

Sino:bit with Arduino

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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
 \ast\, 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:

COM124 (BBC micro:bit)	
	Send
X: 63626, Y: 17781, Z: 816	A
X: 63688, Y: 2430, Z: 822	-
X: 63691, Y: 2432, Z: 820	
X: 63691, Y: 2435, Z: 821	
X: 63694, Y: 2432, Z: 829	
X: 63697, Y: 2431, Z: 822	
X: 63697, Y: 2429, Z: 818	
	Both NL & CR

Note that the magnetometer is not calibrated, so you'll get different numbers on XYZ *but* when you twist and rotate the mirobit 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://adafru.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!

COM124 (BBC micro:bit)	
	Send
13 , 16, 61	*
13 , 16, 61	
-47 , -57, 4	
-62 , -82, 43	
-62 , -82, 43	
18 , -72, 53	
-9 , -28, 50	
-9 , -28, 50	
-29 , 17, -5	
-1 , 36, 36	
-1 , 36, 36	
-68 , 38, 64	
-76 , -1, 67	
-61 , 16, 51	
-61 , 16, 51	-
Autoscroll	Both NL & CR 🗸 9600 baud 🗸 Clear output

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);
}
```

COM124 (BBC micro:bit)	
	Send
0.17 , -0.12, -0.97	*
0.17 , -0.12, -0.95	
0.17 , -0.12, -0.97	
0.17 , -0.12, -0.97	
0.17 , -0.12, -0.97	
0.39 , -0.47, -1.11	
0.02 , -0.08, -1.06	
0.02 , -0.08, -1.06	
-0.06 , 0.03, 0.72	
1.08 , -1.06, 1.00	E
0.14 , 0.20, 1.12	
0.14 , 0.20, 1.12	
-1.25 , 0.41, 0.56	
-0.11 , 0.42, 0.02	
-1.23 , -1.31, -0.11	*
Autoscroll	Both NL & CR 👻 9600 baud 👻 Clear output

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:

Library Manag	er		
Type All		▼] blep	
BLEPeripheral	by Sandeep Mistry V	rsion 0.4.0 INSTALLED m BLE peripherals. Supports nRF8001 and nRF51822 based	d boards/shields
More info			
Select vers	Install		
			Close

Download Adafruit GFX library

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

	All 🔻	Topic	All	-	adafruit gfx
Adaf Adaf More	ruit DotStarMat ruit_GFX-comp info	atible I	Adafruit	/ersion 1.0 DotStar gr	.1 INSTALLED ids Adafruit_GFX-compatible library for DotStar grids
Adaf Adaf addit More	ruit GFX Library ruit GFX graphic tion to the displa- tion	by Ad score ay libra	lafruit Ver library, ti ry for you	sion 1.2.2 his is the 'c hardware.	INSTALLED Core' class that all r other graphics libraries derive from. Install this library in
Adaf	ruit NeoMatrix	by Ada	fruit Vers	on 1.1.2 I NeoPixel g	NSTALLED prids Adafruit_GFX-compatible library for NeoPixel grids
More	info				
Adaf	ruit_EInkGFX V	ersion	unknown	INSTALLED	

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 **arduinosketchfolder/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

blinkdemo Arc	duino 1.8.4	Contraction in the law of			
Edit Sketch	Tools Help				
New Open Open Recent Sketchbook	Ctrl+N Ctrl+O	Column #1 control			2
Examples	1	Adafruit Microbit	1	accelerometer MMA8652	1
Close Save Save As	Ctrl+W Ctrl+S Ctrl+Shift+S	Adafruit_MiniMLX9014 Adafruit_MLX9014 Adafruit_MPL115A2	1	ble_controller ble_dietemp ble_plotterdemo	
Page Setup Print	Ctrl+Shift+P Ctrl+P	Adafruit_MPU9150 Adafruit_NECremote		ble_uartdemo blinkdemo	ED
Preferences	Ctrl+Comma	Adafruit_NeoPixel_ZeroDMA Adafruit_NFCShield_12C		buttondemo matrixdemo	
Quit	Ctrl+Q	Adafruit_OV7670	1	timerdemo	
<pre>did loop() { Serial.print digitalWrite delay(500); digitalWrite delav(500);</pre>	<pre>cln("blink!") e(LED, HIGH); e(LED, LOW);</pre>	Adafruit_PCD8544 Adafruit_PS2_Touchpad Adafruit_Seesaw Adafruit_SI5351 Adafruit_Si7021 Adafruit_SoftServo	* * * * * * *		

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:

blinkdemo Aro	duino 1.8.4	Contract of the local division of the local		
New Open Open Recent Sketchbook	Ctrl+N Ctrl+O	olumn #1 control		<u>ي</u> ۲
Examples	1	Adafruit_Microbit	accelerometer_MMA8653	
Close Save Save As Page Setup Print	Ctrl+W Ctrl+S Ctrl+Shift+S Ctrl+Shift+P Ctrl+P	Adafruit_MiniMLX9014 Adafruit_MLX9014 Adafruit_MPL115A2 Adafruit_MPU9150 Adafruit_NECremote Adafruit_NeoPixel_ZeroDMA	ble_controller ble_dietemp ble_plotterdemo ble_uartdemo blinkdemo buttondemo	ED
Ouit	Ctrl+O	Adafruit_NFCShield_I2C	matrixdemo timerdemo	
<pre>void loop(){ Serial.print digitalWrite delay(500); digitalWrite delay(500);</pre>	<pre>cln("blink!") e(LED, HIGH); e(LED, LOW);</pre>	Adafruit_PCD8544 Adafruit_PS2_Touchpad Adafruit_Seesaw Adafruit_SI5351 Adafruit_Si7021 Adafruit_SoftServo Adafruit_TEA5767		

Load up the BLE UART demo to start



Find these three lines:

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

and change them to:



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

Peripherals (j)	Modules
✓ Filter: with UART ⊗	
Q Filter by name	
RSSI >=	
Show unnamed devices	
Must have UART Service	
Multiple UART mode	
Adafruit Robot Rover Connect	eripheral from the list on the left
Arduino Uart capable	

Press Connect



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

K Modules		Uart		X	í
Display Mode	: Timestamp Text	Data Mode:	Ascii		
15:25:45 RX	16645 tick-tacks!				
15:25:46 RX	17645 tick-tacks!				
15:25:47 RX	18646 tick-tacks!				
15:25:48 RX	19647 tick-tacks!				
15:25:49 RX	20648 tick-tacks!				

Go back to the sketch and change it back to:



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.

K Modules		Uart		X (i
Display Mod	e: Timestamp Text	Data Mode: Ascii	Hex	
16:27:26 RX	hello			
16:27:27 RX	world			
16:27:33 RX	testi			
16:27:33 RX	ng 123			
16:27:43 TX	goodbye moon			

COM124 (BBC micro:bit)	
	Send
goodbye moon	
	E
	-
V Autoscroll	No line ending 🖌 115200 baud 🖌 Clear output

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



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 $\frac{sqrt(x^2 + y^2 + z^2)}{sqrt(x^2 + y^2 + z^2)}$, 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.getZ() * accel.getZ() * accel.getY()) + (accel.getZ() * accel.getZ() * accel.getY());
    // 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

9:01 PM		L 🕑 🕏 19% 🕞
Modules	Controller	(Ì)
STREAM SENSOR DATA		
Quaternion		\bigcirc
Accelerometer		\bigcirc
Gyro		\bigcirc
Magnetometer		\bigcirc
Location		\bigcirc
MODULE		
Control Pad		>
Color Picker		>

9:01 PM		C @ \$ 1856 E
	Controller	0
Quaternion		
x: -0.0216325872451383 y: -0.465155966919205 z: 0.00405919042507684 w: 0.884939154555134		
Accelerometer		\bigcirc
Gyro		\bigcirc
Magnetometer		\bigcirc
Location		\bigcirc
Quaternion		
x: -0.0185877464602513 y: -0.473811101990294 z: 8.90381922390195e-05 w: 0.880430308079221		
Accelerometer		\bigcirc
Gyro		\overline{O}
Magnetometer		Ō
Location		
lat: 40 long: -74. alt: 12.4727907180786		

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 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.

S CON	110 (BBC m	icro:bit)			
1					Send
Contro	ller dem	o ready!			A
Quat	0.35	0.01	0.00	0.94	-
Quat	0.35	0.01	-0.00	0.94	
Quat	0.35	0.01	-0.00	0.94	
Quat	0.36	0.01	-0.00	0.93	
Quat	0.35	0.01	-0.00	0.93	
Quat	0.17	-0.12	-0.04	0.98	
Quat	-0.04	0.03	-0.12	0.99	
Quat	0.41	0.50	-0.03	0.76	
Quat	0.57	0.17	0.17	0.78	
Quat	0.19	-0.29	-0.04	0.94	
Quat	0.38	0.10	-0.02	0.92	
Quat	0.42	0.11	-0.01	0.90	
Button	5 press	ed			
Button	5 relea:	sed			
Button	3 press	ed			
Button	3 releas	sed			
Button	4 press	ed			
Button	4 relea:	sed			
Button	7 press	ed			
Button	7 relea:	sed			
RGB #9	647FF				
RGB #5	4FF45				
RGB #F	F3B46				-
🔽 Auto	scroll				No line ending 🔹 115200 baud 🔹 Clear output

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

Hello, lady ada I Sig	n Out My Account Wishlis	ts A
Create a new Feed	×	
Name		
temp		
Description		
microbit temperature		
	Caract	
	Cancel Create	

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



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 monito	r so you can verify the temperature data there:
--	---

COM10 (BBC micro:bit)	
	Send
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): 31.52	
Temperature (C): 32.76	
V Autoscroli	No line ending 🔹 🔪 [115200 baud 🔹] Clear output

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

Modules		Uart		X	í
Display Mode	Timestamp	Data Mode:	Ascii		
21:16:44 RX	32.00				
21:16:44 RX	32.00				
21:16:44 RX	32.00				
21:16:44 RX	32.00				
21:16:45 RX	32.00				
21:16:45 RX	32.00				
21:16:45 RX	29.00				
21:16:45 RX	32.00				
21:16:45 RX	29.00				
21:16:45 RX	32.00				
21:16:45 RX	32.00				
21:16:45 RX	32.00				

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:

	Uart		MOTT (i)
estamp Text D	STATUS		
	Mqtt Statu	s: Disconnected	Connect
	SERVER		
	Address:	io.adafruit.com	
	Port:	1883	
	PUBLISH		
	Uart RX:		At Most Once

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)

Radafruit	SHOP BLOG LEARN FORUMS VIDEOS
Profile	uniontownlabs / Settings
Groups Dashboards Triggers Settings Guid and Tips Bug Suggestions Adv D Forum API D mentation Blog/C ugelog	Manage Alo Keys View Alo Key Connecte Funts Connect to IFT 20. Manage Account Setting Account Settings includes your time zond, time, email for the formation of the setting for the setting f
	Manage Account Data Download the stored content of your Adafruit IO
click	Settings
	Delete all data, including your to account information. This includes your user, feeds, data streams, groups, and dashboards. Destroy IO Account and All Data

	YOUR AIO KEY your AIO key *
31	Your Adafruit IO key should be kept in a safe place and treated with the same care as your Adafruit username and passw AIO key can view all of your data, create WIII v appear here manipulate your active feeds.
VI	If you need to regenerate an even to key, all of your existing programs and scripts will need to be manually of the new key.
A	Active Key

Then take that and put it here like so:

	llart	MQT (i)
	Uar t	
Text D	SUBSCRIBE	
	Торіс:	At Most Once
	Action: Local Only	
	ADVANCED	
	Username: adafruit2	
	Password:	Senu

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:	io.adefruit.com	
Port:	1863	
PUBLISH	•	
Uart RX:	edefruit2/f/tempbit	At Most Once
Uart TX:		At Most Once
SUBSCRIB	• •	
Topic:	adatruit2/t/onoff	At Most Once
Action:	Local Only	

Then click **Connect** at the top:

Uart		MOTT (i)
STATUS		
Mqtt Status: Connected		Disconnect
SERVER		
Address:	io.adafruit.com	
Port:	1883	

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)