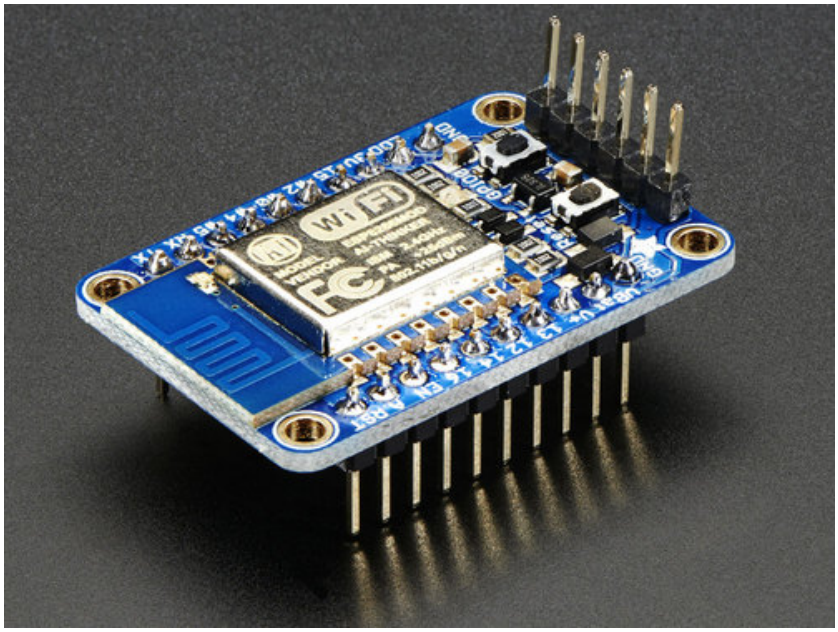
adafruit learning system

Adafruit HUZZAH ESP8266 breakout

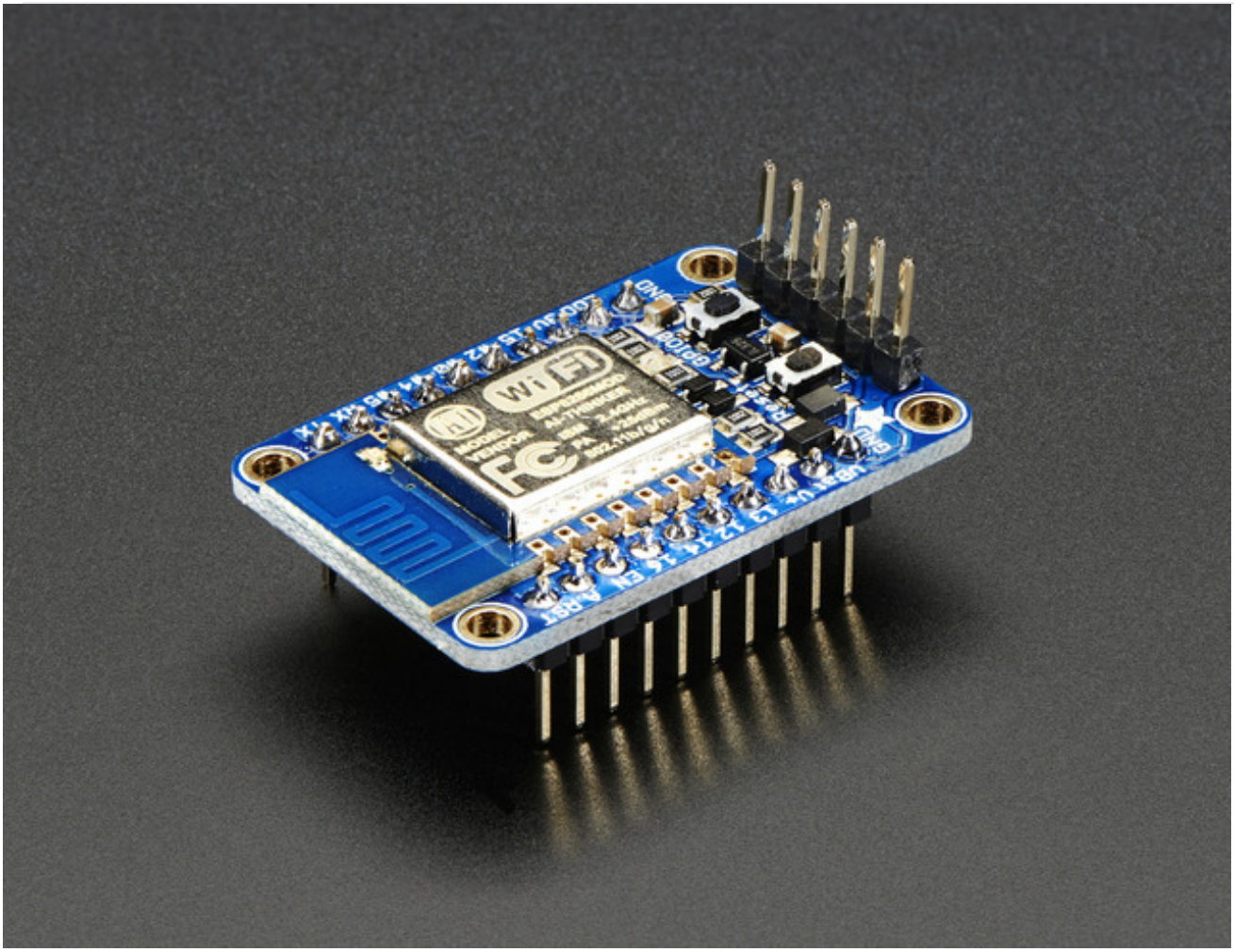
Created by lady ada



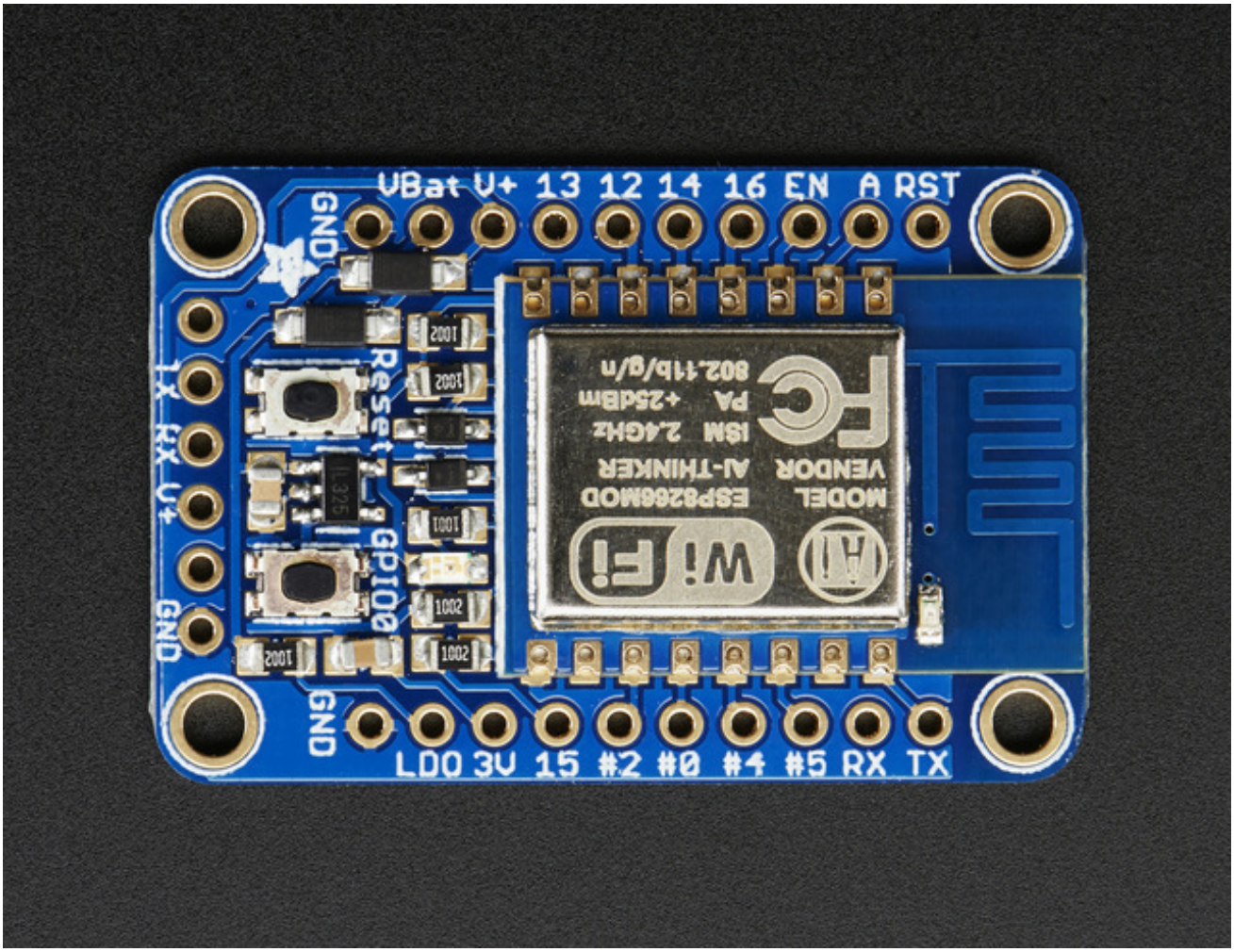
Last updated on 2015-11-28 06:20:33 PM EST

Guide Contents

Overview

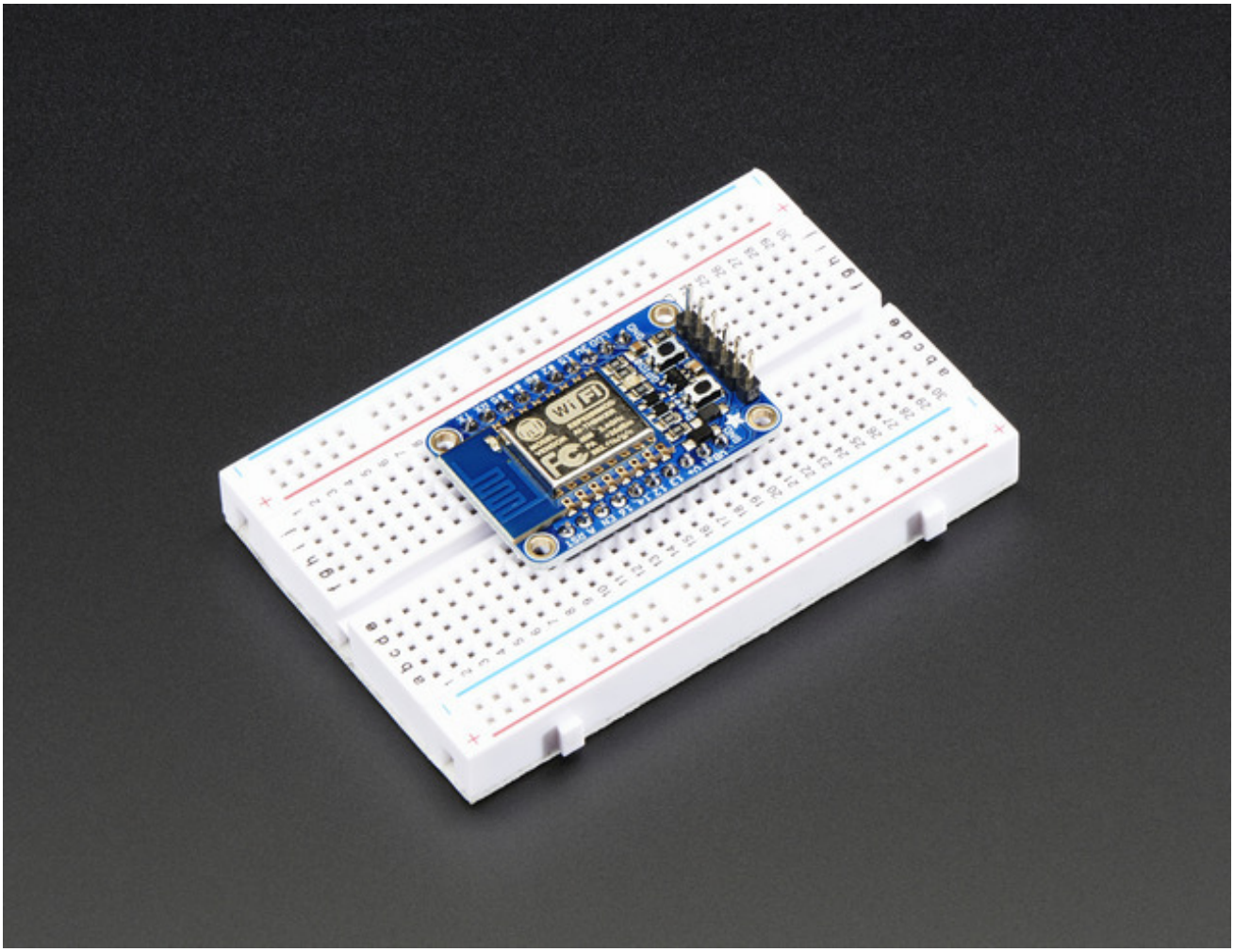


Add Internet to your next project with an adorable, bite-sized WiFi microcontroller, at a price you like! The ESP8266 processor from Espressif is an 80 MHz microcontroller with a full WiFi front-end (both as client and access point) and TCP/IP stack with DNS support as well. While this chip has been very popular, its also been very difficult to use. Most of the low cost modules are not breadboard friendly, don't have an onboard 500mA 3.3V regulator or level shifting, and aren't CE or FCC emitter certified....**UNTIL NOW!**



The HUZZAH ESP8266 breakout is what we designed to make working with this chip super easy and a lot of fun. We took a certified module with an onboard antenna, and plenty of pins, and soldered it onto our designed breakout PCBs. We added in:

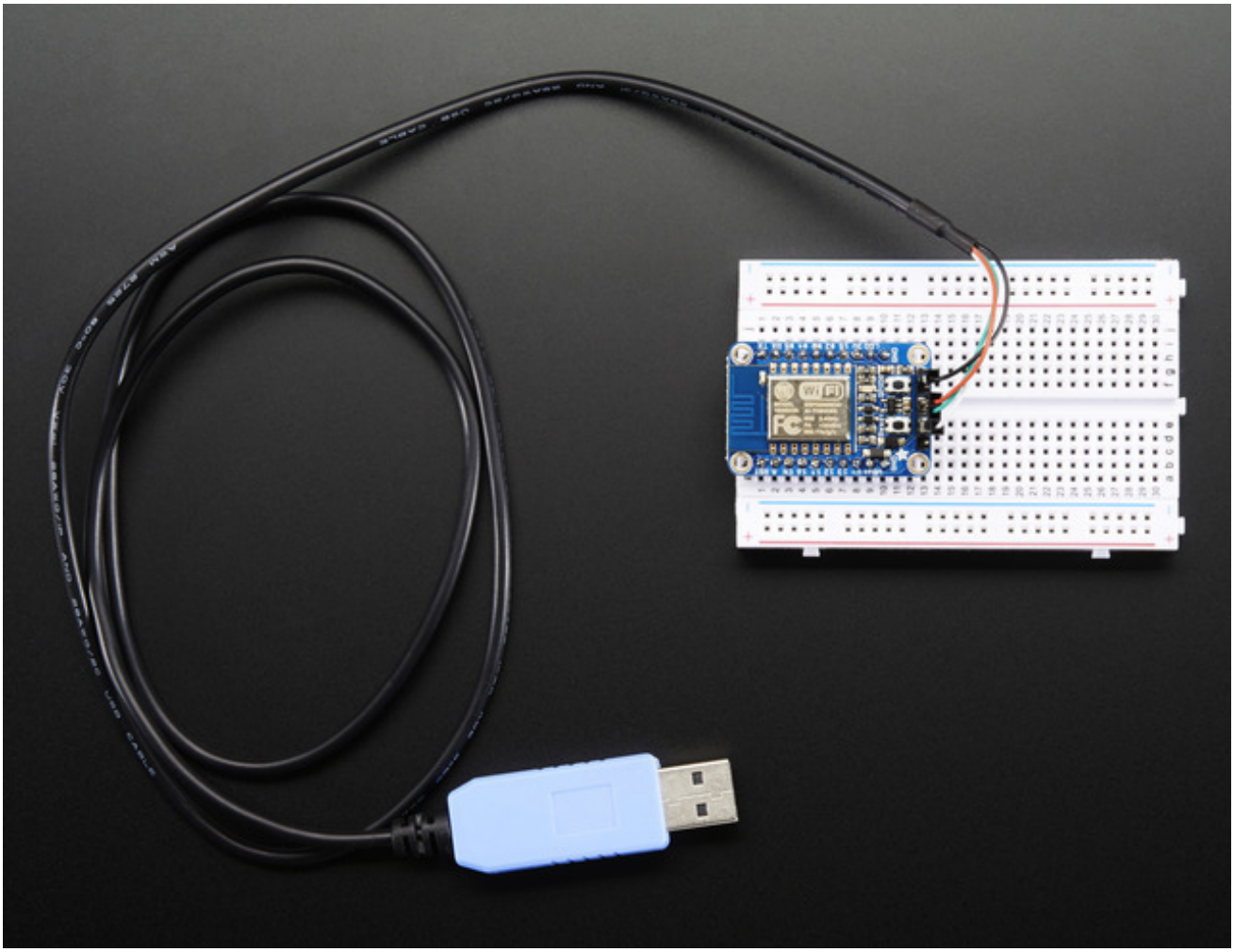
- Reset button,
- User button that can also put the chip into bootloading mode,
- Red LED you can blink
- Level shifting on the UART and reset pin
- 3.3V out, 500mA regulator (you'll want to assume the ESP8266 can draw up to 250mA so budget accordingly)
- Two diode-protected power inputs (one for a USB cable, another for a battery)



Two parallel, breadboard-friendly breakouts on either side give you access to:

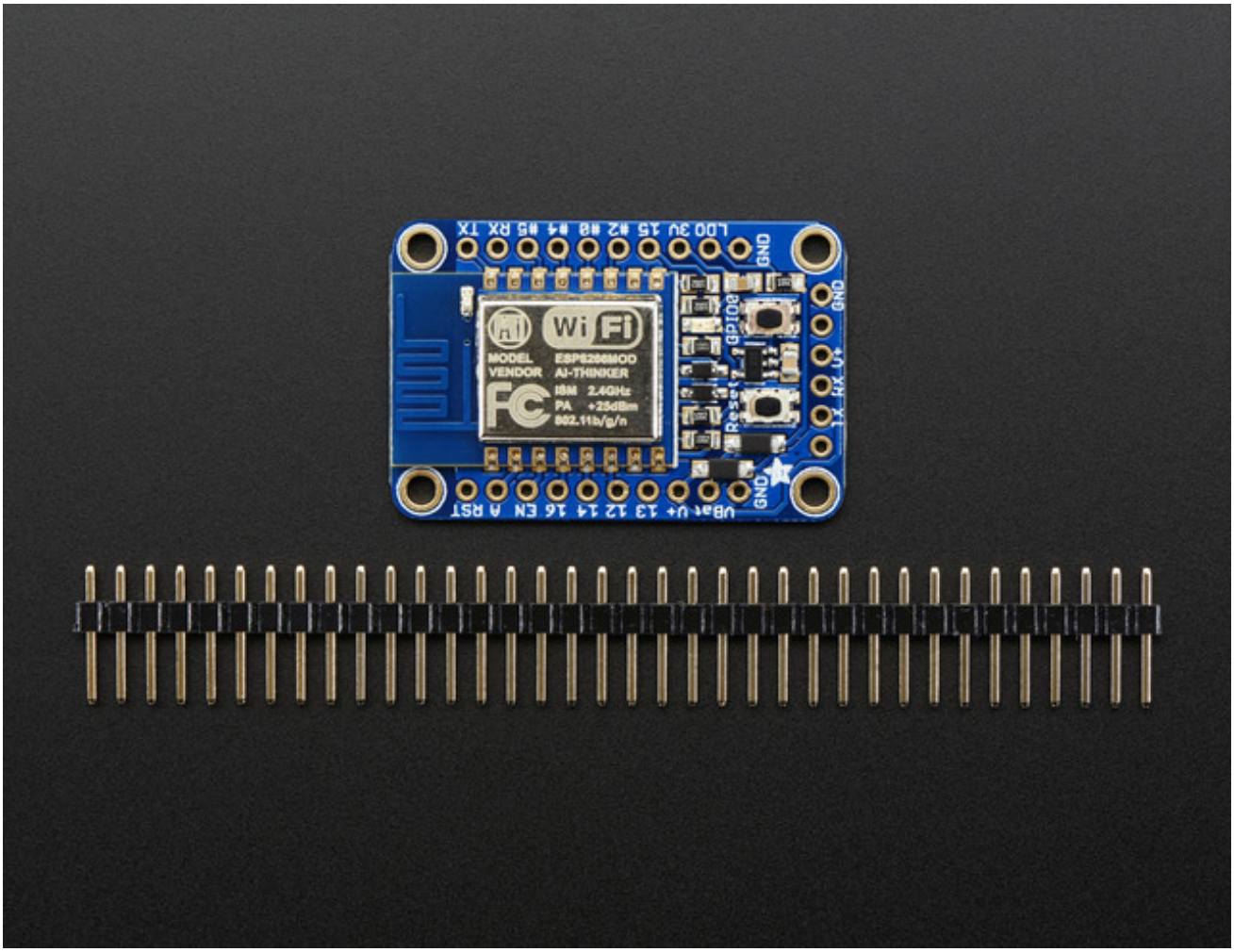
- 1 x Analog input (1.8V max)
- 9 x GPIO (3.3V logic), which can also be used for I2C or SPI
- 2 x UART pins
- 2 x 3-12V power inputs, reset, enable, LDO-disable, 3.3V output

One breakout at the end has an "FTDI" pinout so you can plug in an FTDI or console cable to upload software and read/write debugging information via the UART. When you're done with your coding, remove the cable, and this little module can be embeded into your project box.



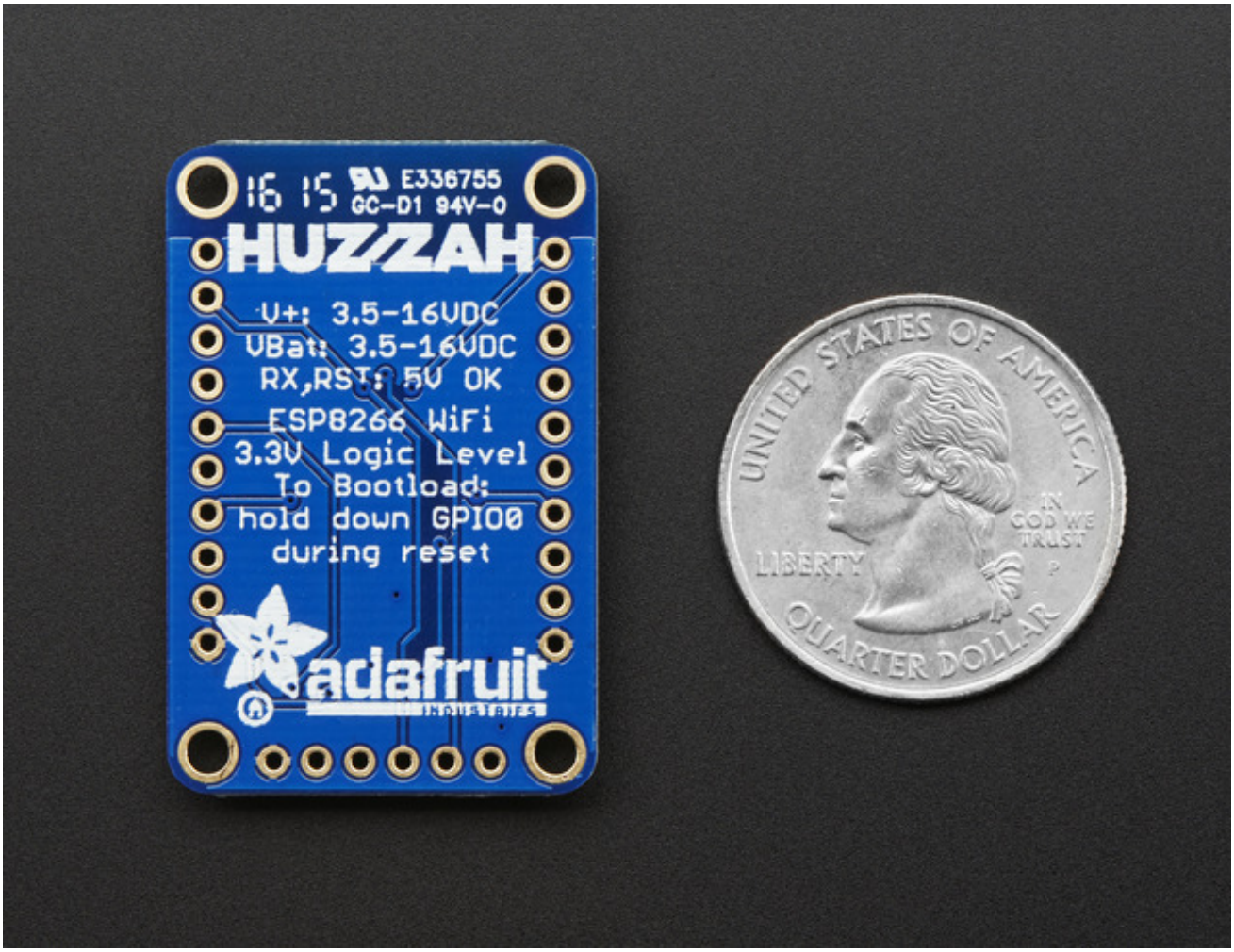
Each module comes pre-loaded with NodeMCU's Lua interpreter (NodeMCU 0.9.5 build 20150318 / Lua 5.1.4 to be specific) (http://adafru.it/inA), you can run commands, and 'save' Lua programs directly to the module's Flash using a USB-Serial converter cable.

But, if you'd like, you can skip Lua and go direct to using the Arduino IDE. Once you download the ESP8266 core, you can treat it just like a microcontroller+WiFi board, no other processors needed (http://adafru.it/inB)!



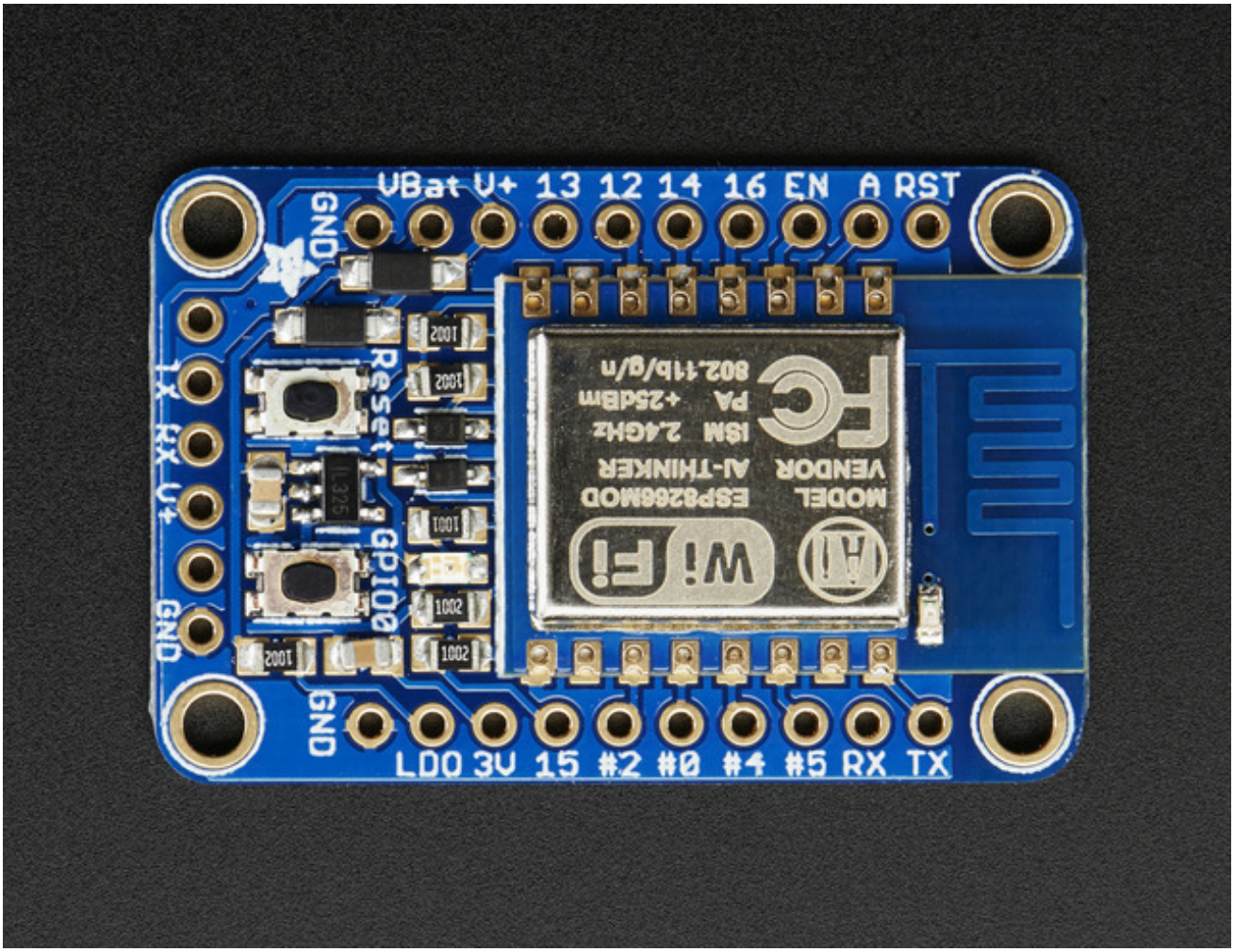
Each order comes with one assembled and tested HUZZAH ESP8266 breakout board, and a stick of 0.1" header that you can solder on and plug the breakout into a breadboard. A soldering iron and solder is required for that, and aren't included. **You'll also need a USB-serial cable** such as a USB console cable (Windows only) (http://adafru.it/dDd), FTDI Friend (any OS) (http://adafru.it/284), or FTDI cable (any OS) (http://adafru.it/70)to upload software to the HUZZAH ESP8266!

Don't forget to visit esp8266.com for the latest and greatest in ESP8266 news, software and gossip! (http://adafru.it/f1F)

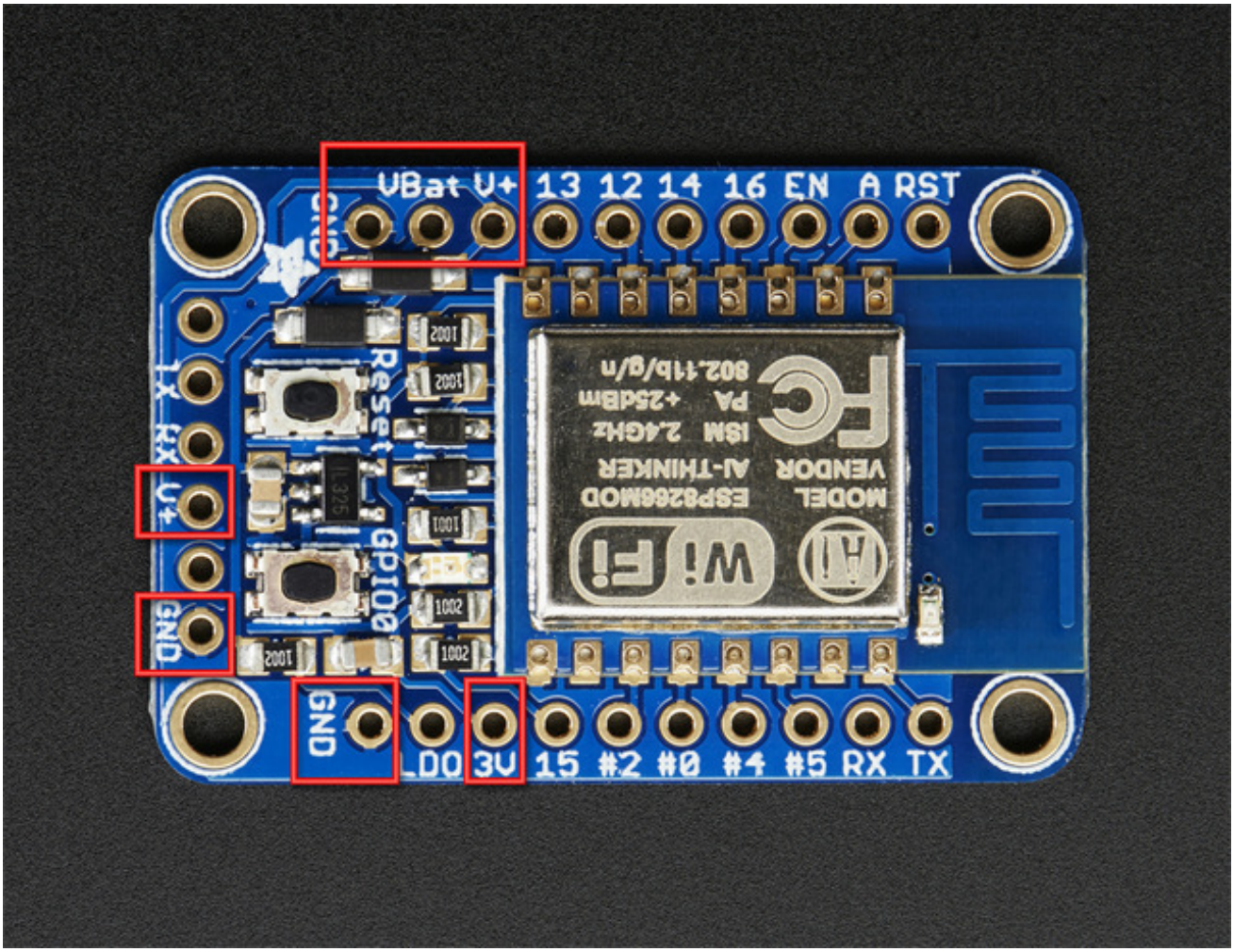

16 15
E336755
GC-D1 94V-0
HUZZAH
V+: 3.5-16VDC
VBat: 3.5-16VDC
RX,RST: 5V OK
ESP8266 WiFi
3.3V Logic Level
To Bootload:
hold down GPIO0
during reset
adafruit
UNITED STATES OF AMERICA
IN GOD WE TRUST
LIBERTY
QUARTER DOLLAR

Pinouts

The ESP8266 runs on 3.3V power and logic, and unless otherwise specified, GPIO pins are not 5V safe! The analog pin is also 1.0V max!



This ESP8266 breakout has a ton of pins available, compared to the mini ESP-01 module. When programming the breakout in Lua or via the Arduino IDE, you can control these I/O pins to light up LEDs, read buttons, talk to sensors etc. There's also a bunch of pins for power and control.



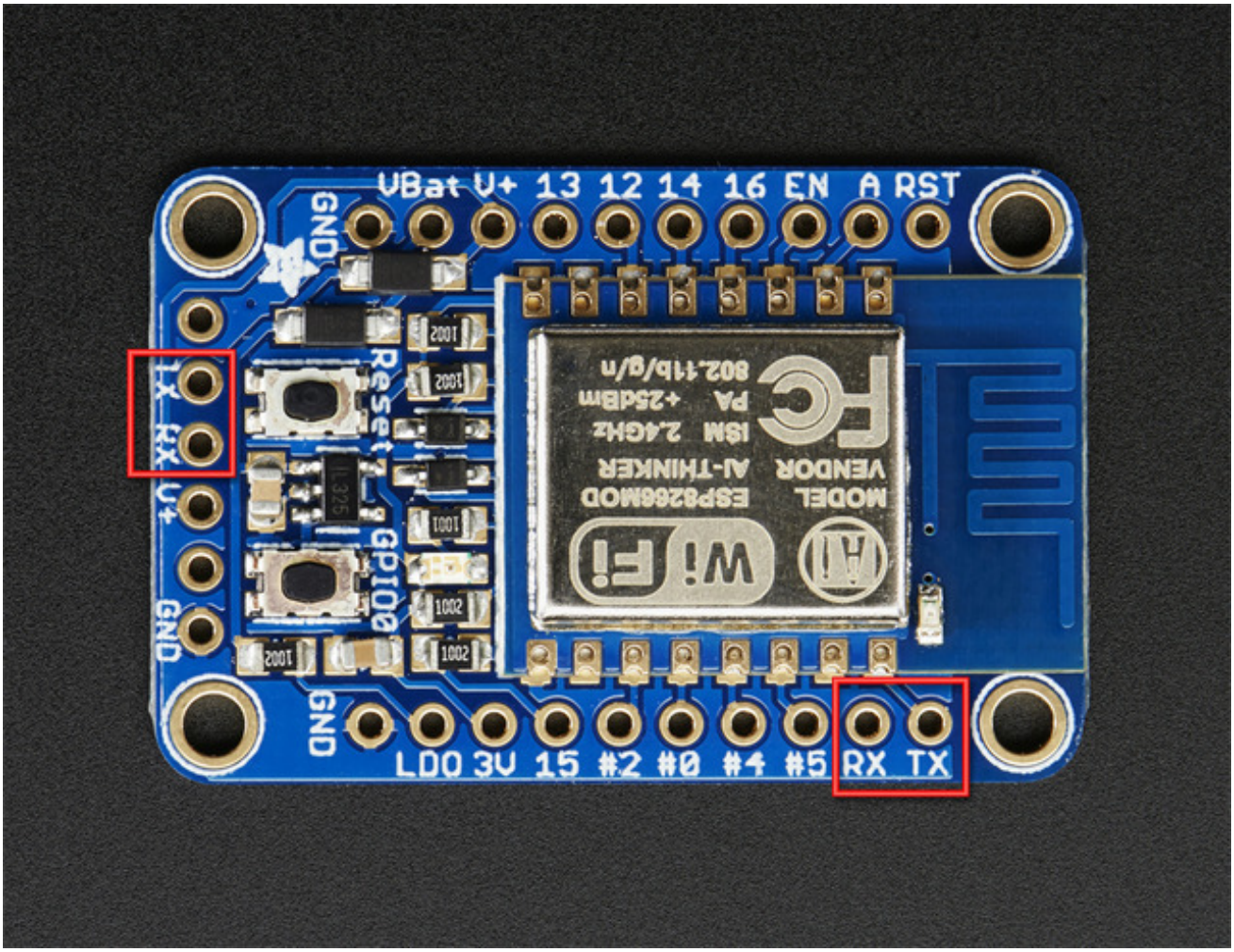
Power Pins

The ESP8266 requires 3.3V power voltage and peaks at 500mA or so of current for small periods of time. You'll want to assume the ESP8266 can draw up to 250mA so budget accordingly. To make it easier to power, we put a high-current-capable 3.3V voltage regulator on the board. It can take 3.4-16V and supply the current for the ESP8266.

There are two inputs for the regulator, **V+** and **VBat**. Both have schottky diodes so you can connect both at different voltages and the regulator will simply power from the higher voltage. The **V+** pin is also on the FTDI/serial header at the bottom edge.

We recommend connecting your LiPoly or AA battery pack directly to **VBat** and then keeping **V+** unused for when an FTDI cable is attached

There's also a 3.3V output from the regulator available on the **3V** pin



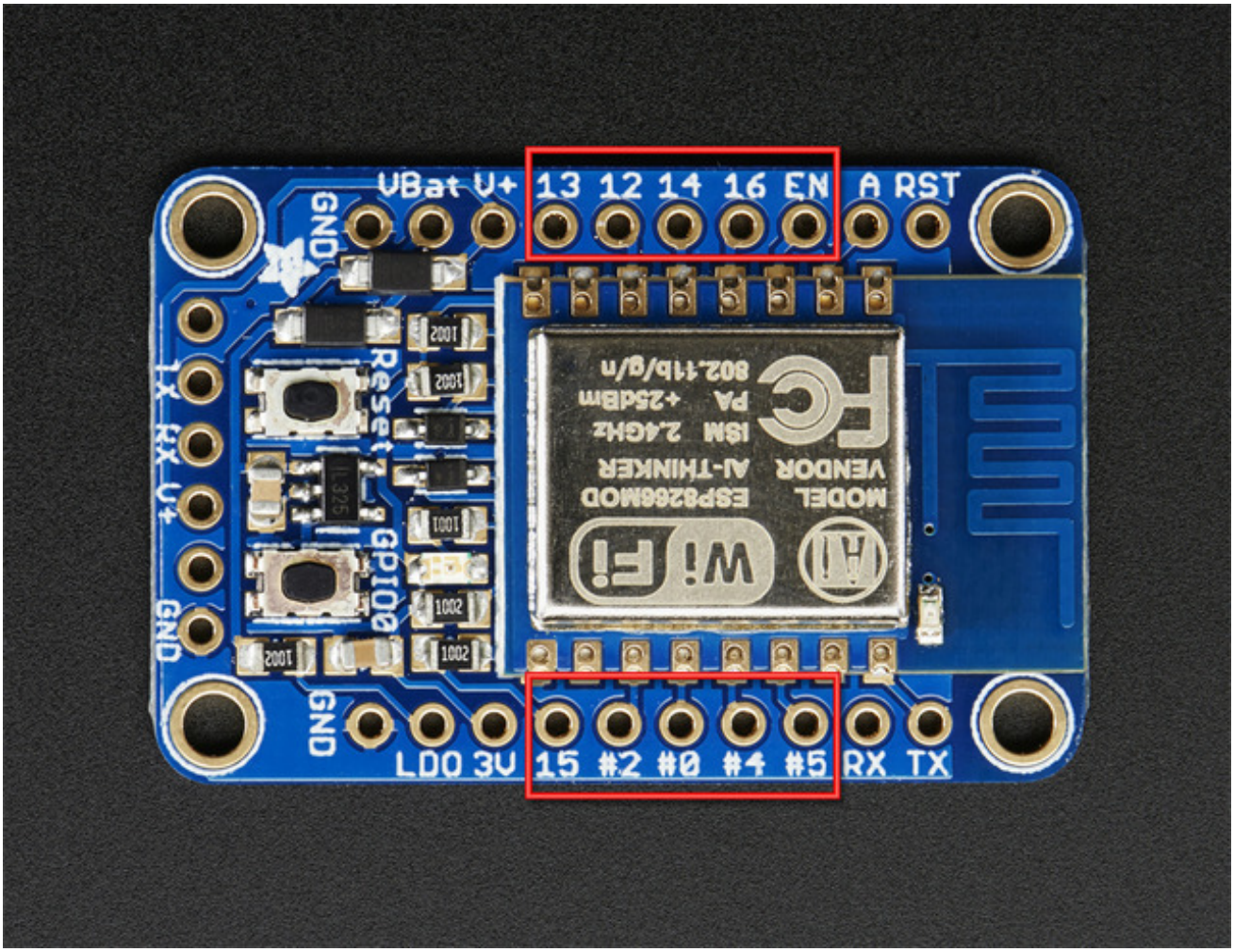
Serial pins

RX and **TX** are the serial control and bootloading pins, and are how you will spend most of your time communicating with the ESP module.

The **TX** pin is the output *from* the module and is 3.3V logic.

The **RX** pin is the input *into* the module and is 5V compliant (there is a level shifter on this pin)

The pins are available in two places, one set is on the right side breakout. The same pins are also at the bottom on the "FTDI/Serial" breakout



GPIO pins

This breakout has 9 GPIO: **#0, #2, #4, #5, #12, #13, #14, #15, #16** all GPIO are 3.3V logic level in and out, and are **not 5V compatible.** Read the full spec sheet (http://adafru.it/f1E) to learn more about the GPIO pin limits, but be aware the maximum current drawn per pin is **12mA**.

These pins are general purpose and can be used for any sort of input or output. Most also have the ability to turn on an internal pullup. Many have *special* functionality:

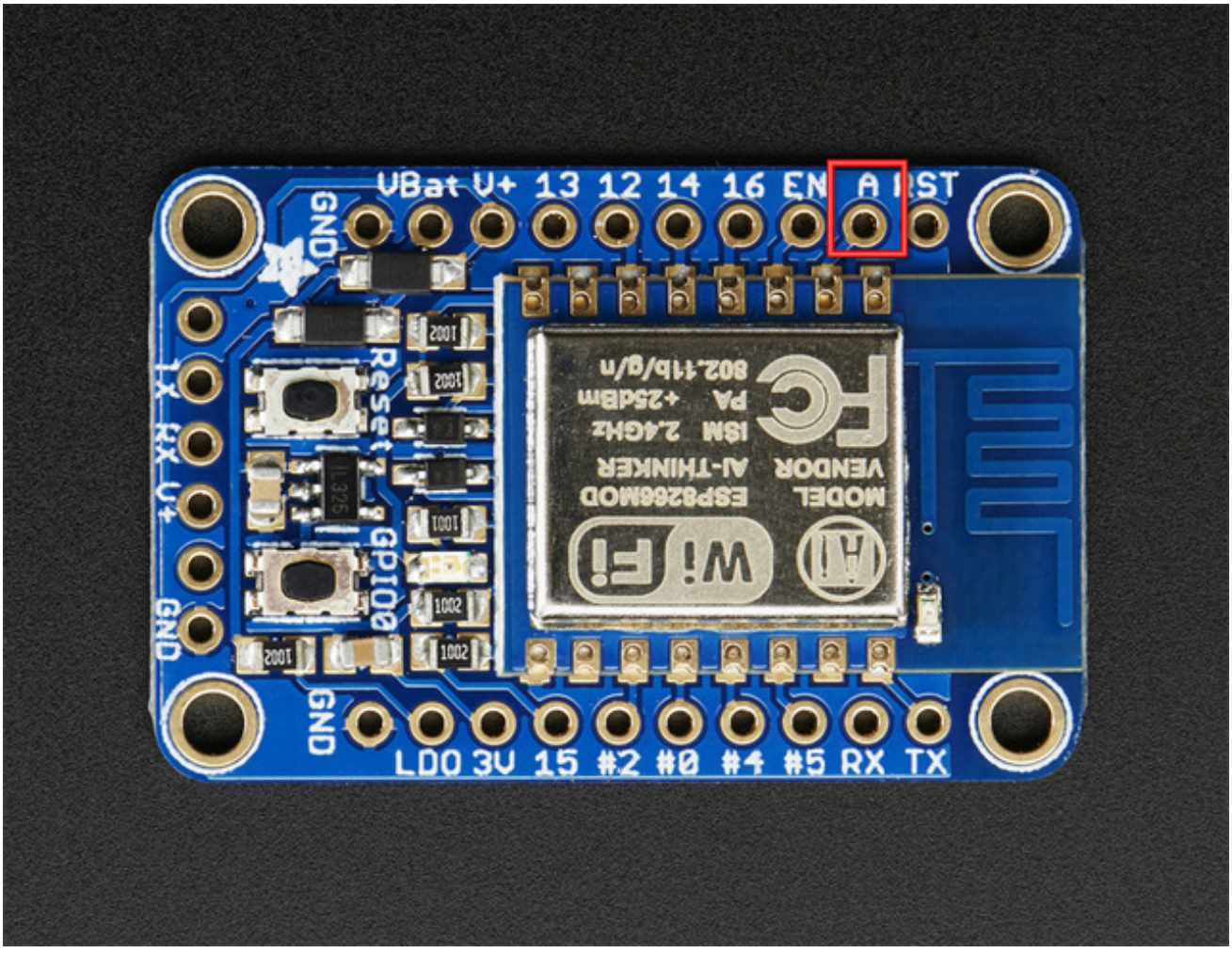
GPIO #0, which does not have an internal pullup, and is also connected to both a mini tactile switch and red LED. This pin is used by the ESP8266 to determine when to boot into the bootloader. If the pin is held low during power-up it will start bootloading! That said, you can always use it as an output, and blink the red LED.

GPIO #2, is also used to detect boot-mode. It also is connected to the blue LED that is near the WiFi antenna. It has a pullup resistor connected to it, and you can use it as any output (like #0) and blink the blue LED.

GPIO #15, is also used to detect boot-mode. It has a pulldown resistor connected to it, make sure this pin isn't pulled high on startup. You can always just use it as an output

GPIO #16 can be used to wake up out of deep-sleep mode, you'll need to connect it to the RESET pin

> Rev A of this board has GPIO #4 and #5 swapped (the modules changed pinouts on us) so if #4/#5 aren't working for you, try swapping! We'll fix in the next PCB run



Analog Pins

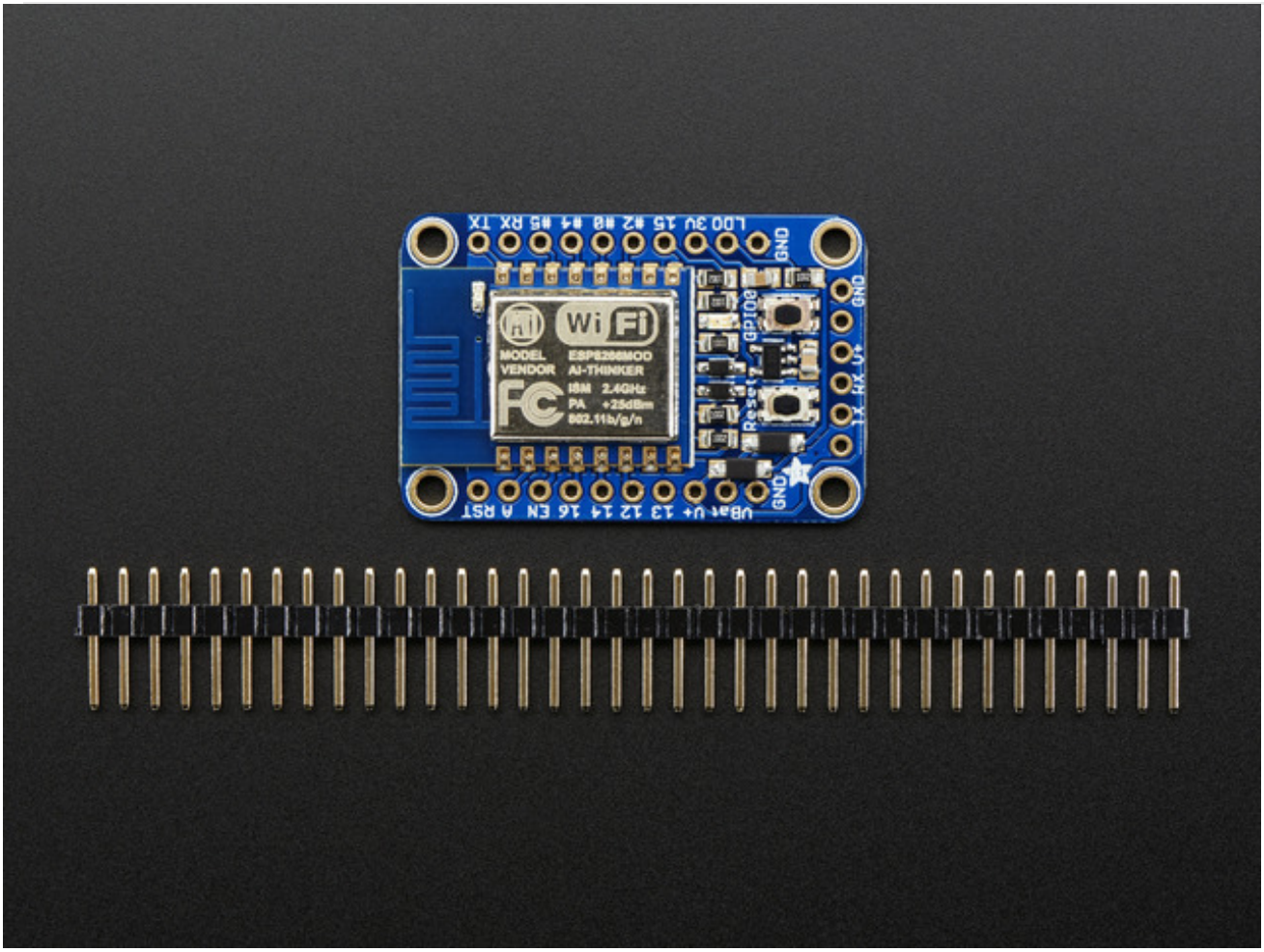
There is also a single analog input pin called **A**. This pin has a ~1.0V maximum voltage, so if you have an analog voltage you want to read that is higher, it will have to be divided down to 0 - 1.0V range

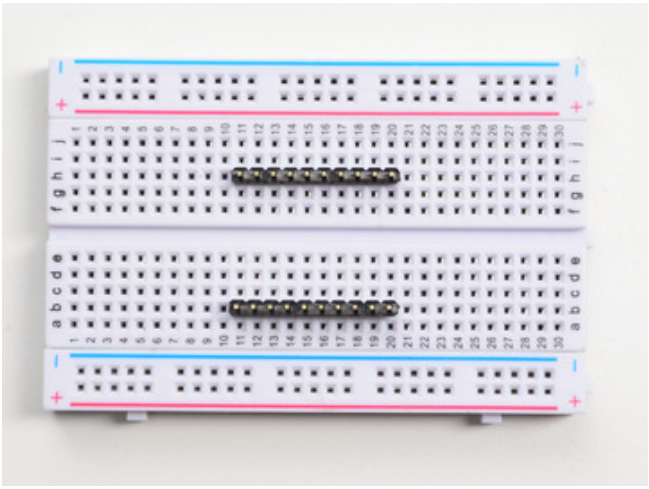
Other control pins

We have a few other pins for controlling the ESP8266

- **LDO** - this is the enable pin for the regulator. By default its pulled high, when connected to ground it will turn off the 3.3V regulator and is an easy way to cut power off to the whole setup. There is a 10K pullup is to whatever is greater, **V+** or **VBat**.
- **RST** - this is the reset pin for the ESP8266, pulled high by default. When pulled down to ground momentarily it will reset the ESP8266 system. This pin is 5V compliant.
- **EN (CH_PD)** - This is the enable pin for the ESP8266, pulled high by default. When pulled down to ground momentarily it will reset the ESP8266 system. This pin is 3.3V logic only

Assembly



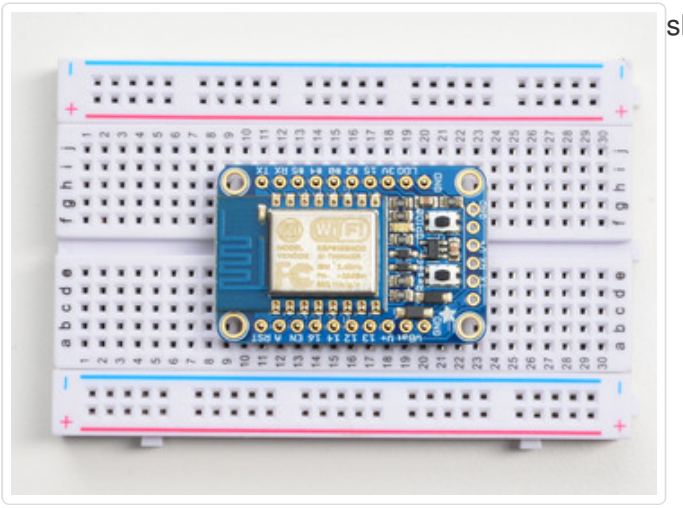


Prepare the header strip:

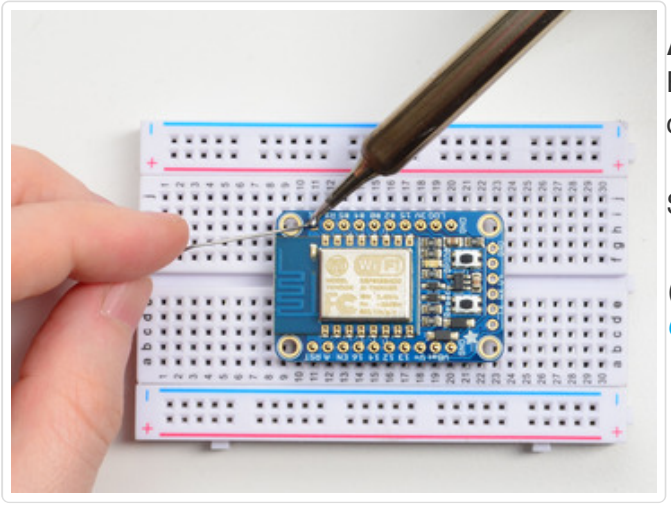
Cut two strips to length if necessary. It will be easier to solder if you insert it into a breadboard - **long pins down**

Add the breakout board:

Place the breakout board over the pins so that the



short pins poke through the breakout pads

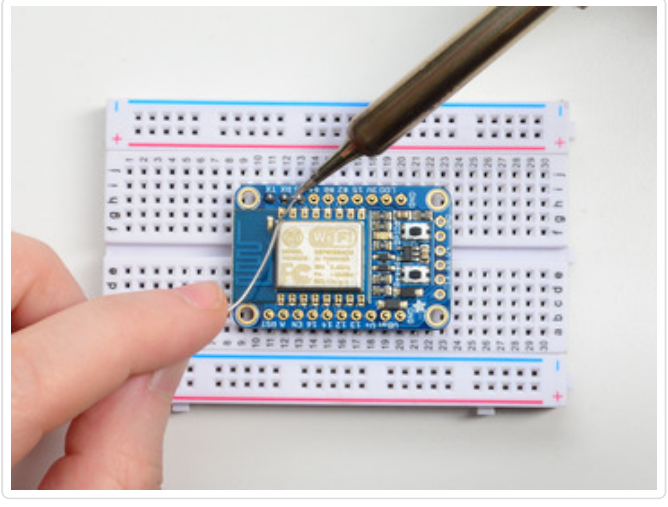


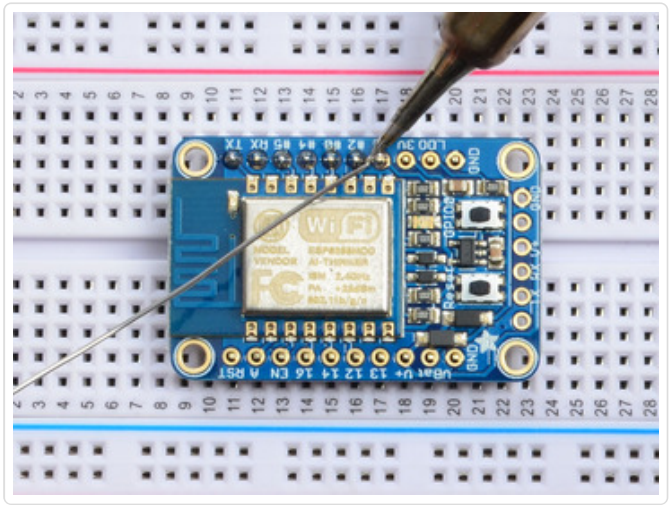
And Solder!

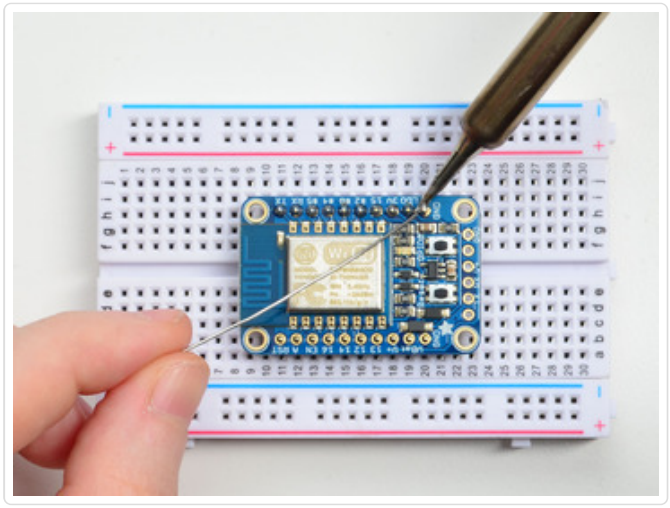
Be sure to solder all pins for reliable electrical contact.

Solder one side of the board at first

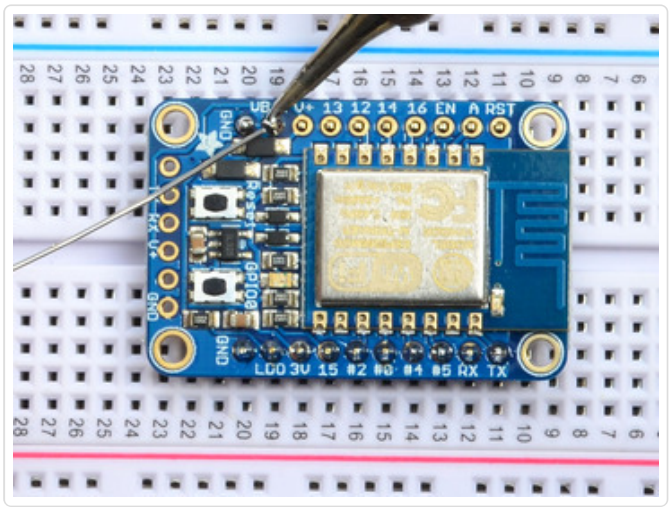
(For tips on soldering, be sure to check out our Guide to Excellent Soldering (http://adafru.it/aTk).

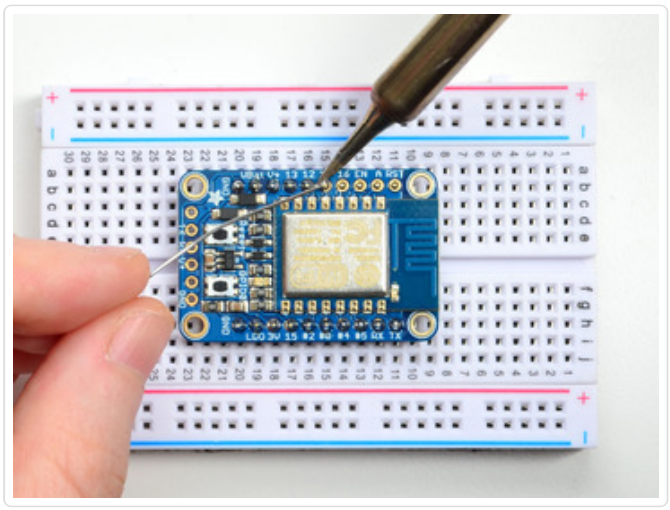


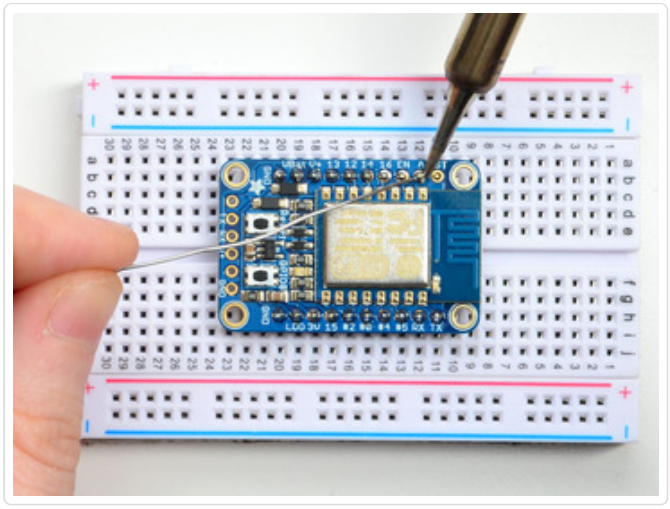




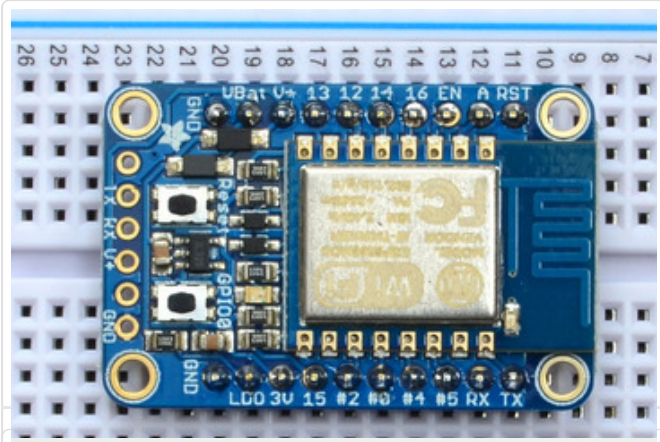
Flip the breadboard around to solder the other strip

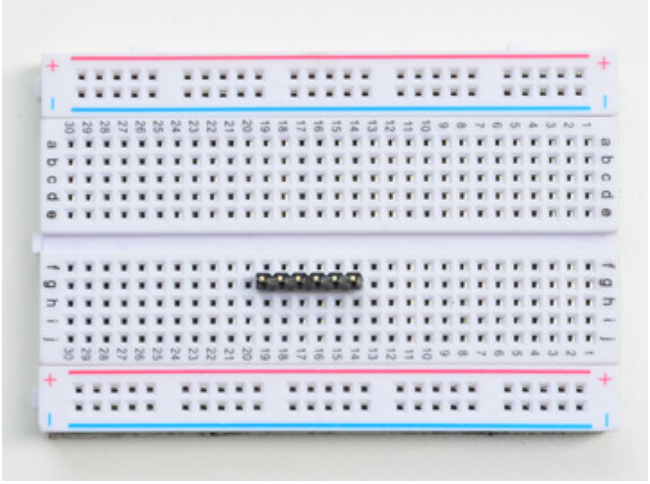






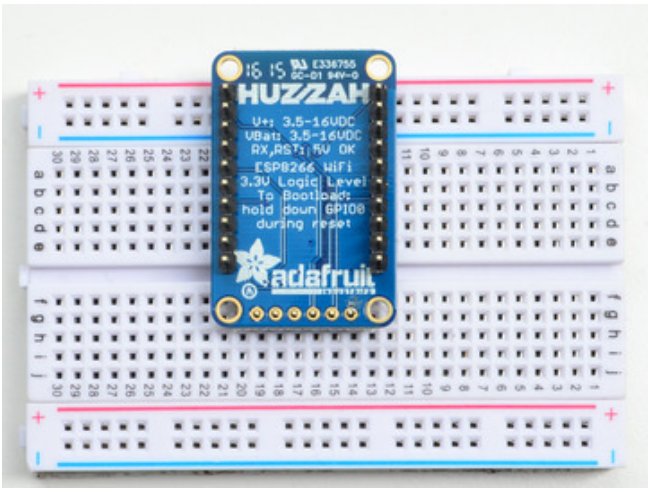
You're done! Check your solder joints visually and continue onto the next steps





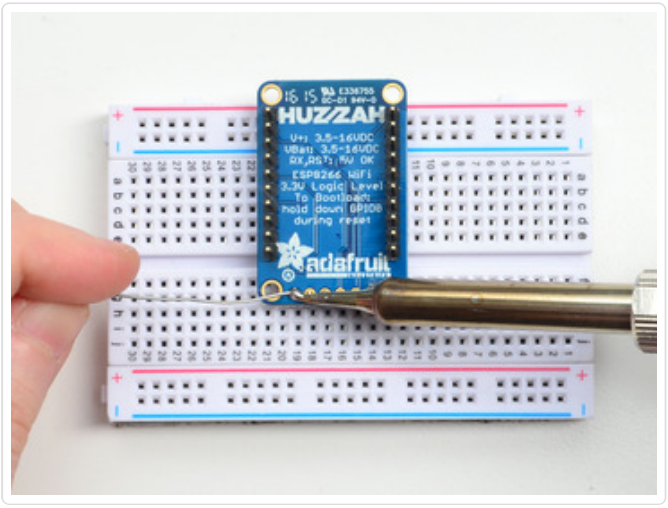
If you're planning on programming with an FTDI or console cable, it's handy to have 6 pins soldered on the end for plugging in.

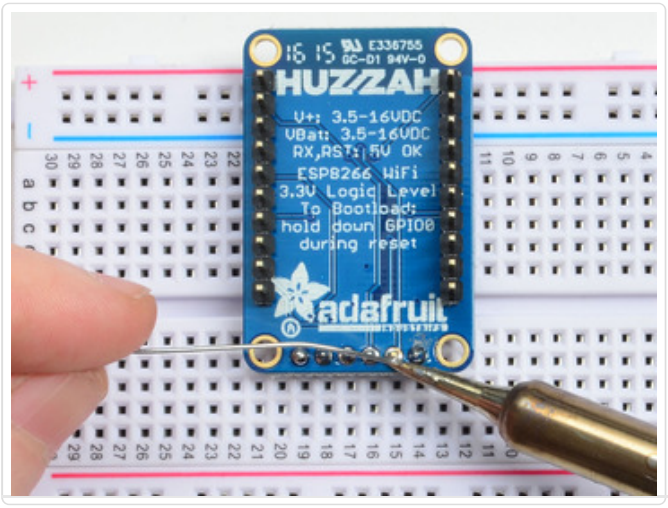
Cut another 6-pin strip to length if necessary. Insert it into a breadboard - **long pins down**

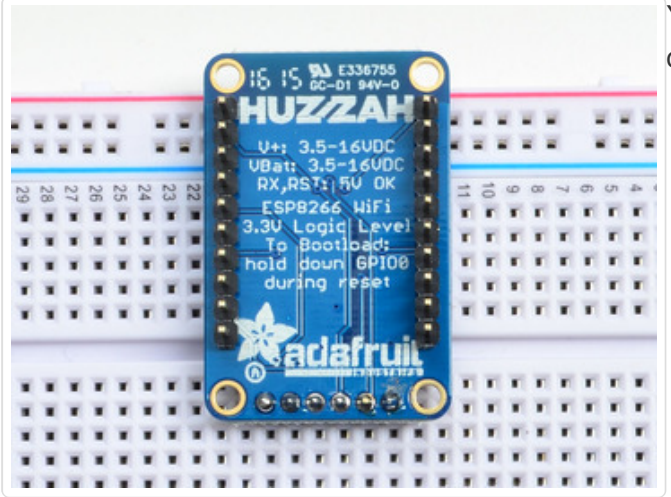


Place the breakout on the breadboard facing down

Solder all 6 pins!







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

Using NodeMCU Lua

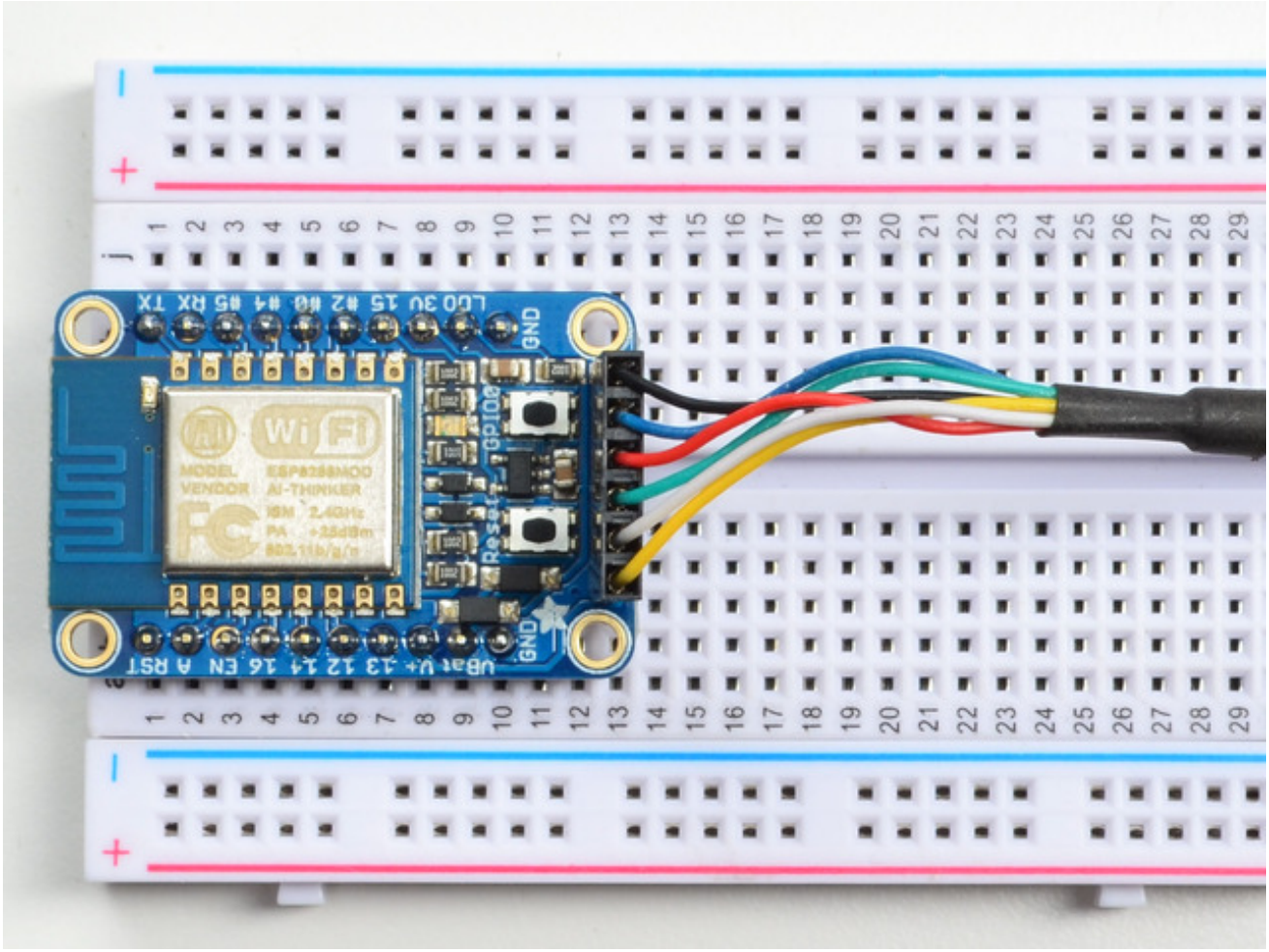
Each HUZZAH ESP8266 breakout comes pre-programmed with NodeMCU's Lua interpretter. As of this writing, we ship with **NodeMCU 0.9.5 build 20150318 powered by Lua 5.1.4** but it may be more recent

The Lua interpretter runs on the ESP8266 and you can type in commands and read out the results over serial. A serial console cable is perfect for this! Use either an FTDI cable (http://adafru.it/dNN) or any console cable (http://adafru.it/954), you can use either 3V or 5V logic and power as there is level shifting on the RX pin.

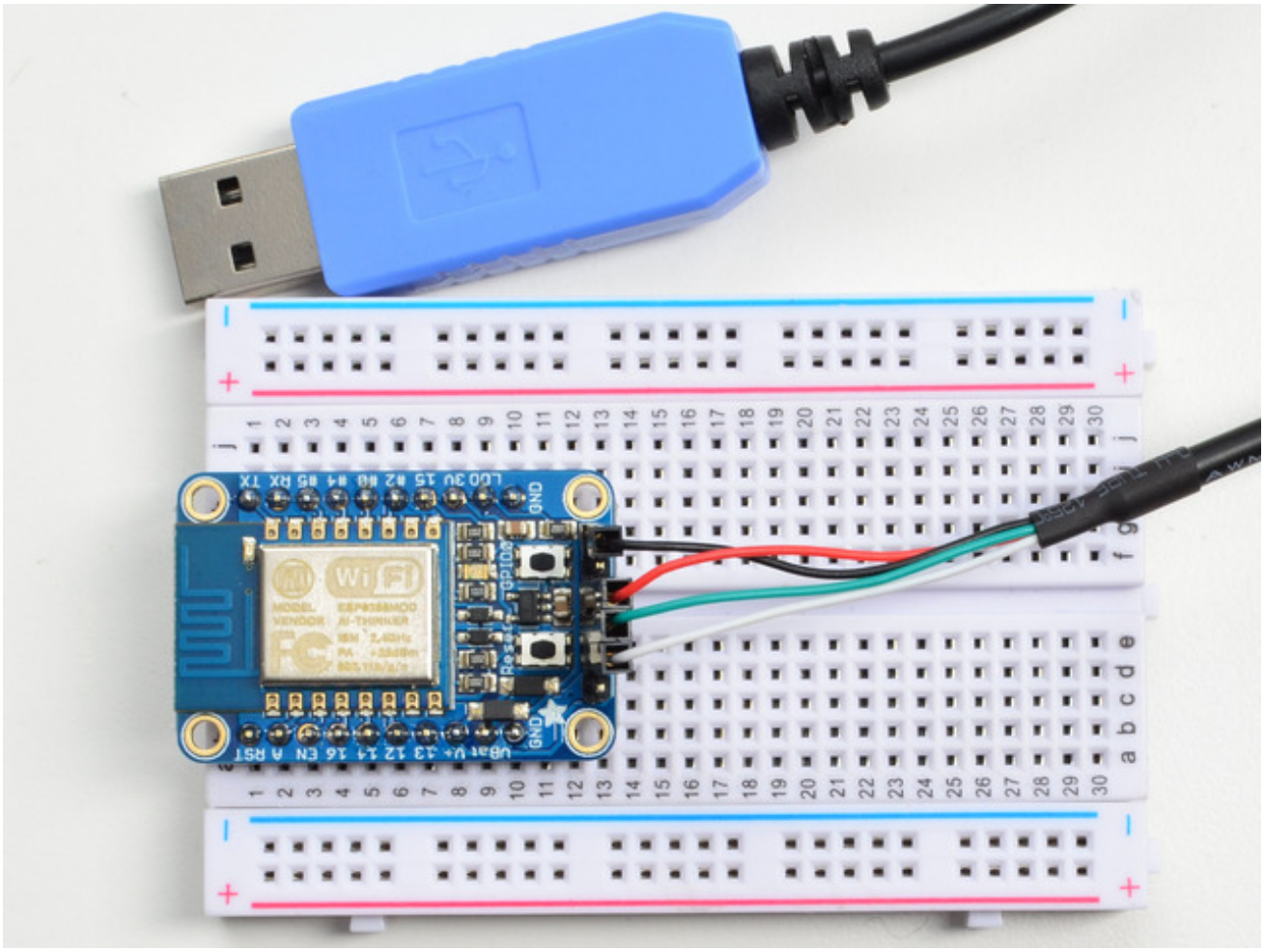
Don't forget to visit esp8266.com for the latest and greatest in ESP8266 news, software and gossip! (http://adafru.it/f1F)

Connect USB-Serial cable

Connect either your console cable or FTDI cable. If using FTDI, make sure the black wire goes to the GND (ground) pin



If using a console cable, connect the black wire to ground, red wire to **V+**, white wire to **TX** and green wire to **RX**

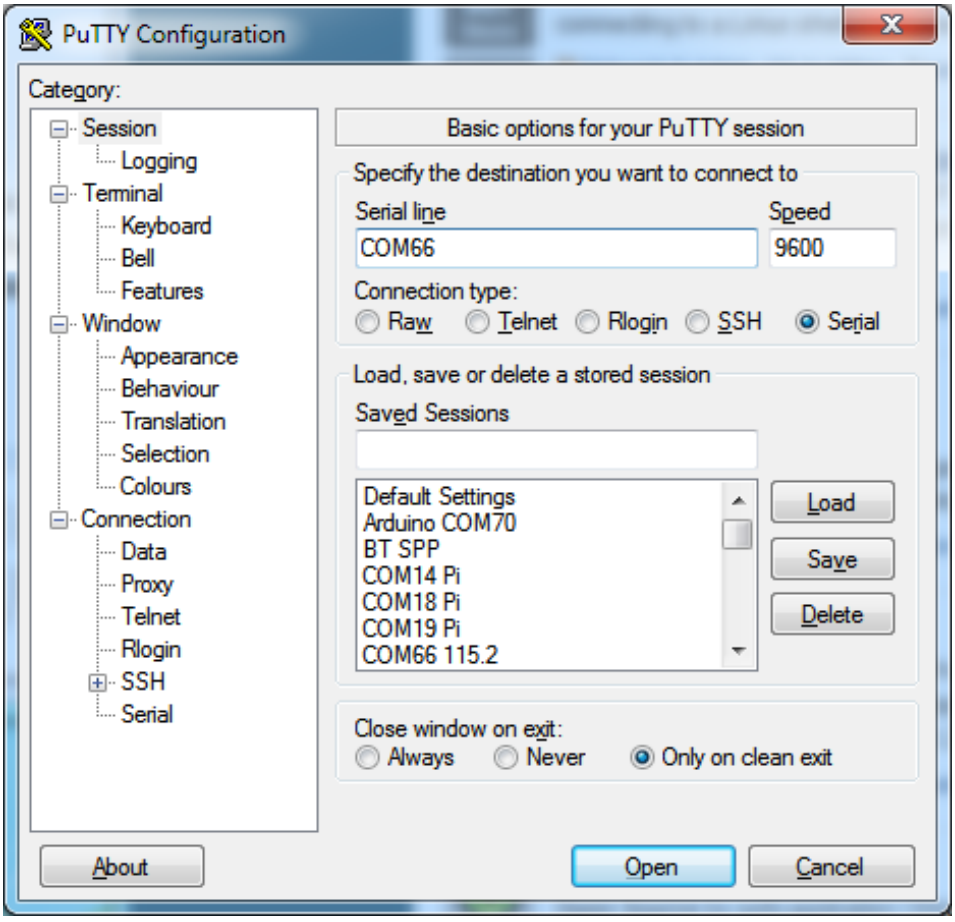


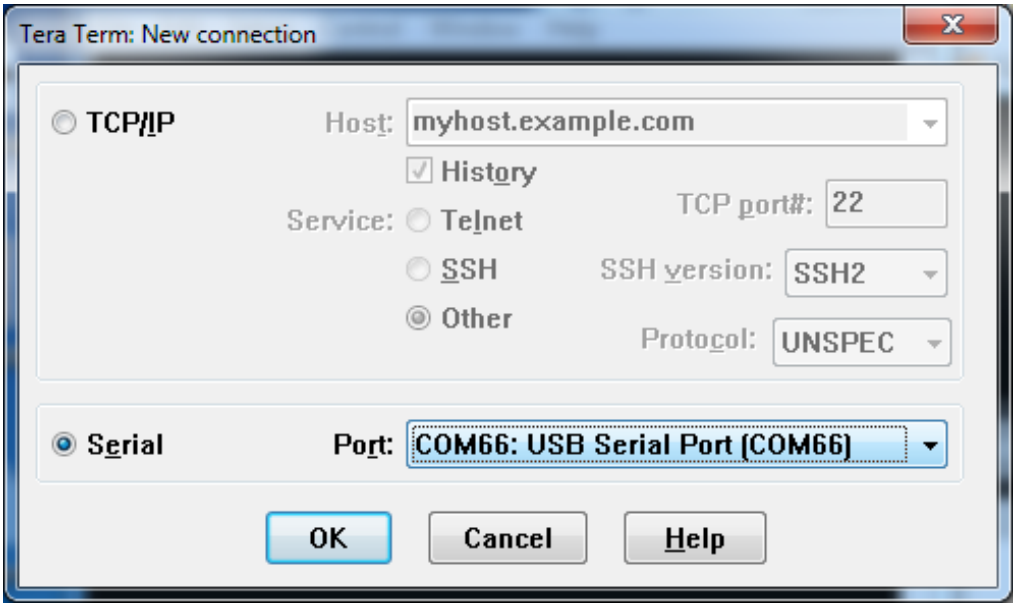
You will see the red and blue onboard LED flicker when powered up, but they will not stay lit.

Open up serial console

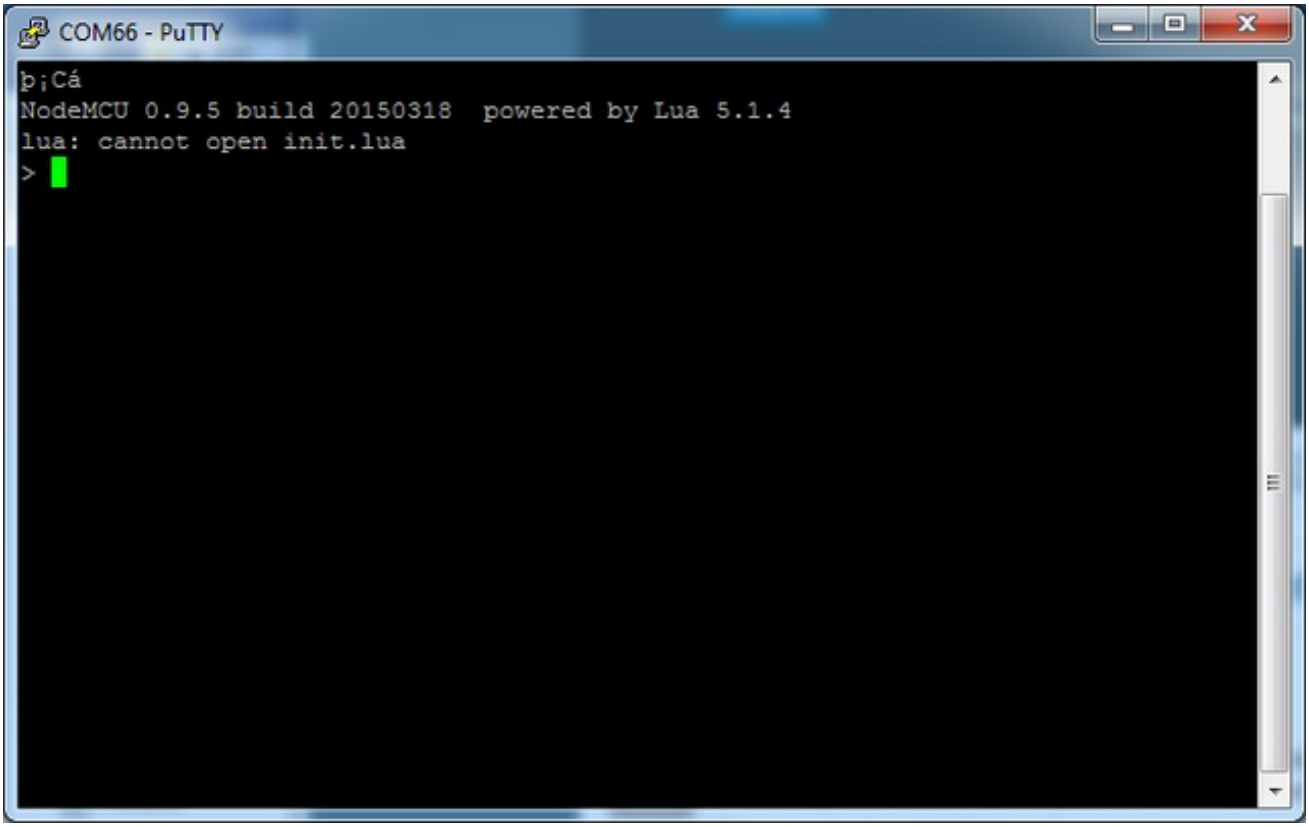
Next up, on your computer, use a serial console program such as **CoolTerm** (Mac) or **Putty** (Windows) or **screen** (linux). Teraterm seems to dislike the initial 115.2kbps data stream from the ESP8266 so you can try it but you'll possibly need to reset the terminal software.

Connect up to the COM or Serial port used by your cable, at 9600 Baud





Once the terminal software is connected, click the **Reset** button on the HUZZAH ESP board to reset it and have it print out the welcome message:



If you don't get this message, first check that the red/blue leds flickered when you press the reset button. If they didnt, make sure the board is powered via **V+** or **Vbat**. If they do flicker, make sure you've got the right baud rate selected in the software (9600) and the RX/TX/GND pins connected right

Hello world!

Ok we can now turn on an LED. There is a red LED on each board, connected to **GPIO #0**

> NodeMCU's pinouts are not the same as the Arduino/gcc pinouts. We print the Arduino pinouts on the board so watch out!

> Rev A of this board has GPIO #4 and #5 swapped (the modules changed pinouts on us) so if #4/#5 aren't working for you, try swapping! We'll fix in the next PCB run

Pin Notes	**PCB/Arduino**	**NodeMCU/Lua**
No pullups!	0	3
	2	4
	3	9
	4	1
	5	2
	9	11
	10	12
	12	6
	13	7
	14	5
	15	8
	16	0

So to set the pin #0 LED on and off first make it an output:

```
gpio.mode(3, gpio.OUTPUT)
```

Turn the LED on with:

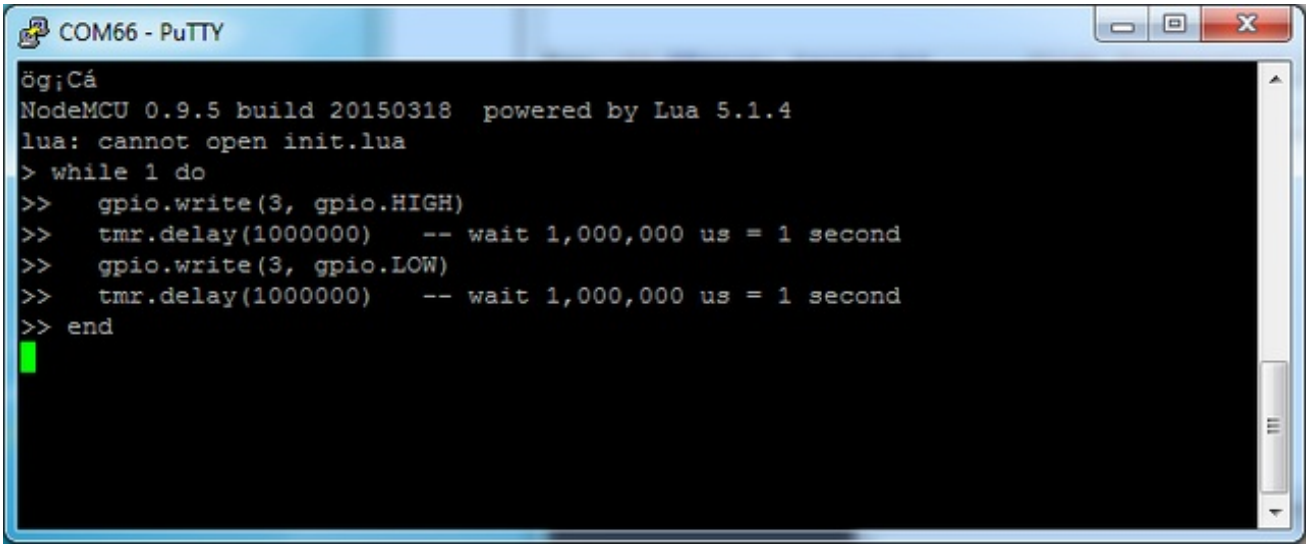
```
gpio.write(3, gpio.LOW)
```

And off with:

```
gpio.write(3, gpio.HIGH)
```

You can make this a little more automated by running:

```
while 1 do
  gpio.write(3, gpio.HIGH)
  tmr.delay(1000000)   -- wait 1,000,000 us = 1 second
  gpio.write(3, gpio.LOW)
  tmr.delay(1000000)   -- wait 1,000,000 us = 1 second
end
```



The LED will now be blinking on and off.

Note that since its in a loop, its not possible to get it to stop via the interpretter. To stop it, click the **Reset** button again!

Scanning & Connecting to WiFi

We'll continue with a quick demo of scanning for WiFi and connecting.

Once you're back at the Lua prompt, set the ESP8266 into WiFi Client mode with

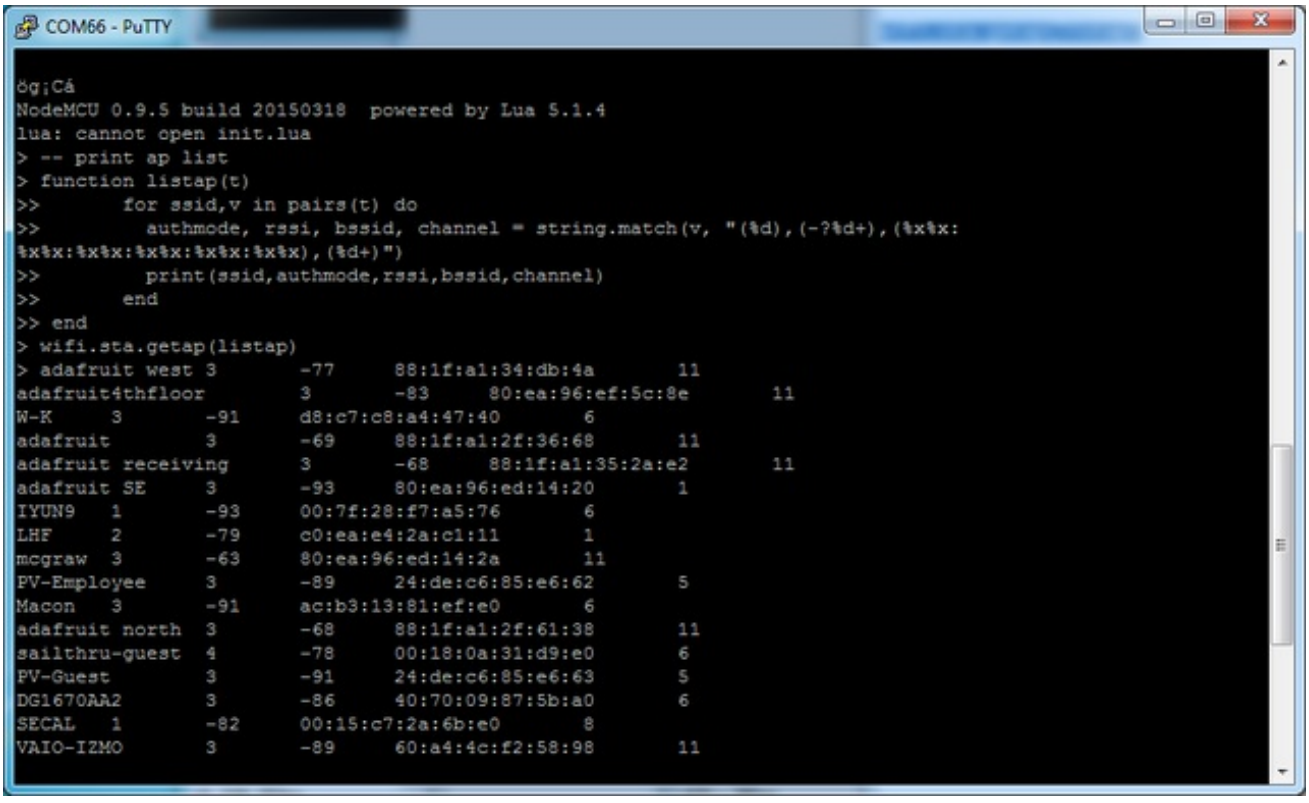
```
wifi.setmode(wifi.STATION)
```

Then you can run the scanner and have it print out the available AP's

```
-- print ap list
function listap(t)
      for k,v in pairs(t) do
        print(k.." : "..v)
      end
end
wifi.sta.getap(listap)
```

or for more detail...

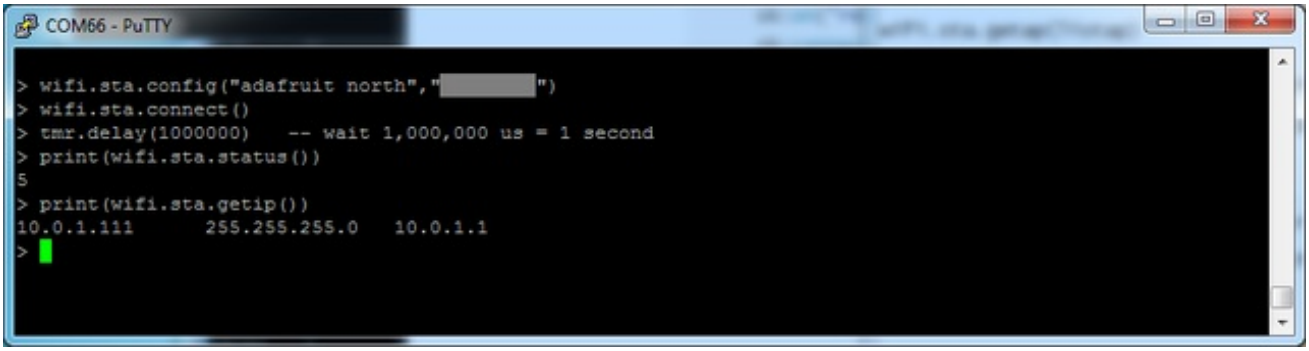
```
-- print ap list
function listap(t)
      for ssid,v in pairs(t) do
        authmode, rssi, bssid, channel =
          string.match(v, "(%d),(-?%d+),(%x%x:%x%x:%x%x:%x%x:%x%x:%x%x),(%d+)")
        print(ssid,authmode,rssi,bssid,channel)
      end
end

wifi.sta.getap(listap)
```



We can connect to the access point with **wifi.sta.config** and **wifi.sta.connect** - it will take a second

or two to complete the connection, you can query the module to ask the status with **wifi.sta.status()** - when you get a 5 it means the connection is completed and DHCP successful

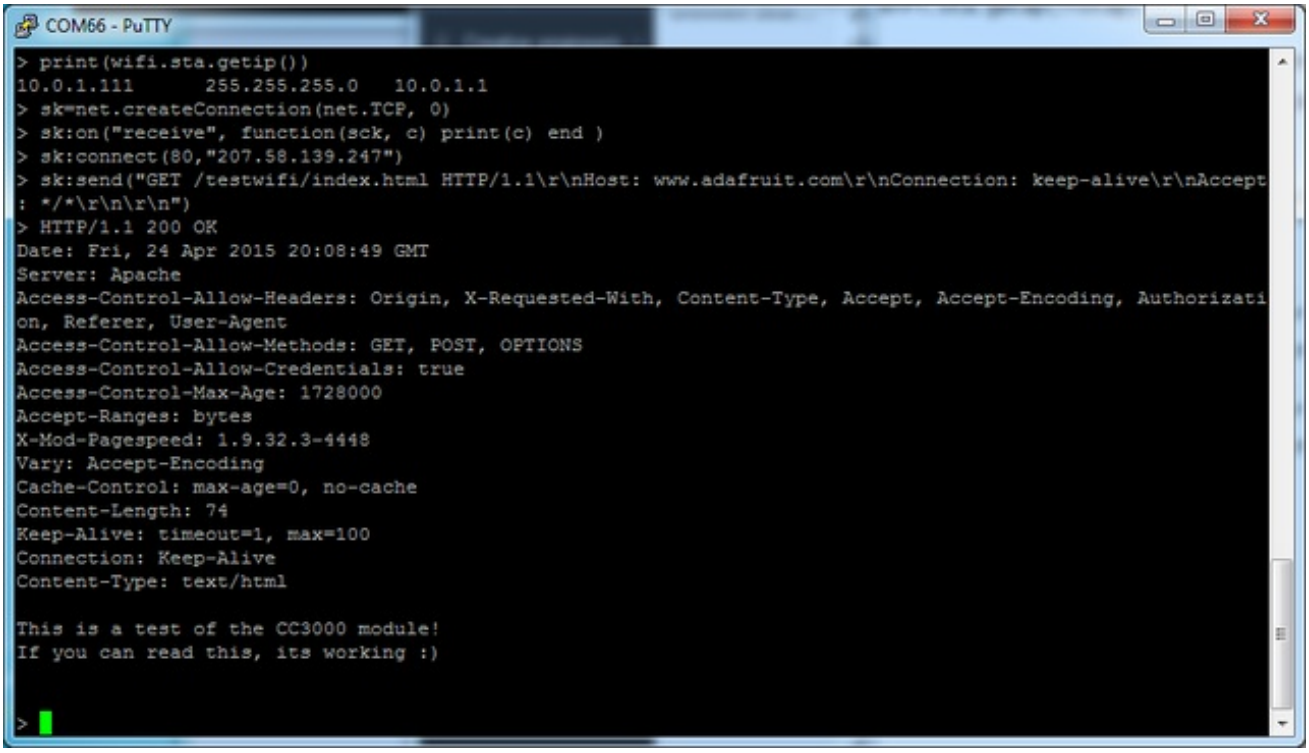
```
wifi.sta.config("accesspointname","yourpassword")
wifi.sta.connect()
tmr.delay(1000000)   -- wait 1,000,000 us = 1 second
print(wifi.sta.status())
print(wifi.sta.getip())
```



WebClient example

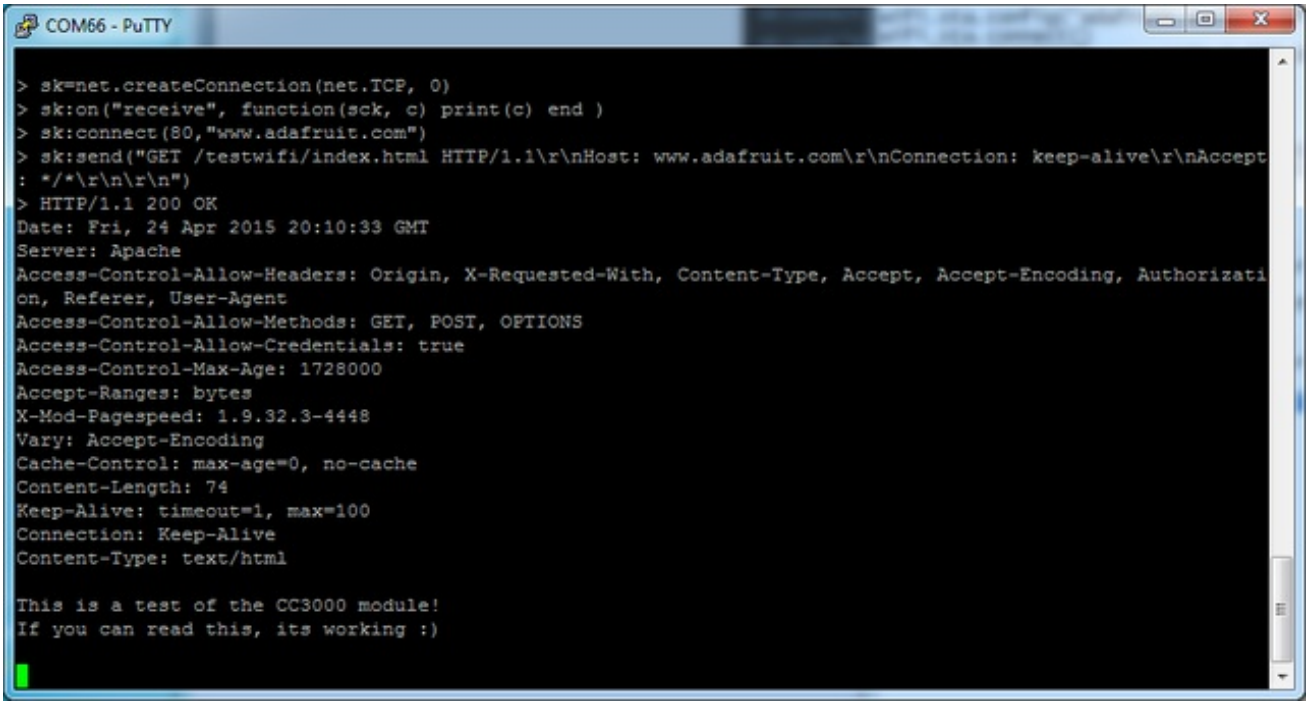
Once you're got the IP address you can connect to adafruit, for example, and read a webpage and print it out:

```
sk=net.createConnection(net.TCP, 0)
sk:on("receive", function(sck, c) print(c) end )
sk:connect(80,"207.58.139.247")
sk:send("GET /testwifi/index.html HTTP/1.1\r\nHost: www.adafruit.com\r\nConnection: keep-alive\r\nAccept: */*
```



You can also have the module do DNS for you, just give it the hostname instead of IP address:

```
sk=net.createConnection(net.TCP, 0)
sk:on("receive", function(sck, c) print(c) end )
sk:connect(80,"www.adafruit.com")
sk:send("GET /testwifi/index.html HTTP/1.1\r\nHost: www.adafruit.com\r\nConnection: keep-alive\r\nAccept: */*
```



This is just a light overview of testing out your HUZZAH ESP breakout! For much more, check out NodeMCU's tutorial page https://github.com/nodemcu/nodemcu-firmware/wiki/nodemcu_api_en (http://adafru.it/f1M) for the details on what functions are available to you, as well as http://www.lua.org (http://adafru.it/f1N) to learn more about the Lua scripting language

Using Arduino IDE

While the HUZZAH ESP8266 breakout comes pre-programmed with NodeMCU's Lua interpretter, you don't have to use it! Instead, you can use the Arduino IDE which may be more familar. **This will write directly to the firmware, erasing the NodeMCU firmware**, so if you want to go back to Lua, use the flasher to re-install it (http://adafru.it/f1O)

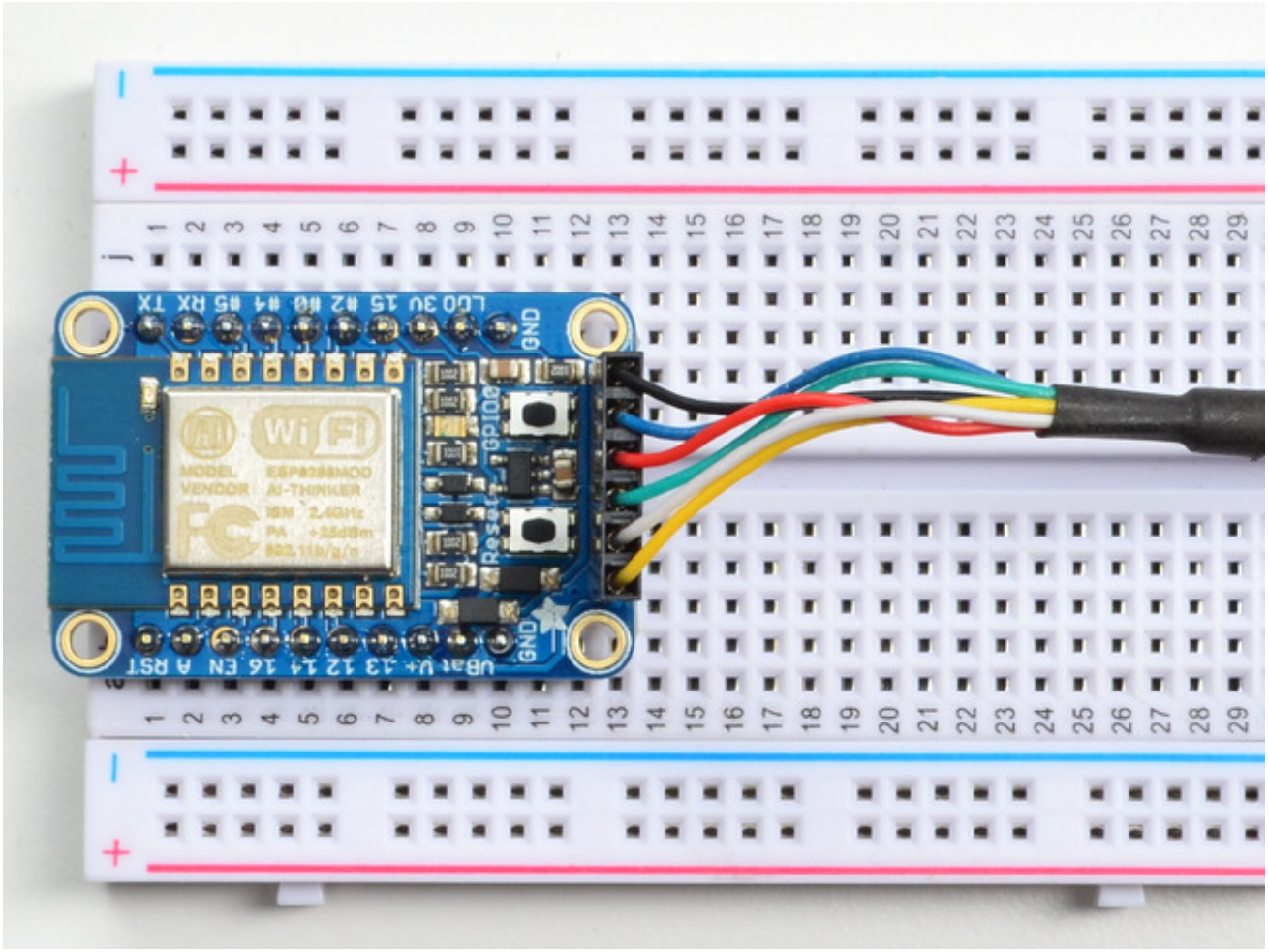
In order to upload code to the ESP8266 and use the serial console, you will need a USB to serial converter! Use either an FTDI cable (http://adafru.it/dNN) or any console cable (http://adafru.it/954), you can use either 3V or 5V logic and power as there is level shifting on the RX pin.

Don't forget to visit esp8266.com for the latest and greatest in ESP8266 news, software and gossip! (http://adafru.it/f1F)

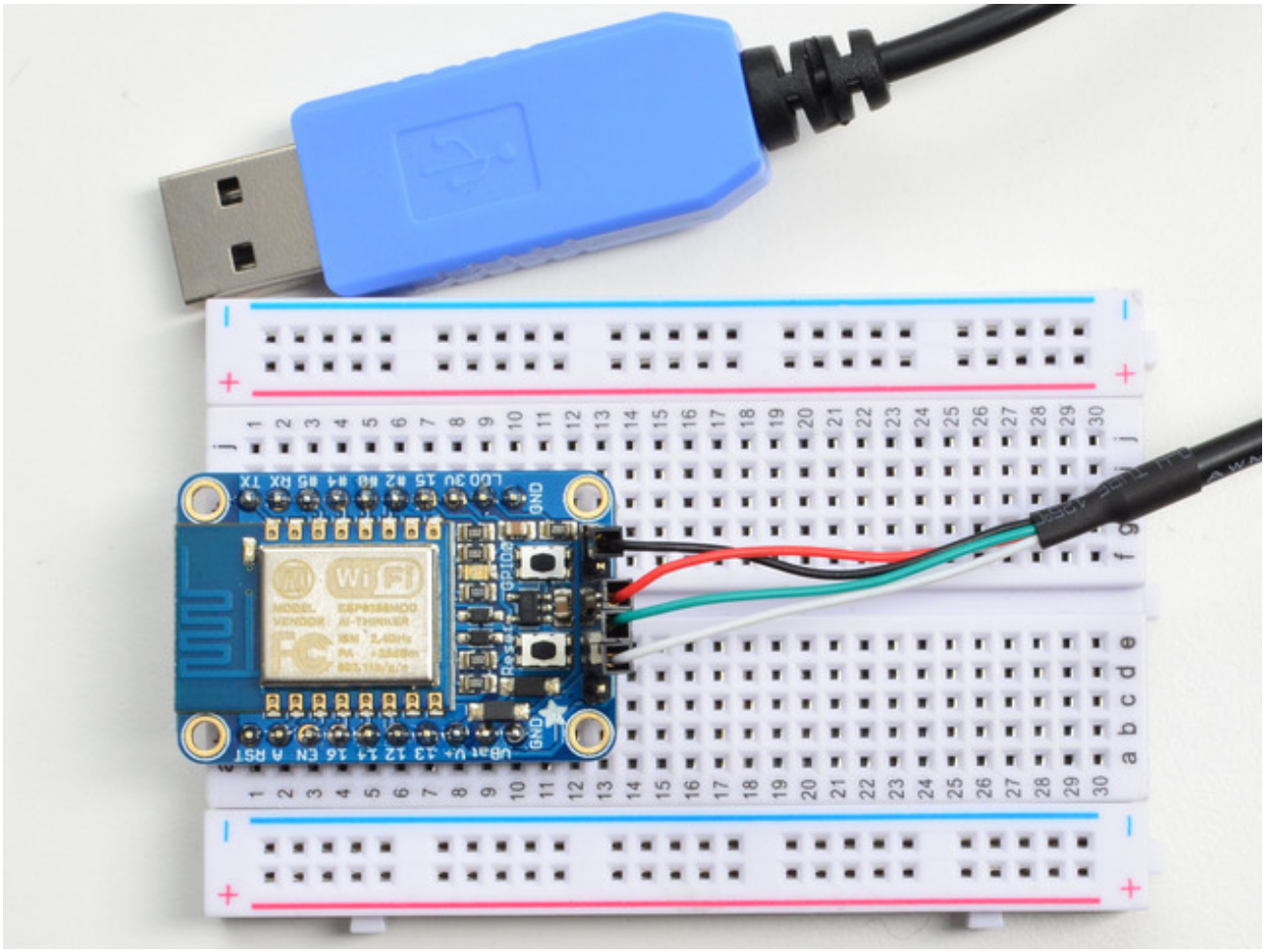
PL2303 USB console cables seem to only work with Windows computers for some reason. Mac users, we suggest FTDI cables!

Connect USB-Serial cable

Connect either your console cable or FTDI cable. If using FTDI, make sure the black wire goes to the GND (ground) pin



If using a console cable, connect the black wire to ground, red wire to **V+**, white wire to **TX** and green wire to **RX**



You will see the red and blue onboard LED flicker when powered up, but they will not stay lit.

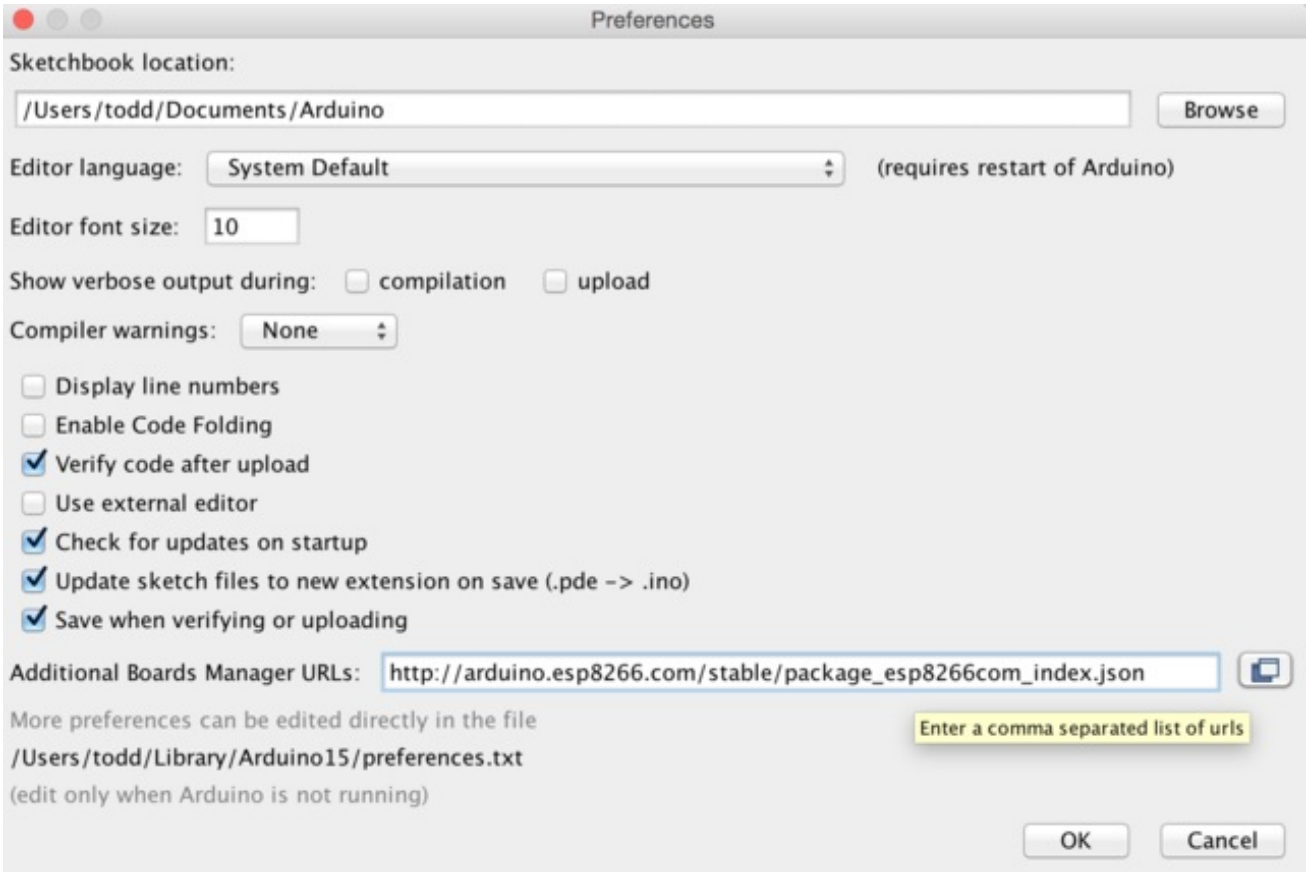
Install the Arduino IDE 1.6.4 or greater

Download Arduino IDE from Arduino.cc (1.6.4 or greater) - don't use 1.6.2! You can use your existing IDE if you have already installed it (http://adafru.it/f1P)

You can also try downloading the ready-to-go package from the ESP8266-Arduino project (http://adafru.it/eSH), if the proxy is giving you problems

Install the ESP8266 Board Package

Enter `http://arduino.esp8266.com/stable/package_esp8266com_index.json` into *Additional Board Manager URLs* field in the Arduino v1.6.4+ preferences.

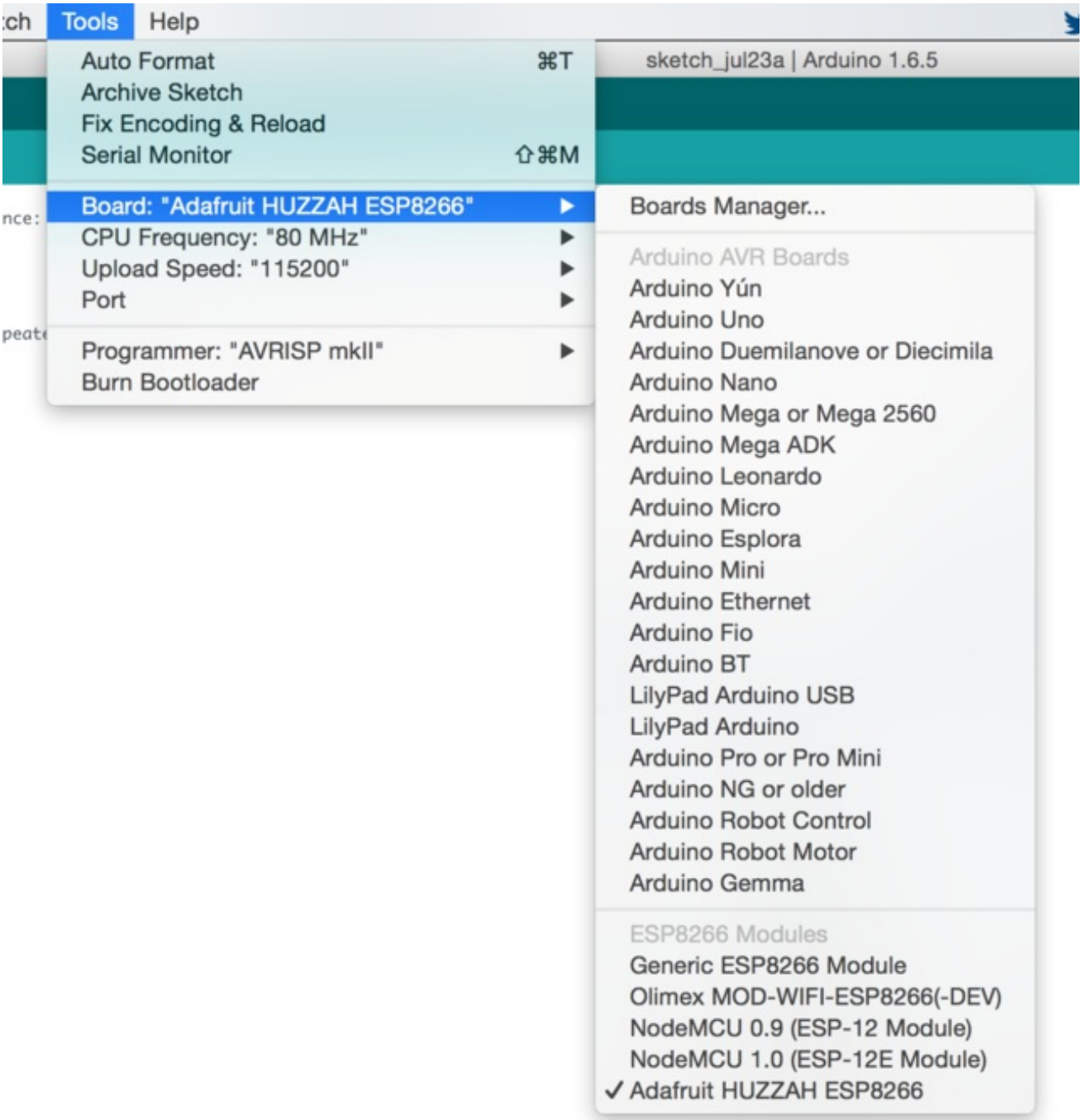


Visit our guide for how to add **new boards to the Arduino 1.6.4+ IDE** for more info about adding third party boards (http://adafru.it/f7X).

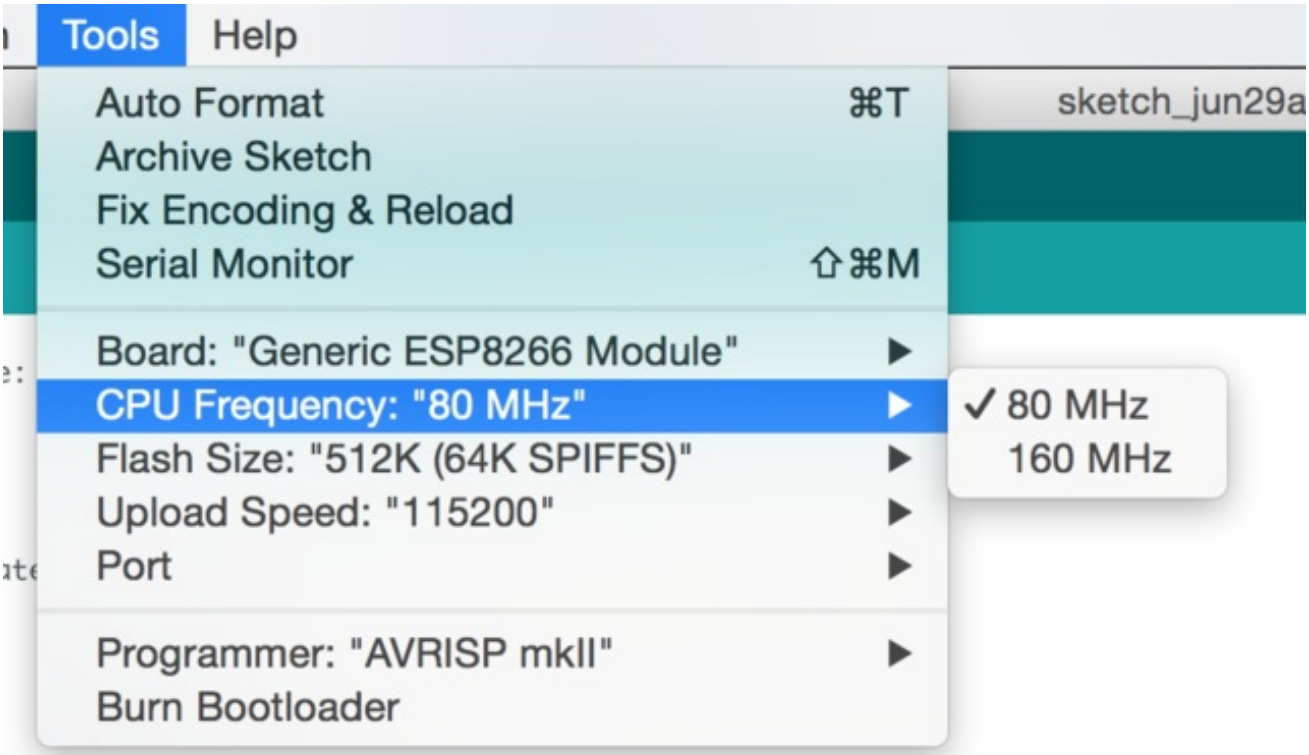
Next, use the **Board manager** to install the ESP8266 package.

Setup ESP8266 Support

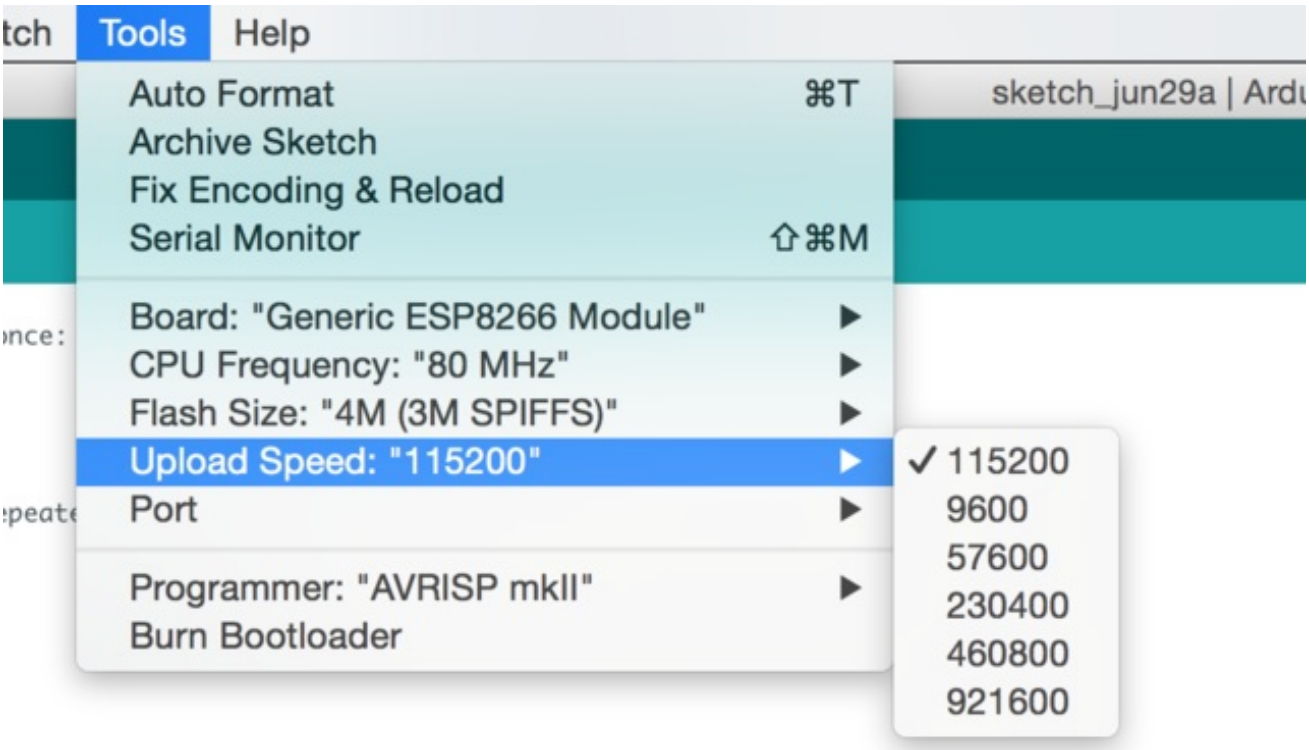
When you've restarted, select **Adafruit HUZZAH ESP8266** from the Tools->Board dropdown



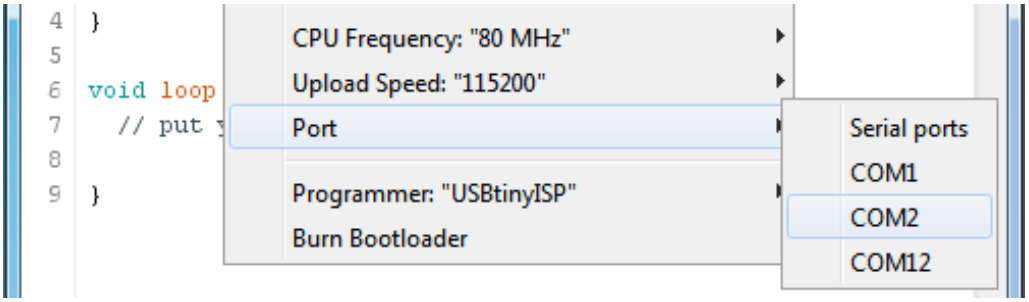
80 MHz as the CPU frequency



115200 baud upload speed



The matching COM port for your FTDI or USB-Serial cable



Blink Test

We'll begin with the simple blink test

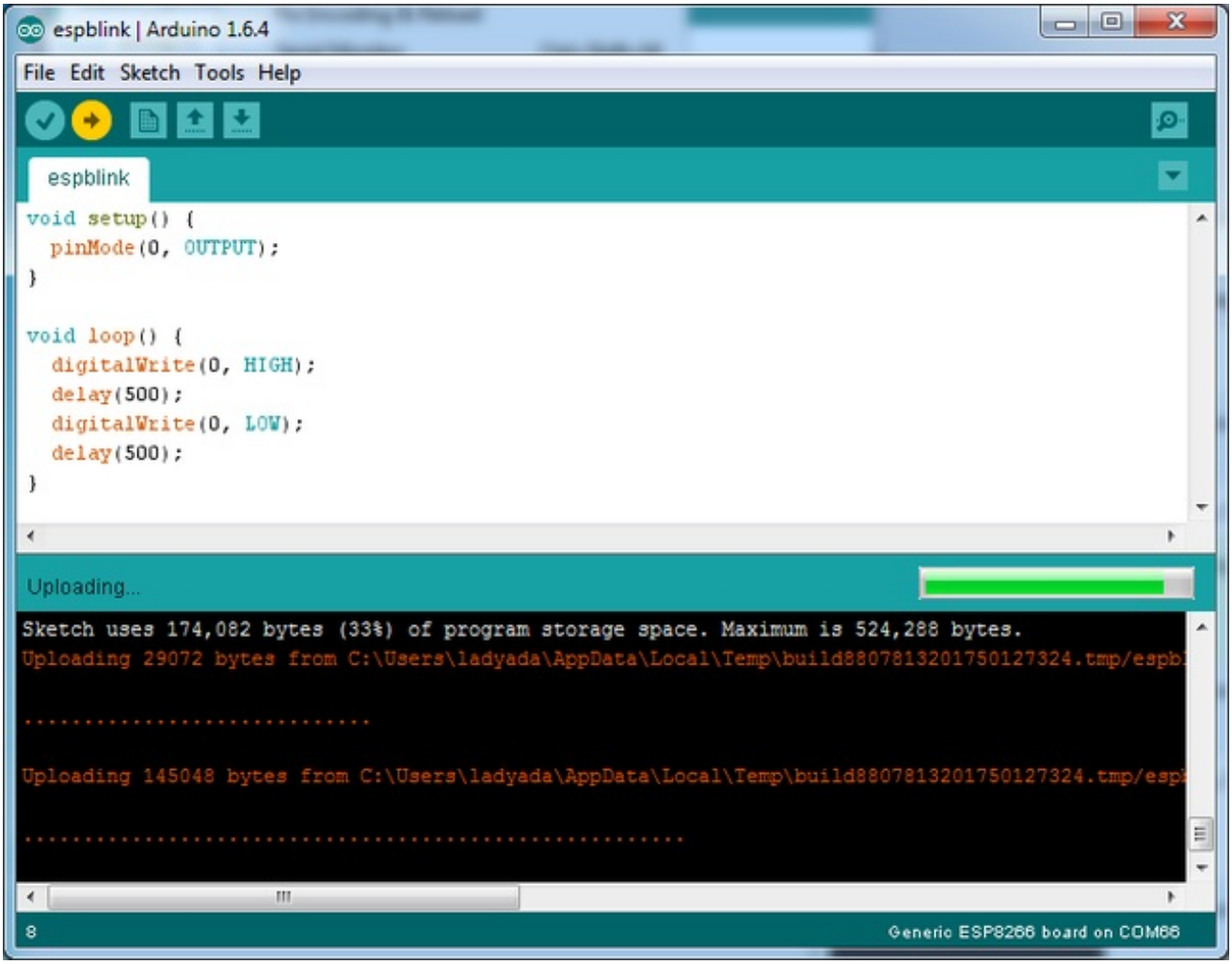
Enter this into the sketch window (and save since you'll have to)

```
void setup() {
  pinMode(0, OUTPUT);
}

void loop() {
  digitalWrite(0, HIGH);
  delay(500);
  digitalWrite(0, LOW);
  delay(500);
}
```

Now you'll need to put the board into bootload mode. You'll have to do this before each upload. There is no timeout for bootload mode, so you don't have to rush!

1. Hold down the **GPIO0** button, the red LED will be lit
2. While holding down **GPIO0**, click the **RESET** button
3. Release **RESET**, then release **GPIO0**
4. When you release the RESET button, the red LED will be lit dimly, this means its ready to bootload

Once the ESP board is in bootload mode, upload the sketch via the IDE



The sketch will start immediately - you'll see the LED blinking. Hooray!

Connecting via WiFi

OK once you've got the LED blinking, lets go straight to the fun part, connecting to a webserver. Create a new sketch with this code:

```
/*
 *  Simple HTTP get webclient test
 */

#include <ESP8266WiFi.h>

const char* ssid     = "yourssid";
const char* password = "yourpassword";

const char* host = "www.adafruit.com";

void setup() {
```

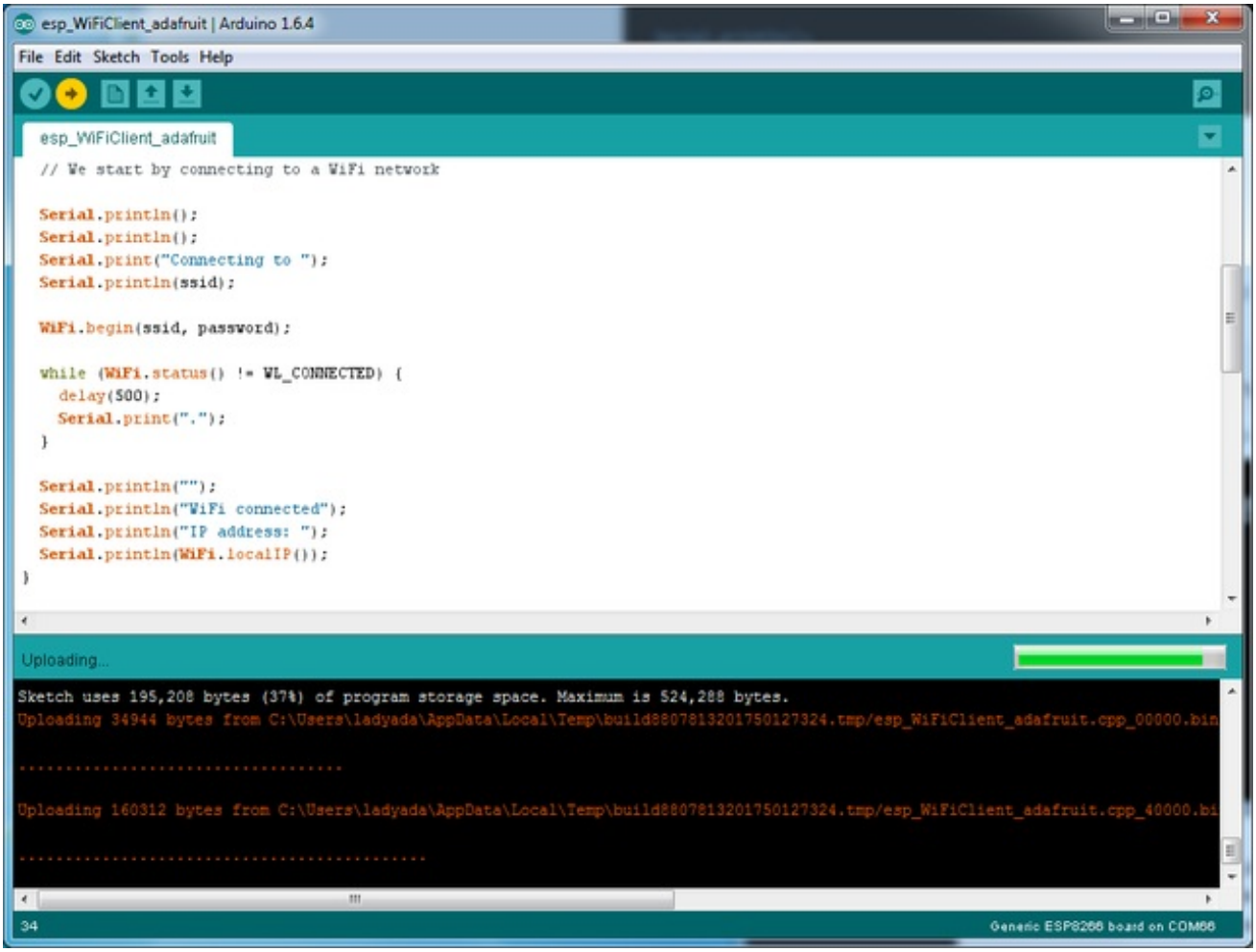
```
void setup() {
  Serial.begin(115200);
  delay(100);

  // We start by connecting to a WiFi network

  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }

  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

int value = 0;

void loop() {
  delay(5000);
  ++value;

  Serial.print("connecting to ");
  Serial.println(host);

  // Use WiFiClient class to create TCP connections
  WiFiClient client;
  const int httpPort = 80;
  if (!client.connect(host, httpPort)) {
    Serial.println("connection failed");
    return;
  }

  // We now create a URI for the request
  String url = "/testwifi/index.html";
  Serial.print("Requesting URL: ");
  Serial.println(url);

  // This will send the request to the server
```

```
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
  delay(500);

  // Read all the lines of the reply from server and print them to Serial
  while(client.available()){
    String line = client.readStringUntil('\r');
    Serial.print(line);
  }

  Serial.println();
  Serial.println("closing connection");
}
```

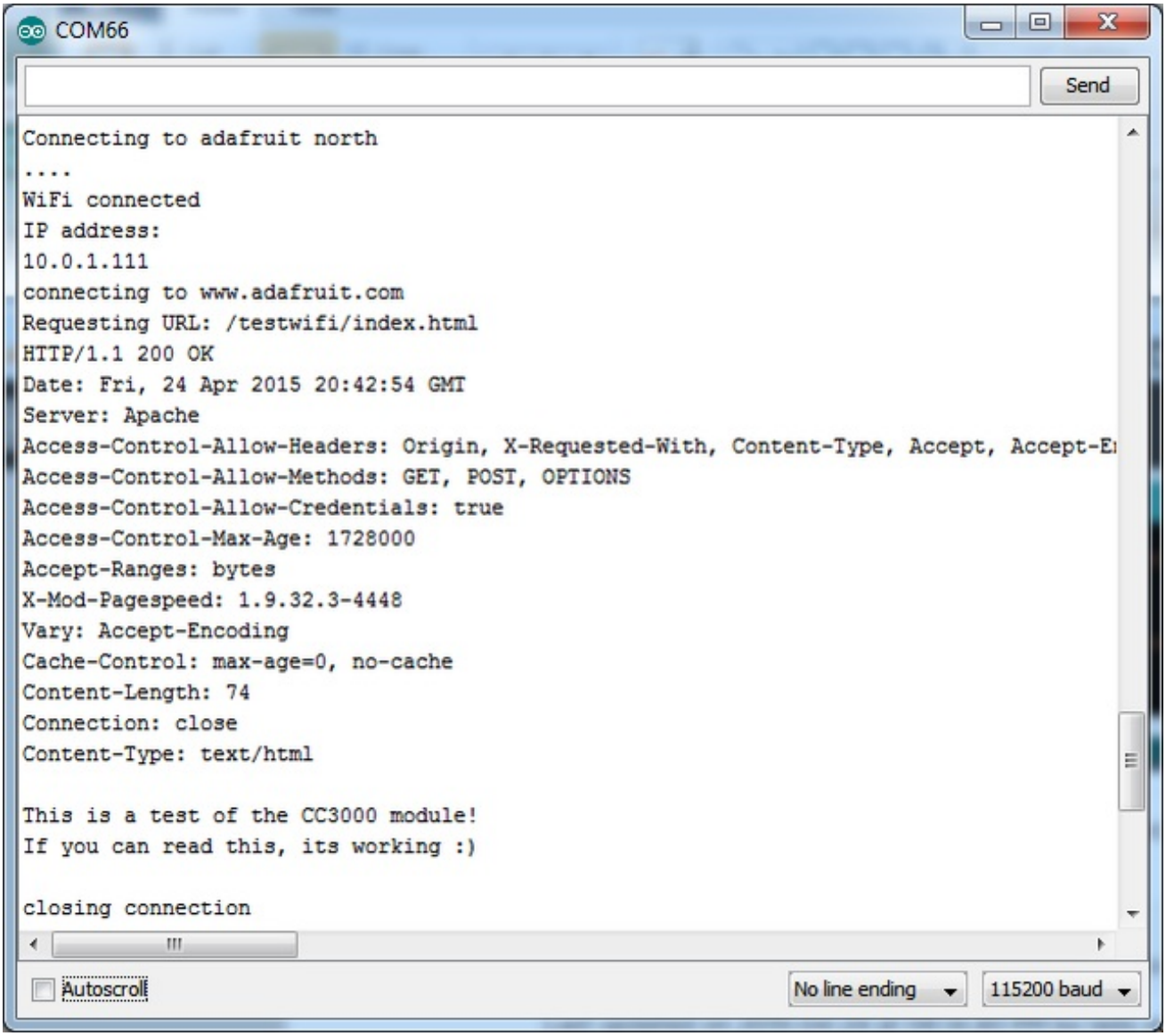
Dont forget to update

```
const char* ssid     = "yourssid";
const char* password = "yourpassword";
```

to your access point and password, then upload the same way: get into bootload mode, then upload code via IDE



Open up the IDE serial console at 115200 baud to see the connection and webpage printout!



That's it, pretty easy!

This page was just to get you started and test out your module. For more information, check out the ESP8266 port github repository (http://adafru.it/eSH) for much more up-to-date documentation!

Other Options

- You can also try using embedXcode (http://adafru.it/f5J) which has a template for the ESP8266 with Xcode
- esp-open-sdk (http://adafru.it/f5K) is a toolchain that will let you progam the ESP8266 processor directly (more info at the esp8266.com wiki (http://adafru.it/f5L))

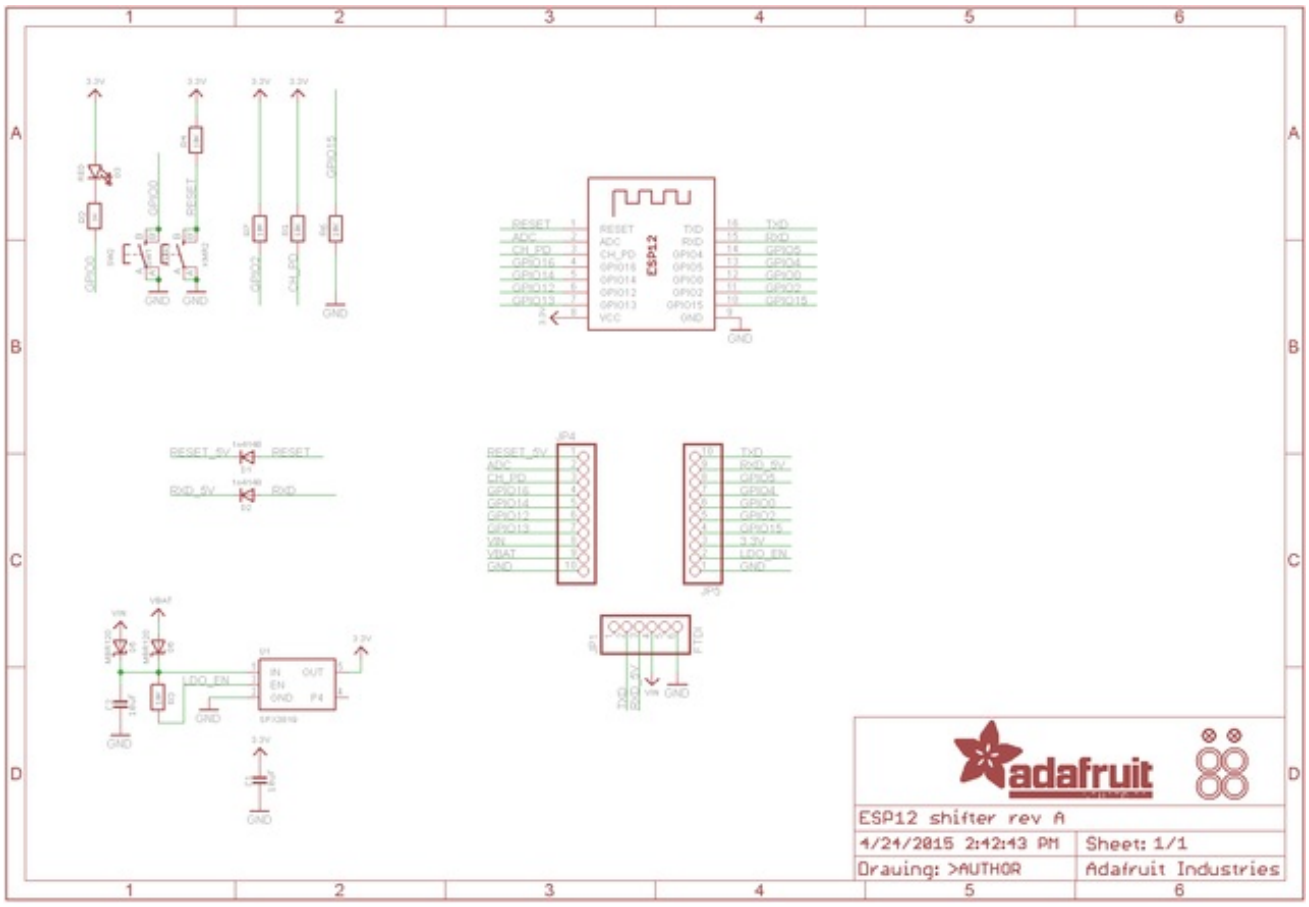
Downloads

More info about the ESP8266

- ESP8266 specification sheet (http://adafru.it/f1E)
- SPX3819 3.3V linear regulator on board (http://adafru.it/f4z)
- FCC test report (http://adafru.it/f1S) for the module used on this breakout
- CE test report for the module used on this breakout (http://adafru.it/f1U)
- Huuuuge amount of information on http://www.esp8266.com/ (http://adafru.it/f1F) community forum!
- NodeMCU (Lua for ESP8266) webpage (http://adafru.it/f1G) with examples and documentation on the Lua framework
- Arduino IDE support for ESP8266 (http://adafru.it/eSH)

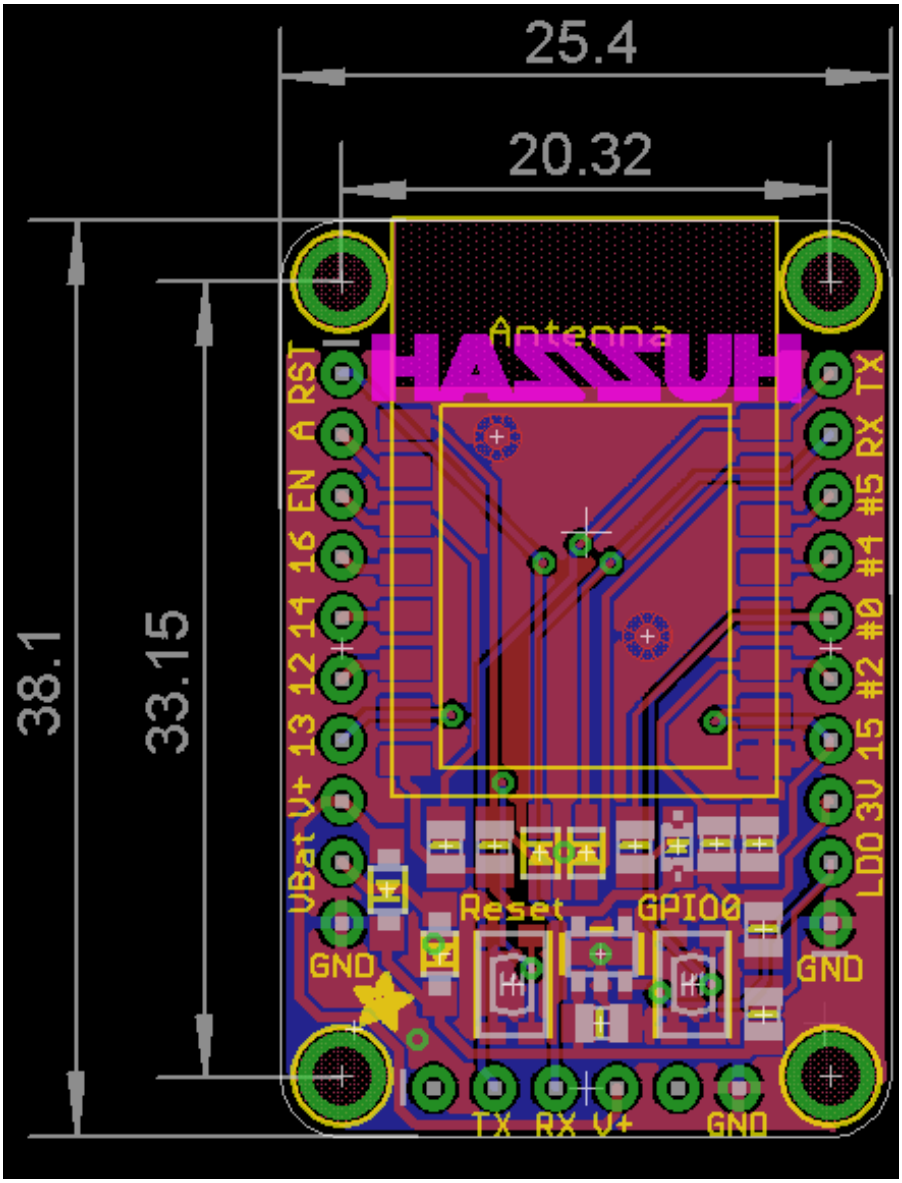
Don't forget to visit esp8266.com for the latest and greatest in ESP8266 news, software and gossip! (http://adafru.it/f1F)

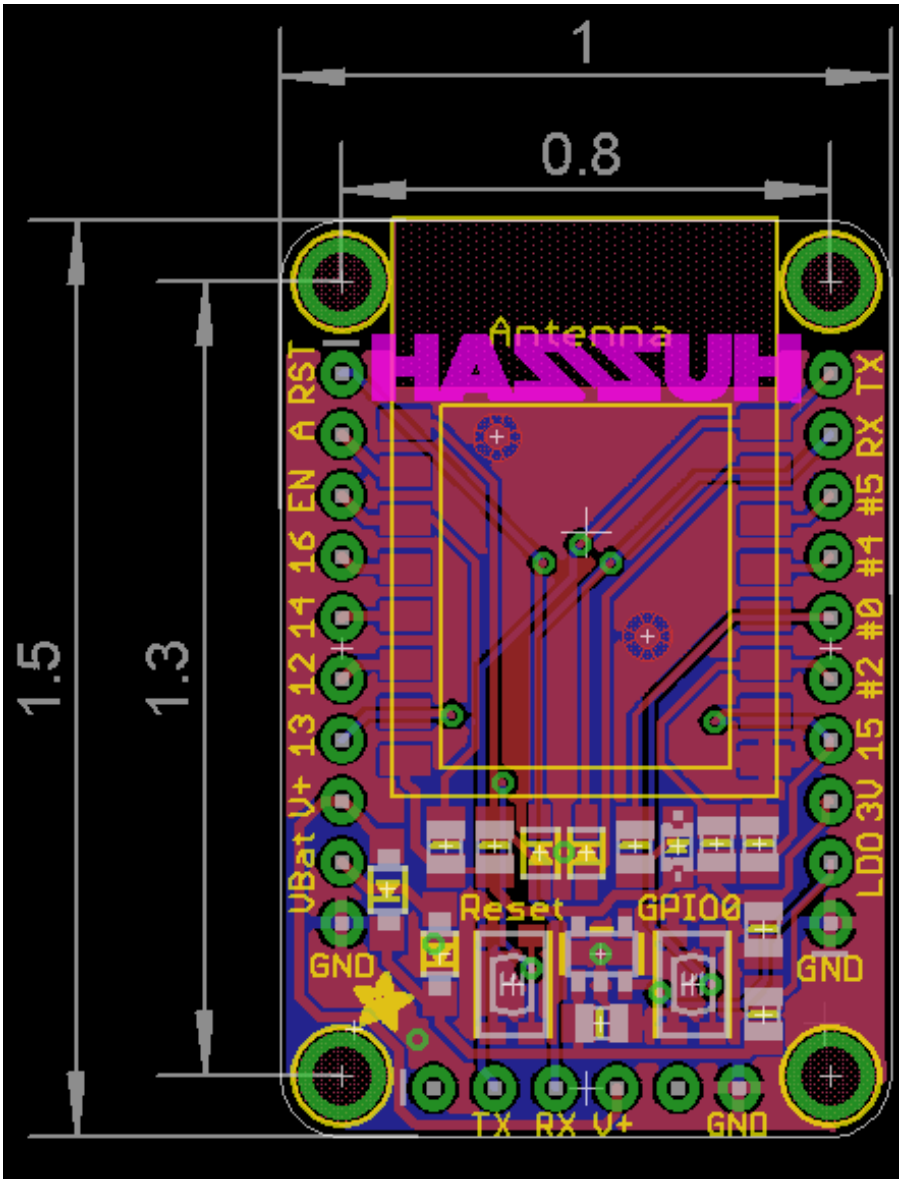
Schematic



Fabrication print

Dimensions in mm & inches




1
0.8
1.5
1.3
Antenna
HASSUH
RST
A
EN
16
14
12
13
V+
VBat
GND
TX
RX
#5
#4
#0
#2
15
3V
LDO
GND
Reset
GPIO0
TX
RX
V+
GND

F.A.Q.

When I connect stuff to some of the pins, the Huzzah stops working. Whats up with that?

The ESP8266 uses some of the pins as 'boot mode' pins so on boot they must be set to certain values:

- **CH_PD** should be always pulled high (it will disable the entire module if low)
- **RST** should be always pulled high (it will disable the entire module if low)
- **GPIO 0** sets whether the bootloader is active, it must be pulled HIGH during power up/reset for the user program to run. If its pulled LOW, it will activate the bootloader. The built-in red LED on #0 pulls it up
- **GPIO 2** must be pulled high on power up/reset.
- **GPIO 15** must be pulled low on power up/reset.

My Huzzah board keeps crashing and resetting, whats up with that?

The most common reason for crashes is power failure. Make sure you're powering the Huzzah with a good ~5V power supply, and if you're using a USB-Serial cable, that its plugged into the mainboard of your computer or through a **powered** hub!

I'm having difficulties uploading to the HUZZAH with the Arduino IDE

Make sure you're using a good quality USB/Serial cable. Install the official drivers for that cable too! We've also noticed that PL2303-based cables don't work on Macs for some reason. FTDI or CP210x based chipsets work best