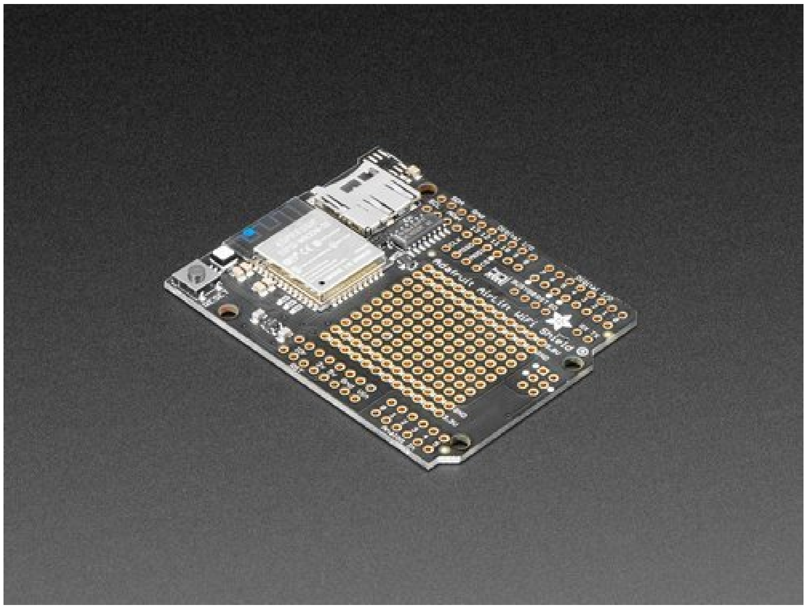
adafruit learning system

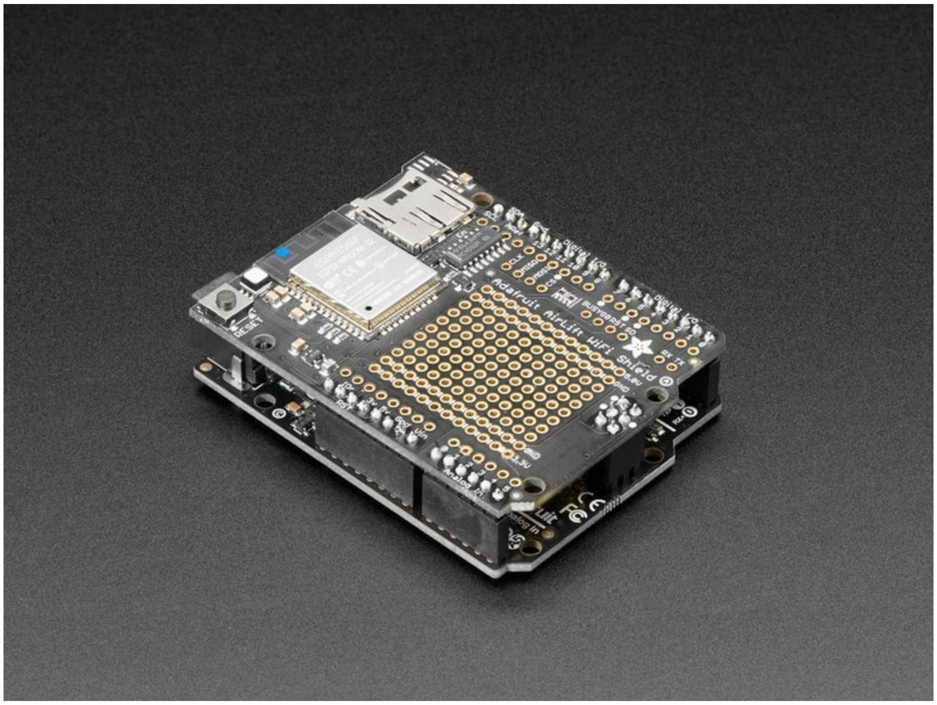
Adafruit AirLift Shield - ESP32 WiFi Co-Processor

Created by Brent Rubell

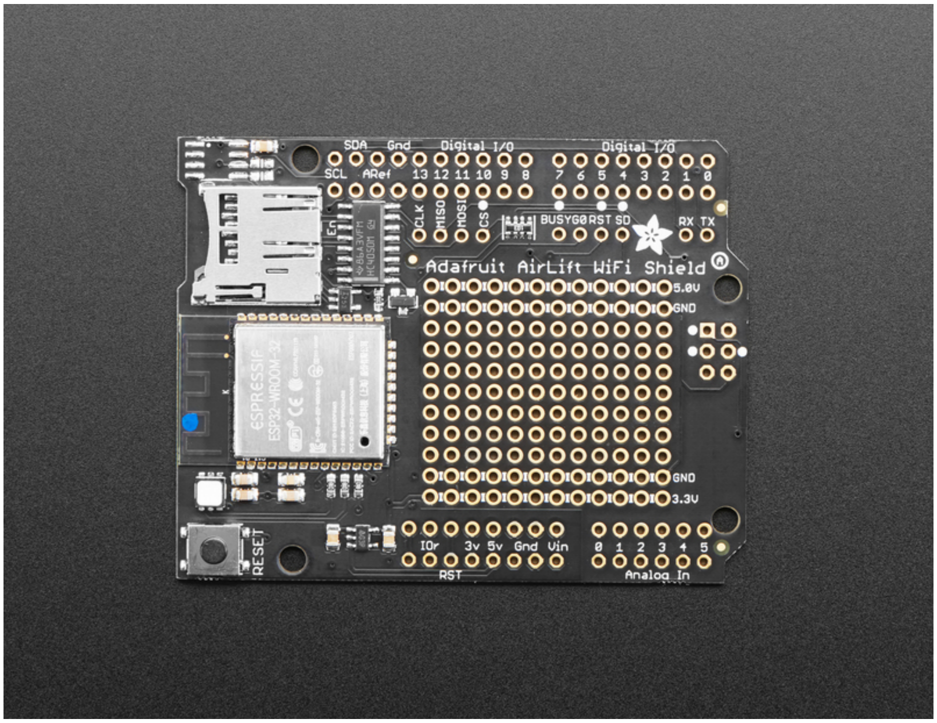


Last updated on 2020-05-05 10:40:43 AM EDT

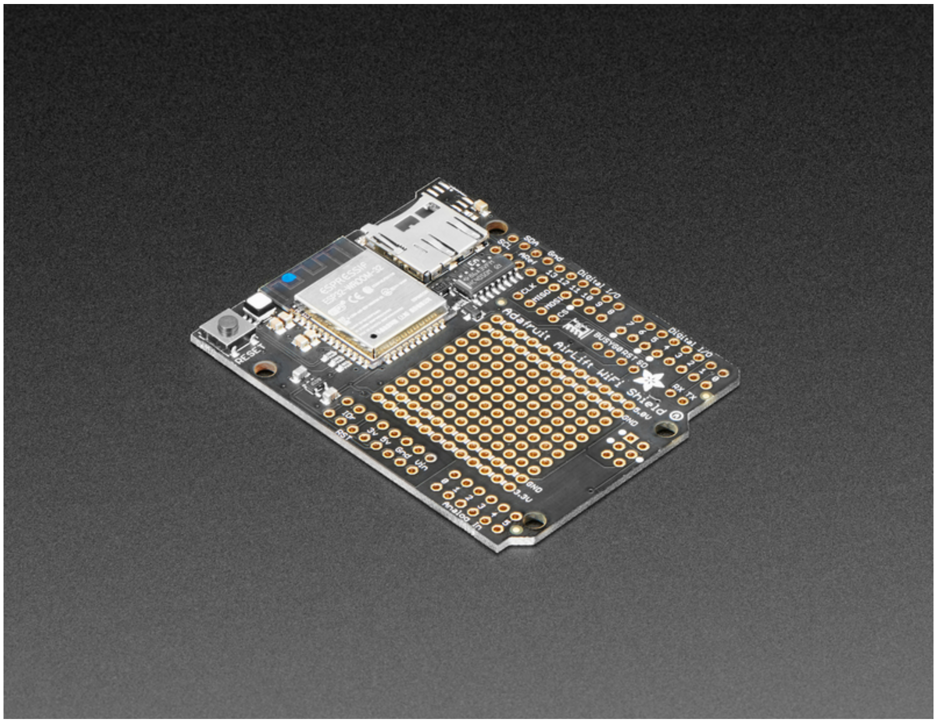
Overview



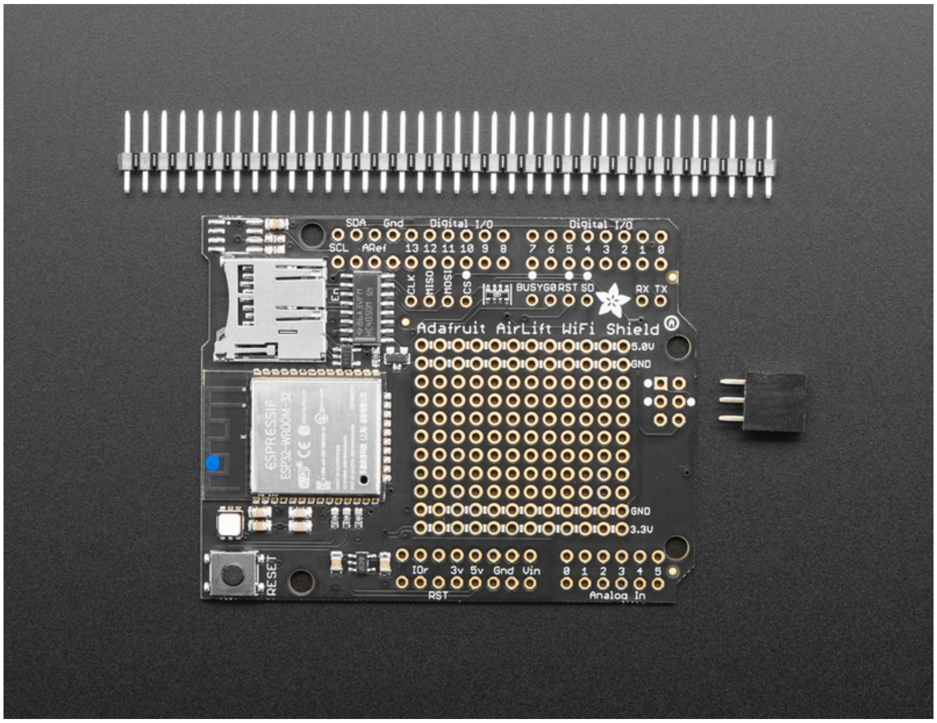
Give your Arduino project a *lift* with the Adafruit AirLift Shield (https://adafru.it/F6v) - a shield that lets you use the powerful ESP32 as a WiFi co-processor. You probably have your favorite Arduino-compatible (like the Metro M4 (https://adafru.it/A5S) or the classic Metro 328 (https://adafru.it/METROXMETR)) that comes with its own set of awesome peripherals and lots of libraries. But it doesn't have WiFi built in! So let's give that chip a best friend, the ESP32. This chip can handle all the heavy lifting of connecting to a WiFi network and transferring data from a site, even if it's using the latest TLS/SSL encryption (it has root certificates pre-burned in).



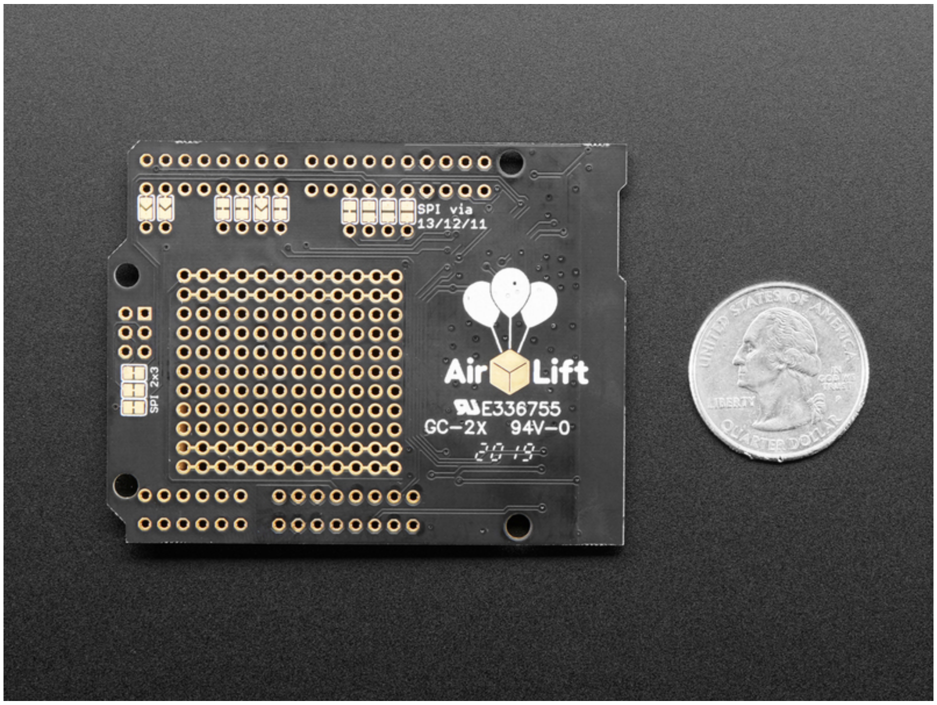
Having WiFi managed by a separate chip means your code is simpler, you don't have to cache socket data, or compile in & debug an SSL library. Send basic but powerful socket-based commands over 8MHz SPI for high speed data transfer. You can use any 3V or 5V Arduino, any chip from the ATmega328 and up (although the '328 will not be able to do very complex tasks or buffer a lot of data). It also works great with CircuitPython, a SAMD51/Cortex M4 minimum required since we need a bunch of RAM. All you need is the SPI bus and 2 control pins plus a power supply that can provide up to 250mA during WiFi usage.



We placed an ESP32 module on a shield with a separate 3.3V regulator, and a tri-state chip for MOSI so you can share the SPI bus with other shields. We also tossed on a micro SD card socket, you can use that to host or store data you get from the Internet. Arduinos based on the ATmega328 (like the UNO) cannot use both the WiFi module and SD library at the same time, they don't have enough RAM. Again, we recommend an M0 or M4 chipset for use with Arduino, M4 for CircuitPython!



Comes fully assembled and tested, pre-programmed with ESP32 SPI WiFi co-processor firmware that you can use in CircuitPython to use this into WiFi co-processsor (https://adafru.it/Evl). We also include some header so you can solder it in and plug right into your Arduino-compatible, but you can also pick up a set of stacking headers to stack above/below your board.

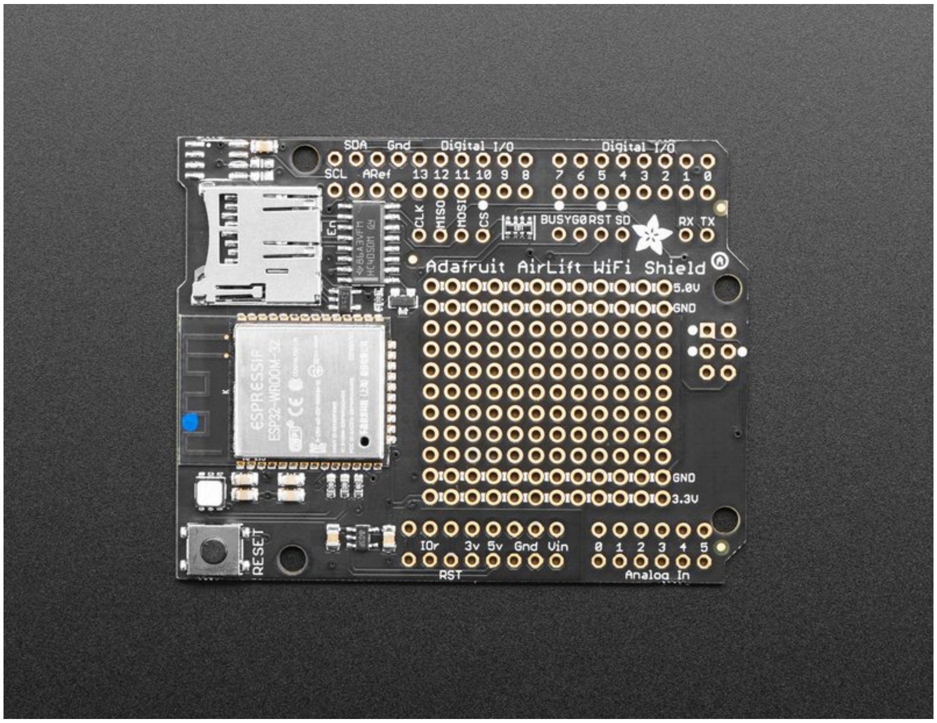


We've tested this with all our Metros and it should work just fine with them except the Metro M4 Airlifts (https://adafru.it/F6o) (because they already have WiFi!). **For use in Arduino**, the '328 and '32u4 you can do basic connectivity and data transfer but they do not have a lot of RAM so we don't recommend them - use the Metro M0, M4 or similar, for best results! **For CircuitPython use**, a Metro M4 works best - the M0 series does not have enough RAM in

CircuitPython.

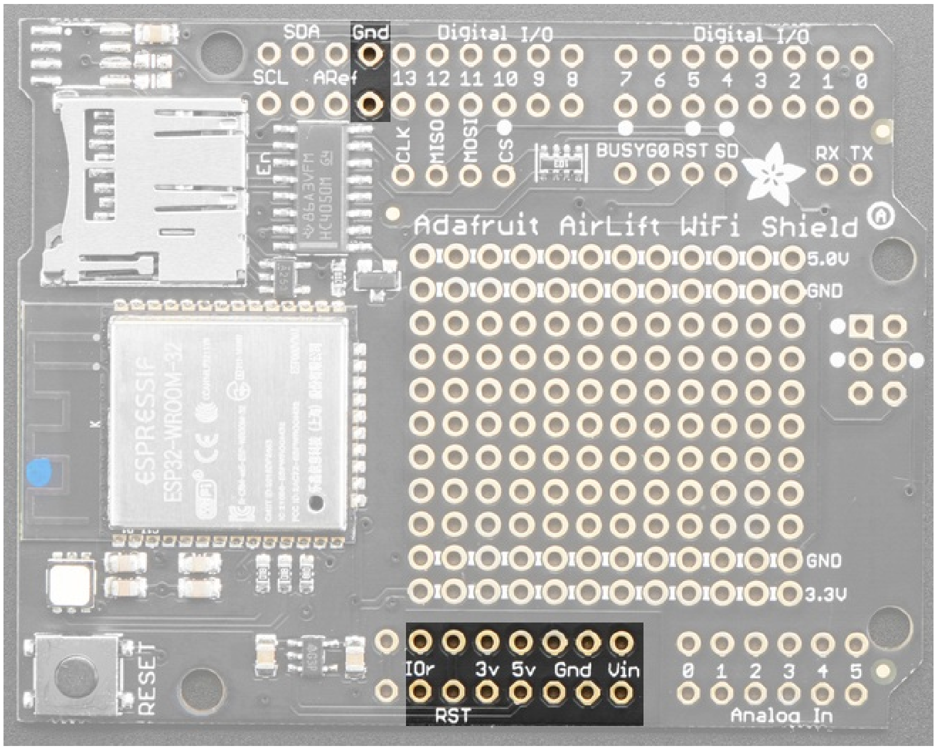
The firmware on board is a slight variant of the Arduino WiFiNINA core, which works great! (https://adafru.it/E7O) At this time connection to Enterprise WiFi is not yet supported.

Pinouts



There's a lot jam-packed into this shield! Let's take a look at what we've got going on.

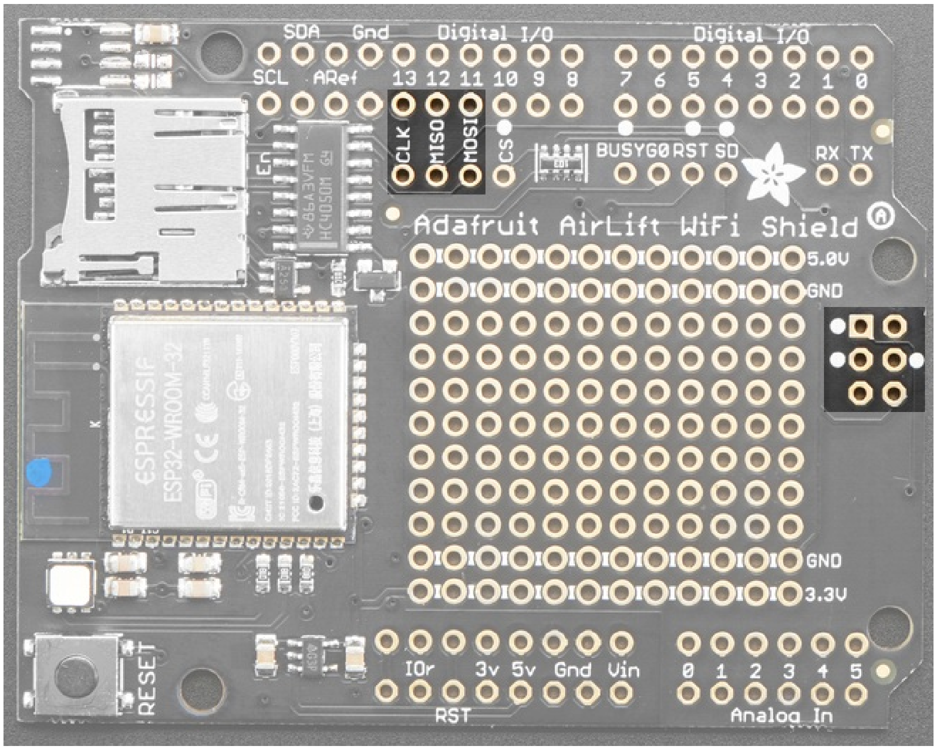
Power Pins



- **GND -** Common power/logic ground

- **GND** - Common power/logic ground.
- **3V** - this is the output from the 3.3V regulator. The regulator can supply 500mA peak but half of that is drawn by the ESP32, and it's a fairly power-hungry chip.
- **5V** - This is the input to the regulator
- **IOr** - This is IORef, the IO voltage we will communicate with and is required.

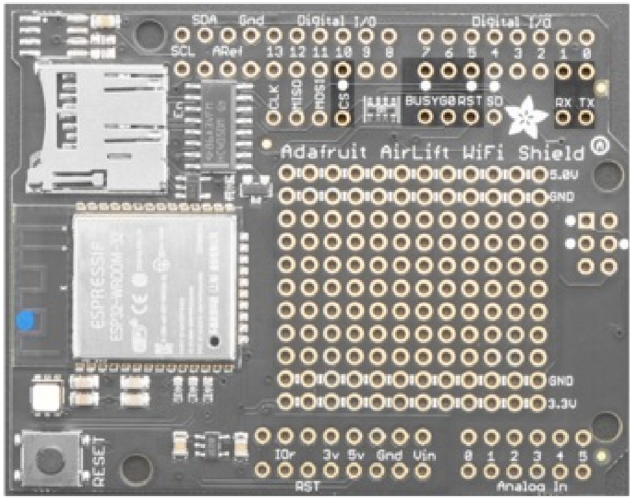
SPI Interface Pins



Both ESP32 and SD card use SPI to send and receive data. These pins are labeled **CLK MISO MOSI** and have level shifting so you can use this shield with 3.3V or 5V microcontroller boards.

By default the 2x3 pin **ICSP** header on the right hand side is where the SPI signals are found.

ESP32 Control Pins


SDA Gnd Digital I/O Digital I/O
SCL ARef 13 12 11 10 9 8 7 6 5 4 3 2 1 0
CLK MISO MOSI CS BUSY G0 RST SD RX TX
Adafruit AirLift WiFi Shield
5.0V
GND
3.3V
RESET
IOr 3v 5v Gnd Vin 0 1 2 3 4 5
RST Analog In

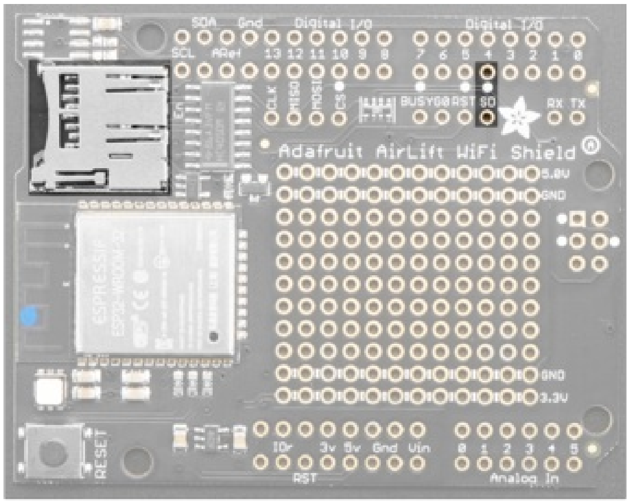
Required Control Pins:

- **BUSY** - this pin is an input from the AirLift, it will let us know when its ready for more commands to be sent. This is 3.3V logic out, can be read by 3-5V logic. This pin *must* be connected.
- **RST**- this pin is an output to the AirLift. Set low to put the AirLift into reset. You should use this pin, even though you might be able to run for a short while without it, it's essential to 'kick' the chip if it ever gets into a locked up state. Level shifted so can be 3-5V logic

Optional Control Pins:

- **GPIO0** - this is the ESP32 **GPIO0** pin, which is used to put it into bootloading mode. It is also used if you like when the ESP32 is acting as a server, to let you know data is ready for reading. It's not required, you'll need to solder the pad on the bottom of the shield to connect it.
- **RX** & **TX** - Serial data in and Serial data out, used for bootloading new firmware only. Leave disconnected when not uploading new WiFi firmware to the AirLift (which is a rare occurrence). You'll need to solder the two pads on the bottom of the shield to use these pins.

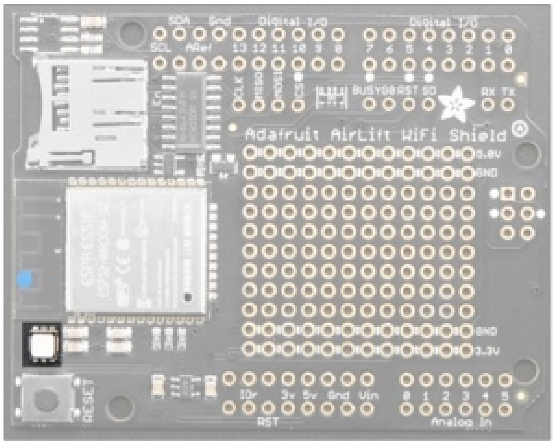
SD Card Interface


SDA Gnd Digital I/O Digital I/O
SCL ARef 13 12 11 10 9 8 7 6 5 4 3 2 1 0
CLK MISO MOSI CS BUSY G0 RST SD RX TX
Adafruit AirLift WiFi Shield
5.0V
GND
3.3V
RESET
IOr 3v 5v Gnd Vin 0 1 2 3 4 5
RST Analog In

There's a lot of space available on this shield so we also stuck on a micro SD card holder, great for datalogging or storing data to transmit over WiFi.

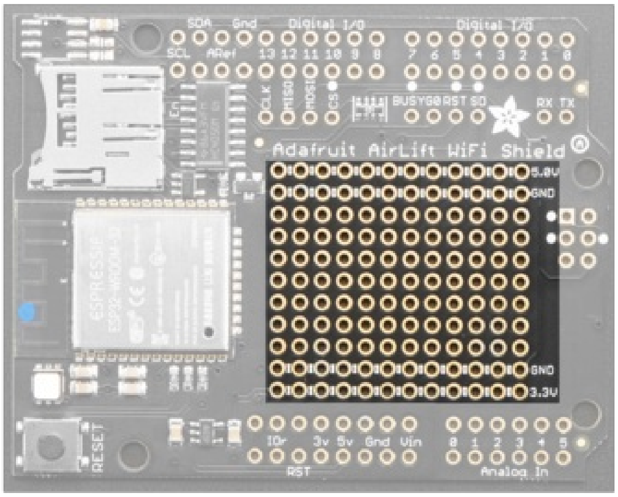
In addition to the shared SPI pins, the **SD** (chip select) pin is also used. It can be re-assigned to any pin by cutting the trace underneath the board and rewiring. If the SD card is not used, the **SD** pin can be used for any other purpose

LEDs



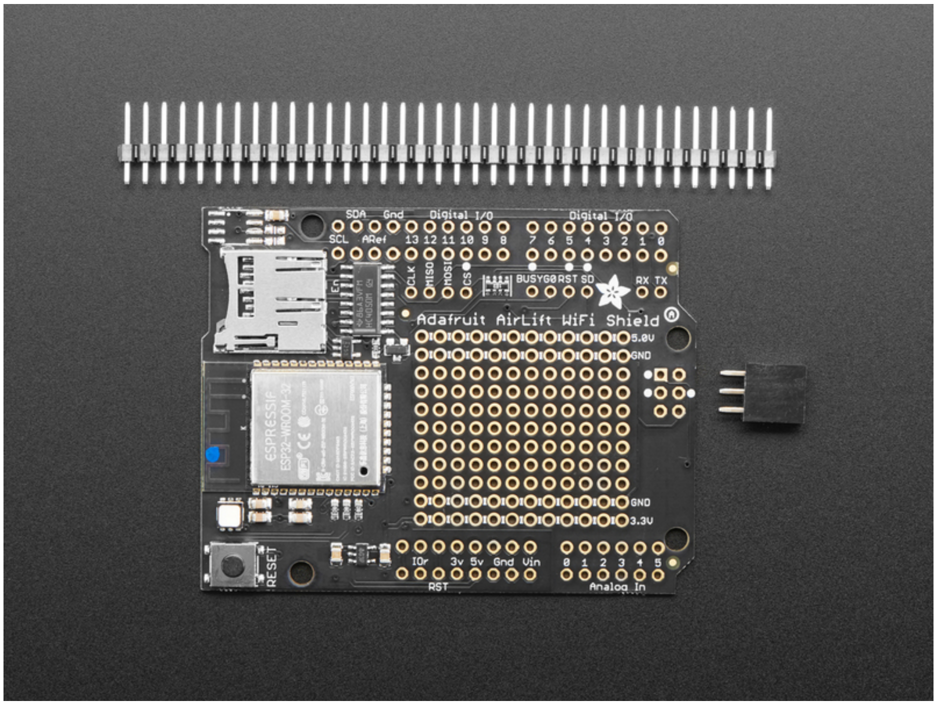
There is a small RGB LED to the left of the ESP32. These RGB LEDs are available in the Arduino and CircuitPython libraries if you'd like to PWM them for a visual alert. They're connected to the ESP32's pins 26 (**Red**), 25 (**Green**), and 27 (**Blue**).

Prototyping Area



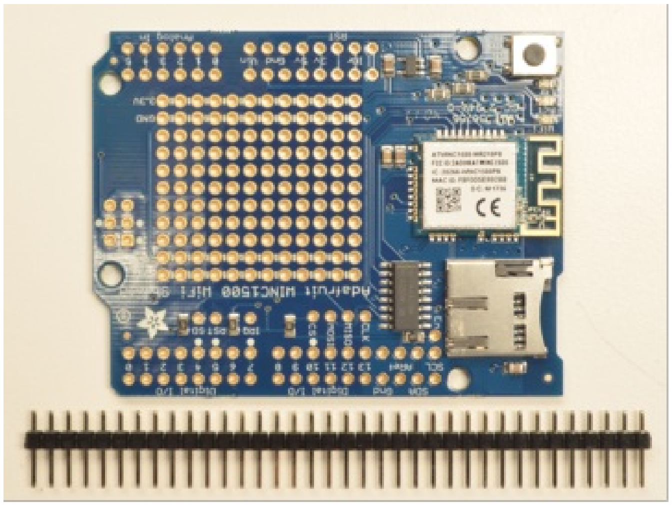
We have a big grid of prototyping holes and power rails if you want to make some custom circuitry!

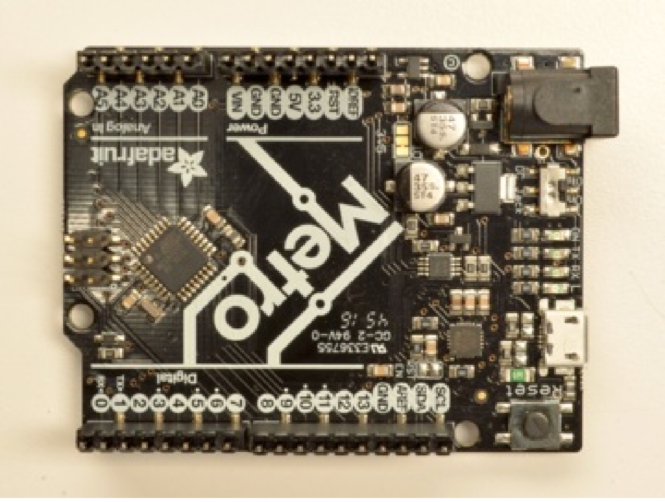
Assembly



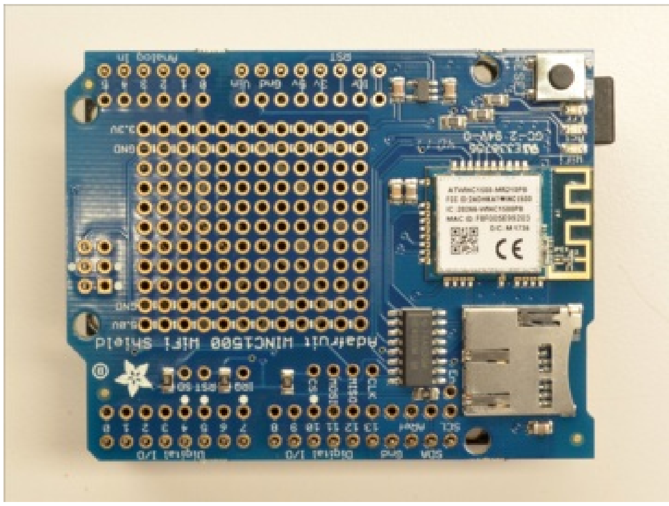
Installing Standard Headers

The shield comes with 0.1" standard header. Standard header does not permit stacking but it is mechanically stronger and they're much less expensive too! If you want to stack a shield on top, do not perform this step as it is not possible to uninstall the headers once soldered in! Skip down to the bottom for the stacking tutorial

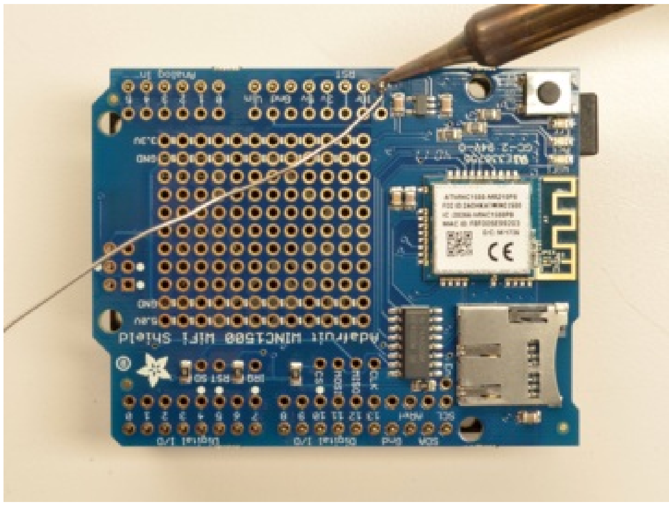




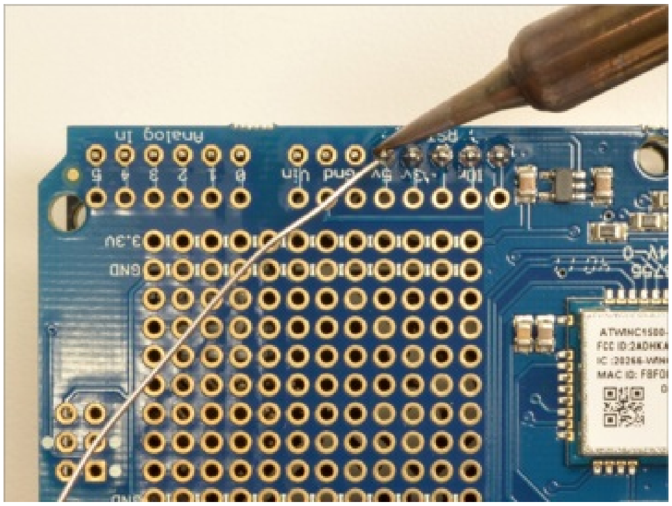
Break apart the 0.1" header into 6, 8 and/or 10-pin long pieces and slip the long ends into the headers of your Arduino.

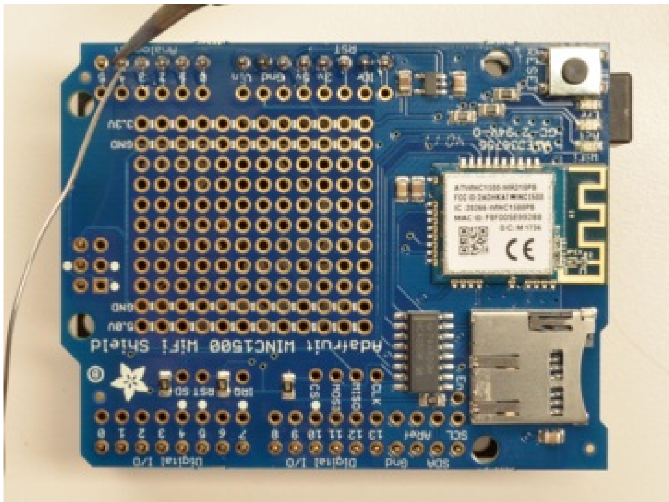


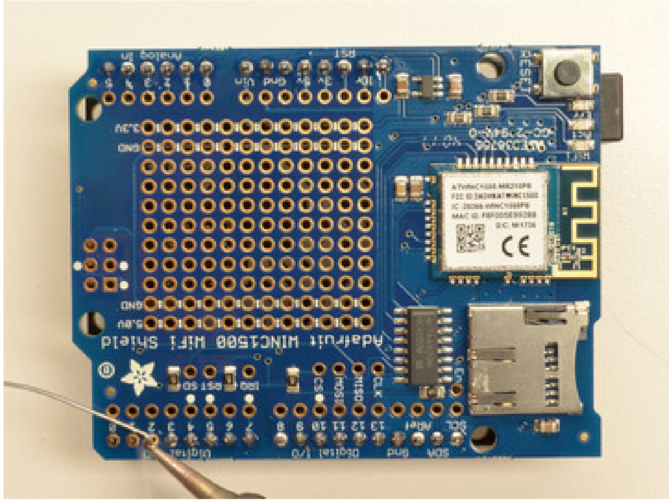
Place the assembled shield on top of the header-ed Arduino so that all of the short parts of the header are sticking through the outer set of pads

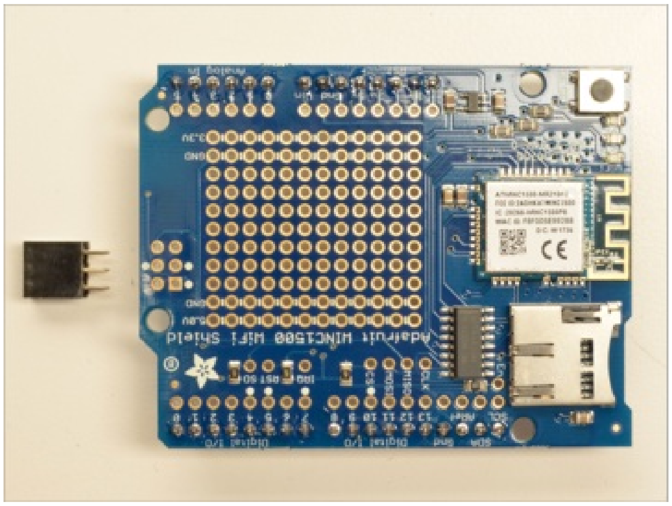


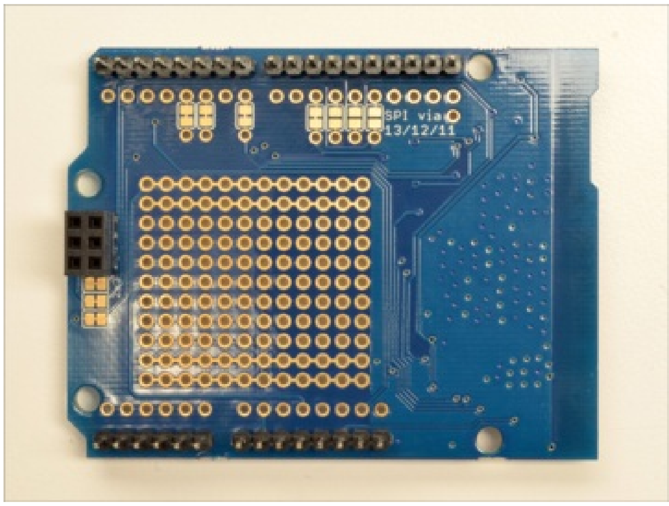
Solder each one of the pins into the shield to make a secure connection





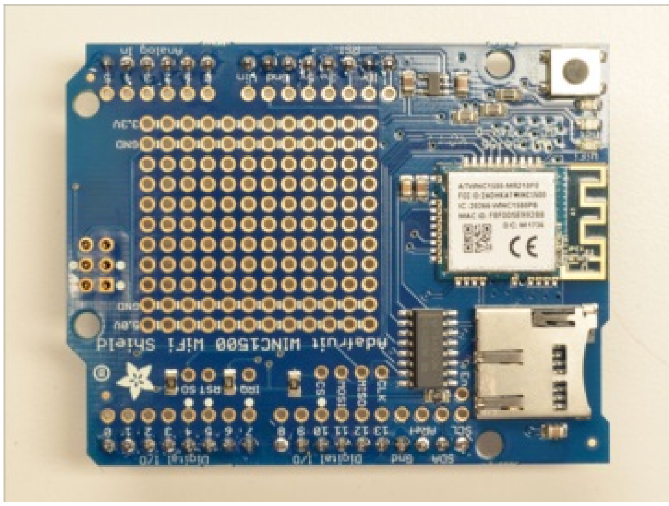


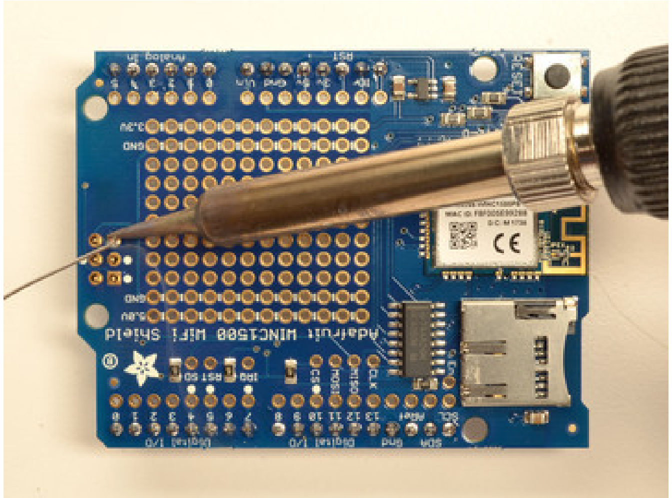


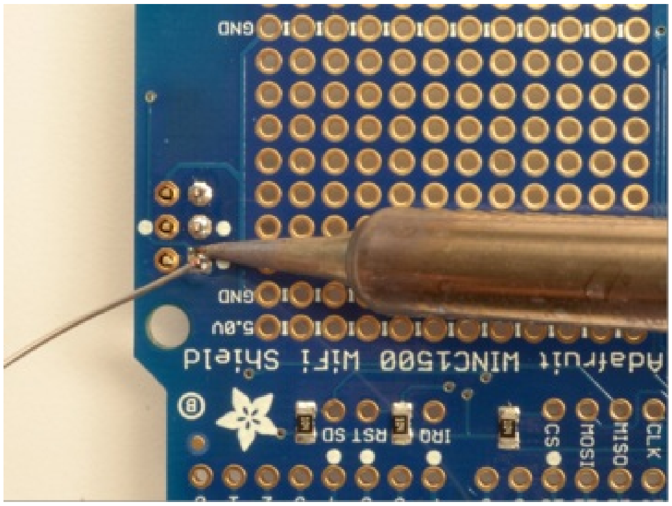


That's it! Now you can install the 2x3 header

Solder the 2x3 header so that it's pointing downwards

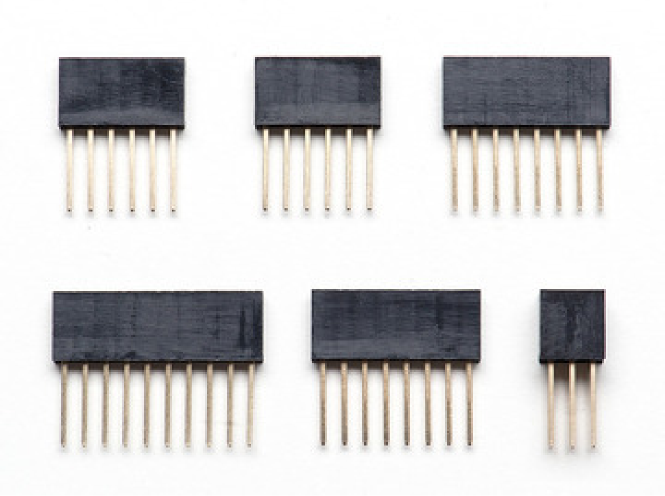




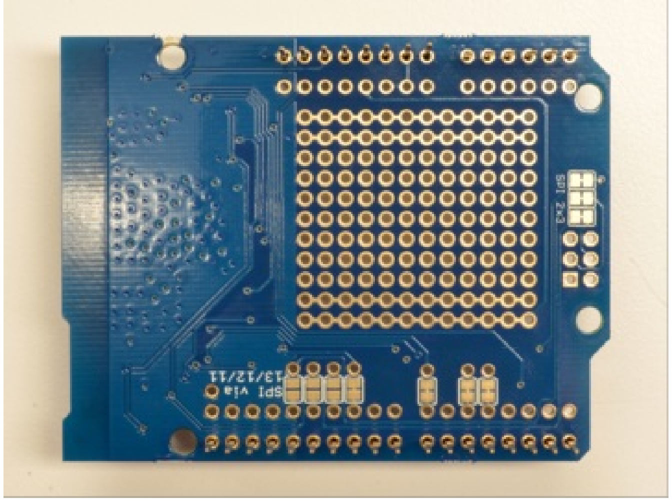


Stack Alert!

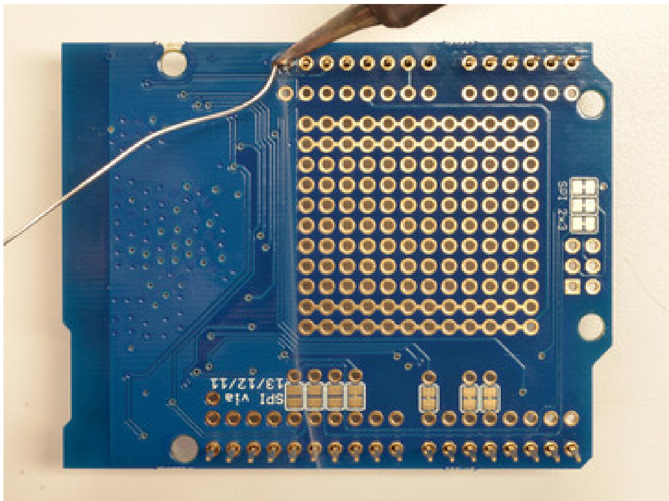
If you want to stack a shield on top of the WiFi Shield, you'll want to pick up some stacking headers and use those instead of the plain header shown here!



Wanna stack? This tutorial shows how to use the plain header to connect to an Arduino. If you want to use stacking headers (https://adafru.it/dsu), don't follow these steps!

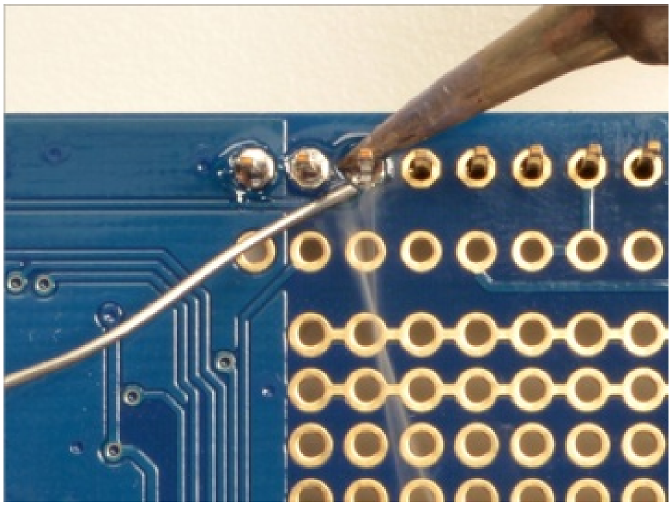


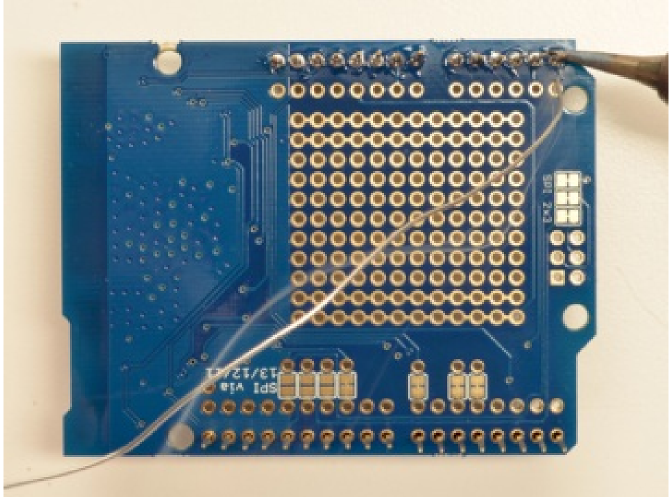
Start by sliding the 10 pin, 2 x 8 pin and 6-pin stacking headers into the outer rows of the shield from the top. Then flip the board over so its resting on the four headers. Pull on the legs if necessary to straighten them out.

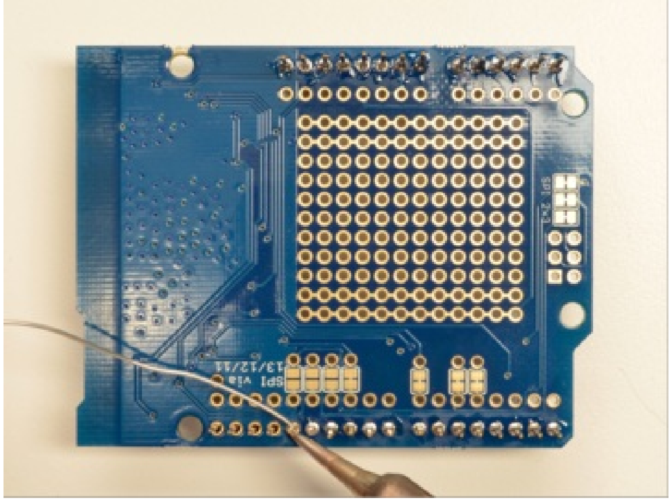


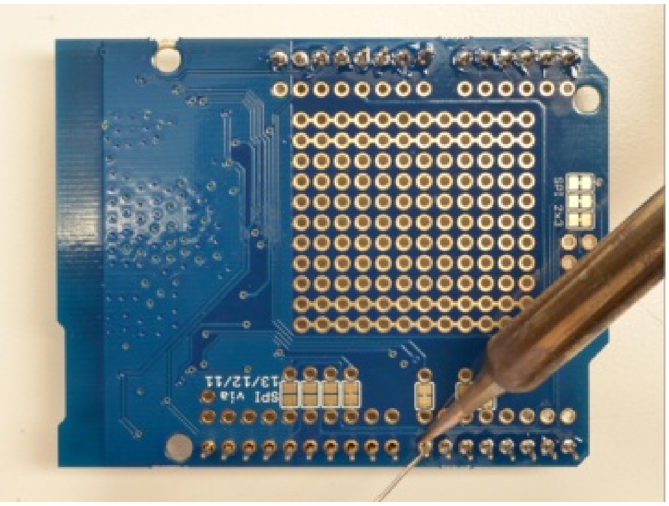
Tack one pin of each header, to get them set in place before more soldering. If the headers go crooked you can re-heat the one pin while re-positioning to straighten them up

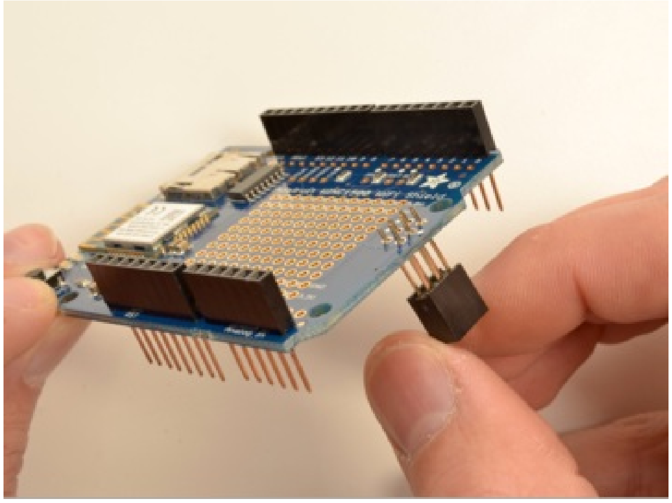
Once you've tacked and straightened all the headers, go back and solder the remaining pins for each header.



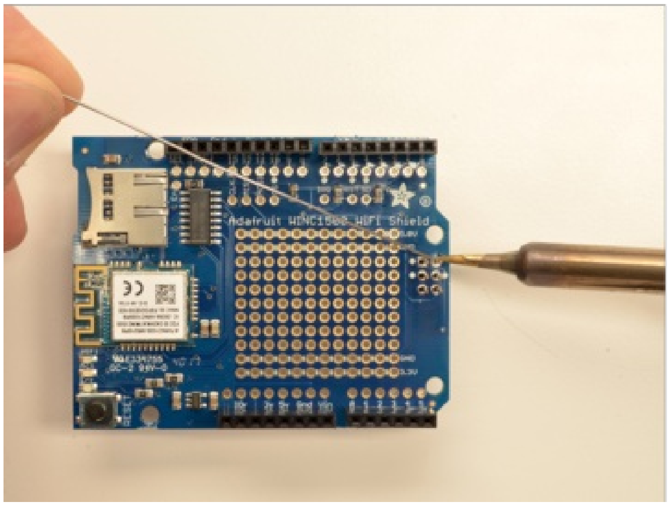

SPI 2x3
SPI via
13/12/11


SPI 2x3
SPI via
13/12/11

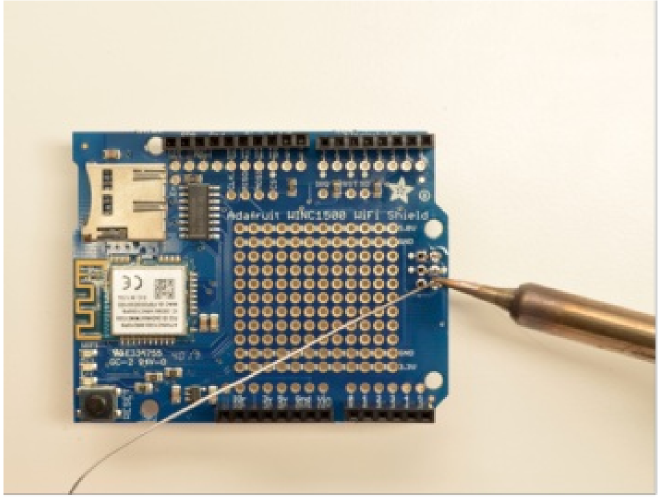




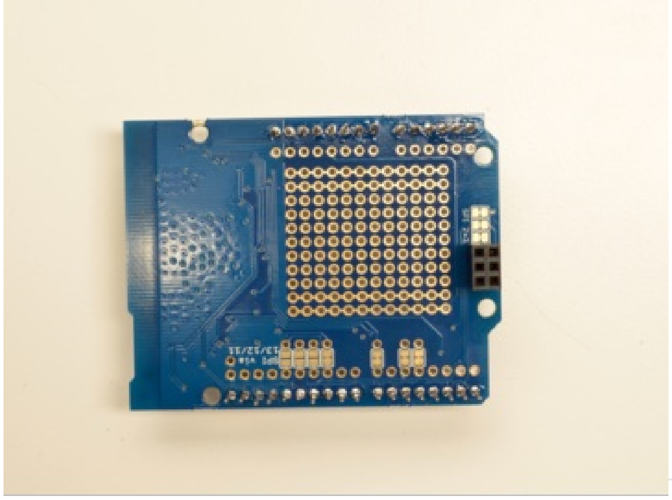
Insert the 2x3 stacking header as shown.



Solder into place.


Adafruit WINC1500 WiFi Shield

Adafruit WINC1500 WiFi Shield



CircuitPython

It's easy to use Adafruit AirLift with CircuitPython and the Adafruit CircuitPython ESP32SPI (https://adafru.it/DWV) module. This module allows you to easily add WiFi to your project.

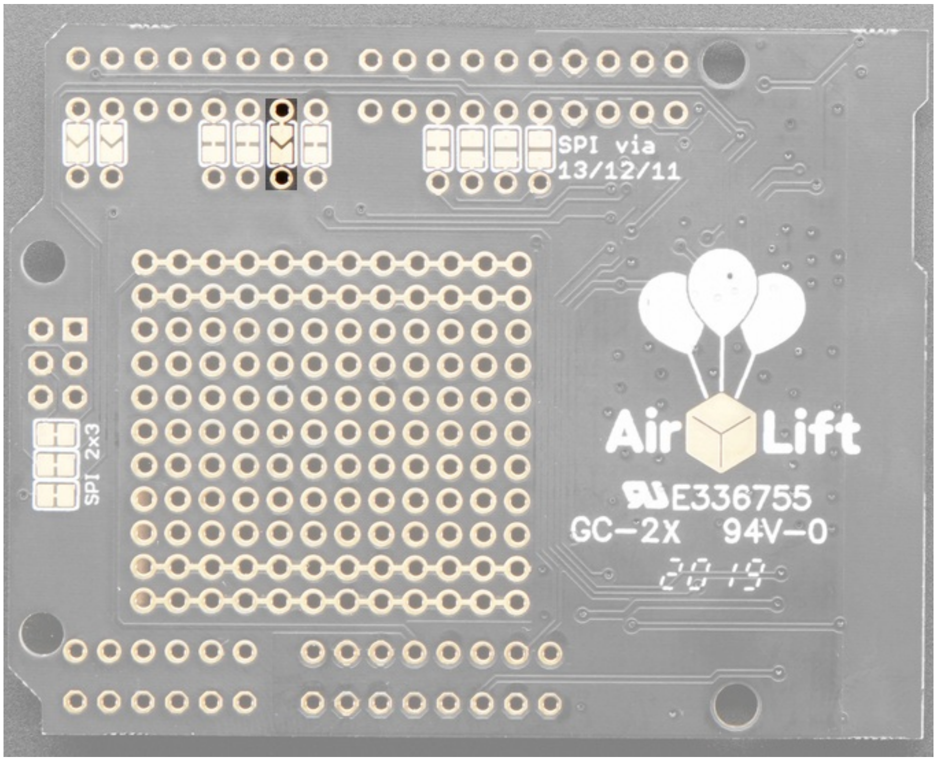
The ESP32SPI library requires an M4 or better microcontroller! The M0 will not work.

CircuitPython Microcontroller Pinout

To use the board's pins with the AirLift shield, copy the following lines into your code:

```
esp32_cs = DigitalInOut(board.D10)
esp32_ready = DigitalInOut(board.D7)
esp32_reset = DigitalInOut(board.D5)
```

If you wish to use the GPIO0 pin on the ESP32 - solder the jumper on the back of the shield, highlighted below:



Then, include the following code to use the pin:

```
esp32_gpio0 = DigitalInOut(board.D6)
```

CircuitPython Installation of ESP32SPI Library

You'll need to install the Adafruit CircuitPython ESP32SPI (https://adafru.it/DWV) library on your CircuitPython board.

First make sure you are running the latest version of Adafruit CircuitPython (https://adafru.it/Amd) for your board.

Next you'll need to install the necessary libraries to use the hardware--carefully follow the steps to find and install these libraries from Adafruit's CircuitPython library bundle (https://adafru.it/uap). Our CircuitPython starter guide has a great page on how to install the library bundle (https://adafru.it/ABU).

You can manually install the necessary libraries from the bundle:

- **adafruit_esp32spi.mpy**
- **adafruit_requests.mpy**
- **adafruit_bus_device**

Before continuing make sure your board's lib folder or root filesystem has the **adafruit_esp32spi.mpy,** and **adafruit_bus_device** files and folders copied over.

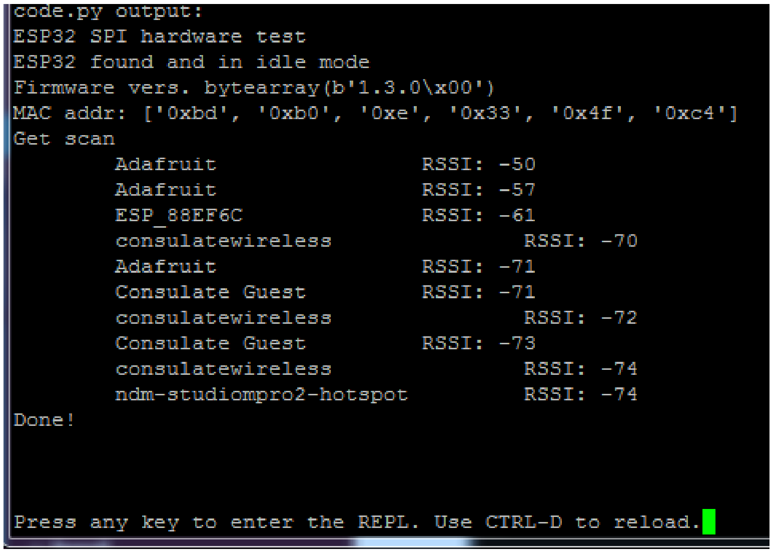
Next connect to the board's serial REPL (https://adafru.it/Awz) so you are at the CircuitPython >>> prompt.

CircuitPython Usage

Copy the following code to your **code.py** file on your microcontroller:

```
import board
import busio
from digitalio import DigitalInOut

from adafruit_esp32spi import adafruit_esp32spi

print("ESP32 SPI hardware test")

esp32_cs = DigitalInOut(board.D10)
esp32_ready = DigitalInOut(board.D7)
esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])

for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap['ssid'], 'utf-8'), ap['rssi']))

print("Done!")
```

Connect to the serial monitor to see the output. It should look something like the following:



```
code.py output:
ESP32 SPI hardware test
ESP32 found and in idle mode
Firmware vers. bytearray(b'1.3.0\x00')
MAC addr: ['0xbd', '0xb0', '0xe', '0x33', '0x4f', '0xc4']
Get scan
        Adafruit                RSSI: -50
        Adafruit                RSSI: -57
        ESP_88EF6C              RSSI: -61
        consulatewireless               RSSI: -70
        Adafruit                RSSI: -71
        Consulate Guest         RSSI: -71
        consulatewireless               RSSI: -72
        Consulate Guest         RSSI: -73
        consulatewireless               RSSI: -74
        ndm-studiompro2-hotspot         RSSI: -74
Done!



Press any key to enter the REPL. Use CTRL-D to reload.
```

Make sure you see the same output! If you don't, check your wiring. Note that we've changed the pinout in the code example above to reflect the CircuitPython Microcontroller Pinout at the top of this page.

Once you've succeeded, continue onto the next page!

If you can read the Firmware and MAC address but fails on scanning SSIDs, check your power supply, you may be running out of juice to the ESP32 and it's resetting

Internet Connect!

Once you have CircuitPython setup and libraries installed we can get your board connected to the Internet.

To get connected, you will need to start by creating a *secrets file*.

What's a secrets file?

We expect people to share tons of projects as they build CircuitPython WiFi widgets. What we want to avoid is people accidentally sharing their passwords or secret tokens and API keys. So, we designed all our examples to use a `secrets.py` file, that is in your **CIRCUITPY** drive, to hold secret/private/custom data. That way you can share your main project without worrying about accidentally sharing private stuff.

Your **secrets.py** file should look like this:

```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : 'home ssid',
    'password' : 'my password',
    'timezone' : "America/New_York", # http://worldtimeapi.org/timezones
    'github_token' : 'fawfj23rakjnfawiefa',
    'hackaday_token' : 'h4xx0rs3kret',
    }
```

Inside is a python dictionary named secrets with a line for each entry. Each entry has an entry name (say `'ssid'`) and then a colon to separate it from the entry key `'home ssid'` and finally a comma ,

At a minimum you'll need the `ssid` and `password` for your local WiFi setup. As you make projects you may need more tokens and keys, just add them one line at a time. See for example other tokens such as one for accessing github or the hackaday API. Other non-secret data like your timezone can also go here, just cause its called secrets doesn't mean you can't have general customization data in there!

For the correct time zone string, look at http://worldtimeapi.org/timezones (https://adafru.it/EcP) and remember that if your city is not listed, look for a city in the same time zone, for example Boston, New York, Philadelphia, Washington DC, and Miami are all on the same time as New York.

Of course, don't share your **secrets.py** - keep that out of GitHub, Discord or other project-sharing sites.

Connect to WiFi

OK now you have your secrets setup - you can connect to the Internet using the ESP32SPI and the Requests modules.

First make sure you are running the latest version of Adafruit CircuitPython (https://adafru.it/Amd) for your board.

Next you'll need to install the necessary libraries to use the hardware--carefully follow the steps to find and install these libraries from Adafruit's CircuitPython library bundle (https://adafru.it/zdx). Our introduction guide has a great page on how to install the library bundle (https://adafru.it/ABU) for both express and non-express boards.

Remember for non-express boards like the, you'll need to manually install the necessary libraries from the bundle:

- adafruit_bus_device
- adafruit_esp32_spi
- adafruit_requests
- neopixel

Before continuing make sure your board's lib folder or root filesystem has the above files copied over.

Next connect to the board's serial REPL (https://adafru.it/Awz) so you are at the CircuitPython >>> prompt.

Into your lib folder. Once that's done, load up the following example using Mu or your favorite editor:

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

print("ESP32 SPI webclient test")

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"


# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an ItsyBitsy Airlift:
# esp32_cs = DigitalInOut(board.D13)
# esp32_ready = DigitalInOut(board.D11)
# esp32_reset = DigitalInOut(board.D12)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

requests.set_socket(socket, esp)

if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])

for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap["ssid"], "utf-8"), ap["rssi"]))

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b"MY_SSID_NAME", b"MY_SSID_PASSWORD")
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print(
    "IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com"))
)
print("Ping google.com: %d ms" % esp.ping("google.com"))

# esp._debug = True
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print("-" * 40)
print(r.text)
print("-" * 40)
r.close()

print()
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print("-" * 40)
print(r.json())
print("-" * 40)
r.close()

print("Done!")
```

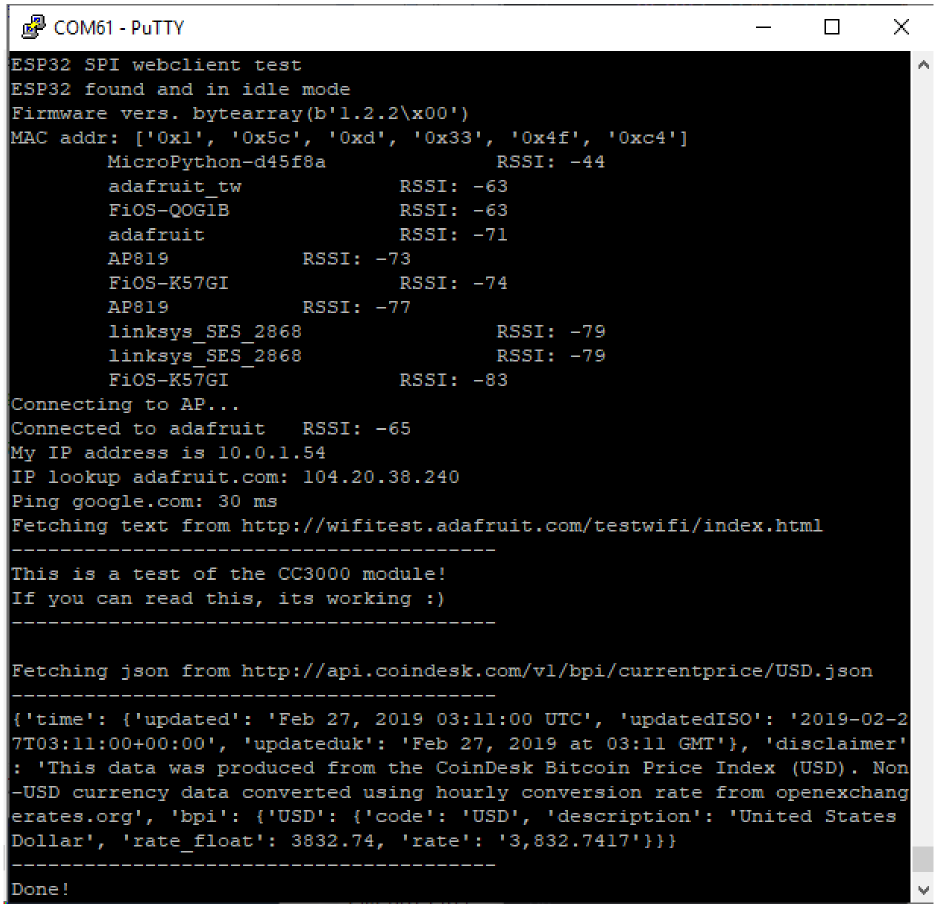
And save it to your board, with the name `code.py`.

> You may need to change the esp32_cs, esp32_ready and esp32_reset pins in the code to match your hardware's pinout.

Then go down to this line

`esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')`

and change `MY_SSID_NAME` and `MY_SSID_PASSWORD` to your access point name and password, keeping them within the '' quotes. (This example doesn't use the secrets' file, but its also very stand-alone so if other things seem to not work you can always re-load this. You should get something like the following:



```
ESP32 SPI webclient test
ESP32 found and in idle mode
Firmware vers. bytearray(b'1.2.2\x00')
MAC addr: ['0x1', '0x5c', '0xd', '0x33', '0x4f', '0xc4']
        MicroPython-d45f8a              RSSI: -44
        adafruit_tw             RSSI: -63
        FiOS-QOG1B              RSSI: -63
        adafruit                RSSI: -71
        AP819           RSSI: -73
        FiOS-K57GI              RSSI: -74
        AP819           RSSI: -77
        linksys_SES_2868                RSSI: -79
        linksys_SES_2868                RSSI: -79
        FiOS-K57GI              RSSI: -83
Connecting to AP...
Connected to adafruit   RSSI: -65
My IP address is 10.0.1.54
IP lookup adafruit.com: 104.20.38.240
Ping google.com: 30 ms
Fetching text from http://wifitest.adafruit.com/testwifi/index.html
----------------------------------------
This is a test of the CC3000 module!
If you can read this, its working :)
----------------------------------------

Fetching json from http://api.coindesk.com/v1/bpi/currentprice/USD.json
----------------------------------------
{'time': {'updated': 'Feb 27, 2019 03:11:00 UTC', 'updatedISO': '2019-02-2
7T03:11:00+00:00', 'updateduk': 'Feb 27, 2019 at 03:11 GMT'}, 'disclaimer'
: 'This data was produced from the CoinDesk Bitcoin Price Index (USD). Non
-USD currency data converted using hourly conversion rate from openexchang
erates.org', 'bpi': {'USD': {'code': 'USD', 'description': 'United States
Dollar', 'rate_float': 3832.74, 'rate': '3,832.7417'}}}
----------------------------------------
Done!
```

In order, the example code...

Initializes the ESP32 over SPI using the SPI port and 3 control pins:

```
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
```

Tells our requests library the type of socket we're using (socket type varies by connectivity type - we'll be using the adafruit_esp32spi_socket for this example). We'll also set the interface to an esp object. This is a little bit of a hack, but it lets us use requests like CPython does.

```
requests.set_socket(socket, esp)
```

Verifies an ESP32 is found, checks the firmware and MAC address

```
if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])
```

Performs a scan of all access points it can see and prints out the name and signal strength:

```
for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap['ssid'], 'utf-8'), ap['rssi']))
```

Connects to the AP we've defined here, then prints out the local IP address, attempts to do a domain name lookup and ping google.com to check network connectivity (note sometimes the ping fails or takes a while, this isn't a big deal)

```
    print("Connecting to AP...")
esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')
print("Connected to", str(esp.ssid, 'utf-8'), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print("IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com")))
print("Ping google.com: %d ms" % esp.ping("google.com"))
```

OK now we're getting to the really interesting part. With a SAMD51 or other large-RAM (well, over 32 KB) device, we can do a lot of neat tricks. Like for example we can implement an interface a lot like requests (https://adafru.it/E9o) - which makes getting data *really really easy*

To read in all the text from a web URL call `requests.get` - you can pass in `https` URLs for SSL connectivity

```
TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print('-'*40)
print(r.text)
print('-'*40)
r.close()
```

Or, if the data is in structured JSON, you can get the json pre-parsed into a Python dictionary that can be easily queried or traversed. (Again, only for nRF52840, M4 and other high-RAM boards)

```
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print('-'*40)
print(r.json())
print('-'*40)
r.close()
```

Requests

We've written a requests-like (https://adafru.it/FpT) library for web interfacing named Adafruit_CircuitPython_Requests (https://adafru.it/FpW). This library allows you to send HTTP/1.1 requests without "crafting" them and provides helpful methods for parsing the response from the server.

Here's an example of using Requests to perform GET and POST requests to a server.

```
# adafruit_requests usage with an esp32spi_socket
import board
import busio
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b"MY_SSID_NAME", b"MY_SSID_PASSWORD")
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_GET_URL = "http://httpbin.org/get"
JSON_POST_URL = "http://httpbin.org/post"

print("Fetching text from %s" % TEXT_URL)
response = requests.get(TEXT_URL)
print("-" * 40)

print("Text Response: ", response.text)
print("-" * 40)
response.close()

print("Fetching JSON data from %s" % JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print("-" * 40)

print("JSON Response: ", response.json())
print("-" * 40)
response.close()

data = "31F"
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
response = requests.post(JSON_POST_URL, data=data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp["data"])
print("-" * 40)
```

```
response.close()

json_data = {"Date": "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp["json"])
print("-" * 40)
response.close()
```

The code first sets up the ESP32SPI interface. Then, it initializes a `request` object using an ESP32 `socket` and the `esp` object.

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you have an externally connected ESP32:
esp32_cs = DigitalInOut(board.D9)
esp32_ready = DigitalInOut(board.D10)
esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')
    except RuntimeError as e:
        print("could not connect to AP, retrying: ",e)
        continue
print("Connected to", str(esp.ssid, 'utf-8'), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)
```

Make sure to set the ESP32 pinout to match your AirLift breakout's connection:

```
esp32_cs = DigitalInOut(board.D9)
esp32_ready = DigitalInOut(board.D10)
esp32_reset = DigitalInOut(board.D5)
```

HTTP GET with Requests

The code makes a HTTP GET request to Adafruit's WiFi testing website - http://wifitest.adafruit.com/testwifi/index.html (https://adafru.it/FpZ).

To do this, we'll pass the URL into `requests.get()`. We're also going to save the response *from* the server into a variable named `response`.

While we requested data from the server, we'd what the server responded with. Since we already saved the server's `response`, we can read it back. Luckily for us, **requests automatically decodes the server's response into human-readable text,** you can read it back by calling `response.text`.

Lastly, we'll perform a bit of cleanup by calling `response.close()`. This closes, deletes, and collect's the response's data.

```
    print("Fetching text from %s"%TEXT_URL)
response = requests.get(TEXT_URL)
print('-'*40)

print("Text Response: ", response.text)
print('-'*40)
response.close()
```

While some servers respond with text, some respond with json-formatted data consisting of attribute–value pairs.

CircuitPython_Requests can convert a JSON-formatted response from a server into a CPython `dict.` object.

We can also fetch and parse **json** data. We'll send a HTTP get to a url we know returns a json-formatted response (instead of text data).

Then, the code calls `response.json()` to convert the response to a CPython `dict`.

```
    print("Fetching JSON data from %s"%JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print('-'*40)

print("JSON Response: ", response.json())
print('-'*40)
response.close()
```

HTTP POST with Requests

Requests can also **POST data to a server by calling the `requests.post` method, passing it a `data` value.**

```
data = '31F'
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
response = requests.post(JSON_POST_URL, data=data)
print('-'*40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp['data'])
print('-'*40)
response.close()
```

You can also post json-formatted data to a server by passing `json` data into the `requests.post` method.

```
json_data = {"Date" : "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print('-'*40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp['json'])
print('-'*40)
response.close()
```

Advanced Requests Usage

Want to send custom HTTP headers, parse the response as raw bytes, or handle a response's http status code in your CircuitPython code?

We've written an example to show advanced usage of the requests module below.

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b"MY_SSID_NAME", b"MY_SSID_PASSWORD")
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)

JSON_GET_URL = "http://httpbin.org/get"

# Define a custom header as a dict.
headers = {"user-agent": "blinka/1.0.0"}

print("Fetching JSON data from %s..." % JSON_GET_URL)
response = requests.get(JSON_GET_URL, headers=headers)
print("-" * 60)

json_data = response.json()
headers = json_data["headers"]
print("Response's Custom User-Agent Header: {0}".format(headers["User-Agent"]))
print("-" * 60)

# Read Response's HTTP status code
print("Response HTTP Status Code: ", response.status_code)
print("-" * 60)

# Read Response, as raw bytes instead of pretty text
print("Raw Response: ", response.content)

# Close, delete and collect the response data
response.close()
```

WiFi Manager

That simpletest example works but its a little finicky - you need to constantly check WiFi status and have many loops to manage connections and disconnections. For more advanced uses, we recommend using the WiFiManager object. It will wrap the connection/status/requests loop for you - reconnecting if WiFi drops, resetting the ESP32 if it gets into a bad state, etc.

Here's a more advanced example that shows the WiFi manager and also how to POST data with some extra headers:

```
import time
import board
import busio
from digitalio import DigitalInOut
import neopixel
from adafruit_esp32spi import adafruit_esp32spi
from adafruit_esp32spi import adafruit_esp32spi_wifimanager

print("ESP32 SPI webclient test")

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
"""Use below for Most Boards"""
status_light = neopixel.NeoPixel(
    board.NEOPIXEL, 1, brightness=0.2
)  # Uncomment for Most Boards
"""Uncomment below for ItsyBitsy M4"""
# status_light = dotstar.DotStar(board.APA102_SCK, board.APA102_MOSI, 1, brightness=0.2)
# Uncomment below for an externally defined RGB LED
# import adafruit_rgbled
# from adafruit_esp32spi import PWMOut
# RED_LED = PWMOut.PWMOut(esp, 26)
# GREEN_LED = PWMOut.PWMOut(esp, 27)
# BLUE_LED = PWMOut.PWMOut(esp, 25)
# status_light = adafruit_rgbled.RGBLED(RED_LED, BLUE_LED, GREEN_LED)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)

counter = 0

while True:
    try:
        print("Posting data...", end="")
        data = counter
        feed = "test"
        payload = {"value": data}
        response = wifi.post(
            "https://io.adafruit.com/api/v2/"
            + secrets["aio_username"]
            + "/feeds/"
            + feed
            + "/data",
            json=payload,
            headers={"X-AIO-KEY": secrets["aio_key"]},
        )
        print(response.json())
        response.close()
        counter = counter + 1
        print("OK")
    except (ValueError, RuntimeError) as e:
        print("Failed to get data, retrying\n", e)
        wifi.reset()
        continue
    response = None
    time.sleep(15)
```

You'll note here we use a secrets.py file to manage our SSID info. The wifimanager is given the ESP32 object, secrets and a neopixel for status indication.

Note, you'll need to add a some additional information to your secrets file so that the code can query the Adafruit IO API:

- aio_username
- aio_key

You can go to your adafruit.io View AIO Key link to get those two values and add them to the secrets file, which will now look something like this:

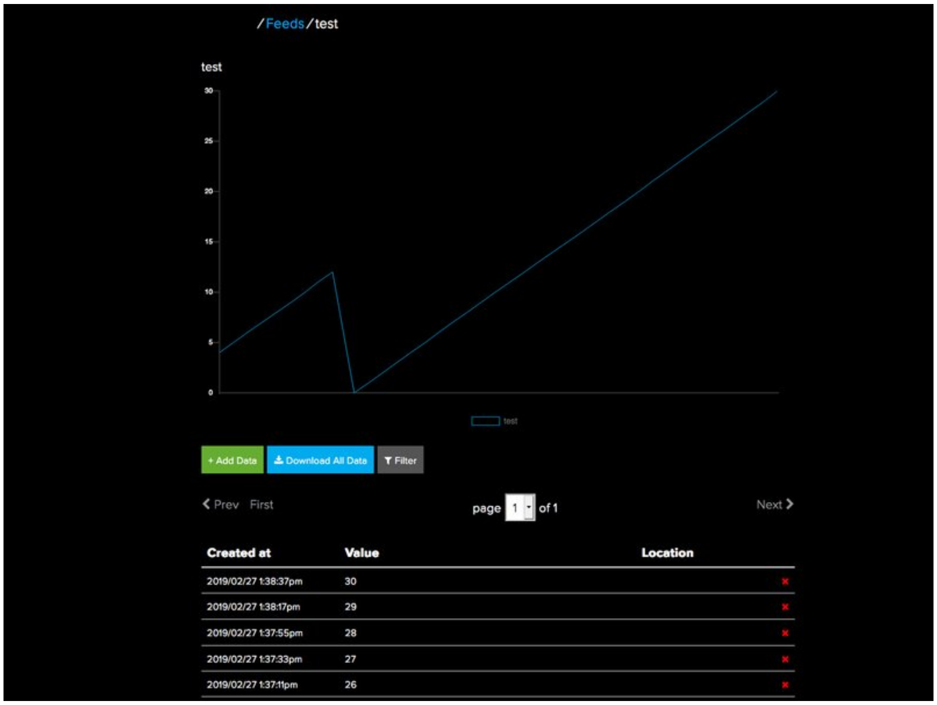
```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : '_your_ssid_',
    'password' : '_your_wifi_password_',
    'timezone' : "America/Los_Angeles", # http://worldtimeapi.org/timezones
    'aio_username' : '_your_aio_username_',
    'aio_key' : '_your_aio_key_',
    }
```

Next, **set up an Adafruit IO feed named test**

- If you do not know how to set up a feed, follow this page and come back when you've set up a feed named test. (https://adafru.it/f5k)

We can then have a simple loop for posting data to Adafruit IO without having to deal with connecting or initializing the hardware!

Take a look at your **test** feed on Adafruit.io and you'll see the value increase each time the CircuitPython board posts data to it!



Created at	Value	Location	
2019/02/27 1:38:37pm	30		✖
2019/02/27 1:38:17pm	29		✖
2019/02/27 1:37:55pm	28		✖
2019/02/27 1:37:33pm	27		✖
2019/02/27 1:37:11pm	26		✖

Arduino

You can use an AirLift with Arduino. Unlike CircuitPython, it work work with just about any Arduino board, even a classic Arduino UNO. However, if you want to use libraries like Adafruit IO Arduino, ArduinoJSON, or add sensors and SD card, you'll really want an ATSAMD21 (Cortex M0) or ATSAMD51 (Cortex M4), both of which have *plenty* or RAM.

Library Install

We're using a variant of the Arduino WiFiNINA library, which is amazing and written by the Arduino team! **The official WiFi101 library won't work because it doesn't support the ability to change the pins**.

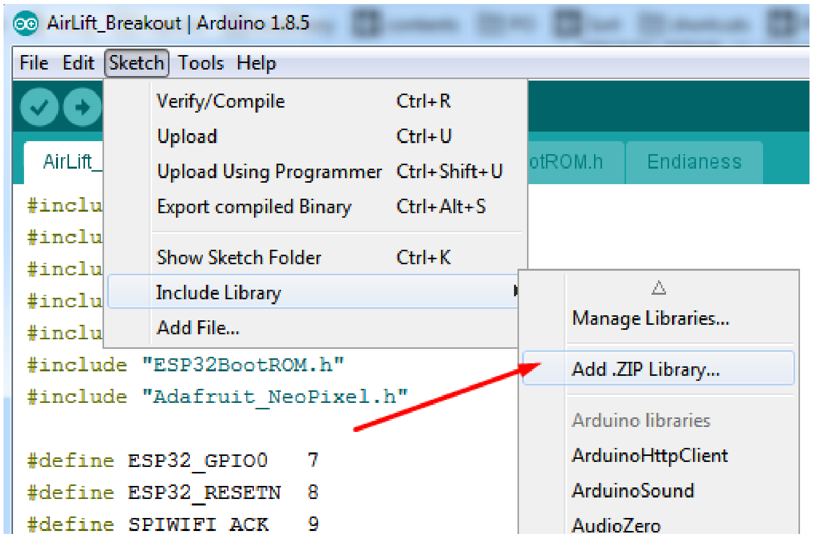
So! We made a fork that you can install.

Click here to download the library:

https://adafru.it/Evm

https://adafru.it/Evm

Within the Arduino IDE, select **Sketch->Include Library -> Add .ZIP library...**



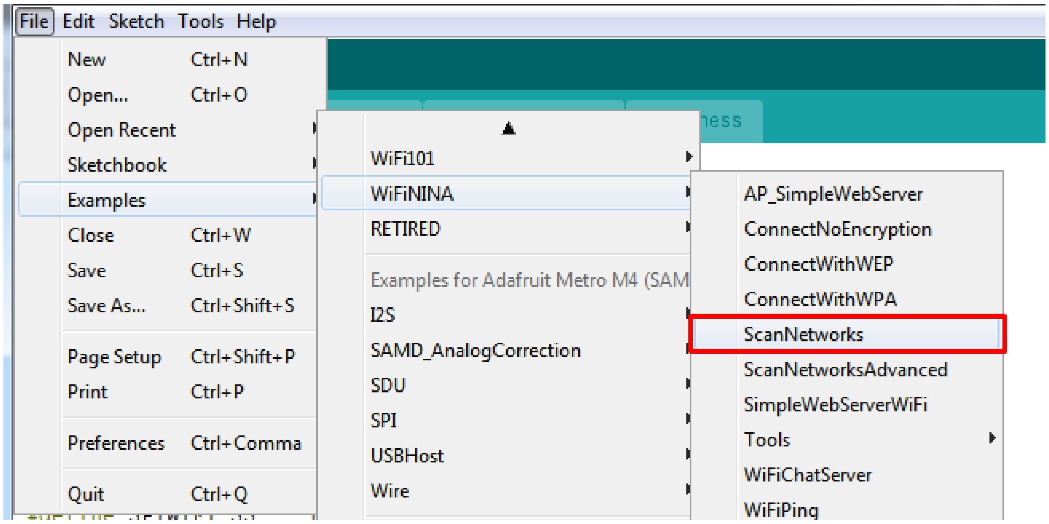
```
#inclu
#inclu
#inclu
#inclu
#inclu
#include "ESP32BootROM.h"
#include "Adafruit_NeoPixel.h"

#define ESP32_GPIO0    7
#define ESP32_RESETN   8
#define SPIWIFI ACK    9
```

And select the zip you just downloaded.

First Test

OK now you have it wired and library installed, time to test it out!

Lets start by scanning the local networks. Load up the **ScanNetworks** example



(https://adafru.it/EVu)

At the top you'll see a section where the GPIO pins are defined

```
// Configure the pins used for the ESP32 connection
#define SPIWIFI      SPI   // The SPI port
#define SPIWIFI_SS    10   // Chip select pin
#define SPIWIFI_ACK   7    // a.k.a BUSY or READY pin
#define ESP32_RESETN  5    // Reset pin
#define ESP32_GPIO0   -1   // Not connected
```

(https://adafru.it/EVv)

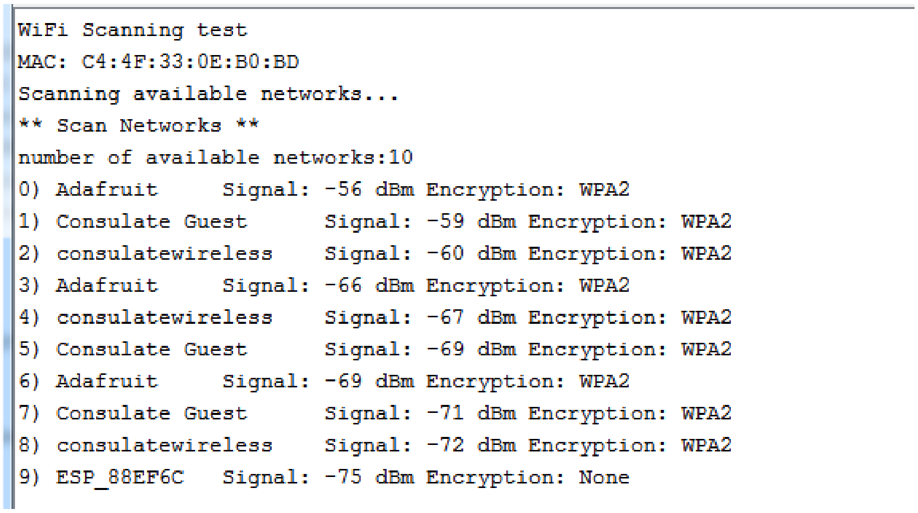
If you don't see this, you may have the wrong WiFiNINA library installed. Uninstall it and re-install the Adafruit one as above.

Arduino Microcontroller Pin Definition

Next, you'll need to need to modify the pin definition above for the AirLift Shield. Replace the configuration in the sketch with the pinouts below:

```
#define SPIWIFI       SPI  // The SPI port
#define SPIWIFI_SS    10   // Chip select pin
#define ESP32_RESETN  5    // Reset pin
#define SPIWIFI_ACK   7    // a.k.a BUSY or READY pin
#define ESP32_GPIO0   6
```

Compile and upload to your board wired up to the AirLift



```
WiFi Scanning test
MAC: C4:4F:33:0E:B0:BD
Scanning available networks...
** Scan Networks **
number of available networks:10
0) Adafruit     Signal: -56 dBm Encryption: WPA2
1) Consulate Guest      Signal: -59 dBm Encryption: WPA2
2) consulatewireless    Signal: -60 dBm Encryption: WPA2
3) Adafruit     Signal: -66 dBm Encryption: WPA2
4) consulatewireless    Signal: -67 dBm Encryption: WPA2
5) Consulate Guest      Signal: -69 dBm Encryption: WPA2
6) Adafruit     Signal: -69 dBm Encryption: WPA2
7) Consulate Guest      Signal: -71 dBm Encryption: WPA2
8) consulatewireless    Signal: -72 dBm Encryption: WPA2
9) ESP_88EF6C   Signal: -75 dBm Encryption: None
```

(https://adafru.it/EVw)

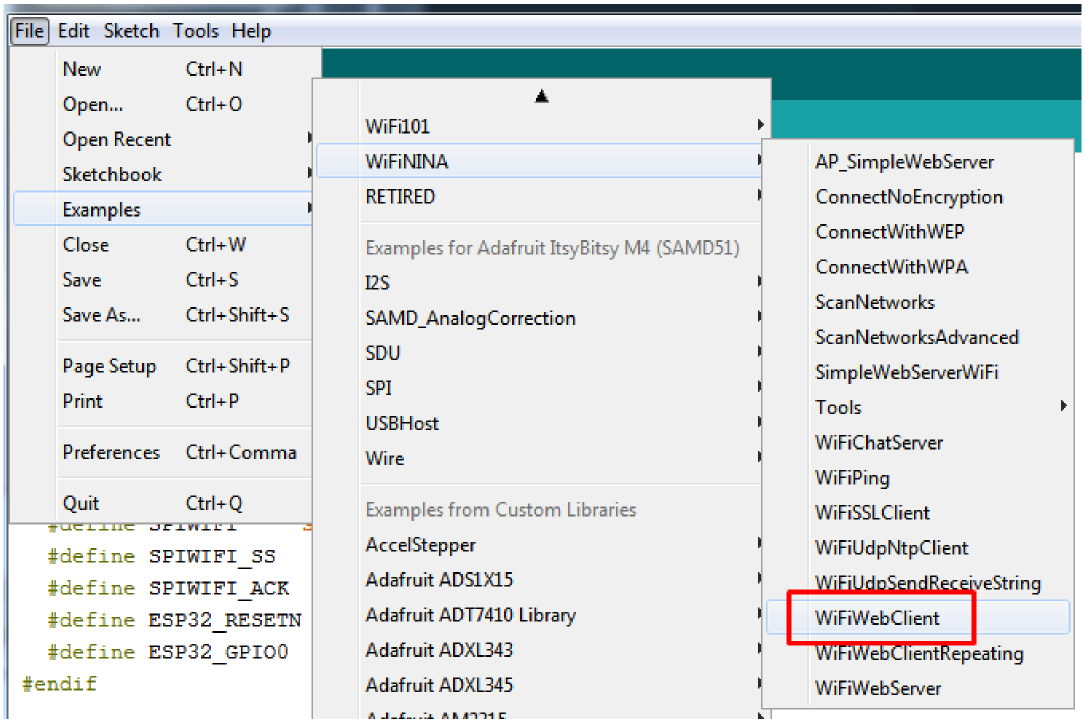
If you don't even get the MAC address printed out, check your wiring.

If you get the MAC address but cannot scan any networks, check your power supply. You need a solid 3-5VDC into **Vin** in order for the ESP32 not to brown out.

WiFi Connection Test

Now that you have your wiring checked, time to connect to the Internet!

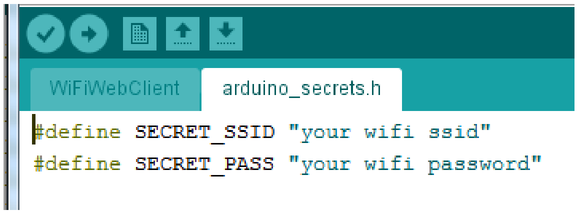
Open up the **WiFiWebClient** example



```
  #define SPIWIFI_SS
  #define SPIWIFI_ACK
  #define ESP32_RESETN
  #define ESP32_GPIO0
#endif
```

(https://adafru.it/EVx)

Open up the secondary tab, **arduino_secrets.h**. This is where you will store private data like the SSID/password to your network.

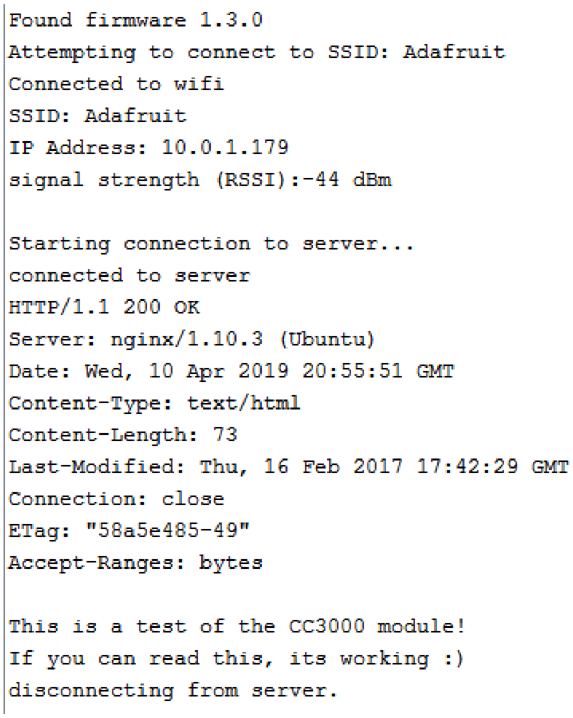


```
#define SECRET_SSID "your wifi ssid"
#define SECRET_PASS "your wifi password"
```

(https://adafru.it/EVy)

You must change these string values before updating to your board!

After you've set it correctly, upload and check the serial monitor. You should see the following. If not, go back, check wiring, power and your SSID/password

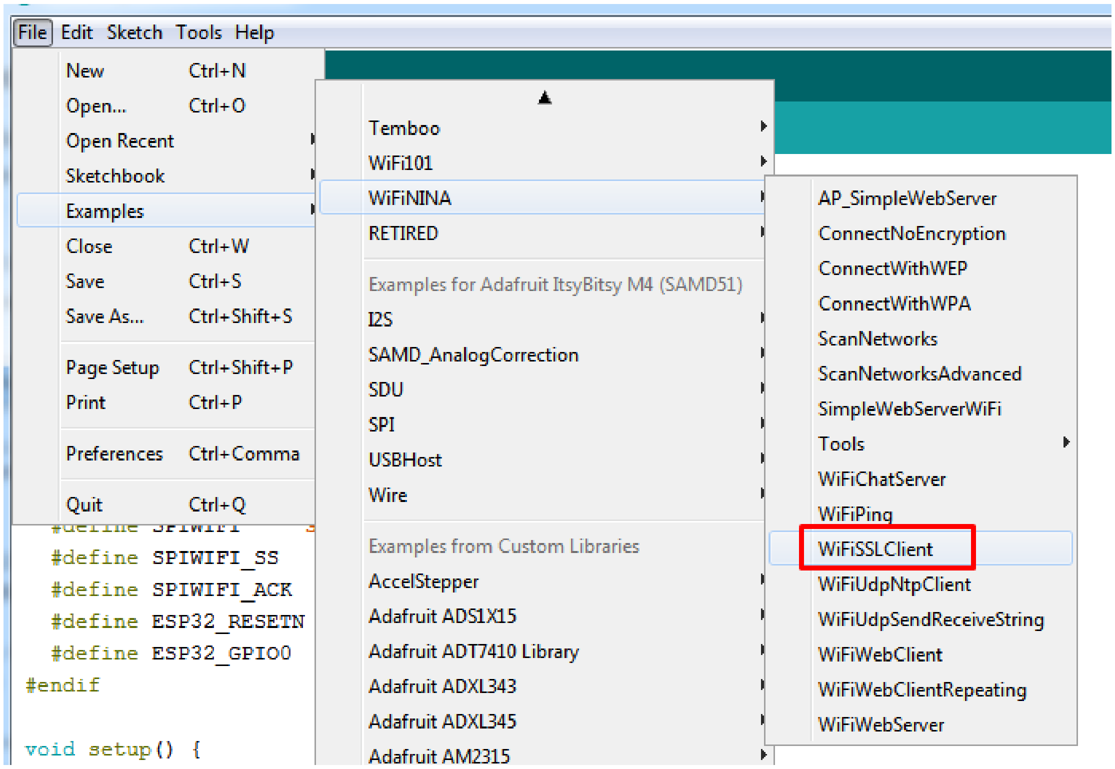


```
Found firmware 1.3.0
Attempting to connect to SSID: Adafruit
Connected to wifi
SSID: Adafruit
IP Address: 10.0.1.179
signal strength (RSSI):-44 dBm

Starting connection to server...
connected to server
HTTP/1.1 200 OK
Server: nginx/1.10.3 (Ubuntu)
Date: Wed, 10 Apr 2019 20:55:51 GMT
Content-Type: text/html
Content-Length: 73
Last-Modified: Thu, 16 Feb 2017 17:42:29 GMT
Connection: close
ETag: "58a5e485-49"
Accept-Ranges: bytes

This is a test of the CC3000 module!
If you can read this, its working :)
disconnecting from server.
```

(https://adafru.it/EVz)

Secure Connection Example

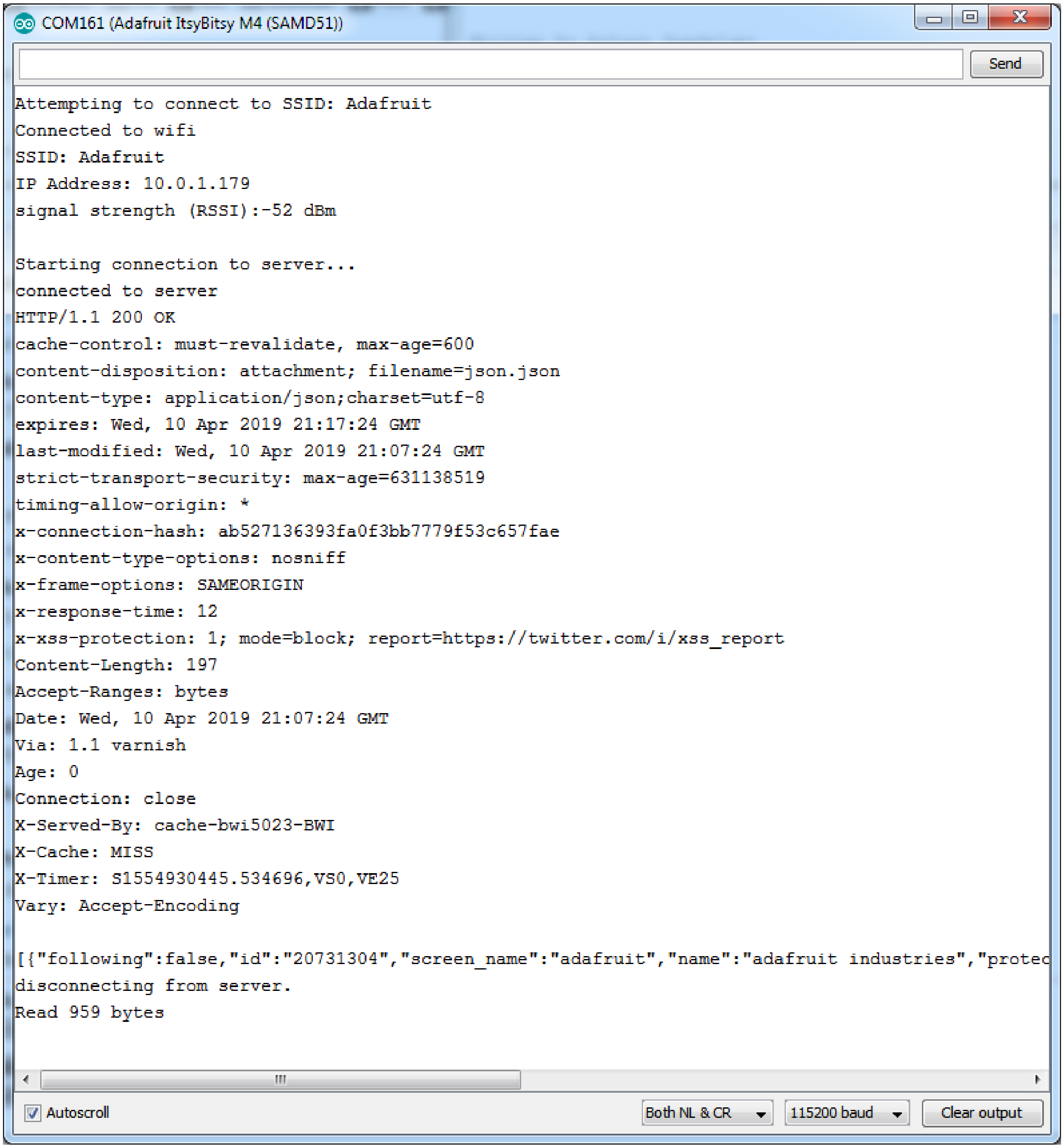
Many servers today do not allow non-SSL connectivity. Lucky for you the ESP32 has a great TLS/SSL stack so you can have that all taken care of for you. Here's an example of a secure WiFi connection:



```
  #define SPIWIFI
  #define SPIWIFI_SS
  #define SPIWIFI_ACK
  #define ESP32_RESETN
  #define ESP32_GPIO0
#endif

void setup() {
```

(https://adafru.it/EVA)

Note we use `WiFiSSLClient client;` instead of `WiFiClient client;` to require an SSL connection!



```
Attempting to connect to SSID: Adafruit
Connected to wifi
SSID: Adafruit
IP Address: 10.0.1.179
signal strength (RSSI):-52 dBm

Starting connection to server...
connected to server
HTTP/1.1 200 OK
cache-control: must-revalidate, max-age=600
content-disposition: attachment; filename=json.json
content-type: application/json;charset=utf-8
expires: Wed, 10 Apr 2019 21:17:24 GMT
last-modified: Wed, 10 Apr 2019 21:07:24 GMT
strict-transport-security: max-age=631138519
timing-allow-origin: *
x-connection-hash: ab527136393fa0f3bb7779f53c657fae
x-content-type-options: nosniff
x-frame-options: SAMEORIGIN
x-response-time: 12
x-xss-protection: 1; mode=block; report=https://twitter.com/i/xss_report
Content-Length: 197
Accept-Ranges: bytes
Date: Wed, 10 Apr 2019 21:07:24 GMT
Via: 1.1 varnish
Age: 0
Connection: close
X-Served-By: cache-bwi5023-BWI
X-Cache: MISS
X-Timer: S1554930445.534696,VS0,VE25
Vary: Accept-Encoding

[{"following":false,"id":"20731304","screen_name":"adafruit","name":"adafruit industries","protec
disconnecting from server.
Read 959 bytes
```

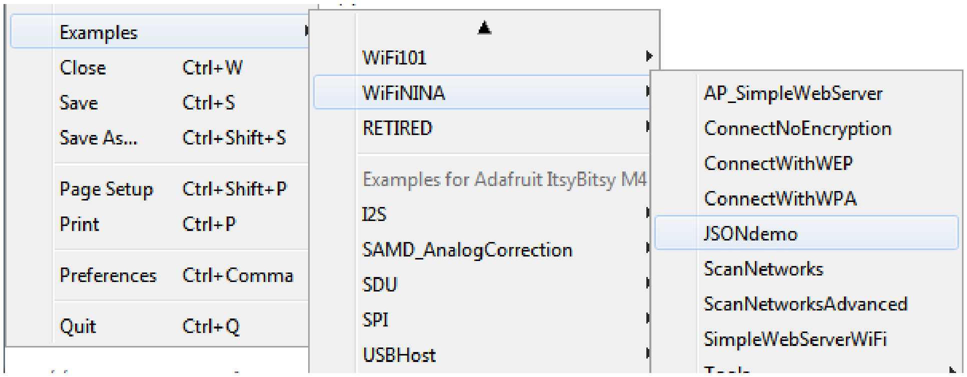
(https://adafru.it/EVB)

JSON Parsing Example

This example is a little more advanced - many sites will have API's that give you JSON data. We'll use ArduinoJSON (https://adafru.it/Evn) to convert that to a format we can use and then display that data on the serial port (which can then be re-directed to a display of some sort)

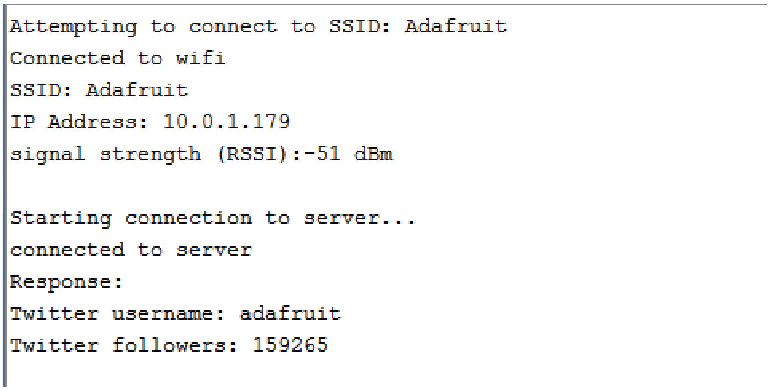
First up, use the Library manager to install ArduinoJSON (https://adafru.it/Evo).

Then load the example **JSONdemo**



(https://adafru.it/EVC)

By default it will connect to to the Twitter banner image API, parse the username and followers and display them.



```
Attempting to connect to SSID: Adafruit
Connected to wifi
SSID: Adafruit
IP Address: 10.0.1.179
signal strength (RSSI):-51 dBm

Starting connection to server...
connected to server
Response:
Twitter username: adafruit
Twitter followers: 159265
```

(https://adafru.it/EVD)

Adapting Other Examples

Once you've got it connecting to the Internet you can check out the other examples. The only change you'll want to make is at the **top** of the sketches, add:

```
#define SPIWIFI       SPI  // The SPI port
#define SPIWIFI_SS    10   // Chip select pin
#define ESP32_RESETN  5    // Reset pin
#define SPIWIFI_ACK   7    // a.k.a BUSY or READY pin
#define ESP32_GPIO0   6
```

And then **before** you check the `status()` of the module, call the function `WiFi.setPins(SPIWIFI_SS, SPIWIFI_ACK, ESP32_RESETN, ESP32_GPIO0, &SPIWIFI);` like so:

```
// check for the WiFi module:
  WiFi.setPins(SPIWIFI_SS, SPIWIFI_ACK, ESP32_RESETN, ESP32_GPIO0, &SPIWIFI);
  while (WiFi.status() == WL_NO_MODULE) {
    Serial.println("Communication with WiFi module failed!");
    // don't continue
    delay(1000);
  }
```

Upgrade External ESP32 Airlift Firmware

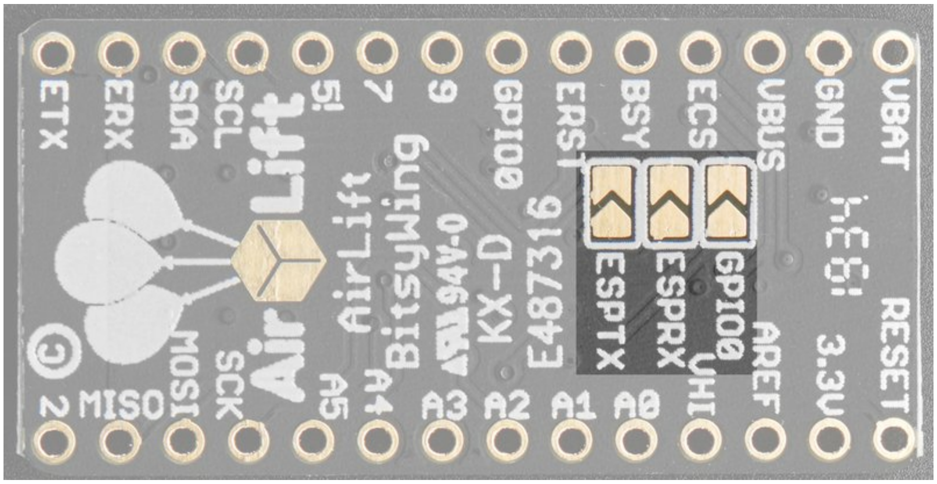
Bridging the ESP32's Optional Control Pins

External AirLift boards have three optional ESP32 control pins which are not connected by default:

- **ESPGPIO0**
- **ESPRX**
- **ESPTX**

Before continuing the steps on this page - you will need to add solder bridges on the ESPTX, EXPRX and GPIO0 pads on the bottom of breakout.

Make sure you solder all three of these pads together. You will not be able to upload firmware to your ESP32 if they are not connected.



This section is only for an AirLift FeatherWing with a Feather M4, or an AirLift BitsyWing with an ItsyBitsy M4. If you are using a different hardware combination - use the "Code - Arduino Passthrough" section instead.

Uploading Serial Passthrough Code for Feather M4 or ItsyBitsy M4

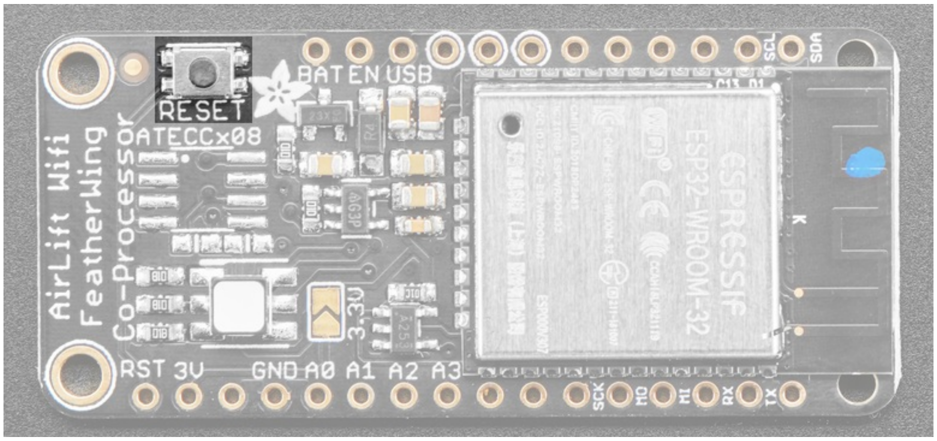
First, **back up any code and files you have on your CIRCUITPY drive**. It will be overwritten by the code you're going to upload to your board. You should not end up losing any files on the QSPI flash, but it's a good idea to back them up anyways.

Download the UF2 for your board to your Desktop.

https://adafru.it/IEK

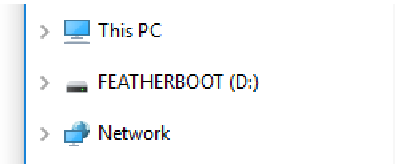
https://adafru.it/IEK

Find the reset button on your board. It's a small, black button, and on most of the boards, it will be the only button available.

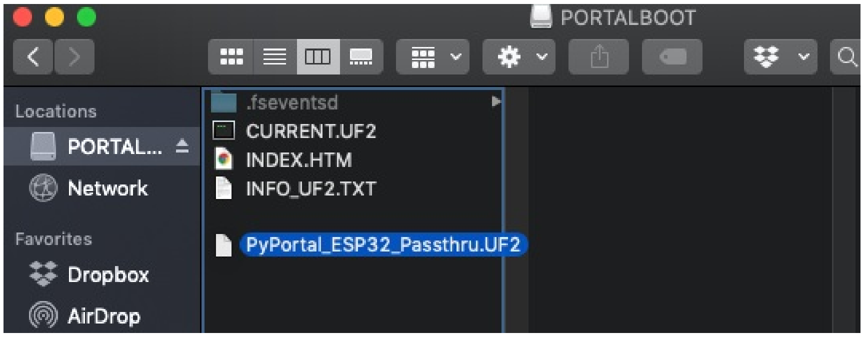


Tap this button twice to enter the bootloader. If it doesn't work on the first try, don't be discouraged. The rhythm of the taps needs to be correct and sometimes it takes a few tries.

Once successful, the RGB LED on the board will flash red and then stay green. A new drive will show up on your computer. The drive will be called *boardname*BOOT where *boardname* is a reference to your specific board. For example, a Feather will have `FEATHERBOOT` and a Trinket will have `TRINKETBOOT` etc. Going forward we'll just call the boot drive `BOOT`

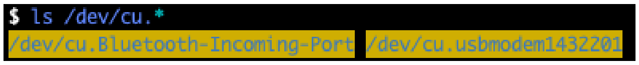


The board is now in bootloader mode. Now find the UF2 file you downloaded. Drag that file to the `BOOT` drive on your computer in your operating system file manager/finder.



The lights should flash again, `BOOT` will disappear. Your board should re-enumerate USB and appear as a COM or Serial port on your computer. Make a note of the serial port by checking the **Device Manager** (Windows) or **typing `ls /dev/cu*` or `/dev/tty*`** (Mac or Linux) **in a terminal.**

If your board is listed in the terminal, proceed to the **Uploading nina-fw with esptool** section of this guide.



```
$ ls /dev/cu.*
/dev/cu.Bluetooth-Incoming-Port /dev/cu.usbmodem1432201
```

Code - Arduino Passthrough

With the ESP32's optional control pins soldered together, you'll be turning your Airlift breakout, shield, or wing into a

USB to Serial converter. To do this, you'll need a special Arduino sketch named **SerialESPPassthrough.ino.**

Click ***Download: Project ZIP*** to download the code below.

```
/*
  SerialNINAPassthrough - Use esptool to flash the ESP32 module
  For use with PyPortal, Metro M4 WiFi...

  Copyright (c) 2018 Arduino SA. All rights reserved.

  This library is free software; you can redistribute it and/or
  modify it under the terms of the GNU Lesser General Public
  License as published by the Free Software Foundation; either
  version 2.1 of the License, or (at your option) any later version.

  This library is distributed in the hope that it will be useful,
  but WITHOUT ANY WARRANTY; without even the implied warranty of
  MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the GNU
  Lesser General Public License for more details.

  You should have received a copy of the GNU Lesser General Public
  License along with this library; if not, write to the Free Software
  Foundation, Inc., 51 Franklin St, Fifth Floor, Boston, MA  02110-1301  USA
*/

#include <Adafruit_NeoPixel.h>

unsigned long baud = 115200;

#if defined(ADAFRUIT_FEATHER_M4_EXPRESS) || \
  defined(ADAFRUIT_FEATHER_M0_EXPRESS) || \
  defined(ARDUINO_AVR_FEATHER32U4) || \
  defined(ARDUINO_NRF52840_FEATHER) || \
  defined(ADAFRUIT_ITSYBITSY_M0_EXPRESS) || \
  defined(ADAFRUIT_ITSYBITSY_M4_EXPRESS) || \
  defined(ARDUINO_AVR_ITSYBITSY32U4_3V)
  // Configure the pins used for the ESP32 connection
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI  // The SPI port
  #define SPIWIFI_SS    13   // Chip select pin
  #define ESP32_RESETN  12   // Reset pin
  #define SPIWIFI_ACK   11   // a.k.a BUSY or READY pin
  #define ESP32_GPIO0   10
  #define NEOPIXEL_PIN   8
#elif defined(ARDUINO_AVR_FEATHER328P)
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI  // The SPI port
  #define SPIWIFI_SS     4   // Chip select pin
  #define ESP32_RESETN   3   // Reset pin
  #define SPIWIFI_ACK    2   // a.k.a BUSY or READY pin
  #define ESP32_GPIO0   -1
  #define NEOPIXEL_PIN   8
#elif defined(TEENSYDUINO)
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI  // The SPI port
  #define SPIWIFI_SS     5   // Chip select pin
  #define ESP32_RESETN   6   // Reset pin
  #define SPIWIFI_ACK    9   // a.k.a BUSY or READY pin
  #define ESP32_GPIO0   -1
  #define ESP32_GPIO0   -1
  #define NEOPIXEL_PIN   8
#elif defined(ARDUINO_NRF52832_FEATHER )
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI  // The SPI port
  #define SPIWIFI_SS    16  // Chip select pin
  #define ESP32_RESETN  15  // Reset pin
  #define SPIWIFI_ACK    7  // a.k.a BUSY or READY pin
  #define ESP32_GPIO0   -1
  #define NEOPIXEL_PIN   8
#elif !defined(SPIWIFI_SS)  // if the wifi definition isnt in the board variant
  // Don't change the names of these #define's! they match the variant ones
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI
  #define SPIWIFI_SS    10   // Chip select pin
  #define SPIWIFI_ACK    7   // a.k.a BUSY or READY pin
  #define ESP32_RESETN   5   // Reset pin
  #define ESP32_GPIO0   -1   // Not connected
  #define NEOPIXEL_PIN   8
#endif

Adafruit_NeoPixel pixel = Adafruit_NeoPixel(1, NEOPIXEL_PIN, NEO_GRB + NEO_KHZ800);

void setup() {
  Serial.begin(baud);
  pixel.begin();
  pixel.setPixelColor(0, 10, 10, 10); pixel.show();

  while (!Serial);
  pixel.setPixelColor(0, 50, 50, 50); pixel.show();

  delay(100);
  SerialESP32.begin(baud);

  pinMode(SPIWIFI_SS, OUTPUT);
  pinMode(ESP32_GPIO0, OUTPUT);
  pinMode(ESP32_RESETN, OUTPUT);

  // manually put the ESP32 in upload mode
  digitalWrite(ESP32_GPIO0, LOW);

  digitalWrite(ESP32_RESETN, LOW);
  delay(100);
  digitalWrite(ESP32_RESETN, HIGH);
  pixel.setPixelColor(0, 20, 20, 0); pixel.show();
  delay(100);
}

void loop() {
  while (Serial.available()) {
    pixel.setPixelColor(0, 10, 0, 0); pixel.show();
    SerialESP32.write(Serial.read());
  }

  while (SerialESP32.available()) {
    pixel.setPixelColor(0, 0, 0, 10); pixel.show();
    Serial.write(SerialESP32.read());
  }
}
```

Code Usage

Unzip the file, and open the **SerialESPPassthrough.ino** file in the Arduino IDE.

If you're using the AirLift FeatherWing, AirLift Shield or AirLift Bitsy Add-On, use the PassThrough UF2 instructions above

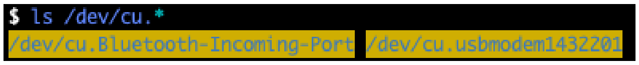
If you have an AirLift Breakout (or are manually wiring up any of the boards above), **change the following pin definitions in the sketch to match your wiring:**

```
#elif !defined(SPIWIFI_SS)  // if the wifi definition isnt in the board variant
  // Don't change the names of these #define's! they match the variant ones
  #define SerialESP32   Serial1
  #define SPIWIFI       SPI
  #define SPIWIFI_SS    10   // Chip select pin
  #define SPIWIFI_ACK    7   // a.k.a BUSY or READY pin
  #define ESP32_RESETN   5   // Reset pin
  #define ESP32_GPIO0   -1   // Not connected
  #define NEOPIXEL_PIN   8
#endif
```

Using the Arduino IDE, **upload the code to your board** (*Sketch->Upload*).

After uploading, the board should enumerate USB and appear as a COM or Serial port on your computer.

Make a note of the serial port by checking the **Device Manager** (Windows) or typing in `ls /dev/cu*` or `/dev/tty*` (Mac or Linux) in a terminal



```
$ ls /dev/cu.*
/dev/cu.Bluetooth-Incoming-Port /dev/cu.usbmodem1432201
```

Burning nina-fw with esptool

Click the link below to download the latest nina-fw .bin file. **Unzip** it **and save the .bin file to your desktop**.

This section assumes you know how to use 'esptool' to upload firmware to your ESP! If you're not sure, check https://github.com/espressif/esptool and look for tutorials.

https://adafru.it/G3D

https://adafru.it/G3D

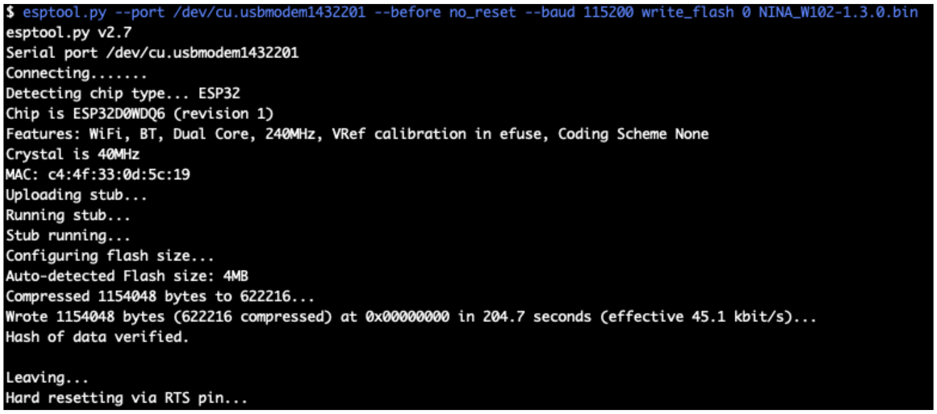
If you're using macOS or Linux - run the following command, replacing `/dev/ttys6` with the serial port of your board and `NINA_W102-1.6.0` with the binary file you're flashing to the ESP32.

`esptool.py --port /dev/ttyS6 --before no_reset --baud 115200 write_flash 0 NINA_W102-1.6.0.bin`

If you're using Windows - run the following command, replacing `COM7` with the serial port of your board and `NINA_W102-1.6.0` with the binary file you're flashing to the ESP32 `esptool.py --port COM7 --before no_reset --baud 115200 write_flash 0 NINA_W102-1.6.0.bin`

The command should detect the ESP32 and will take a minute or two to upload the firmware.

If ESPTool doesn't detect the ESP32, make sure you've uploaded the correct .UF2 file to the bootloader and are using the correct serial port.



```
$ esptool.py --port /dev/cu.usbmodem1432201 --before no_reset --baud 115200 write_flash 0 NINA_W102-1.3.0.bin
esptool.py v2.7
Serial port /dev/cu.usbmodem1432201
Connecting.......
Detecting chip type... ESP32
Chip is ESP32D0WDQ6 (revision 1)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse, Coding Scheme None
Crystal is 40MHz
MAC: c4:4f:33:0d:5c:19
Uploading stub...
Running stub...
Stub running...
Configuring flash size...
Auto-detected Flash size: 4MB
Compressed 1154048 bytes to 622216...
Wrote 1154048 bytes (622216 compressed) at 0x00000000 in 204.7 seconds (effective 45.1 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

Once the firmware is fully uploaded, the ESP32 will reset.

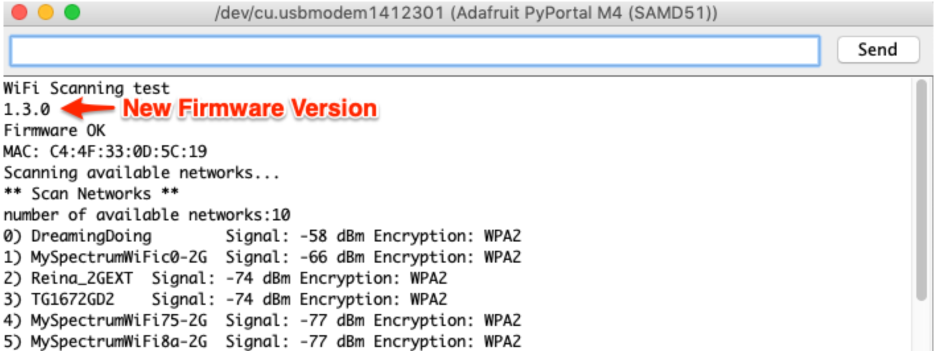
Verifying the Upgraded Firmware Version

To verify everything is working correctly, we'll load up either an Arduino sketch or CircuitPython code. At this point, you may also want desolder the connections between the Optional ESP32 control pins you made earlier using a solder sucker (https://adafru.it/FWk) or a bit of solder wick (https://adafru.it/yrC).

Arduino

If you were previously using your ESP32 with Arduino, you should load up an Arduino sketch to verify everything is working properly and the version of the nina-fw correlates with the version the sketch reads.

Open up **File->Examples->WiFiNINA->ScanNetworks** and upload the sketch. Then, open the Serial Monitor. You should see the firmware version printed out to the serial monitor.

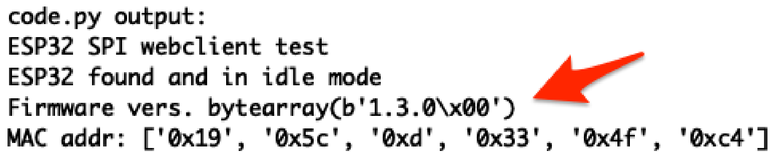


```
WiFi Scanning test
1.3.0
Firmware OK
MAC: C4:4F:33:0D:5C:19
Scanning available networks...
** Scan Networks **
number of available networks:10
0) DreamingDoing        Signal: -58 dBm Encryption: WPA2
1) MySpectrumWiFic0-2G  Signal: -66 dBm Encryption: WPA2
2) Reina_2GEXT  Signal: -74 dBm Encryption: WPA2
3) TG1672GD2    Signal: -74 dBm Encryption: WPA2
4) MySpectrumWiFi75-2G  Signal: -77 dBm Encryption: WPA2
5) MySpectrumWiFi8a-2G  Signal: -77 dBm Encryption: WPA2
```

CircuitPython

If you were previously using your ESP32 project with CircuitPython, you'll need to first reinstall CircuitPython firmware (UF2) for your board. The QSPI flash should have retained its contents. If you don't see anything on the `CIRCUITPY` volume, copy files from the backup you made earlier to CIRCUITPY.

To verify the new ESP32 WiFi firmware version is correct, follow the Connect to WiFi step in this guide (https://adafru.it/Eao) and come back here when you've successfully ran the code. The REPL output should display the firmware version you flashed.



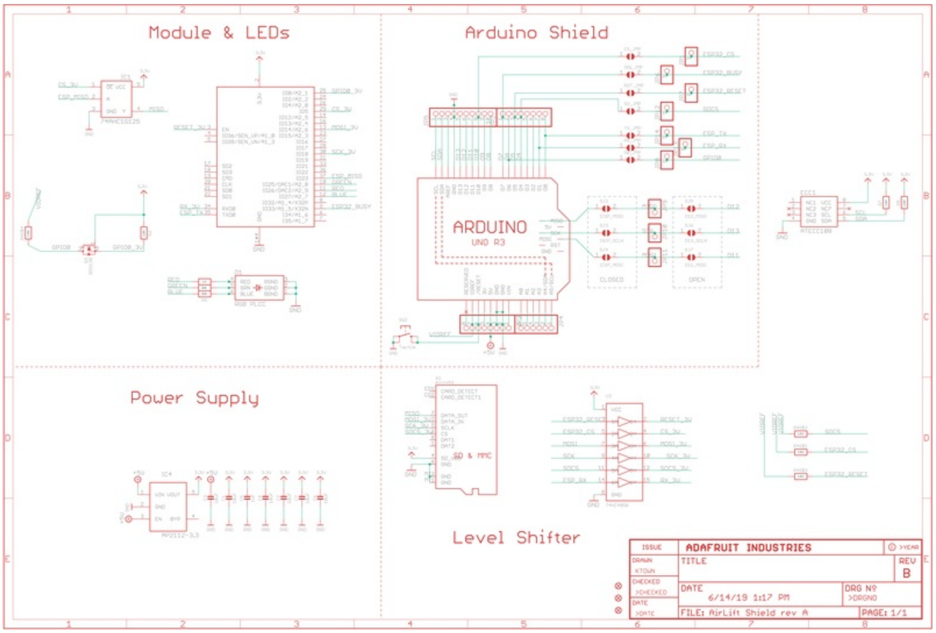
```
code.py output:
ESP32 SPI webclient test
ESP32 found and in idle mode
Firmware vers. bytearray(b'1.3.0\x00')
MAC addr: ['0x19', '0x5c', '0xd', '0x33', '0x4f', '0xc4']
```

Downloads

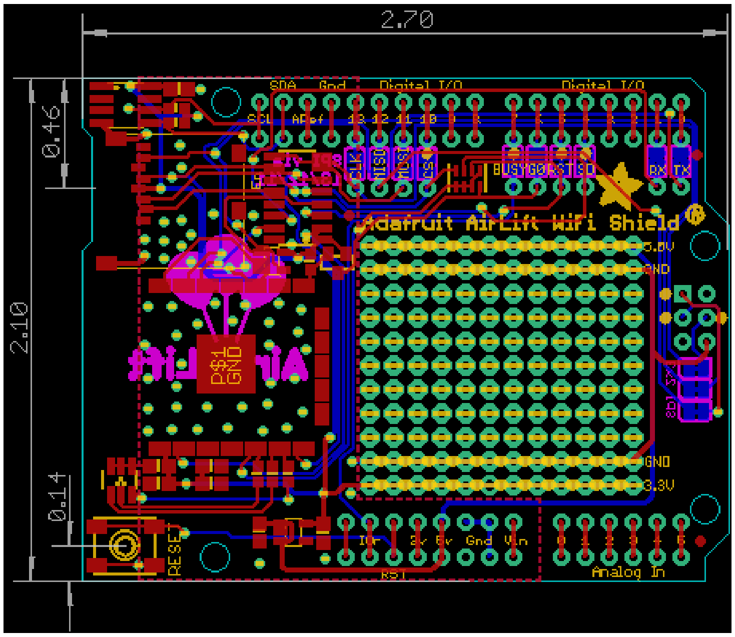
Files

- ESP32 WROOM32 Datasheet (https://adafru.it/EVE)
- EagleCAD files on GitHub (https://adafru.it/F6p)
- Fritzing object in Adafruit Fritzing Library (https://adafru.it/F6q)

Schematic



Fab Print


2.70
0.46
2.10
0.14
SDA
Gnd
Digital I/O
Digital I/O
SCL
ARef
13 12 11 10
SCK
MISO
MOSI
CS
BUSY
G0
RST
SD
RX
TX
Adafruit AirLift WiFi Shield
5.0V
GND
GND
3.3V
RESET
IOr
3v
5v
Gnd
Vin
RST
Analog In