

Sino:bit with Arduino

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Accelerometer and Magnetometer

Magnetometer

Lets start with the magnetometer chip, the MAG3110

MAG3110 Datasheet

<https://adafru.it/z4B>

We can talk to the chip using an Arduino library

You can download Sparkfun's library by clicking the button below!

Download Sparkfun MAG3110 breakout library

<https://adafru.it/z4D>

[And read our guide on how to install libraries](#)

Restart the IDE. Now you can [upload some examples](#). I suggest starting with the [Basic example](#) which is replicated below

```

/* *****
 * SparkFun_MAG3110_Basic
 * Triple Axis Magnetometer Breakout - MAG3110
 * Hook Up Guide Example
 *
 * Utilizing Sparkfun's MAG3110 Library
 * A basic sketch that reads x y and z readings
 * from the MAG3110 sensor
 *
 * George B. on behalf of SparkFun Electronics
 * Created: Sep 22, 2016
 * Updated: n/a
 *
 * Development Environment Specifics:
 * Arduino 1.6.7
 *
 * Hardware Specifications:
 * SparkFun MAG3110
 * Bi-directional Logic Level Converter
 * Arduino Micro
 *
 * This code is beerware; if you see me (or any other SparkFun employee) at the
 * local, and you've found our code helpful, please buy us a round!
 * Distributed as-is; no warranty is given.
 * *****/

#include <SparkFun_MAG3110.h>

MAG3110 mag = MAG3110(); //Instantiate MAG3110

void setup() {
  Serial.begin(9600);

  mag.initialize(); //Initializes the mag sensor
  mag.start();      //Puts the sensor in active mode
}

void loop() {

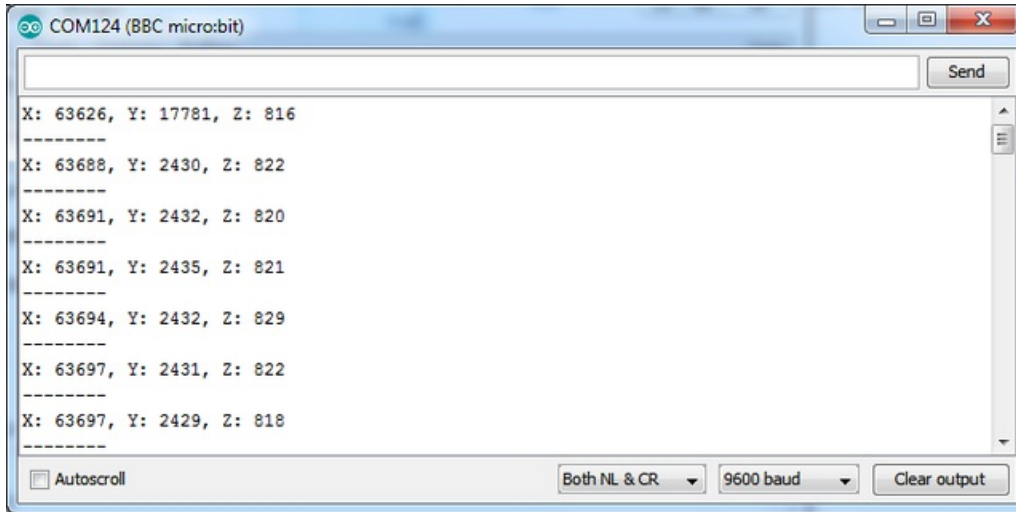
  int x, y, z;
  //Only read data when it's ready
  if(mag.dataReady()) {
    //Read the data
    mag.readMag(&x, &y, &z);

    Serial.print("X: ");
    Serial.print(x);
    Serial.print(", Y: ");
    Serial.print(y);
    Serial.print(", Z: ");
    Serial.println(z);

    Serial.println("-----");
  }
}

```

Upload this to the microbit to see the following raw data:



Note that the magnetometer is not calibrated, so you'll get different numbers on XYZ *but* when you twist and rotate the microbit the numbers should move up and down a bit! (This is why magnetometers must be calibrated)

Accelerometer

The microbit has an onboard 3-axis accelerometer as well!

You can use this **akafugu MMA8653** to communicate with it:

MMA8653.zip

<https://adafruit.it/z5a>

Install like other libraries!

Next up, run this example code:

```

/*
 * MMA845XQ test code
 * (C) 2012 Akafugu Corporation
 *
 * This program is free software; you can redistribute it and/or modify it under the
 * terms of the GNU General Public License as published by the Free Software
 * Foundation; either version 2 of the License, or (at your option) any later
 * version.
 *
 * This program 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 General Public License for more details.
 */

#include "Wire.h"
#include "MMA8653.h"

MMA8653 accel;

void setup() {
  Serial.begin(9600);

  Serial.println("microbit accel test");

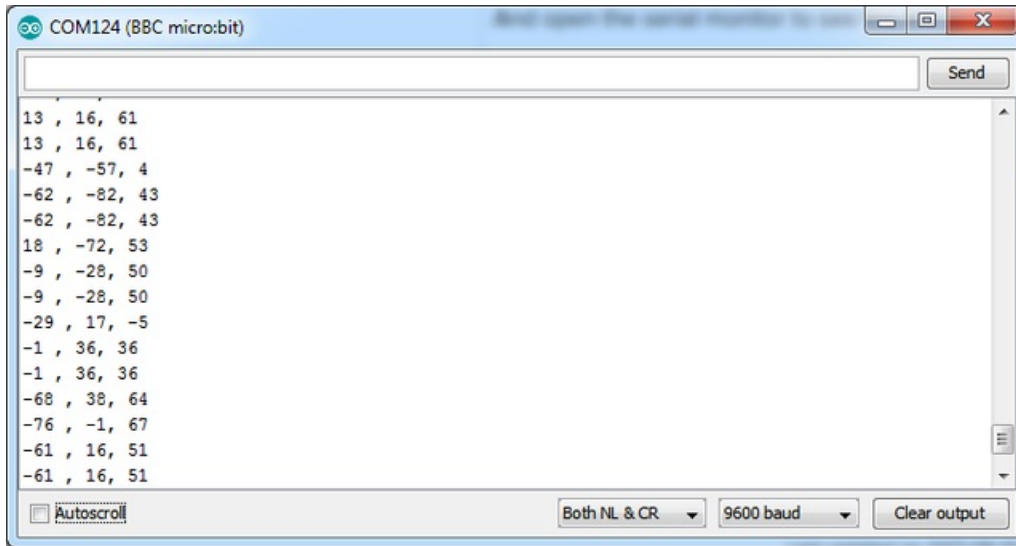
  accel.begin(false, 2); // 8-bit mode, 2g range
}

void loop() {
  accel.update();
  Serial.print(accel.getX());   Serial.print(" , ");
  Serial.print(accel.getY());   Serial.print(" , ");
  Serial.println(accel.getZ());

  delay(100);
}

```

And open the serial monitor to see the X Y and Z acceleration data points!



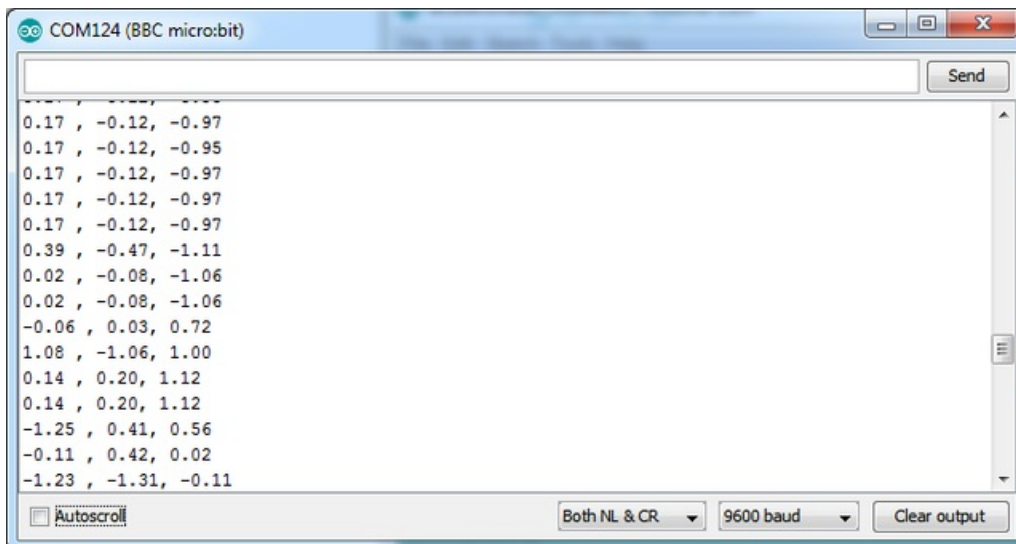
This library is pretty old and incomplete so at this time you can only use it in 8-bit mode. If you want to get the data in g's use this for the loop:

```

void loop() {
  accel.update();
  Serial.print((float)accel.getX() * 0.0156);   Serial.print(" , ");
  Serial.print((float)accel.getY() * 0.0156);   Serial.print(" , ");
  Serial.println((float)accel.getZ() * 0.0156);

  delay(100);
}

```



Adafruit Libraries

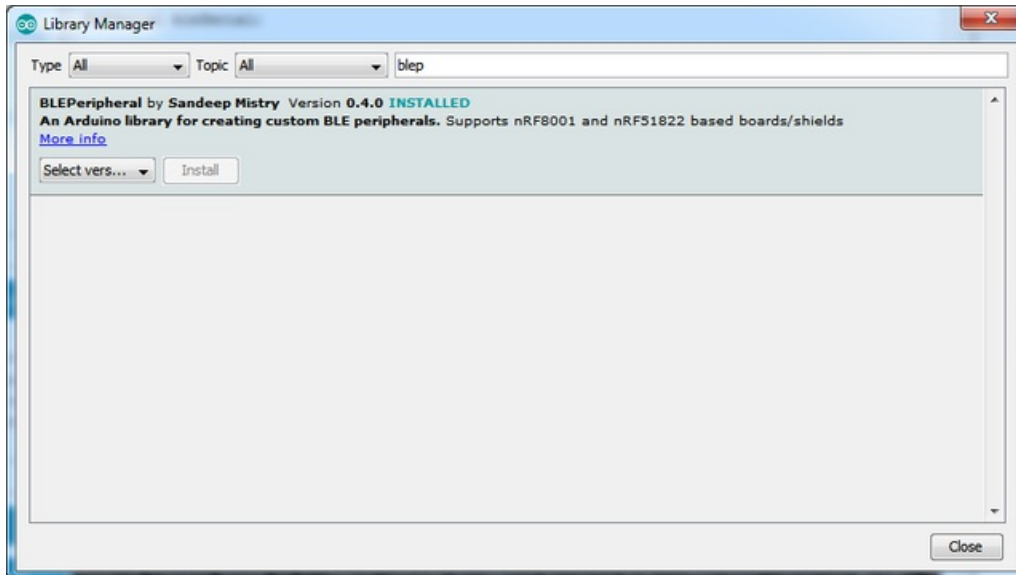
Once you want to get any more complex stuff going, you'll need a helper library to manage stuff like the internal temperature sensor, LED matrix, or Bluetooth connection.

To make your life easier, we've written up a wrapper library that manages all this stuff for you.

You'll also need to install some helpers:

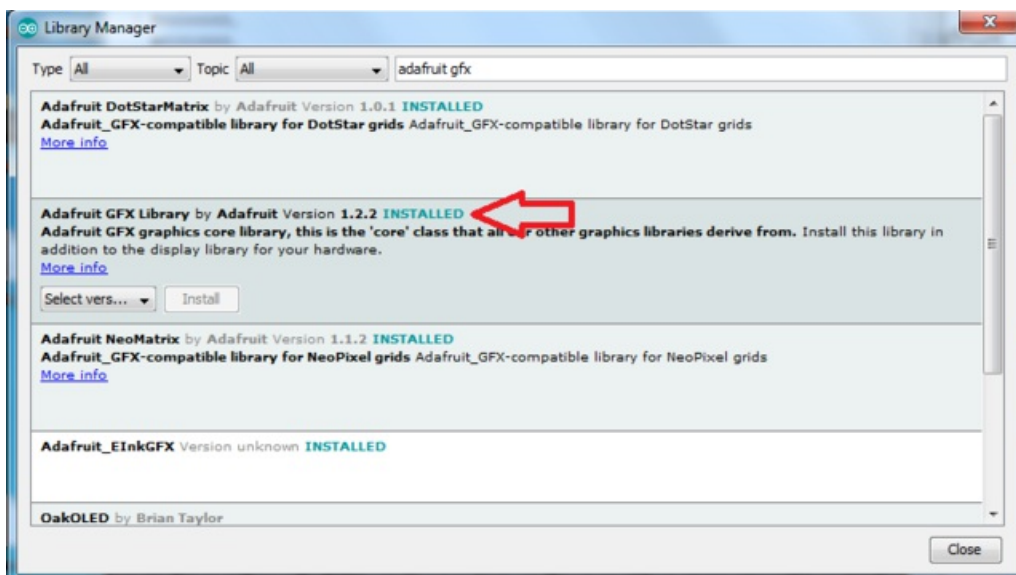
Download BLE Peripheral library

In the Arduino library manager, install the **BLE Peripheral** library:



Download Adafruit GFX library

In the Arduino library manager, install the **Adafruit GFX** library:



Download Adafruit_Microbit library

To use the LED matrix or Bluetooth connection, you will need to download Adafruit_Microbit from our github repository. [You can do that by visiting the github repo](#) and manually downloading or, easier, just click this button to download the zip:

Download Adafruit Microbit Library

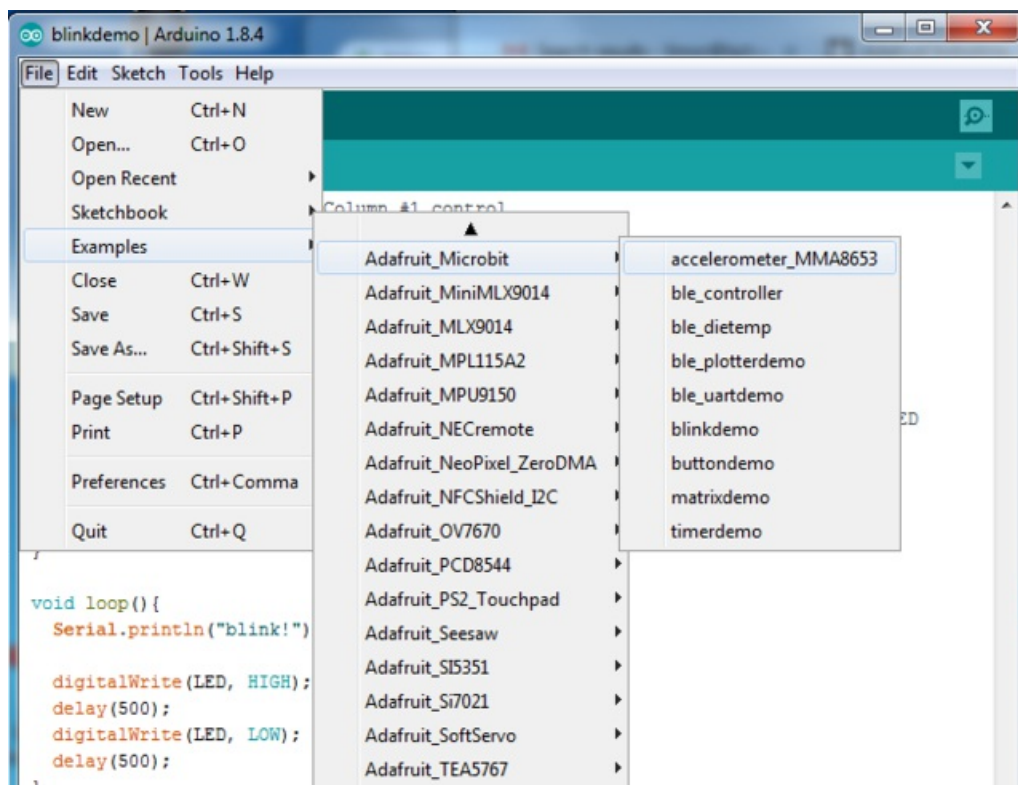
<https://adafru.it/zqD>

Rename the uncompressed folder **Adafruit_Microbit** and check that the **Adafruit_Microbit** folder contains **Adafruit_Microbit.cpp** and **Adafruit_Microbit.h**

Place the **Adafruit_Microbit** library folder your **arduinowsketchfolder/libraries/** folder.
You may need to create the **libraries** subfolder if its your first library. Restart the IDE.

We also have a great tutorial on Arduino library installation at:
<http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use>

Once you've re-started the Arduino IDE you should see the library examples appear in the **File->Examples->Adafruit_Microbit** menu



Bluetooth UART

The main chip has a bluetooth LE radio built in, which is how you can make cool wireless projects!

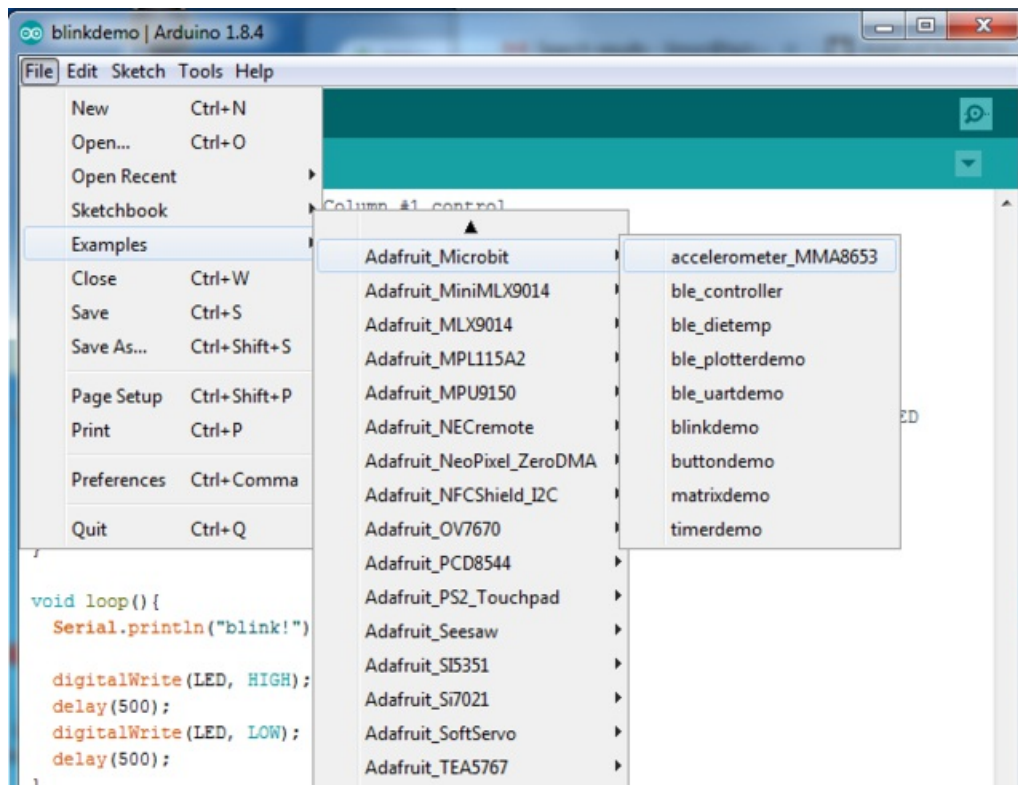
You can use the radio with our Adafruit Bluefruit Connect app without too much difficulty! You can [download Bluefruit Connect](#) in both the [iOS App store](#) and [Android app stores](#)

[Learn more about our app over at the Connect guide](#), we'll assume you've read thru it so you have a rough idea how it works

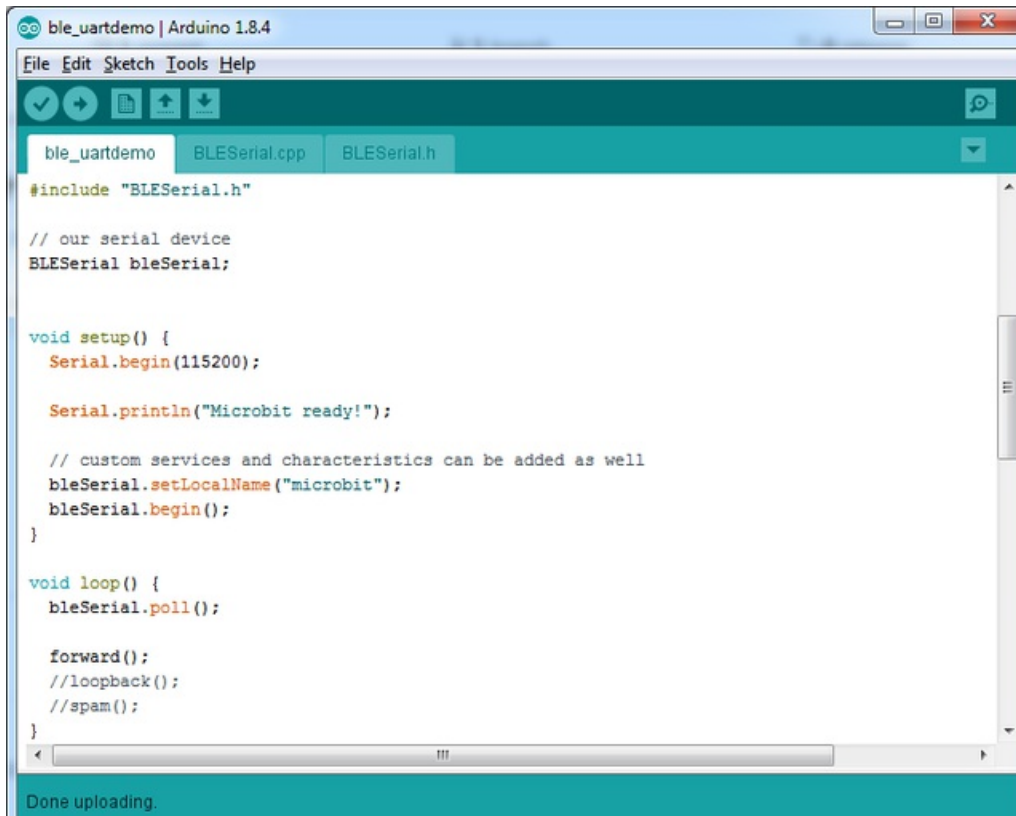
Install Library & Example Code

First up, install the [Adafruit helper library](#) and friends

You can find our BLE demos in the examples menu:



Load up the BLE UART demo to start



Find these three lines:

```
forward();
//loopback();
//spam();
```

and change them to:

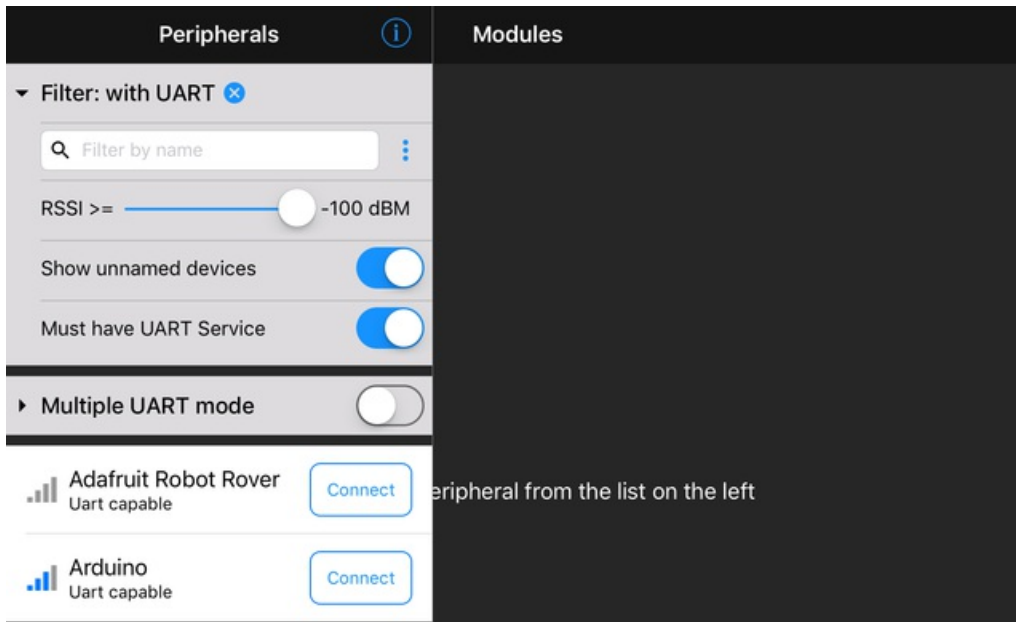
```
//forward();
loopback();
spam();
```

This will turn on auto-transmitting data once a second which will make testing easier. Then upload the sketch

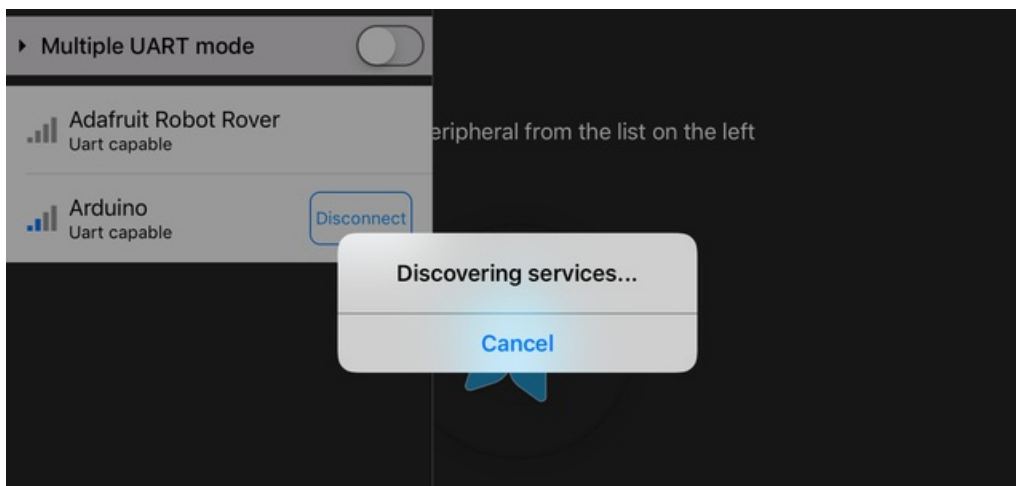
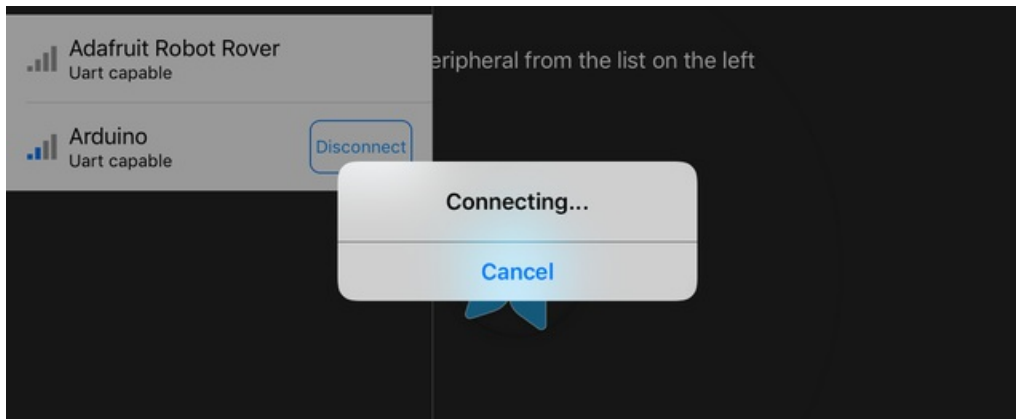
Bluetooth Connection

Once you have the sketch on the microbit, open up the Adafruit Bluefruit Connect app.

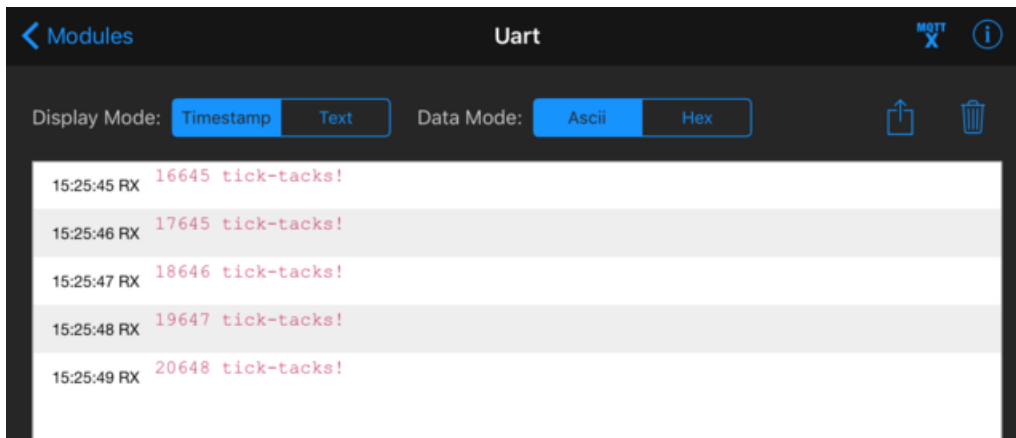
On the left there's a menu you can open. Select the microbit, it might be named **UART** or **Arduino**



Press **Connect**



Then select **UART** from the list of Modules. Go into **Timestamp** mode and you should see messages once a second:



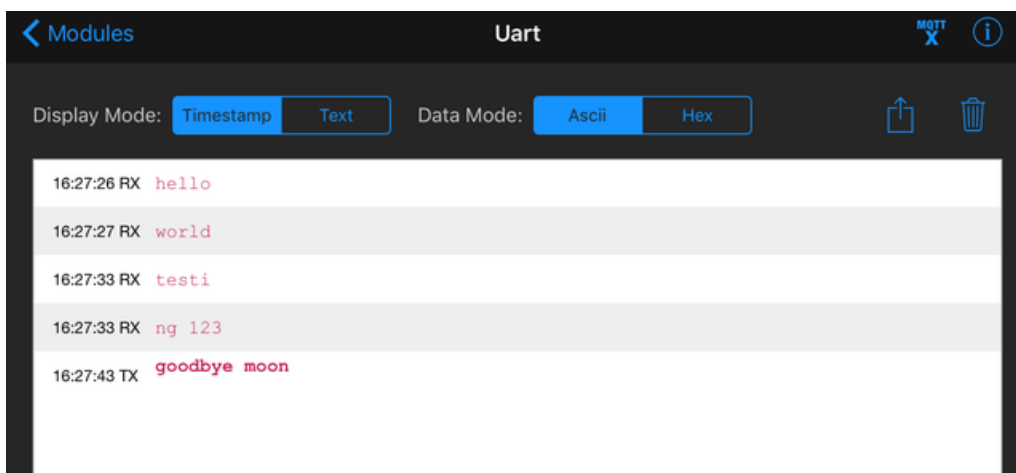
Go back to the sketch and change it back to:

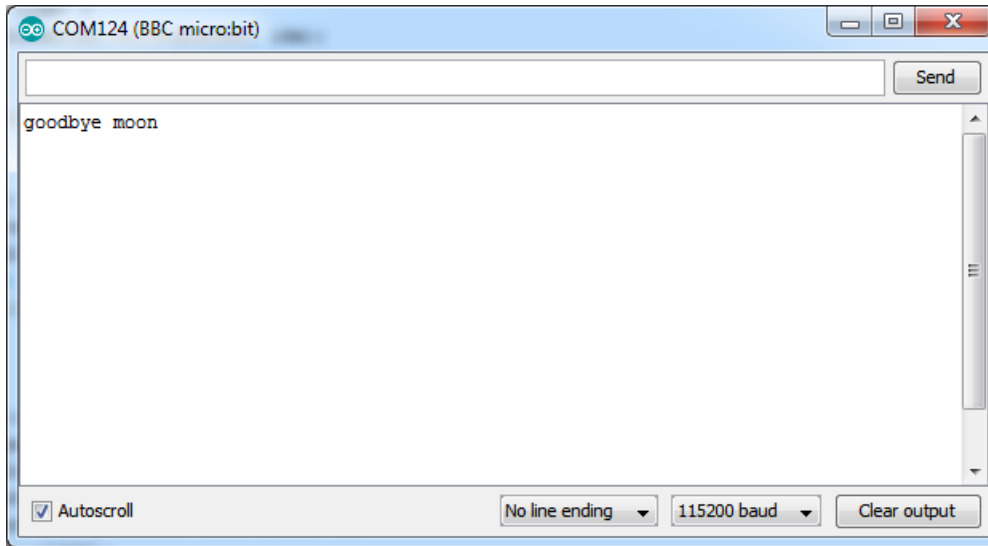
```
forward();  
//loopback();  
//spam();
```

Re-upload. The app will complain you disconnected, just go back and disconnect from the peripheral-list menu.

Open the serial console at **115200 baud**

Then when you go back to UART mode, you can send data from the tablet to the bit and back. Note that the microbit's UART is a little odd - don't send more than 10 or so characters 'at a time' through the serial monitor or it may hang.





Once you've got all that working, you can try our controller sketch!

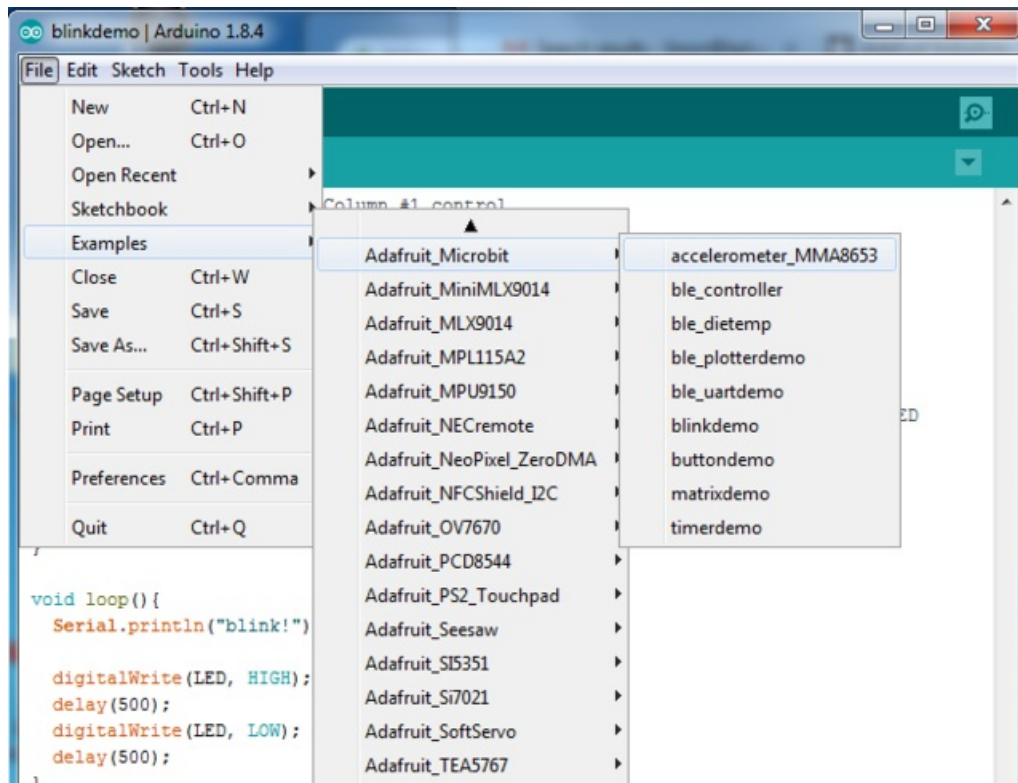
Bluetooth Plotter

The Bluefruit App has a built in plotter that will let you easily visualize data from your microbit! Be sure you got the UART examples working from earlier.

Install Library & Example Code

First up, install the [Adafruit helper library](#) and friends

You can find our BLE demos in the examples menu:



Load up the BLE Plotter demo

```

ble_plotterdemo | Arduino 1.8.4
File Edit Sketch Tools Help

ble_plotterdemo BLESerial.cpp BLESerial.h

void setup() {
  Serial.begin(115200);

  Serial.println("Plotter demo ready!");

  accel.begin(false, 2); // 8-bit mode, 2g range

  // custom services and characteristics can be added as well
  bleSerial.setLocalName("microbit UART");
  bleSerial.begin();
}

void loop() {
  bleSerial.poll();

  accel.update();

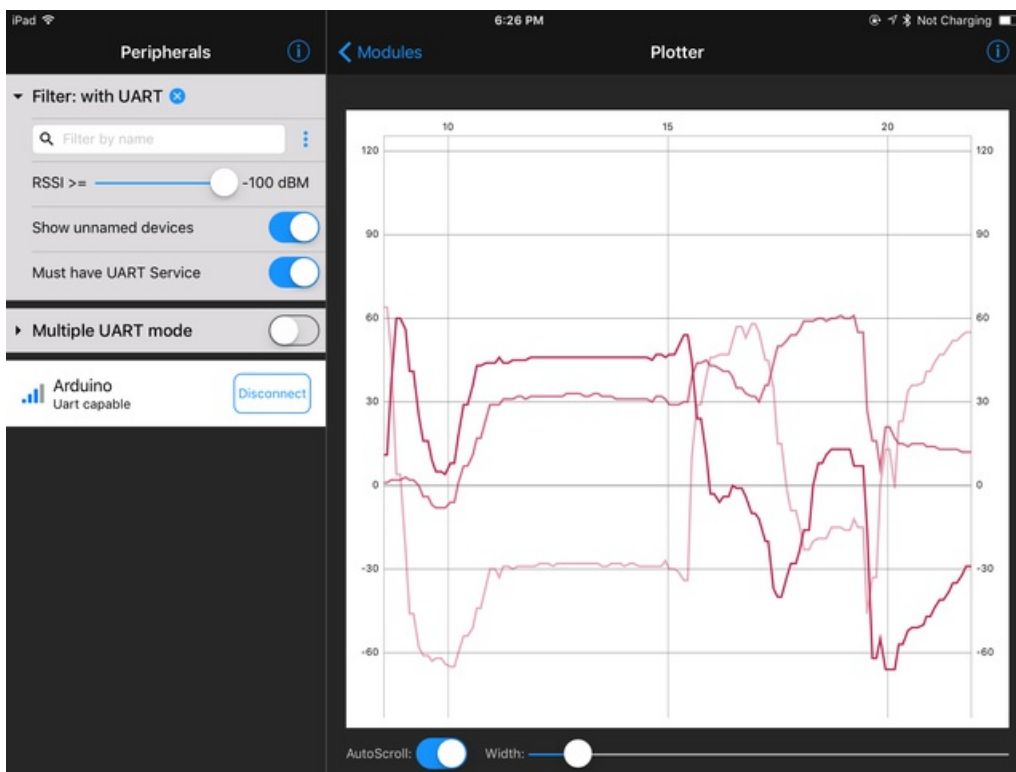
  // print the data on serial port
  Serial.print(accel.getX()); Serial.print(", ");
  Serial.print(accel.getY()); Serial.print(", ");
  Serial.println(accel.getZ());

  // send it over bluetooth
  bleSerial.print(accel.getX()); bleSerial.print(",");

```

This time, in the App, select the **Plotter** module. You will be able to see the X, Y and Z data appear and scroll down!

You can plot anything you like, just use **bleSerial.print()** and print out your data with commas in between. At the end of a data set have a **bleSerial.println()** and it will plot each comma-separated-element as a unique graph



So if you want to just graph the total acceleration vector $\sqrt{x^2 + y^2 + z^2}$, use this code snippet:


```

void loop() {
  bleSerial.poll();

  accel.update();

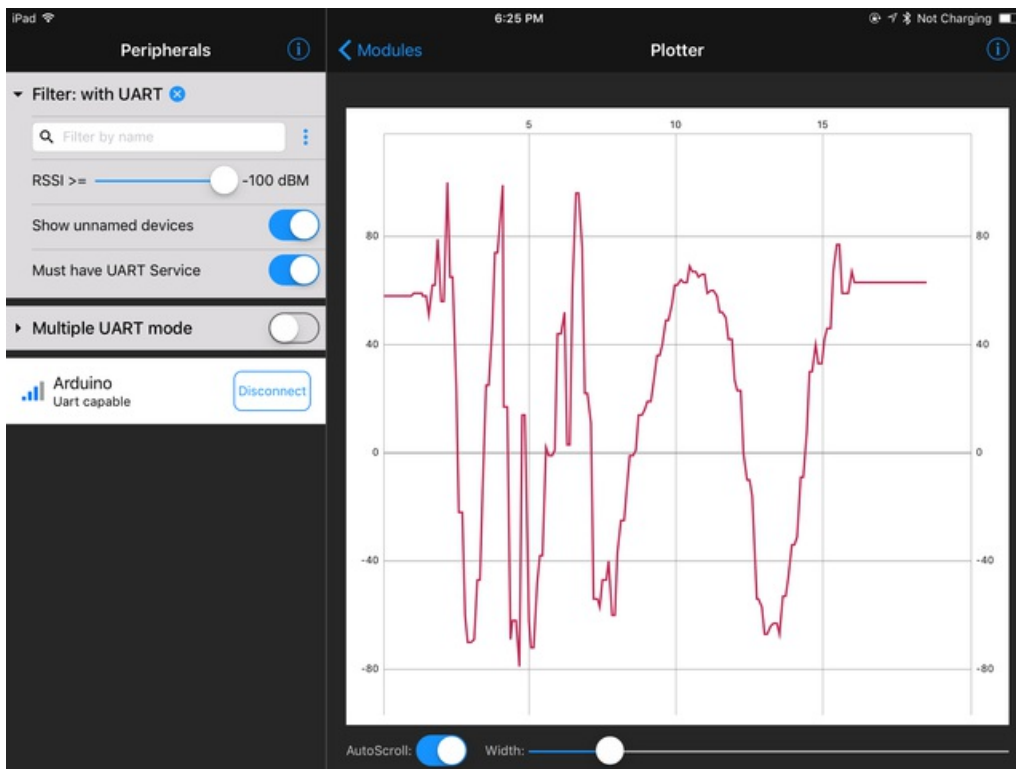
  // print the data on serial port
  Serial.print(accel.getX());   Serial.print(", ");
  Serial.print(accel.getY());   Serial.print(", ");
  Serial.println(accel.getZ());

  float vector = (accel.getX() * accel.getX()) + (accel.getY() * accel.getY()) + (accel.getZ() * accel.getZ());
  vector = sqrt(vector);

  // send it over bluetooth
  bleSerial.println(vector);

  delay(100);
}

```



Bluetooth Controller

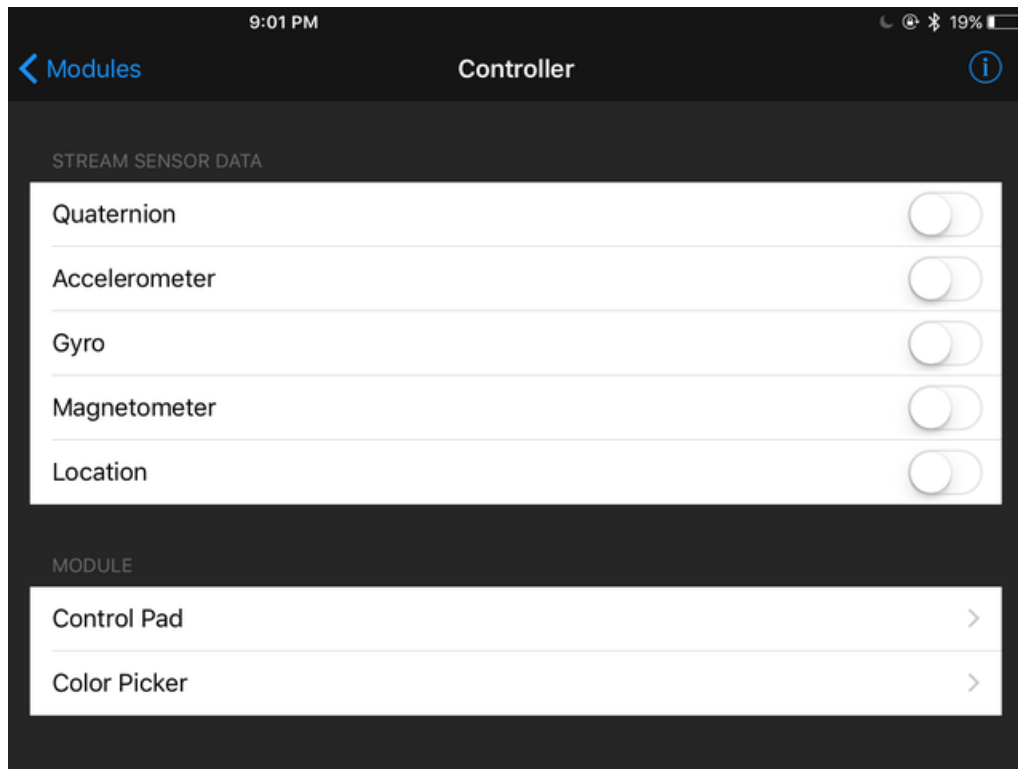
For controlling projects, you may want to use our **Controller** module. It has a bunch of useful interface features that will let you make your next LED or robotics project super easy

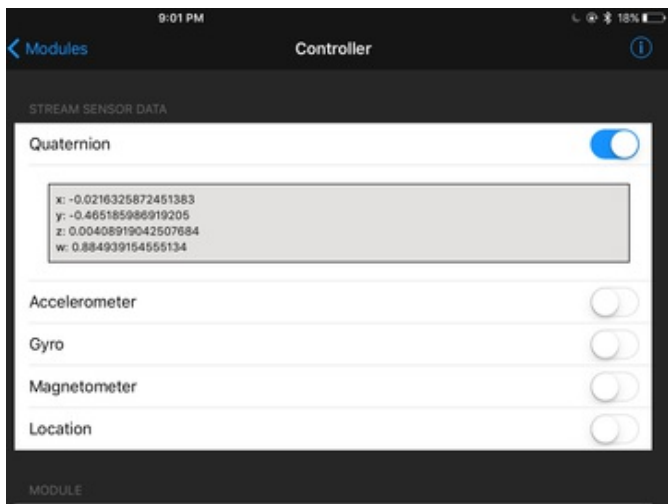
Install Library & Example Code

[Install the Adafruit helper library](#) and friends

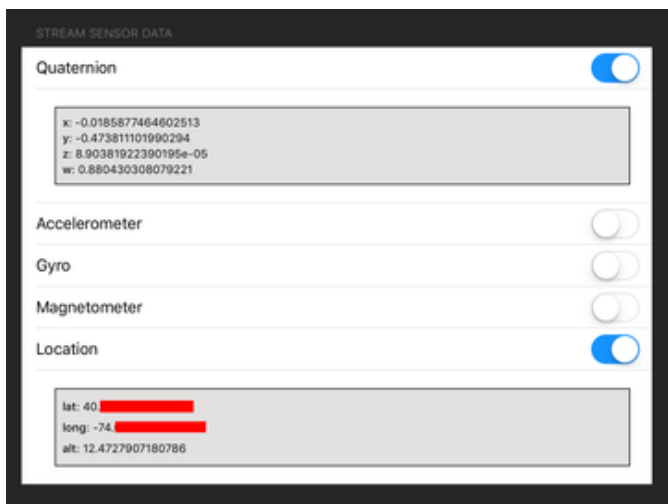
Open up the BLE Controller demo

Load that into your microbit, and connect using BLE connect

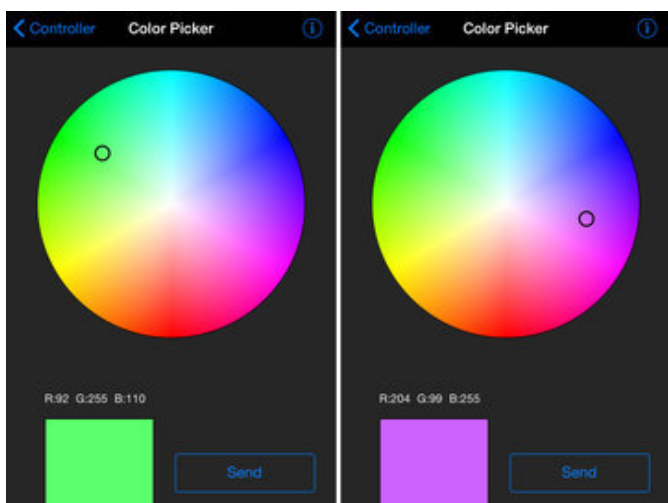




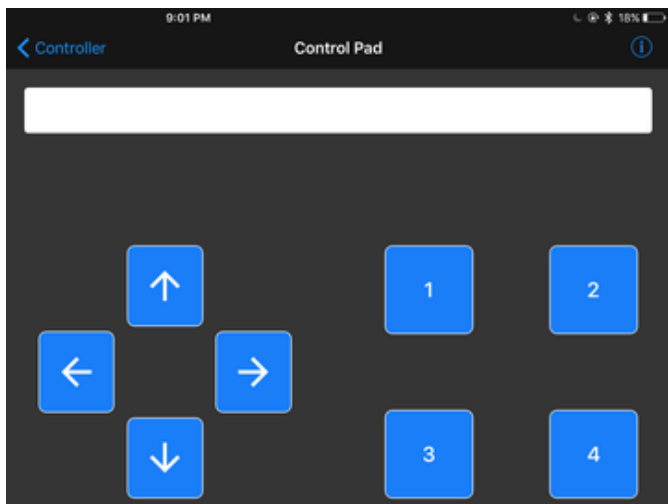
The top 5 selectors allow you to stream data from your tablet or phone to the 'bit. So for example you can send tablet orientation (Quaternion) or GPS location to the 'bit. Turn on one, all five or none.



The two bottom modules can be run whenever you like, click to open up the interfaces:



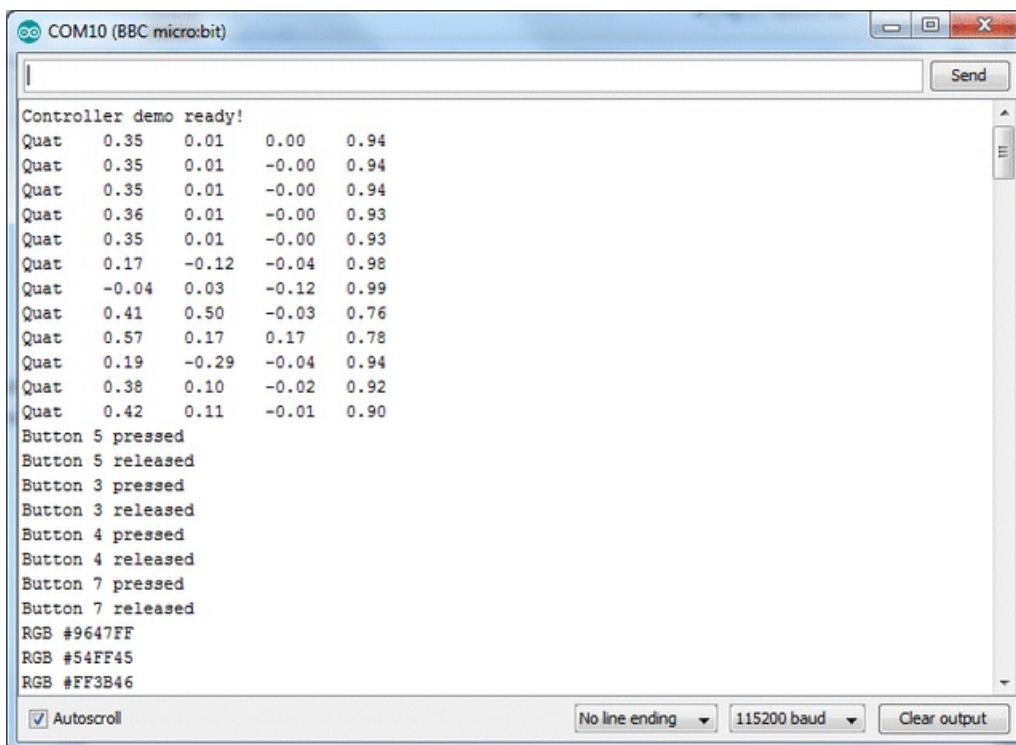
The color picker will let you choose from a color wheel and send the 24-bit color over BLE to the microbit



The control pad interface gives you 8 buttons that you can press - each press and release will send a signal to the microbit.

If the microbit sends any data *back* to the device, it will appear in the text bar above.

You can look at the serial monitor to see the messages as they are received.



Logging Temperature to Adafruit IO

All this Bluetooth data stuff is good if you want to plot the data or add control from your phone. But what if you want to store the data long term, or add remote control from around the world?

It's not too hard! We can use Adafruit IO to create graphs and dashboards. And, best of all, its free just like the Bluefruit app!

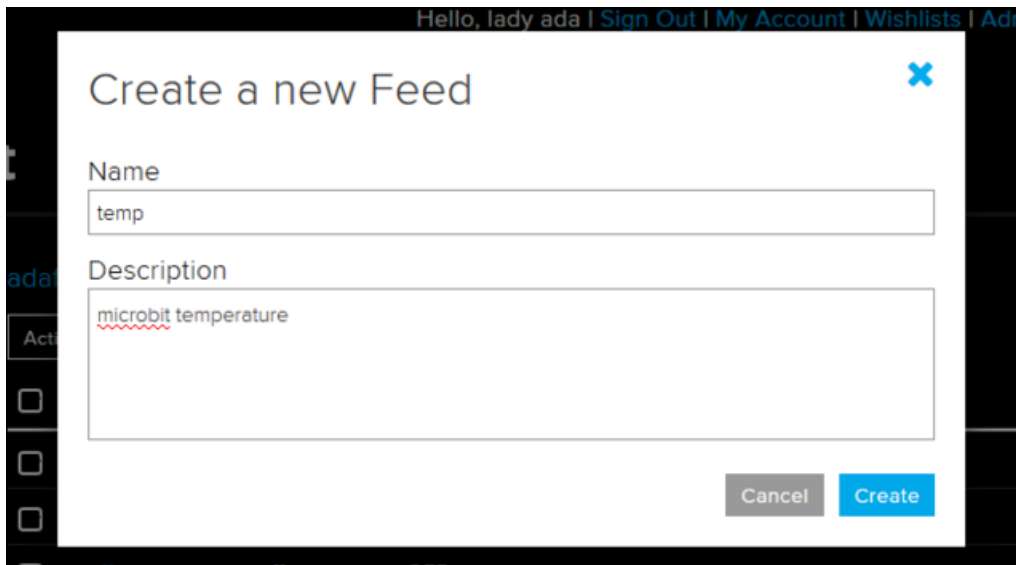
[You can read more about Adafruit IO in this guide](#)

Before continuing, [set yourself up with an Adafruit IO account](#)

We won't cover all the details of Adafruit IO here, so check out the guides we have already written for that good stuff!

Create a Microbit Temperature Feed

We'll want a 'place' for our temperature, so create a new feed called **temp**

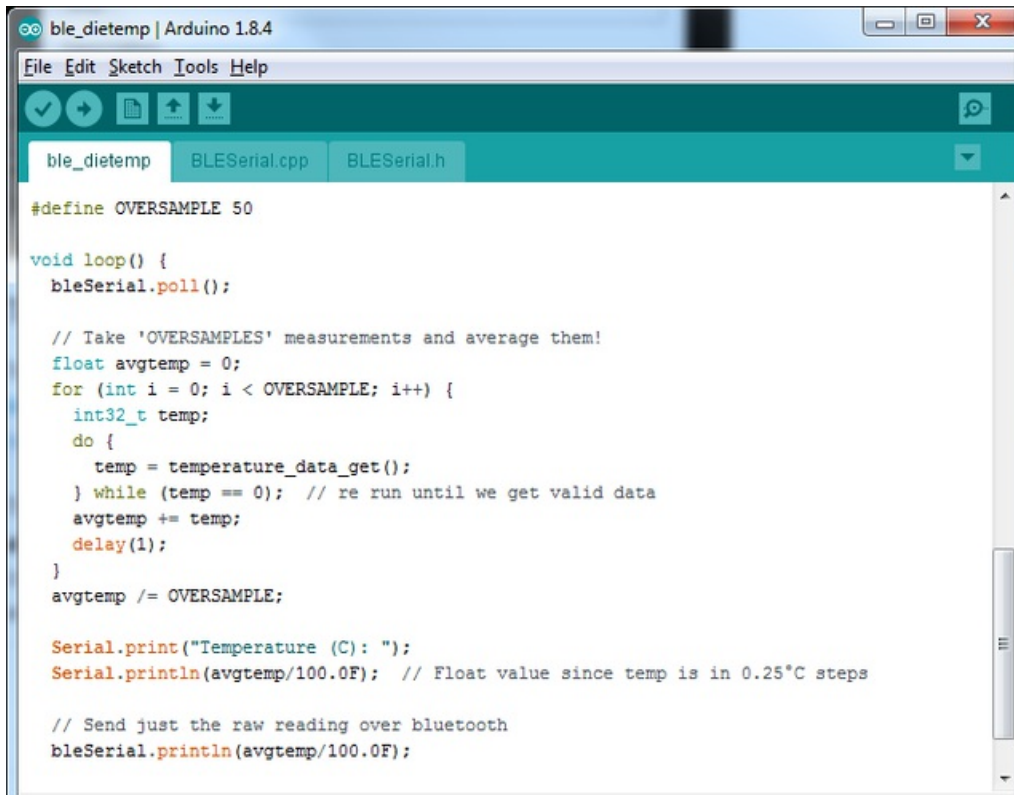
A screenshot of the Adafruit IO web interface showing a modal dialog titled "Create a new Feed". The dialog has a close button (an 'x' in a blue square) in the top right corner. It contains two input fields: "Name" with the text "temp" and "Description" with the text "microbit temperature". Below the description field is a "Cancel" button and a "Create" button. The background of the page is dark, and the dialog is white with a thin border.

Temperature Logger Sketch

[Install the Adafruit helper library](#) and friends

Open up the BLE die temp demo

This will read the temperature on the chip itself. **It's not precise at all** but it does go up when it gets hotter and down when it gets cooler, so its a good place to start and you don't need any additional hardware



```
#define OVERSAMPLE 50

void loop() {
  bleSerial.poll();

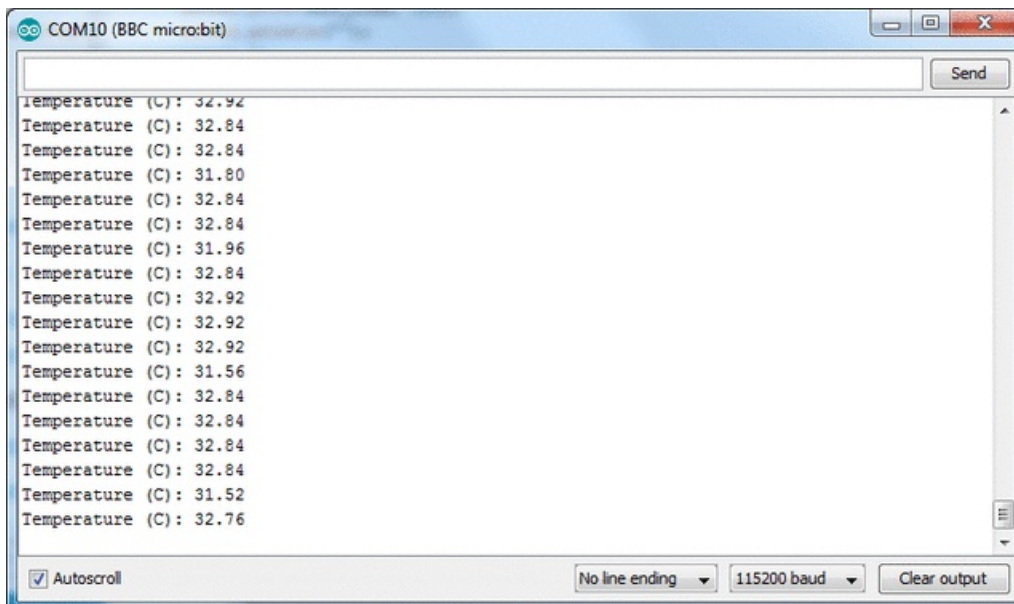
  // Take 'OVERSAMPLES' measurements and average them!
  float avgtemp = 0;
  for (int i = 0; i < OVERSAMPLE; i++) {
    int32_t temp;
    do {
      temp = temperature_data_get();
    } while (temp == 0); // re run until we get valid data
    avgtemp += temp;
    delay(1);
  }
  avgtemp /= OVERSAMPLE;

  Serial.print("Temperature (C): ");
  Serial.println(avgtemp/100.0F); // Float value since temp is in 0.25°C steps

  // Send just the raw reading over bluetooth
  bleSerial.println(avgtemp/100.0F);
}
```

Note that this sketch takes 50 readings and averages it, then waits 5000 ms (5 seconds) between data reports. That's because Adafruit IO is limited in how much data you can upload and store, so we will take it a little slowly.

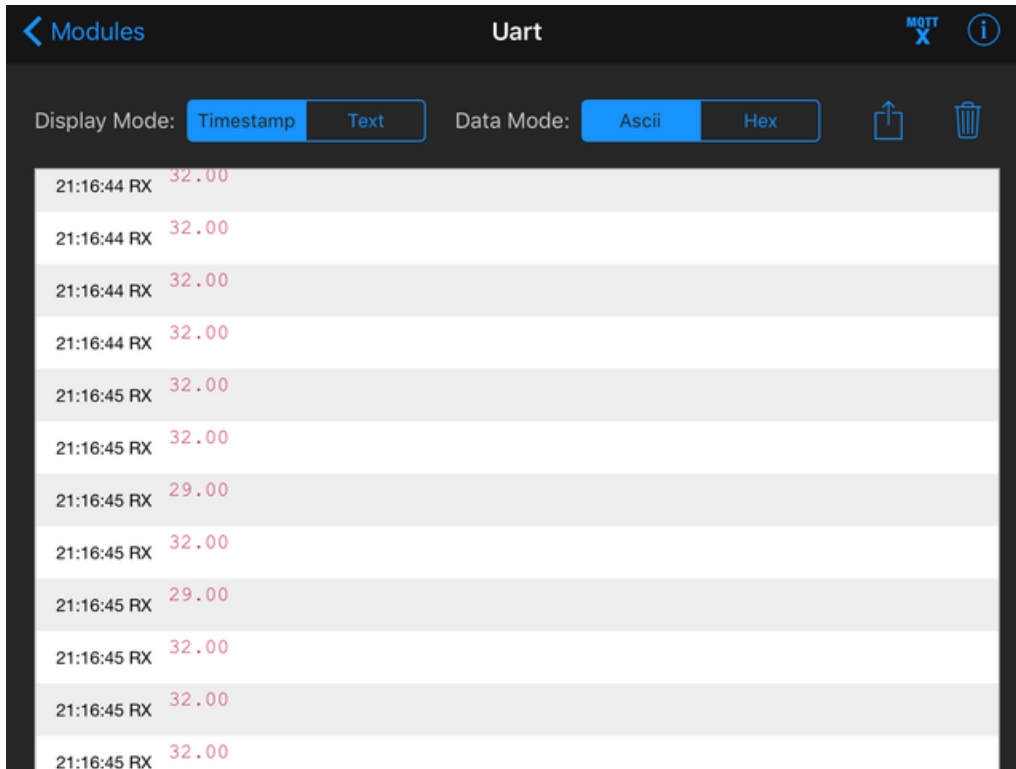
Upload the sketch and open the serial monitor so you can verify the temperature data there:



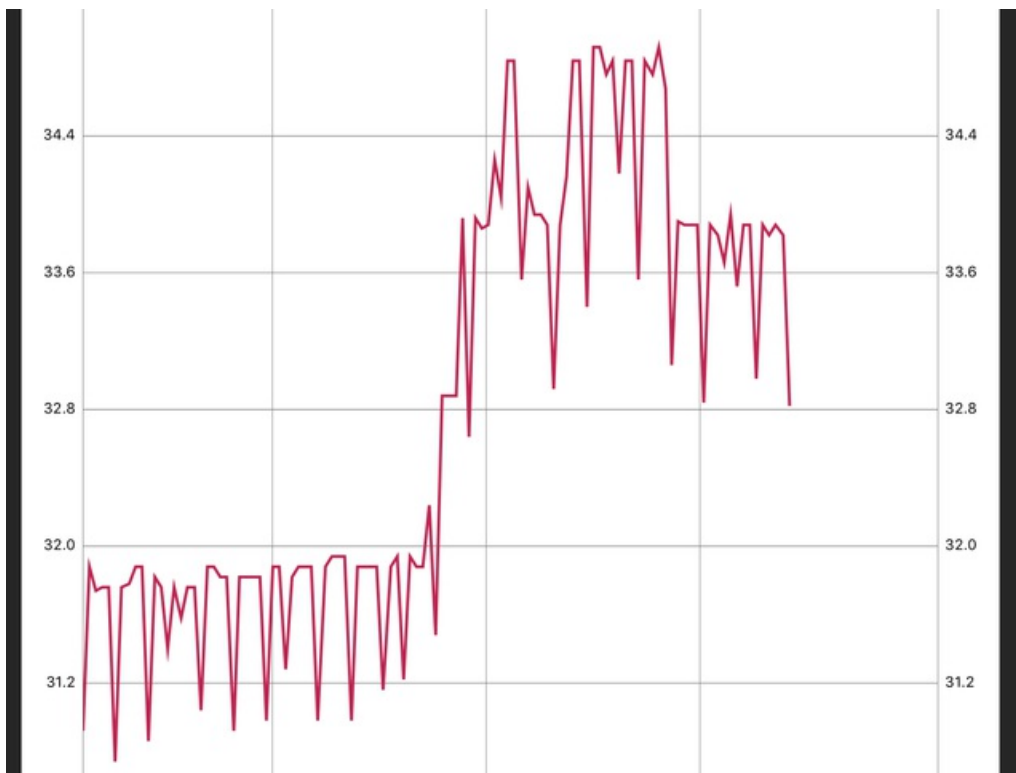
```
Temperature (C): 32.92
Temperature (C): 32.84
Temperature (C): 32.84
Temperature (C): 31.80
Temperature (C): 32.84
Temperature (C): 32.84
Temperature (C): 31.96
Temperature (C): 32.84
Temperature (C): 32.92
Temperature (C): 32.92
Temperature (C): 32.92
Temperature (C): 31.56
Temperature (C): 32.84
Temperature (C): 32.84
Temperature (C): 32.84
Temperature (C): 32.84
Temperature (C): 31.52
Temperature (C): 32.76
```

Test UART Mode

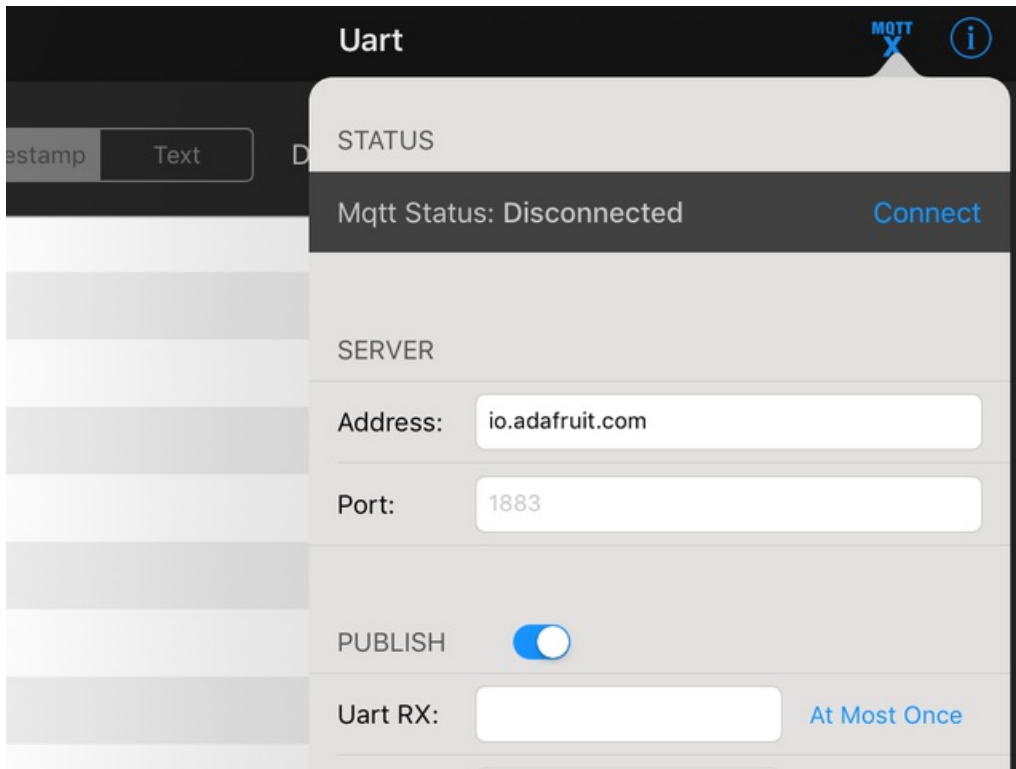
Connect to the microbit over your device using Adafruit Bluefruit Connect as covered in the previous projects, and select **UART** mode. You should see data slowly coming in



You can also plot the data. Note that the data is really not very precise or accurate. But if you heat up the nRF51 with a lamp, the temperature will slowly rise up:

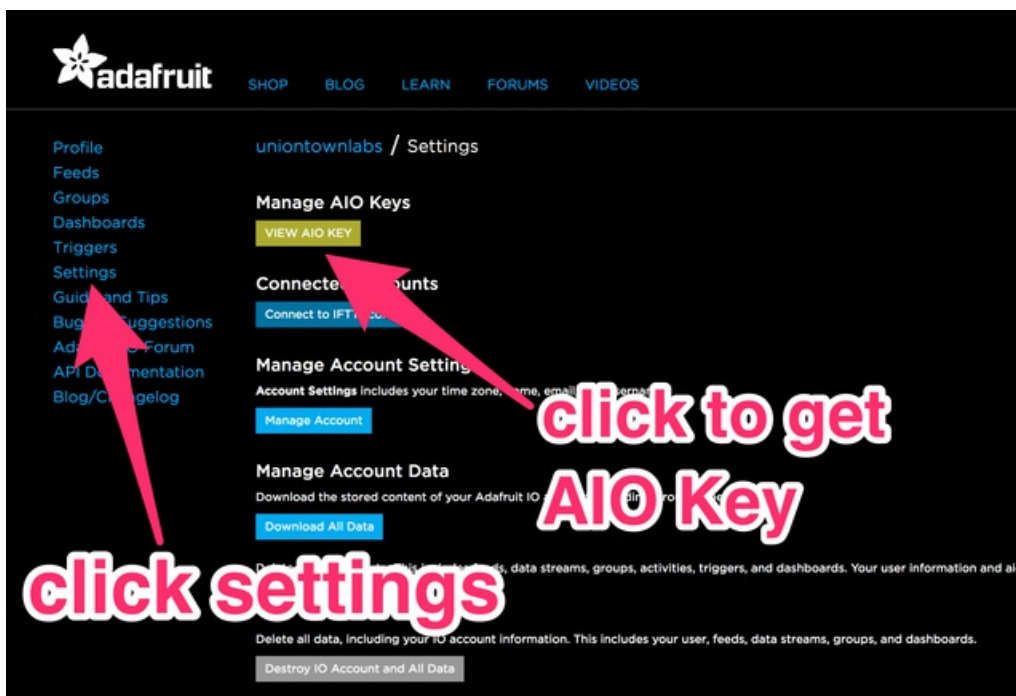


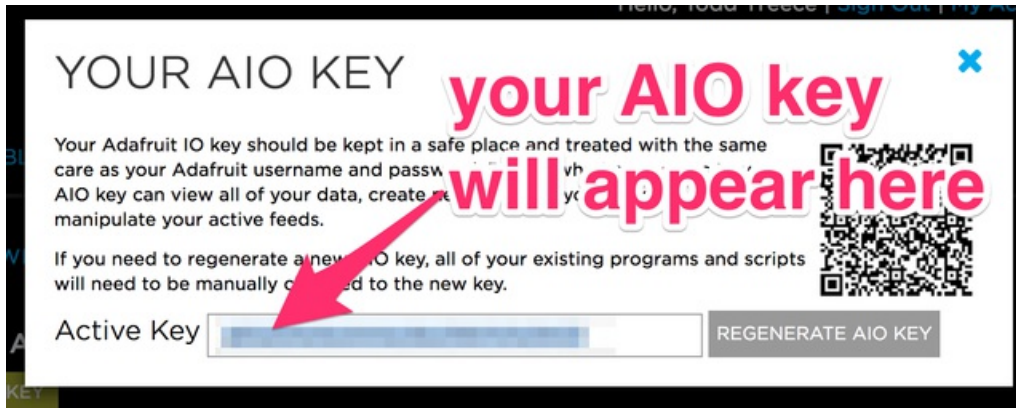
Now go back to UART mode and click the **MQTT** button in the top right:



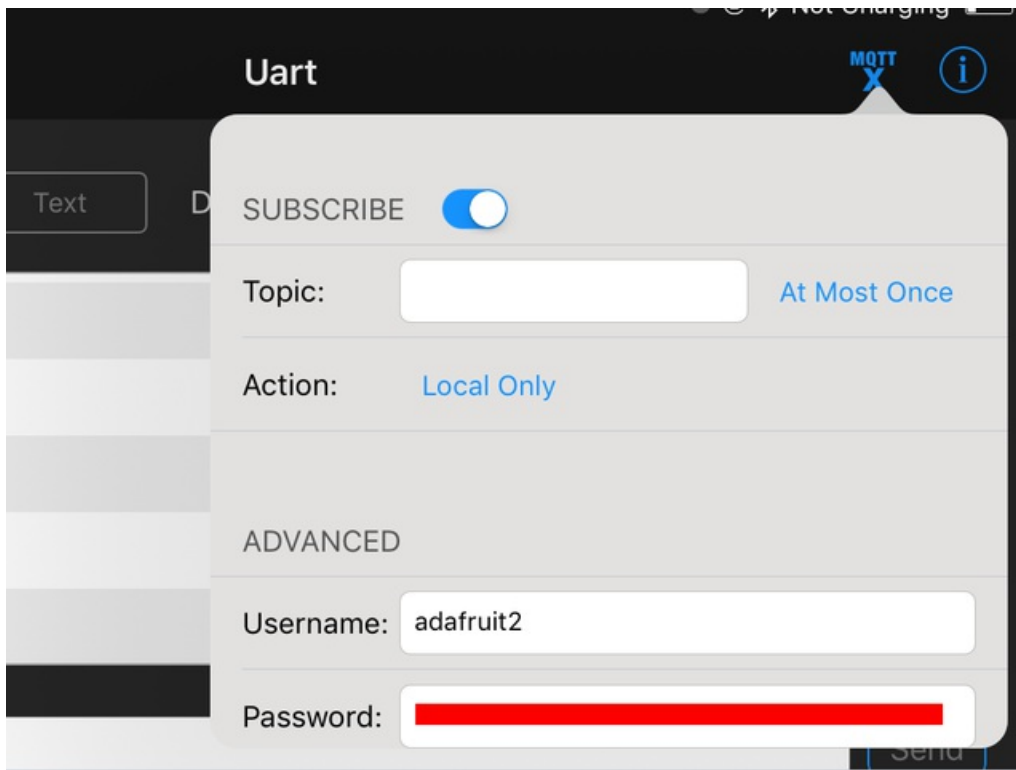
Note that the MQTT server and port will be prefilled for Adafruit IO.

Skip down and enter in your Adafruit IO **Username** and **API Key** (even though it says Password, use the long alphanumeric API key)





Then take that and put it here like so:



Finally enter in the feed name which is ***username/f/tempbit*** into the UART RX Publish entry. (There's currently a bug where you have to have something in the Subscribe so we put the same feed in there):

SERVER

Address:

Port:

PUBLISH ☒

Uart RX: [At Most Once](#)

Uart TX: [At Most Once](#)

SUBSCRIBE ☐

Topic: [At Most Once](#)

Action: [Local Only](#)

Then click **Connect** at the top:

Uart MQTT X i

STATUS

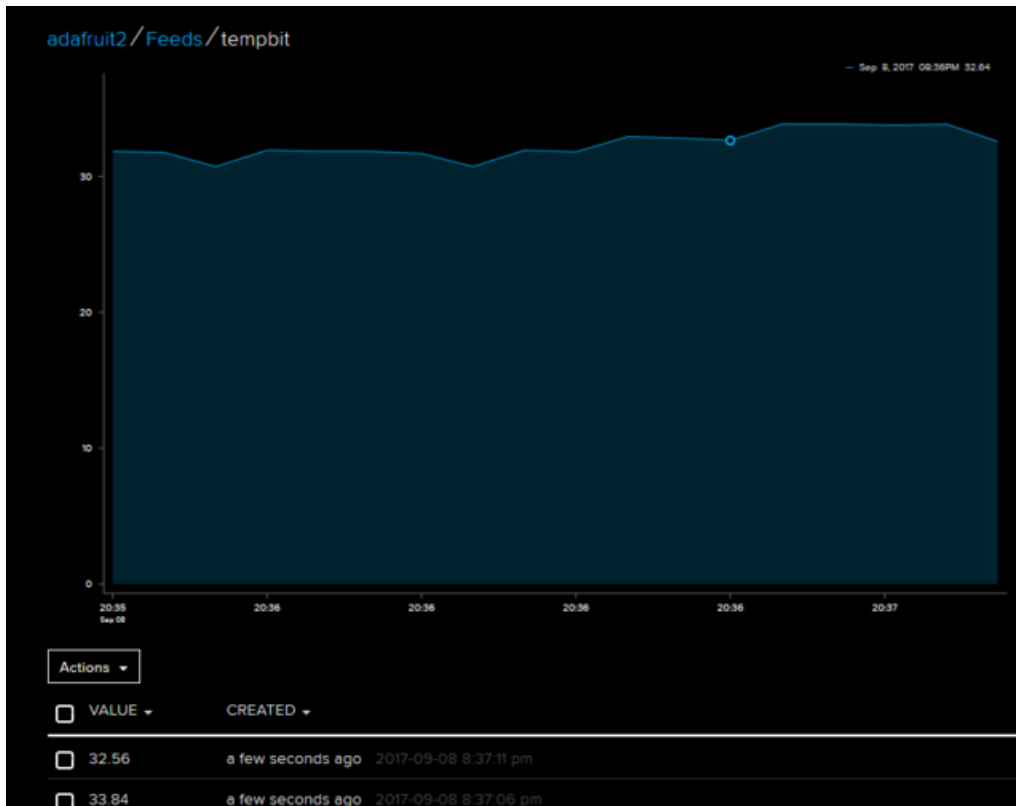
Mqtt Status: Connected [Disconnect](#)

SERVER

Address:

Port:

Wait a few minutes and go visit your Adafruit IO Feeds page, you should see the data start to stream in!



Huzzah! [You can now create a public dashboard if you like, to share it with others](#)

HALP!!!

If you're having issues, you may want to check [Sandeep's installation guide for the nRF5x package](#) which may have more details (in case there are updates)

Some people reported that their microbit did not have a softdevice on it already (which seems odd but is possible!) You can try installing this hex file which will use MakeCode to install a softdevice. Just drag it onto the MICROBIT disk drive

microbit-adv.hex

<https://adafru.it/zwf>

There's also instructions here on how to manually install a softdevice or in the off chance you want softdevice 130 instead of the 'standard' s110 (see [Flashing SoftDevice](#))