WHISKER LABS, INC

Ting M1 Wi-Fi Module User's Manual
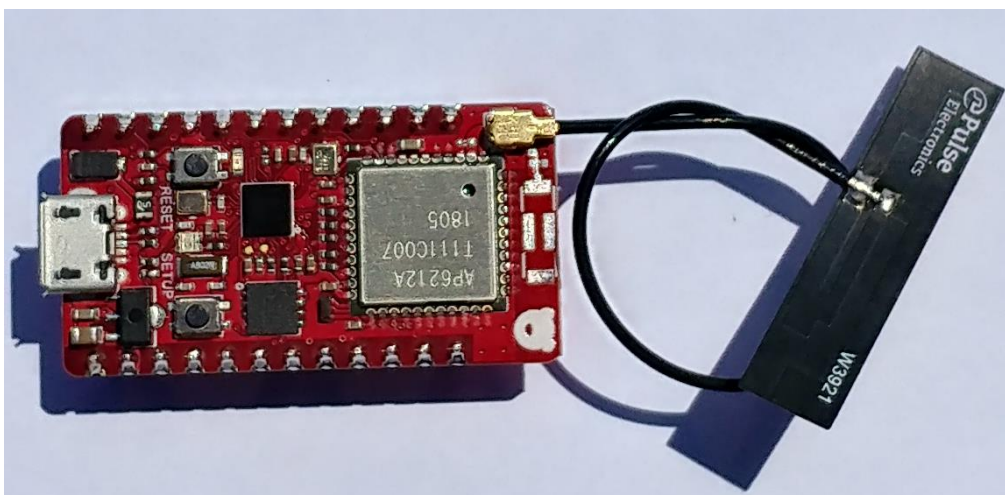
Introduction

T he WL Ting M1 Wi-Fi Module is a small development board designed to provide Internet-of-Things (IoT) developers with a quick way to produce innovative internet connected products to the market.

The module is based on the open source RedBear Duo product (https://redbear.cc/), modified to enable the operation of an external antenna and operates with firmware developed for the Redbear Duo. The device is designed to interface with the Particle (particle.io) cloud. The firmware library makes is easy to interact with the Particle cloud in a secure way.

Specifications

- STMicroelectronics STM32F205 ARM Cortex-M3 @ 120MHz, 128 KB SRAM and 1MB Flash
- Broadcom BCM43438 Wi-Fi 802.11n (2.4GHz only) + Bluetooth 4.1 (Dual Mode) combo chip
- On-board 16 Mbit (2 MB) SPI Flash
- Externally Connected Antenna
- 18 I/O pins
- RGB status LED
- Small single-sided PCB for easy mounting on other PCB boards

Prerequisites for Use

To use the Ting M1 Wi-Fi module, you need to have the following support hardware and software:

Hardware:

- PC with Windows, Mac with OS X
- Wi-Fi Access Point that support 802.11 bgn 2.4 GHz .
- Micro USB Cable

Software:

- Dfu-util (dfu-util.sourceforge.net): Used to download firmware onto the device.

- Latest Redbear Duo Firmware found at https://github.com/redbear/Duo/raw/master/firmware.

- Serial Port tool: For Windows, we recommend using "Putty". For Mac OSX, we recommend using "Serial" downloaded from the Apple Store. You can also use the built-in "screen" application found on OSX.

- For Windows development, you will need to download the device driver software: https://github.com/redbear/Duo/tree/master/driver/windows

- For Windows development, you will need to use the "Zadig" software to properly configure your driver.

- To compile the firmware locally, you will need to install the GNU Arm Embedded Toolchain. The version that works best is the 5-2016-q1 update dated April 4th, 2016. See image capture below of the download site (which may change) Note that there are versions for both Windows and Mac.
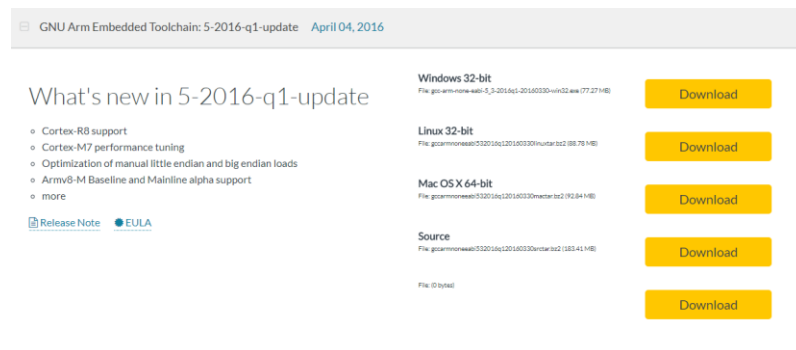
On the Mac, we recommend installing the files into a folder under your home directory. For example, you can install it in a folder called ~/opt/gcc-arm-none-eabi-5_3-2016q1. This allows for multiple compilers to be installed side by side and you can select the best compiler for your needs.

Connecting the Ting M1 to your Computer

The following steps will guide you through getting the Ting M1 Wi-Fi Module connected and communicating with your computer to begin firmware development. These instructions assume you are setting up a device that is "out of the box" with the default factory settings.

- Install all appropriate supporting software listed in the prerequisites on your computer.

- Connect the Ting M1 to your PC or Mac with the micro USB cable

- The RGB LED will show blue in color to indicate the device is in listening mode.
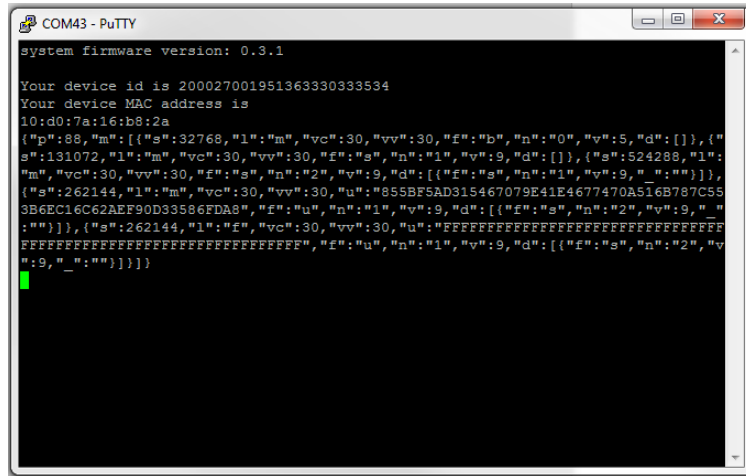
For Windows:

- First you will need to install the driver. When the Ting M1 is setup properly, you should see it show up in your device list as seen below. Note that under the Ports section you see the device labeled as "Duo Serial" and in this case COM43. If you don't see the device in this list, there is a problem with your driver installation.
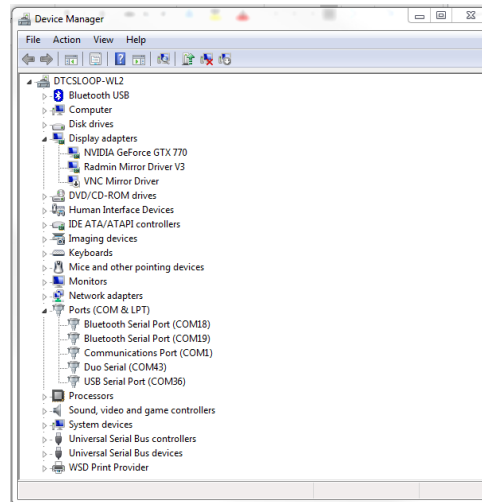
- Now that you have the COM port setup, install the Putty software. This software allows you to communicate via the COM port to the device. Below is an example of what you will see in the PuTTy configuration. Note that the serial line is set for COM43, the same port we saw in the device manager. The speed should be set to 115200. Click the "Open" button to open communications to the serial port.
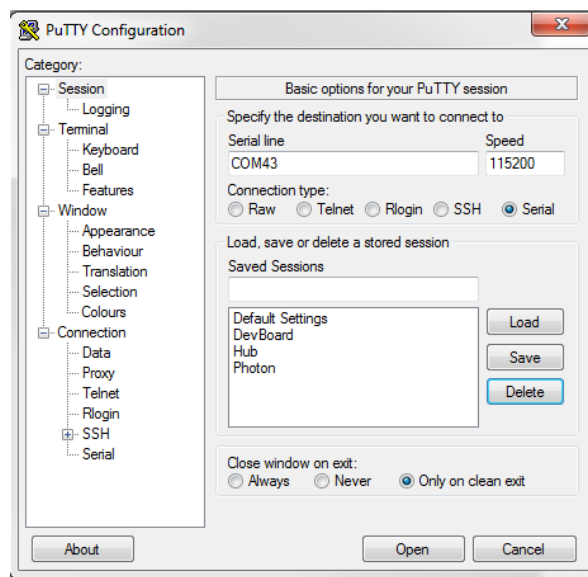
- When the COM port opens, you should see a terminal screen that is blank. You should hit the "v", "i", "m" and "s" keys and then you should see information about your Ting M1 module similar to what is seen below.

```
COM43 - PuTTY
system firmware version: 0.3.1

Your device id is 200027001951363330333534
Your device MAC address is
10:d0:7a:16:b8:2a
{"p":88,"m":[{"s":32768,"l":"m","vc":30,"vv":30,"f":"b","n":"0","v":5,"d":[]},{"
s":131072,"l":"m","vc":30,"vv":30,"f":"s","n":"1","v":9,"d":[]},{"s":524288,"l":
"m","vc":30,"vv":30,"f":"s","n":"2","v":9,"d":[{"f":"s","n":"1","v":9,"_":""}]},
{"s":262144,"l":"m","vc":30,"vv":30,"u":"855BF5AD315467079E41E4677470A516B787C55
3B6EC16C62AEF90D33586FDA8","f":"u","n":"1","v":9,"d":[{"f":"s","n":"2","v":9,"_"
:""}]},{"s":262144,"l":"f","vc":30,"vv":30,"u":"FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF","f":"u","n":"1","v":9,"d":[{"f":"s","n":"2","v
":9,"_":""}]}]}
```

For Mac:

- First you will need to determine what communications device the Ting M1 module shows as on the Mac. You can do this by opening the "Terminal" application and issuing the command "ls /dev/*usb*" to list all USB devices available. You should see a screen similar to below. Note that if it isn't clear which device to use, you can plug in and unplug the device before you execute the command to see what the difference is. On a Macbook Pro the device will typically be /dev/cu.usbmodem1411 for the left hand port. It may be different for your Mac.

```
cdsloop — -bash — 103×25
[[~]> ls /dev/*usb*
/dev/cu.usbmodem1411      /dev/cu.usbmodem142114   /dev/tty.usbmodem1411    /dev/tty.usbmodem142114
/dev/cu.usbmodem142111   /dev/cu.usbmodem142141   /dev/tty.usbmodem142111  /dev/tty.usbmodem142141
[[~]> ls /dev/*usb*
/dev/cu.usbmodem142111   /dev/cu.usbmodem142141   /dev/tty.usbmodem142114
/dev/cu.usbmodem142114   /dev/tty.usbmodem142111  /dev/tty.usbmodem142141
[[~]> ls /dev/*usb*
/dev/cu.usbmodem1411      /dev/cu.usbmodem142114   /dev/tty.usbmodem1411    /dev/tty.usbmodem142114
/dev/cu.usbmodem142111   /dev/cu.usbmodem142141   /dev/tty.usbmodem142111  /dev/tty.usbmodem142141
[[~]>
[[~]>
[~]> screen /dev/cu.usbmodem1411 115200
```

- Next we will want to connect to the serial port. If you want to use the built in screen command (it is free) you will enter the command as "screen /dev/cu.usbmodem1411 115200" where you will substitute for the device you found from the step above.
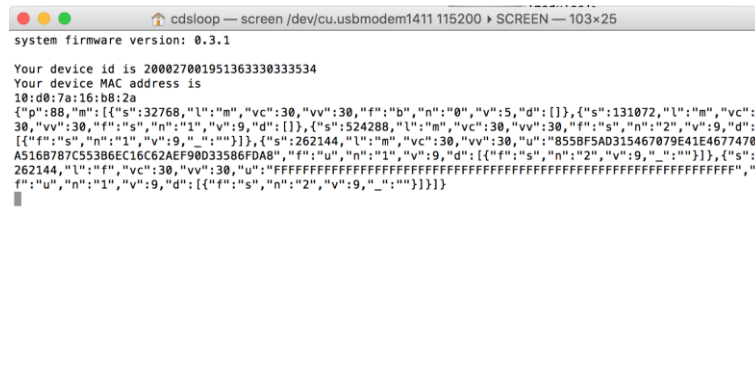
- Alternatively, you can download an application from the Apple App store called "Serial". The screen capture below is from the App Store.
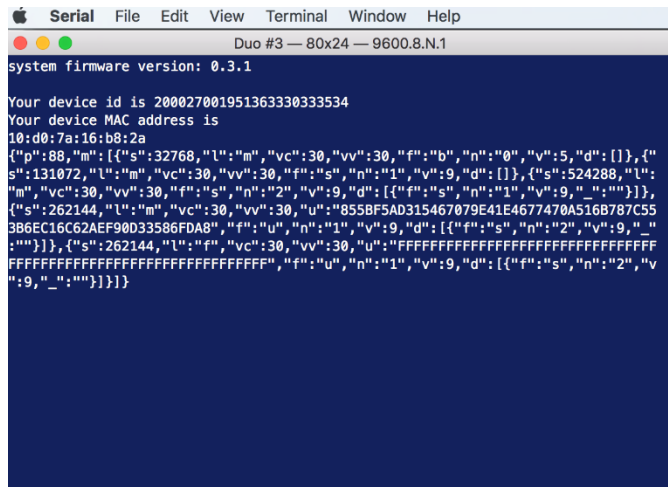

After installing the "Serial" application, it is very simple to connect to the serial port. Simply select the File, Open command and you will see a dialog similar to that shown below. Your device will be listed on the screen if all is working well.
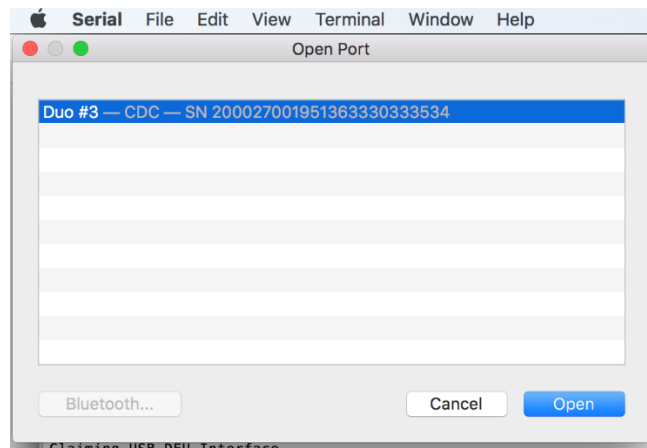
- Once you connect to the serial port, you can issue commands to get information about the Ting M1 device connected. The screen below shows the output of hitting the "v", "i", "m" and "s" keys.

An example of how this looks in the "Serial" application is shown below:

 Serial File Edit View Terminal Window Help
                Duo #3 — 80x24 — 9600.8.N.1
system firmware version: 0.3.1

Your device id is 20002700195136333033534
Your device MAC address is
10:d0:7a:16:b8:2a
{"p":88,"m":[{"s":32768,"l":"m","vc":30,"vv":30,"f":"b","n":"0","v":5,"d":[]},{"
s":131072,"l":"m","vc":30,"vv":30,"f":"s","n":"1","v":9,"d":[]},{"s":524288,"l":
"m","vc":30,"vv":30,"f":"s","n":"2","v":9,"d":[{"f":"s","n":"1","v":9,"_":""}]},
{"s":262144,"l":"m","vc":30,"vv":30,"u":"855BF5AD315467079E41E4677470A516B787C55
3B6EC16C62AEF90D33586FDA8","f":"u","n":"1","v":9,"d":[{"f":"s","n":"2","v":9,"_"
:""}]},{"s":262144,"l":"f","vc":30,"vv":30,"u":"FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF","f":"u","n":"1","v":9,"d":[{"f":"s","n":"2","v
":9,"_":""}]}]}

Another nice feature of the "Serial" application is that when you unplug and re-plug your device, it will automatically connect. This is always helpful when loading new firmware and testing the device as it switches between "dfu" mode and normal running mode.

Building your First Application

For the building your first application, we will show the steps for doing this on Mac OSX. The steps will be similar on a Windows PC.

1. Download the latest Ting M1 compatible firmware for the Duo from Github. The latest version as of this writing is 0.3.2. The URL to access the latest release is https://github.com/redbear/firmware/releases. I recommend downloading the zip file for the source code and placing it on your hard drive. Unzip the files into a folder of your choosing. For the purposes of this manual, we will install the firmware in our home directory at ~/firmware-duo-v0.3.2.

2. Build the default application by changing to the ~/ firmware-duo-v0.3.2/modules folder and issuing the command shown below. You should see output as seen in the screen capture below:

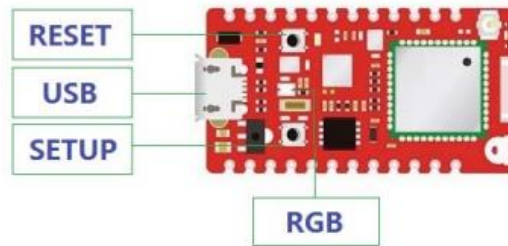   "sudo GCC_ARM_PATH=~/opt/gcc-arm-none-eabi-5_3-2016q1/bin/ make all PLATFORM=duo -s"

3. Once you are able to successfully compile the default application, you can modify the default application by using your favorite editor such as Eclipse or Visual Studio Code. The screen shot below shows what the default application looks like in Visual Studio Code. All user source and include files are in the folders ~/firmware-duo-v0.3.2/user/src and ~/firmware-duo-v0.3.2/user/inc.
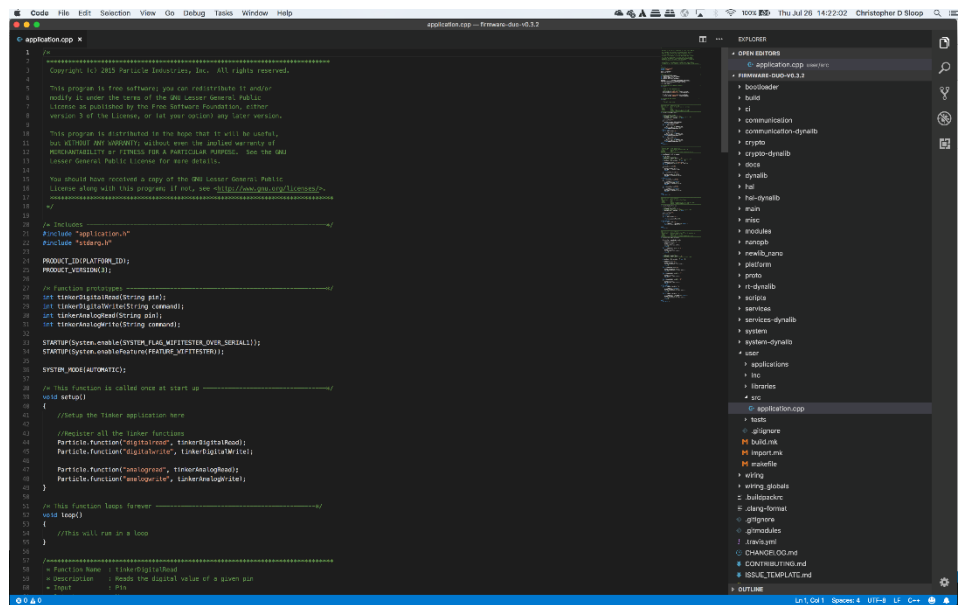
4. Now that you have modified the default application, it is time to load the code on the Ting M1 module. This can be done via a modification of the "make" command from step 2, or by doing a dfu update directly to the device. We will show how to accomplish both cases below.

5. First you will need to get your device into "DFU Mode". To do this, press and hold the "SETUP" button. At the same time, hold down the RESET button. The LED will begin to blink a purple color and then a yellow color. When the LED blinks yellow, release the SETUP button. The LED will continue to blink yellow signifying that it is in DFU Mode.

6. To download firmware to your Ting M1 module from the "make" command, you can add the dfu option to the command as seen below:

"sudo GCC_ARM_PATH=~/opt/gcc-arm-none-eabi-5_3-2016q1/bin/ make all PLATFORM=duo -s program-dfu"

7. To download the user firmware using the dfu-util tool, you can use the following three command. You must be in the ~/firmware-duo-v0.3.2/build/target folder to issue this command:

dfu-util -d 2b04:d058 -a 0 -s 0x80C0000:leave -D user-part/platform-88-m/user-part.bin

8. Now that you have downloaded firmware to your device, you will need to get it connected to the local Wi-Fi network. This can be done through the serial port by hitting a "w" key. When you hit the "w" key the module will respond with several prompts asking you to enter in the details of your Wi-Fi network. The screen capture below shows and example of the prompts you will see.
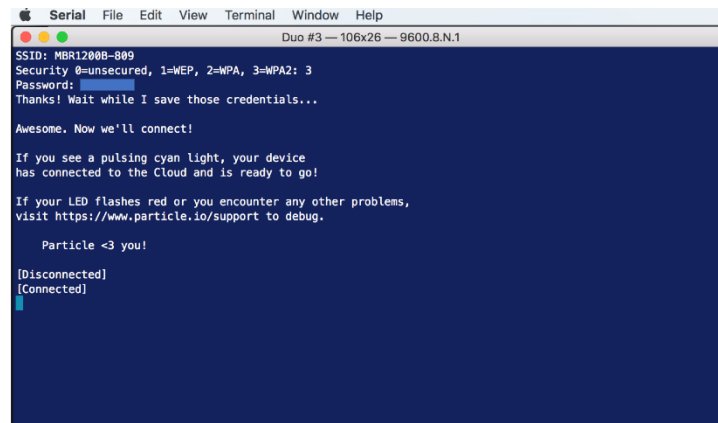
9. As the device connect to the Wi-Fi network you will see the light blink green slowly. When it is connected to the Access Point (AP), it will blink green more rapidly as it acquires an IP Address. Finally the LED will become solid green and then blink slowly cyan as it connects to the particle.io cloud. When complete, the LED should be a pulsing cyan light.

Legal Notices

FCC Class B Part 15: This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The module can be installed or integrated in mobile or fixed devices only. This modular cannot be installed in any portable device, for example, USB dongle like transmitters is forbidden.

FCC Radiation Exposure Statement: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2AQNW-TINGM1" Or "Contains FCC ID: 2AQNW-TINGM1"

When the module is installed inside another device, the user manual of the host must contain below statements;

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
   (1) This device may not cause harmful interference.
   (2) This device must accept any interference received, including interference that may cause undesired operation.
2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Any company of the host device which install this modular with limit modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C : 15.247 and 15.209 requirement, Only if the test result comply with FCC part 15C : 15.247 and 15.209 requirement, then the host can be sold legally.