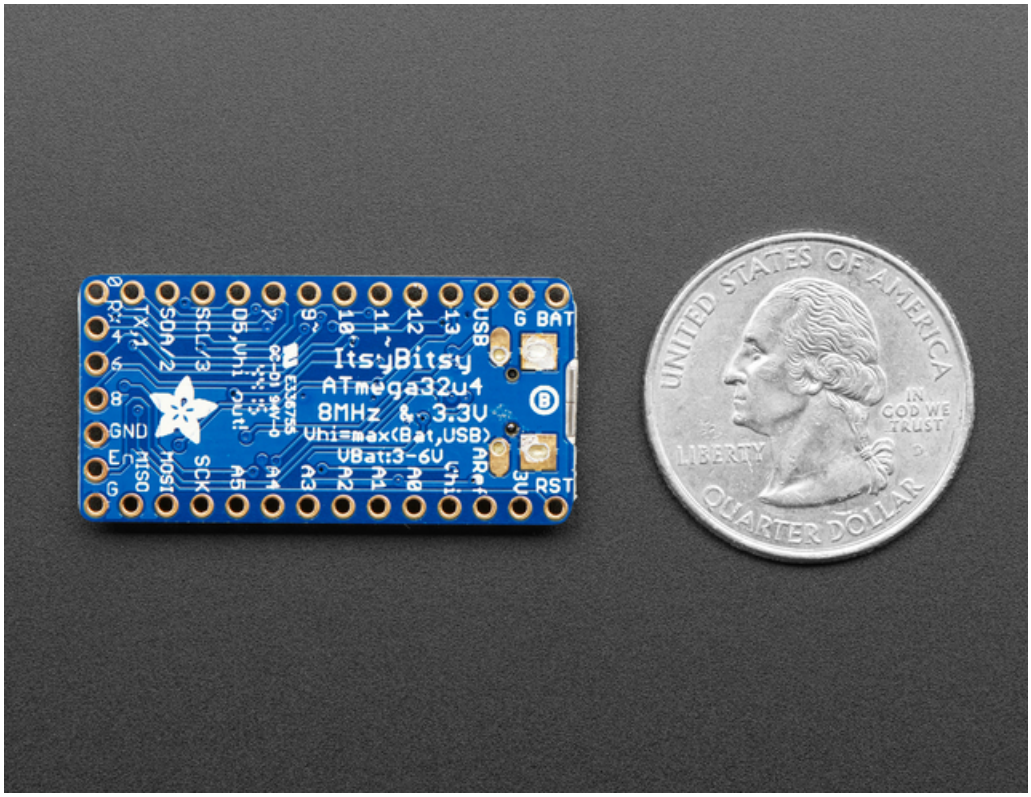
polarity protection, thermal and current-limit protection.
- Low current 3.3V regulator output from chip, for small sensors

For the 3V version:

We have two special pins on the 3V version of this board. There's a VHigh pin, this pin is a power pin whose voltage is the *higher* of VBAT and VUSB. We also made the digital #5 pin extra special on this board, it connects to a level shifter so it is *only an output* but the output is that 'high logic'. Basically what this means is if you want to drive NeoPixels, a picky servo, or a high-dropout-voltage LED from this board, and you want a 5V-logic-level output, this pin is the one you should use!

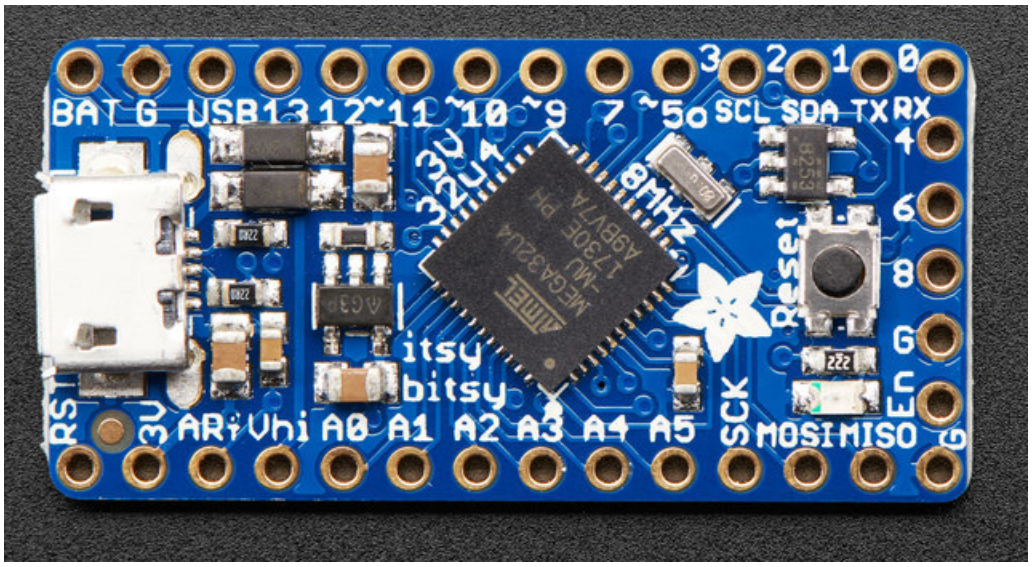
- 3.3V power and logic, 8 MHz clock rate, 2KB RAM and 28K FLASH
- On-board 3.3V power regulator with 500mA output capability and ultra-low dropout. Up to 6V input, reverse-polarity protection, thermal and current-limit protection.
- Special **Vhigh** output pin gives you the higher voltage from VBAT or VUSB, for driving NeoPixels, servos, and other high-current devices. **Digital 5** level-shifted output for high-voltage logic level output.

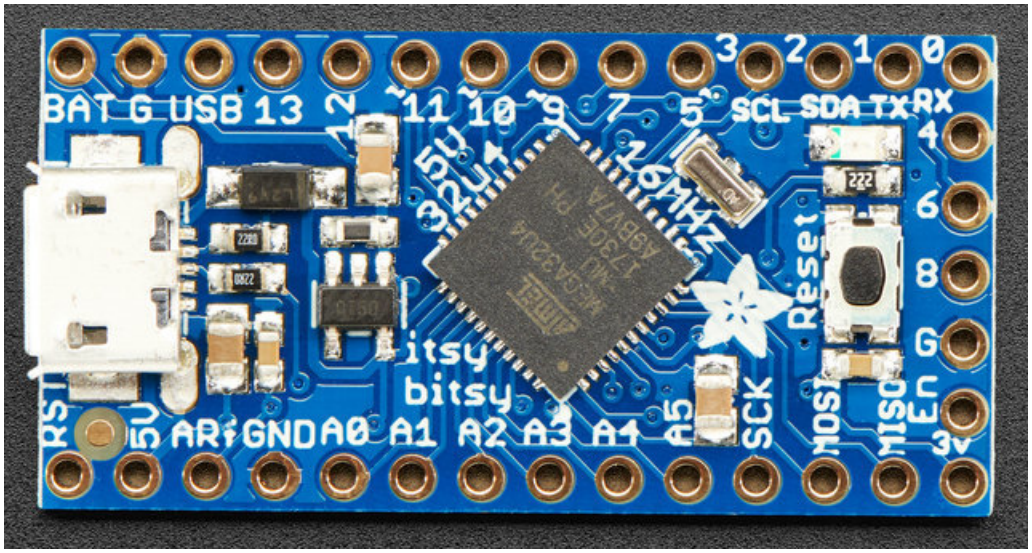
Once headers are installed they can be fitted into 0.6" wide sockets (https://adafru.it/ync)



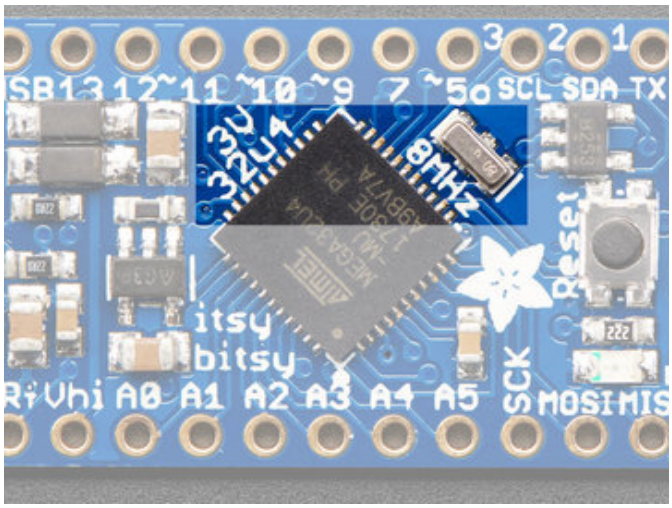
Pinouts

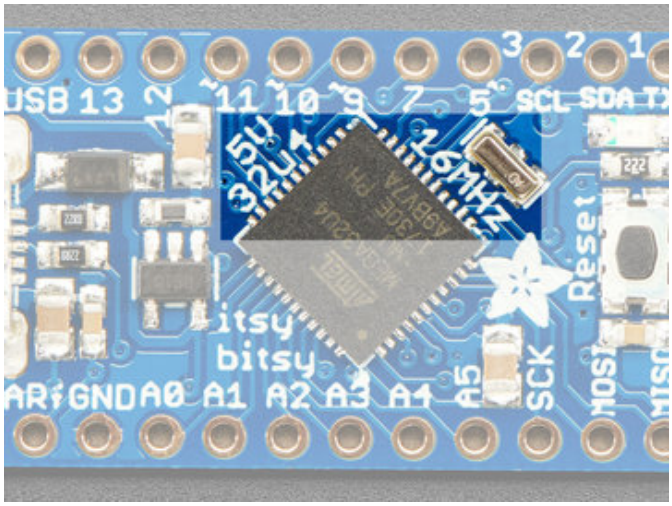
The ItsyBitsy 32u4's come in **two flavors - 5V** and **3V**.





The pinouts for these are very similar **except for the power pins which have different voltages!**





Which do you have?

Look in the middle of the board, you'll see either **32u4 3V 8MHz** or **32u4 5V 16 MHz**

Power Pins

Both ItsyBitsy 32u4's have **BAT G USB** on the top left, right next to the micro USB port

These pins are:

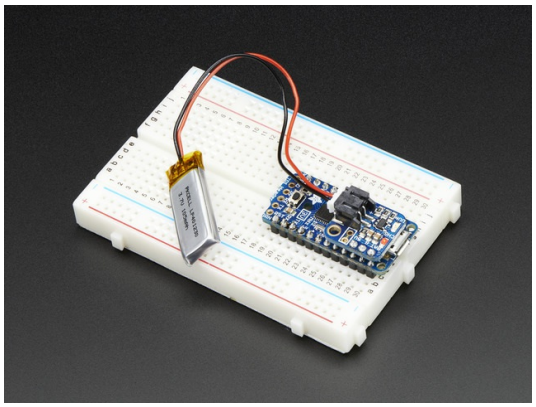
- **BAT** - battery *input* for an alternative power source to USB.
  On the **5V** itsy, this pin can be **5.5-16VDC**

On the **3V** Itsy, we have a different regulator, so the voltage can only be from **3.5V to 6VDC**

- **GND** - Power/data ground
- **USB** - This is the same pin as the MicroUSB connector's 5V USB power pin. This should be used as an *output* to get 5V power from the USB port. Say if you need to power a bunch of NeoPixels or servos.

You can always put any voltage you like into **BAT** and the circuitry will switch between **BAT** and **USB** dynamically for you. That means you can have a **Bat**ter backup that only gets enabled when USB is disconnected.

If you want to add rechargeable power, a LiPoly backpack can be soldered into these three pins that will let you have a battery that is *automatically recharged* whenever USB is plugged in, then switches to LiPoly when on the go:

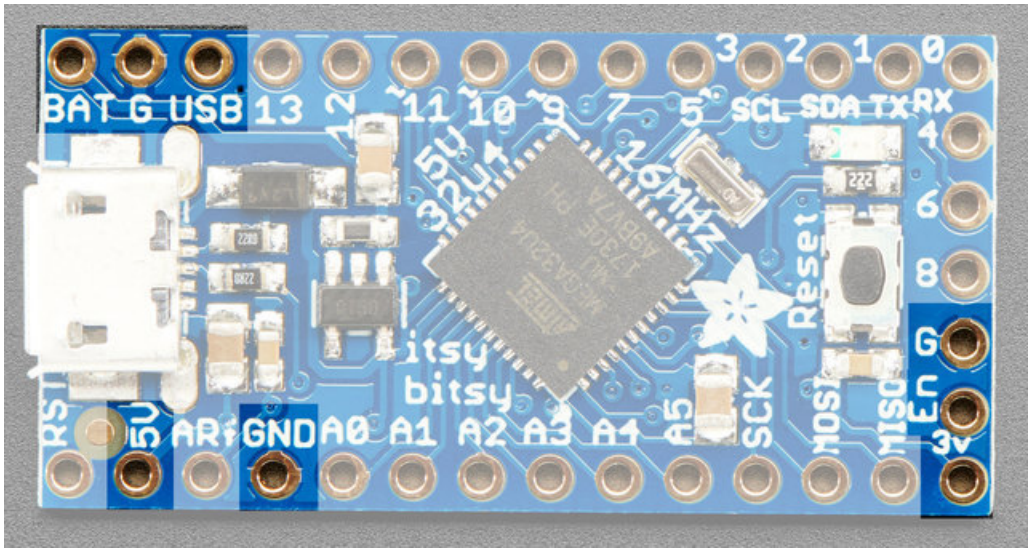


Adafruit Lilon/LiPoly Backpack Add-On for Pro Trinket/ItsyBitsy

$4.95
IN STOCK

ADD TO CART

5V Power Pins

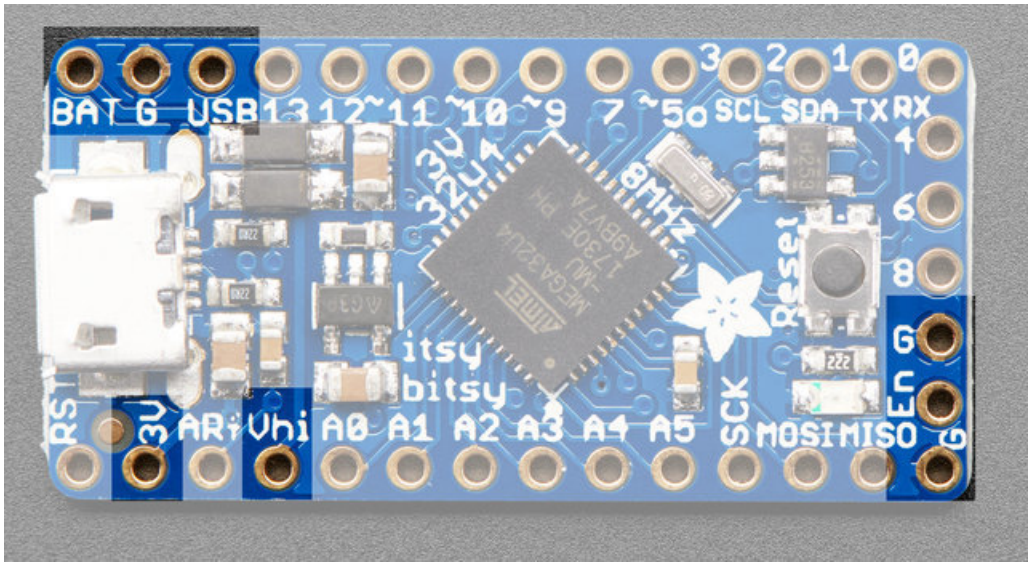


In addition to the three standard power pins, the 5V ItsyBitsy has a few more pins available for power sourcing:

- **5V** - this is the regulated output from the onboard regulator *or* the USB connection (if its powered!) You can draw 500mA when USB is connected, or up to 150mA when on battery.
- **3V** - this power pin is in the bottom right corner. It is a small 3V output from the on-chip regulator. It's very low current, we don't recommend drawing more than maybe 10 mA from this, but it can run small sensors!
- **EN** - connected to the regulator enable, it will let you shut off power - *when running on battery only.* But at least you don't have to cut a trace or wire to your battery. This pin does not affect power when using USB

- **G** - these are all **Ground** pins

3V Power Pins



In addition to the three standard power pins, the 3V ItsyBitsy has a few more pins available for power sourcing:

- **3V** - this is the regulated output from the onboard regulator. You can draw 500mA whether powered by USB or battery.
- **Vhi** - this is a special pin! It is a dual-Schottkey-diode connected output from **BAT** and **USB**. This means this will always have the higher-of-the-two voltages, but will always have power output. The voltage will *about* 5VDC when powered by USB, but can range from 3.5-6VDC when powered from battery. It's not regulated, but it is high-current, great for driving servos and NeoPixels.
- **EN** - connected to the regulator enable, it will let you shut off power - *when running on battery only.* But at least you don't have to cut a trace or wire to your battery. This pin does not affect power when using USB
- **G** - these are all **Ground** pins

Logic pins

This is the general purpose I/O pin set for the microcontroller. All logic is 3.3V on the 3V Itsy, and 5V on the 5V Itsy. You can usually use 3V logic as an input to 5V, *but* the 3V Itsy pins should not be connected to 5V!

Along the right edge

- **#0 / RX** - GPIO #0, also receive (input) pin for **Serial1** and Interrupt #2
- **#1 / TX** - GPIO #1, also transmit (output) pin for **Serial1** 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. On the 3.3V ItsyBitsy this is a special **OUTPUT-only** pin, that is level-shifted up to **Vhi** voltage, so its perfect for driving NeoPixels that want a ~5V logic level input.
- **#7** - GPIO #7. Also hardware Interrupt #4
- **#9** - GPIO #9, also analog input **A9** and can do PWM output.
- **#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**
- **#13** - GPIO #13, can do PWM output and is connected to the **red LED** next to the Reset button

Along the left edge

- **A0 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. Also used to reprogram the chip with an AVR programmer if you need.

Along the short edge:

- **#4** - GPIO #4, also analog input **A6**
- **#6** - GPIO #6, can also do PWM output and analog input **A7**
- **#8** - GPIO #8, also analog input **A8**

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 or 5V) but if you need an alternative analog reference, connect it to this pin and select the external AREF in your firmware. Don't set it higher than the logic level of the Itsy!

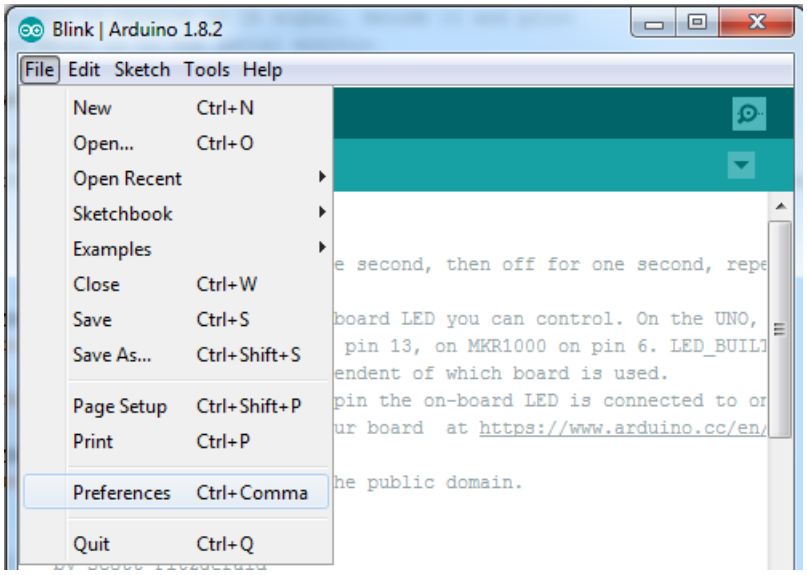
Arduino IDE Setup

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 1.8** or higher for this guide

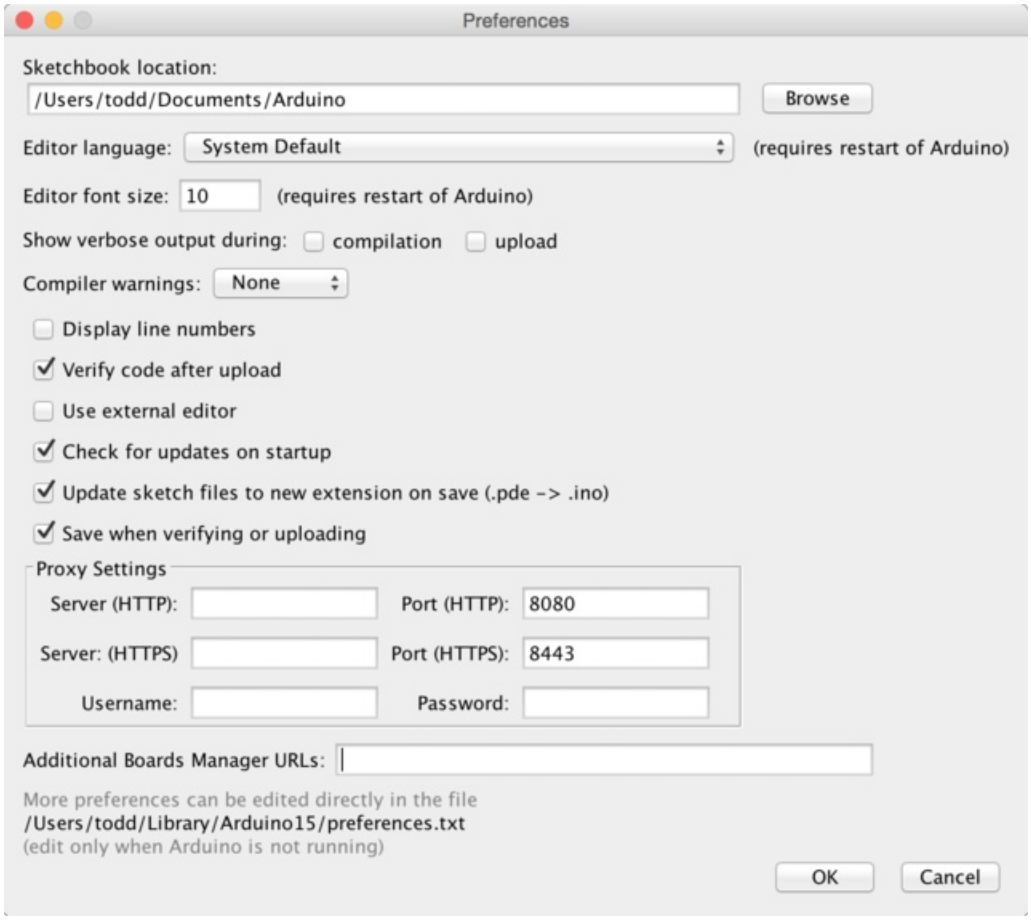
https://adafru.it/f1P

https://adafru.it/f1P

After you have downloaded and installed **the latest version of Arduino IDE**, 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*.



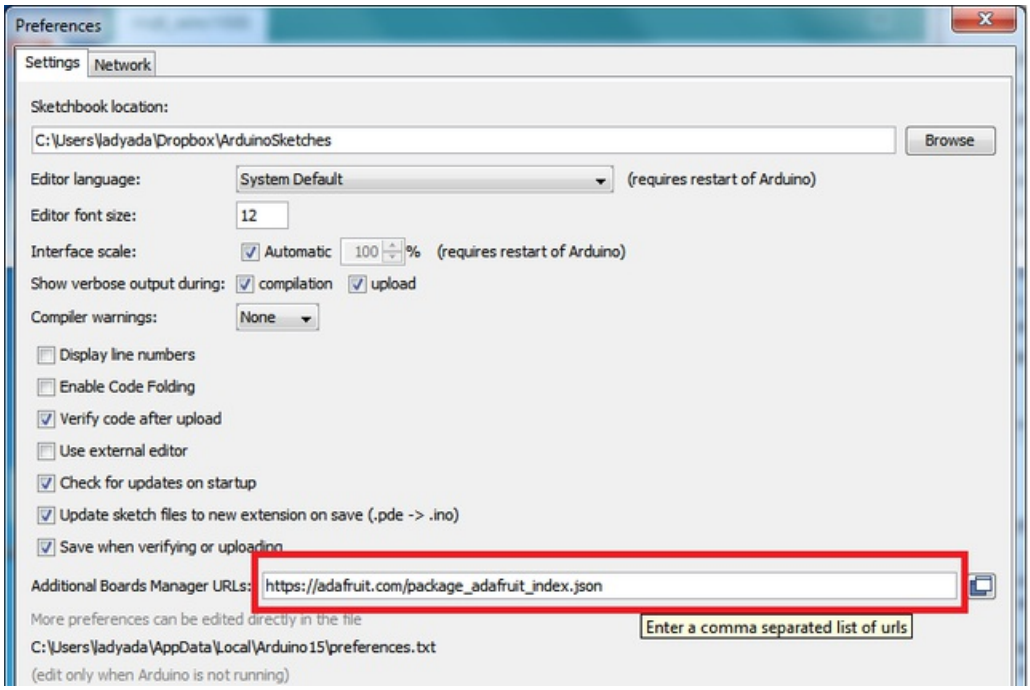
A dialog will pop up just like the one shown below.



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 (https://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 and M4, Metro M0 and M4, ItsyBitsy M0 and M4, Circuit Playground Express, Gemma M0 and Trinket M0
- **Arduino Leonardo & Micro MIDI-USB** - This adds MIDI over USB support for the Flora, Feather 32u4, Micro and Leonardo using the arcore project (https://adafru.it/eSl).

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

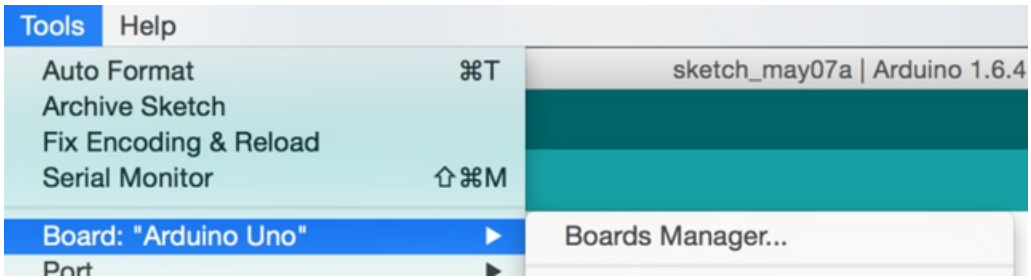
Once done click **OK** to save the new preference settings. Next we will look at installing boards with the Board Manager.

Now continue to the next step to actually install the board support package!

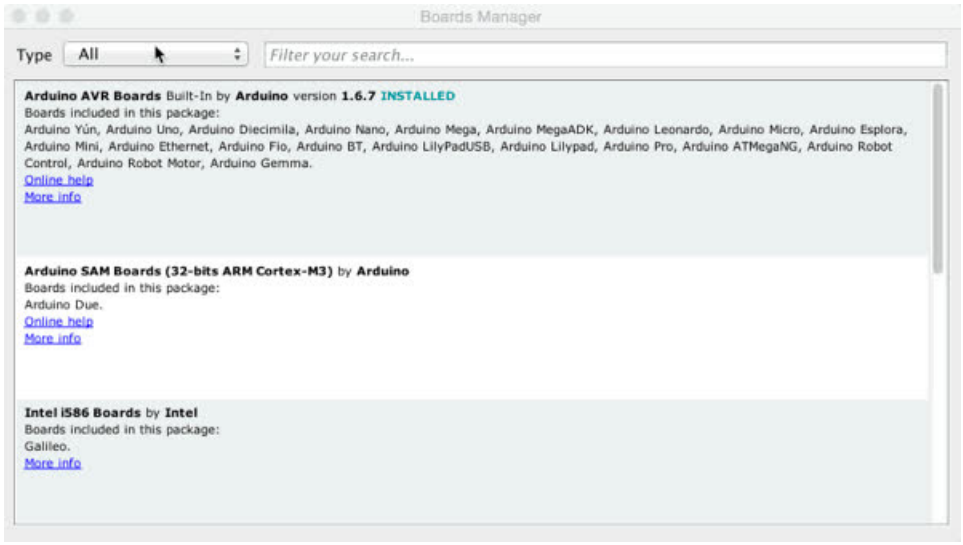
Using with Arduino IDE

Since the ItsyBitsy 32u4 uses an ATmega32u4 chip running at 8 or 16 MHz, you can pretty easily get it working with the Arduino IDE. Many libraries (including the popular ones like NeoPixels and display) work great with the '32u4 and 8/16 MHz clock speed.

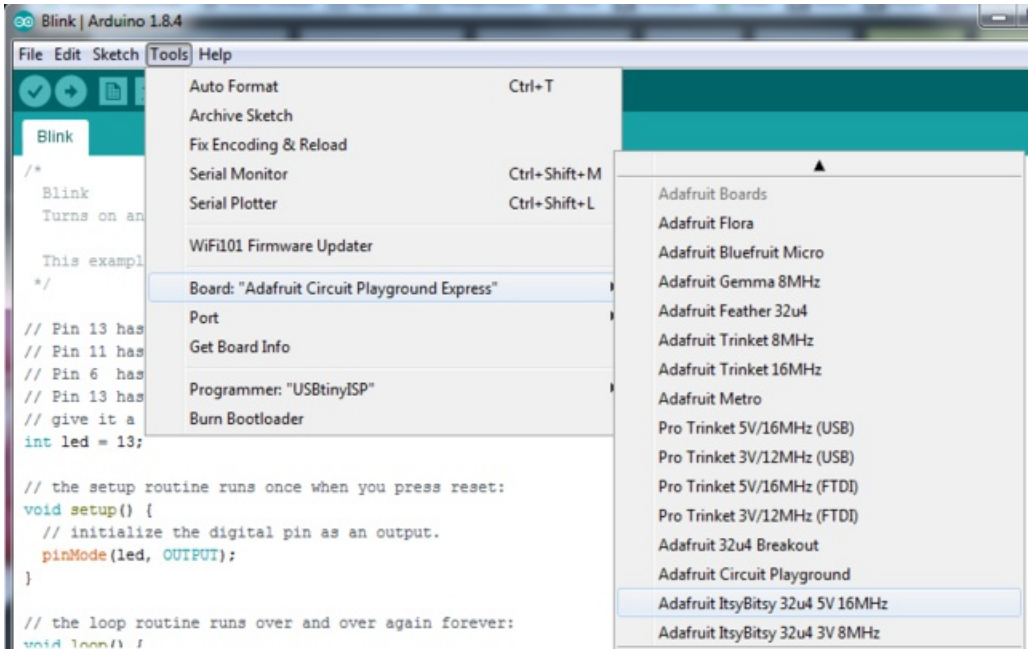
Now that you have added the appropriate URLs to the Arduino IDE preferences, you can open the **Boards Manager** by navigating to the **Tools->Board** menu.



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. In the example below, we are installing support for ***Adafruit AVR Boards***, but the same applies to all boards installed with the Board Manager.



Next, **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)

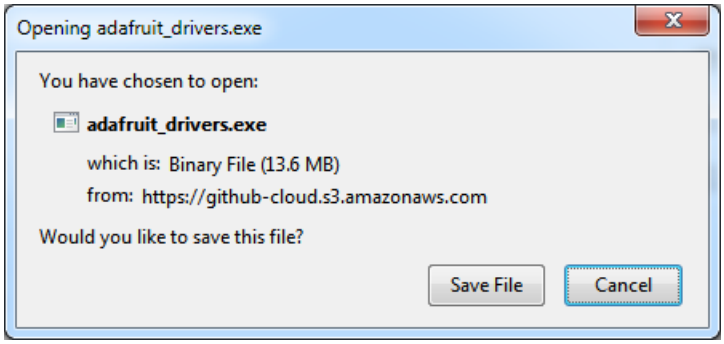
When you plug in the Feather, you'll need to possibly install a driver

Click below to download our Driver Installer

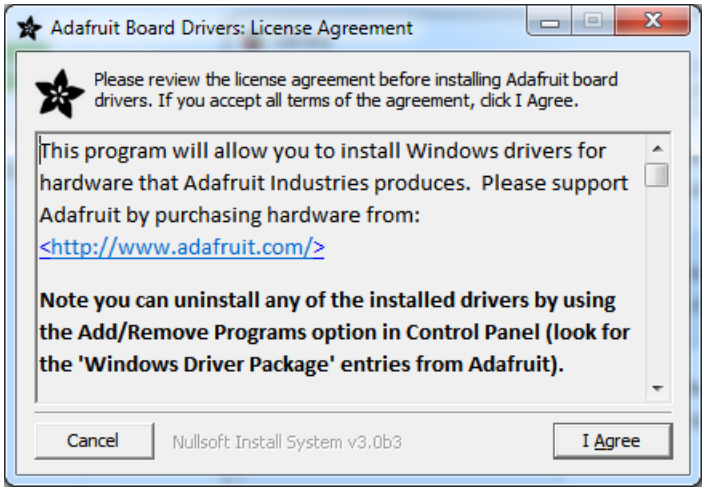
https://adafru.it/AB0

https://adafru.it/AB0

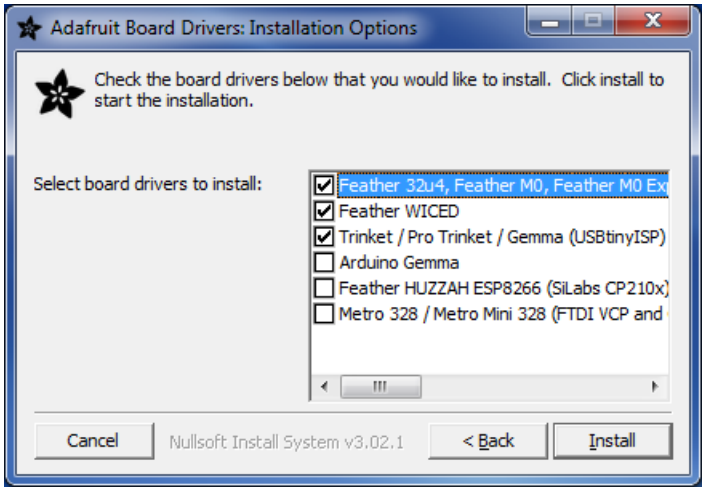
Download and run the installer



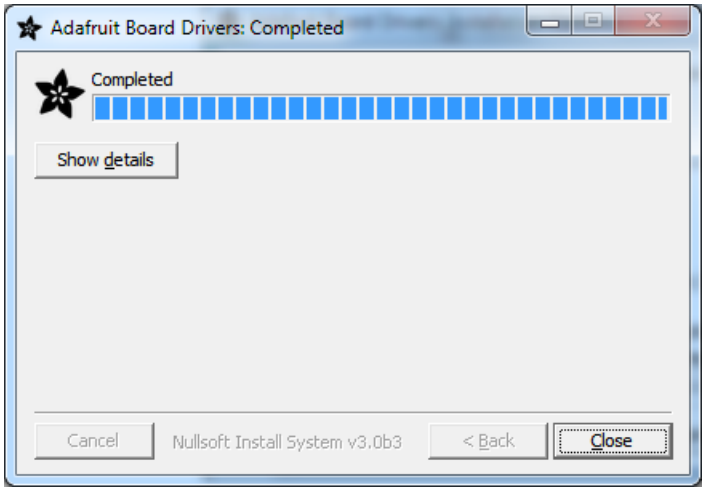
Run the installer! Since we bundle the SiLabs and FTDI drivers as well, you'll need to click through the license



Select which drivers you want to install:



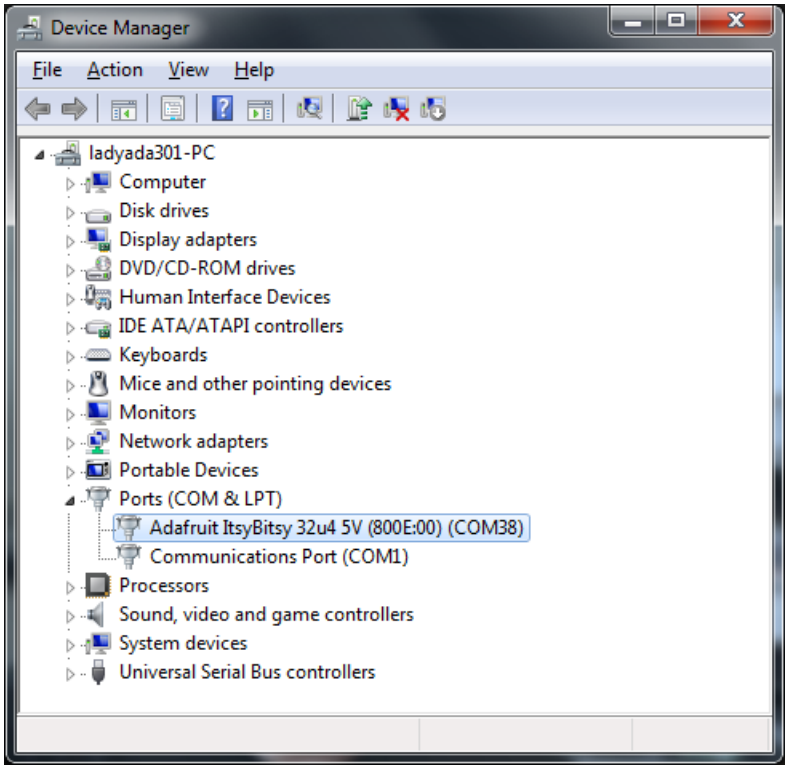
Click **Install** to do the installin'

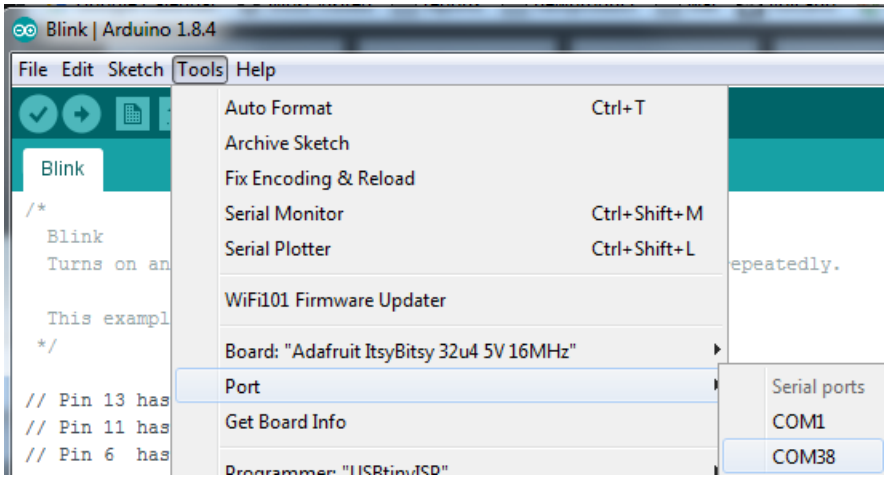


Blink

Now you can upload your first blink sketch!

Plug in the ItsyBitsy 32u4 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!





Now load up the Blink example

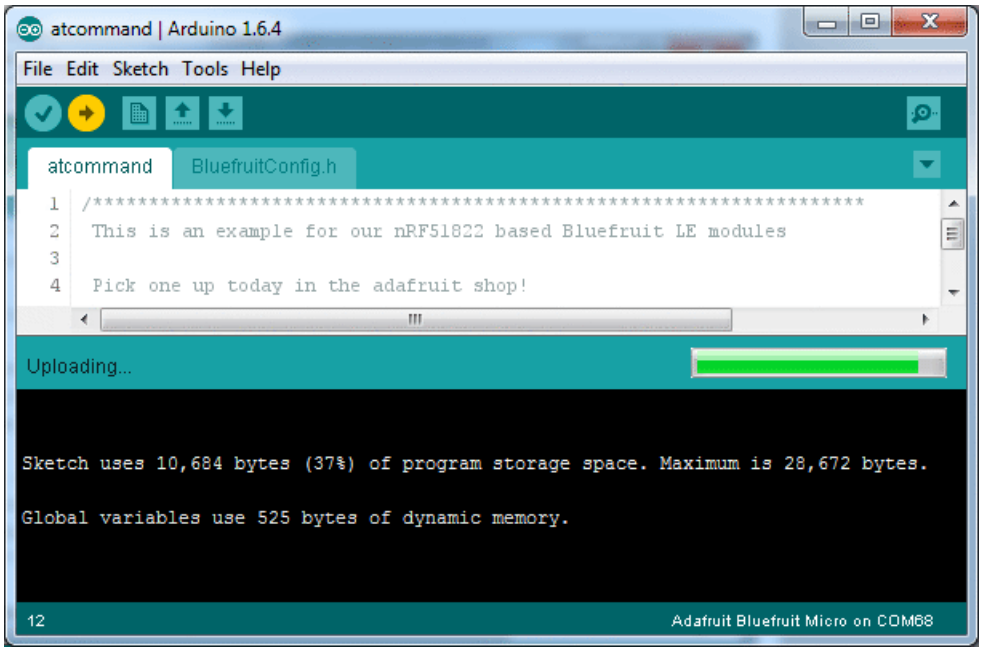
```
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// 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.

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 to get back into the bootloader. The red LED will pulse, so you know that its in bootloader mode. Do the reset button press right as the Arduino IDE says its attempting to upload the sketch, when you see the Yellow Arrow lit and the **Uploading...** text in the status bar.



Don't click the reset button **before** uploading, unlike other bootloaders you want this one to run at the time Arduino is trying to 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 ATmega32u4 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. (https://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 board and will fix the programming difficulty issue. Follow the steps for installing Adafruit's udev rules on this page. (https://adafru.it/iOE)

Downloads

Files

- EagleCAD files for both 3V and 5V 32u4 ItsyBitsy's (https://adafru.it/BkS)
- Fritzing files for both types in the Adafruit Fritzing library (https://adafru.it/aP3)

Bootloaders

https://adafru.it/Apx

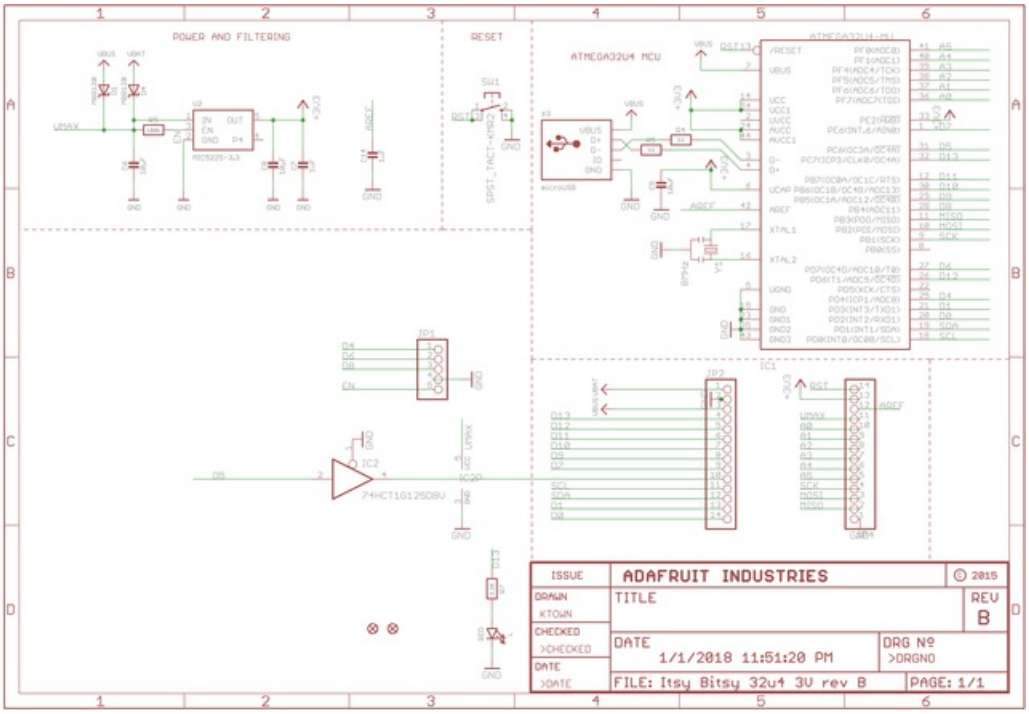
https://adafru.it/Apx

https://adafru.it/Apy

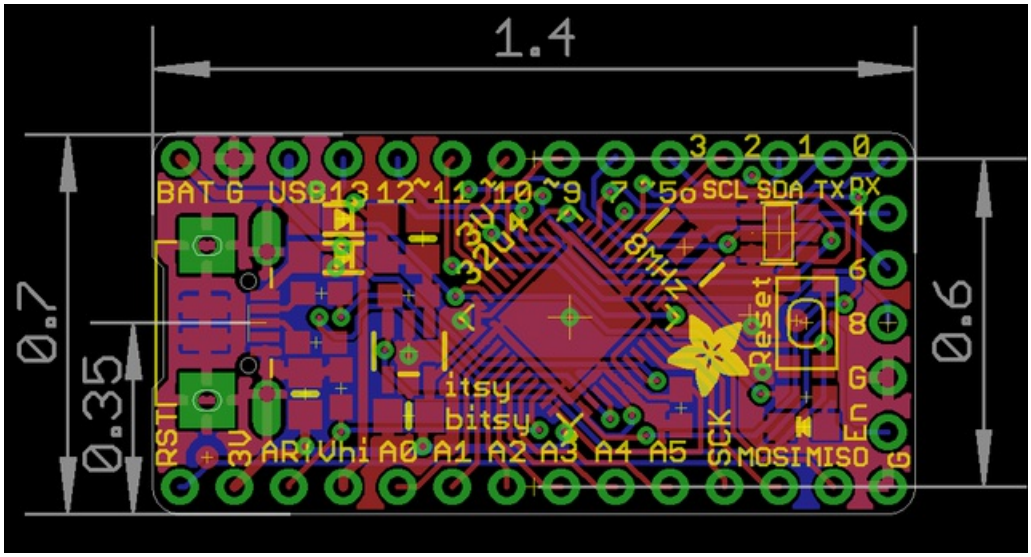
https://adafru.it/Apy

ItsyBitsy 3V

Schematic & Fabrication print

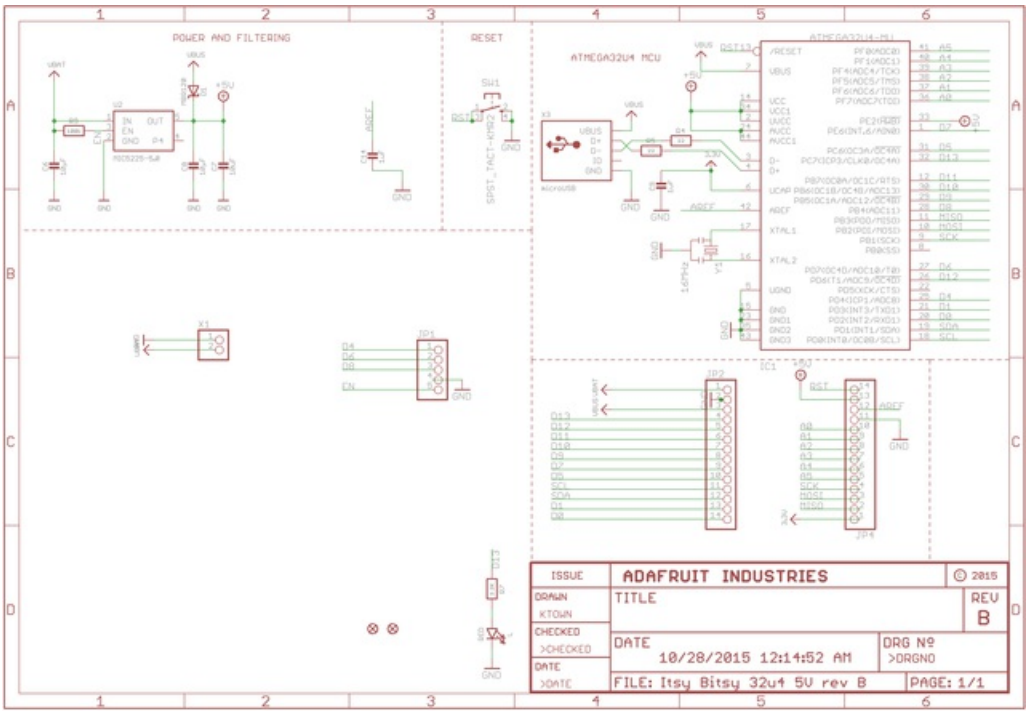


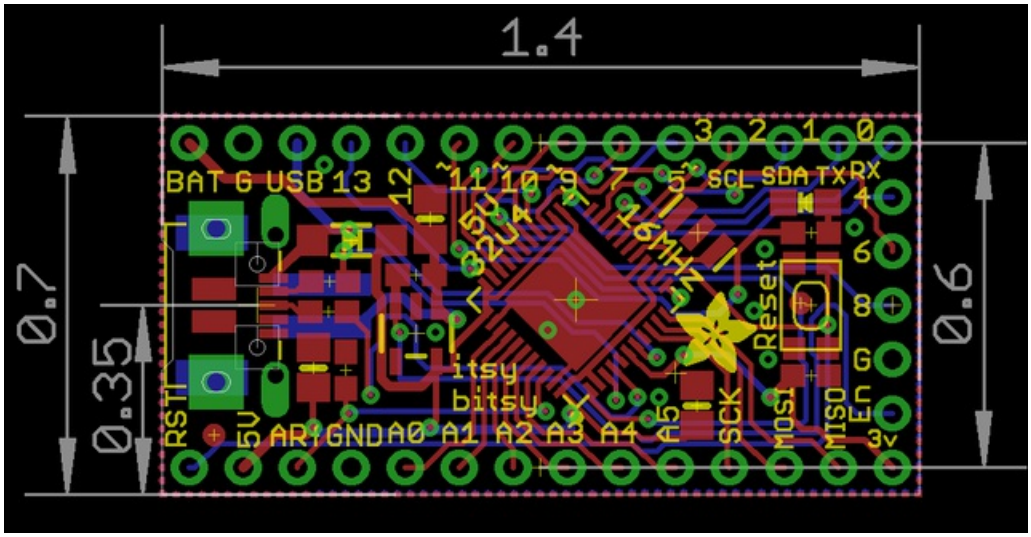
The 3.3V schematic regulator should be AP2112K-3.3



ItsyBitsy 5V

Schematic & Fabrication print




1.4
0.7
0.35
0.6
BAT G USB 13
12
11 10 9 7 5
3 2 1 0
SCL SDA TX RX
4
6
8
G
En
3v
Reset
itsy
bitsy
RST
5V
ARf GND A0 A1 A2 A3 A4 A5
SCK
MOSI
MISO