USR-BLE100 User Manual

File version: V1.1

Contents

1. Quick Start

This chapter aimes at getting start USR-BLE100 quickly. It's recommended that user read this chapter systemically and operate it according to instruction to make a scientific knowledge. Following chapter will introduce specific details and instruction, user can read interested chapter directly.

If you have any question, feed it back to customer center please:

http://h.usriot.com
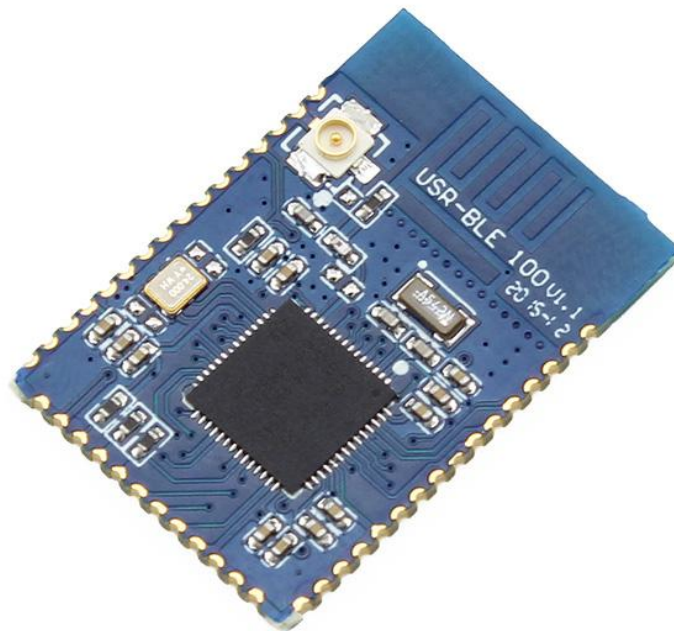
1.1.   Hardware Testing Environment

Module slave mode is similar to smart devices on the market like Smart Band. This module support standard BLE communication protocol, user can independent develop software and communicate by connect module with master device like mobile phone. This test need the device which support ultra-low power Bluetooth:

The device with BLE function and Android system V4.3 or above.

Iphone 4s version or above device with IOS7.0 or above operating system.

1.2.   Data Transmission Testing

Take Android mobile phone as example:

Testing environment: Android 5.0

Testing software : Android Bluetooth Module Debugger and USR-TCP-Test

Use the USR-TCP-Test to open the serial number of the connected module, set the baud rate as 57600. (User can use AT instruction to change parameter, following chapter will introduce it.)

Link light will flash once per second when module power-on. Using the Module Debugger software to search (click magnifying glass button) , you can find the device named USR-BLE100, as shown in figure 1.

Figure 1   Module Debugger software

Click on the device to connect with it, as shown in figure 2, the LINK light will keep on.
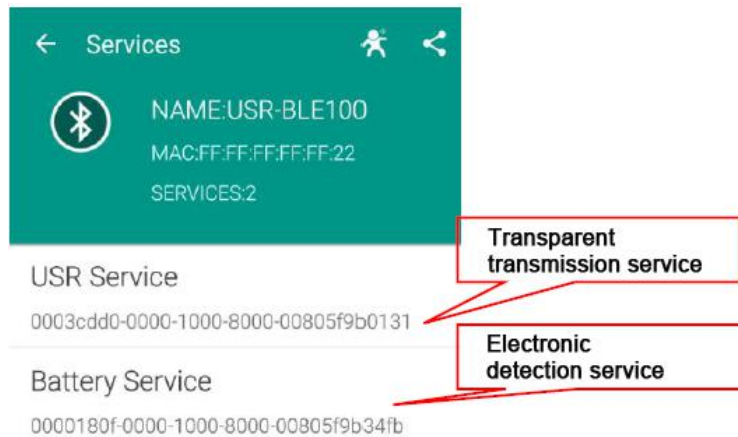
Figure 2   Module Debugger software

Firstly, click on the "USR Service". Then click the "DEBUG" option at the bottom. After it, click on "NOTIFY". When it turn to "STOP NOTIFY", listening state begins. Now we can receive data through serial port. If user want to send data, click on the upward symbol on the left, find out the "WRITE", click it and user can type data. After click "SEND", serial will receive the data you sent.
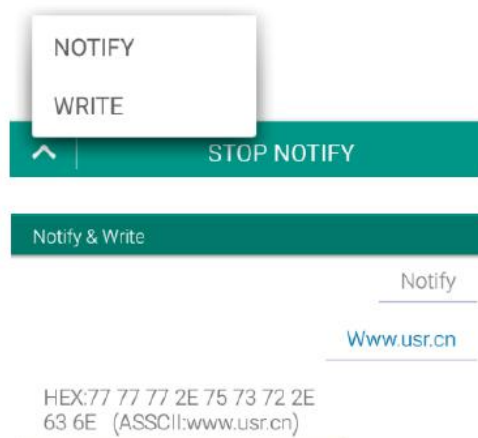
Figure 3   Module Debugger software

Note: According to test, we found that for BLE, the IOS support better than the Android, both at searching speed or connecting speed. This is caused by the different of operating and hardware.

2. Overview

2.1.   Brief Introduction

USR-BLE100 is a module which support ultra-low power Bluetooth4.1, and this module support master and slave, user not only can use both master and salve for transparent transmission, also can make wireless data transmission to the traditional low-end serial device and the device controlled by MCU. User can develop APP on the basis of standardized BLE protocol, make it a easy way to communicate with module. This module support MESH network pattern and one-to-many broadcasting, also has built-in iBeacon protocol, user can

make it a iBeacon equipment after make simple setup. USR-BLE100 is a versatile, simple, and low-power IOT transmission module.

2.2.   Features

- Support standard BLE protocol
- 1.3uA low-power broadcast mode, 150nA sleep mode, and varied wake-up mode
- Support master and slave, switch fast
- configuration mode: serial AT command, transparent transmission AT command
- Support one-to-many broadcast mode, with built-in iBeacon protocol
- Support Mesh network mode, can realize Bluetooth network
- Support UART interface
- 1.9~5.5V single supply
- Support state of charge(SOC) detection
- Ultra-long transmission distance, up to 120m for a pair of modules

2.3.   Parameters

Table 1.   USR-BLE100 parameter

	Item	Index
Wireless parameter	Wireless Standard	802.15.1
	Frequency Range	2.402Ghz-2.480GHz
	Transmit Power	-18dBm~+3dBm
		User can configure power
	Receiving Sensitivity	-89dBm
	Antenna Options	External: I-PEX connector
		Built-in: PCB antenna
Hardware Parameter	Data Interface	UART: 2400bps~115200bps
	Working Voltage	1.9V~5.5V
	Working Current	60nA~12mA
	Working Temperature	-40°C~85°C
	Storage Temperature	-40°C~125°C
	Dimensions	18.2*26.7*3mm
Software Parameter	Device type	Master/Slave
	Security Mechanism	128 bit AES engine
	Data Encryption	PC1 encryption
	Work Mode	Master, Slave, Broadcast
	Set Command	AT+ command structure
	User Configuration	Serial AT Command Transparent Transmission AT command
	User Application Software	Support customized software for VIP users

2.4.   Hardware Introduction
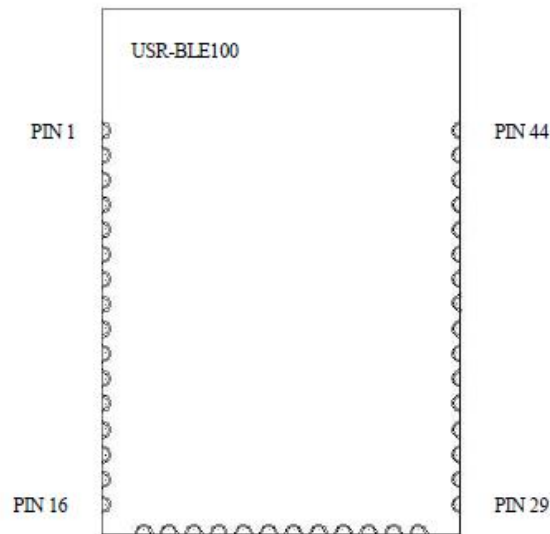
Figure 4   USR-BLE100 PIN

Table 2.   USR-BLE100 Pin Definitions

Pin	Name	Defination
1	GND	Power Ground
2	RF	RF signal output
3	NC	Not connect
4	Reset	Reset, take affect in "0"
5	GPIO1	GPIO1
6	GPIO2	GPIO2
7	GPIO3	GPIO3
8	NC	Not connect
9	12C_SDA	I2C Data Pin
10	12C_SCL	I2C Clock Pin
11	GND	Power Ground
12	GND	Power Ground
13	VCC	Power VCC, positive, range from 1.9v~5.5v
14	VCC	Power VCC, positive, range from 1.9v~5.5v
15	GPIO8	GPIO8
16	NC	Not connect
17	GND	Power Ground
18	PWM1	PWM Output Pin 1
19	UART0_TX	UART0 transmit
20	UART0_RX	UART0 receive
21	nReload	Reload to default settings for 1s Reload to factory defaults for above 3s

22	AD	AD collection
23	LED	Indicator light
24	UART0_CTS	UART0 CTS signal
25	UART0_RTS	UART0 RTS signal
26	SWDATA	Burn Data
27	SWCLK	Burn Clock
28	GND	Power Ground
29	GND	Power Ground
30	UART1_TX	UART1 transmit
31	UART1_RX	UART1 receive
32	PWM2	PWM output 2
33	SPI_SS1	SPI send request
34	SPI_SCLK	SPI clock
35	SPI_MISO	SPI MISO function
36	SPI_MOSI	SPI MOSI function
37	SPI_SS0	SPI chip selection
38	Wake_Up	Wake up
39	UART1_CTS	UART1 CTS signal
40	USRT1_RTS	UART1 RTS signal
41	NC	Not connect
42	NC	Not connect
43	NC	Not connect
44	GND	Power Ground

<Note>

The module minimum system recommend to use: PIN VCC, GND, UART0_TX, UART0_RX, LED, Reset, Reload, Wake_Up. Please refer to the hardware design manual.

2.5.   Applications

- Wearable Smart Device
- Industrial Data Collection
- Smart Meter
- Sport Smart Device
- Medical Smart Device
- Smart Mobile Terminal
- Indoor location
- Information Identification
- iBeacon
- Homekit

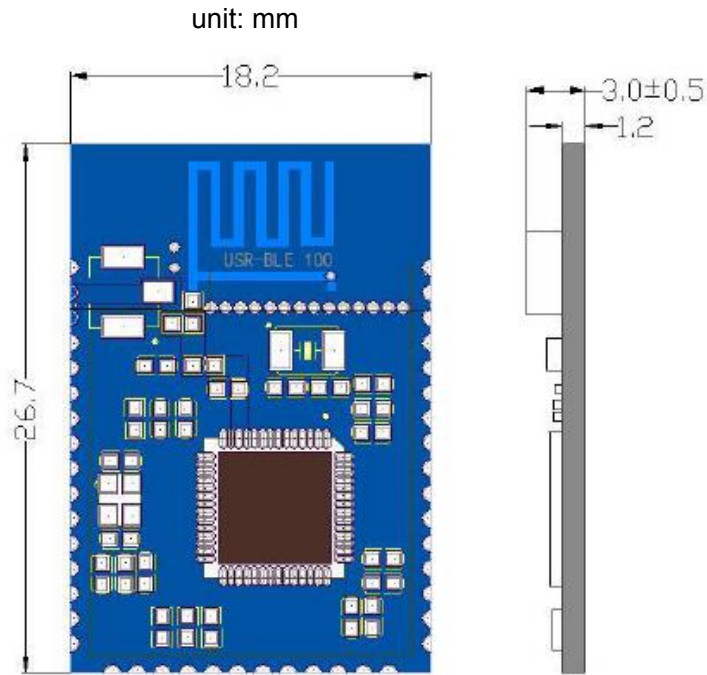## 2.6.   Dimensions

unit: mm

Figure 5   USR-BLE100 Dimension

3. Functions

This chapter introduce the functions of product, as the following figure 6 shown, user can get a good knowledge of product.
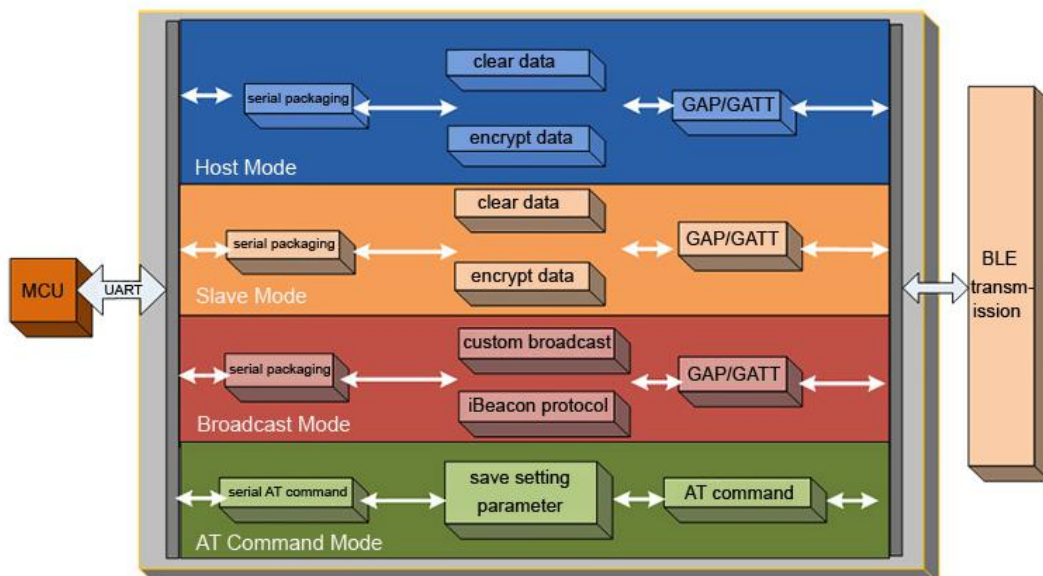

Figure 6   USR-BLE100 Function

3.1. Working Mode

USR-BLE100 has 4 modes:
- Master Mode
- Slave Mode
- Broadcast Mode
- Mesh Networking Mode

<Note>

The module default factory mode is slave pattern, user can use master device to search.

3.1.1. Master Mode

USR-BLE100 support master mode that can connect with a slave device. In this pattern, user can search devices around and choice the slave device need to connect. User also can set the MAC address of the slave for default link, the device can find this pattern to connect when it power on.

<Note>

The USR-BLE100 module in Master mode, it need to connect another USR-BLE100 which is in Slave mode to realize point to point transparent data transfer. It can't connect other brands' device to realize transparent transmission because of the incompatible protocol.

3.1.2. Slave Mode

USR-BLE100 support slave mode, in this mode, device completely conform to BLE 4.1 protocol and compatible with 4.0 protocol, user can develop APP according to protocol. This mode contain a serial transceiver Service, user can find it by UUID. There are 2 channels, read and write, user can transfer data through those channels.

There is no need for user to concern protocol if use the master of USR-BLE100 connect with slave, the serial ports of two devices can transparent transfer data immediately. It develop a easy wireless transmission channel for user.

<Note>

The question how to use BLE protocol to communicate is introduced in software design manual.

3.1.3. Broadcast Mode

USR-BLE100 support broadcasting mode, which support one-to-many broadcast. User can set module broadcasting data through AT instructions. Module can consistent broadcast in low-power pattern, be used to ultra-low power, small-data-sets, simplex transmission application occasions, like wireless measurement, indoor location and so on.

<Note>

Module has built-in iBeacon protocol, user just need a button battery and set parameter through AT instruction to make it a iBeacon device. Following chapter will detailed introduce it.

3.1.4. Mesh Networking Mode

USR-BLE100 support Mesh network mode, can connect many modules with net easily. By using star

network and relay technology, each network can link 65000 or more nodes, networks can be interconnected, and finally countless BLE modules can be interconnected or manipulate directly through mobile phone, pad or PC. It doesn't need gateway, even if one device is broken, other device will skip it and choose the nearest device to transfer. The whole networking process just need a power-on device and communication password.

<Note>

This mode has some limits. Because in the transfer process, module need to constantly switching modes, so the amount of transmitted data is limited to 20bytes per time, and transfer will delay a few seconds. This mode is similar to UDP that can not ensure data would be sent to specified module. Please refer to the software design manual for detailed instructions.

3.2.   Packet Mechanism

Low-power Bluetooth aimed at small-data-sets transmission. According to the different serial baud rate, BLE connect intervals and different contracting intervals, module will has different capacity of data. But, in any case it will not exceed the theory of 4K byte/s. Test shows that leakage probability is lower when forwarding rate is below 2K byte/s. To be safe, whether high speed or low speed, it's better to do check retransmission in the upper.

The serial port of USR-BLE100 can receive up to 512-byte packets per time, module will send automatically according to the size of the packet, the maximum load for each wireless packet is 20 bytes according to the standard. The packets mobile device send to module must packet(1-20byte per package)   by self to transfer. Module will forwarding to module serial port in turn when receive.

Module has two contract award pattern, one is 20 byte per package, another one is100 byte per package. The latter can only be applied to set USR-BLE100 modules separately as Master and Slave to communicate. If user use APP communicate with salve should choice 20 byte per package, there is specialized AT instruction to be set.

<Note>

When serial port use the big package that greater than 100 byte less than 512 byte, serial data can be received at a time. But it need reserved time to let module transfer data through Bluetooth, or it will rear end. Please refer to the software design manual for detailed instructions.

3.3.   iBeacon Protocol

USR-BLE send specific ID to surrounding through BLE broadcasting technology, the software received this ID will take action according this ID. For example, set iBeacon protocol in shop will make the information in iPhone and iPad transfer to the server, or make server send coupon and points to customer. In addition, user can use iBeacon to send information to software when home appliance broken or stop working. Now WeChat also support iBeacon, when user use "shake", the ID registered in the background will receive related information. The Bluetooth pendant key in popular use APP and the gyroscope of mobile phone to locate module, always be used to indoor location.

<Note>

Apple company came out this protocol in 2013,now, Android also compatible with it, make the application range of iBeach father.

3.4.   SOC Detection

USR-BLE100 collecting voltage through built-in ADC, transfer through specific "Service ". Considering many customers use Bluetooth will use battery in most cases, we add a measure function to access battery power in real time. User only need to part voltage on the battery, part 1.024V voltage to AD collection pin when battery in maximum power. Module monitor the change of voltage in real time, and report through private channel.

<Note>

Please refer to the software design manual for detailed instructions.

3.5.   Low Power Mode

USR-BLE100 has many low-power patterns, can provide longer using time for the customer use battery.

The first pattern: Auto Sleep Pattern. User can set a time through AT instruction. When no connection ,serial port has no data and standby time exceeds the set time, module will enter sleep mode automatically. In this pattern module Bluetooth can broadcast and connect, serial data can awake the module at anytime.

The second pattern: Deep Sleep Pattern. Enter this pattern need AT instruction. Then, Bluetooth still can broadcast and connect. There are two awake methods: make connection and use awake pin. In this pattern, power consumption can reach about 1.5uA , many slave work in this pattern.

The third pattern: Sleep Pattern. This pattern still need AT instruction to enter, any peripheral will not work in this pattern, power consumption can reach about 150nA, user can use awake pin to awake it.

<Note>

The low-power patterns here are only relative to salve, master does not have low-power mode. User can make it stop working when master does not work, awake it and search to make connection when user need.

3.6.   Encrypted Transmission

In order to ensure the security of data transmission, user can choose plaintext transmission or encrypted transmission. User can use AT instruction to encrypted transfer, then serial data will be PC1 encrypted by password, the module received data can decrypt only when it has the same password. It ensure the safety of data transmission.

<Note>

There are built-in decrypt function in USR modules. If user want to use this pattern to encrypted transfer through master and salve, he just need a coincident password. Data will be encrypted in one port, decrypted in another port. If user develop APP to encrypted transfer, it need the decrypted function of APP to make sure that data can be transferred. Please refer to the software design manual for detailed instructions.

3.7.   Indicator Status

There is a indicator light(pin) in USR-BLE100 module, it display differently in different modular status. The specific situation as shown below.

Table 3.   USR-BLE100 Light Definition

Module Status	Indicator Status
Master Searching	Flash 3 times per second
Slave Broadcasting	Flash 1 time per second
Connection Establishment	ON
Low Power Mode	OFF
Data Transmission	Flash

4. Setup Method

4.1.   AT Instruction

4.1.1.   Serial AT Instruction

USR-BLE100 has varied work modes, it will enter the mode you set last time when start-up, user can switch into AT Instruction mode through serial instruction.

There are two steps to switch other modes into AT Instruction mode:

1.   Input "+++" in serial port, then module will reply a confirmation code "a" when received "+++";

2.   Input "a" in serial port after received "a", module will reply "+OK" to confirm, then module will enter instruction mode;

User also can directly input "+++a" and wait module reply "+OK" to enter AT command mode. User can send specific instruction in AT format after enter this mode.

4.1.2.   Transparent Transmission Instruction

USR-BLE100 also support transparent transmission AT Instruction, user can use APP or the module connected with it to set parameters in this pattern. User just need to input the 6 digits password of the module and AT instruction to query or set the module's parameter. For example, if user want to query module's version number, he should input "000000, AT+CTVER enter". Like this, user can set and query parameter without entering AT instruction pattern in data transmission period.

4.2.   AT Instructions

Table 4.   USR-BLE100 AT Instructions

Instruction	Description
General Command	
NAME	Query/Set Module Name
MODE	Query/Set Pattern Mode
MAC	Query Module's MAC Address
CIVER	Query Software Version Number

TPL	Query/Set Module Transmission Power
SHOW	Show NAME, Pattern, MAC, Connection, Power and so on.
PASS	Query/Set Mode Password
PASSEN	Query/Set Paired Validation
UART	Query/Set Mode Serial Parameter
UARTTM	Query/Set Serial Packet time
AUTOSLEEP	Query/Set Sleep Automatically
DEEPSLEEP	Enter Ultra-low Pattern
HIBERNATE	Enter Sleep Pattern
HELLO	Query/Set Welcome Words
ENTM	Pull Out Instruction Pattern
RELOAD	Resume To Default Setting
Z	Restart Module
Link Command	
LINK	Query Mode Connection status
SCAN	Query Slaves Surrounded
CONN	Quick Connect By Query Reference Number
CONNADD	Query/Set MAC Address Default Connected
DISCONN	Disconnect Current Connection
ADP	Query/Set If Broadcast In This Pattern
ADPTM	Query/Set Broadcasting Speed
Characteristic Function	
BATEN	Use/Forbidden Power testing
MAXPUT	Use/Forbidden maximum output
TRENC	Use/Forbidden PCI Encrypted Transmission
IBEACON	Query/Set iBeacon Function

How to use AT instruction can refer to the Software design manual.

5. Contact us

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6. Disclaimer

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7. Update History

2015-11-27   V1.0 first version
2016-01-04   V1.1 modify MAC instruction and white list instruction

Federal Communication Commission Statement (FCC, U.S.)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
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.

FCC Caution:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

IMPORTANT NOTES

Co-location warning:
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:
This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the PCB antenna that has been originally tested and certified with this module.

As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:
In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: 2AJDA-USRBLE100".

Information that must be placed in the end user manual:
The OEM integrator has to be aware not to provide
information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.